MOTOTRBO™ TWO-WAY RADIOS
CP200d™
BASIC SERVICE MANUAL

Foreword

This manual covers all models of the CP200d™ series Portable Radios, unless otherwise specified. It includes all the information necessary to maintain peak product performance and maximum working time, using levels 1 and 2 maintenance procedures. This level of service goes down to the board replacement level and is typical of some local service centers, self-maintained customers, and distributors.

RF Energy Exposure and Product Safety Guide for Portable Two-Way Radios

ATTENTION!

Before using the portable two way product, CP200d , read the RF Energy Exposure and Safety guide that ships with the radio which contains important operating instructions for safe usage and RF energy awareness and control for Compliance with applicable Standards and Regulations.

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Notes

Document History

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

Edition	Description	Date
68009616001	Initial Release	June 2013

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CP200d™ Portable Radios	Two (2) Years
Product Accessories (Excluding Batteries, Chargers, and Mag One accessories)	One (1) Year
Mag One Accesories	Six (6) Months

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- the damage or defect is caused by charging or using the battery in equipment or service other than the Product for which it is specified.

H. Freight costs to the repair depot.

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VII. Governing Law

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

Battery and Charger Warranty

Workmanship Warranty

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

All CP200d Batteries	Two (2) Years

Capacity Warranty

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

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

Chapter 1   Introduction

1.1   Notations Used in This Manual

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

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

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

Caution

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

WARNING
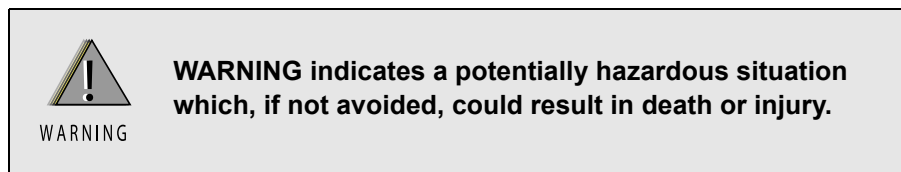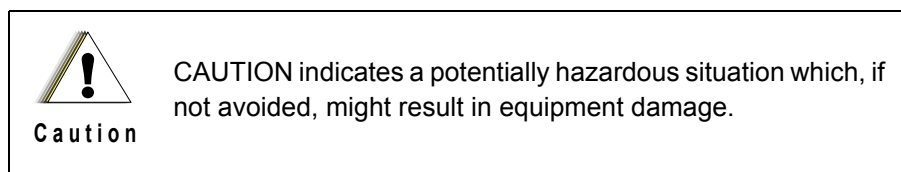
1.2   Radio Description

The CP200d portable radio are available in the following frequency ranges and power levels.

Table 1-1. Radio Frequency Ranges and Power Levels

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

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

1.2.1   Non Keypad Model
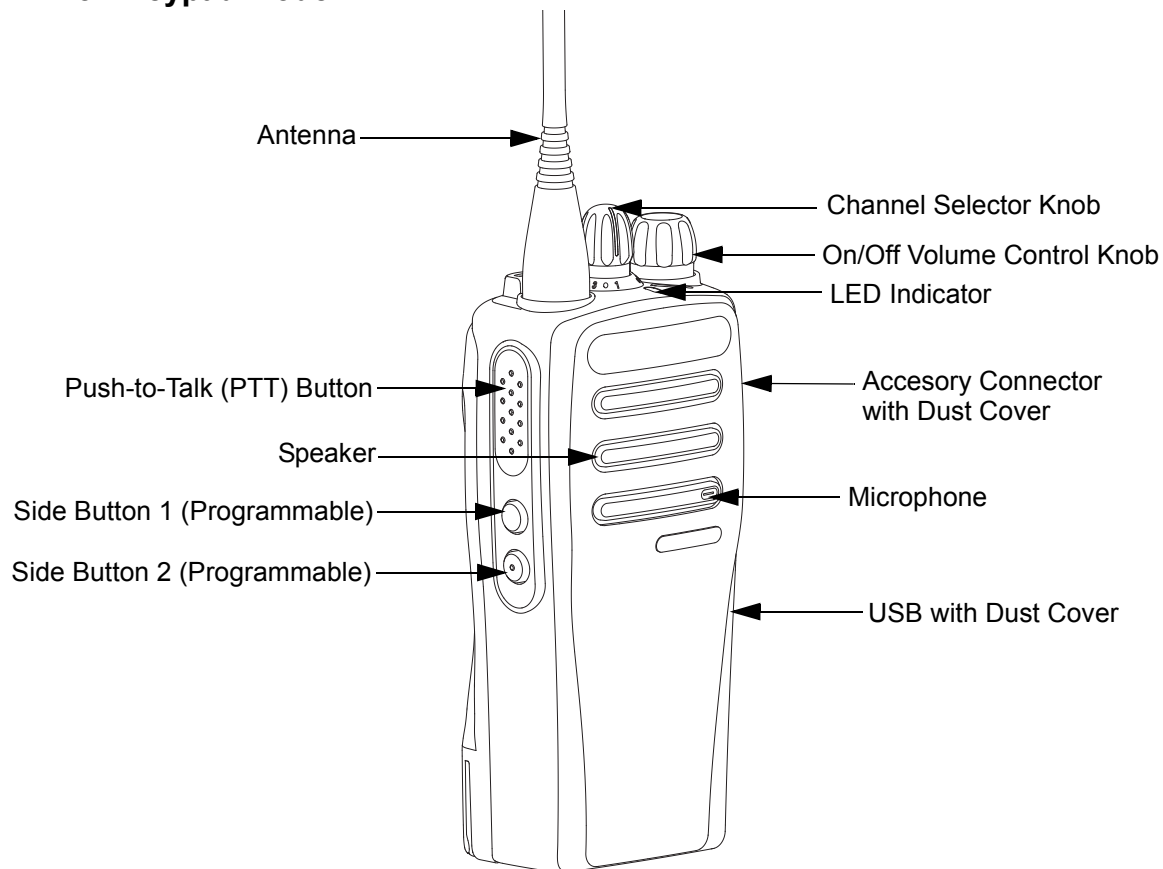
Figure 1-1. Non Keypad Model

- 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.
- LED INDICATOR – Red, green and orange light-emitting diodes indicate operating status.
- SIDE BUTTONS – These 2 buttons are field programmable using the CPS.
- CHANNEL SELECTOR KNOB – Rotate clockwise to increment and counter clockwise to decrement the channel.
- PUSH-TO-TALK (PTT) – Press to execute voice operations (e.g. Group call and Private Call).
- ANTENNA – Provides the needed RF amplification when transmitting or receiving.
- MICROPHONE – Allows the voice to be sent when PTT or voice operations are activated.
- ACCESSORY CONNECTOR WITH DUST COVER – Interface point for all accessories to be used with the radio. It has eight points to which specific accessories will connect to and be activated.
- SPEAKER – Outputs all tones and audio that are generated by the radio (e.g. features like keypad tones and voice audio).
- USB WITH DUST COVER – Dust cover to prevent dust from clogging USB port.

1.3   Portable Radio Model Numbering Scheme

Model No.Example :   AZ   H   5   5   Q   D   H   9   L   A   1   A   N

Position   :   1   2   3   4   5   6   7   8   9   10 11 12

AZ: Asia
LA: Latin America
AA: North America
MD: Europe/Middle East/Africa

H: Portable

MOTOTRBO CP200d: 01

Unique Variation
N: Standard Package

Version Letter

Feature Level
1: Standard w/ FM
2. Non-FM
3. CSA IE CEx ATEX
4. CQST

Band
J: 136-174 MHz
R: 403-470 MHz

Primary System Type
A: Conventional
B: Trunking
C: Analog Only

Power Level
C: 1.0,2.0,2.5 or 3.5 Watt
D: 4.0-5.0 Watt

Primary Operation
J : Basic (No GPS, no Bluetooth, no
    embedded GOB)
K : GPS and Bluetooth
L : GPS Only
M: Bluetooth Only
N : Bluetooth w/ embedded GOB

Physical Packages
C: Low Tier (Plain)
H: Mid Tier (Monochrome Display LKP)
N: HIgh Tier (Color Display FKP)
J: 3 Button MOR
T: No Display - Limited Tier

Channel Information
8: Variable/Programmable Channel Spacing
   w/ unique # of channels
9: Variable/Programmable Channel Spacing

Figure 1-2. Portable Radio Model Numbering Scheme

1.4   Model Charts

1.4.1   VHF Model Chart

CP200d, VHF, 136–174 MHz				
Model			**Description**	
AAH01JDC9JA2_N			CP200d 136–174 MHz, 5W, Non Keypad	
	AAH01JDC9JC2_N		CP200d 136–174 MHz, 5W, Non Keypad, Analog	
		Item	**Description**	
X	X	PMLD4583_S	BC Kit 136–174M, 5W, NKP	
X	X	PMLN6345_S	Front Cover Kit, NKP	
X	X	HAD9742_	VHF Stubby, 146–162MHz	
X	X	HAD9743_	VHF Stubby, 162–174MHz	
X	X	NAD6502_R	VHF Heliflex, 146–174MHz	
X	X	PMAD4012_	VHF Stubby Antenna (136–155 MHz), 9cm	
X	X	PMAD4014_	VHF Antenna (136–155 MHz), 14cm	
X	X	PMAD4042_	VHF Heliflex136–150.8MHz	

NOTE:

X = Item Included

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

1.4.2 UHF Model Chart

CP200d, UHF, 403–470 MHz				
Model			**Description**	
AAH01QDC9JA2_N			CP200d 403–470 MHz, 5W, Non Keypad	
	AAH01QDC9JC2_N		CP200d 403–470 MHz, 4W, Non Keypad, Analog	
		Item	**Description**	
X	X	PMLE4897_S	BC Kit 403–470M, 4W, NKP	
X	X	PMLN6345_S	Front Cover Kit, NKP	
X	X	8505816K24	UHF Heliflex Stubby, 403–440 MHz	
X	X	NAE6522_R	UHF Stubby Antenna, 438–470 MHz	
X	X	PMAE4002_	UHF 9cm Stubby Antenna, 403–433 MHz	
X	X	PMAE4003_	UHF 9cm Helical Antenna, 430–470 MHz	
X	X	PMAE4016_	UHF Whip Antenna, 403–520 MHz, 17cm	

NOTE:

X = Item Included

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

1.5   Specifications

General	CP200d
Channel Capacity	16
Frequency	VHF: 136 – 174 MHz UHF: 403 – 470 MHz
Dimensions (HxWxT) w/ NiMH battery	130mm x 62.5mm x 42mm
Weight (with NiMH 1400 mAh) (with High Cap Li-Ion 2200 mAh battery) (with Slim Li-Ion 1600 mAh battery)	406 g 346 g 341 g
Power Supply	7.5V (nominal)
FCC Description	VHF: ABZ99FT3092 UHF: ABZ99FT4094
IC Description	VHF: 109AB-99FT3092 UHF: 109AB-99FT4094
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 hours Digitial: 11.5 hours
Core Slim Li-Ion 1600 mAh battery	Analog: 10.5 hours Digital: 13.5 hours
High Cap Li-Ion 2200 mAh battery	Analog: 14.5 hours Digital: 18.5 hours

NOTE   Weight can have 5% margin of error

Receiver	CP200d
Frequencies	VHF: 136 – 174 MHz UHF: 403 – 470MHz
Channel Spacing	12.5 kHz/ 25 kHz*
Frequency Stability (-30°C to +60°C, +25 °C Ref)	+/-0.5 ppm
Analog Sensitivity (12 dB SINAD)	0.3 µV 0.22 µV (typical)
Digital Sensitivity (5% BER)	0.25 µV 0.19 µV (typical)
Intermodulation (TIA603D)	70 dB
Adjacent Channel Selectivity TIA603D	45 dB @ 12.5kHz, 70 dB @ 20kHz/25kHz
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 @ 25 kHz*
Audio Response	TIA603D
Conducted Spurious Emission (TIA603D)	-57 dBm
Speaker Impedance	16 Ohms
Voltage @ Rated Audio	2.828 V

NOTE *25 kHz may not be available in the U.S. for Part 90 operation due to the FCC's Narrowbanding requirements.

Transmitter	CP200d
Frequencies	VHF: 136 – 174 MHz UHF: 403 – 470MHz
Channel Spacing	12.5 kHz/ 25 kHz*
Frequency Stability (-30°C to +60°C)	+/-0.5 ppm
Power Output (Low Power)	1 W
Power Output (High Power)	VHF: 5 W UHF/UHF2: 4 W
Modulation Limiting	+/-2.5 kHz @ 12.5 kHz +/-5.0 kHz @ 25 kHz*
FM Hum and Noise	-40 dB @ 12.5 kHz -45 dB @ 25 kHz*
Conducted / Radiated Emission	-36 dBm < 1 GHz -30 dBm > 1 GHz
Adjacent Channel Power	60 dB @ 12.5 kHz 70 dB @ 25 kHz*
Audio Response	TIA603D
Audio Distortion	3% (typical)
4FSK Digital Modulation	12.5kHz Data: 7K60F1D & 7K60FXD 12.5kHz Voice: 7K60F1E & 7K60FXE Combination of 12.5kHz Voice and Data: 7K60F1W
Digital Vocoder Type	AMBE+2™™
Digital Protocol	ETSI-TS102361-1 ETSI-TS102361-2 ETSI-TS102361-3

NOTE *25 kHz may not be available in the U.S. for Part 90 operation due to the FCC's Narrowbanding requirements.

Conforms to:

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

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

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

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

94/62/EC (Packaging and Packaging Waste)

Radio meets applicable regulatory requirements.

VHF Self-Quieter Frequencies
144 MHz +/- 5 kHz
153.6 MHz +/- 5 kHz
172.8 MHz +/- 5 kHz

UHF Self-Quieter Frequencies
420 MHz +/- 5 kHz
440 MHz +/- 5 kHz

Military Standards										
Applicable MIL–STD	810C		810D		810E		810F		810G	
	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Prodecures
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
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	-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

* Operating temperature specification with LiIon battery is -10 °C to +60 °C.

Chapter 2   Test Equipment and Service Aids

2.1   Recommended Test Equipment

The list of equipment contained in Table 2-1 includes most of the standard test equipment required for servicing Motorola portable radios.

Table 2-1. Recommended Test Equipment

Equipment	Characteristics	Example	Application
Service Monitor	Can be used as a substitute for items marked with an asterisk (*)	Aeroflex 3920 (www.aeroflex.com),	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
Digital RMS Multimeter *	100 µV to 300 V 5 Hz to 1 MHz 10 Mega Ohm Impedance	Fluke 179 or equivalent (www.fluke.com)	AC/DC voltage and current measurements. Audio voltage measurements
RF Signal Generator *	100 MHz to 1 GHz -130 dBm to +10 dBm FM Modulation 0 kHz to 10 kHz Audio Frequency 100 Hz to 10 kHz	Agilent N5181A (www.agilent.com), Ramsey RSG1000B (www.ramseyelectronics.com), or equivalent	Receiver measurements
Oscilloscope *	2 Channel 50 MHz Bandwidth 5 mV/div to 20 V/div	Leader LS8050 (www.leaderusa.com), Tektronix TDS1001b (www.tektronix.com), or equivalent	Waveform measurements
Power Meter and Sensor *	5% Accuracy 100 MHz to 500 MHz 50 Watts	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
RF Millivolt Meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 92EA (www.boonton.com) or equivalent	RF level measurements
Power Supply	0 V to 32 V 0 A to 20 A	B&K Precision 1790 (www.bkprecision.com) or equivalent	Voltage supply

2.2   Service Aids

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

Table 2-2. Service Aids

Motorola Part No.	Description	Application
RLN4460_	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.
RVN5115_	Customer Programming Software on DVD-ROM	Allows servicer to program radio parameters, tune and troubleshoot radios.
PMKN4128_	Portable Programming Cable	This cable connects the radio to a USB port for radio programming and data applications.
PMKN4156_	Portable Test Cable	This cable connects the radio to RLN4460 Portable Test Set for test and measurement.
0180305K08EPP	7.5V Universal Battery Eliminator	Connects to radio battery eliminator cable.
5886564Z01	RF Adaptor	Application adapts radio's 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 Tweezer	Remove components during disassembly.
N/A	PTT Roller Pressing Jig	To assist PTT assembly.

