MOTOTRBO™ TWO-WAY RADIOS

DP3441

BASIC SERVICE MANUAL

Foreword

This manual covers all models of the DP 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.

Product Safety and RF Exposure Compliance

ATTENTION!	**Before using this radio, read the guide enclosed with your radio which contains important operating instructions for safe usage and RF energy awareness and control for compliance with applicable standards and regulations.**

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

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Document History

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

Edition	Description	Date
68012009027-A	Initial Release	May 2013

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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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K. Normal and customary wear and tear.

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VII. Governing Law

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

Battery and Charger Warranty

Workmanship Warranty

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

All MOTOTRBO Batteries	Two (2) Years
IMPRES Chargers (Single-Unit and Multi-Unit, Non-Display)	Two (2) Years
IMPRES Chargers (Multi-Unit with Display)	One (1) Year
Core Chargers (Single-Unit and Multi-Unit, Non-Display)	Two (2) Years

Capacity Warranty

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

Nickel Metal-Hydride (NiMH) or Lithium-Ion (Li-Ion) Batteries	12 Months
IMPRES Batteries, When Used Exclusively with IMPRES Chargers	18 Months

Notes

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.

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.

1.2 Radio Description

The DP series portable radios are available in various frequency ranges and power levels. See “Summary of Bands Available” on page 1-3 for Radio Frequency Ranges and Power Levels.

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 DP3441

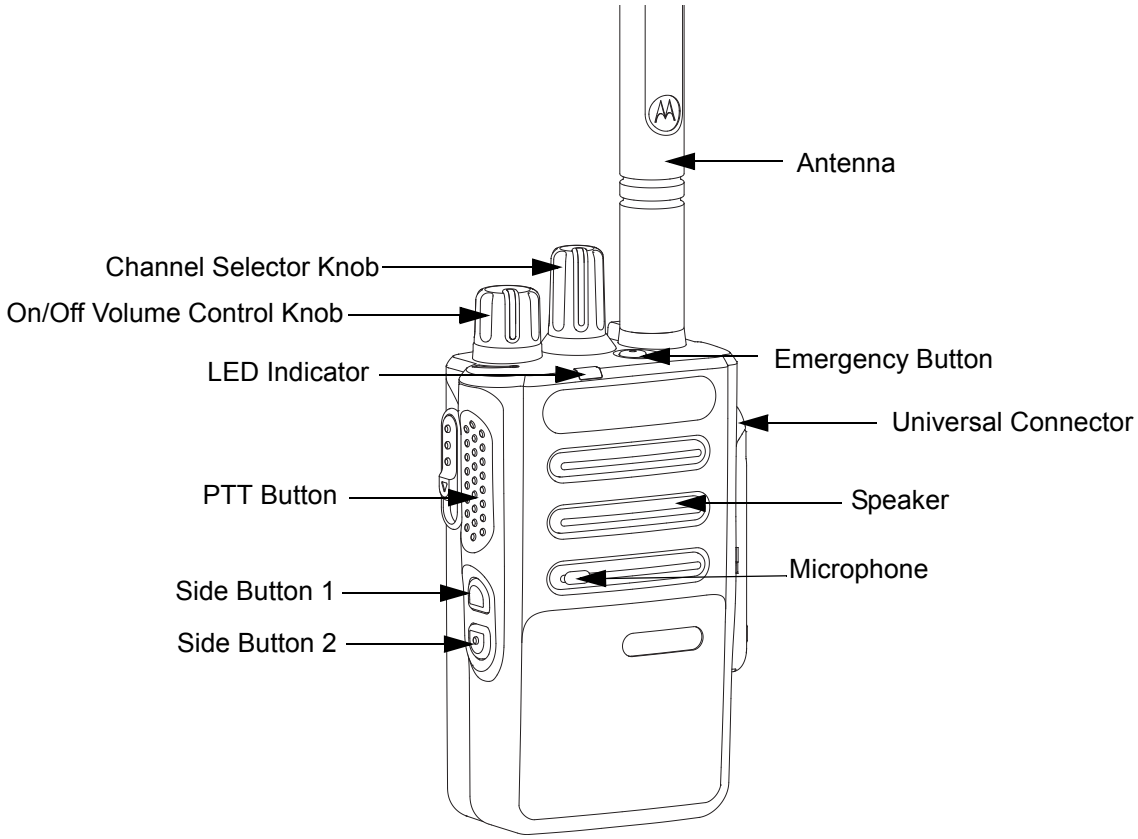


Figure 1-1. DP3441

- 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 INDICATORS – Red, green and orange light-emitting diodes indicate operating status.
- SIDE BUTTONS – These two buttons are field programmable using 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.
- UNIVERSAL CONNECTOR FOR ACCESSORIES – Interface point for all accessories to be used with the radio. It has eight points to which specific accessories will connect and be activated.
- EMERGENCY BUTTON – Turns on and off Emergency Operations.
- SPEAKER – Outputs all tones and audio generated by the radio (e.g. features like keypad tones and voice audio).

1.3 Summary of Bands Available

Table below lists all the bands available in this manual. For details, please refer to the Model Charts section.

Frequency Band	Bandwidth	Power Level
VHF	136–174 MHz	1W–5W
UHF	403–527 MHz	1W–4W

1.4 Portable Radio Model Numbering Scheme

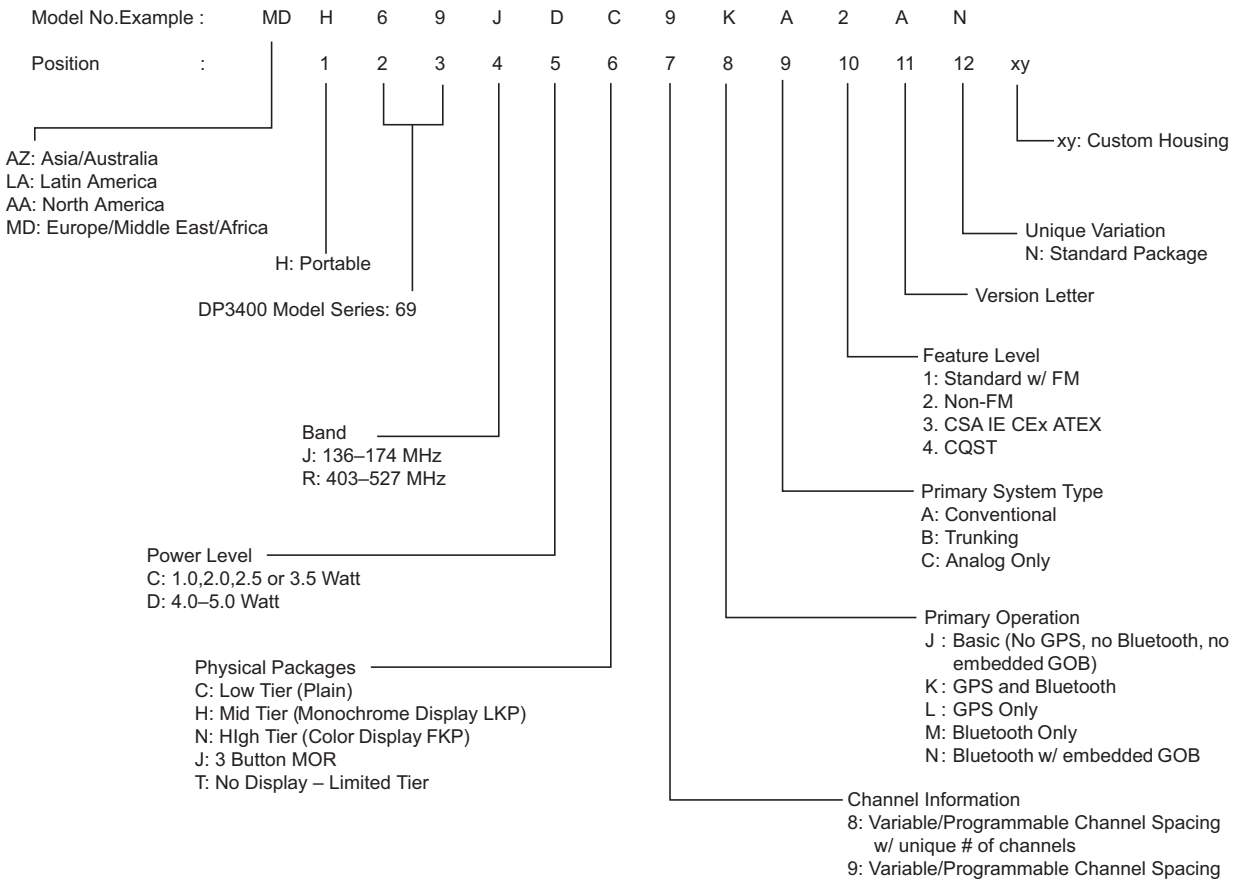


Figure 1-2. Portable Radio Model Numbering Scheme

1.5 Model Charts

1.5.1 VHF Model Chart

DP Series, VHF, 136–174 MHz, 5W		
Model		**Description**
MDH69JDC9KA2AN		136–174 MHz , 5W, DP3441 Non Keypad Portable with GPS and BT
	Item	**Description**
X	PMLD4607_S	BC Kit, 136–174 MHz, 5W, MOTOTRBO Non Keypad Portable with GPS and BT
X	PMLN6484_	Front Cover Kit, Non Keypad Portable with Bluetooth
X	PMAD4119_	VHF Stubby Antenna 136–155 MHz
X	PMAD4120_	VHF Stubby Antenna 140–165 MHz
X	PMAD4121_	VHF Stubby Antenna 160–174 MHz

NOTE:

X = Item Included

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

1.5.2 UHF Model Chart

DP Series, UHF, 403–527 MHz, 4W		
Model		**Description**
MDH69RDC9KA2AN		403–527 MHz, 4W, DP3441 Non Keypad Portable with GPS and BT
	Item	**Description**
X	PMLE4936_S	BC Kit, 403–527 MHz, 4W, MOTOTRBO Non Keypad Portable with GPS
X	PMLN6484_	Front Cover Kit, Non Keypad Portable with Bluetooth
X	PMAE4069_	UHF Stubby Antenna 403–460 MHz
X	PMAE4070_	UHF Stubby Antenna 440–490 MHz
X	PMAE4071_	UHF Stubby Antenna 470–527 MHz

1.6 Specifications

1.6.1 General

General	Non Keypad DP3441
Channel Capacity	32
Frequency	VHF: 136 – 174 MHz UHF: 403 – 527 MHz
Dimensions (HxWxT) w/ NiMH battery	99.8 x 56.0 x 29.7 mm
Weight (with LiIon non-FM battery)	248g
Power Supply	7.5 V nominal
FCC Description	UHF: AZ489FT4914 VHF: AZ489FT3833
IC Description	UHF: 109U-89FT4914 VHF: 109U-89FT3833
Average battery life at 5/5/90 duty cycle with battery saver enabled in carrier squelch and transmitter in high power.	
Core Slim Li-Ion (1600 mAH) battery	Analog: 8.5 hrs Digital: 12.3 hrs

NOTE Weight can have 5% margin of error

1.6.2 Receiver

Receiver	Non Keypad DP3441
Frequencies	VHF: 136 – 174 MHz UHF: 403 – 527 MHz
Channel Spacing	12.5 kHz/ 20 kHz/ 25 kHz
Frequency Stability (-30°C to +60°C)	+/-0.5 ppm
Analog Sensitivity (12 dB SINAD)	0.3 µV (0.22 uV typical)
Digital Sensitivity (5% BER)	0.25µV 0.19µV (typical)
Intermodulation (TIA603C)	70 dB
Adjacent Channel Selectivity TIA603 TIA603C	 60 dB @ 12.5 kHz, 70 dB @ 20/25 kHz 45 dB @ 12.5 kHz, 70 dB @ 20/25 kHz
Spurious Rejection (TIA603C)	70 dB
Rated Audio	0.5 W
Audio Distortion @ Rated Audio	5%(3% typical)
Hum and Noise	-40 dB @ 12.5 kHz -45 dB @ 20/25 kHz
Audio Response	TIA603D
Conducted Spurious Emission (TIA603C)	-57 dBm

1.6.3 Transmitter

Transmitter	Non Keypad DP3441
Frequencies	VHF: 136 – 174 MHz UHF: 403 – 527 MHz
Channel Spacing	12.5 kHz/ 20 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: 4 W
Modulation Limiting	+/-2.5 kHz @ 12.5 kHz +/-4.0kHz @ 20 kHz +/-5.0 kHz @ 25 kHz
FM Hum and Noise	-40 dB @ 12.5 kHz -45 dB @ 20/25 kHz
Conducted / Radiated Emission	-36 dBm < 1 GHz -30 dBm > 1 GHz
Adjacent Channel Power	60 dB @ 12.5 kHz 70 dB @ 20/25 kHz
Audio Response	TIA603D
Audio Distortion	3%
FM Modulation	12.5 kHz: 11K0F3E 25 kHz: 16K0F3E
4FSK Digital Modulation	12.5 kHz Data Only: 7K60F1D and 7K60FXD 12.5 kHz Data & 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 & 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.

