



**SPECTRUM COMMUNICATIONS CORP.**

**ST250A**  
900MHz  
**TRANSMITTER**  
**SERVICE MANUAL**

AD  
\$ 1795

*"Advanced Communications Electronics"*



**ST250A**  
900MHz  
**TRANSMITTER**  
**SERVICE MANUAL**

~~150~~  
\$ 1795

***SPECTRUM COMMUNICATIONS CORP.***

1055 W. GERMANTOWN PIKE  
NORRISTOWN, PA 19403-3924 U.S.A.  
(215) 631-1710

FAX: (215) 631-5017

## ST250A DIGITAL/ANALOG TRANSMITTER MANUAL

### SECTION 1 - INTRODUCTION

We would like to take this opportunity to thank you for becoming one of the discerning business or agencies to purchase the Spectrum Communications ST250 Digital/Analog 'In House' Paging Transmitter. This instrument represents a state-of-the-art achievement, and embodies hundreds 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 unit is 100% solid-state and is designed for 100% duty at the 10 Watt output level. It is intended for direct "on the air" low power operation. We do not recommend driving high power amplifiers with this unit. For high power applications, we recommend our SCT1500 Exciter/Transmitter and SCA100 High Power Amplifier. The ST250 is a self-contained Direct FM Analog and FSK Digital transmitter complete with built-in Audio Stages, Digital Modulator and Power Supply. Audio (600 ohm balanced and Hi Z unbalanced), FSK, Mode Switch and Transmit Key Inputs are connected through barrier strips on the rear of the unit.

### SECTION 2 - 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 damage is 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 INSTRUCTIONS AND CONTROLS

- 3.1 Connect the 50 ohm antenna cable to the RF Output connector on the rear of the unit. Plug the line cord into a 115V 50-60Hz outlet, or 220V 50-60Hz if the unit is so wired.
- 3.1.1 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 five minutes. DO NOT key the transmitter with the antenna cable disconnected! Connect the paging terminal or other TX inputs to the barrier strips on the rear panel as per Section 3.3.

## 3.2 FRONT PANEL CONTROLS AND INDICATORS

- 3.2.1 POWER SWITCH: The Power Control switches the AC line On and Off. The LED Power Light indicates Power On.
- 3.2.2 TRANSMIT LED INDICATOR LIGHT: The LED indicator light is operated by the switched B+ line in the transmitter. It will light whenever the transmitter is keyed and the carrier is on.

## 3.3 REAR PANEL CONNECTIONS, INTERFACE TO THE TERMINAL, RADIO WIRELINE, ETC.

- 3.3.1 AC LINE FUSE: Type AGC, fast blow. 1A for 115VAC units, 1/2A for 220VAC units. IMPORTANT!! - DO NOT USE LARGER VALUE OR "SLOW-BLOW" FUSES! [For 900MHz Units: 2A for 115VAC; 1A for 220VAC.]
- 3.3.2 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.
- 3.3.3 TX KEY: Ground this terminal to transmit. The relay contacts or transistor switch used to 'key' this line must "sink" approximately 2mA to ground. Note: this point must be allowed to float High (to +13VDC) in standby mode in order to turn off the transmitter.
- 3.3.4 TONE & VOICE AUDIO INPUTS: Separate Audio Inputs are provided for Tone and Voice. (Both High Impedance Unbalanced, and 600 ohm 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 Board layout drawing. Balanced 600 ohm lines are recommended for audio cables over 10 feet in length. See Paragraph 4.0 for details on setting the Audio Input Levels.

## 4.0 TONE AND VOICE MODULATION AUDIO ADJUSTMENTS (SEE FIGURE 3)

4.1 The Audio Level controls are factory set so that a 1 volt peak to peak 1KHz audio signal will produce  $\pm 3$ KHz deviation at the transmitter output. When installing or calibrating this transmitter, the following procedure should be used:

Note: Before attempting to adjust audio, the Frequency Adjustments (section 5.0) should be checked.

- 4.1.1 Connect the terminal's audio output lines to the appropriate audio input terminals on the rear of the transmitter. Connect a Deviation Meter to the transmitter output (via a coupler, etc.).
- 4.1.2 Voice Modulation: Key the transmitter in analog mode. With the terminal supplying a voice signal, check for voice peaks producing 5KHz deviation. If the terminal has an adjustment for voice level, the terminal control should be set to produce this condition. If there is no adjustment on the terminal or if the modulation is too low with the terminal set to its maximum output, the settings in the transmitter must be changed. If the voice setting is correct, the tone setup should be performed. If there is no Voice Level Adjust on your terminal, adjust R15 (balanced voice) or R6 (unbalanced voice), as appropriate for the input you are using. These adjustments are located on the AFM-65 board. If the modulation is still low with the adjustment at maximum, the Audio Input Level control on the transmitter board must be adjusted. (See layout drawing of transmitter board.)
- 4.1.3 Tone Modulation: With the transmitter keyed and the terminal Tone Output connected properly to the rear terminals on the transmitter, adjust the terminal Tone Output Level to produce 3.5KHz output deviation. If the terminal does not have a Tone Level control, adjust R1 (unbalanced) or R12 (balanced) as appropriate for the input you are using. If the modulation is still low, the Audio Input Level control\* on the transmitter board must be adjusted. (See transmitter board layout.)

\*[R201 - UHF & 900MHz. R218 - VHF.]

Note: If the Voice Level has already been set and the transmitter Audio Input Level is adjusted, it will be necessary to reset the Voice Level.

### 4.2 PEAK FM DEVIATION ADJUSTMENT - (ANALOG MODULATION)

Note: Peak FM Deviation is factory set, and should not be reset unless absolutely necessary (such as after the crystal is replaced). Normally, only the AF Input Level pots (on the AFM-65 board) need initial adjustment.

Modulate the transmitter with a 1KHz test tone and observe the Deviation Meter's Audio Output with a scope. Slowly

increase the test tone's level from zero, and notice that the modulation waveform changes from a perfect sinewave to a compressed waveform (rounded squarewave) at some point [normally at 5KHz deviation]. Set the test tone's audio input level so that the waveform is "just beginning to flat-top". Then, set the Deviation trim pot (R212-VHF & 900MHz, R213-UHF, see Figure 3) on the exciter board for 5.0KHz deviation.

