

MOTOTRBO™ TWO-WAY RADIOS

# XPR 7550 IS Series

## BASIC

## SERVICE MANUAL

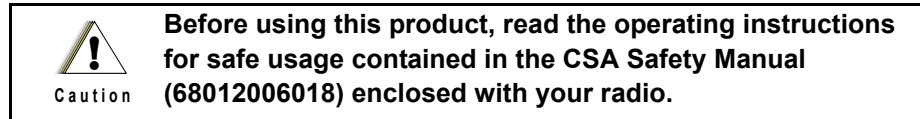




# Foreword

This manual covers all models of the XPR™ 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 testing, programming and maintenance of the radios but does not cover opening the radios 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/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 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/governmentandenterprise>

## Intrinsically Safe Radio Information

**Hazardous Location Safety Instruction and Approved Accesories Listing for Radio Models below:**

- XPR 7550 IS (NAG Full Keypad Model)

**The radio listed above is certified for:**

- Ambient temperature range:  $-30^{\circ}\text{C} \leq T_{\text{amb}} \leq 60^{\circ}\text{C}$
- Ingress protection level: IP67

## Operational Cautions for Intrinsic Safe Equipment

Radios must ship from the Motorola manufacturing facility with the potentially explosive atmosphere capability and the intrinsic safety approval labelling (FM, UL, CSA). Radios will not be upgraded to this capability and labeled once they have been shipped to the field. A modification changes the radio's hardware from its original design configuration. Modifications can only be made by the original product manufacturer.



### Caution

- Do not operate radio communications equipment in a potentially explosive atmosphere unless it is a type especially qualified (for example, FM, UL, CSA approved). An explosion or fire may result.
- Do not operate a radio unit that has been approved as intrinsically safe product in a potentially explosive atmosphere if it has been physically damaged (for example, cracked housing). An explosion or fire may result.
- Do not replace or charge batteries in a potentially explosive atmosphere. Contact sparking may occur while installing or removing batteries and cause an explosion or fire.
- Do not replace or change accessories in a potentially explosive atmosphere. Contact sparking may occur while installing or removing accessories and cause an explosion or fire.
- Turn the radio off before removing or installing a battery or accessory.
- Do not disassemble an intrinsically safe product in any way that exposes the internal circuits of the radio.
- Failure to use an intrinsically safe approved battery or Approved accessories specifically approved for the radio unit may result in the dangerously unsafe condition of an unapproved radio combination being used in a hazardous location.
- Unauthorized or incorrect modification of the intrinsically safe approved Product will negate the approval rating of the product.
- Incorrect repair or relabeling of any intrinsically safe Agency-approved radio could adversely affect the Approval rating of the radio.
- Use of a radio that is not intrinsically safe in a potentially explosive atmosphere could result in serious injury or death.

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## Notes

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## Document History

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

<b>Edition</b>	<b>Description</b>	<b>Date</b>
68009608001-A	Initial Release	Mar 2013
68009608001-B	Updated frequency and volume knob part number	Apr. 2013

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## 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
Product Safety and RF Exposure .....	<b>6864117B25</b>

I

# Chapter 1 Introduction

## 1.1 Notations Used in This Manual

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

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



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



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

## 1.2 Radio Description

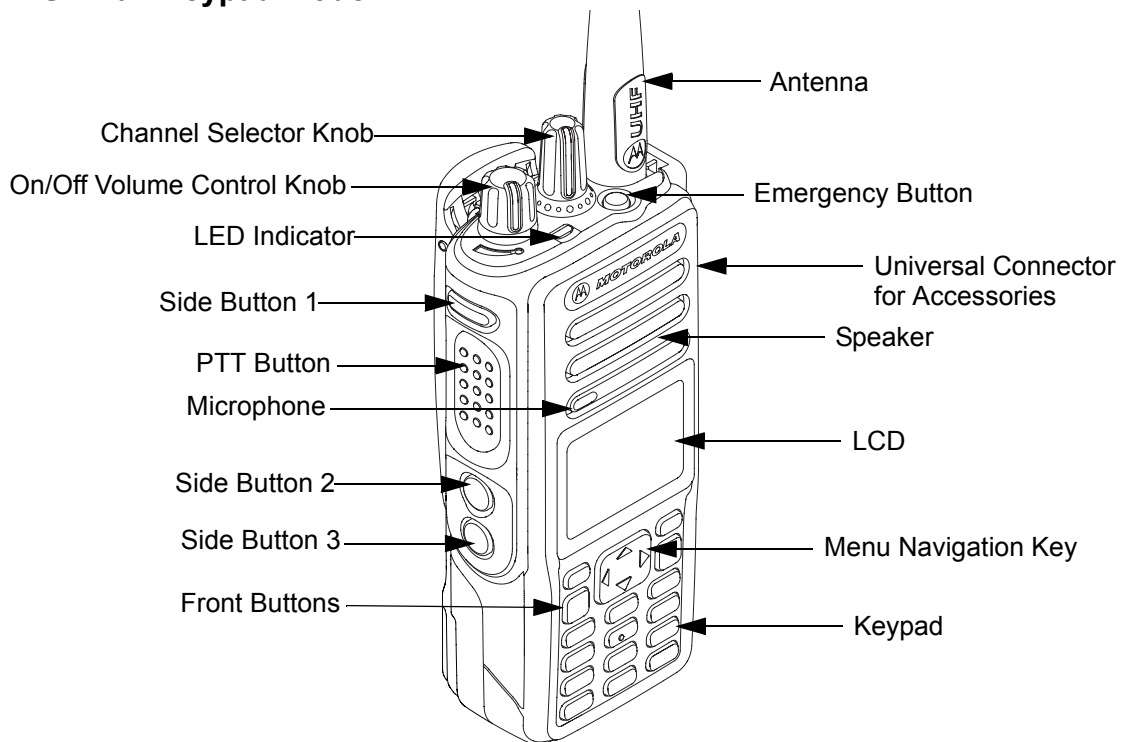
The XPR™ series portable radios are available in the following frequency ranges and power levels.

*Table 1-1. Radio Frequency Ranges and Power Levels*

Frequency Band	Bandwidth	Power Level
VHF	136–174 MHz	5 Watt
UHF	403–470 MHz	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 CSA Full Keypad Model



*Figure 1-1. CSA Full 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.
- **LCD (Liquid Crystal Display):**
  - 132x90 highly transfective color 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).

