APX™ PORTABLE
TWO-WAY RADIO

APX 8000/APX 8000XE
BASIC SERVICE MANUAL

SEPTEMBER 2022

MN001622A01-AN

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Foreword

This manual includes all the information necessary to maintain peak product performance and maximum working time, using levels 1 and 2 maintenance procedures.

CAUTION: These servicing instructions are for the use of qualified personnel only. To reduce the risk of electric shock, do not service parts other than those contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

Product Safety and RF Exposure Compliance

CAUTION: This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the Product Safety and RF Exposure booklet enclosed with your radio which contains important operating instructions for safe usage and RF energy awareness and control for compliance with applicable standards and regulations.

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

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Please note that certain features, facilities, and capabilities described in this document may not be applicable to or licensed for use on a specific system, or may be dependent upon the characteristics of a specific mobile subscriber unit or configuration of certain parameters. Please refer to your Motorola Solutions contact for further information.

Document History

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

Edition	Description	Date
MN001622A01-AA	Initial Release	August 2015
MN001622A01-AB	Added APX 8000XE information	April 2016
MN001622A01-AC	Updated information for APX 8000/APX 8000XE Model Chart Number and Parts List Tables in Chapter 10 (Exploded View and Parts Lists).	June 2016
MN001622A01-AD	Compliance with the new Motorola Solutions design standard.	February 2018
MN001622A01-AE	Updated Test Procedure on page 149.	November 2018
MN001622A01-AF	Removed R-2670 Communication Analyzer information from the manual.	December 2018
MN001622A01-AG	Updated the following sections: • Aligning the Reference Oscillator on page 66 • Power Characterization Points on page 69 • Power Characterization Tuning on page 70 • APX 8000/APX 8000XE Model Chart on page 25 for the following part numbers: - PPNR4000_ - PPNCN6000_ - PPNCN7000_ - PNHN7020_ • APX 8000 Dual Display (Full Keypad) Exploded View Parts List on page 156 and APX 8000XE Dual Display (Full Keypad) Exploded View Parts List on page 165 for the following part part numbers: - PA000429A_ - PA000470A_ - PA000471A_ - PNHN7020_	August 2019
MN001622A01-AH	Updated the following sections: • Service Aids on page 44 • Test Equipment Setup on page 46 Updated the exploded view description for KT000035A, KT000035B, KT000035C, KT000036A, KT000036B, KT000036C, KT000037A, KT000037B, and KT000037C kits.	July 2020

Edition	Description	Date
MN001622A01-AJ	Updated the following sections: • APX 8000/APX 8000XE Model Chart on page 25 • APX 8000 Dual Display (Full Keypad) Exploded View Parts List on page 156 • APX 8000 Top Display Exploded View Parts List on page 162 • APX 8000XE Dual Display (Full Keypad) Exploded View Parts List on page 165 • APX 8000XE Dual Display (Limited Keypad) Exploded View Parts List on page 170 • APX 8000XE Top Display Exploded View Parts List on page 172 • Glossary on page 184 "ABACUS" changed to "RODINIA"	November 2020
MN001622A01-AK	Updated the following section: • Controller Kit Numbers on page 173	May 2021
MN001622A01-AL	Updated the following section: • Exploded Views and Parts Lists on page 155	September 2021
MN001622A01-AM	Updated the following sections: • APX 8000 Dual Display (Full Keypad) Exploded View Parts List on page 156 • APX 8000XE Dual Display (Full Keypad) Exploded View Parts List on page 165 • Controller Kit Numbers on page 173	January 2022
MN001622A01-AN	Updated the following sections: • Performance Checks on page 46 • APX 8000 Dual Display (Full Keypad) Exploded View Parts List on page 156 • APX 8000XE Dual Display (Full Keypad) Exploded View Parts List on page 165 • APX 8000XE Top Display Exploded View Parts List on page 172	September 2022

Notations Used in This Manual

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

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

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

NOTE: NOTICE indicates an operational procedure, practice, or condition that is essential to emphasize.

Related Publications

The following list contains part numbers and titles of related publications.

- MN001422A01, *APX 8000 User Guide Model 1*
- MN001424A01, *APX 8000 User Guide Model 2*
- MN001425A01, *APX 8000 User Guide Model 3*
- PMLN7285, *APX 8000 Quick Reference Card Model 1*
- PMLN7286, *APX 8000 Quick Reference Card Model 2*
- PMLN7287, *APX 8000 Quick Reference Card Model 3*
- MN001623A01, *APX 8000/APX 8000XE Digital Portable Radios Detailed Service Manual*
- MN001435A01, *APX 8000/APX 8000XE Wi-Fi Leaflet*

Commercial Warranty

Limited Warranty

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Product Accessories (Excluding Batteries and Chargers)	One Year

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Product Accessories	One Year

The radios 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 price pages.

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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

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Warranty service will be provided by Motorola Solutions 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 call Motorola Solutions at 1-800-927-2744 US/Canada.

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- Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.
- Breakage or damage to antennas unless caused directly by defects in material workmanship.
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- Product which has had the serial number removed or made illegible.
- 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.
- Freight costs to the repair depot.
- A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product, does not function in accordance with Motorola Solutions published specifications or the FCC type acceptance labeling in effect for the Product at the time the Product was initially distributed from Motorola Solutions.
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- Normal and customary wear and tear.

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VII. Governing Law

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

Chapter 1

Introduction

This manual contains information needed for Level One and Two radio servicing. Level One servicing consists of radio programming, radio alignment, knobs replacement, and installation and removal of the antenna, belt clip, battery, and universal connector cover. Level Two servicing covers disassembly and reassembly of the radio to replace circuit boards.

1.1 Manual Contents

The manual contains radio specification for the VHF , UHF1 , UHF2 , and 700/800 (764–870 MHz) frequency bands, a general description of ASTRO APX 8000/APX 8000XE model, recommended test equipment, service aids, radio alignment procedures, general maintenance recommendations, procedures for assembly and disassembly, and exploded views and parts lists.

1.2 Radio Description

The APX 8000/APX 8000XE radio is among the most sophisticated two-way radios available.

The radio provides improved voice quality across more coverage area. The digital process, called embedded signaling, intermixes system signaling information with digital voice, resulting in improved system reliability and the capability of supporting a multitude of advanced features.

The radio is available in Top Display and Dual Display.
The following table describes the basic features of the radios.

Table 1: ASTRO APX 8000/APX 8000XE Basic Features

Feature	Top-Display	Dual-Display
Display	Model 1.5: • Full bitmap monochromatic LCD top display • 1 line of text (8 characters per line) • 1 line of icons • No menu support • Multi-color backlight	Model 2.5/Model 3.5: Top Display Plus: • Full bitmap color LCD display • 4 lines of text x 14 characters • 2 lines of icons • 1 menu line X 3 menus • White backlight
Keypad	None	Model 2.5: • Backlit keypad • 3 soft keys • 4 direction navigation key • Home and Data buttons Model 3.5: • Backlit keypad

Feature	Top-Display	Dual-Display
		• 3 soft keys • 4 direction navigation key • Home and Data buttons • 4x3 keypad
Channel Capability	1200	3000
Dialing from Pre-stored List	No	Yes
Programmable Softkeys	No	Yes

1.3

Portable Radio Model Numbering System

Table 2: Sales Model Nomenclature

Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Typical Model Number	H	9	1	T	G	D	9	P	W	5	A	N	S	P	0	1

Table 3: Sales Models–Description of Symbols

Position	Description	Value
1	Type of Unit	H = Hand-held Portable
2	Model Series	91 = APX8000/APX 8000XE
3		
4	Frequency Band	T = Multi-Band Capable
		Values given represent range only; they are not absolute.
5	Power Level	G = 0–6 W
6	Physical Packages	D = Standard Control; With Display
		H = Full Keypad; With Display
7	Channel Spacing	9 = Variable/Programmable
8	Primary Operation	P = Programmable
9	Primary System Type	W = Programmable
10	Feature Level	5 = Standard Package
11	Version	Version Letter (Alpha) – Major Change
12	Unique Model Variations	C = Cenelec
		N = Standard Package

Position	Description	Value
13	SP Model Suffix	
14		
15		
16		

1.3.1
Model Charts

Please use the following notations while referring to the model charts.

X = Item Included.

• = Option available. Can be serviced in depot and ordered thru AAD.

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

NOTE:
Refer Accessories on page 174 for antennas, batteries and other applicable accessories.

1.3.1.1
APX 8000/APX 8000XE Model Chart

ASTRO APX 8000/APX 8000XE				VHF/UHF1/UHF2/700–800 MHz
FCC ID				AZ489FT7061
Top Display Model				H91TGD9PW5AN
	Dual Display Model (Limited Keypad)			H91TGD9PW6AN
		Dual Display Model (Full Keypad)		H91TGD9PW7AN
			Item Number	Description
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	43009291001	Insert, Universal Connector
X	X	X	75009299003	Pad, Thermal, RFPA
X	X	X	75009418001	Pad, Support
X	X	X	PMLN7245_	User Guide, APX 8000
X	X	X	PMLN7287_	User Guide, APX 8000XE
X	X	X	0375962B01	Screw, Chassis, (m2.5x30.1)
X	X	X	0375962B02	Screw, Chassis, (m2.5x24.45)
X	X	X	0375962B03	Screw, Chassis, (m2.5x9.2)
X	X	X	0375962B04	Screw, Chassis, (m2.5x7)
X	X	X	1575250H01	Cover, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	3271829H02	Seal, Battery Connector

ASTRO APX 8000/APX 8000XE				VHF/UHF1/UHF2/700–800 MHz
FCC ID				AZ489FT7061
Top Display Model				H91TGD9PW5AN
	Dual Display Model (Limited Keypad)			H91TGD9PW6AN
		Dual Display Model (Full Keypad)		H91TGD9PW7AN
			Item Number	Description
X	X	X	KT000006A_ PMLN7421_	Sub-Assembly, Main Chassis, APX 8000
X	X	X	KT000017A_	Sub-Assembly, Main Chassis (Black), APX 8000XE
X	X	X	KT000018A_	Sub-Assembly, Main Chassis (Yellow), APX 8000XE
X	X	X	KT000019A_	Sub-Assembly, Main Chassis (Green), APX 8000XE
X			KT000007A_	Sub-Assembly, Back Chassis, Top Display
	X	X	KT000008A_	Sub-Assembly, Back Chassis, Dual Display
X	X	X	KT000010A_	Assembly, Speaker Module, APX 8000
	X	X	PNHN7020_	Display, Color
X	X	X	PPNRW4000_ (Replaces PPA000429A)	PC Board Assembly, RF, APX 8000/APX 8000XE
X	X	X	PPNCN6000_ (Replaces PPA000470APM LF4176C	PC Board Assembly, VOCON, APX 8000/APX 8000XE
X	X	X	PPNCN7000_ (Replaces PPA000471APM LF4167D	PC Board Assembly, Expansion, APX 8000/APX 8000XE
X	X	X	LB000623A03	Label, Speaker Grille, APX 8000
X	X	X	LB000623A04	Label, Speaker Grille, APX 8000XE
X	X	X	LB000623A05	Label, Speaker Grille, APX 8000R
X	X	X	PMLN7523_	Grille, Speaker (Black), APX 8000
•	•	•	PMLN7525_	Grille, Speaker (Yellow), APX 8000
•	•	•	PMLN7524_	Grille, Speaker (Green), APX 8000
X	X	X	KT000242A_	Grille, Speaker (Black), APX 8000XE
•	•	•	KT000243A_	Grille, Speaker (Yellow), APX 8000XE
•	•	•	KT000244A_	Grille, Speaker (Green), APX 8000XE
X			KT000032A_	Service Kit, 3 pcs Front Housing, Top Display(Black)
	X		KT000032B_	Service Kit, 3 pcs Front Housing, Dual Display, Limited Keypad (Black)

ASTRO APX 8000/APX 8000XE				VHF/UHF1/UHF2/700–800 MHz
FCC ID				AZ489FT7061
Top Display Model				H91TGD9PW5AN
	Dual Display Model (Limited Keypad)			H91TGD9PW6AN
		Dual Display Model (Full Keypad)		H91TGD9PW7AN
			Item Number	Description
		X	KT000032C_	Service Kit, 3 pcs Front Housing, Dual Display, Full Keypad (Black)
		•	KT000032D_	Service Kit, 3 pcs Front Housing, Dual Display, Full Keypad, Hebrew (Black)
		•	KT000032E_	Service Kit, 3 pcs Front Housing, Dual Display, Full Keypad, Cyrillic(Black)
		•	KT000032F_	Service Kit, 3 pcs Front Housing, Dual Display, Full Keypad, Arabic(Black)
•			KT000033A_	Service Kit, 3 pcs Front Housing, Top Display, (Yellow)
	•		KT000033B_	Service Kit, 3 pcs Front Housing, Dual Display, Limited Keypad (Yellow)
		•	KT000033C_	Service Kit, 3 pcs Front Housing, Dual Display, Full Keypad (Yellow)
•			KT000034A_	Service Kit, 3 pcs Front Housing, Top Display, (Green)
	•		KT000034B_	Service Kit, 3 pcs Front Housing, Dual Display, Limited Keypad (Green)
		•	KT000034C_	Service Kit, 3 pcs Front Housing, Dual Display, Full Keypad (Green)
•			KT000035A_	Service Kit, 3 pcs Front Housing, Top Display, (Orange sides and Black Full Keypad Faceplate)
	•		KT000035B_	Service Kit, 3 pcs Front Housing, Dual Display, Limited Keypad (Orange sides and Black Full Keypad Face-plate)
		•	KT000035C_	Service Kit, 3 pcs Front Housing, Dual Display, Full Keypad (Orange sides and Black Full Keypad Face-plate)
•			KT000036A_	Service Kit, 3 pcs Front Housing, Top Display (Red sides and Black Full Keypad Faceplate)
	•		KT000036B_	Service Kit, 3pcs Front Housing, Dual Display, Limited Keypad (Red sides and Black Full Keypad Faceplate)
		•	KT000036C_	Service Kit, 3 pcs Front Housing, Dual Display, Full Keypad (Red sides and Black Full Keypad Faceplate)
•			KT000037A_	Service Kit, 3 pcs Front Housing, Top Display (Blue sides and Black Full Keypad Faceplate)

ASTRO APX 8000/APX 8000XE				VHF/UHF1/UHF2/700–800 MHz
FCC ID				AZ489FT7061
Top Display Model				H91TGD9PW5AN
	Dual Display Model (Limited Keypad)			H91TGD9PW6AN
		Dual Display Model (Full Keypad)		H91TGD9PW7AN
			Item Number	Description
	•		KT000037B_	Service Kit, 3 pcs Front Housing, Dual Display, Limited Keypad (Blue sides and Black Full Keypad Faceplate)
		•	KT000037C_	Service Kit, 3 pcs Front Housing, Dual Display, Full Keypad (Blue sides and Black Full Keypad Faceplate)

1.3.2
APX 8000/APX 8000XE Specifications (Typical)

All radio specifications are per Telecommunications Industries Association TIA-603 unless otherwise specified.

Table 4: Transmitter Specifications

TRANSMITTER				
Transmitter Parameter	700/800 MHz	VHF	UHF1	UHF2
Frequency Range	764–776 MHz 762-776MHz	136–174 MHz	380–470 MHz	450–520 MHz
	794–806 MHz			
	806–825 MHz			
	851–870 MHz			
Rated RF Output Power Adj	700 MHz: 1–2.5 W	1–6 W	1–5 W	1–5 W
	800 MHz: 1–3 W			
Frequency Stability (-30°C to +60°C; +25°C Ref):	±1.0 ppm	±1.0 ppm	±1.0 ppm	±1.0 ppm
Emission (Conducted and Radiated)*	-75 dBc	-75 dBc	-75 dBc	-75 dBc
FM Hum and Noise (25 kHz/12.5 kHz)	700 MHz: -49 dB/-47 dB	-51 dB/-51 dB	-51 dB/-51 dB	-51 dB/-47 dB
	800 MHz: -49 dB/-46 dB			

TRANSMITTER				
Transmitter Parameter	**700/800 MHz**	**VHF**	**UHF1**	**UHF2**
Audio Distortion (25 kHz/12.5 kHz):	700 MHz: 0.90 % /0.90 % 800 MHz: 0.60 % /0.90 %	0.50 % /0.90 %	0.50 % /0.90 %	0.60 % /0.90 %
Modulation Limiting (25 kHz/20 kHz/ 12.5 kHz):	±5 kHz/±4 kHz/ ±2.5 kHz	±5 kHz/±4 kHz/ ±2.5 kHz	±5 kHz/±4 kHz/ ±2.5 kHz	±5 kHz/±4 kHz/ ±2.5 kHz
Audio Response	+1, -3 dB	+1, -3 dB	+1, -3 dB	+1, -3 dB
ACPR (25 kHz/12.5 kHz)*	700 MHz: 76 dBc/66 dBc 800 MHz: 76 dBc/66 dBc	80 dBc/68 dBc	80 dBc/68 dBc	80 dBc/68 dBc
Transmit Current Drain	1780 mA	2180 mA	2100 mA	2180 mA
Specifications subject to change without notice. * For reference only. The values are obtainable from the factory or laboratory testing.				

Table 5: Receiver Specifications

RECEIVER				
Receiver Parameter	**700/800 MHz**	**VHF**	**UHF1**	**UHF2**
Frequency Range	764–776 MHz762-776MHz 851–870 MHz	136–174 MHz	380–470 MHz	450–520 MHz
Bandwidth	700 MHz: 12 MHz 800 MHz: 19 MHz	38 MHz	90 MHz	70 MHz
Analog Sensitivity (12 dB SINAD)	0.224 µV	0.168 µV	0.199 µV	0.199 µV
Digital Sensitivity				
1% BER	0.316 µV	0.251 µV	0.282 µV	0.282 µV
5% BER	0.211 µV	0.149 µV	0.158 µV	0.158 µV
5% BER Faded	0.562 µV	0.562 µV	0.530 µV	0.530 µV

RECEIVER				
Receiver Parameter	**700/800 MHz**	**VHF**	**UHF1**	**UHF2**
Intermodulation Rejection	700 MHz: 81 dB 800 MHz: 80 dB	82 dB	80 dB	80 dB
Selectivity (25 kHz/12.5 kHz)	700 MHz: 79 dB/72 dB 800 MHz: 78 dB/72 dB	82 dB/77 dB	80 dB/74 dB	80 dB/74 dB
Spurious Rejection	98 dB	92 dB	98 dB	98 dB
Frequency Stability (-30°C to +60°C; +25°C Ref)	± 1.0 ppm	± 1.0 ppm	± 1.0 ppm	± 1.0 ppm
Speech Loudness at 30 cm*	105 Phons	105 Phons	105 Phons	105 Phons
Audio Output Power at Rated/Max	3 W/5 W	3 W/5 W	3 W/5 W	3 W/5 W
FM Hum and Noise (25 kHz/12.5 kHz)	700 MHz: -55 dB/-53 dB 800 MHz: -54 dB/-52 dB	-57 dB/-55 dB	-56 dB/-54 dB	-56 dB/-54 dB
Audio Distortion at rated	700 MHz: 1.2% 800 MHz: 1.3%	1.3%	1.2%	1.2%
Channel Spacing	12.5/20/25 kHz	12.5/20/25 kHz	12.5/20/25 kHz	12.5/20/25 kHz
Receive Current Drain**	700 MHz: 325 mA 800 MHz: 328 mA	316 mA	325 mA	327 mA

Specifications subject to change without notice.
* For reference only. The values are obtainable from the factory or laboratory testing.

** Test Conditions: 1/2 W, 16 Ohm External Load. Features:

ON: GPS, AVR, BT and Amber Light. (PA000470A03 and PA000471A02)

ON: GPS, BT and Amber Light. (PMLF4176C and PMLF4167D)

OFF: Top Display, Marvel, Wi-Fi and Key Pad, Front Display DIM, DVFS set to 168 MHz.

Table 6: General Specifications

GENERAL	
Parameter	
Temperature Range Operating: Storage:	-30°C to +60°C -40°C to +85°C
Power Supply	Lithium-Ion Battery (Li-Ion)
Battery Voltage Nominal: Range:	7.5 Vdc 6 to 9 Vdc
Standby Current Drain (typical) Conditions: ON: GPS, AVR, BT and Amber Light (PA000470A03 and PA000471A02) ON: GPS, BT and Amber Light (PMLF4176C and PMLF4167D) OFF: Top Display, Marvel, Wi-Fi and Keypad, Front Display DIM, DVFS set to 168 MHz	VHF/UHF1/UHF2/700/800 200/210/211/210/212 mA
Battery Refer to the APX 8000/APX 8000XE website for the recommended batteries:	
Dimensions (H x W x D) **NOTE:** H=Height; W=Width; D=Depth 1= (Width at Top)/(Width at PTT) 2= (Depth at Top)/(Depth at PTT)	For APX 8000 without Battery (Radio Only): H = 5.47" (139 mm) W1 = 2.98" (75.7 mm)/2.39" (60.7 mm) D2 = 1.58" (40.1 mm)/1.40" (35.6 mm)
	For APX 8000XE without Battery (Radio Only): H = 6.15" (156.2 mm) W1 = 3.32" (84.3 mm)/2.39" (60.7 mm) D2 = 2.13" (54.1 mm)/1.40" (35.6 mm)
Emissions Designators	LMR: 8K10F1D, 8K10F1E, 8K10F1W, 11K0F3E, 16K0F3E*, 20K0F1E* Bluetooth: 852KF1D, 1M17F1D, 1M19F1D, 1M04F1D WLAN (Wi-Fi): 13M7G1D, 17M0D1D, 18M1D1D
Weight Without Antenna	For APX 8000 : Less Battery: 11.25 oz (319 g) With Li-Ion**: 17.86 oz (506 g)
	For APX 8000XE : Less Battery: 13.9 oz (394.1 g) With Li-Ion**: 20.4 oz (578.3 g)
Specifications subject to change without notice.	

GENERAL
Parameter
* In accordance with the FCC mandate, the APX 8000/APX 8000XE all band radio is restricted to 12.5 kHz operation only and does NOT support 25 kHz in the VHF and UHF bands (excluding T-Band). This applies to customers under Rule Part 90.
**Standard Shipping Battery

1.4

FLASHport®

This radio utilizes Motorola Solutions FLASHport technology. FLASHport makes it possible to add software that drives the capabilities of the radio both at the time of purchase and later on. Previously, changing features and capabilities of a radio meant significant modifications or buying a new radio. But now, similar to how a computer can be loaded with different software, the features and capabilities of the radio can be upgraded with FLASHport software.

Chapter 2

Basic Maintenance

This chapter describes the preventive maintenance and handling precautions.

Each of these topics provides information vital to the successful operation and maintenance of the radio.

2.1 General Maintenance

To avoid operating outside the limits set by the FCC, align the reference oscillator of the radio every time the radio is taken apart, or once per year, whichever comes first.

Checking this parameter when the product is placed in service is especially important if the product has been in storage for a significant period of time (6 months or more) between being shipped from the factory and commissioned for service. (See Aligning the Reference Oscillator on page 66). Periodic visual inspection and cleaning is also recommended.

2.1.1 Inspection

Check that the external surfaces of the radio are clean and that all external controls and switches are functional. A detailed inspection of the interior electronic circuitry is not needed.

NOTE: Verify that all dust covers are in place.

2.1.2 Cleaning

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external surfaces of the radio. External surfaces include the 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.

CAUTION: Use all chemicals as prescribed by the manufacturer. Be sure to follow all safety precautions as defined on the label or material safety data sheet.
The effects of certain chemicals and their vapors can have harmful results on certain plastics. Aerosol sprays, tuner cleaners, and other chemicals should be avoided.

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

2.1.3 General Cleaning

For general cleaning, Motorola Solutions recommends mixing one tablespoon of mild dishwashing detergent to one gallon of water (0.5% solution) to clean the external surfaces of the radio. The solution is to be applied sparingly with a stiff, nonmetallic, short-bristled brush, making sure excess

detergent does not get entrapped near the connectors, controls or crevices. The radio should be dried thoroughly with a soft, lint-free cloth. If the radio battery contact area has been exposed to water, dry and clean the radio battery contacts before attaching a battery to the radio.

If the radio has been exposed to salt water (or salt spray), thoroughly rinse the radio with fresh water. If the radio has been submerged in water, shake the radio briskly so that any water trapped inside the speaker grille and microphone port can be removed. The radio should then be dried per above.

Motorola Solutions also recommends wearing the radio in a carry case or inside the turnout coat (fire departments) to better protect the radio from prolong exposure to dirt, debris, heat and/or impacts.

2.1.4
High Debris Environments

For high debris environments, additional cleaning steps may be needed to maintain optimal radio performance.

- Speaker Grille – In high debris environments, the speaker grille may trap dirt and debris, resulting in degraded audio quality and clarity. Motorola Solutions recommends vacuuming the speaker grille to maintain optimal audio performance. Attach a crevice nozzle to a vacuum cleaner, and vacuum the speaker grille. Avoid covering all the grille openings at once with the nozzle. Move the nozzle back and forth several times horizontally across the grille. Perform a “Talk/Listen” test, to confirm audio performance has returned to normal. If audio issues persist, radio should be sent for servicing.
- Control Top – In high debris environments, the control top may trap dirt and debris, resulting in reduced tactile feel in the buttons, switches, and knobs. Motorola Solutions recommends vacuuming the control top to maintain optimal tactile performance. Attach a crevice nozzle to a vacuum cleaner, and vacuum all radio surfaces, especially the control top, to remove dirt and debris from crevices. For submersible radios (“R” or “XE” designators), turn the radio upside down and place the top of the radio into the water. With the control top submerged, shake the radio vigorously to loosen dirt and debris. Perform vacuuming again, to remove dirt, debris, and water.

2.2
Handling Precautions

Complementary Metal Oxide Semiconductor (CMOS) and Laterally Diffused Metal Oxide Semiconductor (LDMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high-voltage charges.

Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS/LDMOS circuits and are especially important in low humidity conditions. Do not attempt to disassemble your radio without referring to the following caution statement.

CAUTION:
The radio has a vent port that allows for pressure equalization in the radio. Never poke this vent with any objects, such as needles, tweezers, or screwdrivers. This could create a leak path into the radio and the radio loses its submergibility.

The pressure equalization vent is located adjacent to the battery contact opening of the main chassis. Never touch the equalization vent. Ensure that no oily substances come in contact with this vent.

2.2.1
APX 8000 R/APX 8000XE Radios Only

If the radio battery contact area is submerged in water, dry and clean the radio battery contacts before attaching a battery to the radio. Otherwise, the water could short-circuit the radio.

If the radio is submerged in water, shake the radio briskly so that any water that is trapped inside the speaker grille and microphone port can be removed. Otherwise, the water decreases the audio quality of the radio.

Chapter 3

Basic Theory of Operation

This chapter discusses the basic operational theory of the radio. The radio is available in the following frequency bands.

- VHF (136–174 MHz)
- UHF1 (380–480 MHz)
- UHF2 (450–520 MHz)
- 700/800 MHz (764–870 MHz)

This radio is capable of analog operation (12.5 kHz or 25 kHz bandwidths), ASTRO mode (digital) operation (12.5 kHz only), and Phase 2 TDMA mode (12.5 kHz only).

3.1 Major Assemblies

The radio includes the following major assemblies.

VOCON Board
Contains a dual-core processor which includes both the microcontroller unit (MCU) and a digital signal processor (DSP) core, the processors memory devices, an audio and power supply support integrated circuit (IC), an audio CODEC, and MACE (Type III Secure IC).

Transceiver (XCVR) Board
Contains all transmit, receive, and frequency generation circuitry, including the digital receiver back-end IC and the reference oscillator.

Expansion Board
Contains the internal and accessory path audio power amplifier circuitry, a GNSS (GPS/Glonass) IC and supporting circuitry, a combination WLAN/Bluetooth 4.0 capable IC and support circuitry, and a 3-axes digital accelerometer.

Top Display
112 pixels x 32 pixels, transflective monochrome liquid crystal display (LCD).

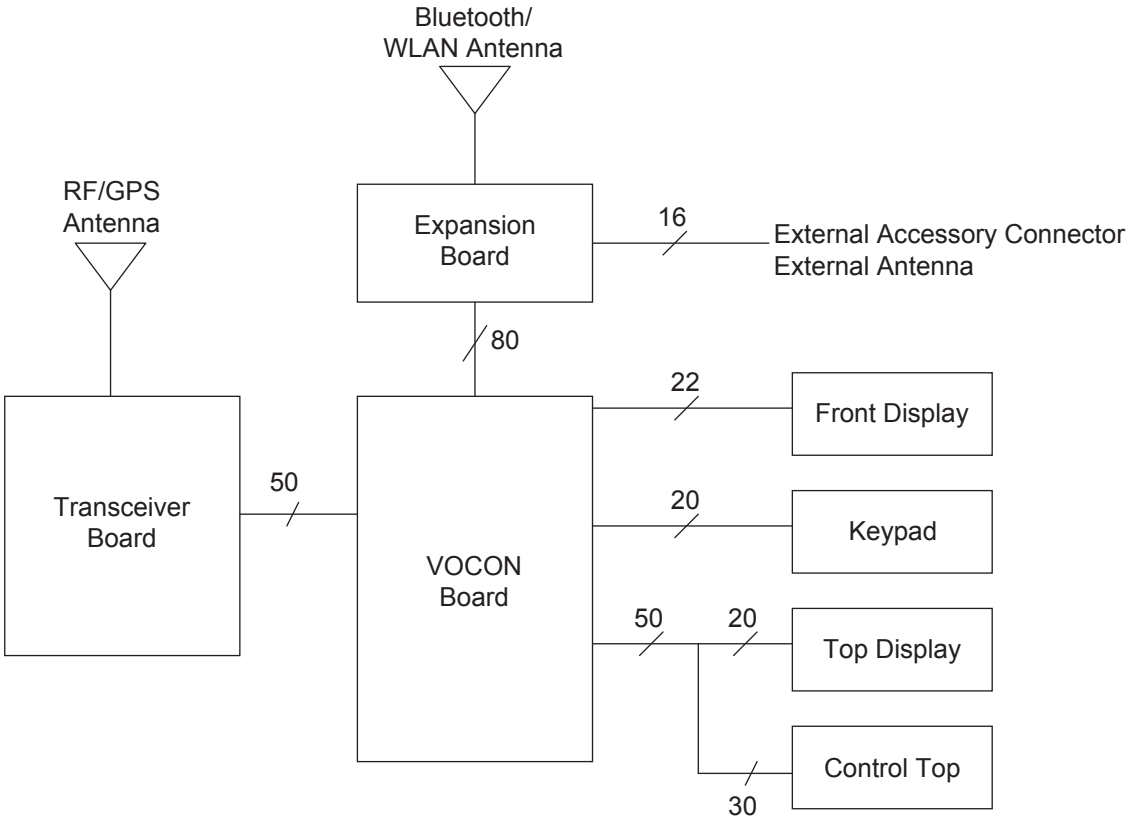
Control Top
Contains five switches: On/Off and Volume Knob, a 16 position Channel/Frequency Knob with concentric 2 position switch (for Secure Enable/Disable operation), a 3 position toggle switch for Zone Selection, and a push-button switch used for Emergency calling. The control top also includes an TX/RX LED that is solid amber upon receive, red on PTT, and blinks amber on secure TX/RX.

Front Display (Dual-Display Version)
130 pixels x 130 pixels, transflective color LCD.

Keypad (Dual-Display Version)
Dual-Display version, Limited Keypad and Full Keypad Version has a
3 x 2 Menu keypad with 4-way navigation button, and Full Keypad Version has a 3 x 4 alphanumeric keypad.

These major assemblies work together as shown in the following figure:

Figure 1: APX 8000/APX 8000XE Overall Block Diagram



3.1.1
Analog Mode of Operation

This section provides an overview of the analog mode receive and transmit theory of operation.

3.1.1.1
Receiving

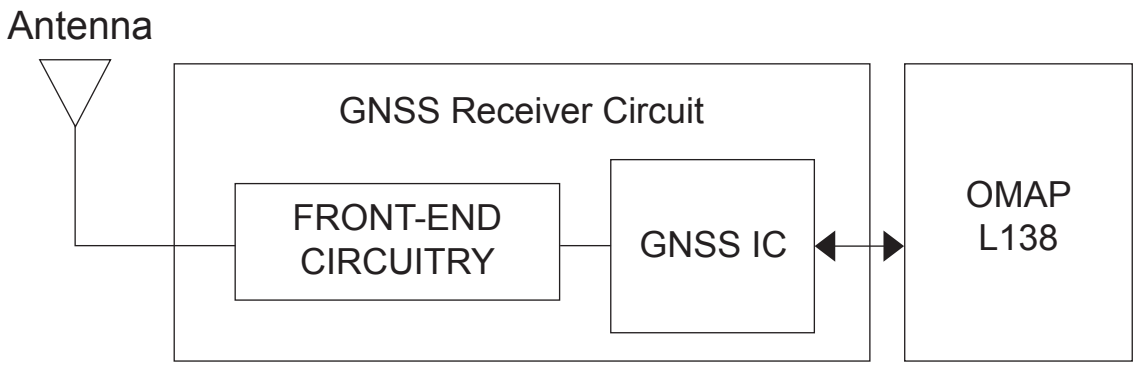
The RF signal is received at the antenna and is routed through the Auxiliary and Multi Switch (SP3T) ICs. The latter contains a switchable attenuator that is enabled at predetermined RF power thresholds present at the antenna port.

3.1.1.1.1
GNSS

The GNSS (Global Navigation Satellite System) architecture features a single chip multi-GNSS receiver which allows for concurrent reception of the GPS and Glonass satellite systems. The GNSS signals are received by the LMR/GPS combination antenna and then routed to the front-end circuitry which filters and amplifies the signals for processing by the GNSS IC.

The GNSS receiver is configured to operate in a continuous navigation and autonomous only mode which means that the GNSS receiver continuously track satellites as long as they are visible to ensure the best possible accuracy. In the event the radio loses visibility of the satellites due to terrain, environmental factors or being inside a building/structure, the GNSS receiver temporarily lose its position fix. A power savings algorithm then cycle the GNSS receiver in and out of a sleep mode until the radio has moved back into an environment where GNSS signals are present.

Figure 2: GNSS Diagram



3.1.1.1.2

RF Receiver Front-End

From the RX/TX select switch, the RF signal is routed to a pre-selector filter, followed by a Low Noise Amplifier (LNA) and a second pre-selector filter. Both filters are used to band limit incoming energy and suppress known spurious responses such as image and ½ IF spur. The Mixer IC is also excited by a Local Oscillator (LO) signal at the LO port to down-convert the RF signal to a 109.65 MHz intermediate frequency (IF). The down converted IF signal is passed through a crystal filter and IF amplifier which drives the input of the RF Backend Analog to Digital Converter IC.

3.1.1.1.3

Analog To Digital Converter

The ADC IC front end down converts the first IF to a second very low IF signal.

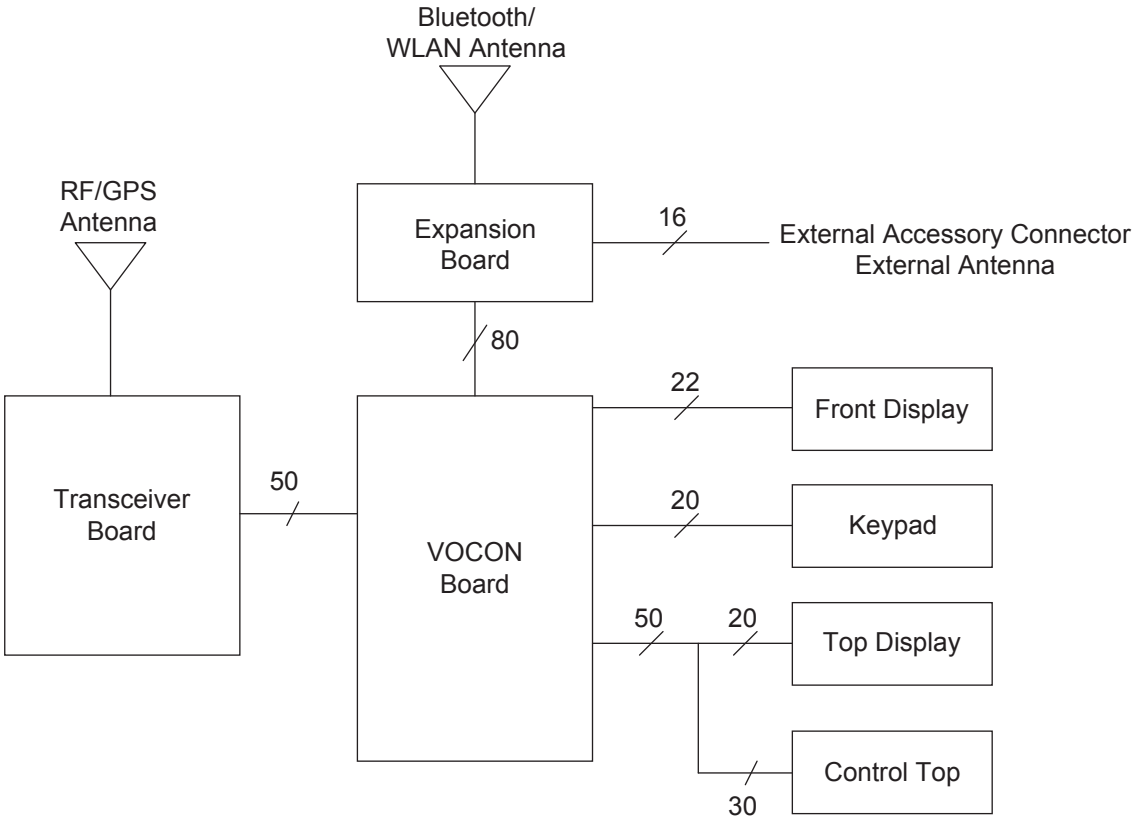
The very low IF signal is sampled (digitized) and converted to Serial Synchronous Interface (SSI) format. The SSI serial data waveform is composed of a 16 bit in-phase word (I) followed by a 16 bit Quadrature word (Q). A 20 kHz Frame Synch and a 1.2 MHz clock waveform are used to synchronize the SSI IQ data transfer to the Digital Signal Processor IC (OMAP L138) for post-processing and demodulation.

3.1.1.2

Transmitting

When the radio is transmitting, microphone audio is digitized and then processed by the DSP and sent to the frequency synthesis IC (see Figure 3: Transmitter Block Diagram on page 39) through the TX SSI interface. The synthesizer IC processes the SSI data for application to the voltage controlled oscillator as a modulation signal.

Figure 3: Transmitter Block Diagram



3.1.1.2.1 Transmit

When a frequency for transmit has been selected, the synthesizer IC and its accompanying logic circuitry enable the correct voltage controlled oscillator which then generates the desired transmit frequency.

The transmit signal is then routed to the TX buffer amplifier which amplifies the signal. An RF switch routes the signal to the appropriate pre-filter and enters Driver amplifier and then to the discrete final stage. The signal is filtered by a harmonic filter and passed through a RF switch into a directional coupler. The Log Amp power detector monitors the output of the directional coupler and adjusts the control voltages to the driver amplifier and the discrete final. The RF switch routes the power to the main antenna.

3.2 Digital Mode of Operation

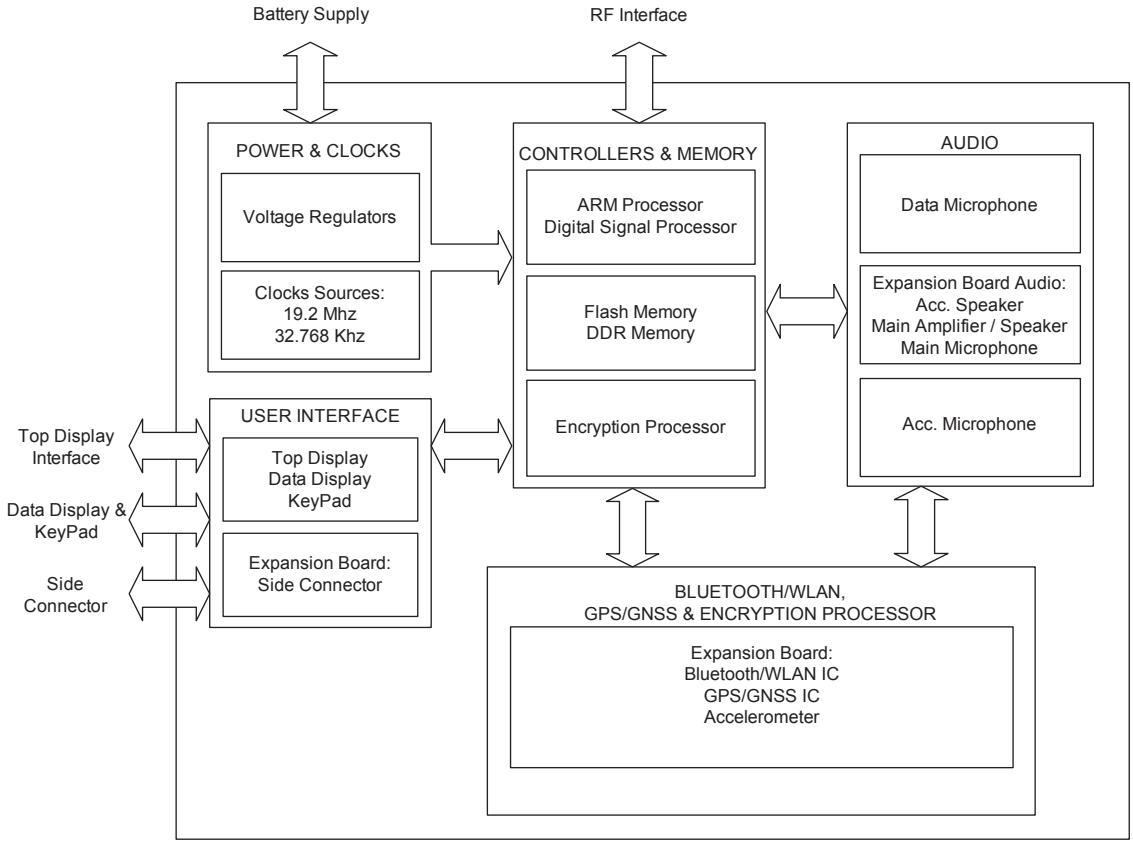
In the digital mode of operation, the transmitted or received signal is limited to a discrete set of frequency deviation levels.

The receiver handles a signal identical to an analog-mode signal, up to the point where the DSP decodes the received data. In the receive mode, the DSP uses a different algorithm to recover data. In the transmit mode, microphone audio is processed identically to an analog mode, with the exception of the algorithm the DSP uses to encode the information. Using this algorithm, transmitter FM deviation is limited to discrete levels.

3.2.1
Controller Section

The controller section comprises of five functional sections that are split among two boards, which are the VOCON and EXPANSION boards. The main functional section consists of a dual core ARM and DSP controller, Flash memory, and a Double Data Rate Synchronous Dynamic Random Access Memory (DDR SDRAM). The main section also includes a Type III encryption processor (MACE).The Power and Clocks section includes a power management IC (CPCAP 4.0) and various external switching regulators, and two clock sources (19.2 MHz and 32.768 kHz) from which all other controller digital clocks are derived. The Audio section has a stereo CODEC and a class-D audio power amplifier that provides the radio with a multiple internal microphone, single speaker design. A secondary class-D audio power amplifier is used for the accessory port. The User Interface section provides communication and control to the top and main Liquid Crystal Displays (LCD) on the radio, as well as a keypad and a side connector interface conforming to Universal Connector specifications. The Expansion Board consists of two class-D audio power amplifiers, a GNSS integrated-circuit providing Global Positioning System (GPS) and GLONASS functionality, a combination-integrated circuit consisting of WLAN (IEEE 802.11 n/g/b) and a Bluetooth (BT) 4.0 capable transceiver, and a 3-axes digital accelerometer.

Figure 4: Controller Block Diagram



The ARM controller core of the OMAP L138 processor handles the power-up sequence of all devices, including firmware upgrades, and all operating system tasks that are associated with FLASH and SDRAM memories and user interface communication. The FLASH memory (4 GB eMMC) is required to store the firmware, tuning, and Codeplug settings, which upon initializations get read and stored into SDRAM (128 MB) for execution. The ARM and DSP core jointly control and configure audio, wireless, and RF devices linked to the Serial Peripheral Interface (SPI) and Synchronous Serial Interface (SSI) buses to enable radio FM, and optional wireless communication protocols. For encryption, a separate ARM processor is used (MACE) to encode and decode encryption packets coming in from the main

OMAP L138 processor through the SSI interface. Its firmware is flashed through the main processor during an upgrade request to its internal FLASH memory.

The power to all the controller devices is provided by the CPCAP IC and the external switching and linear regulators on board. The CPCAP IC also provides the 32.768 kHz clock to the OMAPL138 and expansion, and provides a 4.8 MHz clock to the MACE encryption IC. The main reference clock of OMAPL138 is supplied from the transceiver board.

The radio has two internal microphones and an internal speaker, as well as available microphone and speaker connections for external accessories. The internal 4 Ω speaker is located opposite to the main display and keypad of the radio. The internal speaker is driven by a Class D audio amplifier on the expansion board that is capable of delivering a rated power of 1 W. The external accessory speaker is also driven by a class-D audio amplifier on the expansion board that is capable of delivering 1 W of power into a 4 Ω load. Both speaker paths use the CODEC for volume control and to convert the audio signal from digital to analog. Both internal and external microphones use the CODEC ADC to deliver digital audio samples to the DSP controller.

The user interface block consists of a top and main or "data side" display, a keypad, top controls, and the accessory side connector. The side connector (Universal Connector) provides audio, USB, RS232, and RF communication path for accessories. All signals to and from the connector go through the internal expansion board before reaching the power management IC (CPCAP) and other devices on the main board.

3.2.1.1
Expansion Board

The Expansion Board features consists of two class-D audio power amplifiers dedicated to driving the internal and accessory speakers, a GNSS integrated-circuit engine consisting of a Global Positioning System (GPS) and GLONASS receiver, an integrated circuit that combines a WLAN transceiver (IEEE 802.11 n/g/b) and a Bluetooth (BT) 4.0 capable transceiver, and a 3-axes digital accelerometer.

The GNSS receiver IC interfaces with the OMAP L138 processor though a shared I2C bus. The GNSS receiver also has a dedicated reset controlled solely by the OMAP L138 processor. The radio is able to connect to a wireless Bluetooth audio headset. This feature is implemented using the Bluetooth core of a combined WLAN/Bluetooth integrated circuit (IC) on the expansion board. An optional Bluetooth accessory can be paired to the APX radio using the Bluetooth channels from 2402 MHz to 2480 MHz working in the ISM band. Each APX accessory that is capable of Bluetooth communication has its own unique Bluetooth address. Bluetooth uses a frequency hopping spread spectrum (FHSS) technique to spread the RF power across the spectrum to reduce the interference and spectral power density. The frequency hopping allows the channel to change up to 1600 times a second (625 µs time slot) based on a pseudo random sequence. If a packet is not received on one channel, the packet is re-transmitted on another channel. The Bluetooth/WLAN IC, Marvell 88W8777 IC Multi-function Wireless Connectivity System-On-Chip (SOC) sends data to the OMAP L138 which on the VoCon board over SDIO bus.

