ASTRO® XTS™ 5000

VHF
UHF Range 1
UHF Range 2
700 — 800 MHz
Digital Portable Radios

Basic Service Manual

MOTOROLA
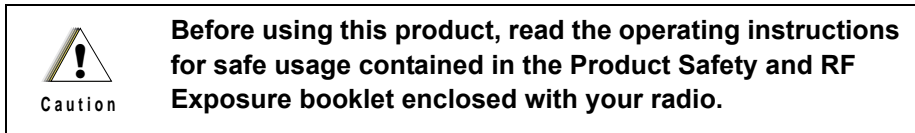*intelligence everywhere*™

ASTRO® XTS™ 5000

VHF/UHF Range 1/UHF Range 2/700–800 MHz
Digital Portable Radios

Basic Service Manual

Foreword

This manual covers all models of the ASTRO® XTS™ 5000 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 x.

Product Safety and RF Exposure Compliance

<table>
<tr><td>⚠
C a u t i o n</td><td>**Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio.**</td></tr>
</table>

ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 6881095C98) to ensure compliance with RF energy exposure limits.

For a list of Motorola-approved antennas, batteries, and other accessories, visit the following web site which lists approved accessories: http://www.motorola.com/cgiss/index.shtml

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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Table of Contents

List of Tables

List of Figures

Commercial Warranty

Limited Warranty

MOTOROLA COMMUNICATION PRODUCTS

I. What This Warranty Covers And For How Long

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

ASTRO XTS 5000 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.

III. State Law Rights

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

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

IV. How To Get Warranty Service

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

B. Defects or damage from misuse, accident, water, or neglect.

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

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

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

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

G. Rechargeable batteries if:

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 type acceptance 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.

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

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VII. Governing Law

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

Notes

Model Numbering, Charts, and Specifications

Portable Radio Model Numbering System

Typical Model Number: **H 1 8 U C F 9 7 P W 7 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
18 = XTS 5000

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 = Product Specific
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

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

Positions 13 - 16
SP Model Suffix

Position 12 - Unique Model Variations
C = Cenelec
N = Standard Package

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

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/
5 = Standard Package	Programmable

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 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

ASTRO XTS 5000 VHF Model Chart

MODEL NUMBER				DESCRIPTION
H18KEC9PW5AN				VHF 1-6 Watts ASTRO XTS 5000 Model I
	H18KEF9PW6AN			VHF 1-6 Watts ASTRO XTS 5000 Model II
		H18KEH9PW7AN		VHF 1-6 Watts ASTRO XTS 5000 Model III
			ITEM NUMBER	**DESCRIPTION**
X	X	X	NLD8910_	Board, Transceiver (VHF)
X	X	X	NNTN4563_ or,	Board, VOCON*
			NNTN4717_	Board, VOCON*
X	X	X	—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X			NTN9682_	Kit, Front Cover, Model I
	X		NTN9681_	Kit, Front Cover, Model II
		X	NTN9680_	Kit, Front Cover, Model III
X	X	X	—	Antenna, VHF (Refer to the Basic Service Manual accessories appendix)
X	X	X	0985973B01	Assembly, B+ Connector
X	X	X	1505579Z01	Cover, Accessory Connector
X			2685567D01	Assembly, VOCON Shield, Model I
	X		2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X	2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X	2685220D02	Shield, RF (Transceiver) Board
X	X	X	2785219D01	Assembly, Casting
X	X	X	2885866A01	Connector, Compression, 26-Pin
X	X	X	3205082E96	Gasket, Antenna O-Ring
X	X	X	3205349Z03	Seal, Main
X	X	X	3205351Z02	Seal, B+
X	X	X	3285877B02	Seal, Port
X	X	X	3385873B01	Label, Port
	X	X	7285726C02	Module, LCD Display
	X	X	7585189D01	Pad, Display Locator
	X		7585104D02	Keypad, Model II
		X	7585104D01	Keypad, Model III

Notes:

X *= Item Included*

* *= The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON Board.*
- *The model number and (sometimes) the FLASHcode can be found on the FCC label on the back of the radio.*
- *The model number, Host code, DSP code, and (sometimes) the FLASHcode can be found by putting a Model II or III radio into the Test Mode.*
- *The model number, Host code, DSP code, and FLASHcode can be found by using the Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.*

ASTRO XTS 5000 R (Ruggedized) VHF Model Chart

MODEL NUMBER						DESCRIPTION
H18KEC9PW5AN w/Q155FE Opt						Ruggedized VHF 1-6 Watts ASTRO XTS 5000 Model I
	H18KEF9PW6AN w/Q155FF Opt					Ruggedized VHF 1-6 Watts ASTRO XTS 5000 Model II
		H18KEH9PW7AN w/Q155FG Opt				Ruggedized VHF 1-6 Watts ASTRO XTS 5000 Model III
			H18KEC9PW5AN w/Q155FS Opt			Ruggedized Yellow VHF 1-6 Watts ASTRO XTS 5000 Model I
				H18KEF9PW6AN w/Q155FT Opt		Ruggedized Yellow VHF 1-6 Watts ASTRO XTS 5000 Model II
					H18KEH9PW7AN w/Q155FU Opt	Ruggedized Yellow VHF 1-6 Watts ASTRO XTS 5000 Model III
					ITEM NUMBER	DESCRIPTION
X	X	X	X	X	X	NLD8910_ Board, Transceiver (VHF)
X	X	X	X	X	X	NNTN4563_ or, Board, VOCON* NNTN4717_ Board, VOCON*
X	X	X	X	X	X	— Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	— Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X						NNTN4059_ Kit, Front Cover, Model I, Ruggedized
	X					NNTN4060_ Kit, Front Cover, Model II, Ruggedized
		X				NNTN4061_ Kit, Front Cover, Model III, Ruggedized
			X			NTN9685_ Kit, Yellow Front Cover, Model I, Ruggedized
				X		NTN9684_ Kit, Yellow Front Cover, Model II, Ruggedized
					X	NTN9683_ Kit, Yellow Front Cover, Model III, Ruggedized
X	X	X	X	X	X	— Antenna, VHF (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	0985973B02 Assembly, B+ Connector
X	X	X	X	X	X	1505579Z01 Cover, Accessory Connector
X			X			2685567D01 Assembly, VOCON Shield, Model I
	X			X		2685567D02 Assembly, VOCON Shield-Keypad, Model II
		X			X	2685567D03 Assembly, VOCON Shield-Keypad, Model III
X	X	X	X	X	X	2685220D02 Shield, RF (Transceiver) Board
X	X	X	X	X	X	2785219D04 Assembly, Ruggedized Casting
X	X	X	X	X	X	2885866A01 Connector, Compression, 26-Pin
X	X	X	X	X	X	3205082E96 Gasket, Antenna O-Ring
X	X	X	X	X	X	3205349Z03 Seal, Main
X	X	X	X	X	X	3205351Z02 Seal, B+ Ruggedized
X	X	X	X	X	X	3285877B02 Seal, Port
X	X	X	X	X	X	3385873B01 Label, Port
	X	X		X	X	7285726C02 Module, LCD Display
	X	X		X	X	7585189D01 Pad, Display Locator
	X			X		7585104D02 Keypad, Model II
		X			X	7585104D01 Keypad, Model III

Notes:

X = Item Included

* = The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON Board.

- The model number and (sometimes) the FLASHcode can be found on the FCC label on the back of the radio.
- The model number, Host code, DSP code, and (sometimes) the FLASHcode can be found by putting a Model II or III radio into the Test Mode.
- The model number, Host code, DSP code, and FLASHcode can be found by using the Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.

ASTRO XTS 5000 UHF Range 1 Model Chart

MODEL NUMBER							DESCRIPTION
H18QDC9PW5AN							UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model I
	H18QDF9PW6AN						UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model II
		H18QDH9PW7AN					UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model III
			H18QCC9PW5AN				UHF Range 1, Low Power, 20 mW - 2 Watts ASTRO XTS 5000 Model I
				H18QCF9PW6AN			UHF Range 1, Low Power, 20 mW - 2 Watts ASTRO XTS 5000 Model II
					H18QCH9PW7AN		UHF Range 1, Low Power, 20 mW - 2 Watts ASTRO XTS 5000 Model III
						ITEM NUMBER	DESCRIPTION
X	X	X				NLE4272_	Board, Transceiver (UHF)
			X	X	X	NLE4278_	Board, Transceiver (UHF) Low Power
X	X	X	X	X	X	NNTN4819_ or, NNTN4717_	Board, VOCON* Board, VOCON*
X	X	X	X	X	X	—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X		X				NTN9682_	Kit, Front Cover, Model I
	X		X			NTN9681_	Kit, Front Cover, Model II
		X			X	NTN9680_	Kit, Front Cover, Model III
X	X	X	X	X	X	—	Antenna, UHF (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	0985973B01	Assembly, B+ Connector
X	X	X	X	X	X	1505579Z01	Cover, Accessory Connector
X		X				2685567D01	Assembly, VOCON Shield, Model I
	X		X			2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X			X	2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X	X	X	X	2685220D02	Shield, RF (Transceiver) Board
X	X	X	X	X	X	2785219D01	Assembly, Casting
X	X	X	X	X	X	2885866A01	Connector, Compression, 26-Pin
X	X	X	X	X	X	3205082E96	Gasket, Antenna O-Ring
X	X	X	X	X	X	3205349Z03	Seal, Main
X	X	X	X	X	X	3205351Z02	Seal, B+
X	X	X	X	X	X	3285877B02	Seal, Port
X	X	X	X	X	X	3385873B01	Label, Port
	X	X		X	X	7285726C03	Module, LCD Display
	X	X		X	X	7585189D01	Pad, Display Locator
	X			X		7585104D02	Keypad, Model II
		X			X	7585104D01	Keypad, Model III

Notes:

X = Item Included

* = The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON Board.
- The model number and (sometimes) the FLASHcode can be found on the FCC label on the back of the radio.
- The model number, Host code, DSP code, and (sometimes) the FLASHcode can be found by putting a Model II or III radio into the Test Mode.
- The model number, Host code, DSP code, and FLASHcode can be found by using the Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.

ASTRO XTS 5000 R (Ruggedized) UHF Range 1 Model Chart

MODEL NUMBER	DESCRIPTION
H18QDC9PW5AN w/Q155FE Opt	Ruggedized UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model I
H18QDF9PW6AN w/Q155FF Opt	Ruggedized UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model II
H18QDH9PW7AN w/Q155FG Opt	Ruggedized UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model III
H18QDC9PW5AN w/Q155FS Opt	Ruggedized Yellow UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model I
H18QDF9PW6AN w/Q155FT Opt	Ruggedized Yellow UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model II
H18QDH9PW7AN w/Q155FU Opt	Ruggedized Yellow UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model III
H18QCC9PW5AN wQ155HW Opt	Ruggedized UHF R1, Low Pwr, 20 mW-2 Watts ASTRO XTS 5000 Model I
H18QCF9PW6AN wQ155HX Opt	Ruggedized UHF R1, Low Pwr, 20 mW-2 Watts ASTRO XTS 5000 Model II
H18QCH9PW7AN wQ155HY Opt	Ruggedized UHF R1, Low Pwr, 20 mW-2 Watts ASTRO XTS 5000 Model III

									ITEM NUMBER	DESCRIPTION
X	X	X	X	X	X	X	X	X	NLE4272_	Board, Transceiver (UHF)
X	X	X	X	X	X	X	X	X	NLE4278_	Board, Transceiver (UHF) Low Power
X	X	X	X	X	X	X	X	X	NNTN4819_ or, NNTN4717_	Board, VOCON* / Board, VOCON*
X	X	X	X	X	X	X	X	X	—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	X	X	X	—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X				X					NNTN4059_	Kit, Front Cover, Model I, Ruggedized
	X				X				NNTN4060_	Kit, Front Cover, Model II, Ruggedized
		X				X			NNTN4061_	Kit, Front Cover, Model III, Ruggedized
			X						NTN9685_	Kit, Yellow Front Cover, Model I, Ruggedized
				X					NTN9684_	Kit, Yellow Front Cover, Model II, Ruggedized
					X				NTN9683_	Kit, Yellow Front Cover, Model III, Ruggedized
X	X	X	X	X	X	X	X	X	—	Antenna, UHF (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	X	X	X	0985973B02	Assembly, B+ Connector
X	X	X	X	X	X	X	X	X	1505579Z01	Cover, Accessory Connector
X			X			X			2685567D01	Assembly, VOCON Shield, Model I
	X			X			X		2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X			X			X	2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X	X	X	X	X	X	X	2685220D02	Shield, RF (Transceiver) Board
X	X	X	X	X	X	X	X	X	2785219D04	Assembly, Ruggedized Casting
X	X	X	X	X	X	X	X	X	2885866A01	Connector, Compression, 26-Pin
X	X	X	X	X	X	X	X	X	3205082E96	Gasket, Antenna O-Ring
X	X	X	X	X	X	X	X	X	3205349Z03	Seal, Main
X	X	X	X	X	X	X	X	X	3205351Z02	Seal, B+ Ruggedized
X	X	X	X	X	X	X	X	X	3285877B02	Seal, Port
X	X	X	X	X	X	X	X	X	3385873B01	Label, Port
	X	X		X	X		X	X	7285726C03	Module, LCD Display
	X	X		X	X		X	X	7585189D01	Pad, Display Locator
	X			X			X		7585104D02	Keypad, Model II
		X			X			X	7585104D01	Keypad, Model III

Notes:
X = Item Included
* = The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON Board.
 • The model number and (sometimes) the FLASHcode can be found on the FCC label on the back of the radio.
 • The model number, Host code, DSP code, and (sometimes) the FLASHcode can be found by putting a Model II or III radio into the Test Mode.
 • The model number, Host code, DSP code, and FLASHcode can be found by using the Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.

ASTRO XTS 5000 UHF Range 2 Model Chart

			MODEL NUMBER	DESCRIPTION
H18SDC9PW5AN				UHF Range 2, 1-5 Watts ASTRO XTS 5000 Model I
	H18SDF9PW6AN			UHF Range 2, 1-5 Watts ASTRO XTS 5000 Model II
		H18SDH9PW7AN		UHF Range 1, 1-5 Watts ASTRO XTS 5000 Model III
			ITEM NUMBER	DESCRIPTION
X	X	X	NLE4273_	Board, Transceiver (UHF R2)
X	X	X	NNTN4717_	Board, VOCON*
X	X	X	—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X			NTN9682_	Kit, Front Cover, Model I
	X		NTN9681_	Kit, Front Cover, Model II
		X	NTN9680_	Kit, Front Cover, Model III
X	X	X	—	Antenna, UHF (Refer to the Basic Service Manual accessories appendix)
X	X	X	0985973B01	Assembly, B+ Connector
X	X	X	1505579Z01	Cover, Accessory Connector
X			2685567D01	Assembly, VOCON Shield, Model I
	X		2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X	2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X	2685220D02	Shield, RF (Transceiver) Board
X	X	X	2785219D01	Assembly, Casting
X	X	X	2885866A01	Connector, Compression, 26-Pin
X	X	X	3205082E96	Gasket, Antenna O-Ring
X	X	X	3205349Z03	Seal, Main
X	X	X	3205351Z02	Seal, B+
X	X	X	3285877B02	Seal, Port
X	X	X	3385873B01	Label, Port
	X	X	7285726C03	Module, LCD Display
	X	X	7585189D01	Pad, Display Locator
	X		7585104D02	Keypad, Model II
		X	7585104D01	Keypad, Model III

Notes:

X = *Item Included*

* = *The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON Board.*
   - *The model number and (sometimes) the FLASHcode can be found on the FCC label on the back of the radio.*
   - *The model number, Host code, DSP code, and (sometimes) the FLASHcode can be found by putting a Model II or III radio into the Test Mode.*
   - *The model number, Host code, DSP code, and FLASHcode can be found by using the Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.*

ASTRO XTS 5000 R (Ruggedized) UHF Range 2 Model Chart

Model Numbers

Model Number	Description
H18SDC9PW5AN w/Q155FL Opt	Ruggedized UHF Range 2, 1-5 Watts ASTRO XTS 5000 Model I
H18SDF9PW6AN w/Q155FM Opt	Ruggedized UHF Range 2, 1-5 Watts ASTRO XTS 5000 Model II
H18SDH9PW7AN w/Q155FN Opt	Ruggedized UHF Range 2, 1-5 Watts ASTRO XTS 5000 Model III
H18SDF9PW5AN w/Q155FZ Opt	Ruggedized Yellow UHF Range 2, 1-5 Watts ASTRO XTS 5000 Model I
H18SDF9PW6AN w/Q155FZ Opt	Ruggedized Yellow UHF Range 2, 1-5 Watts ASTRO XTS 5000 Model II
H18SDH9PW7AN w/Q155GA Opt	Ruggedized Yellow UHF Range 2, 1-5 Watts ASTRO XTS 5000 Model III

Item Chart

Columns 1–6 correspond, left to right, to the six models listed above (I, II, III, Yellow I, Yellow II, Yellow III).

1	2	3	4	5	6	Item Number	Description
X	X	X	X	X	X	NLE4273_	Board, Transceiver (UHF R2)
X	X	X	X	X	X	NNTN4717_	Board, VOCON*
X	X	X	X	X	X	—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X						NNTN4059_	Kit, Front Cover, Model I, Ruggedized
	X					NNTN4060_	Kit, Front Cover, Model II, Ruggedized
		X				NNTN4061_	Kit, Front Cover, Model III, Ruggedized
			X			NTN9685_	Kit, Yellow Front Cover, Model I, Ruggedized
				X		NTN9684_	Kit, Yellow Front Cover, Model II, Ruggedized
					X	NTN9683_	Kit, Yellow Front Cover, Model III, Ruggedized
X	X	X	X	X	X	—	Antenna, UHF (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	0985973B02	Assembly, B+ Connector
X	X	X	X	X	X	1505579Z01	Cover, Accessory Connector
X			X			2685567D01	Assembly, VOCON Shield, Model I
	X			X		2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X			X	2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X	X	X	X	2685220D02	Shield, RF (Transceiver) Board
X	X	X	X	X	X	2785219D04	Assembly, Ruggedized Casting
X	X	X	X	X	X	2885866A01	Connector, Compression, 26-Pin
X	X	X	X	X	X	3205082E96	Gasket, Antenna O-Ring
X	X	X	X	X	X	3205349Z03	Seal, Main
X	X	X	X	X	X	3205351Z02	Seal, B+ Ruggedized
X	X	X	X	X	X	3285877B02	Seal, Port
X	X	X	X	X	X	3385873B01	Label, Port
	X	X		X	X	7285726C03	Module, LCD Display
	X	X		X	X	7585189D01	Pad, Display Locator
	X			X		7585104D02	Keypad, Model II
		X			X	7585104D01	Keypad, Model III

Notes:

X = Item Included

***** = The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON Board.

- The model number and (sometimes) the FLASHcode can be found on the FCC label on the back of the radio.
- The model number, Host code, DSP code, and (sometimes) the FLASHcode can be found by putting a Model II or III radio into the Test Mode.
- The model number, Host code, DSP code, and FLASHcode can be found by using the Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.

ASTRO XTS 5000 700–800 MHz Model Chart

MODEL NUMBER				DESCRIPTION
H18UCC9PW5AN				700/800 MHz 1-3 Watts ASTRO XTS 5000 Model I
	H18UCF9PW6AN			700/800 MHz 1-3 Watts ASTRO XTS 5000 Model II
		H18UCH9PW7AN		700/800 MHz 1-3 Watts ASTRO XTS 5000 Model III
			ITEM NUMBER	**DESCRIPTION**
X	X	X	NUF3577_	Board, Transceiver (700/800 MHz)
X	X	X	NTN9564_ or,	Board, VOCON*
			NNTN4717_	Board, VOCON*
X	X	X	—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X			NTN9682_	Kit, Front Cover, Model I
	X		NTN9681_	Kit, Front Cover, Model II
		X	NTN9680_	Kit, Front Cover, Model III
X	X	X	—	Antenna, 700/800 MHz (Refer to the Basic Service Manual accessories appendix)
X	X	X	0985973B01	Assembly, B+ Connector
X	X	X	1505579Z01	Cover, Accessory Connector
X			2685567D01	Assembly, VOCON Shield, Model I
	X		2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X	2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X	2685220D02	Shield, RF (Transceiver) Board
X	X	X	2785219D01	Assembly, Casting
X	X	X	2885866A01	Connector, Compression, 26-Pin
X	X	X	3205082E96	Gasket, Antenna O-Ring
X	X	X	3205349Z03	Seal, Main
X	X	X	3205351Z02	Seal, B+
X	X	X	3285877B02	Seal, Port
X	X	X	3385873B01	Label, Port
	X	X	7285726C01 or,	Module, LCD Display (for use only with the NTN9564_ VOCON board)
			7285726C02	Module, LCD Display (for use only with the NNTN4717 VOCON board)
	X	X	7585189D01	Pad, Display Locator
	X		7585104D02	Keypad, Model II
		X	7585104D01	Keypad, Model III

Notes:
X = Item Included
* = The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON Board.
  • The model number and (sometimes) the FLASHcode can be found on the FCC label on the back of the radio.
  • The model number, Host code, DSP code, and (sometimes) the FLASHcode can be found by putting a Model II or III radio into the Test Mode.
  • The model number, Host code, DSP code, and FLASHcode can be found by using the Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.

