PROFESSIONAL DIGITAL TWO-WAY RADIOS

MOTOTRBO™ PORTABLE
DP2600e
DP2400e
BASIC
# SERVICE MANUAL

DP4400e

DP4800e

DMR
DIGITAL MOBILE RADIO ASSOCIATION

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

⚠️ **Caution**	**Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio.**
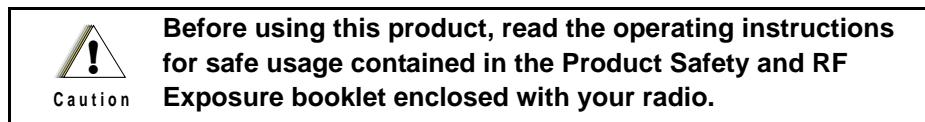
ATTENTION!

This radio is restricted to occupational use only to satisfy FCC ICNIRP energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 6864117B25) to ensure compliance with RF energy exposure limits.

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

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Notes

Document History

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

Edition	Description	Date
MN002211A01-AA	Initial Release	Jan. 2016

Notes

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

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

1.2 Radio Description

The DP2000 series portable radios 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	403–527 MHz	1 Watt or 4 Watt
300 MHz	300–360 MHz	1 Watt or 4 Watt
350 MHz	350–400 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   Limited Keypad Model

Antenna

Channel Selector Knob

On/Off Volume Control Knob

LED Indicator

PTT Button

Microphone

Side Button 1

Side Button 2

Limited Keypad

Universal Connector

Speaker

Display

OK Button

Figure 1-1. Limited 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 INDICATORS – Red, green and amber light-emitting diodes indicate operating status.

- LCD (Liquid Crystal Display) – 65 x132 full dot matrix grayscale display provides visual information about many radio features..

- MENU NAVIGATION KEYS – Five keys to provide menu navigation and selection interface.

- FRONT BUTTONS and SIDE BUTTONS – These four 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.

- 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.

- SPEAKER – Outputs all tones and audio that are generated by the radio (e.g. features like keypad tones and voice audio).

NOTE Limited Keypad Model not applicable to 300 MHz Band.

1.2.2   Non Keypad Model

Figure 1-2. 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 INDICATORS – 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.
- 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 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).

1.3 .Portable Radio Model Numbering Scheme

Model No.Example : MD H 0 2 J D C 9 U A 2 A N

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

AZ: Asia
LA: Latin America
AA: North America
MD: Europe

H: Portable

DP2000 Model Series: 02

Band
J: 136-174 MHz
K: 300-360 MHz
N: 350-400 MHz
R: 403-527 MHz

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

Physical Packages
C: Plain Model
H: Monochrome Display LKP
T: No Display - Limited Tier

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

Primary Operation
U: WiFi Only
W: Basic (No WiFi,Bluetooth,GOB)

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

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

Version Letter

Unique Variation
N: Standard Package

xy: Custom Housing
GP328D: 03
GP338D: 04

Figure 1-3. Portable Radio Model Numbering Scheme

1.4   Model Charts

1.4.1   VHF Model Chart

DP2000e Series, VHF, 136–174 MHz			
Model		**Description**	
MDH02JDH9VA1AN		DP2600e, 136–174 MHz, 5W, MOTOTRBO Limited Keypad Portable	
	MDH02JDC9VA1AN	DP2400e, 136–174 MHz, 5W, MOTOTRBO Non Keypad Portable	
		Item	**Description**
X		PMLD4734_	BC Kit, 136–174 MHz, 5W, Limited Keypad Portable
	X	PMLD4737_	BC Kit, 136–174 MHz, 5W, Non Keypad Portable
X		PMLN7271_	Front Cover Kit Limited Keypad
	X	PMLN7272_	Front Cover Kit Non Keypad
X	X	PMAD4117_	VHF Helical Antenna (136–155 MHz)
X	X	PMAD4116_	VHF HelicalAntenna (144–165 MHz)
X	X	PMAD4118_	VHF Helical Antenna (152–174 MHz)
X	X	PMAD4119_	VHF Stubby Antenna (136–148 MHz)
X	X	PMAD4120_	VHF Stubby Antenna (146–160 MHz)
X	X	PMAD4121_	VHF Stubby Antenna (160–174MHz)

1.4.2 UHF Model Chart

DP2000e Series, UHF, 403–527 MHz			
Model			**Description**
MDH02RDH9VA1AN			DP2600e, 403–527 MHz, 4W, MOTOTRBO Limited Keypad Portable
	MDH02RDC9VA1AN		DP2400e, 403–527 MHz, 4W, MOTOTRBO Non Keypad Portable
		Item	**Description**
X		PMLE5076_	Back Cover Kit, MOTOTRBO Limited Keypad Portable
	X	PMLE5075_	Back Cover Kit, MOTOTRBO Non Keypad Portable
X		PMLN7271_	Front Cover Kit Limited Keypad
	X	PMLN7272_	Front Cover Kit Non Keypad
X	X	PMAE4068_	UHF Whip Antenna 403–527 MHz
X	X	PMAE4069_	UHF Stubby Antenna 403–450 MHz
X	X	PMAE4070_	UHF Stubby Antenna 440–490 MHz
X	X	PMAE4071_	UHF Stubby Antenna 470–527 MHz
X	X	PMAE4079_	Slim UHF Whip Antena 403–527 MHz

1.4.3   300 MHz Model Chart

DP2000e Series, 300 MHz, 300–360 MHz	
Model	**Description**
MDH02KDC9VA1AN	DP2400e, 350–400 MHz, 4W, MOTOTRBO Non Keypad Portable
Item	**Description**
X PMLD4799_	Back Cover Kit, MOTOTRBO Limited Keypad Portable
X PMLN7272_	Front Cover Kit, MOTOTRBO Non Keypad Portable
X PMAD4135_	Stubby Antenna (320–360 MHz)
X PMAD4137_	Stubby Antenna (300–337 MHz)

1.4.4   350 MHz Band Model Chart

DP2000e Series, 350 MHz, 350–400 MHz	
Model	**Description**
MDH02NDC9VA1AN	DP2400e, 350–400 MHz, 4W, MOTOTRBO Non Keypad Portable
Item	**Description**
X PMLD4799_	Back Cover Kit, MOTOTRBO Limited Keypad Portable
X PMLN7272_	Front Cover Kit, MOTOTRBO Non Keypad Portable
X PMAD4136_	Stubby Antenna (350–380 MHz)
X PMAD4133_	Stubby Antenna (360–400 MHz)
X PMAD4139_	VHF Whip Antenna (350–400 MHz)

1.5   Specifications

General	Limited Keypad DP2600e	Non Keypad DP2400e
Channel Capacity	128	16
Frequency	VHF: 136 – 174 MHz UHF: 403 – 527 MHz 300 MHz: 300 – 360 MHz 350 MHz: 350 – 400 MHz	
Dimensions (HxWxT) w/ NiMH battery	122.0 x 56.0 x 39.4 mm	122.0 x 56.0 x 39.4 mm
Weight (with Core Slim LiIon battery) (with IMPRES LiIon battery) (with LiIon IP57 battery)	281g 281g 299g	264g 264g 282g
Power Supply	7.5V nominal	
Average battery life at 5/5/90 duty cycle with battery saver enabled in carrier squelch and transmitter in high power.		
Core NiMH IP56 Battery (1400mAh)	Analog: 9.5 hrs Digital: 12.0 hrs	Analog: 9.5 hrs Digital: 12.0 hrs
Core Li-Mn Low Temp Submersible Battery (1400maH)	Analog: 9.5 hrs Digital: 12.0 hrs	Analog: 9.5 hrs Digital: 12.0 hrs
IMPRES IP56 LiIon Battery (1600mAh)	Analog: 11.0 hrs Digital: 14.5 hrs	Analog: 11.0 hrs Digital: 14.5 hrs
Core Slim LiIon Battery (1650 mAH)	Analog: 11.5 hrs Digital: 15.0 hrs	Analog: 11.5 hrs Digital: 15.0 hrs
Slim IMPRES LiIon Battery (2050 mAH)	Analog: 14.0 hrs Digital: 18.5 hrs	Analog: 14.0 hrs Digital: 18.5 hrs
IMPRES LiIon Battery (2250 mAH)	Analog: 16.0 hrs Digital: 20.5 hrs	Analog: 16.0 hrs Digital: 20.5 hrs
IMPRES TIA4950 Hi-Cap LiIon Battery (2900 mAH)	Analog: 20.0 hrs Digital: 26.5 hrs	Analog: 20.0 hrs Digital: 26.5 hrs
IMPRES Ultra Hi-Cap LiIon Battery (3000 mAH)	Analog: 21.0 hrs Digital: 26.5 hrs	Analog: 21.0 hrs Digital: 26.5 hrs

NOTE   Weight can have 5% margin of error

NOTE   Limited Keypad Model not applicable to 300 MHz Band.

Receiver	Limited Keypad DP2600e	Non Keypad DP2400e
Frequencies	VHF: 136 – 174 MHz UHF: 403 – 527 MHz 300 MHz: 300 – 360 MHz 350 MHz: 350 – 400 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)	0.26 uV (0.15 uV typical)	
Digital Sensitivity (5% BER)	0.22 uV (0.13 uV typical)	
Intermodulation (TIA603D)	70 dB	
Adjacent Channel Selectivity TIA603A TIA603D	60 dB @ 12.5 kHz, 70 dB @ 20 kHz*/25 kHz 45 dB @ 12.5 kHz, 70 dB @ 20 kHz*/25 kHz	
Spurious Rejection (TIA603D)	70 dB	
Rated Audio	500 mW	
Audio Distortion @ Rated Audio	5% (3% typical)	
Hum and Noise	-40 dB @ 12.5 kHz -45 dB @ 20 kHz*/25 kHz	
Audio Response	TIA603D	
Conducted Spurious Emission (TIA603D)	-57 dBm	

* 350 MHz band does not support 20 kHz

NOTE Limited Keypad Model not applicable to 300 MHz Band.

Transmitter	Limited Keypad DP2600e	Non Keypad DP2400e
Frequencies	VHF: 136 – 174 MHz UHF: 403 – 527 MHz 300 MHz: 300 – 360 MHz 350 MHz: 350 – 400 MHz	
Channel Spacing	12.5 kHz/ 20 kHz*/ 25 kHz	
Frequency Stability (-30°C to +60°C)	+/-0.5 ppm	
Power Output (Low Power)	VHF/UHF: 0.5 W 300/350 MHz: 1 W	
Power Output (High Power)	VHF: 5 W UHF/300/350 MHz: 4 W	
Modulation Limiting	+/-2.5 kHz @ 12.5 kHz +/-5.0 kHz @ 25 kHz +/-4.0kHz @ 20 kHz*	
FM Hum and Noise	-40 dB @ 12.5 kHz -45 dB @ 20 20 kHz*/25 kHz	
Conducted / Radiated Emission	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Adjacent Channel Power	60 dB @ 12.5 kHz 70 dB @ 20 20 kHz*/25 kHz	
Audio Response	TIA603D	
Audio Distortion	3%	
FM Modulation	12.5 kHz: 11K0F3E 25 kHz: 16K0F3E	
4FSK Digital Modulation	12.5kHz Data: 7K60F1D & 7K60FXD 12.5kHz Voice: 7K60F1E & 7K60FXE	
Digital Vocoder Type	AMBE+2	
Digital Protocol	ETSI-TS102361-1 ETSI-TS102361-2 ETSI-TS102361-3	

* 350 MHz band does not support 20 kHz

NOTE   Limited Keypad Model not applicable to 300 MHz Band.

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)
2002/95/EC (RohS - Banned Substances)
2002/96/EC (WEEE - Waste Electrical and Electronic Equipment)
94/62/EC (Packaging and Packaging Waste)

Radio meets applicable regulatory requirements.

VHF Self-Quieter Frequencies
139.2
144
148.8
153.6
158.4
160
163.2
168
172.03
172.8

UHF Self-Quieter Frequencies
403.2
422.4
427.2
432
446.4
456
460.8
465.6
480
499.2
504
508.8
519.25

300 MHz Self-Quieter Frequencies
307.2
336
340.8
345.6
360

350 MHz Self-Quieter Frequencies
360
369.6
384
396

Military Standards									
Applicable MIL–STD	810C		810D		810E		810F		810G	
	Methods	Proce-dures	Methods	Proce-dures	Methods	Proce-dures	Methods	Proce-dures	Methods	Prode-cures
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/A1
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/C1
Temperature Shock	503.1	I	503.2	A1/C3	503.3	A1/C3	503.4	I	503.5	I-C
Solar Radiation	505.1	II	505.2	I/Hot-Dry	505.3	I/Hot-Dry	505.4	I/Hot-Dry	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/Hot-Humid	507.3	II/Hot-Humid	507.4	–	507.5	I/Hot-Hu-mid
Salt fog	509.1	I	509.2	I	509.3	I	509.4	–	509.5	–
Dust	510.1	I, II	510.2	I, II	510.3	I, II	510.4	I, II	510.5	I, II
Vibration	514.2	VIII/F, Curve-W, XI	514.3	I/Cat10, II/Cat3	514.4	I/Cat10, II/Cat3	514.5	I/Cat24 II/Cat5	514.6	I/Cat24, II/Cat5
Shock	516.2	I, II	516.3	I, IV	516.4	I, IV	516.5	I, IV	516.6	I, IV

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 4
Water Intrusion	IEC 60529 -IP67
Packaging Test	MIL-STD 810D and E

* Operating temperature specification with LiIon battery is -10 °C to +60 °C.
  Operating temperature specification with NiMH battery is -20 °C to +60 °C.

