



MOTOTRBO™ PORTABLE

PROFESSIONAL DIGITAL TWO-WAY RADIO

MOTOTRBO™ PORTABLE DP4801, DP4401 BASIC SERVICE MANUAL

MAY 2018

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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 perform any servicing other than that contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

Product Safety and RF Exposure Compliance



CAUTION: Before using this product, read the 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 the following web site: <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
68012009091-BA	Initial Release	May 2018

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.

Related Publications

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

- 6816787H01, *IMPRES Adaptive Single-Unit Charger User Manual*
- 6816789H01, *IMPRES Adaptive Multi-Unit Charger User Manual*
- 6871357L01, *IMPRES Adaptive Multi-Unit Charger Service Manual*
- 6871003L01, *Remote Speaker Microphone User Manual*
- 6871004L01, *IMPRES Remote Speaker Microphone User Manual*
- 68710532L01, *Factory Mutual Approval Manual*
- 6864117B25, *Product Safety and RF Exposure*

Warranty and Service Support

Motorola Solutions offers long-term support for its products. This support includes full exchange and/or repair of the product during the warranty period, and service/repair or spare parts support out of warranty.

Warranty Period and Return Instructions

The terms and conditions of warranty are defined fully in the Motorola Solutions Dealer, Distributor, or Reseller contract. These conditions may change from time to time and the following notes are for guidance purposes only. In instances where the product is covered under a "return for replacement" or "return for repair" warranty, a check of the product should be performed prior to shipping the unit back to Motorola Solutions. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

Portable Radios	Two Years
Accessories (Including Batteries and Chargers)	One Year

Prior to shipping any radio back to the appropriate Motorola Solutions warranty depot, please contact Customer Resources or your Motorola Solutions dealer, distributor, or reseller. All returns must be accompanied by a Warranty Claim Form, available from your Customer Service representative or Motorola Online (MOL) or your Motorola Solutions dealer, distributor, or reseller. Products should be shipped back in the original packaging, or correctly packaged to ensure no damage occurs in transit.

After Warranty Period

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

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

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

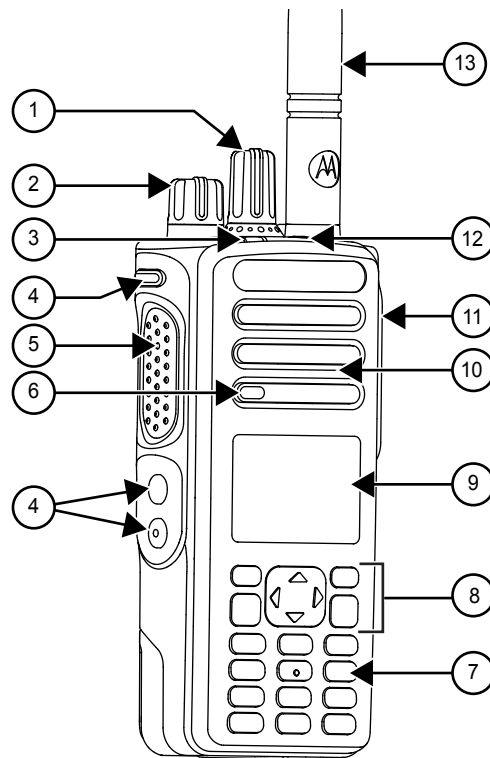
Frequency Band	Bandwidth	Power Level
800/900 RX/TX Talkaround	851–870 MHz 935–941 MHz	1 or 2.5 Watt
800/900 TX Trunking	806–825 MHz 896–902 MHz	1 or 2.5 Watt

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.

1.1.1

Full Keypad Model

Figure 1: Full Keypad Model



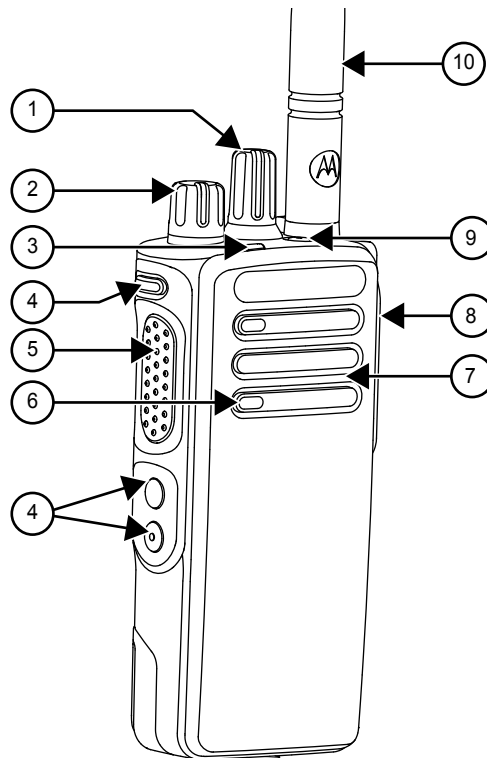
Label	Feature	Description
1	Channel Selector Knob	Rotate clockwise to increase channel and counter clockwise to decrease channel.
2	On/Off/Volume Knob	To turn on the radio, rotate clockwise until the knob clicks; To turn off the radio, rotate counter-clockwise until the knob clicks. Rotate clockwise to increase volume level; rotate counter-clockwise to decrease volume level.
3	LED Indicator	Red, green, and orange light-emitting diodes indicate operating status.
4	Side Buttons	These buttons are field programmable using the Customer Programming Software (CPS).
5	Push-To-Talk (PTT) Button	Press to execute voice operations (For example, Group call and Private Call).
6	Microphone	Allows the voice to be sent when PTT or voice operations are activated.
7	Keypad	Twelve keys that allow the user to input characters for various text based operations. (For color display only)

Label	Feature	Description
8	Menu Navigation Buttons	Five buttons to provide menu navigation and selection interface.
9	Liquid Crystal Display (LCD)	132x90 highly transfective color display provides visual information about many radio features.
10	Speaker	Outputs all tones and audio that are generated by the radio (For example, features like keypad tones and voice audio).
11	Universal Connector For Accessories	Interface point for all accessories to be used with the radio. It has twelve points to which specific accessories will connect and be activated.
12	Emergency Button	Turns on and off the Emergency Operations.
13	Antenna	Provides the needed RF amplification when transmitting or receiving.

1.1.2

Non-Keypad Model

Figure 2: Non-Keypad Model



Label	Feature	Description
1	Channel Selector Knob	Rotate clockwise to increase channel and counter clockwise to decrease channel.

Label	Feature	Description
2	On/Off/Volume Knob	To turn on the radio, rotate clockwise until the knob clicks; To turn off the radio, rotate counter-clockwise until the knob clicks. Rotate clockwise to increase volume level; rotate counter-clockwise to decrease volume level.
3	LED Indicator	Red, green, and orange light-emitting diodes indicate operating status.
4	Side Buttons	These buttons are field programmable using the Customer Programming Software (CPS).
5	Push-To-Talk (PTT) Button	Press to execute voice operations (For example, Group call and Private Call).
6	Microphone	Allows the voice to be sent when PTT or voice operations are activated.
7	Speaker	Outputs all tones and audio that are generated by the radio (For example, features like keypad tones and voice audio).
8	Universal Connector For Accessories	Interface point for all accessories to be used with the radio. It has twelve points to which specific accessories will connect and be activated.
9	Emergency Button	Turns on and off the Emergency Operations.
10	Antenna	Provides the needed RF amplification when transmitting or receiving.

1.2

Portable Radio Model Numbering Scheme

Table 2: Portable Radio Model Numbering Scheme

Position	1	2	3	4	5	6	7	8	9	10	11	12	13
Typical Model Number	MD	H	5	6	U	C	N	9	K	B	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	H = Portable

Position	Description	Value
3	Model Series	56 = DP4000 Model Series
4		
5	Band	U = 806–941 MHz
6	Power Level	C = 1.0, 2.0, 2.5, or 3.5 W D = 4.0, or 5.0 W
7	Physical Packages	C = Plain Model N = Color Display Full Keypad
8	Channel Information	8 = Variable/Programmable Channel Spacing with unique number of channels 9 = Variable/Programmable Channel Spacing
9	Primary Operation	K = GPS and Bluetooth
10	Primary System Type	A = Conventional B = Trunking C = Analog Only
11	Feature Level	1 = Standard with UL 2 = Non-UL
12	Version Letter	N/A
13	Unique Variation	N = Standard Package

1.3

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.

1.3.1

800/900 MHz Model Chart

Table 4: DP4000 Series, 800/900 MHz Model Chart

Model/Item		Description
MDH56UCN9KB1_N		DP4801, 800/900 MHz, 2.5 W, FKP, GPS, BT
MDH56UCC9KB1_N		DP4401, 800/900 MHz, 2.5 W, NKP, GPS, BT
X	PMLF4106_S	Back Cover Kit 806–941 MHz, 2.5 W, FKP, GPS, BT
	X PMLF4105_S	Back Cover Kit 806–941 MHz, 2.5 W, NKP
X	PMLN6528_	Front Cover Kit English, FKP, BT
	X PMLN6526_	Front Cover Kit, NKP, BT
X	X PMAF4011_	800/900 MHz whip antenna (806–870 MHz)

Model/Item			Description
MDH56UCN9KB1_N			DP4801, 800/900 MHz, 2.5 W, FKP, GPS, BT
MDH56UCC9KB1_N			DP4401, 800/900 MHz, 2.5 W, NKP, GPS, BT
X	X	PMAF4012_	800/900 MHz whip antenna (896–941 MHz)
X	X	PMLN5718_S	Option Board Kit
X		33012015018	DP4801 Nameplate
	X	33012015016	DP4401 Nameplate
X	X	32012144001	Antenna ID Band (Grey-10pcs)
X	X	32012144002	Antenna ID Band (Yellow-10pcs)
X	X	32012144003	Antenna ID Band (Green-10pcs)
X	X	32012144004	Antenna ID Band (Blue-10pcs)
X	X	32012144005	Antenna ID Band (Purple-10pcs)

Chapter 2

Specifications

Table 5: General Specifications

Parameter	Full Keypad	Non-Keypad
Channel Capacity	1000	32
Frequency	800 Band: 806–825 MHz; 851–870 MHz	
	900 Band: 896–902 MHz; 935–941 MHz	
Dimensions (H x W x T) with IMPRES Hi-Cap Li-Ion battery	130.3 x 55.2 x 41.1 mm	130.3 x 55.2 x 39.6 mm
Weight with IMPRES Li-Ion Slim (1500 mAh)	330 g	297.5 g
Weight with IMPRES Hi-Cap Li-Ion Non-FM (2150 mAh)	350 g	317.5 g
Weight with IMPRES Hi-Cap Li-Ion FM (2300 mAh)	360 g	327.5 g
Power Supply	7.5 V nominal	
FCC Description	800/900 Band: ABZ99FT5014	
IC Description	800/900 Band: 109AB-99FT5014	
Average battery life at 5/5/90 duty cycle with battery saver enabled in carrier squelch and transmitter in high power.		
Core Slim Li-Ion (1500 mAh) battery	Analog: 9.5 hr	Analog: 9.7 hr
	Digital: 12 hr	Digital: 12.5 hr
IMPRES Li-Ion Slim (1500 mAh) battery	Analog: 9.5 hr	Analog: 9.7 hr
	Digital: 12 hr	Digital: 12.5 hr
IMPRES Hi-Cap Li-Ion Non-FM (2150 mAh) battery ¹	Analog: 13.5 hr	Analog: 14 hr
	Digital: 17 hr	Digital: 17.8 hr
IMPRES Hi-Cap Li-Ion FM (2300 mAh) battery	Analog: 14.5 hr	Analog: 15 hr
	Digital: 18.2 hr	Digital: 19 hr
Core Li-Ion IP68 Battery (2450 mAh)	Analog: 12 hr	Analog: 12 hr
	Digital: 17 hr	Digital: 17 hr
IMPRES Li-Ion IP68 Battery (2450 mAh)	Analog: 12 hr	Analog: 12 hr
	Digital: 17 hr	Digital: 17 hr

¹ PMNN4409_, default battery shipped with MOTOTRBO 800/900.



NOTICE: Battery life hours shown above are without BT and GPS enabled.



IMPORTANT:
Factory Mutual Approval

MOTOTRBO portable radios have been certified by FM in accordance with U.S. Codes as intrinsically safe for use in Class I, II, III, Division 1, Groups C, D, E, F, G, when properly equipped with a Motorola FM approved battery option. They are also approved for use in Class I, Division 2, Groups A, B, C, D.

Table 6: Receiver

Parameter	Full Keypad	Non-Keypad
Frequencies	800 Band: 851–870 MHz	
	900 Band: 935–941 MHz	
Channel Spacing	800 Band: 12.5 and 25 kHz	
	900 Band: 12.5 kHz	
Frequency Stability (-30 °C to +60 °C)	+/-0.5 ppm	
Analog Sensitivity (12 dB SI-NAD)	0.3 µV	
	0.22 µV (typical)	
Digital Sensitivity (5% BER)	0.25 µV	
	0.19 µV (typical)	
Intermodulation (TIA603C)	70 dB	
Adjacent Channel Selectivity	TIA603: 60 dB @ 12.5 kHz, 70 dB @ 25 kHz	
	TIA603C: 45 dB @ 12.5 kHz, 70 dB @ 25 kHz	
Spurious Rejection (TIA603C)	70 dB	
Rated Audio	0.5 W	
Audio Distortion @ Rated Audio	5% (3% typical)	
Hum and Noise	-40 dB @ 12.5 kHz	
	-45 dB @ 25 kHz	
Audio Response	TIA603D	
Conducted Spurious Emission (TIA603C)	-57 dBm	

Table 7: Transmitter

Parameter	Full Keypad	Non-Keypad
Frequencies	800 Band: 806–825 MHz (Trunking)	
	900 Band: 896–902 MHz (Trunking)	
	800 Band: 851–870 MHz (Talkaround)	
	900 Band: 935–941 MHz (Talkaround)	

Parameter	Full Keypad	Non-Keypad
Channel Spacing	800 Band: 12.5 and 25 kHz	
	900 Band: 12.5 kHz	
Frequency Stability (-30 °C to +60 °C)	+/-0.5 ppm	
Power Output (Low Power)	1 W	
Power Output (High Power)	2.5 W	
Modulation Limiting	+/-2.5 kHz @ 12.5 kHz	
	+/-5.0 kHz @ 25 Hz	
FM Hum and Noise	-40 dB @ 12.5 kHz	
	-45 dB @ 25 kHz	
Conducted/Radiated Emission	-36 dBm < 1GHz	
	-30 dBm > 1GHz	
Adjacent Channel Power	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 Only: 7K60F1D and 7K60FXD	
	12.5 kHz Voice Only: 7K60F1E and 7K60FXE	
	Combination of 12.5 kHz Voice and Data: 7K60F1W	
Digital Vocoder Type	AMBE+2™	
Digital Protocol	ETSI-TS102361-1	
	ETSI-TS102361-2	
	ETSI-TS102361-3	

Conforms to:

ETSI TS 102 361 (Parts 1, 2, and 3) - ETSI DMR Standard

ETSI EN 300 086 - ETSI RF Specifications (Analog)

ETSI EN 300 113 - ETSI RF Specifications (Digital)

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

2011/65/EU (RoHS 2 - Banned Substances)

2012/19/EU (WEEE - Waste Electrical and Electronic Equipment)

94/62/EC (Packaging and Packaging Waste)

Radio meets applicable regulatory requirements.

Table 8: Self-Quieter Frequencies

800/900 MHz
854.4 MHz +/- 10 kHz
863.025 MHz +/- 10 kHz
864 MHz +/- 10 kHz
940.8 MHz +/- 10 kHz

Table 9: GNSS

GNSS	
Time To First Fix (TTFF) Cold Start @ -130 dBm (95%)	< 60 seconds
TTFF Hot Start @ -130 dBm (95%)	< 10 seconds
Horizontal Accuracy (2D Accuracy) Cold Start	< 5 meters
Accuracy specs are for long-term tracking (95th percentile values > 5 satellites visible at a nominal -130 dBm signal strength)	

Table 10: Bluetooth

Bluetooth®	
Version	Supports Bluetooth 2.1+ EDR Specification
Range	Class 2, 10 meters

Table 11: Military Standards

Military Standards										
Ap-plica-ble MIL-STD	810C		810D		810E		810F		810G ²	
	Meth-ods	Pro-ce-dures	Meth-ods	Pro-ce-dures	Meth-ods	Pro-ce-dures	Meth-ods	Pro-ce-dures	Meth-ods	Pro-ce-dures
Low Pres-sure	500.1	I	500.2	II	500.3	II	500.4	II	500.5	II
High Tem-perature	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
Low Tem-perature	502.1	I	502.2	I/C3, II/C1	502.3	I-C3, II/C1	502.4	I-C3, II/C1	502.5	I, II

² Tested to MIL standard G which supersedes previous version.

Military Standards										
Temperature Shock	503.1	-	503.2	I/A1/C3	503.3	I/A1/C3	503.4	I	503.5	I-C
Solar Radiation	505.1	II	505.2	I	505.3	I	505.4	I	505.5	I-A1
Rain	506.1	I, II	506.2	I, II	506.3	I, II	506.4	I, III	506.5	I, III
Humidity	507.1	II	507.2	II	507.3	II	507.4	-	507.5	II
Salt fog	509.1	-	509.2	-	509.3	-	509.4	-	509.5	-
Dust	510.1	I	510.2	I	510.3	I	510.4	I	510.5	I
Vibration	514.2	VIII/F, Curve-W	514.3	I/10, II/3	514.4	I/10, II/3	514.5	I/24	514.6	II/5
Shock	516.2	I, II	516.3	I, IV	516.4	I, IV	516.5	I, IV	516.6	I, IV, VI

Table 12: Environmental Specifications

Parameter	Specifications
Operating Temperature ³	-30 °C to +60 °C
Storage Temperature	-40 °C to +85 °C
Thermal Shock	Per MIL-STD
Humidity	Per MIL-STD
ESD	IEC 61000-4-2 Level 3
Water Intrusion	IEC 60529 -IP57

³ Operating temperature specification with Li-Ion battery is -10 °C to +60 °C.

Chapter 3

Test Equipment and Service Aids

Recommended Test Equipment

The list of equipment contained in the following table includes most of the standard test equipment required for servicing Motorola Solutions portable radios.

Table 13: Recommended Test Equipment

Equipment	Characteristics	Example	Application
Service Monitor	Can be used as a substitute.	Aeroflex 3920 or equivalent (www.aeroflex.com)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
Digital RMS Multimeter ⁴	100 μ V to 300 V 5 Hz to 1 MHz 10 Ω Impedance	Fluke 179 or equivalent (www.fluke.com)	AC/DC voltage and current measurements. Audio voltage measurements
RF Signal Generator ⁴	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 or equivalent (www.agilent.com)	Receiver measurements
Oscilloscope ⁴	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 ⁴	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 Millivolt-meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 92EA (www.boonton.com) or equivalent	RF level measurements
Power Supply	0 V to 32 V 0 A to 20 A	B&K Precision 1790 (www.bkprecision.com) or equivalent	Voltage supply

⁴ Service Monitor can be used as a substitute.

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 14: Service Aids

Motorola Solutions Part No.	Description	Application
RLN4460_	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.
GMVN5141_	Customer Programming Software on CD-ROM	Allows servicer to program radio parameters, tune and troubleshoot radios.
PMKN4012B ⁵	Portable Programming Cable	This cable connects the radio to a USB port for radio programming and data applications.
PMKN4013C ⁵	Portable Programming, Testing & Alignment Cable	This cable connects the radio to a USB port for radio programming, testing and alignment.
PMNN4428_	7.5 V Universal Battery Eliminator	Connects to radio via battery eliminator cable.
PMLN6154_	RF Adaptor	Adapts radio antenna port to BNC cabling of test equipment.
PMLN6422_	RF Cable	This cable measures RF related measurements.
PMLN6208_	Chassis and Knob Opener	Enables the removal of chassis from radio housing.
PMLN6155_	RF Adaptor Holder	Holds RF connector to radio.
NLN9839_	Vacuum Pump Kit	Allows servicer to test for leakages.
NTN4265_	Pressure Pump Kit	Allows servicer to locate leakages.
5871134M01	Connector Fitting	This connector allows the vacuum hose to be connected to the radio chassis.
3271133M01	Fitting Seal	This seal secures the connector fitting to the radio chassis.

⁵ Earlier versions of programming cables will not work with the radio.

Programming, Testing, and Alignment Cable

Figure 3: Programming, Testing, and Alignment Cable

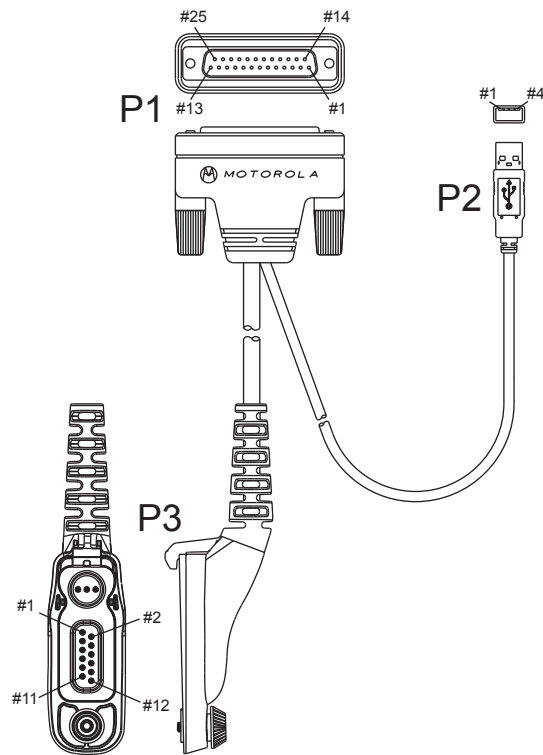
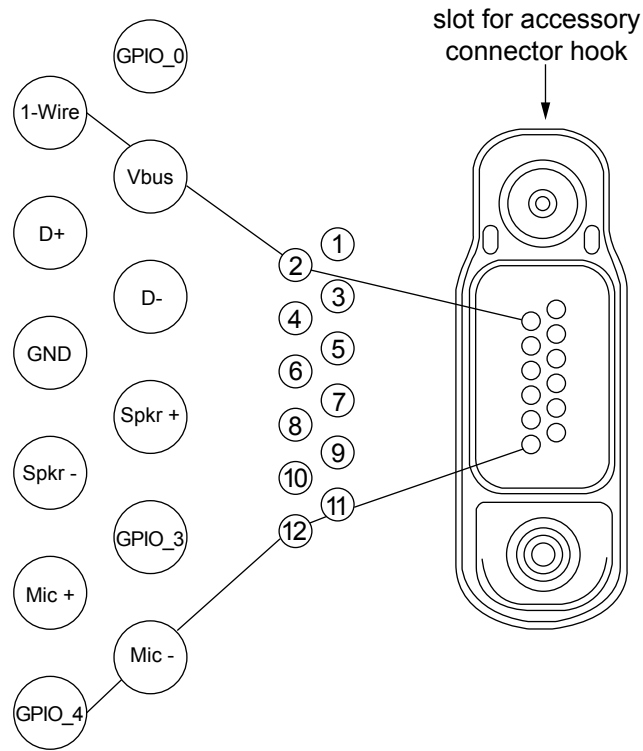


Table 15: Pin Configuration of Side Connector

Connection			
P1	P2	P3	
Pin	Pin	Pin	Function
-	-	1	GROUND
-	1	3	VCC (5V)
-	3	4	DATA+
-	2	5	DATA-
16	4	6	GROUND
1 and 5	-	7	EXTERNAL SPEAK- ER+
2 and 7	-	8	EXTERNAL SPEAK- ER-
20	-	9	EXTERNAL PTT
17	-	10	EXTERNAL MIC+
16	-	11	EXTERNAL MIC-

Figure 4: Pin Layout of Side Connector



Chapter 4

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.

4.1 Setup

Supply voltage is provided using a 7.5 VDC power supply. The equipment required for alignment procedures is connected as shown in the Radio Tuning Equipment Setup Diagram.



