MOTOROLA SOLUTIONS

MOTOTRBO™ PORTABLE

PROFESSIONAL DIGITAL TWO-WAY RADIO

MOTOTRBO™ PORTABLE XiR P3688 BASIC SERVICE MANUAL

JANUARY 2024

68012008048-BG

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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.

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

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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.

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

Document History

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

Edition	Description	Date
68012008048-A	Initial Release	March 2014
68012008048-B	Added 350 MHz information	January 2015
	Added GOB information	
	Added 480 MHz information	
68012008048-BA	Updated Front Kit, Chassis, and Main O-ring part numbers.	December 2017
	Added new battery model.	
68012008048-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.	
68012008048-BC	Updated Authorized Accessories List	September 2018
68012008048-BD	Updated Channel Capacity in Specifications, General Specifications table.	July 2019
68012008048-BE	Added new Non-Option Board topic for PMUE4597C, PMUD3349C, PMUD3306C, PMUE4147C, PMUE4623C, and PMUD3231C.	June 2022
	Added new Option Board Capable topic for PMUE4597C, PMUD3349C, PMUD3306C, PMUE4147C, PMUE4623C, and PMUD3231C.	
	Updated Additional Service Kit Information and Model Charts.	
68012008048-BF	Updated Specifications and Pin Configuration of Portable Test Cable.	July 2023

Edition	Description	Date
68012008048-BG	Updated Authorized Accessories List	January 2024

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Legal and Compliance Statements

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.

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.

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 a faulty accessory or physical aspect of product; not including disassembly of the unit. It is limited to the replacement of antenna, battery, handset, external microphones, external knobs, all related frequency programming to customers, and sometimes alignment or tuning by the Customer Programming Software (CPS).

Level 2 maintenance includes all Level 1 activities plus assessment that require the disassembly of the radio and rectifying a fault by replacement of major mechanical parts (such as replacement of bezels).

Level 2 maintenance does not incorporate discrete component replacement.

For Level 2 maintenance, only Motorola Solutions Service Centers or Authorized Motorola Solutions Service Dealers can perform these functions. Any tampering by unauthorized Motorola Solutions Service Dealers voids the warranty of your radio.

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

NOTE: Only Motorola Solutions Service Center/Depot can perform Level 3 maintenance as it can deeply affect the performance of the radio.

Additional Service Kit Information

Table 1: XiR P3688 Series, VHF, 136–174 MHz

Model/Item			Description
AZH01JDC9JA2_N			136–174 MHz, 5 W, MOTOTRBO XiR P3688 Non-Keypad Portable
	AZH01JDC9JE2_N		136–174 MHz, 5 W, MOTOTRBO XiR P3688 Non-Keypad Portable
X		PMUD3231AAAAAA	Service Tanapa, MOTOTRBO Non Keypad Portable.[1]
X		PMUD3231BAAAAA	Service Tanapa, MOTOTRBO Non-Keypad Portable.[2]
X		PMUD3231CAAAA A	Service Tanapa, MOTOTRBO Non Keypad Portable.[3]
X		PMUD3231AABAAA	Service Tanapa, MOTOTRBO Non Keypad Portable (China).[1]
X		PMUD3231BABAAA	Service Tanapa, MOTOTRBO Non-Keypad Portable (China).[2]
X		PMUD3231CAB-AAA	Service Tanapa, MOTOTRBO Non Keypad Portable (China).[3]
	X	PMUD3349AABAAA	Service Tanapa, MOTOTRBO Non Keypad Portable, Option Board Capable (China).[1]
	X	PMUD3349BABAAA	Service Tanapa, MOTOTRBO Non-Keypad Portable, Option Board Capable (China).[2]

[1] This is applicable to PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, and PMUD3231A.

Model/Item			Description
AZH01JDC9JA2_N			**136–174 MHz, 5 W, MOTOTRBO XiR P3688 Non-Keypad Portable**
	AZH01JDC9JE2_N		**136–174 MHz, 5 W, MOTOTRBO XiR P3688 Non-Keypad Portable**
	X	PMUD3349CAB-AAA	Service Tanapa, MOTOTRBO Non-Keypad Portable, Option Board Capable (China).[3]

Table 2: XiR P3688 Series, UHF, 403–480 MHz

Model/Item					Description
AZH01QDC9JA2_N					**403–438 MHz, 4 W, MOTOTRBO XiR P3688 Non Keypad Portable**
	AZH01QDC9JA2_N				**403–470 MHz, 4 W, MOTOTRBO XiR P3688 Non Keypad Portable**
		AZH01YDC9JA2_N			**403–480 MHz, 4 W, MOTOTRBO XiR P3688 Non Keypad Portable**
			AZH01QDC9JE2_N		**403–470 MHz, 5 W, MOTOTRBO XiR P3688 Non-Display Portable, Option Board Capable**
	X			PMUE4147AAAAAA	Service Tanapa, MOTOTRBO Non Keypad Portable.[1]
	X			PMUE4147BAAAAA	Service Tanapa, MOTOTRBO Non-Keypad Portable (China).[2]
	X			PMUE4147CAAAAA	Service Tanapa, MOTOTRBO Non Keypad Portable.[3]
X				PMUE4147AAAACA	Service Tanapa, MOTOTRBO Non Keypad Portable.[1]
X				PMUE4147BAAACA	Service Tanapa, MOTOTRBO Non-Keypad Portable.[2]
X				PMUE4147CAAACA	Service Tanapa, MOTOTRBO Non Keypad Portable.[3]
	X			PMUE4147AA-BAAA	Service Tanapa, MOTOTRBO Non Keypad Portable (China).[1]
	X			PMUE4147BA-BAAA	Service Tanapa, MOTOTRBO Non-Keypad Portable (China).[2]
	X			PMUE4147CABAAA	Service Tanapa, MOTOTRBO Non Keypad Portable (China).[3]
		X		PMUE4623AAAAAA	Service Tanapa, MOTOTRBO Non Keypad Portable.[1]

[2] This is applicable to PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, and PMUD3231B.
[3] This is applicable to PMUE4597C, PMUE4147C, PMUE4623C, PMUD3349C, PMUD3306C, and PMUD3231C.

Model/Item					Description
AZH01QDC9JA2_N					**403–438 MHz, 4 W, MOTOTRBO XiR P3688 Non Keypad Portable**
	AZH01QDC9JA2_N				**403–470 MHz, 4 W, MOTOTRBO XiR P3688 Non Keypad Portable**
		AZH01YDC9JA2_N			**403–480 MHz, 4 W, MOTOTRBO XiR P3688 Non Keypad Portable**
			AZH01QDC9JE2_N		**403–470 MHz, 5 W, MOTOTRBO XiR P3688 Non-Display Portable, Option Board Capable**
			X	PMUE4623BAAAAA	Service Tanapa, MOTOTRBO Non-Keypad Portable.[2]
		X		PMUE4623CAAAAA	Service Tanapa, MOTOTRBO Non Keypad Portable.[3]
			X	PMUE4597AABAAA	Service Tanapa, MOTOTRBO Non Keypad Portable, Option Board Capable (China).[1]
		X		PMUE4597BABAAA	Service Tanapa, MOTOTRBO Non-Keypad Portable, Option Board Capable (China).
			X	PMUE4597CABAAA	Service Tanapa, MOTOTRBO Non-Keypad Portable, Option Board Capable (China).[3]

Table 3: XiR P3688 Series, 350 Band, 350–400 MHz

Model/Item		Description
AZH01NDC9JA2_N		**350–400 MHz, 4 W, MOTOTRBO XiR P3688 Non Keypad Portable**
X	PMUD3306AAAAAA	Service Tanapa, MOTOTRBO Non Keypad Portable.[1]
X	PMUD3306AABAAA	Service Tanapa, MOTOTRBO Non Keypad Portable (China Only).[1]
X	PMUD3306BAAAAA	Service Tanapa, MOTOTRBO Non-Keypad Portable.[2]
X	PMUD3306BABAAA	Service Tanapa, MOTOTRBO Non-Keypad Portable (China Only).[2]

Chapter 1

Introduction

1.1 Radio Description

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

Table 4: Radio Frequency Ranges and Power Levels

Frequency Band	Bandwidth	Power Level
VHF	136–174 MHz	1 W or 5 W
UHF	403–480 MHz	1 W or 4 W
350 Band	350–400 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 supports a multitude of legacy and advanced features resulting in a more cost-effective two-way radio communication solution.

1.1.1 Non-Keypad Model

This section is applicable to PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A .

Figure 1: Non-Keypad Model

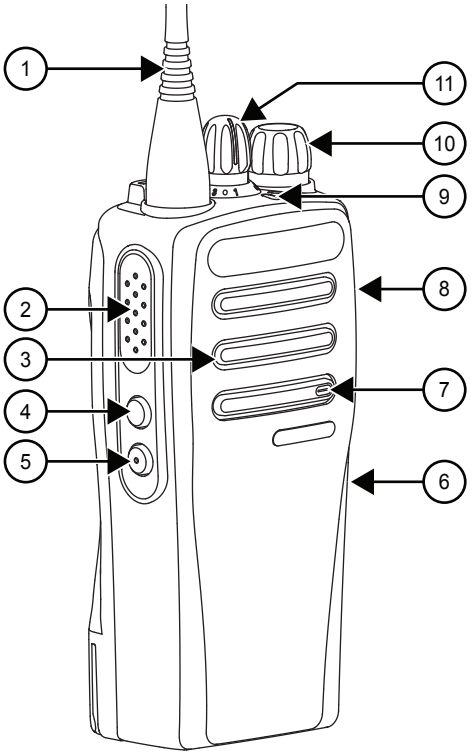
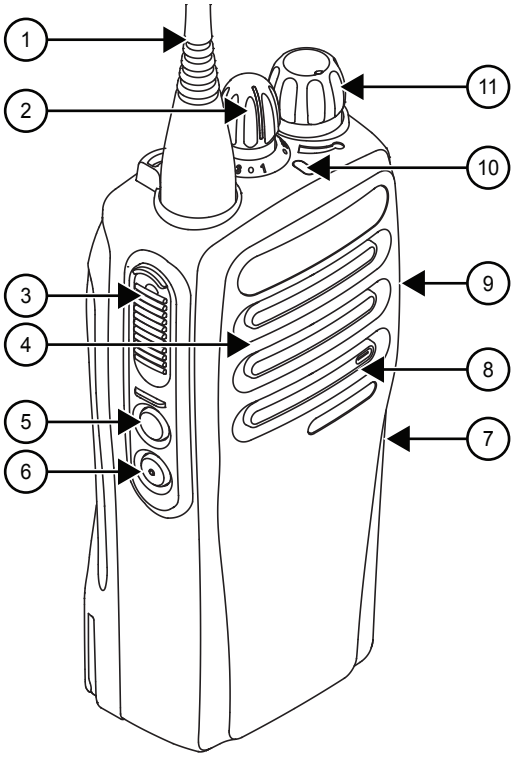


Figure 2: Non-Keypad Model with PTT Paddle

NOTE: This radio model is offered only in China.

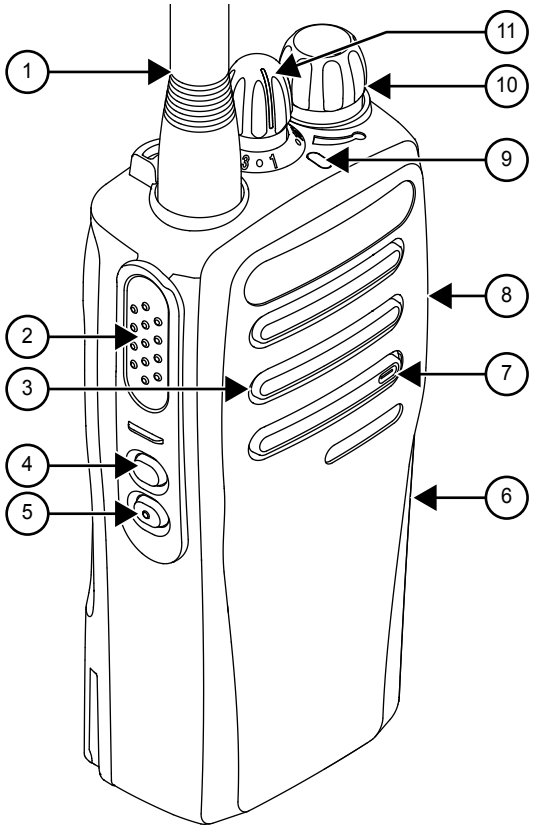


Label	Button Name	Description
1	Antenna	Provides the needed RF amplification when transmitting or receiving.
2	Push-To-Talk (PTT)	Press to execute voice operations (for example, Group Call and Private Call).
3	Speaker	Outputs all tones and audio that are generated by the radio (for example, features 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.
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 PMUE4597B, PMUD3349B, PMUD3306B, PMUE4147B, PMUE4623B, PMUD3231B, PMUE4597C, PMUD3349C, PMUD3306C, PMUE4147C, PMUE4623C, and PMUD3231C.

Figure 3: 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.
10	On/Off/Volume Knob	Rotate clockwise until click is heard to turn on radio; rotate counter-clockwise until click is heard to turn

Label	Button Name	Description
		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 5: Portable Radio Model Numbering Scheme

Position	1	2	3	4	5	6	7	8	9	10	11	12	13
Typical Model Number	AZ	H	0	1	J	D	C	9	J	A	2	A	N

Table 6: 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 XiR 3688
4		
5	Band	J = 136–174 MHz Y = 403–480 MHz N = 350–400 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) 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)

Position	Description	Value
		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

Table 7: Table Legend for Model Charts

Legend	Description
X	The 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 8: XiR P3688 Series, VHF, 136–174 MHz, VHF Model Chart

Model/Item			Description
AZH01JDC9JA2_N			136–174 MHz, 5 W, MOTOTRBO XiR P3688 Non-Display Portable
	AZH01JDC9JE2_N		136–174 MHz, 5 W, MOTOTRBO XiR P3688 Non-Display Portable, Option Board Capable
X		PMLD4583_S	Back Cover Kit, VHF, 5 W, MOTOTRBO Non-Display Portable.[4]
	X	PMLD4713_S	Back Cover Kit, VHF, 5 W, MOTOTRBO Non-Display Portable, Option Board Capable.[4]

[4] This is applicable to PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, and PMUD3231A.

Model/Item			Description
AZH01JDC9JA2_N			**136–174 MHz, 5 W, MOTOTRBO XiR P3688 Non-Display Portable**
	AZH01JDC9JE2_N		**136–174 MHz, 5 W, MOTOTRBO XiR P3688 Non-Display Portable, Option Board Capable**
X		PMLD4879_S	Back Cover Kit 136–174 MHz, 5 W, Non-Keypad.[5]
	X	PMLD4881_S	Back Cover Kit 136–174 MHz, 5 W, Non-Keypad, Option Board Capable.[5]
X		PMLN7210_	Front Cover Kit, Non-Keypad Portable.[4]
X	X	PMLN7230_	Front Cover Kit, Non-Keypad Portable, Option Board Capable (China PTT).[4]
X	X	PMLN7874_	Front Cover Kit, Non-Keypad Portable, Option Board Capable (EXL).[5]
X	X	HAD9742_	VHF Stubby Antenna (146–162 MHz), 9 cm
X	X	HAD9743__	VHF Stubby Antenna (162–174 MHz), 8 cm
X	X	NAD6502	VHF Heliflex Antenna (146–174 MHz), 15 cm
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 Antenna (136–150.8 MHz), 14 cm

NOTE: 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 9: XiR P3688 Series, UHF, 403–480 MHz, UHF Model Chart

Model/Item					Description
AZH01QDC9JA2_N					**403–438 MHz, 4 W, MOTOTRBO XiR P3688 Non-Display Portable**
	AZH01QDC9JA2_N				**403–470 MHz, 4 W, MOTOTRBO XiR P3688 Non-Display Portable**
		AZH01QDC9JE2_N			**403–470 MHz, 5 W, MOTOTRBO XiR P3688 Non-Display Portable, Option Board Capable**
			AZH01YDC9JA2AN		**403–480 MHz, 4 W, MOTOTRBO XiR P3688 Non-Display Portable**
X	X			PMLE4897_S	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable.[6]

[5] This is applicable to PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, PMUD3231B, PMUE4597C, PMUE4147C, PMUE4623C, PMUD3349C, PMUD3306C, and PMUD3231C.

[6] This is applicable to PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, and PMUD3231A.

Model/Item					Description
AZH01QDC9JA2_N					**403–438 MHz, 4 W, MOTOTRBO XiR P3688 Non-Display Portable**
	AZH01QDC9JA2_N				**403–470 MHz, 4 W, MOTOTRBO XiR P3688 Non-Display Portable**
		AZH01QDC9JE2_N			**403–470 MHz, 5 W, MOTOTRBO XiR P3688 Non-Display Portable, Option Board Capable**
			AZH01YDC9JA2AN		**403–480 MHz, 4 W, MOTOTRBO XiR P3688 Non-Display Portable**
		X		PMLE5047_S	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable, Option Board Capable.[6]
			X	PMLE5063_S	Back Cover Kit, UHF (480 MHz), 4 W, MOTOTRBO Non-Display Portable.[6]
X	X			PMLE5225_S	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable.[7]
		X		PMLE5237_S	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable, Option Board Capable.[7]
			X	PMLE5225AS and PMLE8503_S	Back Cover Kit, UHF (480 MHz), 4 W, MOTOTRBO Non-Display Portable.[7]
X	X		X	PMLN7210_	Front Cover Kit, Non-Keypad Portable.[6]
X	X	X		PMLN7230_	Front Cover Kit, Non-Keypad Portable, Option Board Capable (China PTT).[6]
X	X	X	X	PMLN7874_	Front Cover Kit, Non-Keypad Portable, Option Board Capable (EXL).[7]
X		X		PMAE4002_	UHF Stubby Antenna (403–433 MHz), 9 cm
	X	X	X	PMAE4003_	UHF Stubby Antenna (430–470 MHz), 9 cm
	X	X	X	PMAE4016_	UHF Whip Antenna (403–520 MHz), 17 cm

NOTE: 403–438 MHz is only available in Indonesia and Malaysia.

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

[7] This is applicable to PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, PMUD3231B, PMUE4597C, PMUE4147C, PMUE4623C, PMUD3349C, PMUD3306C, and PMUD3231C.

1.3.3
350 Band Model Charts

Table 10: XiR P3688 Series, 350 MHz, 350–400 MHz, 350 MHz Model Chart

Model/Item		Description
AZH01NDC9JA2_N		**350–400 MHz, 4 W, MOTOTRBO XiR P3688 Non-Display Portable**
X	PMLD4680_S	Back Cover Kit, 350–400 MHz, 4 W, MOTOTRBO Non-Display Portable.[8]
X	PMLD4883_S	Back Cover Kit, 350–400 MHz, 4 W, MOTOTRBO Non-Display Portable.[9]
X	PMLN7210_	Front Cover Kit, Non-Keypad Portable.[8]
X	PMLN7874_	Front Cover Kit, Non-Keypad Portable, Option Board Capable (EXL).[9]
X	PMAD4009_	350 MHz Helical Antenna (336–368 MHz), 9 cm
X	PMAD4020_	350 MHz Helical Antenna (370–400 MHz), 9 cm

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

1.4
Specifications

NOTE: Specifications are subject to change without notice. All specifications shown are typical values. For latest information about your radio specifications, refer to the data sheet of your radio model at https://www.motorolasolutions.com/en_xp/products/mototrbo/portable-radios.html.

Table 11: General Specifications

Parameter	Value
Channel Capacity	32
Frequency	VHF: 136–174 MHz UHF: 403–480 MHz 350 Band: 350–400 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)

[8] This is applicable to PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A.
[9] This is applicable to PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, PMUD3231B.

Parameter	Value
FCC Description	VHF: ABZ99FT3092[10]
	UHF: ABZ99FT4094[10]
	VHF: AZ489FT3845[11]
	UHF: AZ489FT4948[11]
IC Description	VHF: 109AB-99FT3092[10]
	UHF: 109AB-99FT4094[10]
	VHF: 109U-89FT3845[11]
	UHF: 109U-89FT4948[11]
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

NOTE: Weight can have 5% margin of error.

Table 12: Receiver Specifications

Parameter	Value
Frequencies	VHF: 136–174 MHz UHF: 403–480 MHz 350 Band: 350–400 MHz
Channel Spacing	12.5 kHz/20 kHz/25 kHz[12]
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

[10] This is applicable to PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A.

[11] This is applicable to PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, PMUD3231B, PMUE4597C, PMUE4147C, PMUE4623C, PMUD3349C, PMUD3306C, and PMUD3231C.

[12] 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
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[12]
Audio Response	TIA603D
Conducted Spurious Emission (TIA603D)	-57 dBm

Table 13: Transmitter Specifications

Parameter	Value
Frequencies	VHF: 136–174 MHz UHF: 403–480 MHz 350 Band: 350–400 MHz
Channel Spacing	12.5 kHz/20 kHz/25 kHz[12]
Frequency Stability (-30 °C to +60 °C)	±0.5 ppm
Power Output (Low Power)	1 W
Power Output (High Power)	VHF: 5 W UHF: 4 W UHF 480 MHz: 4 W 350 Band: 4 W
Modulation Limiting	±2.5 kHz @ 12.5 kHz
	±4.0 kHz @ 20 kHz
	±5.0 kHz @ 25 kHz[12]
FM Hum and Noise	-40 dB @ 12.5 kHz
	-45 dB @ 20 kHz/25 kHz[12]
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[12]
Audio Response	TIA603D
Audio Distortion	3% (typical)
FM Modulation	12.5 kHz: 11K0F3E 25 kHz: 16K0F3E
4FSK Digital Modulation	12.5 kHz Data: 7K60F1D and 7K60FXD

Parameter	Value
	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
- 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 14: Self-Quieter Frequencies

UHF (MHz)	VHF (MHz)	350 Band (MHz)
424.275	144	350
424.315	153.6	360
424.815	-	364.8[13]
480	-	-

Military Standards										
Applicable MIL–STD	810C		810D		810E		810F		810G	
	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Procedures
Low Pressure	500.1	I	500.2	II	500.3	II	500.4	II	500.5	II
High Temperature	501.1	I, II	501.2	I/ A1,II/ A1	501.3	I-A1, II/A1	501.4	I/Hot, II/Hot	501.5	I-A1, II

[13] This is only applicable to PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, PMUD3231B, PMUE4597C, PMUE4147C, PMUE4623C, PMUD3349C, PMUD3306C, and PMUD3231C.

Military Standards										
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.24
Shock	516.2	I, II	516.3	I, IV	516.4	I, IV	516.5	I, IV	516.6	I, IV, V, VI

Environmental Specifications	
Operating Temperature[14]	-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

[14] Operating temperature specification with Li-Ion battery is -10 °C to +60 °C. Operating temperature specification with NiMH battery is -20 °C to +60 °C.

Chapter 2

Test Equipment and Service Aids

This section lists the recommended test equipment and service aids, and information on field programming equipment. You can use this information in servicing and programming radios.

2.1 Recommended Test Equipment

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

Table 15: Test Equipment

Equipment	Characteristics	Example	Application
Service Monitor	Can be used as a substitute.	Aeroflex 3920 (www.aeroflex.com) or equivalent Viavi 3920B or Viavi 8800SX (https://www.viavisolutions.com)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment.
Digital RMS Multimeter[15]	• 100 µV to 300 V • 5 Hz to 1 MHz • 10 Ω Impedance	Fluke 179 (www.fluke.com) or equivalent	AC/DC voltage and current measurements. Audio voltage measurements.
RF Signal Generator[15]	• 100 MHz to 1 GHz • -130 dBm to +10 dBm • FM Modulation: 0 kHz to 10 kHz • Audio Frequency: 100 Hz to 10 kHz	Keysight N5181A (http://www.keysight.com), Ramsey RSG1000B (www.ramseyelectronics.com), or equivalent	Receiver measurements
Oscilloscope[15]	• 2 Channel • 50 MHz Bandwidth • 5 mV/div to 20 V/div	Tektronix TBS1052C (www.tektronix.com) or equivalent	Waveform measurements
Power Meter and Sensor[15]	• 5% Accuracy • 100 MHz to 500 MHz • 50 W	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
RF Millivoltmeter	• 100 mV to 3 V RF • 10 kHz to 1 GHz	Boonton 9240 (www.boonton.com) or equivalent	RF level measurements

[15] Can use Service Monitor as substitute.