## 1.3 .Portable Radio Model Numbering Scheme

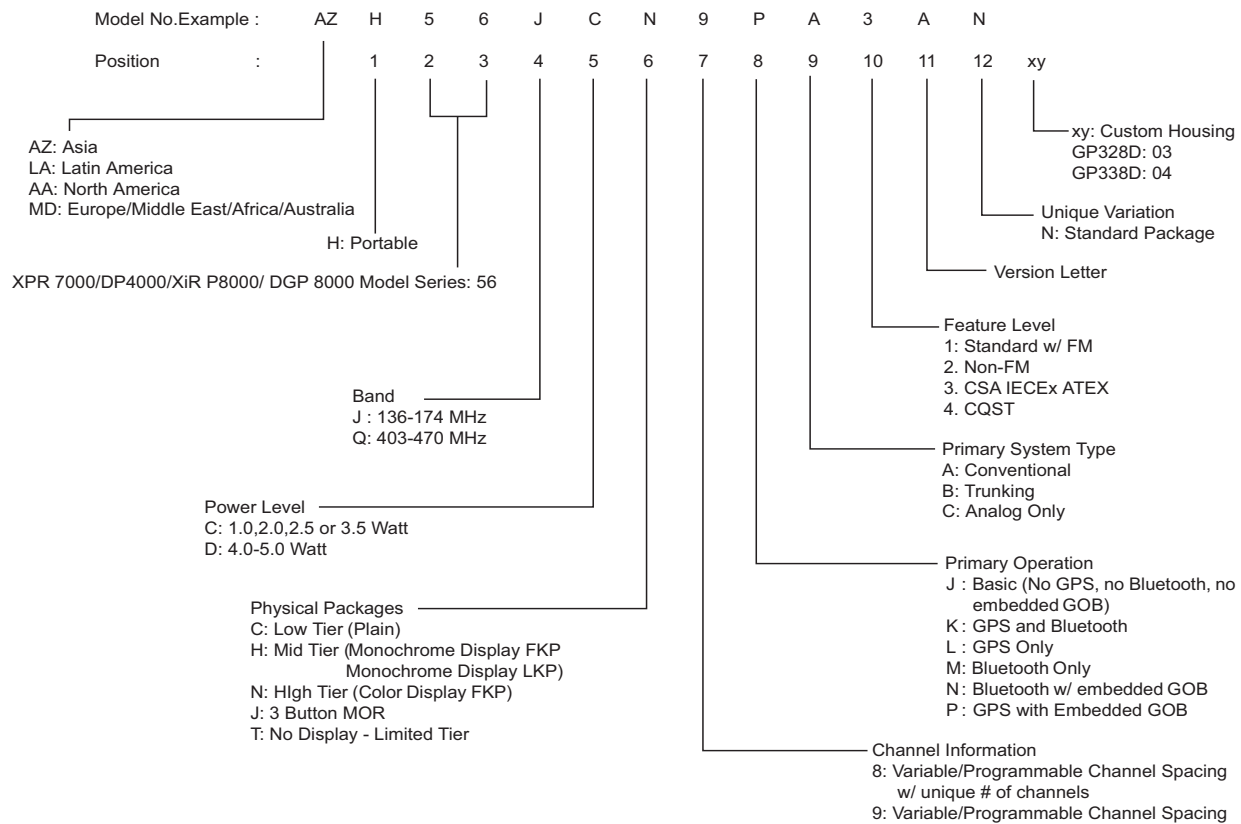


Figure 1-2. Portable Radio Model Numbering Scheme

## 1.4 Model Charts

### 1.4.1 Model Charts NAG (VHF & UHF)

<b>XPR 7000 Series, CSA, VHF, 136–174 MHz</b>		
<b>Model</b>		<b>Description</b>
AAH56JDN9PA3AN		XPR 7550 IS (136–174 MHz), 5W, CSA MOTOTRBO Full Keypad Portable with GPS, GOB
	<b>Item</b>	<b>Description</b>
X	PMAD4067_	GPS Helical Antenna (136–147 MHz)
X	PMAD4068_	GPS Helical Antenna (147–160 MHz)
X	PMAD4069_	GPS Helical Antenna (160–174 MHz)
X	NNTN8386_	MOTOTRBO CSA 157 Lilon HiCap Battery, 2075 mAH
X	54012340001	XPR 7550 IS Nameplate
X	36012024001	Knob, Volume
X	36012025001	Knob, Frequency
X	54012264001	Logo, Label

<b>XPR 7000 Series, CSA, UHF, 403–470 MHz</b>		
<b>Model</b>		<b>Description</b>
AAH56QDN9PA3AN		XPR 7550 IS (403–470 MHz), 4W, CSA MOTOTRBO Full Keypad Portable with GPS, GOB
	<b>Item</b>	<b>Description</b>
X	PMAE4018_	GPS Folded Monopole Antenna (403–433 MHz)
X	PMAE4024_	GPS Folded Monopole Antenna (430–470 MHz)
X	PMAE4023_	GPS Stubby Antenna (430–470 MHz)
X	NNTN8386_	MOTOTRBO CSA 157 Lilon HiCap Battery, 2075 mAH
X	54012340001	XPR 7550 IS Nameplate
X	36012024001	Knob, Volume
X	36012025001	Knob, Frequency
X	54012264001	Logo, Label

## 1.5 Specifications CSA

General	Full Keypad
Channel Capacity	1000
Frequency	VHF: 136 – 174 MHz UHF: 403 – 470 MHz
Dimensions (HxWxT) w/ Li-ion battery	138.5 x 56.7 x 39.8 mm
Weight (with Li-ion battery)	482.5 g
Power Supply	7.5 V nominal
FCC Description	UHF: ABZ99FT4095 VHF: ABZ99FT3093
IC Description	UHF: 109AB-99FT4095 VHF: 109AB-99FT3093
Average battery life at 5/5/90 duty cycle with battery saver enabled in carrier squelch and transmitter in high power.	
Li-ion Battery 2075mAH (Typical)	Analog : 12 hrs Digital : 16 hrs
Li-ion Battery 1800mAH (Minimum)	Analog : 10 hrs Digital : 13.5 hrs

**NOTE** Weight can have 5% margin of error

**Factory Mutual Approval**

XPR 7550 IS radio models, intrinsically safe, when properly equipped with the battery NNTN8386\_ for, Division 1, Class I, Groups A, B, C, D, Class II, Groups E, F, G, and Class III T4.