CAUTION: 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 should be as indicated in the following table:

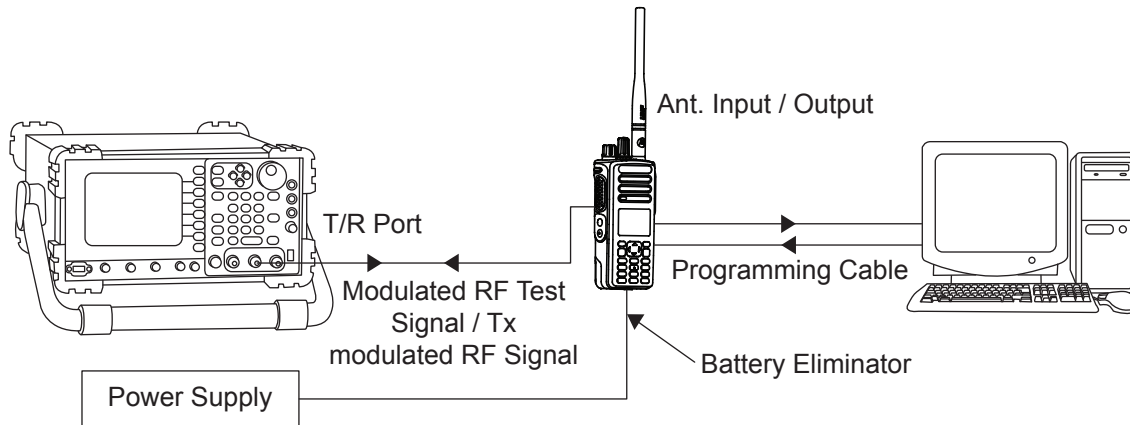
Table 16: Initial Equipment Control Settings

Service Monitor	Power Supply	Test Set
Monitor Mode: Power Monitor	Voltage: 7.5 Vdc	Speaker set: A
RF Attn: -70	DC on/standby: Standby	Speaker/load: Speaker
AM, CW, FM: FM	Volt Range: 10 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: 2.5 A	

Set up the DMR Transmitter and Receiver Test as per the following figure:

- 1 Connect the Programming cable to the radio and to the computer.
- 2 Remove RF plug (orange) as shown in [RF Adaptor Disassembly on page 46](#).
- 3 Connect the RF antenna adaptor to the 50 Ω RF Input/Output port of the radio.
- 4 Connect the other end of the RF antenna adaptor to the T/R port of the Radio Test Set 3920 using the RF cable shown in the figure.

Figure 5: DMR Radio Transmitter and Receiver Testing Setup



4.2 Display Model Test Mode


4.2.1 Entering Display Radio Test Mode

Procedure:

- 1 Turn the radio on.
- 2 Within 10 seconds after Self-Test is complete, press **Side Button 2** 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 17: 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 **Left** button is pressed before the last information is displayed, the radio suspends the information display until the user presses the **Right** button to resume the information display. The last display shows `RF Test Mode`.

4.2.2 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.

4.2.2.1 Testing RF Channel Selections

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

Prerequisites:



NOTICE: The default test environment is CSQ.

Procedure:

- 1 Each short press of **Side Button 2** 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 Test Environments.

Table 18: Test Environments

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

- 2 Each short press of **Side Button 1** toggles the channel spacing between 25 kHz and 12.5 kHz as the radio beeps twice for 25 kHz, and beeps three times for 12.5 kHz.
- 3 Turn **Channel Knob** to change the test channel from 1 to 16.

See Test Frequencies for the test channel descriptions.
The radio beeps in each position.

Table 19: Test Frequencies

Channel Selector Switch Position	Test Channel	800/900 MHz Band
1 Low Power	TX#1 or #9	855.725
9 High Power	RX#1 or #9	855.725
2 Low Power	TX#2 or #10	865.225
10 High Power	RX#2 or #10	865.225
3 Low Power	TX#3 or #11	936.025
11 High Power	RX#3 or #11	936.025
4 Low Power	TX#4 or #12	939.925
12 High Power	RX#4 or #12	939.925
5 Low Power	TX#5 or #13	806.175
13 High Power	RX#5 or #13	851.025
6 Low Power	TX#6 or #14	824.925
14 High Power	RX#6 or #14	860.525
7 Low Power	TX#7 or #15	896.175
15 High Power	RX#7 or #15	869.925
8 Low Power	TX#8 or #16	901.925
16 High Power	RX#8 or #16	940.925

Table 20: Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON Fourth channel test frequency ⁶ Monitor: Frequency error Input at RF In/Out	Test Mode, Test Channel 4 carrier squench	PTT to continuously transmit (during the performance check)	Frequency error to be: ±201 Hz for 800/900 MHz
Power RF	As above	As above	As above	Low Power: 0.9–1.5 W (800/900 MHz) High Power: 2.4–3.0 W (800/900 MHz)

⁶ See Test Frequencies.

Test Name	Communications Analyzer	Radio	Test Set	Comments
Voice Modulation	Mode: PWR MON Fourth channel test frequency ⁶ atten to -70, input to RF In/Out Monitor: DVM: AC Volts Set 1 kHz Mod Out level for 0.025 Vrms at test set, 80 mVrms at AC/DC test set jack	As above	As above, meter selector to mic	Deviation: ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp).
Internal Voice Modulation	Mode: PWR MON Fourth channel test frequency ⁶ atten to -70, input to RF In/Out	Test Mode, Test Channel 4 carrier squelch output at antenna	Remove modulation input	Press PTT switch on radio. Say "four" loudly into the radio mic. Measure deviation: ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp)
TPL Modulation	As above Fourth channel test frequency ⁶ BW to narrow	Test Mode, Test Channel 4 TPL	As above	Deviation: ≥ 500 Hz but ≤ 1000 Hz (25 kHz Ch Sp).
RF Power	DMR mode. Slot 1 Power and Slot 2 Power	Test Mode, Digital Mode, transmit without modulation	Key up radio without modulation using Tuner	TTR Enable is needed and IFR to be set to trigger mode with signal level ~ 1.5 V.
FSK Error	DMR Mode. FSK Error	Test Mode, Digital Mode, transmit with O.153 test pattern	Key up radio with O.153 test pattern modulation using Tuner	Not Exceed 5%
Magnitude Error	DMR Mode. Magnitude error	As above	As above	Not Exceed 1%
Symbol Deviation	DMR Mode. Symbol Deviation	As above	As above	Symbol Deviation should be within 648 Hz +/- 10% and 1944 Hz +/- 10%
Transmitter BER	DMR Mode	As above	As above	Transmitter BER should be 0%

Table 21: Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON Fourth channel test frequency ⁶ Monitor: Frequency error Input at RF In/Out	Test Mode, Test Channel 4 carrier squelch out- put at anten- na.	PTT to continuously transmit (during the performance check).	Frequency error to be: ± 201 Hz for 800/900 MHz
Rated Audio	Mode: GEN Output level: 1.0 mV RF Sixth channel test frequency ⁶ Mod: 1 kHz tone at 3 kHz deviation Monitor: DVM: AC Volts	Test Mode , Test Chan- nel 6 carrier squelch	PTT to OFF (cen- ter), meter selec- tor to Audio PA	Set volume control to 2.83 Vrms
Distortion	As above, except to distortion	As above	As above	Distortion <3.0%
Sensitivity (SINAD)	As above, except SI- NAD, lower the RF level for 12 dB SINAD.	As above	PTT to OFF (cen- ter)	RF input to be: <0.35 μ V
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1 mV RF	As above	PTT to OFF (cen- ter), meter selec- tion to Audio PA, speaker/load to speaker	Set volume control to 2.83 Vrms
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	Out of Test Mode; select a conventional system.	As above	Unsquelch to occur at <0.25 μ V. Preferred SINAD = 9–10 dB
Receiver BER	IFR DMR mode. Signal generator with O.153 test pattern.	Test Mode, Digital Mode, receive 1031 test pattern	Read BER using Tuner. Adjust RF level to get 5% BER	RF level to be <0.35 μ V for 5% BER
Receiver Rated Audio	IFR DMR Mode. Signal generator with 1031 test pattern	Test Mode, Digital Mode, receive 1031 test pattern	RF level = -47 dBm. Set audio analyzer to read Vrms. Adjust vol- ume to get rated audio	Adjust volume until Vrms = 2.83 V
Receiver Audio Dis- tortion	IFR DMR Mode. Signal generator with 1031 test pattern	As above	As above. Then set audio analyzer to measure distor- tion	Distortion <3.0%

4.2.3

LED Test Mode

Procedure:

- 1 Press and hold **Side Button 1** 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 radio lights up both LEDs up while displaying `Both LEDs On`.
The orange LED lights up.



NOTICE: Do not use the ON/OFF Button to change the LED status.

4.2.4

Backlight Test Mode

Procedure:

Press and hold **Side Button 1** after LED Test Mode.
The radio beeps once and displays `Backlight Test Mode`.

The radio turns on both LCD and keypad backlight.

4.2.5

Speaker Tone Test Mode

Procedure:

Press and hold **Side Button 1** 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.

4.2.6

Earpiece Tone Test Mode

Procedure:

Press and hold **Side Button 1** 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.

4.2.7 Audio Loopback Earpiece Test Mode

Procedure:

Press and hold **Side Button 1** after the Earpiece Tone Test Mode.

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

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

4.2.8 Battery Check Test Mode

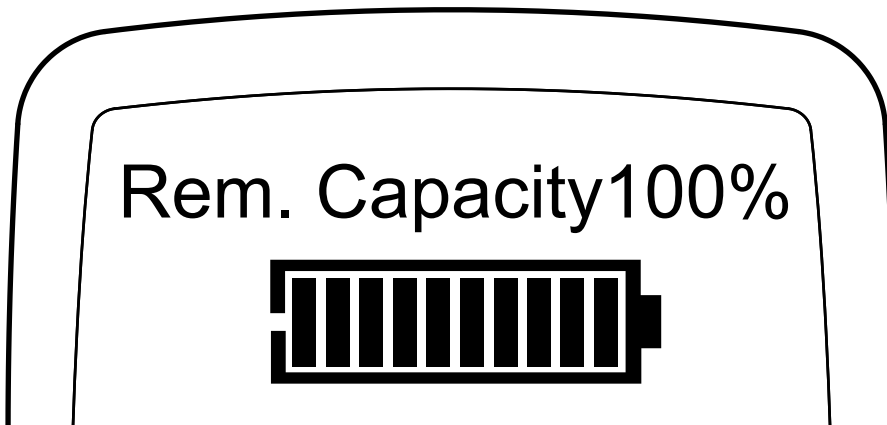
Procedure:

- 1 Press and hold **Side Button 1** after Audio Loopback Earpiece Test Mode.

The radio beeps once and momentarily displays `Battery Check Test Mode`.

- 2 The radio displays the following:

Figure 6: Battery Check Test Mode Display



4.2.9 Button/Knob/PTT Test Mode

Any key press causes the test to advance from one step to the next.

Table 22: Button/Knob/PTT Checks

Action	Result
Press and hold Side Button 1 .	The radio displays <code>Button Test</code> (line 1). The radio beeps once.
Rotate the Volume Knob .	<code>2/1</code> through <code>2/255</code> appears. The radio beeps at each position.
Rotate the Channel Knob clockwise.	<code>4/1</code> appears. The radio beeps at each position.

Action	Result
Rotate the Channel Knob counterclockwise.	4/-1 appears. The radio beeps at each position.
Press Side Button 1 .	96/1 appears. The radio beeps.
Release the button.	96/0 appears. The radio beeps.
Press Side Button 2 .	97/1 appears. The radio beeps.
Release the button.	97/0 appears. The radio beeps.
Press Side Button 3 .	98/1 appears. The radio beeps.
Release the button.	98/0 appears. The radio beeps.
Press the PTT button.	1/1 appears. The radio beeps.
Release the button.	1/0 appears. The radio beeps.
Press the Top Button .	148/1 appears. The radio beeps.
Release the button.	148/0 appears. The radio beeps.

Table 23: Keypad Checks

Action	Result
Press 0 .	48/1 appears. The radio beeps.
Release the button.	48/0 appears. The radio beeps.
Press 1 button.	49/1 appears. The radio beeps.
Release the button.	49/0 appears. The radio beeps.
Press 2 button.	50/1 appears. The radio beeps.
Release the button.	50/0 appears. The radio beeps.
Press 3 button.	51/1 appears. The radio beeps.

Action	Result
Release the button.	51/0 appears. The radio beeps.
Press 4 button.	52/1 appears. The radio beeps.
Release the button.	52/0 appears. The radio beeps.
Press 5 button.	53/1 appears. The radio beeps.
Release the button.	53/0 appears. The radio beeps.
Press 6 button.	54/1 appears. The radio beeps.
Release the button.	54/0 appears. The radio beeps.
Press 7 button.	55/1 appears. The radio beeps.
Release the button.	55/0 appears. The radio beeps.
Press 8 button.	56/1 appears. The radio beeps.
Release the button.	56/0 appears. The radio beeps.
Press 9 button.	57/1 appears. The radio beeps.
Release the button.	57/0 appears. The radio beeps.
Press * button.	58/1 appears. The radio beeps.
Release the button.	58/0 appears. The radio beeps.
Press # button.	59/1 appears. The radio beeps.
Release the button.	59/0 appears. The radio beeps.
Press the P1 button.	160/1 appears. The radio beeps.
Release the button.	160/0 appears. The radio beeps.
Press the P2 button.	161/1 appears.

Action	Result
	The radio beeps.
Release the button.	161/0 appears. The radio beeps.
Press the MENU button.	85/1 appears. The radio beeps.
Release the button.	85/0 appears. The radio beeps.
Press the BACK button.	129/1 appears. The radio beeps.
Release the button.	129/0 appears. The radio beeps.
Press the Left button.	128/1 appears. The radio beeps.
Release the button.	128/0 appears. The radio beeps.
Press the Right button.	130/1 appears. The radio beeps.
Release the button.	130/0 appears. The radio beeps.
Press the Up button.	135/1 appears. The radio beeps.
Release the button.	135/0 appears. The radio beeps.
Press the Down button.	136/1 appears. The radio beeps.
Release the button.	136/0 appears. The radio beeps.

4.3

Display Model Test Mode - Color Display

4.3.1

Color Display Test

Procedure:

- 1 Press any button to test the LCD display, then press the **Right** button.
The display is fixed.

- 2** Press and hold the first side button.

The screen changes.

- 3** Press the **Right** button.

The housing displays a White screen with two pixels wide of a black border inset from the edge by two pixels.

The radio shows `Display Test Mode` in black.

- 4** Press the **Right** button.

The housing displays a Black screen with two pixels wide of a White border inset from the edge by two pixels.

The radio shows `Display Test Mode` in white.

- 5** Press the **Right** button.

The housing displays a full screen in Red.

- 6** Press the **Right** button.

The housing displays a full screen in Green.

- 7** Press the **Right** button.

The housing displays a full screen in Blue.

- 8** Press the **Right** button.

The housing displays growing horizontal bars with a cyclic color of Red->Green->Blue->Black->Red->Green->Blue->Black (Full Screen).

- 9** Press the **Right** button.

The housing displays growing vertical bars with a cyclic color of Red->Green->Blue->Black->Red->Black (Full Screen).

- 10** Press the **Right** button.

The housing displays all icon in color.

The housing displays RSSI icon (with full bar), monitor icon, high power level icon (H), tone disabled icon, priority-two channel scan icon, option board icon, unread message icon, emergency icon, talkaround icon, and battery strength indicator icon (with full bar).

- 11** Press the **Right** button.

The housing clears the screen and displays the rest of the icons in color (low power level icon (L), companding icon, and secure operation icon).

- 12** Press and hold the first side button.

The screen changes.

4.4

Non-Display Model Test Mode

4.4.1

Entering Non-Display Radio Test Mode

Procedure:

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

The radio beeps.

4.4.2

RF Test Mode

When the radio is operating in its normal environment, the microcontroller of the radio 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 via a special routine, called TEST MODE or “air test”.

Procedure:

- 1 Short press **Side Button 2** 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 1](#).
- 2 Short press **Side Button 1** to toggle the channel spacing between 25 kHz and 12.5 kHz.
The radio beeps twice when radio toggles to 25 kHz and beeps three times for 12.5 kHz.
- 3 Turn the **Channel Knob** to change the test channel from 1 to 14.
The radio beeps in each position.

4.4.3

LED Test Mode

Procedure:

- 1 Press and hold **Side Button 1** after RF 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 turns on both LEDs.

4.4.4

Speaker Tone Test Mode

Procedure:

Press and hold **Side Button 1** after LED Test Mode.

The radio beeps once.

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

4.4.5

Earpiece Tone Test Mode

Procedure:

Press and hold **Side Button 1** after Speaker Tone Test Mode.

The radio beeps once.

The radio generates a 1 kHz tone with the earpiece.

4.4.6

Audio Loopback Earpiece Test Mode

Procedure:

Press and hold **Side Button 1** after Earpiece Tone Test Mode.

The radio beeps once.

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

4.4.7

Battery Check Test Mode

Procedure:

Press and hold **Side Button 1** after Audio Loopback Earpiece Test Mode.

The radio beeps once.

The radio LED lights up as follows:

- Green LED for High Battery Level
- Orange LED for Mid Battery Level
- Blinking red LED for Low Battery Level

4.4.8

Button/Knob/PTT Test Mode

Any key press causes the test to advance from one step to the next.

Table 24: Button/Knob/PTT Checks

Action	Result
Press and hold Side Button 1 .	The radio beeps once.
Rotate the Volume Knob .	The radio beeps at each position.
Rotate the Channel Knob .	The radio beeps at each position.
Press Side Button 1 .	The radio beeps.
Release the button.	The radio beeps.
Press Side Button 2 .	The radio beeps.
Release the button.	The radio beeps.
Press Side Button 3 .	The radio beeps.
Release the button.	The radio beeps.
Press the PTT button.	The radio beeps.
Release the button.	The radio beeps.
Press the Top Button .	The radio beeps.
Release the button.	The radio beeps.

Chapter 5

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 25: Software Installation Kits Radio Tuning Setup

Description	Part Number
MOTOTRBO CPS, Tuner, and AirTracer Applications CD	GMVN5141_

5.1

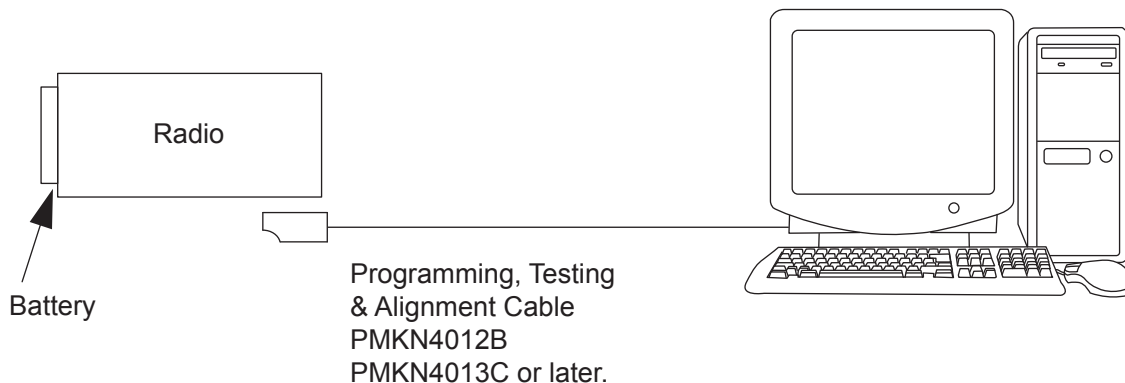
Customer Programming Software Setup

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 7: CPS Programming Setup



5.2

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.

5.3

Radio Tuning Setup

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

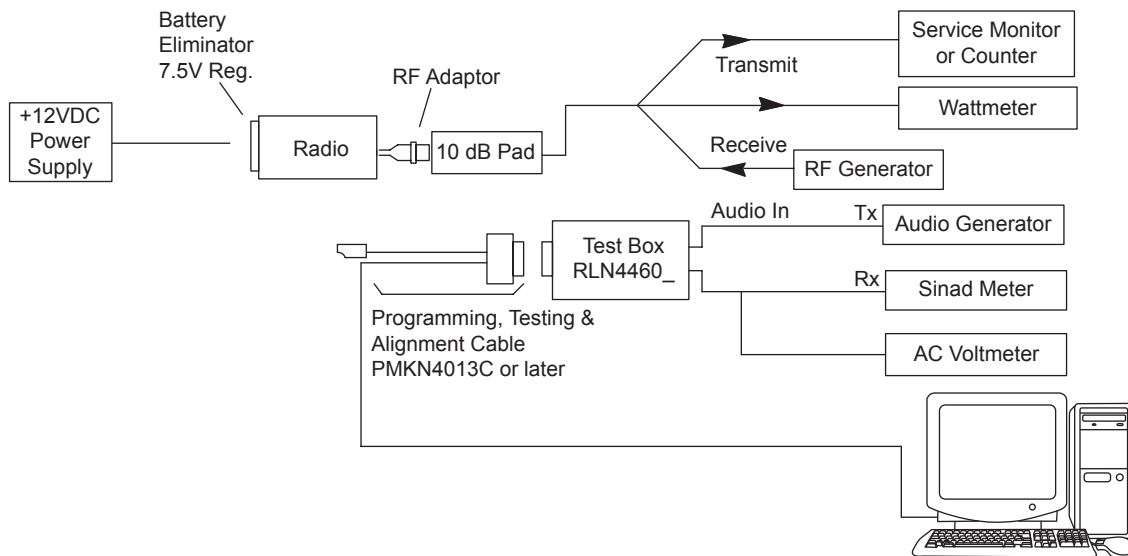
Before keying up the radio, set the Bias DAC for the appropriate final device bias current. If the bias is not properly set, it may cause damage to the transmitter.



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 [Figure 8: Radio Tuning Equipment Setup on page 46](#) to perform tuning procedures.

Figure 8: Radio Tuning Equipment Setup



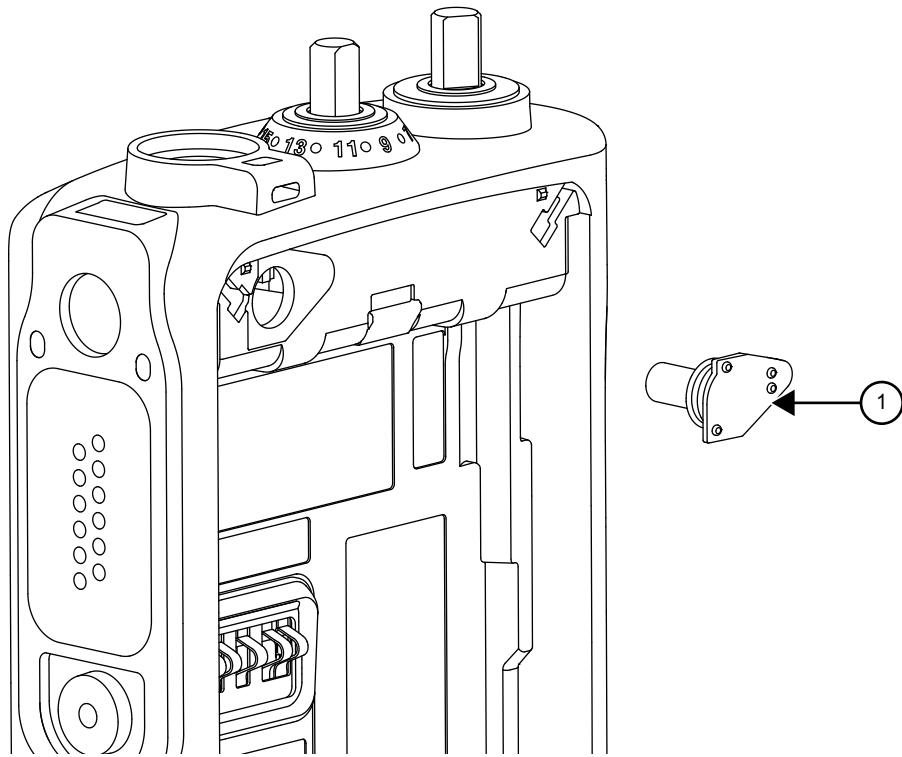
5.4

RF Adaptor Disassembly

Procedure:

- 1 Use a pair of tweezers to remove the RF plug.

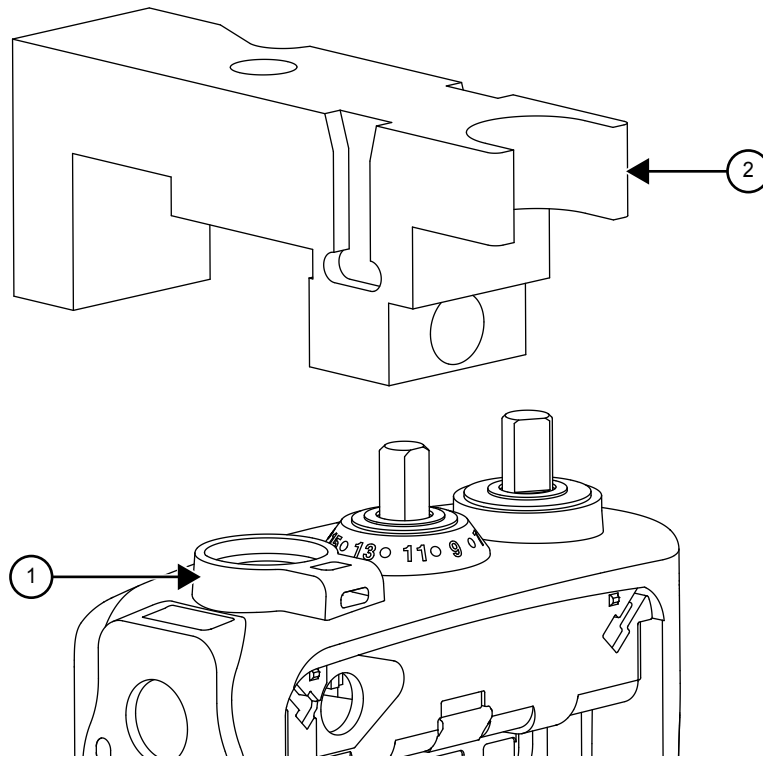
Figure 9: RF Plug Removal



Label	Description
1	RF Plug

- 2 Align the RF Adaptor Holder to the antenna opening of the housing. The RF Adaptor Holder should fit snugly around the outer wall of the antenna opening.

