MOTOROLA

ASTRO™ Digital XTS 3500™

Portable Radios

Basic Service Manual

Foreword

This manual covers all models of the ASTRO™ Digital XTS 3500® Portable Radio, unless otherwise specified. It includes all the information necessary to maintain peak product performance and maximum working time, using the pass/fail service approach. This basic level of service is typical of some local service centers, self-maintained customers, and some distributors.

Included in this manual are: radio specifications for the VHF and UHF frequency bands; a general description of ASTRO Digital XTS 3500 models; recommended test equipment, service aids, and tools; radio alignment procedures; fundamental disassembly/reassembly procedures; and general maintenance recommendations.

For details on the operation of the radio, or board 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 3500 Radio, please read the “Safety 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.

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Related Publications

ASTRO Digital XTS 3500 Model I User Guide 68P81089C77
ASTRO Digital XTS 3500 Model II User Guide 68P81089C78
ASTRO Digital XTS 3500 Model III User Guide 68P81089C79
ASTRO Digital XTS 3500 Detailed Service Manual 68P81089C81

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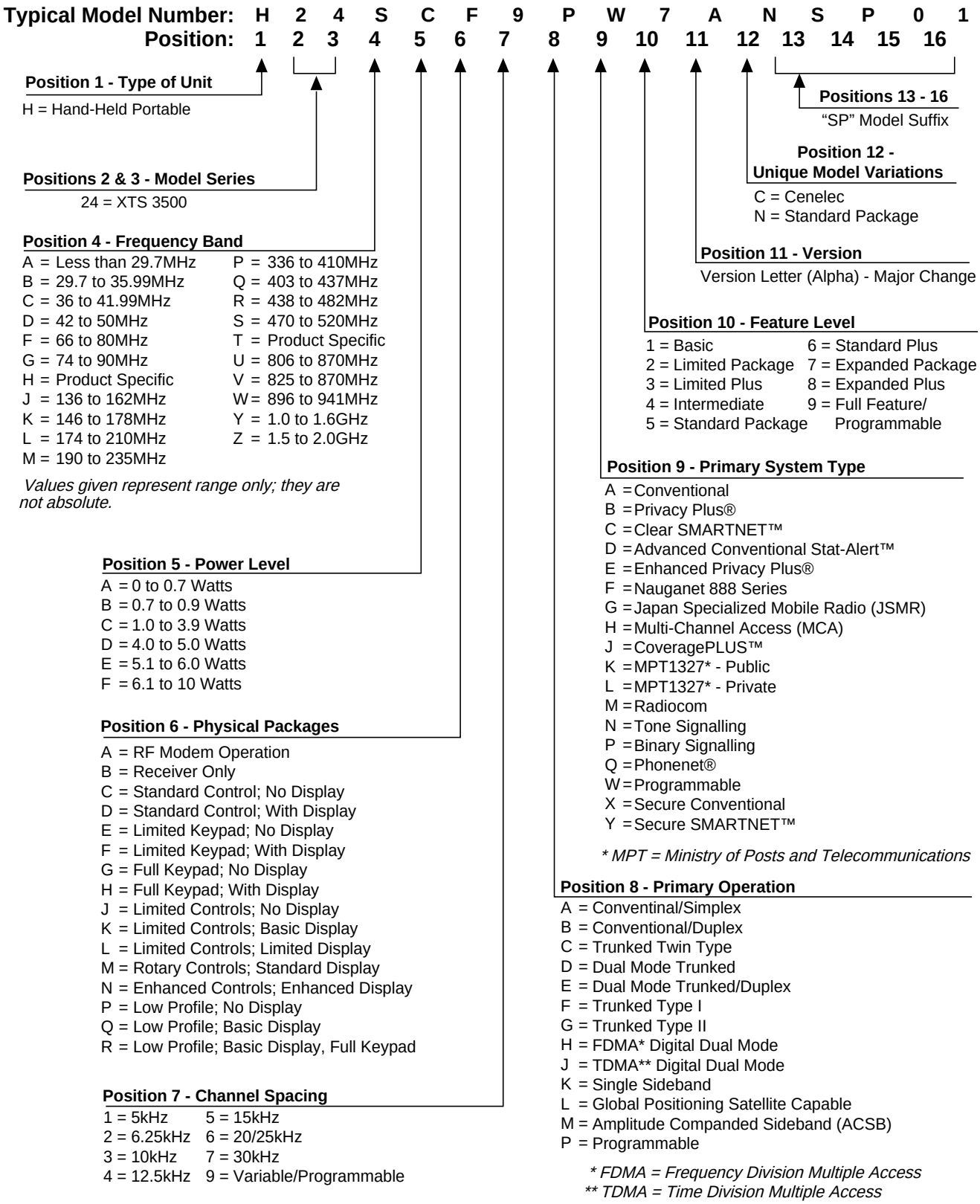
Portable Radio Model Numbering System



SPECIFICATIONS FOR VHF RADIOS

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

GENERAL

FCC Designation: AZ489FT3799

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 Volts
Range: 6 to 9 Volts

Transmit Current Drain (Typical): 2100mA
Receive Current Drain (Rated Audio): 240mA
Standby Current Drain: 80mA

Recommended Battery:
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
Less Battery:
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/Helical 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: 136-174MHz

Bandwidth: 38MHz

Quieting Sensitivity (20dBQ): 0.35µV (typical)

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

Intermodulation: –78dB (typical)

Selectivity (typical)
(25/30kHz Channel): –80dB
(12.5kHz Channel): –67dB

Spurious Rejection: –78dB

Frequency Stability
(–30+60°C; 25°C reference): ±.0002%

Rated Audio: 500mW

FM Hum and Noise (typical):
25kHz –50dB
12.5kHz –44dB

Distortion (At Rated Audio): 1.5% Typical

Channel Spacing: 12.5/25 kHz

TRANSMITTER

RF Power:
136-174MHz: 1 to 6 Watts

Frequency Range: 136-174MHz

Frequency Stability (typical)
(–30 to +60°C; 25°C ref.): ±.0002%

Emission (Conducted and Radiated): –75dBc

FM Hum and Noise (typical)
(Companion Receiver): 25kHz –50dB
12.5kHz –44dB

Distortion: 2% Typical

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

Adjacent Channel Power Ratio:
25kHz –73dBc
12.5kHz –63dBc

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

Specifications subject to change without notice

SPECIFICATIONS FOR UHF RADIOS

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

GENERAL

FCC Designation: AZ489FT4828

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 Volts
- **Range:** 6 to 9 Volts

Transmit Current Drain (Typical): 2000mA
Receive Current Drain (Rated Audio): 240mA
Standby Current Drain: 80mA

Recommended Battery:
- **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
- **Less Battery:**
  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/Helical 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: 450-520MHz

Bandwidth: 70MHz

Quieting Sensitivity (20dBQ): 0.35µV (typical)

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

Intermodulation: –78dB (typical)

Selectivity (typical)
- **(25/30kHz Channel):** –78dB
- **(12.5kHz Channel):** –70dB

Spurious Rejection: –80dB

Frequency Stability
(–30+60°C; 25°C reference): ±.0002%

Rated Audio: 500mW

FM Hum and Noise (typical):
25kHz –48dB
12.5kHz –43dB

Distortion (At Rated Audio): 1.5% Typical

Channel Spacing: 12.5/25 kHz

TRANSMITTER

RF Power:
- **450-520MHz:** 1 Watt/5 Watts

Frequency Range: 450-520MHz

Frequency Stability (typical)
(–30 to +60°C; 25°C ref.): ±.0002%

Emission (Conducted and Radiated): –75dBc

FM Hum and Noise (typical)
(Companion Receiver): 25kHz –48dB
12.5kHz –42dB

Distortion: 2% 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

GLOSSARY

A/D	Analog-to-Digital converter; converts an instantaneous dc voltage level to a corresponding digital value.
ABACUS IC	Custom integrated circuit providing a digital receiver IF backend.
ADDAG	Analog-to-Digital/Digital-to-Analog Glue IC
APCO	Association of Public Safety Communication Officers
CODEC	Coder/Decoder IC for analog-to-digital and digital-to-analog conversion.
D/A	Digital-to-Analog converter; converts a digital value to a corresponding dc voltage value.
DTMF	Dual-Tone Multi-Frequency
DPL	Digital Private-Line™
DSP	Digital Signal Processor; microcontroller specifically tailored for signal processing computations. In this case refers specifically to Motorola DSP56603.
DSPS IC	Digital Signal Processor Support IC. Generates processor clocks and provides peripheral functions for the DSP.
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	Frequency Generation Unit
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	Integrated Circuit
IMBE	Improved Multi-Band Excitation: a sub-band, voice encoding algorithm used in ASTRO digital voice.
MCU	MicroControl Unit
MDC	Motorola Digital Communications

