TYPE OF EXHIBIT: INSTRUCTION MANUALS

FCC PART: 2.1033 (c)

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

MODEL: SST-144

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT13-144

DATE: April 25, 2001

Included is a draft of the Maintenance and Operating Manual for RITRON Model Patriot SST-144 VHF-FM Handheld Transceiver.

Specifically, this manual includes a technical description of the SST-144 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 2.1033 (c):

(2) FCC Identifier.
(3) A copy of the installation and operating instructions.
(4) Type of emission.
(5) Frequency range.
(6) Range of operating power, and means to provide variation in operating power.
(7) Maximum power rating.
(8) DC voltage chart.
(9) Tune-up procedure.
(10) A description of all frequency determining and stabilization circuits. A description of the circuits used to suppress spurious radiation, limiting modulation, and limiting power.
(12) Drawing with labels for controls and complete circuit diagrams.

Signed: Kevin G. Matson

Kevin G. Matson - Project Engineer

Surface Mount Repair

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

Precautions for Handling CMOS Devices

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

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

PC Board Removal - Special Tool

RITRON recommends using a knurled nut tool to remove the slotted knurled nuts that secure the charge and audio jacks on top of the radio. You will need two sizes of this tool, one for each jack size. Mouser Corporation ® is one source, stock number 382-0004 (2.5mm jack) and 382-0006 (3.5mm jack). You can reach Mouser sales and distribution center at 1-800-346-6873.

Properly Attach the Synthesizer Shield

The synthesizer shield should not be removed, unless a component must be replaced. This shield is soldered to the main PC board.

Re-assembly - Speaker Magnet, Battery Voltage on Connector Pin

The speaker magnet will pick up clipped leads and other small metal objects from your bench top. Even tiny objects on the diaphragm will cause the speaker to buzz. Make sure the speaker is free of foreign objects before reassembling the radio.

Radio Transmitter Power Measurements

The SST-144 was designed to produce 4 Watts of Transmitter power at nominal battery voltage (+7.2 VDC), throughout the radio's operating frequency range. Measurements are made with the RITRON SST-SRVBD RF service module connected to the radio antenna terminal. The transmitter was designed with close tolerances to prevent RF power output from exceeding specifications and reducing battery life.

PCB and Firmware Revisions

Changes in circuit design, component values, and radio firmware are made occasionally to enhance the performance of the SST-144. In general, the manual will be periodically updated for component value changes without a change in the manual revision level. Always refer to the Schematic Reference Parts List for the most recent component values. Changes in circuit design that require printed circuit board revision, or changes in firmware that significantly alter the operating characteristics of the radio, will be covered in a revised manual.

This manual is updated for the following revisions:

SST-144-MRM	Rev A
PCB Revision	1750250C
Firmware Revision	v06

GENERAL

FCC ID:	AIERIT13-144
FCC Rule Parts:	22, 74, 90, 95
Frequency Range:	150 to 162 MHz
Max. Freq. Separation:	12 MHz
RF Channels:	Up to 10 Channels, Independent TX/RX frequencies.
Synthesizer Step Size:	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)
Dimensions:	4.75”H x 2.2”W x 1.43”D
Weight:	11.5 oz. with battery pack
Enclosure Material:	Lexan Polycarbonate
Environmental:	Splash resistant and shock and vibration per RITRON Drop Test (6 ft. drop onto concrete on all six sides)
Antenna Fitting:	1/4" - 32 x 1/4" threaded
External RF Test Jack:	Antenna connector with RITRON SST-SRVBD test device
Earphone Jack:	3.5 mm, disconnects the internal speaker for external earphone, speaker / microphone, or headset. Also provides cable connection for PC programming.
Microphone/PTT/ Chg Jack:	2.5 mm, for external speaker/microphone, headset or RITRON model BC-A wall charger.

CONTROLS

Push Button Controls:	On/Volume Up, Volume Down/Off, PTT, Channel

Speaker Beep Indicators:

On/Volume Up:	Radio beeps channel number when turned on, followed by increasing audio to adjust volume.
Volume Down/Off:	Decreasing audio to adjust volume, with two tones when turned off.
Both Volume Buttons:	Alternates between Tone Squelch (single beep) and Carrier Squelch (two beeps). If both buttons are held down until the radio beeps repeatedly, squelch will be disabled.
PTT:	Programmable for a single “transmit beep”.
Channel:	Number of beeps indicates channel.

TRANSMITTER

RF Power Output:	Programmable per channel for high or low power	
High : Low:	4 Watts @ +7.2 VDC 1 Watt	
	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 %	
Spurious & Harmonics:	-60 dBc	
Audio Response:	Meets FCC and EIA requirements	
Time-out Timer:	60 seconds, programmable	

RECEIVER

	Wide band Models	Narrow band Models
Modulation Acceptance:	+/- 7.0 KHz	+/- 3.75 KHz
Sensitivity: (12 dB SINAD)	0.25 µV	0.25 µV
Adjacent Channel (EIA):	-75 dB	-65 dB
Spurious Rejection:	-70 dB	-70 dB
Image Rejection (EIA):	-80 dB	-80 dB
Intermodulation (EIA):	-65 dB	-60 dB
Noise Squelch Sensitivity:	Programmable per channel, factory set for 12 dB SINAD	
Frequency Response:	300 - 3000 Hz, de-emphasized	
Audio Output	1 Watt into 8 Ω, with less than 5 % THD @ the earphone jack	
Receiving System:	Dual conversion superheterodyne	
I.F. System:	1st - 43.65 MHz, 2nd - 450 KHz	
L.O. Injection:	High side	
QC/DQC Decode Time:	per EIA Standards	

BATTERY

Battery Pack:	+7.2 VDC, 800 mAH rechargeable NiCd battery pack standard
	+7.2 VDC, 1500 mAH rechargeable MiMH battery pack optional
Battery Drain:	
Standby:	46 mA
Sleep:	12 mA
Avg. Standby with Power Saver:	20 mA
Receive:	125 mA
Transmit:	1600 mA @ 4 Watts 850 mA @ 1 Watt

Battery Life @ 90/5/5 Duty Cycle with Standard battery pack (800 mAH):

8.3 Hrs, Battery Saver On, TX High Power
15.7 Hrs, Battery Saver On, TX Low Power
6.5 Hrs, Battery Saver Off, TX High Power
10.2 Hrs, Battery Saver Off, TX Low Power

Battery Life @ 90/5/5 Duty Cycle with High capacity battery pack (1500 mAH):

15.6 Hrs, Battery Saver On, TX High Power
29.4 Hrs, Battery Saver On, TX Low Power
12.2 Hrs, Battery Saver Off, TX High Power
19.2 Hrs, Battery Saver Off, TX Low Power

GENERAL

RITRON's SST-144 handheld is a small, programmable two-way radio, designed to operate in the 150-162 MHz professional FM communications band. This handheld features push-button operating controls, with the Push-To-Talk and Channel buttons on one side of the radio. The On / Volume Up and Volume Down / Off, volume and monitor controls are on top.

Each radio can be “dealer” programmed to contain a unique set of operating frequencies and options. Selective signaling options include Quiet Call (CTCSS) and Digital Quiet Call (DCS). Transmitter power, operating bandwidth and battery saver are among the options programmable on a per channel basis.

Model Identification

The SST-144 model, serial number and FCC Identification are displayed on a label located on the back of the radio beneath the belt clip.

FCC REGULATIONS

Licensing

The FCC requires the radio owner to obtain a station license for his radios before using them to transmit, but does not require an operating license or permit.

The station licensee is responsible for ensuring that transmitter power; frequency and deviation are within the limits specified by the station license. The station licensee is also responsible for proper operation and maintenance of the radio equipment. This includes checking the transmitter frequency and deviation periodically, using appropriate methods.

Safety Standards

In 1991 the Institute of Electrical and Electronics Engineers (IEEE), and in 1992 the American National Standards Institute (ANSI) updated the 1982 ANSI standard for safety levels with respect to human exposure to RF energy. Over 120 scientists, engineers, and physicians from universities, government health agencies, and industry, after reviewing the available body of research, developed this updated Standard. In March 1993 the Federal Communications Commission (FCC) proposed the adoption of this updated Standard.

The SST-144 handheld radio is designed to comply with this Standard. To limit your exposure to levels at, or below, the levels in the Standard, please observe the following:

- Use only the antenna(s) available from RITRON for this model. DO NOT attempt to substitute any other antenna.
- Keep talk times as short and infrequent as possible. DO NOT depress the PTT button when not actually wishing to transmit. The radio is equipped with an internal timer to limit continuous transmit times.
- When transmitting, hold the radio in front of the mouth at a distance of at least 4 inches. DO NOT hold the radio in such a manner that the antenna is next to, or touching, exposed parts of the body, especially the face or eyes while transmitting.
- In belt mounted applications, when transmitting, remove the radio from the belt and hold away from the body at least 4 inches.
- When using external headset accessories, hold the unit away from the body at least 4 inches while transmitting.
- DO NOT allow children to operate the radio.

CHARGING

The handheld is powered by a rechargeable battery, which fits into the radio case (see FIG-1).
The battery pack 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 cube charger (model BC-A), the battery should charge completely in 12 hours.

To charge the battery using a RITRON cube charger - plug the charger cord into the smaller of the two jacks on top of the radio. Then plug the cube into a 110 VAC outlet. The green lamp lights while the battery is charging, and should go off only when the cube is unplugged.
Two charger contacts, visible through the bottom of the radio case, allow the battery to be charged using an optional RITRON drop-in charger (model BCC-PS). The battery pack may be charged inside or outside of the radio case.

To charge the battery using a drop-in charger (model BCC-PS) - plug the drop-in charger into a 110 VAC outlet. Set the portable or battery into the charger. Each battery contact must rest on a charger contact pin.

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

PRECAUTIONS

- Use only RITRON-supplied chargers; other chargers might cause fire, explosion, or other damage to the radio.
- Do not "fast-charge" a brand new battery pack. Otherwise, the battery might be damaged.
- Once the battery has been charged fully using the normal rate, the fast rate may be used thereafter.
- Do not fast-charge a battery pack that is fully charged. This can shorten battery life.
- Do not charge or replace a battery in an explosive atmosphere. Contact sparking can ignite an explosion.
- Do not dispose of a battery in fire. An explosion might result.
- Do not charge the battery 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 can reduce its charge capacity.

BATTERY REPLACEMENT

To replace the battery in the SST-144:

1. Hold the radio as shown in FIG-1(A)
2. Use your thumbnail to open the Door Latch, as shown in FIG-1(A).
3. Lift and rotate the Battery Access Door to release it as shown in FIG-1(B).
4. Use the Pull-tab to pull the Battery Pack out of the case as shown in FIG-1(C).
5. Insert the replacement Battery Pack as shown in FIG-1(C). Push the Battery in as far as possible.
6. Replace the Battery Access Door. Secure it by closing the Door Latch as shown in FIG-1(A).
7. Be certain to firmly lock the Door Latch, as shown in FIG-1(A).

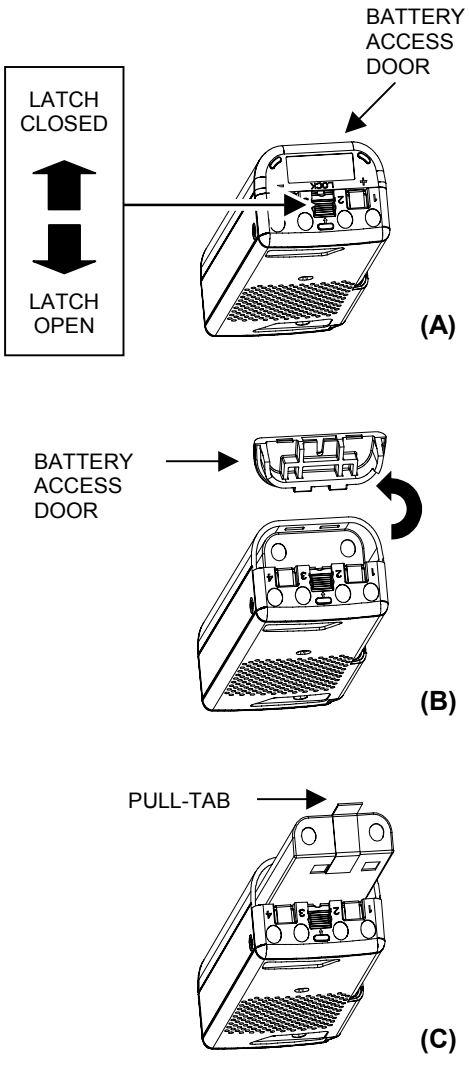


FIG-1: Battery Replacement

BATTERY MAINTENANCE

With daily use and recharging, a battery's service life is about 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 standard battery should not be left to charge continuously.
- Condition battery packs once a month as directed in Battery Conditioning.
- Condition batteries that are run down.
- Charge batteries for 16 hours before storage, and for 16 hours once a month thereafter.
- DO NOT charge batteries in temperatures colder than about 45°F. Charging batteries in temperatures above 95°C. does not harm them, but can reduce charge capacity.

It is time to purchase a new battery:

- When the radio's transmitter coverage decreases or does not work at all.
- When the radio quits working after just a few hours of use, even with a full overnight charge.
- When 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.

BATTERY CONDITIONING

Due to the extended run time of the SST-144 radio, some users may never fully discharge the battery pack during normal use. Achieve maximum battery life by fully discharging the battery periodically to condition it.

After exposing the battery pack to many cycles of not fully discharging it before recharging, the radio may exhibit reduced battery capacity. This reduced capacity is evident when, after several hours of use, battery voltage drops while the radio is transmitting, causing the radio to emit a dead battery warning tone and shut itself off.

