APX™ TWO-WAY RADIOS

APX 5000
APX 6000
APX 6000Li
APX 6000XE
BASIC SERVICE MANUAL

MODEL 1 MODEL 2 MODEL 3 MODEL 1 MODEL 2 MODEL 3

Foreword

This manual covers all models of the ASTRO® APX™ 5000/ APX™ 6000/ APX™ 6000Li/ APX™ 6000XE digital portable radio, unless otherwise specified. It includes all the information necessary to maintain peak product performance and maximum working time, using levels 1 and 2 maintenance procedures. This level of service goes down to the board replacement level and is typical of some local service centers, self-maintained customers, and distributors.

For details on radio operation or component-level troubleshooting, refer to the applicable manuals available separately. A list of related publications is provided in the section, " Related Publications" on page 1:iv and page 2:10.

Product Safety and RF Exposure Compliance

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

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

Manual Revisions

Changes which occur after this manual is printed are described in FMRs (Florida Manual Revisions). These FMRs provide complete replacement pages for all added, changed, and deleted items, including pertinent parts list data, schematics, and component layout diagrams. To obtain FMRs, contact the Customer Care and Services Division (refer to "Appendix B Replacement Parts Ordering").

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Trademarks

ASTRO APX 5000/ APX 6000/ APX 6000Li/ APX 6000XE

Digital Portable Radios

Basic Service Manual

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Document History

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

Edition	Description	Date
68012002028-A	Initial edition	Dec. 2010
68012002028-B	Added APX 6000XE Information	Apr. 2011
68012002028-C	Added APX 5000 and APX 6000Li Information	Aug. 2011
68012002028-D	Added UHF2 for APX 6000 and APX 6000XE	Nov. 2011
68012002028-E	Updated CPS part number. Added extra Reference Oscillator Alignment service information	Jun. 2013
68012002028-F	Updated part list for hewbrew and cyrilic keypad	Jul. 2013
68012002028-GA	Added Three Piece Front Housing Information. Removed R-2670 Communication Analyzer information from the manual.	Dec. 2018
68012002028-GB	Updated the following sections in Chapter 6 Radio Alignment Procedures: • Reference Oscillator Alignment • Power Characterization Points • Power Characterization Tuning	Sep. 2019

Commercial Warranty

Limited Warranty

MOTOROLA COMMUNICATION PRODUCTS

I. What This Warranty Covers And For How Long

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

ASTRO APX 6000/ APX 6000XE Digital Portable Units	One (1) Year
Product Accessories	One (1) Year

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

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

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

II. General Provisions

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

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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

You must provide proof of purchase (bearing the date of purchase and Product item serial number) in order to receive warranty service and, also, deliver or send the Product item, transportation and insurance prepaid, to an authorized warranty service location. Warranty service will be provided by Motorola through one of its authorized warranty service locations. If you first contact the company which sold you the Product, it can facilitate your obtaining warranty service. You can also call Motorola at 1-888-567-7347 US/Canada.

V. What This Warranty Does Not Cover

A. Defects or damage resulting from use of the Product in other than its normal and customary manner.

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C. Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.

D. Breakage or damage to antennas unless caused directly by defects in material workmanship.

E. A Product subjected to unauthorized Product modifications, disassemblies or repairs (including, without limitation, the addition to the Product of non-Motorola supplied equipment) which adversely affect performance of the Product or interfere with Motorola's normal warranty inspection and testing of the Product to verify any warranty claim.

F. Product which has had the serial number removed or made illegible.

G. Rechargeable batteries if:

  H. any of the seals on the battery enclosure of cells are broken or show evidence of tampering.

  I. 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.

J. Freight costs to the repair depot.

K. A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product, does not function in accordance with MOTOROLA's published specifications or the FCC certification labeling in effect for the Product at the time the Product was initially distributed from MOTOROLA.

L. Scratches or other cosmetic damage to Product surfaces that does not affect the operation of the Product.

M. Normal and customary wear and tear.

VI. Patent And Software Provisions

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

A. that MOTOROLA will be notified promptly in writing by such purchaser of any notice of such claim;

B. that MOTOROLA will have sole control of the defense of such suit and all negotiations for its settlement or compromise; and

C. should the Product or parts become, or in MOTOROLA's opinion be likely to become, the subject of a claim of infringement of a United States patent, that such purchaser will permit MOTOROLA, at its option and expense, either to procure for such purchaser the right to continue using the Product or parts or to replace or modify the same so that it becomes noninfringing or to grant such purchaser a credit for the Product or parts as depreciated and accept its return. The depreciation will be an equal amount per year over the lifetime of the Product or parts as established by MOTOROLA.

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VII. Governing Law

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

Notes

ASTRO APX 5000/ APX 6000/ APX 6000Li/ APX 6000XE

Digital Portable Radios

Section 1

APX 5000/ APX 6000/ APX 6000Li

Notes

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Model Numbering, Charts, and Specifications

Portable Radio Model Numbering System

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

Position 1 – Type of Unit

H = Hand-Held Portable

Positions 2 & 3 – Model Series

98 = APX 5000/ APX 6000/ APX 6000Li

Position 4 - Frequency Band

A = Less than 29.7MHz	P = 336 to 410MHz
B = 29.7 to 35.99MHz	Q = 380 to 470MHz
C = 36 to 41.99MHz	R = 438 to 482MHz
D = 42 to 50MHz	S = 470 to 520MHz
F = 66 to 80MHz	T = Dual Band Capable
G = 74 to 90MHz	U = 764 to 870MHz
H = Product Specific	V = 825 to 870MHz
J = 136 to 162MHz	W = 896 to 941MHz
K = 146 to 178MHz	Y = 1.0 to 1.6GHz
L = 174 to 210MHz	Z = 1.5 to 2.0GHz
M = 190 to 235MHz	

Values given represent range only; they are not absolute.

Position 5 – Power Level

A = 0 to 0.7 Watts
B = 0.7 to 0.9 Watts
C = 1.0 to 3.9 Watts
D = 4.0 to 5.0 Watts
E = 5.1 to 6.0 Watts
F = 6.1 to 10 Watts
G = 0 to 6 Watts

Position 6 – Physical Packages

A = RF Modem Operation
B = Receiver Only
C = Standard Control; No Display
D = Standard Control; With Display
E = Limited Keypad; No Display
F = Limited Keypad; With Display
G = Full Keypad; No Display
H = Full Keypad; With Display
J = Limited Controls; No Display
K = Limited Controls; Basic Display
L = Limited Controls; Limited Display
M = Rotary Controls; Standard Display
N = Enhanced Controls; Enhanced Display
P = Low Profile; No Display
Q = Low Profile; Basic Display
R = Low Profile; Basic Display, Full Keypad

Position 7 – Channel Spacing

1 = 5kHz	5 = 15kHz
2 = 6.25kHz	6 = 20/25kHz
3 = 10kHz	7 = 30kHz
4 = 12.5kHz	9 = Variable/Programmable

Position 8 – Primary Operation

A = Conventional/Simplex
B = Conventional/Duplex
C = Trunked Twin Type
D = Dual Mode Trunked
E = Dual Mode Trunked/Duplex
F = Trunked Type I
G = Trunked Type II
H = FDMA* Digital Dual Mode
J = TDMA** Digital Dual Mode
K = Single Sideband
L = Global Positioning Satellite Capable
M = Amplitude Companded Sideband (ACSB)
P = Programmable

** FDMA = Frequency Division Multiple Access*
*** TDMA = Time Division Multiple Access*

Position 9 – Primary System Type

A = Conventional
B = Privacy Plus
C = Clear SMARTNET
D = Advanced Conventional Stat-Alert
E = Enhanced Privacy Plus
F = Nauganet 888 Series
G = Japan Specialized Mobile Radio (JSMR)
H = Multi-Channel Access (MCA)
J = CoveragePLUS
K = MPT1327* – Public
L = MPT1327* – Private
M = Radiocom
N = Tone Signalling
P = Binary Signalling
Q = Phonenet
W = Programmable
X = Secure Conventional
Y = Secure SMARTNET

** MPT = Ministry of Posts and Telecommunications*

Position 10 – Feature Level

1 = Basic	6 = Standard Plus
2 = Limited Package	7 = Expanded Package
3 = Limited Plus	8 = Expanded Plus
4 = Intermediate	9 = Full Feature/ Programmable
5 = Standard Package	

Position 11 – Version

Version Letter (Alpha) – Major Change

Position 12 – Unique Model Variations

C = Cenelec
N = Standard Package

Positions 13 – 16

SP Model Suffix

Notes

ASTRO APX 5000 VHF Model Chart

MODEL NUMBER				
Top Display Model:				H98KGD9PW5_NI
Dual Display (Limited Keypad):				H98KGF9PW6_NI
Dual Display (Full Keypad):				H98KGH9PW7_NI
Non-BT Models FCC ID:				AZ489FT3824
BT Models FCC ID:				AZ489FT3929
MODEL DESCRIPTION:				VHF, APX 5000
Top Display Model	Dual Display Model (Limited Keypad)	Dual Display Model (Full Keypad)	ITEM NUMBER	DESCRIPTION
X	X	X	NHN7015_	Sub-Assembly, Main Chassis
	X	X	NHN7020_	Display, Color
X	X	X	NHN7021_	Grille, Speaker (Black)
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261003	Label, Grille Top APX 5000
X	X	X	33009273001	Label, FM, External
X	X	X	33009273002	Label, FM, Internal
X	X	X	75009299002	Pad, Thermal, Inner
O	O	O	HLN5978_	Opt Expansion Board Kit
X	X	X	HLN5977_	Std Expansion Board Kit
X	X	X	HLN5979_	Assembly, VOCON Board
		X	NHN7024_	Assembly, Main Housing, Dual Display/ Full Keypad (Black)
	X		NHN7027_	Assmbly, Main Housing, Dual Display/ Limited Keypad
X			NHN7030_	Assembly, Main Housing, Top Display
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	NUD7120_	Assembly, RF Board (VHF)
X	X	X	NNTN7930_	User Guide CD, APX 5000
X	X	X	PMLN7523_	Grille, Speaker (Black), APX 6000
●	●	●	PMLN7524_	Grille, Speaker (Green), APX 6000
●	●	●	PMLN7525_	Grille, Speaker (Yellow), APX 6000
X	X	X	LB000623A10	Label, Grille, APX 5000
●	●	●	LB000623A11	Label, Grille, APX 5000R
		●	NHN7025_	Assembly, Main Housing, Dual Display/ Full Keypad (Yellow)
		●	NHN7026_	Assembly, Main Housing, Dual Display/ Full Keypad (Green)
	●		NHN7028_	Assmbly, Main Housing, Dual Display/ Limited Keypad (Yellow)
	●		NHN7029_	Assmbly, Main Housing, Dual Display/ Limited Keypad (Green)
●			NHN7031_	Assembly, Main Housing, Top Display (Yellow)
●			NHN7032_	Assembly, Main Housing, Top Display (Green)

Note:
X *= Item Included.*
O *= Option available.*
● *= Option available. Can be serviced in depot and ordered thru AAD.*
• *Refer* Appendix A for antennas, batteries and other applicable accessories.

ASTRO APX 5000 UHF1 Model Chart

MODEL NUMBER				
Top Display Model:				H98QDD9PW5_NI
Dual Display (Limited Keypad):				H98QDF9PW6_NI
Dual Display (Full Keypad):				H98QDH9PW7_NI
Non-BT Models FCC ID:				AZ489FT4899
BT Models FCC ID:				AZ489FT4892
MODEL DESCRIPTION:				UHF1, APX 5000
Top Display Model				
	Dual Display Model (Limited Keypad)			
		Dual Display Model (Full Keypad)		
			ITEM NUMBER	DESCRIPTION
X	X	X	NHN7015_	Sub-Assembly, Main Chassis
	X	X	NHN7020_	Display, Color
X	X	X	NHN7021_	Grille, Speaker (Black)
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261003	Label, Grille Top APX 5000
X	X	X	33009273001	Label, FM, External
X	X	X	33009273002	Label, FM, Internal
X	X	X	75009299002	Pad, Thermal, Inner
O	O	O	HLN5978_	Opt Expansion Board Kit
X	X	X	HLN5977_	Std Expansion Board Kit
X	X	X	HLN5979_	Assembly, VOCON Board
		X	NHN7024_	Assembly, Main Housing, Dual Display/ Full Keypad (Black)
	X		NHN7027_	Assmbly, Main Housing, Dual Display/ Limited Keypad
X			NHN7030_	Assembly, Main Housing, Top Display
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	MNUE7365	Assembly, RF Board (UHF)
X	X	X	NNTN7930_	User Guide CD, APX 5000
X	X	X	PMLN7523_	Grille, Speaker (Black), APX 6000
●	●	●	PMLN7524_	Grille, Speaker (Green), APX 6000
●	●	●	PMLN7525_	Grille, Speaker (Yellow), APX 6000
X	X	X	LB000623A10	Label, Grille, APX 5000
●	●	●	LB000623A11	Label, Grille, APX 5000R
		●	NHN7025_	Assembly, Main Housing, Dual Display/ Full Keypad (Yellow)
		●	NHN7026_	Assembly, Main Housing, Dual Display/ Full Keypad (Green)
	●		NHN7028_	Assmbly, Main Housing, Dual Display/ Limited Keypad (Yellow)
	●		NHN7029_	Assmbly, Main Housing, Dual Display/ Limited Keypad (Green)
●			NHN7031_	Assembly, Main Housing, Top Display (Yellow)
●			NHN7032_	Assembly, Main Housing, Top Display (Green)

Note:
X *= Item Included.*
O *= Option available.*
● *= Option available. Can be serviced in depot and ordered thru AAD.*
• *Refer* Appendix A for antennas, batteries and other applicable accessories.

ASTRO APX 5000 700–800 Model Chart

MODEL NUMBER	
Top Display Model:	H98UCD9PW5_NI
Dual Display (Limited Keypad):	H98UCF9PW6_NI
Dual Display (Full Keypad):	H98UCH9PW7_NI
Non-BT Models FCC ID:	AZ489FT5859
BT Models FCC ID:	AZ489FT5863
MODEL DESCRIPTION:	700–800, APX 5000

Top Display Model	Dual Display Model (Limited Keypad)	Dual Display Model (Full Keypad)	ITEM NUMBER	DESCRIPTION
X	X	X	NHN7015_	Sub-Assembly, Main Chassis
	X	X	NHN7020_	Display, Color
X	X	X	NHN7021_	Grille, Speaker (Black)
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261003	Label, Grille Top APX 5000
X	X	X	33009273001	Label, FM, External
X	X	X	33009273002	Label, FM, Internal
X	X	X	75009299002	Pad, Thermal, Inner
O	O	O	HLN5978_	Opt Expansion Board Kit
X	X	X	HLN5977_	Std Expansion Board Kit
X	X	X	HLN5979_	Assembly, VOCON Board
		X	NHN7024_	Assembly, Main Housing, Dual Display/ Full Keypad (Black)
	X		NHN7027_	Assmbly, Main Housing, Dual Display/ Limited Keypad
X			NHN7030_	Assembly, Main Housing, Top Display
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	NUF6750_	Assembly, RF Board (7–800 MHz)
X	X	X	NNTN7930_	User Guide CD, APX 5000
X	X	X	PMLN7523_	Grille, Speaker (Black), APX 6000
●	●	●	PMLN7524_	Grille, Speaker (Green), APX 6000
●	●	●	PMLN7525_	Grille, Speaker (Yellow), APX 6000
X	X	X	LB000623A10	Label, Grille, APX 5000
●	●	●	LB000623A11	Label, Grille, APX 5000R
		●	NHN7025_	Assembly, Main Housing, Dual Display/ Full Keypad (Yellow)
		●	NHN7026_	Assembly, Main Housing, Dual Display/ Full Keypad (Green)
	●		NHN7028_	Assmbly, Main Housing, Dual Display/ Limited Keypad (Yellow)
	●		NHN7029_	Assmbly, Main Housing, Dual Display/ Limited Keypad (Green)
●			NHN7031_	Assembly, Main Housing, Top Display (Yellow)
●			NHN7032_	Assembly, Main Housing, Top Display (Green)

Note:
X *= Item Included.*
O *= Option available.*
● *= Option available. Can be serviced in depot and ordered thru AAD.*
- *Refer* Appendix A for antennas, batteries and other applicable accessories.

Specifications for APX 5000 VHF Radios

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

GENERAL

Temperature Range:	
Operating:	-30°C to +60°C
Storage:	-40°C to +85°C
Power Supply:	Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion)
Battery Voltage:	
Nominal:	7.5 Vdc
Range:	6 to 9 Vdc
Transmit Current Drain (Typical):	2060 mA
Receive Current Drain (Rated Audio):	241 mA
Standby Current Drain:	137 mA
Recommended Battery:	
Li-Ion (Slim):	PMN4403_
or **Li-Ion:**	NNTN7038_
or **Li-Ion Ultra High Cap:**	NNTN7034_
or **Li-Ion Ultra High Cap and FM:**	NNTN7033_*
or **NiMH:**	NNTN7037_
or **NiMH Ruggedized:**	NNTN7573_
or **NiMH FM (Factory Mutual):**	NNTN7036_*
or **Li-Ion Ruggedized and FM:**	NNTN8092_*
or **NiMH Ruggedized and FM:**	NNTN7035_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 5.50" (139.7 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.60" (40.5 mm) / 1.37" (34.7 mm)

With Slim Li-Ion Battery:
H = 5.76" (146.3 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

With NiMH Battery:
H = 7.76" (197.1 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):	
Less Battery:	10.7 oz (303 g)
With Li-Ion Slim:	15.7 oz (445 g)
With Li-Ion Ultra High Cap:	21.1 oz (559 g)
With NiMH:	22.3 oz (631 g)

RECEIVER

Frequency Range:	136–174 MHz
Bandwidth:	90 MHz
Analog Sensitivity (typical)	
(12 dB SINAD):	0.17µV
Digital Sensitivity (typical)	
(1% BER):	0.243 µV
(5% BER):	0.15 µV
Intermodulation (typical):	-81.88 dB
Selectivity (typical):	
(25 kHz Channel):	-81.3 dB
(12.5 kHz Channel):	-73.34 dB
Spurious Rejection (typical):	-90.96 dB
Frequency Stability	
(-30+60°C; 25°C reference):	±0.000086%
Rated Audio:	
Internal Speaker:	500 mW
External Speaker:	500 mW
FM Hum and Noise (typical):	25 kHz -56.8 dB 12.5 kHz -50.29 dB
Distortion (typical):	1.57 %
Channel Spacing:	12.5/25 kHz

TRANSMITTER

Frequency Range:	136–174 MHz
RF Power:	
136–174 MHz:	1–6 W
Frequency Stability (typical)	
(-30 to +60°C; 25°C ref.):	±0.000080%
Emission (typical conducted):	-75 dBc
FM Hum and Noise (typical)	
(Companion Receiver):	25 kHz -47 dB 12.5 kHz -45 dB
Distortion (typical):	1%
Modulation Limiting:	25 kHz chnls ±5 kHz 20 kHz chnls ±4 kHz 12.5 kHz chnls ±2.5 kHz
ACPR (typical):	25 kHz -75 dBc 12.5 kHz -68 dBc
Emissions Designators:	11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

Specifications for APX 5000 UHF1 Radios

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

GENERAL

Temperature Range:	
Operating:	-30°C to +60°C
Storage:	-40°C to +85°C
Power Supply:	Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion)
Battery Voltage:	
Nominal:	7.5 Vdc
Range:	6 to 9 Vdc
Transmit Current Drain (Typical):	1960 mA
Receive Current Drain (Rated Audio):	242 mA
Standby Current Drain:	133 mA
Recommended Battery:	
Li-Ion (Slim):	PMN4403_
or **Li-Ion:**	NNTN7038_
or **Li-Ion Ultra High Cap:**	NNTN7034_
or **Li-Ion Ultra High Cap and FM:**	NNTN7033_*
or **NiMH:**	NNTN7037_
or **NiMH Ruggedized:**	NNTN7573_
or **NiMH FM (Factory Mutual):**	NNTN7036_*
or **Li-Ion Ruggedized and FM:**	NNTN8092_*
or **NiMH Ruggedized and FM:**	NNTN7035_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 5.50" (139.7 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.60" (40.5 mm) / 1.37" (34.7 mm)

With Slim Li-Ion Battery:
H = 5.76" (146.3 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

With NiMH Battery:
H = 7.76" (197.1 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):	
Less Battery:	10.7 oz (303 g)
With Li-Ion Slim:	15.7 oz (445 g)
With Li-Ion Ultra High Cap:	21.1 oz (559 g)
With NiMH:	22.3 oz (631 g)

RECEIVER

Frequency Range:	380–470 MHz
Bandwidth:	90 MHz
Analog Sensitivity (typical)	
(12 dB SINAD):	0.224 µV
Digital Sensitivity (typical)	
(1% BER):	0.298 µV
(5% BER):	0.2 µV
Intermodulation (typical):	-81.5 dB
Selectivity (typical):	
(25 kHz Channel):	-77 dB
(12.5 kHz Channel):	-66.7 dB
Spurious Rejection (typical):	-80.5 dB
Frequency Stability	
(-30+60°C; 25°C reference):	±0.000086%
Rated Audio:	
Internal Speaker:	500 mW
External Speaker:	500 mW
FM Hum and Noise (typical):	25 kHz -53.5 dB 12.5 kHz -47.4 dB
Distortion (typical):	0.91 %
Channel Spacing:	12.5/25 kHz

TRANSMITTER

Frequency Range:	380–470 MHz
RF Power:	
380–470 MHz:	5 W
Frequency Stability (typical)	
(-30 to +60°C; 25°C ref.):	±0.000035%
Emission (typical conducted):	-75 dBc
FM Hum and Noise (typical)	
(Companion Receiver):	25 kHz -49.5 dB 12.5 kHz -52 dB
Distortion (typical):	1%
Modulation Limiting:	25 kHz chnls ±5.0 kHz 20 kHz chnls ±4 kHz 12.5 kHz chnls ±2.5 kHz
ACPR (typical):	25 kHz -72 dBc 12.5 kHz -68 dBc

Emissions Designators:
11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

Specifications for APX 5000 7–800 MHz Radios

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

GENERAL

Temperature Range:
Operating: -30°C to +60°C
Storage: -40°C to +85°C

Power Supply:
Nickel-Metal-Hydride Battery (NiMH)
or Lithium-Ion Battery (Li-Ion)

Battery Voltage:
Nominal: 7.5 Vdc
Range: 6 to 9 Vdc

Transmit Current Drain (Typical):
700 MHz: 1410 mA
800 MHz: 1696 mA
Receive Current Drain (Rated Audio): 250 mA
Standby Current Drain: 142 mA

Recommended Battery:
Li-Ion (Slim): PMN4403_
or **Li-Ion:** NNTN7038_
or **Li-Ion Ultra High Cap:** NNTN7034_
or **Li-Ion Ultra High Cap and FM:** NNTN7033_*
or **NiMH:** NNTN7037_
or **NiMH Ruggedized:** NNTN7573_
or **NiMH FM (Factory Mutual):** NNTN7036_*
or **Li-Ion Ruggedized and FM:** NNTN8092_*
or **NiMH Ruggedized and FM:**
NNTN7035_*
* FM Intrinsically Safe.

Dimensions (H x W x D):
Without Battery (Radio Only):
H = 5.50" (139.7 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.60" (40.5 mm) / 1.37" (34.7 mm)
With Slim Li-Ion Battery:
H = 5.76" (146.3 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)
With NiMH Battery:
H = 7.76" (197.1 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):
Less Battery: 10.7 oz (303 g)
With Li-Ion Slim: 15.7 oz (445 g)
With Li-Ion Ultra High Cap: 21.1 oz (559 g)
With NiMH: 22.3 oz (631 g)

RECEIVER

Frequency Range:
700 MHz: 764–776 MHz
800 MHz: 851–870 MHz

Bandwidth:
700 MHz: 12 MHz
800 MHz: 19 MHz

Analog Sensitivity (typical)
(12 dB SINAD): 0.25 μV

Digital Sensitivity (typical)
(1% BER): 0.375 μV
(5% BER): 0.24 μV

Intermodulation (typical): -80.05 dB

Selectivity (typical):
(25 kHz Channel): -75.87 dB
(12.5 kHz Channel): -65.58 dB

Spurious Rejection (typical): -82.16 dB

Frequency Stability
(-30+60°C; 25°C reference): ±0.000086%

Rated Audio:
Internal Speaker: 500 mW
External Speaker: 500 mW

FM Hum and Noise (typical):
25 kHz -54 dB
12.5 kHz -47.92 dB

Distortion (typical): 1.74 %

Channel Spacing: 12.5/25 kHz

TRANSMITTER

Frequency Range:
700 MHz: 764–776; 794–806 MHz
800 MHz: 806–825; 851–870 MHz

RF Power:
700 MHz: 1–2.7 Watts
800 MHz: 1–3.0 Watts

Frequency Stability (typical)
(-30 to +60°C; 25°C ref.):
700 MHz: ±0.000080%
800 MHz: ±0.000080%

Emission (typical conducted): -75 dBc

FM Hum and Noise (typical)
(Companion Receiver): 25 kHz -47 dB
12.5 kHz -45 dB

Distortion (typical): 2%

Modulation Limiting: 25 kHz chnls ±5 kHz
20 kHz chnls ±4 kHz
12.5 kHz chnls ±2.5 kHz

ACPR (typical): 25 kHz -72 dBc
12.5 kHz -66 dBc

Emissions Designators:
11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

ASTRO APX 6000 VHF Model Chart

MODEL NUMBER	
Top Display Model:	H98KGD9PW5_N
Dual Display (Limited Keypad):	H98KGF9PW6_N
Dual Display (Full Keypad):	H98KGH9PW7_N
Non-BT Models FCC ID:	AZ489FT3824
BT Models FCC ID:	AZ489FT3929
MODEL DESCRIPTION:	VHF, APX 6000

Top Display Model	Dual Display Model (Limited Keypad)	Dual Display Model (Full Keypad)	ITEM NUMBER	DESCRIPTION
X	X	X	NHN7015_	Sub-Assembly, Main Chassis
	X	X	NHN7020_S	Display, Color
X	X	X	NHN7021_S	Grille, Speaker (Black)
			NHN7022_S	Grille, Speaker (Yellow)
			NHN7023_S	Grille, Speaker (Green)
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261001	Label, Grille Top APX 6000
X	X	X	75009299002	Pad, Thermal, Inner
X	X	X	HLN5978_Z	Opt/Std Expansion Board Kit
X	X	X	HLN5960_Z	Assembly, VOCON Board
		X	KT000032C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Black)
	X		KT000032B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Black)
X			KT000032A01	Assembly, 3 Piece Main Housing, Top Display (Black)
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	NUD7120_Z	Assembly, RF Board (VHF)
X	X	X	PMLN5335_	User Guide CD, APX 6000
X	X	X	PMLN7523_	Grille, Speaker (Black), APX 6000
●	●	●	PMLN7524_	Grille, Speaker (Green), APX 6000
●	●	●	PMLN7525_	Grille, Speaker (Yellow), APX 6000
X	X	X	LB000623A01	Label, Grille, APX 6000
X	X	X	LB000623A09	Label, Grille, APX 6000P25
●	●	●	LB000623A07	Label, Grille, APX 6000R
		●	KT000033C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Yellow)
		●	KT000034C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Green)
		●	KT000035C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Orange)
		●	KT000036C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Red)
		●	KT000037C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Blue)
	●		KT000033B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Yellow)
	●		KT000034B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Green)
	●		KT000035B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Orange)
	●		KT000036B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Red)
	●		KT000037B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Blue)
●			KT000033A01	Assembly, 3 Piece Main Housing, Top Display (Yellow)

●			KT000034A01	Assembly, 3 Piece Main Housing, Top Display (Green)
●			KT000035A01	Assembly, 3 Piece Main Housing, Top Display (Orange)
●			KT000036A01	Assembly, 3 Piece Main Housing, Top Display (Red)
●			KT000037A01	Assembly, 3 Piece Main Housing, Top Display (Blue)
		●	KT000032D01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Hebrew (Black)
		●	KT000032E01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Cyrillic (Black)
		●	KT000032F01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Arabic (Black)

Note:
X *= Item Included.*
O *= Option available.*
● *= Option available. Can be serviced in depot and ordered thru AAD.*
• *Refer* Appendix A for antennas, batteries and other applicable accessories.

ASTRO APX 6000 UHF1 Model Chart

MODEL NUMBER				
Top Display Model:				H98QDD9PW5_N
Dual Display (Limited Keypad):				H98QDF9PW6_N
Dual Display (Full Keypad):				H98QDH9PW7_N
Non-BT Models FCC ID:				AZ489FT4899
BT Models FCC ID:				AZ489FT4892
MODEL DESCRIPTION:				UHF1, APX 6000
Top Display Model				
	Dual Display Model (Limited Keypad)			
		Dual Display Model (Full Keypad)		
			ITEM NUMBER	DESCRIPTION
X	X	X	NHN7015_	Sub-Assembly, Main Chassis
	X	X	NHN7020_S	Display, Color
X	X	X	NHN7021_S	Grille, Speaker (Black)
			NHN7022_S	Grille, Speaker (Yellow)
			NHN7023_S	Grille, Speaker (Green)
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261001	Label, Grille Top APX 6000
X	X	X	75009299002	Pad, Thermal, Inner
X	X	X	HLN5978_Z	Opt/Std Expansion Board Kit
X	X	X	HLN5960_Z	Assembly, VOCON Board
		X	KT000032C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Black)
	X		KT000032B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Black)
X			KT000032A01	Assembly, 3 Piece Main Housing, Top Display (Black)
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	NUE7365_S	Assembly, RF Board (UHF1)
X	X	X	PMLN5335_	User Guide CD, APX 6000
X	X	X	PMLN7523_	Grille, Speaker (Black), APX 6000
●	●	●	PMLN7524_	Grille, Speaker (Green), APX 6000
●	●	●	PMLN7525_	Grille, Speaker (Yellow), APX 6000
X	X	X	LB000623A01	Label, Grille, APX 6000
X	X	X	LB000623A09	Label, Grille, APX 6000P25
●	●	●	LB000623A07	Label, Grille, APX 6000R
		●	KT000033C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Yellow)
		●	KT000034C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Green)
		●	KT000035C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Orange)
		●	KT000036C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Red)
		●	KT000037C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Blue)
	●		KT000033B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Yellow)
	●		KT000034B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Green)
	●		KT000035B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Orange)
	●		KT000036B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Red)
	●		KT000037B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Blue)
●			KT000033A01	Assembly, 3 Piece Main Housing, Top Display (Yellow)

●			KT000034A01	Assembly, 3 Piece Main Housing, Top Display (Green)
●			KT000035A01	Assembly, 3 Piece Main Housing, Top Display (Orange)
●			KT000036A01	Assembly, 3 Piece Main Housing, Top Display (Red)
●			KT000037A01	Assembly, 3 Piece Main Housing, Top Display (Blue)
		●	KT000032D01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Hebrew (Black)
		●	KT000032E01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Cyrillic (Black)
		●	KT000032F01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Arabic (Black)

Note:
X *= Item Included.*
O *= Option available.*
● *= Option available. Can be serviced in depot and ordered thru AAD.*
- *Refer* Appendix A for antennas, batteries and other applicable accessories.

ASTRO APX 6000 UHF2 Model Chart

MODEL NUMBER				
Top Display Model:				H98SDD9PW5_N
Dual Display (Limited Keypad):				H98SDF9PW6_N
Dual Display (Full Keypad):				H98SDH9PW7_N
Non-BT Models FCC ID:				AZ489FT4858
BT Models FCC ID:				AZ489FT4903
MODEL DESCRIPTION:				UHF2, APX 6000

Top Display Model	Dual Display Model (Limited Keypad)	Dual Display Model (Full Keypad)	ITEM NUMBER	DESCRIPTION
X	X	X	NHN7015_	Sub-Assembly, Main Chassis
	X	X	NHN7020_S	Display, Color
X	X	X	NHN7021_S	Grille, Speaker (Black)
			NHN7022_S	Grille, Speaker (Yellow)
			NHN7023_S	Grille, Speaker (Green)
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261001	Label, Grille Top APX 6000
X	X	X	75009299002	Pad, Thermal, Inner
X	X	X	HLN5978_Z	Opt/Std Expansion Board Kit
X	X	X	HLN5960_Z	Assembly, VOCON Board
		X	KT000032C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Black)
	X		KT000032B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Black)
X			KT000032A01	Assembly, 3 Piece Main Housing, Top Display (Black)
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	NUE7366_Z	Assembly, RF Board (UHF2)
X	X	X	PMLN5335_	User Guide CD, APX 6000
X	X	X	PMLN7523_	Grille, Speaker (Black), APX 6000
●	●	●	PMLN7524_	Grille, Speaker (Green), APX 6000
●	●	●	PMLN7525_	Grille, Speaker (Yellow), APX 6000
X	X	X	LB000623A01	Label, Grille, APX 6000
X	X	X	LB000623A09	Label, Grille, APX 6000P25
●	●	●	LB000623A07	Label, Grille, APX 6000R
		●	KT000033C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Yellow)
		●	KT000034C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Green)
		●	KT000035C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Orange)
		●	KT000036C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Red)
		●	KT000037C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Blue)
	●		KT000033B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Yellow)
	●		KT000034B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Green)
	●		KT000035B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Orange)
	●		KT000036B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Red)
	●		KT000037B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Blue)
●			KT000033A01	Assembly, 3 Piece Main Housing, Top Display (Yellow)

●			KT000034A01	Assembly, 3 Piece Main Housing, Top Display (Green)
●			KT000035A01	Assembly, 3 Piece Main Housing, Top Display (Orange)
●			KT000036A01	Assembly, 3 Piece Main Housing, Top Display (Red)
●			KT000037A01	Assembly, 3 Piece Main Housing, Top Display (Blue)
		●	KT000032D01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Hebrew (Black)
		●	KT000032E01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Cyrillic (Black)
		●	KT000032F01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Arabic (Black)

Note:
X *= Item Included.*
O *= Option available.*
● *= Option available. Can be serviced in depot and ordered thru AAD.*
- *Refer* Appendix A for antennas, batteries and other applicable accessories.

ASTRO APX 6000 700–800 Model Chart

MODEL NUMBER				
			Top Display Model:	H98UCD9PW5_N
			Dual Display (Limited Keypad):	H98UCF9PW6_N
			Dual Display (Full Keypad):	H98UCH9PW7_N
			Non-BT Models FCC ID:	AZ489FT5859
			BT Models FCC ID:	AZ489FT5863
			MODEL DESCRIPTION:	700–800, APX 6000
Top Display Model				
	Dual Display Model (Limited Keypad)			
		Dual Display Model (Full Keypad)		
			ITEM NUMBER	**DESCRIPTION**
X	X	X	NHN7015_	Sub-Assembly, Main Chassis
	X	X	NHN7020_S	Display, Color
X	X	X	NHN7021_S	Grille, Speaker (Black)
			NHN7022_S	Grille, Speaker (Yellow)
			NHN7023_S	Grille, Speaker (Green)
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261001	Label, Grille Top APX 6000
X	X	X	75009299002	Pad, Thermal, Inner
X	X	X	HLN5978_Z	Opt/Std Expansion Board Kit
X	X	X	HLN5960_Z	Assembly, VOCON Board
		X	KT000032C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Black)
	X		KT000032B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Black)
X			KT000032A01	Assembly, 3 Piece Main Housing, Top Display (Black)
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	NUF6750_Z	Assembly, RF Board (7-800 MHz)
X	X	X	PMLN5335_	User Guide CD, APX 6000
X	X	X	PMLN7523_	Grille, Speaker (Black), APX 6000
●	●	●	PMLN7524_	Grille, Speaker (Green), APX 6000
●	●	●	PMLN7525_	Grille, Speaker (Yellow), APX 6000
X	X	X	LB000623A01	Label, Grille, APX 6000
X	X	X	LB000623A09	Label, Grille, APX 6000P25
●	●	●	LB000623A07	Label, Grille, APX 6000R
		●	KT000033C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Yellow)
		●	KT000034C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Green)
		●	KT000035C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Orange)
		●	KT000036C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Red)
		●	KT000037C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Blue)
	●		KT000033B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Yellow)
	●		KT000034B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Green)
	●		KT000035B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Orange)
	●		KT000036B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Red)
	●		KT000037B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Blue)
●			KT000033A01	Assembly, 3 Piece Main Housing, Top Display (Yellow)

●			KT000034A01	Assembly, 3 Piece Main Housing, Top Display (Green)
●			KT000035A01	Assembly, 3 Piece Main Housing, Top Display (Orange)
●			KT000036A01	Assembly, 3 Piece Main Housing, Top Display (Red)
●			KT000037A01	Assembly, 3 Piece Main Housing, Top Display (Blue)
		●	KT000032D01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Hebrew (Black)
		●	KT000032E01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Cyrillic (Black)
		●	KT000032F01	Assembly, 3 Piece Main Housing, Dual Display/Full Keypad, Arabic (Black)

Note:
X *= Item Included.*
O *= Option available.*
● *= Option available. Can be serviced in depot and ordered thru AAD.*
• *Refer* Appendix A for antennas, batteries and other applicable accessories.

Specifications for APX 6000 VHF Radios

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

GENERAL

Temperature Range:
- **Operating:** -30°C to +60°C
- **Storage:** -40°C to +85°C

Power Supply:
Nickel-Metal-Hydride Battery (NiMH)
or Lithium-Ion Battery (Li-Ion)

Battery Voltage:
- **Nominal:** 7.5 Vdc
- **Range:** 6 to 9 Vdc

Transmit Current Drain (Typical): 2060 mA
Receive Current Drain (Rated Audio): 241 mA
Standby Current Drain: 137 mA

Recommended Battery:
- **Li-Ion (Slim):** PMN4403_
- *or* **Li-Ion:** NNTN7038_
- *or* **Li-Ion Ultra High Cap:** NNTN7034_
- *or* **Li-Ion Ultra High Cap and FM:** NNTN7033_*
- *or* **NiMH:** NNTN7037_
- *or* **NiMH Ruggedized:** NNTN7573_
- *or* **NiMH FM (Factory Mutual):** NNTN7036_*
- *or* **Li-Ion Ruggedized and FM:** NNTN8092_*
- *or* **NiMH Ruggedized and FM:** NNTN7035_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 5.50" (139.7 mm)
W^1 = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D^2 = 1.60" (40.5 mm) / 1.37" (34.7 mm)

With Slim Li-Ion Battery:
H = 5.76" (146.3 mm)
W^1 = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D^2 = 1.65" (41.8 mm) / 1.37" (34.7 mm)

With NiMH Battery:
H = 7.76" (197.1 mm)
W^1 = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D^2 = 1.65" (41.8 mm) / 1.37" (34.7 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):
- **Less Battery:** 10.7 oz (303 g)
- **With Li-Ion Slim:** 15.7 oz (445 g)
- **With Li-Ion Ultra High Cap:** 21.1 oz (559 g)
- **With NiMH:** 22.3 oz (631 g)

RECEIVER

Frequency Range: 136–174 MHz

Bandwidth: 90 MHz

Analog Sensitivity (typical)
- **(12 dB SINAD):** 0.17µV

Digital Sensitivity (typical)
- **(1% BER):** 0.243 µV
- **(5% BER):** 0.15 µV

Intermodulation (typical): -81.88 dB

Selectivity (typical):
- **(25 kHz Channel):** -81.3 dB
- **(12.5 kHz Channel):** -73.34 dB

Spurious Rejection (typical): -90.96 dB

Frequency Stability
- **(-30+60°C; 25°C reference):** ±0.000086%

Rated Audio:
- **Internal Speaker:** 500 mW
- **External Speaker:** 500 mW

FM Hum and Noise (typical):
25 kHz -56.8 dB
12.5 kHz -50.29 dB

Distortion (typical): 1.57 %

Channel Spacing: 12.5/25 kHz

TRANSMITTER

Frequency Range: 136–174 MHz

RF Power:
- **136–174 MHz:** 1–6 W

Frequency Stability (typical)
- **(-30 to +60°C; 25°C ref.):** ±0.000080%

Emission (typical conducted): -75 dBc

FM Hum and Noise (typical)
- **(Companion Receiver):** 25 kHz -47 dB
  12.5 kHz -45 dB

Distortion (typical): 1%

Modulation Limiting: 25 kHz chnls ±5 kHz
20 kHz chnls ±4 kHz
12.5 kHz chnls ±2.5 kHz

ACPR (typical): 25 kHz -75 dBc
12.5 kHz -68 dBc

Emissions Designators:
11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

Specifications for APX 6000 UHF1 Radios

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

GENERAL

Temperature Range:

Operating:	-30°C to +60°C
Storage:	-40°C to +85°C

Power Supply:
Nickel-Metal-Hydride Battery (NiMH)
or Lithium-Ion Battery (Li-Ion)

Battery Voltage:

Nominal:	7.5 Vdc
Range:	6 to 9 Vdc

Transmit Current Drain (Typical):	1960 mA
Receive Current Drain (Rated Audio):	242 mA
Standby Current Drain:	133 mA

Recommended Battery:

Li-Ion (Slim):	PMN4403_
or **Li-Ion:**	NNTN7038_
or **Li-Ion Ultra High Cap:**	NNTN7034_
or **Li-Ion Ultra High Cap and FM:**	NNTN7033_*
or **NiMH:**	NNTN7037_
or **NiMH Ruggedized:**	NNTN7573_
or **NiMH FM (Factory Mutual):**	NNTN7036_*
or **Li-Ion Ruggedized and FM:**	NNTN8092_*
or **NiMH Ruggedized and FM:**	NNTN7035_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 5.50" (139.7 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.60" (40.5 mm) / 1.37" (34.7 mm)

With Slim Li-Ion Battery:
H = 5.76" (146.3 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

With NiMH Battery:
H = 7.76" (197.1 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):

Less Battery:	10.7 oz (303 g)
With Li-Ion Slim:	15.7 oz (445 g)
With Li-Ion Ultra High Cap:	21.1 oz (559 g)
With NiMH:	22.3 oz (631 g)

RECEIVER

Frequency Range:	380–470 MHz
Bandwidth:	90 MHz
Analog Sensitivity (typical)	
(12 dB SINAD):	0.224 μV
Digital Sensitivity (typical)	
(1% BER):	0.298 μV
(5% BER):	0.2 μV
Intermodulation (typical):	-81.5 dB
Selectivity (typical):	
(25 kHz Channel):	-77 dB
(12.5 kHz Channel):	-66.7 dB
Spurious Rejection (typical):	-80.5 dB
Frequency Stability	
(-30+60°C; 25°C reference):	±0.000086%
Rated Audio:	
Internal Speaker:	500 mW
External Speaker:	500 mW
FM Hum and Noise (typical):	25 kHz -53.5 dB 12.5 kHz -47.4 dB
Distortion (typical):	0.91 %
Channel Spacing:	12.5/25 kHz

TRANSMITTER

Frequency Range:	380–470 MHz
RF Power:	
380–470 MHz:	5 W
Frequency Stability (typical)	
(-30 to +60°C; 25°C ref.):	±0.000035%
Emission (typical conducted):	-75 dBc
FM Hum and Noise (typical)	
(Companion Receiver):	25 kHz -49.5 dB 12.5 kHz -52 dB
Distortion (typical):	1%
Modulation Limiting:	25 kHz chnls ±5.0 kHz 20 kHz chnls ±4 kHz 12.5 kHz chnls ±2.5 kHz
ACPR (typical):	25 kHz -72 dBc 12.5 kHz -68 dBc

Emissions Designators:
11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

Specifications for APX 6000 UHF2 Radios

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

NOTE: UHF2 operation within the United Stated is limited to 12.5 kHz Channel Spacing due to the 2011 FCC narrowband regulations.

GENERAL

Temperature Range:	
Operating:	-30°C to +60°C
Storage:	-40°C to +85°C
Power Supply:	Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion)
Battery Voltage:	
Nominal:	7.5 Vdc
Range:	6 to 9 Vdc
Transmit Current Drain (Typical):	1990 mA
Receive Current Drain (Rated Audio):	238 mA
Standby Current Drain:	134 mA
Recommended Battery:	
Li-Ion (Slim):	PMN4403_
or **Li-Ion:**	NNTN7038_
or **Li-Ion Ultra High Cap:**	NNTN7034_
or **Li-Ion Ultra High Cap and FM:**	NNTN7033_*
or **NiMH:**	NNTN7037_
or **NiMH Ruggedized:**	NNTN7573_
or **NiMH FM (Factory Mutual):**	NNTN7036_*
or **Li-Ion Ruggedized and FM:**	NNTN8092_*
or **NiMH Ruggedized and FM:**	NNTN7035_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 5.50" (139.7 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.60" (40.5 mm) / 1.37" (34.7 mm)

With Slim Li-Ion Battery:
H = 5.76" (146.3 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

With NiMH Battery:
H = 7.76" (197.1 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):	
Less Battery:	10.7 oz (303 g)
With Li-Ion Slim:	15.7 oz (445 g)
With Li-Ion Ultra High Cap:	21.1 oz (559 g)
With NiMH:	22.3 oz (631 g)

RECEIVER

Frequency Range:	450–520 MHz
Bandwidth:	70 MHz
Analog Sensitivity (typical)	
(12 dB SINAD):	0.203 µV
Digital Sensitivity (typical)	
(1% BER):	0.296 µV
(5% BER):	0.204 µV
Intermodulation (typical):	-80.4 dB
Selectivity (typical):	
(25 kHz Channel):	-78.1 dB
(12.5 kHz Channel):**	-68.5 dB
Spurious Rejection (typical):	-80.8 dB
Frequency Stability	
(-30+60°C; 25°C reference):	±0.000086%
Rated Audio:	
Internal Speaker:	500 mW
External Speaker:	500 mW
FM Hum and Noise (typical):	25 kHz -53.9 dB 12.5 kHz** -47.6 dB
Distortion (typical):	0.9 %
Channel Spacing:	12.5 kHz**/25 kHz

TRANSMITTER

Frequency Range:	450–520 MHz
RF Power:	
450–520 MHz:	5 W
Frequency Stability (typical)	
(-30 to +60°C; 25°C ref.):	±0.000080%
Emission (typical conducted):	-75 dBc
FM Hum and Noise (typical)	
(Companion Receiver):	25 kHz -49 dB 12.5 kHz** -44 dB
Distortion (typical):	1%
Modulation Limiting:	25 kHz chnls ±5.0 kHz 20 kHz chnls ±4 kHz 12.5 kHz** chnls ±2.5 kHz
ACPR (typical):	25 kHz -72 dBc 12.5 kHz** -65 dBc

Emissions Designators:
11K0F3E**, 16K0F3E, 8K10F1D**, 8K10F1E**, 8K10F1W**, 20K0F1E

Note:
** UHF2 operation within the United States is limited to 12.5 kHz Channel Spacing due to the 2011 FCC narrowband regulations.

Specifications subject to change without notice.

Specifications for APX 6000 7–800 MHz Radios

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

GENERAL

Temperature Range:
- **Operating:** -30°C to +60°C
- **Storage:** -40°C to +85°C

Power Supply:
Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion)

Battery Voltage:
- **Nominal:** 7.5 Vdc
- **Range:** 6 to 9 Vdc

Transmit Current Drain (Typical):
- **700 MHz:** 1410 mA
- **800 MHz:** 1696 mA

Receive Current Drain (Rated Audio): 250 mA
Standby Current Drain: 142 mA

Recommended Battery:
- **Li-Ion (Slim):** PMN4403_
- *or* **Li-Ion:** NNTN7038_
- *or* **Li-Ion Ultra High Cap:** NNTN7034_
- *or* **Li-Ion Ultra High Cap and FM:** NNTN7033_*
- *or* **NiMH:** NNTN7037_
- *or* **NiMH Ruggedized:** NNTN7573_
- *or* **NiMH FM (Factory Mutual):** NNTN7036_*
- *or* **Li-Ion Ruggedized and FM:** NNTN8092_*
- *or* **NiMH Ruggedized and FM:** NNTN7035_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 5.50" (139.7 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.60" (40.5 mm) / 1.37" (34.7 mm)

With Slim Li-Ion Battery:
H = 5.76" (146.3 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

With NiMH Battery:
H = 7.76" (197.1 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):
- **Less Battery:** 10.7 oz (303 g)
- **With Li-Ion Slim:** 15.7 oz (445 g)
- **With Li-Ion Ultra High Cap:** 21.1 oz (559 g)
- **With NiMH:** 22.3 oz (631 g)

RECEIVER

Frequency Range:
- **700 MHz:** 764–776 MHz
- **800 MHz:** 851–870 MHz

Bandwidth:
- **700 MHz:** 12 MHz
- **800 MHz:** 19 MHz

Analog Sensitivity (typical)
- **(12 dB SINAD):** 0.25 μV

Digital Sensitivity (typical)
- **(1% BER):** 0.375 μV
- **(5% BER):** 0.24 μV

Intermodulation (typical): -80.05 dB

Selectivity (typical):
- **(25 kHz Channel):** -75.87 dB
- **(12.5 kHz Channel):** -65.58 dB

Spurious Rejection (typical): -82.16 dB

Frequency Stability
- **(-30+60°C; 25°C reference):** ±0.000086%

Rated Audio:
- **Internal Speaker:** 500 mW
- **External Speaker:** 500 mW

FM Hum and Noise (typical):
25 kHz -54 dB
12.5 kHz -47.92 dB

Distortion (typical): 1.74 %

Channel Spacing: 12.5/25 kHz

TRANSMITTER

Frequency Range:
- **700 MHz:** 764–776; 794–806 MHz
- **800 MHz:** 806–825; 851–870 MHz

RF Power:
- **700 MHz:** 1–2.7 Watts
- **800 MHz:** 1–3.0 Watts

Frequency Stability (typical)
(-30 to +60°C; 25°C ref.):
- **700 MHz:** ±0.000080%
- **800 MHz:** ±0.000080%

Emission (typical conducted): -75 dBc

FM Hum and Noise (typical)
(Companion Receiver):
25 kHz -47 dB
12.5 kHz -45 dB

Distortion (typical): 2%

Modulation Limiting:
25 kHz chnls ±5 kHz
20 kHz chnls ±4 kHz
12.5 kHz chnls ±2.5 kHz

ACPR (typical):
25 kHz -72 dBc
12.5 kHz -66 dBc

Emissions Designators:
11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

ASTRO APX 6000Li VHF Model Chart

MODEL NUMBER				
			Top Display Model:	H98KGD9PW5_N
			Dual Display (Limited Keypad):	H98KGF9PW6_N
			Dual Display (Full Keypad):	H98KGH9PW7_N
			Non-BT Models FCC ID:	AZ489FT3824
			BT Models FCC ID:	AZ489FT3929
			MODEL DESCRIPTION:	VHF, APX 6000Li
Top Display Model				
	Dual Display Model (Limited Keypad)			
		Dual Display Model (Full Keypad)		
			ITEM NUMBER	DESCRIPTION
X	X	X	NHN7015_	Sub-Assembly, Main Chassis
	X	X	NHN7020_	Display, Color
X	X	X	PMLN7523_	Grille, Speaker (Black), APX 6000
X	X	X	LB000623A08	Label, Grille, APX 6000Li
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261001	Label, Grille Top APX 6000
X	X	X	33009273001	Label, FM, External
X	X	X	33009273002	Label, FM, Internal
X	X	X	75009299002	Pad, Thermal, Inner
O	O	O	HLN5978_	Opt Expansion Board Kit
X	X	X	HLN5977_	Std Expansion Board Kit
X	X	X	HLN5979_	Assembly, VOCON Board
		X	KT000032C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Black)
	X		KT000032B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Black)
X			KT000032A01	Assembly, 3 Piece Main Housing, Top Display (Black)
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	NUD7120_	Assembly, RF Board (VHF)
X	X	X	PMLN5335_	User Guide CD, APX 6000/ APX 7000

Note:
X *= Item Included.*
O *= Option available.*
- *Refer* Appendix A for antennas, batteries and other applicable accessories.

ASTRO APX 6000Li UHF1 Model Chart

MODEL NUMBER				
Top Display Model:				**H98QDD9PW5_N**
Dual Display (Limited Keypad):				**H98QDF9PW6_N**
Dual Display (Full Keypad):				**H98QDH9PW7_N**
Non-BT Models FCC ID:				**AZ489FT4899**
BT Models FCC ID:				**AZ489FT4892**
MODEL DESCRIPTION:				**UHF1, APX 6000Li**
Top Display Model				
	Dual Display Model (Limited Keypad)			
		Dual Display Model (Full Keypad)		
			ITEM NUMBER	**DESCRIPTION**
X	**X**	**X**	NHN7015_	Sub-Assembly, Main Chassis
	X	**X**	NHN7020_	Display, Color
X	**X**	**X**	PMLN7523_	Grille, Speaker (Black), APX 6000
X	**X**	**X**	LB000623A08	Label, Grille, APX 6000Li
X	**X**	**X**	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	**X**	**X**	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	**X**	**X**	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	**X**	**X**	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	**X**	**X**	1575250H01	Cover, Universal Connector
X	**X**	**X**	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	**X**	**X**	75009418001	Pad, Controls Flex Support
X	**X**	**X**	3271829H02	Seal, Battery Connector
X	**X**	**X**	3275623B03	Pad, Thermal, Outer
X	**X**	**X**	32009356002	Seal, Vacuum Port
X	**X**	**X**	33009261001	Label, Grille Top APX 6000
X	**X**	**X**	33009273001	Label, FM, External
X	**X**	**X**	33009273002	Label, FM, Internal
X	**X**	**X**	75009299002	Pad, Thermal, Inner
O	**O**	**O**	HLN5978_	Opt Expansion Board Kit
X	**X**	**X**	HLN5977_	Std Expansion Board Kit
X	**X**	**X**	HLN5979_	Assembly, VOCON Board
		X	KT000032C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Black)
	X		KT000032B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Black)
X			KT000032A01	Assembly, 3 Piece Main Housing, Top Display (Black)
X	**X**	**X**	NHN7016_	Assembly, Speaker Module
	X	**X**	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	**X**	**X**	MNUE7365	Assembly, RF Board (UHF)
X	**X**	**X**	PMLN5335_	User Guide CD, APX 6000/ APX 7000

Note:
X *= Item Included.*
O *= Option available.*
- *Refer* Appendix A for antennas, batteries and other applicable accessories.

ASTRO APX 6000Li 700–800 Model Chart

MODEL NUMBER				
			Top Display Model:	H98UCD9PW5_N
			Dual Display (Limited Keypad):	H98UCF9PW6_N
			Dual Display (Full Keypad):	H98UCH9PW7_N
			Non-BT Models FCC ID:	AZ489FT5859
			BT Models FCC ID:	AZ489FT5863
			MODEL DESCRIPTION:	700–800, APX 6000Li
Top Display Model				
	Dual Display Model (Limited Keypad)			
		Dual Display Model (Full Keypad)		
			ITEM NUMBER	**DESCRIPTION**
X	X	X	NHN7015_	Sub-Assembly, Main Chassis
	X	X	NHN7020_	Display, Color
X	X	X	PMLN7523_	Grille, Speaker (Black), APX 6000
X	X	X	LB000623A08	Label, Grille, APX 6000Li
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261001	Label, Grille Top APX 6000
X	X	X	33009273001	Label, FM, External
X	X	X	33009273002	Label, FM, Internal
X	X	X	75009299002	Pad, Thermal, Inner
O	O	O	HLN5978_	Opt Expansion Board Kit
X	X	X	HLN5977_	Std Expansion Board Kit
X	X	X	HLN5979_	Assembly, VOCON Board
		X	KT000032C01	Assembly, 3 Piece Main Housing, Dual Display/ Full Keypad (Black)
	X		KT000032B01	Assembly, 3 Piece Main Housing, Dual Display/ Limited Keypad (Black)
X			KT000032A01	Assembly, 3 Piece Main Housing, Top Display (Black)
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	NUF6750_	Assembly, RF Board (7–800 MHz)
X	X	X	PMLN5335_	User Guide CD, APX 6000/ APX 7000

Note:
X *= Item Included.*
O *= Option available.*

- *Refer* Appendix A for antennas, batteries and other applicable accessories.

Specifications for APX 6000Li VHF Radios

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

GENERAL

Temperature Range:	
Operating:	-30°C to +60°C
Storage:	-40°C to +85°C
Power Supply:	Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion)
Battery Voltage:	
Nominal:	7.5 Vdc
Range:	6 to 9 Vdc
Transmit Current Drain (Typical):	2060 mA
Receive Current Drain (Rated Audio):	273 mA
Standby Current Drain:	142 mA
Recommended Battery:	
Li-Ion (Slim):	PMN4403_
or **Li-Ion:**	NNTN7038_
or **Li-Ion Ultra High Cap:**	NNTN7034_
or **Li-Ion Ultra High Cap and FM:**	NNTN7033_*
or **NiMH:**	NNTN7037_
or **NiMH FM (Factory Mutual):**	NNTN7036_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 5.50" (139.7 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.60" (40.5 mm) / 1.37" (34.7 mm)

With Slim Li-Ion Battery:
H = 5.76" (146.3 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

With NiMH Battery:
H = 7.76" (197.1 mm)
W[1] = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D[2] = 1.65" (41.8 mm) / 1.37" (34.7 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):	
Less Battery:	10.7 oz (303 g)
With Li-Ion Slim:	15.7 oz (445 g)
With Li-Ion Ultra High Cap:	21.1 oz (559 g)
With NiMH:	22.3 oz (631 g)

RECEIVER

Frequency Range:	136–174 MHz
Bandwidth:	90 MHz
Analog Sensitivity (typical)	
(12 dB SINAD):	0.17µV
Digital Sensitivity (typical)	
(1% BER):	0.243 µV
(5% BER):	0.15 µV
Intermodulation (typical):	-81.88 dB
Selectivity (typical):	
(25 kHz Channel):	-81.3 dB
(12.5 kHz Channel):	-73.34 dB
Spurious Rejection (typical):	-90.96 dB
Frequency Stability	
(-30+60°C; 25°C reference):	±0.000086%
Rated Audio:	
Internal Speaker:	500 mW
External Speaker:	500 mW
FM Hum and Noise (typical):	25 kHz -56.8 dB 12.5 kHz -50.29 dB
Distortion (typical):	1.57 %
Channel Spacing:	12.5/25 kHz

TRANSMITTER

Frequency Range:	136–174 MHz
RF Power:	
136–174 MHz:	1–6 W
Frequency Stability (typical)	
(-30 to +60°C; 25°C ref.):	±0.000080%
Emission (typical conducted):	-75 dBc
FM Hum and Noise (typical)	
(Companion Receiver):	25 kHz -47 dB 12.5 kHz -45 dB
Distortion (typical):	1%
Modulation Limiting:	25 kHz chnls ±5 kHz 20 kHz chnls ±4 kHz 12.5 kHz chnls ±2.5 kHz
ACPR (typical):	25 kHz -75 dBc 12.5 kHz -68 dBc

Emissions Designators:
11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

Specifications for APX 6000Li UHF1 Radios

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

GENERAL

Temperature Range:	
Operating:	-30°C to +60°C
Storage:	-40°C to +85°C
Power Supply:	Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion)
Battery Voltage:	
Nominal:	7.5 Vdc
Range:	6 to 9 Vdc
Transmit Current Drain (Typical):	1960 mA
Receive Current Drain (Rated Audio):	303 mA
Standby Current Drain:	133 mA
Recommended Battery:	
Li-Ion (Slim):	PMN4403_
or **Li-Ion:**	NNTN7038_
or **Li-Ion Ultra High Cap:**	NNTN7034_
or **Li-Ion Ultra High Cap and FM:**	NNTN7033_*
or **NiMH:**	NNTN7037_
oor **NiMH FM (Factory Mutual):**	NNTN7036_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 5.50" (139.7 mm)
W^1 = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D^2 = 1.60" (40.5 mm) / 1.37" (34.7 mm)

With Slim Li-Ion Battery:
H = 5.76" (146.3 mm)
W^1 = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D^2 = 1.65" (41.8 mm) / 1.37" (34.7 mm)

With NiMH Battery:
H = 7.76" (197.1 mm)
W^1 = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D^2 = 1.65" (41.8 mm) / 1.37" (34.7 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):	
Less Battery:	10.7 oz (303 g)
With Li-Ion Slim:	15.7 oz (445 g)
With Li-Ion Ultra High Cap:	21.1 oz (559 g)
With NiMH:	22.3 oz (631 g)

RECEIVER

Frequency Range:	380–470 MHz
Bandwidth:	90 MHz
Analog Sensitivity (typical)	
(12 dB SINAD):	0.224 µV
Digital Sensitivity (typical)	
(1% BER):	0.298 µV
(5% BER):	0.2 µV
Intermodulation (typical):	-81.5 dB
Selectivity (typical):	
(25 kHz Channel):	-77 dB
(12.5 kHz Channel):	-66.7 dB
Spurious Rejection (typical):	-80.5 dB
Frequency Stability	
(-30+60°C; 25°C reference):	±0.000086%
Rated Audio:	
Internal Speaker:	500 mW
External Speaker:	500 mW
FM Hum and Noise (typical):	25 kHz -53.5 dB 12.5 kHz -47.4 dB
Distortion (typical):	0.91 %
Channel Spacing:	12.5/25 kHz

TRANSMITTER

Frequency Range:	380–470 MHz
RF Power:	
380–470 MHz:	5 W
Frequency Stability (typical)	
(-30 to +60°C; 25°C ref.):	±0.000035%
Emission (typical conducted):	-75 dBc
FM Hum and Noise (typical)	
(Companion Receiver):	25 kHz -49.5 dB 12.5 kHz -52 dB
Distortion (typical):	1%
Modulation Limiting:	25 kHz chnls ±5.0 kHz 20 kHz chnls ±4 kHz 12.5 kHz chnls ±2.5 kHz
ACPR (typical):	25 kHz -72 dBc 12.5 kHz -68 dBc
Emissions Designators:	11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

Specifications for APX 6000Li 7–800 MHz Radios

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

GENERAL

Temperature Range:
- **Operating:** -30°C to +60°C
- **Storage:** -40°C to +85°C

Power Supply:
Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion)

Battery Voltage:
- **Nominal:** 7.5 Vdc
- **Range:** 6 to 9 Vdc

Transmit Current Drain (Typical): 2060 mA
Receive Current Drain (Rated Audio): 273 mA
Standby Current Drain: 142 mA

Recommended Battery:
- **Li-Ion (Slim):** PMN4403_
- *or* **Li-Ion:** NNTN7038_
- *or* **Li-Ion Ultra High Cap:** NNTN7034_
- *or* **Li-Ion Ultra High Cap and FM:** NNTN7033_*
- *or* **NiMH:** NNTN7037_
- *or* **NiMH FM (Factory Mutual):** NNTN7036_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 5.50" (139.7 mm)
W^1 = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D^2 = 1.60" (40.5 mm) / 1.37" (34.7 mm)

With Slim Li-Ion Battery:
H = 5.76" (146.3 mm)
W^1 = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D^2 = 1.65" (41.8 mm) / 1.37" (34.7 mm)

With NiMH Battery:
H = 7.76" (197.1 mm)
W^1 = 2.98" (75.7 mm) / 2.37" (60.2 mm)
D^2 = 1.65" (41.8 mm) / 1.37" (34.7 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):
- **Less Battery:** 10.7 oz (303 g)
- **With Li-Ion Slim:** 15.7 oz (445 g)
- **With Li-Ion Ultra High Cap:** 21.1 oz (559 g)
- **With NiMH:** 22.3 oz (631 g)

RECEIVER

Frequency Range:
- **700 MHz:** 764–776 MHz
- **800 MHz:** 851–870 MHz

Bandwidth:
- **700 MHz:** 12 MHz
- **800 MHz:** 19 MHz

Analog Sensitivity (typical)
- **(12 dB SINAD):** 0.25 µV

Digital Sensitivity (typical)
- **(1% BER):** 0.375 µV
- **(5% BER):** 0.24 µV

Intermodulation (typical): -80.05 dB

Selectivity (typical):
- **(25 kHz Channel):** -75.87 dB
- **(12.5 kHz Channel):** -65.58 dB

Spurious Rejection (typical): -82.16 dB

Frequency Stability
- **(-30+60°C; 25°C reference):** ±0.000086%

Rated Audio:
- **Internal Speaker:** 500 mW
- **External Speaker:** 500 mW

FM Hum and Noise (typical):
25 kHz -54 dB
12.5 kHz -47.92 dB

Distortion (typical): 1.74 %

Channel Spacing: 12.5/25 kHz

TRANSMITTER

Frequency Range:
- **700 MHz:** 764–776; 794–806 MHz
- **800 MHz:** 806–825; 851–870 MHz

RF Power:
- **700 MHz:** 1–2.7 Watts
- **800 MHz:** 1–3.0 Watts

Frequency Stability (typical)
(-30 to +60°C; 25°C ref.):
- **700 MHz:** ±0.000080%
- **800 MHz:** ±0.000080%

Emission (typical conducted): -75 dBc

FM Hum and Noise (typical)
(Companion Receiver): 25 kHz -47 dB
12.5 kHz -45 dB

Distortion (typical): 2%

Modulation Limiting: 25 kHz chnls ±5 kHz
20 kHz chnls ±4 kHz
12.5 kHz chnls ±2.5 kHz

ACPR (typical): 25 kHz -72 dBc
12.5 kHz -66 dBc

Emissions Designators:
11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

Chapter 1 Introduction

This manual contains information needed for Levels 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

Included in this manual is radio specification for the VHF (136–174 MHz), UHF1 (380–470 MHz), UHF2 (450–520 MHz) and 764–870 MHz frequency bands, a general description of ASTRO APX 5000/ APX 6000/ APX 6000Li models, recommended test equipment, service aids, radio alignment procedures, general maintenance recommendations, procedures for assembly and disassembly, and exploded views and parts lists.

1.2 Notations Used in This Manual

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

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

Caution

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

WARNING

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

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or injury.

1.3 Radio Description

The ASTRO APX 5000/ APX 6000/ APX 6000Li radios are among the most sophisticated two-way radios available.

The ASTRO APX 5000/ APX 6000/ APX 6000Li 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.

ASTRO APX 5000/ APX 6000/ APX 6000Li radios are available in two configurations – Top Display and Dual Display. Table 1-1 describes their basic features.

Table 1-1. ASTRO APX 5000/ APX 6000/ APX 6000Li Basic Features

Feature	Top-Display	Dual-Display
Display	LCD (monochrome) Fully bit-mapped Top Display: • 1 line of text (8 characters per line) • 1 line of icons	LCD • Top Display – monochrome • Front Display – color Fully bit-mapped Top Display: • 1 line of text (8 characters per line) • 1 line of icons Front Display: *Dispatch Mode*: • 5 lines of text (14 characters per line) *List Feature Mode*: • 6 lines of text (14 characters per line) • 2 lines of icons
Keypad	None	Dual Display, Limited Keypad Version: 3 x 2 Menu Buttons (with 4-way Navigation button), Dual Display, Full Keypad Version: 3 x 4 Alphanumeric Keypad
Channel Capability	96	APX 6000Li: 512 APX 5000/ APX 6000: 1250
Dialing from Prestored List	No	Yes
Programmable Softkeys	No	Yes

1.4 FLASHport®

The ASTRO APX 5000/ APX 6000/ APX 6000Li radio utilizes Motorola’s FLASHport technology. FLASHport makes it possible to add software that drives the radio’s capabilities both at the time of purchase and later on. Previously, changing a radio’s features and capabilities meant significant modifications or buying a new radio. But now, similar to how a computer can be loaded with different software, the radio’s features and capabilities can be upgraded with FLASHport software.

Chapter 2 Basic Maintenance

This chapter describes preventive maintenance and handling precautions. Each of these topics provides information vital to the successful operation and maintenance of your radio.

2.1 General Maintenance

In order to avoid operating outside the limits set by the FCC, we recommend that you align the ASTRO APX 5000/ APX 6000/ APX 6000Li radio's reference oscillator 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 Section "6.5.1 Reference Oscillator Alignment" on page 1:6-4). Periodic visual inspection and cleaning is also recommended.

For APX 5000 R/ APX 6000 R (Ruggedized) Radios – Radio submergibility should be checked annually by qualified service technicians.

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.

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	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.

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 should be applied sparingly with a stiff, non-metallic, 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 grill 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.

High Debris Environment

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

Speaker Grill: In high debris environments, the speaker grill may trap dirt and debris, resulting in degraded audio quality and clarity. Motorola recommends vacuuming the speaker grill to maintain optimal audio performance. Attach a crevice nozzle to a vacuum cleaner, and vacuum the speaker grill (See Figure 2-1.). Avoid covering all the grill openings at once with the nozzle. Move the nozzle back and forth several times horizontally across the grill. Perform a “Talk and Listen” test to confirm audio performance has returned to normal. If audio issues persist, radio should be sent in for servicing.

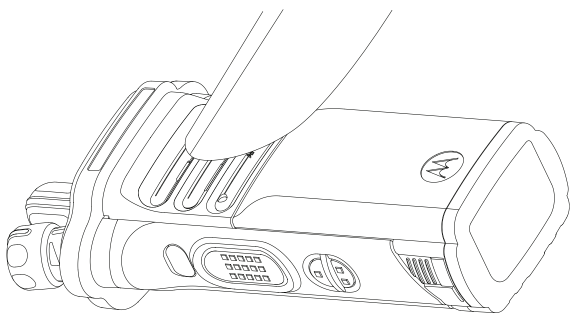

Figure 2-1. Vacuum the Speaker Grill

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 recommends vacuuming the control top to maintain optimal tactile performance. Attach a crevice nozzle to a vacuum cleaner, and vacuum all the radio surfaces, especially the control top, to remove dirt and debris from crevices (See Figure 2-2.). For submersible radios (“R”, “I” 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. Vacuum again to remove dirt, debris and water.

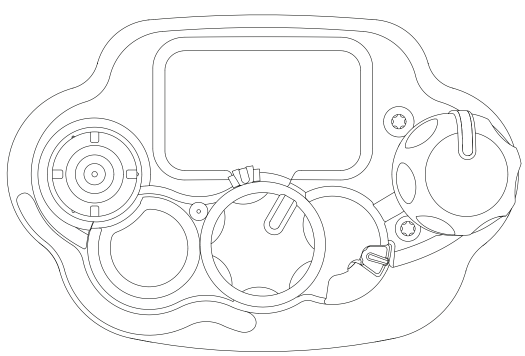

Figure 2-2. Remove Dirt and Debris

2.2 Handling Precautions

Complementary metal-oxide semiconductor (CMOS) devices, and other high-technology devices, are used in this family of radios. While the attributes of these devices are many, their characteristics make them susceptible to damage by electrostatic discharge (ESD) 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 this radio, and are especially important in low-humidity conditions.

Caution

- The APX5000/ APX 6000/ APX 6000Li 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, *in the case of APX 5000 R/ APX 6000 R radios*, the radio's submergibility will be lost.
- 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.
- (**APX 5000 R/ APX 6000 R Radios Only**) The APX 5000 R/ APX 6000 R radio is designed to be submerged to a maximum depth of six (6) feet, with a maximum submersion time of 2 hours per U.S. MIL-STD. Exceeding either maximum limit may result in damage to the radio. For specific U.S. MIL-STD details, see Section "8.10 Ensuring Radio Submergibility" on page 1:8-43.

2.2.1 APX 5000 R/ APX 6000 R Radios Only

If the radio battery contact area has been 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 has been 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 will decrease the audio quality of the radio. If Accessories or the Universal Connector Cover are covering the Universal Connector, check the interface to ensure no liquid has penetrated the seal. Water left in this interface could degraded the performance of the accessories.

Notes

Chapter 3 Basic Theory of Operation

This chapter discusses the basic operational theory of the ASTRO APX 5000/ APX 6000/ APX 6000Li radio, which is a wideband, synthesized radio available in the VHF (136–174 MHz), UHF1 (380–470 MHz), UHF2 (450–520 MHz) and 764–870 MHz frequency bands. All ASTRO APX 5000/ APX 6000/ APX 6000Li radios are capable of both analog operation (12.5 kHz or 25 kHz bandwidths), ASTRO mode (digital) operation (12.5 kHz only) and X2-TDMA mode (25 kHz only).

3.1 Major Assemblies

The ASTRO APX 5000/ APX 6000/ APX 6000Li radio includes the following major assemblies (See Figure 3-1.):

- **VOCON Board** – contains a dual-core processor which includes both the microcontroller unit (MCU) and a digital signal processor (DSP) core, the processor's memory devices, an audio and power supply support integrated circuit (IC), a digital support IC, and external audio power amplifier.
- **Transceiver (XCVR) Board** – contains all transmit, receive, and frequency generation circuitry, including the digital receiver back-end IC and the reference oscillator.
- **Expansion Board**
  - Mace – contains the internal audio power amplifier circuitry, and a Type III secure IC.
  - Mace with Apps – contains the internal audio power amplifier circuitry, a combination Global Positioning System (GPS)/ Bluetooth 2.1 IC and support circuitry, a 3-axes digital accelerometer, an e-MMC NAND flash, and a Type III secure IC.
- **Top Display** – 112 pixels x 32 pixels, transflective monochrome liquid crystal display (LCD).
- **Control Top** – contains five switches: On/Off & 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 only)** – 130 pixels x 130 pixels, transflective color LCD.
- **Keypad (Dual-Display Version Only)** – Dual-Display version, Limited Kaypad Version has a 3 x 2 Menu keypad with 4-way navigation button, and Full Keypad Version has a 3 x 4 alphanumeric keypad.

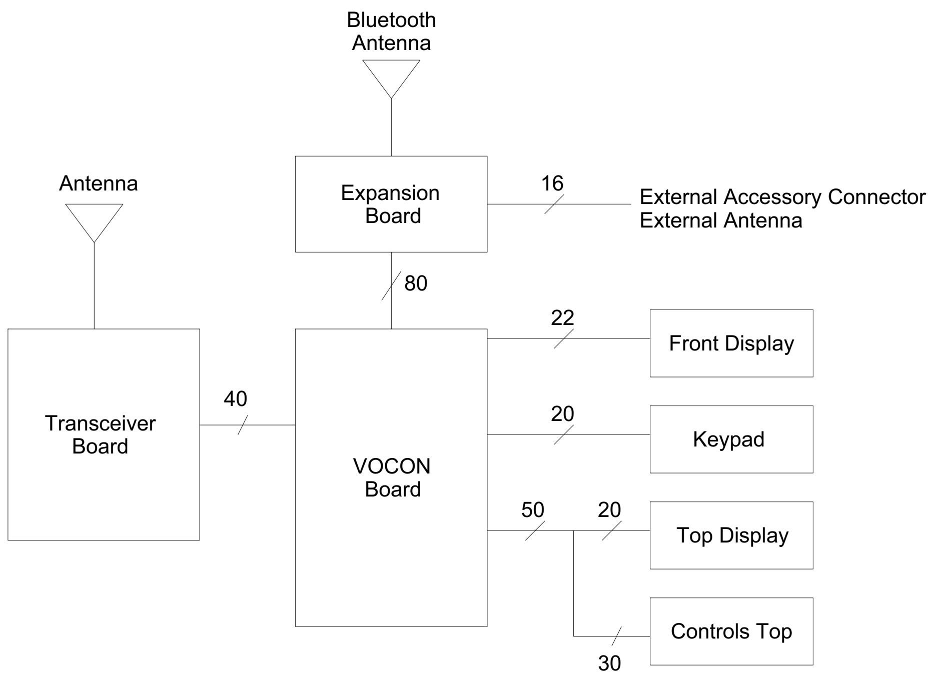

Figure 3-1. APX 5000/ APX 6000/ APX 6000Li Overall Block Diagram

3.2 Analog Mode of Operation

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

3.2.1 Receiving

The RF signal is *received* at the antenna and is routed through the Auxiliary and Multi Switch (SP3T) ICs on the UHF1, UHF2 and 7/800MHz designs. The latter contains a switchable attenuator that is enabled at predetermined RF power thresholds present at the antenna port. The VHF design does not include the Auxiliary switch and thus RF is routed directly to the SP3T switch. See Figure 3-2and Figure 3-5.

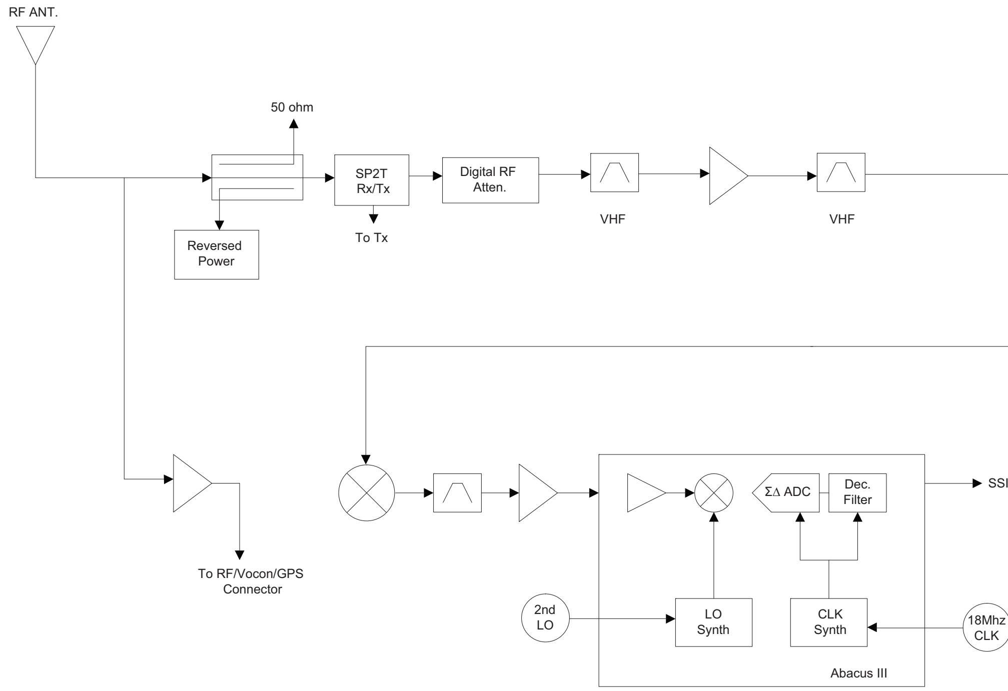

Figure 3-2. Receiver Block Diagram (VHF)

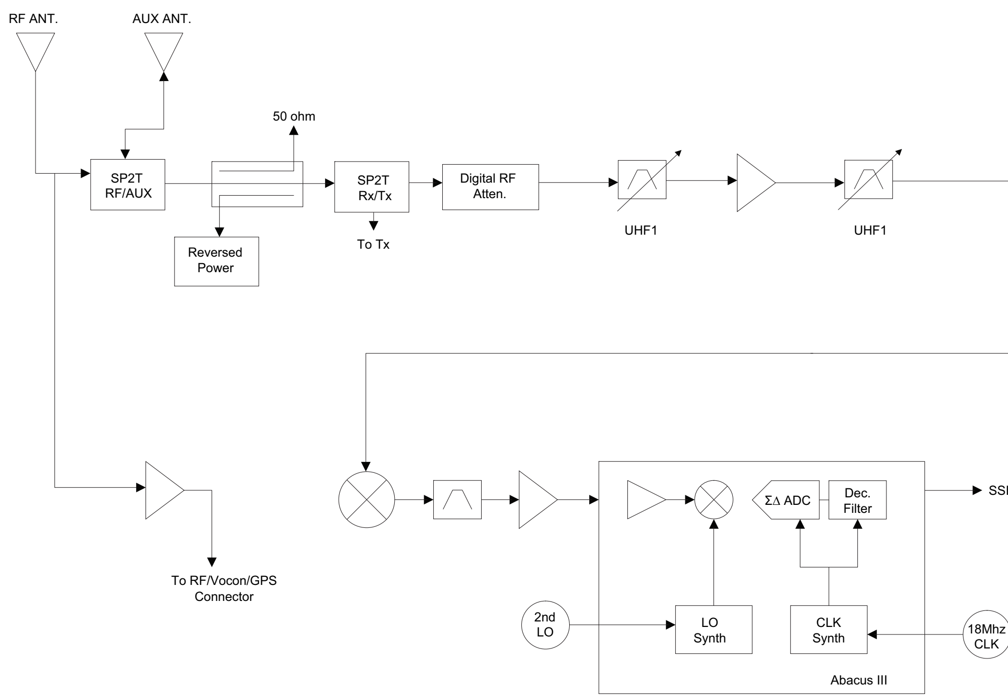

Figure 3-3. Receiver Block Diagram (UHF1)

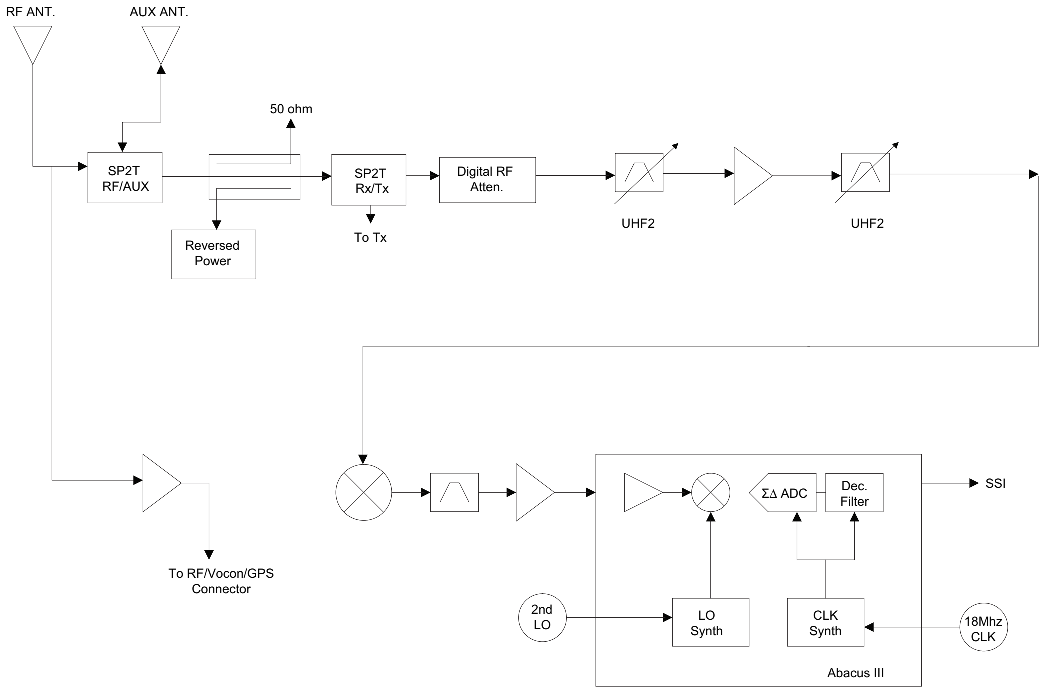

Figure 3-4. Receiver Block Diagram (UHF2)

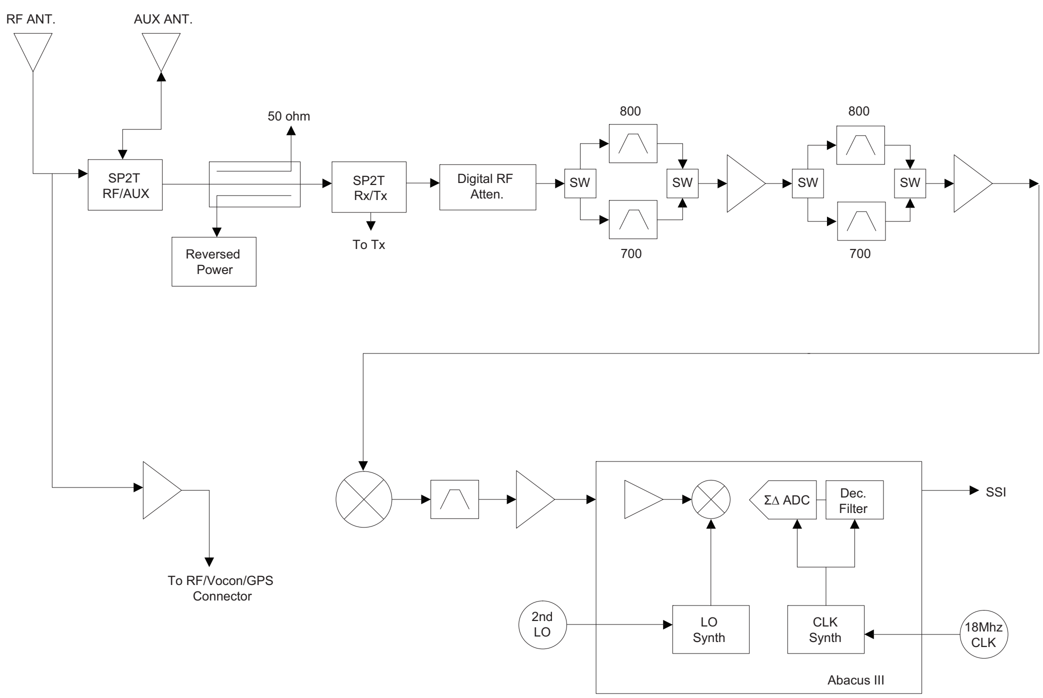

Figure 3-5. Receiver Block Diagram (700/800 MHz)

3.2.1.1 GPS

The GPS architecture employs a combination GPS/Bluetooth IC chip which decodes GPS signals at 1575.42 MHz. It is capable of producing a final position solution including full tracking and data decode capability. The GPS receiver will operate in the autonomous mode only.