Equipment	Characteristics	Example	Application
Power Supply	• 0 V to 32 V • 0 A to 20 A	B&K Precision 9103 (www.bkprecision.com) or equivalent	Voltage supply

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 16: 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.
PMVN4130_	Customer Programming Software and AirTracer on CD-ROM	CPS allows Dealers/Distributors to program radio parameters. AirTracer allows the capturing of radio traffic into logs for analysis by Motorola Solutions.
PMVN4131_	Tuner on CD-ROM	Radio Tuning. Only Motorola Solutions Service Centers or Authorized Motorola Solutions Service Dealers can perform this function
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.
0180305K08EPP	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 4: Portable Programming Cable with TTR (PMKN4128_)

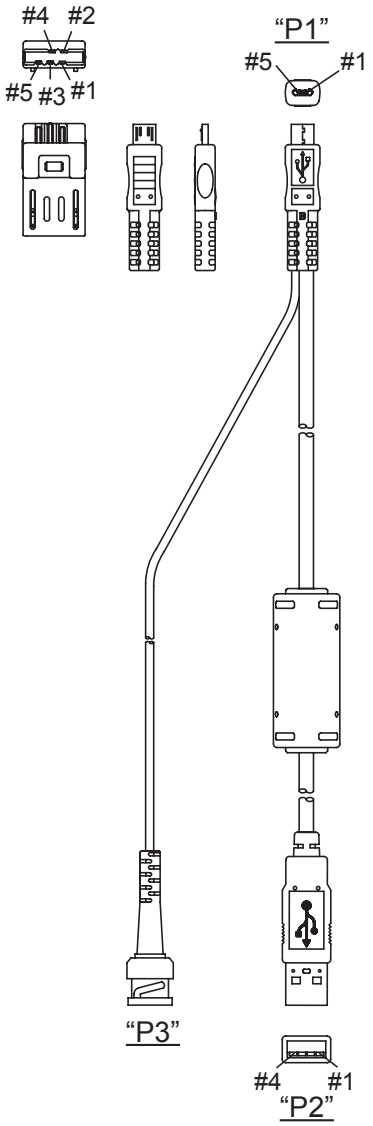


Table 17: Pin Configuration of Portable Programming Cable with TTR

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

CONNECTION			
P1	P2	P3	Function
3	3	-	Data+
4	-	BNC Center Pin	TTR
5	4	BNC Shell	Ground

Figure 5: Portable Test Cable (PMKN4156_)

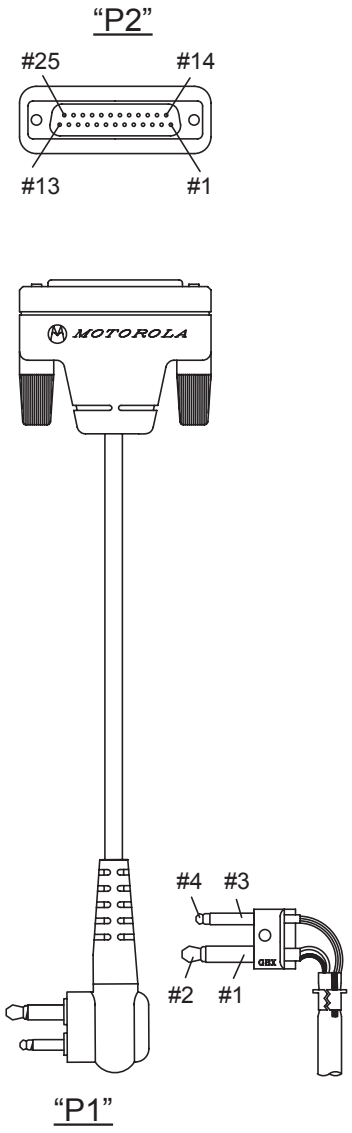


Table 18: Pin Configuration of Portable Test Cable

CONNECTION		
P1	P2	Function
1	1, 5	External Speaker -
2	7, 24	External Speaker +

CONNECTION		
P1	**P2**	**Function**
3	16	External Mic -
4	17	External Mic +

Chapter 3

Transceiver Performance Testing

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

The recommended field service equipment approaches the accuracy of the manufacturing equipment with a few exceptions. This accuracy must be maintained 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 19: 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.

   NOTE: DIG is digital mode and other test environments are analog mode as described in the following.

   Table 20: 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 21: Test Frequencies on page 36. The radio beeps in each position.

   Table 21: Test Frequencies

Channel Selector Switch Position	Test Channel	VHF	UHF	350 MHz	UHF 480 MHz
1 Low Power 9 High Power	TX#1 or #9 RX#1 or #9	136.075 136.075	403.150 403.150	350.025 350.025	403.150 403.150
2 Low Power 10 High Power	TX#2 or #10 RX#2 or #10	142.575 142.575	414.150 414.150	357.525 357.525	414.150 414.150
3 Low Power 11 High Power	TX#3 or #11 RX#3 or #11	146.575 146.575	425.150 425.150	364.525 364.525	425.150 425.150
4 Low Power 12 High Power	TX#4 or #12 RX#4 or #12	155.575 155.575	436.450 436.450	371.525 371.525	436.450 436.450
5 Low Power 13 High Power	TX#5 or #13 RX#5 or #13	161.575 161.575	447.150 447.150	378.525 378.525	447.150 447.150

Channel Selector Switch Position	Test Channel	VHF	UHF	350 MHz	UHF 480 MHz
6 Low Power 14 High Power	TX#6 or #14 RX#6 or #14	167.575 167.575	458.150 458.150	385.525 385.525	458.150 458.150
7 Low Power 15 High Power	TX#7 or #15 RX#7 or #15	173.975 173.975	469.850 469.850	392.525 392.525	469.850 469.850
8 Low Power 16 High Power	TX#8 or #16 RX#8 or #16	174.000 174.000	479.850 479.850	399.925 399.925	479.850 479.850

Table 22: 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 ±175 Hz for 350 MHz
Power RF	As above	As above	As above	Low Power: 0.9–1.5 W (VHF/UHF/ 350 MHz) High Power: 4.0–4.8 W (UHF/ 350 MHz) 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,	As above	As above, meter selector to mic	Deviation: ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp).

Test Name	Communications Analyzer	Radio	Test Set	Comments
	80 mVrms at AC/DC test set jack			
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 ≤ 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 23: Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency*	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

Test Name	Communications Analyzer	Radio	Test Set	Comments
	Monitor: Frequency error Input at RF In/Out			±175 Hz for 350 MHz
Rated Audio	Mode: GEN Output level: 1.0 mV RF 6th channel test frequency* Mod: 1 kHz tone at 3 kHz deviation Monitor: DVM: AC Volts	TEST MODE Test Channel 6 carrier squelch	PTT to OFF (center), meter selector 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 SINAD, lower the RF level for 12dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.35 µV
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 µV. 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 µV 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

Test Name	Communica-tions Analyzer	Radio	Test Set	Comments
Receiver Audio Distortion	IFR DMR Mode. Signal generator with 1031 test pattern	As above	As above. Then set audio ana-lyzer 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.

Result:
The radio beeps.

3.3.2
Entering 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. Press the **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. Press the **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
Performing LED Test

Procedure:

1. Press and hold **Side Button 1** after RF Test Mode.
2. Press any button.

   The red LED lights up.
3. Press any button.

   The red LED turns off and the radio lights up the green LED.
4. Press any button.

   The green LED turns off and the radio turns on both LEDs.

3.3.4
Performing Speaker Tone Test

Procedure:

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

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

3.3.5
Performing Earpiece Tone Test

Procedure:

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

Result: The radio generates a 1 kHz tone with the earpiece.

3.3.6
Performing Audio Loopback Earpiece Test

Procedure:

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

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

3.3.7
Performing Battery Check Test

Procedure:

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

Result: 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 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 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 Windows 2000 onwards environment.

NOTE: 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

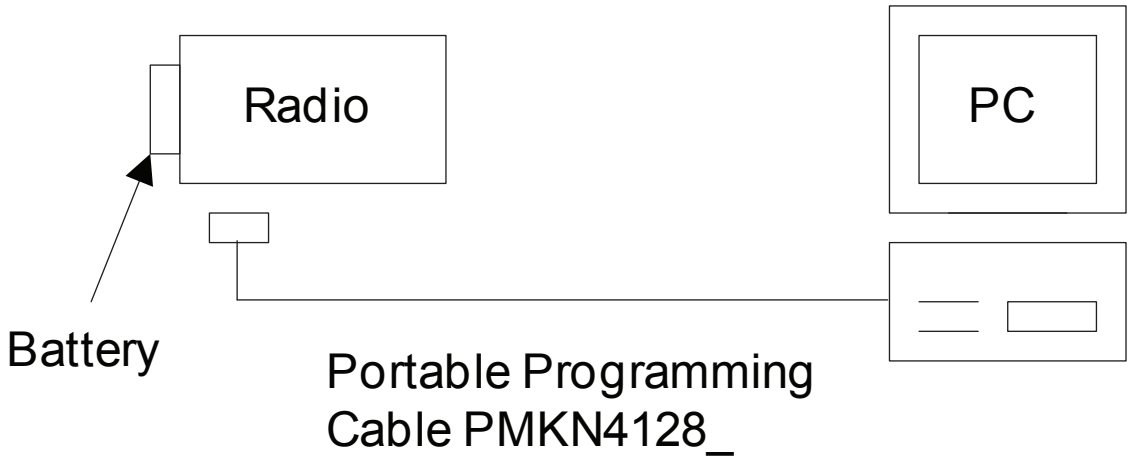
Description	Part Number
MOTOTRBO CPS and AirTracer on CD-ROM	PMVN4130_
MOTOTRBO Tuner on CD-ROM	PMVN4131_

4.1 Customer Programming Software Setup

Program the radio using the following setup.

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

Figure 6: CPS Programming Setup



4.2 AirTracer Application Tool

The MOTOTRBO AirTracer application tool captures over-the-air digital radio traffic and saves the data captured 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

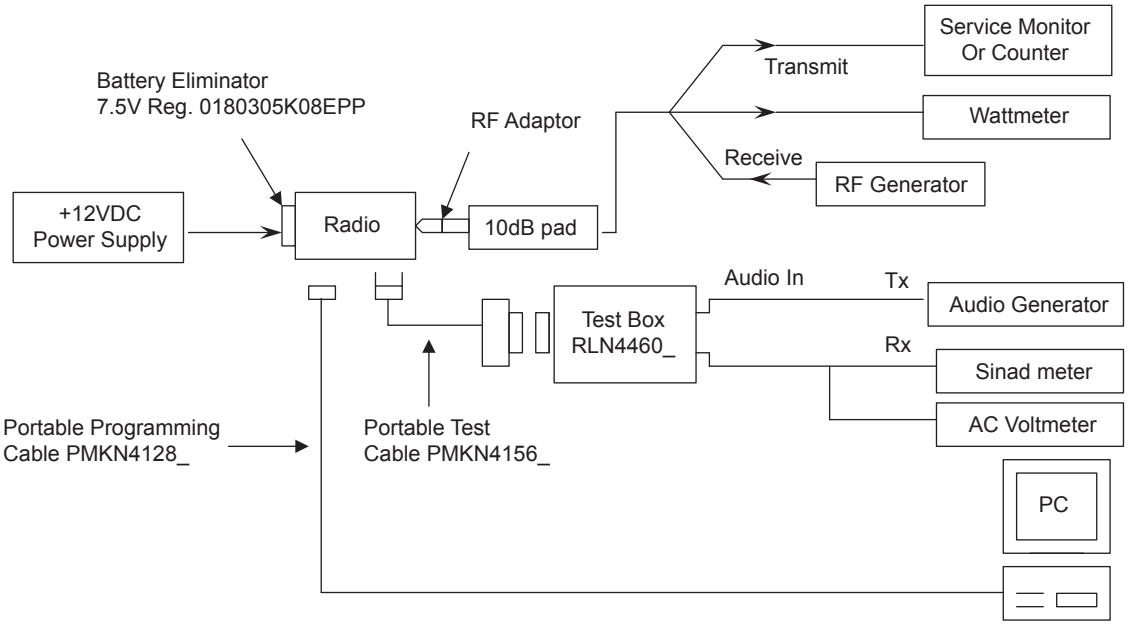
Retuning is not required if service kit has been replaced and factory tuned. However, check service kit for performance before use.

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 8 and above and a tuner program are required to tune the radio. See the following figure to perform the tuning procedures.

Figure 7: Radio Tuning Equipment Setup



Chapter 5

Disassembly and Reassembly Procedures

CAUTION: To assure the safety and regulatory compliance of your radio, repair your radio only at Motorola Solutions service facilities. Contact your dealer for further instructions.

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.
- Radio Exploded Mechanical View and Parts List.
- Battery Maintenance.

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.

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

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.

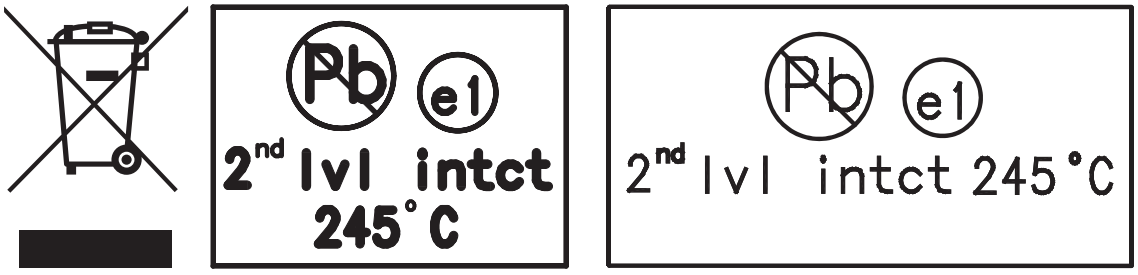
CAUTION:
This radio contains static-sensitive devices. Do not open your radio unless you are properly grounded. Take the following precautions when working on this unit:

- 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. These are in compliant 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 on the Printed Circuit Board (PCB). The following images show examples of the EPP Marking, adhering to the JEDEC Standard No. 97. This marking provides information to those performing assembly, servicing, and recycling operation on this product. 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. These requirements are 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
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 uses bonded, multilayer, printed circuit boards. Special considerations are required when soldering and desoldering components as the inner layers are not accessible. 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 infrared 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
Radio Disassembly and Reassembly

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

NOTE: 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

This section describes the detailed disassembly procedure of your radio.

5.5.1 Disassembling Chassis and Front Housing

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.

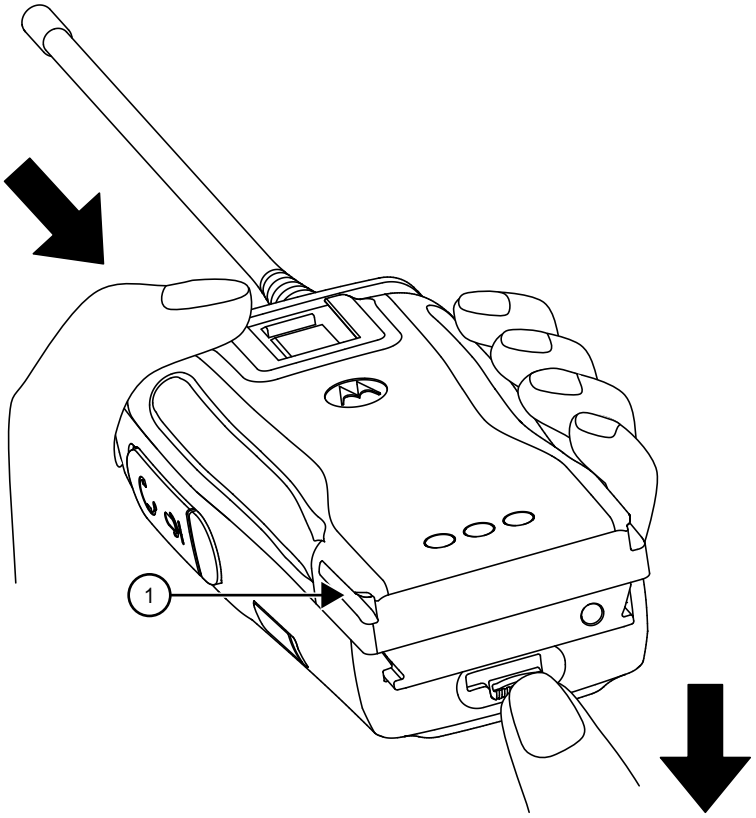
      NOTE: Ensure that metal latch is not protruding out from the slot on the plastic housing.

   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.

      NOTE: 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.

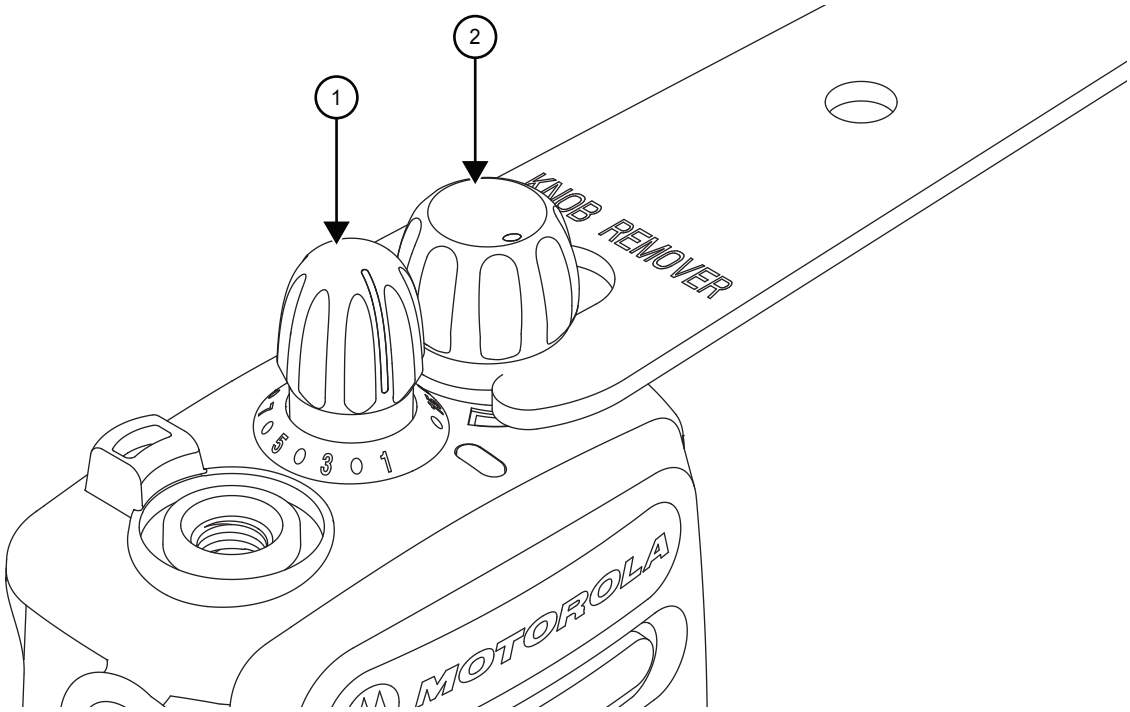
Figure 8: Battery Removal



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 9: Channel Selector and Volume Knob Removal



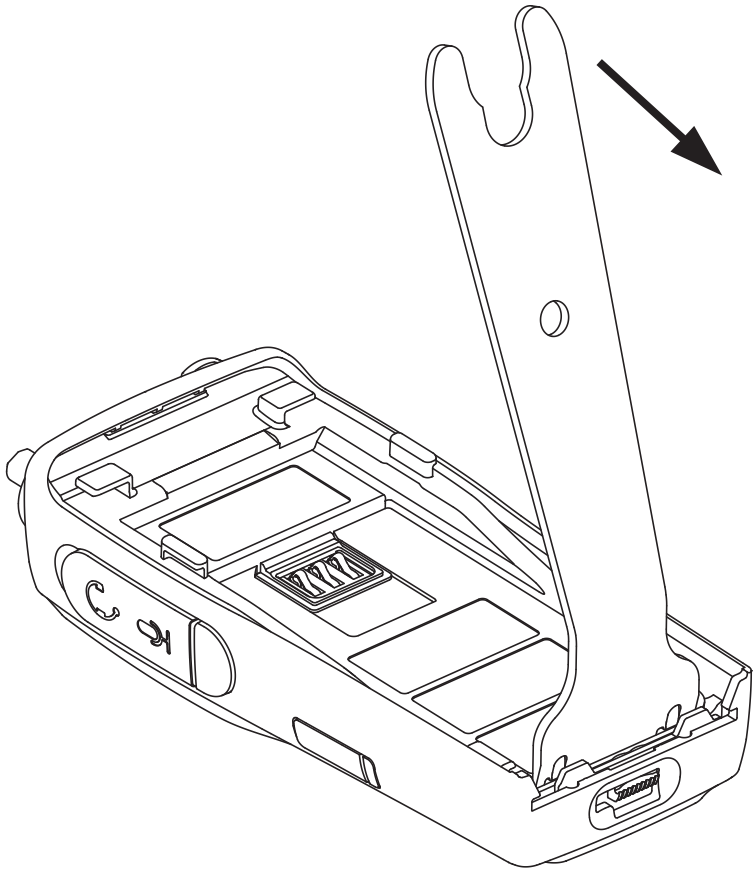
Label	Description
1	Channel Selector Knob
2	On/Off/Volume Knob

NOTE: 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.
   a. Place the broad side of the opener into the slots at the base of the radio.
   b. Press the handle of the opener downwards.

   NOTE: The pressing action forces the thin inner plastic wall towards the base of the radio, releasing the two chassis base tabs.

Figure 10: Chassis Removal

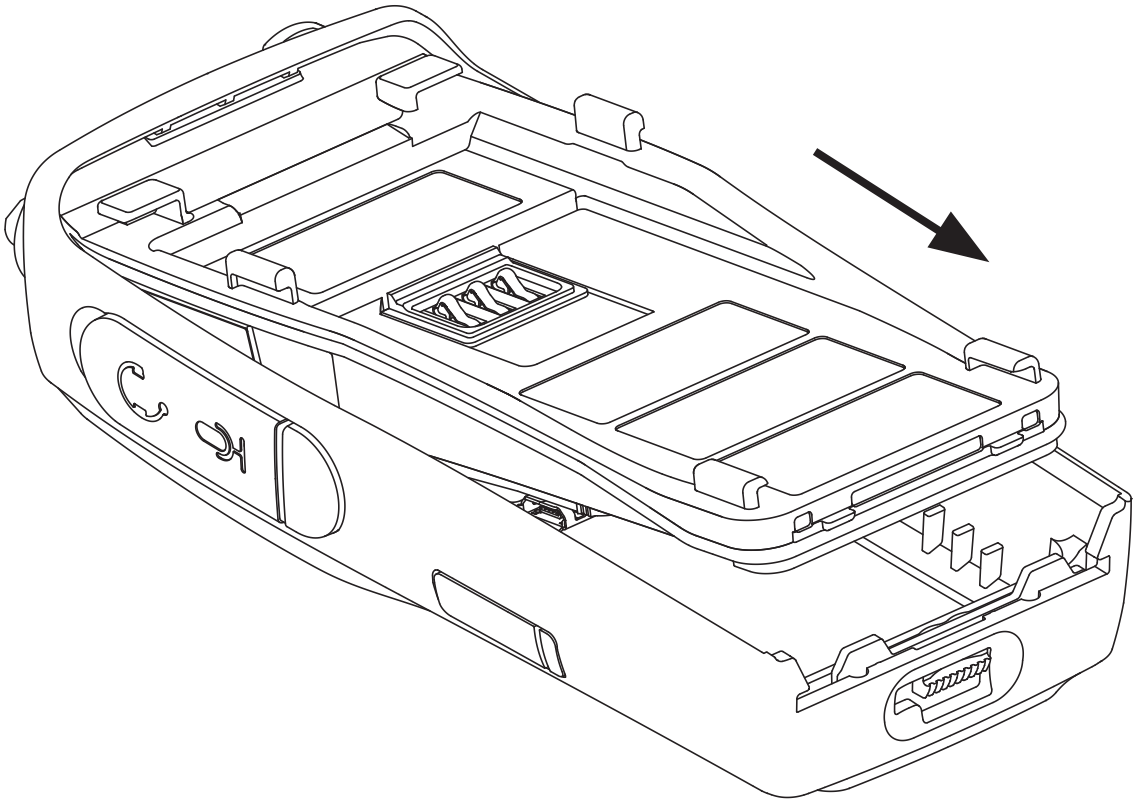


CAUTION: Marring the front housing O-ring, sealing area prevents the radio from sealing properly. If the O-ring is damaged, replace it with a new one.

NOTE: 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.

