SPECTRUM COMMUNICATIONS CORP.

SCT1500

900 MHZ TRANSMITTER

SERVICE MANUAL

"Advanced Communications Electronics"

SCT1500

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1055 W. GERMANTOWN PIKE
NORRISTOWN, PA 19403-3924 U.S.A.

PHONE: (610)631-1710
FAX: (610)631-5017

(GREATER PHILADELPHIA AREA)

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SECTION 1.0 INTRODUCTION

We would like to take this opportunity to thank you for becomming one of the discerning businesses or agencies to purchase the Spectrum Communications SCT1500 Digital/Analog Paging Transmitter. 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 with the finest quality components and workmanship. 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 SCT1500 is a self-contained rack mount transmitter and power supply. It includes front panel metering of critical voltages and currents to facilitate routine maintenance and troubleshooting. Provision is made on the exciter for automatic switchover to emergency battery operation in the event of a power line failure. For the 100 Watt unit, a 'battery backup' option is available for the SCP30 Power Supply. (If you use the battery backup feature on the Exciter, but not on the SCA100 Power Amplifier's power supply (SCP30), and AC power fails, the transmitter will stay on the air with the exciter's low power output.) Audio, FSK, and Transmit Key inputs are connected through barrier strips on the rear of the unit. There is also a front panel Transmit Key switch for test purposes.

SECTION 2.0 UNPACKING

Carefully unpack the transmitter and save the packing material.

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 3.0 OPERATING INSTRUCTIONS AND CONTROLS

3.1 Connect the 50 ohm antenna cable to the RF Output connector on the rear of the transmitter housing. Plug the line cord into a 115V 50-60Hz outlet, (or 220V 50-60Hz if the unit is so wired.)

For proper operation, load VSWR should not exceed 1.5:1 and should never be allowed to exceed 2:1 for prolonged periods - i.e. more than one minute.

After the AC power is energized, all of the meter readings should be logged for future reference. The readings can be extremely helpful in the future for maintenance or trouble-shooting tests.

3.2 FRONT PANEL CONTROLS, INDICATORS, ETC.

The front panel contains two indicating pushbutton switches, a meter and rotary meter selector switch, a monitor jack and an AC line fuse. The Transmit and AC Power switches are latching push on/push off types.

3.2.1 AC POWER SWITCH: The AC power control switches the AC line on and off. Note that this switch does not control the auxiliary DC power (emergency battery). If a battery is connected, turning off the power switch will automatically switch to battery operation. Be sure to disconnect the battery before doing any work on the transmitter or leaving the unit off for extended periods. (Light indicates AC power on.)

3.2.2 AC LINE (FUSE): 3A (Type AGC, fast blow) fuse for **120 OR 220VAC** 30-40W units; 4A for 60-75W units; 1.5A for 2-15W units. IMPORTANT!! - DO NOT USE LARGER VALUE OR "SLOW-BLOW" FUSES! 900MHz units all use a 4A fuse.

3.2.3 TRANSMIT SWITCH: The Transmit switch is used to key the carrier from the front panel. The indicator light is operated by the switched B+ line in the exciter. It will light whenever the carrier is on, if keyed either by the front panel switch or the rear panel PTT/Transmit Key terminal.

3.2.4 METERING: The meter will read Power Supply Voltages, Transmitter Currents and Audio Voltage Level to the FM Analog Modulator. The parameter to be indicated is selected by a rotary switch just below the meter.

3.2.5 MONITOR JACK: Allows monitoring of the tone or voice audio that is being transmitted with a high impedance headset or other audio test/monitor equipment (such as a scope).

3.3 INTERFACE INFORMATION & REAR PANEL CONNECTIONS (SEE FIGURE 1)

3.3.1 The RF Output connector, 12VDC Battery Input and Fuse, and Analog & FSK Input Terminals are located on the rear panels of the unit. See Figure 3 for terminal block connections and other interface information.

3.4 INTERFACE TO THE TERMINAL, OR RADIO OR WIRELINE LINK

3.4.1 FSK and RTS INPUTS: Interface/Hookup & Operation is very straight forward. The FSK (Digital Data Input) and RTS ("Request to Send" Digital Data) Inputs are very versatile and will respond to TTL, CMOS, or RS232 levels. That is, these

inputs will respond properly to a Digital 'High' of +5 to +12V; and a Digital 'Low' of -12 to +1.5V, (0V nom.). The Transmitter is switched from Analog to Digital Mode via a single wire connection to the RTS terminal. [High=Digital Mode; Low or 'open'=Analog Mode.] Modes may be switched at any time without any "lockup" problem which may be found in other make units. Switching is accomplished in milliseconds. For the FSK Data Input: High=high frequency shift. Low=low frequency shift.

3.4.2 TX KEY: Ground this terminal to transmit. (The relay contacts or transistor switch used to 'key' this line must "sink" to ground approx. 2mA. Note: this point must be allowed to float High in standby mode [to +13VDC] in order to turn off the transmitter.)

3.4.3 TONE & VOICE AUDIO INPUTS: Separate Audio Inputs are provided for Tone and Voice. (Both High Impedance Unbalanced, and 600ohm Balanced for each.) The Tone Inputs are not preemphasized. The Voice Inputs are preemphasized. Separate level adjust trim pots are provided for each of the four inputs. For their location, see the AFM-65 AF Mixer & Metering Board layout drawing. Balanced 600ohm lines are recommended for audio cables over 10 feet in length.

3.5 AUDIO INPUT LEVEL ADJUSTMENTS

See Paragraph 6.3.1 for details on setting the Audio Input levels.

3.6 EXTERNAL DC INPUT - EMERGENCY "BATTERY BACKUP" POWER (SEE FIGURE 1)

(Red & Black Binding Posts on Exciter.) This DC input is provided so that the transmitter can be operated on an external source of DC power, such as a high capacity battery, should there be a failure in AC line power. Assuming a 12V battery is connected to the terminals, when the built-in AC power supply's output voltage drops below 11V, the battery current conducts through a power diode to power the transmitter until AC current is restored. The switching action is instantaneous, reliable, and 100% solid state - no manual switches or relays are required.

When the transmitter is operating normally on its built-in AC power supply, about 100-180mA of current is delivered to the battery as a trickle charge. Note: This is *not* enough to charge a discharged battery - only enough to "float" a *fully charged* battery and prevent self-discharge. When the battery is discharged, it must be *disconnected* and charged from a standard heavy duty battery charger.

The Red terminal is the +12VDC input. Black is the ground or - terminal. The input is fused with an 8A fuse. (15A for 40W exciters.) If the 12V leads are reversed, the reverse voltage protection diode will conduct very heavily and blow the fuse - thus protecting the unit from damage. When operating on battery power, the exciter will draw about 4-8 amps of current while transmitting. At least a 70 Amp-Hour battery is recommended. Keep the battery leads as short as possible (6 feet *maximum*) and use *at least* #12 wire (#8 or #10 preferred).

For 100 watt transmitters using the SCP30 Power Supply to operate the SCA100 P.A.: if the battery backup option on the SCP30 is used, the same general notes given above apply except that the current draw is much higher. Therefore, *at least* 150 Amp-hrs. of 12V battery capacity is recommended. DC leads should be under 5 ft. and #8 or 10 wire.

In normal operation, the *battery voltage must not exceed 13.0VDC,* or there could be damage to the power supply. If it is desired to run the transmitter *strictly* on external DC Power, disconnect the AC line cord, and in this case *only*, the external DC voltage may be as high as 14.6V.

3.7 MOUNTING/COOLING IMPORTANT!!!

This unit is designed for mounting in a standard 19" rack/cabinet. **For Proper COOLING**, the heat sinks and fans **MUST** all have **at least 3" of OPEN SPACE above, below, and behind them - (for sufficient air circulation)!!** BE SURE to allow for this in **your cabinet! Very Important for longest service life and reliability!** DO NOT Transmit for more than 20 minutes with the unit sitting flat on a bench or shelf, or with the heat sinks up against a wall, etc.! (Unless the unit is elevated appx. 3" at the rear.) For bench testing 900 MHz units, be sure to prop-up the bottom fan at least 1-2".

DO NOT MOUNT the unit in a small "Hot Box"! Cabinets should be at least 3-4' high, and have many louvers for good air circulation (in and out) - preferably with top & bottom louvers on the sides and rear door. [A Grilled Cabinet Top is highly recommended to allow Hot Air to Escape.] If the cabinet is filled with equipment, or for high power transmitters of 150W or more, it is recommended that 1 or 2 fans be mounted on the side or rear of the cabinet (on the lower half), to force cool air into the cabinet. Remember - Hot Air will Rise to the top of the cabinet, where it should exit via louvers or a grilled top (best).