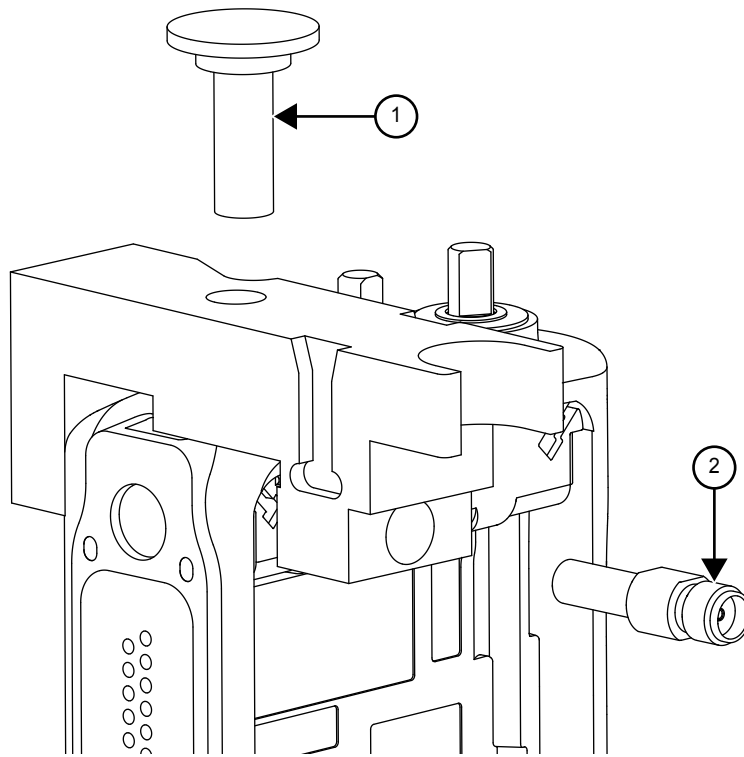
Figure 10: RF Adaptor Holder



Label	Description
1	Antenna Opening
2	RF Adaptor Holder

- 3 Fasten the screw provided to hold the RF Adaptor in place.

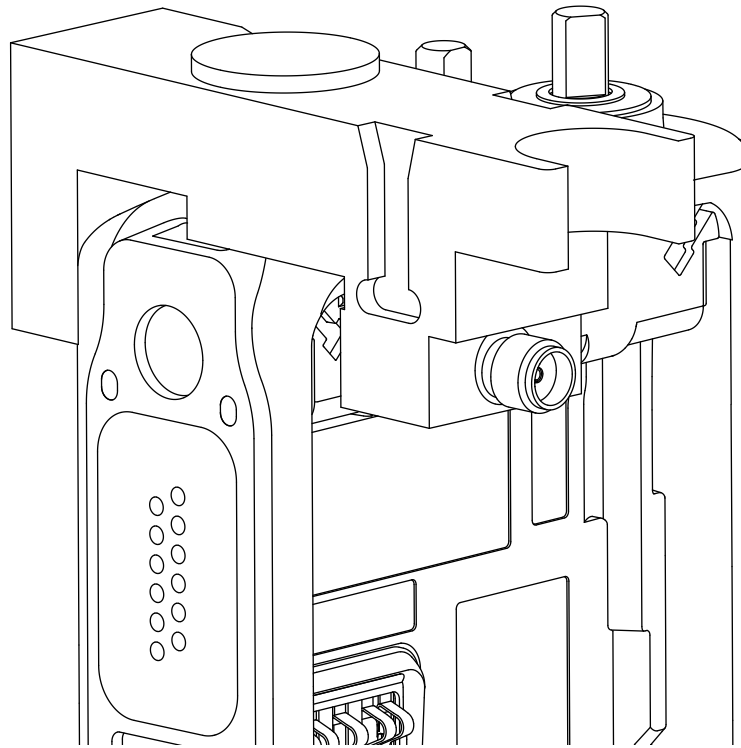
Figure 11: RF Adaptor Screw



Label	Description
1	Screw
2	RF Connector

- 4 Slot the RF Connector into the RF Adaptor Holder slot.

Figure 12: RF Adaptor Complete Assembly



Chapter 6

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.

6.1

Preventive Maintenance

Periodic visual inspection and cleaning are recommended.

Inspection

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

Cleaning Procedures

The following procedures describe the recommended cleaning agents and the methods to clean the external and internal surfaces of your radio.

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



CAUTION: Use all chemicals as prescribed by the manufacturer. 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.



NOTICE: Only clean internal surfaces when your radio is disassembled for service or repair.

Cleaning External Plastic Surfaces



IMPORTANT: The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dish-washing detergent in water.

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

Cleaning Internal Circuit Boards and Components



IMPORTANT: The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (100% by volume).

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

Apply Isopropyl alcohol (100%) 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 your 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 it can cause the liquid to collect in unwanted places. After completing of the cleaning process, use a soft, absorbent, lint-less cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover.

6.2

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:

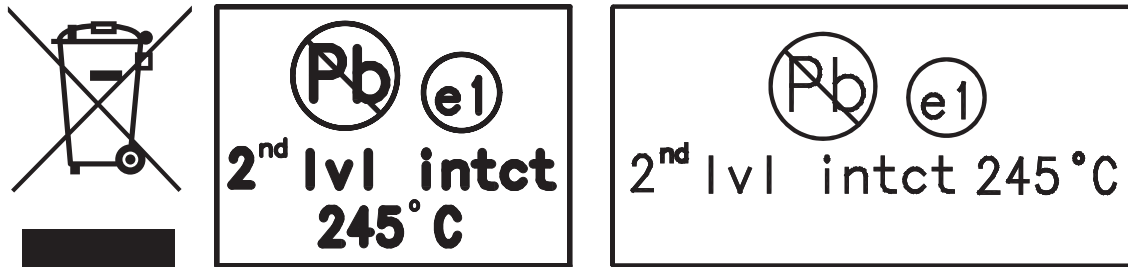
- Store and transport all CMOS/LDMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS/LDMOS devices into conventional plastic "snow" trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench 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.

6.3

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 26: 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 27: 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.

6.4

Disassembling and Reassembling the Radio

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 the radio:

- TORX™ T3 and T6 screwdriver
- Chassis and Knob Opener (PMLN6208)

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

- Grease (1185937A01)
- TORX T3 and T6 screwdriver
- Vacuum Pump Kit (NLN9839) - Radio Immersibility Test
- Pressure Pump Kit (NTN4265) - Radio Immersibility Test
- Connector Fitting (5871134M01) - Radio Immersibility Test
- Fitting Seal (3271133M01) - Radio Immersibility Test
- Seal Port (3286058L01)
- Label Ventilation (5478220A01)



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

6.5

Detailed Radio Disassembly

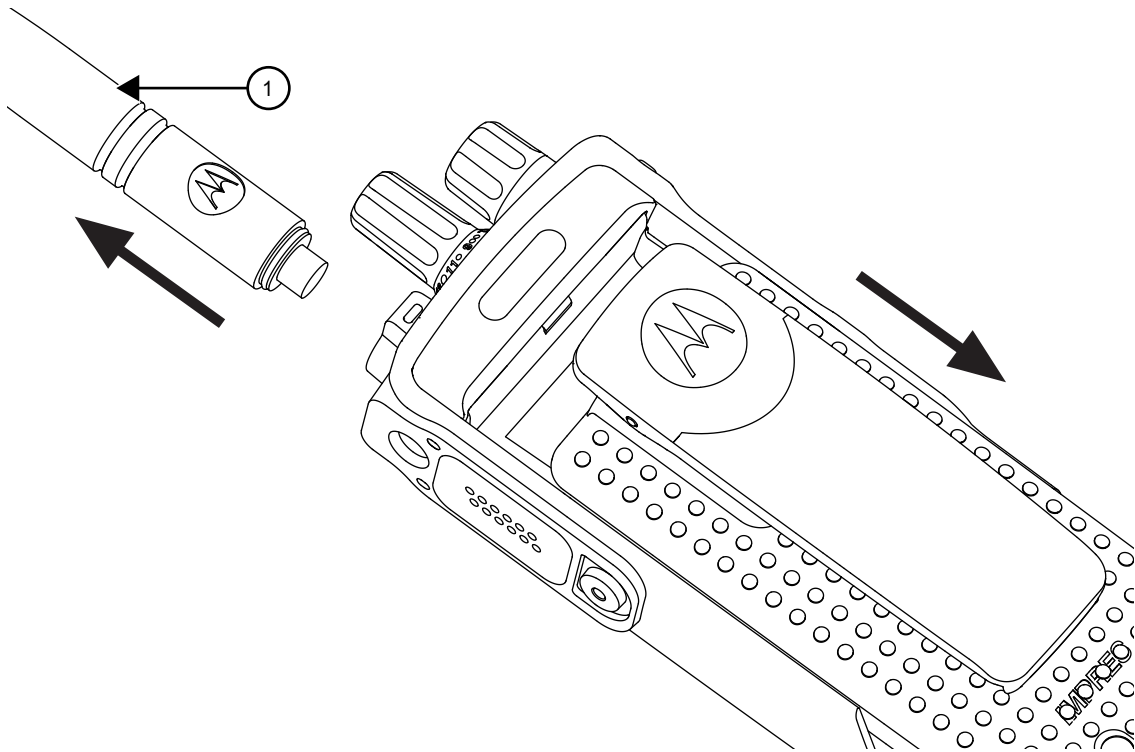
The section describes the detailed disassembly procedure of your radio.

6.5.1

Front Cover from Chassis Disassembly

Procedure:

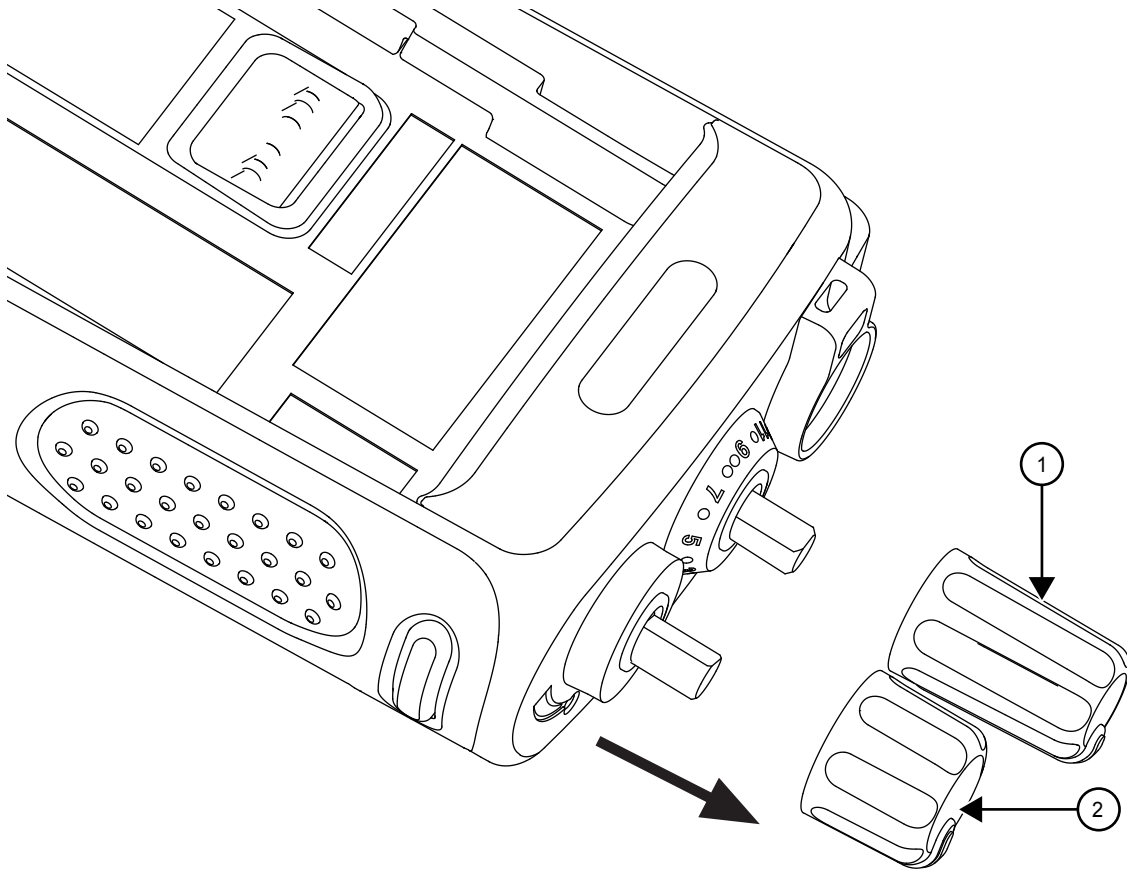
- 1 Turn off the radio.
- 2 Remove the battery:
 - a Release the battery latch by moving it into the unlock position.
 - b With the latch released, slide the battery downwards.
 - c Remove the battery from the radio.
- 3 Remove the antenna by turning it counterclockwise.

Figure 13: Antenna and Battery Removal

Label	Description
1	Antenna

- 4 Remove the Channel Selector Knob and On/Off/Volume knob off from their shafts using the knob removal tool.

Figure 14: Channel Selector Knob and On/Off/Volume Knob Removal



Label	Description
1	Channel Selector Knob
2	On/Off/Volume Knob


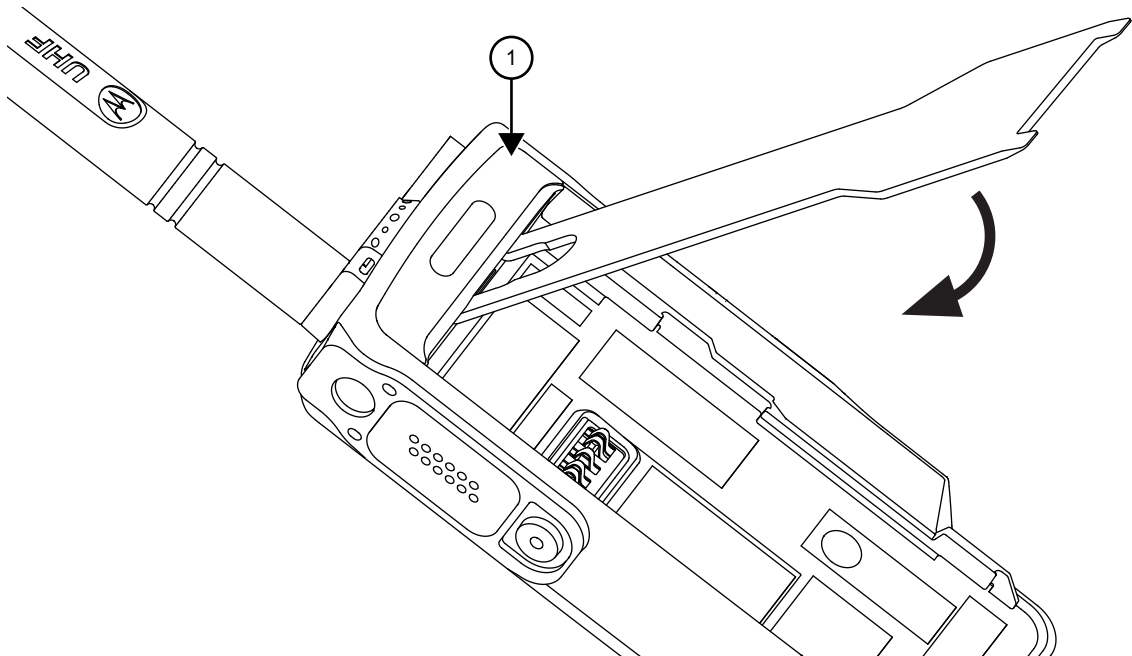
 **NOTICE:** Both knobs slide on and off. However, they are supposed to fit very tightly on their shafts.

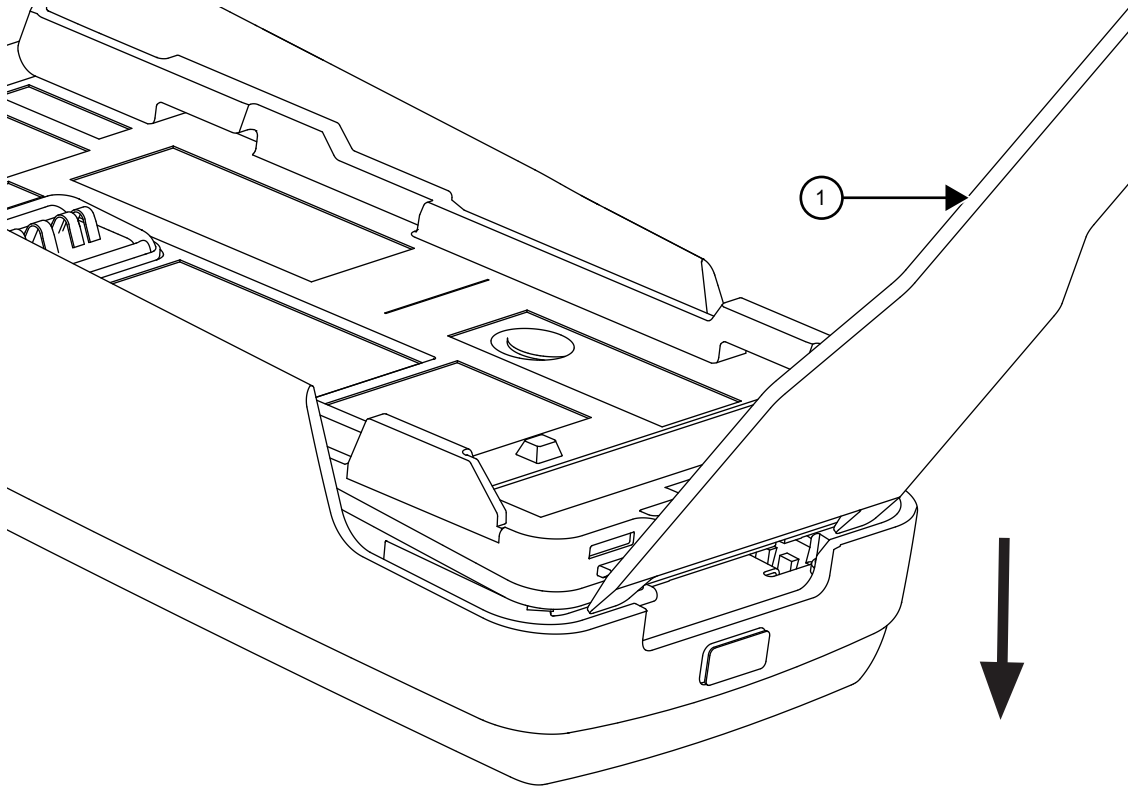
Figure 15: Shroud Removal



Label	Description
1	Shroud

- 5 Hook the knob opener under the shroud and detach it with a downward motion.
- 6 Separate the chassis from the housing assembly as follows:
 - a Insert the chassis opener into the recess at the bottom of the radio. Apply a downward force to separate the chassis from the front housing.
 - b Remove the chassis from the front housing.

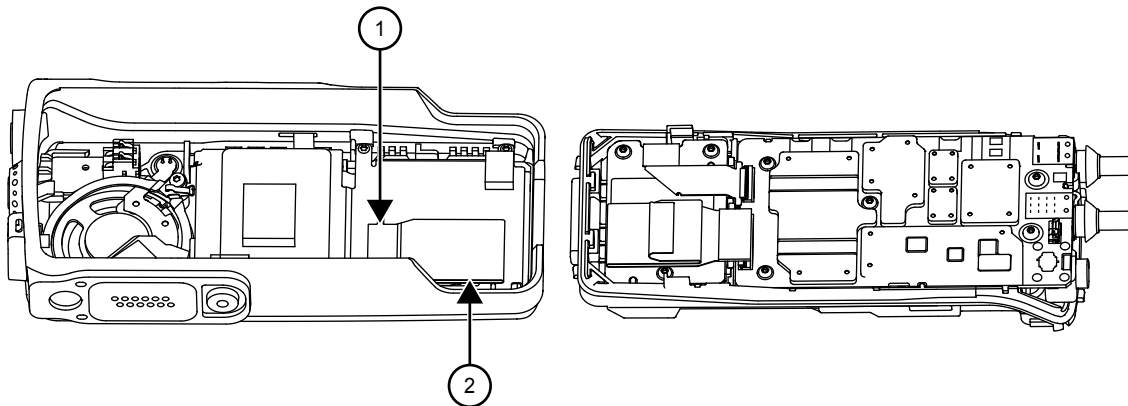
Figure 16: Chassis Removal



Label	Description
1	Chassis Opener

- 7 Lay the chassis down. Rotate the front cover backward and slightly away from the chassis.

Figure 17: Disconnecting the Chassis



Label	Description
1	Latch
2	Flex

- 8 Remove the flex from the main board by pulling it out of its connector gently.



NOTICE: Do not use finger to open the connector snap. Use a pair of plastic tweezers or hand tool to open connector snap.

- 9 Remove the flex from the keypad board by pulling it out of its connector gently.



NOTICE: Do not use finger to open the connector snap. Use a pair of plastic tweezers or hand tool to open connector snap.

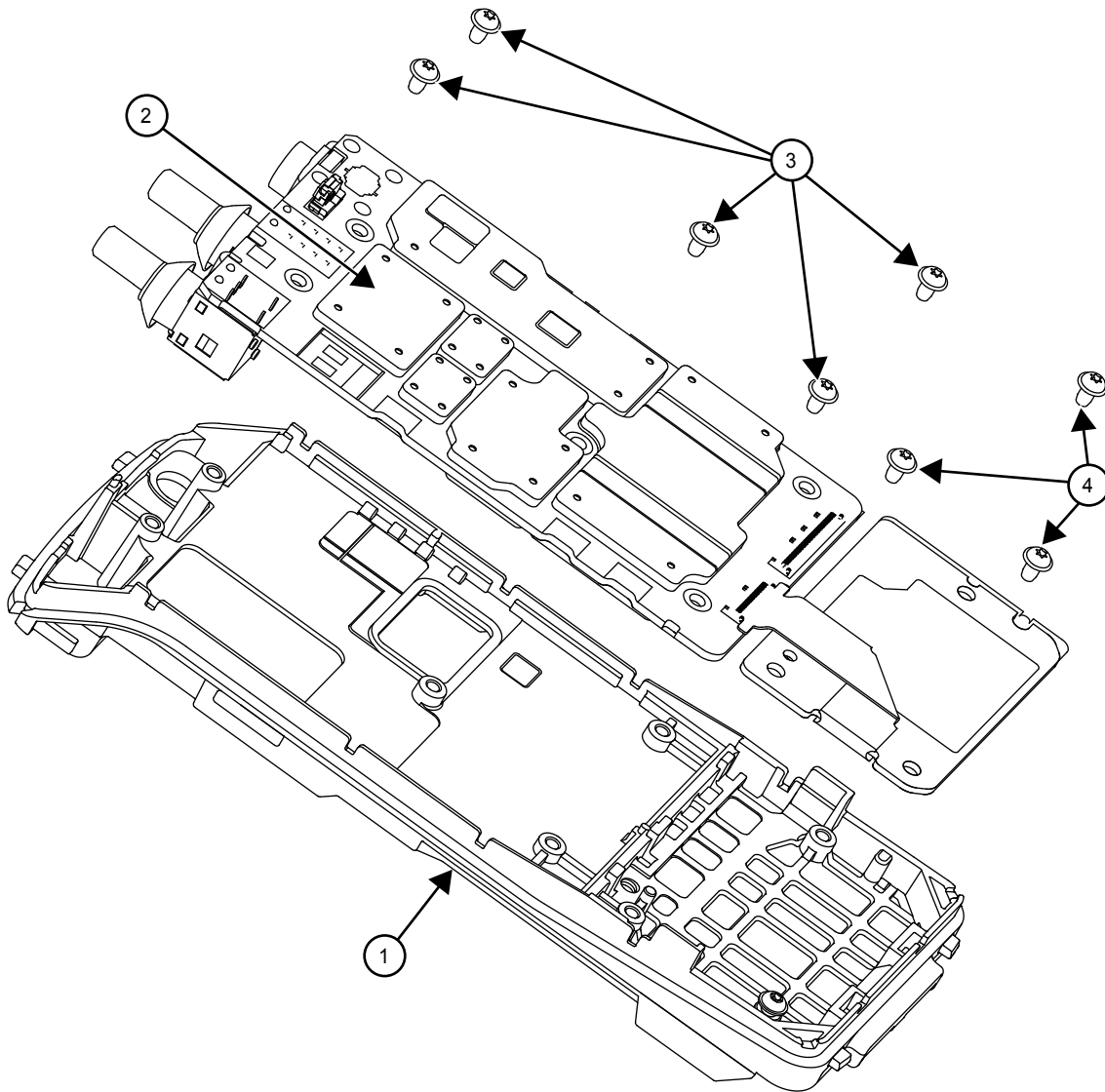
6.5.2

Chassis Disassembly

Procedure:

- 1 Use a TORX screwdriver with a T6 head to remove the five screws holding the main board to the chassis and the three screws holding the GOB.