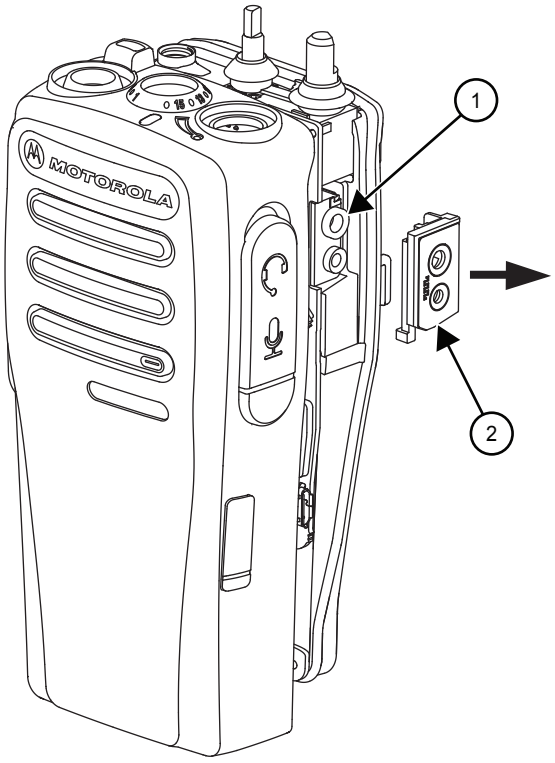
Figure 11: Chassis Removal from Front Housing



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 12: 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 13: Speaker and Microphone Wires Removal for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, and PMUD3231A

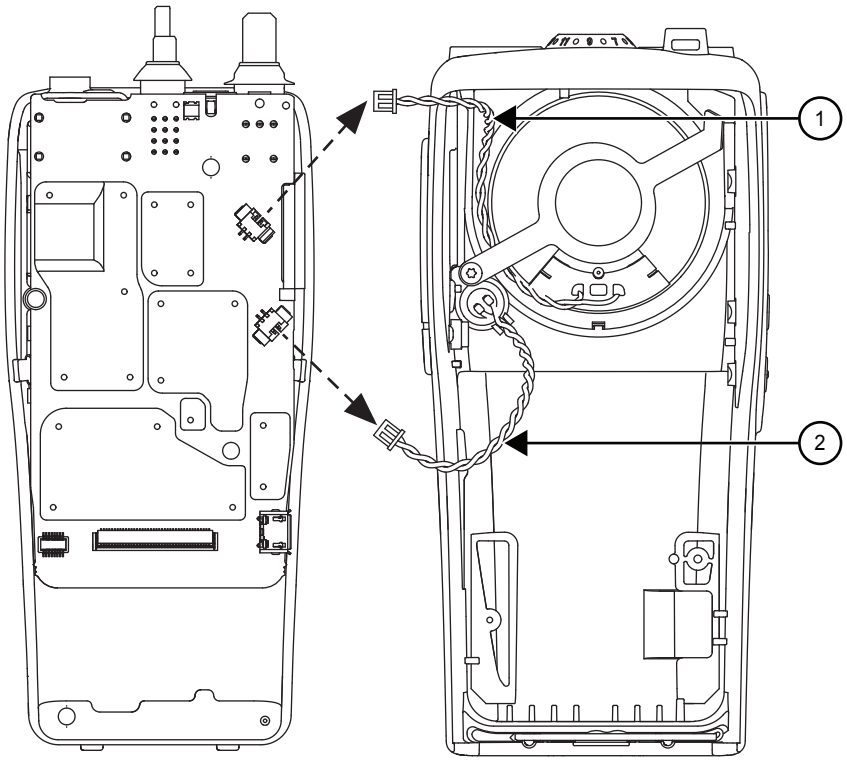
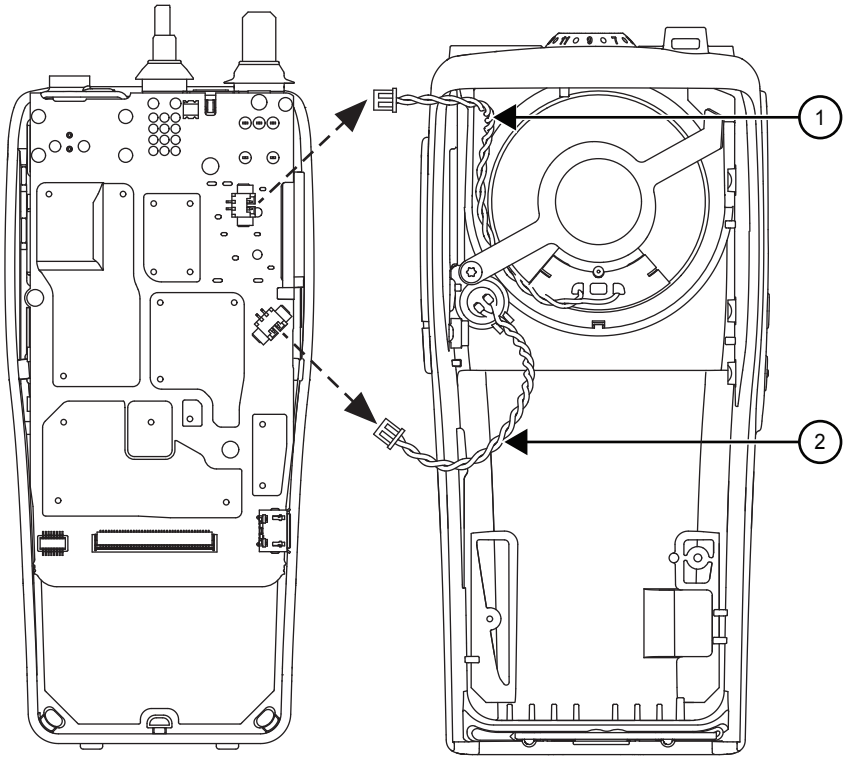


Figure 14: Speaker and Microphone Wires Removal for PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, PMUD3231B, PMUE4597C, PMUE4147C, PMUE4623C, PMUD3349C, PMUD3306C, and PMUD3231C

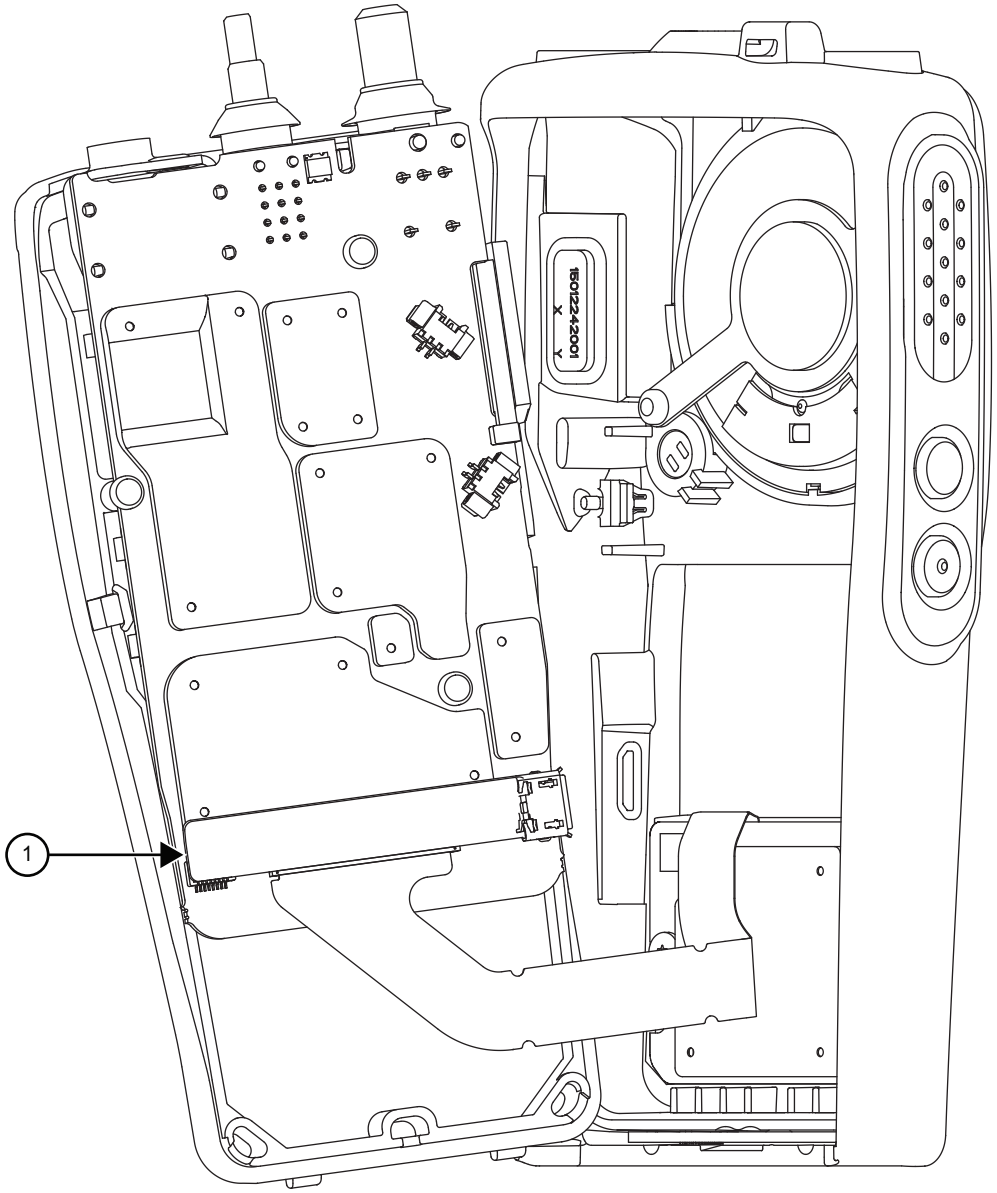


Label	Description
1	Speaker Wire
2	Microphone Wire

5.5.2
Generic Option Board (GOB) Disassembly

Procedure:

1. Use a tweezers to gently remove the poron pad on top of the actuator.

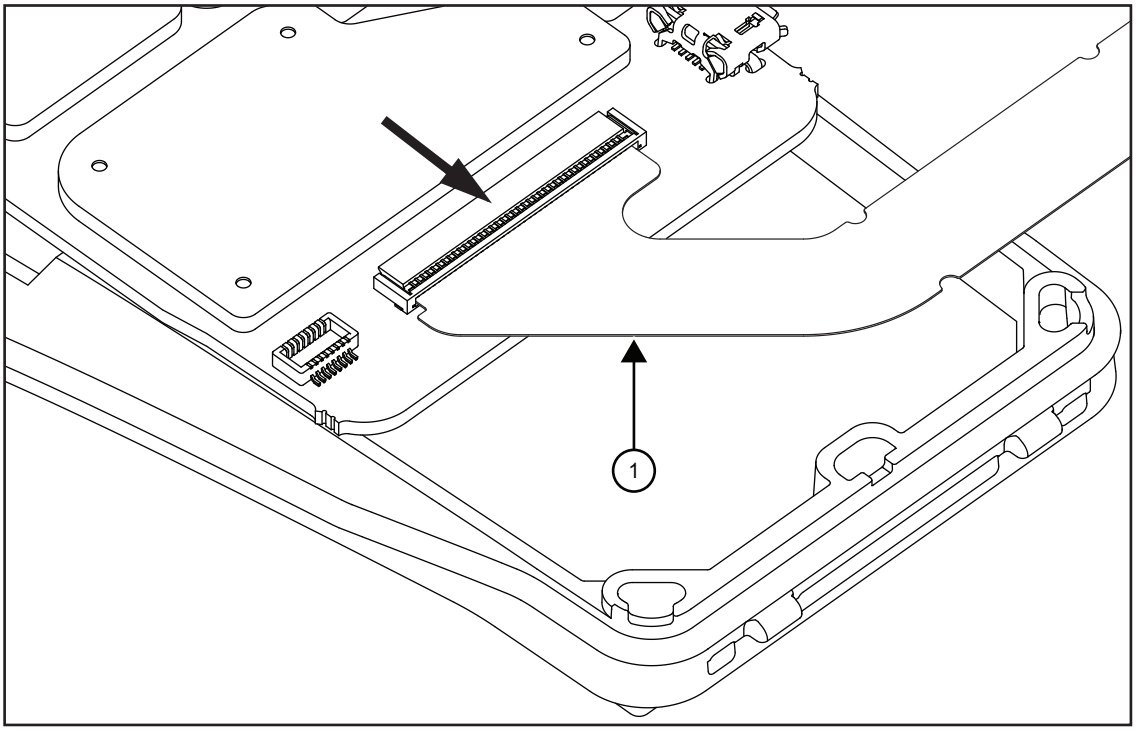


Label	Description
1	Poron Pad

NOTE: This step is applicable to PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A.

2. Place plastic flat-tip tweezers on the central part of the actuator, gently unlatch the actuator by rotating it about 100°.

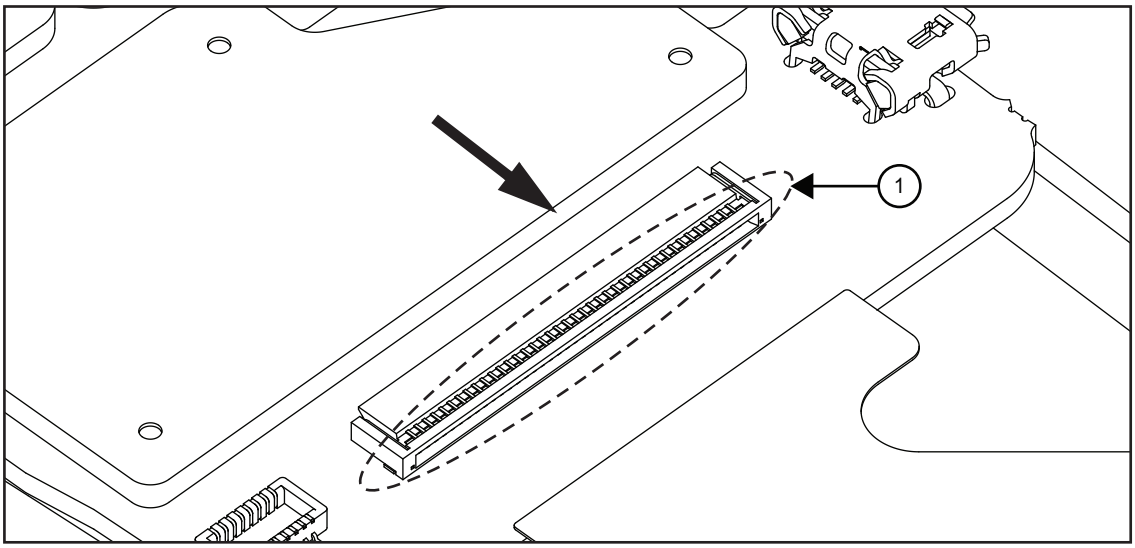
Figure 15: Unlatching the Actuator



Label	Description
1	Flex

CAUTION: Do not attempt to unlatch the actuator by applying load on the both ends of actuator.

Figure 16: Actuator on Mainboard

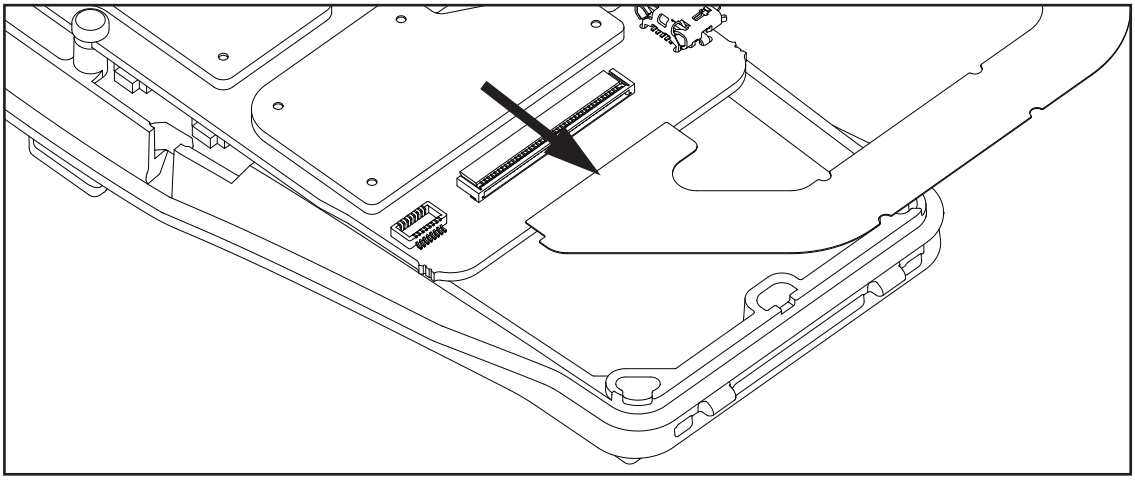


Label	Description
1	"A" Area

CAUTION: Do not touch upper part of the housing ("A" area) at anytime, as it may lead to breakage.

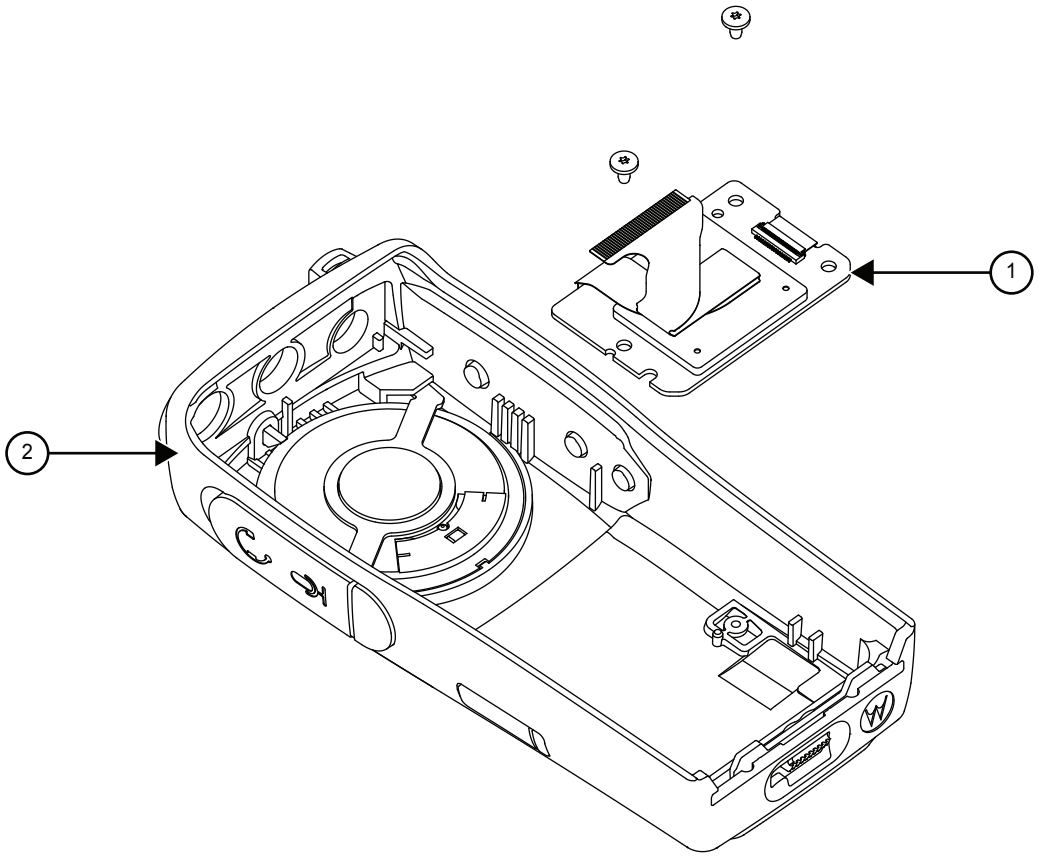
3. Remove the flex from the fully opened connector by pulling it out gently.

Figure 17: Option Board Flex Removal



4. Use TORX screwdriver with T6 bit to remove two screws holding the option board to front housing.
5. Lift the option board with flex from the front kit.

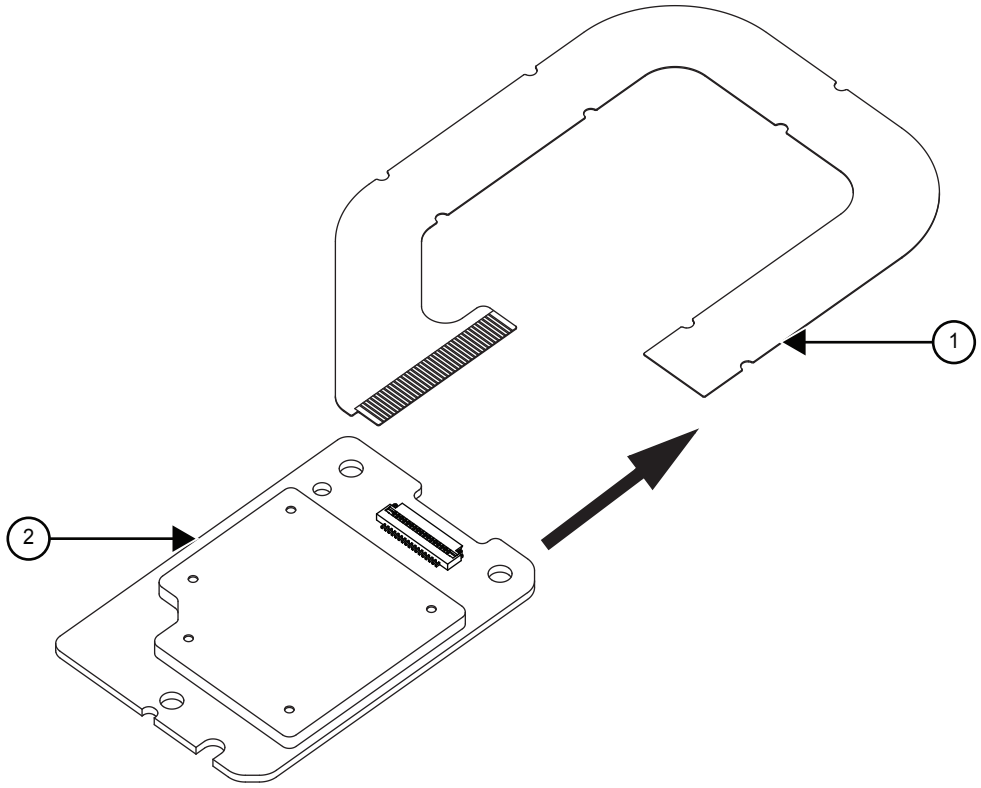
Figure 18: Option Board Disassembly



Label	Description
1	Option Board
2	Front Kit

6. Gently lift the connector actuator on the option board to release the flex.
7. Remove the flex from the connector by pulling it out of its connector gently.

Figure 19: Flex Removal



Label	Description
1	Flex
2	Option Board

5.5.3
Disassembling the Chassis

Procedure:

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

Figure 20: Chassis Disassembly for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A

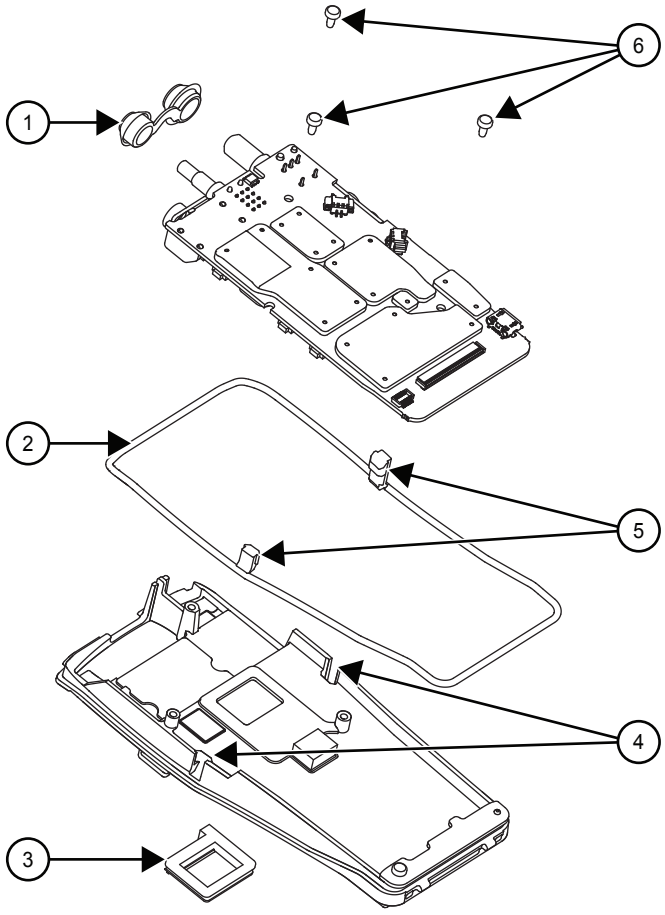
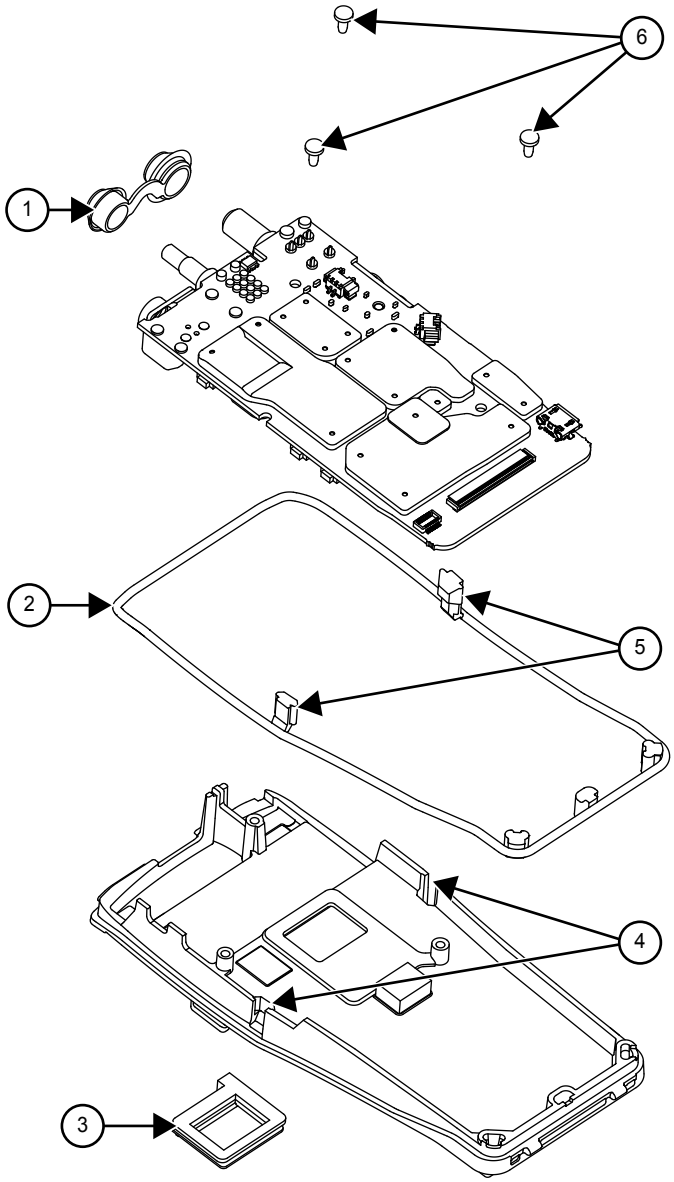


Figure 21: Chassis Disassembly for PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, PMUD3231B, PMUE4597C, PMUE4147C, PMUE4623C, PMUD3349C, PMUD3306C, and PMUD3231C



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.

