~~Pub. RRX-MRM Rev. C 04-98~~

PATRIOT

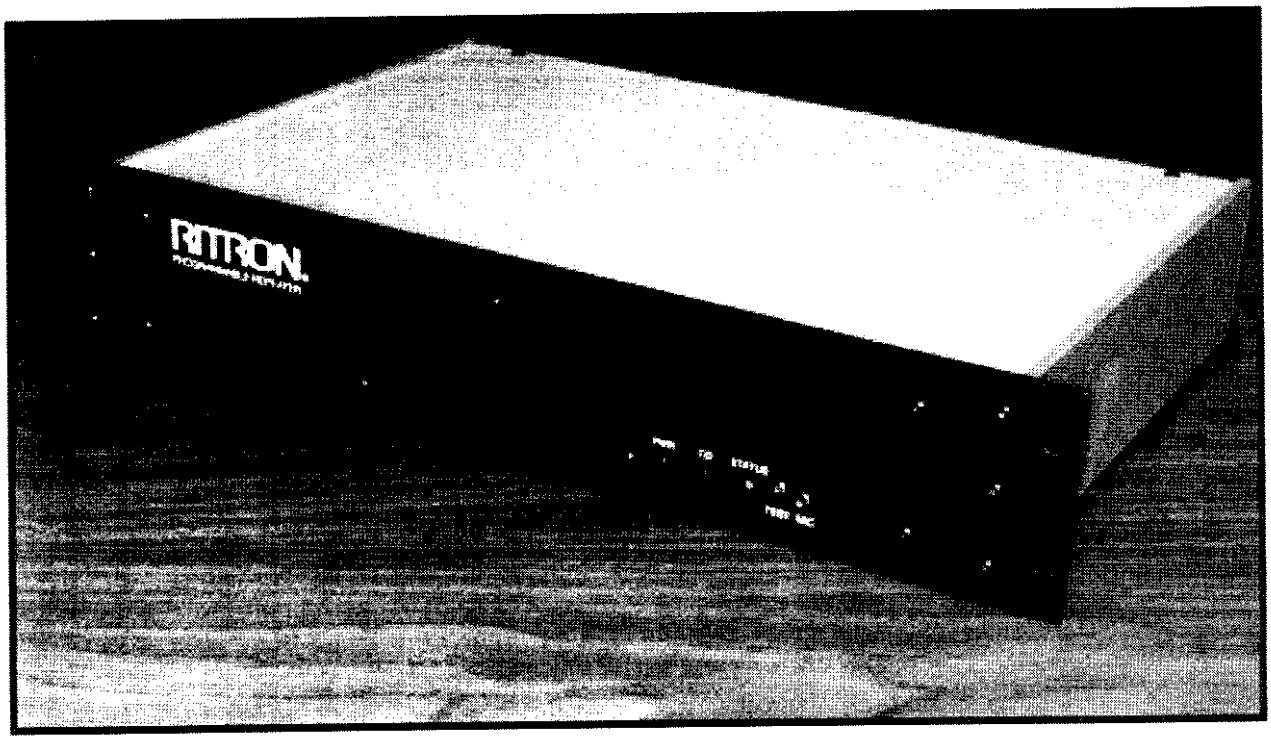
TWO-WAY RADIO BY RITRON

Preliminary

RRX-452 references on pages *i*, 1, 3, 18 and 25.

RITRON REPEATERS Models RRX-450 & RRX-452

Programmable UHF FM Repeaters for 25KHz and 12.5 KHz Standards



MAINTENANCE/REPAIR/OPERATING MANUAL

FOR USE BY AUTHORIZED SERVICE/ MAINTENANCE PERSONNEL ONLY

F. A. Q.
(Frequently Asked Questions)

Q. ***I CHANGED THE PL CODE,*** *but the RRX repeater still encodes the previous tone when I key the hand MIC.* ***OR:*** *The Repeater works fine radio-to-radio, but does not work with the local MIC on Repeater-to-radio. Why?*

A. **When changing tones,** be sure to also set the PTT tone (which is encoded when the key line is pulled low either by the hand MIC PTT or an accessory board like RP-200). In a single-tone repeater, the main repeat mode tone and the PTT tone should both be set to the same tone. In a multiple- tone/ RP-200 Repeater,: choose the tone encoded with incoming phone calls as the PTT tone.

Q. ***I CHANGED THE FREQUENCY OF THE REPEATER;*** *now the "STATUS" light flashes green at 1-second intervals. Why?*

A. **If you have adjusted the frequencies** more by than 4 MHz without readjusting the VCO control voltage, either or both of the synthesizers may be out of lock. Although the RRX is programmable, you must retune TX, RX, TXVCO, RXVCO, RX helicals and the duplexer when changing frequencies more than 1 MHz.

Q. ***HOW DO I SET UP THE INTERFACE*** *to control the RRX with a remote?*

A. **You MUST HAVE** a termination panel that will convert DC or Tone remote functions to control signals to operate the RRX. Wire the termination panel to RWR-10 port J402 of the RRX control board, then set RWR-10 to "Installed" for monitor function. (Key-click to "installed" or programmer to "Y")

Q. ***I AM INTERESTED IN PURCHASING AN RRX.*** *How well-suited is it for high-RF environments?*

A. **The RITRON RRX** standard 4-cavity Repeater has excellent adjacent channel rejection. Each RF module is enclosed in an aluminum case, and the main enclosure is a sturdy, heavy-duty aluminum 19" rack-mount case, which provides good RF isolation. This is suitable for most sites.

NOTE: RRX is available without the 4-cavity duplexer:

1. . . to fit a 6-cavity Cel-Wave or Sinclair inside the Repeater, or
2. . . to use a high-Q external duplexer through 2 back panel SO-239 sockets. Very high RF level sites may require greater isolation provided by a 6-cavity duplexer.

Q. ***WHAT IS THE DUTY CYCLE RATING*** *of the RRX Repeater?*

A.

- **The 8-Watt** output power RRX (standard – 5 Watts output from internal duplexer) can be operated continuous-duty with the internal power supply and cooling fan.
- **The 30-Watt** output model is rated at 50% (3 minutes ON/ 3 minutes OFF), with the internal power supply and cooling fan.

NOTE: Be sure to follow good engineering practices in any installation that is not temperature-controlled.

Q. ***I AM USING AN RRX AS AN EXCITER*** *in a 100-Watt system, and am getting less than optimum performance. What can I do?*

A. **Use these guidelines:**

1. Use double-shielded cable for all RF connection cables.
2. Use 12-gauge or larger cable for the DC power leads.
3. Eliminate ground loops in the rack.
4. Use a high Q, high power external duplexer.
5. Maintain low VSWR through the duplexers to the antenna.
6. Tune the RRX TX output into the external RF PA of choice.
7. Be aware certain applications may require the use of a power circulator.

Q. ***WILL THE RRX WORK WITH A 440 MHz BAND APPLICATION?***

A. **The RRX transmitter** and receiver synthesizers may or may not lock in this range depending on part tolerances. A few capacitor changes will remedy this situation; however, this may result in a slight reduction in TX power output.

NOTE: Be aware the duplexer is NOT DESIGNED to tune in the 440 MHz band range.

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IMPORTANT INFORMATION

SURFACE MOUNT REPAIR: RITRON surface mount products require special equipment and servicing techniques. Improper servicing techniques may cause permanent damage to the printed circuit board and/or components which is not covered by the RITRON warranty. If you are not completely familiar with surface-mount component repair, RITRON recommends you defer maintenance to qualified service personnel.

PRECAUTIONS FOR HANDLING CMOS DEVICES: This radio contains complementary metal-oxide semiconductor (CMOS) devices requiring special handling techniques. CMOS circuits are susceptible to damage by electrostatic or high voltage charges. Such damage can be latent, with the failure not becoming evident for weeks or even months. For this reason, be sure to note the following precautions whenever you disassemble the radio. These rocedures are even more critical in low- humidity environments.

1) **Storage/transport** - Place CMOS devices to be stored or transported in conductive material with all exposed leads shorted together. DO NOT INSERT CMOS devices into conventional-type plastic "snow" or plastic trays used for other sorts of semiconductors.
2) **Grounding** - Place all CMOS devices on a grounded bench surface. All personnel working on the radio/CMOS circuit must be grounded before handling the radio. Normally effective procedure is to wear a conductive wrist strap in series with a 100KΩ resistor to ground.
3) **Clothing** - DO NOT WEAR NYLON clothing while handling CMOS circuits.
4) **Power off** - Remove power BEFORE connecting, removing or soldering a PC board containing CMOS devices.
5) **Power/voltage transients** - Do not insert or remove CMOS devices with power applied. Check all power supplies used for testing CMOS devices to be sure no voltage transients are present.
6) **Soldering** - Use a grounded soldering iron for CMOS circuitry.
7) **Lead-straightening tools** - Provide ground straps for tools used to straighten CMOS leads.