## 5.0 FSK MODULATOR/OSCILLATOR FREQUENCY ALIGNMENT PROCEDURE

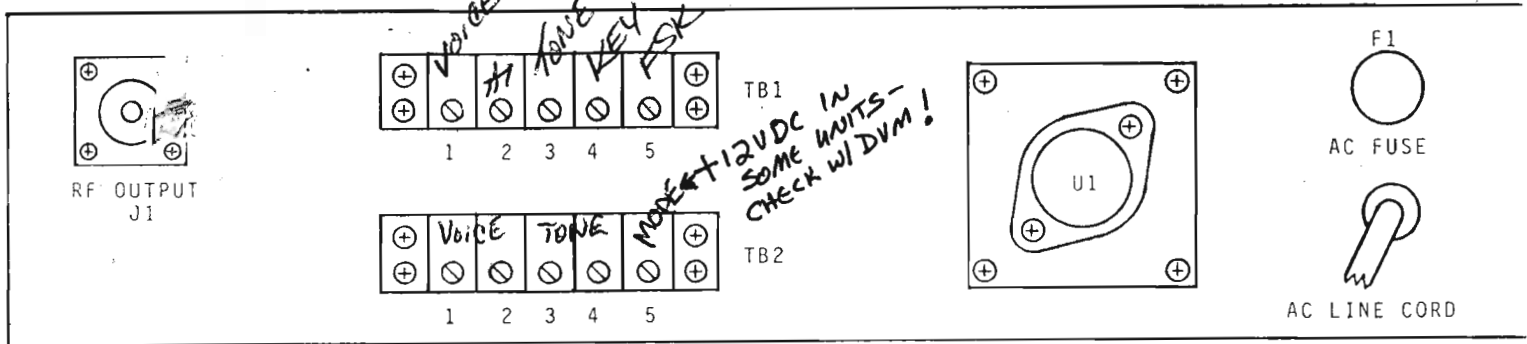
- 5.2.1 Proper frequency alignment depends on following a particular sequence of tuning adjustments. When the unit is received it will have been set on frequency with the proper frequency shifts at the factory. Should you wish to change the crystal frequency or compensate for component aging, etc., the following procedure must be followed.
- 5.2.2 Apply a voltage of +5 to 14VDC to the <sup>TB2-5</sup>RTS terminal and simultaneously jumper the FSK terminal to Ground. While this condition exists, tune the "Digital Low Freq. Adjust" trim cap C258A to set the output frequency 4.5KHz below the desired center frequency. *FSK TB1-5*
- 5.2.3 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" R13 to obtain a frequency reading that is 4.5KHz above the desired center frequency.
- 5.2.4 Remove the voltage from the RTS terminal and set the Center Frequency (FO) by adjusting the "Analog Frequency Adjust" Pot R9.
- 5.2.5 After the above steps are completed, FM Deviation with Analog Modulation may be set (or checked) per paragraph 4.2.

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

**TABLE 1 FREQUENCY ALIGNMENT**

STEP	TERMINAL	'STATE' (or VOLTAGE)	ADJUST	FREQUENCY
#1	RTS FSK	High Low	Digital Low Freq. Adj. (CRYSTAL TRIM CAP)	Fo -4.5KHz
#2	RTS FSK	High High	Digital High Freq. Adj.	Fo +4.5KHz
#3	RTS	Low	Analog Freq. Adj.	Fo (Center Frequency)

**FIGURE 1 - ST250A REAR VIEW**



**FIGURE 2 - ST250A TERMINAL BLOCK CONNECTIONS**

TB1

~~GREY~~  
GREY  
B/W  
W/B  
C/W

- 1 - UNBALANCED AF INPUT - VOICE, PREEMPHASIZED. (HIGH Z, 10K ohm NOMINAL.)
- 2 - GROUND
- 3 - UNBALANCED AF INPUT - TONE, NO PREEMPHASIS. (HIGH Z, 10K ohm NOMINAL.)
- 4 - TRANSMIT-KEY. (GROUND = TRANSMIT.) NOTE: THIS LINE FLOATS HIGH IN STANDBY MODE TO +13.0 VDC.
- 5 - FSK. (DIGITAL DATA INPUT.) [HIGH = +5 TO +12 VDC; LOW = -12 TO +1.5 VDC, 0V NOMINAL.] (SEE NOTE BELOW.)

TB2

w/g

- 1 } 600 ohm BALANCED AF INPUT - VOICE, PREEMPHASIZED.
- 2 }
- 3 } 600 ohm BALANCED AF INPUT - TONE, NO PREEMPHASIS.
- 4 }
- 5 - RTS. (HIGH = DIGITAL; LOW = ANALOG.) [HIGH = +5 TO +12 VDC; LOW = -12 TO +1.5 VDC, 0V NOMINAL.] (SEE NOTE BELOW.)

