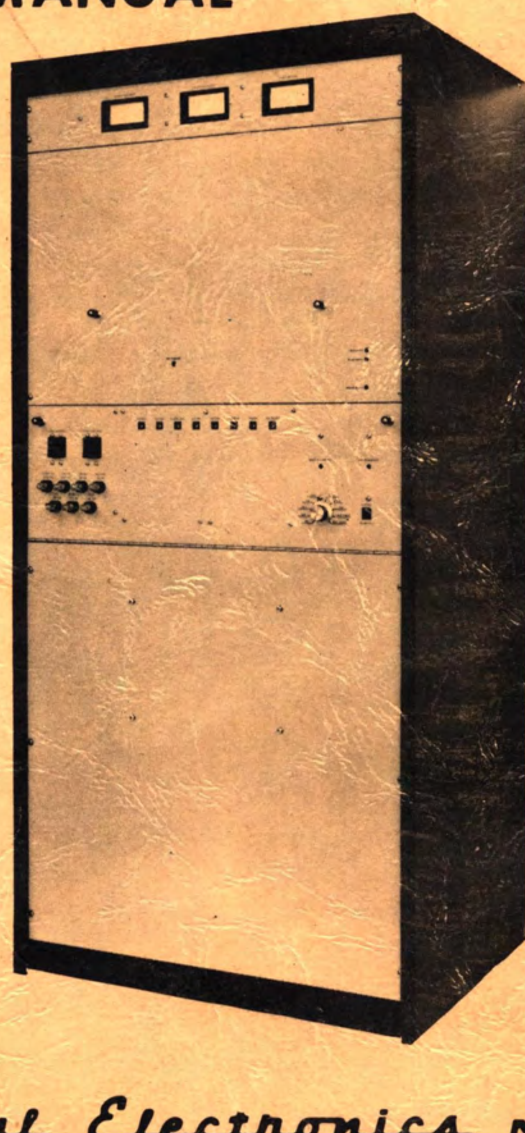
TYPE 314R-1 (828C-1)

AM BROADCAST TRANSMITTER WITH SOLID STATE EXCITER

INSTRUCTION MANUAL



Continental Electronics MFG. CO.
4212 S. BUCKNER BLVD. DALLAS, TEXAS 75227

1 OCTOBER 1980

1 October 1980

214.327.4533

SPECIAL NOTICE

TYPE NUMBER 828C-1

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TYPE 314R-1

CONTINENTAL ELECTRONICS MFG. CO.
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section 1
general description

1.1 INTRODUCTION

This instruction book contains the information necessary to install, operate, maintain, and service the 314R-1 1-kW AM Transmitter. Figure 1-1 shows the external configurations of the transmitter. The following sections of this instruction book provide the following classes of information concerning this transmitter.

a. Section 1, General Description, provides a description of the equipment, identifies the major components, lists physical and electrical characteristics, and describes options.

b. Section 2, Installation, provides information relative to incoming inspection, input/output connections, initial adjustments, and component mounting instructions (where required).

c. Section 3, Operation, identifies and describes the functions of panel- and component-mounted controls and indicators, and provides information necessary to operate the transmitter.

d. Section 4, Principles of Operation, provides descriptions of functional circuits within the transmitter, beginning with an overall functional description of the basic circuits, and proceeding to a description of the function and operation of each individual circuit.

e. Section 5, Maintenance, describes procedures for preventive and corrective maintenance.

f. Section 6, Troubleshooting, provides fault location guidance and troubleshooting procedures.

g. Section 7, Parts List, provides information for ordering replacement components and assemblies, and parts location illustrations for each major assembly and each circuit board.

h. Section 8, Diagrams, contains schematic and wiring diagrams required for transmitter maintenance.

1.2 EQUIPMENT PURPOSE

The 314R-1 transmitter is a 1-kW radio transmitter for amplitude modulation broadcast use. It employs a series switching modulator to provide amplitude modulation up to 125 percent positive, with lower power consumption and better performance. This Instruction Book is effective on Serial No. 101 and above.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

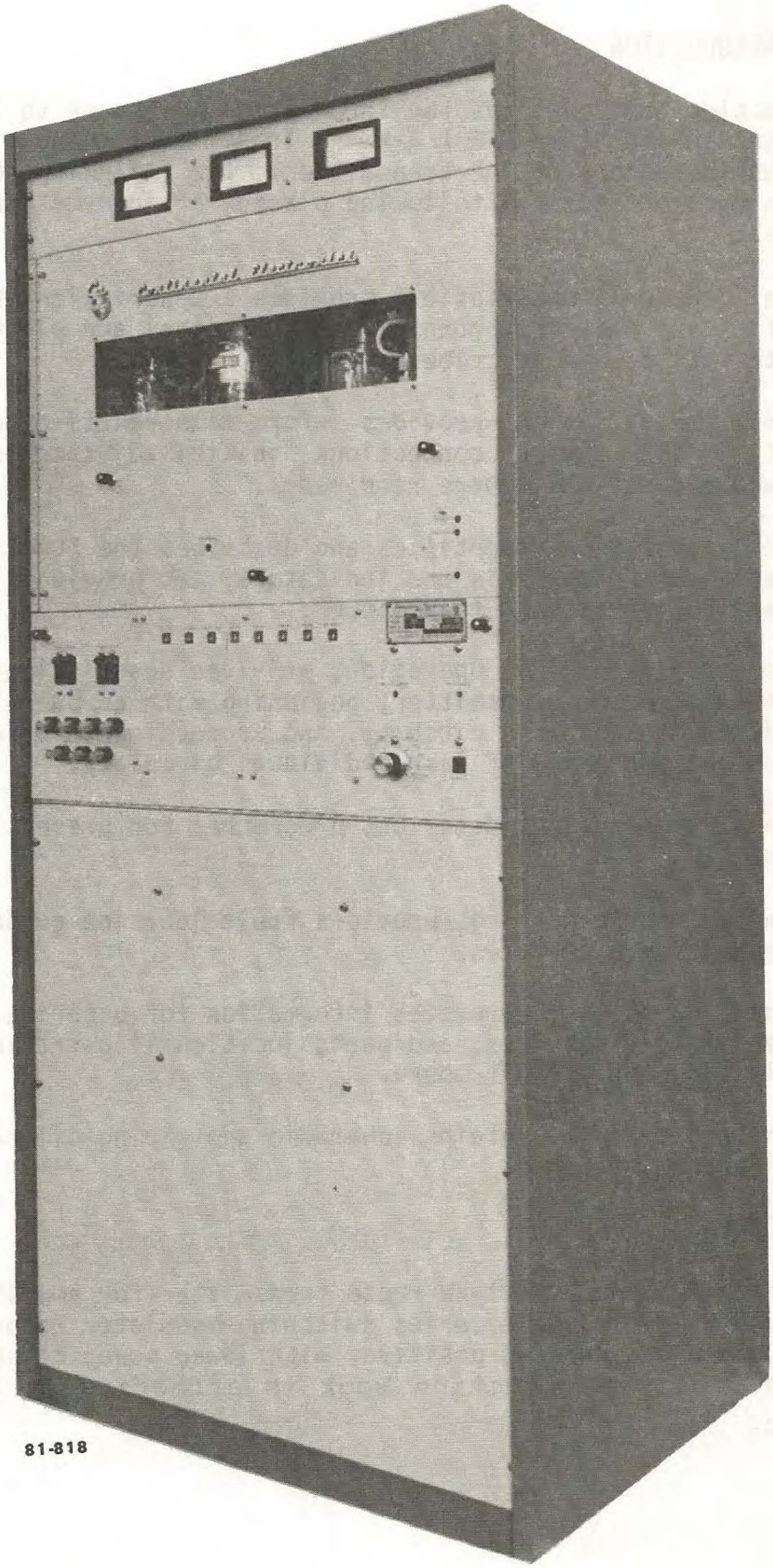

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Figure 1-1. 314R-1, 1 KW AM Transmitter

1.3 PHYSICAL DESCRIPTION

The transmitter is housed in a single cabinet, which requires only 0.52 sq. m. (5.6 sq. ft.) of floor space.

The top front panel contains the meters. Just below the RF cover, the control panel has a piano hinge that permits it to be opened downwards for access to the control circuits card. The rear door permits rear access to interior components. The RF cover, the lower panel, and the rear door are electrically interlocked. Shown below is a list of the 314R-1 subassemblies.

SYMBOL	NAME	PART NUMBER
A1	Control Circuits	650-2891-001
A2	Switchmod Driver	636-9675-003
A3	RF Exciter	650-2893-001
A4	Divider Card	650-2884-001
A5	VSWR Sensor	650-2885-001
A6	Bias PS Filter	650-2897-001

The transmitter output connection is nominally a 50-ohm, LC coax connection. A transmission line that terminates in an AM antenna or in a dummy load of the proper impedance must be connected to the transmitter output before the equipment is energized. The transmitter may be tuned for other impedance levels by special order.

1.4 FUNCTIONAL DESCRIPTION

The transmitter contains an RF oscillator, an RF driver, a power amplifier, audio input and modulator circuits, and power supplies. The circuitry is hybrid in design, employing both discrete and monolithic components. Operating controls are conveniently arranged on the front panel.

A solid state crystal oscillator with buffer amplifiers feeds the solid-state RF driver.

The RF driver operates at a 125-watt power level to drive the RF power amplifier. The power amplifier is a conventional class c amplifier. The power amplifier operates with its plate at dc ground, eliminating the usual RF blocking capacitor, bypass capacitor, and RF choke in the high-voltage feed. This simplifies maintenance, and also allows direct metering at ground potential for both the local and remote metering functions.

The transmitter employs a series switching modulator (class D) between the RF power amplifier and its high-voltage power supply (HVPS). To modulate the carrier, the on/off duty cycle (40 percent on at nominal carrier) of the modulator output is varied at the modulation rate. This causes the average voltage supplied to the RF power amplifier to vary as the modulation. The RF power amplifier and the switching modulator each employ low-cost, high mu triode tubes, Eimac type 3-500Z. The low amount of drive required for these tubes simplifies the driver circuits and power requirements. Spares requirements are reduced by the use of a single type tube.

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description

The incoming audio signal is applied to the pulse-width modulator (PWM), which converts it into a 70-kHz pulse-width modulated signal, which is coupled to the switching modulator through a fiber optic cable. Optical coupling is used to isolate the low-level PWM circuit from the high-voltage switching modulator circuit. Audio and dc feedback from the modulated voltage are used to provide nearly perfect power output control and to improve distortion, response, and transient performance with processed audio waveforms. The RF output network and load are excluded from the feedback loop, eliminating the stability and response problems associated with high-Q nonsymmetrical loads. Automatic modulation control maintains the desired modulation level with changes in power output settings or line voltage fluctuations.

The output of the RF power amplifier is coupled to the antenna through a bandpass Q Taper™ output network. This network has a very flat passband response about the carrier frequency to pass the sidebands, and steep skirts for better harmonic and spurious signal attenuation.

No traps are required and network stress is reduced by operating with lower Q circuits.

The transmitter can be controlled locally by controls on the control panel, or through an (optional) extended control panel, or remotely through conventional remote control equipment. Remote control connections are provided on terminal boards inside the transmitter.

1.5 CHARACTERISTICS

Physical and electrical characteristics are listed in table 1-1.

1.6 OPTIONS

The following optional equipment is available for use with the 828C-1 transmitter:

DESCRIPTION	PART NUMBER
Filament Regulator (60 Hz)	662-0292-050
Filament Regulator (50 Hz)	662-0292-060
Extended Control and Meter Panel	636-7171-001
Extended Meter Panel	636-7173-001
RF Output Stud Connection	650-2985-001

Where the studio and the transmitter are separated by sufficient distance, the operating functions of the transmitter can be controlled from the studio by most of the various remote control systems available today.

For short distances [up to 60.9 m (200 ft)], the optional extended control and meter panel (PN 636-7171-002) or extended meter panel (PN 636-7173-001) may be used for controlling the operating and monitor functions of the transmitter. Paragraph 2.4.5.1 describes the connection and operation of the extended control panel. The remote control interface assembly is not required.

Table 1-1. 314R-1 Physical and Electrical Characteristics.

ITEM	CHARACTERISTICS
1. Size	1752.6 mm (69 in.) high 814.2 mm (32 1-16 in.) wide 636.5 mm (25 1-16 in.) deep
2. Weight	345.5 kg (760 lb) (approximate)
3. Service Conditions	
a. Ambient Temperature	0 to +50 C (+32 to 122 F)
b. Relative Humidity	Up to 95 percent
c. Altitude	Up to 2286 mm (7500 ft) at +30 C (+86 F)
d. Vibration and Shock	Normal handling and transportation
4. Power Requirements	
a. Voltage	200 to 250 volts
b. Frequency	50 to 60 Hz, single-phase
c. Power (at 1000W)	2.8 kW (carrier), 0.92 power factor 3.5 kW (100% modulation), 0.95 power factor
5. RF Power Output	250 to 1100 watts
6. Frequency Range	540 to 1600 kHz; exact operating frequency determined by oscillator crystal
7. RF Output Impedance	50 ohms, LC coax connector (other impedance by special order)
8. Audio Response	± 1 dB, 20 to 10,000 Hz
9. Audio Distortion	Less than 2%, 20 to 10,000 Hz (at 1.0 kW)
10. Modulation Capability	+125%, -100%
11. Harmonic Suppression	Greater than -73.4 dB below carrier
12. Audio Input Level	+10 dBm ± 2 dB or 0 dBm ±2 dB

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2.1 INTRODUCTION

Installation of the transmitter is accomplished in four steps: unpacking and inspecting, transmitter location, external connections, and preoperational checks and adjustments.

2.2 UNPACKING AND INSPECTING

2.2.1 Domestic Shipments

The transmitter is shipped completely assembled and ready for installation, uncrated on a shipping skid, via air-ride van. Unpack and inspect the transmitter as follows:

CAUTION

USE CARE IN MOVING THE TRANSMITTER. USE APPROPRIATE LIFTING AND MOVING EQUIPMENT WITH AT LEAST 345-kg (760-lb) CAPACITY. SOME COMPONENTS MAY BE DAMAGED IF THE TRANSMITTER IS DROPPED OR SEVERELY JARRED.

a. Remove the transmitter from the van to a position near its installation site.

b. Lift the transmitter from the shipping skid.

c. Remove the front cover and open the rear door and the control panel.

d. Inspect the transmitter for loose hardware. Ensure that all controls operate freely. Examine the cabinet for dents and scratches.

e. File any damage claims properly with the transportation company. Retain all packing material if a claim is filed.

2.2.2 Foreign Shipments

The transmitter is shipped in a skid-type crate via a commercial transportation company. Unpack the transmitter as follows:

CAUTION

USE CARE IN UNPACKING AND MOVING THE TRANSMITTER. USE APPROPRIATE LIFTING AND MOVING EQUIPMENT WITH AT LEAST 345-kg (760-lb) CAPACITY. SOME COMPONENTS MAY BE DAMAGED IF THE TRANSMITTER IS DROPPED OR SEVERELY JARRED.

installation

a. Position the crated transmitter near its installation site.

b. Refer to the instructions stenciled on the side of the shipping crate and carefully uncrate the transmitter.

c. Remove the front cover and open the rear door and the control panel.

d. Inspect the transmitter for loose hardware. Ensure that all controls operate freely. Examine the cabinet for dents and scratches.

e. Remove the modulator and power amplifier tubes from their separate containers. Inspect for damage.

f. File any damage claims properly with the transportation company. Retain all packing material if a claim is filed.

2.3 LOCATION

The 314R-1transmitter may be installed in either an attended or, with remote control, unattended location. Refer to figure 2-1 for transmitter dimensions and cable entry information. Observe the following siting practices to ensure optimal transmitter operation.

a. Allow at least 1.1 m (3.5 ft) of clearance at front and rear for servicing access.

b. Ascertain the environmental conditions are within the temperature, humidity, and altitude limits listed in Table 1-1.

c. Make certain that the transmitter site is clean and that the air is not excessively dusty or dirty.

2.3.1 Cooling Air Requirements

Care must be taken in ventilating the room housing the transmitter to provide an adequate flow of cooling air. The 314R-1 transmitter requires 14 .4 cubic meters/min (500 CFM) of cooling air. If a sufficient supply of cooling air is not supplied, overheating may cause equipment failure.

2.3.2 Heat Load

The heat load to the room including exhaust air is 2000 watts or 6826 Btu/hr.

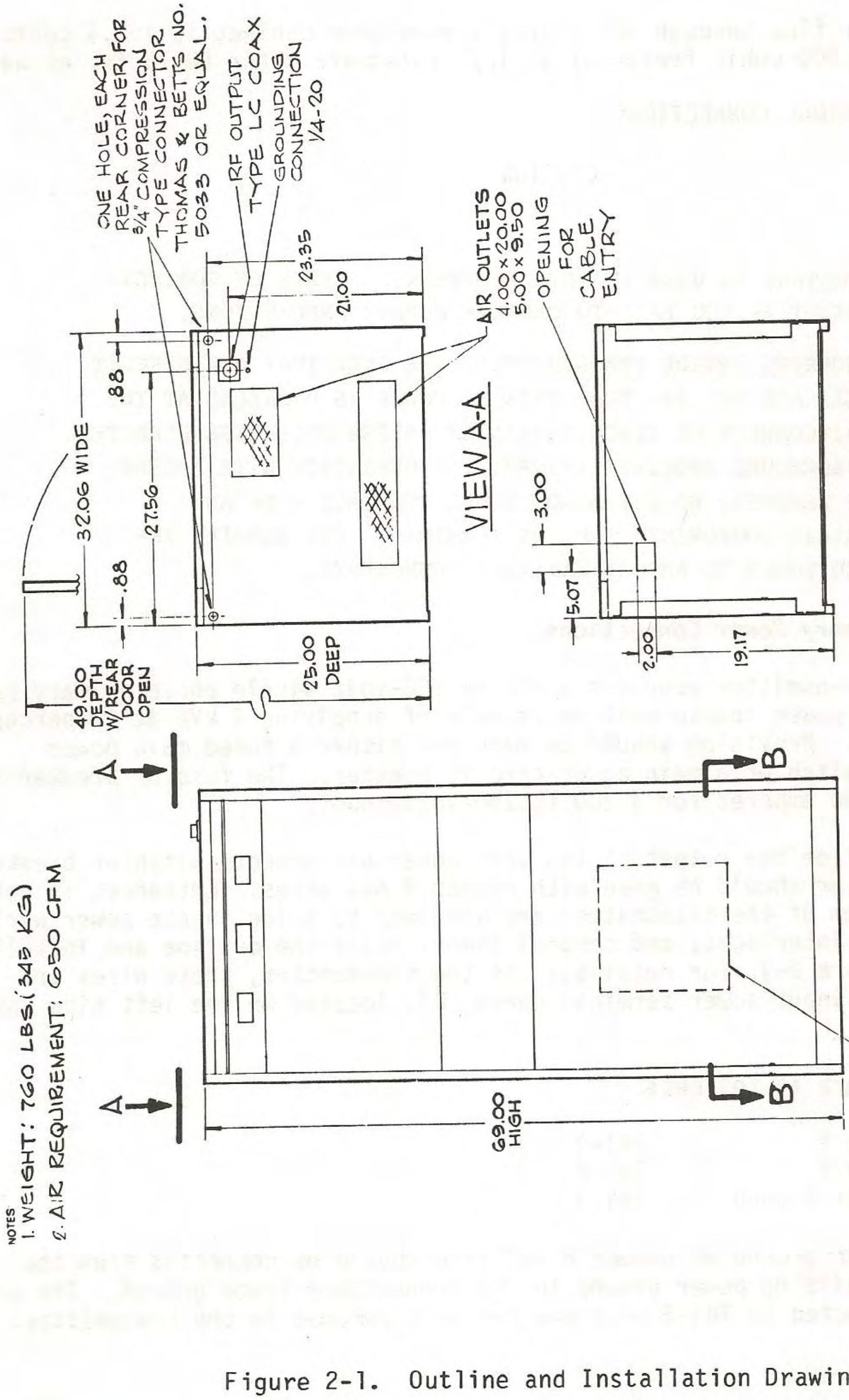


Figure 2-1. Outline and Installation Drawing

2.3.3 Air Flow

The total air flow through the 314R-1 transmitter cabinet is 152.4 cubic meters/min. (500 cubic feet/min) at 1.97 kg/square meter (0.75 in. of water).

2.4 EXTERNAL CONNECTIONS

CAUTION

HIGH VOLTAGE IS USED IN THIS EQUIPMENT. DEATH ON CONTACT MAY RESULT IF YOU FAIL TO OBSERVE SAFETY PRECAUTIONS.

WHEN WORKING INSIDE THE EQUIPMENT, BE SURE THAT ALL CIRCUIT BREAKERS ARE OFF AND THAT PRIMARY POWER IS DISABLED AT THE WALL DISCONNECT OR CIRCUIT BREAKER UNLESS OTHERWISE DIRECTED. IF A PROCEDURE REQUIRES TRANSMITTER OPERATION WITH ACCESS PANELS REMOVED, SO NOT ALLOW BODILY CONTACT WITH ANY ELECTRICAL COMPONENT, TAP, OR TERMINAL. USE HEAVILY INSULATED TOOLS TO ADJUST VARIABLE COMPONENTS.

2.4.1 Primary Power Connections

The 314R-1 transmitter requires a 200 to 250-volt single phase primary power source. The power source must be capable of supplying 4 kVA at 95 percent power factor. Provision should be made for either a fused main power disconnect switch or a main power circuit breaker. The fuse or breaker should be rated at 30 amperes for a 200 to 250-volt input.

Connections from the output of the main power disconnect switch or breaker to the transmitter should be made with number 8 AWG wires. Entrances in both the top and bottom of the transmitter are provided to bring in the power wiring, audio lines, interlocks, and control lines. (See the outline and installation drawing, figure 2-1, for details.) At the transmitter, these wires are connected to input power terminal board TB1, located on the left side inside the cabinet.

Connections are as follows:

Line 1	TB1-1
Line 2	TB1-2
Power Ground	TB1-3

A safety power ground of number 8 AWG wire should be connected from the station or building power ground to the transmitter frame ground. The ground wire is connected to TB1-3 provided for this purpose in the transmitter.

For proper operation, a good RF ground connection is required, using a copper strap 102 to 152 mm (4 to 6 in.) wide for a low inductance RF connection.

The taps on all transformers are connected at the factory for 250-volt operation. If any other primary power source is to be used, the transformer taps must be changed to the tap nearest to the supply voltage. Table 2-1 lists the correct taps for each supply voltage on each transformer.

Figures 2-2 through 2-13 show the details of the proper line connections to HVPS transformer T1 for various line voltages. If the HVPS voltage exceeds 9.5 kV at any line voltage variation during a normal day's operaton, move connections to the next higher line voltage connection.

Table 2-1. Transformer Taps for Each Voltage.

TRANSFORMER	200	210	220	230	240	250
T1 HVPS	3-4	2-4	1-4	3-5	2-5	1-5
T3 28VPS	ALWAYS CONNECTED TO S1-F2					
T4 DR PS	3-4	2-4	1-4	3-5	2-5	1-5
T5 BIAS PS	3-4	2-4	1-4	3-5	2-5	1-5
T6 LOGIC PS	ALWAYS CONNECTED TO S1-F2					
T9 PA FIL*	1-5	1-5	1-5	1-6	1-6	1-6
T10 MOD FIL*	1-5	1-5	1-5	1-6	1-6	1-6

*CAUTION: ALWAYS CONNECT BOTH FILAMENT TRANSFORMERS TO TAPS 1-3 WHEN USING THE OPTIONAL FILAMENT REGULATOR TRANSFORMER, T2. SEE FIGURE 2-3.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

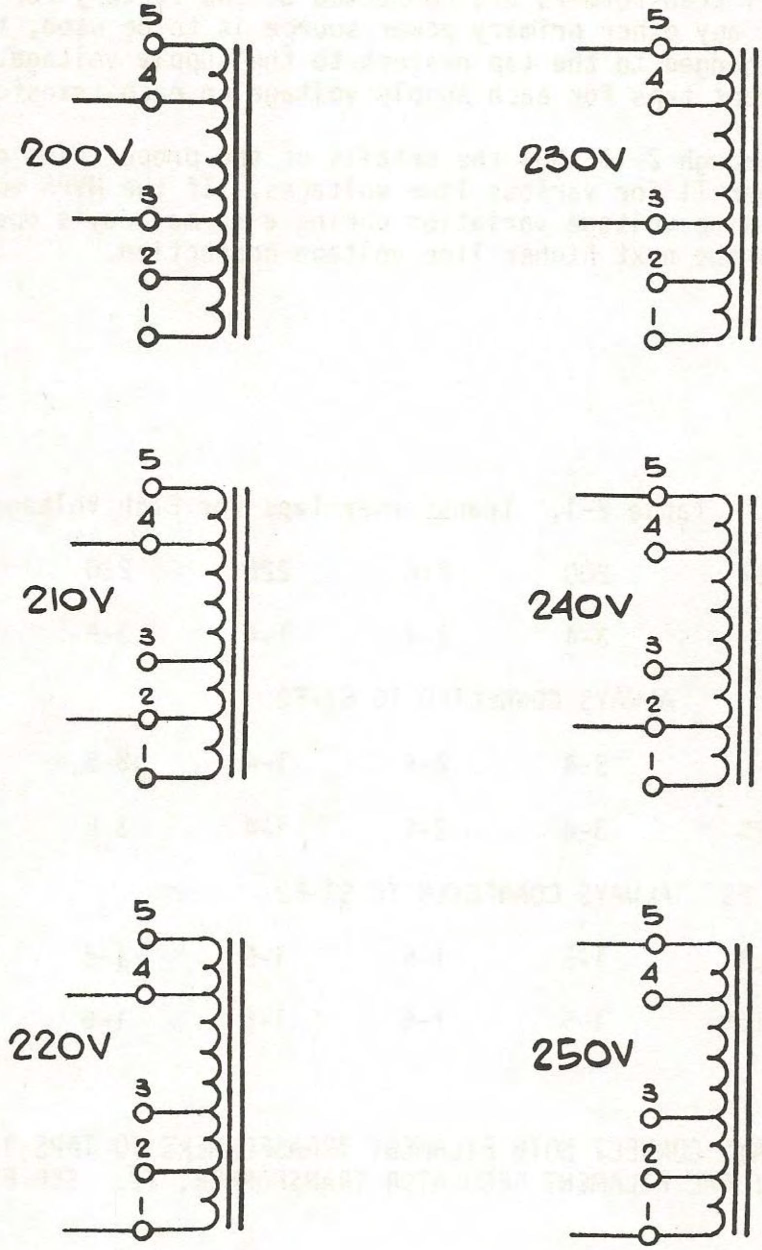
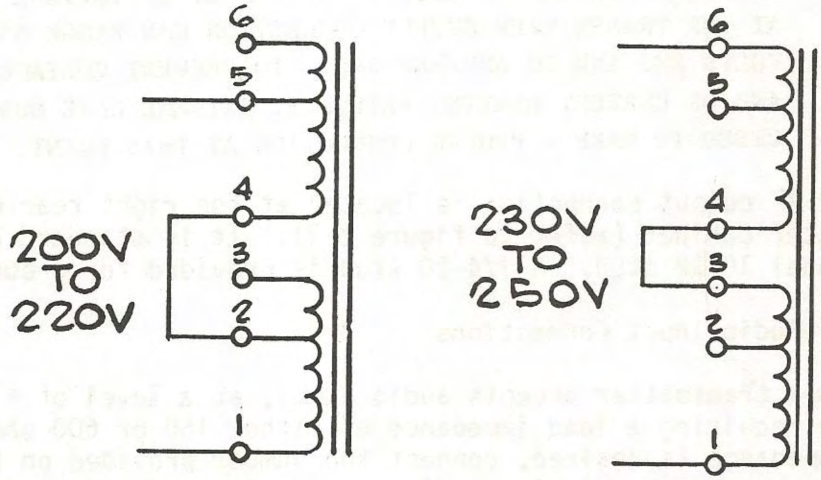
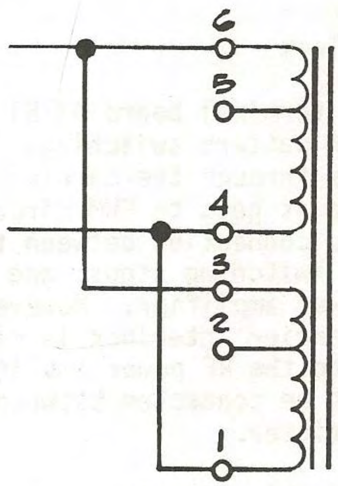


Figure 2-2. Primary Connections For T1, T4, and T5.



CONNECTIONS WITHOUT FILAMENT REGULATOR



CONNECTIONS WITH FILAMENT REGULATOR.

Figure 2-3. Primary Connections for T9 and T10.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

2.4.2 RF Output Connection

CAUTION

DEPENDING ON THE RF OUTPUT IMPEDANCE, RF VOLTAGE AND RF CURRENT AT THE TRANSMITTER OUTPUT CONNECTION CAN RANGE AS HIGH AS 1000 VOLTS RMS AND 10 AMPERES RMS. TO PREVENT VOLTAGE BREAKDOWN AND/OR CURRENT HEATING FAILURES, EXTREME CARE MUST BE EXERCISED TO MAKE A PROPER CONNECTION AT THIS POINT.

The 1-kW RF output connection is located at the right rear of the top of the transmitter cabinet (refer to figure 2-1). It is standard LC coax connection, or optional 10-32 stud. A 1/4-20 stud is provided for ground connections.

2.4.3 Audio Input Connections

The 314R-1 transmitter accepts audio input, at a level of +10 dBm $\pm$ 2 dB, from a source requiring a load impedance of either 150 or 600 ohms. If 150-ohm input impedance is desired, connect the jumper provided on the control circuit card, A1, between terminals at J2 instead of terminals at J1 (see schematic). If 0-dBm input level is desired, it can be obtained by placing a jumper on J3 (see schematic).

Use number 22 AWG, shielded twisted-pair wire (Belden 8451 or equivalent) to connect the audio source to terminal board TB2-1, -2, and -3. The audio "high" wire connects to terminal 1, the "low" wire connects to terminal 2, and the shield to terminal 3.

2.4.4 Carrier Interlock

Terminals 12 and 13 on terminal board A1TB1 are provided to interlock the carrier for purposes of pattern switching. Terminal 13 has plate-controlled +28 volts, which passes through the carrier interlock circuit and returns to terminal 12. From here it goes to PWM circuit where it controls the PWM signal. If there is no connection between terminals 12 and 13, the PWM signal is interrupted (70-kHz switching stops) and the plate voltage is thereby removed from the RF power amplifier. However, the plate contactor and HVPS remain on. When the carrier interlock is closed, the PWM signal resumes and plate voltage returns to the RF power amplifier. If this circuit is not utilized, a jumper must be connected between terminals 12 and 13 for proper operation of the transmitter.

It should be noted that this circuit carries a very low current. Therefore, the external wiring should be kept as short as possible and external contacts used in this circuit must be low-resistance, low-current sealed contacts.

It should also be noted that the RF drive loss circuit works in series with the carrier interlock. If the RF driver current drops below approximately 0.5 amperes, the carrier interlock signal is interrupted, thereby removing high voltage from the RF power amplifiers.

2.4.5 Remote Control and Monitor Connections

Remote control of the 314R-1 transmitter can be accomplished in either of two ways. For relatively short distances, the (optional) extended control panel can be used. For longer distances, remote control can be exercised through various standard remote control units available.

2.4.5.1 Extended Control Panel Connections

Remote control by direct connection of the extended control panel (figure 2-4) to the transmitter can be accomplished at distance up to 61 m (200 ft). Twenty number 22 AWG wires are required, connected as shown in figure 2-6.

The extended control panel (figure 2-4) for the 314R-1 transmitter is connected to function only when LOCAL-REMOTE switch S5 on the 314R-1 is in the REMOTE position.

2.4.5.2 Remote Control Connections

The transmitter internal +28-volt supply is used to power the remote control panel; connections to A1TB1 are as shown in figure 2-6.

2.4.5.3 Remote Monitor Connections

The 314R-1 transmitter has provisions for remote metering of power amplifier plate current, power amplifier plate voltage, and forward and reflected RF power. These remote monitor circuits are designed to use 100-μA meters having an internal resistance of 1750 ohms ±1 percent. The remote monitor meters can be used at distances from the transmitter of up to 61 m (200 ft), using number 22 AWG wire. Figure 2-8 shows the required connections to TB2 on the power control chassis in the transmitter. Full-scale readings for each remote meter are also shown.

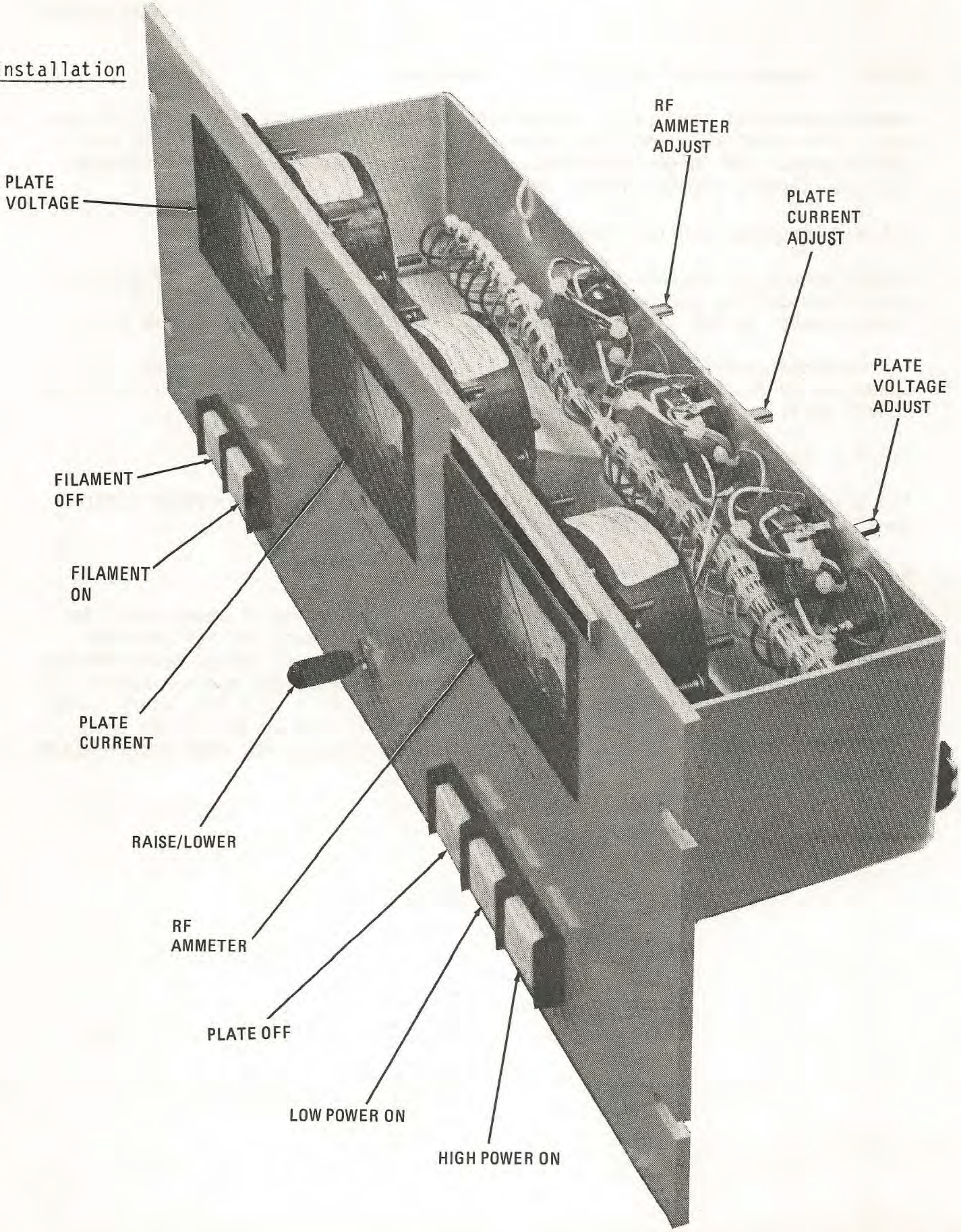


Figure 2-4. Extended Control Panel

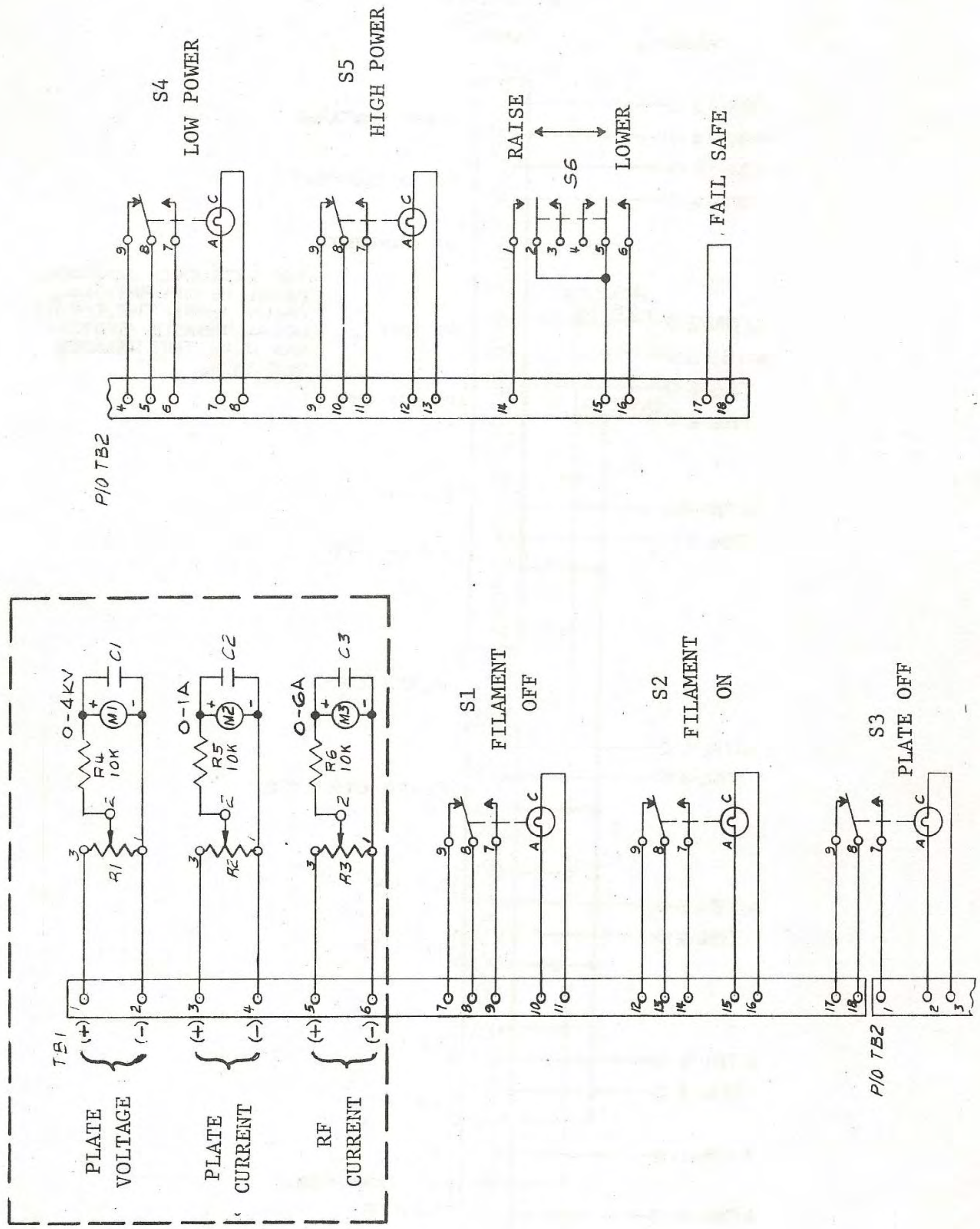


Figure 2-5. Extended Control Panel Schematic.

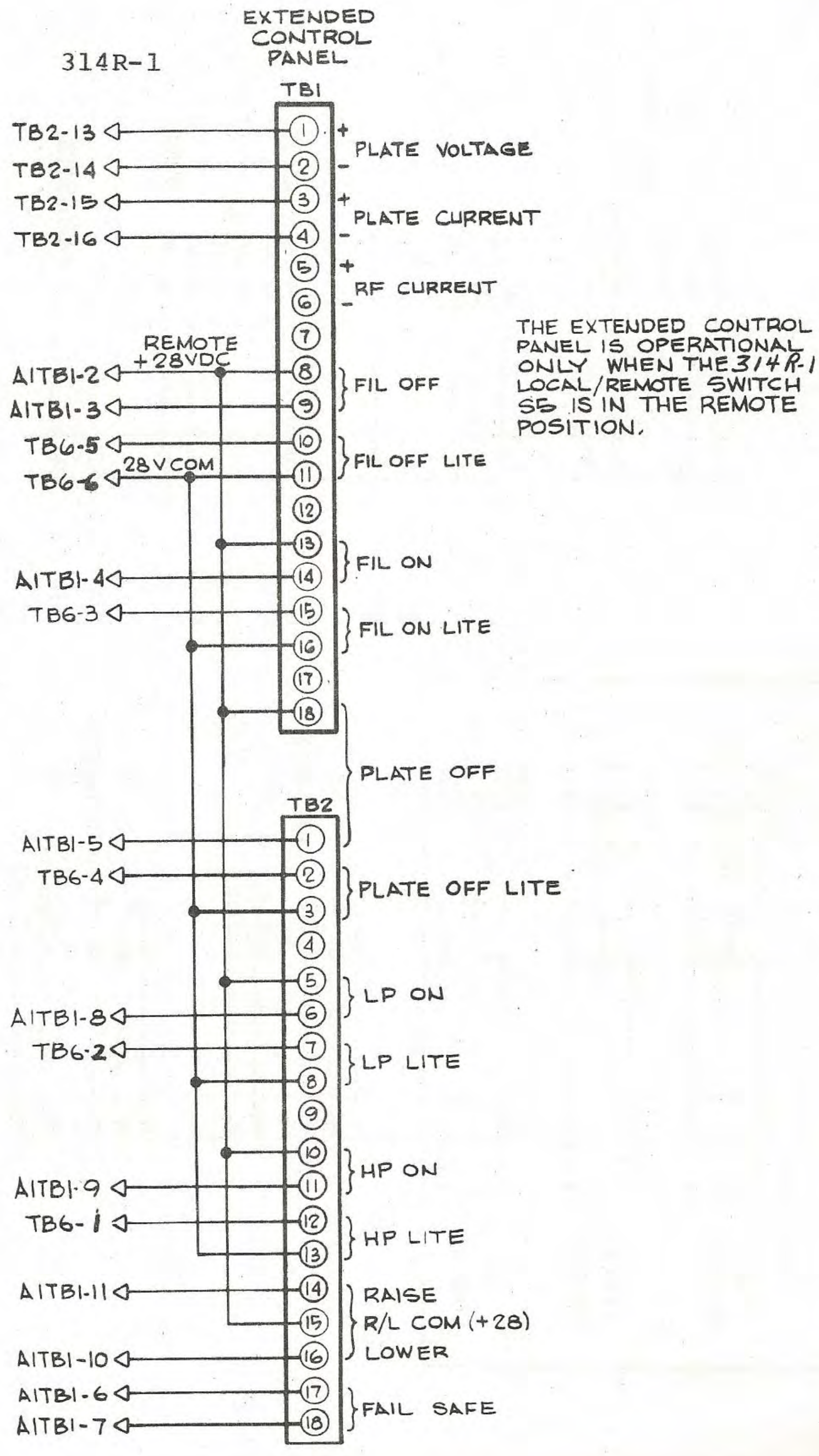


Figure 2-6. Interconnect Wiring for Extended Control Panel

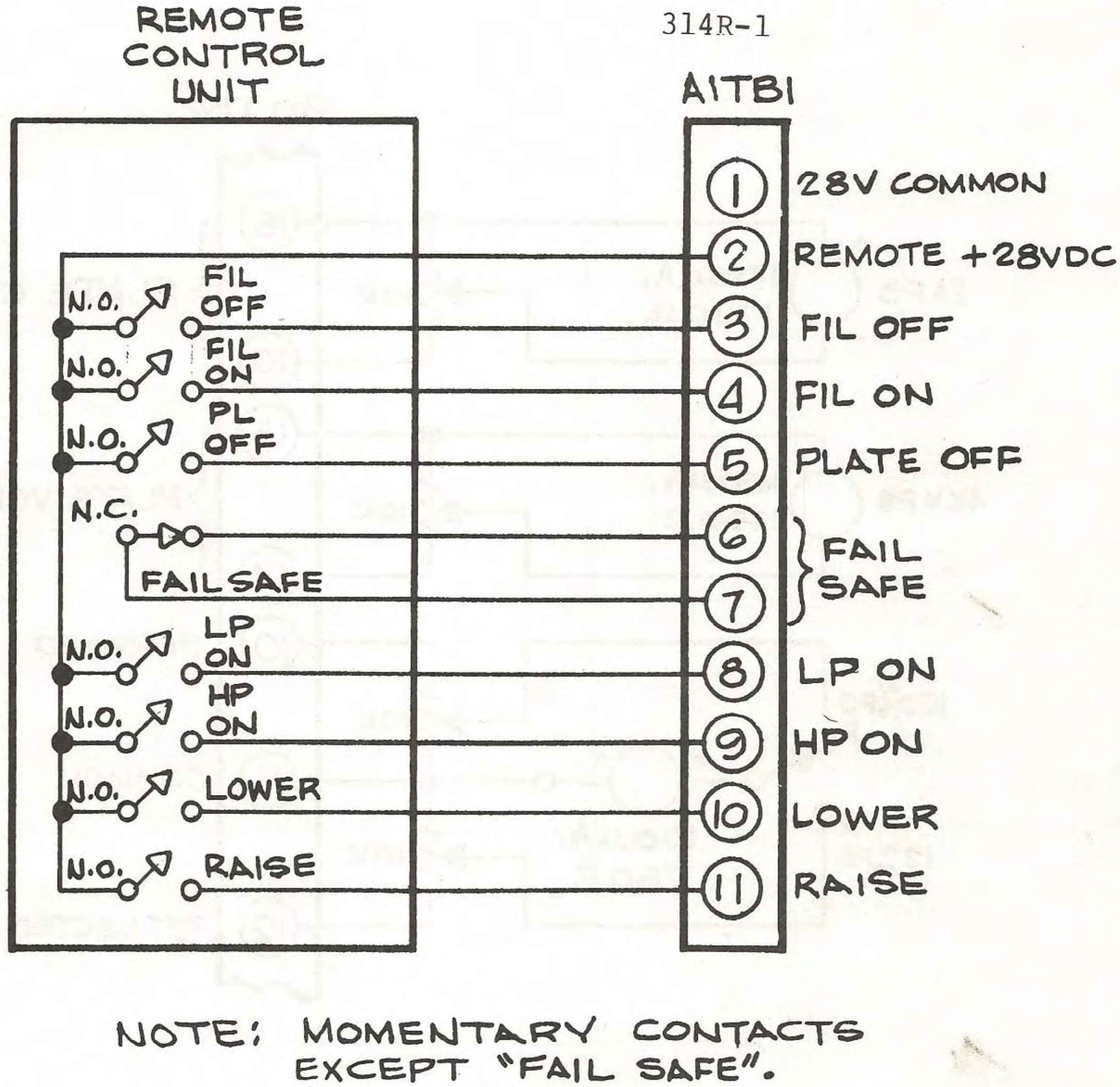


Figure 2-7. Connections Using Internal +28 Volts to Power Remote Control.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

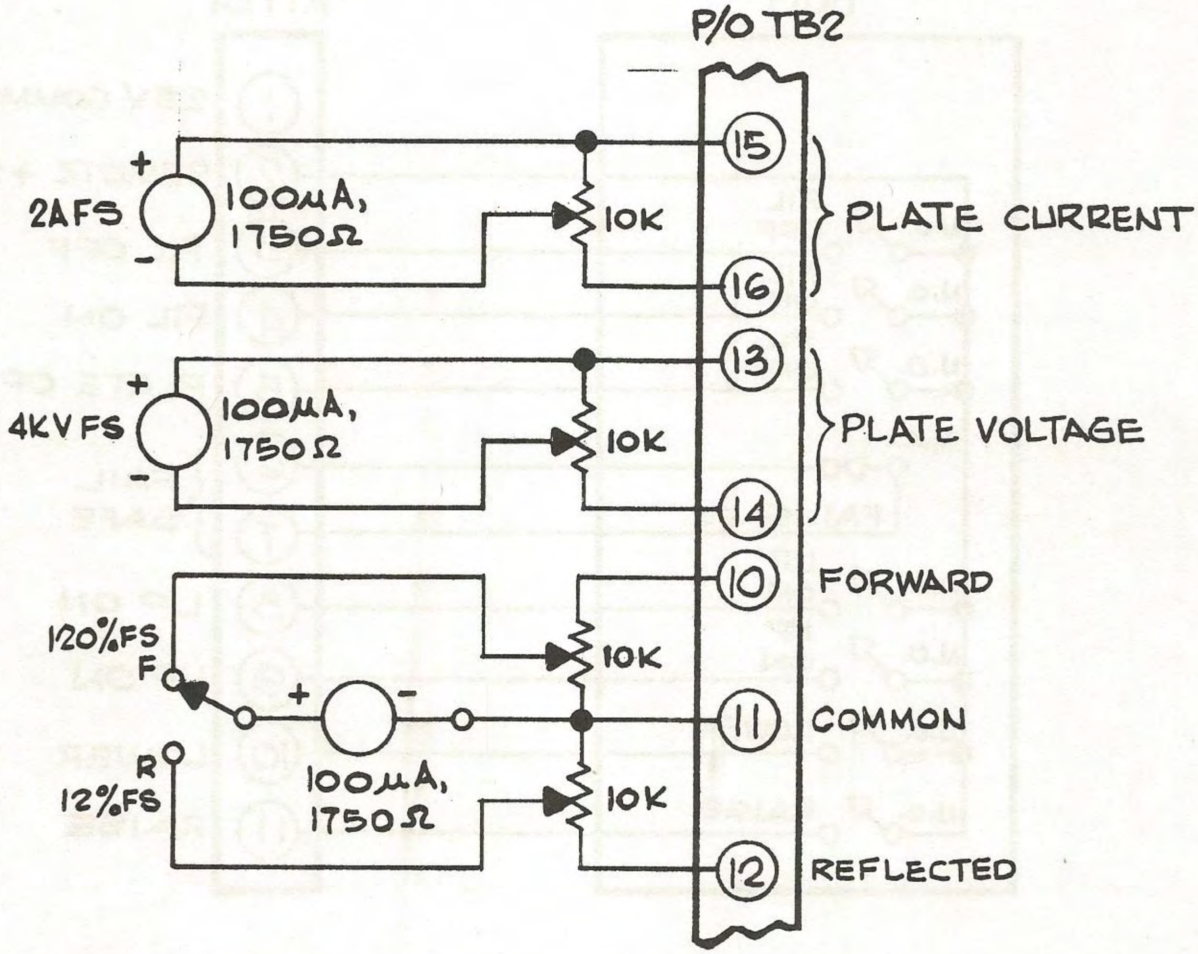


Figure 2-8. Remote Monitor Connections.