Condition battery packs by the following procedure as either a preventive measure, or if you suspect reduced capacity:

1. Use your radio throughout a normal working day without charging.
2. Press and hold the On/ Volume Up and Volume Down/ Off buttons simultaneously for 8 seconds to place the radio in "open squelch" mode.
3. Release both buttons when you hear the radio beep rapidly; it will then emit a loud "rushing" noise. Press On/ Volume Up to maximize this noise.
4. Put the radio away in a secure place (possibly a desk drawer), where nothing can press against the buttons to accidentally turn it off or cause it to transmit. Allow the radio to run until it shuts off when the battery is completely discharged. A typical battery pack may require up to 8 hours to completely discharge.
5. When the radio has shut off, charge it overnight for 12-14 hours. The battery will be ready for use with renewed capacity.

DESCRIPTION OF CONTROLS AND CONNECTORS

Antenna

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

Use only the antenna(s) available from RITRON for the SST-144. Do not attempt to substitute with any other antenna.

On/Volume Up

This button switches on the radio, then increases the volume if you continue to press.

Volume Down/Off

This button decreases the volume, then shuts off the radio if you continue to press.

Push-To-Talk

The PTT activates the transmitter, and must be held down while you talk into the microphone. Release the PTT button to receive.

Channel Selector

Pressing this button selects the next channel. When the maximum number of channels is reached and you press this button, the radio resets to channel 1.

Audio Accessory Jack

This jack connects speaker audio to optional accessories, such as a remote speaker/ microphone or an earphone. For accessories that have a two-plug connector, the smaller plug is inserted into the charge jack.

This jack is also used to program the radio using the optional PC programming kit.

Charge Jack

The battery may be charged through this jack using a standard RITRON wall socket charger cube. This jack also connects microphone audio to the optional remote speaker/microphone.

Microphone

The microphone converts your voice into electrical impulses, which are carried with your broadcast to receiving radios. Hold the radio about four inches away and talk into the microphone while transmitting. Shouting does not improve the listener's reception.

Speaker

The speaker allows you to hear calls on your channel.

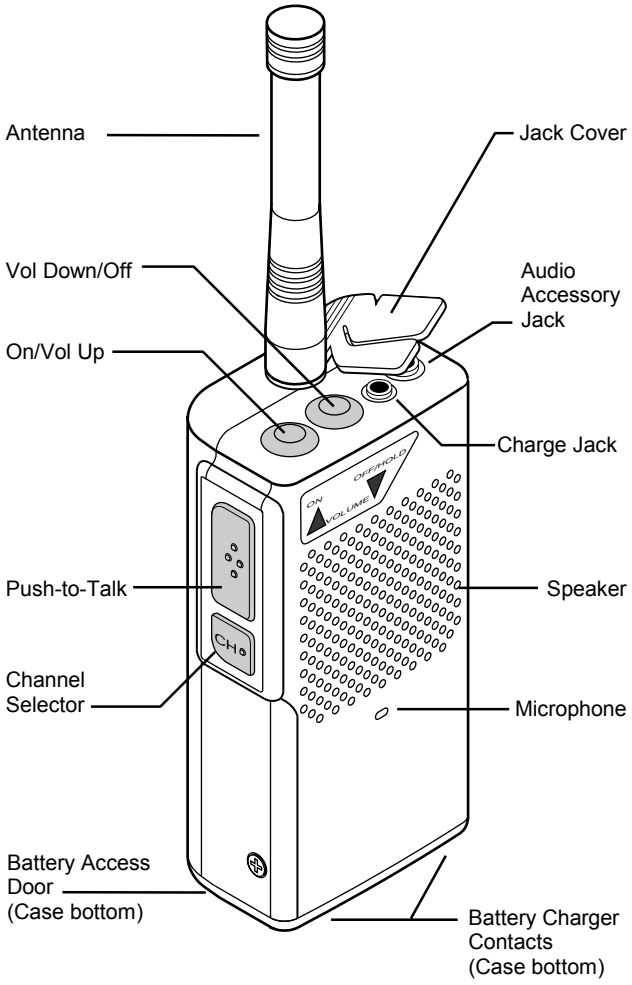


Fig. 2 Controls and Accessory Connectors

Jack Cover

This rubber cover seals out dust and moisture, etc. Snap the cover into the audio accessory and charge jack openings when the jacks are not being used.

Battery Access (Case Bottom)

The battery door on the case bottom may be removed to access the battery. (Refer to the Battery Replacement section of this manual.)

Drop-in Charger Contacts (Case Bottom)

Two charger contacts in the bottom of the SST-144 radio case allow the battery pack to be charged using an optional RITRON drop-in charger (model BCC-PS.)

RADIO OPERATION

On-off/Volume

To switch on the radio - press the On/Volume Up button. The radio will beep a number of times equal to the current channel number.

To adjust the volume - press the volume up button until you reach the desired level. You should hear noise and any broadcasts on the channel.

To turn off the radio - press and hold the Off/Volume Down button until two tones sound.

To determine whether the radio is on - press the volume down button. If the radio is on, noise or activity on the channel is heard.

Receive

To hear calls from other users - adjust the volume as desired. The radio can receive broadcasts while the Push-To-Talk button is not being pressed. Whether or not you hear these broadcasts depends upon the squelch settings.

There are two types of squelch used in the SST-144 portable. 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 one of the selective signaling or “tone squelch” formats available on the SST-144. This allows you to screen out “on-channel” broadcasts that do not carry the correct code programmed for the radio.

Note: It is possible that the beginning of a call might be missed while the radio is in battery saver mode. If this happens, ask the caller to repeat the message.

Selective Signaling Squelch

To activate tone squelch - simultaneously press both of the volume buttons. Hold for a second or two before releasing. When tone squelch is turned on, the handheld sounds one beep. When carrier squelch is on, the radio emits a "double beep."

Note: If you continue to hold down the volume buttons after the beep (or double beep), the radio will start beeping repeatedly. This means that squelch is turned off. Release the buttons. To restore squelch, press and hold both of the volume buttons until the radio sounds a beep or double beep.

Monitor

To monitor the channel - press one of the volume control buttons. When you press the volume up or the volume down button, squelch turns off and all radio traffic on the channel (and noise) sounds in the speaker.

Battery Saver

The handheld has a programmable "battery saver" feature that conserves battery power. The battery saver constantly checks the radio's transmitter, receiver and controls for activity. If a number of 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 can follow.

Transmit

Normally, you should not transmit until no one is talking on the channel.

To transmit - hold down the Push-To-Talk button and with the radio four inches away talk into the microphone. Speak in a normal tone, since talking louder will not improve the listener’s reception.

Channel Selection

To change channels - press and release the Channel button. The radio will beep a number of times equal to the current channel number. Pressing the Channel button again will increment the channel and the radio will beep the new channel number. For example, if you select channel 2, the handheld will beep twice. If the highest channel number is selected and you press the Channel button, the radio will reset to channel 1. A one-channel radio will beep only once when you press the Channel button.

WHAT THE RADIO TONES MEAN

The handheld responds to certain instructions by sounding a beep or series of tones. These tones can tell you whether the radio is working as you expect.

Power On/Self Check "OK"

When it is first turned on, the radio runs a quick "self test" to confirm basic functions. The radio then beeps the number of times equal to the channel number selected. The radio is then ready to use.

Error Tones

However, if the "self test" detects a diagnostic error, an error tone sounds. Alternating tones (the second is longer and lower pitched) indicate the radio frequency synthesizer is malfunctioning. Turn off the radio and try again. A long, low-pitched tone means the battery voltage is too low to operate the radio. In this case, recharge the battery. If you cannot correct a problem, consult an authorized Ritron service facility or Ritron.

Channel Select

When the Channel button is pressed, the radio beeps a number of times equal to the current channel number. Pressing the Channel button again will increment the channel and the radio will beep the new channel number.

Tone Squelch

When you press and hold both Volume buttons at the same time, a single beep will sound to indicate that tone squelch is on. A "double beep" means that carrier squelch is on.

Recharge Battery Alert

As the battery voltage approaches the minimum required "operating voltage" the radio will emit a short beep every minute to alert the user that the battery will soon need recharging. Once the battery charge drops below the required "operating voltage," the radio emits a long, low tone and turns itself off. If you turn the radio back on, it will beep again and shut itself off. Recharge the battery.

OPTIONAL RADIO TONES

The SST-144 can be programmed using the RITRON PC Programmer for optional alert tones.

Receive Squelch Tone

A short tone sounds at the end of each received transmission to indicate that you may transmit.

Busy Channel Transmit Inhibit

If a user is transmitting on your radio frequency without your tone, you will not be allowed to transmit. The radio will beep a series of long, low tones while the PTT is held down (like a busy signal).

Transmitter Time Out

A low tone followed by a higher-pitched tone sounds and the transmitter automatically shuts off if you hold down the PTT button longer than the programmed Time-out. The radio automatically switches to receive mode. Authorized service personnel can turn off this feature.

BELT CLIP INSTALLATION

If you are going to attach the belt clip to the handheld, follow these instructions:

1. The belt clip is fastened to the radio case back with the Philips head screw provided. Use the screw included, since a longer screw might damage the radio's electronics.

   Do not use petroleum solvents of any kind on the radio. These can corrode the case.

2. Place the belt clip on top of the radio case back, with the screw hole in the aligned with the hole in the radio case.

3. Using the screw that came with this accessory, attach the clip to the radio.

TROUBLESHOOTING

If you have trouble operating the handheld, review the radio controls and operation sections. If you think the radio is malfunctioning, check the following table.

GENERAL

The radio does not work at all.

- Make sure the battery is installed correctly, as shown in FIG-1.
- Recharge or replace the battery. (See note 1.)

Operating features do not work exactly as expected.

- The radio has been factory or dealer programmed for customized operation.

Reception is poor.

- Move to a different location. (Note 2.)
- Confirm that the proper antenna is connected to the radio. (See p. 11, "Antenna.")

You cannot hear calls from other radios.

- Turn off tone squelch. (See Note 3.)
- Be certain your radio receives on the same as the caller transmits. (Note 4.)
- Recharge the battery. (Note 1.)

Your calls cannot be heard in other radios.

- Make sure that your radio transmits on the receive frequency of the radio(s) you want to call. (Note 4.)
- Recharge the battery. (Note 1.)

TONE CODED SQUELCH

You cannot screen out calls from users outside of your tone group.

- Make sure the channel is programmed with tone squelch.
- Activate Tone (coded) squelch. (Note 7.)

You cannot hear Tone coded messages while in Tone (coded) squelch.

- Confirm that the channel is programmed to detect the same code as the calling radio(s) transmits. (Note 7.)

Others in your tone group cannot hear your tone coded messages.

- Verify that you transmit the same code as the radio(s) you call are programmed to detect. (Note 7.)

ERROR TONES

An error tone sounds when the radio is first turned on.

- Replace the battery. (Note 1.)
- See "Error Tones" in the Operation section.

An error tone sounds while you are talking. (and the transmitter shuts off).

- Refer to “Error Tones”

BATTERY

The battery loses its charge sooner than expected.

- Review the battery charging instructions.
- Conserve the battery. (Note 5.)
- If the radio is used in extreme cold, warm the radio under your coat. (Note 6.)

Notes

1. Try a battery pack from a working radio. If the radio in question works with that pack, the original battery is suspect. Charge the suspect battery as recommended in this manual. Then, if the charged original battery cannot power the handheld, try charging again with another charger. If the battery still doesn’t hold a charge, the pack should probably be replaced. However, if the battery appears to be good after you try the second charger, the first charger might be faulty. If you think that an accessory is not operating properly, contact your dealer or RITRON. (Radio accessories come with a 90-day limited warranty.)
2. Reception can often be improved by moving a short distance. This effect is more noticeable inside of buildings. The range of these portables equipped with a standard battery pack is about two miles (line-of-sight).
3. If your radio does not detect calls from other radios on the channel, turn off tone squelch. (Press both Volume buttons at the same time - a double beep means that tone squelch is off.)
4. If you want to hear a call, you must select a channel that is programmed to receive the caller’s transmit frequency. If you want to call another unit, you must select a channel that is programmed to transmit the other radio’s receive frequency. However, if you use a repeater, your channel must be programmed to work with the repeater’s transmit and receive frequencies. (A radio channel can hold two separate operating frequencies, one for Receive, the other for Transmit.)
5. Maximum power drain occurs while the radio transmits, so don’t hold down the Push-To-Talk button more than necessary. Battery power is used while the handheld is left on to receive calls. If practical, switch off the unit.
6. In extreme cold, a battery’s charge capacity is greatly reduced. If you use the radio in very cold weather, periodically warm the portable underneath your coat if possible. An optional remote speaker/microphone would allow you to keep the radio under your coat while transmitting and receiving.
7. In order for radios to communicate using Quiet Call, they must be programmed with the same tone code. Each code is unique, and your radio will respond only to the code programmed. Press and hold both volume buttons at the same time. A single beep means that tone squelch is on. A double beep means that tone squelch is off.

PROGRAMMING METHODS

Each SST-144 can be programmed to operate on up to 10 channels. The SST-144 may be programmed using the Push-to-Talk switch or an optional RITRON PC programming kit.

PTT (PUSH-TO-TALK) PROGRAMMING allows you to program any channel to one of the radio frequencies listed in Table 1 and any Quiet Call code listed in Table 2. The radio will transmit and receive on the programmed table frequency and QC code.

PC PROGRAMMING 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.

