

TYPE OF EXHIBIT: INSTRUCTION MANUALS
FCC PART: 2.983 (d) (8)
MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032
MODEL: SST-454
TYPE OF UNIT: UHF-FM Handheld Transceiver
FCC ID: AIERIT06-450
DATE: December 28, 1998


Included is a draft of the Maintenance and Operating Manual for RITRON Model Patriot SST-454 UHF-FM Handheld Transceiver.

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

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

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

Signed:



Michael A. Pickard - Project Engineer

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IMPORTANT MAINTENANCE/REPAIR INFORMATION

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

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

Reassembly - 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-454 was designed to produce a minimum of 3.00 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 shortening battery life.

SST-454 SPECIFICATIONS

GENERAL

FCC ID:	AIERIT06-450
FCC Rule Parts:	22, 74, 80, 90
Frequency Range:	450 to 470 MHz standard
Max. Freq. Separation:	20 MHz
RF Channels:	Conventional: 4 Channels, Independent TX/RX frequencies. Trunking: 40 Channels in any of 4 combinations of systems or groups.
Synthesizer Step Size:	5, 6.25, 12.5 KHz
Frequency Stability:	+/-2.5 PPM (-30 to +60 C) TX/RX
Tone/Code Signaling:	CTCSS (Quiet Call) Digital Coded Squelch (Digital Quiet Call) LTR Trunking Passport npNTS Trunking
Power Supply:	+7.5 VDC, 800 mAH rechargeable NiCad battery pack
Battery Drain:	
<i>Standby :</i>	60 mA
<i>Avg. Standby with Power Saver :</i>	22 mA
<i>Receive -</i>	125 mA
<i>Transmit -</i>	1500 mA @ 4 Watts 650 mA @ 1 Watt
Battery Life:	Standard battery (800 mAH) @ 90/5/5 Duty Cycle 7.9 Hrs, Battery Saver On, TX High Power 13.5 Hrs, Battery Saver On, TX Low Power 5.9 Hrs, Battery Saver Off, TX High Power 8.6 Hrs, Battery Saver Off, TX Low Power High capacity battery (1500 mAH) @ 90/5/5 Duty Cycle 14.7 Hrs, Battery Saver On, TX High Power 25.4 Hrs, Battery Saver On, TX Low Power 11.1 Hrs, Battery Saver Off, TX High Power 16.1 Hrs, Battery Saver Off, TX Low Power
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)

SST-454 SPECIFICATIONS

GENERAL

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
Push Button Controls:	On/Volume Up Volume Down/Off PTT Channel
LED Indicator:	Transmit/channel busy lamp, dual color, Red/Green Green Flashing - Channel busy Red - Transmit enabled
Speaker Beep Indicators:	
<i>On/Volume UP -</i>	Single beep when radio is turned on, followed by increasing audio to adjust volume.
<i>Volume Down/Off -</i>	Decreasing audio to adjust volume, with two tones when unit is turned off.
<i>Both Volume Buttons -</i>	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.
<i>PTT -</i>	Programmable for a single "transmit beep".
<i>Channel -</i>	Number of beeps indicates channel.
QC/DQC Decode Time:	per EIA Standards

SST-454 SPECIFICATIONS

RECEIVER

	<u>Wide band Model</u>	<u>Narrow band Model</u>
Modulation Acceptance:	+/- 7.0 KHz	+/- 3.75 KHz
Sensitivity (12 dB SINAD):	0.3 μ V	0.3 μ V
Adjacent Channel (EIA):	-70 dB	-60 dB
Spurious Rejection:	-70 dB	-70 dB
Image Rejection (EIA):	-70 dB	-70 dB
Intermodulation (EIA):	-67 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:	Fixed tuned, dual conversion superheterodyne	
I.F. System:	1st - 43.65 MHz 2nd - 450 KHz	
L.O. Injection:	Low side	

TRANSMITTER

RF Power Output:	Programmable per channel for high, medium or low power	
<i>High :</i>	3 Watts minimum @ +7.2 VDC	
<i>Medium:</i>	2 Watts	
<i>Low:</i>	1 Watt	
	<u>Wide Mode</u>	<u>Narrow Mode</u>
Emission Designator:	16K0F3E	11K0F3E
Deviation:	+/- 5.00 KHz	+/- 2.50 KHz
FM Hum and Noise:	-43 dB	-37 dB
Audio Distortion:	< 3 %	< 6 %
Spurious and Harmonics:	-50 dBc	
Audio Response:	Meets FCC and EIA requirements	
Time-out Timer:	30 seconds, programmable	

SST-454 INTRODUCTION

General

RITRON's SST-454 handheld is a small, programmable two-way radio, designed to operate in the 450-470 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-off, volume and monitor controls are on top.