5.5.4
Speaker and Microphone Disassembly

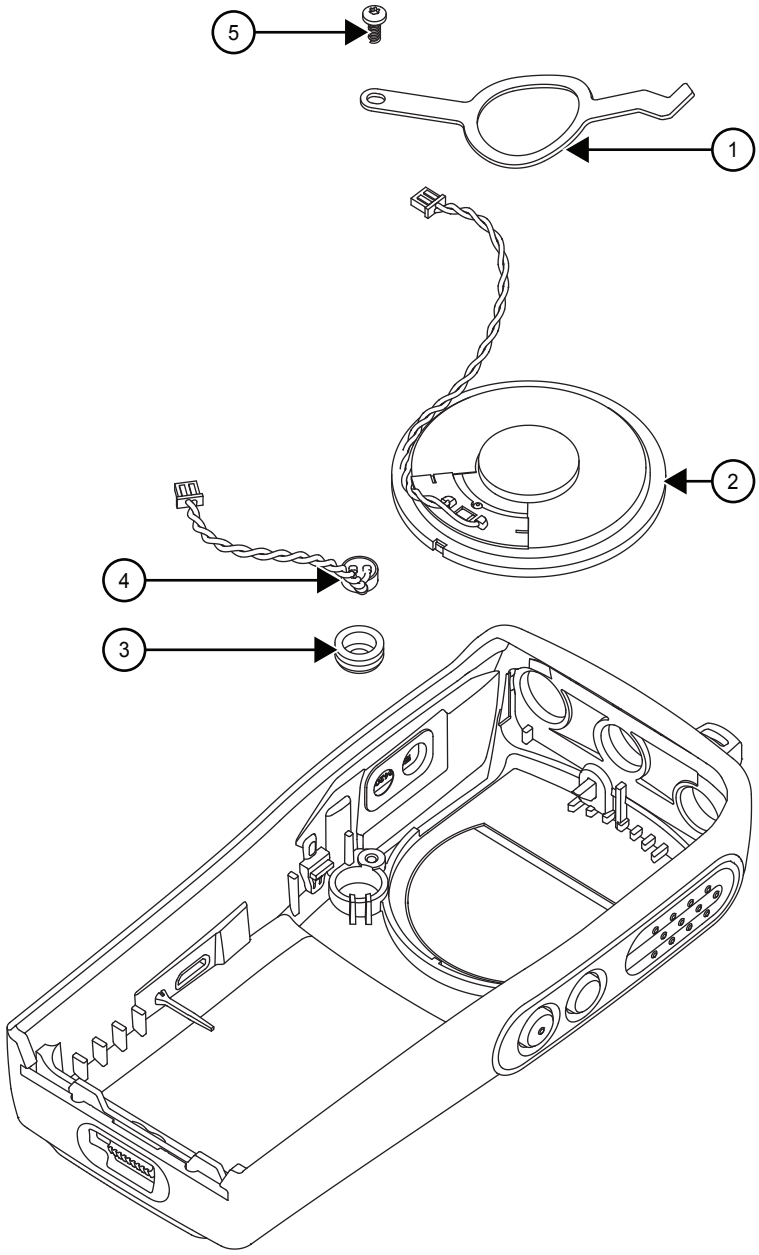
Procedure:

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

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

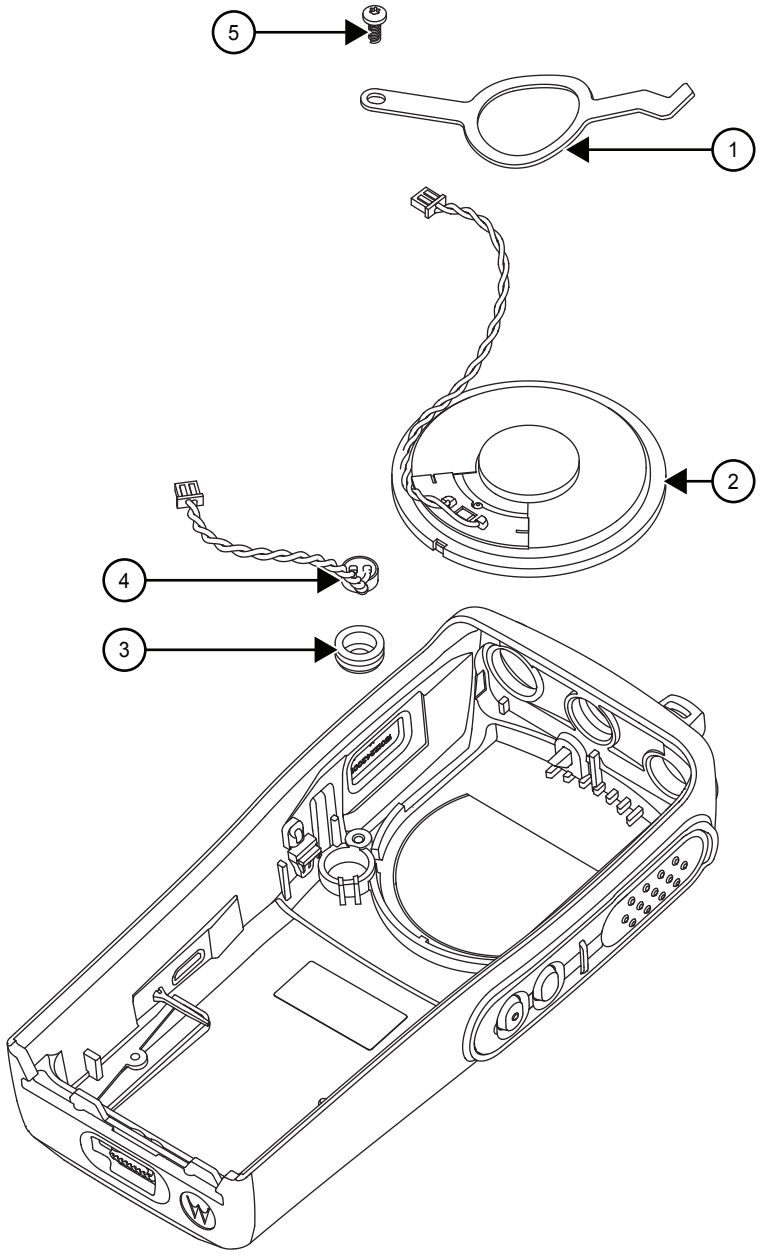
2. Lift the retainer off the speaker by sliding the end of the retainer out of the corner slot on the housing.
3. Lift the speaker out of the housing.
4. Carefully lift the microphone assembly out of the housing. If you are replacing the microphone, remove it from the rubber boot.

Figure 22: Speaker and Microphone Disassembly



NOTE: This diagram is applicable to PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A.

Figure 23: Speaker and Microphone Disassembly



NOTE: This diagram is applicable to PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, PMUD3231B, PMUE4597C, PMUE4147C, PMUE4623C, PMUD3349C, PMUD3306C, and PMUD3231C.

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

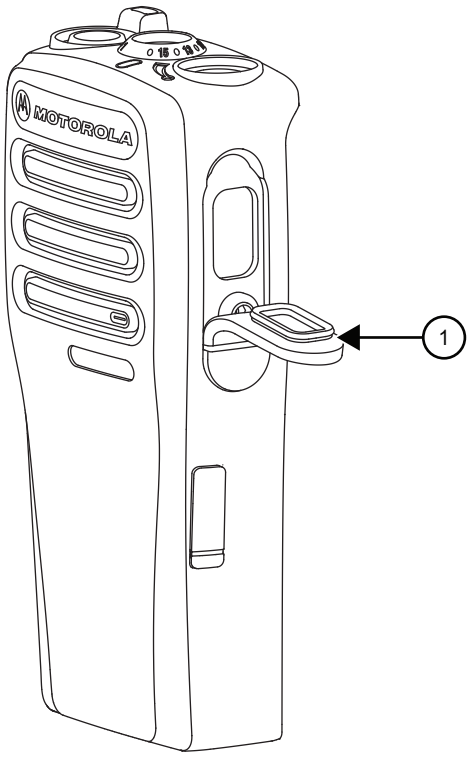
5.5.5

Audio Jack Dust Cover Disassembly

Procedure:

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

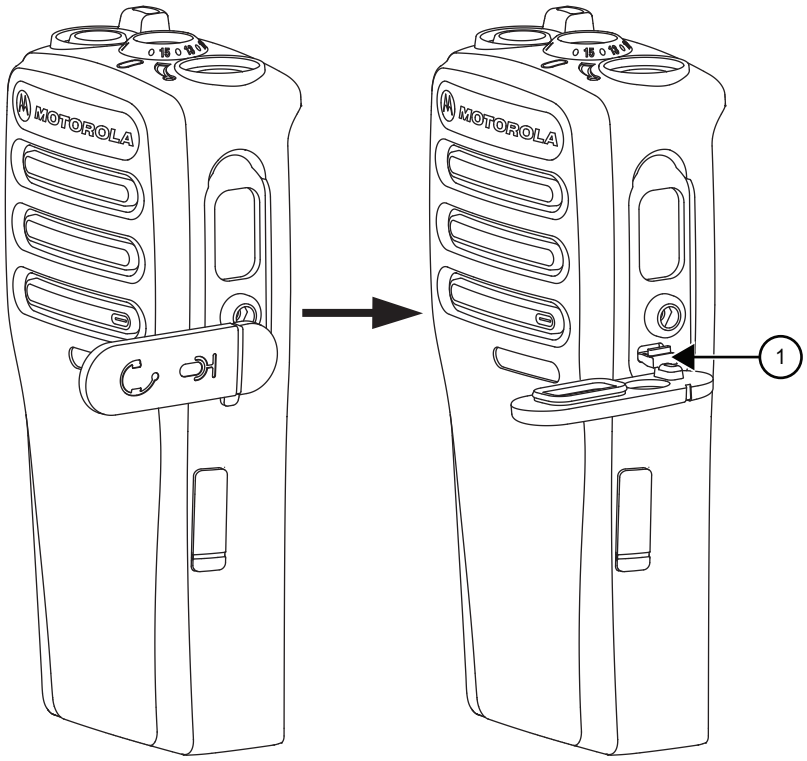
   Figure 24: Dust Cover Disassembly



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 25: Audio Jack Dust Cover Removal on page 66 to allow the key to be removed.

Figure 25: Audio Jack Dust Cover Removal



Label	Description
1	Key

3. Separate the dust cover from the front housing.

   NOTE: 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.

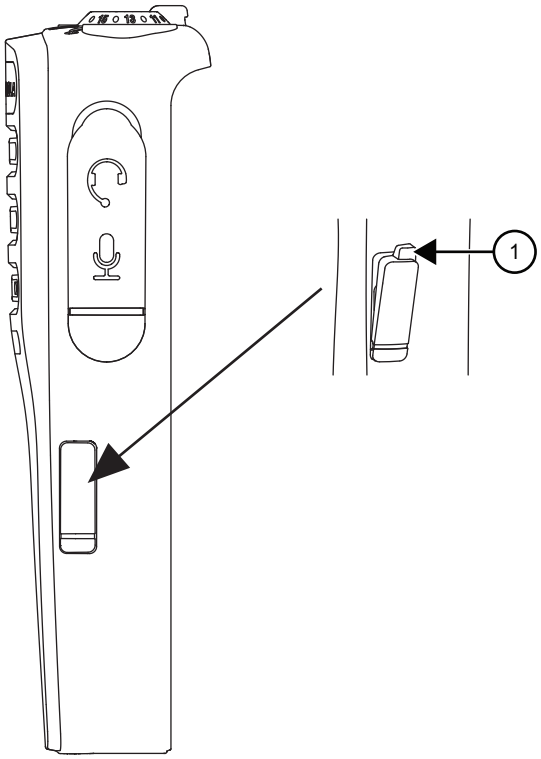
5.5.6
Micro USB Dust Cover Disassembly

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.

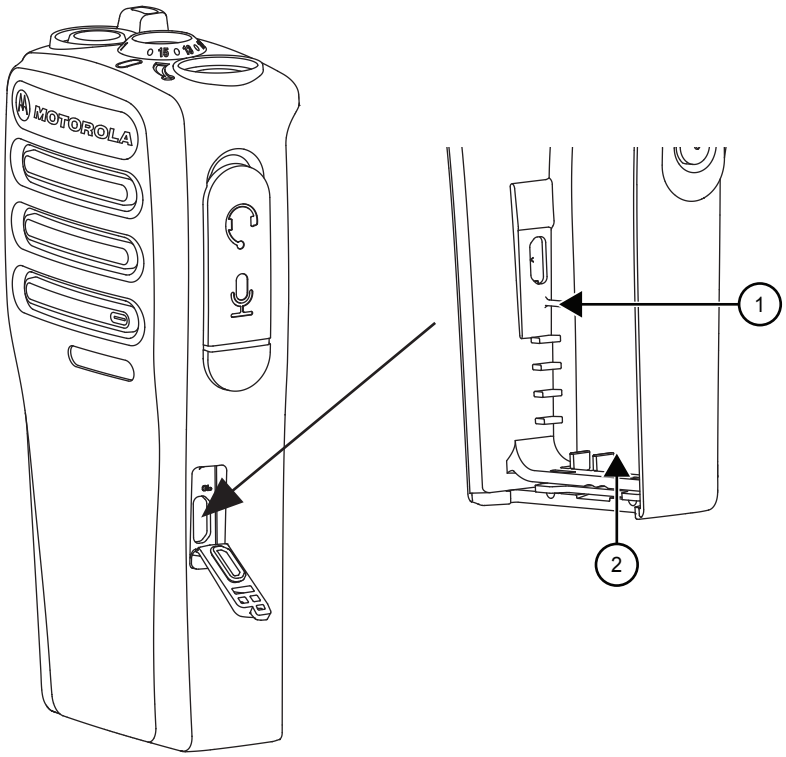
Figure 26: Prying the Micro USB Dust Cover



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 27: Micro USB Dust Cover Removal



Label	Description
1	Head
2	Inside of Front Housing

3. Separate the dust cover from the front housing.

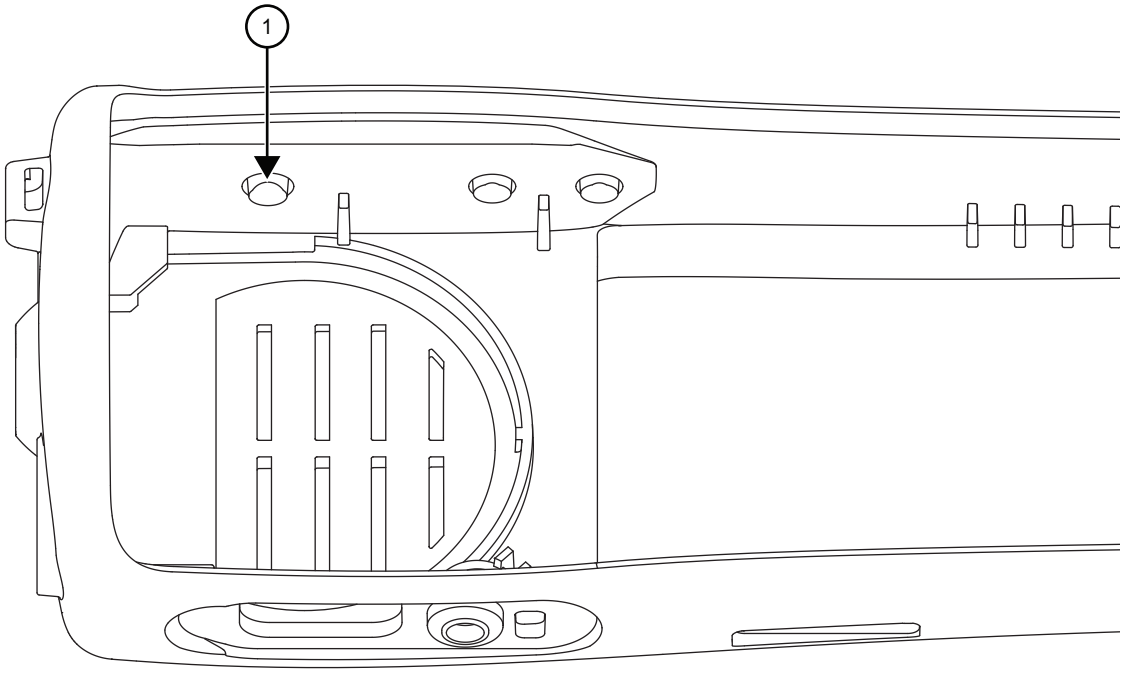
NOTE: Micro USB dust cover is non-serviceable. Replace with a new one during reassembly.

5.5.7
PTT Disassembly

Procedure:

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

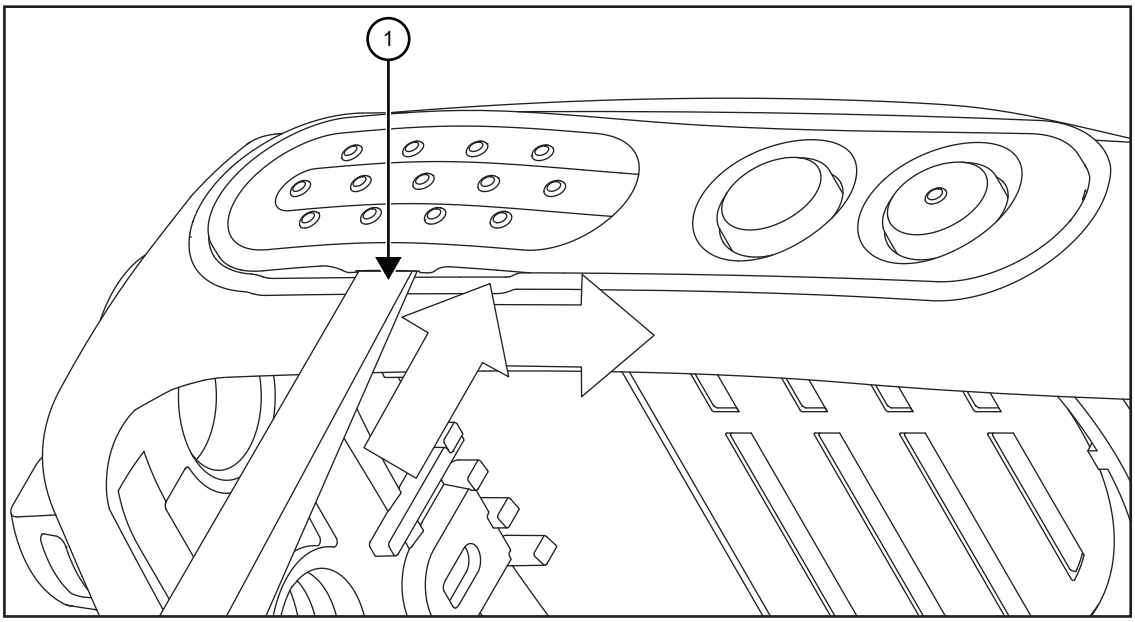
Figure 28: Lifting PTT Bezel with PTT plunger



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 29: PTT Removal



Label	Description
1	Plastic Tweezers

3. Remove PTT bezel followed by the PTT rubber.

CAUTION: PTT bezel is not reusable once removed.

5.6 Detailed Radio Reassembly

This section describes the detailed reassembly procedure of your radio.

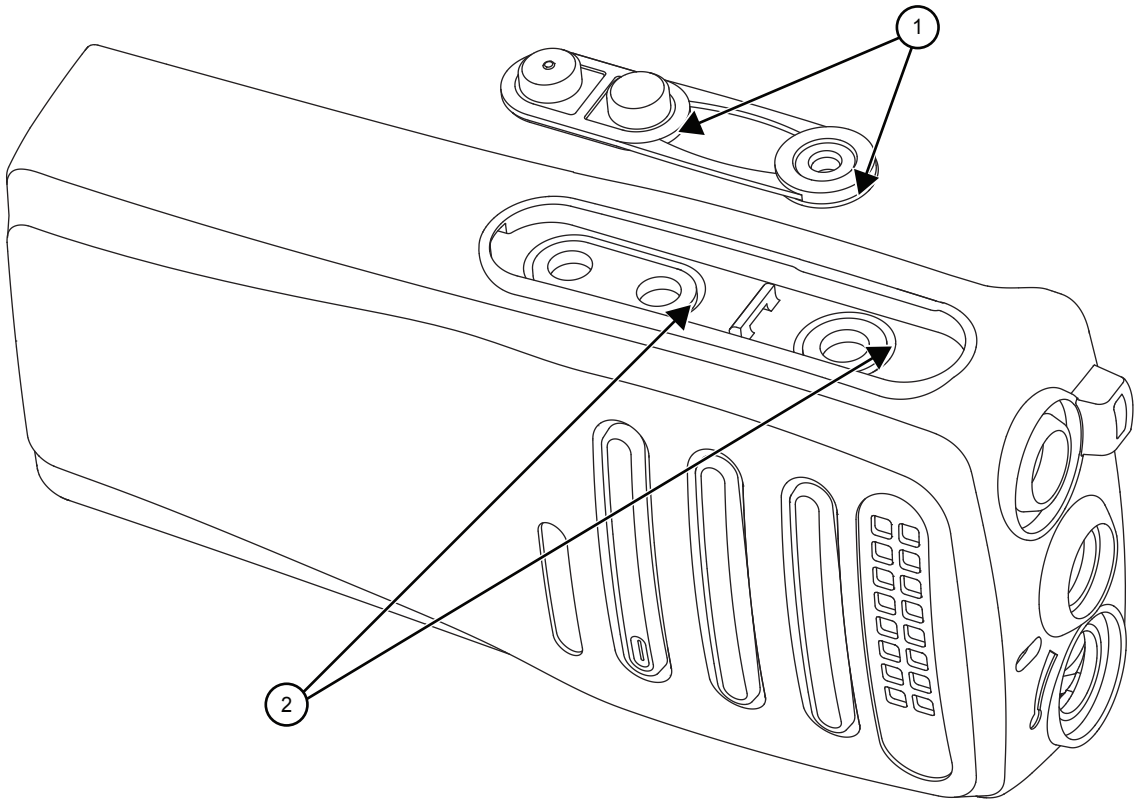
NOTE: Motorola Solutions recommends using a low rotation speed setting when using an electric screwdriver with a selectable rotation speed. The bit must be inline with the direction of the screw when assembling the screws.