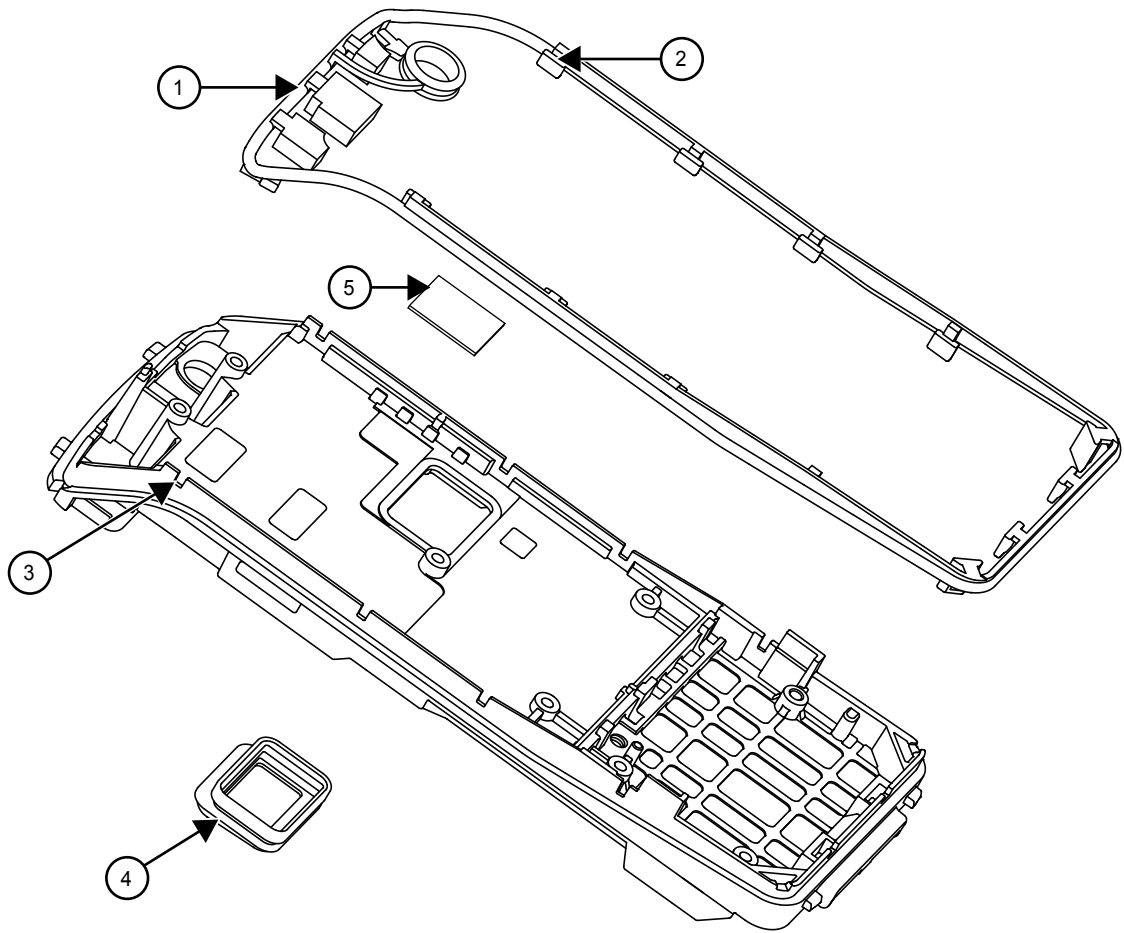
Figure 18: Chassis Disassembly



Label	Description
1	Chassis
2	Main Board
3	Main Board Screws
4	GOB Screws

- 2 Lift the main board from the chassis.
- 3 Lift the latch to separate the flex for the GOB.
- 4 Lift the GOB from the chassis.
- 5 Release all the tabs from the catches.
- 6 Remove the O-ring and battery contact seal

Figure 19: O-ring Removal



Label	Description
1	O-ring
2	Tab
3	Catch
4	Battery Contact Seal
5	Thermal Pad

6.5.3

Keypad, Display, and Keypad Board Disassembly

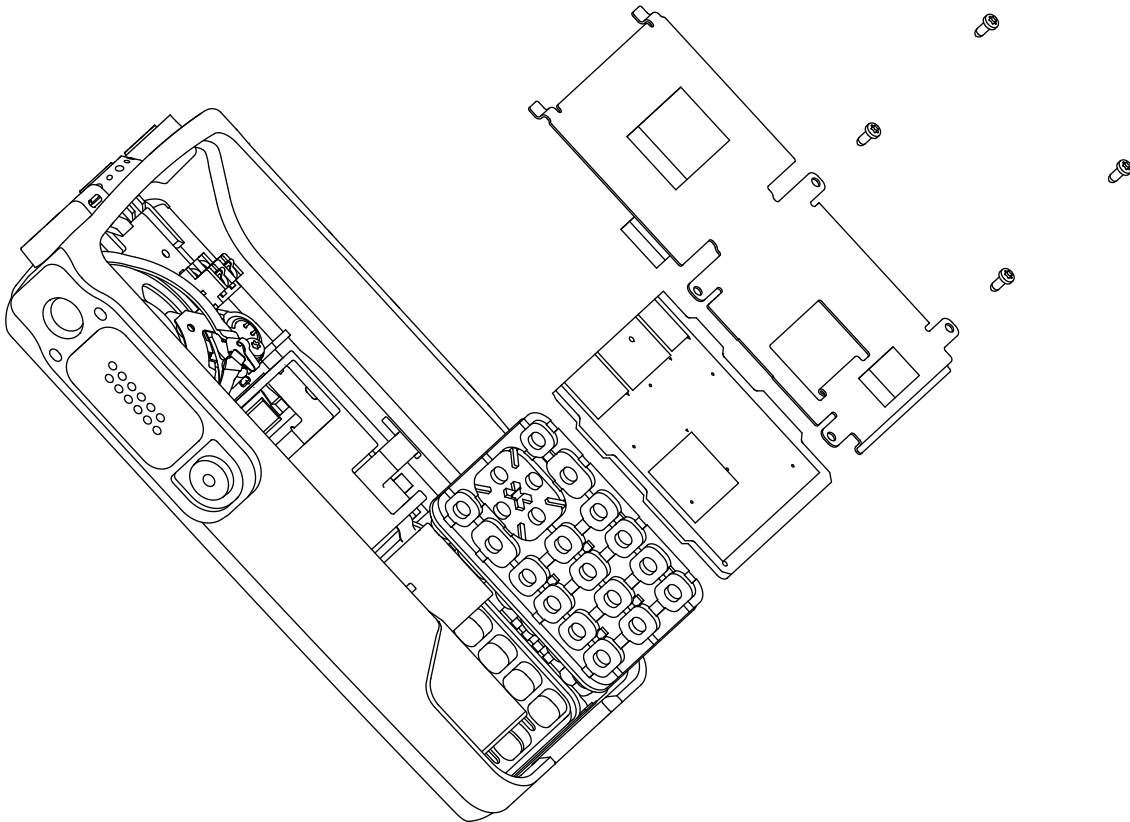
Procedure:

- 1 If the disassembly of the keypad, the keypad printed circuit board, or the display is required, remove the retainer by using a TORX screwdriver with a T6 head to remove the four screws.
- 2 Slide out the retainer from the housing assembly.
- 3 Disconnect the speaker flex, LCD flex, and PTT flex from the keypad board.



NOTICE: The LCD, keypad board, and keypad can be removed without the use of tools.

Figure 20: Keypad, Display, and Keypad Board Disassembly for Full Keypad



6.5.4

Speaker, Microphone, and Universal Connector Flex Disassembly

6.5.4.1

Full Keypad

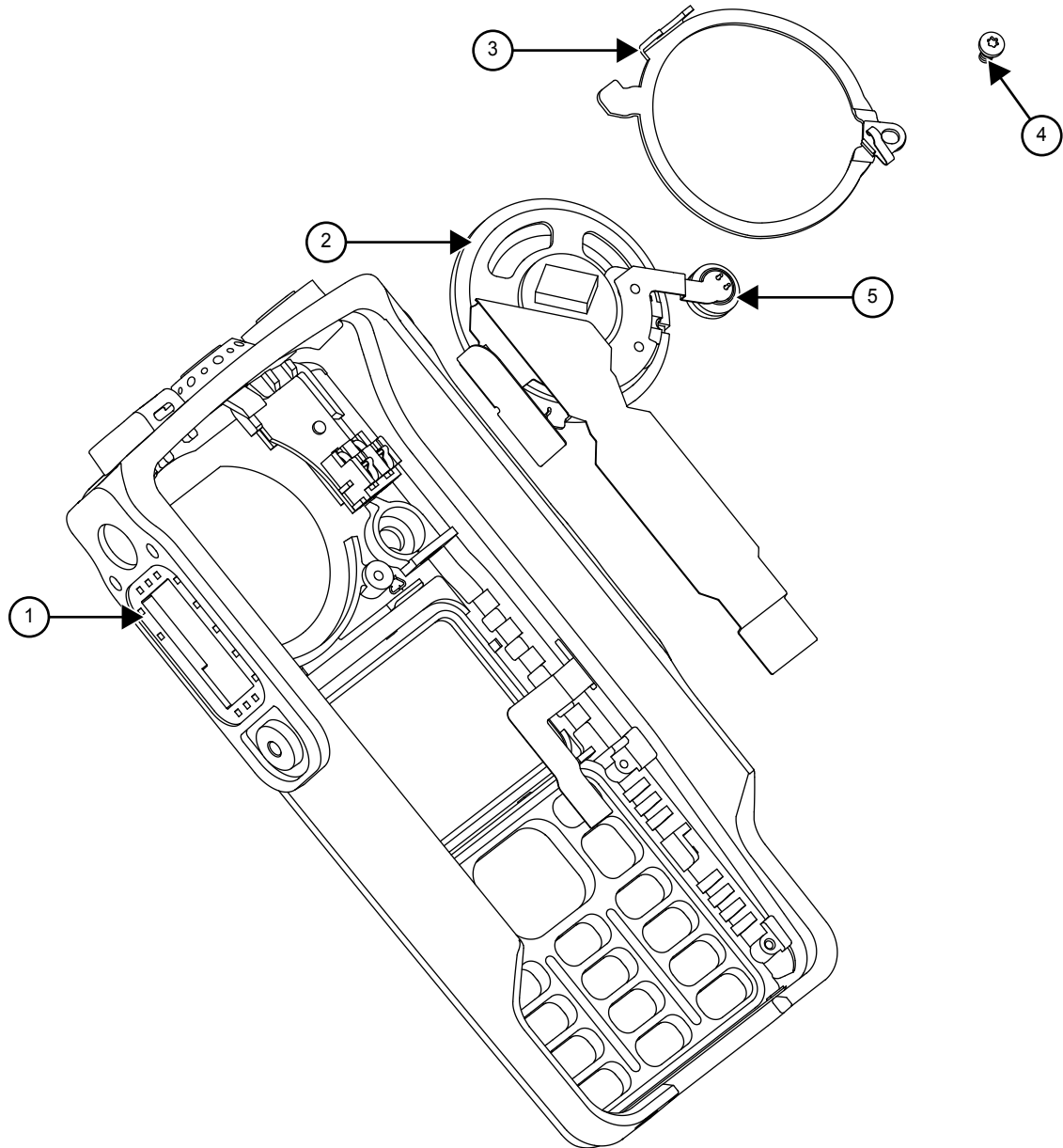
Procedure:

- 1 Pull the microphone boot from its seated position.
- 2 Remove the speaker retainer screw using the TORX T6 screwdriver.
- 3 Peel-off the universal connector flex circuit escutcheon.
- 4 Pull the UC flex circuit (adhesive held) backer board from the front cover. Push the universal connector flex through the UC slot into the housing.
- 5 Remove the speaker retainer from the speaker assembly.
- 6 Remove the assembly from the front housing.

Label	Description
1	UC Slot
2	Speaker, Mic, and Flex Assembly
3	Speaker Retainer
4	Screw

Label	Description
5	Mic Boot

Figure 21: Speaker Removal for Full Keypad Model



6.5.4.2

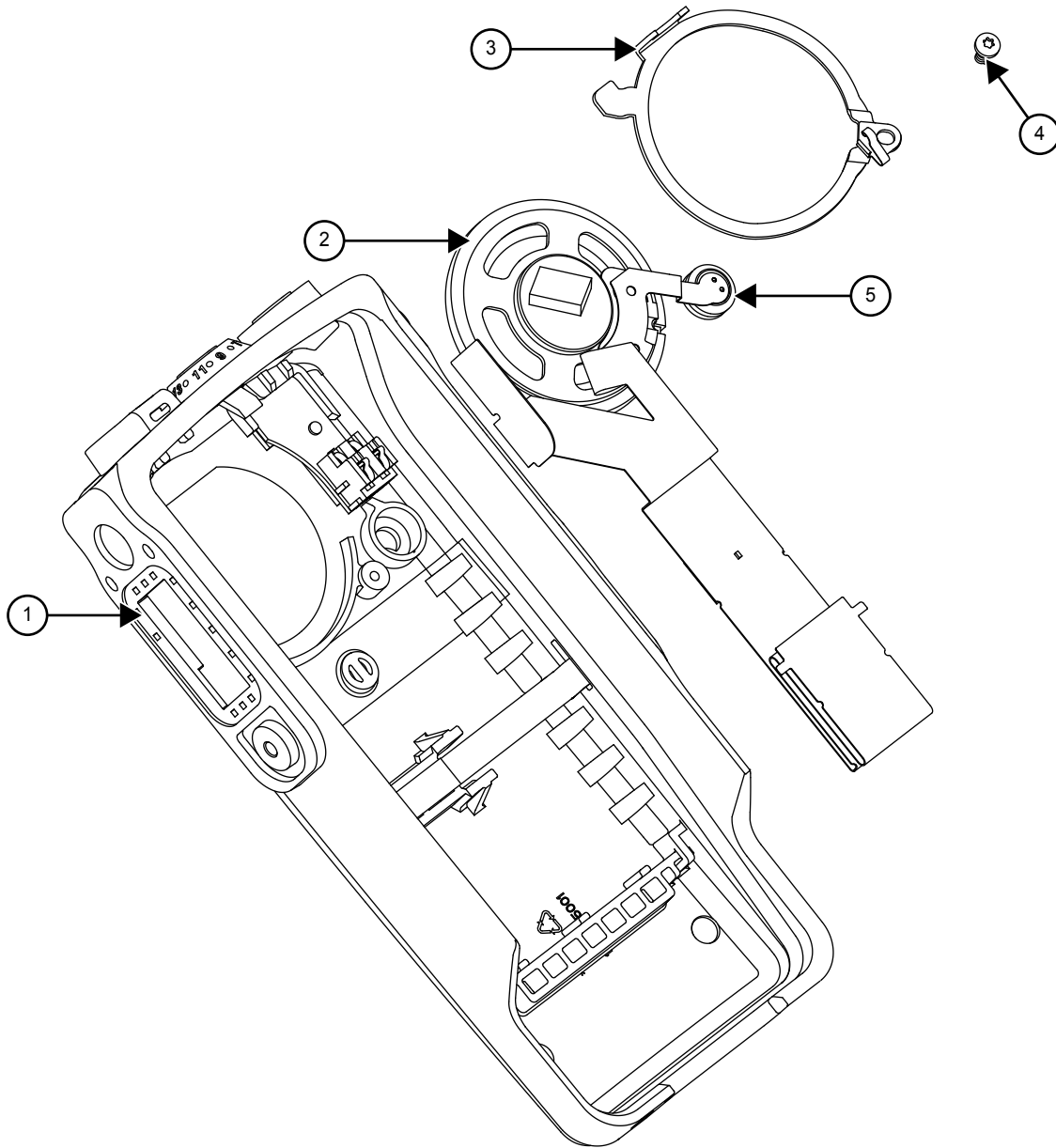
Non-Keypad

Procedure:

- 1 Pull the rubber microphone boot from its seated position.
- 2 Remove the screw using the TORX T6 screwdriver.
- 3 Disconnect the PTT flex and peel the speaker assembly flex from the housing.
- 4 Peel off the universal connector flex circuit escutcheon.

- 5 Pull the UC flex circuit (adhesive held) backer board from the front cover. Push the universal connector flex through the UC slot into the housing.
- 6 Remove the speaker retainer from the speaker assembly.
- 7 Remove the assembly from the front housing.

Figure 22: Speaker Removal for Non-Keypad Model



Label	Description
1	UC Slot
2	Speaker, Mic, and Flex Assembly
3	Speaker Retainer
4	Screw
5	Mic Boot

6.5.5

Emergency Button Assembly Disassembly

Procedure:

The Emergency button can be removed without the use of tools once the speaker retainer is removed.

Figure 23: Emergency Button Disassembly for Full Keypad Model

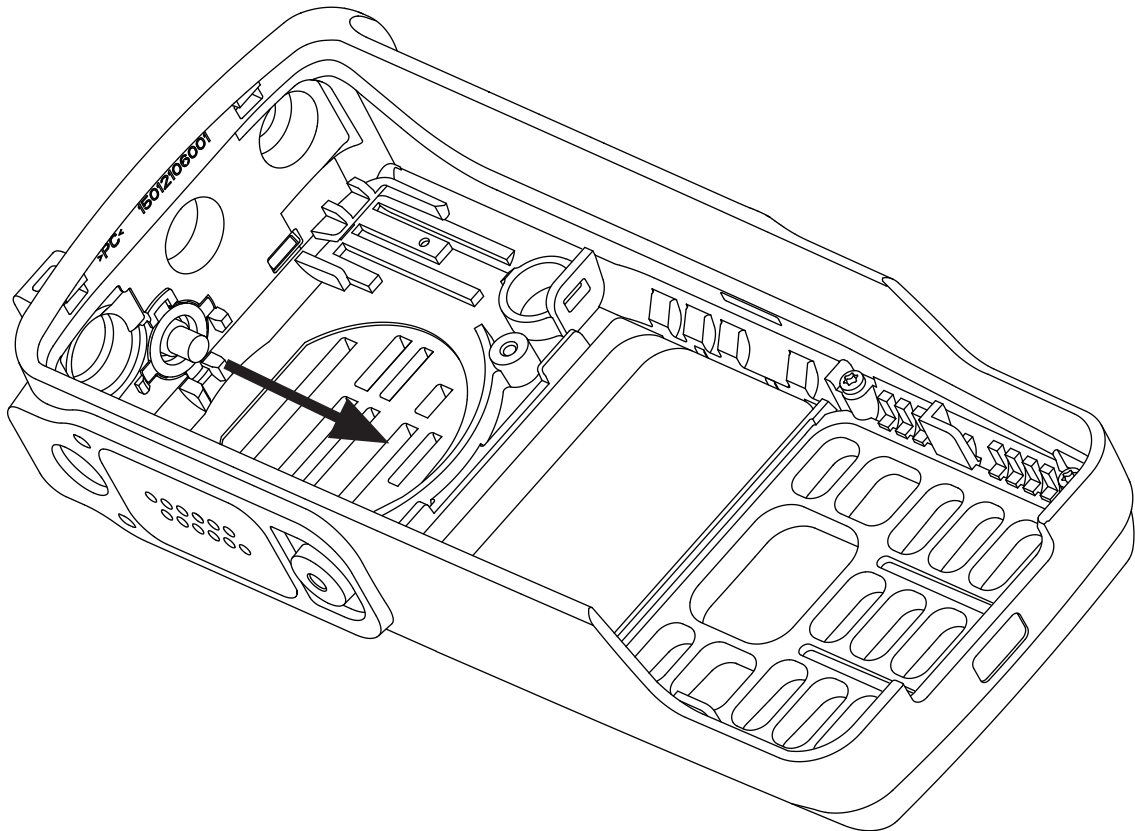
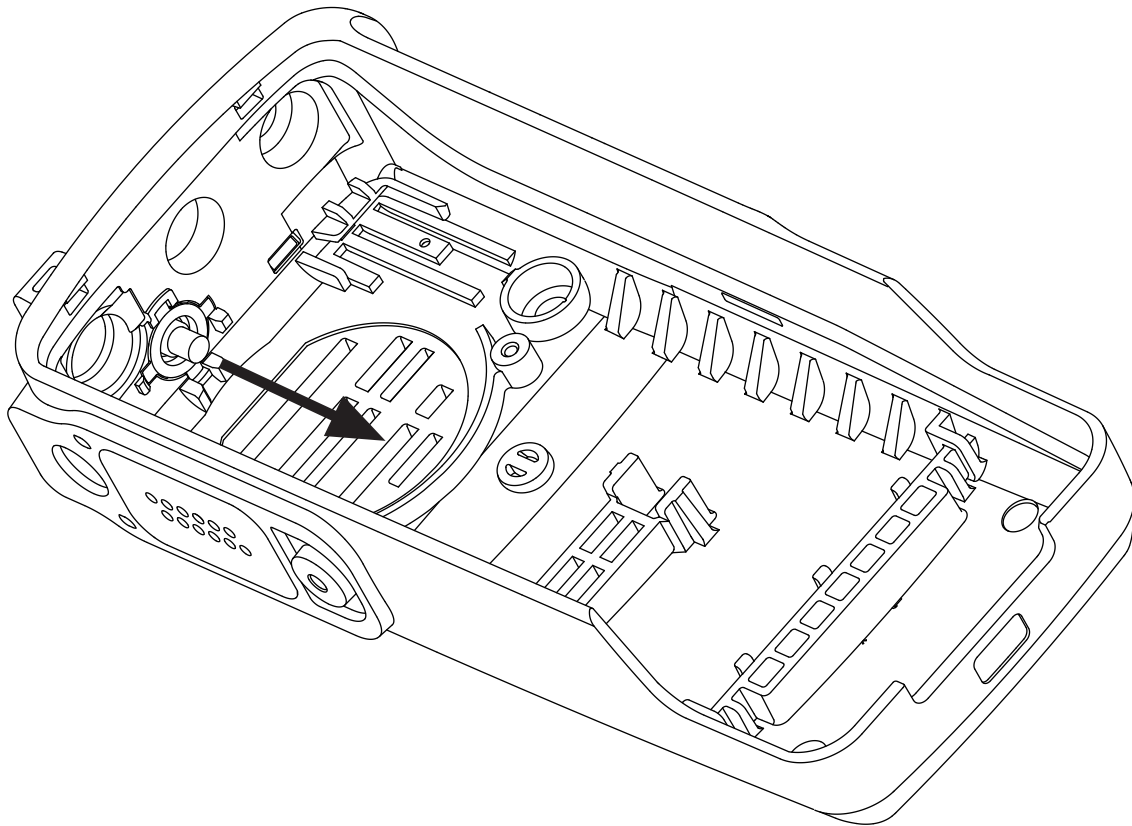


Figure 24: Emergency Button Disassembly for Non-Keypad Model



6.6

Detailed Radio Reassembly

The section describes the detailed reassembly procedure of your radio.

