SCHEMATIC REFERENCE NUMBER PARTS LIST RTX-454

Ref.	RITRON#	Description
	25105600	SHIELD, RF, COVER, RTX PLUS
	25500100	BATTERY CONTACT "X" SERIES
	25101900	MOUNTING BRCKT, ANTENNA, "X" SERIES
	25601300	RUBBER JACK PLUG DUAL
	25601600	BATTERY SHIM; ASSEMBLY ~X~ SERIES
	25601700	FOAM SPACER; ~X~SERIES
	26200600	HEATSINK, R.F POWER, RTX SERIES
	06201009	NUT; SPANNER 7/16~-28 UNEF NICKEL PLATED
	28119101	#4 AB,TORX PH STEEL ZINC, 5/8"
	28722002	SPACER, PCB,.187 X .125 X .343
	25602600	BUMPER STRIP,PTT ACTUATOR,RTX
	28340602	WASHER,STNLS STL,PASSIVATED,.375X.250 ID
	25701300	GROUND STRAP REV B
	02802026	NUT; KNURLED; M4PO.5;/2.5MM JACK
	02802027	NUT; KNURLED; M6PO.5/3.5MM JACK
	28340602	WASHER,STNLS STL, PASSIVATED,.375X.250 ID
	02500120	BUSHING; ANTENNA "X " SERIES
	02802005	8-32 X 11/32 X 1/8 HEX NUT
	13220004	CASE ASSEMBLY; JBX/RTX; PTT,BATT.DOOR
	14200068	LABEL, FCC SERIAL, RTX-454
	14222015	INLAY; TOP PANEL; RTX
	25602300	FOOT, VINYL, ADHESIVE BACK
	25603300	GRILLE CLOTH, SPEAKER, SST
	28159102	SCREW, #4 AB, PH,T10 TORX, STNLS STL, 3/8 LG EACH
	01400672	MADE IN USA LABEL (REVISED)
	28722002	SPACER, PCB,.187 X .125 X .343
	25602600	BUMPER STRIP,PTT ACTUATOR,RTX
	28119101	#4 AB,TORX PH STEEL ZINC, 5/8"
	25800300	KNOB; CHANNEL
	25800400	KNOB; VOLUME "X" SERIES
	25103700	SHIELD, R.F., PARTITION, RTX, REV.A
	25702600	ASSEMBLY, RF SHIELD RTX WElded
	25101100	MOUNTING BRACKET "X" SERIES
	14222061	LABEL, NAMEPLATE, RTX PLUS SERIES
	01410052	FOAM; X-SERIES; INSERT
	AFM-450	ANTENNA, FLEX, MOLDED, 450-470 MHz
	BPX-8N-HC	BATTERY, (RED) 9.6V, HICAP. X-SERIES
	CBX-A	CLIP, BELT, BLACK, W/SCREWS, X-SERIES
	25500300	BELT CLIP "X" SERIES
	28141602	SCREW #6-32 PPHSTL YELCROM./BLK DYE
	28340601	WASHER, PLASTIC, .25"O.D.X .138"ID X .01
	14330003	BAG, PLASTIC, 3X5, .002
	14210004	LOW BATTERY NOTICE LABEL
	01410054	PLUG PAD FOR X-SERIES RADIO
	14500005	MANUAL, USER, RTX PLUS SERIES

TYPE OF EXHIBIT: INSTRUCTION MANUALS

FCC PART: 2.983 (d) (8)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODEL: RTX-454

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT07-450

DATE: November 30, 1998

The following pages are a draft of the Maintenance and Operating Manual for RITRON Model Patriot RTX-454 UHF-FM Handheld Transceiver.

Specifically, this manual includes a technical description of the RTX-454 sufficient to establish compliance with the technical standards of the applicable rule part(s).

This includes, but is not limited to, the following items required under FCC Part 2.983 (d):

(1) Type of emission.
(2) Frequency range.
(3) Range of operating power, and means to provide variation in operating power.
(5) DC voltage chart.
(7) Complete circuit diagrams.
(9) Tune-up procedure.
(10) A description of all frequency determining and stabilization circuits.
(11) A description of the circuits used to suppress spurious radiation, limiting modulation, and limiting power.

Signed: Kevin G Matson

Kevin G. Matson - Project Engineer

Date: 12/16/98

TABLE OF CONTENTS

INTRODUCTION

GENERAL

The RITRON RTX handheld is a programmable, 11-channel two-way radio that operates in a professional FM communications band (UHF or VHF available). This radio features top-mounted controls for on-off/volume and channel selection. Transmit and monitor push-buttons are built into the portable's side. Each channel can be programmed to contain a unique set of operating frequencies and options. These options include communications industry standard signaling formats: Quiet Call, Digital Quiet Call and Paging Quiet Call.

INSPECTION

Make sure the RTX package includes a Patriot radio, antenna, rechargeable battery pack, battery charger, belt clip and any optional accessories ordered. Examine the radio and accessories immediately after delivery; report any damages to your shipping company.

MODEL IDENTIFICATION

The model number appears on a label attached to the case back. This number indicates the radio's operating band. A "RTX-154" number means that the unit is designed to operate in the VHF FM band, on frequencies from 150 to 165 MHz. (Other 15 MHz bands between 138 and 174 MHz are optional.) "RTX-454" identifies the radio as UHF, for use on frequencies from 450 to 480 MHz.

Model	Band	No. Chans.
RTX-154	VHF	11
RTX-454	UHF	11

FCC REGULATIONS

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 his 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.

SAFETY STANDARDS

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

* DO NOT operate radio equipment near electrical blasting caps or in an explosive atmosphere.

* DO NOT position the radio antenna near the face, eyes or other exposed parts of the body while transmitting. Keep the radio vertical, two to three inches away while talking into the front panel grille.

* DO NOT operate any radio transmitter unless all RF connectors are secure and any open connectors are properly terminated.

* 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 press the Push-To-Talk button except when you intend to transmit.

* Repair of RITRON products should be performed only by RITRON authorized personnel.

BATTERY CARE

The RTX portable is powered by a rechargeable battery, which fits into the radio case battery compartment. A battery door and latch hold the pack in place.

CHARGING

The battery can lose its charge during storage and shipment, and should be fully charged before the radio is used. Thereafter, the battery should be charged overnight after each day of use, to ensure peak radio performance for the next day. Using the Ritron cube charger (model BC-A), the standard battery should charge completely in 16 hours. The optional High Capacity and Nickel Metal Hydride batteries require about 20 hours to charge completely.

The battery may be charged using either the cube charger or an optional RITRON drop-in charger. To charge the battery with the standard cube charger, refer to the "Charge Jack" section. For drop-in charger instructions, see "Drop-in Charger Contacts".

Note: A new battery must be cycled (charged and discharged) several times before it will reach its maximum charge capacity.

Typically, a battery's service life is one year. To ensure maximum service life, follow these guidelines:

* Do not discharge a battery that is already "run down." If the battery cannot power your radio, recharge the battery.

* Do not overcharge a battery. The battery should not be charged for more than 16 hours at a time.

* Before storing a battery, charge it for 16 hours. Thereafter, charge the battery for 16 hours once every 30 days.

With daily use and recharging, a battery's service life is about one year. It is time to purchase a new battery:

1) When the radio's transmitter coverage decreases or does not work at all,

2) When the radio quits working after just a few hours of use, despite a full overnight charge or,

3) If the battery is more than two years old. The date of manufacture is stamped on every battery. The first two digits indicate the year, the last two digits the week. For example, "9906" means that the battery was made in the sixth week of 1999.

BATTERY REMOVAL

To remove the battery, first unlock the door latch. Then press down on the door and slide it off the radio. Turn the portable over and tap the battery compartment against the palm of your free hand until the pack drops into your hand.

PRECAUTIONS

* Use only RITRON-supplied chargers; other chargers might cause fire, explosion, or otherwise damage the radio.

* Do not "fast-charge" a new battery pack. Otherwise, the battery might be damaged.

* Once the battery has been charged completely using the slow rate, the fast rate may be used thereafter.

* Do not fast-charge a battery pack that is fully charged. Doing so can shorten battery life.

* Do not charge or replace batteries in an explosive atmosphere. Contact sparking can ignite an explosion.

* Do not dispose of batteries in fire. An explosion might result.

* Do not charge the battery pack in temperatures colder than about 45 F. Electrolyte leakage can occur and ruin the battery.

  Charging in temperatures above approximately 95 F will not harm the battery, but reduces its charge capacity.

BELT CLIP INSTALLATION

The Patriot radio belt clip is designed to bend away rather than damage the radio case or break. The clip may be removed and then bent back into its original shape.

If you are going to attach the belt clip (model CBX-A) to your RTX portable, follow the instructions below.

1) The belt clip is fastened to the radio case back with the two screws and washers provided.

   CAUTION: Use only the screws included, since longer screws might damage the radio's electronics.

2) Carefully remove the peel-off tab from each of the belt clip attachment points. (Screw holes are located under the label.)

3) Place the belt clip on top of the radio case back, with the two screw holes in the clip aligned with the holes in the radio case.

4) Using the screws and washers that came with this accessory, attach the clip to the radio.

Note: If you later remove the belt clip, replace the screws and washers to seal out dirt, moisture, etc.

The radio's controls and accessory connectors are described on the next page.

MODEL RTX-454 SPECIFICATIONS

GENERAL

FCC ID: AIERIT07-450

FCC Rule Parts: 22, 74, 80, 90

Frequency Range: 450 to 480 MHz standard

Max. Freq. Separation: 30 MHz

RF Channels:
Conventional: 11 RX/TX or scan channels
Trunking: 11 Channels with 20 frequencies per channel

Synthesizer Step Size: 5, 6.25, 12.5 KHz

Frequency Stability: +/-2.5 PPM (-30 to +60 C) TX/RX

Tone/Code Signaling:
CTCSS (Quiet Call)
Digital Coded Squelch (Digital Quiet Call)
Two Tone Sequential (Paging Quiet Call)
LTR/Passport Truncking
Two-Tone Sequential Encode/Decode*
MDC-600/1200*
G-Star*

* Available in future firmware revisions

Power Supply: +9.6 VDC, 850 mAH rechargeable NiCad battery pack

Battery Drain:

Standby -	75 mA
Avg. Standby with Power Saver -	8.0 mA
Receive -	100 mA
Transmit -	1200 mA @ 4 Watts
	750 mA @ 2 Watts

Battery Life:
90/5/5 Duty Cycle

Standard battery(850 mAH):
8.1 Hrs, Battery Saver On, TX High Power
13.5 Hrs, Battery Saver On, TX Low Power
6.5 Hrs, Battery Saver Off, TX High Power
9.0 Hrs, Battery Saver Off, TX Low Power

Optional high capacity battery(1200 mAh):
11.5 Hrs, Battery Saver On, TX High Power
17.5 Hrs, Battery Saver On, TX Low Power
9.0 Hrs, Battery Saver Off, TX High Power
12.5 Hrs, Battery Saver Off, TX Low Power

Dimensions: 6.75" H x 2.5" W x 1.5" D

GENERAL (Con't.)

Weight:	18 oz. with battery pack
Antenna Fitting:	5/16" - 32 x 1/4" threaded
RF Test Jack:	50 ½, 2.5 mm jack (located beneath antenna fitting)
Earphone Jack:	3.5 mm, disconnects the internal speaker, for external earphone, speaker/microphone, programming key or cable connection
Microphone/PTT/Chg Jack:	2.5 mm, external speaker/microphone or wall charger
Controls:	Rotary volume/on-off, channel select, Push button PTT, monitor
Indicators:	Transmit/channel busy lamp, dual color, Red/Green Green Flashing - Channel busy Red - Transmit enabled
Enclosure Characteristics:	Impact resistant polycarbonate, with non-slip texture
Environmental:	Splash resistant and shock and vibration per RITRON Drop Test (6 ft. drop onto concrete on all six sides)
QC/DQC Decode Time:	per EIA Standards
Keypad Option:	4 rows by 3 columns, DTMF Encode

RECEIVER

Receiving System:	Track tuned, dual conversion superheterodyne	
I.F. System:	1st - 43.65 MHz 2nd - 450 KHz	
L.O. Injection:	Low side	
	Wide Mode	Narrow Mode
Sensitivity (12 dB SINAD):	0.30 µV	0.30 µV
Noise Squelch Sensitivity:	Programmable (per channel), factory set for 12 dB SINAD	
Adjacent Channel (EIA):	-70 dB	-60 dB
Spurious Rejection:	-70 dB	-70 dB
Image Rejection (EIA):	-70 dB	-70 dB
Intermodulation (EIA):	-70 dB	-70 dB

RECEIVER (Con't.)

Modulation Acceptance:	+/- 7.0 Khz	+/- 3.75 Khz
Frequency Response:	300 - 3000 Hz, de-emphasized	
Audio Output:	1 Watt into 8 ½, with less than 5 % THD @ the earphone jack	

TRANSMITTER

RF Power Output:	4 Watts minimum @ +9.6 VDC, Programmable (per channel) to 1-2 Watts typical	
	Wide Mode	Narrow Mode
Emission Designator:	16K0F3E	11K0F3E
Deviation:	+/- 5.00 KHz	+/- 2.50 KHz
FM Hum and Noise:	-46 dB	-40 dB
Audio Distortion:	< 3 %	< 6 %
Spurious and Harmonics:	-57 dBc	
Audio Response:	Meets FCC and EIA requirements	
Time-out Timer:	30 seconds, programmable	

RADIO CONTROLS & ACCESSORY CONNECTORS

ANTENNA

The flexible antenna radiates and receives radio signals. Before using the radio, make sure the antenna base is threaded fully into the radio's antenna bushing.

VHF and UHF antennas are not interchangeable. Use only the antenna type packaged with the radio. The RTX-150 portable comes with a VHF antenna, the RTX-450 with UHF. The UHF standard antenna (model AFM-450) is smaller in diameter than the VHF, and appears in FIG-2.

ON-OFF/VOLUME CONTROL

To switch on the unit, rotate this knob CW (clockwise) out of the "click" position. Further rotation increases the volume. Rotate this control CCW (counter-clockwise) into the off position if the radio is not being used.

CHANNEL SELECT

To select a channel, rotate the channel knob. If the channel knob is positioned to a blank channel, the radio's microcontroller automatically seeks the next lowest programmed channel. A short tone sounds with each click of the knob.

MONITOR BUTTON

Normally, pressing and releasing the monitor button toggles the unit between monitor and normal modes. These modes are described later on in the manual. (The way the monitor button works is programmable for Quiet Call channels.)

SPEAKER

The speaker allows you to hear incoming calls. Note that you can toggle the monitor button to mute broadcasts from users outside of your Quiet Call group.

TRANSMIT/BUSY LAMP

The transmit/busy lamp flashes green if the channel is in use, and lights red while the transmitter is activated.

PUSH-TO-TALK BUTTON

This push-button switch activates the transmitter, and must be held down while you talk into the radio. Release the PTT button to receive.