SCT1500 CHASSIS LAYOUT

900 MHz RANGE

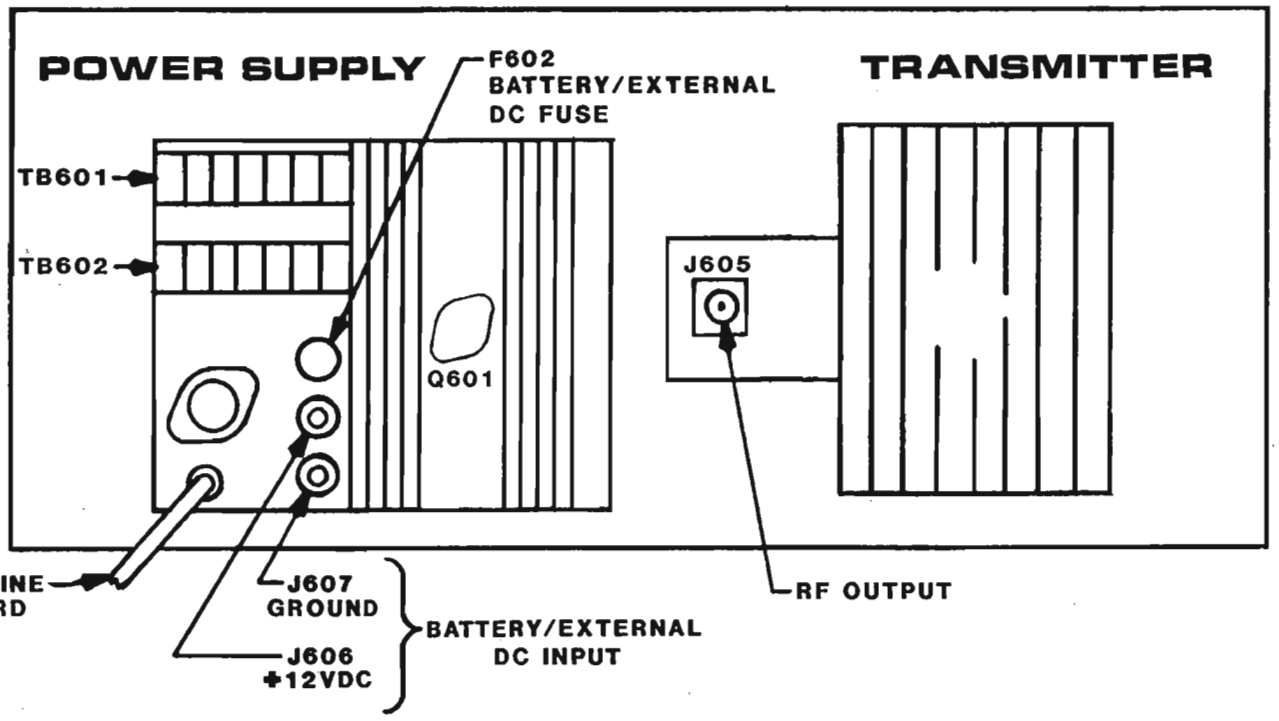


FIGURE 1 - REAR VIEW

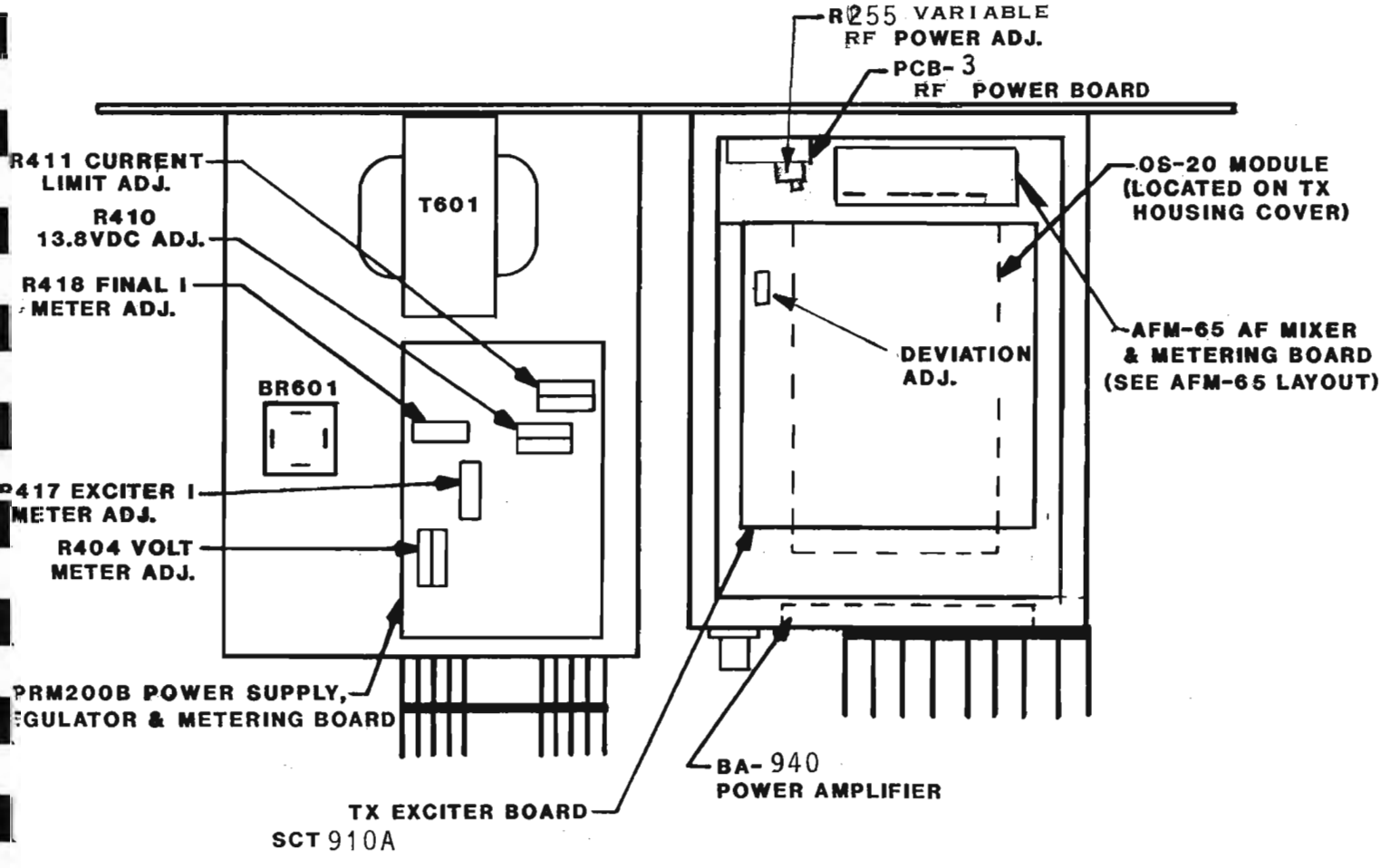


FIGURE 2 - TOP VIEW

SECTION 4.0 SPECIFICATIONS SCT1500 SERIES TRANSMITTERS

FREQUENCY RANGE	**VHF:** 136 – 174, 66 – 88 MHz	**UHF:** 406-512 MHz	806-960 MHz
RF OUTPUT POWER SPECIFY	150, 75, 30, 15 or 2W nom. (5 or 30W @ 66 – 88 MHz)	100, 40, 10 or 2W nom. (80-90, 32, 8 or 1.5W nom. above 470 MHz)	40, 100, 200W 1-15W Variable

RF OUTPUT IMPEDANCE	50 ohms; 1.8:1 VSWR max.
MODULATION	Direct FM; and NRZ FSK for Digital Modes 16F9Y & 16F9
EMISSION	Analog: 15F2, 16F3. Digital: 16F9, 16F9Y
AUDIO DEVIATION	±5KHz Std. Adjustable. Built-in Limiter/Filter.
AUDIO FREQUENCY RESPONSE	To 3000 Hz. (6dB/octave preemphasis per EIA on Voice Input. No preemphasis on Tone Input.)
AUDIO DISTORTION	<2% typ.
AUDIO INPUT LEVEL	**600 Ω BAL:** –20dBm to +10dBm. **Hi Z:** 40mV to 2V rms.
AUDIO INPUT IMPEDANCE	600 ohms balanced, and 10K ohms nom. unbalanced. Separate Inputs for Tone, Voice & Digital.
DIGITAL INPUT	TTL, CMOS and RS-232 compatible
DIGITAL DEVIATION	±4.5 KHz std. Adjustable up to ±5KHz.
ANALOG/DIGITAL SWITCHOVER TIME	<10 milliseconds
SPURIOUS EMISSIONS	–75dB nom.
HARMONICS	–66dB min. Multi-section lowpass filter built-in. (-58dB nom. on 900 MHz unit.) Optional VHF filter, for -80dB min. harmonics.
FREQUENCY STABILITY (–30 to +60°C)	**Digital/Analog Units:** ±0.0001% nom. **Analog Only Units:** ±0.0002% max. (±0.0001% typ.)
FM HUM & NOISE	–55dB typ.
OPERATING TEMP. RANGE	–30 to +60°C
HIGH VSWR	**2–40W:** Ballasted emitter power transistors withstand up to 20:1 VSWR for up to 1 min. without damage. **100 & 150W:** Automatic P.A. "bypass" in case of high VSWR. Auto. 2X reset.
RF CONNECTOR	**VHF:** SO239 **UHF:** Type N
POWER REQUIREMENTS	117/230VAC, 50 - 60 Hz. (Transformer pri. taps available @ ±10%.) Or, 12.6 – 14VDC. (13.8 VDC nom.)
DIMENSIONS	100 & 150W Units: 22 x 22 x 48"H. 2–75W Xmtr./Exciter only: 19"W (Rk. mount) x 7"H x 14"D.
WEIGHT	100 & 150W Units: 225 lbs. net (less front door). 10-75W Xmtr./Exciter only: 22 lbs. typ. net 30 lbs. Packed.

4.2 CRYSTAL SPECIFICATIONS

Transmit Frequency

806-960MHz Xtal. Freq. = $\frac{\text{TX Freq. (MHz)}}{54}$

Fundamental mode, parallel resonant, 32pF Load Cap., Rs less than 25 ohms. Calibration Tolerance: ±0.001% @ 65°C. Temp. Tolerance: ±0.0005% from +40 to +90°C. HC-18/U case. Crystals Must be baked and temperature cycled for at least 6 days before shipment.

SECTION 5.0 THEORY OF OPERATION

5.1 TRANSMITTER

5.1.1 Modulating audio is coupled into the amplifier/clipper through capacitor C201 and the audio input level control R201. The audio is clipped by this stage to limit the output deviation to ±5KHz. The clipped audio is then coupled to an active low pass filter to limit the maximum audio frequency response to 3KHz. The output of the filter is connected to the deviation control R212. The audio is then passed to the OS-20 unit.

The 18MHz output from the OS-20 drives a very tightly shielded and filtered frequency tripler unit which is mounted on the exciter board. The output of the tripler (at 50MHz) is applied to a buffer stage and then to the multiplier chain on the exciter. The multipliers use double tuned circuits to minimize spurious outputs from each stage.

The output of the last multiplier is fed to a 900 MHz amplifier/filter chain, then to the driver amplifier and the power amplifier module. In 40 watt units, the output of the power amplifier module is fed to the power amplifier board which operates class C in a common-base configuration. Its output is then fed through a lowpass filter to the antenna terminal. Output power is set by adjusting the collector voltage of the exciter driver stage using the output level adjustment on the PCB3 board.

5.1.2 POWER CONTROL BOARD

The PCB-3 power control board performs two functions. The first is to allow manual adjustment power adjustment of the transmitter. The second is to automatically compensate for varying input voltage when using battery backup. Without this compensation, the output power is very sensitive to the input DC voltage.

The circuit operates as follows:

Input voltage is applied to the base of Q209 through a voltage divider consisting of R250, potentiometer R251 and R252. The emitter of Q209 is biased up by a 5 volt zener diode CR203. Q209 operates as an inverting amplifier with it's gain established by the ratio of emitter resistor R254/collector resistor R253. With a full 13.8 VDC applied to the input, R251 is adjusted to the point where the collector voltage of Q209 just starts to increase. (Q209 is just out of saturation.) As the input voltage decreases, the base voltage of Q209 will decrease. This will cause Q209's collector current to decrease, so the collector voltage will rise until cutoff occurs at about 11 VDC input. Normal voltages on the collector of Q209 are approximately 5 V with 13.8 V in and 11 V with 11 V in.

R255, the Output Power Control, applies a portion of the voltage present at Q209's collector to the base of a Darlington current amplifier. (Q210 and Q211.) Output voltage is taken from the emitter of Q211.

5.2 FSK MODULATOR AND ANALOG/DIGITAL SWITCHING CIRCUIT OS-20 OVENIZED OSCILLATOR/MODULATOR ASSEMBLY

5.2.1 The purpose of this circuit is to modulate the oscillator with either Analog or FSK Digital Data, and to provide a means for instantly switching back and forth between the two modes. This circuit is DC coupled to the varactor diode in the oscillator's modulating circuit.

5.2.2 The circuit operates as follows. For Analog Mode: a digital Low (OVDC) is applied to the base of Q2 via E2 the 'Request To Send' port. This causes the collector of Q2 to go High. This turns RTS transmission gates U1A and U1C On, and applies a High to the base of Q1 which in turn drives Q1's collector Low and turns gate U1B Off. With gate U1B Off, the digital processing portion of the circuit is isolated. With U1C On, R3 can be varied to set the center frequency for an Analog input. U1A allows the Analog signal to pass from coupling capacitor C2 to the oscillator circuit.

5.2.3 For Digital Data/FSK Transmission, a digital High (+5VDC) is applied to the 'Request To Send' port. This now biases the base of Q2 High causing the collector to go Low, turning RTS gates U1A and U1C Off and U1B On. At this point digital data is applied to the FSK input port E4. A digital High at this point will result in a positive voltage at the wiper of R4 which will in turn cause the frequency to shift high. A Low at the FSK input port will shift the frequency low. R4 is varied to establish the amount of shift and sets the Digital 'High Frequency'. Trim cap C18 sets the Digital 'Low Frequency'. Capacitor C3 in conjunction with R1 limits the slew rate of the carrier shift, insuring that the occupied bandwidth is within specifications.

5.3 POWER SUPPLY

5.3.1 The standard power supply consists of a heavy-duty 12A power transformer, 35A bridge rectifier, 30A/200W pass transistor mounted on a massive heat sink, and an IC voltage regulator/ metering board. The AC line input is fused, and protected from line spikes and transients by a high-capacity MOV (Metal Oxide Varistor) transient suppressor. The supply is very conservatively designed - normal current draw is only 5.5A C401 & C402 are used to filter the rectified AC. U401 is a feedback voltage regulator which drives the Darlington pass transistor configuration made up of Q401 and Q601. These two power transistors provide a very high overall current gain of over 1000. Op Amp IC U402 provides a "foldback current limiting" feature which automatically and instantly "folds-back" the supply's output to very low voltage and current if the output is shorted - thereby protecting the supply. If excessive current is detected across resistors R412 and R413, U402's output at pin 6 feeds this information back to U401's, current sense input, pin 2. This causes U401's output at pin 10 to be pulled low, thereby reducing the voltage and current to the pass transistors and the supply's output.

Trim pot R411 sets the current limit trip point. This circuitry provides excellent regulation and filtering - ripple is less than 10mVp-p at an 8A load.