NOTE: Use the original packing material and shipping carton if possible, when returning a repeater unit for service. Take special care to prevent damage to the rack mounting ears.

1. STANDARD RRX-450/ RRX-452 SPECIFICATIONS

NOTE: Specifications subject to change without notice.

1.1 GENERAL

	RRX-450	RRX-452
FCC ID #:	AIERIT02-450	**AIERIT05-452**
FCC Accepted Parts:	22,74,90,95	**22, 74, 90, 95**
Emission Designators:	16K0F3, 16K0F2	**11K0F3, 11K0F2**
Frequency Range:	450 - 470 MHz	
Frequency Separation:	TX/RX: 4.5 to 5.5 MHz (depending on duplexer)	
RF Channels:	1 TX/RX Channel	
Synthesizer Steps:	12.5 KHz	
Tone/Code Signalling:	QC™ (Quiet-Call) or DQC (Digital Quiet-Call) mode: (1) QC *or* (2) DQC codes standard Up to 3 additional QC codes available (4 total) using optional RTS-6P modules	
Power Requirements: (Standard Model)	110/240 VAC, 0.5 A or External +11 to 15 VDC/2A; 7A amplified	
AC Power Consumption:	60 Watts-Standard unit; 120 Watts–RF Amplified unit	
Local Audio Output:	1 Watt into 8 Ω	
Carrier Dropout Timer:	0 to 8 s, programmable	
Squelch Tail Elimination Timer:	0 to 8 s, programmable	
Time-out Timer:	0 to 30 minutes, programmable	
Auxiliary Equipment Connectors:	(1) internal 10-pin female accessory for RP-200, RTLT, *or* RTSU (1) DB-25F (optional on rear panel) for an external controller (3) internal 8-pin male headers for RTS-6P modules (2) external telephone jacks with RP-200, RTLT-1 or RTSU-2 installed	
RF Connector (external):	(1) SO-239 with duplexer; (2) SO-239 without duplexer	
Antenna Impedance:	50 Ω	
AC Power Connector:	3-pin, fused, power entry module on rear panel	
DC Power Connector:	3-pin polarized socket - rear panel	
Battery Maintenance Charge Current:	Up to 0.7 A maximum	
AC to Battery Backup Transfer:	Automatic relay cutover (Failsafe to DC power)	
Test Speaker Microphone:	2.5 mm and 3.5 mm jacks for RSM-3X	
Dimensions:	3.5" H x 19.0" W x 12.0" D standard rack	
Weight:	Standard Unit: Appx. 12 lb; RF Amplified Unit: 20 lb.	

1.2 RECEIVER

Receiving System:	Fixed tuned, Dual Conversion Superheterodyne	
IF System:	21.4 MHz/455 KHz	
Local Oscillator:	Low side injection	
Sensitivity (12 dB SINAD):	.25 µV, .35 µV through duplexer	
Selectivity:	-80 dB @ +/-25 KHz (EIA Test Method)	**-70 dB +/-12.5 KHz**
Spurious Rejection:	-80 dB (")	
Image Rejection:	-80 dB (")	
Intermodulation Rejection:	-70 dB (")	
Frequency Stability:	+/- 2.5 PPM (-30° to +60° C)	**+/-1.5 PPM**
Noise Squelch Sensitivity:	.2 to 8 µV, adjustable, Factory set to open @ 12 dB SINAD	
Modulation Acceptance:	+/- 7.5 KHz maximum	**+/-4.5 KHz, max.**
Audio Frequency Range:	10 to 3 KHz	
Audio or FSK Data Output:	10 Hz to 3 KHz/P502 in position A 300 to 3 KHz/P502 in position B 2 kΩ Minimum Load Impedance. A received 1 KHz tone @ 3 KHz deviation, set to produce 2.1V p-p at J401, pin 1.	**@ 1.5 KHz dev.**
Power Requirements:	+11 to 15 VDC, 0.2 A nominal, w/o options, RX only	
RF Input Impedance:	50 Ω	
RF Connector:	Phono jack (internal to duplexer)	

1.3 TRANSMITTER

RF Output:	1 to 8 Watts @ 12.6 VDC, adjustable 5 Watts @ duplexer antenna port
100% Duty Cycle	-30° to +50° C. ambient temperature
TX Frequency Stability:	+/- 2.5 PPM (-30° to +60° C) TCXO
Modulation:	Direct FM
Deviation:	0 to +/- 5 KHz, adjustable
Spurious and Harmonics:	Better than 51 dBc
Audio Response:	10 to 3000 Hz (+/-3 dB)
Power Requirements:	+11 to +15 VDC, 1.5 A nominal
FM Hum and Noise:	-60 dB
Audio or FSK Data Input:	Pre-emphasized Impedance: 10 kΩ nominal Frequency Range: 5 to 3000 Hz Signal Level: 500 mV p-p for +/- 3 KHz of deviation
RF Output Impedance:	50 Ω
RF Output Connector:	Phono jack (internal to duplexer)

1.4 AMPLIFIER (OPTIONAL)

RRA-452	30W less duplexer; >20W with duplexer
Power Requirements	+11 to +15 VDC, 5.0A nominal
Duty Cycle	50%

1.5 DUPLEXER

Frequency Range	450 - 470MHz (RD-451)
Frequency Spacing	5MHz (Standard: 4.5MHz minimum)
Maximum Power Input	50 Watts
Insertion Loss, TX to Ant.	1.8dB
Insertion Loss, RX to Ant.	1.5dB
RX Isolation@TX freq.	63dB
TX Noise Suppression@RX freq.	73dB
Impedance	50 Ohms
Temperature Range	-30 to +60°C.
Connectors	Male Phono: TX/RX internal; SO-239 Female Antenna Connector: external

2. INTRODUCTION

2.1 GENERAL

RITRON RRX-450 and RRX-452 are a synthesized rack-mount or table top UHF Repeaters that operate in the 450 to 470 MHz FM communications band. The unit receives messages originating at handheld, mobile, or fixed stations on one frequency, and simultaneously retransmits the message on a second frequency. The unit contains a duplexer which allows a single antenna to be used for simultaneous transmission and reception. This full-duplex operation enables mobile and handheld units to communicate over much greater distance than is possible without the Repeater.

The RRX-450 and RRX-452 are contained in a heavy-duty standard 19" rack-mount enclosure. For easy access to the internal modules, remove five screws securing the Repeater cover, then slide it off. Modular design optimizes RF isolation and contributes to ease of service. Standard unit modules are:

1. Control unit,
2. Transmitter module,
3. Receiver module,
4. Power supply, and
5. 4-cavity notch duplexer.

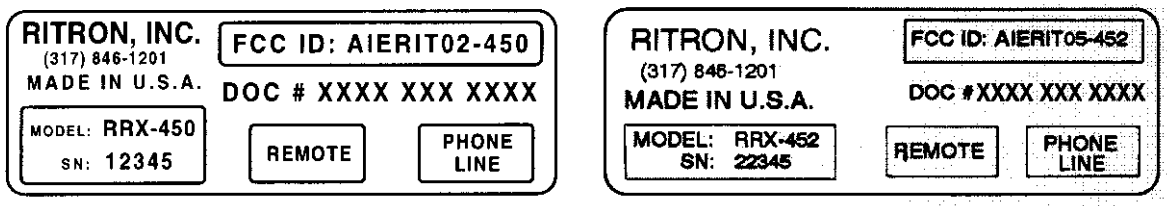
All module assemblies and the power transformer attach to the bottom panel. The antenna, AC power and any optional accessories connect at the back panel. Optional microphone connections are on the front panel.

2.1.1 INSPECTION

Inspect the equipment immediately after delivery and report any damages to the shipping company.

2.1.2 MODEL IDENTIFICATION

The repeater model, serial and FCC identification numbers appear on a label attached to the Repeater's rear panel.



RRX-450 LABEL
Approved for +/-5 KHz deviation channels

RRX-452 LABEL
Approved for +/-2.5 KHz deviation channels

FIG-1: RRX SERIES MODEL, SERIAL AND FCC ID NUMBER LABEL

2.2 FCC REGULATIONS

2.2.1 LICENSING

The FCC requires the radio owner to obtain a station license for his radios before using the equipment to transmit, but does not require an operating license or permit. The station licensee is responsible for proper operation and maintenance of this radio equipment, and for ensuring that transmitter power, frequency and deviation are within the limits specified by the station license. This includes checking the transmitter frequency and deviation periodically, using appropriate methods.

NOTE: Because the RRX-450 and RRX-452 each include a transmitter, THE REPEATER MUST BE LICENSED BEFORE USE. Your RITRON Dealer can help you obtain an FCC license.