3.1 INTRODUCTION

This section contains information pertaining to the identification, location, and function of the controls and indicators on the 314R-1 1-kW AM Transmitter. The procedures required to set up and operate the transmitter are also presented.

3.2 CONTROLS AND INDICATORS

Table 3-1 lists and explains the functions of the front-panel controls and indicators on the transmitter. Table 3-2 similarly lists and explains the functions of internal controls and indicators. Table 3-3 lists the meters on the transmitter; and table 3-4 shows typical meter readings for correct operation.

Table 3-1. Front-Panel Controls and Indicators.

CONTROL/INDICATOR	FUNCTION
FILAMENT:	
OFF (A1S1)	Removes power from both blower relay K3 and filament relay K4 by interrupting holding contact 4 and 12 on relay K3. When lighted, shows filament power is off.
ON (A1S2)	Applies 28-volt power to blower relay K3, which then energizes filament relay K4 through air interlock switch S6. When lighted, shows filament and blower power are on.
PLATE:	
OFF (A1S3)	Disconnects high voltage from plate circuit by interrupting holding contacts 12 and 8 on high-voltage-on relay A1K6. In series with three door interlock switches S7, S2, S3; and with temperature switch S1. When lighted, indicates that no high voltage is applied to plate, three door interlocks are closed, and the temperature interlock is closed.
LP (A1S4)	Applies 28-volt power to low-power latch relay A1K5B and to high-voltage-on relay A1K6 through diode A1CR34; also energizes filament on sequence through diode A1CR27. When lighted, indicates that power is applied to low-power relay A1K7 and modulation monitor relay K2.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Table 3-1. Front-Panel Controls and Indicators (Cont).

CONTROL/INDICATOR	FUNCTION
HP (A1S5)	Applies 28-volt power to high-power latch relay A1K5A and to high-voltage-on relay A1K6 through diode A1CR33; also energizes filament on sequence through diode A1CR58. When lighted, indicates that latch relay A1K5A is in the high power position.
POWER:	
RAISE (A1S7)	Applies 28-volt power to raise relay A1K2 through normally closed contacts on lower relay A1K3.
LOWER (A1S6)	Applies 28-volt power to lower relay A1K3 through normally closed contacts on raise relay A1K2.
PA TUNING (C30)	Screwdriver adjustment; sets PA tuning capacitor C30 to resonate node 1 of the output network.
CONTROL-LOCAL/REMOTE (S5)	In LOCAL position applies LOCAL +28 to FIL ON, LP, HP, RAISE, and LOWER switches and connects jumper between "fail-safe" circuits TB1-6&7. In REMOTE position, applies 28-volt power to remote control terminal board A1TB1-2.
PA FIL (R16)	Screwdriver adjustment to set PA filament voltage.
MOD FIL (R15)	Screwdriver adjustment to set modulator filament voltage.

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Table 3-2. Internal Controls and Indicators.

CONTROL/INDICATOR	FUNCTION
Oscillator Frequency (A2C4)	Screwdriver adjustment to set frequency of the oscillator.
DC Indicator (A2CR7)	LED on module A2 showing that DC power is present.
RF Indicator (A2CR6)	LED on module A2 showing that there is RF output from the module.
IPL On/Off (A1S10)	Connects instantaneous peak limiter (positive and negative audio clippers) into the circuit.
Carrier Interlock (A1CR55)	LED on module A1 showing that carrier interlock (A1TB1-12&13) is closed, plate contactor (K1) is energized and RF drive loss circuit is not energized.
Low-Power Adjust (A1R126)	Screwdriver adjustment to set low-power output to desired fraction of high-power output.

Table 3-2. Internal Controls and Indicators (Con't.).

CONTROL/INDICATOR	FUNCTION
Negative Clipper (A1R100)	Screwdriver adjustment to set level of negative audio clipper.
Positive Clipper (A1R105)	Screwdriver adjustment to set level of af positive audio clipper.
Indicator Reset (A1S8)	Removes +28-V power from overload indicators to reset them to "off" condition
VSWR (A1CR10)	LED on module A1 showing that reflected power overload circuit has been tripped.
ARC (A1CR8)	LED on module A1 showing that arc sensor circuit has been tripped.
HVPS (A1CR9)	LED on module A1 showing that HVPS overload circuit has been tripped.
HVPS O/L (A1R11)	Screwdriver adjustment to set trip level for HVPS overload circuit.
VSWR O/L (A1R34)	Screwdriver adjustment to set trip level for reflected power overload circuit.
RF Driver Current Ind (A1CR56)	LED on A1 showing that RF driver current is greater than 0.5A.
RF Driver Protect (A3R19)	Screwdriver adjustment to set level of driver current that will cause RF drive to be removed from driver.

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Table 3-3. Meters on the Transmitter.

METER	FUNCTION
TEST (M3)	Provides front-panel metering of all power supply voltages except switching modulator bias. Also shows RF driver current and forward and reflected power.
PLATE VOLTAGE (M1)	Indicates PA plate-to-cathode dc voltage.
PLATE CURRENT (M2)	Indicates PA plate current.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Table 3-4. Typical Meter Readings.

METER	SWITCH POSITION	FULL-SCALE READING	TYPICAL READING
TEST	-12 V	15 V	12.0 V
	-6 V	15 V	6.0V
	+5 V	15 V	5.0 V
	+12 V	15 V	12.0 V
	+28 V	30 V	28.0 V
	DR Ec	300 V	200.0 V
	DR Ic	15 A	0.8 A
	HVPS	15 kV	8.5 kV
	Forward	120%	100% (1.1 kW)
	Reflected	12%	0
PLATE VOLTAGE		4 kV	3.0 kV
PLATE CURRENT		1 A	0.50 A

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

3.3 OPERATING PROCEDURE

Read and study this complete section before trying to operate the 314R-1 transmitter.

3.3.1 Primary Power

Apply power to the transmitter by closing the fused-disconnect wall switch.

Close both circuit breakers located on the circuit breaker panel on the front of the transmitter to the ON (up) position.

The control circuits are now energized and ready to receive commands.

3.3.2 Filament On

Press the FILAMENT ON button. This applies power to the blower. When the blower comes up to speed, the air interlock closes, applying power to the PA and modulator filaments, the RF driver, and the bias power supply. If all the door interlocks are closed and the modulator thermal interlock is closed, the PLATE OFF light will be lighted, indicating that the plate circuit is ready to be operated in either low power (LP) or high power (HP).

3.3.3 Plate On, Low Power

Press the LOW POWER ON button. Adjust the LOW POWER control on the CONTROL CIRCUIT module A1R126 to set the plate voltage to the level required to produce the proper low-power output.

3.3.4 Plate On, High Power

Press the HIGH POWER ON button. Use the RAISE or LOWER controls to set the plate voltage to the level required to produce the proper high-power output. Return to LOW POWER and reset the LOW POWER adjustment for the proper low-power level again (operating the RAISE or LOWER controls changes both the high and low-power settings).

3.3.5 Operational Adjustments

3.3.5.1 Filament Voltage

Adjust both the PA and modulator filament voltages to 4.8 volts at the tube socket terminals. Filament voltage specified on the manufacturer's data sheets for the 3-500Z is 5.0 volts rms. However, tube life can be increased significantly by operating

 WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

at slightly reduced filament voltage. Performance in the 314R-1 transmitter is not degraded by reduction of 2 to 3 percent below specified filament voltage and tube life is increased appreciably.

CAUTION

IN NO CASE SHOULD THE FILAMENT VOLTAGE BE REDUCED MORE THAN 5% (BELOW 4.75 VOLTS) BECAUSE THE "GETTERING" ACTION OF THE TUBES WILL BE IMPAIRED, CAUSING FILAMENT "POISONING" AND CONSEQUENT TUBE FAILURE. FILAMENT VOLTAGE IS MEASURED AT THE TUBE SOCKET.

3.3.5.2 Power Output Control, High Power

Transmitter "loading" is adjusted at the factory to the customer's specified value. No "loading control" is provided on the 314R-1 transmitter. When operating in high power, or if the power output as indicated by the customer "common point" meter is either too high or too low due to minor changes in the antenna system, the power output should be adjusted to the proper value by operating the RAISE or LOWER controls on the front panel. If changes in the antenna system are greater than approximately 5 percent, the tap on the coupling coil (L3) must be repositioned to accommodate the changed condition. If the plate voltage required for the proper "common point" current exceeds the range of 2.8 to 3.2 kV, or if the plate current exceeds the range of 0.48 to 0.52 A, coupling coil should be adjusted to bring the voltage and current within these limits. See paragraph 5.3.9 for this procedure.

3.3.5.3 Power Output Control, Low Power

NOTE

The proper high-power settings should be made as described in paragraph 3.3.5.2 before the low-power settings are made.

After setting the power output to its proper level, as described in paragraph 3.3.5.2, the desired low-power can be set by pressing the LOW POWER button and then adjusting the low-power control on the CONTROL CIRCUIT card A1R126 to obtain the power level desired.

3.3.5.4 Instantaneous Peak Limiter (IPL)

The IPL negative and positive limiters are energized by turning the IPL switch on the CONTROL CIRCUIT card (A1S10) to the ON position. When this switch is in the OFF position, both the negative and positive IPL limiters are disconnected from the audio circuitry and have no effect on the audio levels. However, the clamp circuit (A1R142) is always active and is set at the factory to limit the positive peaks to +130% modulation of the 1.1 kW carrier. If this circuit needs readjustment, follow the procedure outlined in section 5, paragraph 5.4.1.3.

operation

To set the positive and negative IPL limiters, first turn the IPL switch to the OFF position and adjust the audio input level with program material (not single tones) until the program material just lights the +125% indicator on the modulation monitor. At this time, the transmitter will be rather severely overmodulated in the negative direction. Turn the IPL switch to the ON position and adjust the negative limiter (A1R100) until it just prevents the negative 100% indicator on the modulation monitor from indicating (counterclockwise lowers the limiting level). Now adjust the positive limiter (A1R105) until it just prevents the +125% indicator on the monitor from indicating.

When properly set, negative levels of modulation down to -95 percent can be achieved without reaching -100 percent, and positive levels of modulation up to +120 percent can be achieved without reaching +125 percent.

It should be noted that the IPL circuits in the 314R-1 transmitter are not intended to replace processing of the audio program material. The design intent is to allow the program material to be set to provide a slightly higher average modulation level without exceeding the peak limits set in either the negative or positive direction. This is accomplished by hard limiters that have no ac coupling following them. Thus tilt and overshoot are minimized and a better limiting performance is achieved. It is therefore recommended that, if limiting is to be used, it should be done by the IPL circuits in the transmitter and not in the external audio processor.

The ability to achieve good positive peak modulation depends on two things in a PWM transmitter. First, it must be loaded properly. In the case of the 314R-1 this means that the ratio of plate voltage to plate current must be equal to 6000 ohms:

$$\frac{E_{BB}}{I_B} = 6000$$

Any deviation from this nominal value causes an improper termination of the 70-kHz filter and therefore degrades the audio performance in both peak capability and distortion. Second, the HVPS voltage must be high enough to allow the positive peaks. In the 314R-1, the HVPS should be about 8.5 kV under load (high-power carrier at 95-percent modulation) and it will rise to about 9.2 kV under no load (low-power carrier or when the carrier interlock is open, which turns off the 70-kHz switching).

CAUTION

In no case should the HVPS voltage ever exceed 10.0 kV!

Power supply components may be damaged if the HVPS is operated with the voltage above 10.0 kV.

Depending on the station line voltage, and the line voltage variation experienced during operation, the taps on the HVPS transformer should be set to give a nominal HVPS output voltage of 8.5 kV at high power 1.0- to 1.1-kW carrier under program modulation. This will provide adequate positive peak capability if the transmitter is properly loaded (E_{BB}/I_B = 6000) and the IPL limiters are set properly.

Again, in no case should the HVPS voltage be allowed to rise above 10.0 kV or damage to the transmitter may result. refer to the tables and charts in section 2 to select the proper transformer taps for your line voltage. If you have set the taps for your line voltage, and still the HVPS voltage is too low, you may increase it by setting the taps for one step (5 percent) lower than your line voltage.

CAUTION

DO NOT EXCEED THIS OR SATURATION AND OVERHEATING OF THE TRANSFORMER MAY RESULT.

If you have different antenna impedance for different antennas (night and day) or for your dummy load, these should all be adjusted to present the same load to the 314R-1 to achieve proper performance in all the loads; otherwise, performance will differ in the different loads depending on how the transmitter is loaded in each load.

3.3.5.5 Power Amplifier Tuning

The PA TUNING control (C30) is a screwdriver adjustment available through the hole in the front cover. It should be adjusted to the "dip" in plate current, as indicated on PLATE CURRENT meter M2. In some cases, a slight improvement in PA efficiency and/or a slight reduction in audio distortion can be achieved by detuning about one-half division from the plate current dip. Under no conditions should the plate be detuned more than 20 mA from the dip in plate current.

3.3.6 Maintenance Adjustments

The following controls, although available on the front of the 314R-1 transmitter, are maintenance adjustments and should only be adjusted by qualified personnel with the proper test equipment following the precedures described in the paragraphs listed below:

CONTROL	PROCEDURE PARAGRAPH NO
Carrier Regulation	5.3.6
Audio Tracking	5.3.5
LF Distortion	5.3.4
Oscillator Frequency	5.3.1

CONTROL	PROCEDURE PARAGRAPH NO
Pulse Width	5.3.2
HVPS Overload	5.3.7
VSWR Overload	5.3.8

3.4 SHUTDOWN PROCEDURE

3.4.1 Normal Shutdown

a. Press PLATE OFF switch.

b. Press FILAMENT OFF switch.

c. Open the HIGH VOLTAGE and LOW VOLTAGE circuit breakers on the transmitter front panel.

d. Open the primary power disconnect switch.

3.4.2 Emergency Shutdown

a. Press FILAMENT OFF switch.

b. Open HIGH VOLTAGE and LOW VOLTAGE circuit breakers

or

c. Open primary power disconnect switch.

4.1 INTRODUCTION

This section presents the principles of operation for the 314R-1 1-kW AM Transmitter at two levels. The first level is an overall functional description of the transmitter on a block diagram basis. The second level provides a detailed explanation of the individual transmitter circuits.

4.2 OVERALL FUNCTIONAL DESCRIPTION

The basic circuits of the 314R-1 transmitter are the RF oscillator, driver, power amplifier, audio input, modulator, and power supplies. Figure 4-1 is a simplified block diagram of the transmitter.

4.2.1 RF Circuits

A crystal oscillator feeds the solid-state driver circuit. The RF driver operates at a 125-watt power level to drive RF power amplifier. The RF power amplifier efficiency is about 73 percent. The power amplifier operates with its plate at dc ground. This eliminates the usual RF blocking capacitor, bypass capacitor, and RF choke in the high-voltage feed circuit, simplifying maintenance, and allowing direct metering at ground potential.

The RF output is coupled to the antenna through a 3-node bandpass network. This network has a very flat response near the carrier frequency in order to pass the sidebands but has very steep skirt attenuation. This provides adequate attenuation of all harmonics without the use of traps.

An RF power meter is provided at the transmitter output to read both forward and reflected power on a 50-ohm transmission line.

4.2.2 High-Voltage Power Supply/Modulator Circuits

The modulator is basically a series regulator between the high-voltage power supply (HVPS) and the RF power amplifier. The series regulator is operated in the switching mode to achieve high efficiency (about 90 percent).

The high-voltage power supply must provide enough voltage to permit the RF power amplifier to achieve +125 percent modulation on positive peaks. With no modulation, the series switching regulator (modulator) regulates the high-voltage power supply voltage (about 8.5 kV) down to the level required for the normal 1-kW carrier (about 3 kV). This is done by allowing the tube to be "on" for approximately 40 percent of the time and "off" for about 60 percent of the time. This on/off cycle operates at a 70-kHz rate.

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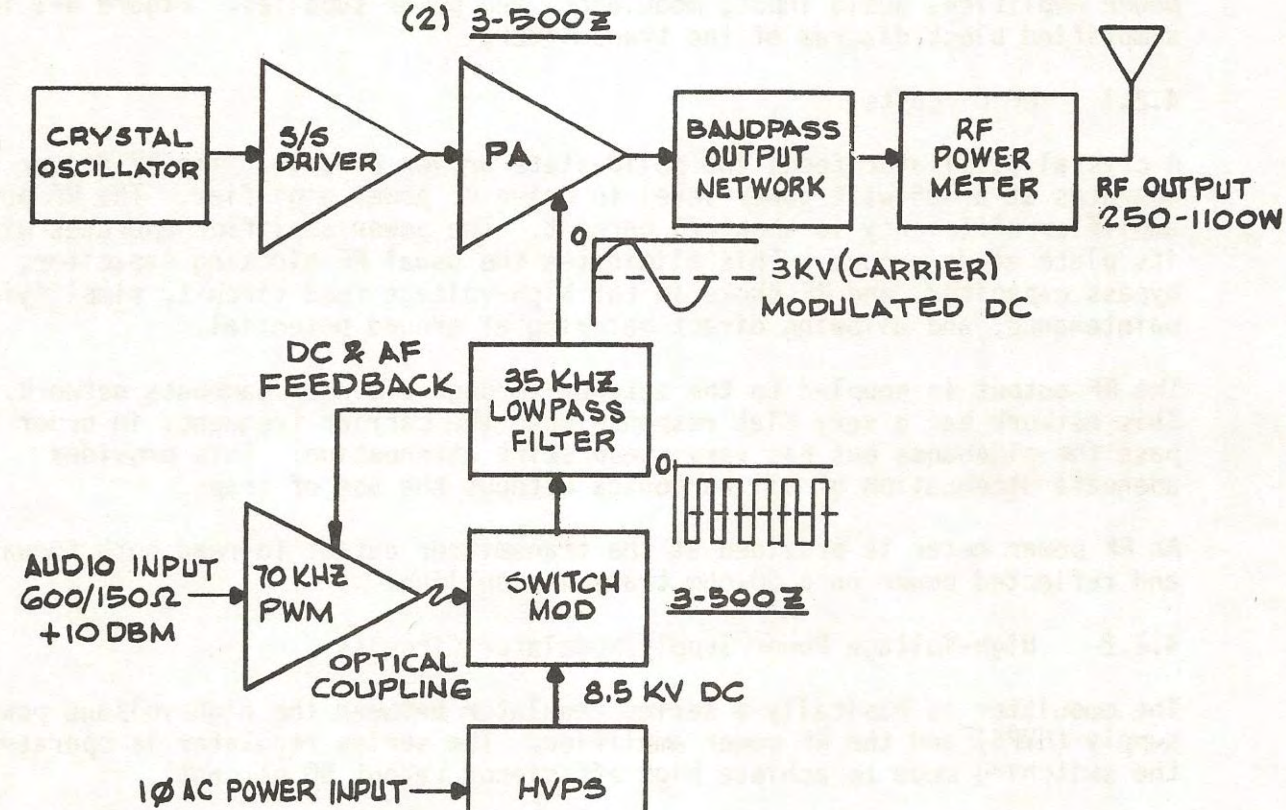

Figure 4-1. 314R-1 Simplified Block Diagram.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

To modulate the carrier, the on/off duty cycle (40 percent on) is varied at the modulation rate. This causes the average voltage supplied to the RF power amplifier to vary as the modulation. On maximum (125 percent) positive modulation peaks, the voltage increases to 6.75 kV, which means that the modulator is on nearly all the time. In the negative modulation trough, the voltage decreases to 0 volts, which means that the modulator is off all the time.

Since the modulator is switching at a very fast rate (about 70 kHz), it can follow the audio frequencies from dc to higher than 10 kHz. A filter is used between the modulator and the RF power amplifier to allow dc and audio modulation to pass, but prevents the 70-kHz switching signal from modulating the carrier. This filter is very important in determining the performance of the transmitter and is discussed in detail in paragraph 4.3.2.3.

4.2.3 Audio Input Circuits

The incoming audio signal is applied to the pulse-width modulator (PWM), which converts it into a 70-kHz pulse-width-modulated signal to drive the switching modulator. The PWM output is coupled to the switching driver module through a fiber optic cable. Optical coupling is used to isolate the low-voltage PWM circuit from the high-voltage modulator circuit.

4.2.4 Low-Voltage Power Supplies

The transmitter contains four low-voltage power supplies to provide the various dc voltages required by the transmitter. These supplies are the logic power supply, 28-volt power supply, RF driver power supply, and switching modulator bias power supply.

4.2.5 Control and Monitor Circuits

The 314R-1 transmitter control circuits can be operated either locally at the front panel, from an optional extended control panel, or from a remote control unit. Remote control is established by setting the front-panel CONTROL switch to REMOTE; however, the local "FIL OFF" and "PLATE OFF" controls are always active regardless of the CONTROL switch setting.

Monitors are provided for the major functions in the transmitter. Both local and remote monitor functions are always energized.

The LED indicators are included on certain circuit cards to aid in troubleshooting.

4.3 DETAILED DISCUSSION OF CIRCUITS

The following subparagraphs discuss the individual circuits in detail. These subsystems are RF circuits, modulator circuits, audio input circuits, high-voltage power supply, low-voltage power supplies, and control and monitor circuits.

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4.3.1 RF Circuits

The RF circuits are a crystal oscillator, a solid-state RF driver, an RF power amplifier, a 3-node bandpass network, and an RF power meter.

4.3.1.1 RF Exciter Module A3

The RF exciter module contains a crystal oscillator, a frequency divider, amplifiers, and a one-shot multivibrator. Figure 4-2 is a block diagram of the RF exciter.

The crystal oscillator operates at either twice or four times the transmitter output frequency, depending on the frequency. If the frequency is 1070 kHz or below, the oscillator operates at four times the output frequency; if the frequency is 1080 kHz or above, the oscillator operates at twice the output frequency.

The output of the oscillator is coupled to buffer amplifier Q2,. which drives frequency divider U1. The outputs from U1 are connected at jumper pins 1, 2, 3, and 4 so that either division by 2 (jumper pin 1 to pin 3) or division by 4 (jumper pin 1 to pin 2 and pin 3 to pin 4) can be selected.

From jumper pin 3, the divider output at the operating frequency is applied to one-shot multivibrator U2. The PULSE WIDTH control (R8) on the module front panel adjusts the multivibrator time constant to provide a 120 degree wide, rectangular output pulse. The output from pin 1 of U2 is fed to isolation amplifier Q3 to provide a frequency monitor output to J3. The output from pin 6 of U2 is applied through buffer amplifier Q4 to output amplifiers Q5, Q7, and Q8 to provide the drive signal to RF driver (refer to paragraph 4.3.1.2). The RF INDICATOR (CR6) lights when RF output is present.

The output of Q5 can be clamped to ground by Q6. This is done to protect the RF driver by removing the RF drive whenever the RF driver collector current exceeds a level of about 1 amp. This is accomplished by feeding a signal to U3 from the RF driver current sample which in turn drives Q6. Thus the drive is removed for a period of about 100 MS by the operation of the one-shot, U3.

4.3.1.2 RF Driver Module A9A4

The RF driver is a totem-pole amplifier operating in the switching mode. It contains two power transistors driven from T7.

The transformer T7 with one primary and two secondaries drives the amplifier so that Q1 and Q2 are turned on and off in sequence by the 120 degree drive signal. The output is taken from the common junction in the totem pole, and is ac coupled through C27 and C28 to power amplifier grid transformer T8 (refer to paragraph 4.3.1.3).

R22 provides a metering sample for the driver collector current. Normal current is 0.8 amperes at 200 volts Ecc.

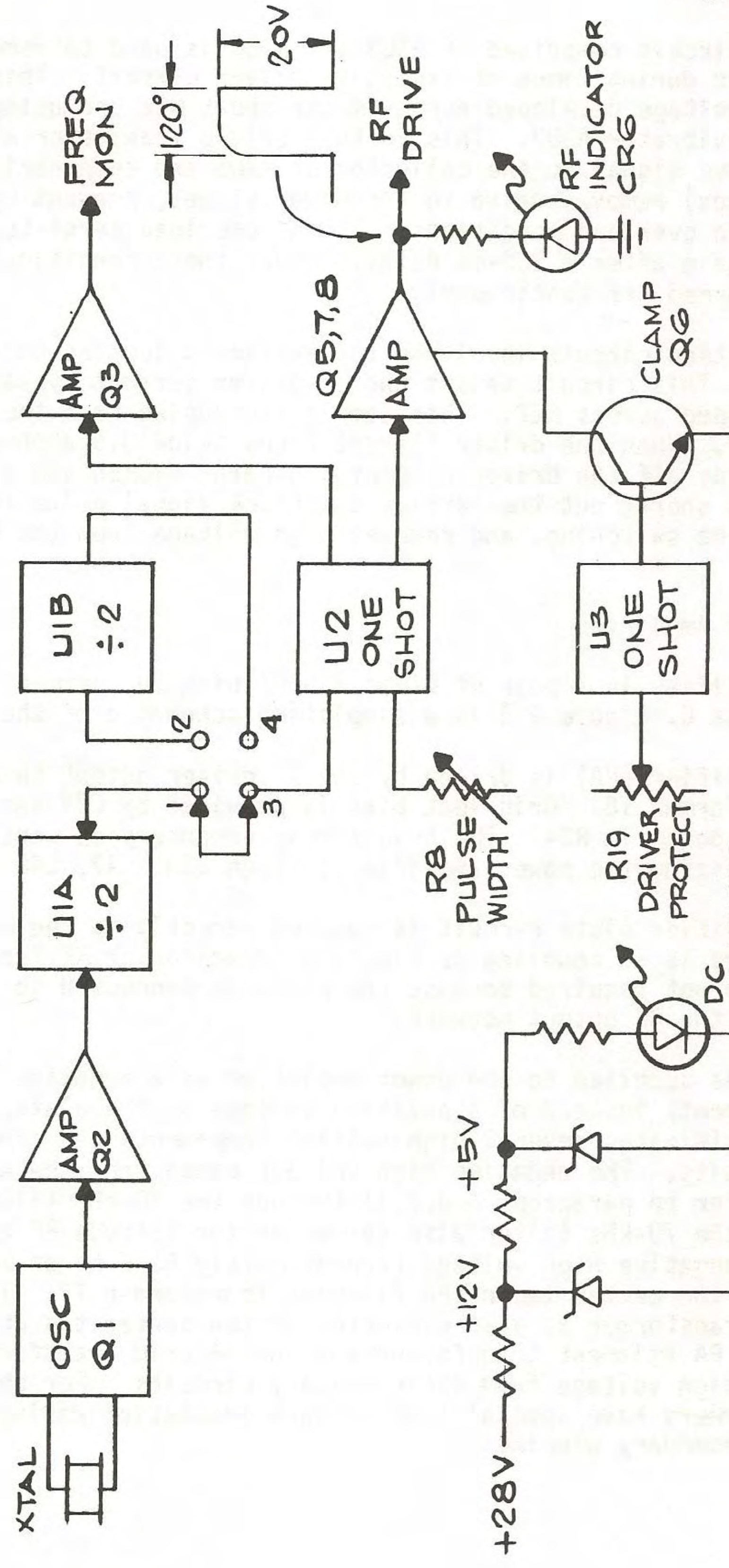

Figure 4-2. RF Exciter Block Diagram.

A protection circuit comprised of A3U3 and A3Q6 is used to remove RF drive from the driver during times of excessive driver current. This is done by sampling the voltage developed across meter shunt R22 and using it to trigger one-shot multivibrator A3U3. This in turn drives transistor A3Q6, which shunts the drive signal at the collector of A3Q5 and temporarily (for about 100 milliseconds) removes drive to the power stages, preventing them from being driven to overload conditions. If the overload persists, the drive will be shut off again after a 100-ms delay. Under these conditions, the driver is effectively turned off continuously.

Another protection circuit involving the driver is located on the control circuit card. This circuit senses the RF driver current by sampling the voltage developed across R22. This sample is coupled from the driver through pin B25 of XA1. When the driver current drops below 0.5 amperes, A1Q21 turns off, which turns off the driver current indicator A1CR56 and allows A1Q22 to turn on. This shorts out the carrier interlock signal going to PWM circuit, stops the 70-kHz switching, and removes high voltage from the RF power amplifier.

4.3.1.3 Power Amplifier

The power amplifier is a pair of Eimac 3-500Z high mu, zero-bias triodes, operating class C. Figure 4-3 is a simplified schematic of the power amplifier.

The power amplifier (PA) is driven by the RF driver output through broadband PA grid transformer T8. Grid leak bias is provided by C34 and R24. L10 limits the RF power in R24. The transformer secondary is center-tapped to permit neutralizing the power amplifier through C38, C47, C48 and C49.

The power amplifier plate circuit is coupled directly to the RF output network. There is no coupling or blocking capacitor or RF feed choke. These components are not required because the plate is connected to dc ground through L1 of the RF output network.

High voltage is supplied to the power amplifier as a negative voltage on the cathode (filament) instead of a positive voltage on the plate. This arrangement eliminates several high-voltage components and simplifies the metering circuits. The negative high voltage comes from the switching modulator (refer to paragraph 4.3.2.1) through the 70-kHz filter. The final capacitor in the 70-kHz filter also serves as the cathode RF bypass to ground. The negative high voltage (approximately 6.75 kV on modulation peaks) is applied to the center tap of PA filament transformer T9. The center tap of the PA grid transformer is also connected to the center tap of T9. This means that both the PA filament transformer and the PA grid transformer must isolate the negative high voltage from their primary circuits. For this purpose, these transformers have special high-voltage insulation ratings between their primary and secondary windings.

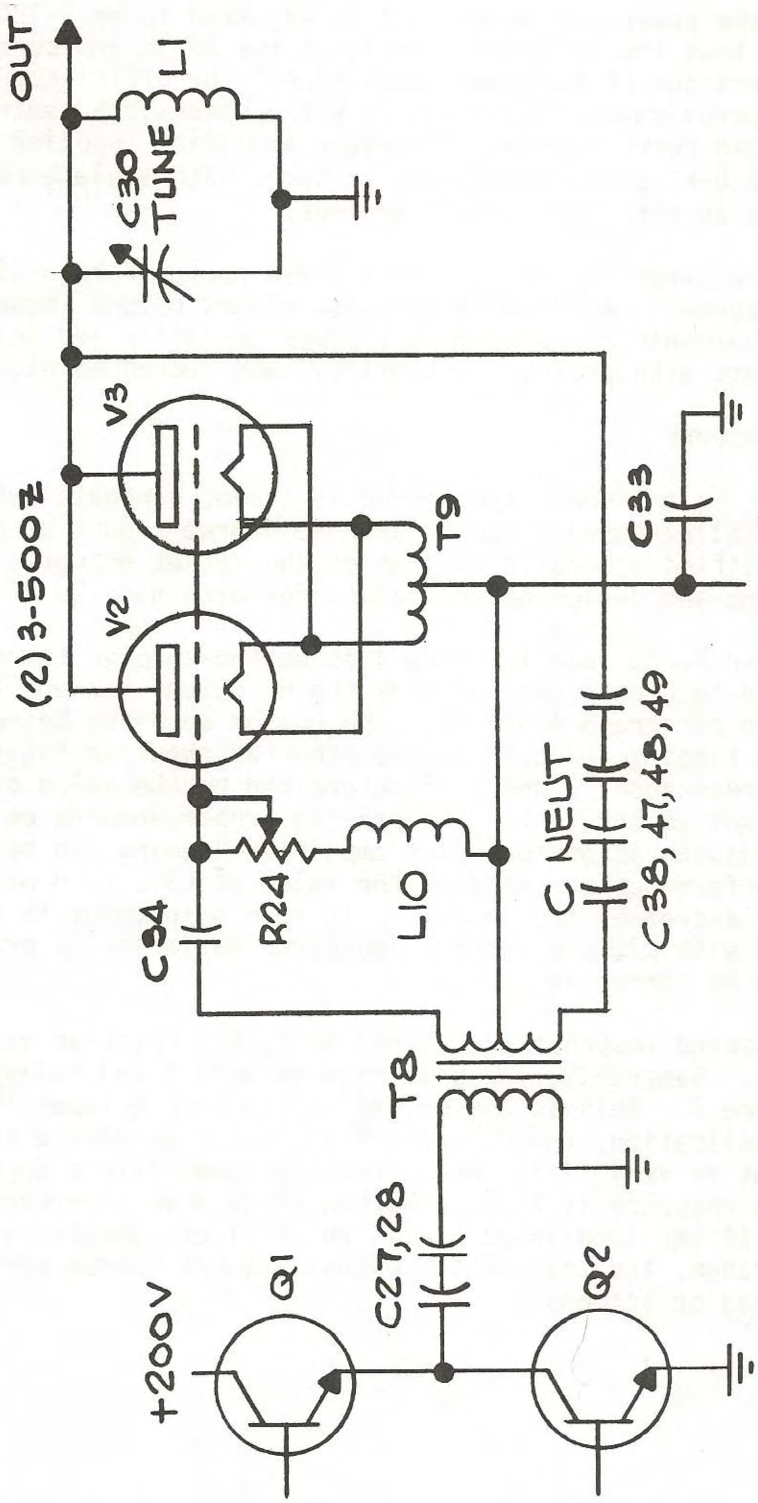

Figure 4-3. Power Amplifier, Simplified Schematic.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

principles of operation

The drive signal on the power amplifier grid is adjusted to be a 120 degree rectangular pulse so that the conduction angle of the PA is the correct amount to produce proper operation of the power amplifier. The efficiency of the power amplifier is approximately 73 percent. With pulse-width control on the RF exciter module, A3R8 correctly set, the power amplifier supplies a 1100-watt output at 3.0-kV plate-to-cathode voltage, with a plate current of 0.5 amperes. This is an efficiency of 73 percent.

The pulse width should never be adjusted to a pulse narrower than 100 degrees nor wider than 140 degrees. Adjustment to pulse widths beyond these values can cause excessive harmonic currents in the power amplifier and lead to poor efficiency and problems with arcing, instability, and increased distortion.

4.3.1.4 RF Output Network

The RF output network is a 3-node, synchronously tuned, bandpass network. It consists of three parallel-tuned circuits with 90 degree inductive couplings. Figure 4-5 is a simplified schematic diagram of the output network, showing the method of coupling and design center values for each node Q.

The RF power amplifier feeds node 1. Node 1 is bottom-coupled to node 2. Node 2 is top-coupled to node 3, which feeds the RF output through the RF power meter (refer to paragraph 4.3.1.5). The bottom coupling between nodes 1 and 2 is achieved by tapping one coil on the other as shown in figure 4-4. The top coupling between nodes 2 and 3 is determined by the value of L3. The coupling values are set at the factory to provide proper loading on the power amplifier. Slight adjustment of the power amplifier loading can be made without degrading performance by changing the value of L3 a turn or two. Decreased inductance decreases the loading. If more adjustment is required than can be obtained with L3, the antenna impedance variation is probably excessive and should be corrected.

The shape of the passband response is determined by the relative value of each node Q to the others. Generally, the Q is high at node 1 and following Q's taper downward to node 3. This is the origin of the term Q Taper ™ network. In this application, the Q Taper ™ is chosen to give a critically coupled response that is very flat. When properly tuned into a 50-ohm load, the network passband response is flat to within ±1 dB over 5 percent of the carrier frequency. If the load impedance is not flat or symmetrical over the sideband frequency range, the transmitter output network cannot correct this deficiency in the load or antenna.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

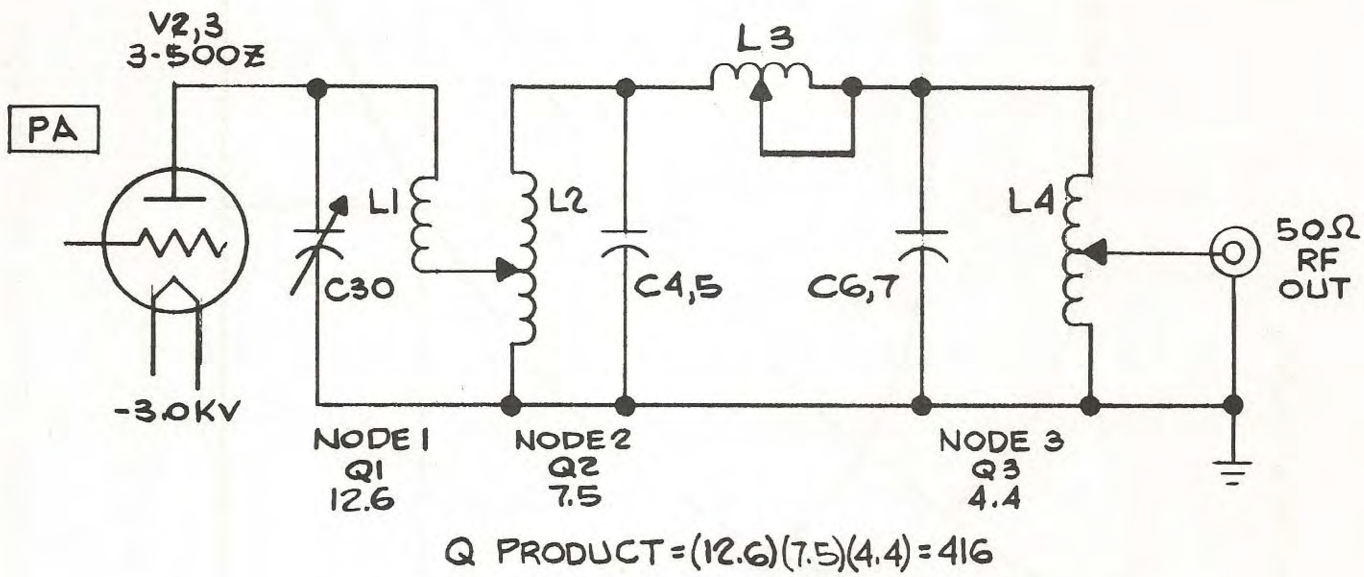

Figure 4-4. 3-Node RF Output Network.

Because it is symmetrical (being bandpass, not low pass) and has a very broad flat response, the Q Taper™ network contributes very little additional attenuation to sidebands. By comparison, the conventional low-pass network is neither symmetrical nor broad in response and normally contributes significant additional attenuation to the sidebands. Figure 4-5 provides a comparison of the response curves of a Q Taper™ bandpass network and the low-pass network.

The Q product (Q1 X Q2 X Q3) determines the steepness of the skirts of the passband. With three nodes and two inductive couplings, the Q product required to obtain 73.4-dB attenuation of the second and higher harmonics is 416.

The modulation monitor sample is provided by K2. It has adjustable taps for high and low power settings. The sample is obtained from a tap on node 3 coil L4.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

principles of operation

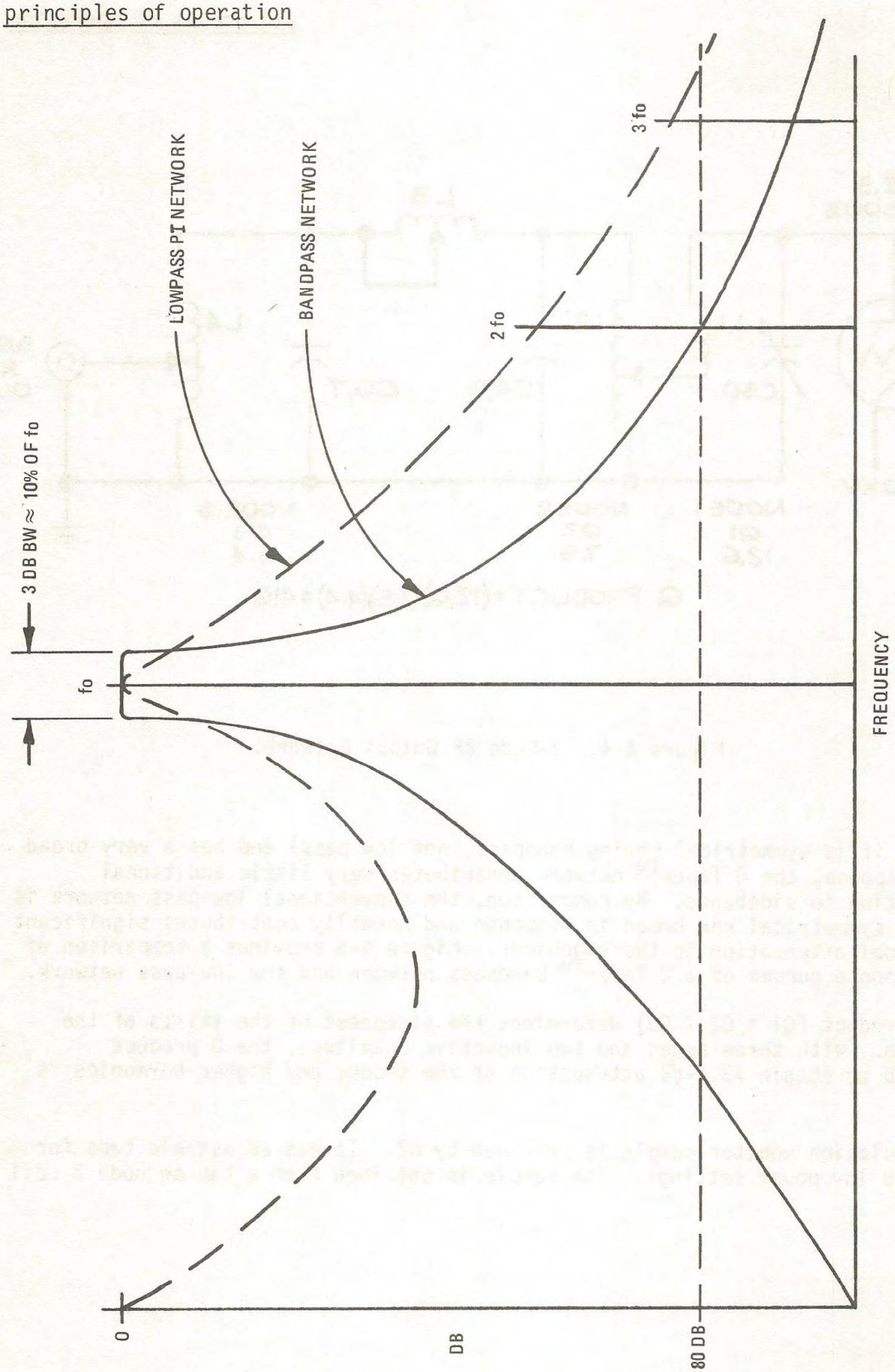

Figure 4-5. Comparison of Q Taper TM Bandpass and Usual Low Pass (PI) Network Response.

4.3.1.5 RF Power Meter A5

The RF power meter circuit is a directional coupler designed to provide both forward and reflected power readings relative to a 50-ohm unbalanced load. It consists of a line current sampling pickup in the form of a shielded ferrite toroidal coil in combination with a capacity divider to sample the line voltage. The current sample is taken in a balanced fashion (center-tap ground). The two current samples are combined with the voltage sample and rectified. One output provides a reading proportional to forward power and the other provides a reading proportional to reflected power. The voltage sample is adjustable to permit balancing the circuit to the 50-ohm load. The forward and reflected power sensing circuit can be balanced for impedances other than 50 ohms, but the value of A5C1 capacitor may have to be changed. For higher impedance lines, this capacitor may need to be reduced in value.