The Bluetooth feature is accompanied by a Low-Frequency (LF) detection circuit that is also on the expansion board. The LF circuit provides an enhanced level of secure Bluetooth pairing for devices that implement our Motorola Solutions Proximity Pairing feature (such as our mission-critical Bluetooth audio headset. Once a radio has the Bluetooth feature enabled, tap LF enabled Bluetooth accessory with the radio at the pairing spot to establish a secure Bluetooth connection. The LF circuit uses a 125 kHz radiated signal to communicate the secure pairing information between the Bluetooth accessory and low-frequency receiver. The low-frequency receiver is programmed by the OMAP L138 processor through a dedicated SPI bus and transfers the pairing data through a dedicated UART. There is also a digital accelerometer on the expansion board that detects the 3-axis force of gravity which can be used to determine the orientation of the radio. The accelerometer position is communicated to the OMAP L138 processor through a I2C bus.

The radio also able to connect to a wireless network access point utilizing the WLAN core of the combined WLAN/Bluetooth integrated circuit (IC) on the expansion board. The WLAN transceiver supports the IEEE 802.11 b/g/n data rate standards and the 802.11i security standard. When this

feature is enabled, Wi-Fi allows the radio to be wirelessly updated with a new codeplug and radio software without the need for connecting the GCAI USB cable. The Wi-Fi AP name and password are set in the codeplug and the radio management software enabled to provide wireless updates. When the Wi-Fi of the radio is actively connected to an AP, a receive signal strength indicator (RSSI) is shown on the front display (model 2.5 or model 3.5). The WLAN core interfaces directly to the OMAP L138 host processor through a dedicated 4-bit wide SDIO bus. The WLAN transceiver also has a dedicated reset controlled solely by the OMAP L138 processor.

Chapter 4

Test Equipment and Service Aids

This section lists the recommended test equipment and service aids, and information on field programming equipment. You can use this information in servicing and programming radios.

4.1 Recommended Test Equipment

The list of equipment in the following table includes all the standard test equipment required for servicing two-way portable radios. The list includes several unique items designed specifically for servicing this family of radios.

The Characteristics column is included so that equivalent equipment can be substituted. However, if no information is provided in this column, the specific Motorola Solutions model listed is either a unique item or no substitution is recommended.

Table 7: List of Recommended Test Equipment

Equipment	Characteristics	Example	Application
DC Block	0.005–26.500 GHz	RF-Lamda RFDCBLK26SMA	To protect test equipments, a DC Block must be placed at the antenna port of the Radio at all times before connecting to the equipment.
Service Monitor	Can be used as a substitute	Viavi 3920 (https://www.viavi-solutions.com/)[1]	Frequency/deviation meter and signal generator for wide-range trouble-shooting and alignment
Digital RMS Multimeter [2]	100 µV to 300 V 5 Hz to 1 MHz 10 Ω Impedance	Fluke 179 (www.fluke.com) or equivalent	AC/DC voltage and current measurements. Audio voltage measurements.
RF Signal Generator [2]	100 MHz to 1 GHz -130 dBm to +10 dBm FM Modulation 0 kHz to 10 kHz Audio Frequency 100 Hz to 10 kHz	Keysight N5181A (www.keysight.com), or equivalent	Receiver measurements
Oscilloscope [2]	2 Channel 50 MHz Bandwidth 5 mV/div to 20 V/div	Tektronix TDS1001b (www.tektronix.com) or equivalent	Waveform measurements

[1] Referenced in this manual as an example for test setup guidelines.
[2] You can use Service Monitor as a substitute.

Equipment	Characteristics	Example	Application
RF Millivolt Meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 9240 (www.boonton.com) or equivalent	Waveform measurements
Power Supply	0 V to 32 V 0 A to 20 A	B&K Precision 1790 (www.bkprecision.com) or equivalent	Voltage supply
Power Meter and Sensor[2]	5% accuracy 100 MHz to 500 MHz 50 W	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power/RF wattage output measurements

4.2 Service Aids

Refer to the following table for a listing and description of the service aids designed specifically for servicing this family of radios. These kits and/or parts are available from the Radio Products and Solutions Organization offices listed in Replacement Parts Ordering on page 176. While all these items are available from Motorola Solutions, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Motorola Solutions Part Number	Description	Application
5880384G68	SMA to BNC Adapter	Adapts antenna port to BNC cabling of test equipment.
66009254002	APX Battery Adapter	Used in place of battery to connect radio to an external power supply.
66009256001	Volume Potentiometer Outer Spanner Bit	Used to assemble and disassemble the spanner nut on the volume potentiometer.
66009258001	Antenna Spanner Bit	Used to assemble and disassemble the spanner nut on the antenna bushing.
66009259001	Vacuum Adapter	Submersible radios only. Connects the vacuum/pressure hose to the radio.
66009260001	Board Analysis Fixture	Special fixture that allows the internal board of the radio to be mounted externally. Provides easy access to electronic circuits, required for board-level troubleshooting.
NLN9839_	Vacuum Pump Kit	Submersible radios only. Vacuum pump with gauge and vacuum hose. Requires TL000128A01 Adapter Kit.
NTN4265_	Pressure Pump Kit	Submersible radios only. Pressure pump with gauge and pressure hose. Requires 66009259001 Adapter Kit.
RVN5224_	Customer Programming Soft-	CPS allows customer-specific programming of modes and features. Tuner software is required to perform alignment of radio parameters.

Motorola Solutions Part Number	Description	Application
	ware (CPS) and Tuner Software	
PMKN4012_	Programming Cable	Used to program the radio through Customer Programming Software and Tuner Software.
PMKN4013_	Programming/ Service Cable	Used to program and service the radio through Customer Programming Software and Tuner Software.
RLN4460_	Portable Test Set	Used for radio performance checks. Connects to the universal connector and allows remote switching and signal injection/outputs for test equipment measurements.

4.3 Field Programming

This family of radios can be programmed in the field.

This requires specific equipment and special instructions. Refer to the online help in the Customer Programming Software (CPS) programming client application for complete field programming information.

Chapter 5

Performance Checks

This chapter covers performance checks used to ensure that the radio meets published specifications.

NOTE: Radios coming from manufacturing do not need to be tuned. Reference oscillator should be checked and aligned (if necessary) for radios in storage for 6 months or more before commission for service.

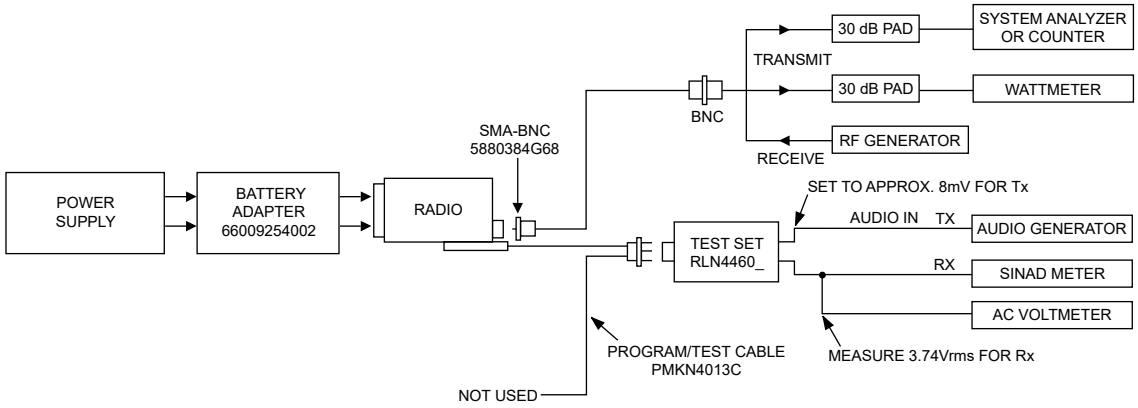
The recommended test equipment listed in the previous section is almost accurate to the manufacturing equipment. Maintenance of the test equipment must be aligned with the manufacturer recommended calibration schedule. Checks should be performed if radio performance declines.

NOTE: If automated testing is performed using Aeroflex 3920 test equipment, the latest software versions can be downloaded from Aeroflex Test Equipment webpage. Proper radio and 3920 test setup guidelines are specified under Manuals and Training tab.

5.1 Test Equipment Setup

Supply voltage can be connected from the battery eliminator. The equipment required for the performance checks is connected as shown in the following figure.

Figure 5: Performance Checks Test Setup



Initial equipment control settings should be as indicated in Table 8: Initial Equipment Control Settings on page 47 and should be the same for all performance checks and alignment procedures, except as noted.

NOTE: If a service monitor such as Aeroflex 3920 test equipment is being used for automated testing, please make sure to use the latest software version available for the equipment. Also make sure to follow test equipment setup guidelines such as accounting for cable loss specified by the manufacturer. Latest release software versions for Aeroflex 3920 can be downloaded from https://www.viavisolutions.com/en-us/products/3920b-series-analog-and-digital-radio-test-platform web page. Proper radio and Aeroflex 3920 test setup guidelines are specified under Manuals and Training tab of the web page.

Table 8: Initial Equipment Control Settings

System Analyzer	Test Set	Power Supply
Mode Analog duplex	**Spkr/Load** Speaker	**Voltage** 7.5 Vdc
Receiver Checks **RF Control** Generator **Meter** RF Display **Output Level** -47 dBm **Modulation** 1 kHz tone @ 1.5 kHz deviation for 12.5kHz ChSp, OR 3 kHz deviation for 25 kHz ChSp **Frequency** Set to selected radio RX frequency **Transmitter Checks** **RF Control** Analyzer **Frequency** Set to selected radio TX frequency **Meter** RF Display **Modulation Type** FM	**PTT** OFF (center)	**DC On/Standby** Standby
	Meter Out RX	**Volt Range** 10 Vdc
	``**Opt Sel** ON	**Current** 2.5 A

5.2
Display Radio Test Mode (Dual-Display Version)

This section provides instructions for performing tests in display radio test mode.

5.2.1
Accessing Test Mode

NOTE:

- All displays in the test mode are temporary and expires without any user intervention. If information is longer than the physical length of the radio display, the information will wrap around to the next display. After the last display, `RF TEST` is displayed.
- Once your radio is in a particular test mode, you must turn off the radio and turn it back on again to access the other test mode.

Procedure:

1 Turn the radio on.

2 Within 10 seconds, press **Side Button 2** five times in succession.

The radio displays a series of information regarding various version numbers and radio specific information.

Table 9: Test-Mode Displays

Name of Display	Description	Appears
`Service`	The literal string indicates the radio has entered test mode.	Always
`Host version`	The version of host firmware is displayed.	Always
`DSP version`	The version of DSP firmware is displayed.	Always
`Secure version/Secure HW Type/Secure HW Ver`	Version of the encryption software and hardware.	When the radio is secure equipped
`KG1` algorithms name (Encryption Type 1)	Type of encryption being used	When the radio is secure equipped
`KG2` algorithms name (Encryption Type 2)	Type of encryption being used	When the radio is secure equipped and 2 or more algorithms are loaded
`KG3` algorithms name (Encryption Type 3)	Type of encryption being used	When the radio is secure equipped and 3 or more algorithms are loaded
`KG4` algorithms name (Encryption Type 4)	Type of encryption being used	When the radio is secure equipped and 4 or more algorithms are loaded
`KG5` algorithms name (Encryption Type 5)	Type of encryption being used	When the radio is secure equipped and 5 or more algorithms are loaded
`KG6` algorithms name (Encryption Type 6)	Type of encryption being used	When the radio is secure equipped and 6 or more algorithms are loaded
`Model number`	The model number of the radio, as programmed in the codeplug	Always
`Serial number`	The serial number of the radio, as programmed in the codeplug	Always
`ESN`	The unique electronic serial number of the radio	Always
`ROM Size`	The memory capacity of the host FLASH part	Always
`FLASHcode`	The FLASH codes as programmed in the codeplug	Always

Name of Display	Description	Appears
RF band 1,2,3,4	The operating frequency of the radio	Always
Tuning Version	Version of Tuning codeplug	Always
Proc Version	Version of Processor	Always
Option Board	Type of Option board being used	Always
Option Board Serial Number	Serial number of the Option board is displayed	Always
Option Board Bluetooth Address	Bluetooth Address of the Option board is displayed	Always
Option Board SW Version	Software version of the Option Board is displayed	Always
Exp Board Type	Type of Expansion Board is displayed	Always
MAC Address AA:BB:CC:DD:EE:FF	Displays the MAC address of the Wi-Fi hardware	Always

3 Press the **Top Side Button** to advance the test environments from RF TEST, CH TEST, RGB TEST, CID TEST then press the **Top Button** to confirm selection.

NOTE:
After the last display, RF TEST is displayed.

To freeze any of the displays in test mode, press the left arrow on the 4-Way Navigation Button. To resume automatic scrolling, press the right arrow on the 4-Way Navigation Button. To rapidly scroll forward through the displays, continue pressing the right arrow. You cannot scroll backwards.

Press any other buttons to advance the test.

Once a test is carried out, restart the radio to proceed to another test.

4 Do one of the following:

- Press the **Top Side Button** to stop the displays and toggle between RF test mode and the Control Top and Keypad test mode. The test mode menu CH TEST is displayed, indicating that you have selected the Control Top and Keypad test mode.

  NOTE: Each press of the **Top Side Button** (Purple button) scrolls through RF TEST, CH TEST, RGB TEST and CID TEST.

- Press the **Top Button** to stop the displays and put the radio into the RF test mode. The test mode menu, 1 CSQ, is displayed, indicating test frequency 1, Carrier SQuelch mode. See RF Test Mode on page 55.

5.2.2

RF Test Mode

When the radio is operating in its normal environment, the radio microcomputer 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 using a special routine, **RF TEST MODE**.

While in RF test mode:

- Each additional press of **Side Button 2** advances to the next test channel. (Refer to Table 10: Test Frequencies (MHz) on page 50.)
- Pressing **Side Button 1** scrolls through and accesses the test environments shown in Table 11: Test Environments on page 50.
- Pressing **Top Side** Button scrolls through the Tx Deviation Frequency.

NOTE: Transmit into a load when keying a radio under test.

Table 10: Test Frequencies (MHz)

Test Channel	RX Frequency (MHz)	TX Frequency (MHz)
F1	136.075	136.025
F2	154.2750	154.2250
F3	173.9250	173.9750
F4	380.0750	380.0250
F5	424.9750	424.9250
F6	469.9750	469.9250
F7	471.0750	471.0250
F8	495.0750	495.0250
F9	519.9250	519.9750
F10	764.0625	764.0125
F11	769.0625	794.0125
F12	851.0625	823.9875
F13	860.0625	851.0125
F14	869.9375	869.8875

Table 11: Test Environments

Display	Description	Function
CSQ	Carrier Squelch	**RX** unsquelch if carrier detected **TX** mic audio
TPL	Tone Private-Line	**RX** unsquelch if carrier and tone (192.8 Hz) detected

Display	Description	Function
		TX mic audio + tone (192.8 Hz)
AST	ASTRO	**RX** none **TX** Digital Voice[3]
USQ	Carrier Unsquelch	**RX** unsquelch always **TX** mic audio

5.2.3
Control Top and Keypad Test Mode

This test mode is used to verify proper operation of the radio buttons and switches if a failure is suspected.

5.2.3.1
Control Top Checks/Keypad Checks (for Model 3 only)

Any key press causes the test to advance from one step to the next.

Table 12: Control Top Checks

Action	Result
Press and hold **Top Button** (Orange button).	Radio icons are displayed and LED lights amber.
Release the **Top Button**.	`148/0` appears. The **Top Button** is in the open position. Your radio is now in the Control Top and Keypad test mode.
Press the **Top Button** again.	`148/1` appears. The **Top Button** is in the closed position.
Rotate the **16-Position Select Switch**.	`4/0` through `4/15` appears. The selector switch is in mode/zone position 1 through 16.
Flip the **Two-Position Concentric Switch**.	`65/0` and `65/1` appear.
Cycle through the **Three-Position A/B/C Switch**.	`67/0`, `67/1`, and `67/2` appear.
Rotate the **Volume Control**.	`2/0` through `2/255` appear. The display values may vary slightly at the upper and lower limits.
Press the **Top Side Button**.	`96/1` appears.
Release the **Top Side Button**.	`96/0` appears.

[3] All deviation values are based on deviation tuning of this mode.

Action	Result
Press the **Side Button 1**.	`97/1` appears.
Release the **Side Button 1**.	`97/0` appears.
Press the **Side Button 2**.	`98/1` appears.
Release the **Side Button 2**.	`98/0` appears.
Press the **PTT Button**.	`1/1` appears.
Release the **PTT Button**.	`1/0` appears.

5.2.4
Performing RGB Test

Perform this test on the top display of the radio.

Procedure:

1. To enter RGB Test Mode, press the **Top (Orange) Button**.
   The display turns black.
2. Press any key consecutively.
   After each key press, the display shows the following results:
   1. Crosstalk pattern appears.
   2. White screen appears.
   3. Red horizontal lines appear.
   4. After seven consecutive key presses, solid red screen appears
   5. After three consecutive key presses, green vertical lines appear.
   6. After nine consecutive key presses, solid green screen appears.
   7. Black screen appears.
   8. Blue screen appears.
   9. Vendor-specific display TEST PATTERN appears.
   10. `Test completed` appears.
3. To exit RGB Test Mode, turn off the radio.

5.2.5
CID Test Mode

Perform the following step for CID test:

Procedure:

1. Press and release **Top Button** (Orange button).
   All pixels are on.
2. Press any key.
   Checker box 1 test appears.

3 Press any key.

Checker box 2 test appears.

4 Press any key.

`4 bolder test` test appears on the top display.

5 Press any key.

`Test completed` appears.

5.3 Display Radio Test Mode (Top-Display Version)

This section provides instructions for performing tests in non-display radio test mode.

5.3.1 Access the Test Mode

To enter the display radio test mode:

Procedure:

1 Turn the radio on.

2 Within 10 seconds after “SELF TEST” is complete, press **Side Button 2** five times in succession.

The radio shows a series of displays that give information regarding various version numbers and subscriber specific information. The displays are described in Table 13: Test-Mode Displays (Top-Display Version) on page 53.

Table 13: Test-Mode Displays (Top-Display Version)

Name of Display	Description	Appears
`Service`	The literal string indicates the radio has entered test mode.	Always
`Host version`	The version of host firmware is displayed.	Always
`DSP version`	The version of DSP firmware is displayed.	Always
`Secure version`	Version of the encryption software	When the radio is secure equipped
`KGI` algorithms name (Encryption Type 1)	Type of encryption being used	When the radio is secure equipped
`KG2` algorithms name (Encryption Type 2)	Type of encryption being used	When the radio is secure equipped and 2 or more algorithms are loaded
`KG3` algorithms name (Encryption Type 3)	Type of encryption being used	When the radio is secure equipped and 3 or more algorithms are loaded

Name of Display	Description	Appears
KG4 algorithms name (Encryption Type 4)	Type of encryption being used	When the radio is secure equipped and 4 or more algorithms are loaded
KG5 algorithms name (Encryption Type 5)	Type of encryption being used	When the radio is secure equipped and 5 or more algorithms are loaded
KG6 algorithms name (Encryption Type 6)	Type of encryption being used	When the radio is secure equipped and 6 or more algorithms are loaded
Model number	The model number of the radio, as programmed in the codeplug	Always
Serial number	The serial number of the radio, as programmed in the codeplug	Always
ESN	The unique electronic serial number of the radio	Always
ROM Size	The memory capacity of the host FLASH part	Always
FLASHcode	The FLASH codes as programmed in the codeplug	Always
RF band 1	The operating frequency of the radio	Always
Tuning Ver	Version of Tuning codeplug	Always
Proc Ver	Version of Processor	Always
Option Board Type	Type of Option board being used	When the radio has an Option Board/Maze with Application Expansion Board
Option Board Serial Number	Serial number of the Option board is displayed	When the radio has an Option Board/Maze with Application Expansion Board
Option Board Bluetooth Addr	Bluetooth Address of the Option board is displayed	When the radio has an Option Board/Maze with Application Expansion Board
Option Board SW Version	Software version of the Option Board is displayed	When the radio has an Option Board/Maze with Application Expansion Board
Exp Board Type	Type of Expansion Board is displayed	When the radio has an Expansion Board

NOTE: All displays are temporary and expires without any user intervention. If information is longer than the physical length of the radio display, the information wraps around to the next display. After the last display, RF TEST is displayed.

Press the **Top Side Button** (Purple button) to advance the test environments from RF TEST, CH TEST, CID TEST, then press the **Top Button** (Orange button) to confirm

selection. Press any other buttons to advance the test.

Once a test is carried out, restart the radio to proceed to another test.

3 Do one of the following:

a Press the **Top Side Button** to stop the displays and toggle between RF test mode and the Control Top and Keypad test mode. The test mode menu `CH TEST` is displayed, indicating that you have selected the Control Top and Keypad test mode.

Each press of the **Top Side Button** (Purple button) scrolls through `RF TEST`, `CH TEST`, and `CID TEST`.

b Press the **Top Button** (Orange button) to stop the displays and put the radio into the RF test mode. The test mode menu, `1 CSQ`, is displayed, indicating test frequency 1, Carrier SQuelch mode. Go to Section RF Test Mode on page 55.

NOTE: Once your radio is in a particular test mode, you must turn off the radio and turn it back on again to access the other test mode.

5.3.2
RF Test Mode

When the radio is operating in its normal environment, the radio microcomputer 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 using a special routine, **RF TEST MODE**.

While in RF test mode:

- Each additional press of **Side Button 2** advances to the next test channel. (Refer to Table 10: Test Frequencies (MHz) on page 50.)
- Pressing **Side Button 1** scrolls through and accesses the test environments shown in Table 11: Test Environments on page 50.
- Pressing **Top Side** Button scrolls through the Tx Deviation Frequency.

NOTE: Transmit into a load when keying a radio under test.

Table 14: Test Frequencies (MHz)

Test Channel	RX Frequency (MHz)	TX Frequency (MHz)
F1	136.075	136.025
F2	154.2750	154.2250
F3	173.9250	173.9750
F4	380.0750	380.0250
F5	424.9750	424.9250
F6	469.9750	469.9250
F7	471.0750	471.0250
F8	495.0750	495.0250
F9	519.9250	519.9750
F10	764.0625	764.0125
F11	769.0625	794.0125

Test Channel	RX Frequency (MHz)	TX Frequency (MHz)
F12	851.0625	823.9875
F13	860.0625	851.0125
F14	869.9375	869.8875

Table 15: Test Environments

Display	Description	Function
CSQ	Carrier Squelch	**RX** unsquelch if carrier detected **TX** mic audio
TPL	Tone Private-Line	**RX** unsquelch if carrier and tone (192.8 Hz) detected **TX** mic audio + tone (192.8 Hz)
AST	ASTRO	**RX** none **TX** Digital Voice[4]
USQ	Carrier Unsquelch	**RX** unsquelch always **TX** mic audio

5.3.3
Control Top Test Mode

This test mode is used to verify proper operation of all radio buttons and switches if a failure is suspected.

5.3.3.1
Control Top Checks

Any key press causes the test to advance from one step to the next.

Table 16: Control Top Checks

Action	Result
Press and hold **Top Button** (Orange button).	The radio icons are displayed and LED lights amber.
Release the **Top Button**.	`148/0` appears.

[4] All deviation values are based on deviation tuning of this mode.

Action	Result
	The **Top Button** is in the open position. Your radio is now in the Control Top and Keypad test mode.
Press the **Top Button** again.	`148/1` appears. appears. The **Top Button** is in the closed position.
Rotate the **16-Position Select Switch**.	`4/0` through `4/15` appears. appears. The selector switch is in mode/zone position 1 through 16.
Cycle through the **Three-Position A/B/C Switch**.	`67/0`, `67/1`, and `67/2` appear.
Rotate the **Volume Control**.	`2/0` through `2/255` appear. The display values may vary slightly at the upper and lower limits.
Press the **Top Side Button**.	`96/1` appears.
Release the **Top Side Button**.	`96/0` appears.
Press the **Side Button 1**.	`97/1` appears.
Release the **Side Button 1**.	`97/0` appears.
Press the **Side Button 2**.	`98/1` appears.
Release the **Side Button 2**.	`98/0` appears.
Press the **PTT Button**.	`1/1` appears.
Release the **PTT Button**.	`1/0` appears.

5.3.4
CID Test Mode

Perform the following step for CID test:

Procedure:

1. Press and release **Top Button** (Orange button).

   All pixels are on.

2. Press any key.

   Checker box 1 test appears.

3. Press any key.

   Checker box 2 test appears.

4. Press any key.

   `4 bolder test` test appears on the top display.

5. Press any key.

   `Test completed` appears.

5.4

Checking Receiver Performance

The following tables outline the performance checks for the receiver.

NOTE: The following tests require a communications system analyzer with the ASTRO 25 test options.

Table 17: Receiver Performance Checks

Test Name	System Analyzer	Radio	Test Set	Comments
Reference Frequency	RF Control: Analyzer Meter: RF Display/Freq Offset Frequency: Selected radio TX frequency	TEST MODE CSQ channel[5] or programmed conventional channel	PTT to continuous (during the performance check)	VHF: ±0.8 ppm (±227 Hz) UHF1: ±0.8 ppm (±289 Hz) 700 MHz–800 MHz: ±0.8 ppm (±709 Hz)
Rated Audio at GCAI connector	RF Control: Generator Output Level: -47 dBm Frequency: Selected radio RX frequency Mod: 1 kHz tone @ 1.5 kHz deviation[6] Meter: RF Display/Audio Level	As above	PTT to OFF (center) Load Selector: A	Set volume control to 3.74 Vrms[6]or 2.8 Vrms [6]
Distortion	As above, except Meter: RF Display/AF Meter Dist.	As above	As above	Distortion <3.0%
Sensitivity (SINAD)	As above, except Meter: RF Display/AF Meter SINAD RF Output Level: Adjust until SINAD = 12 dB	As above	As above	RF input to be <0.35 µV

[5] See Table 11: Test Environments on page 50Table 1
[6] 1 kHz tone @ 1.5 kHz deviation for 12.5 kHz ChSp, OR 3 kHz deviation for 25 kHz ChSp.

Test Name	System Analyzer	Radio	Test Set	Comments
Noise Squelch Threshold (only radios with conventional system need to be tested)	Set as for rated audio check	Out of TEST MODE; select a conventional system	As above	Set volume control to 3.74 Vrms. Set RF level to -130 dBm and raise until radio unsquelches. Unsquelch to occur at <0.25 µV. Preferred SINAD = 6–8 dB.

Table 18: Receiver Tests for ASTRO Conventional Channels

Test Name	System Analyzer	Radio	Test Set	Comments
Bit Error rate (BER) Floor	Mode: P25 RF Control: TX Output Level: -47 dBm P25 Set: Phase 1 C4FM Pattern: STD 1011 Frequency: Selected radio RX frequency	Radio Tuner Software (Bit Error Rate screen) is required	PTT to OFF (center)	BER <0.01 % (Use test setup shown in Test Setup on page 63)
Reference Sensitivity	As above; lower the output level until 5% BER is obtained	As above	As above	Output level <0.35 µV (-116 dBm) (Use test setup shown in Test Setup on page 63)
Audio Output Distortion	Mode: P25 RF Control: TX Output Level: -47 dBm P25 Set: Phase 1 C4FM Pattern: STD 1011 Frequency: Selected radio RX frequency	Radio Tuner Software not used; Radio: Out of TEST MODE; Select a conventional ASTRO channel	PTT to OFF (center) Meter selector to Audio PA Spkr/Load to Speaker	Distortion <3.0 %

Test Name	System Analyzer	Radio	Test Set	Comments
	Meter: Audio Distortion			
Residual Audio Noise Ratio	Mode: P25 RF Control: TX Output Level: -47 dBm P25 Set: Phase 1 C4FM Pattern: • STD 1011 • STD Silence Frequency: Selected radio RX frequency Meter: Audio Distortion	As above	As above	Residual Audio Noise Ratio -45 dB or better

5.5

Checking Transmitter Performance

The following tables outline the performance checks for the transmitter.

NOTE: The following tests require a communications system analyzer with the ASTRO 25 test options.

Table 19: Transmitter Performance Checks

Test Name	System Analyzer	Radio	Test Set	Comments
Reference Frequency	RF Control: Analyzer Meter: RF Display/Freq Offset Freq: Selected radio TX frequency	TEST MODE CSQ channel or programmed conventional channel See Table 11: Test Environments on page 50 .	PTT to continuous (during the performance check).	VHF: ±0.8 ppm (±140 Hz) UHF1: ±0.8 ppm (±376 Hz) 700–800 MHz: ±0.8 ppm (±696 Hz)
RF Power	As above, except Meter: RF Display/Broadband Power	As above	As above	VHF: 1–6 W UHF1: 1–5 W 700: 1–2.7 W 800: 1–3 W
Voice Modulation (external)	As above, except	As above	As above	Deviation:

Test Name	System Analyzer	Radio	Test Set	Comments
	Meter: RF Display/FM Dev Set Audio generator to fixed 1 kHz and audio level to 400 mV			(12.5 kHz) ≥2.1 kHz, but ≤ 2.5 kHz (25 kHz) ≥ 4.1 kHz, but ≤ 5.0 kHz
Voice Modulation (internal)	RF Control: Analyzer Meter: RF Display/FM Dev Freq: Selected radio TX frequency	As above	Remove modulation input. PTT to OFF (center).	Press **PTT** button on the radio. Say “four” loudly into the radio mic. Measure deviation: (12.5 kHz) ≥2.1 kHz but ≤ 2.5 kHz (25 kHz) ≥ 4.1 kHz but ≤ 5.0 kHz
PL Modulation (radios with conventional, clear mode, coded squelch operation only)	As Voice Modulation Test except 300 Hz filtering enabled (internal)	Conventional coded squelch personality (clear mode operation) or TPL channel See Table 11: Test Environments on page 50.	PTT to continuous (during the performance check)	Press PTT on the radio. Deviation: (12.5 kHz) ≥ 375 Hz but ≤ 500 Hz (25 kHz) ≥ 500 Hz but ≤ 1000 Hz
Secure Modulation (radios with conventional, secure mode, talkaround operation only)	As Voice Modulation	Programmed conventional channel (secure mode operation). Load key into radio.	As above	Deviation: ≥ 3.7 kHz but ≤ 4.3 kHz

Table 20: Transmitter Tests for ASTRO Conventional Channels

Test Name	System Analyzer	Radio	Test Set	Comments
RF Power	Mode: P25 RF Control: RX P25 Set: Phase 1 C4FM Freq: Selected radio TX frequency Meter: UUT Measurements/	Radio Tuner Software not used. Radio: Out of TEST MODE; Select a conventional ASTRO channel	PTT to continuous (during measurement).	VHF: 1–6 W UHF1: 1–5 W 700: 1–2.7 W 800: 1–3 W

Test Name	System Analyzer	Radio	Test Set	Comments
	Broadband Power			
Frequency Error	Mode: P25 RF Control: RX P25 Set: Phase 1 C4FM Freq: Selected radio TX frequency Meter: UUT Measurements/ Frequency Error	As above	As above	Error ≤ ±1.0 kHz
Frequency Deviation	Mode: P25 RF Control: RX Analog Freq: Selected radio TX frequency Meter: UUT Measurements/FM Deviation	Radio Tuner Software (Transmitter Test Pattern screen) is required High use: Symbol Rate PAT Low use: Low Symbol Rate P	PTT to OFF (center)	D_{HIGH} ≥2.543 kHz but ≤ 3.110 kHz D_{LOW} ≥0.841 kHz but ≤ 1.037 kHz (Use test setup shown in Test Setup on page 63

Chapter 6

Radio Alignment Procedures

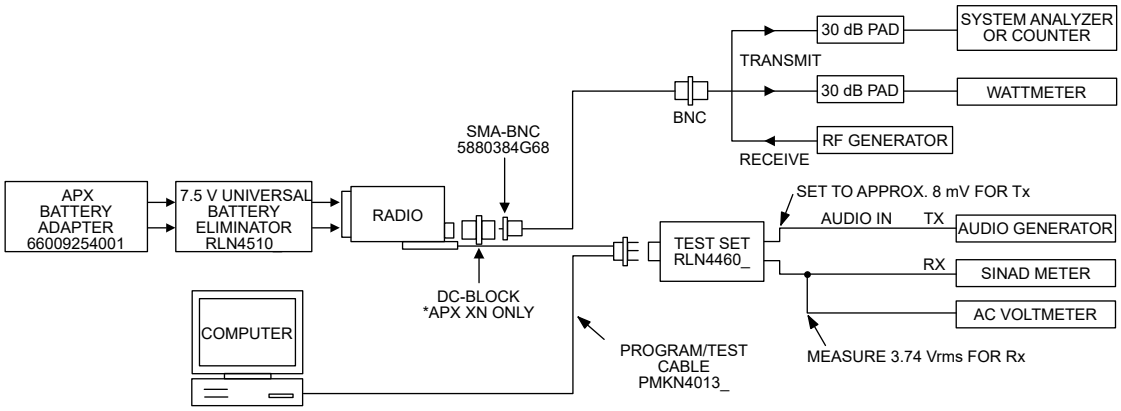
This chapter describes both receiver and transmitter radio alignment procedures.

6.1 Test Setup

A personal computer (PC) and tuner software are required to align the radio. Refer to the applicable manual for installation and setup procedures for the software. To perform the alignment procedures, the radio must be connected to the PC and to a universal test set.

The radio alignment test setup is shown in the following figure.

Figure 6: Radio Alignment Test Setup



CAUTION: These radio alignment procedures must only be attempted by qualified service personnels. Failure to perform alignment procedures properly can result in seriously degraded radio or system performance.

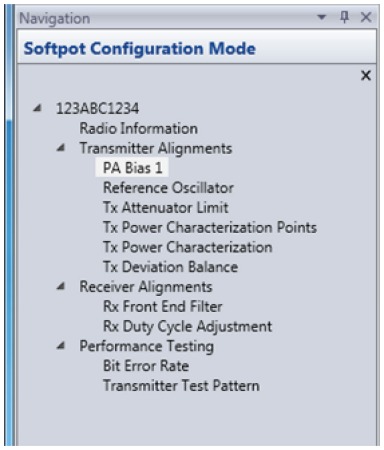
NOTE: If automated testing is to be performed using Aeroflex 3920 Test equipment, latest release software versions can be downloaded from Aeroflex Test Equipment webpage. Proper radio and 3920 test setup guidelines are specified under Manuals and Training tab.

6.2 Tuner Main Menu

Select **Tuner** from the START menu by clicking **Start→Program Files→Motorola→ASTRO 25 Products→ASTRO 25 Tuner**. To read the radio, click **File→Read Device** or click on 

. Figure 7: Tuner Software Main Menu on page 64 illustrates how the alignment screens are organized. To access a screen, double-click on the desired screen name in the Tuner menu.

Figure 7: Tuner Software Main Menu



IMPORTANT: Tuning should follow the order of the Tuning tree view in descending order from top to bottom

NOTE: If a service monitor such as Aeroflex 3920 test equipment is being used for automated testing, please make sure to use the latest software version available for the equipment. Also make sure to follow test equipment setup guidelines such as accounting for cable loss specified by the manufacturer. Latest release software versions for Aeroflex 3920 can be downloaded from https://avcomm.viavisolutions.com/radio-test-sets/land-mobile-radio-products/3920b-series-analog-and-digital-radio-test-platform webpage. Proper radio and Aeroflex 3920 test setup guidelines are specified under Manuals and Training tab of the web page.

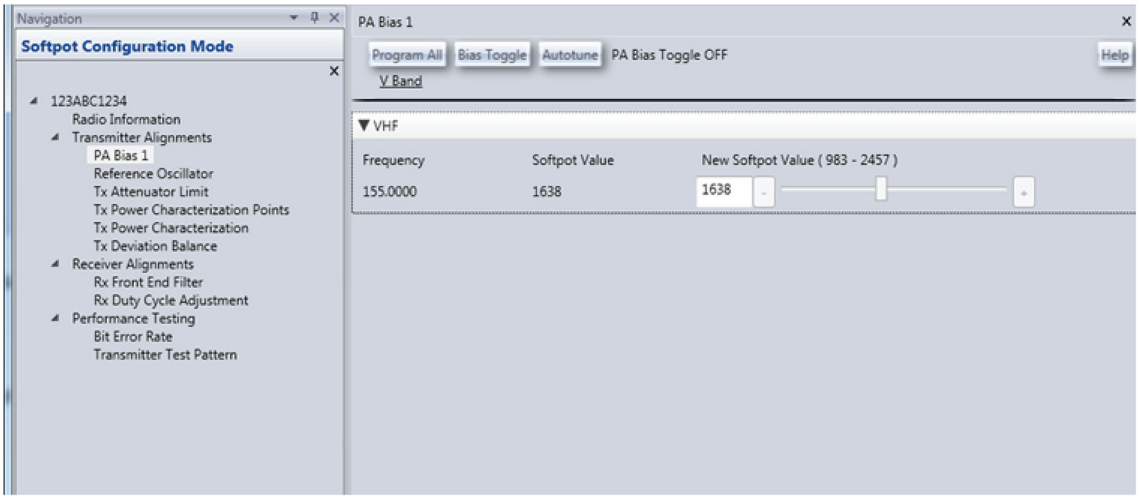
6.3 Softpot

The alignment screens introduce the concept of the softpot, an analog SOFTware-controlled POTentiometer used for adjusting all transceiver alignment controls.

CAUTION: Do not switch radios in the middle of any alignment procedure. Always left-click the **Close** button on the screen to return to the Main Menu screen before disconnecting the radio. Improper exits from the alignment screens might leave the radio in an improperly configured state and result in seriously degraded radio or system performance.

Each alignment screen provides the ability to increase or decrease the softpot value by using a slider, or by entering the new value from the keyboard directly into the box. The slider bar indicates the current softpot value; see Figure 8: Typical Softpot Screen on page 65.

Figure 8: Typical Softpot Screen



Adjusting the softpot value sends information to the radio to increase (or decrease) the voltage in the corresponding circuit. For example, left-clicking the UP spin button in the New Softpot Value scroll box on the **Reference Oscillator** screen instructs the microcomputer to increase the voltage across a varactor in the reference oscillator, which increases the frequency.

In **all** cases, the softpot value is just a relative number corresponding to a digital-to-analog (D/A) generated voltage in the radio.

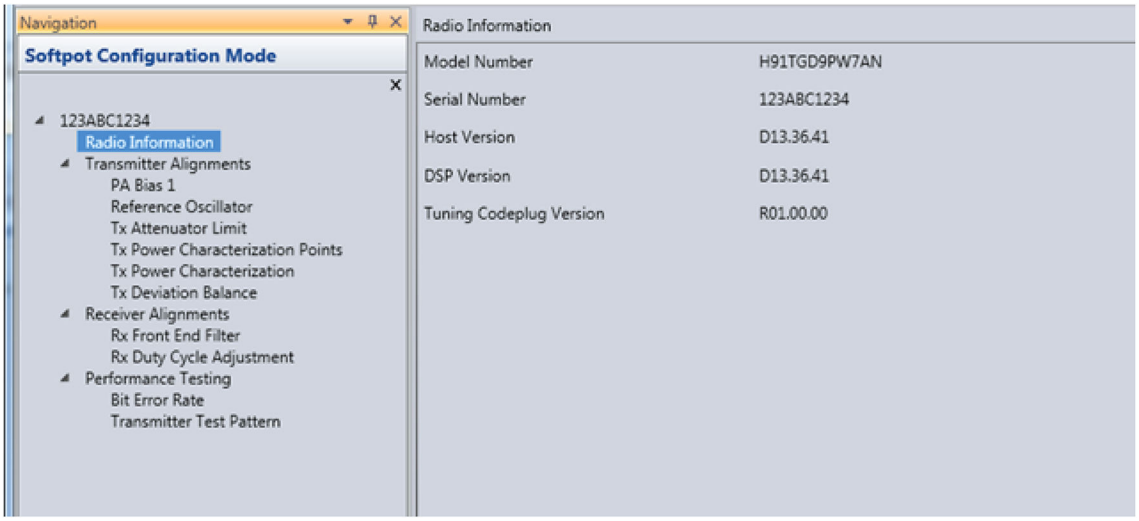
CAUTION: When keying the radio during a test, always transmit into a dummy load.

NOTE: Some of the following screens can vary depending upon the radio under test and the version of tuner software you are using. Refer to the software online help.

6.4 Radio Information

The following figure shows a typical Radio Information screen. This screen is informational only and cannot be directly changed.

Figure 9: Radio Information Screen



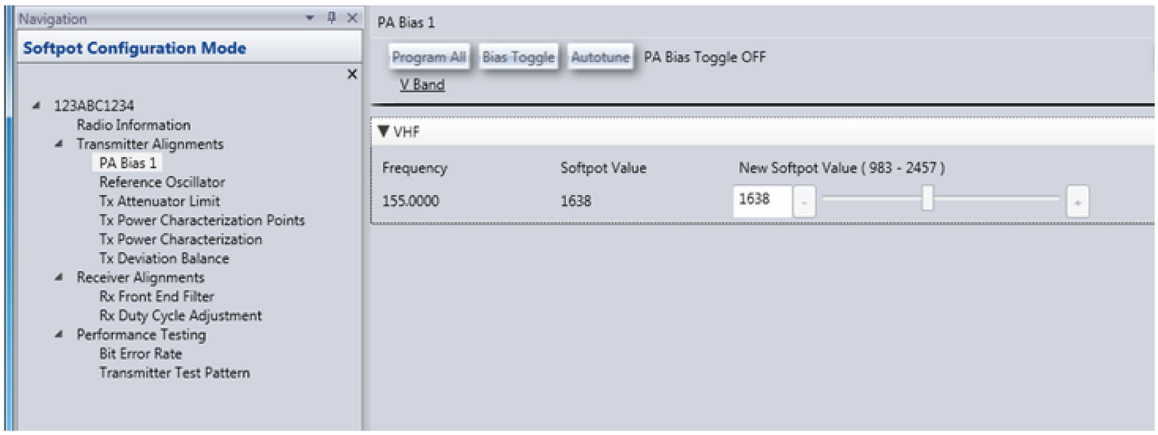
6.5 Transmitter Alignments

The Transmitter Alignment procedure consists of PA Bias 1, Reference Oscillator Alignment, Transmit Attenuator Limit Tuning, Power Characterization Points, Power Characterization Tuning, and Transmit Deviation Balance Alignment.

6.5.1 PA Bias 1

When and where to use: The following figure shows a PA Bias tuning screen.

Figure 10: PA Bias Tune Screen



Procedure:

1. Click on the **Bias Toggle** button to turn on bias mode.
2. Click on the **Autotune** button and the radio tunes PA bias automatically.
3. Click the **Program All** button to save the new value to the radio.

6.5.2 Aligning the Reference Oscillator

Adjustment of the reference oscillator is critical for proper radio operation. Improper adjustment results not only in poor operation, but also in a misaligned radio that interferes with other users operating on adjacent channels.

For this reason, the reference oscillator must be checked every time the radio is serviced, or once a year, whichever comes first.

NOTE: Reference oscillator alignment is required after replacing or servicing the transceiver board.

Prerequisites: The frequency counter used for this procedure must have stability of 0.1 ppm or better. This test can be done with either a Communication Analyzer or Modulation Analyzer. Also, it is recommended to use a 10 MHz external reference. Checking this parameter when the radio is placed in service is important if the product has been in storage for six months or more between being shipped from the factory and commissioned for service.
This procedure should be done with an Aeroflex 3920 service monitor or an acceptable substitute.

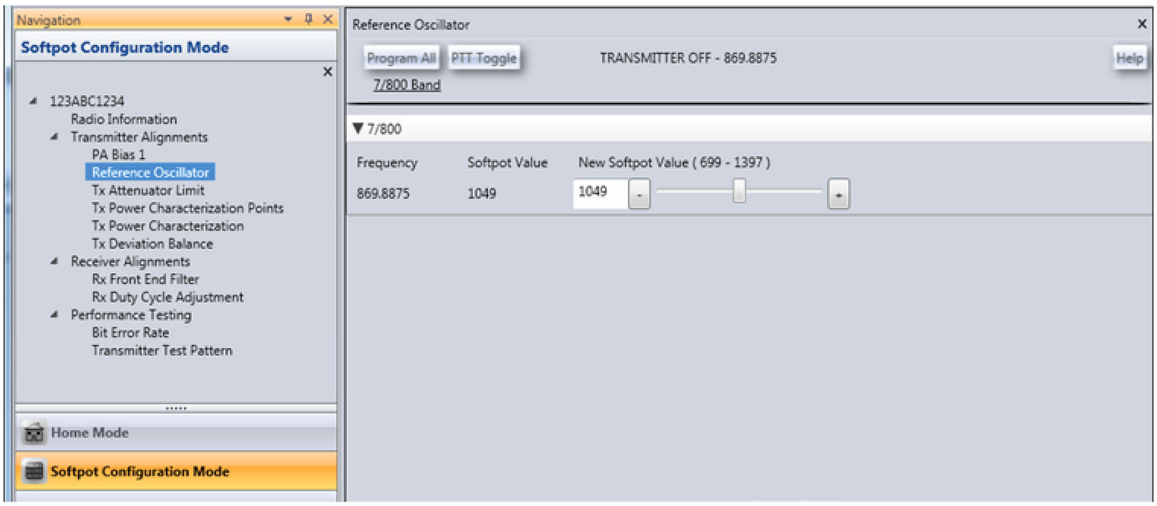
- Initial setup using the Communication Analyzer:
  - RF Control: Analyzer or RX
  - B/W: WB

- Freq: CPS frequency under test
- Attenuation: 20 dB (optional)
- Mon RF in: RF I/O
- Meter: Frequency Counter or Offset
- Mode: Analog or P25 STD

Procedure:

1 Select the **Reference Oscillator** tuning screen.

Figure 11: Reference Oscillator Alignment Screen



2 Ensure that the Communication Analyzer is in **Manual** mode.

3 Set the frequency as per the band shown in the following table:

Table 21: Reference Oscillator Alignment Base Frequencies

Band	Frequency
700/800 MHz	869.8875 MHz

4 Adjust the reference oscillator softpot value with the slider until the measured value is as close as possible to the frequency shown on the screen.

Table 22: Reference Oscillator Alignment

Band	Target
700/800 MHz	±50 Hz

5 Click **Program All** on the screen to dekey the radio and save the tuned values.

6 Click **Close** on the screen to return to the **Transmitter Alignments** menu.

6.5.2.1

Tuning Reference Oscillator

Procedure:

1. Make sure the Communication Analyzer is in **Manual** mode.
2. Set the base frequency to:

   Table 23: Base Frequencies

700/800 MHz
869.8875 MHz

3. Adjust the reference oscillator softpot value with the slider until the measured value is as close as possible to the frequency shown on the screen. See Table 24: Reference Oscillator Alignment on page 68.