5.6.1 PTT Reassembly

Procedure:

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

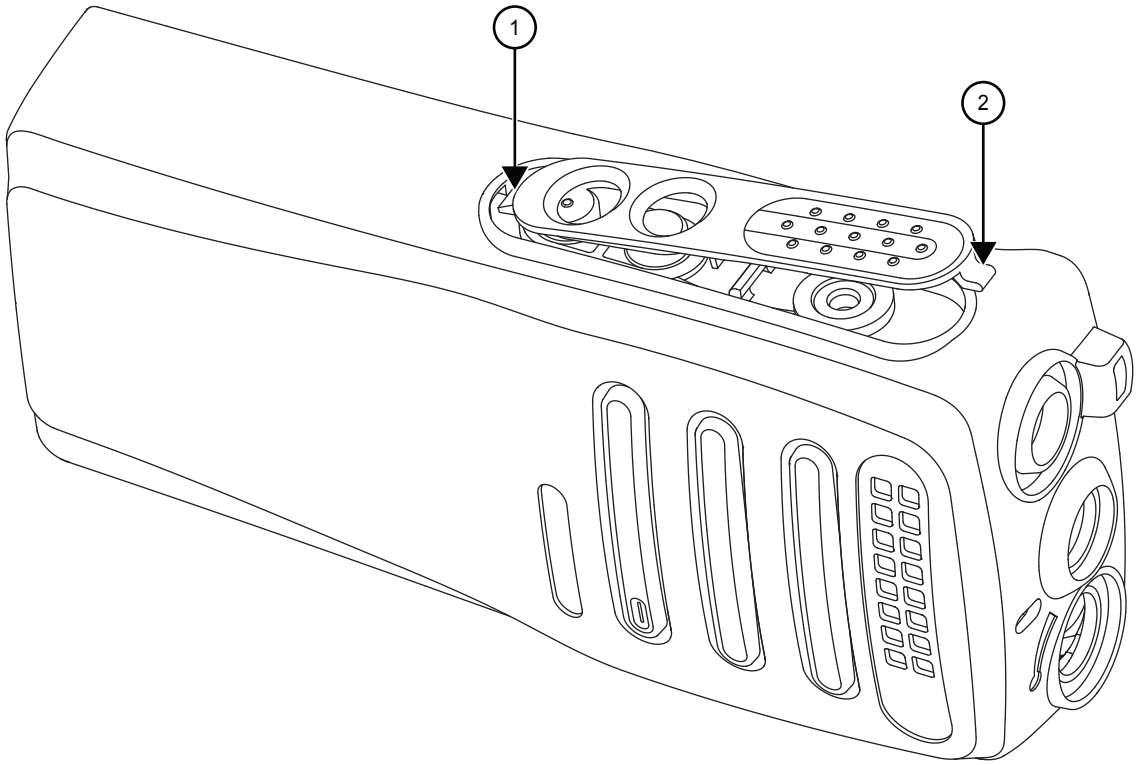
Figure 30: PTT Rubber Assembly



Label	Description
1	Sealing Ribs
2	Sealing Grooves

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

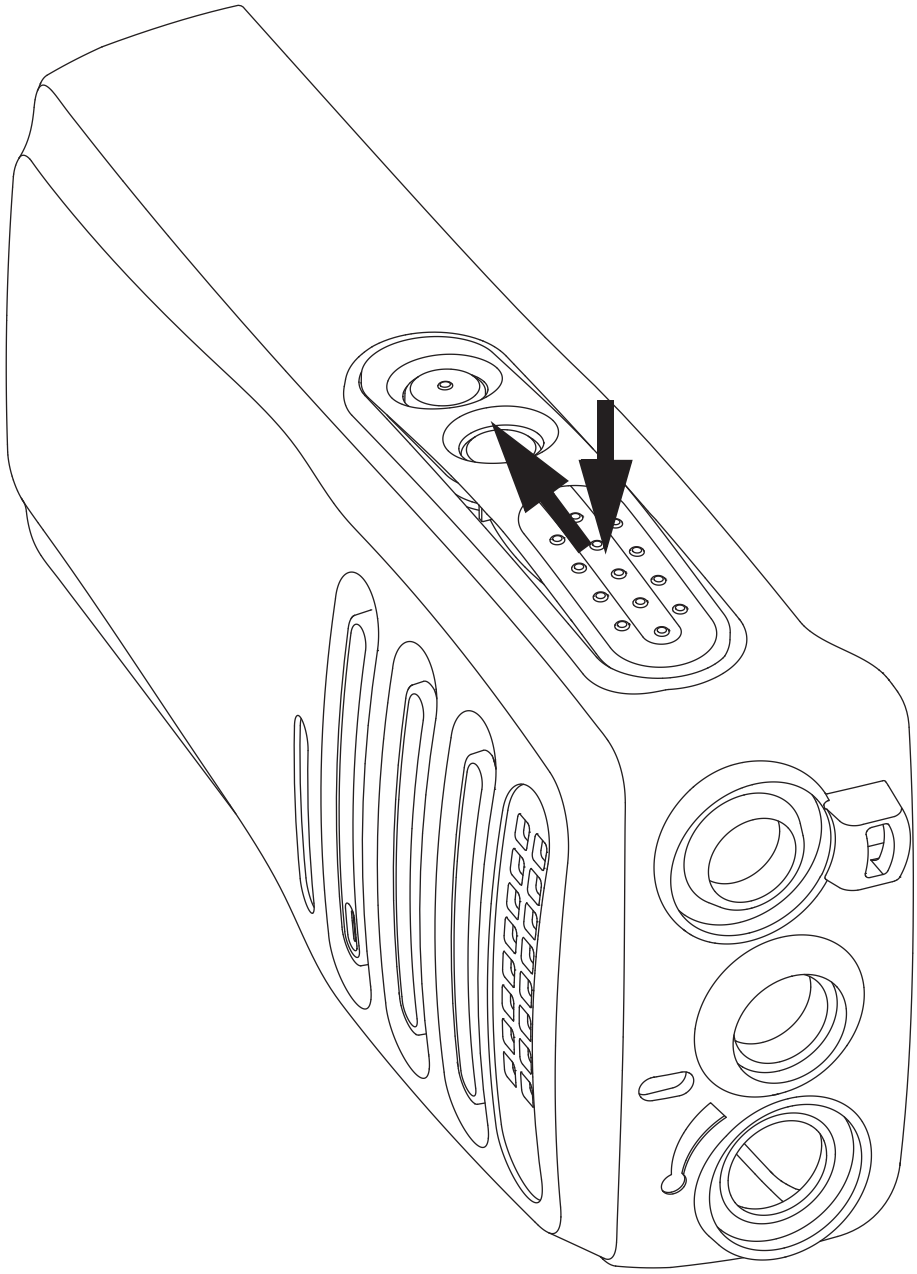
Figure 31: PTT Assembly



Label	Description
1	Bottom
2	Top

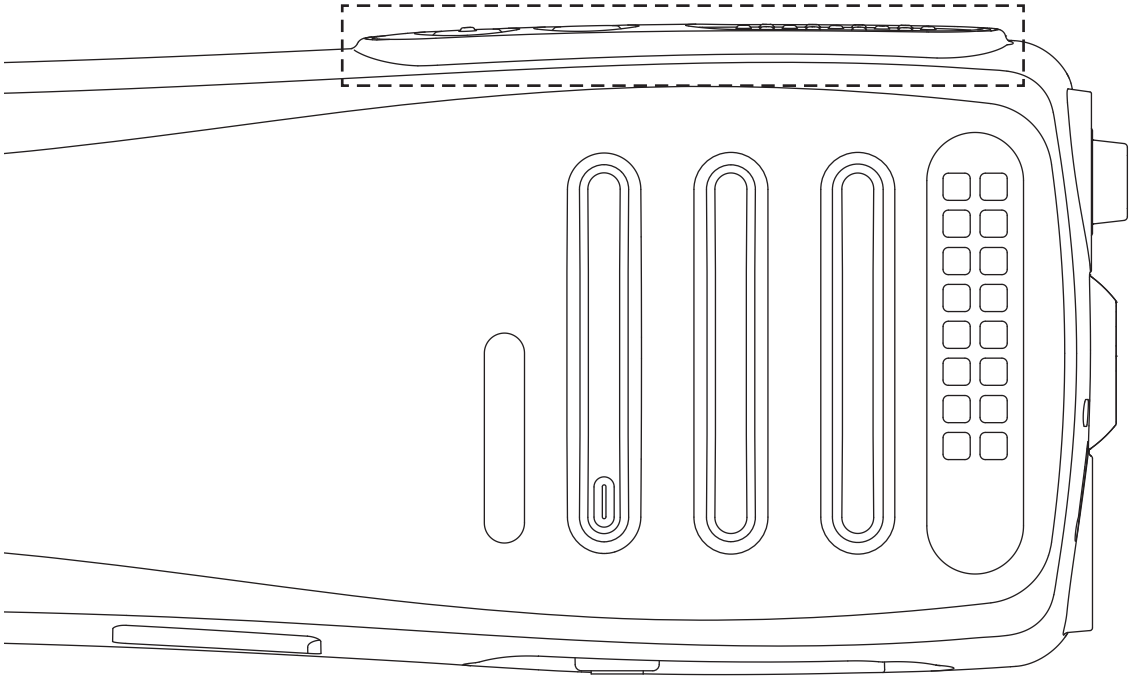
3. Push down PTT and drag towards programming key until bezel snaps in.

Figure 32: Affixing the PTT Bezel



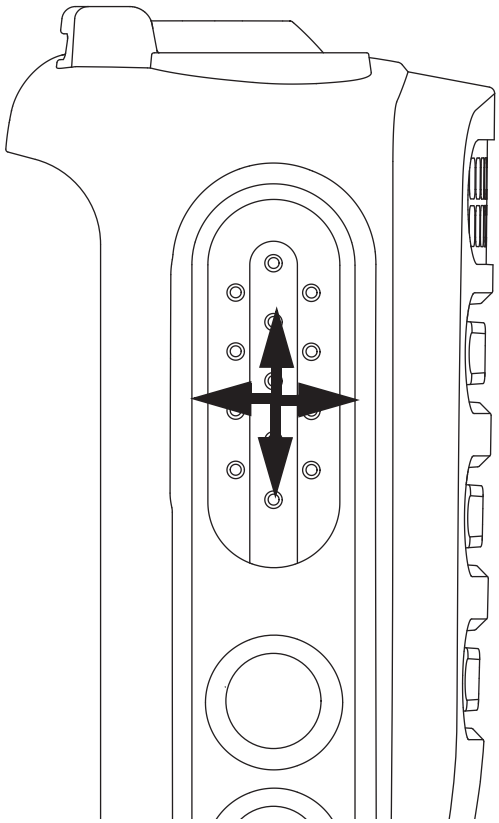
4. Ensure that PTT bezel is flushed to housing (no bulging).

Figure 33: Flushed PTT bezel to housing



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

Figure 34: Bezel Alignment



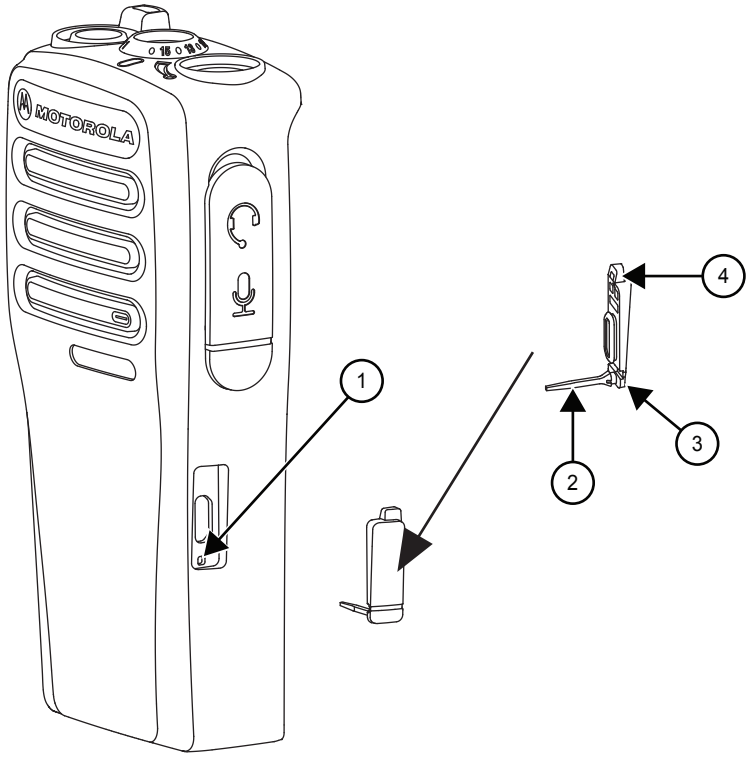
CAUTION: Remove and replace with new PTT bezel if criteria in step 4 and step 5 are not met.

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 35: Micro USB Dust Cover Reassembly



Label	Description
1	Insertion Point
2	Tail
3	Head
4	Tab

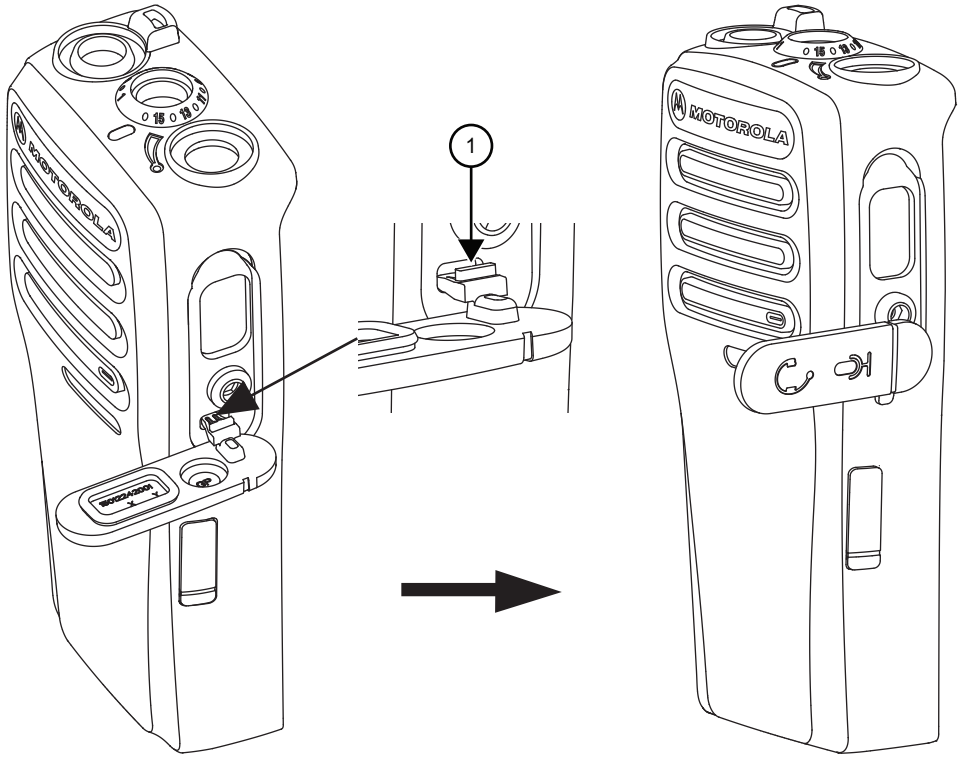
5.6.3
Audio Jack Dust Cover Reassembly

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 36: Audio Jack Dust Cover Reassembly



Label	Description
1	Key

Figure 37: Audio Jack Dust Cover Reassembly

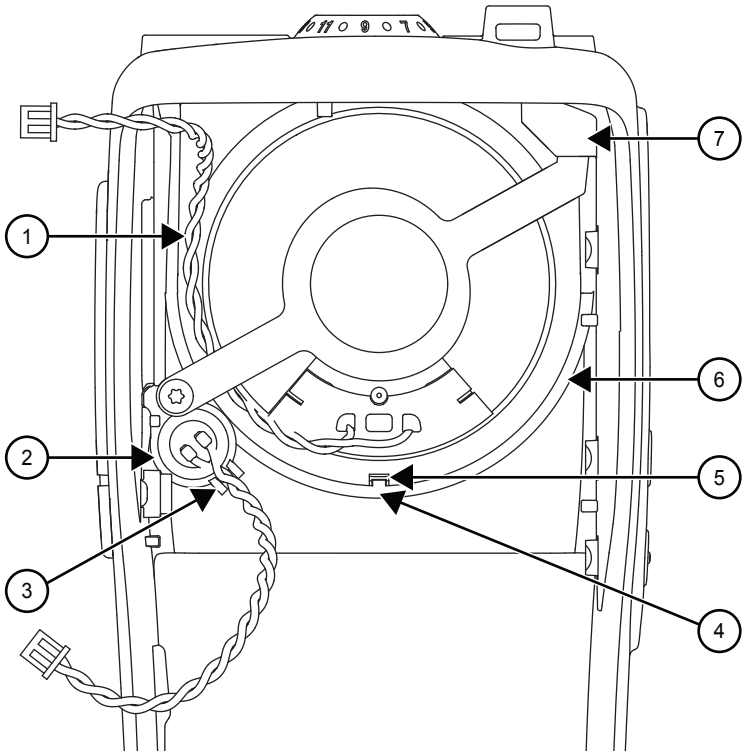
3. With one hand pressing on the bottom of the dust cover, rotate the dust cover 90° in clockwise direction.
4. Press the dust cover to ensure it fully covers the audio jack opening.

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 38: 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.

NOTE: 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

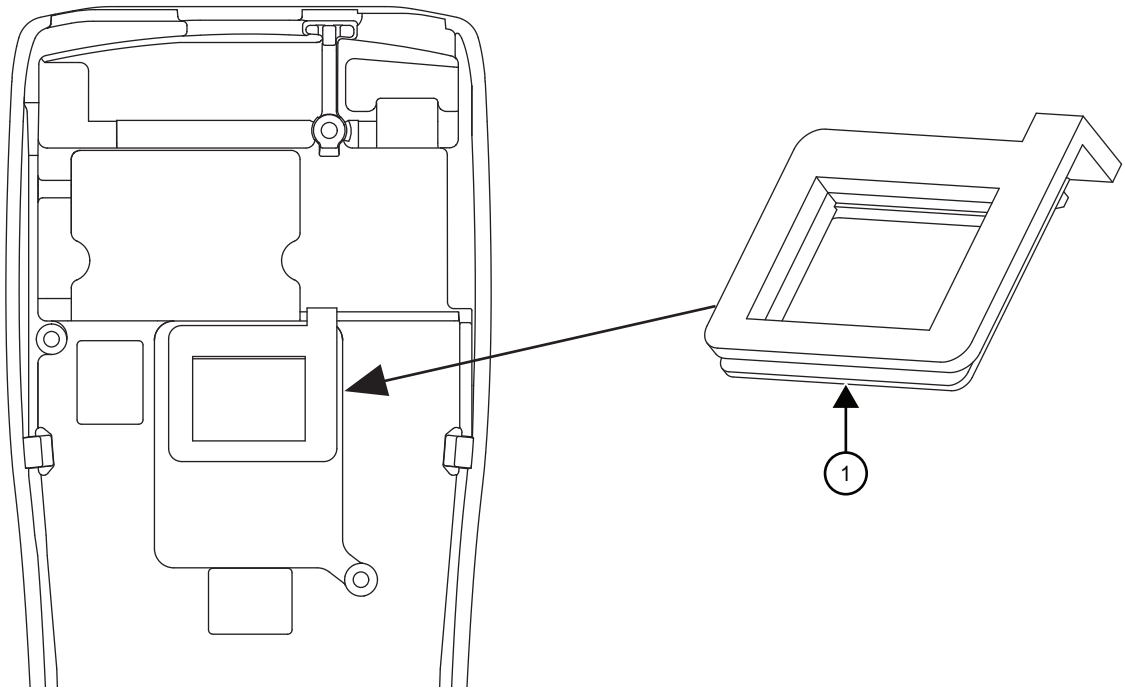
Chassis Reassembly

Procedure:

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

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

   Figure 39: 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.

   NOTE: 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.

   NOTE: 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 40: Thermal Pad Assembly for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A

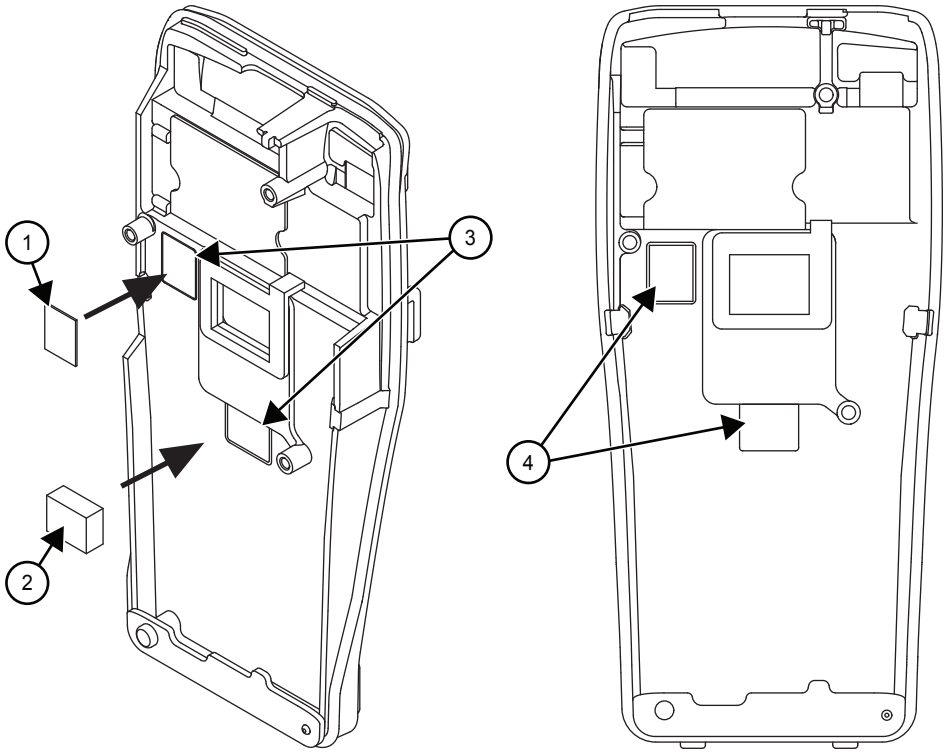
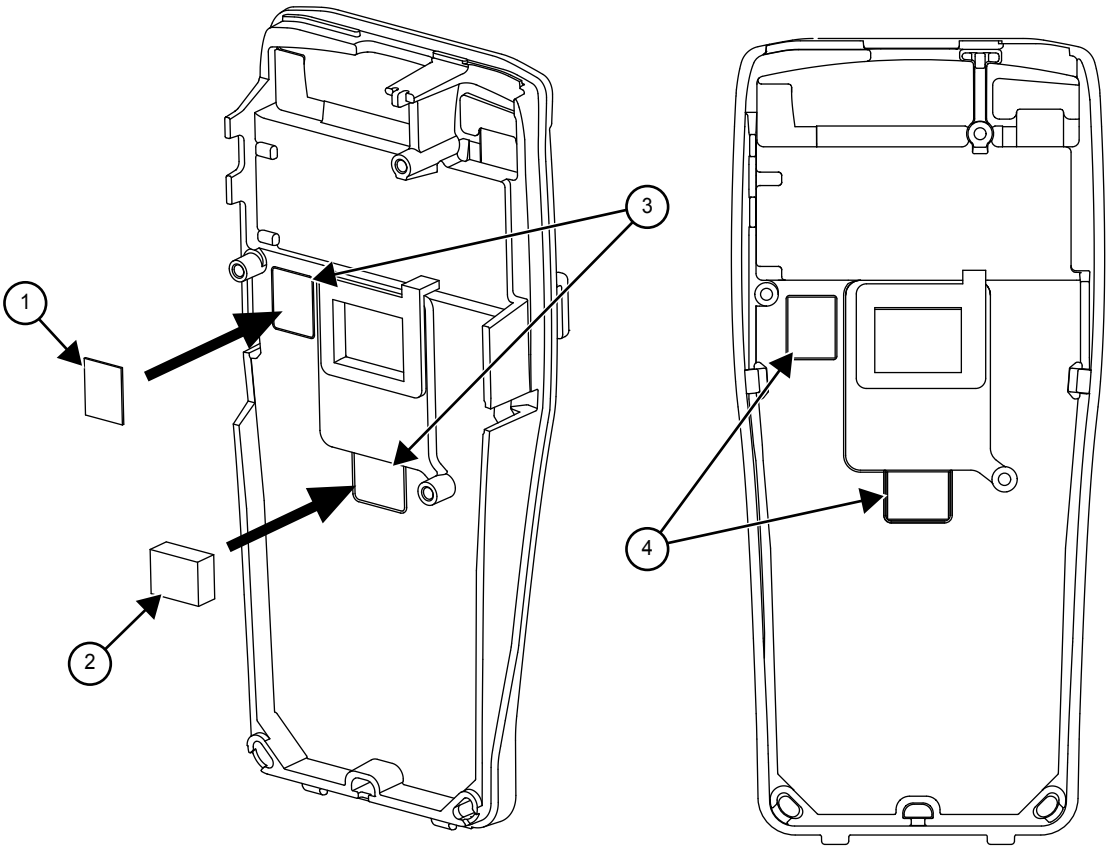


Figure 41: Thermal Pad Assembly for PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, PMUD3231B, PMUE4597C, PMUE4147C, PMUE4623C, PMUD3349C, PMUD3306C, and PMUD3231C



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.

   NOTE: 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.