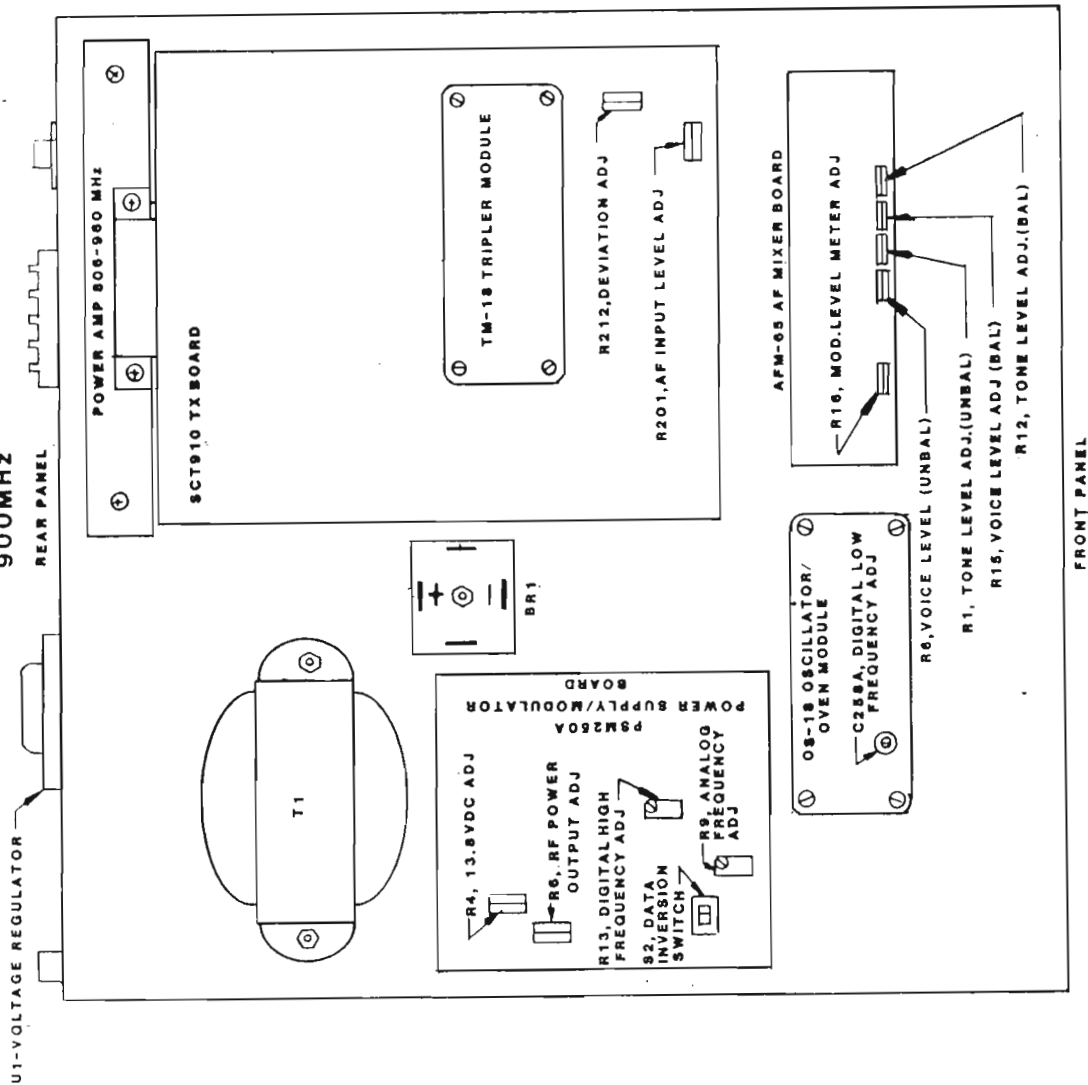
NOTE: FOR USE WITH QUINTRON CONTROLLERS, A PULLUP RESISTOR (2.2K ohm, 1/4 WATT) MUST BE ADDED FROM THIS TERMINAL TO +13.8 VDC. THIS CAN BE DONE INSIDE THE ST250 OR THE CONTROLLER. IN THE ST250, +13.8 VDC IS AVAILABLE AT THE REAR PANEL VOLTAGE REGULATOR; U1 PIN 3 (CASE); AT THE LUG WITH THE HEAVY RED WIRE.

931-7875



# ST250A CHASSIS LAYOUT

## 900MHz



900MHz VERSION

TOLERANCES UNLESS NOTED		REVISIONS	
DECIMAL	FRACTIONAL	NO	DATE
±	±	1	
±	±	2	
±	±	3	
±	±	4	
±	±	5	

SPECTRUM COMMUNICATIONS			
ST250A CHASSIS COMP. VIEW			
DRAWN BY: RTH	SCALE: A	MATERIAL	
CHK'D	DATE: 10-18-71	DRAWING NO	
TRACED	APP'D	DRAWING NO	2200185

FIGURE 3

SPECTRUM COMMUNICATIONS CORPORATION

LIMITED WARRANTY

Spectrum Communications warrants its equipment to be free from defective material or factory workmanship and agrees to remedy any defect which causes the unit to fail to meet published specifications 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 180 days for "rack mount" equipment or 100 days for P.C. "boards", subassemblies, or transceivers, measured from date of original receipt by the original purchaser; provided that the equipment is returned to the factory 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. 6 mo. Warranty on Parts purchased seperately.

NOTE THAT THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT ONLY. WE DO NOT OFFER A MONEY-BACK GUARANTEE.

WHEN IT IS NECESSARY TO RETURN A UNIT FOR FACTORY REPAIR (AT NO CHARGE UNDER WARRANTY), BE SURE TO RETURN IT BEFORE THE WARRANTY PERIOD EXPIRES. UNITS RETURNED FOR REPAIR AFTER THAT TIME PERIOD ARE OF COURSE SUBJECT TO OUR NORMAL PARTS AND LABOR CHARGES.

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.

This warranty shall be invalid in the event of (a) unauthorized repair, detuning, tampering, modification, 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 Corp. without charge to the buyer. Spectrum is liable only for the repair or replacement of defective equipment during the warranty period. 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.

SPECTRUM COMMUNICATIONS CORP. reserves the right to make any improvements/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, including without limitation, any implied warranty of merchantability or fitness for a particular purpose, and no representative or person is authorized to assume for us any other liability in connection with the sale of our products.

DATE	BY	REVISION RECORD	AUTH. DR. CK

SHIELD GROUND  
TO HIGH SIDE OF DEVIATION ADJ. POT  
+13.8VDC INPUT  
GROUND  
TO METER SWITCH S603-10  
SHIELD GROUND  
TO TX AF INPUT (SEE NOTE 1)

MOD. LEVEL METER ADJ.

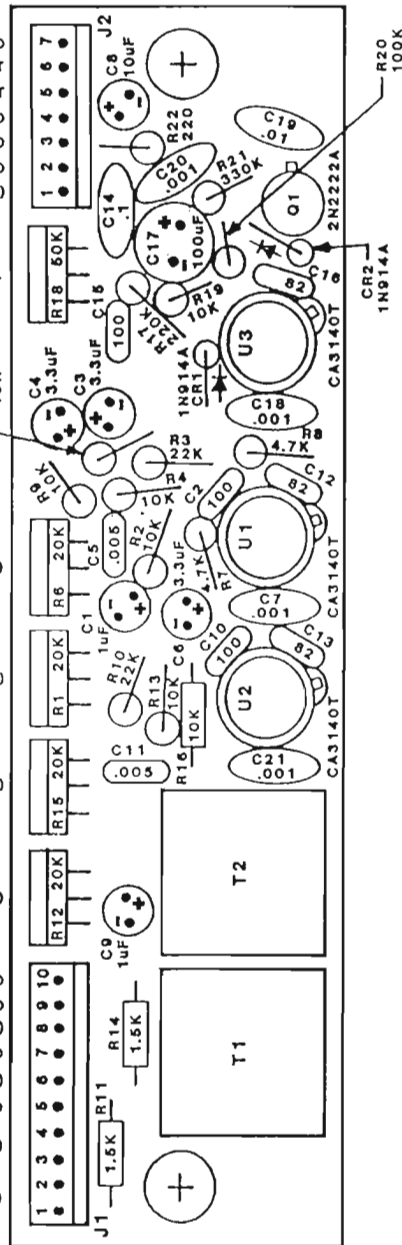
VOICE LEVEL ADJ. (UNBAL)