1.6.4 Self-quieter

VHF Self-Quieter Frequencies
139.2 +/- 10 kHz
139.52 +/- 10 kHz
140.545 +/- 10 kHz
143.615 +/- 10 kHz
143.84 +/- 10 kHz
144.34 +/- 10 kHz
144.385 +/- 10 kHz
148.48 +/- 10 kHz
148.8 +/- 10 kHz
152.575 +/- 10 kHz
153.6 +/- 10 kHz
154.625 +/- 10 kHz
158.4 +/- 10 kHz
158.72 +/- 10 kHz
163.2 +/- 10 kHz
167.68 +/- 10 kHz
168 +/- 10 kHz
172.8 +/- 10 kHz

UHF Self-Quieter Frequencies
403.2 +/- 10 kHz
412.8 +/- 10 kHz
422.4 +/- 10 kHz
441.6 +/- 10 kHz
460.8 +/- 10 kHz
470.4 +/- 10 kHz
480 +/- 10 kHz
499.2 +/- 10 kHz
508.8 +/- 10 kHz
518.4 +/- 10 kHz

1.6.5 GPS

GPS	Non Keypad DP3441
TTFF (Time To First Fix) Cold Start @ -130dBm (95%)	≤ 60 seconds
TTFF (Time To First Fix) Hot Start @ -130 dBm (95%)	≤10 seconds
Horizontal Accuracy (2D Accuracy) Cold Start	< 5 meters
Accuracy specs are for long-term tracking (95th percentile values > 5 satellites visible at a nominal -130 dBm signal strength)	

1.6.6 Bluetooth

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

1.6.7 MIL Standard

Military Standards										
Applicable MIL–STD	810C		810D		810E		810F		810G*	
	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Procedures
Low Pressure	500.1	I	500.2	II	500.3	II	500.4	II	500.5	II
High Temperature	501.1	I, II	501.2	I/A1,II/ A1	501.3	I/A1, II/ A1	501.4	I/Hot, II/ Hot	501.5	I/A1, II
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, 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
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	1/24, II/ 5
Shock	516.2	I, II	516.3	I, IV	516.4	I, IV	516.5	I, IV	516.6	I, IV, VI

NOTE *Tested to MIL standard G which supersedes previous version

1.6.8 Environmental Specification

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
Dust and Water Intrusion	IEC 60529 -IP67
Packaging Test	MIL-STD 810F and G

* 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.
GMVN5141_	Customer Programming Software on CD-ROM	Allows servicer to program radio parameters, tune and troubleshoot radios.
PMKN4115_*	Portable Programming Cable	This cable connects the radio to a USB port for radio programming and data applications.
PMKN4117_*	Portable Programming, Testing & Alignment Cable	This cable connects the radio to a USB port for radio programming, testing and alignment. **NOTE**: 1. This cable does not support external PTT using test box. 2. This cable does not auto route to external Audio path once the cable is attached. 3. All test instructions are carried out through software tool (e.g. CPS, Tuner, etc.)
PMNN4452_	7.5V Universal Battery Eliminator	Connects to radio via battery eliminator cable.
PMLN6154_	RF Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
PMLN6422_	RF Cable	This cable measures RF related measurements.
66012072001	Chassis and Knob Opener	Enables the removal of chassis from radio housing.
PMLN6584_	RF Adaptor Holder	Holds RF Adaptor to radio.
NLN9839_	Vacuum Pump Kit	Allows servicer to test for leakages.
NTN4265_	Pressure Pump Kit	Allows servicer to locate leakages.
5871134M01	Connector Fitting	This connector allows the vacuum hose to be connected to the radio chassis.
3271133M01	Fitting Seal	This seal secures the connector fitting to the radio chassis.

* Version A of the programming cables will not work with the radio.

2.3 Programming, Testing and Alignment Cable

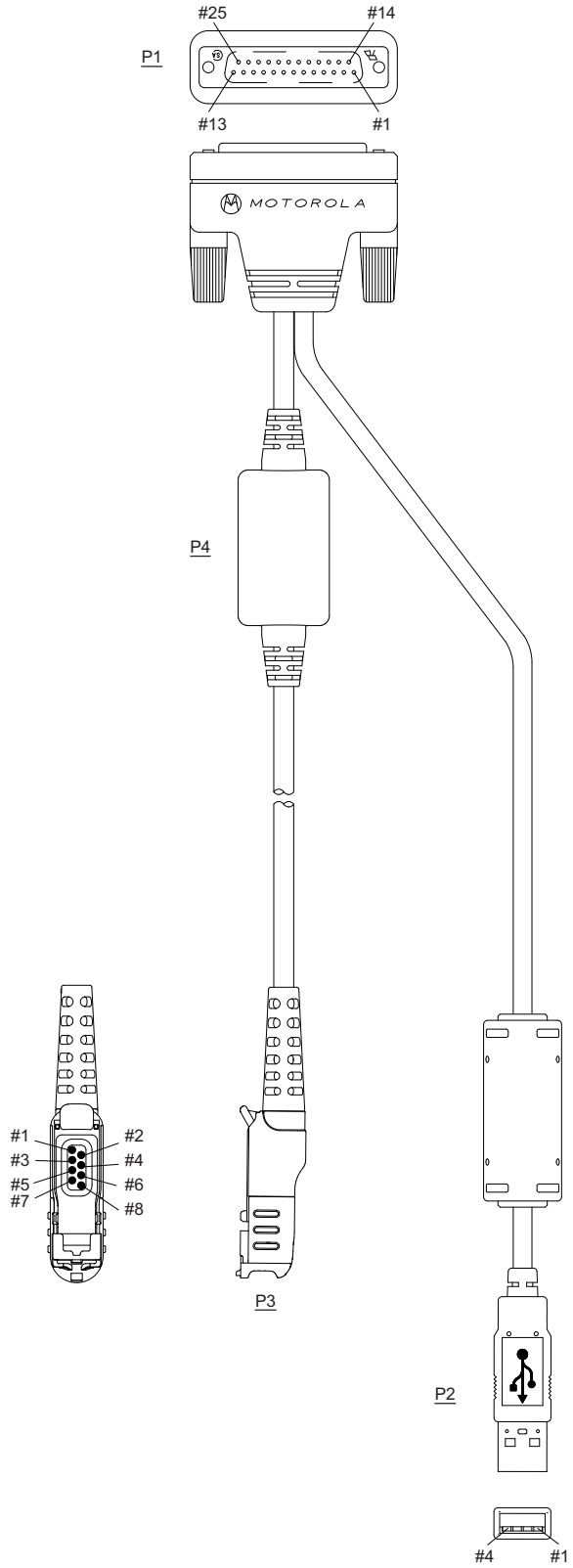


Figure 2-1. Programming, Testing and Alignment Cable

Table 2-3. Pin Configuration of Side Connector

CONNECTION			
P1	**P2**	**P3**	
Pin	**Pin**	**Pin**	**Function**
	1	1	VCC (5V)
	3	5	DATA+
	2	4	DATA-
16	4	8	GROUND
1 and 5		2	EXTERNAL SPEAKER+
2 and 7		3	EXTERNAL SPEAKER-
17		6	EXTERNAL MIC+
16		7	EXTERNAL MIC-

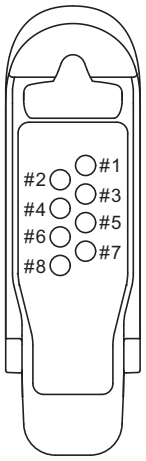


Figure 2-2. Pin Layout of Side Connector

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.

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: 7.5 Vdc	Speaker set: A
RF Attn: -70	DC on/standby: Standby	Speaker/load: Speaker
AM, CW, FM: FM	Volt Range: 10V	PTT: OFF
Oscilloscope Source: Mod Oscilloscope Horizontal: 10 mSec/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: 2.5A	

Setup:

Set up the DMR Transmitter and Receiver Test as per Figure 3-1.

a. Connect the Programming cable to the radio and to the computer.

b. Remove RF Adaptor plug (orange) as shown in Figure 3-2.

c. Connect the RF Adaptor to the 50 Ohm RF Input/Output port of the radio as shown in Figure 3-3.

Connect the other end of the RF Adaptor to the T/R port of the Radio Test Set 3920 using the RF cable shown in Figure 3-1.

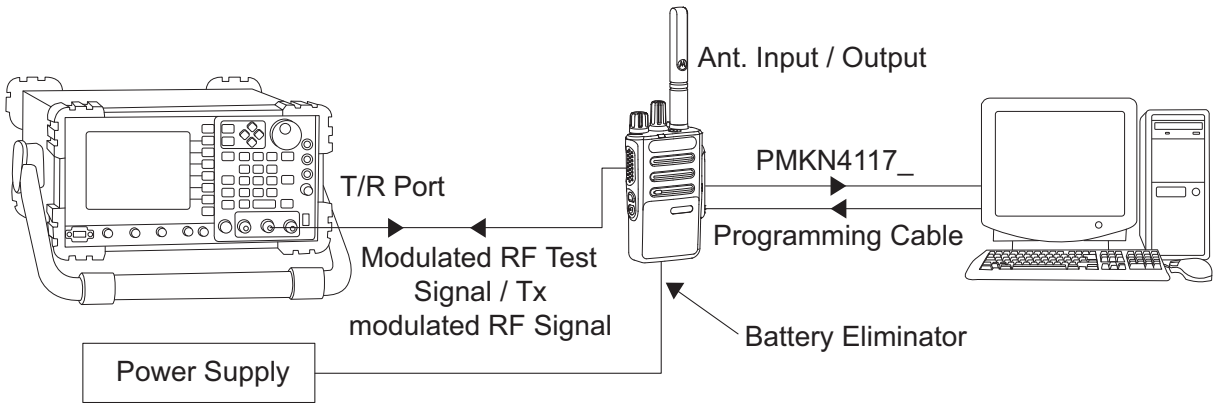


Figure 3-1. DMR Radio Transmitter and Receiver Testing Setup

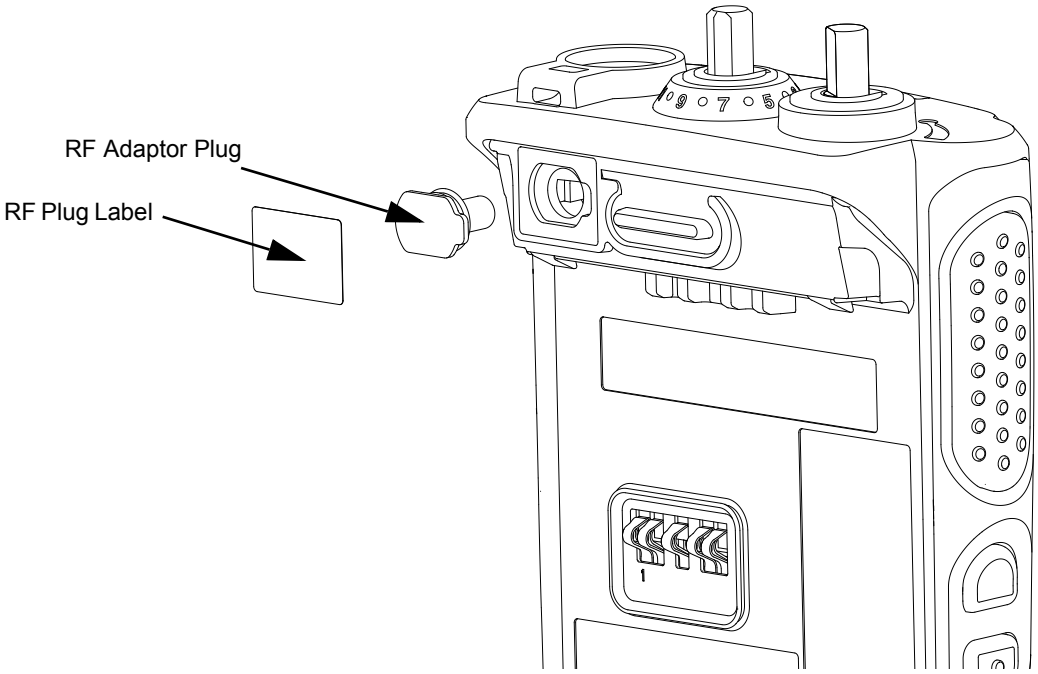


Figure 3-2. RF Adaptor Plug

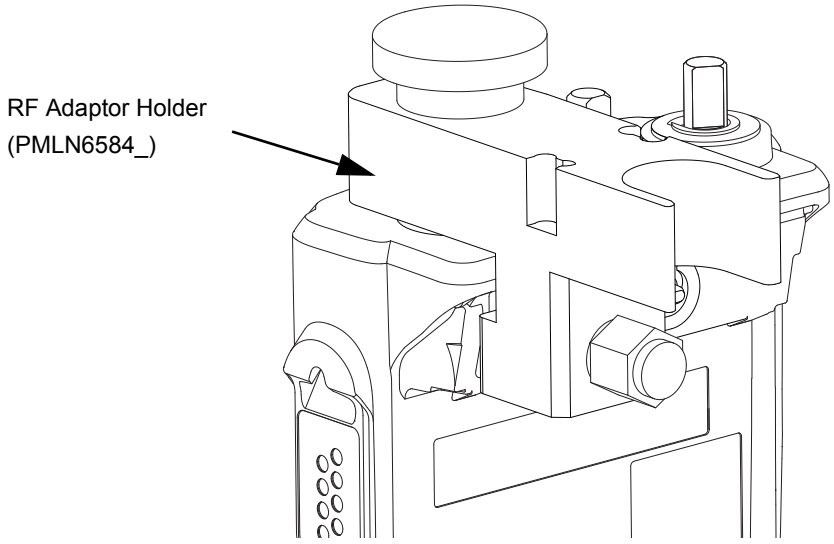


Figure 3-3. Connect RF Adaptor Holder to radio RF input/output port

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.

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. The radio beeps once when it 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 3-3. The radio beeps in each position.

Table 3-3. Test Frequencies

Channel Selector Switch Position	Test Channel	UHF	VHF
1 Low Power 9 High Power	TX#1 or #9 RX#1 or #9	403.15 403.15	136.075 136.075
2 Low Power 10 High Power	TX#2 or #10 RX#2 or #10	423.25 423.25	142.575 142.575
3 Low Power 11 High Power	TX#3 or #11 RX#3 or #11	444.35 444.35	146.575 146.575
4 Low Power 12 High Power	TX#4 or #12 RX#4 or #12	465.45 465.45	155.575 155.575
5 Low Power 13 High Power	TX#5 or #13 RX#5 or #13	485.55 485.55	161.575 161.575
6 Low Power 14 High Power	TX#6 or #14 RX#6 or #14	506.65 506.65	167.575 167.575
7 Low Power 15 High Power	TX#7 or #15 RX#7 or #15	526.75 526.75	173.975 173.975
8 Low Power 16 High Power	TX#8 or #16 RX#8 or #16	527.00 527.00	174.000 174.000

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 ±201 Hz (UHF) ±68 Hz (VHF)
Power RF	As above	As above	As above	Low Power: 0.9 – 1.5 W (VHF/UHF) High Power: 4.0 – 4.8 W (UHF) High Power: 5.0 – 6.0 W (VHF)
Voice Modulation	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out Monitor: DVM: AC Volts Set 1 kHz Mod Out level for 0.025 Vrms at test set, 80 mVrms at AC/DC test set jack	As above	As above, meter selector to mic	Deviation: ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp).
Voice Modulation (internal)	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out	TEST MODE, Test Channel 4 carrier squelch output at antenna	Remove modulation input	Press PTT switch on radio. Say “four” loudly into the radio mic. Measure deviation: ≥ 4.0 kHz but ≤ 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 O.153 test pattern	Key up radio with O.153 test pattern modulation using Tuner	Not Exceed 5%
Magnitude Error	DMR Mode. Magnitude error	As above	As above	Not Exceed 1%

Table 3-4. Transmitter Performance Checks (Continued)

Test Name	Communications Analyzer	Radio	Test Set	Comments
Symbol Deviation	DMR Mode. Symbol Deviation	As above	As above	Symbol Deviation should be within 648 Hz +/- 10% and 1944 Hz +/- 10%
Transmitter BER	DMR Mode	As above	As above	Transmitter BER should be 0%

* 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 ±201 Hz (UHF) ±68 Hz (VHF)
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 12 dB 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 1 mV 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 – 10dB
Receiver BER	IFR DMR mode. Signal generator with O.153 test pattern	Test Mode, Digital Mode, receive O.153 test pattern	Read BER using Tuner. Adjust RF level to get 5% BER	RF level to be < 0.35 µV for 5% BER

Table 3-5. Receiver Performance Checks (Continued)

Test Name	Communications Analyzer	Radio	Test Set	Comments
Receiver Rated Audio	IFR DMR Mode. Signal generator with 1031 test pattern	Test Mode, Digital Mode, receive 1031 test pattern	RF level = -47 dBm. Set audo analyzer to read Vrms. Adjust volume to get rated audio	Adjust volume until Vrms = 2.83 V
Receiver Audio Distortion	IFR DMR Mode. Signal generator with 1031 test pattern	As above	As above. Then set audio analyzer to measure distortion	Not exceed 5%

* See Table 3-3.