2.2.2

SAFETY STANDARDS

The FCC (with its action in General Docket 79-144, March 13, 1986) has adopted a safety standard for human exposure to radio frequency electromagnetic energy emitted by FCC regulated equipment. RITRON follows these safety standards, and recommends that you observe them also:

- DO NOT OPERATE a mobile radio transmitter when someone outside the vehicle is within two feet of the antenna.
- DO NOT OPERATE the transmitter of a fixed radio (base station, microwave, rural telephone RF equipment) or marine radio when someone is within two feet of the antenna.
- DO NOT OPERATE any radio transmitter unless all RF connectors are secure and any open connectors are ##properly terminated.
- DO NOT OPERATE radio equipment near electrical blasting caps or in an explosive atmosphere.
- DO NOT PRESS the Push-To-Talk button except when you intend to transmit.
- GROUND ALL RADIO EQUIPMENT. See Installation section on page 6.
- Repair of RITRON products is to be performed only by RITRON authorized personnel.

3. ACCESSORIES

DESCRIPTION	*ITEM NO./ MODEL*

RRX-450: UHF Rack-mount Repeater includes:
QC (1) or DCS (2): time-out timer; 12V cooling fan; 110/ 240VAC/ 12VDC operation (configured for 110 VAC from factory); 120VAC power cord; continuous-duty (8 Watts); 13.8V trickle-charge and automatic battery cutover standard; up to 4 QC capacity – (1) standard; (3) optional modules (see RTS-6P below)

UHF REPEATER, 1 - 8 Watts, 100% duty cycle operation	
Repeater, 450 - 470 MHz, 1 - 8 Watts, less duplexer	RRX-450-040F0
Repeater, 450 - 470 MHz, 1 - 8 Watts, with duplexer	RRX-450-D40F0
Repeater, 450 - 470 MHz, 1 - 8 Watts, with duplexer & autopatch	RRX-450-D40FP
UHF REPEATER, 30 Watts, 50% duty cycle operation	
Repeater, 450 - 470 MHz, 30 Watts, less duplexer	RRX-450-09AF0
Repeater, 450 - 470 MHz, 30 Watts, with duplexer	RRX-450-D9AF0
Repeater, 450 - 470 MHz, 30 Watts, less duplexer, with autopatch	RRX-450-09AFP

Trunking Interface Options:

The following interface cables require RRX-ACC (below) when ordered with a Repeater:

Interface cable, DB-25M to DB-25M, RRX-450 to Trident TNT™ Controller	RRX-TNT
Interface cable, DB-25M to DB-25M, RRX-450 to Trident Raider/Marauder™	RRX-RMC
Generic interface cable, DB-25M to unfinished end, for external tone panels, local control, or controllers – call RITRON	RRX-GCI

The following connectors mount inside the RRX for external connection from the rear panel:

10-pin connector to DB-25F – req. for External Trunking or Tone Controllers	RRX-ACC
Internal connector, 10-pin to unfinished end – call RITRON	RRX-XCI

RRX-150: VHF Rack-mount Repeater; (not Type-Accepted; for export only) includes:
QC (1) or DCS (2), time-out timer; 12V cooling fan; 110/ 240VAC/ 12VDC operation (configured for 110 VAC from factory); 120VAC power cord; 25 Watts; 12V trickle-charge and battery cutover capable; up to (4) QC capacity – (1) standard, (3) optional modules – see RTS-6P below

VHF REPEATER, 25 Watts, adjustable.	
Repeater, 148 - 174 MHz, 1 - 25 Watts, less duplexer	RRX-150-090F0
Repeater, 148 - 174 MHz, 1 - 25 Watts with 6-cavity duplexer	RRX-150-D90F0

Synthesized Repeater Options/ Accessories:

Bandpass Filter	RF-450
Multifunction Telephone Interconnect (Autopatch)	RP-300
20 Watt Amplified Version	RRA-452
Telenexus Line Terminator	RTLT-1
Telenexus Subscriber Unit	RTSU-2
4-wire Interface Board	RW-4WA
QC Decoder Module, plug-in, DIP switch programmable, up to 3 additional	RTS-6P
Test/ program speaker/ microphone with PTT	RSM-3X
Programming software, 3.5" disk, supports RRX-450 & all RITRON products	RPT-PCPS-3.0
Programming kit, PC, supports RRX-450 (includes disk, cables, adapters)	RPT-PCPK-3.0
NOTE: Programming kits are for use by authorized service/maintenance personnel only.	
Programming: Frequency/ signalling/ tuning, (Factory only)	RPT-FPFTR
Duplexer installation kit for 6-cavity duplexer (supplied by customer)	RIKD-6C
RRX Series Maintenance/ Repair/ Operating Manual	RRX-MRM

NOTES: This is a partial listing of accessories; contact RITRON for more information.
Certain options cannot be used simultaneously; contact RITRON for more information.

4. OPERATION

4.1 SPECIAL NOTES

1. **TEST THE REPEATER** for proper operation as the unit is received, before attempting to reprogram and/or retune it. Standard factory programming is RX 469.500, TX 464.500, 100Hz
2. **RETUNE THE DUPLEXER** if you have reprogrammed a TX or RX frequency change by 0.1 MHz or more.
3. **RETUNE VCO VOLTAGES** if you have reprogrammed a frequency change of more than 1.0 MHz. Flashing GREEN "STATUS" LED indicates VCO is unlocked.
4. **IF PROGRAMMING ERRORS PERSIST:**
   a. reprogram the unit to factory defaults;
   b. reprogram with a PC to desired settings;
   c. realign as necessary.

4.2 GENERAL

The RRX-450 Repeater can be powered by a +11 to +15 VDC, or 110/240 VAC source. The Repeater includes a 13.8V battery maintenance charge output, used during normal AC operation to maintain the charge on an external +12 VDC battery. The battery takes over automatically (failsafe) if AC power fails, and the unit automatically returns to AC power when AC is reapplied.

The RRX-450 has standard frequency separation of 5 MHz between transmit and receive channels. Normal Repeater configuration has the receive frequency higher than the transmit frequency. "Inverted units" have the transmit frequency 5 MHz higher than the receive frequency. The duplexer can be mounted with either the low-pass or the high-pass filter toward the transmitter, as necessary to accommodate inverted-frequency operation.

The output RF power of the transmitter module adjusts from 1 to 8 Watts, 5 Watts nominal at the duplexer output (1.8 dB insertion loss in normal mode). RRA-452, an optional RF power amplifier module that fits inside the Repeater enclosure, has typical power output of 30 Watts, which drops to 20 Watts at the duplexer output.

A time-out timer, a hang-timer and Morse code ID are standard items in the RRX-450, as is QC™ or DQC tone decode/encode.

This Repeater can locally monitor and transmit via an on-board audio amplifier key circuit, using the RSM-3X Local Speaker/Microphone. The RSM-3X encodes only the QC tone programmed in the PTT MIC tone, and is different from the "Repeater" tone unless it is programmed the same.

A 10-pin connector on the main PC board is included to accommodate several RITRON accessories. See "RRX-450 Accessory," page 5.

NOTE: Certain accessories cannot be installed in the same unit with others; call RITRON Sales or Customer Service Departments at 317-846-1201 for details.

The RRX-450 Repeater system can be used with an RP-200 autopatch or a Telenexus system for interconnection with a Public Switched Telephone Network.

The RRX-450 Repeater also includes these features:

- Backup Battery Charger, 500mA: automatic cut-over to Battery when AC power fails, then back when AC power is re-applied.
- Auxiliary Repeater Controller Connector
- Internal QC or DQC Capability
- Modular Design for quick field repairs and RF isolation
- Rack Mount Enclosure for professional installations / Rubber feet for desktop mounting
- User Programmable Functions, programmable by computer or by MIC "key-click"

4.3 INSTALLATION

To install and operate the RRX-450 as a Repeater, connect the unit to an antenna that has been tuned to the transmitter frequency. Then connect the unit to either a +12 Volt battery or plug it into an AC outlet. Make sure that the AC voltage selector (rear panel) is set for the appropriate AC source (110 or 240 VAC). Remove the voltage selector window with a flat blade, remove the internal board, then rotate to the correct voltage and replace.

- The red "POWER" LED on the front panel means the Repeater is ready for operation.
- If the TX LED flashes green, the transmitter must be realigned–refer to page 25.

All internal adjustments have been factory set. A signal on the Repeater receive frequency activates the green Carrier Detect (CD) light emitting diode (LED), regardless of tone. A proper tone signal will cause the Repeater to transmit, confirmed by the red STATUS LED.

4.4 TONE SIGNALING

The Repeater's internal microcontroller may be programmed with QC (Quiet Call) or DQC (Digital Quiet Call) to access the Repeater. QC and DQC cannot be stored in the EEPROM at the same time. The RRX-450 may be programmed with one QC tone, or two DQC codes at a time.

Because the main PC board includes ports for up to three optional RTS-6P QC decode modules, the Repeater may be operated to accommodate separate groups of users. Each group can have its own QC/DQC access tone. The optional (QC only) tone module(s) act as a decoder only; tones program-med into the Repeater are all encoded by the microcontroller IC408..