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

Figure 42: PCB and Top Control Seal Assembly for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A

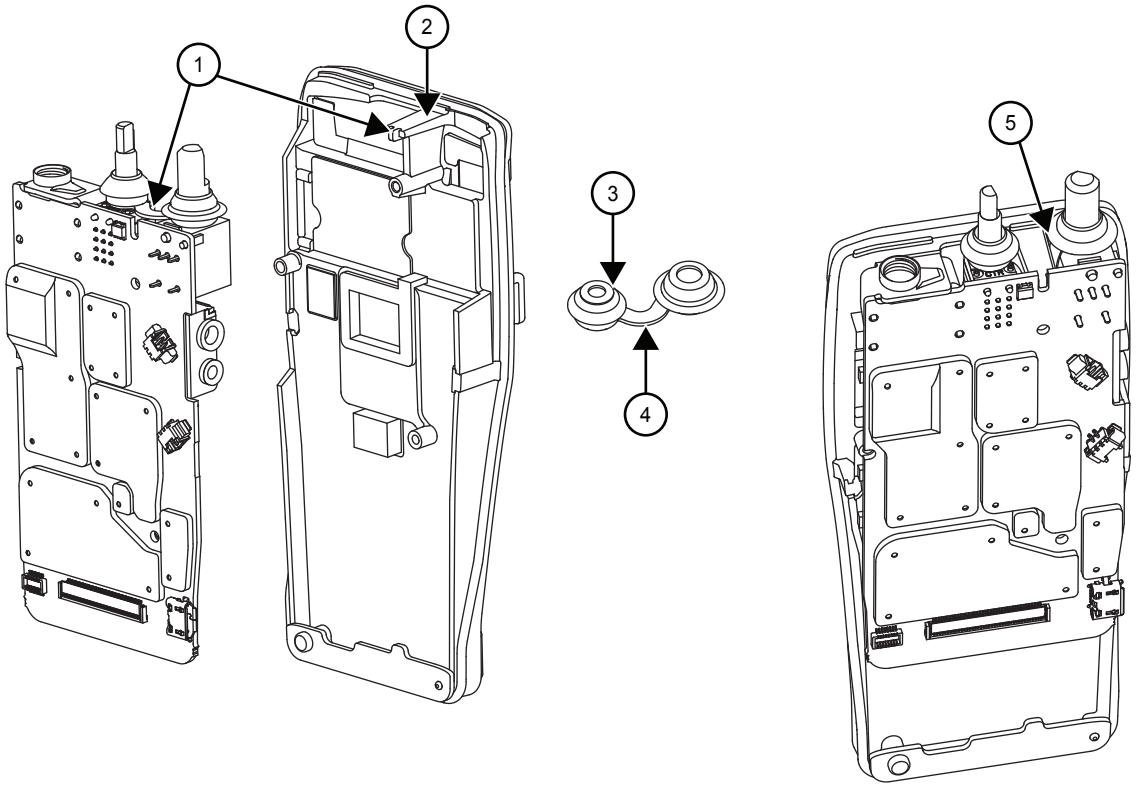
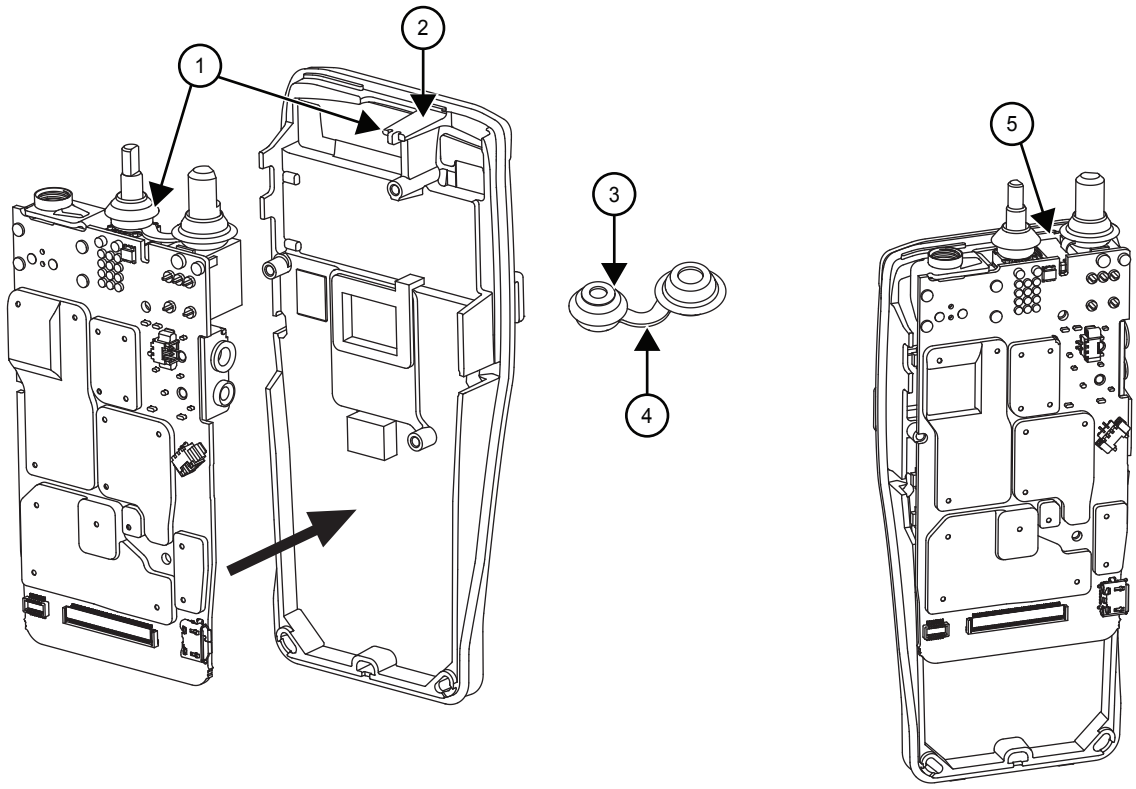


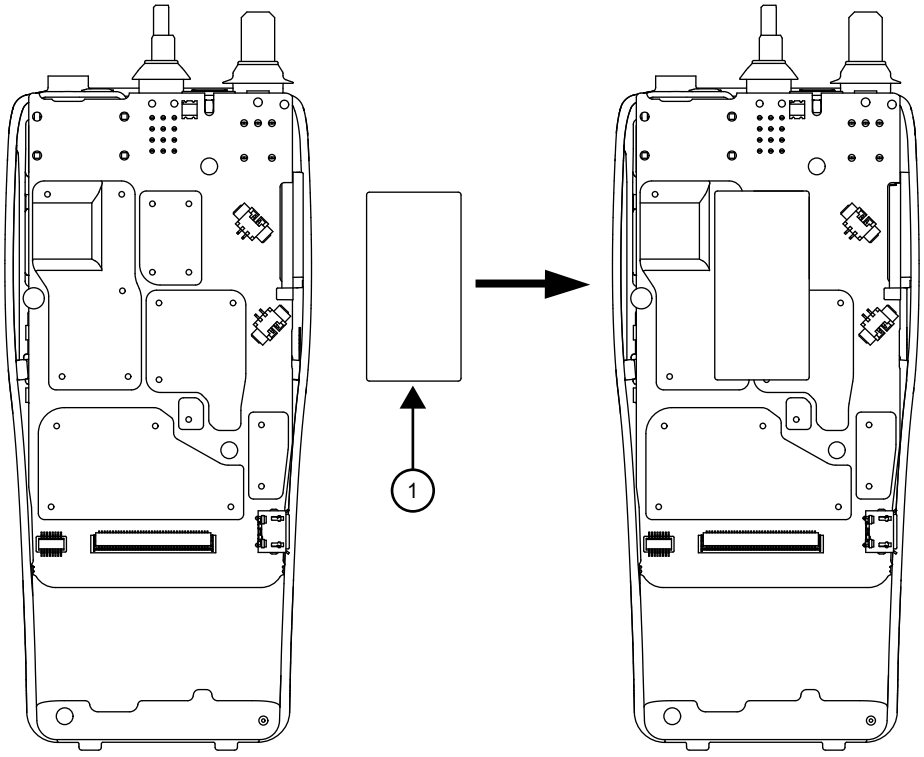
Figure 43: PCB and Top Control Seal Assembly for PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, PMUD3231B, PMUE4597C, PMUE4147C, PMUE4623C, PMUD3349C, PMUD3306C, and PMUD3231C



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 20: Chassis Disassembly for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A on page 60).
8. Adhere the poron pad align to the pointed shield corner.

Figure 44: Poron Pad Alignment



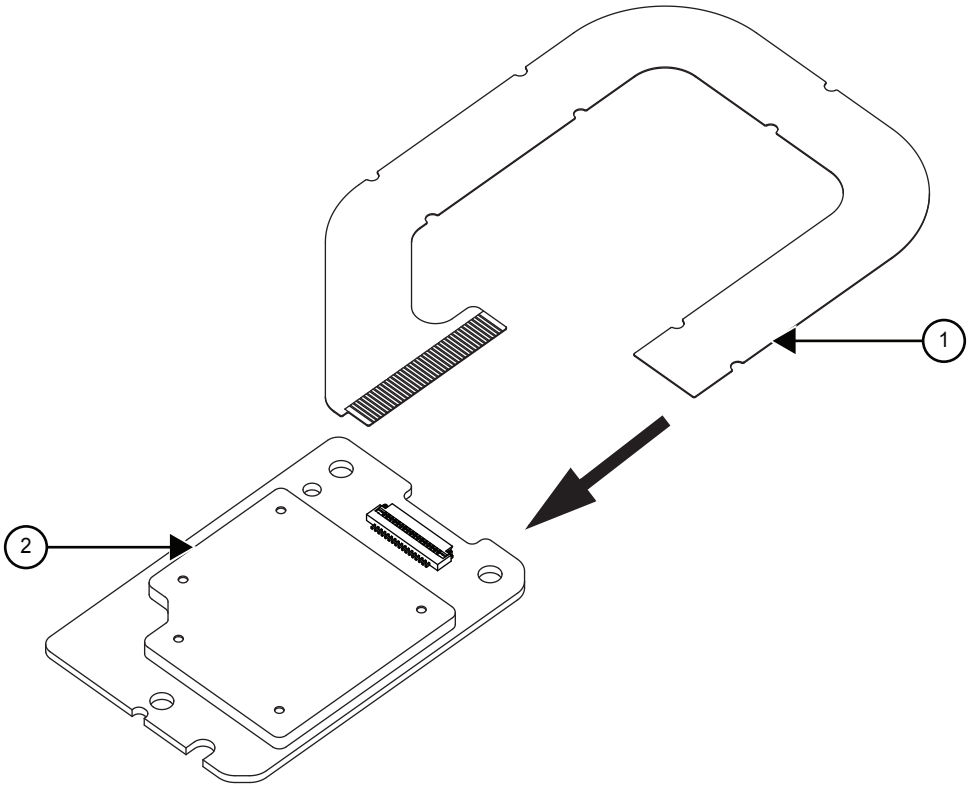
Label	Description
1	Poron Pad

NOTE: This step is applicable to PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A.

5.6.6
Generic Option Board (GOB) Reassembly

Procedure:

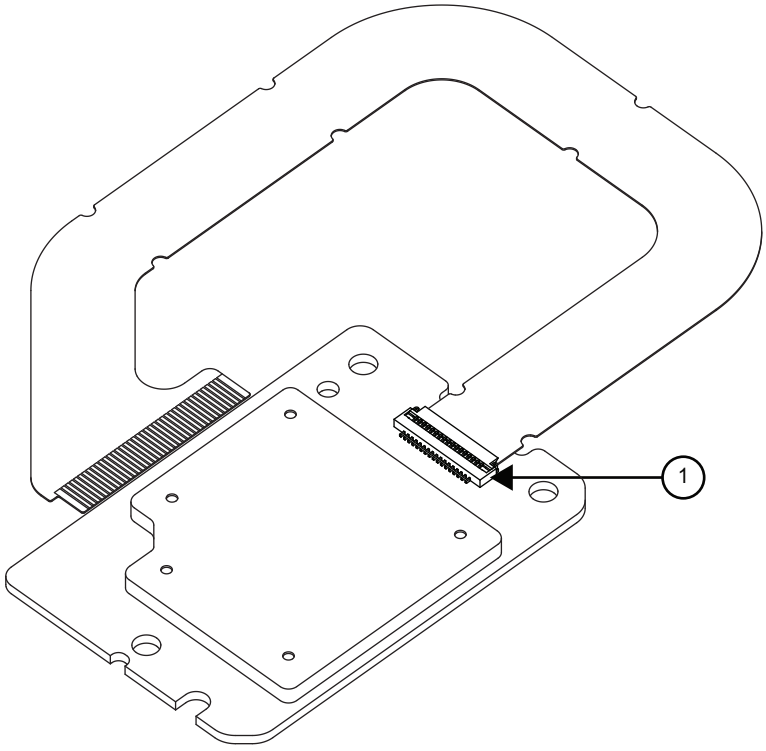
1. Gently lift the connector actuator on the option board and connect the flex.



Label	Description
1	Flex
2	Option Board

2. Gently close the actuator.

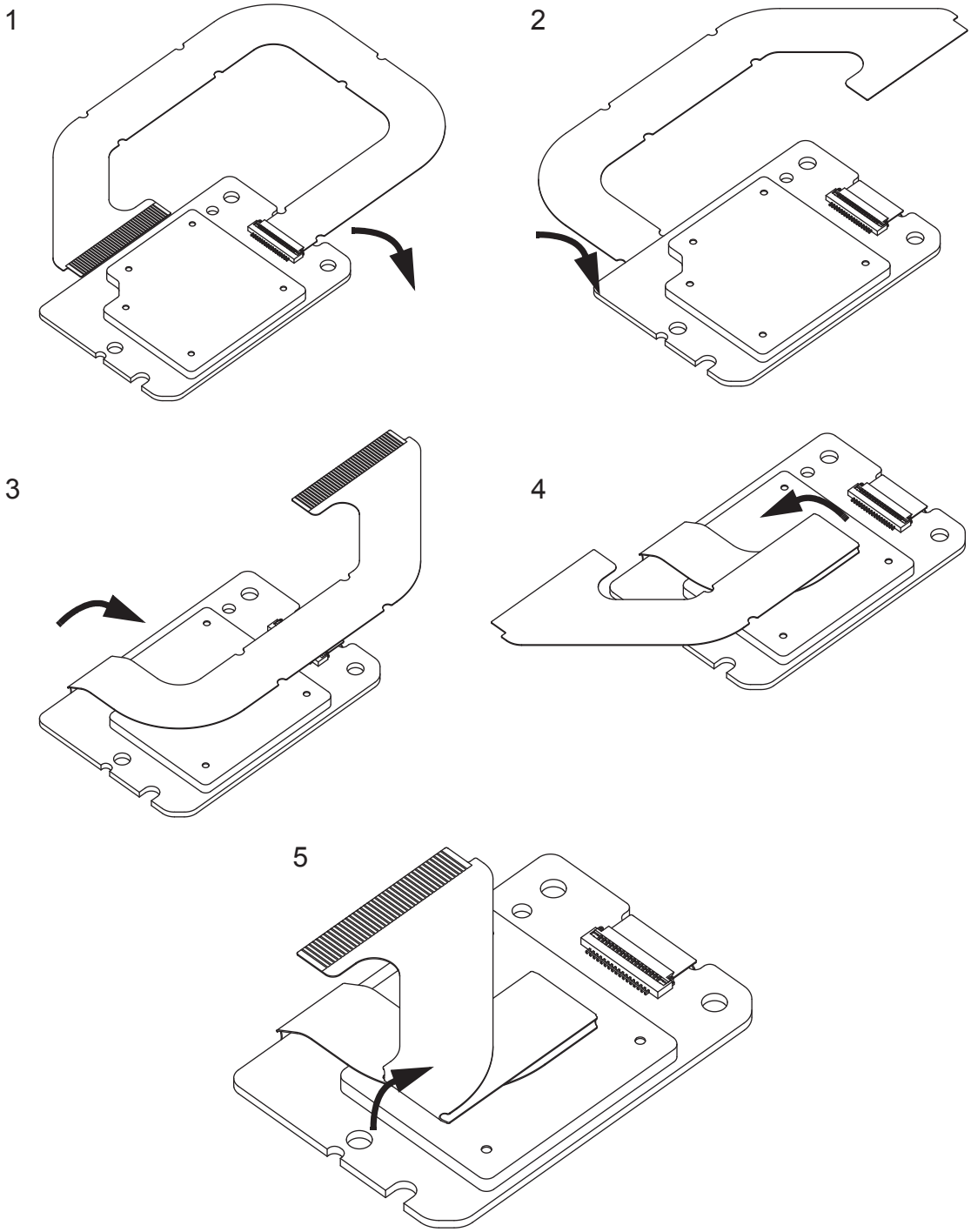
Figure 45: Complete Option Board Assembly

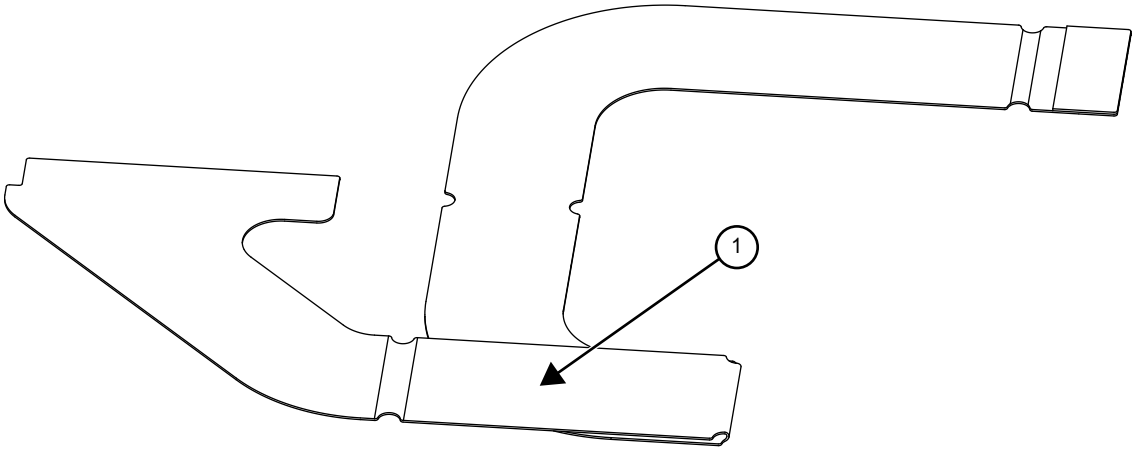


Label	Description
1	Actuator

3. Fold the flex gently as per the sequence from 1 to 5.

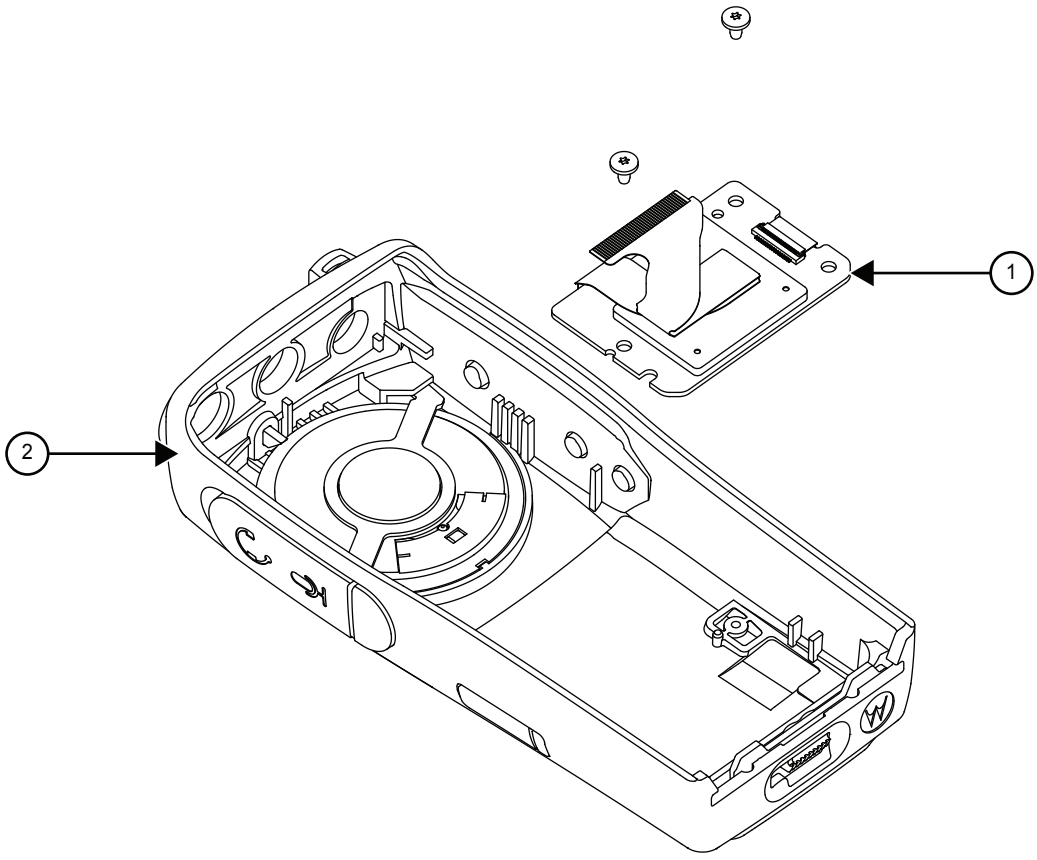
Figure 46: Folding the Flex





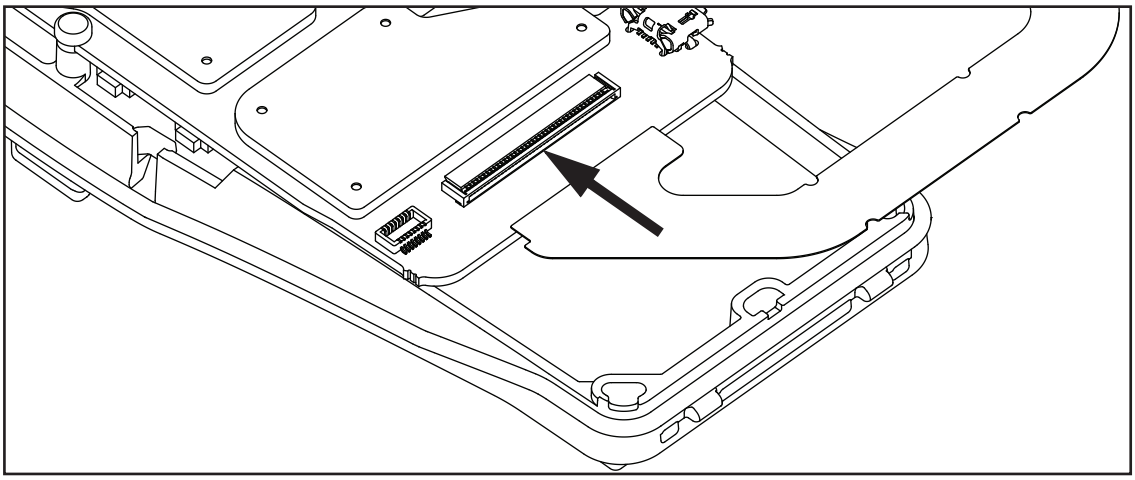
Label	Description
1	Do not hard fold or crease this part of the flex.

4. Place the option board with flex into the front kit.
5. Use TORX screw driver with T6 bit to fasten the two screws to the front housing.

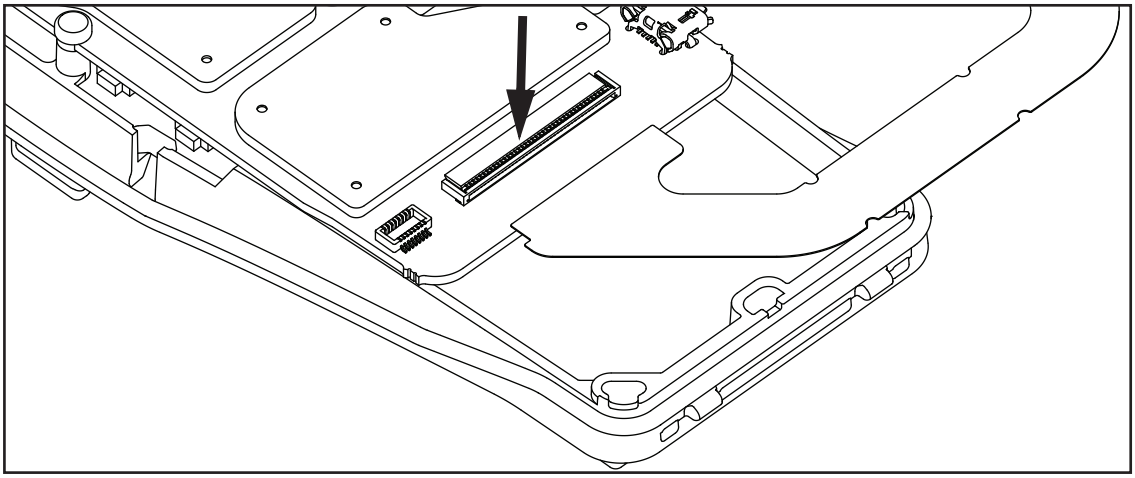


Label	Description
1	Option Board
2	Front Kit

6. Gently insert the flex into the fully opened actuator.



7. Insert the flex and gently close the connector by pushing down at the center of the actuator.



CAUTION: Do not touch upper part of the housing ("A" area) at anytime, as it may lead to breakage.