5.3.2 An overvoltage "crowbar" shutdown circuit is used to shutdown the power supply in the unlikely even that the pass transistor should short out. If Q601 does short, zener diode CR402 will conduct, thereby turning on SCR CR401. When CR401 conducts, it will draw a very large current through R401 for a few hundred milliseconds, thereby quickly blowing front panel AC line fuse F601 and shutting down the transmitter before any damage is done. If this should happen, F601 and Q601 must be replaced, but Q401 should first be checked with an ohmmeter for shorts. Also included on this board are various meter shunts, (wire wound resistors), and calibration pots for the volt and current meter functions.

5.3.3 CHANGING POWER TRANSFORMER TAPS

The AC Power Transformer is normally wired for 115V, 50-60Hz input, but the primary taps may be easily rewired for higher or lower AC line voltage input. For Example: if your AC line voltage is low (say 104-110V), then move the wires on the T601 primary from the 115V lugs to the 105V lugs. Likewise, the primary can be wired for 220V input. See the schematic diagram for the Power Supply.

6.2 OS-20 FSK MODULATOR/OSCILLATOR FREQUENCY ALIGNMENT PROCEDURE

6.2.1 Proper frequency alignment of the OS-20 module depends on *following a particular sequence of tuning adjustments*. When the unit is received it will have been set on frequency with the proper frequency shifts at the factory. Should you wish to change the crystal frequency or compensate for component aging, etc., the following procedure must be followed.

6.2.2 Apply a voltage of +5 to 14VDC to the RTS terminal and simultaneously jumper the FSK terminal to Ground. While this condition exists, tune the "Digital Low Freq. Adjust" trim cap C18 to set the output frequency 4.5KHz *below* the desired center frequency.

6.2.3 Remove the short from the FSK terminal and replace it with a voltage of +5 to 14VDC. At this point the condition will be RTS High, FSK High. Now adjust the potentiometer designated "Digital High Freq. Adjust" R4 to obtain a frequency reading that is 4.5KHz *above* the desired center frequency.

6.2.4 Remove the voltage from the RTS terminal and set the *Center Frequency (FO)* by adjusting the "Analog Frequency Adjust" Pot R3.

6.2.5 <u>After</u> the above steps are completed, FM Deviation with Analog Modulation may be set (or checked) per paragraph 6.3.1.

Once you are familiar with the process, the following table will provide a quick and easy reference for frequency adjustment.

TABLE 1 OS-20 FREQUENCY ALIGNMENT
(SEE FIGURES 5 AND 6)

STEP	TERMINAL	'STATE' (or VOLTAGE)	ADJUST	FREQUENCY
#1	RTS E5 FSK E6	High Low	Digital Low Freq. Adj. C18	Fo -4.5KHz
#2	RTS E5 FSK E6	High High	Digital High Freq. Adj. R4	Fo +4.5KHz
#3	RTS E5	Low	Analog Freq. Adj. R3	Fo (Center Frequency)

6.2.6 OS-20 MODULE SERVICE NOTES

The OS-20 Module is a precision and critical subassembly. It cannot be operated with its internal (heated) copper lid removed, or the heater transistors will overheat and be damaged. If it is necessary to service the OS-20 P.C. board with D.C. power on, then the wires to the emitter leads on the 2 heater transistors (Q9 and Q10) must be carefully disconnected, and reconnected when the unit is reassembled. When replacing the copper lid, be sure there is a good amount of thermal grease on the inside cover flanges to ensure good thermal contact on all mating surfaces.
Replace the insulating foam all around the copper box exactly as it was found. Replace the black outer cover.

6.3 TONE AND VOICE MODULATION AUDIO ADJUSTMENTS (SEE FIGURE 2)

6.3.1 AUDIO INPUT LEVEL ADJUSTMENTS - Refer to the AFM-65 and SCT910 schematic and board layout drawings to perform the audio adjustments. Before any audio setup is attempted, verify that the OS-20 settings are correct. (See section 6.2) The audio (analog) modulation can then be set by following the procedure below.

6.3.2 Connect an audio generator (1 KHz sine wave) to the balanced voice input (TB602 1 and 2). Set the audio level from the generator to the approximate minimum level supplied by your terminal. (Typically about .4 volt R.M.S.) Set the balanced voice level adjust (R15 on AFM-65) for maximum deviation.

6.3.3 Set the A.F. input level adjust (R201 on SCT910 board) for 3.5 KHz deviation. Increase the level from the audio generator to 3-4 volts R.M.S. and adjust the deviation control (R212 on SCT910 board) for 5 KHz deviation. Repeat this step until both settings are correct.

6.3.4 Connect the audio generator to the balanced tone input (TB602 3 and 4). Set the level from the generator as in section 6.3.2. Adjust the balanced tone level (R12 on AFM-65 board) for 3.5 KHz deviation.

6.3.5 Connect the audio generator to the unbalanced voice input (TB601 Terminal 1, ground to Terminal 2). Adjust the unbalanced voice level (R6 on AFM-65) for 3.5 KHz deviation.

6.3.6 Connect the audio generator to the unbalanced tone input (TB601 Terminal 3, ground to Terminal 2). Set the unbalanced tone level (R1 on AFM-65 board) for 3.5 KHz deviation.

6.3.7 Set the front panel meter switch to "MOD.LEVEL". Adjust the modulation meter control (R18 on AFM-65 board) for a reading of 3.5 on the lower (green) scale.

6.3.8 Connect the transmitter audio inputs to your system. Adjust the input level controls on the AFM-65 board for proper deviation levels. Only a slight readjustment should be required. Normally, tone deviation should be at or below 4 KHz to minimize clipping and distortion.

6.4 POWER SUPPLY, REGULATOR AND METERING BOARD ADJUSTMENTS

(SEE FIGURE 2)

6.4.1 R410 - 13.8VDC SUPPLY ADJUST - Adjust for 13.8 volts at E1204 on the transmitter housing with a known accurate DC voltmeter or DVM. This adjustment should be made with the transmitter activated. (After this, and each of the following adjustments, turn the meter knob back and forth one position several times to be sure the meter stabilizes on the correct reading each time. Some resistance in pointer movement is normal.)

6.4.2 R411 - CURRENT LIMIT ADJ. - Connect a variable power supply dummy load with a series DC Ammeter between the supply's main output at E402 (wirewound resistor leads) on the PRM200B board and chassis ground. Connect a DC voltmeter between the same two points. Keep the transmitter in standby mode during this adjustment. Slowly increase the load current from 0 to 9 amps and adjust R411 so that the output DC

voltage just begins to drop at a 9A load. As the load is increased, output voltage and current should continue to drop, indicating that the supply's "foldback current limit" circuit is working properly.

6.4.3 R404 - VOLT METER ADJ. - After the power supply has been adjusted to 13.8 volts under load, put meter switch in the "13.8V" position and adjust R404 for an indication of 13.8V on the front panel meter.

6.4.4 R417 - EXCITER I. METER ADJ. - Unsolder the wire connected to E1205 on the transmitter housing, and connect an accurate DC ammeter in the line. Activate the transmitter and measure the current draw. With the meter switch in the "I. EXC." position, adjust R417 so that the front panel meter reads the same current measured above.

6.4.5 R418 - FINAL I. METER ADJ. - Unsolder the wire connected to E1204 on the transmitter housing and connect an accurate DC ammeter in the line. Activate the transmitter and measure the current draw. With the meter switch in the "I FINAL" position, adjust R418 so that the front panel meter reads the same current measured above.

SECTION 7.0 TROUBLESHOOTING

7.1 SCT1500 EXCITER/TRANSMITTER TROUBLESHOOTING CHART

SYMPTOM	CHECK	REMEDY
Low, Intermittant, or No Power Output. (Low Final Current)	1) Power Supply Voltage	Replace bad part
	2) Q201	"
	3) Damaged Final Amp Module	"
	4) Power Output of Exciter	Retune Exciter or
	5) Crystal & Oscillator Module (OS-20)	Replace damaged part(s)
Low Power Output. (High Final Current.)	1) Detuned Exciter Board	Retune trim caps
	2) High VSWR	Tune or replace antenna, (or coax)
	3) Shorted or open component	Replace damaged part
	4) Damaged Final Module	Replace damaged module
No RF Output from OS-20 Module	1) Q6, Q7, Crystal in OS-20	Replace bad part
	2) 9VDC out of U4 in OS-20	"
Distorted Analog Modulation	1) Excessive Audio Drive	Adjust R1, R6, R12 and/ or R15 on AFM-65 bd. per para. 6.3.1
	2) Off Frequency	Adjust freq. per para. 6.2
	3) U201 & U1 on AFM-65 with scope for distortion. (Pins 12 & 10.) Use 1KHz test tone at AF Input.	Replace defective component(s)
No Analog Modulation	1) U201 & U1 on AFM-65 (Pins 12 & 10) with scope for output and distortion. (Use 1KHz test tone at AF Input.)	Replace defective component(s)
		"
No FSK Modulation (No Frequency Shift)	1) RTS terminal (E2 on OS-20) for correct High state	
	2) Q1 and Q2	Replace defective component. (Typically a transistor or IC.)
	3) Collectors of Q3 & Q4 and U1 pin 3 in OS-20 with scope for datastream.	
FSK Frequency Shifts too low or too high	1) Exact frequency shifts with Counter or Station Monitor.	Align FSK Modulator/Oscillator (OS-20) per paragraph 6.2.

SYMPTOM	CHECK	REMEDY
Crystal can't be set to proper frequency.	1) Off-Frequency Crystal 2) Capacitor value in oscillator circuit.	Replace crystal. See para. 6.1.3
Excessive White Noise or Spurious	1) Exciter (Use of a Spectrum Analyzer is highly recommended.) 2) All bypass caps	Tune all trim caps for min. noise or spurious consistent w/max. power output & min. current draw. Replace any intermittant trim caps. Resolder, or replace.

NOTE: REGARDING Q601 PASS TRANSISTOR MOUNTING:

When replacing Q601, note that one of its mounting screws goes through the plastic insulating cap, and one does not. The one that is under the cap makes the collector connection to the solder lug below. *Always be sure that this transistor is remounted in exactly the original fashion, or there will not be any collector connection!* If this happens Q304 the driver transistor will overheat and be destroyed! Always use thermal grease under Q601 and on both sides of the mica washer. Tighten the 2 screws securely!

7.2 POWER SUPPLY TROUBLESHOOTING

Turn off the unit *immediately* after observing any power supply problem.

SYMPTOM	CHECK	REMEDY
13.8V Supply dead, or very high (18-25VDC). AC hum on Xmtr. signal.	Q601, (and Q401)	Replace if shorted or open. [Replace F601 if blown. Be Sure to use correct value! See para. 3.2.2]

Normal DC Voltage Readings on Q601

Col. - Gnd:	22-25V	(No Load)
Base - Gnd:	15.4V	
Emit. - Gnd:	14.7V	

If replacing Q601 doesn't solve the problem, then replace Q401, U401; or U402, but this normally isn't required.

If a pass transistor shorted, the overvoltage 'crowbar' circuit should have shutdown the supply by blowing the front panel fuse. In that case, replace the shorted pass transistor(s) and the fuse, and check to see if R401 is cracked or open. If so, replace it.

SYMPTOM	CHECK	REMEDY
Current Limit Function not working properly	U402 and associated components	Replace bad part

8.0 REPLACEMENT PARTS/FACTORY REPAIR SERVICE

The factory normally stocks a complete line of replacement parts. Write or call the factory for a quote or for a C.O.D. shipment, etc. If the unit is under warranty and the customer is certain of a defective part, a replacement may be sent at no cost subject to warranty provisions. The factory may request that defective parts be returned.

Units out of warranty: *Always* contact the factory or your dealer *first* before returning any equipment for repair. Be sure to give *full details*. (A simple fix may be possible in the field.) If notified to return the unit, pack it *very carefully & tightly with at least 3" of packing material on all sides, top and bottom*, and ship U.P.S. or Air Freight Insured. The unit will be repaired as quickly as possible. Units in the U.S. are normally returned via U.P.S. - C.O.D. unless your firm has established open account with Spectrum. (If you wish to know the repair costs, please call our factory Service Department after the unit's arrival.)

