

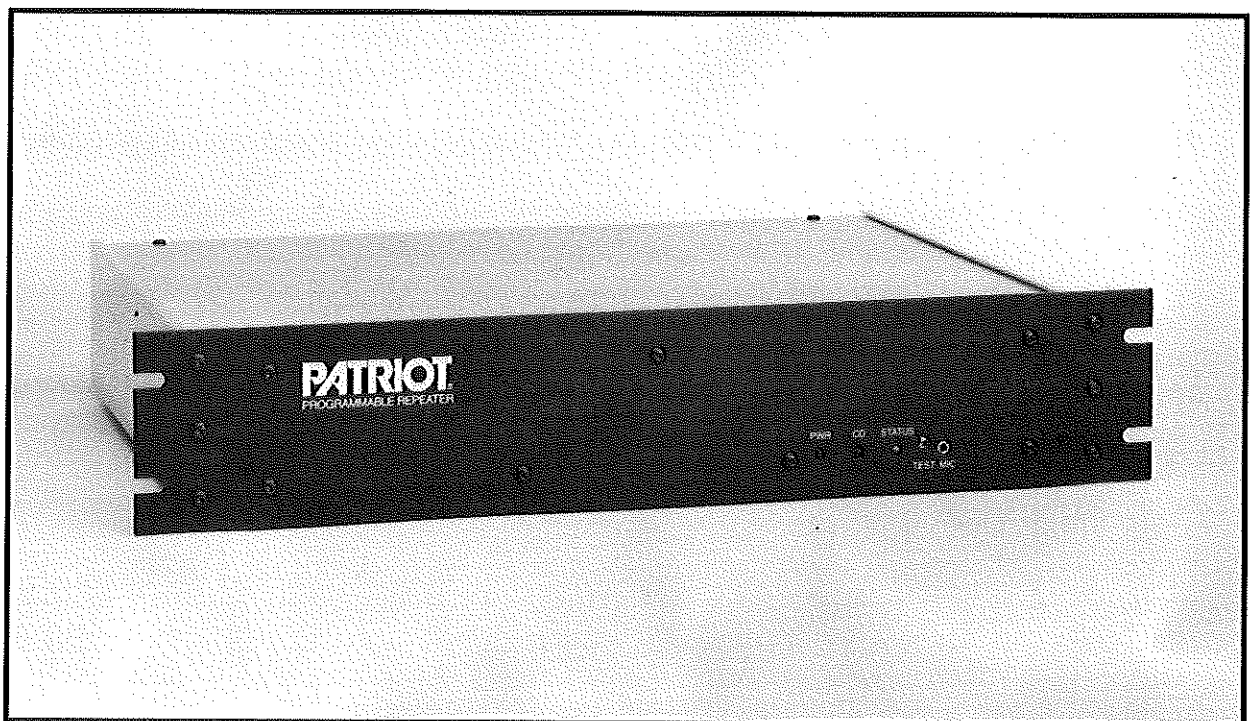
PATRIOT

TWO-WAY RADIO BY RITRON

RITRON MODEL RRX-450

PROGRAMMABLE

UHF FM REPEATER



MAINTENANCE/REPAIR/OPERATING MANUAL

FOR USE BY AUTHORIZED SERVICE/MAINTENANCE PERSONNEL ONLY

TABLE OF CONTENTS

SECTION	TOPIC	PAGE
1.	MODEL RRX-450 SPECIFICATIONS	
1.1	General	1
1.2	Receiver	1
1.3	Transmitter	2
1.4	Duplexer	2
2.	INTRODUCTION	
2.1	General	
2.1.1	Inspection	3
2.1.2	Model Identification	3
2.2	FCC Regulations	
2.2.1	Licensing	3
2.2.2	Safety Standards	3
3.	ACCESSORIES	5
4.	OPERATION	
4.1	General	6
4.2	Tone signaling	7
5.	PROGRAMMING THE REPEATER	
5.1	What Can Be Programmed	8
5.2	Two Ways To Program The Repeater	8
5.3	Setup For Programming Using The Remote PTT	8
5.4	Returning to Normal Operation	8
5.5	Programming New Channel Contents Using The Remote PTT	
5.5.1	Guidelines	9
5.5.2	Entry Mistakes	9
5.5.3	Valid Programming Entries	10
5.6	PC Computer Programming Kit	11
5.6.1	The RPT-PCPK Kit Includes	11
5.6.2	The RPT-PCPK Kit Requires	11
5.7	Computer Software Copyrights	11
	Programming Charts	
	Quiet Call Codes and Frequencies	12
	Digital Quiet Call Codes	12
	MAINTENANCE/REPAIR	13

IMPORTANT INFORMATION

Surface Mount Repair: RITRON surface mount products require special equipment and servicing techniques. Improper servicing techniques can cause permanent damage to the printed circuit board and/or components, which is not covered by RITRON's warranty. If you are not completely familiar with surface mount component repair techniques, RITRON recommends that you defer maintenance to qualified service personnel.

Precautions For Handling CMOS Devices: This radio contains complementary metal-oxide semiconductor (CMOS) devices, which require special handling techniques. CMOS circuits are susceptible to damage by electrostatic or high voltage charges. Damage can be latent, with no failure appearing until weeks or months later. For this reason, take special precautions any time you disassemble the radio. Follow these precautions, which are even more critical in low humidity environments:

- 1) Storage/transport - CMOS devices that will be stored or transported must be placed in conductive material so that all exposed leads are shorted together. CMOS devices must not be inserted into conventional plastic "snow" or plastic trays of the type that are used for other semiconductors.
- 2) Grounding - All CMOS devices must be placed on a grounded bench surface. The technician that will work on the radio/CMOS circuit must be grounded before handling the radio. Normally, the technician wears a conductive wrist strap in series with a 100 K Ω 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 that contains CMOS devices.
- 5) Power/voltage transients - Do not insert or remove CMOS devices with power applied. Check all power supplies to be used for testing CMOS devices, making sure that no voltage transients are present.
- 6) Soldering - Use a grounded soldering iron for soldering CMOS circuitry.
- 7) Lead-straightening tools - When straightening CMOS leads, provide ground straps for the tool used.

When returning a unit for service, use the original packing material and shipping carton if possible. Care must be taken to avoid damage to the rack mounting ears during shipment.

1. MODEL RRX-450 SPECIFICATIONS

1.1

GENERAL

FCC ID #:	AIERIT02-450
FCC Accepted Parts:	22,74,90,95
Emission Designators:	16K0F3, 16K0F2
Frequency Range:	450 - 470 MHz
Frequency Separation:	TX/RX: 4.5 to 5.5 MHz Duplexer
RF Channels:	1 TX/RX Channel
Channel Spacing:	12.5 KHz
Tone/Code Signalling:	CTCSS or DQC mode: 1 CTCSS or 2 DQC codes standard Up to 3 additional CTCSS codes available (4 total) with optional RTS-6P modules
Power Requirements:	110/240 VAC, 0.5A or External +11 to 15 VDC/2A
Power Consumption:	60 Watts
Local Audio Output:	1 W 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 (RP-200, RTLTL, or RTSU) 1 internal 10-pin male header for an external controller 3 internal 8-pin male headers for RTS-6P modules 2 external telephone jacks (w/RP-200 installed)
RF Connector:	SO-239
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
Test Speaker Microphone:	2.5mm and 3.5mm jacks for RSM-3X
Dimensions:	3.5"H x 19.0"W x 12.0"D standard rack
Weight:	12 lbs. (approximate)

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 μ V, .35 μ V through duplexer
Selectivity:	-80 dB @ +/-25 KHz
Spurious Rejection:	-80 dB
Image Rejection:	-80 dB
Intermodulation Rejection:	-70 dB
Frequency Stability	+/- 2.5 PPM (-30° to +60° C)
Noise Squelch Sensitivity:	.2 to 8 μ V, adjustable, Factory set to open @ 12 dB SINAD
Modulation Acceptance:	+/- 7.5KHz maximum
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 K Ω Minimum Load Impedance. A received 1 KHz tone at 3 KHz deviation, set to produce 2.1 V p-p at J401, pin 1.
Power Requirements:	+11 to 15 VDC, 0.5A nominal
RF Input Impedance:	50 Ω
RF Connector:	Phono jack

TRANSMITTER

1.3	
RF Output:	1 to 8 Watts @ 12.6 VDC, adjustable 5 Watts @ duplexer antenna port
Frequency Stability:	+/- 2.5 PPM (-30° to +60° C)
Modulation:	Direct FM
Deviation:	0 to +/- 5KHz, 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 K Ω 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

DUPLEXER

1.4	
Frequency Range (MHz)	450 - 470 (RD-451)
Frequency Spacing (MHz)	5 (standard)
Continuous Power Input (Watts)	50
Insertion Loss, Tx to Ant. (dB)	1.8
Insertion Loss, Rx to Ant. (dB)	1.5
Rx Isolation at Tx frequency (dB)	63
Tx Noise Suppression at RX frequency (dB)	73
Impedance (Ohms)	50
Temperature Range (°C)	-30 to +60
Connectors	Male Phono (TX/RX), SO-239 Female Antenna Connector

2.

INTRODUCTION

2.1

GENERAL

RITRON's RRX-450 is a rack-mount, synthesized UHF repeater that operates in the 450 to 470 MHz FM communications band. The unit receives messages which are originated by handheld, mobile, or fixed stations on one frequency, and simultaneously re-transmits 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 allows mobile and handheld units to communicate over much greater distances than would be possible without the repeater.

The RRX-450 is constructed in a heavy duty standard 19" rack-mount enclosure. By removing the five screws that secure the lid, it can then be slid off for easy access to the internal modules. Since the unit was designed in a modular fashion, ease of service and excellent RF isolation is achieved. The standard unit is made up of: 1) control unit, 2) transmitter module, 3) receiver module, 4) power supply and 5) a 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.

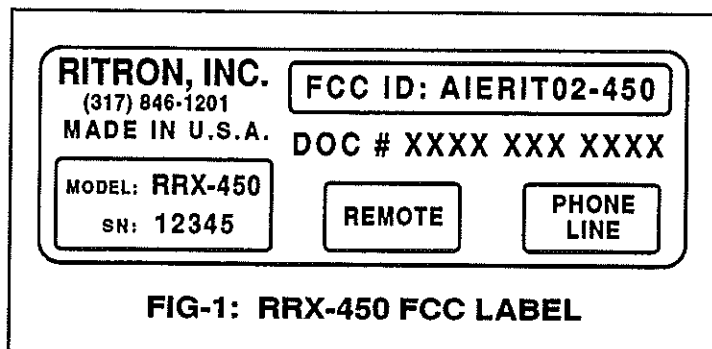
2.1.1

INSPECTION

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

2.1.2

MODEL IDENTIFICATION



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

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.

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:

SAFETY STANDARDS (CONT.)

- 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 according to RITRON's installation instructions.
- Repair of RITRON products should be performed only by RITRON authorized personnel.

3.

ACCESSORIES

Programming kits are for use by authorized service/maintenance personnel only.

<u>DESCRIPTION</u>	<u>ITEM NO.</u>
Programming Kit for RRX-450 Repeater (via PC compatible computer)	RPT-PCPS
Includes: 1) 1 - Software installation instructions 2) 1 - Programming software diskette, 3.5" 3) 1 - PC/radio adapter cable (DB-25F connector to 6-pin modular connector) 4) 1 - PC cable adapter (6-pin modular connector to 3.5 mm plug)	
Factory programming of channels, codes and features is also optional.	
RRX-450 Maintenance/Repair/Operating Manual	RRX-MRM
Bandpass Filter	RF-450
CTCSS Decoder/Encoder Module, Plug-in, Up to 3 additional	RTS-6P
DC Cooling Fan	(call factory)
Multifunction Telephone Interconnect And Paging Terminal	RP-200
No Duplexer Option (UHF Connectors Provided)	(call factory)
Remote Speaker/Microphone	RSM-3X
Autopatch (Telephone Interconnect and Paging Terminal	RP-200
20 Watt Amplified Version	RRA-452
Telenexus Line Terminator	RTLT-1
Telenexus Subscriber Unit	RTSU-1

** Some options cannot be used simultaneously - Contact RITRON for more information. Some options had not yet been assigned item numbers when this manual was printed.*

4.

OPERATION

4.1

GENERAL

The RRX-450 repeater can be powered by an +11 to +15 VDC, or 110/240 VAC source. The repeater includes a battery maintenance charge output, which is used during normal AC operation to maintain the charge on an external +12 VDC battery. The external battery is then ready to use if AC power fails.

The RRX-450 has a standard frequency separation of 5 MHz between transmit and receive channels. Normal repeater operations have 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, to allow inverted-frequency operation if needed.

The transmitter module power output can be adjusted from 1 to 8 Watts, with 5 Watts nominal at the duplexer output (1.8 dB insertion loss in normal mode). An optional amplifier module, the RRA-452, has a typical power output of 20 Watts at the duplexer output. The optional RRA-452 is an enclosed module that fits inside the repeater enclosure.

A time-out timer, a hang-timer and Morse code ID are standard items in the RRX-450, as is CTCSS or DQC tone decode/encode. The use of tone is optional, however, although the repeater microcontroller may be programmed for tone.

This repeater can also locally monitor and transmit via an on-board audio amplifier/key circuit, using the RSM-3X Local Speaker/Microphone.

The RRX-450 is designed to function with several RITRON accessories. For this reason, the RRX-450 main PC board includes a 10-pin accessory connector. Refer to the "RRX-450 Accessory Installation" section in this manual. Note that certain accessories cannot be installed simultaneously in one RRX-450 unit - contact the RITRON Sales or Customer Service Department for details (Ph. 317/846-1201).

Because the RRX-450 includes a transmitter, the repeater **MUST BE LICENSED BEFORE USE**. Your RITRON Dealer can help you obtain an FCC license.

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 a 110 VAC outlet. Make sure that the AC voltage selector (rear panel) is set for the appropriate AC source (110 or 240 VAC). When the red "Power" LED on the front panel lights, the repeater is fully automatic and ready for operation.

All internal adjustments have been factory set. A signal on the repeater receive frequency activates the repeater transmitter, as indicated by the red "Status" LED lighting.

In addition to the standard repeater operation described above, the RRX-450 may be used with an RP-200 autopatch or Telenexus system to provide interconnection with the Public Switched Telephone Network.

The RRX-450 repeater includes these features:

Back-up Battery Charger

External Auxiliary Repeater Controller Connector

Internal CTCSS or DQC Capability

Modular Design For Quick Field Repairs and RF Isolation

Rack Mount Enclosure For Professional Installations

User Programmable Functions

4.2

TONE SIGNALING

The repeater's internal microcontroller may be programmed with CTCSS (Quiet Call) or DQC (Digital Quiet Call) to access the repeater. CTCSS and DQC cannot be used simultaneously. The standard RRX-450 may be operated with one CTCSS tone or two DQC codes.

Additionally, the repeater may be operated to accommodate separate groups of users, each group with its own CTCSS access tone. This is possible because the main PC board includes ports for up to three optional RTS-6P CTCSS tone modules. The optional tone module(s) perform decode operations only. The microcontroller does all encode functions.

NOTE: *In a multiple tone system, if the RP-200 is captured, 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 RTL end set to .5 seconds (9216), and the hangtime in the RTSU end set to 0 seconds (9200).*

5. PROGRAMMING THE REPEATER

5.1 WHAT CAN BE PROGRAMMED

The RRX-450 repeater may be programmed with a transmit frequency, receive frequency, Quiet Call (CTCSS), Digital Quiet Call (DQC) and special features. Additionally, the repeater's internal microcontroller must be programmed for use with certain accessories. For example, the microcontroller must be programmed with a CTCSS/DQC tone(s) in order to access a 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 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

There are two ways to program the RRX-450 repeater. The first method uses a PC compatible computer and the appropriate Ritron programming software kit, which includes a cable that must be connected between a computer serial port and the repeater front panel 3.5 mm jack. The software provides on-screen instructions for programming the repeater.

The second way uses a remote speaker/microphone (model RSM-3X) Push-To-Talk switch. The remote microphone plugs into the repeater front panel. All data is programmed by pressing and releasing the remote PTT. (Refer to the PTT programming explanation on the following pages.)

5.3 SETUP FOR PROGRAMMING USING THE REMOTE PTT

- 1) Remove AC and DC power from the repeater.
- 2) Insert the remote speaker/microphone (model RSM-3X) plug into the two repeater front panel jacks marked "TEST MIC."
- 3) A small black plastic plug is located to the right of these jacks. Remove this plug to uncover an access hole in the front panel.
- 4) Using a pointed tool, press and hold the programming button found behind this hole.
- 5) Apply power, then release the button.

The repeater will sound a 1 sec. tone to confirm that it is in *PROGRAMMING MODE*.

5.4 RETURNING TO NORMAL OPERATION

AFTER YOU FINISH PROGRAMMING, follow the steps below:

- 1) Remove power (AC and/or DC) from the repeater.
- 2) Reconnect power to resume normal operation.

page 8 The repeater is now in *OPERATING MODE*.

5.5 PROGRAMMING NEW CHANNEL CONTENTS USING THE REMOTE PTT

Channel contents are radio frequencies, tones and special features stored in the repeater's EEPROM.

Channel contents are programmed one digit at a time, by pressing and releasing the remote speaker/microphone Push-To-Talk button (RITRON model RSM-3X) a number of times equal to the digit's value. A pause of more than about one second causes the repeater's microcontroller to immediately accept the digit as complete. The unit then sounds a "ready" tone prompt.

Channel contents are stored by pressing and releasing the programming switch (repeater main PC board) after all contents have been programmed. When this button is pressed to save valid data, the repeater sounds a tone.

5.5.1 GUIDELINES

- Follow the setup and RETURNING TO NORMAL OPERATION instructions.
- The repeater will not operate on frequencies outside of the 450-470 MHz band (although the unit will allow you to program frequencies in the wrong band).
- While entering a digit, DO NOT pause after releasing the PTT. A pause tells the microcontroller that you are finished entering the digit.
- To enter the digit "0," press the PTT ten times.
- YOU MUST ENTER ALL RADIO FREQUENCIES AS SIX DIGITS. You cannot skip zero ("0") digits. For instance, you must enter a zero for each of the last two digits in 464.500 MHz.

For 12.5 KHz offset channels (7-digit frequencies), enter only the first six digits.

When modifying tones in a multiple tone application, it is strongly suggested that you start by using the 84 PTT code (DELETE ALL CODES) and then add the appropriate codes, one at a time. For CTCSS, make sure the RTS-6P's are set to higher tones than your lowest tone. The lowest tone is handled by the on-board decoder of the RRX in a multiple tone configuration. Also make sure the additional tones are installed in ascending order starting with J407 and the portables are programmed for tone dropout. (QC decode)

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 DOESN'T change the PTT tone (the code encoded when using the hand-mic). You must use 91XX to set the PTT tone!

5.5.2

ENTRY MISTAKES

If you press the PTT seven times when you intended six, for example, or just lose count, do not press the programming button to store channel contents. Continue pressing the PTT until three beeps sound. Then you can start over.

INVALID ENTRIES

If the repeater sounds 3 tones followed by a long tone after you press the programming button to store an entry, the entry was not valid. No programming changes are made. You are still in Programming mode however. Attempting to save seven digits for a radio frequency, for instance, will not work (remember that all radio frequencies are entered as six digits). The tables on the next page gives valid entries.

5.5.3

VALID PROGRAMMING ENTRIES

THE TABLE BELOW LISTS VALID PROGRAMMING ENTRIES. Check the tables. The example column reflects only a few of the radio frequencies and codes available.

The radio's microcontroller counts the number of digits in an entry to determine what you are programming. The first table shows how the repeater microcontroller interprets the number of digits in an entry.

Exceptions to this rule appear in the special features table below. The microcontroller interprets your entry based on the first two or three digits you enter. (The "X"s in the table represent a code or number of your choice.)

<u>NUMBER OF DIGITS</u>	<u>INTERPRETATION</u>	<u>EXAMPLE</u>
2	QC (Quiet Call)	12
3	QC Decode Only	129
3	DQC (Digital Quiet Call)	071
4	DQC Decode Only	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
8	TX/RX Frequency and QC	46470012
9	TX/RX Frequency and QC Decode Only	464700129
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	464700469700
14	TX Frequency, RX Frequency and QC	46470046970012
15	TX Frequency, RX Frequency and QC Decode Only	464700469700129
15	TX Frequency, RX Frequency and DQC	464700469700071
16	TX Frequency, RX Frequency and DQC Decode Only	4647004697000719
16	TX Frequency, RX Frequency and DQC with Inversion	4647004697000711

<u>ENTRY</u>	<u>INTERPRETATION</u>	<u>EXAMPLE</u>
81XX	Add a QC Code	8112
81XXX	Add a DQC Code	81071
82XX	Delete a QC Code	8212
82XXX	Delete a DQC Code	82071
83	Read Out All Codes	-----
84	Delete All Codes	-----
85XX	Add a RP-200 QC Code	8512
85XXX	Add an RP-200 DQC Code	85071
86XX	Delete a 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 Microcontroller Programmable Encode Tone	9112
92XX	Set Hang Time (00 -99)	9232 (1 Second)
93XX	Set Time Out (00-30)	9303 (3 Minutes)
94X	RWR-10 Installed (0 = not installed, 1 = installed)	941
951	Fan Active on TX	-----
952	Fan on Continuously	-----
96	Turn Off AC Mains Failure Beep	-----
97	Turn On AC Mains Failure Beep	-----

NOTES

- 1) Where "TX/RX Frequency" appears in the interpretation column, the receive frequency is 5 MHz above the TX frequency.
- 2) A "9" added to the end of a QC or DQC entry turns off Quiet Call during transmit. Quiet Call then operates in receive mode only ("decode only").
- 3) A "1" added to the end of a DQC entry inverts the code for receive (RX). A "2" inverts the code for transmit (TX). The examples in the table use the RX inversion.
- 4) If the repeater will be configured for multiple CTCSS tone operation (RTS-6P modules are used), the internal, on-board tone programmed into the repeater must be the lowest tone. The tone(s) programmed for the RTS-6P module(s) must be higher than the "internal" tone.
- 5) In any RRX system containing an RP-200, remember that unless the RP-200 has a CPROM programmed with a timeout, there is NO repeater timeout.

5.6

PC COMPUTER PROGRAMMING KIT

RITRON's programming kit (RPT-PCPK-3.0) allows programming of RRX-450 repeaters with a PC compatible computer.

RITRON's adapter cable connects the radio to a computer's serial communications port. Once the cable is hooked up, the user inserts the diskette provided into his computer's floppy disk drive and loads a software program. This program transfers data between repeater and computer memory, and includes on-screen instructions and help. Radio data may be saved to the computer's hard disk to program other RRX repeaters.

5.6.1

THE RPT-PCPK KIT INCLUDES:

- 1) RITRON RRX Repeater Programmer Software, which is contained on one 3.5" diskette.
- 2) Installation instructions and a registration form.
- 3) RITRON PC to radio adapter cable, which is terminated at one end with a DB-25F connector, at the other end with a modular plug. The DB-25 plugs into the computer's serial port, the modular plug into an adapter for use with RRX repeaters. This adapter mates the modular plug to a 3.5 mm plug, for connection to the repeater's TEST MIC jack.

5.6.2

THE RPT-PCPK KIT REQUIRES:

A PC compatible computer with DOS 3.2 or later. The computer must have a RS-232 serial port available. A hard disk drive is recommended.

5.7

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.

QUIET-CALL CODES AND 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	-	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	IZ	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	2Z	110.9	32	M1	203.5	49	-	206.5
16	2A	114.8	33	-	210.7	50	-	229.1
17	2B	118.8	34	-	218.1	51	-	254.1
						53	-	Custom

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	-	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

<u>SECTION</u>	<u>TOPIC</u>	<u>PAGE</u>
6.	THEORY OF OPERATION	
6.1	Power Supply.	15
6.2	Duplexer.	15
6.3	Receiver.	15
6.4	Transmitter.	17
6.5	Audio Routing (Control Board).	19
6.6	Microcontroller (IC408) Pin Descriptions.	20
6.7	Summary of Microcontroller Pin Descriptions.	23
7.	ALIGNMENT PROCEDURE	
7.1	Recommended Equipment.	24
7.2	Duplexer.	24
7.3	Preliminary.	24
7.4	Power Supply.	25
7.5	Transmitter.	25
7.6	Receiver.	26
7.7	Control and Final Alignment.	27
7.8	Hang Time.	27
7.9	Program Jumper Settings.	27
8.	EXTERNAL CONTROLLER	28
9.	VOLTAGE CHARTS	29
10.	SCHEMATIC TEST POINTS IDENTIFICATION	39
11.	RECEIVER BD SCHEMATIC	41
	RECEIVER BD PARTS PLACEMENT DIAGRAMS	
	Top Side.	43
12.	Bottom Side.	44
13.	RECEIVER BD PARTS LIST	45
14.	TRANSMITTER BD SCHEMATIC	48
15.	TRANSMITTER BD PARTS PLACEMENT DIAGRAMS	
	Top Side.	51
	Bottom Side.	52
16.	TRANSMITTER BD PARTS LIST	53
17.	CONTROL BD SCHEMATIC	57
18.	CONTROL BD PARTS PLACEMENT DIAGRAMS	
	Top Side.	59
	Bottom Side.	60
19.	CONTROL BD PARTS LIST	61

<u>SECTION</u>	<u>TOPIC</u>	<u>PAGE</u>
20.	POWER SUPPLY BD SCHEMATIC.....	64
21.	POWER SUPPLY BD PARTS PLACEMENT DIAGRAMS	
	Top Side.....	65
	Bottom Side.....	66
22.	POWER SUPPLY BD PARTS LIST	67
23.	RRX-450-D4000 (STANDARD) PARTS LIST	68

6.