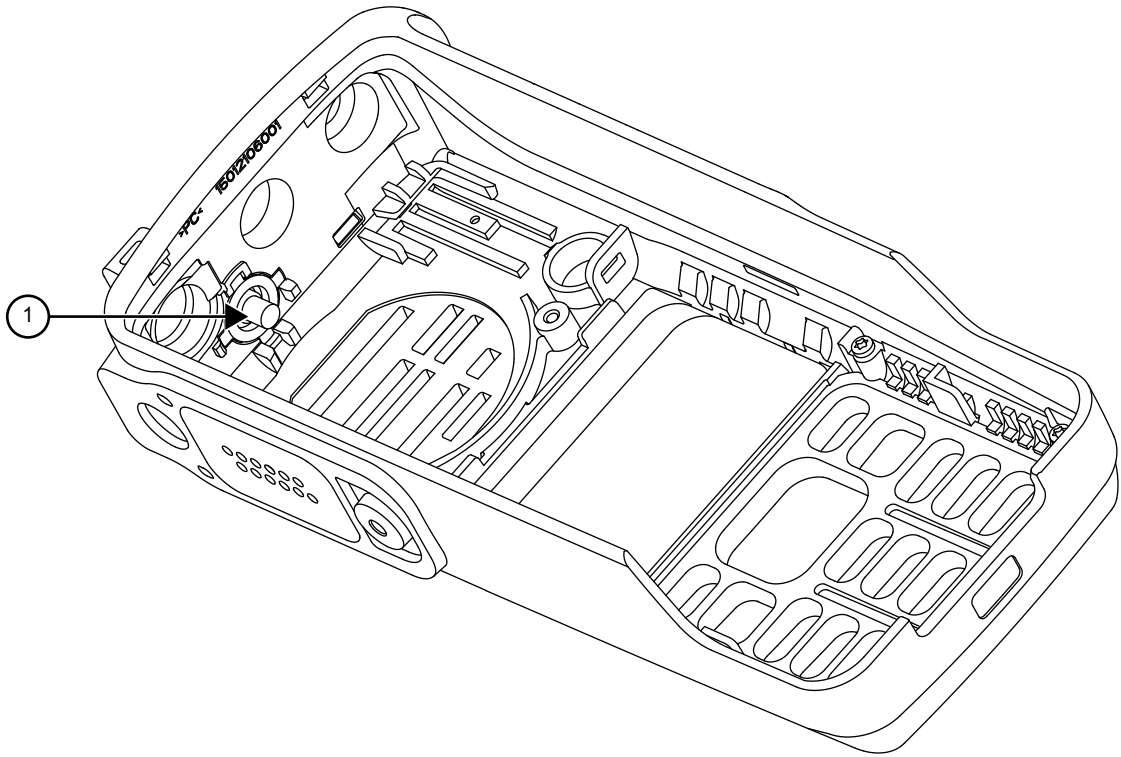
6.6.1

Emergency Button and Speaker Reassembly

Procedure:

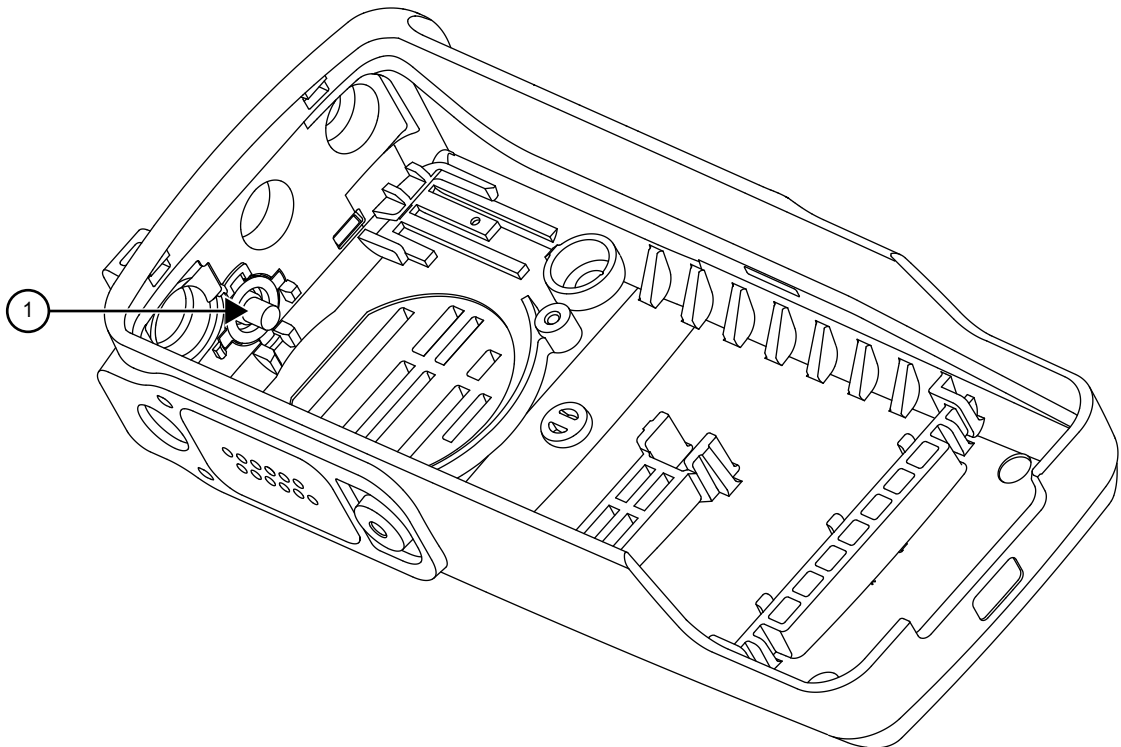
- 1 Slot in the emergency button in its proper slot.

Figure 25: Emergency Button Reassembly for Full Keypad Model



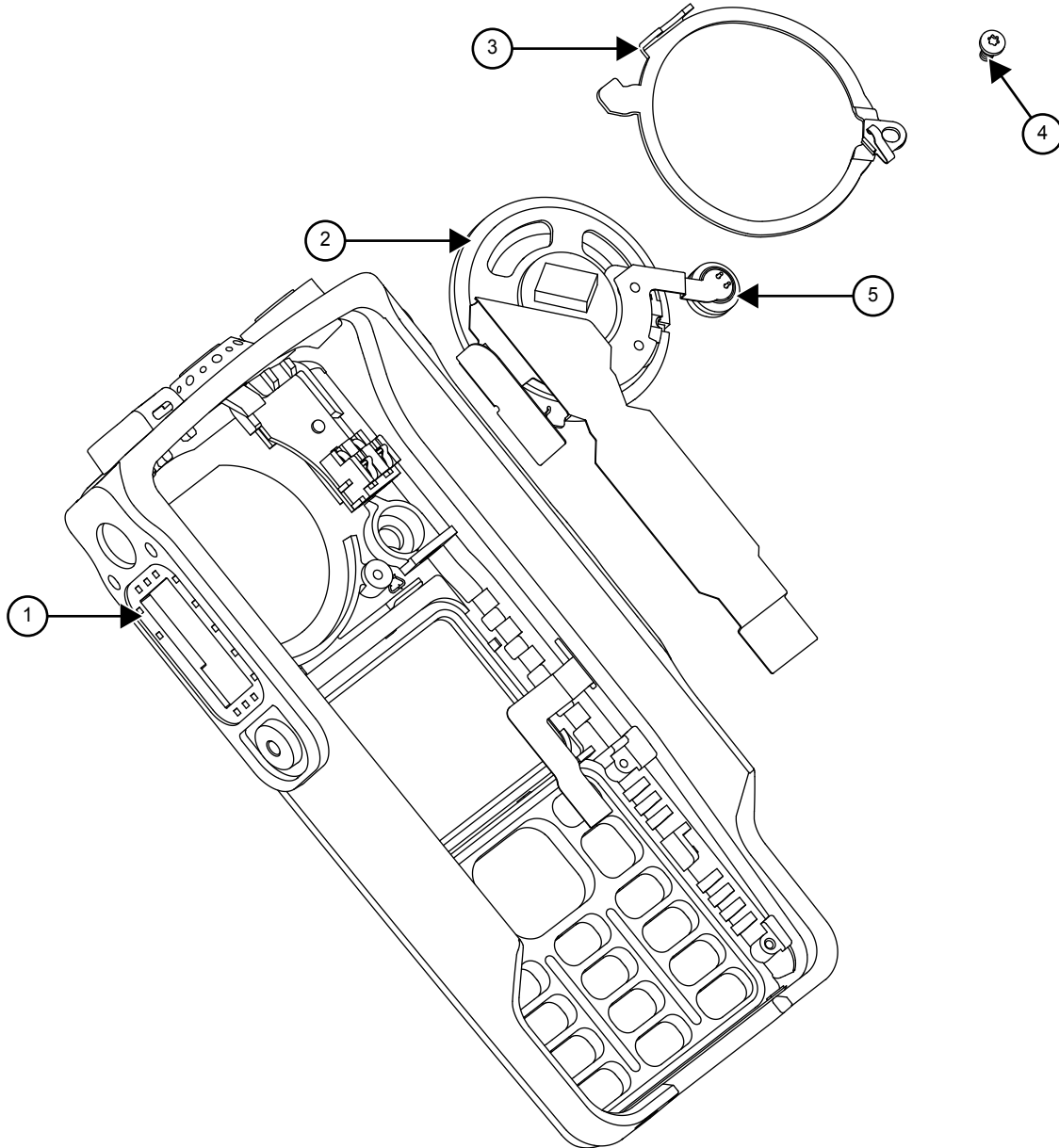
Label	Description
1	Emergency Button

Figure 26: Emergency Button Reassembly for Non-Keypad Model



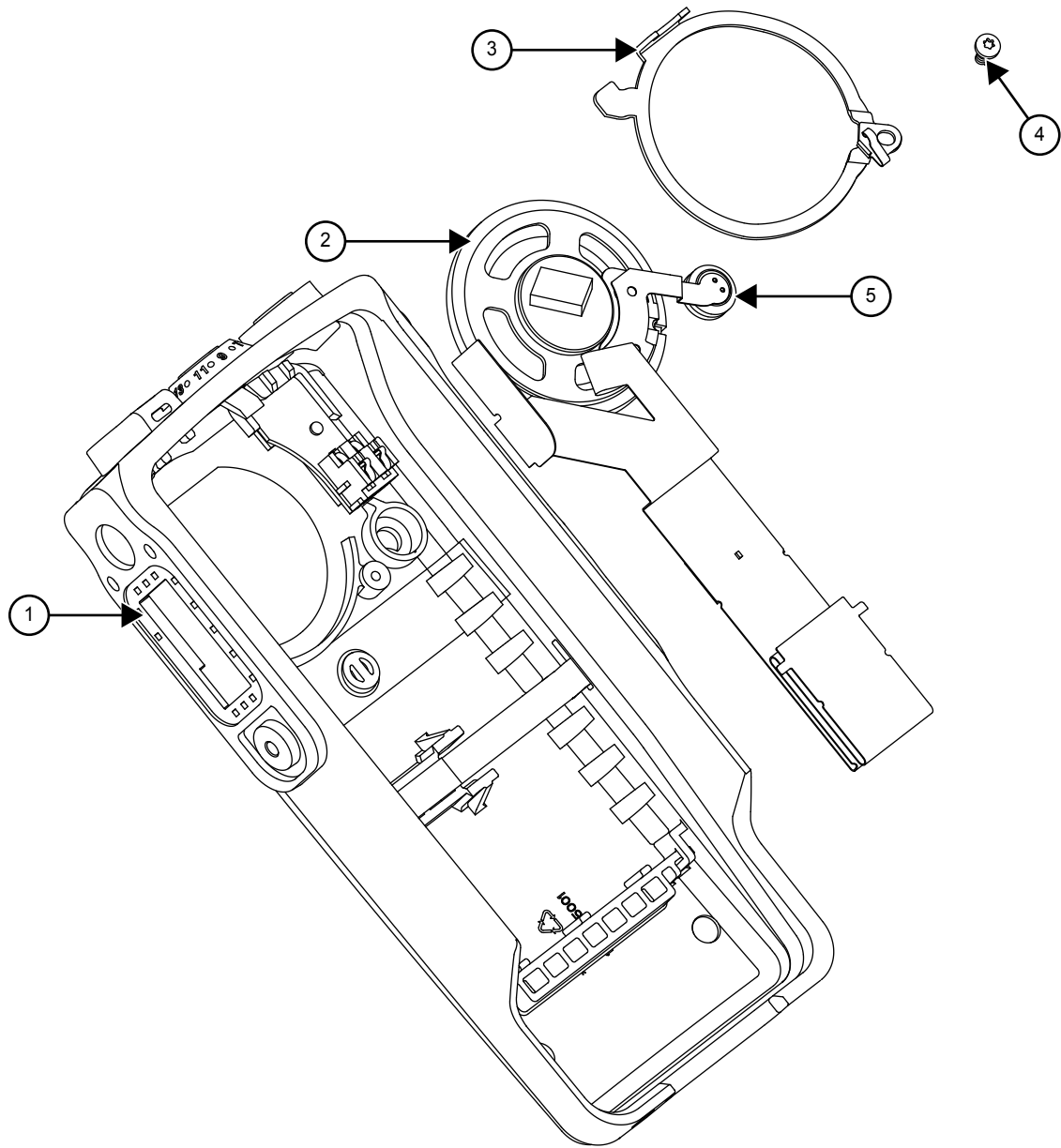
Label	Description
1	Emergency Button

Figure 27: Speaker Reassembly for Full Keypad



Label	Description
1	UC Slot
2	Speaker, Mic and Flex Assembly
3	Speaker Retainer
4	Screw
5	Mic Boot

Figure 28: Speaker Reassembly for Non-Keypad



Label	Description
1	UC Slot
2	Speaker, Mic and Flex Assembly
3	Speaker Retainer
4	Screw
5	Mic Boot

- 2 Insert the flexes through the speaker retainer so that the speaker retainer is placed directly on the speaker assembly.



NOTICE: Ensure all the flexes are above the speaker retainer.

- 3 Slide the universal connector flex into the UC slot.
- 4 Hook in the speaker retainer with speaker assembly at the top left corner of the housing.
- 5 Affix the appropriate screw on the speaker retainer.
- 6 Place the mic boot in the appropriate slot.
- 7 Place a new universal connector escutcheon on the universal connector flex circuit.

6.6.2

Keypad, Display, and Keypad Board Disassembly

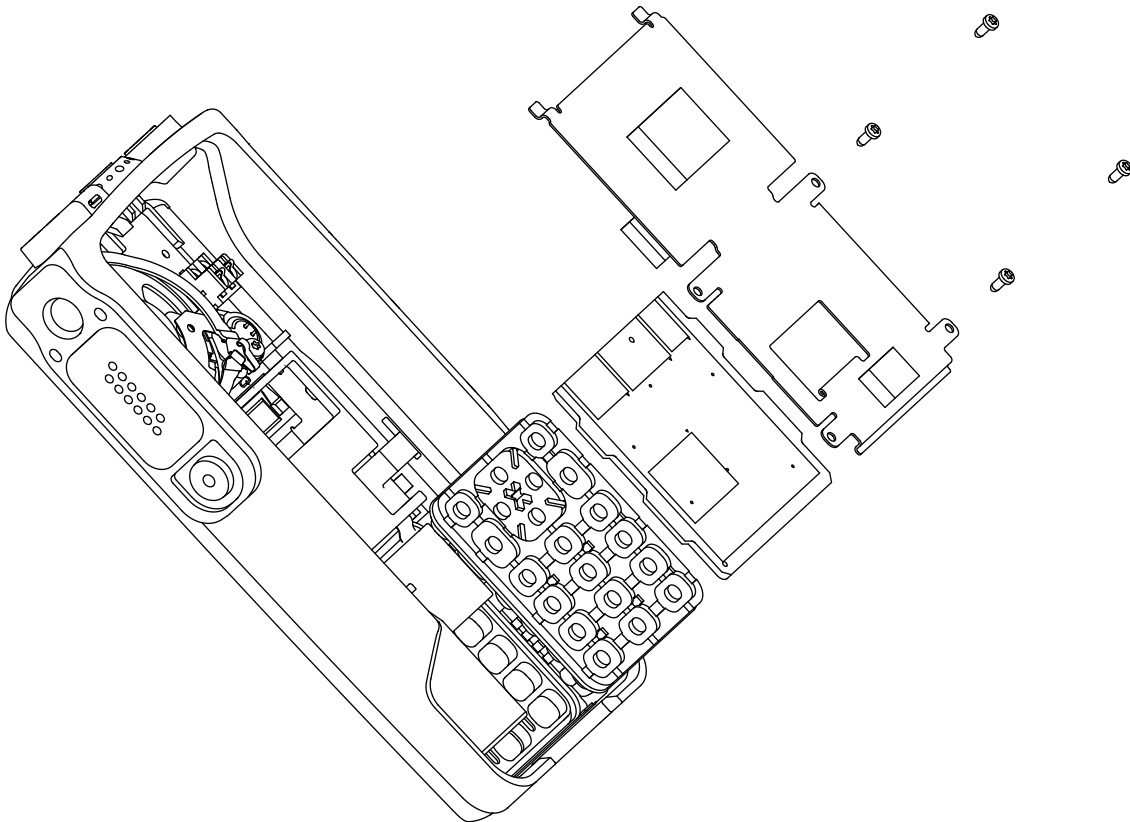
Procedure:

- 1 If the disassembly of the keypad, the keypad printed circuit board, or the display is required, remove the retainer by using a TORX screwdriver with a T6 head to remove the four screws.
- 2 Slide out the retainer from the housing assembly.
- 3 Disconnect the speaker flex, LCD flex, and PTT flex from the keypad board.



NOTICE: The LCD, keypad board, and keypad can be removed without the use of tools.

Figure 29: Keypad, Display, and Keypad Board Disassembly for Full Keypad



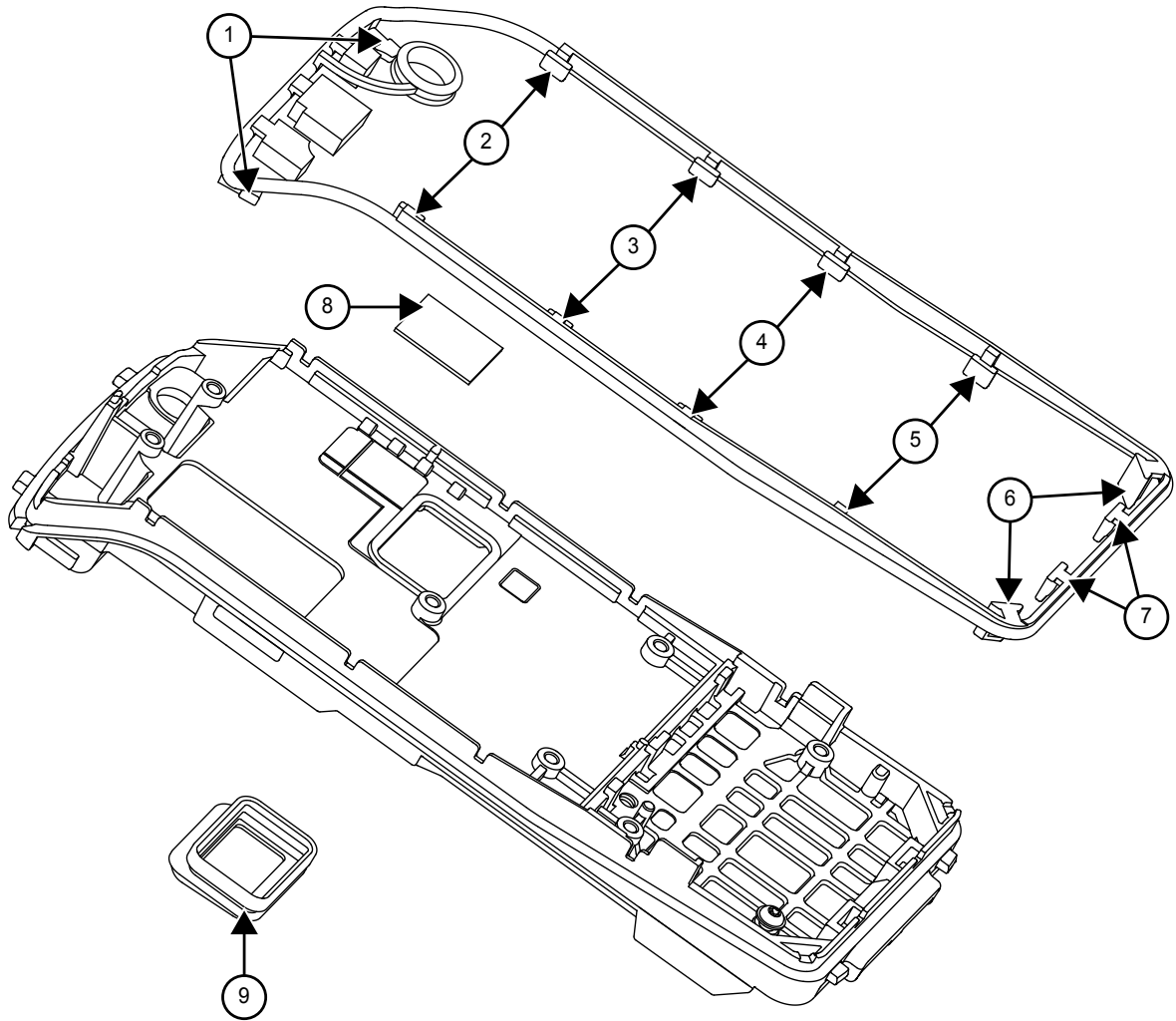
6.6.3

Chassis Reassembly

Procedure:

- 1 Reassemble O-ring.

Figure 30: O-ring Reassembly

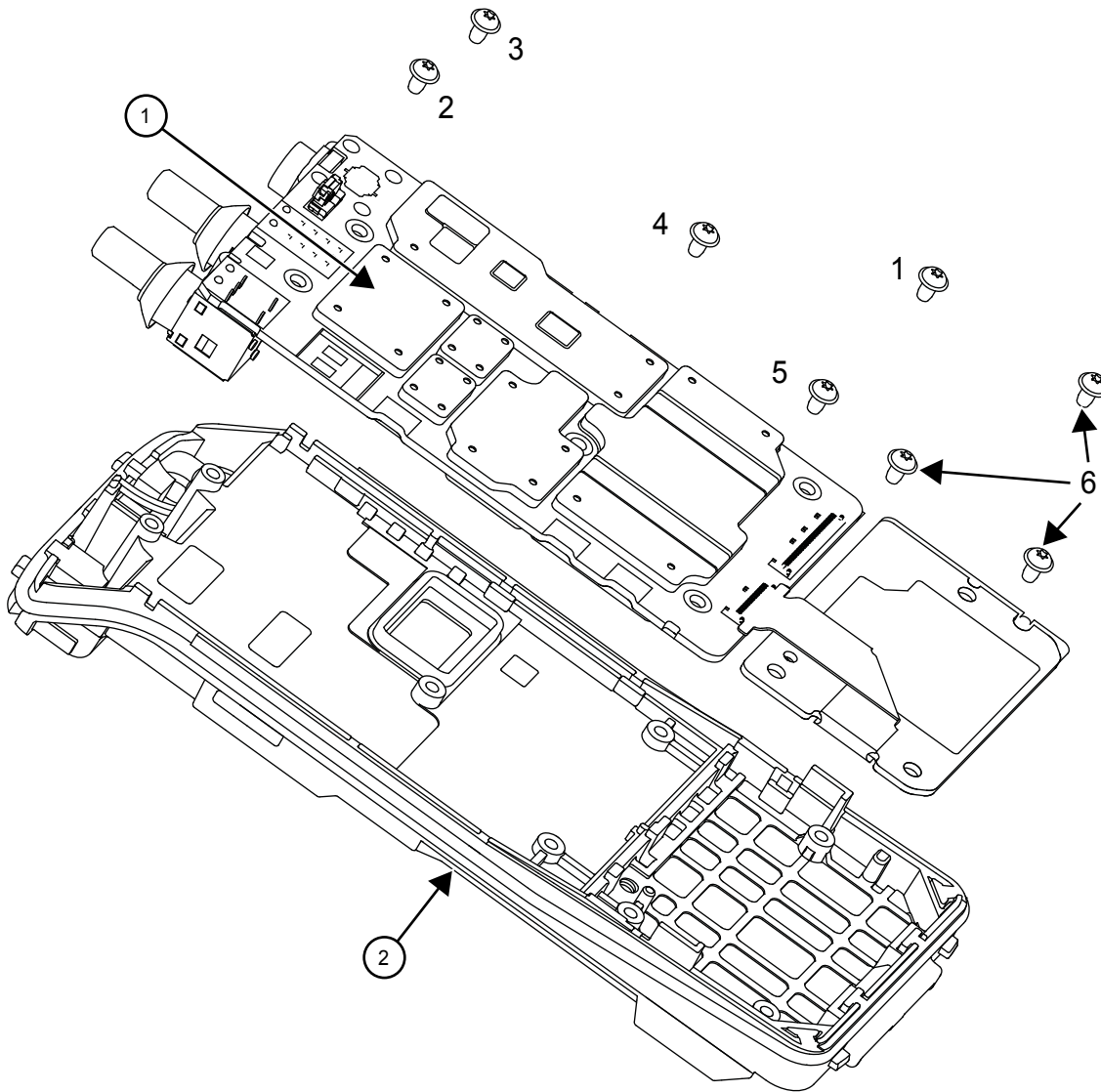


Label	Description
8	Thermal Pad
9	Battery Contact Seal

- a Ensure that the main O-ring is not twisted and untangle it to its actual form if needed before performing reassembly.
- b Insert (7) into the bottom two notches on the chassis.
- c Fit (6) around the bottom two corners of the chassis.
- d Insert (2) to (5) following the sequence as shown in [Figure 30: O-ring Reassembly on page 71](#).
- e Secure (1) into the top 2 notches of the chassis.
- f Replace the battery contact seal.
- g Replace the thermal pad.