Units in warranty: See the Warranty in this manual.

SPECTRUM COMMUNICATIONS LIMITED WARRANTY

Spectrum Communications Corp. warrants its equipment to be free from defective material or factory workmanship and agrees to remedy any such defect by repair or replacement at the company's option, which in the company's judgement is a fault of its manufacturing, for a period of 2 years from date of original receipt by the original purchaser, provided that the equipment is returned to the factory or its authorized dealer intact and with all transportation charges prepaid. If a malfunction is suspected, call or write in detail to our service department for suggestions concerning the operation, repair, or return of the unit if this should prove necessary. Do not return equipment to the factory without authorization!

This warranty shall be invalid in the event of (a) unauthorized repair, detuning, tampering, or alteration of any kind, (b) misuse, abuse, negligence or accident, (c) connection, installation, or operation in a manner at variance with the instruction manual, (d) alteration, disfigurement or removal of the serial number, or (e) use with accessories not manufactured or recommended by us.

Any part of a unit approved for remedy or exchange will be remedied or exchanged by Spectrum Communications or its authorized dealer without charge to the owner. Spectrum is liable only for the repair or replacement of defective equipment during the warranty period. We do not offer a money-back guarantee.

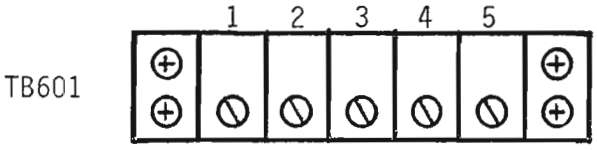
For units to be shipped within the continental 48 U.S. states, return freight from the factory to the customer via U.P.S. surface will be prepaid by Spectrum. For units to be shipped outside of the 48 states, or where a customer desires some premium method of shipment such as Airfreight, the customer must pay the full amount of the freight.

Spectrum Communications Corp. reserves the right to make any changes to designs or specifications of its products without notice, and without assuming any obligation to install such changes in its previously manufactured products.

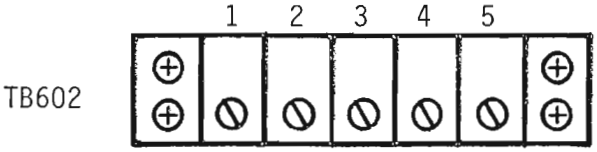
This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our products. This warranty is also in lieu of any implied warranty of merchantability or fitness for a particular purpose.

Other than repair or replacement, no other remedy (including, without limitation, incidental or consequential damages for lost labor expenses or profits, lost sales, injury to persons or property or any other incidental or consequential loss) shall be available to buyer.

SCT1500 TERMINAL BLOCK CONNECTIONS



1 - UNBALANCED AF INPUT - VOICE, PREEMPHASIZED. (HIGH Z, 10K ohm NOM.)
2 - GROUND
3 - UNBALANCED AF INPUT - TONE, NO PREEMPHASIS. (HIGH Z, 10K ohm NOM.)
4 - TRANSMIT KEY. (GROUND=TRANSMIT) NOTE: THIS LINE FLOATS HIGH IN STANDBY MODE TO 13.0 VDC.
5 - FSK (DIGITAL DATA INPUT)

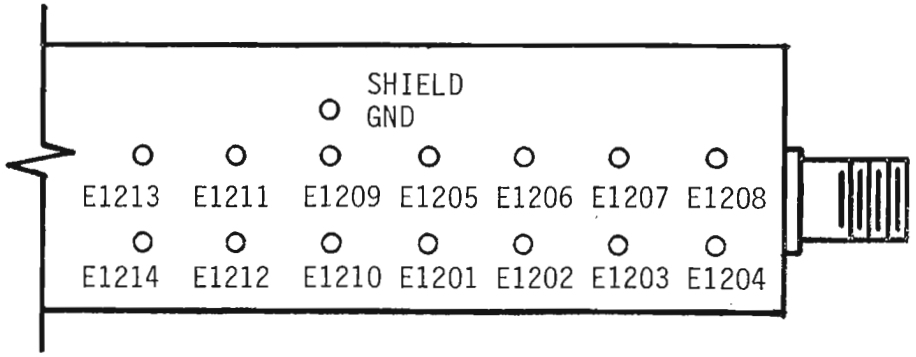


1, 2 > 600 ohm BALANCED AF INPUT - VOICE, PREEMPHASIZED.
3, 4 > 600 ohm BALANCED AF INPUT - TONE, NO PREEMPHASIS.
5 - RTS (HIGH=DIGITAL). (LO=ANALOG).

[High = +5 to +12V; LO = -12 to +1.5V, (0V nom.)]

FIGURE 3

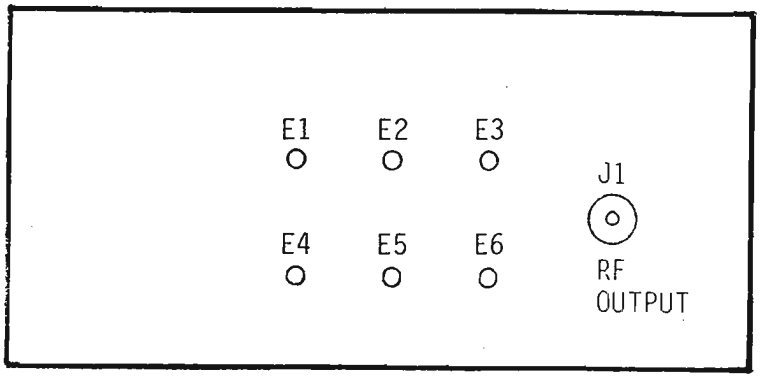
SCT1500 TRANSMITTER HOUSING FEEDTHRU CONFIGURATION



E1201 - UNBALANCED AF INPUT - VOICE, PREEMPHASIZED. (HIGH Z, 10K ohm NOM.)
E1202 - GROUND
E1203 - TRANSMIT KEY (GROUND=TRANSMIT).
E1204 - FINAL +13.8VDC INPUT
E1205 - EXCITER +13.8VDC INPUT
E1206 - TO TRANSMIT LIGHT
E1207 - TO MONITOR JACK. (AF AUDIO OUTPUT)
E1208 - MODULATION LEVEL METER OUTPUT
E1209 - AF AUDIO OUTPUT TO OS-20
E1211 - UNBALANCED AF INPUT - TONE, NO PREEMPHASIS. (HIGH Z, 10K ohm NOM.)
E1210, E1212 > 600 ohm BALANCED AF INPUT - VOICE, PREEMPHASIZED.
E1213, E1214 > 600 ohm BALANCED AF INPUT - NO PREEMPHASIS.

FIGURE 4

OS-20 FEEDTHRU CONFIGURATION



E1 = AUDIO INPUT
E2 = SHIELD GROUND, CHASSIS GROUND
E3 = +13.8VDC INPUT
E4 = +9VDC OUTPUT
E5 = RTS (HI = DIGITAL, LO = ANALOG)
E6 = FSK (DIGITAL DATA INPUT)

FIGURE 5

OS-20 ALIGNMENT LOCATIONS

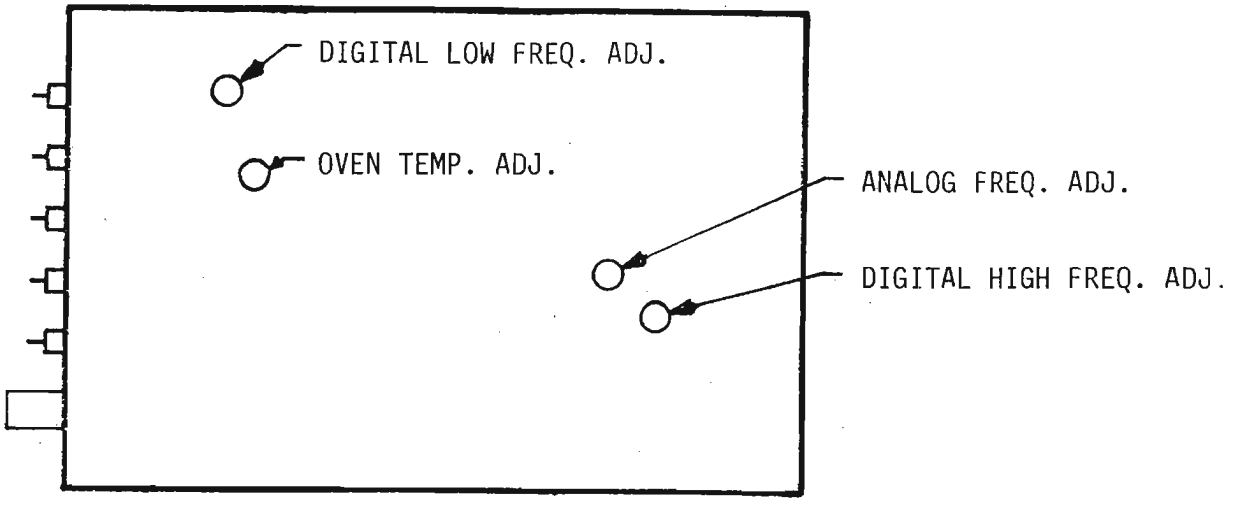
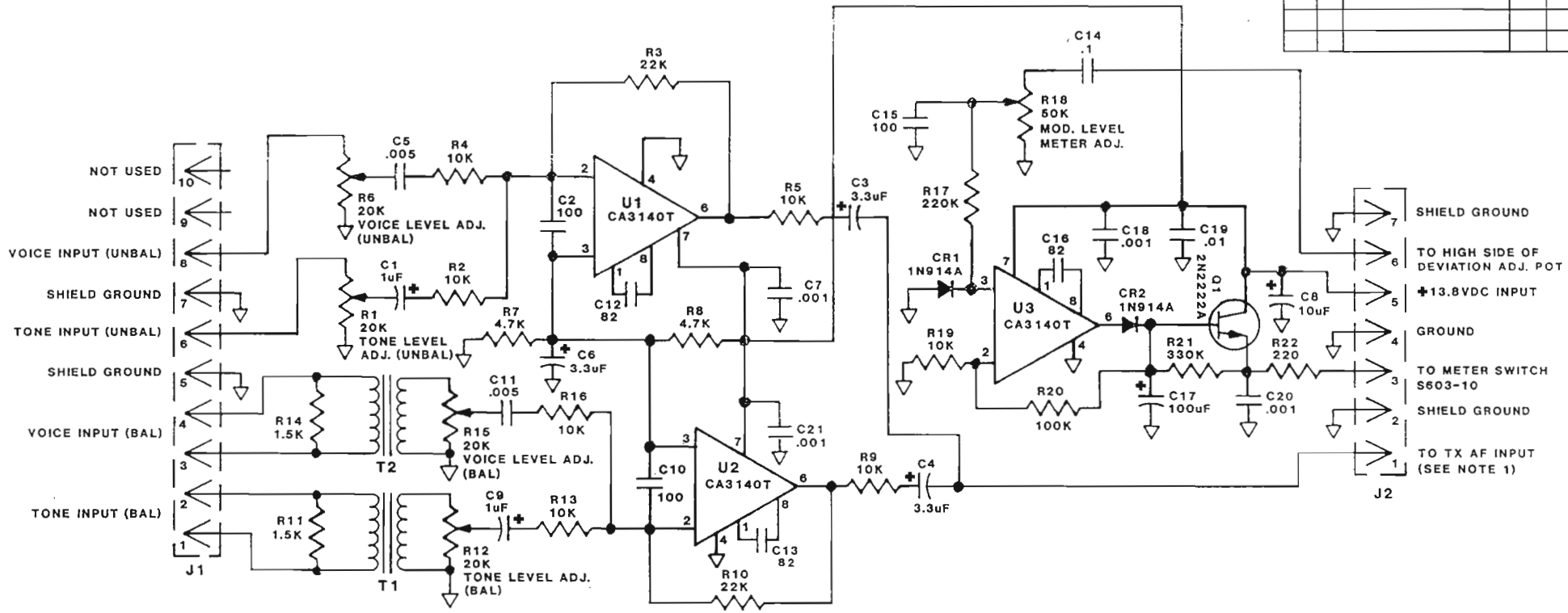