Each radio can be "dealer or factory" programmed to contain a unique set of operating frequencies and options. Selective signalling options include Quiet Call (CTCSS), Digital Quiet Call (DCS), LTR Trunking, and Passport nPNTS Trunking. Transmitter power, operating bandwidth and battery saver are among the options programmable on a per channel basis.

Inspection

Each radio package should include a radio, antenna, rechargeable battery pack, belt clip and any optional accessories ordered. Examine the equipment immediately after delivery and report any damages to your shipping company.

Model Identification

The SST-454 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

The FCC (with its action in General Docket 79-144, March 13, 1985) has adopted a safety standard for human exposure to radio frequency electromagnetic energy emitted by FCC regulated equipment. RITRON follows these safety standards, and recommends that you observe the following guidelines:

- DO NOT hold the radio such that the antenna is very close to or touching exposed parts of the body, especially the face or eyes, while transmitting. Keep the radio vertical, two to three inches away while talking into the microphone.
- DO NOT press the Push-To-Talk except when you intend to transmit.
- DO NOT operate radio equipment near electrical blasting caps or in an explosive atmosphere.
- DO NOT allow children to play with any radio equipment that contains a transmitting device.
- Repair of RITRON products should be performed only by RITRON authorized personnel.

Battery Care

The handheld is powered by a rechargeable battery, which fits into the radio case (see FIG-1).

Charging

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.

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

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 an 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 BCPS-FS). The battery pack may be charged inside or outside of the radio case.

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

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

- Do not discharge a battery that is already "run down." If the battery cannot power your radio, recharge the battery.
- Do not overcharge a battery. The standard battery should not be left to charge continuously.
- Before storing a battery, charge it for 16 hours. Thereafter, charge the battery for 16 hours once every 30 days.

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

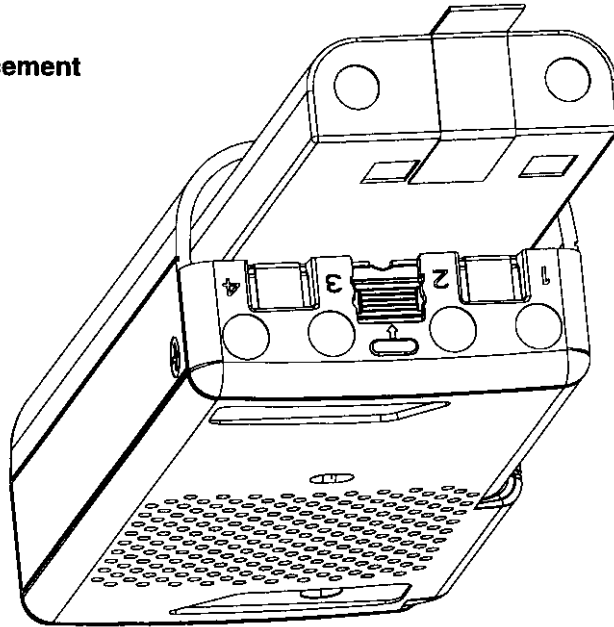
- 1) When the radio's transmitter coverage decreases or does not work at all,
- 2) When the radio quits working after just a few hours of use, despite a full overnight charge or,
- 3) If the battery is more than two years old. The date of manufacture is stamped on every battery. The first two digits indicate the year, the last two digits the week.

Battery Replacement

To take the battery out of the radio, remove the battery door pictured in FIG-1. Use the pull-tab to remove the battery.

Slide the replacement battery into the radio case. Make sure the spring contacts are inserted between the battery and paper insulator. The contacts must not touch the radio PC board.

Fig. 1
Battery Replacement



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.

DESCRIPTION OF CONTROLS AND CONNECTORS

Antenna

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

VHF and UHF antennas are not interchangeable. Use only the antenna type packaged with the radio. A VHF antenna is pictured in FIG-2. (The UHF antenna is smaller in diameter.)

On/Volume Up

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

Off/Volume Down

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

Channel Select

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.

Speaker

The speaker allows you to hear calls on your channel.

Push-To-Talk Button

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

Microphone

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

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.

Battery Access (Case Bottom)

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

Drop-in Charger Contacts

Two charger contacts in the bottom of the SST-454 radio case allow the battery pack to be charged using an optional RITRON drop-in charger (model BCPS-FS).

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.