2.3   Portable Programming Cable
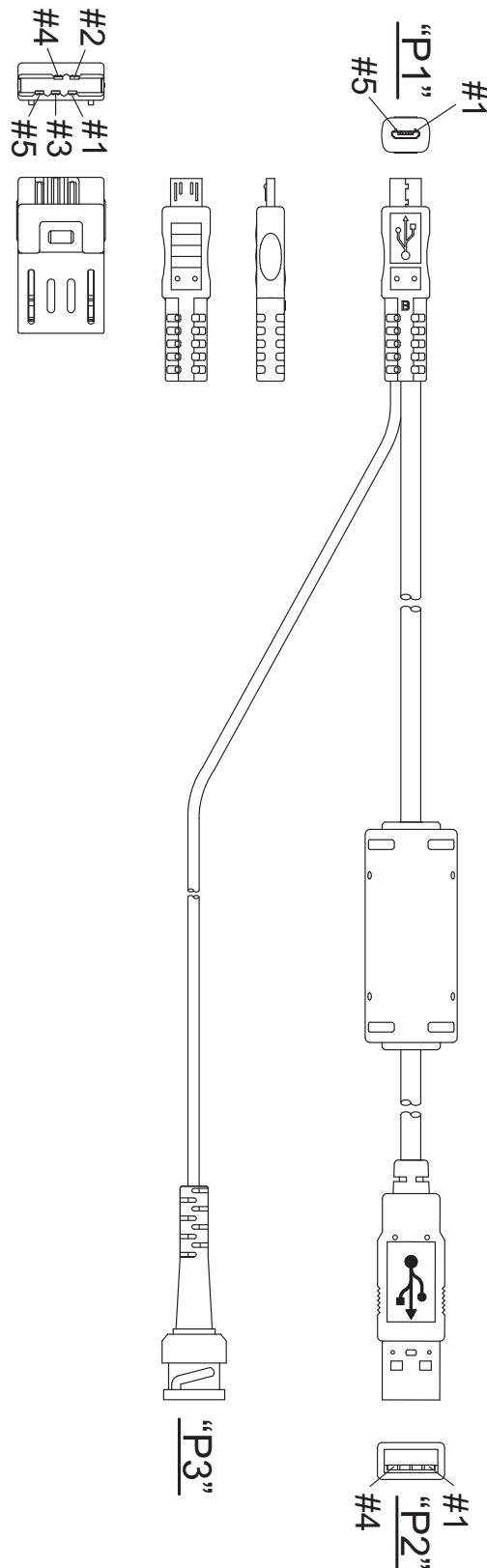
Figure 2-1. Portable Programming Cable with TTR (PMKN4128_)

Table 2-3. Pin Configuration of Portable Programming Cable with TTR

CONNECTION			
P1	**P2**	**P3**	**Function**
1	1		VCC(5V)
2	2		DATA-
3	3		DATA+
4		BNC Center Pin	TTR
5	4	BNC Shell	GROUND

2.4 Portable Test Cable
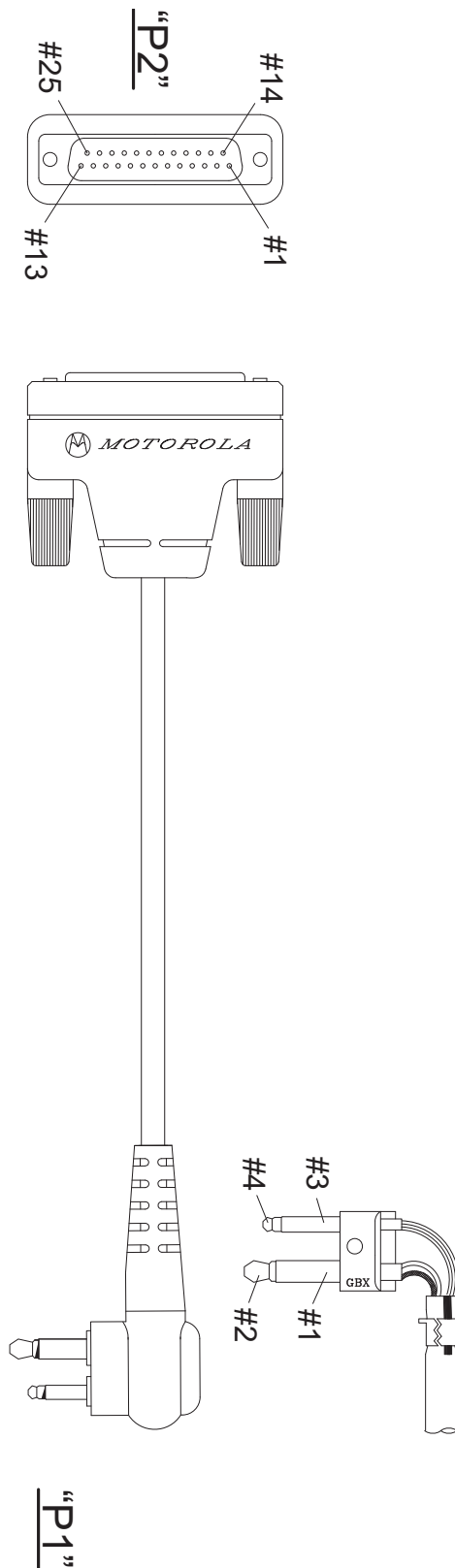
Figure 2-2. Portable Test Cable (PMKN4156_)

Table 2-4. Pin Configuration of Portable Test Cable

CONNECTION		
P1	**P2**	**Function**
1	1,5	GROUND
2	7,24	EXTERNAL MIC
3	16	EXTERNAL SPEAKER -
4	17	EXTERNAL SPEKAER +

Chapter 3   Transceiver Performance Testing

3.1   General

These radios meet published specifications through their manufacturing process by utilizing high-accuracy laboratory-quality test equipment. The recommended field service equipment approaches the accuracy of the manufacturing equipment with few exceptions. This accuracy must be maintained in compliance with the manufacturer's recommended calibration schedule.

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

3.2   Setup

Supply voltage is provided using a 7.5 VDC power supply. The equipment required for alignment procedures is connected as shown in the Radio Tuning Equipment Setup Diagram, Figure 4-2.

> ⚠ **WARNING**
>
> **Do NOT use any form of connector, e.g. wires, crocodile clips, and probes, to supply voltage to the radio, other than the Motorola approved battery eliminator.**

Initial equipment control settings should be as indicated in Table 3-1. The remaining tables in this chapter contain the following related technical data:

Table Number	Title
3-2	Test Environments
3-3	Test Frequencies
3-4	Transmitter Performance Checks
3-5	Receiver Performance Checks

Table 3-1. Initial Equipment Control Settings

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

Table 3-1. Initial Equipment Control Settings

Service Monitor	Power Supply	Test Set
Oscilloscope Source: Mod Oscilloscope Horizontal: 10mSec/Div Oscilloscope Vertical: 2.5kHz/Div Oscilloscope Trigger: Auto Monitor Image: Hi Monitor Bandwidth: Narrow Monitor Squelch: Middle setting Monitor Vol: 1/4 setting	Current: 2.5A	

3.2.1   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 Table 3-2.

Table 3-2. 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 20kHz, 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 3-3. The radio beeps in each position.

Table 3-3. Test Frequencies

Channel Selector Switch Position	Test Channel	VHF	UHF
1 Low Power 9 High Power	TX#1 or #9 RX#1 or #9	136.075 136.075	403.15 403.15
2 Low Power 10 High Power	TX#2 or #10 RX#2 or #10	142.575 142.575	414.15 414.15
3 Low Power 11 High Power	TX#3 or #11 RX#3 or #11	146.575 146.575	425.15 425.15
4 Low Power 12 High Power	TX#4 or #12 RX#4 or #12	155.575 155.575	436.45 436.45
5 Low Power 13 High Power	TX#5 or #13 RX#5 or #13	161.575 161.575	447.15 447.15
6 Low Power 14 High Power	TX#6 or #14 RX#6 or #14	167.575 167.575	458.15 458.15
7 Low Power 15 High Power	TX#7 or #15 RX#7 or #15	173.975 173.975	469.85 469.85
8 Low Power 16 High Power	TX#8 or #16 RX#8 or #16	174.000 174.000	470.000 470.000

Table 3-4. 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 ±201Hz for UHF ±68Hz for VHF
Power RF	As above	As above	As above	Low Power: 0.9 – 1.5W (VHF/UHF) High Power: 4.0 – 4.8W (UHF) High Power: 5.0 – 5.8W (VHF)
Voice Modulation	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out Monitor: DVM: AC Volts Set 1kHz Mod Out level for 0.025Vrms at test set, 80mVrms at AC/DC test set jack	As above	As above, meter selector to mic	Deviation: $\geq$ 4.0 kHz but $\leq$ 5.0 kHz (25 kHz Ch Sp).
Voice Modulation (internal)	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out	TEST MODE, Test Channel 4 carrier squelch output at antenna	Remove modulation input	Press PTT switch on radio. Say "four" loudly into the radio mic. Measure deviation: $\geq$ 4.0 kHz but $\leq$ 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: $\geq$500Hz but $\leq$1000Hz (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 ~1.5V

Table 3-4. Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
FSK Error	DMR Mode. FSK Error	TEST MODE, Digital Mode, transmit with O.153 test pattern	Key up radio with O.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%

* See Table 3-3

Table 3-5. Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4 carrier squelch output at antenna	PTT to continuously transmit (during the performance check)	Frequency error to be ±201Hz for UHF ±68Hz for VHF
Rated Audio	Mode: GEN Output level: 1.0mV RF 6th channel test frequency* Mod: 1kHz tone at 3kHz 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 <0.35μV

Table 3-5. Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
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 2.83Vrms
	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 <0.25μV. Preferred SINAD = 9 – 10dB
Receiver BER	IFR DMR mode. Signal generator with O.153 test pattern	TEST MODE, Digital Mode, transmit with O.153 test pattern	Read BER using Tuner. Adjust RF level to get 5% BER	RF level to be <0.35μV 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 audo analyzer to read Vrms. Adjust volume to get rated audio	Adjust volume until Vrms = 2.83V
Receiver Audio Distortion	IFR DMR Mode. Signal generator with 1031 test pattern	As above	As above. Then set audio analyzer to measure distortion	Not exceed 5%

* See Table 3-3

3.3 Test Mode

3.3.1 Entering Test Mode

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

3.3.2 RF Test Mode

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

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 Table 3-2.

2. Each short press of **Side Button 1** toggles the channel spacing between 20 kHz/25 kHz* and 12.5 kHz. The radio 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 3-4. The radio beeps in each position.

3.3.3 LED Test Mode

1. Press and hold **Side Button 1** in RF Test Mode. The radio beeps once.
2. Upon any button/key press, the radio lights up the red LED.
3. Consequently, upon any button/key press, the red LED is turned off and the radio turns on the green LED.
4. Consequently, upon any button/key press, the green LED is turned off the radio shall turn on both LEDs.

3.3.4 Speaker Tone Test Mode

1. Press and hold **Side Button 1** after LED Test Mode. The radio beeps once.
2. The radio generates a 1 kHz tone with the internal speaker.

NOTE   *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.

3.3.5   Earpiece Tone Test Mode

1. Press and hold **Side Button 1** after Speaker Tone Test Mode. The radio beeps once.
2. The radio generates a 1 KHz tone with the earpiece.

3.3.6   Audio Loopback Earpiece Test Mode

1. Press and hold **Side Button 1** after Earpiece Tone Test Mode. The radio beeps once.
2. The radio shall route any audio on the external mic to the earpiece.

3.3.7   Battery Check Test Mode

1. Press and hold **Side Button 1** after Audio Loopback Earpiece Test Mode. The radio beeps once.
2. The radio LED lights up accordingly; green LED for High Battery Level, amber LED for Mid Battery Level and blinking red LED for Low Battery Level.

3.3.8   Button/Knob/PTT Test Mode

1. Press and hold **Side Button 1** after Battery Check Test Mode. The radio beeps once.
2. Rotate the **Volume Knob**; the radio beeps at each position.
3. Rotate the **Channel Knob**; the radio beeps at each position.
4. Press **Side Button 1**; the radio beeps; release, the radio beeps.
5. Press **Side Button 2**; the radio beeps; release, the radio beeps.
6. Press the **PTT Switch**; the radio beeps; release, the radio beeps.

Chapter 4   Radio Programming and Tuning

4.1   Introduction

This chapter provides an overview of the MOTOTRBO Customer Programming Software (CPS), as well as the Tuner and AirTracer applications, which are all designed for use in a Windows 8/7/Vista/XP environment. These programs are available in one kit as listed in Table 4-1. An Installation Guide is also included with the kit.

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

Table 4-1. Software Installation Kits Radio Tuning Setup

Description	Part Number
MOTOTRBO CPS	RVN5115_

4.2   Customer Programming Software Setup

The CPS programming setup, shown in Figure 4-1 is used to program the radio.

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

> ⚠ **C a u t i o n**
>
> Computer USB ports can be sensitive to Electrostatic Discharge. Do not touch exposed contacts on cable when connected to a computer.

Radio

PC

Battery

Portable Programming
Cable PMKN4128_

Figure 4-1. CPS Programming Setup

4.3   AirTracer Application Tool

The MOTOTRBO AirTracer application tool has the ability to capture over-the-air digital radio traffic and save the captured data into a file. The AirTracer application tool can also retrieve and save internal error logs from MOTOTRBO radios. The saved files can be analyzed by trained Motorola personnel to suggest improvements in system configurations or to help isolate problems.

4.4   Radio Tuning Setup

A personal computer (PC), Windows 8/7/Vista/XP and a tuner program are required to tune the

NOTE   Refer to the appropriate program online help files for the tuning procedures.

radio. To perform the tuning procedures, the radio must be connected to the PC and test equipment setup as shown in Figure 4-2.
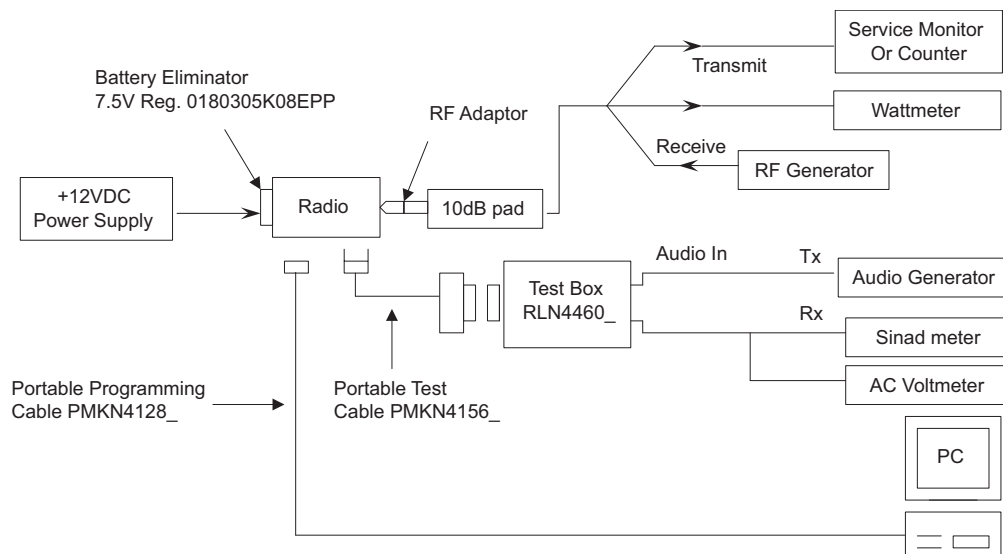

Figure 4-2. Radio Tuning Equipment Setup

Chapter 5   Disassembly/Reassembly Procedures

5.1   Introduction

This chapter provides details about the following:

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

5.2   Preventive Maintenance

Periodic visual inspection and cleaning is recommended.