Notes

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.

https://businessonline.motorolasolutions.com

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 Testbox. 2. This cable does not auto route to external Audio path once the cable is attached. 3. All test instructions will require through software tool (eg. CPS, Tuner, etc.)
PMNN4428_	7.5V Universal Battery Eliminator	Connects to radio via battery eliminator cable.
PMLN6154_	RF Adaptor	Application adapts radio's antenna port to BC cabling of test equipment.
PMLN6201_	RF Adaptor Holder	Holds RF adaptor in place.
PMLN6422_	SMA RF Cable	RF cable with SMA and N-type connector
1185937A01	Grease	Acts to lubricate parts.
TL000013A01	Chassis and Knob Opener	Separates the chassis from the front housing.
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.

2.3   Programming, Testing and Alignment Cable
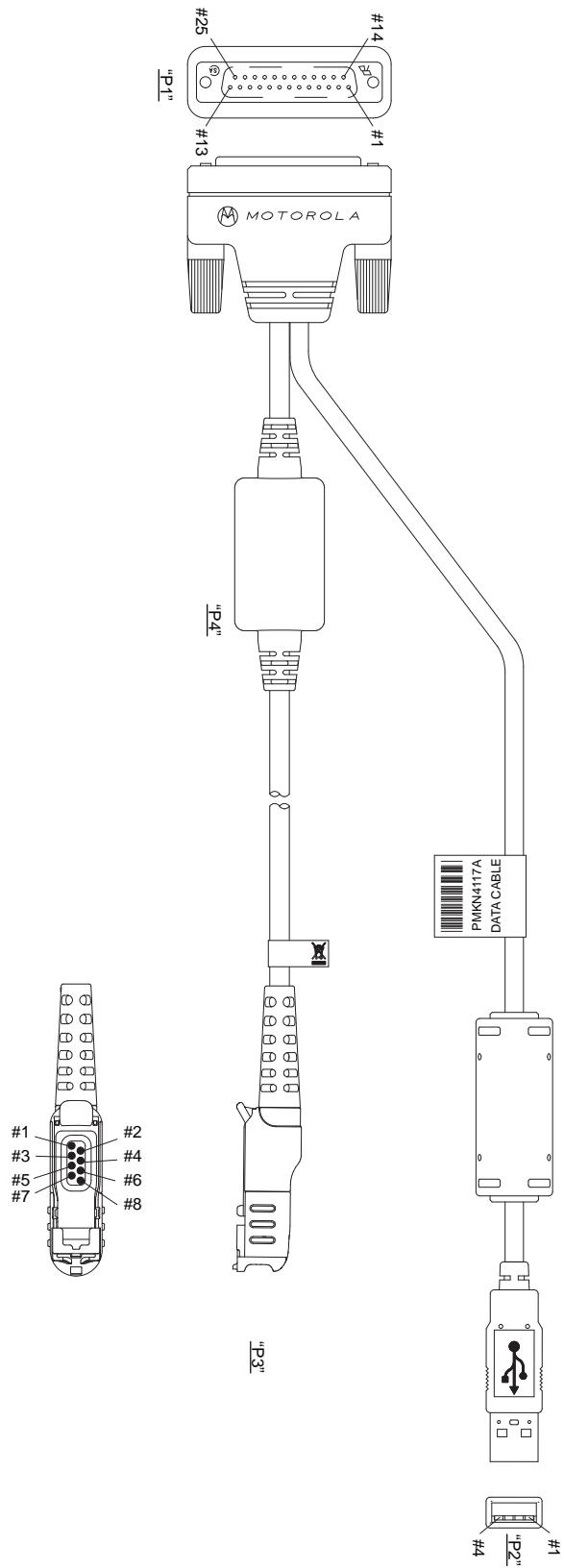
Figure 2-1. Programming, Testing and Alignment Cable

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 & 5		2	EXTERNAL SPEAKER+
2 & 7		3	EXTERNAL SPEAKER-
17		6	EXTERNAL MIC+
16		7	EXTERNAL MIC-
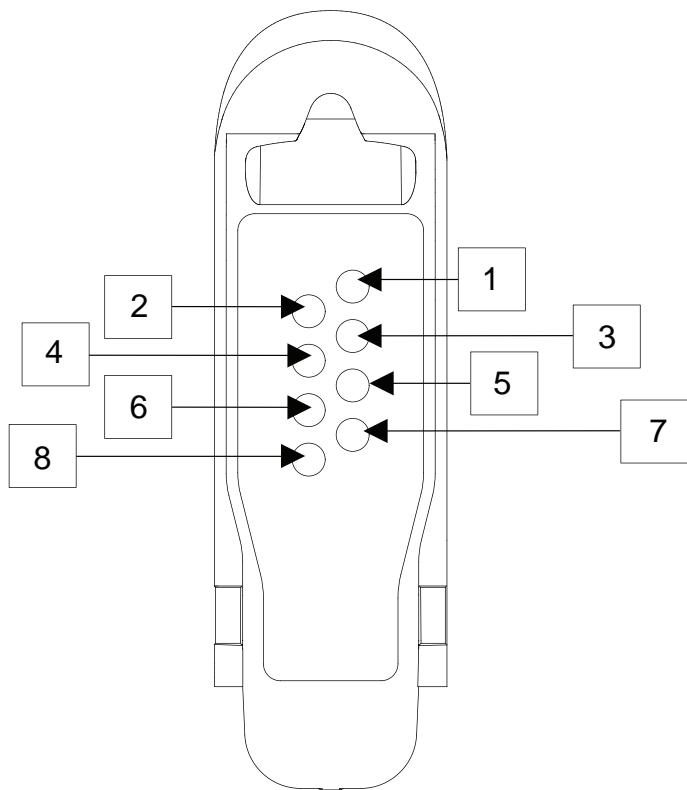
Figure 2-2. Pin Layout of Side Connector

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.

> ⚠️ **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	Front Panel Access Test Mode Displays
3-3	Test Environments
3-4	Test Frequencies
3-5	Transmitter Performance Checks
3-6	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	

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 plug (black) as shown in Figure 4-3, on page 4-3

    c. Connect the RF antenna adaptor to the 50 Ohm RF Input/Output port of the radio as shown in Figure 3-1.

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

See "RF Plug Dissassembly" on page 4-3 for complete RF Adaptor Assembly steps.
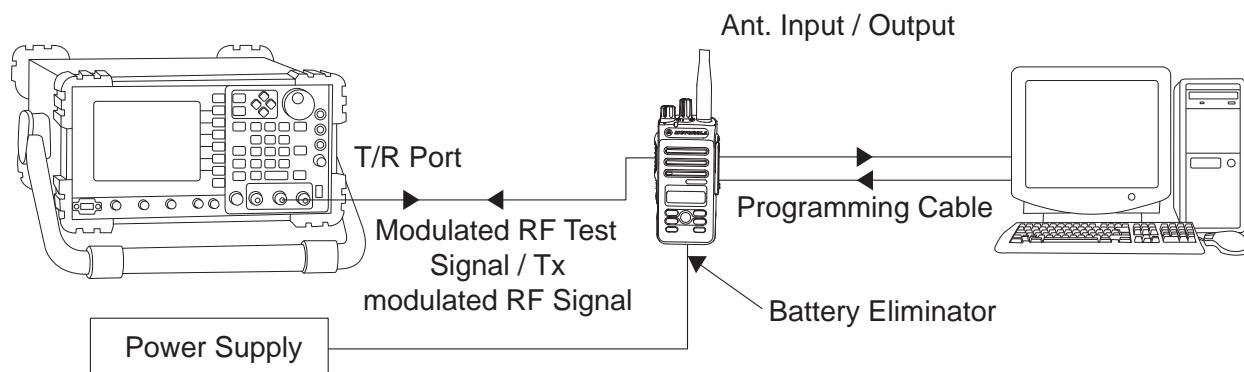
Figure 3-1. DMR Radio Transmitter and Receiver Testing Setup

3.3   Display Model Test Mode

3.3.1   Entering Display Radio 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 and will show a series of displays that will give information regarding various version numbers and subscriber specific information. The displays are described in Table 3-2.

Table 3-2. Front Panel Access Test Mode Displays

Name of Display	Description	Appears
Service Mode	The literal string indicates the radio has entered test mode.	Always
Host Version	The version of host firmware.	Always
DSP Version	The version of DSP firmware.	Always
Model Number	The radio's model number as programmed in the codeplug.	Always
MSN	The radio's serial number as programmed in the codeplug.	Always
FLASHCODE	The FLASH codes as programmed in the codeplug.	Always
RF Band	The radio's band.	Always

NOTE   The radio stops at each display for 2 seconds before moving to the next information display. If the information cannot fit into 1 line, the radio display scrolls automatically character by character after 1 second to view the whole information. If the Left Navigation Key (◀) is pressed before the last information display, the radio shall suspend the information display until the user presses Right Navigation Key (▶) to resume the information display. The radio beeps for each button press. After the last display, RF Test Mode will be displayed.

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.

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 3-3.

Table 3-3. 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 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 3-4. The radio beeps in each position.

Table 3-4. Test Frequencies

Channel Selector Switch Position	Test Channel	UHF	VHF	300 MHz	350MHz
1 Low Power 9 High Power	TX#1 or #9 RX#1 or #9	403.15 403.15	136.075 136.075	300.025 300.025	350.025 350.025
2 Low Power 10 High Power	TX#2 or #10 RX#2 or #10	423.25 423.25	143.575 143.575	308.525 308.525	357.525 357.525
3 Low Power 11 High Power	TX#3 or #11 RX#3 or #11	444.35 444.35	146.575 146.575	317.025 317.025	364.525 364.525
4 Low Power 12 High Power	TX#4 or #12 RX#4 or #12	465.45 465.45	155.575 155.575	325.525 325.525	371.525 371.525
5 Low Power 13 High Power	TX#5 or #13 RX#5 or #13	485.55 485.55	161.575 161.575	334.025 334.025	378.525 378.525
6 Low Power 14 High Power	TX#6 or #14 RX#6 or #14	506.65 506.65	167.575 167.575	342.525 342.525	385.525 385.525
7 Low Power 15 High Power	TX#7 or #15 RX#7 or #15	526.75 526.75	173.975 173.975	351.025 351.025	392.525 392.525
8 Low Power 16 High Power	TX#8 or #16 RX#8 or #16	527.00 527.00	174.000 174.000	359.925 359.925	399.925 399.925

Table 3-5. 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	Please use the PTT Toggle button in Tuner for continous transmit.	Frequency error to be ±201Hz for UHF ±68 Hz for VHF ±150 for 300 MHz ±175 Hz for 350 MH
Power RF	As above	As above	As above	Low Power: 0.9 – 1.5W (VHF/ UHF/300/350 MHz) High Power: 4.0 – 4.8W (UHF/300/ 350 MHz) High Power: 5.0 – 6.0W (VHF)

Table 3-5. Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
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).

* See Table 3-4

Table 3-6. 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	Please use the PTT Toggle button in Tuner for continous transmit.	Frequency error to be ±201Hz for UHF ±68 Hz for VHF ±150 for 300 MHz ±175 Hz for 350 MH
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	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	Nil	RF input to be <0.35µV
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1mV RF	As above	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 = 6 – 8dB

* See Table 3-4

3.3.3   Display Test Mode

1. Press and hold Side Button 1 to enter display test mode.

2. Upon any button or key press, the LCD shall display the growing horizontal bars. Press any button until the LCD display turns black and change to vertical bars. Press any button until LCD display full screen black and change to icon display.

3. The LCD shall display RSSI icon (with full bar), monitor icon, tone disabled icon, priority-two channel scan icon, unread message icon, emergency icon, talkaround icon, and battery strength indicator icon (with full bar).

4. The LCD display shall become clear and consequently display the rest of the icons, high power level icon (H), companding icon, option board icon, and secure operation icon upon any button/key press.

3.3.4   LED Test Mode

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

2. Upon any button/key press, the radio lights the red LED and displays "Red LED On".

3. Consequently, upon any button/key press, the red LED is turned off and the radio lights the green LED and displays "Green LED On".

4. Upon any successive button/key press, the green LED is turned off, and the radio shall light both LEDs up while displaying "Both LEDs On". Since there is only one LED on the portable, the LED color will be amber when the radio lights both LEDs.

3.3.5   Backlight Test Mode

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

2. The radio turns on both LCD and keypad backlight together.

3.3.6   Speaker Tone Test Mode

1. Press and hold **Side Button 1** after Backlight Test Mode. The radio beeps once and displays "Speaker Tone Test Mode".

2. The radio generates a 1 KHz tone with the internal speaker.

3.3.7   Earpiece Tone Test Mode

1. Press and hold **Side Button 1** after Speaker Tone Test Mode. The radio beeps once and displays "Earpiece Tone Test Mode".

2. The radio generates a 1 KHz tone with the earpiece.

3.3.8   Audio Loopback Earpiece Test Mode

1. Press and hold **Side Button 1** after Earpiece Tone Test Mode. The radio beeps once and displays "Audio Loopback Earpiece Test Mode".

2. The radio shall route any audio on the external mic to the earpiece.

3.3.9   Battery Check Test Mode

1. Press and hold **Side Button 1** after Audio Loopback Earpiece Test Mode. The radio beeps once and momentarily displays "Battery Check Test Mode".

