MOTOROLA

ASTRO® XTS 5000™ Digital Portable Radios Basic Service Manual

Model I

Model II

Model III

Foreword

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

Included in this manual are: radio specifications for the 700/800 MHz frequency band; a general description of ASTRO Digital XTS 5000 models; recommended test equipment, service aids, and tools; radio alignment procedures; disassembly/reassembly procedures; exploded views and parts lists, and general maintenance recommendations.

For details on the operation of the radio, or component-level troubleshooting, refer to the applicable manuals, available separately. To help you with your selection, a list is provided under "Related Publications" at the front of this manual.

Safety

Before operating an ASTRO XTS 5000 Radio, please read the "User Safety, Training, and General Information" section in the front of this manual.

Manual Revisions

Changes which occur after this manual is printed are described in "FMRs." These FMRs provide complete information on changes, including pertinent parts list data.

Computer Software Copyrights

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Commercial, Government and Industrial Solutions Sector
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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 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:

- any of the seals on the battery enclosure of cells are broken or show evidence of tampering.
- the damage or defect is caused by charging or using the battery in equipment or service other than the Product for which it is specified.

H) Freight costs to the repair depot.

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

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

K) Normal and customary wear and tear.

VI.Patent And Software Provisions

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

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

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

C) should the Product or parts become, or in MOTOROLA's opinion be likely to become, the subject of a claim of infringement of a United States patent, that such purchaser will permit MOTOROLA, at its option and expense, either to procure for such purchaser the right to continue using the Product or parts or to replace or modify the same so that it becomes non-infringing 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.

Portable Radio Model Numbering System

Typical Model Number:	H	1	8	U	C	F	9	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 = 403 to 437MHz
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 870 MHz
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

Position 8 - Primary Operation

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

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

Position 9 - Primary System Type

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

** MPT = Ministry of Posts and Telecommunications*

Position 10 - Feature Level

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

Position 11 - Version

Version Letter (Alpha) - Major Change

Position 12 - Unique Model Variations

C = Cenelec
N = Standard Package

Positions 13 - 16

SP Model Suffix

ASTRO Digital XTS 5000 Model Chart

MODEL NUMBER	DESCRIPTION
H18UCC9PW5AN	700/800MHz 1-3 Watts ASTRO Digital XTS 5000 Model I
H18UCF9PW6AN	700/800MHz 1-3 Watts ASTRO Digital XTS 5000 Model II
H18UCH9PW7AN	700/800MHz 1-3 Watts ASTRO Digital XTS 5000 Model III

			ITEM NUMBER	DESCRIPTION
X	X	X	NUF3577_	Board, Transceiver (700/800MHz)
X	X	X	NTN9564_	Board, VOCON *
X	X	X	NTN8266_	Belt Clip Kit
X	X	X	HNN9031_	Battery, Nickel-Cadmium, Ultra-High Capacity
X			NTN9682_	Kit, Front Cover, Model I
	X		NTN9681_	Kit, Front Cover, Model II
		X	NTN9680_	Kit, Front Cover, Model III
X	X	X	NAF5080_	Antenna, 700/800 MHz
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 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	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 Digital XTS 5000 R (Ruggedized) Model Chart

MODEL NUMBER	DESCRIPTION
H18UCC9PW5AN w/Q155FP Opt	Ruggedized 700/800MHz 1-3 Watts ASTRO Digital XTS 5000 Model I
H18UCF9PW6AN w/Q155FQ Opt	Ruggedized 700/800MHz 1-3 Watts ASTRO Digital XTS 5000 Model II
H18UCH9PW7AN w/Q155FR Opt	Ruggedized 700/800MHz 1-3 Watts ASTRO Digital XTS 5000 Model III
H18UCC9PW5AN w/Q155GB Opt	Ruggedized Yellow 700/800MHz 1-3 Watts ASTRO Digital XTS 5000 Model I
H18UCF9PW6AN w/Q155GC Opt	Ruggedized Yellow 700/800MHz 1-3 Watts ASTRO Digital XTS 5000 Model II
H18UCH9PW7AN w/Q155GD Opt	Ruggedized Yellow 700/800MHz 1-3 Watts ASTRO Digital 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_	Board, VOCON *
X	X	X	X	X	X							NTN8266_	Belt Clip Kit
X	X	X	X	X	X							NTN8297_	Battery, Nickel-Cadmium (1525mAh)
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							NAF5080_	Antenna, 700/800 MHz
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 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	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.

SPECIFICATIONS FOR 700/800 MHZ RADIOS

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

GENERAL

FCC Designation: AZ489FT5806

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

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

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

Transmit Current Drain (Typical): 1400mA
Receive Current Drain (Rated Audio): 240mA
Standby Current Drain: 80mA

Recommended Battery:
- **Ultra-HIgh-Capacity Smart NiCd:** HNN9031_
- *or* **Ultra-HIgh-Capacity NiCd:** NTN8294_
- *or* **Extended-Capacity NiMH:** NTN8293_
- *or* **Li-Ion:** NTN8610_
- *or* **Ultra–High-Capacity NiCd FM:** NTN8295_*
- *or* **Ultra–High-Capacity NiMH FM:** NTN8299_*

Optional FM (Factory Mutual) Battery:

* FM Intrinsically Safe: Class I, II, III, Division 1, Groups C, D,E, F, and G. FM Non-incendive: Class 1, Division 2, Groups A, B, C, and D.

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"
(167.13mm x 61.90mm x 46.42mm/
167.13mm x 59.49mm x 24.56mm)

With Battery:
6.58" x 2.44" x 1.83"/6.58" x 2.34" x 1.65"
(167.13mm x 61.90mm x 46.42mm/
167.13mm x 59.49mm x 41.97mm)

Weight: (w/ Antenna)
- **Less Battery:** 14.10oz. (383gm)
- **With Ultra-High Cap. NiCd:** 25.19oz. (693gm)
- **With Li-Ion:** 20.41oz. (583gm)
- **With Ultra-High Cap. NiMH:** 23.45oz. (644gm)
- **With Extended- Cap. NiMH:** 24.04oz. (682gm)

RECEIVER

Frequency Range: 764-870MHz

Bandwidth: 106MHz

Usable Sensitivity (typical)
(12dB SINAD): 0.20µV

Intermodulation (typical): –75dB

Selectivity (typical)
- **(25/30kHz Channel):** –72dB
- **(12.5kHz Channel):** –63dB

Spurious Rejection (typical): –75dB

Frequency Stability
(–30+60°C; 25°C reference): ±.00015%

Rated Audio: 500mW

FM Hum and Noise (typical):
- 25kHz –48dB
- 12.5kHz –40dB

Distortion (typical): 1.5%

Channel Spacing: 12.5/25 kHz

TRANSMITTER

Frequency Range: 764-870MHz

RF Power:
- **764-806MHz:** 2.5 Watts
- **806-870MHz:** 3 Watts

Frequency Stability (typical)
(–30 to +60°C; 25°C ref.): ±.00015%

Emission (typical conducted): –75dBc

FM Hum and Noise (typical)
- **(Companion Receiver):** 25kHz –45dB
- 12.5kHz –40dB

Distortion (typical): 1.5% (typical)

Modulation Limiting: 25kHz chnls ±5.0kHz
12.5kHz chnls ±2.5kHz

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

Specifications subject to change without notice

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User Safety, Training, and General Information

READ THIS IMPORTANT INFORMATION ON SAFE AND EFFICIENT OPERATION BEFORE USING YOUR MOTOROLA HANDHELD PORTABLE TWO-WAY RADIO

The information provided in this document supersedes the general safety information contained in user guides published prior to June 2001. For information regarding radio use in a hazardous atmosphere please refer to the Factory Mutual (FM) Approval Manual Supplement or Instruction Card, which is included with radio models that offer this capability.

Compliance with RF Energy Exposure Standards

Your Motorola two-way radio is designed and tested to comply with a number of national and international standards and guidelines (listed below) regarding human exposure to radio frequency electromagnetic energy. This radio complies with the IEEE (FCC) and ICNIRP exposure limits for occupational/controlled RF exposure environment at duty cycles of up to 50% talk-50% listen and should be used for occupational use only. In terms of measuring RF energy for compliance with the FCC exposure guidelines, your radio radiates measurable RF energy only while it is transmitting (during talking), not when it is receiving (listening) or in standby mode. Note that the approved, supplied batteries for this radio are rated for a 5-5-90 duty cycle (5% talk-5% listen - 90% standby), even though this radio complies with the FCC occupational exposure limits at duty cycles of up to 50% talk.

Your Motorola two-way radio complies with the following RF energy exposure standards and guidelines:

- United States Federal Communications Commission, Code of Federal Regulations; 47CFR part 2 sub-part J
- American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronic Engineers (IEEE) C95.1-1999 Edition
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6. Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz, 1999
- Australian Communications Authority Radiocommunications (Electromagnetic Radiation - Human Exposure) Standard 1999 (applicable to wireless phones only)

- ANATEL, Brasil Regulatory Authority, Resolution 256 (April 11, 2001) "additional requirements for SMR, cellular and PCS product certification."

Operational Instructions and Training Guidelines

To ensure optimal performance and compliance with the occupational/controlled environment RF energy exposure limits in the above standards and guidelines, users should transmit no more than 50% of the time and always adhere to the following procedures:

Transmit and Receive

- **To transmit (talk), push the Push-To-Talk (PTT) button; to receive, release the PTT button.**

Hand-held radio operation

- **Hold the radio in a vertical position with the microphone one to two inches (2.5 to 5 cm) away from the lips.**

Body-worn operation

- **Always place the radio in a Motorola approved clip, holder, holster, case, or body harness for this product.** Use of non-Motorola-approved accessories may exceed FCC RF exposure guidelines.
- If you do not use a Motorola approved body-worn accessory and are not using the radio in the intended use position in front of the face, then ensure the antenna and the radio are kept 2.5 cm (one inch) from the body when transmitting.

Antennas & Batteries

- **Use only Motorola approved supplied antenna or Motorola approved replacement antenna.** Unauthorized antennas, modifications, or attachments could damage the radio and may violate FCC regulations.
- **Use only Motorola approved, supplied batteries or Motorola approved replacement batteries.** Use of non-Motorola-approved antennas or batteries may exceed FCC RF exposure guidelines.

Approved Accessories

- For a list of Motorola approved accessories see the appendix of this user manual or visit the following website which lists approved accessories:

  http://www.motorola.com/cgiss/portables/xts5000.shtml

Electromagnetic Interference/ Compatibility

NOTE: Nearly every electronic device is susceptible to electromagnetic interference (EMI) if inadequately shielded, designed, or otherwise configured for electromagnetic compatibility.

Facilities

To avoid electromagnetic interference and/or compatibility conflicts, turn off your radio in any facility where posted notices instruct you to do so. Hospitals or health care facilities may be using equipment that is sensitive to external RF energy.

Aircraft

When instructed to do so, turn off your radio when on board an aircraft. Any use of a radio must be in accordance with applicable regulations per airline crew instructions.

Medical Devices

Pacemakers

The Advanced Medical Technology Association (AdvaMed) recommends that a minimum separation of 6 inches (15 centimeters) be maintained between a handheld wireless radio and a pacemaker. These recommendations are consistent with those of the U.S. Food and Drug Administration.

Persons with pacemakers should:

- ALWAYS keep the radio more than 6 inches (15 centimeters) from their pacemaker when the radio is turned ON.
- not carry the radio in the breast pocket.
- use the ear opposite the pacemaker to minimize the potential for interference.
- turn the radio OFF immediately if you have any reason to suspect that interference is taking place.

Hearing Aids

Some digital wireless radios may interfere with some hearing aids. In the event of such interference, you may want to consult your hearing aid manufacturer to discuss alternatives.

Other Medical Devices

If you use any other personal medical device, consult the manufacturer of your device to determine if it is adequately shielded from RF energy. Your physician may be able to assist you in obtaining this information.

Driver Safety

Check the laws and regulations on the use of radios in the area where you drive. Always obey them.

When using your radio while driving, please:

- Give full attention to driving and to the road.
- Use hands-free operation, if available.
- Pull off the road and park before making or answering a call if driving conditions so require.

Operational Warnings

For Vehicles With an Air Bag

Do not place a portable radio in the area over an air bag or in the air bag deployment area. Air bags inflate with great force. If a portable radio is placed in the air bag deployment area and the air bag inflates, the radio may be propelled with great force and cause serious injury to occupants of the vehicle.

Potentially Explosive Atmospheres

Turn off your radio prior to entering any area with a potentially explosive atmosphere, unless it is a radio type especially qualified for use in such areas as "Intrinsically Safe" (for example, Factory Mutual, CSA, UL, or CENELEC). Do not remove, install, or charge batteries in such areas. Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or even death.

NOTE: The areas with potentially explosive atmospheres referred to above include fueling areas such as below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles, such as grain, dust or metal powders, and any other area where you would normally be advised to turn off your vehicle engine. Areas with potentially explosive atmospheres are often but not always posted.

Blasting Caps and Blasting Areas

To avoid possible interference with blasting operations, turn off your radio when you are near electrical blasting caps, in a blasting area, or in areas posted: "Turn off two-way radio." Obey all signs and instructions.

Operational Cautions

Antennas

Do not use any portable radio that has a damaged antenna. If a damaged antenna comes into contact with your skin, a minor burn can result.