MICROPHONE

The microphone converts your voice into electrical impluses, which are carried with your broadcast to receiving radios. Hold the portable about two inches away while talking into the front grille. Shouting does not improve the listener's reception.

AUDIO JACK

The audio jack can be used to connect optional accessories, such as a remote speaker/microphone or an earphone.

Note: The remote speaker/microphone (model RSM-3X) has a two-plug connector. (The smaller plug is inserted into the charge jack.)

CHARGE JACK

The battery pack may be charged with the RITRON charger cube provided.

To use this cube (model BC-A), plug the charger's cord into the charge jack, which is marked "CHG" on top of the radio. Then plug the charger cube into an 110 VAC outlet. The charger's green lamp lights while the battery is charging, and should go off only when the cube is unplugged.

BATTERY DOOR

This door covers the battery compartment, holding the battery pack in place. (page 7) as you

To remove the battery door, unlock the door latch at the bottom of the radio (using your thumbnail or a dime). Slide the door away.

To install the door, align it with the battery compartment (the door's top edge faces the antenna). Place the door against the compartment and slide the door up, into the slots. After you replace the door, lock the door latch.

DROP-IN CHARGER CONTACTS

Three charger contacts, visible through the bottom of the radio case, allow the battery pack to be charged using an optional RITRON drop-in charger.

The battery pack may be charged inside or outside of the radio case. Plug the drop-in charger into an appropriate wall outlet. (To determine whether to use a 110 VAC or 220 VAC outlet, refer to the instructions packaged with the drop-in unit.) Set the portable or battery into the charger, three contacts facing down. Each battery contact must rest on a charger contact pin. (If the battery is charged separately, its label must face the back of the charger.)

An optional "fast rate" drop-in unit charges the standard battery pack in less than two hours.

TOUCH TONE KEYPAD (OPTIONAL)

If your Patriot radio has the Touch Tone keypad option, you can send Touch Tone digits. In conjunction with other equipment in your radio system, Touch Tone may enable you to:

1) Answer or originate telephone calls.

2) Page specific portable or mobile radios.

3) Control remote electrical equipment.

For more details, refer to the manual provided with your telephone interconnect or other radio system equipment.

Important: To send Touch Tone digits, you must hold down the radio's PTT while dialing.

A "sidetone" sounds in the speaker each time you enter a digit.

OPERATING INSTRUCTIONS

WHAT THE RADIO TONES MEAN

Ritron programmable radios respond to certain instructions by sounding a tone or series of tones. These tones can tell you whether a radio is working as you expect.

POWER ON/SELF CHECK "OK"

Switch on the radio by rotating the on-off/volume control knob clockwise out of the "click" position. The unit then runs a quick "self test." When the internal system checks confirm basic functions, the radio sounds a brief "confirmation tone" to indicate that the unit is in operating mode and ready for use.

ERROR TONES

However, if the self test detects a diagnostic error, an error tone sounds. One low-pitched tone means that the radio microcontroller is not working as it should. Alternating tones (the second is lower pitched) indicate that the radio frequency synthesizer is malfunctioning. If you get one of these messages, turn off the radio and try again. If you cannot correct a problem, consult an authorized Ritron service facility or Ritron.

Repeating error tones occur if you press the Push-To-Talk button while a "Receive Only" channel is selected. This is because a "Receive Only" channel does not contain a transmit frequency, which must be present for the radio to broadcast. The error tone repeats until you release the PTT.

One low tone sounds and the transmitter automatically shuts off if you hold the PTT button down continuously for a specified time (normally, 30 seconds). This transmitter time-out feature may be turned off or adjusted with the optional PC programming kit (model RPT-PCPK).

BATTERY LOW ALERT

Once the RTX portable's battery charge drops below a certain level, a short warning tone sounds every 15 seconds (while the radio is turned on). You should then charge the battery. A final, longer tone means that the battery is discharged and the radio has shut itself off.

CHANNEL SELECTION (IN OPERATING MODE)

Rotating the channel select knob switches channels. Each knob position is marked with a channel number (1 through B). The radio produces a brief confirmation tone each time you select a new channel. Note that this knob cannot move directly from channel 1 to channel B (or vice versa), but must be advanced through the other channels.
If the channel you select has not been programmed, the radio automatically operates on the next previous channel that has been programmed. If all previous channels are blank, the radio then checks channel B. If B is also blank, A is next, and so forth, downward through the remaining channels.

OPERATING MODES

You can hear calls with the RTX handheld in receive mode, and broadcast your voice with the radio in transmit mode. The radio automatically goes into "battery saver" mode if left idle.

RECEIVE MODE

The handheld can receive broadcasts while the Push-To-Talk button is not being pressed. Whether or not you hear these broadcasts depends upon the volume and squelch settings. To adjust the volume, rotate the on-off/volume control clockwise about one-third. Then press and hold the monitor button. After a few seconds, you should hear a rushing noise and any broadcasts on the channel. Squelch is now turned off. Set the volume as desired; then toggle the monitor button to restore squelch.

SQUELCH

HOW TO:

Squelch Noise - the handheld automatically squelches noise.
Squelch All Broadcasts On The Channel Except Those Carrying Your Quiet Call Code - switch to another channel and then back again.

Squelch is the function that mutes interference from other licensees and/or background noise.

There are two types of squelch used in RITRON programmable radios. First is carrier squelch. This lets you hear all broadcasts on your channel strong enough for the radio to detect, and silences noise. Second is Quiet Call (coded) squelch. This allows you to screen out "on-channel" broadcasts that do not carry the Quiet Call code programmed for your unit.

When a radio frequency is shared by several licensees in an area, coded squelch keeps other licensees' broadcasts from disturbing you and others in your radio network. When you select monitor mode (by toggling the monitor button), coded squelch is turned off and you can hear all communications on the channel, similar to a telephone "party-line."

MONITOR

HOW TO:

Hear All On-channel Broadcasts Within Range - press and release the monitor button.

Monitoring a channel lets you listen to all broadcasts on the frequency. Pressing and releasing the monitor button toggles the radio between normal and monitor modes. "Normal mode" means the radio is in receive, and Quiet Call squelch, if programmed for the channel, is activated. In normal mode, you hear only radios that transmit your Quiet Call code. In monitor mode, you hear all broadcasts on the channel.

The monitor button can turn off carrier squelch, too. Pressing and holding this button for about five seconds deactivates squelch so the radio speaker emits noise.

The mode (normal or monitor) in effect when you switch off the handheld resumes when you turn the unit on again. This is true regardless of which channel you select while the radio is turned off.

Determining Monitor Operation Programming

The monitor button can be programmed to operate in different ways. Determine which operating option is programmed for a unit by using the programming kit software, or perform the following test:

1) Select a standard transmit and receive channel not programmed with Paging Quiet Call or Channel Monitor Lock Out;
2) Press and release the monitor button;
3) Press and release the monitor button again.

* If, each time you press the monitor button you hear two tones, the unit is programmed for MOMENTARY monitor operation. This completes the test. MOMENTARY monitor operation means you press and hold the monitor button to hear all broadcasts on a channel, then release it to stop monitoring.

* If you hear one tone followed by two tones (or two tones followed by one tone), the radio is programmed for Toggle monitor operation. This completes the test. Toggle monitor operation means you press and release the monitor button to alternate between monitoring and coded squelch.

After monitoring, press and release the monitor button to activate Quiet Call squelch.

Monitoring a Channel Programmed with QC (Quiet Call)

MOMENTARY monitor operation - To monitor a channel programmed with QC squelch, press and hold the monitor button until you hear two beeps. This is followed by all radio traffic on the channel. Release the button to restore QC squelch.

TOGGLE monitor operation - To monitor a channel programmed with QC squelch, press and release the monitor button. You will hear two beeps, followed by all radio traffic on the channel. Press the monitor button again (one beep sounds), to restore QC squelch.

Monitoring a Channel Programmed with PQC (Paging Quiet Call)

MOMENTARY monitor operation - To monitor a PQC-programmed channel, press and hold the monitor button; the radio will emit three beeps. You will hear all broadcasts on the channel until you release the monitor button; then you will hear only calls carrying your QC code.

The radio will ring if paged, regardless of the squelch status. However, PQC squelch is disabled whenever you press the monitor button or receive a page. To quiet the radio, power cycle it, or switch to another channel and then back.

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If two beeps sound when you press the monitor button, you will hear pages and calls carrying your QC code.

TOGGLE monitor operation - To monitor a channel programmed with QC and PQC, press and release the monitor button; you will hear three beeps. This is followed by all radio traffic on the channel.

If you press the monitor button again, one beep sounds, and the radio will stay quiet unless it is paged. Unless it is programmed to work otherwise, the radio will not detect incoming messages coded with the assigned QC code of the channel unless you transmit. Transmitting allows you to answer a page and to also have two-way conversation with a caller transmitting your QC code.

Reset the radio to receive another page by pressing and releasing the monitor button until one beep sounds.

To hear and reply to QC messages without missing a page, press and release the monitor button again and two beeps will sound. A page will then sound an alert tone in your radio.

Press and release the monitor button again to toggle back to monitor mode (three beeps sound).

BATTERY SAVER MODE

The RTX handheld has a "battery saver" feature that conserves battery power. The battery saver constantly monitors the radio's transmitter, receiver and controls for activity. If ten seconds pass without the receiver detecting a call, and without the user operating a control, this feature removes power from most of the radio.

During this "off-time", any activity restores full power. Every few fractions of a second, the battery saver applies power to the receiver, checking for broadcasts. It is possible that the first part of an incoming call might go unheard before activity is detected and power restored. If this happens, the caller can repeat his message. Once "radio contact" is made, normal unhurried conversation will allow uninterrupted reception. (Note that scanning prevents the radio from going into battery saver mode.)

The battery saver cycle can be altered by an authorized RITRON dealer. Increasing the time that the radio can remain idle (before power is removed) exhausts the battery sooner. Decreasing this time conserves the battery, but slightly raises the chance that the first part of a call might be missed.

TRANSMIT MODE

Before transmitting, make sure the channel is not in use. Check the transmit/busy lamp, which flashes if the channel is busy. This occurs regardless of any code signaling programmed. Normally, you should not transmit until the channel is clear.

To transmit with the handheld, press and hold the PTT (Push-To-Talk) button and talk, with the radio two or three inches away. Speak in a normal tone, since talking louder will not improve the listenerÕs reception. Pressing the PTT button activates the transmitter and lights the transmit/busy lamp only if the channel contains a transmit frequency. The transmitter will not come on for a "Receive Only" channel. Instead, the radio speaker emits an error tone.

RITRON programmable radios feature a transmitter time-out function, which automatically terminates a continuous transmission that lasts for a specified time. (This time may be adjusted by authorized service personnel, using the RPT-PCPK programming kit.) The unit sounds a tone when the transmitter shuts off.

PROGRAMMABLE OPTIONS

RTX handhelds may be operated with options that are programmed on a per channel basis, including Quiet Call code signaling, scanning and special features.

QC (QUIET-CALL) CODE SIGNALING

HOW TO:

Turn Off QC Squelch - press and release the monitor button until you hear two beeps.
Turn On QC Squelch - press and release the monitor button until you hear one beep.
Turn Off QC Transmit - program the channel accordingly.

Code signaling allows you to screen out broadcasts from other systems on the channel. RITRON programmable radios come from the factory ready to operate with three communications industry standard signaling formats, including Quiet Call (QC), Digital Quiet Call (DQC) and Paging Quiet Call (PQC). Generally, "Quiet Call" refers to the entire family of RITRON signaling formats (QC, DQC and PQC), unless specified otherwise.

QC (QUIET-CALL)

Quiet Call is RITRON's tradename for what the communications industry calls sub-audible tone, tone squelch or CTCSS (Continuous Tone Coded Squelch System). A group can use a unique Quiet Call code to avoid the bother of "radio traffic" from other licensees. Units with Quiet Call squelch turned on stay quiet unless they detect the appropriate code on a broadcast.

Channels programmed with Quiet Call automatically transmit a code with your voice when you press the PTT button. This allows your message to be heard. Note that other nearby licensees on your channel can hear your transmissions unless they have another code enabled.

DIGITAL QUIET CALL

Digital Quiet Call is RITRON's tradename for digital coded squelch. DQC works the same as QC, except that a digital code is broadcast with your call. Units programmed with the correct code "recognize" the call and allow the message to be heard.

PAGING QUIET CALL

General

Paging Quiet Call (PQC) is RITRON's tradename for its selective paging system. Each radio or group of radios may have a unique PQC code. Any channel that contains an operating frequency can be programmed with one of these codes. (A channel programmed with PQC may also contain a QC code.) With a PQC channel selected and coded squelch activated, the radio speaker stays quiet until the programmed PQC code is received. A ringing tone announces an incoming call.

Each Paging Quiet Call code is broadcast as a unique pair of audible tones, with the first tone sent for one second, and the second tone for two seconds. PQC codes can be originated by a base station paging encoder, a telephone (via a RITRON RR-454 Repeater Plus/RP-200 system), or a RITRON programmable radio equipped with a Touch Tone encoder keypad.

Automatic Squelch Reset

To eliminate hearing other activity on the channel after a specific unit has been paged, the radio can be programed to automatically reset to paging mode after completion of the incoming voice message.

Message Alert Ring

When the radio is paged and rings, it will ring intermittently every munute to remind you a page was received. To cancel message alert, press the monitor button or the PTT button, or change channels.

QC Squelch Activated After Page is Received

After the radio receives a page and rings, QC squelch is activated so you will hear only calls carrying your programmed code. (Authorized dealers can reprogram this feature to allow all radio traffic on the channel following a page.)

QC Squelch Activated When PQC Channel Selected

Normally, when a channel programmed with PQC is selected manually or in a scan list, the radio is muted until it receives the correct PQC code. A dealer can program the PQC-equipped channel so it does not mute the receiver when it is selected. This allows selection and scanning of a channel, hearing calls carrying your QC code andl also having the radio ring if you are paged.

All-Call Code

Radios operated with PQC respond to a special All-Call code, as well as to their individual codes toallow one page to be heard by all "PQC" units on the channel. Standard RTX handhelds can transmit an All-Call page.

HOW TQ:

Send An All-Call Page -

1) *Select a channel programmed with Paging Quiet Call.*

2) *Turn off the radio.*

3) *Press and hold the PTT button while switching on the radio. Continue to hold down the PTT for six seconds.*

4) *Release the PTT.*

5) *Hold down the PTT and deliver your message.*

All-Call Transmitted through a Repeater

The radio can transmit All-Call paging and QC tones together to send an All-Call page through a repeater to call all radios on the channel set to receive a page. (QC activates the repeater.)

All-Call Decode

RTX radios set to receive a page will respond to an All-Call page, regardless of unique codes in each unit. The All-Call page is transmitted as a single tone (483.5Hz) for a duration of four seconds. All-Call can be disabled using the PC Programmer.