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.

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, orange 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.
7. Press **Top Button**; the radio beeps; release, the radio beeps.

Notes

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 2000/XP/7/8 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, Tuner and AirTracer Applications CD	GMVN5141_

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.

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

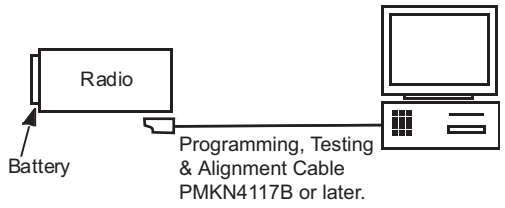


Figure 4-1. CPS Programming Setup

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

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

A personal computer (PC), Windows 2000/XP/7/8 and a tuner program are required to tune the radio. To perform the tuning procedures, the radio must be connected to the PC, Test Box, and test equipment setup as shown in Figure 4-2.

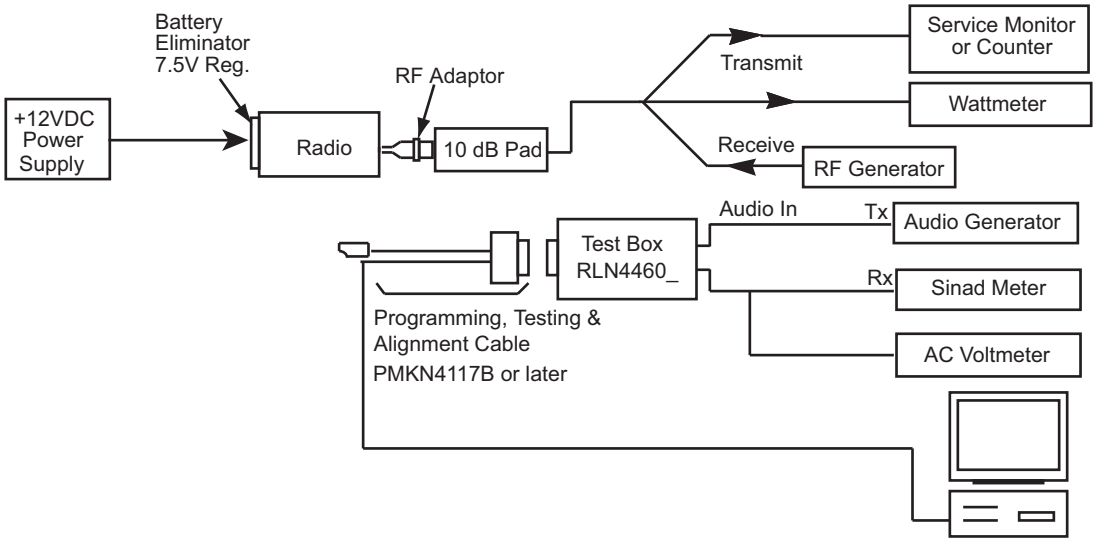


Figure 4-2. Radio Tuning Equipment Setup

4.5 RF Adaptor Assembly

1. Remove RF Plug Label and use tweezer to remove the RF Adaptor Plug.

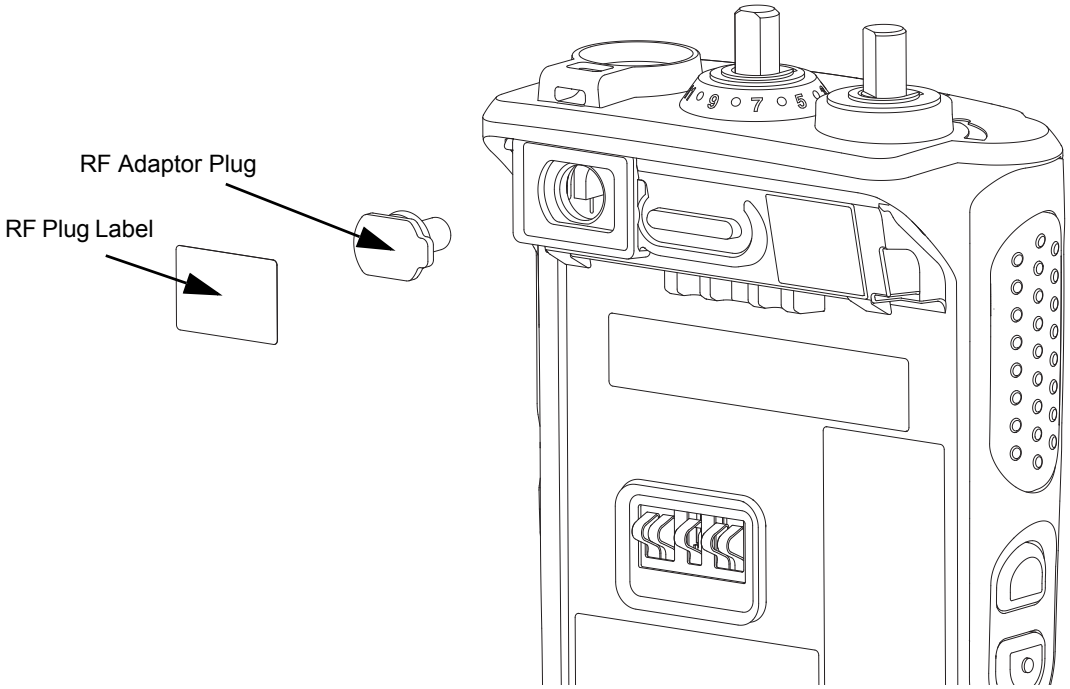


Figure 4-3. RF Plug Label and RF Adaptor Plug Removal

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

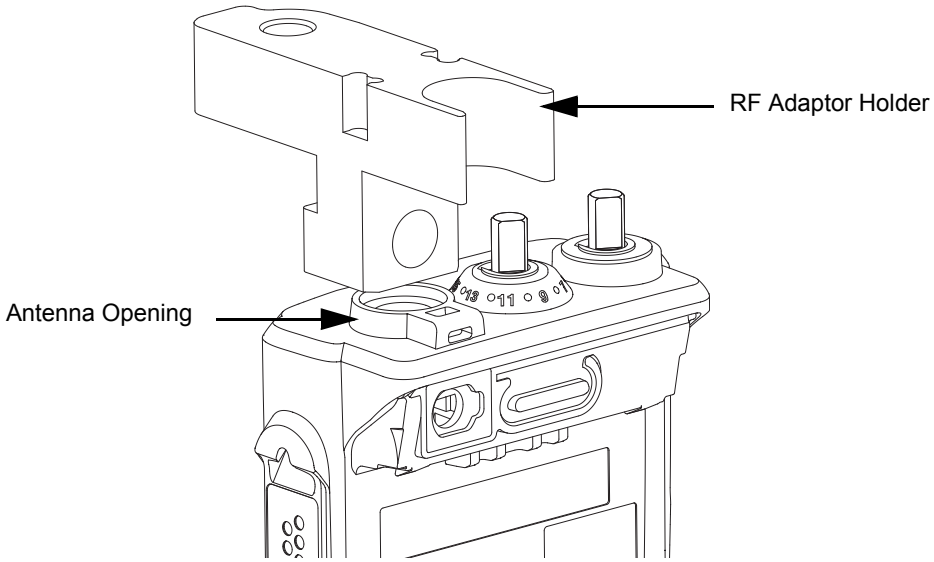


Figure 4-4. RF Adaptor Holder Align

3. Fasten the screw provided to hold the RF Adaptor Holder in place. This is followed by slotting the RF Adaptor into the RF Adaptor Holder slot.

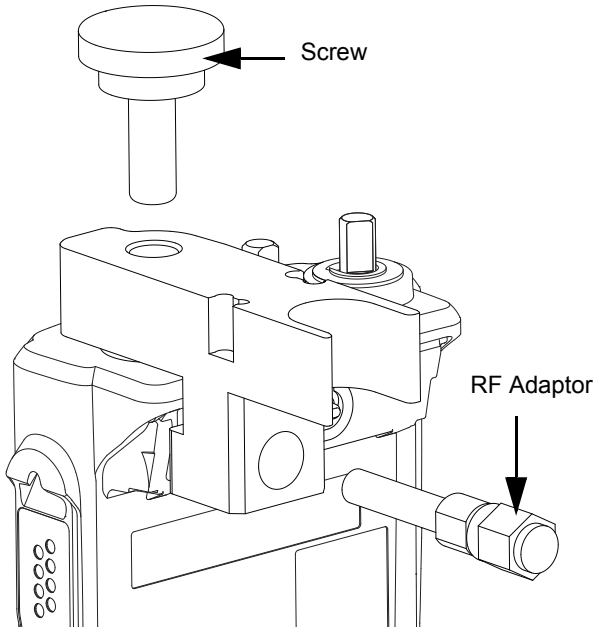


Figure 4-5. RF Adaptor Fasten and Slot

4. The final assembly should look like this.

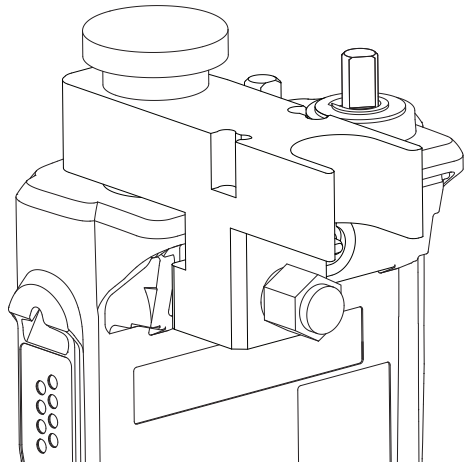


Figure 4-6. RF Adaptor in Place

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.

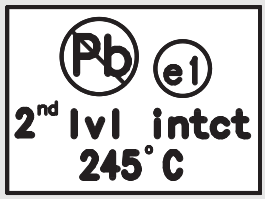
Caution

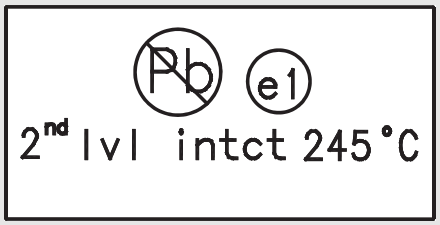
This radio contains static-sensitive devices. Do not open the radio unless you are properly grounded. Take the following precautions when working on this unit:

- 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, and 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 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 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
1085674C03	NC-SMQ230	900-1000KCPs Brookfield (5rpm)	Type 3 (-325/+500)	(95.5%Sn-3.8%Ag-0.7%Cu) 89.3%	217°C

Parts Replacement and Substitution

When damaged parts are replaced, identical parts 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

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.

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

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™ T4, T6 and T8 screwdriver
- Chassis and Knob Opener (66012072001)

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

- Grease (1185937A01)
- TORX™ T4, T6 and T8 screwdriver
- Vacuum Pump Kit (NLN9839) – Radio Immersibility Test
- Pressure Pump Kit (NTN4265) – Radio Immersibility Test
- Connector Fitting (5871134M01) – Radio Immersibility Test
- Fitting Seal (3271133M01) – Radio Immersibility Test
- Seal Port (3286058L01)
- Label Ventilation (5478220A01)

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.

5.6 Radio Disassembly – Detailed

5.6.1 Front Cover from Chassis Disassembly

1. Turn off the radio.
2. Remove the battery:
   a. Release the battery latches by moving them downwards.
   b. Remove the battery from the radio.
3. Remove the antenna by turning it counterclockwise.

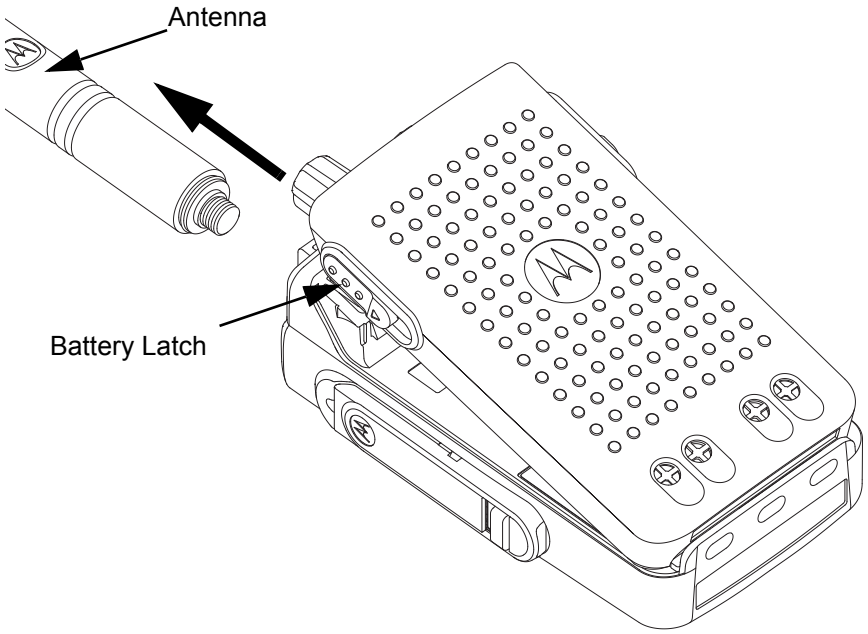


Figure 5-1. Antenna and Battery removal.