THEORY OF OPERATION

Please refer to the RRX-450 schematics while reading the description below.

6.1

POWER SUPPLY

The RRX-450 may be powered by either 110/240 VAC or an +11 to +15 VDC external battery. A detachable 3-conductor power cord applies 110 or 240 VAC to the repeater via J307, depending upon the voltage selector setting. The input is fuse-protected by F303. VR301-303 help limit over-voltage transients from the AC power line. T301 transforms the 110 (or 240) VAC source to a 36 VAC center-tapped line, for application to a full-wave rectifier (CR303 and CR304) and filter (C306). Fuse F302 protects the DC power supply output. CR307 (30 Volt Zener) further clamps line voltage. IC301 and associated circuitry can apply up to 700 mA of charge current to the DC backup battery.

IMPORTANT: This circuit is not designed for continuous charge at maximum current, which will cause components to overheat. Do not connect an external battery that is completely discharged. A battery that is well below its normal charge capacity should first be fully charged using a high current, fast charger that can deliver continuous current for the required recharge cycle.

R306, Q302 and Q303 form the charge current limiting circuit. Q301 disables this circuit during transmit. IC302 provides the main supply voltage, controlling pass transistor Q306. Each module contains its own voltage regulation. Supply current limiting is sensed across R323-325 in the ground return path to T301.

The RRX-450 may be powered by an external +11 to 15 VDC source, applied to J301. F301 and CR301 reverse voltage short circuit and overload protect the RRX-450. C317-319 aid in filtering. An optional hash choke (L901) may be added to remove noise, such as alternator whine, from the +12 VDC source.

If AC power fails, Q305 and its associated circuitry immediately disengage the relay, applying the external battery voltage to the repeater instead. This helps to maintain proper supply voltage to any microprocessor-controlled devices that are installed on the repeater. Q304 applies an "AC status" signal to the main processor.

If an optional DC fan is installed, Q307 functions as the fan switch.

6.2

DUPLEXER

The purpose of the duplexer is to allow a single antenna to be used for simultaneous repeater transmission and reception. This is accomplished by combining frequency notch filters into the same structure so that transmitter power is greatly attenuated at the receiver input to prevent receiver overload. Additionally, the RX frequencies are attenuated at the TX output to prevent TX noise on the RX frequency from passing through to the RX input. The duplexer consists of four resonant cavities coupled to a common transmission line, and is referred to as a notch duplexer because of the unique bandpass that it produces.

The RRX-450 is designed to permit the duplexer to be mounted with either the low-pass or the high-pass filter toward the transmitter - to facilitate reverse-frequency operation (inverted mode).

6.3

RECEIVER

The RRX-450's receiver is a fixed tuned Dual-Conversion Superheterodyne with a first Intermediate Frequency (IF) of 21.4 MHz and a second IF of 455 KHz. A multifunction IC provides demodulated output and noise squelch.

6.3.1

VCO/BUFFER AMPLIFIER

Q107, coaxial resonator TL101, varactor CR106 and associated components form the VCO (Voltage Controlled Oscillator), a resonant circuit that oscillates at approximately 450 MHz. C180 sets the voltage at the cathode of CR106, determining the varactor's capacitance, which in turn sets the VCO output frequency.

C180 is adjusted to give +4 Volts at test point 9. TL101 will oscillate at each end of the band (450-470 MHz); However, C180 should be re-adjusted to give +4 volts each time the frequency is changed. +8 VDC is tied to the collector of Q107. C179 and C190 serve as a feedback network. C182 couples the oscillator signal to buffer amplifier Q108. C163 and C165 function as RF bypass capacitors. The amplified signal at Q108's collector is coupled by C166 and applied both to synthesizer controller IC103 pin 8 (via R152 and C171) and to buffer amplifier Q109. The buffered VCO signal at Q109's collector then feeds through C170 and R159 as local oscillator injection into the source of Q102, the receiver 1st mixer.

6.3.2

PRESCALER DIVIDER/SYNTHESIZER CONTROLLER

IC103 contains both a prescaler and synthesizer controller. The prescaler squares and divides the VCO output tied to pin 8 by either 64 or 65, determined by a synthesizer controller logic signal. A logic high instructs the prescaler to divide the VCO frequency by 64, a low by 65. The exact number of times the prescaler is instructed to change divisors is determined by the channel frequency. +5 VDC is supplied to IC103 at pin 4.

IC103 contains a digital phase detector that works as follows - microcontroller IC408 (pin 28) clocks data into IC103's internal buffer (pin 10) in synchronization with clock pulses applied to IC103 pin 9. (Signals from the microcontroller are usually too fast to observe with an oscilloscope.)

Once data is loaded into the buffer, a single pulse from IC408 appears at IC103 pin 11 that instructs the synthesizer controller to latch and execute the data. IC103 utilizes internal circuitry to determine whether the present VCO output frequency is correct by comparing the phase and frequency of the VCO signal (at pin 8) and the 16.0125 MHz reference oscillator (at pin 1). IC103 produces a pulse output signal proportional to the phase difference between the two input signals. If the VCO output frequency is too high, pin 16 pulses high. If the frequency is too low, pin 15 pulses low.

The charge pump (Q105, Q106 and associated components) and loop filter (C173-176, R141-143 and L111) transform the synthesizer controller output into a DC voltage for application to the VCO. The synthesizer system is "locked" when the phase and frequency of the reference and the divided VCO signal are the same.

6.3.3

REFERENCE OSCILLATOR

The 16.0125 MHz reference oscillator connected to IC103 pin 1 is built around crystal Y102, C201, varactor CR107 and tuning capacitor C206. A temperature compensation circuit (R164-168 and CR108) provides the synthesizer controller with a constant 16.0125 MHz reference frequency. A tightly graded reference crystal maintains +/- 2.5 PPM frequency drift over temperature.

6.3.4

CHARGE PUMP/LOOP FILTER

The charge pump, Q105, Q106 and surrounding parts, processes the phase detector (IC103) pulses to yield a signal that the loop filter can smooth into a DC voltage. R136 applies the pulses to Q105. Q105 turns on, applying a voltage "burst" to the loop filter (C173-176, R141-143 and L111) and charging C173-176 one pulse at time toward + 8 Volts. The loop filter provides the DC level at CR106 that governs the VCO frequency.

R137 routes the signal from IC103 pin 16 to Q106. Q106 turns on and discharges C173-176 one pulse at a time, the resulting DC voltage applied to CR106.

6.3.5

RF FILTERS AND AMPLIFIER

The output from the duplexer is applied to a pair of double-tuned RF bandpass filters that are tuned to the desired receive frequency. These filters reject unwanted signals and provide approximately 80 dB of rejection at the image-frequency [F(Rx) - 42.8 MHz]. The first pair consists of C101, L101, C102, C103 and L102. C104 matches the output of the filter to transistor Q101 which provides gain at the receive frequency. The second filter of C109, L104, C110, C111 and L105 further reduces the input bandwidth to approximately 2 MHz.

6.3.6

MIXER CIRCUIT

The RF input signal is applied to the gate of the mixer, Q102, through C112 and a matching network of C113 and L107. A local oscillator signal from R159 drives the source of the FET mixer. Proper mixer biasing is obtained by the current through R106 and is bypassed at 21.4 MHz by C116 and L108. The tuned circuit (L106 and C115) in the drain of Q102 selects the 21.4 MHz output frequency. C114 bypasses the 21.4 MHz signals and C118 bypasses any 450 MHz signals which could be present on the +8 VDC line.

6.3.7

21.4 MHZ CRYSTAL FILTER AND IF AMPLIFIER

The IF filter is a 4-pole Chebyshev (YF101, C121 and YF102), and has a passband width of approximately 15 KHz with less than 1 dB of ripple. R107 matches the output of the crystal filter to the base of Q103 which provides gain at 21.4 MHz. C124 couples the amplified 21.4 MHz signal to the FM Subsystem IC.

6.3.8

FM RECEIVER SUBSYSTEM

This circuit is built around a multifunction integrated circuit, the MC3371D, IC101. It performs the functions of: 2nd Local Oscillator (20.945 MHz), 2nd Mixer, 2nd IF Amplifier, FM Detector and Noise Amplifier.

The 2nd Local Oscillator is controlled by Y101, a 20.945 MHz crystal, and the feedback capacitors of C125 and C126. The difference frequency is 455 KHz.

The 2nd Mixer's inputs are from the 21.4 MHz signal applied to pin 16 and the output of the 2nd Local Oscillator. Mixer output is present at pin 3 where it is applied to the input of the 455 KHz ceramic filter. This filter provides additional rejection of undesired adjacent channels. The output of the ceramic filter is applied to the input of the 2nd IF Amplifier at pin 5. Pin 6 is the decoupled input to the amplifier and pin 7 is the limited IF output.

The frequency modulated signal is detected by an internal quadrature detector whose center frequency is determined by T101. One input to the quadrature detector is internally connected to the signal at pin 7. The other input is the phase-shifted signal from the quadrature coil at pin 8. The demodulated output is present at pin-9 along with a large amount of 910 KHz signal which must be filtered out by R124 and C140.

R117-119, R122, R125, C132, C136 and the internal circuitry of IC101 form an 8 KHz bandpass filter. A voltage doubling positive peak detector (CR102) detects the noise from pin 11. CR101 acts as a temperature compensation network. C135 integrates the detected signal. C137 and R121 filter the signal and apply it to IC104 pin 2. IC104, a comparator with hysteresis, compares the detected level on pin 2 to the voltage set by squelch control R112 on pin 3. R113 and R115 set hysteresis for the comparator.

When the noise on pin 2 equals the voltage set on pin 3, the comparator output activates Q104. The resulting "low" at Q104's collector is applied to IC408 pin 17 on the control board. IC102 and IC105 supply +5 Volts and +8 Volts, respectively.

6.4

TRANSMITTER

6.4.1

VCO/BUFFER AMPLIFIER

Q204, L207, varactor CR204 and associated components form the VCO (Voltage Controlled Oscillator), a resonant circuit that oscillates at approximately 450 MHz. Varying the voltage at the cathode of CR204 changes the varactor's capacitance, which in turn alters the VCO output frequency; for example, when the voltage at CR204 is increased (normally, the charge in C236-239 provides this voltage), CR204's capacitance decreases, which increases the VCO output frequency. +8 VDC is tied to the collector of Q204. C242 and C243 serve as a feedback network. C244 couples the oscillator signal to buffer amplifier Q205. C230 and C232 function as RF bypass capacitors. The amplified signal at Q205's collector is coupled by C246 and applied both to synthesizer controller IC202 pin 8 (via R236 and C247) and to buffer amplifier Q206. The output of Q206 feeds Q213 (through C235 and C248).

6.4.2

PRESCALER DIVIDER/SYNTHESIZER CONTROLLER

IC202 contains both a prescaler and synthesizer controller. The prescaler squares and divides the VCO output tied to pin 8 by either 64 or 65, determined by a synthesizer controller logic signal. A logic high instructs the prescaler to divide the VCO frequency by 64, a low by 65. The exact number of times the prescaler is instructed to change divisors is determined by the channel frequency. +5 VDC is supplied to IC202 at pin 4.

IC202 contains a digital phase detector that works as follows - microcontroller IC408 (pin 28) clocks data into IC202's internal buffer (pin 10) in synchronization with clock pulses applied to IC202 pin 9. (Signals from the microcontroller are usually too fast to observe with an oscilloscope.)

Once all data is loaded into the buffer, a single pulse from IC408 appears at IC202 pin 11 that instructs the synthesizer controller to latch and execute the data. IC202 utilizes internal circuitry to determine whether the present VCO output frequency is correct by comparing the phase and frequency of the VCO signal (at pin 8) and the 16.0125 MHz reference oscillator. IC202 produces a pulse output signal proportional to the phase difference between the two input signals. If the VCO output frequency is too high, pin 16 pulses high. If the frequency is too low, pin 15 pulses low.

The charge pump (Q202, Q203 and associated components) and loop filter (C236-239, R231-233 and L206) transform the synthesizer controller output into a DC voltage for application to the VCO. The synthesizer system is "locked" when the phase and frequency of the reference and the divided VCO signal are the same.

NOTE: In an effort to achieve fast attack times, the TX VCO is always oscillating in standby. To avoid possible close proximity interference with carrier-only radios or radios in monitor mode, the VCO is shifted off frequency by 37.5KHz.

6.4.3

REFERENCE OSCILLATOR

The 16.0125 MHz reference oscillator connected to IC202 pin 1 is built around crystal Y201, C205, varactor CR202 and tuning capacitor C208. A temperature compensation circuit (R201-202, R269, CR201 and variable thermistors R204 and R268) provides the synthesizer controller with a constant 16.0125 MHz reference frequency. A tightly graded crystal maintains +/- 2.5 PPM frequency stability from -30 to +60° C.

6.4.4

OSCILLATOR MODULATION

When the unit is in transmit, TX modulation is passed to the reference oscillator via C202, and to the VCO via R219. R219 routes modulation through C225 and R220 to the cathode of varactor CR203. Because CR203 is coupled to the VCO through C227, modulation causes the VCO frequency to vary. C202 applies modulation to the reference crystal to provide for the addition of any Quiet Call or Digital Quiet Call signals. If modulation was not applied to the reference, QC and DQC encode tones would be distorted as the synthesizer attempted to track them.

6.4.5

CHARGE PUMP/LOOP FILTER

The charge pump, Q202, Q203 and associated components, processes the phase detector (IC202) pulses to yield a signal that the loop filter can smooth into a DC voltage. R215 applies the pulses to Q202, which turns on, applying a voltage "burst" to the loop filter (C236-239, R231-233, L206) and charging C236-239 one pulse at time toward + 8 Volts. The loop filter provides the DC level at CR204 that governs the VCO frequency.

R228 routes the signal from IC202 pin 16 to Q203. Q203 turns on and discharges C236-239 one pulse at a time, the resulting DC voltage applied to CR204.

6.4.6

KEYING

The transmitter is activated when the microcontroller applies a "high" to J202 pin 8.

6.4.7

+V TX SUPPLY

This high activates Q210 and Q211, which form a voltage regulator pass configuration that supplies buffer amplifier Q206 and pre-driver transistor Q213. (The TX ENABLE line controls other circuitry, too, as related in other paragraphs.) The high at J202 pin 8 is routed to Q210, forward biasing the base-emitter junction and causing current to flow from the +8 Volt line to ground through R248, Q210 and R210. The resulting voltage at Q210's collector switches on Q211, which in turn applies TX +V to Q213 (via R238, R239 and L209).

6.4.8

POWER AMPLIFIER

Q213 and associated components further amplify the VCO signal at Q206's collector before feeding it via C257 to the 8 Watt, wide-band RF power amplifier. C258 matches the signal to the base of Q207. The output at Q207's collector is then coupled into the base of Q209.

The output transistor's impedance is matched to 50 Ω by C279 and C280. A low-pass filter (L215-L217 and C274-C277) attenuates residual harmonics of the output frequency below their specified maximums. The low-pass filter output is matched to the duplexer by C277. The transmitter power output may be adjusted by R243, which drives emitter follower Q208 and in turn sets the collector voltage available to Q207. IC201 and IC204 supply +5 and +8 Volts, respectively.

6.5

AUDIO ROUTING (CONTROL BOARD)

Audio from the receiver is applied to IC410A, a buffer amplifier with gain. If the correct conditions (as determined by IC408) are present, analog switch IC401A is turned on and audio is routed through the high-pass filter, which is comprised of IC410B, IC410C and associated circuitry. This high-pass filtered signal and flat audio is present at PJ402. If PJ402 is in the A position, flat audio will appear at the accessory connector, J401. Position B will pass audio with the sub-audible signal removed. In any case, R475 is adjusted to give 2.1 Vp-p at J401 pin 1. This assures the proper audio level for any accessory boards.

The flat audio at IC410A pin 1 is also routed to IC405, for the purpose of extracting the sub-audible signal. IC405A and B form a 6-pole low-pass filter that attenuates frequencies above 250 Hz. IC405C is a limiter that squares the signal that drives Q410, which insures a good square wave input at IC408 pin 11. R468 is adjusted for a 50% duty cycle (CTCSS) as seen at IC408, pin 11. (R468 -10T trim pot on rev D control boards)

With the repeat audio path open (IC401A and C are on), the repeat audio level may be adjusted with R406. The signal is routed to the summing node of IC402B, a summing amplifier. ACC TX audio, Remote TX audio and Ext Microphone audio are all summed at this amplifier, then applied to transmitter modulator IC404A. All ports (with the exception of the repeat audio path) are pre-emphasized. Repeat audio is "non de-emphasized."

IC404, a sixth order Butterworth switched capacitor low-pass filter, accomplishes modulation limiting and filtering. IC404A, with a closed loop gain of 30, drives the input signal into limiting. The maximum transmitted deviation is then set by R426. The final low-pass filtered output is then routed to the transmitter module via IC404C pin 4.

IC408 (pin 5) generates sub-audible encode tones into buffer amplifier IC403A. The output enters a 250 Hz low-pass filter, IC403B. IC408 sets the corner frequency to 250 Hz (IC408 pin 6 in tri-state) or 150 Hz (IC408 pin 6 at ground). This is also the case for the "decode filter," IC405 and IC408 pin 7. R423 sets the amount of tone deviation that is summed with the voice signal and any external sub-audible at the summing node of IC404.

IC402C is the accessory audio amplifier, and IC402D the amplifier for the remote port, J402.

IC406 is a differential input amplifier that provides about 1 W of audio into 8 Ω at J404. Received signals as well as programming and acknowledgment beeps pass through this amplifier.

Q411 and associated circuitry make up the "BEEP" generator, a twin-T oscillator that generates the programming and system beeps at about 900 Hz.

Up to three CTCSS decoders (RTS-6P) can be added by installing them into J407, J408 and J409 and programming the EE PROM (IC409) accordingly. (A total of four CTCSS decoder/encoders are available, since the repeater microcontroller is also programmed with tone decode/encode.)

IC410D provides a very sturdy Vag (Voltage audio ground) for proper op amp biasing. IC501 and IC407 provide the necessary regulated voltages for the audio routing circuitry.

6.6

MICROCONTROLLER (IC408) PIN DESCRIPTIONS

Microprocessor IC408 (MC68HC705C8) controls circuit operation in the RRX-450 repeater.

PIN DESCRIPTION

- | | |
|----|--|
| 1 | RESET (LOW)
To prevent erroneous microcontroller operation when the unit has been on a battery backup for an extended period of time, this pin should be pulled low if and when V+ drops below on-board regulator dropout specifications. Q402 and associated components will disconnect V+ when V+ drops below +9.0 VDC. R435 then pulls pin 1 low. |
| 2 | IRQ (LOW)
This line will go low if either the external TX key line (J401, pin 10), the remote key line (J402, pin 5) or the PTT on the RSM-3X hand microphone are activated. These control signals will override any current operations. If this line goes low (pin 2), the microcontroller will apply a high to the TX enable line (Pin 30). |
| 5 | PA7 CTCSS/DQC ENCODE OUTPUT
If a correct CTCSS or DQC code is detected, either by the internal algorithm or an external RTS-6P decoder/encoder module, the microcontroller will generate the appropriate output signal via this port. |
| 6 | PA6 LPF SLEW CONTROL
Pin 6 will have a tri-stated waveform for CTCSS tones above 141.3 Hz, and a low for CTCSS tones below 141.3 Hz and DQC signals. Pin 6 is tied to IC403 via C410. |
| 7 | PA5 LPF SLEW CONTROL
Pin 7 will have a tri-stated waveform for CTCSS tones above 141.3 Hz, and a low for CTCSS tones below 141.3 Hz and DQC signals. Pin 7 is tied to IC405 via C428. |
| 8 | PA4 REPEAT DISABLE (EXTERNAL KEY TIMEOUT DISABLE)
If this line is low, the microcontroller will allow the transmitter to be keyed as long as the external key line is low. This function is required for accessory board operation. Main audio at IC401 will not be passed unless tone is present and the key line is low. This DOES NOT defeat the timeout function in normal repeater mode (Tone Control). Do not confuse this with previous Ritron Repeaters. |
| 9 | PA3 BEEP OUT
This pin will enable acknowledgment or alerting tones to the local audio amplifier or to the modulator for transmission. These tones will be the general programming mode beeps and battery cutover/AC Mains failure alert beeps. This pin will be high unless the microcontroller is generating beeps. |
| 10 | FAN CONTROL
This pin goes high to turn on the DC Fan. |

<u>PIN</u>	<u>DESCRIPTION</u>
11	PA1 FILTERED CTCSS/DQC INPUT This pin is used to feed filtered CTCSS/DQC to the microcontroller so that decode operations in the software can be performed.
12	PA0 TONE SQUELCH OUT This pin will go high upon CTCSS/DQC decode. The signal is routed to audio gates IC401A and D in order to let audio pass in a normal repeater mode, as well as in a RP-200/multiple tone configuration. (If the "patch" is captured in a multiple tone system, all other tone groups will be locked out until the hang time expires.) The logic high is also inverted by Q401 and applied to any accessory boards via J401 pin 8.
13	PB0 REPEAT AUDIO ENABLE This pin will go high when a CTCSS tone required to access the repeater is decoded. A separate CTCSS tone is required to access an optional RP-200 autopatch accessory. Pin 13 will also go high if an invalid CTCSS tone for the RP-200 (in a multiple tone RP-200 configuration) is received.
14	PB1 AUXILIARY TONE DECODE 1 INPUT An optional RTS-6P module applies a logic signal to this pin. If no tone board will be installed, the repeater's microcontroller must be programmed to ignore this input. If a tone board is installed and the microcontroller is programmed to recognize this, a high at pin 14 indicates a valid decode. (Q502 in the RTS-6P shuts off and pin 19 is pulled up to +5 V by R490.)
15	PB2 AUXILIARY TONE DECODE 2 INPUT A high at this pin occurs when the RTS-6P module decodes a received CTCSS tone.
16	PB3 AUXILIARY TONE DECODE 3 INPUT A high at this pin occurs when the RTS-6P module decodes a received CTCSS tone.
17	CARRIER DETECT A low present at this pin represents the correct carrier frequency being detected.
19	PB5 MONITOR INPUT Without an RWR-10 connected, this line will remain high. The microcontroller ignores this input, unless programmed for operation with a RWR-10. If an RWR-10 is installed, the 10 K Ω pull-up resistor (12 V) in the RWR-10 must be re-moved (R633). A low indicates an on-hook condition. A high means that the handset is off-hook. A high on this pin tells the microcontroller to place a high on pin 12, which turns on the audio gate (IC401) to allow for monitoring RX audio before transmitting.
20	PB6 SYNTHESIZER LOCK DETECT INPUT As long as the synthesizers are locked, this input will remain low.
21	PB7 CTCSS ENCODE INHIBIT INPUT If an external accessory (such as the RP-200) applies a low to this pin, the microcontroller will inhibit sub-audible encode.
22	VSS GROUND
24	PC7 EEPROM CLOCK This pin will toggle in the middle of each bit period sent via the serial data line (pin 28), and clock data to and from the EEPROM.