SCANNING (NORMAL/ PRIORITY)

HOW TO:

Scan - select the channel that contains your scan list.

Stop Scanning - change channels.

GENERAL

Scanning automatically lets you listen to broadcasts on different radio channels (frequencies). You may choose the channels to be scanned by creating a "scan list." This list of channel numbers is stored in a radio channel. A channel cannot hold both a scan list and an operating frequency.

HOW SCANNING WORKS

When you select a channel that contains a scan list, the radio pauses, sounds a tone, and then repeatedly checks each channel of the scan list in turn. Channels are scanned in the order that they were programmed into the list. When a broadcast is received on a channel being scanned, scanning stops to let you hear communications on that channel. Scanning resumes when the transmission ends.

If you want to know which channel received the last broadcast, move the channel selector slowly through the channels. When the last active channel is selected, the radio emits a "triple beep."

Using the monitor button does not interrupt scanning, and scanning automatically continues after you make a call (and release the PTT).

Answering Calls Received During Scanning

The RTX handheld may be dealer-programmed to transmit on either the last active channel or the priority channel when the user presses the PTT (Push-To-Talk) during scanning.

Finding the Caller's Channel

If you want to know which channel received the last broadcast when the radio is scanning, rotate the selector slowly through the channels. The radio will sound a "triple beep" at selecting the most recent active channel.

NOTE: When you call another unit, state shich channel you are using so that other users can determine which channel toreply to you on.

Transmit on Priority or Last Active Channel

Channels that contain a scan list may be programmed to stop on the priority or last active channel when you press the PTT. This lets you transmit on the caller's channel if you want to respond.

PRIORITY SCANNING

Priority scanning lets you monitor other channels without missing a call on your priority channel, which the radio periodically checks for activity even when scanning has stopped on another channel. Priority scanning works only if the scan list programmed is a Priority Scan List, not a Normal Scan List.

Priority Channel Alert Beep

If the radio is in priority scan mode and a signal on the priority channel is received, the radio will emit a beep.

BUSY CHANNEL DELETE

If a channel in the scan list is so busy that you want to temporarily delete that channel from the list, press the monitor button while scanning is stopped on the channel to be deleted. (The priority channel in a Priority Scan List is an exception, and cannot be removed.) The monitor status will not change. The deleted channel will be skipped in the scan list until you switch channels. You may delete more than one channel in the list.

SPECIAL FEATURES

Each radio channel can be "dealer or factory" programmed to operate with any combination of special features. The features listed below are "PTT programmable." Other features are available, but require a PC to set.

RECEIVER SQUELCH TIGHTENER FACTOR

This feature reduces distant "co-channel" or other interference for channels that are not programmed with Quiet Call. Carrier squelch is set for maximum sensitivity at the factory, but may be adjusted (by authorized service personnel) to mute weak signals.

CHANNEL MONITOR LOCK OUT

This function may be programmed to keep the radio user from listening to other licensees on a shared channel. The transmit/busy lamp indicates whether the channel is busy. Quiet Call or Digital Quiet Call must be used with this option.

BUSY CHANNEL TRANSMIT INHIBIT

Busy Channel Transmit Inhibit keeps the radio from broadcasting if the channel is busy, and is often used in conjunction with Channel Monitoring Lock Out. If you press the PTT when the channel is busy with a signal not intended for your radio (not carrying your Quiet Call code), this feature sounds a "busy" tone in the speaker and keeps the transmitter turned off.

REDUCED TRANSMIT POWER

This feature allows for reduced transmitter power on individual channels, which might be required by the radio owner's FCC license. Reduced transmit power also conserves the battery charge.

PAGING QUIET CALL TRANSPOND

If you receive a page and do not answer within three seconds, this feature automatically keys your radio's transmitter and sends an "acknowledgement" tone to the calling party.

RTX-454 PROGRAMMING INSTRUCTIONS

Each RTX-454 may be programmed for 11 channels, with up to 20 frequencies programmed on any single trunking channel.

How To Program The Radio

RTX-454 programming requires an optional Ritron programming kit. This kit allows you to program any frequency within the band and channel spacing of the radio model. This method also lets you customize the handheld with optional operating features.

How To Find Out What Is Already Programmed

If you do not know what frequencies, tone codes and options are programmed in a radio and want to find out, you can do a contents readout using the PC Programming Kit.

Return To Normal Operation

After you finish programming, turn the radio off and then on again. The radio will beep when it is ready for normal operation.

COMPUTER SOFTWARE COPYRIGHTS

Programming The Radio Using A PC Computer

Ritron's programming kit allows programming of the RTX-454 model radios using a PC compatible computer. (This kit also allows programming of SST-454 handhelds.)

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 radio and computer memory, and includes on-screen instructions and help. Radio data may be saved to the computer's hard disk in order to program other radios.

The PC Programming Kit Includes:

1) Ritron Transceiver Programming software, which is contained on one 3.5" diskette.

2) Installation instructions (RITRON #01454947) 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 the RTX-SRVBD modular jack.

or,

4) An adapter for use with RTX-454 portables. This adapter mates the modular plug to a 3.5 mm plug, for connection to the handheld's audio jack.

The PC Programming 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.

Programmable Features

The list below indicates whether each feature may be programmed on a per channel basis, or will affect all channels together.

Feature	Range	Standard Setting	Per Channel
Battery Saver Enable	Y-N	Yes (except trunking)	√
Battery Saver Off Time			
Beep Volume Fixed	Y-N	Yes	√
Busy Channel Tx Inhibit	Y-N	No	√
Carrier Only, No Tones or Codes			
Compressor On	Y-N	No	√
Digital Tone Invert RX	Y-N	No	√
Digital Tone Invert TX	Y-N	No	√
Digital Quiet Call (DCS)	-	-	√
Disable Monitor	Y-N	No	√
Expander On	Y-N	No	√
Flash green LED on Carrier Detect	Y-N	No	
LTR Trunking	-	-	√
Narrow Band Channel	Y-N	No	√
Passport npNTS Trunking	-	-	√
QC Decode Pre-load	Y-N	Yes	√
Quiet Call (CTCSS)	-	-	√
Quiet Call Encode Only	Y-N	No	√
Quiet Call Transmit Hang Time	0-468 ms	188 ms	
Quiet Call Serarate Encode/Decode			√
Receive Squelch Tone	Y-N	No	√
Squelch Set Point		12dB SINAD	√
Squelch Tightener	Y-N	No	√
Transmit Activate Tone	Y-N	No	√
Transmit Power	L-H	High	√
Transmit Time Out Timer (60 s)	Y-N	Yes	√

Descriptions Of Features

Battery Saver - Enabling this option allows the radio to go into battery saver mode when the radio remains idle. The power strobe begins after eight seconds of inactivity.

Battery Saver Off Time - This is the time that the radio must remain idle before the battery saver begins cycling.

Beep Volume Fixed - Disabling this will allow all beep tones to be adjusted by the position of the Volume Control.

Busy Channel Transmit Inhibit - This keeps the radio from broadcasting if the channel is busy, and is often used in conjunction with Disable Monitor. If you press the PTT when the channel is busy with a signal not intended for your radio (not carrying your tone code), this feature sounds a "busy" tone in the speaker and keeps the transmitter turned off.

Compressor On - Enabling this will activate transmit audio compressor circuitry.

Digital Quiet Call RX Invert - The programmed code is inverted for receive mode only.

Digital Quiet Call TX Invert - The code is inverted for transmit mode.

Disable Monitor - This function may be programmed to keep the radio user from listening to other licensees on a shared channel. QC, DQC or trunking must be used with this option (although, not the encode only feature).

Expander On - Enabling this will activate the receive audio expander circuitry.

Quiet Call (CTCSS) - Programming a Quiet Call code allows you to screen out transmissions that do not carry your code. Your code is broadcast when you press the PTT to make a call.

Quiet Call Encode Only - The Quiet Call code programmed for the channel is transmitted with your calls. However, Quiet Call is turned off during receive mode, allowing all traffic on the channel to be heard.

QC Decode Preload - For a short time after transmitting or receiving a signal with the proper Quiet Call tone, the radio unsquelches when any on-channel signal is present. Until it has time to decode the tone, the radio "assumes" that the correct tone is present. Once the tone is decoded, the radio squelches or unsquelches accordingly. This keeps radio users from missing the first portion of a transmission once radio contact has been made.

Quiet Call Transmit Hang Time - This is the time that the phase reversed Quiet Call tone is transmitted after the PTT is released.

Receive Frequency - The radio frequency that receives broadcasts from other units.

Receive Squelch Tone - The receiving radio beeps at the end of each received transmission.

Squelch Tightner - This feature reduces distant "co-channel" or other interference for channels that are not programmed with Quiet Call. Carrier squelch is set for maximum sensitivity at the factory, but may be adjusted to mute weak signals

Transmit Activate Tone - The radio will automatically beep each time the PTT is pressed. This beep is not heard in the receiving radio(s). (This is a short, high-pitched tone, unlike the long, low-pitched tone of the busy channel transmit inhibit feature.)

Transmit Time Out Timer - This feature automatically shuts off the transmitter (ending your call) if you hold down the PTT button continuously for 60 seconds. The radio sounds a tone when the transmitter shuts off.

RTX-454 THEORY OF OPERATION

INTRODUCTION

The RTX-454 is an eleven-channel handheld transceiver built on a two multilayer printed circuit boards with a separate TCVCXO reference oscillator module. Both sides of the two main printed circuit boards are populated with components, with the bottom side of one of the main boards containing only surface mounted components.

The RTX-454 is frequency synthesized, with all functions of the radio controlled by a microcontroller.

POWER SUPPLY AND VOLTAGE DISTRIBUTION

The RTX-454 is powered by an internal 8-cell rechargeable battery pack. The battery pack supplies power to the radio via two contact terminals, P601 and P602, that are connected to the PCB. F101 is a 3A fuse in series with P601 for short circuit protection. The battery pack may be charged through 2.5 mm charge jack J101 via CR102 and F101. Zener diode CR401 prevents the batteries from discharging through the charger accessory, stops a reverse voltage from being applied to the battery pack through J101, and prevents a high voltage from being applied to the radio circuitry.

The ON/OFF switch, SW103, is closed and battery voltage is sensed at pin 53 of IC101 through voltage divider R175/R176. Pin 49 of IC101 goes high to turn on Q110A which turns on Q110B to apply +Vsw to the input of IC104, a +5 VDC regulator, and the low battery detection circuit.

+5 VDC regulator IC104 supplies power directly to microcontroller IC101, Monitor Switch SW101, Channel Control R102, Volume Control R105, Power Strobe transistor Q108B, and PTT detect transistors Q103/Q104.

Voltage is supplied to the synthesizer and receiver through Q505A /Q505B and IC506. When pin 6 of IC101 is high, Q505A turns on Q505B. The output of Q505B is set to approximately +7 VDC through R520/R521. The +7 VDC is connected to the input of IC506, a +5VDC voltage regulator, the charge pump of synthesizer IC301, and to Q305. Q305 is configured as a super-filter to supply a ultra filtered voltage to the VCO and VCO Buffers. The output of IC506 supplies +5VDC to the synthesizer IC301, the TCVCXO Module, and receiver voltage switch Q504A/Q504B. When the transmitter is off, there is no voltage at the base of Q504B and +5VDC is supplied to the receiver circuitry from the output of IC506. When the transmitter is on, Q504B is turned off disabling the receiver circuitry.

The transmitter is supplied voltage through Q401/Q402 and Q404/Q405/Q406. Battery voltage is connected to the emitters of Q401 and Q405. When pin 20, Tx Enable, of IC101 goes high, Q402 turns on Q401 and Q406 turns on Q405. The output of Q401 is set to +7VDC via R404/R405 and is connected to the 1st amplifier stage of IC401 and to the receiver voltage switch Q504. The output of Q405 is set to +7VDC via R409/R410 and is connected to the 2nd amplifier stage of IC401. Q404 and R408 are used to lower the voltage at the output of Q405 when in the Low Power Mode.

POWER STROBE

The RTX-454 handheld includes a power strobe feature, which reduces battery current drain by periodically removing voltage from part of the radio. The strobe duty cycle is programmable, and can be selectively applied to any programmed channel using the Plus Series PC Programming Kit. The +5VSW power strobe output at Pin 6 of IC101 controls Q108A and Q505A. Q108A controls Q108B which switches the regulated +5 VDC to the audio processing circuitry. This includes IC108B 2 VDC (Vag) for bias on audio processing circuitry, IC107A audio high pass filter, IC106A and IC106C audio low pass filter for sub-audible frequencies, IC106B audio limiting amplifier, IC109 digital

potentiometers, IC105 audio gates, IC107B audio low pass filter, IC108A audio summing node amplifier, and IC102 audio compander. Q505A controls Q505B which switches the TCVCXO reference oscillator, the synthesizer IC301, the VCO and VCO buffers, and the receiver circuitry.

LOW BATTERY VOLTAGE DETECTION

Battery voltage is measured at A/D input Pin 38 of IC302 through voltage divider R120/R121. The radio will emit a periodic beep if low battery voltage is detected, and will emit a long tone and turn the radio off if the battery voltage drops below +7.5 VDC. This is to protect the microcontroller and its EE memory from corruption due to low supply voltage.

REFERENCE OSCILLATOR

Reference oscillator Y302 is a 1.5 ppm temperature controlled, voltage controlled oscillator (TCVCXO) operating at 14.4 MHz. The Pin 4 output of the TCVCXO provides a reference for the frequency synthesizer, and is multiplied up to 43.2 MHz by Q506 and its associated circuitry to provide a receiver 2nd local oscillator signal.

SYNTHESIZER MODULE

The RTX-454 radio is built around a common phase-locked loop (PLL) that consists of a voltage controlled oscillator (VCO) and a frequency synthesizer. The PLL generates both the receiver 1st local oscillator and transmitter carrier signals. The frequency synthesizer and VCO are both contained in shielded sections of the RTX-454 RF Board. Control signals from microcontroller IC302 and Reference oscillator Y302 are routed to frequency synthesizer IC301 per the following chart:

	Clock	Data	Latch	LD	T/R SW	REF	+5SW	+7SW
IC101	62	12	7	64	5	-	-	-
Y302	-	-	-	-	-	4	2	-
IC301	18	19	17	2	-	20	12, 14	5

Q305, CR304, C321 and associated components provide a filtered supply for the VCO oscillator and buffer amplifiers.

PRESCALER DIVIDER/SYNTHESIZER CONTROLLER

IC301 contains both a prescaler and synthesizer controller. The prescaler squares and divides the VCO output present at pin 11 by either 64 or 65, determined by a synthesizer controller logic signal. The exact number of times the prescaler is instructed to change divisors is determined by the channel frequency.

IC301 contains a digital phase detector that works as follows: when an operating channel is changed or the receive/transmit mode switched, a new synthesizer operating frequency is selected. Microcontroller IC101 clocks new data into IC301 internal buffer in syncronization with clock pulses. The channel information is stored in EE memory of IC101 and is loaded into RAM when the radio is initially powered up.