   NOTE: Increases the slider decreases the frequency and vice versa.

   Table 24: Reference Oscillator Alignment

Band	Target
700/800 MHz	±50 Hz

4. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.
5. Left-click the **Close** button on the screen to return to the **Transmitter Alignments** menu.

6.5.3

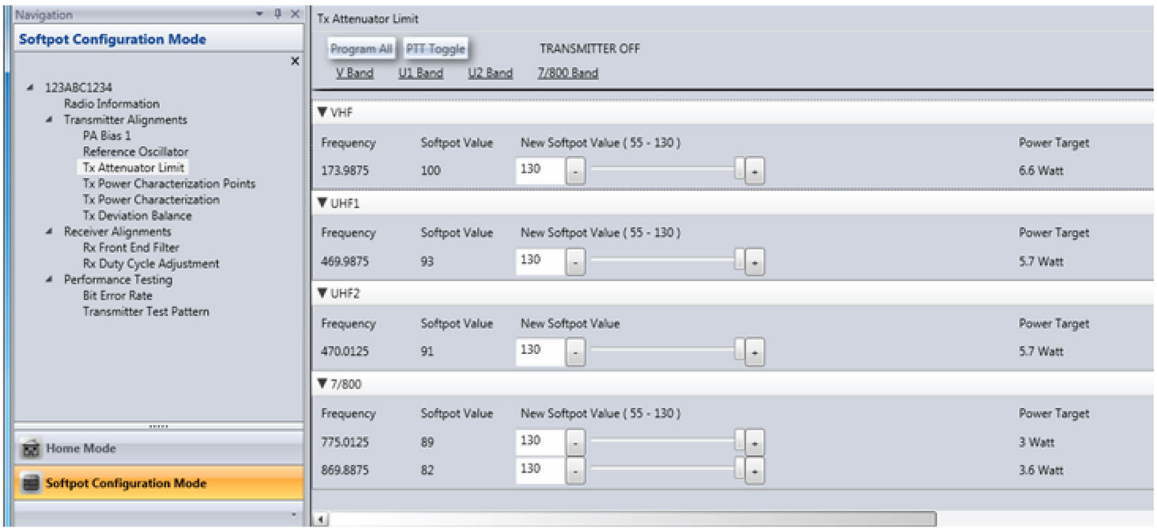
Transmit Attenuator Limit Tuning

The transmit attenuator limit tuning is done through the following:

Procedure:

1. Click into the first VHF softpot box and click the **PTT Toggle** button to make the radio transmit.
2. Slowly decrease the softpot slider until the measured power out increases to the power target. For example, 6.6 W for VHF 173.9875 MHz.
3. Repeat the steps above for the remaining bands of frequencies.
4. Click on the **Program All** button to save the new attenuator limit values to the radio.

Figure 12: Transmit Attenuator Limit Tuning Screen



6.5.4
Power Characterization Points

Prerequisites:

IMPORTANT: Power Characterization Tuning Points must be tuned before tuning Power Characterization Tuning.

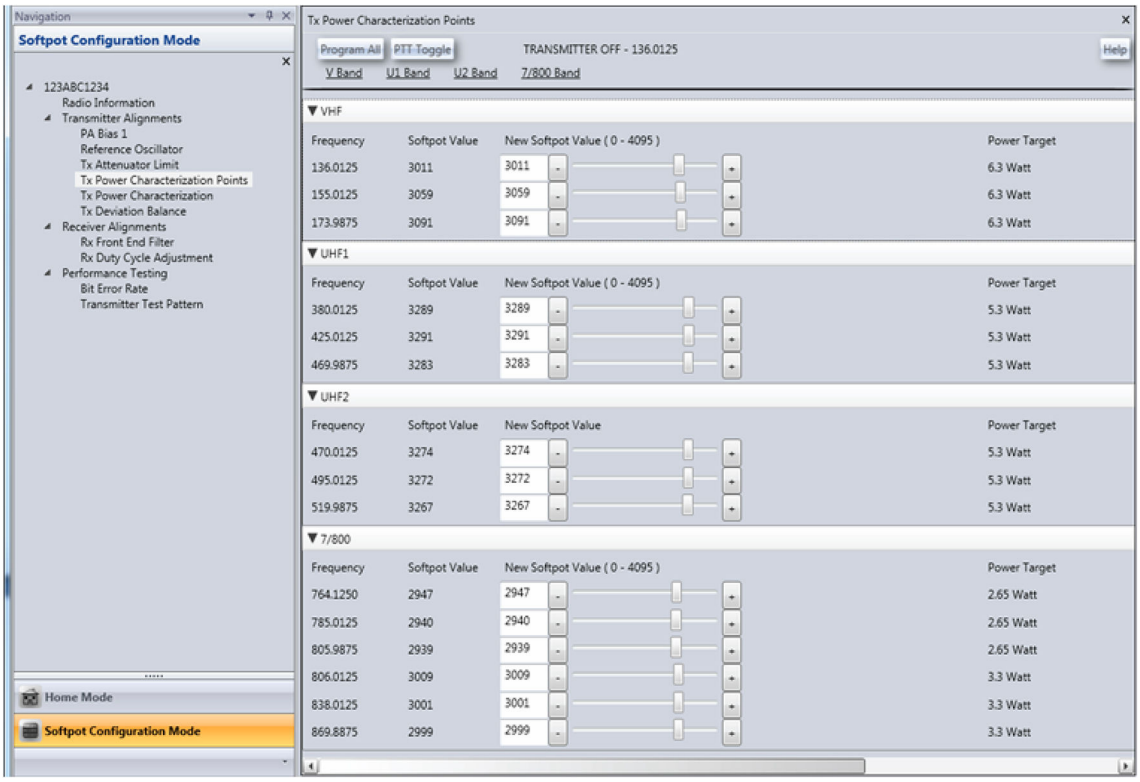
NOTE:

- The longer the RF cable, the more the attenuation of the power reading.
- Ensure that the system is calibrated for cable loss.
- Use a standard 50 Ω cable
- Apply best practices for the equipment being used.

Procedure:

1 Select the **TX Power Characterization Points** alignment screen.

Figure 13: Transmit Power Characterization Points Screen



2 Set the power supply voltage and current limit.

3 Adjust the softpot value by manipulating the slider bar, incrementing the **New Softpot Value** text box, or directly entering the desired value into the text box until the rated power is indicated on the service monitor. For rated power, refer to the help text in the Tuner.

4 Repeat step 2 and step 3 for all frequencies.

5 Click **Program All** on the screen to dekey the radio and save the tuned values.

6.5.5
Power Characterization Tuning

Prerequisites:

IMPORTANT: Power Characterization Tuning Points must be tuned before tuning Power Characterization Tuning.

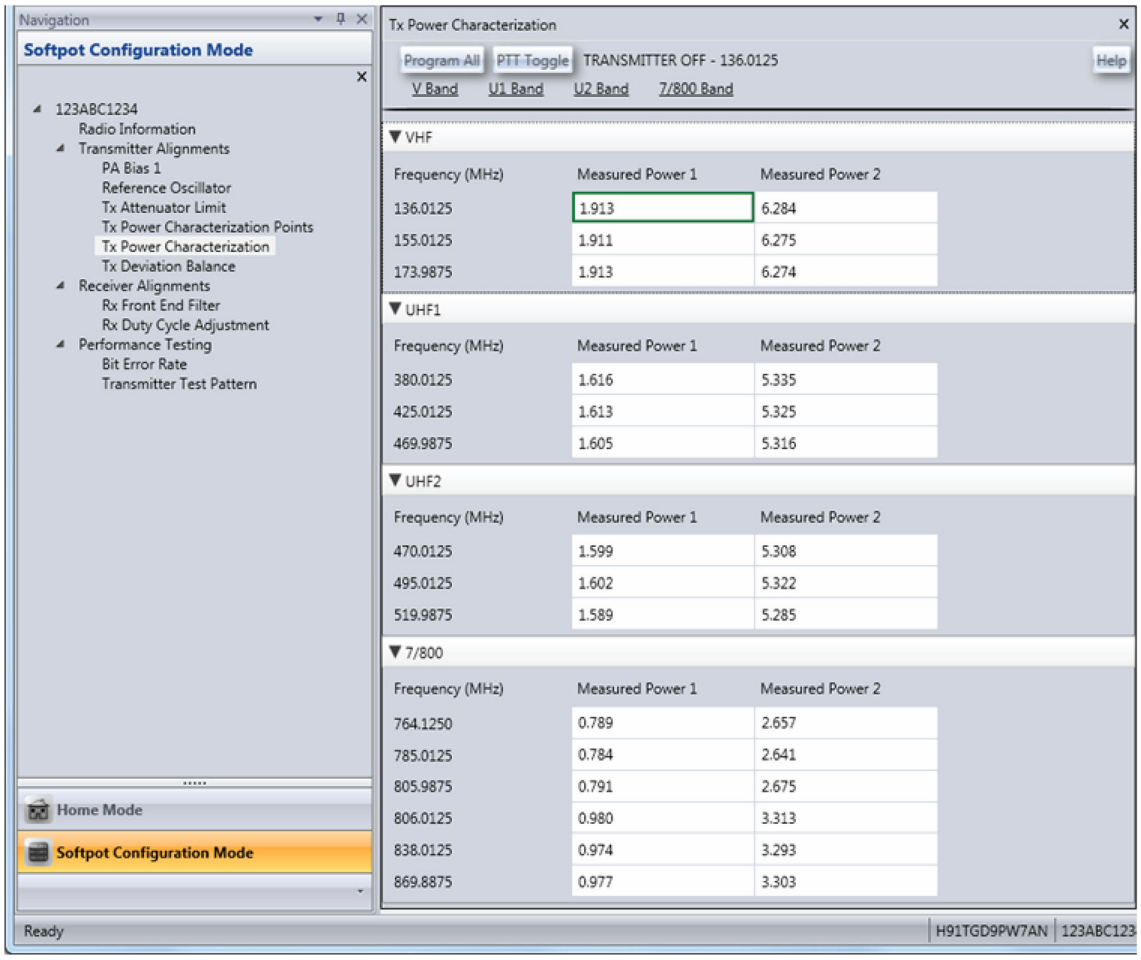
NOTE:

- The longer the RF cable, the more the attenuation of the power reading.
- Ensure that the system is calibrated for cable loss.
- Use a standard 50 Ω cable.
- Apply best practices for the equipment being used.

Procedure:

1 Select the **TX Power Characterization** alignment screen. The screen indicates the transmit power to be used. Refer to the following figures.

Figure 14: Power Characterization Tuning



2 Click the box below **Measure Power 1** for the desired frequency field.

3 Click the **PTT Toggle** button on the screen to make the radio transmit.

The screen indicates whether the radio is transmitting.

4 Measure the transmit power of the radio with a service monitor.

5 Input the transmit power in watts using two decimal places into the selected **Measure Power 1** field.

6 Repeat step 2 through step 5 for **Measure Power 12** for the same frequency field.

7 Repeat step 2 through step 6 for all frequencies.

8 Click **Program All** to dekey the radio and save the tuned values.

6.5.6
Transmit Deviation Balance Alignment

This alignment procedure balances the modulation contributions of the low- and high-frequency portions of a baseband signal.

Prerequisites:
Proper alignment is critical to the operation of signaling schemes that have very low frequency components (for example, DPL) and could result in distorted waveforms if improperly adjusted.

This procedure needs to be performed at multiple frequencies to allow for proper alignment across the entire RF band. The RF band is divided into frequency zones with a calibration point (value) in each zone.

NOTE: This alignment is required after replacing (or servicing) the VOCON board or the transceiver board.

Proper alignment requires a modulation analyzer or meter with a frequency response to less than 10 Hz modulating frequency. The modulation analyzer settings during this test should be set for average deviation, a 15 kHz low-pass filter, no de-emphasis, and no high-pass filter, if these settings are supported.

This procedure should be done with an Aeroflex 3920 service monitor or an acceptable substitute.

Procedure:

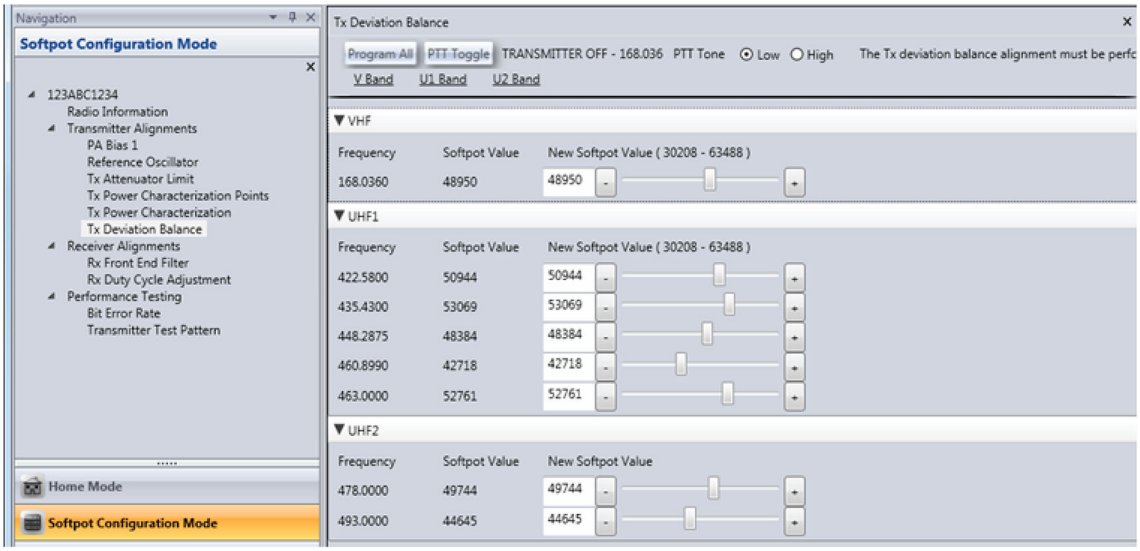
1 Initial setup using the Communication Analyzer:

Mode:	P25 Analog Mode 15 kHz LP filter enabled
RF Control:	P25 RX
Meter:	FM Deviation
Frequency:	Selected radio TX frequency

2 Connect a BNC cable between the “DEMOD OUT” port and the “Audio In 1” port on the service monitor.

3 Select the **TX Deviation Balance** alignment screen. The screen indicates the transmit frequencies to be used.

Figure 15: Transmit Deviation Balance Tuning Screen



4 Set the service Monitor to the desired frequency (as shown in the frequency list in the TX Deviation Balance alignment screen).

5 Left-click the **PTT Tone: Low** button.

6 Left-click the slider of the frequency selected (should be the same frequency as step 4).

7 Left-click the **PTT Toggle** button on the screen to make the radio transmit. The screen indicates whether the radio is transmitting.

8 Measure and Record the Low Tone Tx Deviation value from the service monitor.

9 Left-click the **PTT Tone: High** button.

10 Adjust the softpot value until the measured deviation/voltage, when using the high tone, is within +/- 1.5% of the value observed when using the Low Tone.

11 Left-click the **PTT Toggle** to de-key the radio.

12 Repeat step 4 to step 10 for all frequencies.

13 Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.

6.6 Receiver Alignments

6.6.1 Front End Filter Alignment

CAUTION: This procedure should only be attempted by qualified service technicians.

The alignment procedure adjusts the front end receiver bandpass filters for the best receiver sensitivity and selectivity. This procedure should be performed for all test frequencies to allow for proper software interpolation of frequencies between the test frequencies in the band. See Figure 16: RX Front End Filter AutoTune on page 74.

NOTE: Rx Front End Filter Alignment is required after replacing (or servicing) the transceiver board.

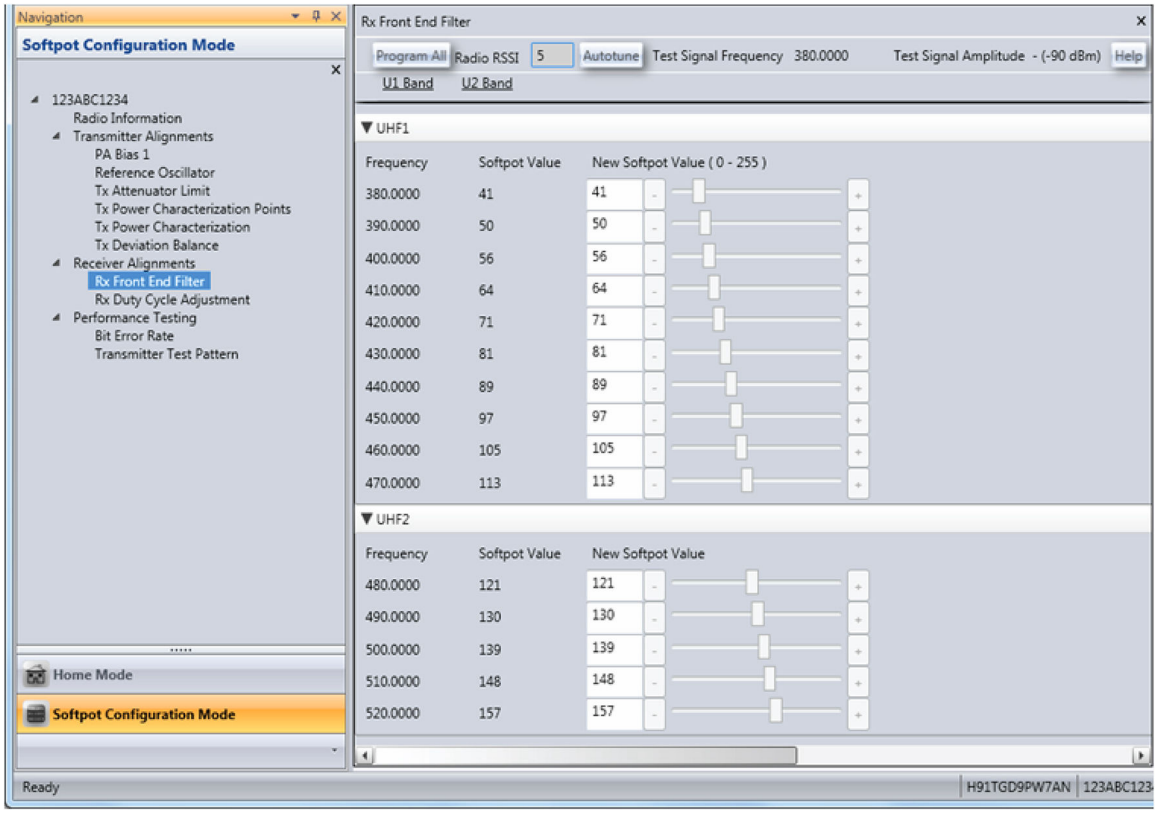
6.6.2 Procedure for UHF1 and UHF2 (Auto Tune)

Tuning of the radio is done through Rx Front End Filter tuning screen

Procedure:

1 Select the **Rx Front End Filter** alignment screen. See the following figure.

Figure 16: RX Front End Filter AutoTune



2 Click on the slider or the **New Softpot Value** text box to select which frequency to tune.

3 Apply RF test signal input with no modulation at the signal level and on the Test Signal Frequency displayed at the top of the screen.

4 Left-click the **Autotune** button.

5 Repeat step 2 to step 4 for all frequencies.

6 Left-click the **Program All** button on the screen to save the tuned values in the radio.

6.6.3
RX Duty Cycle Adjustment

Tuning of the radio is done through the Rx Duty Cycle Adjustment tuning screen.

Procedure:

1 Select the **Rx Duty Cycle Adjustment** screen. See the following figure.

Figure 17: RX Duty Cycle Adjustment AutoTune

2 Apply RF test signal input with no modulation at the signal level and on the Test Signal Frequency
displayed at the top of the screen.

3 Left-click the **Autotune** button.

4 Left-click the **Program All** button on the screen to save the tuned values in the radio.

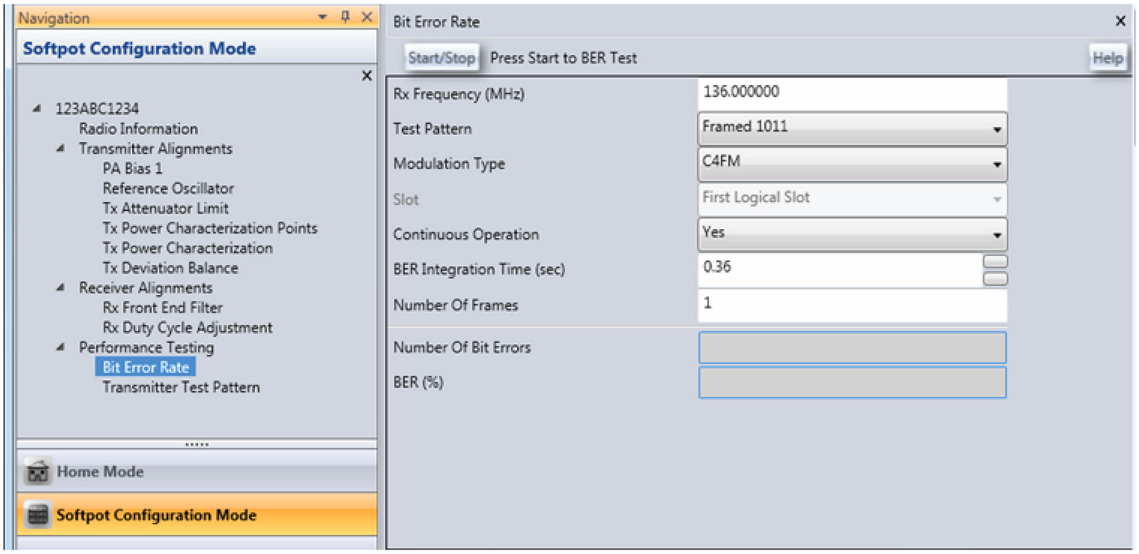
6.7 Performance Testing

This section describes the performance test procedures for Bit Error Rate and Transmitter Test Pattern of the radio.

6.7.1 Bit Error Rate

This section describes the Bit Error Rate (BER) test of the receiver at a desired frequency as shown in the following figures.

Figure 18: Bit Error Rate Testing Screen



6.7.1.1 Bit Error Rate Fields

Before testing the BER of the receiver, some information is shown on the bit error rate screen. The explanation of each field is described in this section.

Rx Frequency
This field selects the Receive Frequency directly in MHz.

Test Pattern
This field selects the Digital test pattern to be received by the radio. Choices are: Standard Tone Test Pattern (Framed 1011), F2 1031, Standard Interface Test Pattern (CCITT V.52), and Phase 2 Digital (1031 Hz) Test Pattern.

Modulation Type
This field represents the digital modulation type of the incoming signal on which BER is to be calculated.

BER Integration Time
BER Integration Time carries with Test Pattern Type.

Number of Frames
Number of Frames over which bit error result are accumulated to produce the result.

Continuous Operation
This field allows the user the option to repeat the BER test indefinitely. A selection of **Yes** causes the radio to calculate BER on a continuous basis and update the results on this screen after each integration time. A selection of **No** causes the BER test to execute for only one sample of the integration time and then update the display.

NOTE:
When Continuous Operation = **Yes**, all fields are grayed out while the test is in progress. They are enabled when the STOP button is pressed.

When Continuous Operation = **No**, a wait cursor is displayed while the test is in progress and return to normal when the test is done.

6.7.1.2 Testing Bit Error Rate

Set up the Communication Analyzer as follows:

Procedure:

1. Connect the RF Input port of the radio under test to the RF IN/OUT port of the Service Monitor.
2. Set up the Service Monitor by configuring as follows:

Table 25: Configuring Service Monitor

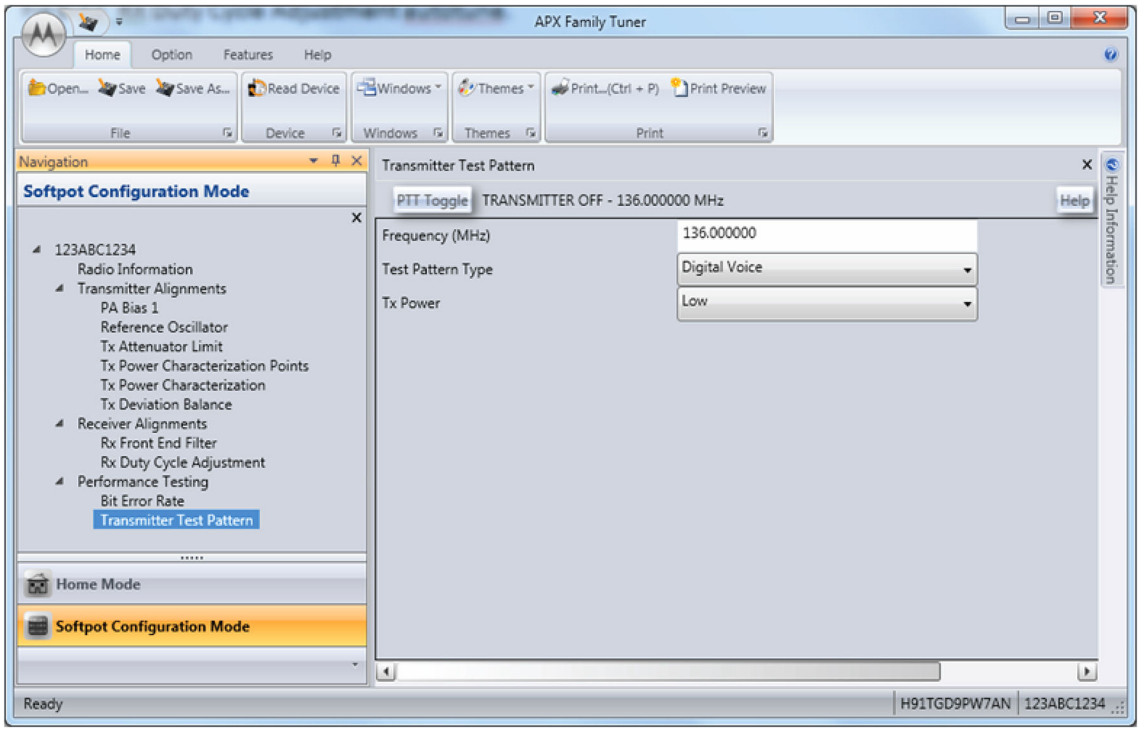
Parameter	Value
Mode	P25
RF Control	TX/Generate
Output Level	-47 dBm
P25 Set	Phase 1 C4FM
Pattern	STD 1011
Frequency	Test frequency (example: 851.0625 MHz)

3. To begin or end BER testing, press the **Start/Stop** button.

6.8 Transmitter Test Pattern

The Transmitter Test Pattern test is used to transmit specific test patterns at a desired frequency so that the user can perform tests on the transmitter.

Figure 19: Transmitter Test Pattern Screen



6.8.1
Transmitter Test Fields

This screen contains the following fields:

Tx Frequency
This field selects the Transmit Frequency directly in MHz.

Test Pattern Type
This field represents the type of test pattern which will be transmitted by the radio when **PTT TOGGLE** button is pressed.

Chapter 7

Encryption

This chapter provides procedures for using the encryption capability of your radio.

The following procedures are outlined:

- Loading an encryption key.
- Selecting an encryption key.
- Selecting an Index (only applicable to Dual Display configured radios).
- Erasing an encryption key(only applicable to Dual Display configured radios)

7.1 Load an Encryption Key

Keys are loaded from the KVL to the radio in either clear or encrypted form depending on the configuration of the CPS parameter "KVL - FIPS Level 3 Approved Mode".

Prerequisites:

NOTE:
If the parameter is disabled, keys are sent in clear form. If the parameter is enabled, keys are sent to the radio in encrypted form.

A KVL3000 Plus with software version R03.52.45 or greater must be used to load keys to a radio with "KVL - FIPS Level 3 Approved Mode" enabled.

The secure kits for the radio is identified by the following kit numbers:

Table 26: Kit Numbers for Secure-Enabled Boards

Kit Number	Description
NNTN8812_	ADP AES Kit
NNTN8813_	ADP Kit
NNTN8814_	ADP/DES/DES-XL/DES-OFB Kit
NNTN8815_	ADP/AES/DES/DES-XL/DES-OFB Kit
NNTN8816_	ADP/DVP-XL Kit
NNTN8817_	ADP/AES/DVP-XL Kit
NNTN8818_	ADP/CFX-256 Configurable
NNTN8819_	ADP/DVP-XL/CFX-256 Configurable
NNTN8820_	ADP/AES/DES/DES-XL/DES-OFB/CFX-256 Configurable
NNTN8821_	ADP/DES/DES-XL/DES-OFB/CFX-256 Configurable
NNTN8822_	ADP/AES/CFX-256 Configurable
NNTN8823_	ADP/AES/DVP-XL/DES-OFB/CFX-256 Configurable
NNTN8824_	ADP/Localized Enabled Encryption
NNTN8825_	ADP/DVP-XL/Localized Enabled Encryption
NNTN8826_	ADP/AES/DES/DES-XL/DES-OFB/Localized Enabled Encryption

Kit Number	Description
NNTN8827_	ADP/DES/DES-XL/DES-OFB/Localized Enabled Encryption
NNTN8828_	ADP/AES/Localized Enabled Encryption
NNTN8829_	ADP/AES/DVP- XL/Localized Enabled Encryption
NNTN8830_	Localized Capable Encryption (Russia)

Procedure:

1. Refer to the key-variable loader (KVL) manual for equipment connections and setup.
2. Attach the KVL to the radio. The top display shows `KEYLOAD` whereas `KEYLOADING` is shown on the front display of a Dual Display configured radio. All other radio functions, except for power down, backlight, and volume, are locked out.
3. Refer to the KVL manual for how to load the encryption keys into the radio.

   When the key is loaded successfully, you hear:

   - On single-key radios – a short tone.
   - On multikey radios – an alternating tone.

7.2 Multikey Feature

This feature allows the radio to be equipped with multiple encryption keys. It can support two or more encryption algorithms simultaneously (for example, AES and DES-XL).

Conventional Multikey

The encryption keys can be tied (strapped), on a one-per-channel basis. In addition, the radio can have operator-selectable keys, operator-selectable indices, and operator-selectable key erasure. If talkgroups are enabled in conventional, then the encryption keys are strapped to the talkgroups.

Trunked Multikey

If the radio is used for both conventional and trunked applications, strap the encryption keys for trunking on a per- talkgroup or announcement group basis. In addition, a different key can be strapped to other features; for example, dynamic regrouping, failsoft, or emergency talkgroup. The radio can have operator-selectable key erasure.

7.3 Select an Encryption Key

You can select an encryption key using either the menu or the keypad.

7.3.1 Use the Menu

To select an encryption key using the menu:

Procedure:

1. Press **Right** or **Left** until the display shows `Key`.
2. Press **Menu Select Button** directly under `Key`. The display shows the last user-selected and -stored encryption key.

3 Press **Up** or **Down** through the list of encryption keys.

NOTE: If a deleted key is selected, `ERASED KEY` is displayed.

4 Press **Menu Select Button** directly below the desired menu.

`SEL` = saves the newly selected key and returns to the home display.

5 Press **Home Button**, the **PTT** button, or **Menu Select Button** directly below `Exit`, or turn the **16-Position Select** knob to exit this menu.

- If the selected key is erased, the display shows `KEY FAIL` and the radio sounds a momentary keyfail tone.
- If the selected key is not allowed, the display shows `ILLEGAL KEY` and the radio sounds a momentary illegal key tone.

7.3.2
Use the Keypad

To select an encryption key using the keypad:

Procedure:

1 Press **Right** or **Left** until the display shows `Key`.

2 Press **Menu Select Button** directly under `Key`. The display shows the last user-selected and -stored encryption key.

3 Using the keypad, enter the number of the desired key.

NOTE: If a deleted key is selected, `ERASED KEY` is displayed.

4 Press **Menu Select Button** directly below the desired menu.

`SEL` = saves the newly selected key and returns to the home display.

5 Press **Home Button**, the **PTT** button, or **Menu Select Button** directly under `Exit`, or turn the **16-Position Select** knob to exit this menu.

- If the selected key is erased, the display shows `KEY FAIL` and the radio sounds a momentary keyfail tone.
- If the selected key is not allowed, the display shows `ILLEGAL KEY` and the radio sounds a momentary illegal key tone.

7.4
Select an Encryption Index

This feature selects one or more groups of several encryption keys from among the available keys stored in the radio. For example, the radio could have a group of three keys structured to one index, and another group of three different keys structured to another index. Changing indices makes the radio automatically switch from one set of keys to the other. Every channel to which one of the original keys was tied now will have the equivalent new key instead.

7.4.1
Use the Menu

To select an index using the menu:

Procedure:

1. Press **Right** or **Left** until the display shows `KSet`.
2. Press **Menu Select Button** directly under `KSet`. The display shows the last user-selected and -stored index.
3. Press **Up** or **Down** to scroll through the list of encryption keys.

   NOTE: If a deleted key is selected, `ERASED KEY` is displayed.

4. Press **Menu Select Button** directly below the desired menu.

   `SEL` = saves the newly selected key and returns to the home display.

5. Press **Home Button**, the **PTT** button, or **Menu Select Button** directly below `Exit`, or turn the **16-Position Select** knob to exit this menu.

   - If the selected key is erased, the display shows `KEY FAIL` and the radio sounds a momentary keyfail tone.
   - If the selected key is not allowed, the display shows `ILLEGAL KEY` and the radio sounds a momentary illegal key tone.

7.4.2
Use the Keypad

To select an index using the keypad:

Procedure:

1. Press **Right** or **Left** until the display shows `KSet`.
2. Press **Menu Select Button** directly under `KSet`. The display shows the last user-selected and -stored index.
3. Using the keypad, enter the number of the desired key.

   NOTE: If a deleted key is selected, `ERASED KEY` is displayed.

4. Press **Menu Select Button** directly below the desired menu.

   `SEL` = saves the newly selected key and returns to the home display.

5. Press **Home Button**, the **PTT** button, or **Menu Select Button** directly under `Exit`, or turn the **16-Position Select** knob to exit this menu.

   - If the selected key is erased, the display shows `KEY FAIL` and the radio sounds a momentary keyfail tone.
   - If the selected key is not allowed, the display shows `ILLEGAL KEY` and the radio sounds a momentary illegal key tone.

7.5 Erase an Encryption Key

This section describes two methods for erasing an encryption key.

7.5.1 Method 1 - Key Zeroization (Multikey Only)

To zeroize an encryption key:

Procedure:

1. Press **Right** or **Left** until the display shows `Eras`.
2. Press **Menu Select Button** directly below `Eras`. The display shows the last user-selected and -stored encryption key.
3. Press **Up** or **Down** to scroll through the list of encryption keys.
4. Select single encryption key or all encrytion keys deletion from the `OPTN` menu.
5. Press **Home Button**, the **PTT** button, or **Menu Select Button** directly below `Exit`, or turn the **16-Position Select** knob to exit this menu.
   - If the selected key is erased, the display shows `KEY FAIL` and the radio sounds a momentary keyfail tone.
   - If the selected key is not allowed, the display shows `ILLEGAL KEY` and the radio sounds a momentary illegal key tone.

7.5.2 Method 2 – All Keys Erased

To erase all encryption keys at one time:

Procedure:

1. With the radio on, press and hold the **Top Side** button and, while holding this button down, press the **Top** button.

   NOTE: DO NOT press the **Top** button before pressing the **Top Side** button unless you are in an emergency situation. This sends an emergency alarm.

   Before the keys are erased, the display shows `PLEASE WAIT`.

   When all the encryption keys have been erased, the display shows `ALL KEYS ERASED`.

Chapter 8

Disassembly/Reassembly Procedures

This chapter provides detailed procedures for disassembling/reassembling and ensuring submergibility of the radio.

When performing these procedures, refer to Exploded Views and Parts Lists on page 155 and the diagrams that accompany the text. Items in parentheses ( ) throughout this chapter refer to item numbers in the exploded view diagrams and their associated parts lists.

This chapter also has procedures for removing and installing the radio standard accessories and changing the Volume and Frequency Knobs.

8.1 Partial Exploded View (Main Subassemblies)

This section contains the radio partial exploded views.

CAUTION: When servicing electronics, always ensure that you are properly grounded with antistatic grounding system approved for electronics handling.

8.1.1

APX 8000 Partial Exploded View

Figure 20: Dual Display (Full Keypad) Partial Exploded View

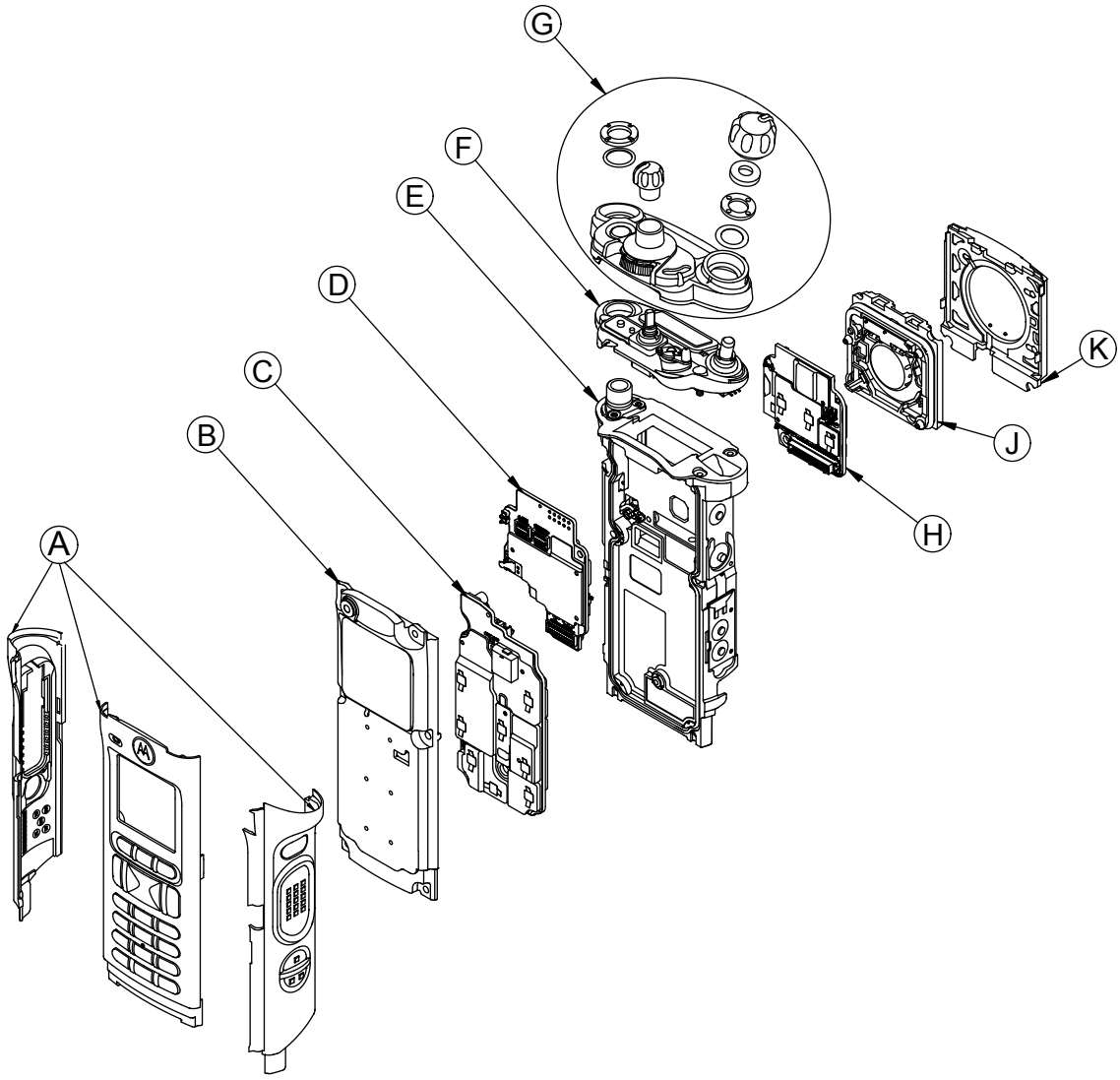


Figure 21: Dual Display (Limited Keypad) Partial Exploded View

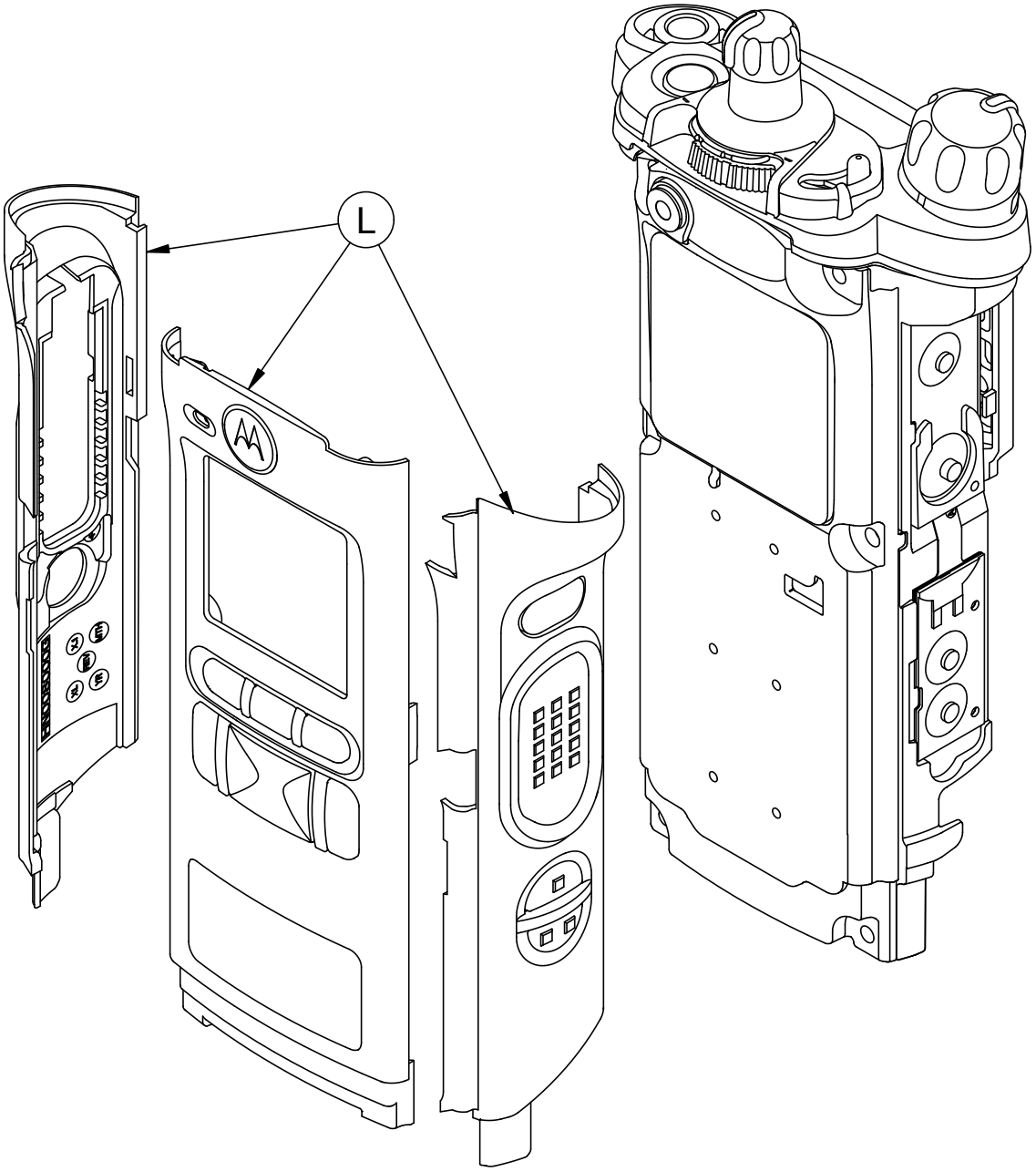


Figure 22: Top Display Partial Exploded View

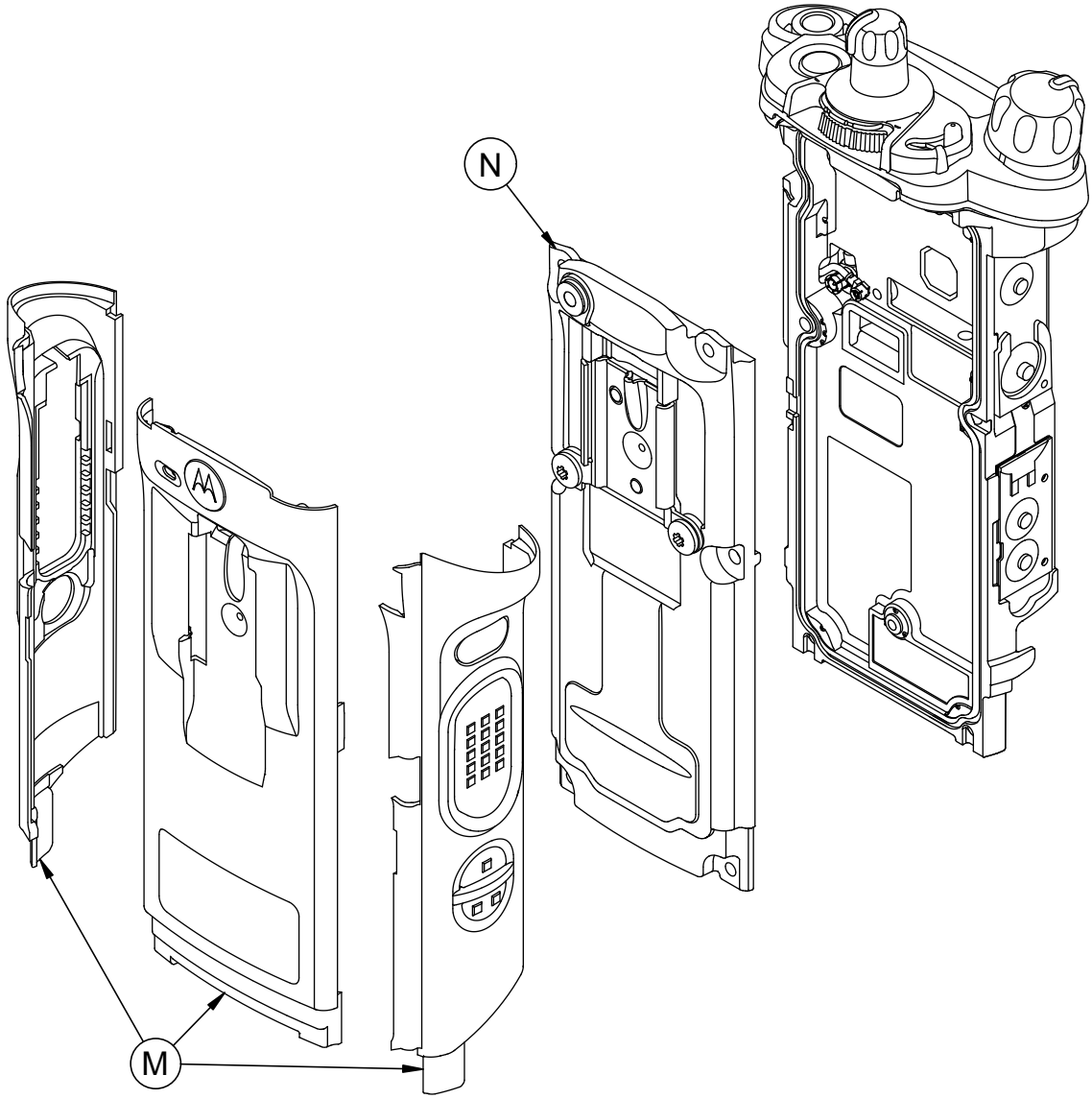


Table 27: Partial Exploded View Parts List

See Exploded Views and Parts Lists on page 155 for more details on the parts list.