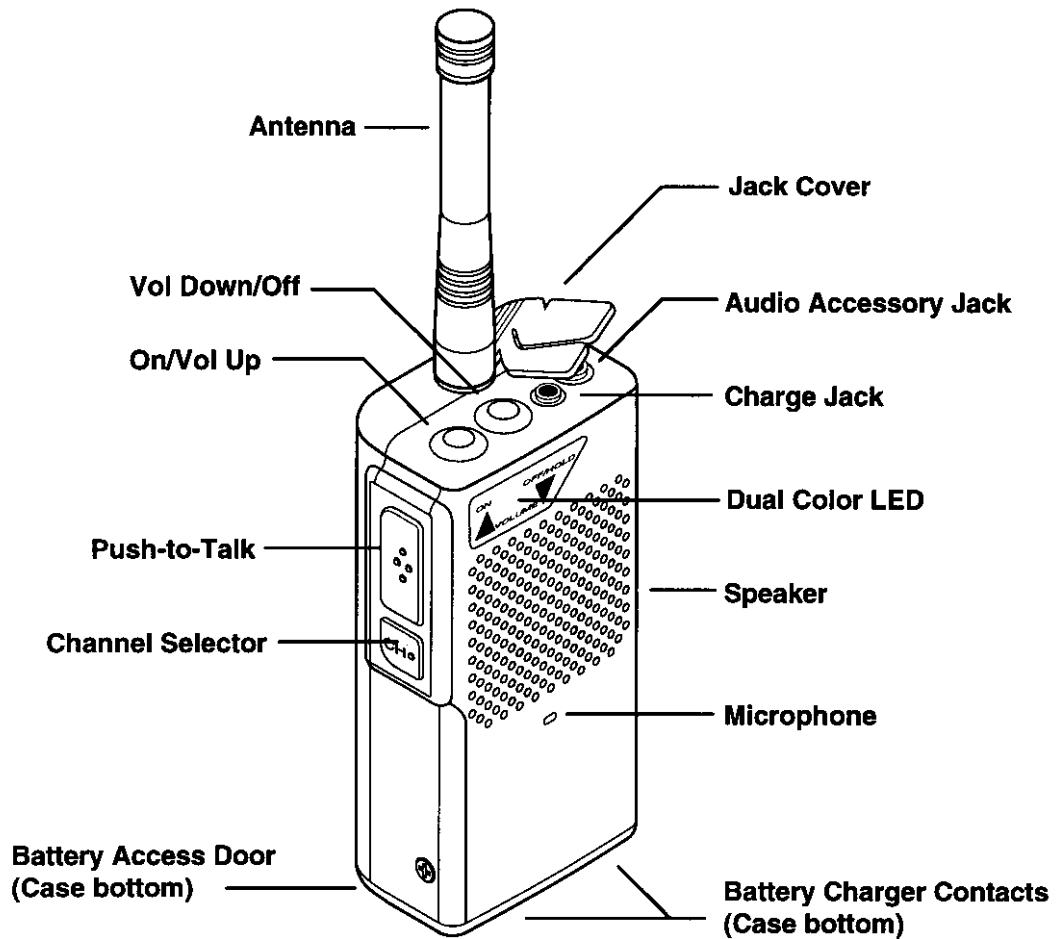


Fig. 2 Controls and Accessory Connectors

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.

OPERATION

On-off/Volume

To switch on the radio - press the on/volume up button.

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-454 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-454. 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 his message.

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.

Selective Signaling Squelch

To activate tone squelch - simultaneously press both 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 all squelch is turned off. Release the buttons. To restore squelch, press and hold both volume buttons until the radio sounds a beep or double beep.

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 a couple of 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 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 the handheld is turned on, it runs a quick "self test." Once the internal system checks confirm basic functions, the radio sounds a brief "confirmation tone." 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 you press the channel button, the radio beeps a number of times equal to the channel number selected.

Tone Squelch

When you press and hold both volume buttons at the same time, a single beep sounds 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 10 seconds 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.

PC Programmable Optional Radio Tones

Receive Squelch Tone

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

Transmit Activate

The radio may be programmed by authorized service personnel to sound a short tone each time you press the Push-To-Talk button to 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.

Troubleshooting

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

Problem

Possible Solutions

GENERAL

The radio does not work at all.

Make sure that 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 frequency 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.)

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.)

Replace the battery. (Note 1.)

Error Tones

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

See "Error Tones" in the Operation section.

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

Refer to "Error Tones"

Troubleshooting (Con't.)

<u>Problem</u>	<u>Possible Solutions</u>
Tone Coded Squelch	
You cannot screen out calls from users outside of your tone group.	Make sure that the channel is programmed with tone squelch. Activate Tone (coded) squelch. (Note 7.)
You cannot hear Tone coded messages while in (coded) squelch.	Confirm that the channel is programmed to Tone 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.)