MISO	Master In Slave Out; used by the slave device to send data to the master device.
MOSI	Master Out Slave In; used by the master device to send data to the slave device.
OMPAC	Over-Molded Pad-Array Carrier; 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	Printed Circuit board
PCIC	Power Control IC
PL	Private-Line® tone squelch; a continuous sub-audible tone that is transmitted along with the carrier.
PLL	Phase-Locked Loop; a circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PTT	Push-To-Talk; 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	Radio Frequency Power Amplifier
RSS	Radio Service Software
RPT/TA	RePeaTer/Talk-Around
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	Serial Communication Interface INput 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	Serial Peripheral Interface; 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	Static-RAM chip used for volatile, program/data memory.
SSI	Synchronous Serial Interface 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	Time-Out Timer; a timer that limits the length of a transmission.
TSOP	Thin Small-Outline Package
UART	Universal Asynchronous Receiver Transmitter.
µC	Microcontrol unit (see MCU).
VCO	Voltage-Controlled Oscillator; an oscillator whereby the frequency of oscillation can be varied by changing a control voltage.
VCOB IC	Voltage-Controlled Oscillator Buffer IC
Vocoder	VOice enCODER; the DSP-based system for digitally processing the analog signals, includes the capabilities of performing voice compression algorithms or voice encoding.
VOCON	VOcoder/CONtroller board
VSWR	Voltage Standing Wave Ratio

Safe And Efficient Operation Of Motorola Two-Way Radios

For information regarding radio use in hazardous areas, please refer to the Factory Mutual (FM) approval manual supplement that is included with radio models that offer this capability.

Exposure To Radio Frequency Energy

National and International Standards and Guidelines

Your Motorola Two-Way Radio, which generates and radiates radio frequency (RF) electromagnetic energy (EME), is designed to comply with the following National and International Standards and Guidelines regarding exposure of human beings to radio frequency electromagnetic energy:

- Federal Communications Commission Report and Order No. FCC 96-326 (August 1996)
- American National Standards Institute (C95.1 - 1992)
- National Council on Radiation Protection and Measurements (NCRP - 1986)
- International Commission on Non-Ionizing Radiation Protection (ICNRP - 1986)
- European Committee for Electrotechnical Standardisation (CENELEC):
    - ENV. 50166-1 1995 E — Human Exposure to Electromagnetic Fields Low Frequency (0Hz to 10kHz)
    - ENV. 50166-2 1995 E — Human Exposure to Electromagnetic Fields High Frequency (10kHz to 300GHz)
    - Proceedings of SC211/8 1996 — Safety Considerations for Human Exposure to E.M.F.s from Mobile Telecommunications Equipment (M.T.E.) in the Frequency Range 30MHz - 6 GHz (E.M.F. - Electromagnetic Fields)

To assure optimal radio performance and that human exposure to radio frequency electromagnetic energy is within the guidelines set forth in the above standards, always adhere to the following procedures:

Portable Radio Operation and EME Exposure

- When transmitting with a portable radio, hold the radio in a vertical position with its microphone 1 to 2 inches (2.5 to 5 centimeters) away from your mouth. Keep the antenna at least 1 inch (2.5 centimeters) from your head and body.
- If you wear a portable two-way radio on your body, ensure that the antenna is at least 1 inch (2.5 centimeters) from your body when transmitting.

Electromagnetic Interference/Compatibility

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

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

Operational Warnings

WARNING

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 two-way radio when you are in any area with a potentially explosive atmosphere, unless it is a radio type especially qualified for use in such areas (for example, Factory Mutual or CENELEC approved). Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or even death.

Batteries

Do not replace or recharge batteries in a potentially explosive atmosphere. Battery contact sparking may occur while installing or removing batteries and may cause an explosion.

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.

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 a vehicle engine. Areas with potentially explosive atmospheres are often but not always posted.

Operational Cautions

Caution

Antennas

- Do not use any portable two-way radio that has a damaged antenna. If a damaged antenna comes into contact with your skin, a minor burn can result.
- Make sure you have the correct antenna installed for your radio’s frequency band. Ask your dealer for details.

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 touch 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.

Battery Information

Charging Batteries

This product is powered by a nickel-cadmium (Ni-Cd), nickel-metal-hydride (NiMH), or lithium-ion rechargeable battery. Charge the battery before use to ensure optimum capacity and performance. The battery was designed specifically to be used with a Motorola charger. Charging in non-Motorola equipment may lead to battery damage and void the battery warranty.

Note When charging a battery attached to a radio, turn the radio off to ensure a full charge.

The battery should be at about 77°F (25°C) (room temperature), whenever possible. Charging a cold battery (below 50° F [10°C]) may result in leakage of electrolyte and ultimately in failure of the battery. Charging a hot battery (above 104°F [40°C]) results in reduced discharge capacity, affecting the performance of the radio. Motorola rapid-rate battery chargers contain a temperature-sensing circuit to ensure that batteries are charged within the temperature limits stated above.

Recycling of Nickel-Cadmium Batteries

Nickel-cadmium (Ni-Cd) rechargeable batteries can be recycled. However, recycling facilities may not be available in all areas. Under various U.S. state laws and the laws of several other countries, Ni-Cd batteries must be recycled or disposed of properly and cannot be disposed of in landfills or incinerators.

Contact your local waste management agency for specific requirements and information in your area.

Motorola fully endorses and encourages the recycling of Ni-Cd batteries. In the U.S. and Canada, Motorola participates in the nationwide Rechargeable Battery Recycling Corporation (RBRC) program for Ni-Cd battery collection and recycling. Many retailers and dealers participate in this program.

For the location of the drop-off facility closest to you, access RBRC's Internet website at www.rbrc.com or call 1-800-8-BATTERY. This internet site and telephone number also provide other useful information concerning recycling options for consumers, businesses, and governmental agencies.

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:

WARNINGS

- 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.

WARNINGS

- 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.

WARNINGS

- 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.

Notes

Introduction

1

General

This manual covers information needed for level one 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.

Included in this manual are radio specifications for the VHF and UHF frequency bands, a general description of XTS 3500 models, recommended test equipment, service aids, radio alignment procedures, general maintenance recommendations, and procedures for basic assembly and disassembly.

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 3500 radios are among the most sophisticated two-way radios available. The radios are available in the VHF and UHF R2 bands.

One of the newest in a long line of quality Motorola products, the ASTRO Digital XTS 3500 radio provides improved voice quality across more coverage area. The digital process, called “embedded signalling,” intermixes system signalling information with digital voice, resulting in improved system reliability, and the capability of supporting a multitude of advanced features. Such features add up to better, more cost-effective two-way radio communications.

ASTRO Digital XTS 3500 radios are available in three basic models. Table 1 describes their basic features.

Table 1 ASTRO XTS 3500 Basic Features

Feature	Model I	Model II	Model III
Display	None	LCD 4 lines/ 12 characters per line	LCD 4 lines/ 12 characters per line
Keypad	None	3 x 2 button	3 x 6 button
Channel Capability	48	255	255
Dialing from Prestored List	No	Yes	Yes
Programmable Softkeys	No	Yes	Yes

FLASHport

The ASTRO Digital XTS 3500 radio utilizes Motorola’s revolutionary 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 to This Section

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.

Preventive Maintenance

The ASTRO Digital XTS 3500 radios do not require a scheduled preventive maintenance program; however, periodic visual inspection and cleaning is recommended.

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, such as JOY®, 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.

Recommended Test Equipment and Service Aids

3

Recommended Test Equipment

The list of equipment contained in Table 2 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 2 Recommended Test Equipment

Motorola Model Number	Description	Characteristics	Application
R2600 Series	Communications System Analyzer	This monitor will substitute for items with an asterisk (*).	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment.
Fluke 8012	Digital Multimeter		Recommended for ac/dc voltage and current measurements
R1150_*	Code Synthesizer		Injection of audio and digital signalling 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
S1350_* ST1213_ (VHF)* ST1223_ (UHF)*	Wattmeter Plug-In Element RF Dummy Load	50-ohm, ±5% accuracy 10 watts, maximum 0-1000MHz, 300W	Transmitter power output measurements
R1065_	Load Resistor	10-watt Broadband	For use with wattmeter
S1339_	RF Millivolt Meter	100µV to 3V RF	RF-level measurements
R1013_*	SINAD Meter		Receiver sensitivity measurements
S1347_ or S1348_ (programmable)	DC Power Supply	0-20Vdc, 0-5 Amps current limited	Bench supply for 7.5Vdc

Service Aids

Refer to Table 3, "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 Motorola Parts 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 3 Service Aids

Motorola Part Number	Description	Application
RKN-4035_	RIB/Radio/Test Set Cable	Connects radio to RTX-4005B Test Box and RIB.
REX-4424_	Battery Eliminator	Interconnects radio to power supply.
RLN-4460_, or RTX-4005_, or both RTX-4005_ and RPX-4665_	Portable Test Set	Enables connection to the universal connector. Allows switching for radio testing.
Field Modification Kit RLN-1015_ or RLN-4008_	Radio Interface Box	Enables communications between the radio and the computer's serial communications adapter.
01-80357A57	Wall-Mounted Power Supply	Used to supply power to the RIB (120 Vac).
01-80358A56	Wall-Mounted Power Supply	Used to supply power to the RIB (220 Vac).
30-80369B71 or 30-80369B72	Computer Interface Cables for RIB RLN4008_	Use B72 for 9-pin serial ports. All other models use B71 (25 pins). Connects the computer's serial communications adaptor to the RIB.
30-80390B48 or 30-80390B49	Computer Interface Cables for Smart RIB RLN1015_	Use B49 for 9-pin serial ports. All other models use B48 (25 pins). Connects the computer's serial communications adaptor to the RIB.
RVN-4170_	Radio Service Software	Software on 3-1/2 in. floppy disks.
58-80348B33	SMA to BNC Adaptor	Adapts radio’s antenna port to BNC cabling of test equipment.