Receiver	Full Keypad
Frequencies	VHF: 136 – 174MHz UHF: 403 – 470 MHz
Channel Spacing	12.5 kHz/ 20 kHz/ 25 kHz
Frequency Stability (-30°C to +60°C)	+/-0.5 ppm
Analog Sensitivity (12 dB SINAD)	0.3 µV
Digital Sensitivity (5% BER)	0.25 µV
Intermodulation (TIA603C)	70 dB
Adjacent Channel Selectivity TIA603 TIA603C	60 dB @ 12.5 kHz, 70 dB @ 20 kHz/ 25 kHz 45 dB @ 12.5 kHz, 70 dB @ 20 kHz/ 25 kHz
Spurious Rejection (TIA603C)	70 dB
Rated Audio	0.5 W
Audio Distortion @ Rated Audio	5%
Hum and Noise	-40 dB @ 12.5 kHz -45 dB @ 20 kHz/ 25 kHz
Audio Response	TIA603C
Conducted Spurious Emission (TIA603D)	-57 dBm

Transmitter	Full Keypad
Frequencies	VHF: 136 – 174 MHz UHF: 403 – 470 MHz
Channel Spacing	12.5 kHz/ 20 kHz/ 25 kHz
Frequency Stability (-30°C to +60°C)	+/-0.5 ppm
Power Output (High Power)  (Low Power)	VHF: 5 W UHF: 4 W  VHF/UHF: 1W
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	TIA603C
Audio Distortion	3%
FM Modulation	12.5 kHz: 11K0F3E 25 kHz: 16K0F3E
4FSK Digital Modulation	12.5 kHz Data Only: 7K60F1D & 7K60FXD 12.5 kHz Data & Voice: 7K60F1E & 7K60FXE Combination of 12.5 kHz Voice and Data: 7K60F1W
Digital Vocoder Type	AMBE+2™
Digital Protocol	ETSI-TS102361-1 ETSI-TS102361-2 ETSI-TS102361-3

VHF Self-Quieten Frequencies
139.200 +/- 10 KHz
144.000 +/- 10 KHz
148.800 +/- 10 KHz
151.000 +/- 10 KHz
151.740 +/- 10 KHz
153.600 +/- 10 KHz
158.400 +/- 10 KHz
163.200 +/- 10 KHz
168.000 +/- 10 KHz
171.900 +/- 10 KHz
172.800 +/- 10 KHz

UHF Self-Quieten Frequencies
403.200 ± 10 KHz
408.000 ± 10 KHz
412.800 ± 10 KHz
416.000 ± 10 KHz
422.400 ± 10 KHz
432.000 ± 10 KHz
440.000 ± 10 KHz
441.600 ± 10 KHz
449.550 ± 10 KHz
451.200 ± 10 KHz
456.000 ± 10 KHz
460.800 ± 10 KHz
468.000 ± 10 KHz

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

Military Standards										
Applicable MIL-STD	810C		810D		810E		810F		810G*	
	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Procedures
Low Pressure	500.1	I	500.2	II	500.3	II	500.4	II	500.5	II
High Temperature	501.1	I, II	501.2	I/A1, II/A1	501.3	I-A1, II/A1	501.4	I/Hot, II/Hot	501.5	I/A1, II
Low Temperature	502.1	I	502.2	I/C3, II/C1	502.3	I-C3, II/C1	502.4	I-C3, II/C1	502.5	I, II
Temperature Shock	503.1	-	503.2	I/A1/C3	503.3	I/A1/C3	503.4	I	503.5	I-C
Solar Radiation	505.1	II	505.2	I	505.3	I	505.4	I	505.5	I-A1
Rain	506.1	I, II	506.2	I, II	506.3	I, II	506.4	I, III	506.5	I, III
Humidity	507.1	II	507.2	II	507.3	II	507.4	—	507.5	II
Salt fog	509.1	-	509.2	-	509.3	—	509.4	—	509.5	—
Dust	510.1	I	510.2	I	510.3	I	510.4	I	510.5	I
Vibration	514.2	VIII/F, Curve-W	514.3	I/10, II/3	514.4	I/10, II/3	514.5	I/24	514.6	II/5
Shock	516.2	I, II	516.3	I, IV	516.4	I, IV	516.5	I, IV	516.6	I, IV, VI

**NOTE** \*Tested to MIL standard G which supersedes previous version

Environmental Specifications	
*Operating Temperature	-30 °C to +60 °C
Storage Temperature	-40 °C to +85 °C
Thermal Shock	Per MIL-STD
Humidity	Per MIL-STD
ESD	IEC 61000-4-2 Level 3
Dust and Water Intrusion	IEC 60529 -IP67

\* Operating temperature specification with Li-ion battery is -10 °C to +60 °C.

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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 3920 ( <a href="http://www.aeroflex.com">www.aeroflex.com</a> ),	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 ( <a href="http://www.fluke.com">www.fluke.com</a> )	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 ( <a href="http://www.agilent.com">www.agilent.com</a> ), Ramsey RSG1000B ( <a href="http://www.ramseyelectronics.com">www.ramseyelectronics.com</a> ), or equivalent	Receiver measurements
Oscilloscope *	2 Channel 50 MHz Bandwidth 5 mV/div to 20 V/div	Leader LS8050 ( <a href="http://www.leaderusa.com">www.leaderusa.com</a> ), Tektronix TDS1001b ( <a href="http://www.tektronix.com">www.tektronix.com</a> ), or equivalent	Waveform measurements
Power Meter and Sensor *	5% Accuracy 100 MHz to 500 MHz 50 Watts	Bird 43 Thruline Watt Meter ( <a href="http://www.bird-electronic.com">www.bird-electronic.com</a> ) or equivalent	Transmitter power output measurements
RF Millivolt Meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 92EA ( <a href="http://www.boonton.com">www.boonton.com</a> ) or equivalent	RF level measurements
Power Supply	0 V to 32 V 0 A to 20 A	B&K Precision 1790 ( <a href="http://www.bkprecision.com">www.bkprecision.com</a> ) or equivalent	Voltage supply

## 2.2 Service Aids

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

*Table 2-2. Service Aids*

Motorola Part No.	Description	Application
RLN4460_	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.**
RVN5115_	Customer Programming Software on DVD-ROM - NAG	Allows servicer to program radio parameters, tune and troubleshoot radios.
PMKN4012B*	Portable Programming Cable	This cable connects the radio to a USB port for radio programming and data applications.
PMKN4013C*	Portable Programming, Testing & Alignment Cable	This cable connects the radio to a USB port for radio programming, testing and alignment.
5880384G68	DMR SMA to BNC RF Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
PMLN6430_	Battery Eliminator	Connects to radio via battery eliminator cable.