NOTE 1: In a multiple tone system, while one (tone) group is using the Repeater, all other user groups will be locked out of the Repeater until the expiration of the hangtime. In a Telenexus system, an RP-200 tone must be set in each unit, the hangtime in the RTLT end set to .5 seconds (9216), and the hangtime in the RTSU end set to 0 seconds (9200).

NOTE 2: The RP-200 will encode on an incoming telephone call with the tone programmed for PTT operation. Calls initiated by radios will be on the radio's tone.

NOTE 3: The lowest QC tone has to be the microprocessor; extra Tone 1, Tone 2 and Tone 3 boards (QC tones #2 to #4) must be in ascending QC order to match programming to prevent "cross-coding".

4.4.1 CROSS-CODING: SEPARATE QC ENCODE/DECODE SETUP

For systems with mobile and/or portable radios that can be QC encoded, sometimes it is desirable to operate the RRX Repeater with separate encode and decode codes. Mobiles and/or portables operating in close proximity to the antenna system can mix L.O. and the Repeater transmitter to create an on-channel product. In this case, the transmitter having the correct tone causes the Repeater to "see" itself and to lock up in transmit mode, and to "howl".

Radios with different I.F. can help alleviate this problem, or the problem can be eliminated by operating with different encode and decode tones. Perform the following:

1. Select a mobile encode tone and a different decode tone (except 67.0Hz).
2. Set RTS-6P DIP switches to decode the mobile or portable encode tone.
3. Install an RTS-6P into the external "Tone 1" header, J407.
4. Set the internal RRX code (Tone #1) to any QC code lower than the tone to be set in Step 5, below.
5. Program the RRX Tone #2 location to the portable or mobile decode tone.
6. Place PJ403 in position "B" to prevent the on-board circuit from decoding the code set in step 4, unless it also is to be used as a valid user tone.

RESULTS: The RTS-6P decodes the proper code, the RRX encodes what is programmed to match the tone board slot, and on-board decode circuitry is defeated.

5. PROGRAMMING THE REPEATER

5.1 WHAT CAN BE PROGRAMMED

The RRX-450 Repeater may be programmed with a transmit frequency, receive frequency, QC, DQC and special features. In addition, the internal microcontroller of the Repeater must be programmed for use with certain accessories. For example, the micro-controller must be programmed with QC/DQC tone(s) in order to access RP-200 paging interconnect.

Other programmable parameters include:

Battery backup cutover beep – When AC power fails and the Repeater has switched to DC backup, a beep will sound at the beginning of the first transmission and every 8 seconds thereafter as long as the transmitter remains keyed.

Transmit time out timer – This feature determines how long the Repeater can broadcast continuously before the transmitter automatically shuts off.

Tone signaling turn off time – This is the time (in addition to "hang-time" with tone) that no tone is transmitted after the Repeater ceases to detect an incoming carrier

Call sign:Morse code identifier – The Repeater may be programmed to transmit a Morse code identifier at a specified time interval after activity.

5.2 TWO WAYS TO PROGRAM THE REPEATER

The two ways to program the RRX-450 Repeater are:

5.2.1 PC/SOFTWARE: The preferred method, using a PC-compatible computer and the RITRON programming software kit RPT-PCPK, provides on-screen programming instructions. This kit also includes a cable to connect the computer serial port to the front panel of the Repeater.

See the description and further information on the PC/Software programming kit on page 11.

5.2.2 PTT: An optional method is to plug a (model RSM-3X) remote speaker/microphone into the Repeater front panel and program data by pressing and releasing the Push-To-Talk switch (PTT).

Refer to the following setup instructions.

5.3 PROGRAMMING SETUP: PC/SOFTWARE & PTT

1. Remove AC and DC power from the Repeater.
2. Insert (a.) the programming cable plug, OR; (b.) the RSM-3X plug into the two "TEST MIC" jacks on the front panel of the Repeater.
3. Remove a small black plastic plug, located on the right side of the jacks, to uncover an access hole in the front panel.
4. Use a pointed tool to press and hold the programming button located in this hole. Hold the button until power is applied, then release it.
5. a. If you are using PC/software programming, no tone is sounded (as noted below). Enter "1" to begin programming; follow on-screen programming instructions. If you experience software failure, repeat steps 4 and 5.
   b. If you are using remote speaker/microphone programming, the Repeater sounds a 1-second tone to confirm it is in programming mode.
6. See Instructions on page 11 to return to operating mode.

5.4 PTT PROGRAMMING: NEW CHANNEL CONTENTS

Channel contents are radio frequencies, tones and special features stored in the Repeater EEPROM. No power is used in retaiing these settings.

To PROGRAM CHANNEL CONTENTS one digit at a time, press, then release the PTT button of the remote speaker/ microphone the number of times equal to the digit value. The unit will emit a "ready" tone prompt for the next digit.

To STORE CHANNEL CONTENTS after programming all valid content data, press then release the programming switch behind the front panel—same as 5.3.4, above. The unit will emit a single confirming tone indicating the data has been "latched' in.

NOTE: A series of beeps indicates an error or an invalid data entry: re-enter the data from the last valid data latched in.

5.5 PTT PROGRAMMING: GUIDELINES

- Follow PROGRAMMING SETUP (page 8) and RETURNING TO OPERATING MODE (page 11) instructions. Be sure to "latch-in" the data by pressing the programming button.
- Press the PTT ten times to enter zero (the digit "0").
- While programming a digit, do not pause for more than about one second between presses; an extended pause tells the microcontroller that you are finished entering the digit.
- Enter ALL radio frequencies as SIX DIGITS; do not skip zero ("0"), or include the seventh digit.
  EXAMPLES:
  - Enter a zero for each of the last two digits in "464500" (464.500MHz).
  - Enter only the first six digits for (12.5 KHz offset channel) 7-digit frequency "461862" (461.8625KHz).
- Although the unit will allow you to program invalid frequencies outside the 450-470 MHz band, the REPEATER WILL NOT OPERATE on frequencies outside the 450-470 MHz band.

5.5.1 PTT PROGRAMMING: ENTRY MISTAKES

If you make a mistake or lose count of your presses, correct your programming entry as follows. EXAMPLE: If you press the PTT seven times when intending six times, do not then press the programming button to store data. Rather, continue pressing the PTT until three beeps sound, then start over from the most recent valid entry. To start over from the beginning, power cycle the Repeater.

PTT PROGRAMMING: INVALID ENTRIES

When you are in programming mode, an invalid entry is indicated by the Repeater emitting three tones then a long tone after you press the programming button to store the entry; NO PROGRAMMING CHANGE is made for an invalid entry.
EXAMPLE: Attempting to save seven digits as a radio frequency will not work, because all radio frequencies are entered as six digits. See VALID PROGRAMMING ENTRIES on page 10.

5.6 *PTT PROGRAMMING: NOTES*

1. For modifying tones in a multiple tone application, RITRON strongly recommends you begin programming using "delete all codes" (PTT "84" code). You can then "ADD" ("81XX") appropriate codes one at a time. For CTCSS, make sure the RTS-6P tones are set higher than the lowest tone. In a multiple-tone configuration, the lowest tone is decoded by the RRX on-board microcontroller.

NOTE: Ensure that any added tones are installed in ascending order starting with J407, (external Tone #1) and the portables are programmed for tone dropout (QC decode).

2. When changing the code in a single CTCSS system, use the 2-digit PTT code. Using 81XX will "ADD" a code to the existing tone data. Changing code data DOES NOT CHANGE the PTT tone (encoded for the hand-mic). You must also use 91XX to set the PTT tone.
3. To read out the programmed frequency, press and hold the programming button and turn ON the Repeater. Press and release the programming button one more time without entering data to read out TX, then RX codes, than tone data. Count the number of beeps per group. Ten beeps indicate zero.
4. Where "TX/RX Frequency" appears in the interpretation column, the receive frequency is 5 MHz above the TX frequency.
5. Adding a "9" to the end of a QC or DQC entry turns OFF Quiet Call during transmit. Quiet Call then operates in receive mode ("decode") only.
6. Adding a "1" to the end of a DQC entry inverts the code for RX and TX.
   Adding a "2" inverts the code for RX.
   Adding a "3" inverts the code for TX.
7. If the Repeater is to be configured for multiple QC tone operation (RTS-6P modules are used), the internal, on-board tone programmed into the Repeater must be the lowest tone; tone(s) programmed for the RTS-6P module(s) must be higher than the "internal" tone.
8. In an RRX system containing an RP-200, the RP-200 controls the Repeater time-out.

5.7 VALID PROGRAMMING ENTRIES

CHECK THE VALID PROGRAMMING ENTRIES IN THE FOLLOWING TABLES. The example column reflects only two of the available radio frequencies and codes.

