



MOTOTRBO™ PORTABLE

PROFESSIONAL DIGITAL TWO-WAY RADIO

MOTOTRBO™ PORTABLE CP200d 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
68009616001-A	Initial Release	June 2013
68009616001-B	Updated front kit number	March 2014
68009616001-BA	Updated Front Kit, Chassis, and Main O-ring part numbers.	December 2017
	Added new battery model.	
68009616001-BB	Updated PTT bezel part number to 13012040002 in Exploded View Parts List.	May 2018
	Added super tanapa and Non-keypad Model. Model Charts, Exploded View Parts List.	
	Updated Model Charts, Specifications, Disassembly/Reassembly Procedures, Exploded View Parts List, Accessory, and Additional Service Kit Information.	

Notations Used in This Manual

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



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



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



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

Commercial Warranty

Limited Warranty

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

I. What This Warranty Covers And For How Long

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

Portable Radios	Two Years
Product Accessories (Excluding Batteries, Chargers and Mag One Accessories)	One Year
Mag One Accessories	Six Months

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

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

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II. General Provisions

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

This warranty is given in lieu of all other express warranties, implied warranties, including without limitation, implied warranties of merchantability and fitness for a particular purpose, are limited to the duration of this limited warranty. In no event shall Motorola Solutions be liable for damages in excess of the purchase price of the product, for any loss of use, loss of time, inconvenience, commercial loss, lost profits or savings or other incidental, special or consequential damages arising out of the use or inability to use such product, to the full extent such may be disclaimed by law.

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

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

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

IV. How To Get Warranty Service

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

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

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

V. What This Warranty Does Not Cover

This warranty does not cover the following conditions:

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

VI. Patent And Software Provisions

Motorola Solutions will defend, at its own expense, any suit brought against the end user purchaser to the extent that it is based on a claim that the Product or parts infringe a United States patent, and

Motorola Solutions will pay those costs and damages finally awarded against the end user purchaser in any such suit which are attributable to any such claim.

But such defense and payments are conditioned on the following:

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

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VII. Governing Law

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

Battery and Charger Warranty

Workmanship Warranty

The workmanship warranty guarantees against defects in workmanship under normal use and service.

All MOTOTRBO Batteries	Two Years
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Capacity Warranty

The capacity warranty guarantees 80% of the rated capacity for the warranty duration.

Lithium-Ion (Li-Ion) Batteries	One Year
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Chapter 1

Introduction

1.1

Radio Description

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

Table 1: Radio Frequency Ranges and Power Levels

Frequency Band	Bandwidth	Power Level
VHF	136–174 MHz	1 W or 5 W
UHF	403–470 MHz	1 W or 4 W

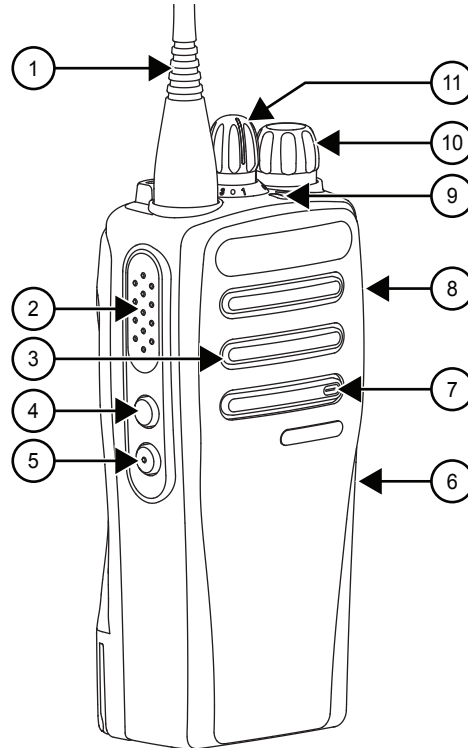
These digital radios are among the most sophisticated two-way radios available. They have a robust design for radio users who need high performance, quality, and reliability in their daily communications. This architecture provides the capability of supporting a multitude of legacy and advanced features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

1.1.1

Non-Keypad Model

This section is applicable to PMUE4147A, PMUD3231A.

Figure 1: Non-Keypad Model



Label	Button Name	Description
1	Antenna	Provides the needed RF amplification when transmitting or receiving.
2	Push-To-Talk (PTT)	Press to execute voice operations (for example, Group Call and Private Call).
3	Speaker	Outputs all tones and audio that are generated by the radio (for example, features like keypad tones and voice audio).
4	Side Button 1	These buttons are field programmable using the Customer Programming Software (CPS).
5	Side Button 2	
6	USB with Dust Cover	Prevent dust from clogging USB port.
7	Microphone	Allows the voice to be sent when PTT or voice operations are activated.
8	Universal Connector	Interface point for all accessories to be used with the radio. It has eight points to which specific accessories will connect and be activated.
9	LED Indicator	Red, green, and amber light-emitting diodes indicate operating status.

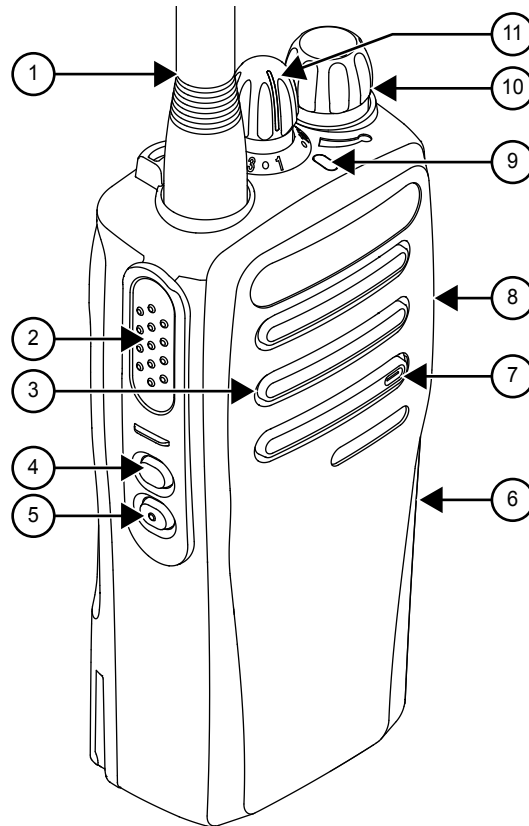
Label	Button Name	Description
10	On/Off/Volume Knob	Rotate clockwise until click is heard to turn on radio; rotate counter-clockwise until click is heard to turn off radio. Rotate clockwise to increase volume level; rotate counter-clockwise to decrease volume level.
11	Channel Selector Knob	Rotate clockwise to increment channel and counter-clockwise to decrement channel.

1.1.2

Non-Keypad Model

This section is applicable to PMUE4147B, PMUD3231B

Figure 2: Non-Keypad Model



Label	Button Name	Description
1	Antenna	Provides the needed RF amplification when transmitting or receiving.
2	Push-To-Talk (PTT)	Press to execute voice operations (for example, Group Call and Private Call).
3	Speaker	Outputs all tones and audio that are generated by the radio (for example, features like keypad tones and voice audio).

Label	Button Name	Description
4	Side Button 1	These buttons are field programmable using the Customer Programming Software (CPS).
5	Side Button 2	
6	USB with Dust Cover	Prevent dust from clogging USB port.
7	Microphone	Allows the voice to be sent when PTT or voice operations are activated.
8	Universal Connector	Interface point for all accessories to be used with the radio. It has eight points to which specific accessories will connect and be activated.
9	LED Indicator	Red, green, and amber light-emitting diodes indicate operating status.
10	On/Off/Volume Knob	Rotate clockwise until click is heard to turn on radio; rotate counter-clockwise until click is heard to turn off radio. Rotate clockwise to increase volume level; rotate counter-clockwise to decrease volume level.
11	Channel Selector Knob	Rotate clockwise to increment channel and counter-clockwise to decrement channel.

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	AA	H	0	1	J	D	C	9	J	A	2	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
3	Model Series	01 = MOTOTRBO CP200d
4		
5	Band	J = 136–174 MHz Q = 403–470 MHz
6	Power Level	C = 1.0, 2.0, 2.5, or 3.5 W D = 4.0–5.0 W
7	Physical Packages	C = Low Tier (Plain)

Position	Description	Value
		H = Mid Tier (Monochrome Display LKP) N = High Tier (Color Display FKP) J = 3 Button MOR T = Limited Tier (No Display)
8	Channel Information	8 = Variable/Programmable Channel Spacing with unique number of channels 9 = Variable/Programmable Channel Spacing
9	Primary Operation	J = Basic (No GPS, no Bluetooth, no embedded GOB) K = GPS and Bluetooth L = GPS only M = Bluetooth only N = Bluetooth with embedded GOB
10	Primary System Type	A = Conventional B = Trunking C = Analog Only
11	Feature Level	1 = Standard with FM 2 = Non-FM 3 = CSA IE CEx ATEX CQST
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

VHF Model Charts

Table 4: CP200d, VHF, 136–174 MHz, VHF Model Chart

Model/Item		Description
AAH01JDC9JA2_N		CP200d, 136–174 MHz, 5 W, Non-Keypad
	AAH01JDC9JC2_N	CP200d, 136–174 MHz, 5 W, Non-Keypad, Analog
X	X	PMLD4583_S
		Back Cover Kit 136–174M, 5 W, Non-Keypad Portable. ¹

¹ This is applicable to PMUE4147A, PMUD3231A.

Model/Item		Description	
AAH01JDC9JA2_N		CP200d, 136–174 MHz, 5 W, Non-Keypad	
AAH01JDC9JC2_N		CP200d, 136–174 MHz, 5 W, Non-Keypad, Analog	
X	X	PMLD4879_S	Back Cover Kit 136–174M, 5 W, Non-Keypad Portable. ²
X	X	0104065J33_	Front Cover Kit, Non-Keypad Portable. ¹
X	X	PMLN7874_	Front Cover Kit, Non-Keypad Portable (EXL). ²
X	X	HAD9742_	VHF Stubby, 146–162 MHz.
X	X	HAD9743_	VHF Stubby, 162–174 MHz.
X	X	NAD6502_R	VHF Heliflex, 146–174 MHz.
X	X	PMAD4012_	VHF Stubby Antenna (136–155 MHz), 9 cm.
X	X	PMAD4014_	VHF Antenna (136–155 MHz), 14 cm.
X	X	PMAD4042_	VHF Heliflex, 136–150.8 MHz.



NOTICE: Analog model radios that are upgraded to digital with a license key will need to request for Analog Service Kit.

1.3.2

UHF Model Charts

Table 5: CP200d, UHF, 403–470 MHz, UHF Model Chart

Model/Item		Description	
AAH01QDC9JA2_N		CP200d, 403–470 MHz, 4 W, Non-Keypad	
AAH01QDC9JC2_N		CP200d, 403–470 MHz, 4 W, Non-Keypad, Analog	
X	X	PMLE4897_S	Back Cover Kit 403–470 MHz, 4 W, Non-Keypad Portable. ³
X	X	PMLE5225_S	Back Cover Kit 403–470 MHz, 4 W, Non-Keypad Portable. ⁴
X	X	0104065J33_	Front Cover Kit, Non-Keypad Portable. ³
X	X	PMLN7874_	Front Cover Kit, Non-Keypad Portable (EXL). ⁴
X	X	8505816K24_	UHF Heliflex Stubby, 403–440 MHz
X	X	NAE6522_R	UHF Stubby Antenna, 438–470 MHz
X	X	PMAE4002_	UHF 9 cm Stubby Antenna, 403–433 MHz
X	X	PMAE4003_	UHF 9 cm Helical Antenna, 430–470 MHz
X	X	PMAE4016_	UHF Whip Antenna, 403–520 MHz, 17 cm



NOTICE: Analog model radios that are upgraded to digital with a license key will need to request for Analog Service Kit.

² This is applicable to PMUE4147B, PMUD3231B.

³ This is applicable to PMUE4147A, PMUD3231A.

⁴ This is applicable to PMUE4147B, PMUD3231B.

1.4 Specifications

Table 6: General Specifications

Parameter	Value
Channel Capacity	16
Frequency	VHF: 136–174 MHz UHF: 403–470 MHz
Dimensions (H × W × T) with NiMH battery	130 mm x 62.5 mm x 42 mm
Weight with NiMH 1400 mAh	406 g
Weight with Slim Li-Ion 1600 mAh battery	341 g
Weight with High Cap Li-Ion 2250 mAh battery	346 g
Power Supply	7.5 V (nominal)
FCC Description	VHF: ABZ99FT3092 ⁵
	UHF: ABZ99FT4094 ⁵
	VHF: AZ489FT3845 ⁶
	UHF: AZ489FT4948 ⁶
IC Description	VHF: 109AB-99FT3092 ⁵
	UHF: 109AB-99FT4094 ⁵
	VHF: 109U-89FT3845 ⁶
	UHF: 109U-89FT4948 ⁶
Average battery life at 5/5/90 duty cycle with battery saver enabled in carrier squelch and transmitter in high power.	
NiMH 1400 mAh battery	Analog: 9 hr
	Digital: 11.5 hr
Core Slim Li-Ion 1600 mAh battery	Analog: 10.5 hr
	Digital: 13.5 hr
High Cap Li-Ion 2250 mAh battery	Analog: 15 hr
	Digital: 19 hr


 **NOTICE:** Weight can have 5% margin of error.

Table 7: Receiver Specifications

Parameter	Value
Frequencies	VHF: 136–174 MHz UHF: 403–470 MHz

⁵ This is applicable to PMUE4147A, PMUD3231A.

⁶ This is applicable to PMUE4147B, PMUD3231B.

Parameter	Value
Channel Spacing	12.5 kHz/20 kHz/25 kHz ⁷
Frequency Stability (-30 °C to +60 °C, +25 °C Ref)	±0.5 ppm
Analog Sensitivity (12 dB SINAD)	0.3 µV
	0.22 µV (typical)
Digital Sensitivity (5% BER)	0.25 µV
	0.19 µV (typical)
Intermodulation (TIA603D)	70 dB
Adjacent Channel Selectivity (TIA603D)	45 dB @ 12.5 kHz
	70 dB @ 20 kHz/25 kHz
Spurious Rejection (TIA603D)	70 dB
Rated Audio	0.5 W (internal)
Audio Distortion @ Rated Audio	5% (3% typical)
Hum and Noise	-40 dB @ 12.5 kHz
	-45 dB @ 20 kHz/25 kHz ⁷
Audio Response	TIA603D
Conducted Spurious Emission (TIA603D)	-57 dBm
Speaker Impedance	16 Ω
Voltage @ Rated Audio	2.828 V

Table 8: Transmitter Specifications

Parameter	Value
Frequencies	VHF: 136–174 MHz UHF: 403–470 MHz
Channel Spacing	12.5 kHz/20 kHz/25 kHz ⁷
Frequency Stability (-30 °C to +60 °C)	±0.5 ppm
Power Output (Low Power)	1 W
Power Output (High Power)	VHF: 5 W
	UHF/UHF2: 4 W
Modulation Limiting	±2.5 kHz @ 12.5 kHz
	±4.0 kHz @ 20 kHz
	±5.0 kHz @ 25 kHz ⁷
FM Hum and Noise	-40 dB @ 12.5 kHz
	-45 dB @ 20 kHz/25 kHz ⁷

⁷ 25 kHz is NOT available in the USA. FCC narrowbanding rules do not allow operation of this model on 25 kHz configuration in Part 90 VHF/UHF frequencies.

Parameter	Value
Conducted/Radiated Emission	-36 dBm < 1 GHz
	-30 dBm > 1 GHz
Adjacent Channel Power	60 dB @ 12.5 kHz
	70 dB @ 20 kHz/25 kHz ⁷
Audio Response	TIA603D
Audio Distortion	3% (typical)
4FSK Digital Modulation	12.5 kHz Data: 7K60F1D and 7K60FXD
	12.5 kHz Voice: 7K60F1E and 7K60FXE
	Combination of 12.5 kHz Voice and Data: 7K60F1W
Digital Vocoder Type	AMBE+2™
Digital Protocol	ETSI-TS102361-1
	ETSI-TS102361-2
	ETSI-TS102361-3

Conforms to:

- ETSI TS 102 361 (Parts 1, 2, and 3) - ETSI DMR Standard
- 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 9: Self-Quieter Frequencies

UHF (MHz)	VHF (MHz)
424.275	144
424.315	153.6
424.815	-
480	-

Military Standards										
Ap- plica- ble MIL- STD	810C		810D		810E		810F		810G	
	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

Military Standards										
High Temperature	501.1	I, II	501.2	I/A1, II/A1	501.3	I-A1, II/A1	501.4	I/Hot, II/Hot	501.5	I-A1, II
Low Temperature	502.1	I	502.2	I/C3, II/C1	502.3	I-C3, II/C1	502.4	I-C3, II/C1	502.5	I-C3, II
Temperature Shock	503.1	-	503.2	I/A1/C3	503.3	I/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-Aggravated
Salt fog	509.1	-	509.2	-	509.3	-	509.4	-	509.5	-
Dust	510.1	I	510.2	I	510.3	I	510.4	I	510.5	I
Vibration	514.2	VIII/F, Curve-W	514.3	I/10, II/3	514.4	I/10, II/3	514.5	I/24	514.6	I-cat.2 4
Shock	516.2	I, II	516.3	I, IV	516.4	I, IV	516.5	I, IV	516.6	I, IV, V, VI

Environmental Specifications	
Operating Temperature ⁸	-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 -IP54
Packaging Test	As per MIL-STD

⁸ Operating temperature specification with Li-Ion battery is -10 °C to +60 °C.

Chapter 2

Test Equipment and Service Aids

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

2.1

Recommended Test Equipment

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

Table 10: Test Equipments

Equipment	Characteristics	Example	Application
Service Monitor	Can be used as a substitute.	Aeroflex 3920 (www.aeroflex.com) or equivalent	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment.
Digital RMS Multimeter ⁹	100 μ V to 300 V	Fluke 179 (www.fluke.com) or equivalent	AC/DC voltage and current measurements. Audio voltage measurements.
	5 Hz to 1 MHz		
	10 $M\Omega$ Impedance		
RF Signal Generator ⁹	100 MHz to 1 GHz	Agilent N5181A (www.agilent.com), Ramsey RSG1000B (www.ramseyelectronics.com), or equivalent	Receiver measurements
	-130 dBm to +10 dBm		
	FM Modulation: 0 kHz to 10 kHz		
	Audio Frequency: 100 Hz to 10 kHz		
Oscilloscope ⁹	2 Channel	Tektronix TDS1001b (www.tektronix.com) or equivalent	Waveform measurements
	50 MHz Bandwidth		
	5 mV/div to 20 V/div		
Power Meter and Sensor ⁹	5% Accuracy	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
	100 MHz to 500 MHz		
	50 W		
RF Millivolt-meter	100 mV to 3 V RF	Boonton 92EA (www.boonton.com) or equivalent	RF level measurements
	10 kHz to 1 GHz		
Power Supply	0 V to 32 V	B&K Precision 1790 (www.bkprecision.com) or equivalent	Voltage supply
	0 A to 20 A		

⁹ Can use Service Monitor as substitute.