TONE LEVEL ADJ. (UNBAL)

VOICE LEVEL ADJ. (BAL)

TONE LEVEL ADJ. (BAL)

NOT USED  
NOT USED  
VOICE INPUT (UNBAL)  
SHIELD GROUND  
TONE INPUT (UNBAL)  
SHIELD GROUND  
VOICE INPUT (BAL)  
TONE INPUT (BAL)



NOTE:

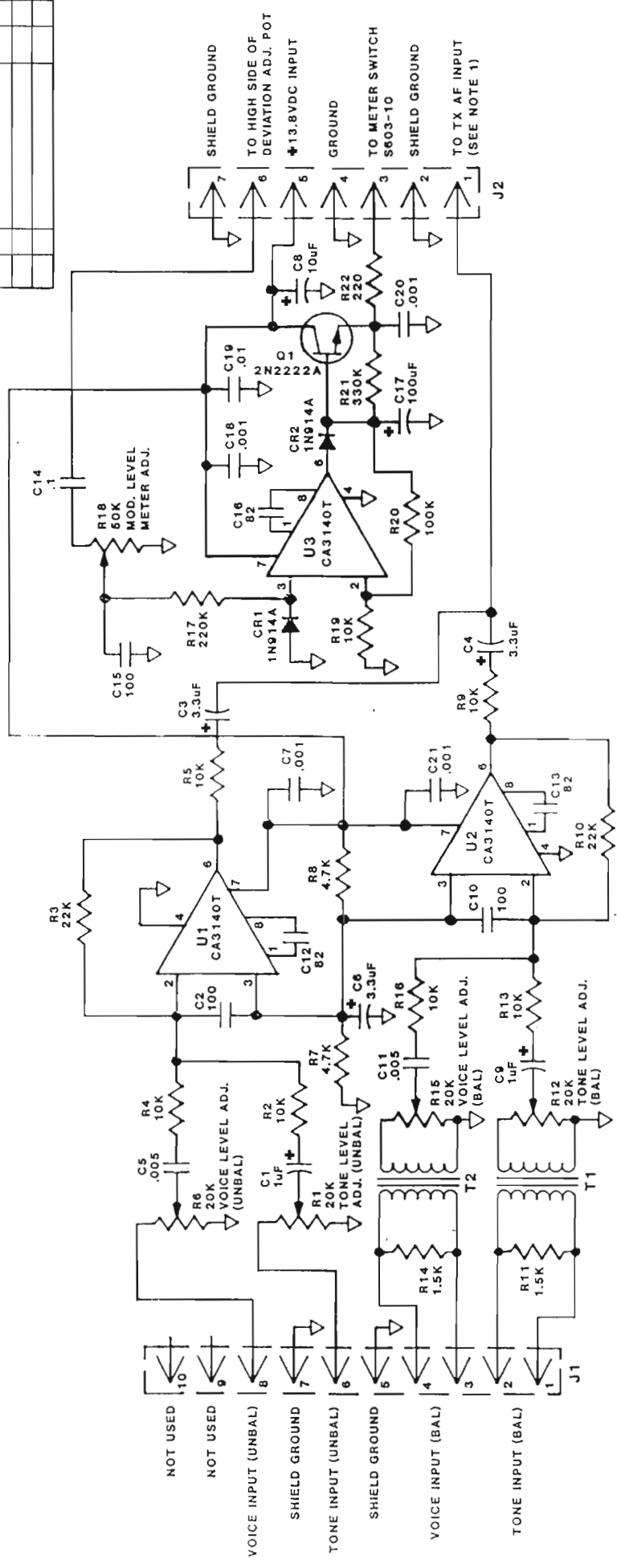
- 1) CHANGE C201 TO A 1µF ELECT. CAP WITH (+) TOWARD U201.  
(SEE TX SCHEMATIC AND COMPONENT LAYOUT).

SPECTRUM COMMUNICATIONS		DRAWN BY R.L.A.	
(ST250A) (SCT1500) SCALE		APPROVED BY	
DECIMAL	1	FRACTIONAL	1
TOLERANCES IN PARENTAL PARENTS		TITLE	AF MIXER/METERING BD.
ANGULAR	1	DATE	8-28-80
		DRAWING NUMBER	1200144

DATE	BY	REVISION RECORD	AUTH.	DR.	CK.

AF MIXER

MODULATION LEVEL METER CIRCUIT



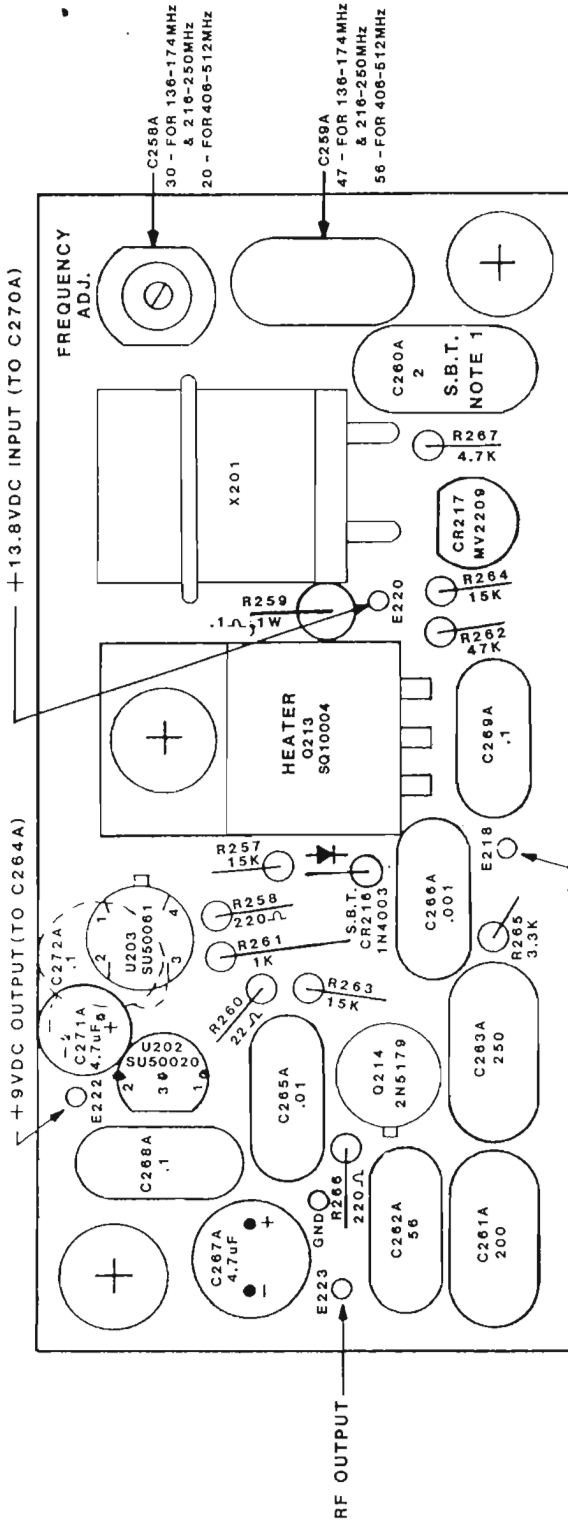
NOTE:

