TYPE OF EXHIBIT:	OPERATIONAL DESCRIPTION
FCC PART:	2.1033 (c)(6)
MANUFACTURER:	RITRON, INC. 505 West Carmel Drive Carmel, IN 46032
MODELS:	SPX-400
FCC ID:	AIERIT19-450
DATE:	December 28, 2004
IC STANDARDS:	RSP-100, Issue 8, Section 7.2(b)
INDUSTRY CANADA:	1084A-RIT19450
MODELS:	SPX-400-CANADA

Included in this exhibit is a draft of the Maintenance and Operating Manual for the Ritron Model SPX-400 UHF-FM Portable Transceiver.

Specifically, the manual includes a technical description of the SPX-400 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

SPX-400

Preliminary

MAINTENANCE / REPAIR/ OPERATING MANUAL

TABLE OF CONTENTS

1. INTRODUCTION

This manual is intended for use by experienced technicians familiar with similar types of commercial grade communications equipment. SPX-400 is a micro size FM transceiver operating between 400 ~ 470 MHz. With the output power of 4 W(1 ~ 4 W).

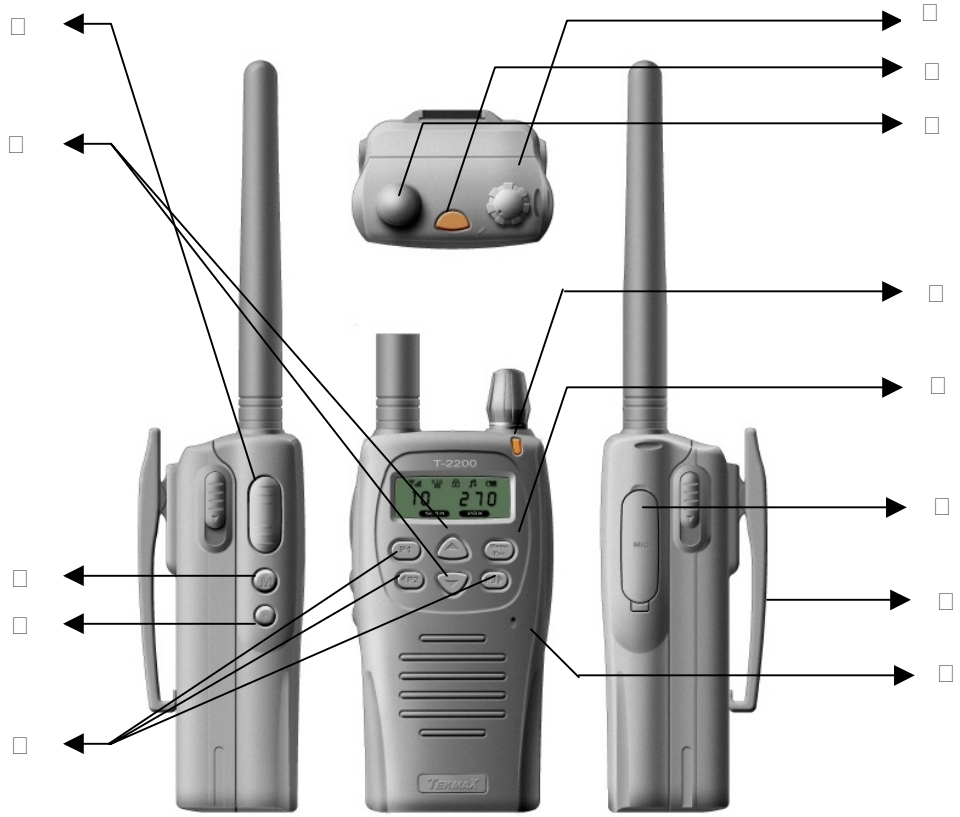
In addition to its small size, the SPX Series offers many advanced features that could only be found in the most expensive Land Mobile Radios.

PERSONAL SAFETY

- DO NOT transmit until all RF connectors are verified secure and any open connectors are properly terminated.
- SHUT OFF and DO NOT operate this equipment near electrical blasting caps or in a n explosive atmosphere.
- A qualified technician should service this equipment only.

2. OPERATION FEATURES

2-1) Physical Layout



2-2) Panel controls

 Power switch / Volume Control
Turn clockwise to switch ON the transceiver. Rotate to adjust the volume. To switch OFF the transceiver, turn counterclockwise fully.
 Emergency button

Pressing this key to enter the emergency mode

 Antenna connector

Connect the supplied antenna here (SMA connector)

 TX / RX / Battery Indicator (LED 3 colors)

Red	On	Transmitting
	Blinking	Low battery
Green	On	Receiving, monitoring
	Blinking	Different sub-tone when receiving
Orange	On	Initializing, programming and cloning

 Function button (Menu / Esc.)