Batteries

All batteries can cause property damage and/or bodily injury such as burns if a conductive material such as jewelry, keys, or beaded chains touches exposed terminals. The conductive material may complete an electrical circuit (short circuit) and become quite hot. Exercise care in handling any charged battery, particularly when placing it inside a pocket, purse, or other container with metal objects.

Intrinsically Safe Radio Information

FMRC Approved Equipment

Anyone intending to use a radio in a location where hazardous concentrations of flammable materials exist (hazardous atmosphere) is advised to become familiar with the subject of intrinsic safety and with the National Electric Code NFPA 70 (National Fire Protection Association) Article 500 (hazardous [classified] locations).

An Approval Guide, issued by Factory Mutual Research Corporation (FMRC), lists manufacturers and the products approved by FMRC for use in such locations. FMRC has also issued a voluntary approval standard for repair service ("Class Number 3605").

FMRC Approval labels are attached to the radio to identify the unit as being FM Approved for specified hazardous atmospheres. This label specifies the hazardous Class/Division/Group along with the part number of the battery that must be used. Depending on the design of the portable unit, this FM label can be found on the back or the bottom of the radio housing. The FM Approval mark is shown below:

- **Do not operate radio communications equipment in a hazardous atmosphere unless it is a type especially qualified (for example, FMRC Approved) for such use. An explosion or fire may result.**
- **Do not operate an FMRC Approved Product in a hazardous atmosphere if it has been physically damaged (for example, cracked housing). An explosion or fire may result.**
- **Do not replace or charge batteries in a hazardous atmosphere. Contact sparking may occur while installing or removing batteries and cause an explosion or fire.**
- **Do not replace or change accessories in a hazardous atmosphere. Contact sparking may occur while installing or removing accessories and cause an explosion or fire.**
- **Do not operate an FMRC Approved Product unit in a hazardous location with the accessory contacts exposed. Keep the connector cover in place when accessories are not used.**
- **Turn a radio off before removing or installing a battery or accessory.**
- **Do not disassemble an FMRC Approved Product unit in any way that exposes the internal electrical circuits of the unit.**

Radios must ship from the Motorola manufacturing facility with the hazardous atmosphere capability and FM Approval labeling. Radios will not be "upgraded" to this capability and labeled in the field.

A modification changes the unit's hardware from its original design configuration. Modifications can only be made by the original product manufacturer at one of its FMRC-audited manufacturing facilities.

- **Failure to use an FMRC Approved Product unit with an FMRC Approved battery or FMRC Approved accessories specifically approved for that product may result in the dangerously unsafe condition of an unapproved radio combination being used in a hazardous location.**
- **Unauthorized or incorrect modification of an FMRC Approved Product unit will negate the Approval rating of the product.**

Repair of FMRC Approved Products

REPAIRS FOR MOTOROLA PRODUCTS WITH FMRC APPROVAL ARE THE RESPONSIBILITY OF THE USER.

You should not repair or relabel any Motorola-manufactured communication equipment bearing the FMRC Approval label ("FMRC Approved Product") unless you are familiar with the current FMRC Approval standard for repairs and service ("Class Number 3605").

You may want to consider using a repair facility that operates under 3605 repair service approval.

- **Incorrect repair or relabeling of any FMRC Approved Product unit could adversely affect the Approval rating of the unit.**
- **Use of a radio that is not intrinsically safe in a hazardous atmosphere could result in serious injury or death.**

FMRC's Approval Standard Class Number 3605 is subject to change at any time without notice to you, so you may want to obtain a current copy of 3605 from FMRC. Per the December 1994 publication of 3605, some key definitions and service requirements are as follows:

Repair

A repair constitutes something done internally to the unit that would bring it back to its original condition—Approved by FMRC. A repair should be done in an FMRC Approved facility.

Items not considered as repairs are those in which an action is performed on a unit which does not require the outer casing of the unit to be opened in a manner which exposes the internal electrical circuits of the unit. You do not have to be an FMRC Approved Repair Facility to perform these actions.

Relabeling

The repair facility shall have a method by which the replacement of FMRC Approval labels are controlled to ensure that any relabeling is limited to units that were originally shipped from the Manufacturer with an FM Approval label in place. FMRC Approval labels shall not be stocked by the repair facility. An FMRC Approval label shall be ordered from the original manufacturer, as needed, to repair a specific unit. Replacement labels may be obtained and applied by the repair facility, provided there is satisfactory evidence that the unit being relabeled was originally an FMRC Approved unit. Verification may include, but is not limited to: a unit with a damaged Approval label, a unit with a defective housing displaying an Approval label, or a customer invoice indicating the serial number of the unit and purchase of an FMRC Approved model.

Do Not Substitute Options or Accessories

The Motorola communications equipment certified by Factory Mutual is tested as a system and consists of the FM Approved portable, FM Approved battery, and FM Approved accessories or options, or both. This FM Approved portable and battery combination must be strictly observed. There must be no substitution of items, even if the substitute has been previously Approved with a different Motorola communications equipment unit. Approved configurations are listed in the FM Approval Guide published by FMRC, or in the product FM Supplement. This FM Supplement is shipped from the manufacturer with the FM Approved radio and battery combination. The Approval Guide, or the Approval Standard Class Number 3605 document for repairs and service, can be ordered directly from Factory Mutual Research Corporation located in Norwood, Massachusetts.

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Introduction

1

General

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

Included in this manual are radio specifications for the 764-870 MHz frequency band, 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.

Notations Used in This Manual

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

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

Caution

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

WARNING

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

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

Radio Description

The ASTRO Digital XTS 5000 radios are among the most sophisticated two-way radios available. The radios are available in the 764-870 MHz band.

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

Table 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), and 3 x 4 Alphanumeric Keypad
Channel Capability	48	512	512
Dialing from Prestored List	No	Yes	Yes
Programmable Softkeys	No	Yes	Yes

FLASHport

The ASTRO Digital 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.

Basic Maintenance

2

Introduction

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

General Maintenance

In order to avoid operating outside the limits set by the FCC, it is recommended that the ASTRO Digital XTS 5000 radio's reference oscillator be aligned every time the radio is taken apart, or once per year, whichever comes first. Periodic visual inspection and cleaning is also recommended.

For XTS 5000R Radios - It is recommended that radio submergibility be checked annually by qualified service personnel.

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.

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.

Cleaning External Plastic Surfaces

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.

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 6 feet, with a maximum submersion time of 4 hours. Exceeding either maximum limit may result in damage to the radio.

XTS 5000 R Radios Only

1. 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.
2. If the radio has been submerged in water, shake the radio well so that any water that may be trapped inside the speaker grille and microphone port can be removed. Otherwise, the water will decrease the audio quality of the radio.

Basic Theory of Operation

3

General Overview

The ASTRO Digital XTS 5000 radio is a wideband, synthesized radio available in the 764 to 870 MHz band. All ASTRO Digital 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).

The ASTRO Digital XTS 5000 radio includes the following major assemblies (see Figure 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.

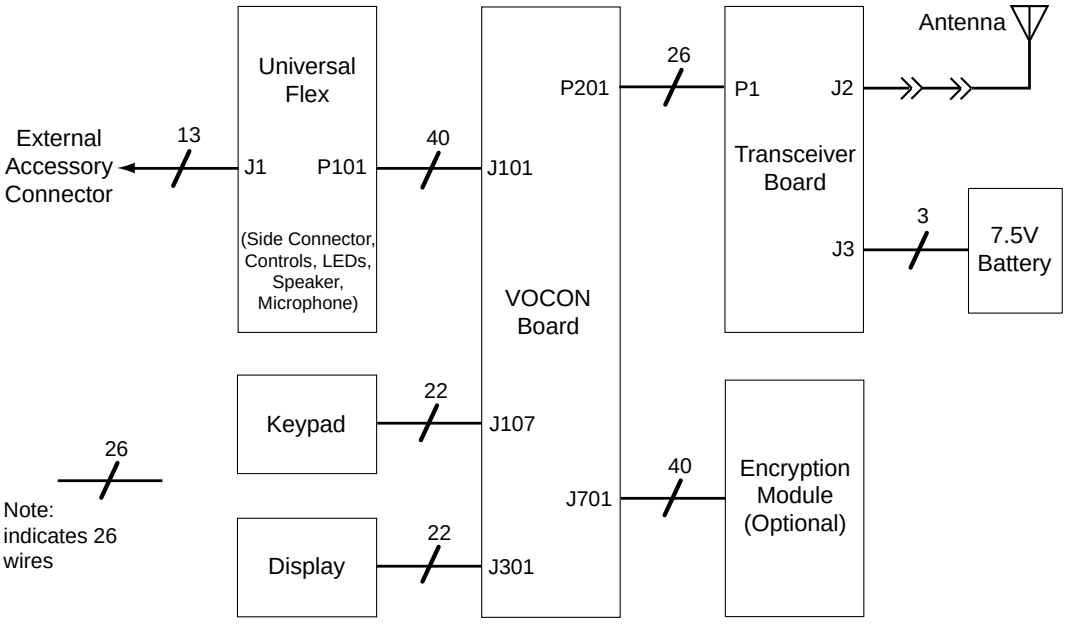


Figure 1. XTS 5000 Overall Block Diagram

Analog Mode of Operation

Receiving

When the radio is *receiving (*see Figure 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).

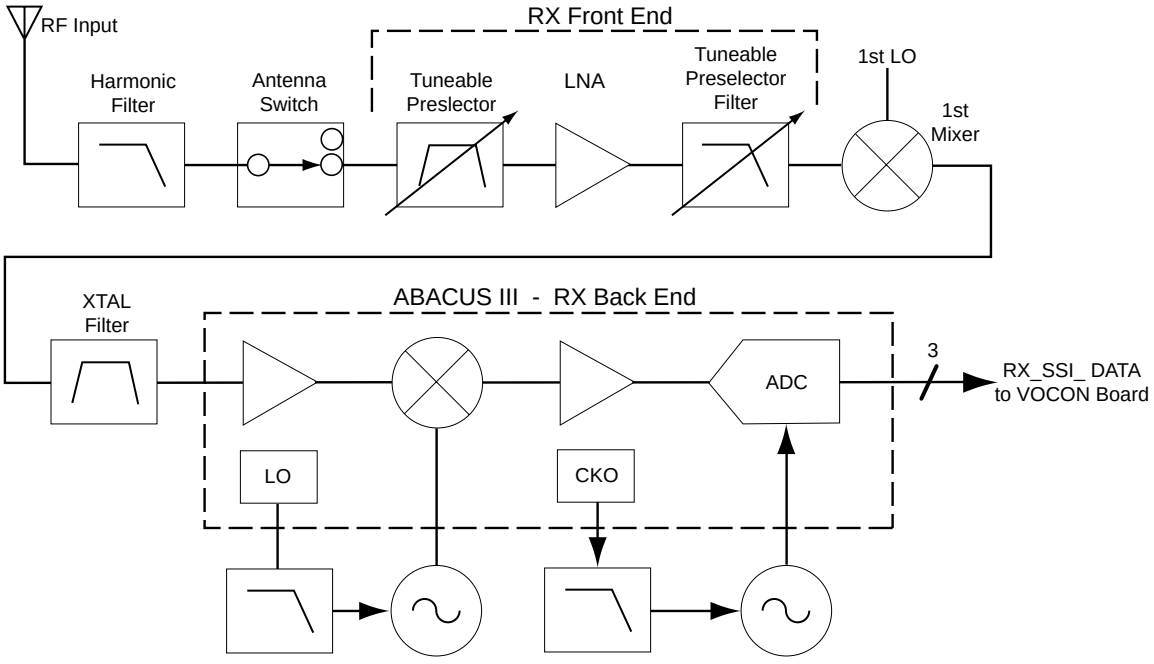


Figure 2. Receiver Block Diagram

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.

Transmitting

When the radio is *transmitting (*see Figure 3.), 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.

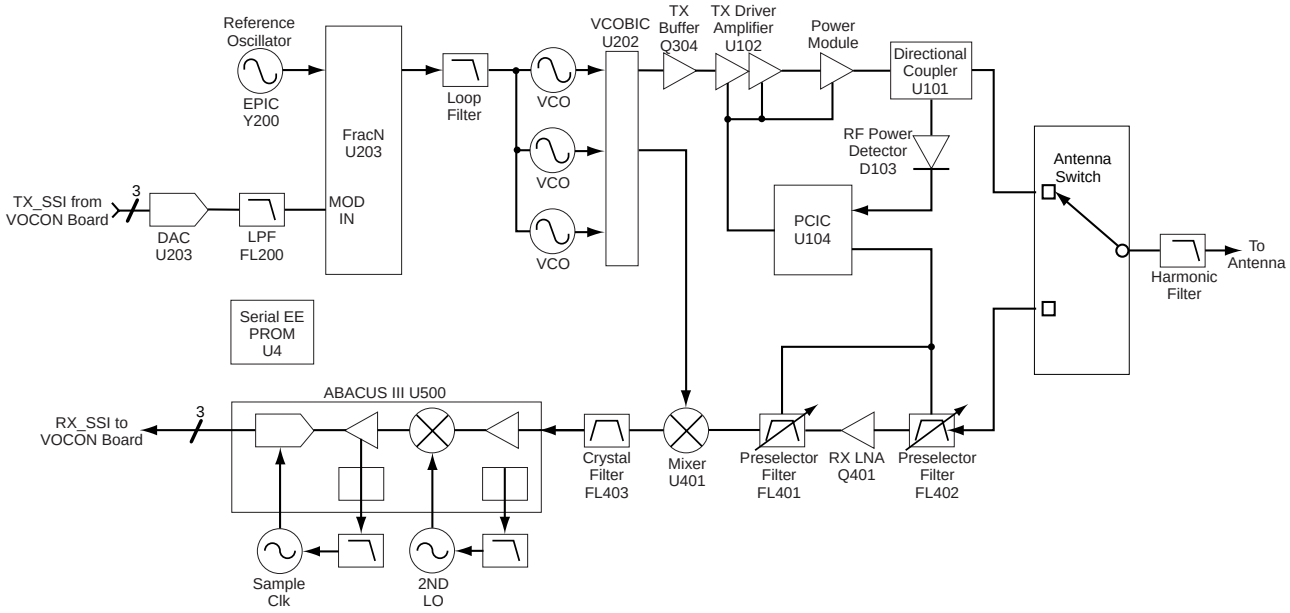


Figure 3. Transceiver Block Diagram (Power and Control Omitted)

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.