<u>PIN</u>	<u>DESCRIPTION</u>
25	PC6 TX SYNTHESIZER LATCH Following an operating frequency change, pin 25 will send a single positive pulse to the TX synthesizer to latch the serial data. If this pin is low at power on, the repeater will enter programming mode. Repeater functions will not operate in this mode.
26	PC5 RX SYNTHESIZER LATCH Following an operating frequency change, pin 26 will send a single positive pulse to the RX synthesizer to latch the serial data.
27	PC4 TX/RX SYNTHESIZER CLOCK This pin will toggle in the middle of each bit period sent via the serial data line (pin 28), and clock data to and from the TX and RX synthesizers.
28	PC3 DATA LINE FOR THE TX/RX SYNTHESIZERS AND EEPROM This port provides data in and out from TX/RX synthesizers and EEPROM.
29	PC2 TEMPERATURE SENSE CONTROL (NOT USED)
30	PC1 TX ENABLE/STATUS INDICATOR DRIVER If the microcontroller determines to activate the transmitter, this pin will go high and bring pin 31 (PC0) low. This will provide the transmitter module with the TX enable logic signal and turn on the "red" transmit indicator. A slow green flashing indicates a EEPROM checksum error. A green flashing about every second indicates that a synthesizer is out of lock.
31	PC0 TX INHIBIT INDICATOR DRIVER If a transmit inhibit condition is present (checksum or out of lock condition), pin 30 will go low. Pin 31 will pulse high every second to flash the green inhibit indicator.
32, 33	RDI, TDO RECEIVED, TRANSMITTED SERIAL DATA Pins 32 and 33 link the microcontroller to communications from an external data terminal, or to a PC compatible computer running the custom RFX-450 Programming software. Data is transmitted or received via these pins.
34	PD2 MISO, PIN 35-PD3 MOSI, PIN 36-PD4 SCK AND PIN 37-PD5 SS - NOT USED
39	PD7 AC MAINS STATUS INPUT Pin 39 will be low if the power supply is "on line." If this pin goes high, battery switch-over has occurred. NOTE: On battery backup cutover, if the repeater is transmitting, the transmitter will momentarily un-key, come back up, and a short alert beep will be heard along with the transmitted audio. Then as long as the repeater is on battery, a beep will be heard every 8 seconds during a continuous transmission.
41	TCAP TEMPERATURE SENSE INPUT (NOT USED)
42	OSC2 OSCILLATOR XTAL OUTPUT
43	OSC1 OSCILLATOR XTAL INPUT
44	VDD POSITIVE POWER SUPPLY, +5 VDC

6.7

SUMMARY OF MICROCONTROLLER PIN DESCRIPTIONS

<u>PIN/PORT</u>	<u>PORT TYPE</u>	<u>DESCRIPTION</u>
1 Reset	Fixed	Reset (-)
2 IRQ	Fixed	Transmit Enable Input
3 NC	Fixed	No Connection
4 NC	Fixed	No Connection
5 PA7	I/O	CTCSS/DQC Encode Output
6 PA6	I/O	Low Pass Filter Shift I/O
7 PA5	I/O	Low Pass Filter Shift I/O
8 PA4	I/O	Repeat Disable
9 PA3	I/O	Beep Output
10 PA2	I/O	Fan Enable
11 PA1	I/O	Filtered CTCSS/DQC Input
12 PA0	I/O	Tone Squelch Out
13 PB0	I/O	Repeat Audio Enable
14 PB1	I/O	Auxiliary Tone Decode 1 Input
15 PB2	I/O	Auxiliary Tone Decode 2 Input
16 PB3	I/O	Auxiliary Tone Decode 3 Input
17 PB4	I/O	Carrier Detect
18 NC	Fixed	No Connection
19 PB5	I/O	Monitor Input
20 PB6	I/O	TX/RX Synth Lock Detect Input
21 PB7	I/O	CTCSS Encode Inhibit Input
22 VSS	Fixed	Ground
23 NC	Fixed	No Connection
24 PC7	I/O	EEPROM Clock
25 PC6	I/O	TX Synth Latch/Program Mode Switch Input
26 PC5	I/O	RX Synth Latch
27 PC4	I/O	TX/RX Synth Clock
28 PC3	I/O	Data, TX/RX Synth and EEPROM
29 PC2	I/O	Temperature Sense
30 PC1	I/O	Transmit Enable LED Output
31 PC0	I/O	Out Of Lock/Checksum LED Output
32 PD0/RDI	Fixed	Received Serial Data
33 PD1/TDO	Fixed	Transmitted Serial Data
34 MISO	SPI	Not Used
35 MOSI	SPI	Not Used
36 SCK	SPI	Not Used
37 SS	SPI	Not Used
38 TCMP	Fixed	Not Used
39 PD7	Input Only	AC Mains Status Input
40 NC	Fixed	No Connection
41 TCAP	Fixed	No Connection
42 OSC2	Fixed	Oscillator Xtal Output
43 OSC1	Fixed	Oscillator Xtal Input
44 VDD	Fixed	Positive Supply

7.

ALIGNMENT PROCEDURE

This alignment procedure is correct for these RRX-450 repeater systems:

Standard Repeater
Repeater with Autopatch
Telenexus

7.1

RECOMMENDED TEST EQUIPMENT

- | | |
|--------------------------------------|---|
| 1) FM service monitor (to 470 MHz) | 6) VTVM or DMM |
| 2) Oscilloscope (to 20 MHz) | 7) SINAD measuring device |
| 3) FM deviation meter | 8) RSM-3X remote speaker/microphone |
| 4) RF Wattmeter, 10 Watts full scale | 9) T-10 Torx Driver (<i>for Top & Front panel screws</i>) |
| 5) Frequency counter (to 470 MHz) | 10) Xcelite XST-100 Phillips screwdriver or equivalent |

NOTE: A special "Test Mode" is available to check repeater sensitivity and desense. Just key the TX to lock the synthesizer on frequency, (VCO runs at 37.5KHz below normal frequency during standby) and before the expiration of hang-time, press the front panel programming button. This defeats the tone decode function to allow audio to pass out to the SINADDER. The transmitter will only key by bringing the external key line low. (PTT on the RSM-3X) This test mode only works on a "standard unit" with standard programming. Any type of accessory board, which would invoke the repeat disable function by shorting pins 3 to 4 on the accessory connector, disrupts the test mode operation.

7.2

DUPLEXER

A normal repeater frequency split will have the transmit frequency low and the receive frequency high. The LP end of the duplexer will connect to the transmitter and the HP end will connect to the receiver. By convention, F-low will be the TX frequency and F-high will be the RX frequency in a NORMAL setup. In a Telenexus or any other "RF LINK" system, the inverse of this arrangement will appear at the other end. So, F-low will be the RX frequency and F-high will be the TX frequency in an INVERTED setup.

- 1) Remove the 5 screws that secure the lid of the enclosure.
- 2) Unplug the two RF cables that connect the transmitter and the receiver to the duplexer.
- 3) Connect a UHF signal generator to the antenna connector (UHF) on the RRX-450 rear panel.
- 4) Connect a spectrum analyzer to the duplexer LP cable. Then connect a 50 Ω load to the HP cable.
- 5) Tune the signal generator and spectrum analyzer to the F-high frequency.
- 6) Carefully loosen the locking nuts on the tuning screws of the LP cavities with a 1/4" open-end wrench and tune the notch by turning the screw while watching the analyzer.
- 7) While keeping the locking nut snug, fine-tune one of the LP tuning screws to achieve minimum transmission of the F-high frequency as seen on the analyzer. Repeat this procedure for the other LP screw. The LP side notch should be about -73 dB deep and within 50 KHz of the desired notch.
- 8) Reverse the LP and HP connections and tune the signal generator to the F- low frequency.
- 9) Repeat steps 6) and 7) for the HP side. The HP notch should be about -63 dB deep and within 50 KHz of the desired notch.

7.3

PRELIMINARY

- 1) Insert a RSM-3X remote speaker/microphone into the test microphone jacks on the front of the repeater.
- 2) Remove the hole plug located on the front panel.
- 3) Rotate the power control (R243-TX MODULE) fully counter-clockwise to set the transmit power to 0 W.

- 4) Connect an RF signal generator to the receiver input port (J101).
- 5) Connect a Wattmeter to the transmitter output port (J201).
- 6) Place the RRX-450 in programming mode. (Refer to the PTT Programming Procedure.) Program the TX and RX frequencies as desired.
- 7) Set the internal (ie., microcontroller programmable) CTCSS tone to the desired code.
- 8) Set the PTT code to the same as in step 7. A QC or DQC code may be programmed.
- 9) Read out the data and verify that it is correct.
- 10) Power cycle the unit and proceed.

7.4

POWER SUPPLY

- 1) Adjust R320 for +12.6 VDC at C253, the feed-thru capacitor on the transmit module.
- 2) Adjust R311 for +13.75 VDC at the external battery connector (J301).

7.5

TRANSMITTER

Since the RRX-450 is operated with a single channel, both synthesizer control voltages are set to the same level, approximately +4 VDC. (The normal voltage swing required in multiple channel radios is not necessary.) If a key component is replaced, make sure the control voltage measures +4 VDC (TP-7 on the transmitter board)

- 1) Remove the module and the synthesizer lids from the transmitter.
- 2) Apply power to the repeater.
- 3) Make sure the power control pot (R243) is turned fully counter-clockwise (low power.)
- 4) Re-adjust the control voltage (TP-7) to 4 VDC by tuning L207. The core is potted to reduce microphonics.
- 5) Key the repeater by grounding pin-10 of the control board accessory connector (J401).
- 6) The modulation balance control (R219) may have to be re-adjusted for high quality audio. Set the PTT tone for DQC, key the repeater, and while scoping the de-mod out on a service monitor, adjust R219 for the best square wave.
- 7) Adjust C208 such that the TX frequency is (+200Hz) above center as seen on the frequency counter.
- 8) Slowly adjust R243 fully clockwise and observe the power reading on the Wattmeter.
- 9) Adjust C277, C279 and C280 for maximum power as seen on the Wattmeter (8 W typical @ 2 Amps). Absolute minimum power should be 7 Watts.
- 10) Recheck the center frequency and adjust if necessary.
- 11) Make sure that all spurious and harmonics are down at least 52 dBc.
- 12) Adjust R243 on the control board to produce 600Hz of transmitted sub-audible CTCSS deviation.
- 13) Re-attach the synthesizer lid (bend all tabs) and the module box lid. All mechanical joints must be SOLID!
- 14) Set the voice deviation by keying the RSM-3X microphone while speaking. Adjust R426 (control board) for a 5KHz maximum deviation. (Injecting a 1 V p-p 1KHz signal into J401, Pin-9 or J402, Pin-1 and manually keying the transmitter while adjusting R426 is acceptable.)
- 15) Un-key the transmitter.
- 16) Attach a duplexer TX cable to the transmitter and terminate the duplexer antenna port into a duplex capable service monitor.

7.6

RECEIVER

- 1) Remove the 4 mounting screws securing the RX module to the RRR-450 enclosure. Remove the module box and synthesizer lids. Check and adjust, if necessary, the control voltage at TP-9 so that it measures about +4 VDC using C180. Re-attach the lids and secure by bending all tabs.
- 2) Adjust R112 fully counter-clockwise to open squelch.
- 3) Connect a SINADDER to R431.
- 4) Set the signal generator to the input frequency of the repeater and modulate the signal with a 1 KHz tone set at 3 KHz of deviation. Set the generator level high enough to achieve a SINAD reading. (About -40 dBm.) If completely de-tuned, adjust C102, C103, C110 and C111 for best SINAD, while lowering the generator's output as needed.
- 5) Connect a probe (set to 10 X) to the oscilloscope's AC coupled Y input, and the tone generator output to the DC coupled X input.
- 6) Connect the 10 X probe to IC101 pin 16. Set the oscilloscope for XY mode.
- 7) Modulate the RF generator with a 30 Hz tone at 20 KHz of deviation. Set the generator level high enough to observe the 21.4 MHz IF response on the oscilloscope.
- 8) Tune C102, C103, C110 and C111 for maximum amplitude of the passband. Reduce the generator level as needed to minimize saturation of the RF amplifier and Q101.
- 9) Tune C115 for maximum amplitude and flattest response. DO NOT retune C115 after this adjustment.
- 10) Remove the scope probe from IC101 pin 16.
- 11) Inject a 1 KHz tone at 7.5 KHz deviation and adjust C206 for best SINAD.
- 12) Reduce the deviation to 3 KHz and increase the generator level to full-quieting.
- 13) With the oscilloscope in normal mode, connect the 10 X probe to R431 (control board) and tune T101 for maximum amplitude of the 1 KHz tone. The waveform should be symmetrical and not distorted.
- 14) Re-adjust C102, C103, C110 and C111 for best sensitivity (.2 μ V or better).
- 15) Increase the input signal by 3 dB; then increase the deviation until the SINAD returns to 12 dB. This deviation is the minimum acceptance bandwidth of the receiver. Minimum is +/- 7.5 KHz. Less than 7.5 KHz indicates that the IF was misaligned or that the local oscillator frequency is incorrect.
- 16) Disconnect the RF signal generator from J101 and re-attach the synthesizer and module box lids to the RX unit. Connect a duplexer cable to the receiver.
- 17) Before connecting the duplexer to the signal generator output, make sure the transmitter is disabled or that the generator output port is protected.
- 18) Put the unit in "Test Mode" by keying the transmitter to lock its synthesizer, and inserting a tool between the front panel and the programming button. This allows the unit to drop out of tone mode and allows you to listen to the signal.
- 19) Re-adjust C102, C103, C110 and C111 for best sensitivity. Sensitivity should be better than .32 μ V through the duplexer.
- 20) Bolt the unit back into the enclosure.

- 21) Set the signal generator to give an 12 dB SINAD reading.
- 22) Make sure that R112 (carrier squelch) is fully clockwise and attach a Voltmeter or oscilloscope to J410 (control module) pin 8. It should read +5 VDC.
- 23) Adjust R112 counter-clockwise to the point that pin 8 drops low (0 VDC).
- 24) Decrease the generator level slowly, making sure the squelch closes with at least 2 dB of hysteresis.
- 25) Increase the signal level slowly, making sure the unit unsquelches @ 12 dB SINAD.

7.7

CONTROL AND FINAL ALIGNMENT

- 1) With the transmitter and receiver modules connected to the duplexer, apply a 1 KHz tone at 3 KHz of deviation on the receive input frequency. Make sure there is no sub-audible tone.
- 2) Inject a full quieting 1 KHz signal, 3 KHz deviation, and adjust R475 on the control board to give a 2.1 V p-p signal at J401 pin-1.
- 3) Key the transmitter with the RSM-3X remote speaker/microphone; adjust C277 for a minimum of 5 Watts at the antenna port. (Set R243 fully clockwise for maximum output.)
- 4) With the unit still in "Test Mode", set the generator for 12 dB SINAD. Increase the generator level by 1 dB and key the transmitter with the remote speaker/microphone. The SINAD should remain at 12 dB or better. The following guidelines should be observed when measuring desense:

Normal or inverted split/no amp- <.5 dB
 Normal split with amp- <1.5 dB
 Inverted split with amp- <2 dB

- 5) Take the unit out of "Test Mode".
- 6) Increase the generator level to achieve a full quieting signal, apply sub-audible tone, and adjust R468 (10 turn trim pot on rev D control boards) for 50% duty cycle at IC408, pin 11.
- 7) Adjust R406 (Repeat Audio) for 3.6KHz of transmitting deviation.

7.8

HANG TIME

If the repeater will be used in a Telenex or Leased-Line system, program 0 seconds of hang time (9200). Refer to the Programming section of this manual.

If the repeater will be used with Patriot handhelds and/or a RP-200, program 3 seconds of hang time (9299).

7.9

Program Jumper Settings

Jumper	A	B
PJ401	Normal	Beep Gen Enable
PJ402	Flat Audio	Normal (High Pass)
PJ403	Normal	External Controller
PJ404	Normal	Repeat Disable
PJ407	Normal	Carrier Detect

8. EXTERNAL CONTROLLER INTERFACE SET-UP

8.1

SET-UP

- 8.1.1) Even though the external controller will be taking care of the tone functions, the RRX has to be "tricked" into thinking it has tone or the transmitter will come up on the correct carrier. This is accomplished by doing the following:
- 1) Remove R465 from the control board. This will break the audio path to the on-board tone decoder. Even though the unit will be looking for a specific tone, it will never see it! REV F control boards have a program jumper to do this. (see chart on page 27)
 - 2) Place a jumper between IC401 pins 1 and 11. This will bring discriminator audio out to the controller. The next revision control board (F) has this designed in.
 - 3) Add R903, a 10K, 1/4 Watt resistor. (See R903 on the parts placement.) Future units will have this part standard.
 - 4) Jumper pins 3 and 4 together on J401. This will allow the external device to take control of the RRX-450. REV F control has a program jumper to do this.
 - 5) Set R423 and R406 fully counter-clockwise to set the internal code deviation and the repeat audio to zero.
 - 6) Make the controller connections to J411. (10-Pin polarized header next to RX port... See schematic for pinouts)
 - 7) The audio output level to the controller is adjusted by R475. (RX Audio)

8.2

PROGRAMMING

- 8.2.1) Set any tone (why not use 100Hz?) by key-clicking...8112 or by using the terminal mode method...S6108.
- 8.2.2) Set the PTT tone (the same as the other tone)...9112 or by the terminal mode method...S7EOC.

8.3

ALIGNMENT

- 8.3.1) Adjust all audio levels into and out of the RRX-450 for the proper received and transmitted deviations.

9.

VOLTAGE CHARTS

MEASUREMENT CONDITIONS:

Supply @ +12.6 VDC, Unit in operating mode, Readings taken with repeater programmed.

IMPORTANT: Because the RRX-450 repeater is constructed with grounding "sub-planes," use a system

Ground in the same proximity as the circuit being measured. All readings indicated as GND are true system Ground.

KEY: ALL MEASUREMENTS ARE IN VOLTS DC, UNLESS AS INDICATED BELOW.

GND = GROUND

NC = NOT CONNECTED

DEVICE	PIN	TRANSMITTER BOARD VOLTAGES			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC201	1	5.1	5.1	5.1	+5 V Regulator
	2	0	---	---	
	3	0	---	---	
	4	0	---	---	
	5	0	---	---	
	6	0	---	---	
	7	0	---	---	
IC202	8	12.6	12.6	12.6	UHF Synthesizer
	1	2.5	2.5	2.5	
	2	2.5	2.5	2.5	
	3	5.1	5.1	5.1	
	4	5.1	5.1	5.1	
	5	0.12	0.02	0.12	
	6	0	0	0	
	7	5.1	5.1	5.1	
	8	3.7	3.7	3.7	
	9	0	0	0	
	10	0	0	0	
	11	0	0	0	
	12	5.1	5.1	5.1	
	13	0	0	0	
	14	0	0	0	
IC204	15	7.8	7.8	7.8	+8 V Regulator
	16	0	0	0	
	1	12.6	12.6	12.6	
	2	0	0	0	
	3	7.9	7.9	7.9	

DEVICE	PIN	TRANSMITTER BOARD VOLTAGES			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
Q201	D	7.8	7.8	7.8	Reference Oscillator (Biased @ 0V)
	S	2	2	2	
	G	Clock	---	---	
Q202	E	7.9	7.9	7.9	Charge Source for VCO
	B	7.9	7.9	7.9	
	C	2.8	2.8	2.8	
Q203	E	0	0	0	Charge Drain for VCO
	B	0	0	0	
	C	2.8	2.8	2.8	
Q204	D	6.6	6.6	6.6	VCO Oscillator
	S	2	2	2	
	G	0	0	0	
Q205	E	0	0	0	VCO Buffer Amplifier
	B	0.5	0.5	0.5	
	C	5.5	5.5	5.5	
Q206	E	0	0.2	0	VCO Output Buffer
	B	0	0.7	0	
	C	-0.5	5.5	-0.5	
Q207	E	0	0	0	Driver
	B	0.25	0.01	0.25	
	C	11.6	11.2	11.6	
Q208	E	11.6	11.2	11.6	Power Pass Element (R259 Fully CW)
	B	12.6	12.4	12.6	
	C	12.7	12.5	12.7	
Q209	E	0	0	0	TX Enable Pass Switch
	B	0	0	0	
	C	12.7	12.4	12.7	
Q210	E	0	3	0	TX +V Pass Element
	B	0	3.6	0	
	C	7.9	7.2	7.9	
Q211	E	7.9	7.9	7.9	Twin-T Oscillator
	B	7.9	7.2	7.9	
	C	-0.5	7.8	-0.5	
Q212	E	7.8	7.8	7.8	Pre-driver
	B	6.7	6.7	6.7	
	C	5.3	5.3	5.3	
Q213	E	0	0	0	
	B	0	0.3	0	
	C	0.5	6	0.5	

DEVICE	PIN	RECEIVER BOARD VOLTAGES			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC101	1	4.5	4.5	4.5	IF Subsystem
	2	4	4	4	
	3	3.63	3.63	3.63	
	4	4.1	4.1	4.1	
	5	3.6	3.6	3.6	
	6	3.4	3.4	3.4	
	7	3.3	3.3	3.3	
	8	4.5	4.5	4.5	
	9	1.7	1.7	1.8	
	10	0.63	0.63	0.6	
	11	3.3	3.3	3.2	
	12	0	0	0	
	13	2.3	2.3	1	
	14	0	0	0	
	15	0	0	0	
	16	1.73	1.73	1.73	
IC102	1	5	5	5	+5 V Regulator
	2	0	0	0	
	3	0	0	0	
	4	0	0	0	
	5	0	0	0	
	6	0	0	0	
	7	0	0	0	
IC103	8	12.6	12.6	12.6	UHF Synthesizer
	1	2.2	2.2	2.2	
	2	2.5	2.5	2.5	
	3	-0.13	-0.13	-0.13	
	4	5	5	5	
	5	-0.05	-0.05	-0.05	
	6	0	0	0	
	7	5	5	5	
	8	3.6	3.6	3.6	
	9	0	0	0	
	10	0	0	0	
	11	0	0	0	
	12	5	5	5	
	13	0	0	0	
	14	0	0	0	
	15	7.9	7.9	7.9	
	16	0	0	0	
IC104	1	6.7	6.7	0	
	2	0.3	0.3	1	
	3	1	1	10.83	

DEVICE	PIN	RECEIVER BOARD VOLTAGES			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC104	4	0	0	0	+8 V Regulator
	5	0	0	0	
	6	0	0	0	
	7	0	0	0	
IC105	8	8	8	8	
	1	8	8	8	
	2	0	0	0	
	3	0	0	0	
	4	0	0	0	
	5	0	0	0	
	6	0	0	0	
	7	0	0	0	
Q101	8	12.6	12.6	12.6	
	E	0	0	0	
	B	0.8	0.8	0.8	
	C	6.25	6.25	6.25	
Q102	D	7.35	7.35	7.35	Mixer
	G	0	0	0	
	S	2.8	2.8	2.8	
Q103	E	0	0	0	IF Amplifier
	B	0.7	0.7	0.7	
Q104	C	1	1	1	Carrier Detect Switch
	E	0	0	0	
	B	6.7	6.7	0	
Q105	C	0	0	5	Charge Source for VCO
	E	8	8	8	
	B	8	8	8	
Q106	C	4.2	4.2	4.2	Charge Drain for VCO
	E	0	0	0	
	B	0	0	0	
Q107	C	4.2	4.2	4.2	VCO Oscillator
	D	7	7	7	
	G	0	0	0	
Q108	S	2.3	2.3	2.3	VCO Buffer/Amplifier
	E	0	0	0	
	B	0.5	0.5	0.5	
Q109	C	6.7	6.7	6.7	VCO Output Buffer
	E	0	0	0	
	B	0.32	0.32	0.32	
Q110	C	2.85	2.85	2.85	Reference Oscillator
	D	7.8	7.8	7.8	
	G	2	2	2	
	S	CLOCK	--	--	

DEVICE	PIN	POWER SUPPLY BOARD VOLTAGES			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC301	1	12.9	0	12.9	3 Terminal Adjust Regulator
	2	14.2	1.25	14.2	
	3	26.8	24.8	26.8	
IC302	1	0	0	0	Voltage Regulator
	2	0	0	0	
	3	0	-0.15	0	
	4	7	7	7	
	5	7	7	7	
	6	7	7	7	
	7	0	0	0	
	8	0	0	0	
	9	3	3.5	3	
	10	9.8	9.7	9.8	
	11	26.3	24.3	26.3	
	12	26	24	24	
	13	11.1	11.1	11.1	
	14	0	0	0	
Q301	E	0	0	0	Battery Charge Switch
	B	0	0.6	0	
	C	12.6	0	12.6	
Q302	E	0	0	0	Battery Charge Current Limit Switch
	B	0	0	0	
	C	12.6	0	12.6	
Q303	E	26	24	26	Battery Charge Current Limiter
	B	26	24	26	
	C	0	0	0	
Q304	E	0	0	0	AC Mains Indication Switch
	B	0.7	0.7	0.7	
	C	0	0	0	
Q305	E	0	0	0	Relay Switch
	B	0.7	0.7	0.7	
	C	0.2	0.2	0.2	
Q306	E	26	24	26	Main Pass Element
	B	25.3	23.7	25.3	
	C	12.7	12.7	12.7	
Q307	E	0	0	0	Fan Switch
	B	0	1.4	0	
	C	12.4	0.7	12.4	