 Universal connector

Connect the external accessories (speaker / microphone, cloning cable & wall charger) (optional)

 Belt clip

 MIC.

 PTT(Push To Talk) Button

Hold down to transmit, release to receive.

 Channel Select Button (Up & Down buttons)

Select the desired channel with pressing Up and Down button, pressing and holding down more than 1 second

 Monitor Button

Press to monitor. Holding down over 2 seconds keeps monitoring function on, and press shortly again or PTT Button to stop.

 Lamp

This key illuminates the LCD and keys on the front panel.

 Programmable keys

3. TECHNICAL SPECIFICATIONS

1) GENERAL

1) Frequency Range	: 400 ~ 430 MHz / 440 ~ 470 MHz
2) Modulation Type	: 11K0F3E / 16K0F3E (FM)
3) Channel capacity	: 128 channels
4) Channel spacing	: 12.5 KHz
5) Power Supply	: DC 7.5V, Ni-Mh Rechargeable Pack
6) Current Drain	: High Transmitter (4W) ----- 2000mA Receiver (0.5W) ----------350mA Standby----------60mA Standby (PSC mode)----------50mA
7) Battery Life	: 10hrs (Ni-Mh Rechargeable Pack) (At 5%-5%-90% transmit-receive-standby cycles)
8) Operating Temperature	: -30 to +50
9) Dimension	: 110(H) x 50.5(W) x 37.5(D) mm
10) Weight (W/Batteries)	: 320g (1350mAH Rechargeable battery)

2) TRANSMITTER

1) Power Output	: High (4W), Low (1W)
2) Frequency Stability	: Better than +/- 0.00025% within operating temperature
3) Hum & Noise	: -45dB (with 300Hz to 3kHz audio filter)
4) Spurious Emissions	: Less than -65dBc
5) Audio Distortion	: Less than 5% (1kHz tone 60% modulation)
6) Audio Response @6dB/oct	: +1 to -3dB
7) Max deviation	: ±2.5kHz at 12.5kHz / +/-5.0kHz at 25kHz

3) RECEIVER

1) Sensitivity (12dB SINAD)	: Less than 0.3 uV(-118dBm)
2) Selectivity	: -60dB
3) Hum & Noise	: -45dB
4) Inter-modulation	: -65dB
5) Spurious and image rejection	: 70dBc
6) Maximum Audio Output(16Ω)	: More than 500mW
7) Audio Distortion	: less than 5% at 1kHz deviation

4. CIRCUIT DESCRIPTIONS

1) PHASE-LOCK LOOP (PLL) CIRCUIT

*** REFERENCE OSCILLATOR**
The reference oscillator consists of X301 in U301 with a frequency of 12.8MHz.

This comparison frequency is selected by decoding the first three bits of the data input from microcomputer.

*** PROGRAMMABLE DIVIDER**
The programmable divider in U301 consists of a two-modulus prescaler with a 7bit control register followed by a 11-bit internal programmable divider. The overall division ratio is selected by a single 19-bit world located on the serial data bus.

*** PHASE COMPARATOR**
A digital-type phase comparator in U301 with output (pin 6) and an open drain lock detect output (pin 10) compares divided VCO frequency with the comparison frequency.

*** VCO CIRCUIT**
The transmit/receive frequency is directly generated by the Colpitts oscillation circuit contains Q302, Q303. The oscillation frequency is variable by applying the VCO control voltage to variable-to-variable capacitors D210, D212, and D106, D108.

2) TRANSMITTER

*** MIC AMP CIRCUIT**
Voice signal from the microphone are applied to microphone amplifier U8 through MK2.
U8 contains a low-pass filter that has a 6dB/oct response between 300Hz and 3 kHz and eliminates harmonics above 3 kHz. The Pre-emphasized audio signal is applied U8 pin 22 to adjust maximum frequency deviation by software.

*** VCO AND AMPLIFIER**
The VCO signal output is amplified by Q102 and then fed to power module Q101.

*** POWER AMPLIFIER CIRCUIT**
Q101 is provided approximately 7.5V DC power source.
RF power output is adjusted by software (DA-TX power) to 1W~4W.
A signal from Q101 is supplied through antenna switch D101, D111 to a low-pass filter made up of L101, L102, L103 and C101-C108, then applied to Antenna Jack.

3) RECEIVER

*** ANT SWITCHING CIRCUIT**
Signals from antenna connector fed to the antenna switching circuit through the low pass filter consisting of L101~L103. In receive mode, D101, D111 is turned off, isolates the antenna from the transmitter circuit and matching circuitry, so that the incoming signals are fed to the RF amplifier through L105.

*** RF AMPIFIER CIRCUIT**
The signals from the switching circuit are fed to the RF amplifier Q201 through a band pass filter made up of spring coil, VVC diode and capacitor.