Once new data is loaded into the buffer, a single pulse from IC101 appears at IC301 to instruct the synthesizer controller to latch and execute the new data. IC301 utilizes internal circuitry to determine wheather the present VCO output frequency is correct by comparing the phase and frequency of the VCO signal at Pin 11 to the 14.4 MHz reference oscillator at Pin 20. IC301 produces an output signal at Pin 6, a single-ended phase/frequency detector output, proportional to the phase difference between the two input signals.

The loop filter C323, C322, R318, R319, R317, and C319 transform the Pin 6 output signal to a DC voltage for application to the VCO tuning varactor CR301. The synthesizer system is "locked" when the phase and frequency of both the reference and the divided VCO signal are the same.

The maximum amount of current this output can sink or source is determined by the value of R323 tied to Pin 8 of IC301, with the output current programmable to 25, 50 or 100% of maximum.

VCO/BUFFER AMPLIFIERS

Q302, L302, CR301 and associated components form the VCO (Voltage Controlled Oscillator), a resonant circuit that oscillates at frequencies from 406 MHz in receive (receive frequency - 43.65 MHz) to 480 MHz in transmit. Varying the voltage at CR301 changes the varactor's capacitance, which in turn alters the VCO output frequency. When in transmit mode a +5 VDC T/RSW signal is applied to Q303, which turns on Q304 to draw current through pin diode CR303 and L305. With CR303 biased on, L303 is effectively shorted to ground, shifting the VCO frequency up 43.65 MHz. Q301 and Q306 are buffer amplifiers, with Q306 feeding in the input of the synthesizer at Pin 11, and Q301 feeding the receiver 1st local oscillator signal at pin 4 IC501 and the transmitter signal to pin 1 IC401.

OSCILLATOR MODULATION

When the RTX-454 is in transmit, modulation balance control IC109E passes TX audio through to the VCO modulation input at J301 Pin 5. TX audio is applied to varactor CR302 to modulate the VCO. TX audio is also routed to the Pin 1 input of TCVCXO reference oscillator Y302 via J301 pin 8. Low frequency tones modulate the reference oscillator because the synthesizer is not able to track them.

DIGITAL POTENTIOMETERS

IC109 contains 6 digital potentiometers programmed by IC101, sharing the same clock and data outputs used by the synthesizer and a seperarate Digital Pot Latch signal from Pin 33. The digital potentiometers are used in conjunction with IC108A, a summing node amplifier used for modulating the VCO and reference oscillator. IC109A, B, C, D, and E can only be changed through serial programming, and can only be performed by an authorized licensed RF technician.

IC109A and IC109B are connected through R168 and R169 to the Pin 2 input of IC108A. IC109A and B adjust the DC output of IC108A to tune the reference oscillator frequency, with IC109A providing a coarse tune and IC109B a fine tune.

Volume control IC109F applies the processed voice band signals at IC102 to audio amplifer IC103 in receive mode. Rotating the volume control R105 clockwise increases the setting of IC109F while rotating R105 counter-clockwise decreases it.

Transmitter tone deviation control IC109D applies the output of the selective signalling low-pass filter IC106C to the Pin 2 input of IC108A through R171. IC109D is completely closed in receive mode.

Transmitter modulation balance control IC109E is used to apply the Pin 1 output of IC108A to the VCO modulation input at J301 Pin 5. This sets the ratio of the modulating signal applied to the VCO and the reference oscillator. IC109E is completely closed in receive mode.

Tranmsitter voice deviation control IC109C applies the processed voice band signals at IC107B to the Pin 2 input of IC108A through R170/C205. IC109C is completely closed in receive mode.

RECEIVER

As mentioned before, Q504B switches the regulated +5 VDC to the receiver. The +VRX receiver voltage is switched at the strobe duty cycle if programmed for power strobe.

RF AMPLIFER

A received signal from the antenna passes through a low-pass filter (L413, C431, C432, L415, C430, L412, C429) and L411 to the receiver headend. L501, L502 and the associated capacitors form a bandpass filter ahead of low-noise RF amplifer Q501. L503 and C509 provide a notch at the receiver image frequency, 87.3 MHz below the receive frequency. The amplifed RF signal is applied to a 4-pole bandpass filter consisting of L505, L506, L507, L508 and associated capacitors. This fixed tuned circuit has a 30 MHz bandwidth of 450-480 MHz.

1st MIXER

The amplified received input signal is applied to the Pin 8 input of IC501, a duoble-balanced mixer configured for single-ended output. The 1st local oscillator signal from the synthesizer is applied to the Pin 4 input of IC501, with C554 coupling the 43.65 Mhz output signal at Pins 5 and 6 to YF503 and YF504, a 43.65 Mhz 4-pole crystal filter bandpass. Q502 and associated components amplify the 43.65 MHz IF signal and apply it to the input of the 2nd mixer at Pin 16 of IC502.

FM RECEIVER SUBSYSTEM

A multi-function integrated circuit, IC502 and associated components for the FM-receiver subsystem. The subsystem performs the following functions: 1) 2nd mixer, 2) 2nd IF amplifier, 3) FM detector,and 4) noise amplifier.

The Pin 4 output of 14.4 MHz reference oscillator Y302 is multiplied up to 43.2 MHz by Q506 and associated components. This signal is applied to the 2nd local oscillator input at Pin 1 of IC502. The 43.65 Mhz signal at Pin 16 and the 2nd local oscillator are mixed, with the resulting 450 Khz output signal appearing at Pin 3. This signal is filtered by a 450 Khz 4-pole ceramic filter YF501 and applied to the common of a SPDT switch pin 5 IC503. The N.C. connection pin 4 IC503 is connected to the N.C. connection of SPDT switch IC504. The common of IC504 is applied to the input of the limiting IF amplifier at Pin 5 IC502. Pin 8 IC101 is connected to pin 1 of IC503 and IC504. When toggled high, IC503 and IC504 switch to the N.O. connection. This allows the 450KHz signal to pass through both YF501 and YF502 before being applied to pin 5 IC502. YF502 is a 4-pole +/-4KHz filter and is switched when used in the narrowband mode for better adjacent channel rejection. IC502 Pin 6 is the decoupled input to the IF amplifier, Pin 7 the limited IF output signal. An internal quadrature detector, whose center frequency is determined by 450 KHz ceramic discriminator Y501, detects the FM IF signal. One input of the quadrature detector is connected internally to the IF signal at Pin 7, while the other detector input is the phase-shifted signal from Y501 at Pin 8. SPDT switch IC505 is used to switch in R517 to keep the demodulated audio level constant when pin 8 IC101 is toggled high for narrow band mode.

Demodulated audio appears at Pin 9, where a low-pass filter (R516, C536) removes spurious quadrature output prior to application to the voice/tone conditioning audio circuitry. Demodulated audio from Pin 9 is applied to the Pin 10 input of a noise filter/amplifier consisting of R511, C537, C538, R512, R513, R514 and R515. The Pin 11 output of the noise amplifier is applied to a biased noise detector Q503A/Q503B, with the output connected to an A/D input of IC101 at Pin 39. The RTX-454 is serial programmed to set the squelch threshold and hysteresis.

VOICE/TONE CONDITIONING IN RECEIVE MODE

RTX-454 audio conditioning filter circuits are shared with the transmitter. The same high-pass filter/amplifier (IC107A and associated components) used in receive voice band conditioning is used

in the transmit band. Similarly, the low-pass filter (IC106C and associated components) used for selective signal tone decode filtering is also used for selective signal encoding. Altering circuit configuration with bilateral switches IC105A, B and C permits the use of the same audio filtering system for both transmit and receive modes.

After R516 and C536 remove the 450 KHz element from the demodulated audio output at Pin 9 of IC502, C138 couples the audio signal to bilateral switch IC105B for subaudible tone detection and connection to IC105B for voice band audio processing.

VOICE BAND

Bilateral switch IC105C passes the received audio signal to the input of IC107A, which along with its associated components for a high-pass filter/amplifier circuit that attenuates audio signals below 300 Hz. The output of IC107A is applied to the input of IC106B limiting amplifier. Bilateral switch IC105A is switched in receive to insert C148 into the feedback circuit of IC106B, providing de-emphasis of the received audio signal. The output from IC106B is applied to the input of IC107B, which along with its associated components form an 18dB/octave low-pass filter for frequencies above 3000 Hz. The output of IC107B is connected to the expander input pin 14 IC102. The expander output pin 15 IC102 is connected to the input of a unity gain amplifier pin 9 IC102. The output of the amplifier is connected to IC109F volume control prior to connection to audio amplifier IC103. Pin 28 IC101 is connected to pin 8 IC102 and enables/disables the compress/expand(compand) function of IC102. When pin 8 IC102 is high, the compand mode is disabled and the gain from pin 14 to pin 15 is unity. When pin 8 is low, the compand mode is enabled and audio signals below a certain level are attenuated and signals above a certain level are amplified. When used in conjunction with a compressed transmitted signal, the signal to noise ratio increases allowing for clearer sounding audio. The output of IC107B is also connected to IC109C voice deviation control, which is completely closed in receive mode to prevent received signals from modulating the VCO and reference oscillators.

In receive, pin 4 IC102 is toggled high to mute the compresser portion of IC102 such that the audio path is open so that receive audio from pin 1 IC107A does not pass through IC102 pins 2 and 3.

Audio frequency tones from Pins 15 and 16 of microcontroller IC101 are applied to the Pin 13 input of IC106B to provide the RTX-454 alert tones.

SUB-AUDIBLE

Bilateral switch IC105B passes the received audio signal to the input of IC106A, which amplifies the signal and applies it to the Pin 8 input of IC106C, a 6-pole low-pass filter that attenuates frequencies above 250 Hz. The output at Pin 3 is applied to an A/D input of IC101 at Pin 36 for tone decoding. An internal digital signal processing routine programmed into microcontroller IC101 is used to decode the correct selective signalling code. The output at Pin 3 of IC106C is also connected to tone deviation control IC109D, which is completely closed in receive mode to prevent received subaudible tone signals from modulating the VCO and reference oscillators.

AUDIO AMPLIFIER

Receive audio from volume control IC109F is applied to the Pin 2 input IC103, a 1 Watt audio amplifier. C133 couples the Pin 5 output to the internal 8Ω speaker SP101 via audio jack J102.

Microcontroller IC101 Pin 19 switches DC power to the audio amplifier by turning on Q106, which then turns on pass transistor Q105 to apply battery voltage to Pin 6 of the audio amp. CR106 prevents an inadvertent DC voltage at J102 from damaging the audio amplifier.

ANTENNA SWITCHING/LOW-PASS FILTER

A low-pass filter comprised of filter L413, C432, C431, L412, C429, C430, L415, and C429 removes harmonics from the transmitter output before applying the RF signal to the antenna. Received signals pass through the low-pass filter before entering the receiver RF amplifier circuitry.

Two PIN diodes (CR402, CR501) and associated components form the antenna switching circuit. With the RTX-454 in receive mode, no voltage is applied to the PIN diodes and they do not conduct. This reverse biases CR402 to prevent the transmitter amplifier from affecting the receiver tuning and removes CR501 from the receiver input. Incoming signals from the antenna pass through the low-pass filter, then L411 and C501 to the receiver headend.

When the RTX-454 is switched into transmit mode, transmitter supply voltage is switched on by Q401 and Q402 and applied to R407. Current flows through R407, L410, CR402, L411 and then CR501 to ground, forward biasing the PIN diodes. CR402 passes transmitter RF power to the antenna while CR501 shunts the receiver RF amplifier input to ground. L411 provides sufficient impedence to isolate the transmitter power from the receiver RF amplifier.

TRANSMITTER

KEYING

The RTX-454 transmitter is keyed when PTT switch SW102 is depressed. Electret condenser microphone MC101 is connected in series to ground with the PTT switch, which when depressed draws current through MC101, SW102, CR105 and R113 to turn on pass transistor Q103. Q103 then turns on Q104 to pull the TX Key Pin 2 input of microcontroller IC101 low. The microcontroller TX Enable output at Pin 20 then goes high to turn on Q406, which turns on pass transistor Q405, and pin 20 also turns on Q402 which turns on Q401 to apply +7VDC and +VTX to the transmitter as described previously. The transmitter can also be keyed through J101 with an audio accessory that inserts a microphone and PTT switch in series to ground, drawing current through CR105. The internal PTT switch SW102 is connected to the Pin 23 PTT input of IC101, allowing the radio to distinguish between an internal or external PTT. This is necessary for certain audio accessories and for VOX operation.

+VTX SUPPLY

With the transmitter enabled as described above, the +VTX voltage from Q405 is applied to the 2nd stage of RF amplifier IC401 and +7VTX from Q401 is applied to the 1st stage of RF amplifier IC401. The transmitter RF final amplifier Q403 is powered by the battery supply.

The Pin 20 TX Enable output of microcontroller IC101 can be PC programmed to hold the transmitter on after the PTT switch has been released to allow tone related turn-off codes for squelch tail elimination.

POWER AMPLIFIER

IC401 and associated components amplify the VCO signal and apply it to the base of RF Final amplifer transistor Q203. The output of Q403 is matched to the antenna switching circuitry through L408, L409, C424, and C425 and applied to the antenna through the low-pass filter.

The RF power output is programmable by a licensed RF technician. The RTX-454 can be programmed on a channel-by-channel basis for low or high power operation. The power control output at Pin 8 of IC101 is applied to the base of Q404, whose collector is connected to the emitter of

Q406 through R408. The state of pin 8 IC101 determines if R408 is switched in or out to set the voltage at the collector of Q405. High power is 4 Watts and low power is 1-2 Watts.

VOICE/TONE CONDITIONING IN TRANSMIT MODE

RTX-454 audio conditioning filter circuits are shared with the receiver. The same high-pass filter/amplifier (IC107A and associated components) used in receive voice band conditioning is used in the transmit voice band. Similarly, the low-pass filter (IC106C and associated components) used for sub-audible tone decode filtering is also used for tone encode. Altering circuit configuration with bilateral switches IC105 A, B and C permits the use of the same audio filtering system for both transmit and receive modes.

VOICE BAND

MC101 microphone audio is passes through CR105, C118, and a 4X amplifier and is switched by IC105C to the input of IC107A, which along with its associated components form a high-pass filter/amplifier circuit that attenuates audio signals below 300 Hz. The output of IC107A is applied to the input of the compresser IC102 pin 3. Pin 4 IC102 is toggled low to allow audio to pass through pins 2 and 3 of IC102. The output of the compresser portion of IC102 pin 2 is connected to pre-emphasis circuit C200/R160 and then to the input of IC106B limiting amplifer. Bilateral switch IC105A switches R137, C147, and C148 out of the circuit. The output of IC106B is applied to the input of IC107B, which along with its associated components form an 18 dB/octave low-pass filter for frequencies above 3 KHz. The output of IC107B is applied to voice deviation control IC109C, which sets the level of the processed transmitter audio applied to summing node amplifer IC108A used to modulate the VCO and reference oscillator.