2. The radio will display the following:
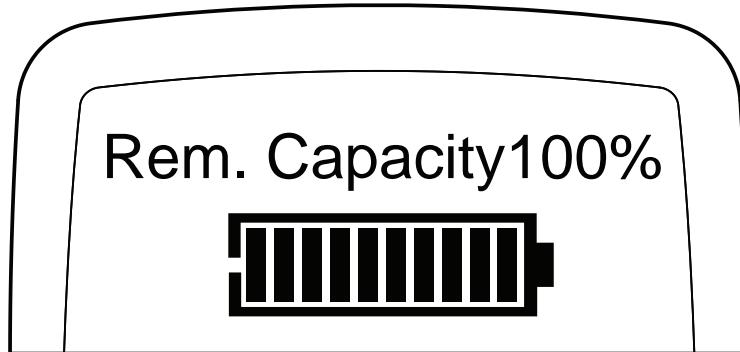
Figure 3-2. Battery Check Test Mode Display

3.3.10 Button/Knob/PTT Test Mode

1. Press and hold **Side Button 1** after Battery Check Test Mode. The radio beeps once and displays "Button Test"(line 1).

2. Rotate the **Volume Knob**; "2/1" through "2/255" appears. The radio beeps at each position.

3. Rotate the **Channel Knob**; When rotate the channel knob in clockwise, "4/1" appear. When rotate the channel knob in counter clockwise, "4/-1" appear. The radio beeps at each position.

4. Press **Side Button 1**; "96/1" appears & radio beeps; release, "96/0" appears & radio beeps.

5. Press **Side Button 2**; "97/1"appears & radio beeps; release, "97/0" appears & radio beeps.

6. Press the **PTT Switch**; "1/1" appears & radio beeps; release, "1/0" appears & radio beeps.

7. Keypad Checks:

    - Press **P1**, "160/1" appears & radio beeps; release, "160/0" appears & radio beeps.

    - Press **P2**, "161/1" appears & radio beeps; release, "161/0" appears & radio beeps.

    - Press **MENU**, "139/1" appears & radio beeps; release, "139/0" appears & radio beeps.

    - Press **BACK**, "129/1" appears & radio beeps; release, "129/0" appears & radio beeps.

    - Press ◄, "128/1" appears & radio beeps; "128/0" appears & radio beeps.

    - Press ►, "130/1" appears & radio beeps; "130/0" appears & radio beeps.

    - Press OK, "85/1" appears & radio beeps; "85/0" appears & radio beeps.

3.4   Non-Display Model Test Mode

3.4.1   Entering Non-Display Radio 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.

3.4.2   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 3-3.

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 radio toggles to 20KHz, beeps twice for 25KHz* and beeps three times for 12.5KHz.
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.

3.4.3   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.

3.4.4   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.

3.4.5 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.

3.4.6 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.

3.4.7 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.

3.4.8 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.

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 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 and AirTracer on CD-ROM	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.
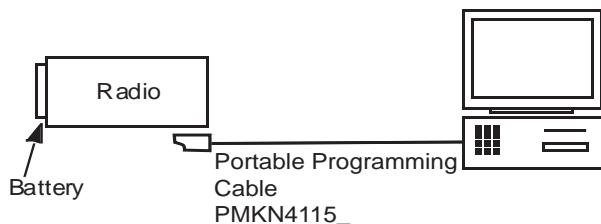
Figure 4-1. CPS Programming Setup

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

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

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

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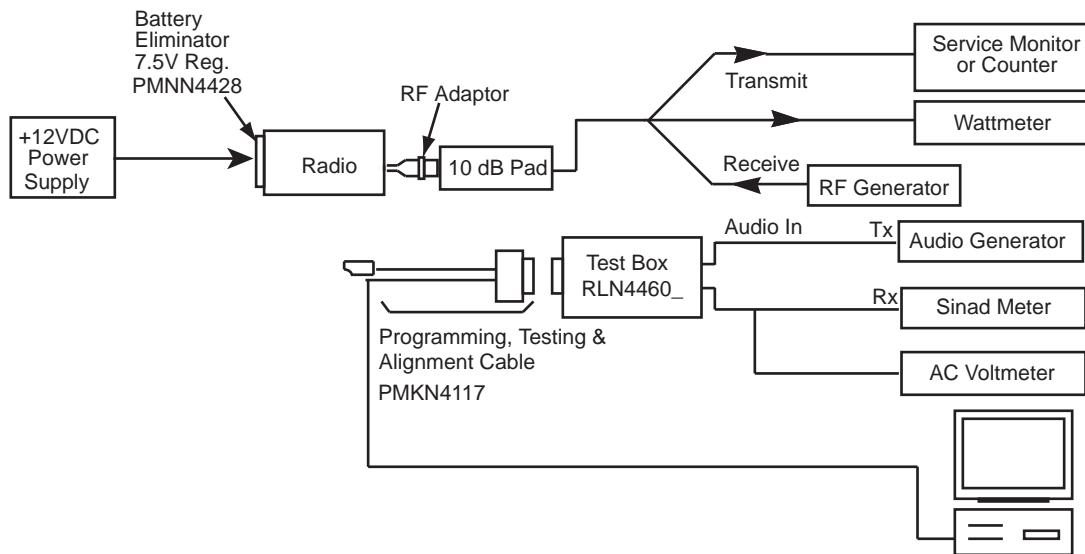
Figure 4-2. Radio Tuning Equipment Setup

4.4.1 RF Plug Dissassembly

1. Use a tweezer to lift up one end of the RF plug and pull it out.

Figure 4-3. RF Plug disassembly

2. Insert the RF Adaptor into the front housing.

Figure 4-4. RF Adaptor insertion

3. Screw in the RF adaptor to the front housing.

Figure 4-5. RF Adaptor screw

4. Insert the RF connector.

Figure 4-6. RF Connector

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 kit, 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 kit 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) and Laterally Diffused Metal Oxide Semiconductor (LDMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS/LDMOS circuits and are especially important in low humidity conditions.

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

<table>
<tr>
<td>
⚠️

C a u t i o n
</td>
<td>
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 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.
</td>
</tr>
</table>

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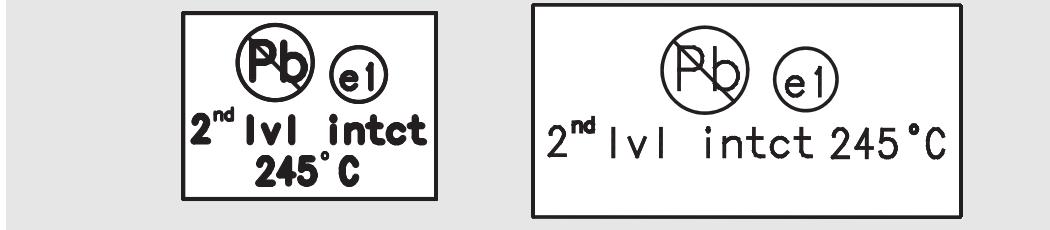
Any rework or repair on Environmentally Preferred Products must be done using the appropriate lead-free solder wire and lead-free solder paste as stated in the following table:

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.

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™ T screwdriver
- Chassis and Knob Opener (p/n: TL000013A01)

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

- Grease (1185937A01)
- TORX™ T 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
- Ventilation Seal (3286058L01)
- Ventilation Label (LB000256A01)

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.

⚠ **Caution**	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 Kit from Chassis Disassembly

1. Turn off the radio.

2. Remove the battery:

a. Release the battery latch by moving it into the unlock position.

Figure 5-1. Battery removal

b. With the latch released, slide the battery downwards.

Figure 5-2. Battery removal

3. Remove the battery from the radio.

4. Remove the antenna by turning it counterclockwise.

Figure 5-3. Antenna removal

5. Remove the volume and channel knobs off from their shafts using the knob removal tool.

Figure 5-4. Volume and Channel Knob removal.

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

6. Separate the back kit from the front kit as follows:

a. Unscrew the screw using TORX T6 screwdriver as shown in Figure 5-5.

Figure 5-5. Front Kit-Back Kit Screw removal

b. Use the chassis and knob opener to separate the back kit from the front kit.

Figure 5-6. Back Kit disassembly

   c. Slide out the back kit slowly from the front kit.

Figure 5-7. Back Kit removal

⚠️ WARNING	**Do not force the chassis out if it gets stuck by pulling it. This will cause damage to the front kit.**

⚠️ WARNING	**Do not pull out the chassis forcefully as this will cause damage to the flex connector.**

7. Lay the front kit down. Rotate the back kit backward and slightly away from the front kit.

8.   Lift the ZIF connector latch on the mainboard assembly to release the flex and separate the back kit from the front kit.

Interface Keypad-Display Flex

Interface UC-Audio Flex
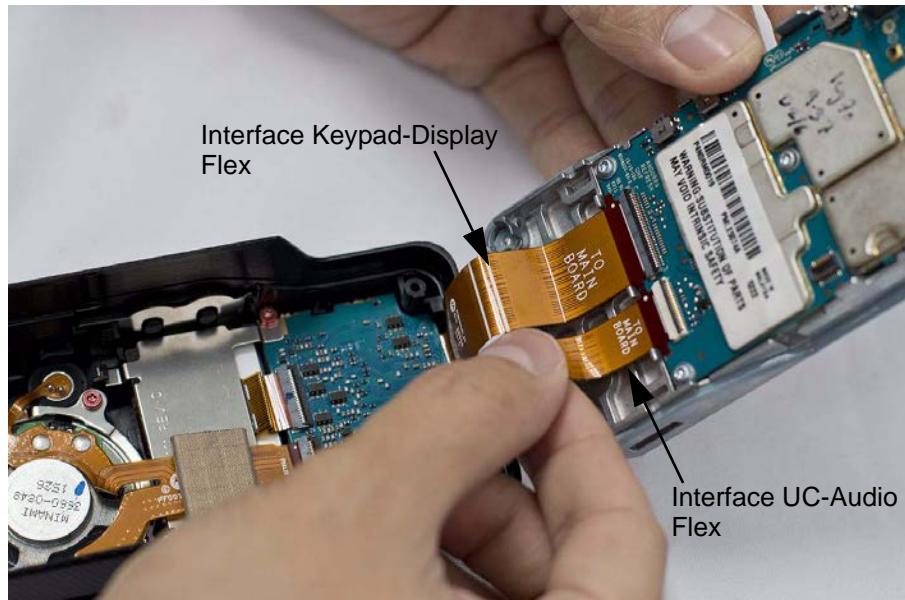
Figure 5-8. Disconnecting the interface UC-audio flex and keypad-display flex (Limited Keypad Model)
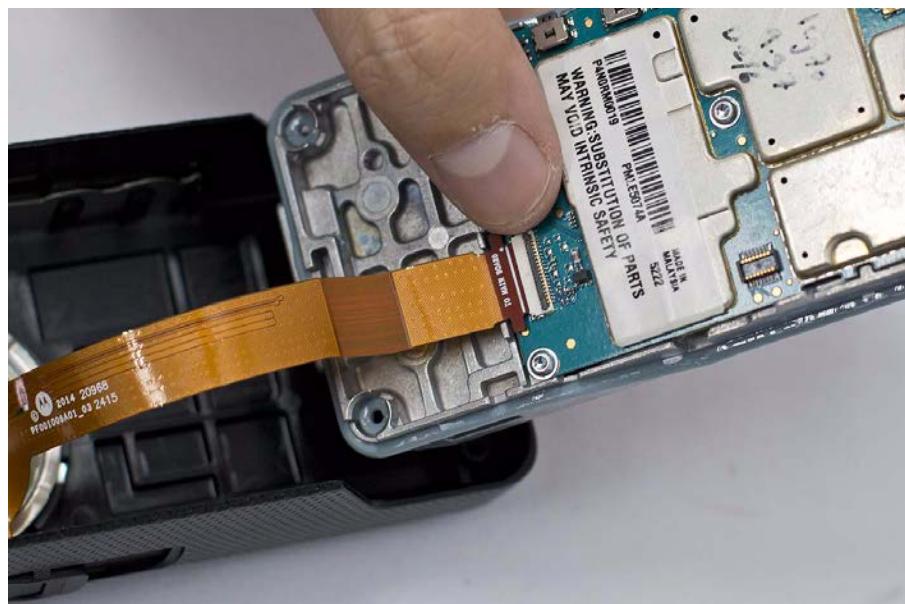
Figure 5-9. Disconnecting the UC-audio flex (Non Keypad Model)

