

Professional Digital Two-Way Radio System

# MOTOTRBO™ Portable

*Basic Service Manual*

DP 3400 Non-Display Portable

DP 3401 Non-Display Portable (with GPS)

DP 3600 Display Portable

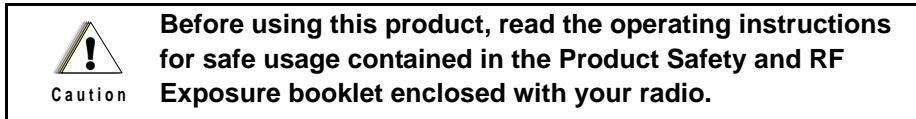
DP 3601 Display Portable (with GPS)



# Foreword

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

## Product Safety and RF Exposure Compliance



### ATTENTION!

**This radio is restricted to occupational use only to satisfy FCC RF 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.motorola.com/governmentandenterprise>**

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## Document History

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

Edition	Description	Date
6866574D29-A	Initial Release	Feb. 2007
6866574D29-B	Added VHF band information. Updated UHF1 Model Chart. Added leak test procedures.	June 2007
6866574D29-C	Added pin layout diagram in Test Equipment and Service Aids chapter. Updated Troubleshooting Charts in Disassembly/ Reassembly chapter. Added warning note in Transceiver Performance Testing chapter. Updated front cover and diagrams of knobs. Updated knob removal tool part number. Updated Technical Support contact information in Appendix A.	Oct. 2007
6866574D29-D	Updated model charts and added 20kHz specifications information in Introduction chapter.	Jan. 2008
6866574D29-E	Added UHF2 band information. Updated Radio Exploded Mechanical Views and Parts Lists.	June 2008

## Notes

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## Related Publications

IMPRES Adaptive Single-Unit Charger User Manual .....	6816787H01
IMPRES Adaptive Multi-Unit Charger User Manual.....	6816789H01
IMPRES Adaptive Multi-Unit Charger Service Manual .....	6871357L01
Remote Speaker Microphone User Manual .....	6871003L01
IMPRES Remote Speaker Microphone User Manual .....	6871004L01
Factory Mutual Approval Manual .....	6871532L01

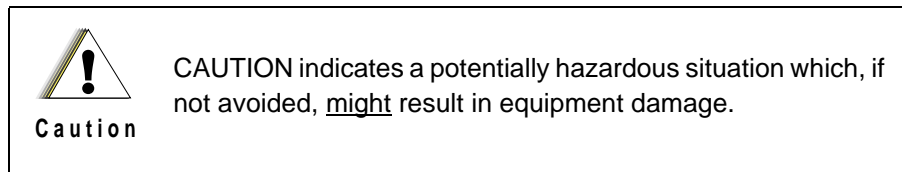
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# Chapter 1 Introduction

## 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.



## 1.2 Radio Description

The DP 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 R1	403–470 MHz	1 Watt or 4 Watt
UHF R2	450–512 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 Display Model

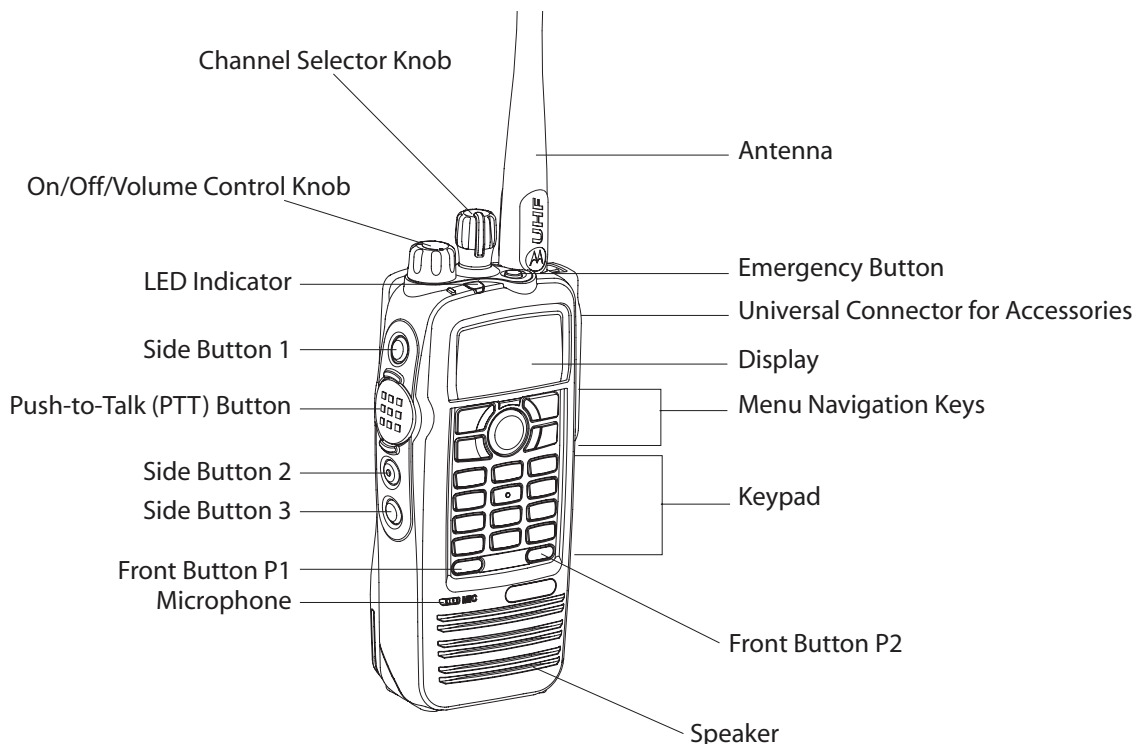


Figure 1-1. Display Model

- **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.
- **LCD (Liquid Crystal Display)** – 132x34 full dot matrix display provides visual information about many radio features.
- **MENU NAVIGATION KEYS** – Five keys to provide menu navigation and selection interface.
- **KEYPAD** – Twelve keys that allows the user to input characters for various text based operations.
- **FRONT BUTTONS and SIDE BUTTONS** – These five 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 twelve points to which specific accessories will connect and be activated.

- EMERGENCY BUTTON – Turns on and off the Emergency Operations.
- SPEAKER – Outputs all tones and audio that are generated by the radio (e.g. features like keypad tones and voice audio).

## 1.2.2 Non-Display Model

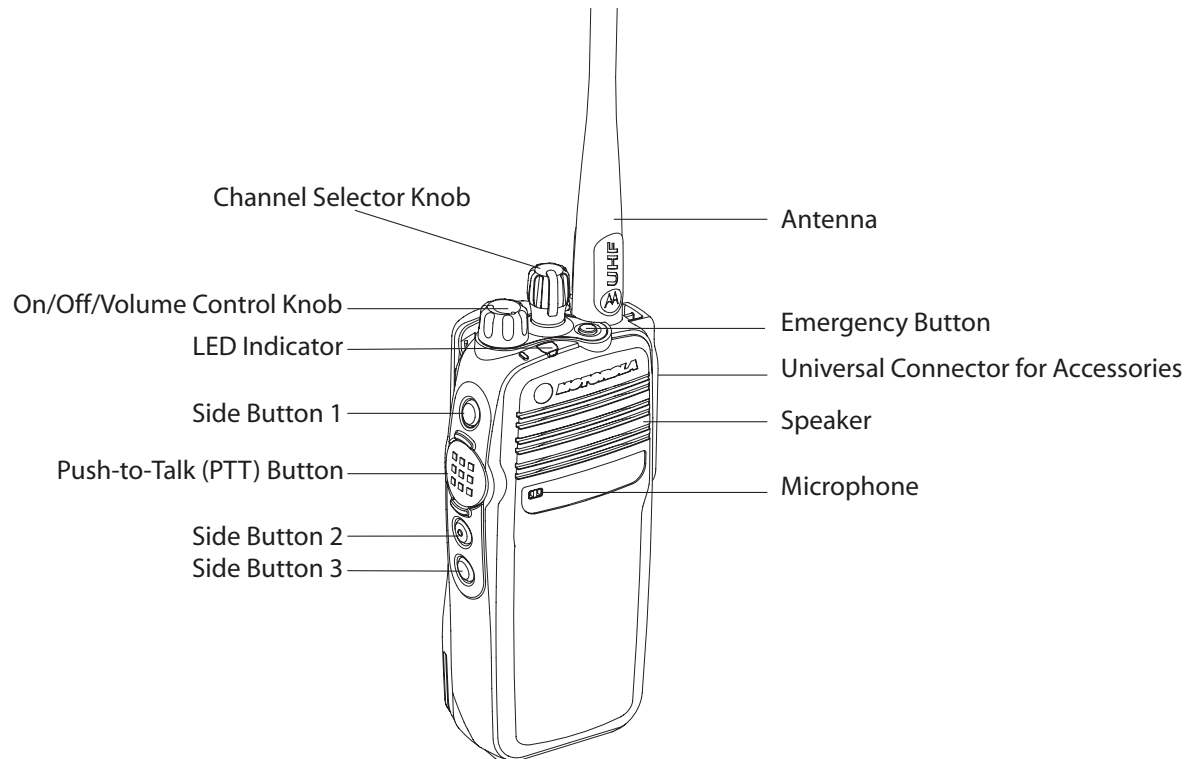


Figure 1-2. Non-Display Model

- 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 3 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 twelve points to which specific accessories will connect to and be activated.
- EMERGENCY BUTTON – Turns on and off the Emergency Operations.
- 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

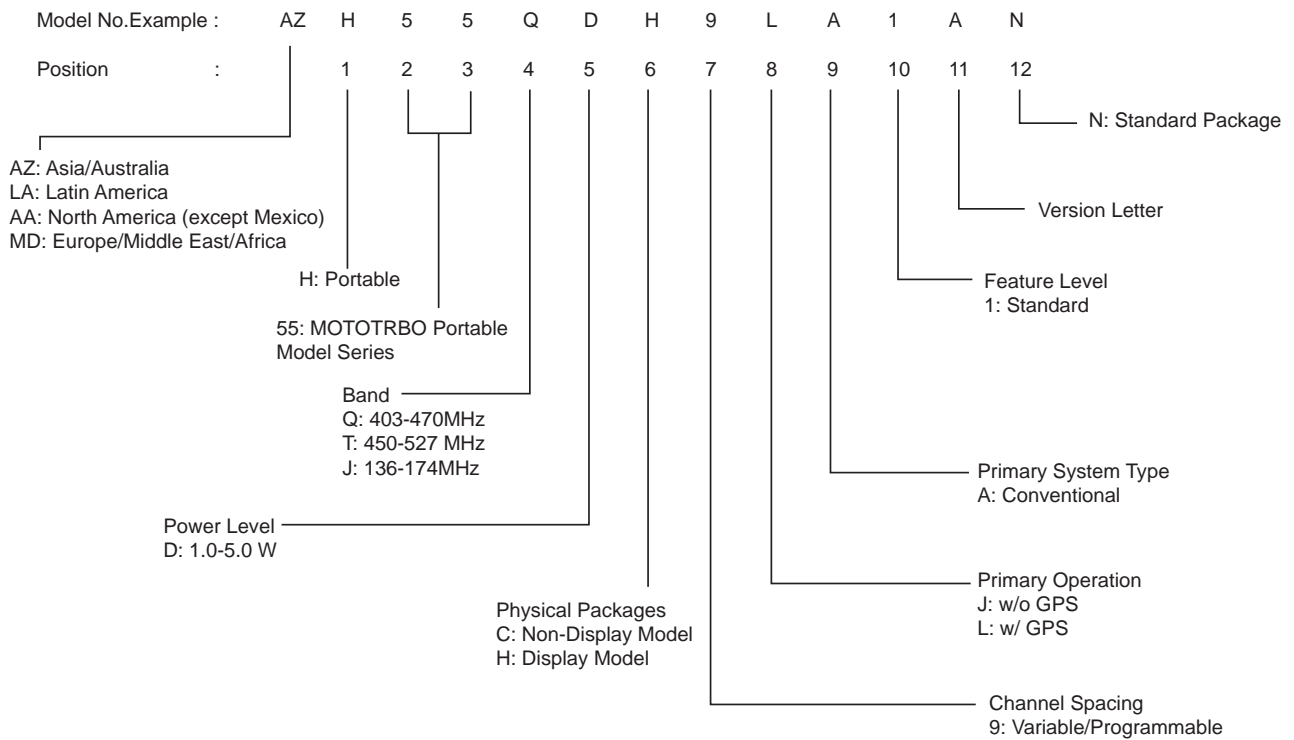


Figure 1-3. Portable Radio Model Numbering Scheme

## 1.4 Model Charts

### 1.4.1 VHF Model Chart

<b>DP Series, VHF, 136–174 MHz</b>					
<b>Model</b>				<b>Description</b>	
MDH55JDH9LA1AN				136–174 MHz 5W, MOTOTRBO Display Portable with GPS	
MDH55JDH9JA1AN				136–174 MHz 5W, MOTOTRBO Display Portable without GPS	
MDH55JDC9LA1AN				136–174 MHz 5W, MOTOTRBO Non-Display Portable with GPS	
MDH55JDC9JA1AN				136–174 MHz 5W, MOTOTRBO Non-Display Portable without GPS	
<b>Item</b>				<b>Description</b>	
X				PMLD4308_	Back Cover Kit, MOTOTRBO Display Portable with GPS
	X			PMLD4309_	Back Cover Kit, MOTOTRBO Display Portable without GPS
		X		PMLD4326_	Back Cover Kit, MOTOTRBO Non-Display Portable with GPS
			X	PMLD4327_	Back Cover Kit, MOTOTRBO Non-Display Portable without GPS
X	X			PMLN4646_	Front Cover Kit with Display and Keypad
		X	X	PMLN4922_	Front Cover Kit without Display and Keypad
X	X	X	X	PMAD4067_	VHF GPS Helical Antenna (136–147MHz)
X	X	X	X	PMAD4068_	VHF GPS Helical Antenna (147–160MHz)
X	X	X	X	PMAD4069_	VHF GPS Helical Antenna (160–174MHz)
		X	X	6866574D01	Quick Reference Guide
X	X			6866574D02	Quick Reference Guide

1.4.2 UHF1 Model Chart

<b>DP Series, UHF1, 403–470 MHz</b>				
<b>Model</b>				<b>Description</b>
			MDH55QDH9LA1AN	403–470 MHz 4W, MOTOTRBO Display Portable with GPS
			MDH55QDH9JA1AN	403–470 MHz 4W, MOTOTRBO Display Portable without GPS
			MDH55QDC9LA1AN	403–470 MHz 4W, MOTOTRBO Non-Display Portable with GPS
			MDH55QDC9JA1AN	403–470 MHz 4W, MOTOTRBO Non-Display Portable without GPS
			<b>Item</b>	<b>Description</b>
X			PMLE4371_	Back Cover Kit, MOTOTRBO Display Portable with GPS
	X		PMLE4372_	Back Cover Kit, MOTOTRBO Display Portable without GPS
		X	PMLE4428_	Back Cover Kit, MOTOTRBO Non-Display Portable with GPS
			X PMLE4429_	Back Cover Kit, MOTOTRBO Non-Display Portable without GPS
X	X		PMLN4646_	Front Cover Kit with Display and Keypad
		X	X PMLN4922_	Front Cover Kit without Display and Keypad
X		X	PMLN4018_	UHF GPS Folded Monopole(403–433 MHz)
X		X	PMLN4024_	UHF GPS Folded Monopole(433–470 MHz)
X		X	PMAE4021_	UHF GPS Stubby Antenna(403–433 MHz)
X		X	PMAE4023_	UHF GPS Stubby Antenna(430–470 MHz)
	X		X PMAE4022_	UHF Whip Antenna(430–470 MHz)
		X	X 6866574D01	Quick Reference Guide
X	X		6866574D02	Quick Reference Guide