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.

Transceiver (XCVR) Board Basic Theory of Operation

The receiver front end consists of a preselector filter, low-noise amplifier, a second preselector, and a mixer. Both preselectors are varactor-tuned band pass filters, controlled by the microcontroller. See Table 2 for local oscillator (LO) and first IF information.

Table 2. Local Oscillator and First IF Frequencies

	700/800 MHz
LO Frequency Range	741.35-885.65 MHz
First IF Frequency	109.65 MHz

The frequency generation function is performed by three ICs, three VCOs, 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, 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 XCVR 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.

VOCON Board Basic Theory of Operation

The vocoder and controller (VOCON) board comprises the dual-core processor, which contains the radio's microcontrol unit and digital signal processor (DSP) in a single integrated circuit (IC) package, its memory ICs, an audio and power supply IC, a digital support IC, and the audio power amplifier. Connected to the VOCON board are the liquid-crystal display (LCD) board, XCVR board, keypad flex, controls/universal flex, and (optional) encryption module.

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 of the dual-core processor requires a 16.8MHz clock on its CKIH pin and a 32kHz clock on its CKIL pin.

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 of the dual-core processor requires a 16.8MHz clock on the CKIH pin. Additionally, it requires the 520kHz clock and 8kHz interrupt signal from the digital support IC, as well as clocks from the Abacus III digital back-end IC on the XCVR board.

The digital support IC is supplied with a 16.8MHz clock from the XCVR board. Using this clock, the digital support IC generates a 13MHz clock for the analog and power supply IC, and a 520kHz clock and an 8kHz interrupt signal for both the DSP and the analog and power supply IC. Additionally, the digital support IC uses a crystal to generate the 32kHz clock used by the dual-core processor and audio and power supply IC. It 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 13-pin universal (accessory) connector. This IC is programmed by the dual-core processor.

The analog and power supply IC has many functions. This IC supplies most of the voltages used on the VOCON board, while an external linear regulator supplies 5 volts. 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. It 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 (nominal value of 7.5 volts). It is programmed by the dual-core processor.

Recommended Test Equipment and Service Aids

4

Recommended Test Equipment

The list of equipment contained in Table 3 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 3. Recommended Test Equipment

Motorola Model Number	Description	Characteristics	Application
R2600 Series with applicable options	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 for <2% accuracy.
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	1mV to 300V, 10-Megohm input impedance	Audio voltage measurements
R1094_	Dual-Trace Oscilloscope	20MHz bandwidth 5mV to 5V/division	Waveform measurements
R1443_*	Wattmeter	Fixed-Element, Broadband	Transmitter power output measurements
S1339_	RF Millivolt Meter	100µV to 3V RF	RF-level measurements
R1013_*	SINAD Meter		Receiver sensitivity measurements
S1348_ (programmable)	DC Power Supply	0-20Vdc, 0-5 Amps current limited	Bench supply for 7.5Vdc

Service Aids

Refer to Table 4, "Service Aids," 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 Accessories and Aftermarkets Division offices listed in the "Replacement Parts Ordering" section located on the inside back cover of this manual. 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. Service Aids

Motorola Part Number	Description	Application
81-80384M64	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.
58-80348B33	SMA to BNC Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
66-85833D01	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.
REX4424_	Battery Eliminator	Used in place of battery to connect radio to external power supply.
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.
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.

Field Programming Equipment

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

Performance Checks

5

Introduction

This section covers performance checks used to ensure that the 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.

Setup

Supply voltage can be connected from the battery eliminator. The equipment required for alignment procedures is connected as shown in Figure 4.

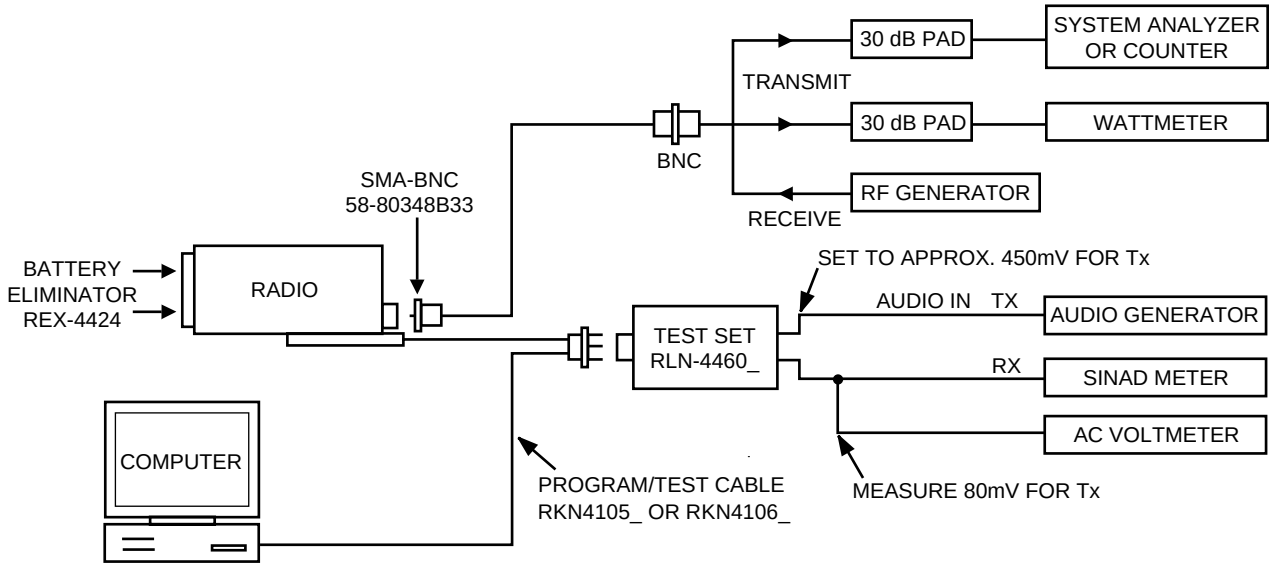


Figure 4. Radio Alignment Test Setup

Initial equipment control settings should be as indicated in Table 5 on page 14, and should hold for all alignment procedures, except as noted.

Table 5. Initial Equipment Control Settings

System Analyzer	Test Set	Power Supply
Monitor Mode: Standard*	**Spkr/Load:** Speaker	**Voltage:** 7.5Vdc
Receiver Checks **RF Control:** GEN **Output Level:** -47 dBm **Modulation:** 1kHz tone @3kHz 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:** 10Vdc
	Opt Sel: ON	**Current:** 2.5 Amps

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

Display Radio Test Mode (Models II/III)

Entering Display Radio Test Mode

1. Turn the radio on.
2. Within 10 seconds after "SELF TEST" is complete, press **Side Button 2** five times in succession.
3. The radio will show a series of displays that give information regarding various version numbers and subscriber specific information. The displays are described in Table 6.

Table 6. Front-Panel Access 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
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

Table 6. Front-Panel Access Test-Mode Displays (Continued)

Name of Display	Description	Appears
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.

4a. Press the **Top Side Button** to stop the displays and put the radio into the Control Top and Keypad test mode. The test mode menu "CH TEST" will be displayed. Go to "Control Top and Keypad Test Mode" on page 16.

NOTE: Each press of the **Top Side Button** will toggle between "CH TEST" and "RF TEST."

OR

4b. 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", will be displayed, indicating test frequency 1, Carrier SQuelch mode. Go to "RF Test Mode", below.

RF Test Mode

When the ASTRO Digital 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 **TEST MODE** or "air test."

1. Each additional press of **Side Button 2** will advance to the next test channel. (Refer to Table 7.)
2. Pressing **Side Button 1** will scroll through and access test environments as shown in Table 8.

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

Table 7. Test Frequencies

Test Channel	700/800 MHz RX (MHz)	700/800 MHz TX (MHz)
F1	764.0625	764.0125
F2	769.0625	769.0125
F3	775.9375	775.9875
F4	851.0625	794.0125
F5	860.0625	809.0125

Table 7. Test Frequencies (Continued)

Test Channel	700/800 MHz RX (MHz)	700/800 MHz TX (MHz)
F6	869.9375	823.9875
F7	851.0625	851.0125
F8	860.0625	860.0125
F9	869.9375	869.8875

Table 8. 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: 1200Hz tone **
12	USQ	Carrier Unsquelch	RX: unsquelch always TX: mic audio

** All deviation values are based on deviation tuning of this mode
*** On radios equipped with secure option

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.

1. Press and hold the **Top Button** (Orange button); all segments on the display will light, and the LED lights red.
2. Release the **Top Button**; "3/0" appears, which indicates that the **Top Button** is in the open condition.
3. Press the **Top Button** again; "3/1" appears, which indicates that the **Top Button** is in the closed condition.
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.
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.
12. Keypad Checks:

Model III Only—

- Press (0), "48/1" appears; release, "48/0" appears.
- Press (1), "49/1" appears; release, "49/0" appears.
- Press (2 abc), "50/1" appears; release, "50/0" appears.
- Press (3 def), "51/1" appears; release, "51/0" appears.
- Press (4 ghi), "52/1" appears; release, "52/0" appears.
- Press (5 jkl), "53/1" appears; release, "53/0" appears.
- Press (6 mno), "54/1" appears; release, "54/0" appears.
- Press (7 pqrs), "55/1" appears; release, "55/0" appears.
- Press (8 tuv), "56/1" appears; release, "56/0" appears.
- Press (9 wxyz), "57/1" appears; release, "57/0" appears.
- Press (*), "58/1" appears; release, "58/0" appears.
- Press (#), "59/1" appears; release, "59/0" appears.

Models II and III—

- Press (◀), "128/1" appears; release, "128/0" appears.
- Press (a), "129/1" appears; release, "129/0" appears.
- Press (▶), "130/1" appears; release, "130/0" appears.
- Press (•), "131/1" appears; release, "131/0" appears.
- Press (••), "132/1" appears; release, "132/0" appears.
- Press (⁂), "133/1" appears; release, "133/0" appears.
- Press (b), "134/1" appears; release, "134/0" appears.
- Press (▲), "135/1" appears; release, "135/0" appears.
- Press (▼), "136/1" appears; release, "136/0" appears.

Non-Display Radio Test Mode (Model I)

Entering 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.

3a. Press the **Top Side Button** to put the radio into the Control Top and Keypad test mode. Go to "Control Top and Keypad Test Mode" on page 18.

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

OR

3b. Press the **Top Button** (Orange button) to stop the displays and put the radio into the RF test mode. Go to “RF Test Mode”, below.

RF Test Mode

When the ASTRO Digital 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 **TEST MODE** or “air test.”

1. Each additional press of **Side Button 2** will advance to the next test channel. (Refer to Table 7 on page 15) 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).
2. Pressing **Side Button 1** will scroll through and access test environments as shown in Table 8 on page 16. 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.

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.

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

Table 9. 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)	Frequency error to be ≤ ±1.2kHz
Rated Audio	**RF Control:** Gen **Output Level:** -47 dBm **Freq:** Selected radio RX freq. **Mod:** 1kHz tone @ 3kHz dev. **Meter:** AC Volts	As above	**PTT** to OFF (center)	Set volume control to 3.74Vrms
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 < 0.35µV
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 3.74Vrms. Set RF level to -130 dBm and raise until radio unsquelches. Unsquelch to occur at < 0.25µV. Preferred SINAD = 6-8dB

***** See Table 8 on page 16.

*Table 10. Receiver Tests for ASTRO Conventional Channels**

Test Name	System Analyzer	Radio/Tuner Software	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 is required; Bit Error Rate Screen	**PTT** to OFF (center)	BER <0.01%
Reference Sensitivity	As above; lower the output level until 5% BER is obtained	As above	As above	Output level <0.35 µV (-116 dBm)
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 >45dB

***** These tests require a communications system analyzer with the ASTRO 25 test options. Some tests require the use of the Radio Tuner Software.