DEVICE	PIN	CONTROL BOARD VOLTAGES			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC401	1	4	4	4	Audio Routing Gates
	2	0	4	0	
	3	5	5	5	
	4	5	5	5	
	5	8	8	8	
	6	0	5	0	
	7	0	0	0	
	8	4	4	4	
	9	4	4	4	
	10	4	4	4	
	11	4	4	4	
	12	0	5	0	
	13	0	4.7	0	
	14	8	8	8	
IC402	1	6.75	6.75	6.75	Audio Buffer/Amplifier
	2	0	0	0	
	3	4	4	4	
	4	8	8	8	
	5	4	4	4	
	6	4	4	4	
	7	4	4	4	
	8	4	4	4	
	9	4	4	4	
	10	4	4	4	
	11	0	0	0	
	12	4	4	4	
	13	4	4	4	
	14	4	4	4	
IC403	1	3	3	3	Switched Capacitor
	2	2.3	3	2.3	
	3	2.8	2.8	2.8	
	4	6.8	6.8	6.8	
	5	3	3	3	
	6	8	8	8	
	7	3	3	3	
	8	3.7	3	3.7	
	9	Clock	---	---	
	10	0	0	0	
	11	Clock	---	---	
	12	0	0	0	
	13	4	4	4	
	14	4	4	4	

DEVICE	PIN	CONTROL BOARD VOLTAGES			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC404	1	4	4	4	Switched Capacitor Filter
	2	4	4	4	
	3	3.6	3.6	3.6	
	4	4	4	4	
	5	4	4	4	
	6	8	8	8	
	7	4	4	4	
	8	4	4	4	
	9	Clock	---	---	
	10	0	0	0	
	11	Clock	---	---	
	12	0	0	0	
	13	4	4	4	
	14	4	4	4	
IC405	1	4	4	4	Switched Capacitor Filter
	2	3.9	3.9	3.9	
	3	3.9	3.9	3.9	
	4	3.8	3.5	3.3	
	5	3.8	3.8	3.8	
	6	8	8	8	
	7	4	4	4	
	8	3.9	3.9	3.9	
	9	Clock	---	---	
	10	0	0	0	
	11	Clock	---	---	
	12	0	0	0	
	13	3.8	3.8	3.8	
	14	4	4	4	
IC406	1	1.35	1.35	1.35	Audio Amplifier
	2	0	0	0	
	3	0	0	0	
	4	0	0	0	
	5	6.5	6.4	6.5	
	6	12.6	12.5	12.6	
	7	6.4	6.3	6.4	
	8	1.36	1.36	1.36	
IC407	1	5	5	5	+5 V Regulator
	2	0	0	0	
	3	0	0	0	
	4	0	0	0	
	5	0	0	0	
	6	0	0	0	
	7	0	0	0	
	8	12.6	12.6	12.6	

DEVICE	PIN	CONTROL BOARD VOLTAGES			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC408	1	5	5	5	Microcontroller
	2	5	5	5	
	3	0	0	0	
	4	4.5	4.5	4.5	
	5	5	2.6	5	
	6	0	0	0	
	7	5	5	5	
	8	5	5	5	
	9	5	5	5	
	10	0	5	0	(If fan enabled on TX)
	11	0	2.2	2	
	12	0	4.9	0	
	13	0	5	0	
	14	5	5	5	(No tone installed)
	15	5	5	5	(No tone installed)
	16	5	5	5	(No tone installed)
	17	0	0	5	
	18	0	0	0	
	19	5	5	5	
	20	0	0	0	
	21	5	5	5	
	22	0	0	0	
	23	0	0	0	
	24	0	0	0	
	25	0	0	0	
	26	0	0	0	
	27	0	0	0	
	28	0	0	0	
	29	0	0	0	
	30	0	3.73	0	
	31	0	0.3	0	
	32	5	5	5	
	33	5	5	5	
	34	0	0	0	
	35	0	0	0	
	36	0	0	0	
	37	0	0	0	
	38	0	0	0	
	39	0	0	0	AC Mains
	40	0	0	0	
	41	5	5	5	
	42	2.3	2.3	2.3	
	43	2.5	2.4	2.5	
	44	5	5	5	

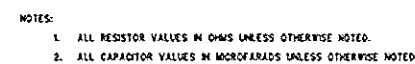
DEVICE	PIN	CONTROL BOARD VOLTAGES			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC409	1	0	0	0	EEPROM
	2	0	0	0	
	3	0	0	0	
	4	0	0	0	
	5	0.09	0.1	0.09	
	6	0	0	0	
	7	0	0	0	
	8	5	5	5	
IC410	1	4	4	4	Conditioning Filters
	2	4	4	4	
	3	4	4	4	
	4	8	8	8	
	5	3.9	3.8	3.9	
	6	4	4	4	
	7	4	4	4	
	8	4	4	4	
	9	4	4	4	
	10	4	4	4	
	11	0	0	0	
	12	4	4	4	
	13	4	4	4	
	14	4	4	4	
Q401	E	0	0	0	Tone Squelch Switch (with correct tone)
	B	4.9	4.9	0	
	C	0	0	0	
Q402	E	5.7	5.7	5.7	Reset Switch
	B	5	5	5	
	C	5.7	5.7	5.7	
Q404	E	5	5	5	Key Switch (upon PTT)
	B	5	4.4	5	
	C	0	5	0	
Q405	E	0	0	0	Key switch (upon PTT)
	B	0	5	0	
	C	5	0	5	
Q408	E	5	5	5	Lock Detect Switch (If locked)
	B	5	5	5	
	C	0	0	0	
Q410	E	0	0	0	QC Decode Switch Square wave biased @ 2.2 VDC Square wave biased @ 2.2 VDC
	B	6 Vp-p	6 Vp-p	6 Vp-p	
	C	5 Vp-p	5 Vp-p	5 Vp-p	

DEVICE	PIN	CONTROL BOARD VOLTAGES			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
Q411	E	0	0	0	Beep Generator
	B	2.5	2.5	2.5	
	C	0.25	0.25	0.25	
Q412	E	5	5	5	Beep Generator Switch "Off"
	B	0	0	0	
	C	0	0	0	

10. SCHEMATIC TEST POINTS (Δ) IDENTIFICATION

SCHEMATIC AND COORDINATES		TEST POINT	DESCRIPTION
CONTROL	D6	$\Delta 71$	+V SUPPLY
	D5	$\Delta 72$	+8V OUTPUT
	D3	$\Delta 74$	SUB-AUDIBLE LPF SHIFT (ENCODE)
	D2	$\Delta 75$	MASTER RESET. Pulling pin 1 to ground causes system reset. Q402 forces this point "low" if the supply falls below about +9 Volts.
	C2	$\Delta 76$	REPEAT DISABLE
	C3	$\Delta 77$	ON-BATTERY BEEP ENABLE
	C2	$\Delta 79$	MONITOR
	C2	$\Delta 80$	LOCK DETECT (RX, TX)
	C2	$\Delta 81$	CTCSS ENCODE INHIBIT
	B4	$\Delta 86$	FLAT RX AUDIO
	A5	$\Delta 89$	RX AUDIO ENABLE
	A4	$\Delta 90$	HIGH-PASS FILTERED AUDIO
TRANSMITTER	D6	$\Delta 1$	TX MODULATION
	C6	$\Delta 2$	+5 VOLT REGULATOR OUTPUT
	C6	$\Delta 3$	SYNTHESIZER CLOCK
	C6	$\Delta 4$	TX DATA
	B6	$\Delta 5$	TX LATCH
	B6	$\Delta 6$	LOCK DETECT
	C4	$\Delta 7$	CONTROL VOLTAGE
	D4	$\Delta 8$	BESSEL GENERATOR SUPPLY
	D3	$\Delta 9$	BESSEL GENERATOR OUTPUT
	D3	$\Delta 10$	GROUND
	D2	$\Delta 11$	+V SUPPLY
	C2	$\Delta 13$	TX ENABLE
	D2	$\Delta 14$	TX +V
RECEIVER	B6	$\Delta 1$	+5 V REGULATOR OUTPUT

SCHEMATIC AND COORDINATES		TEST POINT	DESCRIPTION
RECEIVER	B5	$\Delta 2$	LOCK DETECT
	B5	$\Delta 3$	SYNTHESIZER CLOCK
	B5	$\Delta 4$	DATA
	B5	$\Delta 5$	LATCH
	B5	$\Delta 6$	GROUND
	A5	$\Delta 7$	+12 V SUPPLY
	A5	$\Delta 8$	+8 V REGULATOR OUTPUT
	B4	$\Delta 9$	VCO CONTROL VOLTAGE
	D3	$\Delta 10$	21.4 MHZ BANDPASS RESPONSE
	C2	$\Delta 11$	RX AUDIO
	D1	$\Delta 12$	SQUELCH OUT
	D1	$\Delta 13$	IF SUPPLY
POWER SUPPLY	--	$\Delta 1$	FUSE (F301)
	--	$\Delta 2$	EXTERNAL BATTERY
	--	$\Delta 3$	EXTERNAL BATTERY
	--	$\Delta 4$	BATTERY CHARGE DISABLE
	--	$\Delta 5$	CHARGE VOLTAGE OUTPUT
	--	$\Delta 6$	REG +12.6 V SUPPLY
	--	$\Delta 7$	BATTERY CHARGE CONTROL
	--	$\Delta 8$	FILTERED +V SUPPLY
	--	$\Delta 9$	AC MAINS STATUS
	--	$\Delta 10$	TRANSFORMER CENTER-TAP
	--	$\Delta 11$	RELAY CONTROL
	--	$\Delta 12$	SUPPLY INPUT/F302
	--	$\Delta 13$	FAN ENABLE CONTROL
	--	$\Delta 14$	FAN SWITCH

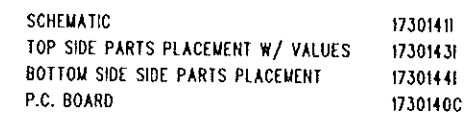


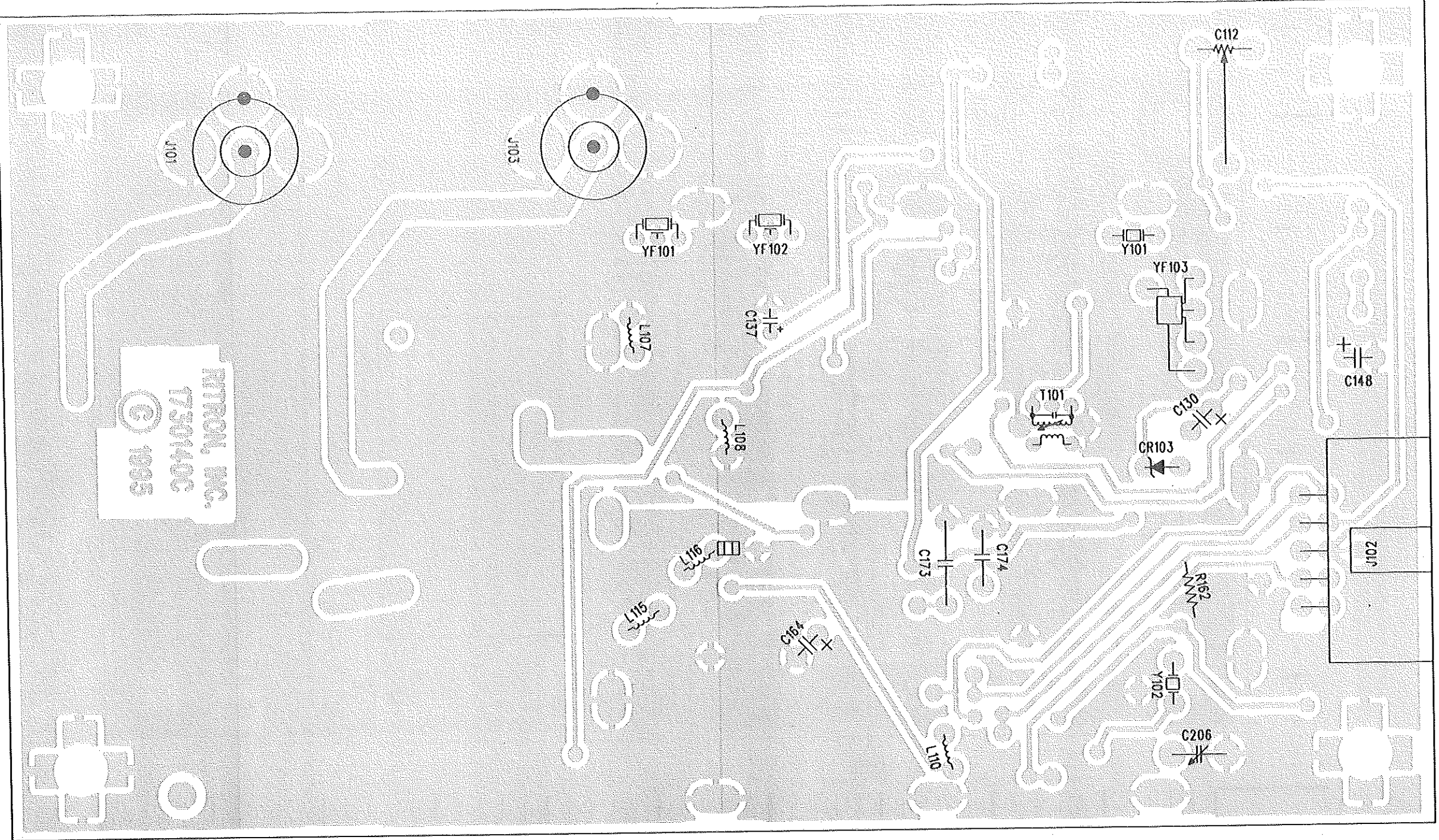
LIST NUMBER USED		NUMBERS NOT USED		
C107	C110	R123	C129	C130
C109	R123	R126	C143	C145
J105	T101	R127	C144	J103
F03	F102	R128	C145	L109
L116	YF103	R129	C148	L112
		R130	C153	Z104
		R131	C156	
		R135	C158	
		P154-R158		
		R161		

P.C. BOARD
TOP SIDE PARTS PLACEMENT /W REF.DES
TOP SIDE PARTS PLACEMENT /W VALUES
BOTTOM SIDE PARTS PLACEMENT

1730140C
1730142H
1730145H
1730144H

REV		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NO.		RITRON, INC.			
EOD		TOLERANCES ARE: FRACTIONS DECIMALS ANGLES	APPROVALS	DATE	505 W. CARMEL DR. CARMEL, N. 46032			
DATE		MATERIAL	DRAWN	RON W.	05/28/86			
		FMSH	CHECKED		SIZE	FSCM NO.	CWG NO.	REV.
			ISSUED		0		17301411	1
		DO NOT SCALE DRAWING			SCALE	30161215108	SHEET	1 of 1





RRX-450 RECEIVER
 BOTTOM SIDE PARTS PLACEMENT

17301441

RITRON, INC.

05/29/96

LAST ECN #2354

SCHEMATIC	17301411
TOP SIDE PARTS PLACEMENT W/ REF.DES.	17301421
TOP SIDE PARTS PLACEMENT W/ VALUES	17301431
P.C. BOARD	1730140C

13. RRX-450 RECEIVER SCHEMATIC REF. PARTS LIST

Ref: ECN - 2354

NOTE: This parts list reflects the most current component values. If a component value given in the schematic differs from that in the parts list, the parts list should be considered most current.

In the coordinates column below, the first number is the "X" coordinate, the second number the "Y" coordinate. A "B" at the end of the "Y" coordinate indicates the PC board bottom side. A "T" means top side.

REF#	RITRON#	DESCRIPTION	COORDINATES		REF#	RITRON#	DESCRIPTION	COORDINATES	
CAPACITORS, CHIP, 50V, UNLESS STATED OTHERWISE					C 155	15121104	.1MF X7R 1206 50V	1.152	1.290 T
					C 156	152C8106	10MFD 16V 6.0X3.2	1.046	1.249 T
					C 157	15111102	.001MF X7R 0805 50	0.419	1.238 T
C 101	1508001L	.68pF P100 .25pF	4.881	1.541 T	C 158	15111102	.001MF X7R 0805 50	0.300	1.663 T
C 102	01550004	0.5/3pf VARCER CAP			C 159	15111102	.001MF X7R 0805 50	0.423	1.640 T
C 103	01550004	0.5/3pf VARCER CAP			C 161	15110101	100PF NPO 0805 50V	1.854	1.185 T
C 104	1510004L	1.2PF NPO .25PF .1	4.051	1.541 T	C 162	15121104	.1MF X7R 1206 50V	2.060	1.186 T
C 105	152A8105	1MFD 16V ~3.2 X 1.	3.979	0.458 T	C 163	15110101	100PF NPO 0805 50V	2.140	1.086 T
C 106	15110330	33PF NPO 0805 50V	3.964	0.888 T	C 164	01503110	100uf ELT CAP 10V	2.098	0.913 T
C 107	15110180	18PF NPO 0805 50V	3.805	0.378 T	C 165	15110101	100PF NPO 0805 50V	2.554	1.001 T
C 108	15110330	33PF NPO 0805 50V	2.943	0.402 T	C 166	151108A2	8.2PF NPO 0805 50V	2.739	1.100 T
C 109	1508001L	.68PF P100 .25PF .	2.904	1.430 T	C 167	152C8106	10MFD 16V 6.0X3.2	1.796	1.308 T
C 110	01550004	0.5/3pf VARCER CAP			C 168	15121104	.1MF X7R 1206 50V	1.971	1.185 T
C 111	01550004	0.5/3pf VARCER CAP			C 169	15110101	100PF NPO 0805 50V	2.352	1.229 T
C 112	1508001L	.68PF P100 .25PF .	3.734	1.430 T	C 170	151102A2	2.2PF NPO 0805 50V	2.457	1.336 T
C 113	151104A7	4.7PF 0805 50V CHI	2.690	1.730 T	C 171	15110100	10PF NPO 0805 50V	2.475	1.108 T
C 114	15111103	.01MF X7R 0805 50V	2.338	2.056 T	C 172	151105A6	5.6PF NPO 0805 50V	2.180	1.301 T
C 115	15400002	CAPACITOR, 6.5-30p	2.530	2.060 T	C 173	01501071	.22uf MLPOLY CAP 5	1.597	1.199 T
C 116	15111103	.01MF X7R 0805 50V	2.530	1.725 T	C 174	01501070	.022uf MLPOLY CAP	1.463	1.217 T
C 117	151101A8	1.8PF NPO 0805 50V	2.688	2.231 T	C 175	15111102	.001MF X7R 0805 50	1.686	0.753 T
C 118	15110330	33PF NPO 0805 50V	2.338	2.148 T	C 176	15111102	.001MF X7R 0805 50	1.817	0.774 T
C 119	15111103	.01MF X7R 0805 50V	1.225	2.388 T	C 177	151104A7	4.7PF 0805 50V CHI	2.093	0.736 T
C 120	15110330	33PF NPO 0805 50V	1.305	2.387 T	C 178	151108A2	8.2PF NPO 0805 50V	2.229	0.788 T
C 121	151106A8	6.8PF NPO 0805 50V	2.414	2.344 T	C 179	151104A7	4.7PF 0805 50V CHI	2.429	0.640 T
C 122	15110470	47PF NPO 0805 50V	1.501	2.381 T	C 180	15400001	3-10PF CERAMIC TRI	2.654	0.501 T
C 123	15121104	.1MF X7R 1206 50V	1.338	2.227 T	C 181	15110101	100PF NPO 0805 50V	2.683	0.719 T
C 124	15111102	.001MF X7R 0805 50	1.470	2.251 T	C 182	151100A5	.5pf NPO 0805 50V	2.372	0.931 T
C 125	15110390	39PF NPO 0805 50V	1.135	2.387 T	C 185	15121104	.1MF X7R 1206 50V	2.238	2.891 T
C 126	15110101	100PF NPO 0805 50V	0.701	2.348 T	C 186	15111103	.01MF X7R 0805 50V	1.785	2.910 T
C 127	15121104	.1MF X7R 1206 50V	0.841	1.722 T	C 187	15121104	.1MF X7R 1206 50V	1.397	1.565 T
C 128	15121104	.1MF X7R 1206 50V	0.930	1.723 T	C 189	152C8106	10MFD 16V 6.0X3.2	1.662	2.860 T
C 129	15110330	33PF NPO 0805 50V	1.013	1.530 T	C 190	151105A6	5.6PF NPO 0805 50V	2.453	0.769 T
C 130	01503110	100uf ELT CAP 10V	0.670	1.704 T	C 191	15110120	12PF NPO 0805 50V	2.460	0.466 T
C 131	15121104	.1MF X7R 1206 50V	1.909	1.792 T	C 192	15110100	10PF NPO 0805 50V	2.450	1.670 T
C 132	15111102	.001MF X7R 0805 50	1.534	1.883 T	C 193	15110101	100PF NPO 0805 50V	0.419	1.367 T
C 133	15121104	.1MF X7R 1206 50V	1.496	2.098 T	C 194	15110101	100PF NPO 0805 50V	0.390	1.537 T
C 134	15110330	33PF NPO 0805 50V	1.644	2.098 T	C 195	15121104	.1MF X7R 1206 50V	2.435	2.231 T
C 135	15121104	.1MF X7R 1206 50V	2.008	2.211 T	C 196	15110101	100PF NPO 0805 50V	2.009	1.766 T
C 136	15111102	.001MF X7R 0805 50	1.352	1.973 T	C 197	15110221	220pf NPO 0805 50V	1.869	1.920 T
C 137	01502003	.22uf TANT CAP 35V	2.216	2.075 T	C 198	15110221	220pf NPO 0805 50V	1.870	2.153 T
C 138	15110330	33PF NPO 0805 50V	1.636	1.689 T	C 199	15110101	100PF NPO 0805 50V	0.769	2.587 T
C 140	15111103	.01MF X7R 0805 50V	1.675	1.560 T	C 200	15110101	100PF NPO 0805 50V	1.832	2.628 T
C 141	15110330	33PF NPO 0805 50V	0.831	2.875 T	C 201	1511Q331	330PF 0805 N750 50	0.651	0.926 T
C 142	15121104	.1MF X7R 1206 50V	0.274	2.499 T	C 202	15110390	39PF NPO 0805 50V	0.960	0.485 T
C 147	15111102	.001MF X7R 0805 50	0.098	2.199 T	C 203	15111103	.01MF X7R 0805 50V	1.017	0.736 T
C 148	01503110	100uf ELT CAP 10V	0.106	1.917 T	C 204	15121104	.1MF X7R 1206 50V	0.985	0.823 T
C 149	15121104	.1MF X7R 1206 50V	0.393	1.988 T	C 205	15110360	36pf NPO 0805 50V		
C 150	15110101	100PF NPO 0805 50V	0.411	0.635 T	C 206	01550021	2-10pf VARCER CAP	0.695	0.508 T
C 151	15111103	.01MF X7R 0805 50V	1.198	0.431 T	C 207	15110101	100PF NPO 0805 50V	1.064	0.441 T
C 152	15111103	.01MF X7R 0805 50V	1.630	0.673 T					
C 153	15110101	100PF NPO 0805 50V	0.850	1.313 T					
C 154	15121104	.1MF X7R 1206 50V	0.720	1.336 T					

REF# RITRON# DESCRIPTION COORDINATES**DIODES, SOT-23, UNLESS STATED OTHERWISE**

CR101	48A1005C	MMBD7000 DUAL DIODE	2.141	1.813 T
CR102	48A1005C	MMBD7000 DUAL DIODE	1.869	2.032 T
CR103	04820007	1N5232 ZENER DIODE	0.878	1.535 T
CR106	48C1004E	MMBV-105G DIODE VVC	1.931	0.769 T
CR107	48C1005L	MMBV609L DIODE VVC	0.615	1.034 T
CR108	48A1005C	MMBD7000 DUAL DIODE	0.699	1.164 T
CR109	48A1005C	MMBD7000 DUAL DIODE	0.617	0.682 T

INTEGRATED CIRCUITS

IC101	31030003	MC3371D SUBSYSTEM I	1.105	2.046 T
IC102	31010002	78L05AC 5V REGULATO	0.291	2.266 T
IC103	31330001	MB1504 UHF SYNTHESI	1.328	0.676 T
IC104	31010005	TLC272 DUAL PKG OP	1.331	2.873 T
IC105	31010009	78L08 8V VOLT. REG.	1.998	2.875 T

CONNECTORS, PHONO JACK, UNLESS STATED OTHERWISE

J 101	02100091	RIGHT ANGLE PC PHON	4.091	2.897 T
J 102	02100351	HEADER, IDC BOX, 10	0.221	1.428 T

INDUCTORS

L 101	01801008	M 1.75T AIRFSW COIL	.44 aL .4 #16	
L 102	01801008	M 1.75T AIRFSW COIL	.44 aL .4 #16	
L 103	18110151	CHIP INDUCTOR .15uhy	3.844	0.969 T
L 104	01801008	M 1.75T AIRFSW COIL	.44 aL .4 #16	
L 105	01801008	M 1.75T AIRFSW COIL	.44 aL .4 #16	
L 106	18110332	CHIP INDUCTOR 3.3uhy	2.434	1.850 T
L 107	01870951	1.5T AIRFCW COIL	2.713	2.030 T
L 108	01870951	1.5T AIRFCW COIL	2.387	1.663 T
L 110	01870956	6.5T AIRFCW COIL .12 aL		
L 111	18110101	CHIP INDUCTOR 0.1uh	1.820	0.933 T
L 113	18110101	CHIP INDUCTOR 0.1uh	2.270	0.935 T
L 114	18110101	CHIP INDUCTOR 0.1uh	2.555	0.684 T
L 115	01870953	3.5T AIRFCW COIL .	2.687	1.010 T
L 116	01870954	4.5T AIRFCW COIL .	2.484	1.219 T