## 1.4.3 UHF2 Model Chart

<b>DP Series, UHF2, 450–512 MHz</b>					
<b>Model</b>				<b>Description</b>	
			MDH55TDH9LA1AN	450–512 MHz 4W, MOTOTRBO Display Portable with GPS	
			MDH55TDH9JA1AN	450–512 MHz 4W, MOTOTRBO Display Portable without GPS	
			MDH55TDC9LA1AN	450–512 MHz 4W, MOTOTRBO Non-Display Portable with GPS	
			MDH55TDC9JA1AN	450–512 MHz 4W, MOTOTRBO Non-Display Portable without GPS	
			<b>Item</b>	<b>Description</b>	
X			PMUE3088_	Back Cover Kit, MOTOTRBO Display Portable with GPS	
	X		PMUE3087_	Back Cover Kit, MOTOTRBO Display Portable without GPS	
		X	PMUE3089_	Back Cover Kit, MOTOTRBO Non-Display Portable with GPS	
			X	PMUE3090_	Back Cover Kit, MOTOTRBO Non-Display Portable without GPS
X	X		PMLN4646_	Front Cover Kit with Display and Keypad	
		X	X	PMLN4922_	Front Cover Kit without Display and Keypad
X		X		PMAE4050_	UHF2 GPS Folded Monopole(450–495 MHz)
X		X		PMAE4051_	UHF2 GPS Folded Monopole(495–527 MHz)
X		X		PMAE4052_	UHF2 GPS Stubby Antenna(450–495 MHz)
X		X		PMAE4048_	UHF2 GPS Stubby Antenna(495–527 MHz)
	X		X	PMAE4049_	UHF2 Whip Antenna(450–527 MHz)
		X	X	6866574D01	Quick Reference Guide
X	X			6866574D02	Quick Reference Guide

## 1.5 Specifications

General	Display DP 3600/ DP 3601	Non-Display DP 3400/ DP 3401
Channel Capacity	160	32
Frequency	VHF: 136 – 174 MHz UHF1: 403 – 470 MHz UHF2: 450 – 512 MHz	
Dimensions (HxWxT) w/ NiMH battery	5.18 x 2.40 x 1.38 in (131.5 x 61 x 35 mm)	
Weight (with NiMH battery) (with Lilon FM battery) (with Lilon non-FM battery) (with Lilon 2200 battery)	15.2 oz (430 g) 13 oz (370 g) 12.7 oz (360 g) 12.7 oz (360 g)	13.2 oz (375 g) 11.1 oz (315 g) 10.75 oz (305 g) 10.75 oz (305 g)
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.		
NiMH core battery	Analog: 8 hrs Digital: 11.2 hrs	
IMPRES Lilon Slim Battery (Standard)	Analog: 9.3 hrs Digital: 13 hrs	
IMPRES FM Lilon	Analog: 8.7 hrs Digital: 12.1 hrs	
IMPRES Lilon 2200	Analog: 13.5 hrs Digital: 19 hrs	

Receiver	Display DP 3600/ DP 3601	Non-Display DP 3400/ DP 3401
Frequencies	VHF: 136 – 174 MHz UHF1: 403 – 470 MHz UHF2: 450 – 512 MHz	
Channel Spacing	12.5 kHz/ *20 kHz/ 25 kHz	
Frequency Stability (-30°C to +60°C)	+/-1.5 ppm (DP 3600) +/-0.5 ppm (DP 3601)	+/-1.5 ppm (DP 3400) +/-0.5 ppm (DP 3401)
Analog Sensitivity	0.35 $\mu$ V (12dB SINAD) 0.22 $\mu$ V (typical) (12dB SINAD) 0.4 $\mu$ V (typical) (20dB SINAD)	
Digital Sensitivity	5% BER: 0.3 $\mu$ V	
Intermodulation (ETS)	65 dB	
Adjacent Channel Selectivity	60 dB @ 12.5 kHz, 70 dB @ *20 kHz/ 25 kHz	
Spurious Rejection	70 dB	
Rated Audio	500 mW	
Audio Distortion @ Rated Audio	3% (typical)	
Hum and Noise	-40 dB @ 12.5 kHz -45 dB @ *20 kHz/ 25 kHz	
Audio Response	+1, -3 dBm	
Conducted Spurious Emission	-57 dBm	

\* 20 kHz channel spacing is not applicable for UHF2.

Transmitter	Display DP 3600/ DP 3601	Non-Display DP 3400/ DP 3401
Frequencies	VHF: 136 – 174 MHz UHF1: 403 – 470 MHz UHF2: 450 – 512 MHz	
Channel Spacing	12.5 kHz/ *20kHz/ 25 kHz	
Frequency Stability (-30°C to +60°C)	+/-1.5 ppm (DP 3600) +/-0.5 ppm (DP 3601)	+/-1.5 ppm (DP 3400) +/-0.5 ppm (DP 3401)
Power Output (Low Power)	1 W	
Power Output (High Power)	VHF: 5 W UHF1/UHF2: 4 W	
Modulation Limiting	+/-2.5 kHz @ 12.5 kHz +/-4.0 kHz @ *20 kHz +/-5.0 kHz @ 25 kHz	
FM Hum and Noise	-40 dB @ 12.5 kHz -45 dB @ *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 kHz/ 25 kHz	
Audio Response	+1, -3 dBm	
Audio Distortion	3% (typical)	
FM Modulation	12.5 kHz: 11K0F3E *20 kHz: 14K0F3E 25 kHz: 16K0F3E	
4FSK Digital Modulation	12.5 kHz Data Only: 7K60FXD 12.5 kHz Data & Voice: 7K60FXE	
Digital Vocoder Type	AMBE+2	
Digital Protocol	ETSI-TS102361-1 ETSI-TS102361-2 ETSI-TS102361-3	

\* 20 kHz channel spacing is not applicable for UHF2.

UHF1 Self-Quieter Frequencies	
GPS	Non-GPS
403.20 MHz $\pm$ 5k	
409.23 MHz $\pm$ 5k	–
414.00 MHz	
417.79 MHz $\pm$ 10k	
420.00 MHz $\pm$ 5k	
425.60 MHz $\pm$ 5k	–
431.10 MHz $\pm$ 5k	
432.00 MHz $\pm$ 5k	
436.80 MHz $\pm$ 5k	
441.97 MHz $\pm$ 5k	–
442.36 MHz $\pm$ 10k	
444.00 MHz $\pm$ 5k	
450.00 MHz	
453.60 MHz $\pm$ 5k	
458.34 MHz $\pm$ 5k	–
466.93 MHz $\pm$ 10k	
468.00 MHz $\pm$ 5k	

VHF Self-Quieter Frequencies	
GPS	Non-GPS
144.000 MHz $\pm$ 100k	
147.320 MHz $\pm$ 5k	–
147.455 MHz $\pm$ 10k	
151.200 MHz $\pm$ 5k	
156.000 MHz $\pm$ 10k	
162.000 MHz $\pm$ 10k	
163.690 MHz $\pm$ 5k	–
166.675 MHz $\pm$ 5k	
168.000 MHz $\pm$ 5k	
172.030 MHz $\pm$ 10k	

UHF2 Self-Quieter Frequencies	
GPS	Non-GPS
450.000 MHz	
453.600 MHz $\pm$ 5k	
458.340 MHz $\pm$ 5k	–
466.930 MHz $\pm$ 10k	
468.000 MHz $\pm$ 5k	
470.400 MHz $\pm$ 5k	
474.701 MHz $\pm$ 10k	–
480.000 MHz $\pm$ 5k	
486.000 MHz $\pm$ 15k	
487.200 MHz $\pm$ 5k	
491.070 MHz $\pm$ 10k	–
491.520 MHz $\pm$ 10k	
502.200 MHz $\pm$ 5k	
504.000 MHz $\pm$ 15k	
506.695 MHz $\pm$ 5k	
507.439 MHz $\pm$ 15k	–

GPS	Display DP 3600/ DP 3601	Non-Display DP 3400/ DP 3401
TTFF (Time To First Fix) Cold Start	< 1 minute	
TTFF (Time To First Fix) Hot Start	< 10 seconds	
Horizontal Accuracy	< 10 meters	
Accuracy specs are for long-term tracking (95th percentile values > 5 satellites visible at a nominal -130 dBm signal strength)		

Military Standards				
Applicable MIL-STD	810E		810F	
	Methods	Procedures	Methods	Procedures
Low Pressure	500.3	II	500.4	II
High Temperature	501.3	I/A, II/A1	501.4	I/Hot, II/Hot
Low Temperature	502.3	I/C3, II/C1	502.4	I/C3, II/C1
Temperature Shock	503.3	I/A, 1C3	503.4	I
Solar Radiation	505.3	I	505.4	I
Rain	506.3	I,II	506.4	I, III
Humidity	507.3	II	507.4	–
Salt fog	509.3	I	509.4	I
Dust	510.3	I	510.4	I
Vibration	514.4	I/10,II/3	514.5	I/24
Shock	516.4	I, IV	516.5	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-801-2KV
Water Intrusion	IEC 60529 -IP57
Packaging Test	MIL-STD 810D and E

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

**Conforms to:**

MOTOTRBO Portable series radios meet FM (Factory Mutual) standards for intrinsic safety used in Class I, II, III, Division 1, Groups C, D, E, F, and G when properly equipped with a Motorola FM approved battery option. They are also approved for nonincendive use in Class I, Division 2, Groups A, B, C, and D. For more details, please refer to the Factory Mutual Approval Manual (6871532L01).

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

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.

Specifications subject to change without notice. All specifications shown are typical.



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## 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 2975 (www.aeroflex.com), Motorola R2670, or equivalent	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
Digital RMS Multimeter *	100 $\mu$ V to 300 V 5 Hz to 1 MHz 10 Mega Ohm Impedance	Fluke 179 or equivalent (www.fluke.com)	AC/DC voltage and current measurements. Audio voltage measurements
RF Signal Generator *	100 MHz to 1 GHz -130 dBm to +10 dBm FM Modulation 0 kHz to 10 kHz Audio Frequency 100 Hz to 10 kHz	Agilent N5181A (www.agilent.com), Ramsey RSG1000B (www.ramseyelectronics.com), or equivalent	Receiver measurements
Oscilloscope *	2 Channel 50 MHz Bandwidth 5 mV/div to 20 V/div	Leader LS8050 (www.leaderusa.com), Tektronix TDS1001b (www.tektronix.com), or equivalent	Waveform measurements
Power Meter and Sensor *	5% Accuracy 100 MHz to 500 MHz 50 Watts	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
RF Millivolt Meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 92EA (www.boonton.com) or equivalent	RF level measurements
Power Supply	0 V to 32 V 0 A to 20 A	B&K Precision 1790 (www.bkprecision.com) or equivalent	Voltage supply

## 2.2 Service Aids

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

Table 2-2. Service Aids

Motorola Part No.	Description	Application
RLN4460_	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.
GMVN5141_	Customer Programming Software on CD-ROM	Allows servicer to program radio parameters, tune and troubleshoot radios.
PMKN4012_	Portable Programming Cable	This cable connects the radio to a USB port for radio programming and data applications.
PMKN4013_	Portable Programming, Testing & Alignment Cable	This cable connects the radio to a USB port for radio programming, testing and alignment.
PMNN4076_	7.5V Universal Battery Eliminator	Connects to radio via battery eliminator cable.
5880348B33	DMR SMA to BNC RF Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
PMHN4085_	Bench Test Housing Eliminator	Interconnects radio to power supply. Provides for troubleshooting of the radio when the housing is removed.
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

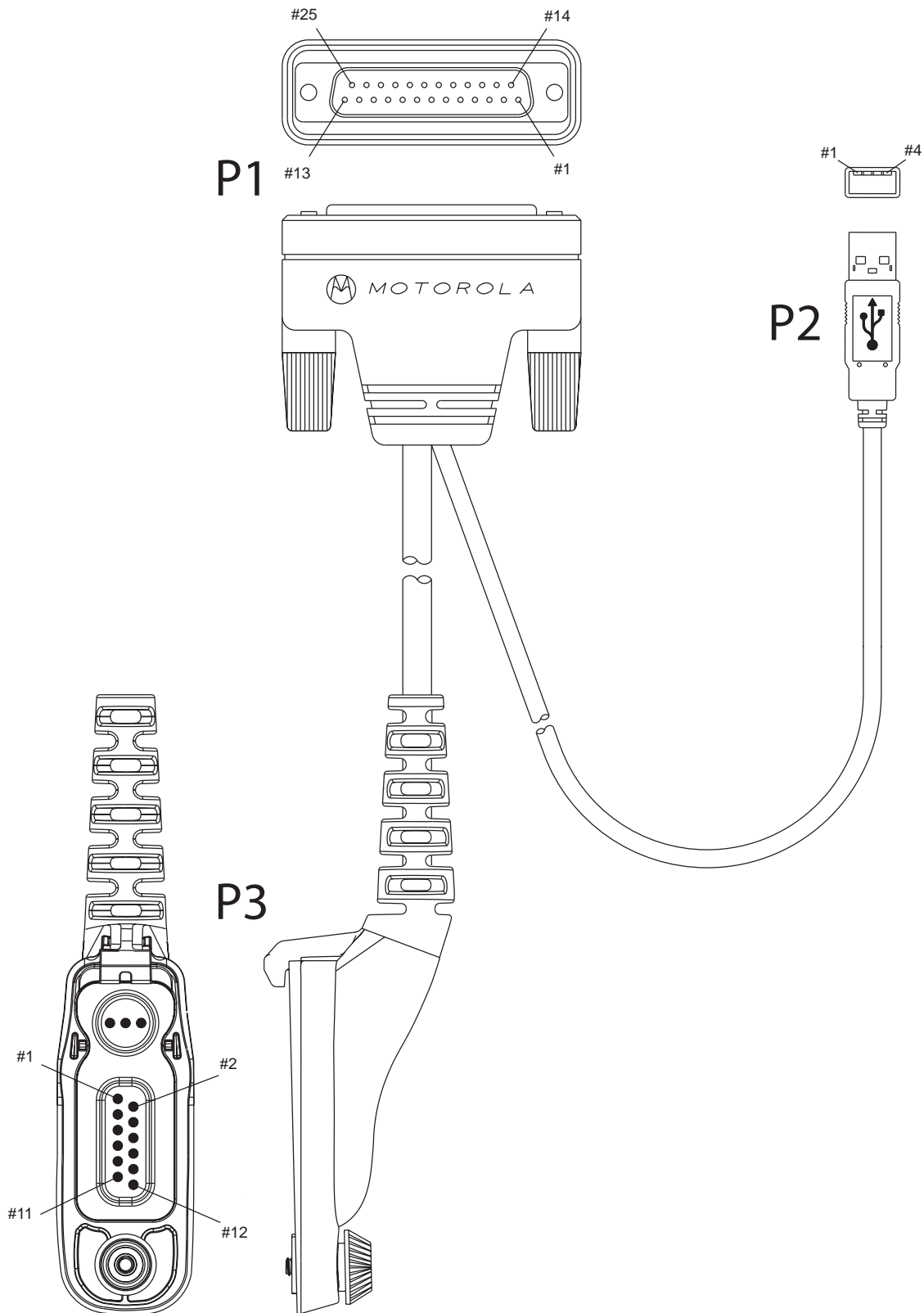


Figure 2-1. Programming, Testing and Alignment Cable

Table 2-3. Pin Configuration of Side Connector

CONNECTION			
P1	P2	P3	
Pin	Pin	Pin	Function
	1	3	VCC (5V)
	3	4	DATA +
	2	5	DATA -
16		6	GROUND
7		8	SPEAKER -
17		10	EXTERNAL MIC +
16		11	EXTERNAL MIC -
20		9	EXTERNAL PTT
1		7	SPEAKER +
	4	1 (Coax Connector)	GROUND

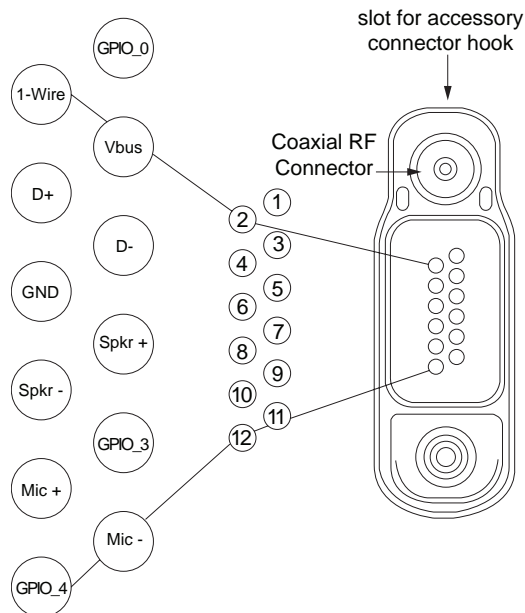


Figure 2-2. Pin Layout of Side Connector

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# 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.