Table 11. 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).	Frequency error to be ≥ ±1.2kHz.
Power RF	As above	As above	As above	Refer to Maintenance Specifications page in front of manual.
Voice Modulation (External)	As above. Set fixed 1kHz audio level to 400 mV.	As above	As above	Deviation: (12.5kHz) ≥ 2.1kHz but ≤ 2.5kHz (25kHz) ≥ 4.1kHz but ≤ 5.0kHz
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: (12.5kHz) ≥ 2.1kHz but ≤ 2.5kHz (25kHz) ≥ 4.1kHz but ≤ 5.0kHz
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: (12.5kHz) ≥ 375Hz but ≤ 500Hz (25kHz) ≥ 500Hz but ≤ 1000Hz
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: ≥ 3.7kHz but ≤ 4.3kHz

***** See Table 8 on page 16

*Table 12. Transmitter Tests for ASTRO Conventional Channels**

Test Name	System Analyzer	Radio	Test Set	Comments
RF Output 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).	Refer to Maintenance Specifications page in front of manual.
Frequency Error	As above	As above	As above	Error ≤ ±1.0 kHz
Frequency Deviation	As above	Radio Tuner Software is required; Transmitter Bit Patterns screen. **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

* These tests require a communications system analyzer with the ASTRO 25 test options. Some tests require the use of the Radio Tuner Software.

Radio Alignment Procedures

6

Introduction

This section describes both receiver and transmitter radio alignment procedures.

General

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 as shown in Table 4 on page 13.

Caution

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

Select **Tuner** from the **START** menu. To read the radio, use the F**ile** → **Read Device** menu or click on . Figure 5 illustrates how the alignment screens are organized. To access a screen, double-click on the desired screen name in the **Tuner** menu.

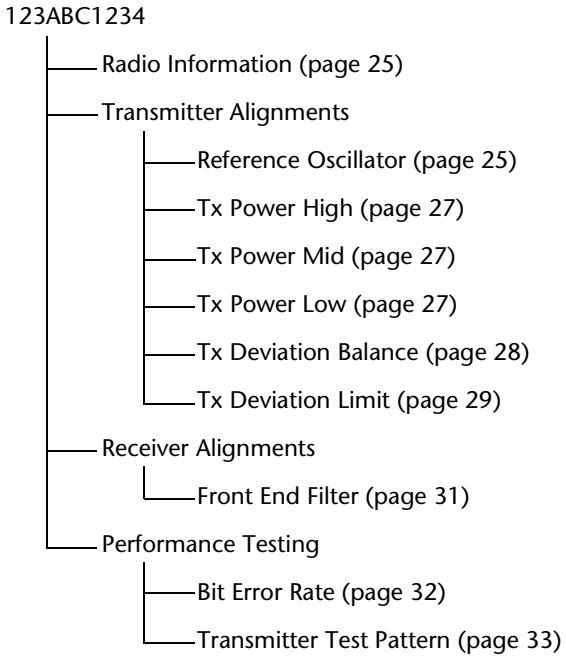


Figure 5. Tuner Menu Layout

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 may 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 screen's UP/DOWN arrow keys (▲ ▼), or by entering the new value from the keyboard. A graphical scale on the display indicates the minimum, maximum, and proposed value of the softpot; see Figure 6.

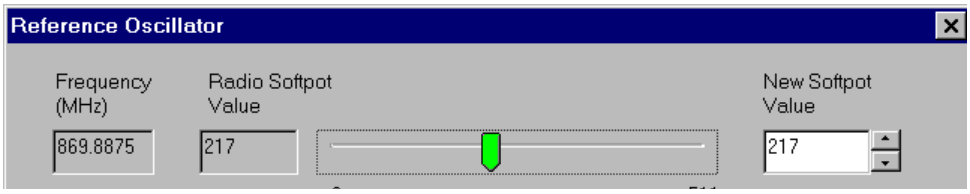


Figure 6. Typical Softpot Screen

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 arrow ▲ 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 on-line help.

Radio Information

Figure 7 shows a typical Radio Information screen.

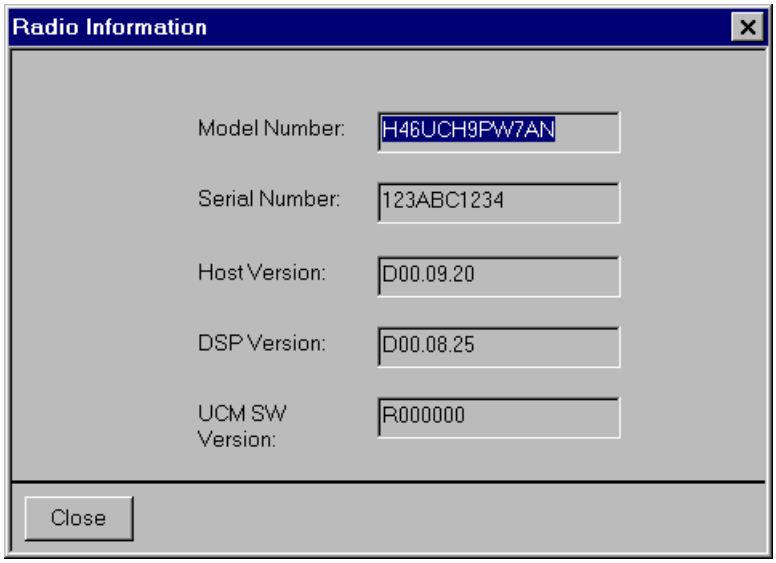


Figure 7. Radio Information Screen

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.

1. Select the **Reference Oscillator** alignment screen. See Figure 8.

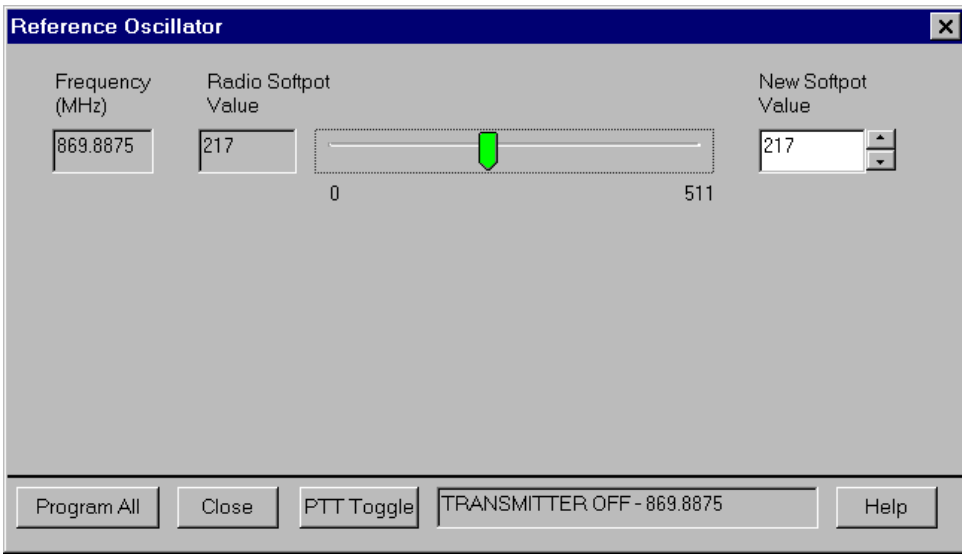


Figure 8. Reference Oscillator Alignment Screen

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 13.

Table 13. Reference Oscillator Alignment

Band	Target
700/800 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.

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.

1. Select the **TX Power** alignment screen. The screen will indicate the transmit frequencies to be used. See Figure 9.
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 14, is indicated on the service monitor.

Table 14. Transmit Power Settings

Power Level	Test Frequencies
	700/800 MHz
Low (1 Watt)	1.2W - 1.4W
Mid (2 Watts)	2.5W - 2.7W
High (3 Watts)	3.2W - 3.4W

6. Repeat the above process 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.

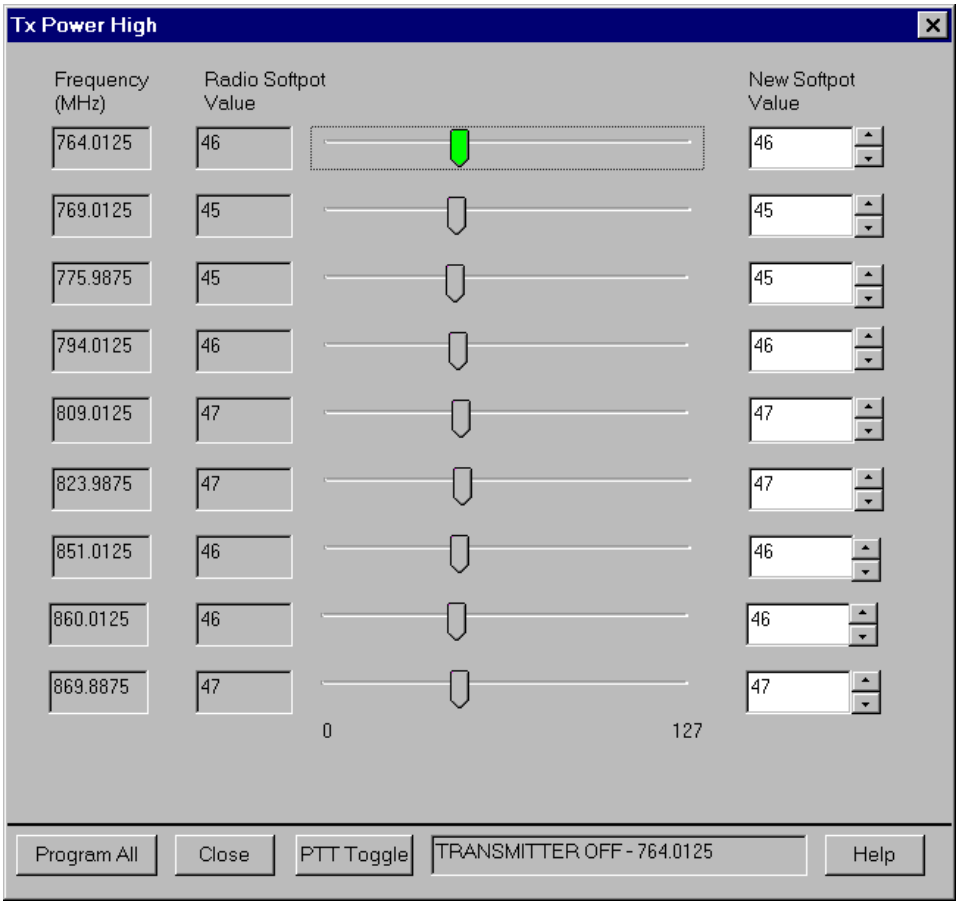


Figure 9. Transmit Power Alignment Screen (Typical)

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.

1. Select the **TX Deviation Balance** alignment screen. The screen will indicate the transmit frequencies to be used. See Figure 10.
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.

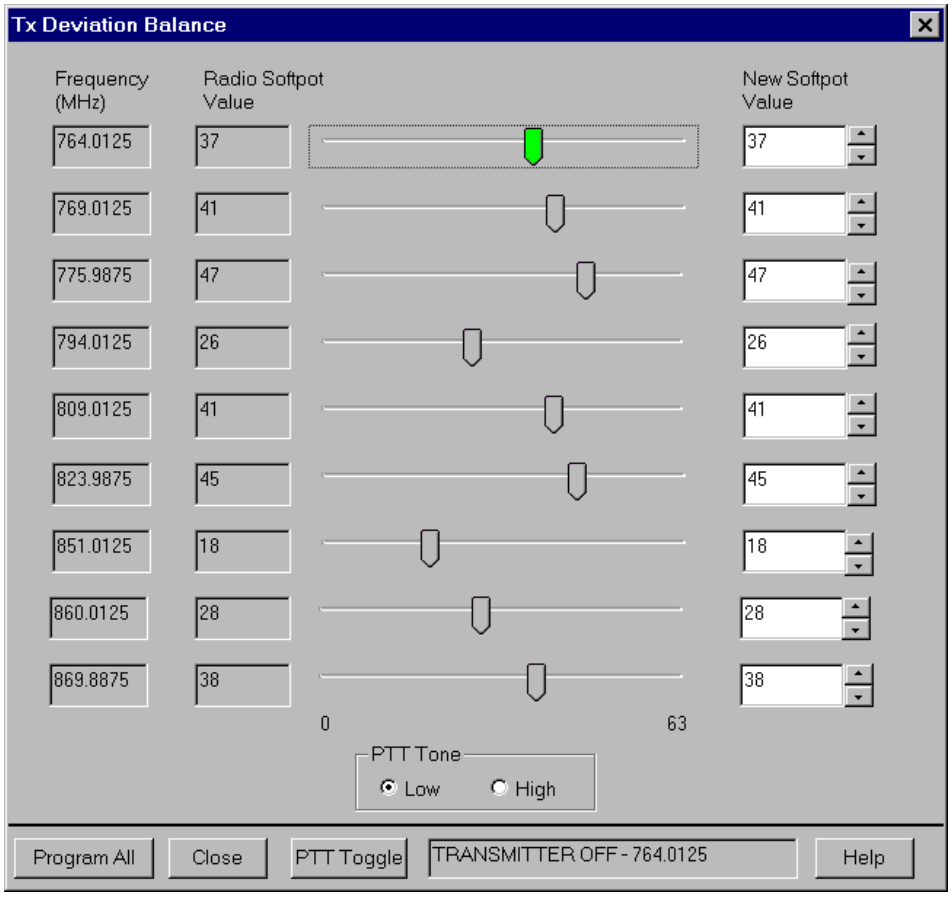


Figure 10. Transmit Deviation Balance Alignment Screen

4. Left-click the **PTT Tone: Low** button.
5. Measure the transmitted signal deviation of the radio with a service monitor.
6. Left-click the **PTT Tone: High** button.
7. Adjust the softpot value until the measured deviation, when using the high tone, is a close as possible to that observed when using the low tone.
8. Repeat the above process for all frequencies.
9. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.
10. Left-click the **Close** button on the screen to return to the **Transmitter Alignments** menu.