PTT (PUSH-TO-TALK) PROGRAMMING

Note: If the radio will not enter PTT program mode, this feature has probably been turned off using the optional PC programming kit.

Reading Out a Radio Channel's Contents

1. Place the radio in Program / Readout mode as described in Fig-3.
2. Press the Channel Selector button to select the radio channel you would like to read out.
3. Press and release the Volume Up button.
4. The radio will emit a series of beeps, pause, and then begin another series. Four series of beeps will be heard, with each series representing a digit. The number of beeps in a series is equal to the digit. (See CHANNEL READOUT)
5. Write down each digit while the radio pauses. List the digits in the order that you hear them.
6. The first two digits represent the frequency as shown in Frequency Table 1 on page 13.
7. The second two digits represent the QC (CTCSS) tone frequency as shown in Quiet-Call Tone Code Table 2 on page 13.
8. To read out another channel, follow steps 2 through 7.
9. Turn the radio off to exit Channel Readout mode.

Notes:

1. Ten (10) beeps = the digit zero (0)
2. The radio will beep out "44" as a tone code if it has been programmed for "No Tone".
3. A radio that has been PC-programmed with any frequency not listed in Frequency Table 1, page 13, will emit the error tone on content readout.

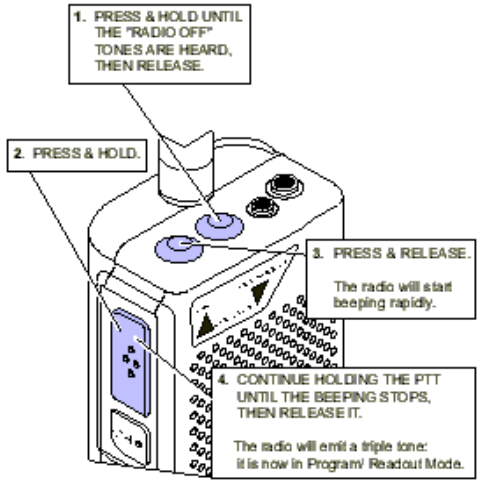


Fig. 3 PLACING THE RADIO IN PTT PROGRAM / READOUT MODE

CHANNEL READOUT:

FREQUENCY CODE

1st digit _____ * 2nd digit _____ *
# of beeps in series *# of beeps in series*

TONE CODE

3rd digit _____ * 4th digit _____ ♦
# of beeps in series *# of beeps in series*

Notes:

* Pause after entering each digit. The radio will emit a low tone, separating one digit from the next.

♦ The radio sounds a triple beep when PTT channel programming is complete.

PTT Programming a Radio Channel

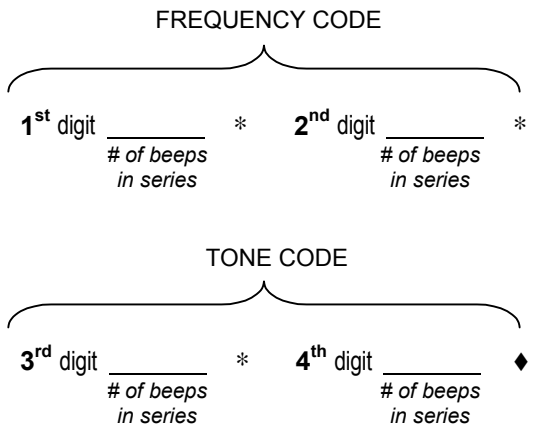
Four valid digits must be entered for the radio to accept PTT programming. The first two digits entered are the frequency code from Table 1, followed by the two digits for the QC code from Table 2.

1. Place the radio in Program / Readout mode as described in Fig-3 on page 11.
2. Press the Channel Selector button to select the radio channel you would like to program.
3. Enter the first digit by pressing the PTT button the number of times equal to the digit's value.
4. Pause after the digit is entered, a low tone will sound indicating that the digit has been accepted.
5. Enter the second, third and fourth digits using the same method as the first digit.
6. Press the Volume Up button to enter the new channel programming. The radio will emit a triple beep confirmation tone to indicate that programming has been accepted.
7. To program another channel, follow steps 2 through 6.
8. Turn the radio off and then on again – the radio is now ready for use.

Notes:

1. To enter the digit zero (0), press the PTT ten times.
2. Program "44" to enter "No Code" for Quiet Call. You must enter "44" to match radios not having tone codes.
3. An error tone will sound if you attempt to save an incorrect digit. Turn the radio off, check the digits you are attempting to enter, then start over again.
4. If you make a PTT click error, turn the radio off then on, and start over.
5. If the radio does not emit a confirming triple tone when you attempt to enter Program / Readout mode, the radio was dealer customized to disable PTT programming.
6. Refer to the Frequency Table 1 and Tone Code (Quiet Call™) Table 2 on page 13.

PTT CHANNEL PROGRAMMING:



Notes:

* Pause after entering each digit. The radio will emit a low tone, separating one digit from the next.

♦ The radio sounds a triple beep when PTT channel programming is complete.

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.

PTT Programming Mistakes

Invalid Entries An error tone means that you tried to save an invalid entry. No programming changes are made in this case. A triple tone will sound next indicating that the radio is still in programming mode, and ready for an entry.

PTT Entry Mistakes If you press the PTT five times when you intended four, for example, or if you just lose count, do not press the Volume Up button to store the entry. Instead, start over by turning the radio off and placing the radio in programming mode again.

Code	Frequency	Description
01	154.600	Green Dot
02	154.570	Blue Dot
03	151.625	Red Dot
04	151.955	Purple Dot
05	151.925	
06	154.540	
07	154.515	
08	154.655	
09	151.685	
10	151.715	
11	151.775	
12	151.805	

Table 1 – PTT Programming Frequency Table

QC Code	Freq (Hz)	QC Code	Freq (Hz)
01	67.0	27	167.9
02	71.9	28	173.8
03	74.4	29	179.9
04	77.0	30	186.2
05	79.7	31	192.8
06	82.5	32	203.5
07	85.4	33	210.7
08	88.5	34	218.1
09	91.5	35	225.7
10	94.8	36	233.6
11	97.4	37	241.8
12	100.0	38	250.3
13	103.5	39	69.4
14	107.2	40	159.8
15	110.9	41	165.5
16	114.8	42	171.3
17	118.8	43	177.3
18	123.0	44	No Tone
19	127.3	45	183.5
20	131.8	46	189.9
21	136.5	47	196.6
22	141.3	48	199.5
23	146.2	49	206.5
24	151.4	50	229.1
25	156.7	51	254.1
26	162.2		

Table 2 – Quiet Call Codes and Frequencies

COMPUTER SOFTWARE COPYRIGHTS

PC COMPUTER PROGRAMMING

RITRON's programming kit allows programming of the SST-144 model radios using a PC compatible computer. An 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 3.5" diskettes.
2) Installation instructions and a registration form.
3) Ritron PC to radio adapter cable, which is terminated at one end with a DB-25F connector, at the other end with a modular plug. The DB-25 plugs into the computer's serial port, the modular plug into the SST-SRVBD modular jack.
4) An adapter for use with SST-144 portables. This adapter mates the modular plug to a 3.5 mm plug, for connection to the handheld audio jack.

The PC Programming Kit Requires:

A PC compatible computer with Windows 95 or later. The computer must have an RS-232 serial port and a minimum of 2MB available on the hard disk drive for installation.

Programmable Features

The following features may be programmed on a per channel basis, or will affect all channels together.

Feature	Range	Factory Setting	
Automatic Inactivity Turn-off	Y - N	Y	-
Battery Saver Enable	Y - N	Y	-
Battery Saver Off Time (seconds)	0 – 8	1	-
Beep Volume Level (Fixed or Controlled)	F-C	C	-
Beep Fixed Level (percent of full volume)	0 – 100%	50%	-
Busy Channel TX Inhibit	Y - N	N	√
Carrier Only, No Codes	-	-	√
Channel Beep Rate (Slow or Fast)	S – F	S	-
Channel Selection Mode (Increment or Enter)	I – E	I	-
Digital Tone Invert RX	Y - N	N	√
Digital Tone Invert TX	Y - N	N	√
Digital Quiet Call (DCS)	-	-	√
Disable Monitor	Y - N	N	√
Number of Channels	0 – 10	4	-
Narrow Band Channel	Y - N	N	√
PTT Programming Enabled	Y – N	Y	-
Quiet Call (CTCSS)	See Table 2	-	√
Receive Squelch Tone	Y - N	N	√
Squelch Tightener	0 - 7	0	√
Transmit Power (Low or High)	L - H	H	√
TX Time-out Enabled	Y – N	Y	-
TX Time-out Timer (seconds)	0 – 255	60	-
Turn On To Medium Volume Level	Y - N	Y	-

Descriptions of Features

Automatic Inactivity Turn-off - The radio automatically shuts itself off if four hours go by without the micro-controller detecting input from the volume, PTT or channel controls.

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

Battery Saver Off Time - This is the cycle time that the radio is off in battery saver mode before it checks for a received signal. A long Battery Saver Off Time may cause the user to miss the beginning of the first message when in battery saver mode.

Beep Volume Level - The radio can be programmed for a fixed beep volume or for a beep volume that is adjusted with the Volume controls. If fixed beep volume is selected, the fixed level can be set between 0 – 100%.

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.

Channel Beep Rate - The rate at which the channel indicator beeps occur can be set to fast or slow.

Channel Selection Mode - This feature allows the channel selector to increment or enter the channel. The channel number is "beeped out" when the channel button is first pressed. The channel is not changed. In increment mode the radio is changed to the next available channel if the channel button is pressed again within three seconds. In enter mode the user must press the channel button the number of times equal to the channel they wish to select.

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 or DQC must be used for this option to have any affect, and the Encode Only feature disabled.

Maximum Number of Channels - The number of channels available on the radio can be set from 1 to 10.

Narrow Band Channel - Any channel can be set to operate in narrow band mode, reducing the transmit deviation to 2.5 KHz.

PTT Programming Mode Enabled - This feature allows channel programming from a table of pre-determined frequencies using the radio PTT switch.

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, no Quiet Call code is programmed for receive mode, allowing all traffic on the channel to be heard.

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 Tightener - 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 Frequency - The radio frequency that broadcasts to other units.

Transmit Power – Any channel can be set to transmit at high or low power.

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.

Turn On To Medium Volume Level - The volume level is at mid-range when the radio is first turned on. Normally, the volume level is low when the radio is turned on.

INTRODUCTION

The SST-144 is a four-channel handheld transceiver built on a single multi-layer printed circuit board. Both sides of the main printed circuit board are populated with components, with the bottom side containing only surface mounted components.

The SST-144 is frequency synthesized, with all functions of the radio controlled by microcontroller.

POWER SUPPLY AND VOLTAGE DISTRIBUTION

The SST-144 is powered by an internal 6-cell rechargeable battery pack. The battery pack supplies power to the radio via two contact terminals that are connected to the PCB through P302. F301 is a 3A fuse in series with P302 for short circuit protection. The battery pack may be charged through 2.5 mm charge jack J301 via CR302 and F301. Zener diode CR301 prevents the batteries from discharging through the charger accessory, stops a reverse voltage from being applied to the battery pack through J301, and prevents a high voltage from being applied to the radio circuitry.

SW301 ON/VOL UP switch is pressed to turn on the SST-144, turning on voltage pass transistor Q304 via R302 and CR303. Q304 supplies power to IC309, a +5 VDC regulator used to power microcontroller IC301. Pin 13 of IC301 turns on Q303, which keeps Q304 turned on after SW301 has been released. Power is removed from the SST-144 by pressing the VOL DN/OFF switch SW302 until a beep is heard from the speaker, at which time Q304 is turned off.

+5 VDC regulator IC309 supplies power directly to microcontroller IC301, bilateral audio gates IC304, reference oscillator Y302, synthesizer IC401, and PTT detect transistor Q302.

The T/R output at Pin 11 of IC301 lets Q101 switch the regulated +5 VDC to the receiver. Pin 11 of IC301 will also turn on Q202, which turns on voltage pass transistor Q201. With Q201 emitter connected to the +VBATT battery supply, the collector output is connected to the emitter of Q202 through voltage divider R202/R203, whose values are selected to limit the TX+V voltage to +6 VDC.

Power Strobe

The SST-144 handheld includes a power strobe feature, which reduces battery current drain by periodically removing voltage from part of the radio. The strobe off cycle time is programmable using the PC Programming Kit. The +5V SW power strobe output at Pin 10 of IC301 controls Q306, which switches the regulated +5 VDC to the audio processing circuitry and the synthesizer circuitry. This includes IC303A 2.5 VDC (Vag) for bias on audio processing circuitry, IC303C audio high pass filter, IC308 and IC305A audio low pass filter for sub-audible frequencies, IC305B audio limiting amplifier, IC306 digital potentiometers, IC303B audio summing node amplifier, and IC303D audio low pass filter.

Low Battery Voltage Detection

Battery voltage is measured at A/D input Pin 16 of IC301 through voltage divider R303/R305. The radio will emit a periodic beep if low battery voltage is detected, and will turn the radio off if the battery voltage drops below +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 IC401 at Pin 20. IC401 is programmed to provide an output at Pin 1 that is ¼ of the reference (3.6 MHz), which is applied as a reference oscillator to Pin 27 of IC301 microcontroller. The Y302 pin 4 output is also multiplied up to 43.2 MHz by Q105 and its associated circuitry to provide a receiver 2nd local oscillator signal.