5.2.1   Inspection

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

5.2.2   Cleaning Procedures

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

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

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

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

Cleaning External Plastic Surfaces

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

Cleaning Internal Circuit Boards and Components

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

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

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

5.3   Safe Handling of CMOS and LDMOS Devices

Complementary metal-oxide semiconductor (CMOS) 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 circuits and are especially important in low humidity conditions. DO NOT attempt to disassemble the radio without first referring to the CMOS CAUTION paragraph in the Disassembly and Reassembly section of the manual.

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


⚠️

C a u t i o n

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

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

- Ground the working surface of the service bench to protect the CMOS/LDMOS device. We recommend using the Motorola Static Protection Assembly (part number 0180386A82), which includes a wrist strap, two ground cords, a table mat, a floor mat, ESD shoes and an ESD chair.

- Wear a conductive wrist strap in series with a 100k resistor to ground. (Replacement wrist straps that connect to the bench top covering are Motorola part number 4280385A59).

- Do not wear nylon clothing while handling CMOS/LDMOS devices.

- Do not insert or remove CMOS/LDMOS devices with power applied. Check all power supplies used for testing CMOS/LDMOS devices to be certain that there are no voltage transients present.

- When straightening CMOS/LDMOS pins, provide ground straps for the apparatus used.

- When soldering, use a grounded soldering iron.

- If at all possible, handle CMOS/LDMOS devices by the package and not by the leads. Prior to touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

5.4   Repair Procedures and Techniques – General

NOTE Environmentally Preferred Products (EPP) (refer to the marking on the printed circuit boards — examples shown below) were developed and assembled using environmentally preferred components and solder assembly techniques to comply with the European Union's **Restriction of Hazardous Substances (ROHS) Directive 2002/95/EC** and **Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC**. To maintain product compliance and reliability, use only the Motorola specified parts in this manual.
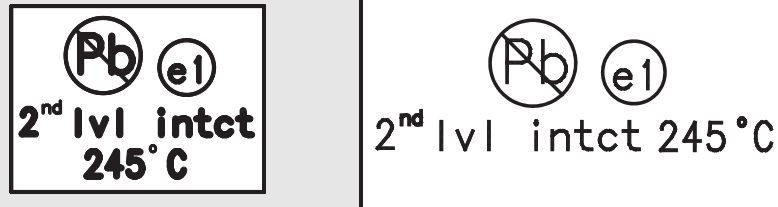
Any rework or repair on Environmentally Preferred Products must be done using the appropriate lead-free solder wire and lead-free solder paste as stated in the following table:

Table 5-1. Lead Free Solder Wire Part Number List

Motorola Part Number	Alloy	Flux Type	Flux Content by Weight	Melting Point	Supplier Part number	Diameter	Weight
1088929Y01	95.5Sn/3.8Ag/0.7Cu	RMA Version	2.7-3.2%	217C	52171	0.015"	1lb spool

Table 5-2. Lead Free Solder Paste Part Number List

Motorola Part Number	Manufacturer Part Number	Viscosity	Type	Composition & Percent Metal	Liquid Temperature
11012015002	IPN800610	1000-1700 poise	Type 4	(95.5Sn 3.8Ag 0.7Cu) 88.5%	217°C

Parts Replacement and Substitution

When damaged parts are replaced, identical parts should be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola part number and order the part from the nearest Motorola Radio Products and Solutions Organization (RPSO) listed in Appendix A of this manual.

Rigid Circuit Boards

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

When soldering near a connector:

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

5.5   Disassembling and Reassembling the Radio — General

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.

The following tools are required for disassembling the radio:

- TORX™ T6 screwdriver
- Chassis and Knob Opener (p/n: 6686533Z01)
- Flat square tip plastic tweezer

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

- Grease (1185937A01)
- TORX™ T6 screwdriver
- Flat square tip plastic tweezer

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

| ⚠️ **C a u t i o n** | To assure the safety and regulatory compliance of the , the radio must be repaired only at Motorola service facilities. Please call Motorola at 800-422-4210 for the address and contact information of your nearest service center |

5.6   Radio Disassembly – Detailed

5.6.1   Front Cover from Chassis Disassembly

  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 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.

  3.   Remove the antenna by turning it counterclockwise.
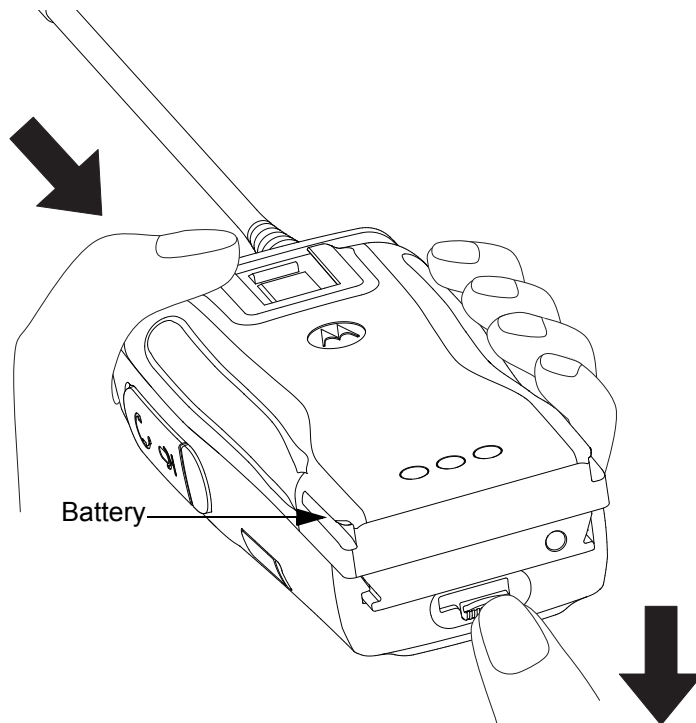

Battery

Figure 5-1. Battery Removal.

4. Pry off the volume and channel selector knobs from their shafts using the knob remover/
   chassis opener tool (Motorola p/n: 6686533Z01).
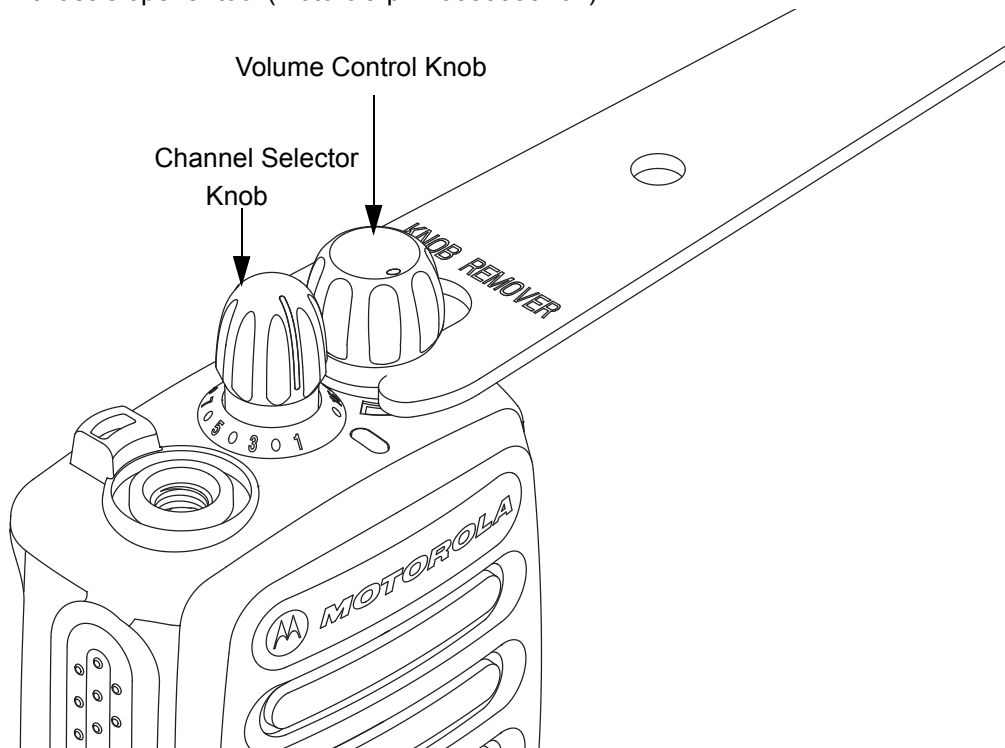
Volume Control Knob

Channel Selector
Knob

Figure 5-2. Channel Selector and Volume Knob Removal.

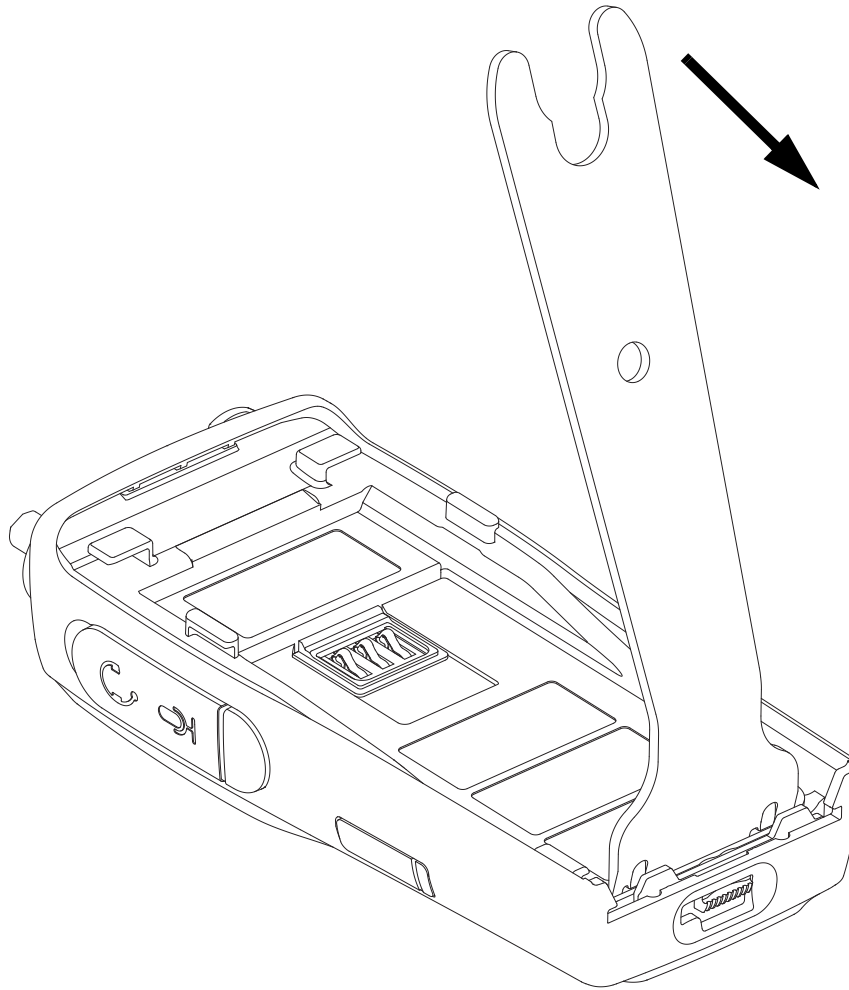**NOTE** Both knobs slide on and off. However, they are supposed to fit very tightly on their shafts.
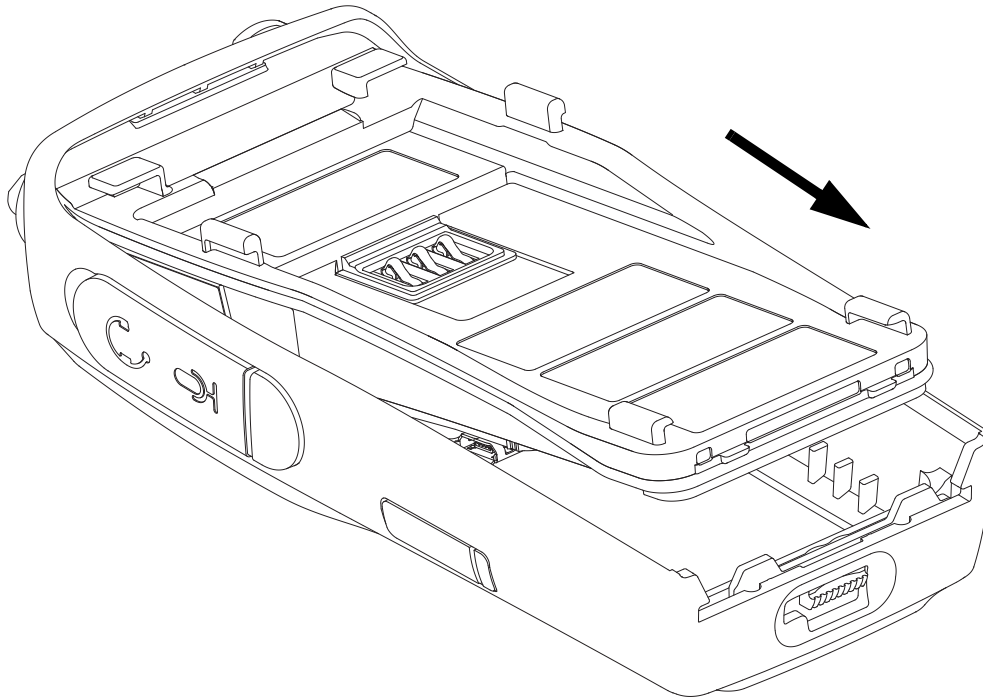
Figure 5-3. Chassis Removal

5.   Separate the chassis from the front housing assembly by using the knob remover/chassis opener tool. Place the broad side of the opener into the slots located at the base of the radio as shown in Figure 5-3. Press the handle of the opener downwards. This pressing action forces the thin inner plastic wall towards the base of the radio, releasing the two chassis base tabs.

> ⚠️
> **Caution**
>
> Marring the front housing O-ring, sealing area will prevent 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.

Figure 5-4. Chassis Removal from Front Housing

6.   Slowly slide out the chassis assembly from the front housing Figure 5-4 until the volume and channel selector shafts are free from the top of the housing.
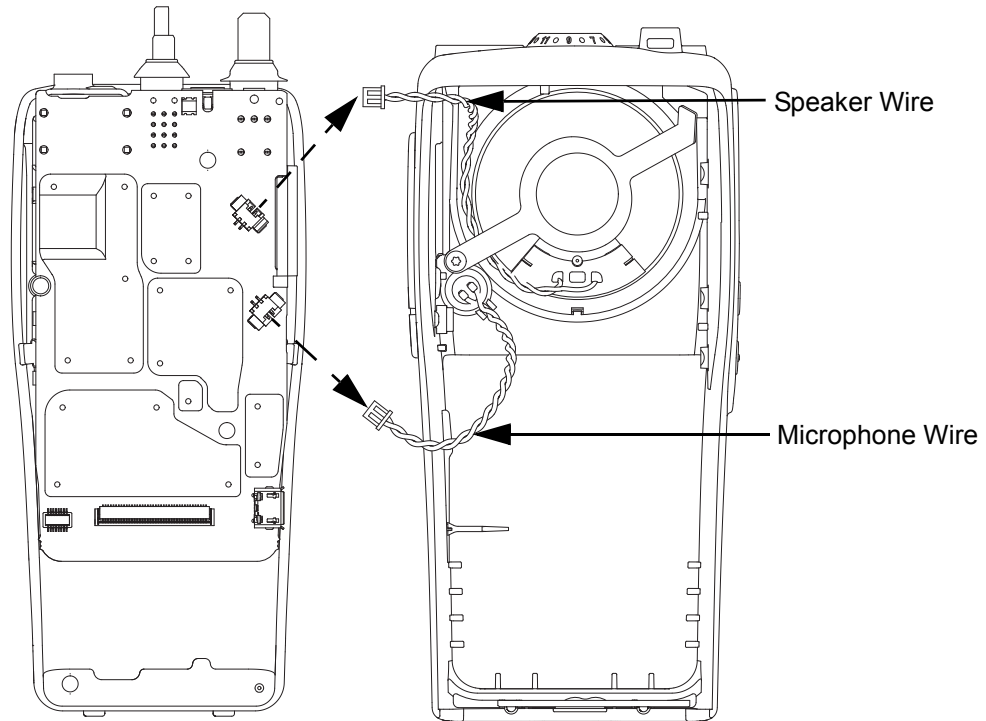
> ⚠️ **C a u t i o n**   Do not pull out the chassis forcefully. This will cause damage to the speaker and microphone wires that are still connected to the chassis assembly.