TRANSISTORS, SOT-23, LO PWR RF, UNLESS STATED OTHERWISE

Q 101	4821007Y	MMBR941LT1 LO POWE	3.844	1.203 T
Q 102	4841006T	MMBFJ310T1 NFET GP	2.610	1.842 T
Q 103	4821003E	MMBT-H10 VHF, SOT-	1.795	2.297 T
Q 104	48010R02	MUN2211T1 W/BIAS R.	0.973	2.908 T
Q 105	4801002A	MMBT3906 "SOT23"	1.330	1.199 T
Q 106	4801001Q	MMBT-5088 "SOT-23"	1.332	1.061 T
Q 107	4841006T	MMBFJ310T1 NFET GP	2.335	0.790 T
Q 108	4821007Y	MMBR941LT1 LO POWER	2.664	0.903 T
Q 109	4821007Y	MMBR941LT1 LO POWER	2.597	1.311 T
Q 110	4841006T	MMBFJ310T1 NFET GP	1.043	0.625 T

REF# RITRON# DESCRIPTION COORDINATES**RESISTORS, CHIP, FIXED, UNLESS STATED OTHERWISE**

R 101	47100123	12K OHM 0805 CHIP R	3.964	1.127 T
R 102	47100222	2.2K OHM 0805 CHIP	3.844	1.314 T
R 103	47100221	220 ohm 0805 CHIP R	3.805	0.457 T
R 104	47100221	220 ohm 0805 CHIP R	2.344	1.973 T
R 105	47100221	220 ohm 0805 CHIP R	1.691	2.376 T
R 106	47100102	1K OHM 0805 CHIP RE	2.530	1.625 T
R 107	47100152	1.5K OHM 0805 CHIP	1.929	2.344 T
R 108	47100182	1.8K OHM 0805 CHIP	1.417	2.384 T
R 109	47100153	15K OHM 0805 CHIP R	1.648	2.257 T
R 110	47100393	39K OHM 0805 CHIP R	1.013	1.750 T
R 111	47100332	3.3K OHM 0805 CHIP	0.585	2.310 T
R 112	04750005	2K OHM TRIM POT; LI	0.571	2.823 T
R 113	47100471	470 OHM 0805 CHIP R	1.066	2.765 T
R 114	47100331	330 OHM 0805 CHIP R	0.357	2.989 T
R 115	47100563	56K OHM 0805 CHIP R	1.105	2.909 T
R 116	47100472	4.7K OHM 0805 CHIP	2.107	1.929 T
R 117	47100394	390K OHM 0805 CHIP	1.764	1.882 T
R 118	47300103	THERMISTOR, 10K SMT	1.655	1.990 T
R 119	47100474	470K OHM 0805 CHIP	1.486	2.003 T
R 120	47100103	10K OHM 0805 CHIP R	2.104	2.207 T
R 121	47100104	100K OHM 0805 CHIP	2.048	2.032 T
R 122	47100821	820 OHM 0805 CHIP R	1.634	1.882 T
R 124	47100222	2.2K OHM 0805 CHIP	1.520	1.725 T
R 125	47100123	12K OHM 0805 CHIP R	1.434	1.884 T
R 132	47100333	33K OHM 0805 CHIP R	1.413	0.432 T
R 133	47100100	10 ohm 0805 CHIP RE	0.931	1.234 T
R 134	47100182	1.8K OHM 0805 CHIP	1.191	1.159 T
R 135	47100102	1K OHM 0805 CHIP RE	1.308	1.312 T
R 136	47100682	6.8K OHM 0805 CHIP	1.129	1.071 T
R 137	47100103	10K OHM 0805 CHIP R	1.146	0.958 T
R 139	47100472	4.7K OHM 0805 CHIP	1.226	0.957 T
R 140	47100102	1K OHM 0805 CHIP RE	1.408	0.943 T
R 141	47100103	10K OHM 0805 CHIP R	1.556	0.970 T
R 142	47100124	120K OHM 0805 CHIP	1.576	0.865 T
R 143	47100104	100K OHM 0805 CHIP	1.696	0.891 T
R 144	47100470	47 OHM 0805 CHIP RE	1.944	0.959 T
R 145	47100330	33 OHM 0805 CHIP RE	2.217	1.086 T
R 146	47100271	270 OHM 0805 CHIP R	2.293	1.086 T
R 147	47100123	12K OHM 0805 CHIP R	2.463	1.001 T
R 148	47100561	560 OHM 0805 CHIP RE	2.554	0.858 T
R 149	47100271	270 OHM 0805 CHIP R	2.683	0.794 T
R 150	47100471	470 OHM 0805 CHIP R	2.177	1.195 T
R 151	47100123	12K OHM 0805 CHIP R	2.714	1.205 T
R 152	47100101	100 OHM 0805 CHIP R	2.633	1.119 T
R 153	47100102	1K OHM 0805 CHIP RE	2.709	1.314 T
R 159	47100101	100 OHM 0805 CHIP R	2.322	1.337 T
R 160	47100563	56K OHM 0805 CHIP R	1.502	1.546 T
R 162	04700139	3.3K OHM 1/4W RE		
R 163	47300103	10K OHM THERMISTOR		
R 164	47100753	RESISTOR, 75K OHM 0805 CHIP		
R 165	47100393	39K OHM 0805 CHIP RES.		
R 166	47100623	62K OHM 0805 CHIP R	0.751	1.040 T
R 167	47300104	THERMISTOR 100K OHM	0.983	0.996 T

REF# RITRON# DESCRIPTION COORDINATES

R 170	47100104	100K OHM 0805 CHIP	0.584	1.316 T
R 171	47100103	10K OHM 0805 CHIP	0.620	0.817 T
R 172	47100102	1K OHM 0805 CHIP RE	0.881	0.492 T
R 173	47100101	100 OHM 0805 CHIP R	0.993	0.917 T

TRANSFORMER

T 101	05600018	455KHZ IF TRANSFORM	1.209	1.689 T
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RESONATOR

TL101	23030575	RESONATOR COAX 575M	2.036	0.545 T
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CRYSTALS

Y 101	02300408	CRYSTAL 20.945MHZ H	0.908	2.365 T
Y 102	02300609	CRYSTAL 16.0125MHZ	0.784	0.763 T

FILTERS

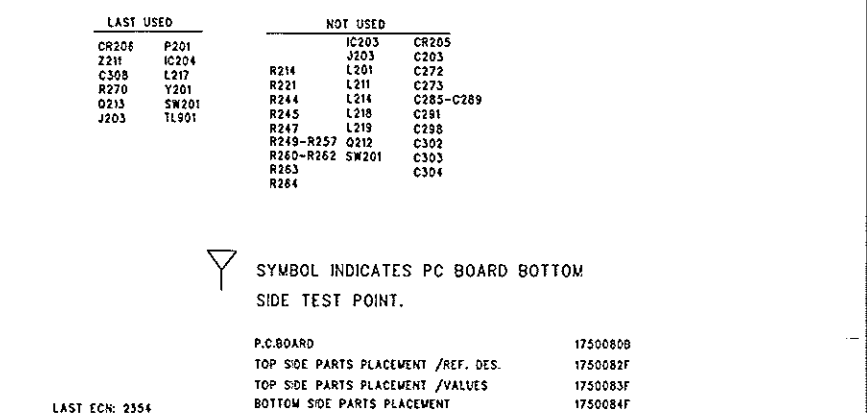
YF101	02301401	21.4MHZ FILTER 7.5KH	2.617	2.375 T
YF102	02301401	21.4MHZ FILTER 7.5KH	2.210	2.384 T
YF103	02301009	455 KHZ FILTER		

FERRITE BEADS

Z 101	18360001	BEAD; FERRITE SUR M	2.081	2.653 T
Z 102	18360001	BEAD; FERRITE SUR M	3.119	0.403 T
Z 103	18360001	BEAD; FERRITE SUR M	1.786	1.068 T

HARDWARE (NOT SHOWN ON SCHEMATIC)

HW 01	02500016	RF SHIELD; UHF HELICAL RESONATOR		
HW 02	02500016	RF SHIELD; UHF HELICAL RESONATOR		
HW 03	02500016	RF SHIELD; UHF HELICAL RESONATOR		
HW 04	02500016	RF SHIELD; UHF HELICAL RESONATOR		
HW 05	02500020	RF SHIELD LID; DR-450		
HW 06	02500020	RF SHIELD LID; DR-450		
HW 07	02800017	STANDOFF; #4-40 X 1/8~ (ROUND)		
HW 08	02800017	STANDOFF; #4-40 X 1/8~ (ROUND)		
HW 09	02800017	STANDOFF; #4-40 X 1/8~ (ROUND)		
HW 10	02800017	STANDOFF; #4-40 X 1/8~ (ROUND)		
HW 11	02800050	SHIELD PLATE .3~ X .8~		
HW 12	02800050	SHIELD PLATE .3~ X .8~		
HW 13	25700100	SHIELD; SYNTHESIZER REV D		
HW 14	25700100	SHIELD; SYNTHESIZER REV D		
HW 15	25101000	SPACER, MALE/FEMALE		
HW 16	25101000	SPACER, MALE/FEMALE		
HW 17	25101000	SPACER, MALE/FEMALE		
HW 18	25101000	SPACER, MALE/FEMALE		
HW 19	02801016	#6-32 X 3/16~ PHIL PHMS		
HW 20	02801016	#6-32 X 3/16~ PHIL PHMS		
HW 21	13403000	ENCLOSURE, TOP, RX,TX,RRX-450		
HW 22	13414000	ENCLOSURE, BOTTOM,RX,TX,RRX-450		
HW 26	25700600	LID; SYNTHESIZER REV E		
HW 27	25701900	SHIELD VCO REV D		
HW 28	25602500	CRYSTAL SUPPORT,UM-1		



NOTES:

1. CAPACITOR VALUES ARE IN μF UNLESS OTHERWISE NOTED.
2. RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE NOTED.

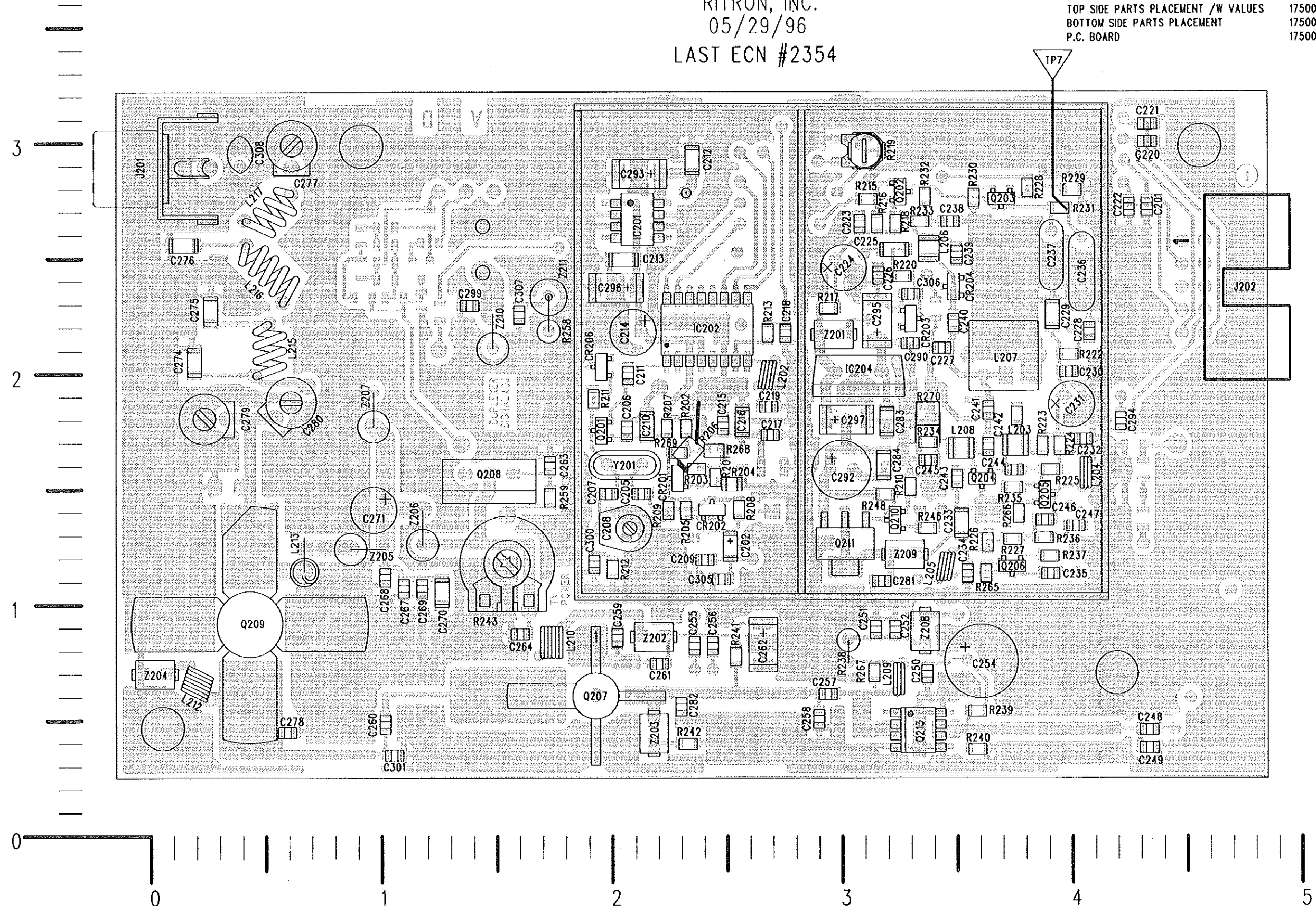
STRIPLINE

REV	ECCO	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES	CONTRACT NO.		RITRON, INC.			
					505 W. CARMEL DR. CARMEL, IN. 46032			
DATE	FINISH	DO NOT SCALE DRAWING	APPROVALS	DATE	DWG. NAME			
			BROWN	05/28/98	RRX-450 REPEATER			
			CHECKED		TRANSMITTER			
			ISSUED		SIZE	FSM NO.	DWG. NO.	REV.
				D	MULTILAYER	1750081F	F	
				SCALE	50081BTF.SCH	SHEET	1 of 1	

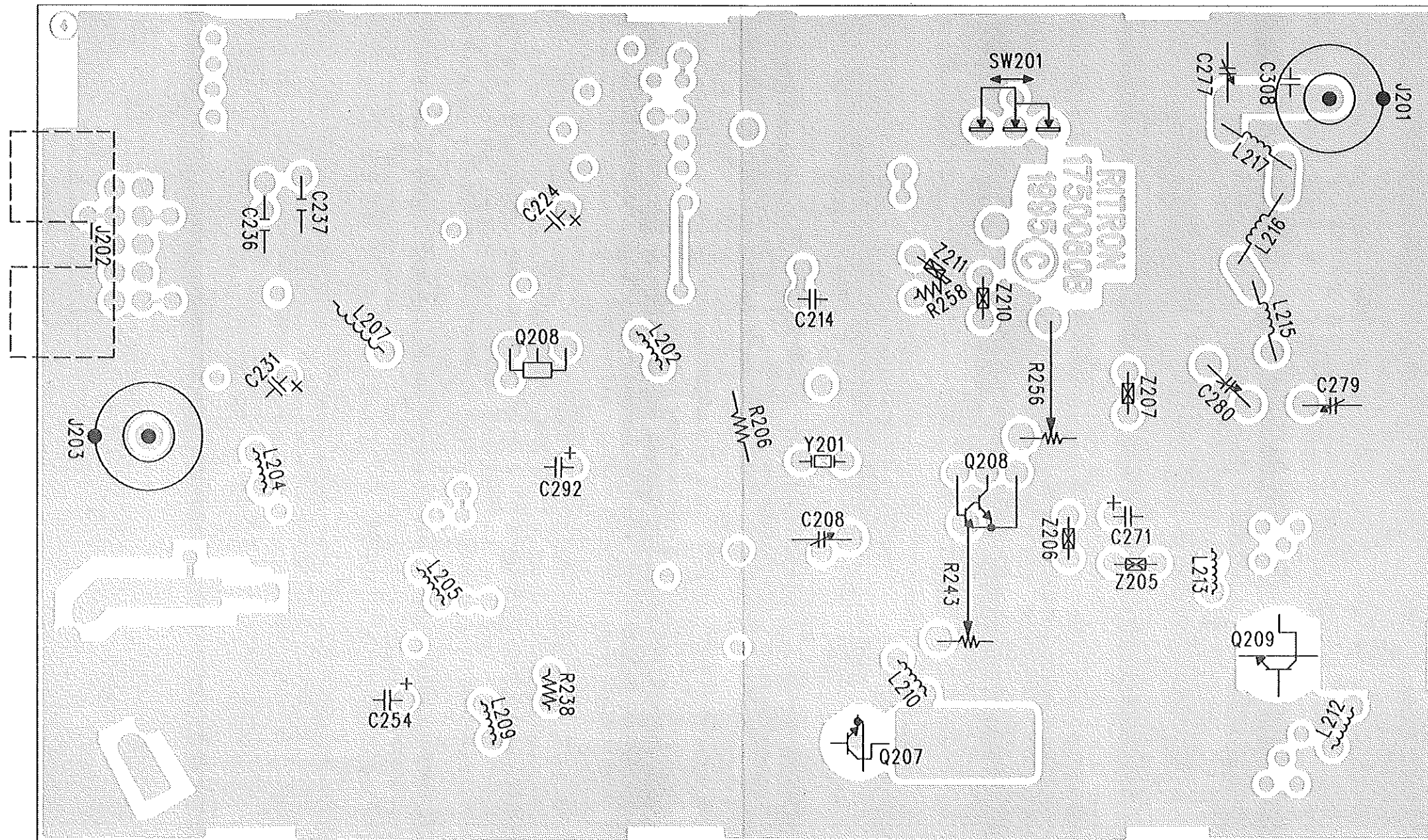
RRX-450 TRANSMITTER
 TOP PARTS PLACEMENT /W RES. DES.
 1750082F
 RITRON, INC.
 05/29/96
 LAST ECN #2354

SCHEMATIC
 TOP SIDE PARTS PLACEMENT /W VALUES
 BOTTOM SIDE PARTS PLACEMENT
 P.C. BOARD

1750081F
 1750083F
 1750084F
 1750080B



RRX-450 TRANSMITTER
 BOTTOM SIDE PARTS PLACEMENT
 1750084F
 RITRON, INC.
 05/29/96
 LAST ECN #2354



SCHEMATIC	1750081F
TOP SIDE PARTS PLACEMENT W/ REF. DES.	1750082F
TOP SIDE PARTS PLACEMENT W/ VALUES	1750083F
P.C. BOARD	1750080B

16. RRX-450 TRANSMITTER SCHEMATIC REF. PARTS LIST

Ref: ECN-2354

NOTE: This parts list reflects the most current component values. If a component value given in the schematic differs from that in the parts list, the parts list should be considered most current.

In the coordinates column below, the first number is the "X" coordinate, the second number the "Y" coordinate. A "B" at the end of the "Y" coordinate indicates the PC board bottom side. A "T" means top side.

REF#	RITRON#	DESCRIPTION	COORDINATES		REF#	RITRON#	DESCRIPTION	COORDINATES	
CAPACITORS, CHIP, FIXED, 50V, UNLESS STATED OTHERWISE					C 251	15110101	100PF NPO 0805 50V	3.143	0.894 T
					C 252	15111102	.001MF X7R 0805 50V	3.227	0.894 T
					C 253	01517502	.001uf FTGER CAP 50V		
C 201	15110390	39PF NPO 0805 50V CHIP	4.323	2.723 T	C 254	01503010	100uf ELT CAP 25V .12~	3.602	0.757 T
C 202	152A6105	1MF 10V ~3.2X1.6~ CHIP	2.511	1.253 T	C 255	15111102	.001MF X7R 0805 50V	2.355	0.823 T
C 204	01517502	.001uf FTGER CAP 50V			C 256	15110101	100PF NPO 0805 50V	2.434	0.823 T
C 205	1511Q331	330PF 0805 N750 50V	2.122	1.481 T	C 257	151105A6	5.6PF NPO 0805 50V	2.935	0.614 T
C 206	15111103	.01MF X7R 0805 50V	2.062	1.758 T	C 258	151106A8	6.8PF NPO 0805 50V	2.896	0.506 T
C 207	15110360	36pf NPO 0805 50V			C 259	15110330	33PF NPO 0805 50V CHIP	2.020	0.859 T
C 208	01550021	2-10pf VARCER CAP 250V	2.056	1.332 T	C 260	151106A8	6.8PF NPO 0805 50V	1.015	0.483 T
C 209	15110390	39PF NPO 0805 50V CHIP	2.399	1.195 T	C 261	15110330	33PF NPO 0805 50V CHIP	2.200	0.747 T
C 210	15121104	.1MF X7R 1206 50V CHIP	2.148	1.775 T	C 262	152C8106	10MFD 16V 6.0X3.2 TANT	2.653	0.828 T
C 211	15110101	100PF NPO 0805 50VCHIP	2.067	1.995 T	C 263	15111102	.001MF X7R 0805 50V	1.729	1.605 T
C 212	15121104	.1MF X7R 1206 50V CHIP	2.346	2.924 T	C 264	15111102	.001MF X7R 0805 50V	1.599	0.874 T
C 213	15121104	.1MF X7R 1206 50V CHIP	2.047	2.495 T	C 265	15110220	22PF NPO 0805 50V CHIP		
C 214	01503110	100uf ELT CAP 10V	2.084	2.181 T	C 266	15110220	22PF NPO 0805 50V CHIP		
C 215	15111102	.001MF X7R 0805 50V	2.480	1.778 T	C 267	15111102	.001MF X7R 0805 50V	1.095	1.071 T
C 216	15121104	.1MF X7R 1206 50V CHIP	2.563	1.793 T	C 268	15110330	33PF NPO 0805 50V CHIP	1.015	1.120 T
C 217	15110101	100PF NPO 0805 50VCHIP	2.685	1.734 T	C 269	15111103	.01MF X7R 0805 50V	1.175	1.071 T
C 218	15111103	.01MF X7R 0805 50VCHIP	2.751	2.176 T	C 270	15121104	.1MF X7R 1206 50V CHIP	1.260	1.053 T
C 219	15111103	.01MF X7R 0805 50VCHIP	2.678	1.858 T	C 271	01503006	10uf ELT CAP 16V .1~	0.965	1.412 T
C 220	15111102	.001MF X7R 0805 50V	4.327	3.004 T	C 274	151241A0	1.0PF NPO 1206 100V	0.189	2.052 T
C 221	15111102	.001MF X7R 0805 50V	4.327	3.080 T	C 275	151243A9	3.9PF NPO 1206 100V	0.259	2.275 T
C 222	15111102	.001MF X7R 0805 50V	4.247	2.723 T	C 276	151243A9	3.9PF NPO 1206 100V	0.141	2.557 T
C 223	15111103	.01MF X7R 0805 50V	3.074	2.650 T	C 277	01550010	1.6-10pf VARTEF CAP	0.611	2.991 T
C 224	01503006	10uf ELT CAP 16V .1~	3.004	2.459 T	C 278	15110150	15PF 0805 NPO 50V CHIP	0.592	0.448 T
C 225	15121104	.1MF X7R 1206 50V CHIP	3.225	2.537 T	C 279	01550010	1.6-10pf VARTEF CAP	0.231	1.807 T
C 226	15110101	100PF NPO 0805 50V	3.155	2.426 T	C 280	01550010	1.6-10pf VARTEF CAP	0.608	1.878 T
C 227	151100A5	.5pf NPO 0805 50V CHIP	3.431	2.113 T	C 281	15111102	.001MF X7R 0805 50V	3.168	1.103 T
C 228	15110101	100PF NPO 0805 50V	4.071	2.186 T	C 282	15110150	15PF 0805 NPO 50V CHIP	2.298	0.559 T
C 229	15121104	.1MF X7R 1206 50V CHIP	3.912	2.257 T	C 283	15121104	.1MF X7R 1206 50V CHIP	3.191	1.794 T
C 230	15110101	100PF NPO 0805 50V	3.984	2.009 T	C 284	15121104	.1MF X7R 1206 50V CHIP	3.177	1.606 T
C 231	01503110	100uf ELT CAP 10V .08~	3.998	1.866 T	C 290	15110330	33PF NPO 0805 50V CHIP	3.293	2.131 T
C 232	15110101	100PF NPO 0805 50V	4.046	1.718 T	C 292	01503211	100uf ELT CAP 16V	2.994	1.585 T
C 233	15121104	.1MF X7R 1206 50V CHIP	3.516	1.355 T	C 293	152C8106	10MFD 16V 6.0X3.2	2.117	2.866 T
C 234	15110101	100PF NPO 0805 50V	3.542	1.137 T	C 294	15111102	.001MF X7R 0805 50V	4.210	1.794 T
C 235	151103A3	3.3pf NPO 0805 CHIP	3.904	1.136 T	C 295	152C8106	10MFD 16V 6.0X3.2 TANT	3.150	2.229 T
C 236	01501071	.22uf MLPOLY CAP 50V	4.039	2.442 T	C 296	152C8106	10MFD 16V 6.0X3.2 TANT	2.015	2.374 T
C 237	01501070	.022uf MLPOLY CAP 50V	3.908	2.514 T	C 297	152C8106	10MFD 16V 6.0X3.2 TANT	3.016	1.801 T
C 238	15111102	.001MF X7R 0805 50V	3.468	2.659 T	C 299	15111102	.001MF X7R 0805 50V	1.381	2.296 T
C 239	15110101	100PF NPO 0805 50V	3.495	2.516 T	C 300	15110360	36pf NPO 0805 50V CHIP	1.920	1.177 T
C 240	151102A2	2.2PF NPO 0805 50V	3.482	2.220 T	C 301	151104A7	4.7PF 0805 50V CHIP	1.054	0.351 T
C 241	151105A6	5.6PF NPO 0805 50V	3.633	1.844 T	C 305	15110101	100PF NPO 0805 50V	2.473	1.112 T
C 242	151103A3	3.3pf NPO 0805 CHIP	3.633	1.684 T	C 306	15110120	12PF NPO 0805 50V CHIP	3.297	2.347 T
C 243	151103A3	3.3pf NPO 0805 CHIP	3.497	1.546 T	C 307	15111102	.001MF X7R 0805 50V	1.596	2.257 T
C 244	151100A5	.5pf NPO 0805 50V CHIP	3.746	1.585 T	C 308	01510004	1.2pf NPO CERDIS CAP	0.387	2.953 T
C 245	15110101	100PF NPO 0805 50V	3.370	1.628 T					
C 246	151103A3	3.3pf NPO 0805 CHIP	3.878	1.368 T					
C 247	15110100	10PF NPO 0805 50V CHIP	4.013	1.343 T					
C 248	15110330	33PF NPO 0805 50V CHIP	4.332	0.460 T					
C 249	151106A8	6.8PF NPO 0805 50V	4.333	0.383 T					
C 250	15110101	100PF NPO 0805 50V	3.367	0.701 T					

page 5

REF# RITRON# DESCRIPTION COORDINATES**DIODES, SOT-23, UNLESS STATED OTHERWISE**

CR201	48A1005C	MMBD7000 DUAL DIODE	2.282	1.549 T
CR202	48C1005L	MMBV609L DIODE VVC	2.431	1.412 T
CR203	48C1004E	MMBV-105G DIODE VVC	3.296	2.238 T
CR204	48C1004E	MMBV-105G DIODE VVC	3.482	2.377 T
CR206	48A1005C	MMBD7000 DUAL DIODE	1.951	2.031 T