SYNTHESIZER

The SST-144 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. Control signals from microcontroller IC301 and Reference oscillator Y302 are routed to frequency synthesizer IC401 per the following chart:

Pin Numbers

	IC301	Y302	IC401
Clock	12	-	18
Data	5	-	19
Latch	20	-	17
LD	12	-	2
T/R SW	11	-	-
REF IN	-	4	20
REF OUT	27	-	1
+5 SW	10	-	12
+5V	1, 15, 28	2	5, 14

Q404, CR401, C414 and associated components provide a filtered supply for the VCO oscillator and buffer amplifiers.

Prescaler Divider / Synthesizer Controller

IC401 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.

IC401 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 IC301 clocks new data into IC401 internal buffer in synchronization with clock pulses. The channel information is stored in EE memory of IC302 and is loaded into RAM when the channel is selected.

Once new data is loaded into the buffer, a single pulse from IC301 appears at IC401 to instruct the synthesizer controller to latch and execute the new data. IC401 utilizes internal circuitry to determine whether the present VCO output frequency is correct by comparing the phase and frequency of the VCO signal at Pin 11 to the 14.4 MHz reference oscillator at Pin 20. IC401 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 C429, C427, R419, R420, R418, and C426 transform the Pin 6 output signal to a DC voltage for application to the VCO tuning varactor CR402. 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 R421 tied to Pin 8 of IC401, with the output current programmable to 25, 50 or 100% of maximum.

VCO / Buffer Amplifiers

Q403, L401, L406, CR402 and associated components form the VCO (Voltage Controlled Oscillator), a resonant circuit that oscillates at frequencies from 150 MHz in transmit to 205 MHz in receive (receive frequency + 43.65 MHz) to. Varying the voltage at CR402 changes the varactor capacitance, which in turn alters the VCO output frequency.

When in receive mode a +5 VDC T/RSW signal is applied to Q406, which turns on Q405 to draw current through pin diode CR404 and L403. With CR404 biased on, L402 is effectively shorted to ground, shifting the VCO frequency up 43.65 MHz.

Q401 and Q402 are buffer amplifiers, with Q401 feeding in the input of the synthesizer at Pin 11, the receiver 1st local oscillator and the transmitter pre-amplifier.

Oscillator Modulation

When the SST-144 is in transmit, modulation balance control IC306E passes TX audio through to the VCO modulation input at R416. TX audio is applied to varactor CR403 to modulate the VCO. TX audio is also routed to the Pin 1 input of TCVCXO reference oscillator Y302. Low frequency tones modulate the reference oscillator because the synthesizer is not able to track them.

DIGITAL POTENTIOMETERS

IC306 contains 6 digital potentiometers programmed by IC301, sharing the same clock and data outputs used by the synthesizer and a separate Digital Pot Latch signal from Pin 8. The digital potentiometers are used in conjunction with IC303B, a summing node amplifier used for modulating the VCO and reference oscillator. IC306A, B, D, E, and F can only be changed through serial programming, and can only be performed by an authorized licensed RF technician.

IC306A is connected through R352 to the Pin 6 input of IC303B. IC306A adjusts the DC output of IC303B to tune the reference oscillator frequency.

IC306B is connected to the Pin 2 Gate control of RF power transistor Q203 to adjust transmitter power output.

Volume control IC306C applies the processed voice band signals at IC303D to audio amplifier IC307 when in receive mode. Depressing the ON/VOL UP switch SW301 increases the setting of IC306C while VOL DN/OFF switch SW302 decreases it.

Transmitter tone deviation control IC306D applies the output of the selective signaling low-pass filter IC308 to the Pin 6 input of IC303B through R350. IC306D is completely closed in receive mode.

Transmitter modulation balance control IC306E is used to apply the Pin 7 output of IC303B to the VCO modulation input. This will set the ratio of the modulating signal applied to the VCO and the reference oscillator. IC306E is completely closed in receive mode.

Transmitter voice deviation control IC306F applies the processed voice band signals at IC303D to the Pin 6 input of IC303B through R349. IC306F is completely closed in receive mode.

RECEIVER

As mentioned before, Q101 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 Amplifier

A received signal from the antenna passes through a low-pass filter (L207, C218, C217, L208, C219, and C222) to the receiver headend. L101, L103, and the associated capacitors form a bandpass filter ahead of low-noise RF amplifier Q102. The amplified RF signal is applied to a 2-pole bandpass filter consisting of L104, L105, and associated capacitors.

1st Mixer

The amplified received input signal is applied to the gate of FET mixer Q103. The 1st local oscillator signal from the synthesizer module is applied to the source of Q103. L106, C117 and C118 tune the drain output of Q103 to 43.65 MHz and apply it to YF101, a 43.65 MHz two-pole crystal filter. Q104 and associated components amplify the 43.65 MHz IF signal and apply it to the input of the 2nd mixer at Pin 16 of IC101.

FM Receiver Subsystem

A multi-function integrated circuit, IC101 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 Q105 and associated components. This signal is applied to the 2nd local oscillator input at Pin 1 of IC101. 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 6-pole ceramic filter YF102 and applied to the input of the limiting IF amplifier at Pin 5. IC101 Pin 6 is the de-coupled input to the IF amplifier, Pin 7 the limited IF output signal. An internal quadrature detector, whose center frequency is determined by 450 KHz quadrature coil T101, detects the FM IF signal. One input of the quadrature detector is connected internally to the IF signal at Pin 7, while the other input is the phase-shifted signal from T101 at Pin 8.

Demodulated audio appears at Pin 9, where a low-pass filter (R114, C130) 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 R112, C123, C124, R110, R111 and R113. The Pin 11 output of the noise amplifier is applied to a biased noise detector CR103, with the output connected to an A/D input of IC301 at Pin 19. The SST-144 is serial programmed to set the squelch threshold and hysteresis.

Voice / Tone Conditioning in Receive Mode

SST-144 audio conditioning filter circuits are shared with the transmitter. The same high-pass filter/amplifier (IC303C and associated components) used in receive voice band conditioning is used in the transmit band. Similarly, the low-pass filter (IC308 and associated components) used for selective signal tone decode filtering is also used for selective signal encoding. Altering circuit configuration with bilateral switches IC304A, B and C permits the use of the same audio filtering system for both transmit and receive modes.

After R114 and C130 remove the 450 KHz element from the demodulated audio output at Pin 9 of IC101, C333 couples the audio signal to bilateral switch IC304C for subaudible tone detection and connection to IC304A for voice band audio processing.

Voice Band

Bilateral switch IC304A passes the received audio signal to the input of IC303C, which along with its associated components for a high-pass filter/amplifier circuit that attenuates audio signals below 300 Hz.

The output of IC303C is applied to the input of IC305B limiting amplifier. Bilateral switch IC304B is switched in receive to insert C351 into the feedback circuit of IC305B, providing de-emphasis of the received audio signal. Bilateral switch IC304B also removes R335 from the Pin 6 input to reduce the gain and prevent limiting.

The output from IC305B is applied to the input of IC303D, which along with its associated components form an 18dB/octave low-pass filter for frequencies above 3000 Hz.

The output of IC303D is connected to IC306C volume control prior to connection to audio amplifier IC307. The output of IC303D is also connected to IC306F voice deviation control, which is completely closed in receive mode to prevent received signals from modulating the VCO and reference oscillators.

Audio frequency tones from Pin 24 of microcontroller IC301 are applied to the Pin 6 input of IC305B to provide the SST-144 alert tones.

Sub-Audible

Bilateral switch IC304C passes the received audio signal to the input of IC305A, which amplifies the signal and applies it to the Pin 2 input of IC308, a 5-pole low-pass filter that attenuates frequencies above 250 Hz.

The output at Pin 5 is applied to an A/D input of IC301 at Pin 18 for tone decoding. An internal digital signal processing routine programmed into microcontroller IC301 is used to decode the correct selective signaling code. The output at Pin 5 of IC308 is also connected to tone deviation control IC306D, 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 IC306C is applied to the Pin 2 input IC307, a 1 Watt audio amplifier. C365 couples the Pin 5 output to the internal 8Ω speaker SP301 via audio jack J303.

Microcontroller IC301 Pin 22 switches DC power to the audio amplifier by turning on Q307, which then turns on pass transistor Q308 to apply battery voltage to Pin 6 of the audio amp. CR307 prevents an inadvertent DC voltage at J303 from damaging the audio amplifier.

ANTENNA SWITCHING / LOW PASS FILTER

A low-pass filter comprised of filter L208, C222, C219, C218, C217, L207, and C220 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 (CR201, CR101) and associated components form the antenna switching circuit. With the SST-144 in receive mode, no voltage is applied to the PIN diodes and they do not conduct. This reverse biases CR201 to prevent the transmitter amplifier from affecting the receiver tuning and removes CR101 from the receiver input. Incoming signals from the antenna pass through the low-pass filter, then L206 and C101 to the receiver headend.

When the SST-144 is switched into transmit mode, transmitter supply voltage is switched on by Q201 and Q202 and applied to R207. Current flows through R207, L205, CR201, L206 and then CR101 to ground, forward biasing the PIN diodes. CR201 passes transmitter RF power to the antenna while CR101 shunts the receiver RF amplifier input to ground. L206 provides sufficient impedance to isolate the transmitter power from the receiver RF amplifier.

TRANSMITTER

Keying

The SST-144 transmitter is keyed when PTT switch SW304 is depressed. Electret condenser microphone M301 is connected in series to ground with the PTT switch, which when depressed draws current through M301, SW304, CR304 and R307 to turn on pass transistor Q302. Q302 then turns on Q301 to pull the TX Key Pin 2 input of microcontroller IC301 low. The microcontroller T/R output at Pin 11 then goes high to turn on Q202, which turns on pass transistor Q201 to apply +6VDC to the transmitter as described previously. The transmitter can also be keyed through J301 with an audio accessory that inserts a microphone and PTT switch in series to ground, drawing current through CR304.

+VTX Supply

With the transmitter enabled as described above, the +VTX voltage from Q201 is applied to transmitter RF amplifier Q204. +VTX supply also forward biases the PIN switching diodes CR201 and CR101 as previously described. The transmitter RF final amplifier Q203 is powered by the battery supply.

The Pin 11 T/R output of microcontroller IC301 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

Q204 and associated components amplify the VCO signal and apply it to the input of RF Final amplifier module Q203 at Pin 1. The 50Ω output of Q203 is matched to the antenna switching circuitry and applied to the antenna through the low-pass filter.

The RF power output is programmable by a licensed RF technician. The SST-144 can be programmed on a channel-by-channel basis for low or high power operation. The power control digital Potentiometer IC306B is used to adjust the Q203 gate voltage and set RF power output.

Voice / Tone Conditioning in Transmit Mode

SST-144 audio conditioning filter circuits are shared with the receiver. The same high-pass filter/amplifier (IC303C and associated components) used in receive voice band conditioning is used in the transmitter voice band. Similarly, the low-pass filter (IC308 and associated components) used for sub-audible tone decode filtering is also used for tone encode. Altering circuit configuration with bilateral switches IC304A, B and C permits the use of the same audio filtering system for both transmit and receive modes.

Voice Band

M301 microphone audio is passes through CR304, C334 and is switched by IC304A to the input of IC303C, which along with its associated components form a high-pass filter/amplifier circuit that attenuates audio signals below 300 Hz. The output of IC303C is applied to the input of IC305B limiting amplifier. Bilateral switch IC304B switches R335 in parallel with R336, raising the gain of limiting amplifier IC305B for full limiting of the transmitter voice audio. The output of IC305B is applied to the input of IC303D, which along with its associated components form an 18 dB/octave low-pass filter for frequencies above 3 KHz. The output of IC303D is applied to voice deviation control IC306F, which sets the level of the processed transmitter audio applied to summing node amplifier IC303B used to modulate the VCO and reference oscillator.

Sub-Audible

Microcontroller IC301 generates the sub-audible selective signaling encode waveforms at Pin 21 and applies them to the input of buffer amplifier IC305A. The output of IC305A is applied to the input of IC308, a 5-pole low-pass filter that attenuates frequencies above 250 Hz. C342 and C343 set the corner frequency of the low-pass filter, with C342 switched in by Pin 7 of IC301 to lower the corner frequency for lower tones. The output of IC308 is applied to tone deviation control IC306D, which sets the level of the transmitter sub-audible encode tones applied to summing node amplifier IC303B used to modulate the VCO and reference oscillator.

MICROCONTROLLER

The SST-144 handheld transceiver is electronically controlled by IC301, an 8-bit microcontroller. IC301 has four 8-bit A/D inputs for processing analog signals.

PIN DESCRIPTION

1 RESET is connected to the SST-144 +5V to start the radio in a known state on power up.

2 TX KEY input is pulled LOW when either the internal or external PTT switch is pressed to initiate transmitter operation.

3 AUDIO GATE ENABLE controls analog switches IC304A and B to configure the shared audio processing circuitry for receive operation when LOW, and for transmitter operation when HIGH.

4 SERIAL DATA INPUT links the microcontroller to communications from an external data terminal via J303 RING connection. This allows programming of the SST-144 EEPROM memory used to store channel frequency and configuration information.

5 DATA output sends serial data to frequency synthesizer IC401 to program frequency information, IC302 EEPROM memory, and to IC306 to set the digital potentiometers.

6 EECLOCK output sends serial data clock pulses to EEPROM IC302 when reading or writing.

7 LOW-PASS CUT-OFF output goes LOW to lower the cut-off frequency of IC308 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.

8 DIGITAL POT LATCH sends a single positive pulse after data has been sent to IC306 to latch the new data and change the digital potentiometers to the new programmed settings.

9 LED output goes LOW when the radio is on channel 1 and is HIGH for all other channels.

10 +5V SW output goes HIGH 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 LOW.