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

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



OS-18



SOLDER SIDE  
COMPONENT SIDE

NOTE:

- 1) THIS CAP IS SELECTED TO CENTER CRYSTAL FREQUENCY. (0-10PF TYP.)
- 2) CR216 IS NOT ALWAYS REQUIRED, S.B.T.

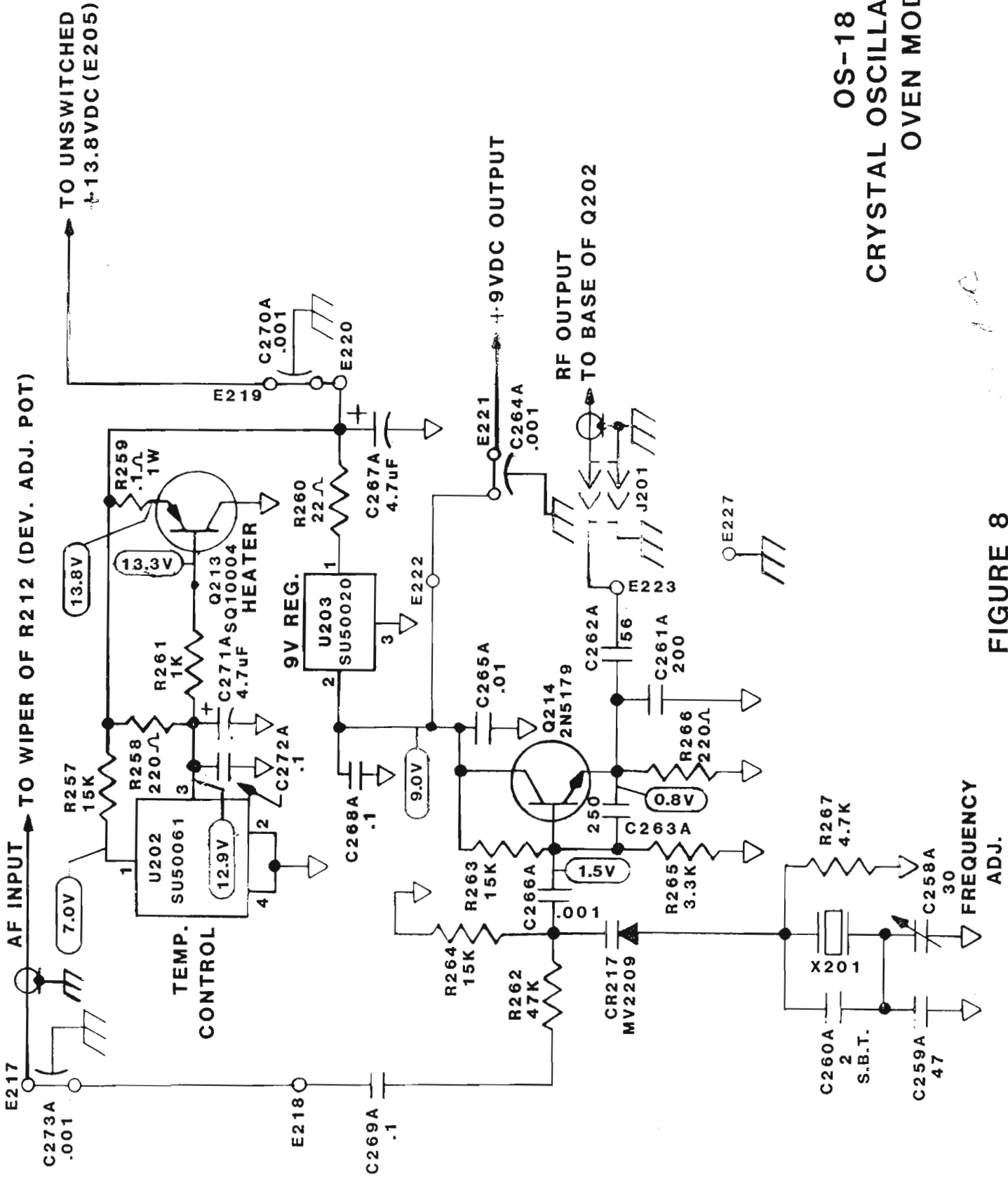
**SPECTRUM COMMUNICATIONS**

APPROVED BY: *[Signature]* DRAWN BY: R.L.A.  
SCALE: *[Blank]* REVISION: *[Blank]*  
DATE: 2-19-88