FIGURE 6

DATE	SYM	REVISION RECORD	AUTH	DR	CK

AF MIXER

MODULATION LEVEL METER CIRCUIT

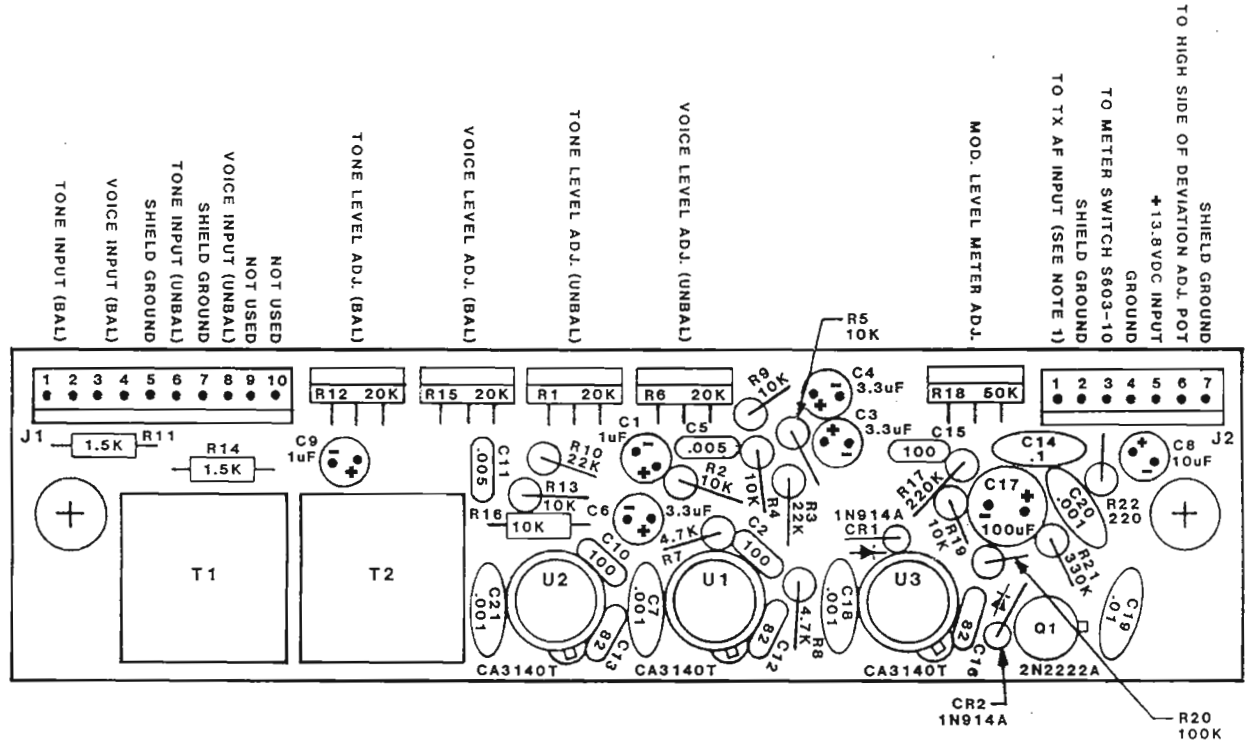


NOTE:

1) CHANGE C201 TO A 1uF ELECT. CAP WITH (+) TOWARD U201. (SEE TX SCHEMATIC AND COMPONENT LAYOUT).

TOLERANCES (EXCEPT AS NOTED)	SPECTRUM COMMUNICATIONS		
DECIMAL ±	(ST250A) (SCT1500) AFM-65	SCALE —	DRAWN BY R.L.A. / APPROVED BY
FRACTIONAL ±	TITLE AF MIXER/METERING BD.		
ANGULAR ±	DATE 8-28-90	DRAWING NUMBER 1200143	

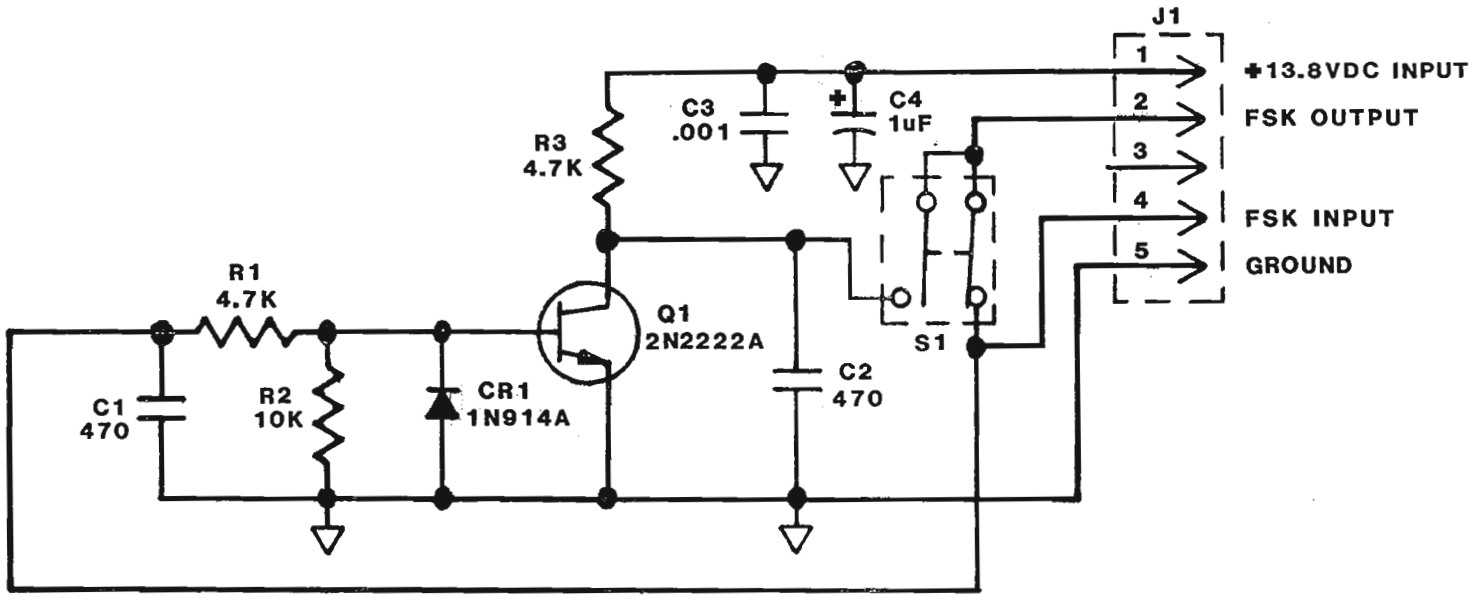
DATE	SYM	REVISION RECORD	AUTH	DR.	CK



NOTE:

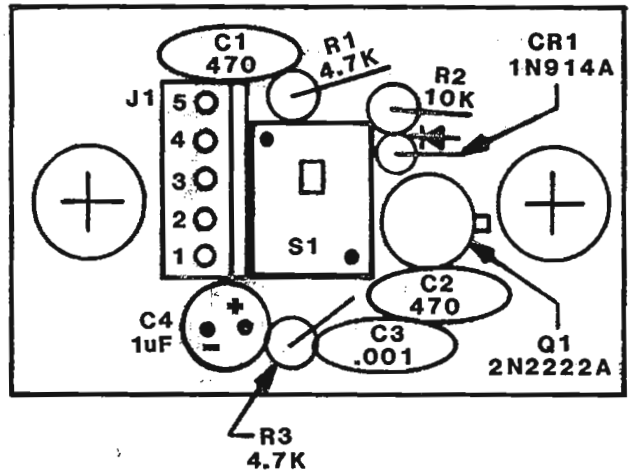
1) CHANGE C201 TO A 1uF ELECT. CAP WITH (+) TOWARD U201. (SEE TX SCHEMATIC AND COMPONENT LAYOUT).

TOLERANCES (EXCEPT AS NOTED)	SPECTRUM COMMUNICATIONS		
DECIMAL ±	(ST250A) (SCT1500) AFM-65	SCALE —	DRAWN BY R.L.A.
			APPROVED BY
FRACTIONAL ±	TITLE AF MIXER/METERING BD.		
ANGULAR ±	DATE 8-28-90	DRAWING NUMBER 1200144	



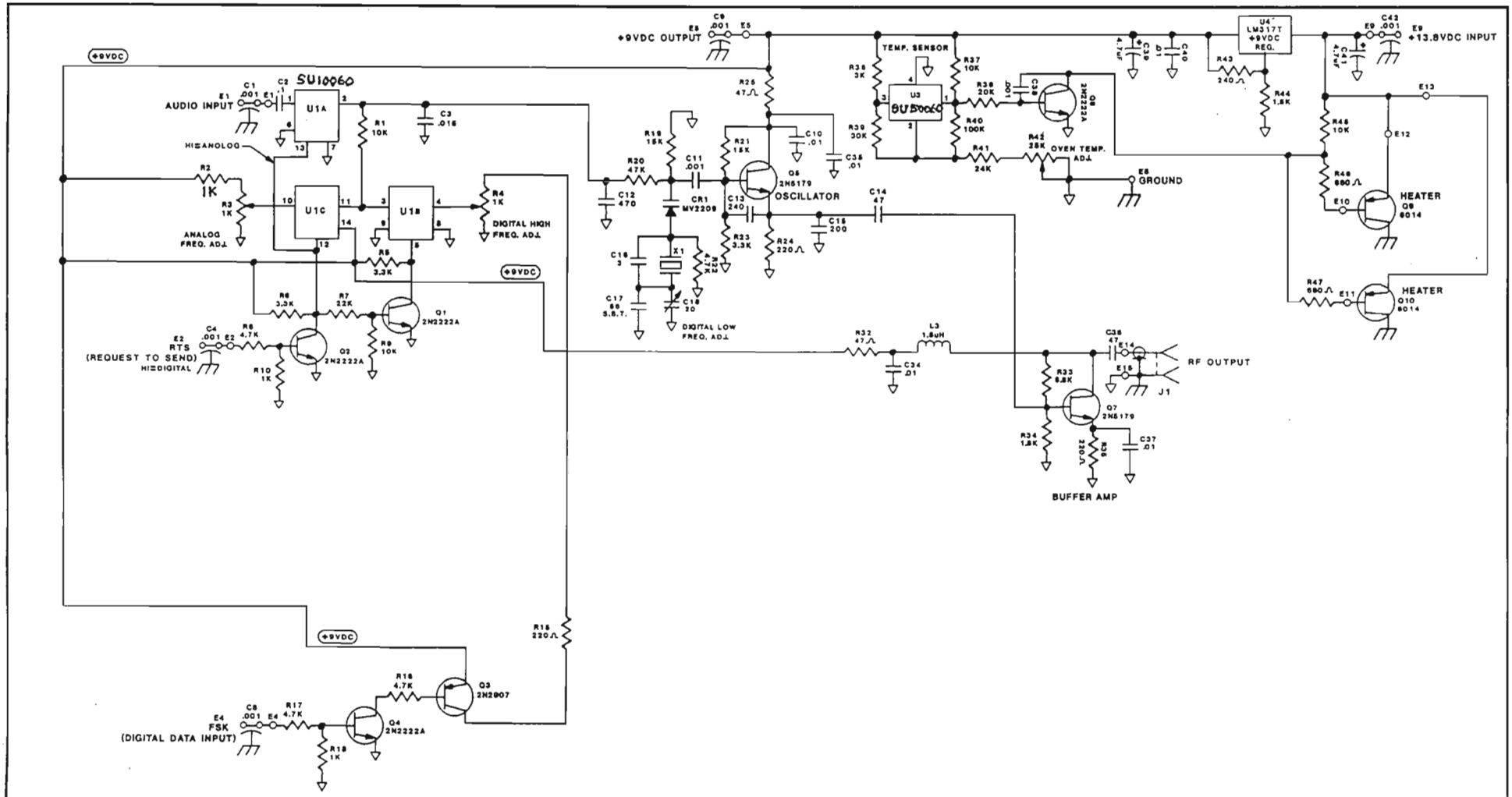
NOTE:

1)SWITCH S1 IS SHOWN IN THE NON-INVERTED DATA POSITION.