Item Letter	Description
A	Main Housing Assembly, 3 pcs (Dual Display, Full Keypad)
B	Back Chassis Assembly (Dual Display, Full Keypad)
C	RF Board Assembly
D	VOCON Board Assembly
E	Main Chassis Assembly
F	Control Top Assembly

Item Letter	Description
G	Control Top Bezel & Knobs Assembly
H	Expansion Board Assembly
J	Speaker Module
K	Speaker Grille Assembly
L	Main Housing Assembly, 3-pieces (Dual Display, Limited Keypad)
M	Main Housing Assembly, 3 pcs (Top Display)
N	Back Chassis Assembly (Top Display)

8.1.2
APX 8000XE Partial Exploded View

Figure 23: Dual Display (Full Keypad) Partial Exploded View

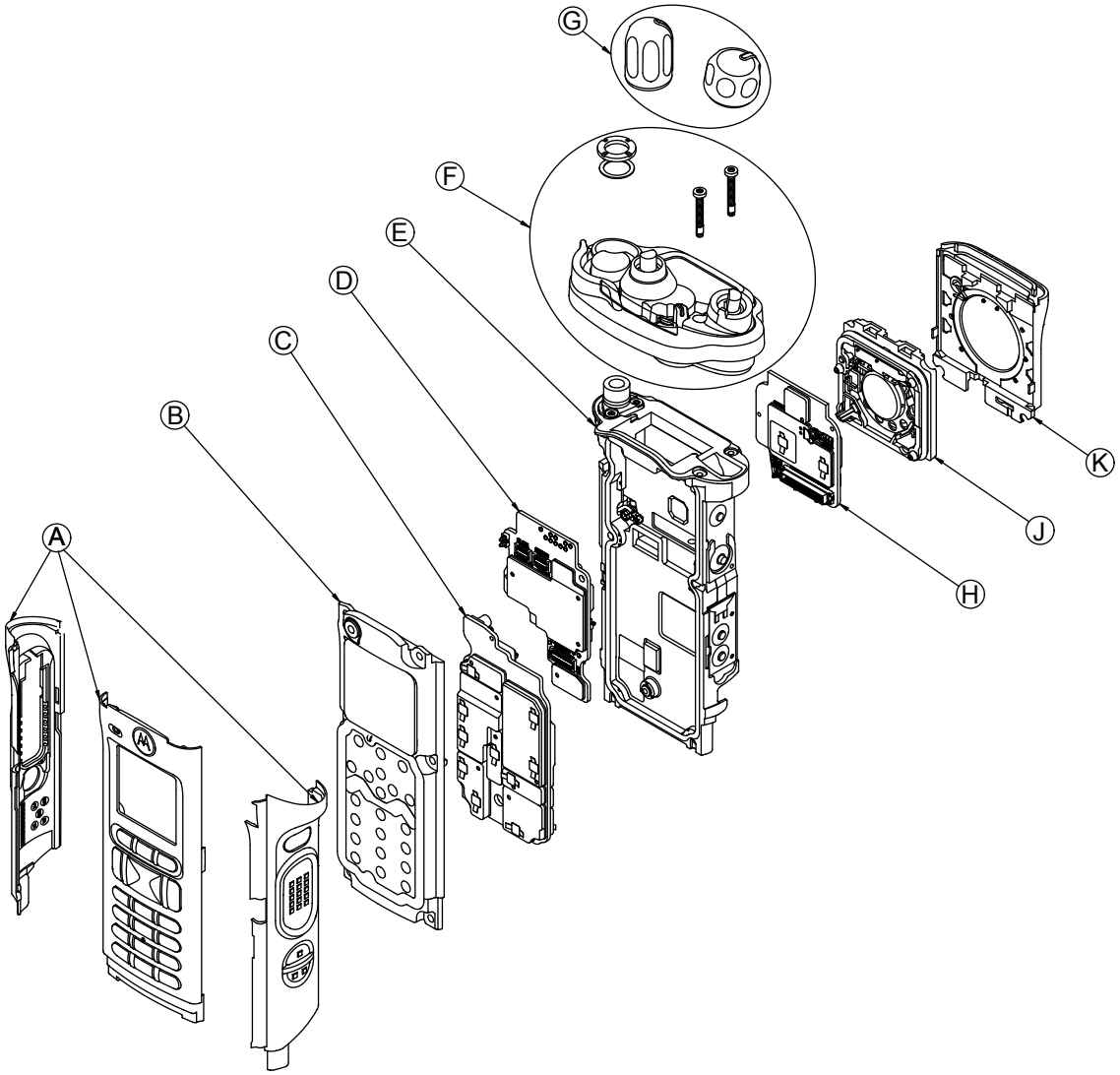


Figure 24: Dual Display (Limited Keypad) Partial Exploded View

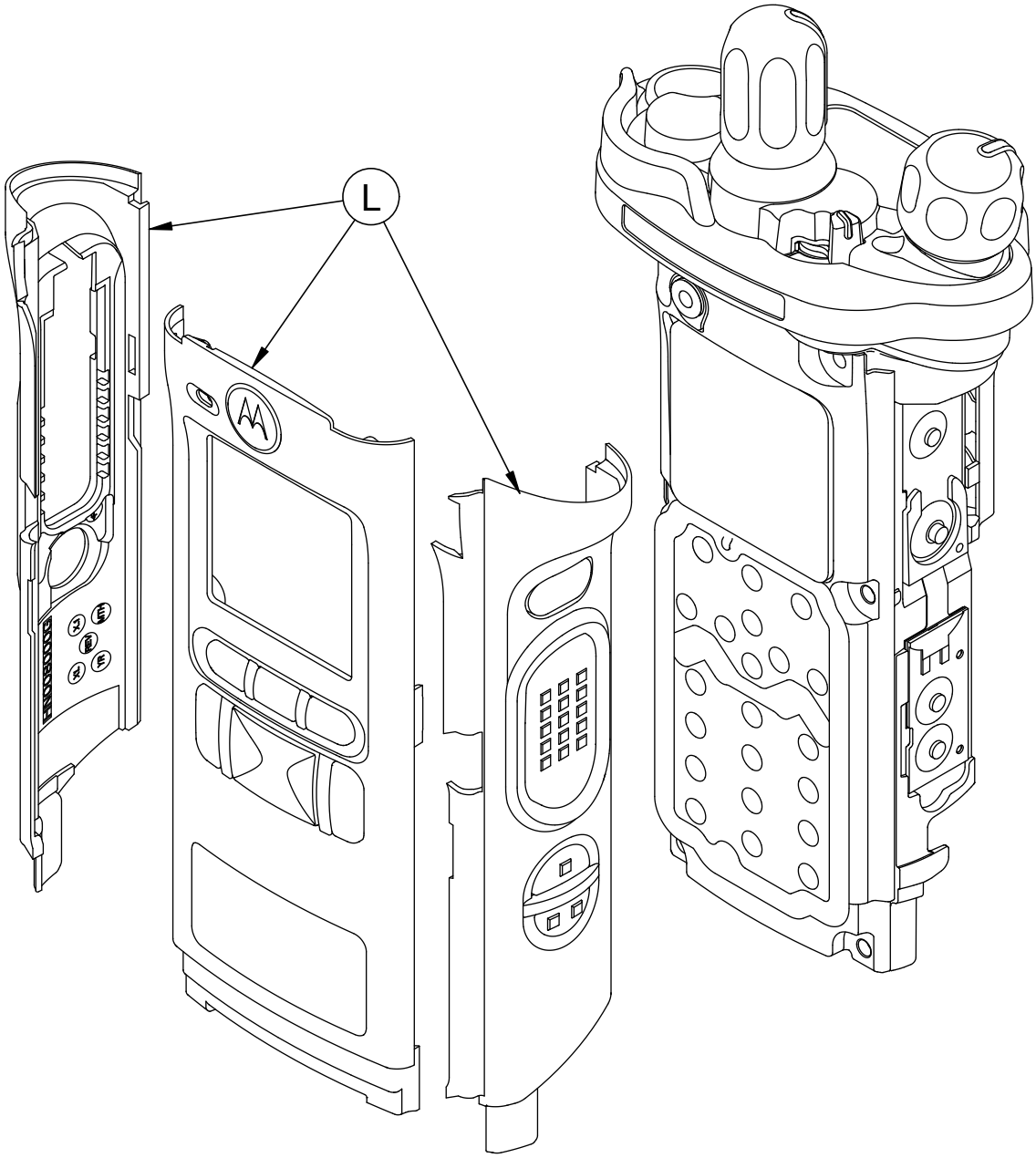


Figure 25: APX 8000XE Top Display Partial Exploded View

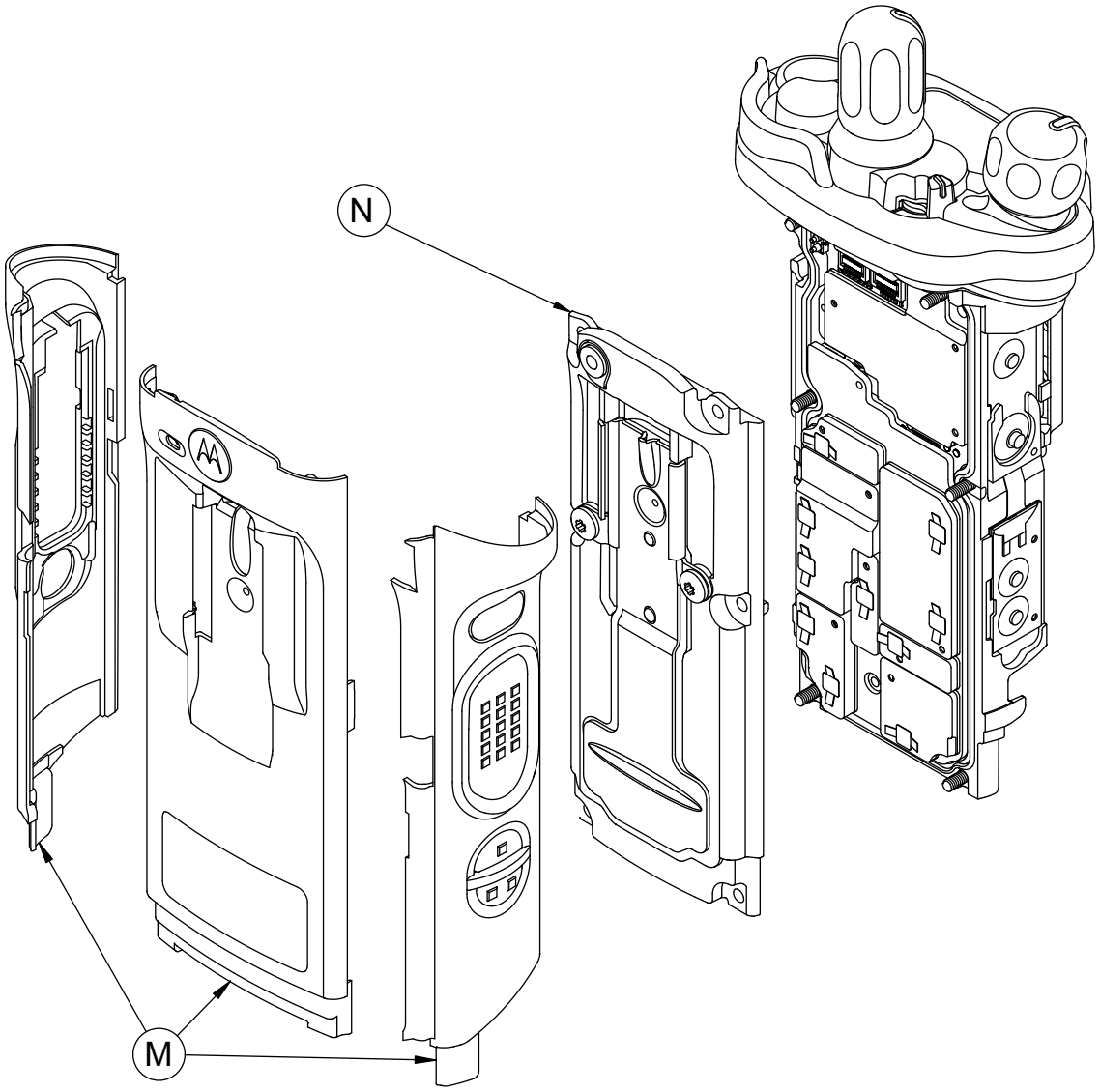


Table 28: Partial Exploded View Parts List

See Exploded Views and Parts Lists on page 155 for more details on the parts list.

Item Letter	Description
A	Main Housing Assembly, 3 pieces (Dual Display, Full Keypad)
B	Back Chassis Assembly (Dual Display, Full Keypad)
C	RF Board Assembly
D	VOCON Board Assembly
E	Main Chassis Assembly
F	Control Top Assembly

Item Letter	Description
G	Knobs Assembly
H	Expansion Board Assembly
J	Speaker Module
K	Speaker Grille Assembly
L	Main Housing Assembly, 3 pieces (Dual Display, Limited Keypad)
M	Main Housing Assembly, 3 pieces (Top Display)
N	Back Chassis Assembly (Top Display)

8.2 Recommended Tools and Suppliers

Tools	Supplier	Part Number	Remarks
Bit, Torx IP8	–	–	Torx T8 may be used, but Torx Plus IP8 is recommended
Bit, Torx 6	–	–	Torx T6 may be used with a Torque Driver
Bit, Volume Spanner Nut	Motorola Solutions	66009256001	–
Bit, Antenna Spanner	Motorola Solutions	66009258001	–
Nylon Spudger	Hexacon Electric Co.	MA-800G	–
Seater, Secure Lever	Motorola Solutions	66009261001	–
Board Level Test Fixture	Motorola Solutions	66009260007	Only optional for individual board evaluation
	Manufacturer	T49-1779	
Vacuum Pump Kit	Motorola Solutions	NLN9839_	For Vacuum Test
Vacuum Adapter	Motorola Solutions	66009259001	For Vacuum Test and Pressure Test
Pressure Pump Kit	Motorola Solutions	NTN4265_	–

8.3 Fastener Torque Chart

Torque all fasteners to the recommended value when assembling the radio.

Table 29: Fastener Torque Chart

Motorola Solutions Part Number	Description	Repair Torque (in-lbs)
0275361H01	Volume Spanner Nut	8
0275891B01	Antenna Spanner Nut	16
0375962B01	Top Screw	10
0375962B02	Center Screw	10
0375962B03	Bottom Screw	10
0375962B04	Top Controls Screw	8
03009304001	RF, Expansion & Vocon Board Screw	8
03009357001	APX 8000XE: Screw, M2.5X0.45, XE CT	7

8.4
Antenna

This section explains how to attach and remove the antenna.

8.4.1
Attaching the Antenna

Procedure:

With the radio turned off, turn the antenna clockwise to attach it to the radio.

Figure 26: Attaching the Antenna - APX 8000

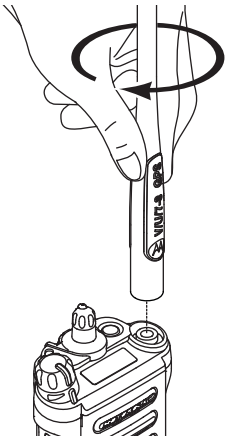
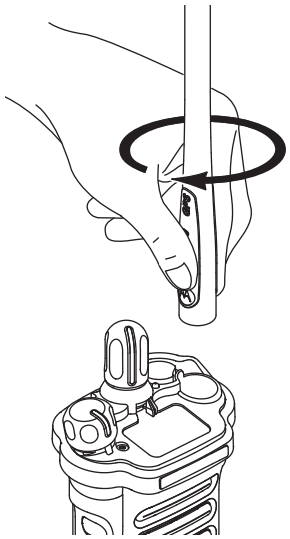


Figure 27: Attaching the Antenna - APX 8000XE



8.4.2

Removing the Antenna

Procedure:

With the radio turned off, turn the antenna counterclockwise to remove it from the radio.

Figure 28: Removing the Antenna - APX 8000

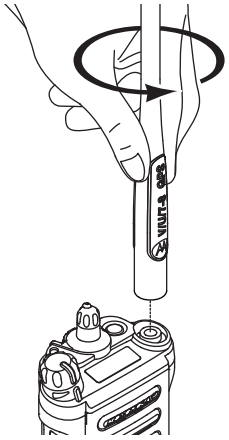
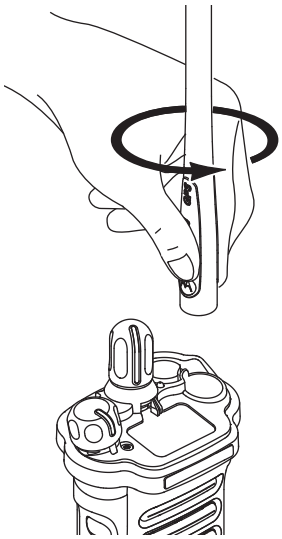


Figure 29: Removing the Antenna - APX 8000XE



8.5 Battery

This section explains how to properly attach and remove the battery.

WARNING:
To avoid a possible explosion:

DO NOT charge, remove, or attach the battery in an area labeled “hazardous atmosphere.”

DO NOT discard batteries in a fire.

CAUTION: If the radio is programmed for volatile-key retention, encryption keys will be retained for approximately 30 seconds after battery removal.

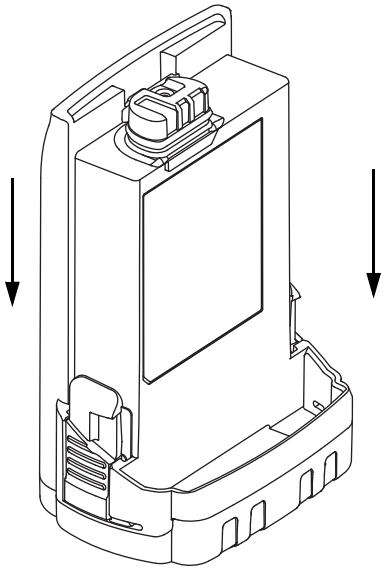
NOTE: The Motorola Solutions-approved battery shipped with the APX 8000/APX 8000XE radio is uncharged. Prior to using a new battery, charge it per the recommended procedure for the battery.

8.5.1 Attaching the Battery

Procedure:

1 With the radio turned off, verify that the battery seal is set properly in its groove.

Figure 30: Attaching Battery – Battery Seal



2 Verify that the Vacuum Port is closed by ensuring it is fully seated and the catch feature on the tab is in the main chassis notch.

Figure 31: Attaching Battery – Vacuum Port Seal - APX 8000

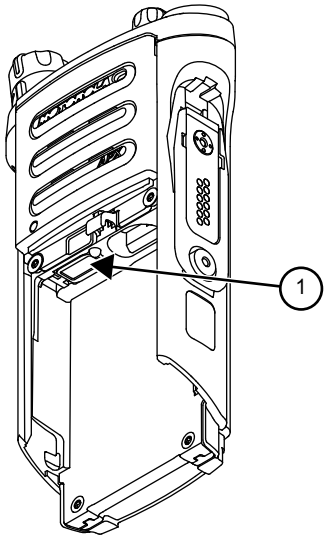
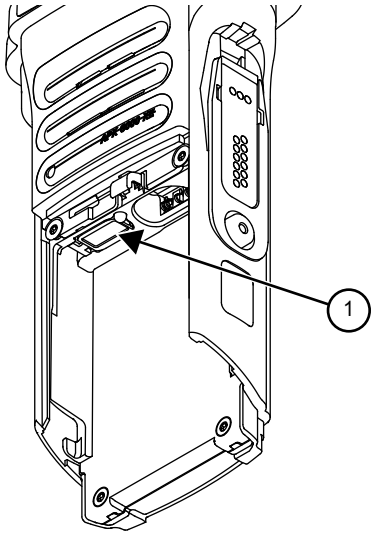


Figure 32: Attaching Battery – Vacuum Port Seal - APX 8000XE



1	Vacuum Port Seal

3 Set the battery onto the chassis and slide it into position. Make sure both battery latches click into position.

Figure 33: Attaching Battery - APX 8000

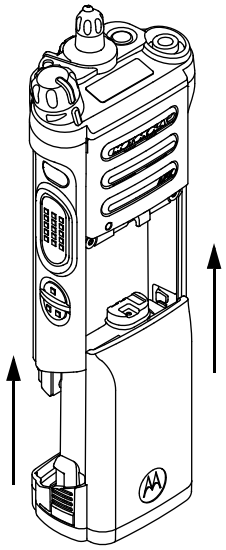
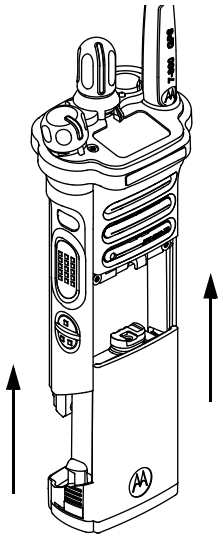


Figure 34: Attaching Battery - APX 8000XE



8.5.2

Removing the Battery

Procedure:

1 With the radio turned off, squeeze the two latches located near the bottom, on the sides of the battery.

Figure 35: Squeezing the Release Latches - APX 8000

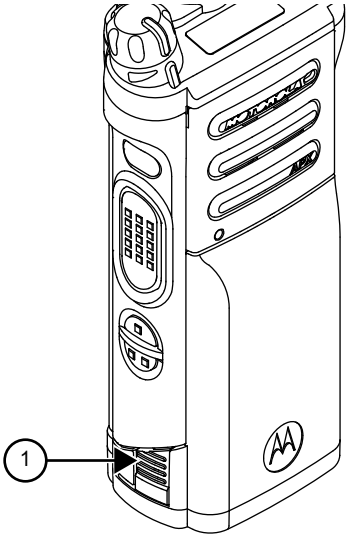
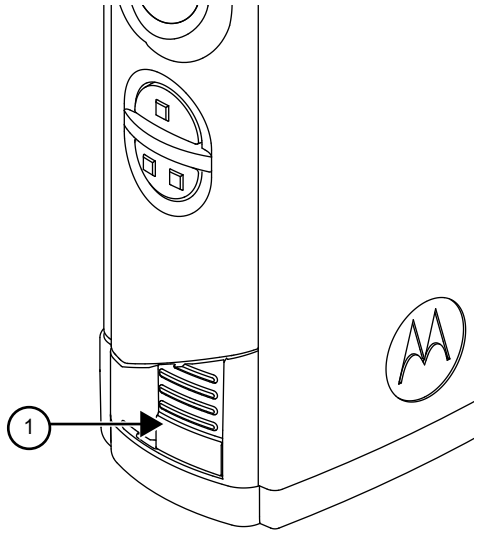


Figure 36: Squeezing the Release Latches - APX 8000XE



1	Battery Latch (other one on opposite side)

2 While squeezing the latches, remove the battery by sliding it out.

Figure 37: Removing the Battery - APX 8000

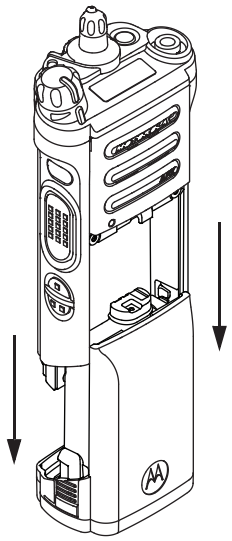
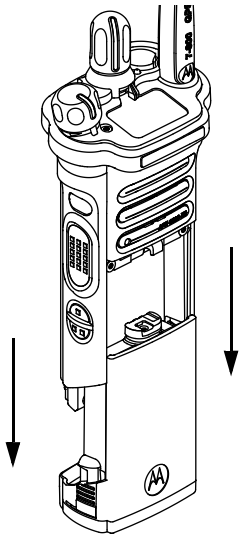


Figure 38: Removing the Battery - APX 8000XE



8.6 Universal Connector Cover

This section explains how to remove and attach the Universal Connector Cover.

CAUTION: When the universal connector is not in use, keep it covered with the Universal Connector Cover.

8.6.1 Removing the Universal Connector Cover

Procedure:

1 Unscrew the thumb screw. If the screw is too tight a hex driver may be used.

NOTE: Do not remove the screw. It should remain captive in the cover.

Figure 39: Removing the Thumb Screw - APX 8000

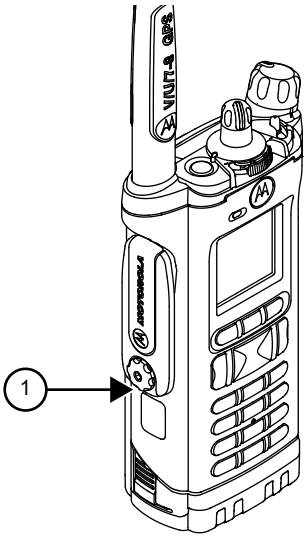
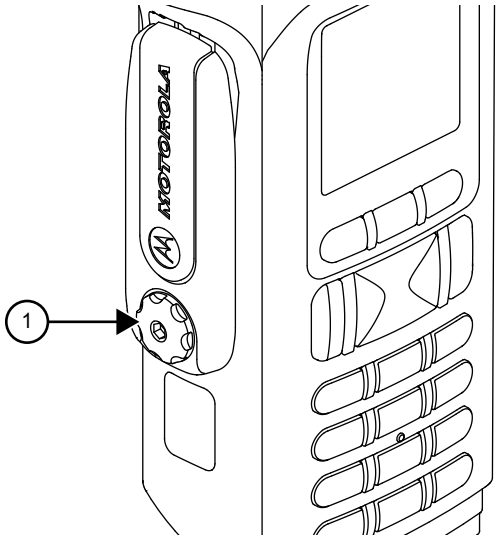


Figure 40: Removing the Thumb Screw - APX 8000XE



1	Thumb Screw with Hex Head Socket

2 Slightly swing the Universal Connector Cover away from radio before sliding it upward to disengage the hook feature.

3 Pull the Universal Connector Cover away from the radio.

8.6.2
Attaching the Universal Connector Cover

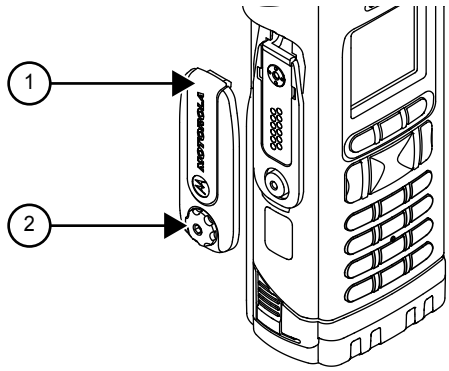
Procedure:

1 Insert the hooked end of the cover into the pocket.

2 Engage the hook beneath the undercut and swing the cover down onto the radio.

3 Ensure that the cover is seated properly and the screw is aligned into the threaded hole.

Figure 41: Engaging Hook and Seating Cover



1	Top Hooked End
2	Thumb Screw

4 Hand tighten the thumb screw clockwise until secured.

NOTE: Do not over-tighten the screw. The screw should be snug and not allow the cover to move.

Figure 42: Securing the Cover - APX 8000

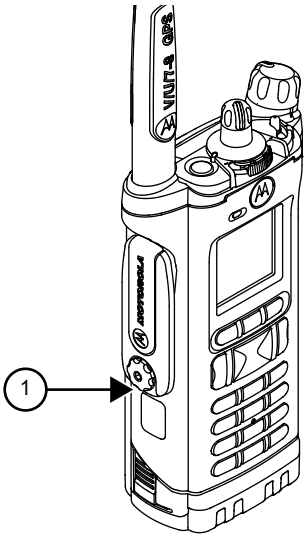
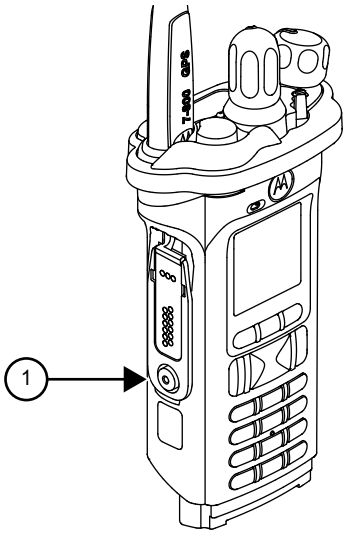


Figure 43: Securing the Cover - APX 8000XE



1	Thumb Screw with Hex Head Socket

8.7
Disassembling the Radio

This section contains instructions for disassembling the radio main subassemblies.

Procedure:

1 To turn off the radio, rotate the **On/Off/Volume Control Knob** counterclockwise until you hear a click.

2 Remove the antenna, the battery, Belt Clip Cover (Top Display Only), the Universal Connector Cover and any other accessory connected to the radio.

8.7.1
Removing the Speaker Grille Assemblies (K)

Procedure:

1 With the Battery removed and the primary loudspeaker side of the radio facing you, remove the center two screws and swing out Speaker Grille Assembly.

Figure 44: Remove Center Screws and Speaker Grille - APX 8000

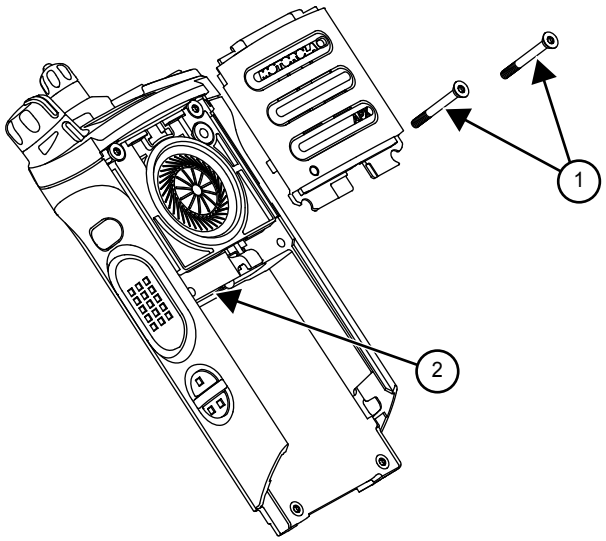
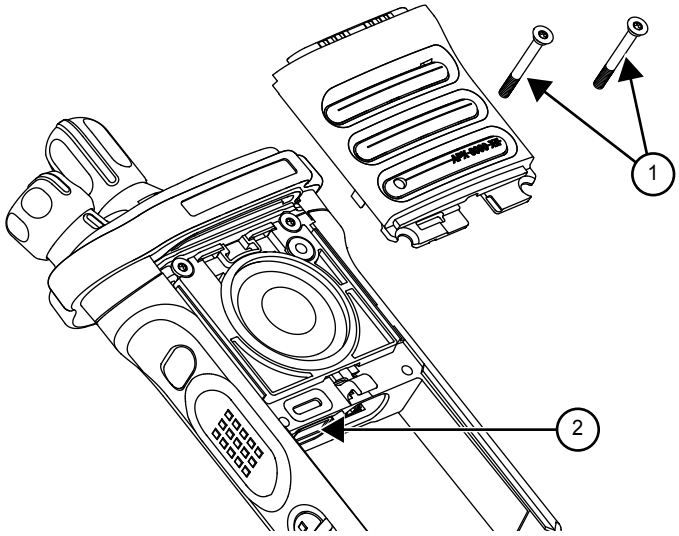


Figure 45: Remove Center Screws and Speaker Grille - APX 8000XE



1	Center Screws

2	Vacuum Port Seal

NOTE: Vacuum Port seal can be removed with the left center screw removed.

2 Remove the bottom two screws if the Main Housing Assembly is to be removed.

Figure 46: Remove Bottom Screws - APX 8000

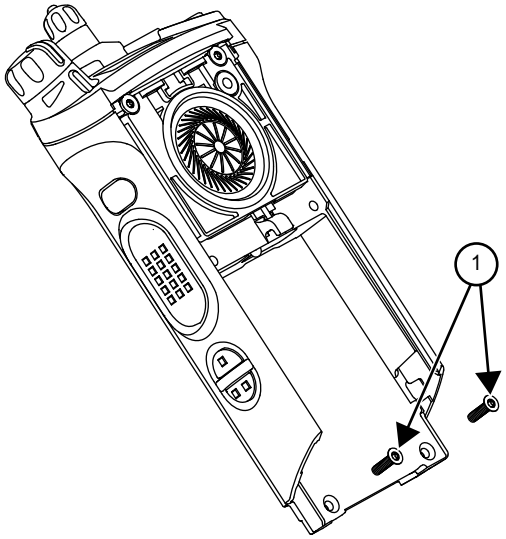
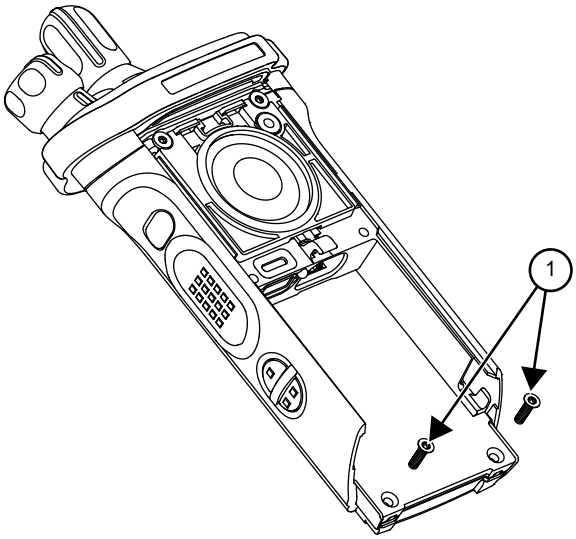


Figure 47: Remove Bottom Screws - APX 8000XE



1	Bottom Screws

CAUTION: Do not touch either the speaker cone or the Vacuum Port. Take extra precaution to make sure neither the speaker nor the breather pad is damaged.

8.7.2

Removing the Speaker Module (J)

Procedure:

1 Remove the two top screws.

Figure 48: Remove Top Screws - APX 8000

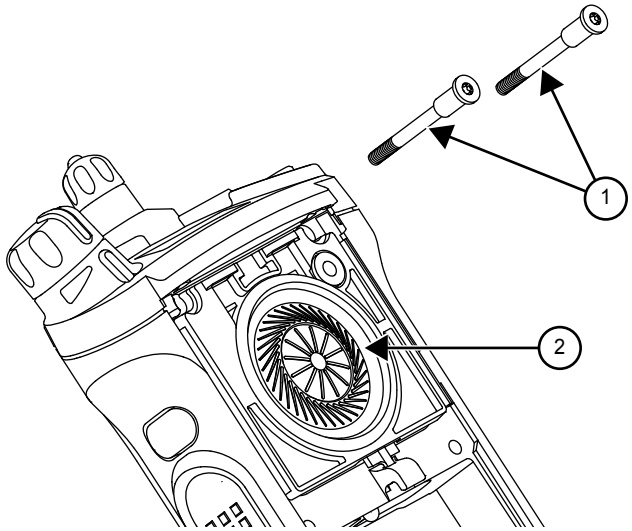
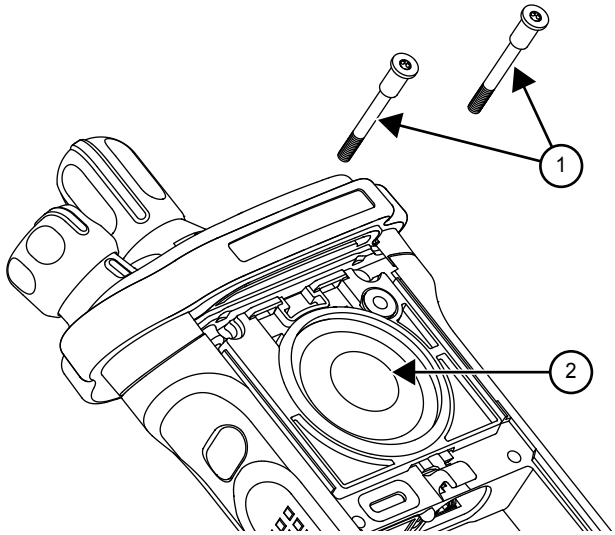


Figure 49: Remove Top Screws - APX 8000XE



1	Top Screws
2	Speaker Cone

2 Carefully pick out the Speaker Module with the Black Stick and remove it out of the Main Chassis Assembly.

Figure 50: Remove Speaker Module - APX 8000

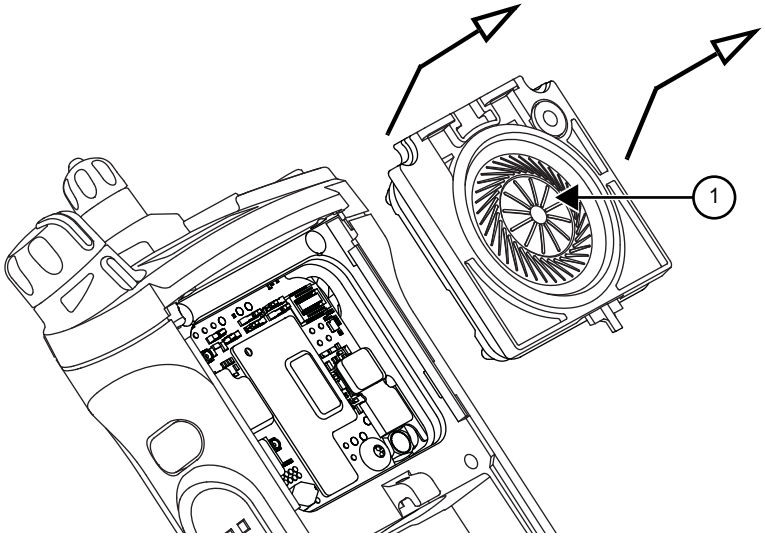
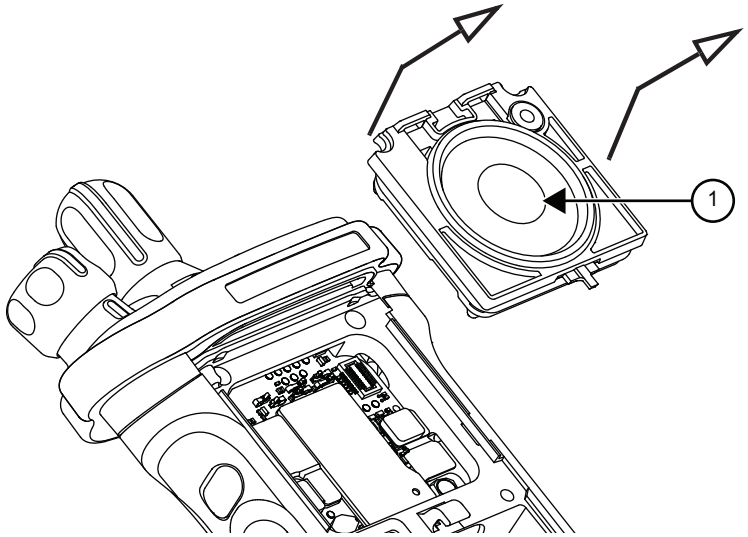


Figure 51: Remove Speaker Module - APX 8000XE



1	Speaker Cone

CAUTION: Be careful not to damage the speaker cone or the Vacuum Port during the disassembly process.

8.7.3
Removing the Expansion Board Assembly

Procedure:

1 Using the Black Stick, unplug the two flex connectors located on the left and right side of the Expansion Board Assembly. Unfold and straighten the flexes located on the right and left side. Remove the board screw.

Figure 52: Remove Flex Connectors and Expansion Board Assembly- - APX 8000

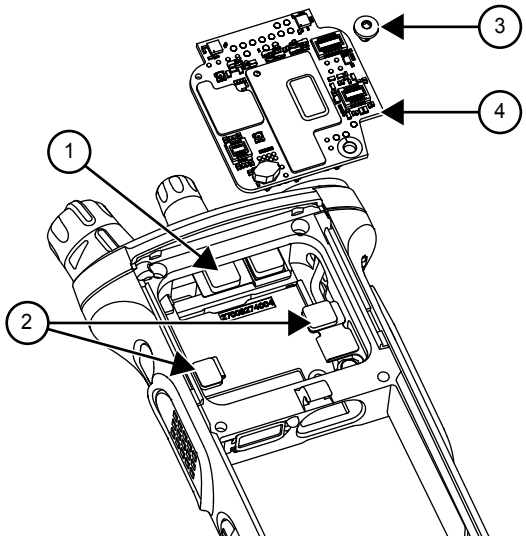
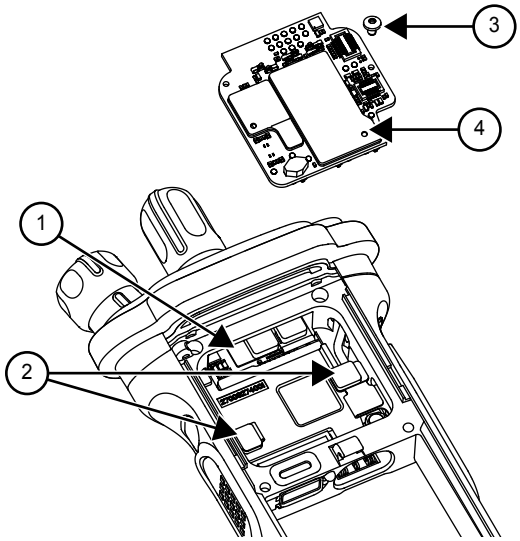


Figure 53: Remove Flex Connectors and Expansion Board Assembly - APX 8000XE



1	Control Top Assembly Flex
2	Flex Connectors
3	Board Screw
4	Expansion Board Assembly

2 Remove the Expansion Board Assembly by gently lifting up the right side of the PCB.

3 If the Control Top Assembly is to be removed from the radio, then unplug the Control Top Assembly flex.

4 If the RF Board Assembly is to be removed, use the Black Stick to unplug the antenna coax cable from the RF Board Assembly.

Figure 54: Remove Antenna Coax Cable Connector - APX 8000

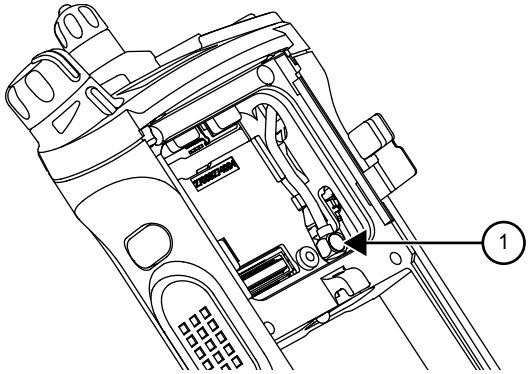
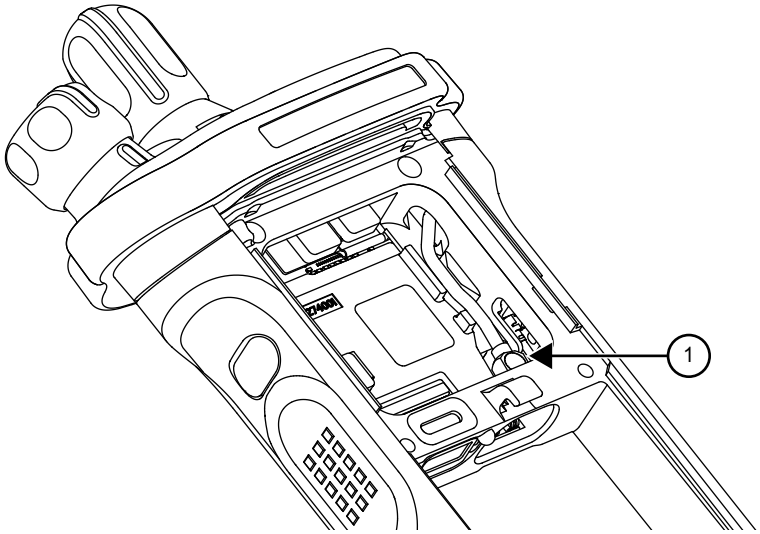


Figure 55: Remove Antenna Coax Cable Connector - APX 8000XE



1	Antenna Coax Cable Connector

5 Flip the radio over.

8.7.4

Removing the Main Housing Assembly (A, L, M)

Procedure:

1 Gently lift up the front housing from the radio and then detach both sides of the Main Housing Assembly outwards of the radio.

NOTE: For Top Display version, ensure the Belt Clip Cover has been removed.