2.2

Service Aids

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

Table 11: Service Aids Part Number and Part Description

Motorola Solutions Part Number	Description	Application
RLN4460_	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.
RVN5115_	Customer Programming Software on CD-ROM	Allows servicer to program radio parameters, tune and troubleshoot radios.
PMKN4128_	Portable Programming Cable	This cable connects the radio to a USB port for radio programming and data applications.
PMKN4156_	Portable Test Cable	This cable connects the radio to RLN4460 Portable Test Set for test and measurement.
0180305K08 EPP	7.5 V Universal Battery Eliminator	Connects to radio by using battery eliminator cable.
5886564Z01	RF Adaptor	Application adapts radio antenna port to BC cabling of test equipment.
1185937A01	Grease	Acts to lubricate parts.
6686533Z01	Chassis and Knob Opener	Separates the chassis from the front housing.
N/A	Flat Square Tip Plastic Tweezers	Remove components during disassembly.
N/A	PTT Roller Pressing Jig	To assist PTT assembly.

2.3

Programming, Testing, and Alignment Cable

Programming, Testing, and Alignment Cable and Side Connector are required in servicing and programming radios.

Portable Programming Cable and Portable Test Cable

Figure 3: Portable Programming Cable with TTR (PMKN4128_)

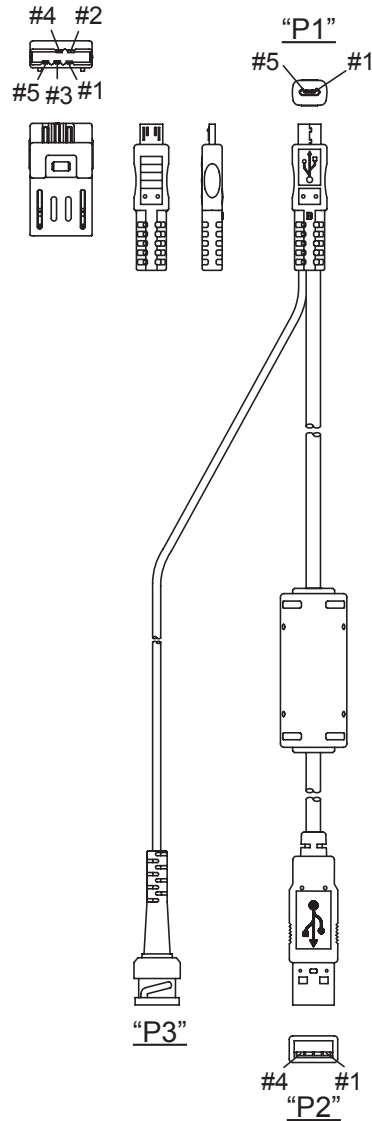


Table 12: Pin Configuration of Portable Programming Cable with TTR

CONNECTION			
P1	P2	P3	Function
1	1	-	VCC(5 V)
2	2	-	Data-
3	3	-	Data+

CONNECTION			
P1	P2	P3	Function
4	-	BNC Center Pin	TTR
5	4	BNC Shell	Ground

Figure 4: Portable Test Cable (PMKN4156_)

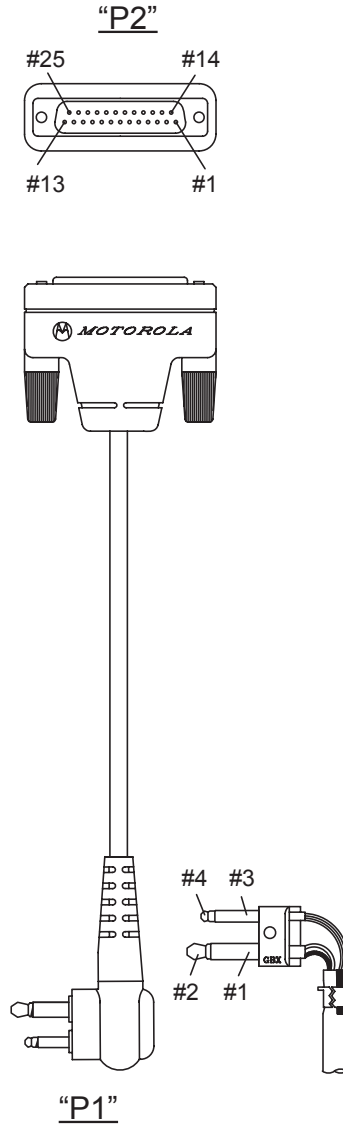


Table 13: Pin Configuration of Portable Test Cable

CONNECTION		
P1	P2	Function
1	1, 5	Ground
2	7, 24	External Mic
3	16	External Speaker -
4	17	External Speaker +

Chapter 3

Transceiver Performance Testing

These radios meet published specifications through their manufacturing process by utilizing high-accuracy laboratory-quality test equipment.

The recommended field service equipment approaches the accuracy of the manufacturing equipment with few exceptions. This accuracy must be maintained in compliance with the calibration schedule recommended by the manufacturer.

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

3.1

Setup

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



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

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

Table 14: 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	

3.2

RF Test Mode

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

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

- 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 the following.

Table 15: 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, 12.5 kHz and 20 kHz as. The radio beeps once when radio toggles to 20 kHz, beeps twice for 25 kHz and beeps three times for 12.5 kHz.
- 3 Turning of the **Channel Knob** changes the test channel from 1 to 14 as described in [Table 16: Test Frequencies on page 31](#). The radio beeps in each position.

Table 16: Test Frequencies

Channel Selector Switch Position	Test Channel	VHF	UHF
1 Low Power 9 High Power	TX#1 or #9 RX#1 or #9	136.075 136.075	403.15 403.15
2 Low Power 10 High Power	TX#2 or #10 RX#2 or #10	142.575 142.575	414.15 414.15
3 Low Power 11 High Power	TX#3 or #11 RX#3 or #11	146.575 146.575	425.15 425.15
4 Low Power 12 High Power	TX#4 or #12 RX#4 or #12	155.575 155.575	436.45 436.45
5 Low Power 13 High Power	TX#5 or #13 RX#5 or #13	161.575 161.575	447.15 447.15
6 Low Power 14 High Power	TX#6 or #14 RX#6 or #14	167.575 167.575	458.15 458.15
7 Low Power 15 High Power	TX#7 or #15 RX#7 or #15	173.975 173.975	469.85 469.85

Channel Selector Switch Position	Test Channel	VHF	UHF
8 Low Power 16 High Power	TX#8 or #16 RX#8 or #16	174.000 174.000	479.850 479.850

Table 17: Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4 carrier squelch	PTT to continuously transmit (during the performance check)	Frequency error to be ± 68 Hz for VHF ± 201 Hz for UHF
Power RF	As above	As above	As above	Low Power: 0.9–1.5 W (VHF/UHF) High Power: 4.0–4.8 W (UHF) High Power: 5.0–5.8 W (VHF)
Voice Modulation	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out Monitor: DVM: AC Volts Set 1 kHz Mod Out level for 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).
Voice Modulation (internal)	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out	TEST MODE, Test Channel 4 carrier squelch output at antenna	Remove modulation input	Press PTT switch on radio. Say “four” loudly into the radio mic. Measure deviation: ≥ 4.0 kHz but \leq

Test Name	Communications Analyzer	Radio	Test Set	Comments
				5.0 kHz (25 kHz Ch Sp)
TPL Modulation	As above 4th channel test frequency* 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 0.153 test pattern	Key up radio with 0.513 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 648Hz +/- 10% and 1944Hz +/- 10%
Transmitter BER	DMR Mode	As above	As above	Transmitter BER should be 0%

Table 18: Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4 carrier squelch output at antenna	PTT to continuously transmit (during the performance check)	Frequency error to be ±201 Hz for UHF ±68 Hz for VHF
Rated Audio	Mode: GEN Output level: 1.0 mV RF 6th channel test frequency*	TEST MODE Test Channel 6 carrier squelch	PTT to OFF (center), meter selector to Audio PA	Set volume control to 2.83 Vrms

Test Name	Communications Analyzer	Radio	Test Set	Comments
	Mod: 1 kHz tone at 3 kHz deviation Monitor: DVM: AC Volts			
Distortion	As above, except to distortion	As above	As above	Distortion <3.0%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.35 μ V
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1mV RF	As above	PTT to OFF (center), meter selection 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 0.153 test pattern	TEST MODE, Digital Mode, transmit with 0.153 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 = -47dBm. Set audio analyzer to read Vrms. Adjust volume to get rated audio	Adjust volume until Vrms = 2.83 V
Receiver Audio Distortion	IFR DMR Mode. Signal generator with 1031 test pattern	As above	As above. Then set audio analyzer to measure distortion	Not exceed 5%

3.3

Non-Display Model Test Mode

3.3.1

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.

3.3.2

RF Test Mode

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

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

Procedure:

- 1 Short press **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.

- 2 Short press **Side Button 1** to toggle the channel spacing between 20 kHz, 25 kHz, and 12.5 kHz.

The radio beeps once when radio toggles to 20 kHz, beeps twice for 25 kHz and beeps three times for 12.5 kHz.

- 3 Turn the **Channel Knob** to change the test channel from 1 to 16.

The radio beeps at each position.

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

3.3.3

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.

3.3.4 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.

3.3.5 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.

3.3.6 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.

3.3.7 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

3.3.8

Button/Knob/PTT Test Mode

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


Table 19: 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 the PTT button.	The radio beeps.
Release the button.	The radio beeps.

Chapter 4

Radio Programming and Tuning

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

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

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

Table 20: Software Installation Kits Radio Tuning Setup

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

4.1

Customer Programming Software Setup

Program the radio using the following setup.


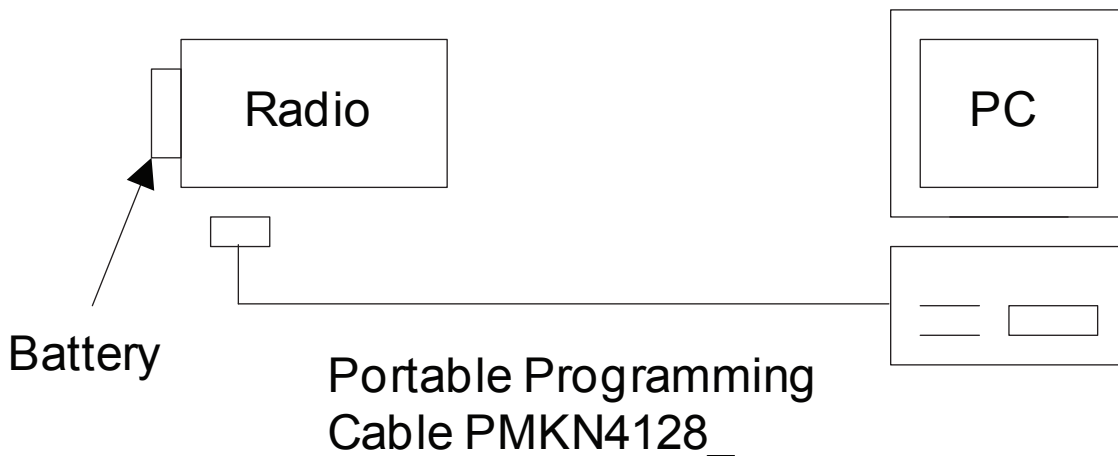
 **CAUTION:** Computer USB ports can be sensitive to Electrostatic Discharge. Do not touch exposed contacts on a cable when connected to a computer.

Figure 5: CPS Programming Setup



4.2

AirTracer Application Tool

The MOTOTRBO AirTracer application tool has the ability to capture over-the-air digital radio traffic and save the captured data into a file.

The AirTracer application tool can also retrieve and save internal error logs from MOTOTRBO radios. The saved files can be analyzed by trained Motorola Solutions personnel to suggest improvements in system configurations or to help isolate problems.

4.3

Radio Tuning Setup

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

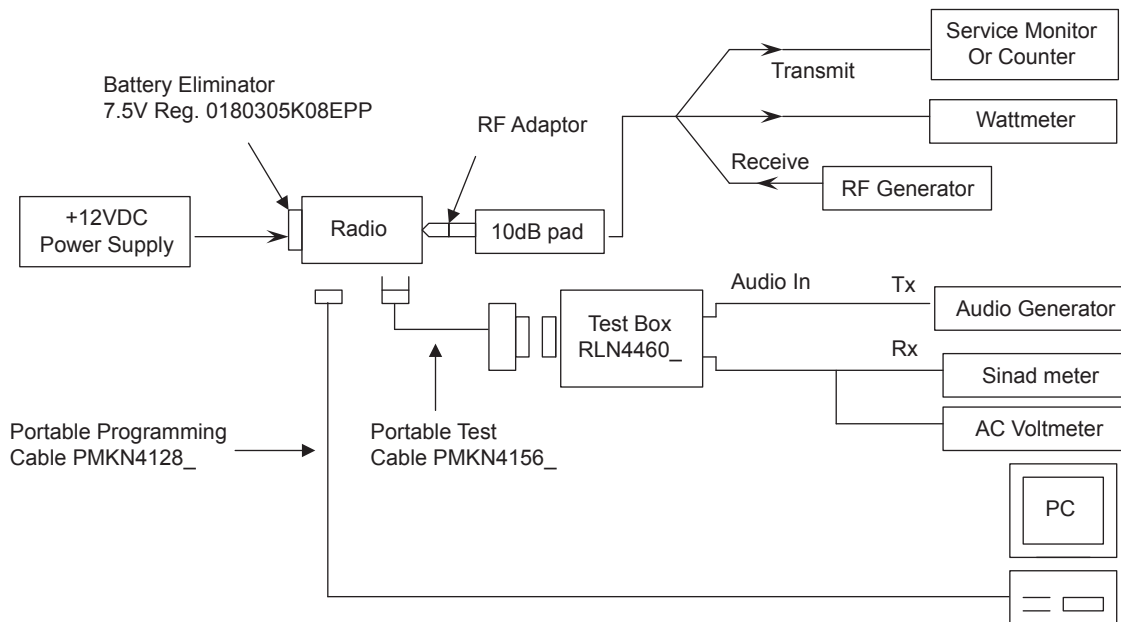
Before keying up the radio, set the Bias DAC for the appropriate final device bias current. If the bias is not properly set, it may cause damage to the transmitter.



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

A personal computer (PC) with Windows, Windows 2000/XP/Vista/Windows 7/Windows 8 and a tuner program are required to tune the radio. See [Figure 6: Radio Tuning Equipment Setup on page 39](#) to perform tuning procedures.

Figure 6: Radio Tuning Equipment Setup



Chapter 5

Disassembly/Reassembly Procedures

This chapter provides details about the following:

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

5.1

Preventive Maintenance

Periodic visual inspection and cleaning 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.

5.2

Safe Handling of CMOS and LDMOS Devices

Complementary Metal Oxide Semiconductor (CMOS) and Laterally Diffused Metal Oxide Semiconductor (LDMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high-voltage charges.

Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS/LDMOS circuits and are especially important in low humidity conditions. Do not attempt to disassemble your radio without referring to the following caution statement.



CAUTION:

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

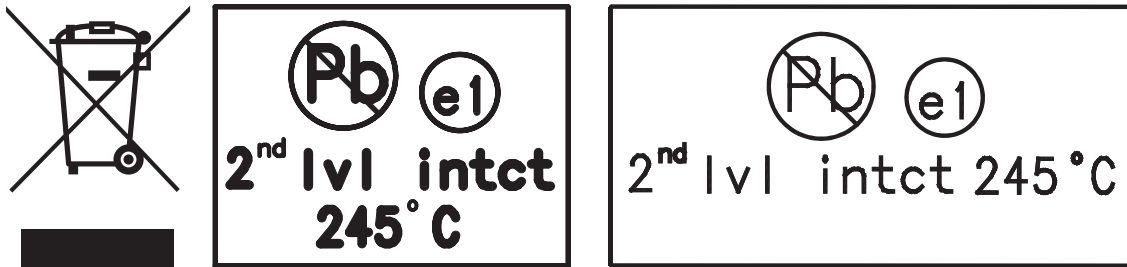
- Store and transport all CMOS/LDMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS/LDMOS devices into conventional plastic "snow" trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench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

5.3

General Repair Procedures and Techniques

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

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



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

Table 21: 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 22: Lead Free Solder Paste Part Number List

Manufacturer Part Number	Viscosity	Type	Composition and Percent Metal	Liquid Temperature
IPN800610	1000-1700 poise	Type 4	(95.5%Sn-3.8%Ag-0.7%Cu) 89.3%	217 °C

Parts Replacement and Substitution

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

Rigid Circuit Boards

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

When soldering near a connector:

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

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

5.4

Disassembling and Reassembling the Radio

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™ T6 screwdriver
- Chassis and Knob Opener (6686533Z01)
- Flat Square tip plastic tweezers

The following tools are required for reassembling the radio:

- Grease (1185937A01)
- TORX T6 Screwdriver
- Flat Square tip plastic tweezers



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

5.5

Detailed Radio Disassembly

The section describes the detailed disassembly procedure of your radio.