ASTRO XTS 5000 R (Ruggedized) 700–800 MHz Model Chart

MODEL NUMBER						DESCRIPTION
H18UCC9PW5AN w/Q155FP Opt						Ruggedized 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model I
	H18UCF9PW6AN w/Q155FQ Opt					Ruggedized 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model II
		H18UCH9PW7AN w/Q155FR Opt				Ruggedized 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model III
			H18UCC9PW5AN w/Q155GB Opt			Ruggedized Yellow 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model I
				H18UCF9PW6AN w/Q155GC Opt		Ruggedized Yellow 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model II
					H18UCH9PW7AN w/Q155GD Opt	Ruggedized Yellow 700/800 MHz 1-3 Watts ASTRO XTS 5000 Model III

						ITEM NUMBER	DESCRIPTION
X	X	X	X	X	X	NUF3577_	Board, Transceiver (700/800 MHz)
X	X	X	X	X	X	NTN9564_ or, NNTN4717_	Board, VOCON* Board, VOCON*
X	X	X	X	X	X	—	Belt Clip Kit (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	—	Battery (Refer to Table 2-1 and Table 2-2 on page 2-1)
X						NNTN4059_	Kit, Front Cover, Model I, Ruggedized
	X					NNTN4060_	Kit, Front Cover, Model II, Ruggedized
		X				NNTN4061_	Kit, Front Cover, Model III, Ruggedized
			X			NTN9685_	Kit, Yellow Front Cover, Model I, Ruggedized
				X		NTN9684_	Kit, Yellow Front Cover, Model II, Ruggedized
					X	NTN9683_	Kit, Yellow Front Cover, Model III, Ruggedized
X	X	X	X	X	X	—	Antenna, 700/800 MHz (Refer to the Basic Service Manual accessories appendix)
X	X	X	X	X	X	0985973B02	Assembly, B+ Connector
X	X	X	X	X	X	1505579Z01	Cover, Accessory Connector
X			X			2685567D01	Assembly, VOCON Shield, Model I
	X			X		2685567D02	Assembly, VOCON Shield-Keypad, Model II
		X			X	2685567D03	Assembly, VOCON Shield-Keypad, Model III
X	X	X	X	X	X	2685220D02	Shield, RF (Transceiver) Board
X	X	X	X	X	X	2785219D04	Assembly, Ruggedized Casting
X	X	X	X	X	X	2885866A01	Connector, Compression, 26-Pin
X	X	X	X	X	X	3205082E96	Gasket, Antenna O-Ring
X	X	X	X	X	X	3205349Z03	Seal, Main
X	X	X	X	X	X	3205351Z02	Seal, B+ Ruggedized
X	X	X	X	X	X	3285877B02	Seal, Port
X	X	X	X	X	X	3385873B01	Label, Port
	X	X		X	X	7285726C01 or, 7285726C02	Module, LCD Display (for use only with the NTN9564_ VOCON board) Module, LCD Display (for use only with the NNTN4717 VOCON board)
	X	X		X	X	7585189D01	Pad, Display Locator
	X			X		7585104D02	Keypad, Model II
		X			X	7585104D01	Keypad, Model III

Notes:

X = *Item Included*

* = *The radio's model number, FLASHcode, Host code, and DSP code are required when placing an order for the VOCON Board.*
 • *The model number and (sometimes) the FLASHcode can be found on the FCC label on the back of the radio.*
 • *The model number, Host code, DSP code, and (sometimes) the FLASHcode can be found by putting a Model II or III radio into the Test Mode.*
 • *The model number, Host code, DSP code, and FLASHcode can be found by using the Programming Cable (RKN4105_ or RKN4106_) and the CPS to read a Model I, II, or III radio.*

Specifications for VHF Radios

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

GENERAL		RECEIVER		TRANSMITTER	
FCC Designation:	AZ489FT3804	**Frequency Range:**	136-174 MHz	**Frequency Range:**	136-174 MHz
Temperature Range:					
Operating:	–30°C to +60°C	**Bandwidth:**	38 MHz	**RF Power:**	
Storage:	–40°C to +85°C			**136-174 MHz:**	1-6 Watts
		Usable Sensitivity (typical)			
Power Supply: Nickel-Cadmium Battery (NiCd)		**(12 dB SINAD):**	0.20 µV	**Frequency Stability (typical)**	
or Nickel-Metal-Hydride Battery (NiMH)				**(–30 to +60°C; 25°C ref.):**	±0.0002%
or Lithium-Ion Battery (Li-Ion)		**Intermodulation (typical):**	–78 dB		
				Emission (typical conducted):	–75 dBc
Battery Voltage:		**Selectivity (typical):**			
Nominal:	7.5 Vdc	**(25/30 kHz Channel):**	–80 dB	**FM Hum and Noise (typical)**	
Range:	6 to 9 Vdc	**(12.5 kHz Channel):**	–63 dB	**(Companion Receiver):** 25 kHz –45 dB	
				12.5 kHz –40 dB	
Transmit Current Drain (Typical): 2100 mA		**Spurious Rejection (typical):**	–80 dB		
Receive Current Drain (Rated Audio): 240 mA				**Distortion (typical):**	1.5% (typical)
Standby Current Drain: 80 mA		**Frequency Stability**			
		(–30+60°C; 25°C reference):	±0.0002%	**Modulation Limiting:** 25 kHz chnls ±5.0 kHz	
Recommended Battery:				12.5 kHz chnls ±2.5 kHz	
Smart NiMH:	NNTN4435	**Rated Audio:**	500 mW		
or **Ultra-HIgh-Capacity NiCd:**	NTN8294			**ACPR (typical):** 25 kHz –73 dBc	
or **Extended-Capacity NiMH:**	NTN8293	**FM Hum and Noise (typical):**		12.5 kHz –63 dBc	
or **Li-Ion:**	NTN8610		25 kHz –48 dB		
or **Ultra–High-Capacity NiCd FM:**	NTN8295*		12.5 kHz –40 dB	**Emissions Designators:**	
or **Ultra–High-Capacity NiMH FM:**	NTN8299*			20K0F1E, 16K0F3E, 11K0F3E, 8K10F1D, and	
Optional FM (Factory Mutual) Battery:		**Distortion (typical):**	1.5%	8K10F1E	
* FM Intrinsically Safe.					
		Channel Spacing:	12.5/25 kHz		
Dimensions (H x W x D):					
Note: 2.44" = width at PTT; 2.34" = width at bottom; 1.83" = depth at speaker; 0.97" = depth at keypad					
Without Battery (Radio Only):					
6.58" x 2.44" x 1.83"/6.58" x 2.34" x 0.97" (167.13 mm x 61.90 mm x 46.42 mm/ 167.13 mm x 59.49 mm x 24.56 mm)					
With Battery:					
6.58" x 2.44" x 1.83"/6.58" x 2.34" x 1.65" (167.13 mm x 61.90 mm x 46.42 mm/ 167.13 mm x 59.49 mm x 41.97 mm)					
Weight: (w/ Antenna):					
Less Battery: 14.10 oz (383 gm)					
With Ultra-High Cap. NiCd: 25.19 oz (693 gm)					
With Li-Ion: 20.41 oz (583 gm)					
With Ultra-High Cap. NiMH: 23.45 oz (644 gm)					
With Extended- Cap. NiMH: 24.04 oz (682 gm)					

Specifications subject to change without notice.

Specifications for UHF Range 1 Radios

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

GENERAL		RECEIVER		TRANSMITTER	
FCC Designation:	AZ489FT4855	**Frequency Range:**	380-470 MHz	**Frequency Range:**	380-470 MHz
Temperature Range:					
Operating:	–30°C to +60°C	**Bandwidth:**	90 MHz	**RF Power:**	
Storage:	–40°C to +85°C			**380-470 MHz:**	1-5 Watts
		Usable Sensitivity (typical)			
Power Supply: Nickel-Cadmium Battery (NiCd)		**(12 dB SINAD):**	0.25 µV	**Frequency Stability (typical)**	
or Nickel-Metal-Hydride Battery (NiMH)				**(–30 to +60°C; 25°C ref.):**	±0.0002%
or Lithium-Ion Battery (Li-Ion)		**Intermodulation (typical):**	–75 dB		
				Emission (typical conducted):	–70 dBc
Battery Voltage:		**Selectivity (typical):**			
Nominal:	7.5 Vdc	**(25/30 kHz Channel):**	–78 dB	**FM Hum and Noise (typical)**	
Range:	6 to 9 Vdc	**(12.5 kHz Channel):**	–60 dB	**(Companion Receiver):** 25 kHz –45 dB	
				12.5 kHz –40 dB	
Transmit Current Drain (Typical):	2100 mA	**Spurious Rejection (typical):**	–80 dB		
Receive Current Drain (Rated Audio):	240 mA			**Distortion (typical):**	1.5% (typical)
Standby Current Drain:	80 mA	**Frequency Stability**			
		(–30+60°C; 25°C reference):	±0.0002%	**Modulation Limiting:** 25 kHz chnls ±5.0 kHz	
Recommended Battery:				12.5 kHz chnls ±2.5 kHz	
Smart NiMH:	NNTN4435	**Rated Audio:**	500 mW		
or **Ultra-HIgh-Capacity NiCd:**	NTN8294			**ACPR (typical):** 25 kHz –77 dBc	
or **Extended-Capacity NiMH:**	NTN8293	**FM Hum and Noise (typical):**		12.5 kHz –62 dBc	
or **Li-Ion:**	NTN8610		25 kHz –54 dB		
or **Ultra–High-Capacity NiCd FM:**	NTN8295*		12.5 kHz –45 dB	**Emissions Designators:**	
or **Ultra–High-Capacity NiMH FM:**	NTN8299*			20K0F1E, 16K0F3E, 11K0F3E, 8K10F1D, and	
Optional FM (Factory Mutual) Battery:		**Distortion (typical):**	1.0%	8K10F1E	
* FM Intrinsically Safe.					
		Channel Spacing:	12.5/25 kHz		
Dimensions (H x W x D):					
Note: 2.44" = width at PTT; 2.34" = width at bottom; 1.83" = depth at speaker; 0.97" = depth at keypad					
Without Battery (Radio Only):					
6.58" x 2.44" x 1.83"/6.58" x 2.34" x 0.97" (167.13 mm x 61.90 mm x 46.42 mm/ 167.13 mm x 59.49 mm x 24.56 mm)					
With Battery:					
6.58" x 2.44" x 1.83"/6.58" x 2.34" x 1.65" (167.13 mm x 61.90 mm x 46.42 mm/ 167.13 mm x 59.49 mm x 41.97 mm)					
Weight: (w/ Antenna):					
Less Battery:	14.10 oz (383 gm)				
With Ultra-High Cap. NiCd:	25.19 oz (693 gm)				
With Li-Ion:	20.41 oz (583 gm)				
With Ultra-High Cap. NiMH:	23.45 oz (644 gm)				
With Extended- Cap. NiMH:	24.04 oz (682 gm)				

Specifications subject to change without notice.

Specifications for UHF Range 2 Radios

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

GENERAL		RECEIVER		TRANSMITTER	
FCC Designation:	**AZ489FT4864**	**Frequency Range:**	450-520 MHz	**Frequency Range:**	450-520 MHz
Temperature Range:					
Operating:	–30°C to +60°C	**Bandwidth:**	70 MHz	**RF Power:**	
Storage:	–40°C to +85°C			**450-520 MHz:**	1-5 Watts
		Usable Sensitivity (typical)			
Power Supply: Nickel-Cadmium Battery (NiCd)		**(12 dB SINAD):**	0.19 µV	**Frequency Stability (typical)**	
or Nickel-Metal-Hydride Battery (NiMH)				**(–30 to +60°C; 25°C ref.):**	±0.0002%
or Lithium-Ion Battery (Li-Ion)		**Intermodulation (typical):**	– 77 dB		
				Emission (typical conducted):	–75 dBc
Battery Voltage:		**Selectivity (typical):**			
Nominal:	7.5 Vdc	**(25/30 kHz Channel):**	– 79 dB	**FM Hum and Noise (typical)**	
Range:	6 to 9 Vdc	**(12.5 kHz Channel):**	–65 dB	**(Companion Receiver):** 25 kHz –45 dB	
				12.5 kHz –40 dB	
Transmit Current Drain (Typical): 2100 mA		**Spurious Rejection (typical):**	– 85 dB		
Receive Current Drain (Rated Audio): 240 mA				**Distortion (typical):**	1.5% (typical)
Standby Current Drain:	80 mA	**Frequency Stability**			
		(–30+60°C; 25°C reference):	±0.0002%	**Modulation Limiting:** 25 kHz chnls ±5.0 kHz	
Recommended Battery:				12.5 kHz chnls ±2.5 kHz	
Smart NiMH:	NNTN4435	**Rated Audio:**	500 mW		
or **Ultra-HIgh-Capacity NiCd:**	NTN8294			**ACPR (typical):** 25 kHz –77 dBc	
or **Extended-Capacity NiMH:**	NTN8293	**FM Hum and Noise (typical):**		12.5 kHz –63 dBc	
or **Li-Ion:**	NTN8610	25 kHz –53 dB			
or **Ultra–High-Capacity NiCd FM:**	NTN8295*	12.5 kHz –45 dB		**Emissions Designators:**	
or **Ultra–High-Capacity NiMH FM:**	NTN8299*			20K0F1E, 16K0F3E, 11K0F3E, 8K10F1D, and	
Optional FM (Factory Mutual) Battery:		**Distortion (typical):**	1.0%	8K10F1E	
* FM Intrinsically Safe.					
		Channel Spacing:	12.5/25 kHz		
Dimensions (H x W x D):					
Note: 2.44" = width at PTT; 2.34" = width at					
bottom; 1.83" = depth at speaker; 0.97" = depth					
at keypad					
Without Battery (Radio Only):					
6.58" x 2.44" x 1.83"/6.58" x 2.34" x 0.97"					
(167.13 mm x 61.90 mm x 46.42 mm/					
167.13 mm x 59.49 mm x 24.56 mm)					
With Battery:					
6.58" x 2.44" x 1.83"/6.58" x 2.34" x 1.65"					
(167.13 mm x 61.90 mm x 46.42 mm/					
167.13 mm x 59.49 mm x 41.97 mm)					
Weight: (w/ Antenna):					
Less Battery:	13.0 oz (368 gm)				
With Ultra-High Cap. NiCd: 25.19 oz (693 gm)					
With Li-Ion:	20.41 oz (583 gm)				
With Ultra-High Cap. NiMH: 23.45 oz (644 gm)					
With Extended- Cap. NiMH: 24.04 oz (682 gm)					

Specifications subject to change without notice.

Specifications for 700–800 MHz Radios

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

GENERAL		RECEIVER		TRANSMITTER	
FCC Designation:	AZ489FT5806	**Frequency Range:**		**Frequency Range:**	
Temperature Range:		**700 MHz:**	764 to 767; 773 to 776 MHz	**700 MHz:**	764 to 767; 773 to 776; 794 to 797;
Operating:	–30°C to +60°C	**800 MHz:**	851 to 870 MHz		803 to 806 MHz
Storage:	–40°C to +85°C			**800 MHz:**	806 to 824; 851 to 870 MHz
		Bandwidth:	106 MHz		
Power Supply: Nickel-Cadmium Battery (NiCd)				**RF Power:**	
or Nickel-Metal-Hydride Battery (NiMH)		**Usable Sensitivity (typical)**		**764-806 MHz:**	2.5 Watts
or Lithium-Ion Battery (Li-Ion)		**(12 dB SINAD):**	0.20 µV	**806-870 MHz:**	3 Watts
Battery Voltage:		**Intermodulation (typical):**	–75 dB	**Frequency Stability (typical)**	
Nominal:	7.5 Vdc			**(–30 to +60°C; 25°C ref.):**	±0.00015%
Range:	6 to 9 Vdc	**Selectivity (typical):**			
		(25/30 kHz Channel):	–72 dB	**Emission (typical conducted):**	–75 dBc
Transmit Current Drain (Typical):	1400 mA	**(12.5 kHz Channel):**	–63 dB		
Receive Current Drain (Rated Audio):	240 mA			**FM Hum and Noise (typical)**	
Standby Current Drain:	80 mA	**Spurious Rejection (typical):**	–75 dB	**(Companion Receiver):**	25 kHz –45 dB
					12.5 kHz –40 dB
Recommended Battery:		**Frequency Stability**		**Distortion (typical):**	1.5% (typical)
Ultra-HIgh-Capacity Smart NiCd:	HNN9031	**(–30+60°C; 25°C reference):**	±0.00015%		
or **Ultra-HIgh-Capacity NiCd:**	NTN8294			**Modulation Limiting:**	25 kHz chnls ±5.0 kHz
or **Extended-Capacity NiMH:**	NTN8293	**Rated Audio:**	500 mW		12.5 kHz chnls ±2.5 kHz
or **Li-Ion:**	NTN8610				
or **Ultra–High-Capacity NiCd FM:**	NTN8295*	**FM Hum and Noise (typical):**		**Emissions Designators:**	
or **Ultra–High-Capacity NiMH FM:**	NTN8299*		25 kHz –48 dB	20K0F1E, 16K0F3E, 11K0F3E, 8K10F1D, and	
Optional FM (Factory Mutual) Battery:			12.5 kHz –40 dB	8K10F1E	
* FM Intrinsically Safe.					
		Distortion (typical):	1.5%		
Dimensions (H x W x D):					
Note: 2.44" = width at PTT; 2.34" = width at		**Channel Spacing:**	12.5/25 kHz		
bottom; 1.83" = depth at speaker; 0.97" = depth					
at keypad					
Without Battery (Radio Only):					
6.58" x 2.44" x 1.83"/6.58" x 2.34" x 0.97"					
(167.13 mm x 61.90 mm x 46.42 mm/					
167.13 mm x 59.49 mm x 24.56 mm)					
With Battery:					
6.58" x 2.44" x 1.83"/6.58" x 2.34" x 1.65"					
(167.13 mm x 61.90 mm x 46.42 mm/					
167.13 mm x 59.49 mm x 41.97 mm)					
Weight: (w/ Antenna):					
Less Battery:	14.10 oz (383 gm)				
With Ultra-High Cap. NiCd:	25.19 oz (693 gm)				
With Li-Ion:	20.41 oz (583 gm)				
With Ultra-High Cap. NiMH:	23.45 oz (644 gm)				
With Extended- Cap. NiMH:	24.04 oz (682 gm)				

Specifications subject to change without notice.

Notes

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 are radio specifications for the VHF (136–174 MHz), UHF Range 1 (380-470 MHz), UHF Range 2 (450-520 MHz), and 764–870 MHz frequency bands, a general description of XTS 5000 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 icon] **Caution**   CAUTION indicates a potentially hazardous situation which, if not avoided, <u>might</u> result in equipment damage.

> ![Warning icon] **WARNING**   **WARNING indicates a potentially hazardous situation which, if not avoided, <u>could</u> result in death or injury.**

> ![Danger icon] **DANGER**   **DANGER indicates an imminently hazardous situation which, if not avoided, <u>will</u> result in death or injury.**

1.3   Radio Description

The ASTRO XTS 5000 radios are among the most sophisticated two-way radios available. The radios are available in the VHF (136–174 MHz), UHF Range 1 (380–470 MHz), UHF Range 2 (450-520 MHz), and 764-870 MHz frequency bands.

The ASTRO XTS 5000 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 XTS 5000 radios are available in three basic models. Table 1-1 describes their basic features.

Table 1-1. ASTRO XTS 5000 Basic Features

Feature	Model I	Model II	Model III
Display	None	LCD Fully bit-mapped. Normal operation = 4 lines/12 characters per line WAP (Wireless Application Protocol) mode = 6 lines/16 characters per line	
Keypad	None	3 x 2 Menu Buttons (with 4-way Navigation button)	3 x 2 Menu Buttons (with 4-way Navigation button), 3 x 4 Alphanumeric Keypad
Channel Capability	48	512	512
Dialing from Prestored List	No	Yes	Yes
Programmable Softkeys	No	Yes	Yes

1.4   FLASHport®

The ASTRO XTS 5000 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 XTS 5000 radio's reference oscillator every time the radio is taken apart, or once per year, whichever comes first. Periodic visual inspection and cleaning is also recommended.

For XTS 5000 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.

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

2.2   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 XTS 5000 radio casting has two vent ports that allow for pressure equalization in the radio. Never poke these vents with any objects, such as needles, tweezers, or screwdrivers. This could create a leak path into the radio and, *in the case of XTS 5000 R radios*, the radio's submergibility will be lost.
>
> • The pressure equalization vent is located on the chassis, just below the battery contact. Never obstruct or cover the two slots with any object, including a label. Ensure that no oily substances come in contact with this vent.
>
> • (**XTS 5000 R Radios Only**) The XTS 5000 R radio is designed to be submerged to a maximum depth of 3 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 8-16.

2.2.1   XTS 5000 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.

Chapter 3   Basic Theory of Operation

This chapter discusses the basic operational theory of the ASTRO XTS 5000 radio, which is a wideband, synthesized radio available in the VHF (136–174 MHz), UHF Range 1 (380–470 MHz), UHF Range 2 (450-520 MHz), and 764 to 870 MHz frequency bands. All ASTRO XTS 5000 radios are capable of both analog operation (12.5 kHz or 25 kHz bandwidths) and ASTRO mode (digital) operation (12.5 kHz only).

3.1   Major Assemblies

The ASTRO XTS 5000 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 the 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.
- **Controls/Universal Flex** — contains volume/on/off switch, frequency selector switch, push-to-talk (PTT) switch, monitor button, several function-selectable switches, universal connector, speaker, and microphone.
- **Display (Models II and III Only)** — 96 pixels x 64 pixels bit-mapped, liquid-crystal display (LCD).
- **Keypad (Models II and III Only)** — Model II - a 3 x 2 Menu keypad with 4-way navigation button; Model III - a 3 x 2 Menu keypad with 4-way navigation button, and a 3 x 4 alphanumeric keypad.
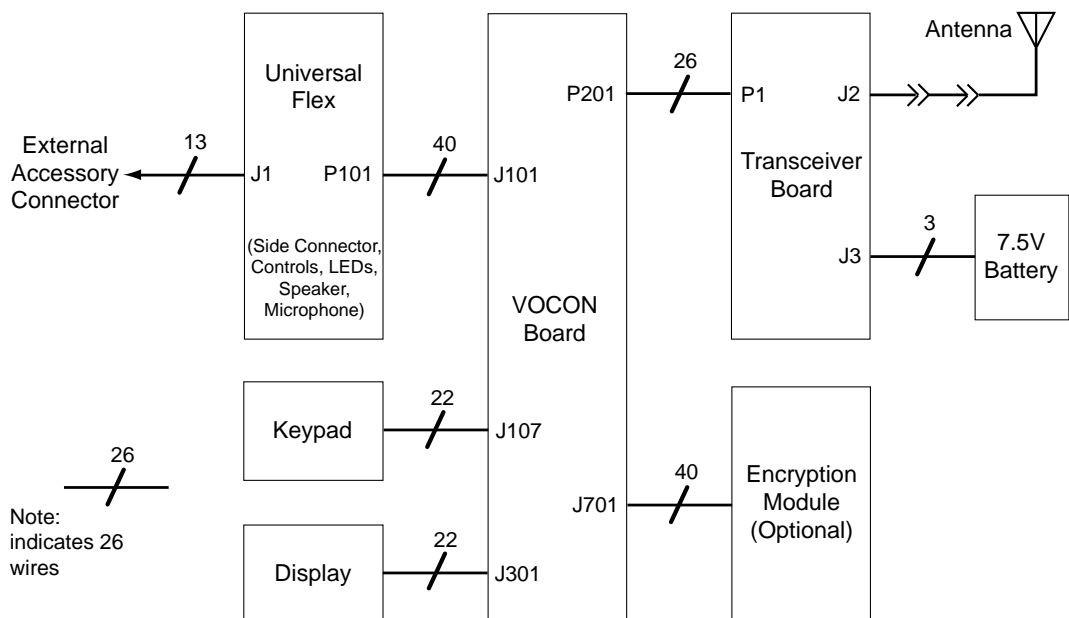
Figure 3-1. XTS 5000 Overall Block Diagram

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

When the radio is *receiving (*See Figure 3-2), the signal comes from the antenna connector to the Transceiver board, passing through the antenna switch and the receiver front end. The signal is then filtered, amplified, and mixed with the first local-oscillator signal, generated by the voltage-controlled oscillator (VCO).
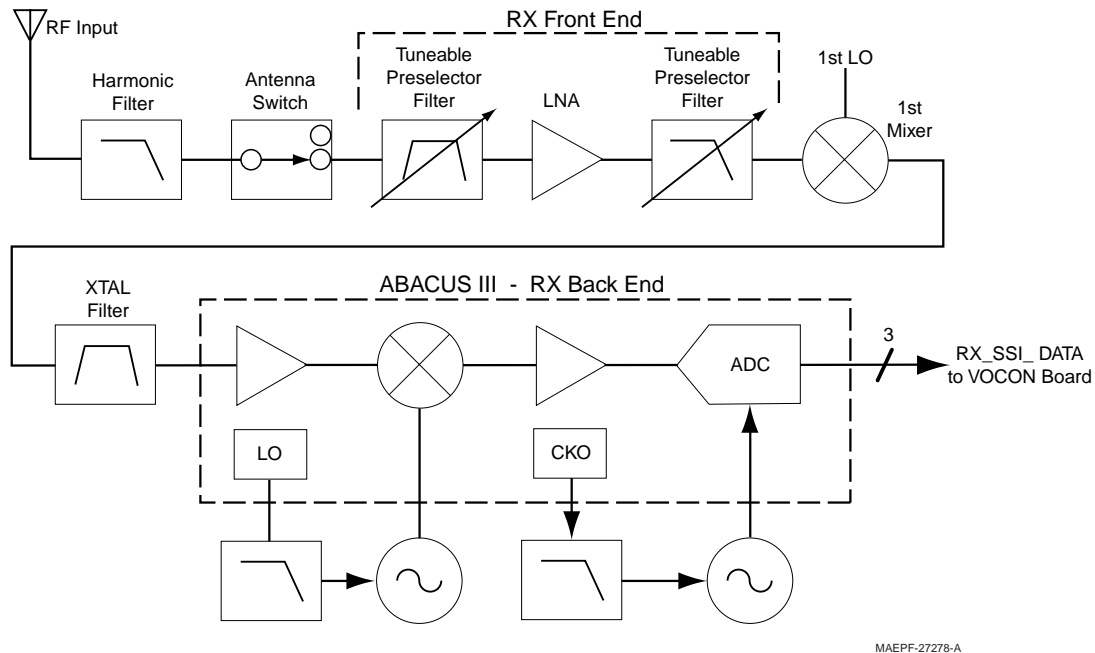
Figure 3-2. Receiver Block Diagram

The resulting intermediate frequency (IF) signal is fed to the IF circuitry, where it is again filtered and passed to the Abacus III digital back-end IC. In the digital back-end IC, the IF signal is mixed with the second local oscillator to create the second IF at 2.25 MHz. In the back-end IC, a bandpass, sigma-delta, analog-to-digital converter then decodes the second IF signal, and outputs, on the radio's serial synchronous interface (SSI) bus, digital audio to the VOCON board.

On the VOCON board, the dual-core processor's digital-signal processor (DSP) digitally filters the PCM audio. The DSP decodes the information in the signal and identifies the appropriate destination for it.

  • For a voice signal, the DSP will route the digital voice data to the CODEC inside the audio and power supply support IC, for conversion to an analog signal. The CODEC will then present the signal to the receive audio pre-amplifier, then to the audio power amplifier, which drives the speaker.

  • For signaling information, the DSP will decode the message and pass it internally to the microcontrol unit of the dual-core processor.