**CRYSTAL OSCILLATOR OVEN MODULE**

136-174MHZ, 216-250MHZ & 406-512MHZ

DRAWING NUMBER  
2200118

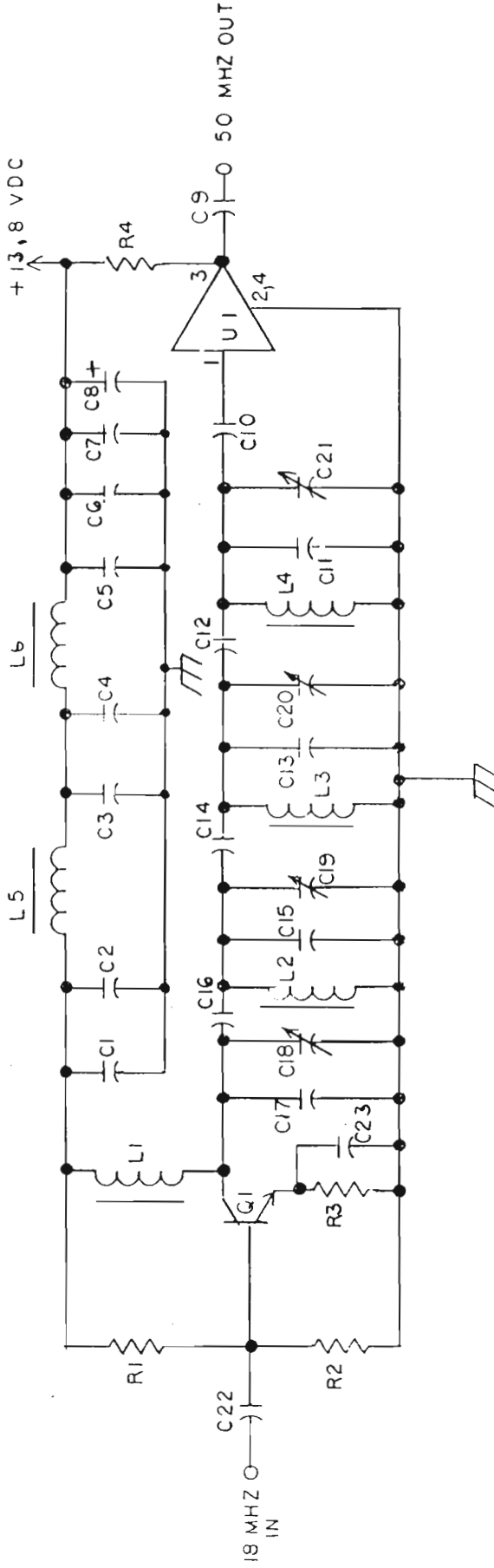


OS-18  
CRYSTAL OSCILLATOR/  
OVEN MODULE

FIGURE 8

*10*

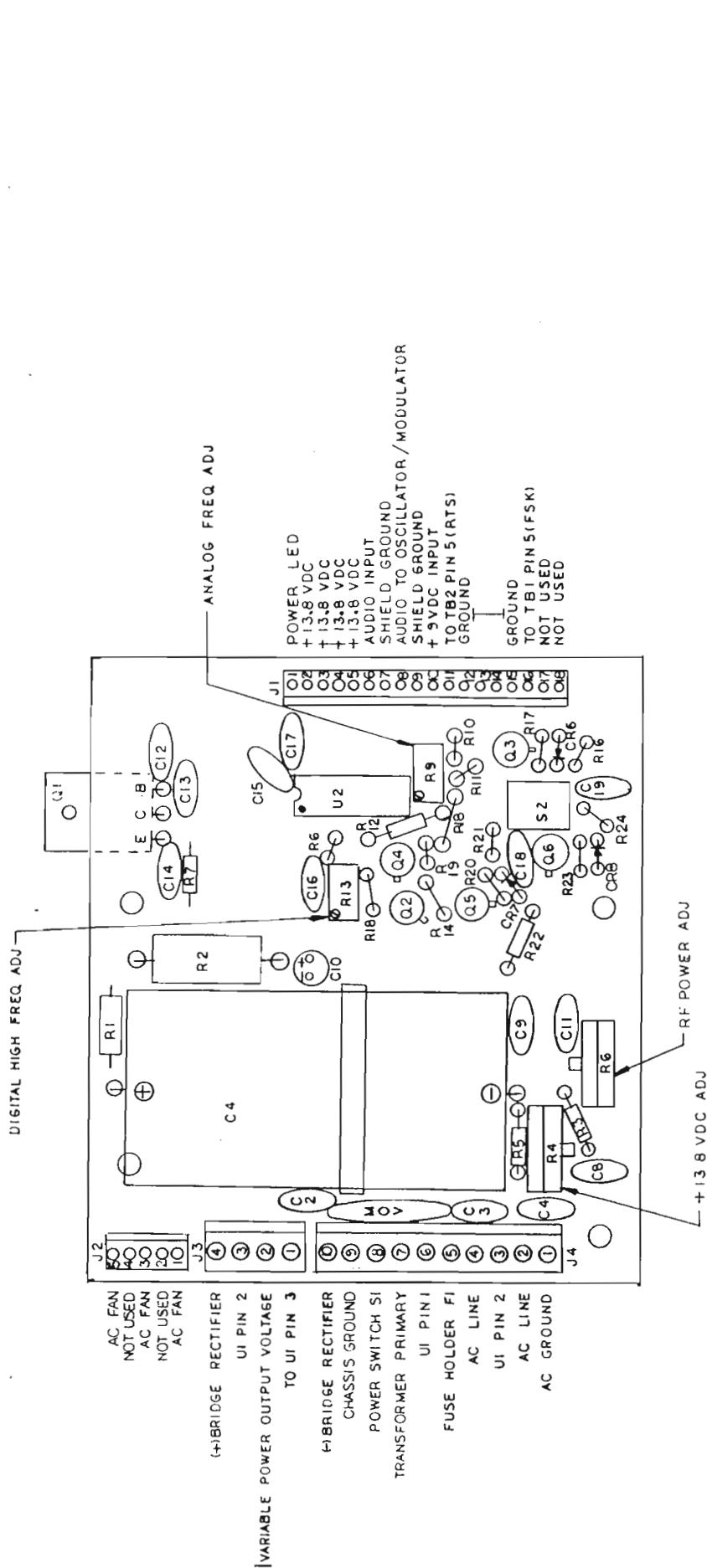




TOLERANCES (EXCEPT AS NOTED)		REVISIONS	
NO.	DATE	NO.	BY
1		1	
2		2	
3		3	
4		4	
5		5	

SPECTRUM COMMUNICATION  
 900 MHz TRIPLER MODULE  
 DRAWN BY: HJB  
 SCALE: 1:1  
 DATE: 4-11-91  
 MATERIAL: 2200163  
 CHK'D: [Signature]  
 APP'D: [Signature]