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

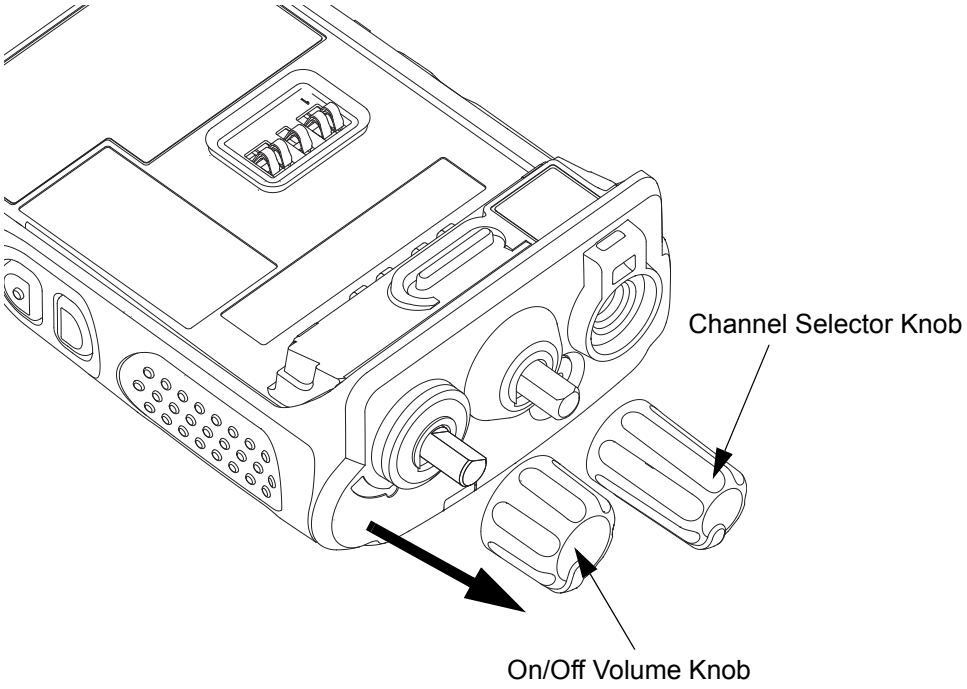


Figure 5-2. Channel Selector and Volume Knob removal.

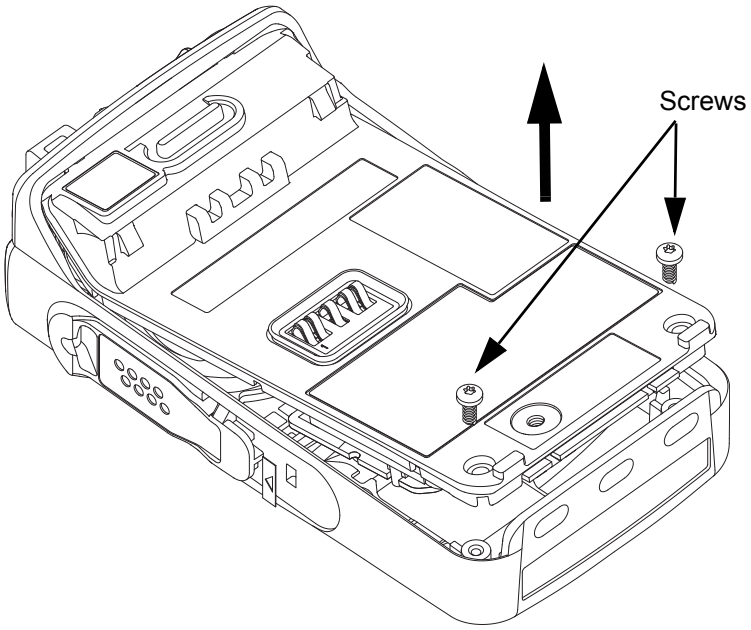


Figure 5-3. Chassis Screw removal

5. Separate the chassis from the Front Cover Assembly as follows:

a. Unscrew the screws using a TORX™ T6 screwdriver as shown in Figure 5-3.

b. Lift the chassis up till the max.

c. Slide the chassis out slowly from the housing as shown in Figure 5-4.

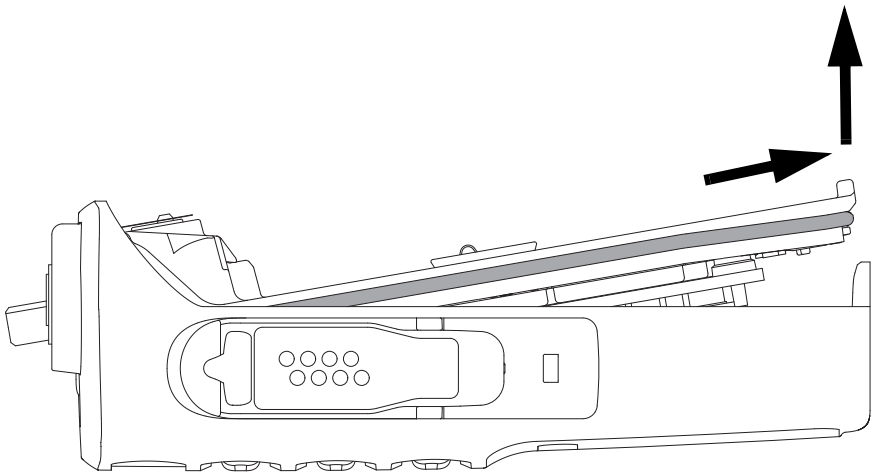


Figure 5-4. Chassis removal

6. Lay the chassis down.

7. Remove the flex from the connector by pulling it out of its connector gently.

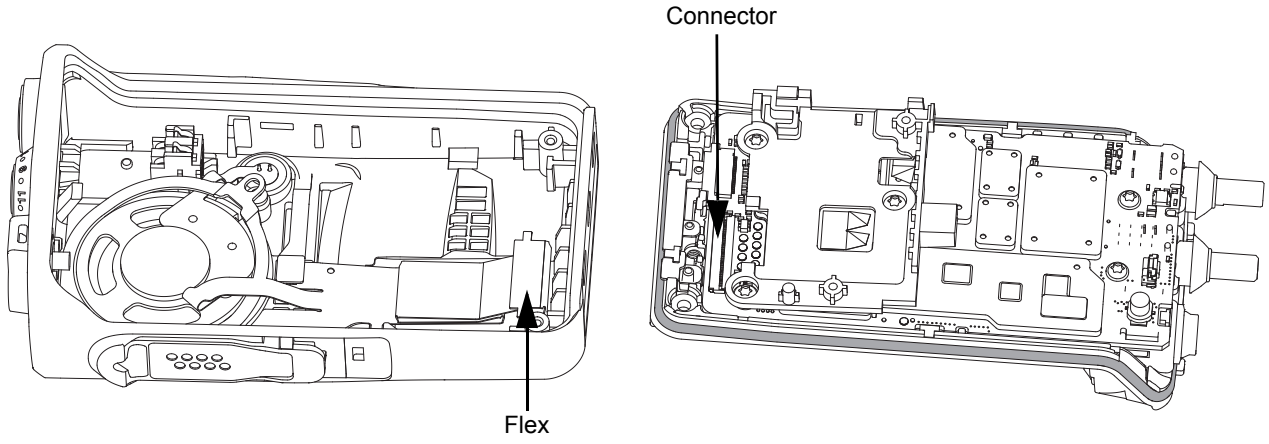


Figure 5-5. Disconnecting the chassis

5.6.2 Chassis Disassembly

1. Remove three screws from the GOB Retainer and two screws from the Main Board with a TORX™ T8 screwdriver.
2. Lift the GOB retainer and main board from chassis.

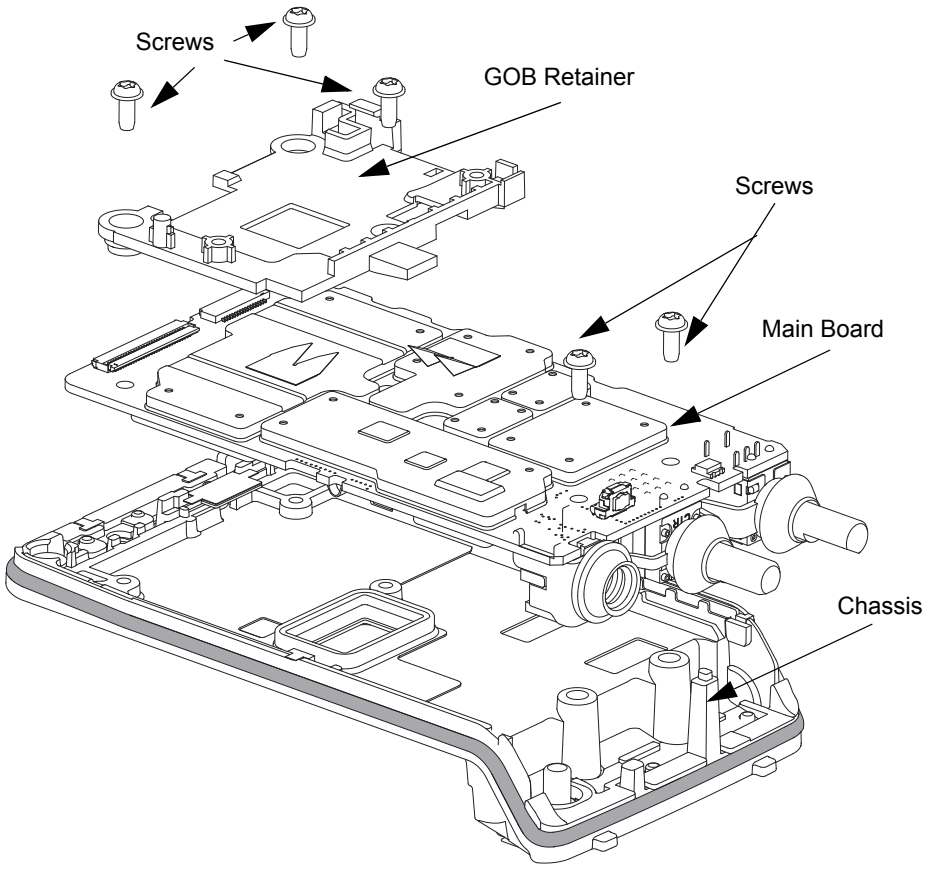


Figure 5-6. Main Board and GOB Retainer removal

3. Remove the main o-ring and Battery Contact Seal.

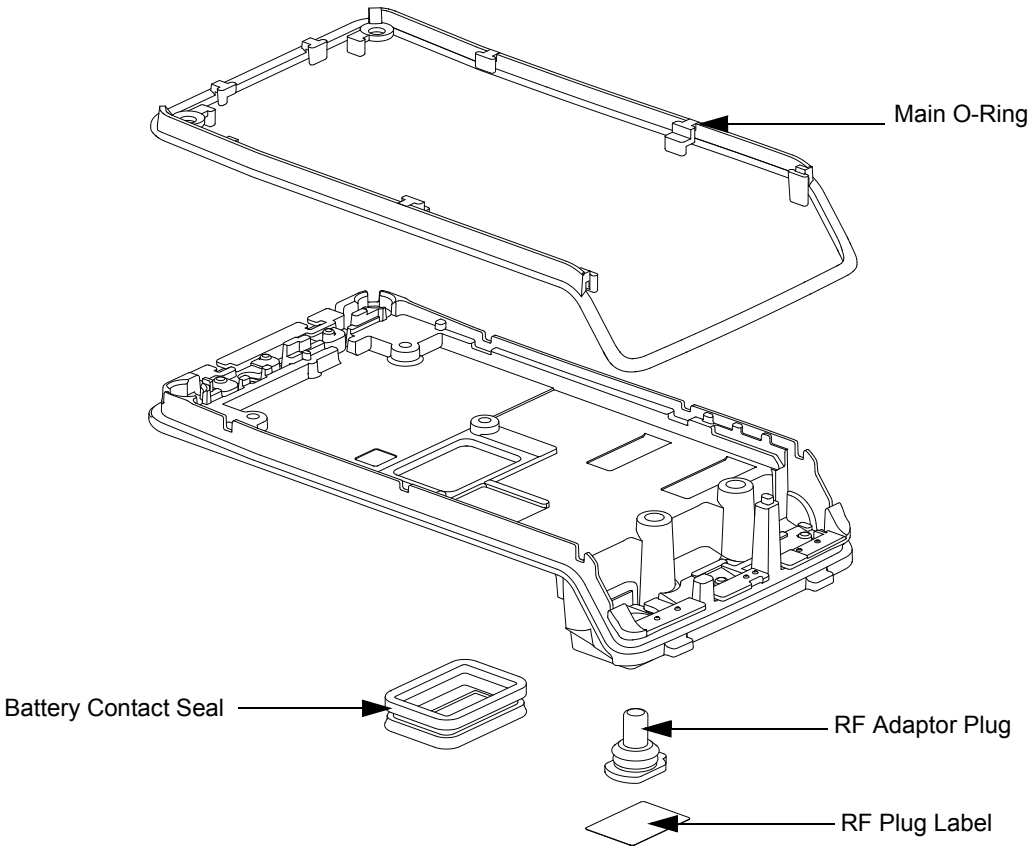


Figure 5-7. O-ring removal

4. Remove the RF plug label and RF Adaptor plug.

5.6.3 Speaker, Microphone, and Universal Connector Flex Disassembly

1. Pull the microphone boot from its seated position.
2. Remove the speaker retainer screw using the TORX T6 screwdriver.
3. Peel-off the universal connector flex circuit escutcheon.
4. Remove the speaker retainer from the speaker assembly.
5. Remove the assembly from the front housing.