The GPS signal is tapped at the antenna port via a series resonant network which provides a very low capacitive load to the transceiver. The signal is routed though a GPS LNA and it's output is applied to the RF-Controller interface connector where it is eventually routed to the expansion board for processing by the GPS/Bluetooth IC.

The GPS receiver is setup in an autonomous one track always (OTA) mode, also known as continuous navigation. This means the GPS will continuously track satellites for as long as the radio is powered to ensure the best possible accuracy. In the event the radio loses visibility of the satellites due to terrain or environmental factors such as driving through a tunnel or entering a building, the GPS will temporarily lose its position fix. A power savings algorithm will then cycle the GPS in and out of a sleep mode at approximately 90 second intervals until the radio has moved back into an environment where GPS signals are present.

The user will be able to view the current latitude, longitude, and time/date stamp on the radio's display. The radio can also be configured to send its' location to the system at predetermined intervals (LRRP). Depending on system options, the user may be able to enable/disable the GPS receiver.

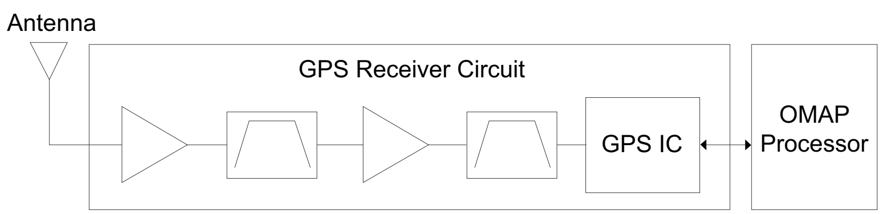

Figure 3-6. GPS Diagram

3.2.1.2 VHF Front-End

From the RX/TX select switch, the VHF signal is routed to a pre-selector filter, followed by a Low Noise Amplifier (LNA) and a second pre-selector filter. Both filters are discrete and fixed designs and 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 Abacus 3 Analog to Digital Converter IC (AD9864).

3.2.1.3 UHF1 Front-End

From the RX/TX select switch, a UHF1 signal is routed to the first pre-selector filter followed by an LNA and a second pre-selector filter. Both filters are discrete and tunable designs and are used to band limit the incoming energy and suppress known spurious responses such as Image spur. The output of the second pre-selector filter is applied to the RF port of the Mixer IC. 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 Abacus 3 Analog to Digital Converter IC (AD9864).

3.2.1.4 UHF2 Front-End

From the RX/TX select switch, a UHF2 signal is routed to the first pre-selector filter followed by an LNA and a second pre-selector filter. Both filters are discrete and tunable designs and are used to band limit the incoming energy and suppress known spurious responses such as Image spur. The output of the second pre-selector filter is applied to the RF port of the Mixer IC. 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 Abacus 3 Analog to Digital Converter IC (AD9864).

3.2.1.5 700/800 Front-End

From the RX/TX select switch, the signal is routed to an RF switch which selects the 700 or 800 Mhz band signal and routes it through a filter, an LNA, another filter, and another LNA. All filters are Surface Acoustic Wave (SAW) designs used to band limit the received energy and suppress known spurious responses. The output of the second filter is applied to the RF port of the Mixer IC. 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 an amplifier which drives the input of the Abacus 3 Analog to Digital Converter IC (AD9864).

3.2.1.6 Analog To Digital Converter

The ADC IC's front end down converts the first IF to a second IF, a 2.25 MHz signal. The second IF is sampled at 18 MHz, a signal generated by an integrated clock synthesizer. The sampled signal is decimated by a factor of 900 to 20 kHz and converted to SSI format at the ADC's output. The Serial Synchronous Interface (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) for post-processing and demodulation.

3.2.2 Transmitting

When the radio is transmitting, microphone audio is digitized and then processed by the DSP and sent to the Trident IC (see Figure 3-7 to Figure 3-10) via the SSI interface. The Trident IC processes the SSI data for application to the voltage controlled oscillator as a modulation signal.

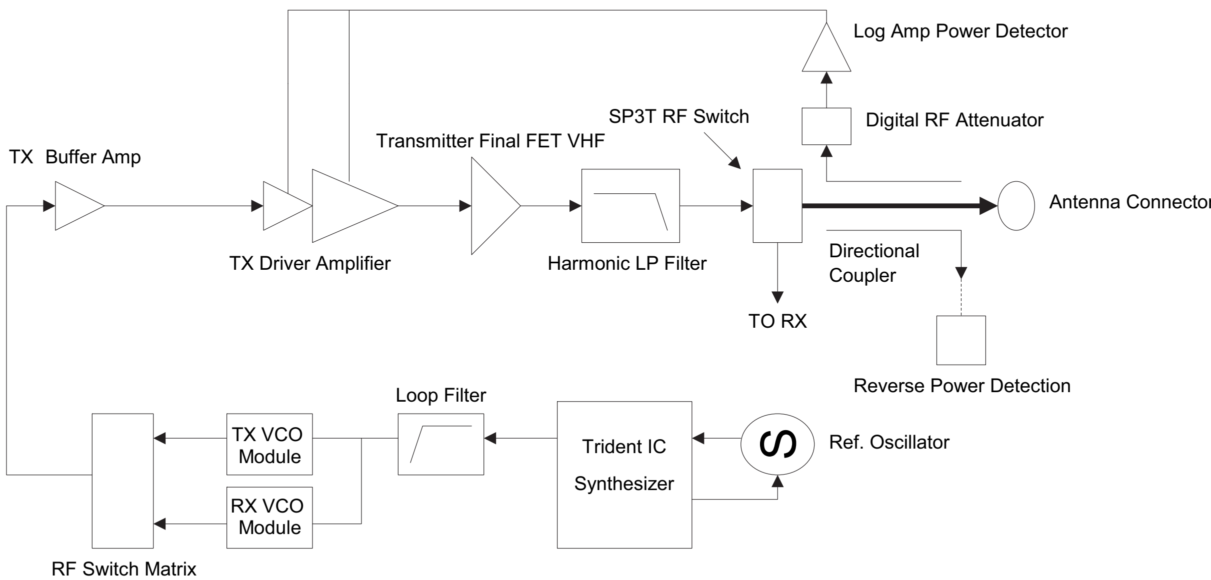

Figure 3-7. Transceiver (VHF) Block Diagram

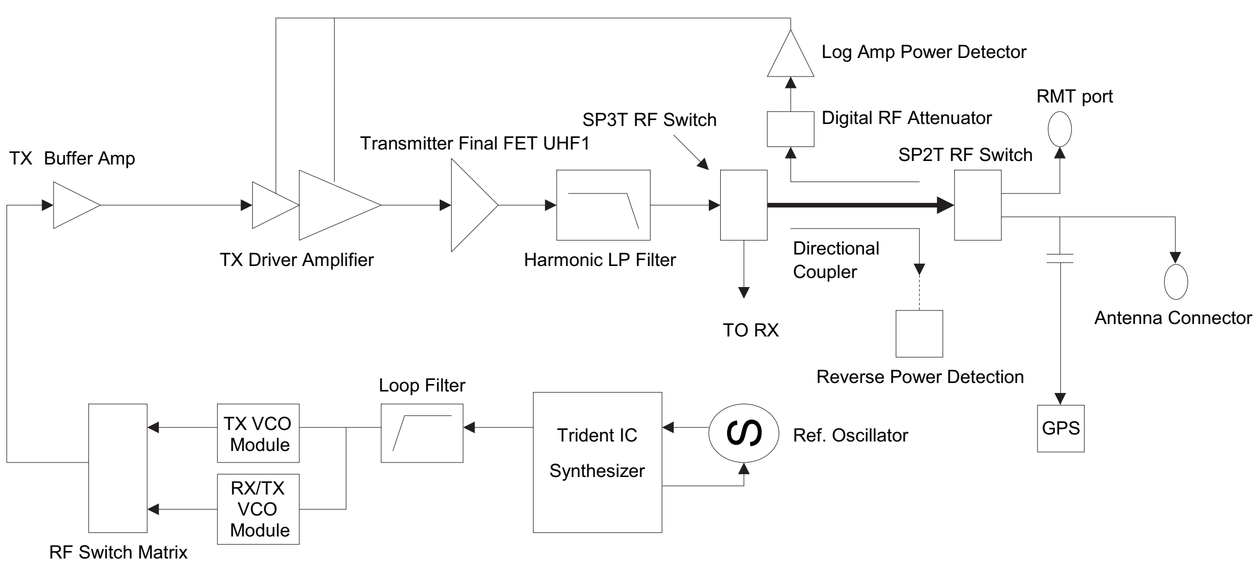

Figure 3-8. Transceiver (UHF1) Block Diagram

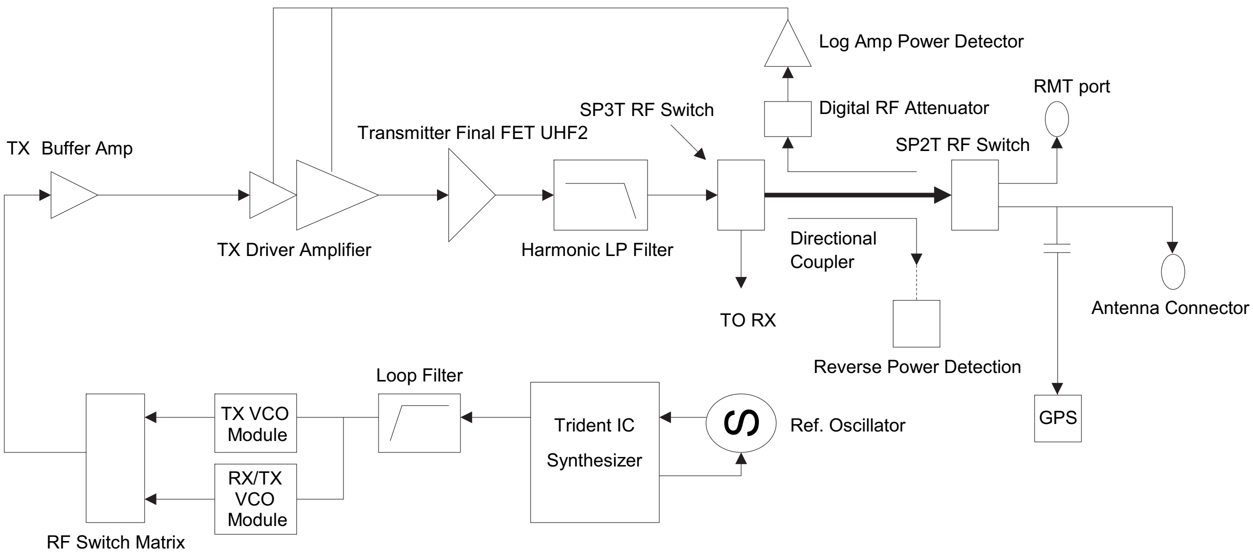

Figure 3-9. Transceiver (UHF2) Block Diagram

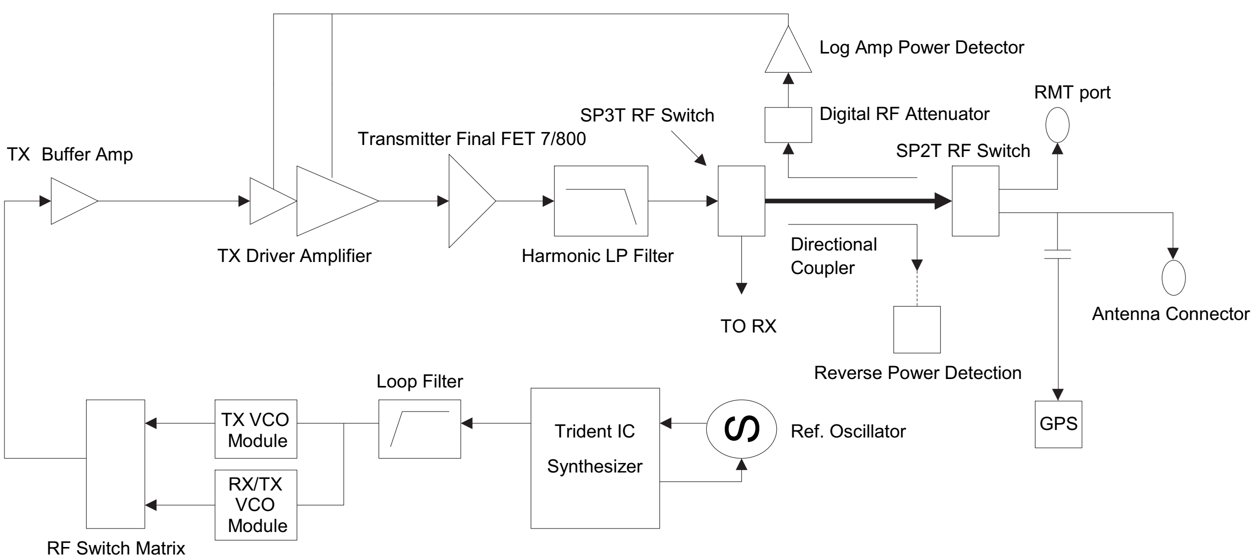

Figure 3-10. Transceiver (700/800 MHz) Block Diagram

3.2.2.1 VHF Transmit

Once a VHF frequency for transmit has been selected, the Trident IC and its accompanying logic circuitry enable the correct voltage controlled oscillator which then generates the desired transmit frequency. This transmit signal is then routed to the TX buffer amplifier which amplifies the signal. An RF switch then routes the signal to the VHF Driver amplifier and then to the discrete final stage. The signal is then 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. Finally, the RF signal routes the power to the main antenna.

3.2.2.2 UHF1 Transmit

Once a UHF frequency for transmit has been selected, the Trident IC and its accompanying logic circuitry enable the correct voltage controlled oscillator which then generates the desired transmit frequency. This transmit signal is then routed to the TX buffer amplifier which amplifies the signal. Then the RF signal is routed to the UHF1 Driver amplifier and then to the discrete final stage. The signal is then 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. Finally, the RF signal comes to a Single Pole double throw (SP2T) RF switch which can route the power to the main antenna or to the Universal Connector port of the radio.

3.2.2.3 UHF2 Transmit

Once a UHF frequency for transmit has been selected, the Trident IC and its accompanying logic circuitry enable the correct voltage controlled oscillator which then generates the desired transmit frequency. This transmit signal is then routed to the TX buffer amplifier which amplifies the signal. Then the RF signal is routed to the UHF2 Driver amplifier and then to the discrete final stage. The signal is then 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. Finally, the RF signal comes to a Single Pole double throw (SP2T) RF switch which can route the power to the main antenna or to the Universal Connector port of the radio.

3.2.2.4 700/800 MHz Transmit

Once a 700/800 MHz frequency for transmit has been selected, the Trident IC and its accompanying logic circuitry enable the correct voltage controlled oscillator which then generates the desired transmit frequency. This transmit signal is then routed to the TX buffer amplifier which amplifies the signal. An RF switch then routes the signal to the 700/800 MHz Driver amplifier and then to the discrete final stage. The signal is then 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. Finally, the RF signal comes to a Single Pole double throw (SP2T) RF switch which can route the power to the main antenna or to the Universal Connector port of the radio.

3.3 Digital (ASTRO) Mode of Operation

In the ASTRO (digital) mode of operation, the transmitted or received signal is limited to a discrete set of frequency deviation levels. The receiver handles an ASTRO-mode signal identically to an analog-mode signal, up to the point where the DSP decodes the received data. In the ASTRO receive mode, the DSP uses a different algorithm to recover data.

In the ASTRO 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.

3.4 Controller Section

The controller section (see Figure 3-11) 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 Power and Clocks section includes a power management IC (MAKO) and various external switching regulators, and two clock sources (12 MHz and 24.576 MHz) from which all other controller digital clocks are derived. The Audio section has a CODEC and a class-D audio power amplifier that provides the radio with a multiple microphone, single speaker design. 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 Mace Expansion Board consists on the main class-D audio power amplifier and the Type III secure IC (MACE). In addition to the Mace features, the Mace with Apps Expansion Board consists of an e-MMC NAND Flash (4GB), a combination integrated-circuit consisting of a Global Positioning System (GPS) receiver and a Bluetooth (BT) 2.1 transceiver, an encryption processor (MACE), and a 3-axes digital accelerometer.

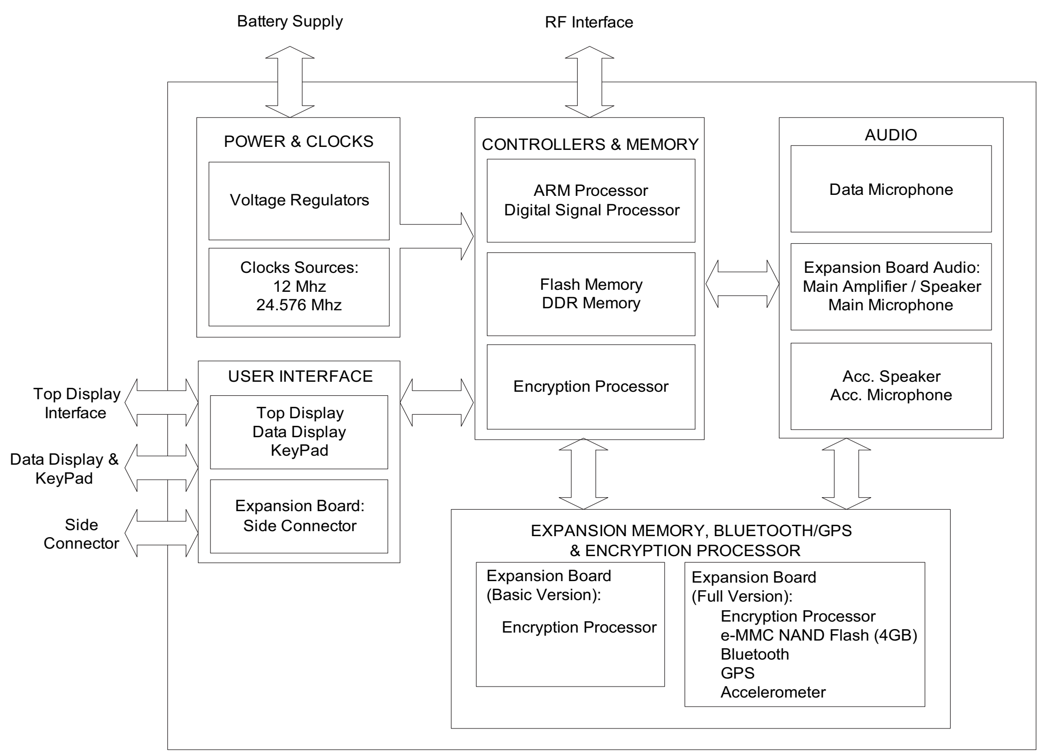

Figure 3-11. Controller Block Diagram

The ARM controller core of the OMAP 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 (64 MB) is required to store the firmware, tuning, and Codeplug settings, which upon initialization get read and stored into SDRAM (32 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 processor through the SSI interface. Its firmware is flashed via the main processor during an upgrade request to its internal FLASH memory. The MACE encryption processor is located on the expansion board.

The power and most clocks to the controller devices are provided by the MAKO IC and external switching and linear regulators on board. A Complex Programmable Logic Array (CPLD) IC divides the 24.576 MHz clock from MAKO to source OMAP's 32 kHz Real Time Clock, and MACE's 4 MHz main clock. OMAP's main clock is supplied externally from an on board 12 MHz crystal.

The radio has two internal microphones and an internal speaker, as well as available microphone and speaker connections for external accessories. The internal 4 Ohm speaker is located opposite to the main display and keypad of the radio. The internal speaker is driven by a Class D audio amplifier located on the expansion board that is capable of delivering a rated power of 0.5 W. The external accessory speaker is driven by a Class AB audio amplifier on the MAKO IC that is capable of delivering 0.5 W of power into a 16 Ohm 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's 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 for accessories. All signals to and from the connector go through the internal expansion board before reaching the microcontroller and other devices on the main board.

3.4.1 Radio with Mace with Apps Expansion Board

In addition to the Mace Expansion Board features, the Mace with Apps Expansion Board consists of an e-MMC 4GB NAND Flash, a 3-axes digital accelerometer, and an integrated-circuit consisting of a Global Positioning System (GPS) and Bluetooth 2.1 transceiver. The 4GB external NAND Flash communicates to the OMAP processor on the VOCON board through the Multi Media Card (MMC) interface. The GPS receiver section of the GPS/BT combination IC interfaces with the OMAP processor though a dedicated UART port. The GPS receiver also has a dedicated reset controlled solely by the OMAP processor.

The radio also has the ability to connect to a wireless Bluetooth audio headset. This feature is implemented using a combination Bluetooth/GPS integrated circuit (IC) located on the expansion board. An optional accessory headset can connect using a low-data rate GFSK modulated signal hopping on 79 x 1 MHz wide Bluetooth channels from 2402 MHz to 2480 MHz in the ISM band. Each APX accessory that is capable of Bluetooth communication will have 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 will be retransmitted on another channel. The Bluetooth IC sends data to the AVR32 processor that is also located on the expansion board over an HCI UART link. The AVR32 processor communicates to the OMAP processor on the VoCon board through a dedicated USB port.

The Bluetooth feature is accompanied by a Low-Frequency (LF) detection circuit that is also located on the expansion board. The LF circuit provides the ability of a secure pairing connection with a Bluetooth accessory. Once a radio has the Bluetooth feature enabled, a user can tap their LF enabled Bluetooth audio 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 AVR32 processor through a dedicated SPI bus and transfers the pairing data through a dedicated UART.

There is a digital accelerometer on the expansion board that detects the 3-axis force of gravity which can be used to determine the radio's orientation. The accelerometer's position is communicated to the AVR32 processor through a SPI bus.

Chapter 4 Recommended Test Equipment and Service Aids

This chapter provides lists of recommended test equipment and service aids, as well as information on field programming equipment that can be used in servicing and programming ASTRO APX 5000/ APX 6000/ APX 6000Li radios.

4.1 Recommended Test Equipment

The list of equipment contained in Table 4-1 includes all of the standard test equipment required for servicing two-way portable radios, as well as several unique items designed specifically for servicing this family of radios. The "Characteristics" column is included so that equivalent equipment may be substituted; however, when no information is provided in this column, the specific Motorola model listed is either a unique item or no substitution is recommended.

Table 4-1. Recommended Test Equipment

Equipment	Characteristics	Example	Application
Service Monitor	Can be used as a substitute for items marked with an asterisk (*)	Aeroflex 3920 (www.aeroflex.com)**	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment. (**) Referenced in this manual as an example for test setup guidelines.
Digital RMS Multimeter *	100 µV to 300 V 5 Hz to 1 MHz 10 Mega Ohm Impedance	Fluke 179 or equivalent (www.fluke.com)	AC/DC voltage and current measurements. Audio voltage measurements
RF Signal Generator *	100 MHz to 1 GHz -130 dBm to +10 dBm FM Modulation 0 kHz to 10 kHz Audio Frequency 100 Hz to 10 kHz	Agilent N5181A (www.agilent.com), Ramsey RSG1000B (www.ramseyelectronics.com, or equivalent	Receiver measurements
Oscilloscope *	2 Channel 50 MHz Bandwidth 5 mV/div to 20 V/div	Leader LS8050 (www.leaderusa.com), Tektronix TDS1001b (www.tektronix.com), or equivalent	Waveform measurements
Power Meter and Sensor *	5% Accuracy 100 MHz to 500 MHz 50 Watts	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
RF Millivolt Meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 92EA (www.boonton.com) or equivalent	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

4.2 Service Aids

Refer to Table 4-2 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 "Appendix B Replacement Parts Ordering" on page B-1. While all of these items are available from Motorola, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 4-2. Service Aids

Motorola Part Number	Description	Application
5880384G68	SMA to BNC Adapter	Adapts radio's antenna port to BNC cabling of test equipment.
66009254001	APX Battery Adapter	Used in place of battery to connect radio to an external power supply. Requires RLN4510_.
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.
66009260002	Board Analysis Fixture	Special fixture that allows radio's internal board 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 66009259001 Adapter Kit.
NTN4265_	Pressure Pump Kit	Submersible radios only. Pressure pump with gauge and pressure hose. Requires 66009259001 Adapter Kit.
RVN5224_	Customer Programming Software (CPS) and Tuner Software	CPS allows customer-specific programming of modes and features. Tuner software required to perform alignment of radio parameters.
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.
RLN4510_	7.5 Volt Universal Battery Eliminator	Used in conjunction with the 66009254001 to adjust the supply voltage to 7.5 Vdc. Allows a multimeter to be attached for monitoring and adjusting voltage and current levels.
RLN4460_	Portable Test Set	Used for radio performance checks. Connects to radio's universal connector and allows remote switching and signal injection/outputs for test equipment measurements.

4.3 Field Programming

This family of radios can be aligned and programmed in the field. This requires specific equipment and special instructions. Refer to the online help in the Customer Programming Software (CPS) for complete field programming information.

Chapter 5 Performance Checks

This chapter covers performance checks used to ensure that the ASTRO APX 5000/ APX 6000/ APX 6000Li radio meets published specifications. The recommended test equipment listed in the previous section approaches the accuracy of the manufacturing equipment, with a few exceptions. Accuracy of the test equipment must be maintained in compliance with the manufacturer's recommended calibration schedule. Checks should be performed if radio performance degradation is suspected.

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 Figure 5-1.

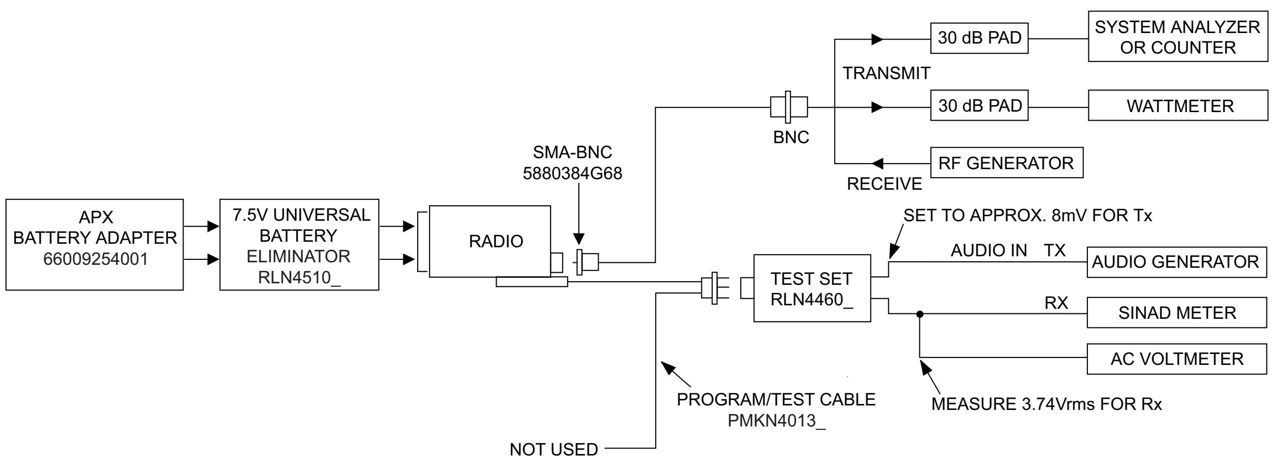

Figure 5-1. Performance Checks Test Setup

Initial equipment control settings should be as indicated in Table 5-1 and should be the same for all performance checks and alignment procedures, except as noted.

Table 5-1. Initial Equipment Control Settings

<table>
<tr><th>System Analyzer</th><th>Test Set</th><th>Power Supply</th></tr>
<tr><td>Mode: Analog Duplex*</td><td>Spkr/Load: Speaker</td><td>Voltage: 7.5 Vdc</td></tr>
<tr><td rowspan="3">Receiver Checks
RF Control: Generator
Output Level: -47 dBm
Modulation: 1 kHz tone @3 kHz deviation
Frequency: Set to selected radio RX frequency
Meter: RF Display

Transmitter Checks
RF Control: Analyzer
Frequency: Set to selected radio TX frequency
Meter: RF Display
Modulation Type: FM</td><td>PTT: OFF (center)</td><td>DC On/Standby: Standby</td></tr>
<tr><td>Meter Out: RX</td><td>Volt Range: 10 Vdc</td></tr>
<tr><td>Opt Sel: ON</td><td>Current: 2.5 A</td></tr>
</table>

* *Use “PROJ 25 STD” if testing ASTRO Conventional channels.*

5.2 Display Radio Test Mode (Dual-Display Version)

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

5.2.1 Access the Test Mode

To enter the display radio test mode:

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

   The radio shows a series of displays that give information regarding various version numbers and subscriber specific information. The displays are described in Table 5-2.

Table 5-2. 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	Version of the encryption software	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 radio’s model number, as programmed in the codeplug	Always
Serial number	The radio’s serial number, as programmed in the codeplug	Always
ESN	The radio’s unique electronic serial number	Always

Table 5-2. Test-Mode Displays (Continued)

Name of Display	Description	Appears
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 radio's operating frequency	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/ Mace with Apps Expansion Board
Option Board Serial Number	Serial number of the Option board is displayed	When the radio has an Option Board/ Mace with Apps Expansion Board
Option Board Bluetooth Addr	Bluetooth Address of the Option board is displayed	When the radio has an Option Board/ Mace with Apps Expansion Board
Option Board SW Version	Software version of the Option Board is displayed	When the radio has an Option Board/ Mace with Apps Expansion Board
Exp Board Type	Type of Expansion Board is displayed	When the radio has an Expansion Board

NOTE: All displays are temporary and will expire without any user intervention. If information is longer than the physical length of the radio's display, the information will wrap around to the next display. After the last display, "**RF TEST**" is displayed.

To freeze any of the displays, 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.

NOTE: Press the **Top Side Button** (Purple button) to advance the test environments from "**RF TEST**", "**CH TEST**", "**RGB 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:
   - 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. Go to Section "5.2.3 Control Top and Keypad Test Mode" on page 1:5-6.

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** (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 "5.2.2 RF Test Mode" below.

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.

5.2.2 RF Test Mode

When the ASTRO APX 6000 radio is operating in its normal environment, the radio's 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, called **RF TEST MODE**.

While in RF test mode:

- Each additional press of **Side Button 2** advances to the next test channel. (Refer to Table 5-3.)
- Pressing **Side Button 1** scrolls through and accesses the test environments shown in Table 5-4.
- Pressing **Top Side Button** scrolls through the Tx Deviation Frequency.

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

Table 5-3. Test Frequencies (MHz)

Test Channel	VHF		UHF1		UHF2		700–800 MHz	
	RX	TX	RX	TX	RX	TX	RX	TX
F1	136.075	136.025	380.075	380.025	450.075	450.025	764.0625	764.0125
F2	142.075	142.125	390.075	390.025	460.075	460.025	769.0625	769.0125
F3	154.275	154.225	400.075	400.025	471.075	471.025	775.9375	775.9875
F4	160.175	160.125	411.075	411.025	484.925	484.975	851.0625	794.0125
F5	168.125	168.075	424.975	424.925	485.075	485.025	860.0625	809.0125
F6	173.925	173.975	435.075	435.025	495.075	495.025	869.9375	823.9875
F7	–	–	445.075	445.025	506.075	506.025	851.0625	851.0125
F8	–	–	457.075	457.025	519.925	519.975	860.0625	860.0125
F9	–	–	469.975	469.925	–	–	869.9375	869.8875

Table 5-4. 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*
USQ	Carrier Unsquelch	RX: unsquelch always TX: mic audio

* *All deviation values are based on deviation tuning of this mode.*

5.2.3 Control Top and Keypad Test Mode

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

5.2.3.1 Control Top Checks

To perform the control top checks:

1. Press and hold the **Top Button** (Orange button); the radio icons are displayed, and the LED lights amber.
2. Release the **Top Button**; “148/0” appears, which indicates that the **Top Button** is in the open position. Your radio is now in the Control Top and Keypad test mode.
3. Press the **Top Button** again; “148/1” appears, which indicates that the **Top Button** is in the closed position.
4. Rotate the **16-Position Select Switch**; “4/0” through “4/15” appears, which indicates that the selector switch is in mode/zone position 1 through 16.
5. Rotate the **Two-Position Concentric Switch**; “65/0” and “65/1” appear.
6. Cycle through the **Three-Position A/B/C Switch**; “67/0,” “67/1,” and “67/2” appear.
7. Rotate the **Volume Control**; “2/0” through “2/255” appear. The display values may vary slightly at the upper and lower limits.
8. Press the **Top Side Button**; “96/1” appears; release, “96/0” appears.
9. Press **Side Button 1**; “97/1” appears; release, “97/0” appears.
10. Press **Side Button 2**; “98/1” appears; release, “98/0” appears.
11. Press the **PTT Button**; “1/1” appears; release, “1/0” appears.

5.2.3.2 Keypad Checks (for Model III only):

To continue to the keypad checks:

- Press , "**48/1**" appears; release, "**48/0**" appears.
- Press , "**49/1**" appears; release, "**49/0**" appears.
- Press , "**50/1**" appears; release, "**50/0**" appears.
- Press , "**51/1**" appears; release, "**51/0**" appears.
- Press , "**52/1**" appears; release, "**52/0**" appears.
- Press , "**53/1**" appears; release, "**53/0**" appears.
- Press , "**54/1**" appears; release, "**54/0**" appears.
- Press , "**55/1**" appears; release, "**55/0**" appears.
- Press , "**56/1**" appears; release, "**56/0**" appears.
- Press , "**57/1**" appears; release, "**57/0**" appears.
- Press , "**58/1**" appears; release, "**58/0**" appears.
- Press , "**59/1**" appears; release, "**59/0**" appears.
- Press , "**128/1**" appears; release, "**128/0**" appears.
- Press , "**129/1**" appears; release, "**129/0**" appears.
- Press , "**130/1**" appears; release, "**130/0**" appears.
- Press , "**131/1**" appears; release, "**131/0**" appears.
- Press , "**132/1**" appears; release, "**132/0**" appears.
- Press , "**133/1**" appears; release, "**133/0**" appears.
- Press , "**134/1**" appears; release, "**134/0**" appears.
- Press , "**135/1**" appears; release, "**135/0**" appears.
- Press , "**136/1**" appears; release, "**136/0**" appears.

5.2.4 RGB Test Mode

To perform the RGB Color Test:

1. Press and release **Top Button** (Orange button)
2. Press any key; Crosstalk test patterns appears.
3. Press any key; White color test appears.
4. Press any key; Red color horizontal lines appears.
5. Press any key until all 13 red color horizontal lines appears.
6. Press any key; Green color vertical line appears.
7. Press any key until all 13 green color vertical lines appears.
8. Press any key; Black color test appears.
9. Press any key; Blue color test appears.
10. Press any key; Vendor specific display test appears.
11. Press any key; "**Test completed**" appears.

5.2.5 CID Test Mode

To perform the CID Test:

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:

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 5-5.

Table 5-5. 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	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
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

Table 5-5. Test-Mode Displays (Continued)

Name of Display	Description	Appears
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 radio's model number, as programmed in the codeplug	Always
Serial number	The radio's serial number, as programmed in the codeplug	Always
ESN	The radio's unique electronic serial number	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 radio's operating frequency	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 Apps Expansion Board
Option Board Serial Number	Serial number of the Option board is displayed	When the radio has an Option Board/ Maze with Apps Expansion Board
Option Board Bluetooth Addr	Bluetooth Address of the Option board is displayed	When the radio has an Option Board/Maze with Apps Expansion Board
Option Board SW Version	Software version of the Option Board is displayed	When the radio has an Option Board/ Maze with Apps Expansion Board
Exp Board Type	Type of Expansion Board is displayed	When the radio has an Expansion Board

NOTE: All displays are temporary and will expire without any user intervention. If information is longer than the physical length of the radio's display, the information will wrap 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:
   - Press the **Top Side Button** to stop the displays and toggle between RF test mode and the Control Top test mode. The test mode menu "**CH TEST**" is displayed, indicating that you have selected the Control Top test mode. Go to Section "5.2.3 Control Top and Keypad Test Mode" on page 1:5-6.

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

   - 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 "5.3.2 RF Test Mode" below.

     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 ASTRO APX 6000 radio is operating in its normal environment, the radio's 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, called **RF TEST MODE**.

While in RF test mode:

- Each additional press of **Side Button 2** advances to the next test channel. (Refer to Table 5-5.)
- Pressing **Side Button 1** scrolls through and accesses the test environments shown in Table 5-4.
- Pressing **Top Side Button** scrolls through the Tx Deviation Frequency.

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

Table 5-6. Test Frequencies (MHz)

Test Channel	VHF		UHF1		UHF2		700–800 MHz	
	RX	TX	RX	TX	RX	TX	RX	TX
F1	136.075	136.025	380.075	380.025	450.075	450.025	764.0625	764.0125
F2	142.075	142.125	390.075	390.025	460.075	460.025	769.0625	769.0125
F3	154.275	154.225	400.075	400.025	471.075	471.025	775.9375	775.9875
F4	160.175	160.125	411.075	411.025	484.925	484.975	851.0625	794.0125
F5	168.125	168.075	424.975	424.925	485.075	485.025	860.0625	809.0125
F6	173.925	173.975	435.075	435.025	495.075	495.025	869.9375	823.9875
F7	–	–	445.075	445.025	506.075	506.025	851.0625	851.0125
F8	–	–	457.075	457.025	519.925	519.975	860.0625	860.0125
F9	–	–	469.975	469.925	–	–	869.9375	869.8875

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

To perform the control top checks:

1. Press and hold the **Top Button** (Orange button); the radio icons are displayed, and the LED lights amber.
2. Release the **Top Button**; "148/0" appears, which indicates that the **Top Button** is in the open position. Your radio is now in the Control Top and Keypad test mode.
3. Press the **Top Button** again; "148/1" appears, which indicates that the **Top Button** is in the closed position.
4. Rotate the **16-Position Select Switch**; "4/0" through "4/15" appears, which indicates that the selector switch is in mode/zone position 1 through 16.
5. Rotate the **Two-Position Concentric Switch**; "65/0" and "65/1" appear.
6. Cycle through the **Three-Position A/B/C Switch**; "67/0," "67/1," and "67/2" appear.
7. Rotate the **Volume Control**; "2/0" through "2/255" appear. The display values may vary slightly at the upper and lower limits.
8. Press the **Top Side Button**; "96/1" appears; release, "96/0" appears.
9. Press **Side Button 1**; "97/1" appears; release, "97/0" appears.
10. Press **Side Button 2**; "98/1" appears; release, "98/0" appears.
11. Press the **PTT Button**; "1/1" appears; release, "1/0" appears.

5.3.4 CID Test Mode

To perform the CID Test:

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 Receiver Performance Checks

The following tables outline the performance checks for the receiver.

Table 5-7. Receiver Performance Checks

Test Name	System Analyzer	Radio	Test Set	Comments
Reference Frequency	**RF Control:** Analyzer **Meter:** RF Display/ Frequency Offset **Freq:** Selected radio TX frequency	TEST MODE CSQ channel* or programmed conventional channel	**PTT** to continuous (during the performance check)	**VHF:** ±0.8 ppm (±227 Hz) **UHF1:** ±0.8 ppm (±289 Hz) **UHF2:** ±0.8 ppm (±329 Hz) **700-800 MHz:** ±0.8 ppm (±709 Hz)
Rated Audio	**RF Control:** Generator **Output Level:** -47 dBm **Freq:** Selected radio RX frequency **Mod:** 1 kHz tone @ 1.5 kHz deviation** **Meter:** RF Display/Audio Level	As above	**PTT** to OFF (center) **Load Selector:** A	Set volume control to 3.74 Vrms
Distortion	As above, except **Meter:** RF Display/AF Meter Distn	As above	As above	Distortion < 3.0%
Sensitivity (SINAD)	As above, except **Meter:** RF Display/AF Meter SINAD **RF Output Level:** Adjust untill SINAD = 12 dB	As above	As above	RF input to be < 0.35 µV
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.

* *See Table 5-4 on page 1:5-6.*

** *1 kHz tone @ 1.5 kHz deviation for 12.5 kHz ChSp, OR 3 kHz deviation for 25 kHz ChSp*

*Table 5-8. 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 Figure 6-1 on page 1:6-1)
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 Figure 6-1 on page 1:6-1)
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 **Meter:** Audio Distortion	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%
Residual Audio Noise Ratio	**Mode:** P25 **RF Control:** TX **Output Level:** -47 dBm **P25 Set:** Phase 1 C4FM **Pattern:** A)STD 1011 B) STD Silence **Frequency:** Selected radio RX frequency **Meter:** Audio Distortion	As above	As above	Residual Audio Noise Ratio -45 dB

* *These tests require a communications system analyzer with the ASTRO 25 test options.*

5.5 Transmitter Performance Checks

The following tables outline the performance checks for the transmitter.

Table 5-9. Transmitter Performance Checks – APX 5000/ APX 6000/ APX 6000Li

Test Name	System Analyzer	Radio	Test Set	Comments
Reference Frequency	**RF Control:** Analyzer **Meter:** RF Display/ Frequency Offset **Frequency:** Selected radio TX frequency	TEST MODE CSQ channel* or programmed conventional channel	**PTT** to continuous (during the performance check).	**VHF:** ±0.8 ppm (±140 Hz) **UHF1:** ±0.8 ppm (±376 Hz) **UHF2:** ±0.8 ppm (±416 Hz) **700–800 MHz:** ±0.8 ppm (±696 Hz)

Table 5-9. Transmitter Performance Checks – APX 5000/ APX 6000/ APX 6000Li (Continued)

Test Name	System Analyzer	Radio	Test Set	Comments
RF Power	As above except, **Meter:** RF Display/ Broadband Power	As above	As above	**VHF:** 1–6 Watts **UHF1**: 1–5 Watt **UHF2**: 1–5 Watt **700**: 1–2.7 Watt **800**: 1–3 Watt
Voice Modulation (external)	As above except, **Meter:** RF Display/FM Dev. Set Audio generator to fixed 1 kHz and audio level to 400 mV.	As above	As above	Deviation: (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 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 filter enabled	Conventional coded squelch personality (clear mode operation) or TPL channel (test mode*)	**PTT** to continuous (during the performance check)	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

* *See Table 5-4 on page 1:5-6.*

*Table 5-10. Transmitter Tests for ASTRO Conventional Channels – APX 5000/ APX 6000/ APX 6000Li**

Test Name	System Analyzer	Radio	Test Set	Comments
RF Power	**Mode:** P25 **RF Control:** RX **P25 Set:** Phase 1 C4FM **Frequency:** Selected radio TX frequency **Meter:** UUT Measurements/ Broadband Power	Radio Tuner Software not used. **Radio:** Out of TEST MODE; Select a conventional ASTRO channel	**PTT** to continuous (during measurement).	**VHF:** 1–6 Watts **UHF1**: 1–5 Watt **UHF2**: 1–5 Watt **700**: 1–2.7 Watt **800**: 1–3 Watt

Table 5-10. Transmitter Tests for ASTRO Conventional Channels – APX 5000/ APX 6000/ APX 6000Li (Con-*

Test Name	System Analyzer	Radio	Test Set	Comments
Frequency Error	**Mode:** P25 **RF Control:** RX **P25 Set:** Phase 1 C4FM **Frequency:** 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 **Frequency:** 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 Figure 6-1 on page 1:6-1)

* *These tests require a communications system analyzer with the ASTRO 25 test options.*

Notes

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 Figure 6-1.

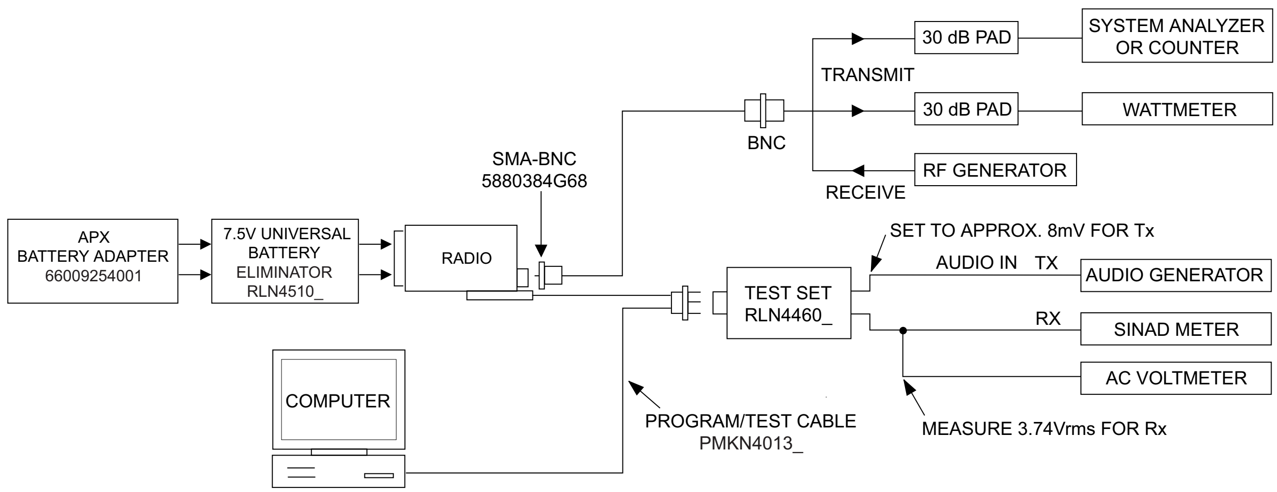

Figure 6-1. Radio Alignment Test Setup

Caution	These radio alignment procedures should only be attempted by qualified service personnel. Failure to perform alignment procedures properly may result in seriously degraded radio or system performance.

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, use the F**ile › Read Device** menu or click on Read Device. Figure 6-2 illustrates how the alignment screens are organized. To access a screen, double-click on the desired screen name in the **Tuner** menu.

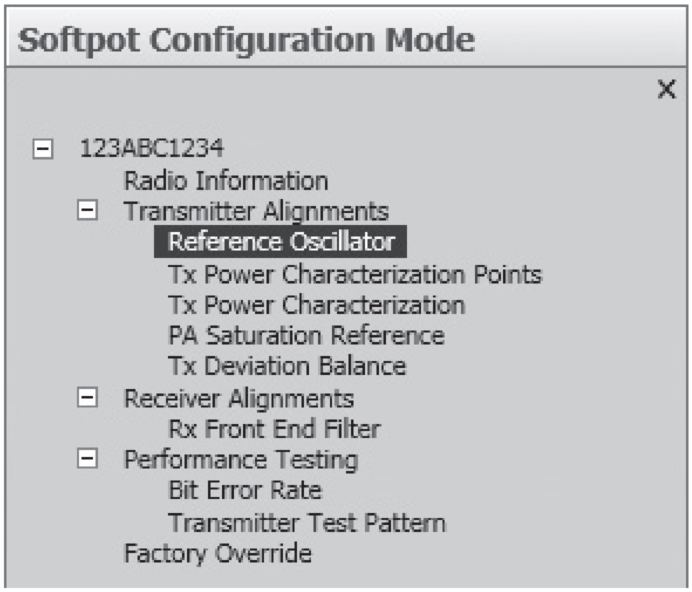

Figure 6-2. Tuner Software Main Menu

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

6.3 Softpot

The alignment screens introduce the concept of the “softpot,” an analog **SOFT**ware-controlled **POT**entiometer 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 6-3.

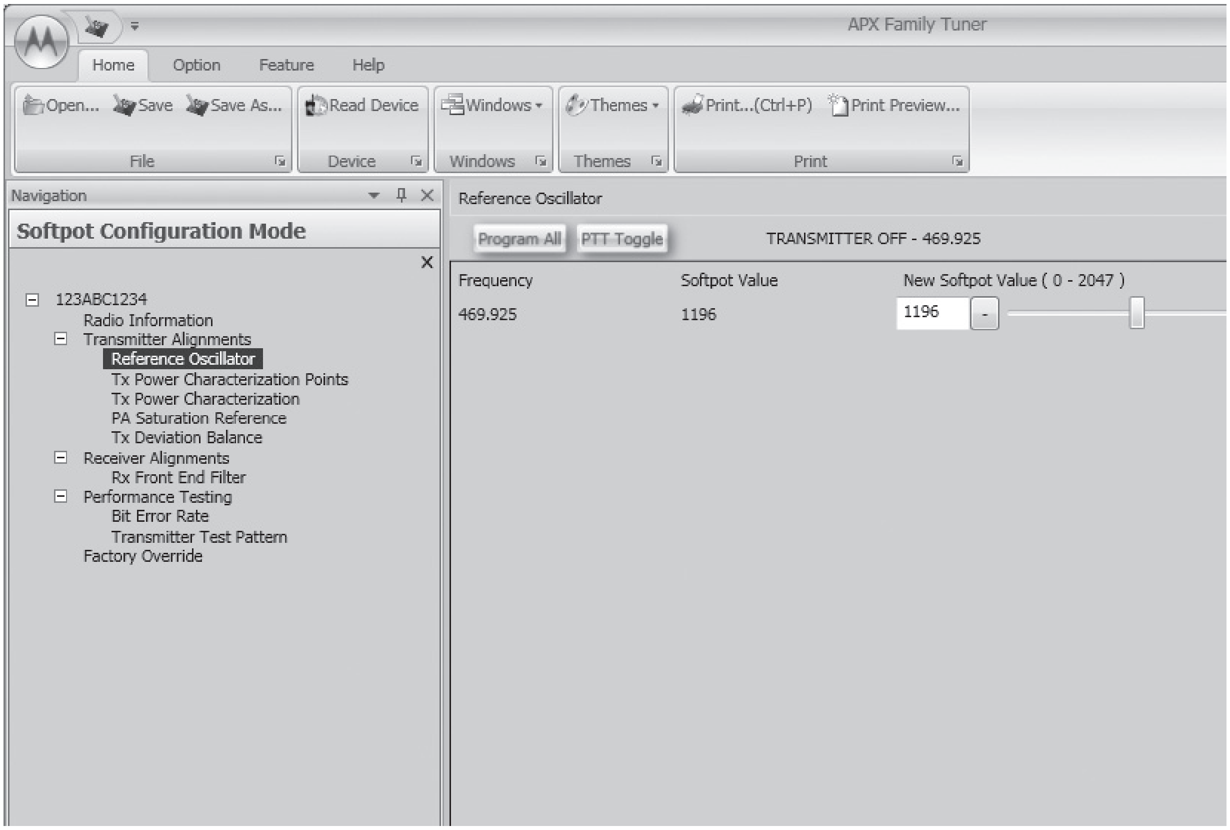

Figure 6-3. Typical Softpot Screen

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 radio's 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.

Perform the following procedures in the sequence indicated.

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

Caution	When keying the radio during a test, <u>always</u> transmit into a dummy load.

6.4 Radio Information

Figure 6-4 shows a typical Radio Information screen. This screen is informational only and cannot be directly changed.

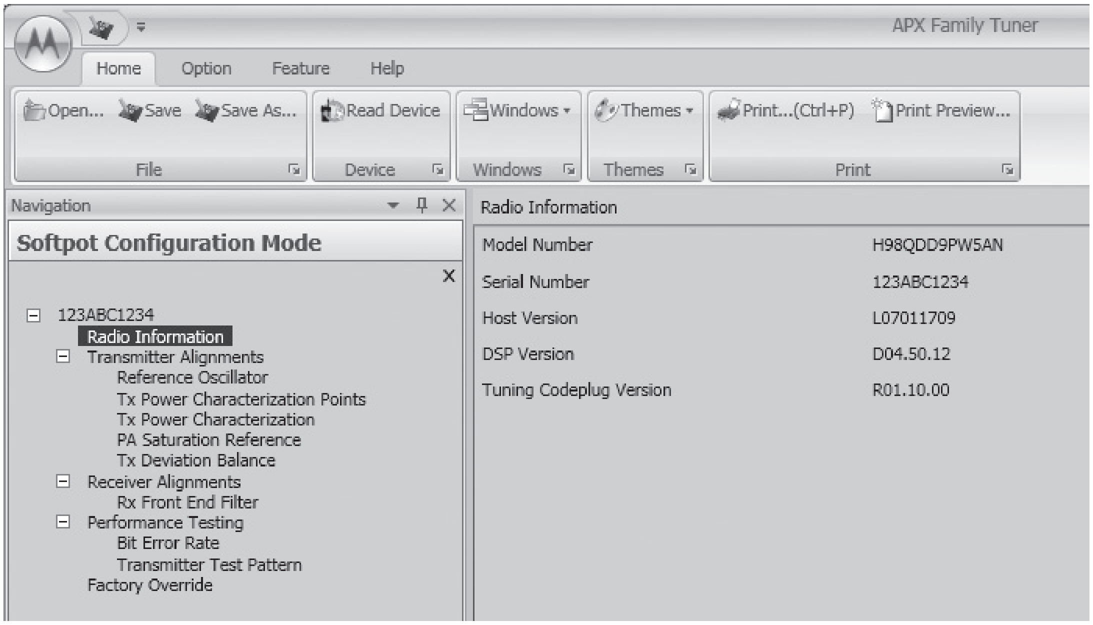

Figure 6-4. Radio Information Screen

6.5 Transmitter Alignments

6.5.1 Reference Oscillator Alignment

Adjustment of the reference oscillator is critical for proper radio operation. Improper adjustment will result not only in poor operation, but also in a misaligned radio that will interfere with other users operating on adjacent channels. For this reason, the reference oscillator should be checked every time the radio is serviced, or once a year, whichever comes first. The frequency counter used for this procedure must have a stability of 0.1 ppm (or better). 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.

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

This test can be done with a Communication Analyzer or Modulation Analyzer.

- Initial setup using the Communication Analyzer:
  - RF Control: Analyzer or RX
  - B/W: WB
  - Freq: CPS frequency under test
  - Attenuation: 20dB (optional)
  - Mon RF in: RF I/O
  - Meter: Frequency Counter or Offset
  - Mode: Analog or P25 STD
- Initial setup using the 8901_ Series Modulation Analyzer:
  - Press the green Automatic Operation button on the analyzer.
  - Press the FREQ key.
  - Type 7.1 followed by SPCL button to set the 8901B_ modulation analyzer for maximum accuracy.

To align the reference oscillator:

Select the **Reference Oscillator** alignment screen. See Figure 6-5 to Figure 6-8.

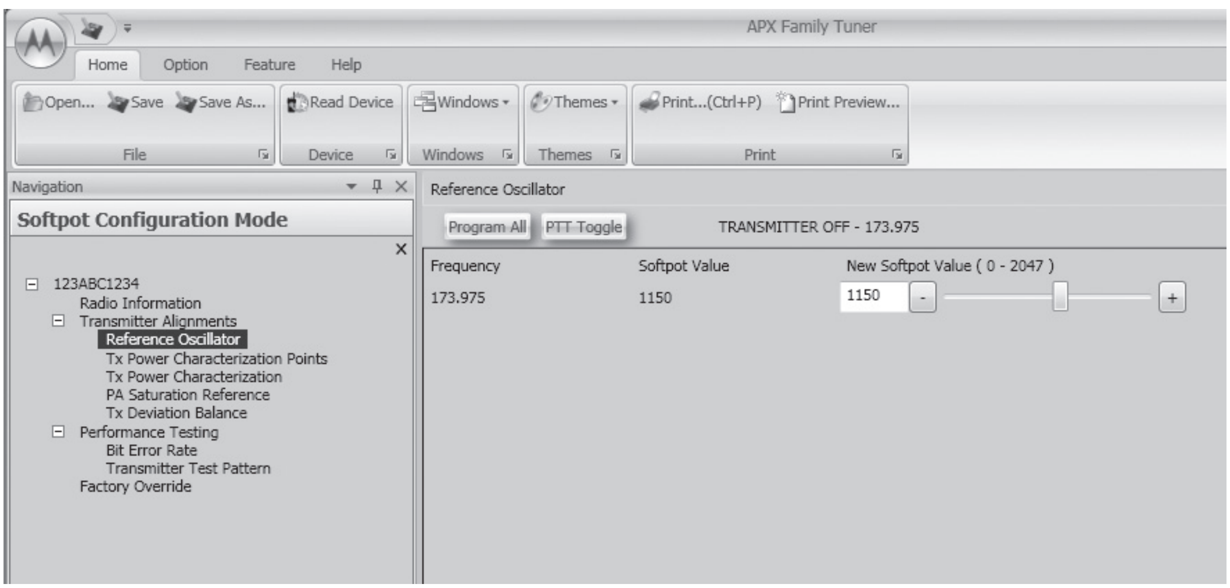

Figure 6-5. Reference Oscillator Alignment Screen (VHF)

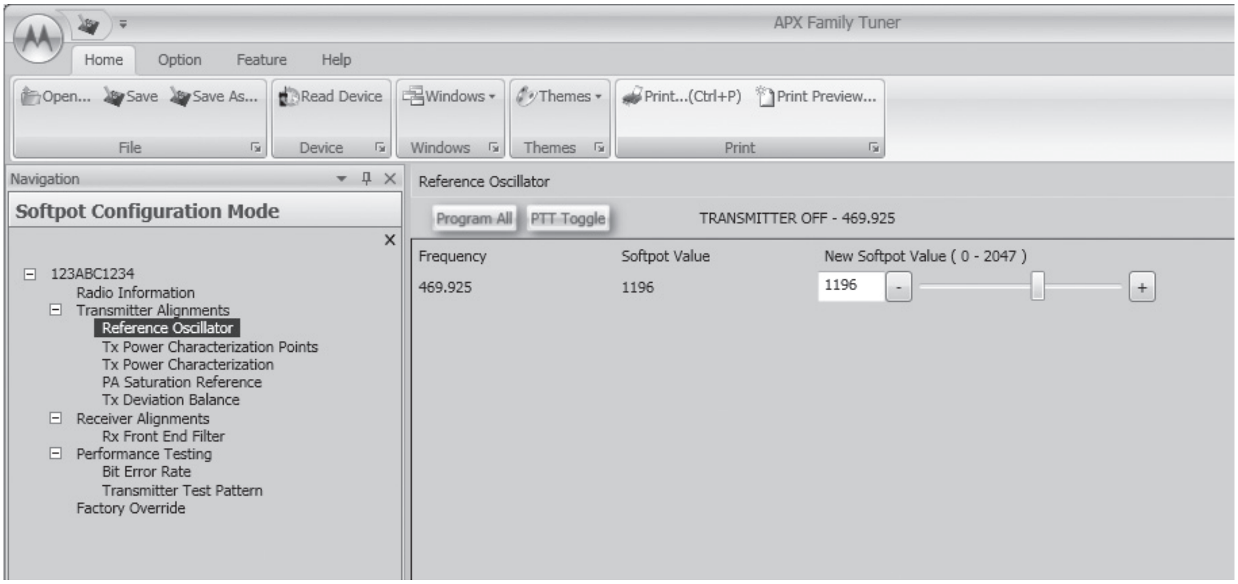

Figure 6-6. Reference Oscillator Alignment Screen (UHF1)

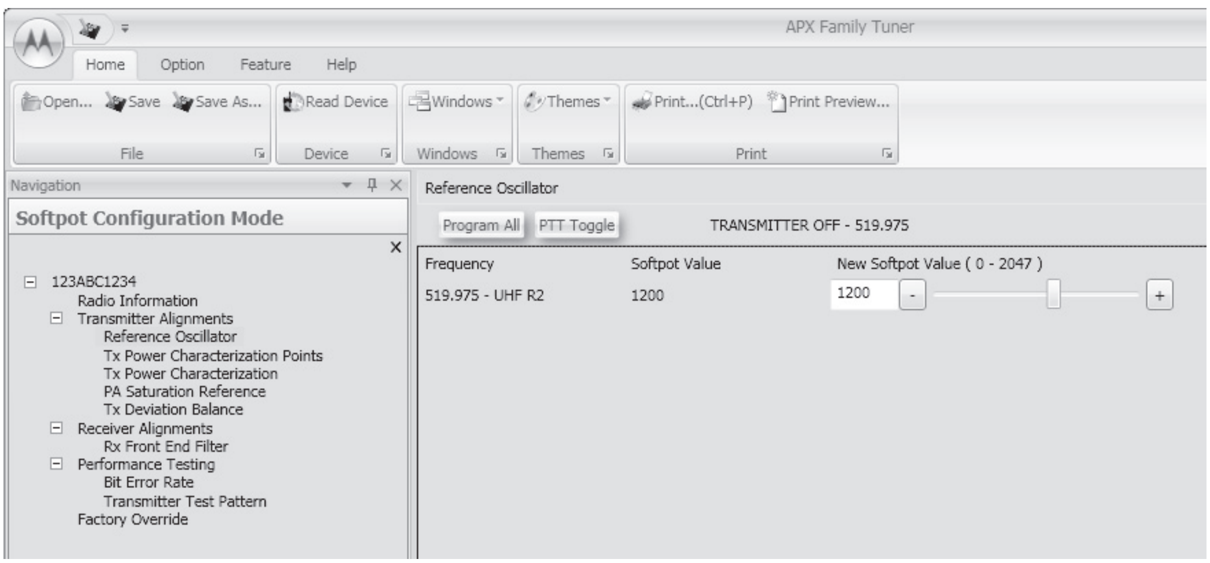

Figure 6-7. Reference Oscillator Alignment Screen (UHF2)

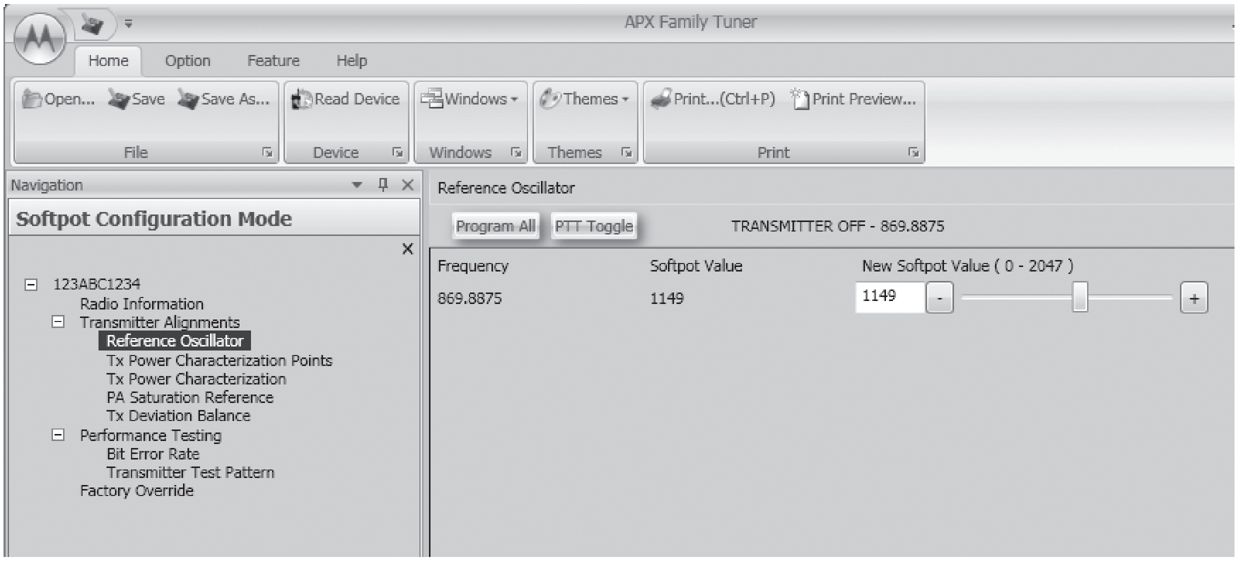

Figure 6-8. Reference Oscillator Alignment Screen (700/800 MHz)

1. Make sure the Communication Analyzer is in **Manual** mode.

2. Set the base frequency to:

Table 6-1. Base Frequencies

VHF	UHF1	UHF2	700/800
173.975 MHz	469.925 MHz	519.975 MHz	869.8875 MHz

3. Adjust the reference oscillator's softpot value with the slider until the measured value is as close as possible to the frequency shown on the screen. See Table 6-2.

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

Table 6-2. Reference Oscillator Alignment

Band	Target
VHF	±50 Hz
UHF1	±50 Hz
UHF2	±50 Hz
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.

6.5.2 Transmit Power Characterization Points

Tuning of the radio is done through **Power Characterization Points** tuning screen.

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

NOTE:

a. The longer the RF cable, the more the attenuation of the power reading.

b. Ensure that the system is calibrated for cable loss.

c. Use a standard 50 ohm cable

d. Apply best practices for the equipment being used.

1. Select the **TX Power Characterization Points** alignment screen. See Figure 6-9 to Figure 6-12.
2. Set power supply voltage and current limit.
3. Adjust softpot value by manipulating the slider bar, incrementing the "New Softpot Value" text box, or directly entering the desired value into the "New Softpot Value" 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 the steps 2 and 3 for all frequencies.
5. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.

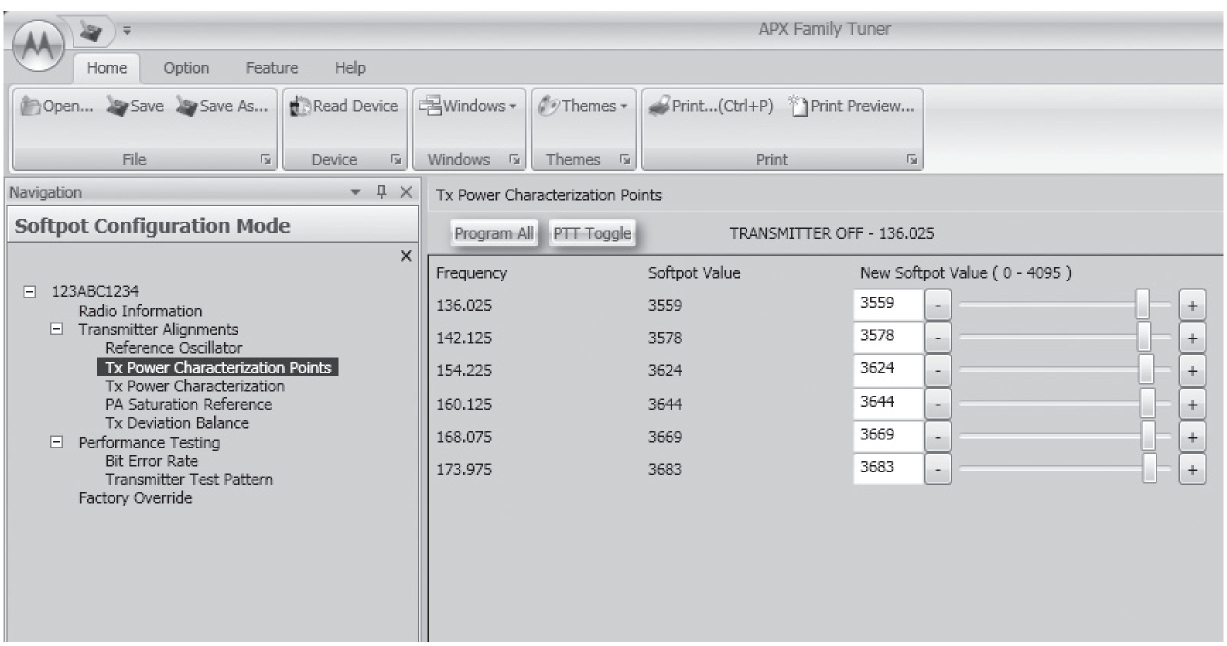

Figure 6-9. Transmit Power Characterization Points Alignment Screen (VHF)

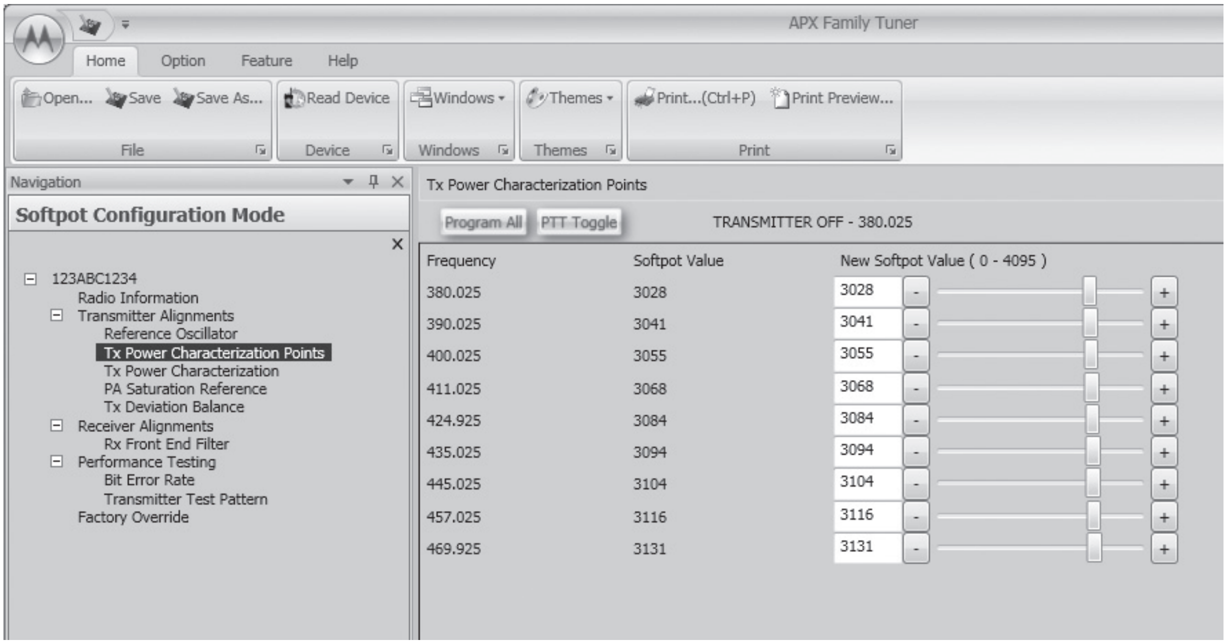

Figure 6-10. Transmit Power Characterization Points Alignment Screen (UHF1)

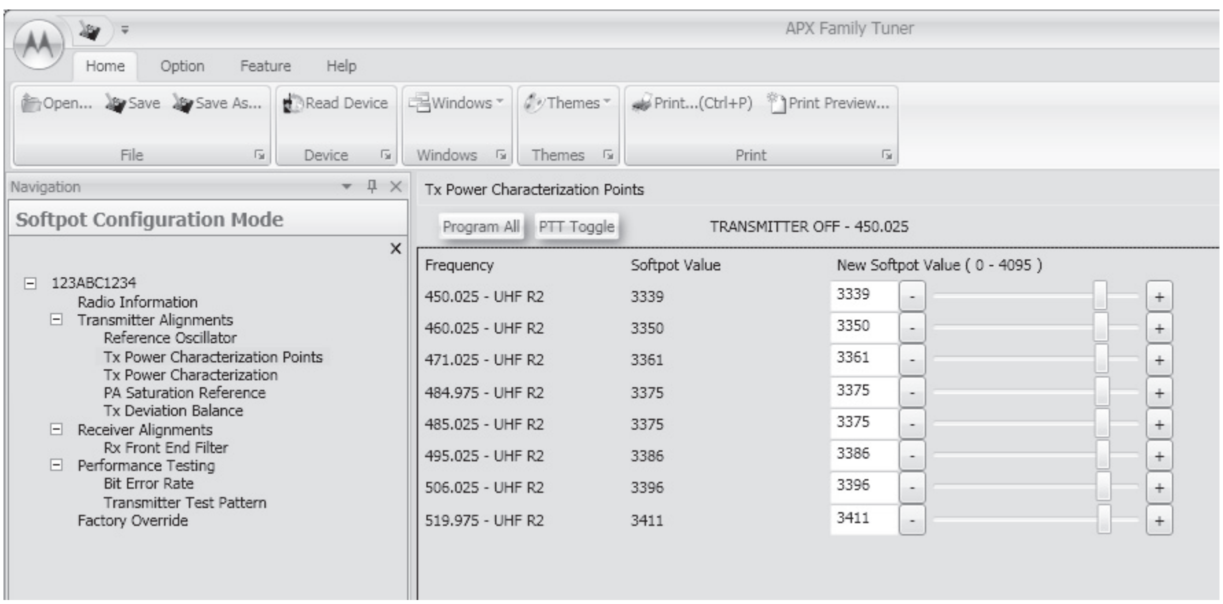

Figure 6-11. Transmit Power Characterization Points Alignment Screen (UHF2)

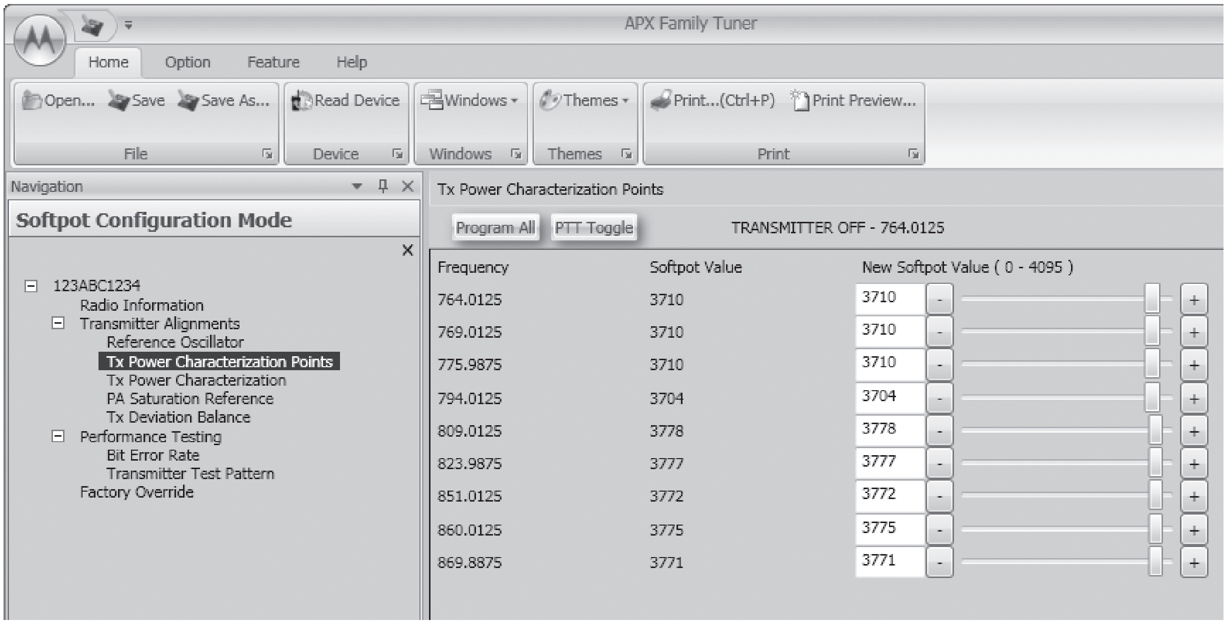

Figure 6-12. Transmit Power Characterization Points Alignment Screen (700/800MHz)

6.5.3 Power Characterization Tuning

Tuning of the radio is done through **Power Characterization** tuning screen.

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

NOTE: **a.**The longer the RF cable, the more the attenuation of the power reading.
b.Ensure that the system is calibrated for cable loss.
c.Use a standard 50 ohm cable
d.Apply best practices for the equipment being used.

1. Select the **TX Power Characterization** alignment screen. The screen indicates the transmit power to be used. See Figure 6-13 to Figure 6-16.
2. Left-click the box under “Measure Power 1” for the desired frequency field. (The selected box is highlighted).
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 highlighted “Measure Power 1” box.
6. Left-click the box under “Measure Power 2” box for the same frequency field. (The selected box is highlighted).
7. Measure the transmit power of the radio with a service monitor.
8. Input the transmit power in watts using two decimal places into the highlighted “Measure Power 2” box.
9. Repeat steps 2 to 8 for all frequencies.
10. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.