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 THE RADIO

Each SST-454 may be programmed for 4 channels, with up to 40 frequencies programmed on any single trunking channel.

How To Program The Radio

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

How To Find Out What Is Already Programmed

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

Return To Normal Operation

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

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Programming The Radio Using A PC Computer

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

Ritron's adapter cable connects the radio to a computer's serial communications port. Once the cable is hooked up, the user inserts the diskette provided into his computer's floppy disk drive and loads a software program.

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

The PC Programming Kit Includes:

- 1) Ritron Transceiver Programming software, which is contained on one 3.5" diskette.
- 2) Installation instructions (RITRON #01454947) and a registration form.
- 3) Ritron PC to radio adapter cable, which is terminated at one end with a DB-25F connector, at the other end with a modular plug. The DB-25 plugs into the computer's serial port, the modular plug into the SST-SRVBD modular jack.
- 4) An adapter for use with SST-454 portables. This adapter mates the modular plug to a 3.5 mm plug, for connection to the handheld's audio jack.

The PC Programming Kit Requires:

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

Programmable Features

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

<u>Feature</u>	<u>Range</u>	<u>Standard Setting</u>	<u>Per Channel</u>
Automatic Inactivity Turn-off	Y-N	Yes	√
Battery Saver Enable	Y-N	Yes (except trunking)	√
Battery Saver Off Time			√
Busy Channel Transmit Inhibit	Y-N	No	√
Carrier Only, No Tones or Codes			
Channel Identification Mode	Y-N	No	√
Digital Tone Invert RX	Y-N	No	√
Digital Tone Invert TX	Y-N	No	√
Digital Quiet Call (DCS)	-	-	√
Disable Monitor	Y-N	No	√
Flash green LED on Carrier Detect	Y-N	No	√
LTR Trunking	-	-	√
Narrow Band Channel	Y-N	No	√
Passport nPNTS Trunking	-	-	√
QC Decode Pre-load	Y-N	Yes	√
Quiet Call (CTCSS)	-	-	√
Quiet Call Encode Only	Y-N	No	√
Quiet Call Transmit Hang Time	0-468 ms	188 ms	√
Receive Squelch Tone	Y-N	No	√
Squelch Tightener	Y-N	No	√
Transmit Activate Tone	Y-N	No	√
Transmit Power	L-M-H	High	√
Transmit Time Out Timer (60 s)	Y-N	Yes	√
Turn On To Channel 1	Y-N	Yes	
Turn On To Medium Volume Level	Y-N	Yes	

Descriptions Of Features

Automatic Inactivity Turn-off - The radio automatically shuts itself off if four hours go by without the microcontroller 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 strobe begins after eight seconds of inactivity.

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

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 Identification Mode - With this feature enabled, the channel number is "beeped out" when the channel button is pressed. The channel is not incremented. To increment the channel, press the channel button again within three seconds.

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

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

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

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

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

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

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

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

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

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

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

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

Turn On To Channel 1 - The radio defaults to channel 1 when turned on. Normally, the radio returns to the channel in use at power 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.

SST-454 THEORY OF OPERATION

INTRODUCTION

The SST-454 is a four-channel handheld transceiver built on a single multilayer printed circuit board with a separate synthesizer/VCO module and TCVCXO reference oscillator module. Both sides of the main printed circuit board are populated with components, with the bottom side containing only surface mounted components.

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

POWER SUPPLY AND VOLTAGE DISTRIBUTION

The SST-454 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. CR307 prevents a reverse voltage from being applied to the radio.

SW301 ON/VOL UP switched is pressed to switch on the SST-454, turning on voltage pass transistor Q305B via R307. Q305B supplies power to IC301, a +5 VDC regulator used to power microcontroller IC302. Pin 19 of IC302 turns on Q305A, which keeps Q305B turned on after SW301 has been released. Power is removed from the SST-454 by pressing the VOL DN/OFF switch SW302 until a beep is heard from the speaker, at which time Q305A is turned off.

+5 VDC regulator IC301 supplies power directly to microcontroller IC302, bilateral audio gates IC304, and PTT detect transistor Q302.

Pin 32 of IC302 lets Q308 switch the regulated +5 VDC to the receiver. Pin 20 of IC302 is used to switch a regulated +6 VDC to the transmitter. Pin 20 of IC302 turns on Q202, which turns on voltage pass transistor Q204. With Q204 emitter connected to the +VBATT battery supply, the collector output is connected to the emitter of Q202 through voltage R205/R214, whose values are selected to limit the TX+V voltage to +6 VDC.