Accesory Connector

Audio Jack Shroud Assembly
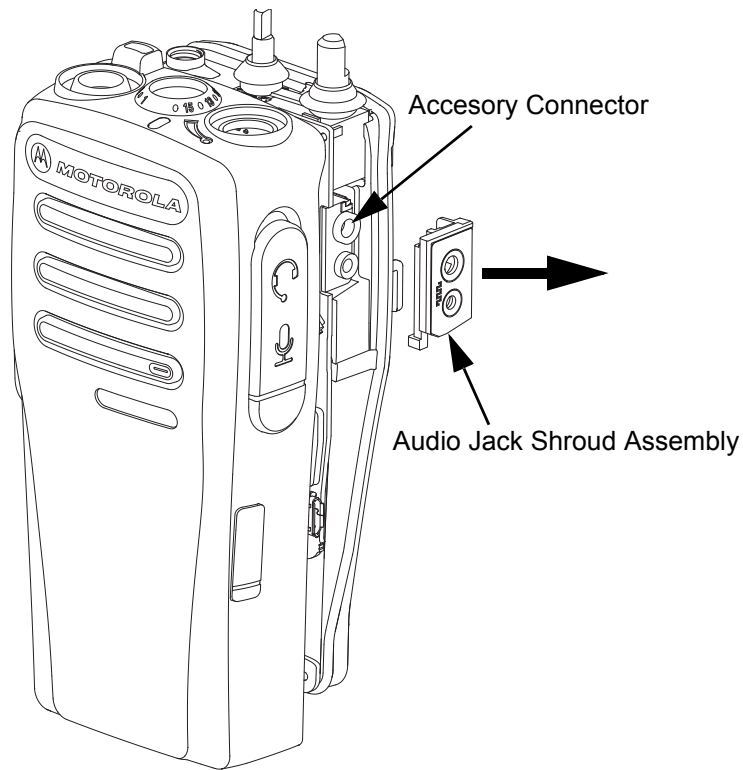
Figure 5-5. Audio Jack Shroud Assembly Removal

7.   Remove the audio jack shroud assembly from the accessory connector on the main board.
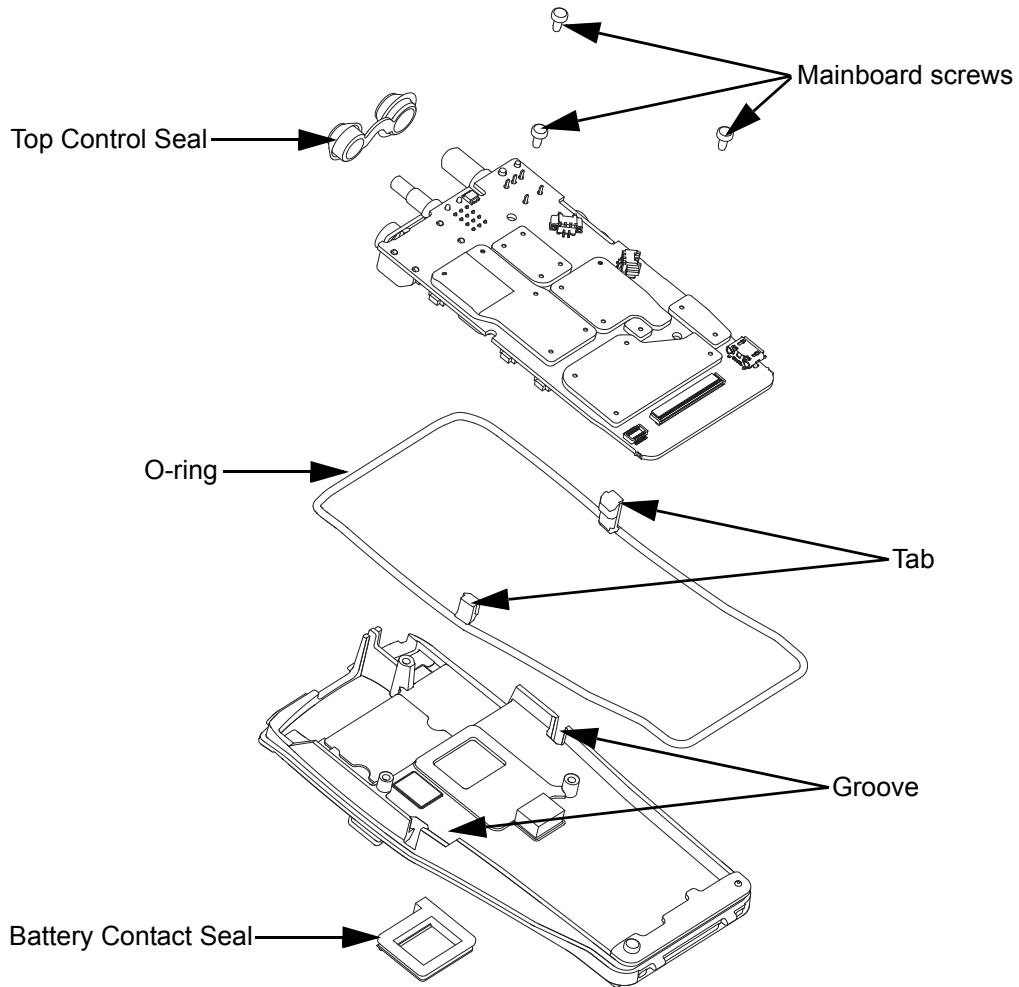
Figure 5-6. Speaker and Microphone Wires Removal

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.

5.6.2   Chassis Disassembly

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

Figure 5-7. Chassis disassembly

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.

5.6.3 Speaker and Microphone Disassembly

1. Remove the screw from the speaker retainer, Figure 5-8, 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.
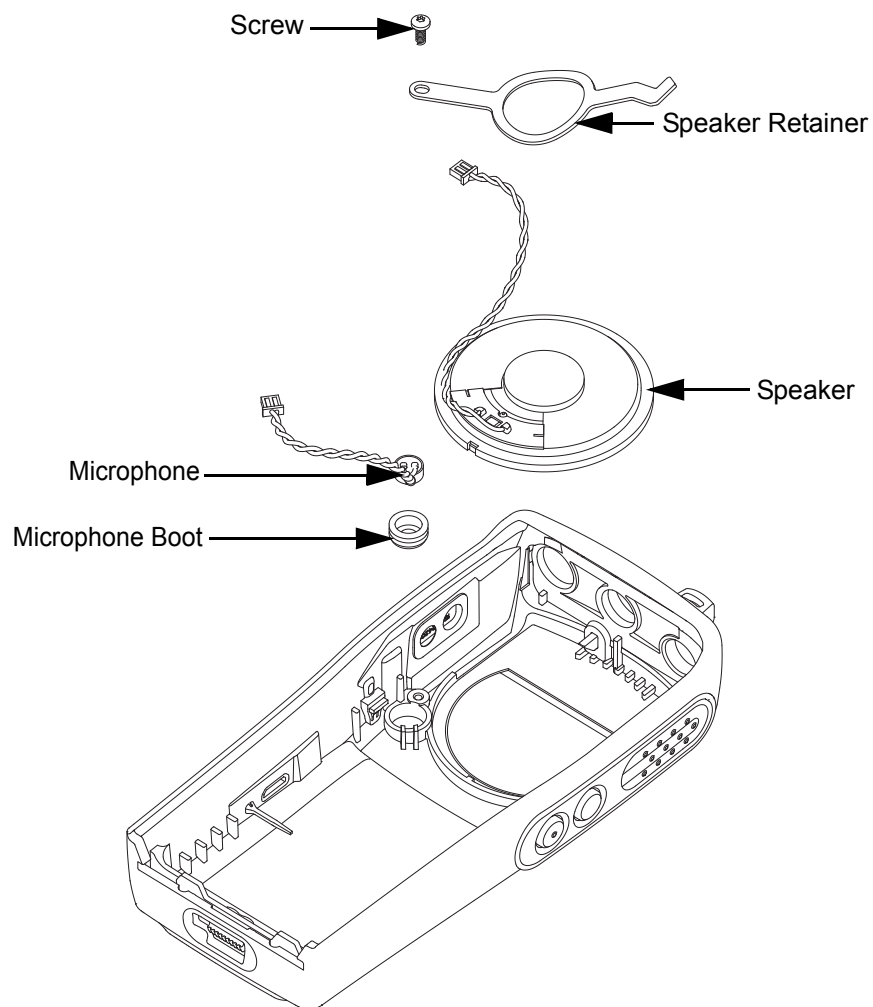

Screw

Speaker Retainer

Speaker

Microphone

Microphone Boot

Figure 5-8. Speaker and Microphone Disassembly

5.6.4 Audio Jack Dust Cover Disassembly

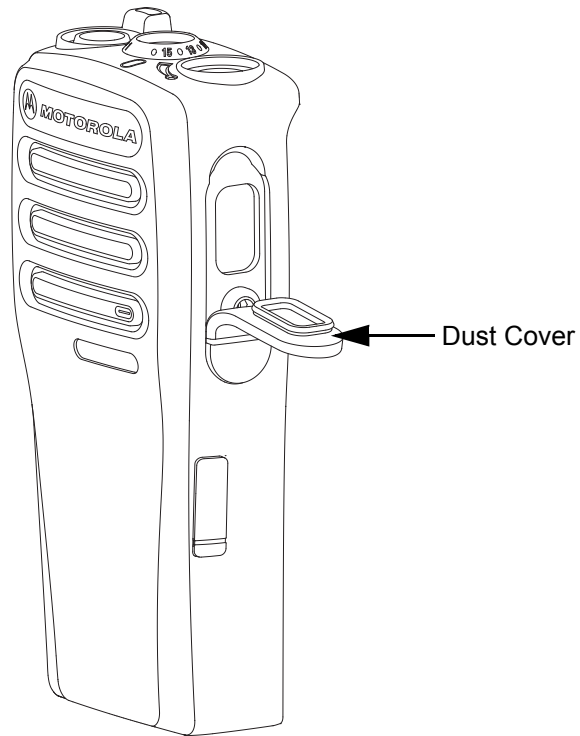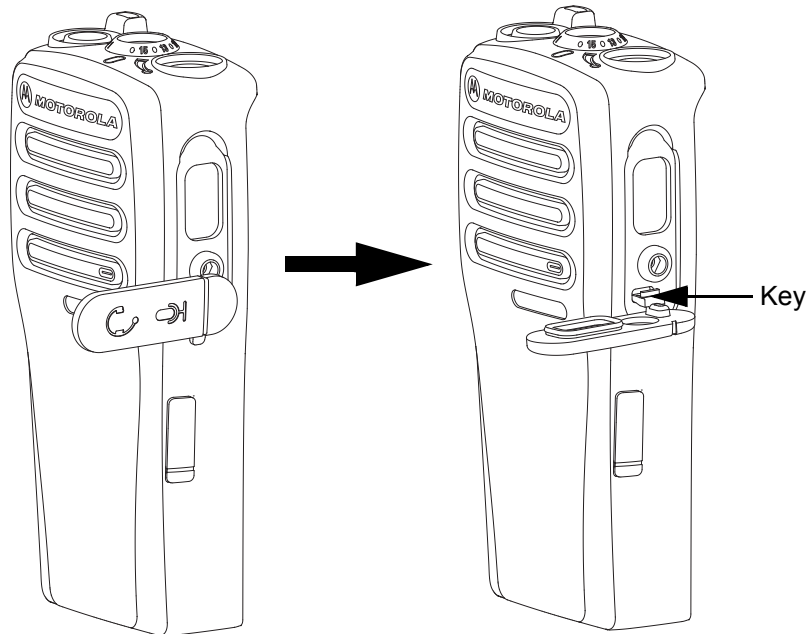1. Gently pry the top of the dust cover away from the body of the housing as in Figure 5-9.

Dust Cover

Figure 5-9. Dust Cover Disassembly

2. Face the audio jack side and rotate the dust cover 90° in counter clockwise direction. Flip open the dust cover 90° in clockwise direction as in Figure 5-10 to allow the key to be removed.

Figure 5-10. Audio Jack Dust Cover Removal

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.

5.6.5　Micro USB Dust Cover Disassembly

1. If required, the micro USB dust cover can be disassembled using a flat square tip plastic tweezer as follows:

    a.　Insert the tip of a plastic tweezer underneath the dust cover from the side. Pry the dust cover to release the top tab as Figure 5-11.
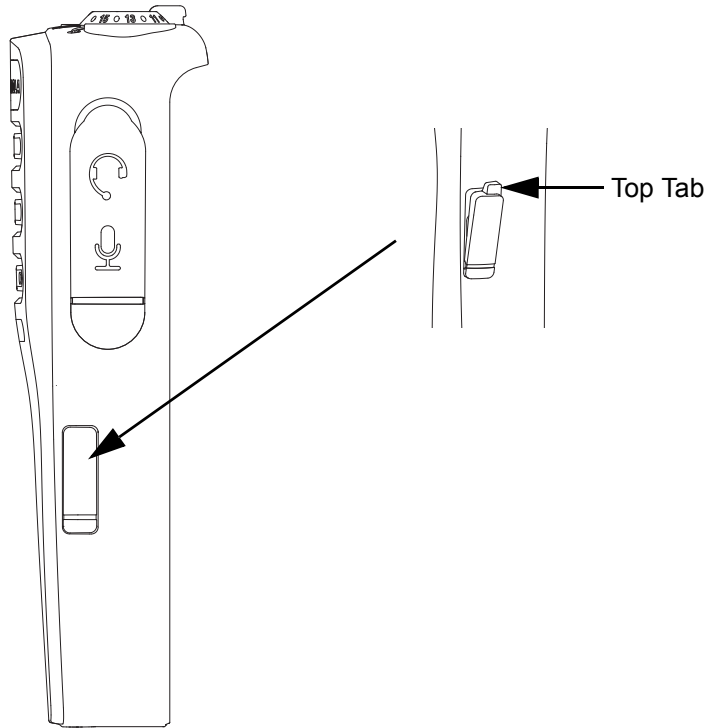
Figure 5-11.　Prying the Micro USB Dust Cover

b. Cut off the head from the inside of the housing with cutter as Figure 5-12.