COMPONENT LAYOUT

SPECTRUM COMMUNICATIONS			
DIGITAL DATA	SCALE —	DRAWN BY R.L.A.	REVISED
INVERSION SCHM. & LAYOUT			
DATE 8-26-87	APPROVED BY JDC	DRAWING NUMBER 1200149	

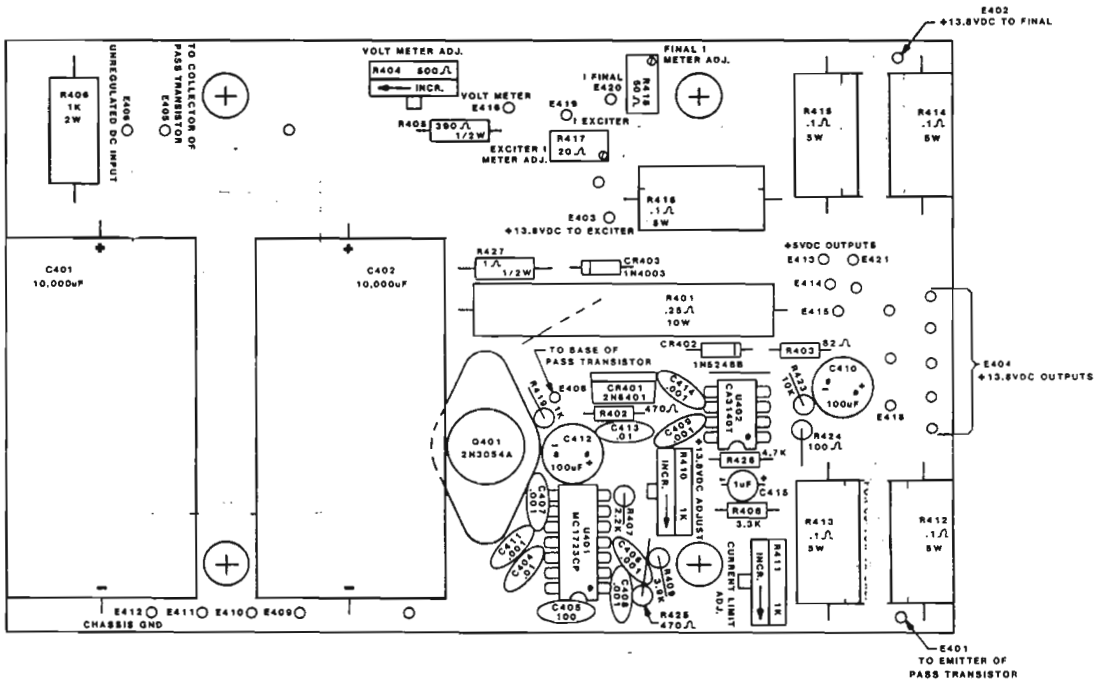


NOTES:

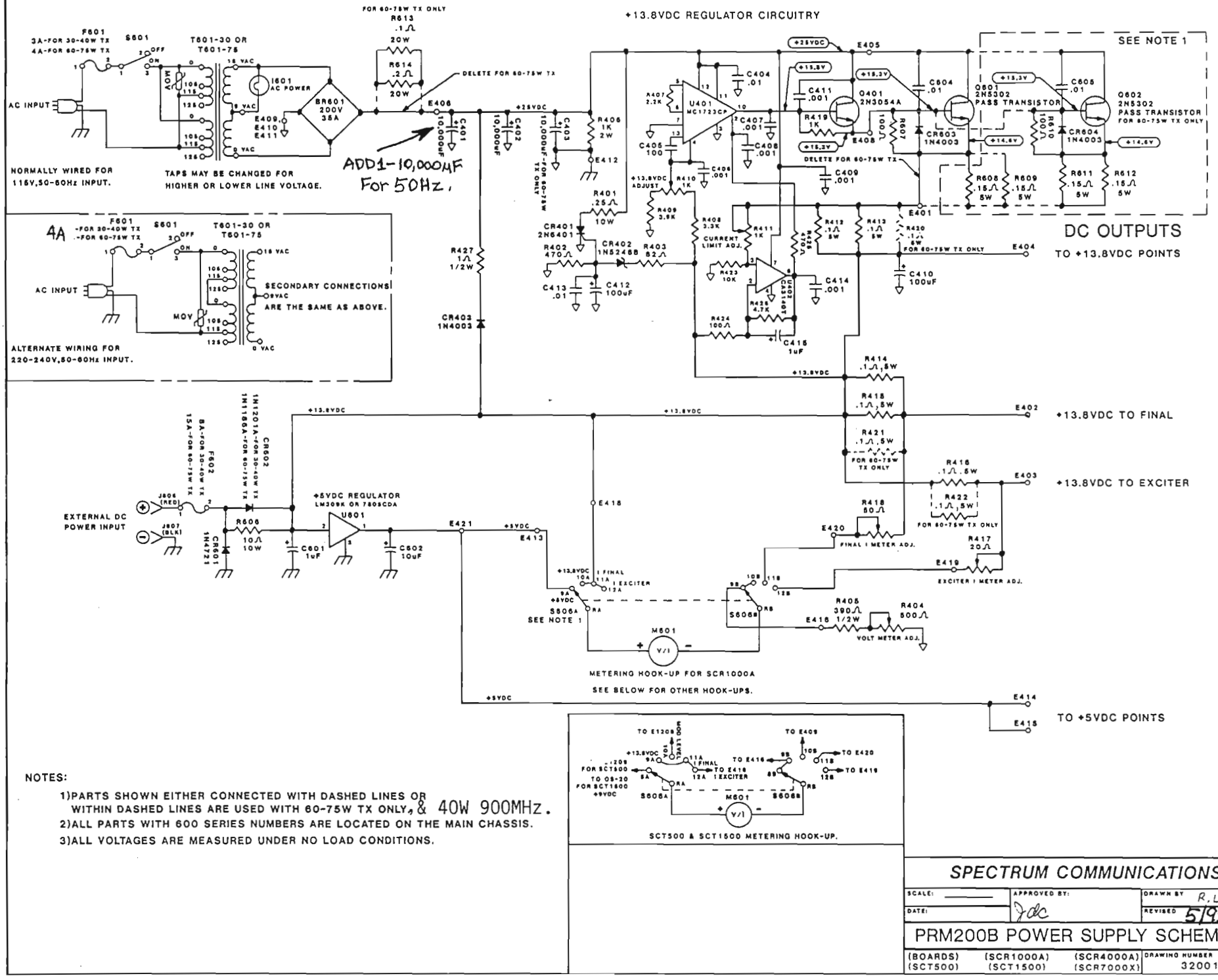
1)U1A IS AN ANALOG INPUT SWITCH.
2) U1B IS A DIGITAL INPUT SWITCH.
3)U1C IS AN ANALOG Fo ADJ. SWITCH.

SPECTRUM COMMUNICATIONS			
SCALE:	APPROVED BY:		DRAWN BY: R. L. A.
DATE:			REVISED
OSCILLATOR/OVEN ASSEMBLY			
FSK MODULATOR			DRAWING NUMBER: 3200173

OS-20



SPECTRUM COMMUNICATIONS			
SCALE: ———	APPROVED BY: JDC 11/5/87	DRAWN BY R.L.A.	
DATE: 10-28-86		REVISED	
PRM200B POWER SUPPLY LAYOUT			
(BOARDS) (SCR1000A) (SCR4000A) (SCT500) (SCT1500) (SCR7000X)			DRAWING NUMBER 3200144



NOTES:

1) PARTS SHOWN EITHER CONNECTED WITH DASHED LINES OR WITHIN DASHED LINES ARE USED WITH 60-75W TX ONLY, & 40W 900MHz.
2) ALL PARTS WITH 600 SERIES NUMBERS ARE LOCATED ON THE MAIN CHASSIS.
3) ALL VOLTAGES ARE MEASURED UNDER NO LOAD CONDITIONS.

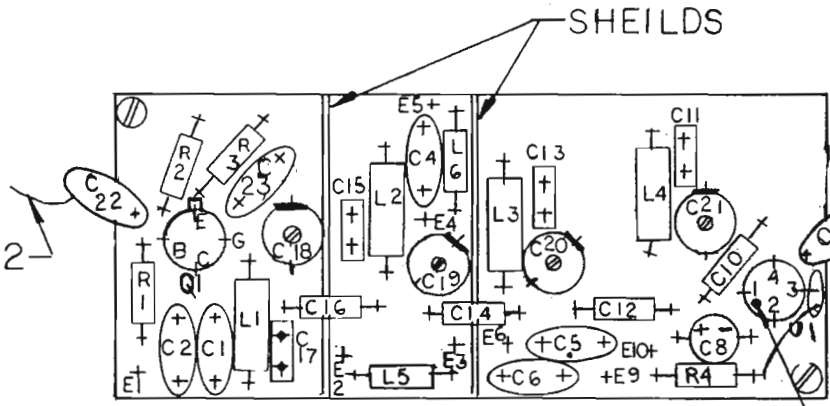
SPECTRUM COMMUNICATIONS

SCALE:	APPROVED BY: JDC	DRAWN BY R.L.A.
DATE:		REVISED 5/93

PRM200B POWER SUPPLY SCHEMATIC

(BOARDS) (SCT500)	(SCR1000A) (SCT1500)	(SCR4000A) (SCR7000X)	DRAWING NUMBER 3200149

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



NOTES

1.

2. SOLDER TO INPUT CONN ON BOX

3. SOLDER TO OUTPUT CONN ON BOX

5 PF DM5	C10
.01 CD	C1, C2 3,5
.001 CD	C4, 6, 22, 9, 2
10 PF DM5	C17, 15, 13, 11
.5 PF TUBE.	C12, 14
1 PF TUBE.	C16
1 UF ELEC	C8
GXL1800	C18, 19, 20, 21

RESISTORS

1.8 K ¼W	R2
18 K ¼W	R1
220Ω ¼W	R3
220Ω ½W	R4

CHOKES

.33 UH	L1, 2, 3, 4
1 UH	L5, SMALL
10 UH	L6, "

