



# **SPECTRUM COMMUNICATIONS CORP.**

## **SECTION 1 INTRODUCTION**

We would like to take this opportunity to thank you for becoming one of the discerning individuals or organizations to own the Spectrum Communications' SCR1000 VHF FM Repeater. This instrument represents a state of the art achievement, and embodies thousands of hours of engineering time. Our company is dedicated to the development of very high quality products, manufactured in limited quantities, and we anticipate that they will always be in short supply. Only the finest quality components and workmanship are used throughout the SCR1000. The components are carefully selected and derated for many years of trouble-free operation. The unit is 100% solid-state and is designed for continuous duty, unattended service. The control, timer, and ID boards all use CMOS logic IC's for long, reliable life. (No relays are used in the system.) Many front panel and "on board" controls, status indicators, and 2 panel meters are provided for operator convenience to facilitate initial set-up and long-term maintenance. 2 jacks are mounted on the back panel and include provisions for remote control, autopatch, DC outputs, AF Inputs, and outputs, etc. 2 binding posts are also provided for automatic emergency DC battery power in the event of an AC power failure. An AC power supply and digital CW ID'er are built-in.

## **SECTION 2 UNPACKING**

Carefully unpack the repeater and *save the packing material*. Locate the local mic and 2 connectors supplied.

In case of damage - be sure to notify the delivering carrier at once. All shipments are insured for full value, and damages are the responsibility of the freight common carrier. Our equipment is carefully packed and shipped in perfect condition, and our responsibility for damage ends when the carton is delivered to the carrier.

## **SECTION 3 OPERATING CONTROLS & INSTRUCTIONS**

Always have a 50 ohm load connected to the transmitter output *before* turning on the AC power as the transmitter will come up in the *transmit* mode for a time duration set by the "HANG TIME" control. Connect the local mic (supplied) to the front panel connector. Connect the receiver input. (Normally from a duplexer.) Plug the line cord into a source of 115-120V, 50-60Hz power. (Or, 220V 50-60Hz if unit is so wired.)

After AC power is energized, all of the meter readings, except the Receiver functions, should be logged for future reference. The readings can be extremely helpful in the future for maintenance or troubleshooting tests.

