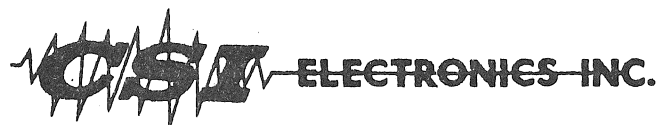
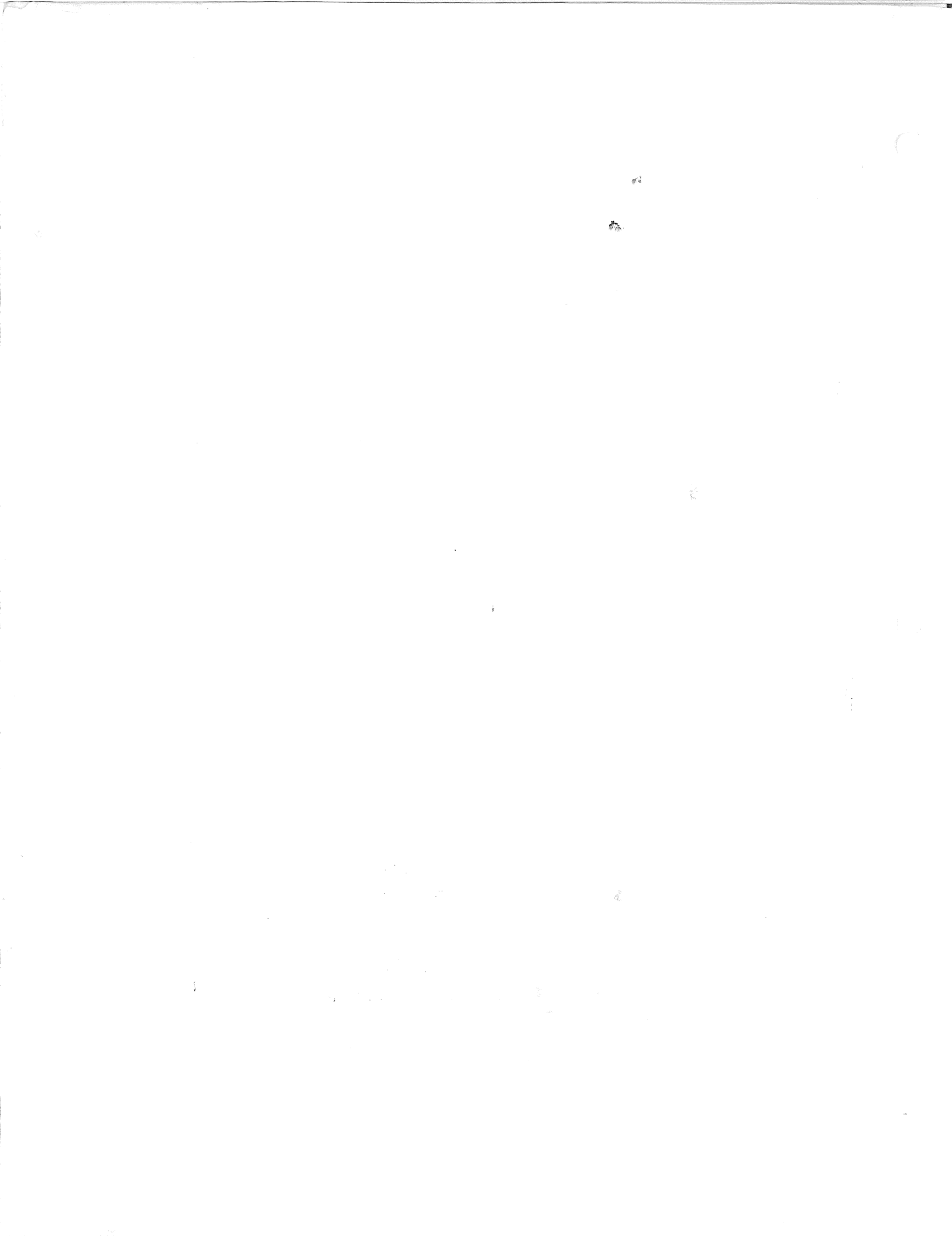


**CSI EX-20F  
F M Broadcast Exciter  
Instruction Manual**



18248 EAST ROGERS CIRCLE  
BOCA RATON, FLORIDA 33431

January 1978



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SECTION 1  
GENERAL DESCRIPTION

1.1 INTRODUCTION

The C S I type EX-20F is an FM Broadcast Exciter (Figure 1-1) that provides a frequency-modulated signal in the 88 to 108 MHZ range (exact frequency as specified by the customer) for further amplification or direct transmission. It is a solid-state exciter which can be manually adjusted to provide a minimum output of 5 watts and a maximum output of 20 watts. The optional SG-1E Stereo Generator may be used to provide Broadcasting compatible time division multiplex stereo. Another option, the SCA-1E is available for 41 and/or 67 KHZ SCA Multiplex service.

1.2 PHYSICAL DESCRIPTION

The EX-20F Exciter is 19 inches wide, 3 1/2 inches high, and 13 inches deep, weighs approximately 17 pounds, and is designed for mounting in a standard 19 inch equipment rack. Heat sinks for the power amplifier and the power supply regulators are located on the side panels of the chassis. Removable top and bottom cover panels provides access to the printed circuit cards. All normal operating controls and indicators are located on the front panel of the unit. Signal input and output connectors, line fuse, A-C power connector and a mono-comp selector switch are located on the rear panel.

1.3 FUNCTIONAL DESCRIPTION

The functional units of the EX-20F FM Broadcast Exciter are: An FM Modulator Module, A Logic Board containing the frequency synthesizer and programming Switches, a power amplifier assembly and a power supply unit.

When the EX-20F is used for monaural broadcasts (without the optional SCA Generator or Stereo Generator) the audio input is applied directly to the modulator carrier oscillator through the required audio processing circuits. The carrier oscillator is modulated to full deviation by the audio input. A sample of the baseband signal is compared with a reference crystal oscillator signal and the resulting error voltage is used to fine tune the FM Modulator (carrier oscillator) frequency.

The output signal from the Phase Comparator is applied to two-stage solid-state power amplifier to provide an adjustable RF output signal of up to 20 watts. The EX-20F Exciter features phase locked stability and on carrier direct FM for full multiplex operation with freedom from spurious responses.

When SG-1E stereo generator is used the exciter functions the same as described above with the exception that left and right audio inputs are applied to the stereo generator through separate preemphasis and shaping networks. These audio signals are multiplexed to provide the baseband signal which is filtered and applied to the FM modulator. When the SCA generator is used, the SCA audio input is amplified and used to frequency modulate a 41 to 67 KHz subcarrier oscillator. The FM SCA output is then applied to the FM modulator.

#### 1.4 OPTIONAL EQUIPMENT

Both the SG-1E stereo generator and the SCA-1E generator are customer options. The exciter may be purchased without either of these, for monophonic broadcasting.

#### 1.5 TECHNICAL CHARACTERISTICS

The technical characteristics for the EX-20F are listed below, and have divided into four lists: (1) General Characteristics which apply to all EX-20F Exciters, (2) Those characteristics which apply to the EX-20F when it is used for monaural FM,

- (3) Those characteristics which apply to the EX-20F when it is used for stereo operation with the SG-1E stereo generator, and
- (4) Those characteristics which apply to the EX-20F when it is used for SCA Transmission with the SCA-1E SCA generator.