5.5.1

Front Cover from Chassis Disassembly

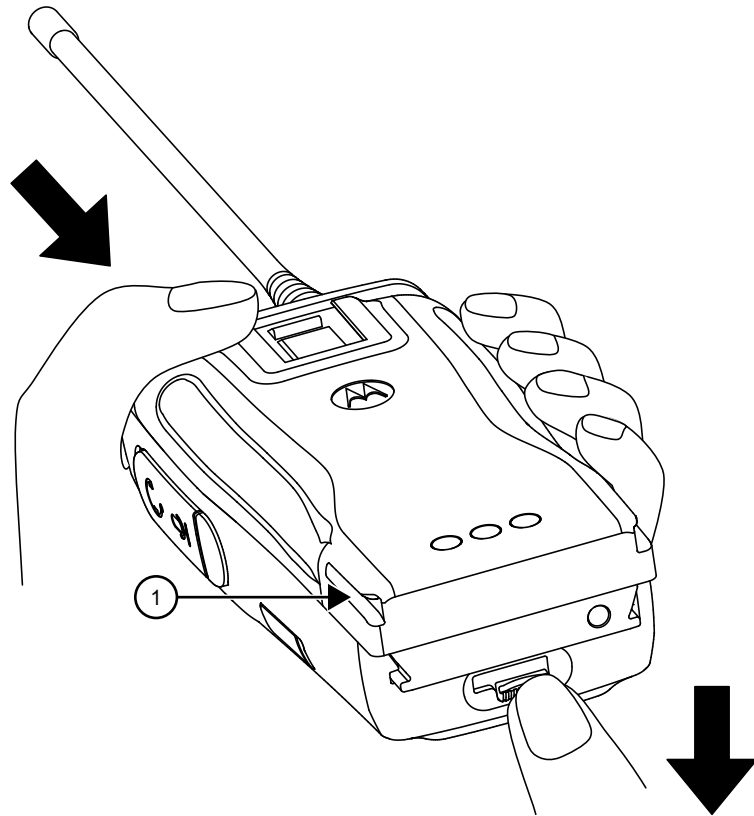
Procedure:

- 1 Turn off the radio.
- 2 Remove the battery:
 - a Slide the battery latch into the unlock position. Disengage by pressing the latch downward fully and holding the latch towards the front of the radio.

NOTICE: Ensure that metal latch is not protruding out from the slot on the plastic housing.
 - b With the battery latch disengaged, slide the battery down from the top of the radio. Once the battery is free from the battery rails, lift it directly away from the radio.

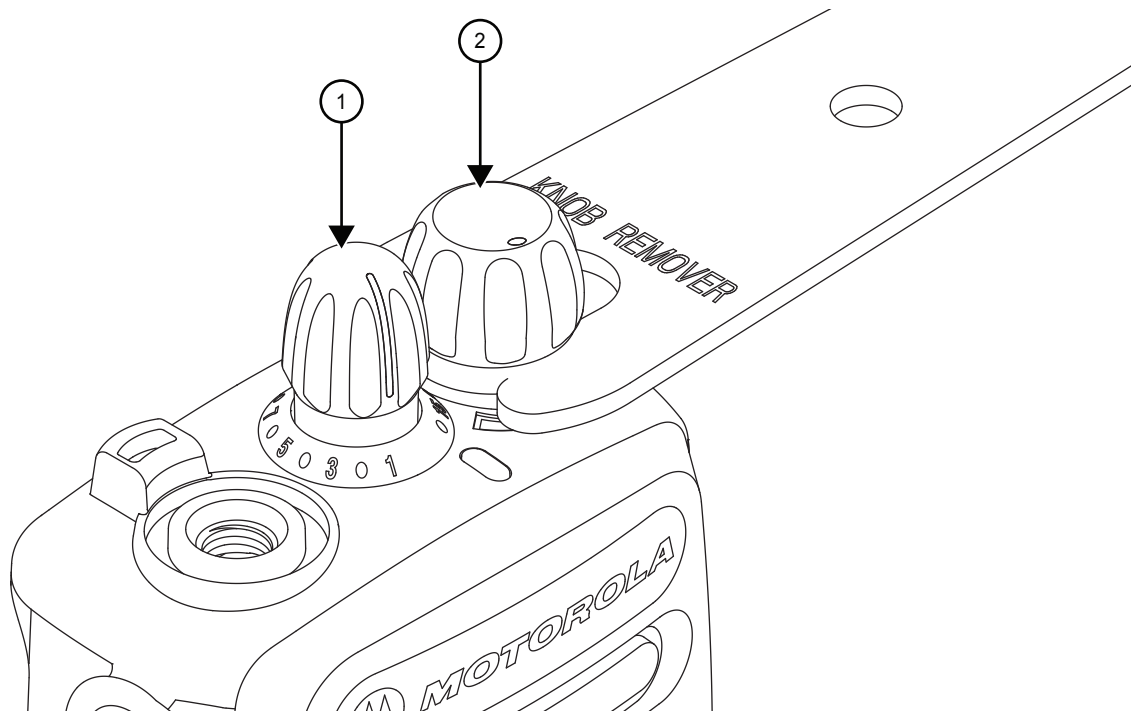
NOTICE: Do not put too much pressure on the battery while sliding it out from top of the radio.
 - c Remove the battery from the radio.

Figure 7: Battery Removal



Label	Description
1	Battery

- 3 Remove the antenna by turning it counter-clockwise.
- 4 Pry off the volume and channel selector knobs from their shafts using the knob remover/chassis opener tool (Motorola Solutions part number: 6686533Z01).

Figure 8: Channel Selector and Volume Knob Removal

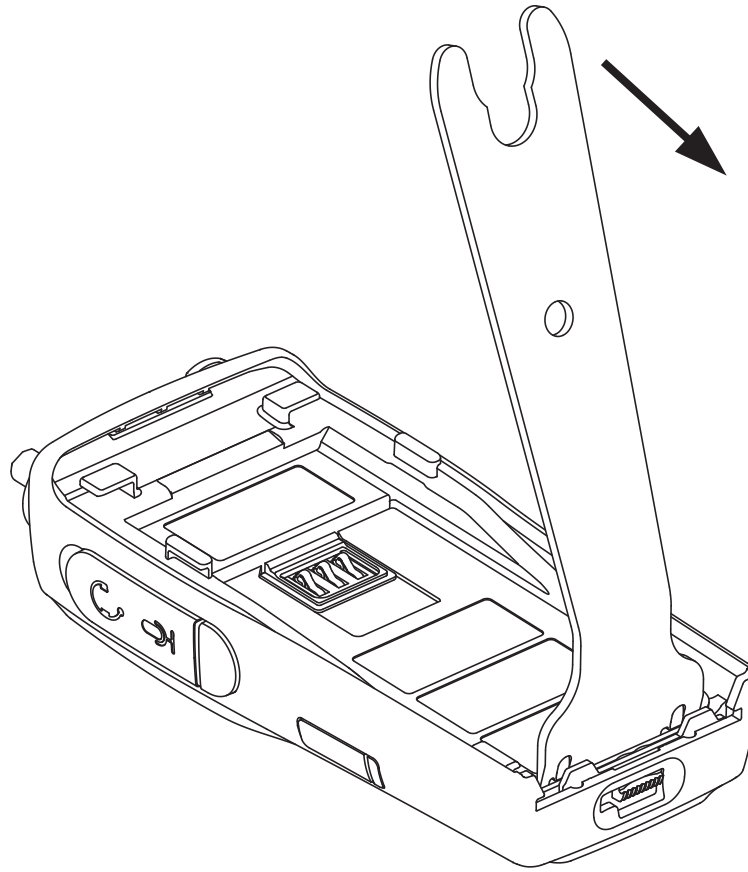
Label	Description
1	Channel Selector Knob
2	On/Off/Volume Knob



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

- 5 Separate the chassis from the front housing assembly by using the knob remover/chassis opener tool. Place the broad side of the opener into the slots at the base of the radio. Press the handle of the opener downwards. This pressing action forces the thin inner plastic wall towards the base of the radio, releasing the two chassis base tabs.

Figure 9: Chassis Removal



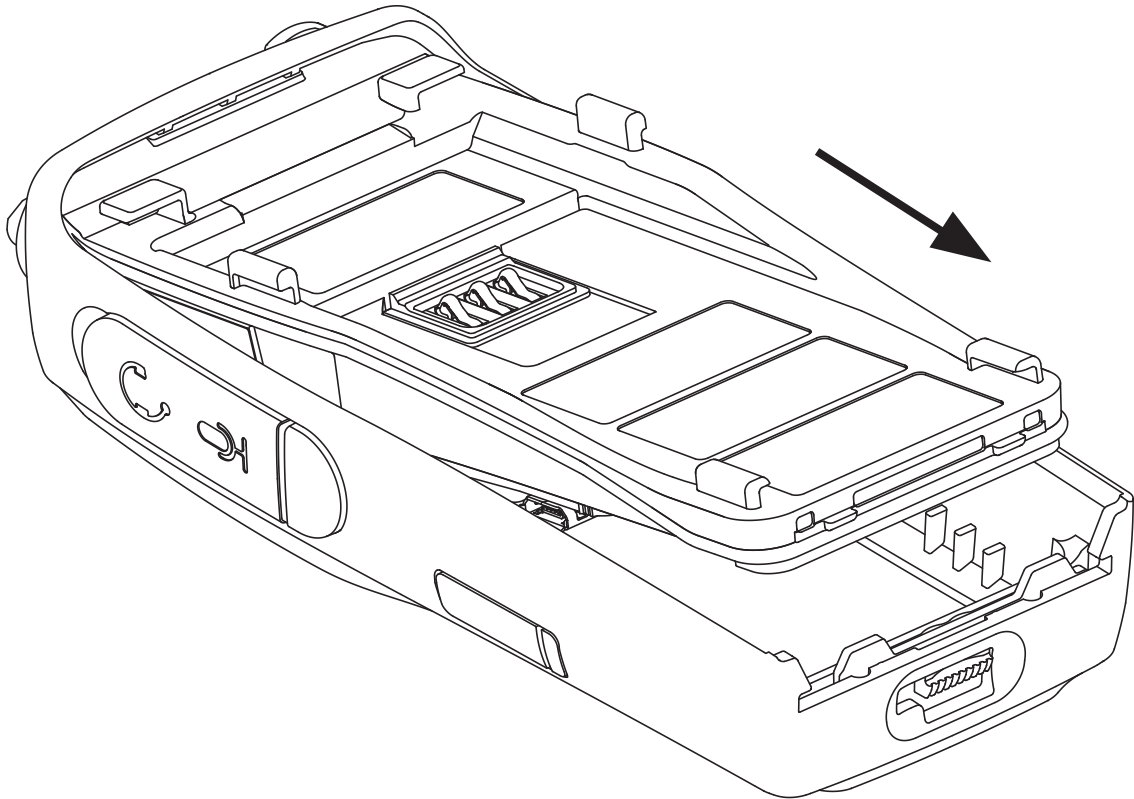
CAUTION: Marring the front housing O-ring, sealing area prevents the radio from sealing properly. If the O-ring is damaged, replace it with a new one.



NOTICE: The speaker wire and microphone wire connecting the front housing assembly and the chassis assembly prevent the two units from being completely separated.

- 6 Slowly slide out the chassis assembly from the front housing until the volume and channel selector shafts are free from the top of the housing.

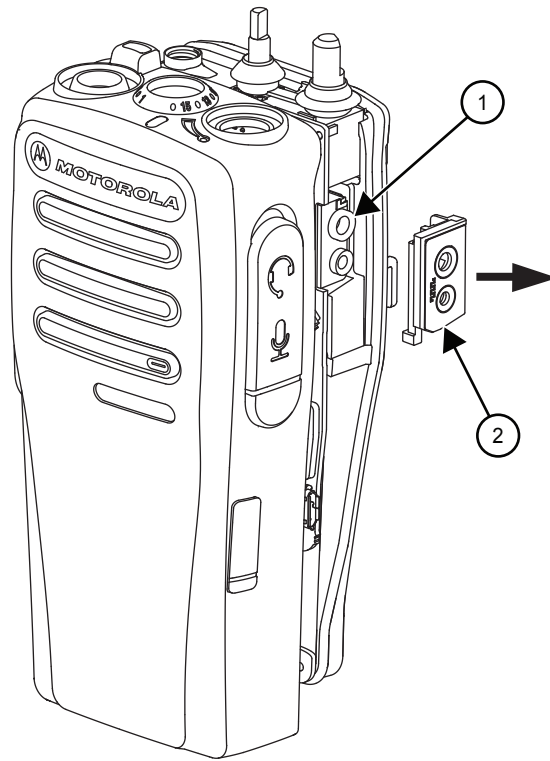
Figure 10: Chassis Removal from Front Housing



CAUTION: Do not pull out the chassis forcefully. This causes damage to the speaker and microphone wires that are still connected to the chassis assembly.

- 7 Remove the audio jack shroud assembly from the accessory connector on the main board.

Figure 11: Audio Jack Shroud Assembly Removal



Label	Description
1	Accessory Connector
2	Audio Jack Shroud Assembly

- 8 Rotate the chassis counterclockwise out of the housing, and position them side by side.
- 9 Peel off the poron pad on back kit.
- 10 Unplug the speaker wire and microphone wire from the 2-pin connector on the main board.

Figure 12: Speaker and Microphone Wires Removal for PMUE4147A, PMUD3231A

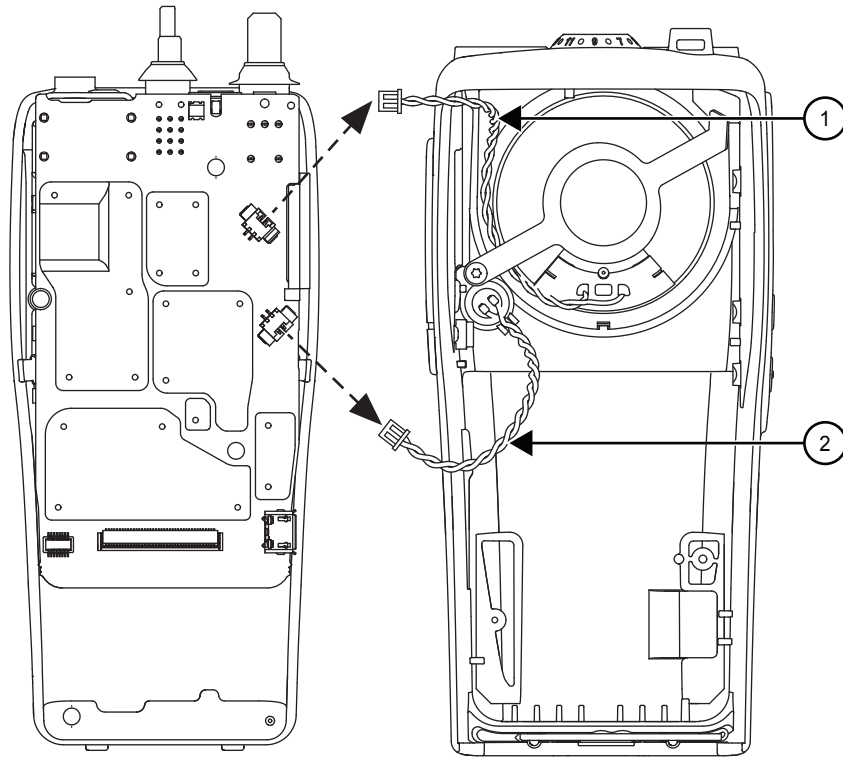
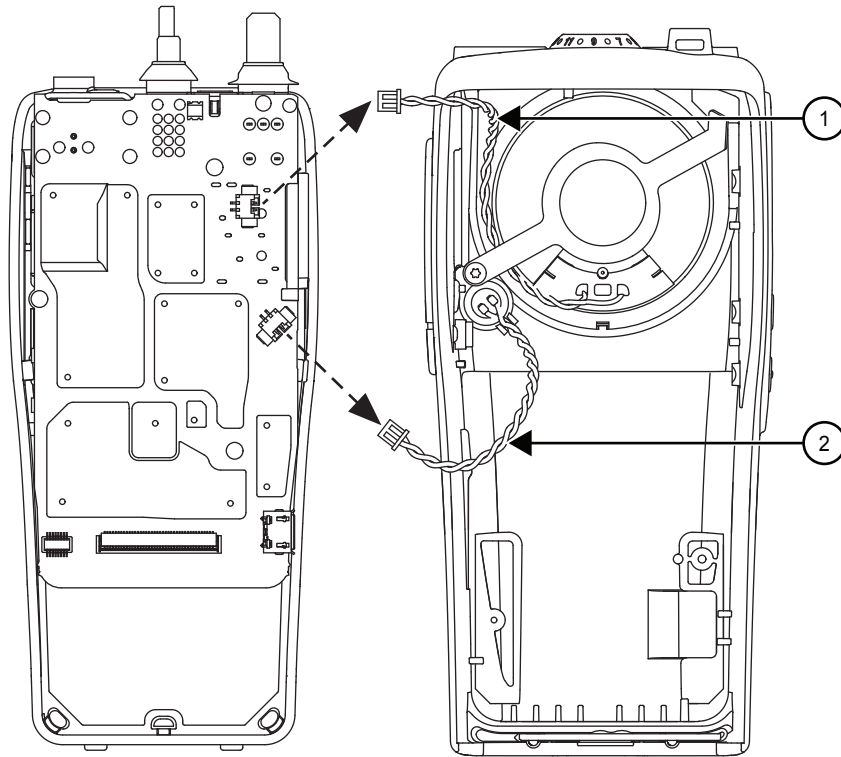


Figure 13: Speaker and Microphone Wires Removal for PMUE4147B, PMUD3231B



Label	Description
1	Speaker Wire
2	Microphone Wire

5.5.2

Chassis Disassembly

Procedure:

- 1 Use a TORX screwdriver with a T6 bit to remove the three screws holding the main board to the chassis.