Head

Inside of front housing
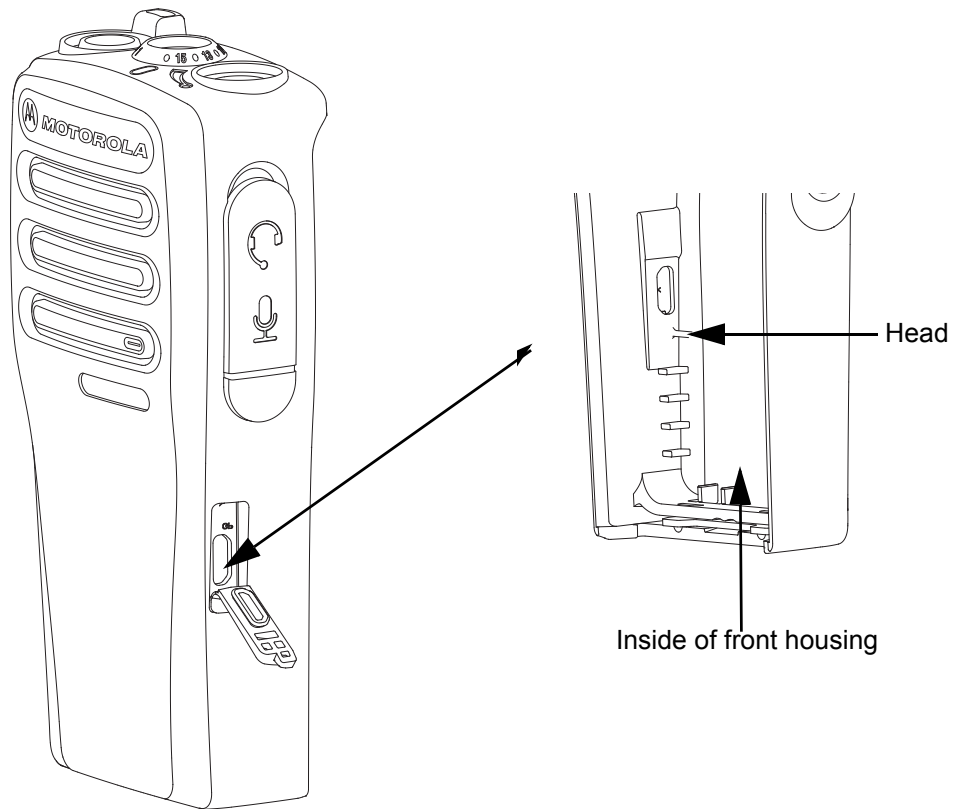
Figure 5-12. Micro USB Dust Cover Removal

c. Separate the dust cover from the front housing.

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

5.6.6   PTT Disassembly

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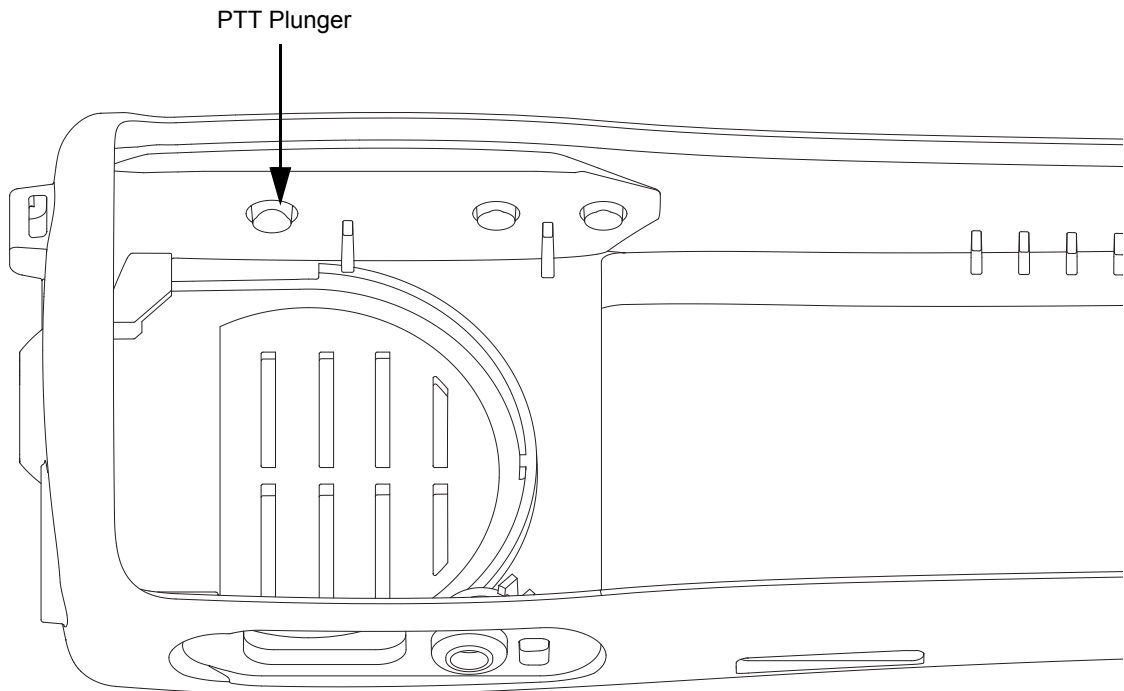
PTT Plunger

Figure 5-13. Lifting PTT Bezel with 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.

Plastic Tweezers
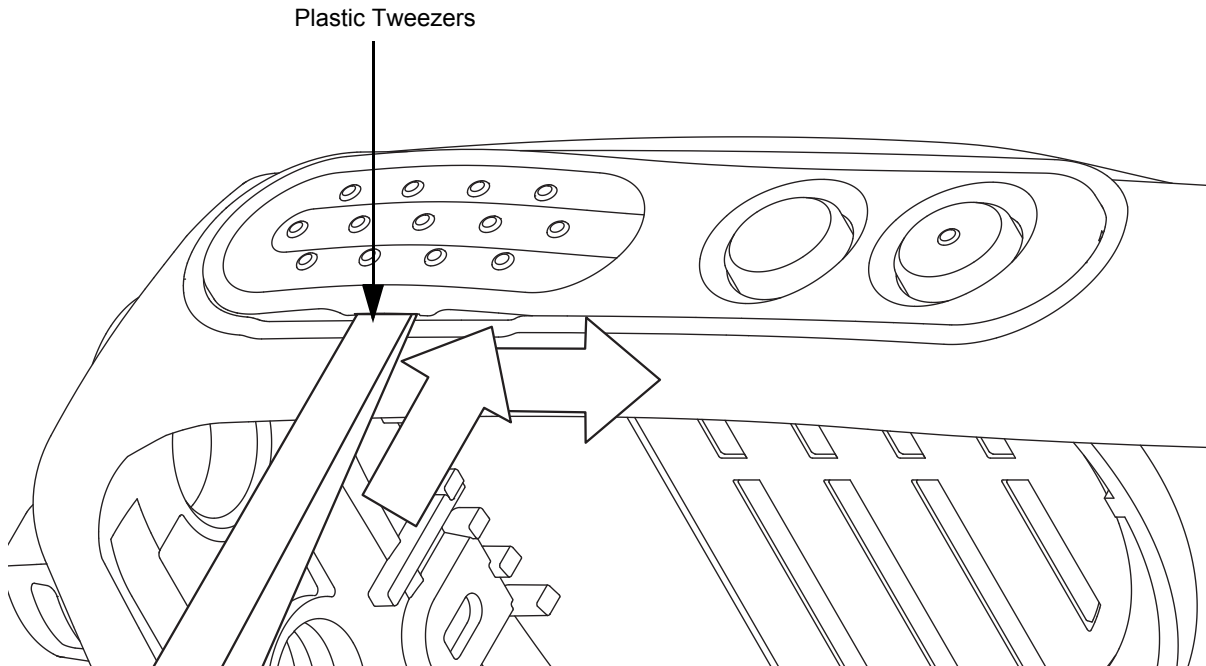
Figure 5-14. PTT Removal

3. Remove PTT bezel followed by the PTT rubber.

PTT bezel is not reusable once removed.

C a u t i o n

5.7   Radio Reassembly - Detailed

5.7.1   PTT Reassembly

   1.   Assemble PTT rubber and ensure that sealing ribs are all-around inserted into sealing groove
            of front housing.
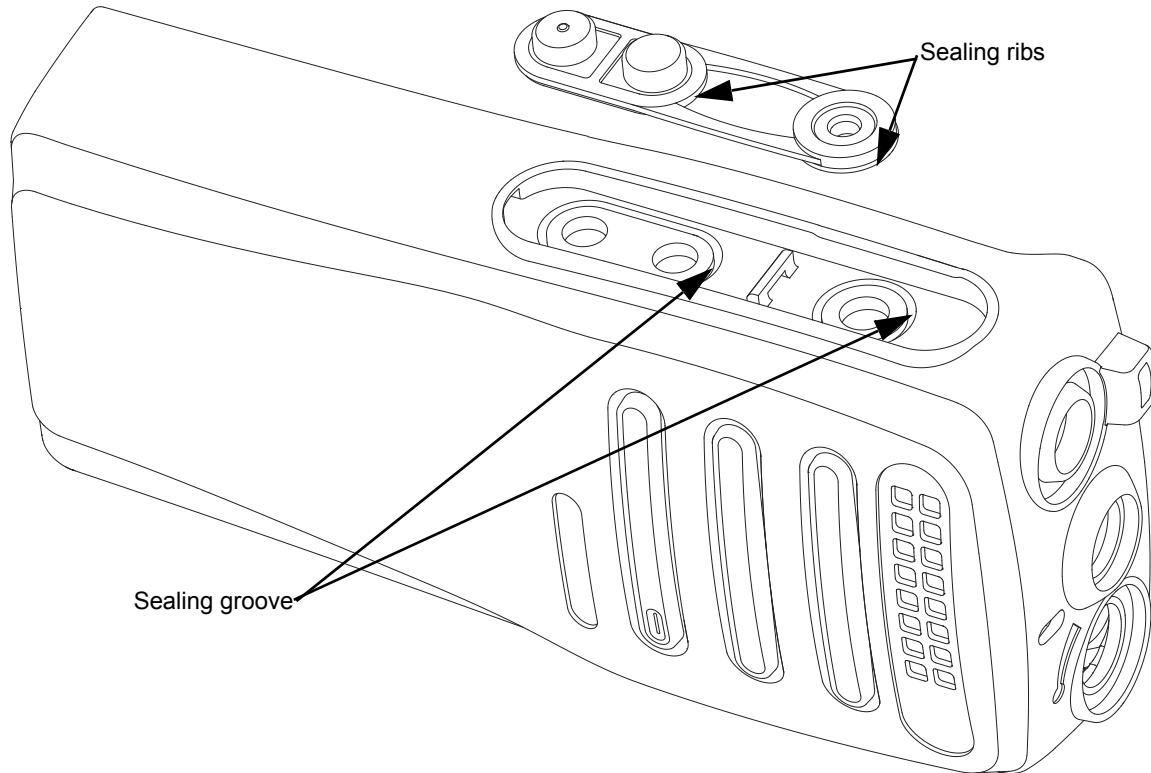
Figure 5-15. PTT Rubber Assembly

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

Bottom

Top
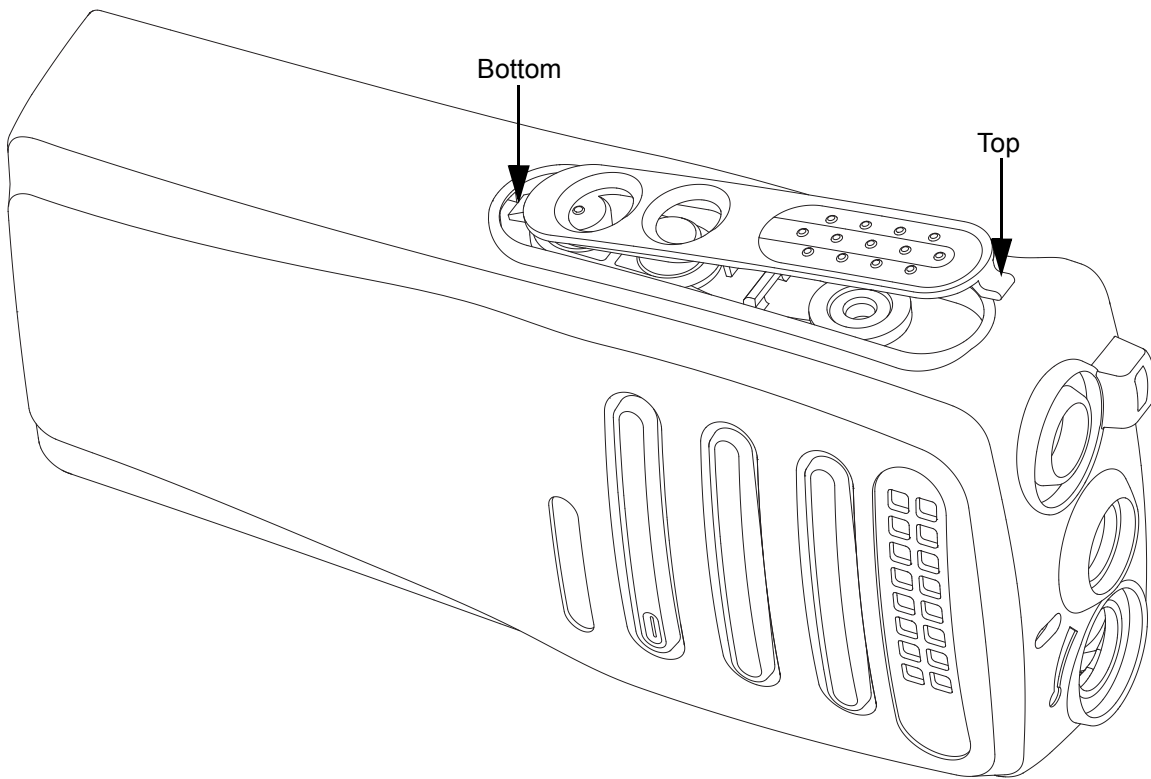
Figure 5-16. PTT Assembly

3. Push down PTT and drag towards programming key until bezel snaps in.
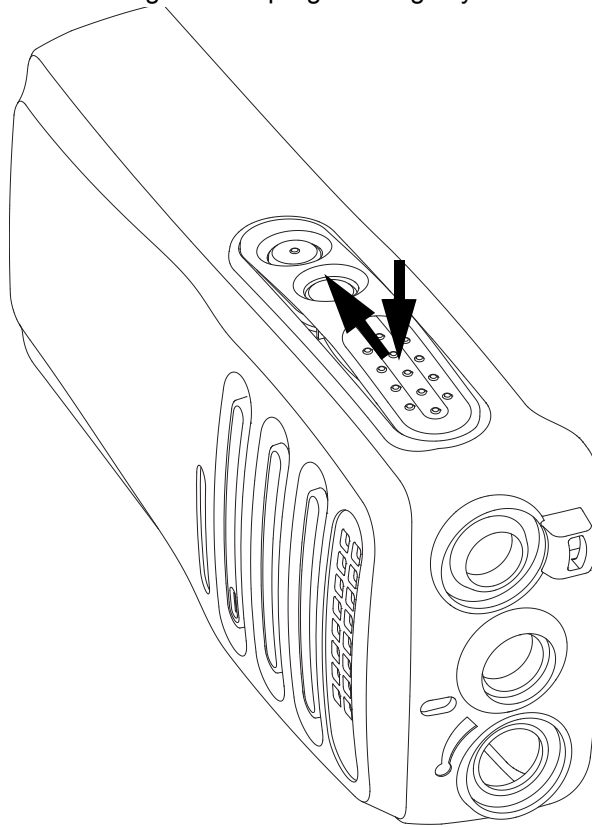
Figure 5-17. Affixing the PTT Bezel