3.2.2 Transmitting

When the radio is *transmitting*, microphone audio is passed through gain stages to the CODEC, where the signal is digitized. The CODEC passes digital data to the DSP, where pre-emphasis and low-pass (splatter) filtering are done. The DSP passes this signal to a digital/analog converter (DAC), where it is reconverted into an analog signal and scaled for application to the voltage-controlled oscillator as a modulation signal (See Figure 3-3 and Figure 3-4).
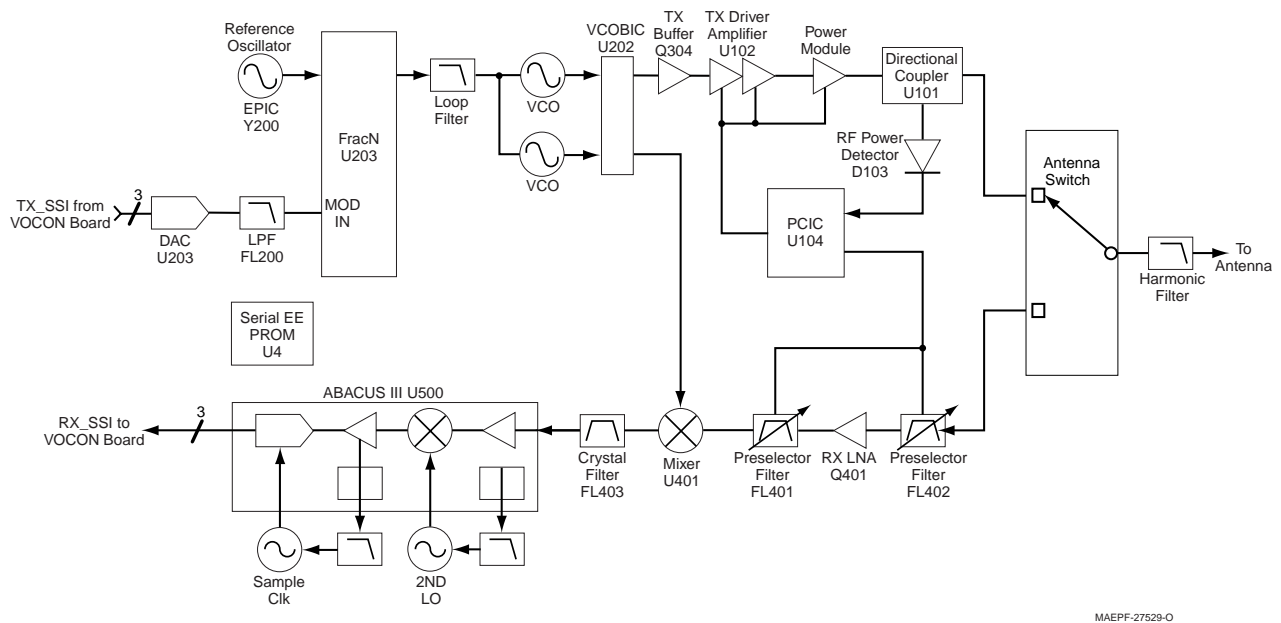
Figure 3-3. Transceiver (VHF) Block Diagram (Power and Control Omitted)
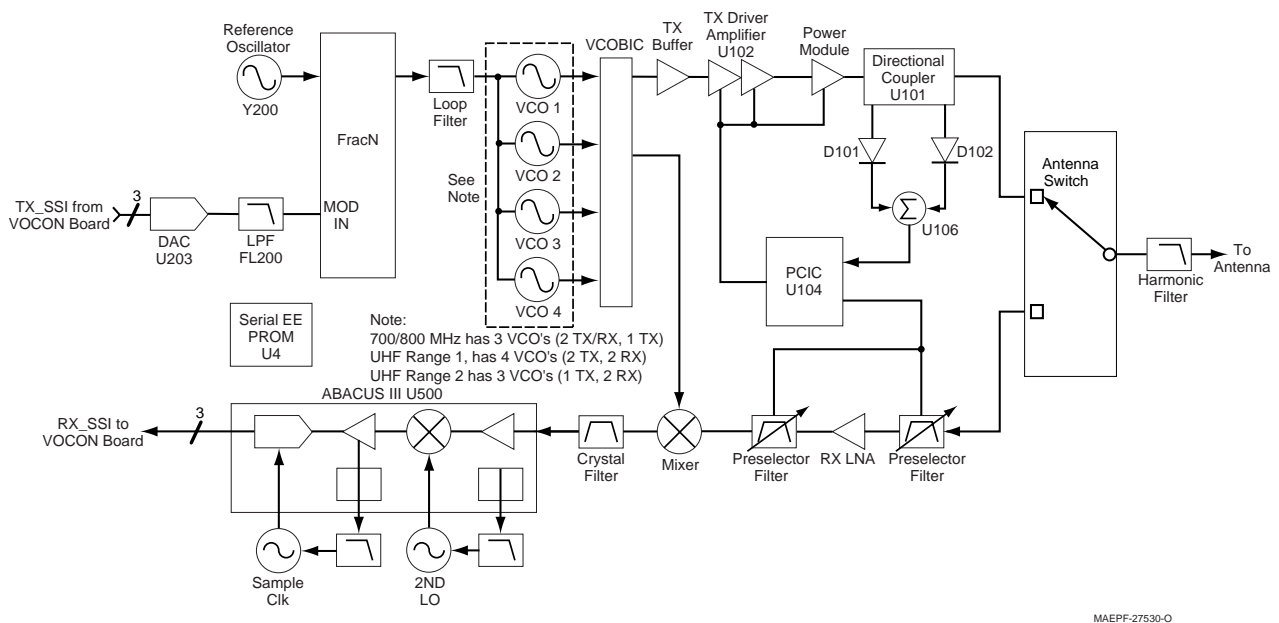
Figure 3-4. Transceiver (UHF Range 1, UHF Range 2, and 700–800 MHz) Block Diagram (Power and Control Omitted)

Transmitted signaling information is applied to the DSP from the microcontrol unit, where it is coded, and passed to the DAC, which handles it the same as a voice signal. The DAC output connects to the synthesizer modulation input. A modulated carrier is provided to the transmitter power amplifier, which transmits the signal under dynamic power control.

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 Transceiver Board

Refer to Figure 3-3, on page 3-3 and Figure 3-4, on page 3-3. The receiver front end consists of a preselector filter, low-noise amplifier, a second preselector, and a mixer. Both preselectors are varactor-tuned bandpass filters, controlled by the microcontroller. See Table 3-1 for local oscillator (LO) and first IF information.

Table 3-1. Local Oscillator and First IF Frequencies

	VHF	**UHF Range 1**	**UHF Range 2**	**700–800 MHz**
LO Frequency Range	180.85–218.85 MHz	306.725–396.625 MHZ	376.65-446.65 MHZ	741.35–885.65 MHz
First IF Frequency	44.85 MHz	73.35 MHz	73.35 MHz	109.65 MHz

The frequency generation function is performed by three ICs, three discrete VCOs for 700–800 MHz radios (two VCOs for VHF, four VCOs for UHF Range 1, and three VCOs for UHF Range 2), and associated circuitry. The reference oscillator IC provides a frequency standard to the synthesizer. The fractional-N synthesizer turns on one of three external VCOs for 700–800 MHz radios (two external VCOs for VHF, or four for UHF Range 1, or three for UHF Range 2), and tunes it to the RX LO or TX carrier frequency. The VCO buffer and a transistor, amplify the signal to the required power level. The synthesizer is controlled by the microcontrol unit through a serial peripheral interface (SPI) bus. Most of the synthesizer circuitry is enclosed in rigid metal cans on the transceiver board to reduce interference and microphonic effects.

The receiver back end consists of a bandpass crystal filter, input and output impedance matching networks, and the digital back-end IC. Final filtering is done digitally in the DSP.

The Abacus III digital back-end IC contains a low-noise amplifier, a mixer, a variable gain amplifier with integral anti-alias filter, a bandpass, sigma delta, analog-to-digital converter, and a decimation filter with a programmable decimation factor. The Abacus III also contains an automatic gain control (AGC) circuit to provide 25 dB of continuous gain adjustments. For the second LO, the Abacus III has an internal, integer-N frequency synthesizer, and an external, discrete loop filter and voltage-controlled oscillator (VCO). The output of the Abacus III is digital data on the RX_SSI bus.

The transmitter power amplifier (PA) consists of a driver amplifier IC and a discrete final-stage. Transmit power is controlled by a power control IC (PCIC) that monitors the output of a directional coupler and adjusts PA control voltages. The transmitter RF signal then passes through a PIN diode antenna switch and a low-pass harmonic filter, which connects to the antenna connector.

3.5 VOCON Board

The vocoder and controller (VOCON) board (See Figure 3-5) comprises the dual-core processor (Patriot), which contains the radio's microcontrol unit (MCU) and digital signal processor (DSP) in a single integrated circuit (IC) package; its memory ICs; an audio and power supply IC (GCAP II); a digital support IC (Flipper); and the audio power amplifier. Connected to the VOCON board are the liquid-crystal display (LCD) board, transceiver board, keypad flex, controls/universal flex, and (optional) encryption module.
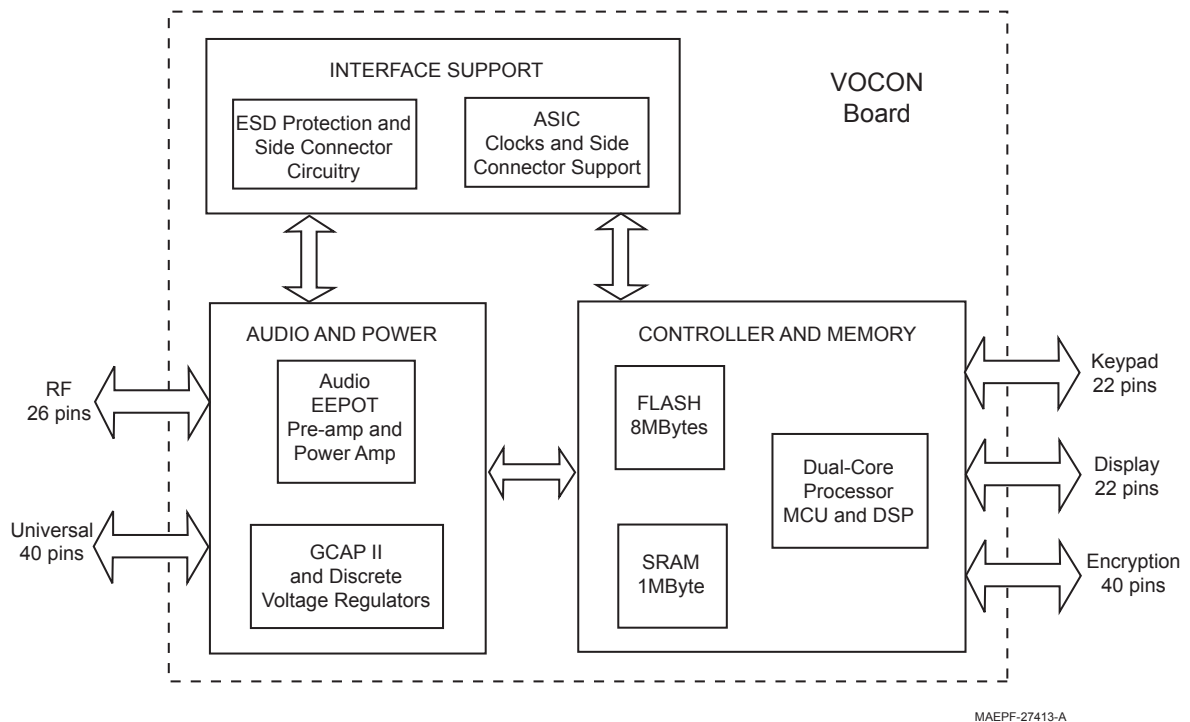
Figure 3-5. VOCON Board Block Diagram

The microcontrol unit portion of the dual-core processor controls receive/transmit frequencies, power levels, display, and other radio functions, using either direct logic control or serial communications paths to the devices. The microcontrol unit executes a stored program located in the FLASH memory device. Data is transferred to and from memory by the microcontrol unit data bus. The memory location from which data is read, or to which data is written, is selected by the address lines. The microcontrol unit requires a 16.8 MHz clock and a 32 kHz clock.

The DSP portion of the dual-core processor performs signaling and voice encoding and decoding, as well as audio filtering and volume control. The DSP performs Private-Line/Digital Private-Line (PL/DPL) encode and alert-tone generation. The DSP transmits pre-emphasis on analog signals, and applies a low-pass (splatter) filter to all transmitted signals. The DSP controls squelch, deviation, and executes receiver and transmitter filtering. The DSP executes a stored program located in the FLASH memory device.

The DSP requires a 16.8 MHz clock. Additionally, the DSP requires clock and frame synchronization from the Abacus III digital back-end IC on the transceiver board to generate another clock and frame synchronization signal, and these signals are supplied to transmit DAC on the transceiver board.

The digital support IC is supplied with a 16.8 MHz clock from the transceiver board. Using this clock, the digital support IC generates a 13 MHz clock for the audio and power supply IC. Additionally, the digital support IC uses a crystal to generate the 32 kHz clock used by the dual-core processor and audio and power supply IC.

The digital support IC also monitors the position of the on/off switch and controls the shutdown of the regulators on the audio and power supply IC. Finally, the digital support IC interfaces to the radio's universal (accessory) connector. This IC is programmed by the dual-core processor.

The audio and power supply IC has many functions. It supplies most of the voltages used on the VOCON board, while external linear regulators supply 5 Vdc and 1.55 Vdc. It also has microphone audio amplifiers, switching between internal and accessory microphones, and the audio CODEC. The audio CODEC performs analog-to-digital and digital-to-analog conversions on audio signals. The audio and power supply IC also has an analog/digital converter (ADC), which is used to monitor volume setting and battery voltage. This IC is programmed by the dual-core processor.

The audio power amplifier (PA) drives the speakers with the received audio from the analog output of the CODEC from the audio and power supply IC. The audio PA is sourced from the battery and programmed by the dual-core processor.

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 XTS 5000 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

Motorola Model Number	Description	Characteristics	Application
R2670	Communications System Analyzer	This monitor will substitute for items with an asterisk (*)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
Agilent 8901B	Modulation Analyzer		Transmitter parameter testing: deviation balance and limit
Fluke 8012	Digital Multimeter		Recommended for ac/dc voltage and current measurements
R1150*	Code Synthesizer		Injection of audio and digital signaling codes
R1377*	AC Voltmeter	1 mV to 300 V, 10-Megohm input impedance	Audio voltage measurements
R1094	Dual-Trace Oscilloscope	20 MHz bandwidth 5 mV to 5 V/division	Waveform measurements
R1443*	Wattmeter	Fixed-Element, Broadband	Transmitter power output measurements
S1339	RF Millivolt Meter	100 µV to 3 V RF	RF level measurements
R1013*	SINAD Meter		Receiver sensitivity measurements
S1348 (programmable) or equivalent	DC Power Supply	0-20 Vdc, 0-5 Amps current limited	Bench supply for 7.5 Vdc

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 Services Division 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
8180384M64	Housing Eliminator Fixture	Special fixture that allows radio's internal board to be mounted externally. Provides easy access to electronic circuits, required for board-level troubleshooting.
5880384G68	SMA to BNC Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
6685833D01	Housing/Casting Separation Tool	Special tool used to separate housing and casting near battery latch area for access to inside of radio.
NLN9839	Vacuum Pump Kit	Submersible radios only. Vacuum pump with gauge and vacuum hose. Requires NTN9279 Adapter Kit.
NTN4265	Pressure Pump Kit	Submersible radios only. Pressure pump with gauge and pressure hose. Requires NTN9279 Adapter Kit.
NTN9279	Vacuum Adapter with Gasket Kit	Submersible radios only. Connects the vacuum/pressure hose to the radio's casting.
R1065	Load Resistor, 10-Watt Broadband	For use with wattmeter.
REX4424	Battery Eliminator	Used in place of battery to connect radio to an external power supply. Requires RLN4510.
RKN4105	USB Cable Kit	Connects radio to RLN-4460 Portable Test Set for radio performance checks, and to Universal Serial Bus (USB) port on personal computer for CPS programming and tuner alignments.
RKN4106	RS232 Cable Kit	Connects radio to RLN-4460 Portable Test Set for radio performance checks, and to serial port on personal computer for CPS programming and tuner alignments.
RLN4510	Battery Eliminator	Used in conjunction with the REX4424 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.
RVN4181	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. Can be used for both XTS 5000 and XTS 2500 products.

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.

Notes

Chapter 5   Performance Checks

This chapter covers performance checks used to ensure that the ASTRO XTS 5000 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.
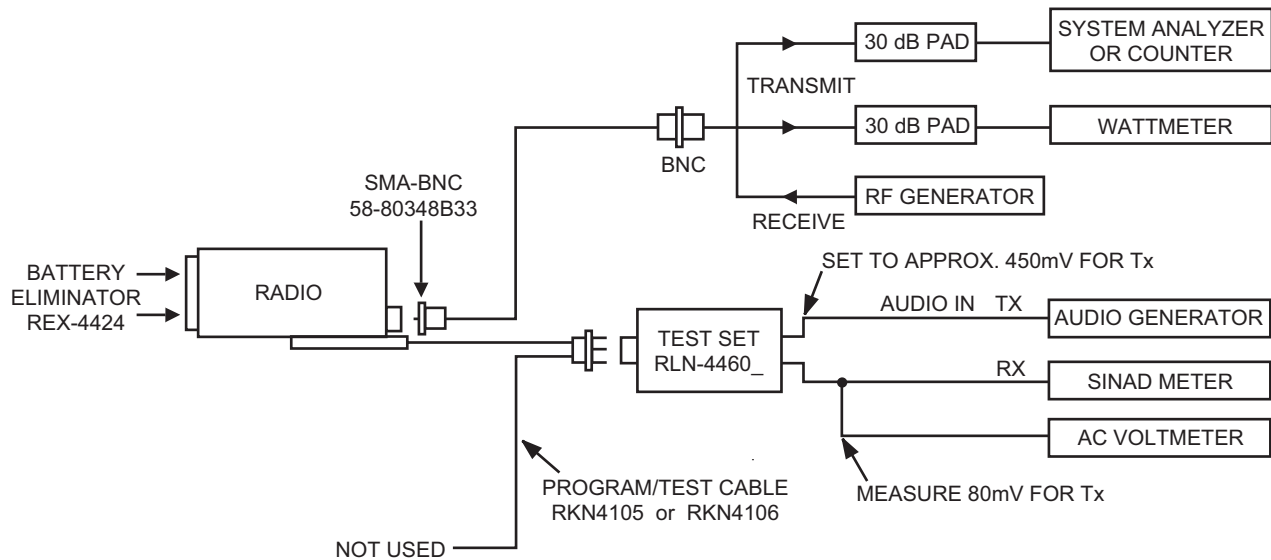
Figure 5-1. Performance Checks Test Setup

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

System Analyzer	Test Set	Power Supply
Monitor Mode: Standard*	**Spkr/Load:** Speaker	**Voltage:** 7.5 Vdc
Receiver Checks **RF Control:** GEN **Output Level:** -47 dBm **Modulation:** 1 kHz tone @3 kHz deviation **Frequency:** Set to selected radio RX frequency **Meter:** AC Volts Transmitter Checks **RF Control:** MONITOR **Frequency:** Set to selected radio TX frequency **Meter:** RF Display **Modulation Type:** FM **Attenuation:** 20 dB	**PTT:** OFF (center)	**DC On/Standby:** Standby
	Meter Out: RX	**Volt Range:** 10 Vdc
	Opt Sel: ON	**Current:** 2.5 Amps

*   Use "PROJ 25 STD" if testing ASTRO Conventional channels.

5.2   Display Radio Test Mode (Models II and III)

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 Software Version	The version of host firmware is displayed.	Always
DSP Software Version	The version of DSP firmware is displayed.	Always

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

Name of Display	Description	Appears
EMC Secure Version	Version of the encryption hardware	When the radio is secure equipped
Encryption Type 1	Type of encryption being used	When the radio is secure equipped
Encryption Type 2	Type of encryption being used	When the radio is secure equipped
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
ROM Size	The memory capacity of the host FLASH part	Always
FLASHcode	The FLASH codes as programmed in the codeplug	Always

> **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.

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 .

     > **NOTE:** Each press of the **Top Side Button** will toggle between "CH TEST" and "RF 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 <u>1</u>, <u>C</u>arrier <u>SQ</u>uelch mode. Go to Section .

     > **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 XTS 5000 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.

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

Table 5-3. Test Frequencies (MHz)

Test Channel	VHF RX	VHF TX	UHF R1 RX	UHF R1 TX	UHF R2 RX	UHF R2 TX	700–800 MHz RX	700–800 MHz 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	425.075	425.025	506.075	495.025	869.9375	823.9875
F7	—	—	435.075	435.025	506.075	506.025	851.0625	851.0125
F8	—	—	445.075	445.025	519.925	519.975	860.0625	860.0125
F9	—	—	457.075	457.025	—	—	869.9375	869.8875
F10	—	—	469.975	469.925	—	—	—	—

Table 5-4. Test Environments

No. of Tones	Display	Description	Function
1	CSQ	Carrier Squelch	RX: unsquelch if carrier detected TX: mic audio
3	TPL	Tone Private-Line	RX: unsquelch if carrier and tone (192.8 Hz) detected TX: mic audio + tone (192.8 Hz)
9	SEC	Secure**	RX: auto-coded clear TX: with key present—encrypted audio with key absent—constant unsquelch
11	AST	ASTRO	RX: none TX: 1200 Hz tone ***
12	USQ	Carrier Unsquelch	RX: unsquelch always TX: mic audio

** On radios equipped with secure option.
***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 red.

2. Release the **Top Button**; "3/0" 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; "3/1" 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:

To continue to the keypad checks:

5.2.3.2.1 Model III Only

- 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.

5.2.3.2.2 Models II and III

- Press **V**, " ⬤ " appears; release, "128/0" appears.
- Press **h**, " 🏠 " appears; release, "129/0" appears.
- Press **U**, " ⬤ " appears; release, "130/0" appears.

- Press **D**, " ⬤• " appears; release, "131/0" appears.
- Press **E**, " ⬤•• " appears; release, "132/0" appears.
- Press **F**, " ⬤∴ " appears; release, "133/0" appears.
- Press **@**, " @ " appears; release, "134/0" appears.
- Press **X**, " ◉ " appears; release, "135/0" appears.
- Press **Y**, " ◉ " appears; release, "136/0" appears.

5.3 Non-Display Radio Test Mode (Model I)

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

5.3.1 Access the Test Mode

To enter the non-display radio test mode:

1. Turn the radio on.
2. Within 10 seconds after the top green LED turns off, press **Side button 2** five times in succession.
3. Do one of the following:
   - Press the **Top Side Button** to put the radio into the Control Top and Keypad test mode. Go to "5.3.3 Control Top Test Mode" below.

     NOTE: Each press of the **Top Side Button** toggles between Control Top and Keypad test mode (non-display radio) and RF test mode (non-display radio).

   - Press the **Top Button** (Orange button) to put the radio into the RF test mode. Go to "5.3.2 RF Test Mode" below.

5.3.2 RF Test Mode

When the ASTRO XTS 5000 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 via 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 on page 5-4) The channel number is represented by the number of tones emitted by the radio after the button press (for example, five tones indicates channel 5).
- Pressing **Side Button 1** scrolls through and accesses test environments shown in Table 5-4 on page 5-4. The test environment is represented by the number of tones emitted by the radio after the button press (for example, 11 tones indicate AST).

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

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.

To perform the control top checks:

1. Press and hold the **Top Button** (Orange button); the LED lights red, and the radio beeps.
2. Release the **Top Button**; the radio beeps, indicating that the **Top Button** is in the open position.

3. Press the **Top Button** again; the radio beeps, indicating that the **Top Button** is in the closed position.

4. Rotate the **Two-Position Concentric Switch**; the radio beeps in each switch position.

5. Rotate the **16-Position Select Switch**; the radio beeps in each switch position.

6. Cycle through the **Three-Position A/B/C Switch**; the radio beeps in each switch position.

7. Rotate the **Volume Control**; the radio beeps at each new volume setting.

8. Press the **Top Side Button**; the radio beeps.

9. Press **Side Button 1**; the radio beeps.

10. Press **Side Button 2**; the radio beeps.

5.4 Receiver Performance Checks

The following tables outline the performance checks for the receiver.