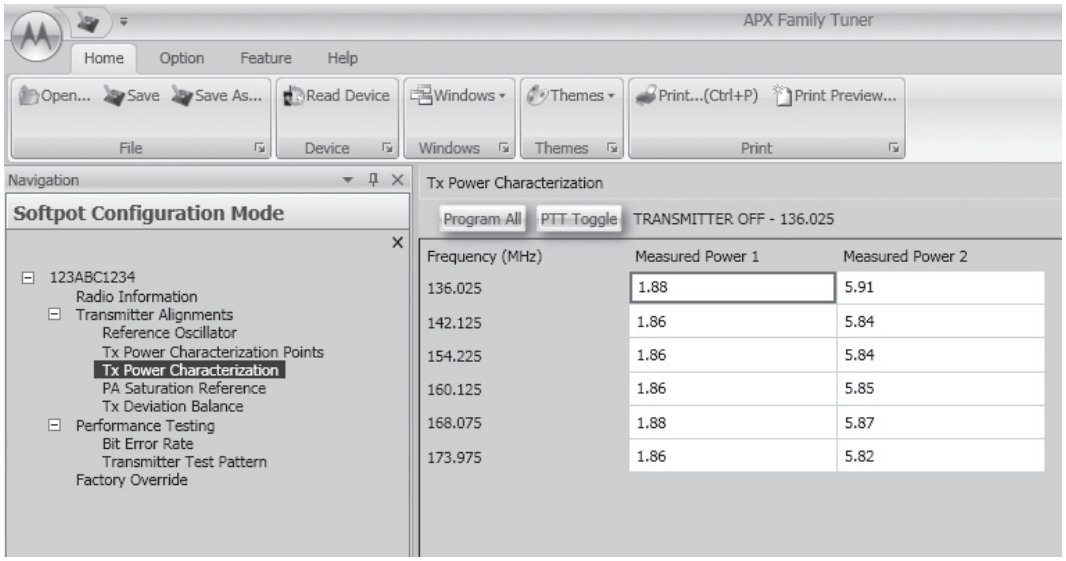

Figure 6-13. Transmit Power Characterization Alignment Screen (VHF)

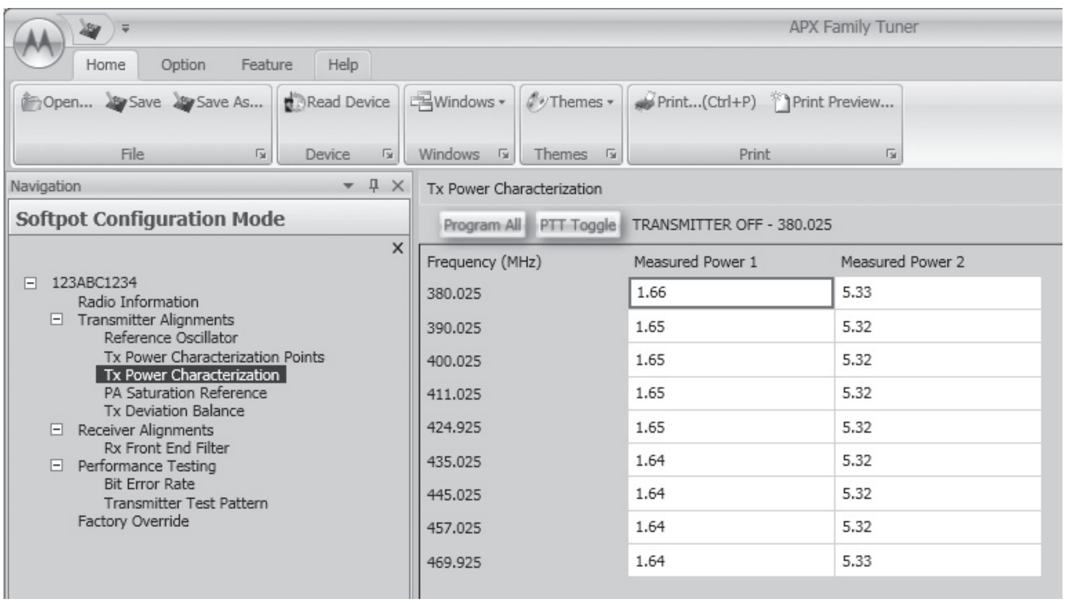

Figure 6-14. Transmit Power Characterization Alignment Screen (UHF1)

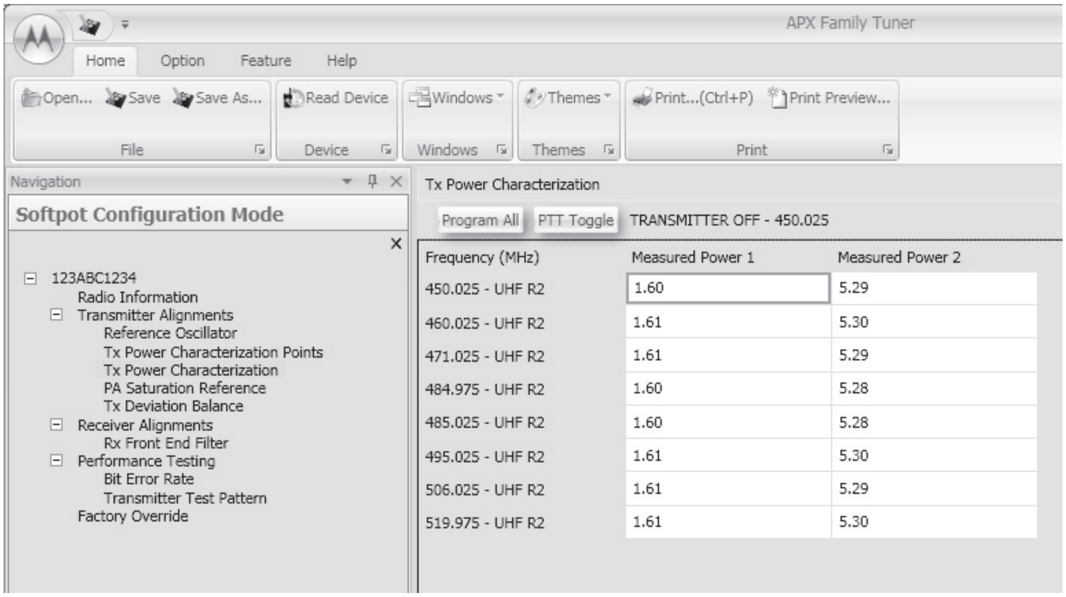

Figure 6-15. Transmit Power Characterization Alignment Screen (UHF2)

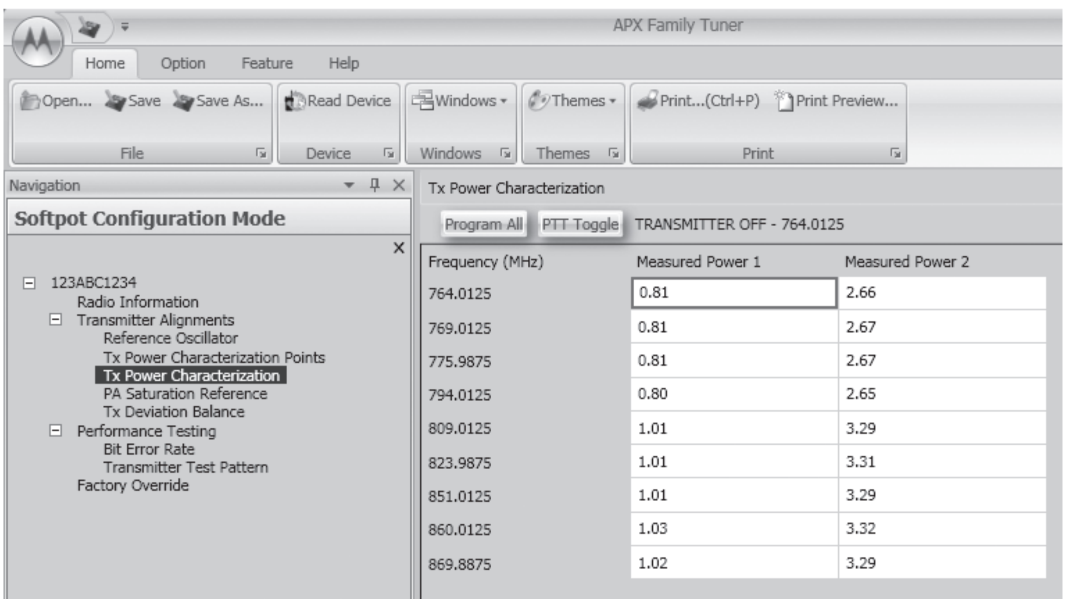

Figure 6-16. Transmit Power Characterization Alignment Screen (700/800 MHz)

6.5.4 PA Saturation Reference Tuning

Tuning is done through **PA Saturation Referencing** screen.

1. Select the **PA Saturation Reference** alignment screen. The screen indicates the transmit frequencies to be used. See Figure 6-17 to Figure 6-20.
2. In Manual Mode, set the service monitor to the desired frequency (as shown in the frequency list in the PA Saturation Reference alignment screen).
3. Adjust the PA Saturation Reference softpot value with the slider until the radio transmits as close as possible to the rated power. For rated power refer to the help text in the Tuner.
4. Left-click the slider of the frequency selected (should be the same frequency as step 2).
5. Left-click the **PTT Toggle** button on the screen to make the radio transmit. The screen indicates whether the radio is transmitting.
6. Repeat the steps 2 to 5 for all frequencies.
7. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.

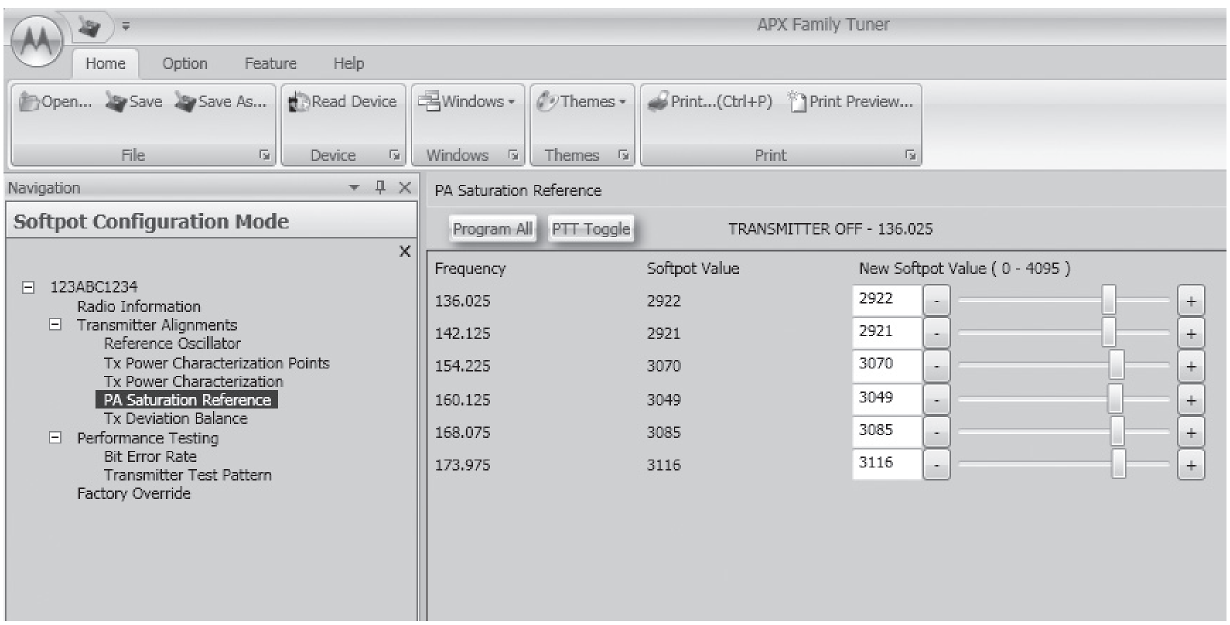

Figure 6-17. PA Saturation Referencing Alignment Screen (VHF)

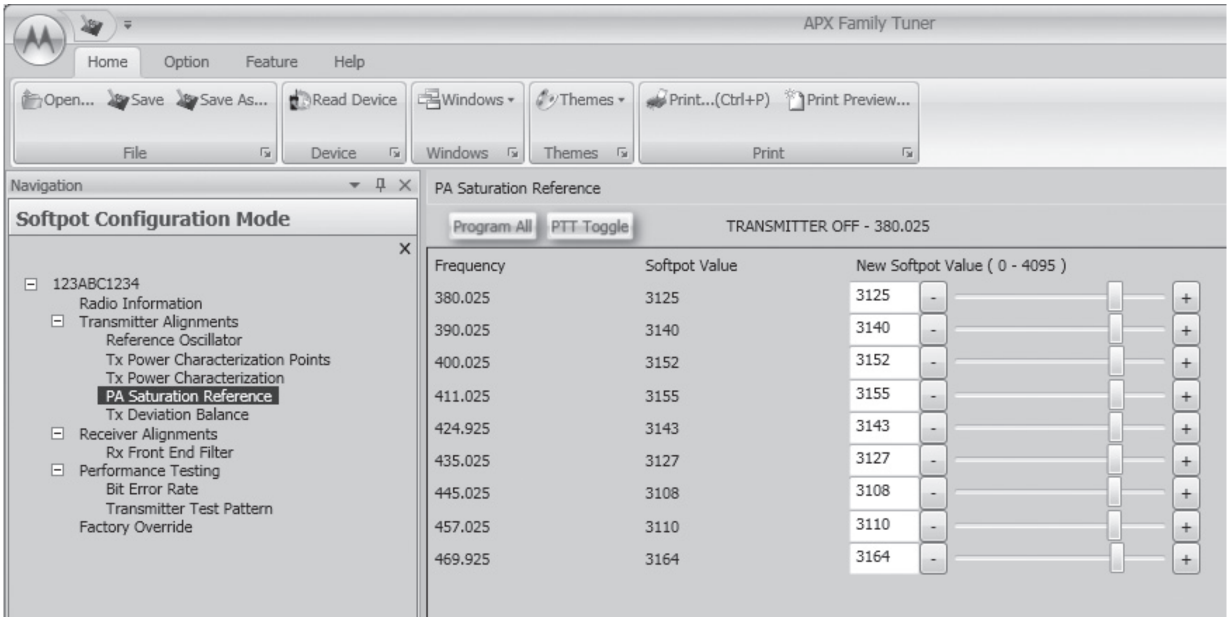

Figure 6-18. PA Saturation Referencing Alignment Screen (UHF1)

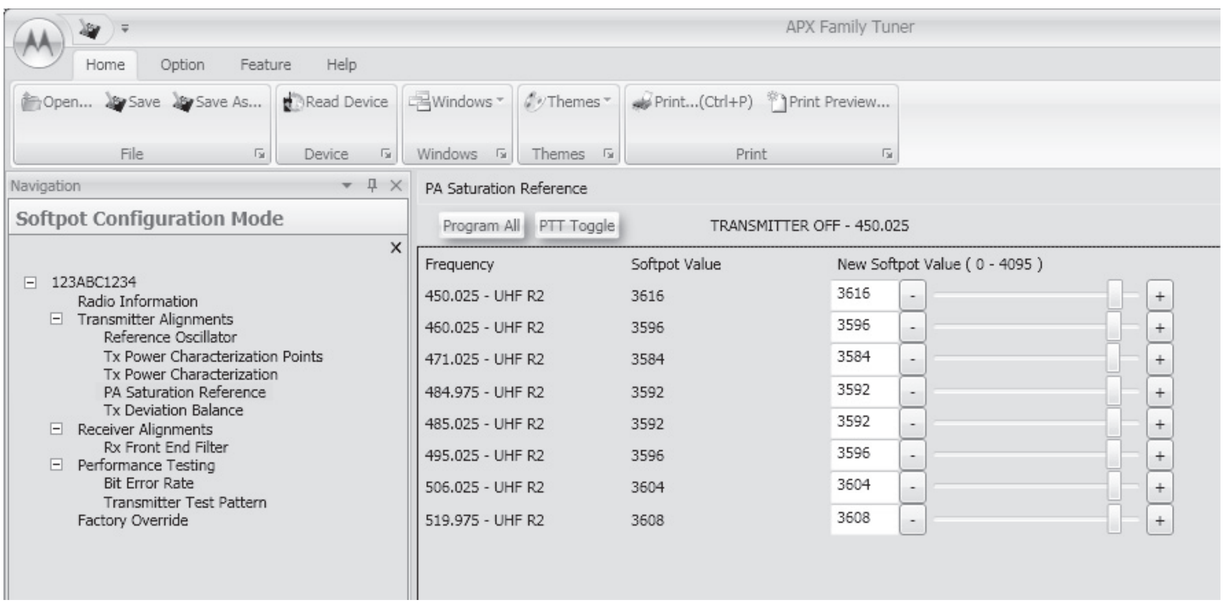

Figure 6-19. PA Saturation Referencing Alignment Screen (UHF2)

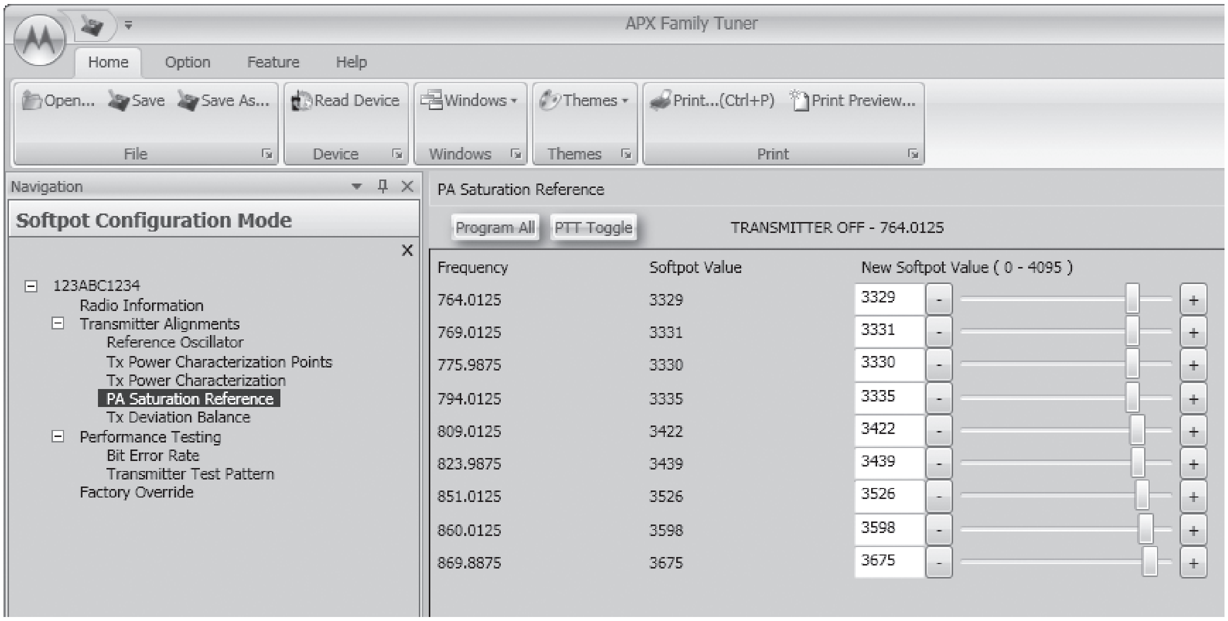

Figure 6-20. PA Saturation Referencing Alignment Screen (700/800 MHz)

6.5.5 Transmit Deviation Balance Alignment

This alignment procedure balances the modulation contributions of the low- and high-frequency portions of a baseband signal. Proper alignment is critical to the operation of signalling 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 alignment can be done with either Communication Analyzer or Modulation Analyzer.

1. Initial setup using the Communication Analyzer:
   - **Mode:** P25 Analog Mode 15Khz LP filter enabled
   - **RF Control:** P25 RX
   - **Meter:** FM Deviation
   - **Frequency:** Selected radio TX frequency
2. Initial setup using a Modulation Analyzer such as the 8901_ Series Modulation Analyzer:
   - Press the **FM MEASUREMENT** button. (The "*Error 0input level too low*" indication is normal until an input signal is applied.)
   - Simultaneously press the **Peak –** and **Peak +** buttons. Both LEDs on the buttons should light.

- Press the 15 kHz LP filter key.

3. Select the **TX Deviation Balance** alignment screen. The screen indicates the transmit frequencies to be used. See Figure 6-21 and Figure 6-24.
4. In the "RF Control" section, 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 analyzer.
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 the steps 4 to 10 for all frequencies.
13. Left-click the **Program All** button on the screen to de-key the radio and save the tuned values.

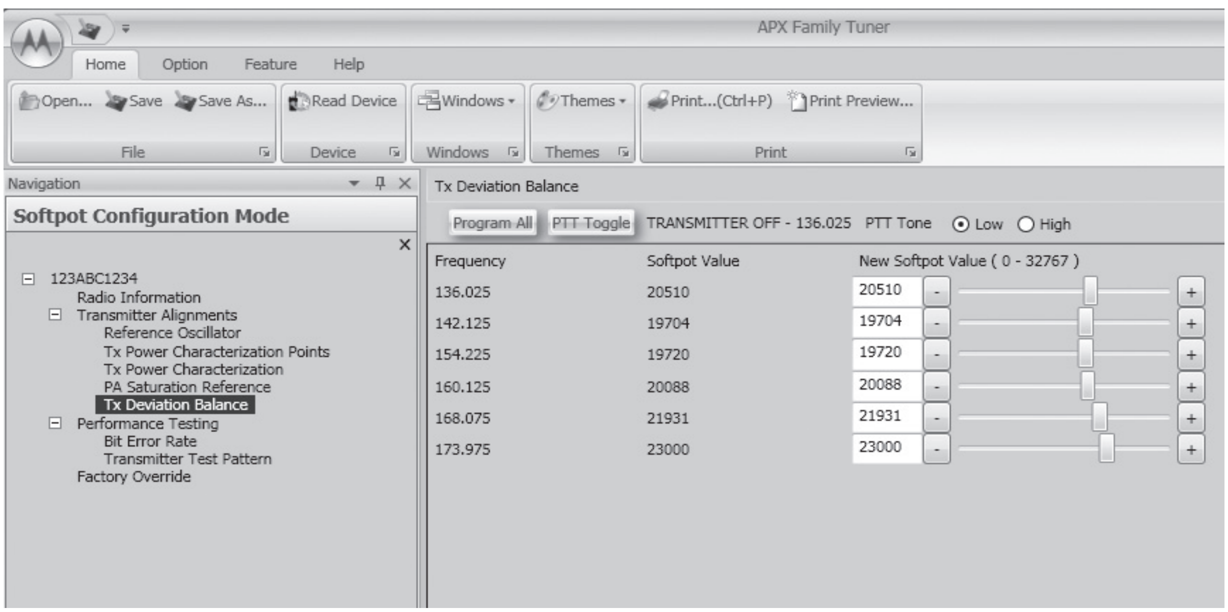

Figure 6-21. Transmit Deviation Balance Alignment Screen (VHF)

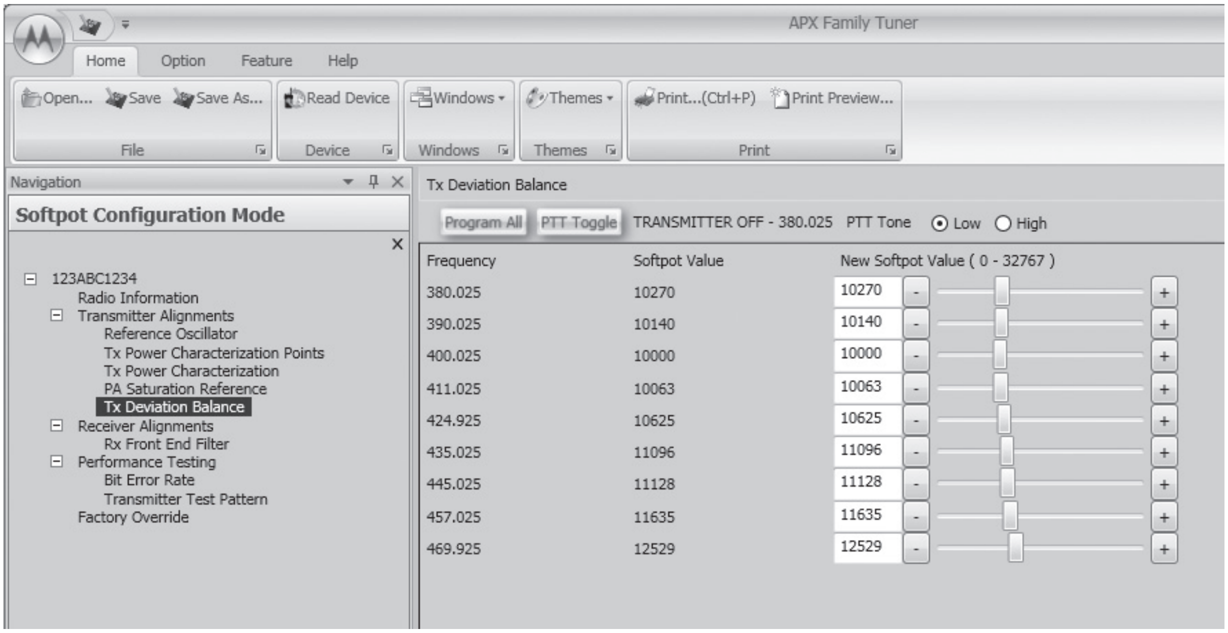

Figure 6-22. Transmit Deviation Balance Alignment Screen (UHF1)

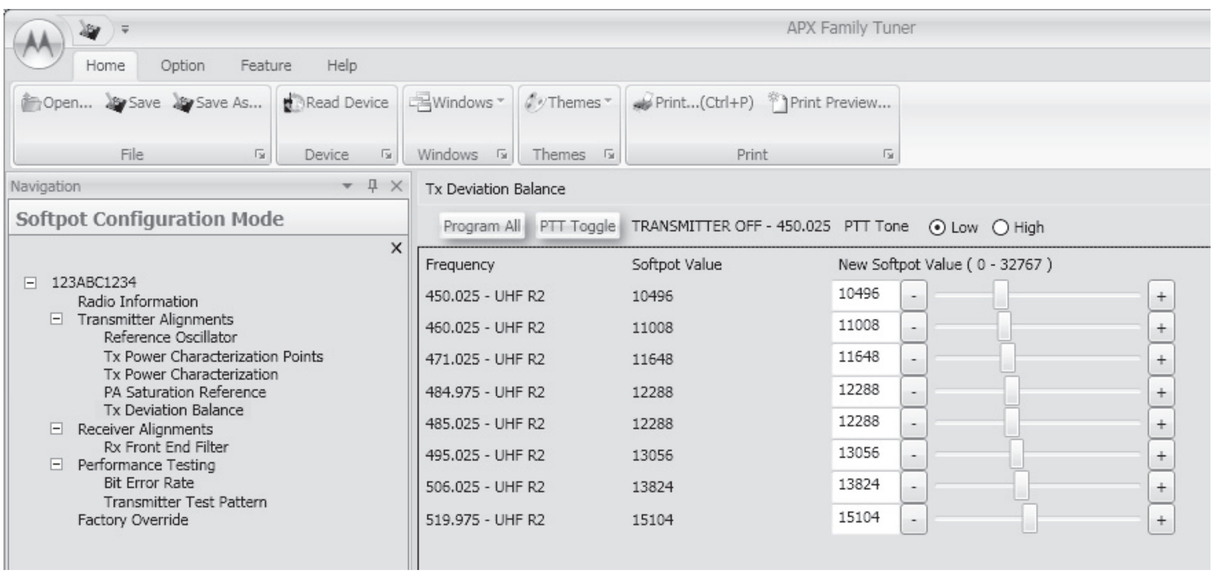

Figure 6-23. Transmit Deviation Balance Alignment Screen (UHF2)

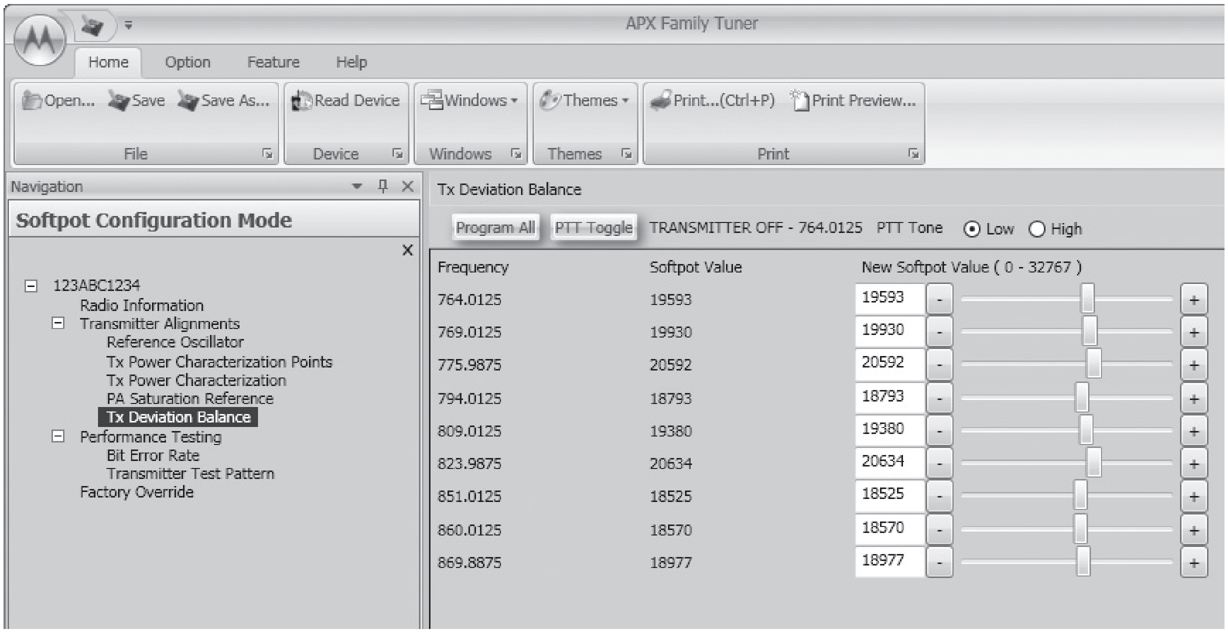

Figure 6-24. Transmit Deviation Balance Alignment Screen (700/800 MHz)

14. Left-click the **PTT Tone: High** button.
15. 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.
16. Left-click the **PTT Toggle** to de-key the radio.
17. Repeat the steps 4 to 10 for all frequencies.
18. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.

6.6 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 6-25 and Figure 6-26).

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

6.6.1 Procedure for UHF Range 1 and UHF Range 2 (Auto Tune)

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

1. Select the **Rx Front End Filter** alignment screen. See Figure 6-25 and Figure 6-26.
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 the steps 2–4 for all frequencies.
6. Left-click the **Program All** button on the screen to save the tuned values in the radio.

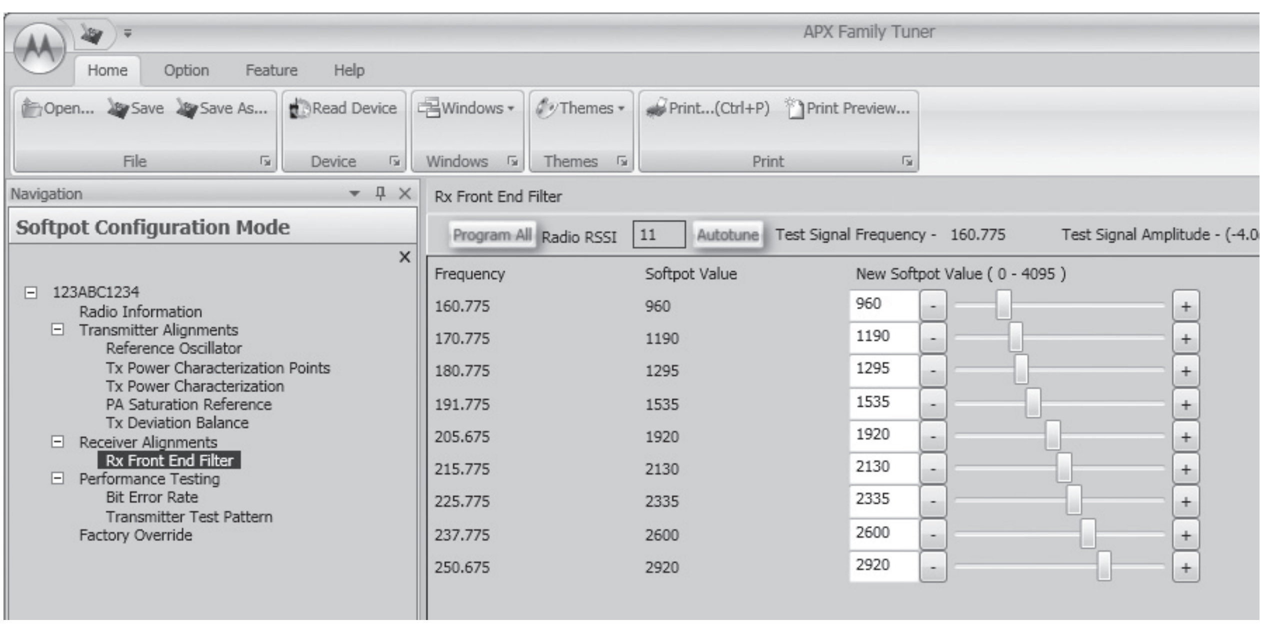

Figure 6-25. Front End Filter Alignment Screen (UHF1)

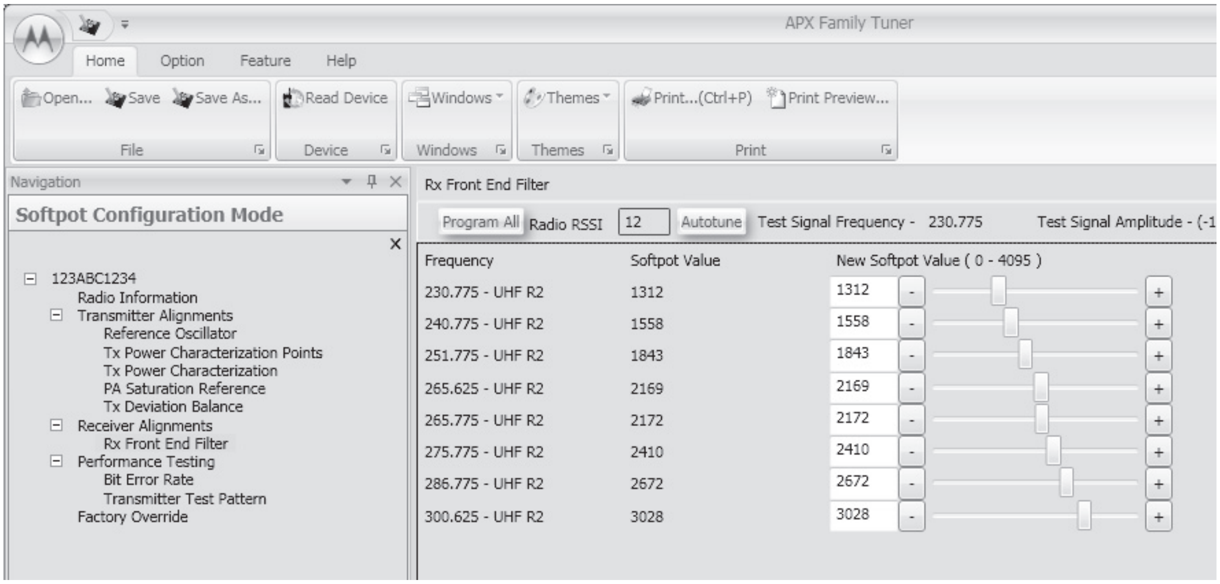

Figure 6-26. Front End Filter Alignment Screen (UHF2)

6.7 Performance Testing

6.7.1 Bit Error Rate

This section describes the Bit Error Rate (BER) test of the radio's receiver at a desired frequency (see Figure 6-27 to Figure 6-30).

6.7.1.1 Bit Error Rate Fields

Set up the Communication Analyzer as follows:

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:

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

The bit error rate screen contains the following fields:

- **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 and Standard Interface Test Pattern (CCITT V.52).
- **Modulation Type**:
  This field represents the digital modulation type of the incoming signal on which BER is to be calculated.
- **Continuous Operation**:
  This field allows the user the option to repeat the BER test indefinitely. A selection of Yes will cause the radio to calculate BER on a continuous basis and update the results on this screen after each integration time. A selection of No will cause the BER test to execute for only one sample of the integration time and then update the display.
- **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.

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

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

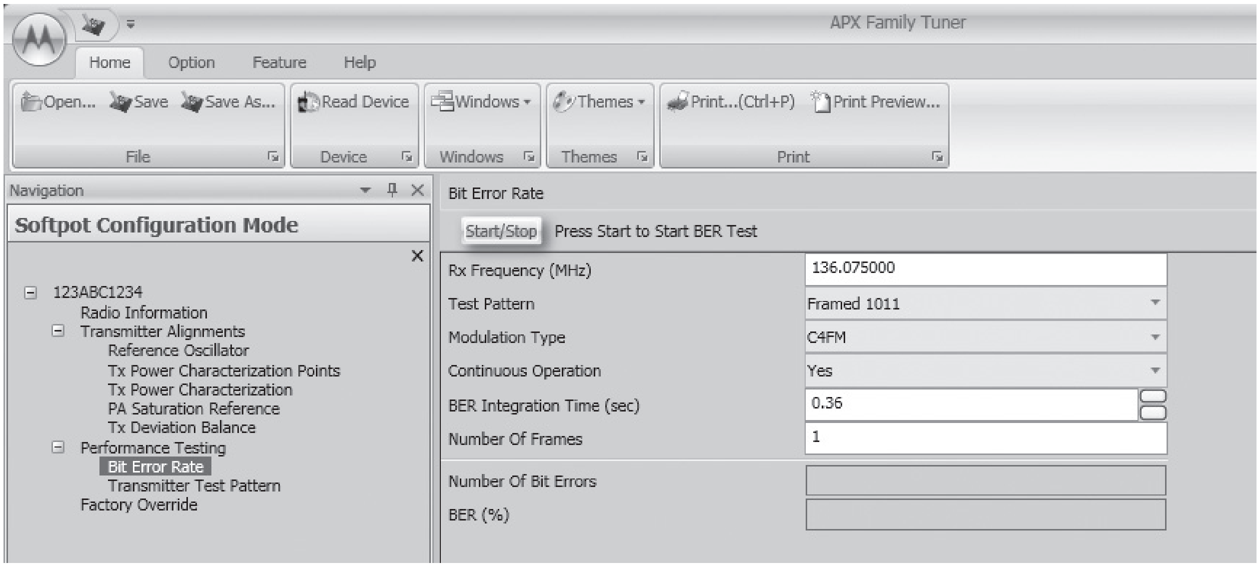

Figure 6-27. Bit Error Rate Screen (VHF)

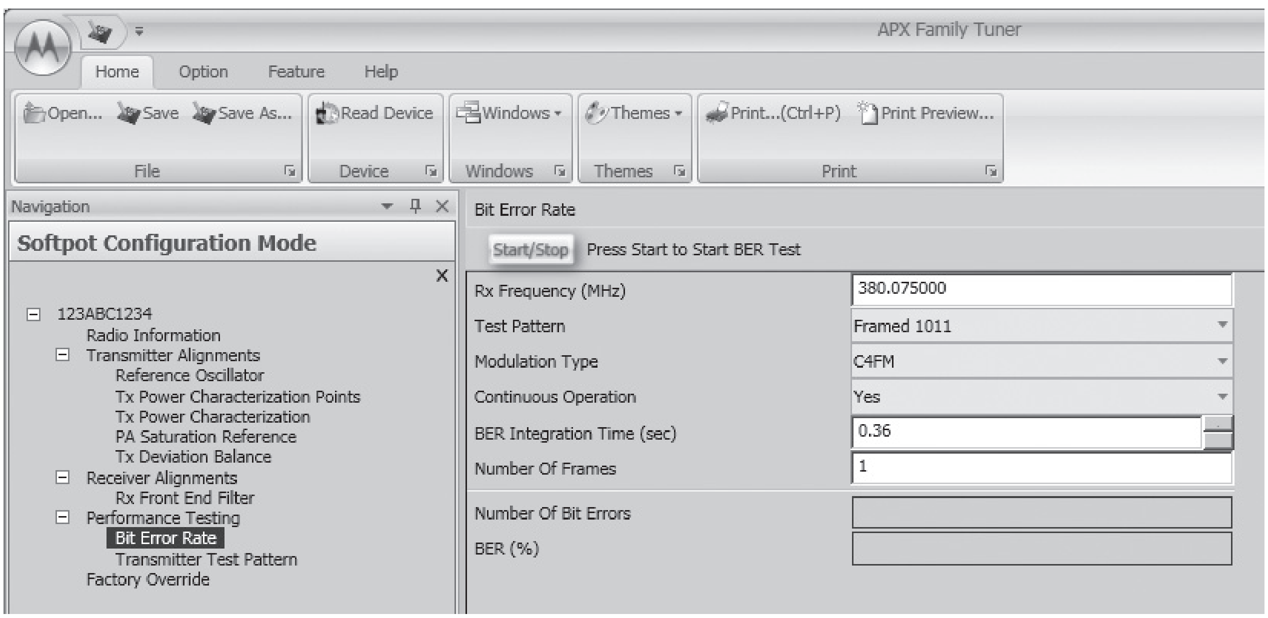

Figure 6-28. Bit Error Rate Screen (UHF1)

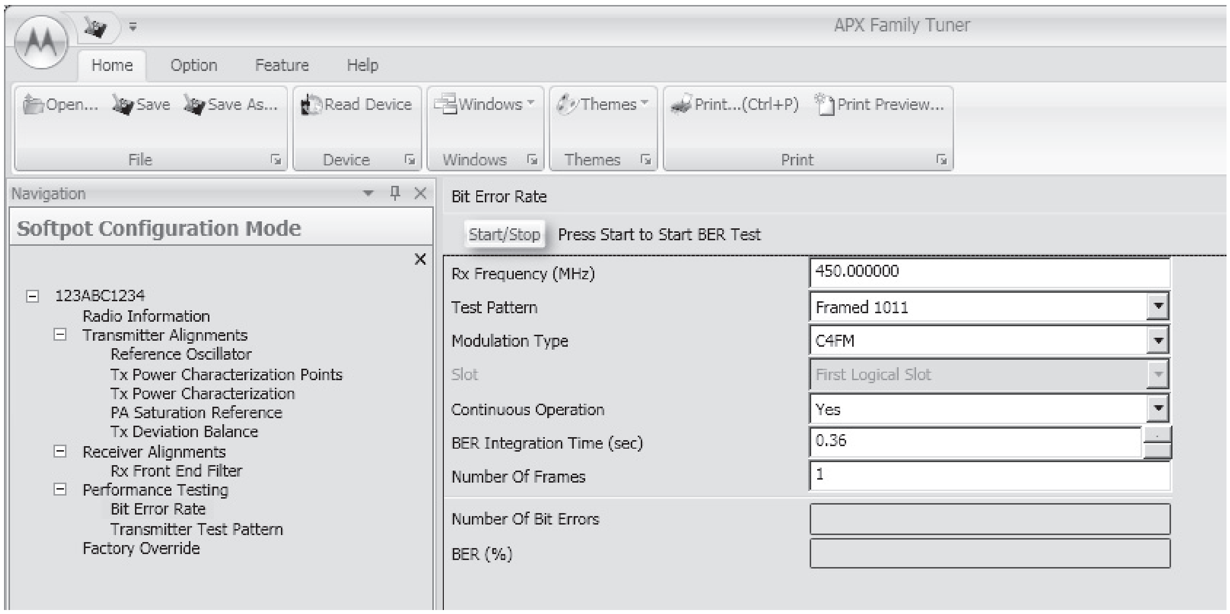

Figure 6-29. Bit Error Rate Screen (UHF2)

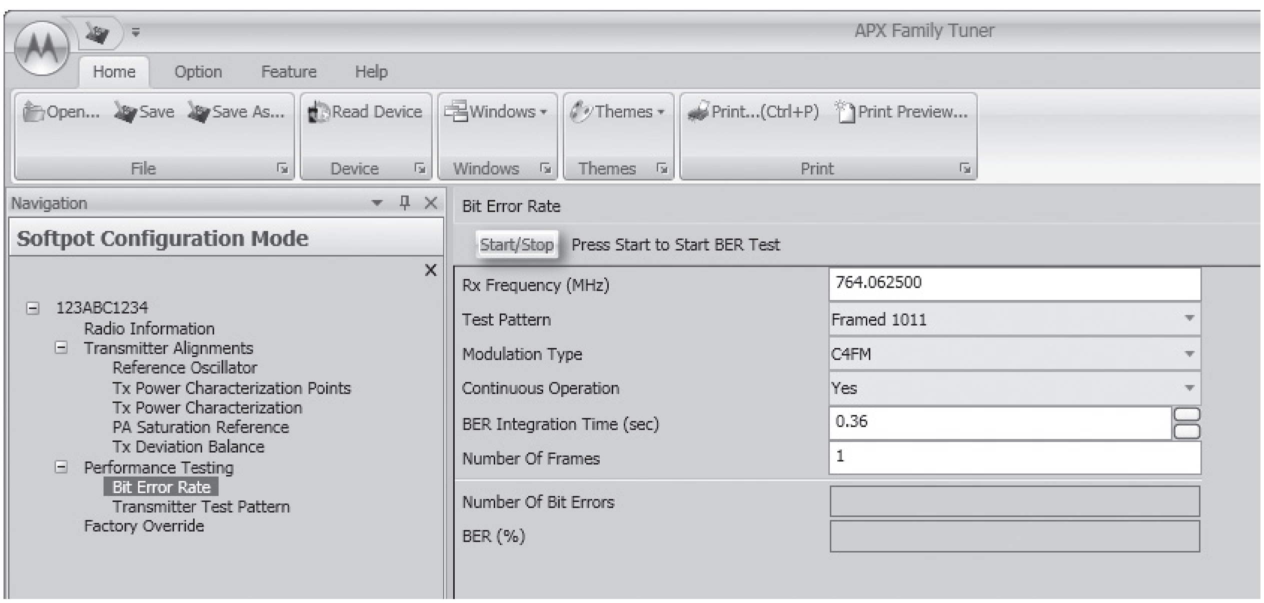

Figure 6-30. Bit Error Rate Screen (700/800 MHz)

3. Press **Start/Stop** button to begin or end BER testing.

6.7.2 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 radio's transmitter (see Figure 6-31 to Figure 6-34).

6.7.2.1 Transmitter Test Fields

This screen contains the following fields:

- **Tx Frequency**:
  This field selects the Transmit Frequency directly in MHz.
- **Channel Spacing**:
  This field allows the user to select the desired transmit deviation in kHz.
- **Test Pattern Type**:
  This field represents the type of test pattern which will be transmitted by the radio when **PTT TOGGLE** button is pressed.

NOTE: Channel Spacing and Test Pattern Type fields will be grayed out while radio is transmitting.

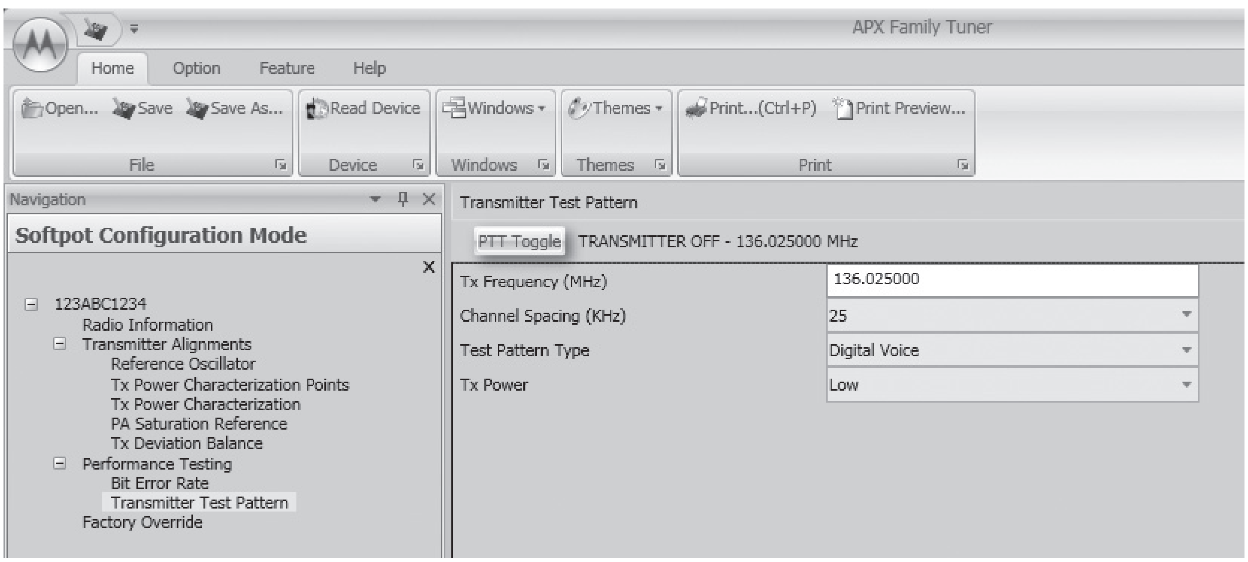

Figure 6-31. Transmitter Test Pattern Screen (VHF)

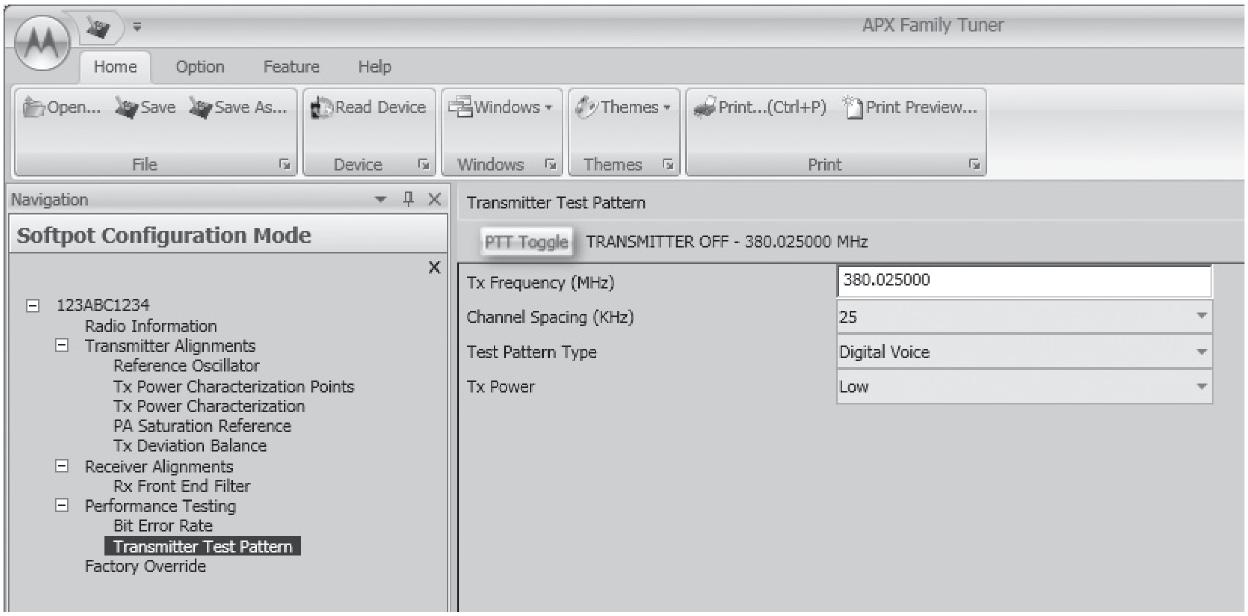

Figure 6-32. Transmitter Test Pattern Screen (UHF1)

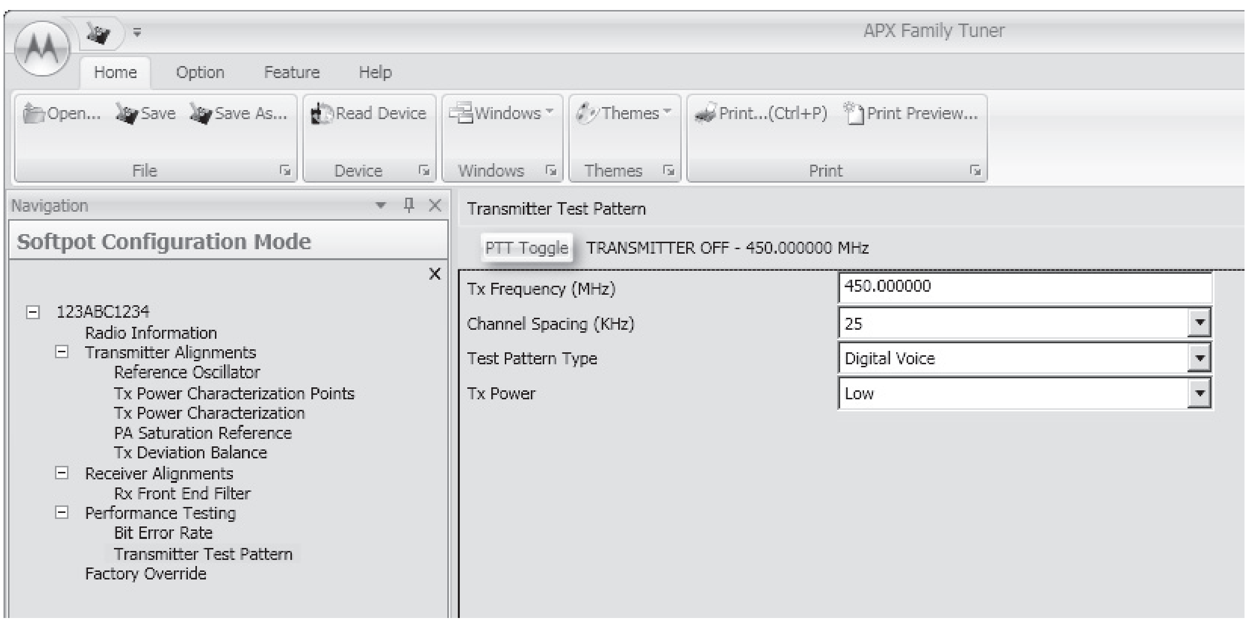

Figure 6-33. Transmitter Test Pattern Screen (UHF2)

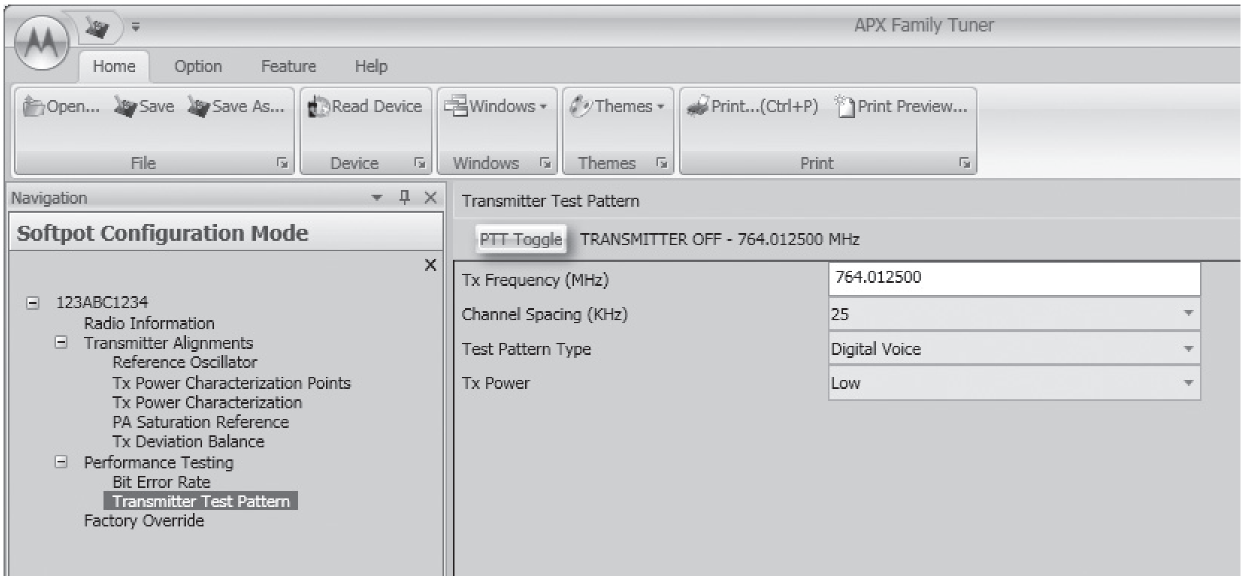

Figure 6-34. Transmitter Test Pattern Screen (700/800 MHz)

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 will be 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". If the parameter is disabled, keys will be sent in clear form; if the parameter is enabled, keys will be sent to the radio in encrypted form.

NOTE: 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.

To load an encryption key:

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.
4. When the key is loaded successfully, you will hear:
   - On single-key radios – a short tone.
   - On multikey radios – an alternating tone.

The secure kits for APX 5000/ APX 6000/ APX 6000Li are identified by the following kit numbers:

Table 7-1. Kit Numbers for Secure-Enabled Expansion Boards

Kit Number	Description
NNTN8171_	APX 5000/ APX 6000/ APX 6000Li DVP-XL Expansion Board
NNTN8172_	APX 5000/ APX 6000/ APX 6000Li DVP-XL Expansion Board with Apps
NNTN8173_	AES Expansion Board
NNTN8174_	AES Expansion Board with Apps
NNTN8175_	DES/ DES-XL/ DES-OFB Expansion Board
NNTN8176_	DES/ DES-XL/ DES-OFB Expansion Board with Apps
NNTN8177_	Expansion Board
NNTN8178_	Expansion Board with Apps

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 (e.g., 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:

1. Press ▶ until the display shows "Key".
2. Press ●, ●●, or ∴ directly below "Key". The display shows the last user-selected and -stored encryption key.
3. Press ▲ or ▼ to scroll through the list of encryption keys.

   NOTE: If a deleted key is selected, "ERASED KEY" will be displayed.
4. Press ●, ●●, or ∴ directly below the desired menu.
   - SEL = saves the newly selected key and returns to the home display.
5. Press ⌂, the **PTT** button, or ●, ●●, or ∴ 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:

1. Press until the display shows “Key”.
2. Press , , or directly below “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” will be displayed.

4. Press , , or directly below the desired menu.
   - SEL = saves the newly selected key and returns to the home display.
5. Press , the **PTT** button, or , , or 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 Select an Encryption Index

This feature lets the user select 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 will now have the equivalent new key instead.

7.4.1 Use the Menu

To select an index using the menu:

1. Press until the display shows “KSet”.
2. Press , , or directly below “KSet”. The display shows the last user-selected and -stored index.
3. Press or to scroll through the list of encryption keys.

   NOTE: If a deleted key is selected, “ERASED KEY” will be displayed.

4. Press , , or directly below the desired menu.
   - SEL = saves the newly selected key and returns to the home display.
5. Press , the **PTT** button, or , , or 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:

1. Press ▶ until the display shows "KSet".
2. Press , , or directly below "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" will be displayed.

4. Press , , or directly below the desired menu.
   - SEL = saves the newly selected key and returns to the home display.
5. Press ⌂, the **PTT** button, or , , or 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 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:

1. Press ▶ until the display shows "Eras".
2. Press , , or directly below "Eras". The display shows the last user-selected and -stored encryption key.
3. Press ▲ or ▼ to scroll through the list of encryption keys.
4. Select single encryption key or all encrytion keys deletion from the "OPTN" menu.
5. Press ⌂, the **PTT** button, or , , or 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:

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 APX 5000/ APX 6000/ APX 6000Li (R) radios. When performing these procedures, refer to “Chapter 10: Exploded Views and Parts Lists” on page 1:10-1 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 APX 5000/ APX 6000/ APX 6000Li radio’s standard accessories and changing the Volume and Frequency Knobs.

8.1 Exploded View (Main Subassemblies)

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

This section contains the APX 5000/ APX 6000/ APX 6000Li radio partially exploded views.

NOTES:

- Refer to Figure 8-1 on page 1:8-2, the Partial Exploded View, and Table 8-1 on page 1:8-5, the Partial Exploded View Parts List.
- Letters in parentheses ( ) refer to item letters in Figure 8-1 on page 1:8-2 and Table 8-1 on page 1:8-5.

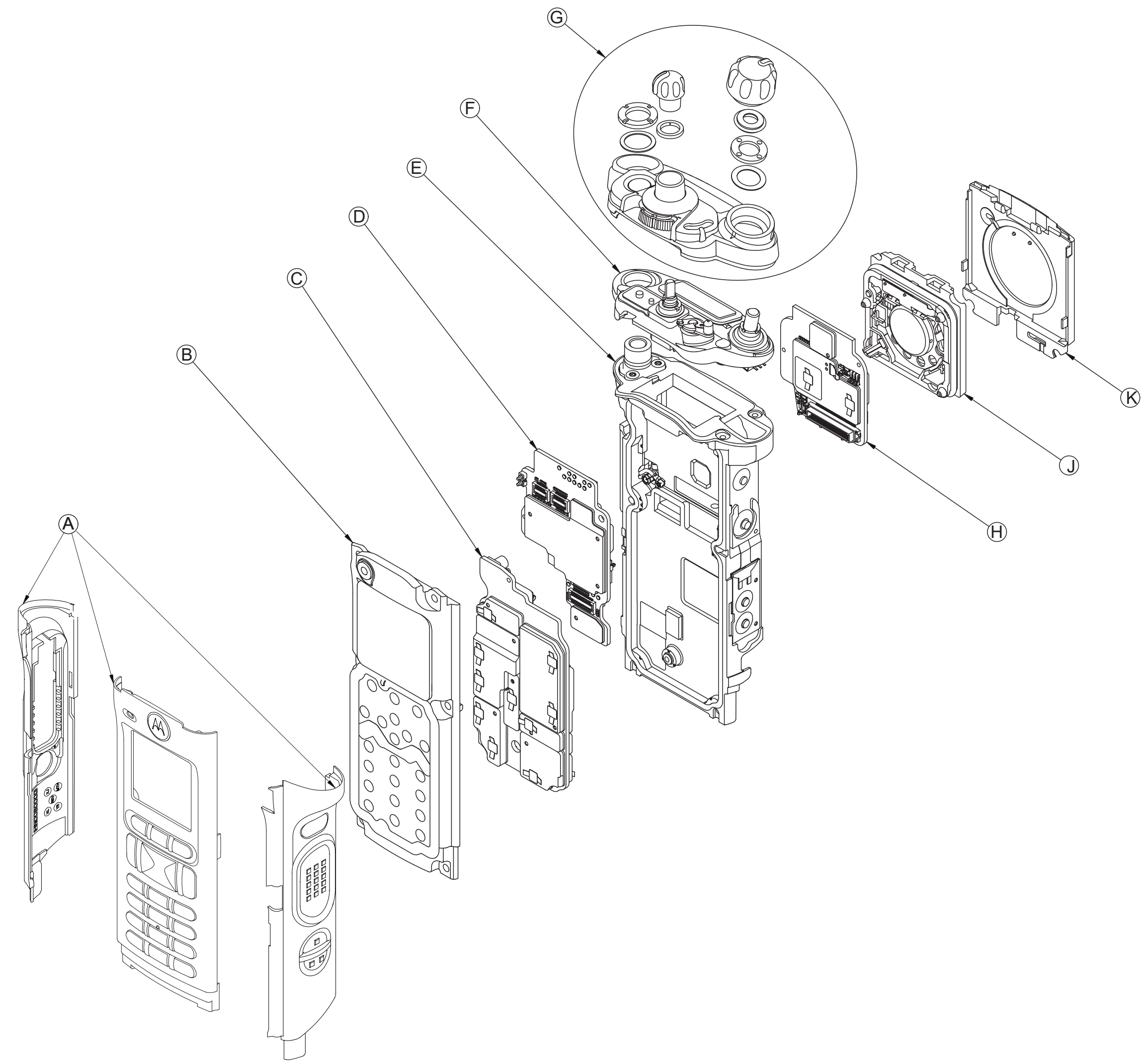

Figure 8-1. APX 5000/ APX 6000/ APX 6000Li Dual Display Partial Exploded View

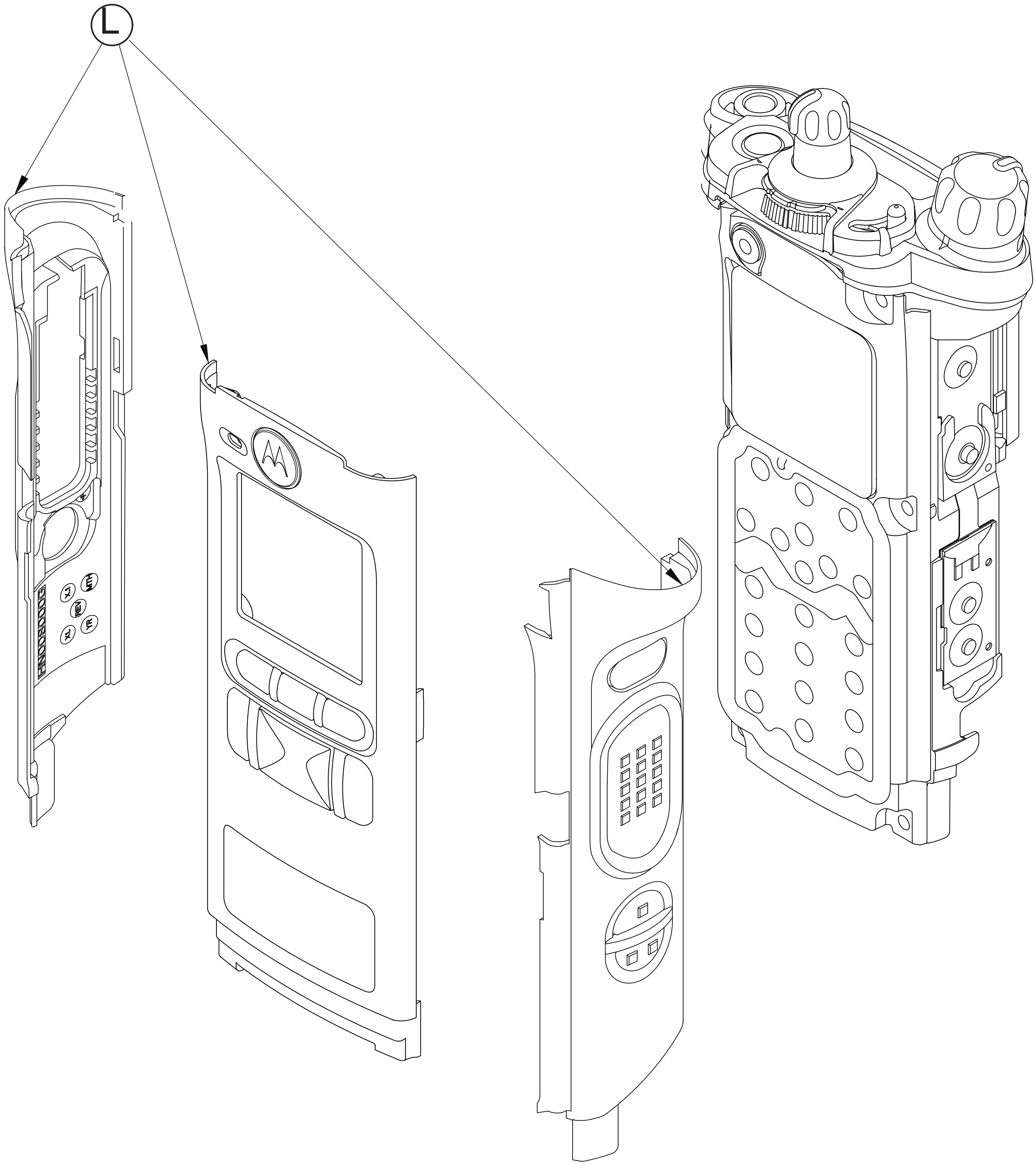

Figure 8-2. APX 5000/ APX 6000/ APX 6000Li Dual Display (Limited Keypad) Partial Exploded View

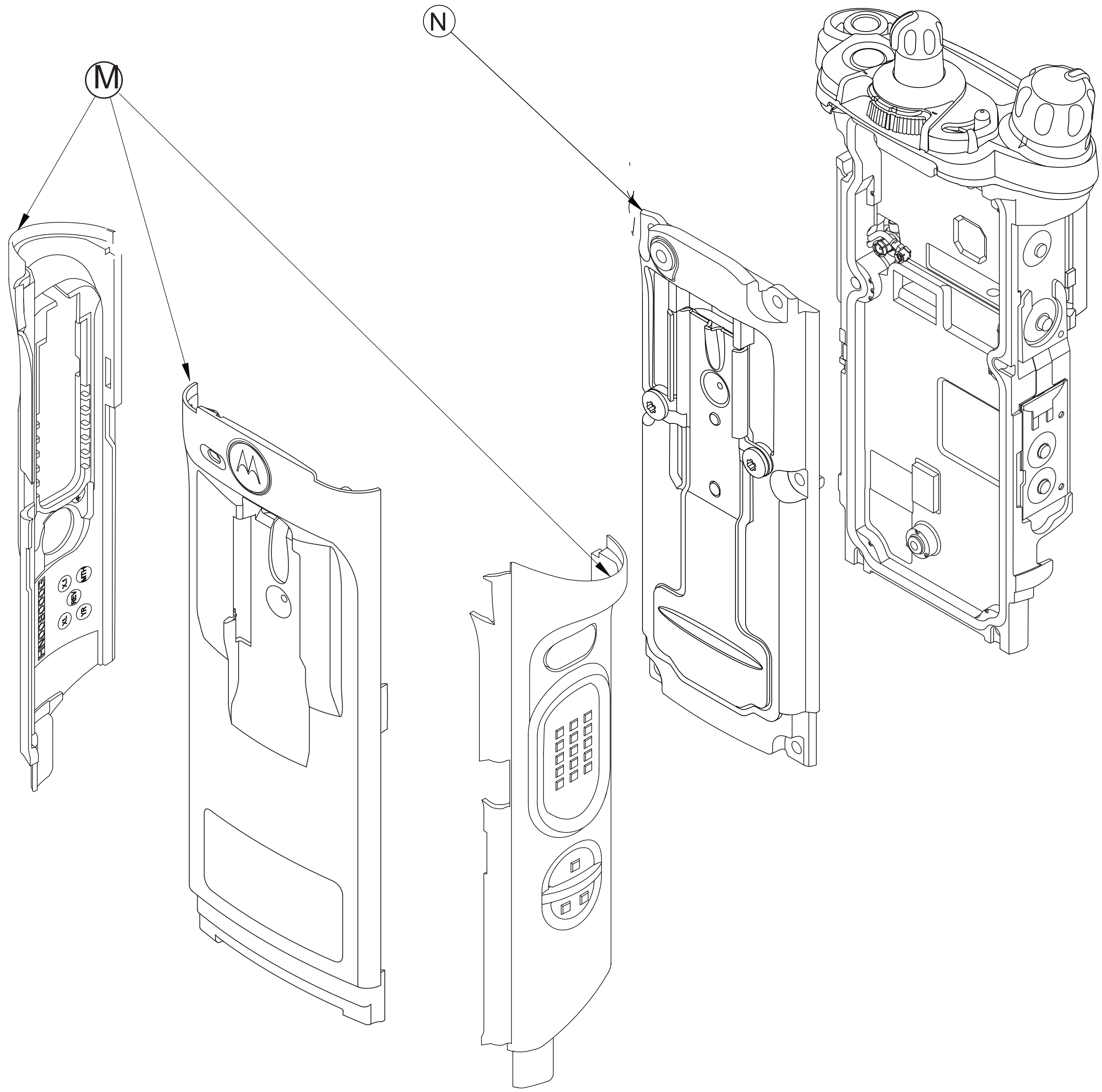

Figure 8-3. APX 5000/ APX 6000/ APX 6000Li Top Display Partial Exploded View

Table 8-1. APX 5000/ APX 6000/ APX 6000Li Partial Exploded View Parts List

Item Letter	Description	Exploded View and Parts List
A	Main Housing Assembly (Dual Display, Full Keypad)	Refer Figure 10-1: "APX 5000/ APX 6000/ APX 6000Li Dual Display (Full Keypad) Exploded View" on page 1:10-2.
B	Back Chassis Assembly (Dual Display)	Refer Figure 10-1: "APX 5000/ APX 6000/ APX 6000Li Dual Display (Full Keypad) Exploded View" on page 1:10-2.
C	RF Board Assembly	Refer Figure 10-1: "APX 5000/ APX 6000/ APX 6000Li Dual Display (Full Keypad) Exploded View" on page 1:10-2.
D	VOCON Board Assembly	Refer Figure 10-1: "APX 5000/ APX 6000/ APX 6000Li Dual Display (Full Keypad) Exploded View" on page 1:10-2.
E	Main Chassis Assembly	Refer Figure 10-1: "APX 5000/ APX 6000/ APX 6000Li Dual Display (Full Keypad) Exploded View" on page 1:10-2.
F	Control Top Assembly	Refer Figure 10-1: "APX 5000/ APX 6000/ APX 6000Li Dual Display (Full Keypad) Exploded View" on page 1:10-2.
G	Knobs & Top Bezel Assembly	Refer Figure 10-1: "APX 5000/ APX 6000/ APX 6000Li Dual Display (Full Keypad) Exploded View" on page 1:10-2.
H	Expansion Board Assembly	Refer Figure 10-1: "APX 5000/ APX 6000/ APX 6000Li Dual Display (Full Keypad) Exploded View" on page 1:10-2.
J	Speaker Module	Refer Figure 10-1: "APX 5000/ APX 6000/ APX 6000Li Dual Display (Full Keypad) Exploded View" on page 1:10-2.
K	Speaker Grille Assembly	Refer Figure 10-1: "APX 5000/ APX 6000/ APX 6000Li Dual Display (Full Keypad) Exploded View" on page 1:10-2.
L	Main Housing Assembly (Dual Display, Limited Keypad)	Refer Figure 10-2: "APX 5000/ APX 6000/ APX 6000Li Dual Display (Limited Keypad) Exploded View" on page 1:10-4.
M	Main Housing Assembly (Top Display)	Refer Figure 10-3: "APX 5000/ APX 6000/ APX 6000Li Top Display Exploded View" on page 1:10-5.
N	Back Chassis Assembly (Top Display)	Refer Figure 10-3: "APX 5000/ APX 6000/ APX 6000Li Top Display Exploded View" on page 1:10-5.

8.2 Required Tools and Supplies

Table 8-2. Required Tools and Supplies

Tools	Motorola Part Number	Supplier	Supplier Part Number	Remarks
Bit, Torx IP8	–	–	–	Torx T8 may be used, but Torx Plus IP8 is recommended
Bit, Volume Spanner Nut	66009256001	Motorola	–	
Bit, Antenna Spanner	66009258001	Motorola	–	
Black Stick	–	Hexacon Electric Co.	MA-800G	
Seater, Secure Lever	66009261001	Motorola	–	
Driver, Torque	–	–	–	
Vacuum Pump Kit	NLN9839_	Motorola	–	For Vacuum Test
Vacuum Adapter	66009259001	Motorola	–	For Vacuum Test and Pressure Test
Pressure Pump Kit	NTN4265_	Motorola	–	For Pressure Test

8.3 Fastener Torque Chart

Table 8-3 lists the various fasteners by part number and description, followed by the torque values and the location where used. Torque all fasteners to the recommended value when assembling the radio.

Table 8-3. Required Tools and Supplies

Motorola Part Number	Description	Repair Torque (in-lbs)
0275361H01	Volume Spanner Nut (3131)	8
0275891B01	Antenna Spanner Nut (2727)	16
0375962B01	Top Screw (4242)	10
0375962B02	Center Screw (4141)	10
0375962B03	Bottom Screw (4343)	10
0375962B04	Control Top Screw (4444)	8
03009304001	RF & Vocon Board Screw (4545)	8

8.4 Antenna

This section explains how to attach and remove the antenna.

8.4.1 Attach Antenna

To attach the antenna:

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

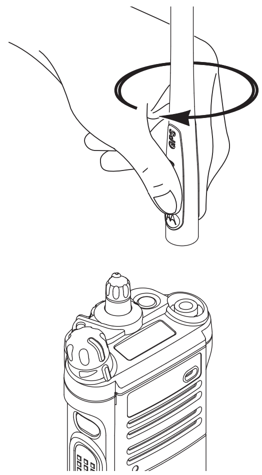

Figure 8-4. Attaching the Antenna

2. To tighten the antenna, grasp the radio in one hand and the antenna in the other, firmly turn the antenna clockwise to tighten it.

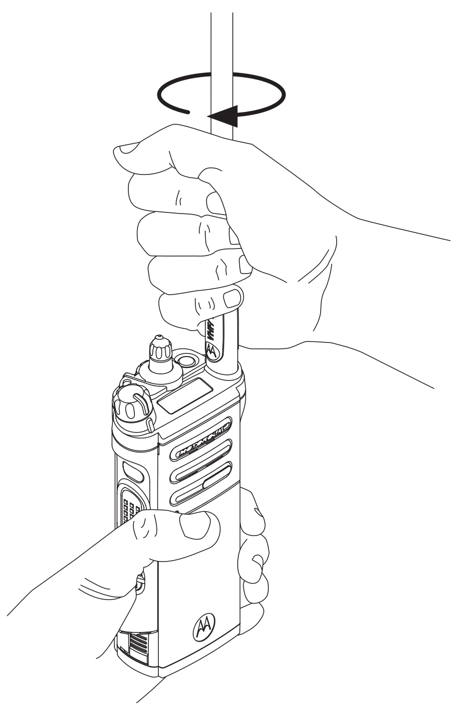

Figure 8-5. Tightening the Antenna

8.4.2 Remove Antenna

To remove the antenna:

With the radio turned off, turn the antenna counter-clockwise to remove it from the radio.

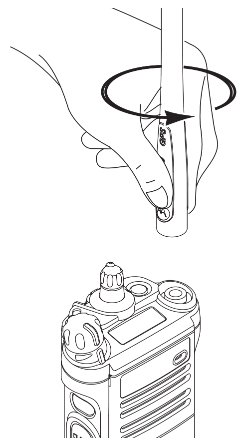

Figure 8-6. Removing the Antenna

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-approved battery shipped with the APX 5000/ APX 6000/ APX 6000Li radio is uncharged. Prior to using a new battery, charge it per the recommended procedure for the battery.

8.5.1 Attach Battery

To attach the battery:

1. With the radio turned off, verify that the battery seal is set properly in its groove as shown in Figure 8-7.

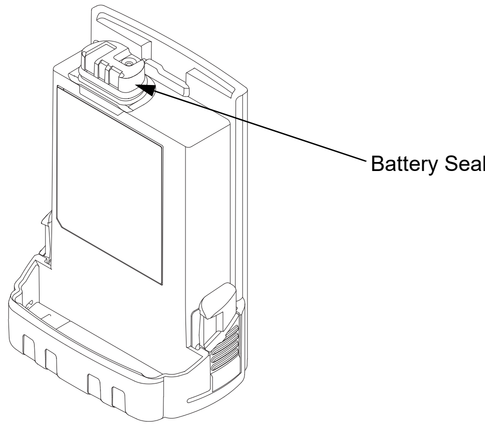

Figure 8-7. Attaching Battery – Battery Seal

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.

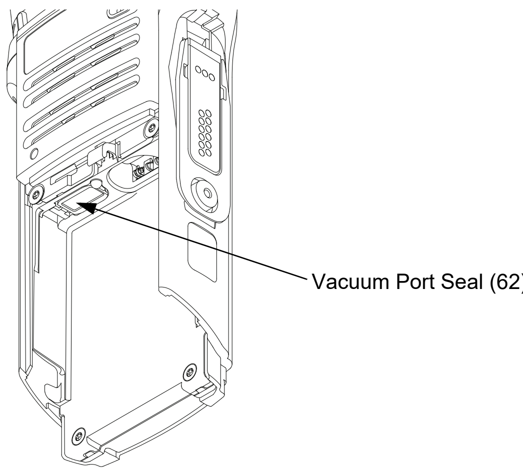

Figure 8-8. Attaching Battery – Vacuum Port Seal

3. Set the battery onto the chassis as shown in Figure 8-9 and slide into position. Make sure both battery latches click into position.

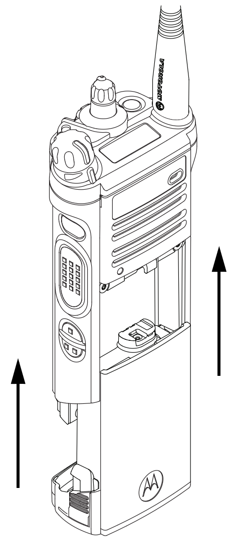

Figure 8-9. Attaching Battery – Slide into Position

8.5.2 Remove Battery

To remove the battery:

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

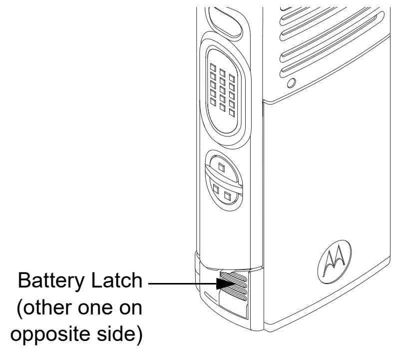

Figure 8-10. Squeezing the Release Latches

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

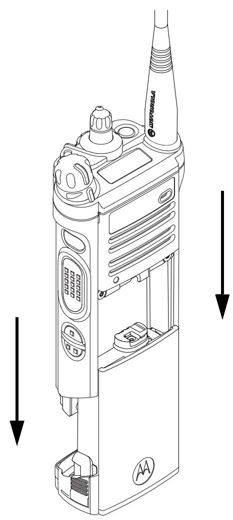

Figure 8-11. Removing the Battery

8.6 Universal Connector Cover

This section explains how to remove and attach the Universal Connector Cover (46).

> **Caution**
>
> When the universal connector is not in use, keep it covered with the Universal Connector Cover. The GCAI interface will be damaged if conductive medium is present on the surface. Regularly inspect the GCAI interface to ensure surface is clean and dry.

8.6.1 Remove Universal Connector Cover

To remove the Universal Connector Cover (46):

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.

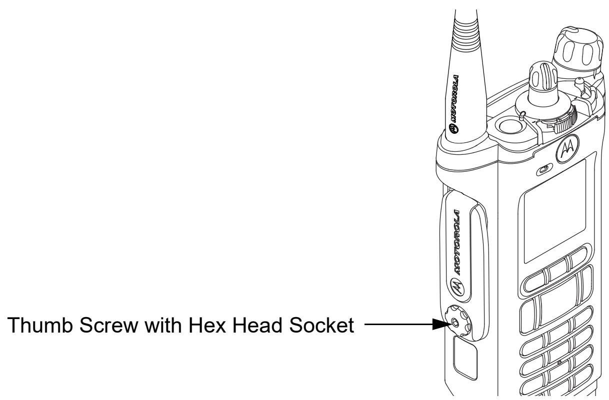

Figure 8-12. Removing the Thumb Screw

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 Attach Universal Connector Cover

To attach the Universal Connector Cover (46):

1. Insert the hooked end of the cover into the pocket. Engage the hook beneath the undercut and swing the cover down onto the radio. Ensure the cover is seated properly and the screw is aligned into the threaded hole.

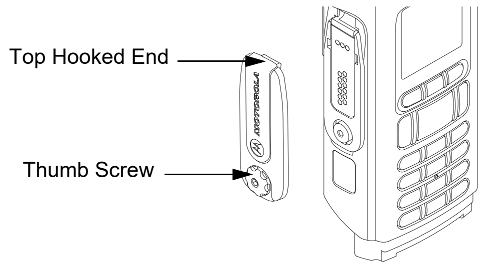

Figure 8-13. Engaging Hook and Seating Cover

2. Hand tighten the thumb screw clockwise until secured.

   NOTE: Do not overtighten the screw. The screw should be snugged and not allow the cover to move.

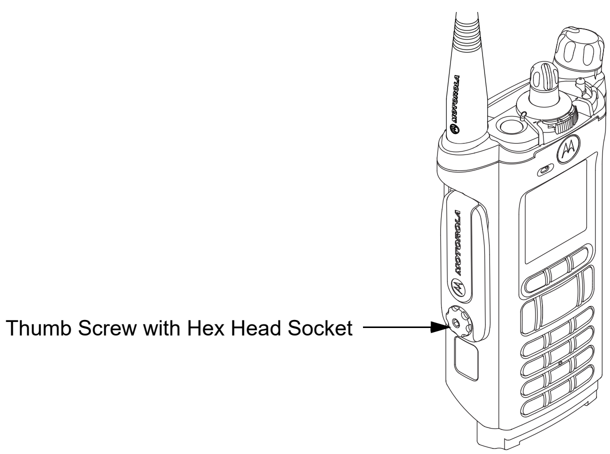

Figure 8-14. Securing the Cover

8.7 Radio Disassembly

This section contains instructions for disassembling the radio's main subassemblies.

Prepare the radio for disassembly:

- Turn off the radio by rotating the On/Off/Volume Knob (29) fully counterclockwise until a click is heard.
- Remove the antenna, the battery, Belt Clip Cover (53) (Top Display Only), the Universal Connector Cover (46) and any other accessory connected to the radio.

8.7.1 Removal of the Speaker Grille Assemblies (K)

1. With the Battery removed and the primary loudspeaker side of the radio facing you, remove the center two screws (41) and swing out Speaker Grille Assembly (K) as shown in Figure 8-15.