Calibration adjustments permit setting the forward and reflected power meters to the desired power level readings. Isolation amplifiers in control circuit card A1 isolate the metering circuit from the detectors. The reflected power signal is used to actuate an overload circuit when the reflected power reaches a predetermined level. The meters are calibrated at the factory to read 100% (120% full scale) at 1.0 kW in the forward power position and 10% (12% full scale) at 100 watts in the reflected position. The vswr overload is set to trip at 100 watts reflected power, which represents a 2:1 vswr with 1.0-kW forward power.

Switch S8 permits reversing the current sample, which in turn reverses the forward and reflected readings (forward now reads reflected power and vice versa). This permits setting the vswr overload without physically turning the vswr detector around. Remember that the reflected power (now reading forward) is only 100 watts full scale and will trip the vswr overload. Transmitter power must be reduced below 100 watts during these adjustments.

4.3.2 Modulator Circuits

The modulator in the 314R-1 transmitter is basically a series regulator between the high-voltage power supply (refer to paragraph 4.3.3) and the RF power amplifier (refer to paragraph 4.3.1.3). It is operated in the switching mode at a frequency of 70 kHz. This allows the modulator to operate at a very high efficiency (about 90 percent), and requires a fast recovery clamp diode and a low-pass filter circuit to function properly. Figure 4-6 is a simplified schematic diagram of the 314R-1 transmitter and illustrates the functions of the modulator and associated circuits.

The modulator circuits are a pulse-width modulator, a switching driver, a switching modulator, feedback circuits, automatic modulation control, and instantaneous peak limiter.

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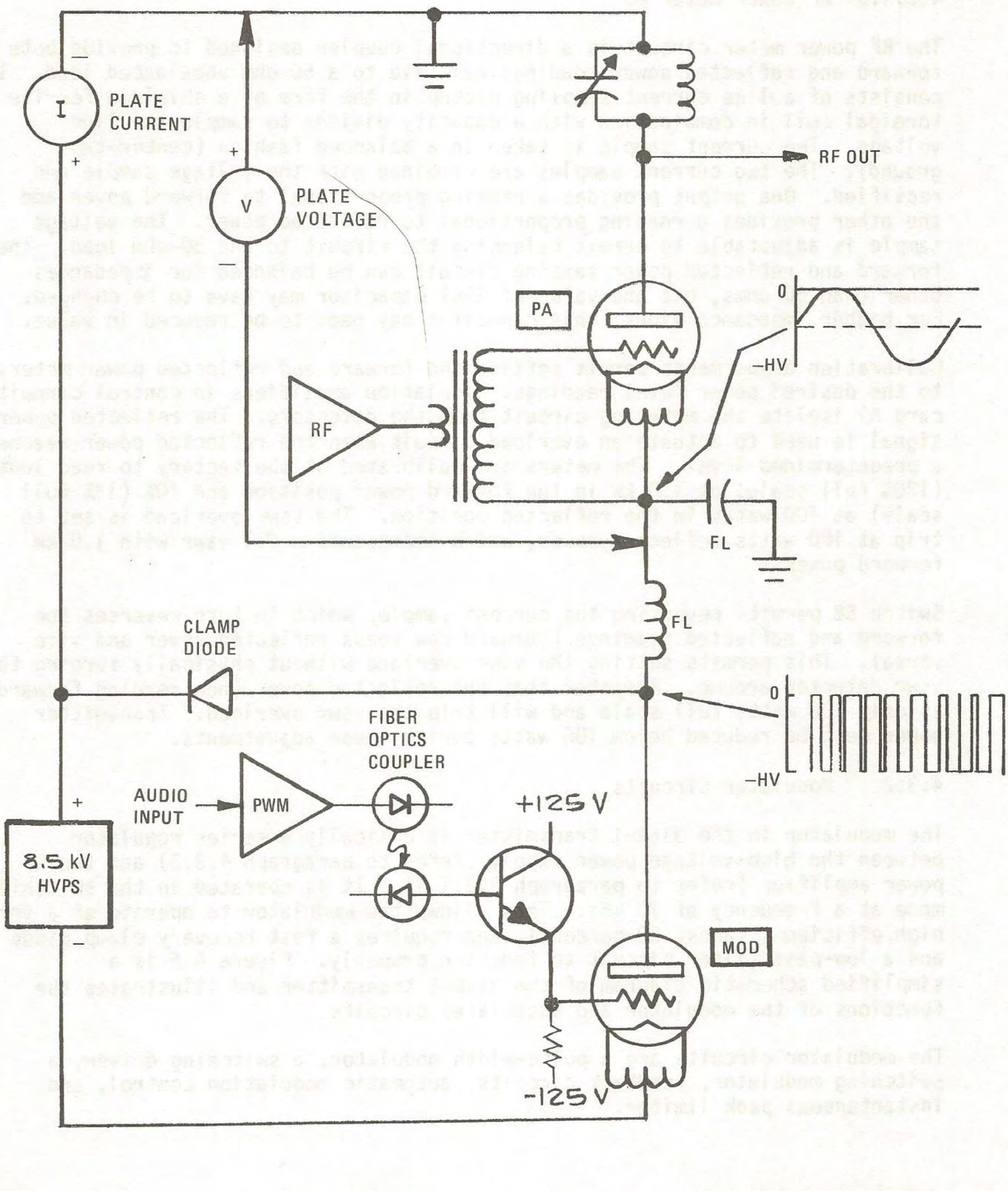

Figure 4-6. Transmitter Simplified Schematic.

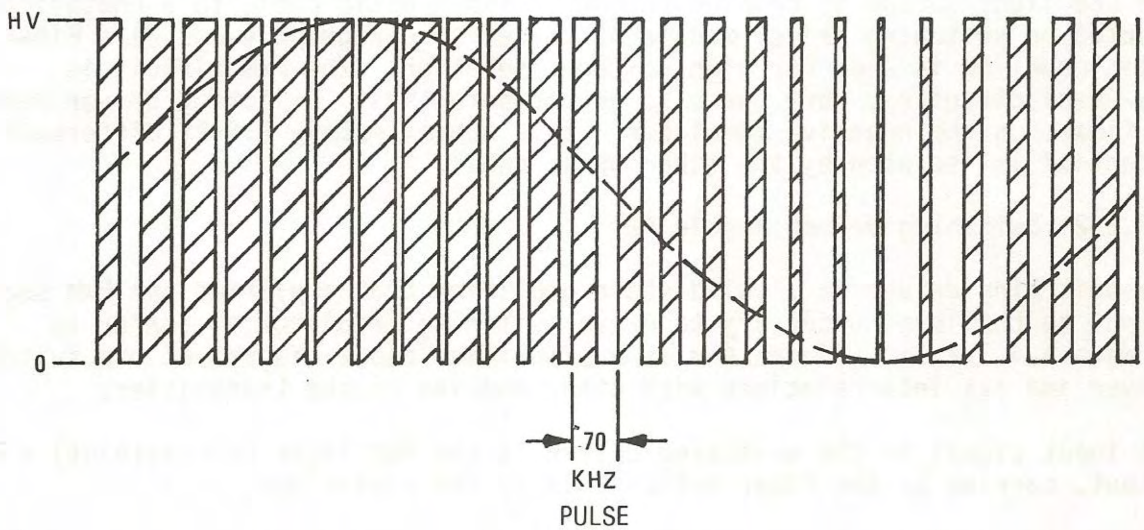

Figure 4-7. Typical PWM Waveform.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

4.3.2.1 Pulse Width Modulator

The pulse-width modulator located on the control circuit card accepts the incoming audio signal and converts it to a 70-kHz pulse-width-modulated signal to drive the switching modulator. This conversion is performed by comparing the audio signal with a 70-kHz triangular waveform in integrated circuit U19, which is a comparator. The comparator output is a PWM waveform, is illustrated in figure 4-7. This is a series of pulses at a 70-kHz rate whose widths vary as the audio signal. The PWM output from the comparator is fed through an inverter and a NAND gate to provide interlock and overload functions. The NAND gate output drives transistor Q23 which controls an LED mounted on the control circuit card.

The LED light output is coupled through a fiber optic cable to a photodiode mounted on switching driver module A2 (refer to paragraph 4.3.2.2). Fiber optic coupling is used for high-voltage isolation. The PWM circuit is low-level circuitry, very close to ground potential. Switching driver module A2 floats on the negative modulator. This approximately 8.5-kV difference in potential is isolated by the fiber optic cable.

4.3.2.2 Switching Driver Module A2

The switching driver is a solid-state amplifier that amplifies the PWM signal output to the level necessary to drive switching modulator V1 (refer to paragraph 4.3.2.3). Figure 4-8 is a simplified block diagram of the switching driver and its interrelations with other modules of the transmitter.

The input signal to the switching driver is the PWM light (ultraviolet) signal output, carried by the fiber optic cable to the photodiode.

The output of the photodiode triggers a comparator at the PWM rate, and thereby regenerates the original PWM electrical signal. A complementary pair emitter-follower stage isolates the comparator output and drives the intermediate amplifier stage at the 28-volt level. This intermediate amplifier is a common-emitter stage driving another complementary pair of emitter-followers. The intermediate amplifier drives the high-voltage amplifier, which in turn drives the Darlington switch stage that is directly coupled to the modulator grid. When the Darlington switch is turned off, the modulator grid is connected to -125 volts with respect to the cathode and the modulator is biased off.

The switching driver stages are all dc coupled and the light signal in the fiber optic cable has a dc component. It follows that the entire signal path, from the PWM generator to the modulator grid, is dc coupled.

The switching driver circuits are referenced to the modulator cathode, which is connected to the negative high-voltage power supply. Therefore, the +125-volt and -125-volt power supply, which furnishes power for the switching driver and acts as bias for the switching modulator, is also floating on, or referenced to, the negative high voltage. For this reason, this power supply requires a special transformer with high-voltage insulation between the primary and secondary windings.

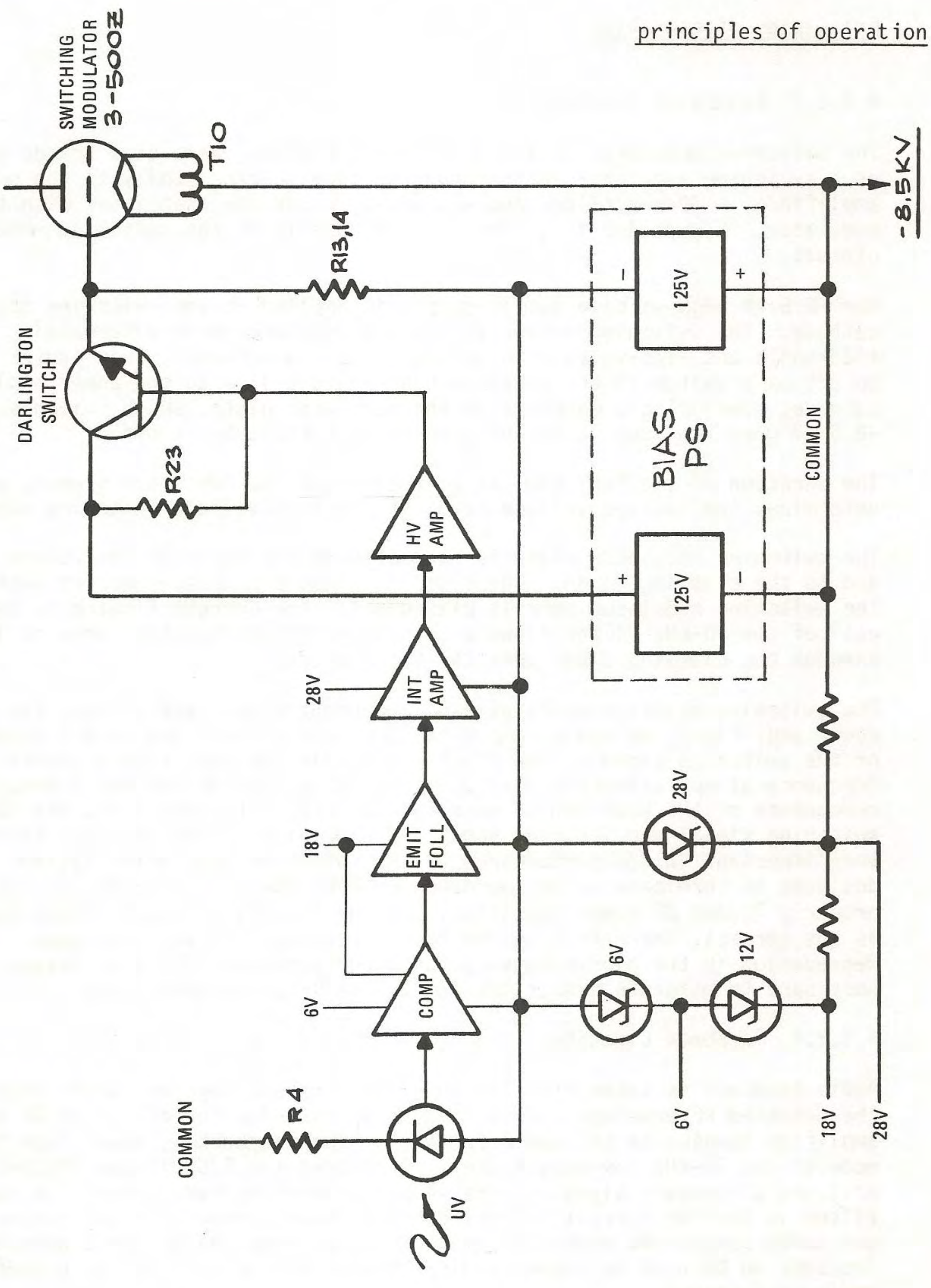

Figure 4-8. Switching Driver Operation, Block Diagram.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

4.3.2.3 Switching Modulator

The switching modulator is an Eimac 3-500Z high mu, zero bias triode operated as a switching regulator in the negative high-voltage supply to the power amplifier. A 70-kHz filter and a clamping diode are associated with the modulator. Figure 4-9 is a simplified schematic of the switching modulator circuit.

The -8.5-kV high-voltage supply output is applied to the switching modulator cathode. The switching driver drives the modulator grid alternately +125-volts and -125-volts with reference to its cathode. This causes the tube to act as a switch in the negative high-voltage line to the power amplifier cathode, developing a waveform on the modulator plate, which switches between -8.5 kV when the tube is on and 0-volts when the tube is off.

The duration of the "on" time is a function of the PWM drive signal, and determines the average voltage level of the high-voltage switching waveform.

The switching modulator plate is connected to the input of the 70-kHz filter and to the clamping diode. The clamping diode provides a current path when the switching modulator tube is biased off. The current flowing in the input coil of the 70-kHz filter flows alternately through the tube when it is on and through the clamping diode when the tube is off.

The switching waveform contains a dc component (the plate voltage for the RF power amplifier), an audio component (the modulation), and 70-kHz components of the switching signal. The 70-kHz filter is low pass with a cutoff frequency at approximately 35-kHz. This allows the dc and audio modulation components of the waveform to pass through the filter but stops the 70-kHz switching signal and its side bands and harmonics. This low-pass filter is very important in the performance of the switching modulation system. It is designed to terminate in an impedance of 6000 ohms, as provided by the properly loaded RF power amplifier. If the loading of the RF power amplifier is not correct, the effect on the filter termination can cause some degradation in the high-frequency audio performance. For this reason, it is necessary to maintain proper loading on the RF power amplifier.

4.3.2.4 Feedback Circuits

Audio feedback is taken from the modulated high-voltage dc rather than from the detected RF envelope. This is done to minimize the effect of RF power amplifier loading on the audio feedback. The feedback is taken from the first node of the 70-kHz low-pass filter. A compensated R/C divider (P/OA4) delivers a feedback signal at the -4-volts level to PWM circuit. A low-level filter in the PWM circuit filters out the 70-kHz components and passes the dc and audio components with a minimum of audio phase shift. This permits the feedback to be used to higher audio frequencies and with better high-frequency audio performance.

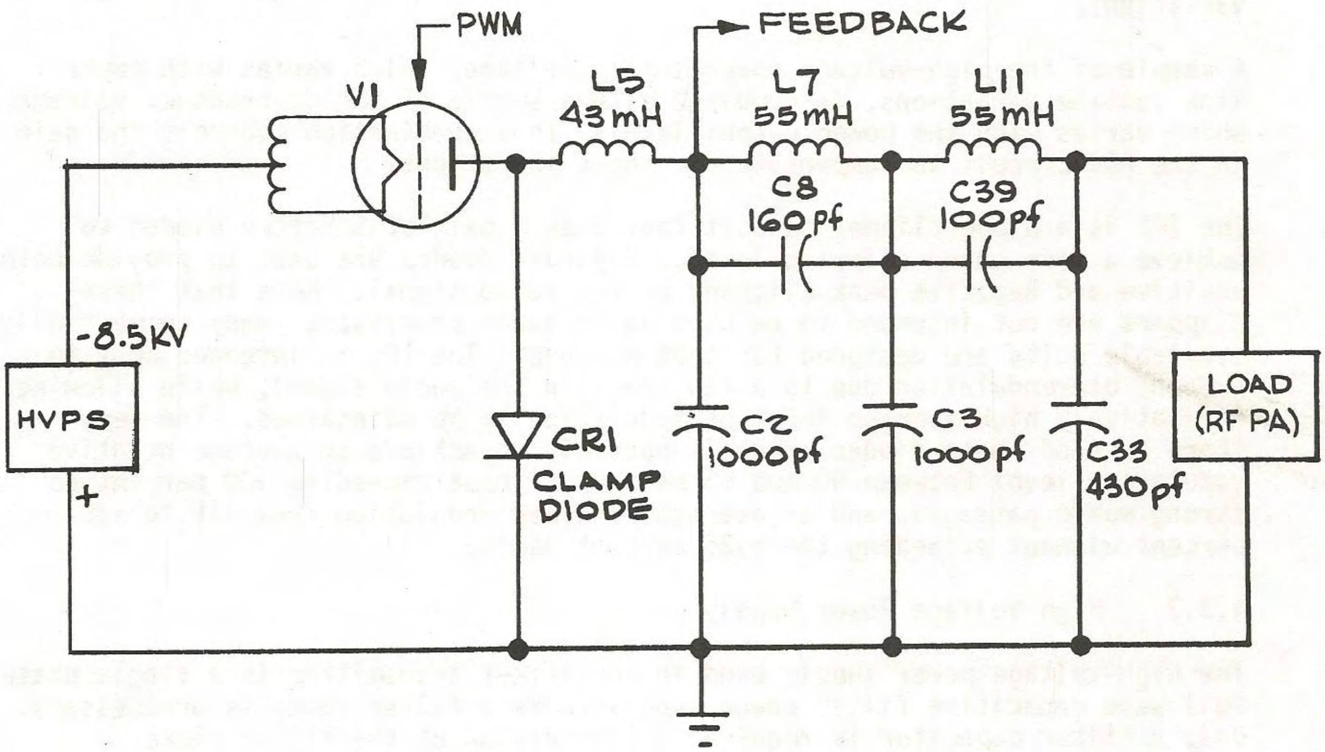

Figure 4-9. Switching Modulator Circuit.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

principles of operation

Since the switching modulator and the feedback circuits are dc coupled, the feedback is effective down to and including dc. This has two advantages; first, it provides excellent low-frequency audio performance, and second, it makes it a very simple matter to adjust the power output. A dc reference voltage is set by a motor-driven potentiometer and the feedback loop adjusts the plate voltage to match it.

4.3.2.5 Automatic Modulation Control and Instantaneous Peak Limiter

Two modulation level control circuits contribute to the superior audio performance of the 314R-1 transmitter. These are the automatic modulation level control circuit and the instantaneous peak limiter (IPL). These two circuits, in combination, adjust the audio level to maintain a high level of modulation at all power levels and to compensate for power line voltage variations.

A sample of the high-voltage power supply voltage, which varies with power line voltage variations, is combined with a sample of the dc feedback voltage, which varies with the power output level. This combination controls the gain in the AGC circuit to compensate for these variations.

The IPL is a diode clipper circuit that uses a pair of Schottky diodes to achieve a very sharp clipping level. Separate diodes are used to provide both positive and negative peak clipping of the audio signal. Note that these clippers are not intended to be used as an audio processor; many commercially available units are designed for that purpose. The IPL is intended only to prevent overmodulation due to a few peaks in the audio signal, while allowing a relatively high average level of modulation to be maintained. The very sharp knee of these diodes makes it possible to achieve an average negative modulation level between 90 and 95 percent without exceeding 100 percent on strong music passages, and an average positive modulation from 115 to 120 percent without exceeding the +125 percent limit.

4.3.3 High-Voltage Power Supply

The high-voltage power supply used in the 314R-1 transmitter is a single phase full wave capacitive filter power supply where a filter choke is unnecessary. Only a filter capacitor is required. Elimination of the filter choke eliminates low audio frequency resonances that occur in most high-voltage power supply filters.

In this power supply, filtering is provided by a capacitance of only 20 microfarads, C1.

The nominal output voltage of the high-voltage power supply is 8.5 kV, and the normal load current at carrier conditions is about 200 mA. At 100 percent modulation, the current increases to about 300 mA. It should be remembered that, in the switching type of series modulator, the high-voltage power supply is connected to the load for only approximately a 40 percent duty cycle. This means that the average current is about 40 percent of the power amplifier plate current (500 mA X 40% = 200 mA). The difference current, between 500 mA and 200 mA, flows through the clamping diode. Note that these numbers represent no moduation conditions. The relative currents vary during modulation, with the power supply furnishing more current and the clamping diode less, as the modulation level increases.

The transformer is rated for either 50- or 60-Hz operation. Taps are provided on the primary windings to accomodate input voltages from 200 to 250 volts. Section 2, Installation, of this instruction book contains tables showing the proper tap connections for various lines voltages.

4.3.4 Low-Voltage Power Supplies

The 314R-1 transmitter uses only triode tubes. This simplifies low-voltage power supply requirements. As a result, there are only four low-voltage power supplies in the transmitter. These are logic power supply, the 28-volt power supply, the RF driver power supply, and the modulator bias power supply.

4.3.4.1 Logic Power Supply

The logic power supply provides the +5, -6, and ±12 volts required by the various low-level circuits. The transformer for this power supply is mounted on the left wall (viewed from rear); it supplies 24 volts ac to the full-wave rectifier on the card. The transformer center-tap is also carried through to provide ±18-volt outputs. Integrated circuit regulators provide the regulated +5, -6, ±12 volts outputs. The regulators are mounted on heat sinks for cooling. The negative regulators (-6 and -12 volts) are located on a separate isolated heat sink and the positive regulators (+5 and +12 volts) on the heat sink bar. The LED indicators on the card indicate the presence of each of the four voltages and the TEST meter reads all four output voltages.

4.3.4.2 28-Volt Power Supply

The 28-volt power supply is a single-phase, full-wave bridge circuit, capable of supplying about 2 amperes of output current.

CAUTION

ENSURE THAT THE 28-VOLT POWER SUPPLY IS NOT LOADED WITH EXTERNAL LOADS IN EXCESS OF 1 AMPERE.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

This power supply furnishes power for the various 28-volt relays and the high-voltage power supply contactor. In addition,the +28 volts is used for intermediate RF amplifiers in RF exciter modulat A3. A 28-volt output is also available at the remote control terminal strip A1TB1 for use in remote control of the transmitter. It is also available on TB2-9.

4.3.4.3 RF Driver Power Supply

The RF driver power supply is a single-phase, full-wave bridge circuit that supplies 0.8 amperes at 200 volts to the solid-state RF driver module. A double LC filter section, consisting of L8 & 9 and C14 & 15, provides adequate filtering of the ripple frequency.

4.3.4.4 Modulator Bias Power Supply

The modulator bias power supply is a full-wave bridge circuit that uses the center-tap of the secondary to provide +125 and -125 volt outputs. Each output, therefore, is a half-wave rectified signal.

The common center-tap of this power supply is connected to the negative high voltage (-8.5 kV), which is connected to the modulator (V1) cathode. Thus, the modulator grid can be switched by the switching driver from +125 to -125 volts with reference to its cathode to control the modulator output.

Note that the transformer for this power supply has special insulation between the secondary windings and the primary and frame to withstand the 8.5-kV potential between them. Note also that the circuit A6 containing the rectifiers and filters is isolated electrically from the chassis because of the 8.5-kV differential.

4.3.5 Control and Monitor Circuits

The control circuits operate from an internal +28-volt power source. The local controls are active when LOCAL/REMOTE switch S5 is in the LOCAL position. With the switch in the REMOTE position, the +28 volt power source is connected to A1TB1-2 to furnish power for remote control functions. In the LOCAL position, the LOCAL/REMOTE switch connects a jumper across the remote fail-safe terminals at A1TB1-6 and 7.

4.3.5.1 Power Control Circuits

The power control circuits include the indicating control pushbutton switches on the front of the transmitter, the low-level 28-volt relays on the control circuit printed circuit board A1, the blower and filament contactors on the right side panel, and the high-voltage contactor on the left side panel. Three door interlock switches are connected in series to prevent application of high voltage if the front panel is open or if either the lower front panel or the rear door is open. An air interlock switch that senses air pressure in the power amplifier grid compartment prevents application of filament power without proper cooling. The operation of the power control circuits when the FILAMENT ON and the PLATE ON sequences are initiated is described in the following subparagraphs.

a. Filament-On Sequence. When LOW VOLTAGE circuit breaker CB1 is closed, 28-volt power is applied to the power control circuits. The FILAMENT OFF switch will light, indicating that the filament power is off. If all three door interlock switches are closed and the thermal interlock switch is closed, then the PLATE OFF switch will also light. This is the normal condition prior to turn-on.

When the FILAMENT ON switch is pressed, it energizes blower contactor K3, which is then held in through its holding contacts, 4 and 12. These contacts are in series with the FILAMENT OFF switch. When the blower contactor is operated, it applies ac power to blower B2 and cabinet fan B1. When the blower and the fan reach operating speed and the resulting air pressure in the power amplifier grid compartment reaches 19 mm (0.75 in.) of water, air interlock switch S6, located on the rear of the power amplifier grid compartment, closes and applies 28-volts to filament contactor to both the power amplifier and modulator filament transformers. It also switches 28-volt power from the lamp in the FILAMENT OFF switch to the lamp in the FILAMENT ON switch.

When the FILAMENT OFF switch is pressed, it causes the holding circuit on the blower contactor to be interrupted, de-energizing the blower contactor and shutting off the blower and cabinet fan. It also removes the 28-volt power from the filament contactor. This disconnects the ac power from the two filament transformers and switches 28-volt power from the FILAMENT ON switch lamp to the lamp in the FILAMENT OFF switch.

There is a very short 1 second HV time-delay because the filaments in both the power amplifier and modulator tubes are thoriated tungsten and require essentially no warmup period. They reach operating temperature in about 1 second and are not damaged or degraded by immediate application of high-voltage power.

b. Plate-On Sequence. The PLATE OFF switch must be lighted, indicating that the door interlocks are all closed and the thermal interlock is closed before 28-volt power is available for the plate-on sequence.

The plate-on sequence is started by pressing either the LP ON or the HP ON switch. Because there is choice of either low power or high power, latching relay A1K5 is provided on the control circuit card to "remember" which has been selected. Pressing either switch puts the latching relay in the corresponding position. The latching relay controls the LP ON relay in PWM circuit and also energizes HV ON relay A1K6 on the control circuit card. When the HV ON relay is energized, through either diode A1CR34 (LP ON) or A1CR33 (HP ON), it holds itself through holding contacts 8 and 12 in series with the overload relay, the door interlocks, and the PLATE OFF switch. It also applies 28-volt power to high-voltage contactor K1*. This connects ac power to the high-voltage plate transformer and 28-volt power to the carrier interlock terminal on terminal board A1TB1-12. This terminal is connected through any desired external interlock circuit and returned to A1TB1-13, where it allows the PWM signal to start switching. This arrangement makes it possible to remove voltage on the power amplifier without deenergizing the high-voltage power supply and can be used for such purposes as interlocking day/night switching, dummy load interlock, etc.

The PLATE ON signal, either LP ON or HP ON, is also coupled back to the FILAMENT ON circuit through diodes A1CR27 and 58 to enable a complete turn-on sequence by merely pressing either the LP ON switch or the HP ON switch without first turning the filaments on. When this is done, there is only a slight delay until the blower reaches operating speed and about 1 second thereafter until the filaments in the power amplifier and modulator tubes reach operating temperature.

The LED indicators on the A1 card indicate which relays are actuated to aid in troubleshooting the power control circuits.

4.3.5.2 Overloads and Recycle

Control circuit module A1 also contains the overload and recycle circuits. The three overload circuits are the high-voltage supply overload, the arc sensor, and the vswr overload. Each overload circuit is connected to a separate LED indicator on the control circuit card. If any one of the overload circuits is actuated, it lights its indicator. It also sends a signal through the U3A logic gate to one-shot multivibrator U4. The $\overline{Q}$ output from U4 is coupled to U21B in PWM circuit. This causes the PWM pulse train to stop for about 100 milliseconds, removing high voltage from the RF power amplifier for that period of time. If the overload was due to some temporary cause and is no longer present after the 100-millisecond interruption, the PWM resumes, and normal operation continues. However, the LED indicator remains lighted until IND RESET switch S8 on the front panel is pushed to reset the SCR and extinguish the LED. S8 is also a front panel summary of all three overload indicators.

The Q signal from U4 is also applied to the input of counter U5. The signal through logic gate U3A that causes U4 to operate is also coupled through a section of U6 to timer U7 and starts a timing cycle of about 20 seconds. The output of timer U7 is coupled through a section of U6 back to counter U5. The counter counts only during the timing cycle of timer U7. If it counts four overloads during the 20-second timing cycle, it then has an output on pin 9 of U5.

*K1 is actuated only if the HV time delay circuit (U13, Q19 & 20) has timed out (approximately 1 second) and Q20 is conducting.

If RECYCLE switch S9 is in the ON position, the output on pin 9 of U5 is coupled to the second one-shot multivibrator, the output of which operates overload relay A1K4 on control circuit card A1, which opens the plate control circuit, dropping the high voltage. After this occurs, high voltage can be restored only by pressing either the PLATE LP switch or the PLATE HP switch again.

If RECYCLE switch A3S2 is in the OFF position, the recycle circuitry is bypassed. The original overload signal from U4 is coupled directly to U8 to operate relay driver Q9 and cuts off the high voltage on the first overload. The circuit of Q7 and Q8 is an integrator, which also can operate overload relay A1K4. If the RECYCLE switch is ON, but a single extended (long time) overload occurs, integrator C25 charges, operating Q8, which operates the overload relay.

4.3.5.3 Monitor Circuits

The monitor circuits consist of the front-panel meters, the lighted switches, and the various LED indicators that show status, overloads, and performance.

Three front-panel meters provide readings of power amplifier dc input nd RF output, and other internal voltages to be used in troubleshooting (refer to Section 6 of this section book). These three meters are PLATE VOLTAGE, PLATE CURRENT, and TEST.

The TEST meter reads the logic power supply output voltages, the 28-volt dc power supply voltage, the RF driver supply voltage and current, the high-voltage power supply voltage and either the forward power or the reflected power at the transmitter output to the antenna. In the FORWARD position, the meter reads up to 120 percent power; in the REFLECTED position up to 12 percent. The voltage shown on this meter is selected by the associated 10-position rotary TEST meter switch.

The PLATE VOLTAGE meter reads the power amplifier plate-to-cathode dc voltage.

The PLATE CURRENT meter reads the power amplifier plate current.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

5.1 INTRODUCTION

The maintenance section is divided into three major segments: Routine Maintenance, which should be performed on a routine or regular basis to prevent transmitter performance from deteriorating; Maintenance Adjustments, which might be needed from time to time, especially if a part or component is changed; and Special Maintenance Adjustments, which might be required in the event of a major change in operating conditions. The recommended test equipment to perform the maintenance described here is listed in table 5-1.

Table 5-1. Recommended Test Equipment for 314R-1 Maintenance.

- Voltohmmeter
- Oscilloscope
- Audio Oscillator
- Audio Distortion Analyzer
- RF Dummy Load (2 kW, 50 ohm non-reactive)
- Frequency Counter
- Variable DC Power Supply (0.6A)

5.2 ROUTINE MAINTENANCE

Routine maintenance should be performed on a regularly scheduled basis to guarantee adequate cooling of the transmitter for long life, cleanliness to minimize both high voltage and heating problems, and regular checks of operational adjustments to ensure top performance and to note any changes in the transmitting system that might indicate potential problem areas.

5.2.1 Inlet Air Filter and Air Switch

The inlet air filter located on the lower rear door of the transmitter should be inspected weekly and cleaned or replaced as necessary. Operation with a dirty filter can cause air starvation and result in reduced life and excessive failure of components, including the modulator and PA tubes. Frequency of this maintenance should be dictated by the general cleanliness of the transmitter environment.

The air interlock switch, S6, located on the rear of the PA grid compartment, should be checked periodically to assure that it is operating properly to protect the transmitter. It is a pressure switch and is set to open when the pressure in the PA grid compartment drops below a safe level. To test its operation, either remove the blower fuse or open the panel door while the filaments are energized. If the air interlock is functioning properly, the filaments will be deenergized as indicated by the green FILAMENT-ON light going out. If this does not happen, readjust the adjustment screw on the air interlock switch until proper operation is restored. If proper operation can not be achieved by adjusting the adjustment screw, the position of the microswitch may have slipped and need realignment. This can best be accomplished by removing the air switch and setting the position of the microswitch in combination with the adjustment screw to allow full travel [approximately 6.3 mm (1/4 in.)] of the diaphram with the application of light air pressure at the inlet tube.

The switch should be adjusted while in the same relative position that it is when mounted in the transmitter, because gravity does have an effect on its operation. Because its operation is relatively delicate and its function rather important, it is advisable to check its operation routinely. As the air filter is inspected for cleanliness, the operation of the air interlock should be checked.

5.2.2. Cleaning

The transmitter should be inspected weekly for general cleanliness, particularly in areas where high voltage is present. Dust is attracted by the high voltage and will eventually lead to high-voltage arcing and overload problems if not controlled by a preventive maintenance routine of regular cleaning. It is recommended that cleaning of the transmitter be accomplished using a vacuum cleaner rather than blowing with air pressure. Air pressure tends to blow the dirt into areas where it may lodge and cause more trouble than if it were left alone in the first place. Again, frequency of this maintenance should be dictated by the general cleanliness of the transmitter environment.

5.2.3 Lubrication

The only points in the 314R-1 transmitter requiring lubrication are the bearings of the fan and blower motors. These can be accessed from the rear of the transmitter and should be lubricated with a few drops of a good grade light machine oil every 3 months of continuous operation under normal conditions. Under high ambient temperatures (86 F or higher) more frequent lubrication, probably every 1 or 2 months, would be advisable.

5.2.4 Normal Operational Adjustments

There are very few normal operational adjustments required in the 314R-1. These are PA tuning, power output, and the IPL clipping levels.

5.2.4.1 PA Tuning

The PA tuning is a front-panel screwdriver adjustment and should be set for a dip in plate current. Sometimes the tuning can be turned slightly (approximately one-half turn) off the plate current dip to improve the audio distortion. This varies from one transmitter to another, depending on the operating frequency and loading of the PA. In any case, the amount of detuning should never exceed on division (20 mA) on the plate current meter. Any more detuning than this results in lowering the efficiency to an unacceptable level.

5.2.4.2 Power Output Level

Since there is no loading control, the power output level should be adjusted in high power by using the RAISE and LOWER controls to set the plate voltage to the level required to give the desired power output. After setting to the proper level in high power, switch to low power and adjust the LOW POWER adjustment on control circuit card A1R126 to set the low power to the desired level.

As long as the antenna and/or dummy load impedance at the transmitter is constant and presents the correct load to the transmitter, the only adjustments necessary are minor adjustments of the PA tuning and power level as previously described. If the transmitter load impedance varies more than approximately 5 percent from the correct value, the performance will be degraded to some degree. The proper loading is when the ratio of plate voltage to plate current is 6000 ohms:

$$\frac{E_{BB}}{I_B} = 6000\Omega$$

At full power (1100 watts), this should nominally be a plate voltage of 3000 volts at a plate current of 0.500 amperes. If the loading varies enough to cause the plate voltage to go below 2850 volts or above 3150 volts, or if the plate current goes below 0.480 amperes or above 0.520 amperes, then the loading error is significant enough so that either the antenna/dummy load impedance needs to be corrected or the loading on the transmitter needs to be changed. This can be done by following the proceedure outlined in paragraph 5.3.9.

5.2.4.3 IPL Clipping Circuits

The only other adjustments that might be required in normal operation are settings of the IPL clipping circuits. It should be remembered that these circuits are not intended to substitute for normal audio processing. They are designed only for protection of the transmitter and to prevent any audio spikes from overmodulating the transmitter in either the negative or positive direction.

To properly set them, first turn off the IPL switch located on the control circuit card A1 (see figure 5-3). Adjust the incoming program audio material level until it just lights the +125% indicator on your modulation monitor. At this time, the transmitter will be heavily overmodulated in the negative direction. Now turn on the IPL switch and adjust the NEGATIVE LIMIT (A1R100) until the negative peaks of modulation no longer lights the -100% indicator on your modulation monitor, but does allow the negative peaks to achieve -95 percent modulation. Adjust the POSITIVE LIMIT (A1R105) until the positive peaks no longer light the +125% indicator on your modulation monitor, but do allow the positive peaks to achieve +120 percent modulation.

Once set, the IPL adjustments should remain the same unless the loading variations exceed the limits stated above.

5.2.5 Tube Filament Voltage

If you have the filament regulator option, the filament voltages will remain very constant, even with line voltage fluctuations and, if properly set, will give very good tube life.

If you do not have the filament regulator option, the filament voltages should be monitored reqularly and adjusted as required to stay within the desired operating range of 4.8 to 5.0 volts.

Adjust both the PA and modulator filament voltage rheostats R15 and R16 to 4.8 volts. Filament voltage specified on the manufacturer's data sheets for the 3-500Z is 5.0 volts rms. However, tube life can be increased significantly by operating at slightly reduced filament voltage. Performance in the 314R-1 transmitter is not degraded by reduction of 2 to 3 percent below specified filament voltage of 5.0 volts and tube life is increased appreciably.

In no case should the filament voltage be reduced more than 5 percent (below 4.75 volts) because the "gettering" action of the tubes will be impaired, causing filament "poisoning" and consequent tube failure.

5.2.6 Arc Gaps

There are three sets of arc gaps in the 314R-1 transmitter to protect various components from excessive voltages during fault conditions. The E19A and E19B gaps are located to the left of the modulator tube and should be set to a gap of 4.93 mm (0.194 in.) from the center post to negative high voltage (E19B) and set to a gap of 3.94 mm (0.155 in.) from the center post to ground (E19A).

The E46 and E47 gaps are located on PA grid transformer T8 and should be set to 0.254 mm (0.010 in.) each. These are very closely spaced and will tend to collect dirt. They should be cleaned periodically depending on the general cleanliness of the transmitter environment.

Gap E20 is mounted to the rear of the PA tubes and is connected to an arc sensor circuit. This gap should be adjusted to 4.93 mm (0.194 in.).

5.3 MAINTENANCE ADJUSTMENTS

The following adjustments should not be required as a normal operating procedure, but may be required periodically due to slight changes in operating conditions, replacement of parts, or changes in ambient conditions.

5.3.1 RF Oscillator Frequency

The RF exciter module A3 contains the crystal oscillator. The oscillator has an adjustment (A3C4) for setting the frequency of operation available from the front panel of the RF exciter module (see figure 5-2). A frequency monitor output of 5 volts p-p into 50 ohms is provided at J3, located on the top rear of the transmitter. This is adequate to drive most 50-ohm counters. If the crystal will not oscillate or stops oscillating before the correct frequency is achieved, the crystal is probably defective and should be replaced. The oscillator circuit is temperature-compensated to have less than 20-Hz change in frequency over a temperature range of -20 to +50 C ambient.

5.3.2 RF Pulse Width

The RF pulse-width adjustment A3R8 is also located on the front of the RF exciter module. Its purpose is to set the pulse width of the RF drive signal into the RF driver module to 120 degrees. This provides the proper conduction angle in the RF drive signal to make the power amplifier circuit function properly. The output of the RF exciter module can be monitored with a scope by observing the waveform on TP6 of the RF exciter module while it is operating. This signal should be approximately 24 volts p-p and should show a positive-going pulse of 120 degrees (one-third duty cycle). With the proper setting of the pulse width, the waveform should look like the one shown in figure 5-1. Try to keep the positive pulse width between 110 and 130 degrees. A final slight adjustment of the control can be made while observing the audio distortion while modulating th transmitter with 1 kHz at 95 percent modulation. A very slight dip in the distortion of about 0.1 or 0.2 percent can be obtained by very carefully adjusting the pulse width, but not exceeding the limits of 110 to 130 degrees.

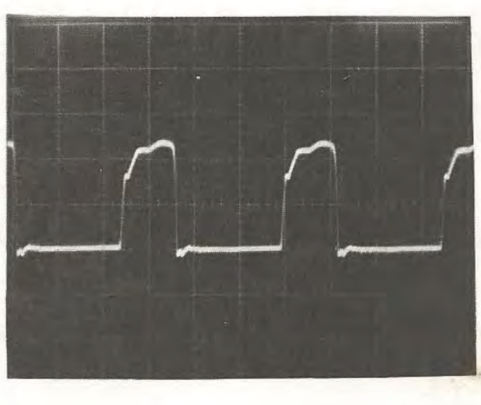

Figure 5-1. RF Exciter Output Waveform

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

5.3.3 RF Driver Protection Circuit

The RF driver protection circuit (driver de-key) acts to protect the RF driver when it is overloaded for any reason. It senses RF driver collector current, Ic, and if it exceeds a predetermined level, removes the drive signal to the RF driver by shorting the collector of A3Q5 stage to ground. To adjust the protect circuit, slowly increase the sensitivity by turning A3R19 in a cw direction in one-half turn steps until the transmitter either will not turn on (high-power on) or sustain +125 percent positive modulation peaks. Correct setting is one turn ccw from this point. This allows the driver to handle turn-on transients and load variations due to normal modulation, but will protect the driver from fault conditions that might otherwise damage transistors.

5.3.4 Low-Frequency Distortion

The LF distortion control A1R121, located on the front of the control circuit card (A1, see figure 5-3), should be adjusted for minimum intermodulation distortion or for minimum total harmonic distortion at 100 Hz. Sometimes there is a slight variation in results between high power and low power and a compromise setting should be made to achieve the best overall performance.

If distortion measuring equipment is not available, adjusting the LF distortion control for minimum audio at TP14 on the control circuit card, while modulating 95 percent in high power with a 1-kHz tone, will be very close to the correct setting.

5.3.5 Audio Tracking

The audio tracking adjusts the audio gain control circuits in the PWM circuit to maintain the proper audio gain at any power level and will therefore always keep the modulation level constant with a given input audio level. The audio tracking control, A1R124, is located on the front of the control circuit card and should be adjusted a follows:

a. Set 90 percent modulation at 1 kHz in high-power operation.

b. Switch to a convenient low-power level of approximately 250 W.

c. With the same audio input level, adjust the audio tracking control to get exactly the same 90 percent modulation level.

d. Return to high power; the modulation level will be slightly off from the original 90 percent level. Reset the input level to achieve 90 percent again.

e. Return to low power and again adjust the audio tracking control to get exactly 90 percent modulation.

f. Repeat steps d. and e. until there is no variation between high and low power. Reset the low-power level, if necessary, back to the desired level.

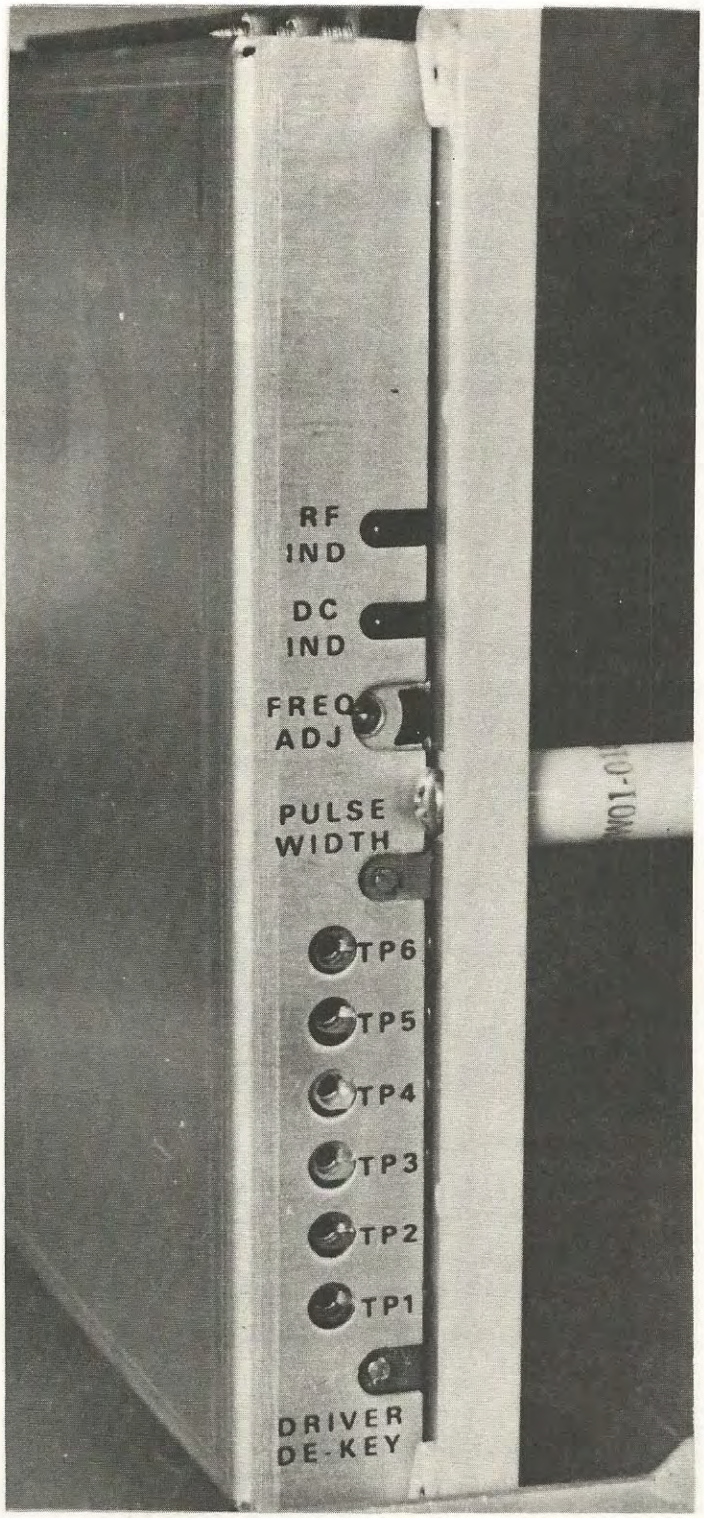

Figure 5-2. RF Exciter Front Panel

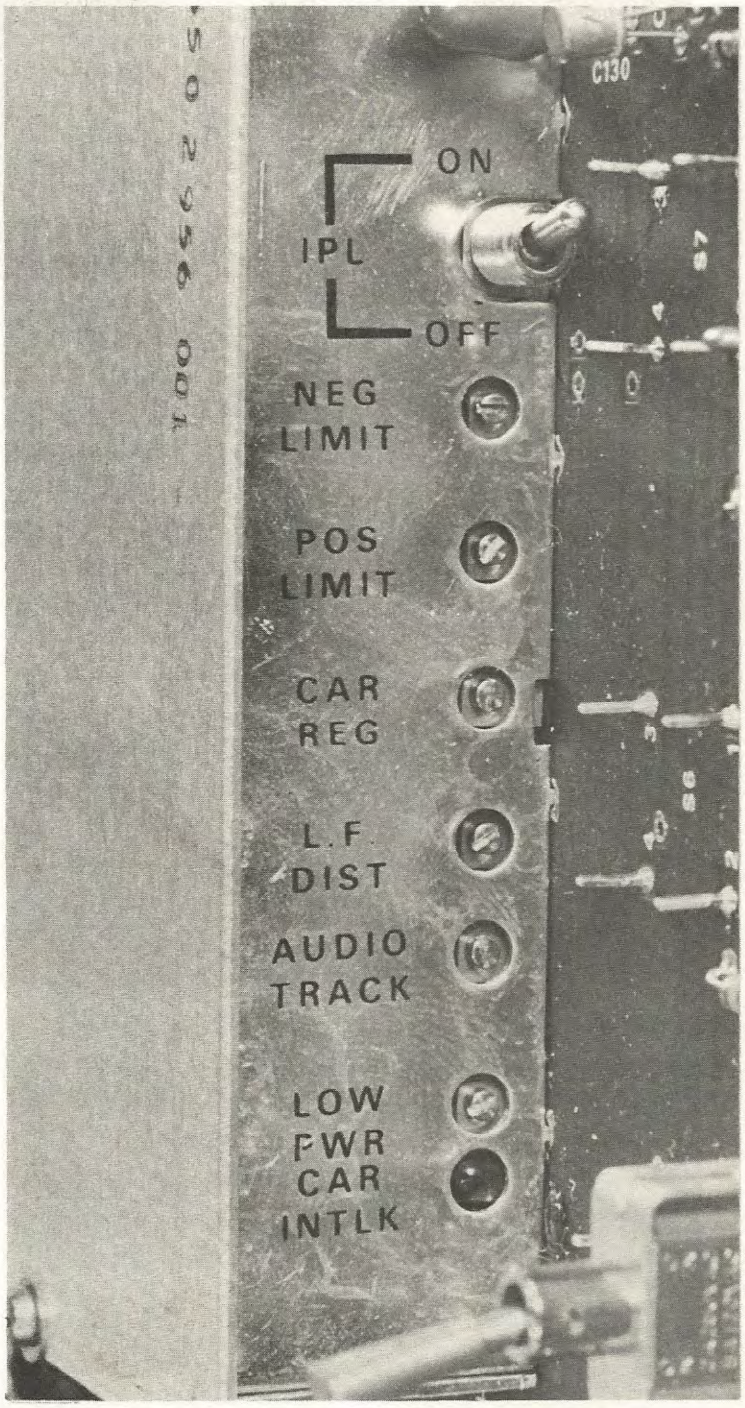

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Figure 5-3. Control Circuit Front Panel

5.3.6 Carrier Regulation

The carrier regulation should be set only after the LF distortion and audio tracking have been properly adjusted per paragraphs 5.3.4 and 5.3.5.