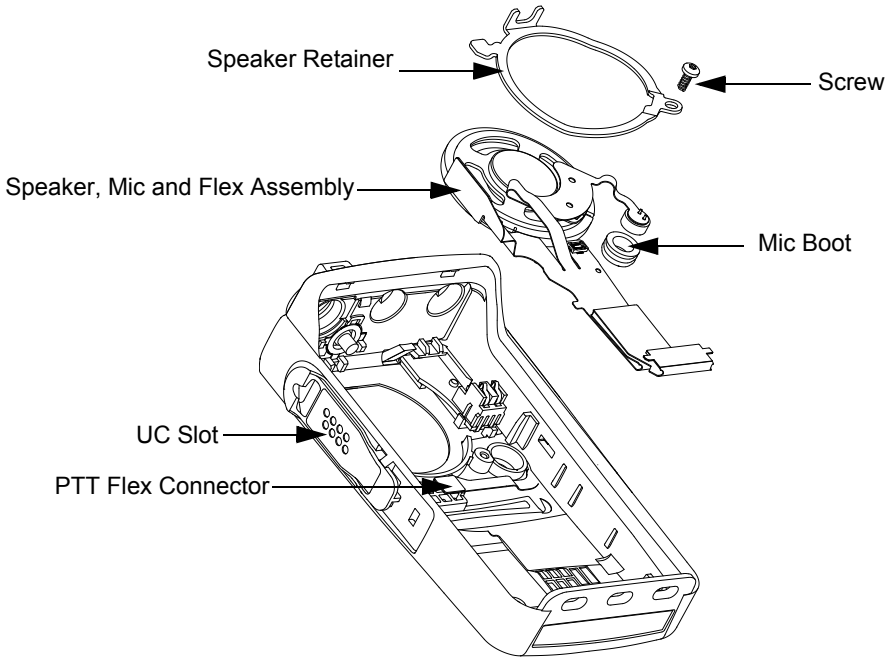


Figure 5-8. Speaker Removal

5.6.4 Emergency Button Assembly Dissassembly

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

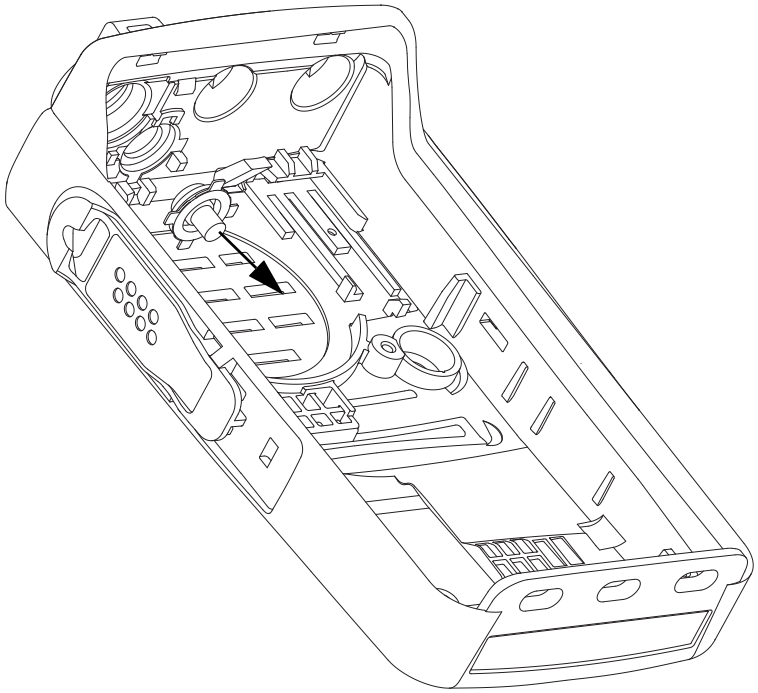


Figure 5-9. Emergency Button Disassembly

5.7 Radio Reassembly – Detailed

5.7.1 Emergency Button and Speaker Reassembly

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

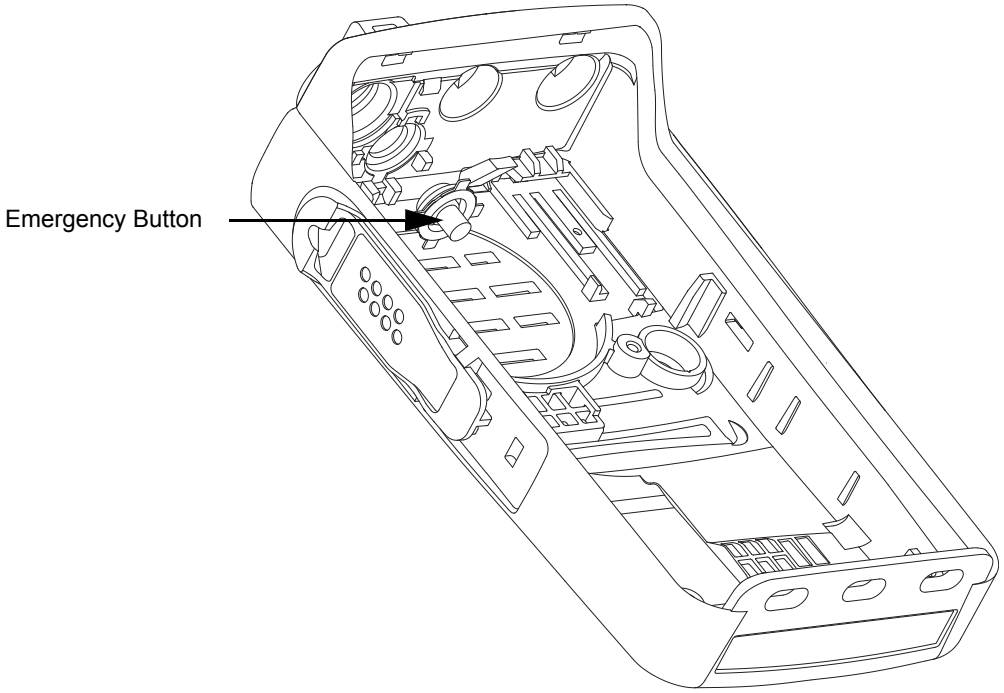


Figure 5-10. Emergency Button Reassembly

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

NOTE Ensure all the flexes are above the speaker retainer.

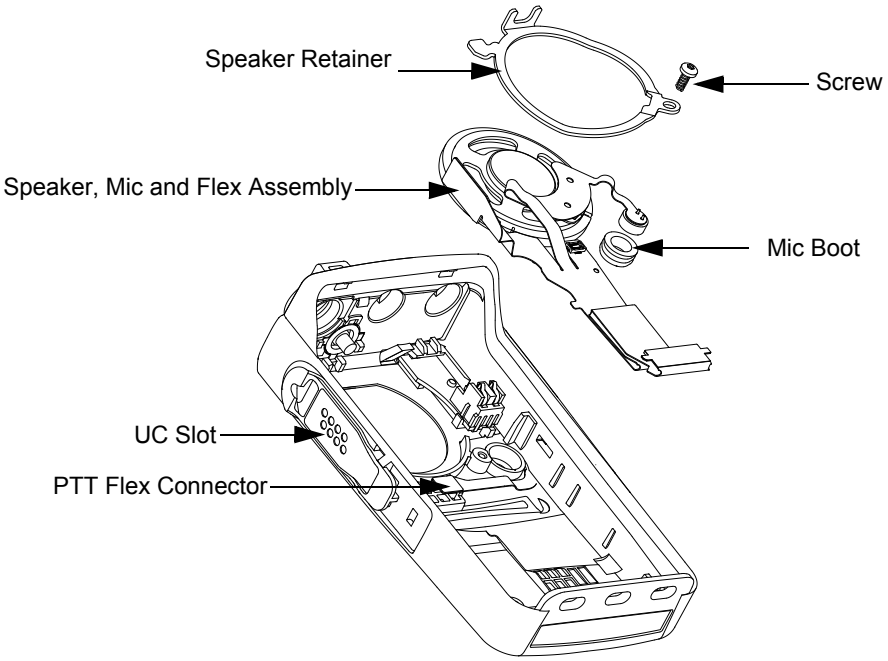


Figure 5-11. Speaker Removal

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

5.7.2 Chassis Reassembly

O-ring reassembly:

i. Ensure that the main O-ring is not twisted and untangle it to its actual form if needed before performing reassembly.

ii. Insert the notches onto the chassis.

iii. Replace the battery contact seal.

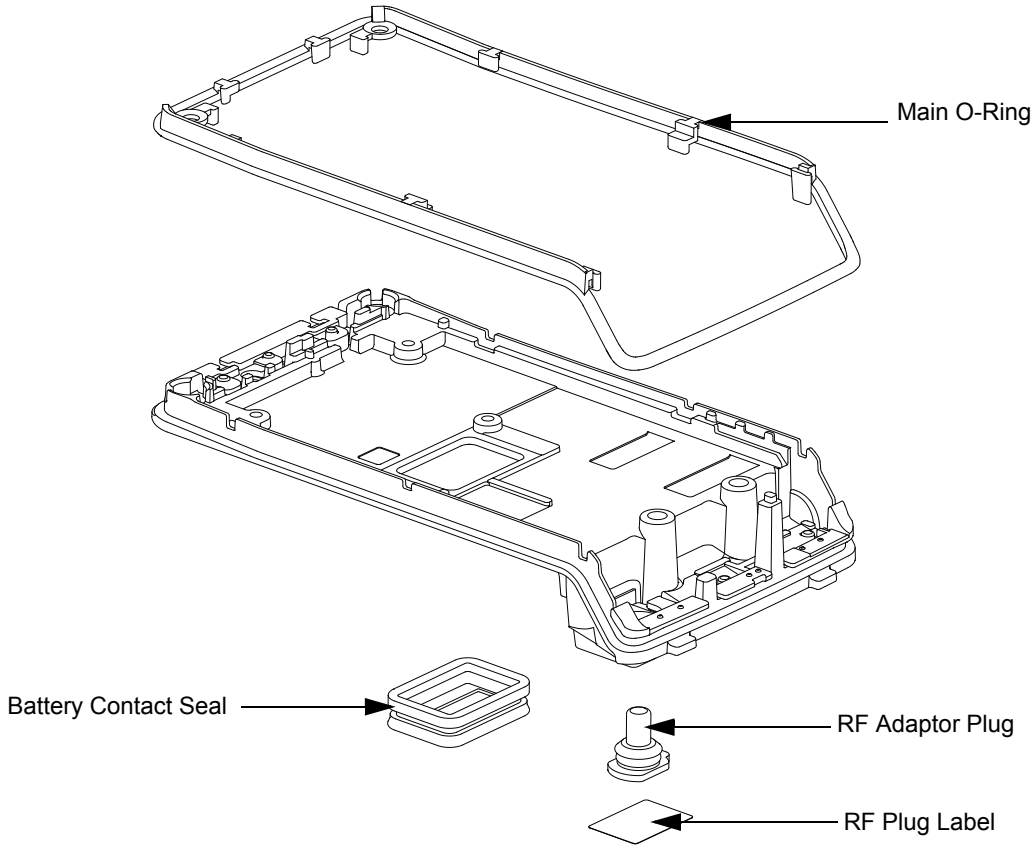


Figure 5-12. O-ring Reassembly.