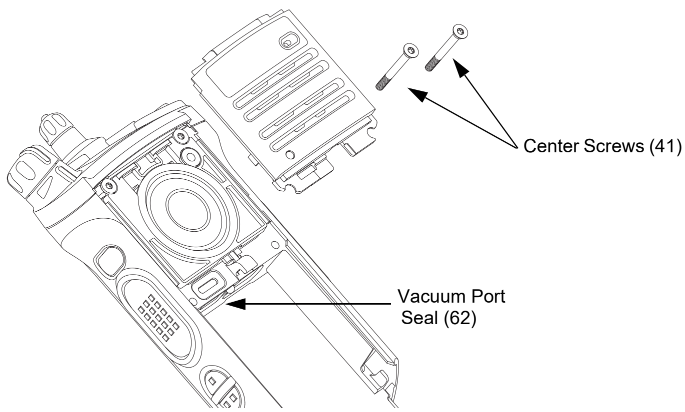

Figure 8-15. Remove Center Screws

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

2. Remove the bottom two screws (43) if the Main Housing Assembly (A, L, M) is to be removed. Refer Figure 8-16.

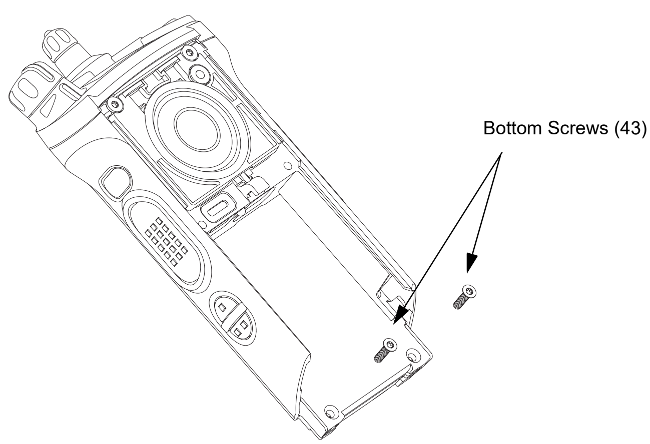

Figure 8-16. Remove Bottom Screws

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 Removal of the Speaker Module (J)

1. Remove the top two screws (42) as shown in Figure 8-17.

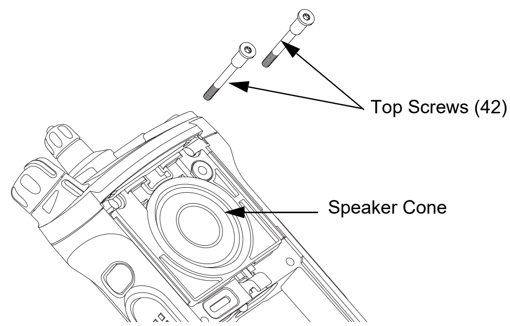

Figure 8-17. Remove Top Screws

2. Carefully pick out the Speaker Module (J) with the Black Stick and swing it out of the Main Chassis Assembly (15) as shown in Figure 8-18.

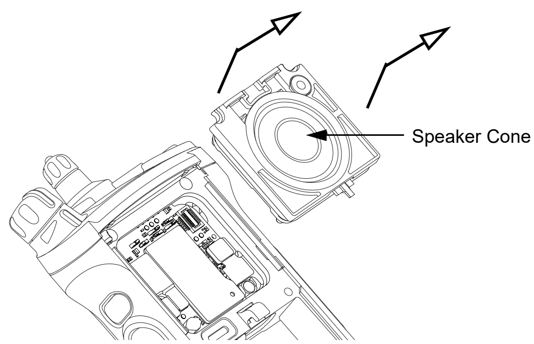

Figure 8-18. Remove Speaker Module

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

8.7.3 Removal of the Expansion Board Assembly (H)

1. Using the Black Stick, pull up the locking feature side of the Expander Board Support (61). Be careful not to damage the flex or any component during the process.

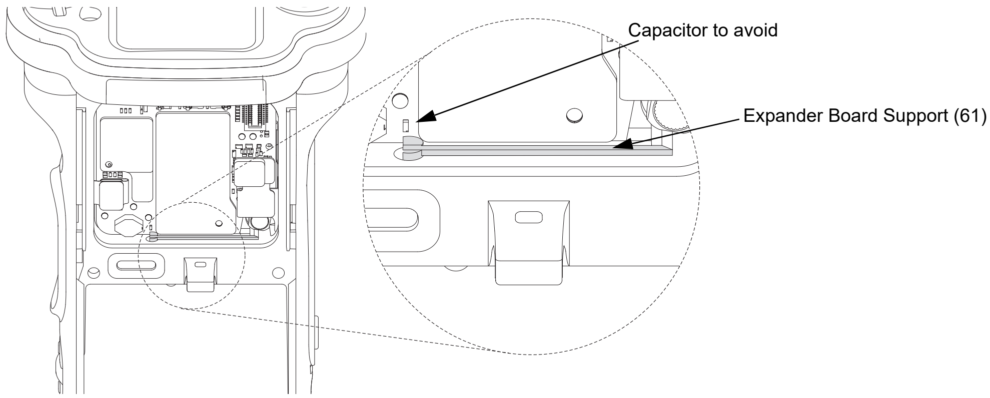

Figure 8-19. Pull Expander Board Support (Opt. Expansion Board)

2. Rotate the Expander Board Support vertically.
3. Remove the rounded portion from the Expander side opening of the vacuum test compartment.

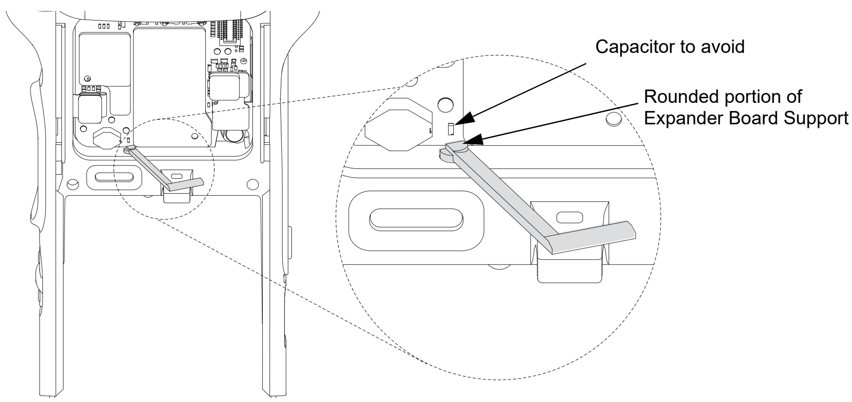

Figure 8-20. Remove Expander Board Support

Be careful not to damage the capacitor during the disassembly process.

4. Using the Black Stick, unplug the two flex connectors located on the left and right side of the Expansion Board Assembly (H). Unfold and straighten the flexes located on the right and left side as shown in Figure 8-21.

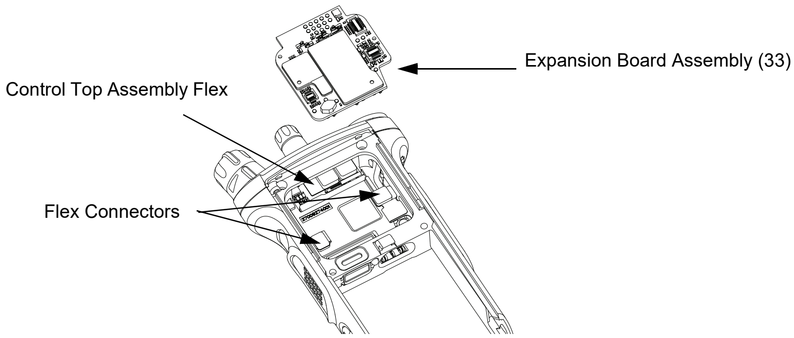

Figure 8-21. Remove Flex Connectors and Expansion Board Assembly

5. Remove the Expansion Board Assembly (HH) by gently lifting up the right side of the PCB as shown in Figure 8-21.

6. If the VOCON Board or Control Top Assembly (DDD, F) is to be removed from the radio, then unplug the Control Top Assembly flex as shown in Figure 8-21.

7. If the RF Board Assembly (C) is to be removed, use the Black Stick to unplug the antenna coax cable from the RF Board Assembly as shown in Figure 8-22.

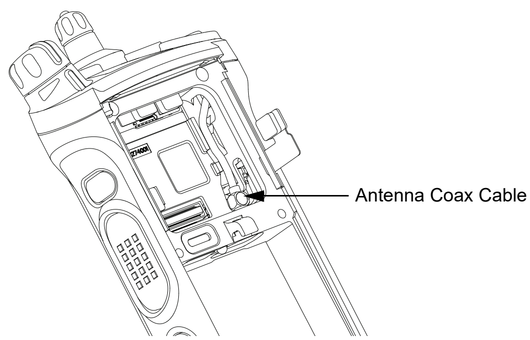

Figure 8-22. Remove Antenna Coax Cable Connector

8. Flip the radio over.

8.7.4 Removal of the Three-Piece Main Housing Assembly (A,L,M)

1. Gently lift the front housing up from the radio and then detach both sides of the Main Housing Assembly (1) . Then lift it over the radio as shown in Figure 8-23.

   NOTE: For Top Display version, ensure the Belt Clip Cover (53) has been removed.

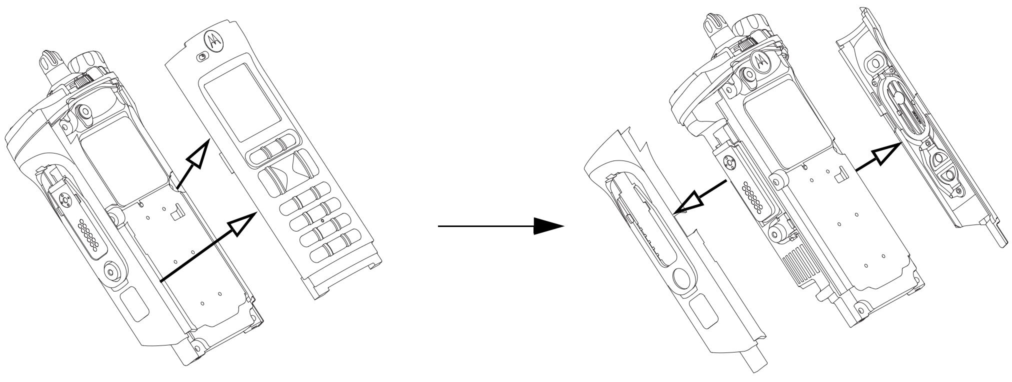

Figure 8-23. Remove Housing

8.7.5 Removal of the Back Chassis Assembly (B, N)

1. Dual Display versions:
   Gently separate the Back Chassis Assembly (B) from the Main Chassis Assembly (E) 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 as shown in Figure 8-24.

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

Caution	Pull the flex connectors vertically upwards by using black stick. Disconnect at two connector locations shown in Figure 8-24.

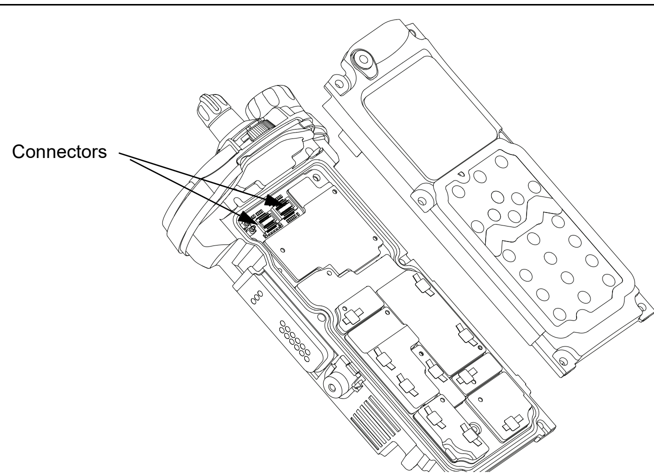

Figure 8-24. Remove Back Chassis Assembly from Main Chassis Assembly

8.7.6 Removal of the RF Board Assembly (C)

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

1. Remove the RF and Vocon Board screw (45) then unplug the RF Board Assembly (C) from the VOCON Board Assembly (D) by using the Black Stick. 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.

Caution	Place the RF Board Assembly in a clean and ESD safe area to avoid contamination to the Battery Connector Seal (13) and electrical damage to the electronics respectively. Replace Thermal Pads (10, 11) whenever RF Board Assembly is removed.

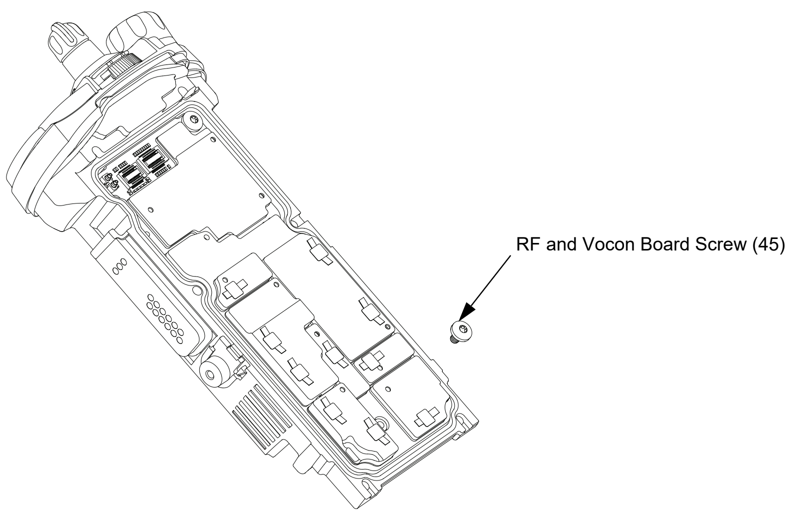

Figure 8-25. Remove RF Board Screw

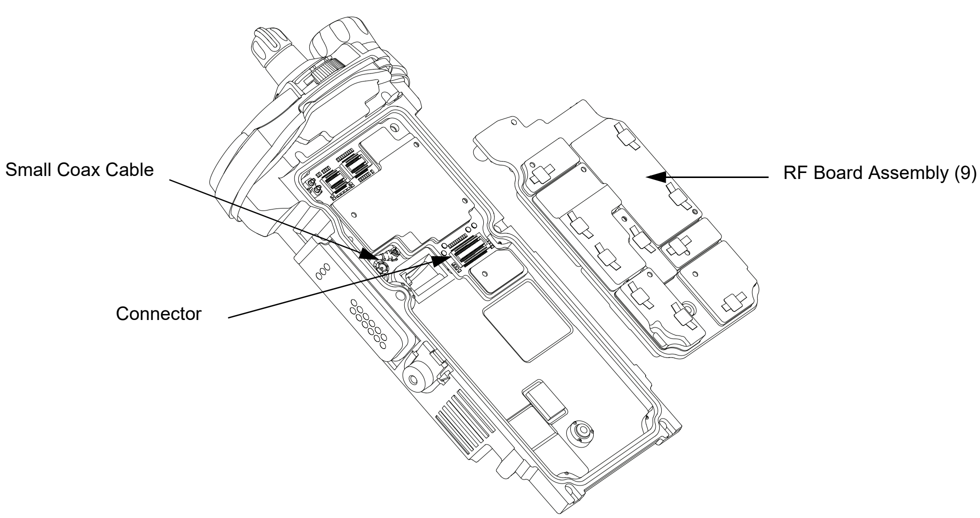

Figure 8-26. Remove RF Board Assembly

8.7.7 Removal of the VOCON Board Assembly (D)

NOTE: Reconfirm the Flex connector between the Control Top Assembly (F) and the VOCON Board Assembly (D) is disconnected. Failure to do so may damage the connectors or the flex.

1. Ensure RF Board is removed (see Section 8.7.6 on page 1:8-19.). Remove RF and VOCON Board screw (45) (as shown in Figure 8-27.), Gently rotate the VOCON Board Assembly just enough to clear the Main Chassis. Slide out the VOCON Board Assembly as shown in Figure 8-28.

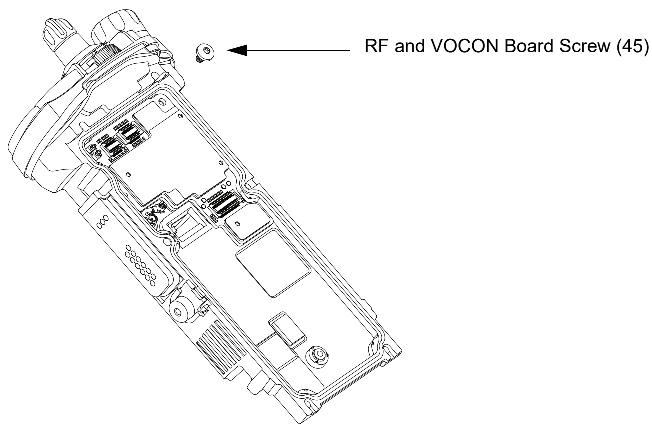

Figure 8-27. Remove VOCON Board Screw

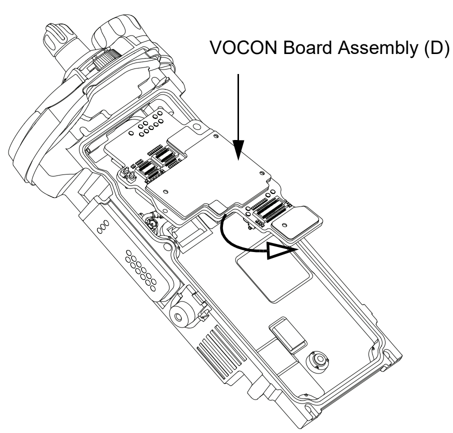

Figure 8-28. Remove VOCON Board Assembly

8.7.8 Removal of the Knobs & Top Bezel Assembly (G)

A. Remove the Frequency Knob

To remove the Frequency Knob (28):

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

2. With the other hand, grasp the Frequency Knob and pull it upward, until it is free from its shaft.

B. Remove the Volume Knob

To remove the Volume Knob (29):

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

2. With the other hand, grasp the Volume Knob and pull it upward.
   - i. Remove the Torque Adder (30) with the Black Stick.
   - ii. Unscrew the Volume Spanner Nut (31) using the Volume Spanner Bit with a driver. Remove the Volume Washer (32) below the nut.
   - iii. Unscrew the Antenna Spanner Nut (27) with the Antenna Spanner Bit and a driver. Remove the Antenna Washer (26) below the nut as shown in Figure 8-29.

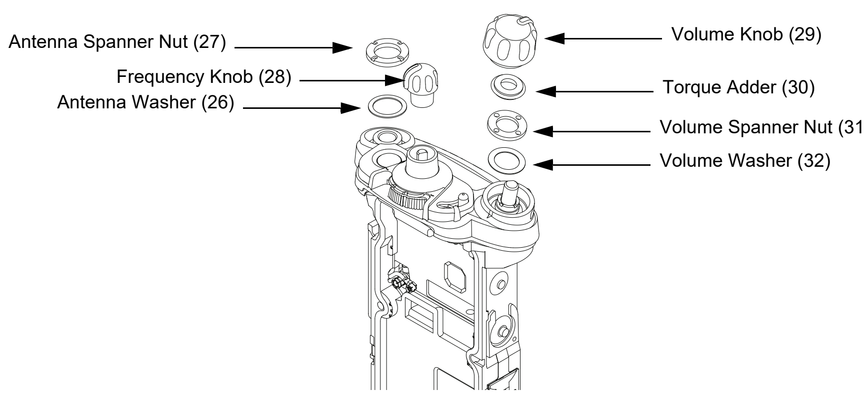

Figure 8-29. Remove Knobs and Fastener Hardware

   - iv. Gently lift the Control Top Bezel (24) and with the aid of the Black Stick, pop the Secure Lever (25) off the Frequency shaft as shown in Figure 8-30.

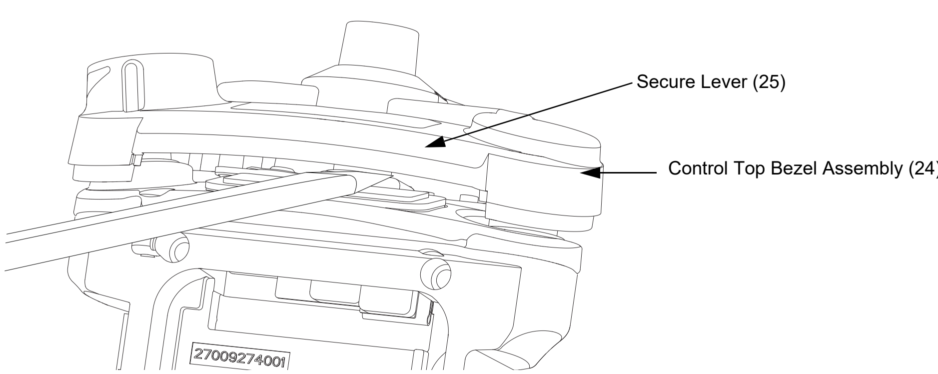

Figure 8-30. Remove Control Top Bezel Assembly

8.7.9 Removal of the Control Top Assembly (F)

i. Use a Torx Plus IP8 bit to remove the two Control Top Screws (44). See Figure 8-31.

NOTE: Ensure the Control Top flex is disconnected from the VOCON Board (D) to prevent damage to the flex or connector. See Section 8.7.3. step 3.

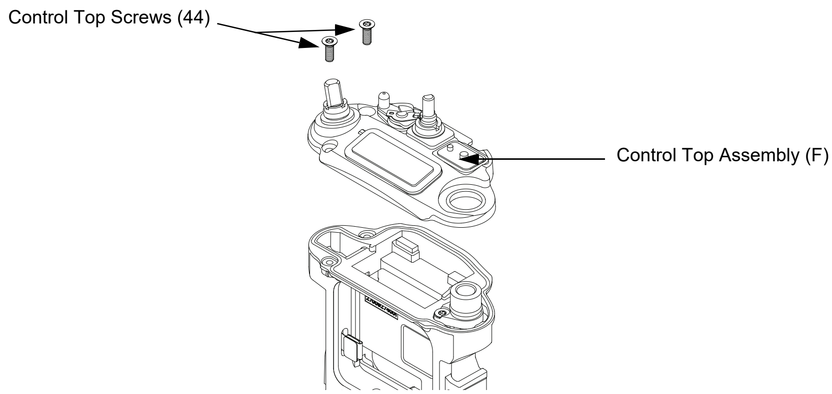

Figure 8-31. Remove Control Top Assembly

ii. Gently separate the Control Top Assembly (F) from the Main Chassis Assembly (E).

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

8.8 Serviceable Components of the Main Sub-Assemblies

8.8.1 Servicing Main Chassis Assembly (E)

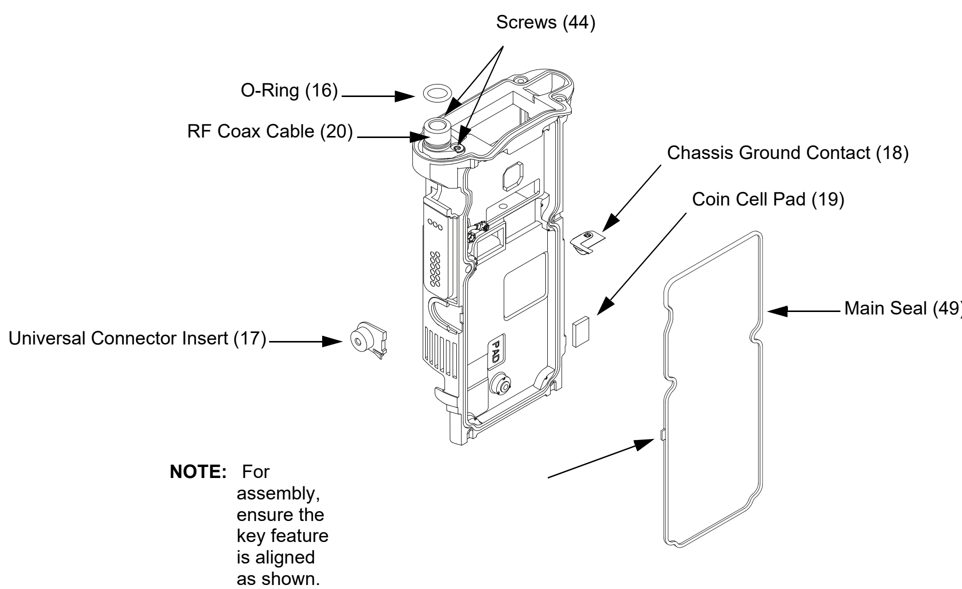

Figure 8-32. Serviceable Components – Main Chassis Assembly

8.8.1.1 Servicing Coin Cell Pad:

1. Complete steps from Section 8.7.1. through Section 8.7.9. of section 8.7 on page 1:8-14.
2. Carefully peel off the pad.
3. Use the Black Stick to help remove any difficult sections of the pad(s).
4. Clean the area once the pad is removed to ensure it is free of adhesive and debris.
5. Peel the liner off the new pad and place in the respective location.
6. Apply slight pressure to set the adhesive.

8.8.1.2 Servicing Universal Connector Insert:

1. Complete steps from Section 8.7.1. through Section 8.7.4. of section 8.7 on page 1:8-14.
2. Ensure the locking tab is pressed and carefully slide the Universal Connector Insert (17) with the Black Stick from the Main Chassis Assembly (15) as shown in Figure 8-32.
3. Press the new Universal Connector Insert until it is fully seated and the lock tab is engaged on the chassis.

8.8.1.3 Servicing Antenna O-ring:

1. Complete steps from Section 8.7.1. through Section 8.7.9. of section 8.7 on page 1:8-14.
2. Remove the O-ring (16) with the Black Stick.
3. Reinstall the O-ring by rolling it over the threaded portion of the antenna hub until it sets in its groove.

   NOTE: Ensure the O-ring is not twisted.

8.8.1.4 Servicing Chassis Ground Contact:

NOTE: Chassis Ground Contact (18) will be damaged during disassembly.

1. Complete steps from Section 8.7.1. through Section 8.7.9. of section 8.7 on page 1:8-14.
2. Slide the Black Stick under the Chassis Ground Contact (18) through the opening on the RF/VOCON PCB side of the radio to lift off the contact.
3. Clean the area once the Chassis Ground Contact is removed to ensure it is free of adhesive and debris.
4. 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 as shown in Figure NOTE:.
5. Apply pressure to the adhesive to activate it.

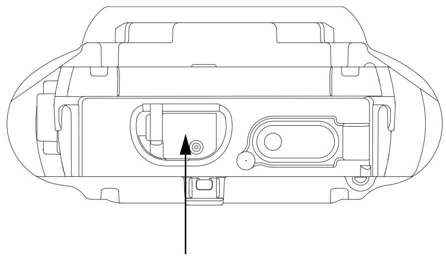

Figure 8-33. Remove Chassis Ground Contact

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

8.8.1.5 Servicing RF Coax Cable:

1. Complete steps from Section 8.7.1. through Section 8.7.9. of section 8.7 on page 1:8-14.
2. Remove the two screws (44) from the top of the assembly.
3. Note the routing of the RF Coax cable (20) as seated onto the chassis grooves. Gently remove the cable by sliding it away from the control top.
4. Replace the RF Coax Cable. Bend and seat the new RF cable within the chassis grooves as noted in step 3.
5. Torque both screws (44) with a Torx IP8 Bit and a torque Driver to 8 in-lbs**.**

8.8.2 Servicing Control Top Assembly (F)

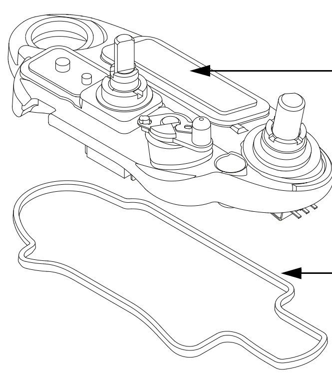

Figure 8-34. Control Top Assembly and Control Top Seal

8.8.2.1 Control Top Main Seal

1. Complete steps from Section 8.7.1. through Section 8.7.9. of section 8.7 on page 1:8-14.
2. Remove the Control Top Seal (22) with the Black Stick.
3. Replace the new seal into the groove provided in the Control Top Assembly's casting.
4. Ensure that seal is set properly and not stretched.

NOTE: There are no other serviceable components on the Control Top Assembly (F).

8.8.3 Servicing Knobs and Top Bezel Assembly (G)

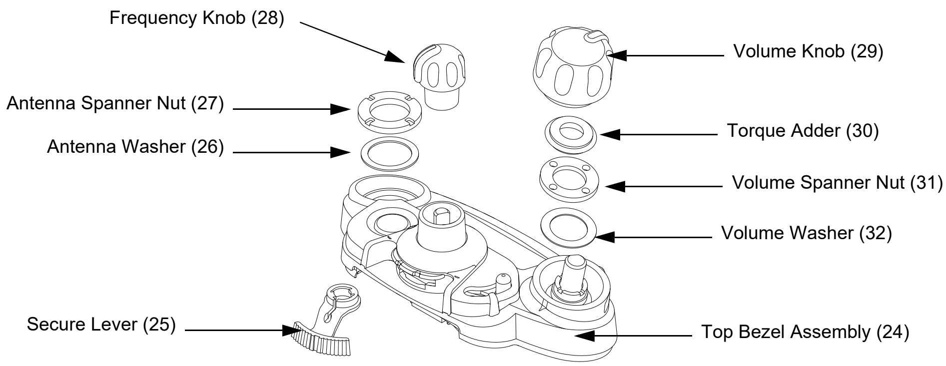

Figure 8-35. Top Bezel Assembly

8.8.3.1 Secure Lever

1. Complete steps from Section 8.7.8. of section 8.7 on page 1:8-14.
2. Pull the Secure Lever (25) straight out of Top Bezel Assembly (24) as shown in Figure 8-35.
3. Insert the lever's arm into the bezel's slot.

NOTE: All serviceable components on the Top Bezel Assembly are shown in Figure 8-35

8.8.4 Servicing VOCON Board Assembly (D)

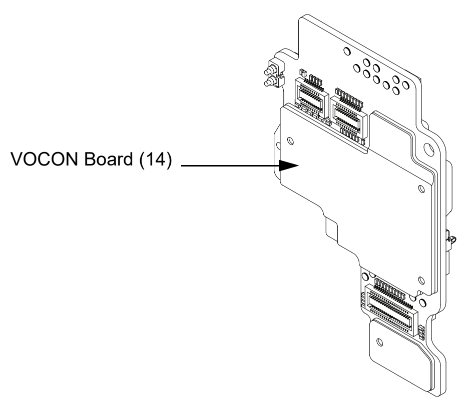

Figure 8-36. VOCON Board Assembly

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

8.8.5 Servicing of RF Board Assembly (C)

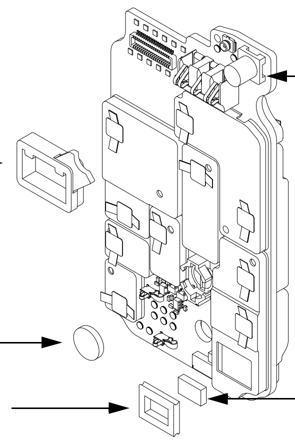

Figure 8-37. RF Board Assembly

8.8.5.1 Battery Seal

1. Complete steps 8.7.1 through 8.7.6 of section 8.7 on page 1:8-14.
2. Slide the Battery Connector Seal (13) from the battery contact header with the Black Stick.
3. Use the Black Stick and push the new Battery Connector Seal until it is properly seated onto the RF Board surface.

8.8.5.2 Thermal Pads

1. Complete steps 8.7.1 through 8.7.6 of section 8.7 on page 1:8-14.
2. Scrape off both thermal pads (10 and 11) from the amplifiers and / or Main chassis with the Black Stick
3. Ensure there are no debris or residue left on the amplifier's surfaces.
4. Replace with new thermal pads.
5. Peel off the back liner from the thermal pads.
6. Insert the Outer Thermal Pad (10) into the shield opening. Make sure the bottom surface of the pad is mating with the top surface of the amplifiers.
7. Insert the Inner Thermal Pad (11) without compressing or deforming it.

Caution

Thermal pads should always be replaced when RF Board assembly is removed.

8.8.5.3 Back up Battery

1. Complete steps from Section 8.7.1. through Section 8.7.7. of section 8.7 on page 1:8-14.
2. Remove the battery with the Black Stick.

   NOTE: Make sure the positive side is facing upwards.

3. 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 RF Board Assembly.

8.8.6 Servicing of Expansion Board Assembly

1. Complete steps 8.7.1 through 8.7.3 of section 8.7 on page 1:8-14.

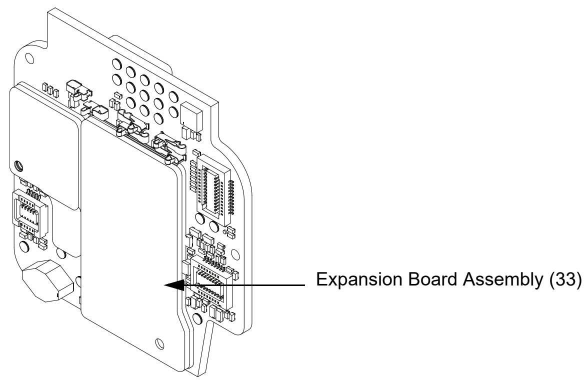

Figure 8-38. Expansion Board Assembly

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

8.8.7 Servicing Back Chassis Assembly (B) – Dual Display Versions

1. Complete steps 8.7.1 through 8.7.5 of section 8.7 on page 1:8-14.

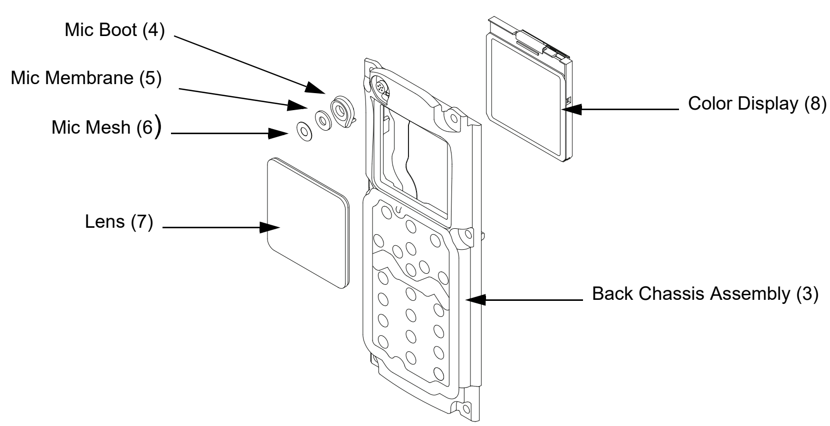

Figure 8-39. Back Chassis Assembly (Dual Display Versions)

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

8.8.7.1 Servicing Microphone Membrane/ Microphone Mesh

NOTE: When servicing microphone membrane, microphone mesh part will also need to be replaced.

1. Complete steps from Section 8.7.1. through Section 8.7.4. of section 8.7 on page 1:8-14.
2. Carefully peel off the Microphone Membrane (5) and Microphone Mesh (6) from the microphone boot (4).
3. 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.
4. Ensure the microphone is seated properly with the microphone boot opening.
5. Remove the backer from the Microphone Membrane.
6. Carefully place the Microphone Membrane centered on the top surface of the microphone boss area on the Main Chassis. Ensure the membrane is flat with no ripples or folds. Press down firmly, applying 2-3 lbs. of force.
7. Repeat step 6 for the microphone mesh.
8. Ensure the microphone boot is correctly seated with the chassis opening.

8.8.7.2 Servicing Microphone Boot (4)

NOTE: When servicing microphone boot, microphone membrane and microphone mesh part will also need to be replaced.

1. Carefully remove the microphone boot (4) 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 Section 8.8.7.1.(steps 5–8) to complete assembling and placing the microphone mesh and membrane.

8.8.7.3 Servicing Color Display

1. Disconnect the Back Chassis Flex from the back of the Color Display (8).
2. Gently pry the Color Display out of the Back Chassis Assembly (3) 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 Display's Pad 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 Display is completely removed.
5. Ensure there are no foreign material on the new Color Display or the Lens (7).
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

NOTE: Prior to Lens removal, Color Display must be removed (See Section 8.8.7.3 on page 1:8-28).

1. Remove the main Lens (7) carefully and slowly with the Black Stick.

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

Caution	Over prying may damage the lens.

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 Back Chassis Assembly (N) – Top Display Version

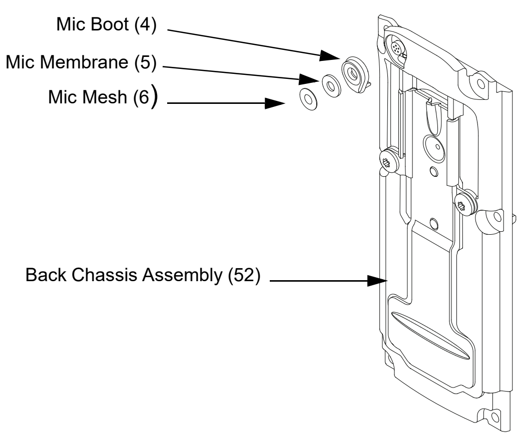

Figure 8-40. Back Chassis Assembly (Top Display Version)

8.8.8.1 Servicing Microphone Membrane/ Microphone Mesh

NOTE: When servicing microphone membrane, microphone mesh part will also need to be replaced.

1. Complete steps from Section 8.7.1. through Section 8.7.4. of section 8.7 on page 1:8-14.
2. Carefully peel off the Microphone Membrane (5) and Microphone Mesh (6) from the microphone boot (4).
3. 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.

4. Ensure the microphone is seated properly with the microphone boot opening.
5. Remove the backer from the Microphone Membrane.
6. Carefully place the Microphone Membrane centered on the top surface of the microphone boss area on the Main Chassis. Ensure the membrane is flat with no ripples or folds. Press down firmly, applying 2-3 lbs. of force.
7. Repeat step 6 for the microphone mesh.
8. Ensure the microphone boot is correctly seated with the chassis opening.

8.8.8.2 Servicing Microphone Boot (4)

NOTE: When servicing microphone boot, microphone membrane and microphone mesh part will also need to be replaced.

1. Carefully remove the microphone boot out of the Back Chassis opening
2. Pinch the sides of the microphone boot (4) 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 Section 8.8.8.1.(steps 5–8) to complete assembling and placing the microphone mesh and membrane.

NOTE: There are No serviceable Components on the Back Chassis Assembly.

8.8.9 Servicing Main Housing (A, L) – Dual Display Versions

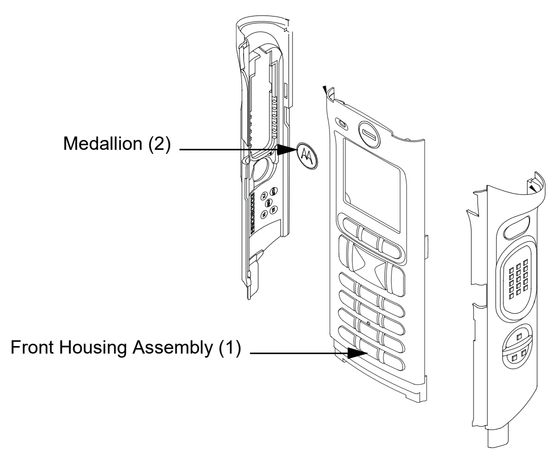

Figure 8-41. Main Housing Assembly (Dual Display Version, Full Keypad)

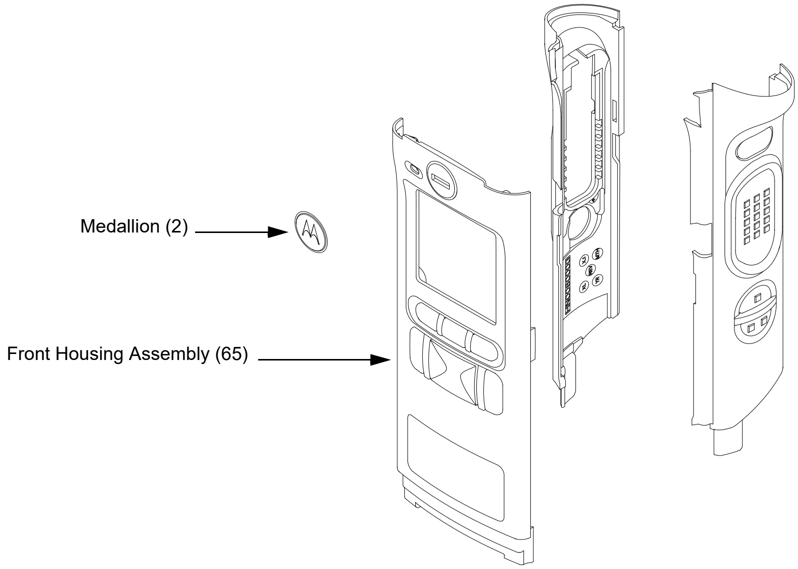

Figure 8-42. Main Housing Assembly (Dual Display Version, Limited Keypad)

8.8.9.1 Medallion

NOTE: There is no need to remove any components in order to service the Medallion (2).

1. Scrape off the Medallion (2) 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 (A, L).

8.8.10 Servicing Main Housing (M) – Top Display Version

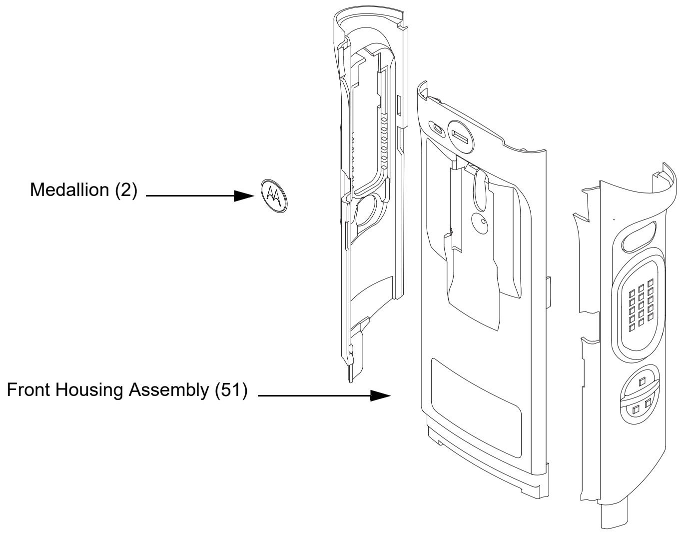

Figure 8-43. Main Housing Assembly (Top Display Version)

8.8.10.1 Medallion

NOTE: There is no need to remove any components in order to service the Medallion (2).

1. Scrape off the Medallion (2) 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 adhersive liner and place the Medallion in the recess.
4. Press the Medallion.

NOTE: There are No Other serviceable components on the Main Housing Assembly (M).

8.8.11 Servicing Speaker Module (J)

1. Complete steps 8.7.1 through 8.7.2 of section 8.7 on page 1:8-14.

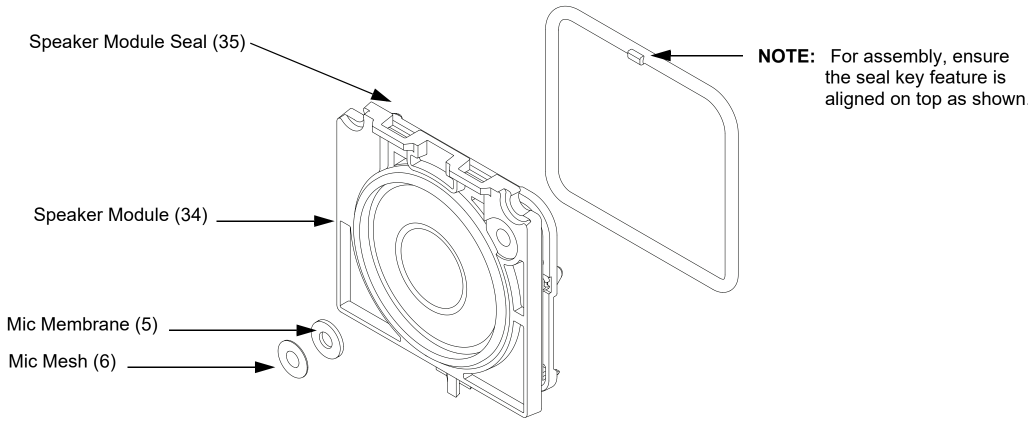

Figure 8-44. Speaker Module

8.8.11.1 Servicing Microphone Membrane/ Microphone Mesh

NOTE: When servicing microphone membrane, microphone mesh part will also need to be replaced.

1. Carefully peel off the Microphone Membrane (5) and Microphone Mesh (6) from the Speaker Module.
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.
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.

8.8.12 Servicing Speaker Grille Assembly (K)

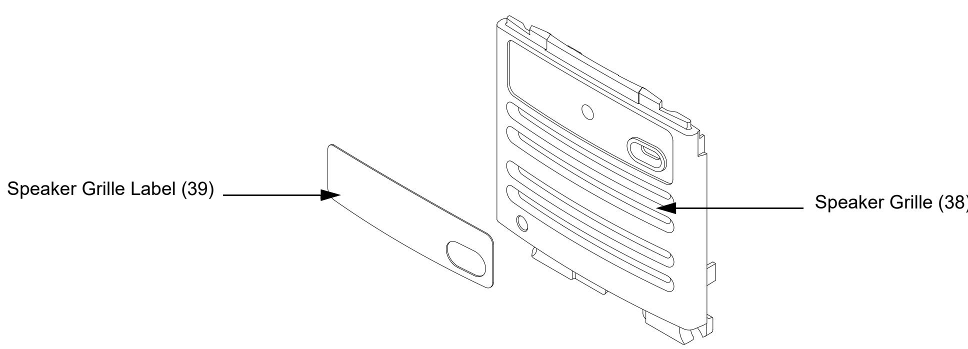

Figure 8-45. Speaker Grille Assembly

8.8.12.1 Servicing Grille Label

NOTE: There is no need to remove any components in order to service the Speaker Grille Label (39).

NOTE: Grille Label will be damaged during its disassembly.

1. Remove the Grille Label by using the Black Stick to lift it. Be careful not to damage the Speaker Grille Assembly's (38) surface.
2. Clean the area once the Grille Label is removed to ensure it is free of adhesive and debris.
3. Remove the backer of the new Grille Label and place in the appropriate location using a flat tip tweezer.

NOTE: There are No Other serviceable components on the Speaker Grille Assembly (K).

8.9 Radio Reassembly

This section contains instructions for reassembling the radio.

8.9.1 Reassemble the Main Sub Assemblies

8.9.1.1 Assemble Control Top Assembly (F) to Main Chassis Assembly (E)

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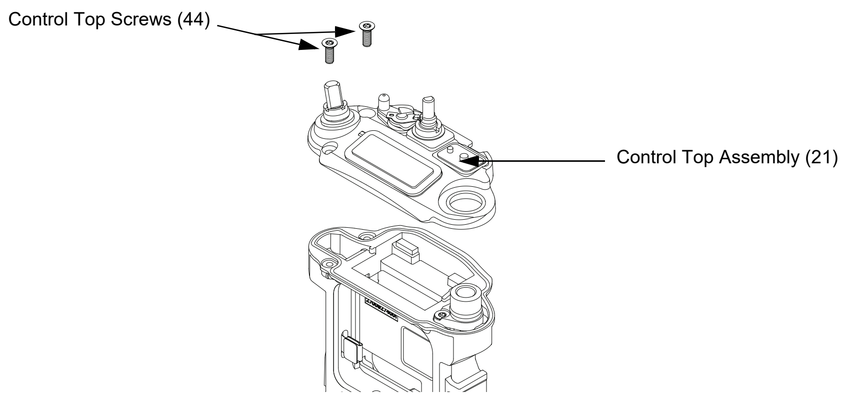


Figure 8-46. Control Top Bezel Assembly

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 (15). Also ensure that the Control Top Main Seal (22) and surrounding surfaces are free of debris and other foreign material.
2. Verify Control Top Main Seal is properly seated into its groove and place Control Top Assembly onto Main Chassis Assembly as shown in Figure 8-46.
3. Torque both screws with a Torx IP8 Bit and a torque Driver to 8 in-lbs.

8.9.1.2 Assemble Knobs and Top Bezel Assembly (G)

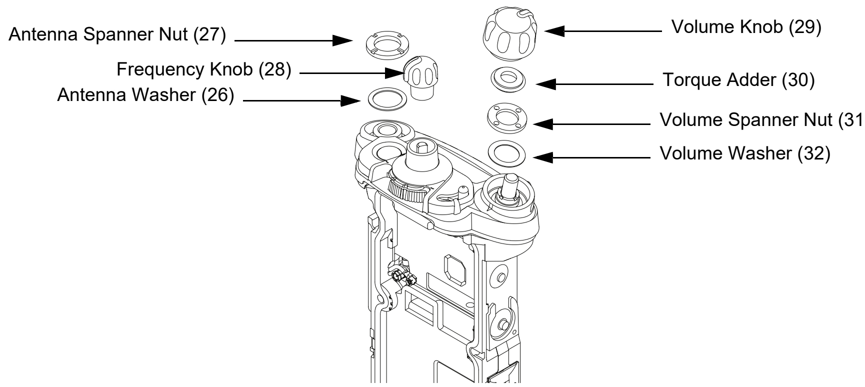


Figure 8-47. Top Bezel Assembly

1. With the Secure Lever (25) 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 (32) onto the Volume Shaft. See Figure 8-47.

3. Tighten the Volume Spanner Nut (31) 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 (26) onto the antenna threaded hub as shown in Figure 8-47. Reuse the Antenna washer if it is metal type. For nylon type, use new Antenna washer from kit KT000009A01.

5. Tighten the Antenna Spanner Nut (27) until it bottoms by hand, to avoid cross threading. If the nylon washer is used, 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 as shown in Figure 8-48. and the threaded portion of the antenna connector. Immediately rotate the antenna spanner nut counter-clockwise (back-out) one full turn.

6. Torque the nut with the Antenna Spanner Bit at 16 in-lbs.

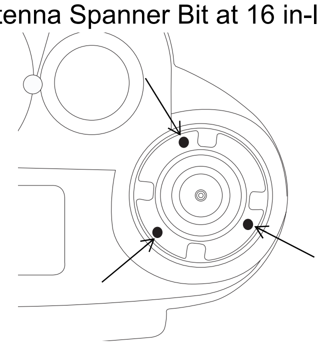


Figure 8-48. Loctite

Caution	Do NOT place the thread-locker within the centre cavity of the antenna connector. Immediately rotate the antenna spanner nut counter-clockwise (back-out) one full turn

7. Slide and ensure the Torque Adder (30) is fully seated onto the Volume Potentiometer's Hub.

8. Align the D-shaped part of the Volume Shaft with the D-shape hole in the Volume Knob (29) and press the Volume Knob into place.

9. Align the D-shaped part of the Frequency Shaft with the D-shape hole in the Frequency Knob (28) and press the Frequency Knob into place.

8.9.1.3 Assemble VOCON Board Assembly (D)

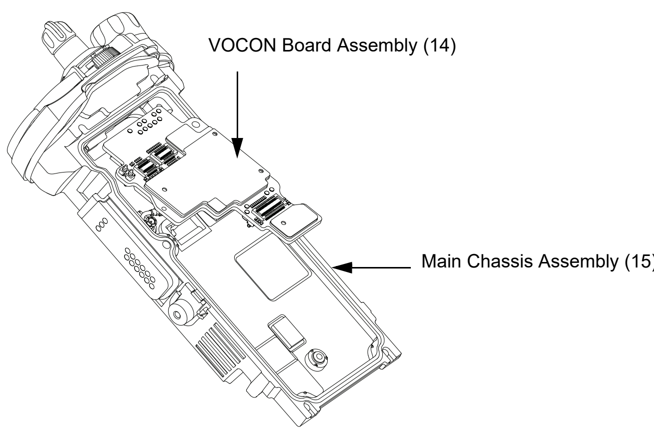


Figure 8-49. Insert VOCON Board

1. Inspect the Main Chassis (15) 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 (15) with the Frequency Knob (28) on top. Insert the VOCON Board Assembly (14) 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. See Figure 8-49.

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.

8.9.1.4 Assemble RF Board Assembly (C)

Caution	Always replace with new thermal pads. See section 8.8.5.2 on page 1:8-26.

1. Inspect the Battery Connector Seal (13) on the RF Board Assembly (9) for any damage or debris. Replace seal if necessary.

2. Connect the small coaxial cable connector into the RF Board (9).

3. Connect the RF Board to the VOCON Board as shown in Figure 8-50.

4. Tighten the RF and VOCON Board screw (45) 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 (1) must be snapped in place prior to connecting the coax.

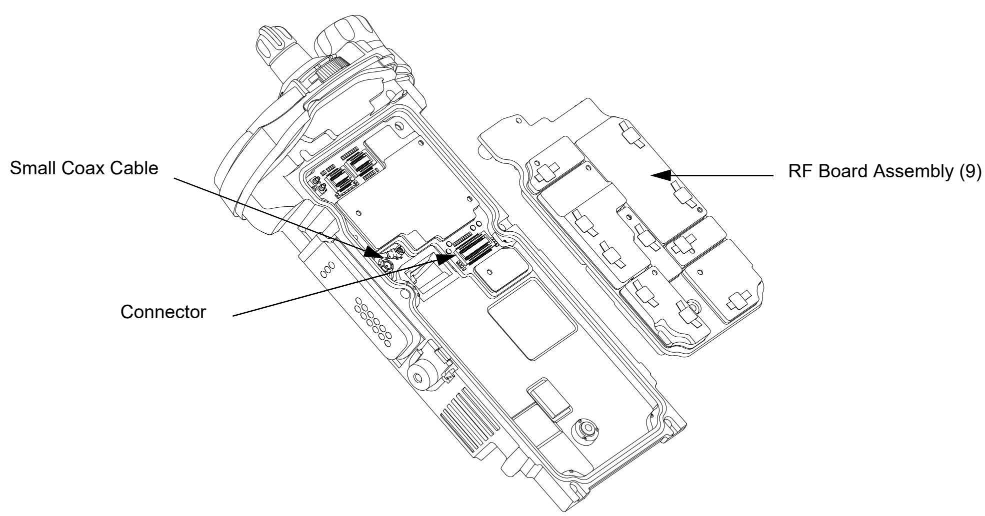


Figure 8-50. Connect RF Board to VOCON Board

8.9.1.5 Assemble Back Chassis Assembly (B, N)

<u>Dual Display versions</u>:

1. Inspect the Back Chassis Assembly Seal for any debris or foreign material.
2. Place the Main Seal (49) onto the main chassis groove. Gently seat the seal around the perimeter of the groove, ensuring the key feature is oriented as shown in Figure 8-51.
3. Connect both Back Chassis Flexes to the VOCON board (D).
4. Set the Back Chassis Assembly (B) onto the Main Chassis Assembly (E).

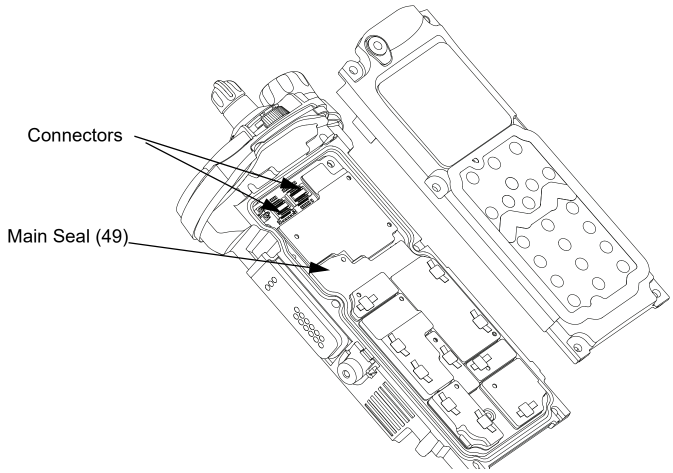


Figure 8-51. Place Back Chassis

Top Display version:

1. Inspect the Back Chassis Assembly (N) seal for any debris or foreign material.
2. Place the Main Seal (49) onto the main chassis groove. Gently seat the seal around the perimeter of the groove, ensuring the key feature is oriented as shown in Figure 8-51.
3. Set the Back Chassis Assembly onto the Main Chassis Assembly (E).

8.9.1.6 Assemble Three-Piece Main Housing Assembly (A, L, M)

1. Snap in the Main Housing Assembly (1, 65, 51) side walls with both hands just enough to attach the Main Chassis Assembly (15) and place it onto the radio.
2. Ensure the top edge of the housing and the bottom edge of the control top are aligned as shown in Figure 8-52. Attach the Front Housing to the radio.
3. Squeeze the Main Housing Assembly (1, 65, 51) and the Main Chassis Assembly (15) in the battery area until the Main Housing Assembly fully snaps in place onto the Main Chassis Assembly.

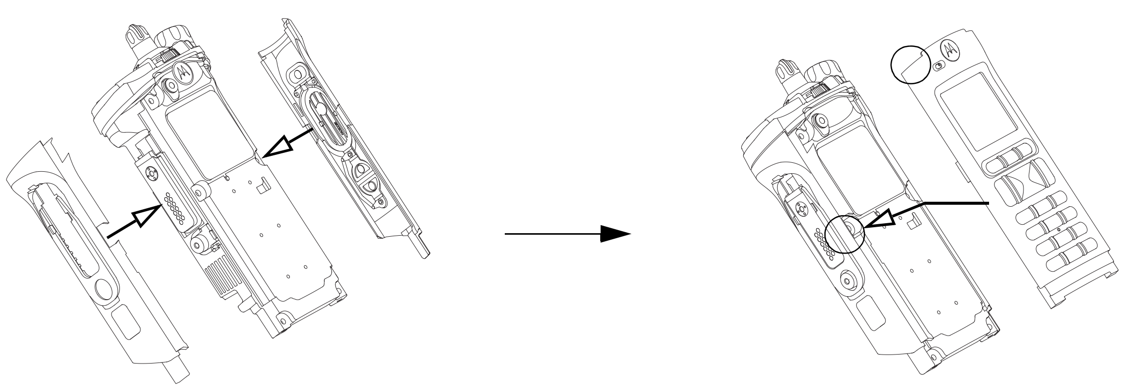


Figure 8-52. Place Three-Piece Housing into Main Chassis

8.9.1.7 Assemble Expansion Board Assembly (H)

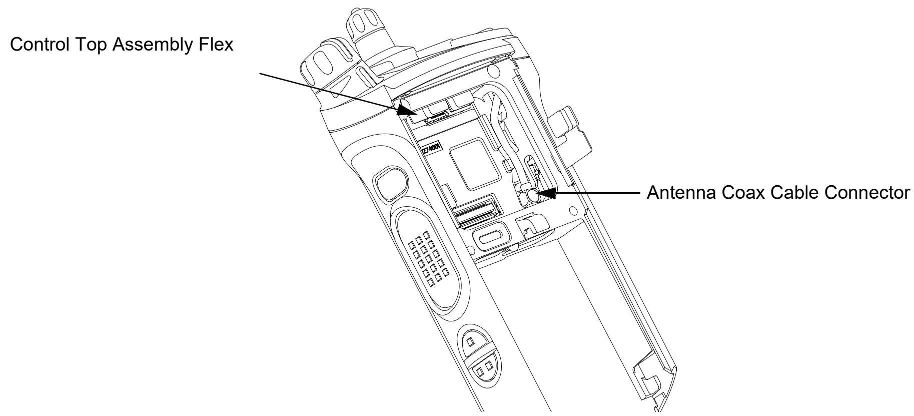


Figure 8-53. Assemble Expansion Board Assembly

1. If the Control Top Assembly (21) or VOCON Board Assembly (14) was NOT removed skip to step 2.
   Connect the Control Top Flex to the VOCON Board Assembly as shown in Figure 8-53.
2. If replacing new Control Top (21) or Main Chassis Assembly (15), add Control Top Support Pads (23) to stainless steel backers at the locations shown on Figure 8-54.
3. If the RF Board Assembly (9) was NOT removed, skip to step 4.
   Carefully align the Antenna Coax Plug to the Coax Receptacle on the RF board Assembly (9) 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 its grooves as shown in Figure 8-53.
5. Plug the Expansion Board Assembly (33) to the VOCON Board Assembly (14) as shown in Figure 8-54. Make sure the connector is fully engaged.
6. Connect the two Flex Connectors to their pairing connectors on the right and left sides of the Expansion Board Assembly as shown in Figure 8-54.

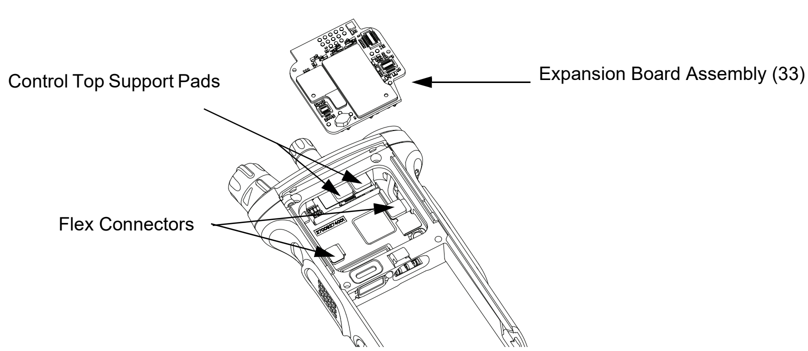


Figure 8-54. Insert Flex Connectors

7. Insert the rounded portion of the Expanded Board Support (61) into the opening of the vacuum test compartment on the expanded side as shown in as shown in Figure 8-52.

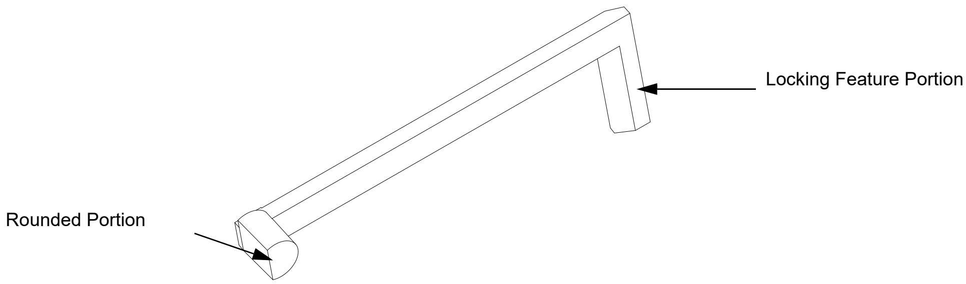


Figure 8-55. Expander Board Support (61)

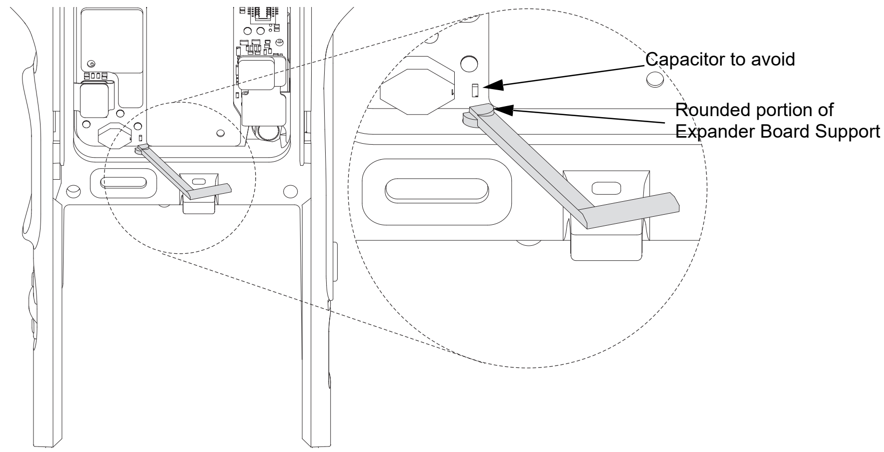


Figure 8-56. Insert Expander Board Support

8. Ensure the Rounded portion of the Expander Board Support is secure properly before rotating the Expander Board Support towards the Antenna Coax Connector.

9. Slide the Locking Feature of the Expander Board Support between the Antenna Coax connector and the Chassis Wall.

10. Gently press down the Expander Board Support into place.

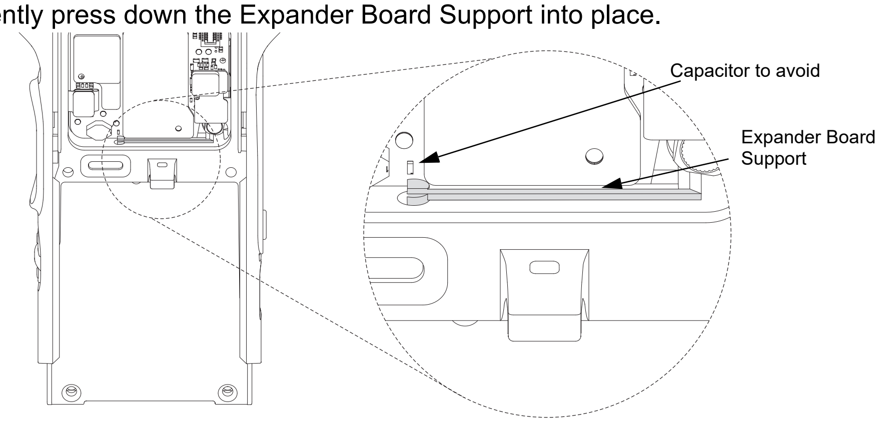


Figure 8-57. Press Expander Board Support into Place (Opt. Expansion Board)

8.9.1.8 Assemble Speaker Module (J)

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.

1. Ensure the Seal is free from any debris or foreign material.

2. Align the Speaker Module's 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 as shown in Figure 8-58.

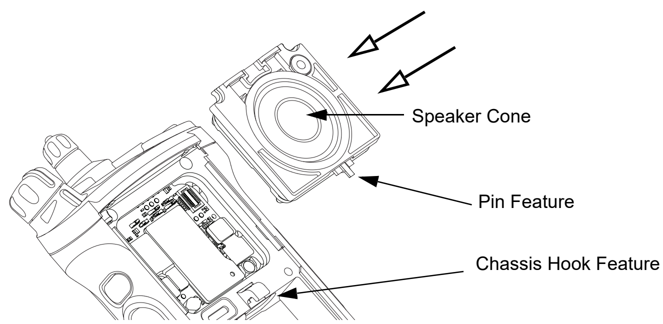


Figure 8-58. Insert Speaker Module

4. While holding the Speaker Module down, place the two top screws (42) into the their respective holes and torque the screws to 10 in-lbs with an IP8 Torx Bit in a torque driver. See Figure 8-59.

IMPORTANT: For proper sealing, Speaker Module (34) must be held down during the torquing of the screws.

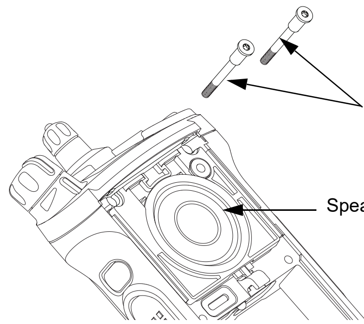


Figure 8-59. Insert Top Screws

8.9.1.9 Assemble Speaker Grille Assembly (K)

1. Install the Speaker Grille (38) by inserting the top lip under the Control Top Bezel (24) and rotating the grille into place. See Figure 8-60. Insert Vacuum Door if it is removed.

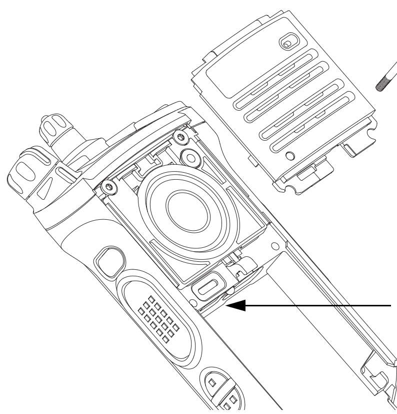


Figure 8-60. Insert Center Screws

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

2. Insert the two center screws (41) and torque to 10 in-lbs. See Figure 8-60.

3. If removed, insert the two bottom screws (43) into the screw holes at the bottom of the radio as shown in Figure 8-61., and torque to 10 in-lbs.

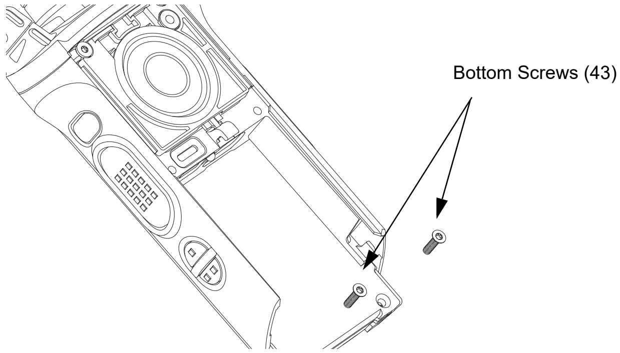


Figure 8-61. Insert Bottom Screws

NOTE: Refer to the appropriate section in this manual for reinstalling the antenna, battery, or any other accessory that was previously connected or attached to the radio prior to servicing.

8.10 Ensuring Radio Submergibility

This section discusses radio submergibility concerns, tests, and disassembly and reassembly of ASTRO APX 5000 R/ APX 6000 R radios.

8.10.1 Standards

ASTRO APX 5000 R/ APX 6000 R radio models meet the stringent requirements of U.S. MIL-STD-810C, Method 512.1, Procedure I; MIL-STD-810D, Method 512.2, Procedure I; MIL-STD-810E, Method 512.3, Procedure I; and MIL-STD-810F, Method 512.4, Procedure I, which require the radio to maintain watertight integrity when immersed in six (6) feet of water for two hours.

8.10.2 Servicing

APX 5000 R/ APX 6000 R radios shipped from the Motorola 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. 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 radio is exposed to water without the battery attached be sure to shake out the water from the battery contact area to avoid causing damage to the radio and battery contacts.

If a conductive medium is present in the water, including salt, salt spray, splash and/or fog), carefully clean the entire radio to remove all conductive medium. Extra attention should be given to all metal surfaces of the radio and/or battery as well as any holes, depressions, or geometry in the radio that may trap the salt/sea water, then shake the radio to remove the excess water from the speaker grille, microphone ports and battery areas.

IMPORTANT: Remove any accessory, including the side connector cover and battery, if applicable, before cleaning the radio. DO NOT use anything abrasive on the metal contacts. Carefully rinse the radio with fresh water and dry it thoroughly with a soft, lint-free cloth.

8.10.4 Specialized Test Equipment

This section summarizes the specialized test equipment necessary for testing the integrity of ASTRO APX 5000 R/ APX 6000 R 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 is needed to perform the vacuum check and pressure testing, if required.

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 (p/n 66009259001) which connects the vacuum pump to the radio, must be ordered separately.

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 section 8.7 on page 1:8-14.

8.10.6 Reassembly

Caution

Do not reassemble the radio without first performing the following preliminary inspection procedure.

To reassemble the radio:

1. Inspect the seal on the Back Chassis Assembly (3, 52) for any damage or foreign material.
2. Inspect the seal on the Speaker Module (34) for any damage or foreign material.
3. Inspect the Battery Connector Seal (13) on the RF Board Assembly (9) for any damage.
4. Inspect the Gore Seal (62) for any nicks or damage and ensure it is fully seated.
5. Inspect the mating seal surfaces on the Main Chassis (15) for all of the above seals for damage or foreign material that might prevent the seals from sealing properly.

Continue reassembling the radio according to section 8.9 on page 1:8-34. Tighten all hardware that was loosened or removed.

8.10.7 Vacuum Test

The Vacuum Test uses a Vacuum Pump 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 (46) or any other accessories to expose the universal connector.
- Remove the screw which holds the vacuum door.
- Remove the vacuum door.

NOTE: Refer to the exploded view diagrams and parts lists found in "Chapter 10: Exploded Views and Parts Lists" on page 1:10-1.

8.10.7.1 Vacuum Tool Setup

1. With Gore Seal removed, replace screw (41) and torque to 10 in-lbs.
2. Attach one end of the hose to the Vacuum Pump. Attach the other side of the hose to the Vacuum Adapter.
3. Tool Leak Test:
   i. Block the open end of the Vacuum Adapter.
   ii. Pull the knob on the Vacuum Pump to create vacuum.
   iii. Pump at least 15 inHg.
   iv. Watch the gauge for a minute. If there is any loss of vacuum, repair or replace the tool.
4. Ensure that the seal is attached to the Vacuum Adapter.

8.10.7.2 Test Procedure

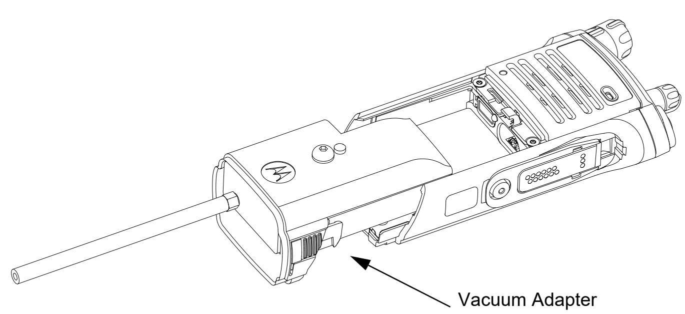


Figure 8-62. Attaching Vacuum Adapter

1. Attach the Vacuum Adapter onto the radio in the same manner as a radio battery. Ensure both latches are clicked into place.
2. 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. The radio has pressure sensitive components that can be damaged if the pressure exceeds this limit.

3. Observe the gauge for approximately 2 minutes.
   - If the needle falls less than 0.25 inHg (Half a tick mark on the recommended Vacuum Pump), the radio passes the vacuum test.
     i. If the seal passes this inspection, this radio is approved for submergibility. No additional testing is required.
   - If the needle falls more than 0.25 inHg, the radio fails the vacuum test and the radio might leak if submerged. Additional troubleshooting of the radio is required.
     i. Keep the Vacuum Adapter on but remove the Vacuum Pump from the Vacuum Adapter.
     ii. Continue with Pressure Test as described in Section 8.10.8.

8.10.8 Pressure Test (using NTN4265_)

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

NOTES: When Radio is placed under the water there will be some air trapped which will be released. This is not a failure.

Refer to the exploded view diagrams and parts lists found in "Chapter 10: Exploded Views and Parts Lists" on page 1:10-1.

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

To conduct the pressure test:

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 will damage the radio.

Caution	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.
10. See "8.10.9: Troubleshooting Leak Areas" on page 1:8-47.

8.10.9 Troubleshooting Leak Areas

Before repairing any leak, first read all of the steps within the applicable section. This will help to eliminate unnecessary disassembly and reassembly of a radio with multiple leaks. Troubleshoot only the faulty seal areas listed in "8.10.8: Pressure Test (using NTN4265_)" on page 1:8-46 and, when multiple leaks exist, in the order listed.

NOTES: All disassembly and reassembly methods can be found in Section 8.7. and Section 8.9.

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 will be needed.

8.10.9.2 Speaker Module

- If leak occurs through the Microphone Membrane (5) or the Speaker Module Seal (35), replace these items.
- If leak occurs elsewhere on the Speaker Module (34), the module will need to be replaced.

8.10.9.3 Battery Contact Seal

- If leak occurs due to damage to the Battery Connector Seal (13), it will need to be replaced.

8.10.9.4 Back Chassis

- If leak occurs through the Microphone Boot (4), replace it.
- If leak occurs through the Color Display Lens (7), replace it.
- If leak occurs elsewhere on the Back Chassis (3,52), it will need to be replaced.

8.10.9.5 Control Top

- If leak occurs through the antenna or the Control Top Seal (22), replace it.
- If leak occurs elsewhere on the Control Top Assembly (21), it will need to be replaced.

8.10.9.6 Main Chassis

- If leak occurs through the Main Seal (49), it will need to be replaced.
- If leak occurs elsewhere on the Main Chassis (15), it will need to be replaced.

Chapter 9 Basic Troubleshooting

This section of the manual contains troubleshooting charts and error codes that will help you to isolate a problem. Level one and two troubleshooting will support only radio alignment, programming, battery replacement, and knob replacement, and circuit board replacement.

Component-level service information can be found in the “ASTRO APX 6000/ APX 6000XE Portable Radios Detailed Service Manual,” Motorola publication number 68012002026.

9.1 Power-Up Error Codes

When the radio is turned on (power-up), the radio performs self-tests to determine if its basic electronics and software are in working order. Problems detected during these tests are presented as error codes on the radio’s display. For non-display radios, the problem will be presented at power-up by a single, low-frequency tone. The radio should be sent to the depot if cycling power and reprogramming the code plug do not solve the problem. The presence of an error should prompt the user that a problem exists and that a service technician should be contacted.

Self-test errors are classified as either fatal or non-fatal. Fatal errors will inhibit user operation; non-fatal errors will not. Use Table 9-1 to aid in understanding particular power-up error code displays.

Table 9-1. Power-Up Error Code Displays

Error Code	Description	Corrective Action
01/02	FLASH ROM Codeplug Checksum Non-Fatal Error	Reprogram the codeplug
01/12	Security Partition Checksum Non-Fatal Error	Send radio to depot
01/81	Host ROM Checksum Fatal Error	Send radio to depot
01/82	FLASH ROM Codeplug Checksum Fatal Error	Reprogram the codeplug
01/84	External EEPROM Blank (or SLIC failure) Fatal Error	Send radio to depot
01/88	External RAM Fatal Error – **Note:** Not a checksum failure	Send radio to depot
01/90	General Hardware Failure Fatal Error	Turn the radio off, then on
01/92	Security Partition Checksum Fatal Error	Send radio to depot
01/93	FLASHport Authentication Code Failure	Send radio to depot
01/94	Internal EEPROM Blank Fatal Error.	Send radio to depot
01/98	Internal RAM Fail Fatal Error	Send radio to depot
01/A0	ABACUS Tune Failure Fatal Error	Send radio to depot
01/A2	Tuning Codeplug Checksum Fatal Error	Send radio to depot
02/81	DSP ROM Checksum Fatal Error	Send radio to depot
02/88	DSP RAM Fatal Error – **Note:** Not a checksum failure	Turn the radio off, then on

Table 9-1. Power-Up Error Code Displays (Continued)

Error Code	Description	Corrective Action
02/90	General DSP Hardware Failure (DSP startup message not received correctly)	Turn the radio off, then on
09/10	Secure Hardware Error	Turn the radio off, then on
09/90	Secure Hardware Fatal Error	Turn the radio off, then on
Hardware board absent/ Hardware board absent then Man-Down Hw error	Expansion board is not connected properly to the radio	Ensure the Expansion board is fixed in place

Note: *If the corrective action does not fix the failure, send the radio to the depot.*

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 radio's display. The presence of an error code should prompt a user that a problem exists and that a service technician should be contacted. Use Table 9-2 to aid in understanding particular operational error codes.

Table 9-2. 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

Table 9-3 lists the possible causes of, and corrections for, receiver problems.

Table 9-3. Receiver Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements at Room Temperature)
Radio Dead; Display Does Not Turn On	1. Dead Battery	Replace with charged battery
	2. Blown Fuse	Send radio to depot
	3. On/Off Switch	
	4. Regulators	
Radio Dead; Display Turns On	1. VOCON Board	Send radio to depot
	2. RF Board	
	3. 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, etc.) 2. Check if radio 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; realign if off by more than ±1000 Hz
RF Sensitivity Poor	1. Synthesizer Not On Frequency	Check synthesizer frequency by measuring the transmitter frequency; realign if off by more than ±1000 Hz
	2. Antenna Switch/ Connector	Send radio to depot
	3. 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

Table 9-4 lists the possible causes of, and corrections for, transmitter problems.

Table 9-4. Transmitter Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
No RF Power Out	1. TX Power Level or Frequency	Check TX power level and frequency programming (from tuner)
	2. No Injection To Power Amplifier	Send radio to depot
	3. Antenna Switch/Connector	
No Modulation; Distorted Modulation	1. Programming	Check deviation and compensation settings using the tuner
	2. VOCON Board	Send radio to depot
Bad Microphone Sensitivity	1. Check Deviation and Compensation	Realign if necessary
	2. Microphone	Send radio to depot
No/Low signaling (PL, DPL, MDC)	1. Programming	Check programming
	2. VOCON Board	Send radio to depot
Cannot Set Deviation Balance	RF Board	Send radio to depot

9.5 Encryption Troubleshooting

Table 9-5 lists the possible causes of, and corrections for, encryption problems.