\* Earlier versions of programming cables will not work with the radio.

\*\* Load selection is set to MX, no external load is required.

## 2.3 Programming, Testing and Alignment Cable

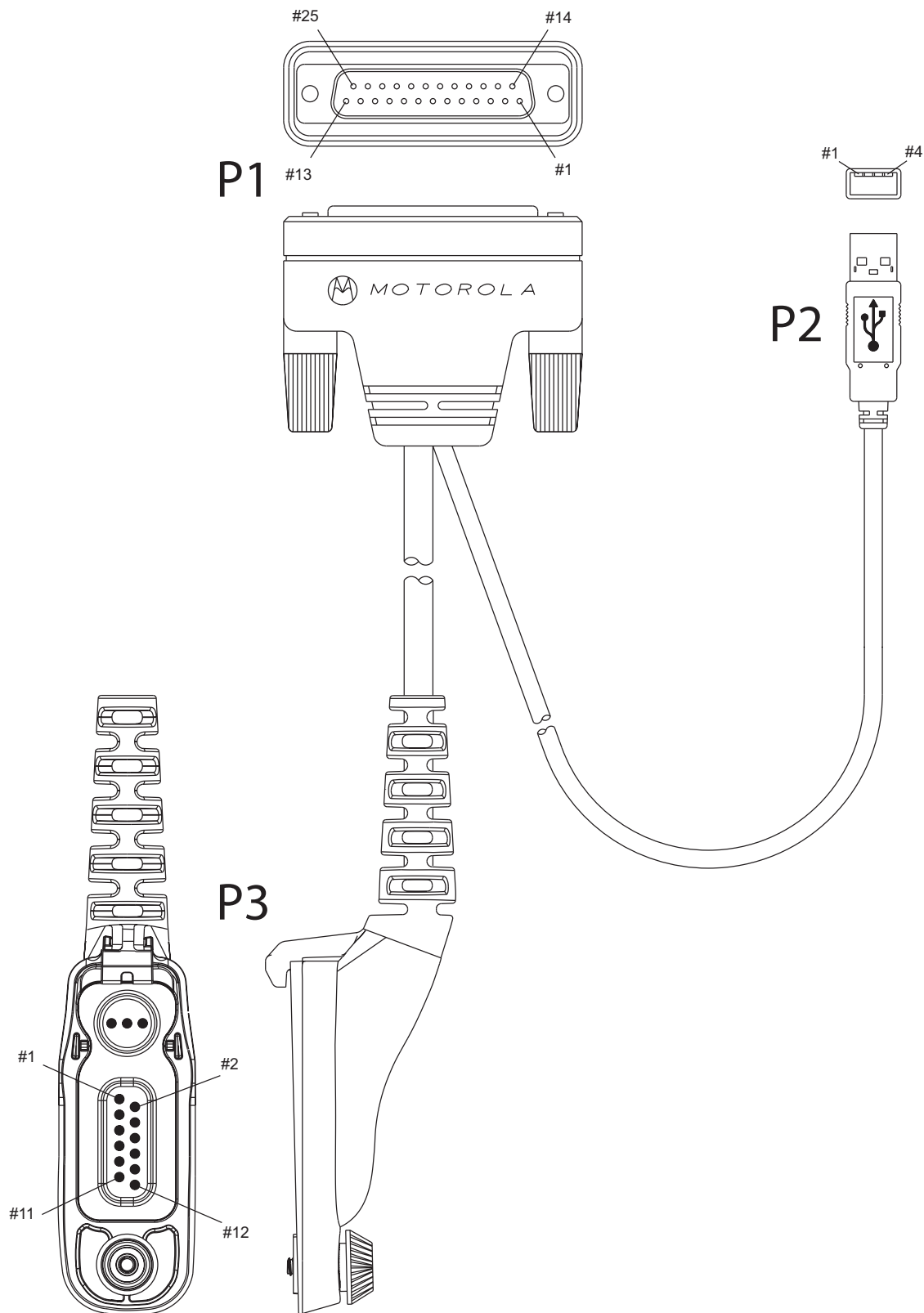


Figure 2-1. Programming, Testing and Alignment Cable

Table 2-3. Pin Configuration of Side Connector

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

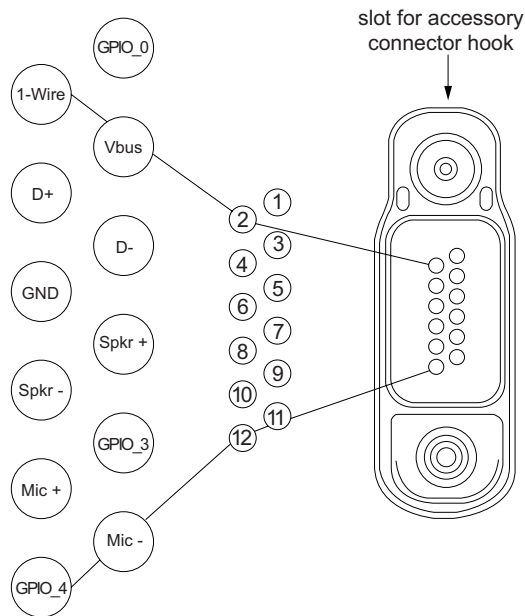


Figure 2-2. Pin Layout of Side Connector

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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.

 WARNING	<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 16 as described in Table 3-4. The radio beeps in each position.

Table 3-4. CSA Test Frequencies

Channel Selector Switch Position	Test Channel	VHF	UHF
1 Low Power 9 High Power	TX#1 RX#1	136.075	403.025
2 Low Power 10 High Power	TX#2 RX#2	143.575	414.225
3 Low Power 11 High Power	TX#3 RX#3	146.575	425.425
4 Low Power 12 High Power	TX#4 RX#4	155.575	436.525
5 Low Power 13 High Power	TX#5 RX#5	161.575	447.825
6 Low Power 14 High Power	TX#6 RX#6	167.575	459.025
7 Low Power 15 High Power	TX#7 RX#7	173.975	469.975
8 Low Power 16 High Power	TX#8 RX#8	174.000	—