For most codes, the Repeater microcontroller determines what you are programming by counting the number of digits entered. The first table shows the interpretation of counting digits.

Exceptions to the rule governing the first table appear in the special features (second) table. The microcontroller interprets the first two or three digits entered as an instruction set. "X" represent a code or number of your choosing.

# DIGITS	INTERPRETATION	EXAMPLE
2	QC (Quiet Call)	12
3	QC Decode Only	129
3	DQC (Digital Quiet Call)	071
4	DQC Decode Only (Does not erase prior codes)	0719
4	DQC with Inversion (Decode/Encode)	0711 - RX & TX
4	DQC RX Inverted (Mobile TX Inverted)	0712
4	DQC TX Inverted (Mobile RX Inverted)	0713
6	TX/RX Frequency (RX Frequency 5 MHz above)	464700 *OR* 464762
8	TX/RX Frequency and QC	46470012
9	TX/RX Frequency and QC Decode Only	464762129
9	TX/RX Frequency and DQC	464700071
10	TX/RX Frequency and DQC Decode Only	4647000719
10	TX/RX Frequency and DQC with Inversion	4647000711
12	TX Frequency and RX Frequency Odd Split	464700469762
12	RX Frequency and TX Frequency Inverted Pair	469700464700
14	RX Frequency, TX Frequency and QC	46970046476212
15	RX Frequency, TX Frequency and QC Decode Only	469700464700129
15	RX Frequency, TX Frequency and DQC	469700464700071
16	RX Frequency, TX Frequency and DQC Decode Only	4697004647000719
16	RX Frequency, TX Frequency and DQC with Inversion	4697004647000711

ENTRY	INTERPRETATION	EXAMPLE
81XX	Add a QC Code	8112
81XXX	Add a DQC Code (Cannot invert or decode only)	81071
82XX	Delete a QC Code	8212
82XXX	Delete a DQC Code	82071
83	Read Out All QC/ DQC Codes	----
84	Delete All QC/ DQC Codes (Will not delete RP-200 codes)	---- (= Carrier Squelch)
85XX	Add an RP-200 QC Code	8512
85XXX	Add an RP-200 DQC Code	85071
86XX	Delete an RP-200 QC Code	8612
86XXX	Delete an RP-200 DQC Code	86071
87	Read Out All RP-200 QC Codes	----
88	Delete All RP-200 QC Codes	----
91XX	Set Repeater MIC/ PTT/ RP-200 (Initiate) External Key Encode Tone	9112
91XXX	DQC	----
92XX	Set Hang Time (00 - 99)	9232 (1 Second)
93XX	Set Time Out (00 - 30)	9303 (3 Minutes)
94X	RWR-10 Installed; 0 = N (not installed), 1 = Y (installed)	941

5.7 PC/SOFTWARE PROGRAMMING

RITRON programming kit RPT-PCPK provides programming RRX-450 Repeaters with a PC compatible computer.

To use PC/Software programming, connect the Repeater to the computer serial port with the RITRON adapter cable. Insert the software diskette into the floppy disk drive and load the software program. The program transfers data between the Repeater and the computer memory. The software includes on-screen instructions and Help files. You can program added Repeaters identically by saving data to the computer hard drive.

5.7.1 RPT-PCPK KIT CONTENTS

1. Ritron RRX Repeater Programming Software, complete on one 3.5" diskette.
2. RITRON PC-to-Repeater adapter cable, terminated at one end with a DB-25F connector for plugging into the computer serial port. The other end terminates in a modular plug, and includes an adapter for connecting it to a 3.5 mm plug which fits the Repeater "TEST MIC" jack.
3. Installation instructions.
4. Registration form.

5.7.2 RPT-PCPK KIT PC REQUIREMENTS

The IBM-compatible computer must run on DOS 3.2 or later, and have a RS-232 serial port available. A hard disk drive is recommended.

5.8 COMPUTER SOFTWARE COPYRIGHTS

The RITRON, INC. products described in this manual include copyrighted RITRON, INC. computer programs. Laws in the United States and other countries grant to RITRON, INC. certain exclusive rights in its copyrighted computer programs, including the exclusive right to distribute copies of the programs, make reproductions of the programs, and prepare derivative works based on the programs. Accordingly, any computer programs contained in RITRON, INC. products may not be copied or reproduced in any manner without the express written permission of RITRON. The purchase of RITRON, INC. products does not grant any license or rights under the copyrights or other intellectual property of RITRON, INC., except for the non-exclusive, royalty-free license to use that arises in the sale of a product, or as addressed in a written agreement between RITRON, INC. and the purchaser of RITRON, INC. products.

5.9 RETURN TO OPERATING MODE FROM PC/SOFTWARE OR PTT PROGRAMMING

WHEN YOU FINISH PROGRAMMING, follow the steps below to return to operating mode.

a. If you have used PC/Software programming, input "R" to the main software screen, OR;

b. if you have used remote speaker/microphone (PTT) programming, first be sure you have latched in your data. Then power-cycle the Repeater by removing power for 5 seconds, then applying AC and/or DC power.

THE REPEATER RETURNS TO OPERATING MODE.

5.10 QUIET-CALL CODES & FREQUENCIES

QC Code	Tone Code	Freq. (Hz.)	QC Code	Tone Code	Freq. (Hz.)	QC Code	Tone Code	Freq. (Hz.)
01	XZ	67.0	18	3Z	123.0	35	M4	225.7
02	XA	71.9	19	3A	127.3	36	--	233.6
03	WA	74.4	20	3B	131.8	37	--	241.8
04	XB	77.0	21	4Z	136.5	38	--	250.3
05	SP	79.7	22	4A	141.3	39	--	69.4
06	YZ	82.5	23	4B	146.2	40	--	159.8
07	YA	85.4	24	5Z	151.4	41	--	165.5
08	YB	88.5	25	5A	156.7	42	--	171.3
09	ZZ	91.5	26	5B	162.2	43	--	177.3
10	ZA	94.8	27	6Z	167.9	44	--	--
11	ZB	97.4	28	6A	173.8	45	--	183.5
12	1Z	100.0	29	6B	179.9	46	--	189.9
13	1A	103.5	30	7Z	186.2	47	--	196.6
14	1B	107.2	31	7A	192.8	48	--	199.5
15	2X	110.9	32	M1	203.5	49	--	206.5
16	2A	114.8	33	M2	210.7	50	--	229.1
17	2B	118.8	34	M3	218.1	51	--	254.1
						53	--	Custom

5.11 DIGITAL QUIET-CALL CODES

Normal	Invert	Normal	Invert	Normal	Invert	Normal	Invert
023	047	143	412	315	423	532	343
025	244	152	115	331	465	546	132
026	464	155	731	343	532	565	103
031	627	156	265	346	612	606	631
032	051	162	503	351	243	612	346
043	445	165	251	364	131	624	632
047	023	172	036	365	125	627	031
051	032	174	074	371	734	631	606
054	413	205	263	411	226	632	624
065	271	223	134	412	143	654	743
071	306	226	411	413	054	662	466
072	245	243	351	423	315	664	311
073	506	244	025	431	723	703	565
074	174	245	072	432	516	712	114
114	712	251	165	445	043	723	431
115	152	261	732	464	026	731	155
116	754	263	205	465	331	732	261
125	365	265	156	466	662	734	371
131	364	271	065	503	162	743	654
132	546	306	071	506	073	754	116
134	223	311	664	516	432		