Table 9-5. Encryption Troubleshooting Chart

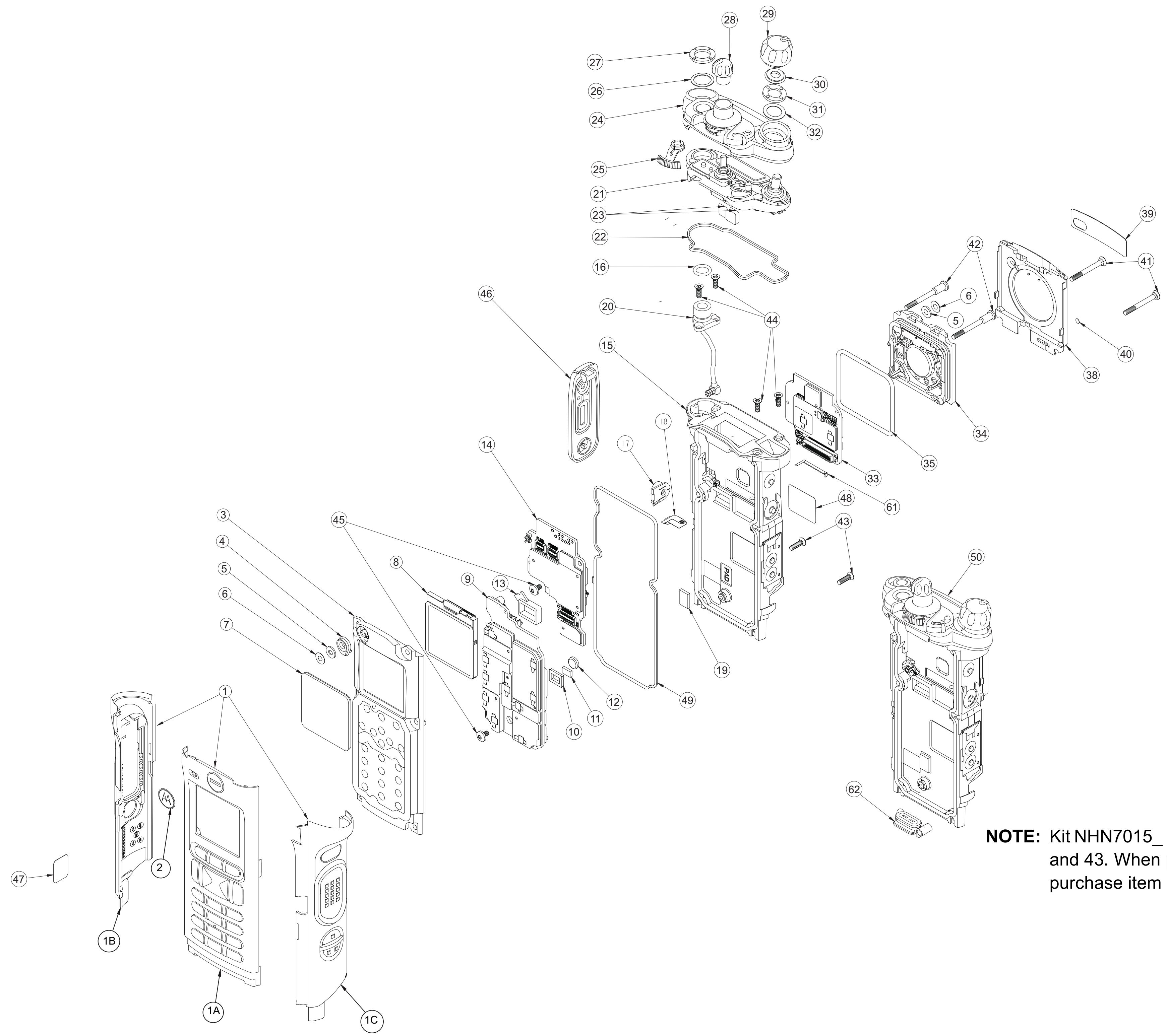
Symptom	Possible Cause	Corrective Action
No “KEYLOAD” on Radio Display When Keyloading Cable is Attached to the Radio Side Connector	1. Defective Keyload Cable	Send radio to depot
	2. Defective Radio	
Keyloader Displays “FAIL”	1. Wrong Keyloader Type	Use correct keyloader type. Refer to Keyloader User Guide for more information
	2. Bad Keyloader	Try another keyloader
	3. 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 APX 5000/ APX 6000/ APX 6000Li digital portable radios. The following table lists the exploded views for the radio in different configurations:

Table 10-1. APX 5000/ APX 6000/ APX 6000Li Exploded Views and Controller Kit

10.1 APX 5000/ APX 6000/ APX 6000Li Dual Display (1-Piece Housing Full Keypad) Exploded View



NOTE: Kit NHN7015_ includes Items #15, 21, 22, 24–32 and 43. When purchasing this kit, need to purchase item 23 (qty. 2) together.

Figure 10-1. APX 5000/ APX 6000/ APX 6000Li Dual Display (Full Keypad) Exploded View

10.2 APX 5000/ APX 6000/ APX 6000Li Dual Display (1-Piece Housing Full Keypad) Exploded View Parts List

Item No.	Motorola Part Number	Description
1	KT000032C_ KT000033C_ KT000034C_ KT000035C_ KT000036C_ KT000037C_ KT000032D_ KT000032E_ KT000032F_	Assembly, Front Housing, Dual Display, M3 (Full Keypad) Assembly, Front Housing, Dual Display, M3 Yellow (Full Keypad) Assembly, Front Housing, Dual Display, M3 Green (Full Keypad) Assembly, Front Housing, Dual Display, M3 Orange (Full Keypad) Assembly, Front Housing, Dual Display, M3 Red (Full Keypad) Assembly, Front Housing, Dual Display, M3 Blue (Full Keypad) Assembly, Front Housing, Dual Display, M3 Black, Hebrew (Full Keypad) Assembly, Front Housing, Dual Display, M3 Black, Cyrillic (Full Keypad) Assembly, Front Housing, Dual Display, M3 Black, Arabic (Full Keypad)
1A	HN008000F03 HN008000F06 HN008000F09	M3 Black Face Housing M3 Yellow Face Housing M3 Green Face Housing
1B	HN008000G08 HN008000G09 HN008000G10 HN008000G12 HN008000G13 HN008000G14	GCAI-side Housing Black GCAI-side Housing Yellow GCAI-side Housing Green GCAI-side Housing Orange GCAI-side Housing Blue GCAI-side Housing Red
1C	HN008000P08 HN008000P09 HN008000P10 HN008000P12 HN008000P13 HN008000P14	PTT-side Housing Black PTT-side Housing Yellow PTT-side Housing Green PTT-side Housing Orange PTT-side Housing Blue PTT-side Housing Red
2	33009265001	Medallion
3	NHN7013_	Assembly, Back Chassis, Dual Display
4	32009357001	Boot, Dataside Mic
5	3275002C03	Mic Membrane
6	35009312002	Mic Mesh
7	61009283002	Lens, Front Display
8	NHN7020_S	Display, Front
9	NUD7120_Z MNUE7365_S NUE7366_Z NUF6750_Z	Board, RF (VHF) Board, RF (UHF1) Board, RF (UHF2) Board, RF (7/800)
10	3275623B03	Thermal Pad, Outer
11	75009299002	Thermal Pad, Inner
12	6071520M01	Battery, Backup, Coincell
13	3271829H02	Seal, Connector, Battery
14	HLN5960_Z	Board, Vocon
15[1]	01009364001	Assembly, Main, Chassis (W/O Control Top)
16	3275033C01	O-Ring, Antenna, Main
17	43009291001	Insert, Universal Connector
18	3971892H01	Contact, Chassis Ground
19	7505316J16	Pad, Coin Cell Battery
20	3075864B02	Cable, RF Coax
21[2]	1375044C06	Assy, Control Top
22	3275031C01	Seal, Control Cap
23[2]	75009418001	Pad, Support
24	1371891H02	Bezel, Control Top, Subassembly
25	4575585B02	Lever, Secure
26	0400129054 HW000085A01	Washer, Lock, Antenna Nylon Washer (sold in sets of 35 in KT000009A01 with thread-lock)
27	0275891B01	Nut, Spanner, Antenna
28	3675590B03	Knob, Frequency
29	3675581B01	Knob, Volume
30	3275377H01	Seal, Cap, Torque Adder
31	0275361H01	Nut, Spanner, Volume
32	0405659W01	Washer, Wave, Volume
33	HLN5978_Z	Std Expansion Board Kit Opt Expansion Board Kit
34	NHN7016_	Module, Speaker
35	32009351001	Seal, Speaker Module
38	NHN7021_S NHN7022_S NHN7023_S	Grille, Speaker (Black) Grille, Speaker (Yellow) Grille, Speaker (Green)
39	33009261001 33009261002 33009261003 33009261004	Label, Grille, Speaker for APX6000 Label, Grille, Speaker for APX6000R Label, Grille, Speaker for APX5000 Label, Grille, Speaker for APX5000R
40	33009271001	Label, Bluetooth APX 5000/ APX 6000/ APX 6000Li
41	0375962B02	Screw(x2), M2.5X0.45, 24.45
42	0375962B01	Screw(x2), M2.5X0.45, 3 0.1
43	0375962B03	Screw(x2), M2.5X0.45, 9.2
44	0375962B04	Screw(x2), M2.5X0.45, 7
45	3009304001	Screw, RF and Vocon Board
46	1575250H01	Cover, Connector, Universal Conncector
49	32009355001	Seal, Main
50[1]	NHN7015_	Assembly, Main Chassis (with Control Top)
61	07009369001	Support, Expander PCB
62	32009356002	Seal, Vacuum Port

NOTE:

1. Kit NHN7015_ includes Items #15, 21, 22, 24–32 and 43. When purchasing this kit, need to purchase item 23 (qty. 2) together.
2. When purchasing item 21, need to purchase item 23 (qty. 2) together.

10.3 APX 5000/ APX 6000/ APX 6000Li Dual Display (1-Piece Housing Limited Keypad) Exploded View

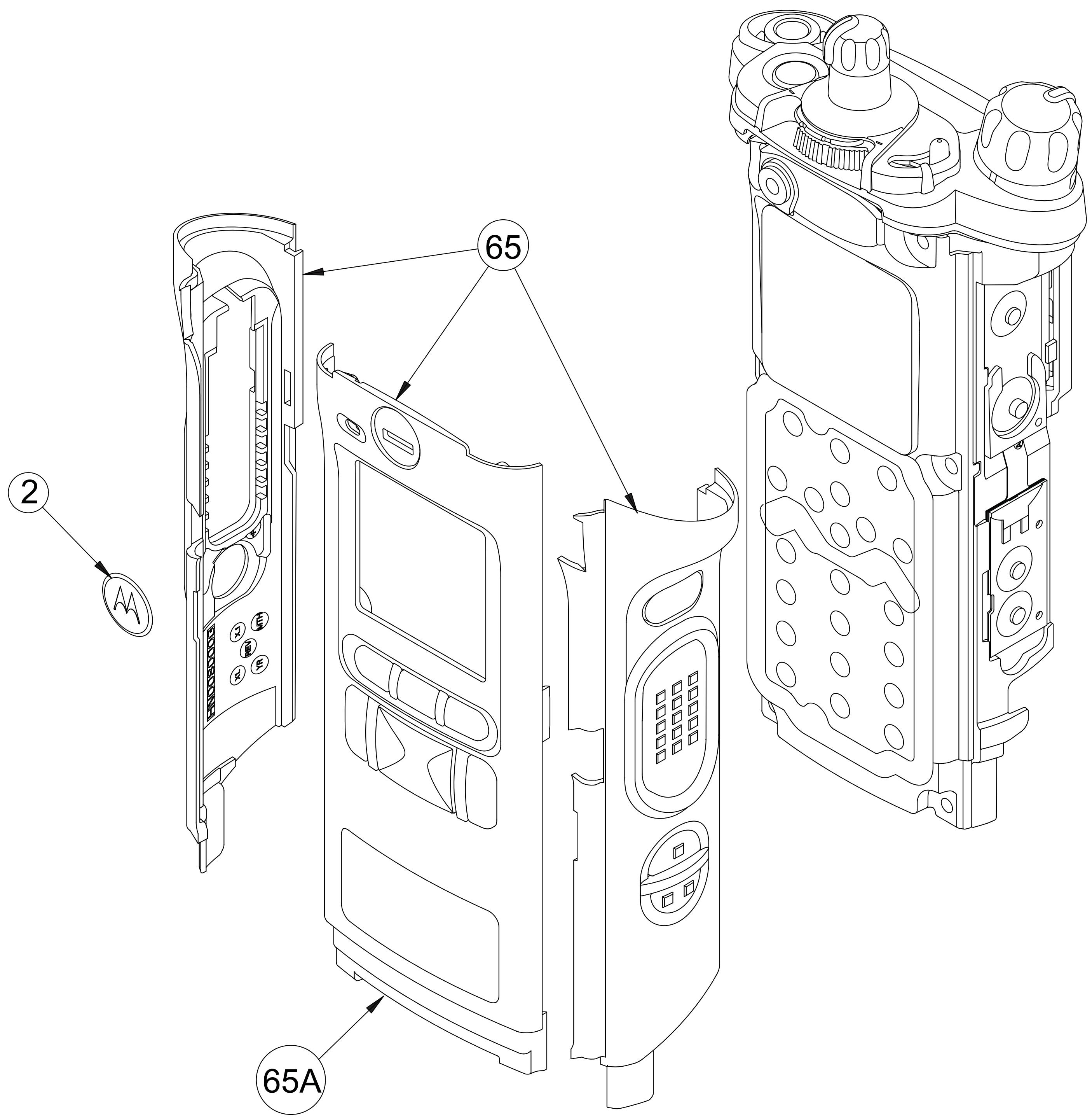


Figure 10-2. APX 5000/ APX 6000/ APX 6000Li Dual Display (Limited Keypad) Exploded View

10.4 APX 5000/ APX 6000/ APX 6000Li Dual Display (1-Piece Housing Limited Keypad) Exploded View Parts List

Item No.	Motorola Part Number	Description
65	KT000032B_ KT000033B_ KT000034B_ KT000035B_ KT000036B_ KT000037B_	Assembly, Front Housing, M2, Black, Dual Display (Limited Keypad) Assembly, Front Housing, M2, Yellow, Dual Display (Limited Keypad) Assembly, Front Housing, M2, Green, Dual Display (Limited Keypad) Assembly, Front Housing, M2, Orange, Dual Display (Limited Keypad) Assembly, Front Housing, M2, Red, Dual Display (Limited Keypad) Assembly, Front Housing, M2, Blue, Dual Display (Limited Keypad)
65A	HN008000F02 HN008000F05 HN008000F08	M2 Black Face Housing M2 Yellow Face Housing M2 Green Face Housing
2	33009265001	Medallion

10.5 APX 5000/ APX 6000/ APX 6000Li Top Display (1-Piece Housing No Keypad) Exploded View

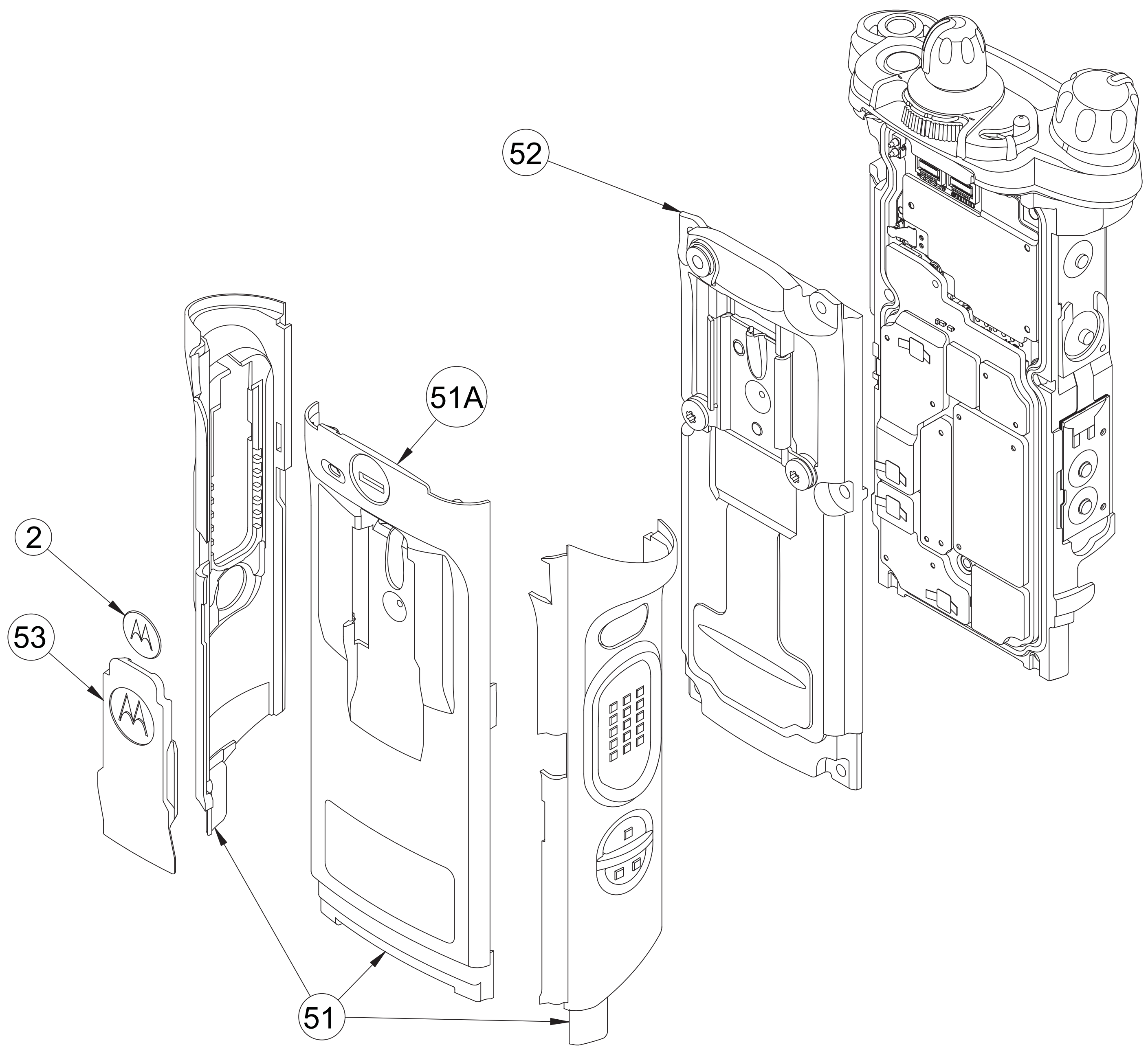


Figure 10-3. APX 5000/ APX 6000/ APX 6000Li Top Display Exploded View

10.6 APX 5000/ APX 6000/ APX 6000Li Top Display (1-Piece Housing No Keypad) Exploded View Parts List

Item No.	Motorola Part Number	Description
51	KT000032A_ KT000033A_ KT000034A_ KT000035A_ KT000036A_ KT000037A_	Assembly, Front Housing, M1, Black, Top Display Assembly, Front Housing, M1, Yellow, Top Display Assembly, Front Housing, M1, Green, Top Display Assembly, Front Housing, M1, Orange, Top Display Assembly, Front Housing, M1, Red, Top Display Assembly, Front Housing, M1, Blue, Top Display
51A	HN008000F01 HN008000F04 HN008000F07	M1 Black Face Housing M1 Yellow Face Housing M1 Green Face Housing
2	33009265001	Medallion
52	NHN7014_	Assembly, Back Chassis, Top Display
53	1575356H01	Cover, Belt Clip, Top Display

10.7 APX 5000/ APX 6000/ APX 6000Li Controller Kit Numbers

Kit Number	Description
NNTN8177_	APX 5000/ APX 6000/ APX 6000Li Mace Expansion Board
NNTN8178_	APX 5000/ APX 6000/ APX 6000Li Mace wth Apps Expansion Board
HLN5960_Z	APX 5000/ APX 6000/ APX 6000Li VOCON Kit

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APX 6000XE Quick Reference Card Model 2 .... PMLN5936_
APX 6000XE Quick Reference Card Model 3 .... PMLN5934_
APX 6000XE Digital Portable Radios Detailed Service Manual 68012002026
APX 6000/ APX 7000 Digital Portable Radios User Guide (CD) .... PMLN5871_

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Model Numbering, Charts, and Specifications

Portable Radio Model Numbering System

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

Position 1 – Type of Unit
H = Hand-Held Portable

Positions 2 & 3 – Model Series
98 = APX 5000/ APX 6000/ APX 6000Li

Position 4 - Frequency Band

- A = Less than 29.7MHz
- B = 29.7 to 35.99MHz
- C = 36 to 41.99MHz
- D = 42 to 50MHz
- F = 66 to 80MHz
- G = 74 to 90MHz
- H = Product Specific
- J = 136 to 162MHz
- K = 146 to 178MHz
- L = 174 to 210MHz
- M = 190 to 235MHz
- P = 336 to 410MHz
- Q = 380 to 470MHz
- R = 438 to 482MHz
- S = 470 to 520MHz
- T = Dual Band Capable
- U = 764 to 870MHz
- V = 825 to 870MHz
- W = 896 to 941MHz
- Y = 1.0 to 1.6GHz
- Z = 1.5 to 2.0GHz

Values given represent range only; they are not absolute.

Position 5 – Power Level

- A = 0 to 0.7 Watts
- B = 0.7 to 0.9 Watts
- C = 1.0 to 3.9 Watts
- D = 4.0 to 5.0 Watts
- E = 5.1 to 6.0 Watts
- F = 6.1 to 10 Watts
- G = 0 to 6 Watts

Position 6 – Physical Packages

- A = RF Modem Operation
- B = Receiver Only
- C = Standard Control; No Display
- D = Standard Control; With Display
- E = Limited Keypad; No Display
- F = Limited Keypad; With Display
- G = Full Keypad; No Display
- H = Full Keypad; With Display
- J = Limited Controls; No Display
- K = Limited Controls; Basic Display
- L = Limited Controls; Limited Display
- M = Rotary Controls; Standard Display
- N = Enhanced Controls; Enhanced Display
- P = Low Profile; No Display
- Q = Low Profile; Basic Display
- R = Low Profile; Basic Display, Full Keypad

Position 7 – Channel Spacing

- 1 = 5kHz
- 2 = 6.25kHz
- 3 = 10kHz
- 4 = 12.5kHz
- 5 = 15kHz
- 6 = 20/25kHz
- 7 = 30kHz
- 9 = Variable/Programmable

Position 8 – Primary Operation

- A = Conventional/Simplex
- B = Conventional/Duplex
- C = Trunked Twin Type
- D = Dual Mode Trunked
- E = Dual Mode Trunked/Duplex
- F = Trunked Type I
- G = Trunked Type II
- H = FDMA* Digital Dual Mode
- J = TDMA** Digital Dual Mode
- K = Single Sideband
- L = Global Positioning Satellite Capable
- M = Amplitude Companded Sideband (ACSB)
- P = Programmable

** FDMA = Frequency Division Multiple Access*
*** TDMA = Time Division Multiple Access*

Position 9 – Primary System Type

- A = Conventional
- B = Privacy Plus
- C = Clear SMARTNET
- D = Advanced Conventional Stat-Alert
- E = Enhanced Privacy Plus
- F = Nauganet 888 Series
- G = Japan Specialized Mobile Radio (JSMR)
- H = Multi-Channel Access (MCA)
- J = CoveragePLUS
- K = MPT1327* – Public
- L = MPT1327* – Private
- M = Radiocom
- N = Tone Signalling
- P = Binary Signalling
- Q = Phonenet
- W = Programmable
- X = Secure Conventional
- Y = Secure SMARTNET

** MPT = Ministry of Posts and Telecommunications*

Position 10 – Feature Level

- 1 = Basic
- 2 = Limited Package
- 3 = Limited Plus
- 4 = Intermediate
- 5 = Standard Package
- 6 = Standard Plus
- 7 = Expanded Package
- 8 = Expanded Plus
- 9 = Full Feature/ Programmable

Position 11 – Version
Version Letter (Alpha) – Major Change

Position 12 – Unique Model Variations

- C = Cenelec
- N = Standard Package

Positions 13 – 16
SP Model Suffix

ASTRO APX 6000XE VHF Model Chart

MODEL NUMBER	
Top Display Model:	H98KGD9PW5_N
Dual Display (Limited Keypad):	H98KGF9PW6_N
Dual Display (Full Keypad):	H98KGH9PW7_N
Non-BT Models FCC ID:	AZ489FT3824
BT Models FCC ID:	AZ489FT3929
MODEL DESCRIPTION:	VHF, APX 6000XE

Top Display Model	Dual Display Model (Limited Keypad)	Dual Display Model (Full Keypad)	ITEM NUMBER	DESCRIPTION
X	X	X	NHN7033_	Sub-Assembly, Main Chassis
●	●	●	NHN7042_	Sub-Assembly, Main Chassis (Yellow)
●	●	●	NHN7043_	Sub-Assembly, Main Chassis (Green)
	X	X	NHN7020_	Display, Color
X	X	X	NHN7034_	Grille, Speaker (Black), APX 6000XE
●	●	●	NHN7036_	Grille, Speaker (Yellow), APX 6000XE
●	●	●	NHN7037_	Grille, Speaker (Green), APX 6000XE
X	X	X	LB000623A02	Label, Grille, APX 6000XE
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261001	Label, Grille Top APX 6000
X	X	X	33009273001	Label, FM, External
X	X	X	33009273002	Label, FM, Internal
X	X	X	75009299002	Pad, Thermal, Inner
X	X	X	07009369001	Support, Expander PCB
O	O	O	HLN5978_	Opt Expansion Board Kit
X	X	X	HLN5977_	Std Expansion Board Kit
X	X	X	HLN5979_	Assembly, VOCON Board
		X	KT000032C_	Assembly, Main Housing, Dual Display/ Full Keypad (Black)
		●	KT000033C_	Assembly, Main Housing, Dual Display/ Full Keypad (Yellow)
		●	KT000034C_	Assembly, Main Housing, Dual Display/ Full Keypad (Green)
	X		KT000032B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Black)
	●		KT000033B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Yellow)
	●		KT000034B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Green)
X			KT000032A_	Assembly, Main Housing, Top Display (Black)
●			KT000033A_	Assembly, Main Housing, Top Display (Yellow)
●			KT000034A_	Assembly, Main Housing, Top Display (Green)
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	NUD7120_	Assembly, RF Board (VHF)
X	X	X	PMLN5871	User Guide CD, APX 6000XE
		●	KT000032D_	Assembly, Main Housing, Dual Display/Full Keypad, Hebrew (Black)
		●	KT000032E_	Assembly, Main Housing, Dual Display/Full Keypad, Cyrillic (Black)
		●	KT000032F_	Assembly, Main Housing, Dual Display/Full Keypad, Arabic (Black)

Note:
X *= Item Included.*
O *= Option available.*
● *= Option available. Can be serviced in depot and ordered thru AAD.*

- *Refer* Appendix A for antennas, batteries and other applicable accessories.

ASTRO APX 6000XE UHF1 Model Chart

MODEL NUMBER				
			Top Display Model:	H98QDD9PW5_N
			Dual Display (Limited Keypad):	H98QDF9PW6_N
			Dual Display (Full Keypad):	H98QDH9PW7_N
			Non-BT Models FCC ID:	AZ489FT4899
			BT Models FCC ID:	AZ489FT4892
			MODEL DESCRIPTION:	UHF1, APX 6000XE
Top Display Model				
	Dual Display Model (Limited Keypad)			
		Dual Display Model (Full Keypad)		
			ITEM NUMBER	**DESCRIPTION**
X	X	X	NHN7033_	Sub-Assembly, Main Chassis
●	●	●	NHN7042_	Sub-Assembly, Main Chassis (Yellow)
●	●	●	NHN7043_	Sub-Assembly, Main Chassis (Green)
	X	X	NHN7020_	Display, Color
X	X	X	NHN7034_	Grille, Speaker (Black)
●	●	●	NHN7036_	Grille, Speaker (Yellow)
●	●	●	NHN7037_	Grille, Speaker (Green)
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261001	Label, Grille Top APX 6000
X	X	X	33009273001	Label, FM, External
X	X	X	33009273002	Label, FM, Internal
X	X	X	75009299002	Pad, Thermal, Inner
X	X	X	07009369001	Support, Expander PCB
O	O	O	HLN5978_	Opt Expansion Board Kit
X	X	X	HLN5977_	Std Expansion Board Kit
X	X	X	HLN5979_	Assembly, VOCON Board
		X	KT000032C_	Assembly, Main Housing, Dual Display/ Full Keypad (Black)
		●	KT000033C_	Assembly, Main Housing, Dual Display/ Full Keypad (Yellow)
		●	KT000034C_	Assembly, Main Housing, Dual Display/ Full Keypad (Green)
	X		KT000032B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Black)
	●		KT000033B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Yellow)
	●		KT000034B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Green)
X			KT000032A_	Assembly, Main Housing, Top Display (Black)
●			KT000033A_	Assembly, Main Housing, Top Display (Yellow)
●			KT000034A_	Assembly, Main Housing, Top Display (Green)
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	MNUE7365	Assembly, RF Board (UHF1)
X	X	X	PMLN5817	User Guide CD, APX 6000XE
		●	KT000032D_	Assembly, Main Housing, Dual Display/Full Keypad, Hebrew (Black)
		●	KT000032E_	Assembly, Main Housing, Dual Display/Full Keypad, Cyrillic (Black)
		●	KT000032F_	Assembly, Main Housing, Dual Display/Full Keypad, Arabic (Black)

Note:
X *= Item Included.*
O *= Option available.*
● *= Option available. Can be serviced in depot and ordered thru AAD.*

- *Refer* Appendix A for antennas, batteries and other applicable accessories.

ASTRO APX 6000XE UHF2 Model Chart

MODEL NUMBER				
			Top Display Model:	H98SDD9PW5_N
			Dual Display (Limited Keypad):	H98SDF9PW6_N
			Dual Display (Full Keypad):	H98SDH9PW7_N
			Non-BT Models FCC ID:	AZ489FT4858
			BT Models FCC ID:	AZ489FT4903
			MODEL DESCRIPTION:	UHF2, APX 6000XE
Top Display Model				
	Dual Display Model (Limited Keypad)			
		Dual Display Model (Full Keypad)		
			ITEM NUMBER	DESCRIPTION
X	X	X	NHN7033_	Sub-Assembly, Main Chassis
●	●	●	NHN7042_	Sub-Assembly, Main Chassis (Yellow)
●	●	●	NHN7043_	Sub-Assembly, Main Chassis (Green)
	X	X	NHN7020_	Display, Color
X	X	X	NHN7034_	Grille, Speaker (Black)
●	●	●	NHN7036_	Grille, Speaker (Yellow)
●	●	●	NHN7037_	Grille, Speaker (Green)
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261001	Label, Grille Top APX 6000
X	X	X	33009273001	Label, FM, External
X	X	X	33009273002	Label, FM, Internal
X	X	X	75009299002	Pad, Thermal, Inner
X	X	X	07009369001	Support, Expander PCB
O	O	O	HLN5978_	Opt Expansion Board Kit
X	X	X	HLN5977_	Std Expansion Board Kit
X	X	X	HLN5979_	Assembly, VOCON Board
		X	KT000032C_	Assembly, Main Housing, Dual Display/ Full Keypad (Black)
		●	KT000033C_	Assembly, Main Housing, Dual Display/ Full Keypad (Yellow)
		●	KT000034C_	Assembly, Main Housing, Dual Display/ Full Keypad (Green)
	X		KT000032B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Black)
	●		KT000033B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Yellow)
	●		KT000034B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Green)
X			KT000032A_	Assembly, Main Housing, Top Display (Black)
●			KT000033A_	Assembly, Main Housing, Top Display (Yellow)
●			KT000034A_	Assembly, Main Housing, Top Display (Green)
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	NUE7366_	Assembly, RF Board (UHF2)
X	X	X	PMLN5817	User Guide CD, APX 6000XE

Note:
X *= Item Included.*
O *= Option available.*
● *= Option available. Can be serviced in depot and ordered thru AAD.*
- *Refer* Appendix A for antennas, batteries and other applicable accessories.

ASTRO APX 6000XE 700–800 MHz Model Chart

MODEL NUMBER				
			Top Display Model:	H98UCD9PW5_N
			Dual Display (Limited Keypad):	H98UCF9PW6_N
			Dual Display (Full Keypad):	H98UCH9PW7_N
			Non-BT Models FCC ID:	AZ489FT5859
			BT Models FCC ID:	AZ489FT5863
			MODEL DESCRIPTION:	700–800, APX 6000XE
Top Display Model				
	Dual Display Model (Limited Keypad)			
		Dual Display Model (Full Keypad)		
			ITEM NUMBER	DESCRIPTION
X	X	X	NHN7033_	Sub-Assembly, Main Chassis
X	X	X	NHN7042_	Sub-Assembly, Main Chassis (Yellow)
X	X	X	NHN7043_	Sub-Assembly, Main Chassis (Green)
	X	X	NHN7020_	Display, Color
X	X	X	NHN7034_	Grille, Speaker (Black)
●	●	●	NHN7036_	Grille, Speaker (Yellow)
●	●	●	NHN7037_	Grille, Speaker (Green)
X	X	X	0375962B01	Screw, Chassis (M2.5 x 30.1 mm)
X	X	X	0375962B02	Screw, Chassis (M2.5 x 24.45 mm)
X	X	X	0375962B03	Screw, Chassis (M2.5 x 9.2 mm)
X	X	X	0375962B04	Screw, Chassis (M2.5 x 7.0 mm)
X	X	X	1575250H01	Cover, Universal Connector
X	X	X	43009291001	Insert, Universal Connector
X			1575356H01	Cover, Belt Clip, Top Display
X	X	X	75009418001	Pad, Controls Flex Support
X	X	X	3271829H02	Seal, Battery Connector
X	X	X	3275623B03	Pad, Thermal, Outer
X	X	X	32009356002	Seal, Vacuum Port
X	X	X	33009261001	Label, Grille Top APX 6000
X	X	X	33009273001	Label, FM, External
X	X	X	33009273002	Label, FM, Internal
X	X	X	75009299002	Pad, Thermal, Inner
X	X	X	07009369001	Support, Expander PCB
O	O	O	HLN5978_	Opt Expansion Board Kit
X	X	X	HLN5977_	Std Expansion Board Kit
X	X	X	HLN5979_	Assembly, VOCON Board
		X	KT000032C_	Assembly, Main Housing, Dual Display/ Full Keypad (Black)
		●	KT000033C_	Assembly, Main Housing, Dual Display/ Full Keypad (Yellow)
		●	KT000034C_	Assembly, Main Housing, Dual Display/ Full Keypad (Green)
	X		KT000032B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Black)
	●		KT000033B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Yellow)
	●		KT000034B_	Assembly, Main Housing, Dual Display/ Limited Keypad (Green)
X			KT000032A_	Assembly, Main Housing, Top Display (Black)
●			KT000033A_	Assembly, Main Housing, Top Display (Yellow)
●			KT000034A_	Assembly, Main Housing, Top Display (Green)
X	X	X	NHN7016_	Assembly, Speaker Module
	X	X	NHN7013_	Sub-Assembly, Back Chassis, Dual Display
X			NHN7014_	Sub-Assembly, Back Chassis, Top Display
X	X	X	NUF6750_	Assembly, RF Board (7–800 MHz)
X	X	X	PMLN5817	User Guide CD, APX 6000XE

Note:
X *= Item Included.*
O *= Option available.*
● *= Option available. Can be serviced in depot and ordered thru AAD.*
• *Refer* Appendix A for antennas, batteries and other applicable accessories.

Specifications for APX 6000XE VHF Radios

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

GENERAL

Temperature Range:

Operating:	-30°C to +60°C
Storage:	-40°C to +85°C

Power Supply:
Nickel-Metal-Hydride Battery (NiMH)
or Lithium-Ion Battery (Li-Ion)

Battery Voltage:

Nominal:	7.5 Vdc
Range:	6 to 9 Vdc

Transmit Current Drain (Typical):	2060 mA
Receive Current Drain (Rated Audio):	241 mA
Standby Current Drain:	137 mA

Recommended Battery:

Li-Ion (Slim):	PMN4403_
or **Li-Ion:**	NNTN7038_
or **Li-Ion Ultra High Cap:**	NNTN7034_
or **Li-Ion Ultra High Cap and FM:**	NNTN7033_*
or **NiMH:**	NNTN7037_
or **NiMH Ruggedized:**	NNTN7573_
or **NiMH FM (Factory Mutual):**	NNTN7036_*
or **Li-Ion Ruggedized and FM:**	NNTN8092_*
or **NiMH Ruggedized and FM:**	NNTN7035_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 6.15" (156.3 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.60" (40.5 mm) / 1.4" (35.5 mm)

With Slim Li-Ion Battery:
H = 6.41" (162.8 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.65" (41.9 mm) / 1.4" (5.5 mm)

With NiMH Battery:
H = 8.41" (213.6 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.65" (41.9 mm) / 1.4" (35.5 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):

Less Battery:	13.7 oz (389 g)
With Li-Ion Slim:	18.7 oz (530 g)
With Li-Ion Ultra High Cap:	24.1 oz (683 g)
With NiMH:	25.3 oz (717 g)

RECEIVER

Frequency Range:	136–174 MHz
Bandwidth:	90 MHz
Analog Sensitivity (typical)	
(12 dB SINAD):	0.17µV
Digital Sensitivity (typical)	
(1% BER):	0.243 µV
(5% BER):	0.15 µV
Intermodulation (typical):	-81.88 dB
Selectivity (typical):	
(25 kHz Channel):	-81.3 dB
(12.5 kHz Channel):	-73.34 dB
Spurious Rejection (typical):	-90.96 dB
Frequency Stability	
(-30+60°C; 25°C reference):	±0.000086%
Rated Audio:	
Internal Speaker:	500 mW
External Speaker:	500 mW
FM Hum and Noise (typical):	
	25 kHz -56.8 dB
	12.5 kHz -50.29 dB
Distortion (typical):	1.57 %
Channel Spacing:	12.5/25 kHz

TRANSMITTER

Frequency Range:	136–174 MHz
RF Power:	
136–174 MHz:	1–6 W
Frequency Stability (typical)	
(-30 to +60°C; 25°C ref.):	±0.000080%
Emission (typical conducted):	-75 dBc
FM Hum and Noise (typical)	
(Companion Receiver):	25 kHz -47 dB
	12.5 kHz -45 dB
Distortion (typical):	1%
Modulation Limiting:	25 kHz chnls ±5 kHz
	20 kHz chnls ±4 kHz
	12.5 kHz chnls ±2.5 kHz
ACPR (typical):	25 kHz -75 dBc
	12.5 kHz -68 dBc

Emissions Designators:
11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

Specifications for APX 6000XE UHF1 Radios

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

GENERAL

Temperature Range:	
Operating:	-30°C to +60°C
Storage:	-40°C to +85°C
Power Supply:	Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion)
Battery Voltage:	
Nominal:	7.5 Vdc
Range:	6 to 9 Vdc
Transmit Current Drain (Typical):	1960 mA
Receive Current Drain (Rated Audio):	242 mA
Standby Current Drain:	133 mA
Recommended Battery:	
Li-Ion (Slim):	PMN4403_
or **Li-Ion:**	NNTN7038_
or **Li-Ion Ultra High Cap:**	NNTN7034_
or **Li-Ion Ultra High Cap and FM:**	NNTN7033_*
or **NiMH:**	NNTN7037_
or **NiMH Ruggedized:**	NNTN7573_
or **NiMH FM (Factory Mutual):**	NNTN7036_*
or **Li-Ion Ruggedized and FM:**	NNTN8092_*
or **NiMH Ruggedized and FM:**	NNTN7035_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 6.15" (156.3 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.60" (40.5 mm) / 1.4" (35.5 mm)

With Slim Li-Ion Battery:
H = 6.41" (162.8 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.65" (41.9 mm) / 1.4" (5.5 mm)

With NiMH Battery:
H = 8.41" (213.6 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.65" (41.9 mm) / 1.4" (35.5 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):	
Less Battery:	13.7 oz (389 g)
With Li-Ion Slim:	18.7 oz (530 g)
With Li-Ion Ultra High Cap:	24.1 oz (683 g)
With NiMH:	25.3 oz (717 g)

RECEIVER

Frequency Range:	380–470 MHz
Bandwidth:	90 MHz
Analog Sensitivity (typical)	
(12 dB SINAD):	0.224 µV
Digital Sensitivity (typical)	
(1% BER):	0.298 µV
(5% BER):	0.2 µV
Intermodulation (typical):	-81.5 dB
Selectivity (typical):	
(25 kHz Channel):	-77 dB
(12.5 kHz Channel):	-66.7 dB
Spurious Rejection (typical):	-80.5 dB
Frequency Stability	
(-30+60°C; 25°C reference):	±0.000086%
Rated Audio:	
Internal Speaker:	500 mW
External Speaker:	500 mW
FM Hum and Noise (typical):	25 kHz -53.5 dB 12.5 kHz -47.4 dB
Distortion (typical):	0.91 %
Channel Spacing:	12.5/25 kHz

TRANSMITTER

Frequency Range:	380–470 MHz
RF Power:	
380–470 MHz:	5 W
Frequency Stability (typical)	
(-30 to +60°C; 25°C ref.):	±0.000035%
Emission (typical conducted):	-75 dBc
FM Hum and Noise (typical)	
(Companion Receiver):	25 kHz -49.5 dB 12.5 kHz -52 dB
Distortion (typical):	1%
Modulation Limiting:	25 kHz chnls ±5.0 kHz 20 kHz chnls ±4 kHz 12.5 kHz chnls ±2.5 kHz
ACPR (typical):	25 kHz -72 dBc 12.5 kHz -68 dBc

Emissions Designators:
11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

Specifications for APX 6000XE UHF2 Radios

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

NOTE: UHF2 operation within the United Stated is limited to 12.5 kHz Channel Spacing due to the 2011 FCC narrowband regulations.

GENERAL

Temperature Range:	
Operating:	-30°C to +60°C
Storage:	-40°C to +85°C
Power Supply:	Nickel-Metal-Hydride Battery (NiMH) *or* Lithium-Ion Battery (Li-Ion)
Battery Voltage:	
Nominal:	7.5 Vdc
Range:	6 to 9 Vdc
Transmit Current Drain (Typical):	1990 mA
Receive Current Drain (Rated Audio):	238 mA
Standby Current Drain:	134 mA
Recommended Battery:	
Li-Ion (Slim):	PMN4403_
or **Li-Ion:**	NNTN7038_
or **Li-Ion Ultra High Cap:**	NNTN7034_
or **Li-Ion Ultra High Cap and FM:**	NNTN7033_*
or **NiMH:**	NNTN7037_
or **NiMH Ruggedized:**	NNTN7573_
or **NiMH FM (Factory Mutual):**	NNTN7036_*
or **Li-Ion Ruggedized and FM:**	NNTN8092_*
or **NiMH Ruggedized and FM:**	NNTN7035_*

* FM Intrinsically Safe.

Dimensions (H x W x D):

Without Battery (Radio Only):
H = 6.15" (156.3 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.60" (40.5 mm) / 1.4" (35.5 mm)

With Slim Li-Ion Battery:
H = 6.41" (162.8 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.65" (41.9 mm) / 1.4" (5.5 mm)

With NiMH Battery:
H = 8.41" (213.6 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.65" (41.9 mm) / 1.4" (35.5 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):	
Less Battery:	13.7 oz (389 g)
With Li-Ion Slim:	18.7 oz (530 g)
With Li-Ion Ultra High Cap:	24.1 oz (683 g)
With NiMH:	25.3 oz (717 g)

RECEIVER

Frequency Range:	450–520 MHz
Bandwidth:	70 MHz
Analog Sensitivity (typical)	
(12 dB SINAD):	0.203 μV
Digital Sensitivity (typical)	
(1% BER):	0.296 μV
(5% BER):	0.204 μV
Intermodulation (typical):	-80.4 dB
Selectivity (typical):	
(25 kHz Channel):	-78.1 dB
(12.5 kHz Channel):**	-68.5 dB
Spurious Rejection (typical):	-80.8 dB
Frequency Stability	
(-30+60°C; 25°C reference):	±0.000086%
Rated Audio:	
Internal Speaker:	500 mW
External Speaker:	500 mW
FM Hum and Noise (typical):	25 kHz -53.9 dB 12.5 kHz** -47.6 dB
Distortion (typical):	0.9 %
Channel Spacing:	12.5 kHz**/25 kHz

TRANSMITTER

Frequency Range:	450–520 MHz
RF Power:	
450–520 MHz:	5 W
Frequency Stability (typical)	
(-30 to +60°C; 25°C ref.):	±0.000080%
Emission (typical conducted):	-75 dBc
FM Hum and Noise (typical)	
(Companion Receiver):	25 kHz -49 dB 12.5 kHz** -44 dB
Distortion (typical):	1%
Modulation Limiting:	25 kHz chnls ±5.0 kHz 20 kHz chnls ±4 kHz 12.5 kHz** chnls ±2.5 kHz
ACPR (typical):	25 kHz -72 dBc 12.5 kHz** -65 dBc

Emissions Designators:
11K0F3E**, 16K0F3E, 8K10F1D**, 8K10F1E**, 8K10F1W**, 20K0F1E

Note:
** UHF2 operation within the United States is limited to 12.5 kHz Channel Spacing due to the 2011 FCC narrowband regulations.

Specifications subject to change without notice.

Specifications for APX 6000XE 7–800 MHz Radios

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

GENERAL

Temperature Range:
Operating: -30°C to +60°C
Storage: -40°C to +85°C

Power Supply:
Nickel-Metal-Hydride Battery (NiMH)
or Lithium-Ion Battery (Li-Ion)

Battery Voltage:
Nominal: 7.5 Vdc
Range: 6 to 9 Vdc

Transmit Current Drain (Typical):
700 MHz: 1410 mA
800 MHz: 1696 mA
Receive Current Drain (Rated Audio): 250 mA
Standby Current Drain: 142 mA

Recommended Battery:
Li-Ion (Slim): PMN4403_
or **Li-Ion:** NNTN7038_
or **Li-Ion Ultra High Cap:** NNTN7034_
or **Li-Ion Ultra High Cap and FM:** NNTN7033_*
or **NiMH:** NNTN7037_
or **NiMH Ruggedized:** NNTN7573_
or **NiMH FM (Factory Mutual):** NNTN7036_*
or **Li-Ion Ruggedized and FM:** NNTN8092_*
or **NiMH Ruggedized and FM:** NNTN7035_*
* FM Intrinsically Safe.

Dimensions (H x W x D):
Without Battery (Radio Only):
H = 6.15" (156.3 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.60" (40.5 mm) / 1.4" (35.5 mm)
With Slim Li-Ion Battery:
H = 6.41" (162.8 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.65" (41.9 mm) / 1.4" (5.5 mm)
With NiMH Battery:
H = 8.41" (213.6 mm)
W[1] = 3.32" (84.3 mm) / 2.39" (60.7 mm)
D[2] = 1.65" (41.9 mm) / 1.4" (35.5 mm)

Note:
H = Height; W = Width; D = Depth
1 = (Width @ Top) / (Width @ PTT)
2 = (Depth @ Bottom) / (Depth @ PTT)

Weight: (w/o Antenna):
Less Battery: 13.7 oz (389 g)
With Li-Ion Slim: 18.7 oz (530 g)
With Li-Ion Ultra High Cap: 24.1 oz (683 g)
With NiMH: 25.3 oz (717 g)

RECEIVER

Frequency Range:
700 MHz: 764–776 MHz
800 MHz: 851–870 MHz

Bandwidth:
700 MHz: 12 MHz
800 MHz: 19 MHz

Analog Sensitivity (typical)
(12 dB SINAD): 0.25 μV

Digital Sensitivity (typical)
(1% BER): 0.375 μV
(5% BER): 0.24 μV

Intermodulation (typical): -80.05 dB

Selectivity (typical):
(25 kHz Channel): -75.87 dB
(12.5 kHz Channel): -65.58 dB

Spurious Rejection (typical): -82.16 dB

Frequency Stability
(-30+60°C; 25°C reference): ±0.000086%

Rated Audio:
Internal Speaker: 500 mW
External Speaker: 500 mW

FM Hum and Noise (typical):
25 kHz -54 dB
12.5 kHz -47.92 dB

Distortion (typical): 1.74 %

Channel Spacing: 12.5/25 kHz

TRANSMITTER

Frequency Range:
700 MHz: 764–776; 794–806 MHz
800 MHz: 806–825; 851–870 MHz

RF Power:
700 MHz: 1–2.7 Watts
800 MHz: 1–3.0 Watts

Frequency Stability (typical)
(-30 to +60°C; 25°C ref.):
700 MHz: ±0.000080%
800 MHz: ±0.000080%

Emission (typical conducted): -75 dBc

FM Hum and Noise (typical)
(Companion Receiver): 25 kHz -47 dB
12.5 kHz -45 dB

Distortion (typical): 2%

Modulation Limiting: 25 kHz chnls ±5 kHz
20 kHz chnls ±4 kHz
12.5 kHz chnls ±2.5 kHz

ACPR (typical): 25 kHz -72 dBc
12.5 kHz -66 dBc

Emissions Designators:
11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, 8K10F1W, 20K0F1E

Specifications subject to change without notice.

Chapter 1 Introduction

This manual contains information needed for Levels 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

Included in this manual is radio specification for the VHF (136–174 MHz), UHF1 (380–470 MHz), UHF2 (450–520 MHz) and 764–870 MHz frequency bands, a general description of ASTRO APX 6000XE models, recommended test equipment, service aids, radio alignment procedures, general maintenance recommendations, procedures for assembly and disassembly, and exploded views and parts lists.

1.2 Notations Used in This Manual

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

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

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

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

DANGER	**DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or injury.**

1.3 Radio Description

The ASTRO APX 6000XE radios are among the most sophisticated two-way radios available.

The ASTRO APX 6000XE 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.

ASTRO APX 6000XE radios are available in two configurations – Top Display and Dual Display. Table 1-1 describes their basic features.

Table 1-1. ASTRO APX 6000XE Basic Features

Feature	Top-Display	Dual-Display
Display	LCD (monochrome) Fully bit-mapped Top Display: • 1 line of text (8 characters per line) • 1 line of icons	LCD • Top Display – monochrome • Front Display – color Fully bit-mapped Top Display: • 1 line of text (8 characters per line) • 1 line of icons Front Display: *Dispatch Mode*: • 5 lines of text (14 characters per line) *List Feature Mode*: • 6 lines of text (14 characters per line) • 2 lines of icons
Keypad	None	Dual Display, Limited Keypad Version: 3 x 2 Menu Buttons (with 4-way Navigation button), Dual Display, Full Keypad Version: 3 x 4 Alphanumeric Keypad
Channel Capability	96	1250
Dialing from Prestored List	No	Yes
Programmable Softkeys	No	Yes

1.4 FLASHport®

The ASTRO APX 6000XE radio utilizes Motorola's FLASHport technology. FLASHport makes it possible to add software that drives the radio's capabilities both at the time of purchase and later on. Previously, changing a radio's features and capabilities meant significant modifications or buying a new radio. But now, similar to how a computer can be loaded with different software, the radio's features and capabilities can be upgraded with FLASHport software.

Chapter 2 Basic Maintenance

This chapter describes preventive maintenance and handling precautions. Each of these topics provides information vital to the successful operation and maintenance of your radio.

2.1 General Maintenance

In order to avoid operating outside the limits set by the FCC, we recommend that you align the ASTRO APX 6000XE radio’s reference oscillator 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 Section “6.5.1 Reference Oscillator Alignment” on page 2:6-4). Periodic visual inspection and cleaning is also recommended.

Radio Submergibility – Radio submergibility should be checked annually by qualified service technicians.

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.

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

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.

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 should be applied sparingly with a stiff, non-metallic, 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 grill 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.

High Debris Environment

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

Speaker Grill: In high debris environments, the speaker grill may trap dirt and debris, resulting in degraded audio quality and clarity. Motorola recommends vacuuming the speaker grill to maintain optimal audio performance. Attach a crevice nozzle to a vacuum cleaner, and vacuum the speaker grill (See Figure 2-1.). Avoid covering all the grill openings at once with the nozzle. Move the nozzle back and forth several times horizontally across the grill. Perform a “Talk and Listen” test to confirm audio performance has returned to normal. If audio issues persist, radio should be sent in for servicing.

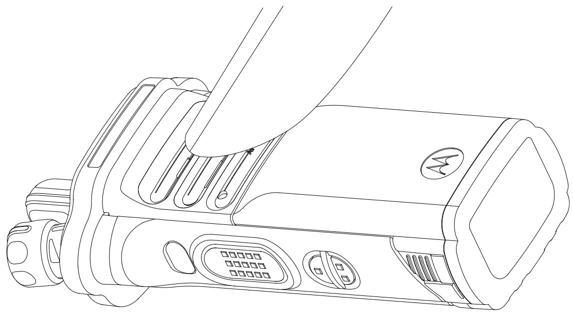

Figure 2-1. Vacuum the Speaker Grill

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 recommends vacuuming the control top to maintain optimal tactile performance. Attach a crevice nozzle to a vacuum cleaner, and vacuum all the radio surfaces, especially the control top, to remove dirt and debris from crevices (See Figure 2-2.). For submersible radios (“R”, “I” 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. Vacuum again to remove dirt, debris and water.

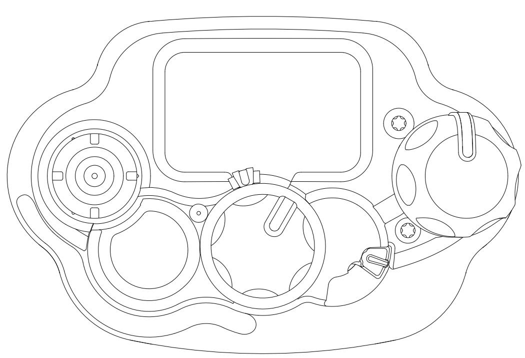

Figure 2-2. Remove Dirt and Debris

2.2 Handling Precautions

Complementary metal-oxide semiconductor (CMOS) devices, and other high-technology devices, are used in this family of radios. While the attributes of these devices are many, their characteristics make them susceptible to damage by electrostatic discharge (ESD) 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 this radio, and are especially important in low-humidity conditions.

Caution

- The APX 6000XE 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's submergibility will be lost.
- 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.
- The APX 6000XE radio is designed to be submerged to a maximum depth of six (6) feet, with a maximum submersion time of 2 hours per U.S. MIL-STD. Exceeding either maximum limit may result in damage to the radio. For specific U.S. MIL-STD details, see Section "8.10 Ensuring Radio Submergibility" on page 2:8-41.

2.2.1 Care After Submerging

If the radio battery contact area has been 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 has been 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 will decrease the audio quality of the radio. If Accessories or the Universal Connector Cover are covering the Universal Connector, check the interface to ensure no liquid has penetrated the seal. Water left in this interface could degraded the performance of the accessories.

Notes

Chapter 3 Basic Theory of Operation

This chapter discusses the basic operational theory of the ASTRO APX 6000XE radio, which is a wideband, synthesized radio available in the VHF (136–174 MHz), UHF1 (380–470 MHz), UHF2 (450–520 MHz) and 764–870 MHz frequency bands. All ASTRO APX 6000XE radios are capable of both analog operation (12.5 kHz or 25 kHz bandwidths), ASTRO mode (digital) operation (12.5 kHz only) and X2-TDMA mode (25 kHz only).

3.1 Major Assemblies

The ASTRO APX 6000XE radio includes the following major assemblies (See Figure 3-1.):

- **VOCON Board** – contains a dual-core processor which includes both the microcontroller unit (MCU) and a digital signal processor (DSP) core, the processor's memory devices, an audio and power supply support integrated circuit (IC), a digital support IC, and external audio power amplifier.
- **Transceiver (XCVR) Board** – contains all transmit, receive, and frequency generation circuitry, including the digital receiver back-end IC and the reference oscillator.
- **Expansion Board**
  - Mace – contains the internal audio power amplifier circuitry, and a Type III secure IC.
  - Mace with Apps – contains the internal audio power amplifier circuitry, a combination Global Positioning System (GPS)/ Bluetooth 2.1 IC and support circuitry, a 3-axes digital accelerometer, an e-MMC NAND flash, and a Type III secure IC.
- **Top Display** – 112 pixels x 32 pixels, transflective monochrome liquid crystal display (LCD).
- **Control Top** – contains five switches: On/Off & 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 only)** – 130 pixels x 130 pixels, transflective color LCD.
- **Keypad (Dual-Display Version Only)** – Dual-Display version, Limited Kaypad Version has a 3 x 2 Menu keypad with 4-way navigation button, and Full Keypad Version has a 3 x 4 alphanumeric keypad.

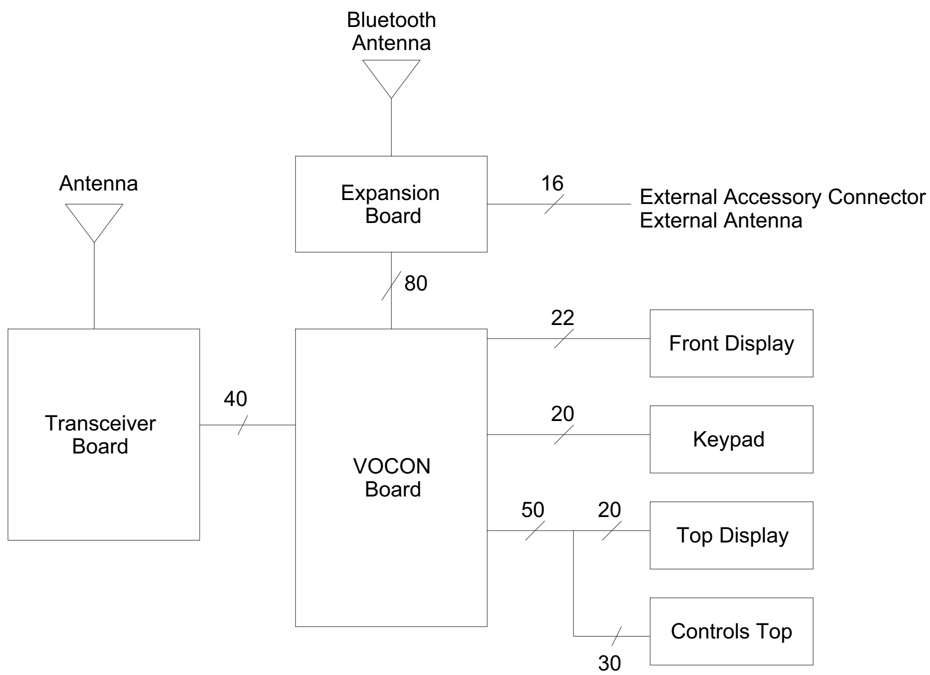

Figure 3-1. APX 6000XE Overall Block Diagram

3.2 Analog Mode of Operation

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

3.2.1 Receiving

The RF signal is *received* at the antenna and is routed through the Auxiliary and Multi Switch (SP3T) ICs on the UHF1, UHF2 and 7/800MHz designs. The latter contains a switchable attenuator that is enabled at predetermined RF power thresholds present at the antenna port. The VHF design does not include the Auxiliary switch and thus RF is routed directly to the SP3T switch. See Figure 3-2.to Figure 3-5.

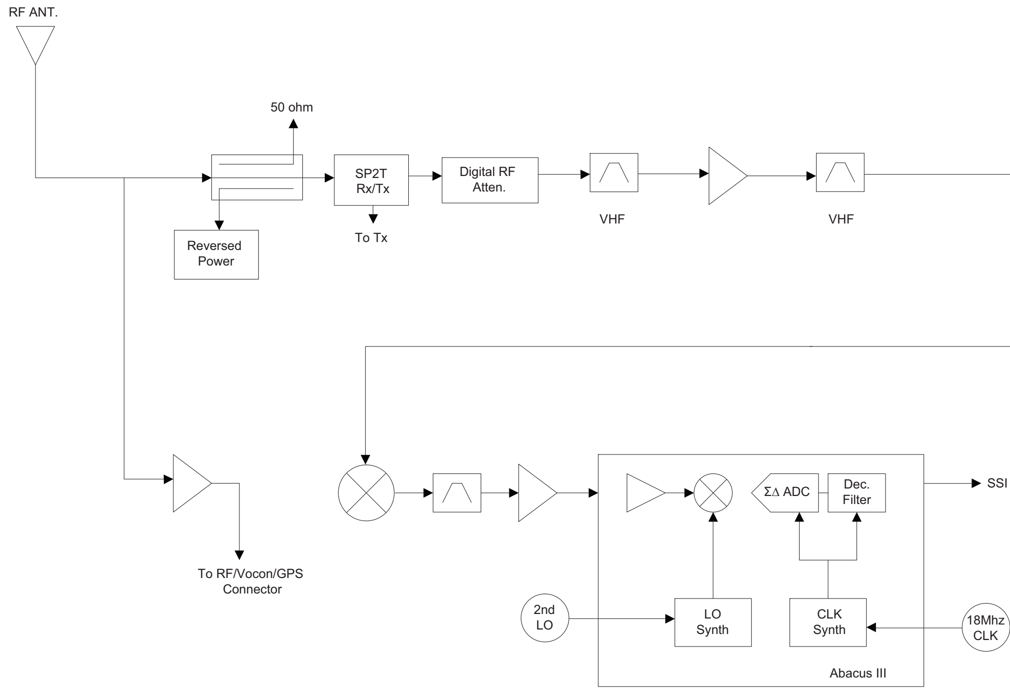

Figure 3-2. Receiver Block Diagram (VHF)

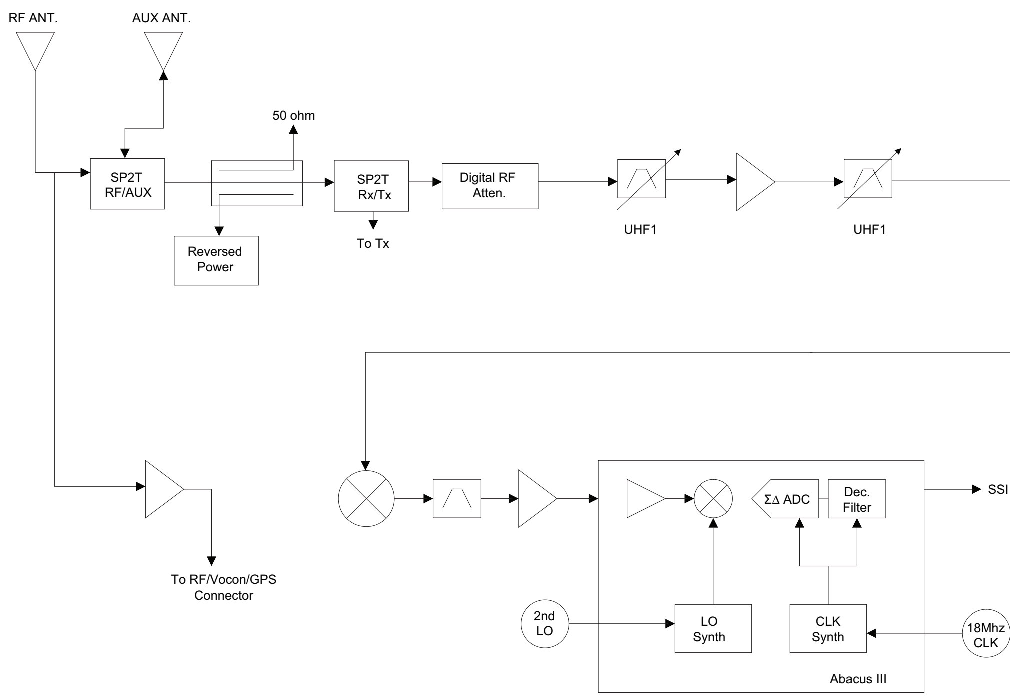

Figure 3-3. Receiver Block Diagram (UHF1)

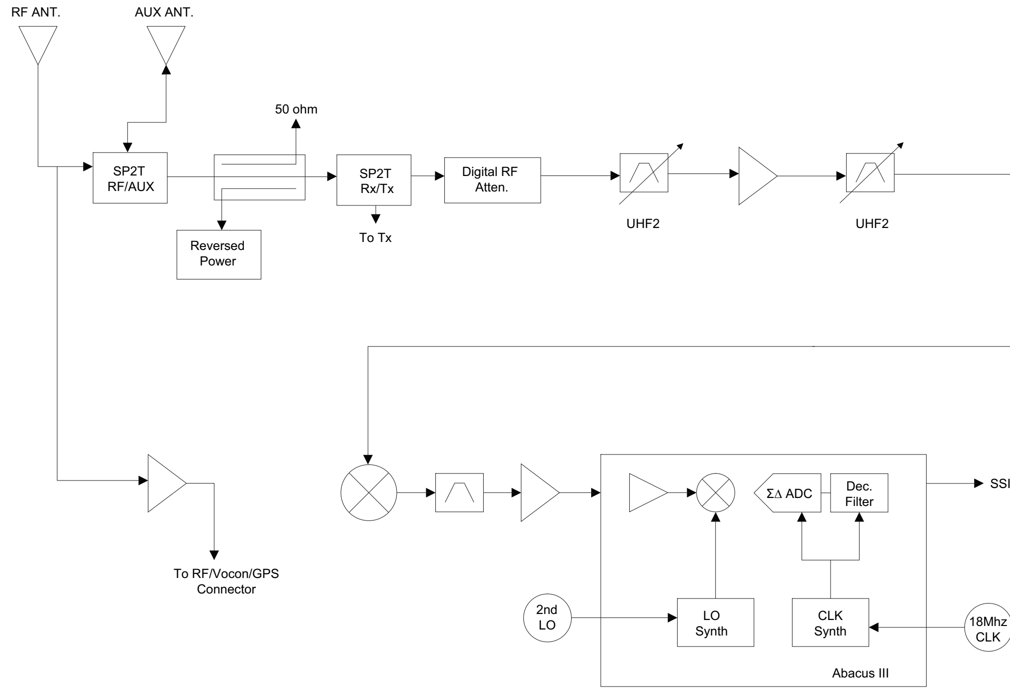

Figure 3-4. Receiver Block Diagram (UHF2)

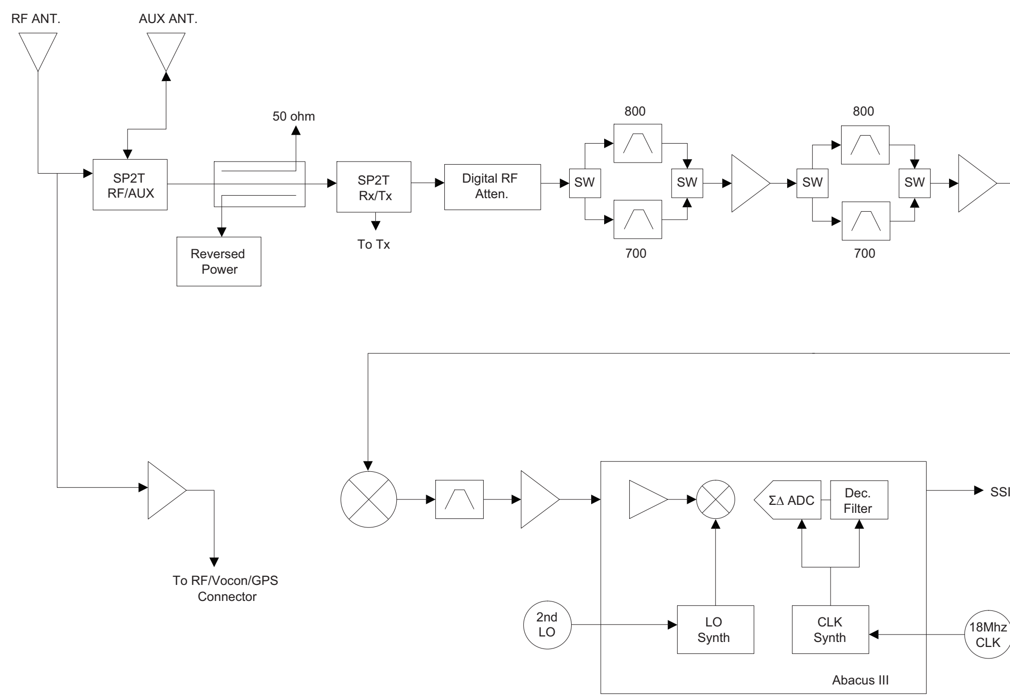

Figure 3-5. Receiver Block Diagram (700/800 MHz)

3.2.1.1 GPS

The GPS architecture employs a combination GPS/Bluetooth IC chip which decodes GPS signals at 1575.42 MHz. It is capable of producing a final position solution including full tracking and data decode capability. The GPS receiver will operate in the autonomous mode only.

The GPS signal is tapped at the antenna port via a series resonant network which provides a very low capacitive load to the transceiver. The signal is routed though a GPS LNA and it's output is applied to the RF-Controller interface connector where it is eventually routed to the expansion board for processing by the GPS/Bluetooth IC.

The GPS receiver is setup in an autonomous one track always (OTA) mode, also known as continuous navigation. This means the GPS will continuously track satellites for as long as the radio is powered to ensure the best possible accuracy. In the event the radio loses visibility of the satellites due to terrain or environmental factors such as driving through a tunnel or entering a building, the GPS will temporarily lose its position fix. A power savings algorithm will then cycle the GPS in and out of a sleep mode at approximately 90 second intervals until the radio has moved back into an environment where GPS signals are present.

The user will be able to view the current latitude, longitude, and time/date stamp on the radio's display. The radio can also be configured to send its' location to the system at predetermined intervals (LRRP). Depending on system options, the user may be able to enable/disable the GPS receiver.

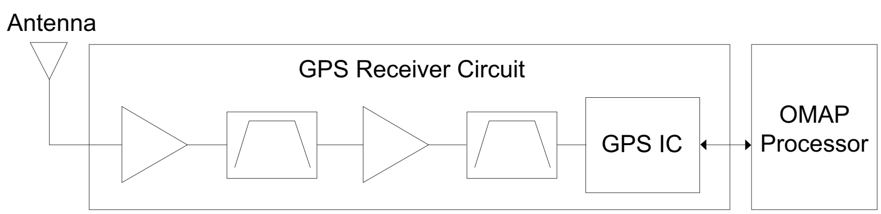

Figure 3-6. GPS Diagram

3.2.1.2 VHF Front-End

From the RX/TX select switch, the VHF signal is routed to a pre-selector filter, followed by a Low Noise Amplifier (LNA) and a second pre-selector filter. Both filters are discrete and fixed designs and 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 Abacus 3 Analog to Digital Converter IC (AD9864).

3.2.1.3 UHF1 Front-End

From the RX/TX select switch, a UHF1 signal is routed to the first pre-selector filter followed by an LNA and a second pre-selector filter. Both filters are discrete and tunable designs and are used to band limit the incoming energy and suppress known spurious responses such as Image spur. The output of the second pre-selector filter is applied to the RF port of the Mixer IC. 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 Abacus 3 Analog to Digital Converter IC (AD9864).

3.2.1.4 UHF2 Front-End

From the RX/TX select switch, a UHF2 signal is routed to the first pre-selector filter followed by an LNA and a second pre-selector filter. Both filters are discrete and tunable designs and are used to band limit the incoming energy and suppress known spurious responses such as Image spur. The output of the second pre-selector filter is applied to the RF port of the Mixer IC. 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 Abacus 3 Analog to Digital Converter IC (AD9864).

3.2.1.5 700/800 Front-End

From the RX/TX select switch, the signal is routed to an RF switch which selects the 700 or 800 Mhz band signal and routes it through a filter, an LNA, another filter, and another LNA. All filters are Surface Acoustic Wave (SAW) designs used to band limit the received energy and suppress known spurious responses. The output of the second filter is applied to the RF port of the Mixer IC. 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 an amplifier which drives the input of the Abacus 3 Analog to Digital Converter IC (AD9864).

3.2.1.6 Analog To Digital Converter

The ADC IC's front end down converts the first IF to a second IF, a 2.25 MHz signal. The second IF is sampled at 18 MHz, a signal generated by an integrated clock synthesizer. The sampled signal is decimated by a factor of 900 to 20 kHz and converted to SSI format at the ADC's output. The Serial Synchronous Interface (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) for post-processing and demodulation.

3.2.2 Transmitting

When the radio is transmitting, microphone audio is digitized and then processed by the DSP and sent to the Trident IC (see Figure 3-7 to Figure 3-10) via the SSI interface. The Trident IC processes the SSI data for application to the voltage controlled oscillator as a modulation signal.

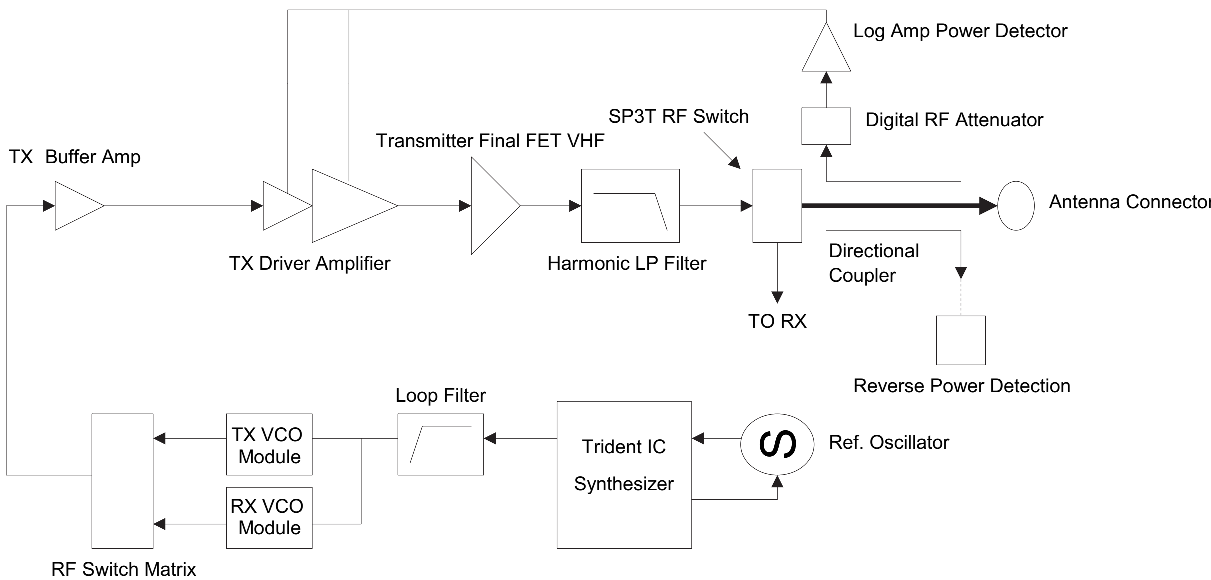

Figure 3-7. Transceiver (VHF) Block Diagram

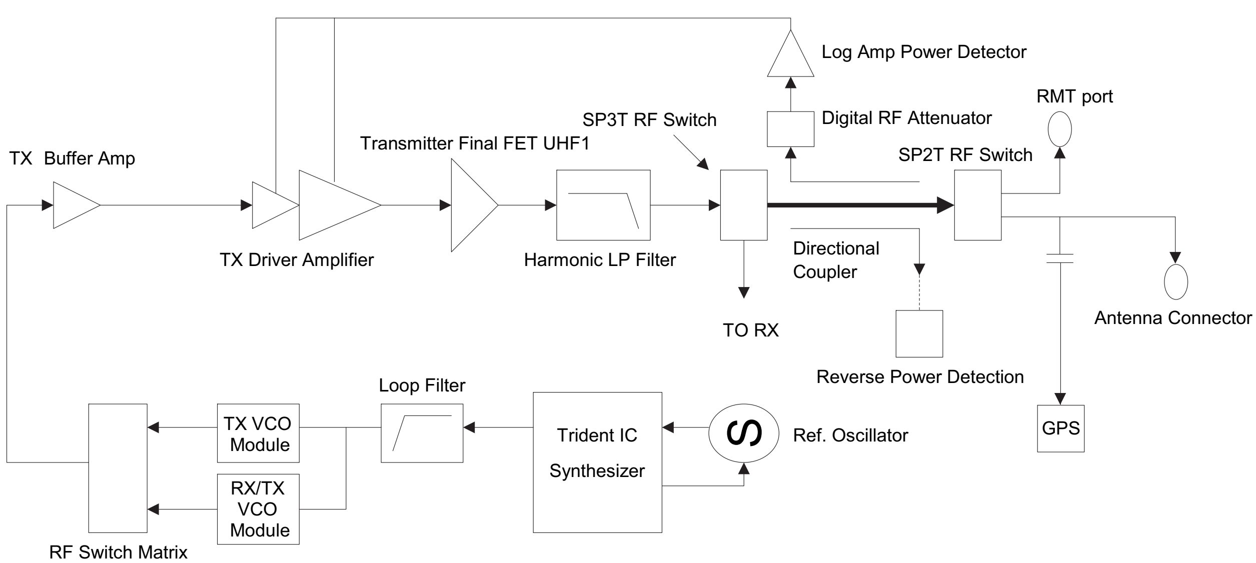

Figure 3-8. Transceiver (UHF1) Block Diagram

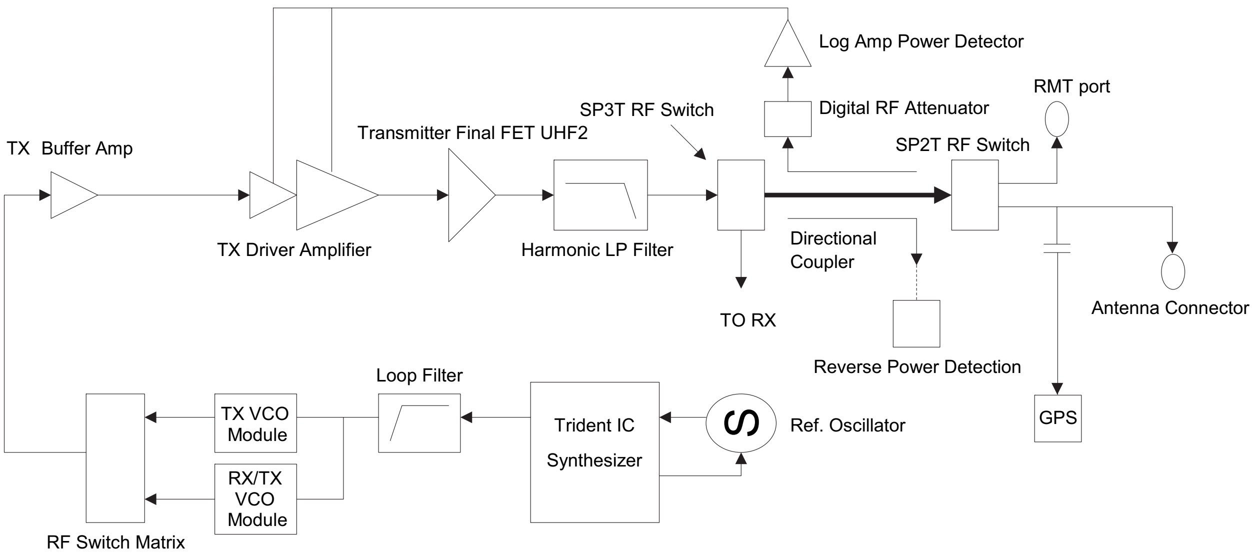

Figure 3-9. Transceiver (UHF2) Block Diagram

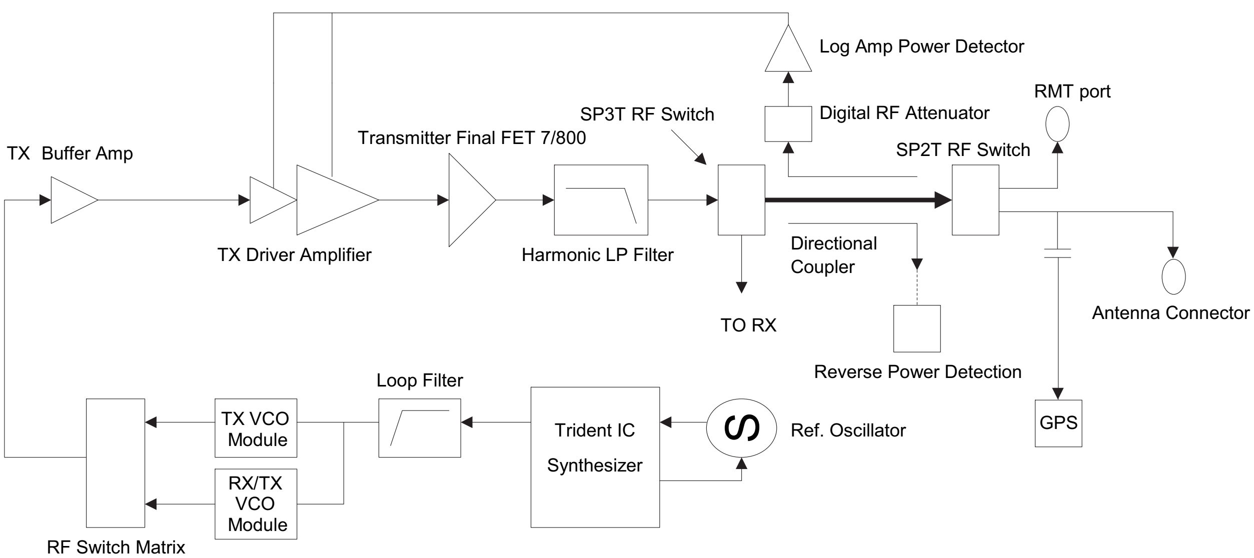

Figure 3-10. Transceiver (700/800 MHz) Block Diagram

3.2.2.1 VHF Transmit

Once a VHF frequency for transmit has been selected, the Trident IC and its accompanying logic circuitry enable the correct voltage controlled oscillator which then generates the desired transmit frequency. This transmit signal is then routed to the TX buffer amplifier which amplifies the signal. An RF switch then routes the signal to the VHF Driver amplifier and then to the discrete final stage. The signal is then 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. Finally, the RF signal routes the power to the main antenna.

3.2.2.2 UHF1 Transmit

Once a UHF frequency for transmit has been selected, the Trident IC and its accompanying logic circuitry enable the correct voltage controlled oscillator which then generates the desired transmit frequency. This transmit signal is then routed to the TX buffer amplifier which amplifies the signal. Then the RF signal is routed to the UHF1 Driver amplifier and then to the discrete final stage. The signal is then 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. Finally, the RF signal comes to a Single Pole double throw (SP2T) RF switch which can route the power to the main antenna or to the Universal Connector port of the radio.

3.2.2.3 UHF2 Transmit

Once a UHF frequency for transmit has been selected, the Trident IC and its accompanying logic circuitry enable the correct voltage controlled oscillator which then generates the desired transmit frequency. This transmit signal is then routed to the TX buffer amplifier which amplifies the signal. Then the RF signal is routed to the UHF2 Driver amplifier and then to the discrete final stage. The signal is then 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. Finally, the RF signal comes to a Single Pole double throw (SP2T) RF switch which can route the power to the main antenna or to the Universal Connector port of the radio.

3.2.2.4 700/800 MHz Transmit

Once a 700/800 MHz frequency for transmit has been selected, the Trident IC and its accompanying logic circuitry enable the correct voltage controlled oscillator which then generates the desired transmit frequency. This transmit signal is then routed to the TX buffer amplifier which amplifies the signal. An RF switch then routes the signal to the 700/800 MHz Driver amplifier and then to the discrete final stage. The signal is then 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. Finally, the RF signal comes to a Single Pole double throw (SP2T) RF switch which can route the power to the main antenna or to the Universal Connector port of the radio.

3.3 Digital (ASTRO) Mode of Operation

In the ASTRO (digital) mode of operation, the transmitted or received signal is limited to a discrete set of frequency deviation levels. The receiver handles an ASTRO-mode signal identically to an analog-mode signal, up to the point where the DSP decodes the received data. In the ASTRO receive mode, the DSP uses a different algorithm to recover data.

In the ASTRO 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.

3.4 Controller Section

The controller section (See Figure 3-11.) 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 Power and Clocks section includes a power management IC (MAKO) and various external switching regulators, and two clock sources (12 MHz and 24.576 MHz) from which all other controller digital clocks are derived. The Audio section has a CODEC and a class-D audio power amplifier that provides the radio with a multiple microphone, single speaker design. 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 Mace Expansion Board consists on the main class-D audio power amplifier and the Type III secure IC (MACE). In addition to the Mace features, the Mace with Apps Expansion Board consists of an e-MMC NAND Flash (4GB), a combination integrated-circuit consisting of a Global Positioning System (GPS) receiver and a Bluetooth (BT) 2.1 transceiver, an encryption processor (MACE), and a 3-axes digital accelerometer.