11 T/R SWITCH output is connected to the Synthesizer circuitry to shift the frequency of the VCO oscillator used in both transmit and receive. The output is HIGH in transmit and LOW in receive. T/R output is also used to switch supply voltage to the transmit and receive circuits.

12 CLOCK output sends serial data clock pulses to frequency synthesizer IC401 and digital potentiometers IC306 when programming these devices.

13 +V SW output is HIGH when the radio is turned on, keeping pass transistor Q304 turned on via Q303 to supply power to the radio.

14 GROUND

15 V_{REFH} sets the upper reference level for the A/D and is connected to the regulated +5 VDC.

16 A/D input BATTERY is used to measure the battery voltage for low and dead battery detection. This input also serves as the ON/VOL UP input, and is pulled LOW when SW301 is depressed to turn on the radio and raise the receiver speaker audio level.

17 A/D input VOL DN/OFF is pulled LOW when SW302 is depressed to lower the receiver speaker audio level and turn off the radio. This input also serves as CHANNEL input, and goes to 2.5 VDC when channel selector switch SW303 is pressed to change the radio to the next programmed channel.

18 A/D input TONE DECODE accepts the received QC (CTCSS) and DQC (DCS) waveforms after signal processing for decode analysis.

19 A/D input RSSI is used to measure the output voltage of the noise filter for squelch detection.

20 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.

21 TONE ENCODE outputs generate the QC (CTCSS) and DQC (DCS) encode waveforms for signal processing prior to modulating the VCO in transmit mode.

22 AUDIO AMP ENABLE output goes HIGH to apply power to audio amp IC307 for receiver speaker audio or radio alert tones.

23 RX AUDIO GATE ENABLE switches IC304C for receive operation when LOW, and for transmitter operation when HIGH.

24 BEEP output generate the radio alert tones heard in the speaker.

25 See Pin 4

27 REFERENCE OSCILLATOR INPUT has the 3.6 MHz reference signal from the synthesizer.

28 +5 VDC V_{DD} supply voltage.

WARNING!

An authorized RF service technician must perform test and alignment of the SST-144. Do not attempt service of the SST-144 if not completely familiar with the operation of frequency synthesized radio operation. The SST-144 can operate in both Narrow Band (2.5 KHz deviation) and 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 162 MHz) with:
   - FM Deviation Meter
   - RF Wattmeter
   - Frequency Counter (to 162 MHz)
   - SINAD Measuring Device
3) Oscilloscope (to 20 MHz)
4) VTVM or DMM
5) RITRON PC Programming Kit
6) RITRON SST-SRVBD Test Module

RADIO PREPARATION

1) Make sure the radio battery is fully charged.
2) Install the RITRON SST-SRVBD test assembly and serial programming cable as follows:
   a) Remove the SST-144 antenna from the radio.
   b) Plug the SST-SRVBD into the 2.5 mm and 3.5 mm jacks on top of the radio.
   c) Screw the SST-SRVBD antenna nut fully into the SST-144 antenna connector.
   d) Set the jumper on the SST-SRVBD assembly to the "UHF" position.
   e) Connect the serial programming cable from the PC computer (with the RITRON PC programming kit software installed) to the SST-SRVBD test assembly
3) Connect the FM communications test set to the BNC connector on the SST-SRVBD test assembly.
4) Turn on the radio to place it in operating mode.
5) From the PC Programmer on-screen menu, select "Tune Radio" to display the Alignment screen.
6) Set the RF Communications Test set to the Alignment Frequency indicated on the Alignment screen.
7) Press the appropriate "Select" button on the Alignment screen to make the following adjustments:

SELECT	Alignment
Frequency	Transmit frequency
Mod Bal	Modulation balance
Tone	QC/DQC tone encode deviation wide and narrow band
Voice	Voice deviation with no tone wide and narrow band
	Voice deviation with tone wide and narrow band
Power	Low transmitter power High transmitter power

8) After you have completed alignment of the SST-144, turn the radio off. This will remove the test frequencies and return to operation on the customer's programmed frequencies.

REFERENCE FREQUENCY

1) Make sure the unit has been switched on and is at room temperature (approximately +25° C)
2) Select "Frequency" from the PC Programmer "Alignment" screen.
3) Set the RF communications test set to the Alignment Frequency on the Alignment screen.
4) Press the "Tune" button on the Alignment screen to activate the transmitter.
5) Transmitter frequency error should be less than +/- 500 Hz.
6) If frequency adjustment is required, press the left arrow on the tuning bar to lower the frequency or the right arrow to raise the frequency.
7) Press the "Save" button to store the new alignment setting or "Cancel" to leave setting unchanged.

MODULATION BALANCE

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

1) Select “Mod Bal” from the PC Programmer “Alignment” screen.
2) Set the RF communications test set to the Alignment Frequency on the Alignment screen.
3) Press the “Tune” button on the Alignment screen to activate the transmitter.
4) Check the de-modulated waveform for a 20 Hz square wave.
5) If adjustment of the modulation balance is required, press the left arrow on the tuning bar to flatten the top of the waveform or the right arrow to reduce overshoot.
6) Press the “Save” button to store the new alignment setting or “Cancel” to leave setting unchanged.

TRANSMITTER TONE DEVIATION

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

1) Select “Tone” from the PC Programmer “Alignment” screen.
2) Set the RF communications test set to the transmit frequency on the screen.
3) Select either “Wide Band” or “Narrow Band” by pressing the desired option button.
4) Press the “Tune” button on the Alignment screen to activate the transmitter.
5) If adjustment of the tone deviation is required, press the left arrow on the tuning bar to lower deviation or the right arrow to raise deviation.
6) Press the “Save” button to store the new alignment setting or “Cancel” to leave setting unchanged.

TRANSMITTER VOICE DEVIATION

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

1) Select “Voice” from the PC Programmer “Alignment” screen.
2) Set the RF communications test set to the transmit frequency on the screen.
3) Select “Voice Only - Wide Band“, “Voice Only - Narrow Band”, “Voice & Tone – Wide Band”, or “Voice & Tone – Narrow Band” by pressing the desired option button.
4) Press the “Tune” button on the Alignment screen to activate the transmitter.
5) If adjustment of the voice deviation is required, press the left arrow on the tuning bar to lower deviation or the right arrow to raise deviation.
6) Press the “Save” button to store the new alignment setting or “Cancel” to leave setting unchanged.

TRANSMITTER POWER

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

1) Select “Power” from the PC Programmer “Alignment” screen.
2) Set the RF communications test set to the transmit frequency on the screen.
3) Select “Low Power” or “High Power” by pressing the desired option button.
4) Press the “Tune” button on the Alignment screen to activate the transmitter.
5) If adjustment of the transmitter power is required, press the left arrow on the tuning bar to lower power or the right arrow to raise power.
6) Press the “Save” button to store the new alignment setting or “Cancel” to leave setting unchanged.

RECEIVER SENSITIVITY AND SQUELCH

The SST-144 receiver is factory tuned for a frequency range of 150 - 162 MHz. The SST-144 receiver is configured from the factory for Wide Band operation, with a Narrow Band Model available as an option. The SST-144 receiver bandwidth is configured on a per radio basis, it cannot be switched on a per channel basis.

The receiver may be programmed to any frequency between 150-162 MHz.

1) Program the radio to a receive frequency in the middle of the 12 MHz band.
2) Set the RF Communications Test Set's generator to the programmed receive frequency at a RF level of –120 dB. Modulate the RF signal with a 1 KHz tone at 3 KHz deviation for wide band, 1.5 KHz deviation for narrow band.
3) Check receiver sensitivity at the lowest and highest operating frequencies and make slight adjustment to L103 and L104 to balance between the two, if necessary.

RECEIVER NOISE SQUELCH

The noise squelch sensitivity is set at the factory for a 12dB SINAD signal. Using the PC Programmer, squelch sensitivity can be adjusted on a per channel basis by adjusting the "Squelch Tightener" number to between 0-7. The higher number will require a stronger received signal to open squelch.

1) Select "Channel" from the PC Programmer "Edit" menu on the main screen.
2) Select the channel to be set and press "Edit" button.
3) Set the RF communications test set to the transmit frequency on the screen.
4) Enter a Squelch Tightener number between 0-7.
5) Press the "OK" button on the Channel Edit screen to return to the Channel List screen.
6) Select any other channels to be set.
7) Press the "OK" button on the Channel List screen to return to the Main screen.
8) Select "Program Radio" from the PC Programmer "Radio" menu to save all setting changes.

SYNTHESIZER

The synthesizer is preset at the factory for operation between 150 and 162 MHz. There is no manual adjustment to center the control voltage, with all adjustment performed by the factory selection of fixed capacitor C413. Do not attempt to adjust the synthesizer control unless a key component in the synthesizer has been replaced. Key components do not include the Y302 reference frequency TCVCXO or IC401 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 7.5 VDC. The following procedure defines testing of the VCO control voltage:

1) Select the channel that has the lowest transmit frequency.
2) Connect a VTVM, DVM or oscilloscope to Test Point 1 and measure the VCO control voltage. This voltage should be no less than 1.5 VDC.
3) Select the channel that has the highest receive frequency and measure Test Point 1. The control voltage should be no higher than 4.5 VDC.
4) a) If adjustment of the VCO control voltage is required, remove the synthesizer shield top.
   b) Squeeze or spread L401 or L406 that allows VCO control voltages between 1.5 and 4.5 VDC for the operating frequencies desired. Squeezing L401 or L406 will raise the operating frequency of the VCO while spreading L401 or L406 will lower the VCO frequency.
   c) Replace the top of the synthesizer shield.

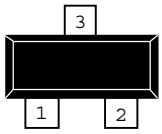
Measurement Conditions

Supply voltage at 7.5 VDC, radio in operating mode, volume control at minimum, power strobe enabled, transmitter set for full power.

IMPORTANT: Because the SST-144 portable is constructed with grounding sub-planes, use a system ground in the same proximity as the circuit being measured. All readings indicated as GND are true system ground.

KEY: All measurements are in VDC unless indicated otherwise.

NC = No connection
GND = Ground
* = Voltage is strobed in Power Saver mode
→ = See note in right column



SOT-23

REF	PIN	TX	RX	SB	DESCRIPTION
CR101	1	0.9	0.0	0.0	TX/RX switching
	2	NC	NC	NC	
	3	GND	GND	GND	
CR102	1	GND	GND	GND	Voltage clamp
	2	GND	GND	GND	
	3	0.0	0.0	*	
CR103	1	GND	GND	GND	Noise detection
	2	0.0	0.5	*	
	3	0.0	0.2	*	
CR201	1	1.8	0.0	0.0	TX/RX switching
	2	NC	NC	NC	
	3	0.7	0.0	0.0	
CR301	C	7.5	7.5	7.5	Over voltage protection
	A	GND	GND	GND	
CR302	C	7.5	7.5	7.5	Reverse voltage
	A	2.2	4.8	4.8	protection
CR303	1	6.8	6.8	6.8	Turn-on detection
	2	3.8	3.8	3.8	
	3	6.5	6.5	6.5	
CR304	1	3.9	4.7	4.7	PTT switching
	2	2.5	4.7	4.7	
	3	3.0	5.0	5.0	
CR305	1	GND	GND	GND	Voltage clamp
	2	5.0	5.0	5.0	
	3	0.0	0.0	0.0	
CR306	1	2.4	2.4	2.4	Voltage clamp
	2	NC	NC	NC	
	3	2.4	2.4	2.4	
CR307	C	7.5	7.5	7.5	Reverse volt protection
	A	0.0	→	*	→ RX audio amp out
CR401	1	5.0	5.0	*	Biasing
	2	4.8	4.8	*	
	3	NC	NC	NC	
CR402	1	GND	GND	GND	VCO tuning
	2	NC	NC	NC	
	3	→	→	*	→ 1.5 – 4.5 VDC VCO tuning voltage
CR403	1	GND	GND	GND	VCO modulation
	2	NC	NC	NC	
	3	2.4	2.4	*	
CR404	1	0.8	0.0	*	TX/RX VCO switching
	2	NC	NC	NC	
	3	0.0	4.8	*	
IC101	1	0.0	4.7	*	RX FM-IF subsystem
	2	NC	NC	NC	
	3	0.0	3.3	*	
	4	0.0	4.7	*	
	5	0.0	3.8	*	
	6	0.0	3.8	*	
	7	0.0	3.8	*	
	8	0.0	4.7	*	
	9	0.0	1.9	*	
	10	0.0	0.6	*	
	11	0.0	1.6	*	
	12	0.0	0.0	*	
	13	NC	NC	NC	
	14	NC	NC	NC	
	15	GND	GND	GND	
	16	0.0	1.4	*	
IC301	1	5.0	5.0	5.0	Microcontroller
	2	0.0	5.0	5.0	
	3	5.0	0.0	0.0	
	4	0.0	0.0	0.0	
	5	0.0	0.0	0.0	
	6	0.0	0.0	0.0	
	7	0.0	0.0	0.0	
	8	0.0	0.0	0.0	
	9	→	→	→	→ 0.0 V on Channel 1
	10	0.0	0.0	*	else 5.0 VDC
	11	5.0	0.0	0.0	
	12	5.0	5.0	*	
	13	5.0	5.0	5.0	
	14	GND	GND	GND	
	15	5.0	5.0	5.0	
	16	3.8	3.8	3.8	
	17	5.0	5.0	5.0	
	18	2.4	2.4	*	
	19	0.0	0.5	*	
	20	5.0	5.0	5.0	
	21	→	2.4	*	→ 0-5 VDC tone
	22	0.0	5.0	0.0	encode waveform
	23	0.0	0.0	0.0	
	24	NC	NC	NC	
	25	0.0	0.0	0.0	
	26	NC	NC	NC	
	27	→	→	→	→ 3.6 MHz clock signal
	28	5.0	5.0	5.0	
IC302	1	GND	GND	GND	EEPROM
	2	GND	GND	GND	
	3	GND	GND	GND	
	4	GND	GND	GND	
	5	0.0	0.0	0.0	
	6	0.0	0.0	0.0	
	7	GND	GND	GND	
	8	5.0	5.0	5.0	