For compresser operation, pin 8 IC102 is toggled low. Audio signals at pin 3 IC102 that are above a certain level are attenuated and audio signals below a certain level are amplified at pin 2 IC102. When used in conjunction with an expanded receive signal, the signal to noise ratio increases allowing for clearer sounding audio.

SUB-AUDIBLE

Microcontroller IC101 generates the sub-audible selective signalling encode waveforms at Pins 17 and 18 and applies them to the input of buffer amplifier IC106A. The output of IC106A is applied to the input of IC106C, a 6-pole low-pass filter that attenuates frequencies above 250 Hz. R146 and C156 set the corner frequency of the low-pass filter, with C155 switched in by Pin 25 of IC101 to lower the corner frequency for lower tones. The output of IC106C is applied to tone deviation control IC109D, which sets the level of the transmitter sub-audible encode tones applied to summing node amplifer IC108A used to modulate the VCO and reference oscillator.

MICROCONTROLLER

The RTX-454 handheld transceiver is electronically controlled by IC101, an 8-bit microcontroller. IC101 ROM is flash programmable by authorized RF service technicians to allow in circuit upgrades to the operating system for new or improved features. The microcontroller contains the EEPROM memory used to store the radio channel frequency and configuration information. IC101 has fifteen 8-bit A/D inputs for processing analog signals. Y101 and and associated components provide an 8 MHz clock oscillator for the microcontroller.

PIN	DESCRIPTION
1	UNUSED
2	TX KEY input is pulled LOW when either the internal or external PTT switch is pressed to initiate transmitter operation.
3	POWER ON RESET is momentarily LOW when the radio is first powered up to provide a reset for the microcontroller.
4, 26	SERIAL DATA INPUT links the microcontroller to communications from an external data terminal via J102 RING connection. This allows programming of the RTX-454 EEPROM memory used to store channel frequency and configuration information, and the FLASH ROM that contains the radio operating system.
5	T/R SWITCH output is connected to the Synthesizer module to shift the frequency of the VCO oscillator used in both transmit and receive. The output is HIGH in transmit and LOW in receive.
6	STROBE output goes LOW at a programmable periodic rate to remove the +5VSW supply from various circuits in the radio, thus conserving battery life. In normal transmit or receive mode this output is HIGH.
7	SYNTHESIZER LATCH output goes LOW to allow serial data to frequency synthesizer IC401 and goes HIGH to latch the data, allowing the synthesizer to execute the new frequency information.
8	HIGH/LOW POWER, WIDE/NARROW output in receive is LOW for WIDE and HIGH for NARROW. In transmit the output is HIGH for HIGH Power and LOW for LOW Power.
9, 10, 11	UNUSED
12	DATA output sends serial data to frequency synthesizer IC301 to program frequency information, and to IC109 to set the digital potentiometers.
13	GREEN LED output goes HIGH and lights the green front panel LED when the radio receives an on-frequency signal.
14	RED LED output goes HIGH and lights the red front panel LED when the radio is in transmit mode.
15, 16	DTMF/BEEP outputs generate the radio alert tones heard in the speaker, as well as the tones required for DTMF encoding in transmit mode.
17, 18	QC ENCODE outputs generate the CTCSS, DQC, LTR Trunking and Passport Trunking encode waveforms for signal processing prior to modulating the VCO in transmit mode.

PIN	DESCRIPTION
19	AUDIO AMP ENABLE output goes HIGH to apply power to audio amp IC103 for receiver speaker audio or radio alert tones.
20	TX ENABLE output goes HIGH in transmit mode to switch the +VTX transmitter supply voltage on. This output is low in receive and standby.
21	GROUND
22	VDD is connected to the regulated +5VDC to supply power to the microcontroller.
23	PTT input is pulled LOW when the internal PTT switch is depressed. In conjuction with the TX KEY input at pin 2, it initiates the desired transmitter operation required for various SST-454 audio accessories and options.
24	MONITOR input when SW101 is depressed, one, two, or three beeps will sound depending on type of tone signalling programmed for selected channel.
25	LOW-PASS CUT-OFF output goes LOW to lower the cut-off frequency of IC307C when the radio is on a channel programmed for a CTCSS tone below 150 Hz. This output is in a tri-state OPEN condition for all other tones.
27	AUDIO INHIBIT disables analog switches IC3105A, B and C when HIGH to disconnect the shared audio processing circuitry from both the receiver and transmitter.
28	COMPAND ENABLE output HIGH disables compand feature, output LOW enables compand feature.
29, 31	UNUSED
30	AUDIO GATE ENABLE controls analog switches IC105A and B to configure the shared audio processing circuitry for receive operation when HIGH, and for transmitter operation when LOW.
32	RX AUD GATE controls analog switch IC105B, connecting received audio from IC502 to the shared audio processing circuitry when LOW and disconnecting receive audio when HIGH.
33	DIGITAL POT LATCH sends a single positive pulse after data has been sent to IC109G to latch the new data and change the digital potentiometers to the new programmed settings.
34	CHANNEL input measures voltage of R102 to determine channel location in EEPROM.
35	VOLUME input measures voltage of R105 to set digital pot IC109F.
36	TONE IN A/D input accepts the received CTCSS, DQC, LTR or Passport trunking waveforms after signal processing for decode analysis.
37	HIGH-PASS AUDIO A/D input accepts voice band audio signals for VOX detection in transmit mode and in-band data decode in receive mode.
38	BATTERY A/D input is used to measure the battery voltage for low and dead battery detection.
39	RSSI A/D input is used to measure the output voltage of the noise detector for squelch detection.

PIN	DESCRIPTION
40	PROGRAM SENSE A/D input is used to identify the device at the J102 RING connection.
41	TEMPERATURE A/D input is used to measure voltage from the temperature sensor to determine the ambient operating temperature of the radio.
42	DTMF COLUMN when DTMF button is depressed, input measures voltage to determine which column is active.
43	DTMF ROW when DTMF button is depressed, input measures voltage to determine which row is active.
44	V_{DDAREF} supplys power to the microcontroller A/D and is connected to the regulated +5 VDC.
45	V_{REFL} sets the lower reference level for the A/D and is connected to ground.
46	VOX SENSE input senses audio signal present to electronically key the transmitter when VOX has been programmed.
47	DISCRIMINATOR AUDIO input from unfiltered demodulated audio output of IC502.
48	uP OSC SKEW output to slightly change frequency of 8 MHz uP oscillator if self-generated receiver interference is detected.
49	TURN ON HOLD+V SW output is HIGH when the radio is turned on, keeping pass transistor Q110B turned on to supply power to the radio.
50, 51 52	UNUSED
53	TURN ON SENSE input to detect when RTX-454 has been turned on.
54	V_{REFH} sets the upper reference level for the A/D and is connected to the regulated +5 VDC.
55	V_{DDA} is connected to the regulated +5 VDC.
56, 61	GROUND
57	CGMFXC has a .1µF capacitor bypass for loop filter phase correction.
58, 59	OSCILLATOR input is connected to an 8 MHz crystal used for cclock reference.
60, 63	UNUSED inputs are pulled HIGH for FLASH programming.
62	CLOCK output sends serial data clock pulses to frequency synthesizer IC401 and digital potentiometers IC308 when programming these devices.
64	LOCK DETECT input senses HIGH voltage when synthesizer IC301 is in lock condition. A LOW voltage will cause out-of-lock error tone.

RTX-454 ALIGNMENT PROCEDURE

Test and alignment of the RTX-454 must be performed by an authorized RF service technician. Do not attempt service of the RTX-454 if not completely familiar with the operation of frequency synthesized radio operation. The RTX-454 can operate in either Narrow Band (2.5 KHz deviation) or Wide Band (5 KHz deviation) systems.

RECOMMENDED TEST EQUIPMENT

1) 0 to +15 VDC, 2A current-limited power supply
2) RF Communications Test Set (to 480 MHz) with:
   - FM Deviation Meter
   - RF Wattmeter
   - Frequency Counter (to 480 MHz)
   - SINAD Measuring Device
3) Oscilloscope (to 50 MHz)
4) VTVM or DMM
5) RITRON PC Programming Kit
6) RTX-SRVBD Assembly

RADIO PREPARATION

1) Make sure the radio battery is fully charged.
2) Install the RITRON serial programming cable as follows:
   a) Remove the RTX-454 antenna from the radio.
   b) Connect the serial programming cable from the PC computer (with the RITRON PC programming kit software installed) into the connector of the RTX-SRVBD.
   c) Plug the RTX-SRVBD into the 2.5 mm and 3.5 mm jacks at the top of the radio.
3) Connect the FM communications test set into the 2.5 mm jack located behind the antenna bushing.
4) Turn on the radio to place it in operating mode.
5) From the PC Programmer on-screen menu, select "RTX Alignment". This will program the radio to temporarily operate on the following frequencies:

Alignment Step	Frequency	Tone	TX Power
Reference Frequency	465.075 MHz	No tone	Low power
Modulation Balance	465.075 MHz	20 Hz - Square wave	Low power
Deviation - Low Frequency	450.075 MHz	100.0 Hz - CTCSS	Low power
Deviation - High Frequency	480.075 MHz	100.0 Hz - CTCSS	Low power
Low TX Power - Low Frequency	450.075 MHz	No tone	Low power
Low TX Power - High Frequency	480.075 MHz	No tone	Low power
High TX Power - Low Frequency	450.075 MHz	No tone	High power
High TX Power - High Frequency	480.075 MHz	No tone	High power
Squelch	465.075 MHz	No tone	Low power

6) After you have completed alignment of the RTX-454, turn the radio off. This will remove the test frequencies and return to operation on the customer's programmed frequencies.

TUNING MODE

Authorized service personal can perform adjustments to the radio from within the PC Programming software.

1) From the PC programmer on-screen menu, select "Access Radio Tech Fields."
2) Type "Tune" to allow adjustments using the PC programmer.

REFERENCE FREQUENCY

1) Make sure that the unit has been switched on and is at room temperature (approximately +25° C)
2) Select "Reference Frequency" from the PC Programmer "RTX-454 Alignment" screen.
3) Set the RF communications test set to the transmit frequency on the screen.
4) Press and hold the PTT switch (SW102) to activate the transmitter.
5) Transmitter frequency error should be less than +/- 500 Hz.
6) If frequency adjustment is required, select "Reference Frequency Adjust" from the PC programmer menu. The "F7" key will lower the frequency; the "F8" key will raise it.
7) Press "F5" to write the new value to memory.

MODULATION BALANCE

Transmitter modulation balance has been set at the factory and should not require adjustment.

1) Select "Modulation Balance" from the PC Programmer "RTX-454 Alignment" screen.
2) Set the RF communications test set to the transmit frequency on the screen.
3) With the PTT switch pressed and no voice applied to the microphone, check the de-modulated waveform for a 20 Hz square wave.
4) If adjustment of the modulation balance is required to flatten the top of the waveform or reduce overshoot:
   a) Select "Modulation Balance Adjust" from the PC Programmer menu.
   b) The "F7" key will lower the balance; the "F8" key will raise it.
   c) Press "F5" to write the new value to memory.

TRANSMITTER TONE DEVIATION

Transmitter tone deviation has been set at the factory and should not require adjustment.

1) Select "Deviation - Low Frequency" from the PC Programmer "RTX-454 Alignment" screen.
2) Set the RF communications test set to the transmit frequency on the screen.
3) Select "Narrow Band" from the PC Programmer "RTX-454 Alignment" screen.
4) With the PTT switch pressed and no voice applied to the microphone, check for 400 to 500 Hz deviation of the programmed tone.
5) If adjustment of the tone deviation is required:
   a) Select "Tone Deviation Adjust" from the PC Programmer menu.
   b) The "F7" key will lower the deviation; the "F8" key will raise it.
   c) Press "F5" to write the new value to memory.
6) Select "Wide Band" from the PC Programmer "RTX-454 Alignment" screen.
7) With the PTT switch pressed and no voice applied to the microphone, check for 700 to 800 Hz deviation of the programmed tone.
8) If adjustment of the tone deviation is required:
   a) Select "Tone Deviation Adjust" from the PC Programmer menu.
   b) The "F7" key will lower the deviation; the "F8" key will raise it.
   c) Press "F5" to write the new value to memory.
9) Select "Deviation - High Frequency" from the PC Programmer "RTX-454 Alignment" screen.
10) Set the RF communications test set to the transmit frequency on the screen.
11) Repeat Steps 3 - 8 for the High transmit frequency.

TRANSMITTER VOICE DEVIATION

Transmitter voice deviation has been set at the factory and should not require adjustment.

1) Select "Deviation - Low Frequency" from the PC Programmer "RTX-454 Alignment" screen.
2) Set the RF communications test set to the transmit frequency on the screen.
3) Select "Narrow Band" from the PC Programmer "RTX-454 Alignment" screen.
4) With the PTT switch pressed, talk loudly into the RTX-454 microphone. Check for +/- 2.5 KHz maximum combined voice and tone deviation.
5) If adjustment of the voice deviation is required:
   a) Select "Voice Deviation Adjust" from the PC Programmer menu.
   b) The "F7" key will lower the deviation; the "F8" key will raise it.
   c) Press "F5" to write the new value to memory.
6) Select "Wide Band" from the PC Programmer "RTX-454 Alignment" screen.
7) With the PTT switch pressed, talk loudly into the RTX-454 microphone. Check for +/- 5 KHz maximum combined voice and tone deviation.
8) If adjustment of the voice deviation is required:
   a) Select "Voice Deviation Adjust" from the PC Programmer menu.
   b) The "F7" key will lower the deviation; the "F8" key will raise it.
   c) Press "F5" to write the new value to memory.
9) Select "Deviation - High Frequency" from the PC Programmer "RTX-454 Alignment" screen.
10) Set the RF communications test set to the transmit frequency on the screen.
11) Repeat Steps 3 - 8 for high transmit frequency.

TRANSMITTER POWER

Transmitter power has been set at the factory and should not require adjustment.

1) Select "High Power - High Frequency" from the PC Programmer "RTX-454 Alignment" screen.
2) With the PTT switch pressed, check for 4 Watts or more of RF power as indicated on the Wattmeter.
3) If adjustment of the Transmitter high power is required:
   a) Disassemble the RTX-454 and power the radio with 9.6 VDC.
   b) Adjust C425 for maximum power as measured on the Wattmeter.
4) Select "High Power - Low Frequency" from the PC Programmer "RTX-454 Alignment" screen.
5) Repeat steps 2 and 3 (if needed).
6) Select "Low Power - Low Frequency" from the PC Programmer "RTX-454 Alignment" screen.
7) Set the RF communications test set to the transmit frequency on the screen.
8) With the PTT switch pressed, check for 1-2 Watts of RF power as indicated on the Wattmeter.
9) Select "Low Power - High Frequency" from the PC Programmer "RTX-454 Alignment" screen.
10) With the PTT switch depressed, check for 1-2 Watts of RF Power as indicated on the Wattmeter.