4.   Ensure that PTT bezel is flushed to housing (no bulging).
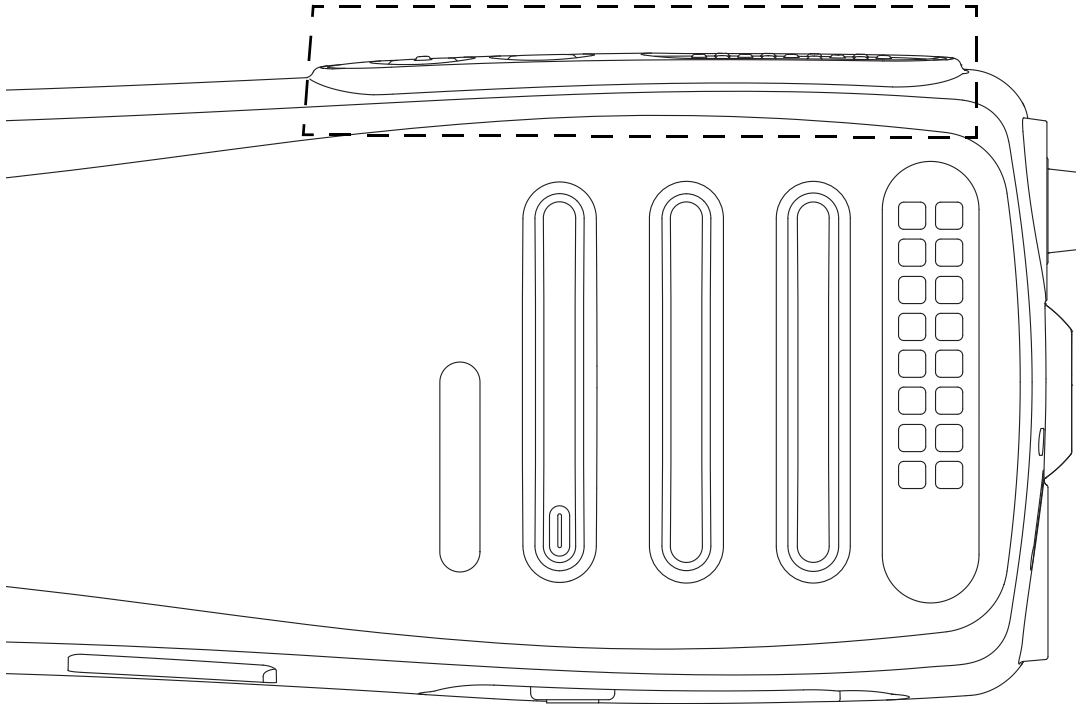
Figure 5-18. Flushed PTT bezel to housing

5. Ensure that bezel can move about in its pocket (not wedged towards one side).
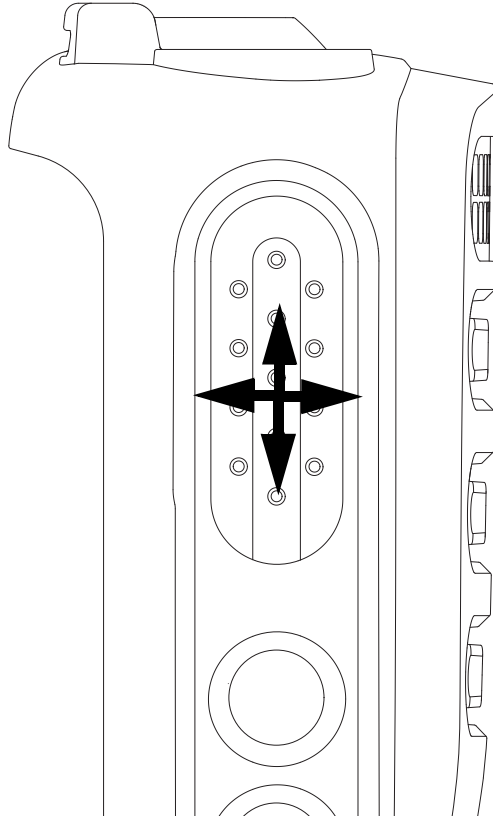
Figure 5-19. Bezel Alignment

> ⚠️ **Caution**
>
> Remove and replace with new PTT bezel if criteria in step 4 and step 5 are not met.

5.7.2   Micro USB Dust Cover Reassembly

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.
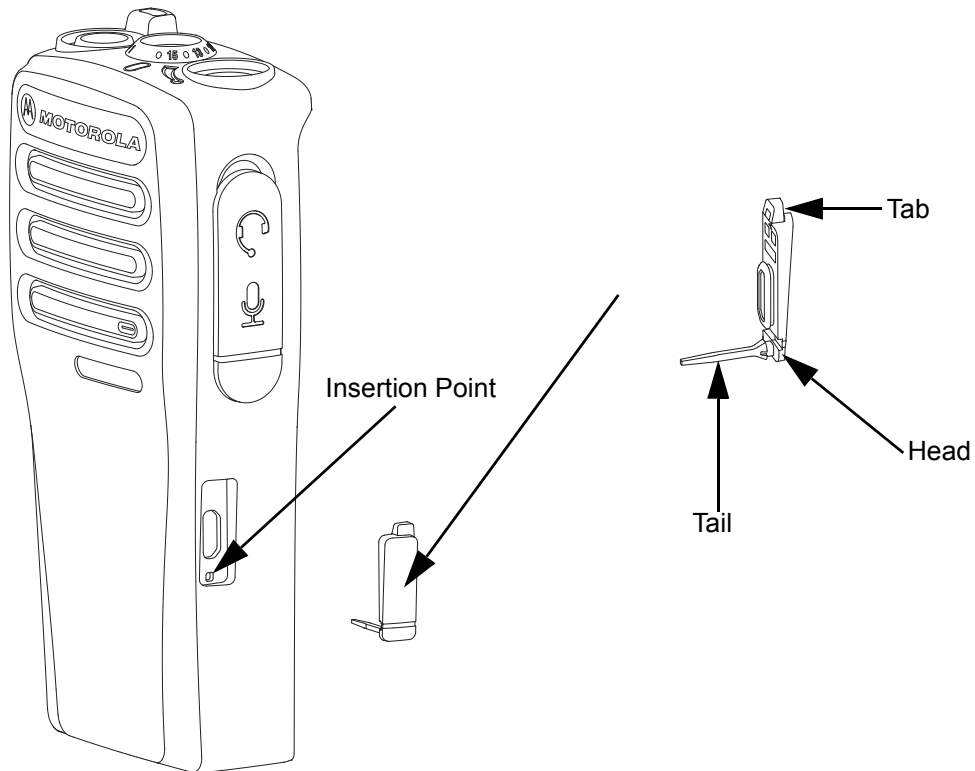
Figure 5-20. Micro USB Dust Cover Reassembly

5.7.3   Audio Jack Dust Cover Reassembly

   1.   Insert the dust cover key into the slot on the housing at a 90° angle.

   2.   Flip the dust cover 90° in counter clockwise direction to allow the key to be fully inserted into the housing as shown in Figure 5-21.
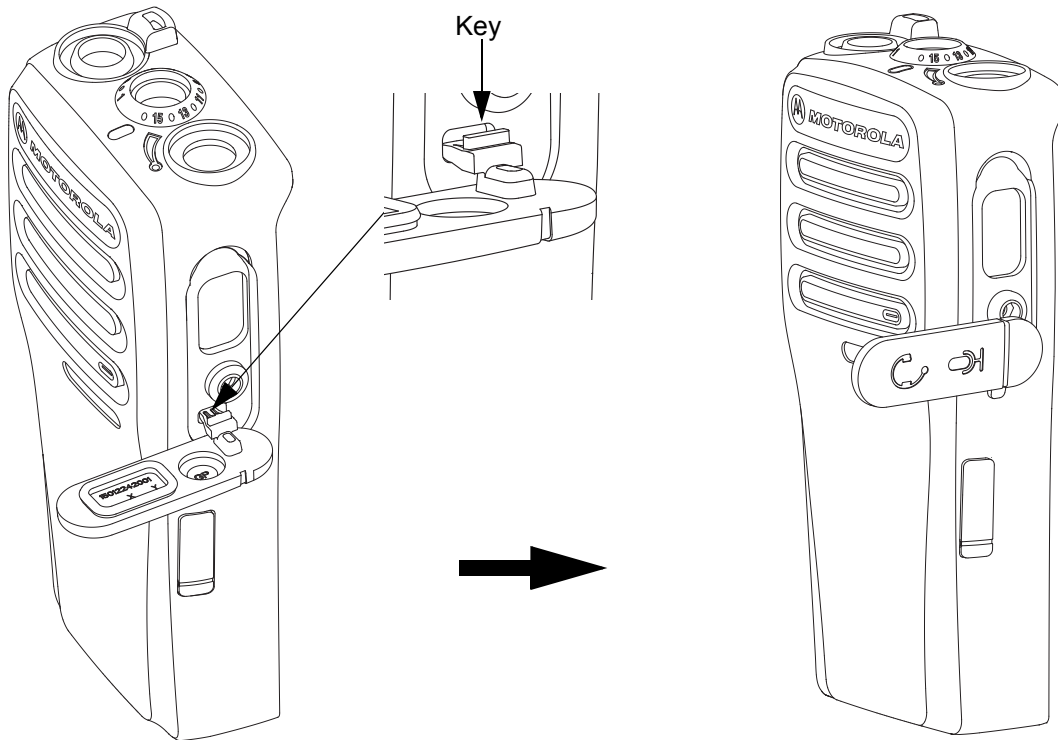
Figure 5-21. Audio Jack Dust Cover Reassembly

   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.

5.7.4   Speaker and Microphone Reassembly

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 as shown in Figure 5-22.
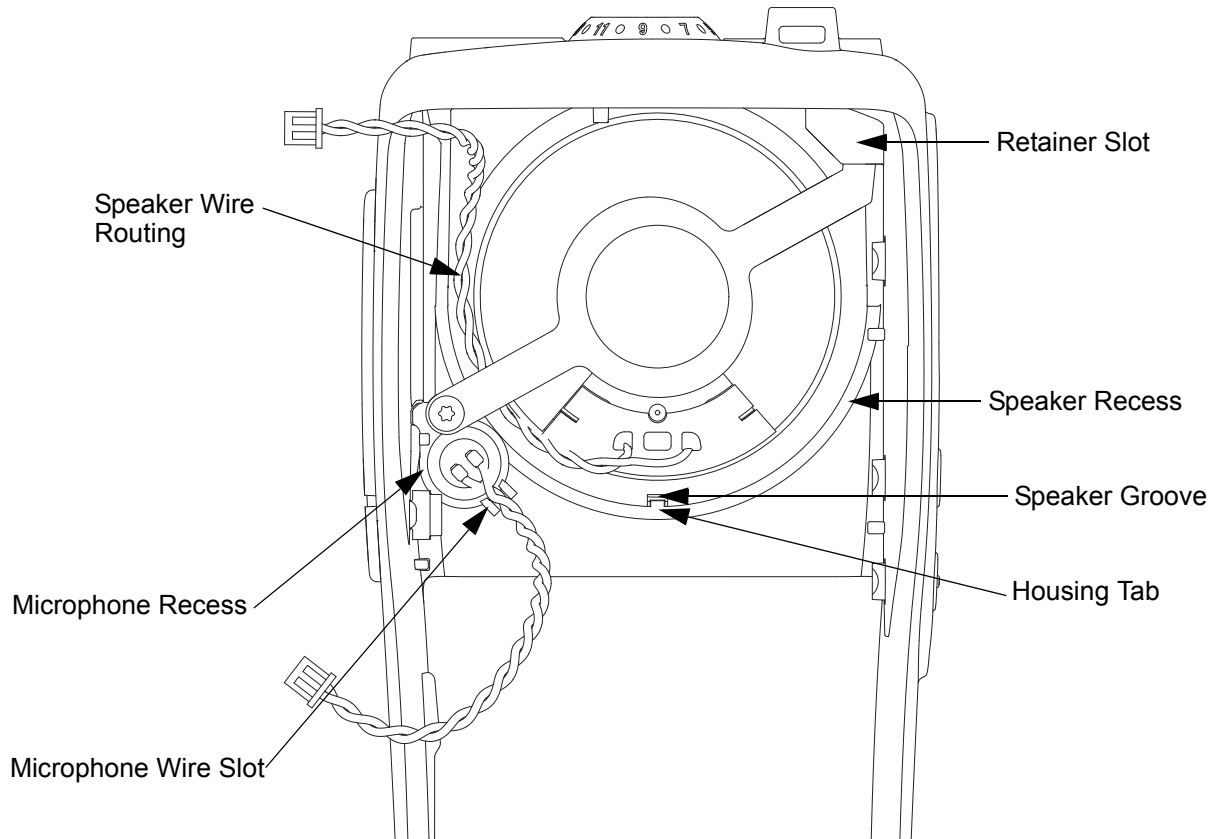
Figure 5-22. Speaker and Microphone Reassembly

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 as shown in Figure 5-22 to prevent pinching by the retainer.

5.7.5   Chassis Reassembly

    1.   Assemble the battery contact seal onto the opening of the chassis in the correct orientation as shown in Figure 5-23.

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

Battery Contact Seal
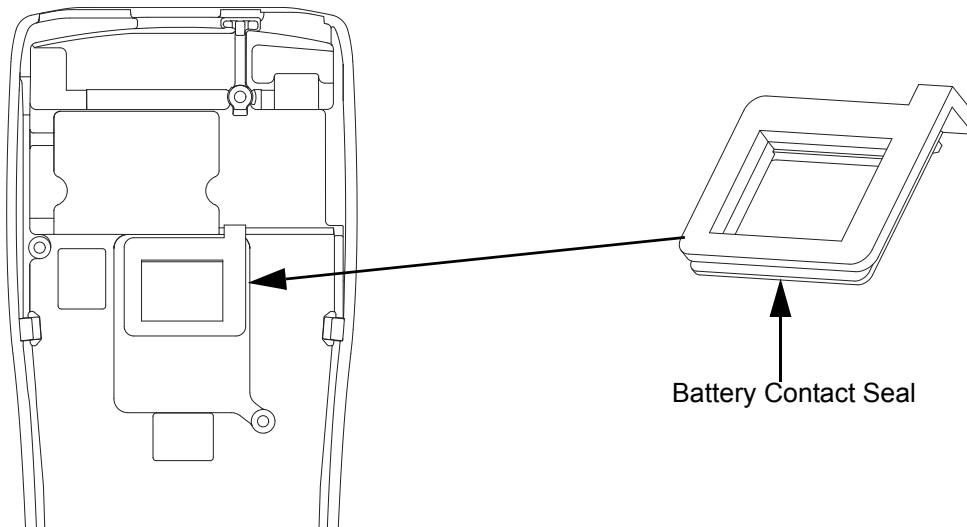
Figure 5-23. Battery Contact Seal Assembly

    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 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 plastic tweezer. 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.

Thin Thermal Pad
(Black color)

Recess

Thermal pads
correctly placed
in the respective recess

Thick Thermal Pad
(Green color)
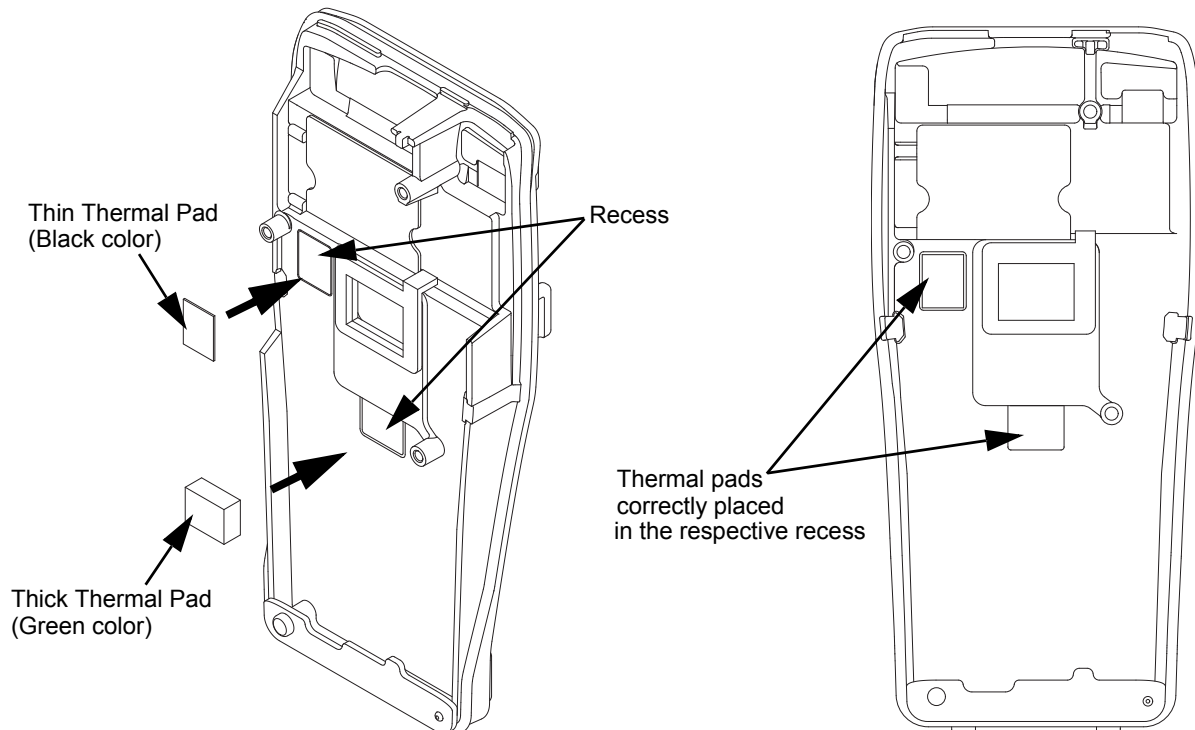
Figure 5-24. Thermal Pad Assembly

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 as shown in Figure 5-25..