REF	PIN	TX	RX	SB	DESCRIPTION
IC303	1	2.4	2.4	*	Audio processing
	2	2.4	2.4	*	
	3	2.4	2.4	*	
	4	5.0	5.0	*	
	5	2.4	2.4	*	
	6	2.4	2.4	*	
	7	2.4	2.4	*	
	8	2.4	2.4	*	
	9	2.4	2.4	*	
	10	2.4	2.4	*	
	11	GND	GND	GND	
	12	2.4	2.4	*	
	13	2.4	2.4	*	
	14	2.4	2.4	*	
IC304	1	0.0	0.0	*	Audio signal switching
	2	2.4	2.4	*	
	3	2.4	2.4	*	
	4	2.4	2.4	*	
	5	0.0	2.5	*	
	6	GND	GND	GND	
	7	GND	GND	GND	
	8	GND	GND	GND	
	9	5.0	0.0	0.0	
	10	5.0	0.0	0.0	
	11	5.0	0.0	0.0	
	12	2.4	2.4	*	
	13	NC	NC	NC	
	14	0.0	2.4	*	
	15	0.0	2.4	*	
	16	5.0	5.0	5.0	
IC305	1	2.4	2.4	*	Audio processing
	2	2.4	2.4	*	
	3	2.4	2.4	*	
	4	GND	GND	GND	
	5	2.4	2.4	*	
	6	2.4	2.4	*	
	7	2.4	2.4	*	
	8	5.0	5.0	*	
IC306	1	2.0	2.0	*	Audio signal level
	2	3.8	0.0	*	control
	3	GND	GND	GND	
	4	0.0	2.5	*	
	5	2.4	2.4	*	
	6	2.4	2.4	*	
	7	2.4	2.4	*	
	8	0.0	0.0	*	
	9	5.0	5.0	*	
	10	GND	GND	GND	
	11	NC	NC	NC	
	12	0.0	0.0	*	
	13	2.4	2.4	*	
	14	2.4	2.4	*	
	15	2.4	2.4	*	
	16	2.4	2.4	*	
	17	2.4	2.4	*	
	18	4.0	4.0	*	
	19	5.0	5.0	*	
	20	5.0	5.0	*	
IC307	1	NC	1.2	0.5	Audio amplifier
	2	0.0	0.0	0.0	
	3	GND	GND	GND	
	4	GND	GND	GND	
	5	0.0	3.7	0.0	
	6	0.0	7.5	0.0	
	7	0.0	3.7	0.4	
	8	NC	1.2	0.4	

REF	PIN	TX	RX	SB	DESCRIPTION
IC308	1	2.4	2.4	*	Tone low pass filter
	2	2.4	2.4	*	
	3	GND	GND	GND	
	4	5.0	5.0	*	
	5	2.4	2.4	*	
	6	2.4	2.4	*	
	7	5.0	5.0	*	
	8	3.2	3.2	*	
IC309	1	7.5	7.5	7.5	+5 VDC voltage
	2	GND	GND	GND	regulator
	3	7.5	7.5	7.5	
	4	NC	NC	NC	
	5	5.0	5.0	5.0	
IC401	1	→	→	→	→ 3.6 MHz clock signal
	2	5.0	5.0	*	Frequency synthesizer
	3	NC	NC	NC	
	4	NC	NC	NC	
	5	5.0	5.0	5.0	
	6	→	→	*	→ 1.5 – 4.5 VDC VCO
	7	GND	GND	GND	tuning voltage
	8	2.2	2.2	*	
	9	NC	NC	NC	
	10	2.4	2.4	*	
	11	2.4	2.4	*	
	12	5.0	5.0	*	
	13	NC	NC	NC	
	14	5.0	5.0	5.0	
	15	0.0	0.0	*	
	16	NC	NC	NC	
	17	5.0	5.0	5.0	
	18	5.0	5.0	*	
	19	0.0	0.0	*	
	20	2.2 →	2.2 →	*	→ 14.4 MHz reference
Q 101	1	5.0	4.3	*	RX +V switching
	2	5.0	5.0	*	
	3	0.0	4.7	*	
Q 102	1	0.0	0.7	*	RX RF amplifier
	2	GND	GND	GND	
	3	0.0	3.5	*	
Q 103	1	0.0	4.8	*	RX mixer
	2	0.0	1.4	*	
	3	0.0	0.0	*	
Q 104	1	0.0	0.7	*	RX IF amplifier
	2	GND	GND	GND	
	3	0.0	4.0	*	
Q 105	1	0.0	0.4	*	RX 2nd LO
	2	GND	GND	GND	multiplier/amp
	3	0.0	4.0	*	
Q 201	1	6.8	7.5	7.5	TX +V switching
	2	7.5	7.5	7.5	
	3	6.0	0.0	0.0	
Q 202	1	5.0	0.0	0.0	TX +V switching
	2	4.3	0.0	0.0	
	3	6.8	7.5	7.5	
Q 203	1	0.0	0.0	0.0	TX RF final amplifier
	2	2.8	0.0	0.0	
	3	7.5	7.5	7.5	
	4	0.0	0.0	0.0	
	5	GND	GND	GND	

REF	PIN	TX	RX	SB	DESCRIPTION
Q 204	1	0.5	0.0	0.0	TX RF driver amplifier
	2	0.0	0.0	0.0	
	3	5.3	0.0	0.0	
Q 301	1	5.0	0.0	0.0	PTT detection
	2	GND	GND	GND	
	3	0.0	5.0	5.0	
Q 302	1	4.3	5.0	5.0	PTT detection
	2	5.0	5.0	5.0	
	3	5.0	0.0	0.0	
Q 303	1	5.0	5.0	5.0	Battery +V switching
	2	4.3	4.3	4.3	
	3	6.8	6.8	6.8	
Q 304	1	6.8	6.8	6.8	Battery +V switching
	2	7.5	7.5	7.5	
	3	7.5	7.5	7.5	
Q 306	1	4.3	4.3	5.0	+5V switching
	2	5.0	5.0	5.0	
	3	5.0	5.0	*	
Q 307	1	0.0	5.0	0.0	Audio amplifier enable
	2	0.0	4.3	0.0	
	3	7.5	6.8	7.5	
Q 308	1	7.5	6.8	7.5	Audio amplifier +V
	2	7.5	7.5	7.5	switching
	3	0.0	7.5	0.0	
Q 401	1	0.7	0.7	*	VCO buffer amplifier
	2	GND	GND	GND	
	3	2.4	2.4	*	
Q 402	1	0.7	0.7	*	VCO buffer amplifier
	2	GND	GND	GND	
	3	2.6	2.6	*	
Q 403	1	1.6	1.6	*	VCO oscillator
	2	1.0	1.0	*	
	3	4.0	4.0	*	
Q 404	1	4.7	4.7	*	VCO voltage
	2	4.0	4.0	*	de-coupling
	3	5.0	5.0	*	
Q 405	1	4.0	0.0	*	TX/RX VCO switching
	2	4.0	4.0	*	
	3	0.0	4.0	*	
Q 406	1	5.0	0.0	*	TX/RX VCO switching
	2	GND	GND	GND	
	3	0.0	2.3	*	
	4	4.0	0.0	*	
	5	0.0	2.3		

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

Last Update: May 18, 2001

Ref	Ritron PN	Description	X	Y	Theta	Loc
CAPACITORS						
C101	15110470	47PF NPO 0805 50V CHIP	1164	3624	270	Top
C102	15110820	82PF NPO 0805 50V CHIP CAPACITOR	899	3667	180	Top
C103	15110151	150PF NPO 0805 50V CHIP	792	3627	270	Top
C104	15110470	47PF NPO 0805 50V CHIP	792	3762	90	Top
C105	15110470	47PF NPO 0805 50V CHIP	716	4125	180	Top
C106	15110330	33PF NPO 0805 50V CHIP	756	4235	90	Top
C108	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	502	4166	180	Top
C109	15110680	68PF NPO 0805 50V CHIP CAPACITOR	525	4371	180	Top
C110	15110330	33PF NPO 0805 50V CHIP	525	4275	0	Top
C112	15110330	33PF NPO 0805 50V CHIP	373	4112	270	Top
C113	15110101	100PF NPO 0805 50V CHIP CAP	265	4152	180	Top
C115	151101A0	1.0PF NPO 0805 50V CHIP	308	3679	0	Top
C116	15182103	.01uF CAPACITOR, CHIP, 0402,Z5U,5/10/20	473	3415	270	Top
C117	15110150	15PF 0805 NPO 50V CHIP CAP	308	3599	180	Top
C118	15110470	47PF NPO 0805 50V CHIP	199	3558	90	Top
C119	15111472	.0047MF X7R 0805 50V CHIP	647	3594	270	Top
C120	151108A2	8.2PF NPO 0805 50V CHIP	407	3548	0	Bottom
C121	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	138	947	90	Bottom
C122	152B6106	10uF 10V 3.4 X 2.8 CHIP TANTALUM	451	1669	0	Bottom
C123	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	450	946	90	Bottom
C124	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	320	904	90	Bottom
C125	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	350	1364	0	Bottom
C126	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	441	1557	0	Bottom
C127	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	63	2202	0	Bottom
C128	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	220	2114	270	Bottom
C129	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	392	1802	0	Bottom
C130	15182103	.01uF CAPACITOR, CHIP, 0402,Z5U,5/10/20	571	904	90	Bottom
C131	15110330	33PF NPO 0805 50V CHIP	38	1263	0	Bottom
C132	15110330	33PF NPO 0805 50V CHIP	64	1156	270	Bottom
C133	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	62	2119	0	Bottom
C134	15182103	.01uF CAPACITOR, CHIP, 0402,Z5U,5/10/20	39	1635	90	Top
C135	15110220	22PF NPO 0805 50V CHIP CAP	171	1533	180	Bottom
C201	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1308	3154	90	Bottom
C202	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	839	3384	270	Bottom
C203	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	997	3248	90	Bottom
C204	152A8105	1MFD 16V ~3.2 X 1.6~ CHIP TANTALUM	959	3458	270	Bottom
C205	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	879	3425	90	Bottom
C206	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1748	3308	90	Bottom
C207	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1748	3104	90	Bottom
C208	15111102	.001MF X7R 0805 50V CHIP CAP	1741	2324	0	Top
C209	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	1427	2284	90	Bottom
C210	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1492	2264	90	Bottom
C212	15110150	15PF 0805 NPO 50V CHIP CAP	1741	2244	0	Top
C215	15110330	33PF NPO 0805 50V CHIP	1495	4105	180	Top
C217	15110150	15PF 0805 NPO 50V CHIP CAP	1387	4085	90	Top
C218	151103A9	3.9PF NPO 0805 50V CHIP	1149	3942	180	Top
C219	15110330	33PF NPO 0805 50V CHIP	1014	3942	180	Top
C220	151104A7	4.7PF NPO 0805 50V CHIP	1013	4177	180	Top
C221	15111102	.001MF X7R 0805 50V CHIP CAP	973	4413	90	Top
C222	15110220	22PF NPO 0805 50V CHIP CAP	933	4296	180	Top
C301	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	774	817	180	Bottom
C302	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	271	522	270	Top
C303	152B4226	22uF 6.3V 3.4 X 2.8 CHIP TANTALUM CAP	199	647	180	Top
C304	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1261	4590	90	Bottom
C305	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1027	384	0	Top
C306	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	563	398	270	Top
C307	15182103	.01uF CAPACITOR, CHIP, 0402,Z5U,5/10/20	20	4621	270	Top