2 Reassemble Chassis

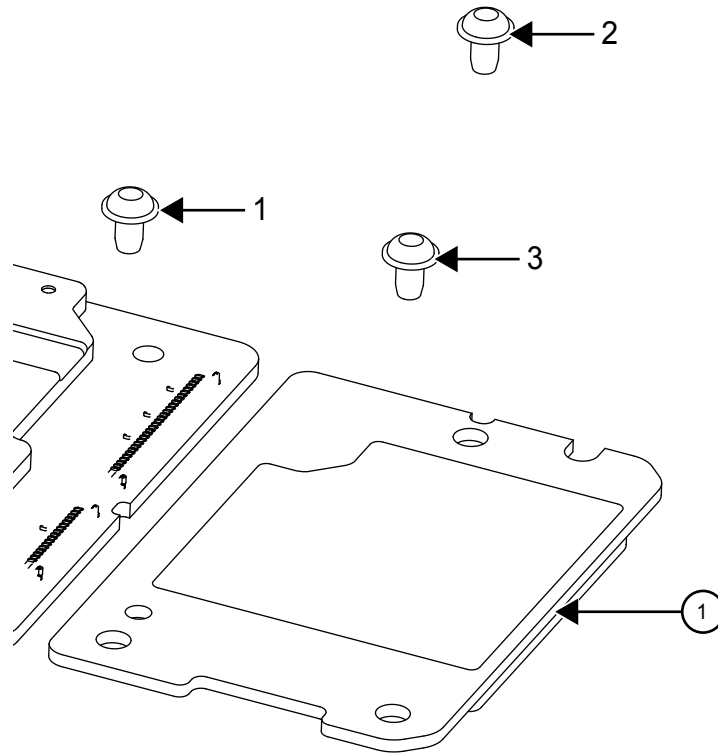
Figure 31: Chassis Reassembly



Label	Description
6	GOB Screws
7	Main Board
8	Chassis

- a Place the main board onto the chassis.
 - b Tighten the main board screws in the sequence shown in [Figure 31: Chassis Reassembly on page 72](#).
 - c Place the GOB on the chassis.
 - d Tighten the GOB screws following the sequence shown in [Figure 32: GOB Reassembly on page 73](#).
- 3** Reassemble GOB.
- a Connect GOB flex to the main board.

Figure 32: GOB Reassembly



Label	Description
4	GOB

6.6.4

Chassis and Front Cover Reassembly

Procedure:

- 1 Connect the flex to the main board and the keypad board.
 - a Bend the flex correctly as shown in the following figure.

Figure 33: Flex Assembly for Full Keypad and Limited Keypad models

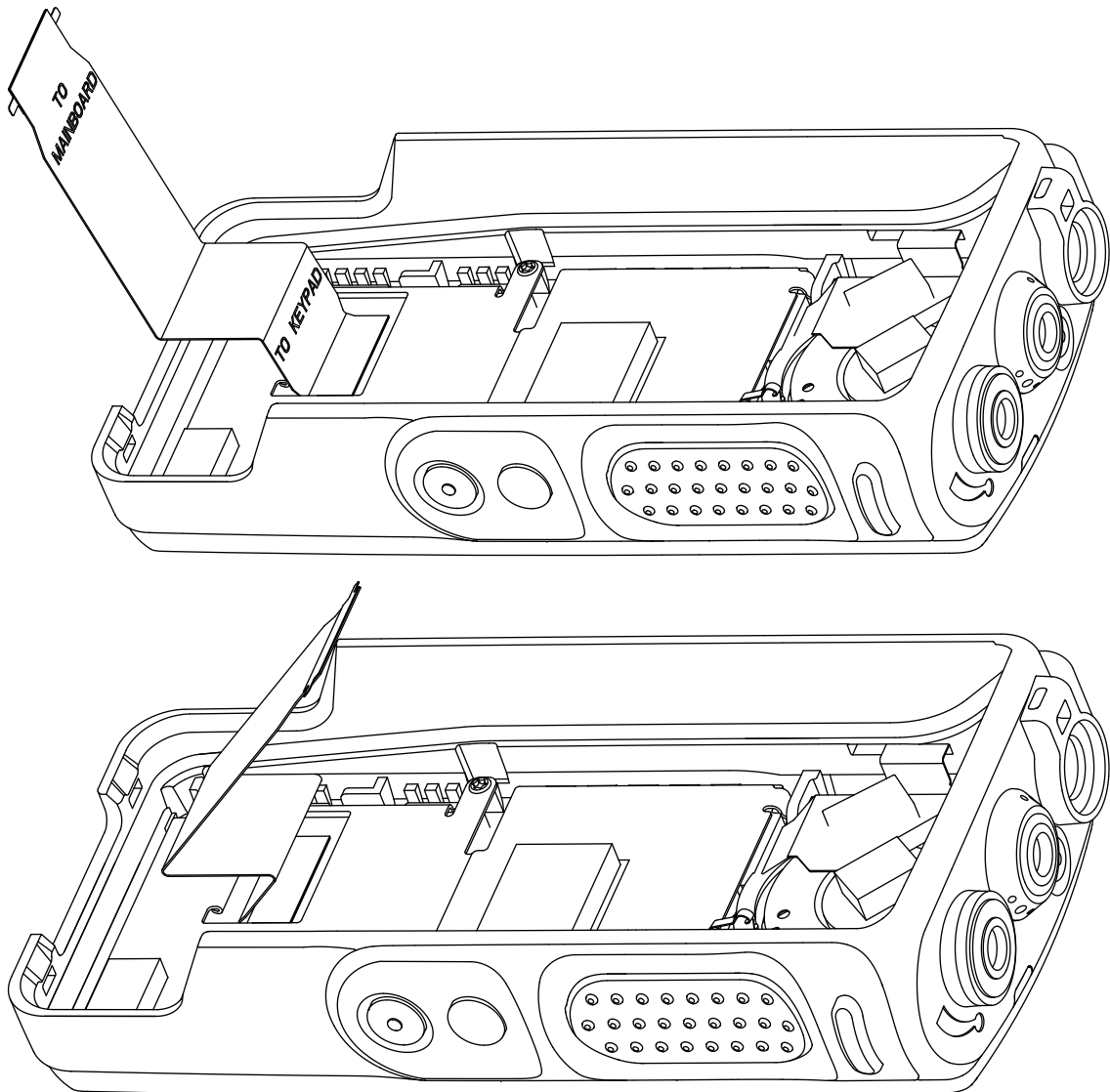
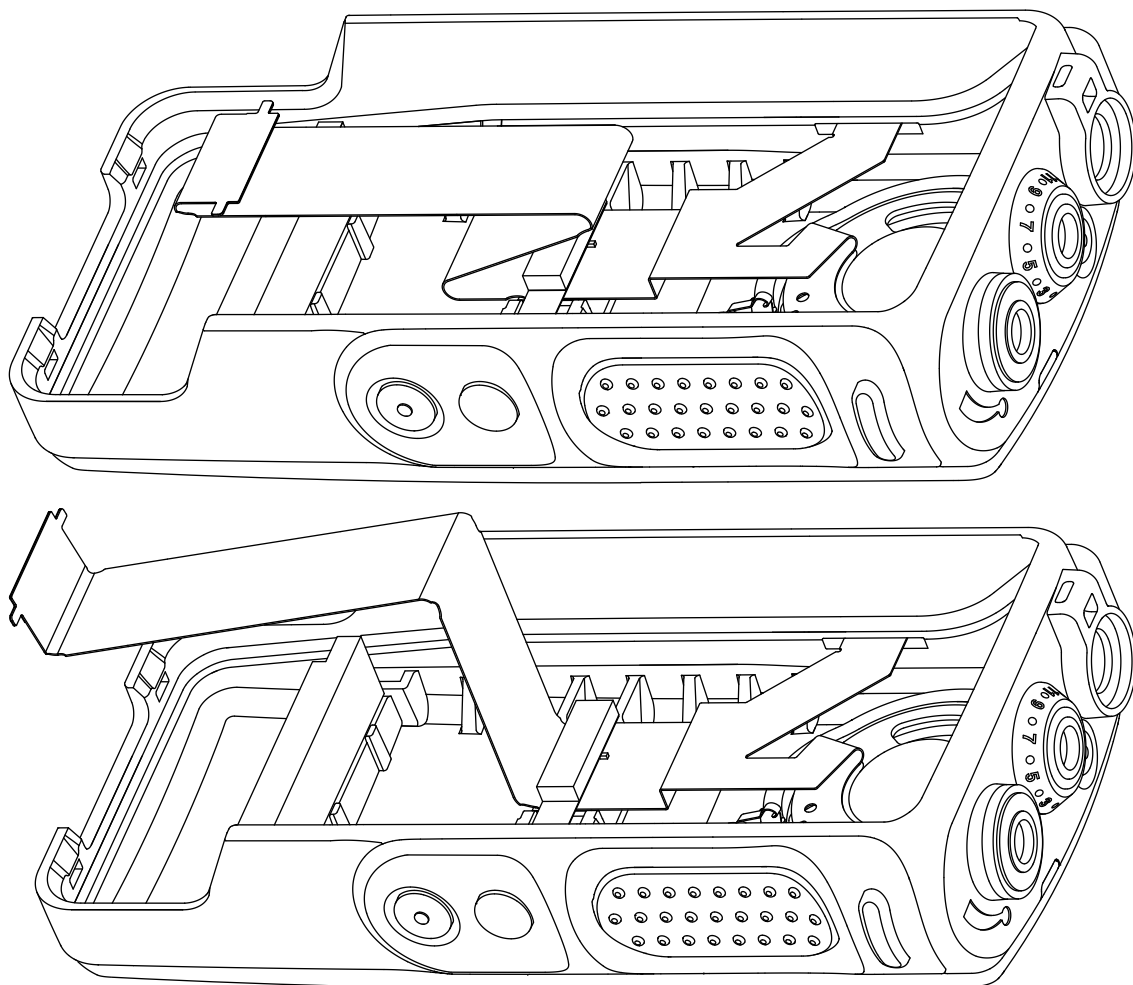
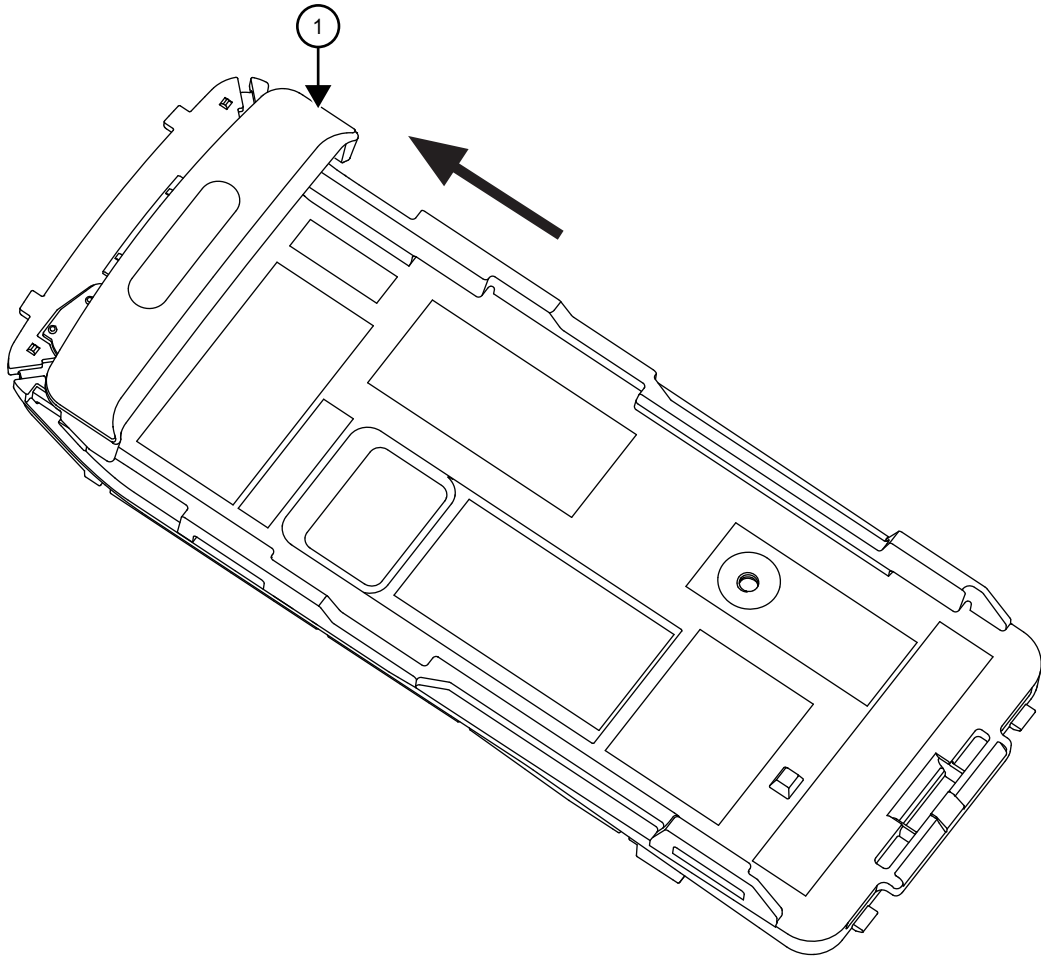


Figure 34: Flex Assembly for Non-Keypad model



- b** Connect flex to the connector snap.
- c** Press the connector snap.
- 2** Insert top chassis tabs into the recesses on front cover and the tabs are fully inserted.
- 3** Gently push down the chassis into the front cover until it snaps in place.
- 4** Align the shroud with the top of the front housing and slide it in place.
- 5** Insert knobs, antenna, and battery.

Figure 35: Chassis Reassembly



Label	Description
1	Shroud

6.6.5 Bluetooth Antenna Kit Disassembly/Reassembly

6.6.5.1 Bluetooth Antenna Kit Disassembly

Procedure:

Use a T3 Torx screwdriver to unfasten the bluetooth module.

Figure 36: Bluetooth Removal for Full Keypad Model

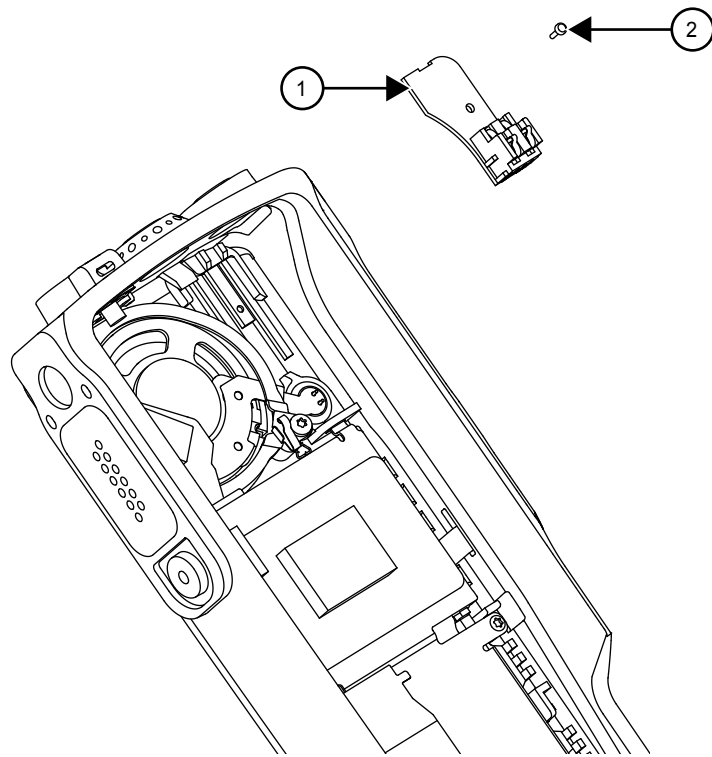
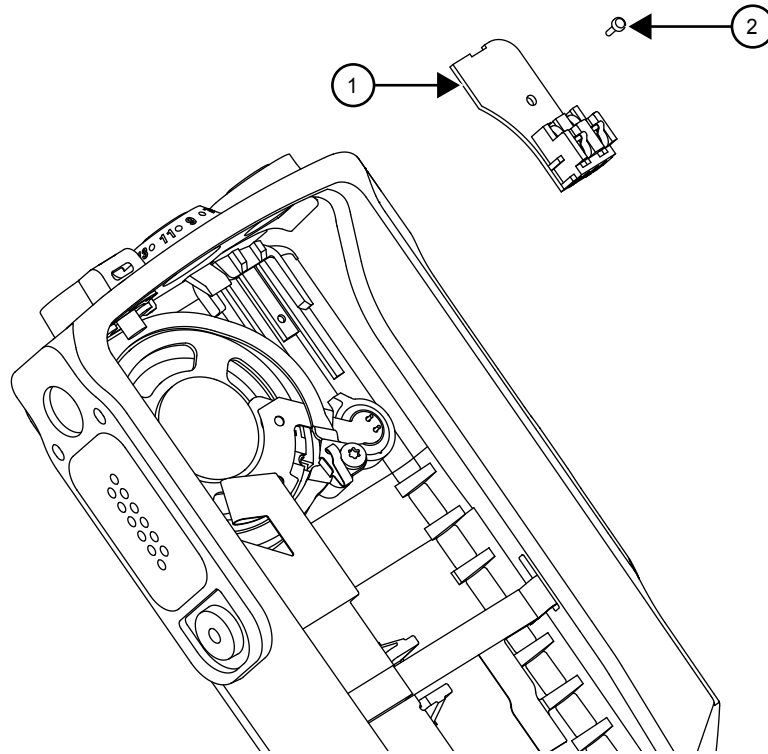


Figure 37: Bluetooth Removal for Non-Keypad Model



Label	Description
1	Bluetooth Module
2	Screw

6.6.5.2 Bluetooth Antenna Kit Reassembly

Procedure:

Place the Bluetooth module in the housing and fasten with a Torx 3 screwdriver.

Figure 38: Bluetooth Reassembly for Full Keypad Model

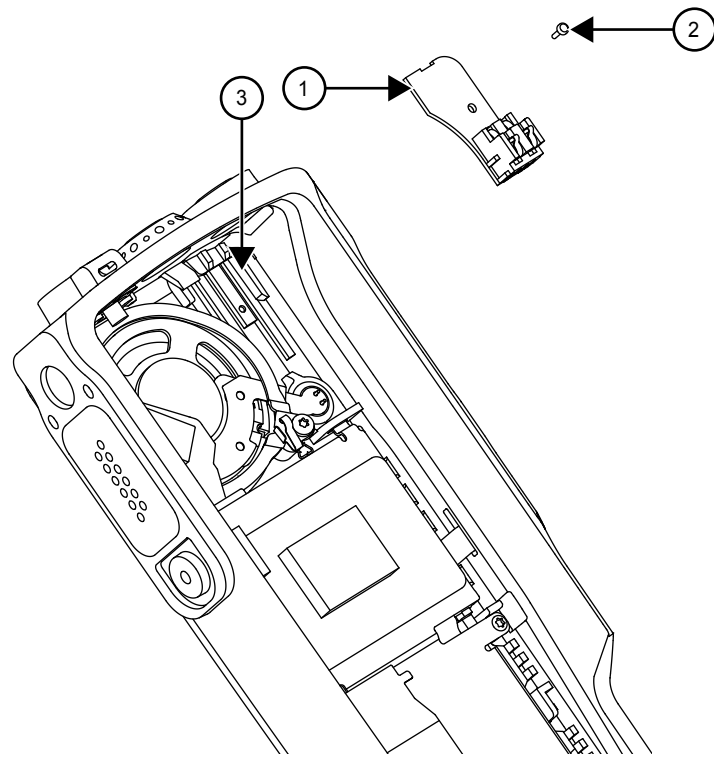
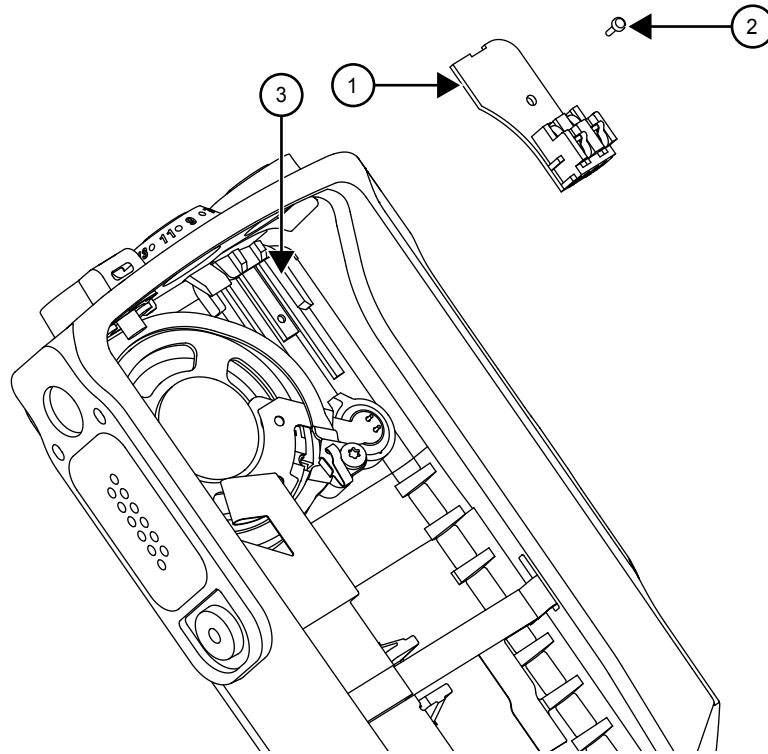


Figure 39: Bluetooth Reassembly for Non-Keypad Model



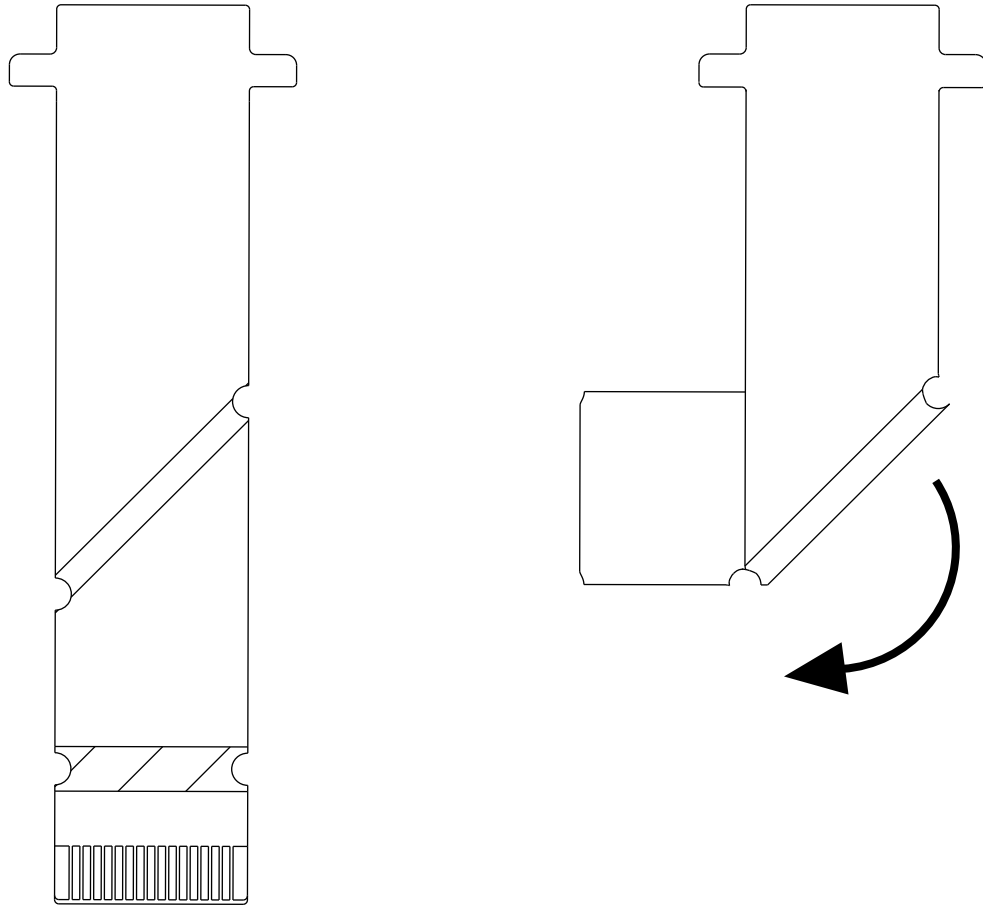
Label	Description
1	Bluetooth Module
2	Screw
3	Bluetooth Module Slot

6.6.6 GOB Installation

Procedure:

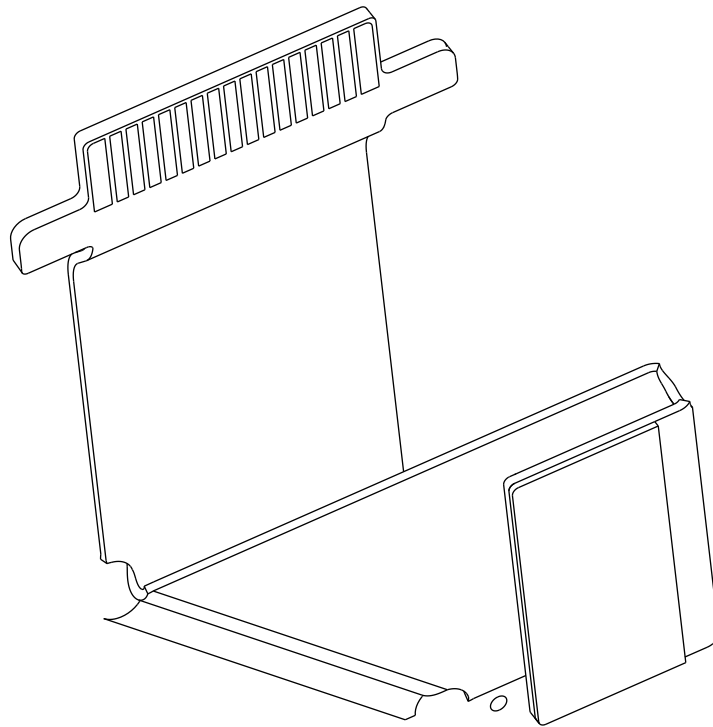
- 1 Fold the option board flex cable as shown.