1. Place the main board onto the chassis.

2. Tighten the main board screws in the sequence shown in Figure 5-13.

3. Place the GOB retainer on the main board and tighten the screws.

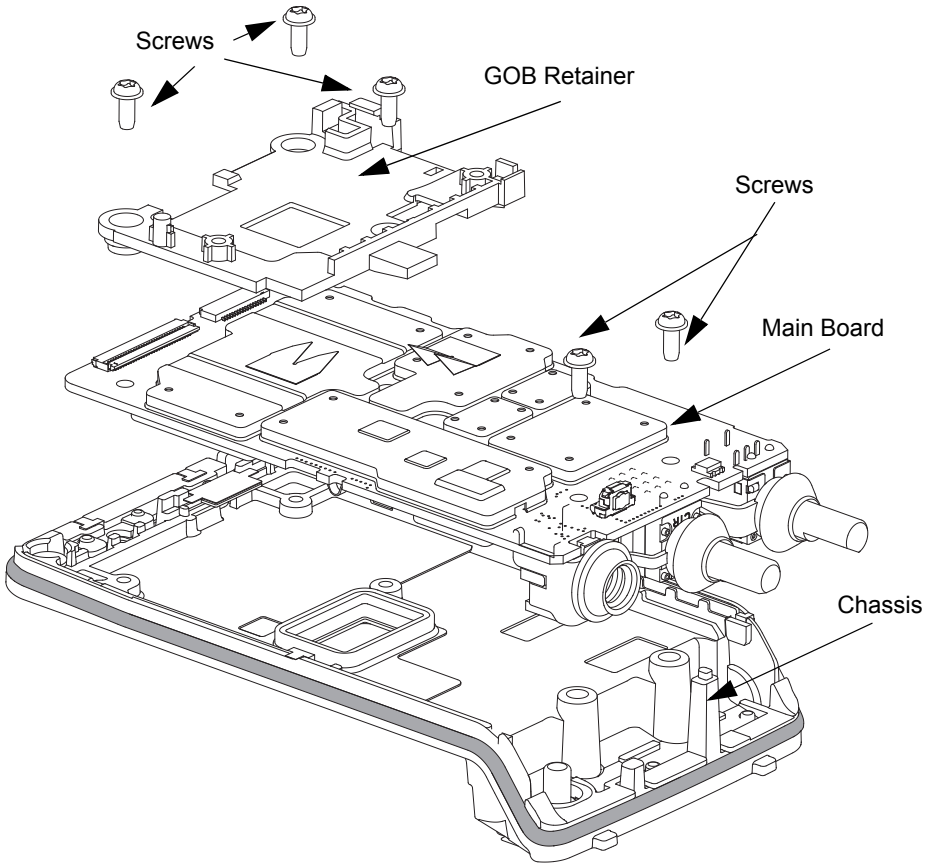


Figure 5-13. Chassis Reassembly

5.7.3 Bluetooth Antenna Kit Disassembly/Reassembly

5.7.3.1 Bluetooth Antenna Kit Disassembly

1. Use a Torx 4 screwdriver to unfasten the bluetooth module.

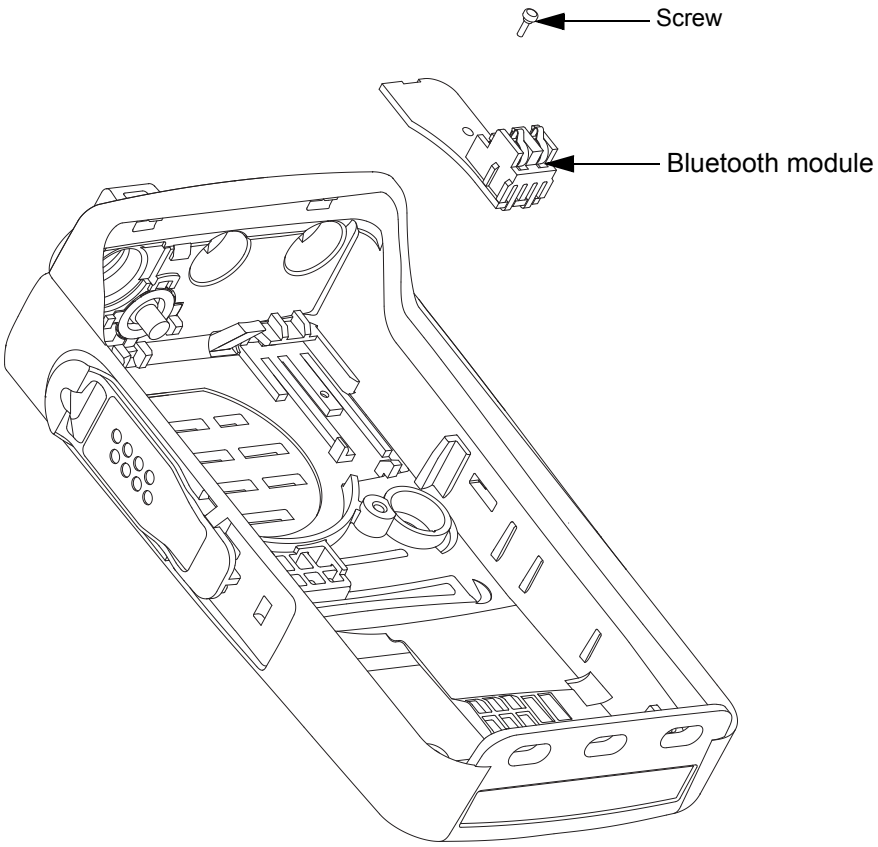


Figure 5-14. Bluetooth Removal

5.7.3.2 Bluetooth Antenna Kit Reassembly

1. Place the Bluetooth module in the housing and fasten with a Torx 4 screwdriver.

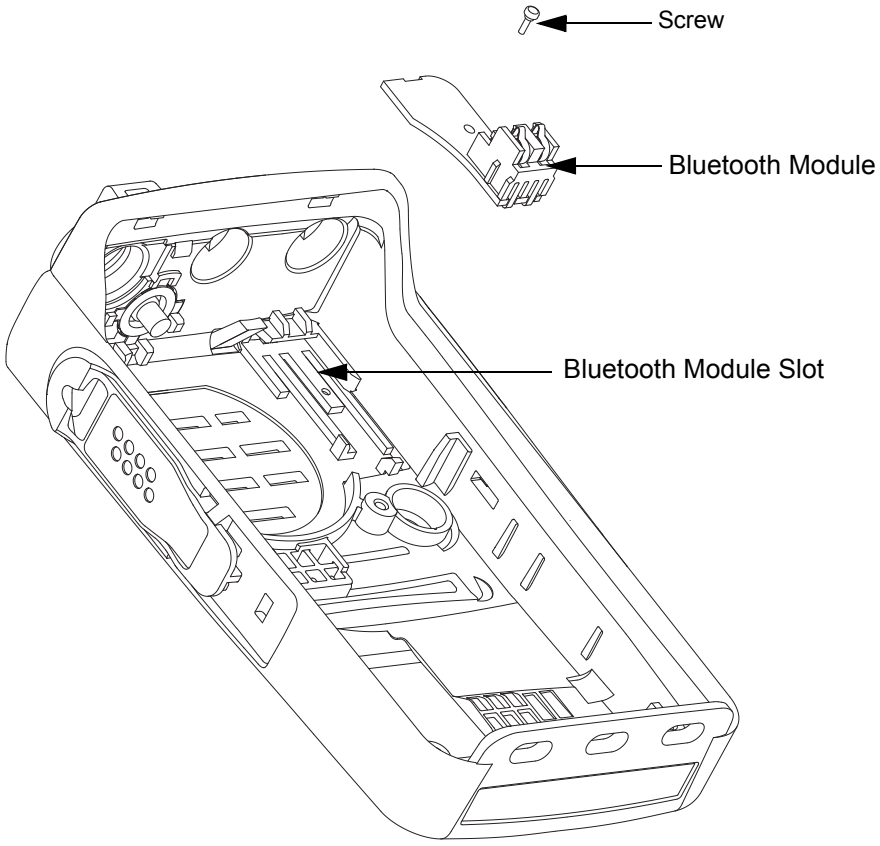


Figure 5-15. Bluetooth Reassembly

5.8 Ensuring Radio Immersibility

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

5.8.1 Servicing

The DP series radios shipped from the Motorola factory have passed vacuum testing and should be capable of restoring the watertight integrity of the radio.

> **Caution**
>
> It is strongly recommended that the maintenance of the radio be deferred to qualified service personnel and service shops. This is of paramount importance as irreparable damage to the radio can result from service by unauthorized persons. If disassembly is necessary, unauthorized attempts to repair the radio may void any existing warranties or extended performance agreements with Motorola. It is also recommended that immersibility be checked annually by qualified service personnel/workshop that is authorized by Motorola.

5.8.2 Accidental Immersion

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

5.8.3 Specialized Test Equipment

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

To ensure that the radio is truly a watertight unit, special testing, test procedures, and specialized test equipment are required. The special testing involves a vacuum check of the radio and pressure testing (troubleshooting) for water leaks if the vacuum check fails. The specialized test equipment/ instrument (Table 2-2 on page 2-2) is authorized by Motorola and needed to perform the vacuum check and pressure testing, if required. Any equipment/tools/instruments not mentioned in the table must not be used to perform these test.

5.8.4 Vacuum Pump Kit NLN9839

The vacuum pump kit includes a vacuum pump with gauge, and a vacuum hose. A connector fitting (part number 5871134M01) and fitting seal (part number 3271133M01) pump connector, which must be ordered separately, connects the vacuum hose to the radio's chassis.

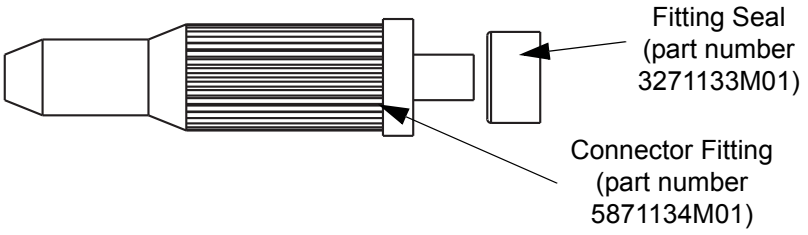


Figure 5-16. Connector Fitting – Fitting Seal Pump Connector

5.8.5 Pressure Pump Kit NTN4265

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

5.8.6 Miscellaneous Hardware

Other items needed for testing the immersibility radio include:

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

5.8.7 Vacuum Test

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

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

To conduct the vacuum test:

1. Attach antenna firmly to the radio.
2. Attach the vacuum hose to the vacuum pump. Check the pump and hose for leaks by blocking off the open end of the hose and operating the pump a few times. The actual reading of the gauge at this point is not important; it is important that the gauge pointer remained steady, indicating no vacuum leaks in the pump.
3. Ensure that the fitting seal is attached to the hose-to-chassis pump connector. Screw the pump connector into the tapped hole in the chassis.

Caution

Please do not bend or over tighten pump connector to the chassis.

4. Attach the open end of the hose to the pointed end of the pump connector.
5. Place the radio on a flat surface with the chassis facing upward.
6. Operate the pump until the gauge indicates 6 in. Hg of vacuum on the radio.Observe the gauge for approximately 1 minute.

- If the needle falls 0.5 in. Hg or less (one scale interval, for example, from 3 in. Hg to 2.5 in. Hg), then the radio has passed the vacuum test and is approved for immersibility. No additional testing will be required.
- If the needle falls more than 0.5 in. Hg (one scale interval, for example, from 3 in. Hg to less than 2.5 in. Hg), then the radio has failed the vacuum test and the radio might leak if

immersed. Additional troubleshooting of the radio will be required; complete this procedure, then go to Section 5.8.8 "Pressure Test".

7. Remove the vacuum hose and pump connector from the radio.

5.8.8 Pressure Test

Pressure testing the radio is necessary only if the radio has failed the vacuum test. Do not perform the pressure test until the vacuum test has been completed. Pressure testing involves creating a positive pressure condition inside the radio, immersing the radio in water, and observing the radio for a stream of bubbles (leak). Since all areas of the radio are being checked, observe the entire unit carefully for the possibility of multiple leaks before completing this test.

To conduct the pressure test:

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

Caution Pressure any greater than 1 psig might push air around the main seal

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

NOTE Some air entrapment may cause the accumulation of bubbles, especially in the grille area, but the bubbles should not be continuous.

Caution Please do not bend or over tighten pump connector to the chassis.

7. Note all of the seal areas that show signs of leakage. Pinpoint the problem(s) to one (or more) of the following areas:

- Front Housing
- Chassis (Main Seal O-ring)
- Battery Contact Seal

8. Remove the radio from the water container, and dry the radio thoroughly. Be especially careful to dry the area around the main seal to prevent contamination of the internal electronics while the unit is open


Caution

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

9. Remove the pump connector from the chassis.
10. Radio after performing Pressure Test must undergo baking process in a temperature chamber for constant temperature soaking at 60°C for 1 hour. This is to ensure no moisture is trapped inside the radio and prevent contamination of the internal electronics after reassembling the radio.

5.8.9 Troubleshooting Leak Areas

Before repairing any leak, first read all of the steps within the applicable section. This will help to eliminate unnecessary disassembly and reassembly of a radio with multiple leaks. Troubleshoot only the faulty seal areas listed in Section 5.8.8 "Pressure Test" on page 5-21, and when multiple leaks exist, in the order listed.

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

5.8.9.1 Front Housing

Do one or both of the following:

1. If a leak occurs at the Lens (Display Models only), Universal Connector, chassis/Housing interface, PTT button area of the housing, replace the housing. Refer to Section 5.6 "Radio Disassembly – Detailed" on page 5-6.
   a. Remove the housing assembly from the radio.
   b. Discard the housing assembly and main seal O-ring.
   c. Install a new main seal O-ring around the chassis assembly.
   d. Install a new housing assembly to the radio.
   e. Inspect the main seal for proper seating.
   f. Observe carefully to ensure that the main seal O-ring is not pinched between the housing and the chassis interface.
2. If the leak occurs at the control top area, remove the knobs in order to determine the leak location:
   a. Conduct the Pressure Test.
   b. Identify the leak location.

5.8.9.2 Chassis (Main Seal O-ring)

To replace the main seal O-ring:

1. Refer to Section 5.6.1 "Front Cover from Chassis Disassembly" on page 5-6, remove the chassis assembly from the radio.
2. Refer to Section 5.6.2 "Chassis Disassembly" on page 5-9, remove the Main Board from chassis.
3. Remove the main seal O-ring.
4. Inspect the seal area around the chassis for foreign material that might prevent the main seal O-ring from sealing properly.
5. Assemble a new O-ring; discard the old O-ring.
6. For detailed O-ring assembly sequence, refer to clause 2, step i. to step viii. of Section 5.7.2 "Chassis Reassembly" on page 5-15.
7. Reassemble the chassis assembly followed by installing into Front Cover. (Refer to Section 5.7 "Radio Reassembly – Detailed" on page 5-13).
8. Inspect the main seal O-ring for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing and the chassis.

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

5.8.9.3 Battery Contact Seal

To replace the Battery Contact Seal:

1. Refer to Section 5.6 "Radio Disassembly – Detailed" on page 5-6 to remove the Battery Contact Seal.
2. Remove the Battery Contact Seal from the Chassis.
3. Inspect the Battery Contact Seal, Chassis and surrounding areas for foreign material that might prevent the Battery Contact Seal from sealing properly.
4. Install a new Battery Contact Seal; discard the old Seal.
5. Replace a new main seal O-ring; discard the old O-ring.
6. Reassemble the chassis assembly followed by installing into Front Cover. (Refer to Section 5.7 "Radio Reassembly – Detailed" on page 5-13).
7. Inspect the main seal O-ring for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing and the chassis.

IMPORTANT: Both Label Ventilation (5478220A01) and Gasket (3286058L01) need to be replaced after vacuum test, pressure test or water leakage troubleshooting.

5.8.9.4 Breathing Vent Membrane and Breathing Vent Label

To replace the Breathing Vent Membrane and Breathing Vent Label:

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

5.8.9.5 Battery Maintenance

1. As part of an Annual Battery Maintenece Program or as required (when the battery contacts are dirty or show signs of wear) it is recommended that the Battery's Radio-side and Charger-side contacts are cleaned with DeoxIT®GOLD cleaner/lubricant.
2. DeoxIT®GOLD (Supplier CAIG Labs, P/N G100P) cleaner/lubricant pen has been found to be very effective at cleaning and extending the life of the battery's contacts. DeoxIT®GOLD cleaner/lubricant is available at numerous electronics suppliers (Radio Shack, McMaster Carr, Fry's, etc.) and directly from manufacturer, CAIG Labs, at http://www.caig.com.
3. This pen based package is recommended as it provides better access to the recessed contacts of the battery. The pen's tip may need to be modified (trimmed on the sides) to improve penetration into the battery contact slots. Per the manufacturer's instructions, shake the pen until the fluid begins to flow and wipe the battery's contact surface with the felt tip. After cleaning, inspect the contact surfaces for signs of advanced wear.
4. Advanced contact wear is defined as wear through either the contact platings (gold and nickel) to the base metal (copper). Copper exposure is characterized by a distinctive orange-brown metal appearance surrounded by the silvery nickel underplate and gold top coat.
5. In some cases, a magnified (10x minimum) inspection may be required to verify wear through to the base material. Polishing of the gold or nickel surface is common and is not considered a need for replacement. In instances where advanced wear is evident, the battery should be replaced.
6. After cleaning the contact areas of any foreign material, let the lubricant/cleaner dry for 2 minutes. Replace the battery on the radio and test for intermittency by moving the battery relative to the radio as might occur in regular use.