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 $\pm 201\text{Hz}$ for UHF  $\pm 68\text{Hz}$ for VHF
Power RF	As above	As above	As above	Low Power: 1 W (VHF/UHF) High Power: 4W (UHF) 5W (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: $\geq 4.0\text{ kHz}$ but $\leq 5.0\text{ kHz}$ (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: $\geq 4.0\text{ kHz}$ but $\leq 5.0\text{ kHz}$ (25 kHz Ch Sp)
TPL Modulation	As above 4th channel test frequency* BW to narrow	TEST MODE, Test Channel 4 TPL	As above	Deviation: $\geq 500\text{Hz}$ but $\leq 1000\text{Hz}$ (25 kHz Ch Sp).
RF Power	DMR mode. Slot 1 Power and Slot 2 Power	TEST MODE, Digital mode, transmit without modulation	Key up radio without modulation using Tuner	TTR Enable is needed and IFR to be set to trigger mode with signal level $\sim 1.5\text{V}$
FSK Error	DMR mode. FSK error	TEST MODE, Digital mode, transmit with 0153 test pattern	Key up radio with 0513 test pattern modulation using Tuner	Not Exceed 5%

*Table 3-5. Transmitter Performance Checks*

Test Name	Communications Analyzer	Radio	Test Set	Comments
Magnitude Error	DMR mode. Magnitude error	As above	As above,	Not Exceed 1%.
Symbol Deviation	DMR mode. Symbol deviation	As above	As above	Symbol Deviation should be within 648Hz +/-10% and 1944Hz +/-10%
Transmitter BER	DMR mode	As above	As above	Transmitter BER should be 0%

\* See Table 3-4

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 $\pm 201\text{Hz}$ for UHF  $\pm 68\text{Hz}$ for VHF
Rated Audio	Mode: GEN Output level: 1.0mV RF 6th channel test frequency* Mod: 1kHz tone at 3kHz deviation Monitor: DVM: AC Volts	TEST MODE Test Channel 6 carrier squelch	Load selection is set to MX, No External load is required	Set volume control to 3.16 Vrms
Distortion	As above, except to distortion	As above	As above	Distortion <5.0%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.3 $\mu\text{V}$
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 3.16 Vrms
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	Out of TEST MODE; select a conventional system	As above	Unsquelch to occur at <0.25 $\mu\text{V}$ . Preferred SINAD = 9 – 10dB
Receiver BER	IFR DMR mode. Signal generator with 0.153 test pattern	Test Mode, Digital mode, receive 0.153 test pattern	Read BER using Tuner. Adjust RF level to get 5% BER	RF level to be <0.35 $\mu\text{V}$ for 5% BER

\* See Table 3-4

### 3.3.3 Color Display Test

1. Press any button to test the LCD display, press button ► until the display are fixed. Then, press and hold the first side button until the screen change.
2. Upon key ► press, the housing shall display a White screen with 2 pixels wide of a black border inset from the edge by 2 pixels and the text "Display Test Mode" in black.
3. Upon key ► press, the housing shall display a Black screen with 2 pixels wide of a White boarder inset from the edge by 2 pixels and the text "Display Test Mode" in White.
4. Upon key ► press, the housing shall display a full screen in Red.
5. Upon key ► press, the housing shall display a full screen in Green.
6. Upon key ► press, the housing shall display a full screen in Blue.
7. Upon key ► press, the housing shall display the growing horizontal bars with a cyclic color of Red>Green>Blue>Black>Red>Green>Blue>Black>Red (Full Screen).
8. Upon key ► press, the housing shall display the growing vertical bars with a cyclic color of Red>Green>Blue>Black>Red>Black (Full Screen).
9. Upon key ">" press, until all icons in color show. The housing shall display RSSI icon (with full bar), monitor icon, high power level icon (H), tone disabled icon, priority-two channel scan icon, option board icon, unread message icon, emergency icon, talkaround icon, and battery strength indicator icon (with full bar).
10. The housing shall clear the screen and display the rest of the icons in color, (low power level icon (L), companding icon, and secure operation icon) upon key ">" press. Then, press and hold the first side button until the screen change.

### 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:

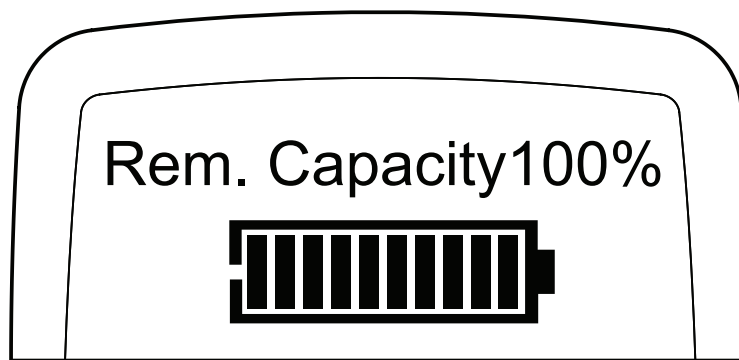


Figure 3-1. Battery Check Test Mode Display

### 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. 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 **Side Button 3**; "98/1" appears & radio beeps; release, "98/0" appears & radio beeps.
7. Press the **PTT Switch**; "1/1" appears & radio beeps; release, "1/0" appears & radio beeps.
8. Press **Top Button**; "148/1" appears & radio beeps; release, "148/0" appears & radio beeps.
9. 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 **MENU**, "85/1" appears & radio beeps; release, "85/0" 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.
- Press ▲, "135/1" appears & radio beeps; release, "135/0" appears & radio beeps.
- Press ▼, "136/1" appears & radio beeps; release, "136/0" appears & radio beeps.

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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/Windows 7 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
Customer Programming Software on DVD-ROM	RVN5115_

### 4.2 Customer Programming Software Setup

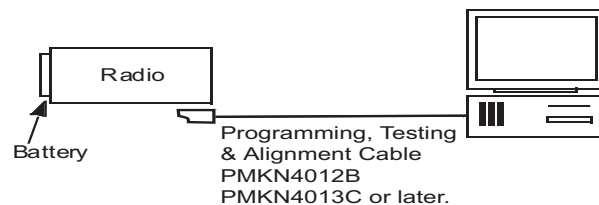
The CPS programming setup, shown in Figure 4-1 is used to program the radio.

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



**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/Windows 7 and a tuner program are required to tune

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

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.