Figure 56: Remove Housing - APX 8000

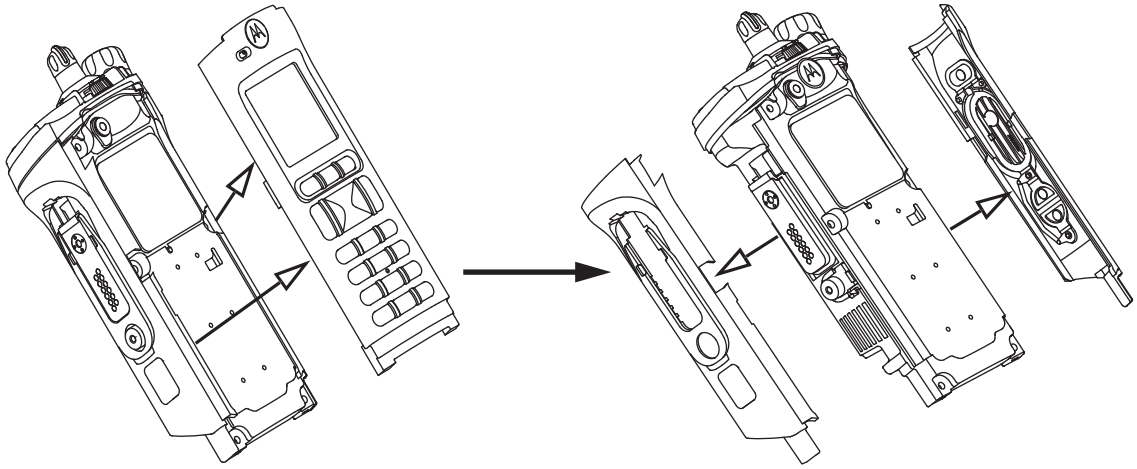
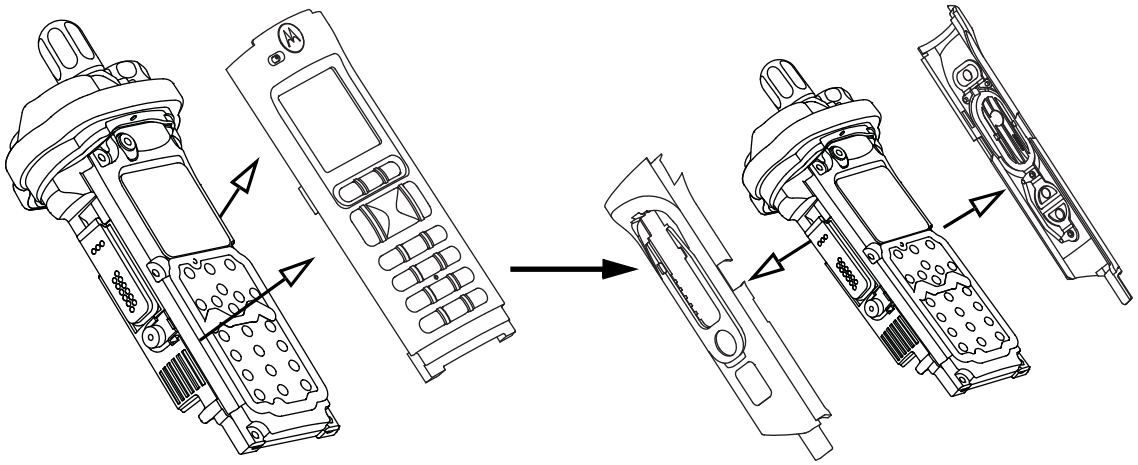


Figure 57: Remove Housing - APX 8000XE



8.7.5

Removing Back Chassis Assembly (B, N)

Procedure:

1 For Dual Display versions: Gently separate the Back Chassis Assembly from the Main Chassis Assembly to allow access to disconnect the two flex connections between both chassis. These connectors are located near the top of the radio. Use the Black Stick to disconnect the connectors.

CAUTION: Pull the flex connectors vertically upwards by using black stick. Disconnect at two connector locations as shown in the following figures.

2 For Top Display version: Back Chassis Assembly has no connections and can be removed by just separating the two chassis apart.

CAUTION: Pull the flex connectors vertically upwards by using black stick. Disconnect at two connector locations shown in the following figures.

Figure 58: Remove Back Chassis Assembly from Main Chassis Assembly - APX 8000

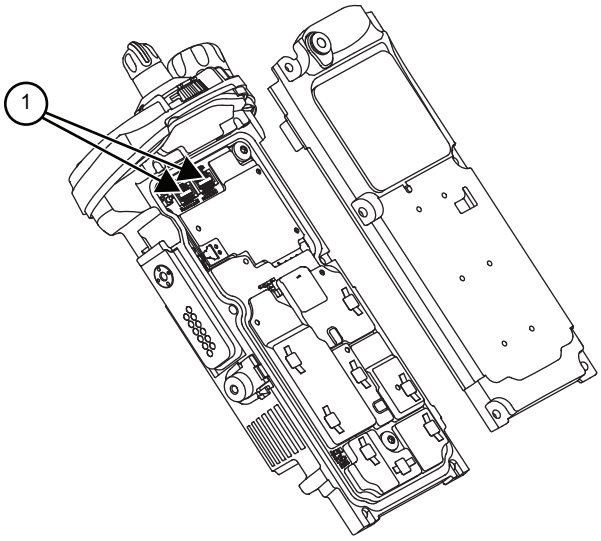
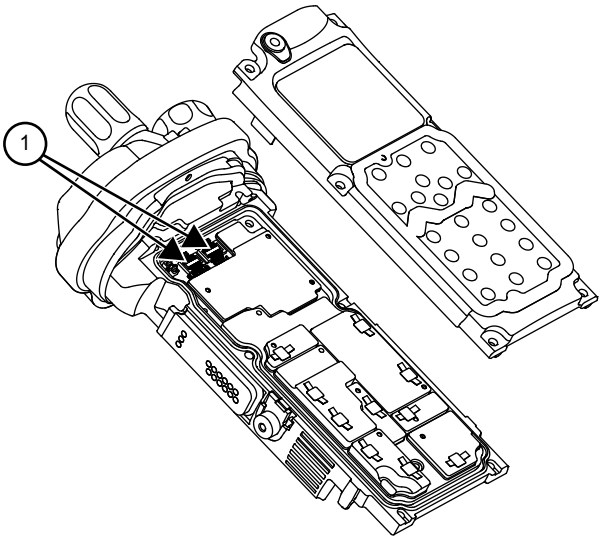


Figure 59: Remove Back Chassis Assembly from Main Chassis Assembly - APX 8000XE



1	Connectors

8.7.6

Removing RF Board Assembly (C)

Prerequisites:

NOTE: Reconfirm the coax cable connector on the bottom side of the RF Board is disconnected before removing the RF Board.

Procedure:

1. Remove the RF and VOCON Board screw.
2. Unplug the RF Board Assembly from the VOCON Board Assembly by using the Black Stick.

Figure 60: Remove RF Board Screw - APX8000

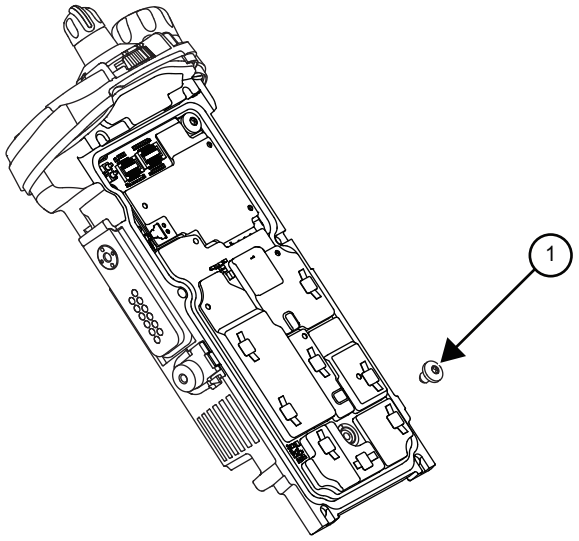
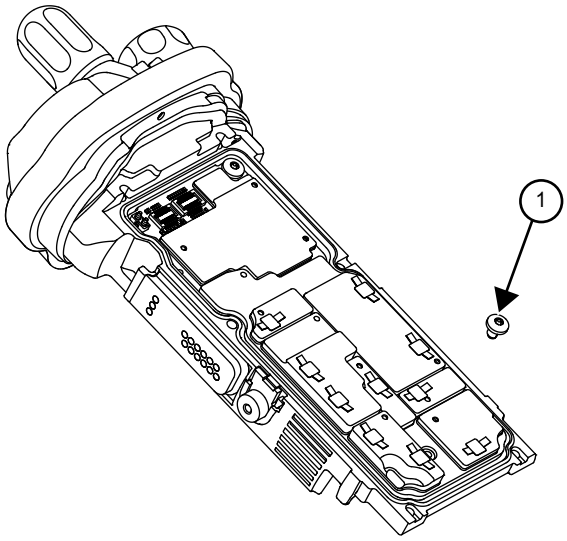


Figure 61: Remove RF Board Screw - APX8000XE



1	RF and Vocon Board Screw

CAUTION:
Place the RF Board Assembly in a clean and ESD safe area to avoid contamination to the Battery Connector Seal and electrical damage to the electronics respectively.

Replace Thermal Pad whenever RF Board Assembly is removed.

3 Slowly lift the RF Board Assembly enough to allow access to the small coax cable. Unplug the small coax cable using a Black Stick or a pair of small tweezers.

Figure 62: Remove RF Board Assembly - APX8000

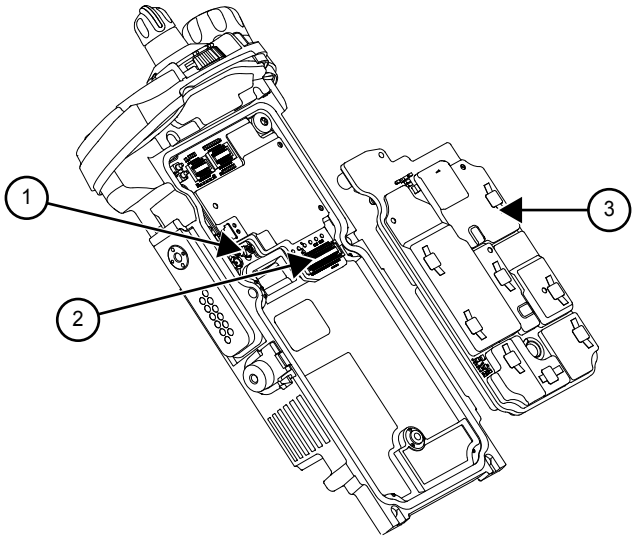
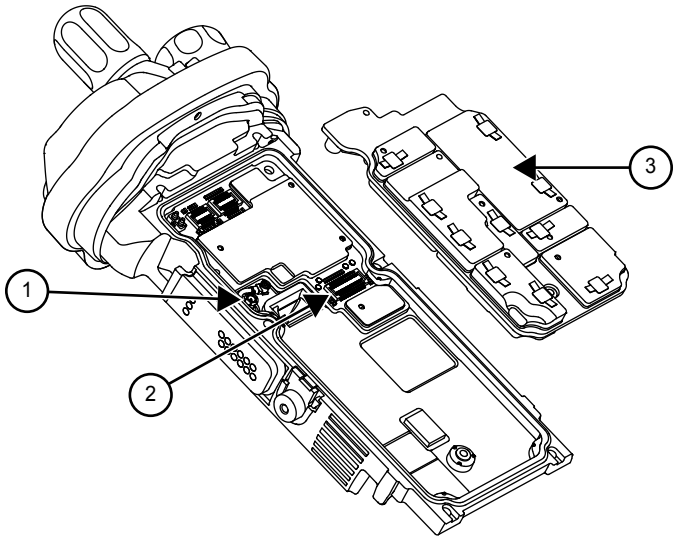


Figure 63: Remove RF Board Assembly - APX8000XE



1	Small Coax Cable
2	Connector
3	RF Board Assembly

8.7.7

Removing VOCON Board Assembly (D)

Procedure:

1. Disconnect the Flex connector between the Control Top Assembly and the VOCON Board Assembly if it is not disconnected. Failure to do so may damage the connectors or the flex.
2. Ensure RF Board is removed.
3. Remove RF and VOCON Board screw.

Figure 64: Remove VOCON Board Screw - APX 8000

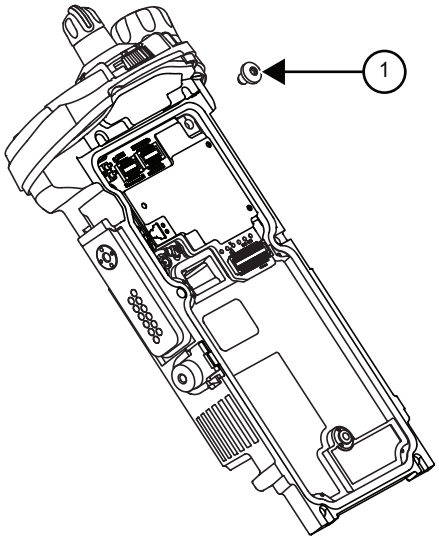
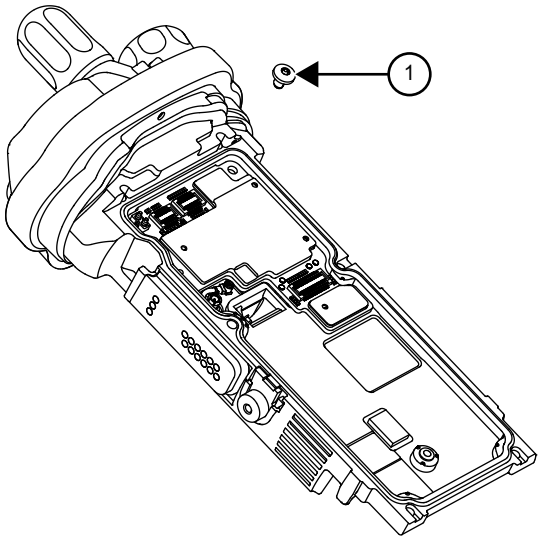


Figure 65: Remove VOCON Board Screw - APX 8000XE



1	RF and VOCON Board Screw

4 Gently rotate the VOCON Board Assembly just enough to clear the Main Chassis and slide out the VOCON Board Assembly.

Figure 66: Remove VOCON Board Assembly - APX 8000

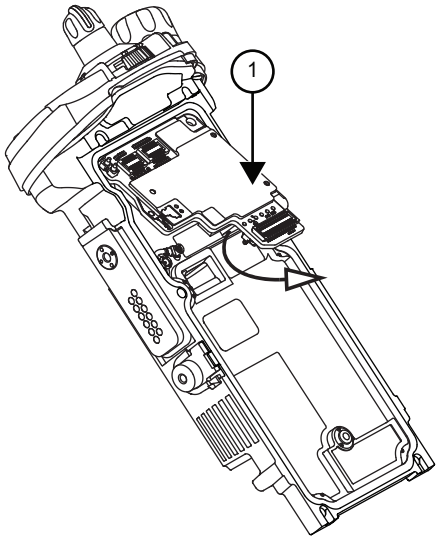
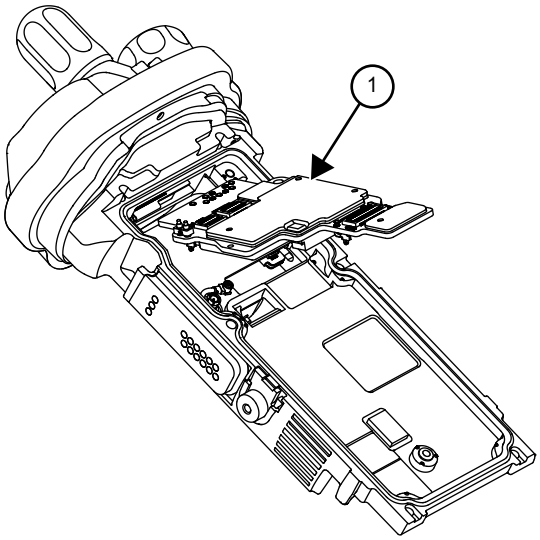


Figure 67: Remove VOCON Board Assembly - APX 8000XE



1	VOCON Board Assembly

8.7.8

Removing Knobs and Top Bezel Assembly for APX 8000

Procedure:

1. Perform the followings to remove the Frequency Knob:
   a. Hold the radio in one hand so that the top of the radio faces upward, and the front of the radio faces you.
   b. With the other hand, grasp the Frequency Knob and pull it upward, until it is free from its shaft.
2. Perform the followings to remove the Volume Knob:

a Hold the radio in one hand so that the top of the radio faces upward and the front of the radio faces you.

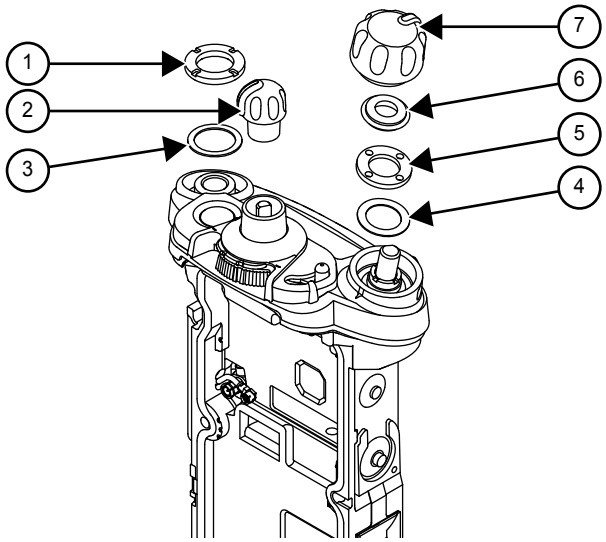
b With the other hand, grasp the Volume Knob and pull it upward.

c Remove the Torque Adder with the Black Stick.

d Unscrew the Volume Spanner Nut using the Volume Spanner Bit with a driver. Remove the Volume Washer below the nut.

e Unscrew the Antenna Spanner Nut with the Antenna Spanner Bit and a driver. Remove the Antenna Washer below the nut Figure 68: Remove Knobs and Fastener Hardware on page 113

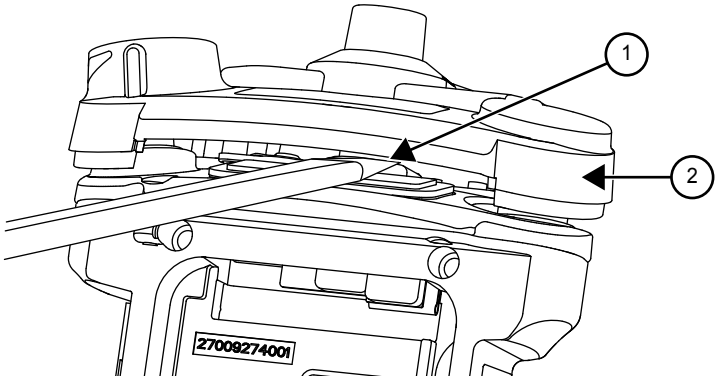
Figure 68: Remove Knobs and Fastener Hardware



1	Antenna Spanner Nut
2	Frequency Knob
3	Antenna Washer
4	Volume Washer
5	Volume Spanner Nut
6	Torque Adder
7	Volume Knob

f Gently lift the Control Top Bezel and with the aid of the Black Stick, pop the Secure Lever off the Frequency shaft as shown in Figure 69: Remove Control Top Bezel Assembly on page 114.

Figure 69: Remove Control Top Bezel Assembly



1	Secure Lever
2	Control Top Bezel Assembly

8.7.9

Removing the Knobs

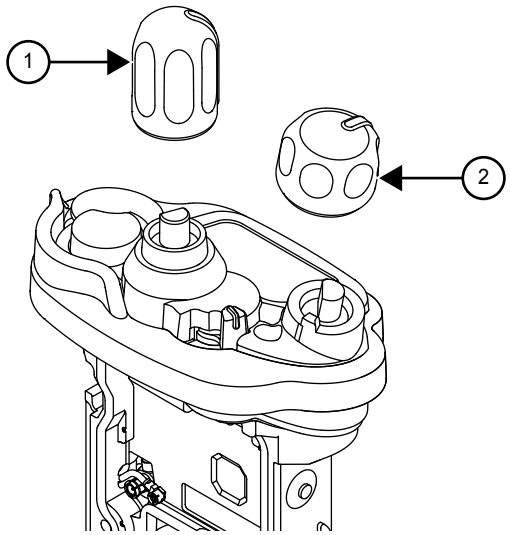
Procedure:

1. Hold the radio firmly in one hand so that the top of the radio faces upward, and the front of the radio faces you.
2. Grasp the knobs with a pair of pliers and pull it upward, until it is free from the shaft.

NOTE:
Knobs should only be removed when damaged.

The knobs are designed to be difficult to remove, however they will come off. If the metal D-Clip stays with the knob post, remove the D-Clip prior to putting on a new knob.

Figure 70: Remove Knobs



1	Frequency Knob

2	Volume Knob

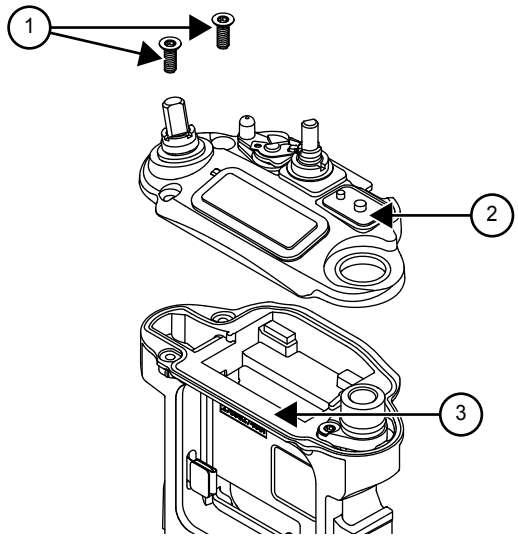
8.7.10

Removing Control Top Assembly (F) for APX 8000

Procedure:

1 Use a Torx Plus IP8 bit to remove the two Control Top Screws.

Figure 71: Remove Control Top Assembly



1	Control Top Screws
2	Control Top Assembly
3	Control Top Assembly Flex

NOTE: Ensure the Control Top flex is disconnected from the VOCON Board to prevent damage to the flex or connector.

2 Gently separate the Control Top Assembly from the Main Chassis Assembly.

NOTE: Place the Control Top Assembly and the remaining Main Chassis Assembly on an ESD safe surface free from debris.

8.7.11

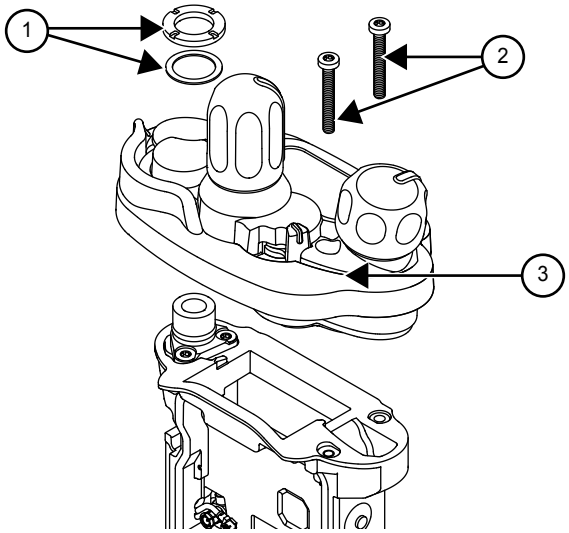
Removing the Control Top Assembly (F) for APX 8000XE

Procedure:

1 Remove the two Control Top screws.

NOTE: Ensure the Control Top flex is disconnected from the VOCON Board to prevent damage to the flex or connector.

Figure 72: Remove Control Top Assembly



1	Antenna Washer and Nut
2	Control Top Screws
3	Control Top Assembly

2 Unscrew the Antenna Spanner Nut with the Antenna Spanner Bit and a driver. Remove the Antenna Washer below the nut.

3 Gently separate the Control Top Assembly from the Main Chassis Assembly.

NOTE: Place the Control Top Assembly and the remaining Main Chassis Assembly on an ESD safe surface free from debris.

8.8 Serviceable Components of the Main Sub-Assemblies

This section contains instructions for the serviceable components of the main sub-assemblies.

8.8.1

Servicing Main Chassis Assembly (E)

Figure 73: Serviceable Components – Main Chassis Assembly - APX 8000

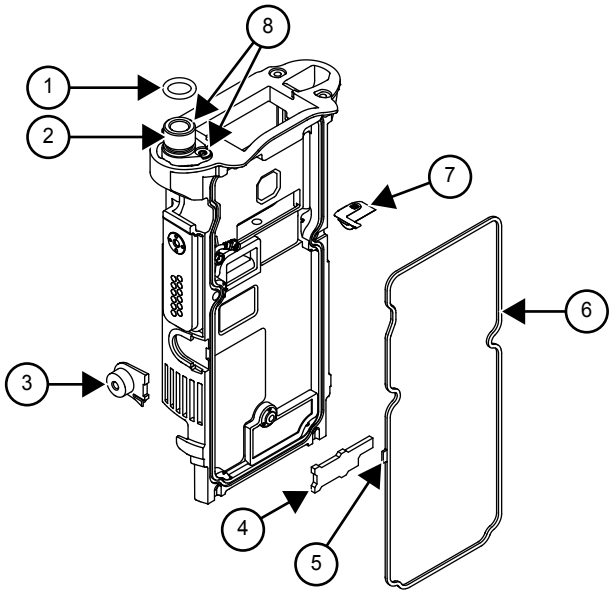
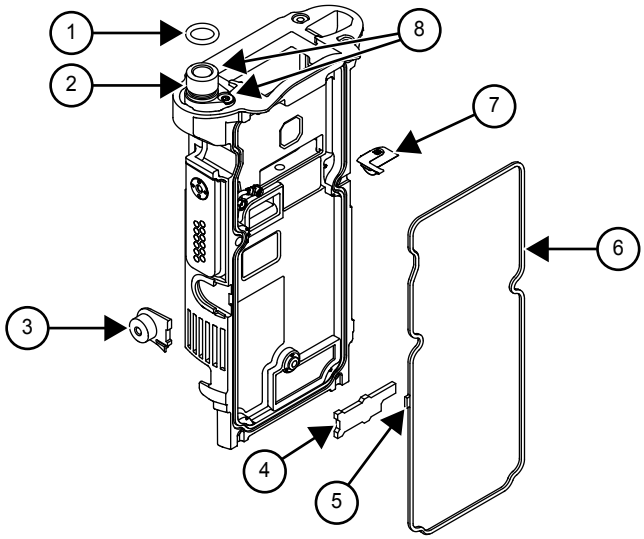


Figure 74: Serviceable Components – Main Chassis Assembly - APX 8000XE



1	O-ring (21)
2	RF Coax Cable
3	Universal Connector Insert (16)
4	Thermal Pad
5	**NOTE:** For assembly, ensure the key feature is aligned as shown.
6	Main Seal

7	Chassis Ground Contact
8	Screws

CAUTION: Always replace with new thermal pad. See Servicing Thermal Pads on page 118.

8.8.1.1
Servicing Universal Connector Insert

Prerequisites: Complete steps from Removing the Speaker Grille Assemblies (K) on page 101 through Removing the Main Housing Assembly (A, L, M) on page 106.

Procedure:

1. Ensure the locking tab is pressed and carefully slide the Universal Connector Insert (16) with the Black Stick from the Main Chassis Assembly.
2. Press the new Universal Connector Insert (16) until it is fully seated and the lock tab is engaged on the chassis.

8.8.1.2
Servicing Antenna O-ring

Prerequisites:
Complete steps from Removing the Speaker Grille Assemblies (K) on page 101 through Removing Control Top Assembly (F) for APX 8000 on page 115 for APX 8000 and from Removing the Speaker Grille Assemblies (K) on page 101 through Removing the Control Top Assembly (F) for APX 8000XE on page 115 for APX 8000XE.

Procedure:

1. Remove the O-ring (21) with the Black Stick.
2. Reinstall the O-ring (21) by rolling it over the threaded portion of the antenna hub until it sets in the groove.

   NOTE: Ensure the O-ring (21) is not twisted.

8.8.1.3
Servicing Thermal Pads

Prerequisites:
Complete steps from Removing the Speaker Grille Assemblies (K) on page 101 through Removing Control Top Assembly (F) for APX 8000 on page 115 for APX 8000 and from Removing the Speaker Grille Assemblies (K) on page 101 through Removing the Control Top Assembly (F) for APX 8000XE on page 115 for APX 8000XE.

Procedure:

1. Scrape off the thermal pad from the amplifiers and/or Main chassis with the Black Stick.
2. Ensure that there are no debris or residue left on the surfaces of the PCB.
3. Replace with new thermal pad.
4. Peel off the back liner from the thermal pad.
5. Insert the Thermal Pad without compressing or deforming it.

8.8.1.4

Servicing Chassis Ground Contact

Prerequisites:

NOTE:
Chassis Ground Contact will be damaged during disassembly.

Complete steps from Removing the Speaker Grille Assemblies (K) on page 101 through Removing Control Top Assembly (F) for APX 8000 on page 115 for APX 8000 and from Removing the Speaker Grille Assemblies (K) on page 101 through Removing the Control Top Assembly (F) for APX 8000XE on page 115 for APX 8000XE.

Procedure:

1. Slide the Black Stick under the Chassis Ground Contact through the opening on the RF/VOCON PCB side of the radio to lift off the contact.
2. Clean the area once the Chassis Ground Contact is removed to ensure it is free of adhesive and debris.
3. Remove the backer of the Chassis Ground Contact and place it in the appropriate location with a pair of flat tip tweezers by aligning the hole in the Ground Contact with the post located on the chassis. Ensure the Ground Contact is centered in the opening and the outer surface of the Ground Contact is parallel to the area adjacent to it in the chassis.

Figure 75: Remove Chassis Ground Contact - APX 8000

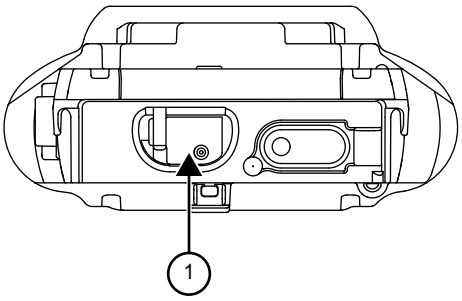
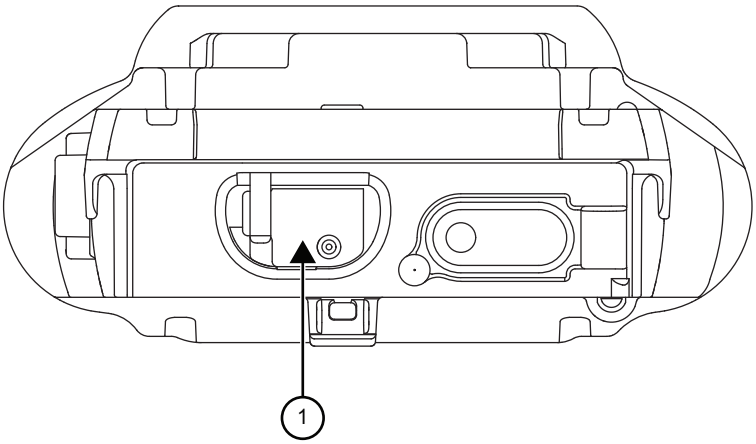


Figure 76: Remove Chassis Ground Contact - APX 8000XE



1	Chassis Ground Contact

NOTE: There are no other serviceable components on the Main Chassis Assembly.

4 Apply pressure to the adhesive to activate it.

8.8.1.5
Servicing RF Coax Cable

Prerequisites:
Complete steps from Removing the Speaker Grille Assemblies (K) on page 101 through Removing Control Top Assembly (F) for APX 8000 on page 115 for APX 8000 and from Removing the Speaker Grille Assemblies (K) on page 101 through Removing the Control Top Assembly (F) for APX 8000XE on page 115 for APX 8000XE.

Procedure:

1 Remove the two screws from the top of the assembly.

2 Note the routing of the RF Coax cable as seated onto the chassis grooves. Gently remove the cable by sliding it away from the control top.

3 Replace the RF Coax Cable. Bend and seat the new RF cable within the chassis grooves as noted in step 2.

4 Torque both screws with a Torx IP8 Bit and a torque Driver to 8 in-lbs.

8.8.2
Servicing Control Top Assembly

Figure 77: Control Top Assembly and Control Top Seal - APX 8000

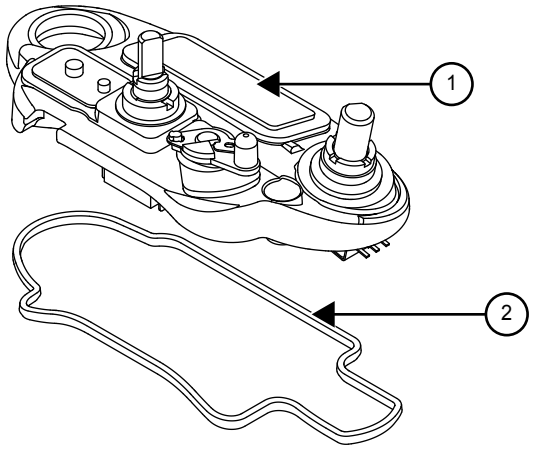
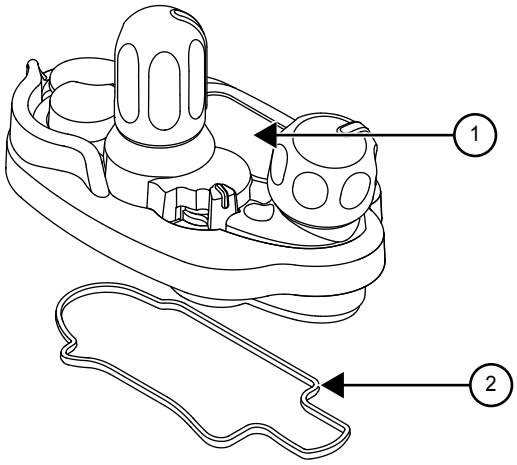


Figure 78: Control Top Assembly and Control Top Seal - APX 8000XE



1	Control Top Assembly
2	Control Top Seal

8.8.2.1

Top Controls Main Seal

Prerequisites:

Complete steps from Removing the Speaker Grille Assemblies (K) on page 101 through Removing Control Top Assembly (F) for APX 8000 on page 115 for APX 8000 and from Removing the Speaker Grille Assemblies (K) on page 101 through Removing the Control Top Assembly (F) for APX 8000XE on page 115 for APX 8000XE.

Procedure:

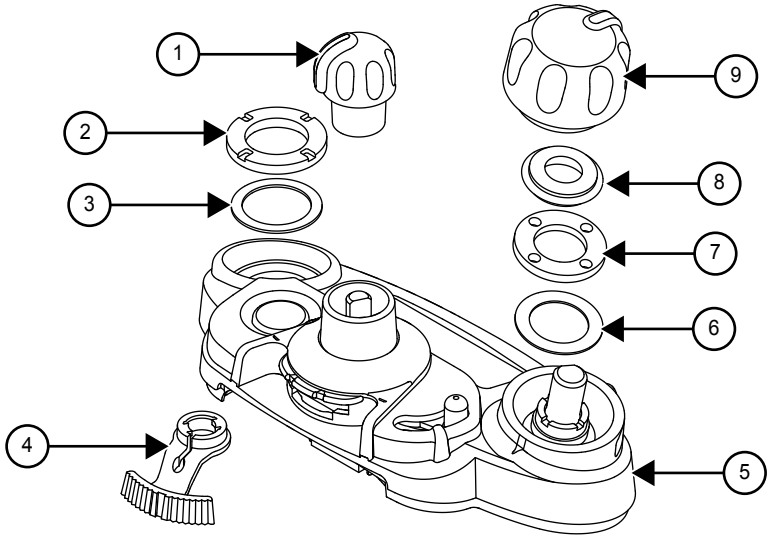
1. Remove the Top Controls Seal with the Nylon spudger.
2. Replace the new seal into the groove provided in the casting of the Top Controls Assembly.
3. Ensure that the seal is set properly and not stretched.

NOTE: There are no other serviceable components on the Top Controls Assembly.

8.8.3

Servicing Knobs and Top Bezel Assembly (G) for APX 8000

Figure 79: Top Bezel Assembly - APX8000



1	Frequency Knob
2	Antenna Spanner Nut
3	Antenna Washer
4	Secure Lever
5	Top Bezel Assembly
6	Volume Washer
7	Volume Spanner Nut
8	Torque Adder
9	Volume Knob

8.8.3.1

Secure Lever

Prerequisites: Complete steps from Removing Knobs and Top Bezel Assembly for APX 8000 on page 112.

Procedure:

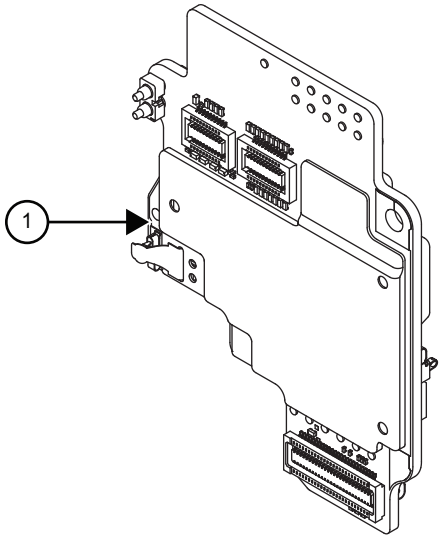
1. Pull the Secure Lever straight out of Top Bezel Assembly.
2. Insert the lever arm into the bezel slot.

NOTE: All serviceable components on the Top Bezel Assembly are shown in Figure 79: Top Bezel Assembly - APX8000 on page 122.

8.8.4

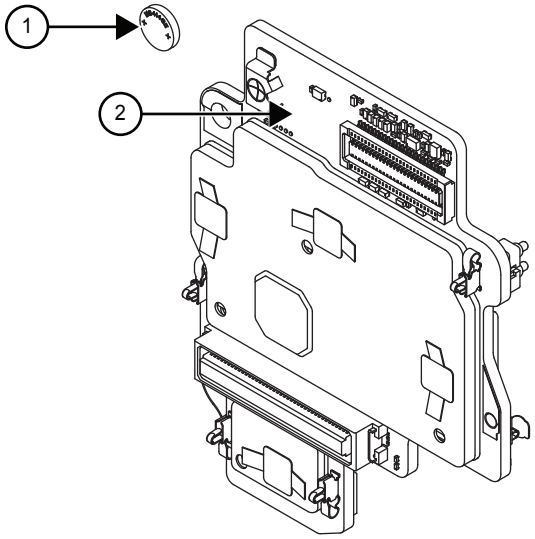
Servicing VOCON Board Assembly (D)

Figure 80: VOCON Board Assembly



1	VOCON Board

Figure 81: VOCON Board Assembly with Coincell Backup Battery



1	Coincell Backup Battery
2	VOCON Board

8.8.4.1

Coincell Back up Battery

Prerequisites: Complete steps from Removing the Speaker Grille Assemblies (K) on page 101 through Removing VOCON Board Assembly (D) on page 110.

Procedure:

1 Remove the battery with the Black Stick.

NOTE: Ensure the positive terminal (with "+" marked on top) of the Coincell Backup Battery faces up when installed onto the VOCON board.

2 Press the new battery into the battery carrier until it is secured and fully snapped into place.

NOTE: There are no serviceable components on the VOCON Board Assembly.

8.8.5
Servicing of RF Board Assembly

Figure 82: RF Board Assembly - APX 8000

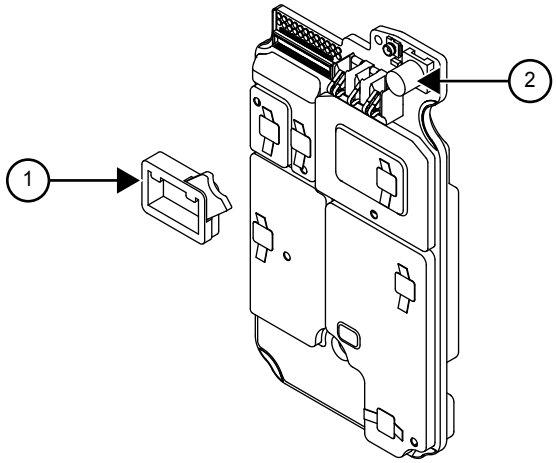
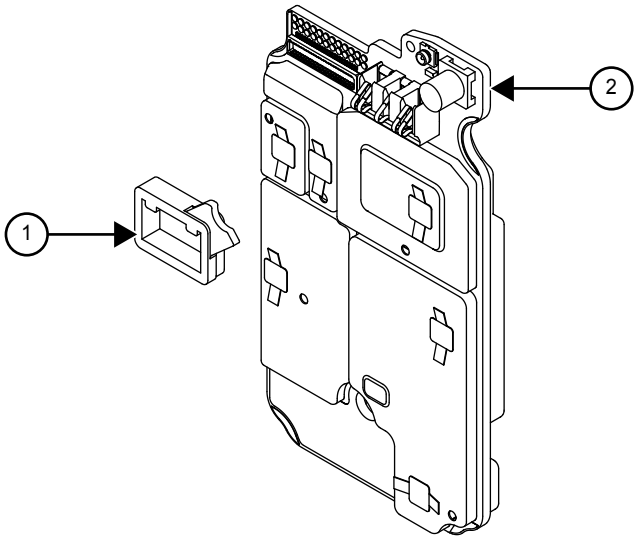


Figure 83: RF Board Assembly - APX 8000XE



1	RF Board Assembly

2	Battery Connector Seal

CAUTION: Thermal pad must be replaced when RF Board assembly is removed.

8.8.5.1
Battery Seal

Prerequisites: Complete steps Removing the Speaker Grille Assemblies (K) on page 101 through Removing RF Board Assembly (C) on page 108.

Procedure:

1. Slide the Battery Connector Seal from the battery contact header with the Black Stick.
2. Use the Black Stick and push the new Battery Connector Seal until it is properly seated onto the RF Board surface.

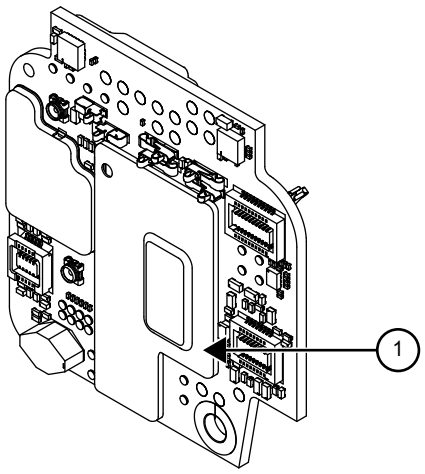
NOTE: There are no serviceable components on the RF Board Assembly.

8.8.6
Servicing of Expansion Board Assembly

Procedure:

1. Complete steps Removing the Speaker Grille Assemblies (K) on page 101 through Removing the Expansion Board Assembly on page 104 of Radio Disassembly.

Figure 84: Expansion Board Assembly



1	Expansion Board Assembly

NOTE: There are no serviceable components on the Expansion Board Assembly.

8.8.7

Servicing Back Chassis Assembly (B, N) for Dual/Top Display Version

Procedure:

1 Complete steps Removing the Speaker Grille Assemblies (K) on page 101 through Removing Back Chassis Assembly (B, N) on page 107.

Figure 85: Back Chassis Assembly (Dual Display Versions) - APX 8000

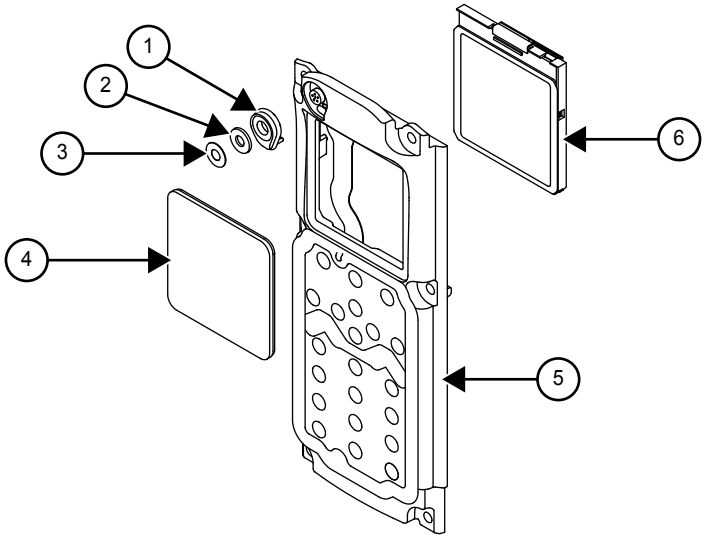
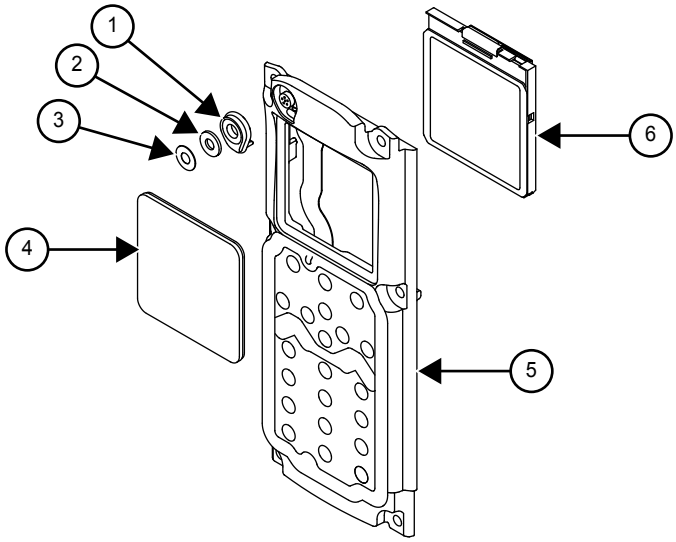


Figure 86: Back Chassis Assembly (Dual Display Versions) - APX 8000XE



1	Mic Boot
2	Mic Membrane
3	Mic Mesh
4	Lens
5	Back Chassis Assembly

6	Color Display

NOTE: Take precaution not to damage the Color Display during disassembly.

Figure 87: Back Chassis Assembly (Top Display Versions) - APX 8000

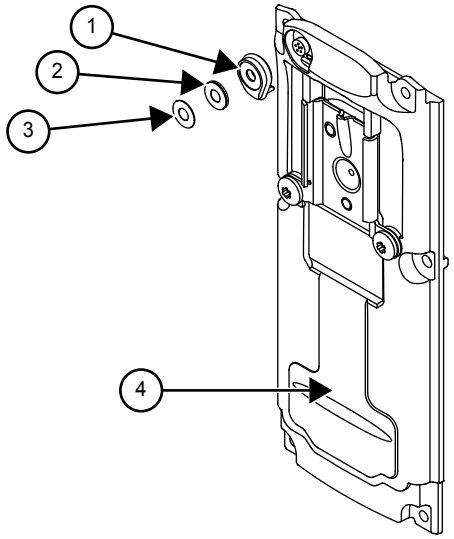
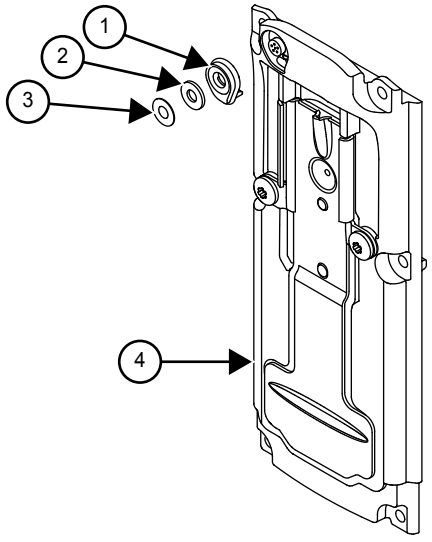


Figure 88: Back Chassis Assembly (Top Display Versions) - APX 8000XE



1	Mic Boot
2	Mic Membrane
3	Mic Mesh
4	Back Chassis Assembly

8.8.7.1

Servicing Microphone Membrane/Microphone Mesh

Prerequisites: Complete steps from Removing the Speaker Grille Assemblies (K) on page 101 through Removing the Main Housing Assembly (A, L, M) on page 106.

Procedure:

1. Carefully peel off the Microphone Membrane and Microphone Mesh from the Speaker Module.

   NOTE: When servicing microphone membrane, microphone mesh part needs to be replaced.

2. Clean the area, once the Microphone Membrane and Microphone Mesh are removed, to ensure it is free of adhesive and debris. Ensure nothing comes in contact with the microphone while cleaning.

   NOTE: Ensure the microphone is seated properly with the microphone boot opening.