5.6.7
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 47: Chassis and Front Housing Reassembly for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A

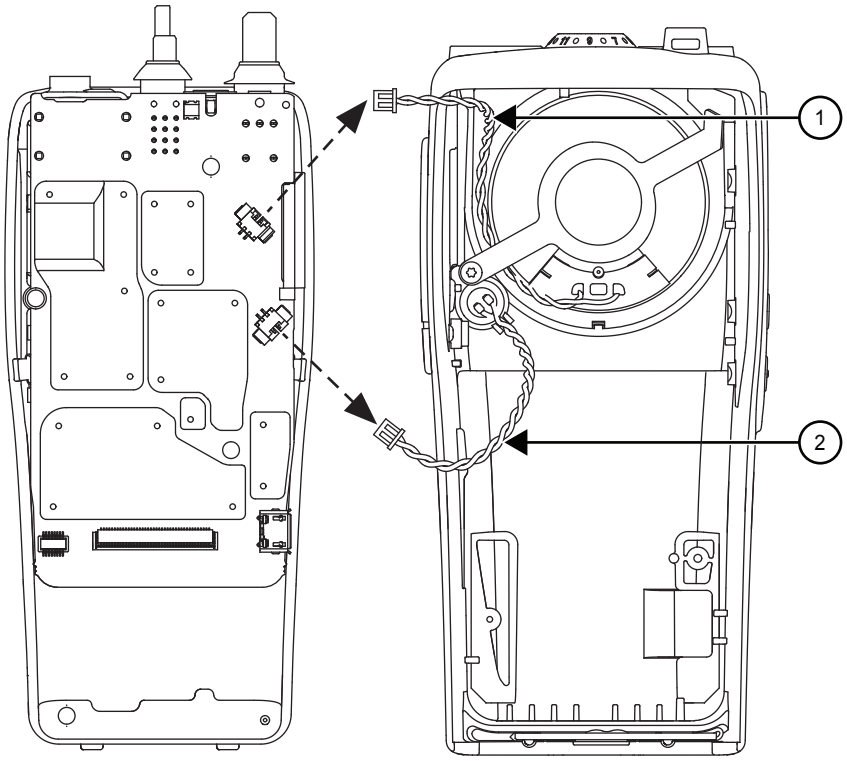
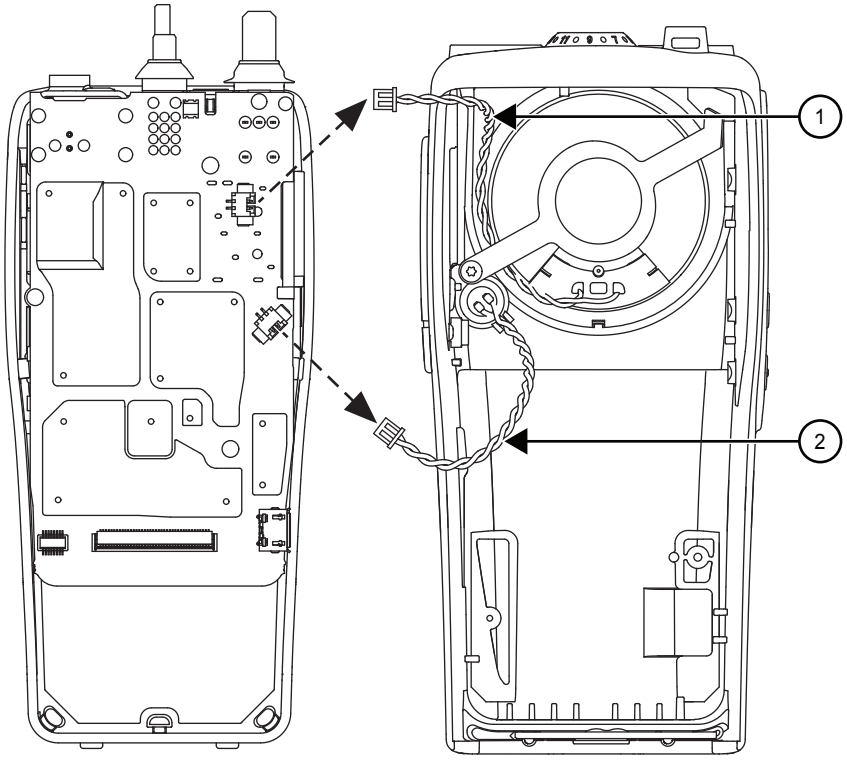


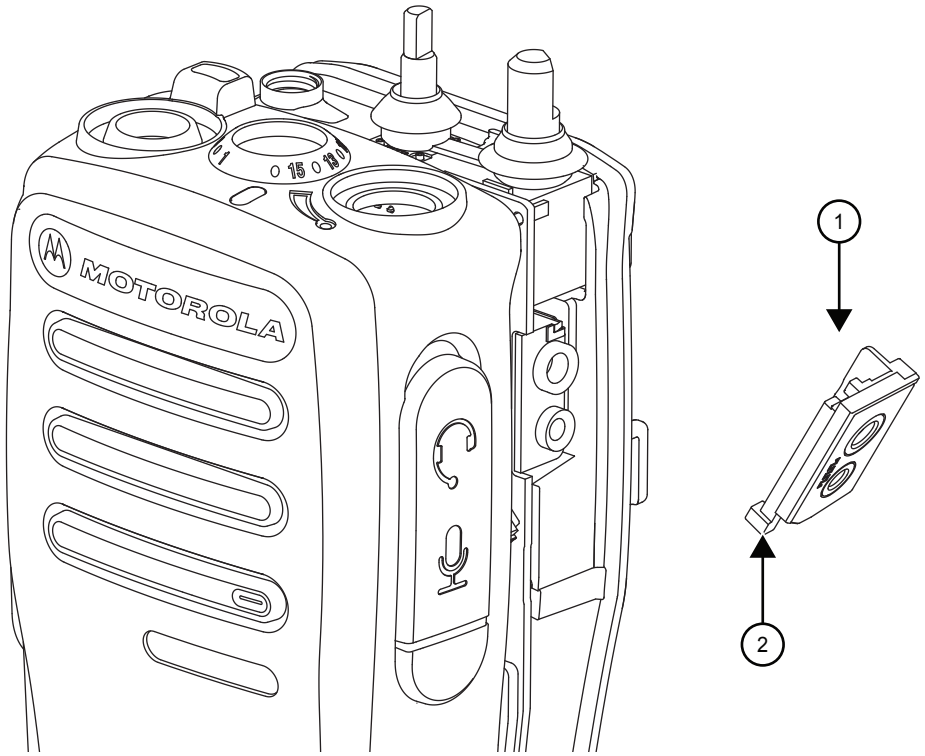
Figure 48: Chassis and Front Housing Reassembly for PMUE4597B, PMUE4147B, PMUE4623B, PMUD3349B, PMUD3306B, PMUD3231B, PMUE4597C, PMUE4147C, PMUE4623C, PMUD3349C, PMUD3306C, and PMUD3231C



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.

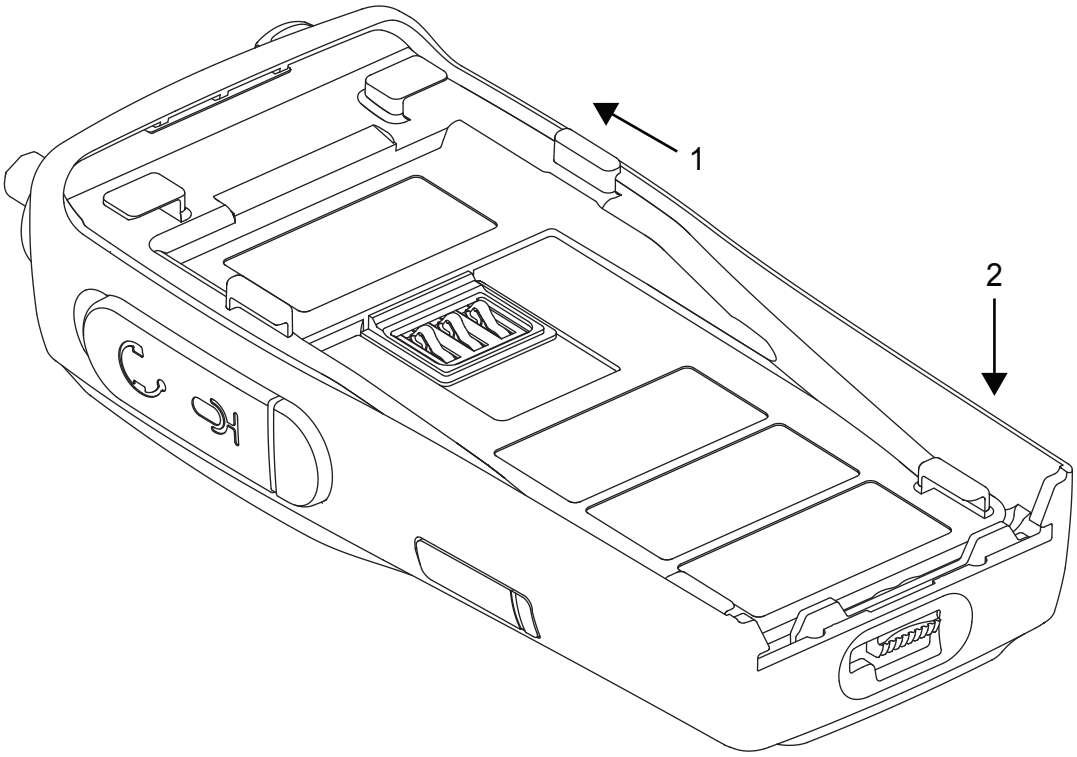
Figure 49: Audio Jack Shroud Reassembly



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 50: 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.

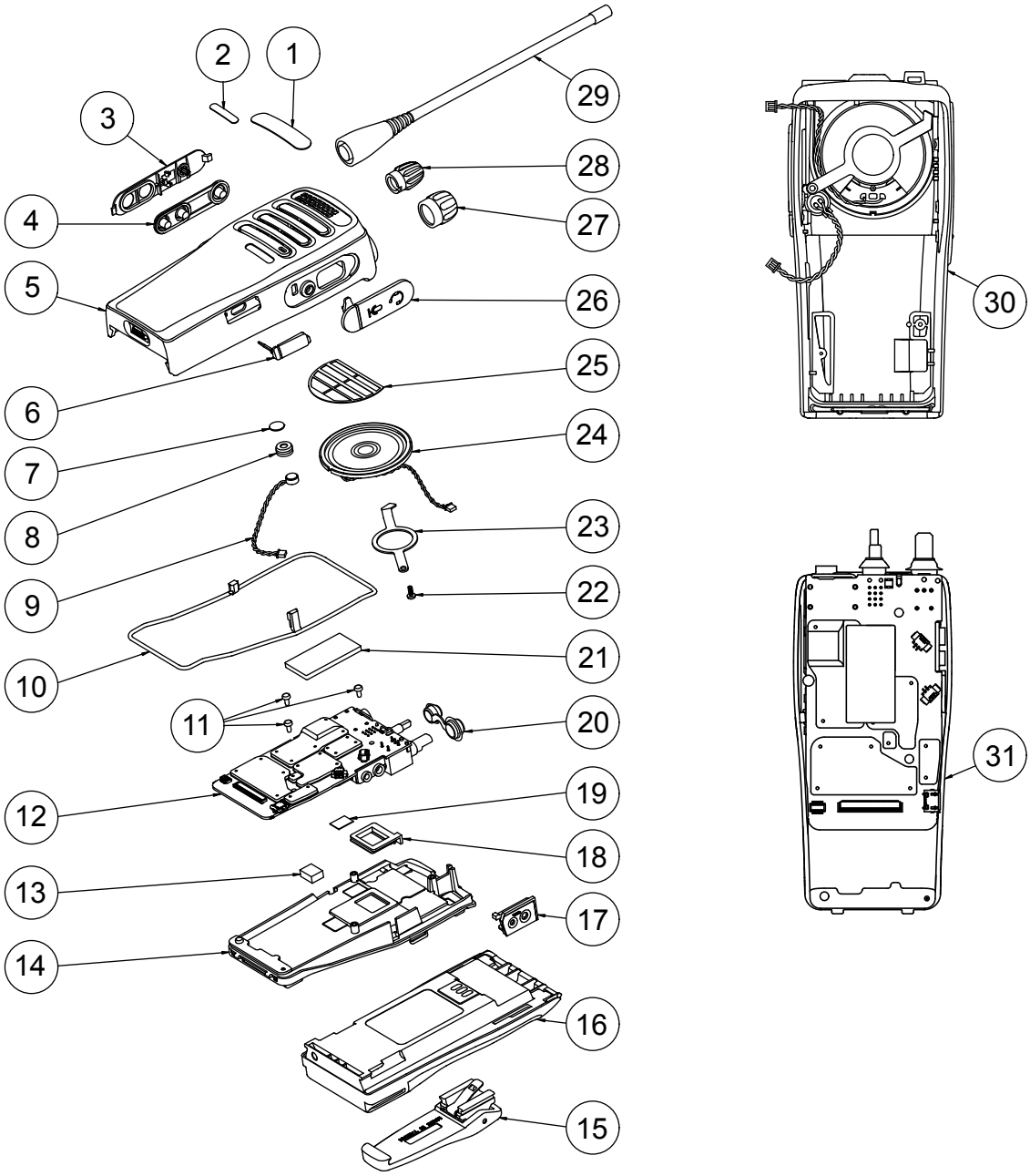
5. Attach the volume and channel selector knobs into their respective shafts.
6. Attach the antenna and battery.

5.7
Radio Exploded Mechanical View and Parts List

5.7.1
Non-Option Board

This section is applicable to PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A.

Figure 51: Non-Option Board



Item	Description	Part Number
1	Nameplate	33012026001
2	Product Number Label	33012039017
3	Bezel, PTT	13012040002 13012050002 (For China Customer Only)
4	Rubber, PTT	32012231001
5	Front Housing Assembly	Part of Front Cover Kit

Item	Description	Part Number
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	Part of Back Cover Kit
13	Thermal Pad (thick)	75012205001
14	Chassis Assembly	2786389Z03
		0104056J93
15	Belt Clip	See Authorized Accessories List.
16	Battery	See Authorized Accessories List.
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.
30	Front Cover Kit	See Front Housing Service Kit for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A on page 105.
31	Back Cover Kit	See Back Cover Kit for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A on page 106.

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

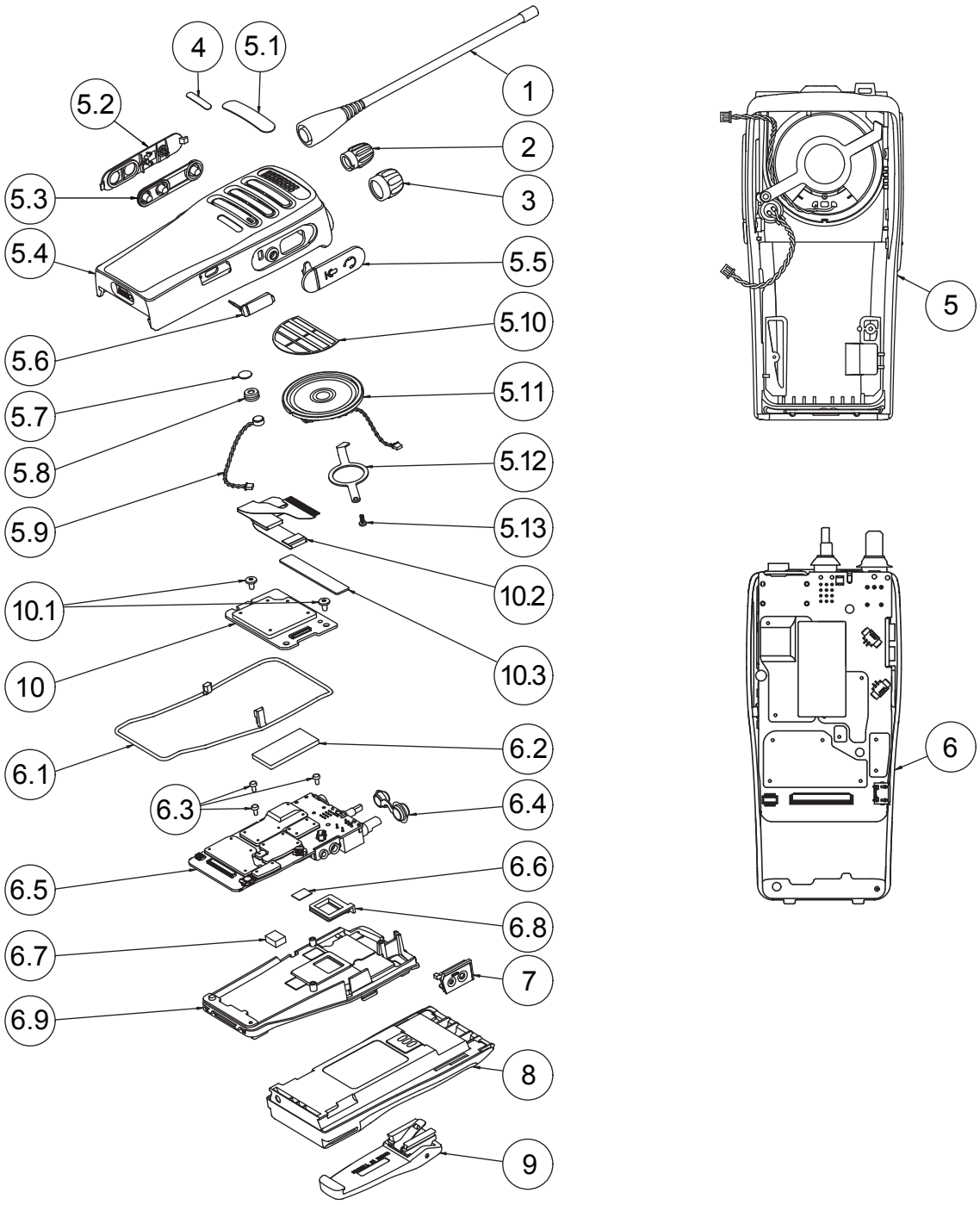
Main O-Ring	Chassis Assembly
3286431Z06	2786389Z03
3286431Z05	0104056J93

5.7.2

Option Board Capable

This section is applicable to PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A.

Figure 52: Option Board Capable



Item		Description	Part Number
1		Antenna	See Authorized Accessories List.
2		Knob, Frequency	3680530Z02
3		Knob, Volume	3680529Z01
4		Product Number Label	33012039017

Item		Description	Part Number
5		Front Cover Kit, Option Board Capable (China PTT)	See Front Housing Service Kit for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A on page 105.
	5.1	Nameplate	33012026001
	5.2	Bezel, PTT	13012040002 13012050002 (For China Customer Only)
	5.3	Rubber, PTT	32012231001
	5.4	Front Housing Assembly	Part of Front Cover Kit
	5.5	Dust Cover, Audio Jack	15012242001
	5.6	Dust Cover, Micro USB	38012042001
	5.7	Felt, Microphone	3586621Z04
	5.8	Boot, Microphone	0780608V01
	5.9	Microphone Assembly	0104055J51
	5.10	Felt, Speaker	35012094001
	5.11	Speaker Assembly	0104055J50
	5.12	Speaker Retainer	4286620Z01
	5.13	Screw, Speaker Retainer	0386434Z02
6		Back Cover Kit	See Back Cover Kit for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A on page 106.
	6.1	Main O-Ring	3286431Z05
	6.2	Poron Pad	75012247001
	6.3	Screw, Main Board	0304726J05
	6.4	Top Control Seal	32012232001
	6.5	Main PCB Assembly	Part of Back Cover Kit
	6.6	Thermal Pad (thin)	7515526H01
	6.7	Thermal Pad (thick)	75012205001
	6.8	Battery Contact Seal	3286435Z01
	6.9	Chassis Assembly	2786389Z03 0104056J93
7		Shroud Assembly, Audio Jack	01012093001
8		Battery	See Authorized Accessories List.
9		Belt Clip	See Authorized Accessories List.

Item		Description	Part Number
10		Option Board	Available from application developer
	10.1	Screw, Option Board	FN000157A01
	10.2	Flex, Option Board	PF000718A01
	10.3	Poron, Option Board	3271467T01

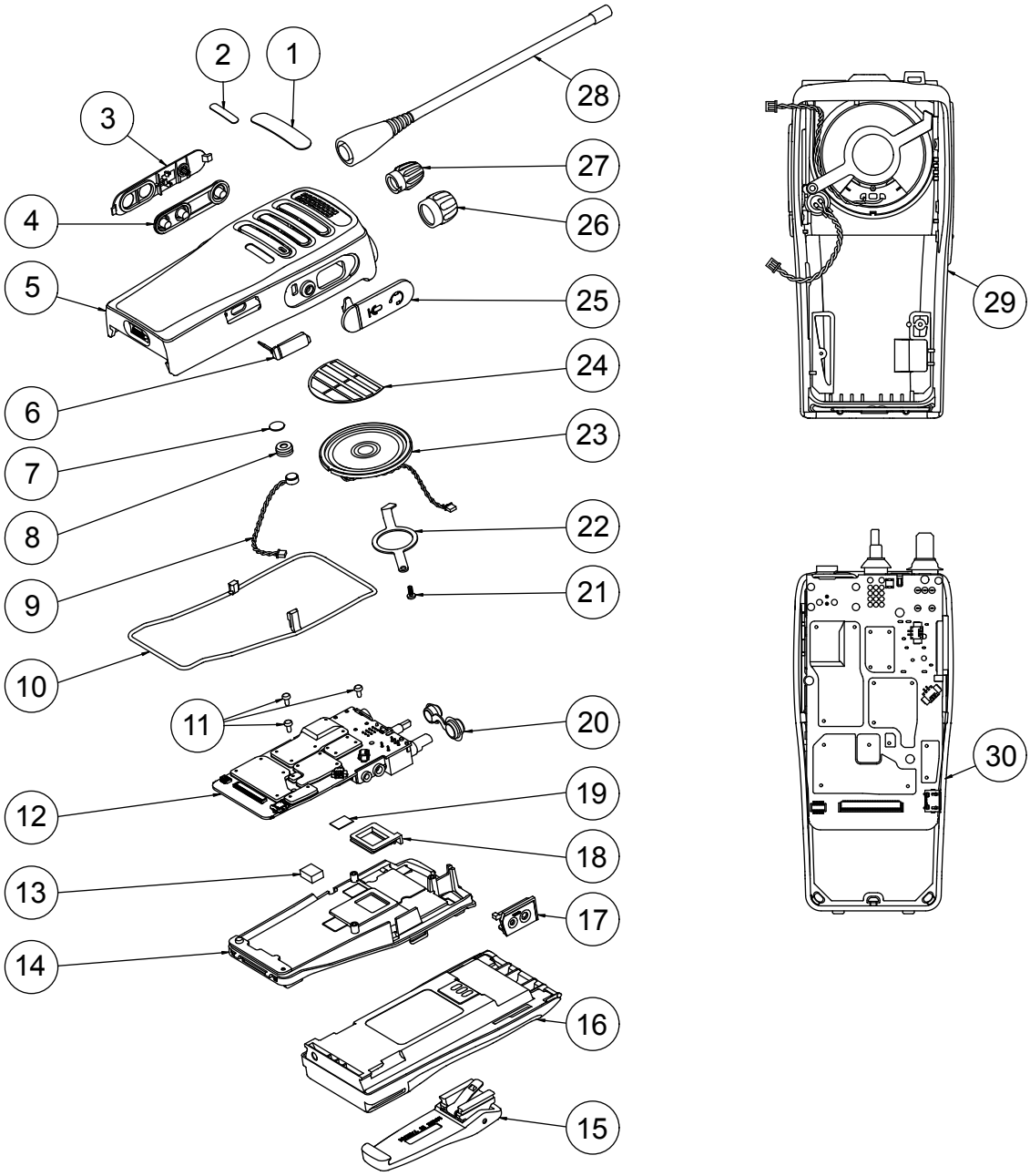
NOTE:
Refer to the following table for the correct pairing of Main O-Ring with Chassis Assembly.

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

5.7.3
Non-Option Board

This section is applicable to PMUE4597B, PMUD3349B, PMUD3306B, PMUE4147B, PMUE4623B, PMUD3231B.