Figure 40: Option Board Flex Cable



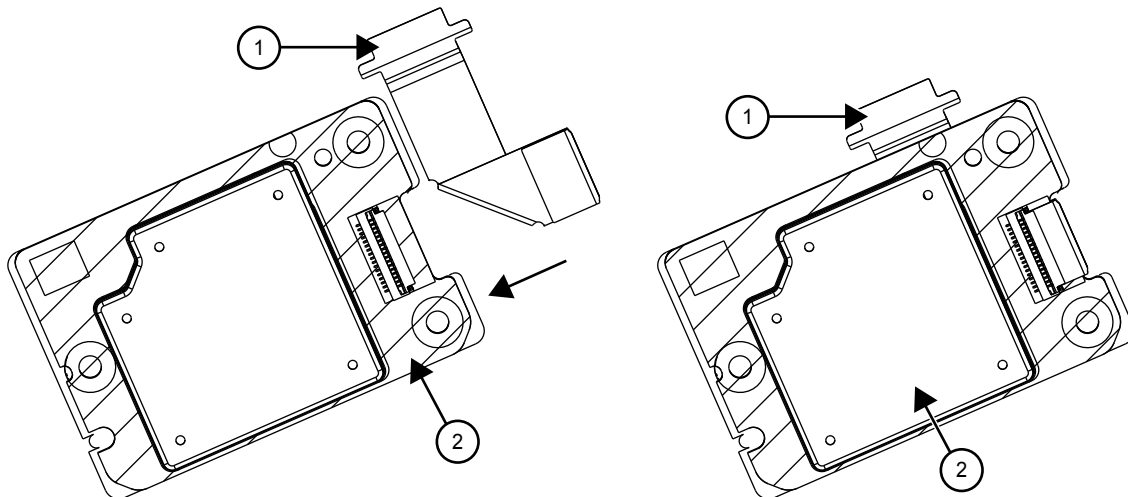
- 2** Peel the adhesive strip off from the spacer supplied and affix the spacer to the bottom side of the option board where marked.

Figure 41: Correctly Folded Option Board Flex Cable



- 3 Gently lift the connector flap of the option board and connect the option board flex cable. Gently close the flap.

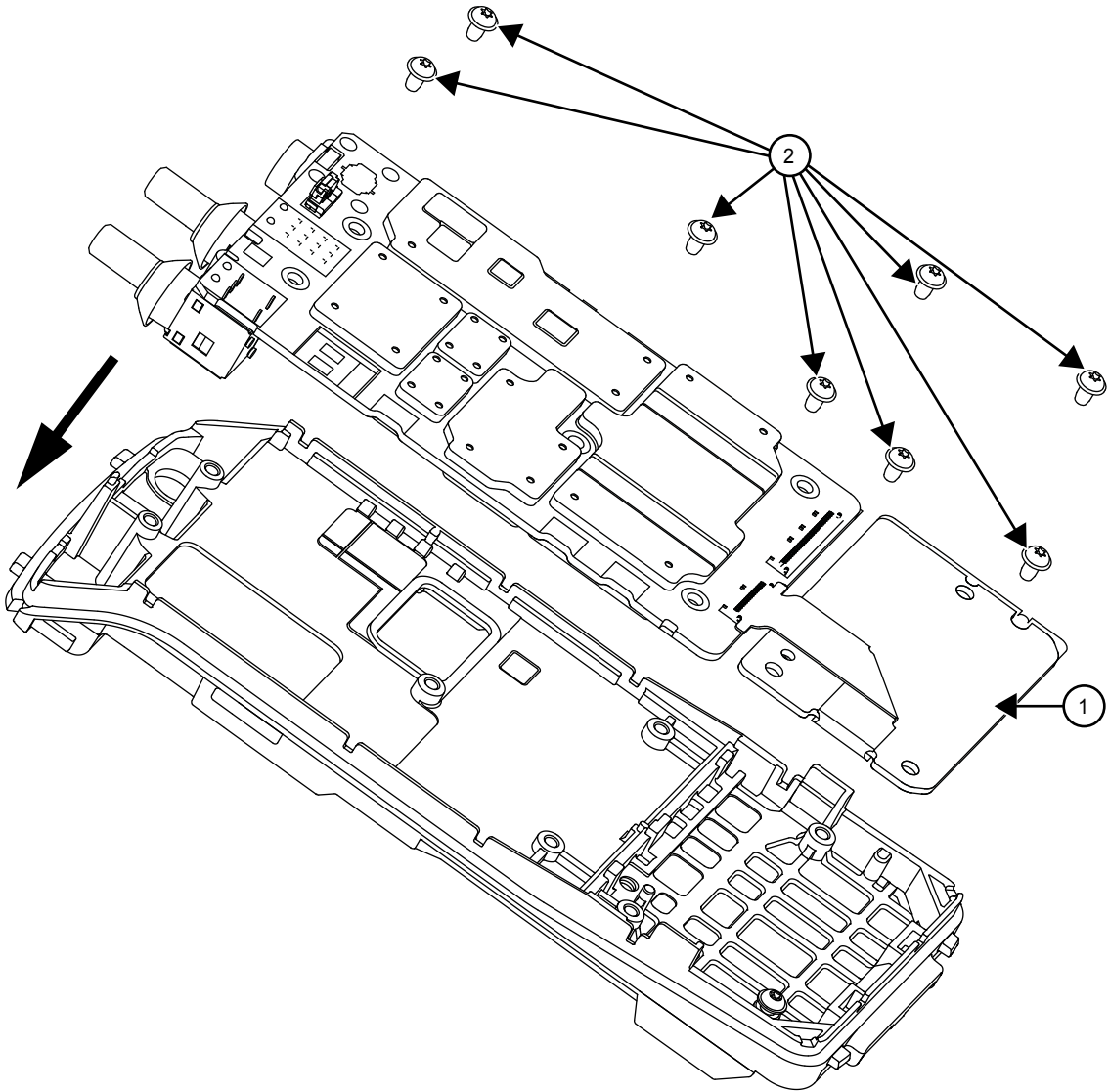
Figure 42: Connector Flap Reassembly



Label	Description
1	Flex
2	GOB

- 4 Insert the option board with the motherboard into the chassis.

Figure 43: Inserting Option Board into Chassis



Label	Description
1	Option Board
2	Screws

6.7

Ensuring Radio Immersibility

This section discusses radio immersibility concerns, tests, and disassembly and reassembly of the radios.

6.7.1

Servicing

Radios shipped from the Motorola Solutions factory have passed vacuum testing and are capable of restoring the watertight integrity of your radio.



CAUTION: It is strongly recommended to defer your radio maintenance to qualified service personnel and service shops. This is of paramount importance as service by unauthorized persons may cause irreparable damage to your radio. If disassembly is necessary, unauthorized attempts to repair the radio may void any existing warranties or extended performance agreements with Motorola Solutions. It is also recommended for qualified service personnel/workshop that is authorized by Motorola Solutions to perform annual check on your radio immersibility.

6.7.2

Accidental Immersion

If radio is accidentally dropped into water, shake your radio to remove the excess water from the speaker grille and microphone port area before operating. Otherwise, the sound may be distorted until water has evaporated, or is dislodged from these areas.

6.7.3

Specialized Test Equipment

This section summarizes the specialized test equipment necessary for testing the integrity of the radios.

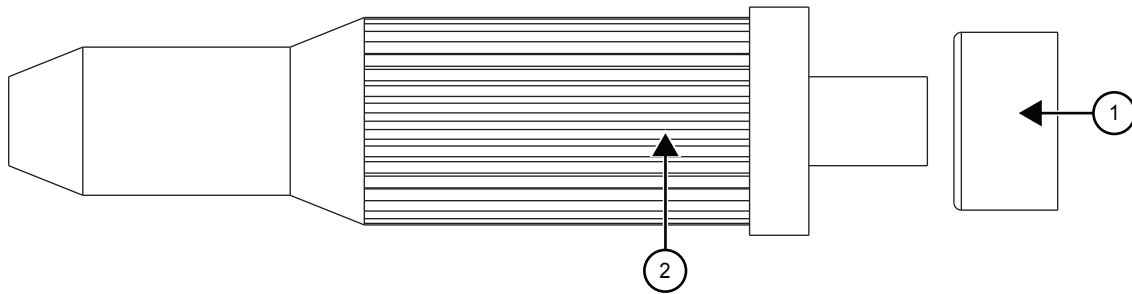
To ensure that the radio is truly a watertight unit, special testing, test procedures, and specialized test equipment are required. The special testing involves a vacuum check of the radio and pressure testing (troubleshooting) for water leaks if the vacuum check fails. The specialized test equipment/instrument mentioned in the "Service Aids" chapter is authorized by Motorola Solutions and needed to perform the vacuum check and pressure testing, if required. Any equipment/tools/instruments not mentioned in this chapter must not be used to perform these tests.

6.7.4

Vacuum Pump Kit

The vacuum pump kit includes a vacuum pump with gauge, and a vacuum hose.

A connector fitting (5871134M01) and fitting seal (3271133M01) pump connector, which must be ordered separately, connects the vacuum hose to the radio chassis.

Figure 44: Connector Fitting - Fitting Seal Pump Connector

Label	Description
1	Fitting Seal
2	Connector Fitting

6.7.5**Pressure Pump Kit NTN4265**

The pressure pump kit includes a pressure pump with gauge, and a pressure hose. As with the vacuum pump kit above, the connector fitting - fitting seal pair connects the pressure hose to the radio chassis.

6.7.6**Miscellaneous Hardware**

Other items needed for testing radio immersibility are:

- Large water container
- Deionized (DI) water
- A supply of replacement parts: Battery Contact Seal, Main seal O-ring, Breathing Vent Label, and Breathing Vent Membrane.

6.7.7**Vacuum Test**

The vacuum test uses a vacuum pump and gauge. The pump creates a vacuum condition inside the radio, and the gauge monitors the radio for a stable vacuum reading; that is, checking for a properly sealed, watertight unit.

Prerequisites:

- Remove the battery.
- Remove the universal connector dustcover to expose the universal connector.
- Remove the breathing vent label and breathing vent membrane.

Procedure:

- 1 Attach antenna firmly to the radio.
- 2 Attach the vacuum hose to the vacuum pump. Check the pump and hose for leaks by blocking off the open end of the hose and operating the pump a few times.

The actual reading of the gauge at this point is not important; it is important that the gauge pointer remained steady, indicating no vacuum leaks in the pump.

- 3 Ensure that the fitting seal is attached to the hose-to-chassis pump connector. Screw the pump connector into the tapped hole in the chassis.



CAUTION: Do not bend or over tighten pump connector to the chassis.

- 4 Attach the open end of the hose to the pointed end of the pump connector.
- 5 Place the radio on a flat surface with the chassis facing upward.
- 6 Operate the pump until the gauge indicates 6 in. Hg of vacuum on the radio. Observe the gauge for approximately 1 min.
 - If the needle falls 0.5 in. Hg or less (one scale interval, for example, from 3 in. Hg to 2.5 in. Hg), then the radio has passed the vacuum test and is approved for immersibility. No additional testing will be required.
 - If the needle falls more than 0.5 in. Hg (one scale interval, for example, from 3 in. Hg to less than 2.5 in. Hg), then the radio has failed the vacuum test and the radio might leak if immersed. Additional troubleshooting of the radio will be required; complete this procedure, then go to [Pressure Test on page 86](#).
- 7 Remove the vacuum hose and pump connector from the radio.

6.7.8

Pressure Test

Pressure testing involves creating a positive pressure condition inside your radio, immersing radio in water, and observing radio for a stream of bubbles (leak). Since all areas of your radio are being checked, observe the entire unit carefully for the possibility of multiple leaks before completing this test.



NOTICE: Pressure testing the radio is necessary only if the radio has failed the vacuum test. Do not perform the pressure test until the vacuum test has been completed.

Procedure:

- 1 Screw the pump connector (with fitting seal) into the tapped hole in the chassis.
- 2 Attach one end of the pressure hose to the pump connector and the other end to the pressure pump.
- 3 Attach antenna firmly to your radio.
- 4 Operate the pump until the gauge reads approximately 1 psig.



CAUTION: Pressure any greater than 1 psig might push air around the main seal.

- 5 Maintain the pressure at 1 psig and immerse the radio into a water-filled container.
- 6 Watch for any continuous series of bubbles.

A stream of bubbles indicates a sign of leakage. Some air entrapment may cause the accumulation of bubbles, especially in the grille area, but the bubbles should not be continuous.



CAUTION: Do not bend or over tighten pump connector to the chassis.

- 7 Note all of the seal areas that show signs of leakage.
Pinpoint the problem to the following areas:
 - Front Housing
 - Chassis kit
 - Battery Contact Seal
- 8 Remove the radio from the water container, and dry the radio thoroughly.



CAUTION: Keep the area around the chassis vacuum port dry by ensuring that there is no water around it.



NOTICE: Dry the area around the main seal with extra care to prevent contamination of the internal electronics while the unit is open.

- 9 Remove the pump connector from the chassis.

Postrequisites: After performing Pressure Test, your radio must undergo baking process in a temperature chamber for constant temperature soaking at 60 °C for 1 hour. This is to ensure no moisture is trapped inside the radio and prevent contamination of the internal electronics after reassembling the radio.

6.7.9

Troubleshooting Leak Areas

Before repairing any leak, read steps in the applicable section. This helps to eliminate unnecessary disassembly and reassembly of a radio with multiple leaks.

Troubleshoot only the faulty seal areas listed in [Pressure Test on page 86](#), and when multiple leaks exist, in the order listed.



NOTICE: Before reassembling the radio, always install a new Main seal O-ring and Battery Contact Seal in the defective area.

6.7.9.1

Front Housing Troubleshooting

Procedure:

Do one or both of the following:

If...	Then...
<p>Leak occurs at the Lens (Display Models only), Universal Connector, Chassis/Housing interface, or PTT button area of the housing</p>	<p>Replace the housing (see Detailed Radio Disassembly on page 54).</p> <ol style="list-style-type: none"> Remove the housing assembly from the radio. Discard the housing assembly and main seal O-ring. Install a new main seal O-ring around the chassis assembly. Install a new housing assembly to the radio. Inspect the main seal for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing and the chassis interface.
<p>Leak occurs at the control top area</p>	<p>Remove the knobs and identify leak location.</p> <ol style="list-style-type: none"> Conduct the Pressure Test Identify the leak location.

6.7.9.2

Replacing Main Seal O-ring

Procedure:

- 1 Remove the chassis assembly from the radio.
- 2 Remove the Mainboard from chassis.
- 3 Remove the main seal O-ring.
- 4 Inspect the seal area around the chassis for foreign material that might prevent the main seal O-ring from sealing properly.
- 5 Assemble a new O-ring; discard the old O-ring.
- 6 Reassemble the chassis assembly followed by installing into Front Cover.
- 7 Inspect the main seal O-ring for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing and the chassis.



NOTICE: When installing the assembled chassis to the Front Cover, ensure the O-ring at the top two corners are not dislodged from the chassis groove.

6.7.9.3

Replacing Battery Contact Seal

Procedure:

- 1 Remove the Battery Contact Seal from the Chassis. Refer to "Radio Disassembly" Chapter.
- 2 Inspect the Battery Contact Seal, Chassis, and surrounding areas for foreign material that might prevent the Battery Contact Seal from sealing properly.
- 3 Install a new Battery Contact Seal, discard the old Seal.
- 4 Reassemble the Chassis assembly followed by installing into Front Kit. Refer to "Radio Reassembly" Chapter.

6.7.9.4

Replacing Ventilation Seal and Ventilation Label

Prerequisites: Both Ventilation Label and Gasket need to be replaced after vacuum test, pressure test, or water leakage troubleshooting.

Procedure:

- 1 Remove the Ventilation Label that covers the Ventilation Seal from the chassis.
- 2 Remove the Ventilation Seal.
- 3 Ensure that the chassis surface (at the Ventilation Label and Ventilation Seal recess) is clean, no/minimum scratches and free from any adhesive or other foreign materials.
- 4 Install a new Ventilation Seal, covering the vent port hole, in the small recessed area in the chassis. Ensure that no oily substance is in contact with the seal.
- 5 Install a new Ventilation Label over the Ventilation Seal in the larger recessed area in the chassis. Press down evenly over the label surface to ensure good adhesion.

6.7.10

Battery Maintenance

Maintain your radio battery annually or as required; when battery contacts are dirty or show signs of wear. Battery Maintenance prolongs battery contacts life and free battery interface from contamination.

It is recommended that the Battery Radio-side and Charger-side contacts are cleaned with DeoxIT GOLD cleaner/lubricant.

DeoxIT GOLD (Supplier CAIG Labs, part number: G100P) cleaner/lubricant pen is very effective at cleaning and extending the life of the battery contacts. DeoxIT GOLD cleaner/lubricant pen is available at numerous electronics suppliers (Radio Shack, McMaster Carr, Fry's, and more) and directly from manufacturer, CAIG Labs, at <http://www.caig.com>.

This pen-based package is recommended as it provides better access to the recessed contacts of the battery. The pen tip may need to be modified (trimmed on the sides) to improve penetration into the battery contact slots.

Advanced contact wear is defined as wear through the contact platings (gold and nickel) to the base metal (copper). Copper exposure is characterized by a distinctive orange-brown metal appearance surrounded by silvery nickel underplate and gold top coat.

In some cases, a magnified (10 times minimum) inspection may be required to verify wear through to the base material. Polishing of the gold or nickel surface is common and is not considered as a need for replacement. Replace battery when advanced wear is evident.

6.7.10.1

Maintaining the Battery

Procedure:

- 1 Shake the lubricant pen until the fluid begins to flow.
- 2 Wipe battery contact surface with felt tip.
- 3 After cleaning the contact areas of any foreign material, let the lubricant/cleaner dry for 2 minutes.
- 4 Replace the battery on the radio. Make sure the battery is attached properly on the radio.

Postrequisites: After cleaning, inspect the contact surfaces for signs of advanced contact wear. See [Battery Maintenance on page 89](#) for advanced contact wear.

6.7.11 Troubleshooting Charts

Figure 45: Troubleshooting Flow Chart for Vacuum Test (Sheet 1 of 2)

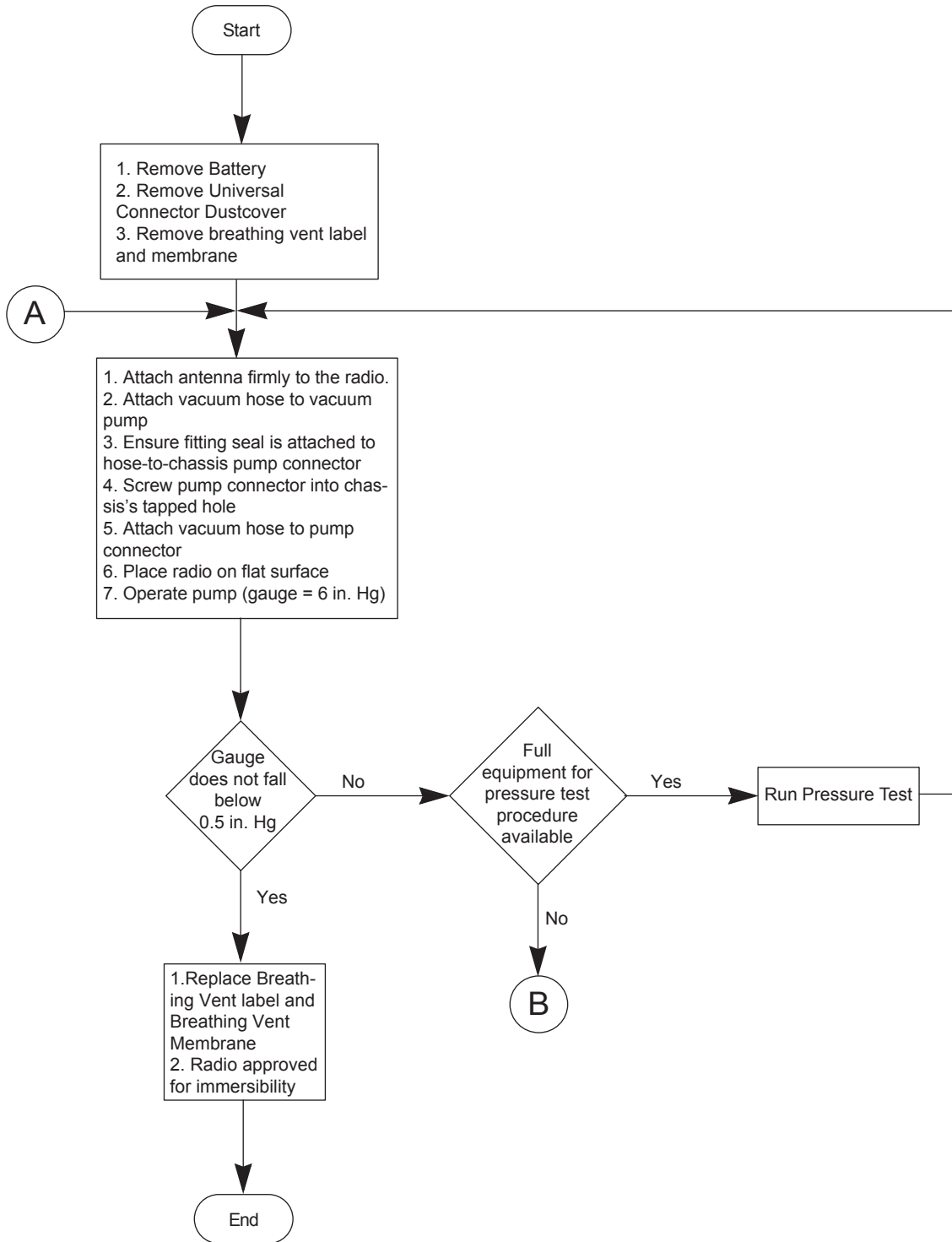


Figure 46: Troubleshooting Flow Chart for Vacuum Test (Sheet 2 of 2)