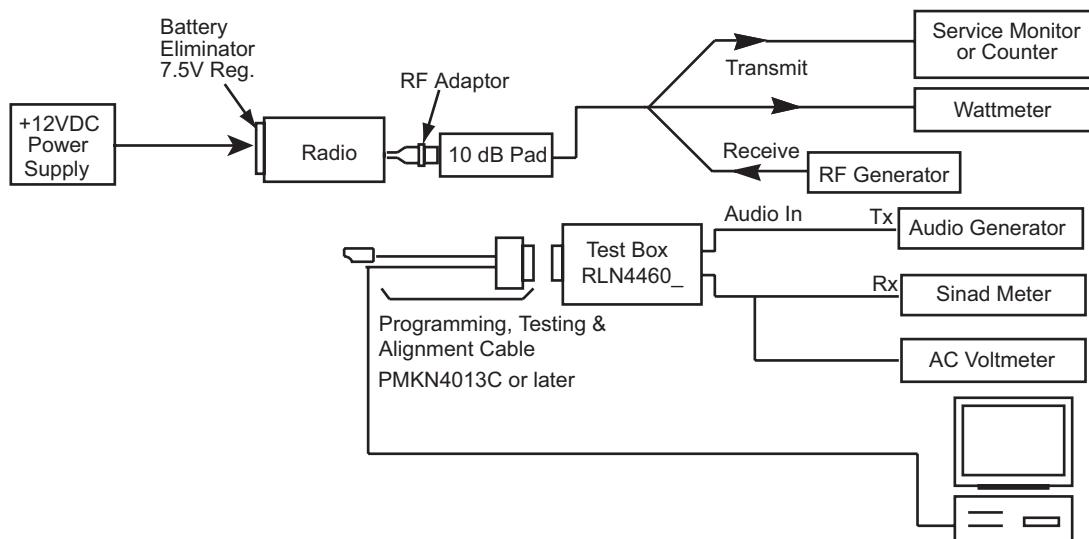


Figure 4-2. Radio Tuning Equipment Setup

## Chapter 5 Radio Maintenance Procedures for CSA Certified Radios

### 5.1 Introduction

This chapter provides details about the following:

- Preventive maintenance (inspection and cleaning).

### 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.



WARNING

#### **Do not inspect the interior electronic circuitry.**

To assure the safety and regulatory compliance of the CSA certified radios, the radio must be repaired only at Motorola service facilities. Please refer to the region specific Appendices for the address and contact information of your nearest Motorola service center.

If the following is observed during inspection of the radios the CSA compliance and safe use of the radios in hazardous environments may be impacted:

1. Modifications of the enclosure, antennas or battery.
2. Batteries antennas or accessories other than the Motorola approved one are attached to the radio.
3. The bottom label or the battery CSA label is damaged and the content is partly or completely unreadable.
4. Stickers or additional labels on the external enclosure of the radio and the battery.
5. Additional labels on the chassis and the battery cover that cover the original Motorola labels.
6. The antenna isolation is damaged broken or partly missing.
7. The dust cover is damaged or broken.
8. The battery contact seal is damaged.
9. Engraving on the radio housing, chassis or the battery enclosure.
10. Cracks or deep scratches in the lens or the radio and battery enclosure.
11. Missing screws or damaged tamper labels (indicate the radios have been opened by unauthorized persons).

12. Signs that the equipment had been exposed to temperatures, chemical substances or mechanical stress exceeding the limits and specification of Motorola like:
  - I. Discoloration of the plastic parts.
  - II. Signs of heavy corrosion on the chassis of the radios.
  - III. Signs of deformation of the radios or battery enclosure (bended antennas are permissible as long the plastic is still intact).
  - IV. Difficulty in screwing/unscrewing the antenna (damaged thread).
  - V. Difficulty to latch and unlatch the battery (battery interface or latch may be damaged).

If any of the above is observed, those radios in particular have to be repaired or defective parts have to be replaced.

### 5.2.2 Handling Precautions

The MOTOTRBO Series Digital Portable radio meets IP67 specifications, allowing the radio to withstand adverse field conditions such as being submersed in water.

- If the radio has been submersed in water, shake the radio well to remove any water that may be trapped inside the speaker grille and microphone port. Trapped water could cause decreased audio performance.
- If the radio's battery contact area has been exposed to water, clean and dry battery contacts on both the radio and the battery before attaching the battery to the radio. The residual water could short-circuit the radio.
- If the radio has been submersed in a corrosive substance (e.g. saltwater), rinse the radio and battery in fresh water then dry the radio and battery.
- To clean the exterior surfaces of the radio, use a diluted solution of mild dishwashing detergent and fresh water (i.e. one teaspoon of detergent to one gallon of water).
- Never poke the vent (hole) located on the radio chassis above the battery contact. This vent allows for pressure equalization in the radio. Doing so may create a leak path into the radio and the radio's submersibility may be lost.
- Never obstruct or cover the vent, even with a label.
- Ensure that no oily substances come in contact with the vent.
- The radio with antenna attached properly is designed to be submersible to a maximum depth of 1 meter (3.28 feet) and a maximum submersion time of 30 minutes. Exceeding either maximum limit or use without antenna may result in damage to the radio.
- When cleaning the radio, do not use a high pressure jet spray on the radio as this will exceed the 1 meter depth pressure and may cause water to leak into the radio.



**Caution**

Do not disassemble the radio. This could damage radio seals and result in leak paths into the radio. Radio maintenance should only be done in service depot that is equipped to test and replace the seal on the radio.

### 5.2.3 Cleaning Procedure

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.

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**

In hazardous environments only use a wet (water) cloth to clean the radios. 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.

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

**Caution**

Do not use chemicals to clean the radio. Only use cleaning agents as prescribed by the manufacturer. Be sure to follow all safety precautions as defined on the label or material safety data sheet.

## 5.3 Assembly Instruction for CSA Certified Radios

### 5.3.1 Antenna, Battery and Dust Cover Disassembly

1. Turn off the radio.
2. 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.
3. Remove the antenna by turning it counterclockwise.