The carrier regulation control, A1R130, is also located on the front of the control circuit card (A1). It adjusts the level of a small rectified audio signal that balances the natural tendancy for a slight negative carrier shift. The carrier shift varies slightly with audio frequency and should be adjusted using a 400-Hz audio signal. Set the modulation to 95 percent in high power and adjust the carrier regulation control until the carrier shift is zero when the 400-Hz modulating signal is alternately turned off and on.

5.3.7 High-Voltage Power Supply (HVPS) Overload

The HVPS overload adjustment, A1R11, is located on the front of the control circuit card (see figure 5-5). The HVPS overload sensor, R3 is lcocated on the right sidewall (viewed from the rear). Electrically, it is in the positive ground return of the HVPS and samples the HVPS current, not the PA plate current. Due to the nature of the switching modulator action and the clamp diode action, the HPVS current is approximately 40 percent of the PA plate current at carrier conditions. At 100 percent modulation, the HVPS current increases to approximately 80 percent of the PA plate current value. The rest of the current flows in the clamp diode, which is returned to ground so its current does not flow in the HVPS overload sensor.

To adjust the HVPS overload, turn the transmitter off and connect a variable low-voltage dc power supply (LVPS) between R3-1 and ground with the negative side grounded. Adjust the variable LVPS to produce 0.400 amperes of current flow in R3. With this connection, the plate current meter on the transmitter front panel, M2, will read the correct current of 0.400 amperes. Turn on only the low-voltage circuit breaker, CB1, and adjust the HVPS overload adjustment on the control circuits module until the HVPS O/L indicator lights. Then recheck the trip point by turning down the current in the variable LVPS, resetting the HVPS O/L indicator by pressing IND RESET pushbutton A1S8, then slowly increase the current through the HVPS overload sensor from the variable LVPS again and observe the trip point. Readjust the HVPS overload adjustment, A1R11, until it trips at 0.400 amperes.

If a LVPS is not available, the HPVS overload may be set to trip at a 95% modulation level when modulating ith a 15 Hz audio tone.

5.3.8 VSWR Overload

The following five adjustments are to be made to the RF power meter and the vswr overload:

a. Vswr balance, C44

b. Reflected power calibrate, A5R4

c. Forward power calibrate, A5R3

d. Vswr overload, A1R34

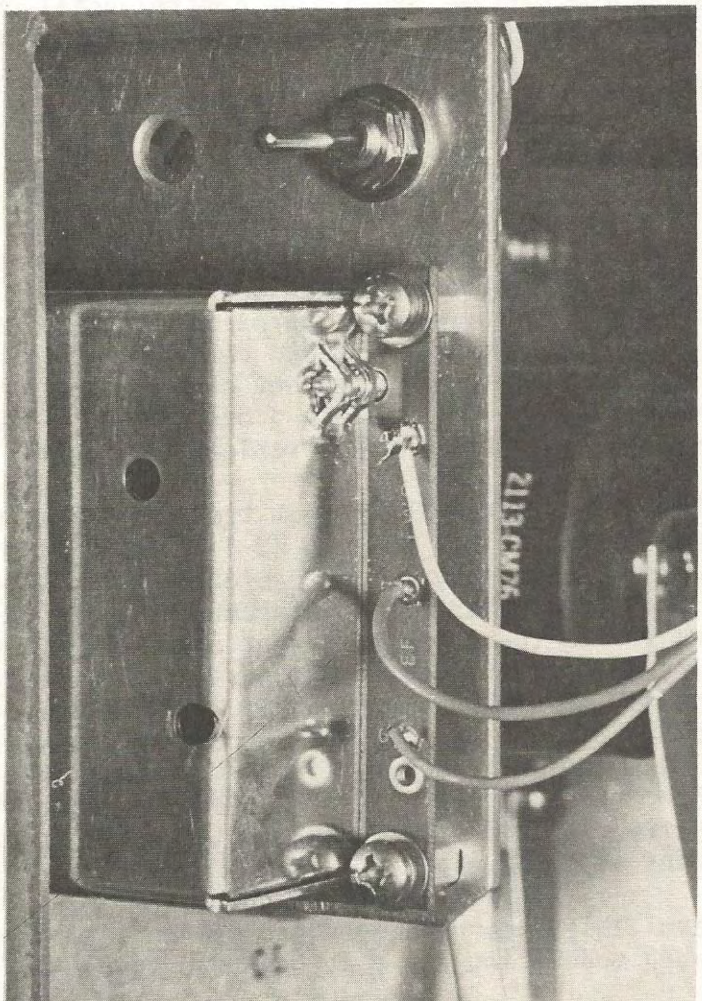

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Figure 5-4. VSWR Adjustments

The balance and calibrate controls are located in the RF power meter sensor and can be accessed from the rear or top of the transmitter. The vswr overload is located on the control circuits card A1. In order to make the first three adjustments, a good load of the proper value must be connected to the transmitter with a means of accurately measuring the RF power output. These adjustments were made at the factory into a nominal 50 +j0 ohm dummy load. For loads between 48 +j0 and 52 +j0 ohms and no more reactance the ±j5 ohms (swr = 1.22:1), the factory settings are adequate and proper operation can be achieved without readjustment. If your antenna impedance exceeds this range, you have two choices: either change the antenna impedance to be within that range, or readjust the RF power meter to a new impedance range. This can be done only under power and therefore requires a known load and means of accurately measuring the power delivered to it. Paragraph 5.4.2 describes the procedure for balancing and calibrating the RF power meter, A5. If the calibration is adequate, the vswr overload may be set as follows:

a. Set the transmitter power output to 100 watts.

b. Place the NORMAL-REVERSE switch, S8, in the REVERSE (left) position.

c. Modulate the transmitter to 95 percent at 1 kHz.

d. Adjust the vswr overload, A1R34, until the vswr overload trips. This sets the vswr overload to trip with a 2:1 vswr with modulation. Return the NORMAL-REVERSE switch to its NORMAL (right) position.

5.3.9 Power Amplifier Loading

If the loading on the transmitter is incorrect (see paragraph 5.2.4.2 of this section), it can be readjusted to the proper value by following the procedure listed below.

Increasing the inductance (adding more active turns) to coupling coil L3 increases the loading on the power amplifier. This means that for the same plate voltage, the plate current and power output will be higher. A very small adjustment in the value of L3 has a fairly large effect on loading. Never change its value by more than one turn in a step. After each change of L3, the PA tuning will need to be checked to make sure it is still tuned to the dip in plate current. Be sure that the RF pulse width is properly set to 120 degrees per paragraph 5.3.2. If this adjustment is not correct, it can erroneously cause the plate current to deviate from its normal value and make it seem that the loading is off. Correct operation is achieved with a ratio of plate voltage to plate current of 6000 ohms,

$$\frac{E_{BB}}{I_B} = 6000\Omega$$

with the proper power output and PA efficiency. The efficiency is normally about 73 percent and the readings in table 5-2 and 5-3 are typical.

Table 5-2. 314R-1 Typical Meter Readings.

POWER OUTPUT (Watts	E_{BB} (Volts)	I_B (Amperes)
1100	3020	0.50
1000	2900	0.48
500	2150	0.36
250	1500	0.26

5.3.10 PA Neutralizing

Normally the PA neutralizing does not require adjustment. It is set at the factory by the choice of values for C38, 47, 48, and 49. If it is felt that the neutralizing is off to the extent that it requires readjustment, this should be accomplished by changing the value of C38.

This adjustment is made with the filament voltage on but with high voltage and bias voltage removed; therefore, it is necessary to have only the LOW VOLTAGE breaker turned on. To prevent the possibility of dangerous high voltage being present during this procedure, remember to turn off the HVPS circuit breaker.

The transmitter must be terminated into a load resistor (not an antenna). This may be accomplished either by utilizing the station's dummy load or, if that is not available, simply by connecting a resistor of the proper value (normally 50 ohms) across the transmitter output. Two 100-ohm/2-watt resistors in parallel are recommended.

Open the rear transmitter door and the output network cover.

CAUTION

THERE ARE 250 VOLTS AC PRESENT AT EXPOSED TERMINALS IN THE TRANSMITTER CABINET.

Since no high voltage will be present for this adjustment, it is not necessary to "cheat" or disable the rear door interlock. Connect an oscilloscope to the modulation monitor sample (J2). With the front door closed, press the FIL ON pushbutton, which will apply filament voltage and will turn on the RF driver. Change the value of C38 for a minimum RF signal as indicated on the oscilloscope. This signal is RF energy that is coupled from the grid to anode due to interelectrode capacitance of the PA tube. The effect of this capacitance is cancelled with proper negative feedback provided by the neutralizing capacitors.

Neutralization is factory adjusted and does not normally require adjustment.

5.4 SPECIAL MAINTENANCE ADJUSTMENTS

The following adjustments are major adjustments that are normally not required unless major components have been changed, frequency of operation is changed, or the antenna impedance is changed. These adjustments should not be attempted unless a thorough understanding of the procedure and the proper test equipment are available.

5.4.1 PWM Internal Adjustments

There are four internal adjustments to be made in the PWM module. These adjustments are available when the PWM area on the control circuit card has its cover removed (see figure 5-5). All adjustments, except the clamp adjustment, can be made on the PWM module with the filaments and high voltage off. Only the low-voltage circuit breaker, A6CB1, should be on.

5.4.1.1 Switching Frequency

Connect a counter to TP17 (violet) in the PWM module. Adjust switch frequency R148 to obtain a frequency of 70.0 $\pm$0.5 kHz. The waveform at TP17 should be a 70-kHz symmetrical triangular waveform of approximately 8 volts p-p.

5.4.1.2 Common Mode

Connect the two audio input lines together and apply an audio signal between these connected lines and ground. The audio should be at the +10-dBm level and 1-kHz. Observe the audio signal at TP11 (brown) with an oscilloscope and adjust R98 for minimum audio signal at TP11. Remove the connection between the audio input lines.

5.4.1.3 Clamp

Operate the transmitter at high power into an antenna or dummy load. Modulate to 100 percent with a 1-kHz audio tone. Observe the modulated output waveform with an oscilloscope. Turn the IPL switch to the off position and increase the audio input level until it becomes flat on top (clipped by the clamp circuit), breaks into a ringing condition like that shown in figure 5-6, or reaches +130 percent positive modulation. Adjust clamp R142 to just stop the ringing effect or to limit the positive peaks to +130 percent. whichever comes first. During this adjustment, it is normal to be overmodulated heavily in the negative direction. If a function generator is available, this adjustment can be made using unsymmetrical waveforms to achieve the 130 percent peak without overmodulating in the negative direction.

5.4.1.4 Offset Adjustments

These adjustments can be made with the filaments and plate voltage off. Only the low-voltage circuit breaker needs to be on. Remove U18 form its socket and connect the positive lead from a variable LVPS to TP14 (yellow). Connect the negative lead to ground. With no audio input, observe the dc voltage at

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

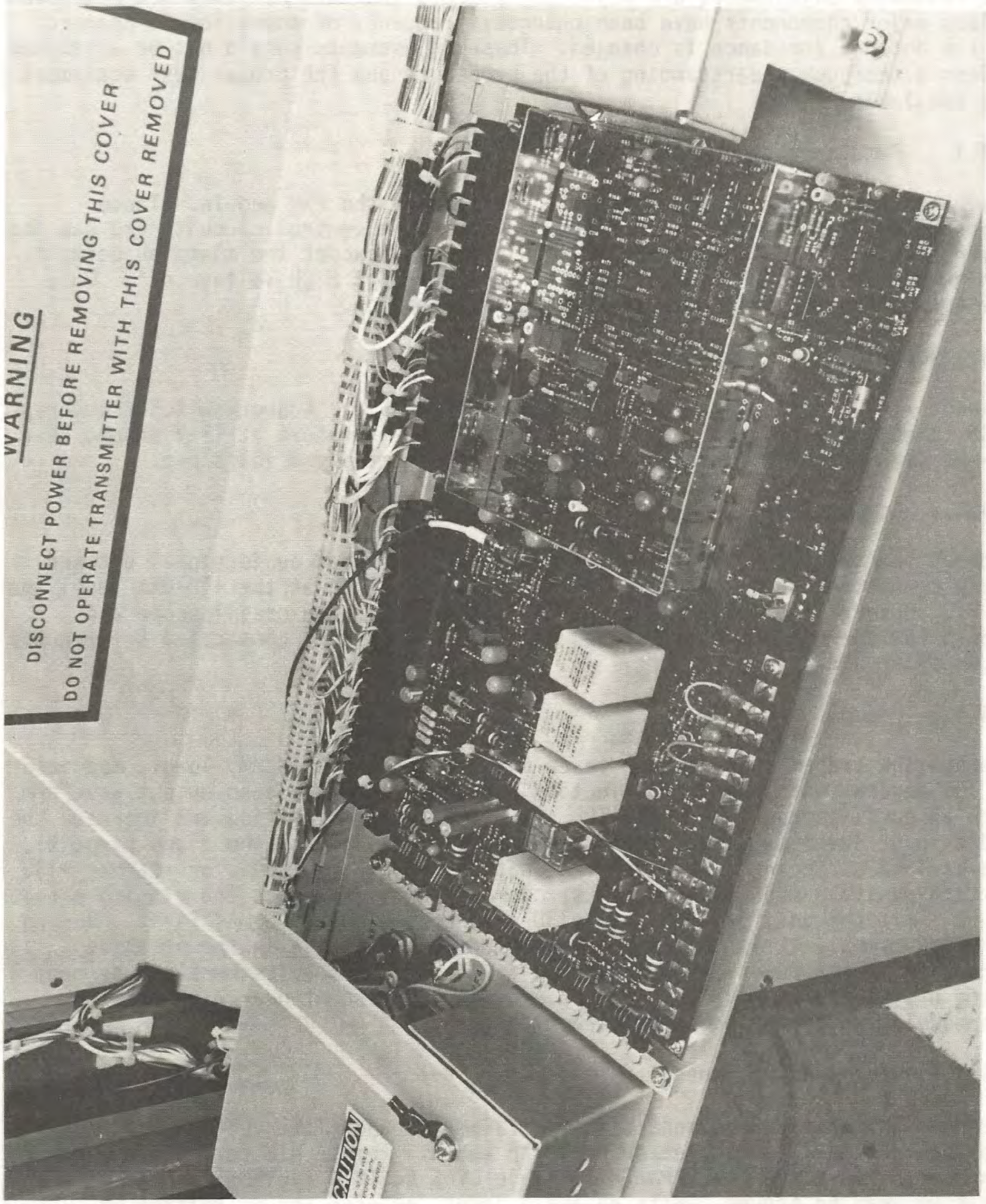

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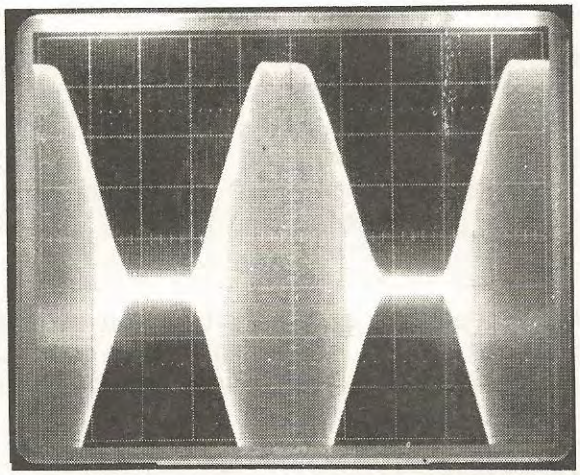
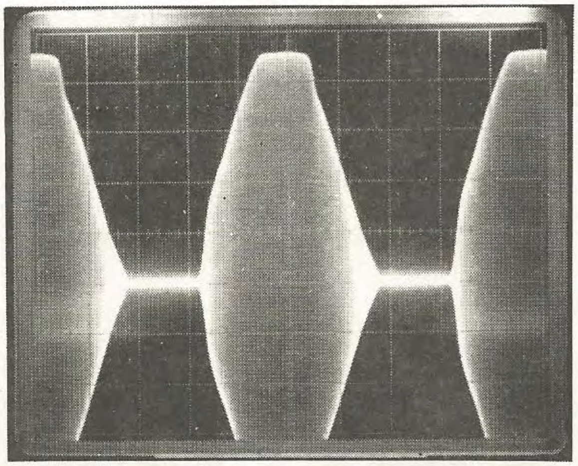
Figure 5-5. Control Circuit Card (A1)

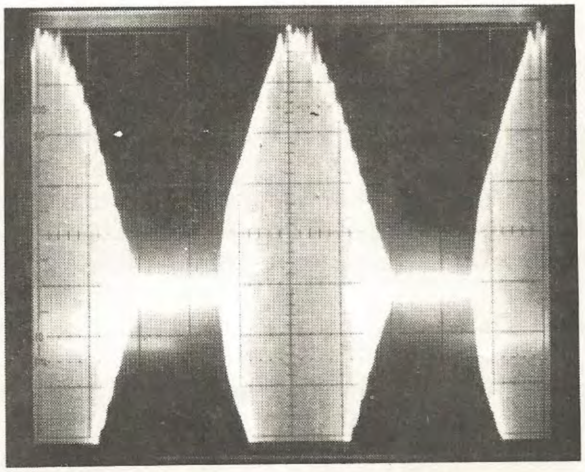
KR1-1(3)



A. WITH THE IPL ON AND PROPERLY ADJUSTED.



B. IPL OFF WITH CLAMP PROPERLY SET.



C. IPL OFF WITH CLAMP SET TOO HIGH.

Figure 5-6. Audio Waveforms.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

TP15 (green) with an oscilloscope. With the variable LVPS set to 0 volt adjust amplifier offset R116 for 0-volts dc at TP15. With the variable LVPS set to +6.0 volts at TP14, adjust control offset R114 for 0-volts dc at TP15. Repeat the above two steps until zero volt appears at TP15 under both conditions; that is, with either 0 or +6.0 volts at TP14. The voltage at TP15 may go either positive or negative and must be adjusted very carefully to be exactly zero volts.

After the dc offsets have been set as described above, apply an audio input signal of 1 kHz at a +10-dBm level. Set the variable LVPS to 0 volt at TP14 and adjust audio offset R115 to obtain minimum audio voltage at TP15. Remove the variable LVPS and reinstall U18.

5.4.2 RF Power Meter Balance and Calibrate

The RF power meter has been balanced and calibrated for a nominal 50 +j0 ohm load. If the R or X components of the load at trasmitter output are within ±5 ohms of these values, the vswr is 1.22:1 or less and the operation of the RF power meter and the vswr overload circuit is probably adequate. This vswr is represented by a reflected power of about 1 percent. If the reflected power is greater than this, either the antenna impedance is incorrect and needs to be readjusted to the correct value, or the RF power meter is not correctly balanced and calibrated for the antenna impedance being used.

5.4.2.1 VSWR Balance

Operate the transmitter into the desired load at the 1-kW power level with no modulation. Adjust the vswr balance, C44, located on top of the transmitter, for minimum indication of the REFLECTED position of the RF power meter. The NORMAL-REVERSE switch, S8, located behind the back door of the RF output network compartment on the RF power meter subassembly, must be in the NORMAL (left) position.

5.4.2.2 Reflected Power Calibrate

Set the transmitter power output to 100 watts. Place the NORMAL-REVERSE switch, S8, in the REVERSE (right) position. Adjust reflected power calibrate A5R4, located inside rear of the transmitter, to obtain a reading of 10 percent (full scale is 12 percent) in the REFLECTED position of RF power meter. Return the NORMAL-REVERSE switch to its NORMAL (left) position.

5.4.2.3 Forward Power Calibrate

Set the transmitter power output to 1000 watts. Place the NORMAL-REVERSE switch, S8, in the NORMAL (left) position. Adjust forward power calibrate A5R3, located inside rear of the transmitter, to obtain a reading of 100 percent (full scale is 120 percent) in the FORWARD position of RF power meter.

5.4.3 RF Output Network Tuning

Before proceeding with any tuning of the output network, be sure that the correct components for the desired operating frequency are installed. The tuning chart of figure 5-6 indicates the capacitor values required for each of the five bands. The parts list in section 7 might also be helpful in verifying the correct components.

The RF output network used in the 314R-1 consists of three parallel-tuned circuits, all tuned to the carrier frequency, coupled together to form a bandpass filter between the power amplifier plate and the antenna. The RF output network actually serves two purposes. One is to filter out harmonics and spurious signals created in the class-C power amplifier. The other function is to match the antenna or load impedance to the plate of the power amplifier. Figure 5-6 shows a simplified schematic of the RF output network. To tune the RF output network, the three parallel tuned circuits, or nodes, must be tuned to resonance at the carrier frequency; and the coupling between nodes must be set to get the proper impedance level at each node, in particular at node 1, which is the PA anode. This impedance level determines the loading of the PA (see paragraph 5.3.9). The tuning is accomplished in the following two steps:

a. Set the coil taps to their approximate position by using the chart and curves included here.

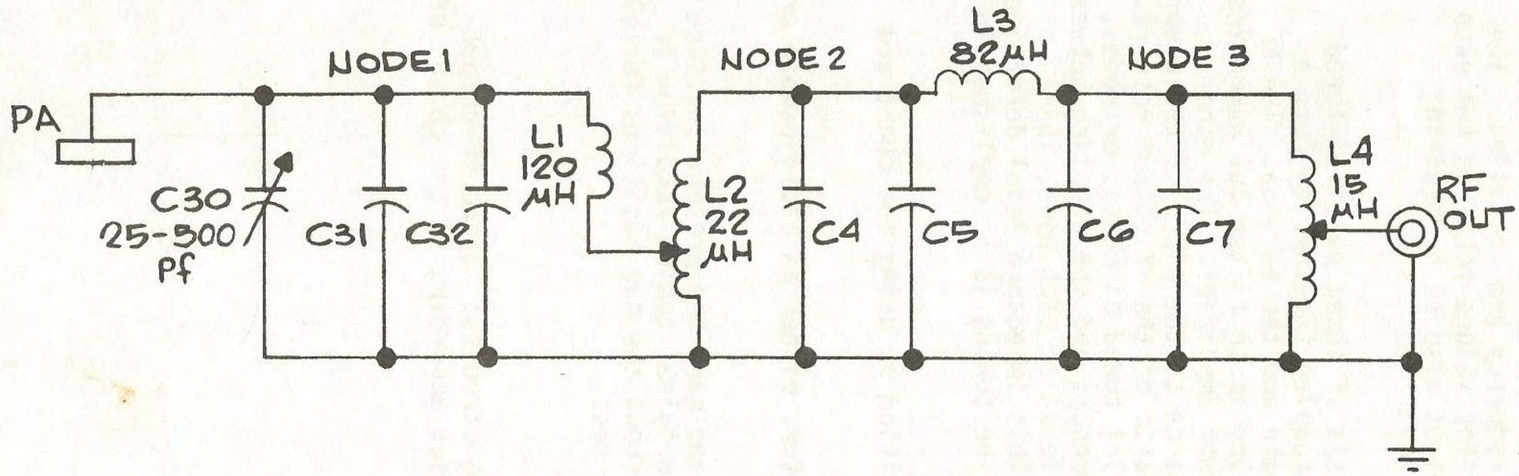
b. Fine-tune, with an RF signal and RF indicator, either an oscilloscope or RF voltmeter.

Before changing any taps on any coils, record and mark the present location of all taps in order to be able to return to the original tuning condition if necessary. The copy of the factory test data shows the tap positions for all coils as they were set in the original factory test.

5.4.3.1 Node Couplings

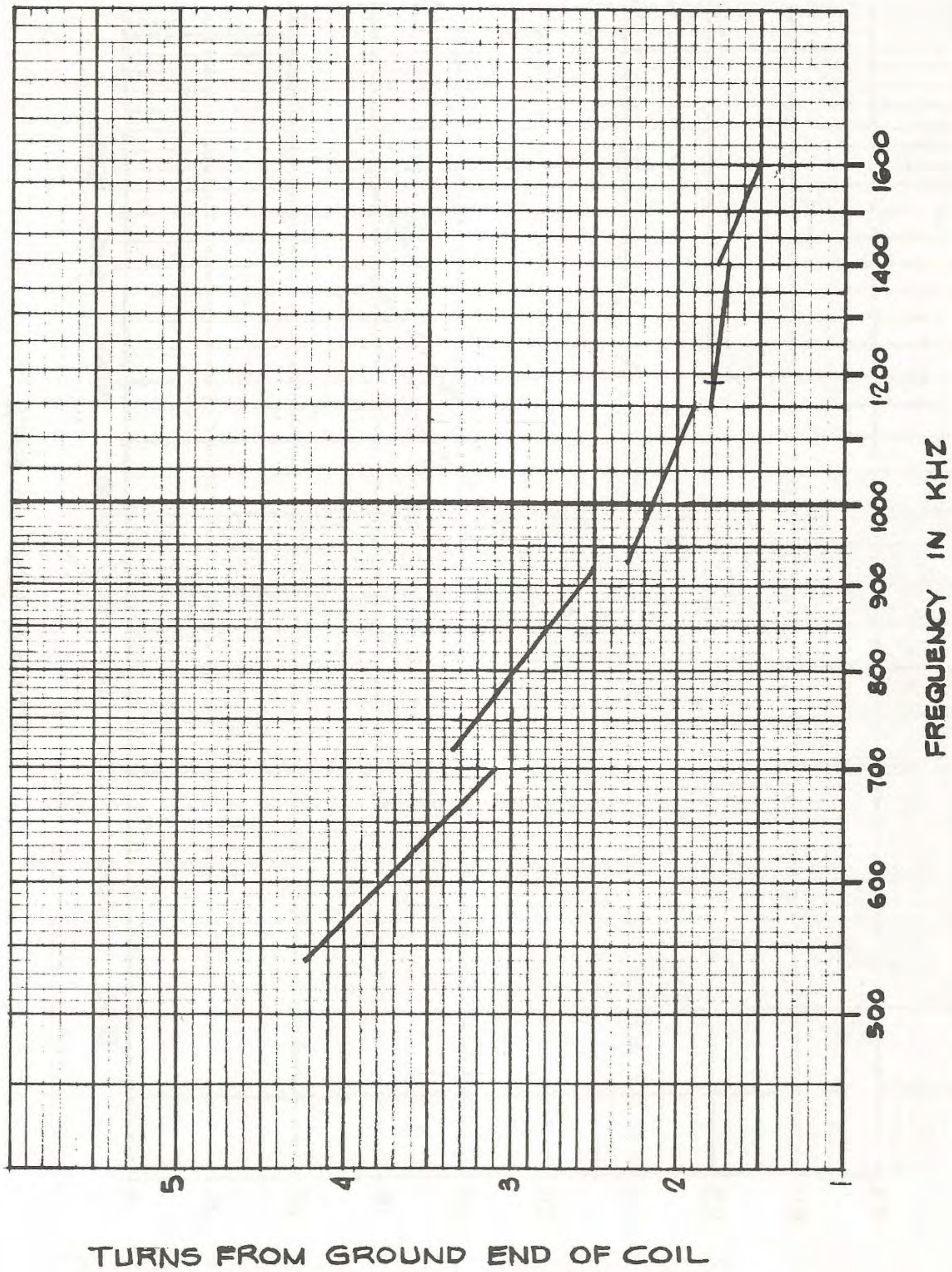
Before tuning any of the nodes (parallel-tuning circuits) in the RF output network, the coupling between nodes should be set according to the curves of figures 5-7, 5-8 and 5-9.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.



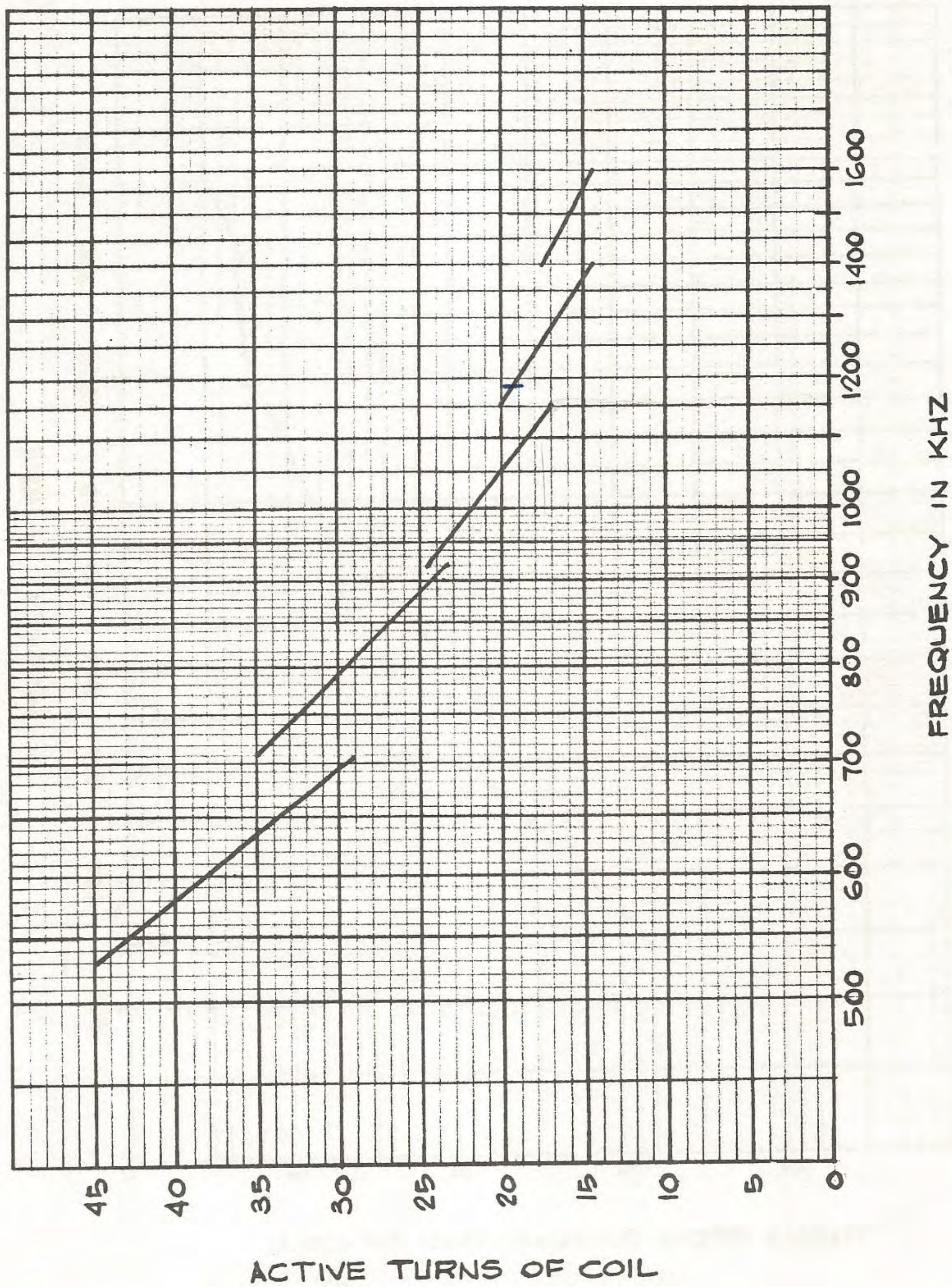
FREQUENCY	C31	C32	C4	C5	C6	C7
570-700	430 PF	240 PF	3900 PF	3900 PF	3900 PF	3900 PF
710- 920	240 PF	NONE	3000 PF	3000 PF	3000 PF	3000 PF
930-1150	180 PF	NONE	2400 PF	2400 PF	2400 PF	2400 PF
1160-1380	NONE	NONE	2000 PF	2000 PF	2000 PF	2000 PF
1390-1600	NONE	NONE	1600 PF	1600 PF	1600 PF	1600 PF

Figure 5-6. RF Output Network Simplified Schematic and Capacitor Values



TURNS FROM GROUND END OF COIL

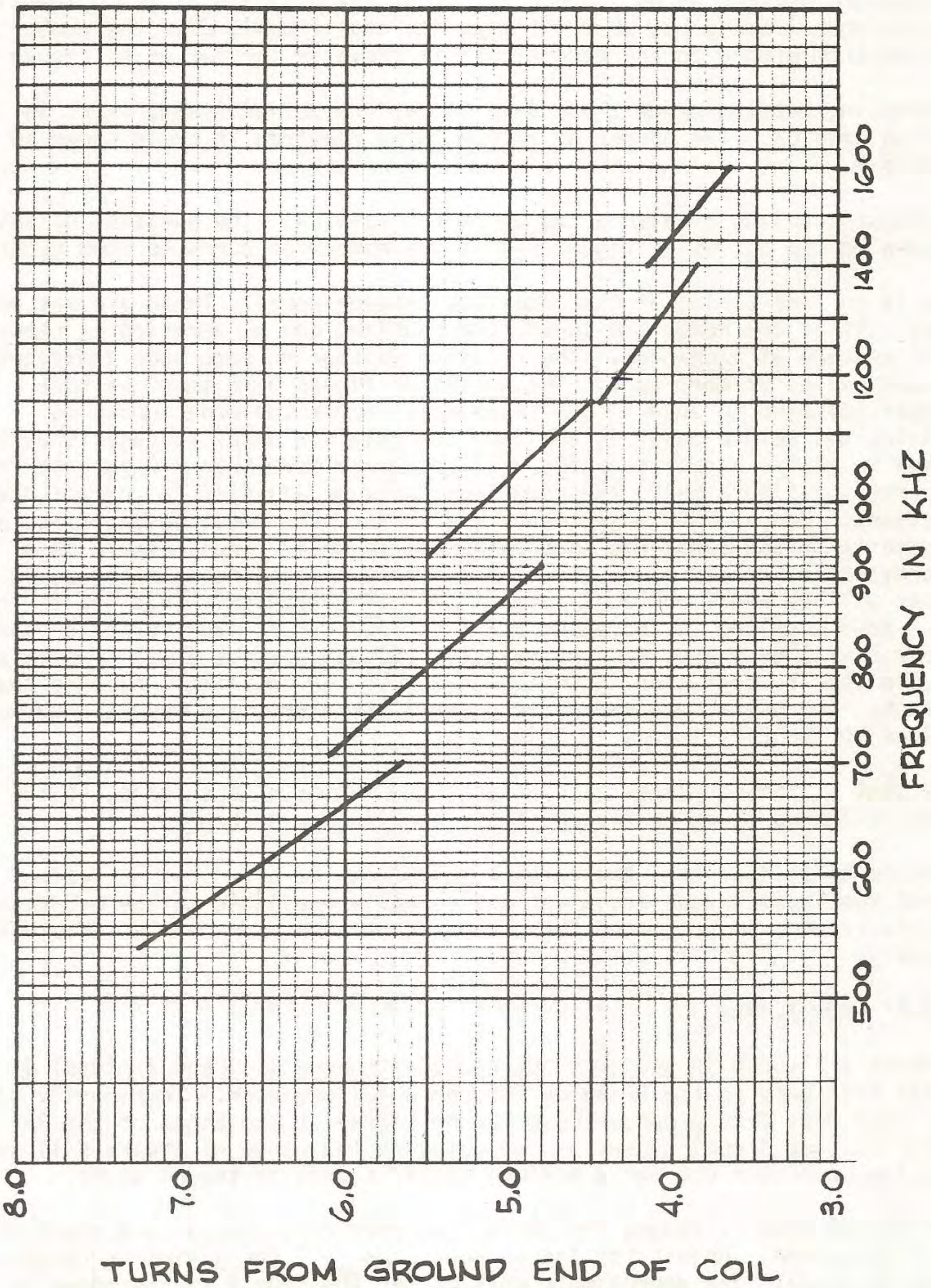
Figure 5-7. 314R-1 Node 1-2 Coupling Tap on L2.



ACTIVE TURNS OF COIL

Figure 5-8. 314R-1 Node 2-3 Coupling, L3.

 WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.



TURNS FROM GROUND END OF COIL

Figure 5-9. 314R-1 Output Tap, L4.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

The coupling between nodes 1 and 2 is set by the position of the connection from the node 1 coil, L1, where it taps the node 2 coil, L2. The number of turns up from ground on the node 2 coil is shown in the curves of figure 5-7.

The coupling between nodes 2 and 3 is set by the active (used) turns in coupling coil L3. The number of active turns required in L3 is shown in figure 5-8.

The output coupling is also a tap on node 3 coil L4. The position of this tap is shown on the curves of figure 5-9 as the number of turns up from ground.

There is no fine-tuning of the couplings between nodes. These are set per the curves. After the nodes are tuned, the coupling can be verified by checking the RF voltage at each node. The relative voltage on each node indicates the impedance level at that node. The curves of figure 5-10 show the node voltages relative to node 1 (the PA anode). After the node tuning is complete, and before power is applied, the relative nodal voltages should be checked to verify proper coupling. If they vary more then ±10 percent from the curves of figure 5-10, the coupling should be adjusted to correct these variations. Very slight adjustments will affect the nodal voltages, so any adjustments to the couplings should be made in small steps. There is a "teeter-totter" effect in the couplings. When a coupling is changed, it affects all the nodal voltages in an alternating fashion. That is, if the node 2-to-3 coupling is increased (L3 less inductance), the relative voltage at node 2 will decrease, and the relative voltage at node 3 will increase. This can lead to confusion in trying to adjust the couplings, because they interact. Therefore, proceed in very small increments and record a series of readings to identify trends in adjustment.

Adjustment of the couplings also affects the tuning of the nodes, so the tuning will have to be rechecked if the couplings are changed.

It should be obvious that the network tuning can be a tedious operation without specialized test equipment not normally available to the broadcaster. For this reason, we recommend that retuning be attempted only if ABSOLUTELY necessary.

5.4.3.3 Node Tuning

The nodes are tuned in sequence beginning with node 1. Feed a signal at the carrier frequency to the PA anode through a 10k resistor. Temporarily place a short from node 2 to ground. Observe the signal at the anode of the PA. With the tap on node 1 coil L1 set as indicated on the curve of figure 5-11 adjust PA tuning capacitor C30 for a maximum (peak) signal at the PA anode.

After tuning node 1, remove the short from node 2 to ground, and place it from node 3 to ground. Adjust the tap on node 2 coil L2 for a minimum (dip) signal at the PA anode. The approximate setting for the node 2 tap is shown in the curves of figure 5-12.

After tuning node 2, remove the short from node 3 to ground and be sure that the correct (50 ohm) load is connected to the output tap on the node 3 coil (see figure 5-9). Set node 3 coil L4 tuning tap to its approximate position as is shown on the curves of figure 5-13. Adjust the tap for a maximum peak signal at the PA anode.

After tuning node 3, verify the proper coupling adjustments as described in paragraph 5.4.3.2 and the curves of figure 5-10, which show the relative nodal voltages when the network is properly tuned.

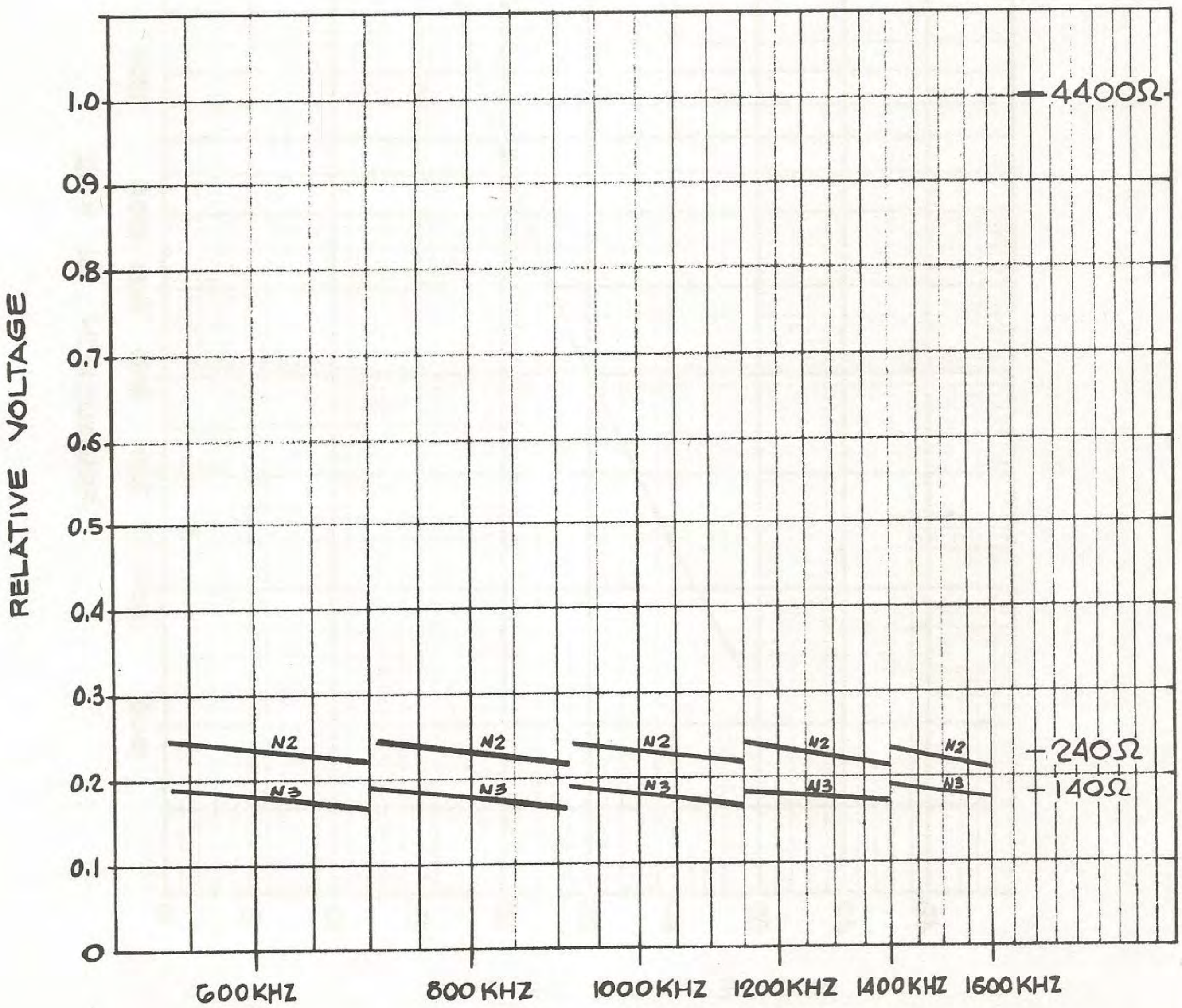
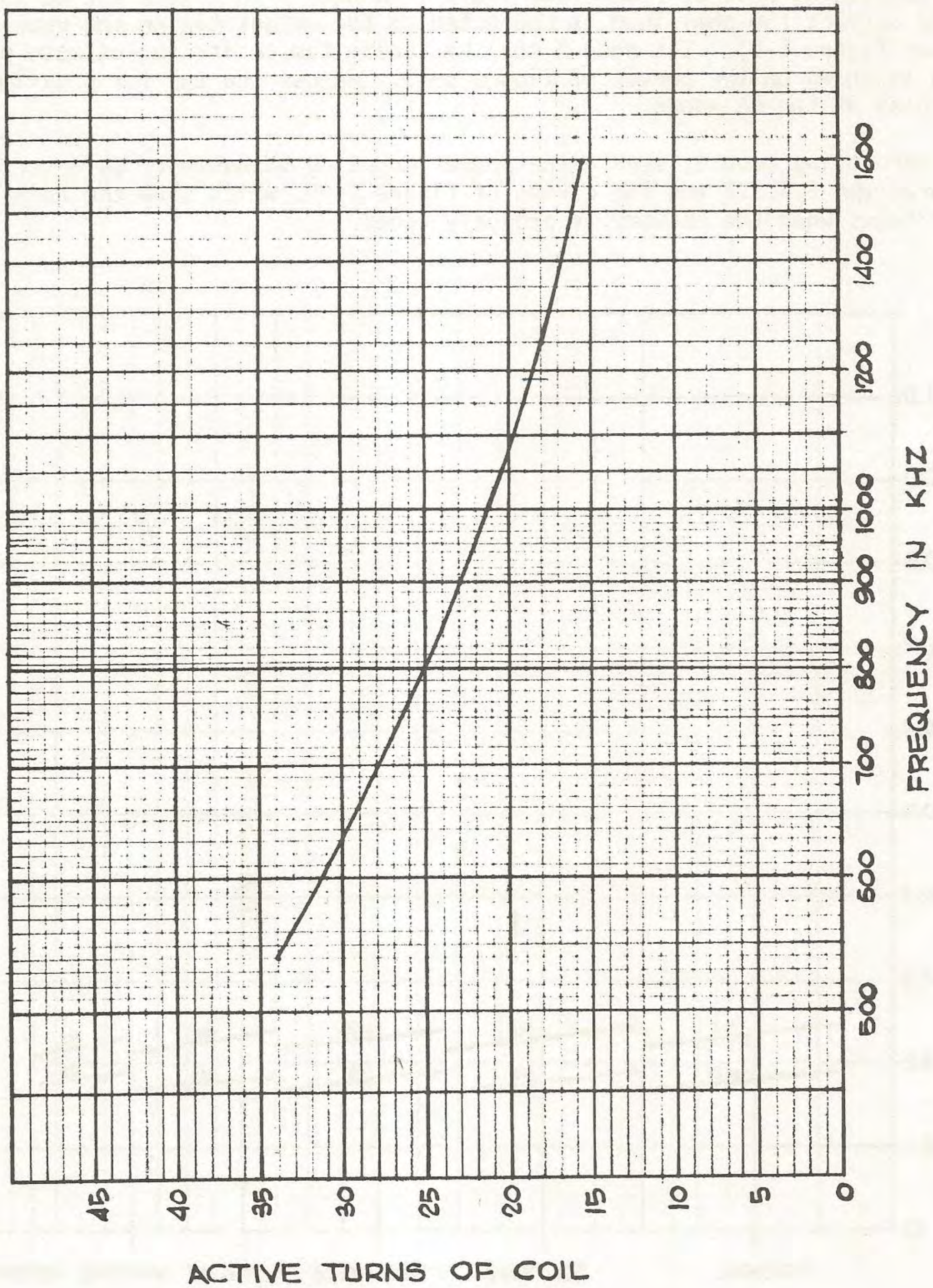


Figure 5-10. Relative Nodal Voltages.