TRANSISTORS

2N5179	Q1
MAR-3	U1

JUMPERS

FROM — TO

E1 — E2

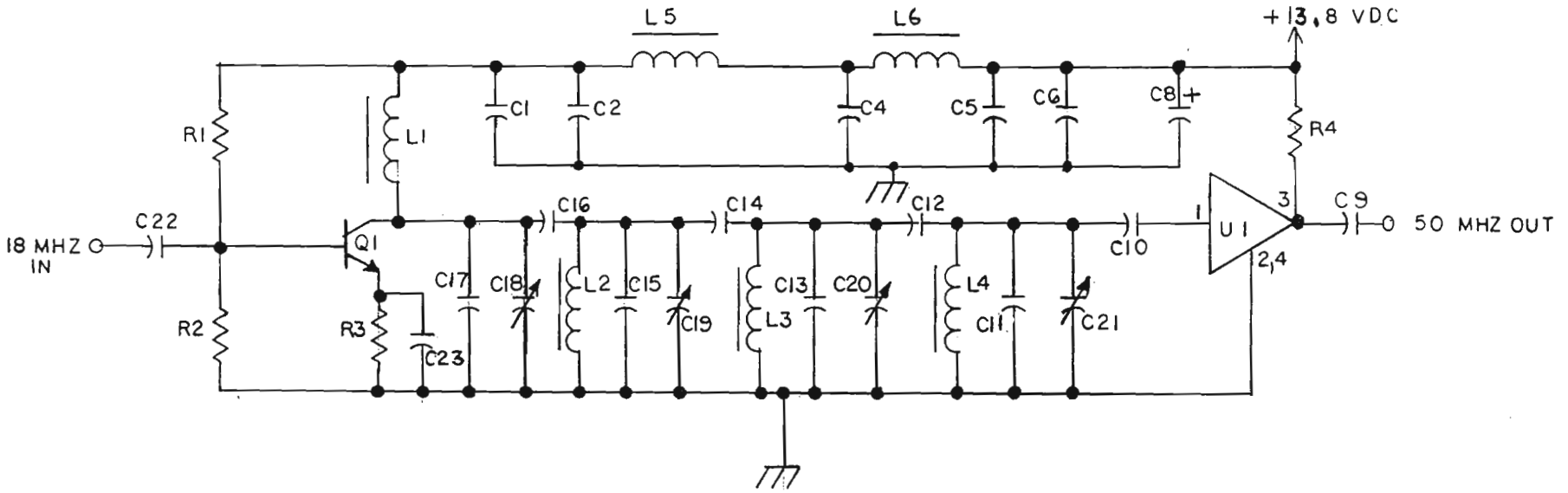
E3 — E4

E5 — E6

E9 — E10

SCHEMATIC 2200163

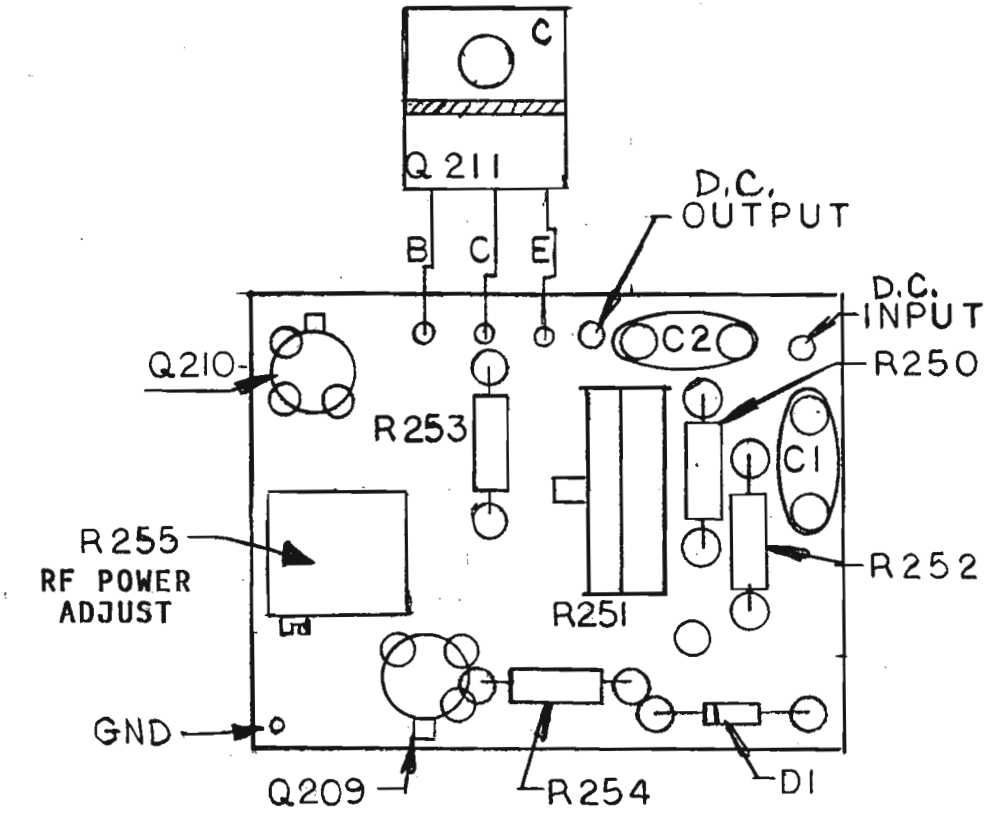
TOLERANCES (EXCEPT AS NOTED)	SPECTRUM COMMUNICATIONS		
DECIMAL Rev. A ± 12/2/93	TM-18	SCALE	DRAWN BY TLK
FRACTIONAL ±	TITLE 900 MHZ TRIPLER MODULE		APPROVED BY
ANGULAR ±	DATE 3-91	DRAWING NUMBER 2200170A	



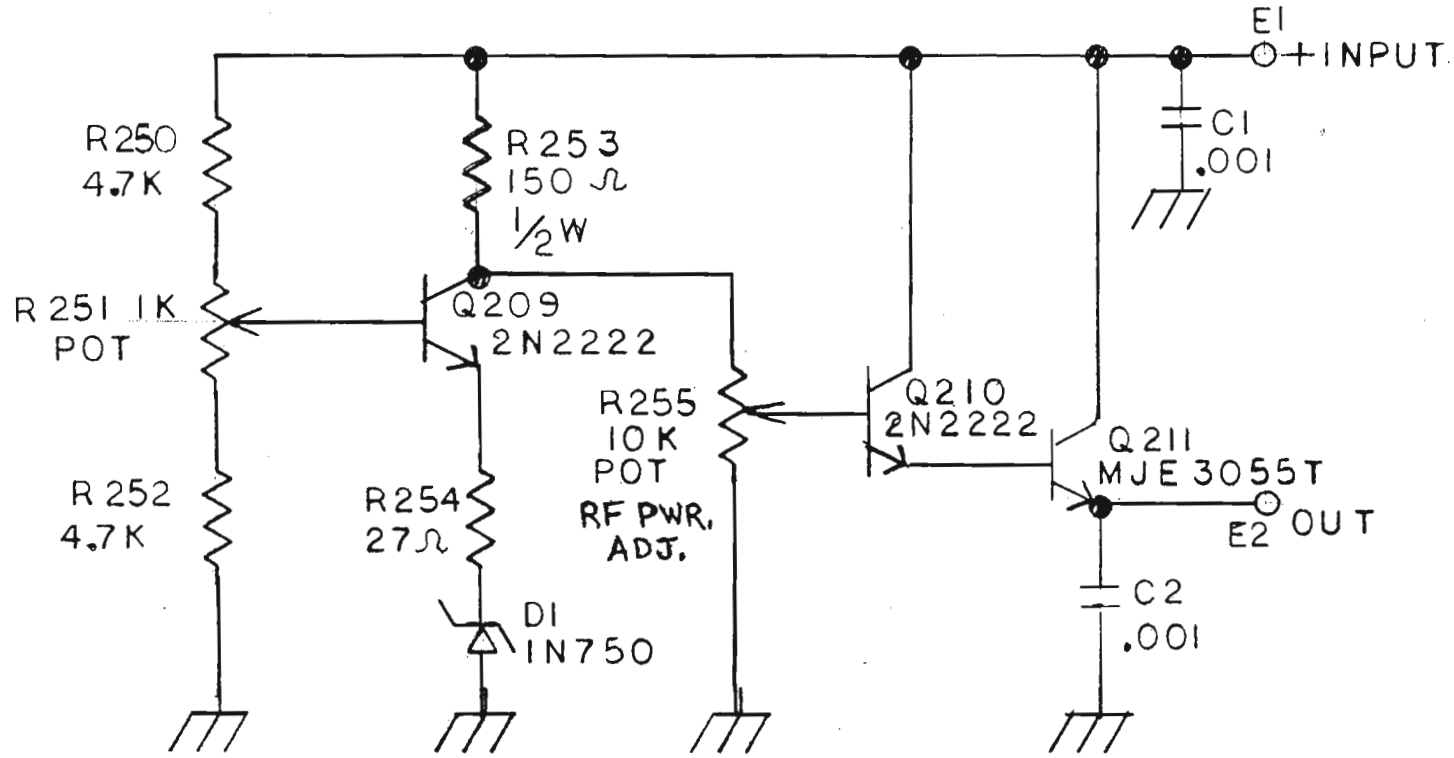
TM-18

TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SPECTRUM COMMUNICATION		
DECIMAL ±	NO.	DATE	BY	900 MHZ TRIPLER MODULE		
FRACTIONAL ±	1					
ANGULAR ±	2					
	3			DRAWN BY T.T.	SCALE	MATERIAL
	4			CHK'D	DATE 1-11-95	DRAWING NO. 2200163A
	5			TRACED	APP'D	

TELEDYNE POST 18AE-08 -11X17

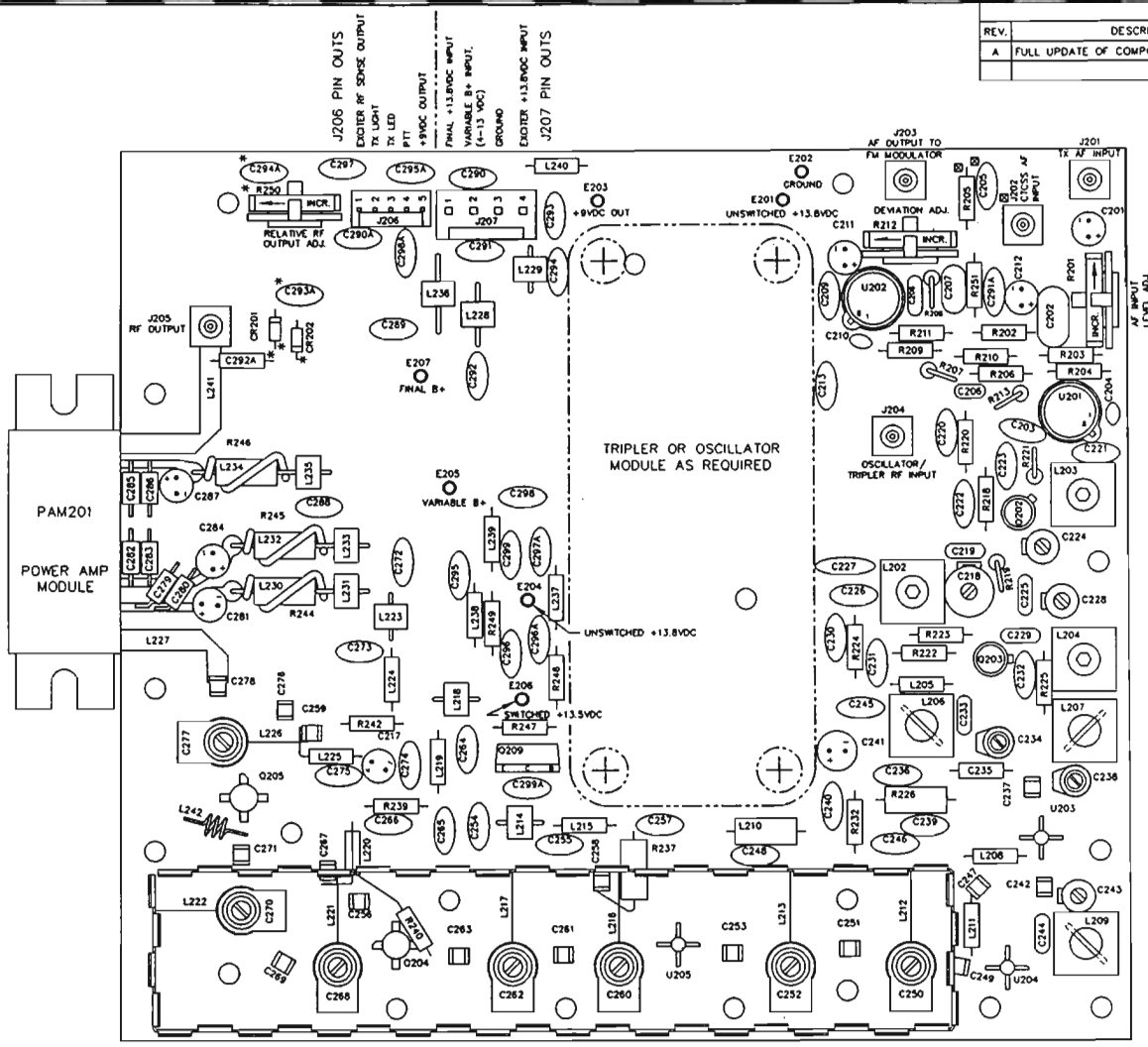


SPECTRUM COMMUNICATIONS		
	SCALE	DRAWN BY H.H.
		REVISED 4-9-97
PCB-3 COMPONENT VIEW		
DATE 7-5-91	APPROVED BY	DRAWING NUMBER 1200163A



SPECTRUM COMMUNICATIONS		
	SCALE	DRAWN BY H.H.
		REVISED
PCB-3 SCHEMATIC		
DATE 7-5-91	APPROVED BY	DRAWING NUMBER 1200164

REVISION				
REV.	DESCRIPTION	ENGR.	APVD.	DATE
A	FULL UPDATE OF COMPONENTS & ID NUMBERS	RLA		



NOTES:

1) * INDICATES PARTS USED FOR RELATIVE RF OUTPUT POWER METERING FUNCTION.
2) ⊠ INDICATES PARTS USED FOR CTCSS FUNCTION.
3) SHOWN WITH SHIELD COVER REMOVED.