5.6.2   Back Kit Disassembly

1.   Remove the top control seal.
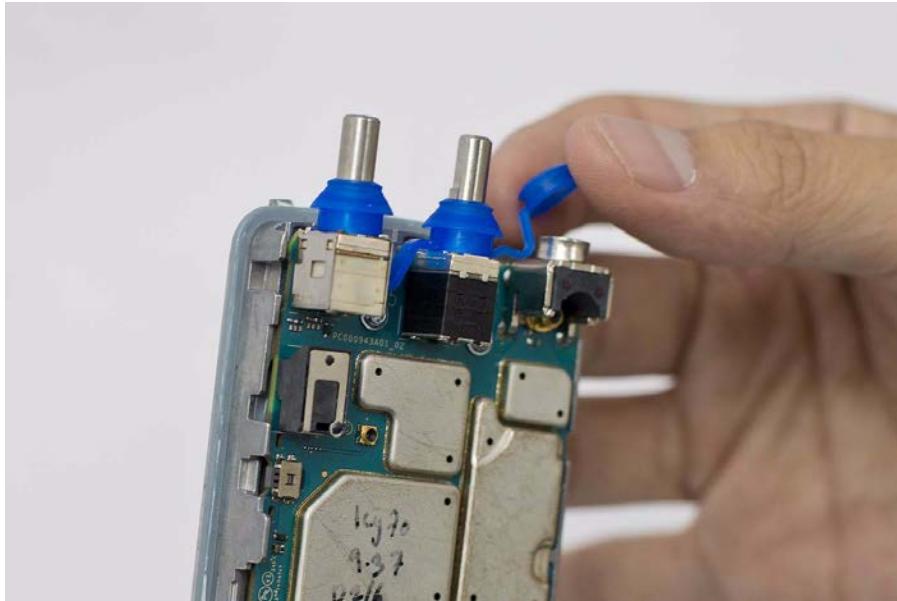
Figure 5-10. Top control seal removal

2.   Use a TORX screwdriver with a T6 head to remove the 5 M2 screws holding the mainboard assembly to the back kit.
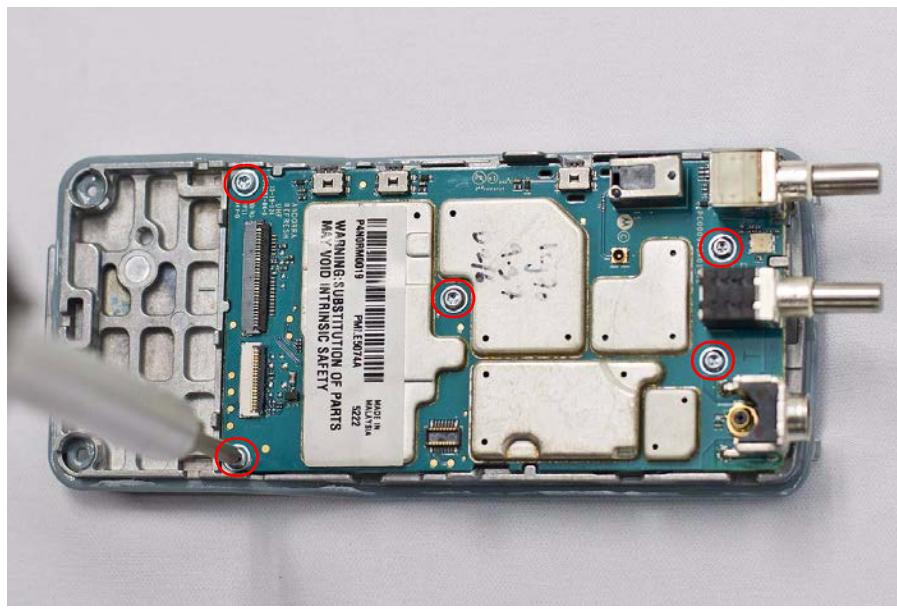
Figure 5-11. Back Kit disassembly

3. Remove the battery contact seal.

Figure 5-12. Battery contact seal removal

5.6.3　Keypad, Display, and Keypad Board Disassembly

　　1.　Disconnect the UC-audio flex.
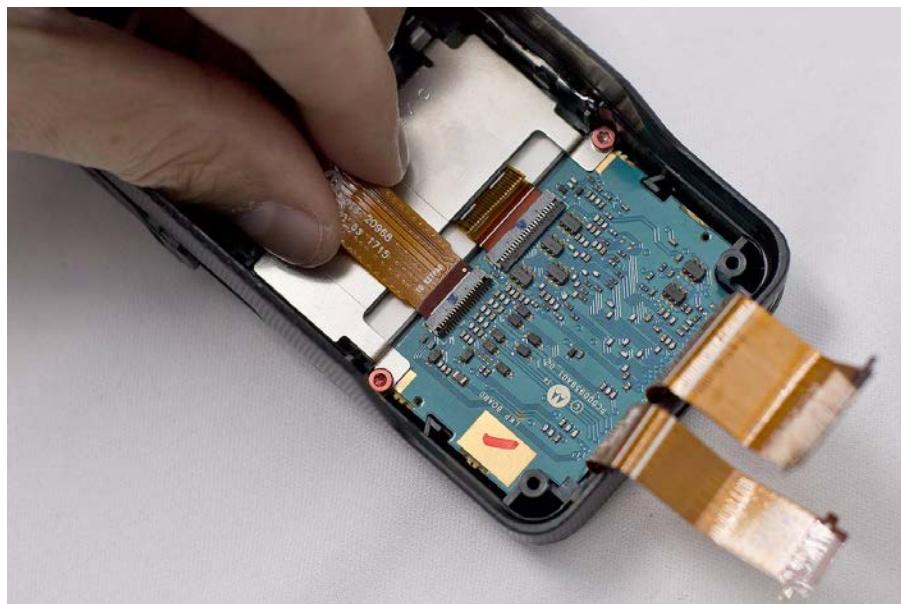
Figure 5-13. UC-audio flex removal

　　2.　Remove the display retainer after removing the 2 K18 screws.
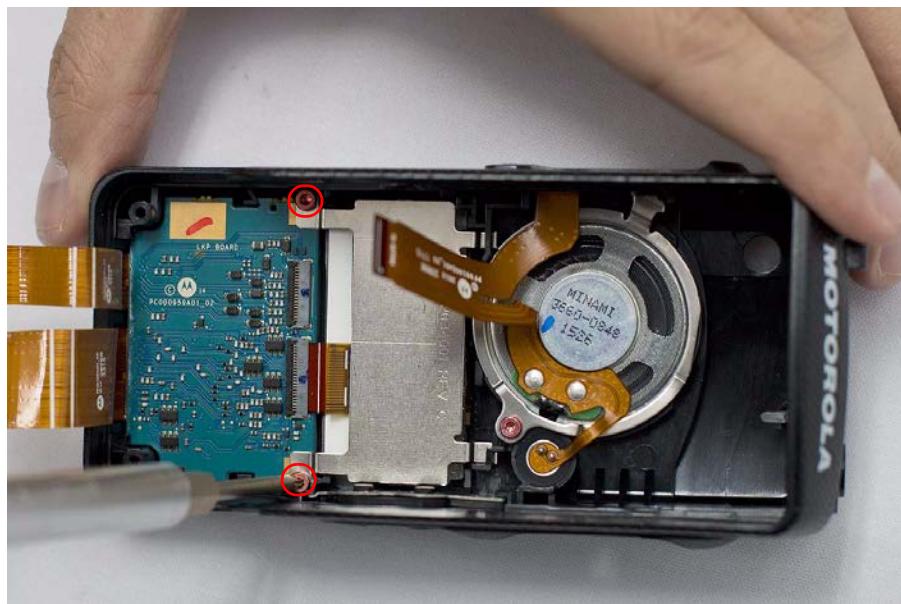
Figure 5-14. K18 screw removal

3. Disconnect the display flex from the keypad board and remove it from the front kit.
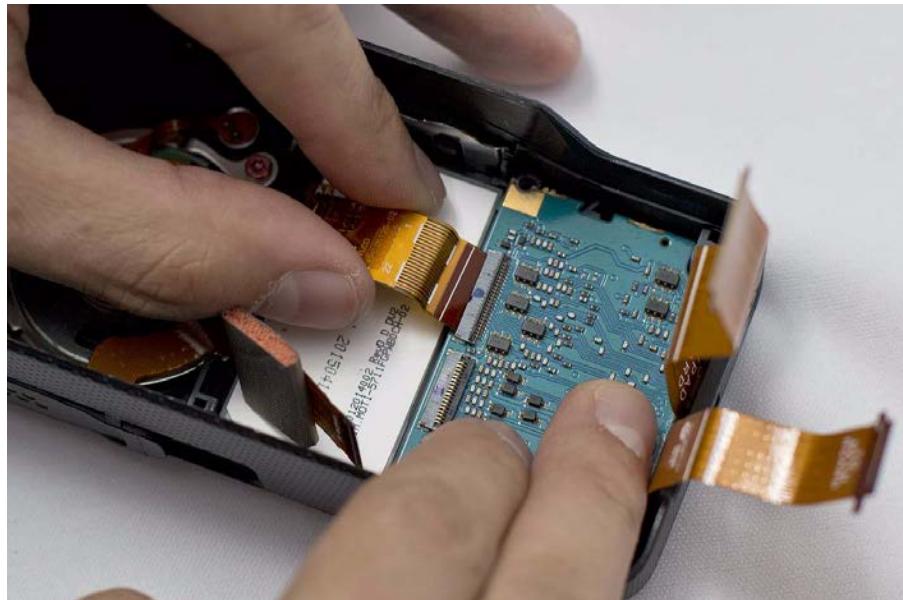
Figure 5-15. Display flex removal

4. Remove the keypad and display module from the front kit.

Keypad

Display module
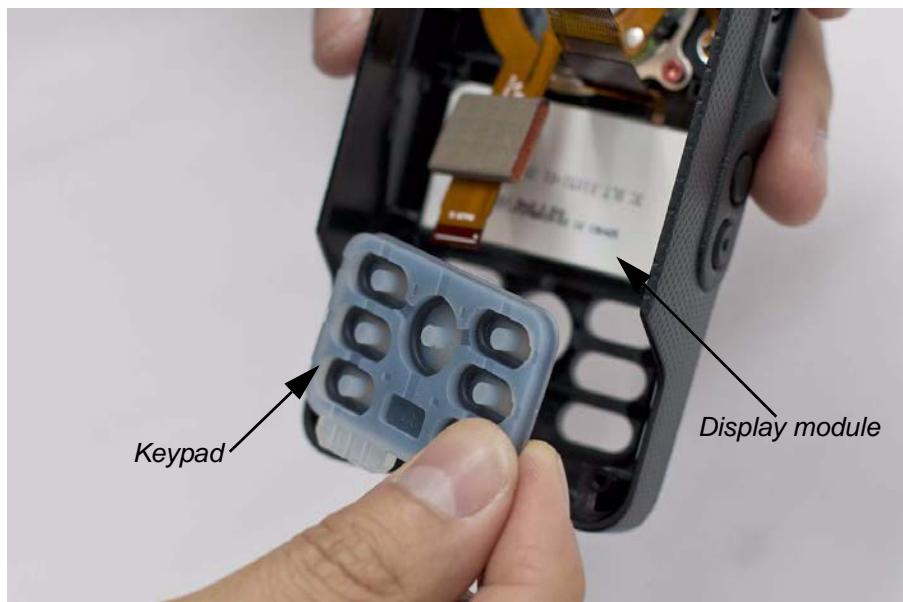
Figure 5-16. Keypad removal

5.6.4 Side Buttton, Speaker, Microphone, and UC-Audio Flex Disassembly

1. Pull out the PTT retainer.
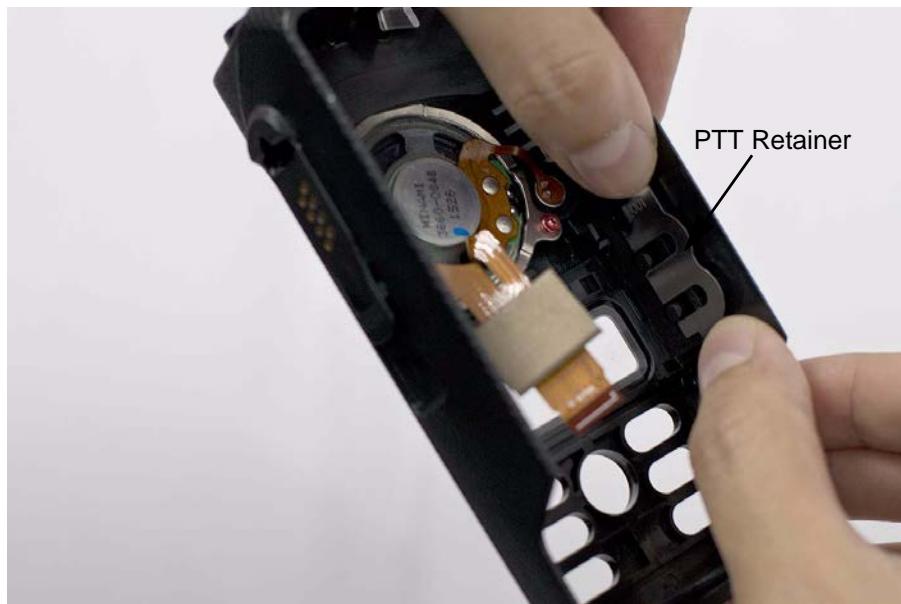
PTT Retainer

Figure 5-17. PTT retainer removal

2. Remove the side button.
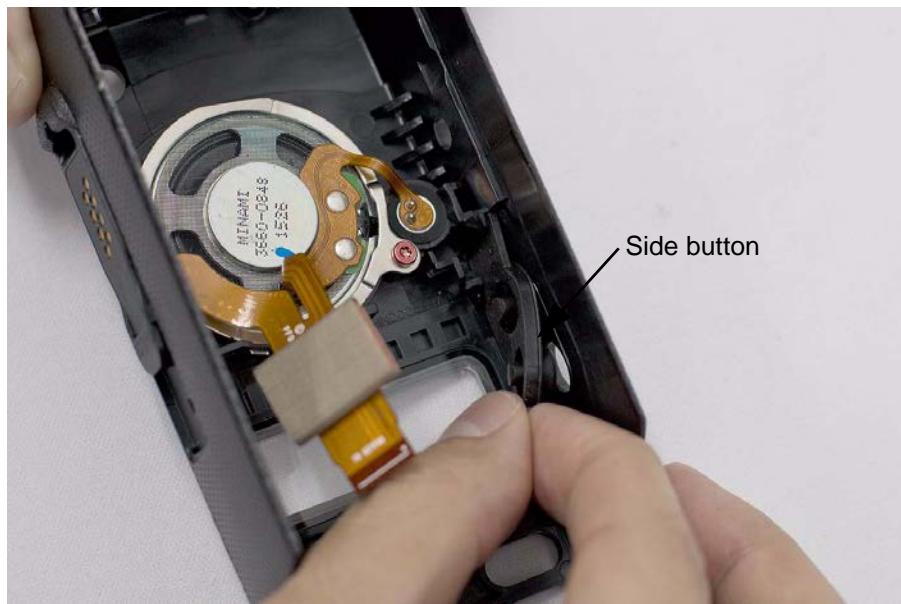
Side button

Figure 5-18. Side button removal

3. Peel off the UC escutcheon.

Figure 5-19. UC escutcheon removal.