NOTE   Make sure the battery contact seal is not pinched under the chassis.
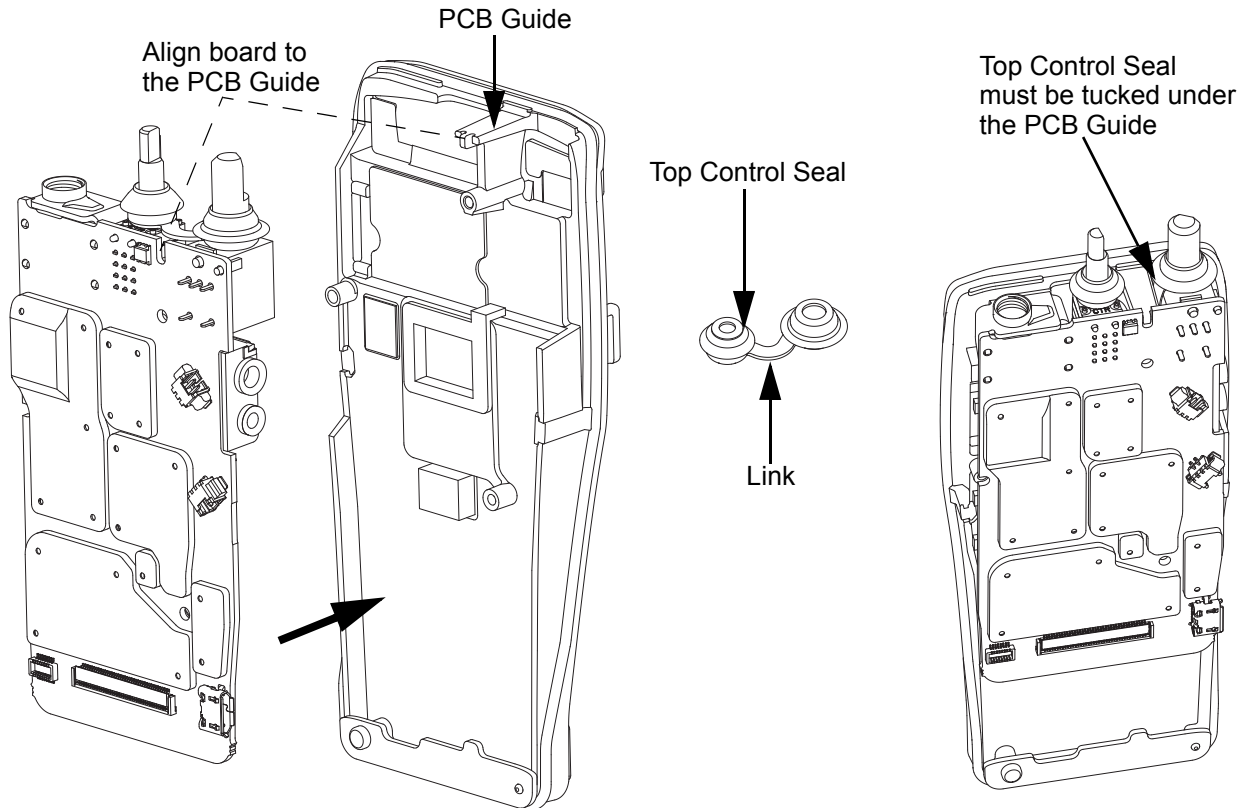
Figure 5-25. PCB and Top Control Seal Assembly

6. Align the 3 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 back to Figure 5-7).

8.   Adhere the poron pad align to the pointed shield corner as Figure 5-26.
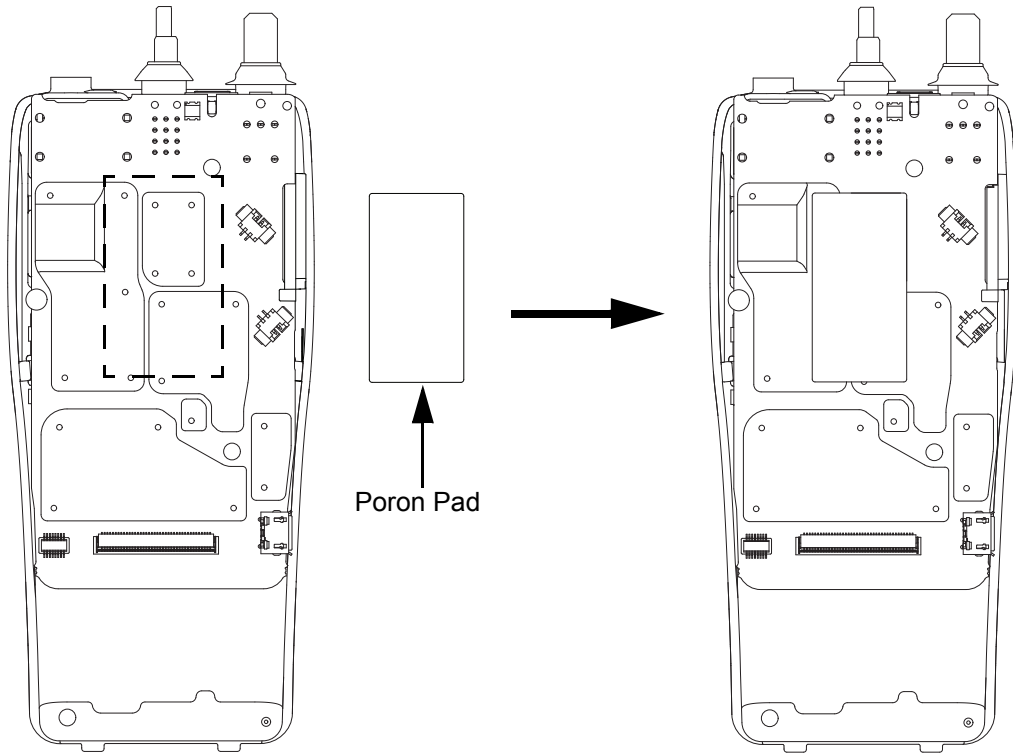
Poron Pad

Figure 5-26. Poron Pad Alignment

5.7.6   Chassis and Front Housing Reassembly

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.
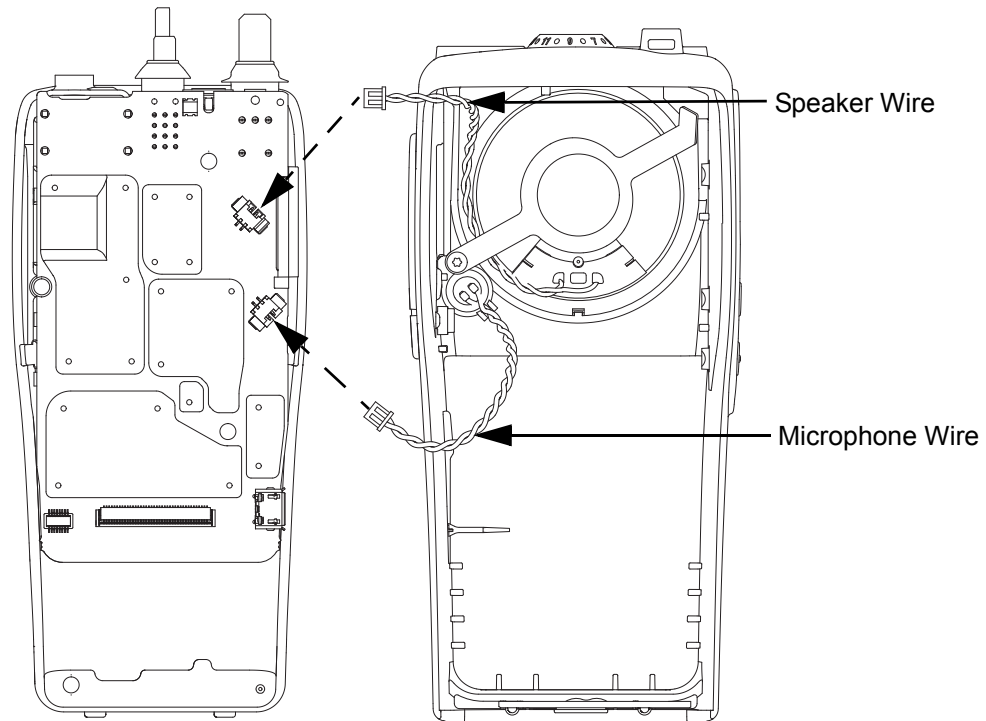
Figure 5-27.   Chassis and Front Housing Reassembly

Audio Jack Shroud

Bottom Edge (insert first)
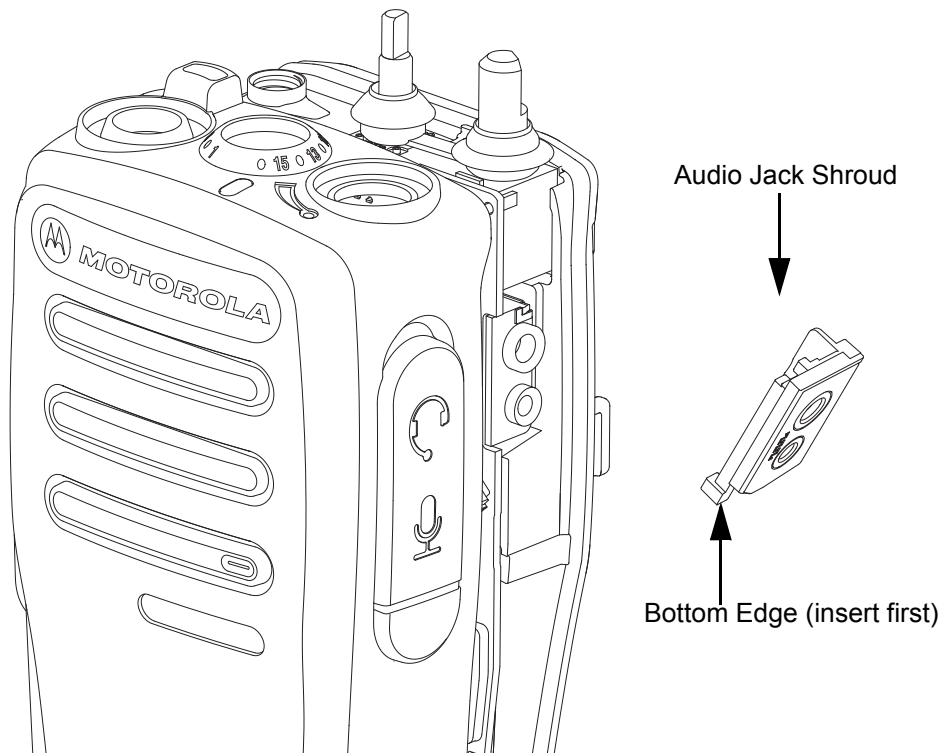
Figure 5-28. Audio Jack Shroud Reassembly

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 Figure 5-28.

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 Figure 5-29.
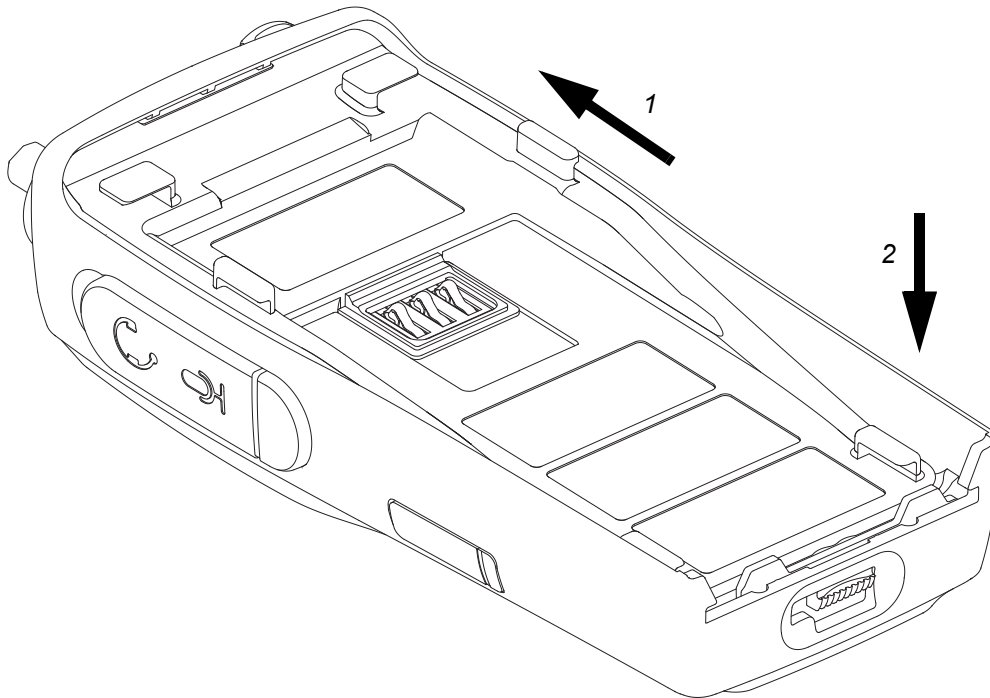
Figure 5-29. Inserting Chassis Assembly into Housing

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

> ⚠ **Caution**
>
> Make sure 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.