Ref	Ritron PN	Description	X	Y	Theta	Loc
C308	15111102	.001MF X7R 0805 50V CHIP CAP	0	0	0	Bottom
C309	15182103	.01uF CAPACITOR, CHIP, 0402,Z5U,5/10/20	496	1867	90	Bottom
C310	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	1107	3264	0	Bottom
C311	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1229	2967	90	Bottom
C312	15182103	.01uF CAPACITOR, CHIP, 0402,Z5U,5/10/20	501	4622	270	Top
C313	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	169	3033	270	Top
C314	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1280	2595	180	Bottom
C315	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1280	2271	180	Bottom
C316	15182103	.01uF CAPACITOR, CHIP, 0402,Z5U,5/10/20	826	2291	180	Top
C317	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	704	2321	0	Bottom
C318	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	826	2371	180	Top
C319	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	704	2360	0	Bottom
C320	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1280	2402	180	Bottom
C321	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1280	2503	180	Bottom
C322	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1280	2311	180	Bottom
C323	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1280	2771	180	Bottom
C324	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	969	2221	0	Top
C325	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1280	2673	180	Bottom
C326	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1280	2634	180	Bottom
C327	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1280	2350	180	Bottom
C328	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	658	2429	0	Bottom
C329	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	638	2501	270	Bottom
C330	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	704	2613	0	Bottom
C331	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	705	2692	0	Bottom
C332	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	705	2731	0	Bottom
C333	152A6475	4.7UF 10V A-SIZE TANTALUM CHIP CAP	502	2703	180	Top
C334	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	91	2749	180	Bottom
C335	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	331	2879	270	Bottom
C336	15181332	.0033uF CAPACITOR, CHIP, 0402, X7R,5/10%	454	3156	90	Bottom
C337	152B6106	10uF 10V 3.4 X 2.8 CHIP TANTALUM	702	3457	270	Bottom
C338	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	254	3129	90	Top
C339	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	245	2945	270	Top
C340	15111333	.033MFD X7R 0805 50V CHIP CAP	339	2675	270	Bottom
C341	15182103	.01uF CAPACITOR, CHIP, 0402,Z5U,5/10/20	585	2328	270	Bottom
C342	15110821	820PF NPO 0805 50V CHIP CAP	635	2984	180	Bottom
C343	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	649	3064	180	Bottom
C344	15181472	.0047uF CAPACITOR, CHIP, 0402, X7R,5/10%	174	2439	0	Top
C345	15181472	.0047uF CAPACITOR, CHIP, 0402, X7R,5/10%	269	2431	0	Top
C346	152A8105	1MFD 16V ~3.2 X 1.6~ CHIP TANTALUM	614	2247	90	Top
C347	15180180	18pF CAPACITOR, CHIP, 0402, COG, 5%	286	2500	90	Top
C348	15119473	.047uF X7R 0805 25V CHIP CAPACITOR	469	2595	0	Top
C349	15111333	.033MFD X7R 0805 50V CHIP CAP	81	2641	90	Bottom
C350	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	493	3156	90	Bottom
C351	15181222	.0022uF CAPACITOR, CHIP, 0402, X7R,5/10%	20	2640	270	Top
C352	15180100	10pF CAPACITOR, CHIP, 0402, COG, 5%	433	3234	90	Top
C353	15182103	.01uF CAPACITOR, CHIP, 0402,Z5U,5/10/20	594	3168	180	Bottom
C354	15181221	220pF CAPACITOR, CHIP, 0402, X7R, 5/10%	379	2436	90	Bottom
C355	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	251	2415	180	Bottom
C356	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	189	2436	90	Bottom
C357	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	126	2415	0	Bottom
C358	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	585	2498	90	Bottom
C359	15180100	10pF CAPACITOR, CHIP, 0402, COG, 5%	471	2588	270	Bottom
C360	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	465	2277	270	Top
C361	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	459	2138	90	Bottom
C362	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	981	752	270	Bottom
C363	152B6106	10uF 10V 3.4 X 2.8 CHIP TANTALUM	1231	427	0	Top
C365	01503212	220MF 10V ELT CAPACITOR, 5mm HEIGHT	1489	5432	0.302	Top
C366	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	1508	709	180	Bottom
C367	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	1357	798	90	Bottom
C368	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	231	2696	270	Bottom
C369	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	663	2469	90	Top
C370	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	293	2856	180	Top
C371	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	704	2652	180	Bottom
C372	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	560	2588	90	Bottom

Ref	Ritron PN	Description	X	Y	Theta	Loc
C373	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	359	2320	90	Bottom
C384	152B6106	10uF 10V 3.4 X 2.8 CHIP TANTALUM	1062	455	90	Bottom
C401	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1566	1966	270	Top
C402	15110101	100PF NPO 0805 50V CHIP CAP	1638	1931	90	Top
C403	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1741	1871	90	Top
C404	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1066	1850	180	Top
C405	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1353	2013	180	Top
C406	15110101	100PF NPO 0805 50V CHIP CAP	1182	1785	270	Top
C409	15119104	.1uF X7R 0805 25V CERAMIC CHIP CAP	980	1766	90	Top
C410	15110100	10PF NPO 0805 50V CHIP CAP	1295	1589	270	Top
C411	15111102	.001MF X7R 0805 50V CHIP CAP	1375	1285	270	Top
C412	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1047	1788	90	Top
C413	151105A6	5.6PF NPO 0805 50V CHIP CAPACITOR	1463	1101	90	Top
C414	152B6106	10uF 10V 3.4 X 2.8 CHIP TANTALUM	722	1625	0	Top
C415	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1695	947	270	Top
C416	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1715	1341	180	Top
C417	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	1717	1145	0	Top
C418	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	677	1121	180	Top
C419	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	678	1214	180	Top
C420	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	678	1254	180	Top
C421	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1053	1601	180	Top
C423	151101A0	1.0PF NPO 0805 50V CHIP	1255	1482	0	Top
C424	151105A6	5.6PF NPO 0805 50V CHIP CAPACITOR	1295	1337	90	Top
C425	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1069	937	90	Top
C426	15111103	.01MF X7R 0805 50V CHIP	832	922	180	Top
C427	152AB224	0.22uF 35V 3.2 X 1.6 CHIP TANATULUM CAP	817	1015	0	Top
C428	15181102	.001uF CAPACITOR, CHIP, 0402, X7R, 5/10%	855	1473	270	Top
C429	15111223	.022mf X7R 0805 CHIP CAP 50V	1029	1028	0	Top
C430	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	971	1460	270	Top
C431	15110100	10PF NPO 0805 50V CHIP CAP	774	1486	270	Top
C432	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	766	1100	180	Top
C433	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	932	1460	90	Top
C434	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1081	1183	270	Top
C435	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	687	1355	180	Top
C436	15180101	100pF CAPACITOR, CHIP, 0402, COG, 5%	1429	1703	90	Top
DIODE						
CR101	48D100A2	MA4CP101A PIN DIODE, SOT-23	1052	3624	90	Top
CR102	48E1005G	MMBD-352LT1 SCHOTTKY DIODE SOT23	852	4125	0	Top
CR103	48A1005C	MMBD7000, DUAL DIODES IN SERIES, SOT-23	366	2121	0	Bottom
CR201	48D100A2	MA4CP101A PIN DIODE, SOT-23	1467	3990	0	Top
CR301	48B61012	1N4742A ZENER DIODE, 12V 1W DL-41 MELF	991	604	90	Top
CR302	48AA01SA	DIODE, 1A, 50V, SMT, D0214AC CASE	1154	630	90	Top
CR303	48A1005B	MMBD6100, DUAL DIODES, COM CATHODE, SOT2	363	431	90	Top
CR304	48A100A3	MMBD2835, DUAL DIODES, COM ANODE, SOT-23	65	4114	0	Top
CR305	48A1005C	MMBD7000, DUAL DIODES IN SERIES, SOT-23	617	2823	0	Bottom
CR306	48A1005C	MMBD7000, DUAL DIODES IN SERIES, SOT-23	449	2956	90	Bottom
CR307	48AA01SA	DIODE, 1A, 50V, SMT, D0214AC CASE	1290	630	90	Top
CR401	48A1005C	MMBD7000, DUAL DIODES IN SERIES, SOT-23	695	1808	90	Top
CR402	48C10AQ3	VARACTOR DIODE, SMV1236-004, SOT-23	1186	1339	0	Top
CR403	48C1004G	MMBV-2101L DIODE VVC SOT-23	1118	1482	180	Top
CR404	48A1004D	MMBV3401 PIN/UHF DIODE SOT-23	1599	1102	270	Top
FUSE						
F301	06000040	WIRE; #40AWG TINNED BUS (INCHES)	754	603	270	Bottom
INTEGRATED CIRCUITS						
IC101	31030003	MC3371D SUBSYSTEM IC, SO-16	314	1158	270	Bottom
IC301	314G0306	MCU, 28 PIN, SOIC, SST/JMX 4 SERIES v06	992	2546	0	Bottom
IC302	31210005	EEPROM, 512X8, 24C04	989	2501	180	Top
IC303	310K0004	LMV324MT RAIL TO RAIL QUAD OP AMP	474	2442	180	Top
IC304	311K0003	SWITCH,ANALOG,TRIPLE SPDT,4053,TSSOP-16	228	2684	0	Top
IC305	310K0003	LMV358MM DUAL OP AMP, GP LV R/R TSSOP	404	3120	0	Top

Ref	Ritron PN	Description	X	Y	Theta	Loc
IC306	310K0001	DS1806E 6 PROG POTS 10K OHM 20-PIN TSSOP	242	2185	0	Top
IC307	31010004	LM386MX-1 AUDIO AMP SO-8	1331	567	90	Bottom
IC308	310K0002	MAX7410 5TH ORDER SW CAP BUTTERWORTH LPF	403	2935	0	Top
IC309	310E0002	REGULATOR,LDO,LP2980,5V,W ENABLE,SOT-25	162	504	0	Top
IC401	313K0005	SYNTHESIZER, MC145193, TSSOP	891	1265	180	Top
JACKS						
J301	02100001	2.5MM PC-MT JACK; ANT-CHGR	1178	4668	0	Top
J303	02100053	3.5MM STEREO JACK; PANEL MOUNT	1560	4646	0	Top
INDUCTORS						
L101	01870954	4.5T AIRFCW COIL .09 a L= 43 nH	1090	3757	125	Top
L103	01870954	4.5T AIRFCW COIL .09 a L= 43 nH	792	38829	0.145	Top
L104	01870955	5.5T AIRFCW COIL .1 a L = 51 nH	413	4371	180	Top
L105	01870954	4.5T AIRFCW COIL .09 a L= 43 nH	268	4044	270	Top
L106	18110102	CHIP INDUCTOR 1.0uhy	381	3481	270	Top
L107	18110220	INDUCTOR, CHIP, 22nH	593	3729	0	Top
L108	18110681	CHIP INDUCTOR .68uhy	51	1648	180	Bottom
L202	18110102	CHIP INDUCTOR 1.0uhy	1454	2281	180	Top
L204	18433108	8T AIRCOIL, SMT, 28.0NH, .120 X .270	1695	3988	90	Top
L205	18110102	CHIP INDUCTOR 1.0uhy	1509	3851	0	Top
L206	01870955	5.5T AIRFCW COIL .1 a L = 51 nH	1163	3757	0	Top
L207	01870954	4.5T AIRFCW COIL .09 a L= 43 nH	1321	39435	0.113	Top
L208	01870954	4.5T AIRFCW COIL .09 a L= 43 nH	1109	40278	0.746	Top
L401	18433107	7T AIRCOIL, SMT, 22.0NH, .120 X .270	1516	1486	0	Top
L402	18433110	10T AIRCOIL, SMT, 43.0NH, .120 X .270	1349	1062	270	Top
L403	18110102	CHIP INDUCTOR 1.0uhy	1590	968	0	Top
L404	18110331	CHIP INDUCTOR .33uhy	1187	964	180	Top
L406	18433104	4T AIRCOIL SMT 12.5nH .120 X .145	1601	1756	90	Top
MICROPHONE						
M301	05500037	MICROPHONE; ELECTRET, MINIATURE	0	0	0	Bottom
PLUGS						
P201	25500700	CONTACT, PCB MNT, ANTENNA,SST	896	4550	90	Top
P302	21310021	HEADER, 2 PIN SIDE ENTRY SHROUDED	754	737	0	Top
TRANSISTORS						
Q101	4801002A	MMBT3906 PNP, SOT23	565	4072	270	Top
Q102	48210E2P	BFS17A, VHF, SOT-23 LOW NOISE	661	4371	0	Top
Q103	4841006U	MMBFJ309LT1, N-CHAN, RF, SOT23	373	3843	270	Top
Q104	4821003B	MMBT918LT1 VHF SOT23 (3B)	270	3548	0	Bottom
Q105	4821003B	MMBT918LT1 VHF SOT23 (3B)	38	1374	180	Bottom
Q201	4801002A	MMBT3906 PNP, SOT23	908	3268	90	Bottom
Q202	4801001Q	MMBT5088, NPN, SOT-23	766	3268	270	Bottom
Q203	04801505	M68776 7W RF MODULE 135-175 MHZ 7.2V	1819	2710	90	Top
Q204	4821007A	MMBR901LT1 1GHZ SOT-23 (7A)	1603	2274	270	Top
Q301	48010R02	MUN2211T1, NPN, INT 10K/10K BIAS, "8A",	1133	2987	90	Bottom
Q302	4801002A	MMBT3906 PNP, SOT23	1094	3124	90	Bottom
Q303	4801001Q	MMBT5088, NPN, SOT-23	583	519	0	Top
Q304	480100DH	BCW68GLT1 .8AMP PNP SOT-23	445	668	0	Top
Q306	480100DH	BCW68GLT1 .8AMP PNP SOT-23	1222	2259	90	Top
Q307	4801001Q	MMBT5088, NPN, SOT-23	964	615	0	Bottom
Q308	480100DH	BCW68GLT1 .8AMP PNP SOT-23	1152	679	0	Bottom
Q401	4821007A	MMBR901LT1 1GHZ SOT-23 (7A)	1470	1919	270	Top
Q402	4821007A	MMBR901LT1 1GHZ SOT-23 (7A)	1289	1920	270	Top
Q403	4821007A	MMBR901LT1 1GHZ SOT-23 (7A)	1333	1724	270	Top
Q404	4801001Q	MMBT5088, NPN, SOT-23	837	1766	270	Top
Q405	4801006A	MUN2111T1, PNP, INT 10K/10K BIAS, SC-59	1556	1241	0	Top
Q406	480A0002	TRANSISTOR, DUAL NPN W/10K UMG9N SOT23-5	1710	1242	270	Top