Table 5-5. Receiver Performance Checks

Test Name	System Analyzer	Radio	Test Set	Comments
Reference Frequency	**RF Control:** Monitor **Meter:** RF Display **Display:** Bar Graphs **Freq:** Selected radio TX freq.	TEST MODE CSQ channel* or programmed conventional channel	**PTT** to continuous (during the performance check)	**VHF:** 2.0 ppm (272–348 Hz) **UHF R1:** 2.0 ppm (760–940 Hz) UHF R2: 2.0 ppm (900–1040 Hz) **700/800 MHz:** 1.5 ppm (1.15–1.30 kHz)
Rated Audio	**RF Control:** Gen **Output Level:** -47 dBm **Freq:** Selected radio RX freq. **Mod:** 1 kHz tone @ 3 kHz dev. **Meter:** AC Volts	As above	**PTT** to OFF (center)	Set volume control to 3.74 Vrms
Distortion	As above, except **Meter:** Ext Dist.	As above	As above	Distortion < 3.0%
Sensitivity (SINAD)	As above, except **Meter:** SINAD	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 5-4.*

Table 5-6. Receiver Tests for ASTRO Conventional Channels*

Test Name	System Analyzer	Radio	Test Set	Comments
Bit Error rate (BER) Floor	**Mode:** Proj 25 Std **RF Control:** Gen **Output Level:** -47 dBm **Proj 25 Dev:** 2.83 kHz **Code:** 1011 Hz PAT	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 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 6-1)
Audio Output Distortion	**Mode:** Proj 25 Std **RF Control:** Gen **Output Level:** -47 dBm **Proj 25 Dev:** 2.83 kHz **Code:** 1011 Hz PAT **Meter:** Ext. 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:** Proj 25 Std **RF Control:** Gen **Output Level:** -47 dBm **Proj 25 Dev:** 2.83 kHz **Code**: A) 1011 Hz PAT B) Silence PAT **Meter:** AC Volts	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 5-7. Transmitter Performance Checks

Test Name	System Analyzer	Radio	Test Set	Comments
Reference Frequency	**RF Control:** Monitor **Meter:** RF Display **Display:** Bar Graphs **Freq:** Selected radio TX freq.	TEST MODE CSQ channel* or programmed conventional channel	**PTT** to continuous (during the performance check).	**VHF:** 2.0 ppm (272–348 Hz) **UHF R1:** 2.0 ppm (760–940 Hz) UHF R2: 2.0 ppm (900–1040 Hz) **700/800 MHz:** 1.5 ppm (1.15–1.3 kHz)

RF Power	As above	As above	As above	**VHF:** 1–6 Watts
				UHF R1: 1–5 Watts
				UHF R2: 1–5 Watts
				700/800 MHz:
				  764–806 MHz: 2.5 Watts
				  806–870 MHz: 3 Watts

Table 5-7. Transmitter Performance Checks (Continued)

Test Name	System Analyzer	Radio	Test Set	Comments
Voice Modulation (external)	As above. Set fixed 1 kHz 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:** Monitor **Meter:** RF Display **Display:** Bar Graphs **Freq:** Selected radio TX freq.	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 above	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 above	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 5-4.

Table 5-8. Transmitter Tests for ASTRO Conventional Channels*

Test Name	System Analyzer	Radio	Test Set	Comments

RF Power	**Mode:** Proj 25 Std
	RF Control: Monitor
	Meter: RF Display
		Radio Tuner Software not used.
		Radio: Out of TEST MODE; Select a conventional ASTRO channel
			PTT to continuous (during measurement).	**VHF:** 1–6 Watts
				UHF R1: 1–5 Watts
				UHF R2: 1–5 Watts
				700/800 MHz:
				  764–806 MHz: 2.5 Watts
				  806–870 MHz: 3 Watts

Frequency Error	As above	As above	As above	Error ≤ ±1.0 kHz

Table 5-8. Transmitter Tests for ASTRO Conventional Channels (Continued)*

Test Name	System Analyzer	Radio	Test Set	Comments
Frequency Deviation	As above	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 6-1

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

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.
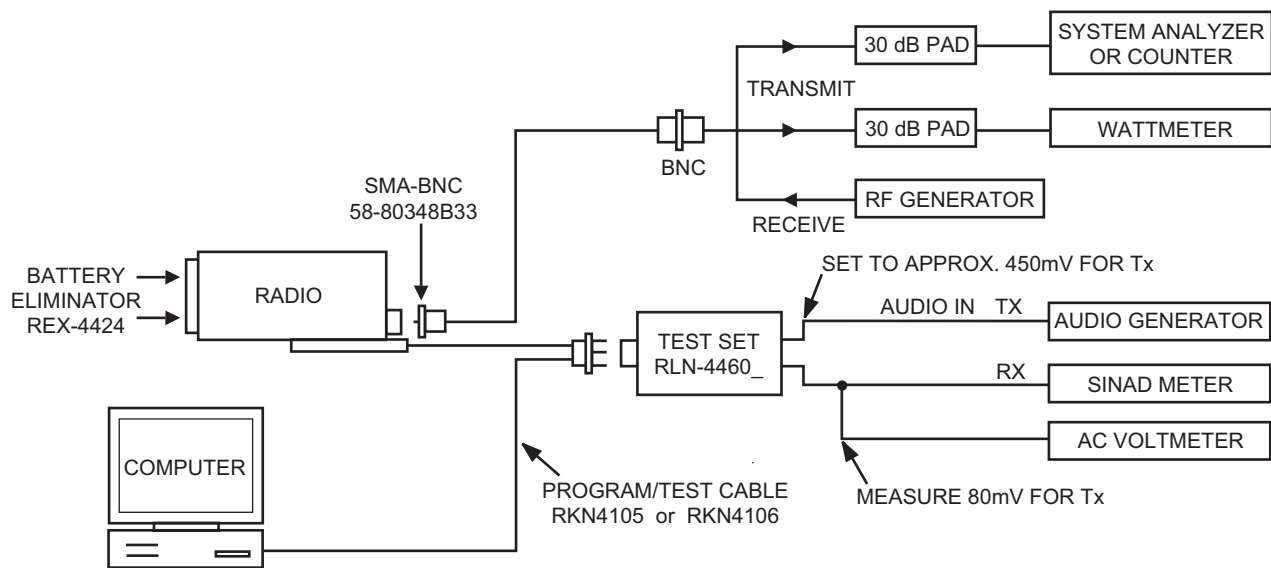
Figure 6-1. Radio Alignment Test Setup

> ⚠ **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. 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.
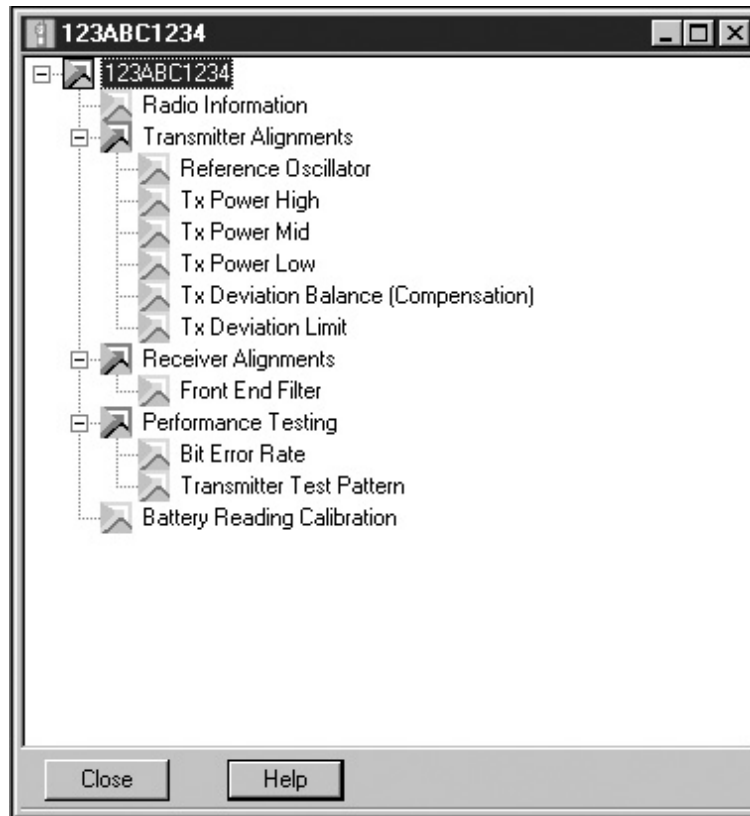
Figure 6-2. Tuner Software Main Menu

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 the spin buttons in the New Softpot Value box, or by entering the new value from the keyboard directly into the box. The slider bar indicates the minimum and maximum values of the softpot, while the Radio Softpot Value indicates the recommended value; see Figure 6-3.
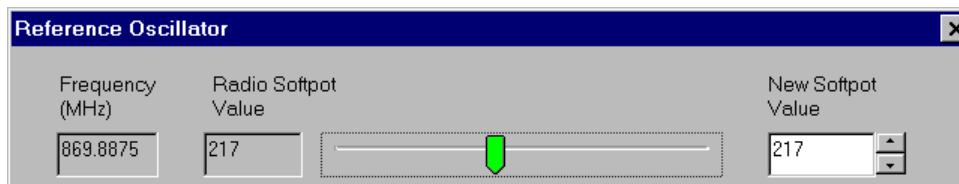
Figure 6-3. Typical Softpot Screen

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.
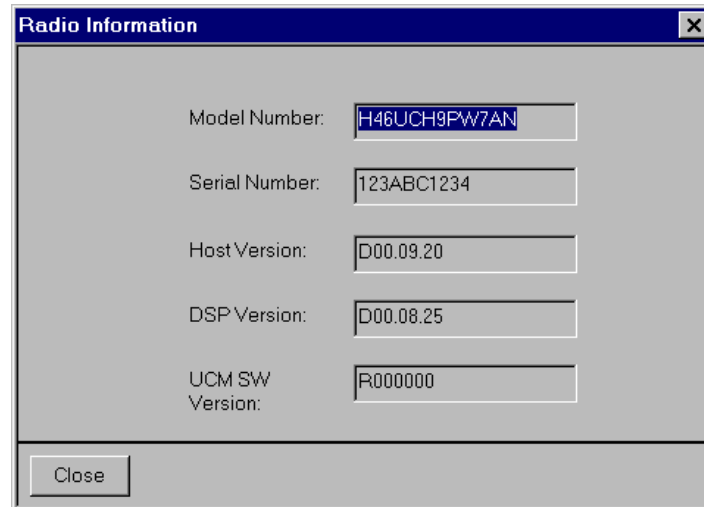
Figure 6-4. Radio Information Screen

6.5   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).

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

This test can be done with either the R-2670 Communication Analyzer or the 8901_ Modulation Analyzer.

- Initial setup using the R-2670 Communication Analyzer:
  - RF Control: MONITOR
  - B/W: WB
  - Freq: CPS frequency under test
  - Attenuation: 20dB
  - Mon RF in: RF I/O
  - Meter: RF Display
  - Mode: STD
  - Input Level: uV or W
  - Display: Bar Graphs
  - Squelch: Mid-range or adjust as necessary
- 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:

1. Select the **Reference Oscillator** alignment screen. See Figure 6-5.
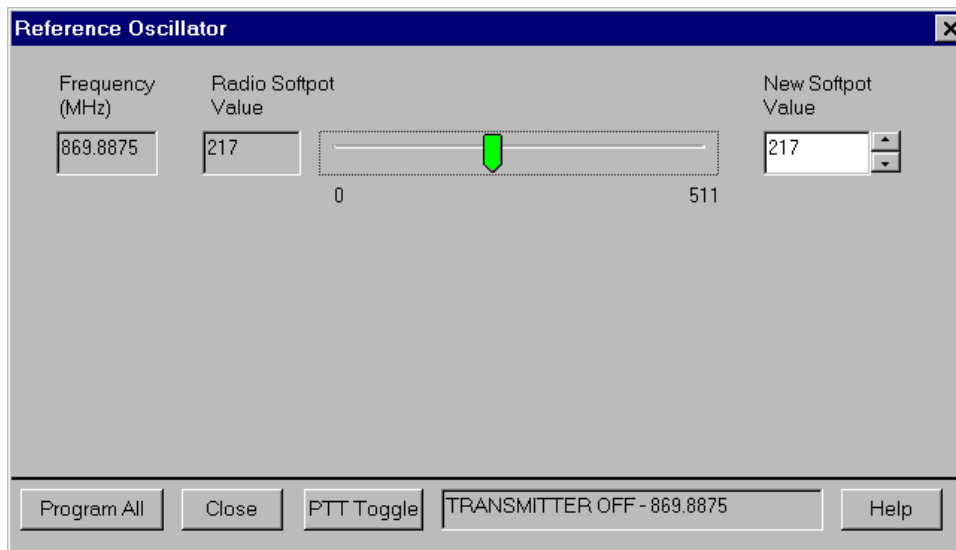
Figure 6-5. Reference Oscillator Alignment Screen

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

3. Measure the transmit RF frequency with your service monitor.

4. Adjust the reference oscillator's softpot value until the measured value is as close as possible to the frequency shown on the screen. See Table 6-1.

Table 6-1. Reference Oscillator Alignment

Band	Target
VHF	±100 Hz
UHF R1 (380–470 MHz)	±100 Hz
UHF R2 (450–520 MHz)	±100 Hz
700 MHz/800 MHz	±100 Hz

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

6. Left-click the **Close** button on the screen to return to the **Transmitter Alignments** menu.

6.6   Transmit Power Alignment

This alignment procedure adjusts the transmit power of the radio and must be performed for three different power levels (Low, Mid, and High), at multiple frequencies for each power level, 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.

NOTES:

- The same softpot attenuation value will result in **different** radio output power levels at different frequencies.
- All power measurements are to be made at the antenna port.
- Transmit Power alignment is required after replacing (or servicing) the transceiver board.
- <u>For 700/800 MHz radios only</u>: FCC requires that portable radios transmitting below 806 MHz transmit at less than 3 watts. Therefore, 700 MHz frequencies are tuned at mid-power levels by the factory.

To align transmit power:

1. Select the **TX Power (Low, Mid,** or **High)** alignment screen. The screen will indicate the transmit frequencies to be used. See Figure 6-6 on page 6-7.
2. Left-click the desired frequency field (starting with the highest frequency shown).
3. Left-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. Adjust the softpot value until the required power, as shown in Table 6-2, is indicated on the service monitor.

Table 6-2. Transmit Power Settings

Power Level	Transmit Power (Watts)				
	VHF	**UHF R1**	**UHF R2**	**700 MHz**	**800 MHz**
Low	1.2–1.4	1.2–1.4	1.2–1.4	1.2–1.4	1.2–1.4
Mid	—	—	—	2.5–2.7	—
High	6.2–6.4	5.2–5.4	5.0–5.3	—	3.2–3.4

6. Repeat Steps 2 through 5 for all frequencies and all power levels.
7. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.
8. Left-click the **Close** button on the screen to return to the **Transmitter Alignments** menu.
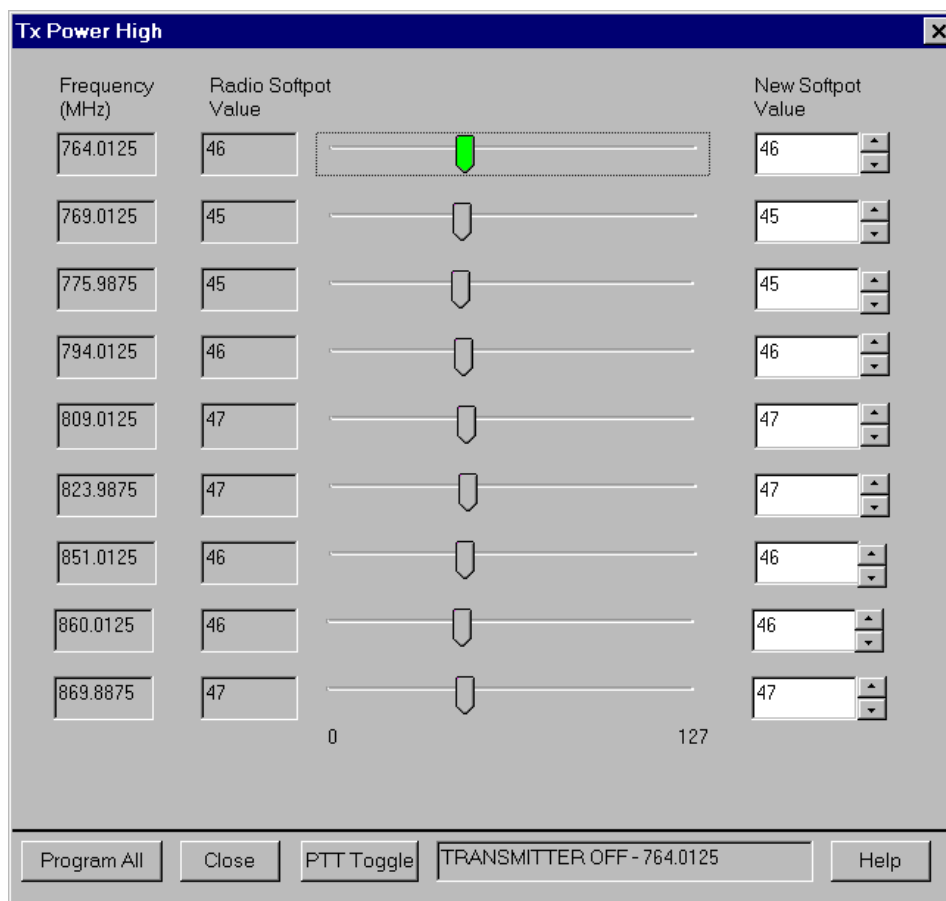
*Figure 6-6. Transmit Power Alignment Screen (Typical)*

6.7   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 test can be done with either the R-2670 Communication Analyzer or the 8901_ Series Modulation Analyzer. The method of choice is the R-2670 analyzer.

1. Initial setup using the R-2670 Communication Analyzer:

    - Connect a BNC cable between the "DEMOD OUT" port and the "VERT/SINAD DIST/DMM COUNTER IN" port on the R-2670.

- Press the **SPF** key on the R-2670 to display the "SPECIAL FUNCTIONS MENU." Move the cursor to "High Pass," and select 5 Hz on the soft key menu. Select 20 kHz for the "Low Pass" setting.

- In the "RF Control" section of the R-2670, enter the frequency displayed on the RSS screen. Move the cursor to the "B/W" setting and select "WIDE +/- 100 kHz" on the soft key menu.

- Place the R-2670 cursor in the "Display" zone. Select "AC VOLTS" on the soft key menu. Move the cursor to the "Range" setting and select "AUTO."

2. Initial setup using 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 6-7 on page 6-8.

4. Left-click the desired frequency field (starting with the highest frequency shown).

5. Left-click the **PTT Toggle** button on the screen to make the radio transmit. The screen indicates whether the radio is transmitting.
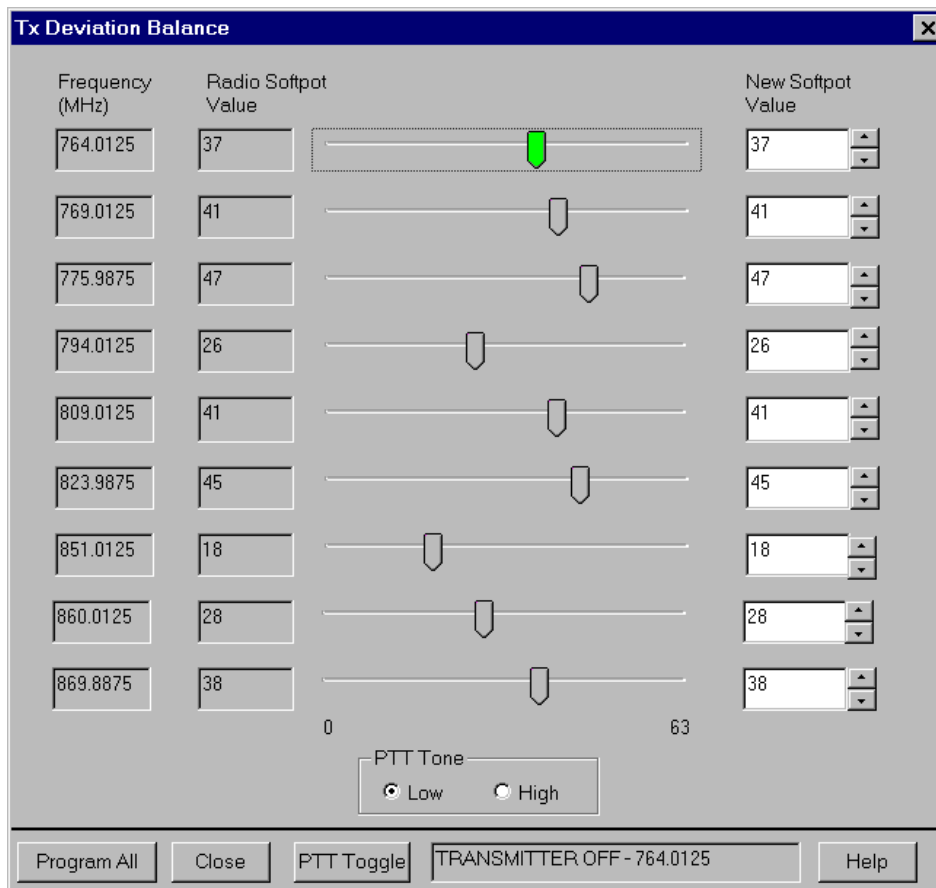
Figure 6-7. Transmit Deviation Balance Alignment Screen

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

7. Left-click the **PTT Toggle** button on the screen to enable transmission. The screen indicates whether the radio is transmitting. Wait approximately 5 seconds until the voltage shown on R-2670, or the deviation shown on the 8901_ analyzer, stabilizes.

8. Measure and record the ac voltage value from the R-2670 analyzer or the deviation value from the 8901_ series 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. Repeat the above process for all frequencies.

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

13. Left-click the **Close** button on the screen to return to the **Transmitter Alignments** menu.

6.8   Transmit Deviation Limit Alignment

This alignment procedure limits the modulation of a baseband signal. It is used for primary modulation limiting.

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.

This test can be done with either the R-2670 Communication Analyzer or the 8901_ Series Modulation Analyzer. The method of choice is the R-2670 analyzer.

1. Initial setup using the R-2670 Communication Analyzer:
   - Connect a BNC cable between the "DEMOD OUT" port and the "VERT/SINAD DIST/DMM COUNTER IN" port on the R-2670.
   - Press the **SPF** key on the R-2670 to display the "SPECIAL FUNCTIONS MENU." Move the cursor to "High Pass," and select 5 Hz on the soft key menu. Select 20 kHz for the "Low Pass" setting.
   - In the "RF Control" section of the R-2670, enter the frequency displayed on the RSS screen. Move the cursor to the "B/W" setting and select "WIDE +/- 100 kHz" on the soft key menu.
   - Place the R-2670 cursor in the "Display" zone. Select "AC VOLTS" on the soft key menu. Move the cursor to the "Range" setting and select "AUTO."