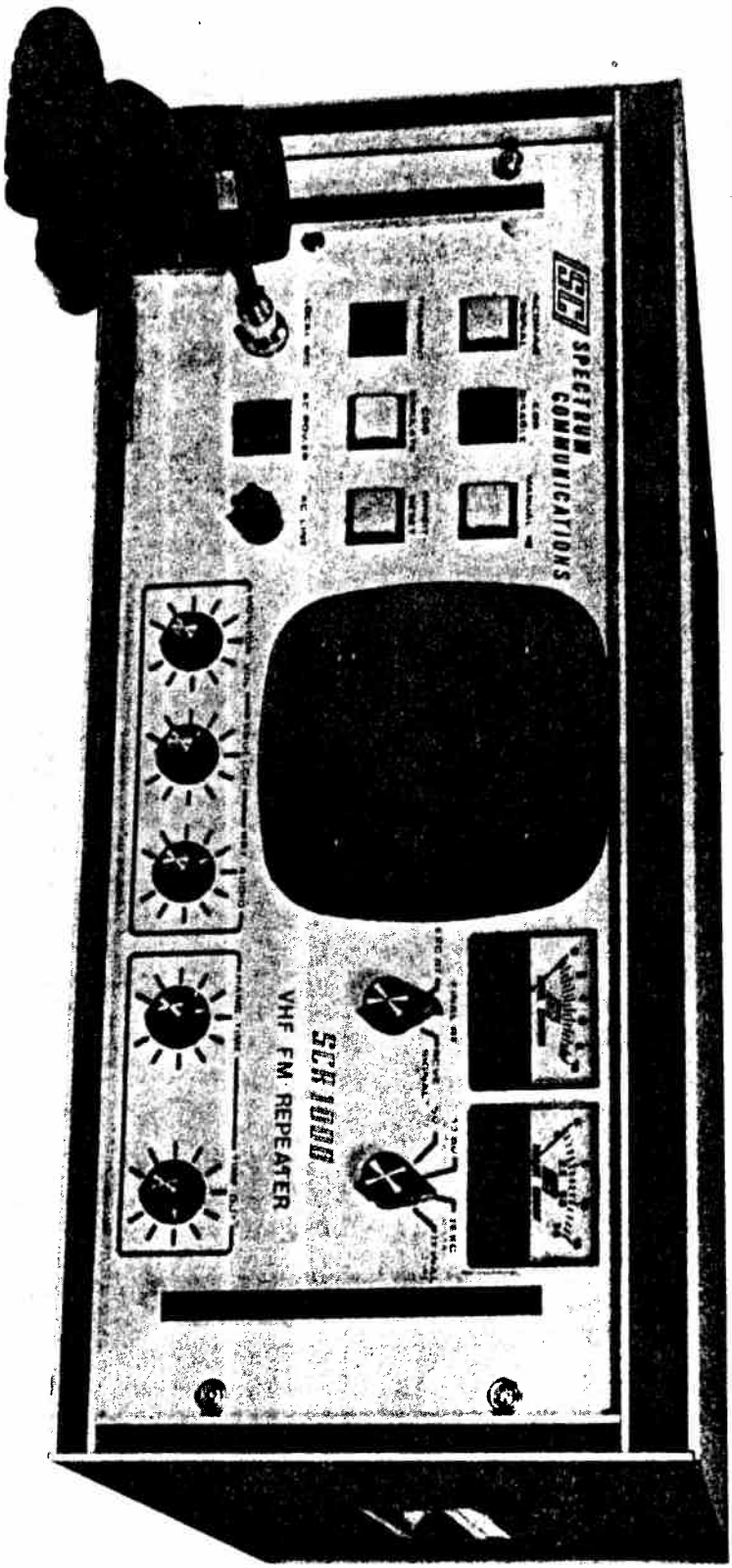


FIGURE 1 - THE SCR1000 - STATE OF THE ART IN FM REPEATERS

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# OPERATION AND MAINTENANCE MANUAL

## SCR1000 VHF FM REPEATER



*'Advanced Communications Electronics'*

**SPECTRUM COMMUNICATIONS**

1055 W. GERMANTOWN PIKE • NORRISTOWN, PA 19401 • USA

(Greater Philadelphia Area)

A handwritten signature in black ink, appearing to be the name 'Joe'.

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**SPECTRUM COMMUNICATIONS**

OPERATION  
AND  
MAINTENANCE MANUAL

**SCR 1000 VHF FM REPEATER**

*"State of the Art in FM Repeaters"*

- 6.1.6 The audio output from the FM detector at pin 9 U101 is de-emphasized by the R145/C178 network at 6dB per octave roll off per EIA specifications, and connected to the AF Preamp input at pin 3 of U102A. A CTCSS tone output point is provided at terminal E109. Op Amp stage U102A is an audio amplifier with a gain of about fourtimes, and the audio output is taken from pin 4. (Gain measured from junction R145/C178 to terminal E110.) The AF Preamp's audio output is connected to the front panel Rpt. Audio and Monitor Volume pots. Audio from the monitor volume pot is fed to pin 1 of U104, the audio power amplifier IC. U104 drives the front panel monitor speaker so that incoming signals may be monitored.
- 6.1.7 U103 is used as the 455 KHz S Meter Amplifier. This amplifier increases the level of the 455 KHz IF signal to a point sufficient to be detected by diodes CR106 and CR107. This detected IF voltage drives Q109 an emitter follower buffer stage. Q109's emitter is connected to E105, the S Meter output, through current limiting resistor R141. (R141 sets full scale on the S Meter and may be adjusted if the S Meter reads too high or low on an extremely strong signal - greater than 100 $\mu$ v.) Q111 is used as a voltage regulator stage, and supplies regulated 9 VDC to all of the appropriate points on the board. Zener diode CR114 sets the 10V reference voltage on the base of Q111. Q112 is a switching transistor which gates U104 on or off for squelch action. (This eliminates idling "hiss" in U104.)

NOTE - Part/Terminal Numbering System

Receiver - 100 Series

Transmitter - 200 Series

COR/Timer/Control - 300 Series

Power Supply/Reg./Mtr. - 400 Series

ID & Audio Mixer - 500 Series

Main Chassis - 600 Series

stages. This filter network is followed by Q103, the first IF amplifier stage, which provides about 30dB of gain. Q103's output is tuned by the L120 and C153 tank circuit, and fed to a second 4 Pole crystal filter (FL103 and FL104) which adds further adjacent channel selectivity. A 21.4 MHz IF frequency is used in this design since it places the image 42.8 MHz away from the desired receive frequency. This image is extremely well attenuated by the very sharp filters in the receiver front end stages. This high frequency IF is far superior in this respect to the commonly used 10.7 MHz IF stages.