MODEL RRX-450 MAINTENANCE/REPAIR TABLE OF CONTENTS

SECTION	*SUBJECT*	*PAGE*

SPECIAL HANDLING NOTES

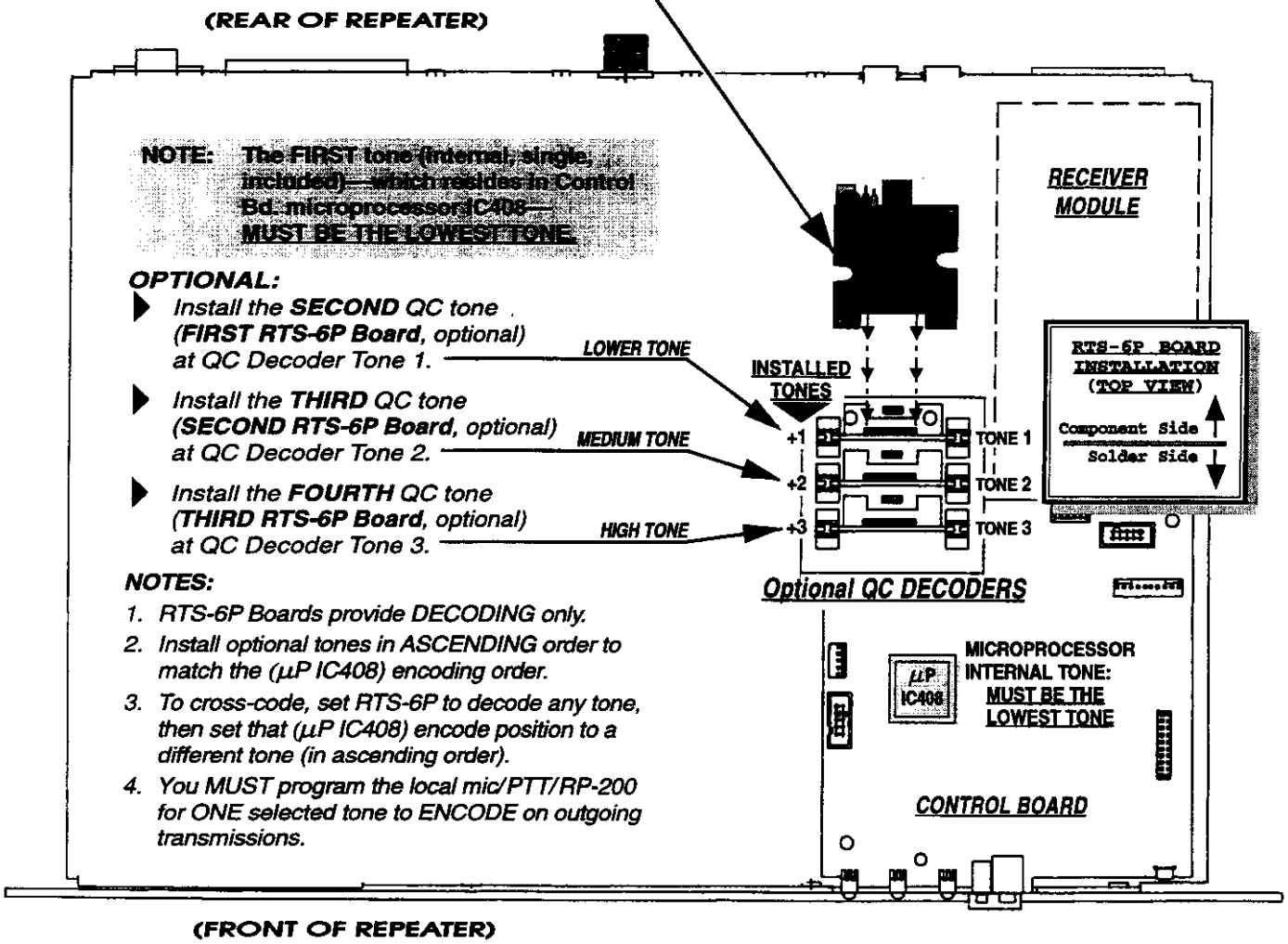
1. TEST THE REPEATER for proper operation as it is received, before attempting to reprogram and/or retune the unit. Factory programming is: 464.500/469.500, 100Hz.
2. RETUNE THE DUPLEXER if you have reprogrammed a TX or RX frequency change by more than 0.1 MHz.
3. RETUNE VCO VOLTAGES AND RECEIVER if you have reprogrammed a frequency change of more than 1 MHz. Flashing GREEN "STATUS" TX LED indicates VCO is unlocked.
4. If programming errors persist:
   a. reprogram the unit to factory defaults;
   b. reprogram with a PC to desired settings;
   c. realign as necessary.

25. RTS-6P BOARD INSTALLATION

RTS-6P BOARD INSTALLATION

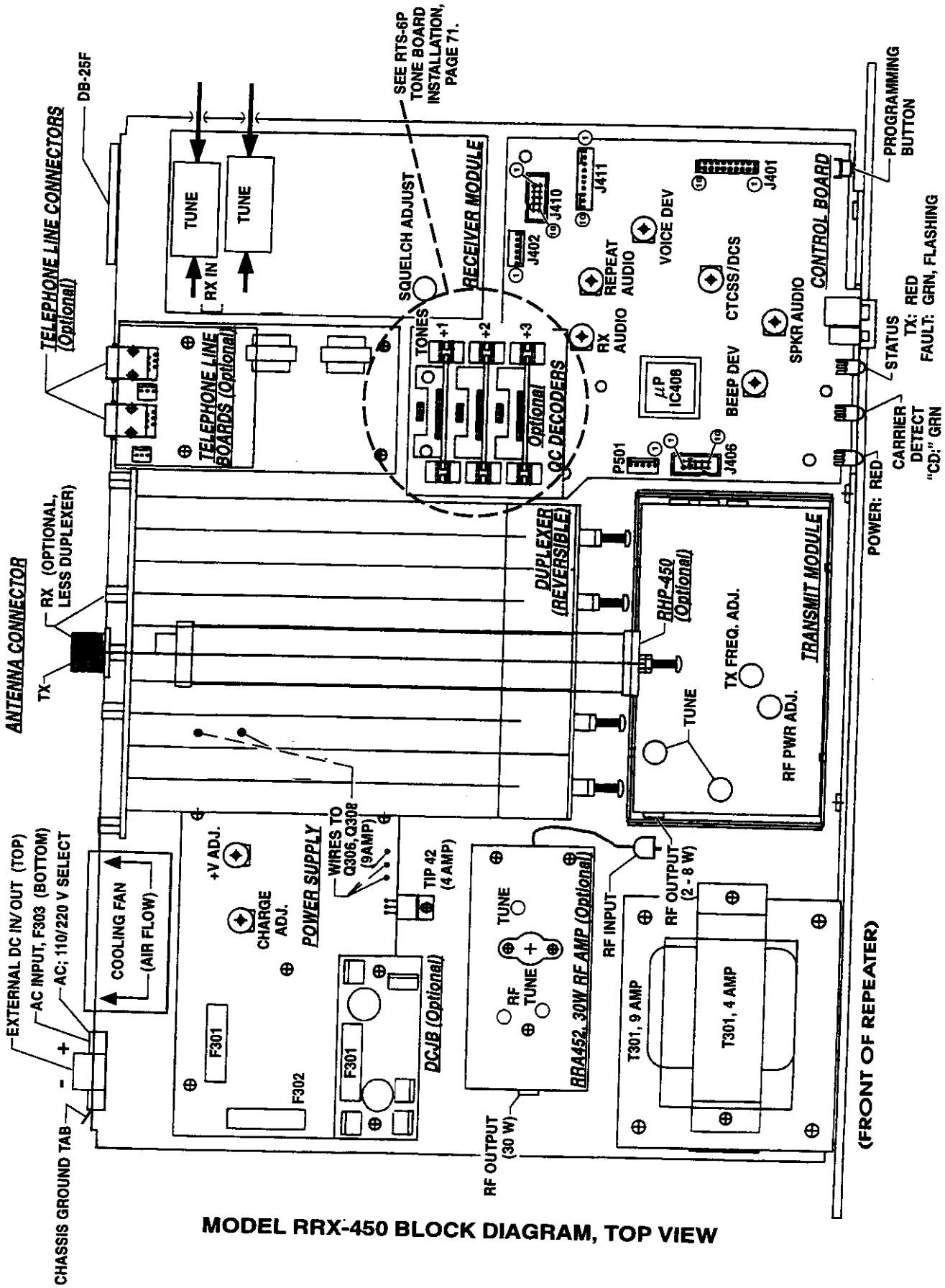
1. Snap a board guide (provided in the kit), into the slot on each side of the connector.
2. Position the RTS-6P Board ***COMPONENT SIDE TOWARD THE REAR*** *and* ***SOLDER SIDE TOWARD THE FRONT of the Repeater*** as shown, then slide the board into position on the connector pins.

CAUTION: **Insert the RTS-6P boards *as directed in Step 2* above. INCORRECT INSTALLATION WILL DAMAGE COMPONENTS.**



RRX TOP VIEW

26. BLOCK DIAGRAM OF RRX-450



MODEL RRX-450 BLOCK DIAGRAM, TOP VIEW

27. RRX-ACCESSORY CABLE PINOUT TECHNICAL NOTES

RRX-ACC (optional internal wiring to back panel DB-25F) and RRX-GCI, -TNT, -RMC Cable(s) color codes are the same throughout, with one exception. Not all wires are used in any one particular installation. Unused lines should be left unterminated as these connections are often in parallel with similar inputs. Grounding an unused line may or may not have an undesired effect. e.g.: Grounding a second PTT line will send the RRX-450 into Transmit Mode, while Grounding a second audio input line will have no adverse effect. Check carefully. Notes below provide details, drive levels, and impedences.