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 applicable “Radio Service Software User's Guide” for complete field programming information.

Performance Checks

4

Introduction to This Section

This section covers performance checks used to verify 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 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 the "Radio Alignment Test Setup" diagram (page 15, Figure 1).

Initial equipment control settings should be as indicated in the following table, and should hold for all alignment procedures except as noted in Table 4.

Table 4 Initial Equipment Control Settings

System Analyzer	Test Set	Power Supply
Monitor Mode: Pwr Mon	**Spkr Set:** A	**Voltage:** 7.5Vdc
RF Attn: –70dB	**Spkr/Load:** Speaker	**DC On/Standby:** Standby
AM, CW, FM: FM	**PTT:** OFF (center)	**Volt Range:** 10Vdc
O'scope Source: Mod **O'scope Horiz:** 10mSec/Div **O'scope Vert:** 2.5kHz/Div **O'scope Trig:** Auto **Monitor Image:** Hi **Monitor BW:** Nar **Monitor Squelch:** Mid CW **Monitor Vol:** 1/4 CW		**Current:** 2.5Amps

Display Radio Test Mode

Entering Display Radio Test Mode

1. Turn the radio on.
2. Within 10 seconds after "**`Self Test`**" is complete, press **Side button 3** five times in succession.
3. The radio will show a series of displays that will give information regarding various version numbers and subscriber specific information. The displays are described in Table 5 on page 8.

Table 5 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.
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" will be displayed.

4a. Press **Side Button 1** to stop the displays and put the radio into the Control Top and Keypad test mode (display radio). The test mode menu "CH TEST" will be displayed. Go to the "Control Top and Keypad Test Mode (Display Radio)" section.

NOTE: Each press of **Side Button 1** will toggle between "CH TEST" and "RF TEST."

OR

4b. Press the **Top Programmable Button** (Emergency button) to stop the displays and put the radio into the RF test mode (display radio). The test mode menu "1 CSQ." will be displayed, indicating test frequency 1, Carrier SQuelch mode. Go to the "RF Test Mode (Display Radio)" section.

RF Test Mode (Display Radio)

When the ASTRO Digital XTS 3500 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 3** will advance to the next test channel. (Refer to Table 6.)
2. Pressing **Side Button 2** will scroll through and access test environments as shown in Table 7.

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

Table 6 Test Frequencies

Test Channel	VHF	UHF Band 2
TX #1	136.025	450.025
RX #1	136.075	450.075
TX #2	142.125	465.225
RX #2	142.075	465.275
TX #3	154.225	475.125
RX #3	154.275	475.275
TX #4	160.125	484.975
RX #4	160.175	485.025
TX #5	168.075	500.275
RX #5	168.125	500.225
TX #6	173.975	511.975
RX #6	173.925	511.925
TX #7	177.975	519.975
RX #7	177.925	519.925

Table 7 Test Environments

No. of Beeps	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 (Display Radio)

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 Programmable Button**; all segments on the display will light, and the LED on the control top will illuminate a red color.
2. Release the **Top Programmable Button**; "**3/0**" appears, which indicates that the **Top Programmable Button** is in the open condition.
3. Press the **Top Programmable Button** again; "**3/1**" appears, which indicates that the **Top Programmable Button** is in the closed condition.
4. Rotate the **Mode/Zone Selector 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 Programmable Switch**; "67/0," "67/1," and "67/2" appear.
7. Rotate the **Volume Control**; "2/0" through "2/255" appear.
8. Press **Side Button 1**; "96/1" appears; release, "96/0" appears.
9. Press **Side Button 2**; "97/1"appears; release, "97/0" appears.
10. Press **Side Button 3**; "98/1"appears; release, "98/0" appears.
11. Press the **PTT Switch**; "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 PRS, "55/1" appears; release, "55/0" appears.
- Press 8 TUV, "56/1" appears; release, "56/0" appears.
- Press 9 WXY, "57/1" appears; release, "57/0" appears.
- Press *, "58/1" appears; release, "58/0" appears.
- Press #, "59/1" appears; release, "59/0" appears.

All Display Models—

- Press ◄, "128/1" appears; release, "128/0" appears.
- Press HOME, "129/1" appears; release, "129/0" appears.
- Press ►, "130/1" appears; release, "130/0" appears.
- Press the left-hand key on the top row of keys, "131/1" appears; release, "131/0" appears.
- Press the center key, "132/1" appears; release, "132/0" appears.
- Press the right-hand key, "133/1" appears; release, "133/0" appears.

Non-Display Radio Test Mode

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 3** five times in succession.

mode (non-display radio). Go to the “Control Top and Keypad Test Mode (Non-Display Radio)” section.

NOTE: Each press of **Side Button 1** will toggle between Control Top and Keypad test mode (non-display radio) and RF test mode (non-display radio).

OR

3b. Press the **Top Programmable Button** (Emergency button) to stop the displays and put the radio into the RF test mode (non-display radio). Go to the “RF Test Mode (Non-Display Radio)” section.

RF Test Mode (Non-Display Radio)

When the ASTRO Digital XTS 3500 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 3** will advance to the next test channel. (Refer to Table 6.) The channel number is represented by the number of beeps emitted by the radio after the button press (for example, five beeps indicates channel 5).
2. Pressing **Side Button 2** will scroll through and access test environments as shown in Table 7. The test environment is represented by the number of beeps emitted by the radio after the button press (for example, 11 beeps indicate AST).

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

Control Top and Keypad Test Mode (Non-Display Radio)

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 Programmable Button**; the LED on the control top lights red, and the radio beeps.
2. Release the **Top Programmable Button**; the radio beeps again.
3. Press the **Top Programmable Button** again; the radio beeps, indicating that the **Top Programmable Button** is in the closed condition.
4. Rotate the **Two-Position Concentric Switch**; the radio beeps in each switch position.
5. Rotate the **Mode/Zone Selector Switch**; the radio beeps in each switch position.
6. Cycle through the **Three-Position Programmable Switch**; the radio beeps in each switch position.
7. Rotate the **Volume Control**; the radio beeps at each new volume setting.
8. Press **Side Button 1**; the radio beeps.
9. Press **Side Button 2**; the radio beeps.
10. Press **Side Button 3**; the radio beeps.

Table 8 Receiver Performance Checks

Test Name	System Analyzer	Radio	Test Set	Comments
Reference Frequency	**Mode:** PWR MON 4th channel test frequency❖ **Monitor:** Frequency error. Input at RF In/Out	TEST MODE, 4 CSQ output at antenna	PTT to continuous (during the performance check)	Frequency error to be ≤ ±1.0kHz
Rated Audio	**Mode:** GEN **Output level:** 1.0mV RF 4th channel test frequency❖ **Mod:** 1kHz tone at 3kHz deviation **Monitor:** DVM: ac Volts	TEST MODE, 4 CSQ	PTT to OFF (center); meter selector to Audio PA	Set volume control to 3.74Vrms
Distortion	As above, except to distortion	As above	As above	Distortion < 3.0%
Sensitivity (SINAD)	As above, except SINAD; lower the RF level for 12dB SINAD	As above	PTT to OFF (center)	RF input to be < 0.35µV
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1mV RF	As above	PTT to OFF (center); meter selection to Audio PA; spkr/load to speaker	Set volume control to 3.74Vrms
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	Out of TEST MODE; select a conventional system	As above	Unsquelch to occur at < 0.25µV. Preferred SINAD = 5-8dB