### 1.5.1 GENERAL

Ambient Temperature Range:	0°C to 55°C operating (-10°C to +55°C with 30 min warm up)
Ambient Humidity Range:	Up to 95% R.H.
Primary Power:	105-125/210-250 VAC 50/60 Hz
Power Consumption:	Approx 50 watts maximum
Power Output:	Adjustable from less than 5 to greater than 20 watts
Frequency Range:	88 to 108 MHZ (programmed)
Output Impedance:	50 ohms unbalanced
Frequency Stability:	± 500 Hz (-10°C to + 55°C)
VSWR Protection:	Any magnitude or phase
Harmonic & Spurious Suppression:	Better than 56 DB
Modulation Capability: (less than 1% THD)	150 KHz Peak
FM noise level: (below 75 KHz DEV with 75 M sec DE-EMP)	Better than - 68 DB
AM noise level:	Better than - 55 DB

### 1.5.2 MONAURAL FM

Audio Input Impedance:	600 ohms balanced
Audio Input level:	+ 10 DBM for 75 KHz Dev. at 400 Hz
Audio Pre-emphasis:	75 Msec ± 1 DB (50 Msec optional)
Audio Distortion:	0.5% Max THD or less at 75 KHz Dev

## 1.5.3 STEREO FM with SG-1E

Audio Input Impedances: 600 ohms balanced  
 (left & right channels)  
 Audio Input levels: + 10 DBM  $\pm$  1 DB  
 Audio Frequency Range: 30 Hz to 15 KHz  
 Stereo Separation: Better than 40 DB from 30 Hz to  
 15 KHz  
 Crosstalk (30 Hz to 15 KHz)  
     Main to Sub: 46 DB  
     Sub to Main: 46 DB  
 38 KHz sub-carrier suppression: 55 DB  
 Pilot carrier frequency: 19 KHz  $\pm$  1 Hz

## 1.5.4 SCA FM with SCA-1E

Audio Input Impedance: 600 ohms balanced  
 Audio Input level: + 10 DBM  $\pm$  1 DB (4 KHz peak Dev.)  
 Frequency Response  
     Flat: + 1.5 DB  
     Pre-Emphasized: 150 Msec  $\pm$  1.5 DB  
 Distortion: (30 Hz to 5KHz) 0.75 % max. L P output filter  
     2.5% max. BP output filter  
 Carrier Stability:  $\pm$  500 Hz  
 Mute  
     Level: 5% to 100%  
     Delay: 0.5 to 5 seconds



## SECTION 2

### INSTALLATION

#### 2.1 GENERAL

Remove all packing material carefully. Check equipment against shipping invoices and records. Inspect the unit for damaged or missing components. Check for free movement of front panel controls. Any claims for damages should be filed promptly with the transportation agency. If such claims are to be filed, all packing material must be retained. Store the factory shipping container for future use.

#### 2.2 PREPARATION FOR USE

The unit is designed to be mounted in a standard 19" rack. Air space should be provided above and below the unit so that heat generated within the unit may be dissipated. Additional cooling may be required if the unit is mounted above high heat generating equipment in order to keep the ambient temperature below the maximum specified.

Mount the unit to the rack with (4) # 10 flat or oval head screws with finishing washers.

##### 2.2.1 WIRING

The unit requires a 105-125 volt or a 210 to 250 volt single phase 50/60 Hz power source. An identification plate on the rear panel indicates the voltage for which the unit is wired. If the unit is not wired for the power source to be used, the power transformer primary windings must be changed accordingly. Refer to the power supply schematic, E 20009 for connection details.

Audio input connections are brought in on TB501 on the rear panel for monaural FM transmission. If stereo or SCA is to be used,

connect their outputs to the high impedance input connectors on the rear panel as required.

Connect a suitable 50 ohm RF load to the RF output connector. Use a type "N" plug and RG-8/U or equivalent cable.

### 2.2.2 REPACKING FOR SHIPMENT

#### NOTE

Before returning a unit to the factory for repair or calibration, contact the factory or your authorized representative for a return authorization. Attach a tag showing the owners' name and address. A description of the service required should also be included. Unit must be shipped prepaid and insured for full value.

Use the original shipping carton and its packing material for reshipment. If they are not available, proceed as follows:

- A. Use a carton with a minimum test strength of 250 lbs.
- B. Use heavy paper or sheets of cardboard to protect all surfaces.
- C. Use at least four inches of tightly packed shock absorbing material such as extra firm polyurethane foam or rubberized hair.  
Newspaper is not sufficient cushioning material.
- D. Use large fragile labels on each surface.
- E. Use heavy reinforced shipping tape to secure the outside of the carton.

SECTION 3  
OPERATION

3.1 CONTROLS & INDICATORS

3.1.1 FRONT PANEL

- A. Power switch S401-K  
Push-button switch which controls primary power to the exciter. Push button latches in position and is illuminated when activated.
- B. Multimeter switch S401A thru J  
Push-button switch which controls the function monitored by the meter, M501.

<u>Position</u>	<u>Scale</u>	<u>Function</u>
A	50V F.S.	24 v P.S.
B	20V F.S.	15 v P.S.
C	10V F.S.	5 v P.S.
D	0-100%	Ref osc output
E	0-100%	FMO output
F	1 amp F.S.	IPA Collector
G	3 amp F.S.	PA Collector
H	0-100%	RF output
J	0-100%	APC lock

- C. Power output adjust potentiometer, R401. Screw-driver adjustable potentiometer which controls the RF power output over a range of approximately 5 watts to over 20 watts.
- D. Frequency adjustment control, R402. A screw-driver adjustment which varies the exciter frequency over a range of  $\pm 500$  Hz, approximately.

## 3.1.2 REAR PANEL

- A. Mono/Stereo Switch, S501  
A single-pole double-throw toggle switch which is used to select either monophonic audio or a composite stereo baseband input to the FM modulator. The monaural audio input is pre-emphasized to follow the 75 Msec curve.
- B. R F output Jack, J601  
A type "N" connector for the RF output signal.
- C. Composite Stereo input jack, J502  
A type "BNC" connector for the stereo baseband signal input. Approximately 4 volts peak to peak into a 10K ohm load provides 7.5 KHz deviation.
- D. SCA input connectors, J503 & J504  
Type "BNC" connectors which accept SCA input signals from a SCA generator. Approximately 1 volt peak to peak at 10 K ohms produces 7.5 KHz deviation.
- E. Audio input terminal strip, TB 501  
A barrier type terminal strip which connects a 600 ohm balanced input to the FM modulator. +10DBM  $\pm$  10B provides 75 KHz deviation at 400 Hz. The center terminal of TB501 is connected to chassis ground.
- F. Primary Power Fuse, F501  
A 2 amp MDL fuse which provides protection for the power transformer and the rectifier circuit. Automatic current limiting protection is provided in each of the DC regulated power supplies.
- G. A-C Primary power connector, J501  
A standard EIA AC power connector which accepts a standard 3 conductor molded power cord connector.