RRX-GCI WIRING COLOR CODES:

DB-25 PIN	*WIRE COLOR*	*J411 PIN*	*DESIGNATION/ USE*
1	Drain Wire	--	Single Point AUDIO ground for foil shield ONLY
2	Bus Bar/Black	--	CHASSIS GROUND/NEGATIVE POWER connection. See notes.
3	Orange	4)	TX AUDIO voice input (filtered internally for 300-3000 Hz, 0.6 V P-P = 3 KHz Dev, 1.0 V P-P max)
4	Blue/White	6)	CARRIER DETect output (LO, if PJ407 in "B" position)
5	Green/Black	8)	TONE SQuelch QC/DQC detected (LO)
6	Blue/Black	10)	Signal Ground (path for PTT) (not intended for power)
7 – 13	N/C		

Second Row:

DB-25		*J411*	
14	Green/White	1)	RX Audio Output (DC blocked). (FACTORY TEST POINT. ADJUST R475 TO SET 2.1 V P-P on this line with a strong RF carrier modulated with a 1000 Hz tone @ 60% of max dev.)
15	Blue	3)	CTCSS/DCS IN Subaudio/Trunking Data INPUT to TX (0.4 V P-P Nominal = 0.6 KHz deviation)
16	Red	5)	+12 Volt, 0.5 A max, unfused
17	White	7)	PTT External TX command line. LO for TX.
18	Orange/Black	9)	REPEAT DISable = External Controller Enable; LO
19	Green	--	C464) True Discriminator out for Trunking Data + RX Audio Output (no DC block)(3.0 KHz dev = 0.7 V P-P).
20	N/C		

DB-25/ J-402

21	1 White/Black		REMOTE TX AUDio voice input (will be filtered to 300 – 3000 Hz) (0.031 V P-P = 3.0 Khz deviation)
22	2 (Black)	N/C	Extra signal ground pin; no wire connection in any external cable; only connected internally to pin.
	3 V+	N/C	
23	4 Black/White		MONITOR Control Line (RWR-10 must be set to "YES")
24	5 Red/Black		REMOTE KEY or TX/PTT Control line
25	6 Red/White		REMOTE RX AUDio output (min 2000 ohm impedence)

See detailed notes and information on following pages by pin number.

NOTES:

1. The DRAINWIRE is connected at ONLY one point (inside RRX-450), to chassis ground for single-point grounding for audio line shielding. To prevent ANY DC current (supply or ground loops) from flowing on the foil shield (which could cause induced hum on the audio), DO NOT GROUND the drain wire or foil shield at any other point (e.g.: the Remote/External Controller). The DC POWER GROUND connection DOES NOT flow across DB-25, Pin 1.
2. The BLACK WIRE of any supplied EXTERNAL cable for DC GROUND/ Negative Power lead is connected to the DB-25M, Pin 2 (RRX end). The Black Wire DOES NOT connect internally to DB-25F, Pin 2. A separate, larger gauge, short length of BUS BAR connects DB-25F, Pin 2 to Chassis Ground to supply the DC current needs of an external device.

   The bus bar splits and isolates the two grounds: Power Ground at Pin 2 and Audio Ground at Pin 1, to provide separate, direct, low impedence ground paths for DC power and audio shielding.

3. Limit the audio input on this line to the transmitter to 1.0 V P-P maximum when the LIMITER (VOICE DEV R426) is set for 5 KHz systems, or 2.5 V P-P for 2.5 KHz systems (yes, more!). This level will drive the transmitter to hard limiting (maximum permitted Deviation). Nominal (60% Deviation) 1000 Hz tone levels are 0.5 V P-P for 3 KHz (5 KHz systems) and 0.6 V P-P for 1.5 KHz (3 KHz systems). Audio (low pass) frequency filtering is internal to the RRX-450 and need not be filtered externally. There is no low-frequency filtering on this line.
4. CARRIER DETECT output, if selected by PJ407 in the "B" position, is pulled HI (47 KOhm to +5 V) until ANY RF CARRIER ON FREQUENCY BREAKS CARRIER SQUELCH level (as set by R112, RX Board). Any received carrier (green "CD" LED) will send this line LO and can sink an additional 50 mA of current to ground.
5. QC/ DQC/ Tone Squelch (internal decode and detect) is to be defeated internally (RRX-450 PJ403 to the "B" position), to isolate the function (pulled HI to +5 V). If an external output of any/all internal decoder(s) is desired (PJ403 left in the "A" position), this line will go LO and sink 50 mA (100 mA max) to ground. There is no differentiation between multiple tones if equipped for more than one tone (up to four with three optional RTS-6P modules).
6. This pin is a local board Ground connection intended for signal level or PTT TX use, NOT a power connection point. Use Pin 2 (Black Wire) for Power Supply.
14. This is the Audio output selected by PJ402; it is DC Blocked, 10 – 3000 Hz (FLAT) or 300 - 3000 Hz (HIGH PASS), (as opposed to DIRECT DISCRIMINATOR line output, DB-25, pin 19 – Green wire). The factory setting is HIGH PASS 2.1 V P-P @ 1000 Hz @ 60% (3 KHz or 1.5 KHz deviation); reset on PN402 if FLAT is selected. The impedence output rating is 2000 Ohm. The level is first set here first, then all other levels (REPEAT, VOICE DEV/ LIMITING) are set from this standard. RITRON accessories are set to accept this 2.1 V P-P input for "plug-in" installation and operation.
15. This is for external sub-audio input (QC, DQC, TRUNKING LOGIC or data) line to RRX-450 TX modulator AFTER VOICE LIMITING. DC is blocked by the negative lead of a 1 uF/16 V tantalum capacitor; 0.45 V P-P = 600 Hz deviation. There is no internal level control.
16. +12.6 VDC Power Connection. Unfused internally except for primary DC power fuse (3 or 10 A, depending on model). Limit draw to 500 mA, 750 mA max.
17. EXT PTT/ TX Control line. Ground to TX, pulled HI by 10 K Ohm to +5 V on RX.
18. REPEAT DISABLE is also EXTERNAL CONTROLLER ENABLE. Grounding this pin disables the internal audio routing and time-out features, etc.
    - Internal tone decoding is disabled only by moving PJ403 to the "B" position.
    - Internal tone encoding is disabled only by turning R423 "CTCSS/DCS" control fully CCW. Repeated audio must now come in from an external source (i.e.: Controller re-routing internal or telephone audio) feeding DB-25 pin 3 or 21.
19. DISCRIMINATOR OUT is direct, non-DC blocked, audio out, unsquelched, from the demodulator. Approximately 0.7 V P-P for 3 KHz deviation of a 1000 Hz tone, 2000 Ohm output impedence, pre-emphasis intact.

NOTE: The following DB-25 pins are referred to the internal RWR-10/ J402 port connections. J402 is for connecting a DC or TONE REMOTE handset. It REQUIRES PROGRAMMING RRX-450 TO "RWR-10 YES" via the computer programmer.

21. REMOTE TX AUDio input from external handset. 0.10 V P-P = max deviation (3 or 5 KHz).
22. NO CONNECTION in any EXTERNAL cable. Inside the RRX-450, the black wire grounds (J402 pin 2) this pin (DB-25F pin 22). This uses all internal wires and provides an additional signal ground pin IF needed for the application. Use pin 6 first for signal ground. Move another wire to connect to this pin if needed. USE PIN 2 FOR (-) POWER.
23. a. MONITOR control line, when programmed and grounded, disables tone squelch function to allow reception in carrier squelch mode to MONITOR the channel for co-channel user traffic prior to transmission. Lifting a telephone-style handset should ground this line.
    - Program RWR-10 bit to "YES".

    OR

(23.) b. REPEAT DISABLE if the RWR-10 bit is left as "NO", then grounded.

N/C to J402 V+ connection. Use RRX-450 end DB-25M pin 16 RED wire.

24. REMOTE KEY or PTT line. Ground for TX. Pulled HI by 10 Kohm to +5 V on RX.
25. REMOTE RX AUDio out. Low power medium impedence (2000 ohm, DC blocked) output to feed handset earpiece (or speaker amplifier when on-hook) tone squelched audio (or carrier squelched audio when MONITOR function activated).

28. SIX-CAVITY DUPLEXER INSTALLATION

SIX-CAVITY DUPLEXER INSTALLATION INSTRUCTIONS FOR RRX-450:

A six-cavity, notch-type duplexer (Sinclair MR356 or Cel-Wave PD633-6A) can be retrofitted inside the RRX-450. Installation kit RIKD-6C-1, described below, provides the necessary hardware.

NOTCH-TYPE DUPLEXERS: 6-CAVITY vs. 4-CAVITY:

A six-cavity duplexer offers performance improvement over the standard RITRON (or any) four-cavity model (RD-451):

- It provides deeper TX and RX notches: an extra cavity per side creates higher Q, which equates to a deeper notch.
- A six-cavity duplexer may be necessary, or more desirable than a four-cavity, to block broadband noise, high transmit powers, or co-located transmitters.
- Six-cavity duplexers generally have notches greater than 75 dB, equating to about 12 dB more rejection (over RD-451), of the TX broadband synthesizer noise at the RX frequency (Normal Split : TX low, RX high) NOTE: The RD-451 high frequency notch depth is comparable to the Sinclair or Cel-wave.