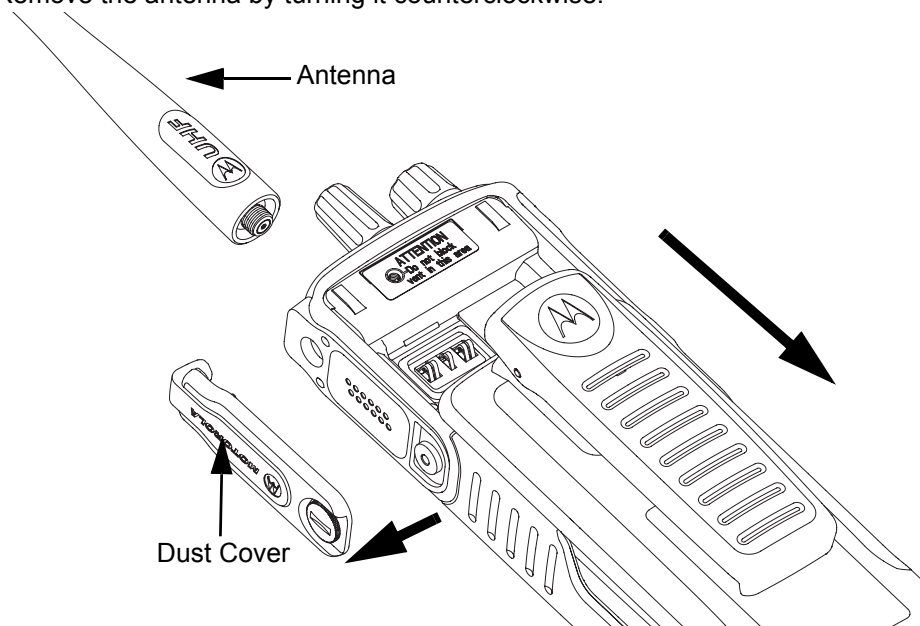


Figure 5-1. Antenna and Battery Removal

4. Remove dust cover by turning thumb screw counterclockwise.

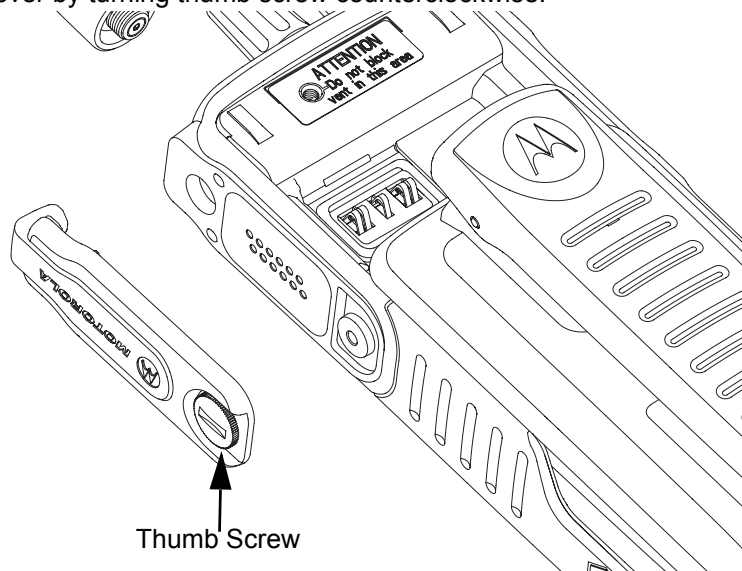


Figure 5-2. Dust Cover Removal

### 5.3.2 Antenna, Battery and Dust Cover Reassembly

1. Attach the dust cover to the opening and secure it by turning the thumb screw clockwise until it is fastened securely.
2. Insert the battery and slide upwards until a click is heard.
3. Fix the antenna by placing it in the antenna slot and turning it clockwise until it is fastened securely.

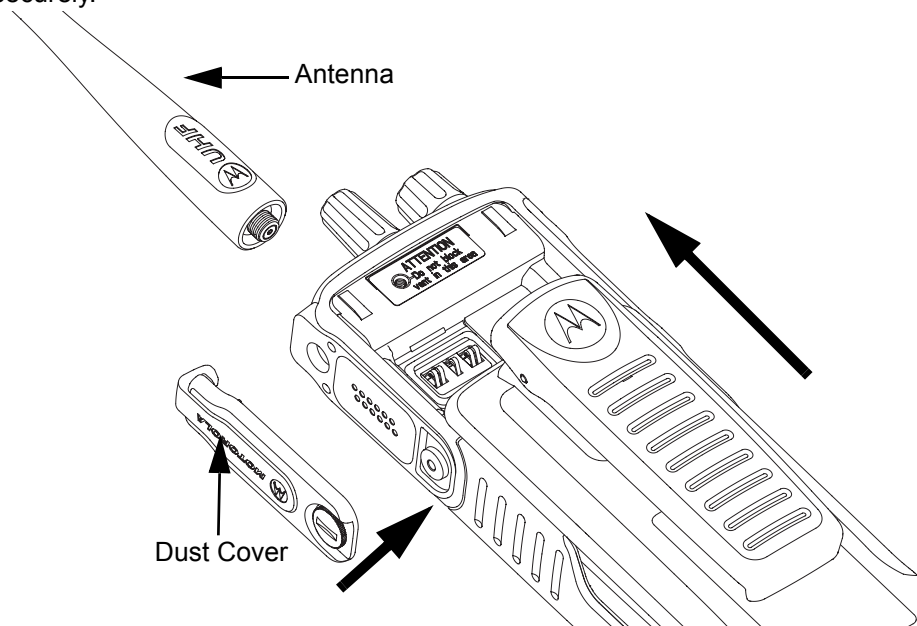


Figure 5-3. Antenna, Battery and Dust Cover Reassembly



Battery, antenna and dustcover or one of the approved accessories have to be attached to the radio in the hazardous environment.

### 5.3.3 Nameplate and Logo Label Replacement

1. Remove damaged nameplate and logo label by peeling off carefully and replace by affixing new nameplate and logo label.

## Notes

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## Chapter 6 Basic Troubleshooting

### 6.1 Introduction

This chapter contains error codes. If repair requires radio level troubleshooting, please send radio to a Motorola Service Center listed in Appendix A.

### 6.2 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, 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 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 send radio to nearest Motorola Depot.

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

Error Code	Description	Error Type	Corrective Action
FAIL 02/81	DSP ROM Checksum is wrong.	Fatal	Reprogram FLASH Memory, then retest. If message reoccurs 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 send radio to nearest Motorola Depot.
FAIL 02/84	DSP RAM2 test failure.	Fatal	Retest radio by turning it off and turning it on again. If message reoccurs 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 send radio to nearest Motorola Depot.
No Display	Display module is not connected properly. Display module is damaged.	Fatal	Send radio to nearest Motorola Depot.

## 6.3 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.

## Notes

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# Appendix A    NAG Regional Warranty, Service and Technical Support

## Limited Warranty

### MOTOROLA COMMUNICATION PRODUCTS

#### I. What This Warranty Covers And For How Long

MOTOROLA INC. ("MOTOROLA") warrants the MOTOROLA manufactured Communication Products listed below ("Product") against defects in material and workmanship under normal use and service for a period of time from the date of purchase as scheduled below:

XPR Series Digital Portable Radios	Three (3) Years
Product Accessories (Excluding Batteries and Chargers)	One (1) Year

The portables additionally ship with a standard 1-year Repair Service Advantage (RSA) (for U.S. customers) or 1-year Extended Warranty (for Canada customers). However, at the time of order, you may choose to omit these warranties. For more RSA or Extended Warranty information, please refer to the portable price pages or Motorola Online (<https://businessonline.motorola.com>) > Resource Center > Services > Service Product Offerings > Repair Service Advantage or Extended Warranty.