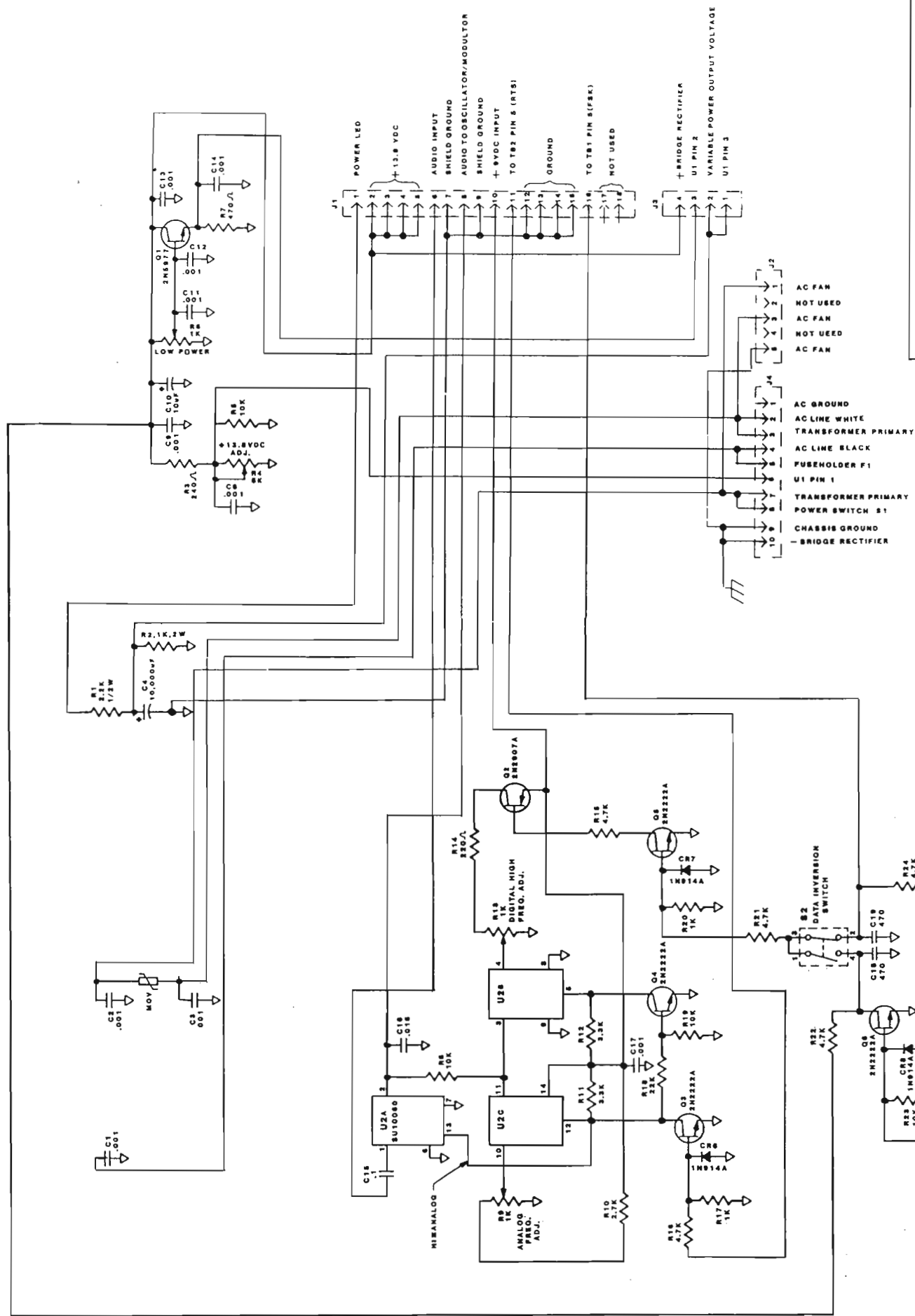


PSM250A POWER SUPPLY/MODULATOR BOARD  
 SPECTRUM COMMUNICATIONS  
 PSM250A COMPONENT VIEW

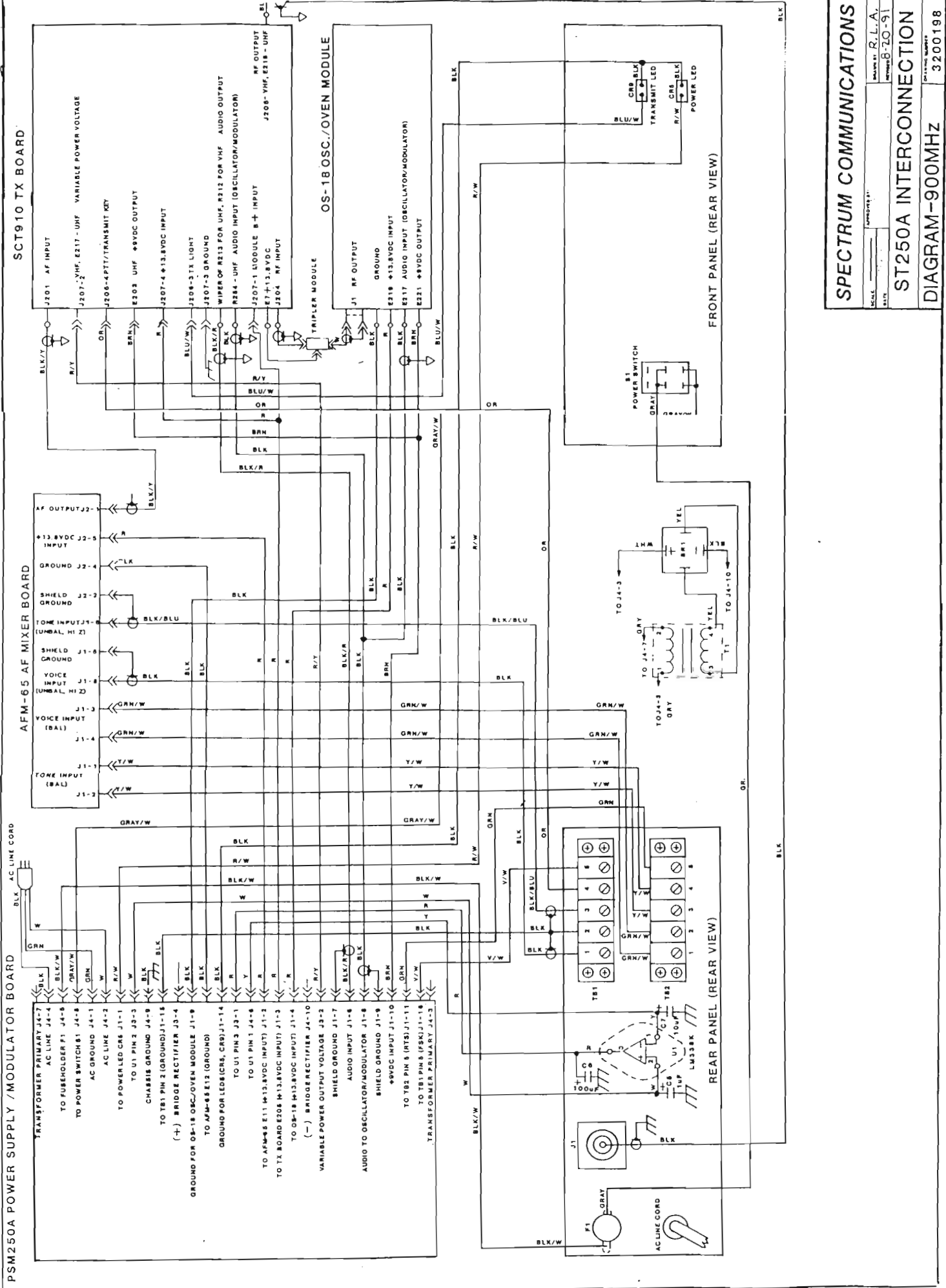
TOLERANCES UNLESS OTHERWISE SPECIFIED	
NO.	REVISIONS
1	DATE
2	BY
3	
4	
5	
6	
7	
8	
9	
10	