#### 6.1.4

The 21.4 MHz first IF signal is fed to U101 which is a multi-purpose second IF IC. This IC performs the functions of second LO and mixer (down to the 455 KHz second IF frequency). This mixer is also doubly-balanced to reduce spurious responses. The second LO operates at a frequency of 21.855 MHz. U101 also includes 455 KHz second IF Amplifier and Limiter stages, as well as the FM Quadrature Detector, and high frequency (35 KHz) Squelch Noise Amp. The second mixer's output at U101 pin 3 is filtered by a 4 Pole ceramic filter which provides additional skirt selectivity for excellent adjacent channel rejection. Its output is fed to pin 5, which is the Limiter Amplifier input. The amplifier's output is at pin 7 and feeds the FM Detector's input at pin 8. The resonant circuit composed of L122 and C162 form the tuned circuit required for the Quadrature Detector. The detected FM output is internally amplified and appears at U101 pin 9. The audio output is coupled to the 35KHz high frequency noise amp. and active bandpass filter, the input to which is U101, pin 10. Pin 11 is the Noise Amp. output. The amplified noise is fed to a detector circuit composed of C175, R150, diode CR108 and bias resistor R151. This circuit rectifies the high frequency noise and converts it to a negative DC voltage which is proportional to signal quieting in the FM receiver; and this negative voltage drives the bias voltage across C175 down as the noise increases (weaker, or no signal).

#### 6.1.5

Front panel squelch pot R604 sets the squelch threshold point by setting the voltage at which diode CR108 begins to conduct, thereby setting the maximum voltage across C175. The voltage across C175 directly triggers the squelch gate built into U101. Pin 12 is the squelch trigger terminal, and pin 14 is the gating terminal which shorts the audio output to ground at the junction of R149 and C179 in order to perform the gating function. There is 100mV of hysteresis at pin 12, and this circuit allows the squelch to close at a weaker incoming signal level than the level required to open the squelch initially. This feature allows the squelch to remain open even though the signal may fade a few dB into the noise, and reduces squelch chopping effects on weak, fluttery mobile signals.





## SECTION 6    CIRCUIT DESCRIPTION

### 6.1    RECEIVER CIRCUIT DESCRIPTION

6.1.1    The receiver front end consists of an RF Preamplifier stage followed by a second RF Amplifier stage. The transistors used for this application are new, state of the art types which are designed to provide an extremely low noise figure while simultaneously giving high gain, and an extremely wide dynamic range. Eight "HI Q" resonators are intermixed before, between, and after the two RF transistors. These tuned circuits provide extremely good rejection of strong out of band signals which could otherwise overload the front end. Shield partitions are used between each tuned circuit in order to obtain optimum skirt selectivity characteristics. The output of the RF amp. stages is fed to a true Double Balanced Mixer which converts the VHF Signal down to the 21.4 MHz IF frequency. This type of mixer is used due to its extremely wide dynamic range characteristics and its extreme simplicity of operation. Note that they are widely used in microwave receiver applications due to their superior performance capabilities. Double Balanced Mixers are well known for their excellent strong signal handling capabilities - which lead to very low spurious responses, "desense" and overload.

6.1.2    The Local Oscillator (LO) chain consists of a third overtone crystal oscillator stage (Q104) which operates in the 40-50MHz range. Q104's collector output is filtered by the L110/C128 tank circuit, and its output is fed to the base of the Q105 multiplier circuit. It's output is filtered by a "double tuned" filter network which consists of L111 and C131 plus L112 and C135. This signal is fed to the base of Q106, a second multiplier or amp stage whose output is similarly filtered by another double tuned filter consisting of L113 and C137 plus L114 and C141. For 136-151 MHz receivers, Q105 and Q106 are doubler stages. For 151.001-174 MHz receivers, Q105 is a tripler stage and Q106 is an amplifier stage. For 216-250 MHz receivers, Q105 is a tripler, and Q106 a doubler stage. The multiplier chain's RF output is filtered by a double tuned filter in order to reduce spurious outputs which would lead to spurious responses in the receiver. The final L.O. output is at a level of approximately 5-15mW, (the relatively high level required by the mixer). The L.O. output frequency is always exactly 21.400 MHz above the desired receive frequency for 136-151.000 MHz (&220MHz) receivers and 21.400 MHz below the desired receive frequency for 151.001-174 MHz receivers. This is done to minimize problems with the image response. A LO output test point is provided at TP1, and a frequency counter or spectrum analyzer may be connected to this terminal.