3. Remove the backer from the Microphone Membrane.
4. Carefully place the Microphone Membrane centered on the top surface of the microphone opening; with no ripples or folds. Press down firmly, applying 2-3 lbs. of force.
5. Repeat step 4 for the Microphone Mesh.

   NOTE: Ensure the microphone boot is correctly seated with the chassis opening.

8.8.7.2

Servicing Microphone Boot

Procedure:

1. Carefully remove the microphone boot out of the Back Chassis opening
2. Pinch the sides of the microphone boot and carefully slide out the microphone cartridge. Make sure the flex is not stretched.
3. Insert the microphone cartridge into the new microphone boot slot using the black stick. Make sure the flex is not stretched.
4. Ensure the microphone cartridge is seated properly with the microphone boot.
5. Ensure the microphone boot is correctly seated with the chassis opening.
6. Follow Servicing Microphone Membrane/Microphone Mesh on page 128 (step 4 to 5) to complete assembling and placing the microphone mesh and membrane.

   When servicing microphone boot, microphone membrane and microphone mesh part needs to be replaced.

8.8.7.3

Servicing Color Display - Dual Display Only

Procedure:

1. Disconnect the Back Chassis Flex from the back of the Color Display.
2. Gently pry the Color Display out of the Back Chassis Assembly by using the Black Stick against the white section of the frame (upper right corner at the back of the Color Display).
3. Remove any remnants of the Pad of the Display if it does not come off completely with the Color Display from the Back Chassis Assembly.

4 Clean the area to ensure it is free of adhesive and debris once the Color Display is completely removed.

5 Ensure there are no foreign material on the new Color Display or the Lens.

6 Remove the liner from the new Color Display and seat it into the Back Chassis Assembly.

7 Ensure the Display is oriented correctly and seated properly.

8.8.7.4

Servicing the Main Lens - Dual Display Only

Prerequisites: Prior to Lens removal, Color Display must be removed (See Servicing Color Display - Dual Display Only on page 128).

Procedure:

1 Remove the main Lens carefully and slowly with the Black Stick.

CAUTION: Over prying may damage the lens.

NOTE: To ease the breaking of the adhesive bond, place Back Chassis in freezer.

2 Clean the area once the Lens is completely removed to ensure it is free of adhesive and debris.

3 Peel the liner off of the adhesive side of the new Lens and place it centered left to right in the lens pocket of the Back Chassis assembly. Bias it upwards against the horizontal surface.

4 Press the Lens down.

5 Ensure the adhesive shows no sign of air entrapments.

NOTE: There are no other serviceable components on the Back Chassis Assembly.

8.8.8

Servicing Main Housing (A, L, M) for Dual/Top Display Version

Figure 89: Main Housing Assembly (Dual Display Version, Full Keypad)

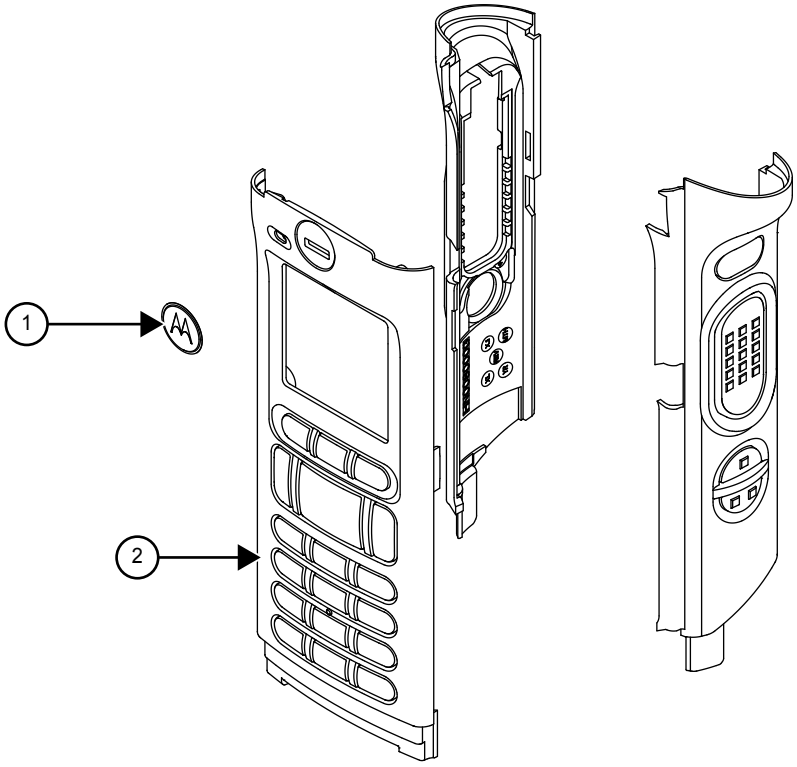


Figure 90: Main Housing Assembly (Dual Display Version, Limited Keypad)

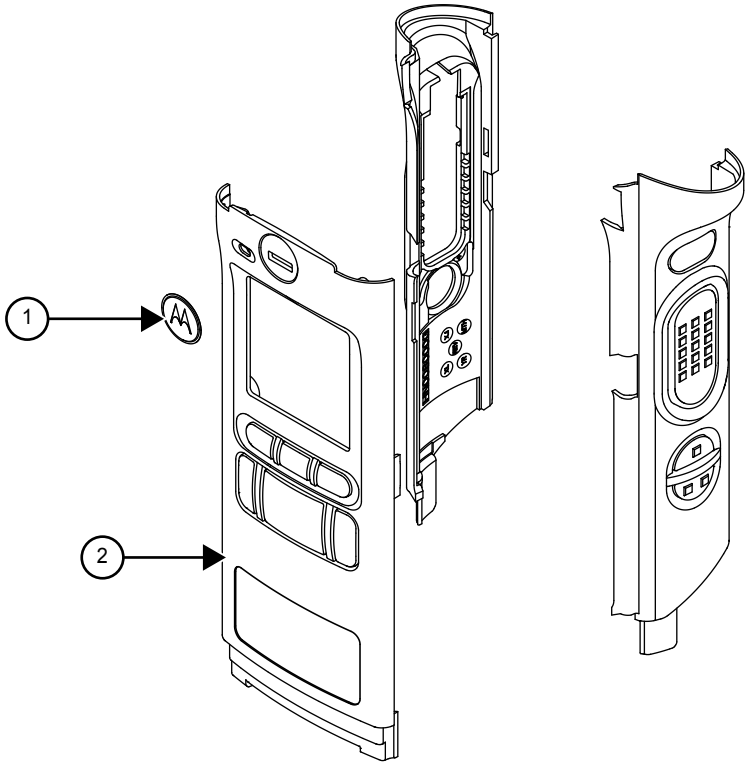
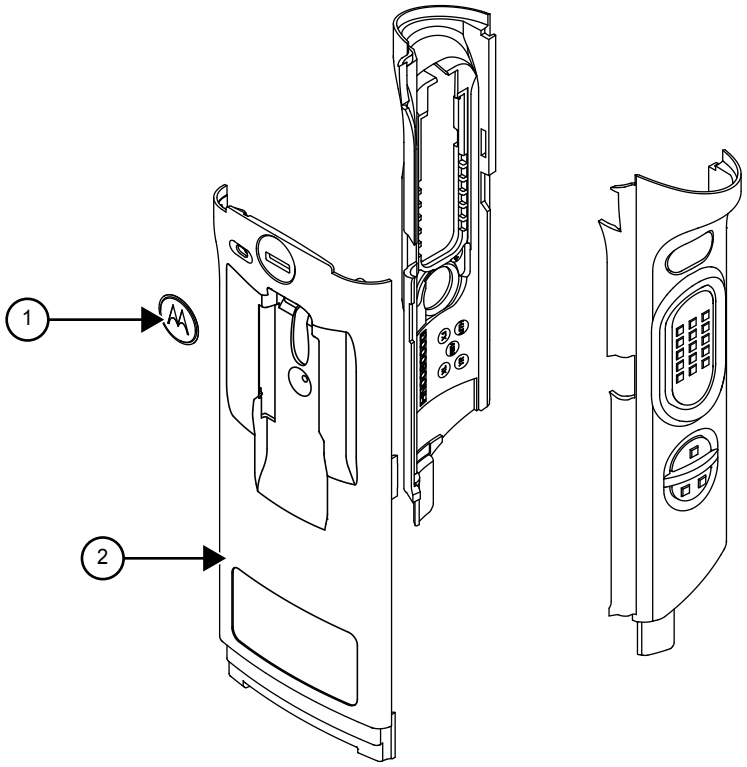


Figure 91: Main Housing Assembly (Top Display Version)



1	Medallion
2	Front Housing Assembly

8.8.8.1

Medallion

Prerequisites:

NOTE: There is no need to remove any components in order to service the Medallion.

Procedure:

1. Scrape off the Medallion with the Black Stick.
2. Clean the area once the Medallion is completely removed to ensure it is free of adhesive and debris.
3. Remove the adhesive liner and place the Medallion in the recess.
4. Press the Medallion.

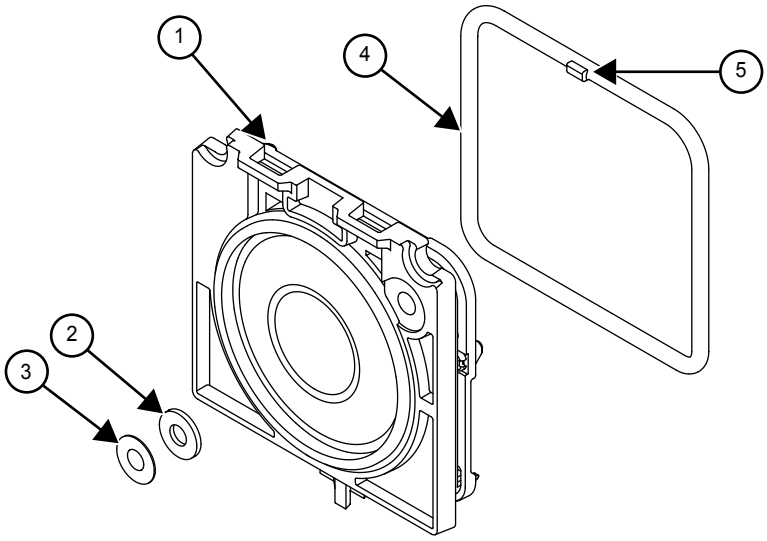
NOTE: There are no other serviceable components on the Main Housing Assembly.

8.8.9
Servicing Speaker Module (J)

Procedure:

1 Complete steps Removing the Speaker Grille Assemblies (K) on page 101 through Removing the Speaker Module (J) on page 103.

Figure 92: Speaker Module



1	Speaker Module
2	Mic Membrane
3	Mic Mesh
4	Speaker Module Seal
5	Seal Key Feature **NOTE:** For assembly, ensure the seal key feature is aligned on top as shown.

8.8.10
Servicing Speaker Grille Assembly (K)

NOTE: There is no serviceable component on the Speaker Grille Assembly.

Figure 93: APX 8000 Speaker Grille

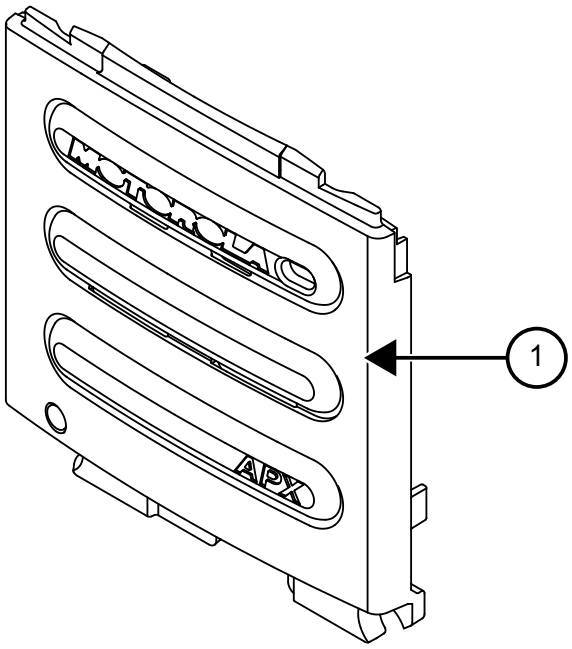
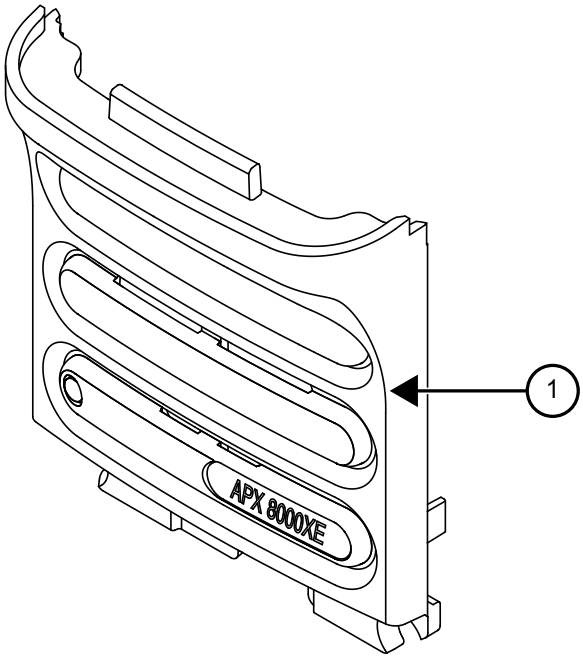


Figure 94: APX 8000XE Speaker Grille



1	Speaker Grille

8.9 Radio Reassembly

This section contains instructions for reassembling the radio.

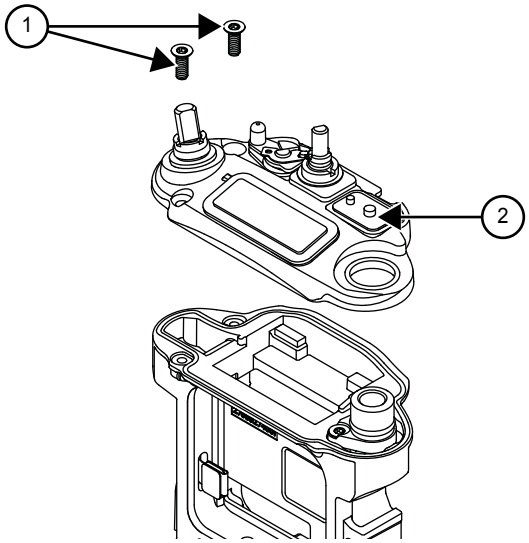
8.9.1

Assembling the Control Top Assembly (F) to Main Chassis Assembly (E)

Procedure:

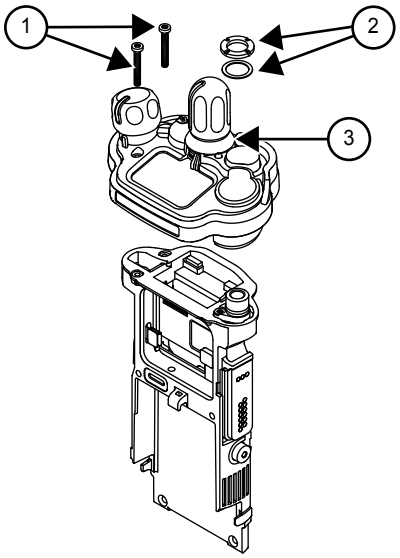
1. Verify there are no surface irregularities such as scratches or indentations on both the Control Top Main Seal Grove and the Seal's mating surface on the Main Chassis Assembly. Also ensure that the Control Top Main Seal and surrounding surfaces are free of debris and other foreign material.
2. Verify Control Top Main Seal is properly seated into the groove and place Control Top Assembly onto Main Chassis Assembly.
3. Torque both screws with a Torx IP8 Bit and a torque Driver to 8 in-lbs.

Figure 95: Control Top Bezel Assembly - APX 8000



1	Control Top Screws
2	Control Top Assembly

Figure 96: Control Top Bezel Assembly - APX 8000XE



1	Control Top Screws
2	Antenna Nut and Washer
3	Control Top Assembly

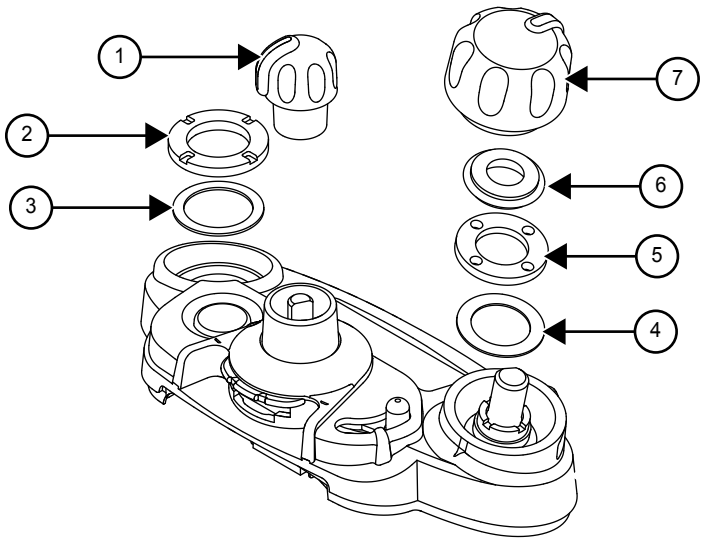
8.9.2

Assembling the Knobs and Top Bezel Assembly (G) for APX 8000

Procedure:

1. With the Secure Lever in place, slide the Control Top Bezel onto the Control Top. Ensure that the Secure Lever is keyed correctly on the Frequency outer shaft. Use the Secure Lever Setter to fully set the lever into place.
2. While holding down the bezel, place the Volume Washer onto the Volume Shaft.

Figure 97: Top Bezel Assembly



1	Frequency Knob
2	Antenna Spanner Nut
3	Antenna Washer
4	Volume Washer
5	Volume Spanner Nut
6	Torque Adder
7	Volume Knob

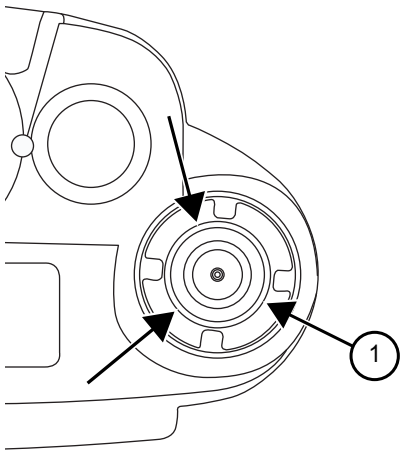
3 Tighten the Volume Spanner Nut by hand first to avoid cross threading. Then, torque the nut with the Volume Spanner Bit at 8 in-lbs.

4 Place the Antenna washer onto the antenna threaded hub.

5 Tighten the Antenna Spanner Nut until it bottoms by hand, to avoid cross threading. Then, torque the nut with the Antenna Spanner Bit at 16 in-lbs. Place the extender nozzle on the tube of Loctite 425 thread-locker (in KT000009A01), and apply three drops 120 degrees apart at the interface between the top inner diameter of the spanner nut and the threaded portion of the antenna connector. Immediately rotate the antenna spanner nut counter-clockwise (back-out) one full turn. Then, torque the nut with the Antenna Spanner Bit at 16 in-lbs.

CAUTION: Do NOT place the thread-locker within the center cavity of the antenna connector.

Figure 98: Application point for Loctite



1	Application point for Loctite

6 Slide and ensure that the Torque Adder is fully seated onto the Volume Potentiometer's Hub.

7 Align the D-shaped part of the Volume Shaft with the D-shape hole in the Volume Knob and press the Volume Knob into place.

8 Align the D-shaped part of the Frequency Shaft with the D-shape hole in the Frequency Knob and press the Frequency Knob into place.

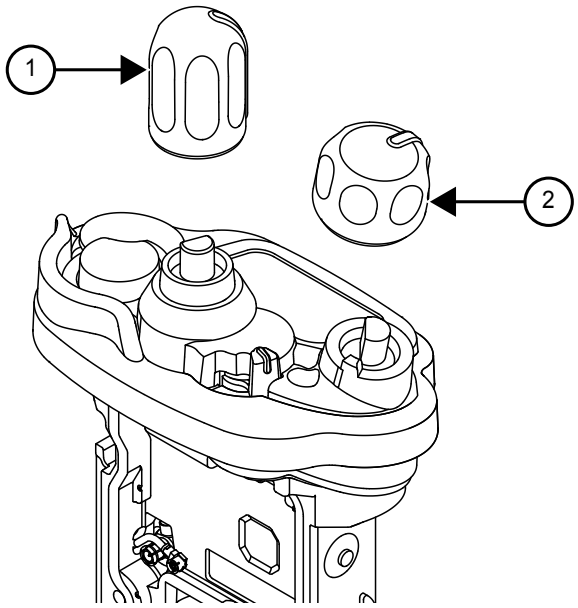
8.9.3
Assembling the Knobs and Control Top Assembly (G) for APX 8000XE

Procedure:

1. Place the knobs on their respective shafts, ensuring the D-shape of the post is aligned with the D-shape of the knob.
2. Press the knob into place.

   NOTE: Considerable force is needed to press the knobs into place. The use of a solid surface may be required. Cover the surface with a clean rubbery covering, such as a mouse pad, to prevent markings to the knob.

Figure 99: Knobs Assembly



1	Frequency Knob
2	Volume Knob

8.9.4
Assembling the VOCON Board Assembly (D)

Procedure:

1. Inspect the Main Chassis sealing surfaces to make sure there is no surface irregularities such as scratches or indentations. Clean any debris or other foreign material.
2. Orient the Main Chassis with the Frequency Knob on top. Insert the VOCON Board Assembly into the chassis starting at a 45° angle and rotate the board into place. Ensure the control top flex is located below the PCB, and is not being pinched between the PCB and the casting.
3. Tighten the Vocon Board screw by hand first to avoid cross threading. Then, torque the screw with a Torx IP8 Bit and a torque Driver to 8 in-lbs.

Figure 100: Insert VOCON Board - APX 8000

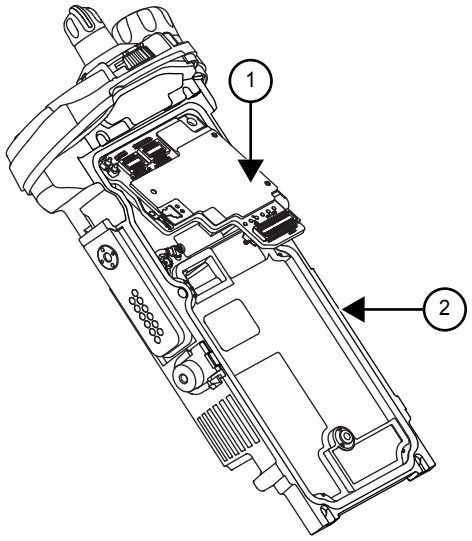
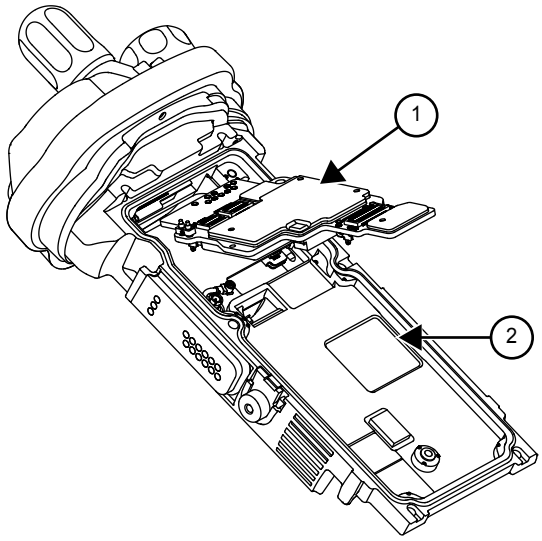


Figure 101: Insert VOCON Board - APX 8000XE



1	VOCON Board Assembly
2	Main Chassis Assembly

8.9.5

Assembling the RF Board Assembly (C)

Procedure:

1. Inspect the Battery Connector Seal on the RF Board Assembly for any damage or debris. Replace seal if necessary.

   CAUTION: Always replace with new thermal pad. See Servicing Thermal Pads on page 118.

2. Connect the small coaxial cable connector into the RF Board.

Figure 102: Connect Small Coaxial Cable - APX 8000

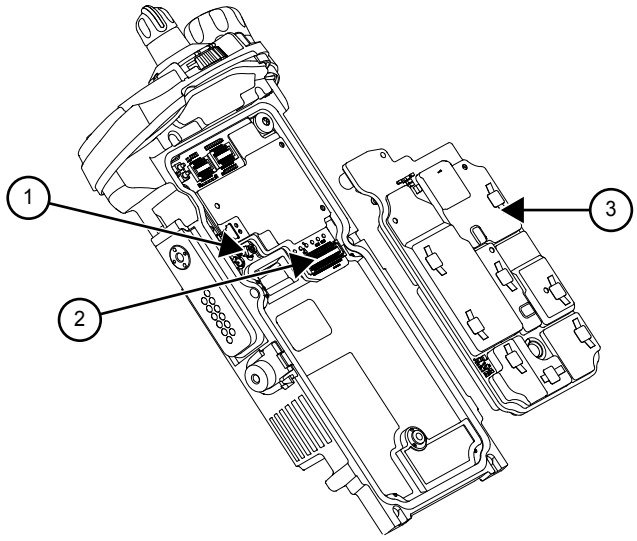
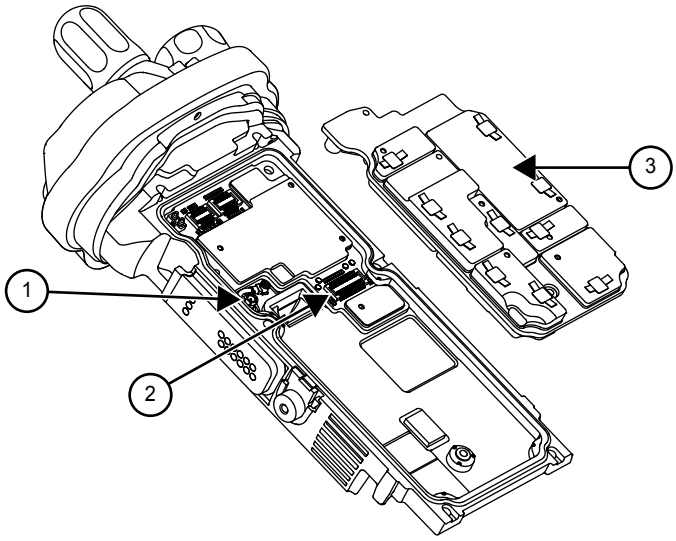


Figure 103: Connect Small Coaxial Cable - APX 8000XE



1	Small Coax Cable
2	Connector
3	RF Board Assembly

3 Connect the RF Board to the VOCON Board.

4 Tighten the VOCON Board Screw and subsequently the RF Board screw by hand first to avoid cross threading. Then, torque the screw with a Torx IP8 Bit and a torque Driver to 8 in-lbs.

NOTE: Do not connect the Antenna coax at this time. Front Housing Assembly must be snapped in place prior to connecting the coax.

8.9.6

Assembling the Back Chassis Assembly (B, N)

Procedure:

1 Dual Display version

a Inspect the Back Chassis Assembly Seal for any debris or foreign material.

b Place the Main Seal onto the main chassis groove. Gently seat the seal around the perimeter of the groove, ensuring the key feature is oriented.

c Connect both the Back Chassis Flexes to the VOCON board.

d Set the Back Chassis Assembly onto the Main Chassis Assembly.

Figure 104: Place Back Chassis - APX 8000

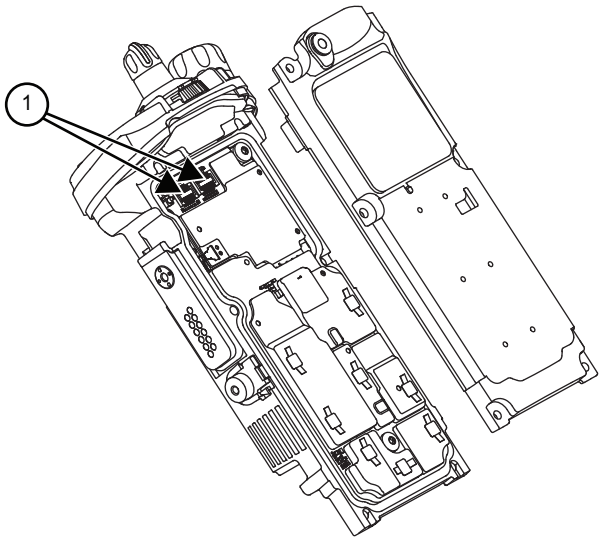
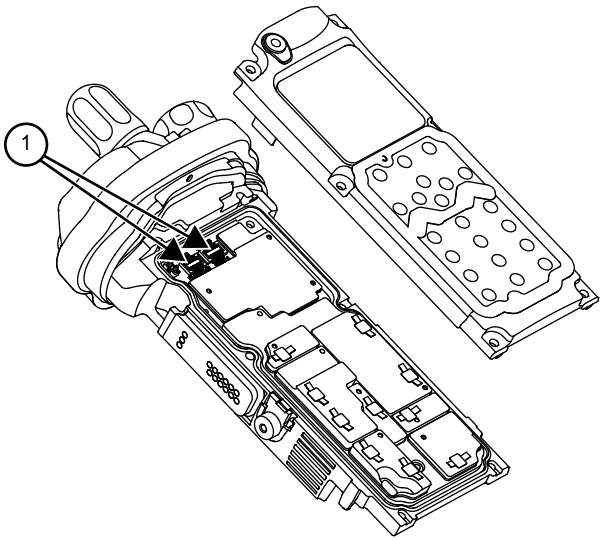


Figure 105: Place Back Chassis - APX 8000XE



1	Connectors

2 Top Display Version

a Inspect the Back Chassis Assembly seal for any debris or foreign material.

b Place the Main Seal onto the main chassis groove. Gently seat the seal around the perimeter of the groove, ensuring the key feature is oriented.

c Set the Back Chassis Assembly onto the Main Chassis Assembly.

8.9.7
Assembling the Main Housing Assembly (A, L, M)

Procedure:

1. Snap in the Main Housing Assembly side walls with both hands just enough to attach them to the Main Chassis Assembly and place it onto the radio.
2. Ensure the top edge of the housing and the bottom edge of the control top are aligned and attach the Front Housing to the radio.
3. Squeeze the Main Housing Assembly and the Main Chassis Assembly in the battery area until the Main Housing Assembly fully snaps in place onto the Main Chassis Assembly.

Figure 106: Place Housing into Main Chassis - APX 8000

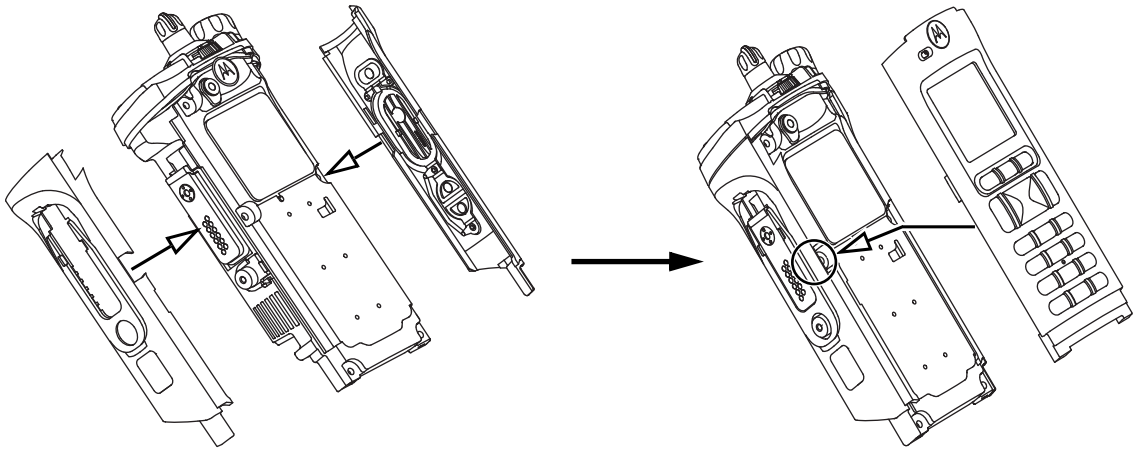
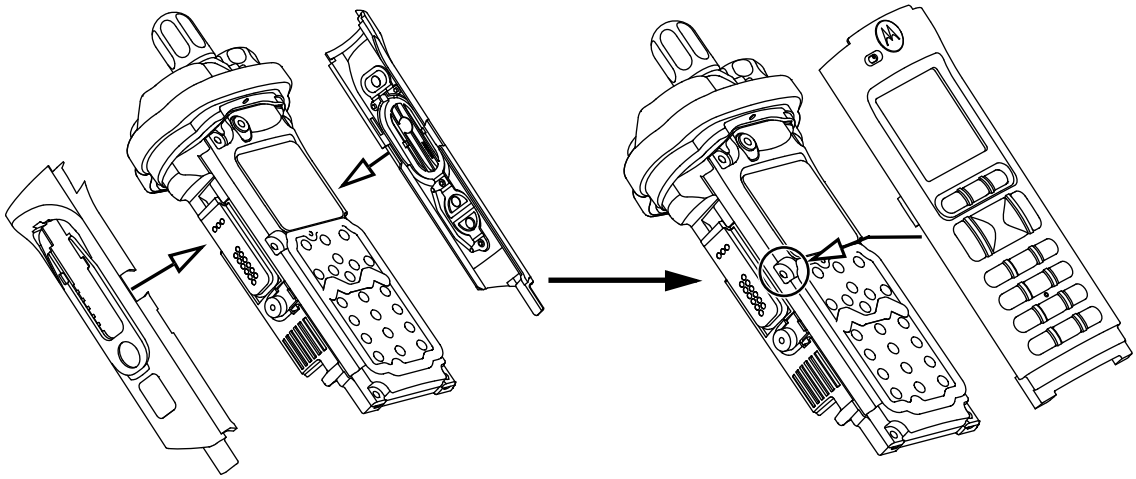


Figure 107: Place Housing into Main Chassis - APX 8000XE



8.9.8

Assembling the Expansion Board Assembly (H)

Procedure:

1 Proceed to step 2 if the Control Top Assembly or VOCON Board Assembly was not removed. Connect the Control Top Flex to the VOCON Board Assembly.

Figure 108: Assembling the Expansion Board Assembly - APX 8000

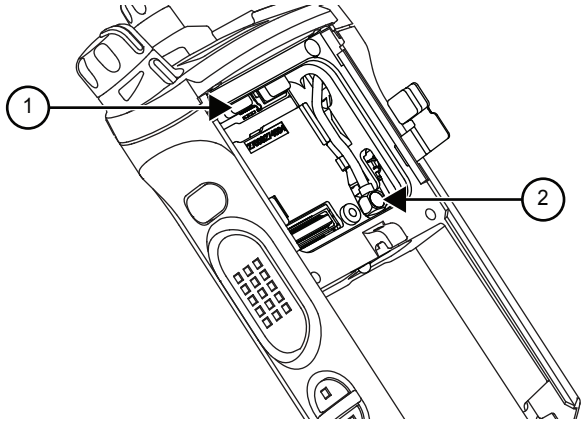
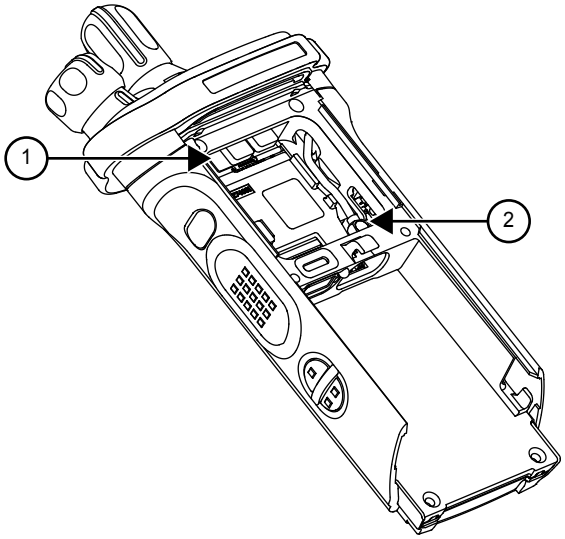


Figure 109: Assembling the Expansion Board Assembly - APX 8000XE



1	Control Top Assembly Flex
2	Antenna Coax Cable Connector

2 If replacing new Control Top or Main Chassis Assembly, add Control Top Support Pads to stainless steel backers at the locations.

3 Proceed to step 4 if the RF Board Assembly was not removed. Carefully align the Antenna Coax Plug to the Coax Receptacle on the RF board Assembly and slide the plug in using the Black Stick. Ensure the universal connector flex is not caught under the antenna coax cable.

4 Tuck in the Antenna Coax Cable into the grooves.

5 Lift the two flex connectors up before plugging the Expansion Board Assembly to the VOCON Board Assembly. Make sure the connector is fully engaged.

Figure 110: Insert Flex Connectors - APX 8000

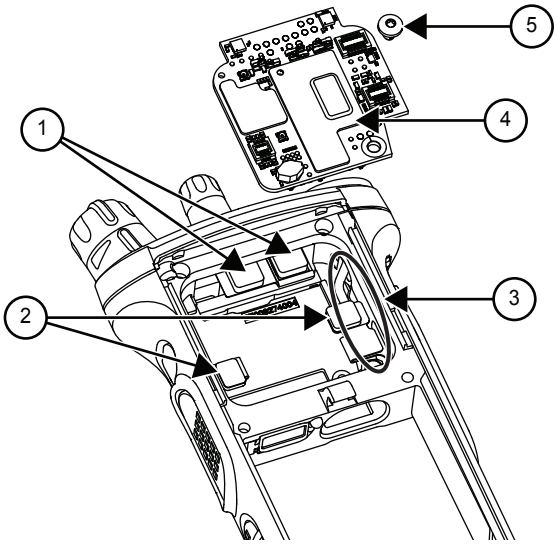
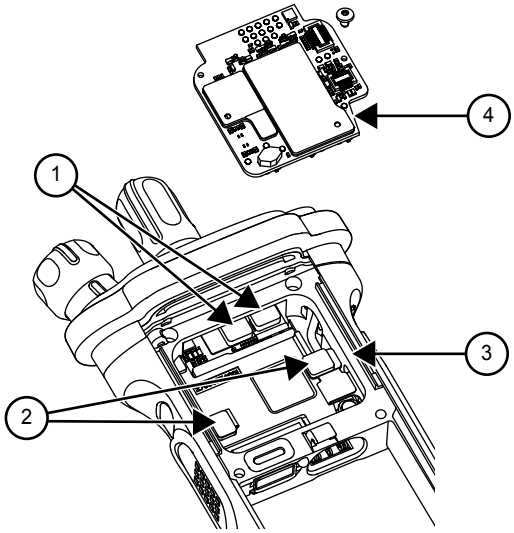


Figure 111: Insert Flex Connectors - APX 8000XE



1	Control Top Support Pads
2	Flex Connectors
3	Antenna Coax Cable In Grooves
4	Expansion Board Assembly
5	Board Screw

6 Tighten the Board Screw by hand first, to avoid cross threading. Then, torque the screw with a Torx IP-8 Bit and torque driver to 8in-lbs.

7 Connect the two Flex Connectors to their pairing connectors on the right and left sides of the Expansion Board Assembly.

8.9.9

Assembling the Speaker Module (J)

Procedure:

1. Ensure the Seal is free from any debris or foreign material.
2. Align the Speaker Module Pin feature located on the bottom edge directly below the speaker, into the hole on the chassis hook feature.
3. Swing the Speaker Module down and firmly press the top side into the radio.

Figure 112: Insert Speaker Module - APX 8000

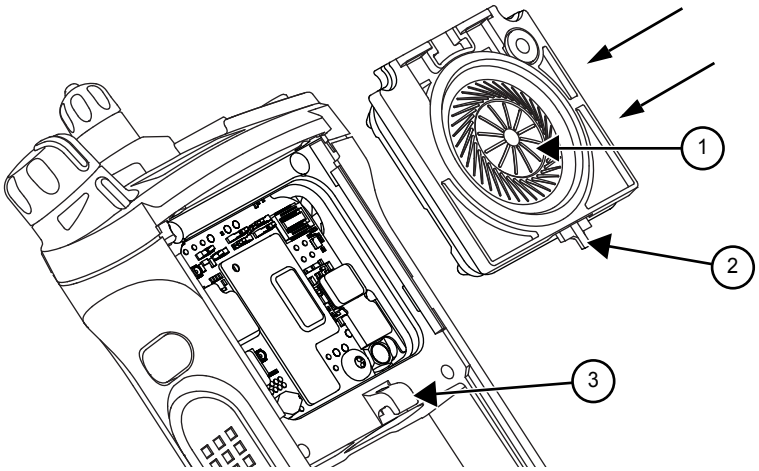
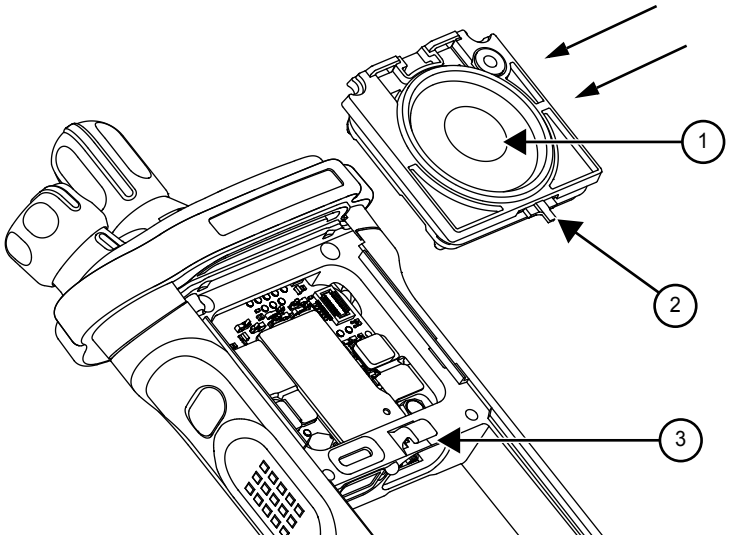


Figure 113: Insert Speaker Module - APX 8000XE



1	Speaker Cone
2	Pin Feature
3	Chassis Hook Feature

CAUTION: Do not touch the speaker cone or the port seal. Take extra precaution to make sure neither the speaker nor the breather pad is damaged.

4 While holding the Speaker Module down, place the two top screws into the their respective holes and torque the screws to 10 in-lbs with an IP8 Torx Bit in a torque driver.

IMPORTANT: For proper sealing, Speaker Module must be held down during the torquing of the screws.

Figure 114: Insert Top Screws - APX 8000

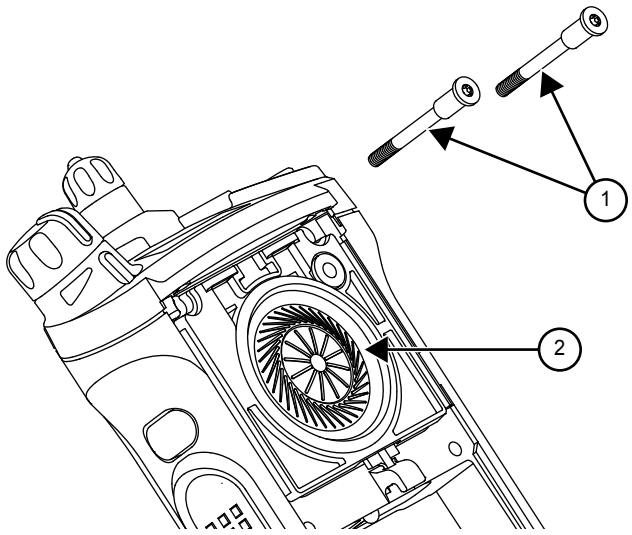
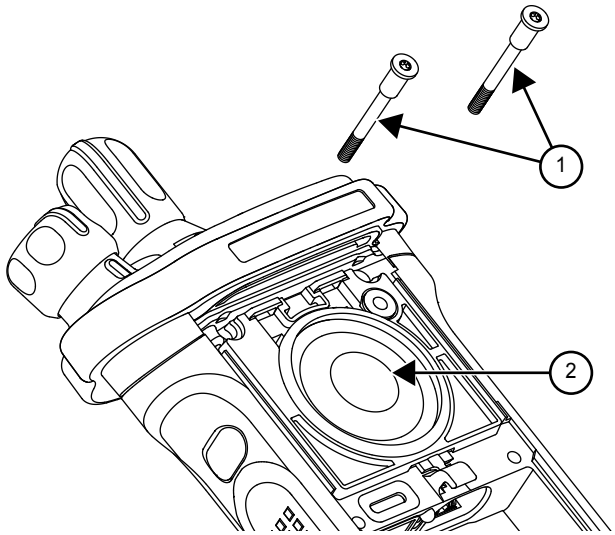


Figure 115: Insert Top Screws - APX 8000XE



1	Top Screws
2	Speaker Cone

8.9.10

Assembling the Speaker Grille Assembly (K)

Procedure:

1. Install the Speaker Grille by inserting the top lip under the Control Top Bezel and rotating the grille into place.
2. Insert the two center screws and torque to 10 in-lbs.

Figure 116: Insert Bottom Screws - APX 8000

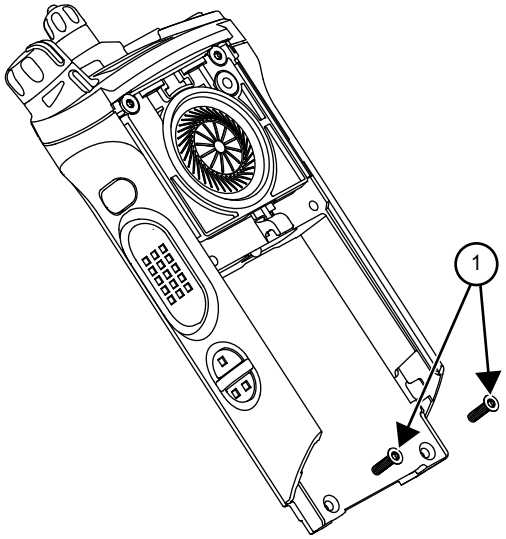
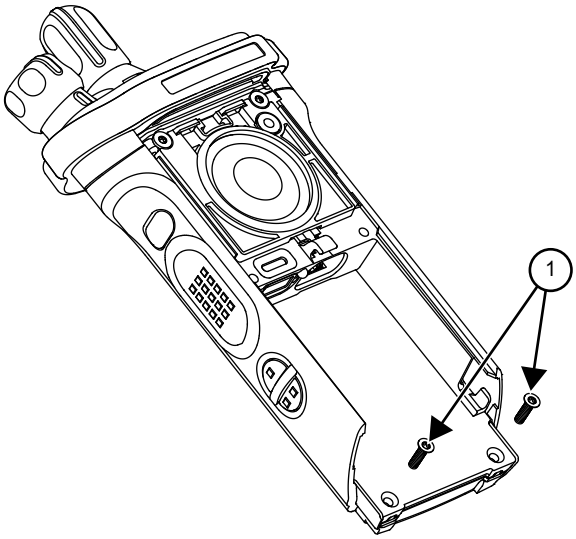


Figure 117: Insert Bottom Screws - APX 8000XE



1	Bottom Screws

NOTE: Ensure the Vacuum Port Seal is in place and the Vacuum Port Seal screw shaft is aligned with the screw hole.