Figure 53: Non-Option Board



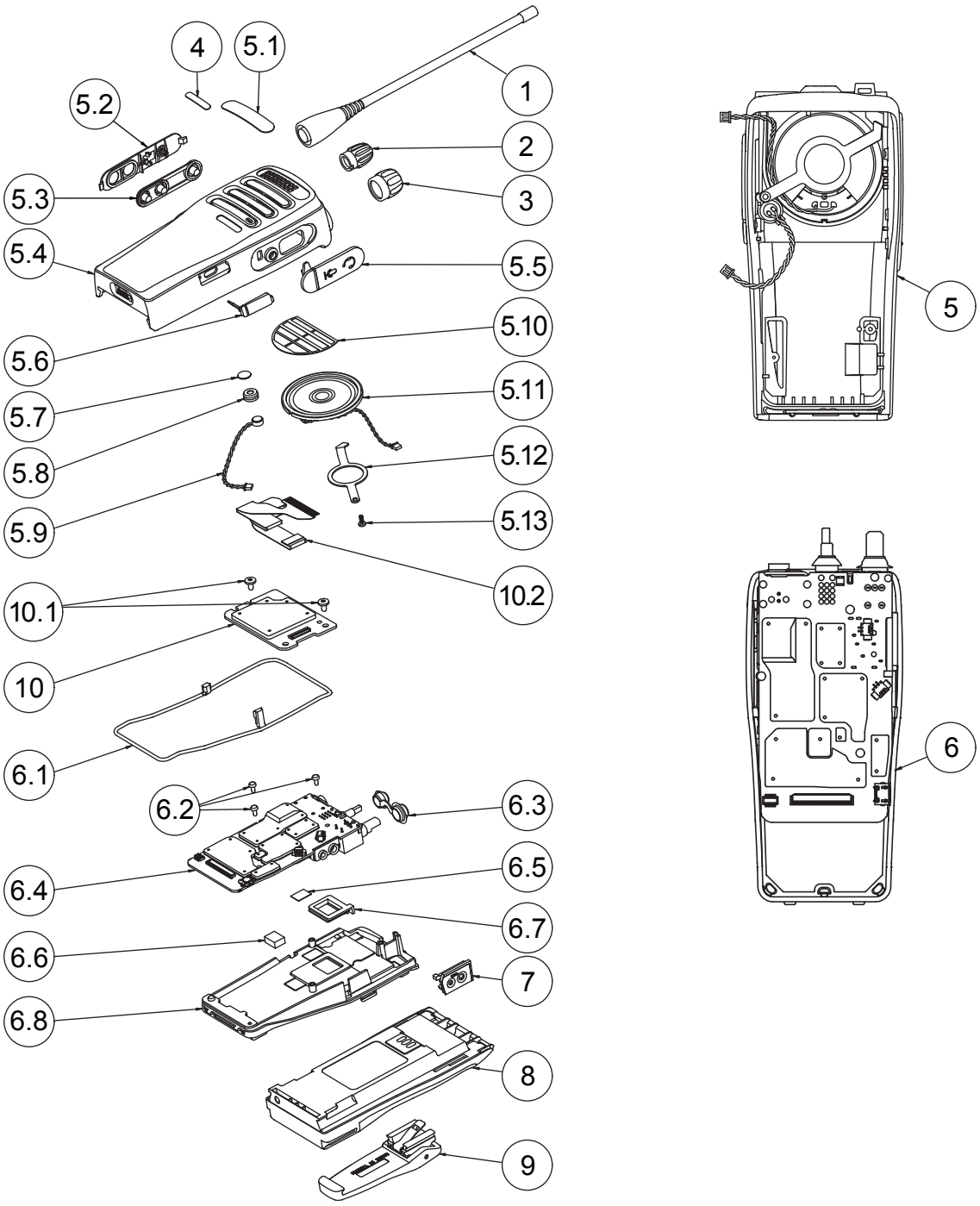
Item	Description	Part Number
1	Nameplate	33012026001
2	Product Number Label	33012039017
3	Bezel, PTT	HN001382A01
4	Rubber, PTT	KP000151A01
5	Front Housing Assembly	Part of Front Cover Kit
6	Dust Cover, Micro USB	38012042001
7	Felt, Microphone	3586621Z04

Item	Description	Part Number
8	Boot, Microphone	0780608V01
9	Microphone Assembly	0104055J51
10	Main O-Ring	3286431Z06
11	Screw, Main Board	0304726J05
12	Main PCB Assembly	Part of Back Cover Kit
13	Thermal Pad (thick)	75012205001
14	Chassis Assembly	2786389Z03
15	Belt Clip	See Authorized Accessories List.
16	Battery	See Authorized Accessories List.
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.
29	Front Cover Kit	See Front Housing Service Kit for PMUE4597B, PMUD3349B, PMUD3306B, PMUE4147B, PMUE4623B, PMUD3231B on page 105.
30	Back Cover Kit	See Back Cover Kit for PMUE4597B, PMUD3349B, PMUD3306B, PMUE4147B, PMUE4623B, PMUD3231B on page 106.

5.7.4
Option Board Capable

This section is applicable to PMUE4597B, PMUD3349B, PMUD3306B, PMUE4147B, PMUE4623B, PMUD3231B.

Figure 54: Option Board Capable



Item		Description	Part Number
1		Antenna	See Authorized Accessories List.
2		Knob, Frequency	3680530Z02
3		Knob, Volume	3680529Z01
4		Product Number Label	33012039017

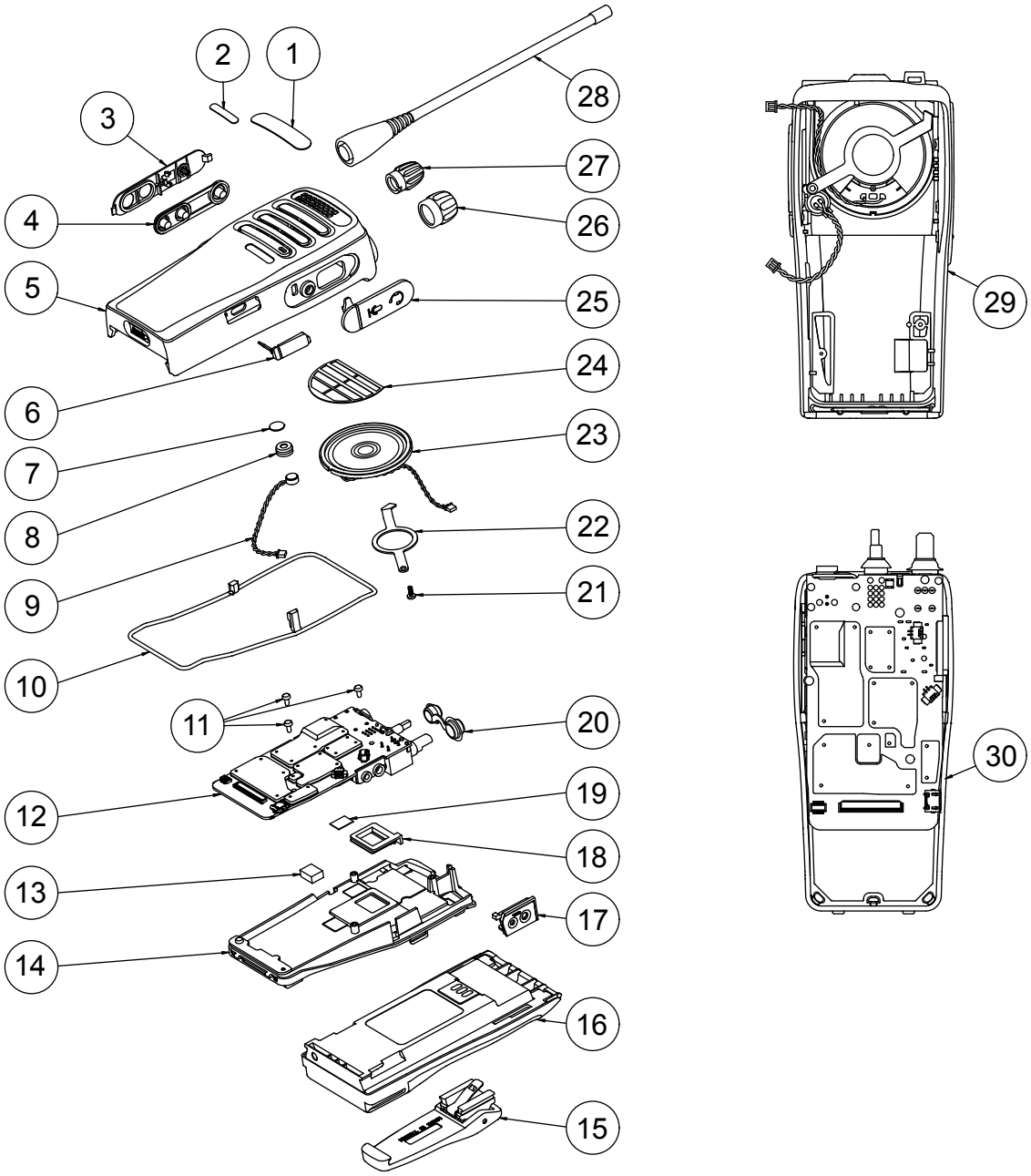
Item		Description	Part Number
5		Front Cover Kit	See Front Housing Service Kit for PMUE4597B, PMUD3349B, PMUD3306B, PMUE4147B, PMUE4623B, PMUD3231B on page 105.
	5.1	Nameplate	33012026001
	5.2	Bezel, PTT	HN001382A01
	5.3	Rubber, PTT	KP000151A01
	5.4	Front Housing Assembly	Part of Front Cover Kit
	5.5	Dust Cover, Audio Jack	15012242001
	5.6	Dust Cover, Micro USB	38012042001
	5.7	Felt, Microphone	3586621Z04
	5.8	Boot, Microphone	0780608V01
	5.9	Microphone Assembly	0104055J51
	5.10	Felt, Speaker	35012094001
	5.11	Speaker Assembly	0104055J50
	5.12	Speaker Retainer	4286620Z01
	5.13	Screw, Speaker Retainer	0386434Z02
6		Back Cover Kit	See Back Cover Kit for PMUE4597B, PMUD3349B, PMUD3306B, PMUE4147B, PMUE4623B, PMUD3231B on page 106.
	6.1	Main O-Ring	3286431Z06
	6.2	Screw, Main Board	0304726J05
	6.3	Top Control Seal	32012232001
	6.4	Main PCB Assembly	Part of Back Cover Kit
	6.5	Thermal Pad (thin)	7515526H01
	6.6	Thermal Pad (thick)	75012205001
	6.7	Battery Contact Seal	3286435Z01
	6.8	Chassis Assembly	2786389Z03
7		Shroud Assembly, Audio Jack	01012093001
8		Battery	See Authorized Accessories List.
9		Belt Clip	See Authorized Accessories List.
10		Option Board	Available from application developer.
	10.1	Screw, Option Board	FN000157A01
	10.2	Flex, Option Board	PF000718A01

5.7.5

Non-Option Board

This section is applicable to PMUE4597C, PMUD3349C, PMUD3306C, PMUE4147C, PMUE4623C, PMUD3231C.

Figure 55: Non-Option Board



Item	Description	Part Number
1	Nameplate	33012026001
2	Product Number Label	33012039017
3	Bezel, PTT	HN001382A01

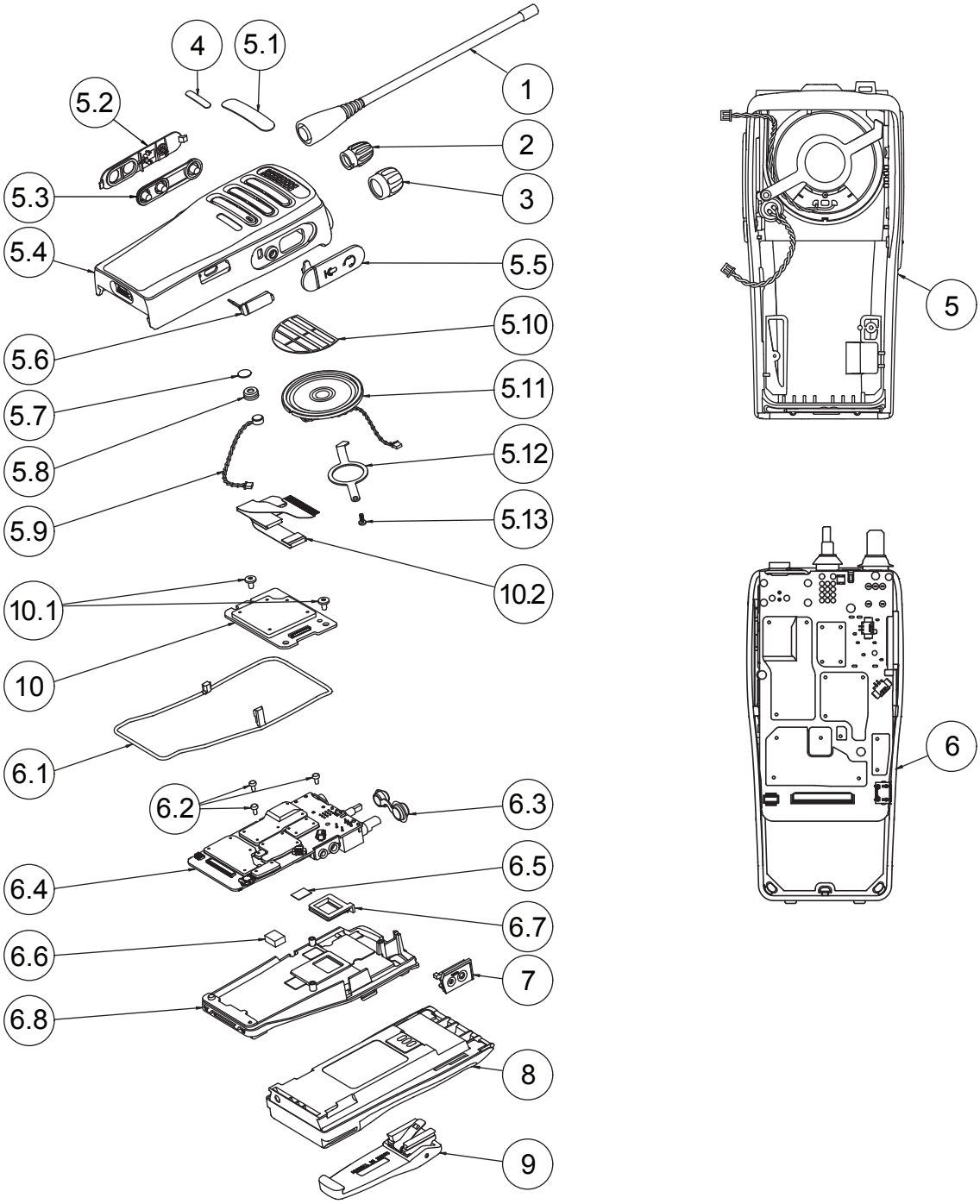
Item	Description	Part Number
4	Rubber, PTT	KP000151A01
5	Front Housing Assembly	Part of Front Cover Kit
6	Dust Cover, Micro USB	38012042001
7	Felt, Microphone	3586621Z04
8	Boot, Microphone	0780608V01
9	Microphone Assembly	0104055J51
10	Main O-Ring	3286431Z06
11	Screw, Main Board	0304726J05
12	Main PCB Assembly	Part of Back Cover Kit
13	Thermal Pad (thick)	75012205001
14	Chassis Assembly	2786389Z03
15	Belt Clip	See Authorized Accessories List.
16	Battery	See Authorized Accessories List.
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.
29	Front Cover Kit	See Front Housing Service Kit for PMUE4597C, PMUD3349C, PMUD3306C, PMUE4147C, PMUE4623C, PMUD3231C on page 105.
30	Back Cover Kit	See Back Cover Kit for PMUE4597C, PMUD3349C, PMUD3306C, PMUE4147C, PMUE4623C, PMUD3231C on page 107.

5.7.6

Option Board Capable

This section is applicable to PMUE4597C, PMUD3349C, PMUD3306C, PMUE4147C, PMUE4623C, PMUD3231C.

Figure 56: Option Board Capable



Item		Description	Part Number
1		Antenna	See Authorized Accessories List.
2		Knob, Frequency	3680530Z02
3		Knob, Volume	3680529Z01
4		Product Number Label	33012039017
5		Front Cover Kit	See Front Housing Service Kit for PMUE4597C, PMUD3349C, PMUD3306C, PMUE4147C, PMUE4623C, PMUD3231C on page 105.
	5.1	Nameplate	33012026001
	5.2	Bezel, PTT	HN001382A01
	5.3	Rubber, PTT	KP000151A01
	5.4	Front Housing Assembly	Part of Front Cover Kit
	5.5	Dust Cover, Audio Jack	15012242001
	5.6	Dust Cover, Micro USB	38012042001
	5.7	Felt, Microphone	3586621Z04
	5.8	Boot, Microphone	0780608V01
	5.9	Microphone Assembly	0104055J51
	5.10	Felt, Speaker	35012094001
	5.11	Speaker Assembly	0104055J50
	5.12	Speaker Retainer	4286620Z01
	5.13	Screw, Speaker Retainer	0386434Z02
6		Back Cover Kit	See Back Cover Kit for PMUE4597C, PMUD3349C, PMUD3306C, PMUE4147C, PMUE4623C, PMUD3231C on page 107.
	6.1	Main O-Ring	3286431Z06
	6.2	Screw, Main Board	0304726J05
	6.3	Top Control Seal	32012232001
	6.4	Main PCB Assembly	Part of Back Cover Kit
	6.5	Thermal Pad (thin)	7515526H01
	6.6	Thermal Pad (thick)	75012205001
	6.7	Battery Contact Seal	3286435Z01
	6.8	Chassis Assembly	2786389Z03
7		Shroud Assembly, Audio Jack	01012093001
8		Battery	See Authorized Accessories List.

Item		Description	Part Number
9		Belt Clip	See Authorized Accessories List.
10		Option Board	Available from application developer.
	10.1	Screw, Option Board	FN000157A01
	10.2	Flex, Option Board	PF000718A01

5.7.7

Front Housing Service Kits

Front Housing Service Kit for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A

Item	Description	Motorola Solutions Part Number
Front Kit	Front Cover Kit, Non-Keypad Portable, Option Board Capable	PMLN7210_
Front Kit	Front Cover Kit, Non-Keypad Portable , Option Board Capable (China PTT)	PMLN7230_

Front Housing Service Kit for PMUE4597B, PMUD3349B, PMUD3306B, PMUE4147B, PMUE4623B, PMUD3231B

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

Front Housing Service Kit for PMUE4597C, PMUD3349C, PMUD3306C, PMUE4147C, PMUE4623C, PMUD3231C

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

5.7.8

Back Cover Kit

Back Cover Kit for PMUE4597A, PMUD3349A, PMUD3306A, PMUE4147A, PMUE4623A, PMUD3231A

Item	Description	Motorola Solutions Part Number
Back Kit	Back Cover Kit, VHF, 5 W, MOTOTRBO Non-Display Portabl	PMLD4583_S
Back Kit	Back Cover Kit, VHF, 5 W, MOTOTRBO Non-Display Portable, Option Board Capable	PMLD4713_S
Back Kit	Back Cover Kit, 350–400 MHz, 4 W, MOTOTRBO Non-Display Portable	PMLD4680_S
Back Kit	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable	PMLE4897_S
Back Kit	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable, Option Board Capable	PMLE5047_S
Back Kit	Back Cover Kit, UHF (480 MHz), 4 W, MOTOTRBO Non-Display Portable	PMLE5063_S

Back Cover Kit for PMUE4597B, PMUD3349B, PMUD3306B, PMUE4147B, PMUE4623B, PMUD3231B

Item	Description	Motorola Solutions Part Number
Back Kit	Back Cover Kit, VHF, 5 W, MOTOTRBO Non-Display Portable	PMLD4879_S
Back Kit	Back Cover Kit, VHF, 5 W, MOTOTRBO Non-Display Portable, Option Board Capable	PMLD4881_S
Back Kit	Back Cover Kit, 350 Band, 4 W, MOTOTRBO Non-Display Portable	PMLD4883_S
Back Kit	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable	PMLE5225_S
Back Kit	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable, Option Board Capable	PMLE5237_S

Back Cover Kit for PMUE4597C, PMUD3349C, PMUD3306C, PMUE4147C, PMUE4623C, PMUD3231C

Item	Description	Motorola Solutions Part Number
Back Kit	Back Cover Kit, VHF, 5 W, MOTOTRBO Non-Display Portable	PMLD4879_S
Back Kit	Back Cover Kit, VHF, 5 W, MOTOTRBO Non-Display Portable, Option Board Capable	PMLD4881_S
Back Kit	Back Cover Kit, 350 Band, 4 W, MOTOTRBO Non-Display Portable	PMLD4883_S
Back Kit	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable	PMLE5225_S
Back Kit	Back Cover Kit, UHF, 4 W, MOTOTRBO Non-Display Portable, Option Board Capable	PMLE5237_S

5.7.9

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 28: 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
FN000157A01	Screw, Option Board	T6 TORX	1.8 to 2.0

Chapter 6

Basic Troubleshooting

This chapter contains error codes and board replacement procedures.

If the board does not pass all the performance checks or exhibits an error code listed below, then the circuit board must be replaced. If repair requires knowledge on details of component level troubleshooting, please send the radio to the Motorola Solutions Offices.

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

6.1 Replacement Back Kit Procedures

If a board is replaced, it does not necessarily need to be retuned if it has been factory tuned. It must however be checked for performance before being placed into service. Of particular concern is the Bias DAC, that must 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.

Chapter 7

Authorized Accessories List

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

Table 29: Antenna

Part Number	Description
HAD9742_	VHF, 146–162 MHz, Stubby Antenna
HAD9743_	VHF, 162–174 MHz, Stubby Antenna
NAD6502_R	VHF, 146–174 MHz, Heliflex Antenna
PMAD4012_	VHF, 136–155 MHz, 9 cm Antenna
PMAD4014_	VHF, 136–155 MHz, 14 cm Antenna
PMAD4042_	VHF, 136–150.8 MHz, Heliflex Antenna
PMAE4002_	UHF, 403–433 MHz, 9 cm Stubby Antenna
PMAE4003_	UHF, 430–470 MHz, 9 cm Stubby Antenna
PMAE4016_	UHF, 403–520 MHz, Antenna Whip
PMAD4009_	336–368 MHz, Stubby Antenna
PMAD4020_	370–400 MHz, Stubby Antenna

Table 30: Batteries

Part Number	Description
NNTN4497_R	Core Li-Ion, 2250 mAh Battery
NNTN4851_	NiMH, 1400 mAh Battery
NNTN4970_	Slim Li-Ion, 1600 mAh Battery
PMNN4072_	NiMH, 1400 mAh MagOne Battery
PMNN4098_	NiMH, 1400 mAh Battery
PMNN4253A_	Li-Ion, 1600 mAh Slim Battery
PMNN4253B_	Li-Ion, 2100 mAh Slim Battery
PMNN4450_R	Standard Li-Ion Battery, 2800M 2900T
PMNN4458_R	MagOne Li-Ion Battery, 2050 mAh min

Table 31: Cables

Part Number	Description
PMKN4128_	Programming Cable USB

Table 32: Carry Devices

Part Number	Description
1505596Z02	Case Adjustable Chest Pack
4280384F89	Universal RadioPAK™ Extension Belt for waist larger than 40 in
4280483B03_	2.5 in. Swivel Belt Loop
4280483B04_	3 in. Swivel Belt Loop
HLN6602_	Universal Chest Pack with Radio Holder, Pen Holder and Velcro Secured Pocket
HLN8255_	Spring Action 3 in. Belt clip
HLN9701_	Nylon case with belt loop and D-rings
HLN9985_	Waterproof Bag, includes large carrying strap
NTN5243_	Carry Case Shoulder Strap
RLN4570_	Breakaway Chest Pack
RLN4815_	Universal RadioPAK™ and Utility Case (fanny pack)
RLN5383_	Non-Display Leather case with Belt loop and D-rings
RLN5384_	Non-Display Leather case with 2.5 in. Swivel and D-rings
RLN5385_	Non-Display Leather case with 3 in. Swivel and D-rings
RLN5644_	Spring Action 2 in. Belt clip

Table 33: Chargers

Part Number	Description
EPNN7997_	10-hour Plug-in Charger
EPNN9288_	Rapid-rate Charger Transformer
NNTN8460_	Charging Insert for Universal Multi-Unit Charger (PMLN6588), compatible with CP200d, CP200, CP150, PR400 and CP200.XLS
PMLN5193_	Rapid-rate Charger with switchmode power supply
PMLN6588_	120 V, 6 Unit Rapid Rate Charger
PMLN6598_	Standard Multi-Unit Charger, Euro Plug
PMLN6600_	Multi-Unit Charger, UK Plug
PMLN7089_	Vehicular Travel Charger
PMPN4173_	120 V, 90 Minute Rapid Rate CEC compliant Charger with Switch Mode Power Supply
WPLN4137_	Charger Base
WPLN4155_	10-hour Desktop Charger

Table 34: Earbuds and Earpieces

Part Number	Description
AARLN4885_	Receive-Only Earpiece with 3.5 mm Jack

Part Number	Description
BDN6720_	Flexible Ear Receiver
PMLN4620_	D-Shell Receive Only Earpiece (One Size) for Remote Speaker Microphone
PMLN6531_	Ear Receiver with In-Line Microphone/ PTT/VOX Switch (Mag One)
PMLN6532_	Swivel Earpiece with In-Line Microphone and PTT
PMLN6533_	Earset with combined microphone and PTT
PMLN6534_	Earbud with In-Line Microphone/PTT/VOX Switch (Mag One)
PMLN6535_	D-Style Earpiece with Microphone/PTT
PMLN6537_	Earset with Boom Mic and In-Line PTT/VOX Switch (Mag One)
PMLN7396_	Adjustable Receive-Only Earpiece with Remote Speaker Micro-phone
PMLN7560	Receive-Only Earpiece with Translucent Tube
RLN4941_	Receiver-Only Earpiece with Translucent Tube and Rubber Eartip
WADN4190_	Receive-Only Flexible Earpiece for Remote Speaker Microphone

Table 35: Headsets and Headset Accessories

Part Number	Description
PMLN6538_	Lightweight Headset with Swivel Boom Microphone
PMLN6541_	Lightweight Temple Transducer Headset
PMLN6542_	MagOne Ultra-Lite Headset, behind-the-head, adjustable with Boom Microphone and In-line PTT
PMLN6854_	Heavy Duty Headset, Noise Canceling Boom Mic Headset
PMLN7468_	Medium Weight Over-the-Head Dual Muff Headset

Table 36: Remote Speaker Microphones

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

Table 37: Surveillance Accessories

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

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 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 nonconductive 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 computer to communicate directly with certain radios 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 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.