### 3.2 PRELIMINARY OPERATIONAL CHECK

Be Sure that a suitable RF load is connected to J601. Before proceeding with the initial tests.

1. Push the power switch to its detent. Note that the push button indicator lamp is lighted.
2. Check multimeter for an AFC voltage and RF output indication. (push indicated switch to select function).
3. Compare all multimeter readings with factory supplied check sheet. Readings should not vary more than  $\pm 10\%$ . (For the same output power level).

### 3.3 NORMAL OPERATION

Set the power output potentiometer R401 to the RF output level required. Check all multimeter readings periodically. Verify that no significant variation has taken place since the last readings were logged.

R402 can be used to provide fine adjustment of the carrier frequency. A Phase-locked frequency synthesizer has much less drift than a frequency-locked type. It is therefore important to insure that the frequency monitor or counter is accurate before the exciter frequency is altered from its factory setting.

The signal levels given in Par. 3.1.2 are for approximate determination of the modulation percentage only. Use an FCC type approved modulation monitor for final modulation settings.

## SECTION 4

### PRINCIPLES OF OPERATION

#### 4.1 GENERAL

The EX-20F exciter produces a frequency modulated RF output for driving a power amplifier in an FM Broadcast transmitter. The EX-20F employs the direct method of frequency modulation. The optional SG-1E Stereo Generator produces signals which meet all FCC requirements for stereophonic broadcasting background music under an FCC subsidiary communications authorization.

#### 4.2 BLOCK DIAGRAM

A Functional Block Diagram of the exciter is given on Figure 4-1.

Major sub-assemblies which make up the exciter are as follows:

1. FM modulator, component designators use the 700 series. This is a sealed unit.
2. Logic Board, 100 series
3. P A Board, 200 series
4. Power Supply 300 series
5. Front panel 400 series
6. Rear panel 500 series
7. Low pass filter 600 series

#### 4.3 CARRIER OSCILLATOR & PHASE-LOCKED LOOP

The FM modulator is a voltage controlled carrier oscillator which employs the direct method of FM generation. A sample of the VCO carrier output is presented to a prescaler which divides it by 20. A programmed counter follows which divides by a selected factor so that the counter produces a 5 KHz output for any carrier frequency. An 8 MHz reference oscillator is digitally divided to 5 KHz. The two 5 KHz signals are compared in a phase detector which produces an error voltage proportional

to the phase difference between the reference and the carrier. The error voltage is then filtered and applied to the VCO to control its frequency.

#### 4.4 POWER AMPLIFIER

The power amplifier consists of a power output stage and a driver which provide a power gain of 200. The output transistors high dissipation rating together with a current limited collector supply permits the power amplifier to operate into any VS R without damage. A sample of the RF output is rectified and filtered to provide a relative power output reading for the multimeter.

#### 4.5 POWER SUPPLY

The power supply provides 3 DC voltages, all of which are regulated and current limited. A 5 volt supply for the logic TTL circuits and a 15 volt regulator for the VCO are driven by a 24 volt regulator, all three are conventional 3-terminal, TO-3 devices. The 24 volt power amplifier collector regulator, in addition to the current limiting features of the other supplies, is provided with a front panel control to provide continuously variable output voltage. This feature is used to vary the RF power output.

#### 4.6 DETAILED CIRCUIT DESCRIPTION

The carrier output of the FM modulator VCO is coupled to the RF carrier amplifier Q104, through a buffer amplifier Q106. Q104 provides a 100 MW output to the power amplifier module. In addition, the output of Q104 is controlled by Q105 which inhibits the RF output when triggered by a phase-lock detector circuit.

A sample of the RF carrier at the collector of Q106 is also fed to a high speed flip-flop U103. The binary output is coupled to U104, a high speed (50MHz) decade counter. Transistor Q113 provides the correct level for the input of the decade counter. The combination of U103 and U104 provides a prescaler which divides the carrier frequency by 20. A programmable divider composed of 3 cascaded BCD counters, U105, U106, and U107 and a TTL Flip-Flop U108 is connected to the prescaler output. Seven-section DIP switches S102 & S103 are used to program the counter division ratio to divide by a number between 881 and 1079 according to the program key given in Figure 5-1 for a specified operating frequency. Division by the programmed number and the prescaler  $\div 20$  always produces a 5 KHz output when the VCO is on the assigned frequency.

An 8 MHz reference signal is produced by the crystal oscillator Q102 and its associated components. C108 is a coarse frequency adjustment. The frequency is also controlled by a front panel potentiometer R402 which supplies a variable voltage to varactor CR706. Q103 provides a buffered output to U110 a 4 bit binary counter which divides by 16. U110 is followed by cascaded decade counters U111 and U112. A fixed division of 1600 is then provided ( $16 \times 10 \times 10 = 1600$ ). The reference frequency at the output of U112 is then  $8\text{MHz} \div 1600$  or 5 Hz. The 5 KHz output is differentiated and applied to the base of Q111. When Q111 conducts it discharges C106 which is connected to a constant current source provides a Linear 5 KHz Sawtooth output.

The 5 KHz signal derived from the carrier and the 5 KHz Sawtooth from the reference oscillator are now applied to a phase detector which consists of U102, and operational transconductance amplifier (OTA), a storage capacitor, C103 and a high impedance input



operational amplifier U101 which serves to prevent loading of the storage capacitor. U102 is a conventional sample-and-hold circuit used as a phase comparator. The 5 KHz carrier derived Sawtooth is applied to the non-inverting input. The reference is used to control the bias of the OTA through Q112 which serves to minimize capacitive feedthru of the carrier signal.

The output of U102 charges the storage capacitor when it is gated by the reference signal. As the phase angle between the carrier derived signal and the reference shifts, the voltage on C103 increases or decreases. The capacitor voltage is fed to a filter circuit through U101. The DC output voltage is used to control a varicap in the VCO thereby providing a closed-loop phase-lock system.

SECTION 5  
MAINTENANCE

## 5.1 GENERAL

The EX-20F FM Broadcast Exciter, which contains all solid-state circuits, has been carefully inspected and adjusted at the factory by skilled technicians using special test equipment. Therefore, the EX-20F should not be readjusted as part of routine maintenance procedures, but instead should be readjusted only after trouble has definitely been traced to misadjustment. When the EX-20F is realigned, adjustments should be performed in accordance with the procedures outlined in the next paragraphs using the equipment listed in table 5-1 or their equivalent.

To ensure peak performance and maximum service life, a regular schedule of routine maintenance should be carried out. For the EX-20F, this routine maintenance should consist only of cleaning and inspecting, and should occasionally include a check of the minimum performance standards for the EX-20F in accordance with the specifications given in paragraph 1.5.