Motorola, at its option, will at no charge either repair the Product (with new or reconditioned parts), replace it (with a new or reconditioned Product), or refund the purchase price of the Product during the warranty period provided it is returned in accordance with the terms of this warranty. Replaced parts or boards are warranted for the balance of the original applicable warranty period. All replaced parts of Product shall become the property of MOTOROLA.

This express limited warranty is extended by MOTOROLA to the original end user purchaser only and is not assignable or transferable to any other party. This is the complete warranty for the Product manufactured by MOTOROLA. MOTOROLA assumes no obligations or liability for additions or modifications to this warranty unless made in writing and signed by an officer of MOTOROLA. Unless made in a separate agreement between MOTOROLA and the original end user purchaser, MOTOROLA does not warrant the installation, maintenance or service of the Product.

MOTOROLA cannot be responsible in any way for any ancillary equipment not furnished by MOTOROLA which is attached to or used in connection with the Product, or for operation of the Product with any ancillary equipment, and all such equipment is expressly excluded from this warranty. Because each system which may use the Product is unique, MOTOROLA disclaims liability for range, coverage, or operation of the system as a whole under this warranty.

## II. General Provisions

This warranty sets forth the full extent of MOTOROLA'S responsibilities regarding the Product. Repair, replacement or refund of the purchase price, at MOTOROLA's option, is the exclusive remedy. THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER EXPRESS WARRANTIES. IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE DURATION OF THIS LIMITED WARRANTY. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT, FOR ANY LOSS OF USE, LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS, LOST PROFITS OR SAVINGS OR OTHER INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE SUCH PRODUCT, TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW.

## III. State Law Rights

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LIMITATION ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION OR EXCLUSIONS MAY NOT APPLY.

This warranty gives specific legal rights, and there may be other rights which may vary from state to state.

## IV. How To Get Warranty Service

You must provide proof of purchase (bearing the date of purchase and Product item serial number) in order to receive warranty service and, also, deliver or send the Product item, transportation and insurance prepaid, to an authorized warranty service location. Warranty service will be provided by Motorola through one of its authorized warranty service locations. If you first contact the company which sold you the Product, it can facilitate your obtaining warranty service. You can also

## V. What This Warranty Does Not Cover

- A. Defects or damage resulting from use of the Product in other than its normal and customary manner.
- B. Defects or damage from misuse, accident, water, or neglect.
- C. Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.
- D. Breakage or damage to antennas unless caused directly by defects in material workmanship.
- E. A Product subjected to unauthorized Product modifications, disassemblies or repairs (including, without limitation, the addition to the Product of non-Motorola supplied equipment) which adversely affect performance of the Product or interfere with Motorola's normal warranty inspection and testing of the Product to verify any warranty claim.
- F. Product which has had the serial number removed or made illegible.
- G. Rechargeable batteries if:
  - any of the seals on the battery enclosure of cells are broken or show evidence of tampering.
  - the damage or defect is caused by charging or using the battery in equipment or service other than the Product for which it is specified.
- H. Freight costs to the repair depot.

- I. A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product, does not function in accordance with MOTOROLA's published specifications or the FCC type acceptance labeling in effect for the Product at the time the Product was initially distributed from MOTOROLA.
- J. Scratches or other cosmetic damage to Product surfaces that does not affect the operation of the Product.
- K. Normal and customary wear and tear.

## VI. Patent And Software Provisions

MOTOROLA will defend, at its own expense, any suit brought against the end user purchaser to the extent that it is based on a claim that the Product or parts infringe a United States patent, and MOTOROLA will pay those costs and damages finally awarded against the end user purchaser in any such suit which are attributable to any such claim, but such defense and payments are conditioned on the following:

- A. that MOTOROLA will be notified promptly in writing by such purchaser of any notice of such claim;
- B. that MOTOROLA will have sole control of the defense of such suit and all negotiations for its settlement or compromise; and
- C. should the Product or parts become, or in MOTOROLA's opinion be likely to become, the subject of a claim of infringement of a United States patent, that such purchaser will permit MOTOROLA, at its option and expense, either to procure for such purchaser the right to continue using the Product or parts or to replace or modify the same so that it becomes noninfringing or to grant such purchaser a credit for the Product or parts as depreciated and accept its return. The depreciation will be an equal amount per year over the lifetime of the Product or parts as established by MOTOROLA.

MOTOROLA will have no liability with respect to any claim of patent infringement which is based upon the combination of the Product or parts furnished hereunder with software, apparatus or devices not furnished by MOTOROLA, nor will MOTOROLA have any liability for the use of ancillary equipment or software not furnished by MOTOROLA which is attached to or used in connection with the Product. The foregoing states the entire liability of MOTOROLA with respect to infringement of patents by the Product or any parts thereof.

Laws in the United States and other countries preserve for MOTOROLA certain exclusive rights for copyrighted MOTOROLA software such as the exclusive rights to reproduce in copies and distribute copies of such Motorola software. MOTOROLA software may be used in only the Product in which the software was originally embodied and such software in such Product may not be replaced, copied, distributed, modified in any way, or used to produce any derivative thereof. No other use including, without limitation, alteration, modification, reproduction, distribution, or reverse engineering of such MOTOROLA software or exercise of rights in such MOTOROLA software is permitted. No license is granted by implication, estoppel or otherwise under MOTOROLA patent rights or copyrights.

## VII. Governing Law

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

## **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>APAC</b>	Asia Pacific Region
<b>ANZ</b>	Australia and New Zealand
<b>Analog</b>	Refers to a continuously variable signal or a circuit or device designed to handle such signals.
<b>ATEX</b>	ATmosphere EXplosive
<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>EMEA</b>	Europe, the Middle East and Africa
<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.

Term	Definition
<b>LACR</b>	Latin American and Caribbean Region
<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>MDC</b>	Motorola Digital Communications.
<b>MHz</b>	Megahertz: One million cycles per second. Used especially as a radio-frequency unit.
<b>NAG</b>	North America Group
<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.

Term	Definition
<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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