POWER STROBE

The SST-454 handheld includes a power strobe feature, which reduces battery current drain by periodically removing voltage from part of the radio. The strobe duty cycle is programmable, and can be selectively applied to any programmed channel using the Plus Series PC Programming Kit. The +5VSW power strobe output at Pin 6 of IC302 controls Q307, which switches the regulated +5 VDC to the audio processing circuitry, Y302 TCVCXO reference oscillator, and the synthesizer module. This includes IC306B 2 VDC (Vag) for bias on audio processing circuitry, IC306A audio high pass filter, IC307B and IC307C audio low pass filter for sub-audible frequencies, IC307A audio limiting amplifier, and IC308 digital potentiometers. +5VSW is also applied to Q304, which along with voltage divider R302/R305 generates the +6VSW output used to supply IC305B audio summing node amplifier, IC305A audio low pass filter, and the synthesizer module.

LOW BATTERY VOLTAGE DETECTION

Battery voltage is measured at A/D input Pin 38 of IC302 through voltage divider R304/R306. 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 module via Pin 5 of P402, and is multiplied up to 43.2 MHz by Q102 and its associated circuitry to provide a receiver 2nd local oscillator signal.

SYNTHESIZER MODULE

The SST-454 radio is built around a common phase-locked loop (PLL) that consists of a voltage controlled oscillator (VCO) and a frequency synthesizer. The PLL generates both the receiver 1st local oscillator and transmitter carrier signals. The frequency synthesizer and VCO are both contained in a shielded Synthesizer Module that is mounted to the SST-454 main pcb via P401 and P402. Control signals from microcontroller IC302 and Reference oscillator Y302 are routed to frequency synthesizer IC401 per the following chart:

PIN NUMBERS

	<u>Clock</u>	<u>Data</u>	<u>Latch</u>	<u>LD</u>	<u>T/R SW</u>	<u>REF</u>	<u>+5SW</u>	<u>+6SW</u>
IC302	62	35	7	64	5	-	-	-
Y302	-	-	-	-	-	4	2	-
P402	7	8	6	2	4	5	3	1
IC401	18	19	17	2	-	20	12, 14	5

Q402, CR401, C428 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 IC302 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 radio is initially powered up.

Once new data is loaded into the buffer, a single pulse from IC302 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 C423, C422, R418, R419, R417, and C421 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 R420 tied to Pin 8 of IC401, with the output current programmable to 25, 50 or 100% of maximum.

VCO/BUFFER AMPLIFIERS

Q404, L403, CR402 and associated components form the VCO (Voltage Controlled Oscillator), a resonant circuit that oscillates at frequencies from 406 MHz in receive (receive frequency - 43.65 MHz) to 470 MHz in transmit. Varying the voltage at CR402 changes the varactor's capacitance, which in turn alters the VCO output frequency. When in transmit mode a +5 VDC T/RSW signal is applied to Q407, which turns on Q406 to draw current through pin diode CR404 and L405. With CR404 biased on, L401 is effectively shorted to ground, shifting the VCO frequency up 43.65 MHz. Q401 and Q403 are buffer amplifiers, with Q403 feeding in the input of the synthesizer at Pin 11, the receiver 1st local oscillator signal at P401 Pin 1 and the transmitter pre-amplifier at P401 Pin 3.

OSCILLATOR MODULATION

When the SST-454 is in transmit, modulation balance control IC308E passes TX audio through to the VCO modulation input at P401 Pin 5. 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

IC308 contains 6 digital potentiometers programmed by IC302, sharing the same clock and data outputs used by the synthesizer and a separate Digital Pot Latch signal from Pin 33. The digital potentiometers are used in conjunction with IC305B, a summing node amplifier used for modulating the VCO and reference oscillator. IC308A, B, D, E, and F can only be changed through serial programming, and can only be performed by an authorized licensed RF technician.

IC308A and IC308B are connected through R351 and R352 to the Pin 6 input of IC305B. IC308A and B adjust the DC output of IC305B to tune the reference oscillator frequency, with IC308A providing a coarse tune and IC308B a fine tune.

Volume control IC308C applies the processed voice band signals at IC305A to audio amplifier IC309 in receive mode. Depressing the ON/VOL UP switch SW301 increases the setting of IC308C while VOL DN/OFF switch SW302 decreases it.

Transmitter tone deviation control IC308D applies the output of the selective signalling low-pass filter IC307C to the Pin 6 input of IC305B through R350. IC308D is completely closed in receive mode.