Figure 14: Chassis Disassembly for PMUE4147A, PMUD3231A

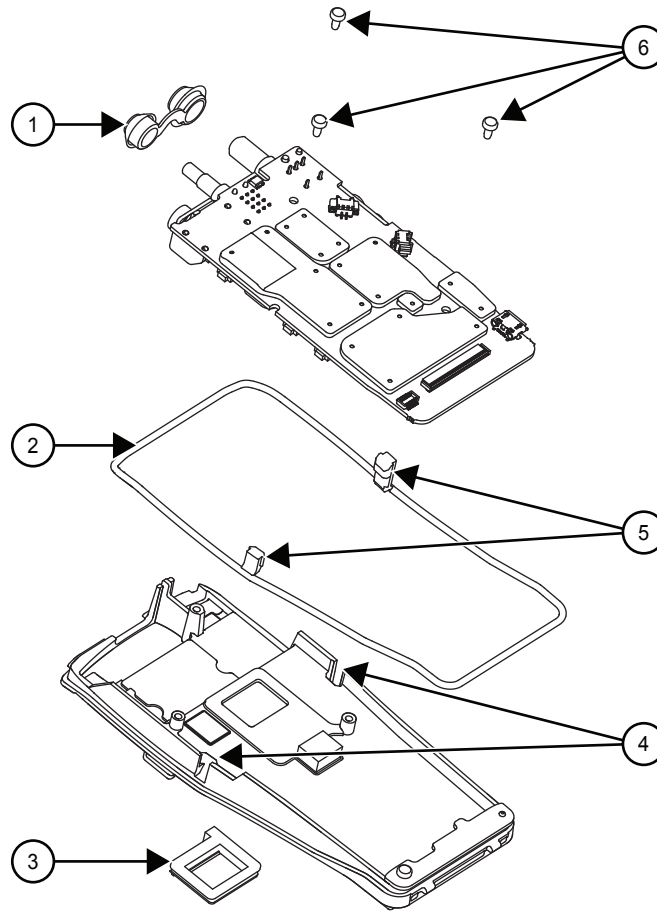
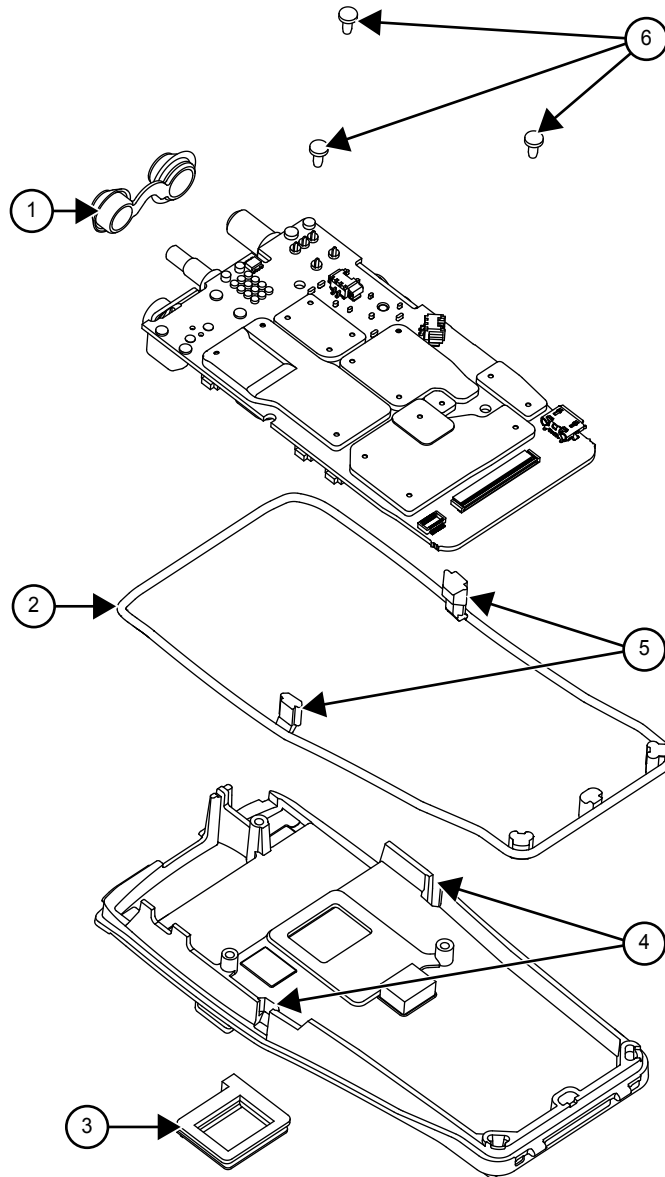


Figure 15: Chassis Disassembly for PMUE4147B, PMUD3231B



Label	Description
1	Top Control Seal
2	O-ring
3	Battery Contact Seal
4	Groove
5	Tab
6	Mainboard screws

- 2 Lift the main board from the chassis.
- 3 Remove the O-ring by releasing the two tabs from the grooves on the chassis.
- 4 Remove the top control seal and battery contact seal.

5.5.3

Speaker and Microphone Disassembly

Procedure:

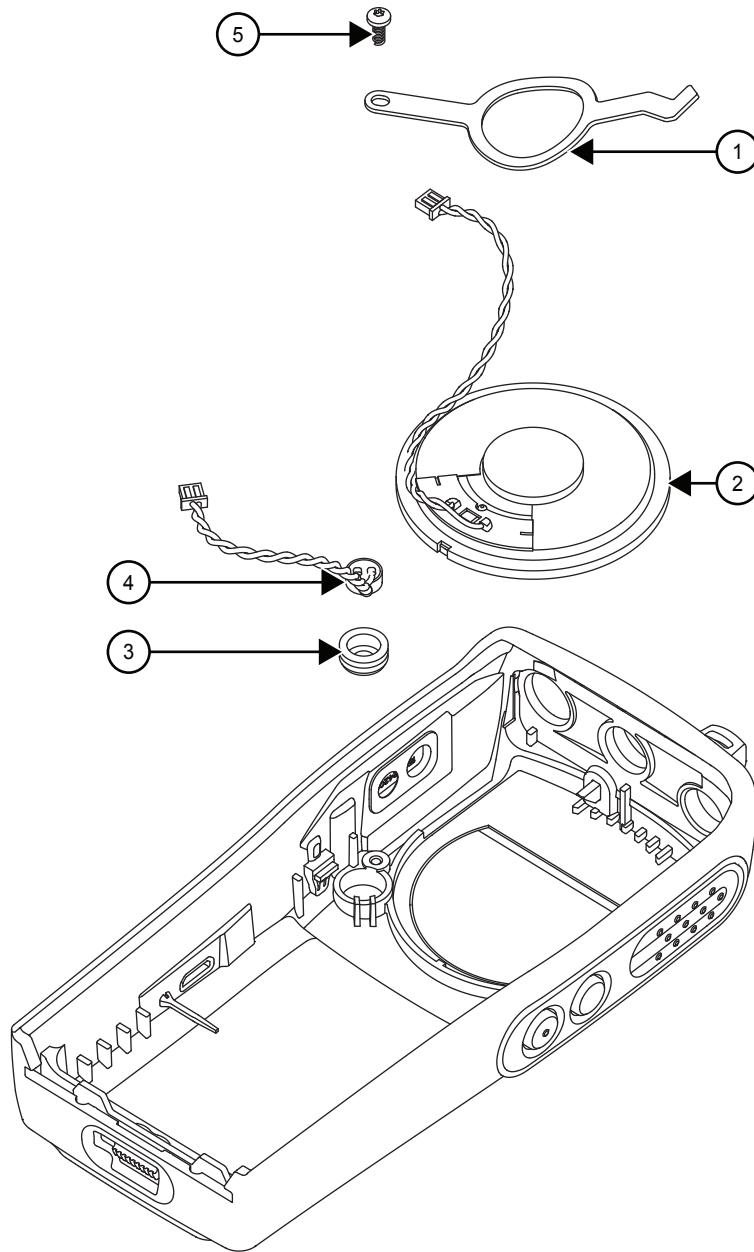
- 1 Remove the screw from the speaker retainer using a TORX screwdriver with a T6 bit.



NOTICE: The speaker is held in place with a retainer. Be careful not to damage the speaker when removing the bracket retainer.

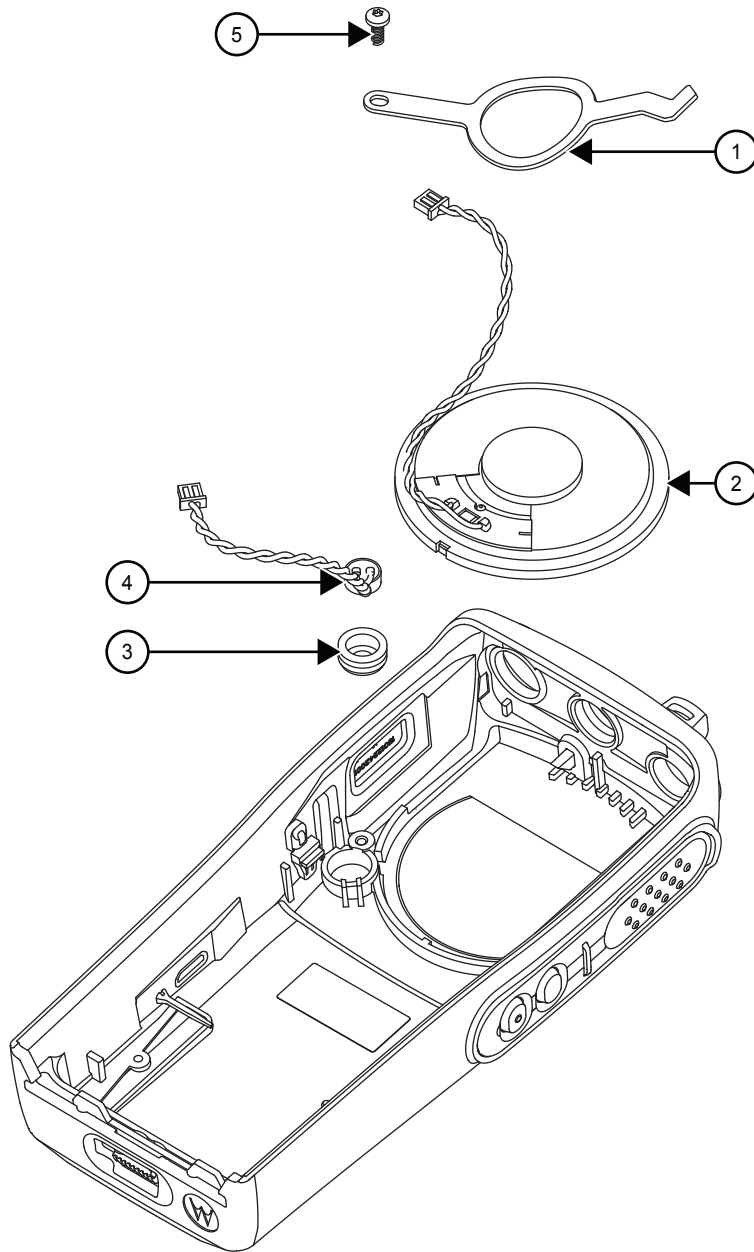
- 2 Lift the retainer off the speaker by sliding the end of the retainer out of the corner slot on the housing.
- 3 Lift the speaker out of the housing.
- 4 Carefully lift the microphone assembly out of the housing. If you are replacing the microphone, remove it from the rubber boot.

Figure 16: Speaker and Microphone Disassembly



NOTICE: This diagram is applicable to PMUE4147A, PMUD3231A.

Figure 17: Speaker and Microphone Disassembly



NOTICE: This diagram is applicable to PMUE4147B, PMUD3231B.

Label	Description
1	Speaker Retainer
2	Speaker
3	Microphone Boot
4	Microphone
5	Screw

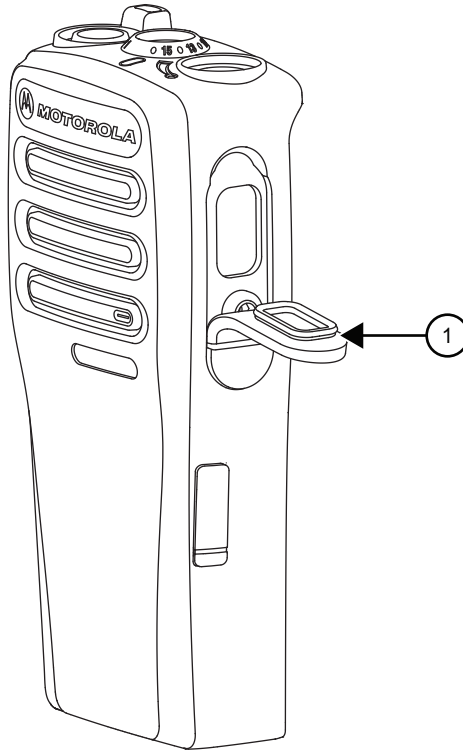
5.5.4

Audio Jack Dust Cover Disassembly

Procedure:

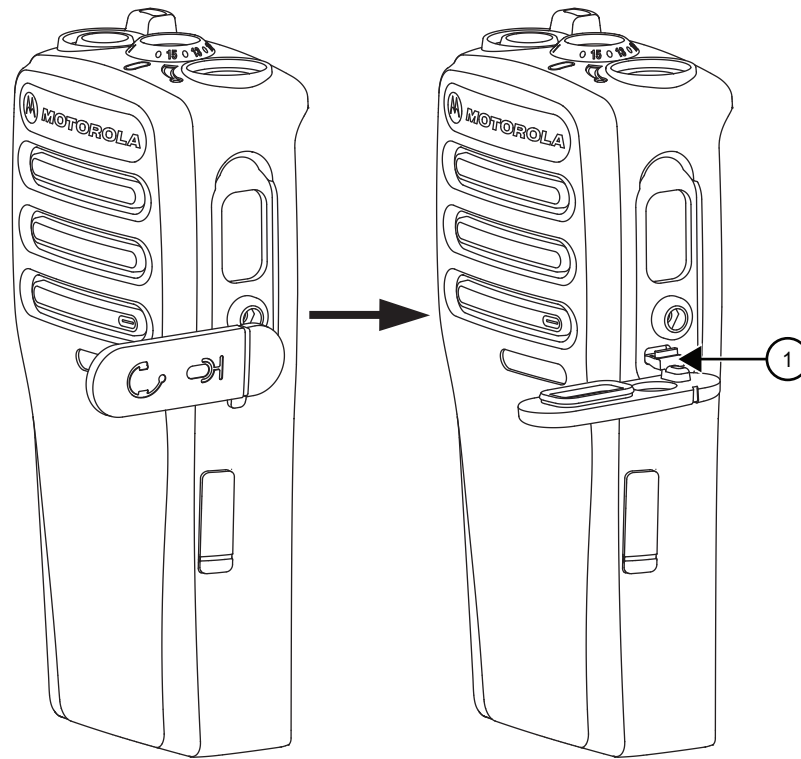
- 1 Gently pry the top of the dust cover away from the body of the housing.

Figure 18: Dust Cover Disassembly



Label	Description
1	Dust Cover

- 2 Face the audio jack side and rotate the dust cover 90 degrees in counter-clockwise direction. Flip open the dust cover 90 degrees in clockwise direction as in [Figure 19: Audio Jack Dust Cover Removal on page 57](#) to allow the key to be removed.

Figure 19: Audio Jack Dust Cover Removal

Label	Description
1	Key

- 3 Separate the dust cover from the front housing.



NOTICE: The dust cover key is fragile; apply only light pressure to the key while removing the dust cover. If the key is damaged, replace with a new dust cover.

5.5.5

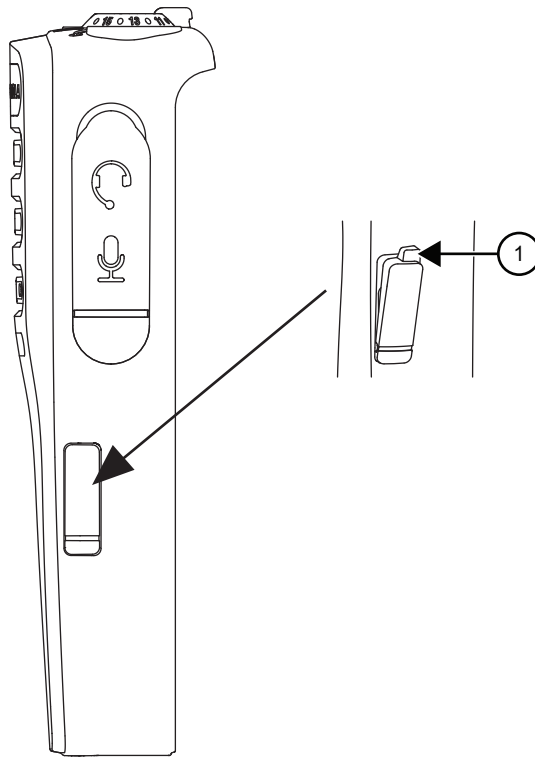
Micro USB Dust Cover Disassembly

Prerequisites: Use a pair of flat square tip plastic tweezers to perform the following actions.

Procedure:

- 1 Insert the tip of the tweezers underneath the dust cover from the side. Pry the dust cover to release the top tab.

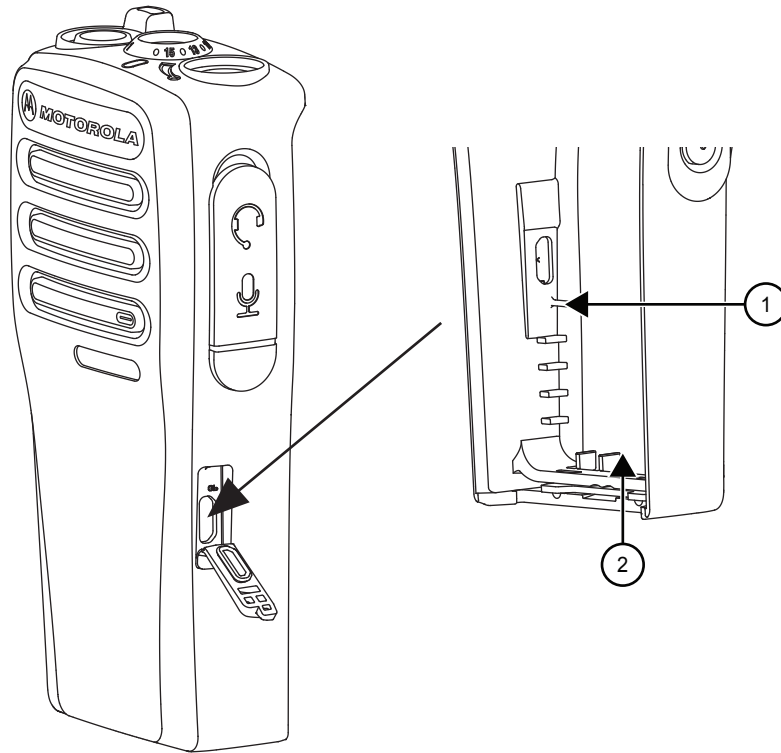
Figure 20: Prying the Micro USB Dust Cover



Label	Description
1	Top Tab

- 2 Cut off the head from the inside of the housing with cutter as shown in the following image.

Figure 21: Micro USB Dust Cover Removal



Label	Description
1	Head
2	Inside of Front Housing

- 3 Separate the dust cover from the front housing.



NOTICE: Micro USB dust cover is non-serviceable. Replace with a new one during reassembly.