❖ See Table 7

Table 9 Transmitter Performance Checks

Test Name	System Analyzer	Radio	Test Set	Comments
Reference Frequency	**Mode:** PWR MON 4th channel test frequency❖ **Monitor:** Frequency error. Input at RF In/Out	TEST MODE, 4 CSQ	PTT to continuous (during the performance check).	Frequency error to be ≤ ±1.0kHz.
Power RF	As above	As above, 4 CSQ	As above	Refer to Maintenance Specifications page in front of manual.
Voice Modulation	**Mode:** PWR MON 4th channel test frequency❖ atten to –70, input to RF In/Out. **Monitor:** DVM, ac Volts. Set 1kHz Mod Out level for 0.025Vrms at test set, 80mVrms at ac/dc test set jack	As above, 4 CSQ	As above, meter selector to mic	**Deviation:** ≥ 4.1kHz but ≤ 5.0kHz
Voice Modulation (internal)	**Mode:** PWR MON 4th channel test frequency❖ atten to –70, input to RF In/Out	TEST MODE, 4 CSQ, output at antenna	Remove modulation input	Press PTT switch on radio. Say “four” loudly into the radio mic. **Measure deviation:** ≥ 4.1kHz but ≤ 5.0kHz
PL Modulation (radios with conventional, clear mode, coded squelch operation only)	Change frequency to a conventional transmit frequency	Conventional coded squelch personality (clear mode operation) 4 TPL	As above	**Deviation:** ≥ 500Hz but ≤ 1000Hz
Talkaround Modulation (radios with conventional, clear mode, talk-around operation only)	Change frequency to conventional talk-around frequency. **Mode:** PWR MON deviation, attenuation to –70, input to RF In/Out. **Monitor:** DVM, ac volts Set 1kHz Mod Out level for 25mVrms at test set.	Conventional talkaround personality (clear mode operation) 1 CSQ	As above	**Deviation:** ≥ 4.1kHz but ≤ 5.0kHz
Talkaround Modulation (radios with conventional, secure mode, talkaround operation only)	Change frequency to conventional talk-around frequency. **Mode:** PWR MON deviation, attenuation to –70, input to RF In/Out. **Monitor:** DVM, ac volts **Mod:** 1kHz out level for25mVrms at test set.	Conventional talkaround personality (secure mode operation) 1 SEC. Load key into radio.	As above	**Deviation:** ≥ 3.7kHz but ≤ 4.3kHz

❖ See Table 7

Notes

Radio Alignment Procedures

5

Introduction to This Section

This section describes both receiver and transmitter radio alignment procedures.

General

A personal computer (PC) and radio service software (RSS) are required to align the radio. Refer to the applicable RSS manual for installation and setup procedures for the software. To perform the alignment procedures, the radio must be connected to the PC, radio interface box (RIB), and a universal test set as shown in Figure 1.

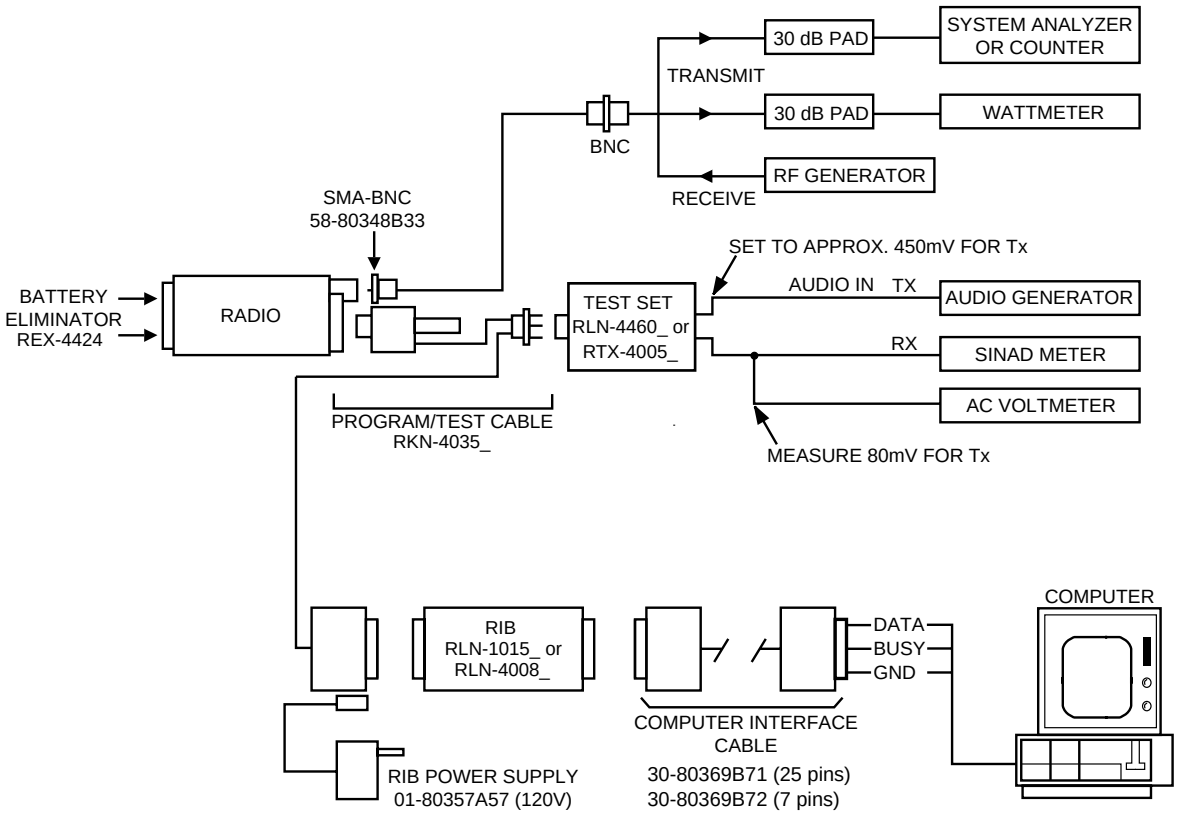


Figure 1 Radio Alignment Test Setup

All service and tuning procedures are performed from the SERVICE menu, which is selected by pressing F2 from the MAIN MENU. Figure 2 illustrates how the RSS alignment SERVICE screens are organized.

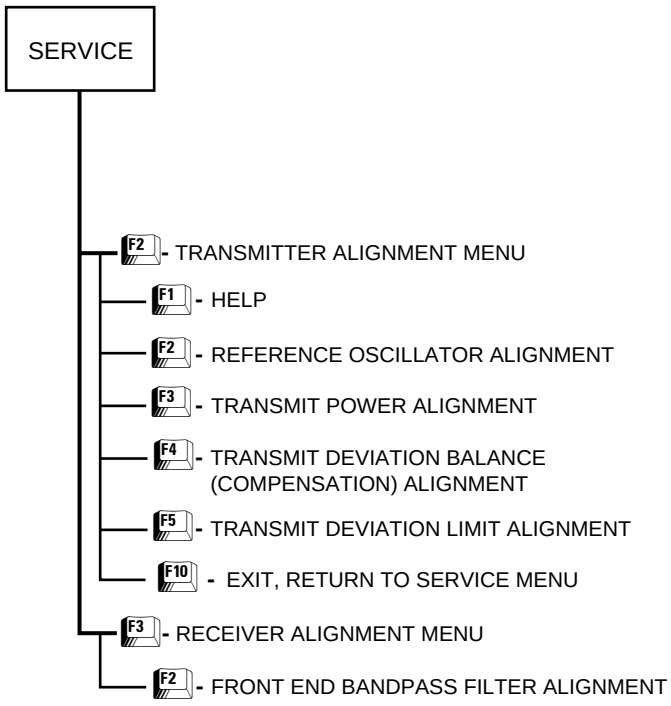


Figure 2 RSS Service Menu Layout

All SERVICE screens read and program the radio codeplug directly; you do NOT have to use the RSS GET/SAVE functions to use the SERVICE menus.

Caution

Do NOT switch radios in the middle of any SERVICE procedure. Always use the EXIT key to return to the MAIN menu screen before disconnecting the radio. Improper exits from the SERVICE screens may leave the radio in an improperly configured state and result in seriously degraded radio or system performance.

The SERVICE screens introduce the concept of the "softpot," an analog **SOFT**ware-controlled **POT**entiometer used for adjusting all transceiver alignment controls.

Each SERVICE screen provides the capability to increase or decrease the 'softpot' value with the keyboard UP/DOWN arrow keys respectively. A graphical scale is displayed indicating the minimum, maximum, and proposed value of the softpot, as shown in Figure 3.

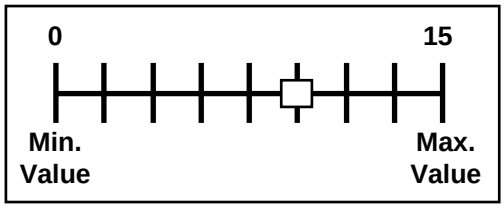


Figure 3 Softpot Concept

Adjusting the softpot value sends information to the radio to increase (or decrease) a dc voltage in the corresponding circuit. For example, pressing the UP arrow key at 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 radio service software you are using. Refer to your radio service software user's guide.

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. The frequency counter used for this procedure must have a stability of 0.1 ppm (or better).

1. From the SERVICE MENU, press F2 to select the TRANSMITTER ALIGNMENT MENU.
2. Press F2 again to select the REFERENCE OSCILLATOR alignment screen. See Figure 4.

