SECTION 5 SPECIFICATIONS

5.1 RECEIVER

Front End	Extremely wide dynamic range/low noise figure front end. Built-in Preamp plus RF Stage and 8 Poles of Preselection filtering. With Exclusive Double Balanced Mixer which greatly reduces intermod, "desense", and overload.
Sensitivity	0.25 to 0.3µV typ. for 12dB SINAD. 0.35µV max.
Squelch/COR/Threshold	0.1 - 0.2µV typ. 0.25µV max. (Noise operated squelch; fast attack.) Schmidt Trigger/ Hysteresis design.
Selectivity Std. Fltr.	8 Pole Crystal Filter, +4 Pole Ceramic Filter. -6db @ ± 6.5KHz;-70dB typ. @ ± 15KHz;>-125dB typ. @ ± 25KHz. (20dB quieting Method) | -85dB nom. EIA
FL-E Opt. Sharp Fltr.	-6dB @ ± 5.5KHz; -104dB typ. @ ± 15KHz. [-94dB nom.EIA]
"Desense" - Overload	With a 1µV desired signal, "desense" begins at approx. 50,000µV @ ±600KHz and 100,000µV @ ± 3MHz.
Modulation Acceptance	7KHz nom.
Image and Spurious Response	-90dB typ. image -85 dB typ . spurious
Intermodulation	-75dB nom. EIA
IF	21.4MHz & 455KHz. Double conversion.
Crystal Info. (40-50MHz Range)	RECV. FREQ.
	136-151.000 MHz Xtal Freq.=$\frac{\text{Recv. Freq.} + 21.4\text{MHz}}{4}$
	151.001-174MHz Xtal Freq.=$\frac{\text{Recv. Freq.} - 21.4\text{MHz}}{3}$
	216-250MHz Xtal Freq.=$\frac{\text{Recv. Freq.} + 21.4\text{MHz}}{6}$
	3rd Overtone, Parallel Resonant, w/12pf Load Cap. Rs<30 ohms. HC-25/U case. Calibration Tolerance: ± 0.001% @ 23°C. Temp. Tolerance: ± 0.0005% from -20 to +60°C.
AF De-emphasis	-6dB/octave per EIA Specifications
Local Monitor	High quality speaker with oversize magnet for excellent voice fidelity.
AF Output (@ 5% Dist. point)	2.2W typ. to std. 8 ohm panelspkr. 5W typ. to a 3.2 ohm spkr.

5.2 TRANSMITTER

RF Output	STD.	30W min. @ 13.8VDC. (35W typ.216-230MHz.)
	HIGH PWR.	75W nom.136-174MHz. (65W nom. 216-230MHz.) 150W SCA100 Power Amplifier available.
Final Stage		Emitter ballasted transistor withstands infinite VSWR for up to 1 min. without damage. High efficiency heat sink.
Modulation STD: 16F3, 5KHz Dev.		True FM for optimum audio quality. Instantaneous deviation limiting. Each unit is factory calibrated for 1:1 input-output deviation. (e.g. 4KHz input dev. = 4KHz output dev.) Front panel adjustable. Hum & Noise on the carrier is negligible. Overall system audio fidelity & quality is excellent - so much so that it's very difficult to tell the difference between "Direct" and "Repeat" copy.
Pre-emphasis		6dB per octave; per EIA Specs
Spurious		-75dB typ. -70dB min.
Harmonics		-65dB min. Triple section lowpass filter built-in.
Transmit Crystals		Fundamental mode, parallel resonant, w/32 pF load capacity; R_S less than 25 ohms, HC-25/U case. Calibration Tolerance: ±0.001% @ 23°C. Temperature Tolerance: ±0.0005% from -20 to +60°C.
FCC Type Acc. Unit - For OS-18 Crystal Oscillator Oven:		Calibration Tolerance: ±0.001% @ 80°C. Temperature Tolerance: ±0.0005% from +40 to +90°C.