Transmitter modulation balance control IC308E is used to apply the Pin 7 output of IC305B to the VCO modulation input at P401 Pin 5. This sets the ratio of the modulating signal applied to the VCO and the reference oscillator. IC308E is completely closed in receive mode.

Transmitter voice deviation control IC308F applies the processed voice band signals at IC305A to the Pin 6 input of IC305B through R349. IC308F is completely closed in receive mode.

RECEIVER

As mentioned before, Q308 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 (L213, C220, C219, L212, C218, L211, C217) and L210 to the receiver headend. L101, L102 and the associated capacitors form a bandpass filter ahead of low-noise RF amplifier Q101. L103 and C109 provide a notch at the receiver image frequency, 87.3 MHz below the receive frequency. The amplified RF signal is applied to a 4-pole

bandpass filter consisting of L105, L106, L107, L108 and associated capacitors. This fixed tuned circuit has a 20 MHz bandwidth of 450-470 MHz.

1st MIXER

The amplified received input signal is applied to the Pin 8 input of IC102, a duobalanced mixer configured for single-ended output. The 1st local oscillator signal from the synthesizer module is applied to the Pin 4 input of IC102, with C129 coupling the 43.65 MHz output signal at Pins 5 and 6 to YF101, a 43.65 MHz two-pole crystal filter. Q103 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 Q102 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 decoupled input to the IF amplifier, Pin 7 the limited IF output signal. An internal quadrature detector, whose center frequency is determined by 450 KHz ceramic discriminator Y101, detects the FM IF signal. One input of the quadrature detector is connected internally to the IF signal at Pin 7, while the other detector input is the phase-shifted signal from Y101 at Pin 8.

Demodulated audio appears at Pin 9, where a low-pass filter (R114, C139) 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 R110, C136, C137, R108, R109 and R111. 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 IC302 at Pin 39. The SST-454 is serial programmed to set the squelch threshold and hysteresis.

VOICE/TONE CONDITIONING IN RECEIVE MODE

SST-454 audio conditioning filter circuits are shared with the transmitter. The same high-pass filter/amplifier (IC306A and associated components) used in receive voice band conditioning is used in the transmit band. Similarly, the low-pass filter (IC307C 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 C139 remove the 450 KHz element from the demodulated audio output at Pin 9 of IC101, C339 couples the audio signal to bilateral switch IC304C for subaudible tone detection and connection to IC304C for voice band audio processing.

VOICE BAND

Bilateral switch IC304A passes the received audio signal to the input of IC306A, which along with its associated components for a high-pass filter/amplifier circuit that attenuates audio signals below 300 Hz. The output of IC306A is applied to the input of IC307A limiting amplifier. Bilateral switch IC304B is switched in receive to insert C327 into the feedback circuit of IC307A, providing de-emphasis of the received audio signal. Bilateral switch IC304B also removes R325 from the Pin 14 input to reduce the gain and prevent limiting. The output from IC307A is applied to the input of IC305A, which along with its associated components form an 18dB/octave low-pass filter for frequencies above 3000 Hz. The output of IC305A is connected to IC308C volume control prior to connection to audio amplifier IC309. The output

of IC305A is also connected to IC308F 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 Pins 15 and 16 of microcontroller IC302 are applied to the Pin 14 input of IC307A to provide the SST-454 alert tones.

SUB-AUDIBLE

Bilateral switch IC304C passes the received audio signal to the input of IC307B, which amplifies the signal and applies it to the Pin 8 input of IC307C, a 6-pole low-pass filter that attenuates frequencies above 250 Hz. The output at Pin 3 is applied to an A/D input of IC302 at Pin 36 for tone decoding. An internal digital signal processing routine programmed into microcontroller IC302 is used to decode the correct selective signalling code. The output at Pin 3 of IC307C is also connected to tone deviation control IC308D, 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 IC308C is applied to the Pin 2 input IC309, a 1 Watt audio amplifier. C359 couples the Pin 5 output to the internal 8Ω speaker SP301 via audio jack J303.

Microcontroller IC302 Pin 34 switches DC power to the audio amplifier by turning on Q312, which then turns on pass transistor Q313 to apply battery voltage to Pin 6 of the audio amp. CR306 prevents an inadvertent DC voltage at J303 from damaging the audio amplifier.

ANTENNA SWITCHING/LOW-PASS FILTER

A low-pass filter comprised of filter L213, C220, C219, L212, C218, L211, and C217 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-454 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 L210 and C102 to the receiver headend.

When the SST-454 is switched into transmit mode, transmitter supply voltage is switched on by Q202 and Q204 and applied to R208. Current flows through R208, L209, CR201, L210 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. L210 provides sufficient impedance to isolate the transmitter power from the receiver RF amplifier.