8.10
Ensuring Radio Submergibility

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

8.10.1
Standards

The radio models meet the stringent requirements of U.S. Mil-Std 810 Revisions C, D, E, F, and G, Method 512.X Procedure 1, which requires the radio to maintain watertight integrity when radio temperature is elevated to +27 °C above water temperature and immersed in 1 meter of water for 2 hours. The radio has an IP68 rating with increased immersion limits up to 2 meters for 4 hours.

8.10.2
Servicing

The radios shipped from the Motorola Solutions factory have passed vacuum testing and should not be disassembled. If disassembly is necessary, refer to qualified service personnel and service shops capable of restoring the watertight integrity of the radio.

CAUTION: It is strongly recommended that 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 Solutions. It is also recommended that submergibility be checked annually by qualified service personnel.

8.10.3
Water Exposure

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

If a conductive medium is present in the water, ensure to thoroughly rinse the radio to remove all the conductive medium, then shake the radio to remove the excess water from the speaker grille and microphone ports areas before operating.

8.10.4
Specialized Test Equipment

This section summarizes the specialized test equipment necessary for testing the integrity of the 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 or instrument mentioned in the *Service Aids* section is authorized by Motorola Solutions and is used to perform the vacuum check and pressure testing, if required. Any equipment, tools, or instruments not mentioned in this chapter must not be used to perform these tests.

8.10.4.1
Vacuum Pump Kit NLN9839

The Vacuum Pump Kit includes a Vacuum Pump with gauge and a Vacuum Hose. The Vacuum Adapter which connects the vacuum pump to the radio, must be ordered separately.

Table 30: Vacuum Adapter Part Number

Vacuum Adapter	66009259001

8.10.4.2
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 Vacuum Adapter connects the pressure pump to the radio.

8.10.5
Disassembly

Disassemble the radio according to Disassembling the Radio on page 100.

8.10.6
Reassembling the Radio

Prerequisites:

CAUTION: Do not reassemble the radio without first performing the preliminary inspection procedure. Reassemble the radio according to the procedures and tighten all hardware that was loosened or removed.

Procedure:

Inspect the Battery Connector Seal on the RF Board Assembly for any damage.

8.10.7
Vacuum Test

A Vacuum Pump is used to create a negative pressure condition inside the radio. The gauge measures this pressure and is used to monitor any pressure changes in the radio. A properly sealed, watertight radio should have minimal change in pressure during the test.

Before starting the vacuum test:

- Remove the battery and antenna.
- Remove the Universal Connector Cover or any other accessories to expose the universal connector.

8.10.7.1
Vacuum Tool Setup

Procedure:

1. Attach one end of the hose to the Vacuum Pump. Attach the other side of the hose to the Vacuum Adapter.
2. Follow the procedures to perform Tool Leak Test:
   a. Block the open end of the Vacuum Adapter.
   b. Pull the knob on the Vacuum Pump to create vacuum.
   c. Pump at least 15 inHg.
   d. Watch the gauge for a minute. If there is any loss of vacuum, repair or replace the tool.
3. Ensure that the seal is attached to the Vacuum Adapter.

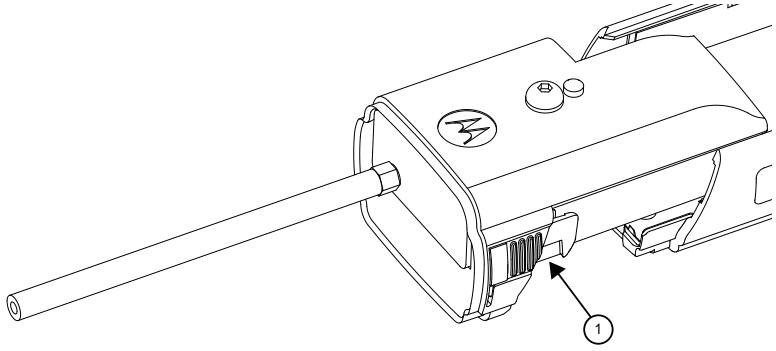
8.10.7.2

Test Procedure

Procedure:

1. After unscrewing the speaker grille screw beside the vacuum port, remove the vacuum port from the main chassis with a black stick.
2. Attach the Vacuum Adapter onto the radio in the same manner as a radio battery. Ensure that both latches are clicked into place.

   Figure 118: Attaching Vacuum Adapter



1	Vacuum Adapter

3. Pull the knob on the Vacuum Pump to create vacuum. The vacuum test pressure should be between 5–7 inHg.

   CAUTION: Ensure that the vacuum pressure never exceeds 7 inHg. If the pressure exceeds this limit, the radio has pressure sensitive components that can be damaged.
4. Observe the gauge for approximately 2 minutes.

- Option 1: Radio passes the vacuum test – If the needle falls less than 0.25 inHg (1/2 a tick mark on the Vacuum Pump). If the seal passes this inspection, this radio is approved for submergibility. No additional testing is required. Assemble the vacuum port back in place after testing.
- Option 2: Radio fails the vacuum test – If the needle falls more than 0.25 inHg. The radio might leak if submerged. More troubleshooting is required. Keep the Vacuum Adapter on but remove the Vacuum Pump from the Vacuum Adapter and continue with Pressure Test.

8.10.8

Pressure Test (using NTN4265_)

Pressure testing involves creating a positive pressure condition inside your radio, immersing radio in water, and observing radio for a stream of bubbles (leak). Since all areas of your radio are being checked, observe the entire unit carefully for the possibility of multiple leaks before completing this test.

NOTE:
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.

When Radio is placed under the water, some trapped air is released. This is not a failure.

Refer to the exploded view diagrams and parts lists found in Exploded Views and Part List section.

If the radio is still set up from vacuum test, skip steps 1 through 4.

Procedure:

1. Ensure that an seal is attached to the Vacuum Adapter.
2. Attach the Vacuum Adapter onto the radio in the same manner as a radio battery. Ensure both the latches are clicked into place.
3. Attach one end of the hose to the Pressure Pump. Attach the other side of the hose to the Vacuum Adapter.
4. Operate the pump until the gauge reads approximately 1 psig.

   CAUTION: Pressure must remain between 0.5 psig and 1.5 psig. Pressure lower then 0.5 psig may allow water into the radio, which damages the radio.
   Ensure that the pressure NEVER exceeds 1.5 psig. The radio has pressure sensitive components that can be damaged if the pressure exceeds this limit.
5. Maintain the pressure around 1 psig and submerge the radio into a water-filled container.
6. Watch for any continuous series of bubbles. A steady stream of bubbles indicates a sign of leakage.

   NOTE: Some accumulation of air may be entrapped in the main housing which may cause a false diagnosis of a leak. Ensure there is a steady stream of bubbles before concluding there is a leak.
7. Note all of the seal areas that show signs of leakage. Rotate the radio to view all sides to pinpoint the problem(s) to one (or more) of the following areas:
   - Seal Interfaces
   - Speaker Assembly
   - Battery Connector Seal
   - Main Chassis, including the Control Top
   - Back Chassis
8. Remove the radio from the water container and dry the radio thoroughly. Be especially careful to dry the area around the Vacuum Port and the battery contacts area.

   CAUTION: To avoid equipment damage, keep the area inside the Battery contact pocket is dry before assembling battery.
9. With the Radio in an upright position and Control Top up, remove the vacuum adapter by squeezing the release latches, and pulling the adapter down and away from the radio.

8.10.9
Troubleshooting Leak Areas

Before repairing any leak, read all of the steps within the applicable section. This helps to eliminate unnecessary disassembly and reassembly of a radio with multiple leaks. Troubleshoot only the faulty seal areas listed in Pressure Test (using NTN4265_) on page 150 and, when multiple leaks exist, in the order listed.

NOTE: All disassembly and reassembly methods can be found in Disassembling the Radio on page 100 and Radio Reassembly on page 133
If in the field, water is found around the battery leads, the O-ring on the Battery should be inspected and replaced if needed.

8.10.9.1
Seal Interfaces

- If leak occurs at one or more of the seal interfaces, disassembly of the component(s) and inspection of the interfaces to determine if there is any damage. If no damage is observed, re-assemble the radio as directed.
- If damage has occurred, replacement parts is needed.

8.10.9.2
Speaker Module

- If leak occurs through the Microphone Membrane or the Speaker Module Seal, replace these items.
- If leak occurs elsewhere on the Speaker Module, the module needs to be replaced.

8.10.9.3
Battery Contact Seal

- If leak occurs due to damage to the Battery Connector Seal, it needs to be replaced.

8.10.9.4
Back Chassis

- If leak occurs through the Microphone Boot, replace it.
- If leak occurs through the Color Display Lens, replace it.
- If leak occurs elsewhere on the Back Chassis, it needs to be replaced.

8.10.9.5
Control Top

- If leak occurs through the antenna or the Control Top Seal, replace it.
- If leak occurs elsewhere on the Control Top Assembly, it needs to be replaced.

8.10.9.6
Main Chassis

- If leak occurs through the Main Seal, it needs to be replaced.
- If leak occurs elsewhere on the Main Chassis, it needs to be replaced.

Chapter 9

Basic Troubleshooting

This section of the manual contains troubleshooting charts and error codes that helps you to isolate a problem.

Level one and two troubleshooting supports only radio alignment, programming, battery replacement, knob replacement, and circuit board replacement. Component-level service information can be found in the *Detailed Service Manual*, Motorola Solutions publication number MN001623A01.

9.1 Power-Up Error Codes

When the radio is turned on (powered-up), the radio performs cursory tests to determine if its basic electronics and software are in working order.

NOTE: Send the radio to the depot if the corrective action does not fix the failure.

9.2 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 display of the radio.

The presence of an error code can prompt a user that a problem exists and that a service technician must be contacted. Use the following table to aid in understanding particular operational error codes.

Table 31: Operational Error Code Displays

Error Code	Description	Corrective Action
FAIL 001	Synthesizer Out-of-Lock	1 Reprogram external codeplug. 2 Send radio to depot.
FAIL 002	Selected Mode/Zone Codeplug Checksum Error	Reprogram external codeplug

9.3 Receiver Troubleshooting

The following table lists the possible causes of, and corrections for, receiver problems.

Table 32: Receiver Troubleshooting Solution

Symptom	Possible Cause	Correction or Test (Measurements at Room Temperature)
Radio Dead; Display Does Not Turn On	Dead Battery	Replace with charged battery
	Blown Fuse	Send radio to depot
	On/Off Switch	

Symptom	Possible Cause	Correction or Test (Measurements at Room Temperature)
	Regulators	
Radio Dead; Display Turns On	VOCON Board	Send radio to depot
	RF Board	
	Expansion Board	
Radio On; Front Display Off	High operating temperature (above 80°C)	Allow radio to return to normal operating temperature
No Receive Audio, or Receiver Does Not Unmute	Programming	1 Check if transmitted signal matches the receiver configuration (PL, DPL, CSQ, or others). 2 Check if radio is able to unmute with Monitor function enabled.
Audio Distorted or Not Loud Enough	Synthesizer Not On Frequency	Check synthesizer frequency by measuring the transmitter frequency; if off by more than ±1000 Hz, send radio to depot.
RF Sensitivity Poor	Synthesizer Not On Frequency	Check synthesizer frequency by measuring the transmitter frequency; if off by more than ±1000 Hz, send radio to depot.
	Antenna Switch/ Connector	Send radio to depot
	Receiver Front-End Tuning	Check RF front-end tuning for optimum sensitivity using the tuner
Radio Will Not Turn Off	VOCON Board	Send radio to depot

9.4 Transmitter Troubleshooting

The following table lists the possible causes of, and corrections for, transmitter problems.

Table 33: Transmitter Troubleshooting Solution

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
No RF Power Out	TX Power Level or Frequency	Check TX power level and frequency programming (from tuner)
	No Injection to Power Amplifier	Send radio to depot
	Antenna Switch/Connector	
No Modulation; Distorted Modulation	Programming	Check deviation and compensation settings using the tuner
	VOCON Board	Send radio to depot
Bad Microphone Sensitivity	Check Deviation and Compensation	Realign if necessary

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
	Microphone	Send radio to depot
No/Low signaling (PL, DPL, MDC)	Programming	Check programming
	VOCON Board	Send radio to depot
Cannot Set Deviation Balance	RF Board	Send radio to depot

9.5

Encryption Troubleshooting

The following table lists the possible causes of, and corrections for, encryption problems.

Table 34: Encryption Troubleshooting Chart

Symptom	Possible Cause	Corrective Action
No KEYLOADING on Radio/External Display When Keyloading Cable is Attached to the Radio Side Connector	Defective Keyload Cable	Send radio to depot
	Defective Radio	
Keyloader Displays FAIL	Wrong Keyloader Type	Use correct keyloader type. Refer to *Keyloader User Guide* for more information
	Bad Keyloader	Try another keyloader
	Defective Radio	Send radio to depot

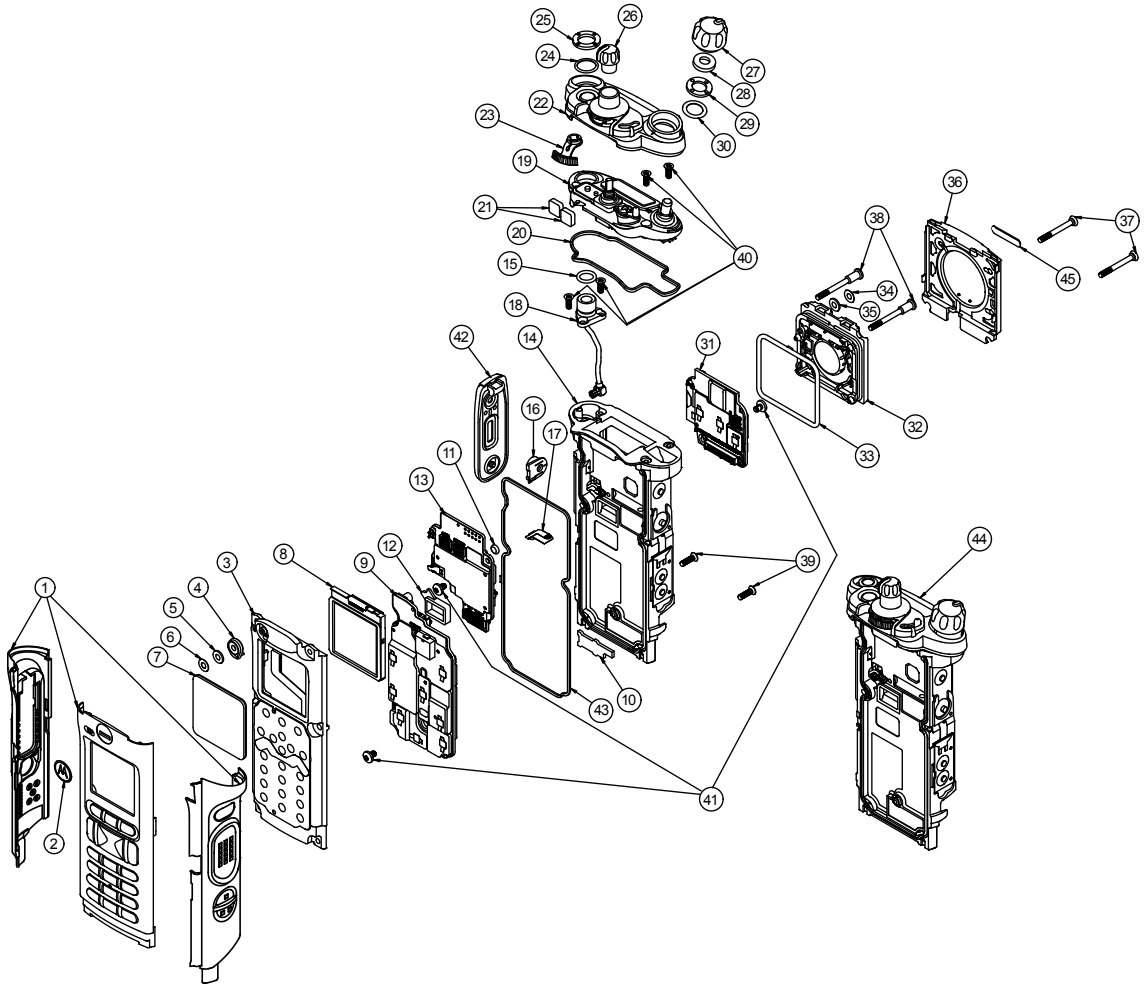
Chapter 10

Exploded Views and Parts Lists

This chapter contains exploded views and associated parts lists for the ASTRO digital portable radio. The following table lists the exploded views for the radio in different configurations:

10.1 Dual Display (Full Keypad) Exploded View

Figure 119: Dual Display (Full Keypad) Exploded View



10.1.1
APX 8000 Dual Display (Full Keypad) Exploded View Parts List

Table 35: APX 8000 Dual Display (Full Keypad) Exploded View Parts List

Item No.	Motorola Solutions Part No.	Description
1[7]	KT000032C_	Assembly, Front Housing, Dual Display, M3 (Full Keypad)
	KT000033C_	Assembly, Front Housing, Dual Display, M3 Yellow (Full Keypad)
	KT000034C_	Assembly, Front Housing, Dual Display, M3 Green (Full Keypad)
	KT000035C_	Assembly, Front Housing, Dual Display, M3 Orange sides, and Black Faceplate
	KT000036C_	Assembly, Front Housing, Dual Display, M3 Red sides, and Black Faceplate
	KT000037C_	Assembly, Front Housing, Dual Display, M3 Blue sides, and Black Faceplate
	KT000032D_	Assembly, Front Housing, Dual Display, M3 Black, Hebrew (Full Keypad)
	KT000032E_	Assembly, Front Housing, Dual Display, M3 Black, Cyrillic (Full Keypad)
	KT000032F_	Assembly, Front Housing, Dual Display, M3 Black, Arabic (Full Keypad)
2	33009265001	Medallion
3	KT000008A01	Assembly, Back Chassis, Dual Display
4	32009357002	Boot, Dataside Mic
5	3275002C03	Mic Membrane
6	35009312002	Mic Mesh
7	61009283002	Lens, Front Display
8	PNHN7020_	Display, Color
9	PA000429A_	PC Board Assembly, RF
10	75009299003	Thermal Pad, RFPA
11	60009265001	Battery, Backup, Coincell
12	3271829H02	Seal, Connector, Battery
13	PA000470A_	PC Board Assembly, VOCON
	PMLF4176_	
14	01009364009	Assembly, Main, Chassis (without Control Top)
15	3275033C01	O-Ring, Antenna, Main

[7] When purchasing any of item 1, purchase items 22, 36 (in the appropriate color), and 45 too.

Item No.	Motorola Solutions Part No.	Description
16	43009291001	Insert, Universal Connector
17	3971892H01	Contact, Chassis Ground
18	3075864B02	Cable, RF Coax
19[8]	0104072J03	Assembly, Control Top
20	3275031C01	Seal, Control Cap
21	75009418001	Pad, Support
22	137891H04	Bezel, Control Top, Sub-assembly
23	4575585B02	Lever, Secure
24	HW000085A01	Washer, Nylon, Antenna
25	0275891B01	Nut, Spanner, Antenna
26	3675590B03	Knob, Frequency
27	3675581B01	Knob, Volume
28	3275377H02	Seal, Cap, Torque Adder, High
29	0275361H01	Nut, Spanner, Volume
30	0405659W01	Washer, Wave, Volume
31	PA000471A_	PC Board Assembly, Expansion
	PMLF4514_	
32	KT000010A_	Assembly, Speaker Module
33	32009351001	Seal, Speaker Module
34	35009312002	Mic Mesh
35	3275002C03	Mic Membrane
36[9]	PMLN7523_	Assembly, Grille, Speaker (Black)
	PMLN7525_	Assembly, Grille, Speaker (Yellow)
	PMLN7524_	Assembly, Grille, Speaker (Green)
37	0375962B02	Screw (x2), M2.5X0.45, 24.45
38	0375962B01	Screw (x2), M2.5X0.45, 3 0.1
39	0375962B03	Screw (x2), M2.5X0.45, 9.2
40	0375962B04	Screw (x2), M2.5X0.45, 7
41	03009304001	Screw, Board
42	1575250H01	Cover, Connector, Universal Connector
43	32009355001	Seal, Main
44	KT000006A_[10]	Assembly, Main Chassis (with Control Top)

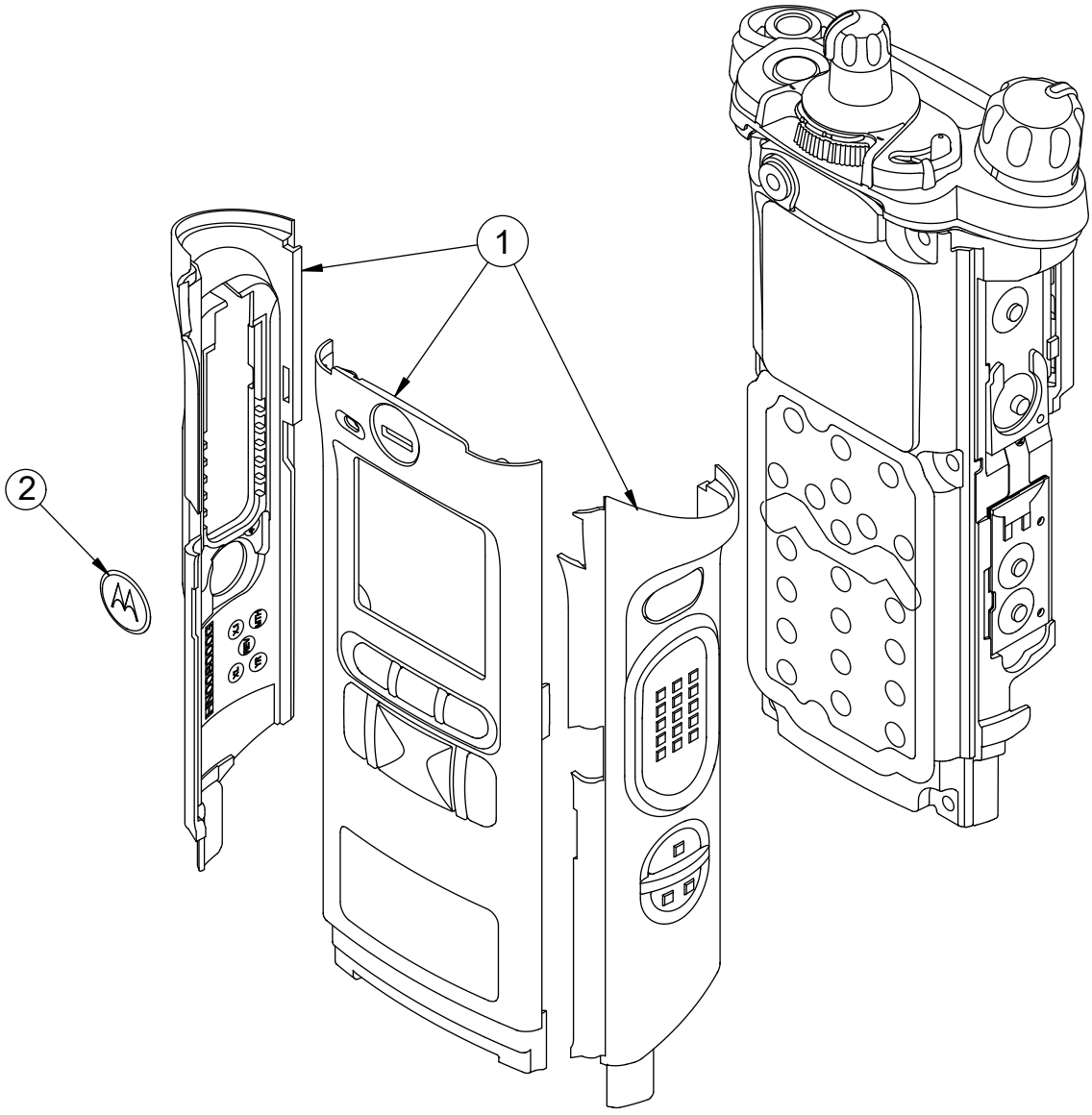
[8] When purchasing item 19, purchase item 21 (quantity 2) too.
[9] When purchasing item 36, purchase item 45 too.
[10] Kit KT000006A_includes items 14, 19,20,22-25, and 40. When purchasing this kit, purchase item 21 (quantity 2) too.

Item No.	Motorola Solutions Part No.	Description
	PMLN7421_[11]	
45	LB000623A03	Label, Speaker Grille, APX8000
	LB000623A05	Label, Speaker Grille, APX8000 R

10.2

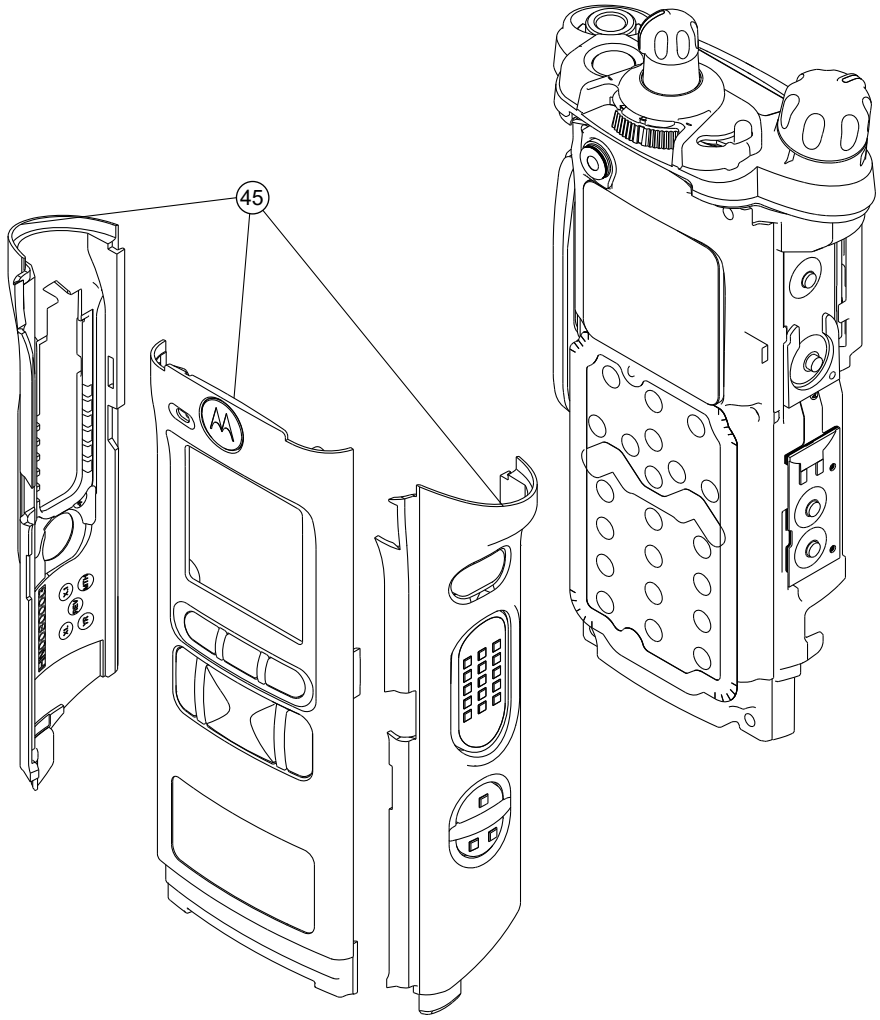
APX 8000 Dual Display (Limited Keypad) Exploded View

Figure 120: Dual Display (Limited Keypad) Exploded View



[11] Kit PMLN7421_ includes items 14,19, 20, 22–25, 30, and 40. When purchasing this kit, purchase item 21 (quantity 2) too. Kit PMLN7421B onward requires a minimum software version of R27.xx.xx (or higher.

Figure 121: Dual Display (Limited Keypad) Exploded View



10.2.1
APX 8000 Dual Display (Limited Keypad) Exploded View Parts List

Table 36: APX 8000 Dual Display (Limited Keypad) Exploded View Parts List

Item No.	Motorola Solutions Part Number	Description
1[12]	KT000032B_	Assembly, Front Housing, M2, Black, Dual Display (Limited Keypad)
	KT000033B_	Assembly, Front Housing, M2, Yellow, Dual Display (Limited Keypad)

[12] When purchasing any of item 1, purchase items 22, 36 (in the appropriate color), and 45 too.

Item No.	Motorola Solutions Part Number	Description
	KT000034B_	Assembly, Front Housing, M2, Green, Dual Display (Limited Keypad)
	KT000035B_	Assembly, Front Housing, Dual Display (Limited Keypad), M2, Orange sides, and Black Faceplate
	KT000036B_	Assembly, Front Housing, Dual Display (Limited Keypad), M2, Red sides, and Black Faceplate
	KT000037B_	Assembly, Front Housing, Dual Display (Limited Keypad), M2, Blue sides, and Black Faceplate

Table 37: APX 8000 Dual Display (Limited Keypad) Exploded View Parts List

Item No.	Motorola Solutions Part Number	Description
45[13]	KT000032B_	Assembly, Front Housing, M2, Black, Dual Display (Limited Keypad)
	KT000033B_	Assembly, Front Housing, M2, Yellow, Dual Display (Limited Keypad)
	KT000034B_	Assembly, Front Housing, M2, Green, Dual Display (Limited Keypad)
	KT000035B_	Assembly, Front Housing, Dual Display (Limited Keypad), M2, Orange sides, and Black Faceplate
	KT000036B_	Assembly, Front Housing, Dual Display (Limited Keypad), M2, Red sides, and Black Faceplate
	KT000037B_	Assembly, Front Housing, Dual Display (Limited Keypad), M2, Blue sides, and Black Faceplate

[13] When purchasing any of item 45, purchase items 22, 36 (in the appropriate color) too.

10.3

APX 8000 Top Display Exploded View

Figure 122: APX 8000 Top Display Exploded View

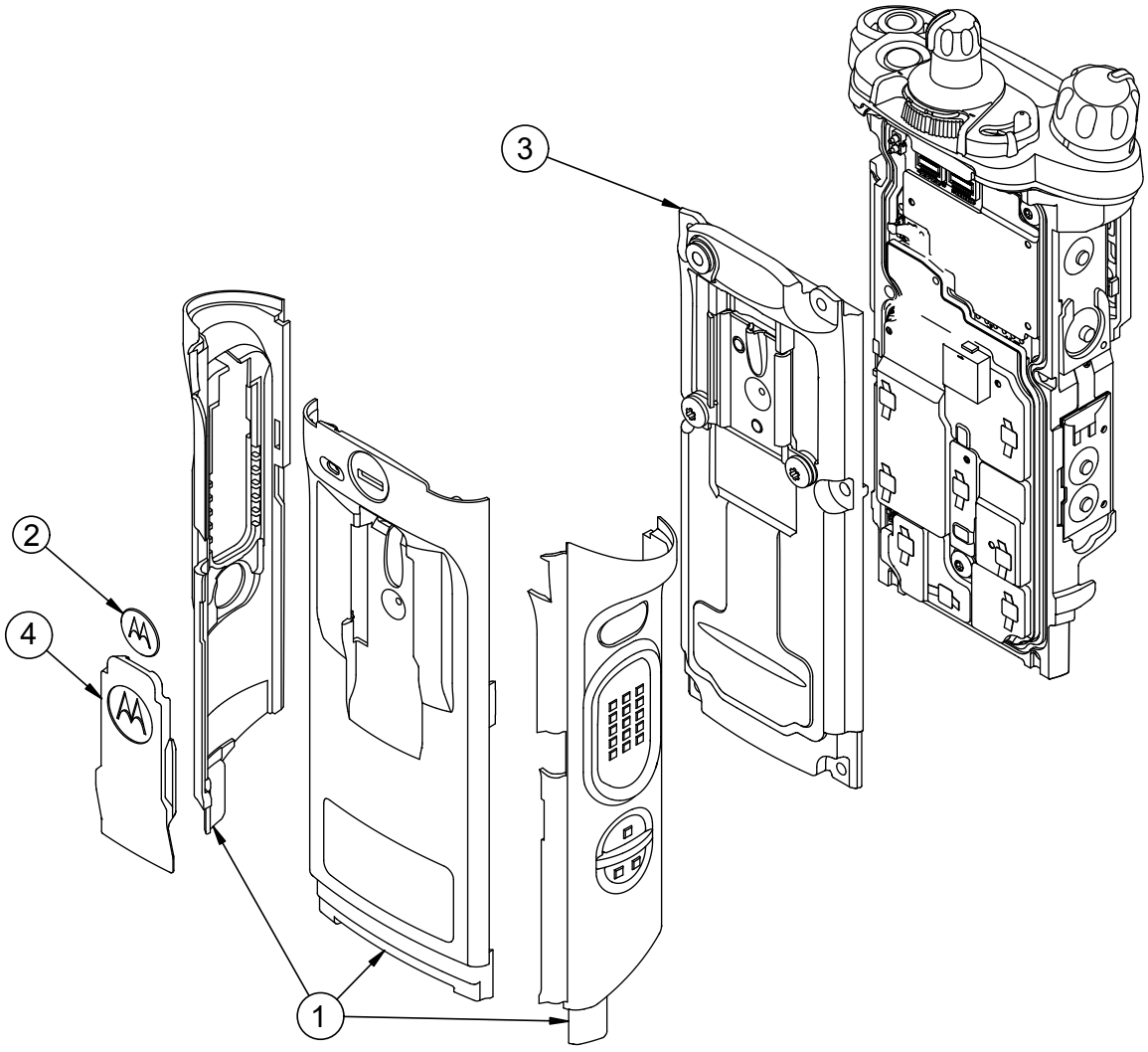
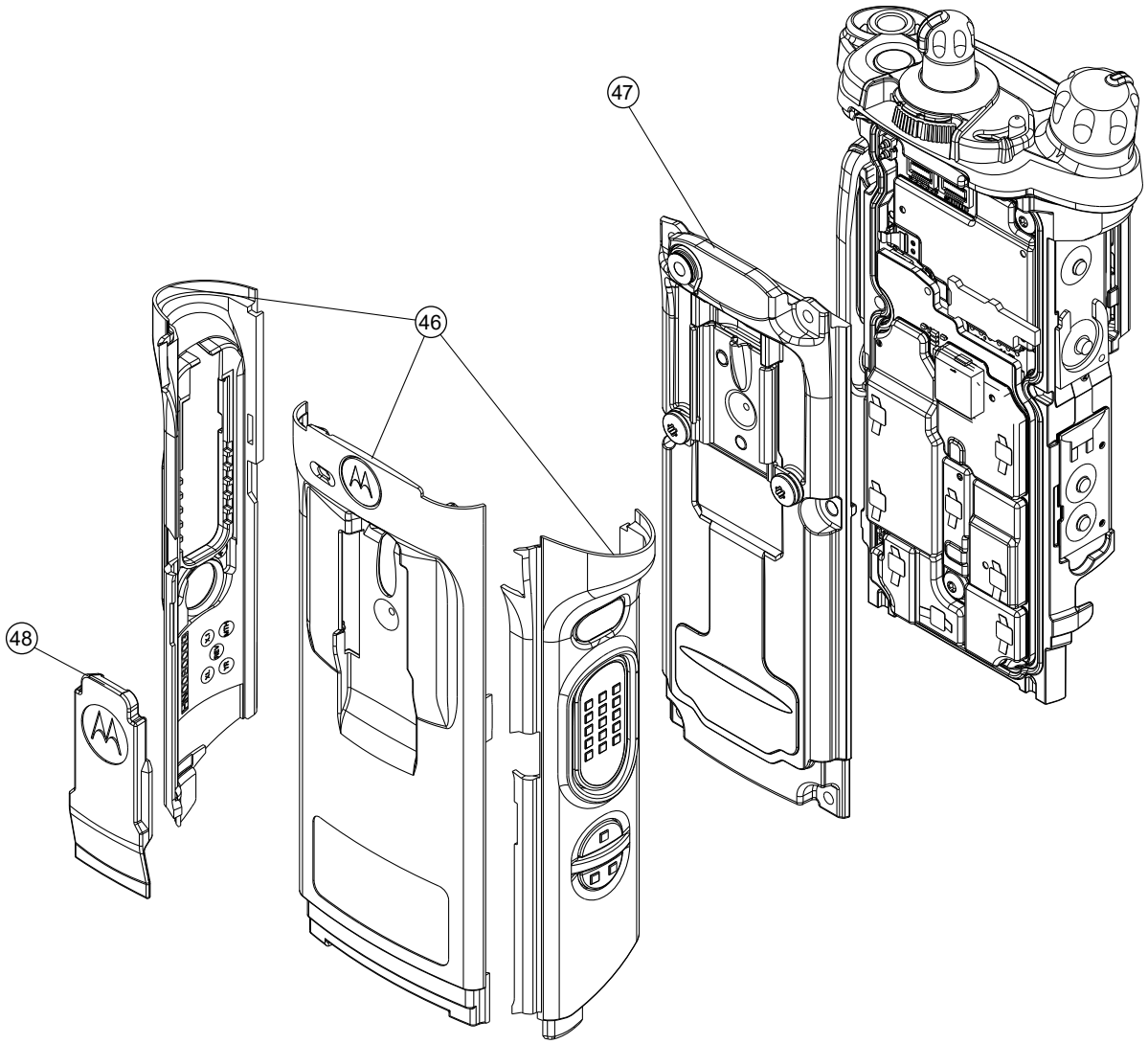


Figure 123: APX 8000 Top Display Exploded View



10.3.1
APX 8000 Top Display Exploded View Parts List

Table 38: APX 8000 Top Display Exploded View Parts List

Item No.	Motorola Solutions Part Number	Description
1[14]	KT000032A_	Assembly, Front Housing, M1, Black, Top Display
	KT000033A_	Assembly, Front Housing, M1, Yellow, Top Display
	KT000034A_	Assembly, Front Housing, M1, Green, Top Display

[14] When purchasing any of item 1, purchase items 22, 36 (in the appropriate color), and 45 too.

Item No.	Motorola Solutions Part Number	Description
	KT000035A_	Assembly, Front Housing, Top Display, M1, Orange sides, and Black Faceplate
	KT000036A_	Assembly, Front Housing, Top Display, M1, Red sides, and Black Faceplate
	KT000037A_	Assembly, Front Housing, Top Display, M1, Blue sides, and Black Faceplate
43	KT000007A_	Assembly, Back Chassis, Top Display
44	1575356H01	Cover, Belt Clip, Top Display

Table 39: APX 8000 Top Display Exploded View Parts List

Item No.	Motorola Solutions Part Number	Description
46[15]	KT000032A_	Assembly, Front Housing, M1, Black, Top Display
	KT000033A_	Assembly, Front Housing, M1, Yellow, Top Display
	KT000034A_	Assembly, Front Housing, M1, Green, Top Display
	KT000035A_	Assembly, Front Housing, Top Display, M1, Orange sides, and Black Faceplate
	KT000036A_	Assembly, Front Housing, Top Display, M1, Red sides, and Black Faceplate
	KT000037A_	Assembly, Front Housing, Top Display, M1, Blue sides, and Black Faceplate
47	KT000007A_	Assembly, Back Chassis, Top Display
48	1575356H01	Cover, Belt Clip, Top Display

[15] When purchasing any of item 46, purchase items 22, 36 (in the appropriate color), and 45 too.

10.4

APX 8000XE Dual Display (Full Keypad) Exploded View

Figure 124: Dual Display (Full Keypad and Limited Keypad) Exploded View

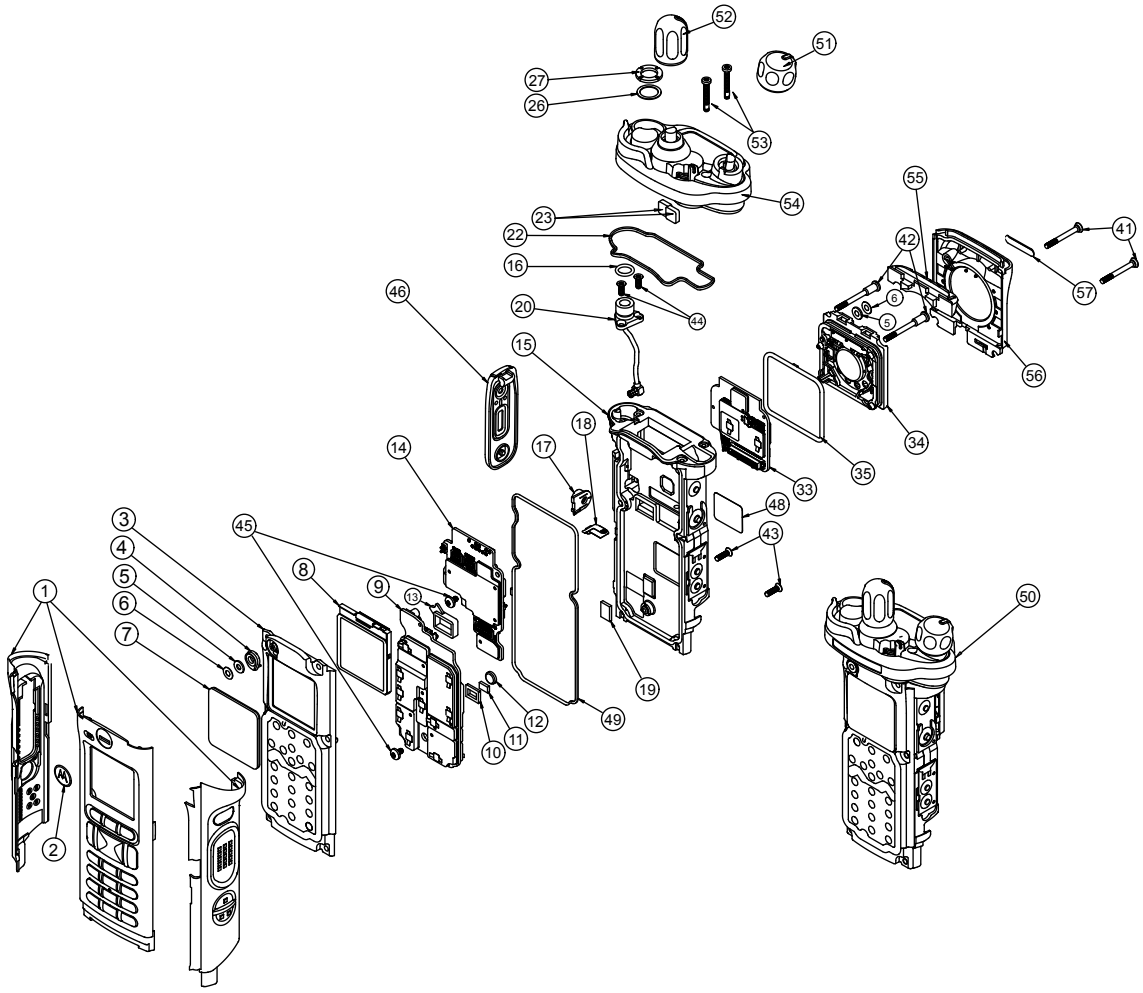
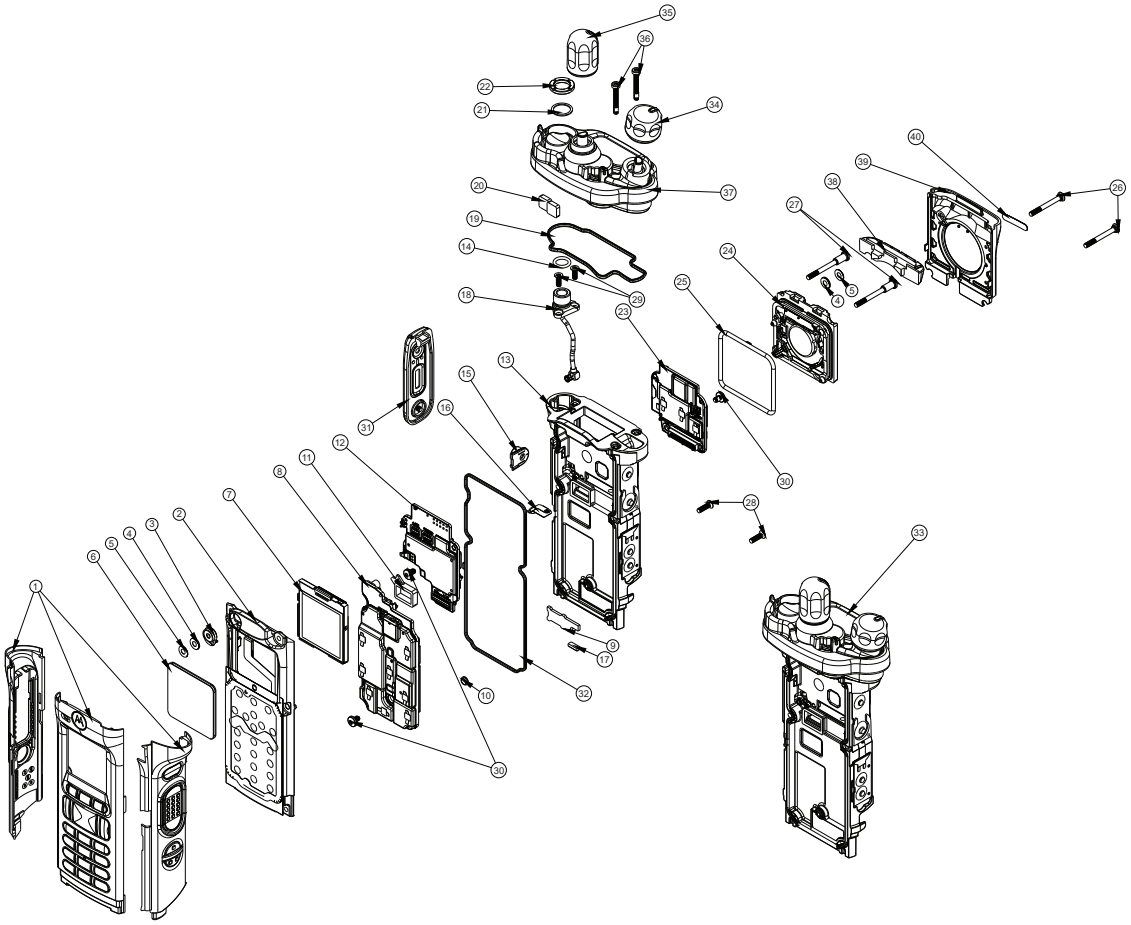


Figure 125: Dual Display (Full Keypad) Exploded View



10.4.1
APX 8000XE Dual Display (Full Keypad) Exploded View Parts List

Table 40: Dual Display (Full Keypad) Exploded View Parts List

Item No.	Motorola Solutions Part No.	Description
1[16]	KT000032C_	Assembly, Front Housing, Dual Display, M3 (Full Keypad)
	KT000033C_	Assembly, Front Housing, Dual Display, M3 Yellow (Full Keypad)
	KT000034C_	Assembly, Front Housing, Dual Display, M3 Green (Full Keypad)
	KT000035C_	Assembly, Front Housing, Dual Display, M3 Orange sides, and Black Faceplate

[16] When purchasing any of item 1, purchase items 20 (quantity 2), 21, 22, 34, 36, 37, 39 (in the appropriate color), and 40 too.