5.8   Radio Exploded Mechanical View and Parts Lists
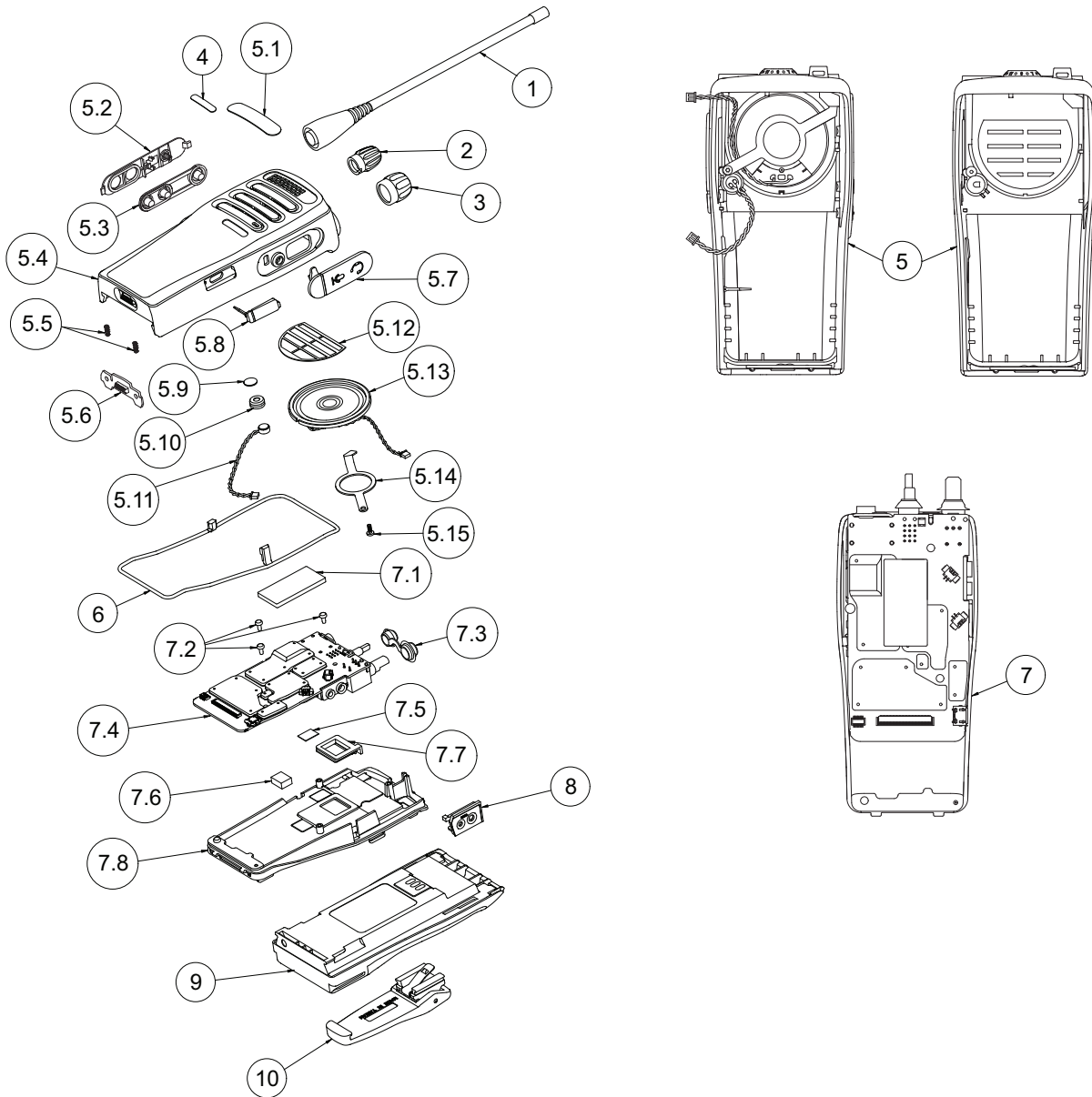
Table 5-3. Exploded View Part List

Item		Description	Part Number
1		Antenna	See Chapter 7: Accessories
2		Knob, Frequency	3680530Z02
3		Knob, Volume	3680529Z01
4		Product Number Label	33012039017
5		Front Cover Kit	See Table 5-4 Front Cover Kits
	5.1	Nameplate	33012026001
	5.2	Bezel, PTT	13012040001
	5.3	Rubber, PTT	32012231001
	5.4	Front Housing Assembly	Not supported. Please order Item No.5
	5.5	Spring, Battery Latch	Not supported. Please order Item No.5
	5.6	Battery Latch	Not supported. Please order Item No.5
	5.7	Dust Cover, Audio Jack	15012242001
	5.8	Dust Cover, Micro USB	38012042001
	5.9	Felt, Microphone	3586621Z04
	5.10	Boot, Microphone	0780608V01
	5.11	Microphone Assembly	0104055J51
	5.12	Felt, Speaker	35012094001
	5.13	Speaker Assembly	0104055J50
	5.14	Retainer, Speaker	4286620Z01
	5.15	Screw, Speaker Retainer	0386434Z02
6		Main O-Ring	3286431Z05
7		Back Cover Kit	See Table 5-5 Back Cover Kits
	7.1	Poron Pad	75012247001
	7.2	Screw, Main Board	0304726J05
	7.3	Top Control Seal	32012232001
	7.4	Main PCB Assembly	Not supported. Please order Item No.7
	7.5	Thermal Pad (thin)	7515526H01
	7.6	Thermal Pad (thick)	75012205001
	7.7	Battery Contact Seal	3286435Z01

Table 5-3. Exploded View Part List

Item		Description	Part Number
	7.8	Chassis Assembly	0104056J93
8		Shroud Assembly, Audio Jack	01012093001
9		Battery	See Chapter 7: Accessories
10		Belt Clip	See Chapter 7: Accessories

Table 5-4. Front Cover Kit Part Numbers

Item	Description	Motorola Part Number
Front Kit	Front Cover Kit, MOTOTRBO Non-Keypad Portable (Include all items from 5.1 to 5.15)	PMLN6345_
Front Kit	Front Cover Kit, MOTOTRBO Non-Keypad Portable (Only items 5.4, 5.5 & 5.6)	PMLN6345_S

Table 5-5. Back Cover Kit Part Numbers

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

5.8.1   Torque Chart

Table 5-6 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 5-6. Torque Specifications for Screws

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

Chapter 6 Basic Troubleshooting

6.1 Introduction

If the board does not pass all the performance checks in Chapter 3, then the circuit board should be replaced. If repair requires knowledge of details of component level troubleshooting, please send radio to a Motorola Service Center listed in Appendix B.

6.2 Replacement Back Cover Kit Procedures

Once a problem has been isolated to a specific board, install the appropriate service kit (See Model Charts in Chapter 1), which is orderable. from Motorola Radio Products and Solutions Organization at 1-800-422-4210.

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

> ⚠️
> **C a u t i o n**
>
> The Tuner Tool only allows the serial number of the blank board to be entered once. Be very attentive during this procedure.

Notes

Chapter 7 Accessories

7.1 Introduction

Motorola provides the following approved accessories to improve the productivity of your digital portable two-way radio.

For a list of Motorola-approved antennas, batteries and other accessories, visit the following web site: http://www.motorolasolutions.com/governmentandenterprise

7.1.1 Batteries

Part No.	Description
NNTN4851_	Battery NIMH 1400 mAh STD
NNTN4970_	Slim Li-Ion Battery 1600 mAh
NNTN4497_R	Assembly,Battery, Li-Ion Battery 2190 mAh

7.1.2 Chargers

Part No.	Description
EPNN7997_	10-Hour Plug-in Charger
EPNN9288_	Rapid-rate Charger Transformer
NLN7967_	Multi-Unit Charger Wall Mount Kit
NNTN8353_	Multi-Unit Charger
PMLN5193_	Rapid-rate Charger with switchmode power supply
RLN6296_	120 v MUC conversion Kit
WPLN4137_R	Charger Base
WPLN4138_R	Rapid-rate Desktop Charger

7.1.3 Carry Devices

Part No.	Description
1505596Z02	Replacement strap for HLN6602_/RLN4570_
4280384F89	RadioPAK Belt extender for RLN4815_
4280483B03	2.5 inch Swivel Belt Loop
4280483B04	3 inch Swivel Belt Loop
HLN6602_	Nylon Chest Pack
HLN8255_	Spring Action 3" Belt clip
HLN9701_	Nylon case with belt loop & D-rings

HLN9985_	Waterproof Bag, Includes Large Carrying Strap
NTN5243_	Carry case shoulder strap
RLN4570_	Breakaway Chest Pack
RLN4815_	Radio pack
RLN5383_	ND Leather case with Belt loop and D-rings
RLN5384_	ND Leather case with 2.5" Swivel and D-rings
RLN5385_	ND Leather case with 3" Swivel and D-rings
RLN5644_	Spring Action 2" Belt clip
RLN5716_	T-Strap for leather cases
TDN9373_	Door Hanger
TDN9327_	Radio Hanger

7.1.4   Audio

Part No.	Description
0186180Z01	Replacement Foam Earbuds
5080369E39	Extra Loud Earpiece - Beige
5080370E91	Extra Loud Earpiece - Black
5080370E97	Replacement Rubber Ear Buds
5080384F72	Replacement Foam Plug Ins
7580372E11	Replacement Foam Ear Cushion For BDN6720_
AARLN4885_	Receive-Only Earpiece with 3.5mm Jack
BDN6720_	Flexible Ear Receiver
PMLN4605_	Clear Coiled Voicetube Kit
PMLN4620_	D-Shell RSM Earpiece (3.5mm)
PMLN6445_	2-Wire Surveillance Kit (Beige)with Clear Acoustic Earpiece
PMLN6530_	2-Wire Surveillance Kit (Black)with Clear Acoustic Earpiece
PMLN6531_	EarReceiver with In-Line Mic/ PTT/VOX switch (Mag One)
PMLN6532_	Swivel Earpiece with in-line mic and PTT (over the ear solution)
PMLN6534_	Earbud with In-Line Mic/PTT /VOX switch (Mag One)
PMLN6535_	D-Style Earpiece with Mic/PTT
PMLN6536_	2-Wire Surveillance kit with quick disconnect acoustic tube, black
PMLN6537_	Earset with Boom Mic and In-Line PTT/VOX switch (Mag One)
PMLN6538_	Lightweight Headset with Swivel Boom Microphone
PMLN6539_	Medium Weight Over-The-Head Dual Muff Headset
PMLN6540_	Heavy-Duty Noise Cancelling Boom Mic Headset
PMLN6541_	Lightweight Temple Transducer Headset

PMMN4013_	Remote Speaker Microphone With 3.5 mm Audio Jack
PMMN4029_	Remote Speaker Microphone IP57
PMMN4092_	Remote Speaker Microphone (Mag One)
REX4648_	Replacement Windscreen And Foam Ear Pad
RLN4760_	Clear Comfortable Earpiece Small Right
RLN4761_	Clear Comfortable Earpiece Med Right
RLN4762_	Clear Comfortable Earpiece Large Right
RLN4763_	Clear Comfortable Earpiece Small Left
RLN4764_	Clear Comfortable Earpiece Med Left
RLN4765_	Clear Comfortable Earpiece Large Left
RLN4941_	Receive Only Earpiece With Translucent Tube & Eartip
RLN5500_	Retainer Kit
RLN6230_	Extreme Noise Kit - Black
RLN6231_	Extreme Noise Kit - Beige
RLN6232_	Low Noise Kit - Black
RLN6241_	Low Noise Kit - Beige
RLN6242_	Quick Disconnect Acoustic Tube
WADN4190_	Over the Ear Receiver for RSM

7.1.5   Antennas

Part No.	Description
8505816K24	UHF Heliflex Stubby, (403–440 MHz)
HAD9742_	VHF Stubby Antenna (146–162 MHz), 9cm
HAD9743_	VHF Stubby Antenna (162–174 MHz), 8cm
NAD6502_R	VHF Heliflex Antenna (146–174 MHz), 15cm
NAE6522_R	UHF Stubby Antenna (438–470 MHz), 7.5cm
PMAD4012_	VHF Stubby Antenna (136–155 MHz), 9cm
PMAD4014_	VHF Antenna (136–155 MHz), 14cm
PMAD4042_	VHF Heliflex Antenna (136–150.8 MHz), 14cm
PMAE4002_	UHF Stubby Antenna (403–433 MHz), 9cm
PMAE4003_	UHF Stubby Antenna (430–470 MHz), 9cm
PMAE4016_	UHF Whip Antenna (403–520 MHz), 17cm

7.1.6   Service/Replacement Parts

Part No.	Description
6686533Z01	Chassis and Knob Opener

7.1.7   CPS

Part No.	Description
RVN5115_	CPS R8.6 MOTOTRBO

Appendix A   Replacement Parts Ordering

A.1   Basic Ordering Information

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

A.2   Motorola Online

Motorola Online users can access our online catalog at

https://businessonline.motorolasolutions.com

To register for online access, please call 800-422-4210 (for U.S. and Canada Service Centers only). International customers can obtain assistance at https://businessonline.motorolasolutions.com

A.3   Mail Orders

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

Motorola
7031 Columbia Gateway Drive
3rd Floor - Order Processing
Columbia, MD 21046
U.S.A.

A.4   Telephone Orders

The Radio Products and Solutions Organization*
(United States and Canada)
7:00 AM to 7:00 PM (Central Standard Time)
Monday through Friday (Chicago, U.S.A.)
1-800-422-4210
1-847-538-8023 (United States and Canada)

U.S. Federal Government Markets Division (USFGMD)
1-800-826-1913 Federal Government Parts - Credit Cards Only
8:30 AM to 5:00 PM (Eastern Standard Time)

A.5   Fax Orders

The Radio Products and Solutions Organization*
(United States and Canada)
1-800-622-6210
847-576-3023 (United States and Canada)

USFGMD
(Federal Government Orders)
1-800-526-8641 (For Parts and Equipment Purchase Orders)

A.6   Parts Identification

The Radio Products and Solutions Organization*
(United States and Canada)
1-800-422-4210

A.7   Product Customer Service

Radio Products and Solutions Organization (United States and Canada)
1-800-927-2744

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

Appendix B   Motorola Service Centers

B.1   Servicing Information

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

B.2   Motorola Service Center

1220 Don Haskins Drive.
Suite. A
El Paso, TX 79936

Telephone: 915-872-8200

B.3   Motorola Canadian Technical Logistics Center

181 Whitehall Drive
Markham, Ontario
L3R 9T1

Toll Free: 800-543-3222

B.4   Motorola Federal Technical Center

10105 Senate Drive
Lanham, MD 20706

Tel: 1800-969-6680
Fax: 1800-784-4113

Notes

Glossary

This glossary contains an alphabetical listing of terms and their definitions that are applicable to portable and mobile subscriber radio products. All terms do not necessarily apply to all radios, and some terms are merely generic in nature.

Term	Definition
Analog	Refers to a continuously variable signal or a circuit or device designed to handle such signals.
Band	Frequencies allowed for a specific purpose.
CPS	Customer Programming Software: 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.
DPL	Digital Private-Line: A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.
FCC	Federal Communications Commission.
Frequency	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).
GPIO	General-Purpose Input/Output: Pins whose function is programmable.
GPS	Global Positioning System.
IC	Integrated Circuit: An assembly of interconnected components on a small semiconductor chip, usually made of silicon. One chip can contain millions of microscopic components and perform many functions.
IF	Intermediate Frequency.
kHz	kilohertz: One thousand cycles per second. Used especially as a radio-frequency unit.
LCD	Liquid-Crystal Display: An LCD uses two sheets of polarizing material with a liquid-crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.
LED	Light Emitting Diode: An electronic device that lights up when electricity is passed through it.
MDC	Motorola Digital Communications.

Term	Definition
MHz	Megahertz: One million cycles per second. Used especially as a radio-frequency unit.
Paging	One-way communication that alerts the receiver to retrieve a message.
PC Board	Printed Circuit Board. Also referred to as a PCB.
PL	Private-Line Tone Squelch: A continuous sub-audible tone that is transmitted along with the carrier.
Programming Cable	A cable that allows the CPS to communicate directly with the radio using USB.
Receiver	Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.
Repeater	Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).
RF	Radio Frequency: The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).
RX	Receive.
Signal	An electrically transmitted electromagnetic wave.
Spectrum	Frequency range within which radiation has specific characteristics.
Squelch	Muting of audio circuits when received signal levels fall below a pre-determined value. With carrier squelch, all channel activity that exceeds the radio's preset squelch level can be heard.
TOT	Time-out Timer: A timer that limits the length of a transmission.
TPL	Tone Private Line.
Transceiver	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
Transmitter	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
TX	Transmit.
UHF	Ultra-High Frequency.
USB	Universal Serial Bus: An external bus standard that supports data transfer rates of 12 Mbps.
VIP	Vehicle Interface Port.
XPR	Refers to Digital Professional Radio model names in the MOTOTRBO Professional Digital Two-Way Radio System.

MOTOROLA

68009616001-A