TRANSMITTER

KEYING

The ST-454 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 R318 to turn on pass transistor Q302. Q302 then turns on Q301 to pull the TX Key Pin 2 input of microcontroller IC302 low. The microcontroller TX Enable output at Pin 20 then goes high to turn on Q202, which turns on pass transistor Q204 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. The internal PTT switch SW304 is connected to the Pin 23 PTT input of IC302, allowing the radio to distinguish between an internal or external PTT. This is necessary for certain audio accessories and for VOX operation.

+VTX SUPPLY

With the transmitter enabled as described above, the +VTX voltage from Q204 is applied to transmitter RF amplifier Q205 and PWM power control transistor Q201. +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 20 TX Enable output of microcontroller IC307 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

Q205 and associated components amplify the VCO signal and apply it to the input of RF Final amplifier module Q203 at Pin 1. The 50 Ω 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-454 can be programmed on a channel-by-channel basis for low, medium or high power operation. The PWM power control output at Pin 8 of IC302 is applied to the base of Q201, whose emitter is connected to the Pin 2 Gate control input of Q203. The pulse width from Pin 8 is varied and filtered by R202, C202, R203, C203 to adjust the Q203 gate voltage.

VOICE/TONE CONDITIONING IN TRANSMIT MODE

SST-454 audio conditioning filter circuits are shared with the receiver. The same high-pass filter/amplifier (IC306A and associated components) used in receive voice band conditioning is used in the transmit voice band. Similarly, the low-pass filter (IC307C and associated components) used for sub-audible tone decode filtering is also used for tone encode. Altering circuit configuration with bilateral switches IC304 A, 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, C354 and is switched by IC304A to the input of IC306A, which along with its associated components form a high-pass filter/amplifier circuit that attenuates audio signals below 300 Hz. The output of IC304A is applied to the input of IC307A limiting amplifier. Bilateral switch IC304B switches R325 in parallel with R326, raising the gain of limiting amplifier IC307A for full limiting of the transmitter voice audio. The output of IC307A is applied to the input of IC305A, which along with its associated components form an 18 dB/octave low-pass filter for frequencies above 3 KHz. The output of IC305A is applied to voice deviation control IC308F, which sets the level of the processed transmitter audio applied to summing node amplifier IC305B used to modulate the VCO and reference oscillator.

SUB-AUDIBLE

Microcontroller IC302 generates the sub-audible selective signalling encode waveforms at Pins 17 and 18 and applies them to the input of buffer amplifier IC307B. The output of IC307B is applied to the input of IC307C, a 6-pole low-pass filter that attenuates frequencies above 250 Hz. R338 and C345 set the corner frequency of the low-pass filter, with C346 switched in by Pin 25 of IC302 to lower the corner frequency for lower tones. The output of IC307C is applied to tone deviation control IC308D, which sets the level of the transmitter sub-audible encode tones applied to summing node amplifier IC305B used to modulate the VCO and reference oscillator.

MICROCONTROLLER

The SST-454 handheld transceiver is electronically controlled by IC302, an 8-bit microcontroller. IC302 ROM is flash programmable by authorized RF service technicians to allow in circuit upgrades to the operating system for new or improved features. The microcontroller contains the EEPROM memory used to store the radio channel frequency and configuration information. IC302 has fifteen 8-bit A/D inputs for processing analog signals. Y301 and associated components provide an 8 MHz clock oscillator for the microcontroller.

PIN DESCRIPTION

- | | |
|--------------|--|
| 1 | RX AUD GATE controls analog switch IC304C, connecting received audio from IC101 to the shared audio processing circuitry when LOW and disconnecting receive audio when HIGH. |
| 2 | TX KEY input is pulled LOW when either the internal or external PTT switch is pressed to initiate transmitter operation. |
| 3 | POWER ON RESET is momentarily LOW when the radio is first powered up to provide a reset for the microcontroller. |
| 4, 26 | SERIAL DATA INPUT links the microcontroller to communications from an external data terminal via J303 RING connection. This allows programming of the SST-454 EEPROM memory used to store channel frequency and configuration information, and the FLASH ROM that contains the radio operating system. |
| 5 | T/R SWITCH output is connected to the Synthesizer module to shift the frequency of the VCO oscillator used in both transmit and receive. The output is HIGH in transmit and LOW in receive. |
| 6 | STROBE output goes 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. |
| 7 | SYNTHESIZER LATCH output goes LOW to allow serial data to frequency synthesizer IC401 and goes HIGH to latch the data, allowing the synthesizer to execute the new frequency information. |
| 8 | POWER CONTROL is a 15 KHz output whose programmable duty cycle is used to control the transmitter RF power output by adjusting the gate voltage of final amplifier Q203. This output is LOW in receive or standby mode. |
| 9, 10,
11 | UNUSED |
| 12 | ON/VOL UP input is pulled LOW when SW301 is depressed to to turn on the radio and raise the receiver speaker audio level. |
| 13 | GREEN LED output goes HIGH and lights the green front panel LED when the radio receives an on-frequency signal. |
| 14 | RED LED output goes HIGH and lights the red front panel LED when the radio is in transmit mode. |