Table 5-1 Required Test Equipment

1. RF load, 50 ohms (25 watts minimum)
2. RF Wattmeter (Bird model 43)
3. Distortion Analyzer (Hewlett-Packard 331A)
4. FM Modulation Monitor (FCC approved type)
5. AF Signal Generator (Hewlett-Packard 206A)
6. Oscilloscope (Tektronix 581A)
7. RF Voltmeter (Hewlett-Packard 410B)
8. 110 MHz counter (1 part in  $10^6$  or better)
9. Spectrum Analyzer (HP model 141T system)
10. Signal Sampler (-20 DB Minimum output)  
or a 25 DB attenuator rated at 25 watts minimum

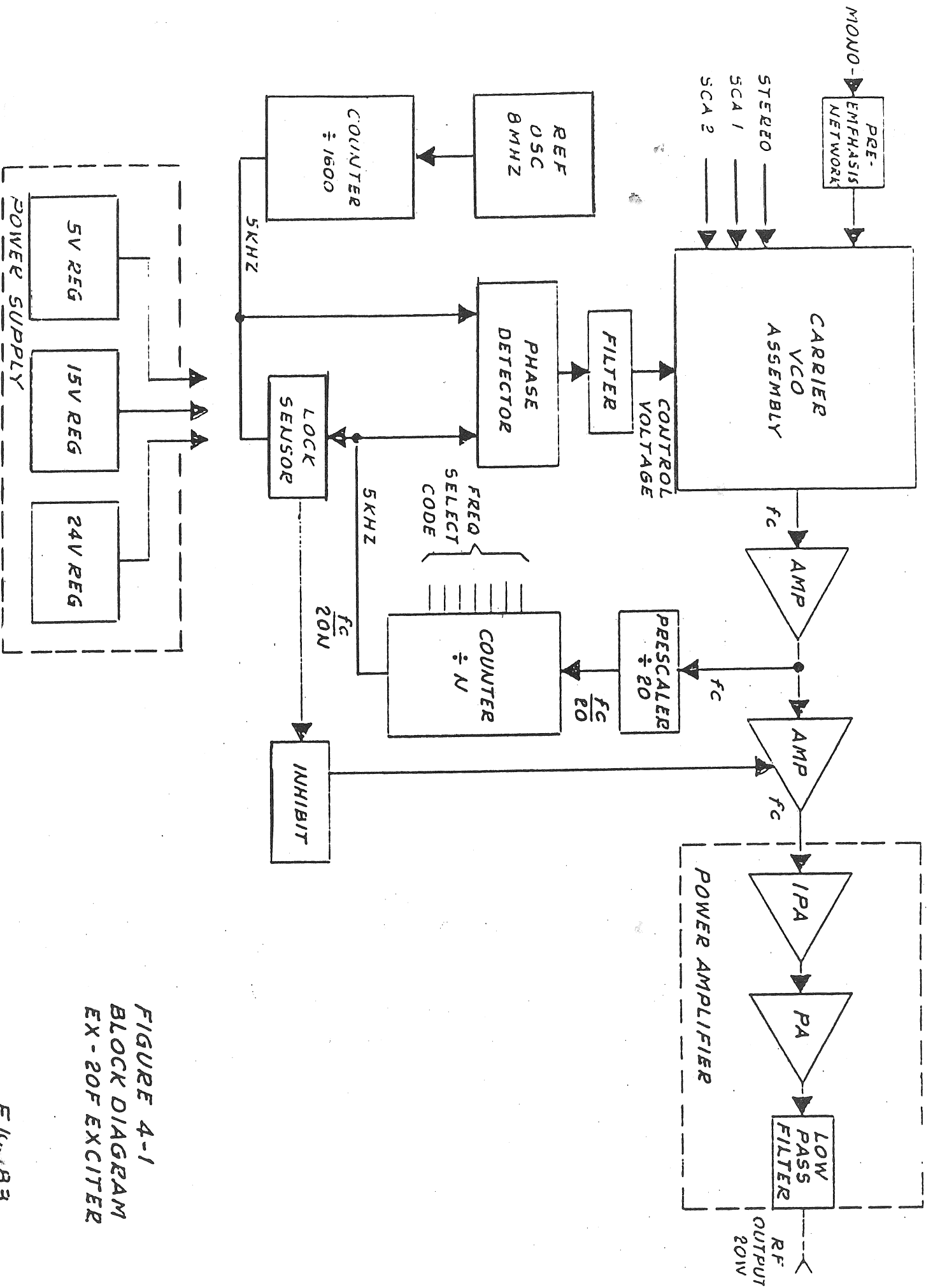


FIGURE 4-1  
BLOCK DIAGRAM  
EX - 20F EXCITER

January 5, 1983

## EX-20-F FM EXCITER

## SPECIAL INSTRUCTIONS FOR SETTING

## VOLTAGE SELECTOR &amp; FUSE ASSEMBLY

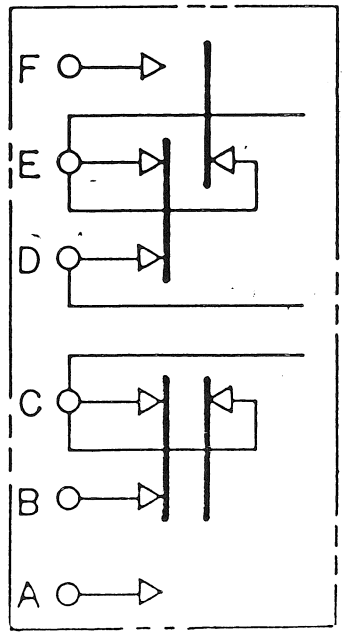
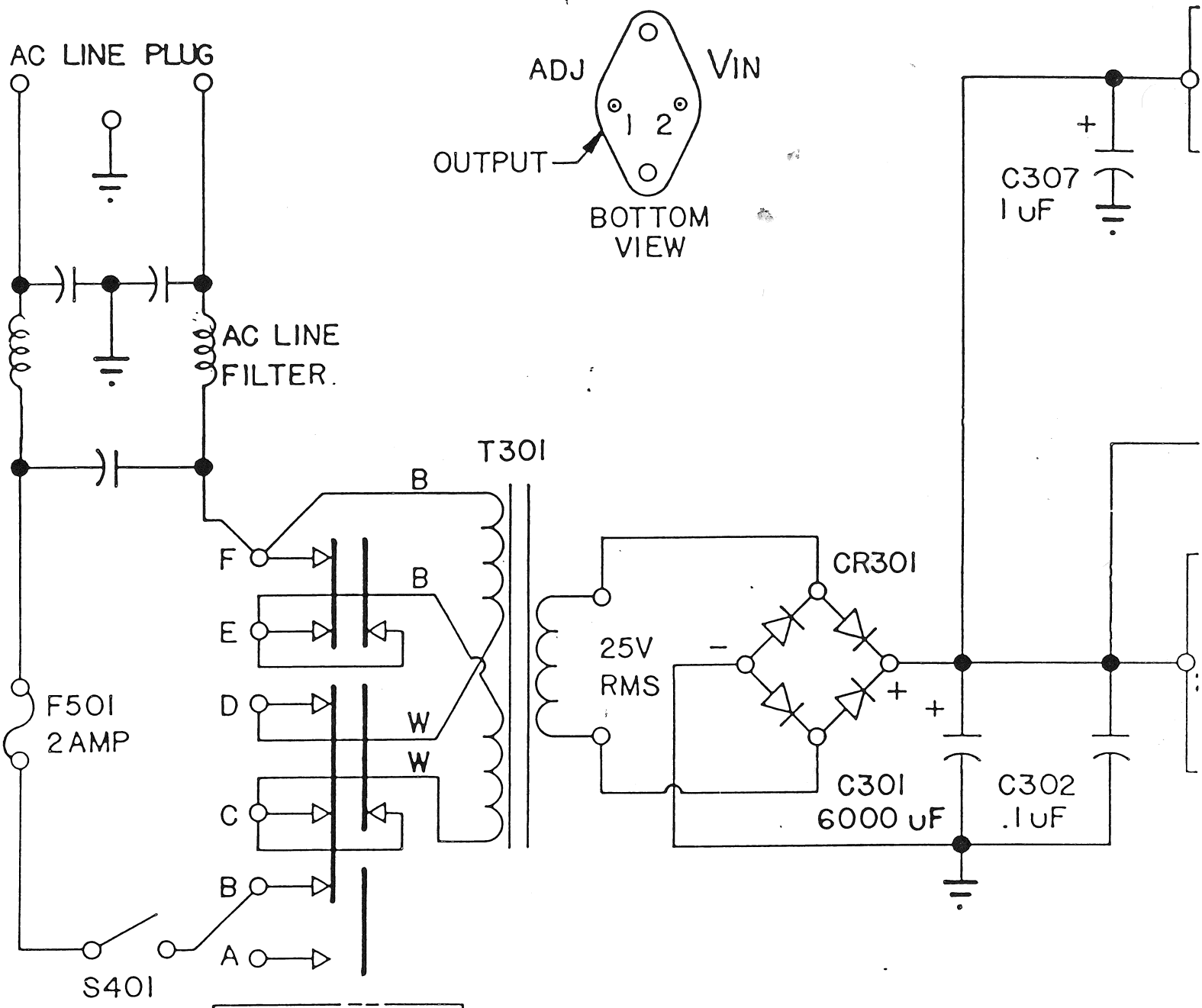
refer to drawing E 20009 REV. 5