USED ON SCT1500, SCT910A, SCT500, ST250A

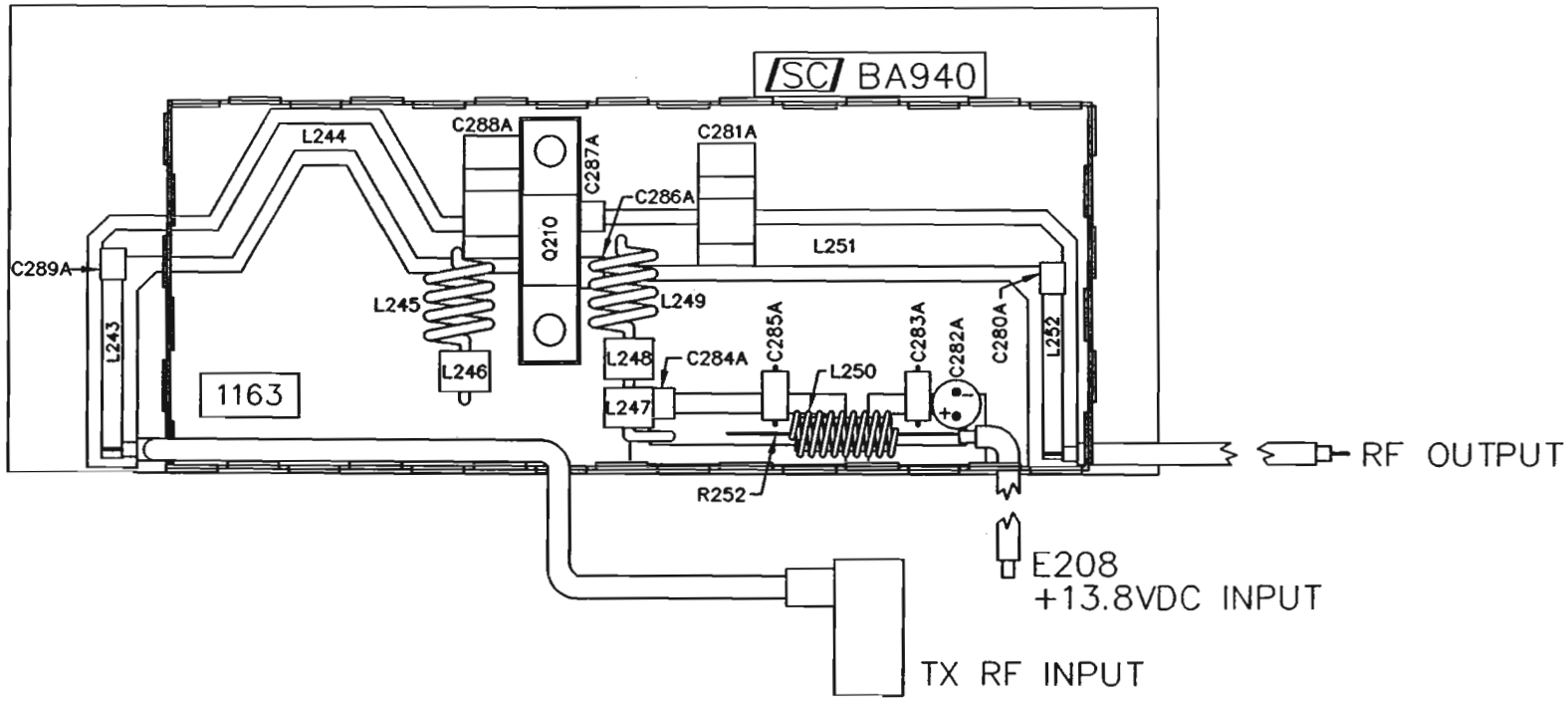
SCT910A – (806–960MHz)

SPECTRUM COMMUNICATIONS CORP.

SCALE 2:1	APPROVED BY JAC 1/20/94	DRAWN BY RLA
DATE 4/17/91		REVISED

900MHz TRANSMITTER/EXCITER

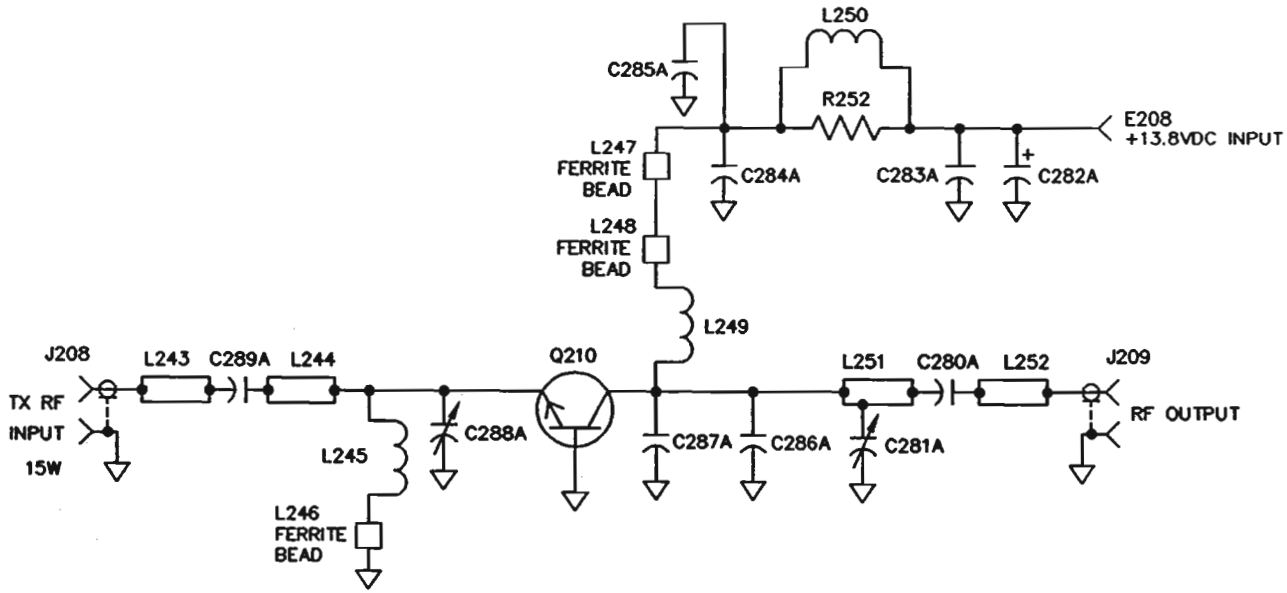
COMPONENT LAYOUT — DRAWING NUMBER: 3200190A



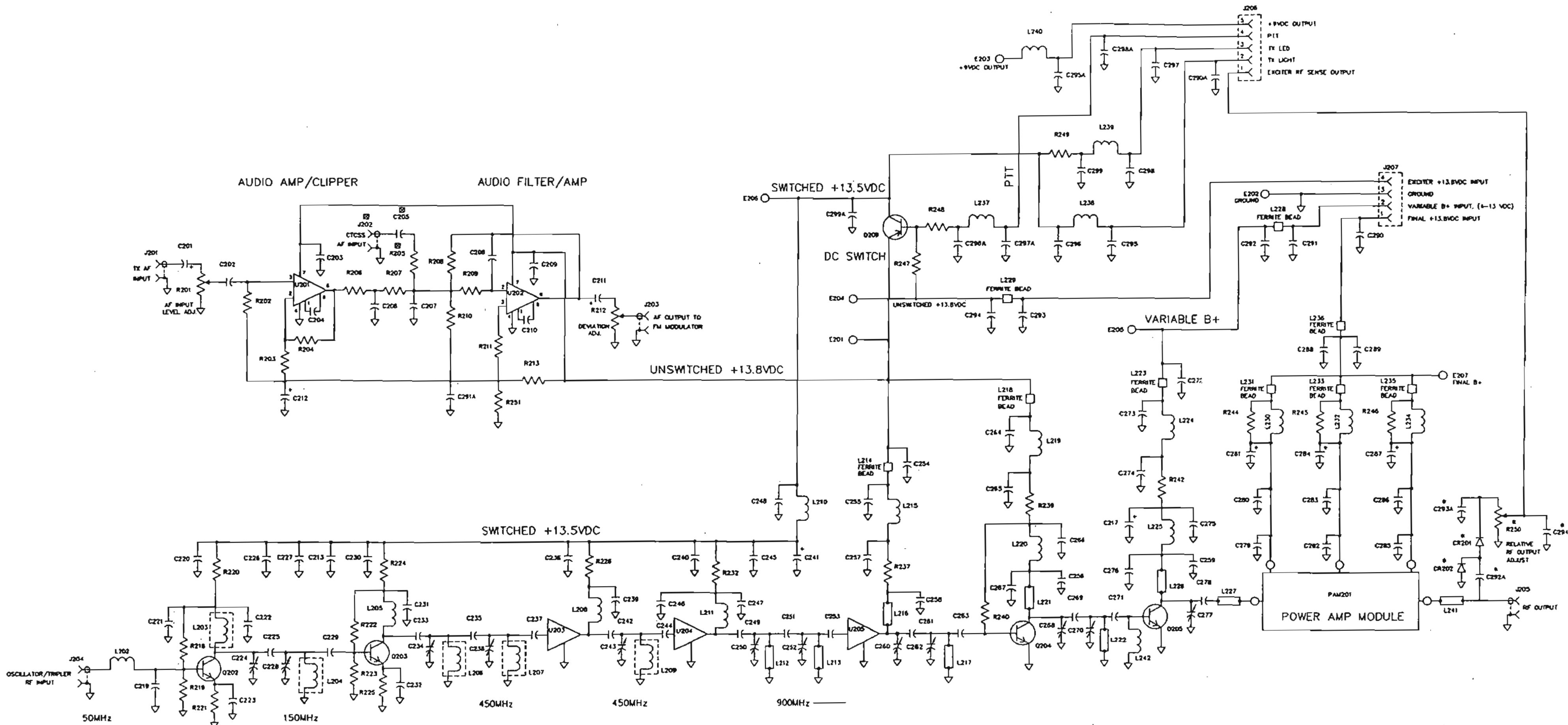
NOTES:

1) SHOWN WITH SHEILD COVER REMOVED.

SPECTRUM COMMUNICATIONS CORP.			
SCALE: 2" = 1"	APPROVED BY: V.M. Doc 10/27/93	DRAWN BY: RLA	
DATE: 9/27/93		REVISED:	
BA940 RF POWER AMPLIFIER			
COMPONENT LAYOUT		DRAWING NUMBER: 2200245	



SPECTRUM COMMUNICATIONS CORP.			
SCALE: NONE	APPROVED BY: JDC 9/24/93	DRAWN BY: RLA	
DATE: 9/17/93		REVISED:	
BA940 RF POWER AMPLIFIER			
SCHEMATIC (870 – 960MHz)		DRAWING NUMBER: 2200242	



SCT910A – (806-960MHz)

NOTES:
1) ∗ INDICATES PARTS USED FOR RELATIVE RF OUTPUT POWER METERING FUNCTION.
2) ⊠ INDICATES PARTS USED FOR CTCSS FUNCTION.

USED ON SCT1500, SCT910A, SCT500, ST250A

REVISION				
REV.	DESCRIPTION	CHKD	APVD	DATE
A	FULL UPDATE OF COMPONENTS & ID NUMBERS	RLA		
B	CORRECTION OF COMPONENTS,VALUES & RF IN	RLA		

SPECTRUM COMMUNICATIONS CORP.

SCALE NONE | DATE 8/27/93 | RLA

900MHz TRANSMITTER/EXCITER

SCHEMATIC

410015[illegible]A

S