51250A  
 USED ON

REVISIONS		DATE		BY	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					



NOTE:  
 1) SWITCH S2 IS SHOWN IN THE NON-INVERTED DATA POSITION.

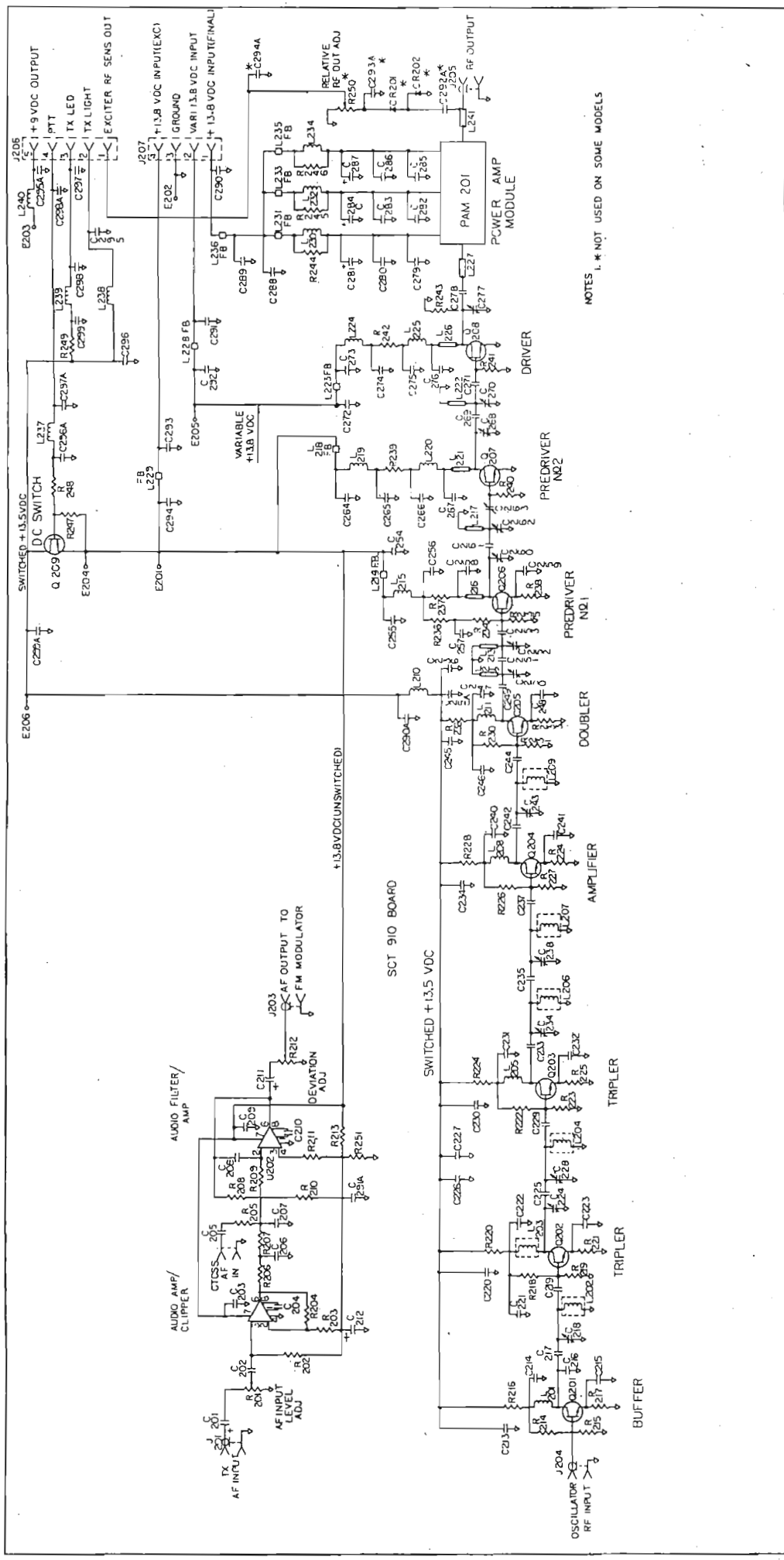


**SPECTRUM COMMUNICATIONS**

**ST250A INTERCONNECTION**

**DIAGRAM-900MHZ**

APPROVED BY:  
SCALE:  
DATE:  
DESIGNED BY:  
3200198



NOTES: \* NOT USED ON SOME MODELS

SPECTRUM COMMUNICATIONS CORP.	
DATE: 8-15-74	DESIGNED BY: R.L.A.
900 MHZ TRANSMITTER/EXCITER SCHEMATIC	
1906-960 MHZ, USED ON: ST-250	
41001.30	

ST-250