6.1.3    The first mixer (M101) is immediately followed by a 4 Pole first IF crystal filter (FL101 and FL102) which begins to filter out off channel signals before they reach the IF amp.

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Aux. PTT - (Gnd. to Xmit); "Inhibit" & Reset, (trigger w/positive going 5 V (TTL) logic pulse or other switched 5 V level); and Ground. 2 spare pins are also provided. (When SCAP Autopatch is used, these 2 pins are used for Phone Line Input.)

DC Current Draw  
(@ 13.8VDC)  
(@ 12VDC, Subtract apx. 20%)

Standby - Squelched - all panel lights off - 320 mA nom. Unsquelched,  $\frac{1}{2}$  Local Volume, 2 Panel lamps on, "Inhibited" - 550 mA nom. Transmit - 5.5 A nom.

RF Connectors

Type N Std.

Panel Size

7" H x 19" W. Chassis Depth: 13" plus 2 5/8" for heat sink.

#### 5.4 FRONT PANEL METERING & STATUS INDICATORS

Meter #1:

Exciter Relative Output, Final Relative Output. Receiver Signal Strength.

Meter #2:

+5 V Supply Voltage, +13.8 Supply Voltage,  
Exciter Current 0-1.5A  
Final Current 0-7.5 A.

Indicator Lights:

AC Power; Incoming Signal (COR); Transmit.

#### 5.5 FRONT PANEL TEST & CONTROL FUNCTIONS

Lighted Pushbuttons:

COR Disable, COR Simulate - manually activates COR & Timer circuits, etc. Manual ID Trigger. Local (Transmitter) Inhibit/Reset - illuminated when the transmitter is in "Inhibit" mode. For positive local control, or, may be used to reset a remotely triggered shutdown.

Panel Controls:

Local Monitor Volume. Squelch/COR Threshold Adjust. Repeat AF Level. Carrier Hang Time. Time-Out Time.

Control Logic & Timers

Fully Solid State CMOS logic, (TTL compatible). No Relays. "Time-Out" may be triggered on repeater input, (received signal); or repeater output (xmtr. carrier drop) - simple jumper wire change. CMOS circuitry assures extremely good long term reliability - and, its super-low current consumption is very beneficial when operating on battery power.

CMOS CW IDer

Factory Programmed Memory is contained in a PROM IC chip. Adjustable code speed, tone pitch, timing cycle, and AF output level. Very pleasing (sinusoidal) tone quality. 250 bit memory - sufficient for any call sign. 1 channel std. (4 channel ID max.)

Local Mic

Supplied with high quality ceramic or dynamic mic w/neoprene coiled cord & 4 pin plug. Adjustable Mic Gain.

AC Power Supply

110-125 V (or 220-240 V) @ 50/60 Hz. Extremely heavy duty power transformer. Massive heat sink on regulator transistor. Although normal DC current consumption is about 5 A, the transformer & regulator pass transistor are rated for 12 & 30 A, and the bridge rectifier 35 A for extremely high reliability. AC Line Input is protected from transients, spikes, and surges by a heavy duty MOV (Metal Oxide Varistor) transient suppressor.

Emergency Battery Power

Provision for automatic instantaneous (solid state) switchover to 12 VDC Emergency Battery Power if normal AC power fails. No manual switching or relays required. (Reset is also instantaneous & automatic.) DC Input is fused and reverse polarity protected. Trickle charge to battery is provided.

Accessory Jacks (2)

For CTCSS Community Tone Panel, Autopatch, Transmitter Remote Control, DC out to auxiliary equipment, etc. Includes: +5 and +13.8 VDC @ 500 mA each; Rcvr. AF out, (High Impedance - use 10 K minimum load impedance); Aux. Xmtr. AF input, (1 K ohm) - adjustable level.