	<b>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.</b>
---	--

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	

### 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

- Each short press of **Side Button 1** toggles the channel spacing between 25 kHz, 12.5 kHz and 20 kHz as. The radio beeps once when radio toggles to 20kHz, beeps twice for 25 kHz and beeps three times for 12.5 kHz.
- 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	UHF1	UHF2	VHF
1 Low Power 8 High Power	TX#1 or #8 RX#1 or #8	403.000 403.000	450.075 450.075	136.075 136.075
2 Low Power 9 High Power	TX#2 or #9 RX#2 or #9	414.150 414.150	464.075 464.075	142.575 142.575
3 Low Power 10 High Power	TX#3 or #10 RX#3 or #10	425.350 425.350	475.075 475.075	146.575 146.575
4 Low Power 11 High Power	TX#4 or #11 RX#4 or #11	436.500 436.500	486.525 486.525	155.575 155.575
5 Low Power 12 High Power	TX#5 or #12 RX#5 or #12	447.675 447.675	496.875 496.875	161.575 161.575
6 Low Power 13 High Power	TX#6 or #13 RX#6 or #13	458.850 458.850	504.875 504.875	167.575 167.575
7 Low Power 14 High Power	TX#7 or #14 RX#7 or #14	470.000 470.000	511.875 511.875	173.975 173.975



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	PTT to continuously transmit (during the performance check)	Frequency error to be $\pm 654$ Hz for non-GPS models (UHF1) $\pm 218$ Hz for GPS models (UHF1) $\pm 729$ Hz for non-GPS models (UHF2) $\pm 243$ Hz for GPS models (UHF2) $\pm 233$ Hz for non-GPS models (VHF) $\pm 77$ Hz for GPS models (VHF)
Power RF	As above	As above	As above	Low Power: 1.0 – 1.6W (VHF/ UHF1/UHF2) High Power: 4.0 – 4.8W (UHF1/ UHF2) 5.0 – 6.0W (VHF)
Voice Modulation	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out Monitor: DVM: AC Volts Set 1kHz Mod Out level for 0.025Vrms at test set, 80mVrms at AC/DC test set jack	As above	As above, meter selector to mic	Deviation: $\geq 4.0$ kHz but $\leq 5.0$ kHz (25 kHz Ch Sp).
Voice Modulation (internal)	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/Out	TEST MODE, Test Channel 4 carrier squelch output at antenna	Remove modulation input	Press PTT switch on radio. Say “four” loudly into the radio mic. Measure deviation: $\geq 4.0$ kHz but $\leq 5.0$ kHz (25 kHz Ch Sp)
TPL Modulation	As above 4th channel test frequency* BW to narrow	TEST MODE, Test Channel 4 TPL	As above	Deviation: $\geq 500$ Hz but $\leq 1000$ Hz (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	PTT to continuously transmit (during the performance check)	Frequency error to be $\pm 654$ Hz for non-GPS models (UHF1) $\pm 218$ Hz for GPS models (UHF1) $\pm 729$ Hz for non-GPS models (UHF2) $\pm 243$ Hz for GPS models (UHF2) $\pm 233$ Hz for non-GPS models (VHF) $\pm 77$ Hz for GPS models (VHF)
Rated Audio	Mode: GEN Output level: 1.0mV RF 4th channel test frequency* Mod: 1kHz tone at 3kHz deviation Monitor: DVM: AC Volts	TEST MODE Test Channel 4 carrier squelch	PTT to OFF (center), meter selector to Audio PA	Set volume control to 2.83Vrms
Distortion	As above, except to distortion	As above	As above	Distortion <3.0%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.35 $\mu$ V
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1mV RF	As above	PTT to OFF (center), meter selection to Audio PA, speaker/load to speaker	Set volume control to 2.83Vrms
	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 <0.25 $\mu$ V. Preferred SINAD = 9 – 10dB

\* See Table 3-4

### 3.3.3 Display Test Mode

1. Press and hold **Side Button 1** in RF Test Mode. The radio beeps once and momentarily displays "Display Test Mode".
2. Upon entering Display Test Mode, the radio displays a horizontal line on row 8 (center row).
3. With each button/key press, the radio fills the screen up with 2 horizontal lines from the center row (1 line each above and below the center row) until the top and bottom of the screen (row 7-0 and row 9-16) is completely full.
4. When the screen is filled up with the horizontal lines, any button/key press clears the screen and displays vertical lines at column 0, 6, 12, 18, 24, 30, 36, 42, 48, 54, 60. Any button/key press fills the screen with vertical lines, (1 line to the right of any existing line) until the display is full.
5. When the screen is filled up with the vertical lines, any button/key press clears the screen and displays the first 10 available icons on the screen. Successive button/key press displays the remaining 4 icons.

### 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 orange 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:

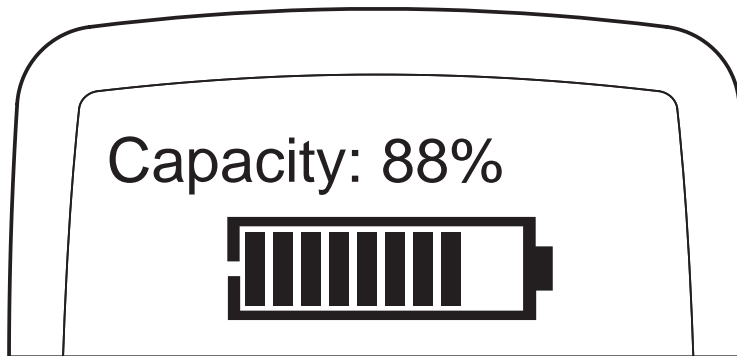


Figure 3-1. Battery Check Test Mode Display

### 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. The radio also displays the button/knob/PTT button command opcode (BCO) and state (BCO/state) on the screen (line 2) upon any button state changes.
3. Rotate the **Volume Knob**; "2/0" through "2/255" appears. The radio beeps at each position.
4. Rotate the **Channel Knob**; "4/0" through "4/15" appears. The radio beeps at each position.
5. Press **Side Button 1**; "96/1" appears & radio beeps; release, "96/0" appears & radio beeps.
6. Press **Side Button 2**; "97/1" appears & radio beeps; release, "97/0" appears & radio beeps.
7. Press **Side Button 3**; "98/1" appears & radio beeps; release, "98/0" appears & radio beeps.
8. Press the **PTT Switch**; "1/1" appears & radio beeps; release, "1/0" appears & radio beeps.
9. Press **Top Button**; "148/1" appears & radio beeps; release, "148/0" appears & radio beeps.
10. Keypad Checks:
  - Press **0**, "48/1" appears & radio beeps; release, "48/0" appears & radio beeps.
  - Press **1**, "49/1" appears & radio beeps; release, "49/0" appears & radio beeps.
  - Press **2**, "50/1" appears & radio beeps; release, "50/0" appears & radio beeps.
  - Press **3**, "51/1" appears & radio beeps; release, "51/0" appears & radio beeps.
  - Press **4**, "52/1" appears & radio beeps; release, "52/0" appears & radio beeps.
  - Press **5**, "53/1" appears & radio beeps; release, "53/0" appears & radio beeps.
  - Press **6**, "54/1" appears & radio beeps; release, "54/0" appears & radio beeps.
  - Press **7**, "55/1" appears & radio beeps; release, "55/0" appears & radio beeps.
  - Press **8**, "56/1" appears & radio beeps; release, "56/0" appears & radio beeps.
  - Press **9**, "57/1" appears & radio beeps; release, "57/0" appears & radio beeps.
  - Press **\***, "58/1" appears & radio beeps; release, "58/0" appears & radio beeps.
  - Press **#**, "59/1" appears & radio beeps; release, "59/0" appears & radio beeps.
  - 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 **OK**, “85/1” appears & radio beeps; release, “85/0” 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; release, “128/0” appears & radio beeps.
  - Press **▶**, “130/1” appears & radio beeps; release, “130/0” 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 as. 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, orange 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 **Side Button 3**; the radio beeps; release, the radio beeps.
7. Press the **PTT Switch**; the radio beeps; release, the radio beeps.
8. Press **Top Button**; the radio beeps; release, the radio beeps.

## Notes



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# Chapter 4 Radio Programming and Tuning

## 4.1 Introduction

This chapter provides an overview of the MOTOTRBO Customer Programming Software (CPS), as well as the Tuner and AirTracer applications, which are all designed for use in a Windows 2000/XP 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	Kit Number
MOTOTRBO CPS, Tuner and AirTracer Applications CD	GMVN5141_

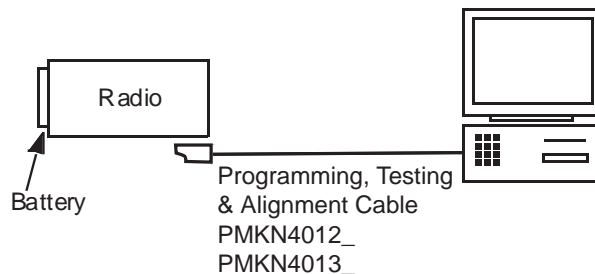
## 4.2 Customer Programming Software Setup

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

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



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



*Figure 4-1. CPS Programming Setup*

## 4.3 AirTracer Application Tool

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

internal error logs from MOTOTRBO radios. The saved files can be analyzed by trained Motorola personnel to suggest improvements in system configurations or to help isolate problems.

## 4.4 Radio Tuning Setup

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

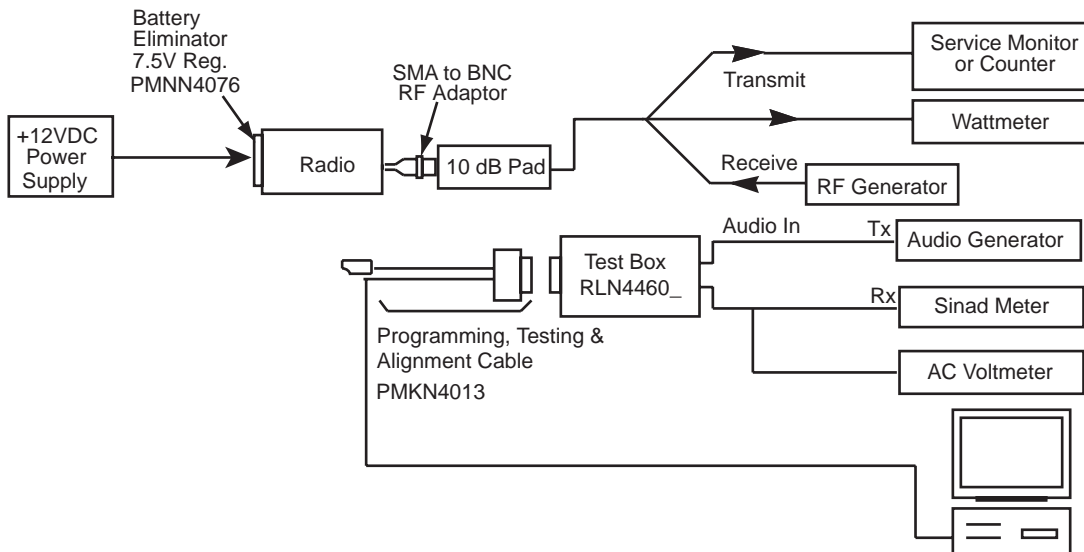


Figure 4-2. Radio Tuning Equipment Setup

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# Chapter 5 Disassembly/Reassembly Procedures

## 5.1 Introduction

This chapter provides details about the following:

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

## 5.2 Preventive Maintenance

Periodic visual inspection and cleaning is recommended.

### 5.2.1 Inspection

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

### 5.2.2 Cleaning Procedures

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

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

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



**Caution**

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

### **Cleaning External Plastic Surfaces**

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

### **Cleaning Internal Circuit Boards and Components**

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

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

## **5.3 Safe Handling of CMOS and LDMOS Devices**

Complementary metal-oxide semiconductor (CMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS circuits and are especially important in low humidity conditions. **DO NOT** attempt to disassemble the radio without first referring to the CMOS CAUTION paragraph in the Disassembly and Reassembly section of the manual.

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



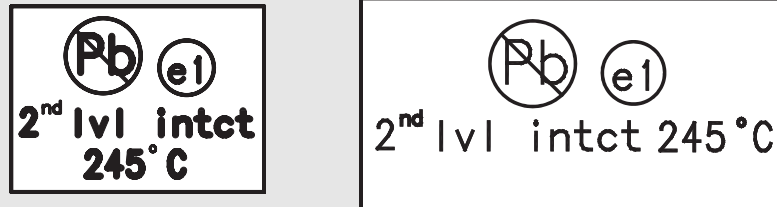
Caution

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

- Store and transport all CMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS 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 device. We recommend using the Motorola Static Protection Assembly (part number 0180386A82), which includes a wrist strap, two ground cords, a table mat, and a floor mat.
- 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 devices.
- Do not insert or remove CMOS devices with power applied. Check all power supplies used for testing CMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- If at all possible, handle CMOS devices by the package and not by the leads. Prior to touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

## 5.4 Repair Procedures and Techniques – General

**NOTE** Environmentally Preferred Products (EPP) (refer to the marking on the printed circuit boards — examples shown below) were developed and assembled using environmentally preferred components and solder assembly techniques to comply with the European Union's Restriction of Hazardous Substances (ROHS) Directive 2002/95/EC and Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC. To maintain product compliance and reliability, use only the Motorola specified parts in this manual.