WITH THE POWER CORD REMOVED FROM THE SOCKET AT THE REAR OF THE EXCITER, SLIDE THE FUSE COMPARTMENT COVER TO THE LEFT; CHECK THE FIBREGLAS "PROGRAM CARD" LOCATED BELOW THE FUSE HOLDER CLIPS; FOR OPERATION ON 115 TO 125 VOLT LINE POWER, INSERT THE "CARD" SO "120" IS VISIBLE. (DO NOT USE THE SIDE OF THE PROGRAM CARD MARKED 110/220.) FOR 208 TO 240 VOLT LINE POWER OPERATION INSERT THE "CARD" SO "240" IS VISIBLE.

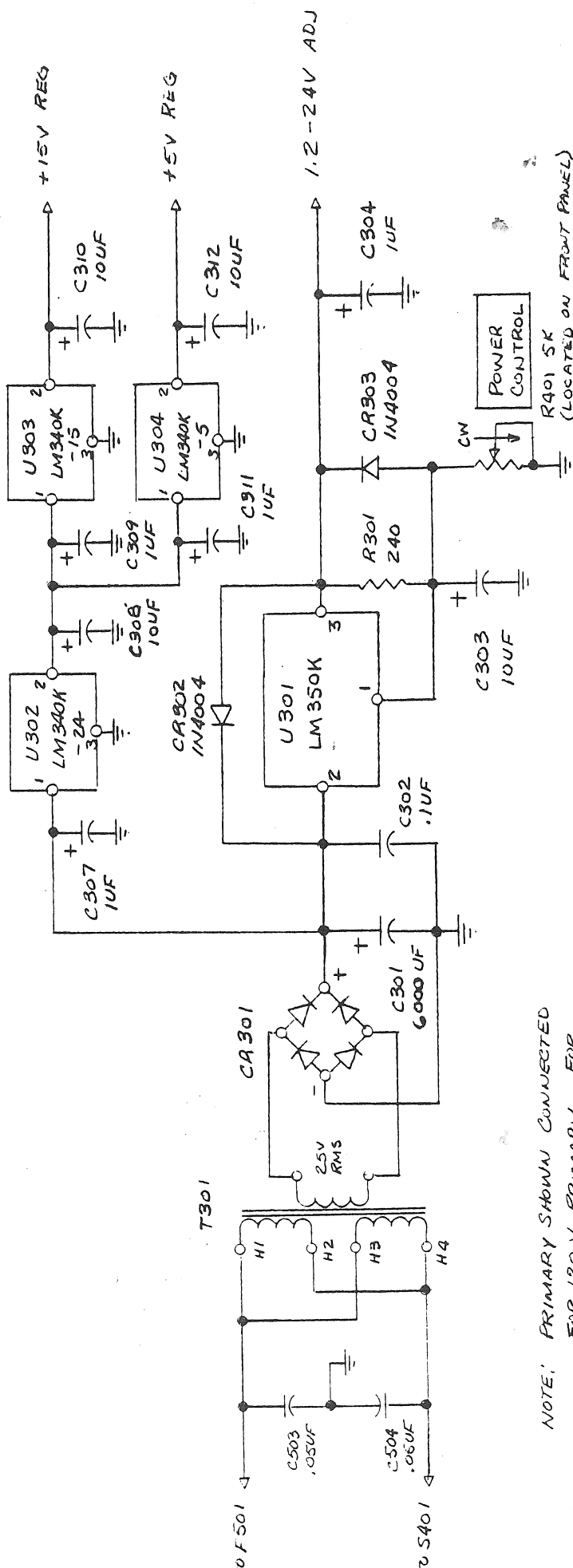
NOTE: IF THE CARD IS ACCIDENTALLY INSERTED FOR "110" OR "220" POSITIONS (NOT USED IN THE EX-20-F EXCITER) THE EXCITER POWER SUPPLY WILL NOT RECEIVE LINE POWER, AND WILL NOT WORK.

CHECK THE FUSE; SLIDE THE COVER TO THE RIGHT, AND RE-INSERT THE POWER CORD IN THE SOCKET; THE UNIT IS NOW READY FOR OPERATION.

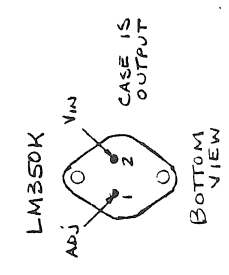
PLEASE CHECK THE LINE VOLTAGE, AND SETTING OUTLINED ABOVE BEFORE CONNECTING THE EXCITER TO THE MAINS POWER TO PREVENT DAMAGE TO THE POWER SUPPLY TRANSFORMER. REFER TO ILLUSTRATION ON REVERSE.



NOTE : PRIMARY SHOWN CONNECTED FOR 120 V PRIMARY. FOR 240 V SEE -----. INSERT PROGRAM CARD IN FUSE ASS'Y IN POSITION WITH DESIRED VOLTAGE (120 OR 240) VISIBLE.