TX. FREQ.	
136-174 MHz	Crystal Frequency = $\frac{\text{Transmit Frequency (MHz)}}{8}$
216-250 MHz	Crystal Frequency = $\frac{\text{Transmit Frequency (MHz)}}{12}$

5.3 GENERAL

Frequency Range	136-174MHz. 216-240MHz.
Frequency Stability TX:	±0.00020% max. (-30 to +60°C.) w/OS-18 Crystal Oscillator Oven.
TX without OS-18:	±0.001% nom. (-20 to +60°C.). ±0.0005% Precision Grade Crystals supplied throughout.
Receiver:	±0.0005% typ. (-20 to +60°C). ±0.001% max. (-30 to +60°C).
Remote Control	"Inhibits" or Resets xmtr. remotely with a 5V trigger pulse or level shift.
Timers (All adjustable)	"Time Out": 0.5 to 4 min. typ. Carrier "Hang" Time: 0.1 - 6 sec. typ. ID Time: 0.5 to 11 min. typ. (15 & 30 min. ID available.)

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.

	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, ½ Local Volume, 2 Panel lamps on, "Inhibited" - 550 mA nom. Transmit - 5.5 A nom.
RF Connectors	SO239 Std. Type N optional.
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.(X2 for 220MHz & 75W) Final Current 0-7.5 A.(X2 for 75 & 65W Xmtrs.
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.