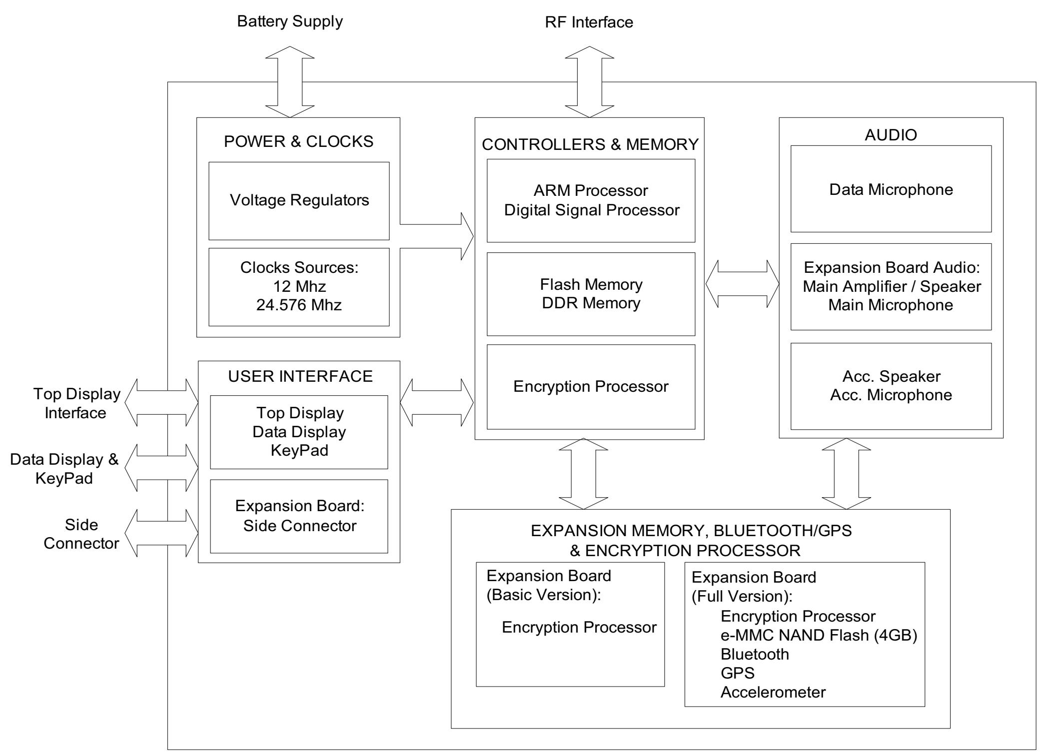

Figure 3-11. Controller Block Diagram

The ARM controller core of the OMAP 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 (64 MB) is required to store the firmware, tuning, and Codeplug settings, which upon initialization get read and stored into SDRAM (32 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 processor through the SSI interface. Its firmware is flashed via the main processor during an upgrade request to its internal FLASH memory. The MACE encryption processor is located on the expansion board.

The power and most clocks to the controller devices are provided by the MAKO IC and external switching and linear regulators on board. A Complex Programmable Logic Array (CPLD) IC divides the 24.576 MHz clock from MAKO to source OMAP's 32 kHz Real Time Clock, and MACE's 4 MHz main clock. OMAP's main clock is supplied externally from an on board 12 MHz crystal.

The radio has two internal microphones and an internal speaker, as well as available microphone and speaker connections for external accessories. The internal 4 Ohm speaker is located opposite to the main display and keypad of the radio. The internal speaker is driven by a Class D audio amplifier located on the expansion board that is capable of delivering a rated power of 0.5 W. The external accessory speaker is driven by a Class AB audio amplifier on the MAKO IC that is capable of delivering 0.5 W of power into a 16 Ohm 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's 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 for accessories. All signals to and from the connector go through the internal expansion board before reaching the microcontroller and other devices on the main board.

3.4.1 Radio with Mace with Apps Expansion Board

In addition to the Mace Expansion Board features, the Mace with Apps Expansion Board consists of an e-MMC 4GB NAND Flash, a 3-axes digital accelerometer, and an integrated-circuit consisting of a Global Positioning System (GPS) and Bluetooth 2.1 transceiver. The 4GB external NAND Flash communicates to the OMAP processor on the VOCON board through the Multi Media Card (MMC) interface. The GPS receiver section of the GPS/BT combination IC interfaces with the OMAP processor though a dedicated UART port. The GPS receiver also has a dedicated reset controlled solely by the OMAP processor.

The radio also has the ability to connect to a wireless Bluetooth audio headset. This feature is implemented using a combination Bluetooth/GPS integrated circuit (IC) located on the expansion board. An optional accessory headset can connect using a low-data rate GFSK modulated signal hopping on 79 x 1 MHz wide Bluetooth channels from 2402 MHz to 2480 MHz in the ISM band. Each APX accessory that is capable of Bluetooth communication will have 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 will be retransmitted on another channel. The Bluetooth IC sends data to the AVR32 processor that is also located on the expansion board over an HCI UART link. The AVR32 processor communicates to the OMAP processor on the VoCon board through a dedicated USB port.

The Bluetooth feature is accompanied by a Low-Frequency (LF) detection circuit that is also located on the expansion board. The LF circuit provides the ability of a secure pairing connection with a Bluetooth accessory. Once a radio has the Bluetooth feature enabled, a user can tap their LF enabled Bluetooth audio 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 AVR32 processor through a dedicated SPI bus and transfers the pairing data through a dedicated UART.

There is a digital accelerometer on the expansion board that detects the 3-axis force of gravity which can be used to determine the radio's orientation. The accelerometer's position is communicated to the AVR32 processor through a SPI bus.

Chapter 4 Recommended Test Equipment and Service Aids

This chapter provides lists of recommended test equipment and service aids, as well as information on field programming equipment that can be used in servicing and programming ASTRO APX 6000XE radios.

4.1 Recommended Test Equipment

The list of equipment contained in Table 4-1 includes all of the standard test equipment required for servicing two-way portable radios, as well as several unique items designed specifically for servicing this family of radios. The “Characteristics” column is included so that equivalent equipment may be substituted; however, when no information is provided in this column, the specific Motorola model listed is either a unique item or no substitution is recommended.

Table 4-1. Recommended Test Equipment

Equipment	Characteristics	Example	Application
Service Monitor	Can be used as a substitute for items marked with an asterisk (*)	Aeroflex 3920 (www.aeroflex.com)**	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment. (**) Referenced in this manual as an example for test setup guidelines.
Digital RMS Multimeter *	100 µV to 300 V 5 Hz to 1 MHz 10 Mega Ohm Impedance	Fluke 179 or equivalent (www.fluke.com)	AC/DC voltage and current measurements. Audio voltage measurements
RF Signal Generator *	100 MHz to 1 GHz -130 dBm to +10 dBm FM Modulation 0 kHz to 10 kHz Audio Frequency 100 Hz to 10 kHz	Agilent N5181A (www.agilent.com), Ramsey RSG1000B (www.ramseyelectronics.com, or equivalent	Receiver measurements
Oscilloscope *	2 Channel 50 MHz Bandwidth 5 mV/div to 20 V/div	Leader LS8050 (www.leaderusa.com), Tektronix TDS1001b (www.tektronix.com), or equivalent	Waveform measurements
Power Meter and Sensor *	5% Accuracy 100 MHz to 500 MHz 50 Watts	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
RF Millivolt Meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 92EA (www.boonton.com) or equivalent	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

4.2 Service Aids

Refer to Table 4-2 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 “Appendix B Replacement Parts Ordering” on page B-1. While all of these items are available from Motorola, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 4-2. Service Aids

Motorola Part Number	Description	Application
5880384G68	SMA to BNC Adapter	Adapts radio’s antenna port to BNC cabling of test equipment.
66009254001	APX Battery Adapter	Used in place of battery to connect radio to an external power supply. Requires RLN4510_.
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.
66009260002	Board Analysis Fixture	Special fixture that allows radio’s internal board 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 66009259001 Adapter Kit.
NTN4265_	Pressure Pump Kit	Submersible radios only. Pressure pump with gauge and pressure hose. Requires 66009259001 Adapter Kit.
RVN5224_	Customer Programming Software (CPS) and Tuner Software	CPS allows customer-specific programming of modes and features. Tuner software required to perform alignment of radio parameters.
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.
RLN4510_	7.5 Volt Universal Battery Eliminator	Used in conjunction with the 66009254001 to adjust the supply voltage to 7.5 Vdc. Allows a multimeter to be attached for monitoring and adjusting voltage and current levels.
RLN4460_	Portable Test Set	Used for radio performance checks. Connects to radio’s universal connector and allows remote switching and signal injection/outputs for test equipment measurements.

4.3 Field Programming

This family of radios can be aligned and programmed in the field. This requires specific equipment and special instructions. Refer to the online help in the Customer Programming Software (CPS) for complete field programming information.

Chapter 5 Performance Checks

This chapter covers performance checks used to ensure that the ASTRO APX 6000XE radio meets published specifications. The recommended test equipment listed in the previous section approaches the accuracy of the manufacturing equipment, with a few exceptions. Accuracy of the test equipment must be maintained in compliance with the manufacturer's recommended calibration schedule. Checks should be performed if radio performance degradation is suspected.

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 Figure 5-1.

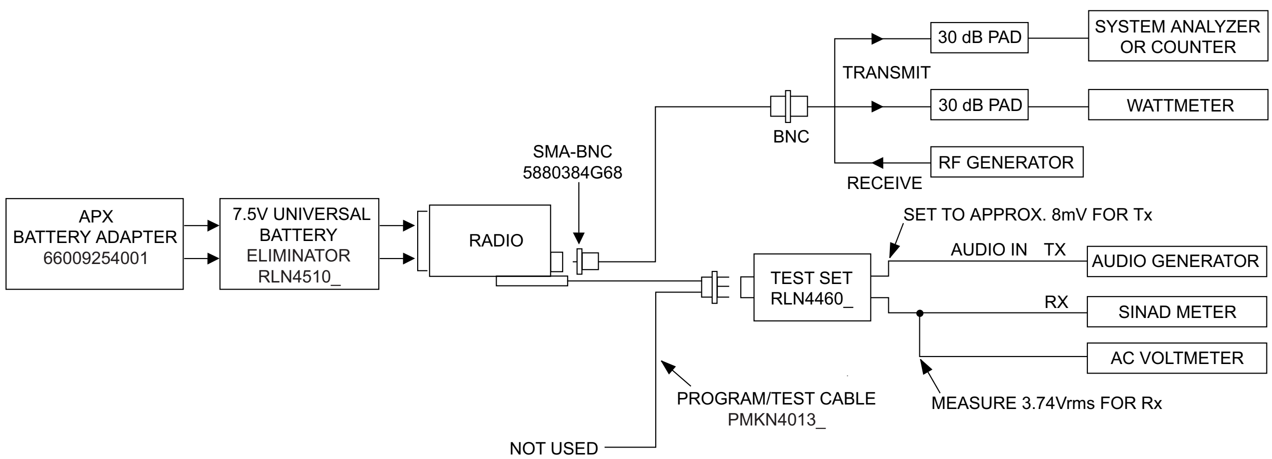

Figure 5-1. Performance Checks Test Setup

Initial equipment control settings should be as indicated in Table 5-1 and should be the same for all performance checks and alignment procedures, except as noted.

Table 5-1. Initial Equipment Control Settings

<table>
<tr><th>System Analyzer</th><th>Test Set</th><th>Power Supply</th></tr>
<tr><td>Mode: Analog Duplex*</td><td>Spkr/Load: Speaker</td><td>Voltage: 7.5 Vdc</td></tr>
<tr><td rowspan="4">Receiver Checks
RF Control: Generator
Output Level: -47 dBm
Modulation: 1 kHz tone @3 kHz deviation
Frequency: Set to selected radio RX frequency
Meter: RF Display

Transmitter Checks
RF Control: Analyzer
Frequency: Set to selected radio TX frequency
Meter: RF Display
Modulation Type: FM</td><td>PTT: OFF (center)</td><td>DC On/Standby: Standby</td></tr>
<tr><td>Meter Out: RX</td><td>Volt Range: 10 Vdc</td></tr>
<tr><td>Opt Sel: ON</td><td rowspan="2">Current: 2.5 Amps</td></tr>
<tr><td></td></tr>
</table>

* *Use “PROJ 25 STD” if testing ASTRO Conventional channels.*

5.2 Display Radio Test Mode (Dual-Display Version)

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

5.2.1 Access the Test Mode

To enter the display radio test mode:

1. Turn the radio on.
2. Within 10 seconds after "SELF TEST" is complete, press **Side Button 2** five times in succession.

   The radio shows a series of displays that give information regarding various version numbers and subscriber specific information. The displays are described in Table 5-2.

Table 5-2. 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	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
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 radio's model number, as programmed in the codeplug	Always
Serial number	The radio's serial number, as programmed in the codeplug	Always
ESN	The radio's unique electronic serial number	Always

Table 5-2. Test-Mode Displays (Continued)

Name of Display	Description	Appears
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 radio’s operating frequency	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/ Mace with Apps Expansion Board
Option Board Serial Number	Serial number of the Option board is displayed	When the radio has an Option Board/ Mace with Apps Expansion Board
Option Board Bluetooth Addr	Bluetooth Address of the Option board is displayed	When the radio has an Option Board/ Mace with Apps Expansion Board
Option Board SW Version	Software version of the Option Board is displayed	When the radio has an Option Board/ Mace with Apps Expansion Board
Exp Board Type	Type of Expansion Board is displayed	When the radio has an Expansion Board

NOTE: All displays are temporary and will expire without any user intervention. If information is longer than the physical length of the radio’s display, the information will wrap around to the next display. After the last display, “**RF TEST**” is displayed.

To freeze any of the displays, 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.

NOTE: Press the **Top Side Button** (Purple button) to advance the test environments from “**RF TEST**”, “**CH TEST**”, “**RGB 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:
   - 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. Go to Section “5.2.3 Control Top and Keypad Test Mode” on page 2:5-6.

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** (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 "5.2.2 RF Test Mode" below.

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.

5.2.2 RF Test Mode

When the ASTRO APX 6000 radio is operating in its normal environment, the radio's 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, called **RF TEST MODE**.

While in RF test mode:

- Each additional press of **Side Button 2** advances to the next test channel. (Refer to Table 5-3.)
- Pressing **Side Button 1** scrolls through and accesses the test environments shown in Table 5-4.
- Pressing **Top Side Button** scrolls through the Tx Deviation Frequency.

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

Table 5-3. Test Frequencies (MHz)

Test Channel	VHF		UHF1		UHF2		700–800 MHz	
	RX	TX	RX	TX	RX	TX	RX	TX
F1	136.075	136.025	380.075	380.025	450.075	450.025	764.0625	764.0125
F2	142.075	142.125	390.075	390.025	460.075	460.025	769.0625	769.0125
F3	154.275	154.225	400.075	400.025	471.075	471.025	775.9375	775.9875
F4	160.175	160.125	411.075	411.025	484.925	484.975	851.0625	794.0125
F5	168.125	168.075	424.975	424.925	485.075	485.025	860.0625	809.0125
F6	173.925	173.975	435.075	435.025	495.075	495.025	869.9375	823.9875
F7	–	–	445.075	445.025	506.075	506.025	851.0625	851.0125
F8	–	–	457.075	457.025	519.925	519.975	860.0625	860.0125
F9	–	–	469.975	469.925	–	–	869.9375	869.8875

Table 5-4. 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*
USQ	Carrier Unsquelch	RX: unsquelch always TX: mic audio

* *All deviation values are based on deviation tuning of this mode.*

5.2.3 Control Top and Keypad Test Mode

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

5.2.3.1 Control Top Checks

To perform the control top checks:

1. Press and hold the **Top Button** (Orange button); the radio icons are displayed, and the LED lights amber.
2. Release the **Top Button**; "148/0" appears, which indicates that the **Top Button** is in the open position. Your radio is now in the Control Top and Keypad test mode.
3. Press the **Top Button** again; "148/1" appears, which indicates that the **Top Button** is in the closed position.
4. Rotate the **16-Position Select Switch**; "4/0" through "4/15" appears, which indicates that the selector switch is in mode/zone position 1 through 16.
5. Rotate the **Two-Position Concentric Switch**; "65/0" and "65/1" appear.
6. Cycle through the **Three-Position A/B/C Switch**; "67/0," "67/1," and "67/2" appear.
7. Rotate the **Volume Control**; "2/0" through "2/255" appear. The display values may vary slightly at the upper and lower limits.
8. Press the **Top Side Button**; "96/1" appears; release, "96/0" appears.
9. Press **Side Button 1**; "97/1" appears; release, "97/0" appears.
10. Press **Side Button 2**; "98/1" appears; release, "98/0" appears.
11. Press the **PTT Button**; "1/1" appears; release, "1/0" appears.

5.2.3.2 Keypad Checks (for Model III only):

To continue to the keypad checks:

- Press 0, "48/1" appears; release, "48/0" appears.
- Press 1, "49/1" appears; release, "49/0" appears.
- Press 2, "50/1" appears; release, "50/0" appears.
- Press 3, "51/1" appears; release, "51/0" appears.
- Press 4, "52/1" appears; release, "52/0" appears.
- Press 5, "53/1" appears; release, "53/0" appears.
- Press 6, "54/1" appears; release, "54/0" appears.
- Press 7, "55/1" appears; release, "55/0" appears.
- Press 8, "56/1" appears; release, "56/0" appears.
- Press 9, "57/1" appears; release, "57/0" appears.
- Press *, "58/1" appears; release, "58/0" appears.
- Press #, "59/1" appears; release, "59/0" appears.
- Press ◀, "128/1" appears; release, "128/0" appears.
- Press ⌂, "129/1" appears; release, "129/0" appears.
- Press ▶, "130/1" appears; release, "130/0" appears.
- Press •, "131/1" appears; release, "131/0" appears.
- Press ••, "132/1" appears; release, "132/0" appears.
- Press •••, "133/1" appears; release, "133/0" appears.
- Press , "134/1" appears; release, "134/0" appears.
- Press ▲, "135/1" appears; release, "135/0" appears.
- Press ▼, "136/1" appears; release, "136/0" appears.

5.2.4 RGB Test Mode

To perform the RGB Color Test:

1. Press and release **Top Button** (Orange button)
2. Press any key; Crosstalk test patterns appears.
3. Press any key; White color test appears.
4. Press any key; Red color horizontal lines appears.
5. Press any key until all 13 red color horizontal lines appears.
6. Press any key; Green color vertical line appears.
7. Press any key until all 13 green color vertical lines appears.
8. Press any key; Black color test appears.
9. Press any key; Blue color test appears.
10. Press any key; Vendor specific display test appears.
11. Press any key; "Test completed" appears.

5.2.5 CID Test Mode

To perform the CID Test:

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:

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 5-5.

Table 5-5. 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	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
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

Table 5-5. Test-Mode Displays (Continued)

Name of Display	Description	Appears
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 radio's model number, as programmed in the codeplug	Always
Serial number	The radio's serial number, as programmed in the codeplug	Always
ESN	The radio's unique electronic serial number	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 radio's operating frequency	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 Apps Expansion Board
Option Board Serial Number	Serial number of the Option board is displayed	When the radio has an Option Board/ Maze with Apps Expansion Board
Option Board Bluetooth Addr	Bluetooth Address of the Option board is displayed	When the radio has an Option Board/Maze with Apps Expansion Board
Option Board SW Version	Software version of the Option Board is displayed	When the radio has an Option Board/ Maze with Apps Expansion Board
Exp Board Type	Type of Expansion Board is displayed	When the radio has an Expansion Board

NOTE: All displays are temporary and will expire without any user intervention. If information is longer than the physical length of the radio's display, the information will wrap 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:
   - Press the **Top Side Button** to stop the displays and toggle between RF test mode and the Control Top test mode. The test mode menu "CH TEST" is displayed, indicating that you have selected the Control Top test mode. Go to Section "5.2.3 Control Top and Keypad Test Mode" on page 2:5-6.

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

   - 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 "5.3.2 RF Test Mode" below.

     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 ASTRO APX 6000 radio is operating in its normal environment, the radio's 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, called **RF TEST MODE**.

While in RF test mode:

- Each additional press of **Side Button 2** advances to the next test channel. (Refer to Table 5-5.)
- Pressing **Side Button 1** scrolls through and accesses the test environments shown in Table 5-4.
- Pressing **Top Side Button** scrolls through the Tx Deviation Frequency.

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

Table 5-6. Test Frequencies (MHz)

Test Channel	VHF		UHF1		UHF2		700–800 MHz	
	RX	TX	RX	TX	RX	TX	RX	TX
F1	136.075	136.025	380.075	380.025	450.075	450.025	764.0625	764.0125
F2	142.075	142.125	390.075	390.025	460.075	460.025	769.0625	769.0125
F3	154.275	154.225	400.075	400.025	471.075	471.025	775.9375	775.9875
F4	160.175	160.125	411.075	411.025	484.925	484.975	851.0625	794.0125
F5	168.125	168.075	424.975	424.925	485.075	485.025	860.0625	809.0125
F6	173.925	173.975	435.075	435.025	495.075	495.025	869.9375	823.9875
F7	–	–	445.075	445.025	506.075	506.025	851.0625	851.0125
F8	–	–	457.075	457.025	519.925	519.975	860.0625	860.0125
F9	–	–	469.975	469.925	–	–	869.9375	869.8875

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

To perform the control top checks:

1. Press and hold the **Top Button** (Orange button); the radio icons are displayed, and the LED lights amber.
2. Release the **Top Button**; "148/0" appears, which indicates that the **Top Button** is in the open position. Your radio is now in the Control Top and Keypad test mode.
3. Press the **Top Button** again; "148/1" appears, which indicates that the **Top Button** is in the closed position.
4. Rotate the **16-Position Select Switch**; "4/0" through "4/15" appears, which indicates that the selector switch is in mode/zone position 1 through 16.
5. Rotate the **Two-Position Concentric Switch**; "65/0" and "65/1" appear.
6. Cycle through the **Three-Position A/B/C Switch**; "67/0," "67/1," and "67/2" appear.
7. Rotate the **Volume Control**; "2/0" through "2/255" appear. The display values may vary slightly at the upper and lower limits.
8. Press the **Top Side Button**; "96/1" appears; release, "96/0" appears.
9. Press **Side Button 1**; "97/1" appears; release, "97/0" appears.
10. Press **Side Button 2**; "98/1" appears; release, "98/0" appears.
11. Press the **PTT Button**; "1/1" appears; release, "1/0" appears.

5.3.4 CID Test Mode

To perform the CID Test:

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 Receiver Performance Checks

The following tables outline the performance checks for the receiver.

Table 5-7. Receiver Performance Checks

Test Name	System Analyzer	Radio	Test Set	Comments
Reference Frequency	**RF Control:** Analyzer **Meter:** RF Display/ Frequency Offset **Freq:** Selected radio TX frequency	TEST MODE CSQ channel* or programmed conventional channel	**PTT** to continuous (during the performance check)	**VHF:** ±0.8 ppm (±227 Hz) **UHF1:** ±0.8 ppm (±289 Hz) **UHF2:** ±0.8 ppm (±329 Hz) **700-800 MHz:** ±0.8 ppm (±709 Hz)
Rated Audio	**RF Control:** Generator **Output Level:** -47 dBm **Freq:** Selected radio RX frequency **Mod:** 1 kHz tone @ 1.5 kHz deviation** **Meter:** RF Display/Audio Level	As above	**PTT** to OFF (center) **Load Selector:** A	Set volume control to 3.74 Vrms
Distortion	As above, except **Meter:** RF Display/AF Meter Distn	As above	As above	Distortion < 3.0%
Sensitivity (SINAD)	As above, except **Meter:** RF Display/AF Meter SINAD **RF Output Level:** Adjust untill SINAD = 12 dB	As above	As above	RF input to be < 0.35 µV
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.

* *See* *Table 5-4 on page 2:5-6**.*

*** 1 kHz tone @ 1.5 kHz deviation for 12.5 kHz ChSp, OR 3 kHz deviation for 25 kHz ChSp*

*Table 5-8. Receiver Tests for ASTRO Conventional Channels**

Test Name	System Analyzer	Radio	Test Set	Comments
Bit Error rate (BER) Floor	**Mode:** P25 **RF Control:** Generator **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 Figure 6-1 on page 2:6-1)
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 Figure 6-1 on page 2:6-1)
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 **Meter:** Audio Distortion	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%
Residual Audio Noise Ratio	**Mode:** P25 **RF Control:** TX **Output Level:** -47 dBm **P25 Set:** Phase 1 C4FM **Pattern:** A)STD 1011 B) STD Silence **Frequency:** Selected radio RX frequency **Meter:** Audio Distortion	As above	As above	Residual Audio Noise Ratio -45 dB

* *These tests require a communications system analyzer with the ASTRO 25 test options.*

5.5 Transmitter Performance Checks

The following tables outline the performance checks for the transmitter.

Table 5-9. Transmitter Performance Checks – APX 6000XE

Test Name	System Analyzer	Radio	Test Set	Comments
Reference Frequency	**RF Control:** Analyzer **Meter:** RF Display/ Frequency Offset **Frequency:** Selected radio TX frequency	TEST MODE CSQ channel* or programmed conventional channel	**PTT** to continuous (during the performance check).	**VHF:** ±0.8 ppm (±140 Hz) **UHF1:** ±0.8 ppm (±376 Hz) **UHF2:** ±0.8 ppm (±416 Hz) **700–800 MHz:** ±0.8 ppm (±696 Hz)

Table 5-9. Transmitter Performance Checks – APX 6000XE (Continued)

Test Name	System Analyzer	Radio	Test Set	Comments
RF Power	As above except, **Meter:** RF Display/ Broadband Power	As above	As above	**VHF:** 1–6 Watts **UHF1**: 1–5 Watt **UHF2**: 1–5 Watt **700**: 1–2.7 Watt **800**: 1–3 Watt
Voice Modulation (external)	As above except, **Meter:** RF Display/FM Dev. Set Audio generator to fixed 1 kHz and audio level to 400 mV.	As above	As above	Deviation: (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 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 filter enabled	Conventional coded squelch personality (clear mode operation) or TPL channel (test mode*)	**PTT** to continuous (during the performance check)	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

* *See* Table 5-4 on page 2:5-6.

*Table 5-10. Transmitter Tests for ASTRO Conventional Channels – APX 6000XE**

Test Name	System Analyzer	Radio	Test Set	Comments
RF Power	**Mode:** P25 **RF Control:** RX **P25 Set:** Phase 1 C4FM **Frequency:** Selected radio TX frequency **Meter:** UUT Measurements/ Broadband Power	Radio Tuner Software not used. **Radio:** Out of TEST MODE; Select a conventional ASTRO channel	**PTT** to continuous (during measurement).	**VHF:** 1–6 Watts **UHF1**: 1–5 Watt **UHF2**: 1–5 Watt **700**: 1–2.7 Watt **800**: 1–3 Watt

Table 5-10. Transmitter Tests for ASTRO Conventional Channels – APX 6000XE (Continued)*

Test Name	System Analyzer	Radio	Test Set	Comments
Frequency Error	**Mode:** P25 **RF Control:** RX **P25 Set:** Phase 1 C4FM **Frequency:** 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 **Frequency:** 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 Figure 6-1 on page 2:6-1)

* *These tests require a communications system analyzer with the ASTRO 25 test options.*

Notes

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 Figure 6-1.

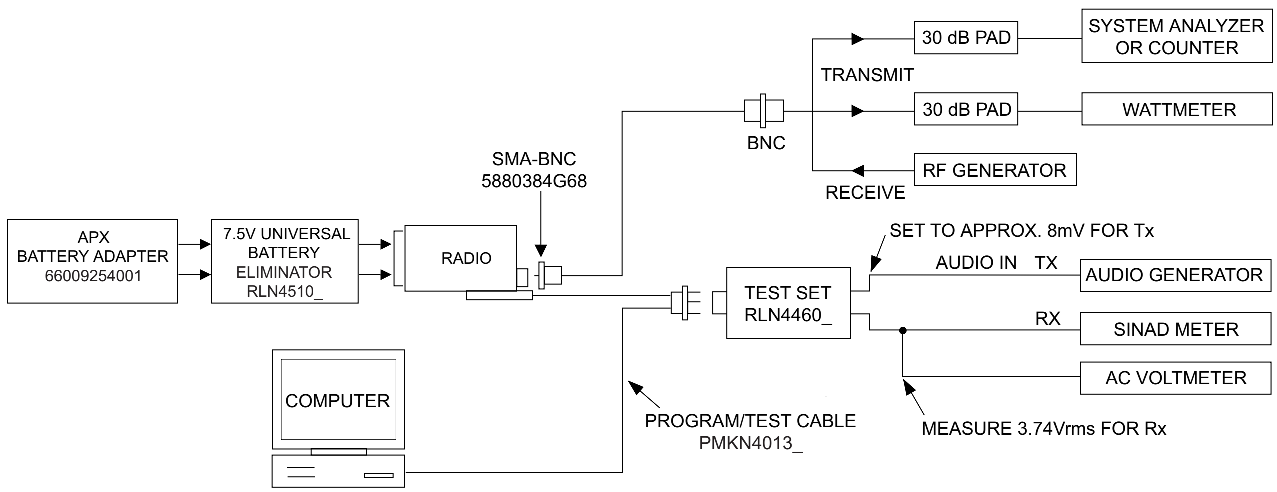

Figure 6-1. Radio Alignment Test Setup

> **Caution**: These radio alignment procedures should only be attempted by qualified service personnel. Failure to perform alignment procedures properly may result in seriously degraded radio or system performance.

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, use the F**ile › Read Device** menu or click on 

. Figure 6-2 illustrates how the alignment screens are organized. To access a screen, double-click on the desired screen name in the **Tuner** menu.

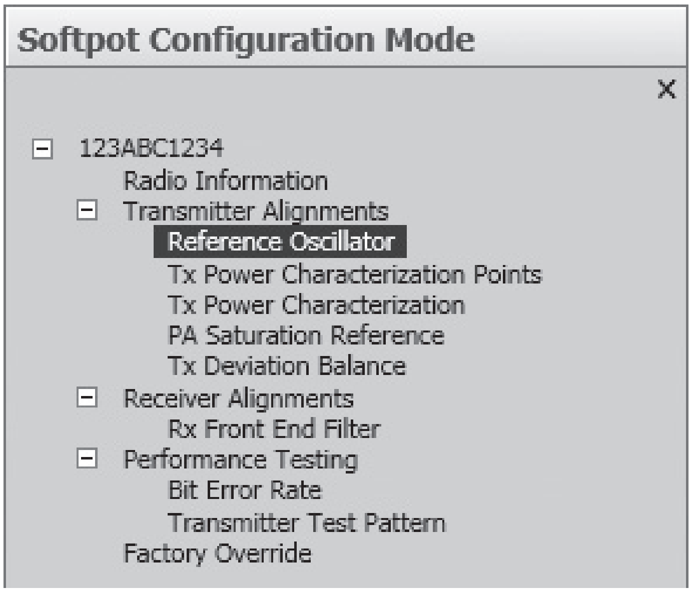

Figure 6-2. Tuner Software Main Menu

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

6.3 Softpot

The alignment screens introduce the concept of the “softpot,” an analog **SOFT**ware-controlled **POT**entiometer 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 6-3.

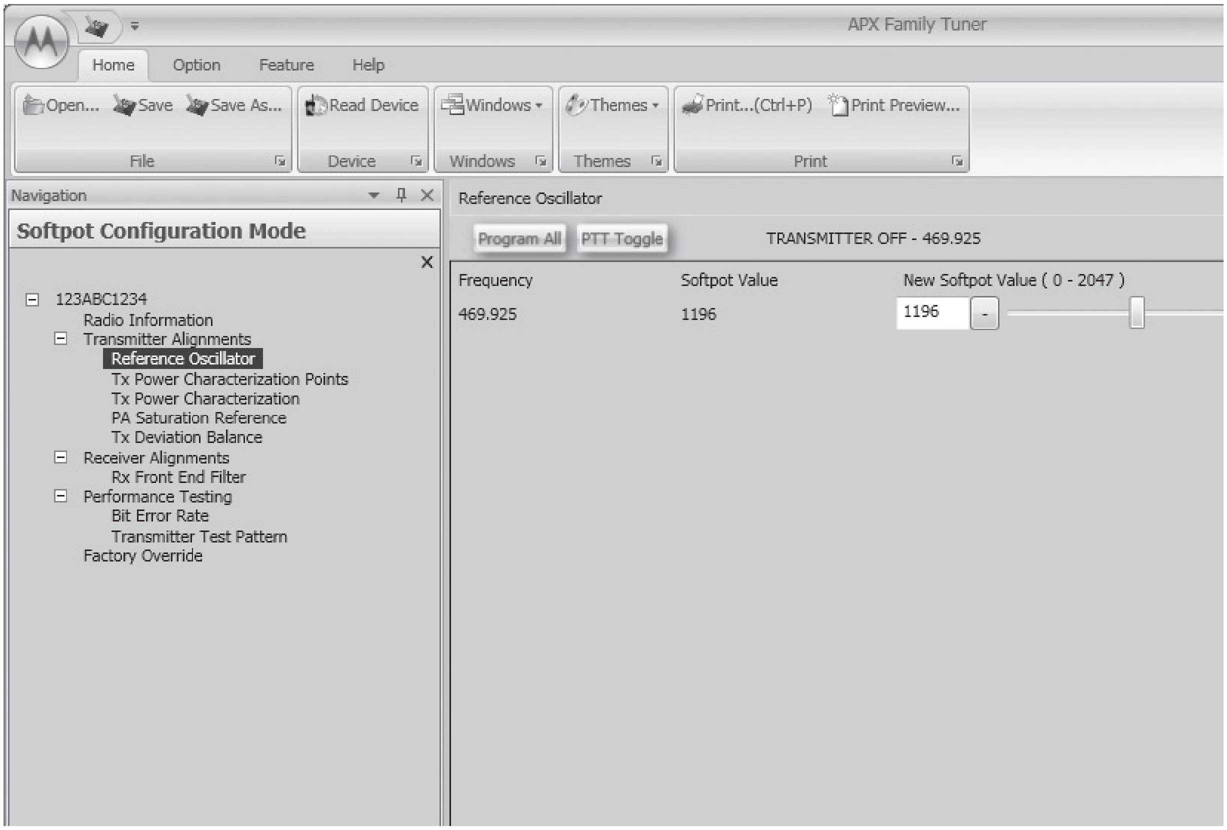

Figure 6-3. Typical Softpot Screen

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 radio's 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.

Perform the following procedures in the sequence indicated.

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

Caution

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

6.4 Radio Information

Figure 6-4 shows a typical Radio Information screen. This screen is informational only and cannot be directly changed.

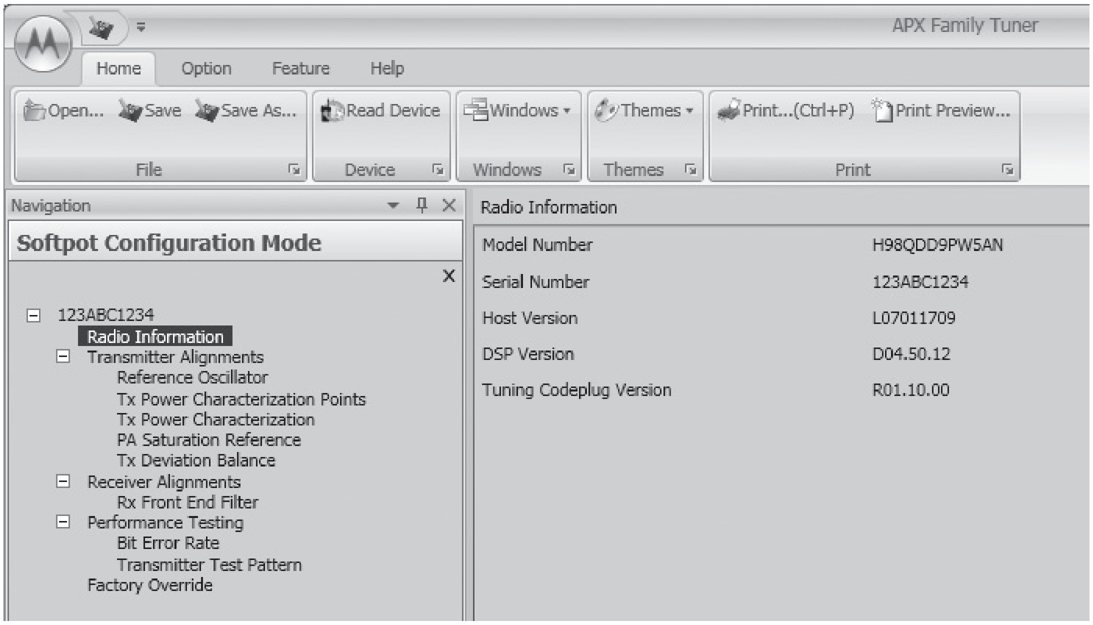

Figure 6-4. Radio Information Screen

6.5 Transmitter Alignments

6.5.1 Reference Oscillator Alignment

Adjustment of the reference oscillator is critical for proper radio operation. Improper adjustment will result not only in poor operation, but also in a misaligned radio that will interfere with other users operating on adjacent channels. For this reason, the reference oscillator should be checked every time the radio is serviced, or once a year, whichever comes first. The frequency counter used for this procedure must have a stability of 0.1 ppm (or better). 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.

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

This test can be done with a Communication Analyzer or Modulation Analyzer.

- Initial setup using the Communication Analyzer:
  - RF Control: Analyzer or RX
  - B/W: WB
  - Freq: CPS frequency under test
  - Attenuation: 20dB (optional)
  - Mon RF in: RF I/O
  - Meter: Frequency Counter or Offset
  - Mode: Analog or P25 STD
- Initial setup using the 8901_ Series Modulation Analyzer:
  - Press the green Automatic Operation button on the analyzer.
  - Press the FREQ key.
  - Type 7.1 followed by SPCL button to set the 8901B_ modulation analyzer for maximum accuracy.

To align the reference oscillator:

Select the **Reference Oscillator** alignment screen. See Figure 6-5 to Figure 6-8.

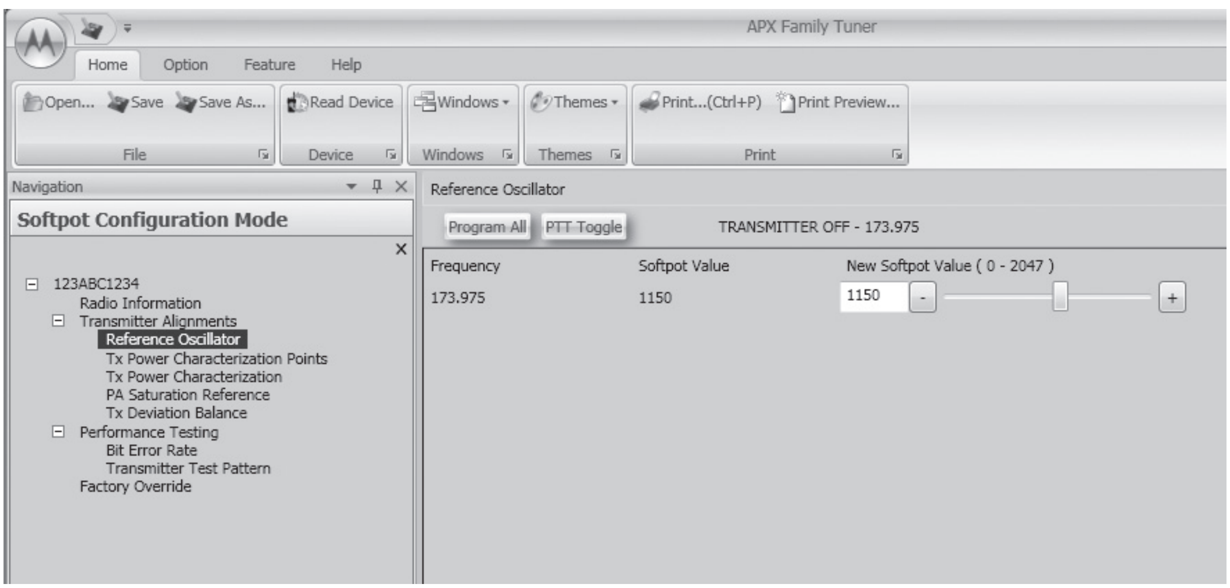

Figure 6-5. Reference Oscillator Alignment Screen (VHF)

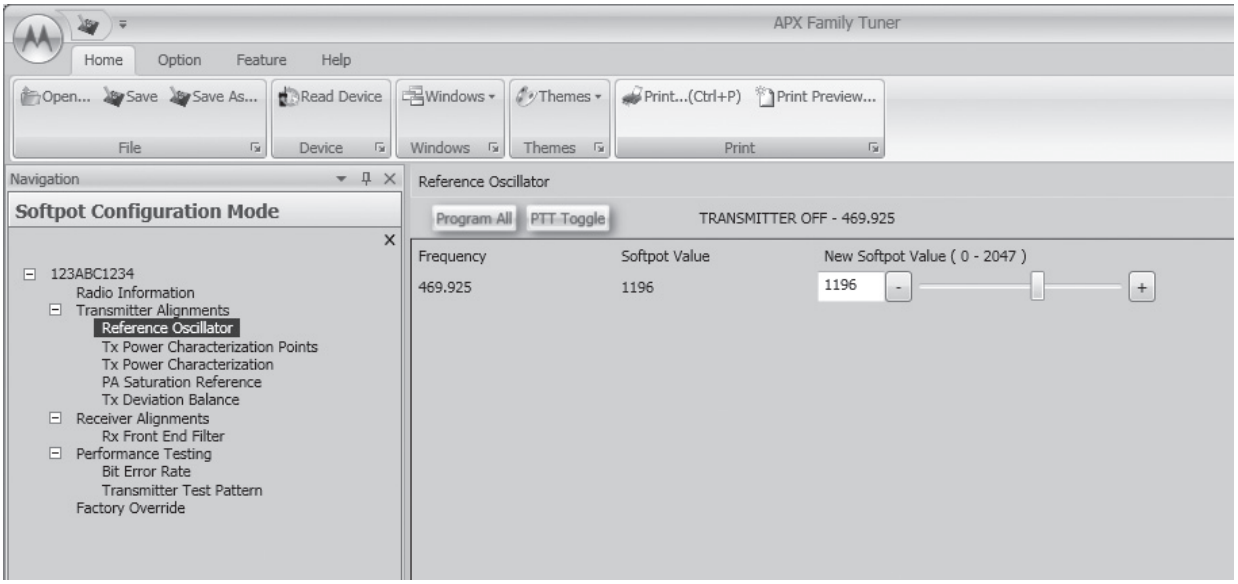

Figure 6-6. Reference Oscillator Alignment Screen (UHF1)

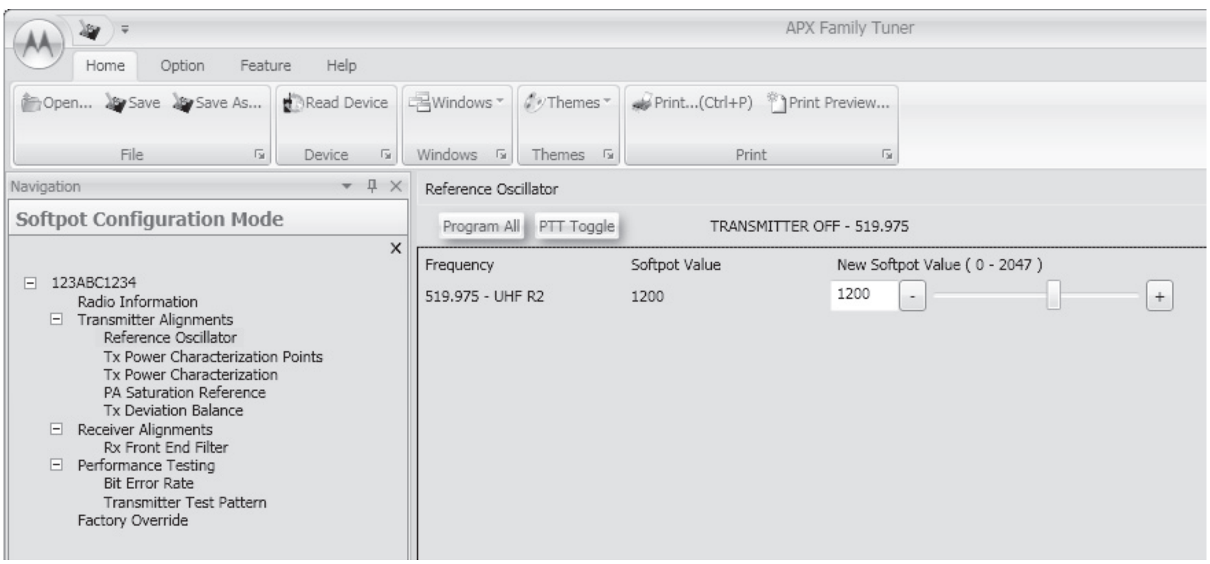

Figure 6-7. Reference Oscillator Alignment Screen (UHF2)

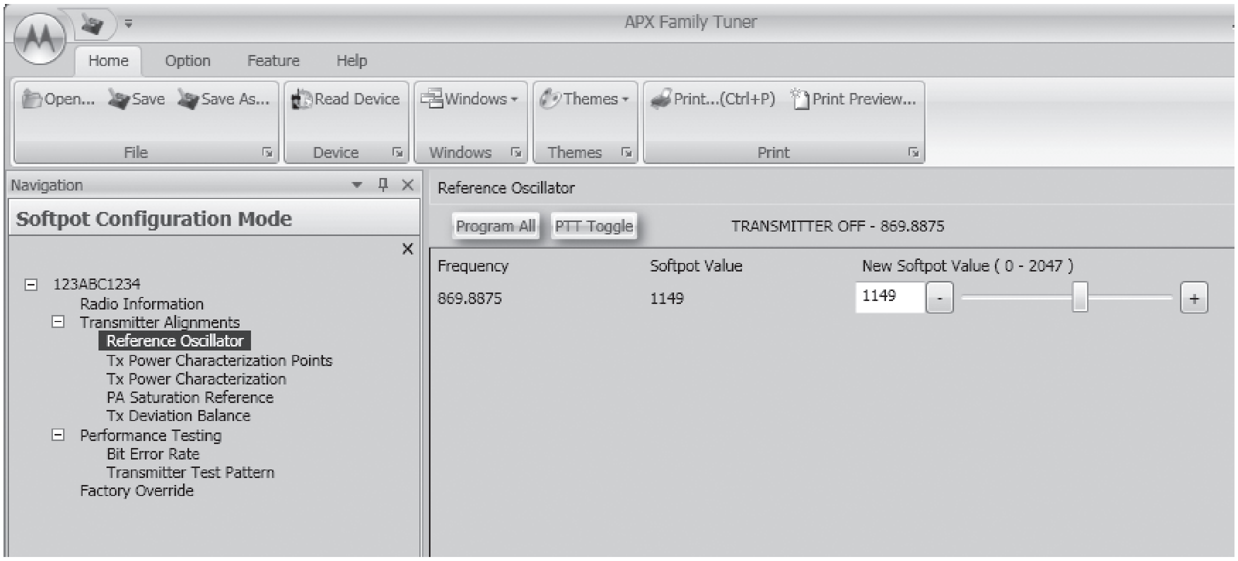

Figure 6-8. Reference Oscillator Alignment Screen (700/800 MHz)

1. Make sure the Communication Analyzer is in **Manual** mode.

2. Set the base frequency to:

Table 6-1. Base Frequencies

VHF	UHF1	UHF2	700/800
173.975 MHz	469.925 MHz	519.975 MHz	869.8875 MHz

3. Adjust the reference oscillator's softpot value with the slider until the measured value is as close as possible to the frequency shown on the screen. See Table 6-2.

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

Table 6-2. Reference Oscillator Alignment

Band	Target
VHF	±50 Hz
UHF1	±50 Hz
UHF2	±50 Hz
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.

6.5.2 Transmit Power Characterization Points

Tuning of the radio is done through **Power Characterization Points** tuning screen.

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

NOTE:

a. The longer the RF cable, the more the attenuation of the power reading.

b. Ensure that the system is calibrated for cable loss.

c. Use a standard 50 ohm cable

d. Apply best practices for the equipment being used.

1. Select the **TX Power Characterization Points** alignment screen. See Figure 6-9 to Figure 6-12.
2. Set power supply voltage and current limit.
3. Adjust softpot value by manipulating the slider bar, incrementing the "New Softpot Value" text box, or directly entering the desired value into the "New Softpot Value" 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 the steps 2 and 3 for all frequencies.
5. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.

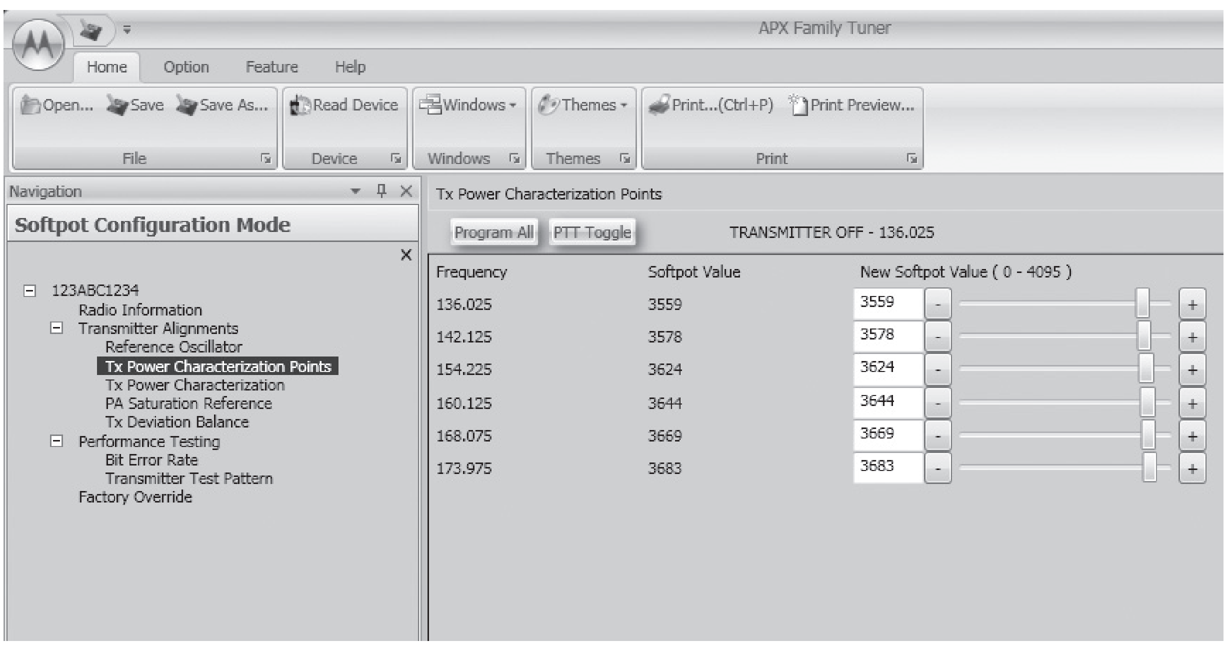

Figure 6-9. Transmit Power Characterization Points Alignment Screen (VHF)

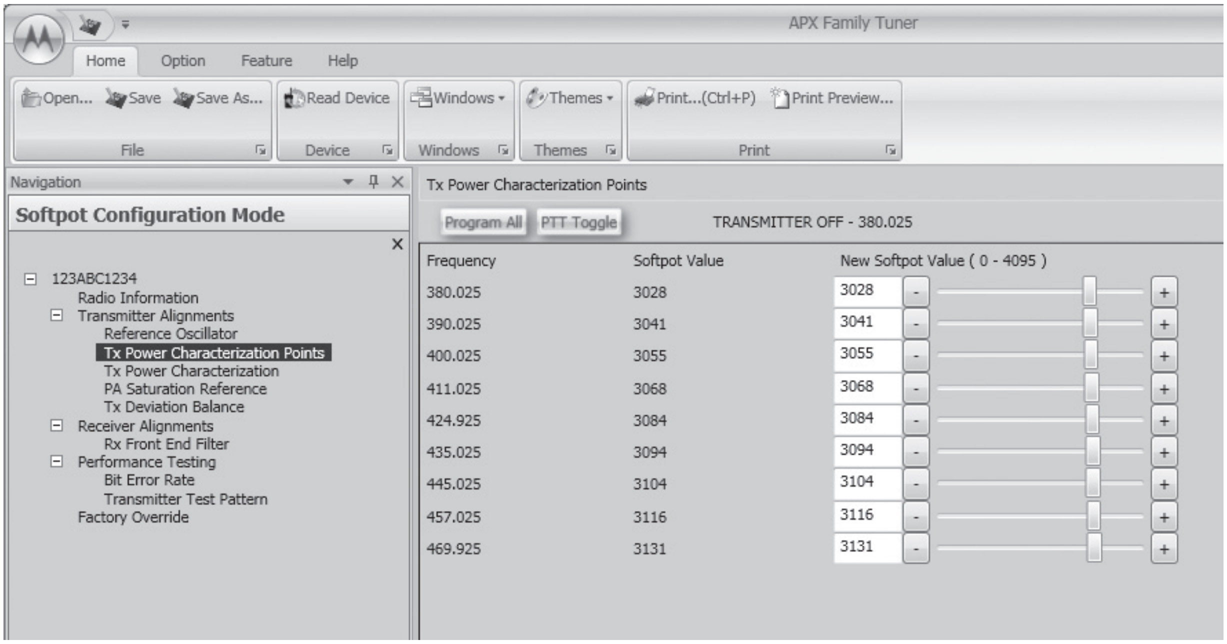

Figure 6-10. Transmit Power Characterization Points Alignment Screen (UHF1)

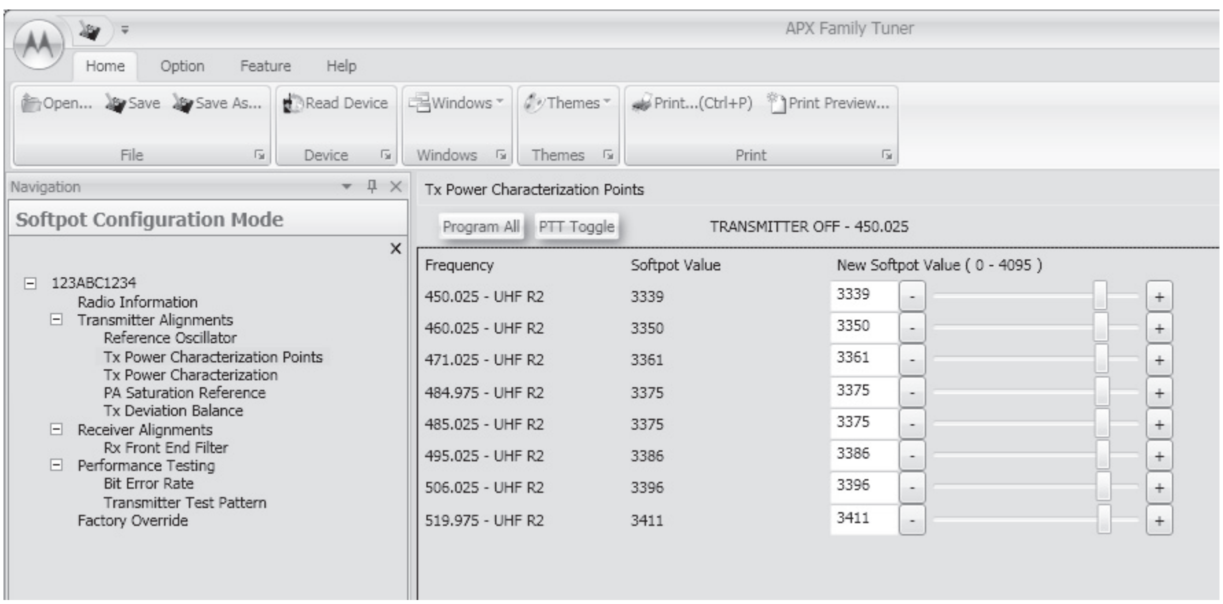

Figure 6-11. Transmit Power Characterization Points Alignment Screen (UHF2)

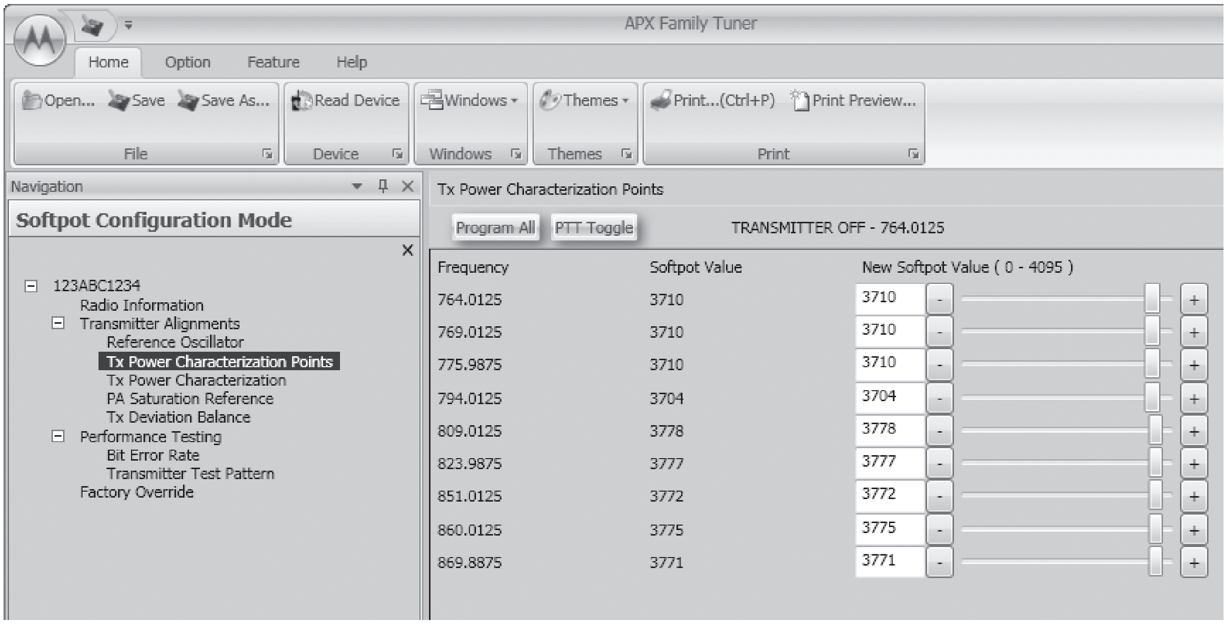

Figure 6-12. Transmit Power Characterization Points Alignment Screen (700/800MHz)

6.5.3 Power Characterization Tuning

Tuning of the radio is done through **Power Characterization** tuning screen.

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

NOTE: **a.**The longer the RF cable, the more the attenuation of the power reading.
b.Ensure that the system is calibrated for cable loss.
c.Use a standard 50 ohm cable
d.Apply best practices for the equipment being used.

1. Select the **TX Power Characterization** alignment screen. The screen indicates the transmit power to be used. See Figure 6-13 to Figure 6-16.
2. Left-click the box under “Measure Power 1” for the desired frequency field. (The selected box is highlighted).
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 highlighted “Measure Power 1” box.
6. Left-click the box under “Measure Power 2” box for the same frequency field. (The selected box is highlighted).
7. Measure the transmit power of the radio with a service monitor.
8. Input the transmit power in watts using two decimal places into the highlighted “Measure Power 2” box.
9. Repeat steps 2 to 8 for all frequencies.

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

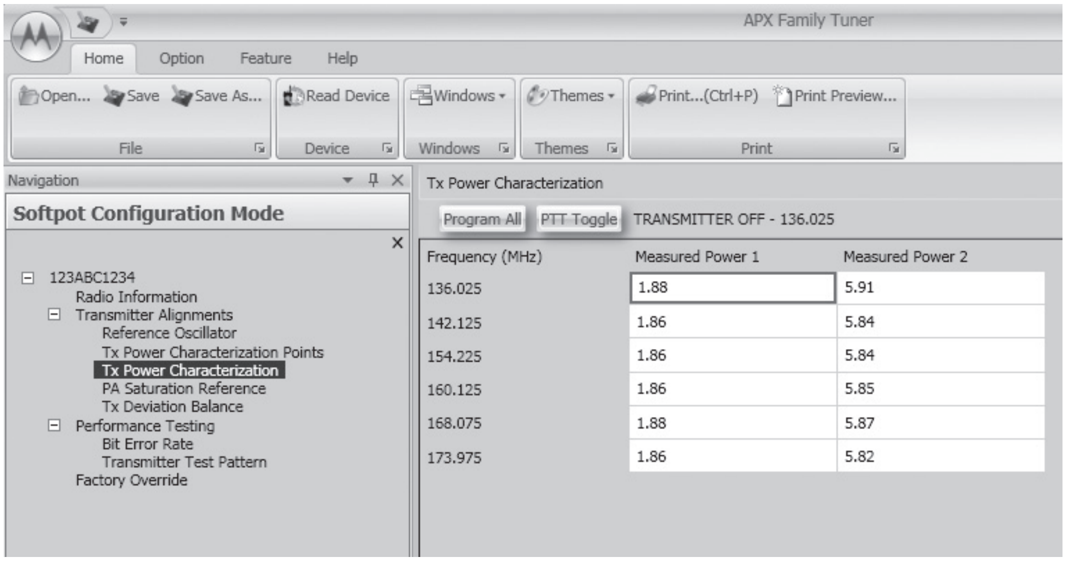

Figure 6-13. Transmit Power Characterization Alignment Screen (VHF)

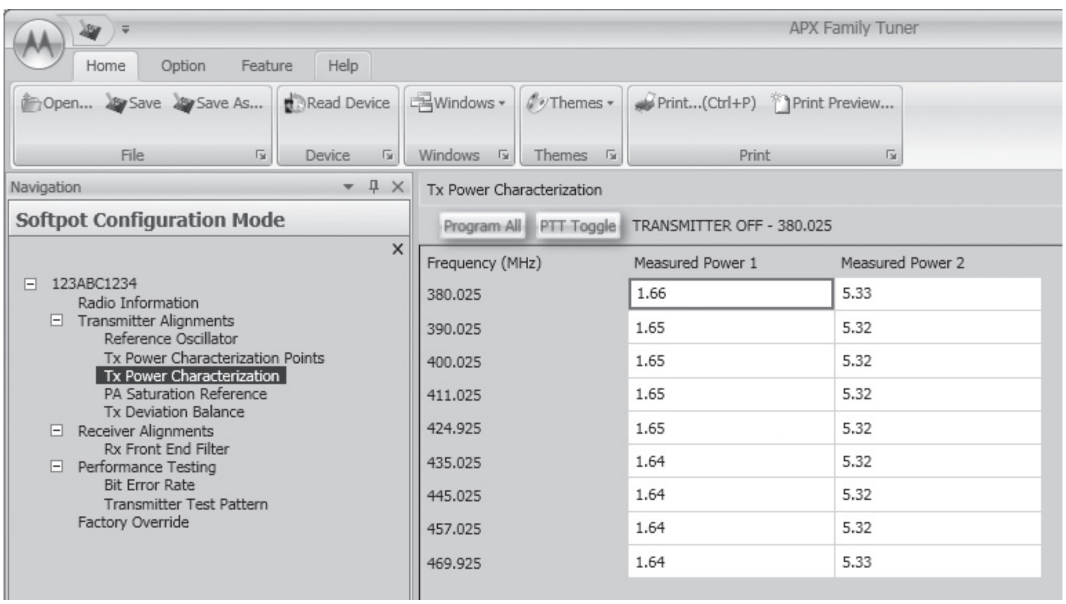

Figure 6-14. Transmit Power Characterization Alignment Screen (UHF1)

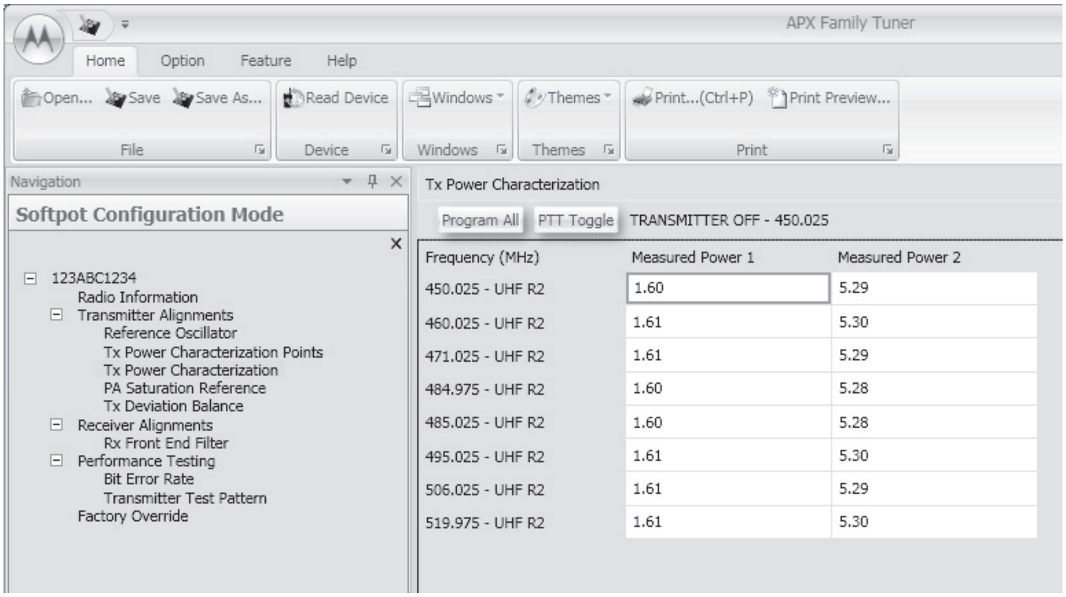

Figure 6-15. Transmit Power Characterization Alignment Screen (UHF2)

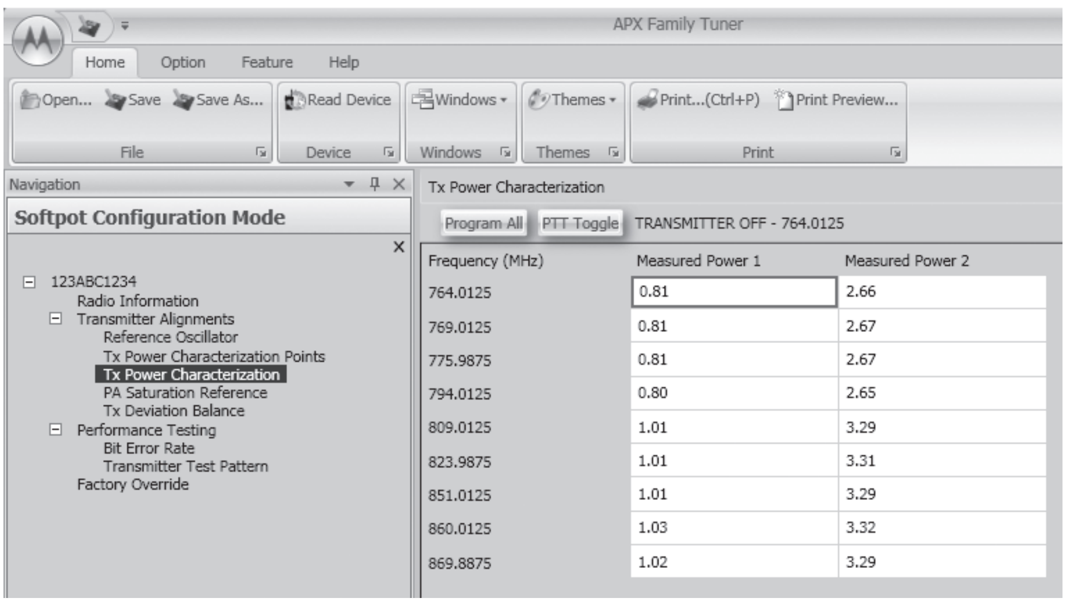

Figure 6-16. Transmit Power Characterization Alignment Screen (700/800 MHz)

6.5.4 PA Saturation Reference Tuning

Tuning is done through **PA Saturation Referencing** screen.

1. Select the **PA Saturation Reference** alignment screen. The screen indicates the transmit frequencies to be used. See Figure 6-17 to Figure 6-20.
2. In Manual Mode, set the service monitor to the desired frequency (as shown in the frequency list in the PA Saturation Reference alignment screen).
3. Adjust the PA Saturation Reference softpot value with the slider until the radio transmits as close as possible to the rated power. For rated power refer to the help text in the Tuner.
4. Left-click the slider of the frequency selected (should be the same frequency as step 2).
5. Left-click the **PTT Toggle** button on the screen to make the radio transmit. The screen indicates whether the radio is transmitting.
6. Repeat the steps 2 to 5 for all frequencies.
7. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.

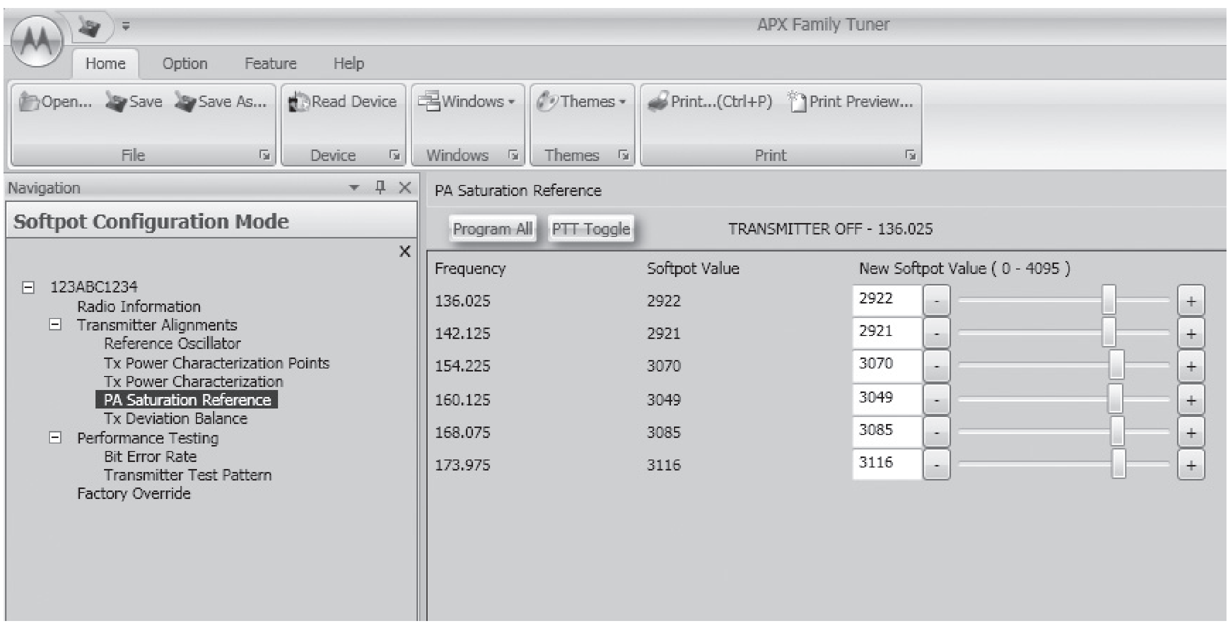

Figure 6-17. PA Saturation Referencing Alignment Screen (VHF)

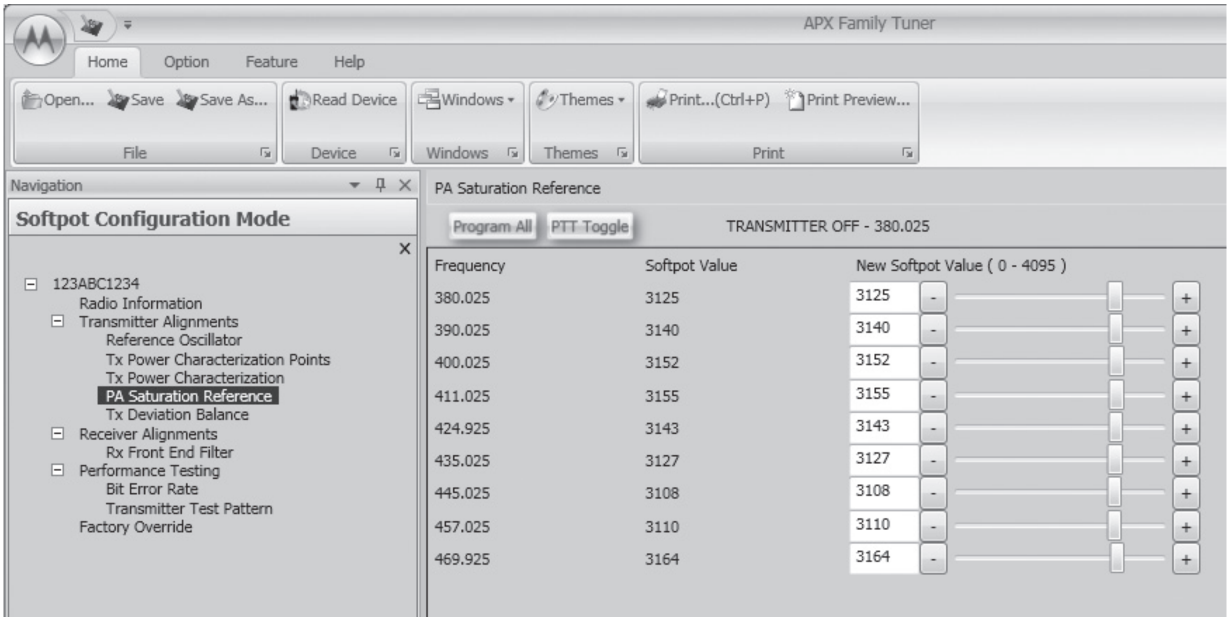

Figure 6-18. PA Saturation Referencing Alignment Screen (UHF1)

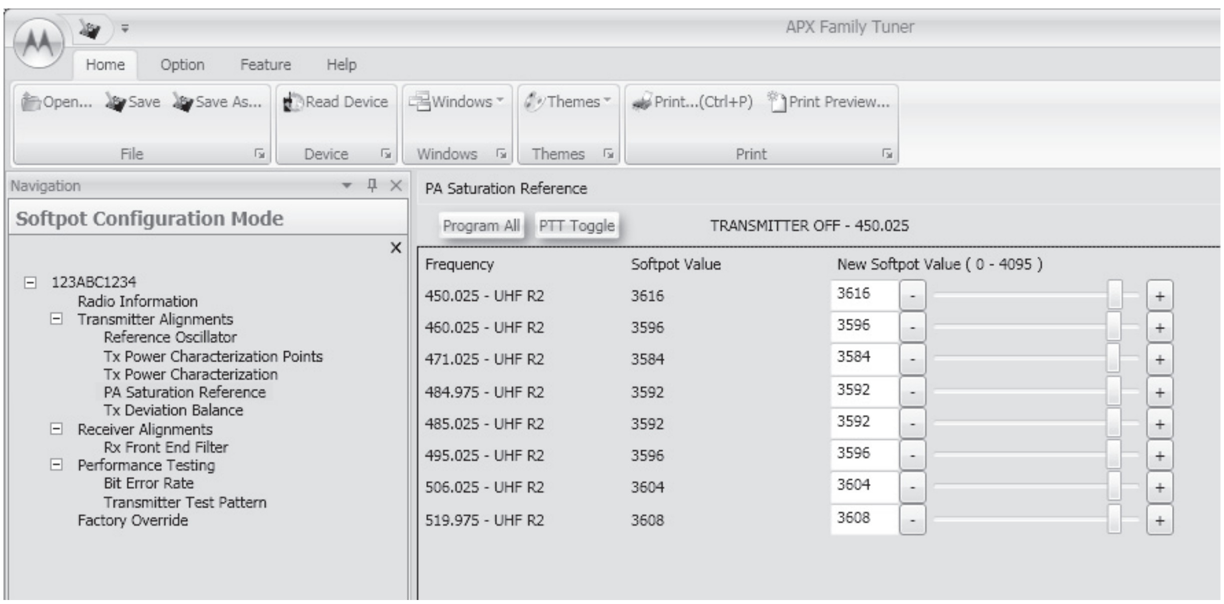

Figure 6-19. PA Saturation Referencing Alignment Screen (UHF2)

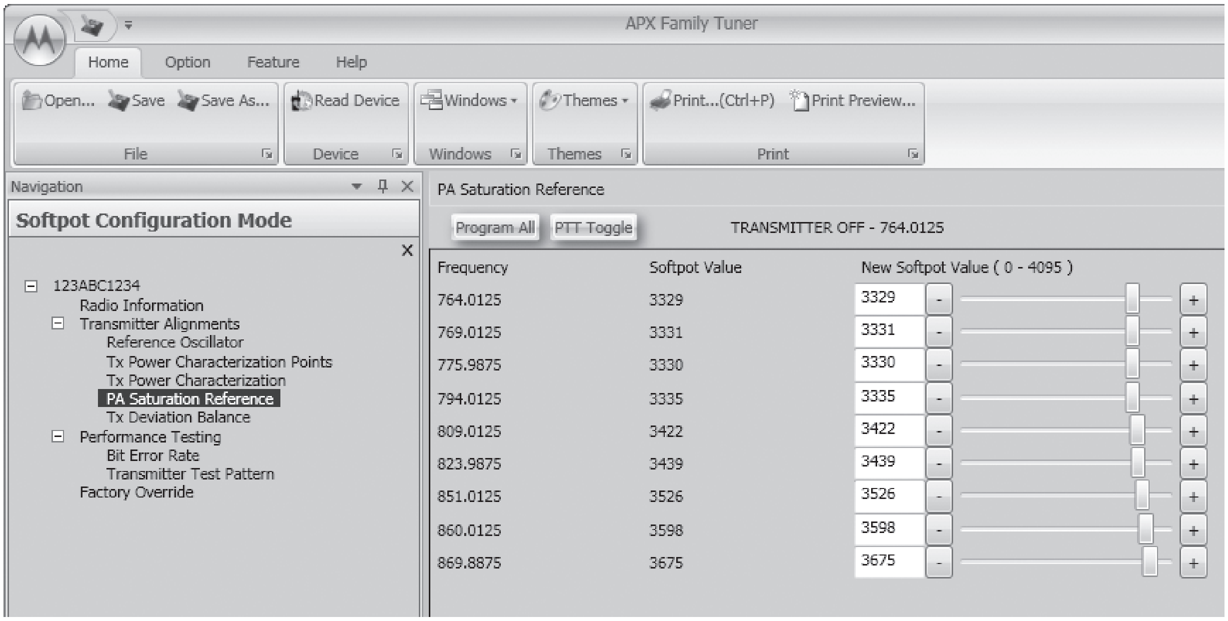

Figure 6-20. PA Saturation Referencing Alignment Screen (700/800 MHz)

6.5.5 Transmit Deviation Balance Alignment

This alignment procedure balances the modulation contributions of the low- and high-frequency portions of a baseband signal. Proper alignment is critical to the operation of signalling 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 alignment can be done with either Communication Analyzer or Modulation Analyzer.

1. Initial setup using the Communication Analyzer:
   - **Mode:** P25 Analog Mode 15Khz LP filter enabled
   - **RF Control:** P25 RX
   - **Meter:** FM Deviation
   - **Frequency:** Selected radio TX frequency
2. Initial setup using a Modulation Analyzer such as the 8901_ Series Modulation Analyzer:
   - Press the **FM MEASUREMENT** button. (The “*Error 03-input level too low”* indication is normal until an input signal is applied.)
   - Simultaneously press the **Peak –** and **Peak +** buttons. Both LEDs on the buttons should light.
   - Press the 15 kHz LP filter key.
3. Select the **TX Deviation Balance** alignment screen. The screen indicates the transmit frequencies to be used. See Figure 6-21 to Figure 6-24.
4. In the "RF Control" section, 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 analyzer.
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 the steps 4 to 10 for all frequencies.
13. Left-click the **Program All** button on the screen to de-key the radio and save the tuned values.