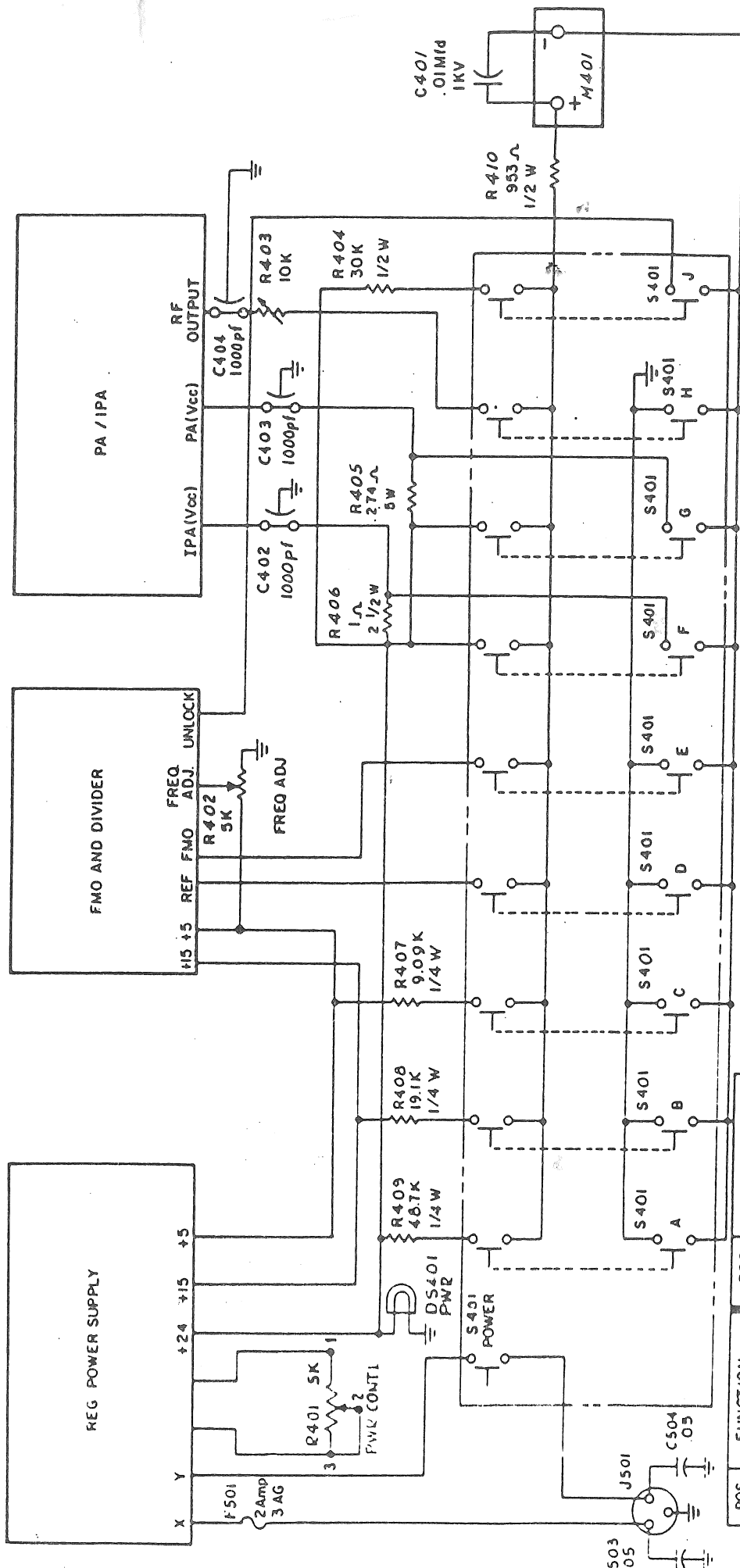
NOTE: PRIMARY SHOWN CONNECTED FOR 120 V PRIMARY. FOR 240V CONNECT LINE TO H1 & H4, JUMPER H2 TO H3



REVISEMENTS		C.A.I. ELECTRONICS INC.	
No.	Date	By	
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121	10-0-78	JB	BJ
122	10-11-78	JB	BJ
123	7-0-78	JB	BJ
124	10-0-78	JB	BJ
125	10-11-78	JB	BJ
126	7-0-78	JB	BJ
127	10-0-78	JB	BJ
128	10-11-78	JB	BJ
129	7-0-78	JB	BJ
130	10-0-78	JB	BJ
131	10-11-78	JB	BJ
132	7-0-78	JB	BJ
133	10-0-78	JB	BJ
134	10-11-78	JB	BJ
135	7-0-78	JB	BJ
136	10-0-78	JB	BJ
137	10-11-78	JB	BJ
138	7-0-78	JB	BJ
139	10-0-78	JB	BJ
140	10-11-78	JB	BJ
141	7-0-78	JB	BJ
142	10-0-78	JB	BJ
143	10-11-78	JB	BJ
144	7-0-78	JB	BJ
145	10-0-78	JB	BJ
146	10-11-78	JB	BJ
147	7-0-78	JB	BJ
148	10-0-78	JB	BJ
149	10-11-78	JB	BJ
150	7-0-78	JB	BJ
151	10-0-78	JB	BJ
152	10-11-78	JB	BJ
153	7-0-78	JB	BJ
154	10-0-78	JB	BJ
155	10-11-78	JB	BJ
156	7-0-78	JB	BJ
157	10-0-78	JB	BJ
158	10-11-78	JB	BJ
159	7-0-78	JB	BJ
160	10-0-78	JB	BJ
161	10-11-78	JB	BJ
162	7-0-78	JB	BJ
163	10-0-78	JB	BJ
164	10-11-78	JB	BJ
165	7-0-78	JB	BJ
166	10-0-78	JB	BJ
167	10-11-78	JB	BJ
168	7-0-78	JB	BJ
169	10-0-78	JB	BJ
170	10-11-78	JB	BJ
171	7-0-78	JB	BJ
172	10-0-78	JB	BJ
173	10-11-78	JB	BJ
174	7-0-78	JB	BJ
175	10-0-78	JB	BJ
176	10-11-78	JB	BJ
177	7-0-78	JB	BJ
178	10-0-78	JB	BJ
179	10-11-78	JB	BJ
180	7-0-78	JB	BJ
181	10-0-78	JB	BJ
182	10-11-78	JB	BJ
183	7-0-78	JB	BJ
184	10-0-78	JB	BJ
185	10-11-78	JB	BJ
186	7-0-78	JB	BJ
187	10-0-78	JB	BJ
188	10-11-78	JB	BJ
189	7-0-78	JB	BJ
190	10-0-78	JB	BJ
191	10-11-78	JB	BJ
192	7-0-78	JB	BJ
193	10-0-78	JB	BJ
194	10-11-78	JB	BJ
195	7-0-78	JB	BJ
196	10-0-78	JB	BJ
197	10-11-78	JB	BJ
198	7-0-78	JB	BJ
199	10-0-78	JB	BJ
200	10-11-78	JB	BJ

POWER SUPPLY SCHEMATIC DIAGRAM

Used on: EX-20F EXCITER  
 Drawn By: R.H  
 Date: 10-5-78  
 Drawing No: E20009



REVISIONS		REVISIONS	
No.	Date	No.	Date
6	10-17-78	1	1-17-78
	1000-103	2	2-2-79
		3	2-26-79
		4	3-12-79
		5	3-12-79
		6	7-28-79
		7	10-20-79
		8	10-20-79

POS	FUNCTION	POS	FUNCTION
A	50V F.S.	F	IPA 1AMP F.S.
B	20V F.S.	G	PA 3AMP F.S.
C	10V F.S.	H	RF OUTPUT
D	REF OSC	J	AFC
E	FMO		

CSEI ELECTRONICS INC

CHASSIS METERING CIRCUIT

Drawing No. E 20,010

Desig. by: DJS Date: 12-14-76

Approved: \_\_\_\_\_ Date: \_\_\_\_\_

**CAUTION**

Do not attempt to make any adjustment to the EX-20F unless trouble has been definitely traced to misadjustment and the recommended test equipment is available. Be sure that all three regulated voltages are correct before any adjustments are made.