Item No.	Motorola Solutions Part No.	Description
	KT000036C_	Assembly, Front Housing, Dual Display, M3 Red sides, and Black Faceplate
	KT000037C_	Assembly, Front Housing, Dual Display, M3 Blue sides, and Black Faceplate
	KT000032D_	Assembly, Front Housing, Dual Display, M3 Black, Hebrew (Full Keypad)
	KT000032E_	Assembly, Front Housing, Dual Display, M3 Black, Cyrillic (Full Keypad)
	KT000032F_	Assembly, Front Housing, Dual Display, M3 Black, Arabic (Full Keypad)
2	KT000008A01	Assembly, Front Chassis, Dual Display
3	32009357002	Boot, Dataside Mic
4	3275002C03	Mic Membrane
5	35009312002	Mic Mesh
6	61009283002	Lens, Front Display
7	PNHN7020_	Display, Color
8	PA000429A_	PC Board Assembly, RF
9	75009299003	Thermal Pad, RFPA
10	60009265001	Battery, Backup, Coincell
11	3271829H02	Seal, Connector, Battery
12	PA000470A_	PC Board Assembly, VOCON
	PMLF4176_	
13[17]	AS000020A04	Assembly, Main, Chassis (without Control Top)
14	3275033C01	O-Ring, Antenna, Main
15	43009291001	Insert, Universal Connector
16	3971892H01	Contact, Chassis Ground
17	7505316J14	Pad, Coin Cell Battery
18	3075864B02	Cable, RF Coax
19	3275031C01	Seal, Control Cap
20[18]	75009418001	Pad, Support
21	HW000085A01	Washer, Nylon, Antenna
22	0275891B01	Nut, Spanner, Antenna
23	PA000471A_	PC Board Assembly, Expansion
	PMLF4514_	

[17] Kit KT000017A_ includes Items 13–19, 21, 22, 29 and 34–37. When purchasing this kit, purchase item 20 (quantity 2) too. Kit KT000017A02 onward requires a minimum software version of R27.xx.xx (or higher).

[18] When purchasing item 37, purchase items 20 (quantity 2), 21, 22, 34, and 36 too.

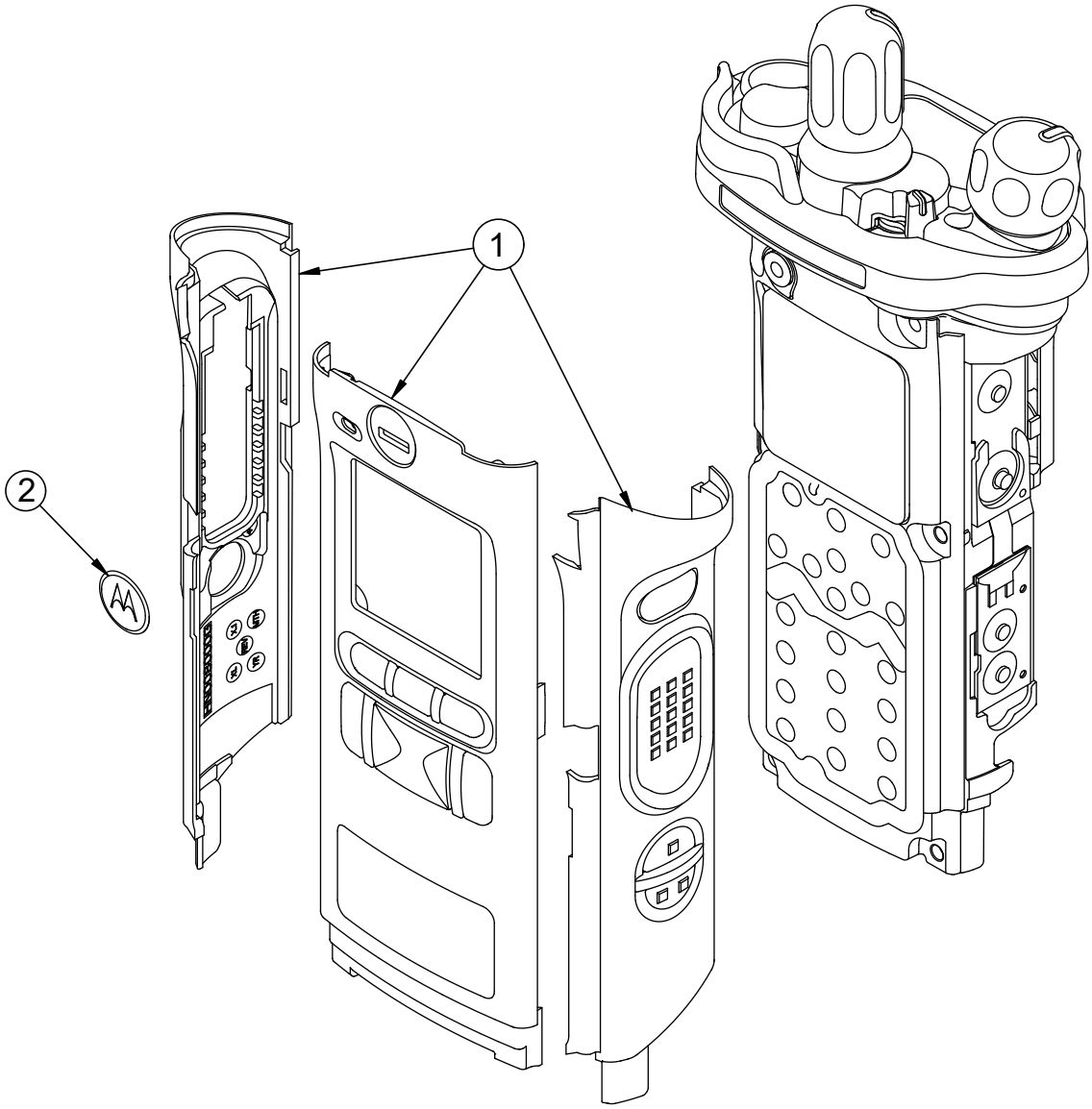
Item No.	Motorola Solutions Part No.	Description
24	KT000010A_	Assembly, Speaker Module
25	32009351001	Seal, Speaker Module
26	0375962B02	Screw (x2), M2.5X0.45, 24.45
27	0375962B01	Screw (x2), M2.5X0.45, 3 0.1
28	0375962B03	Screw (x2), M2.5X0.45, 9.2
29	0375962B04	Screw (x2), M2.5X0.45, 7
30	03009304001	Screw, Board
31	1575250H01	Cover, Connector, Universal Connector
32	32009355001	Seal, Main
33[17]	KT000017A_	Assembly, Main Chassis (with Control Top)
34	36009257001	Knob, Volume
35	36009258001	Knob, Frequency
36	03009357001	Screw, Top Bezel
37[18], [19]	AS000022A07	Control Cap Assembly, MT-XE – Black
	AS000022A08	Control Cap Assembly, MT-XE – Yellow
	AS000022A09	Control Cap Assembly, MT-XE – Green
38[20]	32009436001	Sound Dampener
39[21],[22]	KT000242A_	Assembly, Grille, Speaker – Black
	KT000243A_	Assembly, Grille, Speaker – Yellow
	KT000244A_	Assembly, Grille, Speaker – Green
40	LB000623A04	Label, Speaker Grille, APX 8000XE

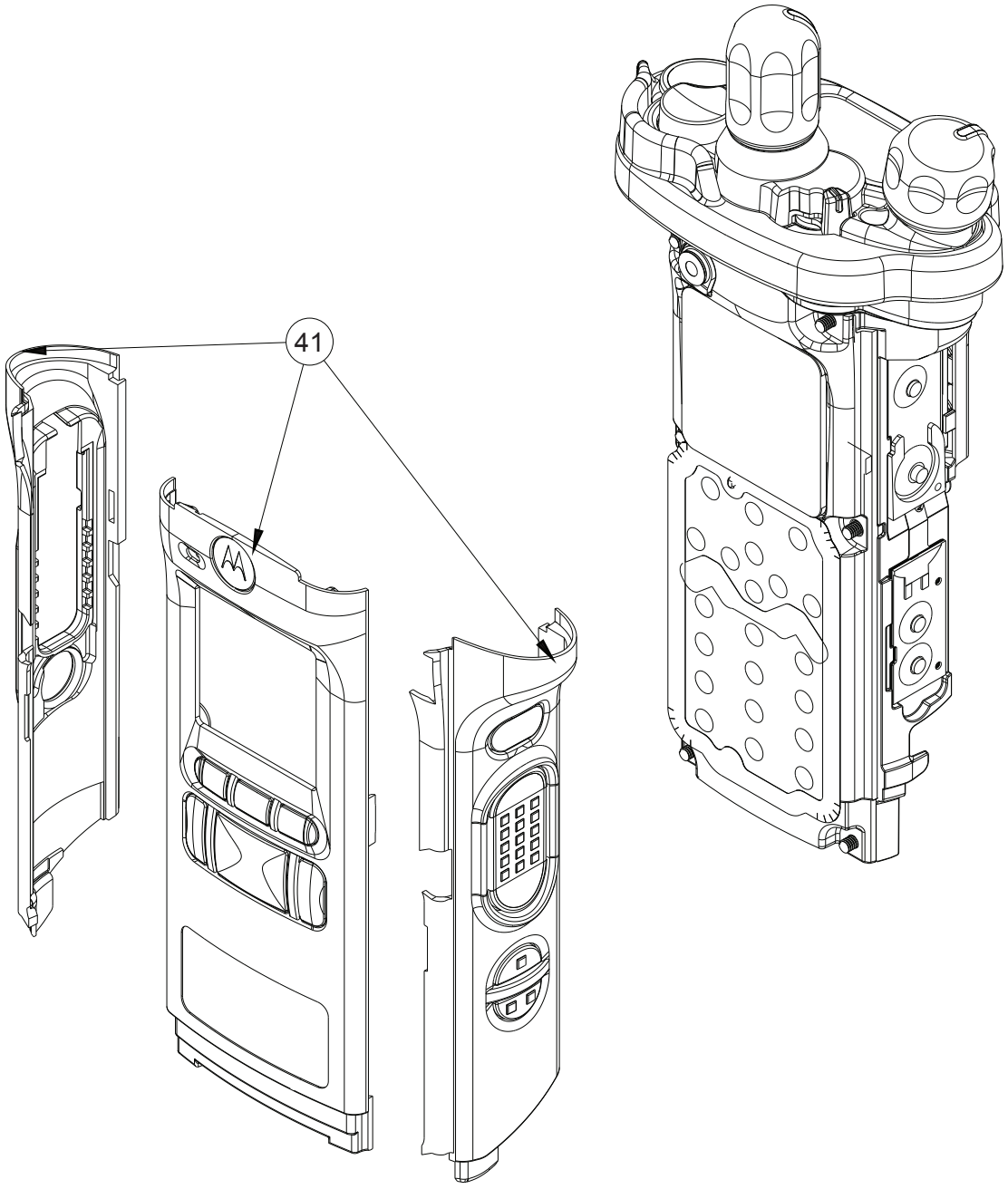
[19] Item 37 comes with item 19 and 35.
[20] Item 38 is not orderable and it comes with item 39.
[21] Item 39 comes with item 38.
[22] When purchasing item 39, purchase item 40 too.

10.5

APX 8000XE Dual Display (Limited Keypad) Exploded View

Figure 126: Dual Display (Limited Keypad) Exploded View




41

10.5.1

APX 8000XE Dual Display (Limited Keypad) Exploded View Parts List

Table 41: APX 8000XE Dual Display (Limited Keypad) Exploded View Parts List

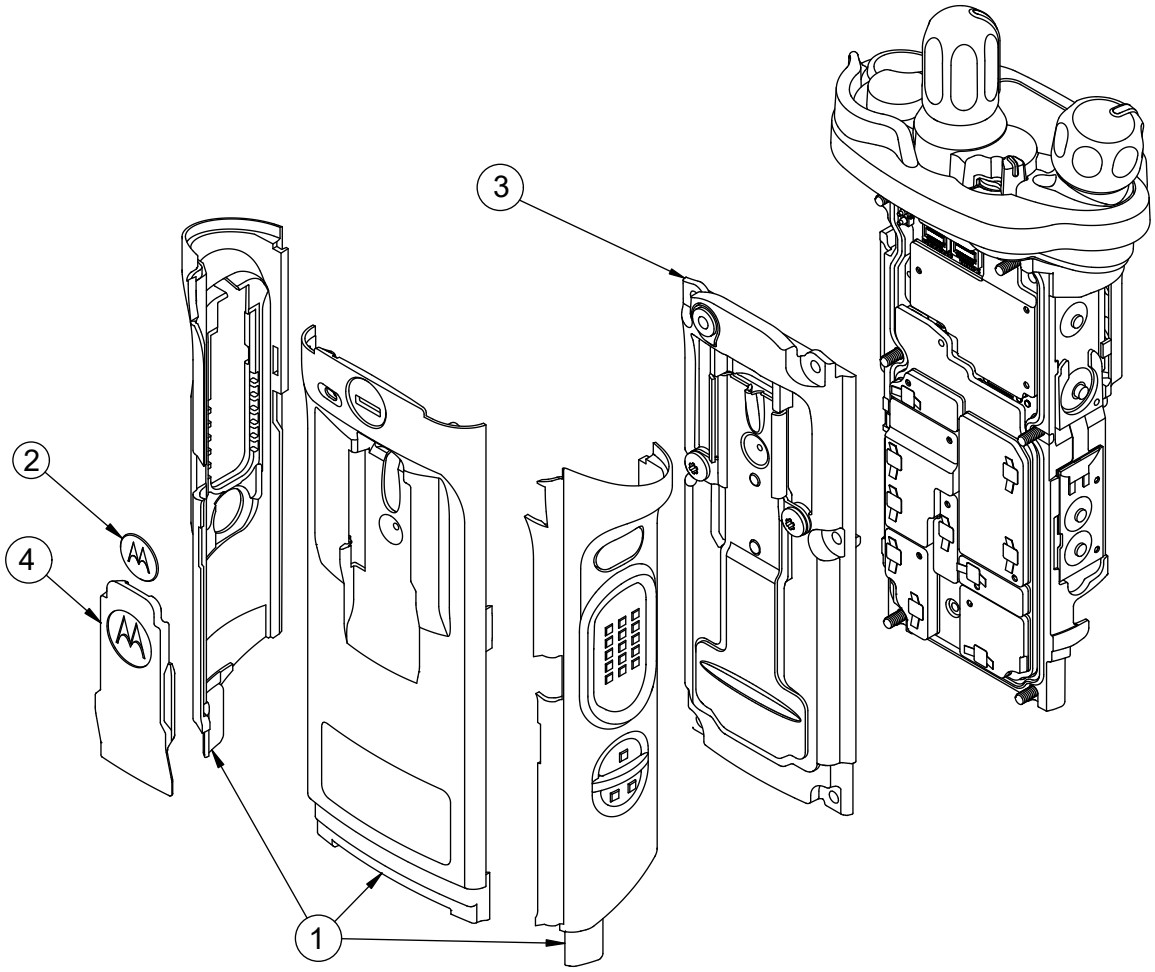
Item No.	Motorola Solutions Part Number	Description
41[23]	KT000032B_	Assembly, Front Housing, M2, Black, Dual Display (Limited Keypad)
	KT000033B_	Assembly, Front Housing, M2, Yellow, Dual Display (Limited Keypad)
	KT000034B_	Assembly, Front Housing, M2, Green, Dual Display (Limited Keypad)
	KT000035B_	Assembly, Front Housing, Dual Display (Limited Keypad), M2, Orange sides (1B, 1C) and Black Faceplate (1A)
	KT000036B_	Assembly, Front Housing, Dual Display (Limited Keypad), M2, Red sides (1B, 1C) and Black Faceplate (1A)
	KT000037B_	Assembly, Front Housing, Dual Display (Limited Keypad), M2, Blue sides (1B, 1C) and Black Faceplate (1A)

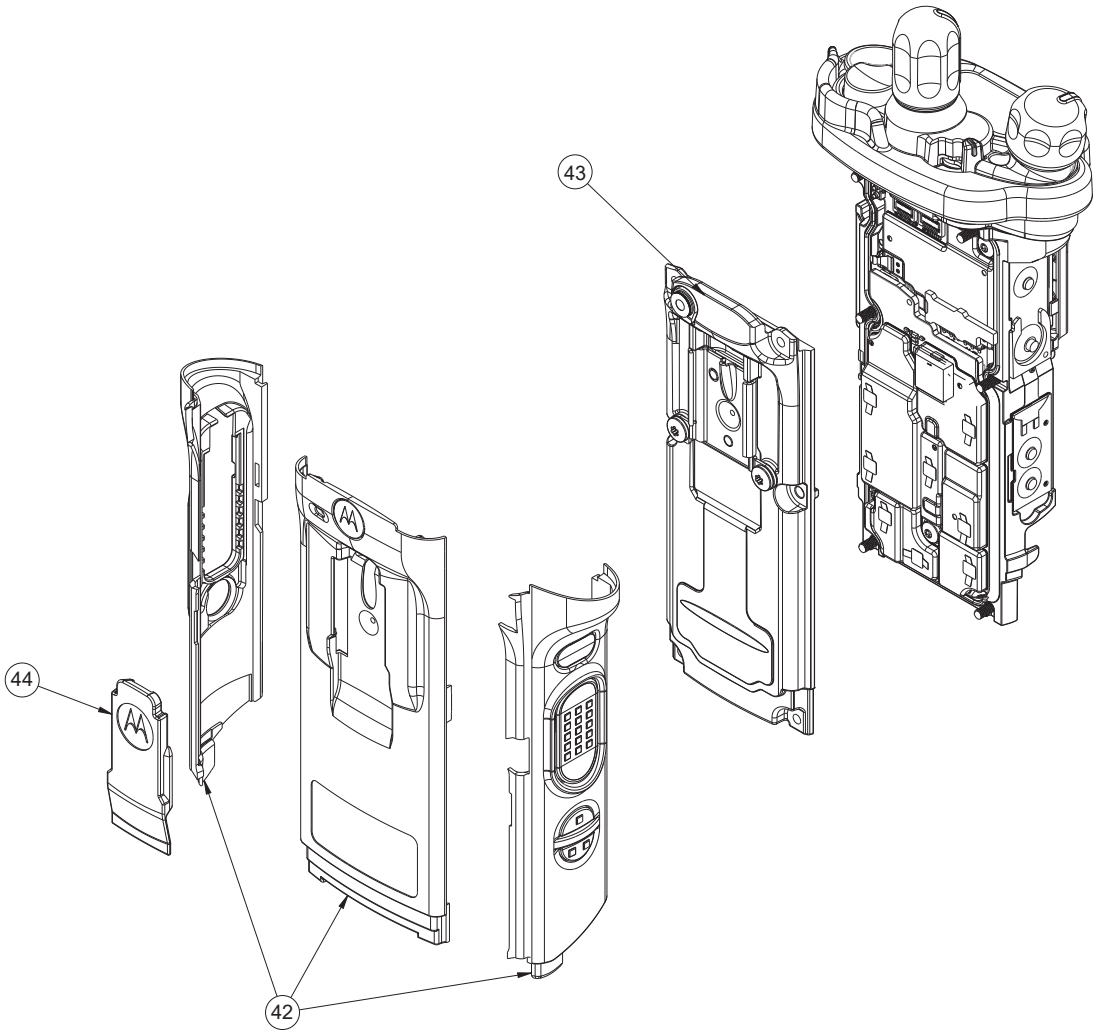
[23] When purchasing any of item 1 or 41, purchase items 20 (quantity 2), 21, 22, 34, 36, 37, 39 (in the appropriate color), and 40 too.

10.6

APX 8000XE Top Display Exploded View

Figure 127: APX 8000XE Top Display Exploded View





10.6.1
APX 8000XE Top Display Exploded View Parts List

Item No.	Motorola Part Number	Description
42[24]	KT000032A_	Assembly, Front Housing, M1, Black, Top Display
	KT000033A_	Assembly, Front Housing, M1, Yellow, Top Display
	KT000034A_	Assembly, Front Housing, M1, Green, Top Display
	KT000035A_	Assembly, Front Housing, Top Display, M1, Orange sides, and Black Faceplate

[24] When purchasing any of item 1 or 42, purchase items 20 (quantity 2), 21, 22, 34, 36,37, 39 (in the appropriate color), and 40 too.

Item No.	Motorola Part Number	Description
	KT000036A_	Assembly, Front Housing, Top Display, M1, Red sides, and Black Faceplate
	KT000037A_	Assembly, Front Housing, Top Display, M1, Blue sides, and Black Faceplate
43	KT000007A01	Assembly, Back Chassis, Top Display
44	1575356H01	Cover, Belt Clip, Top Display

10.7
Controller Kit Numbers

Kit Number	Description
PPA000471A_ / PPMLF4514_	PC Board Assembly, Expansion
PPA000470A_ / PPMLF4176_	PC Board Assembly, VOCON

Appendix A

Accessories

Motorola Solutions provides various approved optional accessories to improve the performance of your radio.

Not all accessories are FCC-certified to operate with all APX models and/or bandsplits. Refer to the specific radio price pages for a list of FCC-certified and/or Motorola Solutions-approved accessories. You can also contact your sales representative for accessory compatibility.

For more information, visit http://www.motorolasolutions.com.

Appendix B

Replacement Parts and Kits

This manual covers Level 1 and 2 Maintenance.

Level 1 maintenance is the assessment and/or repair of fault in terms of a faulty accessory or physical aspect of product; not including disassembly of the unit. It is limited to the replacement of antenna, battery, handset, external microphones, external knobs, all related frequency programming to customers, and sometimes alignment or tuning by the Customer Programming Software (CPS).

Level 2 maintenance includes all Level 1 activities plus assessment that require the disassembly of the radio and rectifying a fault by replacement of major mechanical parts (such as replacement of bezels).

Level 2 maintenance does not incorporate discrete component replacement.

To find out more about Motorola Solutions Service Center, visit http://www.motorolasolutions.com.

NOTE: Only Motorola Solutions Service Center/Depot can perform Level 3 maintenance as it can deeply affect the performance of the radio.

NOTE: Expansion and Vocon board are working in pair, whenever expansion board is replaced, Vocon board also have to be replaced and vice versa. PA000471A02 pair with PA000470A03 and PMLF4167D pair with PMLF4176C. There is not allowed to mix the pair as it can deeply affect the functionality of the radio.

Appendix C

Replacement Parts Ordering

Some replacement parts, spare parts, and/or product information can be ordered directly from the Motorola Solutions local distribution organization or through Motorola Online.

Basic Ordering Information

While parts may be assigned with a Motorola Solutions part number, they may not be available from the Motorola Solutions Radio Products and Solutions Organization (RPSO) [25]. Some parts may have become obsolete and are no longer available in the market due to cancellations by the supplier. If no Motorola Solutions part number is assigned, the part is normally not available from Motorola Solutions, or is not a user-serviceable part. Part numbers appended with an asterisk are serviceable by Motorola Solutions Depot only.

Place orders for replacement parts, kits, and assemblies directly on Motorola Solutions local distribution organization or through Motorola Online. When ordering replacement parts or equipment information, include the complete identification number. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part of, and sufficient description of the desired component to identify it.

To identify non-referenced spare parts, request for help from the Customer Care organization of a Motorola Solutions local area representative.

Motorola Online

The product catalog is available on the Motorola Online website. To register for login access:

- For U.S. and Canada Service Centers only, call 1-800-422-4210.
- For APAC and ANZ regions, sign up at https://asiaonline.mot-solutions.com.
- For LACR region, sign up at https://businessonline.motorolasolutions.com.

Types of Orders	Contact Information
Mail Orders Mail orders are only accepted by the U.S. Federal Government Markets Division (USFGMD).	Motorola Solutions 7031 Columbia Gateway Drive 3rd Floor – Order Processing Columbia, MD 21046 U.S.A.
Telephone Orders and Parts Identification	Radio Products and Solutions Organization (RPSO) (United States and Canada) 7:00 AM to 7:00 PM (Central Standard Time) Monday through Friday (Chicago, U.S.A.) 1-800-422-4210 1-847-538-8023 (United States and Canada)

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

Types of Orders	Contact Information
	U.S. Federal Government Markets Division (USFGMD) 1-800-826-1913 Federal Government Parts (Credit Cards Only) 8:30 AM to 5:00 PM (Eastern Standard Time)
Fax Orders	Radio Products and Solutions Organization (RPSO) (United States and Canada) 1-800-622-6210 1-847-576-3023 (United States and Canada)
	U.S. Federal Government Markets Division (USFGMD) 1-800-526-8641

Product Customer Service

Radio Products and Solutions Organization (RPSO) (United States and Canada)

1-800-927-2744

Appendix D

Motorola Solutions Service Centers

For more information regarding to your radio, please contact the following Motorola Solutions Service Centers to submit your queries.

Table 42: North America Motorola Solutions Offices

Office	Address	Telephone Number
Motorola Solutions Service Center	1220 Don Haskins Drive, Suite A El Paso, TX 79936	915-872-8200
Motorola Solutions Federal Technical Center	10105 Senate Drive Lanham, MD 20706	1800-969-6680
		Fax: 1800-784-4113
Motorola Solutions Canadian Technical Logistics Center	181 Whitehall Drive Markham, Ontario L3R 9T1	1-800-543-3222

Table 43: Latin America Motorola Solutions Offices

Office	Address	Telephone Number
Motorola Solutions de Mexico, S.A.	Bosques de Alisos 58 Col. Bosques de las Lomas CP 05120 México D.F. México	+52-55-5257-6700
Motorola Solutions de Colombia, Ltd	Carrera 98 No. 25G-20 of 105 Bogota Colombia	+57-1-508-90-00
Motorola Solutions Brazil, Ltd	Avenida Magalhães de Castro, 4800 Cidade Jardim Corporate Center Torre 3, 8º andar, 05676-120	0800-0552277 0800-0168272

Appendix E

Warranty, Service, and Technical Support

Warranty and Service Support

Motorola Solutions 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 Solutions Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorized Motorola Solutions Dealer.

Warranty Period and Return Instructions

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

Before shipping any radio back to the appropriate Motorola Solutions warranty depot, contact Customer Resources. 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 that no damage occurs in transit.

After Warranty Period

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

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

Further Assistance

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

E.1
Service Information

Technical & Repair Support (for contracted customers only)

The Motorola Solutions Customer Care team can be contacted with the appropriate contact details below. Please be prepared to provide your contract number, product serial numbers and detailed issue description for faster response and resolution. If the support request is Technical Support related, the request will be handled by the Technical Support Operations (TSO) team. This team of highly skilled professionals provide Technical Support to help resolve technical issues and quickly restore networks and systems. If you are unsure whether your current service agreement entitles you to benefit from this

service, or if you would like more information about the Technical or Repair Support Services, contact your local customer support or account manager for further information.

Contact Details

Technical Requests: techsupport.emea@motorolasolutions.com

Repair Support: repair.emea@motorolasolutions.com

Contact Us: https://www.motorolasolutions.com/en_xu/support.html

Parts Identification and Ordering

If you need help in identifying non-referenced spare parts, direct a request to the Customer Care Organization of a local area Motorola Solutions representative. Orders for replacement parts, kits, and assemblies should be placed directly at the local distribution organization of Motorola Solutions or through the Extranet site Motorola Online at https://emeaonline.motorolasolutions.com.

Your Input

Send questions and comments regarding user documentation to documentation@motorolasolutions.com.

E.2

Service Information for APAC

This topic contains contact details to service centers in Asia and Pacific region.

Technical Support

Technical support is available to assist the dealer/distributor in resolving any malfunction which may be encountered. Initial contact should be by telephone wherever possible. When contacting Motorola Solutions Technical Support, be prepared to provide the product model number and the serial number.

Further Assistance from Motorola Solutions

You can also contact the Customer Help Desk through the website: http://www.motorolasolutions.com/en_xp/products. If a unit requires further complete testing, knowledge and/or details of component level troubleshooting or service than is customarily performed at the basic level, send the radio to a Motorola Solutions Service Center as listed in the following table:

Table 44: Service Information – Telephone Numbers and Addresses of the Asia and Pacific Motorola Solutions Centers

Country	Telephone Number	Address
Singapore	+65-6352-6383	**Motorola Solutions Singapore Pte. Ltd,** c/o Azure Engineering, 49 Jalan Pemimpin, #03-11 APS Industrial Building, Singapore 577203 Contact: Alvin Tan E-mail: alvin.tan@motorolasolutions.com Contact: Gan Saw See E-mail: gan.sawsee@motorolasolutions.com
Malaysia	+603-7809-0000	**Motorola Solutions Sdn. Bhd.**

Country	Telephone Number	Address
		Level 14, Persoft Tower, No. 68, Pesiaran Tropicana, 47410 Petaling Jaya, Selangor Darul Ehsan, Malaysia Contact: Koh Tiong Eng E-mail: A21001@motorolasolutions.com
Indonesia	+62-21-3043-5239	**PT. Motorola Solutions Indonesia** 30th Floor, Gedung BRI II, Suite 3001, Jl. Jend. Sudirman Kav. 44-46, Jakarta 10210, Indonesia Contact: Eko Haryanto E-mail: Eko.Haryanto@motorolasolutions.com
Thailand	Tel: +662-653-220 Fax: +668-254-5922	**Motorola Solutions (Thailand) Ltd.** 142 Two Pacific Place Suite 2201, 3220 Sukhumvit Road, Klongtoey, Bangkok 10110 Contact: Nitas Vatanasupapon E-mail: Nitas@motorolasolutions.com
India	+91-9844218850	**Motorola Solutions India Pvt. Ltd.** C/o Communication Test Design India Private Limited, #4, 5 Maruthi Industrial Estate, Rajapalya, Hoodi Village, Bangalore - 560048, India Contact: K. Umamaheswari E-mail: umamaheshwari@motorolasolutions.com
China	+86-10-8473-5128	**Motorola Solutions (China) Co. Ltd.** No. 1 Wang Jing East Road, Chao Yang District, Beijing, 100102, P.R. China Contact: Sophy Wang E-mail: C18170@motorolasolutions.com
Hong Kong	852-2966-4823	**Motorola Solutions Asia Pacific Ltd.** Unit 1807-1812, 18/F, Two Harbourfront, 22 Tak Fung Street, Hunghom, Kowloon, Hong Kong Contact: Judy Leung E-mail: Judy.Leung@motorolasolutions.com
Philippines	Tel: +632 858-7500	**Motorola Communications Philippines, Inc.**

Country	Telephone Number	Address
	Fax: +632 841-0681	Unit 2102, One Global Place Building, 5th Ave., Bonifacio Global City, Taguig, Philippines 1634. Contact: Arthur Nieves E-mail: Arthur.Nieves@motorolasolutions.com
Korea	+822-3497-3649	**Motorola Solutions Korea, Inc.** 9th Floor, Hibrand Building, 215, Yangjae-Dong, Seocho-Gu, Seoul, 137-924, Korea. Contact: KS Kwak E-mail: r45321@motorolasolutions.com
Taiwan	+886-2-8729 8000	**Motorola Solutions Taiwan, Ltd.** 8F, No. 9, Songgao Rd., Taipei 110, Taiwan (R.O.C.) Contact: Michael Chou E-mail: ftpe239@motorolasolutions.com
Australia	+613-9847-7725	**Motorola Solutions Australia Pty. Ltd.** 10 Wesley Court, Tally Ho Business Park, East Burwood Victoria 3151, Australia. E-mail: servicecentre.au@motorolasolutions.com

Piece Parts

Some replacement parts, spare parts, and/or product information can be ordered directly. If a complete Motorola Solutions part number is assigned to the part, it is available from Motorola Solutions Service Organization. If no part number is assigned, the part is not normally available from Motorola Solutions. If a list of parts is not included, that means that no user-serviceable parts are available for that kit or assembly.

Customer Programming Software has no capability to tune the radio. Tuning the radio can only be performed at the factory or at the appropriate Motorola Solutions Repair Center. Component replacement can affect the radio tuning and must only be performed by the appropriate Motorola Solutions Repair Center.

All orders for parts/information should include the complete Motorola Solutions identification number. All part orders should be directed to your local Motorola Solutions Service Organization. See your latest price pages.

Expansion and Vocon board are working in pair for AVR version and NON-AVR version, whenever expansion board is replaced, Vocon board also have to be replaced and vice versa. PA000471A02 need to pair with PA000470A03 and PMLF4167D need to pair with PMLF4176C. There is not allowed to mix the Vocon-expansion pair as it can deeply affect the functionality of the radio.

Parts Identification and Ordering

Request for help in identification of non-referenced spare parts should be directed to the Customer Care Organization of Motorola Solutions local area representation. Orders for replacement parts, kits, and assemblies should be placed directly on a Motorola Solutions local distribution organization or from the Motorola Solutions Online (Extranet).

Glossary

This glossary contains an alphabetical listing of terms and their definitions that are applicable to portable and mobile subscriber radio products.

Active Channel
A channel that has traffic on it.

Analog Refers to a continuously variable signal or a circuit or device designed to handle such signals.

Analog-to-Digital Converter A device that converts analog signals into digital data. Also known as codec.

Abbreviation:ADC

ASTRO 25
Motorola Solutions standard for wireless digital trunked communications.

ASTRO conventional
Motorola Solutions standard for wireless analog or digital conventional communications.

Automatic Gain Control (AGC) A process or means by which gain is automatically adjusted in a specified manner as a function of a specified parameter, such as received signal level.

Automatic Level Control
A circuit in the transmit RF path that controls RF power amplifier output, provides leveling over frequency and voltage, and protects against high VSWR.

Autoscan
A feature that allows the radio to automatically scan the members of a scan list.

Ball Grid Array (BGA)
A type of IC package characterized by solder balls arranged in a grid that are located on the underside of the package.

Band Frequencies allowed for a specific purpose.

Bluetooth A wireless protocol utilizing short-range communications over short distances.

Call Alert
Privately paging an individual by sending an audible tone.

Carrier Squelch
Feature that responds to the presence of an RF carrier by opening or unmuting (turning on) a receiver's audio circuit. A squelch circuit silences the radio when no signal is being received so that the user does not have to listen to “noise.”

Central Controller
A software-controlled, computer-driven device that receives and generates data for the trunked radios assigned to it. It Monitors and directs the operations of the trunked repeaters.

Channel The multiple frequencies/talkgroups that a Consolette station can support.

Coded Squelch Used on conventional channels to ensure that the receiver hears only those communications intended for the receiver.

Codeplug
Firmware that contains the unique personality for a system or device. A codeplug is programmable and allows changes to system and unit parameters.

Coder/Decoder (CPCAP)
A device that encodes or decodes a signal.

Control Channel
In a trunking system, one of the channels that is used to provide a continuous, two-way/data-communications path between the central controller and all radios on the system.

Conventional
Typically refers to radio-to-radio communications, sometimes through a repeater. Frequencies are shared with other users without the aid of a central controller to assign communications channels.

Conventional Scan List
A scan list that includes only conventional channels.

CMOS Complementary Metal-Oxide Semiconductor

Cursor
A visual tracking marker (a blinking line) that indicates a location on a display.

Customer Programming Software (CPS) Software with a graphical user interface containing the feature set of a radio.

Deadlock
Displayed by the radio after three failed attempts to unlock the radio.The radio must be powered off and on prior to another attempt.

Default A pre-defined set of parameters.

Digital Refers to data that is stored or transmitted as a sequence of discrete symbols from a finite set; most commonly this means binary data represented using electronic or electromagnetic signals.

Digital-to-Analog Converter
A device that converts digital data into analog signals.

Digital Private-Line (DPL) A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.

Digital Signal Processor (DSP) A special-purpose microprocessor that can perform math calculations very rapidly.

Dispatcher
An individual who has radio-system management duties and responsibilities.

Dynamic Regrouping
A feature that allows the dispatcher to temporarily reassign selected radios to a single special channel so they can communicate with each other.

Electrically Erasable Programmable Read-Only Memory (EEPROM) Integrated circuit used to store data, which can be erased by electrical methods.

Failsoft
A backup system that allows communication in a non-trunked, conventional mode if the trunked system fails.

FCC
Federal Communications Commission.

Firmware
Code executed by an embedded processor such as the Host or DSP in a subscriber radio. This type of code is typically resident in non-volatile memory and as such is more difficult to change than code executed from RAM.

Flash
A non-volatile memory device similar to an EEPROM. Flash memory can be erased and reprogrammed in blocks instead of one byte at a time.

FLASHcode
A 13-digit code which uniquely identifies the System Software Package and Software Revenue Options that are enabled in a particular subscriber radio. FLASHcodes are only applicable for radios which are upgradeable through the FLASHport process.

FLASHport
A Motorola Solutions term that describes the ability of a radio to change memory. Every FLASHport radio contains a FLASHport EEPROM memory chip that can be software written and rewritten to, again and again.

Frequency Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).

Frequency generation unit
This unit generates ultra-stable, low-phase noise primary clock and other derived synchronization clocks that are distributed throughout the communication network.

General-Purpose Input/Output

Pins whose function is programmable.

Global Navigation Satellite System GNSS uses satellites from the GPS, GLONASS and BeiDou systems.

- Global Positioning System (GPS)
  - It includes Satellite Based Augmentation System (SBAS).
  - Method of location based on reception of multiple satellite signals by a device on the ground or in an airplane.
- Global Navigation Satellite System (GLONASS)
- BeiDou Navigation Satellite System (BDS)
  - Chinese Satellite Navigation System.

Global Positioning System (GPS) System of 24 satellites that identify earth locations, launched by the U.S. Department of Defense. By triangulating signals from three of the satellites, a GPS receiving unit can pinpoint its current location anywhere on earth to within a few meters.

Hang up

Disconnect.

Home Display

The first information display shown after a radio completes its self test.

Host Code

Object code executed by the host processor in a subscriber radio. The host is responsible for control-oriented tasks such as decoding and responding to user inputs.

IMBE

A sub-band, voice-encoding algorithm used in digital voice.

Inbound Signaling Word

Data transmitted on the control channel from a subscriber unit to the central control unit.

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.

Key-Variable Loader

A device used to load encryption keys into a radio.

kilohertz (kHz) One thousand cycles per second. Used especially as a radio-frequency unit.

LDMOS Laterally Diffused Metal Oxide Semiconductor

Light Emitting Diode (LED)

An electronic device that lights up when electricity is passed through it.

Liquid-Crystal Display (LCD) 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.

LO
Local oscillator.

Low-speed Handshake 150-baud digital data sent to the radio during trunked operation while receiving audio.

Secondary In Primary Out
SPI data line from a peripheral to the MCU.

Primary Out Secondary In
SPI data line from the MCU to a peripheral.

MDC
Motorola Solutions Digital Communications.

Motorola Digital Communications (MDC) A Motorola Solutions proprietary signaling scheme permitting the transfer of data communications at the rate of 1200 bits per second. Designed specifically for high reliability in the land-mobile radio environment. Digital encoding allows a much greater amount of information to pass over the channel with each message than with alternative tone encoding methods. Some features include: PTT ID, Emergency, Call Alert, Emergency Alarm, Voice Selection Call (SelCall), Radio Check, and Monitor.

Megahertz (MHz) One million cycles per second. Used especially as a radio-frequency unit.

Menu Entry
A software-activated feature shown at the bottom of the display. Selection of a feature is controlled by the programming of the buttons on the side of the radio.

Microcontroller Unit (MCU)
MCU-Also written as µC. A microprocessor that contains RAM and ROM components, as well as communications and programming components and peripherals.

Mode A programmed combination of operating parameters; for example, a channel or talkgroup.

Mode Secondary A radio programmed to automatically provide the proper operation for a given selected mode.

Monitoring
Used in conventional operation where the programmed Monitor button is pressed to listen to another user who is active on a channel. This prevents one user from interfering with another user’s conversation.

Multiplexer

An electronic device that combines several signals for transmission on some shared medium.

Network Access Code

Network Access Code (NAC) operates on digital channels to reduce voice channel interference between adjacent systems and sites.

NiCd

Nickel-cadmium.

NiMH

Nickel-metal-hydride.

Non-tactical/revert

The user will talk on a preprogrammed emergency channel. The emergency alarm is sent out on this same channel.

Open Architecture

A controller configuration that utilizes a microprocessor with extended ROM, RAM, and EEPROM.

Oscillator

An electronic device that produces alternating electric current and commonly employs tuned circuits and amplifying components.

Outbound Signaling Word

Data transmitted on the control channel from the central controller to the subscriber unit.

Over-molded Pad-array Carrier

A Motorola Solutions custom IC package, distinguished by the presence of solder balls on the bottom pads.

Over-The-Air Rekeying

Allows the dispatcher to remotely reprogram the encryption keys in the radio.

PA

Power amplifier.

Page

A one-way alert with audio and/or display messages.

Paging One-way communication that alerts the receiver to retrieve a message.

Personality

A set of unique features specific to a radio.

Printed Circuit Board (PC Board) A circuit manufactured so that many or all of the components are attached to a non-conductive circuit board with copper strips on one or both sides to replace wires.

Phase-locked Loop (PLL) A circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.

Preprogrammed
A software feature that has been activated by a qualified radio technician.

Private (Conversation) Call
A feature that lets you have a private conversation with another radio user in the group.

Private-Line Tone Squelch (PL) A continuous sub-audible tone that is transmitted along with the carrier.

Programmable
A radio control that can have a radio feature assigned to it.

Programmable Read-Only Memory
A memory chip on which data can be written only once. Once data has been written onto a PROM, it remains there forever.

Programming Cable A cable that allows the computer to communicate directly with certain radios using USB.

Push-to-Talk The switch or button on the radio which, when pressed, causes the radio to transmit. When the switch or button is released, the unit returns to receive operation.

Abbreviation:PTT

Radio Frequency (RF) The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).

Radio Frequency Power Amplifier Amplifier having one or more active devices to amplify radio signals.

Abbreviation:RFPA

Radio Interface Box
A service aid used to enable communications between a radio and the programming software.

Radio Service Software
DOS-based software containing the feature set of a radio.

Random Access Memory (RAM)
A type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the preceding bytes.

Read-only memory (ROM)
A type of computer memory on which data has been prerecorded. Once data has been written onto a ROM chip, it cannot be removed and can only be read.

Real-time Clock
A module that keeps track of elapsed time even when a computer is turned off.

Receiver Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.

Registers
Short-term data-storage circuits within the microcontroller unit or programmable logic IC.

Repeater Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).

RESET
Reset line: an input to the microcontroller that restarts execution.

Repeater/Talkaround
A conventional radio feature that permits communication through a receive/transmit facility, which re-transmits received signals in order to improve communication range and coverage.

Abacus IC
A custom integrated circuit providing a digital receiver intermediate frequency (IF) backend.

RSSI
Received Signal Strength Indicator.

RX DATA
Receive digital data line.

SCI IN
Serial Communications Interface Input line.

Selective Call
A feature that allows you to call a selected individual, intended to provide privacy and to eliminate the annoyance of having to listen to conversations of no interest to you.

Selective Switch
Any digital P25 traffic having the correct Network Access Code and the correct talkgroup.

Serial Audio CODEC Port
SSI to and from the GCAP II IC CODEC used to transfer transmit and receive audio data.

Serial Communication Interface Input Line
A full-duplex (receiver/transmitter) asynchronous serial interface.

Serial Peripheral Interface
How the microcontroller communicates to modules and ICs through the CLOCK and DATA lines.

Signal An electrically transmitted electromagnetic wave.

Signal Qualifier mode
An operating mode in which the radio is muted, but still continues to analyze receive data to determine RX signal type.

Software Potentiometer Softpot-A computer-adjustable electronic attenuator.

Spectrum Frequency range within which radiation has specific characteristics.

Squelch Muting of audio circuits when received signal levels fall below a pre-determined value. With carrier squelch, all channel activity that exceeds the radio's preset squelch level can be heard.

SRIB
Smart Radio Interface Box.

Standby mode
An operating mode in which the radio is muted but still continues to Monitor data.

Static RAM
A type of memory used for volatile, program/data memory that does not need to be refreshed.

Status Calls
Pre-defined text messages that allow the user to send a conditional message without talking.

Synchronous Serial Interface (SSI)
DSP interface to peripherals that consists of a clock signal line, a frame synchronization signal line, and a data line.

System Central Controllers
Main control unit of the trunked dispatch system; handles ISW and OSW messages to and from subscriber units.

System Select
The act of selecting the desired operating system with the system-select switch (also, the name given to this switch).

Tactical/non-revert
The user will talk on the channel that was selected before the radio entered the emergency state.

TalkAround
Bypassing a repeater and talking directly to another unit for local unit-to-unit communications.

Talkgroup
An organization or group of radio users who communicate with each other using the same communications path.

Talkgroup Scan List A scan list that can include both talkgroups (trunked) and channels (conventional).

Thin Small-outline Package
A type of dynamic random-access memory (DRAM) package that is commonly used in memory applications.

Time-out Timer (TOT) A timer that limits the length of a transmission.

Tone A continuous, sub-audible tone transmitted with the carrier.

Transceiver Transmitter-receiver: A device that both transmits and receives signals.
Abbreviation:XCVR

Transmitter Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.

Trunking
The automatic sharing of communications paths between a large number of users. Allows users to share a smaller number of frequencies because a repeater or communications path is assigned to a talkgroup for the duration of a conversation.

Trunking Priority Monitor scan list
A scan list that includes talkgroups that are all from the same trunking system.

Ultra-High Frequency (UHF) The term for the International Telecommunication Union (ITU) Radio Band with a frequency range of 300 to 3000 MHz.

USK
Unique shadow key.

Universal Asynchronous Receiver Transmitter (UART)
A computer peripheral used to send and receive data. It is asynchronous in that a clock is not used and a device connected to this peripheral can send data at any time.

Universal Serial Bus (USB) An external bus standard that supports data transfer rates of 12 Mbps.

VHF
Very-High Frequency.

Vector Sum Excited Linear Predictive Coding
A voice-encoding technique used in digital voice.

Vocoder
An electronic device for synthesizing speech by implementing a compression algorithm particular to voice.

Vocoder/Controller

A PC board that contains a microcontroller, DSP, memory, audio and power functions, and interface support circuitry.

Voice Encoder

The DSP-based system for digitally processing analog signals, and includes the capabilities of performing voice compression algorithms or voice encoding.

Voltage-controlled Oscillator (VCO)

An oscillator in which the frequency of oscillation can be varied by changing a control voltage.