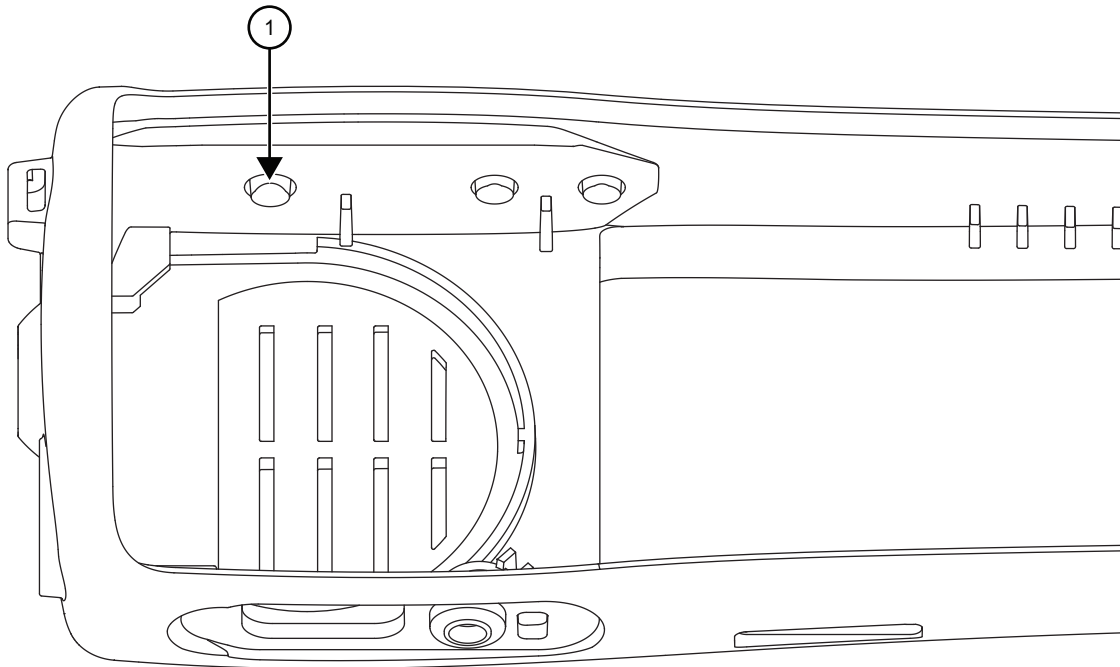
5.5.6

PTT Disassembly

Procedure:

- 1 Push PTT plunger from the inside to lift the PTT bezel slightly.

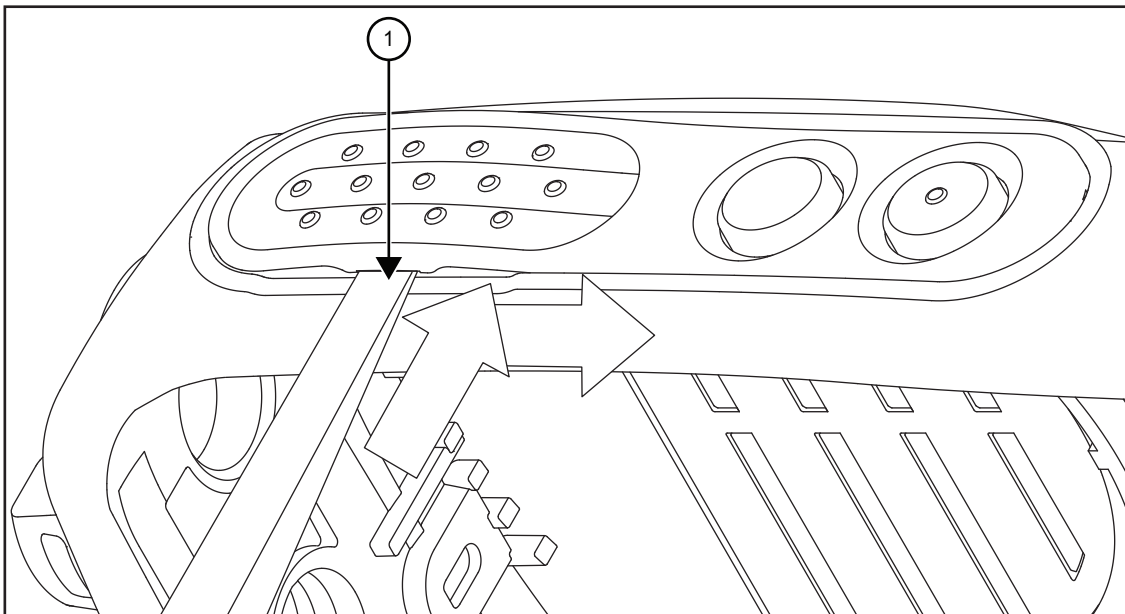
Figure 22: Lifting PTT Bezel with PTT plunger



Label	Description
1	PTT Plunger

- 2 Insert plastic tweezers into the gap between bezel and front housing. Pop out PTT bezel by pulling the plastic tweezers towards programming button.

Figure 23: PTT Removal



Label	Description
1	Plastic Tweezers

- Remove PTT bezel followed by the PTT rubber.



CAUTION: PTT bezel is not reusable once removed.

5.6

Detailed Radio Reassembly

The section describes the detailed reassembly procedure of your radio.

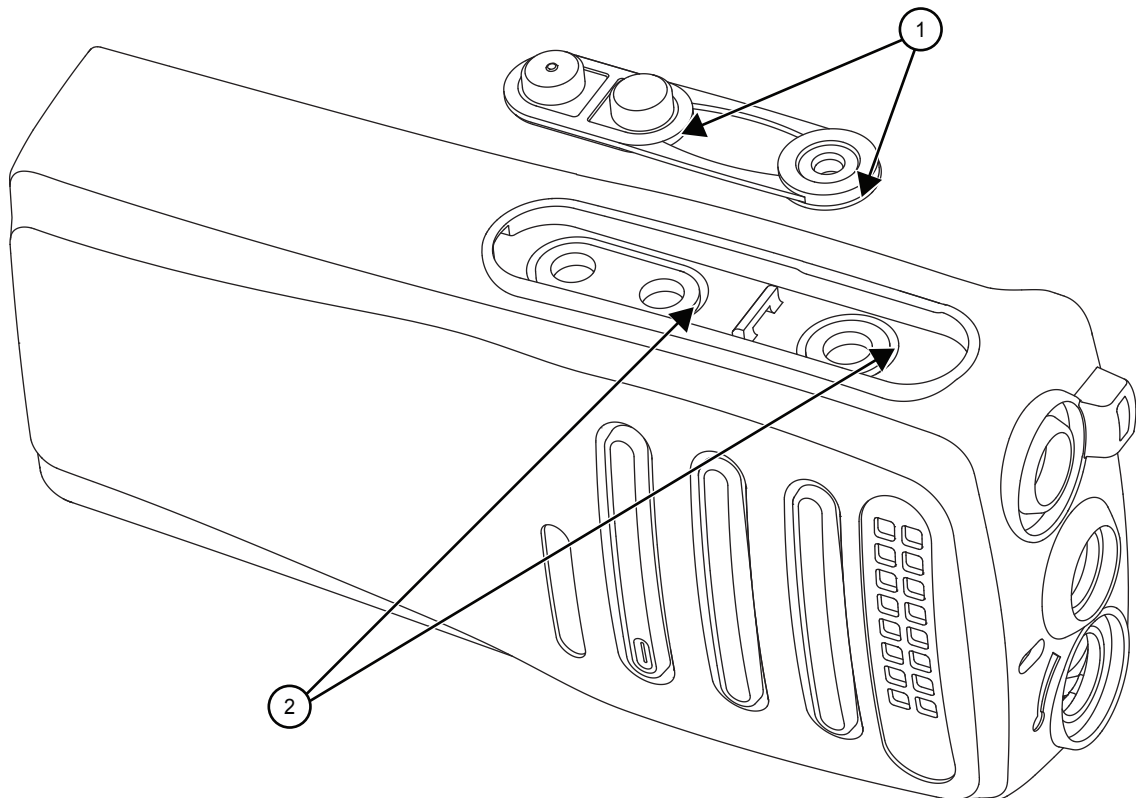
5.6.1

PTT Reassembly

Procedure:

- Assemble PTT rubber and ensure that sealing ribs are all-around inserted into sealing groove of front housing.

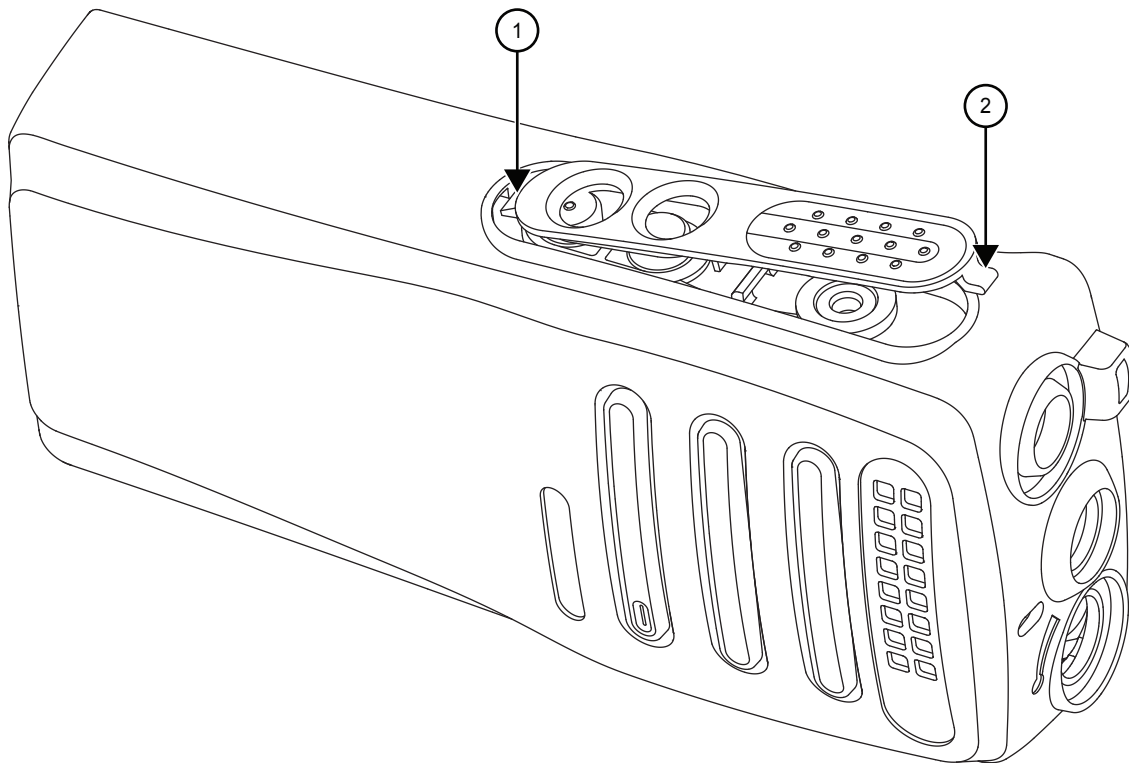
Figure 24: PTT Rubber Assembly



Label	Description
1	Sealing Ribs
2	Sealing Grooves

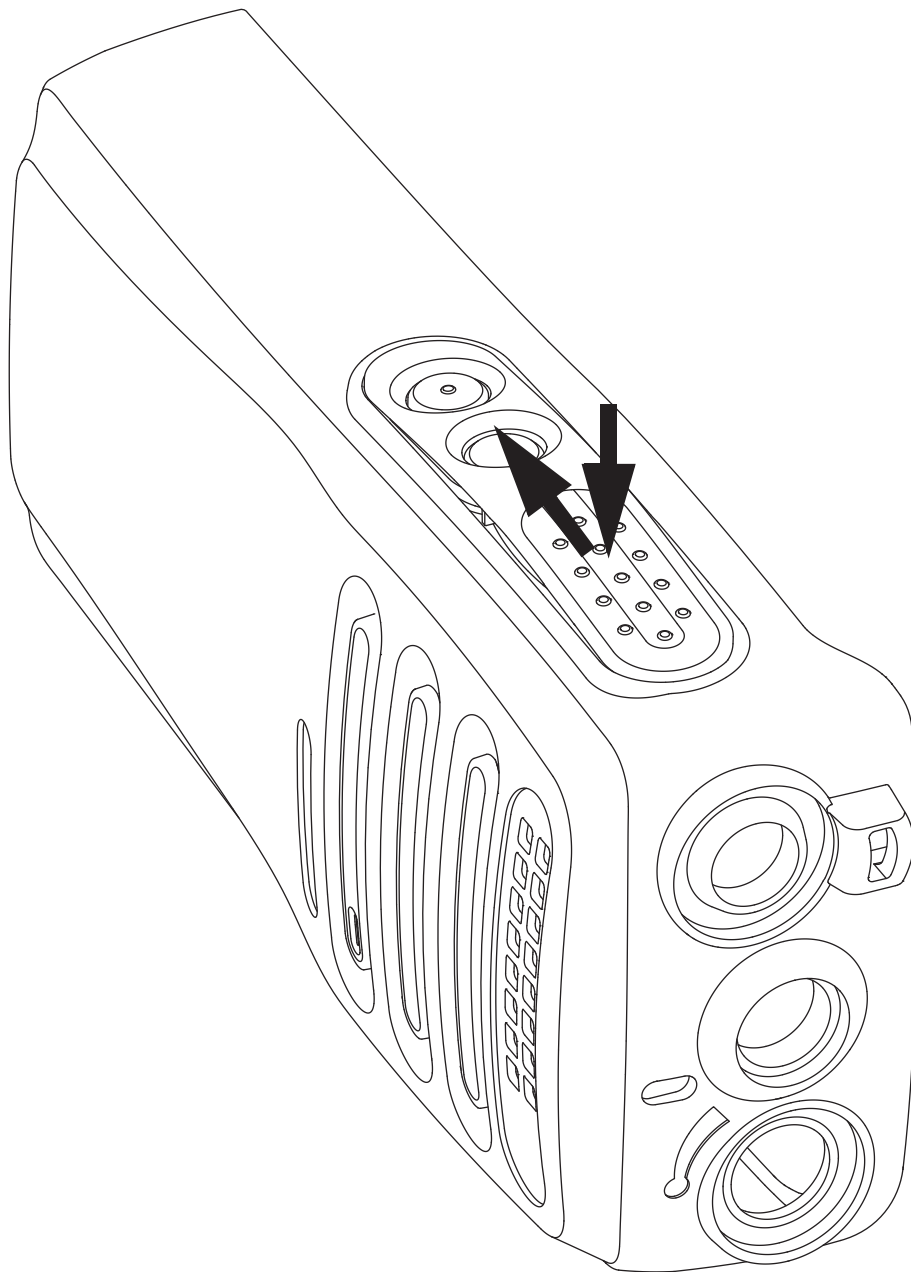
- Orient and slot in bottom end of PTT bezel. Proceed with slotting in the top end.

Figure 25: PTT Assembly



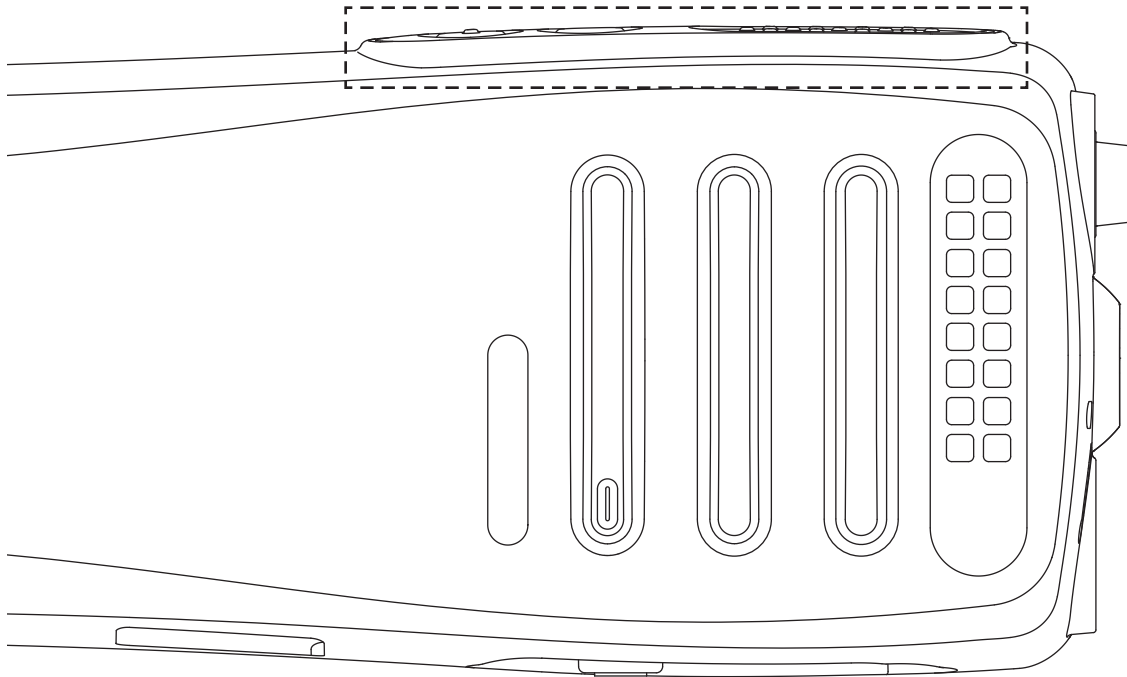
Label	Description
1	Bottom
2	Top

- 3 Push down PTT and drag towards programming key until bezel snaps in.

Figure 26: Affixing the PTT Bezel

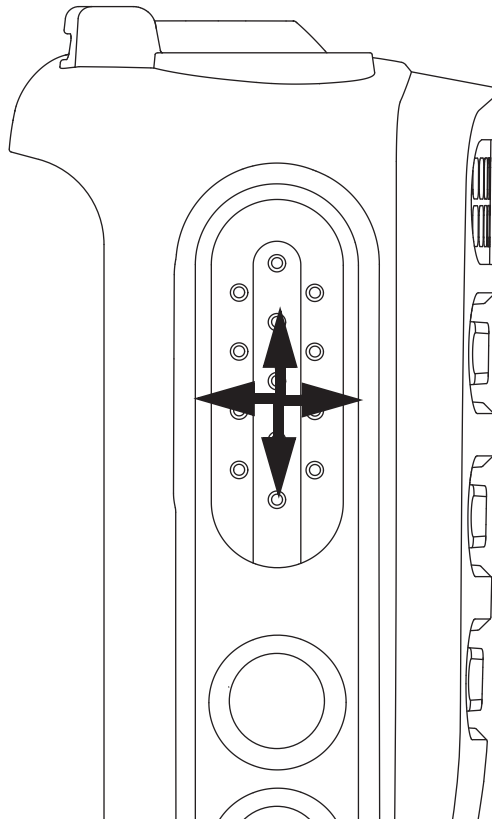
- 4 Ensure that PTT bezel is flushed to housing (no bulging).