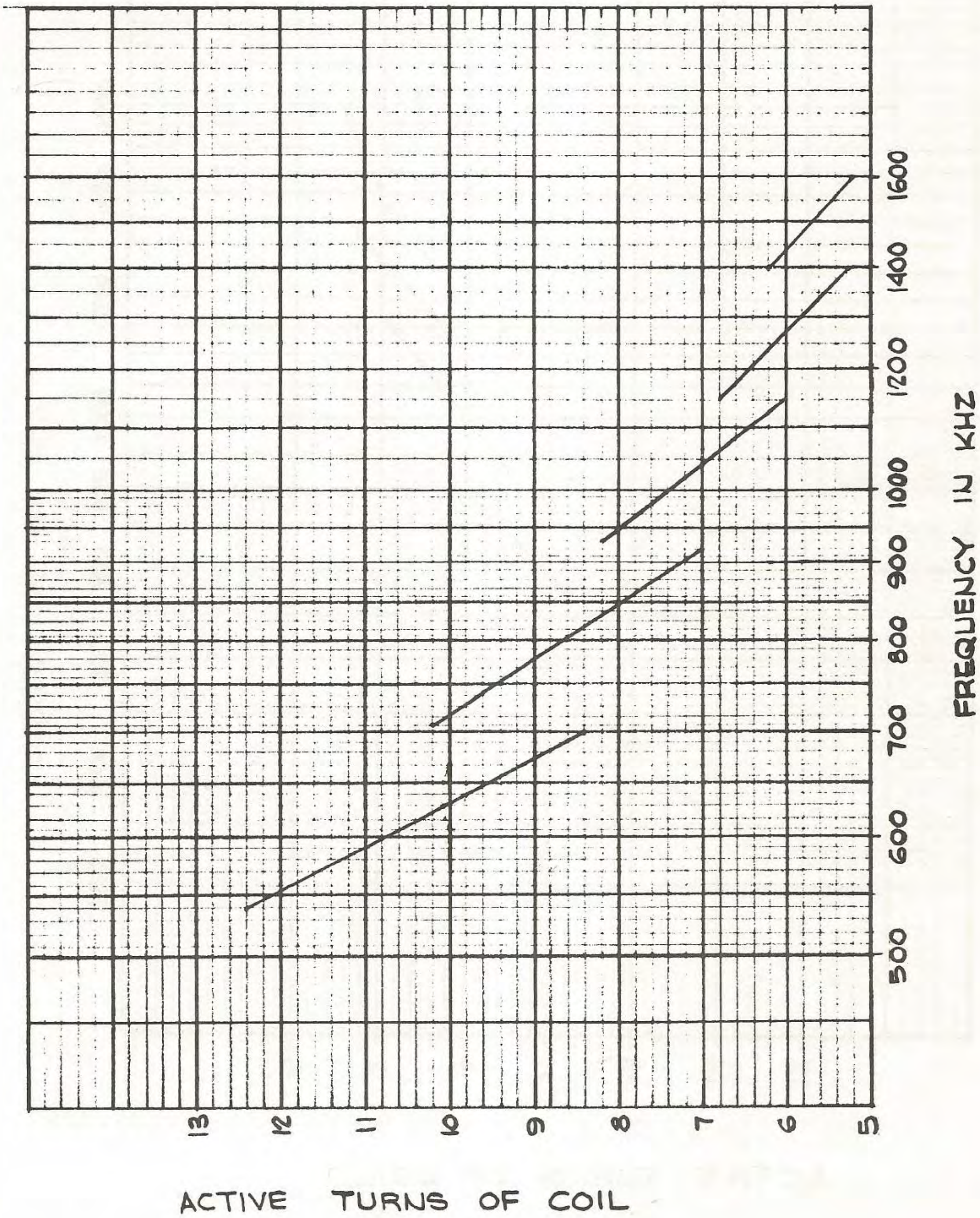
WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.



ACTIVE TURNS OF COIL

Figure 5-11. 314R-1 Node 1 Tuning, L1.

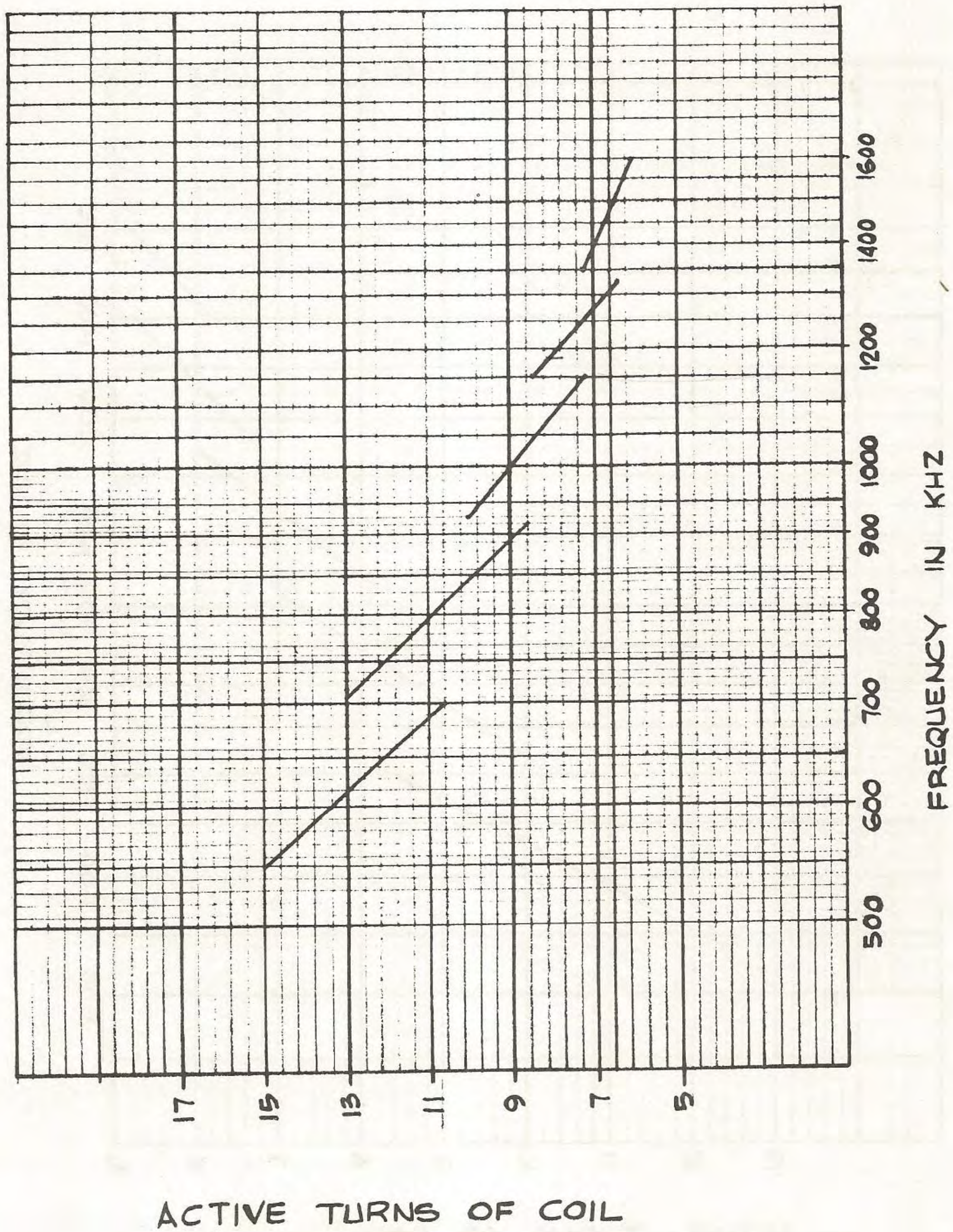
WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.



ACTIVE TURNS OF COIL

Figure 5-12. 314R-1 Node 2 Tuning, L2.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.



ACTIVE TURNS OF COIL

Figure 5-13. 314R-1 Node 3 Tuning, L4.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

6.1 INTRODUCTION

This section contains simplified diagrams of various circuits grouped by function, such as control circuits, RF circuits, PWM circuits, power supplies, and metering circuits. Included with the simplified diagrams are some suggestions on how to troubleshoot each area in order to more quickly isolate a problem. Paragraph 6.10 is a wire listing of the cables in the transmitter in alphanumeric order in the FROM column. This permits tracing of every wire in the cable.

6.2 CONTROL CIRCUITS

Figure 6-1 is a simplified schematic of the control circuits for the 314R-1 transmitter. It shows the complete path from +28 volts to the operation of all control relays up to high power on. It also shows the connection of the high/low-power relay and the carrier interlock circuits in the control circuits card.

A typical problem of the control circuit may be an interruption in the carrier interlock circuit between terminals A1TB1-12 and 13 or interruptions in the interlock chain feeding the high/low-power-on circuits. Interruption of the carrier interlock between A1TB1-12 and 13 causes the 70-kHz switching to stop, but does not drop the plate contactor to turn off the HVPS. So, loss of plate voltage (due to loss of 70-kHz switching), but not loss of HVPS, is probably a carrier interlock fault. An interruption of the carrier interlock circuit will extinguish the LED carrier interlock indicator on the control circuit card.

A loss of RF driver current will also interrupt the carrier interlock control circuit, which can be diagnosed quickly by observing the LED, A1CR56, mounted on the control circuit card. When driver current is present, the LED glows brightly. (Refer to paragraph 6.3 for RF circuit troubleshooting).

Interruptions of the interlock chain feeding the high/low-power-on circuits causes the plate contactor to drop the HVPS. It should be noted that the PLATE OFF light is connected so that it is lighted only when the interlock chain is complete. This permits an operator to check the interlock chain without energizing the plate contactor.

The high/low-power-on circuits are connected back to the filament-on circuits through diodes A1CR27 and 58 on the control circuit card. This allows operation from a filament-off condition directly to high/low-power-on by pressing a single button.

It should also be noted that LEDs are provided on the control circuit card to indicate operation of the various relays to assist in troubleshooting.

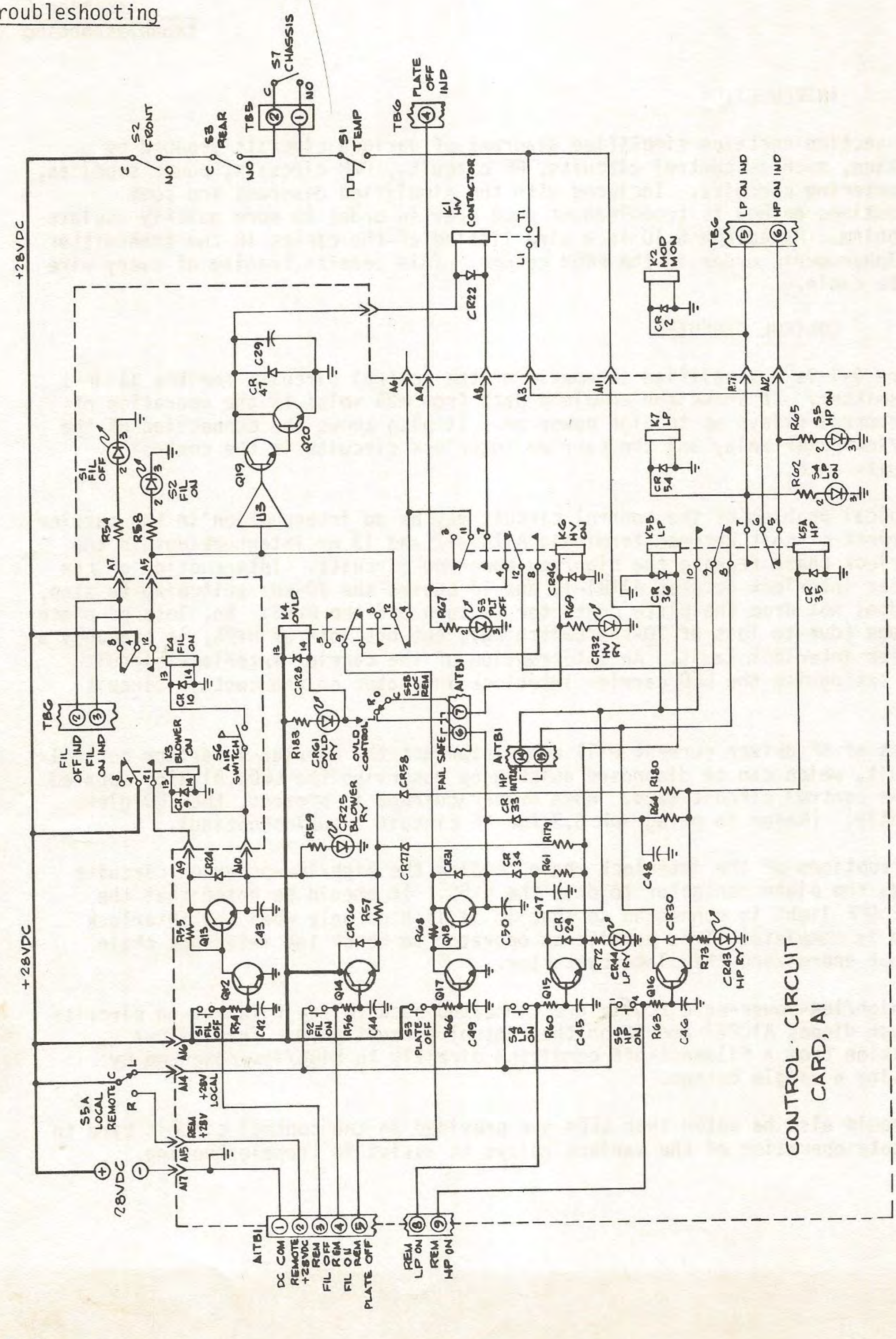


Figure 6-1. 1-kW Control Circuit

6.3 RF CIRCUITS

Figure 6-2 shows the RF signal path from the crystal to the antenna output terminals. A very quick determination of fault areas can be made by observing the RF indicator LED on the RF exciter card.

If the RF indicator is lighted, this immediately establishes proper functioning of the RF exciter card. The positive pulse width can be checked at this point and should be 120 degrees wide (one-third duty cycle) and 25 volts peak to peak at TP6.

The RF driver operation usually can be verified by noting the I_C (driver-collector current) on the dc multimeter. It normally reads between 0.7 and 0.9 amperes depending on frequency of operation. Lower frequencies usually have lower current. The RF exciter has a protective circuit (U3) that acts to short out its own driver signal if the driver I_C gets too high. Also, if fuse F8 in the driver blows, the driver I_C goes to zero. If F1 opens, it nearly always indicates shorted transistors in the driver. It should be noted that arc gaps E46 and E47 on the PA grid transformer are set at 0.254 mm (0.010 in.). This is a very close gap and may tend to collect dirt or come out of adjustment easily if it is bumped during routine cleaning or inspections. If set too close or if dirty, the arc gaps will short out the RF drive to the PA. See paragraph 5.2.6 for proper settings of arc gaps. It should also be remembered that there is a high dc potential between the primary and secondary of the PA grid transformer. The secondary is at the negative high-voltage potential of -3 kV modulated to -6.75 kV, while the primary is at approximately 200 volts.

CAUTION

THE 314R-1 TRANSMITTER HAS THE PA GRID AND CATHODE CIRCUITS AT HIGH DC VOLTAGE. UNLIKE THE OLDER, CONVENTIONAL TRANSMITTERS, THE MODULATED DC IS NEGATIVE AND APPLIED TO THE PA CATHODE RATHER THAN POSITIVE AND APPLIED TO THE ANODE. THIS CAN BE A SAFETY CONCERN FOR TECHNICIANS OR SERVICE PERSONNEL NOT ACCUSTOMED TO THIS CIRCUIT CONFIGURATION.

This configuration has another unusual aspect. The PA anode is at dc ground - not RF ground. This means there is no plate blocking capacitor or plate dc feed choke. These components are not necessary in this configuration. This does, however, permit an easy test of the PA tubes. Remove the drive by removing the RF driver fuse. Connect the PA anodes directly to the chassis using a short [not longer than 152 mm (6 in.)] test lead. The collector of A1Q24 in the PWM circuit will have to be shorted to override the drive loss/carrier interlock circuit, which can be accomplished by grounding the case of the transistor with a short clip lead. Apply high voltage and the zero bias static current can be read on the plate current meter. It should be approximately 0.2 ampere for 3 kV of plate voltage.

The output network is not like the networks in older, conventional transmitters. It is a bandpass configuration as opposed to the more common low-pass pi network. See paragraphs 4.3.1.4 and 5.4.3 for discussions of the output network theory of operation and tuning.

The RF power meter shows the condition of the antenna or dummy load. It is affected only by the transmission line and/or the load impedance, not by anything inside the transmitter. Any reflected power can be reduced only by correcting the load impedance and not by tuning of the transmitter network. The RF power meter is calibrated for a nominal 50 ohm load at the factory. For other impedance levels, see paragraph 5.4.2.

6.4 PWM CIRCUITS

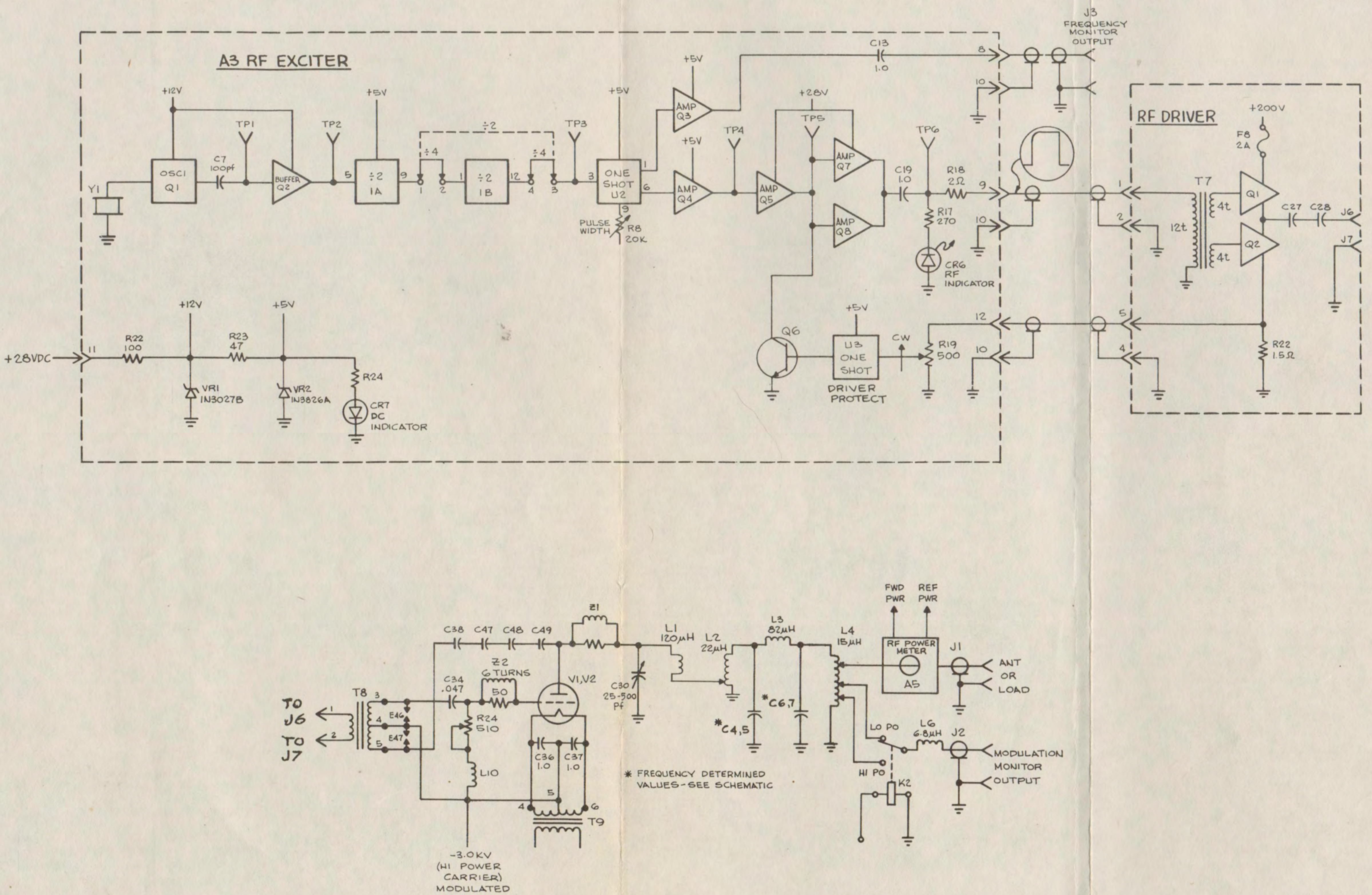
Figure 6-3 is a simplified schematic of the PWM circuits from the audio input lines to the modulated dc supplied to the RF power amplifier.

With this circuit configuration of achieving AM, it should be remembered that the HVPS is approximately -8.5 kV and is controlled by the plate contactor, but the plate voltage is approximatley -3.0 kV and is controlled by the PWM circuits. Therefore, presence of HVPS and absence of plate voltage indicates a problem in the PWM circuits. An exception to these symptoms would be a loss of RF drive, which would cause the drive loss protect circuit to shut off the PWM signal.

A good checkpoint is the output of the PWM circuit on TP19. The waveform here is normally a 70 kHz square wave from 0 to +1.5 volts (see figure 6-4). Zero volts turns plate voltage off and +1.5 volts turns it on. So, if the voltage at TP19 is low (zero volts) and the plate voltage is missing, the fault is probably in the PWM circuit. However, if the voltage at TP19 is high (+1.5 volts) and the plate voltage is missing, the fault is probably in the LED, the fiber optic cable, or in switching modulator (switchmod) card A3.

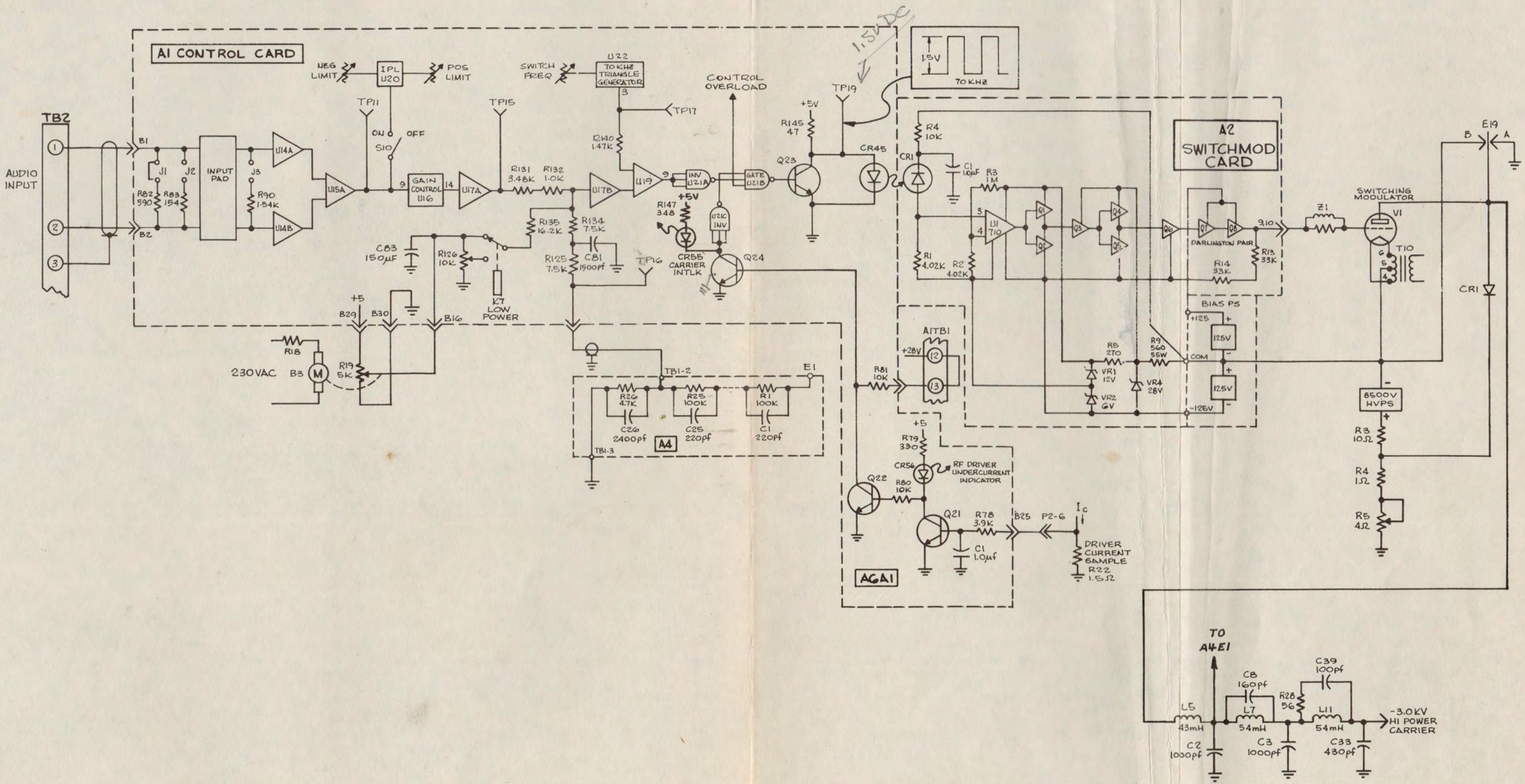
To test the PWM output, it is necessary to operate the power controller to its minimum position and bypass the carrier interlock by grounding the case (collector) of Q24 in the control circuit card. The control circuit card may then be tested with only the LOW VOLTAGE circuit breaker on. The positive voltage from the power control resistor, R19, offsets part of the -4.5 volts from the feedback divider, A4, to control the width of the pulses and thus the amount of plate voltage. Without feedback, the output of the PWM will be full on (steady state +1.5 volts) unless the positive power control voltage is reduced.

If the trouble appears to be located on the switchmod card, it can be serviced, but extreme care must be exercised, because in its normal operation, it is connected to the negative high-voltage bus, which is -8500 volts. To service this card, first turn off all voltages, use the grounding stick to discharge all capacitors (including the switchmod card itself), and disconnect the fiber optic cable connection on the lower right-hand corner of the card. Then the card can safely be removed for servicing. Arcing in the modulator circuit can cause damage to one or more of the three power transistors, Q6, 7 or 8 (2N6575), and sometimes a change in value in R10.



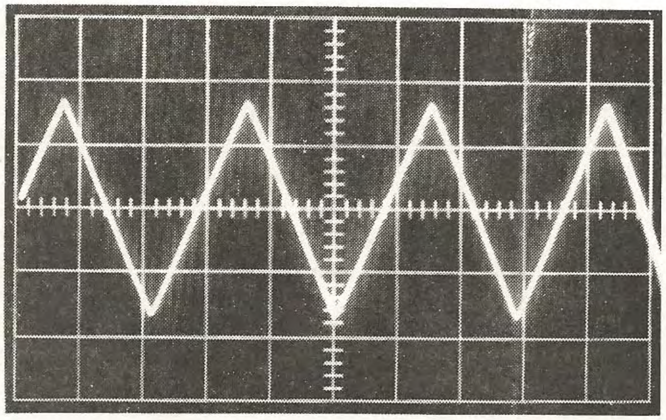
WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Figure 6-2. RF Circuits

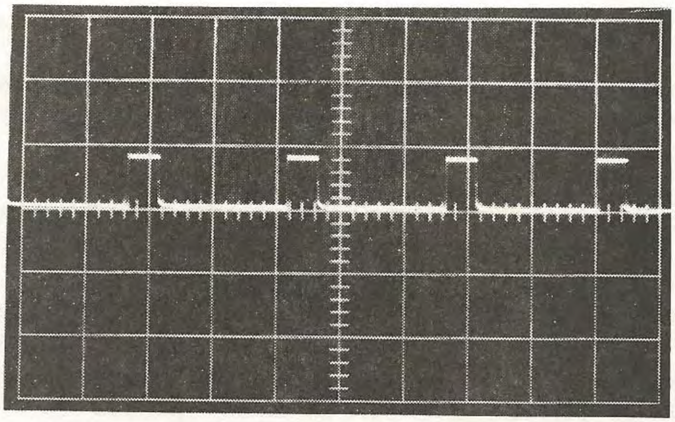


WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

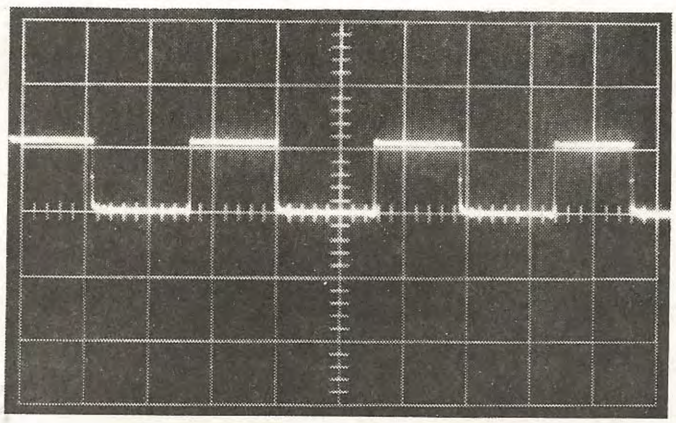
Figure 6-3. PWM Circuits



A. WAVEFORM AT A1TP17



B. WAVEFORM AT A1TP19, LOW POWER



C. WAVEFORM AT A1TP19, HIGH POWER

Figure 6-4. 314R-1 PWM Waveforms.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

troubleshooting

Improper setting of arc gaps E19A and B, located to the left of switching modulator tube V1, can cause unnecessary arcing or failure to protect the tube. See paragraph 5.2.6 for proper gap settings.

When the bias power supply fails, a peculiar failure mode for the switching modulator exists. If for some reason the bias is lost, the switching regulator becomes a "class A" regulator operating in the zero bias mode. The output voltage to the PA is fairly normal, but may be slightly more or less than the normal 3 kV. No control of the voltage is present and no modulation occurs.

CAUTION

THE "CLASS A" REGULATOR IS DISSIPATING NEARLY 2.5 KW IN ITS ANODE DUE TO THE INEFFICIENT MODE OF OPERATION. IT WILL BE DAMAGED IN A VERY FEW MINUTES OF OPERATION IN THIS CONDITION.

To sense this condition, a thermal sensor is located in the exhaust air stream above the modulator tube. It is in the high-voltage interlock chain and when 240 F is reached, it will open and disconnect the HVPS.

The 70 kHz filter between the modulator anode and the PA cathode is a very special design and is critical to achieving proper audio performance. It very directly affects the feedback, audio response, and audio distortion, particularly at the high audio frequencies like 5 kHz and above. Input coil L5 is slightly different from the other two, L7 and L11. The dc resistance of each coil is approximately 22 to 24 ohms. Any deviation of more than 10 percent from this value probably indicates a damaged coil.

Clamp diode CR1, connected to the anode of the switching tube, is also critical to the operation of the switching modulator. Of course, a shorted diode will short the HVPS when the switching tube is on, and if the diode should somehow open, there will be severe arcing at arc gap E19. To test this diode, it takes approximately 25 to 30 volts in the forward direction to cause it to conduct, because there are many diode junctions in series in it. Its reverse voltage is 17 kV.

6.5 POWER SUPPLIES

There are only five power supplies in the 314R-1 transmitter.

a. Logic Power Supply, +12, +5, -6, -12 volts

b. 28-Volt Power Supply, +28 Volts

c. Driver Power Supply, +200 Volts

d. Bias Power Supply, +125, -125 Volts

e. High-Voltage Power Supply, -8500 Volts

The simplified diagram of figure 6-5 shows the connections of the logic power supply. Figure 6-6 shows the distribution of the loads on the 28-volt power supply.

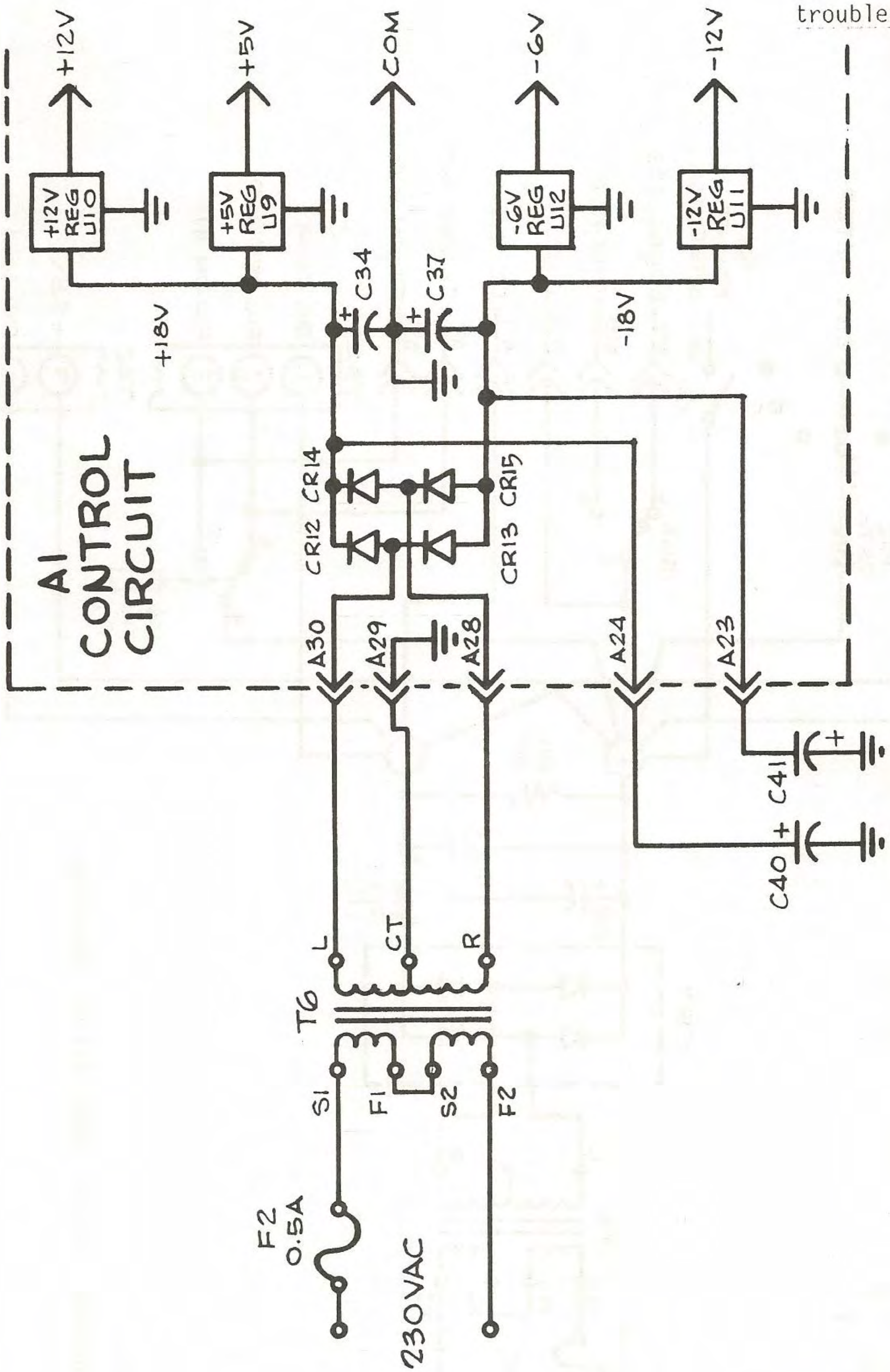
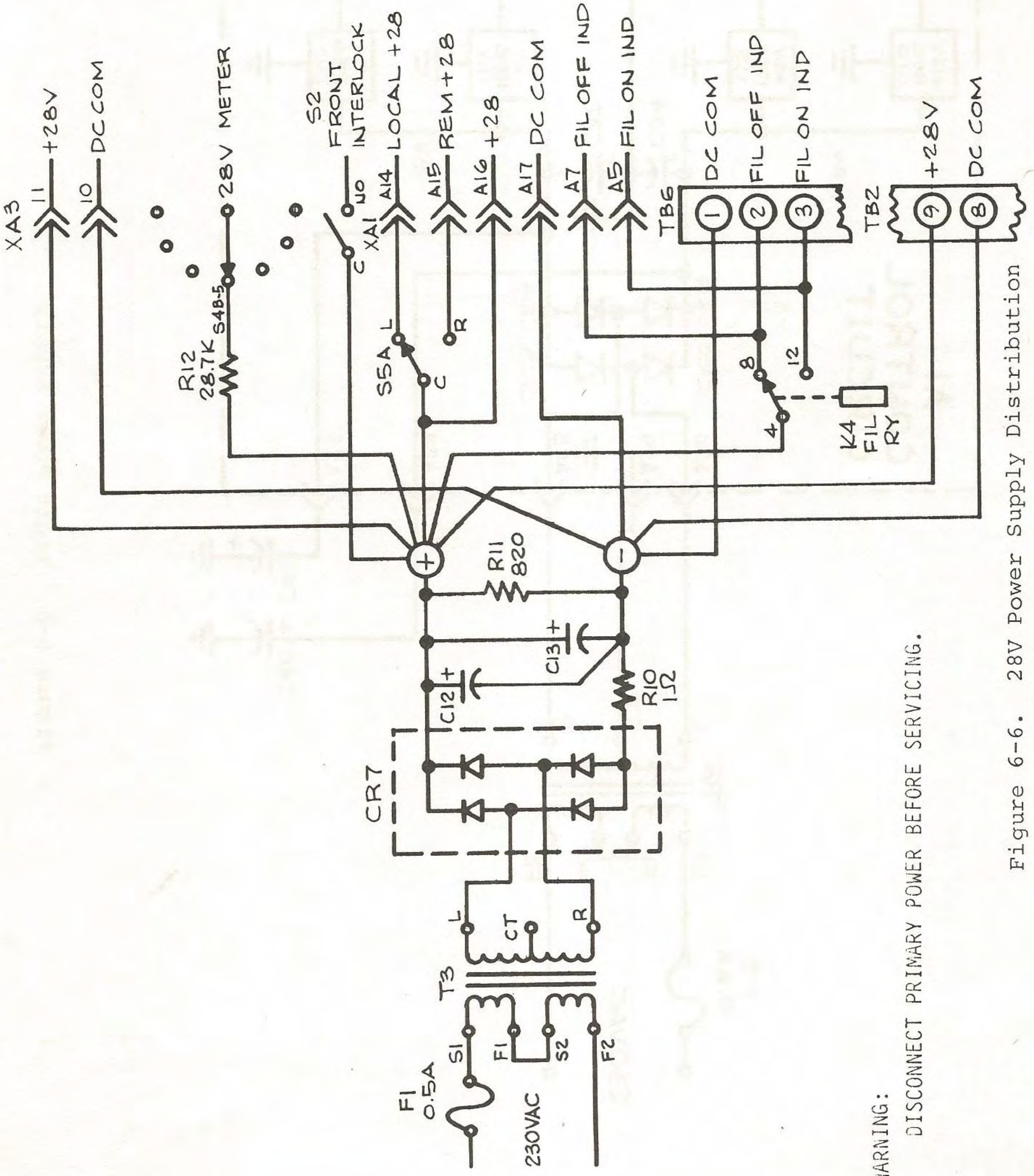


Figure 6-5. Logic Power Supply

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.



WARNING:
DISCONNECT PRIMARY POWER BEFORE SERVICING.

Figure 6-6. 28V Power Supply Distribution

Figure 6-7 shows the connections of the 200-volt driver power supply.

Figure 6-8 shows the connections of the HVPS and how the ±125 volt bias power supply is connected to it.

WARNING

THE BIAS POWER SUPPLY FLOATS ON THE NEGATIVE HIGH VOLTAGE AND IS THEREFORE 8500 VOLTS AWAY FROM GROUND. CARE SHOULD BE EXERCISED WHEN TROUBLESHOOTING THIS AREA. DO NOT TURN ON THE LOW OR HIGH POWER SWITCHES. PROPER PROCEDURE IS TO DE-ENERGIZE THE TRANSMITTER, CONNECT THE VOLTMETER, AND THEN TURN THE FILAMENT ON TO READ THE VOLTAGE. DE-ENERGIZE THE TRANSMITTER AGAIN TO REMOVE THE VOLTMETER.

The plus and minus 125 volts can be measured by turning high-voltage circuit breaker CB2 off. This ensures that the high voltage can not be accidentally applied. The bias, +125 and -125 volts, is energized by turning on the filament only.

6.6 DC METERING CIRCUITS

Figure 6-9 is a simplified diagram of the dc multimeter circuits except for the RF power metering which is covered in paragraph 6.9 below. The dc meter multipliers are all located at their source. The meter movement is a 1-mA full scale with internal resistance of 1500 ohms.

6.7 PLATE VOLTAGE METERING CIRCUITS

Figure 6-10 is a simplified circuit of the plate voltage metering circuits showing both the front-panel meter and the remote metering connections.

6.8 PLATE CURRENT METERING CIRCUITS

Figure 6-11 is a simplified circuit of the plate current metering circuits showing both the front-panel meter and the remote metering connections. Notice the protective zener diodes across both circuits. Failure of these can affect the metering circuits.