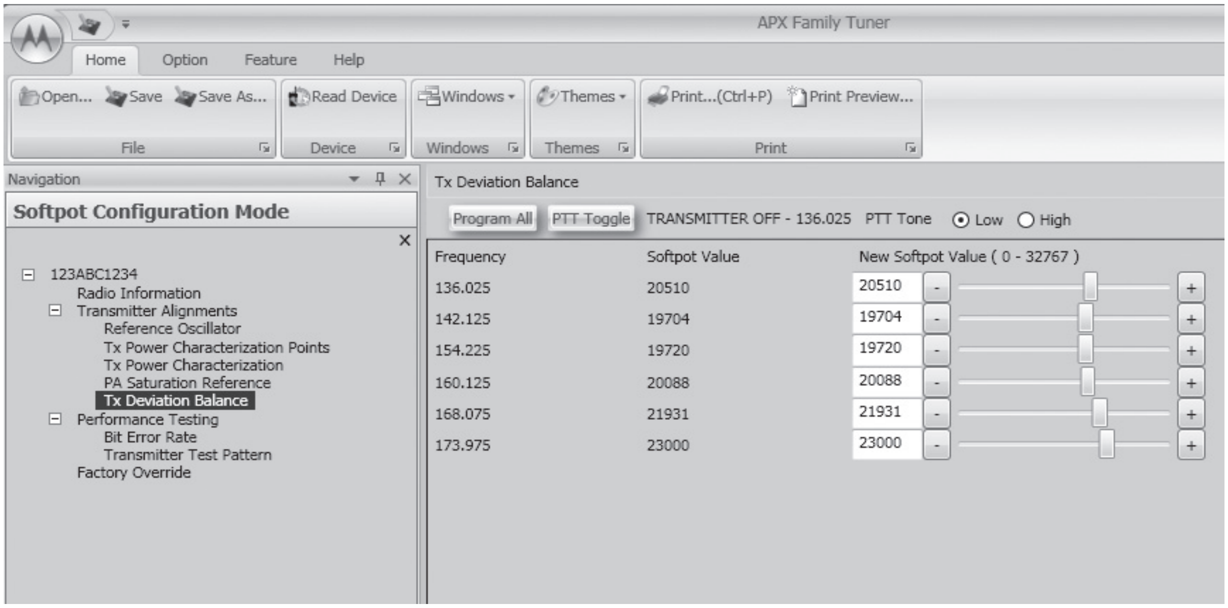

Figure 6-21. Transmit Deviation Balance Alignment Screen (VHF)

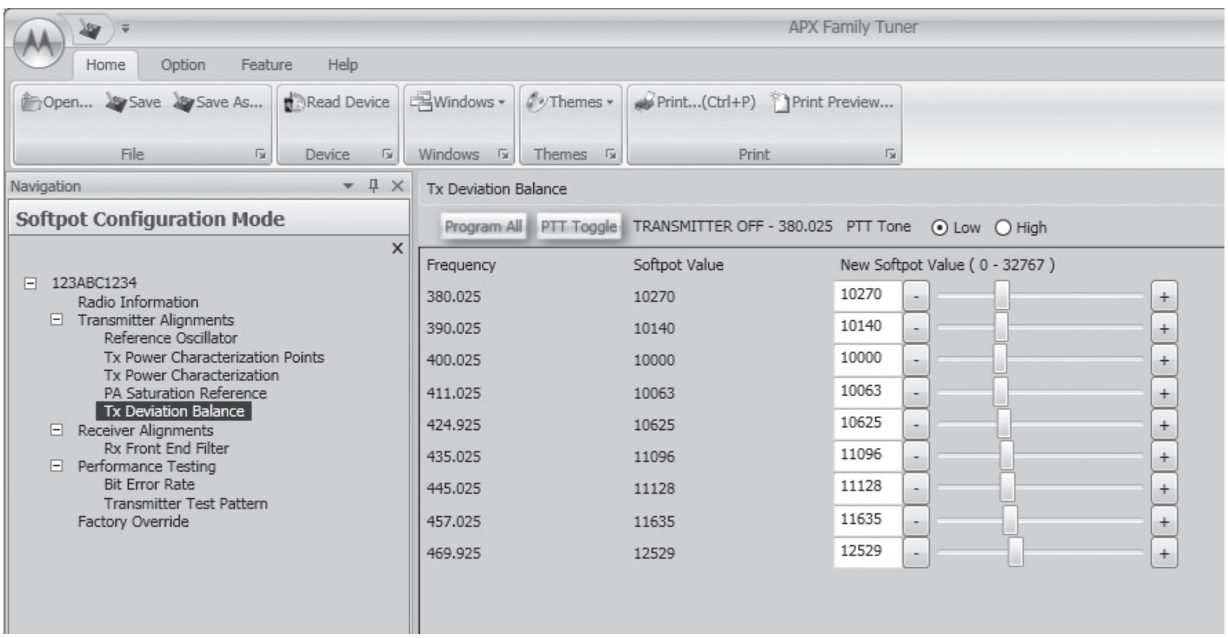

Figure 6-22. Transmit Deviation Balance Alignment Screen (UHF1)

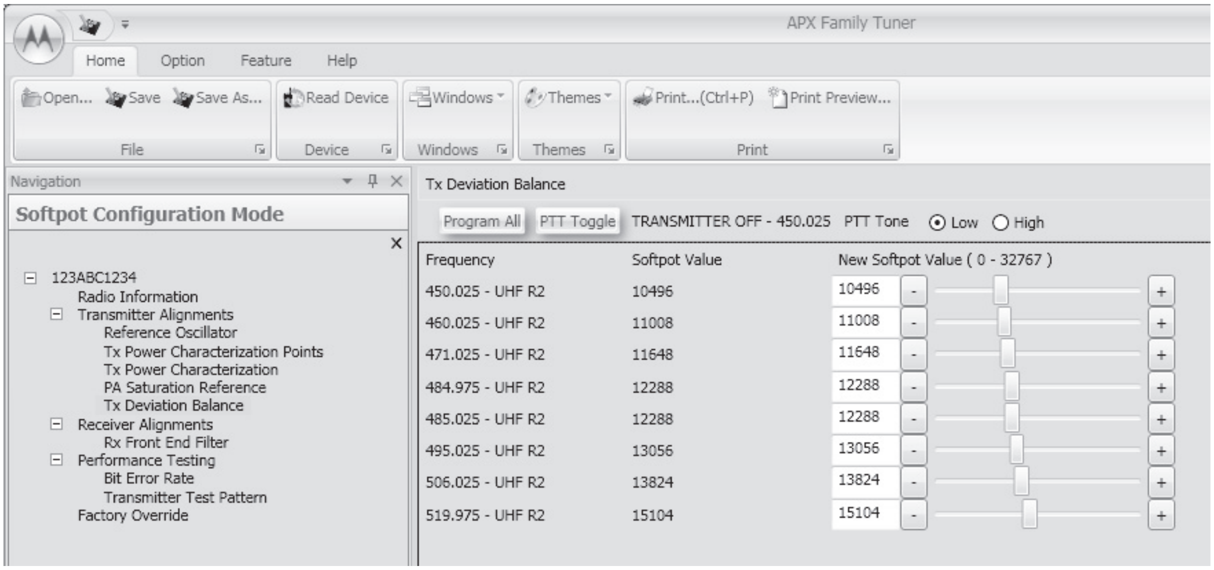

Figure 6-23. Transmit Deviation Balance Alignment Screen (UHF2)

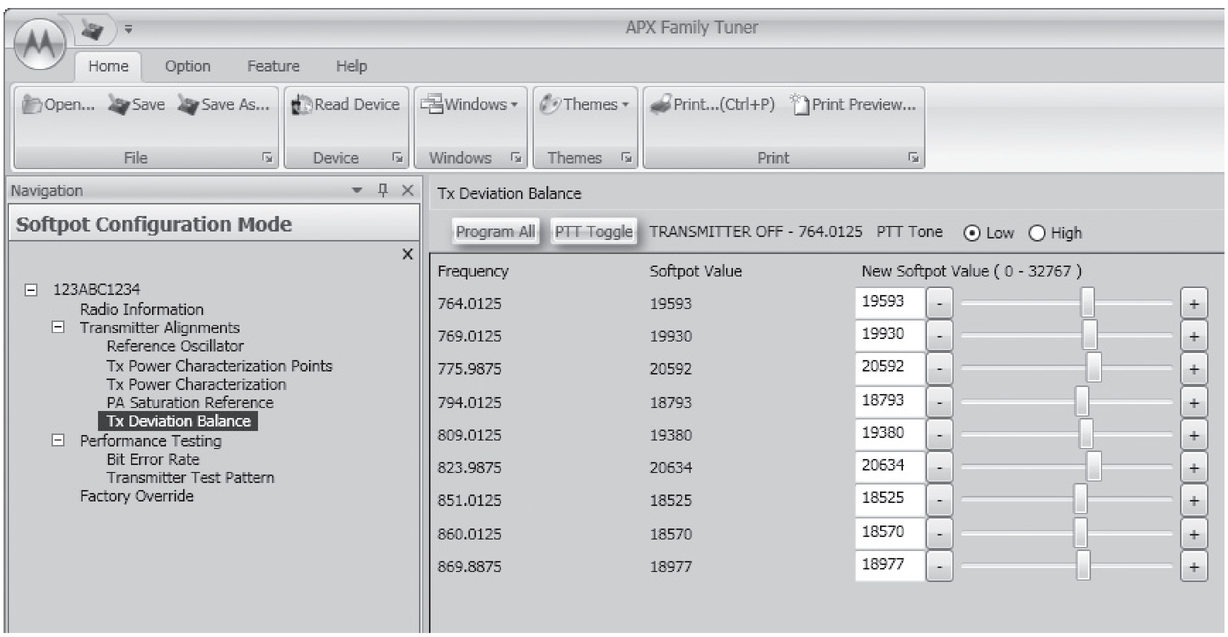

Figure 6-24. Transmit Deviation Balance Alignment Screen (700/800 MHz)

14. Left-click the **PTT Tone: High** button.
15. 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.
16. Left-click the **PTT Toggle** to de-key the radio.
17. Repeat the steps 4 to 10 for all frequencies.
18. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.

6.6 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 6-25 and Figure 6-26).

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

6.6.1 Procedure for UHF Range 1 and UHF Range 2 (Auto Tune)

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

1. Select the **Rx Front End Filter** alignment screen. See Figure 6-25 and Figure 6-26.
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 the steps 2–4 for all frequencies.
6. Left-click the **Program All** button on the screen to save the tuned values in the radio.

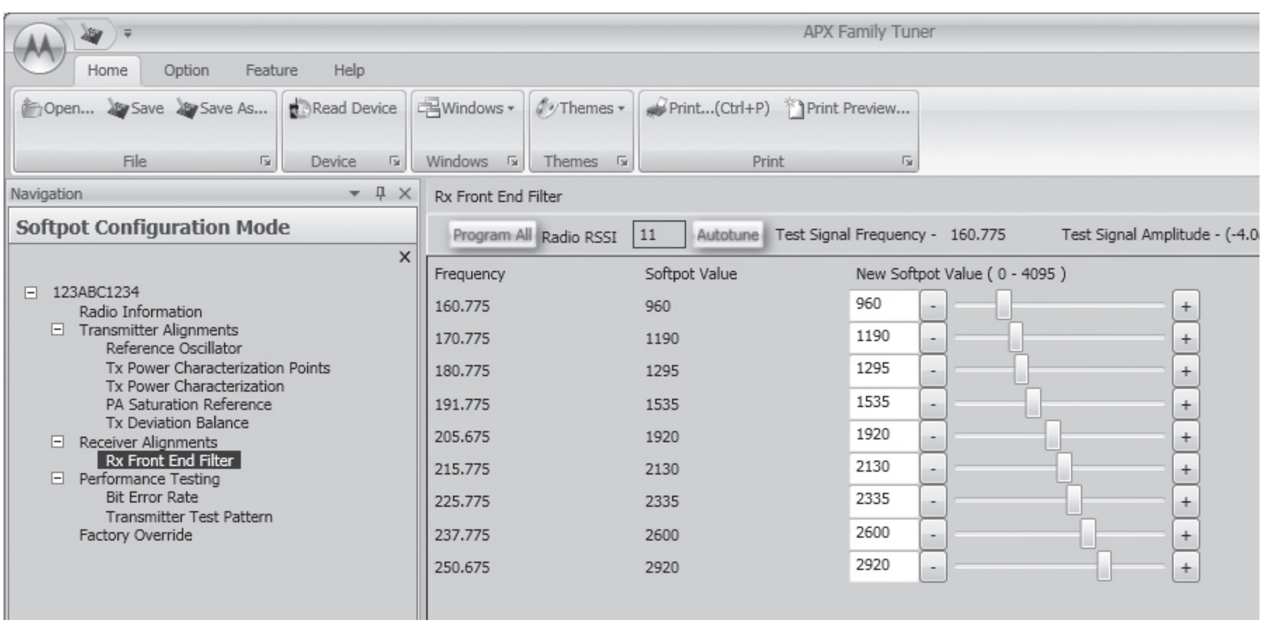

Figure 6-25. Front End Filter Alignment Screen (UHF1)

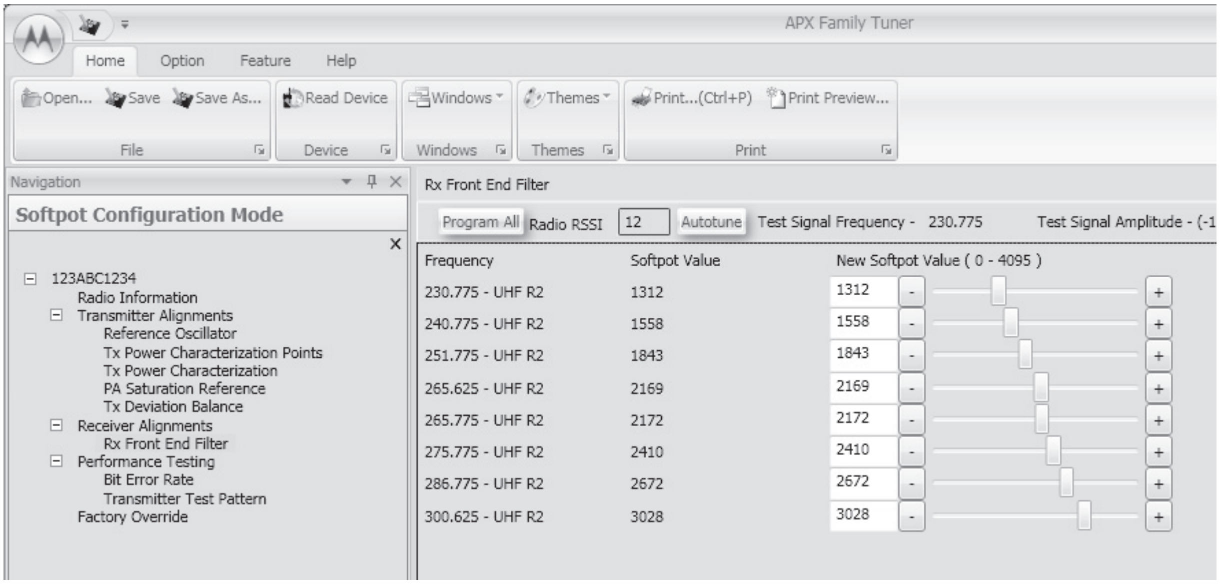

Figure 6-26. Front End Filter Alignment Screen (UHF2)

6.7 Performance Testing

6.7.1 Bit Error Rate

This section describes the Bit Error Rate (BER) test of the radio’s receiver at a desired frequency (see Figure 6-27 to Figure 6-30).

6.7.1.1 Bit Error Rate Fields

Set up the Communication Analyzer as follows:

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:

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

The bit error rate screen contains the following fields:

- **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 and Standard Interface Test Pattern (CCITT V.52).
- **Modulation Type**:
  This field represents the digital modulation type of the incoming signal on which BER is to be calculated.
- **Continuous Operation**:
  This field allows the user the option to repeat the BER test indefinitely. A selection of Yes will cause the radio to calculate BER on a continuous basis and update the results on this screen after each integration time. A selection of No will cause the BER test to execute for only one sample of the integration time and then update the display.
- **Audio**:
  This field allows the user to select the audio output during a test. Selecting Internal will cause the radio's built-in speaker to unmute to any signals at the desired frequency which are present during the test. Selecting External will route the same signal to the radio's accessory connector audio output. Selecting Mute will disable the audio output.

NOTE: There will be **no audio** option available for APX 7000 when performing a Bit Error Rate Test.

- **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.

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

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

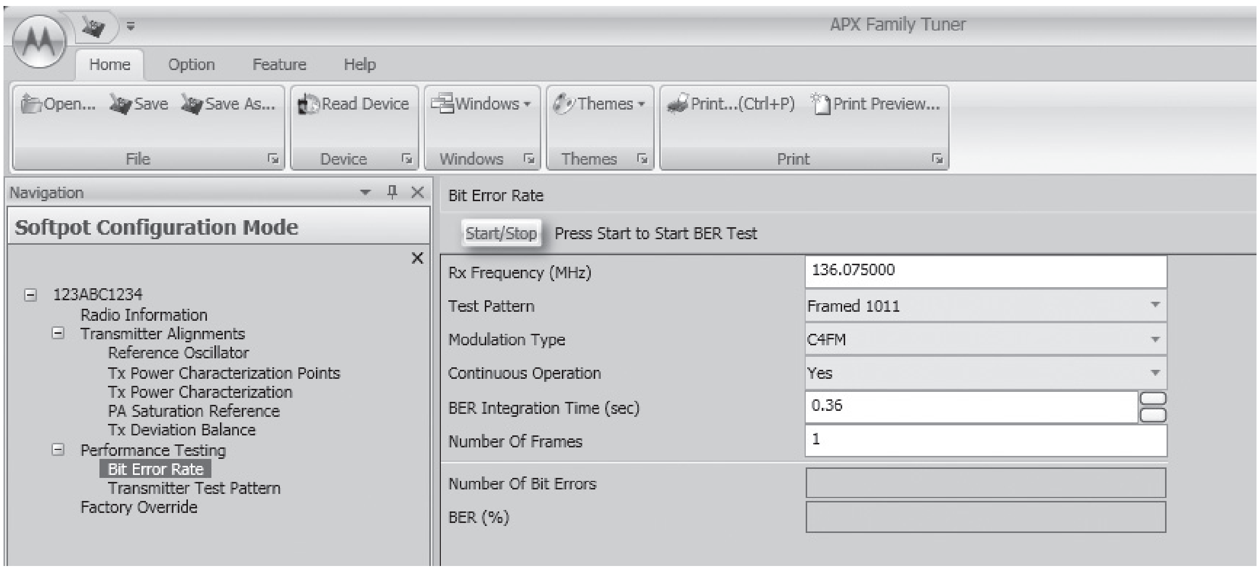

Figure 6-27. Bit Error Rate Screen (VHF)

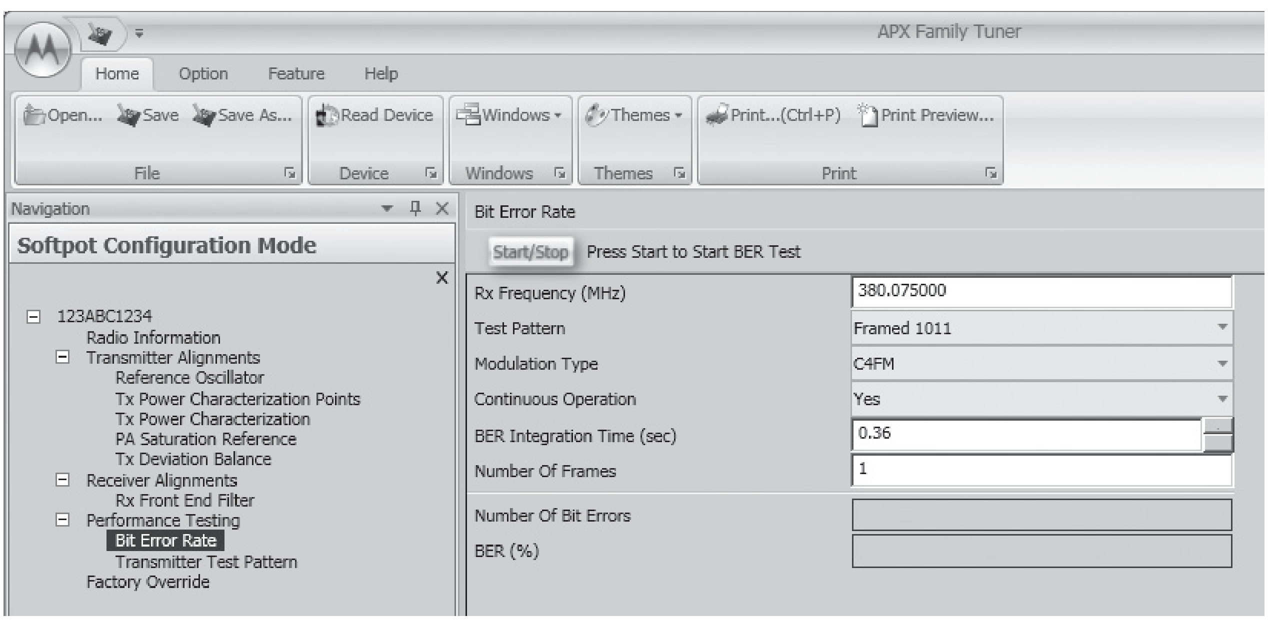

Figure 6-28. Bit Error Rate Screen (UHF1)

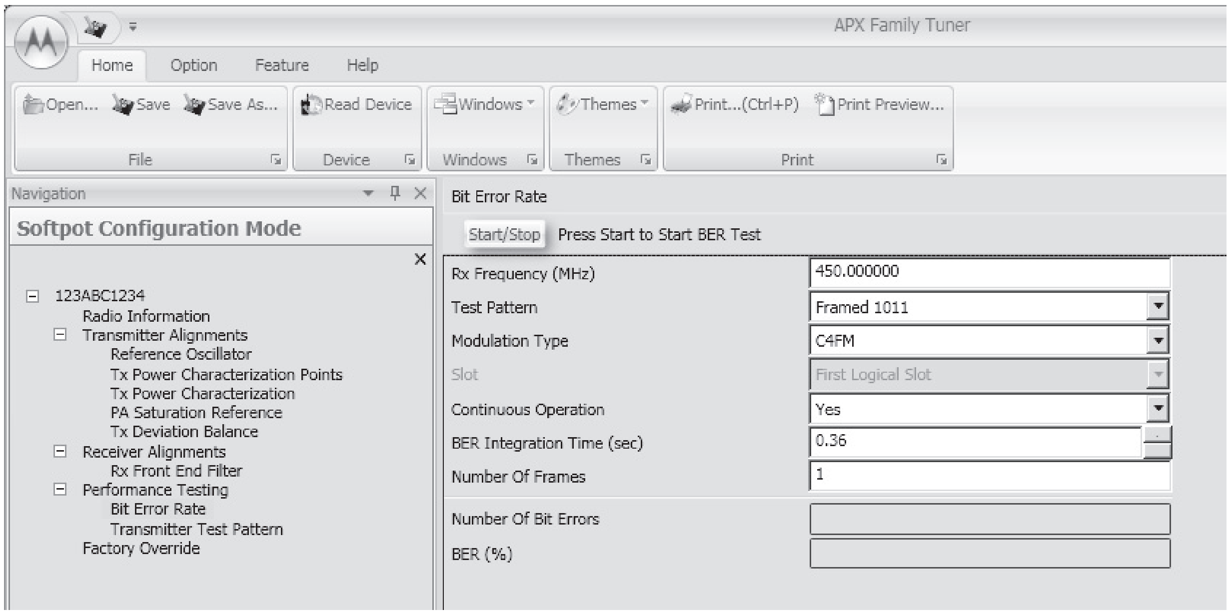

Figure 6-29. Bit Error Rate Screen (UHF2)

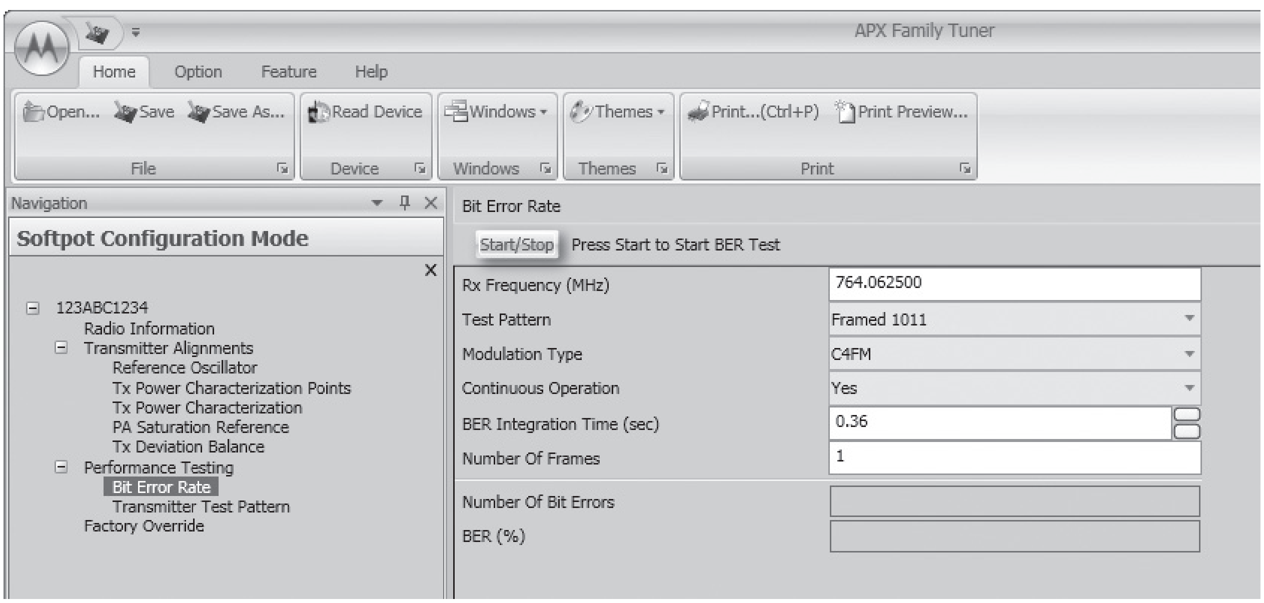

Figure 6-30. Bit Error Rate Screen (700/800 MHz)

3. Press **Start/Stop** button to begin or end BER testing.

6.7.2 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 radio's transmitter (see Figure 6-31 to Figure 6-34).

6.7.2.1 Transmitter Test Fields

This screen contains the following fields:

- **Tx Frequency**:
  This field selects the Transmit Frequency directly in MHz.
- **Channel Spacing**:
  This field allows the user to select the desired transmit deviation in kHz.
- **Test Pattern Type**:
  This field represents the type of test pattern which will be transmitted by the radio when **PTT TOGGLE** button is pressed.

NOTE: Channel Spacing and Test Pattern Type fields will be grayed out while radio is transmitting.

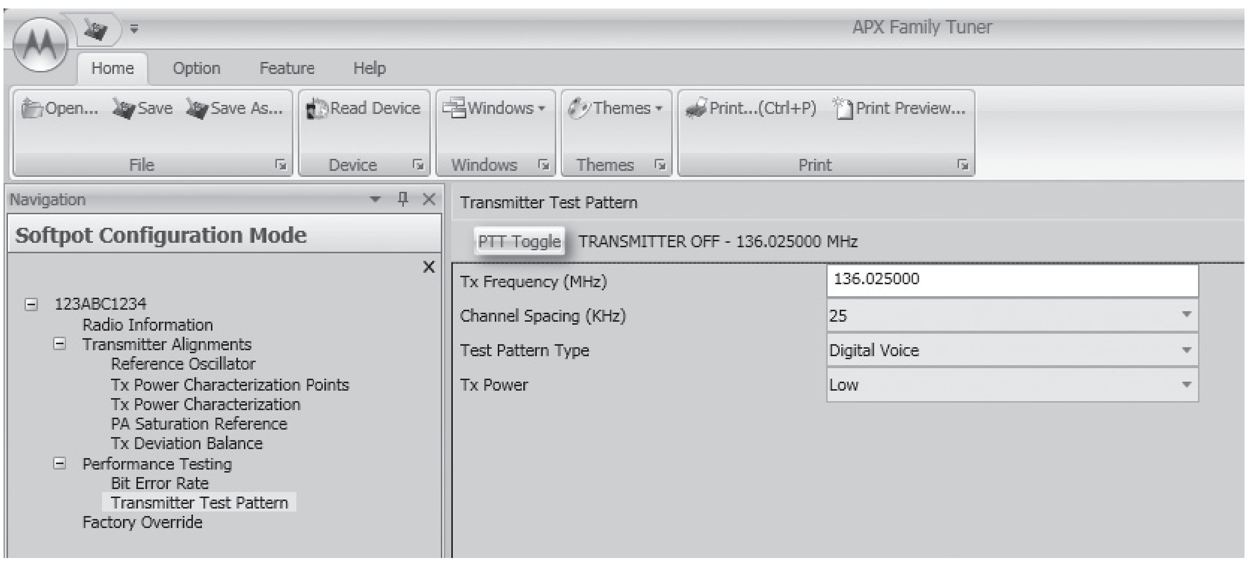

Figure 6-31. Transmitter Test Pattern Screen (VHF)

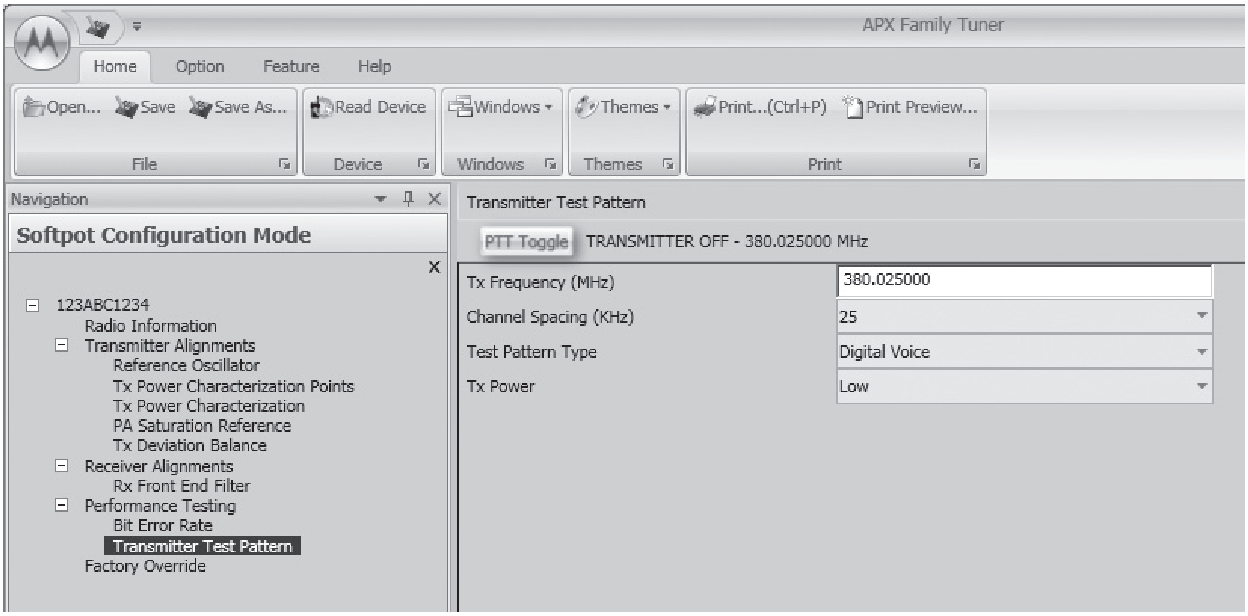

Figure 6-32. Transmitter Test Pattern Screen (UHF1)

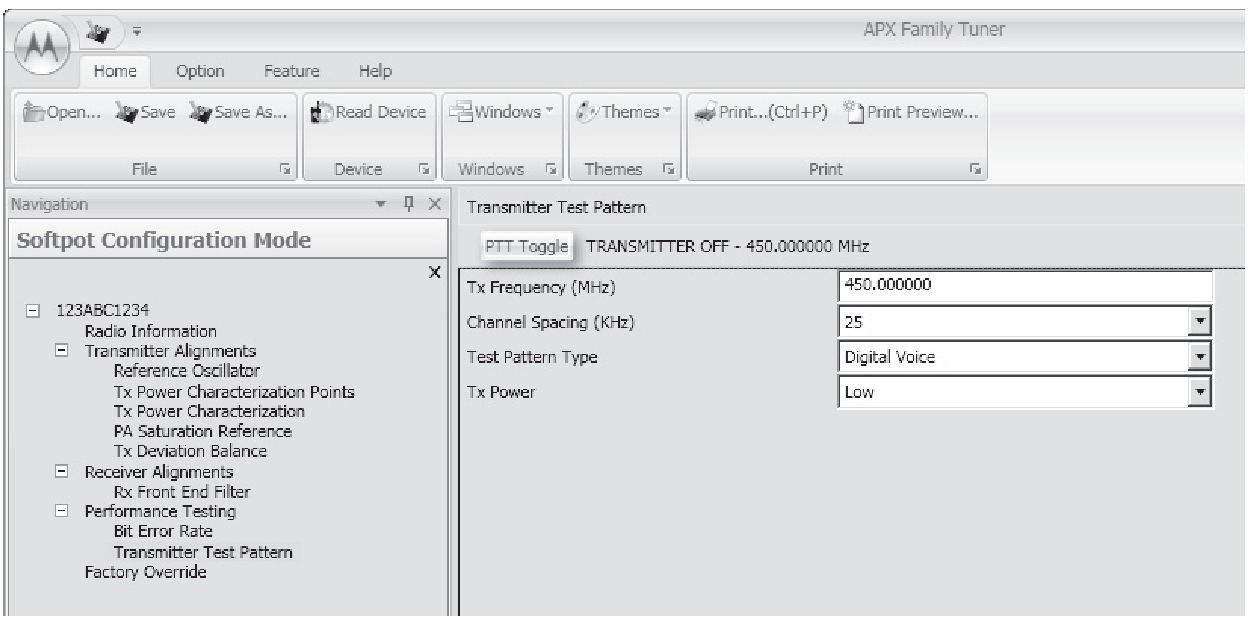

Figure 6-33. Transmitter Test Pattern Screen (UHF2)

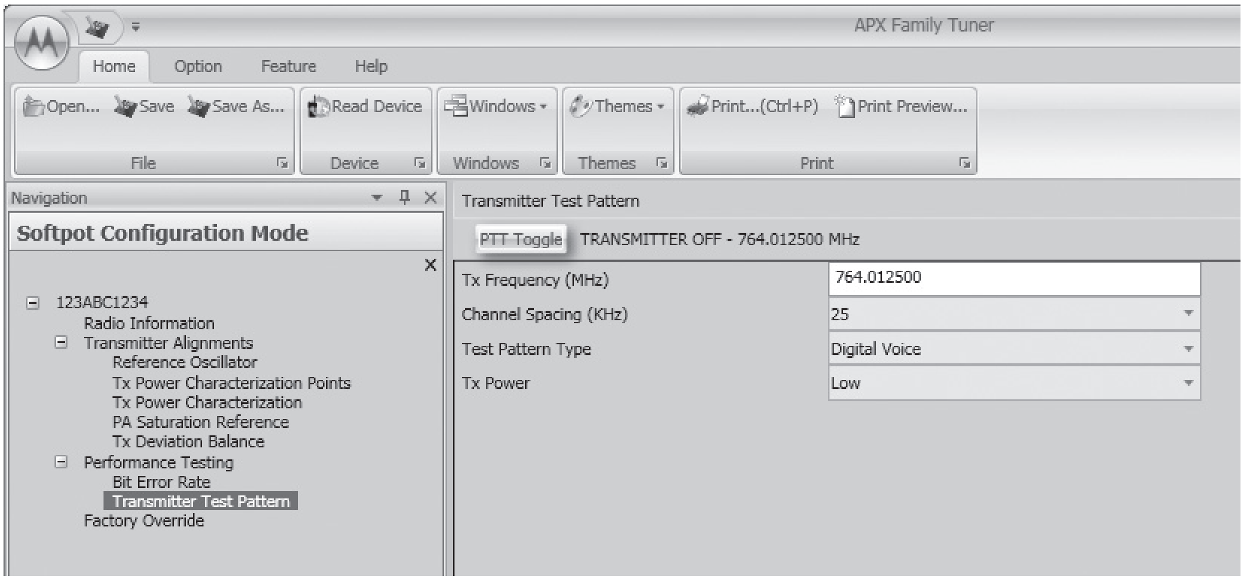

Figure 6-34. Transmitter Test Pattern Screen (700/800 MHz)

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 will be 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". If the parameter is disabled, keys will be sent in clear form; if the parameter is enabled, keys will be sent to the radio in encrypted form.

NOTE: 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.

To load an encryption key:

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.
4. When the key is loaded successfully, you will hear:
   - On single-key radios – a short tone.
   - On multikey radios – an alternating tone.

The secure kits for APX 6000XE are identified by the following kit numbers:

Table 7-1. Kit Numbers for Secure-Enabled Expansion Boards

Kit Number	Description
NNTN8171_	APX 6000 DVP-XL Expansion Board
NNTN8172_	APX 6000 DVP-XL Expansion Board with Apps
NNTN8173_	AES Expansion Board
NNTN8174_	AES Expansion Board with Apps
NNTN8175_	DES/ DES-XL/ DES-OFB Expansion Board
NNTN8176_	DES/ DES-XL/ DES-OFB Expansion Board with Apps
NNTN8177_	Expansion Board
NNTN8178_	Expansion Board with Apps

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 (e.g., 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:

1. Press ▶ until the display shows "Key".
2. Press , , or directly below "Key". The display shows the last user-selected and -stored encryption key.
3. Press ▲ or ▼ to scroll through the list of encryption keys.

   NOTE: If a deleted key is selected, "ERASED KEY" will be displayed.

4. Press , , or directly below the desired menu.
   - SEL = saves the newly selected key and returns to the home display.
5. Press , the **PTT** button, or , , or 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:

1. Press until the display shows "Key".
2. Press , , or directly below "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" will be displayed.

4. Press , , or directly below the desired menu.
   - SEL = saves the newly selected key and returns to the home display.
5. Press , the **PTT** button, or , , or 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 Select an Encryption Index

This feature lets the user select 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 will now have the equivalent new key instead.

7.4.1 Use the Menu

To select an index using the menu:

1. Press until the display shows "KSet".
2. Press , , or directly below "KSet". The display shows the last user-selected and -stored index.
3. Press or to scroll through the list of encryption keys.

   NOTE: If a deleted key is selected, "ERASED KEY" will be displayed.

4. Press , , or directly below the desired menu.
   - SEL = saves the newly selected key and returns to the home display.
5. Press , the **PTT** button, or , , or 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:

1. Press ▶ until the display shows "KSet".
2. Press , , or directly below "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" will be displayed.

4. Press , , or directly below the desired menu.
   - SEL = saves the newly selected key and returns to the home display.
5. Press , the **PTT** button, or , , or 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 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:

1. Press ▶ until the display shows "Eras".
2. Press , , or directly below "Eras". The display shows the last user-selected and -stored encryption key.
3. Press ▲ or ▼ to scroll through the list of encryption keys.
4. Select single encryption key or all encrytion keys deletion from the "OPTN" menu.
5. Press , the **PTT** button, or , , or 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:

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 APX 6000XE radios. When performing these procedures, refer to "Chapter 10: Exploded Views and Parts Lists" on page 2:10-1 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 APX 6000XE radio's standard accessories and changing the Volume and Frequency Knobs.

8.1 APX 6000XE Exploded View (Main Subassemblies)

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

This section contains the APX 6000XE radio partially exploded views.

NOTES:

- Refer to Figure 8-1, on page 2:8-2, the Partial Exploded View, and Table 8-1 on page 2:8-5, the Partial Exploded View Parts List.
- Letters in parentheses ( ) refer to item letters in Figure 8-1, on page 2:8-2 and Table 8-1 on page 2:8-5.

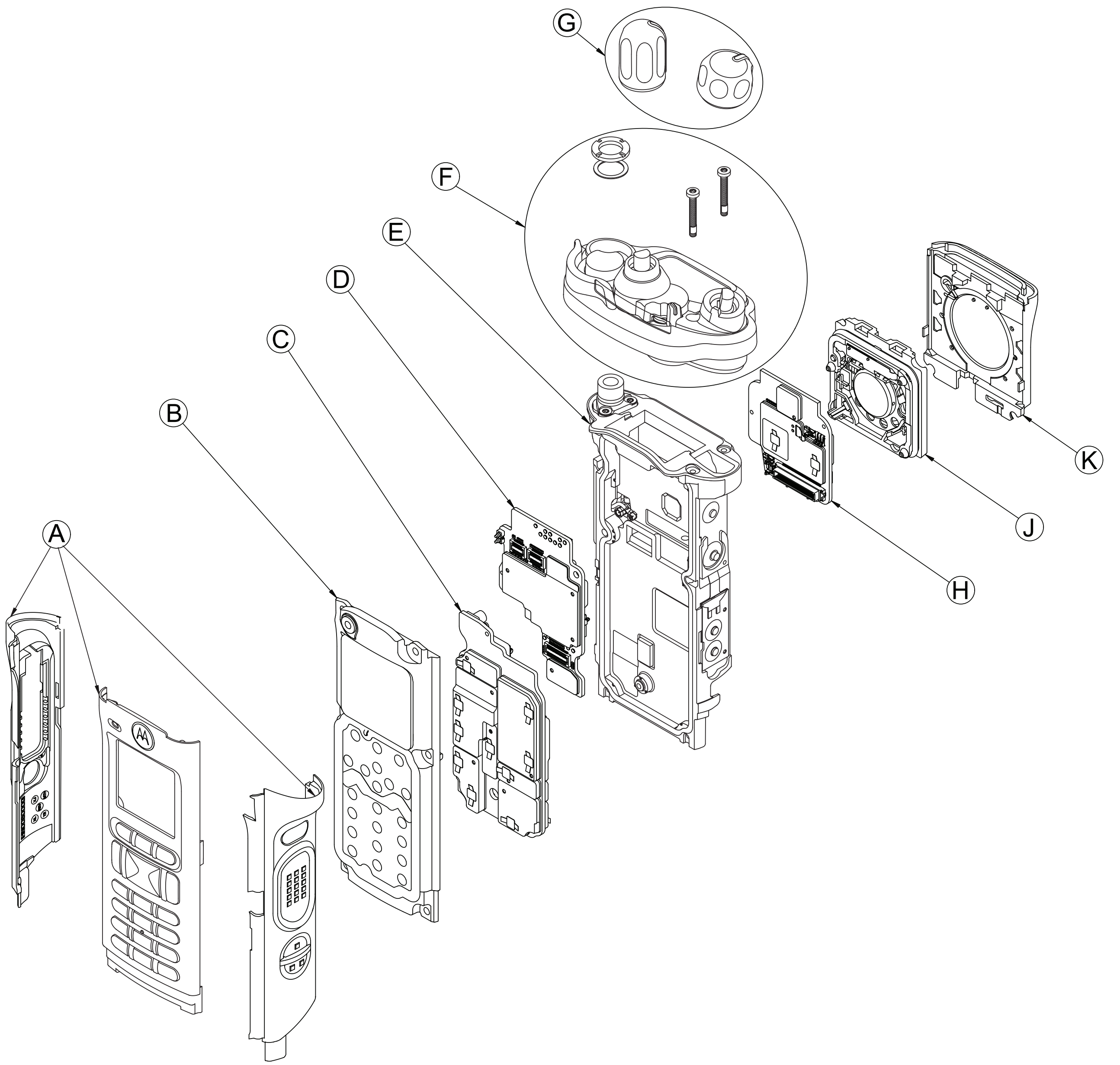

Figure 8-1. APX 6000XE Dual Display Partial Exploded View

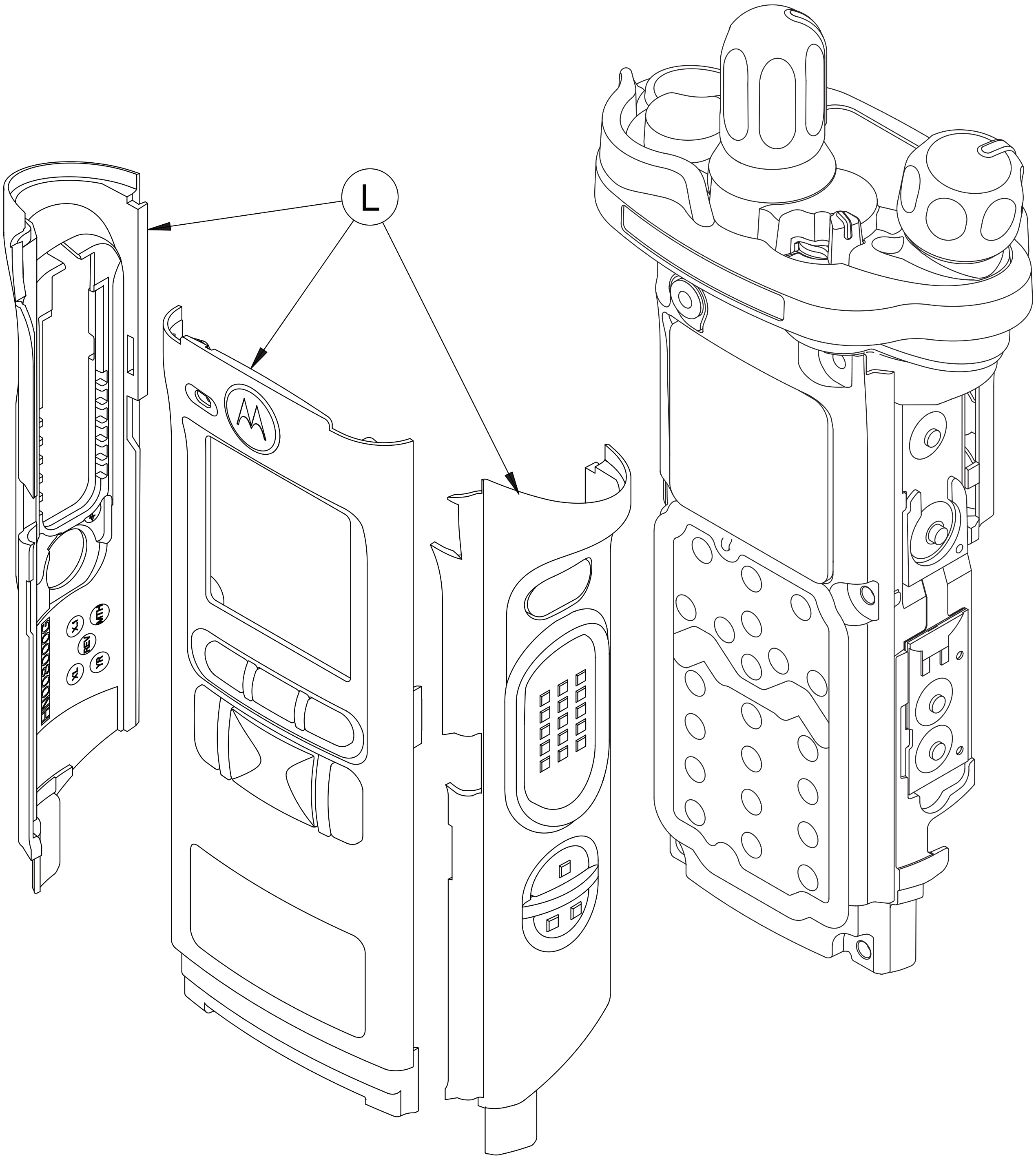

Figure 8-2. APX 6000XE Dual Display (Limited Keypad) Partial Exploded View

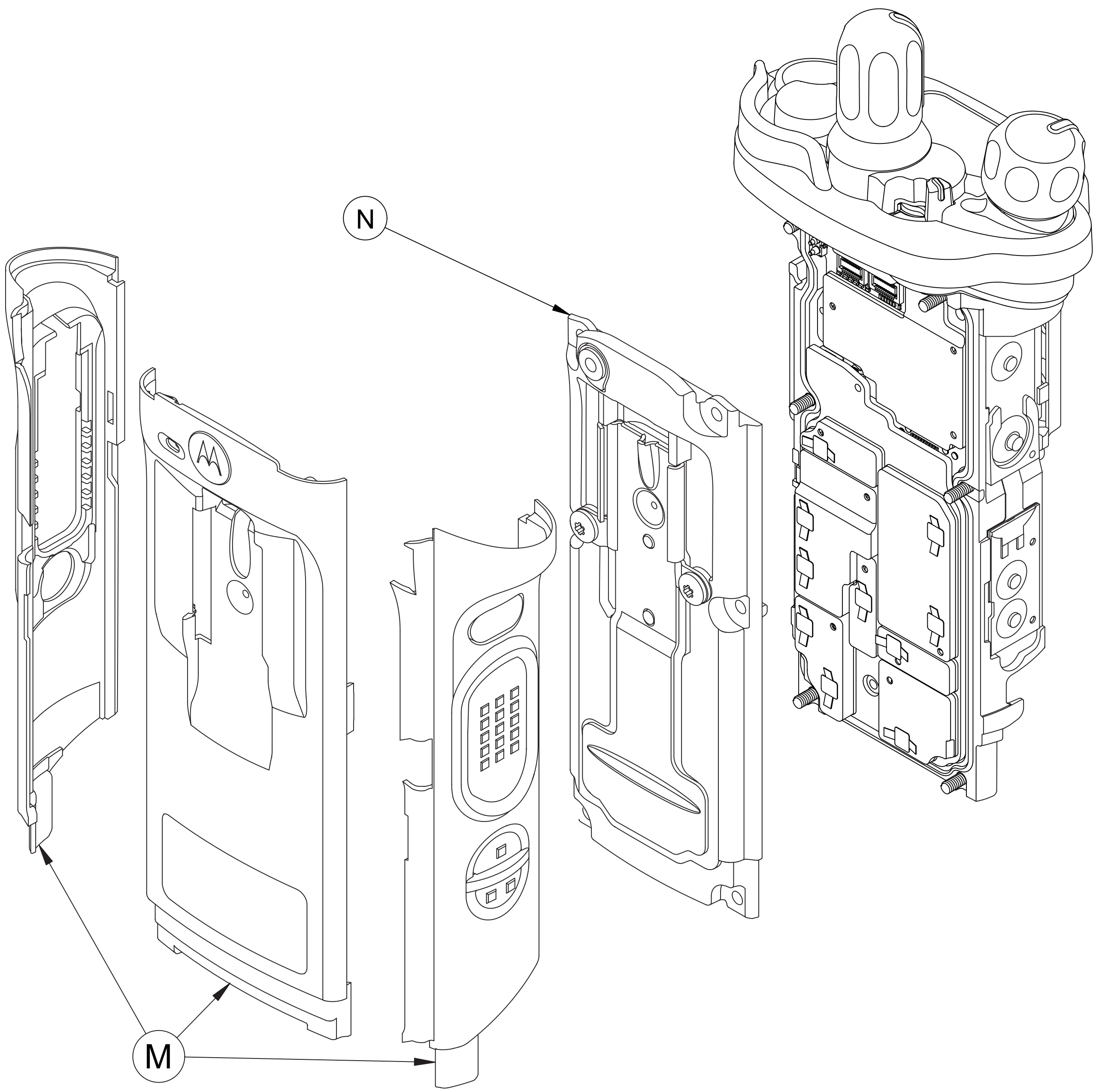

Figure 8-3. APX 6000XE Top Display Partial Exploded View

Table 8-1. APX 6000XE Partial Exploded View Parts List

Item Letter	Description	Exploded View and Parts List
A	Main Housing Assembly (Dual Display, Full Keypad)	Refer Figure 10-1: "APX 6000XE Dual Display (Full Keypad) Exploded View" on page 2:10-2.
B	Back Chassis Assembly (Dual Display)	Refer Figure 10-1: "APX 6000XE Dual Display (Full Keypad) Exploded View" on page 2:10-2.
C	RF Board Assembly	Refer Figure 10-1: "APX 6000XE Dual Display (Full Keypad) Exploded View" on page 2:10-2.
D	VOCON Board Assembly	Refer Figure 10-1: "APX 6000XE Dual Display (Full Keypad) Exploded View" on page 2:10-2.
E	Main Chassis Assembly	Refer Figure 10-1: "APX 6000XE Dual Display (Full Keypad) Exploded View" on page 2:10-2.
F	Control Top Assembly	Refer Figure 10-1: "APX 6000XE Dual Display (Full Keypad) Exploded View" on page 2:10-2.
G	Knobs	Refer Figure 10-1: "APX 6000XE Dual Display (Full Keypad) Exploded View" on page 2:10-2.
H	Expansion Board Assembly	Refer Figure 10-1: "APX 6000XE Dual Display (Full Keypad) Exploded View" on page 2:10-2.
J	Speaker Module	Refer Figure 10-1: "APX 6000XE Dual Display (Full Keypad) Exploded View" on page 2:10-2.
K	Speaker Grille Assembly	Refer Figure 10-1: "APX 6000XE Dual Display (Full Keypad) Exploded View" on page 2:10-2.
L	Main Housing Assembly (Dual Display, Limited Keypad)	Refer Figure 10-2: "APX 6000XE Dual Display (Front Housing Limited Keypad) Exploded View" on page 2:10-4.
M	Main Housing Assembly (Top Display)	Refer Figure 10-3: "APX 6000XE Top Display (Front Housing No Keypad) Exploded View" on page 2:10-5.
N	Back Chassis Assembly (Top Display)	Refer Figure 10-3: "APX 6000XE Top Display (Front Housing No Keypad) Exploded View" on page 2:10-5.

8.2 Required Tools and Supplies

Table 8-2. Required Tools and Supplies

Tools	Motorola Part Number	Supplier	Supplier Part Number	Remarks
Bit, Torx IP8	–	–	–	Torx T8 may be used, but Torx Plus IP8 is recommended
Bit, Antenna Spanner	66009258001	Motorola	–	
Black Stick	–	Hexacon Electric Co.	MA-800G	
Seater, Secure Lever	66009261001	Motorola	–	
Driver, Torque	–	–	–	
Vacuum Pump Kit	NLN9839_	Motorola	–	For Vacuum Test
Vacuum Adapter	66009259001	Motorola	–	For Vacuum Test and Pressure Test
Pressure Pump Kit	NTN4265_	Motorola	–	For Pressure Test

8.3 Fastener Torque Chart

Table 8-3 lists the various fasteners by part number and description, followed by the torque values and the location where used. Torque all fasteners to the recommended value when assembling the radio.

Table 8-3. Required Tools and Supplies

Motorola Part Number	Description	Repair Torque (in-lbs)
0275891B01	Antenna Spanner Nut (27)	16
0375962B01	Top Screw (42)	10
0375962B02	Center Screw (41)	10
0375962B03	Bottom Screw (43)	10
03009357001	Control Top Screw (57)	7
03009304001	RF & Vocon Board Screw (45)	8

8.4 Antenna

This section explains how to attach and remove the antenna.

8.4.1 Attach Antenna

To attach the antenna:

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

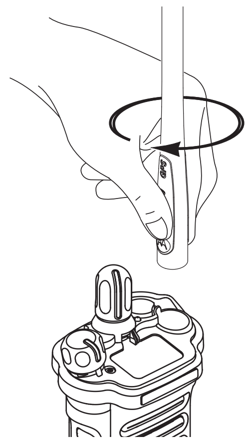

Figure 8-4. Attaching the Antenna

2. To tighten the antenna, grasp the radio in one hand and the antenna in the other, firmly turn the antenna clockwise to tighten it

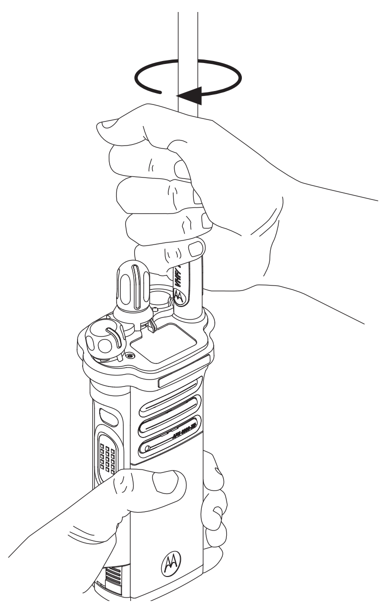

Figure 8-5. Tightening the Antenna

8.4.2 Remove Antenna

To remove the antenna:

With the radio turned off, turn the antenna counter-clockwise to remove it from the radio.

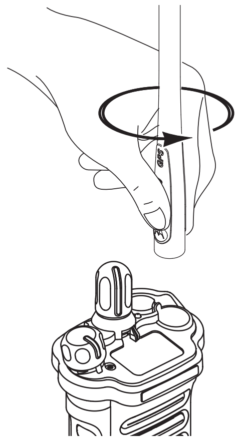

Figure 8-6. Removing the Antenna

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-approved battery shipped with the APX 6000XE radio is uncharged. Prior to using a new battery, charge it per the recommended procedure for the battery.

8.5.1 Attach Battery

To attach the battery:

1. With the radio turned off, verify that the battery seal is set properly in its groove as shown in Figure 8-7.

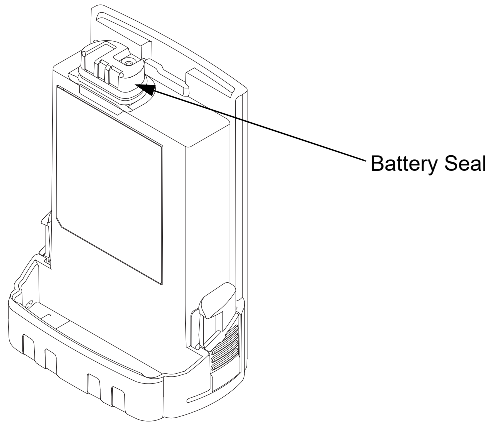

Figure 8-7. Attaching Battery – Battery Seal

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.

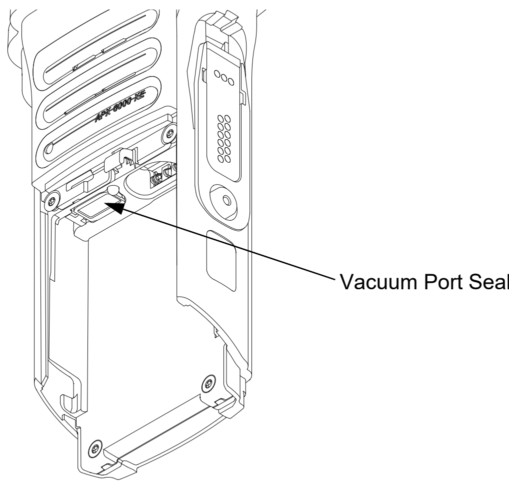

Figure 8-8. Attaching Battery – Vacuum Port Seal

3. Set the battery onto the chassis as shown in Figure 8-9 and slide into position. Make sure both battery latches click into position.

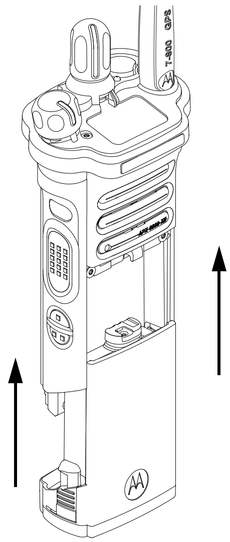

Figure 8-9. Attaching Battery – Slide into Position

8.5.2 Remove Battery

To remove the battery:

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

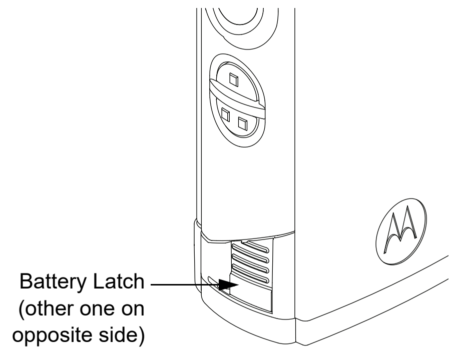

Figure 8-10. Squeezing the Release Latches

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

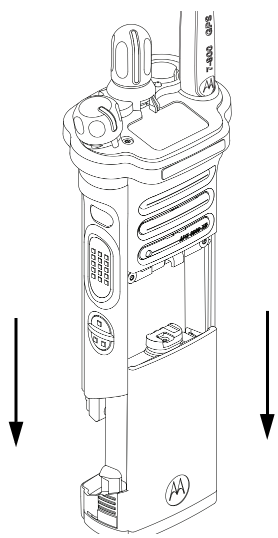

Figure 8-11. Removing the Battery

8.6 Universal Connector Cover

This section explains how to remove and attach the Universal Connector Cover (46).

Caution	When the universal connector is not in use, keep it covered with the Universal Connector Cover. The GCAI interface will be damaged if conductive medium is present on the surface. Regularly inspect the GCAI interface to ensure surface is clean and dry.

8.6.1 Remove Universal Connector Cover

To remove the Universal Connector Cover (46):

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.

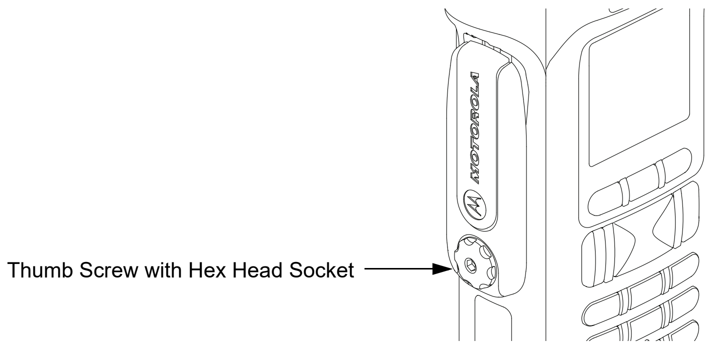

Figure 8-12. Removing the Thumb Screw

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 Attach Universal Connector Cover

To attach the Universal Connector Cover (46):

1. Insert the hooked end of the cover into the pocket. Engage the hook beneath the undercut and swing the cover down onto the radio. Ensure the cover is seated properly and the screw is aligned into the threaded hole.

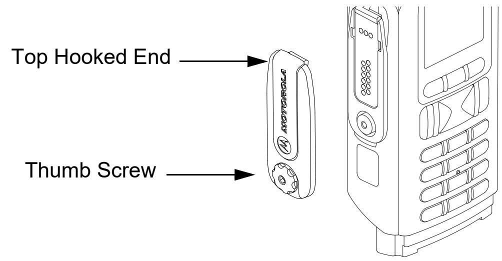

Figure 8-13. Engaging Hook and Seating Cover

2. Hand tighten the thumb screw clockwise until secured.

   NOTE: Do not overtighten the screw. The screw should be snugged and not allow the cover to move.

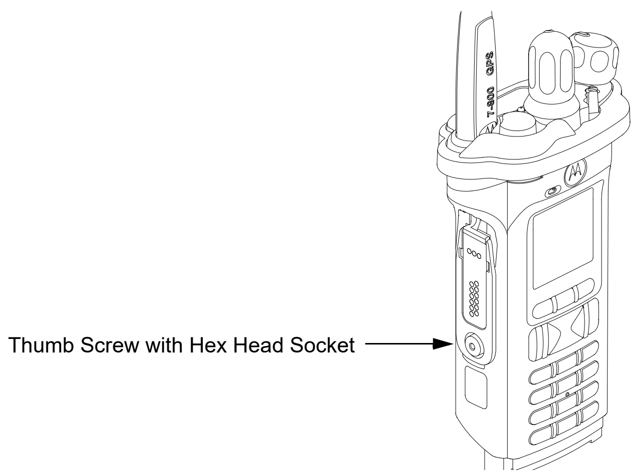

Figure 8-14. Securing the Cover

8.7 Radio Disassembly

This section contains instructions for disassembling the radio's main subassemblies.

Prepare the radio for disassembly:

- Turn off the radio by rotating the On/Off/Volume Knob (55) fully counterclockwise until a click is heard.
- Remove the antenna, the battery, Belt Clip Cover (53) (Top Display Only), the Universal Connector Cover (46) and any other accessory connected to the radio.

8.7.1 Removal of the Speaker Grille Assemblies (K)

1. With the Battery removed and the primary loudspeaker side of the radio facing you, remove the center two screws (41) and swing out Speaker Grille Assembly (K) as shown in Figure 8-15, taking care to ensure the sound dampener (59) stays with the Speaker Grill Assembly.

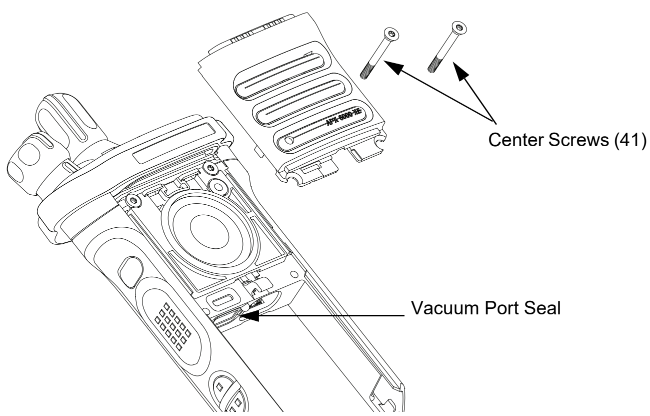

Figure 8-15. Remove Center Screws

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

2. Remove the bottom two screws (43) if the Main Housing Assembly (A, L, M) is to be removed. Refer Figure 8-16.

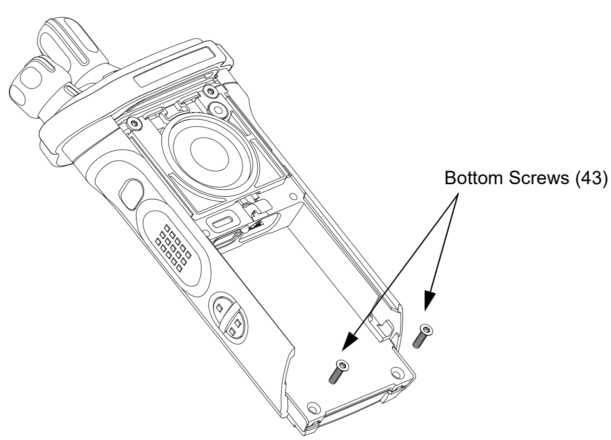

Figure 8-16. Remove Bottom Screws

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 Removal of the Speaker Module (J)

1. Remove the top two screws (42) as shown in Figure 8-17.

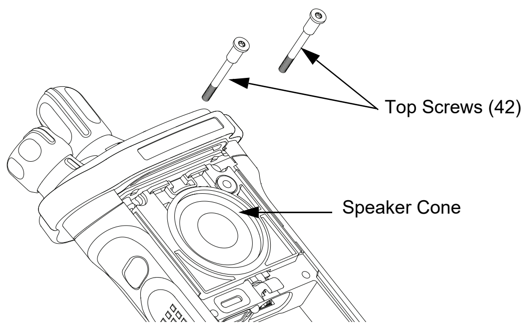

Figure 8-17. Remove Top Screws

2. Carefully pick out the Speaker Module (34) with the Black Stick and swing it out of the Main Chassis Assembly (E) as shown in Figure 8-18.

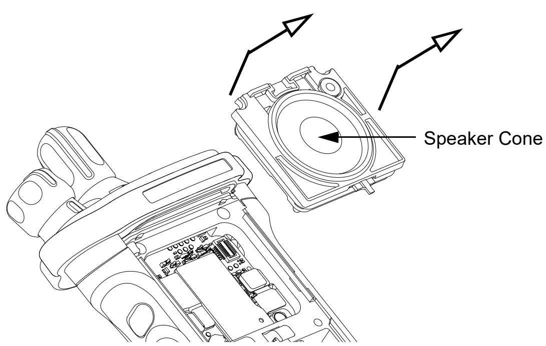

Figure 8-18. Remove Speaker Module

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

8.7.3 Removal of the Expansion Board Assembly (H)

1. Using the Black Stick, pull up the locking feature side of the Expander Board Support (61). Be careful not to damage the flex or any component during the process.

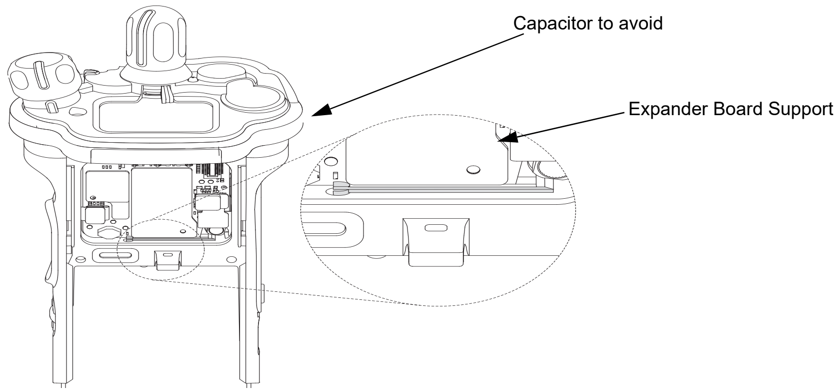

Figure 8-19. Pull Expander Board Support (Opt. Expansion Board)

2. Rotate the Expander Board Support vertically.
3. Remove the rounded portion from the Expander side opening of the vacuum test compartment.

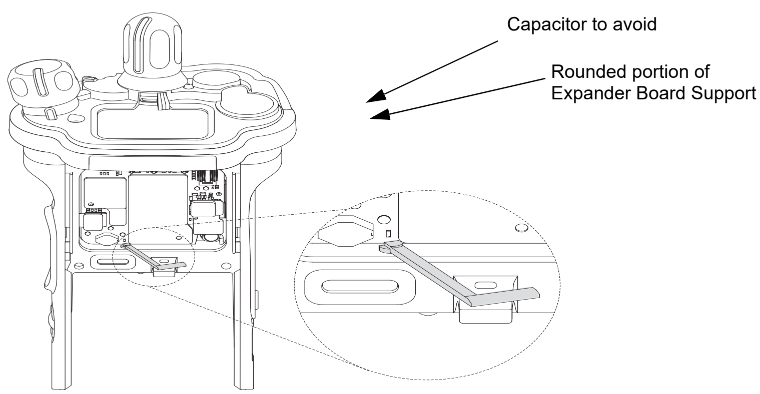

Figure 8-20. Remove Expander Board Support

Caution	Be careful not to damage the capacitor during the disassembly process.

4. Using the Black Stick, unplug the two flex connectors located on the left and right side of the Expansion Board Assembly (33). Unfold and straighten the flexes located on the right side as shown in Figure 8-21.

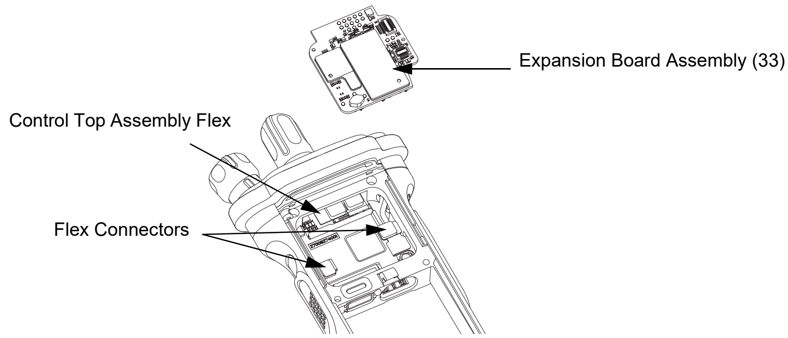

Figure 8-21. Remove Flex Connectors and Expansion Board Assembly

5. Remove the Expansion Board Assembly (H) by gently lifting up the right side of the PCB as shown in Figure 8-21.

6. If the VOCON Board or Control Top Assembly (D,F) is to be removed from the radio, then unplug the Control Top Assembly flex as shown in Figure 8-21.

7. If the RF Board Assembly (C) is to be removed, use the Black Stick to unplug the antenna coax cable from the RF Board Assembly as shown in Figure 8-22.

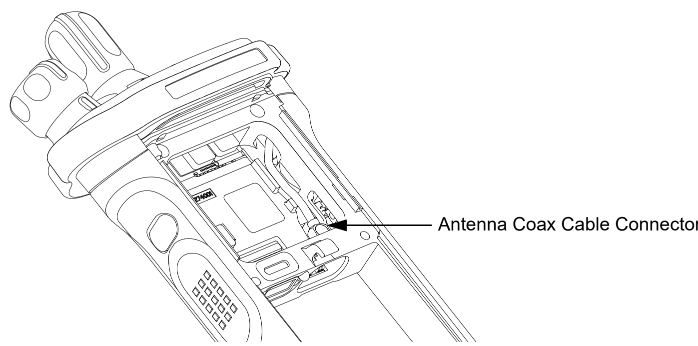

Figure 8-22. Remove Antenna Coax Cable Connector

8. Flip the radio over.

Figure 8-23. Remove Housing

8.7.4 Removal of the Three-Piece Main Housing Assembly (A,L,M)

1. Gently lift the front housing up from the radio and then detach both sides of the Main Housing Assembly (1) . Then lift it over the radio as shown in Figure 8-24.

   NOTE: For Top Display version, ensure the Belt Clip Cover (53) has been removed.

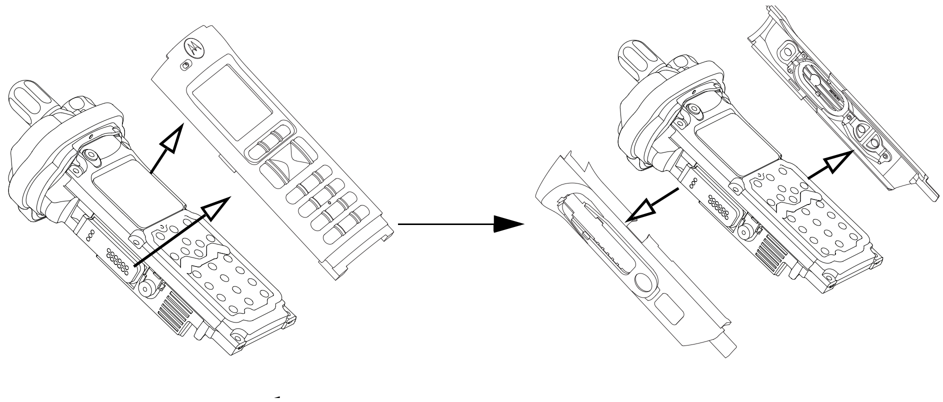

Figure 8-24. Remove Housing

8.7.5 Removal of the Back Chassis Assembly (B, N)

1. Dual Display versions:
   Gently separate the Back Chassis Assembly (B) from the Main Chassis Assembly (E) 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 as shown in Figure 8-25.

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

> **Caution**
>
> Pull the flex connectors vertically upwards by using black stick. Disconnect at two connector locations shown in Figure 8-25.

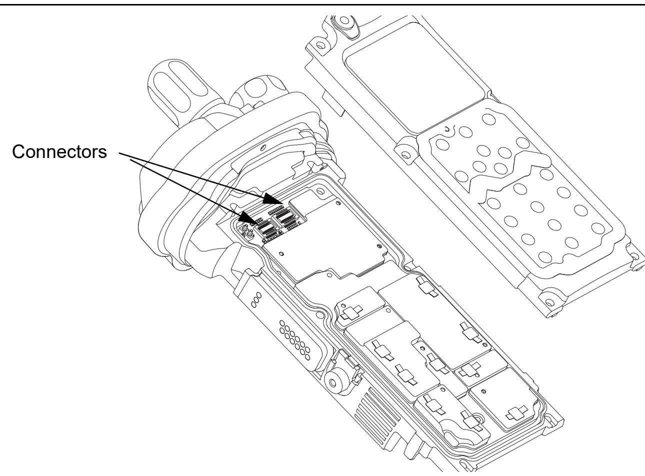

Figure 8-25. Remove Back Chassis Assembly from Main Chassis Assembly

8.7.6 Removal of the RF Board Assembly (C)

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

1. Remove the RF and Vocon Board screw (45) then unplug the RF Board Assembly (C) from the VOCON Board Assembly (D) by using the Black Stick. 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.

Caution	Place the RF Board Assembly in a clean and ESD safe area to avoid contamination to the Battery Connector Seal (13) and electrical damage to the electronics respectively. Replace Thermal Pads (10, 11) whenever RF Board Assembly is removed.

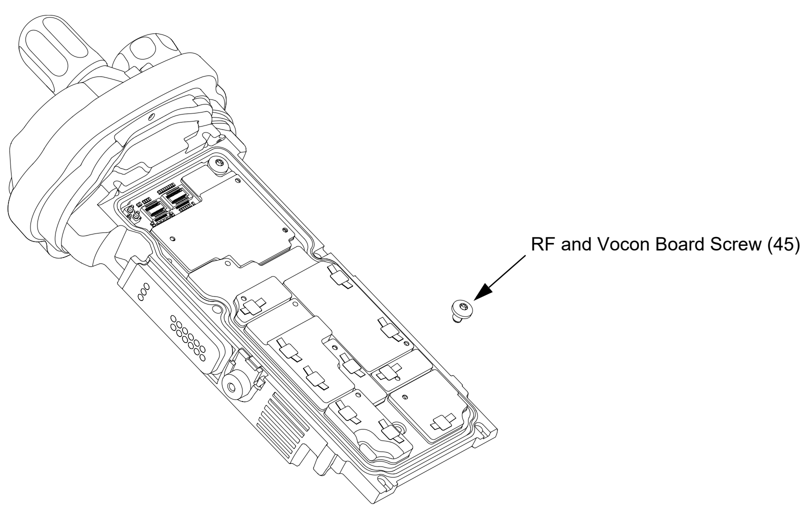

Figure 8-26. Remove RF Board Screw

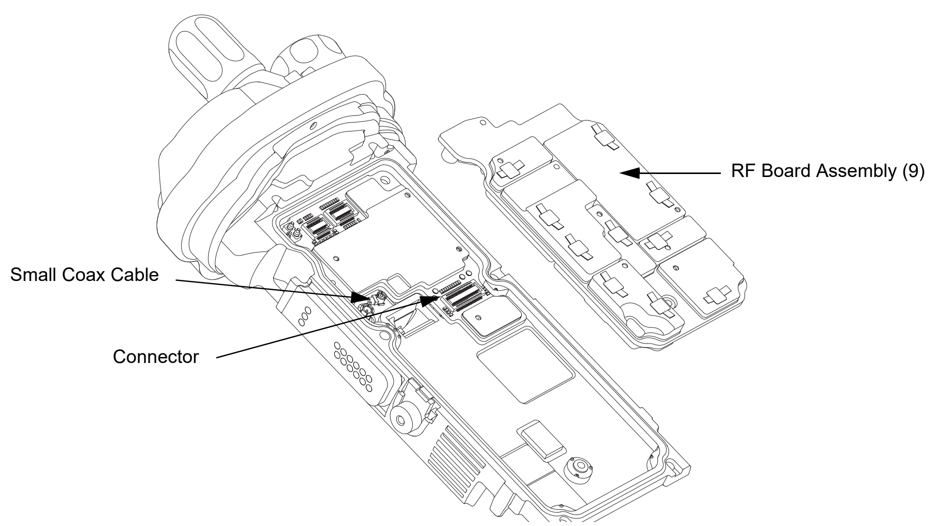

Figure 8-27. Remove RF Board Assembly

8.7.7 Removal of the VOCON Board Assembly (D)

NOTE: Reconfirm the Flex connector between the Control Top Assembly (F) and the VOCON Board Assembly (D) is disconnected. Failure to do so may damage the connectors or the flex.

1. Ensure RF Board is removed (see Section 8.7.6 on page 2:8-19.). Remove RF and VOCON Board screw (45) (as shown in Figure 8-28.), Gently rotate the VOCON Board Assembly just enough to clear the Main Chassis. Slide out the VOCON Board Assembly as shown in Figure 8-29.

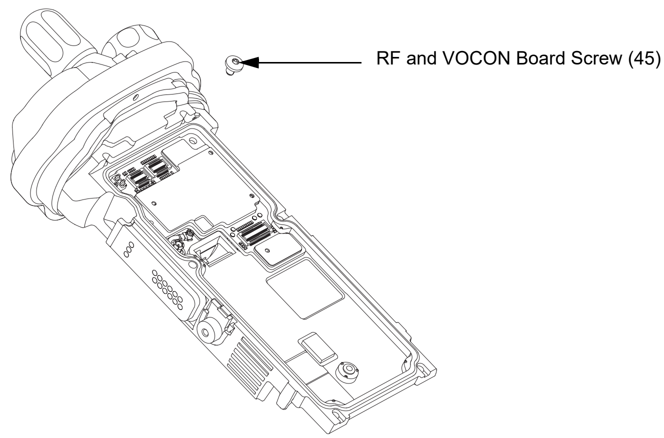

Figure 8-28. Remove VOCON Board Screw

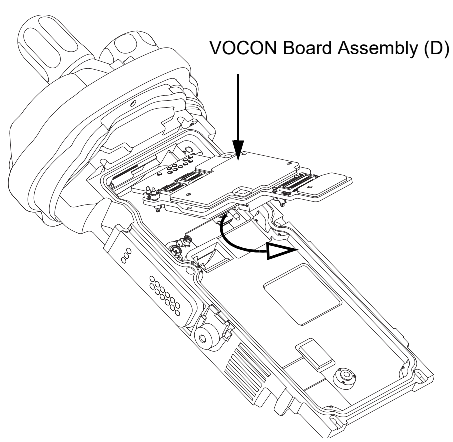

Figure 8-29. Remove VOCON Board Assembly

8.7.8 Removal of the Knobs (G)

NOTE: Knobs should only be removed when damaged. Knob removal is not necessarily to remove the Control Top (F). Knobs, once removed, are not reusable.

To remove the Frequency (56) and Volume Knobs (55):

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. With a pair of pliers grasp the knob and pull it upward, until it is free from its shaft.

NOTE: The knobs is 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.

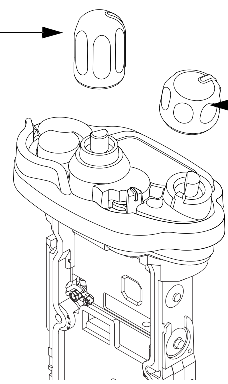

Figure 8-30. Remove Knobs

8.7.9 Removal of the Control Top Assembly (F)

NOTE: Knob removal is not necessarily to remove the Control Top (F)

i. Use a Torx Plus IP8 bit to remove the two Control Top Screws (57).

ii. Unscrew the Antenna Spanner Nut (27) with the Antenna Spanner Bit and a driver. Remove the Antenna Washer (26) below the nut as shown in Figure 8-31.

NOTE: Ensure the Control Top flex is disconnected from the VOCON Board (D) to prevent damage to the flex or connector. See Section 8.7.3. Step 3.

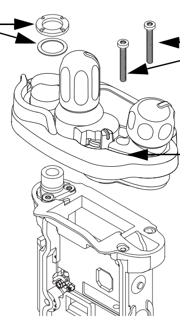

Figure 8-31. Remove Control Top Assembly

iii. Gently separate the Control Top Assembly (F) from the Main Chassis Assembly (E).