Figure 27: Flushed PTT bezel to housing



- 5 Ensure that bezel can move about in its pocket (not wedged towards one side).

Figure 28: Bezel Alignment



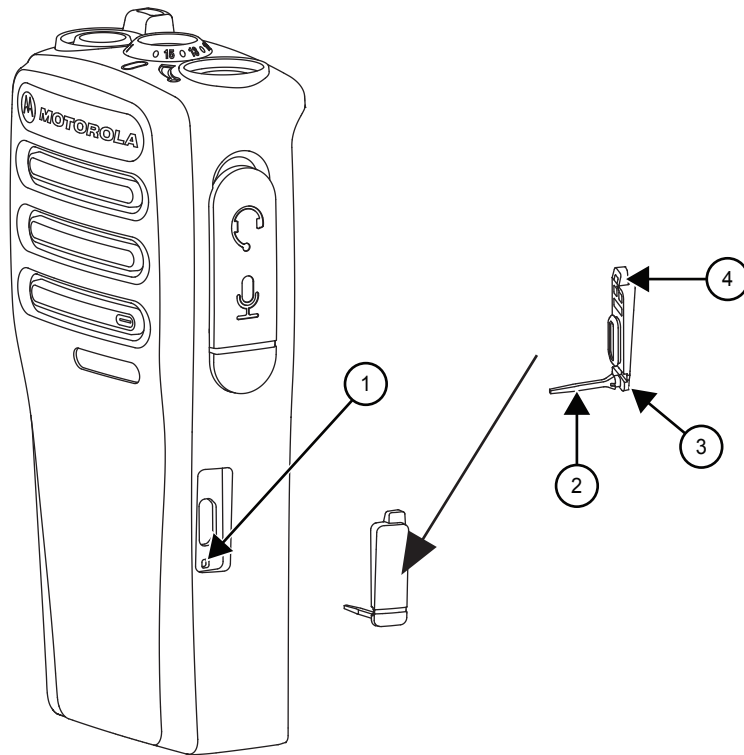
CAUTION: Remove and replace with new PTT bezel if criteria in [step 4](#) and [step 5](#) are not met.

5.6.2 Micro USB Dust Cover Reassembly

Procedure:

- 1 Insert the tail of the dust cover into the bottom hole on the front housing micro USB opening.
- 2 By using a long nose plier, pull the tail inward from the inside of the housing until the head is fully inserted.
- 3 Cut off the tail with a cutter.
- 4 Insert the top tab into the slot on the housing.

Figure 29: Micro USB Dust Cover Reassembly



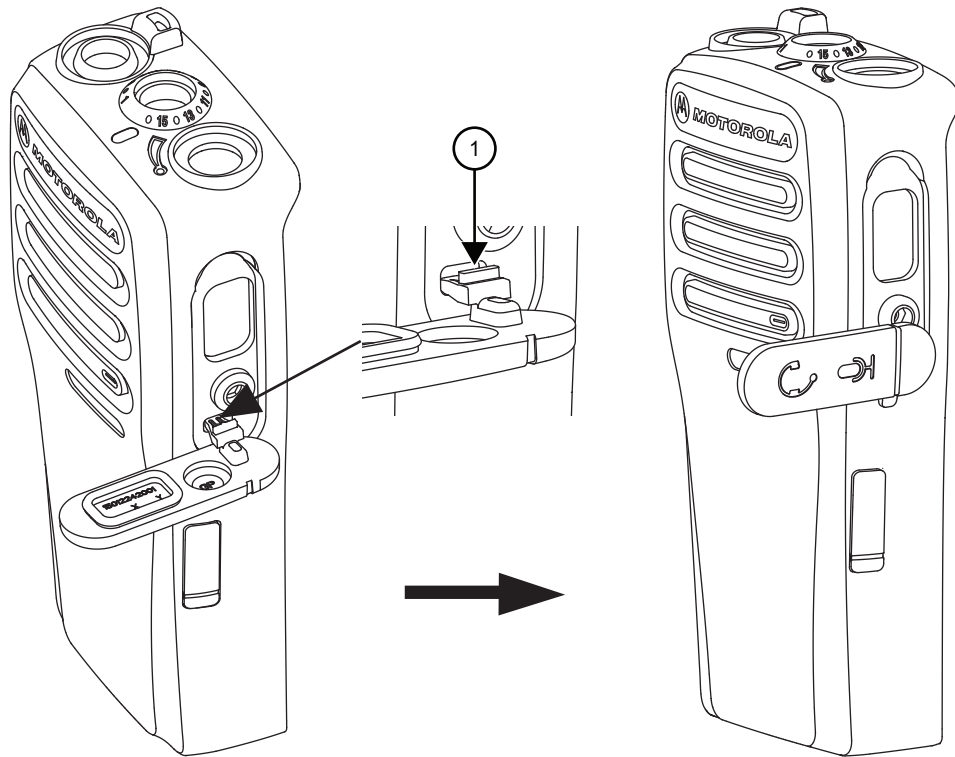
Label	Description
1	Insertion Point
2	Tail
3	Head
4	Tab

5.6.3 Audio Jack Dust Cover Reassembly

Procedure:

- 1 Insert the dust cover key into the slot on the housing at a 90° angle.
- 2 Flip the dust cover 90° in counterclockwise direction to allow the key to be fully inserted into the housing.

Figure 30: Audio Jack Dust Cover Reassembly



Label	Description
1	Key

- 3 With one hand pressing on the bottom of the dust cover, rotate the dust cover 90° in clockwise direction.
- 4 Press the dust cover to ensure it fully covers the audio jack opening.

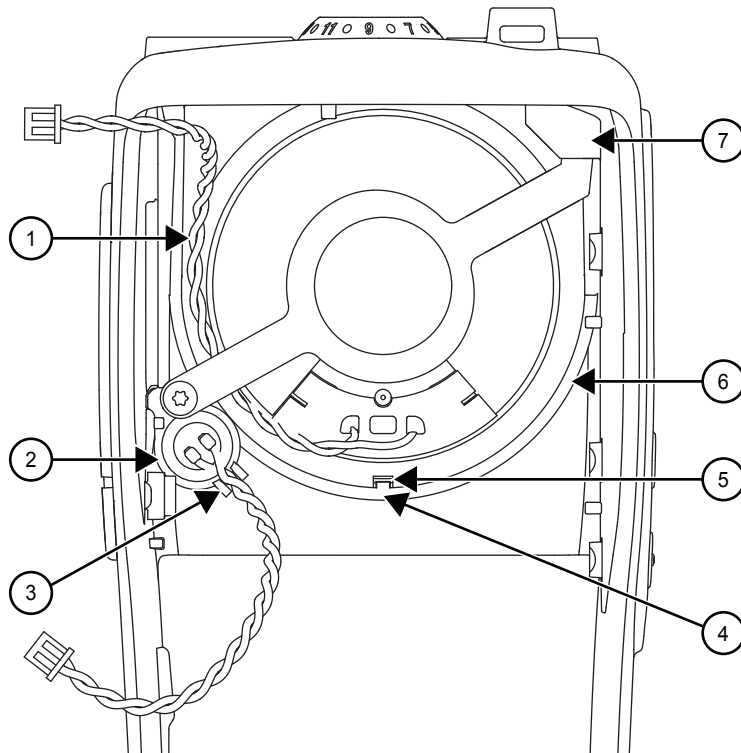
5.6.4

Speaker and Microphone Reassembly

Procedure:

- 1 Check if the microphone and speaker felts are in position and not damaged. If damaged, replace felts.
- 2 Insert the microphone into the microphone rubber boot.
- 3 Place the microphone assembly into the microphone recess on the housing and route the wire into the wire slot.
- 4 Align the groove on the speaker to the tab on the housing and place the speaker into the speaker recess. Ensure the speaker is seated flush to the housing.

Figure 31: Speaker and Microphone Reassembly



Label	Description
1	Speaker Wire Routing
2	Microphone Recess
3	Microphone Wire Slot
4	Housing Tab
5	Speaker Groove
6	Speaker Recess
7	Retainer Slot

- 5 Insert one end of the speaker retainer into the corner slot on the housing. Align the other end to the screw boss.
- 6 With one hand holding the retainer to the housing, fasten the screw using a T6 TORX screwdriver. Tighten torque should be between 2.7 to 2.9 lb/in.



NOTICE: When fastening the speaker retainer screw, make sure the speaker wire is routed under the retainer to prevent pinching by the retainer.

5.6.5

Chassis Reassembly

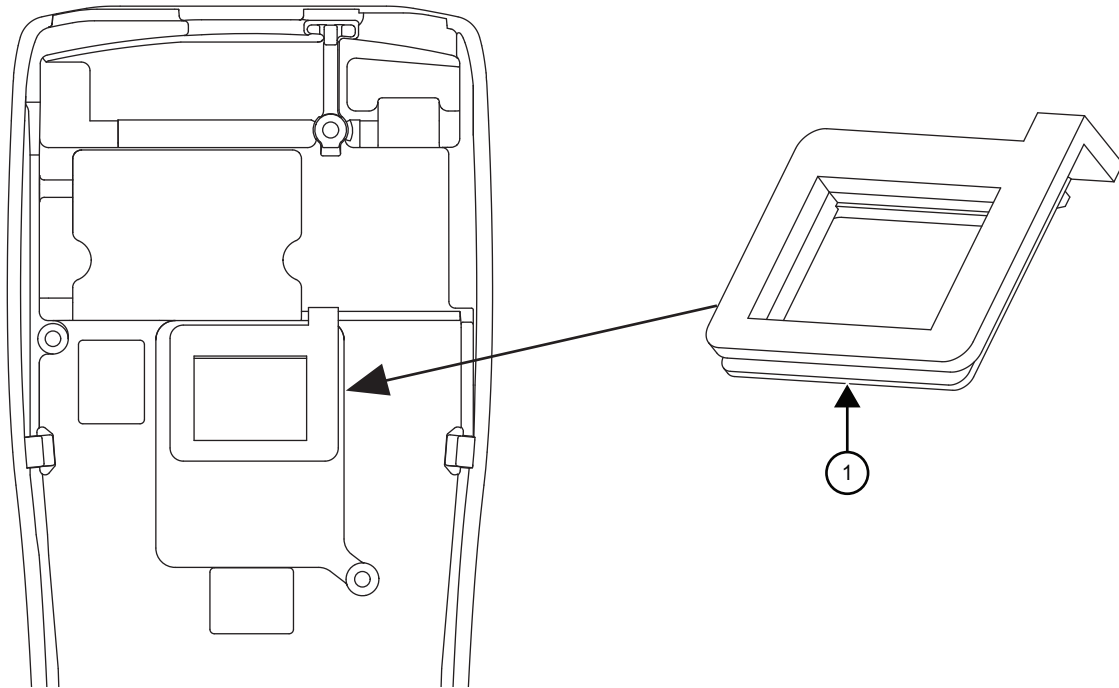
Procedure:

- 1 Assemble the battery contact seal onto the opening of the chassis in the correct orientation.




NOTICE: Make sure that the battery contact seal protrudes through the chassis, following the recess shape.

Figure 32: Battery Contact Seal Assembly



Label	Description
1	Battery Contact Seal

- 2 Assemble the main O-ring onto the chassis by pushing the two tabs all the way into the chassis main O-ring groove. Stretch the O-ring to fit it around the sides of the chassis.

 **NOTICE:** Make sure that the main O-ring is not twisted.

- 3 Remove both the thermal pads and place the new ones onto their respective recess on the chassis by using a clean pair of plastic tweezers. Thin thermal pad (black color) is to be placed on the recess to the left of the battery contact seal. Thick thermal pad (green color) is to be placed on the recess to the bottom of the battery contact seal.


 **NOTICE:** Replace with new thermal pads each time when the board is disassembled from chassis and ensure that both the thermal pads are placed correctly in their respective position and orientation.

Figure 33: Thermal Pad Assembly for PMUE4147A, PMUD3231A

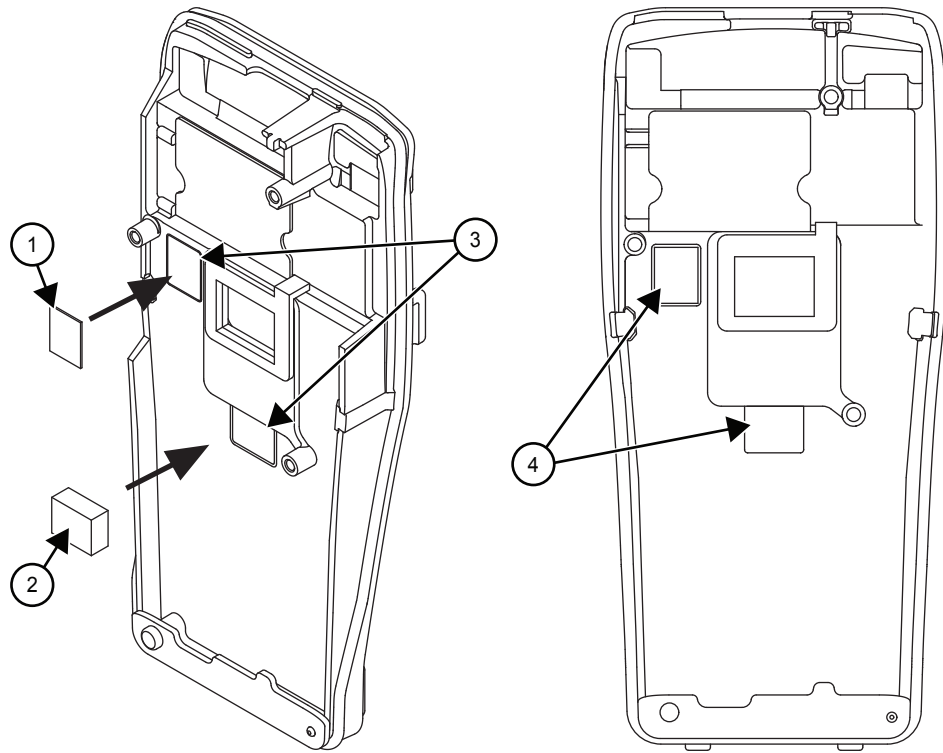
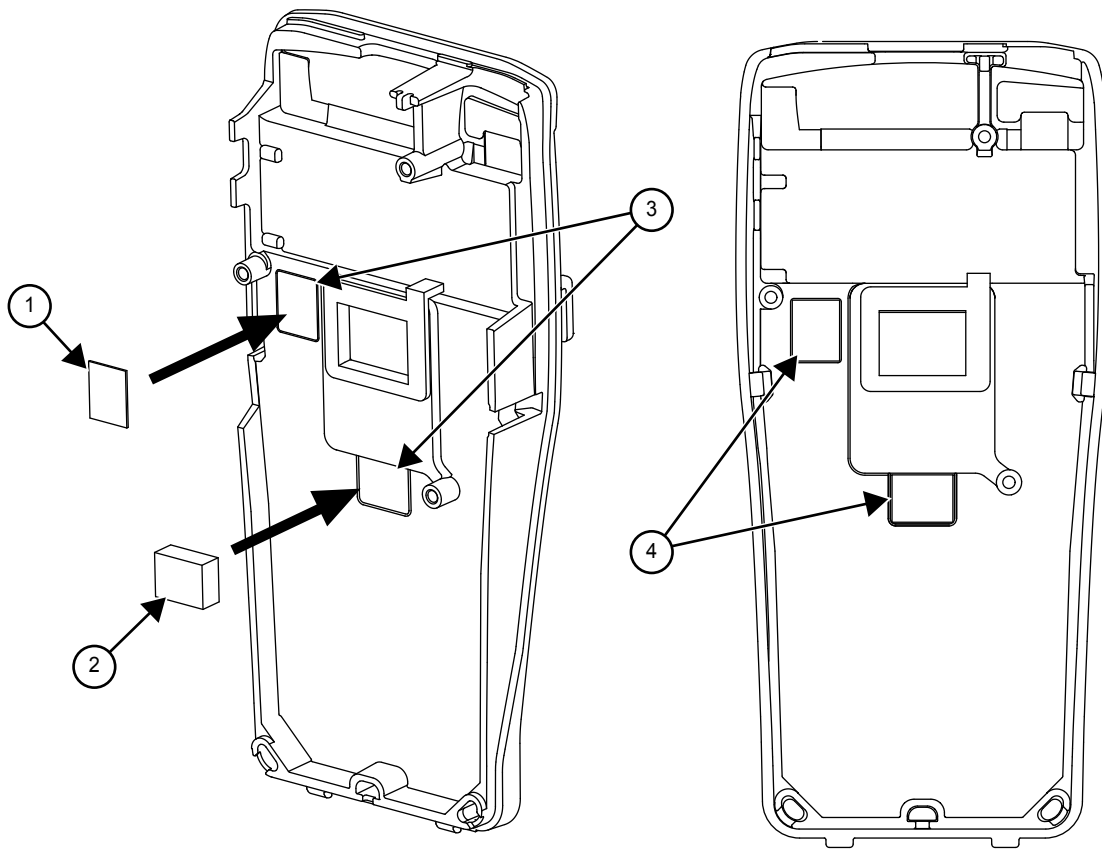



Figure 34: Thermal Pad Assembly for PMUE4147B, PMUD3231B



Label	Description
1	Thin Thermal Pad (Black color)
2	Thick Thermal Pad (Green color)
3	Recess
4	Thermal pads correctly placed in the respective recess.

- 4 Insert the top control seal into the volume and channel selector shafts until it is seated on the switches.

 **NOTICE:** Replace the battery contact seal, main O-ring, and top control seal with a new one if marred.

- 5 Assemble the main board to the chassis by aligning the board to the PCB guide protruded from the chassis, with the volume and frequency switches facing downward. The top control seal link must be tucked under the PCB guide.