2. Initial setup using 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 Limit** alignment screen. The screen will indicate the transmit frequencies to be used. See Figure 6-8 below.
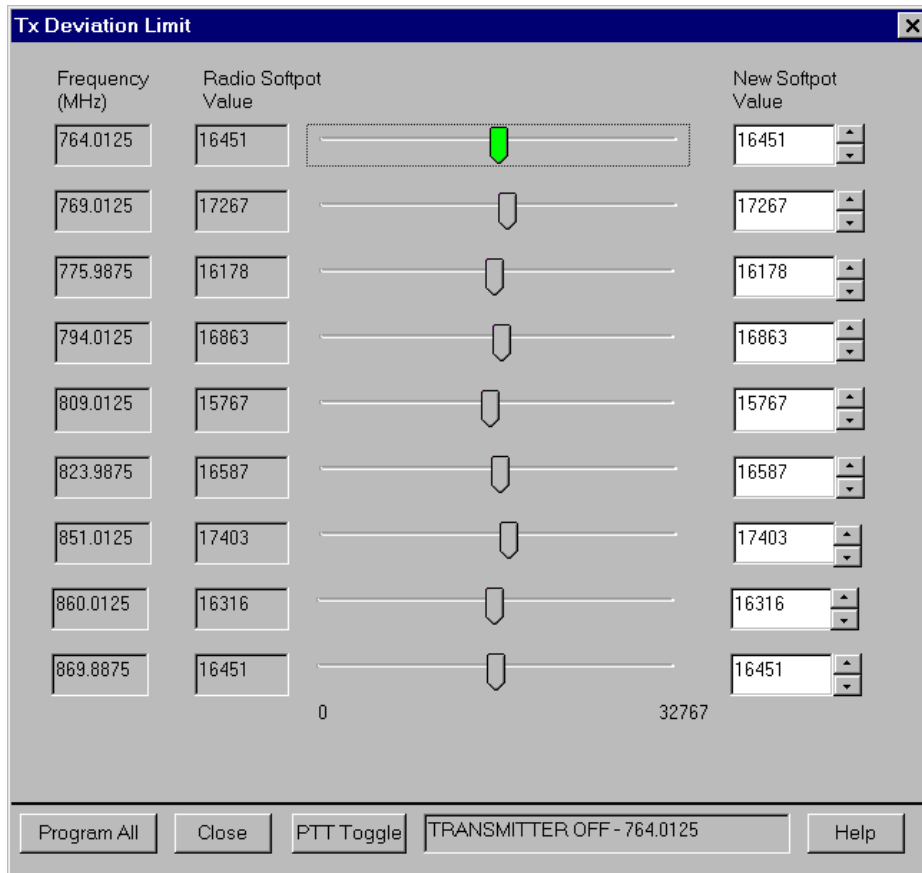
Figure 6-8. Transmit Deviation Limit Alignment Screen

4. Left-click the desired frequency field (starting with the highest frequency shown).

5. Left-click the **PTT Toggle** button on the screen to make the radio transmit. Wait approximately 5 seconds until the deviation/voltage displayed on the analyzer stabilizes. The screen indicates whether the radio is transmitting.

6. Adjust the deviation limit to within 0.158 to 0.163 Vac on the R-2670 (2.785 to 2.885 kHz). The optimum setting is 0.160 Vac (2.83 kHz).

7. Repeat the above process for all frequencies.

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

9. Left-click the **Close** button on the screen to return to the **Transmitter Alignments** menu.

6.9   Front End Filter Alignment

> ⚠️
> **Caution**
>
> This procedure should only be attempted by qualified service technicians.

This 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 6-9 on page 6-12).

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

6.9.1   Procedure for VHF

Tuning is not necessary for the VHF band.

6.9.2   Procedure for UHF Range 1 and Range 2

Tuning is not necessary for the UHF Range 1 & 2 bands.

6.9.3   Procedure for 700 MHz Frequencies

To align the 700 MHz receiver front end:

1. Left-click the desired frequency field.
2. Apply an RF signal with no modulation at -90 dBm on the current operating frequency.
3. Start with a softpot value (approximately 10 or 20), increase softpot in ascending order, and note the RSSI values. The RSSI will reach a peak value and remain stable and then decrease. Allow the limits of the peak range to be defined as RSSI PEAK - 3. Choose the middle of the peak range and program the corresponding softpot value as the tuned softpot value.
4. Repeat the above process for all 700 MHz frequencies.
5. Click on the **Program All** button to save the tuned values in the radio.
6. Left-click the **Close** button on the screen to return to the **Transmitter Alignments** menu.

6.9.4   Procedure for 800 MHz Frequencies

To align the 800 MHz receiver front end:

1. Left-click the desired frequency field.
2. Apply an RF signal with no modulation at -90 dBm on the current operating frequency.
3. Start with a softpot value of 50, increase softpot in ascending order, and note the RSSI values. The RSSI will reach a peak value and remain stable and then decrease. Allow the limits of the peak range to be defined as RSSI PEAK - 3. Note the upper end of the peak range and program the corresponding softpot value as the tuned softpot value.
4. Repeat the above process for all 800 MHz frequencies.
5. Click on the **Program All** button to save the tuned values in the radio.
6. Left-click the **Close** button on the screen to return to the **Transmitter Alignments** menu.
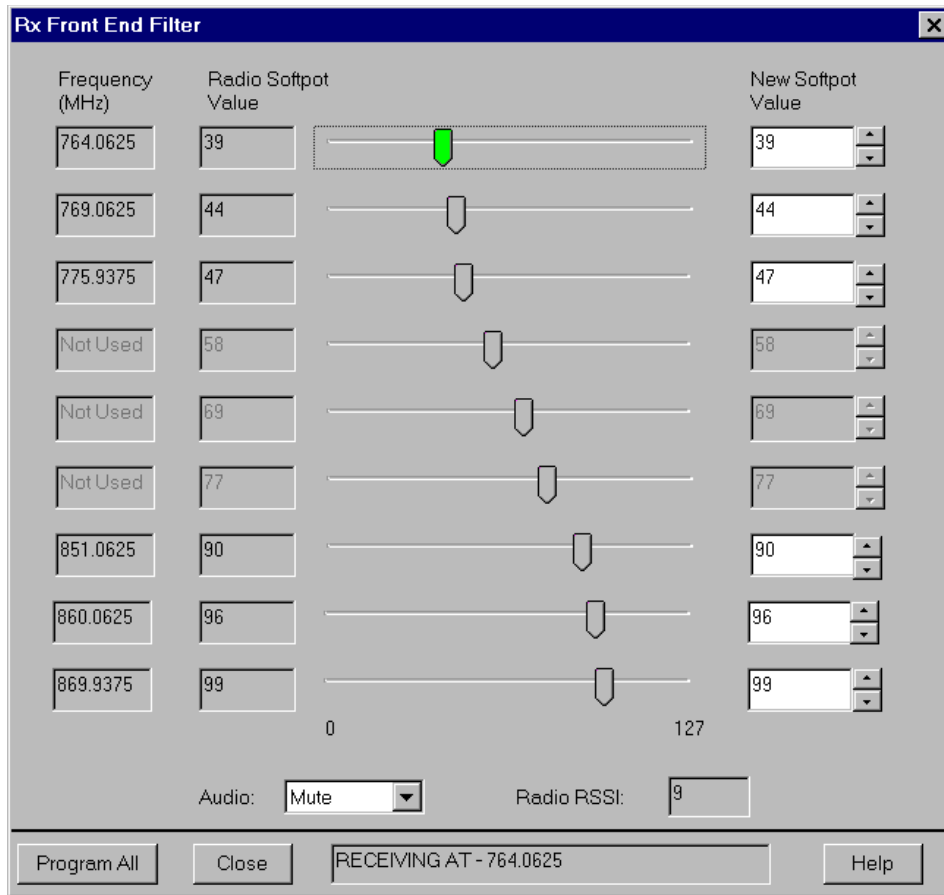
Figure 6-9. Front End Filter Alignment Screen

6.10   Bit Error Rate

This section describes the Bit Error Rate (BER) test of the radio's receiver at a desired frequency (see).

6.10.1 Bit Error Rate Fields

Set up the R2670 Communication Analyzer as follows:

1. Connect the RF Input port of the radio under test to the RF IN/OUT port of the R2670 Service Monitor.

2. Set up the R2670 Service Monitor:

    - In the Display Zone, select PROJ 25 STD mode and set the meter to RF DISPLAY.

    - In the RF Zone, configure the analyzer as follows:

RF Control:	Generate
Preset:	B/W: NB
Freq:	Test frequency (Ex: 851.0625 MHz)
Output Level:	-50.0 dBm
Gen RF Out:	RF I/O

    - In the Audio Zone, select the 1011 Hz PAT code and set the deviation to "PROJ25Dev: 2.83 kHz ~".

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 — TIA. Choices are: Standard Tone Test Pattern (Framed 1011) 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.

- **BER Integration Time**:
  This field represents the amount of time over which the Bit Error Rate is to be calculated. The range is from 0.360 to 91.8 seconds in increments of 0.360 seconds.

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.
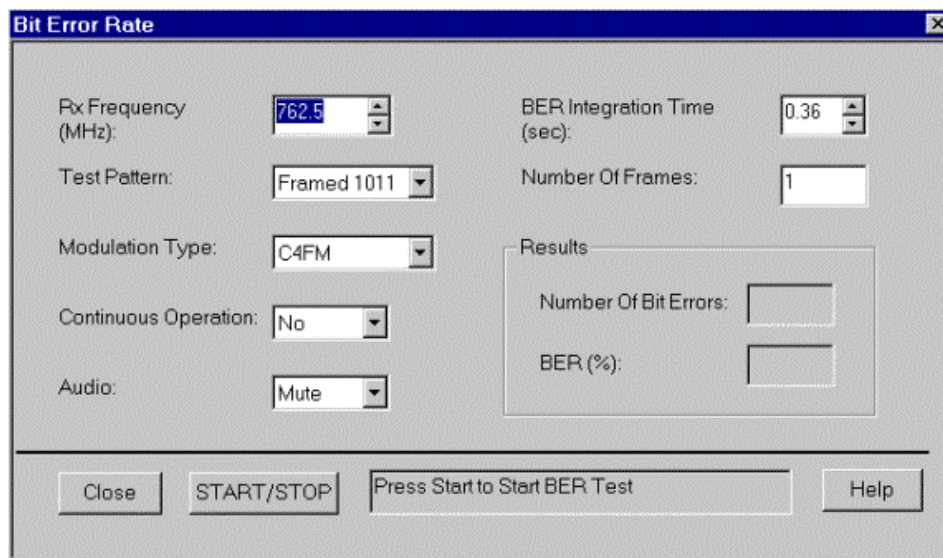
Figure 6-10. Bit Error Rate Screen

6.11   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 6-11).

6.11.1 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.
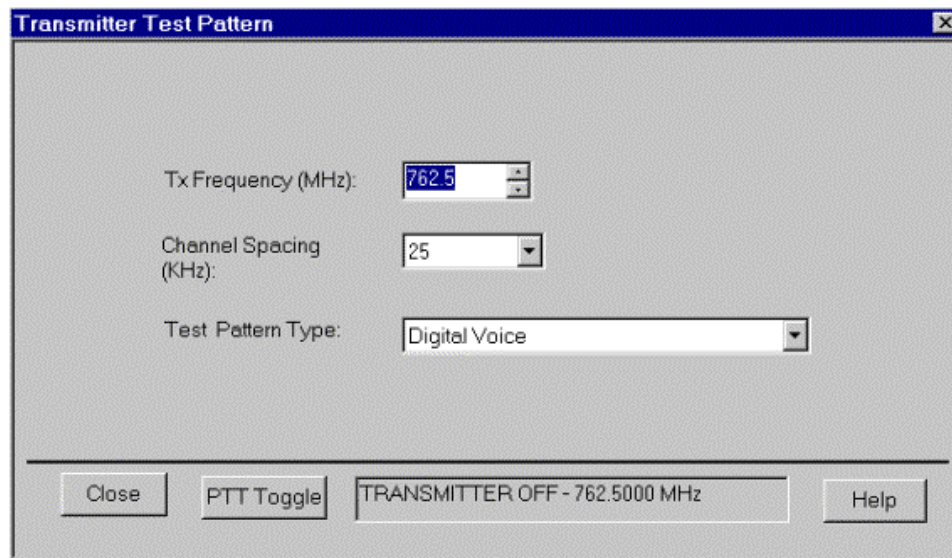
Figure 6-11. Transmitter Test Pattern Screen

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
- Erasing an encryption key

7.1   Load an Encryption Key

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 display shows "KEYLOADING." 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.

7.2   Multikey Feature

This feature allows the radio to be equipped with multiple encryption keys. It can support up to two different encryption algorithms simultaneously (e.g., DVP-XL 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, as well as the available menu selections.
3. Press ◂⬤ or ⬤▸ to scroll through the list of encryption keys.

   NOTE: If you select an erased key, the display alternates between showing the encryption key and "ERASED KEY."

4. Press ⬭, ⬭, or ⬭ directly below the desired menu.
  - PSET = selects the preset or default encryption key.
  - SEL = saves the newly selected key and returns to the home display.
5. Press ⬭, the **PTT** button, or ⬭, ⬭, or ⬭ directly below the ABRT menu, 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, as well as the available menu selections.
3. Using the keypad, enter the number of the desired key.

   NOTE: If you select an erased key, the display alternates between showing the encryption key and "ERASED KEY."

4. Press ⬭ or ⬭ to select from the menu.
  - PSET = selects the preset or default encryption key.
  - SEL = saves the newly selected key and returns to the home display.
5. Press ⬭, the **PTT** button, or ⬭, ⬭, or ⬭ directly below the ABRT menu, 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 "INDX."
2. Press ⬭, ⬭, or ⬭ directly below "INDX." The display shows the last user-selected and -stored index, as well as the available index menu selections.
3. Press ⬭, ⬭, or ⬭ directly below the desired index. The display shows the last user-selected and -stored index, as well as the available index menu selections.
4. Choose one of the following:
   a. To save the index, press ⬭, ⬭, or ⬭ directly below "SEL."

b. To exit this menu without changing the index selection, press ⓐ or the **PTT** button, or turn the **16-Position Select** knob.

7.4.2 Use the Keypad

To select an index using the keypad:

1. Press ⬬ until the display shows "INDX."

2. Press (•), (••), or (•••) directly below "INDX." The display shows the last user-selected and -stored index, as well as the available index menu selections.

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

4. Choose one of the following:

   a. To save the index, press (•), (••), or (•••) directly below "SEL."

   b. To exit this menu without changing the index selection, press ⓐ or the **PTT** button, or turn the **16-Position Select** knob.

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, as well as the available menu selections that are listed in Table 7-1.

3. Choose one of the following:

   • If you want to erase all the encryption keys at once, go to step 4 below.

   • If you want to erase a single encryption key, do one of the following:

     – Press ⬬ or ⬬ to find the desired key. The display shows the selected key and the available menu selections shown in Table 7-1.

     – Using the keypad, enter the location number of the desired key. The display shows the selected key, as well as the available menu selections shown in Table 7-1.

Table 7-1. Encryption Key Zeroization Options

Menu Selection	Action
ALL	Erases all the encryption keys in the radio. The display shows "ERS ALL KEYS" and "YES" and "NO."
SNGL	Selects the displayed encryption key to be erased.The display shows "ERS SNGL KEY" and "YES" and "NO."
ABRT	Exits this menu and returns to the home display

NOTE: To exit this menu at any time without erasing the key selection, press ⓐ or the **PTT** button, or turn the **16-Position Select** knob.

4. Press (•), (••), or (•••) directly below the desired menu selection.

5. Press ⓐ, the **PTT** button, or turn the **16-Position Select** knob to exit this menu.

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 XTS 5000 radios, and ensuring the submergibility of ruggedized radios. When performing these procedures, refer to "Chapter 10: Exploded Views and Parts Lists" on page 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 XTS 5000 radio's standard accessories and changing the Volume and Frequency Knobs.

8.1   XTS 5000 Exploded View (Partial)

This section contains the XTS 5000 radio partially exploded view and parts list.

NOTES:

- Refer to Figure 8-1 on page 8-2, the Partial Exploded View, and Table 8-1 on page 8-3, the Partial Exploded View Parts List.
- Numbers in parentheses ( ) refer to item numbers in Figure 8-1 on page 8-2 and Table 8-1 on page 8-3.
- The battery (56) should be removed from the radio before installing or removing the frequency knob (13).
- In cases where the frequency knob retainer insert (11) and frequency dial escutcheon (12) must be removed, a new insert and new escutcheon *must* be used for reassembly.

Alignment Tabs
Alignment Notch
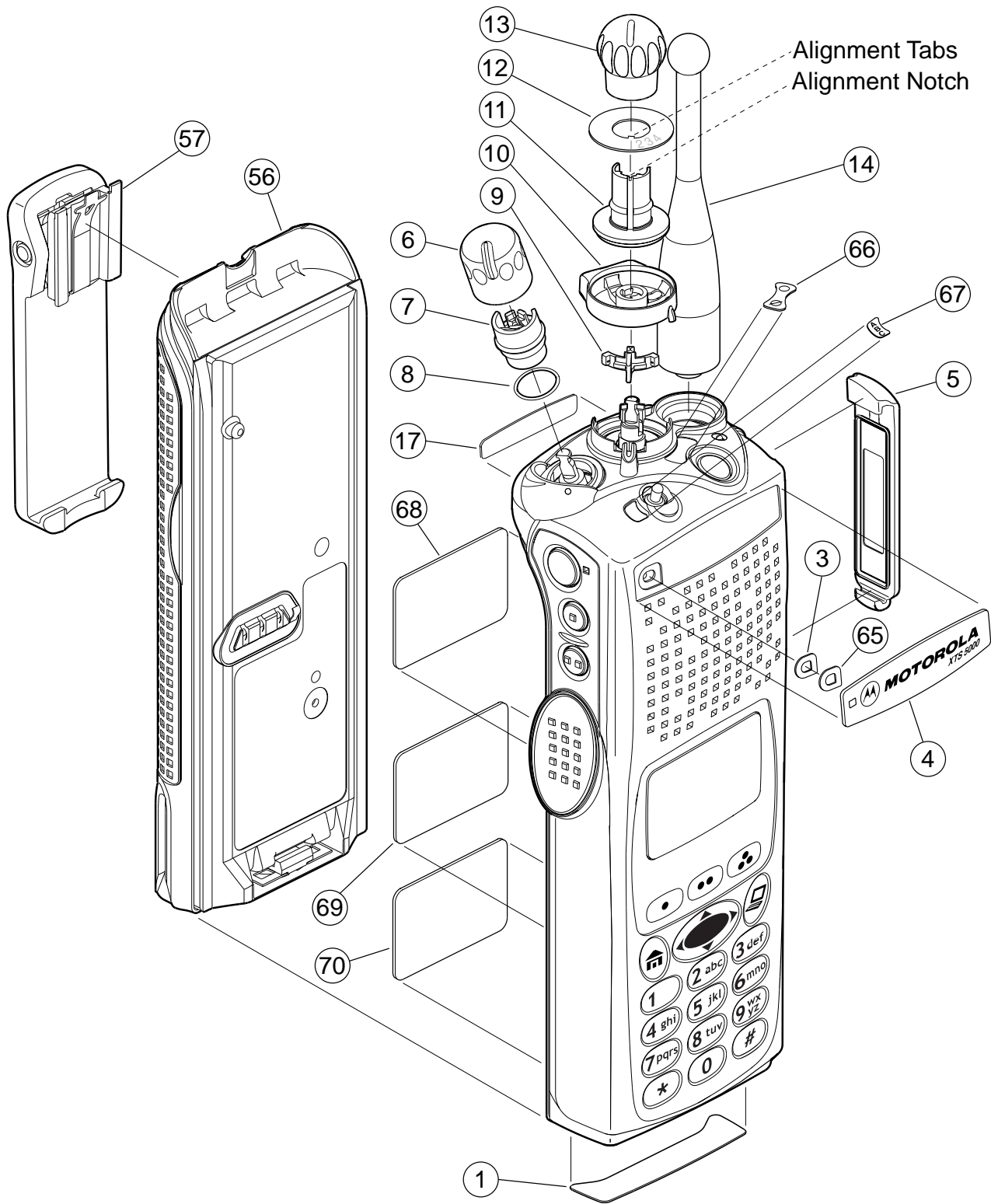
MAEPF-27211-A

Figure 8-1. XTS 5000 Partial Exploded View

Table 8-1. XTS 5000 Partial Exploded View Parts List

Item Number	Motorola Part Number	Description
1	3305630Z01	LABEL, Motorola Bottom
3	3285757D01	MEMBRANE, Microphone Front
4	3385221D01	LABEL, Motorola, Front
5	1505579Z01	COVER, Universal Connector
6	3605371Z01	KNOB, Volume
7	4305372Z01	INSERT, Volume Knob Retainer
8	3205379W01	O-RING, Volume Torque
9	6105376Z01	LIGHTPIPE, Indicator
10	4505375Z01	LEVER, Secure
11	4305373Z02	INSERT, Frequency Knob Retainer
12	1305374Z03	ESCUTCHEON, Frequency Dial
13	3605370Z01	KNOB, Frequency
14	- - - - - - - - - -	See "A.1: Antennas" in "Appendix A: Accessories"
17	3305574Z01	LABEL, Motorola Back
56	- - - - - - - - - -	See "A.2 Batteries and Battery Accessories" on page A-1 in "Appendix A: Accessories"
57	- - - - - - - - - -	See "A.3.1 Belt Clips" on page A-2 in "Appendix A: Accessories"
65	3585741D01	MESH, Microphone
66	3385658D01	ESCUTCHEON, Concentric Switch
67	3385657D01	ESCUTCHEON, Toggle
68	- - - - - - - - - -	LABEL, Flashport
69	- - - - - - - - - -	LABEL, Radio Serial Number
70	- - - - - - - - - -	LABEL, Approval Agency

8.2   Antenna

This section explains how to attach and remove the antenna.

8.2.1   Attach the Antenna

To attach the antenna:

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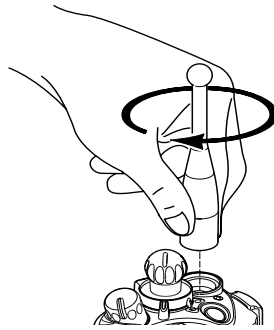

Figure 8-2. Attaching the Antenna

8.2.2   Remove the Antenna

To remove the antenna:

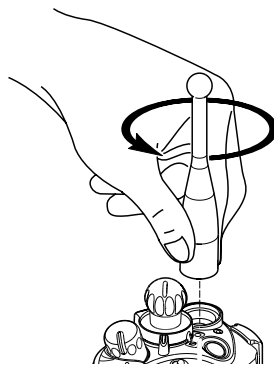With the radio turned off, turn the antenna counter-clockwise to remove it from the radio.

Figure 8-3. Removing the Antenna

8.3 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 XTS 5000 radio is uncharged. Prior to using a new battery, charge it for a minimum of 16 hours to ensure optimum capacity and performance.

8.3.1 Attach the Battery

To attach the battery:

1. With the radio turned off, insert the top edge of the battery into the radio's frame as shown.
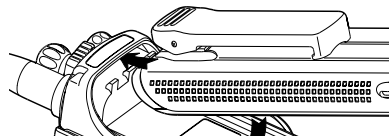

Figure 8-4. Inserting the Top Edge of the Battery

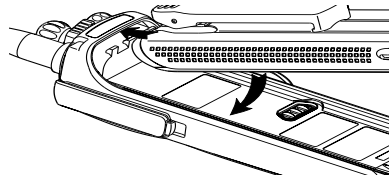2. Rotate the battery toward the radio and press down until the battery clicks into place.

Figure 8-5. Pressing the Battery into Place

8.3.2   Remove the Battery

To remove the battery:

1. With the radio turned off, press the release button on the bottom of the battery until the battery releases from the radio.
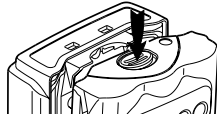

Figure 8-6. Pressing the Release Button
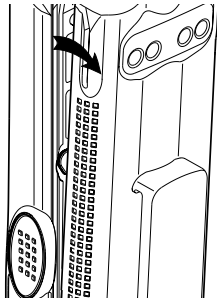
2. Remove the battery from the radio.

Figure 8-7. Removing the Battery

8.4 Belt Clip

This section explains how to attach and remove the belt clip.

NOTE: The battery must be removed from the radio before the belt clip can be installed or removed.

8.4.1 Attach the Belt Clip

To attach the belt clip:

1. Align the grooves of the belt clip with those of the battery.

Grooves
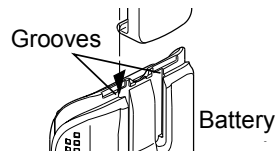
Battery

Figure 8-8. Aligning the Belt Clip With the Battery

2. Press the belt clip downward until you clear a click.

Battery

Figure 8-9. Pressing the Belt Clip into Place

8.4.2 Remove the Belt Clip

To remove the belt clip:

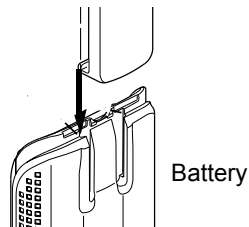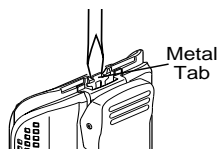1. Use a flat-bladed object to press the belt clip tab away from the battery.

Metal
Tab

Figure 8-10. Pressing the Belt Clip Tab Away From the Battery

2. Slide the belt clip upward to remove it.
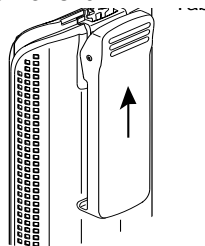
Figure 8-11. Removing the Belt Clip

8.5 Universal Connector Cover

This section explains how to remove and attach the universal connector cover.

> ⚠️ **Caution**
>
> When the universal connector is not in use, keep it covered with the universal connector cover.