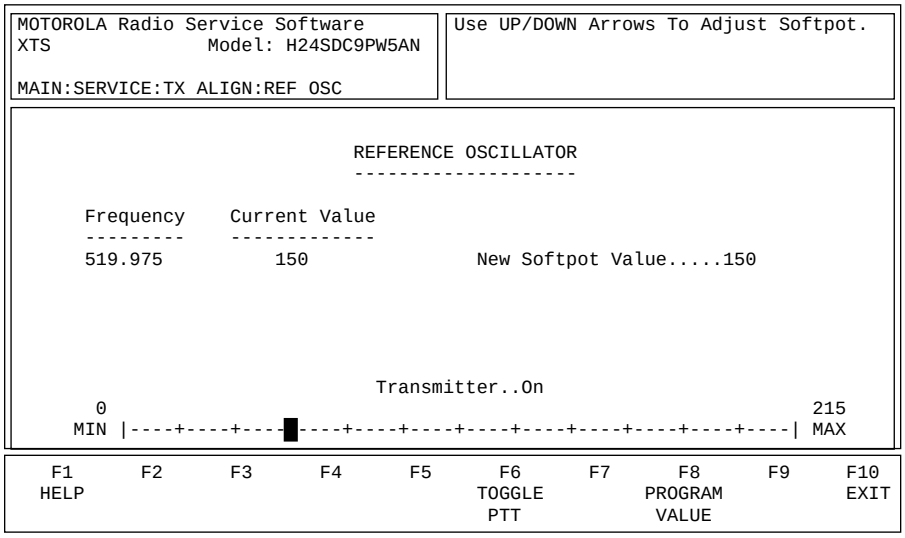


Figure 4 Reference Oscillator Alignment Screen

3. Press F6 to key the radio. The screen will indicate that the radio is transmitting.
4. Measure the transmit frequency on your service monitor.
5. Use the ↑/↓ arrow keys to adjust the reference oscillator softpot value. See Table 10.

Table 10 Reference Oscillator Alignment

Band	Target
VHF or UHF	±100 Hz

6. Press F6 again to dekey the radio.
7. Press F8 to program the new softpot value.
8. Press F10 once to return to the TRANSMITTER ALIGNMENT MENU, or press F10 twice to return to the SERVICE MENU.

Transmit Power Alignment

NOTES:

- All power measurements are to be made at the antenna port.
- The transmitter power setting keeps the radiated power at or below the level specified in the exclusionary clause for low power devices of IEEE Standard C95.1-1991.

1. From the SERVICE MENU, press F2 to select the TRANSMITTER ALIGNMENT MENU.
2. Press F3 to select the TRANSMIT POWER alignment screen. The screen will indicate the transmit frequencies to be used. See Figure 5.

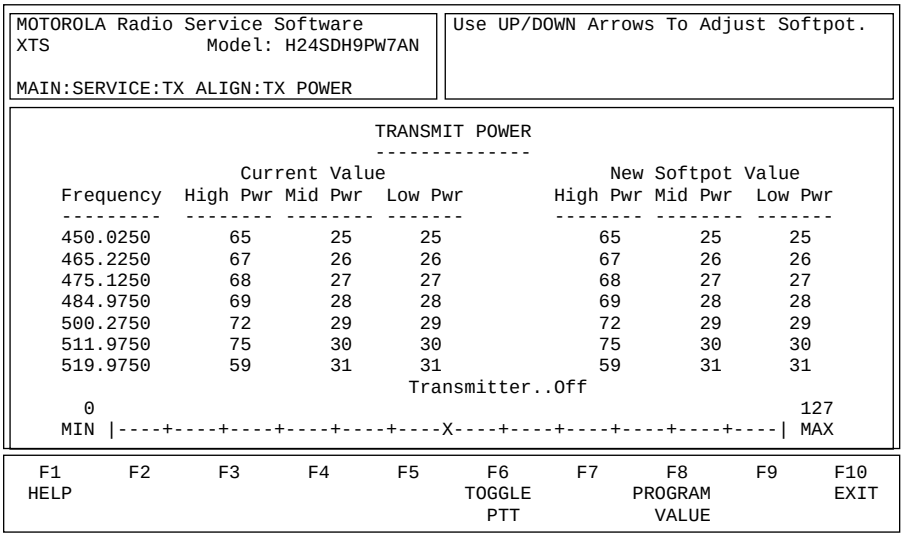


Figure 5 Transmit Power Alignment Screen

3. Press TAB (or ENTER or [**RETURN]**) to select a frequency field (starting with the highest frequency shown). Then, press F6 to key the radio. The screen will indicate that the radio is transmitting.
4. Use the ↑/↓ arrow keys to adjust the transmit power per the values shown in Table 11.

Table 11 Transmit Power Settings

Power Level	Test Frequencies		
	136-174MHz	450-512MHz	512-520MHz
1 Watt	1.2W - 1.4W	1.2W - 1.4W	1.2W - 1.4W
5 Watts	————	5.2W - 5.4W	3.2W - 3.4W
6 Watts	6.2W - 6.5W	————	————

5. Press F6 to dekey the radio.
6. Press F8 to program the value.
7. Repeat steps 3-6 for the remaining frequencies.
8. Press F10 once to return to the TRANSMITTER ALIGNMENT MENU, or press F10 twice to return to the SERVICE MENU.

Transmit Deviation Balance (Compensation) Alignment

Compensation alignment balances the modulation sensitivity of the VCO and reference modulation (synthesizer low-frequency port) lines. The compensation algorithm 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.

1. From the SERVICE MENU, press F2 to select the TRANSMITTER ALIGNMENT MENU.
2. Press F4 to select the TRANSMIT DEVIATION BALANCE (COMPENSATION) alignment screen. The screen will indicate the transmit frequencies to be used. See Figure 6.

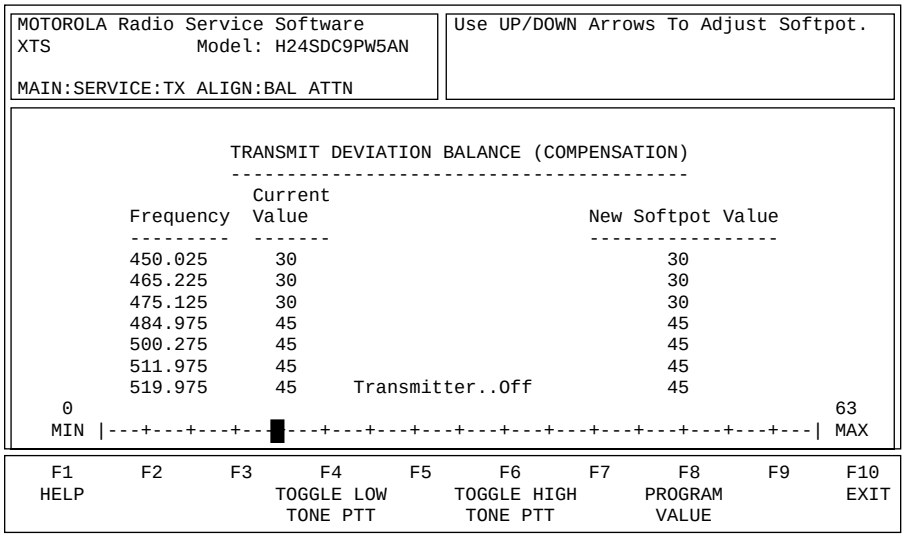


Figure 6 Transmit Deviation Balance (Compensation) Alignment Screen

3. Press TAB (or ENTER or **[RETURN]**) to select a frequency field (starting with the lowest frequency shown).
4. Press F4. This will cause the radio to key and the radio's DSP IC to inject an 80Hz tone into the RF board.
5. Measure the deviation and record this value.

6. Press F4 to dekey the radio.
7. Press F6. This will cause the radio's DSP IC to change the injection tone to 3kHz, 100mVrms. Use the ↑/↓ arrow keys to adjust the deviation to within ±2% of the value recorded in step 5.
8. Repeat steps 4-7 until the 3kHz tone deviation is within ±2% of the 80Hz tone deviation.
9. Press F6 again to dekey the radio.
10. Press F8 to program the new softpot value.
11. Repeat steps 3-10 for the remaining frequencies.
12. Press F10 once to return to the TRANSMITTER ALIGNMENT MENU, or press F10 twice to return to the SERVICE MENU.

Transmit Deviation Limit Alignment

1. From the SERVICE MENU, press F2 to select the TRANSMITTER ALIGNMENT MENU.
2. Press F5 to select the TRANSMIT DEVIATION LIMIT alignment screen. The screen will indicate the transmit frequencies to be used. See Figure 7.