 **NOTICE:** Make sure that the battery contact seal is not pinched under the chassis.

Figure 35: PCB and Top Control Seal Assembly for PMUE4147A, PMUD3231A

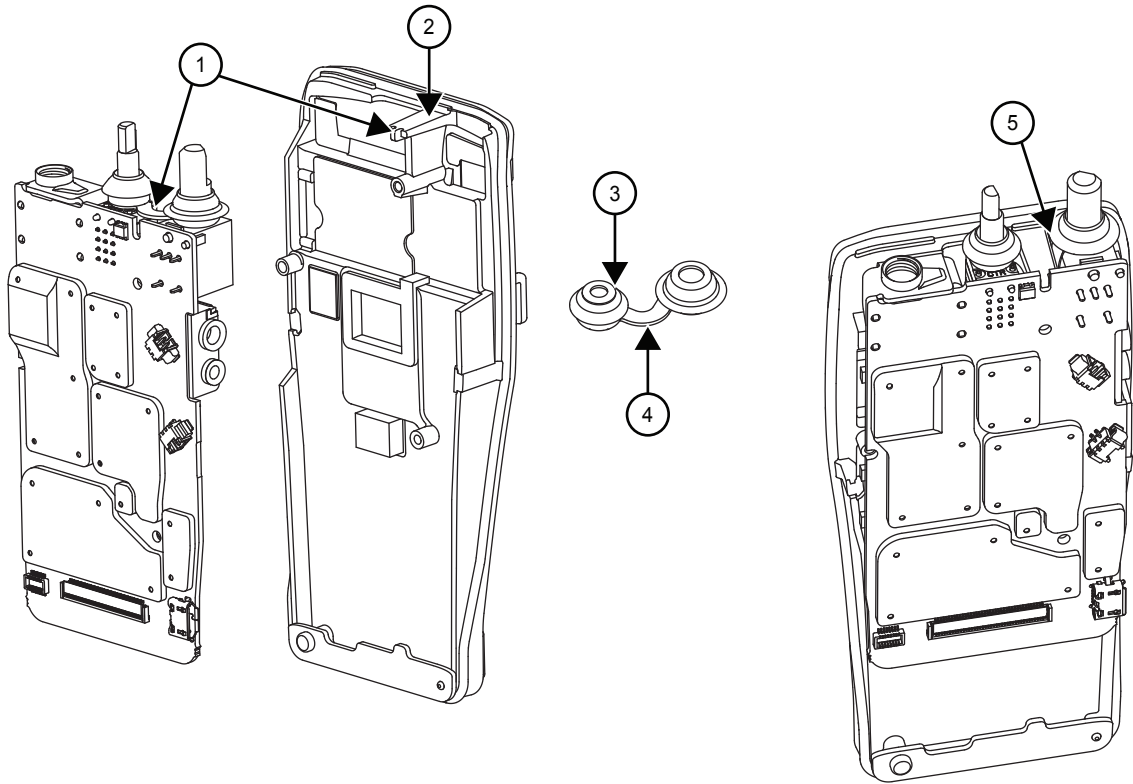
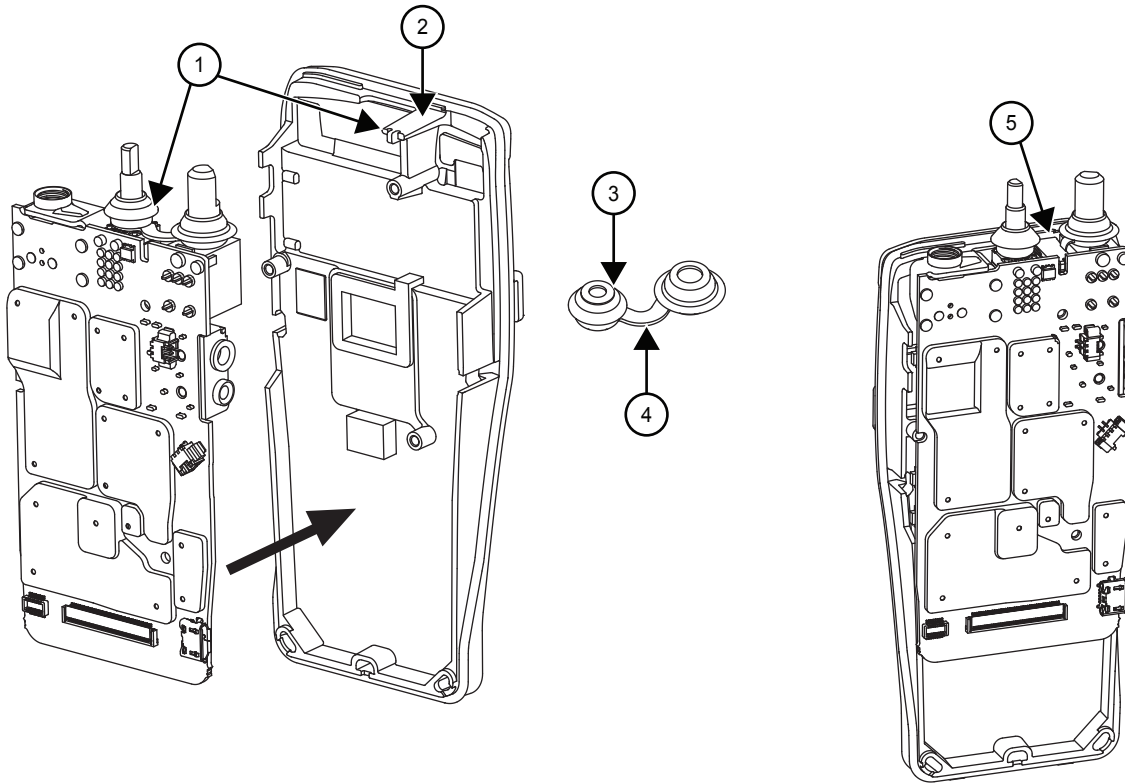
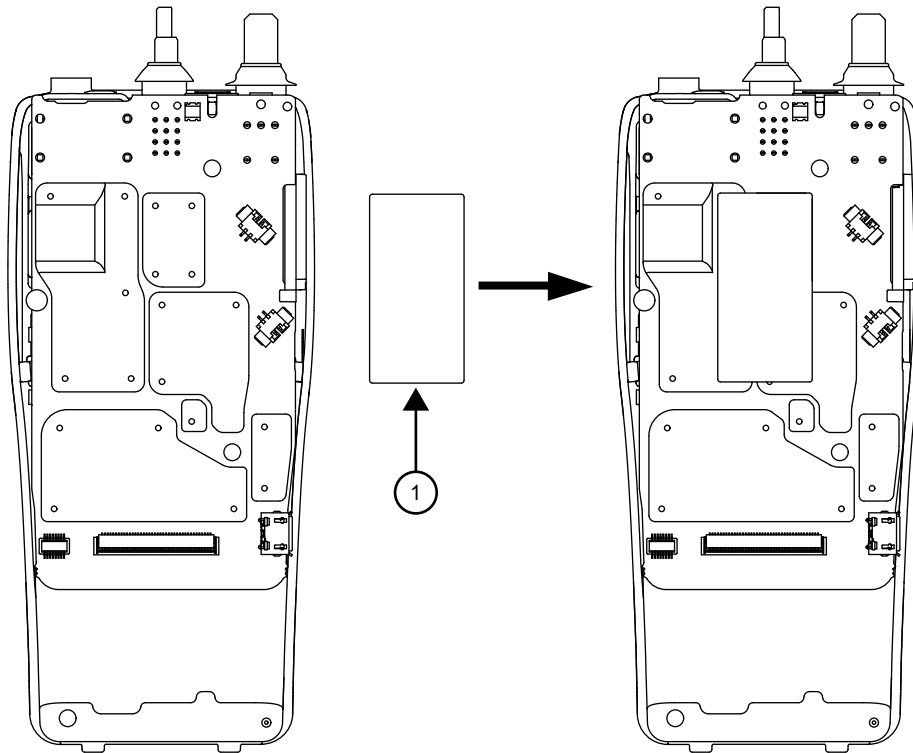


Figure 36: PCB and Top Control Seal Assembly for PMUE4147B, PMUD3231B



Label	Description
1	Align board to the PCB Guide
2	PCB Guide
3	Top Control Seal
4	Link
5	Top Control Seal must be tucked under the PCB Guide.

- 6 Align the three screw holes to the screw bosses on the chassis.
- 7 Use a T6 TORX screwdriver to fasten the screws holding the main board to the chassis. Tighten torque should be between 3.7 to 3.9 lb/in. (Refer to [Figure 14: Chassis Disassembly for PMUE4147A, PMUD3231A on page 51](#)).
- 8 Adhere the poron pad align to the pointed shield corner.

Figure 37: Poron Pad Alignment

Label	Description
1	Poron Pad



NOTICE: This step is applicable to PMUE4147A, PMUD3231A.

5.6.6

Chassis and Front Housing Reassembly

Procedure:

- 1 Apply a thin layer of grease on both the sides and the bottom (except the top) of the main O-ring.
- 2 Connect the speaker and microphone wires from the housing to the 2-pin connector on the main board.

Figure 38: Chassis and Front Housing Reassembly for

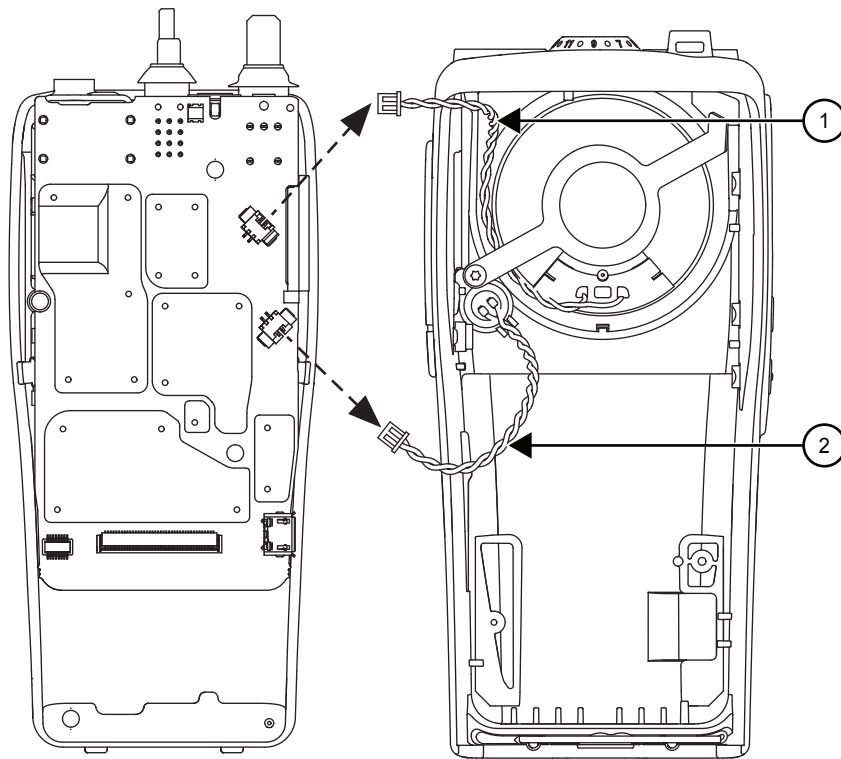
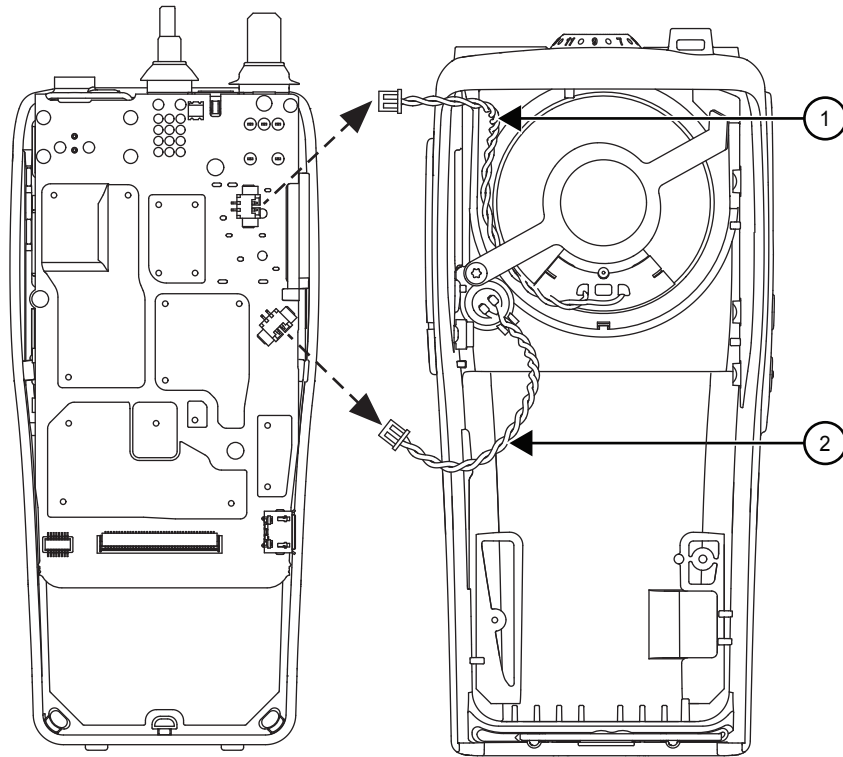


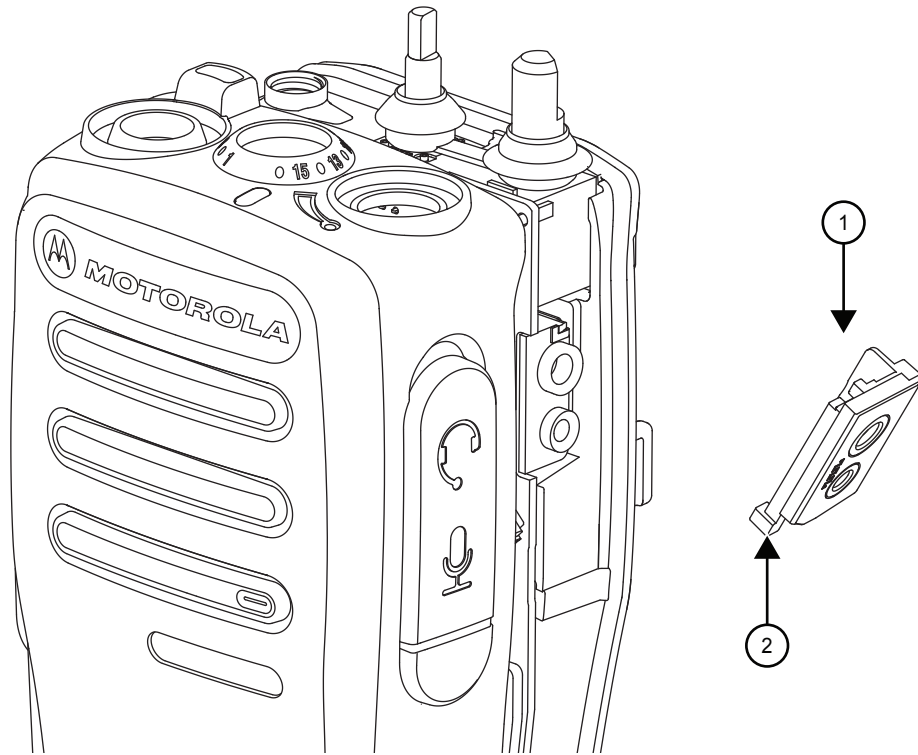
Figure 39: Chassis and Front Housing Reassembly for PMUE4147B, PMUD3231B



Label	Description
1	Speaker Wire
2	Microphone Wire

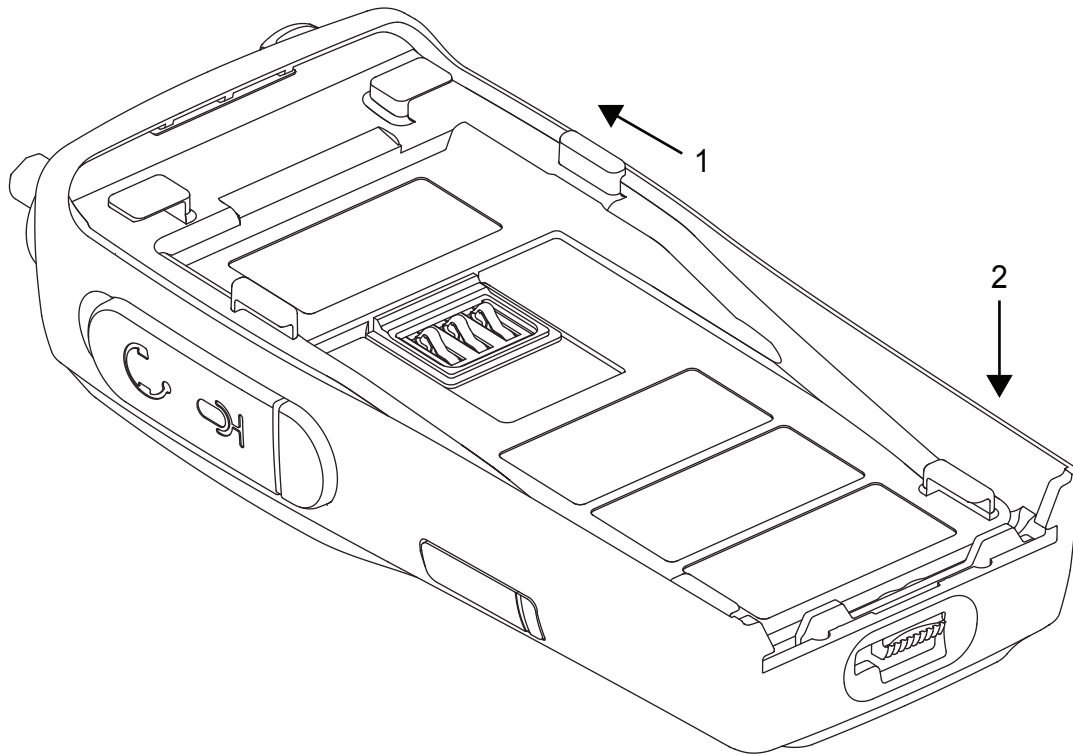
- 3 Attach the audio jack shroud assembly to the accessory connector on the main board by inserting the bottom edge of the shroud first, followed by the top edge as shown in the following image.

Figure 40: Audio Jack Shroud Reassembly



Label	Description
1	Audio Jack Shroud
2	Bottom Edge (to insert first)

- 4 Slide the chassis assembly into the front housing with the volume and channel selector shafts to the respective opening on the housing. Snap the bottom side of the chassis assembly into the housing as shown in the following image.

Figure 41: Inserting Chassis Assembly into Housing**CAUTION:**

Make sure the speaker and microphone wires are not pinched in between the audio jack shroud and housing.

Make sure that the main O-ring is not pinched in between the chassis and housing.