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

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

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

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

Motorola Part Number	Manufacturer Part Number	Viscosity	Type	Composition & Percent Metal	Liquid Temperature
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™ T6 screwdriver
- Knob Removal Tool (6671789L02)

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

- Grease (1185937A01)
- TORX™ T6 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

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

## 5.6 Radio Disassembly – Detailed

### 5.6.1 Front Cover from Chassis Disassembly

1. Turn off the radio.
2. Unscrew the fastener screw.
3. Pull the dust cover upward to remove it.

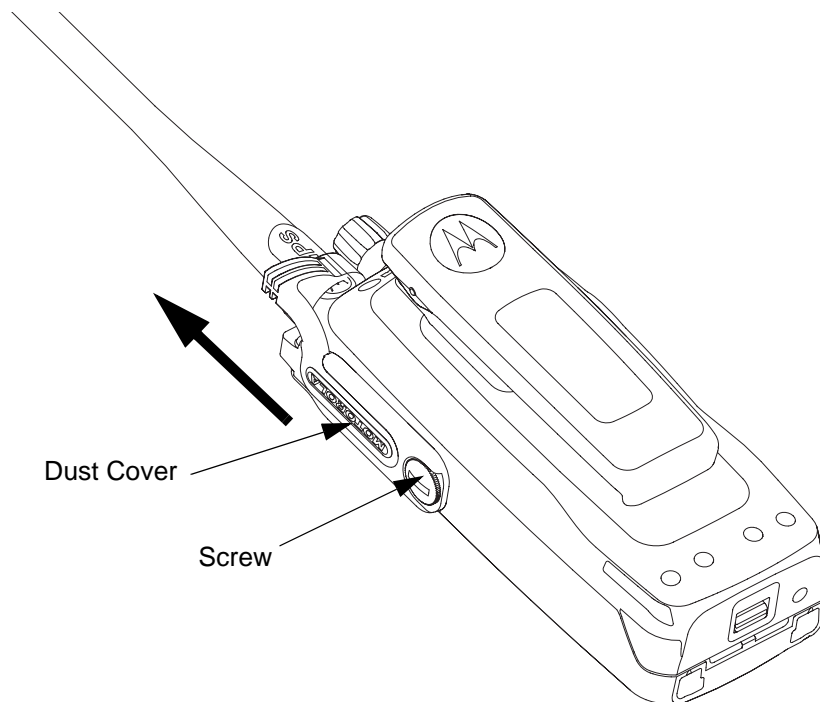


Figure 5-1. Dust Cover removal.

4. Remove the battery:
  - a. Release the battery latch by moving it into the unlock position.
  - b. With the latch released, slide the battery downwards.
  - c. Remove the battery from the radio.

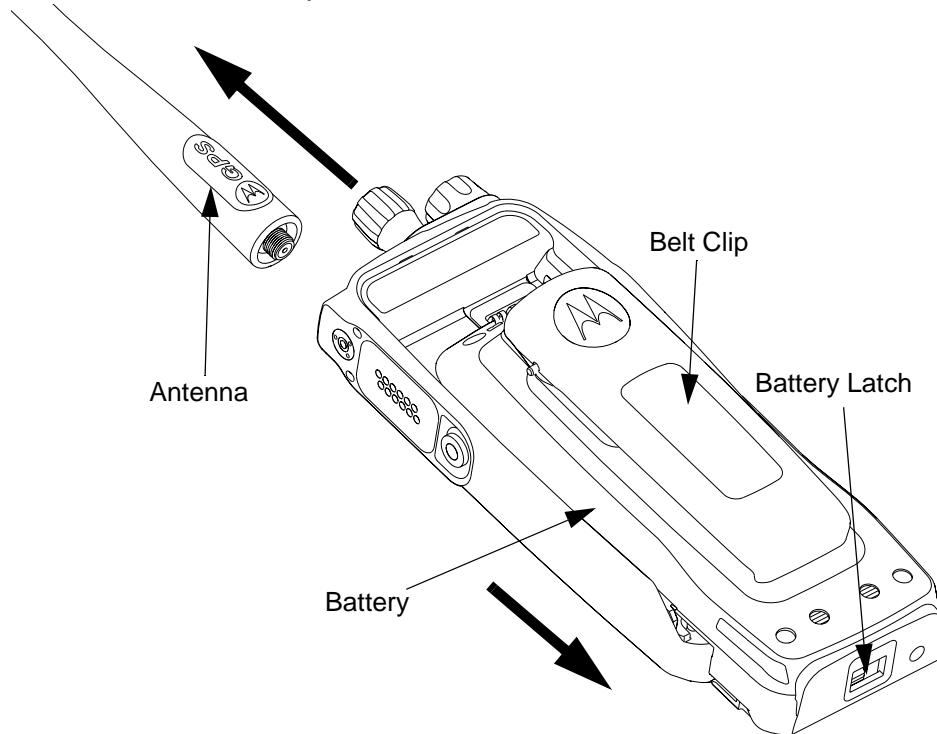


Figure 5-2. Battery and Antenna removal.

5. Remove the antenna by turning it counterclockwise.
6. Remove the volume and channel selector knobs off from their shafts using the knob removal tool.

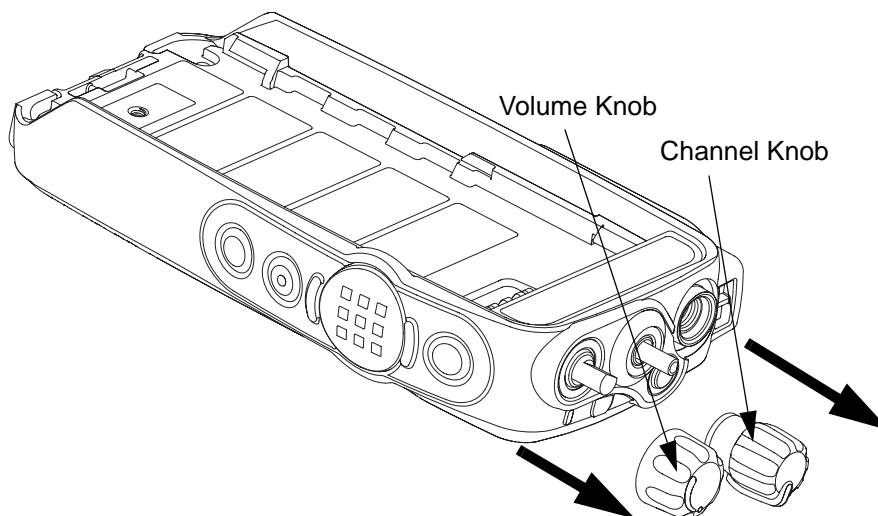


Figure 5-3. Knob removal.

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



7. Separate the chassis from the internal electronics front cover assembly as follows:
  - a. Unscrew the screws using the TORX™ T6 screwdriver.
  - b. Release the chassis slightly upward and disconnect the board-to-board connector between the option board and the keypad flex.
  - c. Remove the chassis from the front cover.

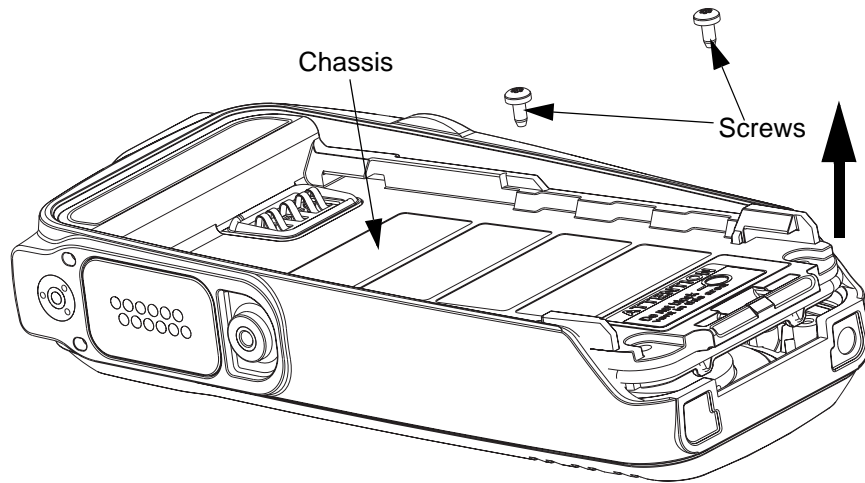


Figure 5-4. Chassis removal.

## 5.6.2 Chassis Disassembly

1. Display Module Disassembly
  - a. Release the display retainer catch and disconnect the board-to-board connector between the display flex and the transmission board, subsequently remove the display module.

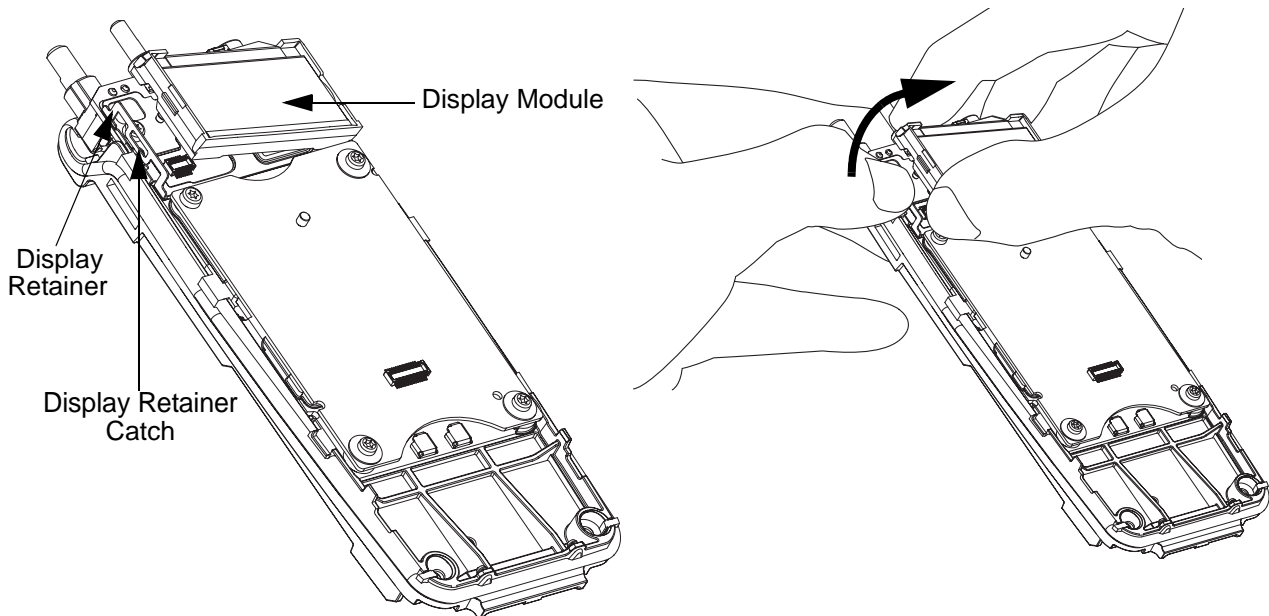


Figure 5-5. LCD Module removal.

- b. Remove the two screws using the TORX™ T6 screwdriver.
    - c. Remove the display retainer.

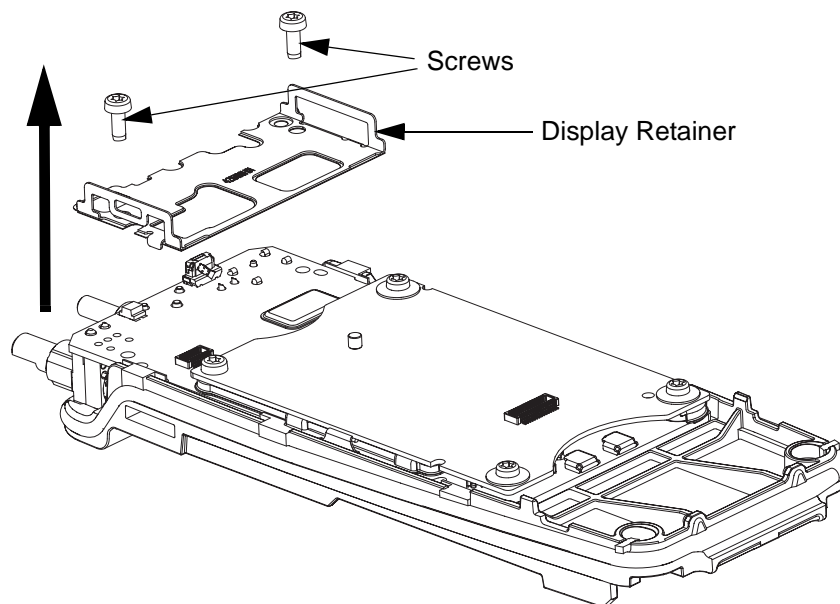


Figure 5-6. LCD Retainer removal.

2. Use the TORX™ T6 screwdriver to remove the four screws holding the transmission board and interface board.
3. Lift up the interface and transmission board to remove.

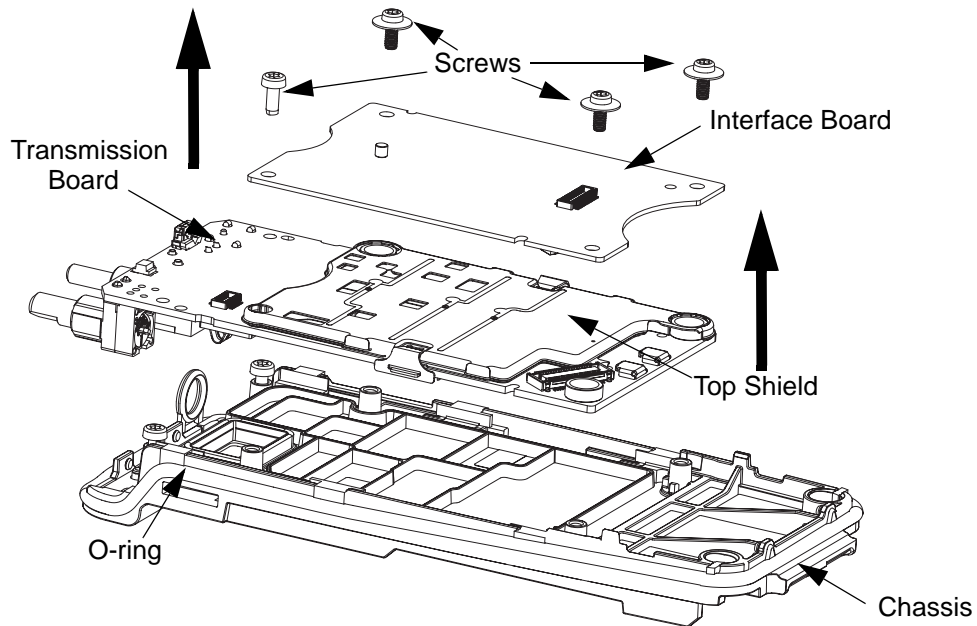


Figure 5-7. Transmission and Interface Board removal.