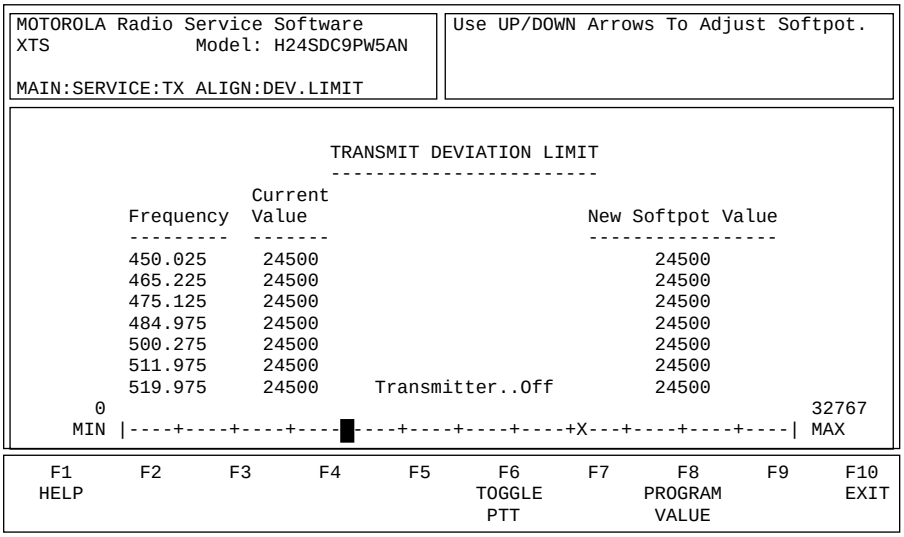


Figure 7 Transmit Deviation Limit Alignment Screen

3. Press TAB (or ENTER or [**RETURN]**) to select a frequency field (starting with the lowest frequency shown).
4. Press F6 to key the radio. Then use the ↑/↓ arrow keys to adjust for a deviation per the values shown in Table 12.

Table 12 Transmit Deviation Limit

Band	Deviation (Hz)
VHF or UHF	2785 - 2885

5. Press F6 again to dekey the radio.
6. Press F8 to program the softpot value.
7. Repeat steps 3-6 for the remaining frequencies.

8. Press F10 once to return to the TRANSMITTER ALIGNMENT MENU, or press F10 twice to return to the SERVICE MENU.

Front End Filter Alignment

1. From the SERVICE MENU, press F3 to select the RECEIVER ALIGNMENT MENU.
2. Press F2 to select the FRONT END FILTER (VHF AND UHF ONLY) screen. The screen will indicate the receive frequencies at which the filter is to be aligned. See Figure 8.

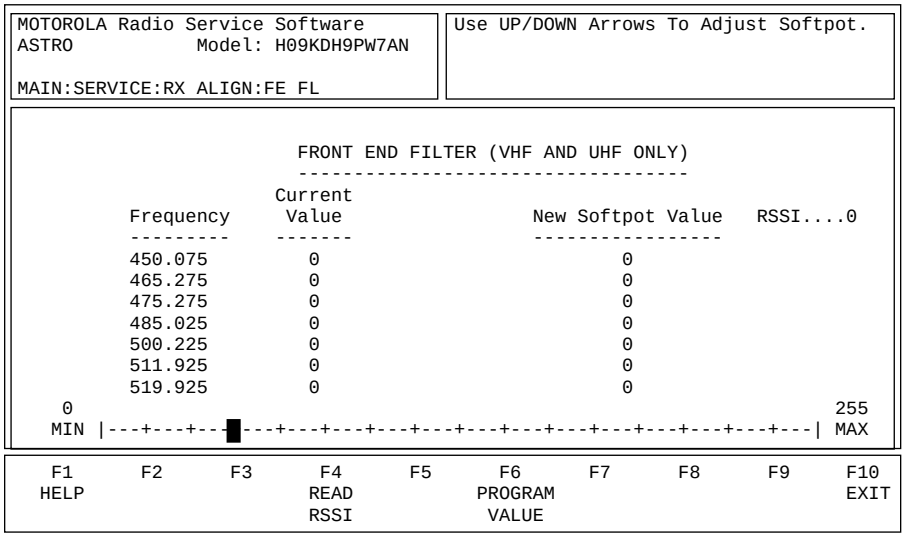


Figure 8 Front End Filter (VHF and UHF Only) Alignment Screen

3. Press TAB (or ENTER or [**RETURN**]) to select a frequency field.
4. Set the RF test generator to the first receive frequency +150Hz. Set the RF level at the radio standard antenna port to 4.0µV with no modulation.
5. Adjust the ↑/↓ arrow keys to obtain a peak value in the RSSI (receive signal strength indicator) field.

   NOTE: F4 must be pressed to obtain each RSSI reading after adjustment.

6. Press F8 to program the new softpot value.
7. Repeat steps 3-6 for the remaining frequencies.
8. Press F10 once to return to the RECEIVER ALIGNMENT MENU, or press F10 twice to return to the SERVICE MENU.

Notes

Basic Removal/Installation Procedures

6

Introduction to This Section

This section gives basic procedures for removing and installing the XTS 3500 radio's:

- Antenna,
- Battery,
- Belt Clip,
- Universal Connector Cover,
- Volume Knob, and
- Frequency Knob.

Antenna

Installing the Antenna

Screw the threaded end of the antenna into the antenna receptacle on the top of the radio. Rotate the antenna clockwise until it seats firmly against the bushing.

Removing the Antenna

Rotate the antenna counterclockwise until its threaded end unscrews from the radio's antenna receptacle.

Battery

NOTE: The battery is shipped uncharged, and must be charged for at least 16 hours before use.

WARNING

To avoid a possible explosion:

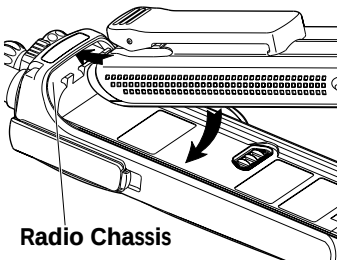
- DO NOT replace the battery in an area labeled "hazardous atmosphere."
- DO NOT discard batteries in a fire.

Caution

If your radio is programmed with volatile-key retention (consult your service technician), encryption keys will be retained for approximately 30 seconds after battery removal.

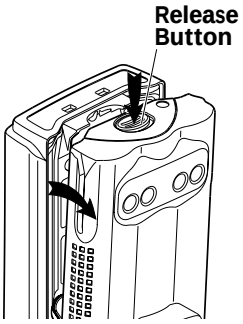
Installing the Battery

1. Turn off the radio and hold it with the back of the radio facing upward
2. Insert the top edge of the battery into the area at the top of the radio between the radio's case and chassis. Make sure the three tabs on the radio chassis align with the three slots under the top edge of the battery.
3. Rotate the battery toward the radio, and squeeze the battery and radio together until the battery "clicks" in place.



Removing the Battery

1. Turn off the radio and hold it so that the release button on the bottom of the battery is facing upward.
2. Press downward on the release button so the battery disengages from the radio.
3. Remove the battery completely away from the radio

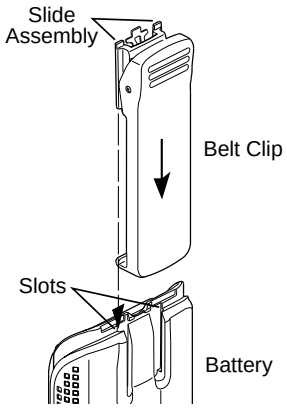


Belt Clip

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

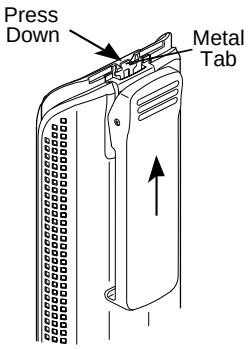
Installing the Belt Clip

1. Hold the battery in one hand so that the top of the battery faces upward, and the back of the battery faces you.
2. Holding the belt clip in the other hand with its top facing upward, align the slide assembly on the front of the belt clip with the slots on the back of the battery.
3. Slide the belt clip downward toward the bottom of the battery until the belt clip "clicks" in place.



Removing the Belt Clip

1. Hold the battery (with belt clip installed) in one hand so that the top of the battery faces upward, and the front (radio side) of the battery faces you.
2. At the top of the battery, press down on the belt clip's metal tab and slide the belt clip upward until it disengages from the battery.
3. Continue to slide the belt clip upward until it is free from the battery.



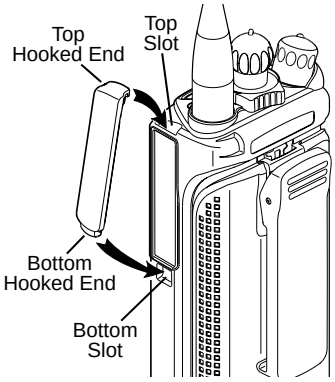
Universal Connector Cover

Caution

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

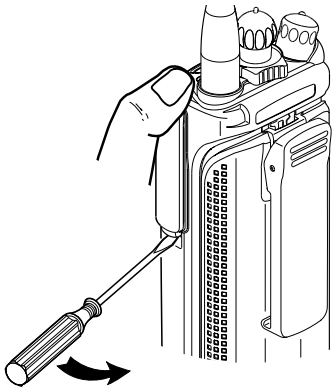
Installing the Universal Connector Cover

1. Looking at the antenna side of the radio, insert the top (flat) hooked end of the cover into the slot on the top of the radio, above the universal connector. Press downward on the cover's top to seat it in the slot.
2. While holding the cover seated in the top slot, insert the cover's bottom (rounded) hooked end into the slot below the universal connector. Press firmly inward on the cover's bottom until it snaps in place.