RECEIVER SENSITIVITY AND SQUELCH

The RTX-454 receiver is fixed tuned for a frequency range of 450 - 480 MHz, there are no tuning adjustments required for receiver sensitivity. The RTX-454 receiver is configured from the factory for Wide or Narrow Band operation. The RTX-454 receiver bandwidth is configured on a

per channel basis. The noise squelch sensitivity is on a per channel basis.

1) Select "Squelch" from the PC Programmer "RTX-454 Alignment" screen.
2) Connect an 8 Ohm speaker to the 3.5 mm audio jack on the RTX-SRVBD test assembly.
3) Set the RF communications test set to:
   a) Generate the radio receive frequency on the screen.
   b) Set the RF output to a level required to produce a 12 dB SINAD measurement across the speaker, typically -119 dBm.
   c) Modulate the RF signal with a 1 KHz tone at 60% system deviation (3 KHz for Wide band receiver and 1.5 KHz for Narrow band).
4) Reduce the RF signal level until the radio squelches, then slowly raise the level until squelch opens. This should be at the level required for 12 dB SINAD receiver sensitivity.
5) If adjustment of squelch is required:
   a) Select "Squelch Adjust" from the PC Programmer menu.
   b) The "F7" key will lower the squelch sensitivity; the "F8" key will raise it.
   c) Press "F5" to write the new value to memory.
6) Slowly reduce the RF signal level until the radio is squelched. This level should be 3 - 5 dB below that required to open squelch in Step 4.
7) If adjustment of squelch hysteresis is required:
   a) Select "Squelch Hysteresis Adjust" from the PC Programmer menu.
   b) The "F7" key will decrease the squelch hysteresis; the "F8" key will increase it.
   c) Press "F5" to write the new value to memory.

SYNTHESIZER

The synthesizer is preset at the factory for operation between 450 and 480 MHz. There is no manual adjustment to center the control voltage, with all adjustment performed by the factory selection of fixed capacitor C311. Do not attempt to adjust the synthesizer control unless a key component in the synthesizer has been replaced. Key components do not include the reference frequency TCVCXO or IC301 synthesizer IC. Synthesizer alignment errors cause poor operation at temperature extremes.

Should adjustment of the VCO control voltage be necessary, the radio must first be disassembled and powered up at 9.6 VDC. The following procedure defines testing of the VCO control voltage:

1) Select the channel with the lowest receive frequency.
2) Connect a VTVM, DVM or oscilloscope to R317/C319 and measure the VCO control voltage. This voltage should be no less than 1.0 VDC.
3) Select the channel with the highest receive frequency and measure R317/C319. The control voltage should be no higher than 6.0 VDC.
4) If adjustment of the VCO control voltage is required:
   a) Remove the shield top from the synthesizer module.
   b) Replace C311 with a capacitor value that allows VCO control voltages between 1.0 and 6.0 VDC for the operating frequencies desired. Decreasing the value of C311 will raise the operating frequency of the VCO while increasing the value will lower the VCO frequency.
   c) Replace the top of the synthesizer shield.

MEASUREMENT CONDITIONS:

Power Supply set to 9.6 VDC, unit in operating mode, Volume Control set to minimum, and measurements taken with Channel Selector in Channel 6 position.

IMPORTANT: Because the RTX-454 is constructed with serarate modules, use a system ground in the same proximity as the circuit being measured. All readings indicated as GND are true system ground.

KEY:

1. All measurements are in VDC, unless otherwise noted.
2. GND = ground.
3. NC = no connection.
4. [ ] = low power mode in Transmit.

DEVICE	PIN	RTX-454 VOLTAGE MEASUREMENTS		
		Receive	Transmit	Standby
IC101	1	NC	-	-
	2	5.0	0.0	5.0
	3	5.0	5.0	5.0
	4	5.0	5.0	5.0
	5	0.0	5.0	0.0
	6	5.0	5.0	5.0
	7	5.0	5.0	5.0
	8	0.0	5.0[0.0]	0.0
	9	NC	-	-
	10	NC	-	-
	11	NC	-	-
	12	0.0	0.0	0.0
	13	5.0	0.0	0.0
	14	0.0	5.0	0.0
	15	0.0	0.0	0.0
	16	0.0	0.0	0.0
	17	2.0	2.0	2.0
	18	2.2	2.2	2.2
	19	5.0	0.0	0.0
	20	0.0	5.0	0.0
	21	GND	GND	GND
	22	4.9	4.9	4.9
	23	4.9	0.0	4.9
	24	5.0	5.0	5.0
	25	0.0	0.0	0.0
	26	5.0	5.0	5.0
	27	0.0	0.0	0.0
	28	5.0	5.0	5.0

DEVICE	PIN	RTX-454 VOLTAGE MEASUREMENTS		
		Receive	Transmit	Standby
IC101	29	0.0	0.0	0.0
	30	0.0	5.0	0.0
	31	0.0	0.0	0.0
	32	0.0	5.0	0.0
	33	0.0	0.0	0.0
	34	3.0	3.0	3.0
	35	4.4	4.4	4.4
	36	2.1	2.1	2.1
	37	2.2	2.2	2.2
	38	NC	-	-
	39	0.6	0.6	1.1
	40	5.0	5.0	5.0
	41	0.2	0.2	0.2
	42	4.9	4.9	4.9
	43	4.9	4.9	4.9
	44	5.0	5.0	5.0
	45	GND	GND	GND
	46	1.5	1.5	1.5
	47	0.0	0.0	0.0
	48	0.0	0.0	0.0
	49	0.0	0.0	0.0
	50	NC	-	-
	51	NC	-	-
	52	NC	-	-
	53	0.0	0.0	0.0
	54	5.0	5.0	5.0
	55	5.0	5.0	5.0
	56	GND	GND	GND
	57	1.7	1.7	1.7
	58	2.5	2.5	2.5
	59	2.4	2.4	2.4
	60	5.0	5.0	5.0
	61	GND	GND	GND
	62	0.0	0.0	0.0
	63	5.0	5.0	5.0
	64	4.3	4.3	4.3
IC102	1	GND	GND	GND
	2	1.5	1.5	1.5
	3	1.5	1.5	1.5
	4	5.0	0.0	0.0
	5	1.8	1.4	2.0
	6	1.5	1.5	1.5

DEVICE	PIN	RTX-454 VOLTAGE MEASUREMENTS		
		Receive	Transmit	Standby
IC102	7	1.5	1.5	1.5
	8	5.0	5.0	5.0
	9	1.5	1.5	1.5
	10	1.5	1.5	1.5
	11	1.6	1.4	1.6
	12	GND	GND	GND
	13	GND	GND	GND
	14	1.5	1.5	1.5
	15	1.5	1.5	1.5
	16	4.9	4.9	4.9
IC103	1	1.3	0.5	0.5
	2	0.0	0.0	0.0
	3	GND	GND	GND
	4	GND	GND	GND
	5	5.0	0.5	0.5
	6	9.6	0.0	0.0
	7	5.0	0.5	0.5
	8	1.3	0.5	0.5
IC104	1	9.6	9.6	9.6
	2	GND	GND	GND
	3	9.6	9.6	9.6
	4	NC	-	-
	5	5.0	5.0	5.0
IC105	1	NC	-	-
	2	2.2	2.2	2.2
	3	0.0	0.0	0.0
	4	2.2	0.0	2.2
	5	2.2	2.2	2.2
	6	0.0	0.0	0.0
	7	GND	GND	GND
	8	GND	GND	GND
	9	0.0	5.0	0.0
	10	0.0	5.0	0.0
	11	0.0	5.0	0.0
	12	2.2	0.0	2.2
	13	0.0	2.2	0.0
	14	2.2	2.2	2.2
	15	2.2	0.6	2.2
	16	5.0	5.0	5.0

DEVICE	PIN	RTX-454 VOLTAGE MEASUREMENTS		
		Receive	Transmit	Standby
IC106	1	2.2	2.2	2.2
	2	2.2	2.2	2.2
	3	2.1	2.1	2.1
	4	2.2	2.2	2.2
	5	2.2	2.2	2.2
	6	5.0	5.0	5.0
	7	2.3	2.3	2.3
	8	2.2	2.2	2.2
	9	2.6	2.6	2.6
	10	GND	GND	GND
	11	2.6	2.6	2.6
	12	GND	GND	GND
	13	2.2	2.2	2.2
	14	2.2	2.2	2.2
IC107	1	2.2	2.2	2.2
	2	2.2	2.2	2.2
	3	2.2	2.2	2.2
	4	GND	GND	GND
	5	2.2	2.2	2.2
	6	2.2	2.2	2.2
	7	2.2	2.2	2.2
	8	5.0	5.0	5.0
IC108	1	3.0	3.0	3.0
	2	2.2	2.2	2.2
	3	2.2	2.2	2.2
	4	GND	GND	GND
	5	2.2	2.2	2.2
	6	2.2	2.2	2.2
	7	2.2	2.2	2.2
	8	5.0	5.0	5.0
IC109	1	1.8	1.8	1.8
	2	2.9	2.9	2.9
	3	GND	GND	GND
	4	0.0	0.0	0.0
	5	2.2	2.2	2.2
	6	2.2	2.2	2.2
	7	2.2	2.2	2.2
	8	0.0	0.0	0.0

DEVICE	PIN	RTX-454 VOLTAGE MEASUREMENTS		
		Receive	Transmit	Standby
IC109	9	0.0	0.0	0.0
	10	GND	GND	GND
	11	NC	-	-
	12	0.0	0.0	0.0
	13	2.2	2.2	2.2
	14	2.5	2.5	2.5
	15	2.9	2.9	2.9
	16	1.7	1.7	1.7
	17	0.0	0.0	0.0
	18	4.9	4.9	4.9
	19	4.9	4.9	4.9
	20	4.9	4.9	4.9
Q101	E	0.0	3.4	0.0
	B	0.0	5.0	0.0
	C	9.6	9.6	9.6
Q102	E	3.4	0.0	0.0
	B	5.0	0.0	0.0
	C	9.6	9.6	9.6
Q103	E	5.0	5.0	5.0
	B	4.9	4.3	4.9
	C	0.0	5.0	0.0
Q104	E	GND	GND	GND
	B	0.0	5.0	0.0
	C	5.0	0.0	5.0
Q105	E	9.6	9.6	9.6
	B	9.0	9.6	9.6
	C	9.6	0.0	0.0
Q106	E	4.3	0.0	0.0
	B	5.0	0.0	0.0
	C	9.0	9.6	9.6
Q107	E	2.4	2.4	2.4
	B	0.0	0.0	0.0
	C	2.3	2.3	2.3

DEVICE	PIN	RTX-454 VOLTAGE MEASUREMENTS		
		Receive	Transmit	Standby
Q108	1	4.2	4.2	4.2
	2	5.0	5.0	5.0
	3	5.0	5.0	5.0
	4	5.0	5.0	5.0
	5	4.2	4.2	4.2
	6	4.2	4.2	4.2
Q110	1	4.3	4.3	4.3
	2	5.0	5.0	5.0
	3	9.6	9.6	9.6
	4	9.6	9.6	9.6
	5	8.9	8.9	8.9
	6	8.9	8.9	8.9

DEVICE	PIN	RTX-454 VOLTAGE MEASUREMENTS		
		Receive	Transmit	Standby
IC301	1	NC	-	-
	2	4.3	4.3	4.3
	3	NC	-	-
	4	NC	-	-
	5	7.0	7.1	7.0
	6	3.4	3.7	7.4
	7	GND	GND	GND
	8	3.5	3.7	3.5
	9	NC	-	-
	10	2.2	2.2	2.2
	11	2.2	2.2	2.2
	12	4.3	4.3	4.3
	13	NC	-	-
	14	4.3	4.3	4.3
	15	0.0	0.0	0.0
	16	NC	-	-
	17	5.0	5.0	5.0
	18	0.0	0.0	0.0
	19	0.0	0.0	0.0
	20	2.0	2.0	2.0
IC401	1	0.0	1.4	0.0
	2	GND	GND	GND
	3	GND	GND	GND
	4	0.0	4.7	0.0
	5	0.0	1.1	0.0
	6	0.0	6.0	0.0
	7	0.0	6.0	0.0
	8	0.0	7.3[2.8]	0.0
	9	0.0	7.3[2.8]	0.0
	10	GND	GND	GND
	11	GND	GND	GND
	12	GND	GND	GND
	13	0.0	7.3[2.8]	0.0
	14	0.0	7.3[2.8]	0.0
IC501	1	1.6	0.0	1.6
	2	4.8	0.3	4.8
	3	4.8	0.3	4.8
	4	4.8	0.3	4.8
	5	4.8	0.3	4.8
	6	4.8	0.3	4.8
	7	GND	GND	GND
	8	0.8	0.0	0.8

DEVICE	PIN	RTX-454 VOLTAGE MEASUREMENTS		
		Receive	Transmit	Standby
IC502	1	4.8	0.0	4.8
	2	NC	-	-
	3	3.9	0.0	3.9
	4	4.8	0.0	4.8
	5	3.8	0.0	3.8
	6	3.8	0.0	3.8
	7	3.8	0.0	3.8
	8	4.8	0.0	4.8
	9	2.1	0.0	2.1
	10	0.6	0.0	0.6
	11	3.5	0.0	3.5
	12	NC	-	-
	13	NC	-	-
	14	NC	-	-
	15	GND	GND	GND
	16	1.8	0.0	1.8
IC503	1	0.0	0.0	0.0
	2	4.8	0.0	4.8
	3	GND	GND	GND
	4	3.8	0.0	3.8
	5	3.8	0.0	3.8
	6	0.0	0.0	0.0
IC504	1	0.0	0.0	0.0
	2	4.8	0.0	4.8
	3	GND	GND	GND
	4	3.8	0.0	3.8
	5	3.8	0.0	3.8
	6	0.0	0.0	0.0
IC505	1	0.0	0.0	0.0
	2	4.8	0.0	4.8
	3	GND	GND	GND
	4	4.8	0.0	4.8
	5	4.8	0.0	4.8
	6	NC	-	-
IC506	1	4.9	4.9	4.9
	2	GND	GND	GND
	3	GND	GND	GND
	4	NC	-	-