SECTION 6 CIRCUIT DESCRIPTION

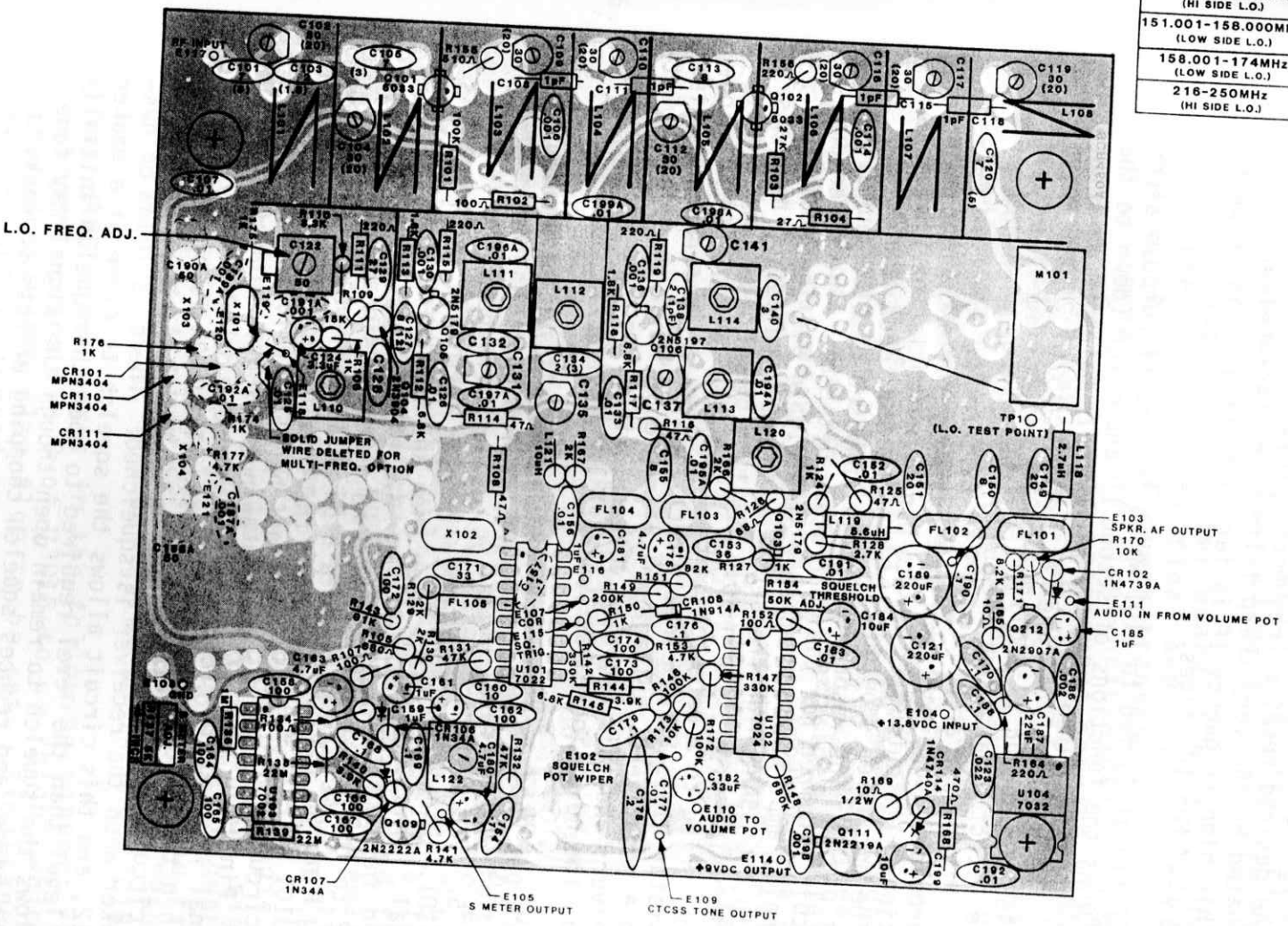
6.1 RECEIVER CIRCUIT DESCRIPTION

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 capabilites - 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 <u>above</u> the desired <u>receive</u> frequency for 136-151.000 MHz (&220MHz) receivers and 21.400 MHz <u>below</u> 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.

Rx FREQ. RANGE	CAP VALUES					
	C128	C131	C132	C135	C137	C141
136-151.000MHz (HI SIDE L.O.)	56	50	2	50	30	30
151.001-158.000MHz (LOW SIDE L.O.)	47	20	1pF	20	50	50
158.001-174MHz (LOW SIDE L.O.)	36	20	1pF	20	50	50
216-250MHz (HI SIDE L.O.)	39	20	1pF	20	10	10



NOTES:

1) ( ) DENOTES VALUE CHANGES FOR 216-250MHz.
2) EXCEPT AS INDICATED, DECIMAL VALUES OF CAPACITANCE ARE IN MICROFARADS (uF); OTHERS ARE IN PICOFARADS (pF).
3) PARTS SHOWN IN DASHED LINES ARE USED FOR MULTI-FREQUENCY OPTION ONLY.

SOLDER SIDE

COMPONENT SIDE

FIGURE 6

SPECTRUM COMMUNICATIONS		
SCALE:	APPROVED BY:	DRAWN BY R. L. A.
DATE: 6-19-84	JAC 7.9.84	REVISED
SCR200A RECEIVER COMPONENT LAYOUT (SCR1000)		DRAWING NUMBER 3200151

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. This terminal is open when an incoming signal is present and goes to ground in the absence of signal. Pin 14 is connected through zener diode CR102 to the base of Q112. With no incoming signal, Q112 is turned on causing Pin 2 of U104 to go to a high positive level. This biases U104 off. When U101 detects a signal above the squelch level, Pin 14 of U101 becomes an open circuit and Q112 is biased off by R171, allowing normal operation of U104. Pin 13 of U101 is the COR output which is high with no signal and low when signal is present. This pin is connected to Pin 3 of U102A through R149. When the COR line is high (no signal) U102A is biased off. The result of these circuits is complete silencing of both the repeat audio and the monitor speaker when the receiver is squelched. There is 100mV of hysterisis 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 though the signal may fade a few dB into the noise, and reduces squelch chopping effects on weak, fluttery mobile signals.

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 four times, and the audio output is taken from pin 4. (Gain measured from junction R146/C179 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 100μV.) 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.

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