NOTE Regular maintenance (at least annually) of this area is recommended to ensure contamination free interface and to prolong the life of the battery contacts.

5.8.10 Troubleshooting Charts

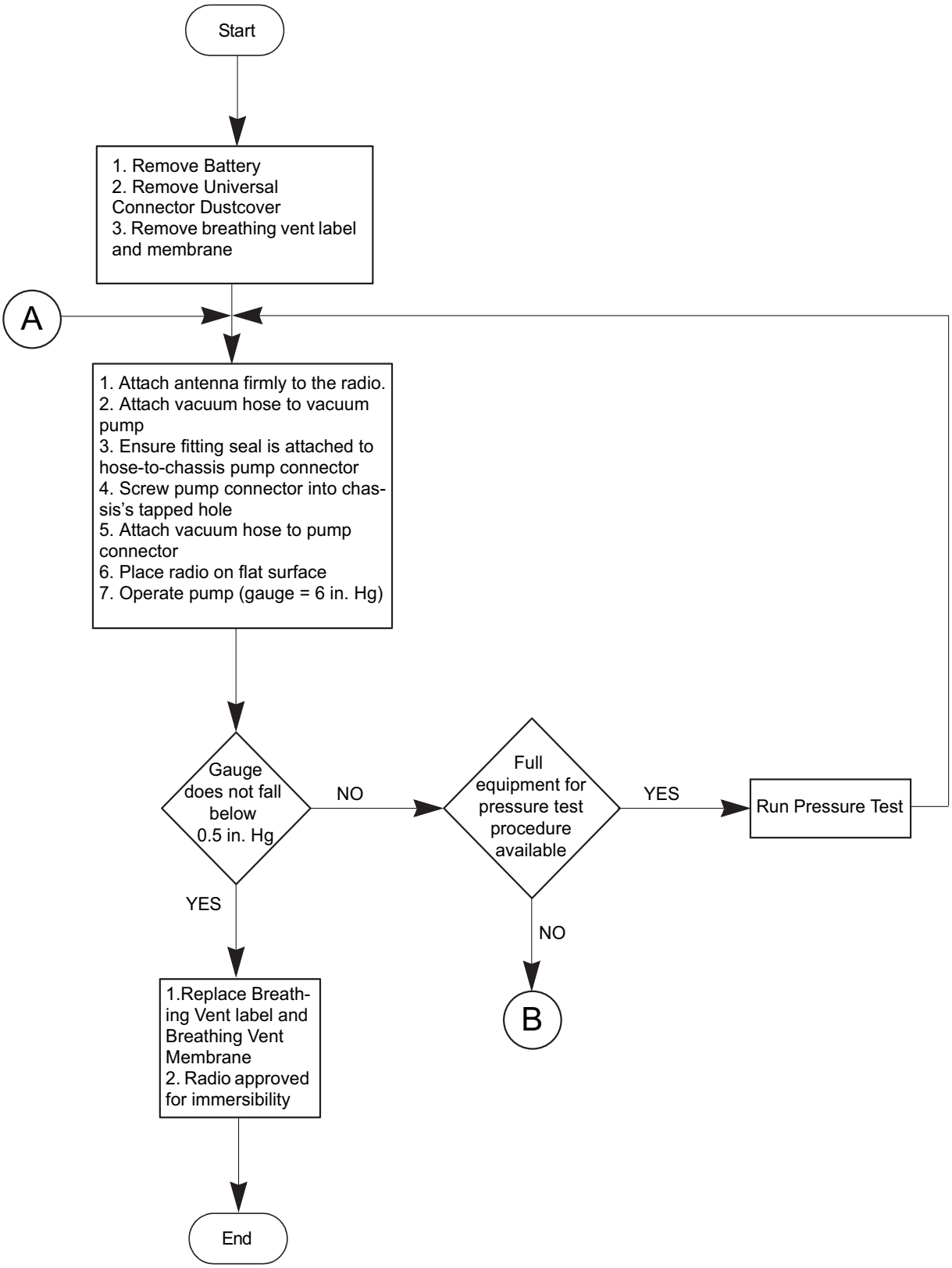


Figure 5-17. Troubleshooting Flow Chart for Vacuum Test (Sheet 1 of 2)

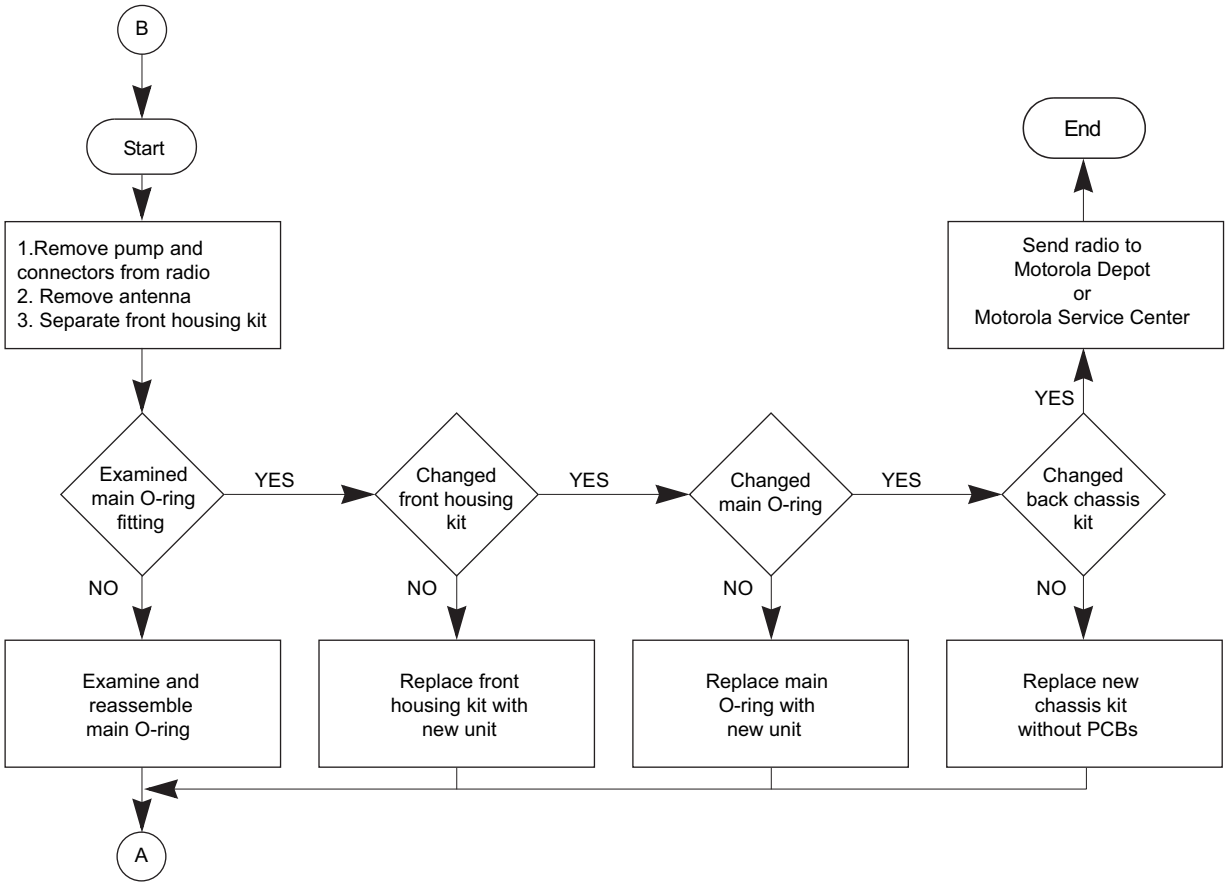


Figure 5-18. Troubleshooting Flow Chart for Vacuum Test (Sheet 2 of 2)