DEVICE	PIN	RTX-454 VOLTAGE MEASUREMENTS		
		Receive	Transmit	Standby
IC506	5	NC	-	-
	6	GND	GND	GND
	7	GND	GND	GND
	8	7.1	7.1	7.1
Q301	E	2.3	2.3	2.3
	B	2.9	2.9	2.9
	C	6.0	6.0	6.0
Q302	E	2.1	2.1	2.1
	B	2.8	2.8	2.8
	C	5.8	5.8	5.8
Q303	E	GND	GND	GND
	B	0.0	5.0	0.0
	C	5.8	0.0	5.8
Q304	E	6.0	6.0	6.0
	B	5.8	0.0	5.8
	C	5.0	2.0	5.0
Q305	E	5.9	6.0	5.9
	B	6.7	6.7	6.7
	C	7.0	7.1	7.0
Q306	E	GND	GND	GND
	B	0.8	0.8	0.8
	C	1.8	1.8	1.8
Q401	E	9.6	9.6	9.6
	B	9.6	8.7	9.6
	C	0.0	6.7	0.0
Q402	E	0.0	4.4	0.0
	B	0.0	5.0	0.0
	C	9.6	8.7	9.6
Q403	E	GND	GND	GND
	B	0.0	0.0	0.0
	C	9.6	9.6	9.6
Q404	E	GND	GND	GND
	B	0.0	5.0[0.0]	0.0
	C	0.0	0.0[2.6]	0.0

DEVICE	PIN	RTX-454 VOLTAGE MEASUREMENTS		
		Receive	Transmit	Standby
Q405	E	9.0	9.6	9.6
	B	9.6	8.8	9.6
	C	0.0	7.2[2.8]	0.0
Q406	E	0.0	2.5	0.0
	B	0.0	3.2	0.0
	C	9.6	5.9	9.6
Q501	E	GND	GND	GND
	B	0.8	0.0	0.8
	C	3.1	0.0	3.1
Q502	E	GND	GND	GND
	B	0.7	0.0	0.7
	C	1.2	0.0	1.2
Q503	1	1.1	0.0	1.1
	2	1.1	0.0	1.1
	3	NC	-	NC
	4	1.1	0.0	1.1
	5	0.7	0.0	0.7
	6	4.8	0.0	4.8
Q504	1	4.2	6.1	4.2
	2	0.0	6.7	0.0
	3	4.8	0.0	4.8
	4	4.9	4.9	4.9
	5	4.2	6.1	4.2
	6	NC	-	-
Q505	1	4.5	4.5	4.5
	2	4.9	4.9	4.9
	3	7.1	7.1	7.1
	4	9.6	9.6	9.6
	5	8.8	8.9	8.8
	6	8.9	8.9	8.9
Q506	E	GND	GND	GND
	B	0.7	0.0	0.0
	C	3.8	0.0	3.8

SCHEMATIC REFERENCE NUMBER PARTS LIST RTX-454

Ref.	RITRON#	Description
CAPACITORS		
C 101	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 102	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 103	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 104	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 105	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 106	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 107	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 108	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 109	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 110	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 111	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 112	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 113	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 114	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 115	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 116	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 117	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 118	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 119	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 120	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 121	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 122	152A8105	1MFD 16V ~3.2 X 1.6~ CHIP TANTALUM
C 123	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 124	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 125	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 126	152A8105	1MFD 16V ~3.2 X 1.6~ CHIP TANTALUM
C 127	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 128	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 129	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 130	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 131	152B8106	CAP 10uF 16V 3.4 X 2.8 CHIP TANTALUM
C 132	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 133	01503011	220uf ELT CAP 16V .12~ .32~x.48~ r
C 134	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 135	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 136	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 137	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 138	1522A475	4.7MFD 5.6X3.3 25V TANT CHIP CAP
C 139	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 140	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 141	152B8106	CAP 10uF 16V 3.4 X 2.8 CHIP TANTALUM
C 142	15111333	.033MFD X7R 0805 50V CHIP CAP
C 143	15179472	.0047UF X7R 0603 25V CHIP CAPACITOR
C 144	15179472	.0047UF X7R 0603 25V CHIP CAPACITOR
C 145	15170180	18pF NPO 0603 50V CHIP CAPACITOR
C 146	15119473	.047uF X7R 0805 25V CHIP CAPACITOR
C 147	15111153	.015MF X7R 0805 50 CHIP CAP
C 148	15179222	.0022UF X7R 0603 25V CHIP CAPACITOR
C 149	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 150	15170100	10 PF NPO 0603 50V CHIP CAPACITOR

SCHEMATIC REFERENCE NUMBER PARTS LIST RTX-454

Ref.	RITRON#	Description
C 151	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 152	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 153	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 154	152B8106	CAP 10uF 16V 3.4 X 2.8 CHIP TANTALUM
C 155	15110821	820PF NPO 0805 50V CHIP CAP
C 156	15179122	.0012UF X7R 0603 25V CHIP CAPACITOR
C 157	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 158	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 159	15179122	.0012UF X7R 0603 25V CHIP CAPACITOR
C 160	15179122	.0012UF X7R 0603 25V CHIP CAPACITOR
C 161	15110221	220pf NPO 0805 50V CHIP CAPACITOR
C 162	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 163	15170330	33pF NPO 0603 50V CHIP CAPACITOR
C 164	15170330	33pF NPO 0603 50V CHIP CAPACITOR
C 165	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 167	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 168	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 169	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 170	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 171	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 172	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 173	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 174	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 175	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 176	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 177	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 178	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 179	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 180	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 181	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 182	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 183	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 184	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 185	15170100	10 PF NPO 0603 50V CHIP CAPACITOR
C 186	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 187	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 188	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 189	152B8106	CAP 10uF 16V 3.4 X 2.8 CHIP TANTALUM
C 301	15170220	22pF NPO 0603 50V CHIP CAPACITOR
C 302	151701A0	1.0pF NPO 0603 50V CHIP CAPACITOR
C 303	15170180	18pF NPO 0603 50V CHIP CAPACITOR
C 304	15170390	39pF NPO 0603 50V CHIP CAPACITOR
C 305	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 306	151703A3	3.3pF NPO 0603 50V CHIP CAPACITOR
C 307	151703A3	3.3pF NPO 0603 50V CHIP CAPACITOR
C 308	151704A7	4.7pF NPO 0603 50V CHIP CAPACITOR
C 309	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 310	151708A2	8.2pF NPO 0603 50V CHIP CAPACITOR
C 311	151701A0	1.0pF NPO 0603 50V CHIP CAPACITOR
C 312	151701A0	1.0pF NPO 0603 50V CHIP CAPACITOR

SCHEMATIC REFERENCE NUMBER PARTS LIST RTX-454

Ref.	RITRON#	Description
C 314	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 315	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 316	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 317	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 318	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 319	15179222	.0022UF X7R 0603 25V CHIP CAPACITOR
C 320	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 321	152B8106	CAP 10uF 16V 3.4 X 2.8 CHIP TANTALUM
C 322	152AB334	.33MF 35V ~3.2X1.6~ CHIP TANTALUM
C 323	15111333	.033MFD X7R 0805 50V CHIP CAP
C 324	151701A0	1.0pF NPO 0603 50V CHIP CAPACITOR
C 325	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 327	15170100	10 PF NPO 0603 50V CHIP CAPACITOR
C 328	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 329	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 330	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 331	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 332	15170100	10 PF NPO 0603 50V CHIP CAPACITOR
C 333	15170100	10 PF NPO 0603 50V CHIP CAPACITOR
C 334	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 335	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 336	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 337	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 338	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 339	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 340	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 341	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 342	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 343	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 344	15170330	33pF NPO 0603 50V CHIP CAPACITOR
C 401	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 402	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 403	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 404	15170151	150PF NPO 0603 50V CHIP CAPACITOR
C 405	152B8106	CAP 10uF 16V 3.4 X 2.8 CHIP TANTALUM
C 406	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 407	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 408	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 409	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 410	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 411	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 412	151704A7	4.7pF NPO 0603 50V CHIP CAPACITOR
C 413	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 414	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 415	152B8106	CAP 10uF 16V 3.4 X 2.8 CHIP TANTALUM
C 416	15170120	12PF NPO 0603 50V CHIP CAPACITOR
C 417	15170220	22pF NPO 0603 50V CHIP CAPACITOR
C 418	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 419	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 420	15170101	100PF NPO 0603 50V CHIP CAPACITOR

SCHEMATIC REFERENCE NUMBER PARTS LIST RTX-454

Ref.	RITRON#	Description
C 421	15110220	22PF NPO 0805 50V CHIP CAP
C 422	15110270	27pf NPO 0805 50V CHIP CAPACITOR
C 423	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 424	15170100	10 PF NPO 0603 50V CHIP CAPACITOR
C 425	15400001	3-10PF CERAMIC TRIMMER CAP
C 426	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 427	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 428	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 429	151704A7	4.7pF NPO 0603 50V CHIP CAPACITOR
C 430	151704A7	4.7pF NPO 0603 50V CHIP CAPACITOR
C 431	151703A3	3.3pF NPO 0603 50V CHIP CAPACITOR
C 432	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 433	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 434	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 435	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 436	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 501	151708A2	8.2pF NPO 0603 50V CHIP CAPACITOR
C 502	15170120	12PF NPO 0603 50V CHIP CAPACITOR
C 503	151708A2	8.2pF NPO 0603 50V CHIP CAPACITOR
C 504	15170120	12PF NPO 0603 50V CHIP CAPACITOR
C 505	151708A2	8.2pF NPO 0603 50V CHIP CAPACITOR
C 506	151706A8	6.8pF NPO 0603 50V CHIP CAPACITOR
C 507	15170150	15PF NPO 0603 50V CHIP CAPACITOR
C 508	15170180	18pF NPO 0603 50V CHIP CAPACITOR
C 509	15170180	18pF NPO 0603 50V CHIP CAPACITOR
C 510	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 513	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 514	151706A8	6.8pF NPO 0603 50V CHIP CAPACITOR
C 515	15170120	12PF NPO 0603 50V CHIP CAPACITOR
C 516	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 517	15170100	10 PF NPO 0603 50V CHIP CAPACITOR
C 518	15170330	33pF NPO 0603 50V CHIP CAPACITOR
C 519	151706A8	6.8pF NPO 0603 50V CHIP CAPACITOR
C 520	151708A2	8.2pF NPO 0603 50V CHIP CAPACITOR
C 521	15170120	12PF NPO 0603 50V CHIP CAPACITOR
C 522	151704A7	4.7pF NPO 0603 50V CHIP CAPACITOR
C 523	151706A8	6.8pF NPO 0603 50V CHIP CAPACITOR
C 524	151703A3	3.3pF NPO 0603 50V CHIP CAPACITOR
C 525	151706A8	6.8pF NPO 0603 50V CHIP CAPACITOR
C 526	15170100	10 PF NPO 0603 50V CHIP CAPACITOR
C 527	151708A2	8.2pF NPO 0603 50V CHIP CAPACITOR
C 528	151708A2	8.2pF NPO 0603 50V CHIP CAPACITOR
C 529	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 530	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 531	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 532	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 533	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 534	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 535	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 536	15179102	.001UF X7R 0603 25V CHIP CAPACITOR

SCHEMATIC REFERENCE NUMBER PARTS LIST RTX-454

Ref.	RITRON#	Description
C 537	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 538	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 539	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 540	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 541	15170330	33pF NPO 0603 50V CHIP CAPACITOR
C 542	15170330	33pF NPO 0603 50V CHIP CAPACITOR
C 543	15179103	.01UF X7R 0603 25V CHIP CAPACITOR
C 544	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 545	152B8106	CAP 10uF 16V 3.4 X 2.8 CHIP TANTALUM
C 546	152C6226	22uf 10V 6.0 X 3.2 CHIP TANTALUM CAP
C 547	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
C 548	152C8106	10MFD 16V 6.0X3.2 TANT CHIP CAP
C 549	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP
C 550	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 551	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 552	15170101	100PF NPO 0603 50V CHIP CAPACITOR
C 553	15170150	15PF NPO 0603 50V CHIP CAPACITOR
C 554	151704A7	4.7pF NPO 0603 50V CHIP CAPACITOR
C 555	15170100	10 PF NPO 0603 50V CHIP CAPACITOR
C 556	15179102	.001UF X7R 0603 25V CHIP CAPACITOR
DIODES		
CR101	02450016	LED, GREEN/RED 3 TERMINAL
CR102	04810003	1N4001 DIODE 50 VOLT/1AMP
CR103	48A1005C	MMBD7000 DUAL DIODE SOT-23
CR104	48A1005C	MMBD7000 DUAL DIODE SOT-23
CR105	48A100A3	MMBD2835, DUAL DIODE SOT-23
CR106	04810003	1N4001 DIODE 50 VOLT/1AMP
CR107	48A1005C	MMBD7000 DUAL DIODE SOT-23
CR301	48C1004E	MMBV-105G DIODE VVC, SOT-23
CR302	48C1004G	MMBV-2101L DIODE VVC SOT-23
CR303	48A1004D	MMBV3401TI UHF DIODE SOT-23
CR304	48A1005C	MMBD7000 DUAL DIODE SOT-23
CR401	04820017	MZP4744A ZENER DIODE 15V 3W 5% BULK
CR402	04810032	DIODE; PIN ; UHF 10W DO-34PKG
CR501	04810032	DIODE; PIN ; UHF 10W DO-34PKG
CR502	48A1005C	MMBD7000 DUAL DIODE SOT-23
CR503	48A1005C	MMBD7000 DUAL DIODE SOT-23
FUSE		
F 101	06000040	WIRE; #40AWG TINNED BUS (INCHES)
INTEGRATED CIRCUITS		
IC101	314J0005	MCU,FLASH,64-PIN QFP,AZ60 FP
IC102	31030005	MC33111D, LOW VOLTAGE COMPANDER, SO-16
IC103	31010004	LM386MX-1 AUDIO AMP SO-8
IC104	310E0002	REGULATOR,LDO,LP2980,5V,W ENABLE,SOT-25
IC105	31134053	HC4053 ANALOG TRIPLE SPDT SWITCH
IC106	31020001	MF6CWM-50 6 POLE FILT. SOLIC
IC107	31010016	OP AMP, DUAL, LOW VOC, RAIL TO RAIL SO-8