4. Pull the UC-audio flex (adhesive held) FR4 from the front housing. Push the UC-audio flex through the UC slot into the housing.

Figure 5-20. UC-audio flex removal

5. Remove the K18 screw securing the speaker retainer.

Figure 5-21. Speaker retainer screw removal

6. Remove the speaker assembly from the front kit and separate the speaker module and retainer.

Figure 5-22. Speaker retainer removal

5.7   Radio Reassembly - Detailed

5.7.1   Speaker Reassembly

1.   Insert the UC-audio flex through the speaker retainer so that the speaker retainer is placed directly on the speaker assembly.
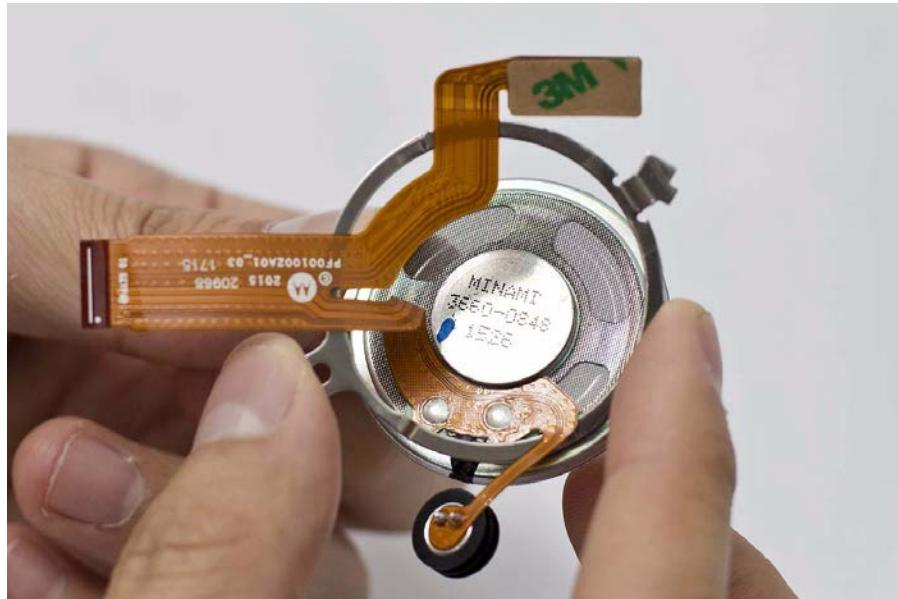
Figure 5-23. Speaker assembly

NOTE   Ensure the flex is on top of the retainer to prevent it being torn during reassembly.

2.   Use a tweezer to pull UC-audio flex circuit through the UC slot and place the speaker assembly in the recess on the front kit.

Figure 5-24. UC-audio flex

3. Replace with a new UC escutcheon.

Figure 5-25. UC escutcheon

4. Ensure the mic is seated properly in the mic boot. Screw in the K18 screw to the speaker retainer.
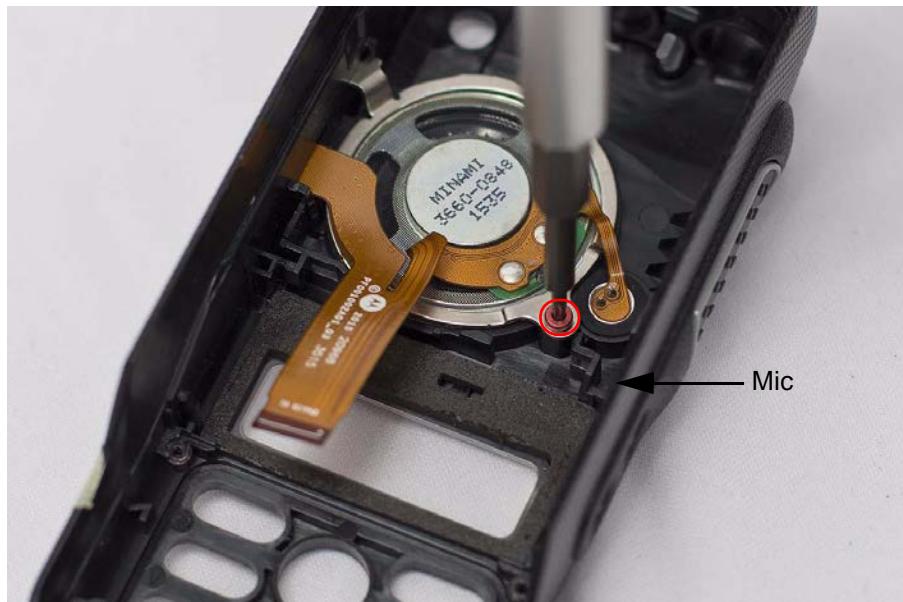
Figure 5-26. Speaker retainer reassembly

5.7.2   Side Button, Keypad, Display and Keypad Board Reassembly

   1.   Insert side button to the front housing.
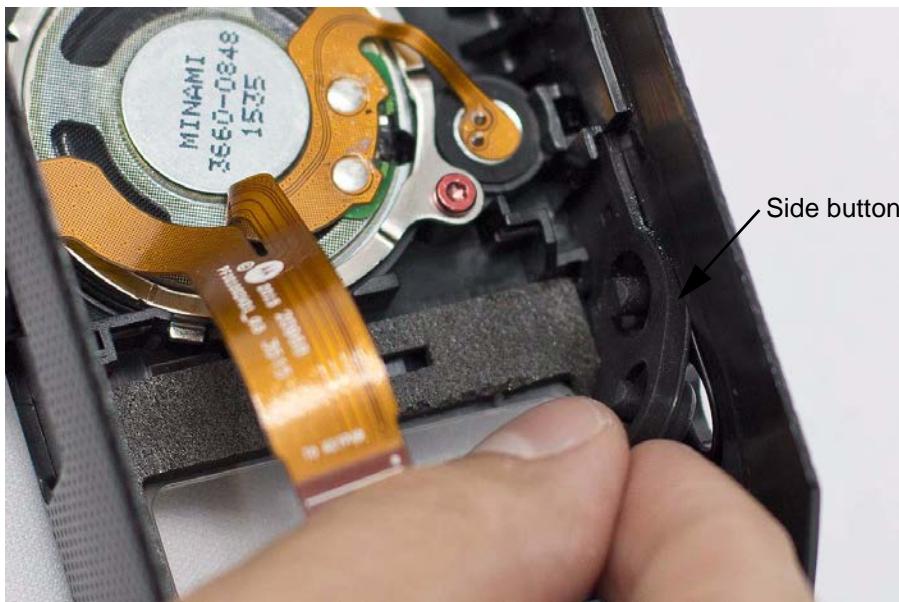
Figure 5-27. Side button reassembly

NOTE   Ensure the side button is seated firmly without any pinching as this will impact the sealing performance

   2.   Replace the PTT retainer.

Figure 5-28. PTT retainer reassembly

3. Place the display module into the display module recess.

Figure 5-29. Display module reassembly

4. Place the keypad into the front kit and press firmly in place.

Figure 5-30. Keypad reassembly

NOTE Ensure the keypad mushroom rib is fully seated in the sealing groove to prevent any pinching or bulging.

5. Tongue in the keypad board.
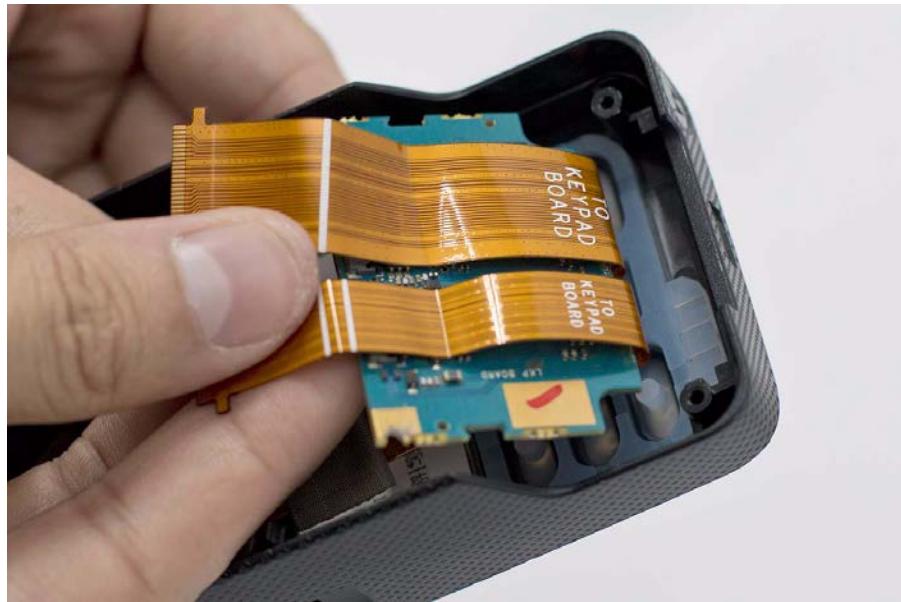
Figure 5-31. Keypad board reassembly

6. Connect the display flex and gently latch it down.
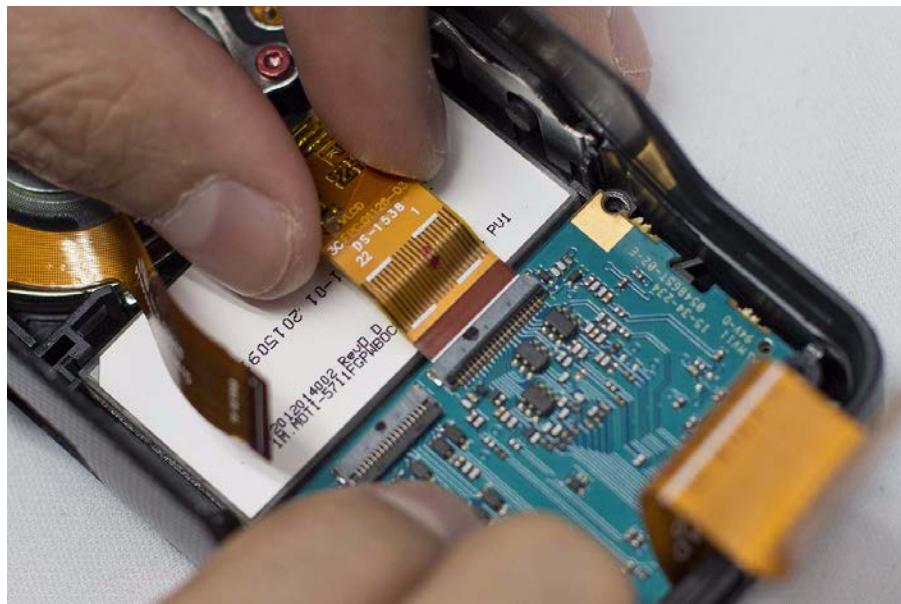
Figure 5-32. Display flex reassembly

7. Hold up the UC-audio flex and insert the display retainer. Screw in the K18 screw to the speaker retainer.

Figure 5-33. Speaker retainer reassembly

NOTE Ensure the UC-audio flex is not trapped under the speaker retainer.