6.9 RF POWER METERING CIRCUITS

Figure 6-12 is a simplified diagram of the RF power metering circuits. The levels involved in the RF power metering are relatively low, so amplifiers are provided to prevent loading of the RF detector circuits. These amplifiers are not located in the RF power meter, but on the control circuits card due to availability of supply voltages and the fact that the reflected power signal is used for the vswr overload. The internal meter used is a 1 mA movement with internal resistance of 1500 ohms. The remote meters should be 100 microamperes. Downscale readings, or no readings at all, usually indicate failure of the operation amplifier U1 used in the control circuits card as the amplifier.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

troubleshooting

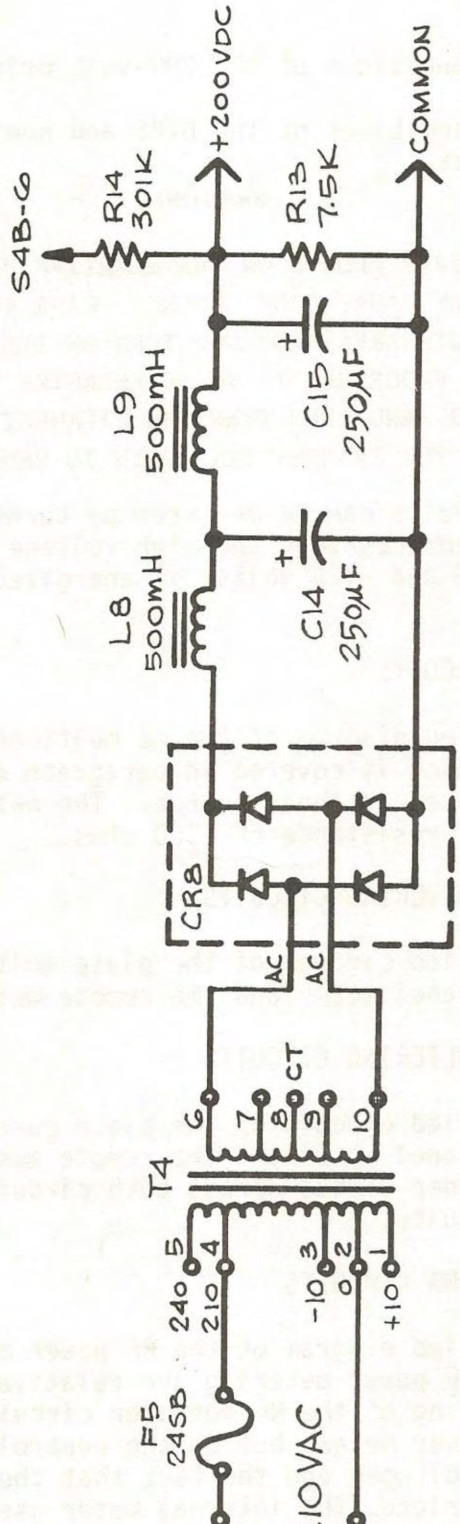


Figure 6-7. 314R-1 Driver Power Supply.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

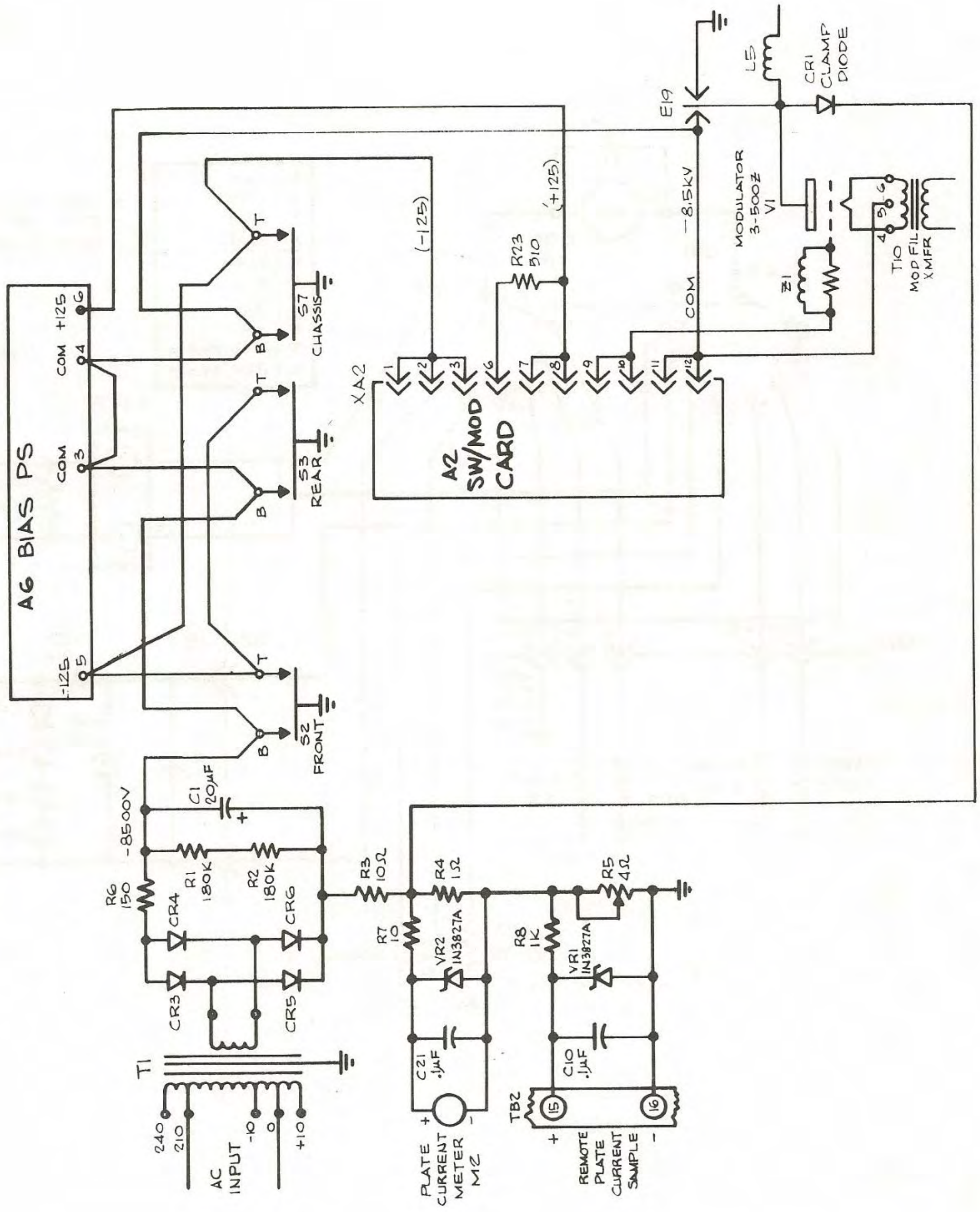


Figure 8. 314R-1 High-Voltage Power Supply Distribution.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

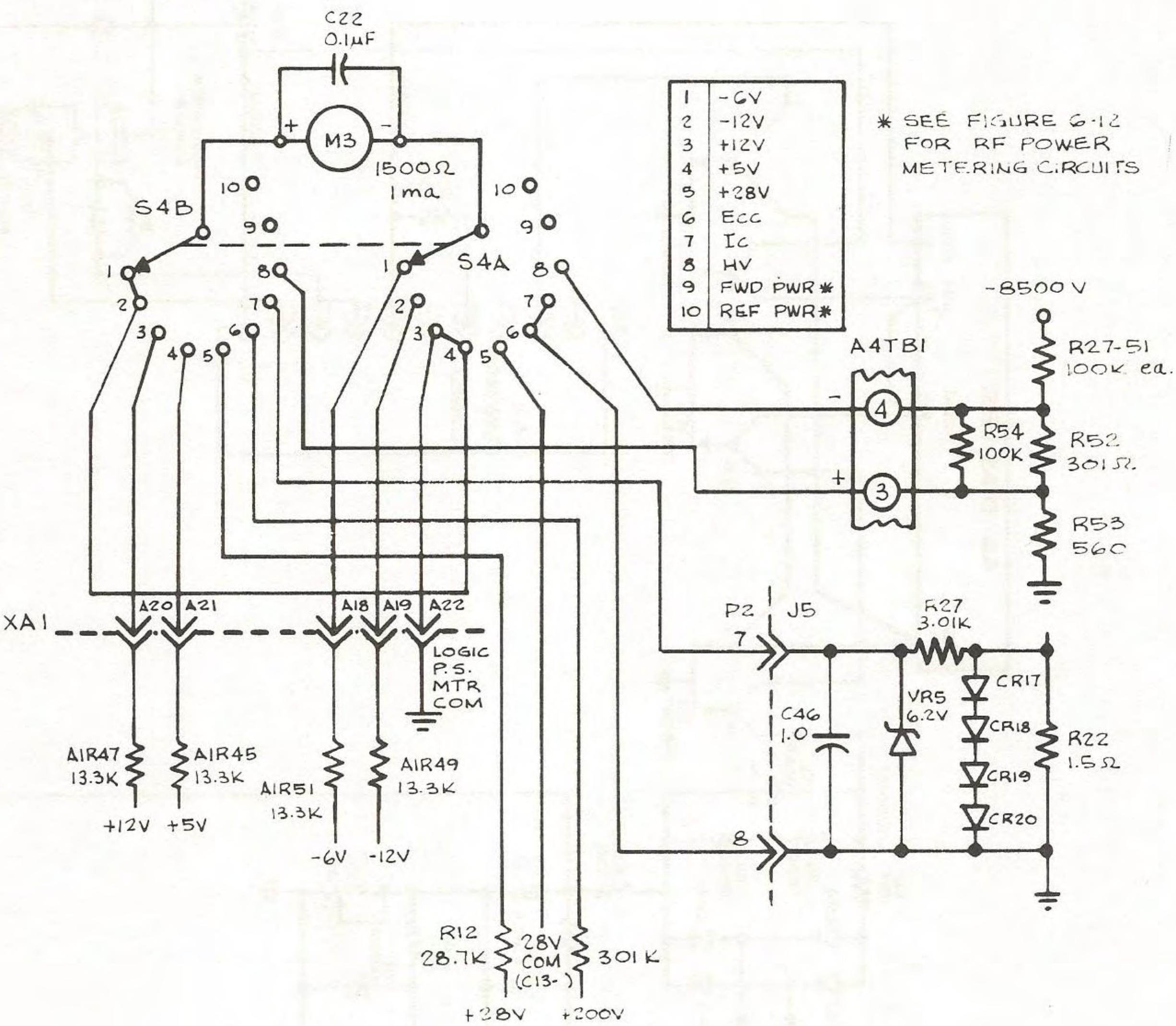


Figure 9. 314R-1 DC Metering Circuits.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

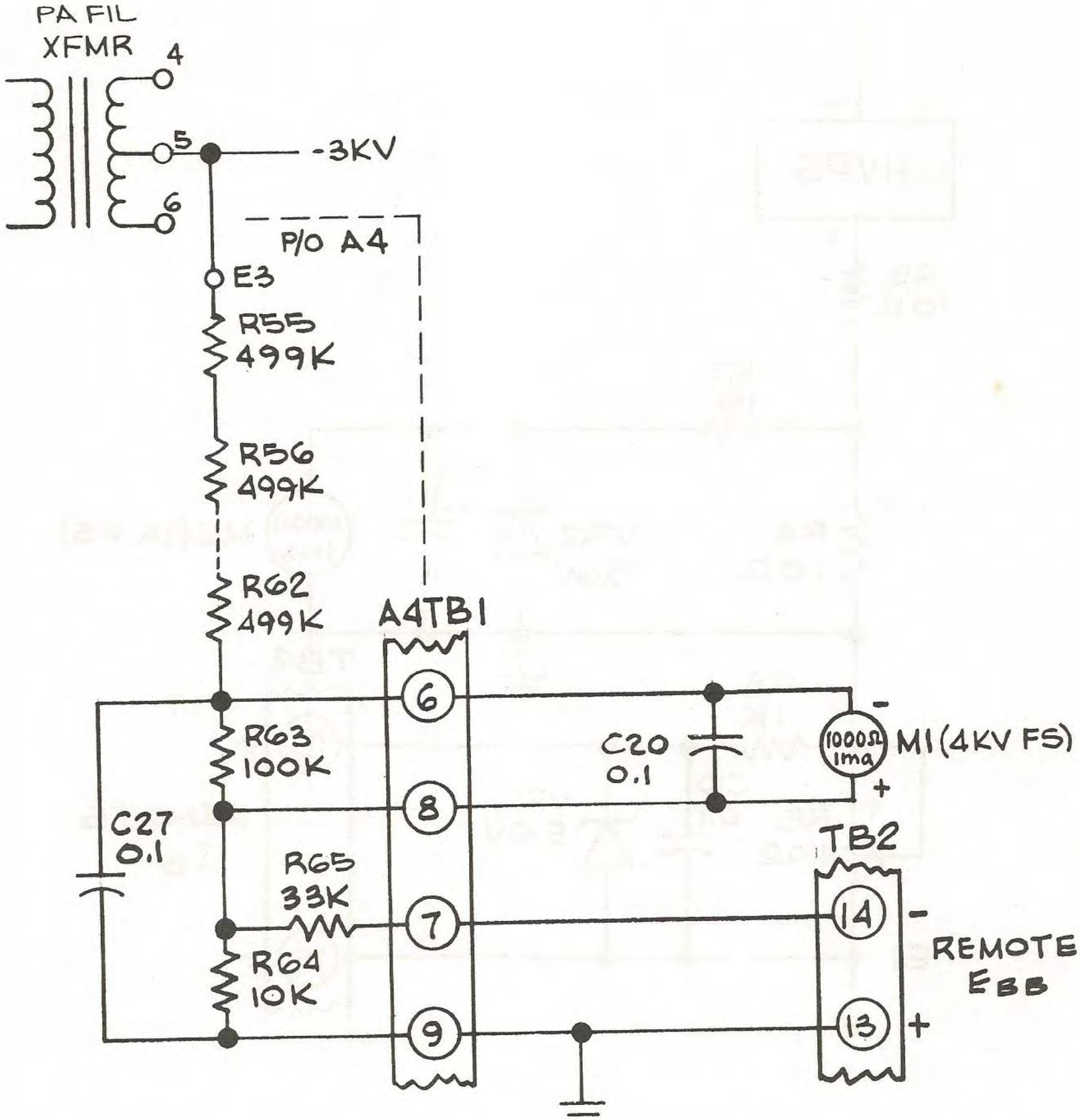


Figure 10. 314R-1 Plate Voltage Metering Circuits.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

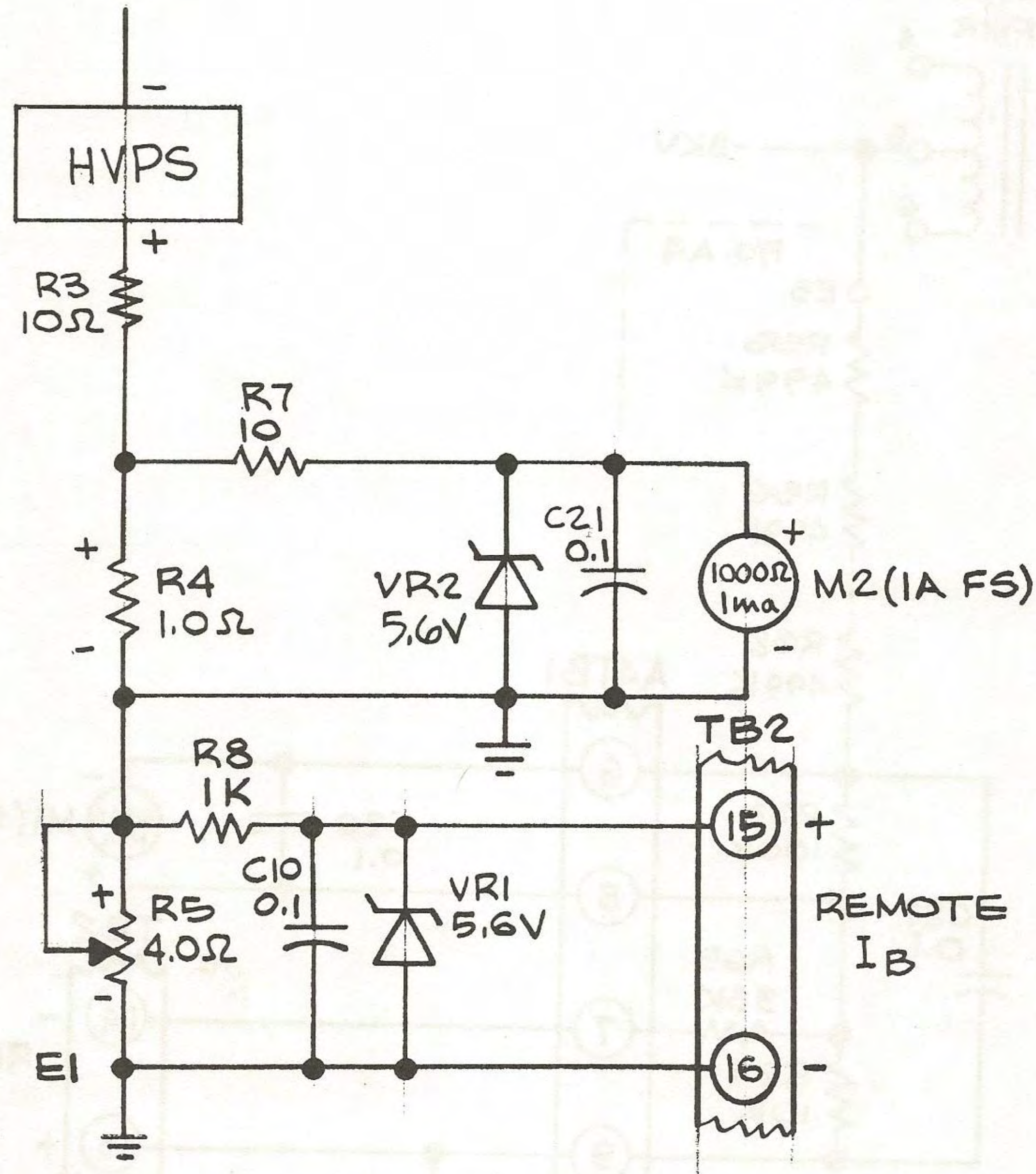


Figure 6-11. 314R-1 Plate Current Metering Circuits.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

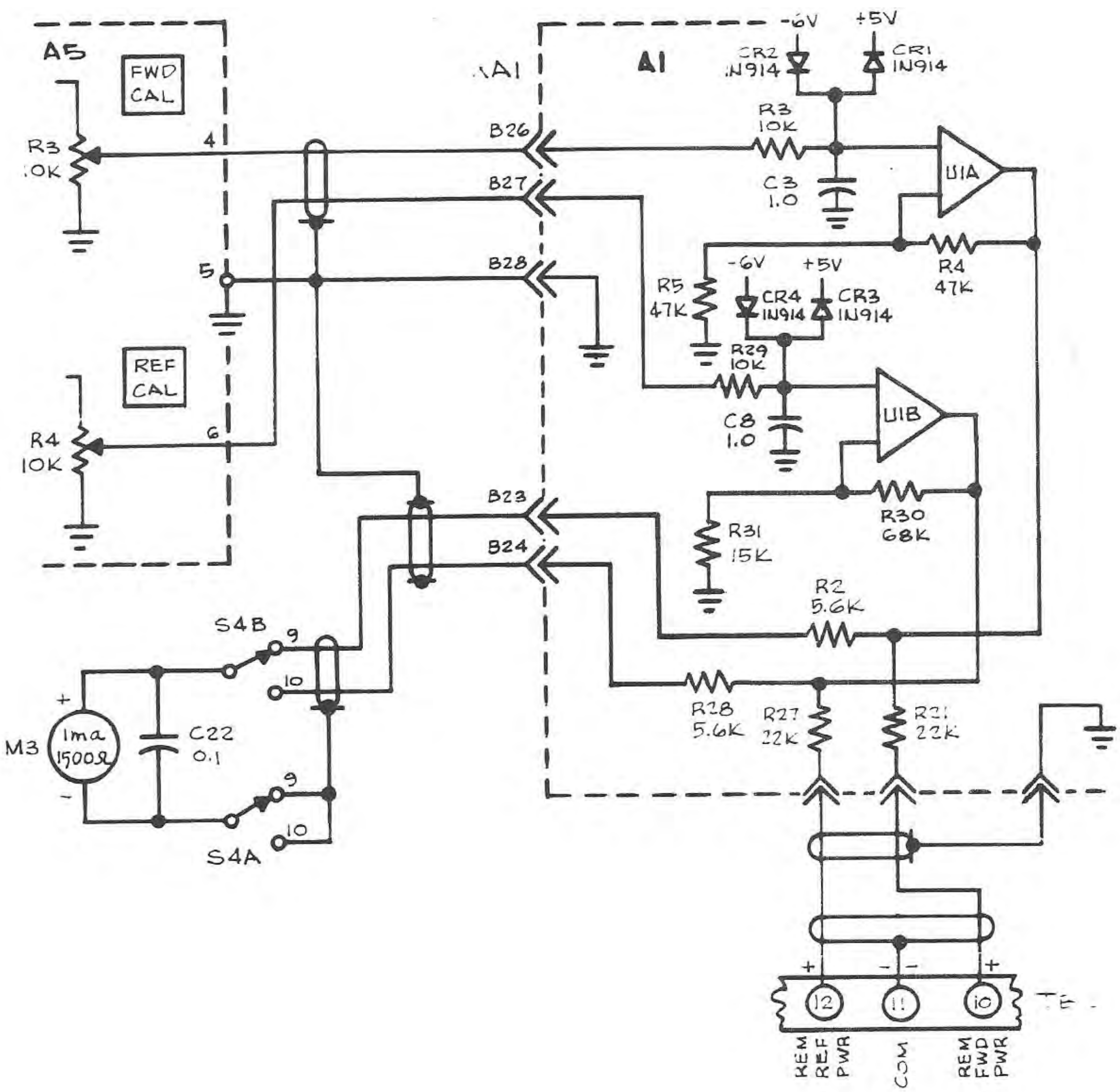


Figure 12. 314R--1 RF Power Metering Circuits.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

troubleshooting

6.11 828C-1 1kW AM transmitter wirelist sorted by the FROM TERMINAL.

WIRE NO.	FROM TERMINAL	TO TERMINAL	FUNCTION
146	A1TB1-6	S5-2	FAIL SAFE
145	A1TB1-7	S5-1	FAIL SAFE
85	A4TB1-1	XA1B-12	FEEDBACK
85	A4TB1-2	XA1B-13	SHIELD
28	A4TB1-3	XA1B-15	HVPS SAMPLE (-)
27	A4TB1-3	S4B-8	HV METER (+)
29	A4TB1-5	S4A-8	HV METER (-)
26	A4TB1-5	XA1B-14	HVPS COM (+)
102	A4TB1-6	M1 -	PLATE VOLTAGE MTR -
71	A4TB1-7	TB2-14	REMOTE PLATE V -
102	A4TB1-8	M1 +	PLATE VOLTAGE MTR +
70	A4TB1-9	TB2-13	REMOTE PLATE V +
68	A5-4	XA1B-26	FWD POWER IN
68	A5-5	Xa1B-28	SHIELD
68	A5-6	XA1B-27	REF POWER IN
9	CB1-3	K4-1	FIL PWR
10	CB1-4	K4-2	FIL PWR
11	CB1-4	K4-2	AC TO LVPS
1	CB2-1	TB1-1	AC PWR IN
2	CB2-2	TB1-2	AC PWR IN
3	CB2-4	K1-L1	HV PWR
4	CB2-4	K1-L3	HV PWR
137	CR1-C	R3-2	JUMPER
138	CR5-C	R3-1	JUMPER
122	CR7 -	R10-2	JUMPER
120	CR7 +	C13 +	JUMPER
123	CR7-AC	T3-5	JUMPER
124	CR7-AC	T3-7	JUMPER
127	CR8 +	C14	JUMPER
128	CR8-AC	T4-10	JUMPER
129	CR8-AC	T4-6	JUMPER
121	C12 -	R10-1	JUMPER
45	C12 -	XA1A-17	28V COMMON
42	C12 -	TB2-8	28V COMMON
43	C12 +	TB2-9	+28V DC
79	C12 +	S2-C	+28V DC
44	C12 +	XA1A-16	+28V DC
46	C12 +	S5A-C	+28V DC
119	C13 -	E32	JUMPER
118	C13 +	E31	JUMPER
120	C13 +	CR7 +	JUMPER
75	C13 -	XA3-10	28V COMMON
74	C13 +	XA3-11	+28V DC
61	C13 +	K4-4	+28V DC
127	C14 -	CR8 +	JUMPER

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

WIRE NO.	FROM TERMINAL	TO TERMINAL	FUNCTION
92	C15 -	P2-11	DR PS COMMON
126	C15 -	R13-1	JUMPER
125	C15 +	R13-2	JUMPER
91	C15+	P2-12	DR ECC +200V
5	E1	TB1-3	GROUND
6	E1	TB1-4	GROUND
62	E8	XA1A-1	HVPS OVERLOAD +
63	E9	XA1A-2	HVPS OVERLOAD -
132	E10	R4-1	JUMPER
101	E11	M2 +	PLATE CURRENT MTR +
101	E12	M2 -	PLATE CURRENT MTR -
136	E12	R4-2	JUMPER
135	E13	R5-1	JUMPER
72	E14	TB2-15	REMOTE PLATE I +
73	E15	TB2-16	REMOTE PLATE I -
84	E16	XA1A-25	LOWER
113	E16	E24	MOTOR CAP C42
83	E17	XA1A-26	RAISE
112	E17	E23	MOTOR CAP C42
114	E18	E21	MOTOR COMMON
114	E21	E18	MOTOR COMMON
20	E22	XF2-1	AC TO POWER CONTROL
112	E23	E17	MOTOR CAP C42
113	E24	E16	MOTOR CAP C42
100	E26	XA1A-24	LOGIC PS +
103	E28	XA1A-23	LOGIC PS -
36	E30	S4B-5	28V METER
118	E31	C13 +	JUMPER
119	E32	C13 -	JUMPER
35	E33	S4B-6	DR ECC
102	E37	NC	SHIELD
101	E38	NC	SHIELD
39	E39	NC	SHIELD
69	E40	XA1B-18	ARDC SENSOR IN
69	E41	XA1B-19	SHIELD
130	E7	R3-1	JUMPER
133	E9A	R3-2	JUMPER
109	J3	XA3-8	FREQ MON
109	J3	XA3-10	SHIELD
86	J4-1	XF7-2	FAN AC
87	J4-2	K3-10	FAN AC COMMON
53	K1-C3	XA1A-8	HV ON
54	K1-C1	XA1A-13	HV ON TIME DELAY
52	K1-L1	XA1A-3	PLATE ON IND
50	K1-T1	XA1A-11	INTERLOCKED +28V DC

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

troubleshooting

WIRE NO.	FROM TERMINAL	TO TERMINAL	FUNCTION
51	K1-T1	S1-1	TEMPERATURE INTERLOCK
3	K1-L1	CB2-3	HV PWR
8	K1-T2	T1-2	HVPS AC IN
4	K1-L3	CB2-4	HV PWR
7	K1-T3	T1-4	HVPS AC IN
13	K3-1	XF1-1	AC TO LVPS
15	K3-1	T3-F2	AC TO LVPS
12	K3-2	K4-2	AC TO LVPS
111	K3-4	K4-4	+28V DC
24	K3-9	XF6-1	AC TO BLOWER
87	K3-10	J4-2	FAN AC COMMON
90	K3-10	TB4-2	BLOWER AC COMMON
59	K3-12	XA1A-9	FIL HOLD
58	K3-13	S6-C	AIR INTERLOCK
60	K3-13	XA1A-10	FIL ON
9	K4-1	CB1-3	FIL PWR
11	K4-2	CB1-4	AC TO LVPS
10	K4-2	CB1-4	FIL PWR
12	K4-2	K3-2	AC TO LVPS
61	K4-4	C13+	+28V DC
111	K4-4	K3-4	+28V DC
55	K4-8	XA1A-7	FIL OFF IND
140	K4-8	TB6-2	FIL OFF IND
22	K4-9	XF3-1	AC TO FIL
23	K4-10	T4-2	AC JUMPER
94	K4-10	TB3-4	FIL AC COMMON
56	K4-12	XA1A-5	FIL ON IND
141	K4-12	TB6-3	FIL ON IND
57	K4-13	S6-NO	AIR INTERLOCK
102	M1 -	A4TB1-6	PLATE VOLTAGE MTR -
102	M1 +	A4TB1-8	PLATE VOLTAGE MTR +
101	M2 -	E12	PLATE CURRENT MTR -
101	M2 +	E11	PLATE CURRENT MTR +
39	M3 -	S4A-C	TEST METER -
39	M3 +	S4B-C	TEST METER +
39	NC	E39	SHIELD
101	NC	E38	SHIELD
102	NC	E37	SHIELD
33	NC	P2-9	DR METER SHIELD
67	NC	XA1B-22	SHIELD
115	P2-1	XA3-9	RF DRIVE SIGNAL
115	P2-2	XA3-10	SHIELD
34	P2-3	XA1B-22	SHIELD
116	P2-4	XA3-10	SHIELD
116	P2-5	XA3-12	DR PROTECT

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

WIRE NO.	FROM TERMINAL	TO TERMINAL	FUNCTION
34	P2-6	XA1B-25	DR IC SENSOR
33	P2-7	S4B-7	DR IC METER
33	P2-8	S4A-6	DR METER COMMON
33	P2-9	NC	DR METER SHIELD
92	P2-11	C15 -	DR PS COMMON
91	P2-12	C15+	DR ECC +200V
121	R10-1	C12 -	JUMPER
122	R10-2	CR7 -	JUMPER
126	R13-1	C15 -	JUMPER
125	R13-2	C15 +	JUMPER
96	R15-1	TB3-1	FIL AC POWER
99	R15-3	T10-3	MOD FIL POWER
98	R16-3	T9-3	PA FIL POWER
82	R19-1	XA1B-30	POWER CONTROL COMMON
80	R19-2	XA1B-29	+5V TO POWER CONTROL
81	R19-3	XA1B-16	POWER CONTROL, ARM
130	R3-1	E7	JUMPER
138	R3-1	CR5-C	JUMPER
133	R3-2	E9A	JUMPER
137	R3-2	CR1-C	JUMPER
132	R4-1	E10	JUMPER
136	R4-2	E12	JUMPER
135	R5-1	E13	JUMPERE
51	S1-1	K1-T1	TEMPERATURE INTERLOCK
76	S1-2	TB5-1	DOOR INTERLOCK
79	S2-C	C12+	+28V DC
78	S2-NO	S3-C	DOOR INTERLOCK
78	S3-C	S2-NO	DOOR INTERLOCK
77	S3-NO	TB5-2	DOOR INTERLOCK
39	S4A-C	M3 -	TEST METER -
30	S4A-1	XA1A-18	-6V METER
31	S4A-2	XA1A-19	-12V METER
33	S4A-6	P2-8	DR METER COMMON
29	S4A-8	A4TB1-4	HV METER (-)
32	S4A-10	XA1A-22	METER COMMON
39	S4B-C	M3 +	TEST METER +
38	S4B-3	XA1A-20	+12V METER
37	S4B-4	XA1A-21	5V METER
36	S4B-5	E30	28V METER
35	S4B-6	E33	DR ECC
33	S4B-7	P2-7	DR IC METER
27	S4B-8	A4TB1-3	HV METER (+)
67	S4B-9	XA1B-23	FWD POWER METER
67	S4B-10	XA1B-24	REF POWER METER
47	S5A-4	XA1A-14	LOCAL +28V DC

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

troubleshooting

WIRE NO.	FROM TERMINAL	TO TERMINAL	FUNCTION
46	S5A-5	C12+	+28V DC
48	S5A-6	XA1A-15	REMOTE +28V DC
145	S5-1	A1TB1-7	FAIL SAFE
146	S5-2	A1TB1-6	FAIL SAFE
58	S6-C	K3-13	AIR INTERLOCK
57	S6-NO	K4-13	AIR INTERLOCK
147	S7-C	TB5-2	DOOR INTERLOCK
148	S7-NO	TB5-1	DOOR INTERLOCK
1	TB1-1	CB2-1	AC PWR IN
2	TB2-2	CB2-2	AC PWR IN
5	TB1-3	E1	GROUND
6	TB1-4	E1	GROUND
64	TB2-1	XA1B-1	LEFT AUDIO +
64	TB2-2	XA1B-2	LEFT AUDIO -
64	TB2-3	XA1B-3	SHIELD
65	TB2-3	XA1B-3	SHIELD
65	TB2-4	XA1B-4	RIGHT AUDIO +
65	TB2-5	XA1B-5	RIGHT AUDIO -
42	TB2-8	C12-	28V COMMON
139	TB2-8	TB6-1	28V COMMON
43	TB2-9	C12+	+28V DC
66	TB2-10	XA1B-20	FWD POWER REMOTE
66	TB2-11	XA1B-22	SHIELD
66	TB2-12	XA1B-21	REF POWER REMOTE
70	TB2-13	A4TB1-9	REMOTE PLATE V +
71	TB2-14	A4TB1-7	REMOTE PLATE V -
72	TB2-15	E14	REMOTE PLATE I +
73	TB2-16	E15	REMOTE PLATE I -
96	TB3-1	R15-1	FIL AC POWER
95	TB3-2	XF3-2	FIL AC POWER
97	TB3-3	T9-1	FIL AC COMMON
94	TB3-4	K4-10	FIL AC COMMON
89	TB4-1	XF6-2	BLOWER AC
90	TB4-2	K3-10	BLOWER AC COMMON
76	TB5-1	S1-2	DOOR INTERLOCK
148	TB5-1	S7-NO	DOOR INTERLOCK
147	TB5-2	S7-C	DOOR INTERLOCK
77	TB5-2	S3-NO	DOOR INTERLOCK
139	~~TB6-1~~ TB6-6	TB2-8	28V COMMON
140	~~TB6-2~~ TB6-5	K4-8	FIL OFF IND
141	~~TB6-3~~ TB6-4	K4-12	FIL ON IND
142	~~TB6-4~~ TB6-3	XA1A-4	PLATE OFF IND
143	~~TB6-5~~ TB6-2	XA1B-17	LP ON IND
144	~~TB6-6~~ TB6-1	XA1A-12	HP ON IND
8	T1-2	K1-T2	HVPS AC IN

revised because of wiring harness layout

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

WIRE NO.	FROM TERMINAL	TO TERMINAL	FUNCTION
7	T1-4	K1-T3	HVPS AC IN
16	T3-F2	T6-5	AC TO LVPS
15	T3-F2	K3-1	AC TO LVPS
17	T3-S1	XF1-2	AC TO LVPS
123	T3-5	CR7-AC	JUMPER
124	T3-7	CR7-AC	JUMPER
117	T4-2	T5-1	AC JUMPER
23	T4-2	K4-10	AC JUMPER
104	T4-4	XF5-2	DR PS AC
129	T4-6	CR8-AC	JUMPER
128	T4-10	CR8-AC	JUMPER
117	T5-1	T4-2	AC JUMPER
105	T5-2	XF4-2	BIAS PS AC
18	T6-1	XF2-2	AC TO LVPS
21	T6-5	XA1A-27	AC TO POWER CONTROL
16	T6-5	T3-F2	AC TO LVPS
25	T6-7	XA1A-30	LOGIC PS AC IN
19	T6-8	XA1A-29	LOGIC PS COMMON
41	T6-9	XA1A-29	LOGIC PS AC IN
14	T9-1	T10-1	AC TO FIL
97	T9-1	TB3-3	FIL AC COMMON
98	T9-3	R16-3	PA FIL POWER
14	T10-1	T9-1	AC TO FIL
99	T10-3	R15-3	MOD FIL POWER
62	XA1A-1	E8	HVPS OVERLOAD +
63	XA1A-2	E9	HVPS OVERLOAD -
52	XA1A-3	K1-L1	PLATE ON IND
142	XA1A-4	TB6-4	PLATE OFF IND
56	XA1A-5	K4-12	FIL ON IND
55	XA1A-7	K4-8	FIL OFF INC
53	XA1A-8	K1-C3	HV ON
59	XA1A-9	K3-12	FIL HOLD
60	XA1A-10	K3-13	FIL ON
50	XA1A-11	K1-T1	INTERLOCKED +28V DC
144	XA1A-12	TB6-6	HP ON IND
54	XA1A-13	K1-C1	HV ON TIME DELAY
47	XA1A-14	S5A-4	LOCAL +28V DC
48	XA1A-15	S5A-6	REMOTE +28V DC
44	XA1A-16	C12+	+28V DC
45	XA1A-17	C12-	28V COMMON
30	XA1A-18	S4A-1	-6V METER
31	XA1A-19	S4A-2	-12V METER
38	XA1A-20	S4B-3	+12V METER
37	XA1A-21	S4B-4	5V METER
32	XA1A-22	S4A-10	METER COMMON

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

troubleshooting

WIRE NO.	FROM TERMINAL	TO TERMINAL	FUNCTION
103	XA1A-23	E28	LOGIC PS -
100	XA1A-24	E26	LOGIC PS +
84	XA1A-25	E16	LOWER
83	XA1A-26	E17	RAISE
21	XA1A-27	T6-5	AC TO POWER CONTROL
19	XA1A-29	T6-8	LOGIC PS COMMON
41	XA1A-29	T6-9	LOGIC PS AC IN
25	XA1A-30	T6-7	LOGIC PS AC IN
64	XA1B-1	TB2-1	LEFT AUDIO +
64	XA1B-2	TB2-2	LEFT AUDIO -
64	XA1B-3	TB2-3	SHIELD
65	XA1B-3	TB2-3	SHIELD
65	XA1B-4	TB2-4	RIGHT AUDIO +
65	XA1B-5	TB2-5	RIGHT AUDIO -
110	XA1B-10	XA3-1	L-R
85	XA1B-12	A4TB1-1	FEEDBACK
85	XA1B-13	A4TB1-2	SHIELD
110	XA1B-13	XA3-2	SHIELD
26	XA1B-14	A4TB1-5	HVPS COM (+)
28	XA1B-15	A4TB1-3	HVPS SAMPLE (-)
81	XA1B-16	R19-3	POWER CONTROL, ARM
93	XA1B-17	XK2-13	LOW POWER ON
143	XA1B-17	TB6-5	LP ON IND
69	XA1B-18	E40	ARC SENSOR IN
69	XA1B-19	E41	SHIELD
93	XA1B-19	XK2-14	SHIELD
66	XA1B-20	TB2-10	FWD POWER REMOTE
66	XA1B-21	TB2-12	REF POWER REMOTE
66	XA1B-22	TB2-11	SHIELD
67	XA1B-22	NC	SHIELD
34	XA1B-22	P2-3	SHIELD
67	XA1B-23	S4B-9	FWD POWER METER
67	XA1B-24	S4B-10	REF POWER METER
34	XA1B-25	P2-6	DR IC SENSOR
68	XA1B-26	A5-4	FWD POWER IN
68	XA1B-27	A5-6	REF POWER IN
68	XA1B-28	A5-5	SHIELD
80	XA1B-29	R19-2	+5V TO POWER CONTROL
82	XA1B-30	R19-1	POWER CONTROL COMMON
110	XA3-1	XA1B-10	L-R
110	XA3-2	XA1B-13	SHIELD
109	XA3-8	J3	FREQ MON
115	XA3-9	P2-1	RF DRIVE SIGNAL
109	XA3-10	J3	SHIELD
115	XA3-10	P2-2	SHIELD

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WIRE NO.	FROM TERMINAL	TO TERMINAL	FUNCTION
116	XA3-10	P2-4	SHIELD
75	XA3-10	C13-	28V COMMON
74	XA3-11	C13+	+28V DC
116	XA3-12	P2-5	DR PROTECT
13	XF1-1	K3-1	AC TO LVPS
17	XF1-2	T3-S1	AC TO LVPS
20	XF2-1	E22	AC TO POWER CONTROL
18	XF2-2	T6-1	AC TO LVPS
22	XF3-1	K4-9	AC TO FIL
95	XF3-2	TB3-2	FIL AC POWER
105	XF4-2	T5-2	BIAS PS AC
104	XF5-2	T4-4	DR PS AC
24	XF6-1	K3-9	AC TO BLOWER
89	XF6-2	TB4-1	BLOWER AC
86	XF7-2	J4-1	FAN AC
93	XK2-13	XA1B-17	LOW POWER ON
93	XK2-14	XA1B-19	SHIELD

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section 7

parts list

7.1 INTRODUCTION

The following paragraphs include the 314R-1 1-kW Transmitter main frame parts list (paragraph 7.2), the subassembly list and photos (paragraph 7.3), and the semiconductor list (paragraph 7.4).

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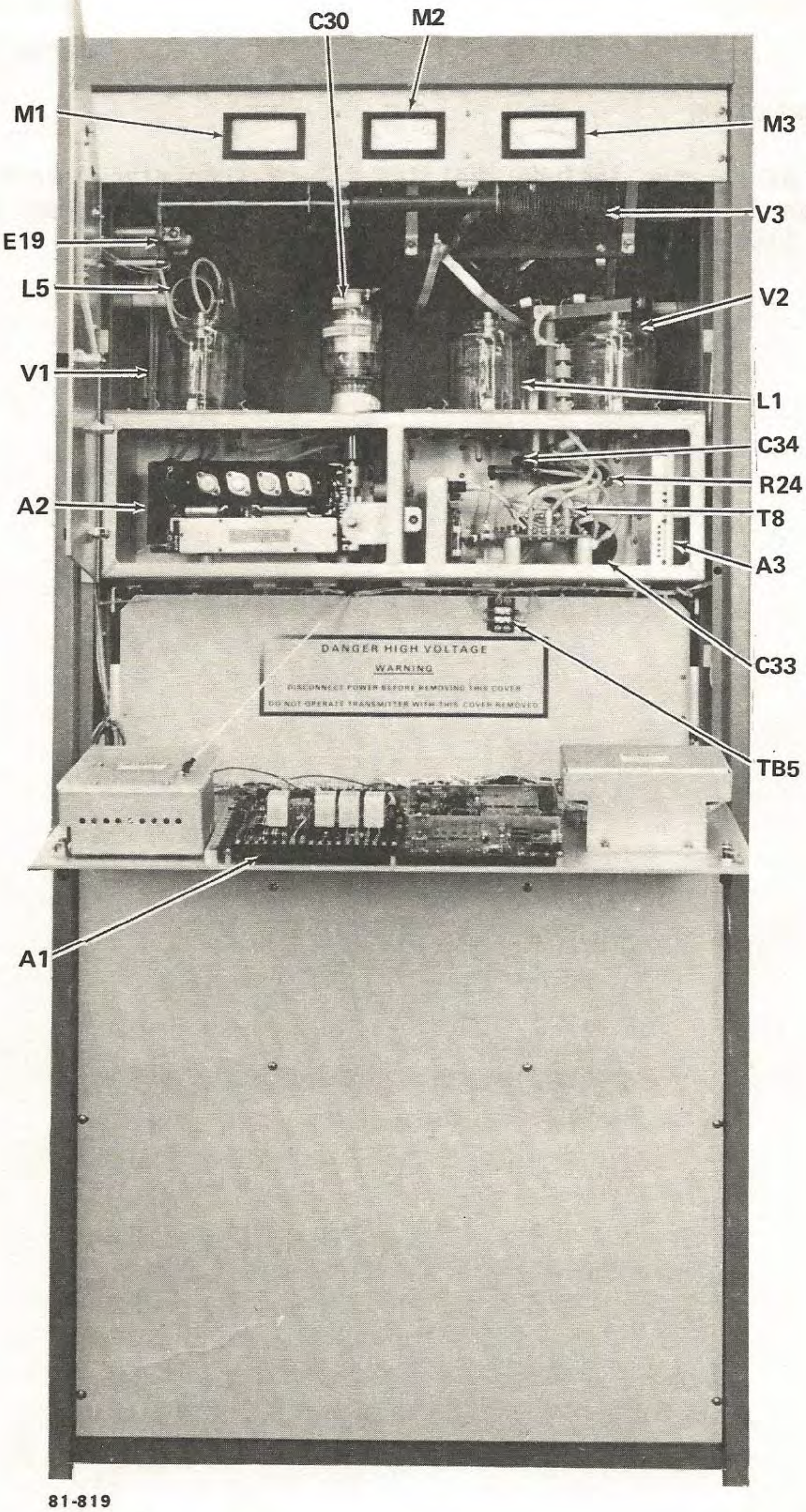
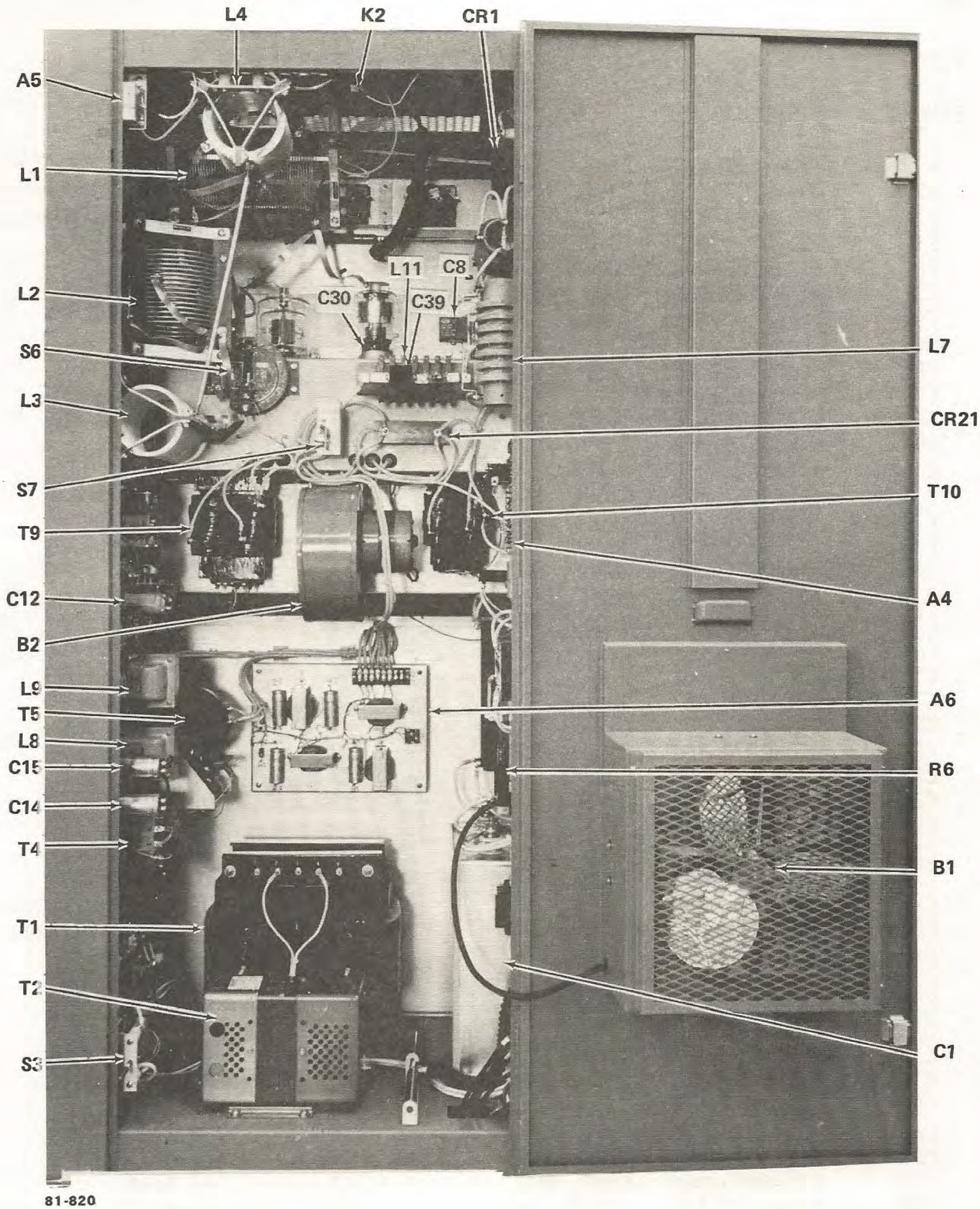


Figure 7-1. 314R-1 Main Frame (Front View)



KR1-1(6)

Figure 7-2. 314R-1 Main Frame (Rear View)

parts list

7.2 314R-1 1KW AM TRANSMITTER MAIN FRAME PARTS LIST

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
B1	230-0663-010	230V., 1500 RPM	1	Fan - Dayton 5K003
B2	009-0253-020	230V, 1.9A,325 CFM	1	Blower KBB43 - Dayton 1TDR8
B3	230-0641-010	120V, 30mA, 10 RPM	1	Power Control - Airpax 550012
C1	930-0781-040	20 UF, 10KV	1	HVPS Filter
C2	912-4126-030	1000PF, 10KV	1	70 KHZ FL
C3	912-4126-030	1000 PF, 10KV	1	70 KHZ FL
C4	Frequency Kit			Node 2
C5	Frequency Kit			Node 2
C6	Frequency Kit			Node 3
C7	Frequency Kit			Node 3
C8	912-4125-320	160PF, 5KV	1	Tune L7
C9	NOT USED			
C10	913-3681-000	0.1UF, 200V	1	Remote IB FL
C11	913-3681-000	0.1UV, 200V	1	O/L Protect
C12	183-1278-370	3900UF, 50V	1	28V Filter
C13	183-1278-370	3900UF, 50V	1	28V Filter
C14	184-2536-000	250UF, 300V	1	DR PS Filter
C15	184-2536-000	250UF,300V	1	DR PS Filter
C16	913-1188-000	0.01UF, 500V	1	Motor Bypass
C17	NOT USED			
C18	NOT USED			
C19	NOT USED			
C20	913-3279-200	0.1UF, 50V	1	Meter Bypass
C21	913-3279-200	0.1UF, 50V	1	Meter Bypass
C22	913-3279-200	0.1UF, 50V	1	Meter Bypass
C23	913-5019-200	.01UF, 100V	1	Q1 Base
C24	913-5019-200	.01UF, 100V	1	Q2 Base
C25	933-1059-050	1.0UF, 200V	1	200V Bypass
C26	933-1059-050	1.0UF, 200V	1	200V Bypass
C27	933-1059-050	1.0UF, 200V	1	Output Coupling
C28	933-1059-050	1.0UF, 200V	1	Output Coupling
C29	933-1059-050	1.0UF, 200V	1	Meter Bypass
C30	919-0293-080	25-500pF, 10kv	1	Plate Tuning
C31	Frequency Kit			Node 1
C32	NOT USED			
C33	912-4126-150	430pF, 10kv	1	70 KHz Filter
C34	937-2068-000	.047uF, 600V	1	PA Grid
C35	NOT USED			
C36	933-1059-050	1.0uF, 200V	1	PA Fil Bypass
C37	933-1059-050	1.0uF, 200V	1	PA Fil Bypass
C38	913-0829-000	67pF, 4kv	1	PA Neut
C39	912-4125-140	100pF, 5kv	1	Tune L11
C40	183-1313-000	1000uF, 25V	1	Logic PS +
C41	183-1313-000	1000uF, 25V	1	Logic PS -
C42	951-1066-000	0.33uF, 600V	1	Motor Run Cap.
C43	912-2768-000	22pF, 500V	1	VSWR Sensor
C44	922-3910-000	6-140pF	1	VSWR Balance

parts list

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
C45	912-2768-000	22pF, 500V	1	VSWR Sensor
C46	913-3279-270	1.0uF, 50V	1	Meter Bypass
C47	913-0829-000	67pF, 4kv	1	PA Neut
C48	913-0829-000	67pF, 4kv	1	PA Neut
C49	913-0829-000	67pF, 4kv	1	PA Neut
C50	912-2804-000	68pF, 500v	1	Mod Grid
C51	912-2804-000	68pF, 500v	1	PA Grid
C52	912-2804-000	68pF, 500v	1	PA Grid
CB1	260-1049-040	6A, HI Inrush	1	LV CB
CB2	260-1049-010	30A, HI Inrush	1	HV CB
CR1	353-6599-020	17kv, 1.0A	1	Clamp Diode
CR2	353-6442-040	IN4004	1	Mod Monitor Relay
CR3	353-0413-020	15KV, 600MA	1	HVPS Rectifier
CR4	353-0413-020	15KV, 600MA	1	HVPS Rectifier
CR5	353-0413-020	15KV, 600MA	1	HVPS Rectifier
CR6	353-0413-020	15KV, 600MA	1	HVPS Rectifier
CR7	Not Used			
CR8	353-0417-060	600V,22A,Bridge	1	DR PS Rectifier
CR9	353-6442-040	1N4004,400V	1	K3 Suppressor
CR10	353-6442-040	1N4004,400V	1	K4 Suppressor
CR11	353-9009-440	1N5418	1	Q1 Base
CR12	353-9009-440	1N5418	1	Q2 Base
CR13	353-0221-660	1N5661A	1	Q1
CR14	353-0221-660	1N5661A	1	Q1
CR15	353-0221-660	1N5661A	1	Q2
CR16	353-0221-660	1N5661A	1	Q2
CR17	353-3718-060	1N5552	1	Meter Protect
CR18	353-3718-060	1N5552	1	Meter Protect
CR19	353-3718-060	1N5552	1	Meter Protect
CR20	353-3718-060	1N5552	1	Meter Protect
CR21	353-0413-020	15KV,600MA	1	Transient Diode
CR22	353-6442-040	1N4004	1	K1 Suppressor
F1	264-1164-000	0.5ASB,250v	1	28V PS
F2	264-1164-000	0.5ASB,250v	1	Logic PS
F3	264-0305-000	2ASB,250v	1	Filaments
F4	264-0303-000	1.5ASB, 250V	1	Bias PS
F5	264-0305-000	2ASB,250v	1	Driver PS
F6	264-0305-000	2ASB,250v	1	Blower
F7	264-0305-000	2ASB,250v	1	Fan
F8	264-4070-000	2A,250v. (Norm)	1	Driver Fuse
J1	357-9385-000	LC Coax Conn	1	R.F. Output
J2	357-7093-000	BNC Conn	1	Mod Monitor
J3	357-7093-000	BNC Conn	1	Freq Monitor
J4	368-0383-010	AC Recp	1	Fan
J5	372-5909-730	12 Pin - Molex	1	RF Driver
J6	372-3390-000	Binding Post, Red	1	RF Driver
J7	372-3389-000	Binding Post, Black	1	RF Driver
K1	401-0004-020	3PNO,25A,250v	1	Plate Contactor
K2	970-0002-030	4PDT, 28V COI	1	Mod Mon HI/LO