Removing the Universal Connector Cover

1. Looking at the antenna side of the radio, insert a flat-bladed screwdriver into the area between the lower end of the universal connector cover and the slot below the universal connector.
2. *While holding the cover's top (flat) end in place with your thumb*, pry upward on the cover's lower end until it disengages from the radio.



Frequency Knob

NOTES:

- Refer to Figure 9, the Partial Exploded View, and Table 13, the Partial Exploded View Parts List. Numbers in parentheses ( ) refer to item numbers in Figure 9 and Table 13.
- The battery (7) should be removed from the radio before installing or removing the frequency knob (1).
- In cases where the frequency insert (3) and escutcheon (2) must be removed, a new frequency insert and new escutcheon **must** be used for reassembly.

Removing 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 (1) and pull it upward, while rocking the knob back and forth, until it is free from the frequency insert (3) or the insert is free from the shaft.
3. If necessary, while pressing the insert's (3) 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 frequency insert.
4. Remove the secure lever (4) and the lightpipe (5).

Installing 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 (5) 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 (4) 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 escutcheon (2):
   a. Remove the backing paper from the escutcheon.
   b. Align the number "1" on the escutcheon with the alignment notch on the insert (3).
   c. Slide the escutcheon down over the insert until the alignment tabs on the escutcheon fit inside the tab recesses on the insert.
   d. Adhere the escutcheon to the insert.
5. Place a new frequency insert (3) and new escutcheon (2) 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 (1) on the frequency insert (3), aligning it's pointer with the number "**1**" on the escutcheon (2). Press firmly downward on the knob until it seats securely in place.

Volume Knob

NOTES:

- Refer to Figure 9, the Partial Exploded View, and Table 13, the Partial Exploded View Parts List. Numbers in parentheses ( ) refer to item numbers in Figure 9 and Table 13.
- The battery (7) should be removed from the radio before installing or removing the volume knob (8).
- In cases where the volume insert (9) must be removed, a new volume insert **must** be used for reassembly.

Removing the Volume 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 volume knob (8) and pull it upward, while pushing it toward the back of the radio, until it is free from the volume insert (9).
3. While pressing the volume insert's (9) two snap tabs away from the volume control shaft so that the insert disengages from the shaft, use needle-nosed pliers to pull the insert up and off of the volume control shaft. Discard the removed volume insert.
4. Using needle-nosed pliers or some other pointed instrument, remove the o-ring (21).

Installing the Volume Knob

1. Place the o-ring (21) inside a new volume insert (9), 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 insert (9) 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 (8) on the volume insert (9), 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.

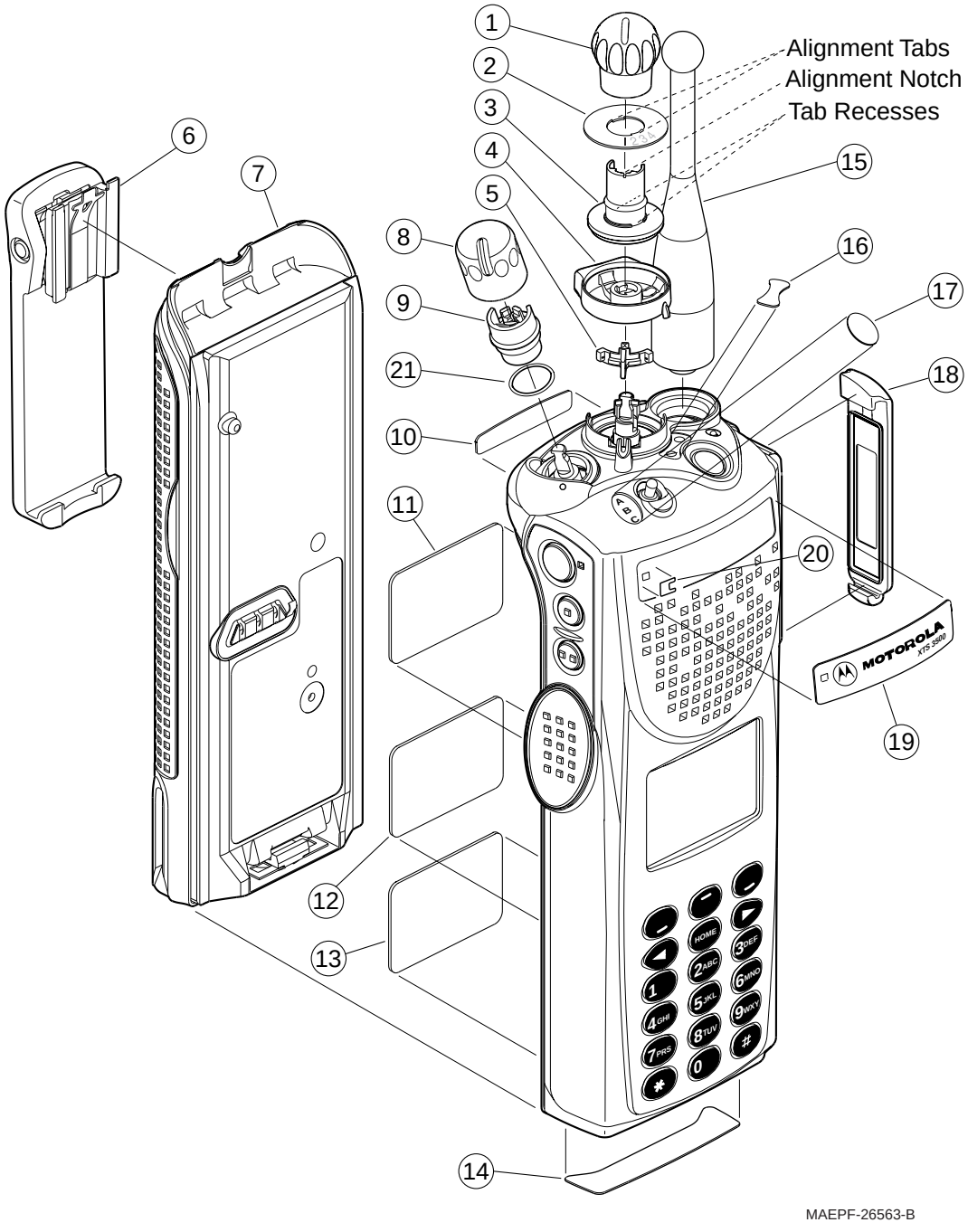


Figure 9 Partial Exploded View

Table 13 Partial Exploded View Parts List

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	3605370Z01	KNOB, Frequency
2	1305374Z01	ESCUTCHEON, Frequency
3	4305373Z01	INSERT RETAINER, Frequency Knob
4	4305375Z01	LEVER, Secure Frequency
5	6105376Z01	LIGHTPIPE INDICATOR/STOP, Frequency
6	NTN8266_	CLIP, Belt
7	NTN8923_ or NTN8294_ or NTN8295_ or NTN8299_ or NTN8610_	Battery, NiMH Extended Life Battery, NiCd Battery, NiCd FM Battery, NiMH FM Battery, Li-Ion
8	3605371Z01	KNOB, Volume
9	4305372Z01	INSERT RETAINER, Volume Knob
10	3305574Z03	LABEL, Motorola, Back
11	- - - - - - - - - -	LABEL, Flashport
12	- - - - - - - - - -	LABEL, Radio Serial Number
13	- - - - - - - - - -	LABEL, Approval Agency
14	3305630Z02 or 3305630Z01	LABEL, Bottom LABEL, Bottom, FM
15	NAD6563_ or NAD6566_ or NAD6567_ or NAD6568_ or NAE6547_ or NAE6548_ or NAE6549_	ANTENNA, Wideband Helical (136-174 MHz) ANTENNA, Helical (136-151 MHz) ANTENNA, Helical (151-162 MHz) ANTENNA, Helical (162-174 MHz) ANTENNA, Helical (430-470 MHz) ANTENNA, Helical (470-512 MHz) ANTENNA, Wideband Whip (403-512 MHz)
16	- - - - - - - - - -	ESCUTCHEON, Concentric Switch (optional)
17	- - - - - - - - - -	ESCUTCHEON, Toggle (optional)
18	1505579Z01	COVER, Dust, Universal Connector
19	3386139A01	LABEL, Motorola, Front
20	3505586Z01	Gortex
21	3205379W01	O-Ring

Basic Theory of Operation

7

General Overview

The ASTRO Digital XTS 3500 radio is a wideband, synthesized, fixed-tuned radio available in the VHF and UHF bands. All ASTRO Digital XTS 3500 radios are capable of both analog operation (12.5kHz or 25kHz bandwidths) and ASTRO mode (digital) operation (12.5kHz only).