8. Connect the UC-audio flex to the keypad board and gently press the ZIF connector until it latches shut.

9. Affix a poron pad on top of the UC-audio flex.
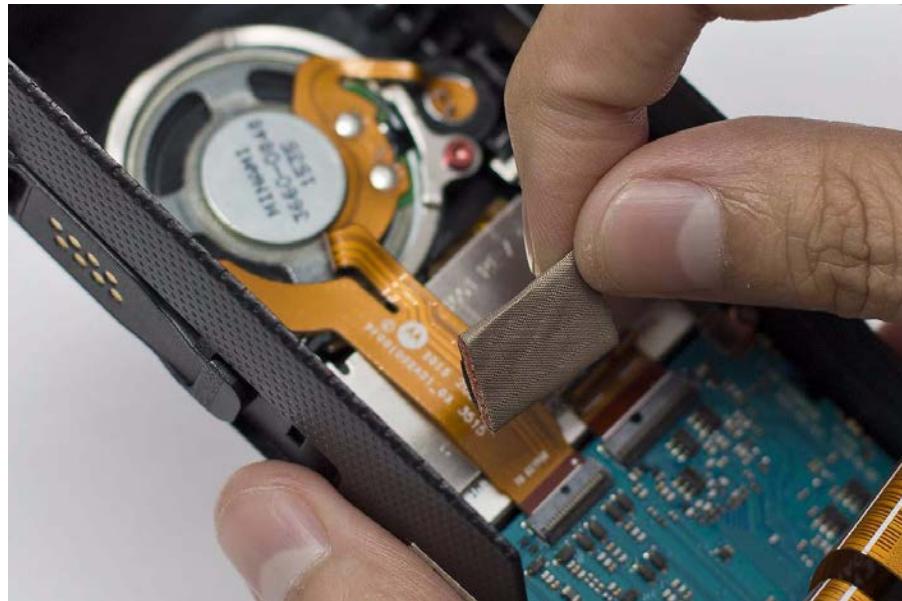
Figure 5-34. UC-Audio Flex Pad Reassembly

5.7.3   Back Kit Reassembly

   1.   Replace the thermal pad on the chassis.
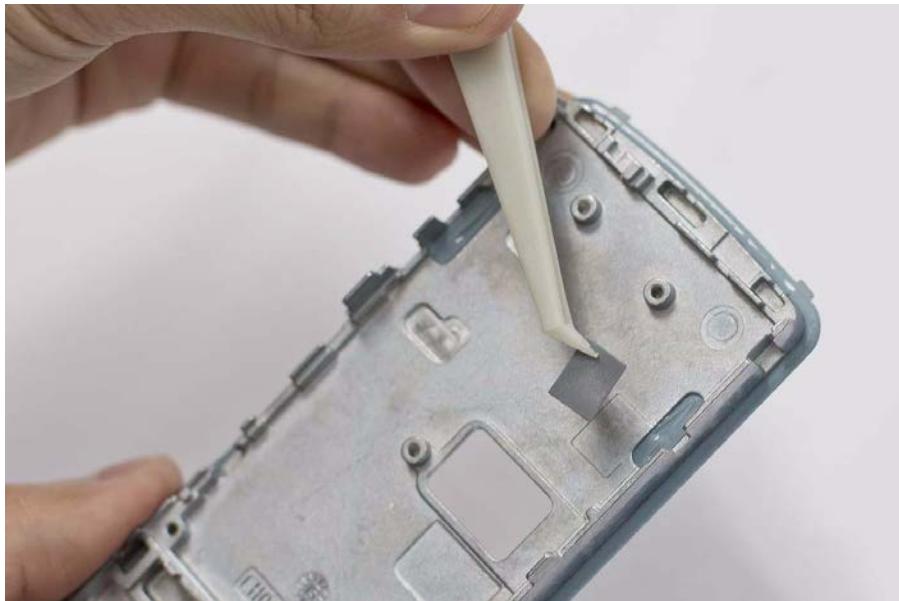
Figure 5-35.   Thermal pad

   2.   Affix the chassis label on both the left and right side of the chassis.
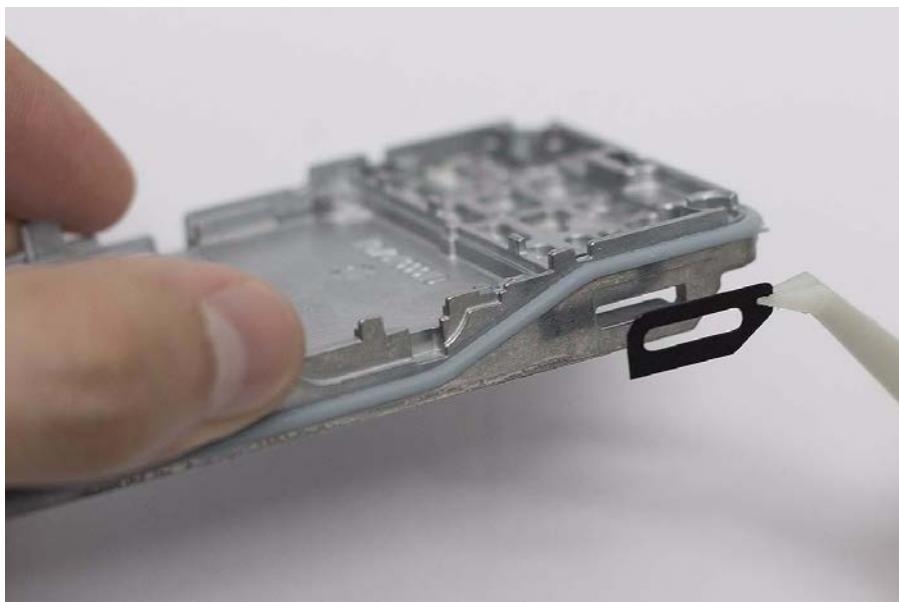
   3.   Replace battery contact seal on the chassis. Orientate the battery contact seal so that the

wider edge is at the top side as per Figure 5-36.
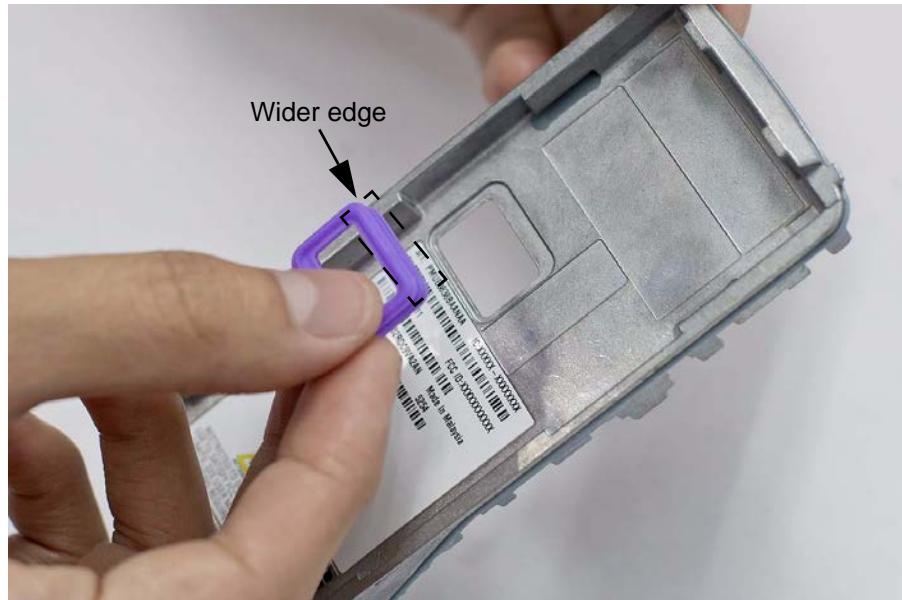
Figure 5-36. Battery contact seal reassembly

> ⚠️ **Caution**
>
> Make sure the battery contact seal is not twisted or lifted when the mainboard assembly is placed on the chassis.

4.   Place the mainboard assembly on the chassis and replace the 5 M2 screws.
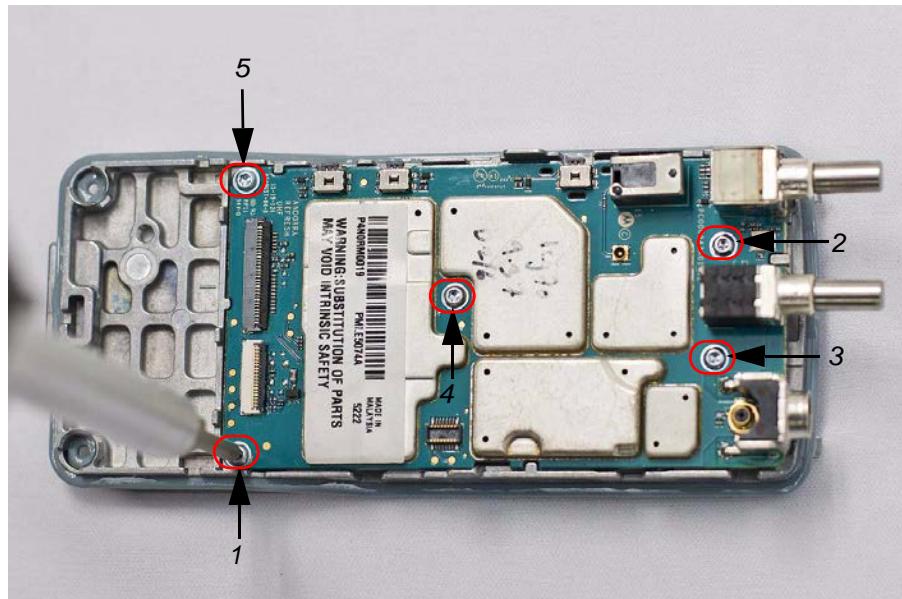
Figure 5-37. Mainboard reassembly

5. Insert the top control seal into the volume and channel shaft. Push on the wing of the top control seal as shown in Figure 5-38, until it is seated on the base of the switches.
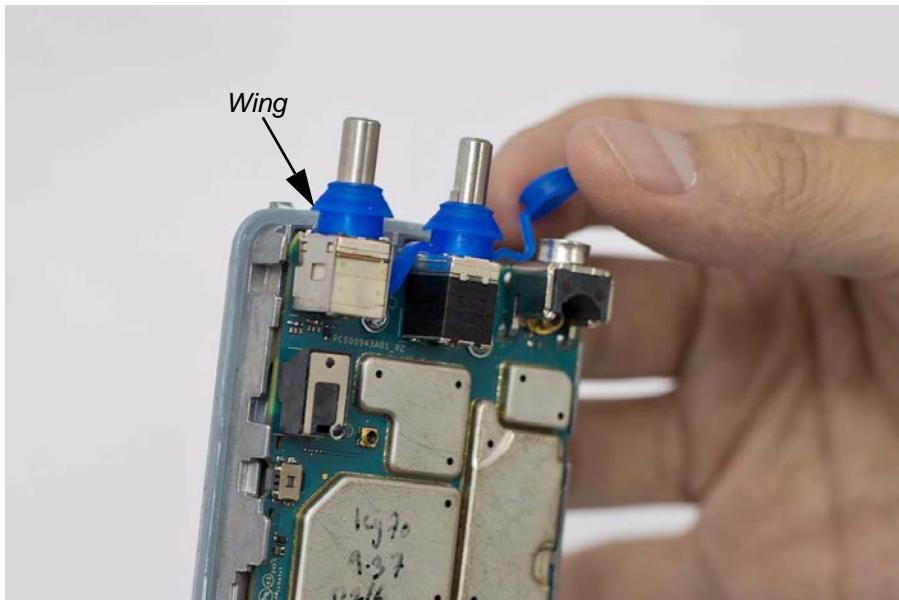
Figure 5-38. Top control seal reassembly

> ⚠️
> **C a u t i o n**   Ensure the top control seal is seated properly on the shafts.

5.7.4 Back Kit and Front Kit Reassembly

1. Apply a thin layer of grease to the full perimeter of the dispensed O-ring.

2. Connect the 2 flexes to the mainboard ZIF connector and gently latch it firmly shut.
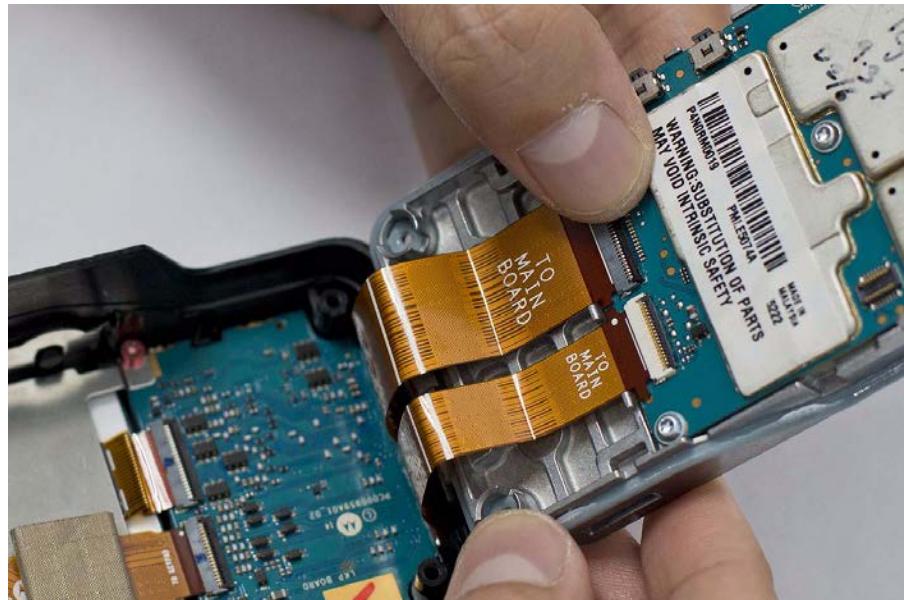
Figure 5-39. Interface flexes reassembly (Limited Keypad Model)
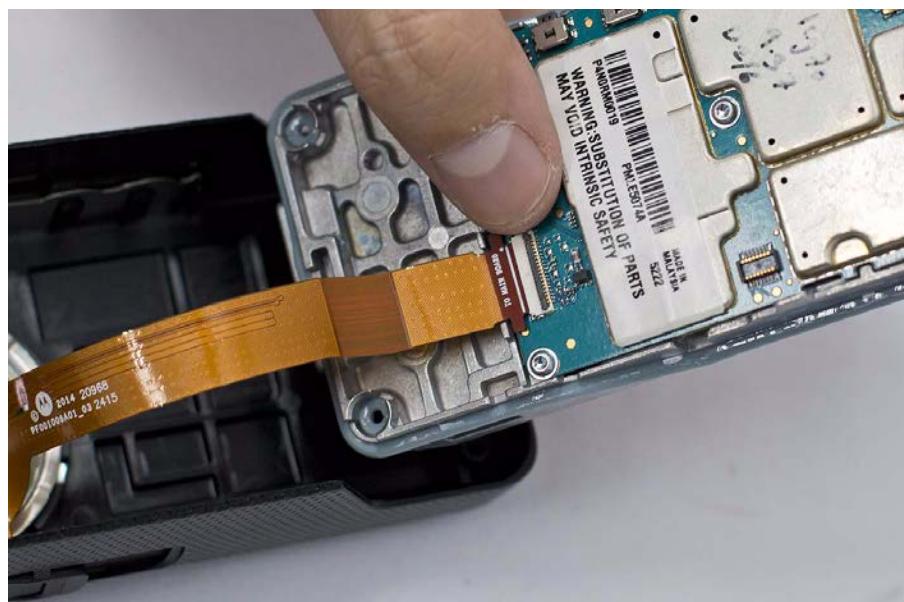
Figure 5-40. Interface flexes reassembly (Non Keypad Model)

3. Slide in the back kit into the front kit and firmly press down to snap it in.

Figure 5-41. Front kit reassembly

4. Fasten the 2 Front Kit-Back Kit screws by using TORX™ T6 screwdriver.

5. Slide in the volume and channel knob fully on the shafts on the front kit.

Figure 5-42. Knob reassembly

6. Attach antenna by turning it in clockwise.

Figure 5-43. Attaching the antenna

5.7.5   RF Plug Reassembly

1.   If required, replace the RF plug by using a tweezer.

Figure 5-44. RF Plug reassembly

2.   If Motorola nameplate is damaged, remove nameplate with a tweezer and replace a new one.

Figure 5-45. Nameplate replacement

3.   Make sure the RF plug and nameplate is flush to the housing and not bulging up. If its bulging up disassemble and reassemble back.