INTEGRATED CIRCUITS

IC201	31010002	78L05AC 5V REGULATOR	2.107	2.664 T
IC202	31330001	MB1504 UHF SYNTH	2.410	2.192 T
IC204	03131015	MC78M08CT 8V REG		

JACKS

J 201	02100091	RIGHT ANGLE PC PHONO	0.056	2.892 T
J 202	02100351	HEADER, IDC BOX, 10	4.575	2.172 T

INDUCTORS

L 202	01870953	3.5T AIRFCW COIL .07	2.672	1.996 T
L 203	18110101	CHIP INDUCTOR 0.1uhy	3.751	1.692 T
L 204	01870952	2.5T AIRFCW COIL .05	4.057	1.573 T
L 205	01870953	3.5T AIRFCW COIL .07	3.447	1.165 T
L 206	18110101	CHIP INDUCTOR 0.1uhy	3.375	2.542 T
L 207	01850301	1.5T SHIELDED COIL	3.700	2.079 T
L 208	18110101	CHIP INDUCTOR 0.1uhy	3.515	1.678 T
L 209	01870952	2.5T AIRFCW COIL .05	3.244	0.680 T
L 210	01870955	5.5T AIRFCW COIL .1	1.735	0.840 T
L 212	01870956	6.5T AIRFCW COIL .12	0.200	0.661 T
L 213	01800101	.15 uh PHE FCW COIL	0.665	1.144 T
L 215	01804203	COIL 3.5T #20AWG MAG	0.515	2.217 T
L 216	01804204	4.5T #20AWG MAG WIRE	0.414	2.557 T
L 217	01804203	COIL 3.5T #20AWG MAG	0.611	2.778 T

TRANSISTORS, SOT-23, LO PWR RF, UNLESS STATED OTHERWISE

Q 201	4841006T	MMBFJ310T1 NFET GP	1.951	1.755 T
Q 202	4801002A	MMBT3906 "SOT23"	3.250	2.788 T
Q 203	4801001Q	MMBT-5088 "SOT-23"	3.691	2.758 T
Q 204	4841006T	MMBFJ310T1 NFET GP	3.605	1.546 T
Q 205	4821007Y	MMBR941LT1 LO PR RF	3.878	1.477 T
Q 206	4821007Y	MMBR941LT1 LO PR RF	3.736	1.168 T
Q 207	04801030	MRF-555 NPN RF BIPOLAR	1.926	0.607 T
Q 208	04800023	TIP-122; NPN PWR DARL	1.468	1.565 T
Q 209	04801021	MRF652 UHF RF POWER	0.428	0.918 T
Q 210	4801001Q	MMBT-5088 "SOT-23"	3.226	1.367 T
Q 211	48180001	BCP-69 PNP RF PWR	3.010	1.266 T
Q 213	48220001	MRF-5812 NPN LOW PR	3.327	0.458 T

RESISTORS, CHIP, FIXED, UNLESS STATED OTHERWISE

R 201	47100393	39K OHM 0805 CHIP RES.		
R 202	47100753	75K OHM 0805 CHIP RES.		
R 203	47100332	3.3K OHM 0805 CHIP RES.		
R 204	47300103	THERMISTOR, 10K SMT	2.517	1.523 T

REF# RITRON# DESCRIPTION COORDINATES

R 205	47100104	100K OHM 0805 CHIP RES	2.318	1.410 T
R 206	04750100	10K OHM THERMISTOR		
R 207	47100101	100 OHM 0805 CHIP RES.	2.235	1.764 T
R 208	47100273	27K OHM 0805 CHIP RES.	2.549	1.414 T
R 209	47100224	220K OHM 0805 CHIP RES	2.241	1.410 T
R 210	47100102	1K OHM 0805 CHIP RES	3.294	1.512 T
R 211	47100103	10K OHM 0805 CHIP RES	1.918	1.894 T
R 212	47100102	1K OHM 0805 CHIP RES	2.000	1.154 T
R 213	47100333	33K OHM 0805 CHIP RES	2.674	2.176 T
R 214	47100000	ZERO OHM 0805 CHIP RES	3.757	1.819 T
R 215	47100103	10K OHM 0805 CHIP RES	3.111	2.756 T
R 216	47100272	2.7K OHM 0805 CHIP RES	3.150	2.650 T
R 217	47100102	1K OHM 0805 CHIP RES	2.939	2.283 T
R 218	47100102	1K OHM 0805 CHIP RES	3.229	2.650 T
R 219	47270104	VARIABLE RESISTOR 100K	3.081	2.965 T
R 220	47100102	1K OHM 0805 CHIP RES	3.259	2.422 T
R 222	47100470	47 OHM 0805 CHIP RES	3.983	2.085 T
R 223	47100470	47 OHM 0805 CHIP RES	3.868	1.690 T
R 224	47100101	100 OHM 0805 CHIP RES	3.943	1.690 T
R 225	47100822	8.2K OHM 0805 CHIP RES	3.903	1.586 T
R 226	47100221	220 ohm 0805 CHIP RES	3.630	1.271 T
R 227	47100103	10K OHM 0805 CHIP RES	3.739	1.285 T
R 228	47100103	10K OHM 0805 CHIP RES	3.804	2.806 T
R 229	47100472	4.7K OHM 0805 CHIP RES	3.999	2.795 T
R 230	47100102	1K OHM 0805 CHIP RES	3.570	2.763 T
R 231	47100103	10K OHM 0805 CHIP RES	3.945	2.717 T
R 232	47100103	10K OHM 0805 CHIP RES	3.358	2.768 T
R 233	47100103	10K OHM 0805 CHIP RES	3.335	2.659 T
R 234	47100221	220 ohm 0805 CHIP RES	3.370	1.704 T
R 235	47100102	1K OHM 0805 CHIP RES	3.742	1.508 T
R 236	47100101	100 OHM 0805 CHIP RES	3.876	1.291 T
R 237	47100152	1.5K OHM 0805 CHIP RES	3.901	1.212 T
R 238	04700115	33 OHM 1/4W 5%	3.024	0.848 T
R 239	47100682	6.8K OHM 0805 CHIP RES	3.585	0.541 T
R 240	47100102	1K OHM 0805 CHIP RES	3.587	0.376 T
R 241	47100222	2.2K OHM 0805 CHIP RES	2.535	0.777 T
R 242	47100470	47 OHM 0805 CHIP RES.	2.327	0.399 T
R 243	04750008	10K OHM TRIM POT/HORZ	1.543	1.180 T
R 246	47100103	10K OHM 0805 CHIP RES	3.367	1.331 T
R 248	47100103	10K OHM 0805 CHIP RES	3.185	1.478 T
R 252	47100222	2.2K OHM 0805 CHIP RES	0.912	2.458 T
R 258	04700104	4.7 OHM 5% 1/4W CF	1.724	2.185 T
R 259	47100102	1K OHM 0805 CHIP RES	1.729	1.465 T
R 265	47100180	18 OHM 0805 CHIP RESIS	3.623	1.137 T
R 266	47100180	18 OHM 0805 CHIP RESIS	3.765	1.397 T
R 267	47100221	220 ohm 0805 CHIP RES	3.136	0.708 T
R 268	47300104	THERMISTOR 100K OHM	2.440	1.668 T
R 269	47100623	62K OHM 0805 CHIP RES	2.285	1.659 T
R 270	04750101	THERMISTOR; 200 OHM		

REF# RITRON# DESCRIPTION COORDINATES**CRYSTALS**

Y 201	02300609	CRYSTAL 16.0125MHZ	2.052	1.606 T
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FERRITE BEADS

Z 201	18360001	BEAD; FERRITE S MOUNT	2.961	2.170 T
Z 202	18360001	BEAD; FERRITE S MOUNT	2.177	0.862 T
Z 203	18360001	BEAD; FERRITE S MOUNT	2.177	0.445 T
Z 204	18360001	BEAD; FERRITE S MOUNT	0.017	0.701 T
Z 205	01801029	FAIR-RITE BEAD AXL	0.865	1.243 T
Z 206	01801029	FAIR-RITE BEAD AXL	1.176	1.261 T
Z 207	01801029	FAIR-RITE BEAD AXL	0.965	1.773 T
Z 208	18360001	BEAD; FERRITE S MOUNT	3.357	0.887 T
Z 209	18360001	BEAD; FERRITE S MOUNT	3.269	1.218 T
Z 210	01801029	FAIR-RITE BEAD AXL	1.481	2.110 T
Z 211	01801003	BEAD FR-RT 2643000301	1.724	2.334 T

PLUGS

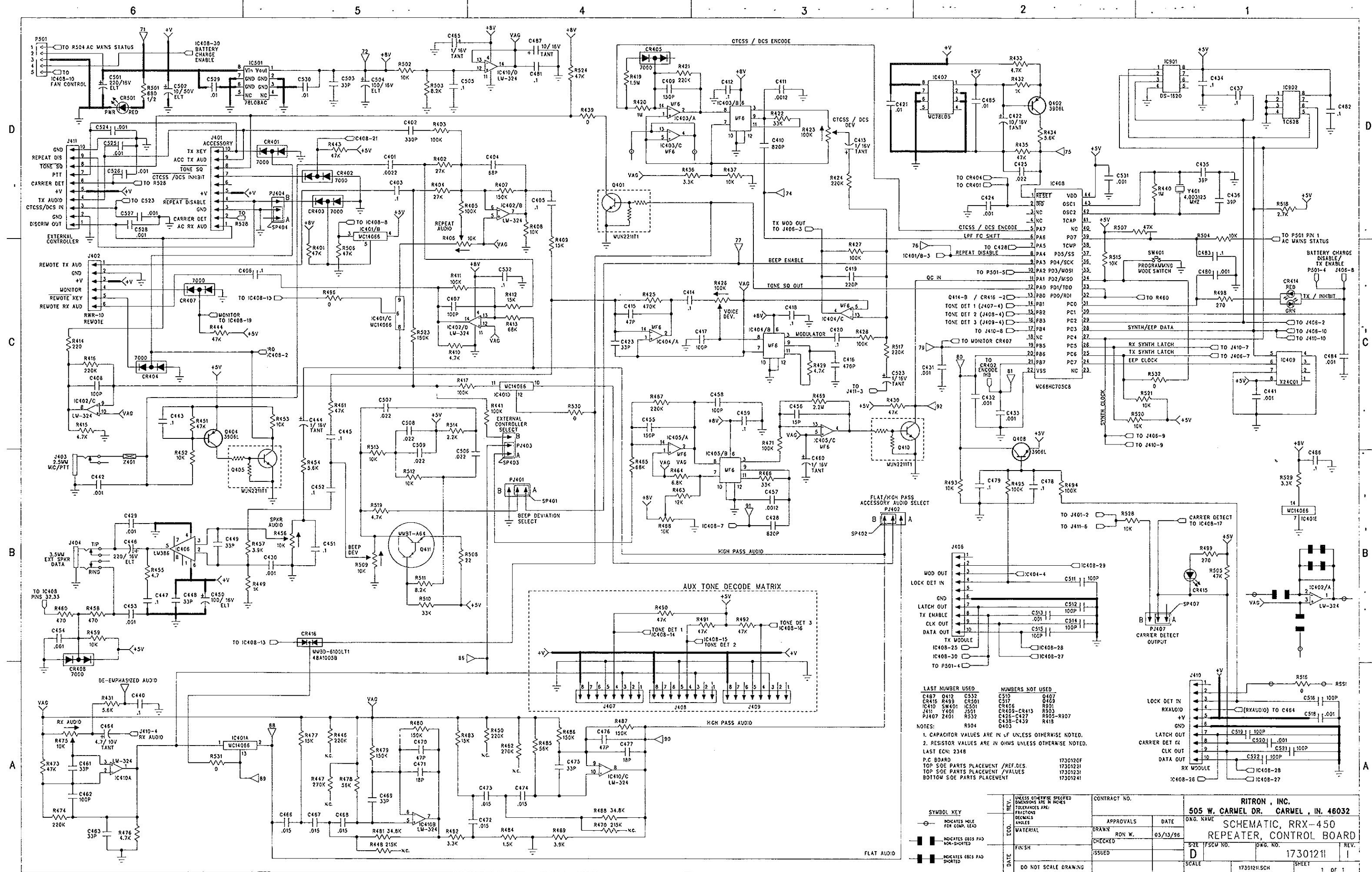
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JUMPERS

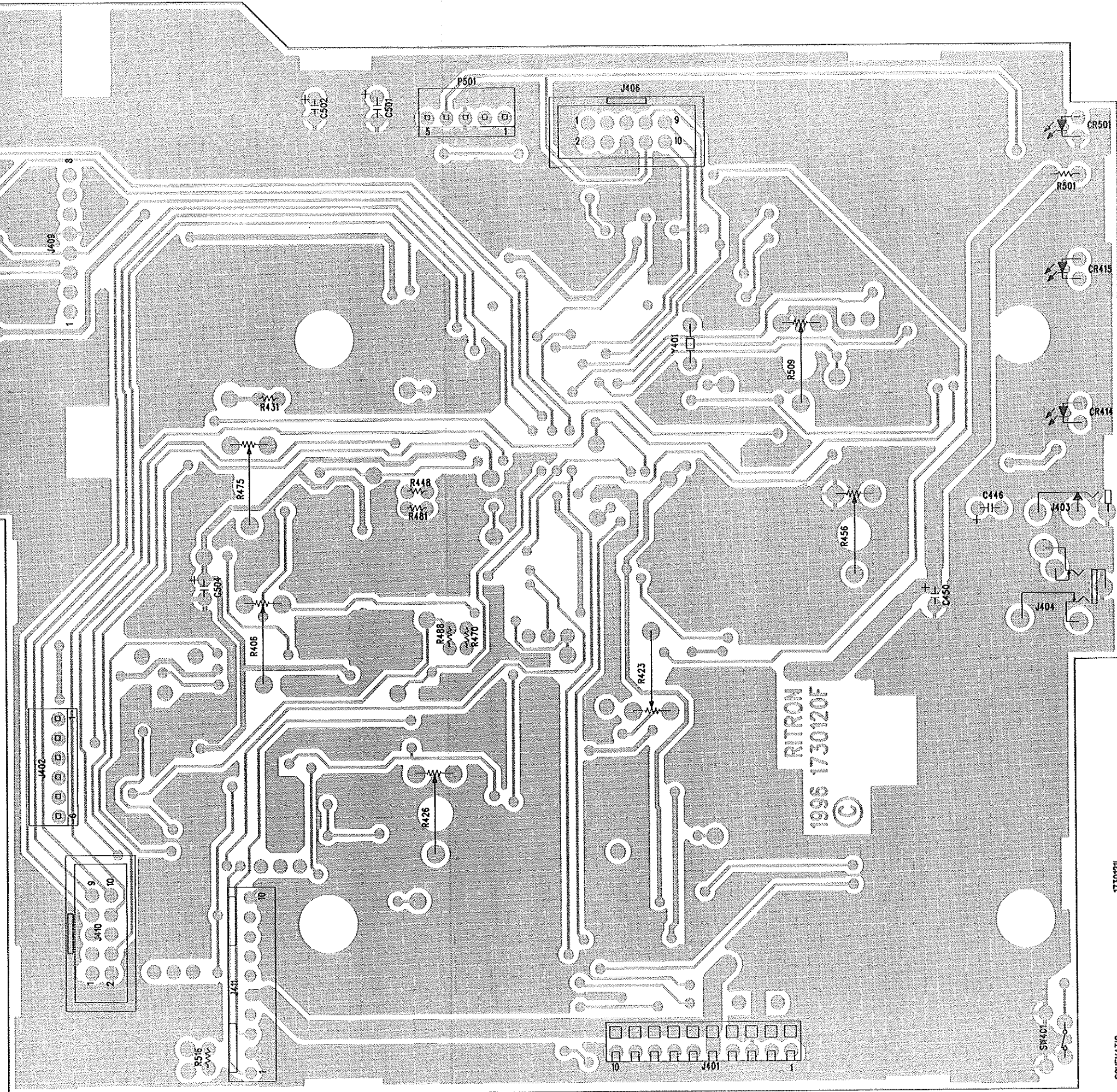
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HARDWARE (NOT SHOWN ON SCHEMATIC)

HW 01	25700100	SHIELD; SYNTHESIZER REV D
HW 02	25700100	SHIELD; SYNTHESIZER REV D
HW 03	25700600	LID; SYNTHESIZER REV E
HW 04	02100129	.156~ CRIMP CONTACT TERM
HW 05	02100129	.156~ CRIMP CONTACT TERM
HW 06	02500122	BRACKET, MOUNTING, TRANSISTOR RF POWER / MRF652 MNTN
HW 07	02500123	HEATSINK, MNTN NUT 8-32,.625 X .075
HW 08	02800020	STANDOFF; 4-40 X 3/16~
HW 09	02800020	STANDOFF; 4-40 X 3/16~
HW 10	02800020	STANDOFF; 4-40 X 3/16~
HW 11	02800020	STANDOFF; 4-40 X 3/16~
HW 12	02801005	4-40; 1/4~ PHILLIPS PAN
HW 13	02801005	4-40; 1/4~ PHILLIPS PAN
HW 14	02801005	4-40; 1/4~ PHILLIPS PAN
HW 15	02801009	4 X 1/4~ PPHMS SELF-TAP/TYPE 25
HW 16	02801009	4 X 1/4~ PPHMS SELF-TAP/TYPE 25
HW 17	02801039	#6-32 X 1/4~ PHIL PHMS
HW 18	02801039	#6-32 X 1/4~ PHIL PHMS
HW 19	02802003	4-40 X 1/4~ X 3/32~ HEX NUT/ZINC PLT.
HW 20	02802005	8-32 X 11/32~ X 1/8~ HEX NUT
HW 21	02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 22	13403000	ENCLOSURE, TOP, RX,TX,RRX-450
HW 23	13414000	ENCLOSURE, BOTTOM,RX,TX,RRX-450
HW 24	25103900	BRACKET, MOUNTING, FEED-THRU
HW 25	25104300	SHIELD,VCO,RRX-450
HW 26	25602500	CRYSTAL SUPPORT, UM-1
HW 27	25702000	SHIELD, VCO CUP, RTX



BOTTOM SIDE PARTS PLACEMENT
 CONTROL BOARD 1730124F
 RITRON, INC. 05/13/96



SCHEMATIC 17301211
 TOP SIDE PARTS PLACEMENT W/ REF DES 17301221
 TOP SIDE PARTS PLACEMENT W/ VALUES 17301231
 P.C. BOARD 1730120F

* INDICATES OPTIONAL PARTS

19. RRX-450 CONTROL BD. SCHEMATIC REF. PARTS LIST

Ref. ECN-2348

NOTE: This parts list reflects the most current component values. If a component value given in the schematic differs from that in the parts list, the parts list should be considered most current.

In the coordinates column below, the first number is the "X" coordinate, the second number the "Y" coordinate. A "B" at the end of the "Y" coordinate indicates the PC board bottom side. A "T" means top side.