**5.2 PHASE LOCKED LOOP ADJUSTMENT**

5.2.1 Connect an oscilloscope to the collector for Q11 (test point B) adjust R114 for a maximum amplitude 5 KHz Sawtooth waveform.

5.2.2 Connect a DC voltmeter with a 10 Volt scale to the control (error) voltage input to the VCO module or the junction of R101 and CR101 on the logic board. Adjust the trimmer (accessible through a hole in the VCO housing) for 7.0 VDC ( $\pm 0.1v$ ).

**5.3 FREQUENCY ADJUSTMENT**

1. Connect a frequency counter to the RF output of the exciter through a suitable attenuator or signal sampling tee. Insure that the counter has had sufficient warm-up time and has at least 1 part in  $10^6$  accuracy before proceeding.
2. Remove all modulation from the exciter inputs.
3. Set the frequency adjust potentiometer, R402 to mid-range. (on the front panel)
4. Adjust C108 on the logic board until the frequency is correct.
5. Adjust R402 to its end stops and note that the frequency range is approximately  $\pm 500$  Hz. Return to mid-range setting and recheck frequency.



#### 5.4 POWER AMPLIFIER ALIGNMENT

1. Connect an RF wattmeter and a RF load to the exciter with a suitable isolator in series with the wattmeter to connect a spectrum analyzer.
2. Turn the power output control, R401 to its counter clockwise end stop.
3. Adjust C123 and C124 on the logic board for maximum output as observed on the spectrum analyzer.
4. Turn the power output control, R401 1/4 turn clockwise.
5. Move to the power amplifier board and adjust C203, C208, and C217 for maximum output as indicated on the wattmeter.
6. Move the power output control, R401 to its maximum clockwise position. Retune C203, C208, and C217. Continue tuning until at least 20 watts is indicated on the RF wattmeter. The power amplifier collector current should be approx. 1.2 amps at 20 watts output. It should never exceed 1.5 amps.

#### 5.5 MODULATION LEVEL ADJUSTMENTS

1. Connect an FM modulation monitor to the low level sample of the RF output.
2. Connect an audio generator to the audio input terminal board, TB 501 (terminals 1 & 3) on the rear panel. Switch S501 to the Mono position. Adjust the audio generator to 400 Hz at + 10 DBM.
3. Adjust R161 on the logic board until the monitor indicates 100% modulation ( $\pm 75$  KHz).
4. Move the audio signal to the composite input jack, J502, and set S501 to the Stereo position. Adjust the audio level to 4 volts peak to peak. Adjust R164 until the monitor reads 100%.

List of Illustrations

- |        |       |   |
|--------|-------|---|
| Figure | 1 - 1 | Photograph, EX-20F Exciter              |
| Figure | 4 - 1 | Functional Block Diagram, EX-20F F11083 |
| Figure | 5 - 1 | Program Key EX-20F Exciter              |

## SECTION 1

### GENERAL DESCRIPTION

#### 1.1 INTRODUCTION

The C S I type EX-20F is an FM Broadcast Exciter (Figure 1-1) that provides a frequency-modulated signal in the 88 to 108 MHz range (exact frequency as specified by the customer) for further amplification or direct transmission. It is a solid-state exciter which can be manually adjusted to provide a minimum output of 5 watts and a maximum output of 20 watts. The optional SG-1E Stereo Generator may be used to provide Broadcasting compatible time division multiplex stereo. Another option, the SCA-1E is available for 41 and/or 67 KHZ SCA Multiplex service.

#### 1.2 PHYSICAL DESCRIPTION

The EX-20F Exciter is 19 inches wide, 3 1/2 inches high, and 13 inches deep, weighs approximately 17 pounds, and is designed for mounting in a standard 19 inch equipment rack. Heat sinks for the power amplifier and the power supply regulators are located on the side panels of the chassis. Removable top and bottom cover panels provides access to the printed circuit cards. All normal operating controls and indicators are located on the front panel of the unit. Signal input and output connectors, line fuse, A-C power connector and a mono-comp selector switch are located on the rear panel.

#### 1.3 FUNCTIONAL DESCRIPTION

The functional units of the EX-20F FM Broadcast Exciter are: An FM Modulator Module, A Logic Board containing the frequency synthesizer and programming Switches, a power amplifier assembly and a power supply unit.

When the EX-20F is used for monaural broadcasts (without the optional SCA Generator or Stereo Generator) the audio input is applied directly to the modulator carrier oscillator through the required audio processing circuits. The carrier oscillator is modulated to full deviation by the audio input. A sample of the baseband signal is compared with a reference crystal oscillator signal and the resulting error voltage is used to fine tune the FM Modulator (carrier oscillator) frequency.

The output signal from the Phase Comparator is applied to two-stage solid-state power amplifier to provide an adjustable RF output signal of up to 20 watts. The EX-20F Exciter features phase locked stability and on carrier direct FM for full multiplex operation with freedom from spurious responses.

When SG-1E stereo generator is used the exciter functions the same as described above with the exception that left and right audio inputs are applied to the stereo generator through separate preemphasis and shaping networks. These audio signals are multiplexed to provide the baseband signal which is filtered and applied to the FM modulator. When the SCA generator is used, the SCA audio input is amplified and used to frequency modulate a 41 to 67 KHz subcarrier oscillator. The FM SCA output is then applied to the FM modulator.

#### 1.4 OPTIONAL EQUIPMENT

Both the SG-1E stereo generator and the SCA-1E generator are customer options. The exciter may be purchased without either of these, for monophonic broadcasting.

#### 1.5 TECHNICAL CHARACTERISTICS

The technical characteristics for the EX-20F are listed below, and have divided into four lists: (1) General Characteristics which apply to all EX-20F Exciters, (2) Those characteristics which apply to the EX-20F when it is used for monaural FM,