4. Release the catch from the reflow post by pushing away the shield clips.
5. Remove the shield clip by releasing the hook from the slot at the top shield.

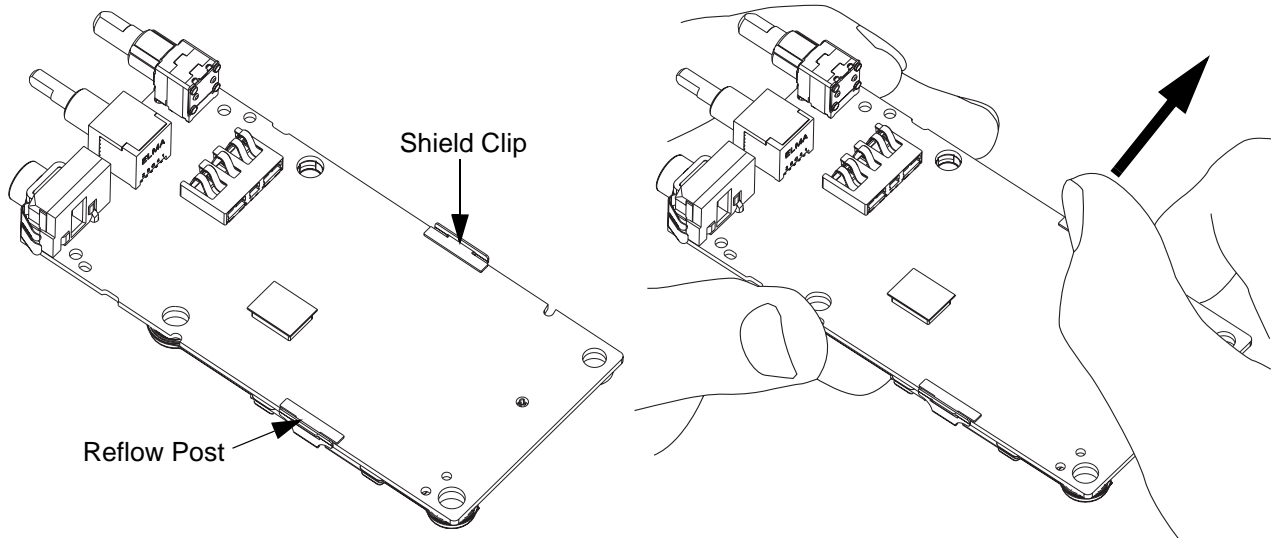


Figure 5-8. Shield Clip removal.

6. Release all the tabs from the catches.
7. Remove O-ring and battery contact seal.

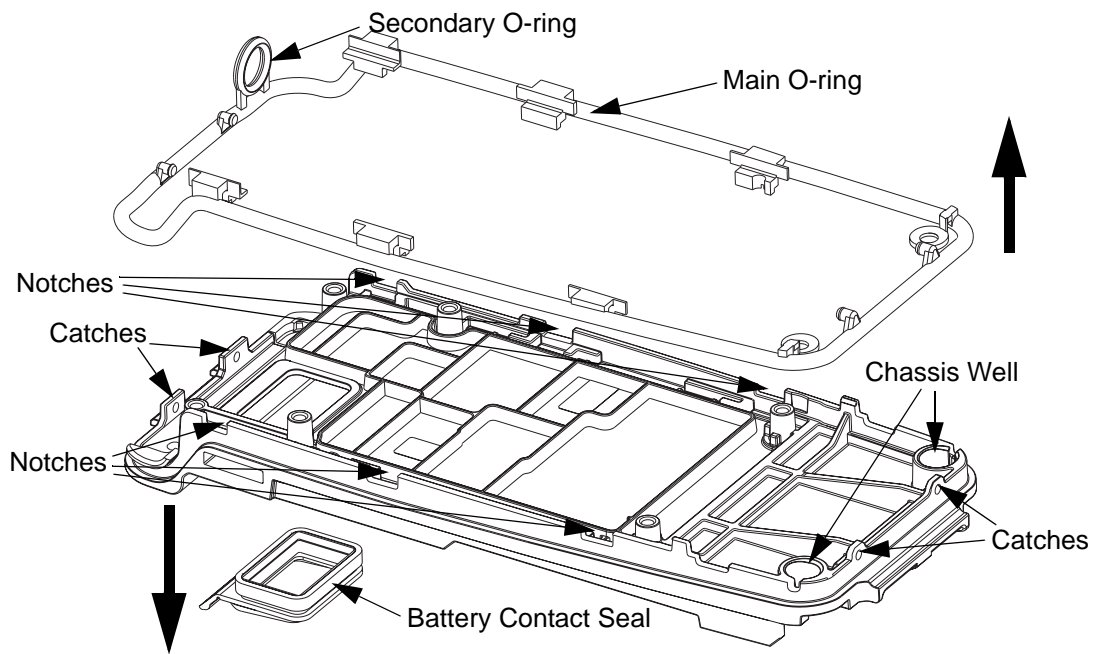


Figure 5-9. O-ring and Battery Contact Seal removal.

### 5.6.3 Speaker Disassembly

1. Remove the screws using the TORX™ T6 screwdriver.
2. Remove the speaker retainer and subsequently the speaker.

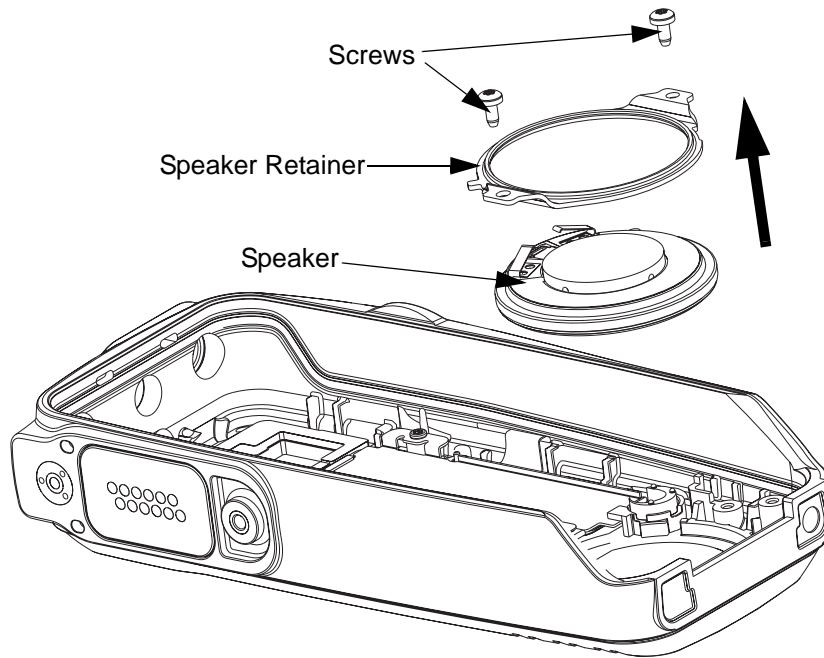


Figure 5-10. Speaker removal.

## 5.7 Radio Reassembly – Detailed



Caution

Adhere strictly to ALL reassembly procedures to ensure radio immersibility.

### 5.7.1 Speaker Reassembly

1. Place the speaker onto the front cover with the orientation tab aligned with the orientation slot on the front cover.
2. Place speaker retainer in the correct orientation.
3. Fasten the screws using TORX™ T6 screwdriver.

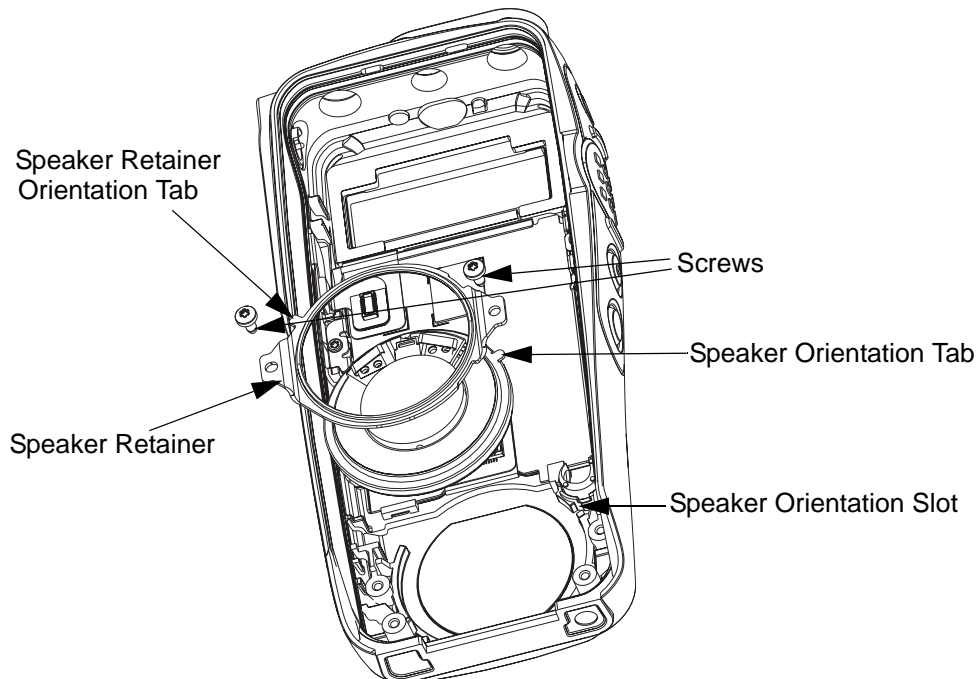


Figure 5-11. Speaker reassembly (Display Model).

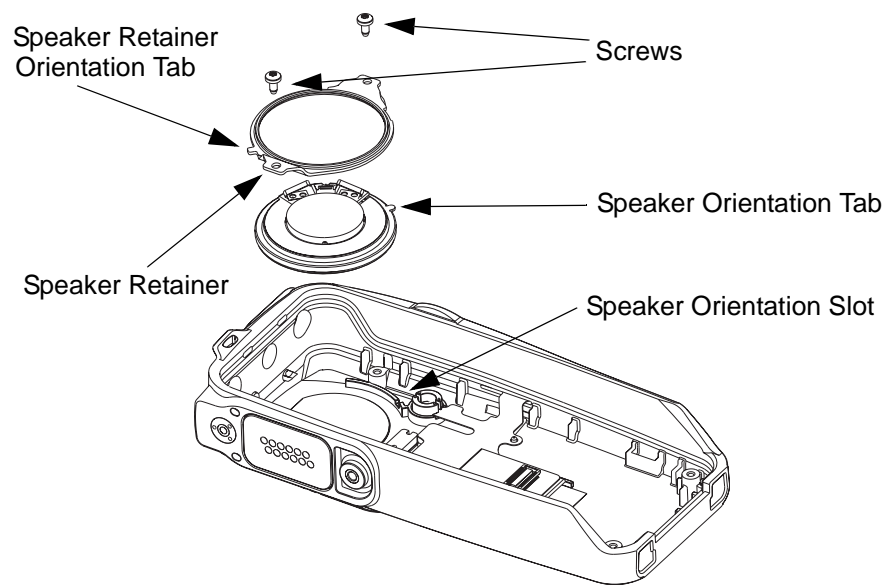


Figure 5-12. Speaker reassembly (Non-Display Model).

## 5.7.2 Chassis Reassembly

1. Fit the battery contact seal onto the battery contact slot.
2. Refer to Figure 5-13 to fit the main O-ring onto the chassis in the following sequence:
  - i. Ensure that the main O-ring is not twisted and untangle it to its actual form if needed before performing reassembly.
  - ii. Secure **A1** into the top two notches on the chassis.
  - iii. Fit the top section of the main O-ring by inserting it into the grooves at the top two corners formed by the black retainers.
  - iv. Insert **B1** into the top two catches on the chassis.
  - v. Fit the bottom section of the main O-ring around the bottom two corners of the chassis.
  - vi. Secure **A2** into the remaining four notches on the chassis.
  - vii. Insert **C** into the chassis well and push to the bottom of the well to secure it.
  - viii. Insert **B2** into the bottom two catches on the chassis.

**NOTE:** To maintain radio immersibility, it is recommended that the main O-ring be replaced although the existing one may appear undamaged. Be sure to replace the battery contact seal also if necessary.

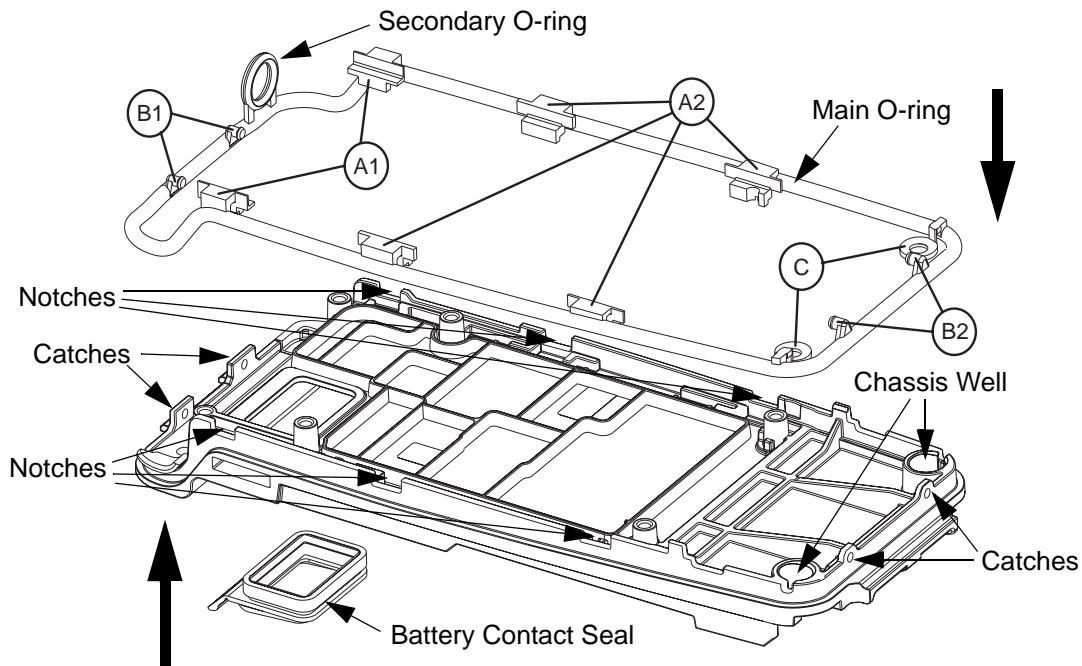
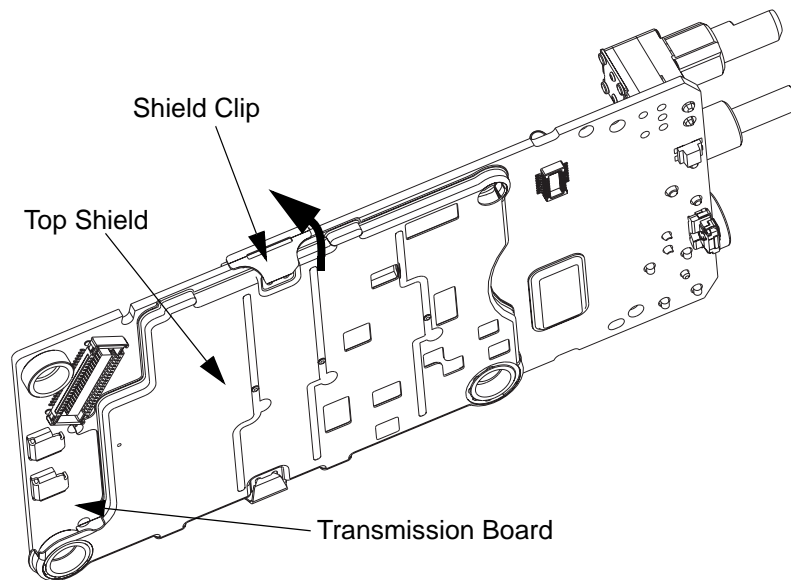


Figure 5-13. O-ring and Battery Contact Seal reassembly.