4. If product nameplate is damaged, remove nameplate with a tweezer and replace a new one.

Figure 5-46. Product Nameplate Reassembly

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   Ensuring Radio Immersibility

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

5.8.1   Servicing

The 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 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.

Fitting Seal
(part   number
           3271133M0

Connector   Fitting
(part   number
5871134M01)
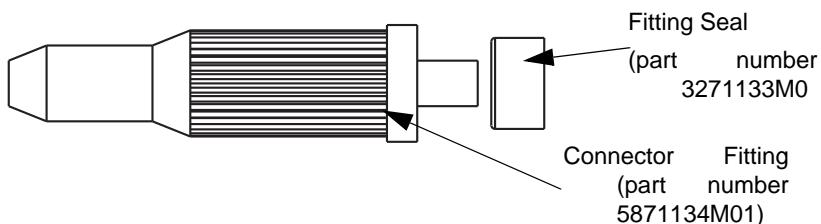
Figure 5-47. Connector Fitting - Fitting Seal Pump Connector

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: 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.

> ⚠️ Please do not bend or over tighten pump connector to the chassis.
>
> **C a u t i o n**

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.

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

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.

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

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 kit
• 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 5-36, and when multiple leaks exist, in the order listed.

NOTE Before reassembling the radio, always install a 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.
    c. Install a new housing assembly to the radio.
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

To replace the Chassis Assembly:

1. Refer to Section Section 5.6.1 "Front Kit from Chassis Disassembly" on page 5-6, remove the chassis assembly from the radio.
2. Refer to Section Section 5.6.2 "Back Kit Disassembly" on page 5-12, remove the Mainboard from chassis.
3. Assemble a new chassis assembly; discard the old chassis assembly.
4. Reassemble the chassis assembly followed by installing into front kit. (Refer to Section 5.7 "Radio Reassembly - Detailed" on page 5-20.

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.　Reassemble the chassis assembly followed by installing into front kit. (Refer to Section 5.7 "Radio Reassembly - Detailed" on page 5-20).

IMPORTANT:　Both Ventilation Label (LB000256A01) and Ventilation Seal (3286058L01) need to be replaced after vacuum test, pressure test or water leakage troubleshooting.

5.8.9.4 Ventilation Seal and Ventilation Label

To replace the Ventilation Seal and Ventilation Label:

1.　Remove the Ventilation Label that covers the Ventilation Seal from the chassis.

2.　Remove the Ventilation Seal.

3.　Ensure that the chassis's surface (at the Ventilation Label & Ventilation Seal recessed) is clean, no/minimum scratches and free from any adhesive or other foreign materials.

4.　Install a new Ventilation Seal, covering the vent port hole, in the small recessed area in the chassis. Ensure that no oily substance come in contact with the seal.

5.　Install a new Ventilation Label over the Ventilation Seal in the larger recessed area in the chassis. Press down evenly over the label'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

```
                          ( Start )
                              |
                              v
              +-------------------------------+
              | 1. Remove Battery             |
              | 2. Remove Universal           |
              | Connector Dustcover           |
              | 3. Remove ventilation label   |
              | and seal                      |
              +-------------------------------+
                              |
       (A) ------------------>|<------------------------------------+
                              v                                     |
              +-------------------------------+                     |
              | 1. Attach antenna firmly to   |                     |
              | the radio.                    |                     |
              | 2. Attach vacuum hose to      |                     |
              | vacuum pump                   |                     |
              | 3. Ensure fitting seal is     |                     |
              | attached to hose-to-chassis   |                     |
              | pump connector                |                     |
              | 4. Screw pump connector into  |                     |
              | chassis's tapped hole         |                     |
              | 5. Attach vacuum hose to pump |                     |
              | connector                     |                     |
              | 6. Place radio on flat surface|                     |
              | 7. Operate pump               |                     |
              | (gauge = 6 in. Hg)            |                     |
              +-------------------------------+                     |
                              |                                     |
                              v                                     |
                         /Gauge\         NO      /Full      \   YES +---------------+
                        / does not\ ----------> / equipment  \ --->| Run Pressure  |
                        < below    >            < for pressure >    | Test          |
                         \0.5 in.  /             \test         /    +---------------+
                          \Hg/                    \procedure  /
                            |                      \available/
                           YES                         |
                            |                          NO
                            v                          v
              +-------------------------+            ( B )
              | 1.Replace ventilation   |
              | label and seal          |
              | 2. Radio approved for   |
              | immersibility           |
              +-------------------------+
                            |
                            v
                         ( End )
```

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

```
                    ( B )
                      │
                      ▼
                 ( Start )                      ( End )
                      │                            ▲
                      ▼                            │
   ┌──────────────────────────────┐   ┌──────────────────────────────┐
   │ 1. Remove pump and           │   │      Send radio to           │
   │ connectors from radio        │   │      Motorola Depot          │
   │ 2. Remove antenna            │   │           or                 │
   │ 3. Separate front housing kit│   │  Motorola Service Center     │
   └──────────────────────────────┘   └──────────────────────────────┘
                      │                            ▲
                      ▼                         YES │
                   ◇ Changed          YES      ◇ Changed
                   front housing  ─────────▶    chassis
                     kit                          kit
                      │ NO                        │ NO
                      ▼                            ▼
   ┌──────────────────────┐         ┌────────────────────────────────┐
   │   Replace front      │         │   Apply grease to the full     │
   │   housing kit with   │         │ perimeter of the chassis O-ring│
   │     new unit         │         │   and replace the Chassis Kit  │
   │                      │         │         without PCBs           │
   └──────────────────────┘         └────────────────────────────────┘
                      │                            │
                      ▼◀───────────────────────────┘
                   ( A )
```

Troubleshooting Flow Chart for Vacuum Test (Sheet 2 of 2)

```
                            ┌─────────┐
                            │  Start  │
                            └─────────┘
                                 │
                                 ▼
          ┌──────────────────────────────────┐
          │ 1. Remove vacuum hose from        │
          │ pump connector                    │
          │ 2. Attach pressure hose to        │
          │ pump connector                    │
          └──────────────────────────────────┘
                                 │
                                 ▼
          ┌──────────────────────────────────┐          ┌──────────────────┐
          │ 1. Operate pressure pump          │ ◀─────── │ 1. Remove Knobs  │
          │ (pressure = 1 psig)               │          └──────────────────┘
          │ 2. Immerse radio into a water-    │                  ▲
          │ filled container                  │                 NO
          └──────────────────────────────────┘
```

1. Remove vacuum hose from pump connector
2. Attach pressure hose to pump connector

1. Operate pressure pump (pressure = 1 psig)
2. Immerse radio into a water-filled container

1. Remove Knobs

Continuous Series of bubbles — YES → **Bubbles from Front Housing** — YES → **Bubbles from Lens*/Universal Connector/ chassis/ Housing Interface/ PTT** — YES →

1. Dry the radio
2. Apply grease to the full perimeter of the chassis O-Ring and replace Chassis Kit and repeat steps in Troubleshooting Flow Chart for Vacuum Test

* Only for Display Model

Continuous Series of bubbles — NO →

1. Dry the radio
2. Replace Ventilation Label and Ventilation Seal
3. Radio approved for immersibility

┌─────────┐
│   End   │
└─────────┘

Bubbles from Front Housing — NO ↓

Bubbles from Chassis — YES →

1. Dry the radio
2. Apply grease to the full perimeter of the chassis O-Ring and replace Chassis Kit and repeat steps in Troubleshooting Flow Chart for Vacuum Test

Bubbles from Chassis — NO ↓

Bubbles from Battery Contact Seal — YES →

1. Dry the radio
2. Replace Battery Contact Seal, Apply grease to the full perimeter of the chassis O-Ring and replace Chassis Kit. Repeat steps in Troubleshooting Flow Chart for Vacuum Test

Bubbles from Battery Contact Seal — NO →

Troubleshooting Flow Chart for Pressure Test & Leakage Areas

5.9 Radio Exploded Mechanical Views and Parts Lists

5.9.1 Limited Keypad Model Exploded View and Partslist

Figure 5-48. Limited Keypad Model Exploded View

Table 5-3. Limited Keypad Model Exploded View Parts List

Item Level				Description	Part Number
1				Nameplate (Product Number)	Refer Table 5-5
2				Nameplate (Motorola)	33012026001
3				RF Plug	38012018001
4				Volume Knob	36012016001
5				Channel Knob	36012017001
6				Antenna ID Band	Refer Table 5-5
7				Antenna	Refer Table 5-5
8				Aesthetic Cover	0104058J40
9				Front Kit	PMLN7271_
	9.1			PTT Retainer	42012035001
	9.2			Side Button	KP000087A01
	9.3			Housing Assembly	0104067J09
	9.4			PTT Keypad	KP000086A01
	9.5			PTT Paddle	HN000696A01
	9.6			UC Escutcheon	33012020001
	9.7			Microphone Membrane	SL000209A01
	9.8			Microphone Boot	SL000208A01
	9.9			Microphone	50012012001
	9.10			Speaker Mesh	HW000738A01
	9.11			Speaker	AC000028A02
	9.12			UC-Audio Flex	PF001002A01
	9.13			Speaker Retainer	42012044001
	9.14			K18 Screw (Keypad-Display Retainer & Speaker Retainer)	0385273D06
	9.15			Front Display Poron	75012078001
	9.16			Display Module (2-Line Monochrome)	72012014002
	9.17			Back Display Poron	HW000757A01
	9.18			Display Retainer	42012034001
	9.19			Conductive Pad	75012147001
	9.20			Limited Keypad	75012080001
	9.21			Keypad Board Assembly	0104065J98

Table 5-3. Limited Keypad Model Exploded View Parts List

Item Level				Description	Part Number
	9.22			Interface Keypad-Display Flex	PF001004A01
	9.23			Interface UC-Audio Flex	PF001005A01
10				Back Kit	Refer Table 5-5
	10.1			Main Board Assembly	Part of Back Kit
	10.2			Chassis Assembly	PMLN7273_
		10.2.1		M2 Screw (Main Board Assembly)	03012034001
		10.2.2		Top Control Seal	32012269001
		10.2.3		Thermal Pad	75012234001
		10.2.4		Battery Contact Seal	32012110001
		10.2.5		Chassis (With dispensed O-Ring)	0104067J11
			10.2.5.1	Chassis Left Label	LB000706A01
			10.2.5.2	Chassis Right Labe	LB000706A02
11				Front Kit-Back Kit Screw	0316281H01
12				Compro Label	LB000560A01
13				Ventilation Seal	3286058L01
14				Ventilation Label	LB000256A01
15				UL Label (Repaired)	LB000559A02 (For UL radio, need to replace with UL Label (Repaired) for all repaired radios)
16				Battery	Refer Table 5-5
17				Belt Clip	Refer Table 5-5
18				RTTE Label	5486749Z01