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.

1. Select the **TX Deviation Limit** alignment screen. The screen will indicate the transmit frequencies to be used. See Figure 11.

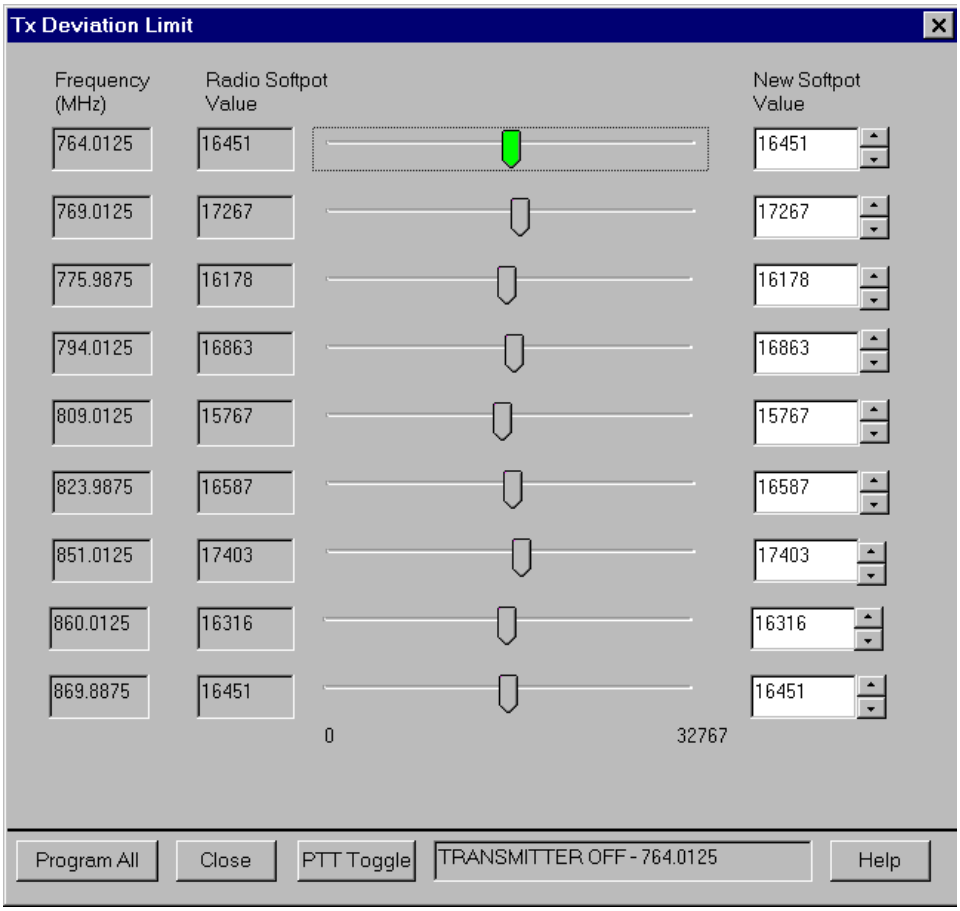


Figure 11. Transmit Deviation Limit Alignment Screen

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 transmitted signal deviation of the radio with a service monitor.
5. Adjust softpot value until the measured deviation is as close as possible to 2.83 kHz.
6. Repeat the above process for all frequencies.
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.

Front End Filter Alignment

Caution

This procedure should only be attempted by qualified service personnel.

Definition

This alignment procedure adjusts the front end receiver bandpass filters for best receiver sensitivity and selectivity. It should be performed for all test frequencies to allow for proper software interpolation for frequencies in between the test frequencies in the band (see Figure 12).

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

Procedure for 700 MHz Frequencies

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 700MHz frequencies.
5. Click on the “Program All” button to save the tuned values in the radio.

Procedure for 800 MHz Frequencies

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 800MHz frequencies.
5. Click on the “Program All” button to save the tuned values in the radio.

Procedure for UHF/VHF

1. Left-click the desired frequency field.
2. Apply an RF signal with no modulation at -90 dBm on the current operating frequency.
3. Adjust the softpot value until the maximum RSSI value is found.
4. Repeat the above process for all frequencies.
5. Click on the “Program All” button to save the tuned values in the radio.

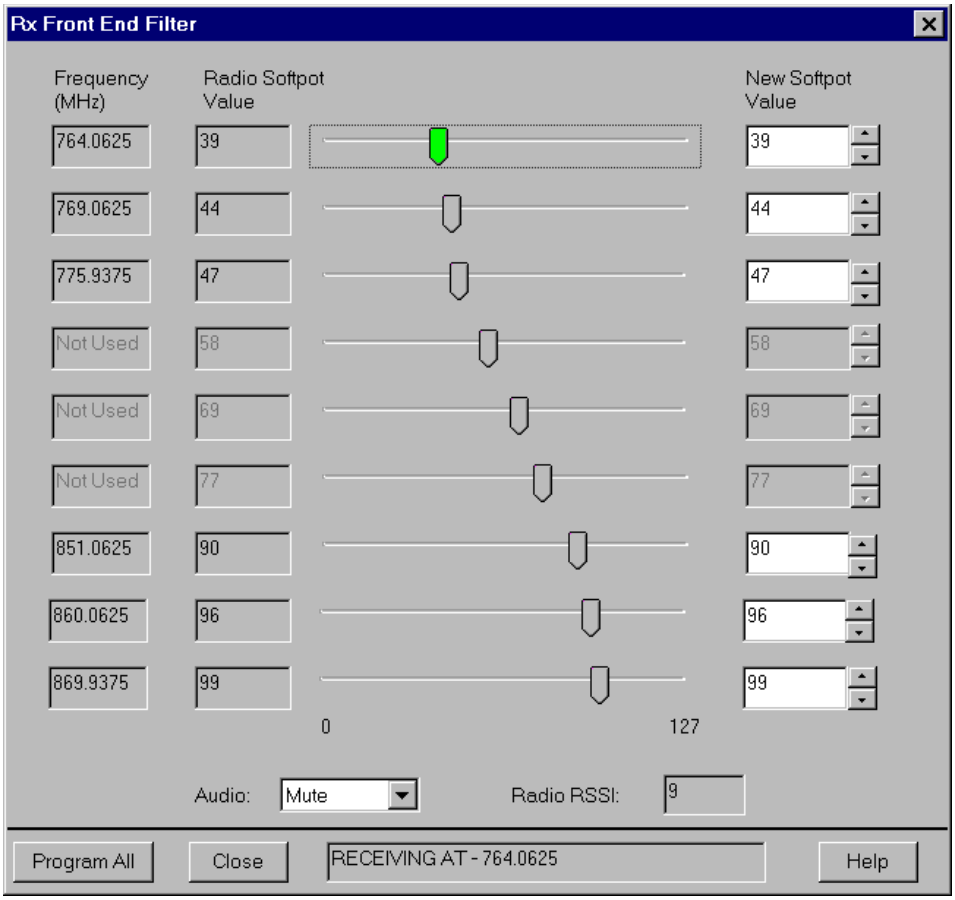


Figure 12. Front End Filter Alignment Screen

Bit Error Rate

Definition

This screen is used to test the Bit Error Rate (BER) of the radio's receiver at a desired frequency (see Figure 13).

Bit Error Rate Fields

This 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.

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 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.

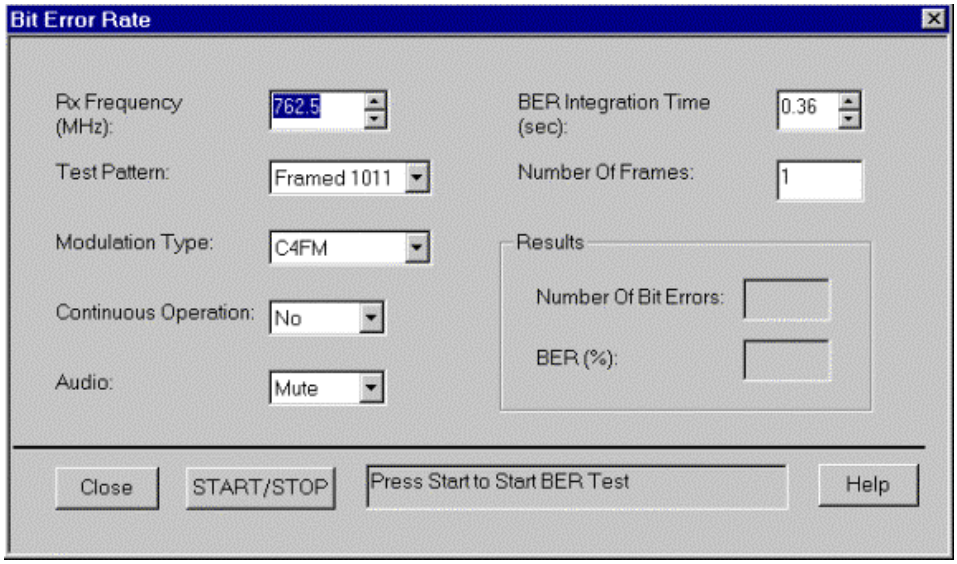


Figure 13. Bit Error Rate Screen

Transmitter Test Pattern

Definition

This screen 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 14).

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.

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.

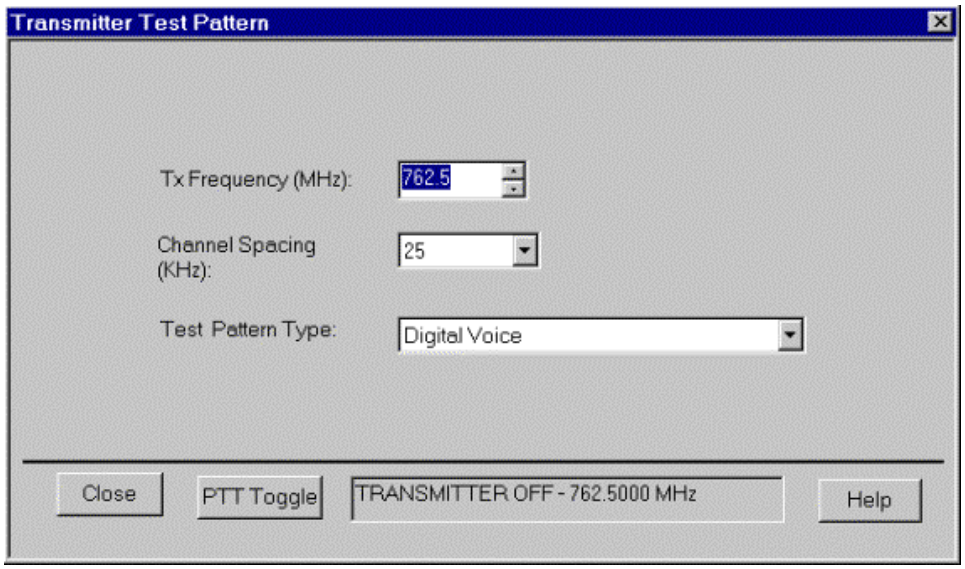


Figure 14. Transmitter Test Pattern Screen

Notes

Encryption

7

Loading 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.

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.

Selecting a 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, and the available menu selections.
3. Press ⬭ or ⬭ to scroll through the list of encryption keys.

   NOTE: If you select an erased key, the display shows the 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.

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, and the available menu selections.
3. Enter the number of the desired key, using the keypad.

   NOTE: If you select an erased key, the display shows the 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.

Selecting an 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 to will now have the equivalent new key instead.

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, and the available index menu selections.
3. Press , , or directly below the desired index. The display shows the last user selected and stored index, and the available index menu selections.

4. To save the index, press •, ••, or ⁂ directly below "SEL."

   OR

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

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, and the available index menu selections.
3. Enter the number of the desired index, using the keypad.
4. To save the index, press •, ••, or ⁂ directly below "SEL."

   OR

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

Erasing a Key

Method 1 — Key Zeroization (Multikey Only)

1. Press ⬭ until the display shows "ERAS."
2. Press •, ••, or ⁂ directly below "ERAS." The display shows the last user selected and stored encryption key, and the available menu selections:
   - 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 changing the index selection, press ⏻ or the **PTT** button, or turn the **16-Position Select** knob.

3. Press •, ••, or ⁂ directly below the desired menu.

   OR

   Press ⬭ or ⬭ to find the desired encryption key. The display shows the selected key, and the available menu selections shown in step 2. Press •, ••, or ⁂ directly below the desired menu.

   OR

   Enter the location number of the desired key, using the keypad. The display shows the selected key, and the available menu selections shown in step 2. Press •, ••, or ⁂ directly below the desired menu.

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

Method 2 — All Keys Erased

NOTE: This is the method used for erasing the key in radios with the "single key" option.

1. With the radio on, press and hold the **Top Side** button; 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 would send an emergency alarm.