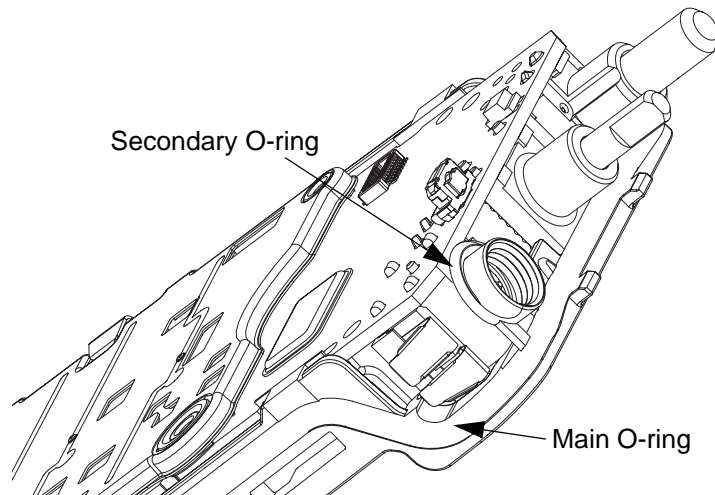


3. Hook the shield clip on the top shield slot.
4. Push against the clip towards the board until catch is securely in place.



*Figure 5-14. Shield Clip reassembly.*

5. Fit the secondary O-ring onto the antenna nut securely.



*Figure 5-15. Secondary O-ring reassembly.*

6. Place the transmission board onto the chassis.
7. Put on the interface board by connecting the board-to-board connectors between the interface and transmission board.
8. Fasten the screws using the TORX™ T6 screwdriver.

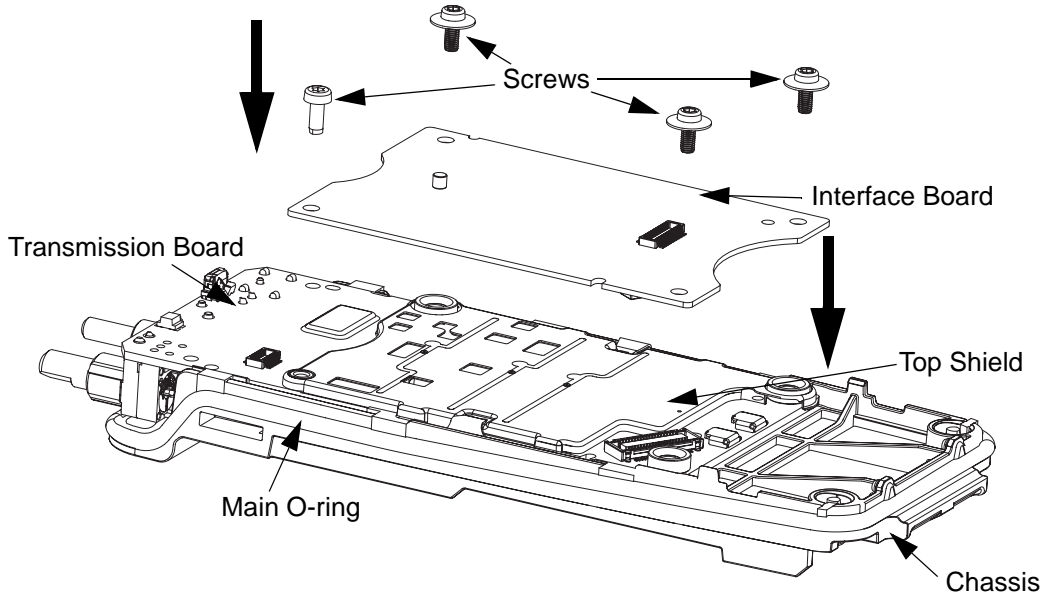


Figure 5-16. Transmission and Interface Board reassembly.

9. Place the display retainer.
10. Fasten the screws using the TORX™ T6 screwdriver.
11. Snap the display module onto the display retainer catch.

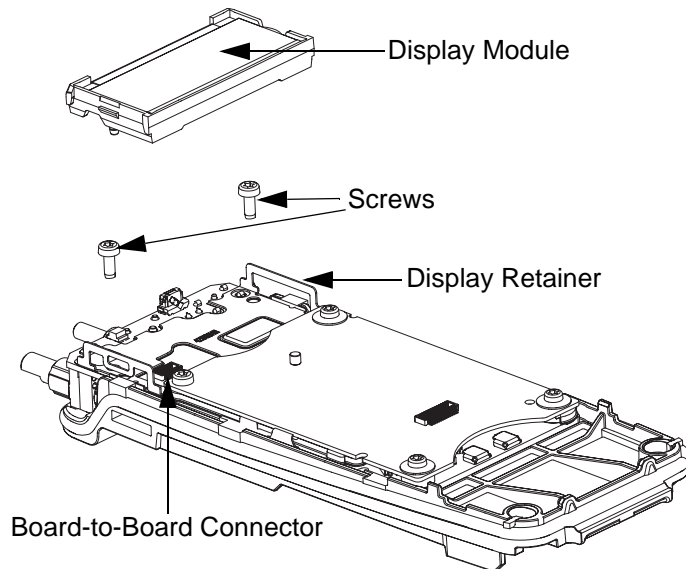


Figure 5-17. LCD Retainer and LCD Module reassembly.

### 5.7.3 Chassis and Front Cover Reassembly

1. Slide in the volume and channel shafts into the top slot.
2. Connect the board-to-board connector between the keypad flex and the transmission board.
3. Insert top chassis tabs into recesses on front cover and apply some force until tabs are fully inserted.
4. Apply some grease at the bottom portion of the main O-ring.
5. Gently push the chassis onto the front cover.

**NOTE:** Take necessary precautions while performing step 5 of See Section 5.7.3: Chassis and Front Cover Reassembly to prevent visible outward pinches of the main O-ring.

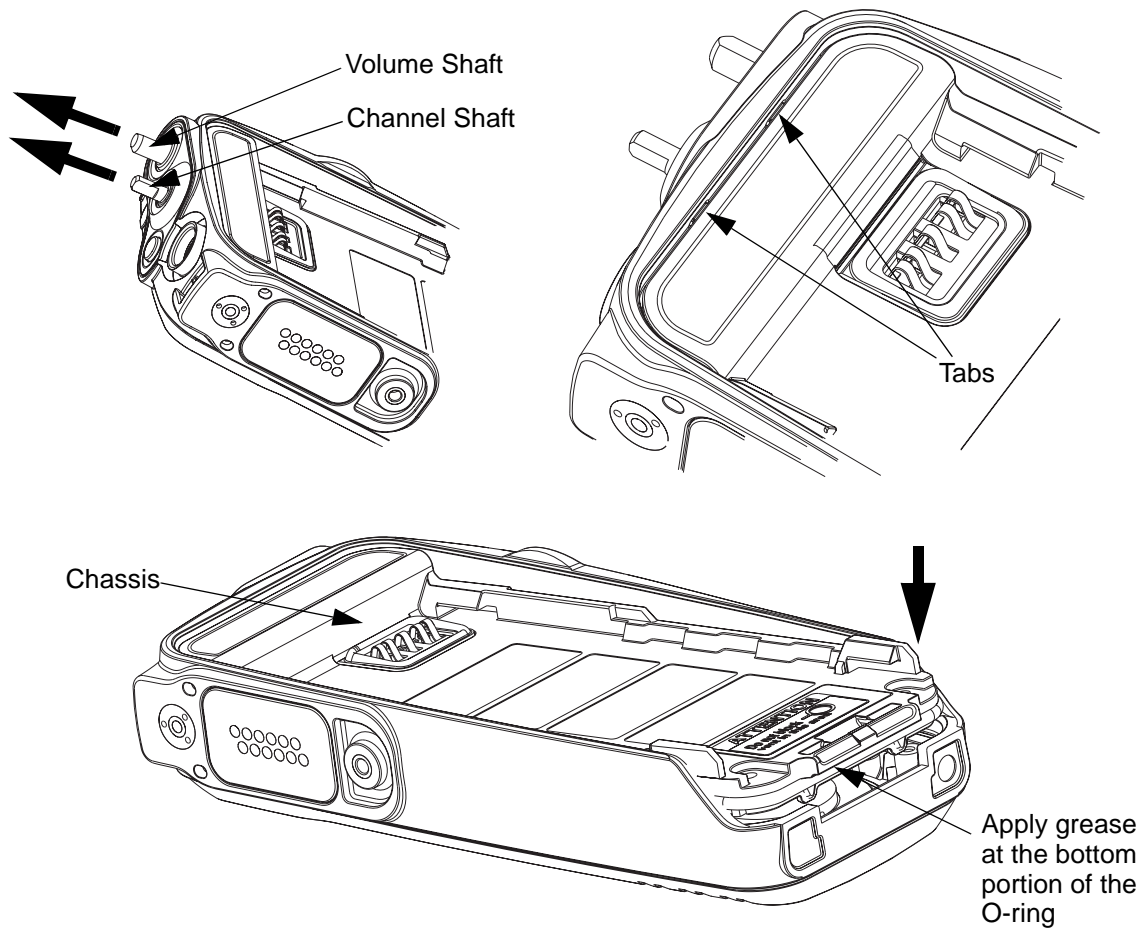


Figure 5-18. Back Cover Kit reassembly.

6. A visual inspection into the two screw holes will reveal blockage by a pinched O-ring in that area which requires the chassis to be re-inserted into the front cover. See "Chassis and Front Cover Reassembly" on page 5-17.

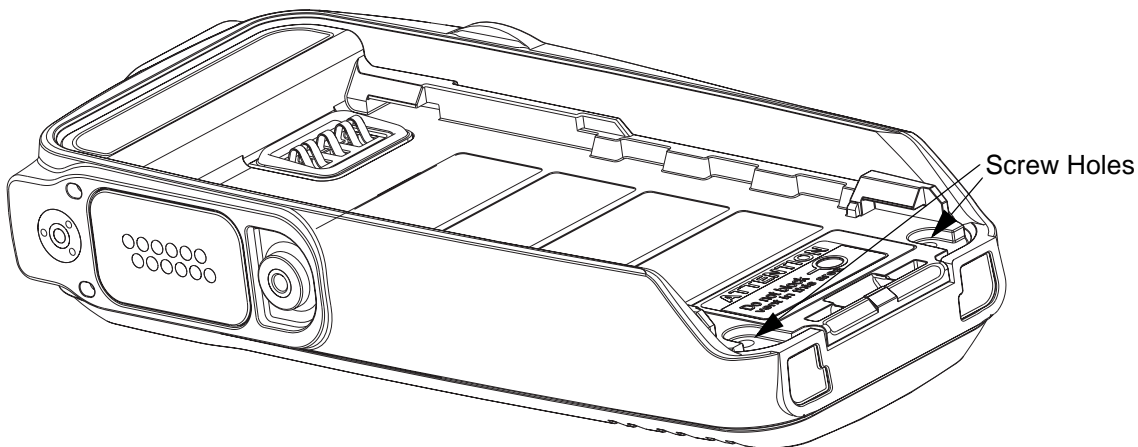


Figure 5-19. Chassis to Front Cover reassembly.

7. Fasten the screws using TORX™ T6 screwdriver.
8. Reassemble knobs.



Caution

If the antenna needs to be replaced, ensure that only MOTOTRBO antennas are used. Neglecting this would damage your radio. Refer to separate Accessory List Leaflet 6866574D04 for a list of available antennas.

## 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.

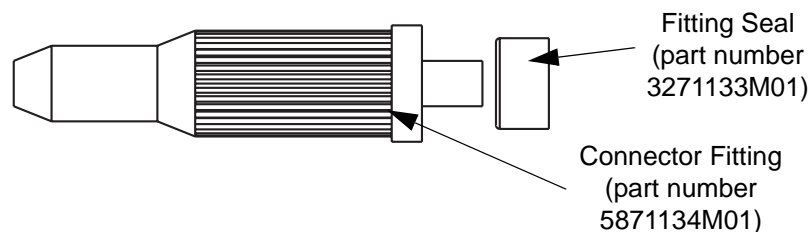


Figure 5-20. Connector Fitting - Fitting Seal Pump Connector

### 5.8.5 Pressure Pump Kit NTN4265

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

### 5.8.6 Miscellaneous Hardware

Other items needed for testing the immersibility radio include:

- Large water container
- Deionized (DI) water
- A supply of replacement parts: Main seal O-ring, Battery Contact Seal, Breathing Vent Label and Breathing Vent Membrane. (Refer to Section 5.9.1 "Display Model Exploded View and Parts List" on page 5-27 or Section 5.9.2 "Non-Display Model Exploded View and Parts List" on page 5-30.)

### 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.
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 6 in. Hg to 5.5 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 6 in. Hg to less than 5.5 in. Hg), then the radio has failed the vacuum test and the radio might leak if immersed. Additional troubleshooting of the radio will be required; complete this procedure, then go to Section 5.8.8 "Pressure Test".
7. Remove the vacuum hose and pump connector from the radio.

### 5.8.8 Pressure Test

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

To conduct the pressure test:

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

**CAUTION: Pressure any greater than 1 psig might push air around the main seal.**

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

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

7. Note all of the seal areas that show signs of leakage. Pinpoint the problem(s) to one (or more) of the following areas:
  - Front Housing
  - Chassis (Main Seal O-ring)
  - Battery Contact Seal
8. Remove the radio from the water container, and dry the radio thoroughly. Be especially careful to dry the area around the main seal to prevent contamination of the internal electronics while the unit is open.

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

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

### 5.8.9 Troubleshooting Leak Areas

Before repairing any leak, first read all of the steps within the applicable section. This will help to eliminate unnecessary disassembly and reassembly of a radio with multiple leaks. Troubleshoot only the faulty seal areas listed in Section 5.8.8 "Pressure Test" on page 5-20, and when multiple leaks exist, in the order listed.

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

#### 5.8.9.1 Front Housing

Do one or both of the following:

1. If a leak occurs at the Lens (Display Models only), Universal Connector, chassis/Housing interface, PTT button area of the housing, replace the housing. Refer to Section 5.6 "Radio Disassembly – Detailed" on page 5-5.
  - a. Remove the housing assembly from the radio.
  - b. Discard the housing assembly and main seal O-ring.
  - c. Install a new main seal O-ring around the chassis assembly according to Section 5.7.2 "Chassis Reassembly" on page 5-14.
  - d. Install a new housing assembly to the radio.
  - e. Inspect the main seal for proper seating.
  - f. Observe carefully to ensure that the main seal O-ring is not pinched between the housing and the chassis interface.
2. If the leak occurs at the control top area, remove the knobs in order to determine the leak location:
  - a. Conduct the Pressure Test.
  - b. Identify the leak location.