SCHEMATIC REFERENCE NUMBER PARTS LIST RTX-454

Ref.	RITRON#	Description
IC108	31010016	OP AMP, DUAL, LOW VOC, RAIL TO RAIL SO-8
IC109	310K0001	DS1806E 6 PROG POTS 10K OHM 20-PIN TSSOP
IC301	313K0002	SYNTHESIZER, MC145190????,TSSOP20 PIN
IC401	31520001	RF2114 MED PWR 1.0GHZ RF AMP
IC501	31510001	MIXER, DOUBLE BALANCED, MC13143D, SO-8
IC502	31030003	MC3371D SUBSYSTEM IC, SO-16
IC503	311E0001	SWITCH, ANALOG, SPDT, MAX4544, SOT23-6
IC504	311E0001	SWITCH, ANALOG, SPDT, MAX4544, SOT23-6
IC505	311E0001	SWITCH, ANALOG, SPDT, MAX4544, SOT23-6
IC506	31010006	LM2931 5vDC Low Volt Reg, SO-8
CONNECTORS		
J 101	02100001	2.5MM PC-MT JACK; ANT-CHGR
J 102	02100053	3.5MM STEREO JACK; PANEL MOUNT
J 301	21443081	CONNECTOR, 8 POS, PC VERT, GOLD
J 401	02100339	2.5 mm JACK P.C. MOUNT, MICRO
J 501	21443081	CONNECTOR, 8 POS, PC VERT, GOLD
P 301	21343081	HEADER, 8 POS., NON-POLAR, VERT., GOLD
P 501	21343081	HEADER, 8 POS., NON-POLAR, VERT., GOLD
INDUCTORS		
L 101	18110103	CHIP INDUCTOR 10uhy
L 301	18414105	5.5T AIRCOIL #24AWG .0625"ID RHH SMT
L 302	18433209	9T AIRCOIL, SMT, 9.85 nH, .159 X .056
L 303	18414107	7.5T AIRCOIL #24 .0625"ID RHH SMT
L 304	18110101	CHIP INDUCTOR 0.1uhy
L 305	18110680	CHIP INDUCTOR 68nhy
L 306	18110101	CHIP INDUCTOR 0.1uhy
L 401	18110471	CHIP INDUCTOR .47uhy
L 402	18110330	INDUCTOR, CHIP, 33nH
L 403	18433101	1T AIRCOIL, SMT 2.5nH, .120 X .145
L 405	18433102	2T AIRCOIL SMT 5.0nH .120 X .145
L 406	18414108	8.5T AIRCOIL #24AWG .0625"ID RHH SMT
L 407	18414108	8.5T AIRCOIL #24AWG .0625"ID RHH SMT
L 408	18433101	1T AIRCOIL, SMT 2.5nH, .120 X .145
L 409	18433102	2T AIRCOIL SMT 5.0nH .120 X .145
L 410	18110102	CHIP INDUCTOR 1.0uhy
L 411	18414104	4.5T AIRCOIL #24AWG .0625"ID RHH SMT
L 412	18414104	4.5T AIRCOIL #24AWG .0625"ID RHH SMT
L 413	18414104	4.5T AIRCOIL #24AWG .0625"ID RHH SMT
L 414	18414108	8.5T AIRCOIL #24AWG .0625"ID RHH SMT
L 415	18433101	1T AIRCOIL, SMT 2.5nH, .120 X .145
L 416	18433103	3T AIRCOIL, SMT, 8.0nH, .120 X .145
L 501	18433103	3T AIRCOIL, SMT, 8.0nH, .120 X .145
L 502	18433103	3T AIRCOIL, SMT, 8.0nH, .120 X .145
L 503	18433103	3T AIRCOIL, SMT, 8.0nH, .120 X .145
L 504	18414104	4.5T AIRCOIL #24AWG .0625"ID RHH SMT
L 505	18433103	3T AIRCOIL, SMT, 8.0nH, .120 X .145
L 506	18433103	3T AIRCOIL, SMT, 8.0nH, .120 X .145
L 507	18433103	3T AIRCOIL, SMT, 8.0nH, .120 X .145

SCHEMATIC REFERENCE NUMBER PARTS LIST RTX-454

Ref.	RITRON#	Description
L 508	18433103	3T AIRCOIL, SMT, 8.0nH, .120 X .145
L 509	18110391	CHIP INDUCTOR .39uhy
L 510	18110391	CHIP INDUCTOR .39uhy
L 511	18110681	CHIP INDUCTOR .68uhy
MICROPHONE		
MC101	05500037	MICROPHONE; ELECTRET, MINIATURE
TRANSISTORS		
Q 101	48010R02	MUN2211T1 NPN W/BIAS RES. SOT-23
Q 102	48010R02	MUN2211T1 NPN W/BIAS RES. SOT-23
Q 103	4801002A	MMBT3906 "SOT23"
Q 104	48010R02	MUN2211T1 NPN W/BIAS RES. SOT-23
Q 105	48130001	TRANSISTOR PNP 1AMP CBCX69 SOT-89
Q 106	4801001Q	MMBT-5088 "SOT-23"
Q 107	4801001Q	MMBT-5088 "SOT-23"
Q 108	4801002A	MMBT3906 "SOT23"
Q 301	4821007Y	MMBR941LT1 LO POWER RF, SOT-23
Q 302	4821007Y	MMBR941LT1 LO POWER RF, SOT-23
Q 303	48010R02	MUN2211T1 NPN W/BIAS RES. SOT-23
Q 304	4801006A	TRANSISTOR, PNP W/10K BIAS, SC-59
Q 305	4801001Q	MMBT-5088 "SOT-23"
Q 306	4821007Y	MMBR941LT1 LO POWER RF, SOT-23
Q 401	48130001	TRANSISTOR PNP 1AMP CBCX69 SOT-89
Q 402	4801001Q	MMBT-5088 "SOT-23"
Q 403	04801021	MRF652 UHF RF POWER AMP, 5 WT
Q 404	48010R02	MUN2211T1 NPN W/BIAS RES. SOT-23
Q 405	48130001	TRANSISTOR PNP 1AMP CBCX69 SOT-89
Q 406	4801001Q	MMBT-5088 "SOT-23"
Q 501	4821007Y	MMBR941LT1 LO POWER RF, SOT-23
Q 502	4821003B	MMBT918LT1 VHF SOT23 (3B)
Q 503	480A0001	TRANSISTOR,DUAL,PNP/NPN,UMZINTR,SOT23-6
Q 504	480A0001	TRANSISTOR,DUAL,PNP/NPN,UMZINTR,SOT23-6
Q 505	480A0001	TRANSISTOR,DUAL,PNP/NPN,UMZINTR,SOT23-6
Q 506	4821003B	MMBT918LT1 VHF SOT23 (3B)
RESISTORS		
R 101	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 102	04750051	10K OHM 11 POSITION W/ DETENT/washer/nut
R 103	47170221	220 OHM 0603 1/16W CHIP RESISTOR
R 104	47170221	220 OHM 0603 1/16W CHIP RESISTOR
R 105	04750053	10K POT W/SPST,SW AUDIO,PCMNT/washer/nut
R 106	47170105	1M OHM 0603 1/16W CHIP RESISTOR
R 107	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 108	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 109	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 110	47170471	470 OHM 0603 1/16W CHIP RESISTOR
R 111	47170471	470 OHM 0603 1/16W CHIP RESISTOR
R 112	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 113	47170103	10K OHM 0603 1/16W CHIP RESISTOR

SCHEMATIC REFERENCE NUMBER PARTS LIST RTX-454

Ref.	RITRON#	Description
R 114	47170222	2.2K OHM 0603 1/16W CHIP RESISTOR
R 115	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 116	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 117	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 118	47170333	33K OHM 0603 1/16W CHIP RESISTOR
R 119	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 120	47170224	220K OHM 0603 1/16W CHIP RESISTOR
R 121	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 122	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 123	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 124	47170102	1K OHM 0603 1/16W CHIP RESISTOR
R 125	47170153	15K OHM 0603 1/16W CHIP RESISTOR
R 126	47170273	27K OHM 0603 1/16W CHIP RESISTOR
R 127	471004A7	4.7 OHM 0805 CHIP RES.
R 128	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 129	47170471	470 OHM 0603 1/16W CHIP RESISTOR
R 130	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 131	47170153	15K OHM 0603 1/16W CHIP RESISTOR
R 132	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 133	47170154	150K OHM 0603 1/16W CHIP RESISTOR
R 134	47170473	47K OHM 0603 1/16W CHIP RESISTOR
R 135	47170222	2.2K OHM 0603 1/16W CHIP RESISTOR
R 136	47170273	27K OHM 0603 1/16W CHIP RESISTOR
R 137	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 138	47100225	2.2M 0805 CHIP RESISTOR
R 139	47170334	330K OHM 0603 1/16W CHIP RESISTOR
R 140	47170224	220K OHM 0603 1/16W CHIP RESISTOR
R 141	47170393	39K OHM 0603 1/16W CHIP RESISTOR
R 142	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 143	47270103	VARIABLE RESISTOR 10K SEALED
R 144	47170123	12K OHM 0603 1/16W CHIP RESISTOR
R 145	47170682	6.8K OHM 0603 1/16W CHIP RES
R 146	47170333	33K OHM 0603 1/16W CHIP RESISTOR
R 147	47170224	220K OHM 0603 1/16W CHIP RESISTOR
R 148	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 149	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 150	47100184	180K OHM 0805 CHIP RES.
R 151	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 152	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 153	47170334	330K OHM 0603 1/16W CHIP RESISTOR
R 154	47170000	0 OHM 0603 1/16W CHIP RESISTOR
R 155	47170105	1M OHM 0603 1/16W CHIP RESISTOR
R 156	47170223	22K OHM 0603 1/16W CHIP RESISTOR
R 157	47170472	4.7K OHM 0603 1/16W CHIP RESISTOR
R 158	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 159	47170683	68K OHM 0603 1/16W CHIP RESISTOR
R 160	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 161	47170473	47K OHM 0603 1/16W CHIP RESISTOR
R 162	47170103	10K OHM 0603 1/16W CHIP RESISTOR

SCHEMATIC REFERENCE NUMBER PARTS LIST RTX-454

Ref.	RITRON#	Description
R 163	47170474	470K OHM 0603 1/16W CHIP RESISTOR
R 164	47170474	470K OHM 0603 1/16W CHIP RESISTOR
R 165	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 166	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 167	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 168	47170683	68K OHM 0603 1/16W CHIP RESISTOR
R 169	47100475	4.7M OHM 0805 CHIP RESISTOR
R 170	47170333	33K OHM 0603 1/16W CHIP RESISTOR
R 171	47170474	470K OHM 0603 1/16W CHIP RESISTOR
R 172	47170274	270K OHM 0603 1/16W CHIP RESISTOR
R 173	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 301	47170471	470 OHM 0603 1/16W CHIP RESISTOR
R 302	47170391	390 OHM 0603 1/16W CHIP RESISTOR
R 303	47100100	10 ohm 0805 CHIP RESISTOR
R 304	47170272	2.7K OHM 0603 1/16W CHIP RESISTOR
R 305	47170272	2.7K OHM 0603 1/16W CHIP RESISTOR
R 306	47170470	47 OHM 0603 1/16W CHIP RESISTOR
R 307	47100100	10 ohm 0805 CHIP RESISTOR
R 308	47170561	560 OHM 0603 1/16W CHIP RESISTOR
R 309	47170153	15K OHM 0603 1/16W CHIP RESISTOR
R 310	47170153	15K OHM 0603 1/16W CHIP RESISTOR
R 311	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 312	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 313	47170102	1K OHM 0603 1/16W CHIP RESISTOR
R 313	47170223	22K OHM 0603 1/16W CHIP RESISTOR
R 314	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 315	47170101	100 OHM 0603 1/16W CHIP RESISTOR
R 316	47170561	560 OHM 0603 1/16W CHIP RESISTOR
R 317	47170102	1K OHM 0603 1/16W CHIP RESISTOR
R 318	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 319	47170153	15K OHM 0603 1/16W CHIP RESISTOR
R 320	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 321	47170153	15K OHM 0603 1/16W CHIP RESISTOR
R 322	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 323	47170333	33K OHM 0603 1/16W CHIP RESISTOR
R 324	47170101	100 OHM 0603 1/16W CHIP RESISTOR
R 325	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 401	47100100	10 ohm 0805 CHIP RESISTOR
R 402	47170102	1K OHM 0603 1/16W CHIP RESISTOR
R 403	47170472	4.7K OHM 0603 1/16W CHIP RESISTOR
R 404	47170152	1.5K OHM 0603 1/16W CHIP RESISTOR
R 405	47170222	2.2K OHM 0603 1/16W CHIP RESISTOR
R 406	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 407	47170271	270 OHM 0603 1/16W CHIP RESISTOR
R 408	47170391	390 OHM 0603 1/16W CHIP RESISTOR
R 409	47170681	680 OHM 0603 1/16W CHIP RESISTOR
R 410	47170392	3.9K OHM 0603 1/16W CHIP RESISTOR
R 411	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 501	47170223	22K OHM 0603 1/16W CHIP RESISTOR
R 502	47170153	15K OHM 0603 1/16W CHIP RESISTOR

SCHEMATIC REFERENCE NUMBER PARTS LIST RTX-454

Ref.	RITRON#	Description
R 503	47170471	470 OHM 0603 1/16W CHIP RESISTOR
R 505	47170223	22K OHM 0603 1/16W CHIP RESISTOR
R 506	47170561	560 OHM 0603 1/16W CHIP RESISTOR
R 507	47170152	1.5K OHM 0603 1/16W CHIP RESISTOR
R 508	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 509	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 510	47170104	100K OHM 0603 1/16W CHIP RESISTOR
R 511	47170822	8.2K OHM 0603 1/16W CHIP RESISTOR
R 512	47170122	1.2K OHM 0603 1/16W CHIP RESISTOR
R 513	47170394	390K OHM 0603 1/16W CHIP RESISTOR
R 514	47300103	THERMISTOR, 10K SMT
R 515	47170474	470K OHM 0603 1/16W CHIP RESISTOR
R 516	47170122	1.2K OHM 0603 1/16W CHIP RESISTOR
R 517	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 518	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 519	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 520	47170332	3.3K OHM 0603 1/16W CHIP RESISTOR
R 521	47170272	2.7K OHM 0603 1/16W CHIP RESISTOR
R 522	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 523	47170470	47 OHM 0603 1/16W CHIP RESISTOR
R 524	47170470	47 OHM 0603 1/16W CHIP RESISTOR
R 525	47170103	10K OHM 0603 1/16W CHIP RESISTOR
R 526	47170152	1.5K OHM 0603 1/16W CHIP RESISTOR
R 527	47170681	680 OHM 0603 1/16W CHIP RESISTOR
SPEAKER		
SP101	05500045	SPEAKER, 45MM, 1W, LOW PROFILE SST
SWITCHES		
SW101	05100042	SWITCH SPST MOMENTARY MINI PC 260GM
SW102	05100042	SWITCH SPST MOMENTARY MINI PC 260GM
CRYSTALS/FILTERS		
Y 101	02300115	8 MHz AT-49 uP REFERENCE CRYSTAL
Y 501	02302004	CERAMIC DISCRIMINATOR, CDBM450C18
YF501	02301012	FILTER,CERAMIC,450KHz,+/-7.5KHz,4 POLE
YF502	02301010	FILTER,CERAMIC,450KHz,+/-4.5KHz,4 POLE
YF503	02301403	43.650 MHz Crystal Filter +/-6.0KHz UM-1
YF504	02301403	43.650 MHz Crystal Filter +/-6.0KHz UM-1
	23050003	TCVCXO, 14.400 MHz, 1.5 PPM, VC=30 PPM/V
FERRITE BEADS		
Z 101	18360001	BEAD; FERRITE SURFACE MOUNT
Z 102	18360001	BEAD; FERRITE SURFACE MOUNT
Z 103	18360001	BEAD; FERRITE SURFACE MOUNT
Z 401	18360001	BEAD; FERRITE SURFACE MOUNT
Z 402	18360001	BEAD; FERRITE SURFACE MOUNT
HARDWARE		
	02500120	BUSHING; ANTENNA ~X~ SERIES