REF#	RITRON#	DESCRIPTION	COORDINATES		REF#	RITRON#	DESCRIPTION	COORDINATES	
CAPACITORS, CHIP, FIXED, 50V, UNLESS STATED OTHERWISE					C 455	15110151	150PF NPO 0805 50V	3.807	4.610 T
C 401	15121222	.0022MF X7R 1206	3.061	5.200 T	C 456	15110150	15PF 0805 NPO 50V	3.404	4.380 T
C 402	15120331	330PF NPO 1206 50V	3.169	4.776 T	C 457	15111122	.0012MF X7R 0805	4.096	4.229 T
C 403	15121104	.1MF X7R 1206 50V	3.113	5.336 T	C 458	15110101	100PF NPO 0805 50V	3.913	4.086 T
C 404	15110680	68PF NPO 0805 50V	3.249	4.939 T	C 459	15121104	.1MF X7R 1206 50V	3.400	4.163 T
C 405	15121104	.1MF X7R 1206 50V	3.261	4.776 T	C 460	152A8105	1MFD 16V 3.2 X 1.6	3.134	4.589 T
C 406	15121104	.1MF X7R 1206 50V	3.684	5.364 T	C 461	15110330	33PF NPO 0805 50V	2.310	4.525 T
C 407	15110101	100PF NPO 0805 50V	3.412	5.334 T	C 462	15110101	100PF NPO 0805 50V	2.165	4.490 T
C 408	15110101	100PF NPO 0805 50V	3.717	4.754 T	C 463	15110330	33PF NPO 0805 50V	2.125	4.385 T
C 409	15110151	150PF NPO 0805 50V	3.518	3.142 T	C 464	15226475	4.7MF 10V CHIP TAN	1.413	4.900 T
C 410	15110821	820PF NPO 0805 50V	3.891	2.600 T	C 465	152A8105	1MFD 16V CHIP TANT	2.080	4.255 T
C 411	15111122	.0012MF X7R 0805	3.974	2.748 T	C 466	15121153	.015MF X7R 1206	2.500	3.655 T
C 412	15121104	.1MF X7R 1206 50V	3.578	2.567 T	C 467	15121153	.015MF X7R 1206	2.168	3.776 T
C 413	152A8105	1MFD 16V 3.2 X 1.6	3.044	3.766 T	C 468	15121153	.015MF X7R 1206	2.253	3.994 T
C 414	15121104	.1MF X7R 1206 50V	3.362	3.694 T	C 469	15110330	33PF NPO 0805 50V	2.200	4.150 T
C 415	15110470	47PF NPO 0805 50V	3.219	3.808 T	C 470	15110470	47PF NPO 0805 50V	2.050	4.150 T
C 416	15110471	470PF NPO 0805 50V	3.887	3.269 T	C 471	15110180	18PF NPO 0805 50V	2.125	4.150 T
C 417	15110101	100PF NPO 0805 50V	3.929	3.681 T	C 472	15121153	.015MF X7R 1206 50V	2.545	3.795 T
C 418	15121104	.1MF X7R 1206 50V	3.233	3.271 T	C 473	15121153	.015MF X7R 1206 50V	2.770	3.920 T
C 419	15110221	220pf NPO 0805 50V	3.215	3.482 T	C 474	15121153	.015MF X7R 1206 50V	2.790	4.265 T
C 420	15121104	.1MF X7R 1206 50V	3.134	3.577 T	C 475	15110330	33PF NPO 0805 50V	2.640	4.150 T
C 421	15111103	.01MF X7R 0805 50V	2.022	2.657 T	C 476	15110470	47PF NPO 0805 50V	2.715	4.115 T
C 422	152C8106	10MFD 16V 6.0X3.2	1.745	2.463 T	C 477	15110180	18PF NPO 0805 50V	2.790	4.115 T
C 423	15110330	33PF NPO 0805 50V	3.259	3.918 T	C 478	15121104	.1MF X7R 1206 50V	1.701	3.872 T
C 424	15111102	.001MF X7R 0805	1.569	2.432 T	C 479	15121104	.1MF X7R 1206 50V	1.790	3.872 T
C 425	15111223	.022mf X7R 0805			C 480	15111102	.001MF X7R 50V	0.967	3.281 T
C 428	15110821	820PF NPO 0805 50V	4.016	4.126 T	C 481	15121104	.1MF X7R 1206 50V	2.350	4.690 T
C 429	15111102	.001MF X7R 0805 50V	2.600	1.000 T	C 482	15121104	.1MF X7R 1206 50V	0.950	2.487 T
C 430	15111102	.001MF X7R 0805 50V	1.914	1.205 T	C 483	15121104	.1MF X7R 1206 50V	0.929	2.864 T
C 431	15111102	.001MF X7R 0805 50V	1.702	3.711 T	C 484	15111102	.001MF X7R 0805 50V	1.831	0.537 T
C 432	15111102	.001MF X7R 0805 50V	1.540	3.760 T	C 485	15111103	.01MF X7R 0805 50V	1.886	2.317 T
C 433	15111102	.001MF X7R 0805 50V	1.540	3.683 T	C 486	15121104	.1MF X7R 1206 50V	2.068	3.482 T
C 434	15121104	.1MF X7R 1206 50V	0.682	1.900 T	C 487	152C8106	10MFD 16V TANT CHIP	2.470	4.725 T
C 435	15110390	39PF NPO 0805 50V	1.270	2.370 T	C 501	01503011	220uf ELT CAP 16V	0.060	4.162 T
C 436	15110390	39PF NPO 0805 50V	1.161	2.331 T	C 502	01503021	10uf ELT CAP 50V	0.058	4.485 T
C 437	15121104	.1MF X7R 1206 50V	0.574	2.376 T	C 503	15110330	33PF NPO 0805 50V	1.955	5.308 T
C 440	15121104	.1MF X7R 1206 50V	1.534	4.929 T	C 504	01503211	100uf ELT CAP 16V	2.522	5.071 T
C 441	15111102	.001MF X7R 0805	1.438	4.152 T	C 505	15121104	.1MF X7R 1206 50V	2.657	4.387 T
C 442	15111102	.001MF X7R 0805	1.466	1.003 T	C 506	15111223	.022mf X7R 0805 50V	1.594	1.477 T
C 443	15121104	.1MF X7R 1206 50V	1.814	1.046 T	C 507	15111223	.022mf X7R 0805 50V	1.724	1.363 T
C 444	152A8105	1MFD 16V 3.2 X 1.6	1.937	1.770 T	C 508	15111223	.022mf X7R 0805 50V	1.401	1.401 T
C 445	15121104	.1MF X7R 1206 50V	1.844	1.688 T	C 509	15111223	.022mf X7R 0805 50V	1.479	1.401 T
C 446	01503011	220uf ELT CAP 16V	2.134	1.015 T	C 511	15110101	100PF NPO 0805 50V	0.466	3.023 T
C 447	15121104	.1MF X7R 1206 50V	2.735	1.045 T	C 512	15110101	100PF NPO 0805 50V	0.077	2.380 T
C 448	15110330	33PF NPO 0805 50V	2.381	1.262 T	C 513	15111102	.001MF X7R 0805 50V	0.467	2.735 T
C 449	15110330	33PF NPO 0805 50V	1.916	1.340 T	C 514	15110101	100PF NPO 0805 50V	0.182	2.410 T
C 450	01503211	100uf ELT CAP 16V	2.583	1.302 T	C 515	15110101	100PF NPO 0805 50V	0.467	2.599 T
C 451	15121104	.1MF X7R 1206 50V	1.997	1.480 T	C 516	15110101	100PF NPO 0805 50V	4.568	5.279 T
C 452	15121104	.1MF X7R 1206 50V	1.844	1.503 T	C 518	15111102	.001MF X7R 0805 50V	4.799	5.285 T
C 453	15111102	.001MF X7R 0805	1.183	1.153 T	C 519	15110101	100PF NPO 0805 50V	4.272	5.278 T
C 454	15111102	.001MF X7R 0805	1.118	1.230 T	C 520	15111102	.001MF X7R 0805 50V	4.349	5.278 T

page 61

REF#	RITRON#	DESCRIPTION	COORDINATES
C 521	15110101	100PF NPO 0805 50V	4.117 5.278 T
C 522	15110101	100PF NPO 0805 50V	4.195 5.278 T
C 523	152A8105	1MFD 16V CHIP TANT	3.134 3.762 T
C 524	15111102	.001MF X7R 0805 50V	4.122 5.128 T
C 525	15111102	.001MF X7R 0805 50V	4.199 5.128 T
C 526	15111102	.001MF X7R 0805 50V	4.388 5.098 T
C 527	15111102	.001MF X7R 0805 50V	4.549 5.129 T
C 528	15111102	.001MF X7R 0805 50V	4.727 5.129 T
C 529	15111103	.01MF X7R 0805 50V	2.493 5.308 T
C 530	15111103	.01MF X7R 0805 50V	2.034 5.309 T
C 531	15111102	.001MF X7R 0805 50V	1.449 2.253 T
C 532	15121104	.1MF X7R 1206 50V	3.204 5.106 T

DIODES, SOT-23, UNLESS STATED OTHERWISE

CR401	48A1005C	MMBD7000 DUAL DIODE	4.656 3.005 T
CR402	48A1005C	MMBD7000 DUAL DIODE	4.609 2.705 T
CR403	48A1005C	MMBD7000 DUAL DIODE	4.654 2.328 T
CR404	48A1005C	MMBD7000 DUAL DIODE	3.623 5.612 T
CR405	48A1005C	MMBD7000 DUAL DIODE	3.662 3.105 T
CR407	48A1005C	MMBD7000 DUAL DIODE	3.446 5.610 T
CR408	48A1005C	MMBD7000 DUAL DIODE	1.115 1.341 T
CR414	02450014	LED DUAL COLOR R/A	1.645 0.345 T
CR415	02450015	LED, GREEN, R/A	0.905 0.345 T
CR416	48A1005B	MMBD 6100 LT1	2.419 3.542 T
CR501	02450013	LED RED R/A	0.175 0.345 T

INTEGRATED CIRCUITS

IC401	31124066	MC14066 QUAD ANALOG	2.432 3.186 T
IC402	31020324	LMT324AD/NJM324E OP	3.551 5.051 T
IC403	31020001	MF6CWM-50 6 POLE FIL	3.589 2.807 T
IC404	31020001	MF6CWM-50 6 POLE FIL	3.544 3.431 T
IC405	31020001	MF6CWM-50 6 POLE FIL	3.707 4.329 T
IC406	31010004	LM386MX-1 AUDIO AMP	2.149 1.327 T
IC407	31010002	78L05AC 5V REG	2.057 2.450 T
IC408	314A1001	MC68HC705C8ACFN	
IC409	31210001	X24C01S EEPROM	1.283 4.107 T
IC410	31020324	LMT324AD/NJM324E OP	2.420 4.255 T
IC501	31010009	78L08 8V VOLT. REG	2.264 5.273 T

JACKS

J 401	02100062	10 PIN FEMALE CONN	4.865 2.515 T
J 402	02100082	6 PIN MALE HEADER	3.436 5.855 T
J 403	02100001	2.5MM PC-MT JACK	2.159 0.407 T
J 404	02100053	3.5MM STEREO JACK	2.546 0.555 T
J 406	02100347	CONNECTOR, HEADER	0.142 3.075 T
J 407	02100350	HEADER 8 PIN .1" CEN	
J 408	02100350	HEADER 8 PIN .1" CEN	
J 409	02100350	HEADER 8 PIN .1" CEN	
J 410	02100347	CONNECTOR, HEADER, 10	4.490 5.664 T
J 411	02100313	10 PIN POLAR PC MNT	5.007 4.850 T

JUMPERS AND PLUGS

P 501	02100072	5-PIN PLRZD PC MNT	0.112 3.504 T
PJ401	02100024	3 PIN HEADER	
PJ402	02100024	3-PIN HEADER	2.773 3.300 T
PJ403	02100024	3 PIN HEADER	
PJ404	02100024	3 PIN HEADER	
PJ407	02100024	3 PIN HEADER	
SP401	02100075	2 PIN SHORTING PLUG	
SP402	02100075	2 PIN SHORTING PLUG	
SP403	02100075	2 PIN SHORTING PLUG	
SP404	02100075	2 PIN SHORTING PLUG	
SP407	02100075	2 PIN SHORTING PLUG	

TRANSISTORS, SOT-23, UNLESS STATED OTHERWISE

Q 401	48010R02	MUN2211T1 W/BIAS RES	4.487 2.881 T
Q 402	4801002A	MMBT3906 "SOT23"	1.660 2.617 T
Q 404	4801002A	MMBT3906 "SOT23"	1.599 1.110 T
Q 405	48010R02	MUN2211T1 W/BIAS RES	1.628 1.252 T
Q 408	4801002A	MMBT3906 "SOT23"	1.581 3.959 T
Q 410	48010R02	MUN2211T1 W/BIAS RES	3.216 4.300 T
Q 411	4801002V	MMBT464 PNP DARL.	1.476 1.678 T

RESISTORS, CHIP, FIXED, UNLESS STATED OTHERWISE

R 401	47100473	47K OHM 0805 CP RES.	4.487 2.607 T
R 402	47100273	27K OHM 0805 CP RES.	3.124 5.092 T
R 403	47100104	100K OHM 0805 CP RES	3.131 4.942 T
R 404	47100273	27K OHM 0805 CP RES.	3.051 5.092 T
R 405	47100104	100K OHM 0805 CP RES	3.056 4.942 T
R 406	04750008	10K OHM TRIMMER/H MT	2.808 4.769 T
R 407	47100154	150K OHM 0805 RES.	3.331 4.933 T
R 408	47100103	10K OHM 0805 RES	3.349 4.791 T
R 409	47100153	15K OHM 0805 RES	3.302 4.642 T
R 410	47100472	4.7K OHM 0805 RES.	3.411 5.471 T
R 411	47100104	100K OHM 0805 RES	3.489 5.335 T
R 412	47100153	15K OHM 0805 RES	3.296 5.295 T
R 413	47100683	68K OHM 0805 RES.	3.567 5.335 T
R 414	47100221	220 ohm 0805 RES	3.824 4.793 T
R 415	47100472	4.7K OHM 0805 RES.	3.638 4.755 T
R 416	47100224	220K OHM 0805 RES.	3.770 4.911 T
R 417	47100104	100K OHM 0805 RES	3.864 4.715 T
R 419	47100155	1.5M OHM 0805 RES.	3.779 3.105 T
R 420	47100105	1M OHM 0805 RES	3.859 3.065 T
R 421	47100224	220K OHM 0805 RES.	3.518 3.064 T
R 422	47100333	33K OHM 0805 RES.	3.891 2.747 T
R 423	04750028	100K MINI POT;HORZ	2.959 2.767 T
R 424	47100224	220K OHM 0805 RES.	2.972 3.597 T
R 425	47100474	470K OHM 0805 RES.	3.300 3.809 T
R 426	04750028	100K MINI POT;HORZ	3.684 3.889 T
R 427	47100104	100K OHM 0805 RES	3.052 3.462 T
R 428	47100104	100K OHM 0805 RES	3.052 3.597 T

REF#	RITRON#	DESCRIPTION	COORDINATES	REF#	RITRON#	DESCRIPTION	COORDINATES
R 429	47100472	4.7K OHM 0805 RES.	3.847 3.380 T	R 491	47100473	47K OHM 0805 RES	0.833 6.208 T
R 430	47100473	47K OHM 0805 RES.	2.931 4.378 T	R 492	47100473	47K OHM 0805 RES	0.833 6.122 T
R 431	4700142L	5.6K OHM 5% 1/4W CF		R 493	47100103	10K OHM 0805 RES	1.540 3.840 T
R 432	47100102	1K OHM 0805 RES	1.770 2.617 T	R 494	47100104	100K OHM 0805 RES	1.740 4.000 T
R 433	47100472	4.7K OHM 0805 RES	1.875 2.657 T	R 495	47100104	100K OHM 0805 RES	1.618 4.113 T
R 434	47100562	5.6K OHM 0805 RES	1.545 2.685 T	R 496	47100000	ZERO OHM 0805 RES	
R 435	47100473	47K OHM 0805 RES.	1.423 2.359 T	R 498	47100271	270 OHM 0805 RES	0.487 3.321 T
R 437	47100103	10K OHM 0805 RES	3.280 3.028 T	R 499	47100271	270 OHM 0805 RES	0.881 0.853 T
R 439	47100000	ZERO OHM 0805 RES.		R 501	04710030	680 OHM 5% 1/2W	0.423 0.693 T
R 440	47100105	1M OHM 0805 RES	1.161 2.408 T	R 502	47100103	10K OHM 0805 RES	2.262 5.032 T
R 441	47100104	100K OHM 0805 RES		R 503	47100822	8.2K OHM 0805 RES	2.770 4.480 T
R 443	47100473	47K OHM 0805 RES	4.378 2.745 T	R 504	47100103	10K OHM 0805 RES	0.815 2.922 T
R 444	47100473	47K OHM 0805 RES	3.193 5.643 T	R 505	47100473	47K OHM 0805 RES.	0.921 0.765 T
R 446	47100224	220K OHM 0805 RES		R 506	47100473	47K OHM 0805 RES.	2.342 2.933 T
R 447	47100274	270K OHM 0805 RES		R 507	47100473	47K OHM 0805 RES.	0.815 2.843 T
R 448	04732153	215K OHM 1 % METAL		R 508	47100220	22 OHM 0805 RESISTOR	1.363 1.678 T
R 449	47100102	1K OHM 0805 RES	1.836 1.207 T	R 509	04750008	10K OHM TRIMMER HMT	1.383 1.987 T
R 450	47100224	220K OHM 0805 RES		R 510	47100333	33K OHM 0805 RES.	1.594 1.741 T
R 451	47100473	47K OHM 0805 RES	1.730 1.066 T	R 511	47100822	8.2K OHM 0805 RES.	1.594 1.607 T
R 452	47100103	10K OHM 0805 RES	1.624 1.003 T	R 512	47100103	10K OHM 0805 RES	1.479 1.541 T
R 453	47100103	10K OHM 0805 RES	1.758 1.207 T	R 513	47100103	10K OHM 0805 RES	1.705 1.478 T
R 454	47100562	5.6K OHM 0805 RES	1.937 1.609 T	R 514	47100222	2.2K OHM 0805 RES	1.586 1.361 T
R 455	471004A7	4.7 OHM 0805 RES	2.590 1.100 T	R 515	47100103	10K OHM 0805 RES	
R 456	04750008	10K OHM TRIMMER HMT	2.261 1.715 T	R 516	04720009	ZERO OHM 5% 1/4W CF	4.883 5.067 T
R 457	47100392	3.9K OHM 0805 RES	1.836 1.342 T	R 517	47100224	220K OHM 0805 RES.	3.219 3.619 T
R 458	47100471	470 OHM 0805 RES	1.302 1.188 T	R 518	47100272	2.7K OHM 0805 RES.	1.021 3.731 T
R 459	47100103	10K OHM 0805 RES	1.302 1.324 T	R 519	47100472	4.7K OHM 0805 RES.	1.705 1.552 T
R 460	47100471	470 OHM 0805 RES	1.223 1.266 T	R 520	47100103	10K OHM 0805 RES	1.061 3.825 T
R 461	47100473	47K OHM 0805 RES	1.773 1.857 T	R 521	47100103	10K OHM 0805 RES	1.061 3.906 T
R 462	47100274	270K OHM 0805 RES		R 523	47100154	150K OHM 0805 RES	3.801 5.136 T
R 463	47100123	12K OHM 0805 RES		R 524	47100473	47K OHM 0805 RES	
R 464	47100682	6.8K OHM 0805 CHIP		R 528	47100103	10K OHM 0805 CHIP	
R 465	47100473	47K OHM 0805 RES	3.950 4.604 T	R 529	47100332	3.3K OHM 0805 RES	
R 466	47100333	33K OHM 0805 RES	4.011 4.268 T	R 530	47100000	ZERO OHM 0805 RES	
R 467	47100224	220K OHM 0805 RES	3.727 4.610 T	R 531	47100000	ZERO OHM 0805 RES	
R 468	47270103	10K OHM SEALED	3.251 4.564 T	R 532	47100000	ZERO OHM 0805 RES	
R 469	47100225	2.2M 0805 RESISTOR	3.328 4.380 T				
R 470	04732153	215K OHM 1% METAL					
R 471	47100104	100K OHM 0805 RES	3.358 4.526 T				
R 472	47100000	ZERO OHM 0805 RES	2.312 3.426 T				
R 473	47100473	47K OHM 0805 RES	2.415 4.510 T				
R 474	47100224	220K OHM 0805 RES	2.165 4.565 T				
R 475	04750008	10K OHM TRIMMER HMT	1.992 4.836 T				
R 476	47100472	4.7K OHM 0805 RES.	2.200 4.385 T				
R 477	47100153	15K OHM 0805 RES	2.455 3.790 T				
R 478	47100563	56K OHM 0805 RES	2.415 3.920 T				
R 479	47100154	150K OHM 0805 RES	2.415 4.000 T				
R 480	47100154	150K OHM 0805 RES	1.975 4.150 T				
R 481	04732496	34.8K OHM 1% METAL	2.205 3.886 T				
R 482	47100332	3.3K OHM 0805 RES	2.380 3.790 T				
R 483	47100153	15K OHM 0805 RES	2.525 3.960 T				
R 484	47100152	1.5K OHM 0805 RES	2.303 3.713 T				
R 485	47100563	56K OHM 0805 RES	2.770 4.405 T				
R 486	47100154	150K OHM 0805 RES	2.640 4.015 T				
R 487	47100154	150K OHM 0805 RES	2.865 4.115 T				
R 488	04732496	34.8K OHM 1% METAL	2.827 3.808 T				
R 489	47100392	3.9K OHM 0805 RES	2.755 4.010 T				
R 490	47100473	47K OHM 0805 RES	0.893 6.836 T				

CRYSTALS

Y 401 02300066 CRYSTAL; 4.003125MHZ 1.282 2.554 T

FERRITE BEADS

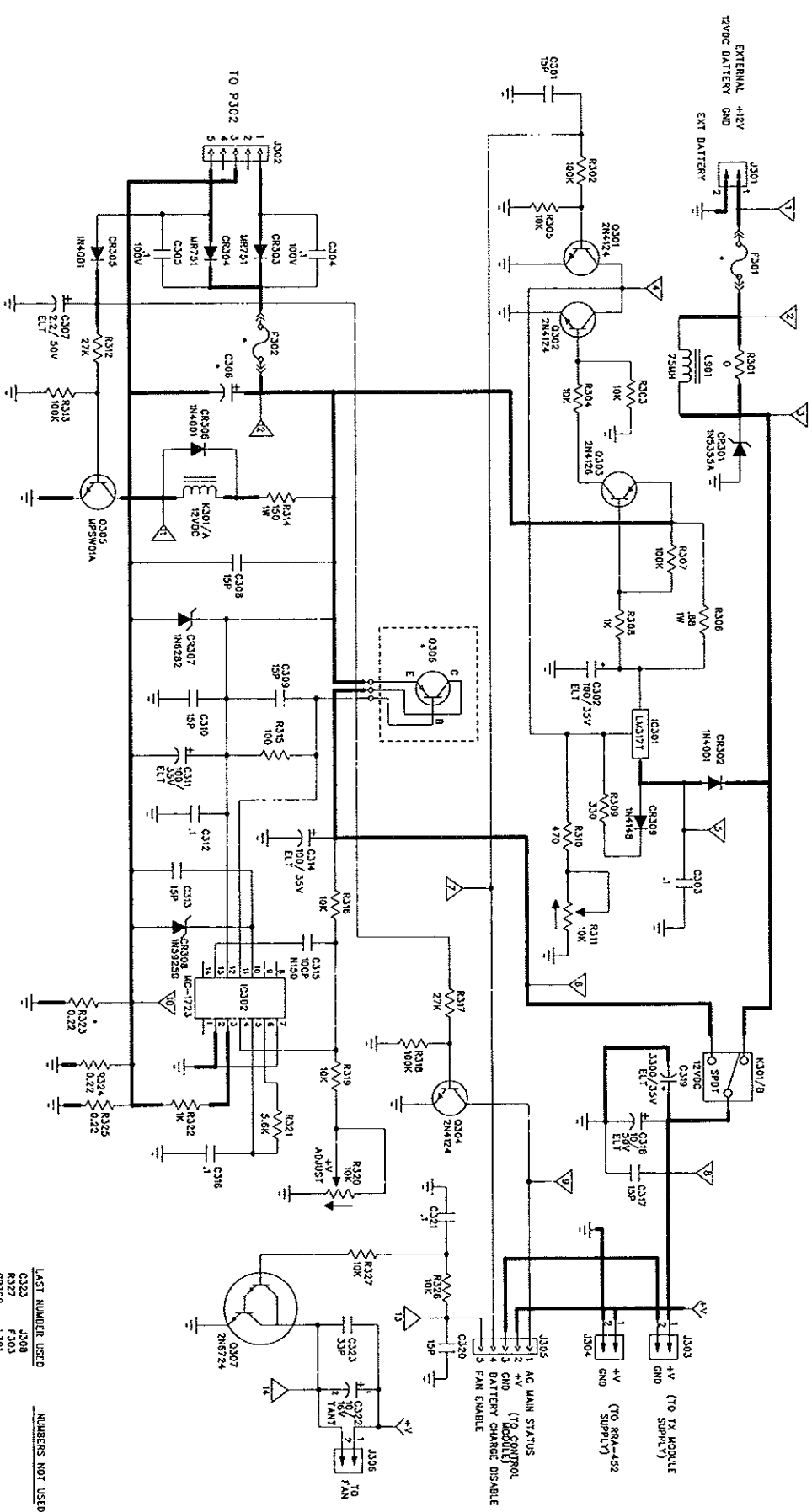
Z 401 18360001 BEAD; FERRITE SMOUNT 1.694 0.890 T

HARDWARE (NOT SHOWN ON SCHEMATIC)

HW 01 02800114 CRYSTAL SUPPORT
 HW 02 02100229 PLCC SOCKET 44 PIN SURFACE MNT
 HW 03-10 02800020 STANDOFF; 4-40 X 3/16~
 HW 11-14 02800074 NYLON STANDOFF .250D X .625L
 HW 15-18 02801005 4-40; 1/4~ PHILLIPS PAN
 HW 19-22 02804008 SPRINGTENSION WASHER

SWITCHES

SW401 05100042 SWITCH SPST MOMENTARY

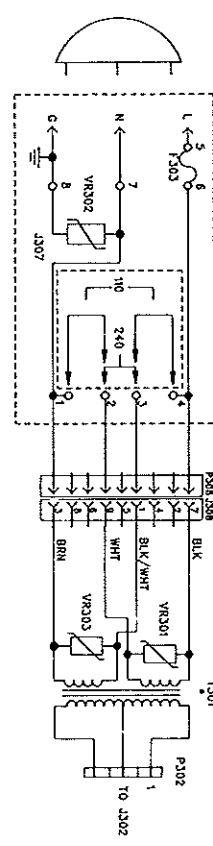


Q	1301	F302	C306	1301	Q306	R323
4A SUPPLY	0510005	0510005	01000036	05000039	04600019	NOT USED
9A SUPPLY	0510012	0510012	01000039	05000040	04600027	04720046

NOTES:
 1. CAPACITOR VALUES ARE IN μ F UNLESS OTHERWISE NOTED.
 2. RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE NOTED.