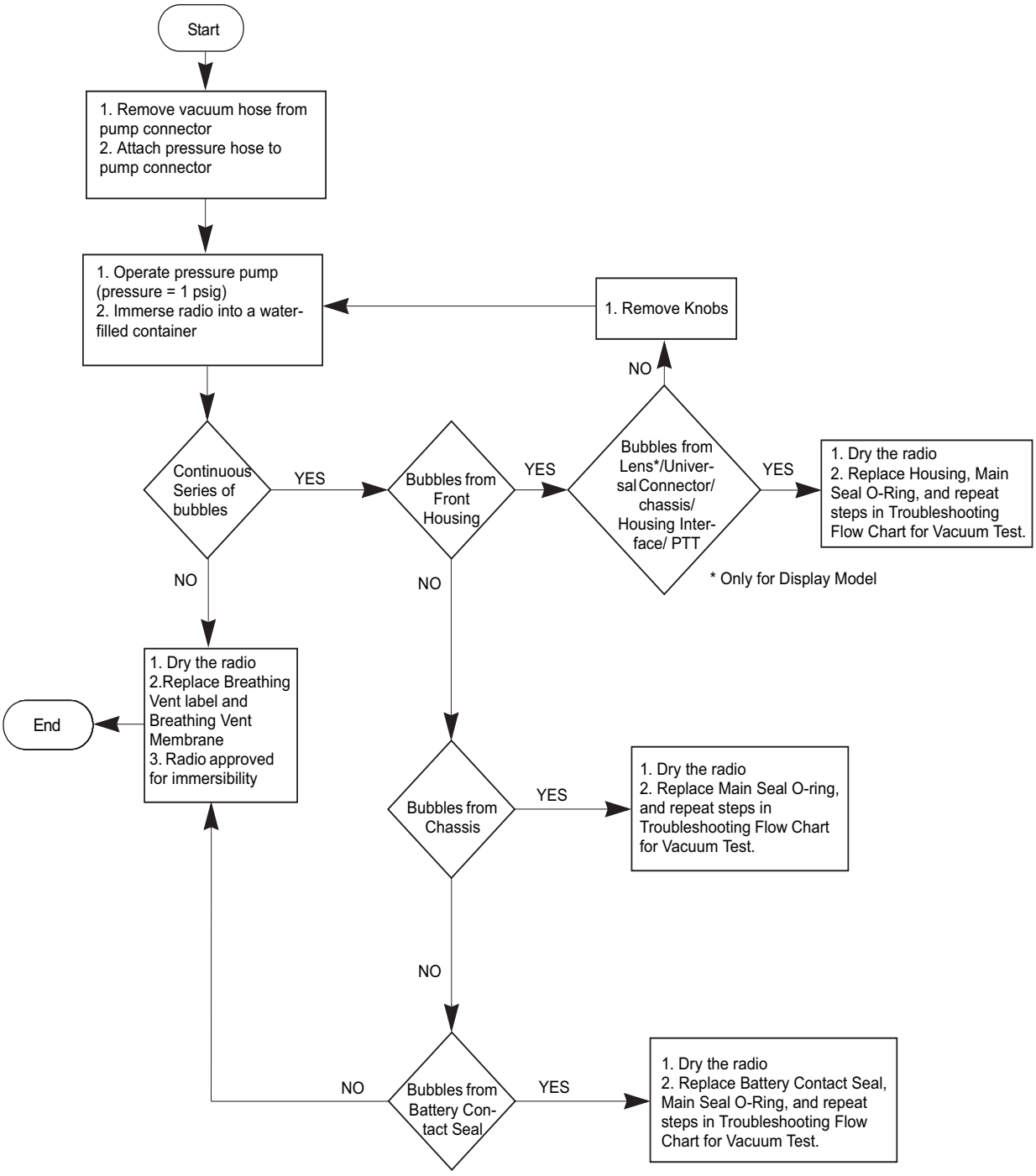


Figure 5-19. Troubleshooting Flow Chart for Pressure Test & Leakage Areas

5.9 Radio Exploded Mechanical Views and Parts Lists

5.9.1 DP3441 Model Exploded View and Parts List

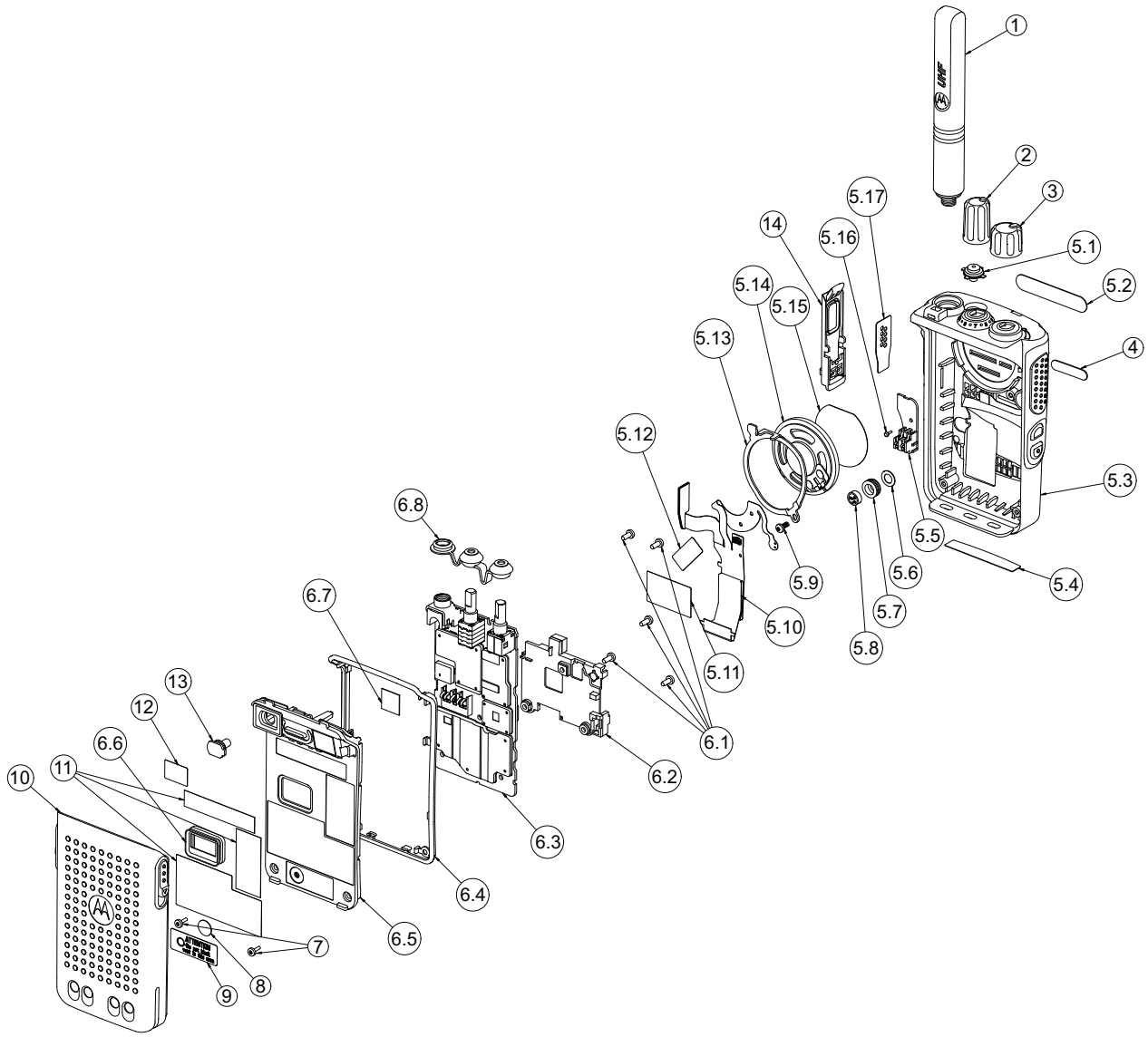


Figure 5-20. DP3441 Exploded View

Table 5-3. DP3441 Exploded View Parts List

Item No.		Description	Part Number
1		Antenna	See Chapter 6: Accessories
2		Knob, Frequency	36012004001
3		Knob, Volume	36012005001
4		Product Number Label	See Table 5-4: Product Number Label
5		Front Cover Kit	See Table 5-4: Front Cover Kit
	5.1	Button, Emergency	38012008001
	5.2	Name plate	33012026001
	5.3	Front housing Assembly	0104057J43
	5.4	Label, Front housing	54012348001
	5.5	BT/GPS Antenna Module	85012045001
	5.6	Mic Membrane with Stiffener	Not supported. Please order Item No.5.
	5.7	Boot, Microphone	Not supported. Please order Item No.5.
	5.8	Microphone	50012012001
	5.9	Screw, speaker retainer	0386434Z02
	5.10	Main Flex Assembly	0104057J44
	5.11	Kapton Tape, Flex	Not supported. Please order Item No.5.
	5.12	Kapton Tape, Speaker	Not supported. Please order Item No.5.
	5.13	Speaker Retainer Assembly	0104045J57
	5.14	Speaker	50012013001
	5.15	Mesh, Speaker	Not supported. Please order Item No.5.
	5.16	Screw, bluetooth board	0371160D01
	5.17	UC Escutcheon	33012020001
6		Back Cover Kit	See Table 5-4: Back Cover Kit
	6.1	Screw, main board	03012073001
	6.2	GOB Retainer Assembly	0104059J98
	6.3	Main Board	Not supported. Please order Item No.6.
	6.4	O-ring	32012253001
	6.5	Chassis Assembly Kit	0104057J75
	6.6	Battery contact seal	32012254001

Table 5-3. DP3441 Exploded View Parts List

Item No.		Description	Part Number
	6.7	Pad, Thermal	75012234001
	6.8	Seal, Top Control	Not supported. Please order Item No.6.
7		Screw, housing	0316281H01
8		Gasket	3286058L01
9		Label, Ventilation	5478220A01
10		Battery	PMNN4440_
11		Labels	Not Field Replaceable
12		RF Adaptor Plug label	33012058001
13		RF Adaptor Plug	38012048001
14		Dust Cover Assembly	0104058J40

Table 5-4. Additional Part List Information

Item	Description	Part Number
Product Numbering Label	DP3441	33012015025
Front Cover Kit	Front Cover Kit with BT	PMLN6484_
Back Cover Kit	Back Kit UHF with BT/GPS	PMLE4936_S
	Back Kit VHF with BT/GPS	PMLD4607_S

5.9.2 Torque Chart

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

Part Number	Description	Driver/ Socket	Torque	
			lbs-in	N-m
03012073001	Screw, Main Board	T8 Torx	3.1 – 3.3	0.35 – 0.37
0386434Z02	Screw, Speaker Retainer	T6 Torx	2.3 – 2.5	0.26 – 0.28
0371160D01	Screw, Bluetooth Antenna	T4 Torx	0.4 – 0.6	0.05 – 0.07
0316281H01	Screw, Housing Chassis	T6 Torx	2.1 – 2.3	0.24 – 0.26

Notes

Appendix A EMEA Regional Warranty, Service and Technical Support

A.1 Warranty and Service Support

Motorola 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. Any "return for exchange" or "return for repair" by an authorized Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorized Motorola Dealer.

A.1.1 Warranty Period and Return Instructions

The terms and conditions of warranty are defined fully in the Motorola Dealer or 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. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

Prior to shipping any radio back to the appropriate Motorola warranty depot, please contact Customer Resources (Please see page A-3). All returns must be accompanied by a Warranty Claim Form, available from your Customer Services representative. Products should be shipped back in the original packaging, or correctly packaged to ensure no damage occurs in transit.

A.1.2 After Warranty Period

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

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

A.2 European Radio Support Centre (ERSC)

The ERSC Customer Information Desk is available through the following service numbers:

Austria:	08 00 29 75 41	Italy:	80 08 77 387
Belgium:	08 00 72 471	Luxemburg:	08 00 23 27
Denmark:	80 88 58 80	Netherlands:	08 00 22 45 13
Finland:	08 00 11 49 910	Norway:	80 01 11 15
France:	08 00 90 30 90	Portugal:	08 00 84 95 70
Germany:	08 00 18 75 240	Spain:	90 09 84 902
Greece:	00 80 04 91 29 020	Sweden:	02 07 94 307
UK :	08 00 96 90 95	Switzerland:	08 00 55 30 82
Ireland:	18 00 55 50 21	Iceland:	80 08 147

Or dial the European Repair and Service Centre:
Telephone: +49 30 6686 1555
Fax ERSC: +49 30 6686 1579
Email ERSC: ERSC@motorolasolutions.com

Please use these numbers for repair enquiries only.

A.3 Piece Parts

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

Orders for replacement parts, kits and assemblies should be placed directly on Motorola's local distribution/dealer organisation or via Motorola Online at: http://emeaonline.motorolasolutions.com

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

A.4 Technical Support

Motorola Product Services is available to assist the dealer/distributors in resolving any malfunctions which may be encountered.

Russia and Armenia – Andrey Nagornykh
Telephone: +7 495 787 8910
Fax: +7 495 785 0185
Email: mwcb47@motorolasolutions.com

Middle East and Africa – Wayne Holmes
Telephone: +49 (0) 6126 957 6237
Fax: +49 (0) 6126 957 6826
Email:
wayne.holmes@motorolasolutions.com

France – Armand Roy
Telephone: +33 1 6935 7868
Fax: +33 1 6935 7808
Email: armand.roy@motorolasolutions.com

France – Laurent Irrmann
Telephone: +33 1 6935 7866
Fax: +33 1 6935 7808
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laurent.irrmann@motorolasolutions.com

Central and East Europe – Siggy Punzenberger
Telephone: +49 (0) 6128 70 2342
Fax: +49 (0) 6128 95 1096
Email: TFG003@motorolasolutions.com

Germany – Customer Connect Team
Telephone: +49 (0) 30 6686 1539
Fax: +49 (0) 30 6686 1916
Email: ESSC@motorolasolutions.com

Italy – Ugo Gentile
Telephone: +39 02 5220 7825
Fax: +39 02 5220 7810
Email: Ugo.Gentile@motorolasolutions.com

A.5 Further Assistance From Motorola

You can also contact the Customer Help Desk through the following web address.
http://www.motorolasolutions.com

Notes

Appendix B Limited Level 3 Servicing

B.1 Maintenance

For details on the following, please refer to section 5.2 on page 5-1 to section 5.4 on page 5-4.

• Preventive maintenance (inspection and cleaning).

• Safe handling of CMOS and LDMOS devices.

• Repair procedures and techniques.

B.2 Chip Components

Use a Hot-Air Repair Station for chip component replacement. Adjust the temperature control to 370°C (700°F), and adjust the airflow to a minimum setting. Airflow can vary due to component density.

- **To remove a chip component**:
  1. Use a hot-air hand piece and position the nozzle of the hand piece approximately 0.3 cm (1/8") above the component to be removed.
  2. Begin applying the hot air. Once the solder reflows, remove the component using a pair of tweezers.
  3. Using a solder wick and a soldering iron or a power desoldering station, remove the excess solder from the pads.
- **To replace a chip component using a soldering iron**:
  1. Select the appropriate micro-tipped soldering iron and apply fresh solder to one of the solder pads.
  2. Using a pair of tweezers, position the new chip component in place while heating the fresh solder.
  3. Once solder wicks onto the new component, remove the heat from the solder.
  4. Heat the remaining pad with the soldering iron and apply solder until it wicks to the component. If necessary, touch up the first side. All solder joints should be smooth and shiny.
- **To replace a chip component using hot air**:
  1. Use the hot-air hand piece and reflow the solder on the solder pads to smooth it.
  2. Apply a drop of solder paste flux to each pad.
  3. Using a pair of tweezers, position the new component in place.
  4. Position the hot-air hand piece approximately 0.3 cm (1/8") above the component and begin applying heat.
  5. Once the solder wicks to the component, remove the heat and inspect the repair. All joints should be smooth and shiny.

B.3 Component and Parts list

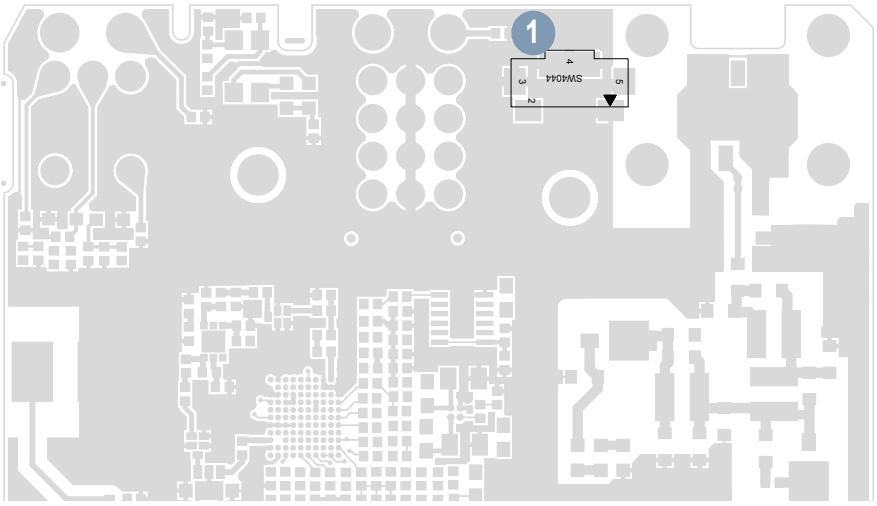

Figure B-1. PCB Top View

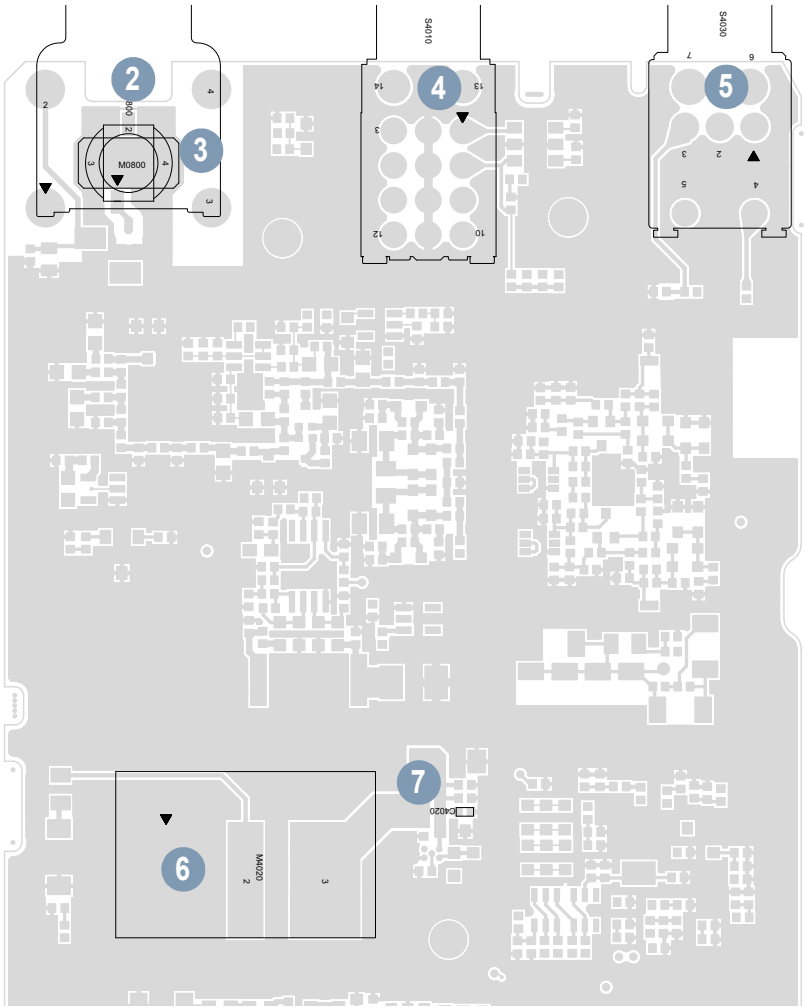

Figure B-2. PCB Bottom View

Table B-1 Component Parts List

No.	Circuit Ref	Motorola Part Num.	Description
1	SW4044	4086470Z01	Tact Switch
2	M0800	0987378K01	RF Connector, coaxial, female
3	E0800	02012010001	Antenna Nut
4	S4010	40012029001	Frequency Switch
5	S4030	1875103C04	Volume Rotary On/Off Switch
6	M4020	9012098001	Battery Contact Connector
7	F4020	6515076H01	Fuse Fast Blow 3A 24V

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.
DP	Refers to Digital Professional Radio model names in the MOTOTRBO Professional Digital Two-Way Radio System.
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.

Term	Definition
MDC	Motorola Digital Communications.
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.

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