8.5.1 Remove the Universal Connector Cover

To remove the universal connector cover:

1. Insert a flat-blade screwdriver into the area between the bottom of the cover and the slot below the connector.
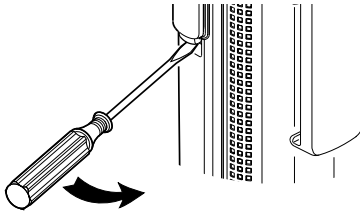
Figure 8-12. Inserting a Screwdriver Below the Cover

2. Hold the top of the cover with your thumb while you pry the bottom of the cover away from the radio with the screwdriver.
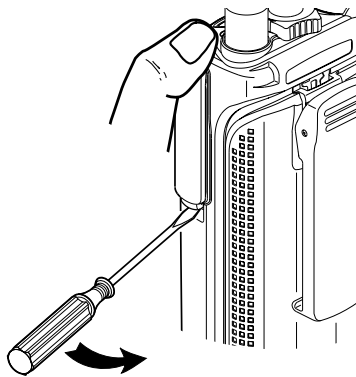
Figure 8-13. Removing the Cover

8.5.2   Attach the Universal Connector Cover

To attach the universal connector cover:

1. Insert the hooked end of the cover into the slot above the connector. Press downward on the cover's top to seat it in the slot.
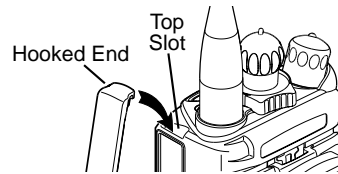

Figure 8-14. Hooking the End into the Slot

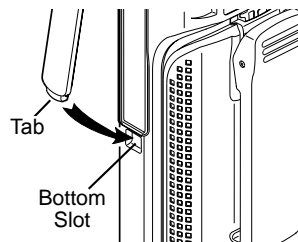2. Press the cover's lower tab into the slot below the connector until it snaps in place.

Figure 8-15. Pressing the Cover into Place

8.6　Frequency Knob

This section explains how to remove and attach the frequency knob.

8.6.1　Remove the Frequency Knob

To remove the frequency knob:

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 (13) and pull it upward, while rocking the knob back and forth, until it is free from the frequency knob retainer insert (11), or the insert is free from the shaft.

3. If necessary, while pressing the insert's (11) two snap tabs away from the frequency control shaft so that the insert disengages from the shaft, use needle-nosed pliers to lift the insert up and off of the frequency control shaft. Discard the removed insert.

4. Remove the secure lever (10) and the indicator lightpipe (9).

8.6.2　Install the Frequency Knob

To install the frequency knob:

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

2. Align the lightpipe indicator (9) so that its straight tab is over the slot for the illuminated pointer. Push the tab down into the slot so that it is securely seated.

3. Place the secure lever (10) on the frequency control shaft, aligning it so that its pointer is at the front of the radio and its two inner slots line up with the two keys on the shaft. Slide the secure lever down to the bottom of the shaft.

4. If you are replacing the frequency dial escutcheon (12):

   a. Remove the backing paper from the escutcheon.

   b. Align the number "1" on the escutcheon with the alignment notch on the frequency knob retainer insert (11).

   c. Slide the escutcheon down over the insert, ensuring that the alignment tab on the escutcheon fits inside the tab recess on the insert.

   d. Press the escutcheon firmly onto the insert to ensure proper adhesion.

5. Place a new frequency knob retainer insert (11) and new frequency dial escutcheon (12) on the frequency control shaft, aligning the insert's D-shaped hole with the D-shaped shaft. Press downward firmly on the insert until it snaps in place on the shaft.

6. Place the frequency knob (13) on the insert (11), aligning it's pointer with the number "**1**" on the escutcheon (12). Press firmly downward on the knob until it seats securely in place.

8.7 Volume Knob

This section explains how to remove and install the volume knob.

NOTES:

- Refer to Figure 8-1 on page 8-2, the Partial Exploded View, and Table 8-1 on page 8-3, the Partial Exploded View Parts List. Numbers in parentheses ( ) refer to item numbers in Figure 8-1 and Table 8-1.

- The battery (56) should be removed from the radio before installing or removing the volume knob (6).

- In cases where the volume insert (7) must be removed, a new volume insert **must** be used for reassembly.

8.7.1 Remove the Volume Knob

To remove the volume knob:

1. Turn the volume knob (6) to the off position.

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

3. With the other hand, grasp the volume knob (6) and pull it upward, while pushing it toward the back of the radio, until it is free from the volume knob retainer insert (7).

4. Bend the volume knob retainer insert's (7) two snap tabs away from the volume control shaft so that the insert disengages from the shaft, then use needle-nosed pliers to pull the insert up and off of the volume control shaft. Discard the removed volume insert.

5. Using needle-nosed pliers or some other pointed instrument, remove the volume torque O-ring (8).

8.7.2 Install the Volume Knob

To install the volume knob:

1. Place the volume torque O-ring (8) inside a new volume knob retainer insert (7), and press it downward until it seats securely at the bottom of the insert.

2. Hold the radio so that the top of the radio faces upward, and the front of the radio faces you.

3. Place a new volume knob retainer insert (7) on the volume control shaft, aligning the insert's D-shaped hole with the D-shaped shaft. Press downward firmly on the insert until it snaps in place on the shaft.

4. Place the volume knob (6) on the volume knob retainer insert (7), aligning the two lugs on the inside of the knob with the insert's two snap tabs. Press firmly downward on the knob until it seats securely in place.

8.8   Radio Disassembly

This section contains instructions for disassembling the radio.

8.8.1   Separate the Casting and Housing Assemblies

To separate the housing assembly from the casting assembly:

1. Turn off the radio by rotating the **On/Off/Volume** control fully counterclockwise until you hear a click.

2. Remove the antenna, the battery, and the universal connector cover or any accessory connected to the radio.

    NOTE: It is not necessary to remove the volume knob (6) and insert (7) or frequency knob (13) and insert (11) to service the casting assembly. However, if any top control is suspected, then the knobs and inserts should be removed prior to removing the casting assembly (51) from the housing assembly (2). Refer to Section "8.1 XTS 5000 Exploded View (Partial)" on page 8-1 and Section "8.7 Volume Knob" on page 8-11.

3. With the back of the radio facing upward, insert the 6685833D01 special tool at the bottom of the radio between the housing assembly (2) and the two housing tabs on the casting assembly (51) until the special tool's latch engages the two battery tabs on the casting assembly. With the latch engaged, gently pull the casting away to remove it from the housing (do not use a prying motion). Making sure that the antenna bushing has cleared the hole in the control top, carefully lift the casting assembly clear of the housing assembly.

4. While holding the casting assembly (51) in one hand and the housing assembly (2) in the other, unplug the 40-pin connector, on the controls flex assembly (18), from the VOCON board (44).
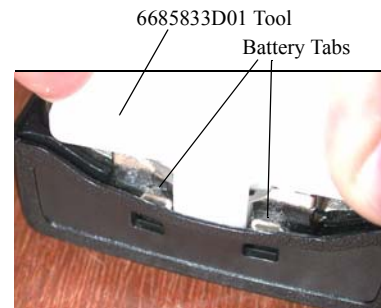
    NOTE: This can easily be done using the thumb of the hand holding the housing assembly.

8.8.2   Disassemble the Casting Assembly

To disassemble the casting assembly:

1. Put the housing assembly aside.

2. Remove the main seal (55) from around the casting assembly (51).

3. If you are disassembling a model I radio, skip to step 6; if you are disassembling a model II or III radio, continue this procedure.

4. With the front of the radio facing upward, unplug the 22-pin connector for the LCD module (38) (located to the right and above the LCD module). Lift the LCD module (38), with display locator pad (39), up and off of the two locator posts on the casting (51).

5. Remove the LCD module (38) and put it aside.

6. Unplug the 22-pin connector for the keypad flex (37) (located to the left and above the LCD module area).

7. Pry upward on all four control locking clips (40) for the VOCON board shield assembly (41), alternating diagonally across the shield. Remove the VOCON board shield assembly, with keypad flex assembly (37) (models II and III only) and clips still attached, from the casting.

8. Lift the VOCON board (44) up and away from the casting.

> NOTE: If the radio is equipped with hardware encryption, the encryption board (45) is attached to the back side of the VOCON board via a 40-pin connector. When the VOCON board is lifted out of the casting, the encryption board is removed with it.

9. Lift out the 26-pin compression connector (46).

10. Using needle-nosed pliers, carefully unplug the coaxial cable's connector (52) from the transceiver board's (48) surface-mount connector.

11. With the front of the radio facing upward, disengage the clip (63) that secures the upper left portion of the RF shield (47) by inserting a thin, flat-bladed screwdriver between the clip and the casting assembly (51) and prying the clip free. Then, release the snap on the bottom left side and the two snaps on the right side of the RF shield. Lift the shield out, with the clip still attached, rotating it around its top edge.

12. Remove the rubber pad (71).

13. Lift the transceiver board (48) out of the casting assembly. Inspect the casting to make sure that the thermal pad (58) is attached to the casting. If the pad is attached to the transceiver board, remove it from the board and discard it. Attach a new thermal pad to the casting as shown in the exploded view.

14. Lift the B+ assembly (49) and B+ seal (50) out of the casting assembly.

8.8.3 Disassemble the Housing Assembly

To disassemble the housing assembly:

1. Referring to Section "8.8.1 Separate the Casting and Housing Assemblies" on page 8-12, remove the housing assembly (2) from the radio.

2. To begin housing disassembly, remove the speaker retainer screw (23).

3. Remove the speaker retainer (36).

4. Install the universal connector cover (5) (see page 8-9). This will hold the universal connector in place when the controls flex is removed.

⚠️ **Caution**   Removing the controls flex without installing the universal connector cover may compromise the universal connector.

---

5. Disconnect the controls flex (18) from the universal connector by disengaging the spring tab on the backer from the catch features on the housing.

6. Disconnect the controls flex's (18) 22-pin connector from PTT area of the housing assembly (2).

7. Referring to Section "8.1 XTS 5000 Exploded View (Partial)" on page 8-1 and Section "8.7 Volume Knob" on page 8-11, remove the frequency knob (13), frequency insert (11), secure lever (10), lightpipe (9), volume knob (6), volume insert (7), and O-ring (8).

8. Using a thin, flat-bladed screwdriver, unsnap the left snap of the controls bracket assembly (34) first, then unsnap the right snap.

9. Remove the controls bracket assembly (34).

10. Remove the controls seal (35).

8.9   Radio Reassembly

This section contains instructions for reassembling the radio.

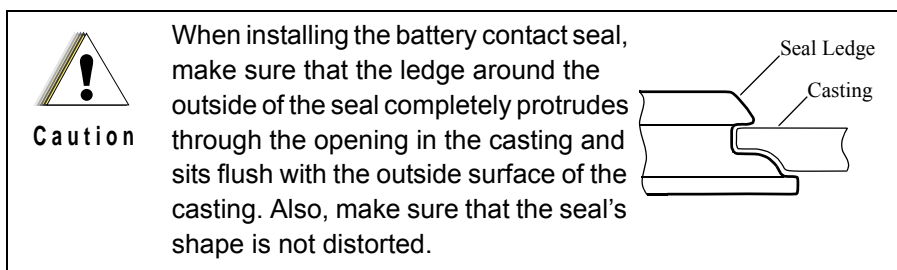### 8.9.1   Reassemble the Housing Assembly

To reassemble the housing assembly:

1. Inspect the housing seal surfaces for debris. Remove any debris.

2. Install the controls seal (35).

3. Reassemble the controls bracket assembly (34) into the housing (2) by snapping in the right side of the bracket first, then snapping in the left side.

4. Referring to Section "8.1 XTS 5000 Exploded View (Partial)" on page 8-1 and Section "8.7 Volume Knob" on page 8-11, install the frequency knob (13), new frequency escutcheon (12), new frequency insert (11), secure lever(10), lightpipe (9), volume knob (6), new volume insert (7), and O-ring (8).

5. Reconnect the controls flex (18) to the universal connector and the PTT area of the housing assembly (2). Make sure the spring tabs on the backer fully engage the catch features on the housing.

6. Install the speaker retainer (36), and secure it with the speaker retainer screw (23).

7. Install the main seal O-ring (55) around the casting assembly (51).

8. Reassemble the housing assembly (2) to the radio.

9. Inspect the main seal (55) for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing (2) and the casting (51).

8.9.2   Reassemble the Casting Assembly

To reassemble the casting assembly:

1. Reinstall the B+ assembly (49) and B+ seal (50), making sure that the seal seats properly in the casting assembly (51). Inspect the B+ assembly from the back of the casting to ensure that the seal shows evenly around the B+ assembly.

⚠ **Caution**	When installing the battery contact seal, make sure that the ledge around the outside of the seal completely protrudes through the opening in the casting and sits flush with the outside surface of the casting. Also, make sure that the seal's shape is not distorted.	Seal Ledge · Casting

2. Make sure that a thermal pad (58) is attached to the casting. If it is not, attach a new thermal pad to the casting as indicated in the exploded view.

3. With the front of the radio facing upward, place the transceiver board (48) in position, tucking the right side of the board in first — in the casting slot.

4. Put the rubber pad (71) in place on top of the transceiver board (48).

5. Reinstall the RF shield (47). Insert the shield's top edge in first, aligning the two tabs on the shield's top edge with the two slots in the casting, then pivot the shield down into position. Engage the two snaps on the right side and the snap on the bottom left side first, then snap down the single left side clip (63).

6. Plug the coaxial cable's connector (52) into the transceiver board's (48) surface-mount con-
    nector, making sure to lead the coax's connector straight into the surface-mount connector.
    An angled lead-in can damage the surface-mount connector or the center of the coax.

7. Reinstall the 26-pin compression connector (46). It can only be inserted in one way—with the
    two-peg edge pointing downward on the left side.

8. If the radio is equipped with an encryption board (45), connect it to the back of the VOCON
    board (44) through the 40-pin connector. Ensure that these connectors are properly engaged.

9. Reinstall the VOCON board (44). Tuck the tab at the top of the VOCON board into the reten-
    tion slot on the casting, rotate the board into position, and engage the 26-pin connector.

10. Reinstall the VOCON board shield assembly (41), with keypad (models II and III only) and
    four clips (40) attached, onto the casting. Snap the shield's clips down, alternating diagonally
    across the shield.

11. If you are reassembling a model I radio, skip to step 14; if you are reassembling a model II or
    III radio, complete the remainder of step 10. Plug the 22-pin connector at the end of the key-
    pad flex's (43) tail into the connector on the VOCON board (44).

12. Reinstall the LCD module (38) and display locator pad (39). Position the LCD module, with
    the display locator pad facing upward, so that the connector on the flex points toward the bot-
    tom of the radio. Press the display locator pad (39) down over the two locator posts on the
    casting, making sure that the locator pad's loops are fully captured by the casting posts.

13. Plug the 22-pin connector at the end of the display module (38) flex into the mating connector
    on the VOCON board (44).

14. Reinstall the main seal (55) around the casting assembly (51). Start at the top of the casting
    and work the seal around the perimeter of the casting until it is completely in place.

8.9.3 Join the Casting and Housing Assemblies

To join the casting and housing assemblies:

1. While holding the casting assembly (51) in one hand and the housing assembly (2) in the
    other, plug the 40-pin connector on the controls flex assembly (18) into the connector on the
    VOCON board (44).

    NOTE: This can easily be done using the thumb of the hand holding the casting.

2. With the fronts of both the casting assembly (51) and housing assembly (2) facing downward,
    carefully insert the top of the casting into the top of the housing assembly. Making sure that
    the antenna bushing is inside the antenna hole in the control top, pivot the bottom of the cast-
    ing downward toward the bottom of the housing until they meet. Snap the housing assembly
    and casting assembly together.

> ⚠️ The main seal O-ring should not be visible when looking at the
> back side of the radio. If the seal is visible, it is improperly
> **Caution** installed.

3. Referring to the appropriate section in this manual, reinstall the universal connector cover or
    any accessory connected to the radio, the antenna, and the battery.

    NOTE: If the volume knob (6) or frequency knob (13) were removed prior to servicing the
    main casting, reinstall them.

8.10   Ensuring Radio Submergibility

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

8.10.1 Standards

ASTRO XTS 5000 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 three feet of water for two hours.

8.10.2 Servicing

XTS 5000 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 Accidental Submersion

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

8.10.4 Specialized Test Equipment

This section summarizes the specialized test equipment necessary for testing the integrity of ASTRO XTS 5000 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. An adapter with gasket (NTN9279A), which must be ordered separately, connects the vacuum hose to the radio's casting. The vacuum pump kit is also used on Motorola ASTRO SABER R radio models. The adapter with gasket is the same as that for the ASTRO XTS 3000 R and XTS 3500 R radio models.

8.10.4.2 Pressure Pump Kit NTN4265

The pressure pump kit includes a pressure pump with gauge, and a pressure hose; the pressure pump kit is also used on Motorola ASTRO SABER R radio models. As with the vacuum pump kit above, the NTN9279A adapter connects the pressure hose to the radio's casting.
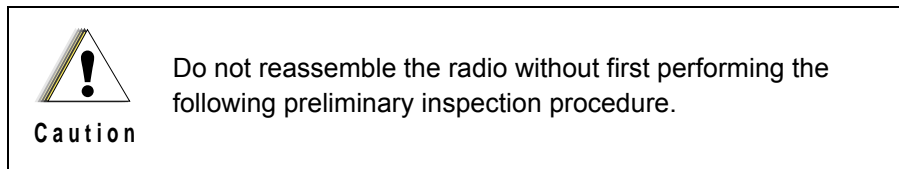
8.10.4.3 Miscellaneous Hardware

Other items needed for testing the submersible radio include:

- Large water container
- Deionized (DI) water
- A supply of replacement seals, O-rings, and gaskets (refer to the ASTRO XTS 5000 R exploded view parts list)
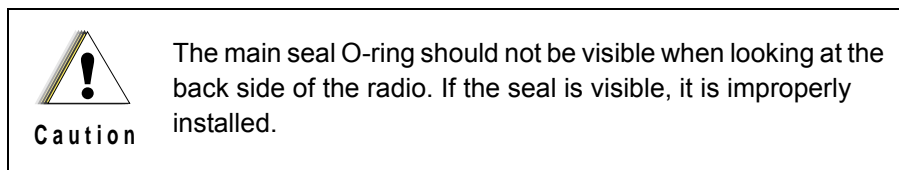
8.10.5 Disassembly

Disassemble the radio according to Section "8.8.1 Separate the Casting and Housing Assemblies" on page 8-12.

8.10.6 Reassembly

> ⚠️
> **Caution**
>
> Do not reassemble the radio without first performing the following preliminary inspection procedure.

To reassemble the radio:

1. Remove the main seal O-ring from the casting.
2. Inspect the seal area around the casting for foreign material that might prevent the main seal O-ring from sealing properly.
3. Install a new main seal O-ring; discard the old O-ring.
4. Reassemble the housing.

> ⚠️
> **Caution**
>
> The main seal O-ring should not be visible when looking at the back side of the radio. If the seal is visible, it is improperly installed.

Continue reassembling the radio according to Section "8.9 Radio Reassembly" on page 8-14. Tighten all hardware that was loosened or removed.

8.10.7 Vacuum Test

The vacuum test uses a vacuum pump and gauge. The pump creates a vacuum condition inside the radio, and the gauge monitors the radio for a stable vacuum reading; that is, checking for a properly sealed, watertight unit. Before starting the vacuum test:

- Remove the battery.
- Remove the universal connector cover to expose the universal connector.

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

To conduct the vacuum test:

1. Attach the vacuum hose to the vacuum pump. Check the pump and hose for leaks by blocking off the open end of the hose and operating the pump a few times. The actual reading of the gauge at this point is not important; it is important that the gauge pointer remains steady, indicating no vacuum leaks in the pump.

2. Remove the vacuum test port using a pair of needle-nosed pliers and pulling upward.

3. Ensure that a rubber gasket is attached to the hose-to-casting adapter. Screw the adapter into the tapped hole in the casting.

4. Attach the open end of the hose to the adapter.

5. Place the radio on a flat surface with the casting facing upward. Place two or three drops of water on each slot of the label (62) that protects the vent port seal (61) on the casting. This will ensure that no air goes through the seal.

6. Operate the pump a few times until the gauge indicates 5 in. Hg; do not pull more than 7 in. Hg of vacuum on the radio.

7. Operate the pump again until the gauge indicates 6 in. Hg.

8. Observe the gauge for approximately 1 minute.

    - If the needle falls 1 in. Hg or less (for example, from 6 in. Hg to 5 in. Hg), then the radio has passed the vacuum test and is approved for submergibility. No additional testing will be required.

    - If the needle falls more than 1 in. Hg (for example, from 6 in. Hg to less than 5 in. Hg), then the radio has failed the vacuum test and the radio might leak if submerged. Additional troubleshooting of the radio will be required; complete this procedure, then go to the "Pressure Test" section of this manual.

9. Dry the water from the slots on the label (62) that protects the vent port seal to allow the radio to equalize. The pressure should drop slowly to "0."

10. Remove the vacuum hose and adapter from the radio.

11. Install the vacuum test port plug by pressing it in, ensuring that the plug sits flat all around the edges and it is flush with the casting.

8.10.8 Pressure Test

Pressure testing the radio is necessary only if the radio has failed the vacuum test. Do not perform the pressure test until the vacuum test has been completed. Pressure testing involves creating a positive pressure condition inside the radio, 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.

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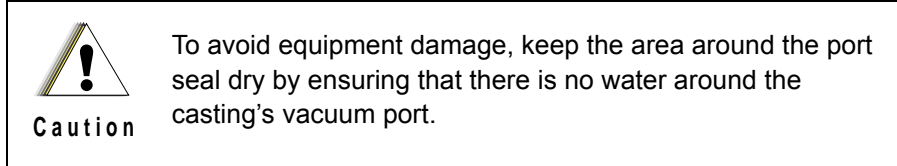
To conduct the pressure test:

1. Remove the vacuum test port using a pair of needle-nosed pliers and pulling upward.

2. Screw the adapter (with gasket) into the tapped hole in the casting.

3. Attach one end of the pressure hose to the adapter and the other end to the pressure pump.

4. Cover the vent port seal (61) and label (62) on the back of the casting with your thumb. This will prevent air from going through the seal. Keep the vent port covered with your thumb until the test is complete (through step 8).

5. Operate the pump until the gauge reads approximately 1 psig.

> ⚠️ **Caution**
>
> Pressure any greater than 1 psig might push air around the main seal.
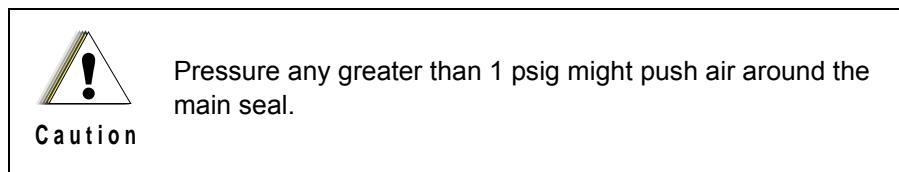
6. Maintain the pressure at 1 psig and submerge the radio into a water-filled container. Keep the vent port covered with your thumb while the radio is submerged.

7. Watch for any continuous series of bubbles. A stream of bubbles indicates a sign of leakage.

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

8. Note all of the seal areas that show signs of leakage. Pinpoint the problem(s) to one (or more) of the following areas:
   - Housing
   - Antenna bushing seal
   - Controls seal
   - Frequency switch, toggle, and on/off/volume control switch
   - Main seal
   - Battery contact and battery contact seal
   - Keypad

9. Remove the radio from the water container, remove your thumb from the vent port seal, and dry the radio thoroughly. Be especially careful to dry the area around the main seal to prevent contamination of the internal electronics while the unit is open.

> ⚠ **C a u t i o n**
>
> To avoid equipment damage, keep the area around the port seal dry by ensuring that there is no water around the casting's vacuum port.

10. Remove the adapter and pressure hose added in steps 1 and 2, above.

11. Install the vacuum test port plug by pressing it in, ensuring that the plug sits flat all around the edges and it is flush with the casting.

12. Inspect the vent port seal (61) to ensure that the seal behind the label's (62) two slots has not been punctured. If it has been punctured, the seal and the label must be replaced.

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 Section "8.10.8 Pressure Test" on page 8-19, and, when multiple leaks exist, in the order listed.

NOTE: Before reassembling the radio, always install a new main seal O-ring, and new seals in the defective area.