Ref	Ritron PN	Description	X	Y	Theta	Loc
RESISTORS						
R101	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	527	3955	90	Top
R102	47180472	4.7K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	175	3530	270	Bottom
R103	47180332	3.3K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	645	4275	180	Top
R104	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	756	4355	270	Top
R105	47180271	270 OHM RESISTOR, CHIP, 0402, 1/16W, 5%	565	4187	270	Top
R106	47180152	1.5K OHM RESISTOR, CHIP, 0402, 1/16W,5%	469	3824	270	Top
R107	47180152	1.5K OHM RESISTOR, CHIP, 0402, 1/16W,5%	388	3484	180	Bottom
R108	47180223	22K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	251	3450	180	Bottom
R109	47180101	100 OHM RESISTOR, CHIP, 0402,1/16W,5%	167	3450	180	Bottom
R110	47180154	150K OHM RESISTOR, CHIP, 0402, 1/16W,5%	411	946	270	Bottom
R111	47180122	1.2K OHM RESISTOR, CHIP, 0402, 1/16W,5%	529	904	270	Bottom
R112	47180224	220K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	349	966	180	Bottom
R113	47180123	12K OHM RESISTOR, CHIP, 0402, 1/16W,5%	489	946	90	Bottom
R114	47180152	1.5K OHM RESISTOR, CHIP, 0402, 1/16W,5%	551	966	0	Bottom
R115	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	155	2174	270	Bottom
R116	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	155	2089	90	Bottom
R117	47180393	39K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	117	1676	90	Top
R118	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	49	1486	90	Bottom
R119	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	9	1486	270	Bottom
R120	47180681	680 OHM RESISTOR, CHIP, 0402, 1/16W, 5%	78	1635	90	Top
R201	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	800	3384	90	Bottom
R202	47180471	470 OHM RESISTOR, CHIP, 0402, 1/6W, 5%	669	3248	270	Bottom
R203	47180121	120 OHM, RESISTOR, CHIP, 0402, 1/16W,5%	908	3151	90	Bottom
R205	47180822	8.2K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	1555	2244	0	Bottom
R206	47180182	1.8K OHM RESISTOR, CHIP, 0402, 1/16W,5%	1618	2264	270	Bottom
R207	47180181	180 OHM RESISTOR, CHIP, 0402, 1/16W, 5%	1384	3842	180	Top
R208	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	899	4425	90	Top
R301	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	536	686	90	Top
R302	47100471	470 OHM 0805 CHIP RES.	475	479	270	Top
R303	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	316	546	90	Top
R304	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	623	639	270	Top
R305	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	410	547	270	Top
R306	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	535	1867	90	Bottom
R307	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	998	3143	90	Bottom
R308	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	1127	3328	180	Bottom
R309	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	1257	2891	270	Bottom
R310	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	704	2191	0	Bottom
R311	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	461	4622	270	Top
R312	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	704	2230	0	Bottom
R313	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	1184	2376	270	Top
R314	47180472	4.7K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	1260	2375	270	Top
R315	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	738	2841	90	Bottom
R316	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	760	2506	90	Top
R317	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	799	2506	90	Top
R318	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	704	2521	180	Bottom
R319	47180471	470 OHM RESISTOR, CHIP, 0402, 1/6W, 5%	705	2770	180	Bottom
R320	47180471	470 OHM RESISTOR, CHIP, 0402, 1/6W, 5%	643	2919	0	Bottom
R321	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	752	2957	180	Bottom
R322	47180393	39K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	294	3070	270	Bottom
R323	47180823	82K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	371	3070	270	Bottom
R324	47180224	220K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	332	3070	270	Bottom
R325	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	416	3156	90	Bottom
R326	47180183	18K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	585	2413	270	Bottom
R327	47180183	18K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	624	2328	90	Bottom
R328	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	479	2791	270	Bottom
R329	47180153	15K OHM RESISTOR, CHIP, 0402, 1/16W,5%	174	2400	180	Top
R330	47180100	10 OHM RESISTOR, CHIP,0402, 1/16W 5%	664	2384	90	Top
R331	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	269	2391	0	Top
R332	47180154	150K OHM RESISTOR, CHIP, 0402, 1/16W,5%	207	2501	90	Top
R333	47180473	47K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	246	2500	90	Top
R334	47180273	27K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	561	2588	90	Top
R335	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	39	2787	270	Top

Ref	Ritron PN	Description	X	Y	Theta	Loc
R336	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	2	2787	270	Top
R337	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	532	3156	270	Bottom
R338	47180224	220K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	393	3234	90	Top
R339	47180394	390K OHM RESISTOR, CHIP, 0402, 1/6W, 5%	467	2361	270	Bottom
R340	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	340	2436	90	Bottom
R341	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	251	2456	0	Bottom
R342	47180184	180K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	65	2394	270	Bottom
R343	47180564	560K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	696	3167	0	Top
R344	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	26	2424	270	Bottom
R345	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	127	2456	180	Bottom
R346	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	697	3129	180	Bottom
R347	47180100	10 OHM RESISTOR, CHIP,0402, 1/16W 5%	517	2650	180	Bottom
R348	47180473	47K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	432	2588	270	Bottom
R349	47180473	47K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	29	2146	0	Top
R350	47180224	220K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	29	2198	0	Top
R351	47180222	2.2K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	426	2277	90	Top
R352	47100225	2.2M 0805 CHIP RESISTOR	50	2410	0	Top
R353	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	483	2162	180	Top
R354	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	847	653	180	Bottom
R355	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	912	772	90	Bottom
R356	47180273	27K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	1172	775	0	Bottom
R357	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	1178	534	270	Bottom
R358	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	251	2376	0	Bottom
R359	47180100	10 OHM RESISTOR, CHIP,0402, 1/16W 5%	1600	730	270	Bottom
R360		Factory Select	139	588	90	Bottom
R361		Factory Select	188	588	90	Bottom
R401	47180101	100 OHM RESISTOR, CHIP, 0402,1/16W,5%	1517	2006	90	Top
R402	47180221	220 OHM RESISTOR, CHIP, 0402, 1/16W, 5%	1702	1871	270	Top
R403	47180272	2.7K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	1450	2013	180	Top
R404	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	1429	1802	90	Top
R405	47180471	470 OHM RESISTOR, CHIP, 0402, 1/6W, 5%	1153	1900	270	Top
R406	47180272	2.7K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	1193	1900	270	Top
R407	47180470	47 OHM RESISTOR, CHIP, 0402, 1/16W, 5%	1086	1788	270	Top
R408	47180470	47 OHM RESISTOR, CHIP, 0402, 1/16W, 5%	1067	1726	180	Top
R409	47180100	10 OHM RESISTOR, CHIP,0402, 1/16W 5%	1390	1631	180	Top
R410	47180153	15K OHM RESISTOR, CHIP, 0402, 1/16W,5%	1206	1633	180	Top
R411	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	1206	1684	0	Top
R412	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	1271	1827	180	Top
R413	47180472	4.7K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	677	1903	0	Top
R414	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	1464	1311	270	Top
R415	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	1695	1032	90	Top
R416	47180104	100K OHM, RESISTOR, CHIP, 0402,1/16W,5%	1138	1601	0	Top
R417	47180102	1K OHM RESISTOR, CHIP,0402, 1/16W,5%	924	933	90	Top
R418	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	936	1028	90	Top
R419	47180123	12K OHM RESISTOR, CHIP, 0402, 1/16W,5%	718	906	0	Top
R420	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	718	946	180	Top
R421	47180392	3.9K OHM RESISTOR, CHIP, 0402, 1/16W, 5%	1081	1325	90	Top
R422	47180100	10 OHM RESISTOR, CHIP,0402, 1/16W 5%	894	1461	90	Top
R423	47180474	470K OHM RESISTOR, 0402, 1/16W, 5%	850	1100	180	Top
R424	47180681	680 OHM RESISTOR, CHIP, 0402, 1/16W, 5%	1468	1703	90	Top
R425	47180103	10K OHM, RESISTOR, CHIP, 0402,1/16W,5%	1617	1337	180	Top
SPEAKER						
SP301	05500045	SPEAKER, 45MM, 1W, LOW PROFILE SST/RTX	0	0	0	Bottom
SWITCHES						
SW301	05100042	SWITCH SPST MOMENTARY MINI PC 260GM	268	4587	180	Top
SW302	05100042	SWITCH SPST MOMENTARY MINI PC 260GM	788	4588	180	Top
SW303	05100046	SWITCH, TACT LO PROFILE RT ANGLE 160gf	82	3097	270	Top
SW304	05100046	SWITCH, TACT LO PROFILE RT ANGLE 160gf	82	3948	270	Top

Ref	Ritron PN	Description	X	Y	Theta	Loc
TRANSFORMER						
T101	05600018	455KHZ IF TRANSFORMER (5MM)	128	1822	180	Top
CRYSTAL						
Y302	23050003	TCVCXO, 14.400 MHz, 1.5 PPM, VC=30 PPM/V	146	837	90	Top
FILTERS						
YF101	02301403	43.650 MHz Crystal Filter +/-6.0KHz UM-1	44	3524	90	Top
YF102	02301013	FILTER,CERAMIC,450KHz,+/-7.5KHz,6 POLE	249	1614	90	Top

HARDWARE

1750250A	PCB, ML4 FR4 5UPM, .062 MIX, SST-144
25602500	CRYSTAL SUPPORT, RUBBER PAD, SMALL/UM-1
06001010	#24 AWG STRANDED WIRE; RED (INCHES)
06001011	#24 AWG STRANDED WIRE; BLACK INCHES
06001023	#28 AWG STRANDED WIRE;GREEN INCHES
06001029	#28 AWG STRANDED WIRE; BLUE INCHES
25105500	SHIELD, SST-PLUS SYNTHESIZER
25603000	FOAM, MOUNTING, SPEAKER,SST
25603900	SPACER, MIC FOAM, SST
25605700	MICROPHONE HOLDER, SST-PLUS

ANTENNA

AFS-150	ANTENNA VHF MOLDED, 150-160 REG LEN SST

MAIN CASE ASSEMBLY

13250000	CASE W/INSERT, PLASTIC, SST BLACK
13578000	DOOR, BATTERY, PLASTIC, SST 2-PC
13588000	LATCH, BATTERY DOOR, PLASTIC SST 2-PC
25106400	BATTERY DOOR HINGE RETAINER
25201500	RETAINER, PLASTIC, PTT, SST
25400600	BUSHING, THREADED, PLATED, ANTENNA SS
25603300	GRILLE CLOTH, SPEAKER, SST
25603400	DUAL JACK PLUG, RUBBER,SST
25606200	HINGE, BATTERY DOOR, SST
25800500	ACTUATOR, RUBBER,PTT,SST
25800600	ACTUATOR, RUBBER, TACT, SST
02802026	NUT; KNURLED; M4PO.5;/2.5MM JACK
02802027	NUT; KNURLED; M6PO.5/3.5MM JACK
28112401	SCREW 4-40 X 1/4" PHFLST
28233G03	KNURLED NUT, ANTENNA, JMX

CASE BOTTOM ASSEMBLY

13564000	CASE, BOTTOM, PLASTIC, SST 2-PC
2142D021	CONNECTOR, CABLE ASSEMBLY, 2-POS, SST+
25400800	SPRING CONTACT, BATTERY, SST W/O TABSC
25400900	CONTACT BATTERY SST-PLUS (POLARIZED)
25604800	SPACER, PCB, FOAM, SST 2-PC

BELT CLIP

25201600	BELT CLIP, PLASTIC, SST BLACK
2811B600	SCREW 6-32 X 1/4" PHTRST

Ritron PN	Description

SST-144 MODELS ONLY

CASE LABELS

14220001	LABEL, CONTROLS, SST
14222029	LABEL, NAMEPLATE, SST
14290002	BLANK LABEL, .75" X .25" GLOSSY WHITE
14200037	LABEL SST/JMX MFG DATE CODE
14200104	LABEL, FCC SERIAL, SST-144

BATTERY PACK AND INSULATOR

BPS-6N-SC	BATTERY,RECHG,7.2V NiCd,BLUE ,SST
14230088	LABEL, BATTERY, BPS-6N-SC, SST
25300600	INSULATOR, BATTERY, FIBRE, SST
25606000	FOAM SUPPORT, BATTERY JMX SERIES
25601600	BATTERY SHIM; ASSEMBLY ~X~ SERIES

PACKING MATERIALS

14210004	LOW BATTERY NOTICE LABEL
14312006	SHIPPING CARTON, CARDBOARD,SST
14321002	FOAM INSERT, PACKING, SST/MINI
14500025	OWNER'S MANUAL, 14x/44x SERIES, JMX/SST
14540006	WARRANTY REGISTRATION CARD

JMX-144 MODELS ONLY

CASE LABELS

14220002	LABEL, CONTROLS, JMX
14222035	LABEL, NAMEPLATE, JMX
14290002	BLANK LABEL, .75" X .25" GLOSSY WHITE
14200037	LABEL SST/JMX MFG DATE CODE
14200103	LABEL, FCC SERIAL, JMX-144

BATTERY PACK AND INSULATOR

BPJS-6N	BATTERY, YELLOW, RECHG,7.2V NiCd 700 mAH
BC-A	BATTERY CHARGER, 120VAC-5.5VDC 100mA
14230088	LABEL, BATTERY, BPS-6N-SC, SST
25300600	INSULATOR, BATTERY, FIBRE, SST
25606000	FOAM SUPPORT, BATTERY JMX SERIES
25601600	BATTERY SHIM; ASSEMBLY ~X~ SERIES

PACKING MATERIALS

14210004	LOW BATTERY NOTICE LABEL
14313012	BOX, CHIPBOARD, SMALL, 4 COLOR, JMX
14352004	INSERT, CORREGATED CARDBOARD, JMX
14500025	OWNER'S MANUAL, 14x/44x SERIES, JMX/SST
14540006	WARRANTY REGISTRATION CARD
14610006	JOBCOM BROCHURE