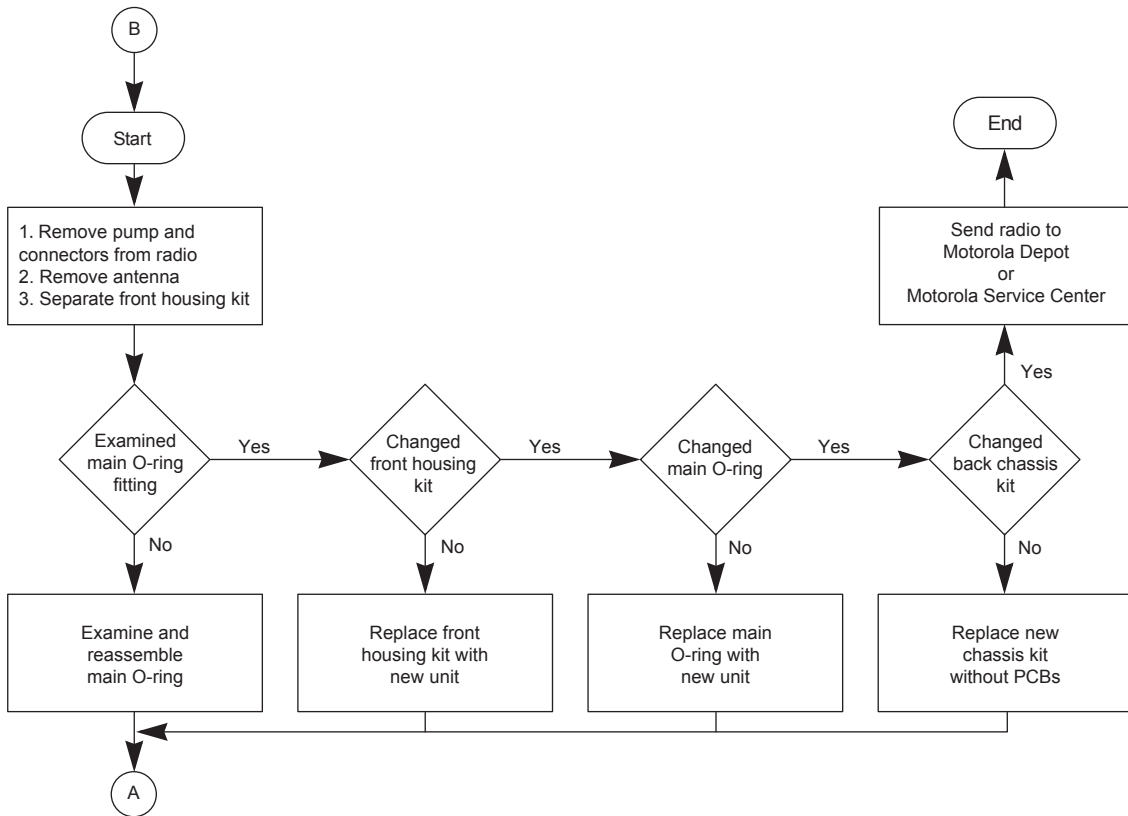
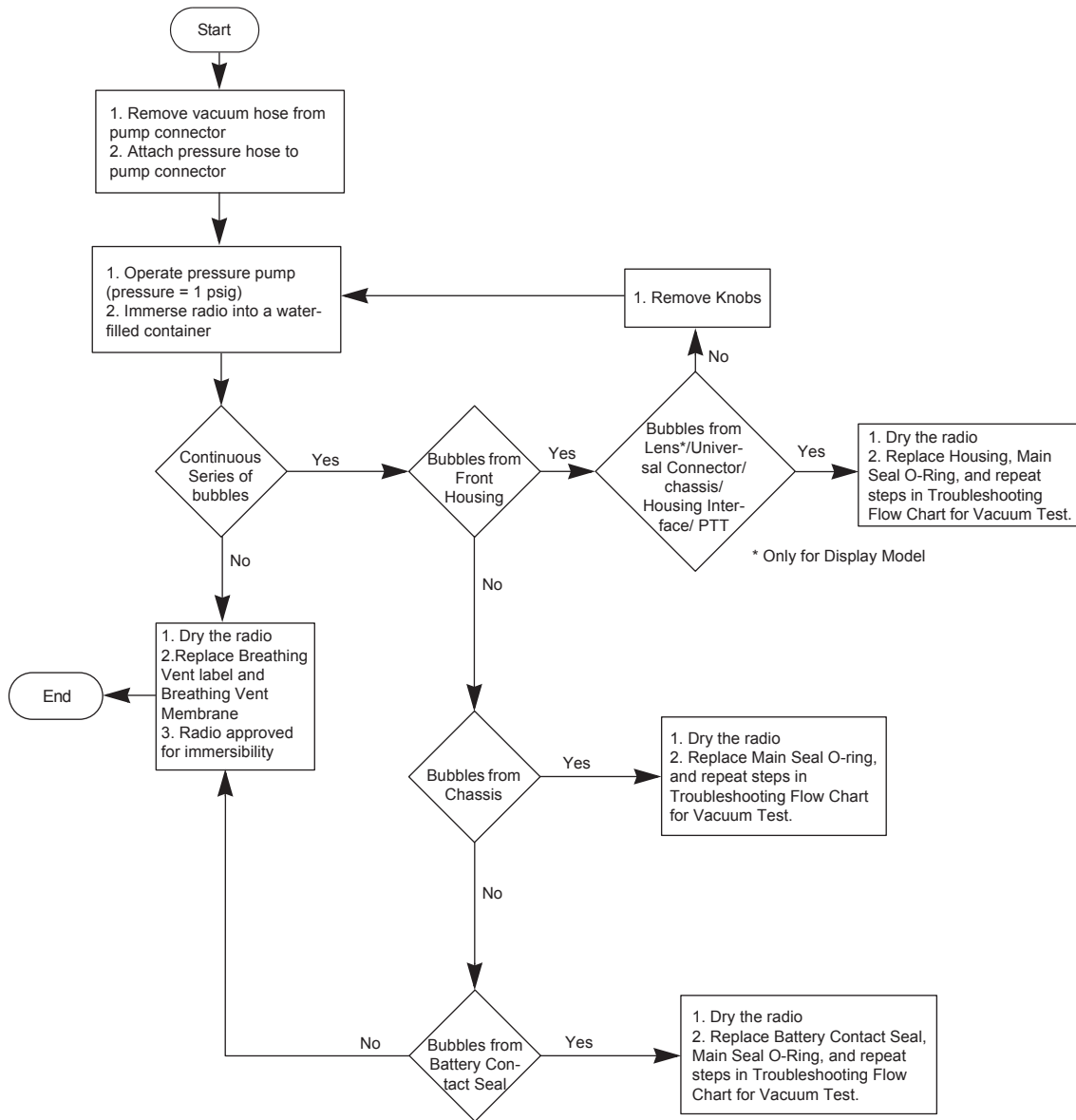


Figure 47: Troubleshooting Flow Chart for Pressure Test and Leakage Areas



6.8

Radio Exploded Mechanical Views and Parts Lists

6.8.1

Full Keypad Model Exploded View and Parts List

Figure 48: Full Keypad Model Exploded View

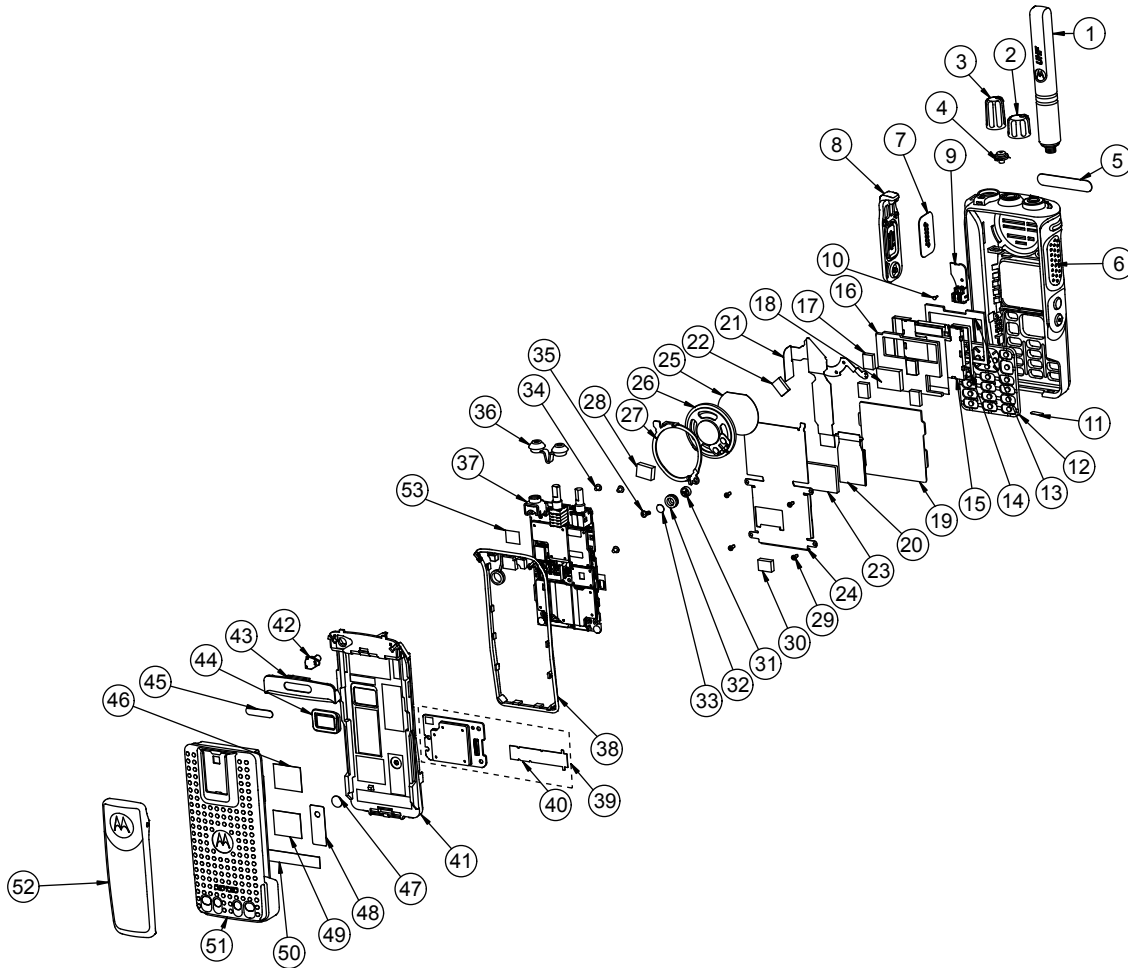


Table 28: Full Keypad Model Exploded View Parts List

Item	Description	Part Number
1	Antenna	PMAF4011_ PMAF4012_
2	Volume, Knob	36012005001
3	Frequency, Knob	36012004001
4	Emergency Button	38012008001
5	Nameplate, Front	33012037001
6	Front Cover Kit ⁷	See Additional Parts List Information on page 98
7	UC Escutcheon	Part of Front Cover Kit

Item	Description	Part Number
8	Dust Cover Assembly	15012157001
9	Bluetooth/GPS Antenna	85012045001
10	Screw, Shoulder, M1.2 x 3.2 mm	0371160D01
11	Label, Agency Indicator	Not Field Replaceable
12	Full Keypad	See Additional Parts List Information on page 98
13	Front Dampener, Color Display	Part of Front Cover Kit
14	Color Display Padding	Part of Front Cover Kit
15	Color Display Module ⁸	72012010001
16	Back Dampener, Color Display	Part of Front Cover Kit
17	Conductive Pad (Small)	Part of Front Cover Kit
18	Conductive Pad (Big)	Part of Front Cover Kit
19	Keypad Controller, FKP	0104038J16
20	Keypad to Mainboard Flex	84012214005
21	UC to Keypad Flex	Part of Front Cover Kit
22	TX Shield Poron	Part of Front Cover Kit
23	Keypad Stiffener	Part of Front Cover Kit
24	Keypad-LCD Retainer ⁹	42012029001
25	Mesh, Speaker	Part of Front Cover Kit
26	Speaker, Electromagnetic, 36 mm Dia	50012013001
27	Retainer Assembly, Speaker	0104045J57
28	Conductive Pad (SS3700)	Part of Front Cover Kit
29	Keypad Retainer Screw	0378212A02
30	Conductive Poron	Part of Front Cover Kit
31	Microphone, EMI, Electret Condenser	50012012001
32	Boot, Microphone	32012099001
33	Mic Membrane with Stiffener	Part of Front Cover Kit
34	Screw, Main Board	03012034001
35	Screw, Thread Forming	0386434Z02

⁷ Comprises of 4, 5, 7, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33 and 35.

⁸ This item must be purchased with item no.14.

⁹ This item must be purchased with items 16, 17, 18, 23 and 29.

Item	Description	Part Number
36	Seal, Top Control	32012089001
37	Back Cover Kit ¹⁰	See Additional Parts List Information on page 98
38	Main O-Ring	32012097001
39	Option Board Kit	PMLN5718_S
40	GOB to Mainboard Flex	84012217003
41	Chassis	27012027001
42	Rubber Plug	38012017001
43	Housing, Shroud	15012092001
44	Battery Contact Seal	32012096001
45	Nameplate	See Additional Parts List Information on page 98
46	Warning Label	Part of Back Cover Kit
47	Gasket	3286058L01
48	Label Ventilation	5478220A01
49	RF Label	Not Field Replaceable
50	Chassis Label	Not Field Replaceable
51	Battery	See PMNN4409_
52	Belt Clip	See Additional Parts List Information on page 98
53	Pad, Thermal	75012220001

¹⁰ Comprises of 34, 36, 38, 39, 40, 41,42, 43, 44, 45, 46, 47, 48 and 53

6.8.2

Non-Keypad Model Exploded View and Parts List

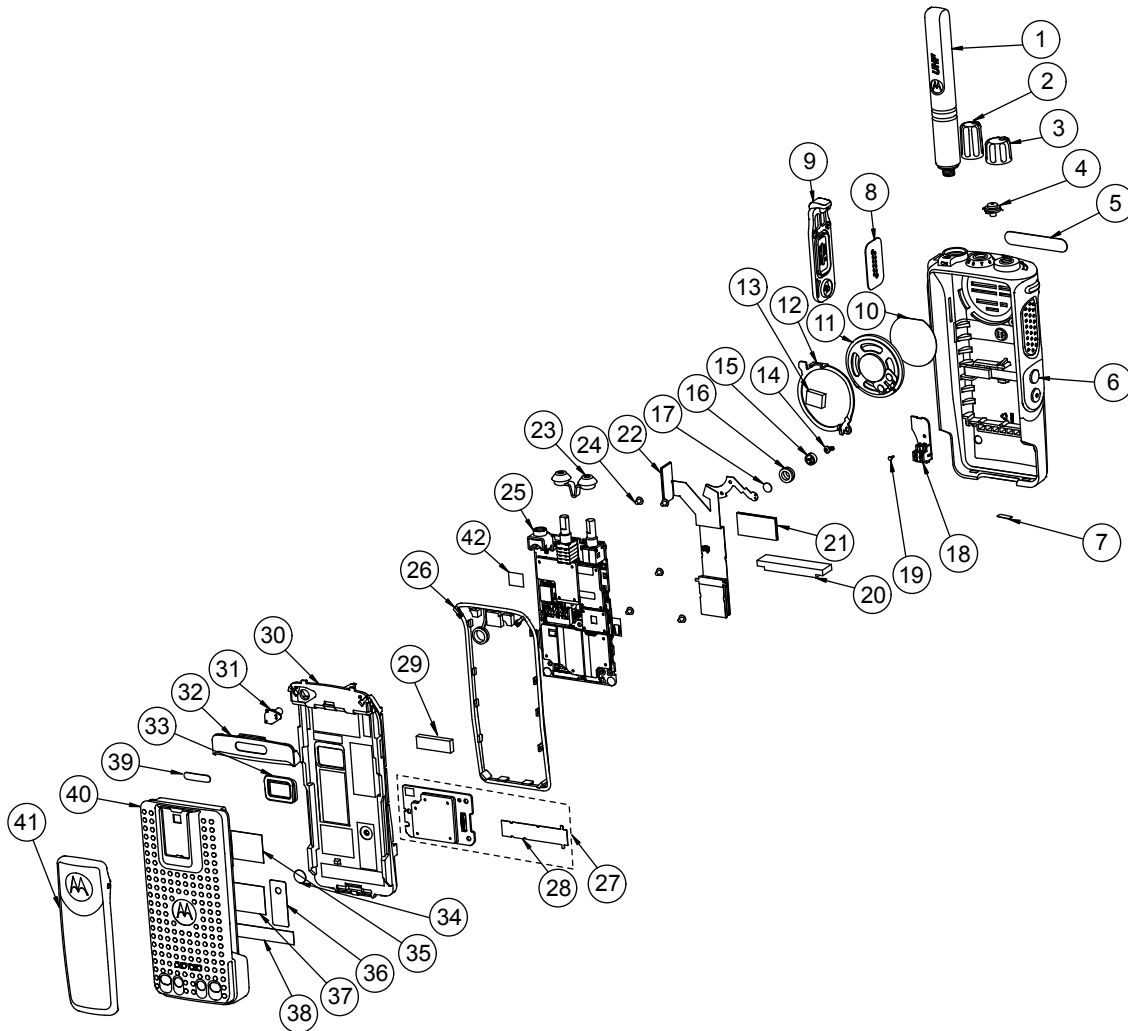


Table 29: Non-Keypad Model Exploded View Parts List

Item	Description	Part Number
1	Antenna	PMAF4011_ PMAF4012_
2	Knob, Frequency	36012005001
3	Knob, Volume	36012004001
4	Emergency Button	38012008001
5	Nameplate Front	33012037001
6	Front Cover Kit ¹¹	See Additional Parts List Information on page 98
7	Label, Agency Indicator	Not Field Replaceable

¹¹ Comprises of 4, 5, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 and 29

Item	Description	Part Number
8	UC Escutcheon	Part of Front Cover kit
9	Dust Cover Assembly	15012157001
10	Mesh, Speaker	Part of Front Cover Kit
11	Speaker, Electromagnetic, 36 mm Dia	50012013001
12	Retainer Assembly, Speaker	0104045J57
13	Conductive Pad (SS3700)	Part of Front Cover Kit
14	Screw, Thread Forming	0386434Z02
15	Microphone, EMI, Electret Condenser	50012012001
16	Boot, Microphone	32012099001
17	Mic Membrane with Stiffener	Part of Front Cover Kit
18	Bluetooth/GPS Antenna	85012045001
19	Screw, Shoulder, M1.2 x 3.2 mm	0371160D01
20	Plain Front Housing Poron	Part of Front Cover Kit
21	Plain UC Flex Poron	Part of Front Cover Kit
22	UC to Keypad Flex	Part of Front Cover kit
23	Seal, Top Control	32012089001
24	Screw, Main Board	03012034001
25	Back Cover Kit ¹²	See Additional Parts List Information on page 98
26	Main O-Ring	32012097001
27	Option Board Kit	PMLN5718_S
28	GOB to Mainboard Flex	84012217003
29	Plain PTT Flex Poron	Part of Front Cover Kit
30	Chassis	27012027001
31	Rubber Plug	38012017001
32	Housing, Shroud	15012092001
33	Battery Contact Seal	32012096001
34	Gasket	3286058L01
35	Warning Label	Part of Back Cover Kit
36	Label Ventilation	5478220A01
37	RF Label	Not Field Replaceable
38	Label Chassis	Not Field Replaceable

¹² Comprises of 23,24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 39 and 42.

Item	Description	Part Number
39	Nameplate	See Additional Parts List Information on page 98
40	Battery	PMNN4409_
41	Belt Clip	See Additional Parts List Information on page 98
42	Pad, Thermal	75012220001

6.8.3 Additional Parts List Information

Table 30: Front Cover Kit

Item	Part Number
Front Cover Kit, English, FKP	PMLN6529_
Front Cover Kit, English, FKP, BT	PMLN6528_
Front Cover Kit, English, NKP	PMLN6525_
Front Cover Kit, English, NKP, BT	PMLN6526_

Table 31: Keypad

Item	Part Number
Full Keypad, English	75012064004

Table 32: Back Cover Kit

Item	Part Number
BC Kit 806–941 MHz, 2.5 W, FKP, GPS, BT	PMLF4106_S
BC Kit 806–941 MHz, 2.5 W, FKP	PMLF4107_S
BC Kit 806–941 MHz, 2.5 W, NKP, GPS, BT	PMLF4105_S
BC Kit 806–941 MHz, 2.5W, NKP	PMLF4108_S

Table 33: Nameplate

Item	Part Number
DP 4801	33012015018
DP 4401	33012015016

Table 34: Belt Clips

Item	Part Number
Belt Clip 2 in.	PMLN4651_
Belt Clip 2.5 in.	PMLN7008_

6.8.4

Torque Chart

Torque Chart lists the various 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 35: Torque Specifications for Screws

Part Number	Description	Driver/Socket	Torque
			lbs-in
03012034001	Screw, Main Board	T6 Torx	2.8
0386434Z02	Screw, Thread Forming	T6 Torx	2.3–2.5
0378212A02	Screw, Keypad Retainer	T6 Torx	1.1–1.3
0371160D01	Screw, Shoulder, M1.2 x 3.2 mm	T3 Torx	0.4–0.6

Chapter 7

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 30](#) 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.

7.1

Replacement Back Cover Kit Procedures

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



CAUTION:

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

7.2

Power-Up Error Codes

Upon powering up, the radio performs certain tests to determine if its basic electronics and software are in working order. Any error detected has an associated error code that is presented on the radio display.



NOTICE: Power-Up error codes are only applicable to Display Models only.

These error codes are intended to be used by a service technician when the radio generates the Self-Test Fail Tone. If these tests are successfully completed, the radio will generate the Self-Test Tone.



NOTICE: Non-display radios emit only the Self-Test Fail Tone if it fails the self-test.

There are two classes of detectable errors: fatal and non-fatal.

Fatal errors

Normal radio operation is inhibited when your radio encounters fatal errors.

Fatal errors include hardware errors detected by the microprocessor and certain memory errors.

These memory errors include incorrect ROM checksum, incorrect RAM checksum, and incorrect checksums of codeplug (Persistent Storage) blocks that contain operating parameters.

If the codeplug block operating parameters are corrupted, operation of the unit on the proper frequency, system, and group are in question.

Attempts to use this information could provide a false sense of security that others are receiving your messages.

Non-fatal errors

Corrupted codeplug blocks of call IDs, or their associated aliases are considered non-fatal errors. Normal communication is still possible, but the user may be inconvenienced.

Table 36: Types of Error Code

Error Code	Description	Error Type	Corrective Action
ERROR 01/02	Call ID or associated aliases codeplug block checksum is wrong.	Non-Fatal	Normal communication is still possible, but the user may be inconvenienced. Reprogram codeplug.
ERROR 01/22	Tuning Codeplug block checksum is wrong.	Non-Fatal	Normal communication is still possible.
FAIL 01/82	External Codeplug block checksum is wrong.	Fatal	Reprogram codeplug.
FAIL 01/92	Secure Codeplug checksum error.	Fatal	Reprogram codeplug.
FAIL 01/A2	Tuning Codeplug block checksum is wrong.	Fatal	Reprogram codeplug.
FAIL 01/81	ROM Checksum is wrong.	Fatal	Reprogram FLASH Memory, then retest.
FAIL 01/88	Radio RAM test failure.	Fatal	Retest radio by turning it off and turning it on again.
FAIL 01/90 or FAIL 02/90	General hardware test failure.	Fatal	Retest radio by turning it off and turning it on again.
FAIL 02/81	DSP ROM Checksum is wrong.	Fatal	Reprogram FLASH Memory, then retest.
FAIL 02/82	DSP RAM1 test failure.	Fatal	Retest radio by turning it off and turning it on again.
FAIL 02/84	DSP RAM2 test failure.	Fatal	Retest radio by turning it off and turning it on again.
FAIL 02/88	DSP RAM test failure.	Fatal	Retest radio by turning it off and turning it on again.
FAIL 02/C0	DSP ROM Checksum is wrong.	Fatal	Retest radio by turning it off and turning it on again.
No Display	Display module is not connected properly. Display module is damaged.	Fatal	Check connection between main board and display module. Replace with new display module.



NOTICE:

If error message reoccurs, replace main board or send radio to nearest Motorola Solutions Depot.

7.3

Operational Error Codes

During radio operation, your radio performs dynamic tests to determine if your radio is working properly. Problems detected during these tests are presented as error codes on your radio display. Use the following table to aid in understanding particular operational error codes.

Table 37: Types of Error Code

Error Code	Description	Error Type	Corrective Action
FAIL 001	Synthesizer Out-of-Lock.	Non-fatal	Reprogram the codeplug. Refer to <i>Detailed Service Manual</i> .
FAIL 002	Personality checksum or system block error.	Non-fatal	Reprogram the codeplug.



NOTICE: If error message reoccurs, send radio to nearest Motorola Solutions Service Centers or Authorized Motorola Solutions Service Dealers.

Appendix A

Replacement Parts and Kits

This manual covers Level 1 and 2 Maintenance.

Level 1 maintenance is the assessment and/or repair of fault in terms of faulty accessory or physical aspect of product; not including opening of the unit. Limited to replacement of antenna, battery, handset, external microphones, external knobs, all related frequency programming to customers, and in some cases alignment/tuning by the Customer Programming Software (CPS).

Level 2 maintenance includes all Level 1 activities plus: Assessment that require opening the Subscriber Product and rectifying a fault by replacement of a board or module, or replacement of major mechanical parts (like Front Housing Kit or Control Head Board), followed by alignment/tuning to ensure the replacement of board/module/major mechanical parts are within Subscriber Product specifications as per the service manual. It does not incorporate discrete component replacement.

To find out more about Motorola Solutions Service Center, please visit <http://www.motorolasolutions.com>.



NOTICE: The Level 3 Maintenance can only be done at the Motorola Solutions Service Center/ Depot since it can deeply affect the performance of the radio.

Appendix B

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>.

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).

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.

Telecommunications Industry Associatio (TIA) An organization representing the global information and communications technology (ICT) industry that develops and publishes telecommunication standards.

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.