The ASTRO Digital XTS 3500 radio includes the following major assemblies:

- VOCON Board - contains the microcontrol unit (MCU) and its associated memory and memory management integrated circuit (IC), the audio power amplifier, and a switching regulator. The board also contains the digital signal processor (DSP) and its support IC and associated memories.
- RF 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) — a four-line, 12-character liquid- crystal display (LCD).
- Keypad (Models II and III Only) — Model II - a 3 x 2 keypad; Model III - a 3 x 6 keypad.

Analog Mode of Operation

When the radio is *receiving*, the signal comes from the antenna connector to the RF board, passes through the RX/TX 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).

The resulting intermediate frequency (IF) signal is fed to the IF circuitry, where it is again filtered and amplified. This amplified signal is passed to the digital back-end IC, where it is mixed with the second local oscillator to create the second IF at 450kHz. It is then converted to a digital bit stream and mixed a third time to produce a baseband signal. This signal is passed to the VOCON board through a current-driven differential output.

On the VOCON board, the digital-signal processor (DSP) support IC digitally filters and discriminates the signal, and passes it to the digital-signal processor (DSP). 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 for conversion to an analog signal. The CODEC will then present the signal to the audio power amplifier, which drives the speaker.

For signalling information, the DSP will decode the message and pass it to the microcontrol unit.

When the radio is *transmitting*, microphone audio is passed through gain stages to the CODEC, where the signal is digitized. The CODEC passes digital data to the DSP, where pre-emphasis and low-pass (splatter) filtering are done. The DSP passes this signal to a digital/analog (D/A) converter, where it is reconverted into an analog signal and scaled for application to the voltage-controlled oscillator as a modulation signal.

Transmitted signalling information is accepted by the DSP from the microcontrol unit, coded appropriately, and passed to the D/A converter, which handles it the same as a voice signal. Modulation information is passed to the synthesizer along the modulation line. A modulated carrier is provided to the RF PA, which transmits the signal under dynamic power control.

ASTRO Mode of Operation

In the ASTRO mode (digital mode) of operation, the transmitted or received signal is limited to a discrete set of deviation levels, instead of continuously varying. 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 specifically defined algorithm to recover information.

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. This algorithm will result in deviation levels that are limited to discrete levels.

RF Board Basic Theory of Operation

The receiver front end consists of a preselector, an RF amplifier, a second preselector, and a mixer. Both preselectors are varactor-tuned, two-pole filters, controlled by the microcontroller unit through the digital/analog (D/A) IC. The RF amplifier is a dual-gate, gallium-arsenide-based IC. The mixer is a double-balanced, active mixer, coupled by transformers. Injection is provided by the VCO through an injection filter. See Table 14 for local oscillator (LO) and first IF information.

Table 14 Local Oscillator and First IF Frequencies

	VHF	UHF
LO Frequency Range	180.85-218.85MHz	376.65-446.65MHz
First IF Frequency	44.85MHz	73.35MHz

The frequency generation function is performed by three ICs and associated circuitry. The reference oscillator provides a frequency standard to the synthesizer/prescaler IC, which controls the VCOB IC. The VCOB IC actually generates the first LO and transmit-injection signals and buffers them to the required power level. The synthesizer/prescaler circuit module incorporates frequency-division and comparison circuitry to keep the VCO signals stable. The synthesizer/prescaler IC is controlled by the microcontrol unit through a serial bus. Most of the synthesizer circuitry is enclosed in rigid metal cans on the RF board to reduce microphonic effects.

The receiver back end consists of a two-pole crystal filter, an IF amplifier, a second two-pole crystal filter, and the digital back-end IC. The two-pole filters are wide enough to accommodate 4kHz modulation. Final IF filtering is done digitally in the DSP.

The digital back-end IC consists of an amplifier, the second mixer, an IF analog-to-digital converter, a baseband down-converter, and a 2.4MHz synthesis circuit to provide a clock to the DSP-support IC on the VOCON board. The second LO is generated by discrete components external to the IC. The output of the digital back-end IC is a digital bit stream that is current driven on a differential pair for a reduction in noise generation.

The transmitter consists of an RF driver IC that gets an injection signal from the VCO and a final-stage power amplifier. Transmit power is controlled by a power-control IC that monitors the output of a directional coupler and adjusts PA control voltages correspondingly. The signal passes through a RX/TX switch that uses PIN diodes to automatically provide an appropriate interface to transmit or receive signals. Antenna selection is done mechanically in the control top.

VOCON Board Basic Theory of Operation

The vocoder and controller (VOCON) board contains the radio's microcontrol unit with its memory and support circuits, the digital-signal processor (DSP), its memory devices, and the DSP-support IC, voltage regulators, audio, and power control circuits. Connected to the VOCON board are the display board, RF board, keypad board, controls/universal flex, and (optional) encryption module.

The microcontrol unit 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 ROM. 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 DSP-support IC is supplied with a 16.8MHz clock from the RF board. Both the DSP and the microprocessor have their clocks generated by the DSP-support IC. They can both be adjusted so that the harmonics do not cause interference with the radio's receive channel.

The regulator and power-control circuits include 3.3-volt analog, 3.3-volt digital, and 5-volt regulators. The audio PA is sourced from 7.5V. The regulator's power-down mode is controlled by the microcontrol unit, which senses the position of the on/off switch. The 5-volt regulator has an error pin for low-voltage resets.

The DSP performs signalling and voice encoding and decoding as well as audio filtering and volume control. This IC performs Private-Line®/Digital Private Line™ (PL/DPL) encode and alert-tone generation. The IC transmits pre-emphasis on analog signals and applies a low-pass (splatter) filter to all transmitted signals. It requires a clock on the EXTAL pin. An 8kHz interrupt signal generated by the DSP-support IC is also required for functionality. It is programmed using parallel programming from the microcontrol unit.

The audio CODEC performs analog-to-digital and digital-to-analog conversions on audio signals. The DSP controls squelch, deviation, and executes receiver and transmitter filtering. The DSP-support IC receives a 2.4MHz clock, and receives data and formats it for the DSP.

Radio-Level Troubleshooting

8

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 troubleshooting will support only radio alignment, programming, battery replacement, and knob replacement. If the radio needs further troubleshooting, it must be sent to the depot.

Board- and component-level and service information can be found in the "ASTRO Digital XTS 3500 Portable Radios Detailed Service Manual," Motorola publication number 68P81089C81.

Power-Up Error Codes

When the radio is turned on (power-up), the radio performs cursory 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 15 to aid in understanding particular power-up error code displays.

Table 15 Power-Up Error Code Displays

Error Code	Description	Corrective Action
01/02	FLASH ROM Codeplug Checksum Non-Fatal Error	Reprogram the codeplug.
01/12	Internal EEPROM Codeplug Checksum Non-Fatal Error	Reprogram the codeplug.
01/22	RF Deck Codeplug Checksum Non-Fatal Error	Reprogram the codeplug.
01/82	FLASH ROM Codeplug Checksum Fatal Error	Reprogram the codeplug.
01/88	RAM Fatal Error — **Note:** not a checksum failure	Send radio to depot.
01/92	Internal EEPROM Codeplug Checksum Fatal Error	Reprogram the codeplug.
01/A2	RF Deck Codeplug Checksum Fatal Error	Reprogram the codeplug.
02/10	DSP Support IC Checksum Non-Fatal Error	Turn the radio off, then on.
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	Send radio to depot.

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 16 to aid in understanding particular operational error codes.

Table 16 Operational Error Code Displays

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

Table 17 Receiver Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
Radio Dead; Display Does Not Light Up	1. Dead Battery	Replace with charged battery.
	2. Blown Fuse	Send radio to depot.
	3. On/Off Switch	
	4. Regulators	
Radio Dead; Display Lights Up	1. VOCON Board	Send radio to depot.
	2. RF Board	
No Receiver 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	Send radio to depot.
	3. Receiver Front-End Tuning	Check RF front-end tuning for optimum sensitivity using the RSS.
Radio Will Not Turn Off	VOCON Board	Send radio to depot.

Table 18 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 RSS).
	2. No PTT From Control Top	Send radio to depot.
	3. No Injection To Power Amplifier	
No Modulation; Distorted Modulation	1. Programming	Check deviation and compensation settings using the RSS.
	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 Signalling (PL, DPL, MDC)	1. Programming	Check Programming
	2. VOCON Board	Send radio to depot.
Can't Set Deviation Balance	RF Board	Send radio to depot.

Table 19 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	Make Sure the Keyloader is a "T----CX" or "T----DX" Keyloader.
	2. Bad Keyloader	Try Another Keyloader
	3. Defective Radio	Send radio to depot.

Note: Keyloaders "T----AX" and "T----BX" must be upgraded to "T----CX" and "T----DX" in order to keyload an XTS 3500 radio.

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 and channel element orders should specify the crystal or channel element 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
Aftermarket Products Division
Attention: Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Federal Government Orders:

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

International Orders:

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

TELEPHONE ORDERS

United States and Canada Aftermarket Products 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: 847-576-2828

FAX ORDERS

United States and Canada Aftermarket Products 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 Aftermarket Products 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

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