→ Rowan Controls 2160 BZ30JA, 22, 29, 66, MOD. A
Fe Gmechanic

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
K3	970-2426-070	4PDT,25A,250v	1	Blower Relay
K4	970-2426-070	4PDT,25A,250v	1	Filament Relay
K5	970-0007-270	Relay 240VAC coil	1	Bias Interlock-14UP14A51-240
L1	980-0048-000	120uH, 10A	1	Node 1 Coil
L2	980-0133-000	22uH, 20A	1	Node 2 Coil
L3	980-0047-000	82uH, 10A	1	Node 2-3 Coil
L4	980-0132-000	15uH, 20A	1	Node 3 Coil
L5	640-3434-003	43MH, 1A	1	70KHz FL
L6	240-2715-230	6.8uH	1	Mod Monitor Coil
L7	640-3434-004	54MH, 1 A	1	70KHz FL
L8	668-0432-000	500MH, 1A	1	DR PS Filter
L9	668-0432-000	500MH, 1 A	1	DR PS Filter
L10	240-9006-000	4MH, 400MA	1	PA Grid Coil
L11	640-3434-004	54MH, 1A	1	70 KHz FL
L12	650-2992-001	50 Turns	1	VSWR Coil
M1	458-0859-330	0-4KV	1	Plate Voltage
M2	458-0859-320	0-1A	1	Plate Current
M3	458-0859-310	0-1MA,1500ohms	1	Multimeter
ME1	~~270-0547-050~~	SPX-3130-141	1	Fiber Optic Cable [419-0123-010]
ME2	139-1405-000	Lower Flange	1	PA Tuning Cap
ME3	139-0736-000	Upper Flange	1	PA Tuning Cap
P1	368-0390-010	AC Plug, 250v	1	Fan Plug
P2	372-5909-790	12 Pin Molex	1	RF Driver
PS1	109-0597			Power Supply
Q1	352-1134-010	2N6575	1	RF Driver
Q2	352-1134-010	2N6575	1	RF Driver
R1	746-6742-000	180K,210W	1	HVPS Bleeder
R2	746-7642-000	180K,210W	1	HVPS Bleeder
R3	747-2813-000	15,55W	1	HVPS O/L Shunt
R4	710-5076-010	1,36W,1%	1	Plt Cur Mtr Shunt
R5	710-5076-060	4,100W,Tap	1	Rem Plt Cur Shunt
R6	712-4401-420	150,100W	1	HVPS FL
R7	745-0914-170	10,1/2W,5%	1	Plate Current Meter
R8	745-0914-650	1K,1/2W,5%	1	Remote IB
R9	745-5596-000	47,2W	1	O/L Protect
R10	Not Used			
R11	745-5649-000	820R,2W	1	28V PS Bleeder
R12	705-6666-000	28.7K,1/4W,1%	1	28V PS Meter
R13	710-2932-000	7.5K,10W	1	DR PS Bleeder
R14	705-6715-000	301K,10	1	DR PS Meter
R15	738-0076-000	150,100W, VAR	1	Mod Fil Adj
R16	738-0076-000	150,100W, VAR	1	PA Fil Adj
R17	745-0914-410	100,1/2W,5%	1	Motor Bypass
R18	747-5535-000	3.3K, 6.5W	1	Motor Dropping
R19	381-1648-020	5K POT,2W,10T	1	Power Adj
R20	745-3275-000	15, 1W	1	Q1 Base
R21	745-3275-000	15, 1W	1	Q2 Base
R22	747-5406-000	2.0, 6W	1	Meter Shunt

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SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
R23	747-3798-000	510, 100W.	1	Switchmod R
R24	716-0059-600	500,75W TAPPED	1	PA Grid Resistor
R25	747-5493-000	47, 6.5W	1	PA RF ARC Gap
R26	745-5680-000	4.7K,2W	1	Pa RF ARC Gap
R27	705-6628-000	4.64K, 1%	1	Driver Meter
R28	745-5600-000	56, 2W	1	L11 Suppressor
R29	745-5600-000	56, 2W	1	Mod Grid
R30	745-5600-000	56, 2W	1	PA Grid
R31	745-5600-000	56, 2W	1	PA Grid
R32	745-5603-000	68, 2W	1	
S1	267-0243-100	Open 240F,CL 200F	1	Thermostat
S3	627-9743-011	Switch	1	HV Intlk Assy Rear
S4	259-9475-200	Switch, 2P,10 POS	1	Mult, Meter Switch
S5	266-5420-160	DPDT, Black	1	Local/Remote
S6	266-8384-060	Switch	1	Air Interlock
S7	627-9743-010	Switch	1	HV Intlk Assy,PA Box
S8	266-5321-200	SW DPDT	1	VSWR Calibrate
T1	662-0672-010	8500 VDC, 315mA	1	HVPS Xfmr
T2	662-0292-050	60Hz, 250W	OPTION	Filament Reg
T2	662-0292-060	50Hz, 250W	OPTION	Fil Reg
T3	Not Used			
T4	662-0910-010	200VDC,1A	1	DR PS Xfmr
T5	662-0911-010	±125VDC,500MA	1	Bias PS Xfmr
T6	662-0912-010	28VCT,500MA	1	Logic PS Xfmr
T7	640-9675-002	12T PRI,4T SEC	1	DR Input Xfmr
T8	650-2906-001	4T PRI, 8T CT SEC	1	PA Grid Xfmr
T9	662-1809-020	5.25V@30A	1	PA Fil Xfmr
T10	662-1809-010	5.25V@15A	1	Mod Fil Xfmr
TB1	306-0778-000	4 Term	1	Input Power
TB2	367-4160-000	16 Term	1	Remote Monitor
TB3	367-4040-000	4 Term 6-32	1	Fil Reg
TB4	367-4020-000	2 Term 6-32	1	Blower
TB5	367-4020-000	2 Term 6-32	1	Interlock
TB6	367-4080-000	8 Term 6-32	1	Remote indicator
V1	256-0191-010	3-500Z	1	Modulator
V2	256-0191-010	3-500Z	1	L.PA.
V3	256-0191-010	3-500Z	1	R.PA.
VR1	353-6316-000	5.6V, 1N3827A	1	Remote IB
VR2	353-6316-000	5.6V, 1N3827A	1	IB
VR3	353-3129-000	1N3024B, 15V.	1	O/L Protect
VR4	353-6313-000	4.3V, 1N3824A	1	PA RF Arc Gap
VR5	353-6317-000	6.2V, 1N3828A	1	Driver Meter
XA1A	372-0149-010	30Pin Connector	1	Control Card
XA1B	372-0149-010	30Pin Connector	1	Control Card
XA2	650-2929-001	Socket Assy	1	Switchmod Card
XA3	650-2994-001	Socket Assy	1	R.F. Exciter Socket
XF1	265-1241-090	Lighted 3AG	1	Fuse Holder
XF2	265-1241-090	Lighted 3AG	1	Fuse Holder
XF3	265-1241-090	Lighted 3AG	1	Fuse Holder
XF4	265-1241-090	Lighted 3AG	1	Fuse Holder

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
XF5	265-1241-090	Lighted 3AG	1	Fuse Holder
XF6	265-1241-090	Lighted 3AG	1	Fuse Holder
XF7	265-1241-090	Lighted 3AG	1	Fuse Holder
XF8	265-1037-000	Driver	1	Fuse Holder
XK2	220-1543-000	Relay Socket	1	K2 Socket
XQ1-2	220-0968-010	TO-3 Sockets	2	Sockets
XTB2	367-1627-000	16 Term	1	Marker
XTB3	367-1845-030	4 Term 6-32	1	Marker Strip
XTB6	367-1845-070	8 Term 6-32	1	Marker Strip
XV1	220-1016-000	5-Pin SK-410	1	Socket
XV2	220-1016-000	5-Pin SK-410	1	Socket
XV3	220-1016-000	5-Pin SK-410	1	Socket
YV1	192-1024-000	SK-406	1	Chimney
YV2	192-1024-000	SK-406	1	Chimney
YV3	192-1024-000	SK-406	1	Chimney
Z1	650-2976-001	47, 20T	1	Mod Grid Supp.
Z2	650-2976-001	47, 20T	1	PA Grid Supp.
Z3	650-2976-001	47, 20T	1	PA Grid Supp.
Z4	650-2969-001	47, 8T	1	PA Plate Supp.
Z5	650-2969-001	47, 8T	1	PA Plate Supp.
Z6	714-3258-240	130V MOV	1	GE V130H6150
ZV1-3	301-1013-000	HR-6	3	Heat Diss. Conn

Intersil V130HE150
V131DB40

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

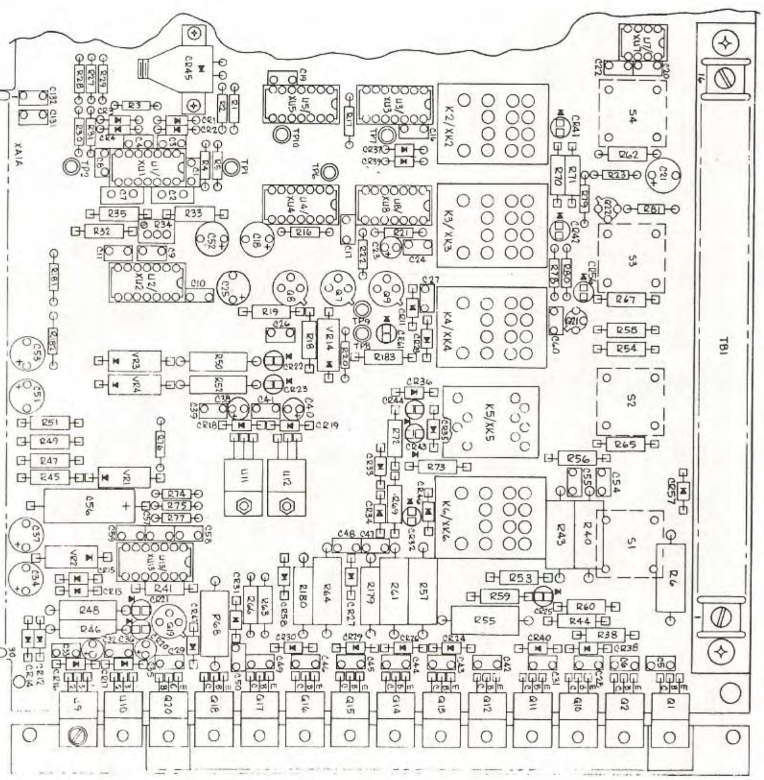

Fig. 7-3. Control Circuit Card (A1) (Left Side)

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

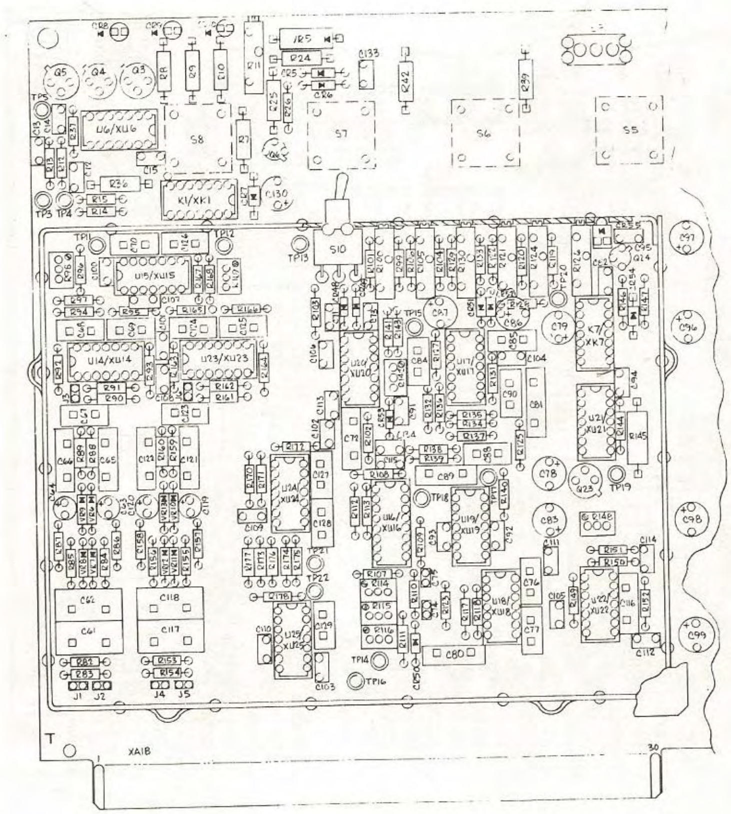

Fig. 7-4. Control Circuit Card (A1) (Right Side)

parts list

CONTROL CIRCUITS CARD, A1

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A1	650-2891-001	Control Circuits	1	PCB Assy - Complete
A1C1	913-3279-200	0.1uF, 50V	1	U1 Bypass
A1C2	912-2754-000	10pF, 500V	1	U1A Comp
A1C3	913-3279-270	1.0 uF, 50V	1	U1A Input Fl.
A1C4	913-3279-200	0.1uF, 50V	1	U1 Bypass
A1C5	913-3279-270	1.0uF, 50V	1	Q2 Collector
A1C6	913-3279-270	1.0uF, 50V	1	Q2 Base
A1C7	912-2754-000	10pF, 500V	1	U1B Comp
A1C8	913-3279-270	1.0uF, 50V	1	U1B Input Fl.
A1C9	913-3279-200	0.1uF, 50V	1	U2 Input Fl.
A1C10	913-3279-200	0.1uF, 50V	1	U2 Bypass
A1C11	913-3279-200	0.1uF, 50V	1	U2 Bypass
A1C12	913-3279-200	0.1uF, 50V	1	U3A Input Fl.
A1C13	913-3279-200	0.1uF, 50V	1	U3A Input Fl.
A1C14	913-3279-200	0.1uF, 50V	1	U3A Input Fl.
A1C15	913-3279-200	0.1uF, 50V	1	U6 Bypass
A1C16	913-3279-200	0.1uF, 50V	1	U3 Bypass
A1C17	913-3279-200	0.1uF, 50V	1	U4 Bypass
A1C18	184-9102-190	.47uF, 20V	1	U4 Timing
A1C19	913-3279-200	0.1uF, 50V	1	U5 Bypass
A1C20	913-3279-200	0.1uF, 50V	1	U7 Bypass
A1C21	184-9102-440	33uF, 35V	1	U7 Timing
A1C22	913-3279-200	0.1uF, 50V	1	U7 Bypass
A1C23	184-9102-240	10uF, 50V	1	U8 Timing
A1C24	913-3279-200	0.1uF, 50V	1	U8 Bypass
A1C25	184-9102-440	33uF, 35V	1	Q7 Collector
A1C26	913-3279-270	1.0uF, 50V	1	Q8 Base
A1C27	913-3279-270	1.0uF, 50V	1	Q9 Collector
A1C28	913-3279-270	1.0uF, 50V	1	Q10 Base
A1C29	913-3279-270	1.0uF, 50V	1	HV Time Delay
A1C30	NOT USED			
A1C31	913-3279-270	1.0uF, 50V	1	Q11 Base
A1C32	184-9102-370	2.2uF, 35V	1	+5V Reg Fl
A1C33	913-3279-200	0.1uF, 50V	1	+5V Reg Fl
A1C34	184-9102-270	47uF, 25V		LOGIC PS +
A1C35	184-9102-370	2.2uF, 35V	1	+12V Reg Fl
A1C36	913-3279-200	0.1uF, 50V	1	+12V Reg Fl
A1C37	184-9102-270	47uF, 25V		Logic PS -
A1C38	184-9102-370	2.2uF, 35V	1	-12V Reg Fl
A1C39	913-3279-270	1.0uF, 50V	1	-12V Reg Fl
A1C40	184-9102-370	2.2uF, 35V	1	-6V Reg Fl
A1C41	913-3279-270	1.0uF, 50V	1	-6V Reg Fl
A1C42	913-3279-270	1.0uF, 50V	1	Q12 Base
A1C43	913-3279-270	1.0uF, 50V	1	Q13 Emitter
A1C44	913-3279-270	1.0uF, 50V	1	Q14 Base
A1C45	913-3279-270	1.0uF, 50V	1	Q15 Base
A1C46	913-3279-270	1.0uF, 50V	1	Q16 Base
A1C47	913-3279-270	1.0uF, 50V	1	Q15 Emitter
A1C48	913-3279-270	1.0uF, 50V	1	Q16 Emitter

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parts list

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A1C49	913-3279-270	1.0uF, 50V	1	Q17 Base
A1C50	913-3279-270	1.0uF, 50V	1	Q18 Emitter
A1C51	184-9102-930	22MF, 50V	1	+28V Bypass
A1C52	184-9102-930	22MF, 50V	1	L+28V Bypass
A1C53	184-9102-930	22MF, 50V	1	R+28V Bypass
A1C54	913-3279-270	1.0uF, 50V	1	Q10 Emitter
A1C55	913-3279-270	1.0uF, 50V	1	Q11 Emitter
A1C56	184-9086-370	150uF, 15V	1	HV Time Delay
A1C57	913-3279-270	1.0uF, 50V	1	HV Time Delay
A1C58	913-3279-200	0.1uF, 50V	1	U13 Bypass
A1C59	913-3279-200	0.1uF, 50V	1	U13 Bypass
A1C60	913-3279-270	1.0uF, 50V	1	Q21 Base
A1C61	912-3052-000	4700pF, 500V	1	Left Input Pad
A1C62	912-3052-000	4700pF, 500V	1	Left Input Pad
A1C63	184-9102-390	4.7uF, 35V	1	Left Input Coupling
A1C64	184-9102-390	4.7MF, 35V	1	Left Input Coupling
A1C65	912-2974-000	470pF, 500V	1	Left Input Pad
A1C66	912-2974-000	470pF, 500V	1	Left Input Pad
A1C67	912-2816-000	100pF, 500V	1	Left Input Pad
A1C68	912-2768-000	22pF, 500V	1	U14A Comp
A1C69	912-2768-000	22pF, 500V	1	U14B Comp
A1C70	912-2762-000	18pF, 500V	1	U15A Comp
A1C71	913-3279-270	1.0uF, 50V	1	Neg. Limit Bypass
A1C72	912-2858-000	390pF, 500V	1	Gain Comp
A1C73	913-3279-270	1.0uF, 50V	1	Pos. Limit Bypass
A1C74	913-3279-110	0.01, 50V	1	U16 Bypass
A1C75	913-3279-110	0.01, 50V	1	U16 Bypass
A1C76	912-2768-000	22pF, 500V	1	U18A Comp
A1C77	912-2768-000	22pF, 500V	1	U18B Comp
A1C78	184-9102-190	47MF, 20V	1	LF Dist
A1C79	184-9102-110	220MF, 10V	1	Audio Track Filter
A1C80	912-3013-000	1500pF, 500V	1	Feedback Bypass
A1C81	912-3013-000	1500pF, 500V	1	Feedback Bypass
A1C82	913-3279-270	1.0uF, 50V	1	Ref Bypass
A1C83	184-9102-160	150uF, 15V	1	Ref Bypass
A1C84	912-2780-000	33pF, 500V	1	U17A Feedback
A1C85	912-2754-000	10pF, 500V	1	U17A Comp
A1C86	184-9102-410	10uF, 35V	1	U17A Output
A1C87	184-9102-410	10uF, 35V	1	Car Reg Filter
A1C88	912-2858-000	390pF, 500V	1	U17A Output
A1C89	912-3013-000	1500pF, 500V	1	U17B Feedback
A1C90	912-2754-000	10pF, 500V	1	U17B Comp
A1C91	913-3279-270	1.uF, 50V	1	U20C Input
A1C92	913-3279-200	0.1uF, 50V	1	U19 Bypass
A1C93	913-3279-200	0.1uF, 50V	1	U19 Bypass
A1C94	913-3279-270	1.0uF, 50V	1	U21A Bypass
A1C95	913-3279-270	1.0uF, 50V	1	Q24 Base
A1C96	184-9102-110	220uF, 10V	1	+5V Bypass
A1C97	184-9102-110	220uF, 10V	1	-6V Bypass

parts list

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A1C98	184-9102-200	100uF, 20V	1	+12V Bypass
A1C99	184-9102-200	100uF, 20V	1	-12V Bypass
A1C100	913-3279-200	0.1uF, 50V	1	U15A Bypass
A1C101	913-3279-200	0.1uF, 50V	1	U14A Bypass
A1C102	NOT USED			
A1C103	NOT USED			
A1C104	913-3279-200	0.1uF, 50V	1	U17A Bypass
A1C105	913-3279-200	0.1uF, 50V	1	U18B Bypass
A1C106	913-3279-200	0.1uF, 50V	1	U20A Bypass
A1C107	NOT USED			
A1C108	913-3279-200	0.1uF, 50V	1	U14B Bypass
A1C109	NOT USED			
A1C110	NOT USED			
A1C111	913-3279-200	0.1uF, 50V	1	U18B Bypass
A1C112	913-3279-200	0.1uF, 50V	1	U22 Bypass
A1C113	913-3279-200	0.1uF, 50V	1	U20A Bypass
A1C114	913-3279-200	0.1uF, 50V	1	U22 Bypass
A1C115	913-3279-200	0.1uF, 50V	1	U16 Bypass
A1C116	912-3001-000	1000pF, 500V	1	U22 Timing
A1C117	NOT USED			
A1C118	NOT USED			
A1C119	NOT USED			
A1C120	NOT USED			
A1C121	NOT USED			
A1C122	NOT USED			
A1C123	NOT USED			
A1C124	NOT USED			
A1C125	NOT USED			
A1C126	912-2762-000	18 pf., 500V	1	U15A Comp.
A1C127	NOT USED			
A1C128	NOT USED			
A1C129	NOT USED			
A1C130	184-9102-110	220uF, 10V	1	O/L Timer
A1C131	913-3279-200	0.1uF, 50V	1	Bypass
A1C132	913-3279-200	0.1uF, 50V	1	Bypass
A1C133	913-3279-200	0.1uF, 50V	1	Bypass
A1C134	913-3279-200	0.1uF, 50V	1	U16 Bypass
A1C135	913-3279-270	1.0uF, 50V	1	Q22 Time Delay
A1CR1	353-2906-000	1N914	1	U1A Input Clamp
A1CR2	353-2906-000	1N914	1	U1A Input Clamp
A1CR3	353-2906-000	1N914	1	U1B Input Clamp
A1CR4	353-2906-000	1N914	1	U1B Input Clamp
A1CR5	353-2906-000	1N914	1	ARC Sensor Gate
A1CR6	353-2906-000	1N914	1	ARC Sensor Gate
A1CR7	353-6442-040	1N4004	1	K1 Suppressor
A1CR8	353-0293-040	Red Led	1	ARC O/L
A1CR9	353-0293-040	Red Led	1	HVPS O/L
A1CR10	353-0293-040	Red Led	1	VSWR O/L
A1CR11	353-6442-040	1N4004	1	Q9 Collector
A1CR12	353-6442-040	1N4004	1	Logic PS Rect
A1CR13	353-6442-040	1N4004	1	Logic PS Rect

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parts list

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A1CR14	353-6442-040	1N4004	1	Logic PS Rect
A1CR15	353-6442-040	1N4004	1	Logic PS Rect
A1CR16	353-6442-040	1N4004	1	+5V U9 Clamp
A1CR17	353-6442-040	1N4004	1	+12V U10 Clamp
A1CR18	353-6442-040	1N4004	1	-12V U11 Clamp
A1CR19	353-6442-040	1N4004	1	-6V U12 Clamp
A1CR20	353-0293-040	Red Led	1	+5V Ind
A1CR21	353-0293-040	Red Led	1	+12V Ind
A1CR22	353-0293-040	Red Led	1	-12V Ind
A1CR23	353-0293-040	Red Led	1	-6V Ind
A1CR24	353-6442-040	1N4004	1	Q13 Collector
A1CR25	353-0293-040	Red Led	1	Fil on Ind.
A1CR26	353-6442-040	1N4004	1	Q14 Collector
A1CR27	353-6442-040	1N4004	1	Plate/Fil Gate
A1CR28	353-6442-040	1N4004	1	K4 Suppressor
A1CR29	353-6442-040	1N4004	1	Q15 clamp
A1CR30	353-6442-040	1N4004	1	Q16 clamp
A1CR31	353-6442-040	1N4004	1	Q18 clamp
A1CR32	353-0293-040	Red Led	1	HV on Ind
A1CR33	353-6442-040	1N4004	1	HP Gate
A1CR34	353-6442-040	1N4004	1	LP Gate
A1CR35	353-6442-040	1N4004	1	K5A Suppressor
A1CR36	353-6442-040	1N4004	1	K5B Suppressor
A1CR37	353-6442-040	1N4004	1	K2 Suppressor
A1CR38	353-6442-040	1N4004	1	Q10 clamp
A1CR39	353-6442-040	1N4004	1	K3 Suppressor
A1CR40	353-6442-040	1N4004	1	Q11 clamp
A1CR41	353-0293-040	Red Led	1	Raise Ind
A1CR42	353-0293-040	Red Led	1	Lower Ind
A1CR43	353-0293-040	Red Led	1	HP Ind
A1CR44	353-0293-040	Red Led	1	LP Ind
A1CR45	270-0547-010	SPX-3191 optek OPF372A	1	70KHz, Led
A1CR46	353-6442-040	1N4004	1	K6 Suppressor
A1CR47	353-6442-040	1N4004	1	Q20 clamp
A1CR48	353-3691-010	1N5711	1	(-) IPL
A1CR49	353-3691-010	1N5711	1	POS IPL
A1CR50	353-3644-010	1N4454	1	U16 Input Clamp
A1CR51	353-3644-010	1N4454	1	Car Reg Rect
A1CR52	353-3644-010	1N4454	1	Car Reg Rect
A1CR53	353-3691-010	1N5711	1	POS Clamp
A1CR54	353-6442-040	1N4004	1	K7 Clamp
A1CR55	636-6171-001	Led, Red	1	Carrier Intlk
A1CR56	353-0293-040	Red Led	1	Dr. I. Ind.
A1CR57	353-6442-040	1N4004	1	Fil Off Gate
A1CR58	353-6442-040	1N4004	1	Hi Pwr On Gate
A1CR59	NOT USED			
A1CR60	NOT USED			
A1CR61	353-0293-040	Red Led	1	O/L Relay Ind
A1K1	410-0572-020	5V, 500 ohm dip	1	HVPS O/L 14 Pin
A1K2	970-0002-030	28V, 4PDT	1	Raise
A1K3	970-0002-030	28V, 4PDT	1	Lower

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SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A1K4	970-0002-030	28V, 4PDT	1	O/L Summary
A1K5	970-0004-030	28V, 2PDT, LATCHING	1	HP/LP Latch
A1K6	970-0002-030	28V, 4PDT	1	HV On
A1K7	410-0572-010	28V DIP Relay	1	Pwr Select
A1Q1	352-1114-010	MPS-U06	1	O/L Reset
A1Q2	352-1114-010	MPS-U06	1	O/L Reset
A1Q3	353-6468-010	C6F	1	ARC SCR
A1Q4	353-6468-010	C6F	1	HVPS SCR
A1Q5	353-6468-010	C6F	1	VSWR SCR
A1Q6	352-0661-020	2N2222A	1	ARC Sensor
A1Q7	352-0646-010	2N2102	1	1 Sec O/L
A1Q8	352-0646-010	2N2102	1	1 Sec O/L
A1Q9	352-0646-010	2N2102	1	O/L Relay Dr.
A1Q10	352-1114-010	MPS-U06	1	Lower
A1Q11	352-1114-010	MPS-U06	1	Raise
A1Q12	352-1114-010	MPS-U06	1	Fil Off
A1Q13	352-1114-010	MPS-U06	1	Fil Hold
A1Q14	352-1114-010	MPS-U06	1	Fil On
A1Q15	352-1114-010	MPS-U06	1	LP On
A1Q16	352-1114-010	MPS-U06	1	HP On
A1Q17	352-1114-010	MPS-U06	1	Plate Off
A1Q18	352-1114-010	MPS-U06	1	Plate Hold
A1Q19	352-0646-010	2N2102	1	HV Time Delay
A1Q20	352-1104-010	MJ3-243	1	HV Time Delay
A1Q21	352-0661-020	2N2222A	1	DR De-Key
A1Q22	352-0661-020	2N2222A	1	DR De-Key
A1Q23	352-0646-010	2N2102	1	Led Driver
A1Q24	352-0661-020	2N2222A	1	Car Intlk
A1R1	745-0910-970	22K, 1/4W, 5%	1	For Pwr Out
A1R2	745-0910-830	5.6K, 1/4W, 5%	1	For Pwr Out
A1R3	745-0910-890	10K, 1/4W, 5%	1	U1A Input
A1R4	745-0911-060	47K, 1/4W, 5%	1	U1A FB
A1R5	745-0911-060	47K, 1/4W, 5%	1	U1A Input
A1R6	745-5638-000	470, 2W, 10%	1	Q1 Base
A1R7	745-0914-730	2.2K, 1/2W, 5%	1	Q2 Base
A1R8	745-0914-730	2.2K, 1/2W, 5%	1	Q3 Collector
A1R9	745-0914-730	2.2K, 1/2W, 5%	1	Q4 Collector
A1R10	745-0914-730	2.2K, 1/2W, 5%	1	Q5 Collector
A1R11	382-0012-260	1K POT, 15T	1	HVPS O/L Adj
A1R12	745-0910-570	470, 1/4W, 5%	1	ARC Sens F1
A1R13	745-0910-570	470, 1/4W, 5%	1	HVPS O/L F1
A1R14	745-0910-810	4.7K, 1/4W, 5%	1	HVPS O/L
A1R15	745-0910-810	4.7K, 1/4W, 5%	1	ARC Sensor
A1R16	745-0910-970	22K, 1/4W, 5%	1	U4 Timing
A1R17	745-0910-970	22K, 1/4W, 5%	1	Q7 Base
A1R18	745-0914-790	3.9K, 1/2W, 5%	1	Q7 Collector
A1R19	745-0914-270	27, 1/2W, 5%	1	Q7 Collector
A1R20	745-0910-810	4.7K, 1/4W, 5%	1	Q8 Base
A1R21	745-0910-970	22K, 1/4W, 5%	1	U8 Timing
A1R22	745-0910-570	470, 1/4W, 5%	1	Q9 Base

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SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A1R23	745-0911-300	470K, 1/4W, 5%	1	U7 Timing
A1R24	745-0914-490	220, 1/2W 5%	1	Q6 Base
A1R25	745-0914-490	220, 1/2W, 5%	1	Q6 Base
A1R26	745-0910-650	1K, 1/4W, 5%	1	Q6 Base
A1R27	745-0910-970	22K, 1/4W, 5%	1	Ref Pwr Out
A1R28	745-0910-830	5.6K 1/4W, 5%	1	Ref Pwr Out
A1R29	745-0910-890	10K, 1/4W, 5%	1	U1B Input
A1R30	745-0911-100	68K, 1/4W, 5%	1	U1B FB
A1R31	745-0910-930	15K, 1/4W, 5%	1	U1B Input
A1R32	745-0914-690	1.5K, 1/2W, 5%	1	U2 Input
A1R33	745-0914-730	2.2K, 1/2W, 5%	1	U2 Bias
A1R34	382-1405-060	5K, POT 25T	1	VSWR O/L Adj
A1R35	745-0914-650	1K, 1/2W, 5%	1	U2 Bias
A1R36	745-0914-410	100, 1/2W, 5%	1	U2 Output
A1R37	745-0910-570	470, 1/4W, 5%	1	U6 Output
A1R38	745-0914-730	2.2K, 1/2W, 5%	1	Q10 Base
A1R39	745-0914-730	2.2K, 1/2W, 5%	1	S6
A1R40	745-5589-000	33, 2W, 10%	1	Q10 Emitter
A1R41	745-0914-390	82, 1/2W, 5%	1	Q19 Base
A1R42	745-0914-730	2.2K, 1/2W, 5%	1	S7
A1R43	745-5589-000	33, 2W, 10%	1	Q11 Emitter
A1R44	745-0914-730	2.2K, 1/2W, 5%	1	Q11 Base
A1R45	705-6666-000	28.7K, 1%	1	+5V Mtr
A1R46	745-3331-000	330, 1W, 10%	1	+5V Led
A1R47	705-6666-000	28.7K, 1%	1	+12V Mtr
A1R48	745-3352-000	1K, 1W, 10%	1	+12V Led
A1R49	705-6666-000	28.7K, 1%	1	-12V Mtr
A1R50	745-3352-000	1K, 1W, 10%	1	-12V Led
A1R51	705-6666-000	28.7K, 1%	1	-6V Mtr
A1R52	745-3335-000	390, 1W, 10%	1	-6V Led
A1R53	745-0914-730	2.2K,1/2W, 5%	1	Q12 Base
A1R54	745-0914-730	2.2K, 1/2W, 5%	1	S1
A1R55	745-5638-000	470, 2W, 10%	1	Q13 Base
A1R56	745-0914-730	2.2K, 1/2W, 5%	1	Q14 Base
A1R57	745-5589-000	33, 2W, 10%	1	Q14 Emitter
A1R58	745-0914-730	2.2K, 1/2W, 5%	1	S2
A1R59	745-0914-730	2.2K, 1/2W, 5%	1	Fil Led
A1R60	745-0914-730	2.2K, 1/2W, 5%	1	Q15 Base
A1R61	745-5589-000	33, 2W, 10%	1	Q15 Emitter
A1R62	745-0914-730	2.2K, 1/2W, 5%	1	S4
A1R63	745-0914-730	2.2K, 1/2W, 5%	1	Q16 Base
A1R64	745-5589-000	33, 2W, 10%	1	Q16 Emitter
A1R65	745-0914-730	2.2K, 1/2W, 5%	1	S5
A1R66	745-0914-730	2.2K, 1/2W, 5%	1	Q17 Base
A1R67	745-0914-730	2.2K, 1/2W, 5%	1	S3
A1R68	745-5638-000	470, 2W, 10%	1	Q18 Base
A1R69	745-0914-730	2.2K, 1/2W, 5%	1	HV Led
A1R70	745-0914-730	2.2K, 1/2W, 5%	1	Raise Led
A1R71	745-0914-730	2.2K, 1/2W, 5%	1	Lower Led
A1R72	745-0914-730	2.2K, 1/2W, 5%	1	HP Led
A1R73	745-0914-730	2.2K, 1/2W, 5%	1	LP Led

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A1R74	745-0910-890	10K, 1/4W, 5%	1	U13 Input
A1R75	745-0910-890	10K, 1/4W, 5%	1	U13 Input
A1R76	745-0910-990	27K, 1/4W, 5%	1	U13 Input
A1R77	745-0910-910	12K, 1/4W, 5%	1	U13 Input
A1R78	745-0910-790	3.9K, 1/4W, 5%	1	Q21 Base
A1R79	745-0910-530	330, 1/4W, 5%	1	CR56
A1R80	745-0910-890	10K, 1/4W, 5%	1	Q22 Base
A1R81	745-0910-890	10K, 1/4W, 5%	1	Q22 Collector
A1R82	705-0985-000	590, 1%	1	LT Input Pad
A1R83	705-0957-000	154, 1%	1	LT Input Pad
A1R84	705-1044-000	10K, 1%	1	LT Input Pad
A1R85	705-1044-000	10K, 1%	1	LT Input Pad
A1R86	705-1044-000	10K, 1%	1	LT Input Pad
A1R87	705-1044-000	10K, 1%	1	LT Input Pad
A1R88	705-1044-000	10K, 1%	1	LT Input Pad
A1R89	705-1044-000	10K, 1%	1	LT Input Pad
A1R90	705-1005-000	1.54K, 1%	1	LT Input Term
A1R91	705-1036-000	6.81K, 1%	1	LT Input Term
A1R92	705-1020-000	3.16K, 1%	1	U14A Feedback
A1R93	705-1020-000	3.16K, 1%	1	U14B Feedback
A1R94	705-1013-000	2.26K, 1%	1	U15A Input
A1R95	705-1013-000	2.26K, 1%	1	U15A Input
A1R96	705-1028-000	4.64K, 1%	1	U15A Feedback
A1R97	705-1027-000	4.42K, 1%	1	U15A Bias
A1R98	382-1405-030	500, POT, 25T	1	LT IA Balance Adj
A1R99	705-1004-000	1.47K, 1%	1	Neg Lim
A1R100	382-0012-270	2K, POT, 15T	1	Neg Lim Adj
A1R101	705-0996-000	1K, 1%	1	Neg Lim
A1R102	705-1059-000	20.5K, 1%	1	U16 Input
A1R103	705-1044-000	10K, 1%	1	U16 Input
A1R104	705-0900-000	10, 1%	1	POS Limit
A1R105	382-0012-270	2K, POT, 15T	1	POS Lim Adj
A1R106	705-0990-000	750, 1%	1	POS Lim
A1R107	705-1067-000	30.1K, 1%	1	U16 Bias
A1R108	705-1054-000	16.2K, 1%	1	U16 Bias
A1R109	705-1053-000	15.4K, 1%	1	U16 Bias
A1R110	705-0996-000	1K, 1%	1	U16 Input
A1R111	705-0996-000	1K, 1%	1	U16 Input
A1R112	705-1016-000	2.61K, 1%	1	U16 Offset
A1R113	705-1016-000	2.61K, 1%	1	U16 Offset
A1R114	382-1405-070	10K, POT, 25T	1	Cont Offset Adj
A1R115	382-1405-070	10K, POT, 25T	1	Audio Offset Adj
A1R116	382-1405-070	10K, POT, 25T	1	Ampl Offset Adj
A1R117	705-3605-820	52.3K, 1%	1	U18A Feedback
A1R118	705-1072-000	38.3K, 1%	1	U18A Input
A1R119	705-1040-000	8.25K, 1%	1	U18A Input
A1R120	705-1087-000	78.7K, 1%	1	LF Dist
A1R121	382-0012-280	5K, POT 15T	1	LF Dist Adj
A1R122	705-1013-000	2.26K, 1%	1	LF Dist
A1R123	705-1069-000	33.2K, 1%	1	U18B Input
A1R124	382-0012-290	10K, POT, 15T	1	Audio Track Adj

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A1R125	705-1038-000	7.5K, 1%	1	Feedback
A1R126	382-0012-290	10K, POT, 15T	1	Low Pwr Adj
A1R127	705-1053-000	15.4K, 1%	1	U17A Feedback
A1R128	705-1044-000	10K, 1%	1	Car Reg
A1R129	705-0917-000	22.6, 1%	1	Car Reg
A1R130	382-0012-290	10K, POT, 15T	1	Car Reg Adj
A1R131	705-1022-000	3.48K, 1%	1	U17A Output
A1R132	705-0996-000	1K, 1%	1	U17B Input
A1R133	705-1061-000	22.6K, 1%	1	U17B Input
A1R134	705-1038-000	7.5K, 1%	1	U17B Input
A1R135	705-1054-000	16.2K, 1%	1	U17B Input
A1R136	705-1006-000	1.62K, 1%	1	U17B Bias
A1R137	705-1092-000	100K, 1%	1	U17B Feedback
A1R138	705-1012-000	2.15K, 1%	1	U17B Output
A1R139	705-1029-000	4.87K, 1%	1	U19 Input
A1R140	705-1004-000	1.47K, 1%	1	U19 Input
A1R141	705-0996-000	1K, 1%	1	Pos Clamp
A1R142	382-1405-040	1K, POT, 25T	1	Pos Clamp Adj
A1R143	705-0997-000	1.05K, 1%	1	Pos Clamp
A1R144	705-0992-000	825, 1%	1	Q23 Base
A1R145	745-3296-000	47, 1W	1	Q23 Collector
A1R146	705-1013-000	2.26K, 1%	1	Q24 Base
A1R147	705-0974-000	348, 1%	1	Carr Intlk
A1R148	382-1405-030	500, POT, 25T	1	SW Freq Adj
A1R149	705-1007-000	1.69K, 1%	1	U22 Ftn Gen
A1R150	705-0948-000	100, 1%	1	U22 Ftn Gen
A1R151	705-0948-000	100, 1%	1	U22 Ftn Gen
A1R152	705-1088-000	82.5K, 1%	1	U22 Ftn Gen
A1R153	NOT USED			
A1R154	NOT USED			
A1R155	NOT USED			
A1R156	NOT USED			
A1R157	NOT USED			
A1R158	NOT USED			
A1R159	NOT USED			
A1R160	NOT USED			
A1R161	NOT USED			
A1R162	NOT USED			
A1R163	NOT USED			
A1R164	NOT USED			
A1R165	NOT USED			
A1R166	NOT USED			
A1R167	NOT USED			
A1R168	NOT USED			
A1R169	NOT USED			
A1R170	NOT USED			
A1R171	NOT USED			
A1R172	NOT USED			
A1R173	NOT USED			
A1R174	NOT USED			

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A1R175	NOT USED			
A1R176	NOT USED			
A1R177	NOT USED			
A1R178	NOT USED			
A1R179	745-3282-000	22, 1W	1	CR27 I Limit
A1R180	745-3268-000	10, 1W	1	CR58 I Limit
A1R181	745-0910-890	10K, 1/4W	1	Bleeder
A1R182	745-0910-890	10K, 1/4W	1	Bleeder
A1R183	745-0914-730	2.2K, 1/2W	1	CR61 I Limit
A1S1	266-7545-060	Green 1A	1	Fil Off
A1S2	266-7545-040	Red 1A	1	Fil On
A1S3	266-7545-060	Green 1A	1	Plate Off
A1S4	266-7545-050	Yellow 1A	1	LP On
A1S5	266-7545-040	Red 1A	1	HP On
A1S6	266-7545-050	Yellow 1A	1	Lower
A1S7	266-7545-050	Yellow 1A	1	Raise
A1S8	266-7545-040	Red 1A	1	O/L Reset
A1S9	266-5415-360	SPDT	1	O/L Recycle
A1S10	266-5321-980	SPDT	1	IPL Off/On
A1TB1	367-1888-210	16 Term PCB	1	Remote Control
A1TP1	360-0489-070	Brown Test Pt.	1	FWD Pwr Out
A1TP2	360-0489-020	Red Test Pt.	1	Ref Pwr Out
A1TP3	360-0489-050	Orange Test Pt.	1	HVPS Ovld
A1TP4	360-0489-060	Yellow Test Pt.	1	ARC Sensor
A1TP5	360-0489-040	Green Test Pt.	1	VSWR Ovld
A1TP6	360-0489-080	Blue Test Pt.	1	Control Ovld
A1TP7	360-0489-090	Violet Test Pt.	1	Ovld Signal
A1TP8	360-0489-100	Gray Test Pt.	1	Time Ovld
A1TP9	360-0489-010	White Test Pt.	1	Ovld Relay
A1TP10	360-0489-030	Black Test Pt.	1	Recycle
A1TP11	360-0489-070	Brown Test Pt.	1	LT Audio
A1TP12	NOT USED			
A1TP13	360-0489-050	Orange Test Pt.	1	Mult Input
A1TP14	360-0489-060	Yellow Test Pt.	1	Control
A1TP15	360-0489-040	Green Test Pt.	1	Gain Cont Out
A1TP16	360-0489-080	Blue Test Pt.	1	Audio Feedback
A1TP17	360-0489-090	Violet Test Pt.	1	Ftn Gen Out
A1TP18	360-0489-100	Gray Test Pt.	1	U19 AF Input
A1TP19	360-0489-010	White Test Pt.	1	Led Drive
A1TP20	360-0489-030	Black Test Pt.	1	Audio Tracking
A1TP21	NOT USED			
A1TP22	NOT USED			
A1U1	351-1339-020	NE5533AN	1	RF Mtr Ampl
A1U2	351-7189-050	UA710	1	VSWR O/L
A1U3	351-7635-010	7410	1	Gate
A1U4	351-7645-010	74121	1	One Shot
A1U5	351-7771-010	7492	1	Counter
A1U6	351-7630-010	7404	1	Hex Inverter
A1U7	351-1137-020	NE555V	1	Timer
A1U8	351-7645-010	74121	1	One Shot

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

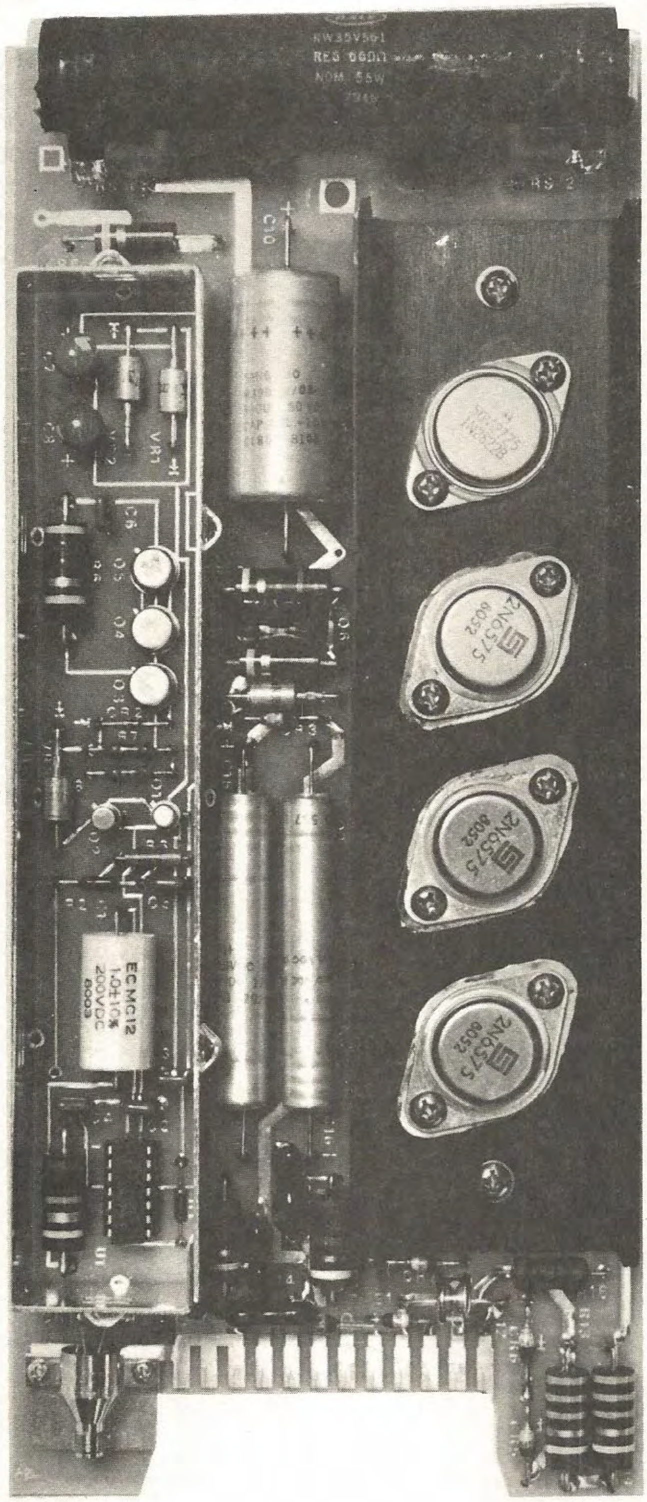
SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A1U9	351-1120-010	LM340-5	1	+5V Reg
A1U10	351-1120-040	LM340-12	1	+12V Reg
A1U11	351-1178-060	MC7912P	1	-12V Reg
A1U12	351-1178-040	MC7906P	1	-6V Reg
A1U13	351-7189-050	UA710	1	HV Time Delay
A1U14	351-1339-020	NE5533AN	1	LT Audio Input
A1U15	351-1339-020	NE5533AN	1	Audio Input
A1U16	351-1116-010	MC1494L	1	Gain Control
A1U17	351-1339-020	NE5533AN	1	Audio Ampl
A1U18	351-1339-020	NE5533AN	1	FB Ampl
A1U19	351-7189-050	UA710	1	PWM Gen
A1U20	351-1223-020	3403	1	Limiter Ampl
A1U21	351-7635-010	7410	1	PWM Gate
A1U22	351-1231-020	8038	1	U22 Ftn Gen
A1U23	NOT USED			
A1U24	NOT USED			
A1U25	NOT USED			
A1VR1	353-6317-000	6.2V, 1N3828A	1	+5V Protect
A1VR2	353-3129-000	15.0V, 1N3024B	1	+12V Protect
A1VR3	353-3129-000	15.0V, 1N3024B	1	-12V Protect
A1VR4	353-3122-000	7.5V, 1N3017B	1	-6V Protect
A1VR5	353-6316-000	5.6V, 1N3827A	1	ARC Sensor Input
A1VR6	353-2720-000	8.2V 1N756A	1	Lt Audio Protect
A1VR7	353-2720-000	8.2V 1N756A	1	Lt Audio Protect
A1VR8	353-2720-000	8.2V 1N756A	1	Lt Audio Protect
A1VR9	353-2720-000	8.2V 1N756A	1	Lt Audio Protect
A1VR10	NOT USED			
A1VR11	NOT USED			
A1VR12	NOT USED			
A1VR13	NOT USED			
A1VR14	353-3129-000	1N3024B	1	Overload
A1XK1	220-0075-020	14Pin	1	K1
A1XK2-4	220-1582-010	Socket	3	K2, 3, 4
A1XK5	220-1518-000	Socket	1	K5
A1XK6	220-1582-010	Socket	1	K6
A1XK7	220-0075-020	14 Pin	1	Socket
A1XU1	220-0075-020	14Pin	1	NE5533AN
A1XU2	220-0075-020	14Pin	1	UA710
A1XU3	220-0075-020	14Pin	1	7410
A1XU4	220-0075-020	14Pin	1	74121
A1XU5	220-0075-020	14Pin	1	7492
A1XU6	220-0075-020	14Pin	1	7404
A1XU7	220-0075-010	8Pin	1	NE555V
A1XU8	220-0075-020	14Pin	1	74121
A1XU9 thru A1XU12	NOT USED			
A1XU13	220-0075-020	14 Pin	1	UA710
A1UX14	220-0075-020	14 Pin	1	Socket
A1UX15	220-0075-020	14 Pin	1	Socket

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A1UX16	220-0075-030	16 Pin	1	Socket
A1UX17	220-0075-020	14 Pin	1	Socket
A1UX18	220-0075-020	14 Pin	1	Socket
A1UX19	220-0075-020	14 Pin	1	Socket
A1UX20	220-0075-020	14 Pin	1	Socket
A1UX21	220-0075-020	14 Pin	1	Socket
A1UX22	220-0075-020	14 Pin	1	Socket
A1UX23	NOT USED			
A1UX24	NOT USED			
A1UX25	NOT USED			

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.