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

   When all the encryption keys have been erased, the display shows "ERASED."

Disassembly/Reassembly Procedures

8

Introduction

This section gives detailed procedures for disassembling/reassembling XTS 5000 radios, and ensuring the submergibility of ruggedized radios. When performing these procedures, refer to “Exploded Views and Parts Lists” on page 67 and the diagrams that accompany the text. Items in parentheses ( ) refer to item numbers in the exploded view diagrams.

This section also has procedures for removing and installing the XTS 5000 radio’s standard accessories and changing the Volume and Frequency Knobs.

Antenna

Attach the Antenna

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

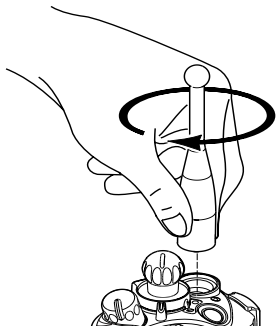


Figure 15. Attach the antenna

Remove the Antenna

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

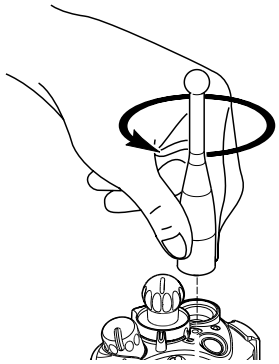


Figure 16. Remove the antenna

Battery

WARNING

To avoid a possible explosion:

- **DO NOT replace the battery in an area labeled "hazardous atmosphere."**
- **DO NOT discard batteries in a fire.**

Caution

If the radio is programmed with 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.

Attach the Battery

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

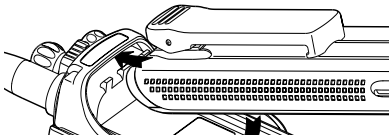


Figure 17. Insert the top edge of the battery

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

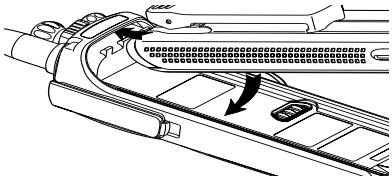


Figure 18. Press the battery into place

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.

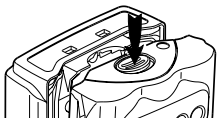


Figure 19. Press the release button

2. Remove the battery from the radio.

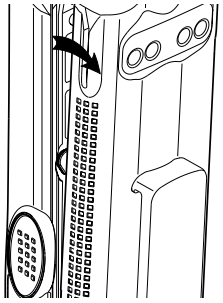


Figure 20. Remove the battery

Belt Clip

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

Attach the Belt Clip

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

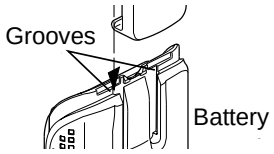


Figure 21. Align the belt clip with the battery

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

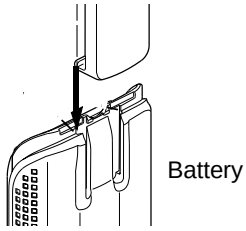


Figure 22. Press the belt clip into place

Remove the Belt Clip

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

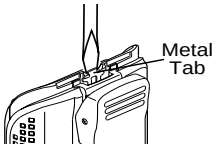


Figure 23. Press the belt clip tab away from the battery

2. Slide the belt clip upward to remove it.

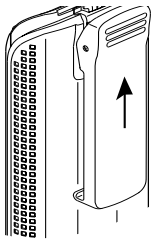


Figure 24. Remove the belt clip

Universal Connector Cover

Caution

When the universal connector is not in use, keep it covered with the universal connector cover.

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.

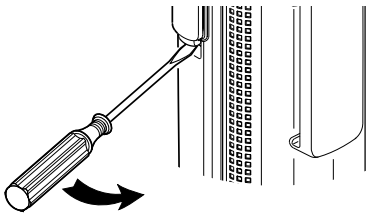


Figure 25. Insert a screwdriver below the cover

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.

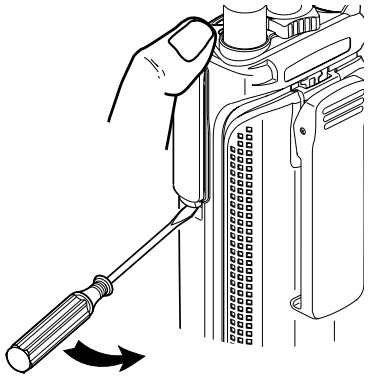


Figure 26. Remove the cover

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.

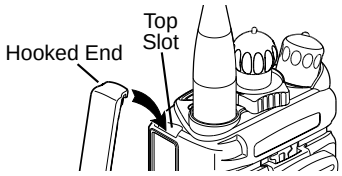


Figure 27. Hook the end into the slot

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

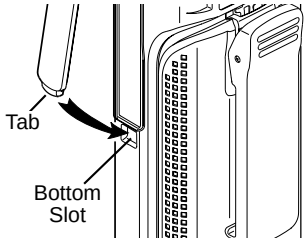


Figure 28. Press the cover into place

Frequency Knob

NOTES:

- Refer to Figure 29, the Partial Exploded View, and Table 15, the Partial Exploded View Parts List. Numbers in parentheses ( ) refer to item numbers in Figure 29 and Table 15.
- 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.

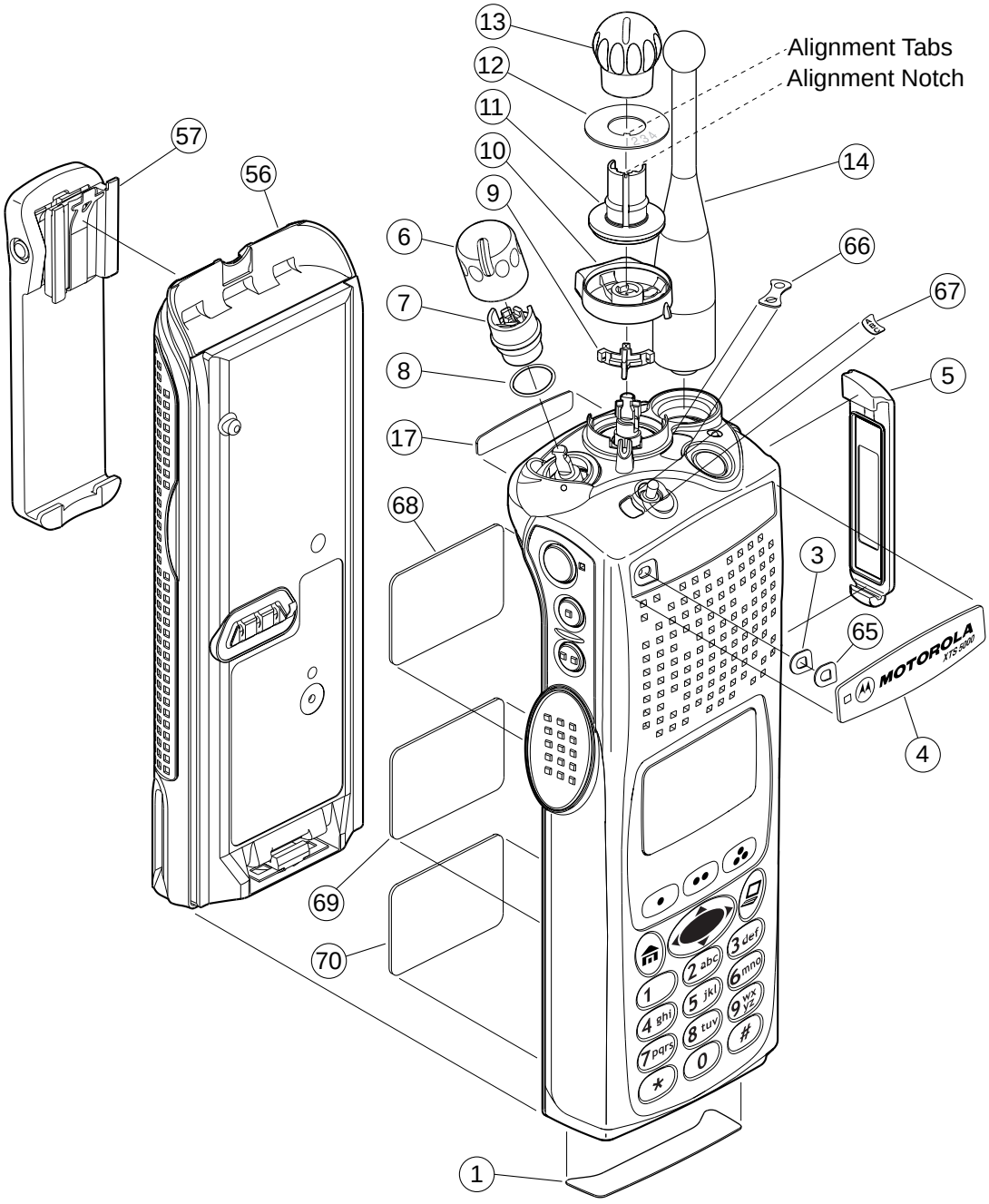


Figure 29. Partial Exploded View

Table 15. Partial Exploded View Parts List

ITEM NO.	MOTOROLA PART NO.	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	NAF5037_ or NAF5042_ or NAF5080_	ANTENNA, Whip, Halfwave (806-870 MHz) ANTENNA, Stubby, 1/4 Wave (806-870 MHz) ANTENNA, Whip (764-870 MHz)
17	3305574Z01	LABEL, Motorola Back
56	NTN8294_	BATTERY, NiCd
57	NTN8266_	CLIP, Belt
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

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).

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.

Volume Knob

NOTES:

- Refer to Figure 29. on page 44, the Partial Exploded View, and Table 15 on page 45, the Partial Exploded View Parts List. Numbers in parentheses ( ) refer to item numbers in Figure 29 and Table 15.
- 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.

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).

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.

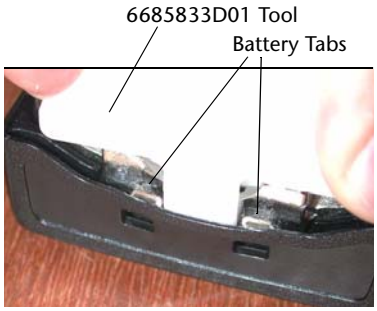
Radio Disassembly and Reassembly

Disassembly

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 "Frequency Knob" on page 44 and "Volume Knob" on page 47.

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.

   Put the housing assembly aside.

5. Remove the main seal (55) from around the casting assembly (51).
6. If you are disassembling a model I radio, skip to step 9; if you are disassembling a model II or III radio, continue this procedure.

   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).

7. Remove the LCD module (38) and put it aside.
8. Unplug the 22-pin connector for the keypad flex (37) (located to the left and above the LCD module area).
9. 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.

10. 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.

11. Lift out the 26-pin compression connector (46).
12. Using needle-nosed pliers, carefully unplug the coaxial cable's connector (52) from the transceiver board's (48) surface-mount connector.
13. 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.
14. Remove the rubber pad (71).
15. 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.
16. Lift the B+ assembly (49) and B+ seal (50) out of the casting assembly.

Housing Assembly

1. Referring to "Radio Disassembly and Reassembly" on page 48, 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 43). 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 "Frequency Knob" on page 44 and "Volume Knob"

on page 47, 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).

Battery Contact and Battery Contact Seal

1. Referring to "Radio Disassembly and Reassembly" on page 48, remove the housing assembly (2) from the radio.
2. Completely disassemble the casting assembly (51).
3. Remove the battery contact (49) and battery contact seal (50).

Reassembly

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.
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 connector, 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 retention 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 keypad 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 bottom 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.
15. 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.

16. 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 casting downward toward the bottom of the housing until they meet. Snap the housing assembly and casting assembly together.

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.

17. 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.

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 "Frequency Knob" on page 44 and "Volume Knob" on page 47, install the frequency knob, new frequency escutcheon, new frequency insert, secure lever, lightpipe, volume knob, new volume insert, and o-ring.
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.

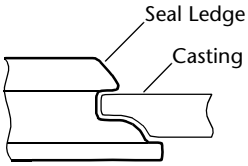
6. Install the main seal o-ring (55) around the casting assembly (51).
7. Reassemble the housing assembly (2) to the radio.
8. Inspect the main seal (55) for proper seating. Observe carefully to ensure that the main seal o-ring is not pinched between the housing (2) and the casting (51).

Battery Contact and Battery Contact Seal

1. Inspect the casting seal surface for debris or damage. Remove any debris and replace casting if damaged.
2. Install the battery contact (49) and battery contact seal (50).

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.



3. Reassemble the casting assembly (51).
4. Install the 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).

Ensuring Radio Submergibility

Introduction

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. XTS 5000R 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.

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.

General Information

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.

Specialized Test Equipment

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 radios. The adapter with gasket is the same as that for the ASTRO XTS 3000R and XTS 3500 R.

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 radios. As with the vacuum pump kit above, the NTN9279A adapter connects the pressure hose to the radio's casting.

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).

Disassembly and Reassembly

If disassembly and reassembly of the radio is required, refer to"Radio Disassembly and Reassembly" on page 48.

Disassembly

Disassemble the radio according to "Disassembly" on page 48.

Reassembly

Reassemble the radio according to "Reassembly" on page 50. Tighten all hardware that was loosened or removed.