SYMBOL INDICATES P.C BOARD BOTTOM SIDE TEST POINT

LAST NUMBER USED	NUMBERS NOT USED
C323	J308
R327	F303
CR309	L301
IC302	Q307
TP14	K301
	VR303



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		APPROVALS		DATE	
TOLERANCES ARE (EXCEPT AS NOTED)		DRAWN W.		01/25/96	
FRACTIONS		CHECKED			
DECIMALS		TESTED			
ANALOGS		FUNCTION		UNITARY	
DO NOT SCALE DRAWING		SCALE		1730151A	
		SHEET		OF	

505 W. CARREL DR. CARREL, IN. 46032
 RITRON, INC.
 RRX-450 REPEATER
 POWER SUPPLY

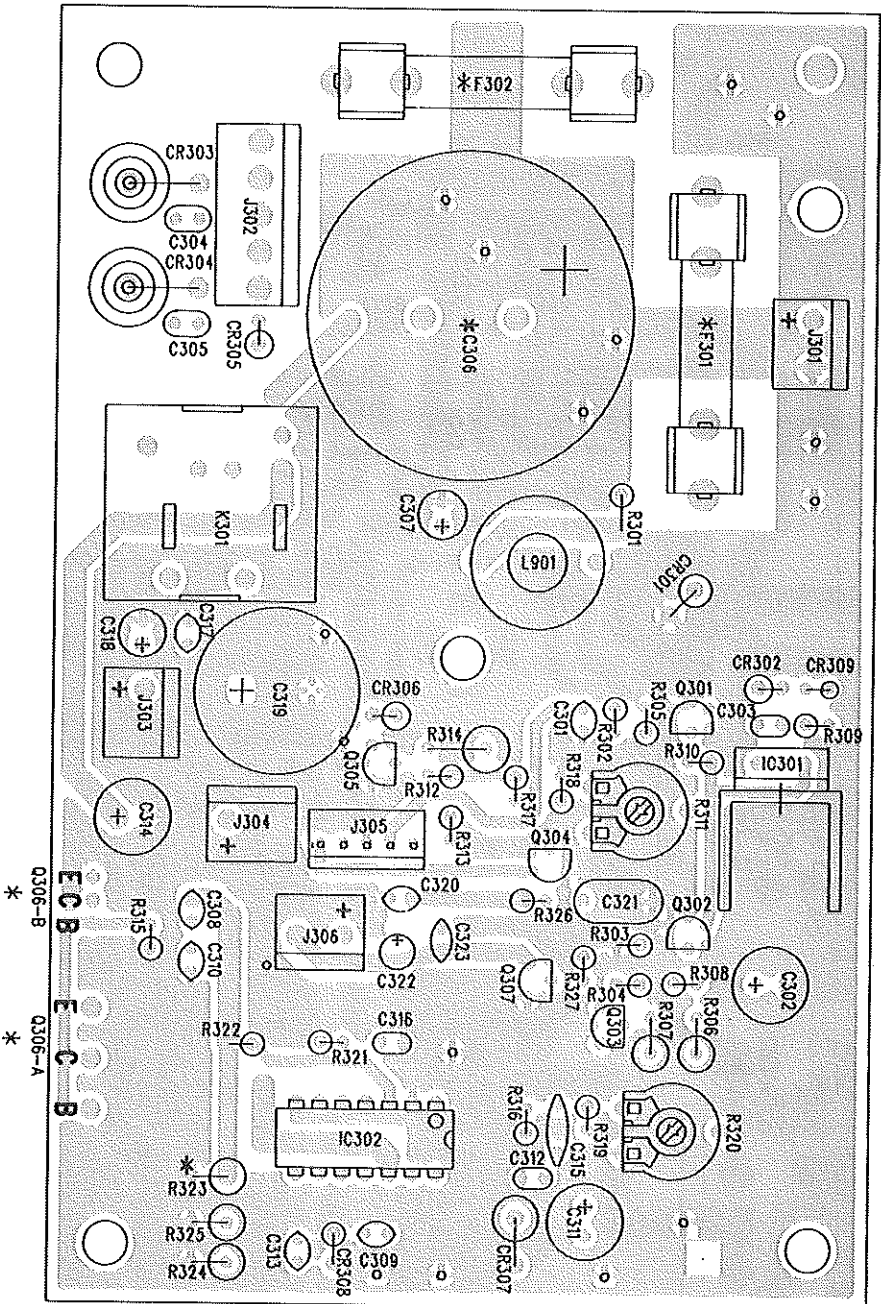
RRX-450 REPEATER POWER SUPPLY

TOP SIDE PARTS PLACEMENT W/ REF.DES.

1730152A

RITRON, INC.

06/08/95



COMPONENT CHART

*	F301	F302	C306	Q306	R323
4A SUPPLY	05110005	05110005	01503036	04800019	NOT USED
9A SUPPLY	05110012	05110012	01503038	04800027	04720048

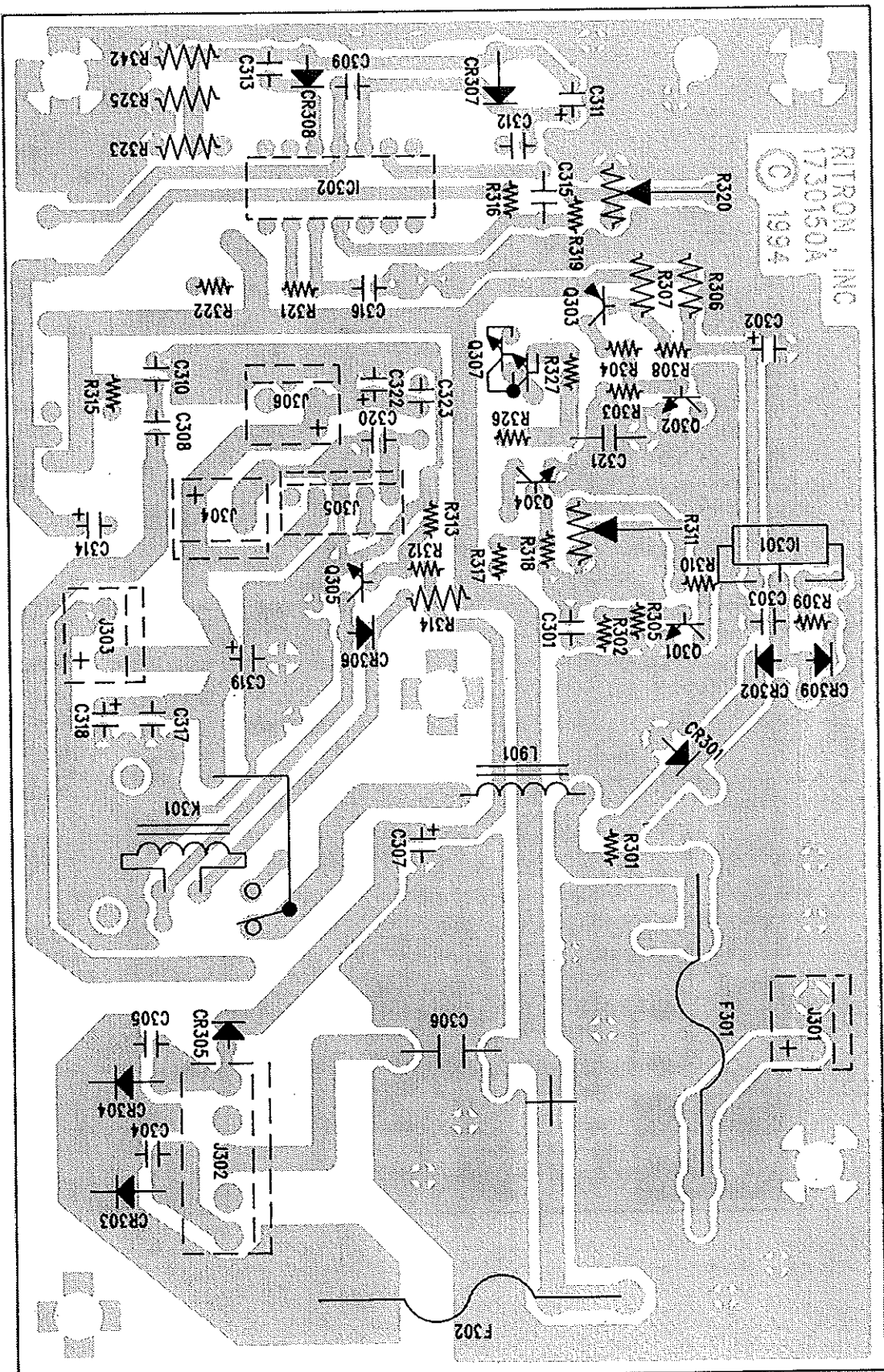
SCHEMATIC
TOP SIDE PARTS PLACEMENT W/VALUES
BOTTOM SIDE PARTS PLACEMENT
P.C. BOARD

1730151A
1730152A
1730153A
1730154A
1730155A

RRX-4: JWER SUPPLY BOARD
1730154A

BOTTOM SIDE PARTS PLACEMENT

RITRON, INC.
07/26/95



SCHEMATIC

TOP SIDE PARTS PLACEMENT W/REF. DES. 1730151A
TOP SIDE PARTS PLACEMENT W/VALUES 1730152A
P.C.B. BOARD 1730153A
1730150A

22. RRX-450 PWR SUPPLY SCHEMATIC REF. PARTS LIST

Ref. ECN-2279

NOTE: This parts list reflects the most current component values. If a component value given in the schematic differs from that in the parts list, the parts list should be considered most current.

REF#	RITRON#	DESCRIPTION	COORDINATES	REF#	RITRON#	DESCRIPTION	COORDINATES
------	---------	-------------	-------------	------	---------	-------------	-------------

CAPACITORS

C 301	01510017	15pf NP0 CERDIS CAP 50V .160X.1 r	
C 302	01503024	100uf ELT CAP 35V .14~.32~X.47~ r	
C 303	01515463	.1uf X7R MLCER CAP 50V .100 r K	
C 304	01517006	.1uf X7R MLCER CAP 100V .100 r M	
C 305	01517006	.1uf X7R MLCER CAP 100V .100 r M	
C 307	01503003	2.2uf ELT CAP 50V .1~.2~X.46~ r	
C 308	01510017	15pf NP0 CERDIS CAP 50V .160X.1 r	
C 309	01510017	15pf NP0 CERDIS CAP 50V .160X.1 r	
C 310	01510017	15pf NP0 CERDIS CAP 50V .160X.1 r	
C 311	01503024	100uf ELT CAP 35V .14~.32~X.47~ r	
C 312	01515463	.1uf X7R MLCER CAP 50V .100 r K	
C 313	01510017	15pf NP0 CERDIS CAP 50V .160X.1 r	
C 314	01503024	100uf ELT CAP 35V .14~.32~X.47~ r	
C 315	01510127	100pf N150 CERDIS CAP 50V .32x.2 r	
C 316	01515463	.1uf X7R MLCER CAP 50V .100 r K	
C 317	01510017	15pf NP0 CERDIS CAP 50V .160X.1 r	
C 318	01503021	10uf ELT CAP 50V .1~.2~X.46~ r	
C 319	01503028	3300uf ELT CAP 35V .3~.72~X1.4~ r	
C 320	01510017	15pf NP0 CERDIS CAP 50V .160X.1 r	
C 321	01501063	.1MF MYLAR CAP 100V .300~ r 10%	
C 322	01502013	10uf TANT CAP 16V(C) .1~ r 20%	
C 323	01510017	15pf NP0 CERDIS CAP 50V .160X.1 r	

DIODES

CR301	04820119	1N5355A; ZENER 18V; 5W	
CR302	04810003	1N4001 DIODE 50V/1A	
CR303	04810009	MRF751 DIODE 100V/6A	
CR304	04810009	MRF751 DIODE 100V/6A	
CR305	04810003	1N4001 DIODE 50V/1A	
CR306	04810003	1N4001 DIODE 50V/1A	
CR307	04820028	1N6282; SURGE SUPPRESSOR DIODE	
CR308	04820038	DIODE, 1N5925B, ZENER, 1.5W	
CR309	04810001	1N4148; DIODE/GENERAL PURPOSE	

INTEGRATED CIRCUITS

IC301	03131027	LM317T ADJ. VOLTAGE REG.	
IC302	03131053	VOLTAGE REGULATOR IC; MC1723	

CONNECTORS, HEADERS

J 301	02100305	2 PIN POLAR HDR .2~LS	
J 302	02100149	5 PIN PLUG .156~ LOCKING	
J 303	02100305	2 PIN POLAR HDR .2~LS	
J 304	02100305	2 PIN POLAR HDR .2~LS	
J 305	02100072	5-PIN PLRZD PC MNT HEADER	
J 306	02100305	2 PIN POLAR HDR .2~LS	

RELAY

K 301	04500008	12 VDC SPDT RELAY	
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TRANSISTORS

Q 301	04800006	MPS-4124 NPN LOW NOISE AUD.	
Q 302	04800006	MPS-4124 NPN LOW NOISE AUD.	
Q 303	04800011	2N4126 PNP GP AUDIO TO-92	
Q 304	04800006	MPS-4124 NPN LOW NOISE AUD.	
Q 305	04800048	TRANSISTOR NPN 1W MPSW01A	
Q 307	04800012	2N6724/92PU45 NPN DARL' TO-134	

RESISTORS

R 301	04720009	ZERO OHM 5% 1/4W CF RESISTOR	
R 302	04700145	10K OHM 5% 1/4W CF	
R 303	04700145	10K OHM 5% 1/4W CF	
R 304	04700145	10K OHM 5% 1/4W CF	
R 305	04700145	10K OHM 5% 1/4W CF	
R 306	04720052	.68 OHM 1W RES	
R 307	04700157	100K OHM 5% 1/4W CF	
R 308	04700133	1K OHM 5% 1/4W CF	
R 309	04700127	330 OHM 5% 1/4W CF	
R 310	04700129	470 OHM 5% 1/4W CF	
R 311	04750008	10K OHM TRIM POT/HORZ MOUNT	
R 312	04700150	27K OHM 5% 1/4W CF	
R 313	04700157	100K OHM 5% 1/4W CF	
R 314	04710822	150 OHM 1W 5% CF	
R 315	04700121	100 OHM 5% 1/4W CF	
R 316	04700145	10K OHM 5% 1/4W CF	
R 317	04700150	27K OHM 5% 1/4W CF	
R 318	04700157	100K OHM 5% 1/4W CF	
R 319	04700145	10K OHM 5% 1/4W CF	
R 320	04750008	10K OHM TRIM POT/HORZ MOUNT	
R 321	04700142	5.6K OHM 5% 1/4W CF	
R 322	04700133	1K OHM 5% 1/4W CF	
R 324	04720048	0.22 OHM 1W 5% METAL RESISTOR	
R 325	04720048	0.22 OHM 1W 5% METAL RESISTOR	
R 326	04700145	10K OHM 5% 1/4W CF	
R 327	04700145	10K OHM 5% 1/4W CF	

HARDWARE (NOT SHOWN ON SCHEMATIC)

HW 00	02600003	HEATSINK; TO-220 LAY DOWN	
HW 01	05120002	FUSE HOLDER; PC BOARD MOUNT	
HW 02	05120002	FUSE HOLDER; PC BOARD MOUNT	
HW 03	05120002	FUSE HOLDER; PC BOARD MOUNT	
HW 04	05120002	FUSE HOLDER; PC BOARD MOUNT	
HW 05	02800020	STANDOFF; 4-40 X 3/16~	
HW 06	02800020	STANDOFF; 4-40 X 3/16~	
HW 07	02800020	STANDOFF; 4-40 X 3/16~	
HW 08	02800020	STANDOFF; 4-40 X 3/16~	
HW 09	02800020	STANDOFF; 4-40 X 3/16~	

23.

RRX-450-D4000 (STANDARD) PARTS LIST

<u>RITRON#</u>	<u>DESCRIPTION</u>	<u>RITRON#</u>	<u>DESCRIPTION</u>
HW 01 02100129	.156~ CRIMP CONTACT TERM	HW 59 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 02 02100129	.156~ CRIMP CONTACT TERM	HW 60 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 03 02100129	.156~ CRIMP CONTACT TERM	HW 61 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 04 02100150	5 PIN SOCKET.156~LOCKING	HW 62 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 05 02100202	9 POS. RECPT. W/DETENT LOCK	HW 63 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 06 02100203	9 POS.PLUG W/O MNTG. EARS	HW 64 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 07 02100327	DC POWER CONNECTOR PIN	HW 65 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 08 02100327	DC POWER CONNECTOR PIN	HW 66 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 09 02100327	DC POWER CONNECTOR PIN	HW 67 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 10 02100327	DC POWER CONNECTOR PIN	HW 68 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 11 02100328	DC POWER CONTACT SOCKET	HW 69 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 12 02100328	DC POWER CONTACT SOCKET	HW 70 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 13 02100328	DC POWER CONTACT SOCKET	HW 71 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 14 02100328	DC POWER CONTACT SOCKET	HW 72 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 15 02100349	AC INLET VOLTAGE SELECTABLE FUSED	HW 73 02803006	#6 INTERNAL TOOTH LOCKWASHER
HW 16 02500028	TO-220 INSULATOR BUSHING SMALL	HW 74 02803006	#6 INTERNAL TOOTH LOCKWASHER
HW 17 02500029	INS. WASHER FOR TO-220 TRANS	HW 75 02803006	#6 INTERNAL TOOTH LOCKWASHER
HW 18 02500125	HOLE PLUG RRX-450	HW 76 02803008	#10 INTERNAL TOOTH STEEL WASHER
HW 19 02800079	ANGLE BRACKET~STEEL~ 6/32 TAP	HW 77 02803008	#10 INTERNAL TOOTH STEEL WASHER
HW 20 02800079	ANGLE BRACKET~STEEL~ 6/32 TAP	HW 78 02803025	#8 FLAT WASHER STEEL
HW 21 02800079	ANGLE BRACKET~STEEL~ 6/32 TAP	HW 79 02803025	#8 FLAT WASHER STEEL
HW 22 02800116	#6 SOLDER LUG	HW 80 06002013	1/4~ DIA CLEAR HEAT SHRK / INCHES
HW 23 02800120	TERMINAL #4 LUG FASTON .020 TIN 45D	HW 81 13241000	PANEL, FRONT, RRX-450
HW 24 02800121	PAD, STICK-ON, BUMPER, BLACK	HW 82 13242000	PANEL, REAR, RRX-450
HW 25 02800121	PAD, STICK-ON, BUMPER, BLACK	HW 83 13244000	PANEL, BOTTOM, RRX-450
HW 26 02800121	PAD, STICK-ON, BUMPER, BLACK	HW 84 13247000	EXTRUSION, SIDE PANEL, RRX-450
HW 27 02800121	PAD, STICK-ON, BUMPER, BLACK	HW 85 13247000	EXTRUSION, SIDE PANEL, RRX-450
HW 28 02801005	4-40; 1/4~ PHILLIPS PAN	HW 86 28110601	SCREW 6-32x3/8 TRXHD THREADFORM
HW 29 02801005	4-40; 1/4~ PHILLIPS PAN	HW 87 28110601	SCREW 6-32x3/8
HW 30 02801005	4-40; 1/4~ PHILLIPS PAN	HW 88 28110601	SCREW 6-32x3/8 TORXHEAD
HW 31 02801005	4-40; 1/4~ PHILLIPS PAN	HW 89 28110601	SCREW 6-32x3/8 TORXHEAD
HW 32 02801005	4-40; 1/4~ PHILLIPS PAN	HW 90 28110601	SCREW 6-32x3/8 TORXHEAD
HW 33 02801005	4-40; 1/4~ PHILLIPS PAN	HW 91 28110601	SCREW 6-32x3/8 TORXHEAD
HW 34 02801005	4-40; 1/4~ PHILLIPS PAN	HW 92 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 35 02801005	4-40; 1/4~ PHILLIPS PAN	HW 93 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 36 02801005	4-40; 1/4~ PHILLIPS PAN	HW 94 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 37 02801005	4-40; 1/4~ PHILLIPS PAN	HW 95 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 38 02801005	4-40; 1/4~ PHILLIPS PAN	HW 96 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 39 02801005	4-40; 1/4~ PHILLIPS PAN	HW 97 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 40 02801005	4-40; 1/4~ PHILLIPS PAN	HW 98 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 41 02801005	4-40; 1/4~ PHILLIPS PAN	HW 99 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 42 02801005	4-40; 1/4~ PHILLIPS PAN	HW100 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 43 02801011	10-32 X 1/2~ HEX HEAD WASHER SCRE	HW101 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 44 02801011	10-32 X 1/2~ HEX HEAD WASHER SCRE	HW102 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 45 02801012	4-40 X 3/8~ PHIL (PHMS)	HW103 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 46 02801014	SCREW; 4-40 X 3/8~ PFHMS	HW104 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 47 02801014	SCREW; 4-40 X 3/8~ PFHMS	HW105 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 48 02802003	4-40 X 1/4~ X 3/32~ HEX NUT/ZINC PLT.	HW106 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 49 02802003	4-40 X 1/4~ X 3/32~ HEX NUT/ZINC PLT.	HW107 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 50 02802003	4-40 X 1/4~ X 3/32~ HEX NUT/ZINC PLT.	HW108 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 51 02802007	6-32 X 5/16~ X 7/64~ ANGLE BRKTS	HW109 2811DH01	SCREW, TAPTITE,TRSHD 6-32 X3/8
HW 52 02802007	6-32 X 5/16~ X 7/64~ ANGLE BRKTS	HW110 28721007	SPACER 1/4 HEX NYLON 6-32
HW 53 02802007	6-32 X 5/16~ X 7/64~ ANGLE BRKTS	HW111 02801005	4-40; 1/4~ PHILLIPS PAN
HW 54 02802017	10-32 X 3/8~ X 1/8~ HEX STEEL NUT	HW112 02801005	4-40; 1/4~ PHILLIPS PAN
HW 55 02802017	10-32 X 3/8~ X 1/8~ HEX STEEL NUT	HW113 02801005	4-40; 1/4~ PHILLIPS PAN
HW 56 02803004	#4 INTERNAL TOOTH LOCKWASHER	HW114 02801005	4-40; 1/4~ PHILLIPS PAN
HW 57 02803004	#4 INTERNAL TOOTH LOCKWASHER	HW115 02803004	#4 INTERNAL TOOTH LOCKWASHER
HW 58 02803004	#4 INTERNAL TOOTH LOCKWASHER	HW116 02803004	#4 INTERNAL TOOTH LOCKWASHER

<u>REF#</u>	<u>RITRON#</u>	<u>DESCRIPTION</u>	<u>COORDINATES</u>	<u>REF#</u>	<u>RITRON#</u>	<u>DESCRIPTION</u>	<u>COORDINATES</u>
HW117	02803004	#4 INTERNAL TOOTH LOCKWASHER					
HW118	02803004	#4 INTERNAL TOOTH LOCKWASHER					
HW119	13523000	PANEL, TOP, RRX-450, VENTED					
HW120	25200500	PUSH IN FASTENER NYLON BLK .140 DIA					
HW121	2811DH01	SCREW, TAPTITE, TRSHD 6-32 X3/8					
HW122	2811DH01	SCREW, TAPTITE, TRSHD 6-32 X3/8					
HW123	2811DH01	SCREW, TAPTITE, TRSHD 6-32 X3/8					
HW124	2811DH01	SCREW, TAPTITE, TRSHD 6-32 X3/8					
HW125	2811DH01	SCREW, TAPTITE, TRSHD 6-32 X3/8					
HW126	14313007	RRX SHIPPING CARTON					
HW127	02100079	3-PIN POLARIZED RECEPTCL					
HW128	02100081	.093~ MALE CONTACT PIN					
HW129	02100081	.093~ MALE CONTACT PIN					
HW130	06001059	CORD, 3 CONDUCTOR, AC POWER					
	RD-451	STANDARD RITRON DUPLEXER					
C 306	01503036	4700UF ELT CAP 35V					
Q 306	04800019	TIP-42 40V 6A POWER TRANSISTOR					
F 301	05110005	FUSE 250V 3A					
F 302	05110005	FUSE 250V 3A					
F 303	05110018	FUSE 5X20 mm SLO-BLO 250V 3A					
VR301	05111002	130 VOLT VARISTOR					
VR302	05111002	130 VOLT VARISTOR					
VR303	05111002	130 VOLT VARISTOR					
T 301	05600039	POWER TRANSFORMER (4A SUPPLY)					
	06001007	#18 AWG/IRPVC, BLK 2"					
	06001113	RIBBON CABLE ASSEMBLY TX-CNTL					
	06001113	RIBBON CABLE ASSEMBLY RX-CNTL					
	06001115	CONTROL CABLE					
	06001116	EXT DC CABLE					
	RRX-MRM	MAINTENANCE AND REPAIR MANUAL					

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06/96 MODEL RRX-MRM

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