PIN DESCRIPTION

- | | |
|--------|--|
| 15, 16 | DTMF/BEEP outputs generate the radio alert tones heard in the speaker, as well as the tones required for DTMF encoding in transmit mode. |
|--------|--|

- 17, 18 QC ENCODE outputs generate the CTCSS, DQC, LTR Trunking and Passport Trunking encode waveforms for signal processing prior to modulating the VCO in transmit mode.
- 19 +V SW output is HIGH when the radio is turned on, keeping pass transistor Q305 turned on to supply power to the radio.
- 20 TX ENABLE output goes HIGH in transmit mode to switch the +VTX transmitter supply voltage on. This output is low in receive and standby.
- 21 GROUND
- 22 VDD is connected to the regulated +5VDC to supply power to the microcontroller.
- 23 PTT input is pulled LOW when the internal PTT switch is depressed. In conjunction with the TX KEY input at pin 2, it initiates the desired transmitter operation required for various SST-454 audio accessories and options.
- 24 CHANNEL input goes LOW when channel selector switch SW303 is pressed to change the radio to the next programmed channel.
- 25 LOW-PASS CUT-OFF output goes LOW to lower the cut-off frequency of IC307C when the radio is on a channel programmed for a CTCSS tone below 150 Hz. This output is in a tri-state OPEN condition for all other tones.
- 27 AUDIO INHIBIT disables analog switches IC304A, B and C when HIGH to disconnect the shared audio processing circuitry from both the receiver and transmitter.
- 28, 29, 31 UNUSED
- 30 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.
- 32 RX ENABLE output goes LOW in receive mode to switch RX+V receiver supply voltage on. This output is HIGH in transmit and standby mode.
- 33 DIGITAL POT LATCH sends a single positive pulse after data has been sent to IC308A to latch the new data and change the digital potentiometers to the new programmed settings.
- 34 AUDIO AMP ENABLE output goes HIGH to apply power to audio amp IC309 for receiver speaker audio or radio alert tones.
- 35 DATA output sends serial data to frequency synthesizer IC401 to program frequency information, and to IC308 to set the digital potentiometers.
- 36 TONE IN A/D input accepts the received CTCSS, DQC, LTR or Passport trunking waveforms after signal processing for decode analysis.
- 37 HIGH-PASS AUDIO A/D input accepts voice band audio signals for VOX detection in transmit mode and in-band data decode in receive mode.
- PIN DESCRIPTION**
- 38 BATTERY A/D input is used to measure the battery voltage for low and dead battery detection.
- 39 RSSI A/D input is used to measure the output voltage of the noise detector for squelch detection.

- 40 PROGRAM SENSE A/D input is used to identify the device at the J303 RING connection.
- 41 TEMPERATURE A/D input is used to measure voltage from the temperature sensor to determine the ambient operating temperature of the radio.
- 42 VOL DN/OFF input is pulled LOW when SW302 is depressed to lower the receiver speaker audio level and turn off the radio.
- 43 UNUSED
- 44 V_{DDAREF} supplies power to the microcontroller A/D and is connected to the regulated +5 VDC.
- 45 V_{REFL} sets the lower reference level for the A/D and is connected to ground.
- 46, 47, 48, 49, 50, 51, 52, 53 UNUSED
- 54 V_{REFH} sets the upper reference level for the A/D and is connected to the regulated +5 VDC.
- 55 V_{DDA} is connected to the regulated +5 VDC.
- 56, 61 GROUND
- 57 CGMFXC has a .1 μ F capacitor bypass for loop filter phase correction.
- 58, 59 OSCILLATOR input is connected to an 8 MHz crystal used for clock reference.
- 60, 63 UNUSED inputs are pulled HIGH for FLASH programming.
- 62 CLOCK output sends serial data clock pulses to frequency synthesizer IC401 and digital potentiometers IC308 when programming these devices.
- 64 LOCK DETECT input connected to the Pin 2, IC401 lock detect output of the synthesizer is HIGH when the synthesizer is locked and low pulses when unlocked.