Caution

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

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.

Vacuum Test

Refer to the exploded view diagrams and parts lists in this manual.

General

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.

Conducting the 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.

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

7. 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.
8. 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."
9. Remove the vacuum hose and adapter from the radio.
10. 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.

Pressure Test

Refer to the exploded view diagrams and parts lists in this manual.

General

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.

Conducting the 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.

Pressure any greater than 1 psig may push air around the main seal.

Caution

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.

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.

Caution

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.

Troubleshooting Leak Areas

Before repairing any leak, read all applicable area repair paragraphs. This will help to eliminate unnecessary disassembly and reassembly of a radio with multiple leaks. Troubleshoot only the faulty seal areas listed in "Pressure Test" on page 55, 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.

Housing

1. If a leak occurs at the lens, universal connector, casting/housing interface, or PTT/Ratt button area of the housing, replace the housing. Referring to “Disassembly” on page 48:
   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.

Antenna Bushing Seal

1. Referring to “Radio Disassembly and Reassembly” on page 48, 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).

Controls Seal

1. Referring to “Radio Disassembly and Reassembly” on page 48, 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 43). 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 “Frequency Knob” on page 44 and “Volume Knob” on page 47, 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 “Frequency Knob” on page 44 and “Volume Knob” on page 47, 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). Make sure 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).

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

1. Referring to “Radio Disassembly and Reassembly” on page 48, 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 43). 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 (18) 22-pin connector from PTT area of the housing assembly (2).
7. Referring to “Frequency Knob” on page 44 and “Volume Knob” on page 47, 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 "Frequency Knob" on page 44 and "Volume Knob" on page 47, 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).

Main Seal

1. Referring to "Radio Disassembly and Reassembly" on page 48, 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).

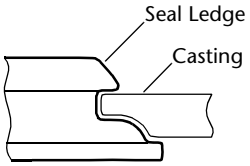
Battery Contact and Battery Contact Seal

1. Referring to "Radio Disassembly and Reassembly" on page 48, 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.



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).

Keypad

1. Referring to "Radio Disassembly and Reassembly" on page 48, 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).

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 16. Submersible Radio Torque Specifications

Application	Torque (in.-lbs)	Torque (N•m)	Torque Bit Part No.
Speaker Bracket Screw	2	0.23	66-80321B79

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.

Notes

Basic Troubleshooting

9

Introduction to This Section

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

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 17 on page 64 to aid in understanding particular power-up error code displays.

Table 17. 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
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.		

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 18 to aid in understanding particular operational error codes.

Table 18. Operational Error Code Displays

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

Table 19. Receiver Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken 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 Off	1. VOCON Board	Send radio to depot.
	2. RF Board	
No Receive Audio or Receiver Does Not Unmute	Programming	a. Does the transmitted signal match the receiver configuration (PL, DPL, etc.)? b. With the monitor function enabled, can the radio be unmuted?
Audio Distorted or Not Loud Enough	Synthesizer Not On Frequency	Check synthesizer frequency by measuring the transmitter frequency; if off by more than ±1000Hz, realign.
RF Sensitivity Poor	1. Synthesizer Not On Frequency	Check synthesizer frequency by measuring the transmitter frequency; if off by more than ≤ ±1000Hz, realign.
	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.

Table 20. 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.

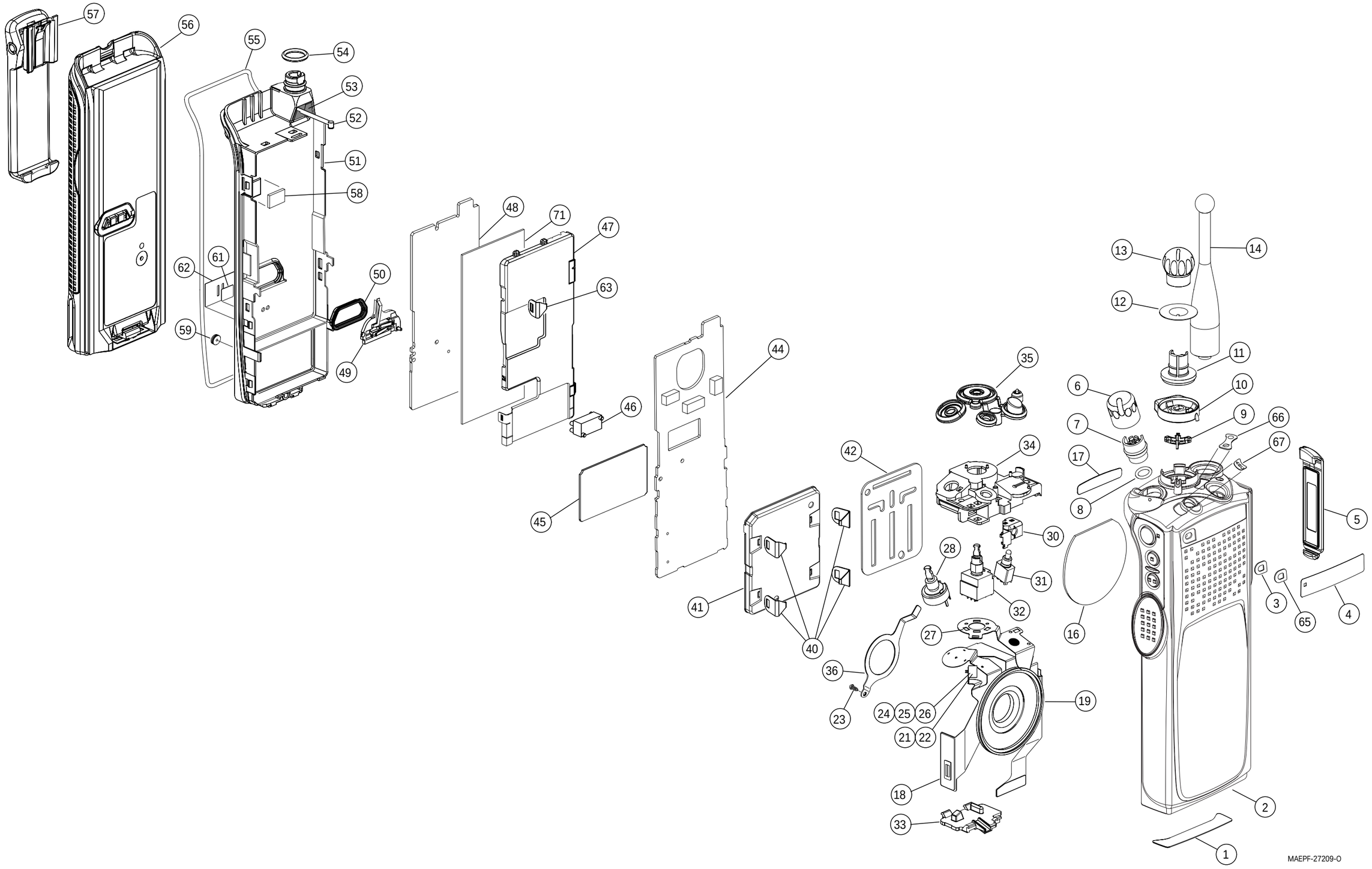
Table 21. Encryption Troubleshooting Chart

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.

Exploded Views and Parts Lists

Model I
Exploded View Parts List

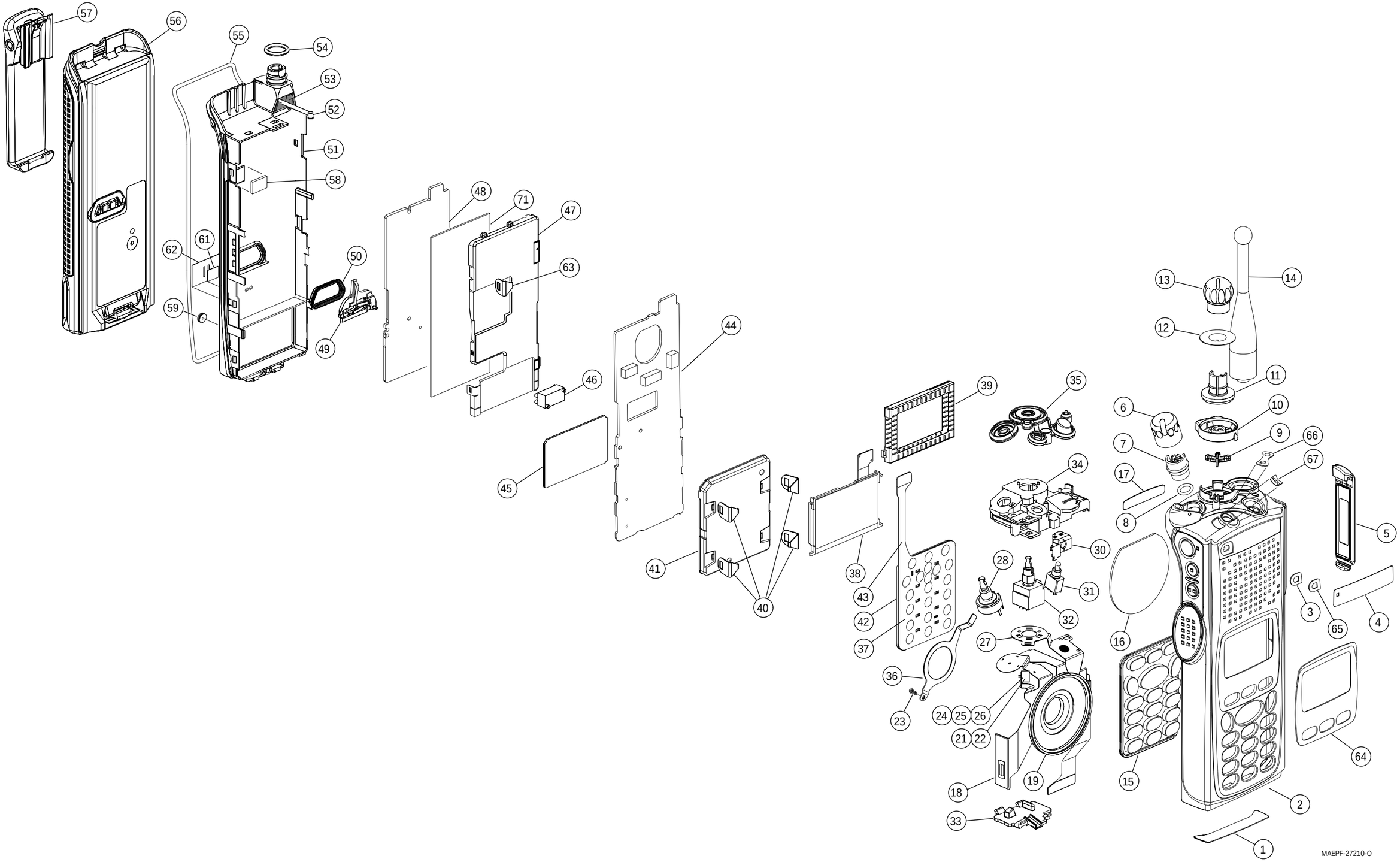
ITEM NO.	MOTOROLA PART NUMBER	DESCRIPTION
1	3305630Z02	LABEL, Motorola Bottom (non-intrinsic) (part of item 2)
	3305630Z04	LABEL, Motorola Bottom (intrinsic) (part of item 2)
2	1585468D07	ASSEMBLY, Model I Housing (Standard Models) (includes items 1, 3, 4, 5, 16, 17, and 65 thru 67)
	or 1585468D10	ASSEMBLY, 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	NAF5037_	ANTENNA, 800MHz Whip (806-870MHz)
	or NAF5042_	ANTENNA, 800MHz Stubby1/4 Wave (806-870MHz)
	or NAF5080_	ANTENNA, 700/800MHz Whip (764-870MHz)
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 req'd) (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
36	4285400D01	RETAINER, Speaker
40	4205631Z01	CLIP, Control Locking (Part of item 41) (4 req'd)
41	2685567D01	SHIELD, Controller Front (Includes items 40 and 42)
42	4285288D01	RETAINER (Part of item 41)
44	NTN9564_	KIT, VOCON Board
45	NTN9837A	DES, DES-XL, DES-OFB with DVP-XL Encryption Kit - UCM
	NTN9838A	DVI-XL Encryption Kit - UCM
	NTN9839A	DVP-XL Encryption Kit - UCM
	NNTN4006A	DES, DES-XL, DES-OFB Encryption Kit - UCM
46	2885866A01	CONNECTOR, Compression, 26-Pin
47	2685220D02	SHIELD, RF with Insulator and Clip (Includes item 63)
48	NUF3577_	KIT, Transceiver Board, 700/800MHz
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	HNN9031_	BATTERY, NiCd, Ultra-High Capacity
57	NTN8266_	KIT, Belt Clip
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	7585936D01	PAD