8.10.9.1 Housing

Do one or both of the following:

1. If a leak occurs at the lens, universal connector, casting/housing interface, or PTT/Ratt button area of the housing, replace the housing. Refer to Section "8.8.1 Separate the Casting and Housing Assemblies" on page 8-12.

   a. Remove the housing assembly (2) from the radio.

   b. Discard the housing assembly (2) and main seal O-ring (55).

   c. Install a new main seal O-ring (55) around the casting assembly (51).

   d. Install a new housing assembly (2) to the radio.

   e. Inspect the main seal (55) for proper seating.

   f. Observe carefully to ensure that the main seal O-ring (55) is not pinched between the housing (2) and the casting (51).

2. If the leak occurs at the control top area, remove the knobs, knob inserts and antenna in order to determine the leak location:

   a. Conduct the Pressure Test.

   b. Identify the leak location.

8.10.9.2 Antenna Bushing Seal

To replace the antenna bushing seal:

1. Referring to Section "8.8.1 Separate the Casting and Housing Assemblies" on page 8-12, remove the housing assembly (2) from the radio.

2. Remove and discard the antenna bushing gasket (54).

3. Inspect the housing seal surface for debris or damage. Remove any debris and replace housing if damaged.

4. Install new antenna bushing gasket (54).

5. Install a new main seal O-ring (55) around the casting assembly (51).

6. Reassemble the housing assembly (2) to the radio.

7. Inspect the main seal (55) for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing (2) and the casting (51).
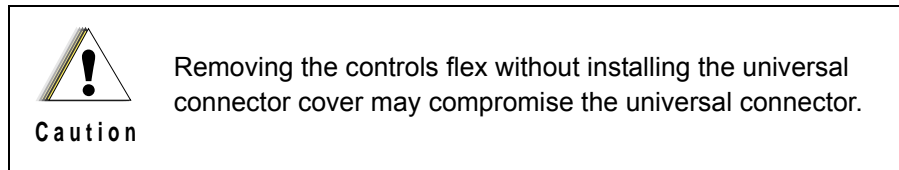
8.10.9.3 Controls Seal

To replace the controls seal:

1. Referring to Section "8.8.1 Separate the Casting and Housing Assemblies" on page 8-12, remove the housing assembly (2) from the radio.

2. Remove the speaker retainer screw (23).

3. Remove the speaker retainer (36).

4. Install the universal connector cover (5) (see page 8-9). This will hold the universal connector in place when the controls flex is removed.

> ⚠️ **Caution**
>
> Removing the controls flex without installing the universal connector cover may compromise the universal connector.
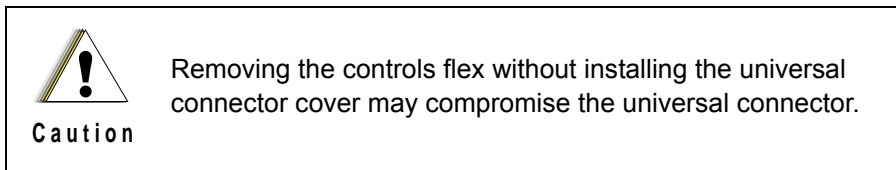
5. Disconnect the controls flex (18) from the universal connector by disengaging the spring tab on the backer from the catch features on the housing.

6. Disconnect the controls flex's (18) 22-pin connector from PTT area of the housing assembly (2).

7. Referring to Section "8.6 Frequency Knob" on page 8-10 and Section "8.7 Volume Knob" on page 8-11, remove the frequency knob, frequency insert, secure lever, lightpipe, volume knob, volume insert, and O-ring.

8. Using a thin, flat-bladed screwdriver, unsnap the left snap of the controls bracket assembly (34) first, then unsnap the right snap.

9. Remove the controls bracket assembly (34).

10. Remove and discard the controls seal (35).

11. Inspect the housing seal surfaces for debris. Remove any debris.

12. Install a new controls seal (35).

13. Reassemble the controls bracket assembly (34) into the housing (2) by snapping in the right side of the bracket first, then snapping in the left side.

14. Referring to Section "8.6 Frequency Knob" on page 8-10 and Section "8.7 Volume Knob" on page 8-11, install the frequency knob, new frequency escutcheon, new frequency insert, secure lever, lightpipe, volume knob, new volume insert, and O-ring.

15. Reconnect the controls flex (18) to the universal connector and the PTT area of the housing assembly (2). Ensure the spring tabs on the backer fully engage the catch features on the housing.

16. Install a new main seal O-ring (55) around the casting assembly (51).

17. Reassemble the housing assembly (2) to the radio.

18. Inspect the main seal (55) for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing (2) and the casting (51).

8.10.9.4 Frequency Switch, Toggle, and On/Off/Volume Control Switch

To replace the frequency switch, toggle, and On/Off volume control switch:

1. Referring to Section "8.8.1 Separate the Casting and Housing Assemblies" on page 8-12, remove the housing assembly (2) from the radio.

2. Remove the speaker retainer screw (23).

3. Remove the speaker retainer (36).

4. Install the universal connector cover (5) (see page 8-9). This will hold the universal connector in place when the controls flex is removed.

> ⚠ **C a u t i o n**   Removing the controls flex without installing the universal connector cover may compromise the universal connector.

5. Disconnect the controls flex (18) from the universal connector by disengaging the spring tab on the backer from the catch features on the housing.

6. Disconnect the controls flex (18) 22-pin connector from PTT area of the housing assembly (2).

7. Referring to Section "8.6 Frequency Knob" on page 8-10 and Section "8.7 Volume Knob" on page 8-11, remove the frequency knob, frequency insert, secure lever, lightpipe, volume knob, volume insert, and O-ring.

8. Using a thin, flat-bladed screwdriver, unsnap the left snap of the controls bracket assembly (34) first, then unsnap the right snap.

9. Remove the controls bracket assembly (34).

10. Remove the controls seal (35).

11. Disassemble the controls bracket assembly (34) by disengaging the snaps to remove the bottom bracket (33).

12. Replace the switch that leaks by following the unsoldering and replacement instructions contained in the new switch's instruction sheet.

13. Reassemble the controls bracket assembly (34) by snapping the two brackets together.

14. Install the controls seal (35).

15. Reassemble the controls bracket assembly (34) into the housing (2) by snapping in the right side of the bracket first, then snapping in the left side.

16. Referring to Section "8.6 Frequency Knob" on page 8-10 and Section "8.7 Volume Knob" on page 8-11, install the frequency knob, new frequency escutcheon, new frequency insert, secure lever, lightpipe, volume knob, new volume insert, and O-ring.

17. Reconnect the controls flex (18) to the universal connector and the PTT area of the housing assembly (2). Make sure the spring tabs on the backer fully engage the catch features on the housing.

18. Install a new main seal O-ring (55) around the casting assembly (51).

19. Reassemble the housing assembly (2) to the radio.

20. Inspect the main seal (55) for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing (2) and the casting (51).
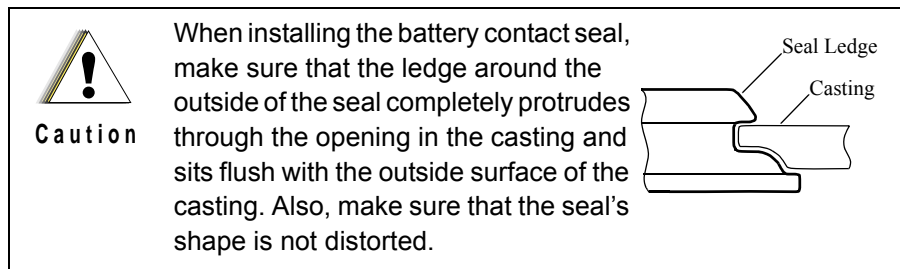
8.10.9.5 Main Seal

To replace the main seal:

1. Referring to Section "8.8.1 Separate the Casting and Housing Assemblies" on page 8-12, remove the housing assembly (2) from the radio.

2. Remove and discard the main seal (55).

3. Inspect the housing and casting seal surfaces for debris or damage. Remove any debris and replace the housing (2) or casting (51) if damaged.

4. Install a new main seal O-ring (55) around the casting assembly (51).

5. Reassemble the housing assembly (2) to the radio.

6. Inspect the main seal (55) for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing (2) and the casting (51).

8.10.9.6 Battery Contact and Battery Contact Seal

To replace the battery contact and battery contact seal:

1. Referring to Section "8.8.1 Separate the Casting and Housing Assemblies" on page 8-12, remove the housing assembly (2) from the radio.

2. Completely disassemble the casting assembly (51).

3. Remove and discard the leaking component.

4. Inspect the casting seal surface for debris or damage. Remove any debris and replace casting if damaged.

5. Install a new battery contact (49) and a new battery contact seal (50), if necessary.

> **! Caution**
> When installing the battery contact seal, make sure that the ledge around the outside of the seal completely protrudes through the opening in the casting and sits flush with the outside surface of the casting. Also, make sure that the seal's shape is not distorted.
>
> Seal Ledge
> Casting

6. Reassemble the casting assembly (51).

7. Install a new main seal O-ring (55) around the casting assembly (51).

8. Reassemble the housing assembly (2) to the radio.

9. Inspect the main seal (55) for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing (2) and the casting (51).

8.10.9.7 Keypad

To replace the keypad:

1. Referring to Section "8.8.1 Separate the Casting and Housing Assemblies" on page 8-12, remove the housing assembly (2) from the radio.

2. Remove and discard the keypad (15).

3. Inspect the housing seal surface for debris or damage. Remove any debris and replace housing if damaged.

4. Install new keypad (15).

5.   Install a new main seal O-ring (55) around the casting assembly (51).

6.   Reassemble the housing assembly (2) to the radio.

7.   Inspect the main seal (55) for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing (2) and the casting (51).

8.10.9.8 Vacuum Port Seal

To replace the vacuum port seal:

1.   Remove the vacuum port plug (59), using a pair of needle-nosed pliers and pulling upward.

2.   Inspect the casting seal surface for debris or damage. Remove any debris and replace the casting if damaged.

3.   Install a new vacuum port plug (59) by pressing it in, ensuring that the plug sits flat all around the edges and it is flush with the casting.

Table 8-2. Submersible Radio Torque Specifications

Application	Torque (in.-lbs)	Torque (N•m)	Torque Bit Part Number
Speaker Bracket Screw	2	0.23	66-80321B79

8.10.9.9 Vent Port Seal

To replace the vent port seal:

1.   Remove the seal label (62) that covers the vent port seal (61).

2.   Remove the vent port seal (61).

3.   Ensure that the casting's surfaces are clean and free from any adhesive or other foreign materials.

4.   Install a new vent port seal (61), covering the two vent port holes, in the small recessed area in the casting. Ensure that no oily substances come in contact with the seal.

5.   Install a new seal label (62) over the vent port seal (61) in the larger recessed area in the casting. Press down evenly over the label's surface to ensure good adhesion.

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 XTS 5000 Portable Radios Detailed Service Manual," Motorola publication number 68P81094C31.

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
01/20	ABACUS Tune Failure Non-Fatal Error	Turn the radio off, then on
01/22	Tuning Codeplug 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
01/88	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
01/98	Internal RAM Fail 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
02/90	General DSP Hardware Failure (DSP startup message not received correctly)	Turn the radio off, then on

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

Error Code	Description	Corrective Action
09/10	Secure Hardware Error	Turn the radio off, then on
09/90	Secure Hardware Fatal Error	Turn the radio off, then on
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	
No Receive Audio, or Receiver Does Not Unmute	Programming	1. Does the transmitted signal match the receiver configuration (PL, DPL, etc.)? 2. With the monitor function enabled, can the radio be unmuted?

Table 9-3. Receiver Troubleshooting Chart (Continued)

Symptom	Possible Cause	Correction or Test (Measurements at Room Temperature)
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 XTS 5000 digital portable radios. The following table lists the exploded views for each of the XTS 5000 radio models:

Table 10-1. XTS 5000 Exploded Views

View	Page
Model I Exploded View	10-2
Models II and III Exploded View	10-4

10.1   Model I Exploded View
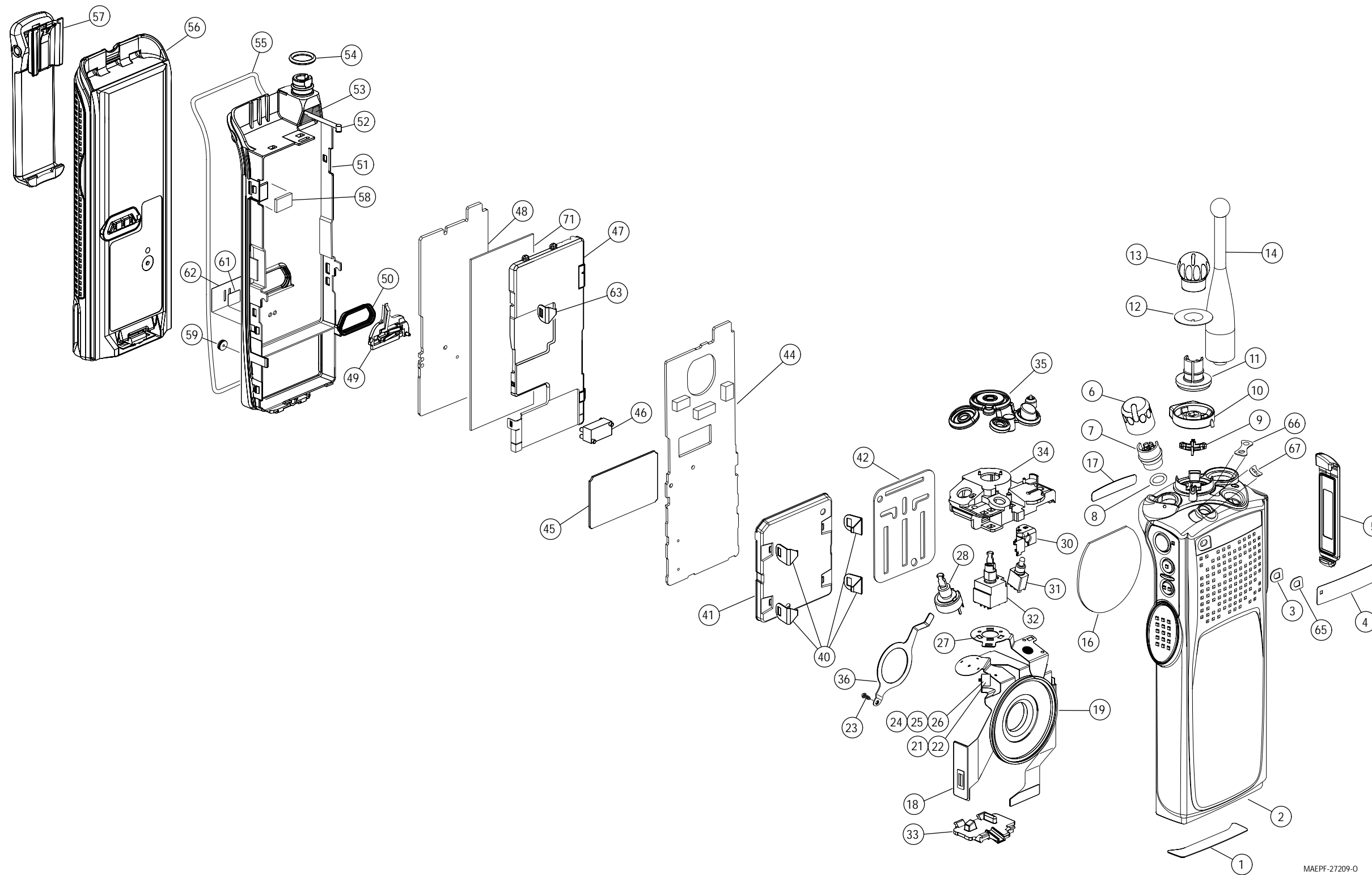
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Figure 10-1. Model I Exploded View

10.2 Model I Exploded View Parts List

Item No.	Motorola Part Number	Description
1	3305630Z02	LABEL, Motorola Bottom (non-intrinsic) (part of item 2)
	or 3305630Z04	LABEL, Motorola Bottom (intrinsic) (part of item 2)
2	1585468D07	ASSEMBLY, Model I Housing (standard models) (includes items 1, 3, 4, 5, 16, 17, and 65 thru 67)
	or 1585468D10	ASSEMBLY, Model I Housing (R models) (includes items 1, 3, 4, 5, 16, 17, and 65 thru 67)
	or 1585468D13	ASSEMBLY, Model I Housing (yellow R model) (includes items 1, 3, 4, 5, 16, 17, and 65 thru 67)
3	3285757D01	MEMBRANE, Microphone (part of item 2)
4	3385221D01	LABEL, Motorola Front (part of item 2)
	or 3385221D02	LABEL, Motorola Front (R model) (part of item 2)
	or 3385221D03	LABEL, Motorola Front (yellow R model) (part of item 2)
5	1505579Z01	COVER, Universal Connector (part of item 2)
6	3605371Z01	KNOB, Volume
7	4305372Z01	INSERT, Volume Knob Retainer
8	3205379W01	O-RING, Volume Torque
9	6105376Z01	LIGHTPIPE, Indicator
10	4505375Z01	LEVER, Secure
11	4305373Z02	INSERT, Frequency Knob Retainer
12	1305374Z03	ESCUTCHEON, Frequency Dial
13	3605370Z01	KNOB, Frequency
14	- - - - - - - - - -	See Section "A.1 Antennas" on page A-1 in "Appendix A: Accessories"
16	3585340D01	MESH, Speaker (part of item 2)
17	3305574Z01	LABEL, Motorola Back (part of item 2)
	or 3305574Z02	LABEL, Motorola Back (yellow R model) (part of item 2)
18	0105956T85	ASSEMBLY, Controls Universal Flex (includes items 19, 21, 22, 24 thru 28, and 30 thru 34)
19	5085272D01	SPEAKER (part of item 18)
21	- - - - - - - - - -	MICROPHONE, Electret (part of item 18) (not field replaceable)
22	- - - - - - - - - -	CAPACITOR, 56pF (part of item 18) (not field replaceable)
23	0300140332	SCREW, Tapping - 28 x 3/16
24	0660076A93	RESISTOR, 68kΩ (part of item 18)
25	0660076A96	RESISTOR, 91kΩ (part of item 18)
26	0660076B05	RESISTOR, 150kΩ (part of item 18)
27	4805729G99	LED, Green/Red (5 required) (part of item 18)
28	1805629V04	POTENTIOMETER, Volume (part of item 18)
30	1486164A02	BOOT, Microphone Boot (part of item 18)
31	4005572W04	SWITCH, Toggle, 3 Pos. A/B/C (part of item 18)
32	4002622J04	SWITCH, Frequency (part of item 18)
33	0705357Z01	BRACKET, Controls Bottom (part of item 18)
34	0705352Z01	BRACKET, Controls (part of item 18)
35	3205354Z02	SEAL, Controls

Item No.	Motorola Part Number	Description
36	4285400D01	RETAINER, Speaker
40	4205631Z01	CLIP, Control Locking (part of item 41) (4 required)
41	2685567D01	SHIELD, Controller Front (includes items 40 and 42)
42	4285288D01	RETAINER (part of item 41)
44	NTN9564	KIT, VOCON Board (Revision O and A)
	or NNTN4563	KIT, VOCON Board, VHF (Revision B)
	or NNTN4819	KIT, VOCON Board, UHF (Revision A)
	NNTN4717	KIT, VOCON Board, All Bands (Revision D)
45	NTN9837A or NNTN5032	DES, DES-XL, DES-OFB with DVP-XL Encryption Kit - UCM
	or NTN9838A	DVI-XL Encryption Kit - UCM
	or NTN9839A	DVP-XL Encryption Kit - UCM
	or NNTN4006A	DES, DES-XL, DES-OFB Encryption Kit - UCM
46	2885866A01	CONNECTOR, Compression, 26-Pin
47	2685930E01	SHIELD, RF with Insulator and Clip (includes item 63)
48	NUF3577	KIT, Transceiver Board, 700/800MHz
	or NLD8910	KIT, Transceiver Board, VHF
	or NLE4272	KIT, Transceiver Board, UHF R1
	or NLE4273A	Kit, Transceiver Board, UHF R2
49	0985973B01	ASSEMBLY, B+
	or 0985973B02	ASSEMBLY, B+ (R models)
50	3205351Z02	SEAL, B+
51	2785219D01	ASSEMBLY, Casting
	or 2785219D04	ASSEMBLY, Casting (R models)
52	3005664Z01	ASSEMBLY, Coaxial Cable
53	7505487Z01	PAD, Coaxial
54	3205082E96	GASKET, O-Ring Bushing
55	3205349Z03	SEAL, Main
56	- - - - - - - - - -	See Section "A.2 Batteries and Battery Accessories" on page A-1 in "Appendix A: Accessories"
57	- - - - - - - - - -	See Section "A.3.1 Belt Clips" on page A-2 in "Appendix A: Accessories"
58	3262737D01	PAD, Thermal
59	3285688D01	PLUG, Vacuum Test Port
61	3285877B02	SEAL, Port
62	3385873B01	LABEL, Seal
63	4285704D01	CLIP, RF Locking (part of item 47)
65	3585741D01	MESH, Microphone (part of item 2)
66	3385658D01	ESCUTCHEON, Concentric Switch (part of item 2)
67	3385657D01	ESCUTCHEON, Toggle (part of item 2)
71	7585936D04	PAD, UHF Range 1/700/800 MHz
	or 7585936D02	PAD, VHF, UHF R2, VHF

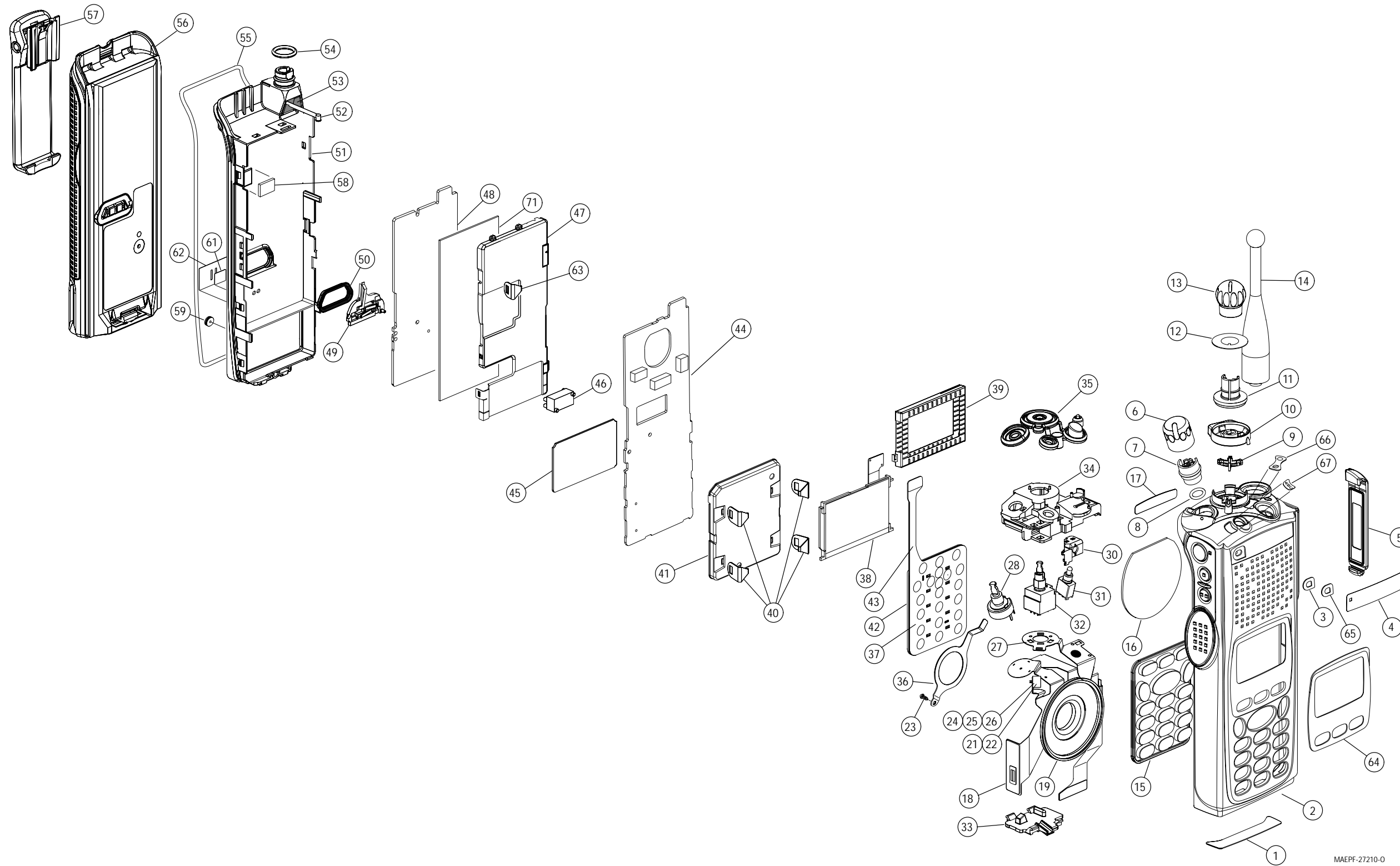## 10.3 Models II and III Exploded View

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Figure 10-2. Models II and III Exploded View