FREQ MHZ	S102							S103						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
88.1	0	X	0	X	X	0	X	*	0	0	X	0	0	X
88.3	0	X	0	X	X	X	0	X	X	X	X	0	0	X
88.5	0	X	0	X	X	X	0	X	X	X	X	0	0	0
88.7	0	X	0	X	X	X	0	X	X	0	X	0	0	X
88.9	0	X	0	X	X	X	0	X	X	0	X	0	0	0
89.1	0	X	0	X	X	X	0	X	X	X	0	0	0	X
89.3	0	X	0	X	X	X	0	0	X	X	X	0	0	X
89.5	0	X	0	X	X	X	0	0	X	X	X	0	0	0
89.7	0	X	0	X	X	X	0	0	X	0	X	0	0	X
89.9	0	X	0	X	X	X	0	0	X	0	X	0	0	0
90.1	0	X	0	X	X	X	0	0	X	X	0	0	0	X
90.3	0	X	0	0	X	X	X	X	X	X	X	0	0	X
90.5	0	X	0	0	X	X	X	X	X	X	X	0	0	0
90.7	0	X	0	0	X	X	X	X	X	0	X	0	0	X
90.9	0	X	0	0	X	X	X	X	X	0	X	0	0	0
91.1	0	X	0	0	X	X	X	X	X	X	0	0	0	X
91.3	0	X	0	0	X	X	X	0	X	X	X	0	0	X
91.5	0	X	0	0	X	X	X	0	X	X	X	0	0	0
91.7	0	X	0	0	X	X	X	0	X	0	X	0	0	X
91.9	0	X	0	0	X	X	X	0	X	0	X	0	0	0
92.1	0	X	0	0	X	X	X	0	X	X	0	0	0	X
92.3	0	X	0	0	X	X	X	X	0	X	X	0	0	X
92.5	0	X	0	0	X	X	X	X	0	X	X	0	0	0
92.7	0	X	0	0	X	X	X	X	0	0	0	X	0	X
92.9	0	X	0	0	X	X	X	X	0	0	0	X	0	0
93.1	0	X	0	0	X	X	X	X	0	X	0	0	0	X
93.3	0	X	0	0	X	X	X	0	0	X	X	0	0	X
93.5	0	X	0	0	X	X	X	0	0	X	X	0	0	0
93.7	0	X	0	0	X	X	X	0	0	0	X	0	0	X
93.9	0	X	0	0	X	X	X	0	0	0	X	0	0	0
94.1	0	X	0	0	X	X	X	0	0	X	0	0	0	X
94.3	0	X	0	0	X	0	X	X	X	X	X	0	0	X
94.5	0	X	0	0	X	0	X	X	X	X	X	0	0	0
94.7	0	X	0	0	X	0	X	X	X	0	X	0	0	X
94.9	0	X	0	0	X	0	X	X	X	0	X	0	0	0
95.1	0	X	0	0	X	0	X	X	X	X	0	0	0	X
95.3	0	X	0	0	X	0	X	0	X	X	X	0	0	X
→ 95.5	0	X	0	0	X	0	X	0	X	X	X	0	0	0
95.7	0	X	0	0	X	0	X	0	X	0	X	0	0	X
95.9	0	X	0	0	X	0	X	0	X	0	X	0	0	0
96.1	0	X	0	0	X	0	X	0	X	X	0	0	0	X
96.3	0	X	0	0	X	0	X	X	0	X	X	0	0	X
96.5	0	X	0	0	X	0	X	X	0	X	X	0	0	0
96.7	0	X	0	0	X	0	X	X	0	0	X	0	0	X
96.9	0	X	0	0	X	0	X	X	0	0	X	0	0	0

EX-20F  
Program Key

- X - Tie to Ground
- O - Open
- \* - Not Used

Figure 5-1

FREQ MHZ	S 102							S 103						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
97.1	0	x	0	0	x	0	x	*	x	0	x	0	0	x
97.3	0	x	0	0	x	0	x	0	0	x	x	0	x	
97.5	0	x	0	0	x	0	x	0	0	x	*	0	0	
97.7	0	x	0	0	x	0	x	0	0	0	x	0	x	
97.9	0	x	0	0	x	0	x	0	0	0	x	0	0	
98.1	0	x	0	0	x	0	x	0	0	x	0	0	x	
98.3	0	x	0	0	x	x	0	x	x	x	x	0	x	
98.5	0	x	0	0	x	x	0	x	x	x	x	0	0	
98.7	0	x	0	0	x	x	0	x	x	0	x	0	x	
98.9	0	x	0	0	x	x	0	x	x	0	x	0	0	
99.1	0	x	0	0	x	x	0	x	x	x	0	0	x	
99.3	0	x	0	0	x	x	0	0	x	x	x	0	x	
99.5	0	x	0	0	x	x	0	0	x	x	x	0	0	
99.7	0	x	0	0	x	x	0	0	x	0	x	0	x	
99.9	0	x	0	0	x	x	0	0	x	0	x	0	0	
100.1	x	x	x	x	x	x	x	x	x	x	x	x	x	
100.3	x	x	x	x	x	x	x	x	x	x	x	x	0	
100.5	x	x	x	x	x	x	x	x	x	0	x	x	x	
100.7	x	x	x	x	x	x	x	x	x	0	x	x	0	
100.9	x	x	x	x	x	x	x	x	x	x	0	x	x	
101.1	x	x	x	x	x	x	x	0	x	x	x	x	x	
101.3	x	x	x	x	x	x	x	0	x	x	x	x	0	
101.5	x	x	x	x	x	x	x	0	x	0	x	x	x	
101.7	x	x	x	x	x	x	x	0	x	0	x	x	0	
101.9	x	x	x	x	x	x	x	0	x	x	0	x	x	
102.1	x	x	x	x	x	x	x	x	0	x	x	x	x	
102.3	x	x	x	x	x	x	x	x	0	x	x	x	0	
102.5	x	x	x	x	x	x	x	x	0	0	x	x	x	
102.7	x	x	x	x	x	x	x	x	0	0	x	x	0	
102.9	x	x	x	x	x	x	x	x	0	x	0	x	x	
103.1	x	x	x	x	x	x	x	0	0	x	x	x	x	
103.3	x	x	x	x	x	x	x	0	0	x	x	x	0	
103.5	x	x	x	x	x	x	x	0	0	0	x	x	x	
103.7	x	x	x	x	x	x	x	0	0	0	x	x	0	
103.9	x	x	x	x	x	x	x	0	0	x	0	x	x	
104.1	x	x	x	x	x	0	x	x	x	x	x	x	x	
104.3	x	x	x	x	x	0	x	x	x	x	x	x	0	
104.5	x	x	x	x	x	0	x	x	0	x	x	x	x	
104.7	x	x	x	x	x	0	x	x	0	x	x	0	x	
104.9	x	x	x	x	x	0	x	x	x	0	x	x	x	
105.1	x	x	x	x	x	0	x	0	x	x	x	x	x	
105.3	x	x	x	x	x	0	x	0	x	x	x	x	0	
105.5	x	x	x	x	x	0	x	0	x	0	x	x	x	
105.7	x	x	x	x	x	0	x	0	x	0	x	x	0	
105.9	x	x	x	x	x	0	x	0	x	x	0	x	x	
106.1	x	x	x	x	x	0	x	0	x	x	x	x	x	
106.3	x	x	x	x	x	0	x	0	x	x	x	0	x	
106.5	x	x	x	x	x	0	x	0	0	x	x	x	x	
106.7	x	x	x	x	x	0	x	0	0	x	x	0	x	
106.9	x	x	x	x	x	0	x	0	x	0	x	x	x	

0 = open  
x = tuned signal

FREQ MHZ	S102							S103						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
107.1	x	x	x	x	x	o	x	*	o	o	x	x	x	x
107.3	x	x	x	x	x	o	x		o	o	x	x	x	o
107.5	x	x	x	x	x	o	x		o	o	o	x	x	x
107.7	x	x	x	x	x	o	x		o	o	o	x	x	o
107.9	x	x	x	x	x	o	x		o	o	x	o	x	x

SECTION 6

PARTS LIST



SECTION 7  
SCHEMATIC DIAGRAMS

D W G NUMBER

1. Logic Board	C 40005
2. Power Amplifier & L. P. Filter	E 20003
3. Power Supply	E 20009
4. Chassis Metering Circuit	E 20010
5. P. A. Board Component Location	E 20013
6. Logic Board Component Location	D 30023