Model I Exploded View

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)
	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	NAF5037_	ANTENNA, 800MHz Whip (806-870MHz)
	or NAF5039_	ANTENNA, 800MHz Dipole (806-870MHz)
	or NAF5042_	ANTENNA, 800MHz Stubby1/4 Wave (806-870MHz)
	or NAF5080_	ANTENNA, 700/800MHz Whip (764-870MHz)
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 req'd) (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
36	4285400D01	RETAINER, Speaker
37	2685567D03	ASSEMBLY, Keypad Flex, Model III (Includes items 41 and 43)
	or 2685567D02	ASSEMBLY, Keypad Flex, Model II (Includes item 41 and 43)
38	7285726C01	MODULE, LCD
39	7585189D01	PAD, Display Locator
40	4205631Z01	CLIP, Control Locking (part of item 41) (4 req'd)
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
45	NTN9837A	DES, DES-XL, DES-OFB with DVP-XL Encryption Kit - UCM
	NTN9838A	DVI-XL Encryption Kit - UCM
	NTN9839A	DVP-XL Encryption Kit - UCM
	NNTN4006A	DES, DES-XL, DES-OFB Encryption Kit - UCM
46	2885866A01	CONNECTOR, Compression, 26-Pin
47	2685220D02	SHIELD, RF with Insulator and Clip (Includes item 63)
48	NUF3577_	KIT, Transceiver Board, 700/800MHz
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	HNN9031_	BATTERY, NiCd, Ultra-High Capacity
57	NTN8266_	KIT, Belt Clip
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)
64	3385419C01	BEZEL, Display - Titanium Silver (part of item 2)
	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	7585936D01	PAD



Models II and III Exploded View

MOTOROLA

ASTRO® XTS 5000™ Digital Portable Radios Accessory Section Changes

This FMR applies to the accessory section of the following publications and CDs:

- 68P81094C25-O ASTRO XTS 5000 Digital Portable Radio Model I User Guide
- 68P81094C26-O ASTRO XTS 5000 Digital Portable Radio Model II User Guide
- 68P81094C27-O ASTRO XTS 5000 Digital Portable Radio Model III User Guide
- 68P81094C28-O ASTRO XTS 5000 Digital Portable Radio Basic Service Manual
- 9985901D01 ASTRO XTS 5000 Digital Portable Radio Models I, II, and III User Guides CD
- 9985902D01 ASTRO XTS 5000 Digital Portable Radio Basic Service Manual CD

The accessories listed below are not compatible with the XTS 5000 at this time. Please refer to the following web site for a complete list of approved accessories:
http://www.motorola.com/cgiss/portables/xts5000.shtml

Motorola Kit Numbers

BDN6664	BDN6669	BDN6728	BDN6780	NMN6246
BDN6665	BDN6670	BDN6729	BDN6781	NTN1624
BDN6666	BDN6676	BDN6730	BDN6782	NTN1625
BDN6667	BDN6726	BDN6731	NMN1020	NTN1663
BDN6668	BDN6727	BDN6732	NMN6245	NTN1736

FMR-2014-1

Accessories

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

Antennas

NAF5037	800 MHz Whip, Halfwave (806-870 MHz)
NAF5042	800 MHz Stubby, Quarterwave (806-870 MHz)
NAF5080	700/800 MHz Whip (764-870 MHz)

Audio Adapters

BDN6676	Adapter, 3.5mm w/PTT Switch

Batteries

NTN8294	NiCd, Ultra-High Capacity

Carry Accessories

Belt Clips

NTN8266	Belt Clip Kit (Compatible with Clamshell Batteries)

Belt Loops

NTN8040	Belt Loop, Swivel, Leather, 3.0”, High-Activity (For use only with the high-activity leather swivel snap carry cases.)

Carry Cases

NTN8381	Leather High Activity, 3.0”, Swivel Belt Loop, Model II and III Radios

Chargers

NTN1873	Single-Unit, Dual Rate, Rapid, Tri-Chemistry; 110 V
NTN1874	Single-Unit, Dual Rate, Rapid, Tri-Chemistry; 220 V (2-prong Euro plug)
NTN1875	Single-Unit, Dual Rate, Rapid, Tri-Chemistry 240 V (3-prong UK plug)
NTN1177	Multi-Unit, Dual Rate, Rapid: 110 V
NTN1178	Multi-Unit, Dual Rate, Rapid: 220 V (2-prong Euro plug)
NTN1179	Multi-Unit, Dual Rate, Rapid: 240V (UK 13 MAP Plug)
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)
NTN4796	Multi-Unit, Tri-Chemistry, Rapid Rate,110 V
NTN9176	Vehicular, Tri-Chemistry and compatible with PAC•RT
WPLN4111	Impres™ Single-Unit, Tri-Chemistry,110 V

Enhanced and Multi-Unit Line Cords

NTN7373	110 V Interchangeable Line
NTN7374	220 V Interchangeable Line (2 prong Euro plug)
NTN7375	240 V Interchangeable Line (3 prong UK plug)

Commport Integrated Microphone/Receiver

NTN1624	MTS/XTS/HT w/ Palm PTT

Headset / Surveillance Accessories

(May require BDN6676D — 3.5 mm adapter jack that attaches to the radio)

BDN6645	Noise-Canceling Boom Mic Headset with PTT on earcup
BDN6780	Earbud, Single with Mic and PTT Combined
NMN6246	Ultralite Headset w/Boom Microphone
NMN6258	Over the Head Headset w/ In Line PTT

Earpieces

BDN6641	Ear mic, high noise level up to 105dB GREY (must order Interface module)
BDN6664	Earpiece with standard earpiece 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 earpiece BEIGE
BDN6670	Earpiece, Mic and PTT separate with extra loud earpiece BEIGE
BDN6677	Ear mic, standard, noise up to 95dB BLACK (must order Interface module)
BDN6726	Earpiece with standard earpiece BLACK
BDN6727	Earpiece with extra loud earphone 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 earpiece BLACK
BDN6732	Earpiece, Mic and PTT separate with extra loud earpiece BLACK
BDN6781	Earbud, dual, receive only BLACK
BDN6782	Earbud single receive only BLACK
NTN1625	Commport ear mic, with PTT for noise levels up to 100 db (ship w/ BDN6676 adapter)
NTN1663	Commport ear mic, with Ring PTT for noise levels up to 100 db (ship w/ BDN6676 adapter)
NTN1736	Commport ear mic, with Snap-On Side PTT for noise levels up to 100 db (ship w/ BDN6676 adapter)

Headset Accessories

BDN6635	Heavy-Duty VOX Headset with Noise-Cancelling Boom Mic (Requires BDN6673_)

BDN6636	Heavy-Duty VOX Headset with Throat Microphone (Requires BDN6673_)
BDN6673	Cable, Headset Adapter
NMN1020	Lightweight with Boom Mic to be Worn on Helmet or Safety Glasses
NMN6245	Lightweight with Single-Sided Headset and In-Line PTT Switch
NMN6259	Medium Weight, Behind-the-Head with In-Line PTT Switch
RMN4049	Temple Transducer

Ear Microphones (Require Radio Interface Module)

BDN6677	Ear Mic, Standard — 95 dB (Black)
BDN6678	Ear Mic, Standard — 95 dB (Beige)

Radio Interface Modules for Ear Microphones

BDN6671	Voice-activated Interface Module
BDN6708	Push-to-Talk Interface Module

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

Vehicular Adapters

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
NTN8270	Tool Wrench
NTN8480	Vehicular Adapter Trunnion Kit
NTN8560	Vehicular Adapter, Mini-U, Open Faced
NTN8561	Vehicular Adapter, Mini-U, Closed Faced
NTN9176	Vehicular Charger, XTS
PLN7737	Handheld Control Head

Allied Models

N1799	Vehicular Adapter, Mini-U, Closed Faced
N2001	Vehicular Adapter, Mini-U, Open Face
N2002	Vehicular Adapter, BNC, Open Face
N2003	Vehicular Adapter, BNC, Closed Face

Notes

Glossary

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A/D, ADC	**A**nalog-to-**D**igital converter; converts an instantaneous dc voltage level to a corresponding digital value.
ABACUS IC	Custom integrated circuit providing a digital receiver IF backend.
CODEC	**Cod**er/**Dec**oder IC for analog-to-digital and digital-to-analog conversion.
CPS	Customer Programming Software
D/A, DAC	**D**igital-to-**A**nalog converter; converts a digital value to a corresponding dc voltage value.
DPL	**D**igital **P**rivate-**L**ine™
DSP	**D**igital **S**ignal **P**rocessor; microcontroller specifically tailored for signal processing computations. In this case refers specifically to Motorola DSP56603.
Firmware	Software or a software/hardware combination of computer programs and data, with a fixed logic configuration stored in a read-only memory; information can not be altered or reprogrammed.
FGU	**F**requency **G**eneration **U**nit
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.
Host	Motorola HC12A4 microcontrol unit U204 (see MCU).
Host Port	Parallel memory mapped interface consisting of eight registers in the DSP56603.
IC	**I**ntegrated **C**ircuit
IMBE	**I**mproved **M**ulti-**B**and **E**xcitation: a sub-band, voice encoding algorithm used in ASTRO digital voice.
MCU	**M**icro**C**ontrol **U**nit
MDC	**M**otorola **D**igital **C**ommunications
MISO	**M**aster **I**n **S**lave **O**ut; used by the slave device to send data to the master device.
MOSI	**M**aster **O**ut **S**lave **I**n; used by the master device to send data to the slave device.
OMPAC	**O**ver-**M**olded **P**ad-**A**rray **C**arrier; a Motorola custom IC package, distinguished by the presence of solder balls on the bottom pads.

Open Architecture	A controller configuration that utilizes a microprocessor with extended ROM and RAM.
PC Board	**P**rinted **C**ircuit board
PCIC	**P**ower **C**ontrol **IC**
PL	**P**rivate-**L**ine® tone squelch; a continuous sub-audible tone that is transmitted along with the carrier.
PLL	**P**hase-**L**ocked **L**oop; a circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PTT	**P**ush-**T**o-**T**alk; the switch located on the left side of the radio which, when pressed, causes the radio to transmit.
Registers	Short-term data-storage circuits within the microcontrol unit or programmable logic IC.
Repeater	Remote transmit/receive facility that re-transmits received signals in order to improve communications coverage.
RESET	Reset line; an input to the microcontroller that restarts execution.
RF PA	**R**adio **F**requency **P**ower **A**mplifier
RPT/TA	**R**e**P**ea**T**er/**T**alk-**A**round
RX DATA	Recovered digital data line.
Signal Qualifier Mode	An operating mode whereby the radio is muted but still continues to analyze receive data to determine RX signal type.
SCI IN	**S**erial **C**ommunication **I**nterface **IN**put line
Softpot	Software potentiometer; a computer-adjustable electronic attenuator.
Software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
SPI	**S**erial **P**eripheral **I**nterface; how the microcontroller communicates to modules and ICs through the CLOCK and DATA lines.
Squelch	Muting of audio circuits when received signal levels fall below a pre-determined value.
SRAM	**S**tatic-**RAM** chip used for volatile, program/data memory.
SSI	**S**ynchronous **S**erial **I**nterface on the DSP56603 to the CODEC, DSPS IC, and ADDAG.
Standby Mode	An operating mode whereby the radio is muted but still continues to monitor data.
System Select	The act of selecting the desired operating system with the system-select switch (also, the name given to this switch).
TOT	**T**ime-**O**ut **T**imer; a timer that limits the length of a transmission.
TSOP	**T**hin **S**mall-**O**utline **P**ackage

UART	**U**niversal **A**synchronous **R**eceiver **T**ransmitter.
µC	Microcontrol unit (see MCU).
USB	Universal Serial Bus
VCO	**V**oltage-**C**ontrolled **O**scillator; an oscillator whereby the frequency of oscillation can be varied by changing a control voltage.
VCOB IC	**V**oltage-**C**ontrolled **O**scillator **B**uffer **IC**
Vocoder	**VO**ice en**CODER**; the DSP-based system for digitally processing the analog signals, includes the capabilities of performing voice compression algorithms or voice encoding.
VOCON	**VO**coder/**CON**troller board
VSWR	**V**oltage **S**tanding **W**ave **R**atio

Notes

Index

REPLACEMENT PARTS ORDERING

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.

MAIL ORDERS

Send written orders to the following addresses:

Replacement Parts/
Test Equipment/Manuals/
Crystal Service Items:

Motorola Inc.
United States and Canada
Accessories and Aftermarket
Division
Attention: Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Federal Government Orders:

Motorola Inc.
United States and Canada
Accessories and Aftermarket
Division
Attention: Order Processing
7230 Parkway Drive
Landover, MD 21076

International Orders:

Motorola Inc.
United States and Canada
Accessories and Aftermarket
Division
Attention: International Order
Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

TELEPHONE ORDERS

United States and Canada Accessories and Aftermarket Division:
Call: 1-800-422-4210
1-800-826-1913 (For Federal Government Orders)
1-847-538-8023 (International Orders)

Servicers Training (VHS Video Tapes):
Call: 847-783-2522
847-783-2523 (FAX)

FAX ORDERS

United States and Canada Accessories and Aftermarket Division:
FAX: 847-538-8198 (Domestic)
847-576-3023 (International)
Parts ID: 847-538-8194

Federal Government Orders:
FAX: 410-712-4991
International: 410-712-6200

PARTS CUSTOMER SERVICE

United States and Canada Accessories and Aftermarket Division:
Call: 1-800-422-4210
Parts Identification:
Call: 847-538-0021

PRODUCT CUSTOMER SERVICE

Customer Response Center
(Sales and Service Assistance):
Call: 1-800-247-2346
FAX: 1-800-232-9272

Motorola, Inc.
8000 W. Sunrise Blvd.
Ft. Lauderdale, FL 33322

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