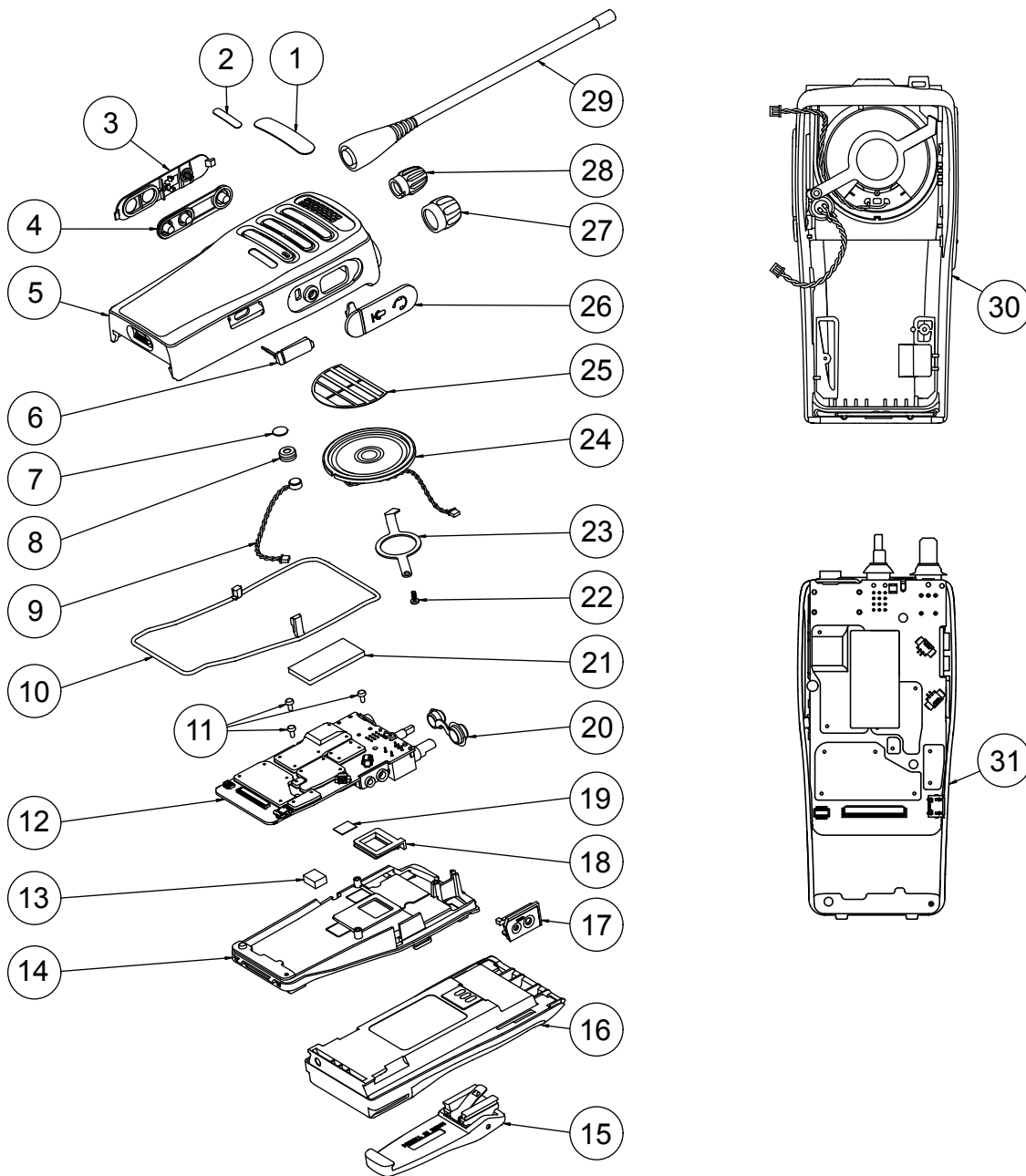
- 5 Attach the volume and channel selector knobs into their respective shafts.
- 6 Attach the antenna and battery.

5.7 Radio Exploded Mechanical View and Parts List

5.7.1 Non-Option Board

This section is applicable to PMUE4147A, PMUD3231A.

Figure 42: Non-Option Board



Item	Description	Part Number
1	Nameplate	33012026001

Item	Description	Part Number
2	Product Number Label	33012039020
3	Bezel, PTT	13012040002
4	Rubber, PTT	32012231001
5	Front Housing Assembly	Not supported. Please order Front Cover Kit.
6	Dust Cover, Micro USB	38012042001
7	Felt, Microphone	3586621Z04
8	Boot, Microphone	0780608V01
9	Microphone Assembly	0104055J51
10	Main O-Ring	3286431Z06
		3286431Z05
11	Screw, Main Board	0304726J05
12	Main PCB Assembly	Not supported. Please order Back Cover Kit.
13	Thermal Pad (thick)	75012205001
14	Chassis Assembly	2786389Z03
		0104056J93
15	Belt Clip	See Authorized Accessories List on page 86 .
16	Battery	See Authorized Accessories List on page 86 .
17	Shroud Assembly, Audio Jack	01012093001
18	Battery Contact Seal	3286435Z01
19	Thermal Pad (thin)	7515526H01
20	Top Control Seal	32012232001
21	Poron Pad	75012247001
22	Screw, Speaker Retainer	0386434Z02
23	Speaker Retainer	4286620Z01
24	Speaker Assembly	0104055J50
25	Felt, Speaker	35012094001
26	Dust Cover, Audio Jack	15012242001
27	Knob, Volume	3680529Z01
28	Knob, Frequency	3680530Z02
29	Antenna	See Authorized Accessories List on page 86 .
30	Front Cover Kit	See Front Housing Service Kit for PMUE4147A, PMUD3231A on page 83 .

Item	Description	Part Number
31	Back Cover Kit	See Back Cover Kit for PMUE4147A, PMUD3231A on page 83.



NOTICE:

Refer to the following table for the correct pairing of Main O-Ring with Chassis Assembly.

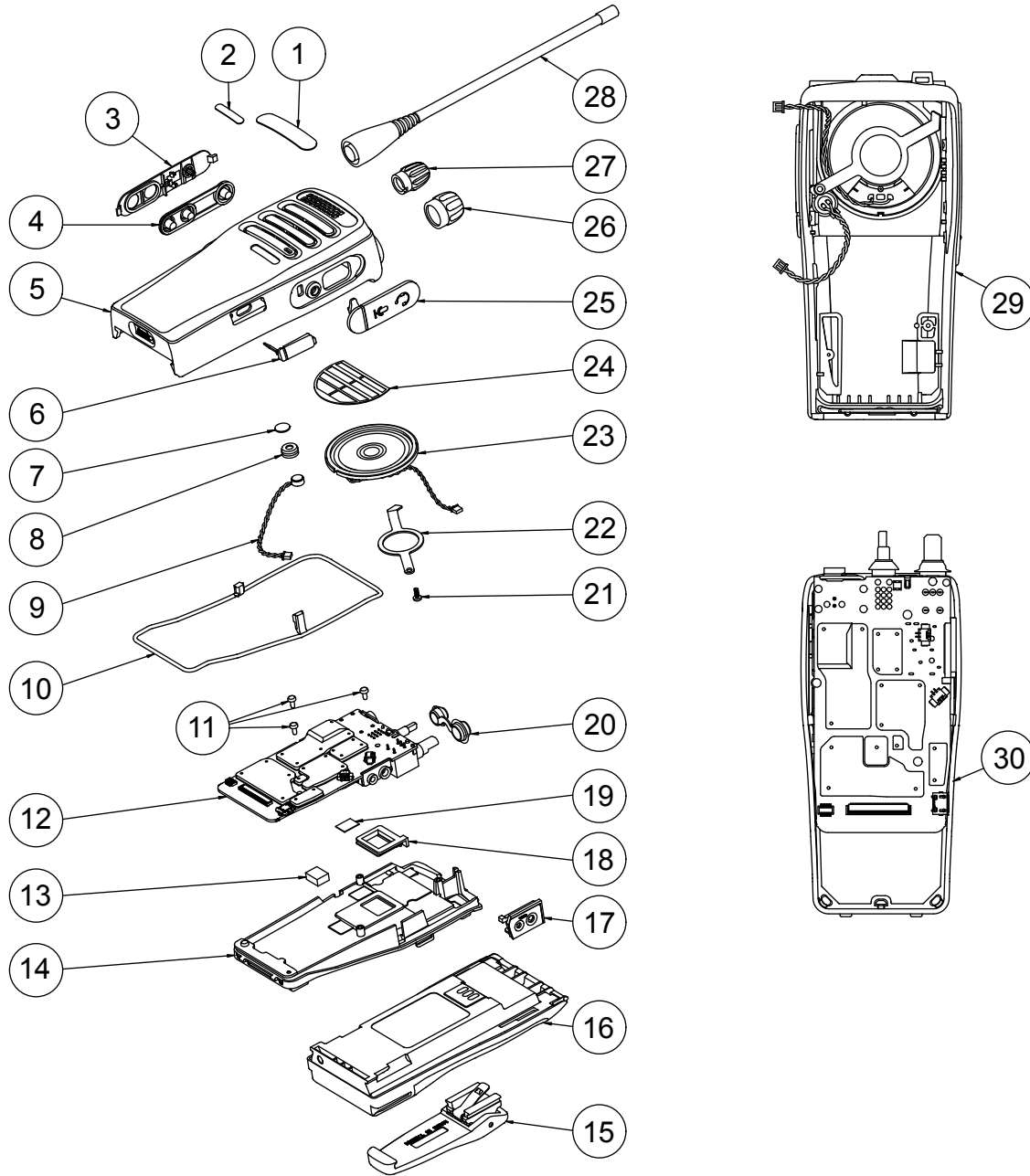
Main O-Ring	Chassis Assembly
3286431Z06	2786389Z03
3286431Z05	0104056J93

5.7.2

Non-Option Board

This section is applicable to PMUE4147B, PMUD3231B.

Figure 43: Non-Option Board



Item	Description	Part Number
1	Nameplate	33012026001
2	Product Number Label	33012039018
3	Bezel, PTT	HN001382A01
4	Rubber, PTT	KP000151A01

Item	Description	Part Number
5	Front Housing Assembly	Not supported. Please order Front Cover Kit.
6	Dust Cover, Micro USB	38012042001
7	Felt, Microphone	3586621Z04
8	Boot, Microphone	0780608V01
9	Microphone Assembly	0104055J51
10	Main O-Ring	3286431Z06
11	Screw, Main Board	0304726J05
12	Main PCB Assembly	Not supported. Please order Back Cover Kit.
13	Thermal Pad (thick)	75012205001
14	Chassis Assembly	2786389Z03
15	Belt Clip	See Authorized Accessories List on page 86 .
16	Battery	See Authorized Accessories List on page 86 .
17	Shroud Assembly, Audio Jack	1012093001
18	Battery Contact Seal	3286435Z01
19	Thermal Pad (thin)	7515526H01
20	Top Control Seal	32012232001
21	Screw, Speaker Retainer	0386434Z02
22	Speaker Retainer	4286620Z01
23	Speaker Assembly	0104055J50
24	Felt, Speaker	35012094001
25	Dust Cover, Audio Jack	15012242001
26	Knob, Volume	3680529Z01
27	Knob, Frequency	3680530Z02
28	Antenna	See Authorized Accessories List on page 86 .
29	Front Cover Kit	See Front Housing Service Kit for PMUE4147B, PMUD3231B on page 83 .
30	Back Cover Kit	See Back Cover Kit for PMUE4147B, PMUD3231B on page 83 .

5.7.3

Front Housing Service Kits**Front Housing Service Kit for PMUE4147A, PMUD3231A**

Item	Description	Motorola Solutions Part Number
Front Kit	Front Cover Kit, Non-Keypad Portable, Option Board Capable	PMLN7210_
Front Housing Assembly	Front Cover Kit, MOTOTRBO Non-Keypad Portable	0104062J75

Front Housing Service Kit for PMUE4147B, PMUD3231B

Item	Description	Motorola Solutions Part Number
Front Kit	Front Cover Kit, Non-Keypad Portable, Option Board Capable (EXL)	PMLN7874_
Front Housing Assembly	Housing Assembly, Non-Keypad Portable (EXL)	0104078J79

5.7.4

Back Cover Kit**Back Cover Kit for PMUE4147A, PMUD3231A**

Item	Description	Motorola Solutions Part Number
Back Kit	Back Cover Kit, VHF, 5 W, MOTOTRBO Non-Display Portable	PMLD4583_S
Back Kit	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable	PMLE4897_S

Back Cover Kit for PMUE4147B, PMUD3231B

Item	Description	Motorola Solutions Part Number
Back Kit	Back Cover Kit, VHF, 5 W, MOTOTRBO Non-Display Portable	PMLD4879_S

Item	Description	Motorola Solutions Part Number
Back Kit	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable	PMLE5225_S

5.7.5

Torque Chart

The following table 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 23: Torque Specifications for Screws

Part Number	Description	Driver/ Socket	Torque
			lbs-in
0304726J05	Screw, Main Board	T6 TORX	3.7 to 3.9
0386434Z02	Screw, Speaker Retainer	T6 TORX	2.7 to 2.9

Chapter 6

Basic Troubleshooting

This chapter contains error codes and board replacement procedures.

If the board does not pass all the performance checks in [Transceiver Performance Testing on page 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.

6.1

Replacement Back Cover Kit Procedures

Once a problem has been isolated to a specific board, install the appropriate back cover kit (Refer to "Model Charts"), which is orderable from Motorola Solutions Radio Products and Solutions Organization.

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:

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

Chapter 7

Authorized Accessories List

Antenna

- VHF, 146 – 162MHz, Stubby Antenna (HAD9742_)
- VHF, 162 – 174MHz, Stubby Antenna (HAD9743_)
- VHF, 146 – 174MHz, Heliflex Antenna (NAD6502_)
- UHF, 403 – 440MHz, Heliflex Stubby Antenna (NAE6521_)
- UHF, 438 – 470 MHz Stubby Antenna (NAE6522_)
- VHF, 136 – 155MHz, 9 cm Antenna (PMAD4012_)
- VHF, 136 – 155MHz, 14 cm Antenna (PMAD4014_)
- VHF, 136 – 150.8MHz, Heliflex Antenna (PMAD4042_)
- UHF, 403 – 433MHz, 9 cm Stubby Antenna (PMAE4002_)
- UHF, 430 – 470MHz, 9 cm Stubby Antenna (PMAE4003_)
- UHF, 403 – 520MHz, Antenna Whip (PMAE4016_)

Batteries

- NiMH, 1400mAH Battery (NNTN4851_)
- Slim Li-Ion, 1600mAH Battery (NNTN4970_)
- Core Li-Ion, 2250 mAh Battery (NNTN4497_R)

Cables

- Programming Cable USB (PMKN4128_)

Carry Devices

- Non-Display Leather case with Belt loop and D-rings (RLN5383_)
- Non-Display Leather case with 2.5 in. Swivel and D-rings (RLN5384_)
- Non-Display Leather case with 3 in. Swivel and D-rings (RLN5385_)
- Nylon case with belt loop and D-rings (HLN9701_)
- 2.5 in. Swivel Belt Loop (4280483B03_)
- 3 in. Swivel Belt Loop (4280483B04_)
- Spring Action 2 in. Belt clip (RLN5644_)
- Spring Action 3 in. Belt clip (HLN8255_)

Chargers

- Rapid-rate Desktop Charger (WPLN4138_)
- Rapid-rate Charger with switchmode power supply (PMLN5193_)
- Rapid-rate Charger Transformer (EPNN9288_)
- 10-hour Plug-in Charger (EPNN7997_)

Earbuds and Earpieces

- Flexible Ear Receiver (BDN6720_)
- Receive-Only Earpiece with 3.5 mm Jack (AARLN4885_)
- Receive-Only Flexible Earpiece for Remote Speaker Microphone (WADN4190_)
- D-Shell Receive Only Earpiece (One Size) for Remote Speaker Microphone (PMLN4620_)
- Receiver-Only Earpiece with Translucent Tube and Rubber Eartip (RLN4941_)
- Earbud with In-Line Microphone/PTT/VOX Switch (Mag One)(PMLN6534_)
- Ear Receiver with In-Line Microphone/ PTT/VOX Switch (Mag One) (PMLN6531_)
- Swivel Earpiece with In-Line Microphone and PTT (PMLN6532_)
- D-Style Earpiece with Microphone/PTT (PMLN6535_)
- Earset with Boom Mic and In-Line PTT/VOX Switch (Mag One) (PMLN6537_)

Headsets and Headset Accessories

- Heavy Duty Headset, Noise Cancelling Boom Mic Headset (PMLN6854_)
- Lightweight Headset with Swivel Boom Microphone (PMLN6538_)
- Medium Weight Over-the-Head Dual Muff Headset (PMLN7468_)
- Lightweight Temple Transducer Headset (PMLN6541_)

Remote Speaker Microphones

- Remote Speaker Microphone IP57 (PMMN4029_)
- Remote Speaker Microphone (Mag One) (PMMN4092_)
- Remote Speaker Microphone with 3.5 mm Audio Jack (PMMN4013_)

Surveillance Accessories

- 2-Wire Surveillance Kit, with Clear Acoustic Earpiece, Black (Palm Garden) (PMLN6530_)
- 2-Wire Surveillance Kit with Quick Disconnect Acoustic Tube, Black (OTTO) (PMLN6536_)
- 2-Wire Surveillance Kit (Beige) with Clear Acoustic Earpiece (Palm Garden) (PMLN6445_)

Appendix A

Replacement Parts Ordering

Basic Ordering Information

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

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

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

Motorola Online

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

To register for online access:

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

Types of Orders

Mail Orders

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

Motorola
Solutions

7031 Columbia Gateway Drive

3rd Floor - Order Processing

Columbia, MD 21046

U.S.A.

Telephone Orders and Parts Identification

- RPSO
(United States and Canada)
7:00 AM to 7:00 PM (Central Standard Time)
-

Types of Orders

	Monday through Friday (Chicago, U.S.A.) 1-800-422-4210 1-847-538-8023 (United States and Canada) <ul style="list-style-type: none">• USFGMD 1-800-826-1913 Federal Government Parts - Credit Cards Only 8:30 AM to 5:00 PM (Eastern Standard Time)
Fax Orders	RPSO (United States and Canada) 1-800-622-6210 1-847-576-3023 (United States and Canada) USFGMD (Federal Government Orders) 1-800-526-8641 (For Parts and Equipment Pur- chase Orders)

Product Customer Service

RPSO (United States and Canada)

1-800-927-2744



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

Appendix B

Motorola Solutions Service Centers

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

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

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.

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.

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

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

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

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

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

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

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

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

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

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

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

Programming Cable A cable that allows the CPS to communicate directly with the radio using USB.

Receiver Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.

Repeater Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).

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

Signal An electrically transmitted electromagnetic wave.

Spectrum Frequency range within which radiation has specific characteristics.

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

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

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

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