10.4　Models II and III Exploded View Parts List

Item No.	Motorola Part Number	Description
1	3305630Z02	LABEL, Motorola Bottom (non-intrinsic) (part of item 2)
	or 3305630Z04	LABEL, Motorola Bottom (intrinsic) (part of item 2)
2	1585468D08	ASSEMBLY, Model II Housing (standard models) (includes items 1, 3, 4, 5, 16, 17, and 64 thru 67)
	or 1585468D11	ASSEMBLY, Model II Housing (R models) (includes items 1, 3, 4, 5, 16, 17, and 64 thru 67)
	or 1585468D14	ASSEMBLY, Model II Housing (yellow R model) (includes items 1, 3, 4, 5, 16, 17, and 64 thru 67)
	1585468D09	ASSEMBLY, Model III Housing (standard models) (includes items 1, 3, 4, 16, 17, and 64 thru 67)
	or 1585468D12	ASSEMBLY, Model III Housing (R models) (includes items 1, 3, 4, 16, 17, and 64 thru 67)
	or 1585468D15	ASSEMBLY, Model III Housing (yellow R model) (includes items 1, 3, 4, 5, 16, 17, and 64 thru 67)
3	3285757D01	MEMBRANE, Microphone (part of item 2)
4	3385221D01	LABEL, Motorola Front (part of item 2)
	or 3385221D02	LABEL, Motorola Front (R models) (part of item 2)
	or 3385221D03	LABEL, Motorola Front (yellow R models) (part of item 2)
5	1505579Z01	COVER, Universal Connector (part of item 2)
6	3605371Z01	KNOB, Volume
7	4305372Z01	INSERT, Volume Knob Retainer
8	3205379W01	O-RING, Volume Torque
9	6105376Z01	LIGHTPIPE, Indicator
10	4505375Z01	LEVER, Secure
11	4305373Z02	INSERT, Frequency Knob Retainer
12	1305374Z03	ESCUTCHEON, Frequency Dial
13	3605370Z01	KNOB, Frequency
14	- - - - - - - - - -	See Section "A.1 Antennas" on page A-1 in "Appendix A: Accessories"
15	7585104D01	KEYPAD, Model III
	or 7585104D02	KEYPAD, Model II
16	3585340D01	MESH, Speaker (part of item 2)
17	3305574Z01	LABEL, Motorola Back (part of item 2)
	or 3305574Z02	LABEL, Motorola Back (yellow R models) (part of item 2)
18	0105956T85	ASSEMBLY, Controls Universal Flex (includes items 19, 21, 22, 24 thru 28, and 30 thru 34)
19	5085272D01	SPEAKER (part of item 18)
21	- - - - - - - - - -	MICROPHONE, Electret (part of item 18) (not field replaceable)
22	- - - - - - - - - -	CAPACITOR, 56pF (part of item 18) (not field replaceable)
23	0300140332	SCREW, Tapping - 28 x 3/16
24	0660076A93	RESISTOR, 68kΩ (part of item 18)
25	0660076A96	RESISTOR, 91kΩ (part of item 18)
26	0660076B05	RESISTOR, 150kΩ (part of item 18)
27	4805729G99	LED, Green/Red (5 required) (part of item 18)
28	1805629V04	POTENTIOMETER, Volume (part of item 18)

Item No.	Motorola Part Number	Description
30	1486164A02	BOOT, Microphone Boot (part of item 18)
31	4005572W04	SWITCH, Toggle, 3 Pos. A/B/C (part of item 18)
32	4002622J04	SWITCH, Frequency (part of item 18)
33	0705357Z01	BRACKET, Controls Bottom (part of item 18)
34	0705352Z01	BRACKET, Controls (part of item 18)
35	3205354Z02	SEAL, Controls
36	4285400D01	RETAINER, Speaker
37	2685567D03	ASSEMBLY, Keypad Flex, Model III (includes items 41 and 43)
	2685567D02	ASSEMBLY, Keypad Flex, Model II (includes item 41 and 43)
38	7285726C01	MODULE, LCD (700–800 MHz)
	or 7285726C02	MODULE, LCD (700-800 MHz, VHF)
	or 7285726C03	MODULE, LCD (UHF R1, UHF R2)
39	7585189D01	PAD, Display Locator
40	4205631Z01	CLIP, Control Locking (part of item 41) (4 required)
41	2685567D01	SHIELD, Controller Front (includes items 40 and 42)
42	- - - - - - - - - -	RETAINER (part of item 41)
43	8485188D01	FLEX, Keypad, Model III (part of item 37)
	or 8485187D01	FLEX, Keypad, Model III (part of item 37)
44	NTN9564	KIT, VOCON Board (Revision O and A)
	or NNTN4563	KIT, VOCON Board, VHF (Revision B)
	or NNTN4819	KIT, VOCON Board, UHF (Revision A)
	or NNTN4717	KIT, VOCON Board, All Bands (Revision D)
45	NTN9837A	DES, DES-XL, DES-OFB with DVP-XL Encryption Kit - UCM
	or NNTN5032	
	or NTN9838A	DVI-XL Encryption Kit - UCM
	or NTN9839A	DVP-XL Encryption Kit - UCM
	or NNTN4006A	DES, DES-XL, DES-OFB Encryption Kit - UCM
46	2885866A01	CONNECTOR, Compression, 26-Pin
47	2685930E01	SHIELD, RF with Insulator and Clip (includes item 63)
48	NUF3577	KIT, Transceiver Board, 700/800MHz
	or NLD8910	KIT, Transceiver Board, VHF
	or NLE4272	KIT, Transceiver Board, UHF
	or NLE4273A	KIT, Transceiver Board, UHF R2
49	0985973B01	ASSEMBLY, B+
	or 0985973B02	ASSEMBLY, B+ (R models)
50	3205351Z02	SEAL, B+
51	2785219D01	ASSEMBLY, Casting
	or 2785219D04	ASSEMBLY, Casting (R models)
52	3005664Z01	ASSEMBLY, Coaxial Cable
53	7505487Z01	PAD, Coax
54	3205082E96	GASKET, O-Ring Bushing
55	3205349Z03	SEAL, Main
56	- - - - - - - - - -	See Section "A.2 Batteries and Battery Accessories" on page A-1 in "Appendix A: Accessories"
57	- - - - - - - - - -	See Section "A.3.1 Belt Clips" on page A-2 in "Appendix A: Accessories"
58	3262737D01	PAD, Thermal
59	3285688D01	PLUG, Vacuum Test Port

Item No.	Motorola Part Number	Description
61	3285877B02	SEAL, Port
62	3385873B01	LABEL, Seal
63	4285704D01	CLIP, RF Locking (part of item 47)
64	3385419C01	BEZEL, Display–Titanium Silver (part of item 2)
	or 3385419C07	BEZEL, Display–Black (part of item 2)
	or NNTN4071	BEZEL Display Kit
65	3585741D01	MESH, Microphone (part of item 2)
66	3385658D01	ESCUTCHEON, Concentric Switch (part of item 2)
67	3385657D01	ESCUTCHEON, Toggle (part of item 2)
71	7585936D04	PAD, UHF Range 1/700/800 MHz
	or 7585936D02	PAD, VHF, UHF R2, VHF

Notes

Appendix A   Accessories

Motorola provides the following approved optional accessories to improve the productivity of the XTS 5000 portable radio.

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

A.1   Antennas

NAD6563	136-174 MHz helical
NAD6566	136-150.8 MHz helical
NAD6567	150.8-162 MHz helical
NAD6568	162-174 MHz helical
NAE6546	380-435 MHz helical
NAE6547	435-470 MHz helical
NAE6548	470-512 MHz helical
NAE6549	380-520 MHz wideband whip
NAF5037	800 MHz whip, halfwave (806-870 MHz)
NAF5042	800 MHz stubby, quarterwave (806-870 MHz)
NAF5080	700/800 MHz whip (764-870 MHz)

A.2   Batteries and Battery Accessories

HNN9031	1525 mAh NiCd impres™ (non-FM)
HNN9032	1525 mAh NiCd impres™ Intrinsically Safe (FM)
NNTN4435	1800 mAh NiMH impres™ (non-FM)
NNTN4436	1750 mAh NiMH impres™ Intrinsically Safe (FM)
NNTN4437	1750 mAh NiMH impres™ Intrinsically Safe (FM) Ruggedized
NTN9862	2000 mAh impres™ Li Ion
NTN8294	1525 mAh NiCd (non FM)
NTN8295	1525 mAh NiCd Intrinsically Safe (FM)
NTN8297	1525 mAh NiCd Intrinsically Safe (FM) Ruggedized
NTN8299	1700 mAh NiMH Intrinsically Safe (FM)
NTN8610	1650 mAh Li Ion
NTN8923	1800 mAh NiMH ultra-capacity (non FM)
RNN4006	3000 mAh NiMH (non FM)
RNN4007	3000 mAh NiMH Intrinsically Safe (FM)
NTN9177	Battery holder, clamshell, black (requires 12AA alkaline batteries)
NTN9183	Battery holder, clamshell, orange (requires 12AA alkaline batteries)

A.3   Carry Accessories

A.3.1   Belt Clips

NTN8266	Belt clip kit, 2.25", plastic (compatible with clamshell batteries)
NTN8460	Public Safety belt clip, 3.0", metal (VHF use only)
NTN9179	Combo, high-activity D clip (NTN9212) and high-activity belt loop (NTN9213)
NTN9212	D clip, high-activity, swivel (for use with NTN9213)

A.3.2   Belt Loops

NTN8039	Swivel Belt Loop, 2.5" (for use only with the high-activity leather swivel snap carry cases)
NTN8040	Belt Loop, Swivel, Leather, 3.0", High-Activity (for use only with the high-activity leather swivel snap carry cases)
NTN8383	T-strap, Plain, Action Snaps
NTN9213	Belt loop, 2.5", High-Activity, D Clip

A.3.3   Carry Cases

NTN8380	Case, hard leather high-activity (includes swivel belt loop and T-strap), 2.5" belt loop, for Model II and III radios
NTN8381	Case, hard leather high-activity (includes swivel belt loop and T-strap), 3.0" belt loop, for Model II and III radios
NTN8382	Case (includes belt loop and T-strap), for Model II and III radios
NTN8385	Case, hard leather high-activity (includes swivel belt loop and T-strap), 2.5" belt loop, for Model I radio
NTN8386	Case, hard leather high-activity (includes swivel belt loop and T-strap), 3.0" belt loop, for Model I radio
NTN8387	Leather case (includes belt loop and T-strap), for Model I radio
NTN8725	Nylon carry case with belt loop and T-strap
NTN9184	Leather case (includes belt loop), for clamshell battery

A.4   Chargers

NTN1667	Single-unit, tri-chemistry, rapid rate, 110 V
NTN1668	Single-unit, tri-chemistry, rapid rate, 230 V (2-prong Euro plug)
NTN1669	Single-unit, tri-chemistry, rapid rate, 230 V (3-prong UK plug)
WPLN4108	impres™ multi-unit, tri-chemistry, 110 V (US, NA plug)
WPLN4111	impres™ single-unit, tri-chemistry, 110 V
WPLN4130	impres™ multi-unit, tri-chemistry, with display (US, NA plug)

A.5   Surveillance Accessories

A.5.1   Earpieces

BDN6664	Earpiece with standard earphone, beige
BDN6665	Earpiece with extra-loud earphone (exceeds OSHA limits), beige
BDN6666	Earpiece with volume control, beige
BDN6667	Earpiece, mic and PTT combined, beige
BDN6668	Earpiece, mic and PTT separate, beige
BDN6669	Earpiece, mic and PTT combined, with extra-loud earphone (exceeds OSHA limits), beige
BDN6670	Earpiece, mic and PTT separate with extra-loud earphone (exceeds OSHA limits), beige
BDN6726	Earpiece with standard earphone, black
BDN6727	Earpiece with extra-loud earphone (exceeds OSHA limits), black
BDN6728	Earpiece with volume control, black
BDN6726	Earpiece with Standard Earphone, Black
BDN6727	Earpiece with Extra-Loud Earphone (exceeds OSHA limits), Black
BDN6728	Earpiece with Volume Control, Black
BDN6729	Earpiece, mic and PTT combined, black
BDN6730	Earpiece, mic and PTT separate, black
BDN6731	Earpiece, mic and PTT combined, with extra-loud earphone (exceeds OSHA limits), black
BDN6732	Earpiece, mic and PTT separate, with extra-loud earphone (exceeds OSHA limits), black
BDN6780	Earbud, single with mic and PTT combined, beige
BDN6781	Earbud, single, receive only, black

A.5.2   Headsets and Headset Accessories

BDN6635	Heavy-duty VOX headset with noise-canceling boom mic (requires BDN6673 adapter cable)
BDN6636	Heavy-duty VOX headset with throat mic (requires BDN6673 adapter cable)
BDN6645	Noise-canceling boom mic headset with PTT on earcup
BDN6673	Headset adapter cable (for use with BDN6635, BDN6636, and BDN6645)
BDN6676	3.0 mm threaded adapter jack
NMN1020	Safety helmet headset (requires BDN6676 adapter cable)
NMN6245	Light-weight headset
NMN6246	Ultralite headset with boom mic
NMN6258	Over-the-head headset with in-line PTT
NMN6259	Medium-weight, dual headset with NC mic
NTN8613	Keyload adapter
RMN4049	Temple Transducer

A.5.3   Radio Interface Modules for Ear Microphones

BDN6641	Ear mic, high noise level up to 105 dB, grey (must order interface module separately)
BDN6677	Ear mic, standard, noise up to 95 dB (must order interface module separately), black
BDN6678	Ear mic, standard, noise up to 95 dB (must order interface module separately), beige
BDN6671	Push-to-talk (PTT) and voice-activated (VOX) interface module (for use with BDN6641, BDN6677, and BDN6678)
BDN6708	PTT interface module (for use with BDN6641, BDN6677, and BDN6678)

A.5.4   Speaker, Remote Speaker, and Public Safety Microphones

NMN6191	RSM noise-canceling (includes 6.0' coiled cord assembly, 3.5mm earjack, swivel clip, quick disconnect)
NMN6193	Remote speaker mic
NMN6247*	Public safety mic with straight cord, 30"
NMN6250*	Public safety mic with straight cord, 24"
NMN6251*	Public safety mic with straight cord, 18"
RMN5021	Commander, smart remote speaker mic
RMN5023	Commander, submersible smart remote speaker mic

** For XTS 5000 UHF Range 1 radio models. Use only approved antennas NAE6547 or
NAE6549 with these microphones.*

A.5.5 CommPort® Integrated Microphone/Receiver

NTN1624	CommPort with palm PTT
NTN1625	CommPort ear mic with PTT for noise levels up to 100 dB (requires BDN6676 adapter)
NTN1663	CommPort ear mic with ring PTT for noise levels up to 100 dB (requires BDN6676 adapter)
NTN1736	CommPort ear mic with snap-on side PTT for noise levels up to 100 dB (requires BDN6676 adapter)
NNTN4186	CommPort ear mic receiver w/ body PTT

A.6 Switches

0180300E83	Remote PTT body switch for EMS
NTN7660	Tilt / man down switch
NTN8327	External RF switch

A.7 Vehicular Adapters

A.7.1 Accessories

HMN4069	Next-generation mobile mic
HSN1006	Speaker, 6-watt
NKN6455	Cable, 6-watt speaker
NTN1606	Vehicular adapter, BNC, open face
NTN1607	Vehicular adapter, BNC, closed face
NTN8560	Vehicular adapter, mini-U, open face
NTN8561	Vehicular adapter, mini-U, closed face
NTN8940	Vehicular adapter, trunnion mount
NTN9176	Vehicular charger, XTS, tri-chemistry, compatible with PAC•RT
PLN7737	Handheld control head
RLN4884	XTS travel charger (uses cigarette lighter adapter)

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.

Crystal orders should specify the crystal type number, crystal and carrier frequency, and the model number in which the part is used.

B.2   Transceiver Board and VOCON Board Ordering Information

When ordering a replacement Transceiver Board or VOCON Board, refer to the applicable Model Chart in the front of this manual, read the Transceiver Board or VOCON Board note, and include the proper information with your order.

B.3   Motorola Online

Motorola Online users can access our online catalog at

https://www.motorola.com/businessonline

To register for online access, please call 800-814-0601 (for U.S. and Canada Service Centers only). International customers can obtain assistance at https://businessonline.motorola.com.

B.4   Mail Orders

Send written orders to the following addresses:

Replacement Parts/ Test Equipment/Manuals/ Crystal Service Items (United States and Canada)**:**	**Federal Government Orders:**	**International Orders:**
Motorola Inc. Radio Products Services Division* Attention: Order Processing 1307 E. Algonquin Road Schaumburg, IL 60196 U.S.A.	Motorola Inc. U.S. Federal Government Markets Division Attention: Order Processing 7230 Parkway Drive Landover, MD 21076 U.S.A.	Motorola Inc. Radio Products Services Division* (United States and Canada) Attention: Order Processing 1307 E. Algonquin Road Schaumburg, IL 60196 U.S.A.

* The Radio Products Services Division (RPSD) was formerly known as the Customer Care and Services Division (CCSD) and/or the Accessories and Aftermarket Division (AAD).

B.5 Telephone Orders

Radio Products Services Division*
(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
(International Orders)
1-847-538-8023

U.S. Federal Government Markets Division (USFGMD)
1-800-826-1913 Federal Government Parts - Credit Cards Only
8:30 AM to 5:00 PM (Eastern Standard Time)

B.6 Fax Orders

Radio Products Services Division*
(United States and Canada)
1-800-622-6210
(International)
1-847-576-3023

USFGMD
(Federal Government Orders)
1-800-526-8641 (For Parts and Equipment Purchase Orders)

B.7 Parts Identification

Radio Products Services Division*
(United States and Canada)
1-800-422-4210, menu 3

B.8 Product Customer Service

Customer Response Center
(Non-technical Issues)
1-800-247-2346
FAX:1-800-247-2347

* The Radio Products Services Division (RPSD) was formerly known as the Customer Care and Services Division (CCSD) 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.
ADC	*See analog-to-digital converter.*
ADDAG	*See Analog-to-Digital, Digital-to-Analog and Glue.*
ALC	*See automatic level control.*
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.*
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.
band	Frequencies allowed for a specific purpose.
BBP	*See baseband interface port.*
baseband interface port	Synchronous serial interface to the transceiver board used to transfer transmit and receive audio data.
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.
CODEC	*See coder/decoder.*

Term	Definition
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.
CPS	*See Customer Programming Software.*
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.*
default	A pre-defined set of parameters.
digital	Refers to data that is stored or transmitted as a sequence of discrete symbols from a finite set; most commonly this means binary data represented using electronic or electromagnetic signals. *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.
DPL	*See Digital Private Line. See also PL.*
DSP	*See digital signal processor.*
DSP code	*See digital signal processor code.*
DTMF	*See dual tone multi-frequency.*
dual tone multi-frequency	The system used by touch-tone telephones. DTMF assigns a specific frequency, or tone, to each key so that it can easily be identified by a microprocessor.

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

Term	Definition
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.
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.
MDI	MCU/DSP Interface internal to the Patriot IC.
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.

Term	Definition
MISO	*See Master In Slave Out.*
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.*
NiCd	Nickel-cadmium.
NiMH	Nickel-metal-hydride.
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.
paging	One-way communication that alerts the receiver to retrieve a message.
Patriot IC	A dual-core processor that contains an MCU and a DSP in one IC package.
PC Board	Printed Circuit Board. Also referred to as a PCB.
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.*
private-line tone squelch	A continuous sub-audible tone that is transmitted along with the carrier. *See also DPL.*
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.

Term	Definition
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.
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.*

Term	Definition
ROM	*See read-only memory.*
RPCIC	Regulator/power control IC.
RPT/TA	*See repeater/talkaround.*
RSS	*See Radio Service Software.*
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.
Serial Audio CODEC Port	SSI to and from the GCAP II IC CODEC used to transfer transmit and receive audio data.
Serial Communication Interface Input Line	A full-duplex (receiver/transmitter) asynchronous serial interface.
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.*

Term	Definition
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.
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).
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.
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.
TSOP	*See thin small-outline package.*
TX	Transmit.
UART	*See also Universal Asynchronous Receiver Transmitter.*
UHF	Ultra-High Frequency.
Universal Asynchronous Receiver Transmitter	A microchip with programming that controls a computer's interface to its attached serial devices.
Universal Serial Bus	An external bus standard that supports data transfer rates of 12 Mbps.
USB	*See Universal Serial Bus.*
VCO	*See voltage-controlled oscillator.*
vector sum excited linear predictive coding	A voice-encoding technique used in ASTRO digital voice.
VHF	Very-High Frequency.
VIP	Vehicle Interface Port.
VOCON	*See vocoder/controller.*

Term	Definition
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

Index

P

parts, ordering replacement B-1
performance checks
   receiver 5-7
   test setup 5-1
   transmitter 5-8
power amplifier theory of operation 3-4
power-up error codes 9-1
precautions, handling 2-1
pressure test, submergibility 8-19
product safety information i-ii

R

radio
   alignment 6-1
   basic description 1-2
   disassembling
      casting assembly 8-12
      housing assembly 8-13
      separating casting and housing assemblies 8-12
   exploded view
      complete Model I 10-2
      complete Models II and III 10-4
      partial 8-2
   features 1-2
   FLASHport feature 1-2
   information screen 6-4
   interface modules for ear microphones A-4
   Model I
      control top test mode 5-6
      entering non-display test mode 5-6
      RF test mode 5-6
   model numbering system 4-xiii
   models 1-2
   Models II/III
      control top and keypad test mode 5-5
      entering display test mode 5-2
      RF test mode 5-3
      test environments 5-4
      test frequencies 5-4
   reassembling
      casting assembly 8-14
      housing assembly 8-14
      joining casting and housing assemblies 8-15
   submergibility
      pressure test 8-19
      specialized test equipment 8-16
      standards 8-16
      troubleshooting leak areas 8-20
      vacuum test 8-18
   submergible models
      disassembling 8-17
      reassembling 8-17
   test mode
      model I 5-6
      models II and III 5-2
receiver
   ASTRO conventional channel tests 5-8
   backend theory of operation 3-4
   performance checks 5-7
   troubleshooting 9-2
receiving

analog mode 3-2
   ASTRO mode 3-4
reference oscillator alignment 6-4
reference oscillator theory of operation 3-4
replacement parts, ordering B-1
RF exposure compliance information i-ii
RF test mode
   display radio 5-3
   non-display radio 5-6
ruggedized radios
   handling precautions 2-2
   submergibility checks 2-1

S

service aids 4-2
softpot 6-3
speaker, remote speaker and public safety microphone
      accessories A-4
specifications
   700-800 MHz radios 4-xxv
   UHF radios 4-xxiii
   VHF radios 4-xxii
Specifications for UHF Range 2 Radios 4-xxiv
standards, radio submergibility 8-16
submergibility
   pressure test 8-19
   radio disassembly 8-17
   radio reassembly 8-17
   specialized test equipment 8-16
   standards 8-16
   troubleshooting leak areas 8-20
   vacuum test 8-18
surveillance accessories A-3
switch accessories A-5
synthesizer theory of operation 3-4

T

terms and definitions Glossary-1
test equipment
   recommended 4-1
   specialized submergibility 8-16
test mode, entering
   display radios 5-2
   non-display radios 5-6
test setup
   alignment 6-1
   performance checks 5-1
tests
   receiver
      ASTRO conventional channels 5-8
      performance checks 5-7
   transmitter
      ASTRO conventional channels 5-9
      performance checks 5-8
theory of operation
   Abacus III 3-4
   analog mode 3-2
   ASTRO mode 3-4
   first IF frequencies 3-4
   frequency generation 3-4
   local oscillator frequencies 3-4

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