NOTE: DO NOT confuse poor duplexer performance with adjacent channel interference; adjacent channel rejection is purely a function of the receiver. A "notch-type" duplexer DOES NOT affect adjacent channel performance (+/- 25 KHz) of the Repeater. Model RRX-450 adjacent channel specification is as good as or better than any other synthesized product in its price range.

ALIGNMENT:

Align the duplexer before installing it, because the tuning screws are not accessible after it is installed. Alignment accuracy is critical to reduce any de-sense naturally present in the system. Proper tuning achieves maximum notch depth and low SWR simultaneously.

- Use a signal generator and spectrum analyzer to perform the alignment. Terminate the unused port into 50 Ohms.
- The vertical range on most spectrum analyzers is about 70 dB. When you have "notched" the carrier down into the noise floor, increase the generator level 20 to 30 dB to bring the carrier back out of the noise floor. This allows you to tune for maximum notch depth.

INSTALLATION:

If the Repeater includes RTS-6P tone boards, remove and discard the left-side (with the RRX front panel facing you) nylon PC board guides before you install the duplexer. The remaining guide and 8-pin header are sufficient to secure the RTS-6P.

ASSEMBLY INSTRUCTIONS:

1. Construct two (2) RF patch cables from the furnished parts.

   NOTE: Each cable assembly is to include a BNC connector on one end and a phono plug on the other. Make cables to required length. Bear in mind whether the RRX-450 is an inverted unit–TX high / RX low. Be aware that Sinclair and Cel-Wave duplexers are not identical in that their high and low sides are reversed.

2. Attach a BNC connector to one end of the remaining coax cable. Attach a connector of your choice to the other end—this connector is to be either panel-mounted or inserted through the antenna connector opening located at the center of the back panel.
3. Mount the hex spacers to the Repeater bottom panel as shown in Figure 1, then mount the duplexer on the spacers.
4. Attach the RF patch cables to the appropriate ports.
5. Check Repeater performance.

NOTE: Be sure to perform de-sense before you install the Repeater at the selected site. With the six-cavity duplexer installed, RRX-450 30 Watt Repeaters are to have less than 2 dB of de-sense, more than 20 Watts of RF power and more than .32 μV of RX sensitivity.

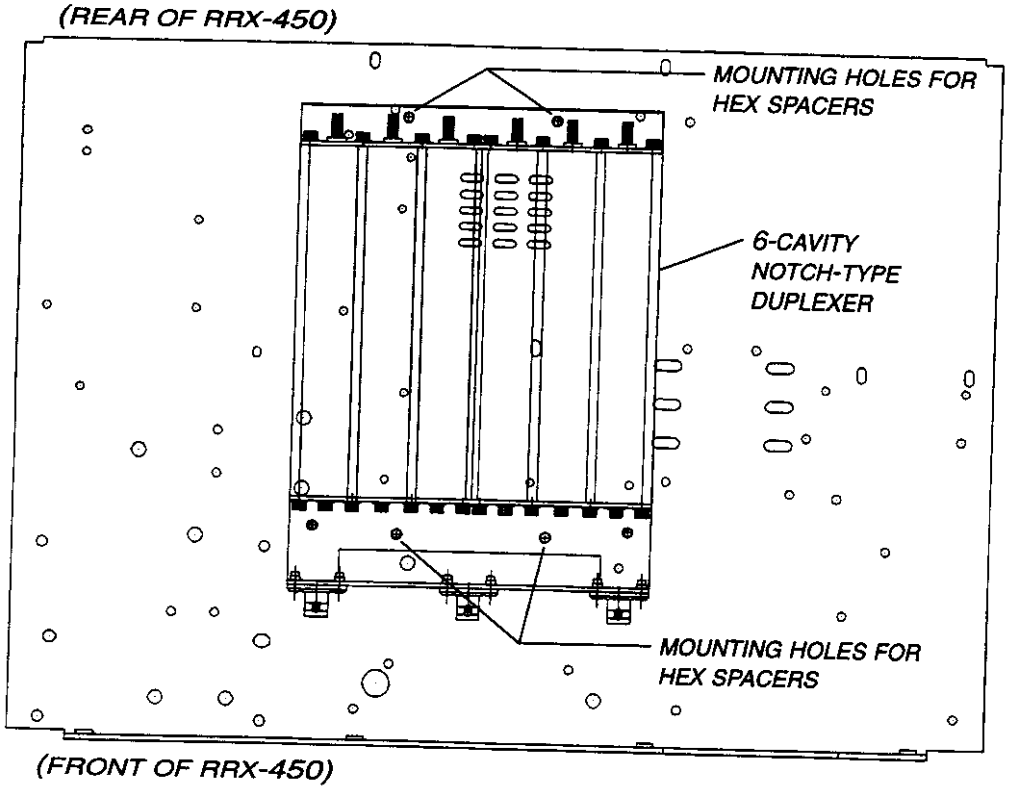


Figure 1—Six Cavity Duplexer Installation

RRX Series Programmable Repeater
LIMITED WARRANTY STATEMENT

WHAT THIS WARRANTY COVERS

RITRON, INC. ("RITRON") provides the following warranty against defects in materials and/or workmanship in RITRON Programmable Repeaters under normal use and service during the applicable warranty period (as stated below).

WHAT IS COVERED	***FOR HOW LONG***	***WHAT RITRON WILL DO***
RITRON Programmable Repeaters	1 year after date of purchase	During the first year after date of purchase, RITRON will repair or replace the defective product, at RITRON's option, parts and labor included at no charge.

What this warranty DOES NOT COVER

- Any technical information provided with the covered product or any other products;
- Installation, maintenance or service of the product, unless this is covered by a separate written agreement with RITRON;
- Any products not furnished by RITRON which are attached or used with the covered product, or defects or damage from the use of the covered product with equipment that is not covered (such as defects or damage from the charging or use of batteries);
- Defects or damage resulting from:
  – misuse, abuse, improper maintenance, alteration, modification, neglect, accident or act of God,
  – the use of covered products other than in normal and customary manner, or
  – improper testing or installation;
- Defects or damages from unauthorized disassembly, repair or modification, or where unauthor-ized disassembly, repair or modification prevents inspection and testing necessary to validate warranty claims;
- Defects or damages in which the serial number has been removed, altered or defaced.

IMPORTANT: This warranty sets forth the full extent of RITRON's express responsibilities regarding the covered products, and is given in lieu of all other express warranties. What RITRON has agreed to do above is your sole and exclusive remedy. No person is authorized to make any other warranty to you on behalf of RITRON. Warranties implied by state law, such as implied warranties of merchantability and fitness for a particular purpose, are limited to the duration of this limited warranty as it applies to the covered product. Incidental and consequential damages are not recoverable under this warranty (this includes loss of use or time, inconvenience, business interruption, commercial loss, lost profits or savings). **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 limitations or exclusions may not apply to you. Because each covered product system is unique, RITRON disclaims liability for range, coverage, or operation of the system as a whole under this warranty.**

WHO IS COVERED BY THIS WARRANTY

This warranty is given only to the purchaser of lessee of covered products when acquired for use, not resale. This warranty is not assignable or transferable.

HOW TO GET WARRANTY SERVICE

To receive warranty service, you MUST deliver or send the defective product, delivery costs and insurance prepaid, within the applicable warranty period, to RITRON, INC., 505 West Carmel Drive, Carmel, Indiana 46032, Attention: Warranty Department. Please point out the nature of the defect in as much detail as you can. You MUST retain your sales or lease receipt (or other written evidence of the date of purchase) and deliver it along with the product. If RITRON chooses to repair or replace a defective product, RITRON may replace the product or any part of component with reconditioned product, parts or components. Replacements are covered for the balance of the original applicable warranty period. All replaced covered products, parts or components become RITRON's property.

RIGHTS TO SOFTWARE RETAINED

Title and all rights or licenses to patents, copyrights, trademarks and trade secrets in any RITRON software contained in covered products are and shall remain in RITRON. RITRON nevertheless grants you a limited non-exclusive, transferable right to use the RITRON software only in conjunction with covered products. No other license or right to the RITRON software is granted or permitted.

YOUR RIGHTS UNDER STATE LAW

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

WHERE THIS WARRANTY IS VALID

This warranty is valid only within the United States, the District of Columbia and Puerto Rico.

RITRON makes a full line of radio communications products: high power portables, mobiles, base stations, range-extending repeaters and telephone interconnects.

Call your dealer or RITRON for more information.

RITRON, INC.
P.O. BOX 1998
505 WEST CARMEL DRIVE
CARMEL, IN 46032 USA

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FAX: 317-846-4978

RITRON 2-WAY RADIOS & REPEATERS ARE DESIGNED & MANUFACTURED IN THE U.S.A.

Preliminary

RRX-452 references on pages *i*, 1, 3, 18 and 25.

MADE IN THE USA

~~*Pub. RRX-MRM Rev. C 04-98*~~