### 5.8.9.2 Chassis (Main Seal O-ring)

To replace the main seal O-ring:

1. Refer to Section 5.6.1 "Front Cover from Chassis Disassembly" on page 5-5, remove the chassis assembly from the radio.
2. Refer to Section 5.6.2 "Chassis Disassembly" on page 5-8, remove the Main Board from chassis.
3. Remove the main seal O-ring.
4. Inspect the seal area around the chassis for foreign material that might prevent the main seal O-ring from sealing properly.
5. Assemble a new O-ring; discard the old O-ring.
6. For detailed O-ring assembly sequence, refer to clause 2, step i. to step viii. of Section 5.7.2 "Chassis Reassembly" on page 5-14.
7. Reassemble the chassis assembly followed by installing into Front Cover. (Refer to Section 5.7 "Radio Reassembly – Detailed" on page 5-12).
8. Inspect the main seal O-ring for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing and the chassis.

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

### 5.8.9.3 Battery Contact Seal

To replace the Battery Contact Seal:

1. Refer to Section 5.6 "Radio Disassembly – Detailed" on page 5-5 to remove the Battery Contact Seal.
2. Remove the Battery Contact Seal from the Chassis.
3. Inspect the Battery Contact Seal, Chassis and surrounding areas for foreign material that might prevent the Battery Contact Seal from sealing properly.
4. Install a new Battery Contact Seal; discard the old Seal.
5. Replace a new main seal O-ring; discard the old O-ring.
6. Reassemble the chassis assembly followed by installing into Front Cover. (Refer to Section 5.7 "Radio Reassembly – Detailed" on page 5-12).
7. Inspect the main seal O-ring for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing and the chassis.

**IMPORTANT:** Both Breathing Vent Label (3371478L01) and Breathing Vent Membrane (3271570L01) need to be replaced after vacuum test, pressure test or water leakage troubleshooting.

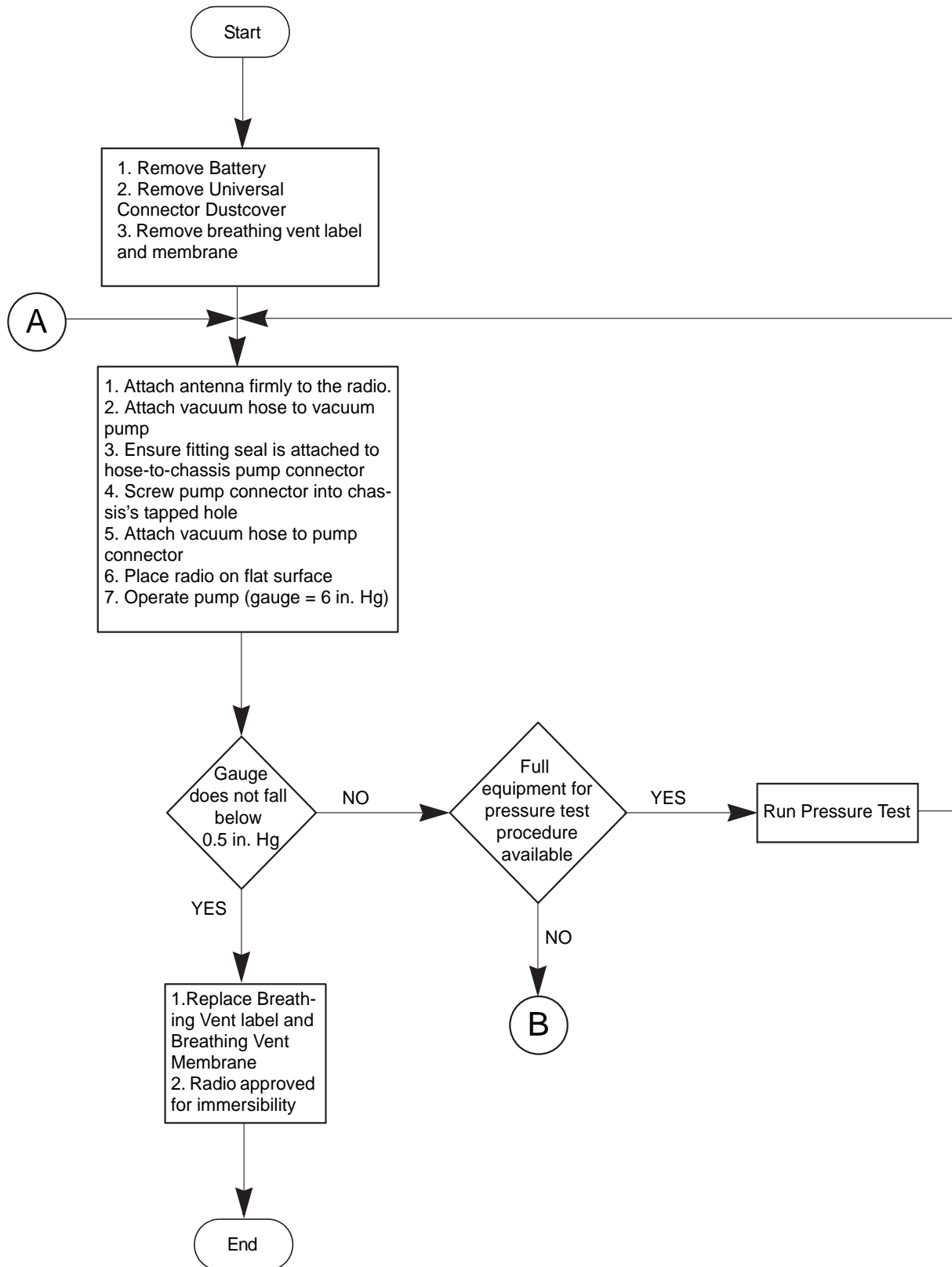


#### 5.8.9.4 Breathing Vent Membrane and Breathing Vent Label

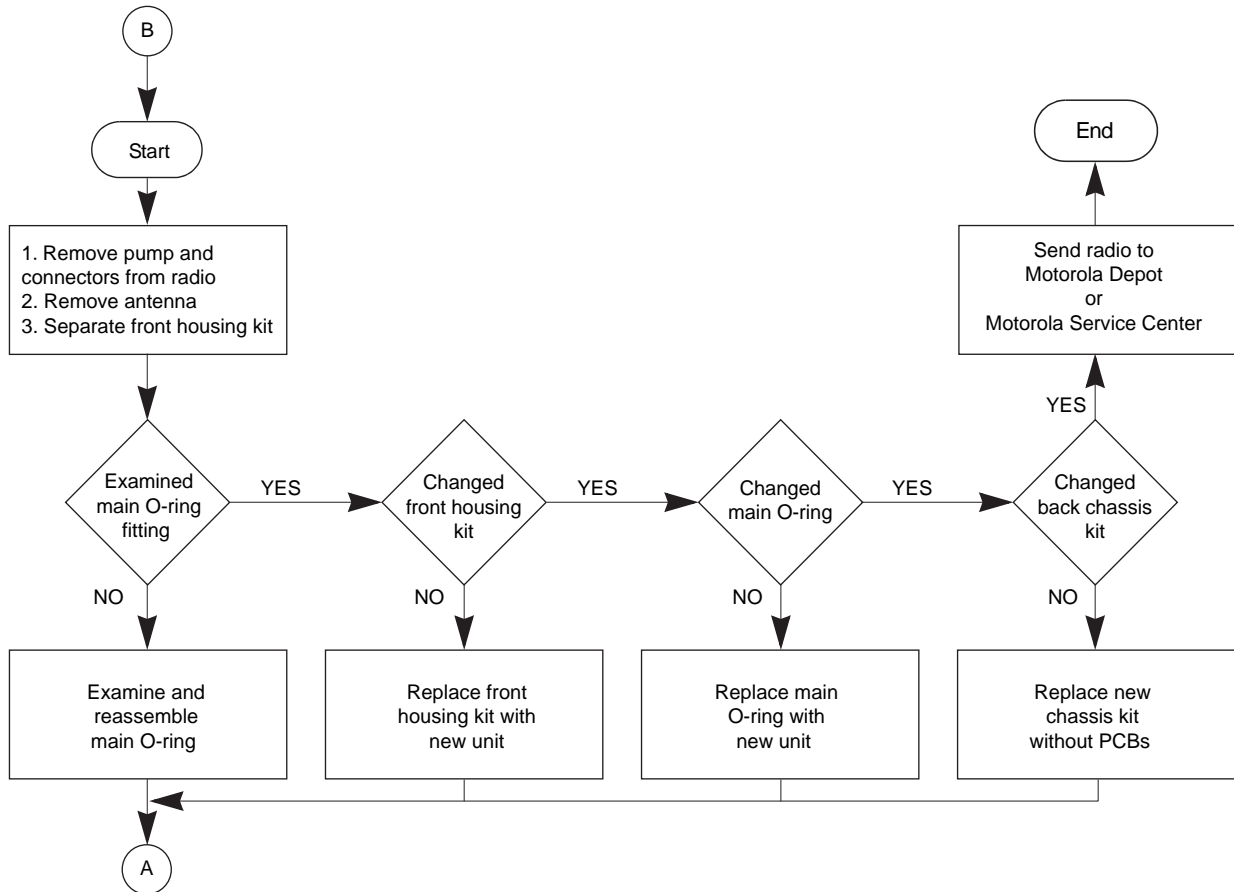
To replace the Breathing Vent Membrane and Breathing Vent Label:

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

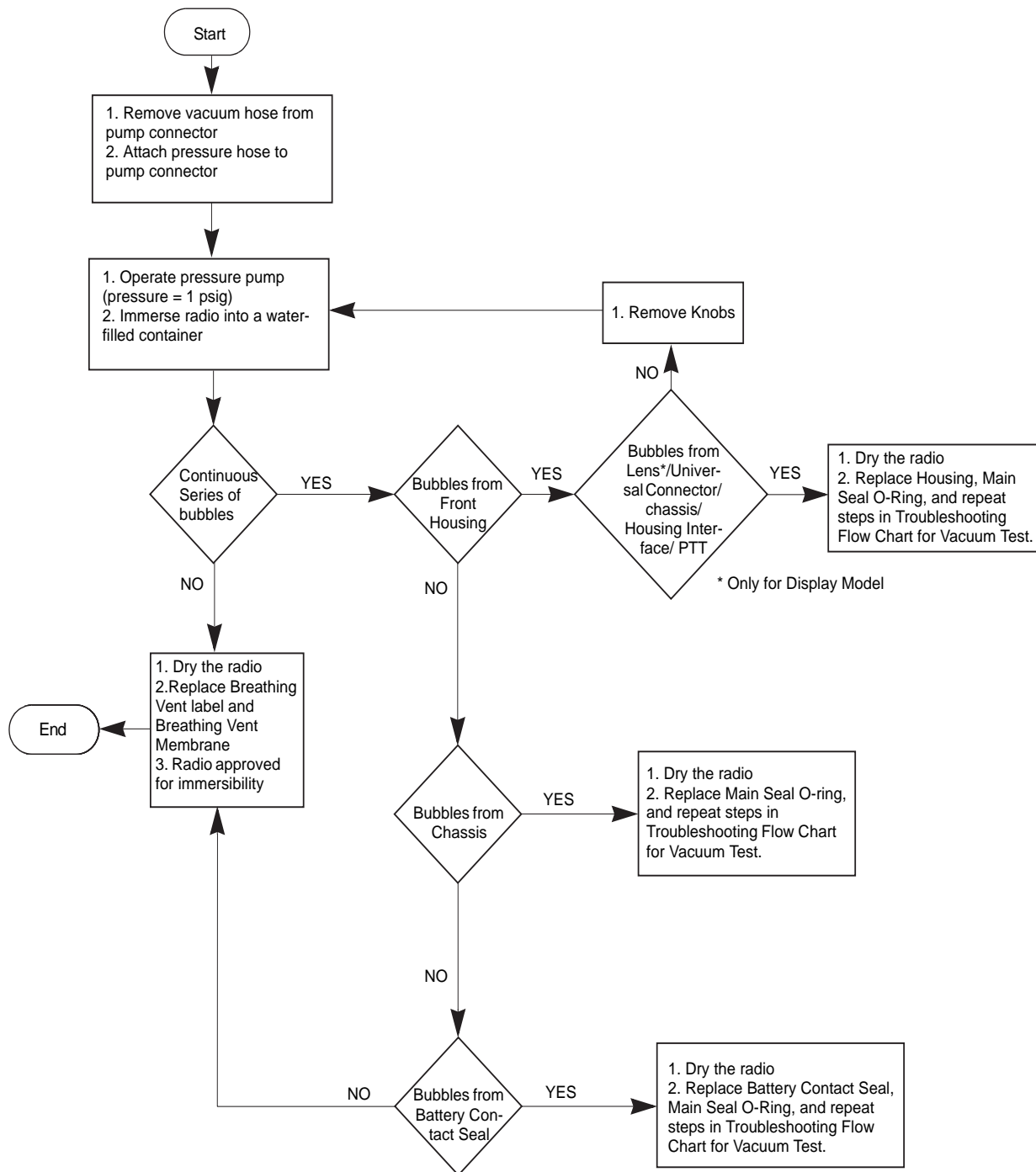
**5.8.10 Troubleshooting Charts**



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



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



**Troubleshooting Flow Chart for Pressure Test & Leakage Areas**

## 5.9 Radio Exploded Mechanical Views and Parts Lists

### 5.9.1 Display Model Exploded View and Parts List

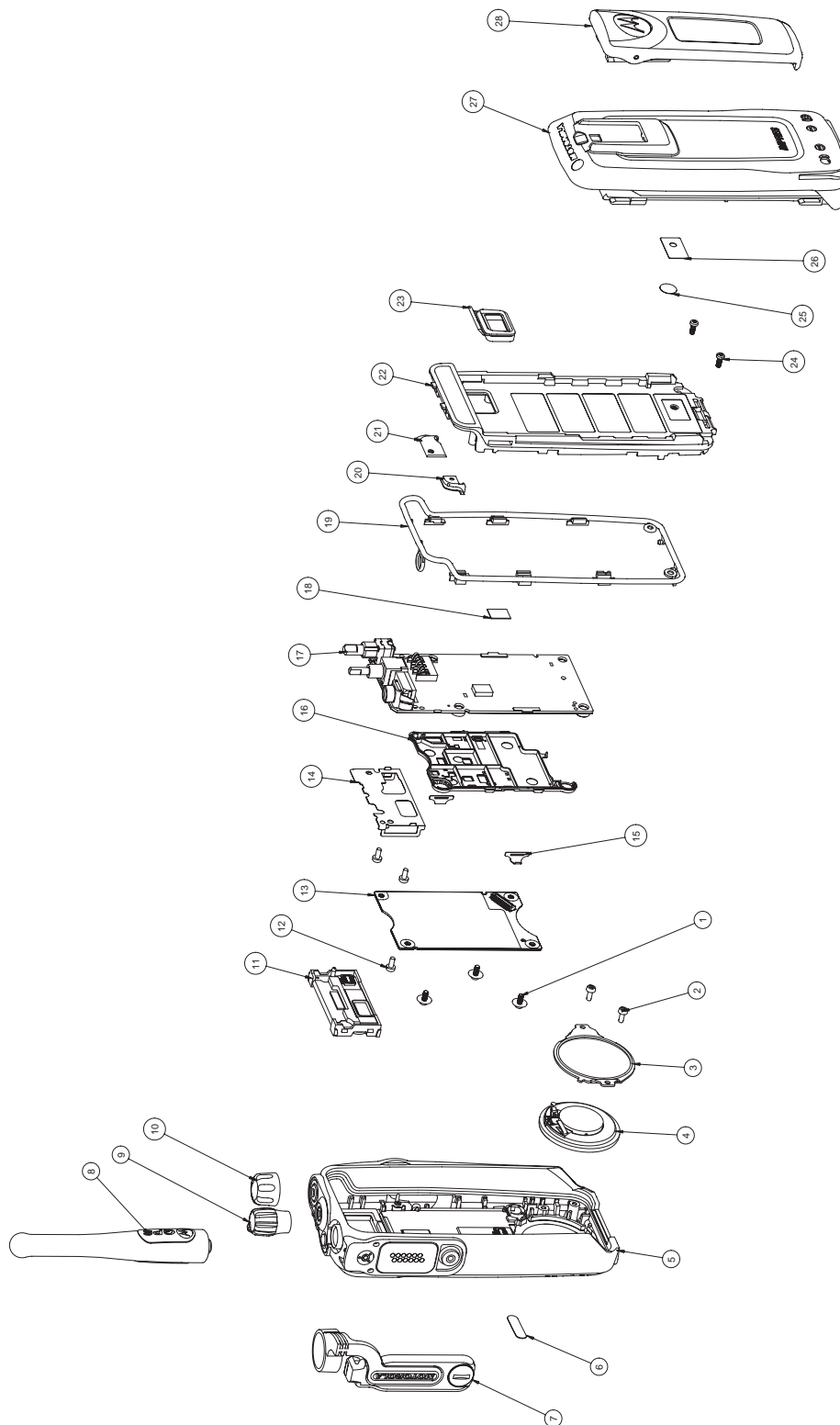


Figure 5-21. Display Model Exploded View

Table 5-3. Display Model Exploded View Parts List

Item	Description	Part Number
1	Screw with Washer	0371981L01
2	Screw, Speaker Retainer	0386434Z02
3	Retainer, Speaker	4271352L02
4	Speaker	5085798F09
5	Assembly, Front Housing	PMLN4646_
6	Nameplate for DP 3601 Nameplate for DP 3600	3371390L03 3371390L04
7	Cover, Dust	1571477L01
8	Antenna	Refer to separate Accessory List Leaf- let 6866574D04
9	Knob, Frequency	3615204H01
10	Knob, Volume	3615205H01
11	Module, Display	7215182H01
12	Screw	0386104Z04
13	Board, Interface	0104022J35
14	Retainer, Display	4215189H01
15	Clip, Shield	4271320L01
16	Shield, Can	2615156H01
17	Back Cover Kit	See Section 1.4: Model Charts
18	Pad, Thermal	7515526H01
19	O-ring, Chassis	3215181H01
20	Retainer, O-ring	4216293H01
21	Retainer, O-ring	4216292H01
22	Assembly, Chassis Molded w/ MIP Shield	0104023J31
23	Seal, Battery Contact	3215177H02
24	Screw	0316281H01
25	Seal, Pot	3271570L01

*Table 5-3. Display Model Exploded View Parts List*

<b>Item</b>	<b>Description</b>	<b>Part Number</b>
26	Label, Pot Seal	3371478L01
27	Battery	Refer to separate Accessory List Leaf- let 6866574D04
28	Belt Clip	Refer to separate Accessory List Leaf- let 6866574D04

### 5.9.2 Non-Display Model Exploded View and Parts List

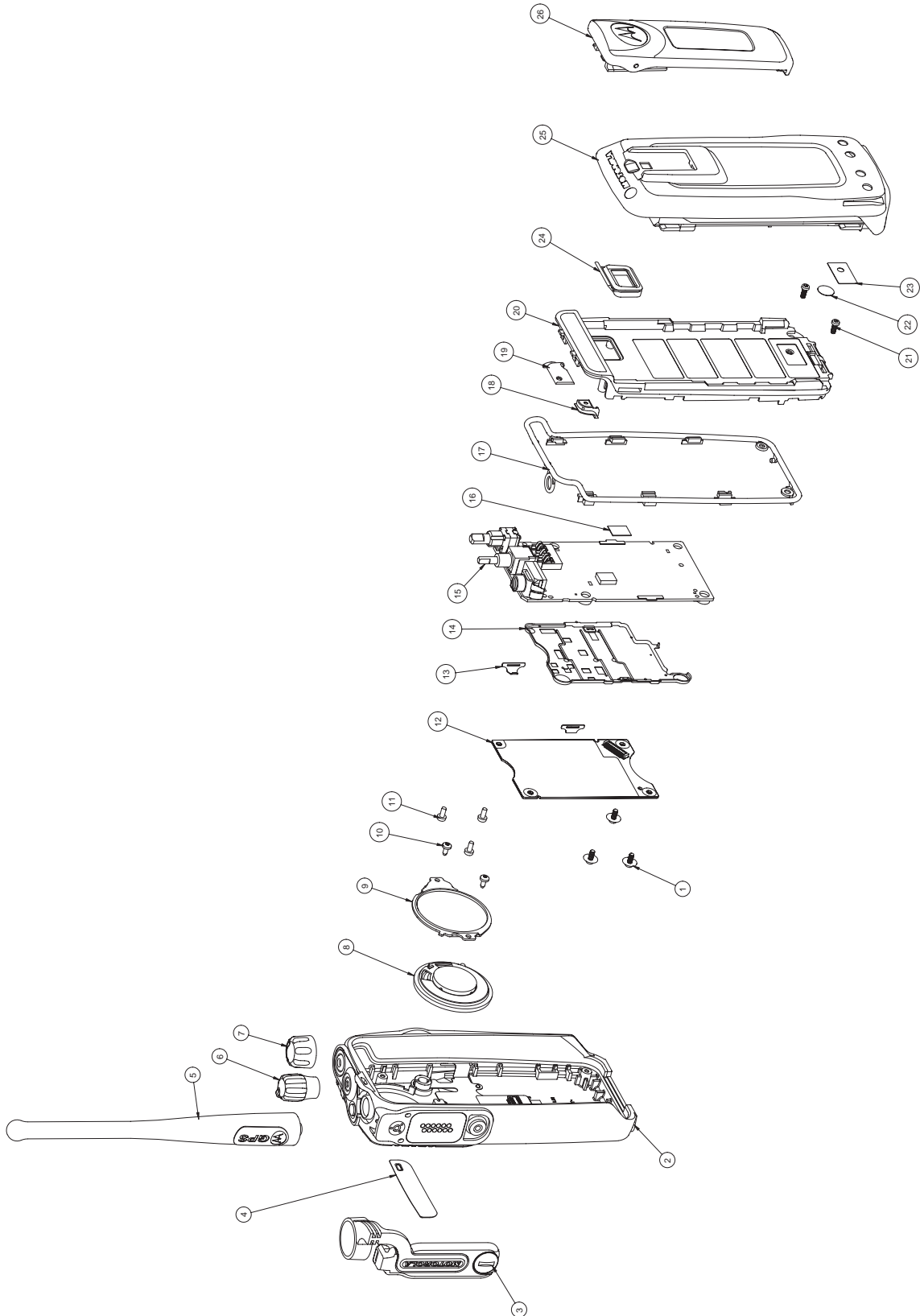


Figure 5-22. Non-Display Model Exploded View



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

Item	Description	Part Number
1	Screw with Washer	0371981L01
2	Assembly, Front Housing	PMLN4922_
3	Cover, Dust	1571477L01
4	Nameplate for DP 3401 Nameplate for DP 3400	3371391L03 3371391L04
5	Antenna	Refer to separate Accessory List Leaf- let 6866574D04
6	Knob, Frequency	3615204H01
7	Knob, Volume	3615205H01
8	Speaker	5085798F09
9	Retainer, Speaker	4271352L02
10	Screw, Speaker Retainer	0386434Z02
11	Screw	0386104Z04
12	Board, Interface	0104022J35
13	Clip, Shield	4271320L01
14	Shield, Can	2615156H01
15	Back Cover Kit	See Section 1.4: Model Charts
16	Pad, Thermal	7515526H01
17	O-Ring	3215181H01
18	Retainer, O-Ring	4216293H01
19	Retainer, O-Ring	4216292H01
20	Assembly, Chassis Molded w/ MIP Shield	0104023J31
21	Screw	0316281H01
22	Seal, Pot	3271570L01

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

Item	Description	Part Number
23	Label, Pot Seal	3371478L01
24	Seal, Battery Contact	3215177H02
25	Battery	Refer to separate Accessory List Leaf- let 6866574D04
26	Belt Clip	Refer to separate Accessory List Leaf- let 6866574D04

### 5.9.3 Torque Chart

Table 5-5 lists the various screws by part number and description, followed by the torque values in different units of measure. Torque all screws to the recommended value when assembling the radio.

Table 5-5. Torque Specifications for Screws

Part Number	Description	Driver/ Socket	Torque		
			N-m	lbs-in	kgf-cm
0386434Z02	Screw, M1.91 x 0.79 x 5.8 mm	T6 Torx	0.25	2.2	2.54
0316281H01	Screw, M2 x 0.8 x 6.3 mm	T6 Torx	0.25	2.2	2.54
0386104Z04	Screw, M2 x 0.4 x 4.5 mm	T6 Torx	0.25	2.2	2.54
0371981L01	Screw, M2 x 0.4 x 5.0 mm	T6 Torx	0.25	2.2	2.54

---

## 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 from page 1-5 to page 1-6), 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*

<b>Error Code</b>	<b>Description</b>	<b>Error Type</b>	<b>Corrective Action</b>
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.

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# Appendix A EMEA Regional Warranty, Service and Technical Support

## A.1 Warranty and Service Support

Motorola offers long term support for its products. This support includes full exchange and/or repair of the product during the warranty period, and service/ repair or spare parts support out of warranty. Any "return for exchange" or "return for repair" by an authorized Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorized Motorola Dealer.

### A.1.1 Warranty Period and Return Instructions

The terms and conditions of warranty are defined fully in the Motorola Dealer or Distributor or Reseller contract. These conditions may change from time to time and the following notes are for guidance purposes only.

In instances where the product is covered under a "return for replacement" or "return for repair" warranty, a check of the product should be performed prior to shipping the unit back to Motorola. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

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

### A.1.2 After Warranty Period

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

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

## A.2 European Radio Support Centre (ERSC)

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

Austria:	08 00 29 75 41	Italy:	80 08 77 387
Belgium:	08 00 72 471	Luxemburg:	08 00 23 27
Denmark:	80 88 05 72	Netherlands:	08 00 22 45 13
Finland:	08 00 11 49 910	Norway:	80 01 11 15
France:	08 00 90 30 90	Portugal:	08 00 84 95 70
Germany:	08 00 18 75 240	Spain:	90 09 84 902
Greece:	00 80 04 91 29 020	Sweden:	02 07 94 307
UK :	08 00 96 90 95	Switzerland:	08 00 55 30 82
Ireland:	18 00 55 50 21	Iceland:	80 08 147

Or dial the European Repair and Service Centre:  
Tel: +49 30 6686 1555

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. If a complete Motorola part number is assigned to the part, it is available from Motorola Radio Products and Solutions Organization (RPSO). If no part number is assigned, the part is not normally available from Motorola. If the part number is appended with an asterisk, the part is serviceable by Motorola Depot only. If a parts list is not included, this generally means that no user-serviceable parts are available for that kit or assembly.

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

North Europe – Stephen Woodrow  
Telephone: +44 (0) 1256 488 082  
Fax: +44 01256 488 080  
Email: CSW066@motorola.com

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

Russia and Belarus – Oleg Machnev  
Telephone: +7 495 785 0150  
Fax: +7 495 785 0185  
Email: CSA002@email.mot.com

Germany – Customer Connect Team  
Telephone: +49 (0) 30 6686 1539  
Fax: +49 (0) 30 6686 1916  
Email: cgiss.emea@europe.mot.com

Middle East and Africa – Wayne Holmes  
Telephone: +27 11 800 7922  
Fax: +27 11 800 7923  
Email: radiosupport.za@motorola.com

Italy – Ugo Gentile  
Telephone: +39 0 2822 0325  
Fax: +39 0 2822 0334  
Email: C13864@email.mot.com

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

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

## A.5 Further Assistance From Motorola

You can also contact the Customer Help Desk through the following web address.  
<http://www.motorola.com/governmentandenterprise/contactus>

## **Notes**

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# Glossary

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

Term	Definition
<b>Analog</b>	Refers to a continuously variable signal or a circuit or device designed to handle such signals.
<b>Band</b>	Frequencies allowed for a specific purpose.
<b>CPS</b>	Customer Programming Software: Software with a graphical user interface containing the feature set of a radio.
<b>Default</b>	A pre-defined set of parameters.
<b>DP</b>	Refers to Digital Professional Radio model names in the MOTOTRBO Professional Digital Two-Way Radio System.
<b>Digital</b>	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.
<b>DPL</b>	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.
<b>FCC</b>	Federal Communications Commission.
<b>Frequency</b>	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).
<b>GPIO</b>	General-Purpose Input/Output: Pins whose function is programmable.
<b>GPS</b>	Global Positioning System.
<b>IC</b>	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.
<b>IF</b>	Intermediate Frequency.
<b>kHz</b>	kilohertz: One thousand cycles per second. Used especially as a radio-frequency unit.
<b>LCD</b>	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.
<b>LED</b>	Light Emitting Diode: An electronic device that lights up when electricity is passed through it.

<b>Term</b>	<b>Definition</b>
<b>MDC</b>	Motorola Digital Communications.
<b>MHz</b>	Megahertz: One million cycles per second. Used especially as a radio-frequency unit.
<b>Paging</b>	One-way communication that alerts the receiver to retrieve a message.
<b>PC Board</b>	Printed Circuit Board. Also referred to as a PCB.
<b>PL</b>	Private-Line Tone Squelch: A continuous sub-audible tone that is transmitted along with the carrier.
<b>Programming Cable</b>	A cable that allows the CPS to communicate directly with the radio using USB.
<b>Receiver</b>	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.
<b>Repeater</b>	Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).
<b>RF</b>	Radio Frequency: The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).
<b>RX</b>	Receive.
<b>Signal</b>	An electrically transmitted electromagnetic wave.
<b>Spectrum</b>	Frequency range within which radiation has specific characteristics.
<b>Squelch</b>	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.
<b>TOT</b>	Time-out Timer: A timer that limits the length of a transmission.
<b>TPL</b>	Tone Private Line.
<b>Transceiver</b>	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
<b>Transmitter</b>	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
<b>TX</b>	Transmit.
<b>UHF</b>	Ultra-High Frequency.
<b>USB</b>	Universal Serial Bus: An external bus standard that supports data transfer rates of 12 Mbps.
<b>VIP</b>	Vehicle Interface Port.



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