*** FIRST MIXER CIRCUIT**
The amplified signals are fed to Gate 1 of the first mixer Q202 through C232. First local oscillator signal is supplied to Gate 2 of Q202 form the PLL circuit through C259 to convert the RF signals into 45.3MHz first IF signal.

*** IF CIRCUIT**
The first IF signals from Q202 are fed to the matched pair crystal filter XFL201, then IF signals are amplified in Q203. And those signals are fed to U201, which is composed of the second local oscillator, second mixer, limiter amplifier, quadrature detector and active filter circuit. The second local oscillator at 44.845MHz with X202 and is fed to the second mixer with the first IF signals to convert into 455kHz second IF signals..
The second IF signals leave through pin 3,and are fed to external ceramic filters XFL203, XFL204 that has excellent selectivity, then fed to U201 (pin 5) again to be amplified and detected. Narrow /Wide band are switched by software. The detected AF signals are output from pin 9.

*** AUDIO AND SQUELCH CIRCUIT**
The detected audio signals are put through a 6dB/oct de-emphasis circuit made up of R222 and C258. The signal is then applied to audio power amplifier U3 through the volume control VR1 to obtain enough power to driver the speaker.
Part of the recovered noise signal is fed to the integrated operational amplifier inside U201, which, with R228, C255, C256 makes up an low pass filter . The DC signal detected by U201 (pin13) reaches the integrated DC amplifier in U201, which has hysteresis to prevent jitter..

5. ALIGNMENT PROCEDURE

1) MEASUREMENT CONDITION

The following sections describes the alignment procedure for TR-4400H LMR transceiver under the following reference environment conditions:

Temperature	:	25° C (77° F)
Relative Humidity	:	65%
Power Supply Voltage	:	7.5VDC +/- 5%

TEST EQUIPMENT / TOOLS REQUIRED

The following list of equipment is recommended for use in setting up the radio properly. Please ensure the test equipment are calibrated according to the manufacturer's instructions:

- Frequency counter more than 1GHz +/-100Hz tolerance, high input impedance and high sensitivity
- FM Signal generator, 1GHz with adjustable frequency, FM deviation, and RF output attenuators. 50Ω Output impedance.
- Oscilloscope, high input impedance.
- 16Ω 1 Watt resistor as loudspeaker load
- Audio Signal Generator, 10Hz to 20KHz, 600Ω impedance with attenuators.
- RF Watt meter, with 50Ω 10 Watt termination resistor (Or RF Voltmeter with 50Ω termination and external 50Ω attenuators)
- Regulated Power Supply 7.5VDC 3A output
- Digital A-V-O Multi-meter
- SINAD Meter
- External Speaker Mic. plug (or special audio test jig)
- Interconnection test cable for RF and Control PCB
- Circuit Diagram for TR 4400H
- PCB layout diagram for TR 4400H

- Tuning tools for RF/IF transformer and the VR potentiometers

2) DISASSEMBLING THE UNIT

The antenna

Disconnect the antenna.

The Cover

1- Remove the battery.
2- Remove the Volume Knob.
3- Remove the 2 screws on the back panel.
4- The case could then be opened for servicing.
5- Be careful NOT to disconnect the pin connector between RF board and Control board.

The PCBs

- The radio consists of two PCBs, the RF (rear side) and control board (front side)..
- On the RF Board, connect ANT1 to a signal generator or RF power meter.
- On the RF Board, connect Power Supply to the battery terminal contacts.
- Connect External Speaker Mic Plug (or Audio Test Jig) to J3.

3) TRANSMITTER CIRCUIT ADJUSTMENT

- Crystal frequency
  On receiving mode, check Crystal output is at 12.8MHz

- Transmitter Frequency
  Connect RF Power meter to ANT1, Activate PTT to transmit on 455.0125MHz.

- Transmitter Output Power
  Activate PTT to transmit on 455.0125MHz, Output power is adjustable by software

- Transmitter Sub-Audible Tone Deviation
  Set radio to transmit on 455.125Hz, with CTCSS code 01 (67Hz) and no audio modulation. It is adjustable by software for 0.35KHz deviation.

- Transmitter Deviation Limit
  Set radio to transmit on 455.0125MHz, with CTCSS code 01 (67Hz) and audio modulation. At the external microphone input, inject 1KHz tone at –20dBm. It is adjustable by software for 2.3KHz deviation.

4) RECEIVER CIRCUIT ADJUSTMENT

- FM Demodulator Adjustment
  Set radio to receive on 455.0125MHz, No CTCSS or DCS. Connect RF Signal Generator to ANT1, Set generator to 455.0125MHz at –60dBm (50Ω) output with 1KHz tone modulation at 1.5KHz deviation.

- Receiver Squelch Adjustment
  After checking the receiver sensitivity, further lower the RF Signal Generator output to 8-10dB SINAD and observe the squelch circuit operates.