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

8.8 Serviceable Components of the Main Sub-Assemblies

8.8.1 Servicing Main Chassis Assembly (E)

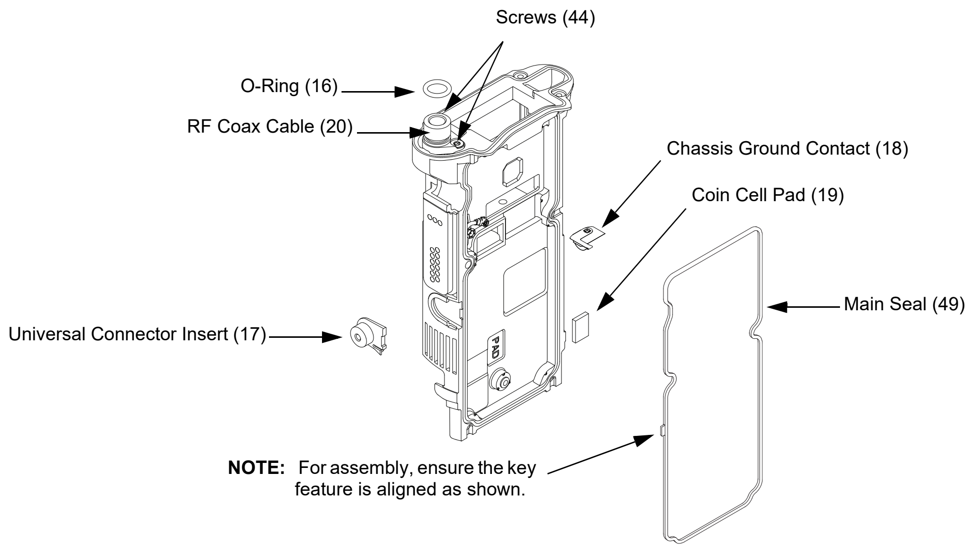

Figure 8-32. Serviceable Components – Main Chassis Assembly

8.8.1.1 Servicing Coin Cell Pad:

1. Complete steps from Section 8.7.1. through Section 8.7.9. of section 8.7 on page 2:8-14.
2. Carefully peel off the pad.
3. Use the Black Stick to help remove any difficult sections of the pad(s).
4. Clean the area once the pad is removed to ensure it is free of adhesive and debris.
5. Peel the liner off the new pad and place in the respective location.
6. Apply slight pressure to set the adhesive.

8.8.1.2 Servicing Universal Connector Insert:

1. Complete steps from Section 8.7.1. through Section Figure 8-23.. of section 8.7 on page 2:8-14.
2. Ensure the locking tab is pressed and carefully slide the Universal Connector Insert (17) with the Black Stick from the Main Chassis Assembly (15) as shown in Figure 8-32.
3. Press the new Universal Connector Insert until it is fully seated and the lock tab is engaged on the chassis.

8.8.1.3 Servicing Antenna O-ring:

1. Complete steps from Section 8.7.1. through Section 8.7.9. of section 8.7 on page 2:8-14.
2. Remove the O-ring (16) with the Black Stick.
3. Reinstall the O-ring by rolling it over the threaded portion of the antenna hub until it sets in its groove.

NOTE: Ensure the O-ring is not twisted.

8.8.1.4 Servicing Chassis Ground Contact:

NOTE: Chassis Ground Contact (18) will be damaged during disassembly.

1. Complete steps from Section 8.7.1. through Section 8.7.9. of section 8.7 on page 2:8-14.
2. Slide the Black Stick under the Chassis Ground Contact (18) through the opening on the RF/VOCON PCB side of the radio to lift off the contact.
3. Clean the area once the Chassis Ground Contact is removed to ensure it is free of adhesive and debris.
4. 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 as shown in Figure 8-33.
5. Apply pressure to the adhesive to activate it.

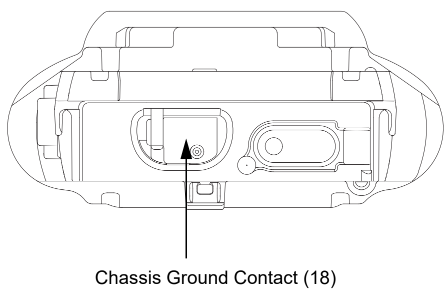

Figure 8-33. Remove Chassis Ground Contact

8.8.1.5 Servicing RF Coax Cable:

1. Complete steps from Section 8.7.1. through Section 8.7.9. of section 8.7 on page 2:8-14.
2. Remove the two screws (44) from the top of the assembly.
3. Note the routing of the RF Coax cable (20) as seated onto the chassis grooves. Gently remove the cable by sliding it away from the control top.
4. Replace the RF Coax Cable. Bend and seat the new RF cable within the chassis grooves as noted in step 3.
5. Torque both screws (44) with a Torx IP8 Bit and a torque Driver to 8 in-lbs.

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

8.8.2 Servicing Control Top Assembly (F)

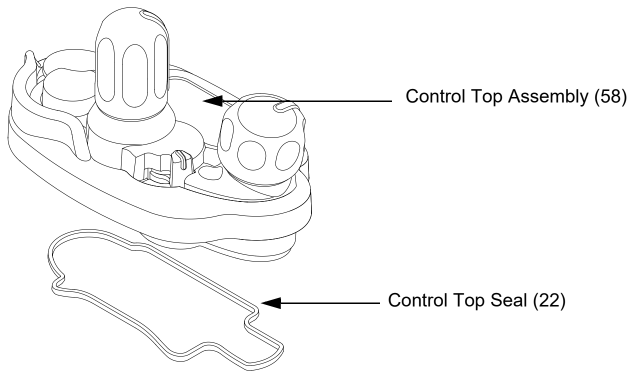

Figure 8-34. Control Top Assembly and Control Top Seal

8.8.2.1 Control Top Main Seal

1. Complete steps from Section 8.7.1. through Section 8.7.9. of section 8.7 on page 2:8-14.
2. Remove the Control Top Seal (22) with the Black Stick.
3. Replace the new seal into the groove provided in the Control Top Assembly's casting.
4. Ensure that seal is set properly and not stretched.

NOTE: There are no other serviceable components on the Control Top Assembly (F).

8.8.3 Servicing VOCON Board Assembly (D)

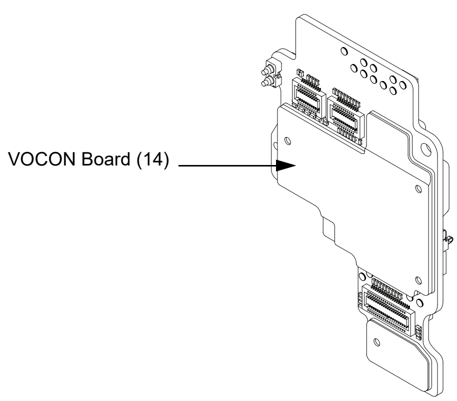

Figure 8-35. VOCON Board Assembly

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

8.8.4 Servicing of RF Board Assembly

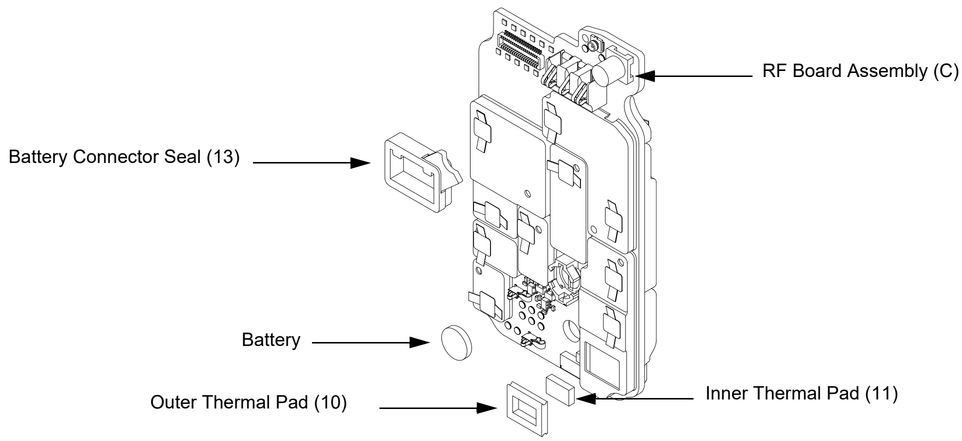

Figure 8-36. RF Board Assembly

8.8.4.1 Battery Seal

1. Complete steps 8.7.1 through 8.7.6 of section 8.7 on page 2:8-14.
2. Slide the Battery Connector Seal (13) from the battery contact header with the Black Stick.
3. Use the Black Stick and push the new Battery Connector Seal until it is properly seated onto the RF Board surface.

8.8.4.2 Thermal Pads

1. Complete steps 8.7.1 through 8.7.6 of section 8.7 on page 2:8-14.
2. Scrape off both thermal pads (10 and 11) from the amplifiers and / or Main chassis with the Black Stick.
3. Ensure there are no debris or residue left on the amplifier's surfaces.
4. Replace with new thermal pads.
5. Peel off the back liner from the thermal pads.
6. Insert the Outer Thermal Pad (10) into the shield opening. Make sure the bottom surface of the pad is mating with the top surface of the amplifiers.
7. Insert the Inner Thermal Pad (11) without compressing or deforming it.

Caution	Thermal pads should always be replaced when RF Board assembly is removed.

8.8.4.3 Back up Battery

1. Complete steps from Section 8.7.1. through Section 8.7.7. of section 8.7 on page 2:8-14.
2. Remove the battery with the Black Stick.

   NOTE: Make sure the positive side is facing upwards.

3. 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 RF Board Assembly.

8.8.5 Servicing of Expansion Board Assembly

1. Complete steps 8.7.1 through 8.7.3 of section 8.7 on page 2:8-14.

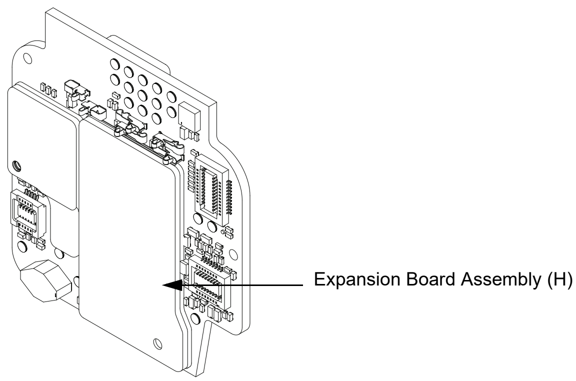

Figure 8-37. Expansion Board Assembly

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

8.8.6 Servicing Back Chassis Assembly (B) – Dual Display Versions

1. Complete steps 8.7.1 through 8.7.5 of section 8.7 on page 2:8-14.

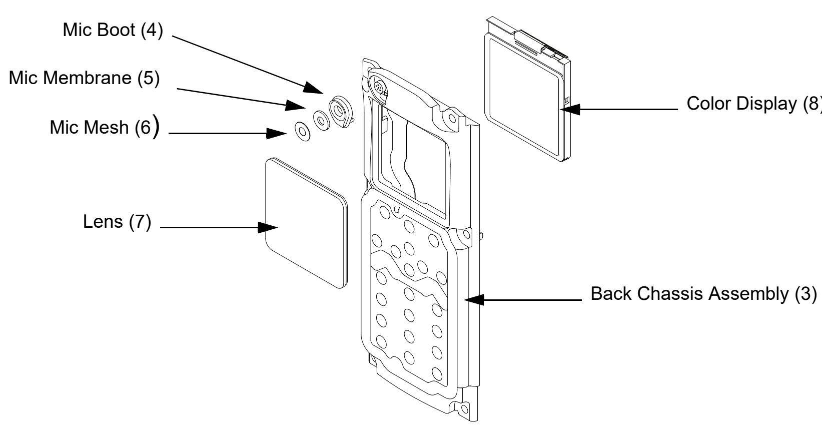

Figure 8-38. Back Chassis Assembly (Dual Display Versions)

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

8.8.6.1 Servicing Microphone Membrane/ Microphone Mesh

NOTE: When servicing microphone membrane, microphone mesh part will also need to be replaced.

1. Complete steps from Section 8.7.1. through Section Figure 8-23.. of section 8.7 on page 2:8-14.
2. Carefully peel off the Microphone Membrane (5) and Microphone Mesh (6) from the microphone boot (4).
3. 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.
4. Ensure the microphone is seated properly with the microphone boot opening.
5. Remove the backer from the Microphone Membrane.
6. Carefully place the Microphone Membrane centered on the top surface of the microphone boss area on the Main Chassis. Ensure the membrane is flat with no ripples or folds. Press down firmly, applying 2-3 lbs. of force.
7. Repeat step 6 for the microphone mesh.
8. Ensure the microphone boot is correctly seated with the chassis opening.

8.8.6.2 Servicing Microphone Boot (4)

NOTE: When servicing microphone boot, microphone membrane and microphone mesh part will also need to be replaced.

1. Carefully remove the microphone boot (4) 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 Section 8.8.6.1.(steps 5–8) to complete assembling and placing the microphone mesh and membrane.

8.8.6.3 Servicing Color Display

1. Disconnect the Back Chassis Flex from the back of the Color Display (8).
2. Gently pry the Color Display out of the Back Chassis Assembly (3) 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 Display's Pad 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 Display is completely removed.
5. Ensure there are no foreign material on the new Color Display or the Lens (7).
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.

8.8.6.4 Servicing the Main Lens

NOTE: Prior to Lens removal, Color Display must be removed (See Section 8.8.6.3 on page 2:8-27).

1. Remove the main Lens (7) carefully and slowly with the Black Stick.

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

Caution

Over prying may damage the lens.

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.

8.8.7 Servicing Back Chassis Assembly (N) – Top Display Version

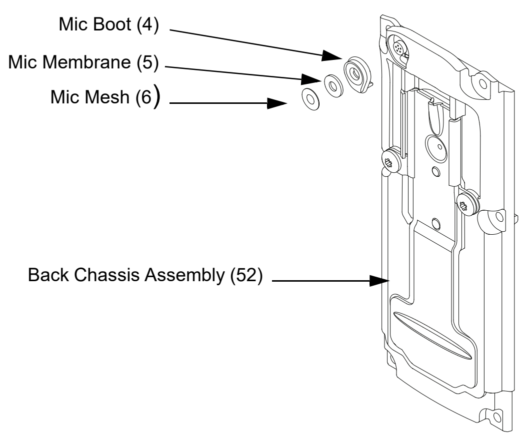

Figure 8-39. Back Chassis Assembly (Top Display Version)

8.8.7.1 Servicing Microphone Membrane/ Microphone Mesh

NOTE: When servicing microphone membrane, microphone mesh part will also need to be replaced.

1. Complete steps from Section 8.7.1. through Section Figure 8-23.. of section 8.7 on page 2:8-14.
2. Carefully peel off the Microphone Membrane (5) and Microphone Mesh (6) from the microphone boot (4).
3. 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.
4. Ensure the microphone is seated properly with the microphone boot opening.
5. Remove the backer from the Microphone Membrane.
6. Carefully place the Microphone Membrane centered on the top surface of the microphone boss area on the Main Chassis. Ensure the membrane is flat with no ripples or folds. Press down firmly, applying 2-3 lbs. of force.
7. Repeat step 6 for the microphone mesh.
8. Ensure the microphone boot is correctly seated with the chassis opening.

8.8.7.2 Servicing Microphone Boot (4)

NOTE: When servicing microphone boot, microphone membrane and microphone mesh part will also need to be replaced.

1. Carefully remove the microphone boot out of the Back Chassis opening.
2. Pinch the sides of the microphone boot (4) 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 Section 8.8.7.1.(steps 5–8) to complete assembling and placing the microphone mesh and membrane.

NOTE: There are No serviceable Components on the Back Chassis Assembly.

8.8.8 Servicing Main Housing (A, L) – Dual Display Versions

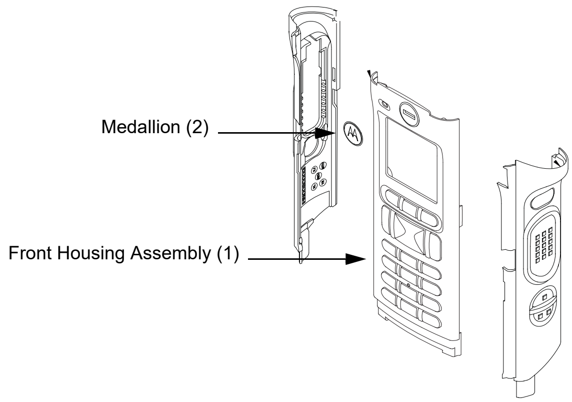

Figure 8-40. Main Housing Assembly (Dual Display Version, Full Keypad)

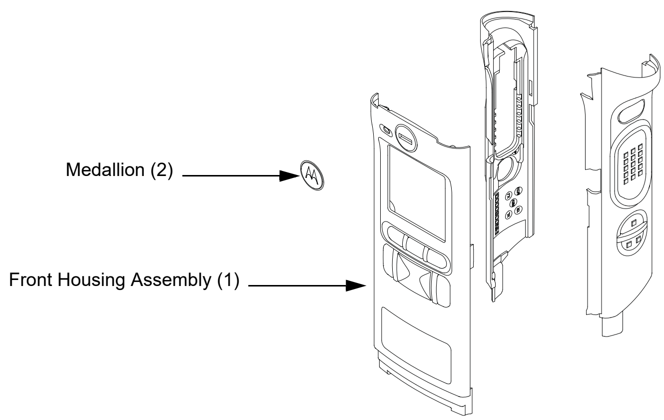

Figure 8-41. Main Housing Assembly (Dual Display Version, Limited Keypad)

8.8.8.1 Medallion

NOTE: There is no need to remove any components in order to service the Medallion (2).

1. Scrape off the Medallion (2) 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 (A, L).

8.8.9 Servicing Main Housing (M) – Top Display Version

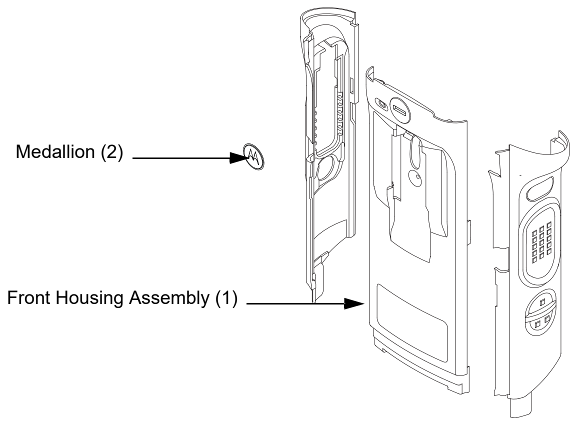

Figure 8-42. Main Housing Assembly (Top Display Version)

8.8.9.1 Medallion

NOTE: There is no need to remove any components in order to service the Medallion (2).

1. Scrape off the Medallion (2) 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 adhersive liner and place the Medallion in the recess.
4. Press the Medallion.

NOTE: There are No Other serviceable components on the Main Housing Assembly (M).

8.8.10 Servicing Speaker Module (J)

1. Complete steps 8.7.1 through 8.7.2 of section 8.7 on page 2:8-14.

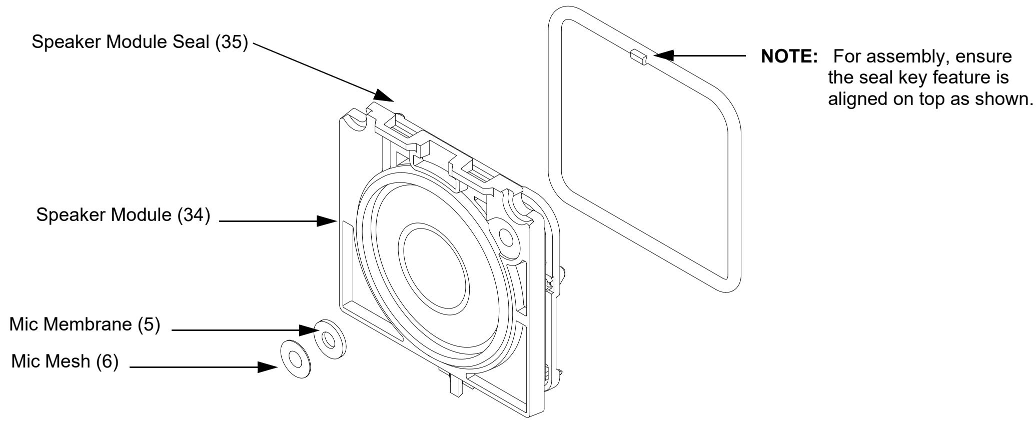

Figure 8-43. Speaker Module

8.8.10.1 Servicing Microphone Membrane/ Microphone Mesh

NOTE: When servicing microphone membrane, microphone mesh part will also need to be replaced.

1. Carefully peel off the Microphone Membrane (5) and Microphone Mesh (6) from the Speaker Module.
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.
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.

8.8.11 Servicing Speaker Grille Assembly (K)

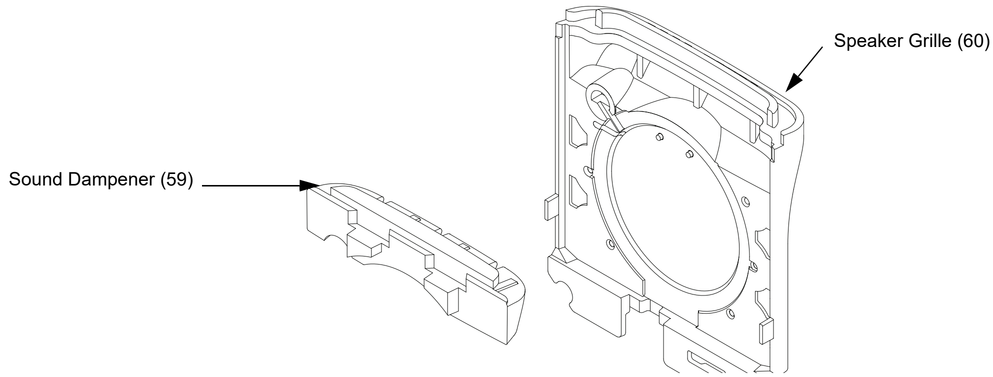

Figure 8-44. Speaker Grille Assembly

NOTE: There are No serviceable components on the Speaker Grille Assembly (K).

8.9 Radio Reassembly

This section contains instructions for reassembling the radio.

8.9.1 Reassemble the Main Sub Assemblies

8.9.1.1 Assemble Control Top Assembly (F) to Main Chassis Assembly (E)

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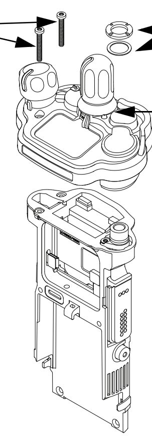


Figure 8-45. Control Top Bezel Assembly

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 (15). Also ensure that the Control Top Main Seal (22) and surrounding surfaces are free of debris and other foreign material.
2. Verify Control Top Main Seal is properly seated into its groove and place Control Top Assembly onto Main Chassis Assembly as shown in Figure 8-45.
3. Torque both screws with a Torx IP8 Bit and a torque Driver to 7 in-lbs.
4. Place the new nylon Antenna washer (26) (Found in kit KT000009A01) onto the antenna threaded hub as shown in Figure 8-45.
5. Tighten the Antenna Spanner Nut (27) by hand first to avoid cross threading. Tighten the Antenna Spanner Nut (27) until it bottoms by hand to avoid cross threading. 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.

CAUTION: Care should be taken to NOT place the thread-locker within the center cavity 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.

8.9.1.2 Assemble Knobs (G)

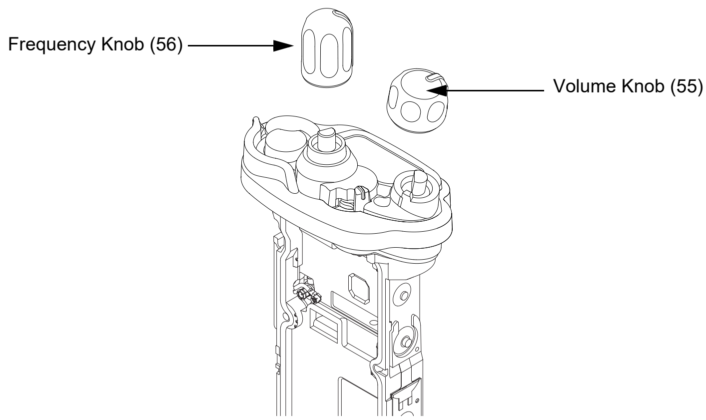


Figure 8-46. Knobs Assembly

Frequency and Volume Knob Assembly:

1. Place the respective 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 require, but if used should be covered with a clean rubbery covering, such as a mouse pad, to prevent markings to the knob.

8.9.1.3 Assemble VOCON Board Assembly (D)

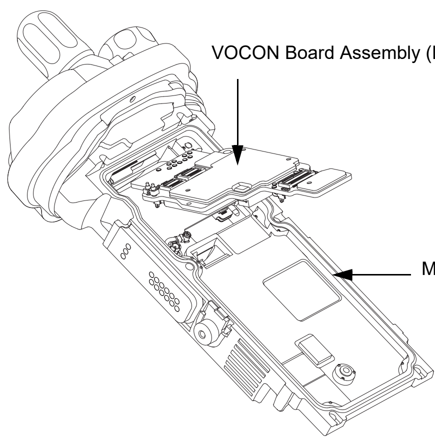


Figure 8-47. Insert VOCON Board

1. Inspect the Main Chassis (15) 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 (15) with the Frequency Knob (56) on top. Insert the VOCON Board Assembly (14) 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. See Figure 8-47.

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.

8.9.1.4 Assemble RF Board Assembly (C)

Caution

Always replace with new thermal pads. See section 8.8.4.2 on page 2:8-25.

1. Inspect the Battery Connector Seal (13) on the RF Board Assembly (C) for any damage or debris. Replace seal if necessary.

2. Connect the small coaxial cable connector into the RF Board (9).

3. Connect the RF Board to the VOCON Board as shown in Figure 8-48.

4. Tighten the RF and VOCON Board screw (45) 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 (1) must be snapped in place prior to connecting the coax.

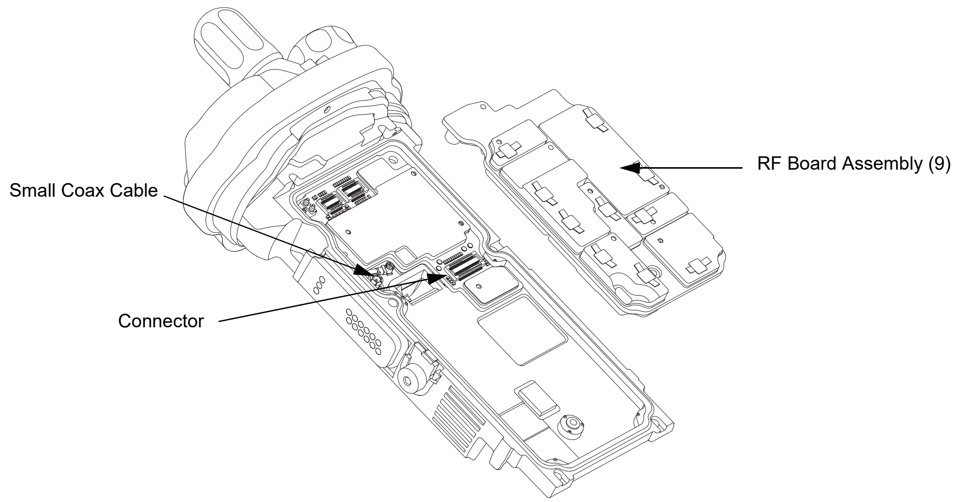


Figure 8-48. Connect RF Board to VOCON Board

8.9.1.5 Assemble Back Chassis Assembly (B, N)

Dual Display versions:

1. Inspect the Back Chassis Assembly Seal for any debris or foreign material.
2. Place the Main Seal (49) onto the main chassis groove. Gently seat the seal around the perimeter of the groove, ensuring the key feature is oriented as shown in Figure 8-49.
3. Connect both Back Chassis Flexes to the VOCON board (D).
4. Set the Back Chassis Assembly (B) onto the Main Chassis Assembly (E).

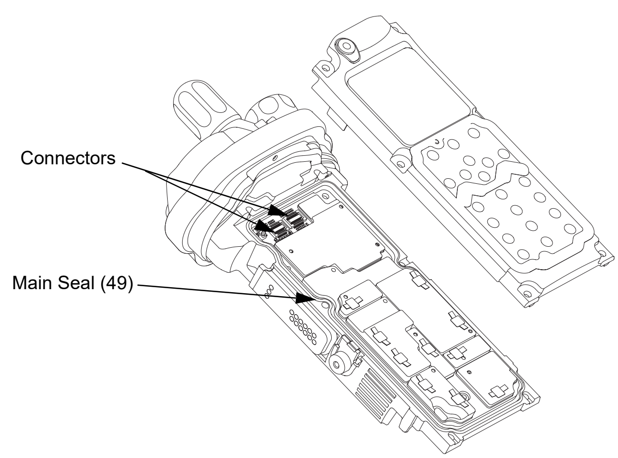


Figure 8-49. Place Back Chassis

Top Display version:

1. Inspect the Back Chassis Assembly (N) seal for any debris or foreign material.

2. Place the Main Seal (54) onto the main chassis groove. Gently seat the seal around the perimeter of the groove, ensuring the key feature is oriented as shown in Figure 8-49.
3. Set the Back Chassis Assembly onto the Main Chassis Assembly (E).

8.9.1.6 Assemble Three-Piece Main Housing Assembly (A, L, M)

1. Snap in the Main Housing Assembly (A, L, M) side walls with both hands just enough to attach the Main Chassis Assembly (E) and place it onto the radio.
2. Ensure the top edge of the housing and the bottom edge of the control top are aligned as shown in Figure 8-50. Attach the Front Housing to the radio.
3. Squeeze the Main Housing Assembly (A, L, M) and the Main Chassis Assembly (E) in the battery area until the Main Housing Assembly fully snaps in place onto the Main Chassis Assembly.

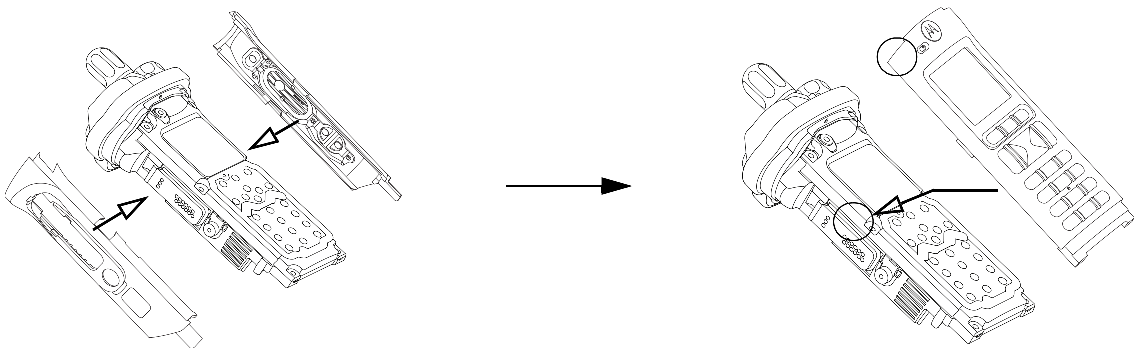


Figure 8-50. Place Three-Piece Housing into Main Chassis

8.9.1.7 Assemble Expansion Board Assembly (H)

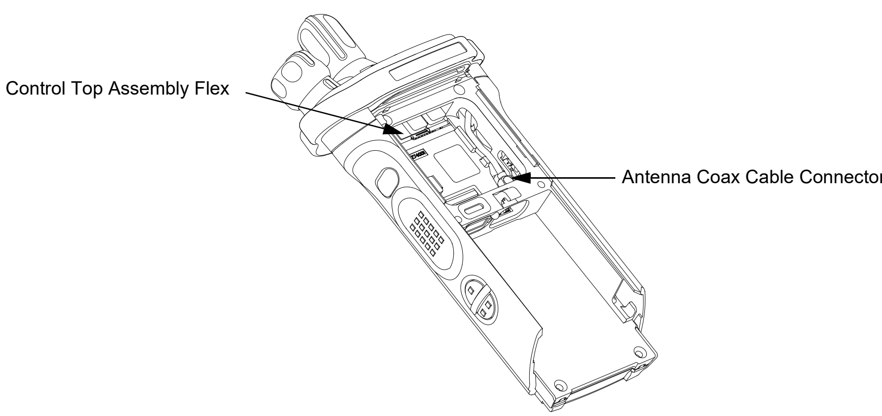


Figure 8-51. Assemble Expansion Board Assembly

1. If the Control Top Assembly (F) or VOCON Board Assembly (D) was NOT removed skip to step 2.
   Connect the Control Top Flex to the VOCON Board Assembly as shown in Figure 8-51.
2. If replacing new Control Top (58) or Main Chassis Assembly (15), add Control Top Support Pads (23) to stainless steel backers at the locations shown on Figure 8-52.
3. If the RF Board Assembly (9) was NOT removed, skip to step 4.
   Carefully align the Antenna Coax Plug to the Coax Receptacle on the RF board Assembly (C) 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 its grooves as shown in Figure 8-51.

5. Plug the Expansion Board Assembly (H) to the VOCON Board Assembly (D) as shown in Figure 8-52. Make sure the connector is fully engaged.

6. Connect the two Flex Connectors to their pairing connectors on the right and left sides of the Expansion Board Assembly as shown in Figure 8-52.

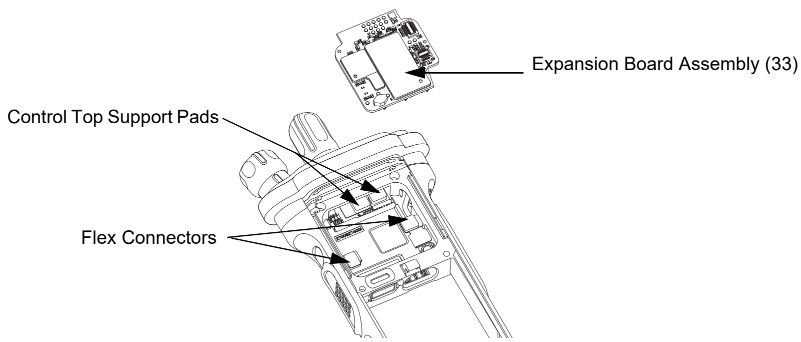


Figure 8-52. Insert Flex Connectors

7. Insert the rounded portion of the Expanded Board Support (61) into the opening of the vacuum test compartment on the expanded side as shown in as shown in Figure 8-54.

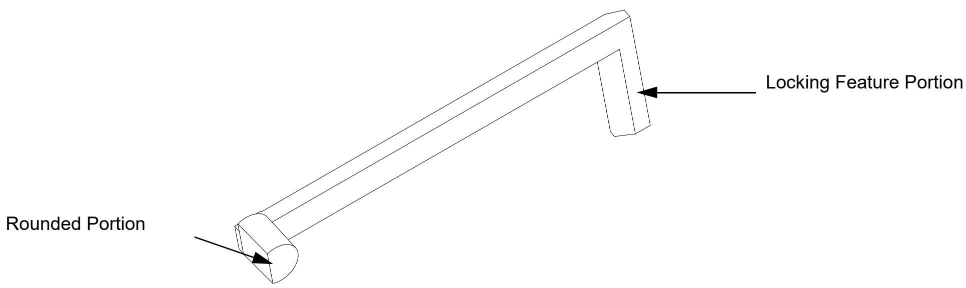


Figure 8-53. Expander Board Support (61)

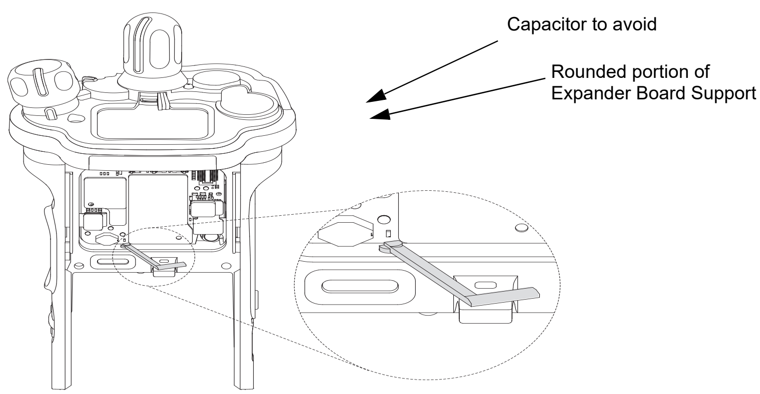


Figure 8-54. Insert Expander Board Support

8. Ensure the Rounded portion of the Expander Board Support is secure properly before rotating the Expander Board Support towards the Antenna Coax Connector.

9. Slide the Locking Feature of the Expander Board Support between the Antenna Coax connector and the Chassis Wall.

10. Gently press down the Expander Board Support into place.

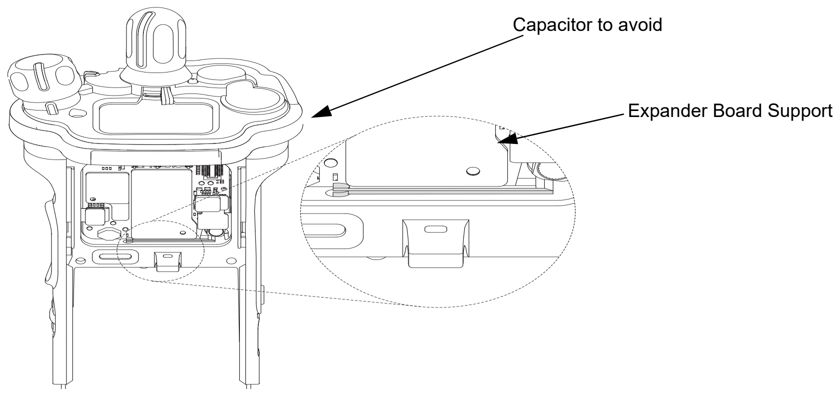


Figure 8-55. Press Expander Board Support into Place (Opt. Expansion Board)

8.9.1.8 Assemble Speaker Module (J)

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.

1. Ensure the Seal is free from any debris or foreign material.

2. Align the Speaker Module's 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 as shown in Figure 8-56.

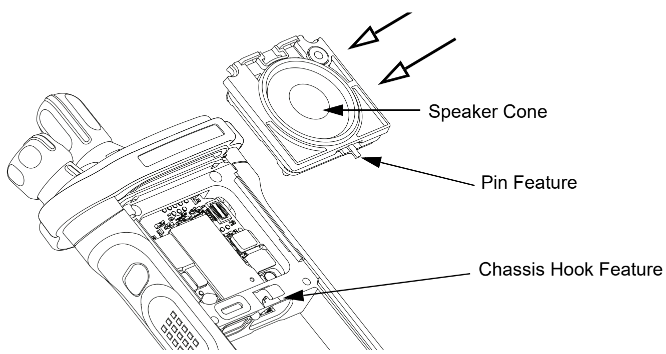


Figure 8-56. Insert Speaker Module

4. While holding the Speaker Module down, place the two top screws (42) into the their respective holes and torque the screws to 10 in-lbs with an IP8 Torx Bit in a torque driver. See Figure 8-57.

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

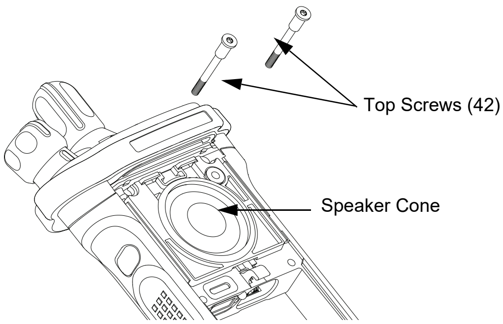


Figure 8-57. Insert Top Screws

8.9.1.9 Assemble Speaker Grille Assembly (K)

1. Ensure the sound dampener is in place and install the Speaker Grille (K) by inserting the top lip under the Control Cap Assembly (58) and rotating the grille into place. See Figure 8-58

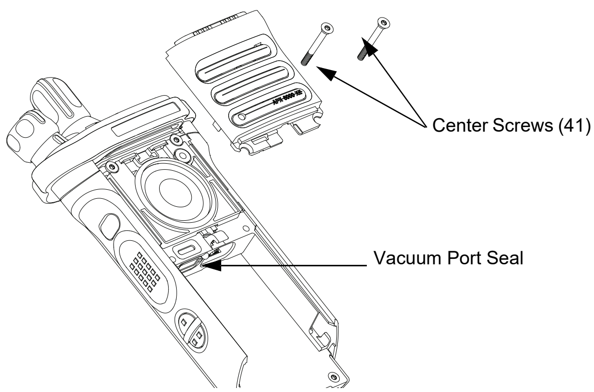


Figure 8-58. Insert Center Screws

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

2. Insert the two center screws (41) and torque to 10 in-lbs. See Figure 8-58.

3. If removed, insert the two bottom screws (43) into the screw holes at the bottom of the radio as shown in Figure 8-59., and torque to 10 in-lbs.

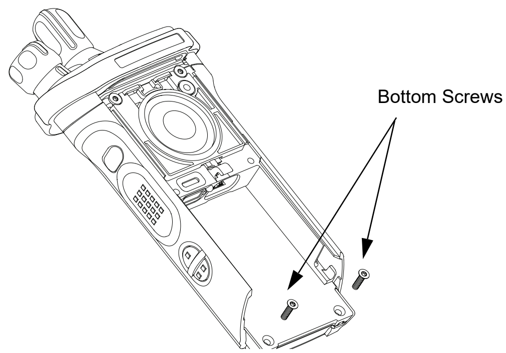


Figure 8-59. Insert Bottom Screws

NOTE: Refer to the appropriate section in this manual for reinstalling the antenna, battery, or any other accessory that was previously connected or attached to the radio prior to servicing.

8.10 Ensuring Radio Submergibility

This section discusses radio submergibility concerns, tests, and disassembly and reassembly of ASTRO APX 6000XE radios.

8.10.1 Standards

ASTRO APX 6000XE radio models meet the stringent requirements of U. S. MIL-STD-810C, Method 512.1, Procedure I; MIL-STD-810D, Method 512.2, Procedure I; MIL-STD-810E, Method 512.3, Procedure I; and MIL-STD-810F, Method 512.4, Procedure I, which require the radio to maintain watertight integrity when immersed in six (6) feet of water for two hours.

8.10.2 Servicing

APX 6000XE radios shipped from the Motorola 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. 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.

has evaporated, or is dislodged from these areas.

If radio is exposed to water without the battery attached be sure to shake out the water from the battery contact area to avoid causing damage to the radio and battery contacts.

If a conductive medium is present in the water, including salt, salt spray, splash and/or fog), carefully clean the entire radio to remove all conductive medium. Extra attention should be given to all metal surfaces of the radio and/or battery as well as any holes, depressions, or geometry in the radio that may trap the salt/sea water, then shake the radio to remove the excess water from the speaker grille, microphone ports and battery areas.

IMPORTANT: Remove any accessory, including the side connector cover and battery, if applicable, before cleaning the radio. DO NOT use anything abrasive on the metal contacts. Carefully rinse the radio with fresh water and dry it thoroughly with a soft, lint-free cloth.

8.10.4 Specialized Test Equipment

This section summarizes the specialized test equipment necessary for testing the integrity of ASTRO APX 6000XE 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 is needed to perform the vacuum check and pressure testing, if required.

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 (p/n 66009259001) which connects the vacuum pump to the radio, must be ordered separately.

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 section 8.7 on page 2:8-14.

8.10.6 Reassembly

Caution: Do not reassemble the radio without first performing the following preliminary inspection procedure.

To reassemble the radio:

1. Inspect the seal on the Back Chassis Assembly (B, N) for any damage or foreign material.
2. Inspect the seal on the Speaker Module (J) for any damage or foreign material.
3. Inspect the Battery Connector Seal (13) on the RF Board Assembly (C) for any damage.
4. Inspect the Gore Seal (62) for any nicks or damage and ensure it is fully seated.
5. Inspect the mating seal surfaces on the Main Chassis (15) for all of the above seals for damage or foreign material that might prevent the seals from sealing properly.

Continue reassembling the radio according to section 8.9 on page 2:8-33. Tighten all hardware that was loosened or removed.

8.10.7 Vacuum Test

The Vacuum Test uses a Vacuum Pump 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 (46) or any other accessories to expose the universal connector.
- Remove the screw (41) which holds the vacuum door.
- Remove the vacuum door.

NOTE: Refer to the exploded view diagrams and parts lists found in "Chapter 10: Exploded Views and Parts Lists" on page 2:10-1.

8.10.7.1 Vacuum Tool Setup

1. With Gore Seal removed, replace screw (41) and torque to 10 in-lbs.
2. Attach one end of the hose to the Vacuum Pump. Attach the other side of the hose to the Vacuum Adapter.
3. Tool Leak Test:
   i. Block the open end of the Vacuum Adapter.
   ii. Pull the knob on the Vacuum Pump to create vacuum.
   iii. Pump at least 15 inHg.
   iv. Watch the gauge for a minute. If there is any loss of vacuum, repair or replace the tool.
4. Ensure that the seal is attached to the Vacuum Adapter.

8.10.7.2 Test Procedure

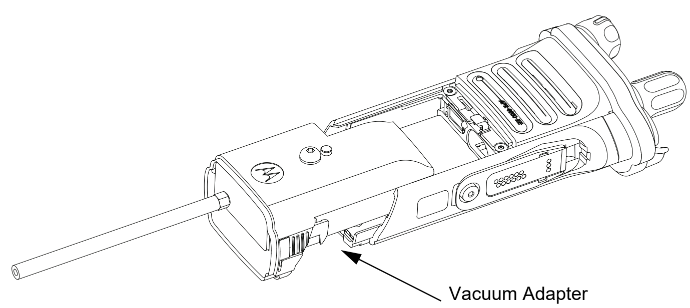


Figure 8-60. Attaching Vacuum Adapter

1. Attach the Vacuum Adapter onto the radio in the same manner as a radio battery. Ensure both latches are clicked into place.

   NOTE: Vacuum Port door must be opened and held out of the way prior to assembly of the Vacuum Adaptor.

2. 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. The radio has pressure sensitive components that can be damaged if the pressure exceeds this limit.

3. Observe the gauge for approximately 2 minutes.
   - If the needle falls less than 0.25 inHg (half a tick mark on the recommended Vacuum Pump), the radio passes the vacuum test.
     i. If the seal passes this inspection, this radio is approved for submergibility. No additional testing is required.
   - If the needle falls more than 0.25 inHg (half a tick mark on the recommended Vacuum
   - Pump), the radio fails the vacuum test and the radio might leak if submerged. Additional troubleshooting of the radio is required.
     i. Keep the Vacuum Adapter on but remove the Vacuum Pump from the Vacuum Adapter.
     ii. Continue with Pressure Test as described in Section 8.10.8.

8.10.8 Pressure Test (using NTN4265_)

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

NOTES: When Radio is placed under the water there will be some air trapped which will be released. This is not a failure.

Refer to the exploded view diagrams and parts lists found in “Chapter 10: Exploded Views and Parts Lists” on page 2:10-1.

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

To conduct the pressure test:

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.

   NOTE: Vacuum Port door must be opened and held out of the way prior to assembly of the Vacuum Adaptor.

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 will damage the radio.

Caution

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.
10. Re-Seat Vacuum Port Door.
11. See "8.10.9: Troubleshooting Leak Areas" on page 2:8-45.

8.10.9 Troubleshooting Leak Areas

Before repairing any leak, first read all of the steps within the applicable section. This will help to eliminate unnecessary disassembly and reassembly of a radio with multiple leaks. Troubleshoot only the faulty seal areas listed in "8.10.8: Pressure Test (using NTN4265_)" on page 2:8-44 and, when multiple leaks exist, in the order listed.

NOTES: All disassembly and reassembly methods can be found in Section 8.7. and Section 8.9.

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 will be needed.

8.10.9.2 Speaker Module

- If leak occurs through the Microphone Membrane (5) or the Speaker Module Seal (35), replace these items.
- If leak occurs elsewhere on the Speaker Module (J), the module will need to be replaced.

8.10.9.3 Battery Contact Seal

- If leak occurs due to damage to the Battery Connector Seal (13), it will need to be replaced.

8.10.9.4 Back Chassis

- If leak occurs through the Microphone Boot (4), replace it.
- If leak occurs through the Color Display Lens (7), replace it.
- If leak occurs elsewhere on the Back Chassis (B/N), it will need to be replaced.

8.10.9.5 Control Top

- If leak occurs through the antenna or the Control Top Seal (22), replace it.
- If leak occurs elsewhere on the Control Top Assembly (F), it will need to be replaced.

8.10.9.6 Main Chassis

- If leak occurs through the Main Seal (49), it will need to be replaced.
- If leak occurs elsewhere on the Main Chassis (15), it will need to be replaced.

Chapter 9 Basic Troubleshooting

This section of the manual contains troubleshooting charts and error codes that will help you to isolate a problem. Level one and two troubleshooting will support only radio alignment, programming, battery replacement, and knob replacement, and circuit board replacement.

Component-level service information can be found in the "ASTRO APX 6000XE Portable Radios Detailed Service Manual," Motorola publication number 68012002026.

9.1 Power-Up Error Codes

When the radio is turned on (power-up), the radio performs self-tests to determine if its basic electronics and software are in working order. Problems detected during these tests are presented as error codes on the radio's display. For non-display radios, the problem will be presented at power-up by a single, low-frequency tone. The radio should be sent to the depot if cycling power and reprogramming the code plug do not solve the problem. The presence of an error should prompt the user that a problem exists and that a service technician should be contacted.

Self-test errors are classified as either fatal or non-fatal. Fatal errors will inhibit user operation; non-fatal errors will not. Use Table 9-1 to aid in understanding particular power-up error code displays.

Table 9-1. Power-Up Error Code Displays

Error Code	Description	Corrective Action
01/02	FLASH ROM Codeplug Checksum Non-Fatal Error	Reprogram the codeplug
01/12	Security Partition Checksum Non-Fatal Error	Send radio to depot
01/81	Host ROM Checksum Fatal Error	Send radio to depot
01/82	FLASH ROM Codeplug Checksum Fatal Error	Reprogram the codeplug
01/84	External EEPROM Blank (or SLIC failure) Fatal Error	Send radio to depot
01/88	External RAM Fatal Error – **Note:** Not a checksum failure	Send radio to depot
01/90	General Hardware Failure Fatal Error	Turn the radio off, then on
01/92	Security Partition Checksum Fatal Error	Send radio to depot
01/93	FLASHport Authentication Code Failure	Send radio to depot
01/94	Internal EEPROM Blank Fatal Error.	Send radio to depot
01/98	Internal RAM Fail Fatal Error	Send radio to depot
01/A0	ABACUS Tune Failure Fatal Error	Send radio to depot
01/A2	Tuning Codeplug Checksum Fatal Error	Send radio to depot
02/81	DSP ROM Checksum Fatal Error	Send radio to depot
02/88	DSP RAM Fatal Error – **Note:** Not a checksum failure	Turn the radio off, then on

Table 9-1. Power-Up Error Code Displays (Continued)

Error Code	Description	Corrective Action
02/90	General DSP Hardware Failure (DSP startup message not received correctly)	Turn the radio off, then on
09/10	Secure Hardware Error	Turn the radio off, then on
09/90	Secure Hardware Fatal Error	Turn the radio off, then on
Hardware board absent/ Hardware board absent then Man-Down Hw error	Expansion board is not connected properly to the radio	Ensure the Expansion board is fixed in place

Note: *If the corrective action does not fix the failure, send the radio to the depot.*

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 radio's display. The presence of an error code should prompt a user that a problem exists and that a service technician should be contacted. Use Table 9-2 to aid in understanding particular operational error codes.

Table 9-2. 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

Table 9-3 lists the possible causes of, and corrections for, receiver problems.

Table 9-3. Receiver Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements at Room Temperature)
Radio Dead; Display Does Not Turn On	1. Dead Battery	Replace with charged battery
	2. Blown Fuse	Send radio to depot
	3. On/Off Switch	
	4. Regulators	
Radio Dead; Display Turns On	1. VOCON Board	Send radio to depot
	2. RF Board	
	3. 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, etc.) 2. Check if radio 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; realign if off by more than ±1000 Hz
RF Sensitivity Poor	1. Synthesizer Not On Frequency	Check synthesizer frequency by measuring the transmitter frequency; realign if off by more than ±1000 Hz
	2. Antenna Switch/ Connector	Send radio to depot
	3. 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

Table 9-4 lists the possible causes of, and corrections for, transmitter problems.

Table 9-4. Transmitter Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
No RF Power Out	1. TX Power Level or Frequency	Check TX power level and frequency programming (from tuner)
	2. No Injection To Power Amplifier	Send radio to depot
	3. Antenna Switch/Connector	
No Modulation; Distorted Modulation	1. Programming	Check deviation and compensation settings using the tuner
	2. VOCON Board	Send radio to depot
Bad Microphone Sensitivity	1. Check Deviation and Compensation	Realign if necessary
	2. Microphone	Send radio to depot
No/Low signaling (PL, DPL, MDC)	1. Programming	Check programming
	2. VOCON Board	Send radio to depot
Cannot Set Deviation Balance	RF Board	Send radio to depot

9.5 Encryption Troubleshooting

Table 9-5 lists the possible causes of, and corrections for, encryption problems.

Table 9-5. Encryption Troubleshooting Chart

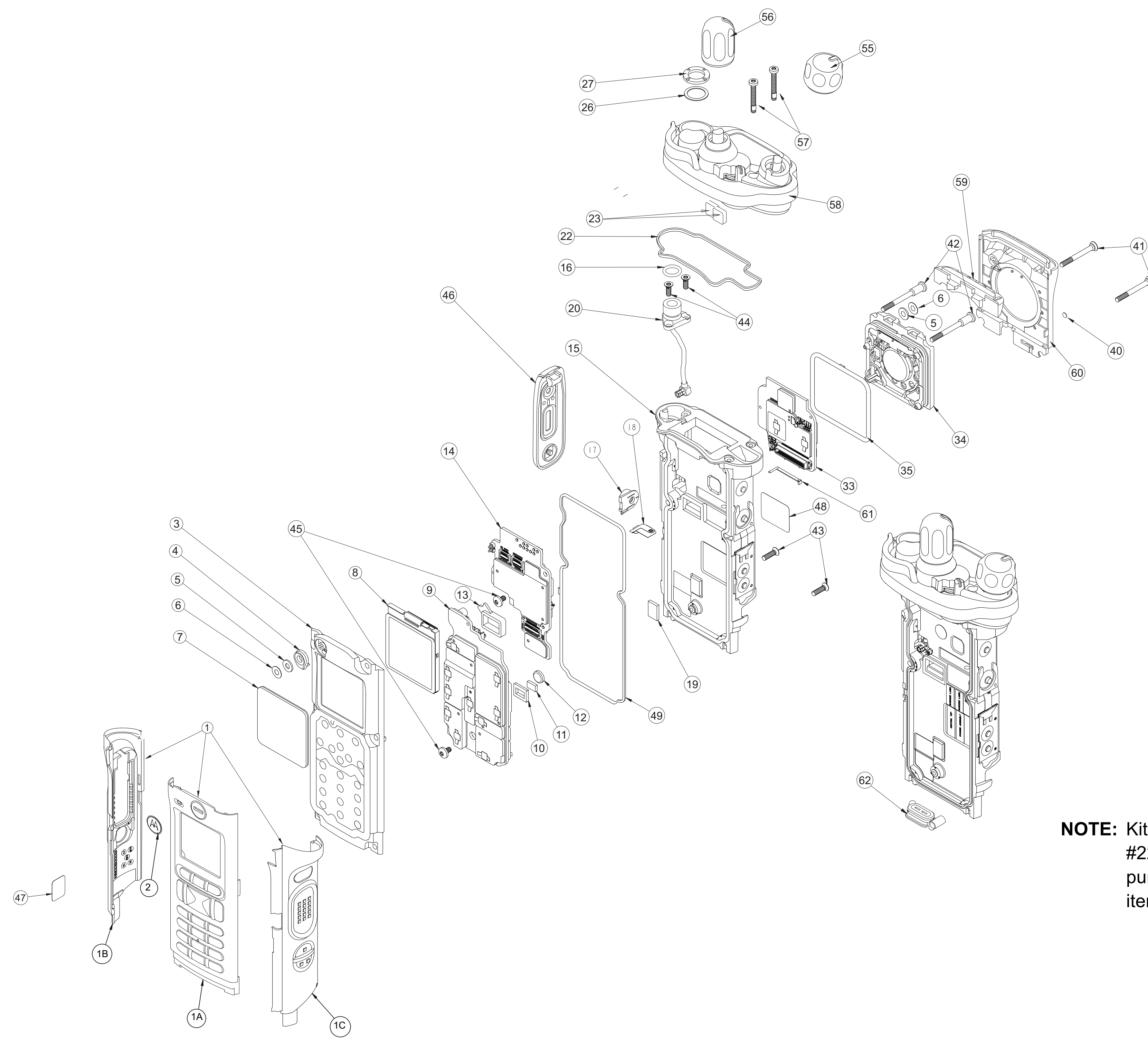
Symptom	Possible Cause	Corrective Action
No “KEYLOAD” on Radio Display When Keyloading Cable is Attached to the Radio Side Connector	1. Defective Keyload Cable	Send radio to depot
	2. Defective Radio	
Keyloader Displays “FAIL”	1. Wrong Keyloader Type	Use correct keyloader type. Refer to Keyloader User Guide for more information
	2. Bad Keyloader	Try another keyloader
	3. 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 APX 6000XE digital portable radios. The following table lists the exploded views for the APX 6000XE radio in different configurations:

Table 10-1. APX 6000XE Exploded Views and Controller Kit

10.1 APX 6000XE Dual Display (Full Keypad) Exploded View



NOTE: Kit NHN7033_ includes Items #15–#20, #22, #26, #27, #44, #55–#58. When purchasing this kit, need to purchase item #23 (qty. 2) together.

Figure 10-1. APX 6000XE Dual Display (Full Keypad) Exploded View

10.2 APX 6000XE Dual Display (Full Keypad) Exploded View Parts List

Item No.	Motorola Part Number	Description
1	KT000032C_ KT000033C_ KT000034C_ KT000035C_ KT000036C_ KT000037C_ KT000032D_ KT000032E_ KT000032F_	Assembly, Front Housing, Dual Display, M3 (Full Keypad) Assembly, Front Housing, Dual Display, M3 Yellow (Full Keypad) Assembly, Front Housing, Dual Display, M3 Green (Full Keypad) Assembly, Front Housing, Dual Display, M3 Orange (Full Keypad) Assembly, Front Housing, Dual Display, M3 Red (Full Keypad) Assembly, Front Housing, Dual Display, M3 Blue (Full Keypad) Assembly, Front Housing, Dual Display, M3 Black, Hebrew (Full Keypad) Assembly, Front Housing, Dual Display, M3 Black, Cyrillic (Full Keypad) Assembly, Front Housing, Dual Display, M3 Black, Arabic (Full Keypad)
1A	HN008000F03 HN008000F06 HN008000F09	M3 Black Face Housing M3 Yellow Face Housing M3 Green Face Housing
1B	HN008000G08 HN008000G09 HN008000G10 HN008000G12 HN008000G13 HN008000G14	GCAI-side Housing Black GCAI-side Housing Yellow GCAI-side Housing Green GCAI-side Housing Orange GCAI-side Housing Blue GCAI-side Housing Red
1C	HN008000P08 HN008000P09 HN008000P10 HN008000P12 HN008000P13 HN008000P14	PTT-side Housing Black PTT-side Housing Yellow PTT-side Housing Green PTT-side Housing Orange PTT-side Housing Blue PTT-side Housing Red
2	33009265001	Medallion
3	NHN7013_	Assembly, Back Chassis, Dual Display
4	32009357001	Boot, Dataside Mic
5	3275002C03	Mic Membrane
6	35009312002	Mic Mesh
7	61009283002	Lens, Front Display
8	NHN7020_	Display, Front
9	NUD7120_Z NUE7365_S NUE7366_Z NUF6750_Z	Board, RF (VHF) Board, RF (UHF1) Board, RF (UHF2) Board, RF (7/800)
10	3275623B03	Thermal Pad, Outer
11	75009299002	Thermal Pad, Inner
12	6003710K08	Battery, Backup, Coincell
13	3271829H02	Seal, Connector, Battery
14	HLN5960_Z	Board, VOCON
15[1]	01009364001	Assembly, Main, Chassis (W/O Control Top)
16	3275033C01	O-Ring, Antenna, Main
17	43009291001	Insert, Universal Connector
18	3971892H01	Contact, Chassis Ground
19	7505316J16	Pad, Coin Cell Battery
20	3075864B02	Cable, RF Coax
22	3275031C01	Seal, Control Cap
23[2]	75009418001	Pad, Support
26[6]	HW000085A01	Washer, Nylon, Antenna
27	0275891B01	Nut, Spanner, Antenna
33	HLN5978_Z	Opt Expansion Board Kit

Item No.	Motorola Part Number	Description
34	NHN7016_	Module, Speaker
35	32009351001	Seal, Speaker Module
40[5]	33009271001	Label, Bluetooth APX 6000
41	0375962B02	Screw(x2), M2.5X0.45, 24.45
42	0375962B01	Screw(x2), M2.5X0.45, 3 0.1
43	0375962B03	Screw(x2), M2.5X0.45, 9.2
44	0375962B04	Screw(x2), M2.5X0.45, 7
45	3009304001	Screw, RF and Vocon Board
46	1575250H01	Cover, Connector, Universal Conncector
49	32009355001	Seal, Main
54[1]	NHN7033_	Assembly, Main Chassis (with Control Top)
55	36009257001	Knob, Volume
56	36009258001	Knob, Frequency
57	03009357001	Screw, Top Bezel
58[2,3]	01009506010 01009506011 01009506012	Control Cap Assembly, MT-XE – Black Control Cap Assembly, MT-XE – Yellow Control Cap Assembly, MT-XE – Green
59[5]	32009436001	Sound Dampener
60[4]	NHN7034_S NHN7036_S NHN7037_S	Assembly, Speaker Grill – Black Assembly, Speaker Grill – Yellow Assembly, Speaker Grill – Green
61	07009369001	Support, Expander PCB
62	32009356002	Seal, Vacuum Port

NOTE:

1. Kit NHN7033_ includes Items #15–#20, #22, #26, #27, #44, #55–#58. When purchasing this kit, need to purchase item #23 (qty. 2) together.
2. When purchasing item #58, need to purchase items #23 (qty. 2), #26, #27, #55–#57 together.
3. Item #58 comes with items #22 and #56.
4. Item #60 comes with items #40 and #59.
5. Items #40 and #59 are not orderable. Both items come with item #60.
6. Items #26 (HW000085A01) is sold in sets of 35 in KT000009A01 with thread lock.

10.3 APX 6000XE Dual Display (Front Housing Limited Keypad) Exploded View

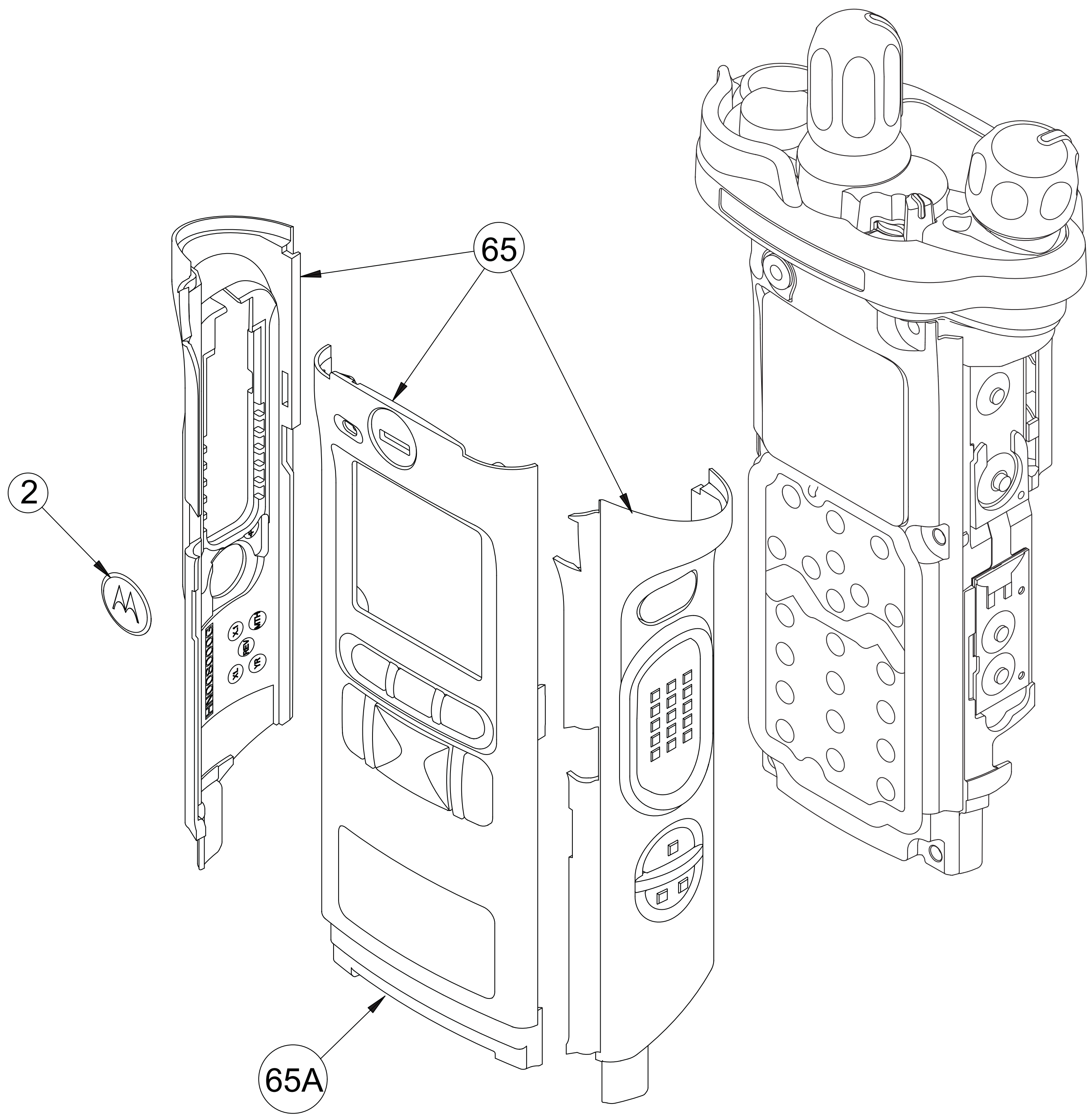


Figure 10-2. APX 6000XE Dual Display (Front Housing Limited Keypad) Exploded View

10.4 APX 6000XE Dual Display (Front Housing Limited Keypad) Exploded View Parts List

Item No.	Motorola Part Number	Description
65	KT000032B_ KT000033B_ KT000034B_ KT000035B_ KT000036B_ KT000037B_	Assembly, Front Housing, M2, Black, Dual Display (Limited Keypad) Assembly, Front Housing, M2, Yellow, Dual Display (Limited Keypad) Assembly, Front Housing, M2, Green, Dual Display (Limited Keypad) Assembly, Front Housing, M2, Orange, Dual Display (Limited Keypad) Assembly, Front Housing, M2, Red, Dual Display (Limited Keypad) Assembly, Front Housing, M2, Blue, Dual Display (Limited Keypad)
65A	HN008000F02 HN008000F05 HN008000F08	M2 Black Face Housing M2 Yellow Face Housing M2 Green Face Housing
2	33009265001	Medallion

10.5 APX 6000XE Top Display (Front Housing No Keypad) Exploded View

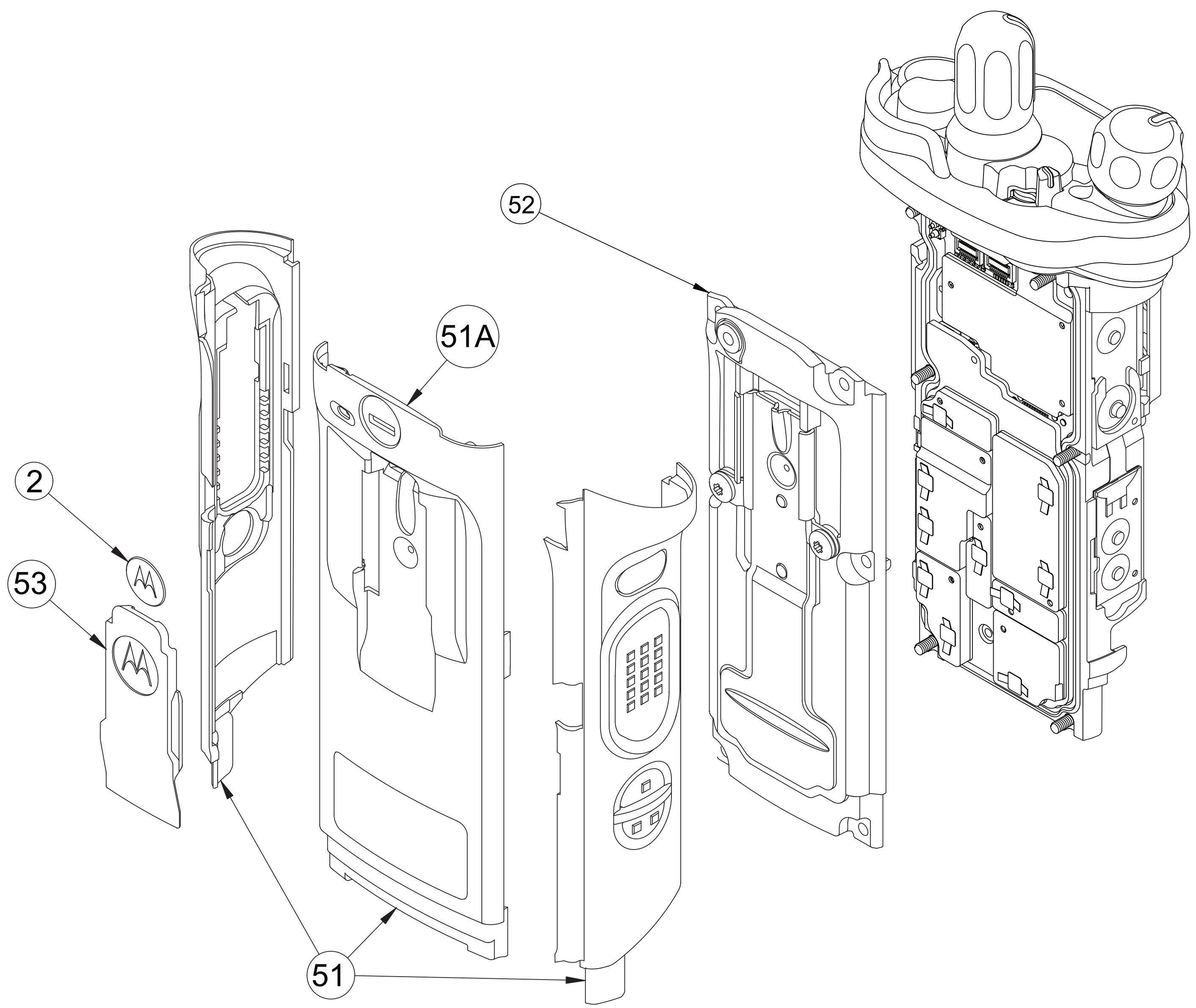


Figure 10-3. APX 6000XE Top Display (Front Housing No Keypad) Exploded View

10.6 APX 6000XE Top Display (Front Housing No Keypad) Exploded View Parts List

Item No.	Motorola Part Number	Description
51	KT000032A_ KT000033A_ KT000034A_ KT000035A_ KT000036A_ KT000037A_	Assembly, Front Housing, M1, Black, Top Display Assembly, Front Housing, M1, Yellow, Top Display Assembly, Front Housing, M1, Green, Top Display Assembly, Front Housing, M1, Orange, Top Display Assembly, Front Housing, M1, Red, Top Display Assembly, Front Housing, M1, Blue, Top Display
51A	HN008000F01 HN008000F04 HN008000F07	M1 Black Face Housing M1 Yellow Face Housing M1 Green Face Housing
2	33009265001	Medallion
52	NHN7014_	Assembly, Back Chassis, Top Display
53	1575356H01	Cover, Belt Clip, Top Display

10.7 APX 6000XE Controller Kit Numbers

Kit Number	Description
NNTN8177_	APX 6000 Mace Expansion Board
NNTN8178_	APX 6000 Mace with Apps Expansion Board
HLN5960_Z	APX 6000 VOCON Kit

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Digital Portable Radios

Section 3
Appendices

Notes

Appendix A Accessories

Motorola provides the following approved optional accessories to improve the productivity of the APX 6000/ APX 6000XE portable radio.

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

Notes

Appendix B Replacement Parts Ordering

B.1 Basic Ordering Information

When ordering replacement parts or equipment information, the complete identification number should be included. 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, and sufficient description of the desired component to identify it.

B.2 Transceiver Board, VOCON Board and Expansion Board Ordering Information

When ordering a replacement Transceiver Board, VOCON Board or Expansion Board, refer to the applicable Model Chart in the front of this manual. Read the Transceiver Board, VOCON Board, or Expansion Board note, and include the proper information with your order.

B.3 Motorola Online

Motorola Online users can access our online catalog at

http://www.motorola.com/businessonline

To register for online access, please call 1-800-422-4210 (for U.S. and Canada Service Centers only). International customers can obtain assistance at http://www.motorola.com/businessonline

B.4 Mail Orders

Mail orders are only accepted by the US Federal Government Markets Division (USFGMD).

Motorola Solutions
7031 Columbia Gateway Drive
3rd Floor – Order Processing
Columbia, MD 21046
U.S.A.

B.5 Telephone Orders

Radio Products and Solutions Organization*
(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)

U.S. Federal Government Markets Division (USFGMD)
1-877-873-4668
8:30 AM to 5:00 PM (Eastern Standard Time)

B.6 Fax Orders

Radio Products and Solutions Organization*
(United States and Canada)
1-800-622-6210
1-847-576-3023 (United States and Canada)

USFGMD
(Federal Government Orders)
1-800-526-8641 (For Parts and Equipment Purchase Orders)

B.7 Parts Identification

Radio Products and Solutions Organization*
(United States and Canada)
1-800-422-4210

B.8 Product Customer Service

Radio Products and Solutions Organization (United States and Canada)
1-800-927-2744

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

Glossary

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

Term	Definition
A/D	*See analog-to-digital conversion.*
Abacus IC	A custom integrated circuit providing a digital receiver intermediate frequency (IF) backend.
active channel	A channel that has traffic on it.
ACK	Acknowledgment of communication.
ADC	*See analog-to-digital converter.*
ADDAG	*See Analog-to-Digital, Digital-to-Analog and Glue.*
analog	Refers to a continuously variable signal or a circuit or device designed to handle such signals. *See also digital.*
Analog-to-Digital, Digital-to-Analog and Glue	An integrated circuit designed to be an interface between the radio's DSP, which is digital, and the analog transmitter and receiver ICs.
analog-to-digital conversion	Conversion of an instantaneous dc voltage level to a corresponding digital value. *See also D/A.*
analog-to-digital converter	A device that converts analog signals into digital data. *See also DAC.*
ASTRO 25 trunking	Motorola standard for wireless digital trunked communications.
ASTRO conventional	Motorola standard for wireless analog or digital conventional communications.
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.
band	Frequencies allowed for a specific purpose.
BGA	*See ball grid array.*
ball grid array	A type of IC package characterized by solder balls arranged in a grid that are located on the underside of the package.
Call Alert	Privately paging an individual by sending an audible tone.

Term	Definition
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	A group of characteristics, such as transmit/receive frequency pairs, radio parameters, and encryption encoding.
CODEC	*See coder/decoder.*
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. *See also firmware.*
coder/decoder	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. *See also trunking.*
conventional scan list	A scan list that includes only conventional channels.
CPS	*See Customer Programming Software.*
cursor	A visual tracking marker (a blinking line) that indicates a location on a display.
Customer Programming Software	Software with a graphical user interface containing the feature set of an ASTRO radio. *See also RSS.*
D/A	*See digital-to-analog conversion.*
DAC	*See digital-to-analog converter.*
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.

Term	Definition
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. *See also analog.*
digital-to-analog conversion	Conversion of a digital signal to a voltage that is proportional to the input value. *See also A/D.*
digital-to-analog converter	A device that converts digital data into analog signals. *See also ADC.*
Digital Private Line	A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.
digital signal processor	A microcontroller specifically designed for performing the mathematics involved in manipulating analog information, such as sound, that has been converted into a digital form. DSP also implies the use of a data compression technique.
digital signal processor code	Object code executed by the Digital Signal Processor in an ASTRO subscriber radio. The DSP is responsible for computation-intensive tasks, such as decoding ASTRO signaling.
dispatcher	An individual who has radio-system management duties and responsibilities.
DPL	*See Digital Private Line. See also PL.*
DSP	*See digital signal processor.*
DSP code	*See digital signal processor code.*
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.
EEPOT	Electrically Programmable Digital Potentiometer.
EEPROM	*See Electrically Erasable Programmable Read-Only Memory.*
Electrically Erasable Programmable Read-Only Memory	A special type of PROM that can be erased by exposing it to an electrical charge. An EEPROM retains its contents even when the power is turned off.
Failsoft	A backup system that allows communication in a non-trunked, conventional mode if the trunked system fails.
FCC	Federal Communications Commission.

Term	Definition
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.
FGU	*See frequency generation unit.*
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 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.
FMR	*See Florida Manual Revision.*
Florida Manual Revision	A publication that provides supplemental information for its parent publication before it is revised and reissued.
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 master clock and other derived synchronization clocks that are distributed throughout the communication network.
General-Purpose Input/Output	Pins whose function is programmable.
GPIO	*See General-Purpose Input/Output.*
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 an ASTRO subscriber radio. The host is responsible for control-oriented tasks such as decoding and responding to user inputs.
IC	*See integrated circuit.*
IF	Intermediate Frequency.
IMBE	A sub-band, voice-encoding algorithm used in ASTRO digital voice.
inbound signaling word	Data transmitted on the control channel from a subscriber unit to the central control unit.

Term	Definition
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.
ISW	*See inbound signaling word.*
key-variable loader	A device used to load encryption keys into a radio.
kHz	*See kilohertz.*
kilohertz	One thousand cycles per second. Used especially as a radio-frequency unit.
KVL	*See key-variable loader.*
LCD	*See liquid-crystal display.*
LED	*See LED.*
light emitting diode	An electronic device that lights up when electricity is passed through it.
liquid-crystal display	An LCD uses two sheets of polarizing material with a liquid-crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.
LO	Local oscillator.
low-speed handshake	150-baud digital data sent to the radio during trunked operation while receiving audio.
LSH	*See low-speed handshake.*
Master In Slave Out	SPI data line from a peripheral to the MCU.
Master Out Slave In	SPI data line from the MCU to a peripheral.
MCU	*See microcontroller unit.*
MDC	Motorola Digital Communications.
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.
MHz	*See Megahertz.*
Megahertz	One million cycles per second. Used especially as a radio-frequency unit.
microcontroller unit	Also written as µC. A microprocessor that contains RAM and ROM components, as well as communications and programming components and peripherals.
MISO	*See Master In Slave Out.*

Term	Definition
mode	A programmed combination of operating parameters; for example, a channel or talkgroup.
mode slaving	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.
MOSI	*See Master Out Slave In.*
multiplexer	An electronic device that combines several signals for transmission on some shared medium (e.g., a telephone wire).
MUX	*See multiplexer.*
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.
OMPAC	*See over-molded pad-array carrier.*
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.
OSW	*See outbound signaling word.*
OTAR	*See over-the-air rekeying.*
outbound signaling word	Data transmitted on the control channel from the central controller to the subscriber unit.
over-molded pad-array carrier	A Motorola 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.
PC Board	Printed Circuit Board. Also referred to as a PCB.

Term	Definition
personality	A set of unique features specific to a radio.
phase-locked loop	A circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PL	*See private-line tone squelch.*
PLL	*See phase-locked loop.*
preprogrammed	A software feature that has been activated by a qualified radio technician.
Private (Conversatiion) Call	A feature that lets you have a private conversation with another radio user in the group.
private-line tone squelch	A continuous sub-audible tone that is transmitted along with the carrier. *See also DPL.*
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.
PROM	*See Programmable Read-Only Memory.*
PTT	*See Push-to-Talk.*
Push-to-Talk	The switch or button usually located on the left side of the radio which, when pressed, causes the radio to transmit. When the PTT is released, the unit returns to receive operation.
radio frequency	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.
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 an ASTRO radio. *See also CPS.*
random access memory	A type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the preceding bytes.
RAM	*See random access memory.*
read-only memory	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.

Term	Definition
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).
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.
RESET	Reset line: an input to the microcontroller that restarts execution.
RF	*See radio frequency.*
RF PA	*See radio frequency power amplifier.*
RIB	*See Radio Interface Box.*
ROM	*See read-only memory.*
RPCIC	Regulator/power control IC.
RPT/TA	*See repeater/talkaround.*
RSS	*See Radio Service Software.*
RSSI	Received Signal Strength Indicator.
RTC	*See real-time clock.*
RX	Receive.
RX DATA	Recovered digital data line.
SAP	*See Serial Audio CODEC Port.*
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.

Term	Definition
Serial Communication Interface Input Line	A full-duplex (receiver/transmitter) asynchronous serial interface.
SCI IN	*See Serial Communication Interface Input Line.*
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.
softpot	*See software potentiometer.*
software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
software potentiometer	A computer-adjustable electronic attenuator.
spectrum	Frequency range within which radiation has specific characteristics.
SPI	*See Serial Peripheral Interface.*
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.
SRAM	*See static RAM.*
SRIB	Smart Radio Interface Box. *See RIB.*
SSI	*See Synchronous Serial Interface.*
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	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 *(See ISW and OSW)*.
system select	The act of selecting the desired operating system with the system-select switch (also, the name given to this switch).

Term	Definition
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	A timer that limits the length of a transmission.
tone	A continuous, sub-audible tone transmitted with the carrier.
TOT	*See time-out timer.*
transceiver	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
transmitter	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
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. *See also conventional.*
trunking priority monitor scan list	A scan list that includes talkgroups that are all from the same trunking system.
TSOP	*See thin small-outline package.*
TX	Transmit.
UART	*See also Universal Asynchronous Receiver Transmitter.*
UHF	Ultra-High Frequency.
USK	Unique shadow key.
Universal Asynchronous Receiver Transmitter	A microchip with programming that controls a computer's interface to its attached serial devices.
Universal Connector	Interface point for all accessories to the radio.
Universal Serial Bus	An external bus standard that supports data transfer rates of 12 Mbps.
USB	*See Universal Serial Bus.*

Term	Definition
VCO	*See voltage-controlled oscillator.*
vector sum excited linear predictive coding	A voice-encoding technique used in ASTRO digital voice.
VHF	Very-High Frequency.
VOCON	*See vocoder/controller.*
vocoder	An electronic device for synthesizing speech by implementing a compression algorithm particular to voice. *See also voice encoder.*
vocoder/controller	A PC board that contains an ASTRO radio’s 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. *See also vocoder.*
voltage-controlled oscillator	An oscillator in which the frequency of oscillation can be varied by changing a control voltage.

Notes

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