5.9.2 Non-Keypad Model Exploded View and Partslist
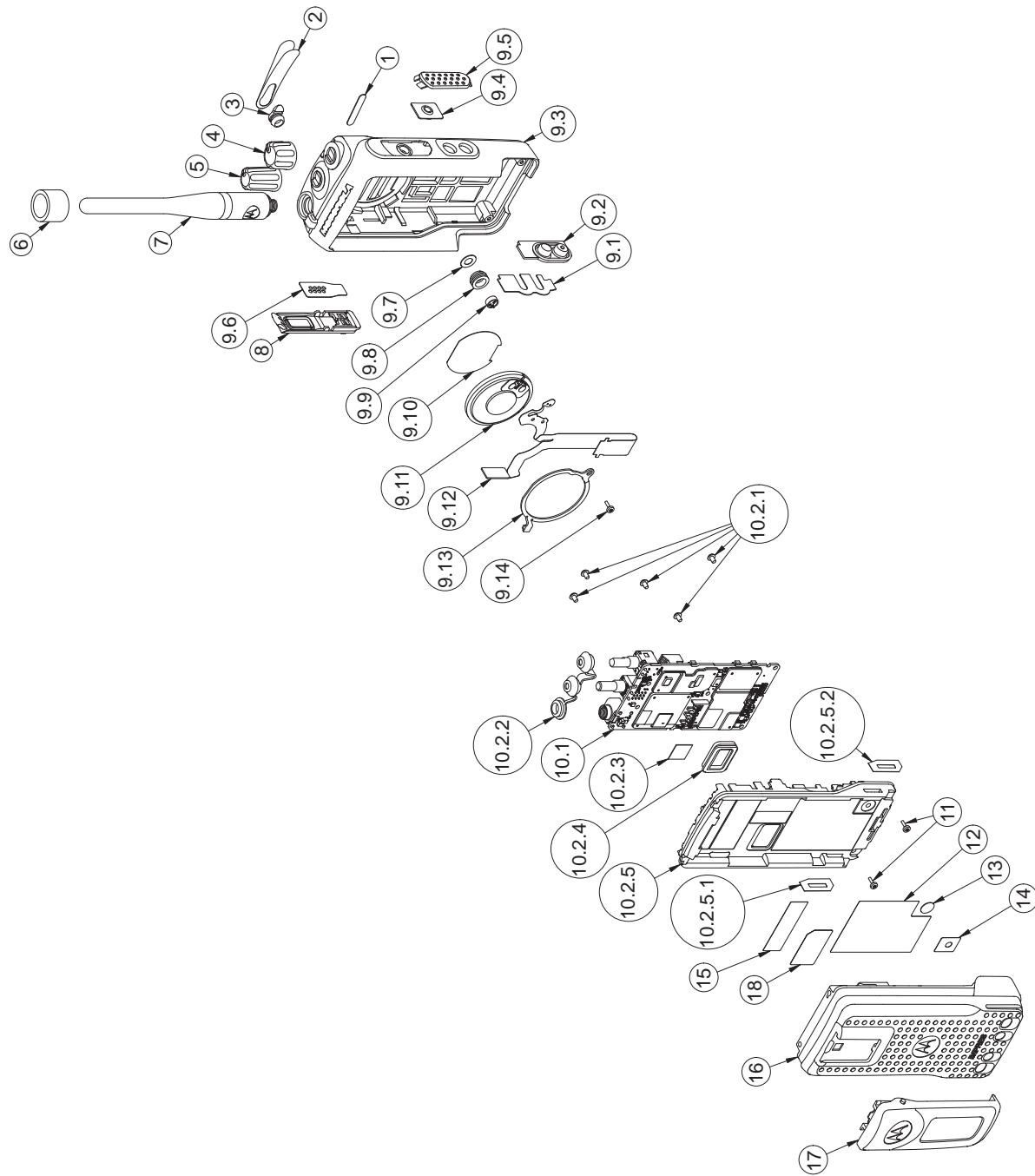
*Figure 5-49. Non-Keypad Model Exploded View*

Table 5-4. Non Keypad Model Exploded View Parts List

Item			Description	Part Number
1			Nameplate (Product Number)	Refer Table 5-5
2			Nameplate (Motorola)	33012026001
3			RF Plug	38012018001
4			Volume Knob	36012016001
5			Channel Knob	36012017001
6			Antenna ID Band	Refer Table 5-5
7			Antenna	Refer Table 5-5
8			Aesthetic Cover	0104058J40
9			Front Kit	PMLN7272_
	9.1		PTT Retainer	42012035001
	9.2		Side Button	KP000087A01
	9.3		Housing Assembly	0104067J10
	9.4		PTT Keypad	KP000086A01
	9.5		PTT Paddle	HN000696A01
	9.6		UC Escutcheon	33012020001
	9.7		Microphone Membrane	SL000209A01
	9.8		Microphone Boot	SL000208A01
	9.9		Microphone	50012012001
	9.10		Speaker Mesh	HW000738A01
	9.11		Speaker	AC000028A02
	9.12		UC-Audio Flex	PF001006A01
	9.13		Speaker Retainer	42012044001
	9.14		K18 Screw (Keypad-Display Retainer & Speaker Retainer)	0385273D06
10			Back Kit	Refer Table 5-5
	10.1		Main Board Assembly	Part of Back Kit
	10.2		Chassis Assembly	PMLN7273_
		10.2.1	M2 Screw (Main Board Assembly)	03012034001
		10.2.2	Top Control Seal	32012269001
		10.2.3	Thermal Pad	7515526H01
		10.2.4	Battery Contact Seal	32012110001

Table 5-4. Non Keypad Model Exploded View Parts List

Item				Description	Part Number
		10.2.5		Chassis (With dispensed O-Ring)	0104067J11
			10.2.5.1	Chassis Left Label	LB000706A01
			10.2.5.2	Chassis Right Label	LB000706A02
11				Front Kit-Back Kit Screw	0316281H01
12				Compro Label	LB000560A01
13				Ventilation Seal	3286058L01
14				Ventilation Label	LB000256A01
15				UL Label (Repaired)	LB000559A02 (For UL radio, need to replace with UL Label (Repaired) for all repaired radios)
16				Battery	Refer Table 5-5
17				Belt Clip	Refer Table 5-5
18				RTTE Label	5486749Z01

NOTE *Items included in Front Kit (PMLN7272_)
** Items included in Chassis Assembly (PMLN7273_)
*** Back Kit (Refer to Table 5-5) included Chassis Assembly (PMLN7273_)

Table 5-5. Additional Parts List

Item	Description	Part Number
Battery		
	Core NIMH 1300 mAH	PMNN4415_
	Core Slim LiIon 1500 mAH	PMNN4406_
	IMPRES LiIon 1500 mAH	PMNN4417_
	IMPRES LiIon Non-FM 2150 mAH	PMNN4418_
Nameplate		
	DP 2400e	33012039027
	DP 2600e	33012039028
Back Kit	Back Cover Kit, 136–174 MHz, 5W, Limited Keypad Portable	PMLD4733_S
	Back Cover Kit, 136–174 MHz, 5W, Limited Keypad Portable	PMLD4734_S
	Back Cover Kit, 136–174 MHz, 5W, Non Keypad Portable	PMLD4737_S

Table 5-5. Additional Parts List (Continued)

Item	Description	Part Number
	Back Cover Kit, 403–527 MHz, 4W, Limited Keypad Portable	PMLE5074_S
	Back Cover Kit, 300–360 MHz, 4W, Non Keypad Portable	PLMLD4749_
	Back Cover Kit, 350–400 MHz, 4W, Limited Keypad Portable	PMLD4755_S
	Back Cover Kit, 350–400 MHz, 4W, Limited Keypad Portable	PMLD4800_S
	Back Cover Kit, 350–400 MHz, 4W, Non Keypad Portable	PMLD4799_S
	Back Cover Kit Non Keypad (300 MHz)	PMLD4646_S
Antenna ID Band	Antenna ID Band (Grey- Pack Of 10 PCS)	32012144001
	Antenna ID Band (Yellow- Pack Of 10 PCS)	32012144002
	Antenna ID Band (Green- Pack Of 10 PCS)	32012144003
	Antenna ID Band (Blue- Pack Of 10 PCS)	32012144004
	Antenna ID Band (Purple- Pack Of 10 PCS)	32012144005
Batteries	Core NIMH 1300mAH	PMNN4415_
	Core Slim LiIon 1500 mAH	PMNN4418_
	IMPRES LiIon 1500 mAH	PMNN4416_
	IMPRES LiIon Non-FM 2150 mAH	PMNN4117_
Belt Clips	Belt Clip 2”	PMLN4651_
	Belt Clip 2.5"	PMLN7008_

5.9.3 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	**N-m**
0385273D06	K18 Screw (Speaker Retainer) K18 Screw (Keypad-Display Retainer)	T6 Torx T6 Torx	2.0 to 2.2 1.5 to 1.7	0.23 to 0.25 0.17 to 0.19
03012034001	M2 Screw (Mainboard Assembly) - New Chassis M2 Screw (Mainboard Assembly) - Rework Chassis	T6 Torx T6 Torx	3.1 to 3.5 2.0	0.35 to 0.40 0.23
0316281H01	Front Kit-Back Kit Screw	T6 Torx	2.1 to 2.3	0.24 to 0.26

Chapter 6   Basic Troubleshooting

6.1   Introduction

This chapter contains error codes and board replacement procedures. If the board does not pass all the performance checks in Chapter 3 or exhibits an error code listed below, then the circuit board should be replaced. If repair requires knowledge of details of component level troubleshooting, please send radio to a Motorola Service Center listed in Appendix A.

> **NOTE** To access the various connector pins, use the housing eliminator/test fixture along with the diagrams found in this section of the manual. (See the section, "Service Aids" on page 2-2, for the appropriate Motorola service aids and tools parts numbers.)

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.

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.

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

6.3   Power-Up Error Codes (Display Model only)

Upon powering up, the radio performs certain tests to determine if its basic electronics and software are in working order. Any error detected has an associated error code that is presented on the radio display. These error codes are intended to be used by a service technician when the radio generates the Self Test Fail Tone. If these tests are successfully completed, the radio will generate the Self Test Tone.

There are two classes of detectable errors, fatal and non-fatal. If it is considered as a fatal error, then the normal radio operation will be inhibited. Fatal errors include hardware errors detected by the microprocessor and certain memory errors. These memory errors include incorrect ROM checksum, incorrect RAM checksum, and incorrect checksums of codeplug (Persistent Storage) blocks that contain operating parameters. If the codeplug block operating parameters are corrupted, operation of the unit on the proper frequency, system, and group are in question. Attempts to use this information could provide the user with a false sense of security that others are receiving his messages. Corrupted codeplug blocks of call IDs, or their associated aliases are considered non-fatal errors. While the user may be inconvenienced, normal communication is still possible.

Table 6-1. Power-Up Error Codes

Error Code	Description	Error Type	Corrective Action
ERROR 01/02	Call ID or associated aliases codeplug block checksum is wrong.	Non-Fatal	Normal communication is still possible, but the user may be inconvenienced. Reprogram codeplug.
ERROR 01/22	Tuning Codeplug block checksum is wrong.	Non-Fatal	Normal communication is still possible.
FAIL 01/82	External Codeplug block checksum is wrong.	Fatal	Reprogram codeplug.
FAIL 01/92	Secure Codeplug checksum error	Fatal	Reprogram codeplug.
FAIL 01/A2	Tuning Codeplug block checksum is wrong.	Fatal	Reprogram codeplug.
FAIL 01/81	ROM Checksum is wrong.	Fatal	Reprogram FLASH Memory, then retest. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
FAIL 01/88	Radio RAM Test Failure.	Fatal	Retest radio by turning it off and turning it on again. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
FAIL 01/90 or FAIL 02/90	General hardware test failure.	Fatal	Retest radio by turning it off and turning it on again. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
FAIL 02/81	DSP ROM Checksum is wrong.	Fatal	Reprogram FLASH Memory, then retest. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
FAIL 02/82	DSP RAM1 test failure.	Fatal	Retest radio by turning it off and turning it on again. If message reoccurs, replace main board or send radio to nearest Motorola Depot.

Table 6-1. Power-Up Error Codes (Continued)

Error Code	Description	Error Type	Corrective Action
FAIL 02/84	DSP RAM2 test failure.	Fatal	Retest radio by turning it off and turning it on again. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
FAIL 02/88	DSP RAM test failure.	Fatal	Retest radio by turning it off and turning it on again. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
FAIL 02/C0	DSP ROM Checksum is wrong.	Fatal	Retest radio by turning it off and turning it on again. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
No Display	Display module is not connected properly. Display module is damaged.	Fatal	Check connection between main board and display module. Replace with new display module.

NOTE A non-display radio emits only the Self Test Fail Tone if it fails the self-test

6.4   Operational Error Codes

During radio operation, the radio performs dynamic tests to determine if the radio is working properly. Problems detected during these tests are presented as error codes on the radio's display. The presence of an error code should prompt a user that a problem exists and that a Motorola Authorized MOTOTRBO dealer should be contacted. Use Table 6-2 to aid in understanding particular operational error codes.

Table 6-2. Operational Error Codes

Error Code	Description	Error Type	Corrective Action
FAIL 001	Synthesizer Out-of-Lock	NON-FATAL	1. Reprogram the codeplug. 2. Refer to Detailed Service Manual.
FAIL 002	Personality checksum or system block error	NON-FATAL	Reprogram the codeplug.

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)

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: https://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.

The Technical Support is available through the following service numbers:

Austria:	01 206 091 087	Poland:	00 800 141 0252
Denmark:	04 368 2114	Portugal:	02 176 161 60
France:	01 57 32 34 34	Russia:	810 800 228 41044/ 810 800 120 1011
Germany:	06 95 00 70 204	Saudi Arabia:	800 844 5345
Israel:	180 931 5818	South Africa:	08 009 819 00
Italy:	02 914 832 30	Spain:	09 12 75 47 87
Lithuania:	880 030 828	United Kingdom:	02 03 02 77 499
Netherlands :	02 02 06 14 04	Norway:	24 15 98 15

All other countries+44 2030 277499

A.5   Further Assistance From Motorola

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

Glossary

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.
LKP	Limited Keypad Model

Term	Definition
MDC	Motorola Digital Communications.
MHz	Megahertz: One million cycles per second. Used especially as a radio-frequency unit.
NKP	Non Keypad Model
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.

Term	Definition
VIP	Vehicle Interface Port.
ZIF	Zero Insertion Force

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www.motorolasolutions.com/mototrbo