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KR1-1(4)

Figure 7-5. Switchmod Card (A2)

parts list

SWITCHMOD CARD A2.

SYMBOL	PART NO.	VALUE	QTY	DESCRIPTION
A2	636-9675-003	Switchmod Card	1	PCB Assy - Complete
A2C1	933-1059-050	1.0 uF, 200V	1	Diode Bypass
A2C2-6	913-3279-270	1.0 uF, 50V	5	Bypass
A2C7	184-9102-160	150 uF, 15 V	1	VR1 Bypass
A2C8	184-9102-110	220 uF, 10 V	1	VR2 Bypass
A2C9	NOT USED			
A2C10	184-5102-040	330 uF, 50V	1	28V Bypass
A2C11	912-2723-000	6800 pF, 500 V	1	Q6 Base
A2C12	912-3046-000	3900 pF, 500 V	1	Compensation
A2C13	912-3025-000	2200 pF, 500 V	1	Compensation
A2C14	912-3025-000	2200 pF, 500 V	1	Compensation
A2C15	183-1277-560	33 uF, 150 V	1	Common Bypass
A2C16	183-1277-900	22 uF, 250 V	1	+125 V Bypass
A2C17	NOT USED			
A2C18	912-3001-000	1000 pF, 500 V	1	Transient Suppressor
A2CR1	270-0547-030	SPX-3194 Optek OPF482	1	Pin Photodiode 270-3399-030
A2CR2	353-2906-000	1N914	1	Q3 Base
A2CR3-4	353-9009-440	1N5418	2	Gate
A2CR5-7	353-9009-440	1N5418	3	Current Limiter
A2CR8	353-9009-440	1N5418	1	Grid Clamping
A2CR9	353-9009-440	1N5418	1	Grid Clamping
A2E1	013-1455-040	Arc Gap	1	350 V
A2Q1	352-0661-020	2N2222A	1	Amplifier
A2Q2	352-0551-010	2N2907A	1	Amplifier
A2Q3-4	352-0646-010	2N2102	2	Amplifier
A2Q5	352-0714-010	2N4036	1	Amplifier
A2Q6-8	352-1134-010	2N6575	3	Amplifier
A2R1-2	705-1025-000	4.02 K, 1/2W 1%	2	U1
A2R3	705-6740-000	1.0 M, 1/4W 1%	1	U1
A2R4	745-5694-000	10 K, 2W	1	Diode Limiter
A2R5	745-3328-000	270, 1W	1	18V Regulator
A2R6	745-5638-000	470, 2W	1	Q3 Collector
A2R7	745-0914-470	180, 1/2W	1	Q3 Base
A2R8	745-0914-510	270 Ohms, 1/2W	1	Q3 Base
A2R9	747-2742-000	560 Ohms, 55W	1	28V Reg
A2R10	745-5645-000	680 Ohms, 2W	1	Q6 Base
A2R11	745-5659-000	1.5 K, 2W	1	Q6 Comp
A2R12	745-3366-000	2.2 K, 1W	1	Q6 Comp
A2R13-14	745-5715-000	33 K, 2W	2	Mod Grid
A2R15	745-3268-000	10, 1W	1	Q6 Base
A2R16	747-5122-000	0.22, 3W	1	Current Limit
A2U1	351-7189-050	uA710	1	Line Receiver
A2VR1	353-3127-000	1N3022B	1	12V, 1W Zener
A2VR2-3	353-6316-000	1N3827A	2	5.6V, 1W Zener
A2VR4	353-1915-000	1N2822B	1	27V, 50W Zener
A2VR5	353-6316-000	1N3827A	1	5.6V, 1W Zener
A2XU1	220-0075-020	14-Pin Socket	1	U1
		Adapter plate	1	180362-1

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

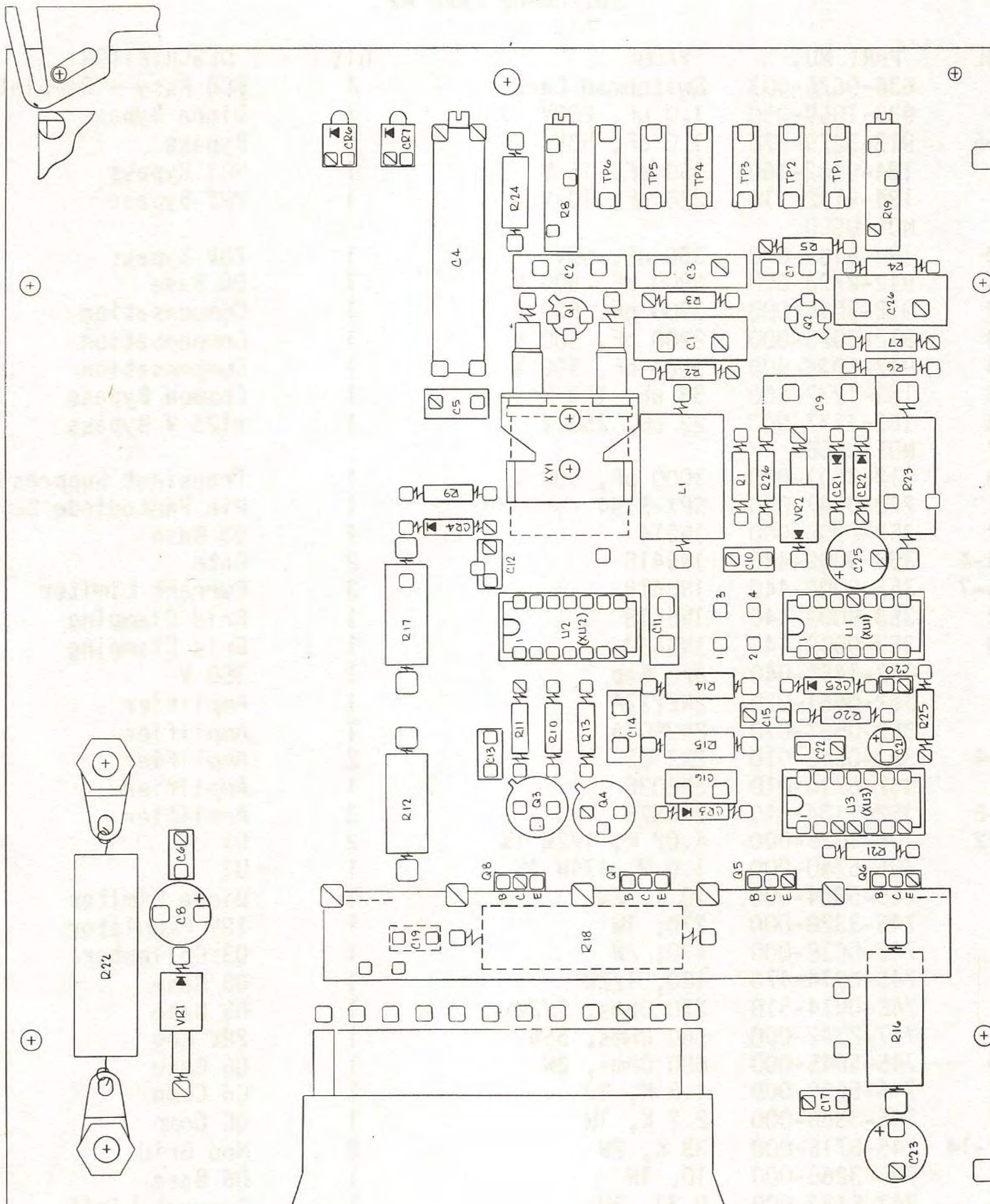


Fig. 7-6. RF Exciter (A3)

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

R. F. EXCITER CARD, A3

SYMBOL	PART NO.	VALUE	QTY	DESCRIPTION
A3	650-2893-001	R. F. Exciter	1	PCB Assy - Complete
A3C1	912-3025-000	2200pF, 500V	1	Q1 Base
A3C2	912-2980-000	510pF, 500V	1	Q1 Emitter
A3C3	912-2980-000	510pF, 500V	1	Q1 Emitter
A3C4	922-0609-000	1-60pF	1	Freq Adj
A3C5	916-0671-000	15pF	1	Padder
A3C6	913-3279-270	1.0uF, 50V	1	Bypass
A3C7	912-2816-000	100pF, 500V	1	Q1 Coupling
A3C8	184-9102-200	100uF, 20V	1	Bypass
A3C9	912-3025-000	2200pF, 500V	1	Q2 Coupling
A3C10	913-3279-270	1.0uF, 50V	1	U1 Bypass
A3C11	912-2798-000	56pF	1	U2 Timing
A3C12	913-3279-270	1.0uF, 50V	1	U2 Bypass
A3C13	913-3279-270	1.0uF, 50V	1	Q3 Coupling
A3C14	912-2828-000	150pF, 500V	1	Q4 Coupling
A3C15	913-3279-270	1.0uF, 50V	1	Q4 Bypass
A3C16	912-2858-000	390pF, 500V	1	Q5 Coupling
A3C17	913-3279-270	1.0uF, 50V	1	Q5 Bypass
A3C18	NOT USED			
A3C19	913-3279-270	1.0uF, 50V	1	Output Coupling
A3C20	913-3279-110	0.01uF, 50V	1	U3 Bypass
A3C21	184-9102-170	10uF, 10V	1	U3 Timing
A3C22	913-3279-270	1.0uF, 50V	1	U3 Bypass
A3C23	184-9102-930	22uF, 50V	1	28V Filter
A3C24	NOT USED			
A3C25	184-9102-110	220uF, 10V	1	5V Filter
A3C26	912-3025-000	2200pF, 500V	1	Q2 Emitter
A3CR1	353-2906-000	1N914	1	U1 Clamp
A3CR2	353-2906-000	1N914	1	U1 Clamp
A3CR3	353-2906-000	1N914	1	Q5 Clamp
A3CR4	353-2906-000	1N914	1	Led Protect
A3CR5	353-2906-000	1N914	1	U3 Clamp
A3CR6	636-6171-001	Red Led	1	RF Indicator
A3CR7	636-6171-001	Red Led	1	DC Indicator
A3L1	240-0844-000	10MH	1	Q1 Collector
A3Q1	352-0661-020	2N2222	1	Crystal OSC
A3Q2	352-0661-020	2N2222	1	Buffer
A3Q3	352-0646-010	2N2102	1	Freq Mon Amp
A3Q4	352-0646-010	2N2102	1	Int. Amp
A3Q5	352-1104-010	MJE-243	1	Int. Amp
A3Q6	352-1104-010	MJE-243	1	Dekey Clamp
A3Q7	352-1104-010	MJE-243	1	Output Amp
A3Q8	352-1105-010	MJE-253	1	Output Amp
A3R1	745-0910-970	22K	1	Q1 Base
A3R2	745-0910-850	6.8K	1	Q1 Base
A3R3	745-0910-610	680	1	Q1 Emitter
A3R4	745-0911-040	39K	1	Q2 Base

parts list

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A3R5	745-0910-890	10K	1	Q2 Base
A3R6	745-0910-830	5.6K	1	Q2 Collector
A3R7	745-0910-730	2.2K	1	Q2 Emitter
A3R8	382-0012-300	20K, POT, 15T	1	Pulse Width
A3R9	745-0910-650	1K	1	U2 Padder
A3R10	745-0910-650	1K	1	Q3 Base
A3R11	745-0910-410	100	1	Q3 Emitter
A3R12	745-3296-000	47, 1W	1	Q3 Emitter
A3R13	745-0910-730	2.2K	1	Q4 Base
A3R14	745-0914-410	100, 1/2W	1	Q4 Collector
A3R15	745-0914-730	2.2K, 1/2W	1	Q5 Base
A3R16	745-5624-000	220, 2W	1	Q5 Collector
A3R17	745-3328-000	270, 1W	1	Output Ind.
A3R18	747-5406-000	2, 6.5W	1	Output Limit
A3R19	382-0012-250	500, POT, 15T	1	Dekey Adj
A3R20	745-0911-020	33K, 1/4W	1	U3 Timer
A3R21	745-0914-570	470, 1/2W	1	Q6 Base
A3R22	747-5440-000	100, 6.5W	1	12V Reg
A3R23	745-5596-000	47, 2W, 10%	1	5V Reg
A3R24	745-0914-570	470, 1/2W, 5%	1	DC Indicator
A3R25	745-0910-730	2.2K	1	U1 Input
A3R26	745-0910-830	5.6K, 1/4W	1	Q1 Collector
TP1	360-0495-020	Brown Test Pt.	1	Q2 RF Input
TP2	360-0495-030	Red Test Pt.	1	U1 Input
TP3	360-0495-040	Orange Test Pt.	1	Divider Output
TP4	360-0495-050	Yellow Test Pt.	1	Q4 Output
TP5	360-0495-060	Green Test Pt.	1	Q7/Q8 Base
TP6	360-0495-070	Blue Test Pt.	1	Exciter Output
A3U1	351-7640-010	SN7473N	1	Divider
A3U2	351-7645-010	SN74121	1	Pulse Width
A3U3	351-7645-010	SN74121	1	Dekey
A3VR1	353-3127-000	12V, 1W	1	1N3022B
A3VR2	353-6315-000	5.1V, 1W	1	1N3826A
A3XU1-3	220-0075-020	14 Pin Dip	3	Socket
A3XY-1	292-0305-020	Crystal Socket	1	Socket
A3Y1	289-7274-XXX	Crystal	Freq Kit	

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

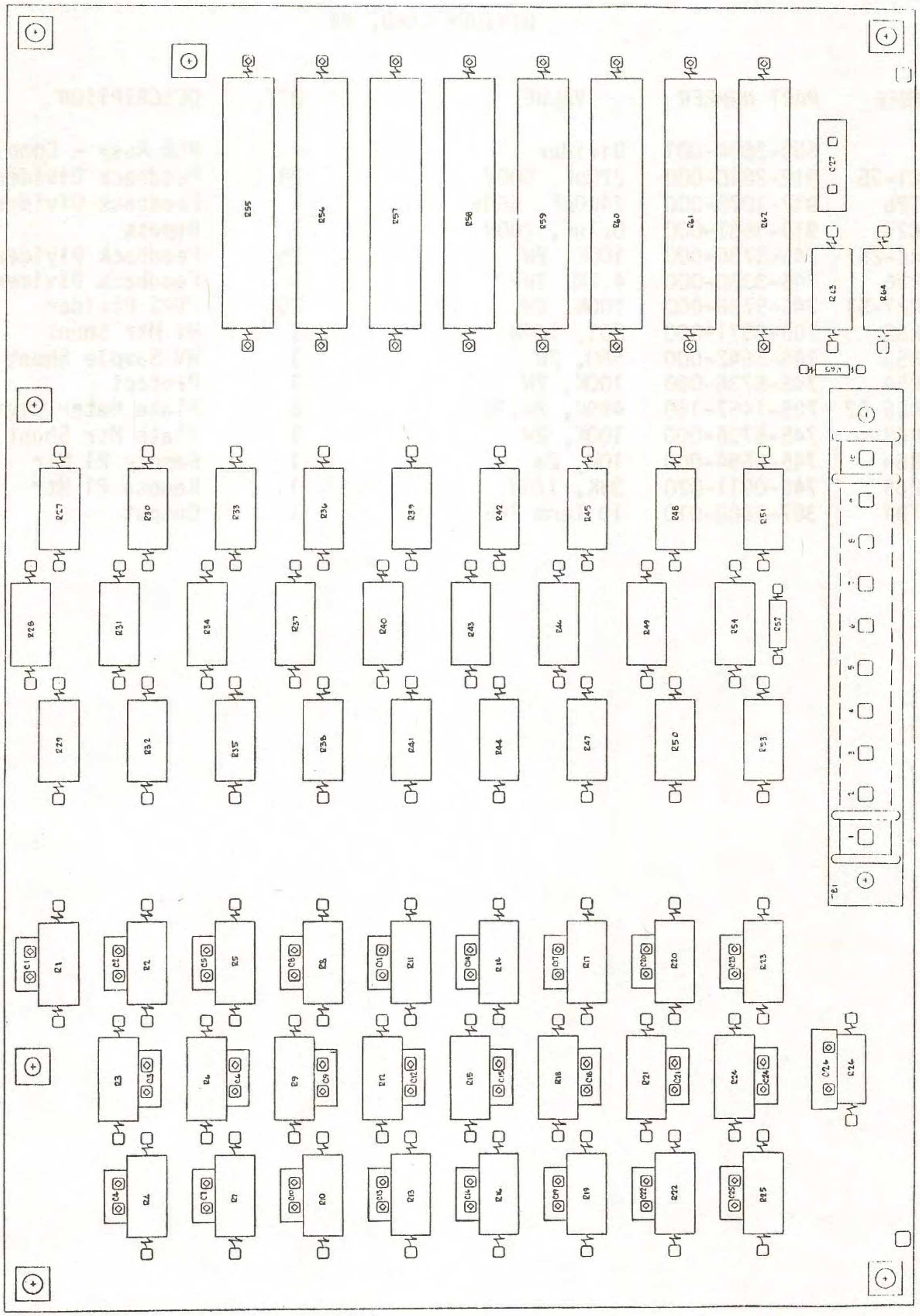


Fig. 7-7. Divider Card (A4)

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

DIVIDER CARD, A4

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A4	650-2884-001	Divider	1	PCB Assy - Complete
A4C1-25	912-2840-000	220pF, 500V	25	Feedback Divider
A4C26	912-3028-000	2400pF, 500V	1	Feedback Divider
A4C27	913-3681-000	0.1uF, 200V	1	Bypass
A4R1-25	745-5736-000	100K, 2W	25	Feedback Divider
A4R26	745-3380-000	4.7K, 1W	1	Feedback Divider
A4R27-51	745-5736-000	100K, 2W	25	HVPS Divider
A4R52	705-6571-000	301, 1/4W	1	HV Mtr Shunt
A4R53	745-5642-000	560, 2W	1	HV Sample Shunt
A4R54	745-5736-000	100K, 2W	1	Protect
A4R55-62	705-1457-160	499K, 2W,1%	8	Plate Meter Divider
A4R63	745-5736-000	100K, 2W	1	Plate Mtr Shunt
A4R64	745-5694-000	10K, 2W	1	Remote Pl Mtr
A4R65	745-0911-020	33K, 1/4W	1	Remote Pl Mtr
A4TB1	367-1888-010	10 Term PCB	1	Output

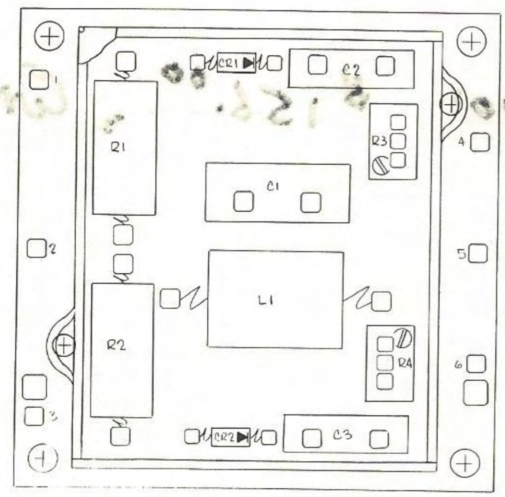


Fig. 7-8. VSWR Sensor (A5)

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

VSWR SENSOR CARD, A5

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A5	650-2885-001	VSWR Sensor	1	PCB Assy -Complete
A5C1	912-3004-000	1100pF, 500V	1	Divider
A5C2-3	912-2974-000	470pF, 500V	2	Bypass
A5CR1	353-3691-010	1N5711	1	Detector
A5CR2	353-3691-010	1N5711	1	Detector
A5L1	240-1649-000	10mHy	1	RFC
A5R1	745-5582-000	22, 2W	1	Current Load
A5R2	745-5582-000	22, 2W	1	Current Load
A5R3	382-1405-070	10K, 1W, 25T	1	DC Load
A5R4	382-1405-070	10K, 1W, 25T	1	DC Load

$65.00

650-2886-001 $156.00 - Entire assy.

Dave Chinowith ext 401
~~214-327-4533~~
~~214 327-4532~~ - parts
214 381 7161

Gary Kral - Parts

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

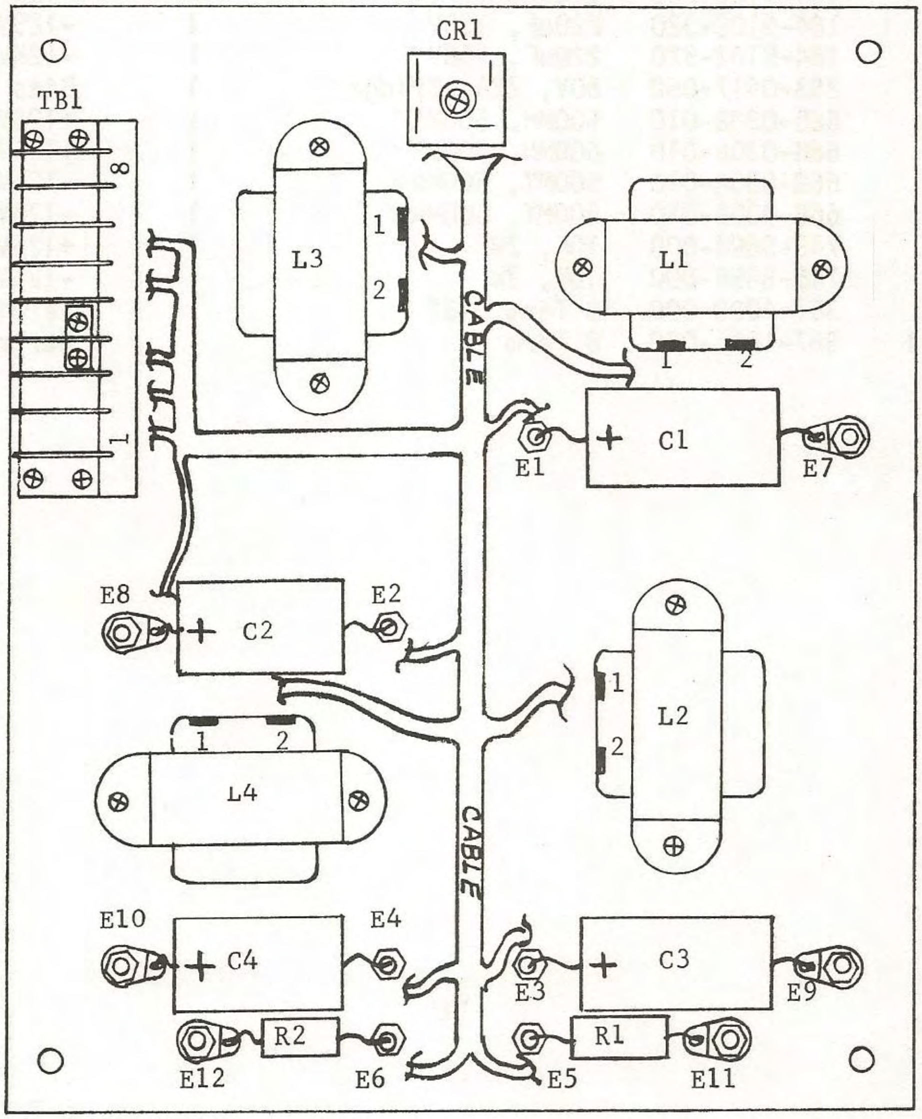


Fig. 7-9. Bias PS (A6)

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

parts list

BIAS PS ASSEMBLY, A6

SYMBOL	PART NUMBER	VALUE	QTY	DESCRIPTION
A6	650-2897-001	Bias PS	1	Assy - Complete
A6C1	184-5102-320	220uF, 150V	1	+125V Filter
A6C2	184-5102-320	220uF, 150V	1	+125V Filter
A6C3	184-5102-320	220uF, 150V	1	-125V Filter
A6C4	184-5102-320	220uF, 150V	1	-125V Filter
A6CR1	353-0417-060	60V, 22A, Bridge	1	Bias PS Rectifier
A6L1	668-0308-010	500MH, 500MA	1	+125V Filter
A6L2	668-0308-010	500MH, 500MA	1	+125V Filter
A6L3	668-0308-010	500MY, 500MA	1	-125V Filter
A6L4	668-0308-010	500MY, 500MA	1	-125V Filter
A6R1	745-5694-000	10K, 2W	1	+125V Bleeder
A6R2	745-5694-000	10K, 2W	1	-125V Bleeder
A6TB1	367-4080-000	8 Term 6-32	1	Terminal Strip
A6XTB1	367-1845-070	8 Term	1	Marker Strip

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

314R-1 1KW AM TRANSMITTER FREQUENCY KIT PARTS LIST

BAND 1 540 to 700 KHz

C4	912-4140-180	3900pF, 6KV	1	Node 2, Band 1
C5	912-4140-180	3900pF, 6KV	1	Node 2, Band 1
C6	912-4140-180	3900pF, 6KV	1	Node 3, Band 1
C7	912-4140-180	3900pF, 6KV	1	Node 3, Band 1
C31	912-4126-150	430pF, 10KV	1	PA Tune, Band 1
A3Y1	289-7274-XXX	Crytstal	1	

Band 2 710 to 920 KHz

C4	912-4140-170	3000pF, 6KV	1	Node 2, Band 2
C5	912-4140-170	3000pF, 6KV	1	Node 2, Band 2
C6	912-4140-170	3000pF, 6KV	1	Node 3, Band 2
C7	912-4140-170	3000pF, 6KV	1	Node 3, Band 2
C31	912-4126-100	240pF, 10KV	1	PA Tune, Band 2
A3Y1	289-7274-XXX	Crystal	1	

BAND 3 930 to 1150 KHz

C4	912-4140-160	2400pF, 6KV	1	Node 2, Band 3
C5	912-4140-160	2400pF, 6KV	1	Node 2, Band 3
C6	912-4140-160	2400pF, 6KV	1	Node 3, Band 3
C7	912-4140-160	2400pF, 6KV	1	Node 3, Band 3
C31	912-4126-090	180pF, 10KV	1	PA Tune, Band 3
A3Y1	289-7274-XXX	Crystal	1	

BAND 4 1160 to 1380 KHz

C4	912-4140-150	2000pF, 6KV	1	Node 2, Band 4
C5	912-4140-150	2000pF, 6KV	1	Node 2, Band 4
C6	912-4140-150	2000pF, 6KV	1	Node 3, Band 4
C7	912-4140-150	2000pF, 6KV	1	Node 3, Band 4
A3Y1	289-7274-XXX	Crystal	1	

BAND 5 1390 to 1600 KHz

C4	912-4140-140	1600pF, 6KV	1	Node 2, Band 5
C5	912-4140-140	1600pF, 6KV	1	Node 2, Band 5
C6	912-4140-140	1600pF, 6KV	1	Node 3, Band 5
C7	912-4140-140	1600pF, 6KV	1	Node 3, Band 5
A3Y1	289-7274-XXX	Crystal	1	

parts list

Crystal Table.

OPERATING FREQUENCY (kHz)	CRYSTAL FREQUENCY (kHz)	PART NUMBER
540	2160	289-7274-010
550	2200	289-7274-030
560	2240	289-7274-050
570	2280	289-7274-070
580	2320	289-7274-090
590	2360	289-7274-110
600	2400	289-7274-130
610	2440	289-7274-150
620	2480	289-7274-170
630	2520	289-7274-190
640	2560	289-7274-210
650	2600	289-7274-230
660	2640	289-7274-250
670	2680	289-7274-270
680	2720	289-7274-290
690	2760	289-7274-310
700	2800	289-7274-330
710	2840	289-7274-350
720	2880	289-7274-370
730	2920	289-7274-390
740	2960	289-7274-410
750	3000	289-7274-430
760	3040	289-7274-450
770	3080	289-7274-470
780	3120	289-7274-490
790	3160	289-7274-510
800	3200	289-7274-530
810	3240	289-7274-540
820	3280	289-7274-550
830	3320	289-7274-560
840	3360	289-7274-570
850	3400	289-7274-580
860	3440	289-7274-590
870	3480	289-7274-600
880	3520	289-7274-610
890	3560	289-7274-620
900	3600	289-7274-630

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Crystal Table (cont.)

OPERATING FREQUENCY (kHz)	CRYSTAL FREQUENCY (kHz)	PART NUMBER
910	3640	289-7274-640
920	3680	289-7274-650
930	3720	289-7274-660
940	3760	289-7274-670
950	3800	289-7274-680
960	3840	289-7274-690
970	3880	289-7274-700
980	3920	289-7274-710
990	3960	289-7274-720
1000	4000	289-7274-730
1010	4040	289-7274-740
1020	4080	289-7274-750
1030	4120	289-7274-760
1040	4160	289-7274-770
1060	4200	289-7274-780
1060	4240	289-7274-790
1070	4280	289-7274-800
1080	2160	289-7274-010
1090	2180	289-7274-020
1100	2200	289-7274-030
1110	2220	289-7274-040
1120	2240	289-7274-050
1130	2260	289-7274-060
1140	2280	289-7274-070
1150	2300	289-7274-080
1160	2320	239-7274-090
1170	2340	289-7274-100
1180	2360	289-7274-110
1190	2380	289-7274-120
1200	2400	289-7274-130
1210	2420	289-7274-140
1220	2440	289-7274-150
1230	2460	289-7274-160
1240	2480	289-7274-170
1250	2500	289-7274-180
1260	2520	289-7274-190
1270	2540	289-7274-200
1280	2560	289-7274-210
1290	2580	289-7274-220
1300	2600	289-7274-230

parts list

Crystal Table (cont.)

OPERATING FREQUENCY (kHz)	CRYSTAL FREQUENCY (kHz)	PART NUMBER
1310	2620	289-7274-240
1320	2640	289-7274-250
1330	2660	289-7274-260
1340	2680	289-7274-270
1350	2700	289-7274-280
1360	2720	289-7274-290
1370	2740	289-7274-300
1380	2760	289-7274-310
1390	2780	289-7274-320
1400	2800	289-7274-330
1410	2820	289-7274-340
1420	2840	289-7274-350
1430	2860	289-7274-360
1440	2880	289-7274-370
1450	2900	289-7274-380
1460	2920	289-7274-390
1470	2940	289-7274-400
1480	2960	289-7274-410
1490	2980	289-7274-420
1500	3000	289-7274-430
1510	3020	289-7274-440
1520	3040	289-7274-450
1530	3060	289-7274-460
1540	3080	289-7274-470
1550	3100	289-7274-480
1560	3120	289-7274-490
1570	3140	289-7274-500
1580	3160	289-7274-510
1590	3180	289-7274-520
1600	3200	289-7274-530

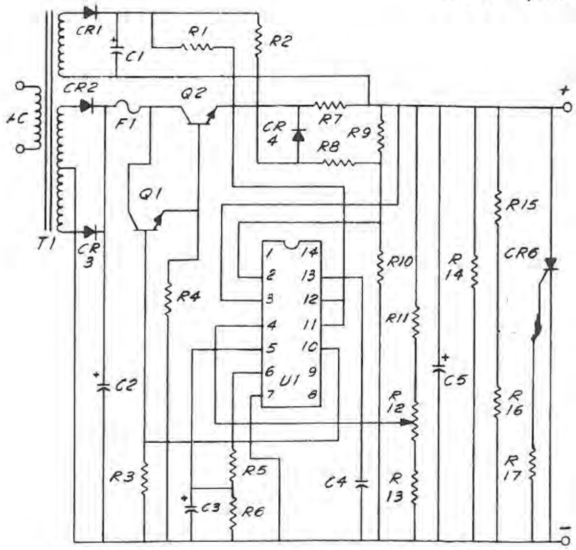
WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

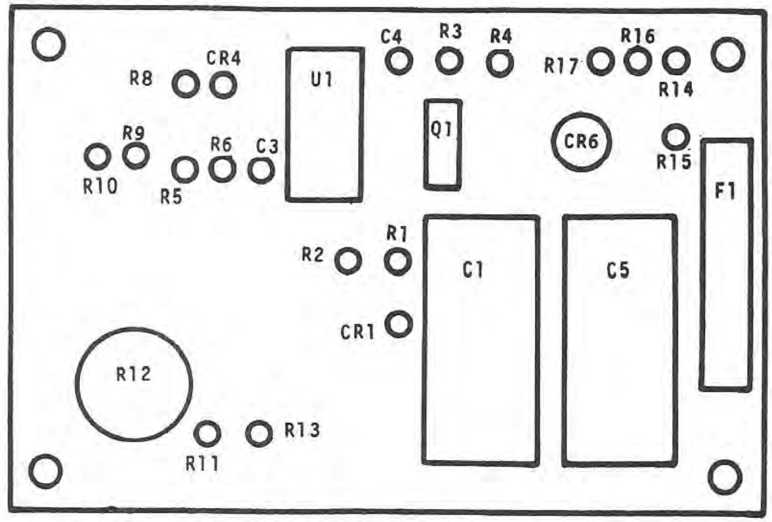
7.4 314R-1 SEMICONDUCTOR LIST

270-0547-010	LED, SPX-3191
270-0547-030	Photodiode, SPX-3194
351-1116-010	Int Ckt, MC1494L
351-1120-010	Int Ckt, LM340-5
351-1120-040	Int Ckt, LM340-12
351-1137-020	Int Ckt, NE555V
351-1178-040	Int Ckt, MC7906P
351-1178-060	Int Ckt, MC7912P
351-1223-020	Int Ckt, 3403
351-1231-020	Int Ckt, 8038
351-1339-020	Int Ckt, NE5533AN
351-7189-050	Int Ckt, UA710
351-7630-010	Int Ckt, 7404
351-7635-010	Int Ckt, 7410
351-7640-010	Int Ckt, SN7473N
351-7645-010	Int Ckt, SN74121
351-7771-010	Int Ckt, 7492
352-0551-010	XSTR, 2N2907A
352-0646-010	XSTR, 2N2102
352-0661-020	XSTR, 2N2222A
352-0714-010	XSTR, 2N4036
352-1104-010	XSTR, MJE-243
352-1105-010	XSTR, MJE-253
352-1114-010	XSTR, MPS-U06
352-1134-010	XSTR, 2N6575
353-0221-660	Diode, 1N5661A
353-0293-040	Diode, LED-RED
353-0413-020	Diode, 15KV, 600MA
353-0417-060	Diode, 600V, 22A
353-1915-000	Diode, 1N2822B
353-2720-000	Diode, 1N756A, 8.2V
353-2906-00	Diode, 1N914
353-3122-000	Diode, 1N3017B, 7.5V
353-3127-000	Diode, 1N3022B, 12V
353-3129-000	Diode, 1N3024B
353-3644-010	Diode, 1N4454
353-3691-010	Diode, 1N5711
353-3718-060	Diode, 1N5552
353-6313-000	Diode, 1N3824A, 4.3V
353-6315-000	Diode, 1N3826A, 5.1V
353-6316-000	Diode, 1N3827A, 5.6V
353-6317-000	Diode, 1N3828A, 6.2V
353-6442-040	Diode, 1N4004
353-6468-010	SCR, C6F
353-9009-440	Diode, 1N5418

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

MODEL 55-28 POWER SUPPLY
28V (27-29 VDC) 2 Amperes





R2,17	1.2K	55-3 to -20	CR2, 3	2N5296	55-3 to -20			
R1	120	55-3 to -20	C1	500 mfd 50v		Q2	2N3055	
	1.2K	55-22 to -30	C3	4.7 mfd 10v		U1	MC1723CL	
R2, 17	1K		C4	1000 mmfd		F1	AGC6	55-3 to -11
R3	10K		CR1, 4	1N4002			AGC4	55-12 to -30
R5	910		CR2, 3	VTA200/T				
R8	100		CR6	S2800B		T1	55T3 to 55T30	
R9	510		Q1	2N5296	55-3 to -20			
R12	500 POT			2N5294	55-22 to -30			

	R4	R6	R7	R10	R11	R13	R14	R15	R16	C2	C5	
55-3		470			0			0				
55-4		470		1.6K	390		100	0		9200 mfd 15v		
55-5	1K		.05 WW		510	510		27	1K			1N752A
55-6		510		2.7K	510		150	100				
55-7					750		100	150			500 mfd 15v	
55-8					750	430	430	0				
55-9				2.7K	220	1K	430					
55-10	1.2K				100		620	100	680	6800 mfd 25v		1N4939A
55-11					100	750	620					
55-12			.10 WW	3.3K	430		820	47				1N4742A
55-14				3.9K	820		1.2K	47	820			1N4744A
55-16	1.6K	Omitted		4.3K	820			220	5.1K	3900 mfd 40v		
55-18				5.1K	1K	820	1.6K		1K		150 mfd 50v	1N4746A
55-20				6.2K	1.5K			47	1.8K			
55-22				6.2K	1.5K				2.2K			
55-24					2.7K		2.7K	100	2.2K			
55-26	2.7K		.20 WW	4.3K	2.7K	1K		100		1700 mfd 75v		
55-28					3.3K		3.6K	220	3.3K			
55-30					3.3K		3.6K	220				

All resistors ½ watt carbon film unless otherwise shown.
On units without overvoltage protection CR5, 6, R15, 16, 17 and F1 are omitted.

THEORY OF OPERATION The Model 55 DC Power Supply is an all-silicon, regulated supply with 0.005% line regulation, 0.05% load regulation, 500 microvolts maximum ripple, foldback current limiting, and minimum size and weight.

Transformer T1 isolates the AC line from the supply and furnishes an AC voltage to auxiliary supply diode CR1 and main supply diodes CR2 and CR3.

Diode CR1 rectifies the auxiliary voltage, furnishing 10 volts to filter capacitor C1. The DC voltage from C1 is applied to voltage regulator U1 through R1 and to the overcurrent circuit through R2.

Main power diodes CR2 and CR3 rectify the AC voltage which is then filtered by C2 and provided to the collector of pass transistor Q2.

The output voltage is controlled by voltage regulator U1. This regulator consists of a temperature-compensated reference amplifier, error amplifier, series-pass transistor, and current-limiting circuitry. A portion of the output voltage from R12 (dual supply - R11 & 27) is fed into U1 and compared against the internal voltage reference. The amplified error signal is fed to Q1, causing it to turn on or off. Q2 follows Q1 and keeps the output voltage constant.

FACTORY TEST DATA

FACTORY TEST DATA

TYPE 314R-1 SERIAL NO. 352 DATE 1-20-82

RADIO STATION WMGO FREQUENCY 1370 LOAD IMPEDANCE 50 ohms

MEASURED PERFORMANCE DATA @ 1 / .5 kW

PERCENT HARMONIC DISTORTION

FREQUENCY (Hz)	25% MOD.		50% MOD.		85% MOD.		95% MOD.	
	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH
20	0.5	0.4	0.4	0.5	0.6	0.5	0.6	0.6
50	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
100	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2
400	0.3	0.3	0.3	.2	0.2	0.3	0.2	0.3
1,000	0.3	0.3	0.4	0.3	0.3	0.4	0.3	0.4
5,000	0.7	0.4	1.1	0.6	1.4	1.4	1.6	1.4
7,500	0.9	0.5	1.5	0.7	1.2	1.9	1.3	1.4
10,000	0.6	0.6	1.1	0.7	1.3	1.0	2.2	1.7

FREQUENCY RESPONSE @ 70% MOD., HIGH POWER

FREQUENCY (Hz)	LEVEL (dBm)
20	-0.3
50	-0.1
100	0
400	0
1,000	0 REF.
3,000	-0.2
5,000	-0.5
7,500	-0.7
10,000	-0.9

AUDIO INPUT FOR 100% MODULATION (1,000 Hz) +10 dBm

CARRIER SHIFT 0.2 %

NOISE LEVEL BELOW 100% MOD. -60 dB

TESTED BY Anthony Peterson

FACTORY TEST DATA

TYPE 314 R-1 SERIAL NO. 352 DATE 1-20-82

TRANSMITTER METER READINGS

TEST METER	
- 6 VOLT	-6V
-12 VOLT	-12V
+12 VOLT	+12V
+ 5 VOLT	+5V
+28 VOLT	+28V
DR E_C	+210V
DR I_C	-6A

	CARRIER		95% MOD.	
	LP	HP	LP	HP
HV	8.9KV	8.6KV	8.7KV	8.5KV
FWD PWR	54%	100%	58%	105%
REF PWR	.1%	.3%	.3%	.5%
PLATE VOLTAGE	2050V	2900V	2075V	2900V
PLATE CURRENT	.33A	.46A	.33A	.46A
RF LINE CURRENT	3.2A	4.47A		
POWER OUTPUT	500	1000W		
LINE VOLTAGE	208	208		

FACTORY TEST DATA

TYPE 314R-1 SERIAL NO. 352 DATE 1-20-82

OUTPUT NETWORK TUNING DATA

C4, C5, C6, C7	TYPE 291	2000 pF
C31	TYPE 292	Not used pF
C30 TURNS (CCW FROM STOP)		15.3
L1 TYPE 980-0048-000	NO. TURNS SHORTED	25.5
L2 TYPE 980-0133-000	NO. TURNS SHORTED	10.8
STRAP 2 (TURNS ABOVE GROUND)		1.8
L3 TYPE 980-0047-000	NO. TURNS SHORTED	29
L4 TYPE 980-0132-000	NO. TURNS SHORTED	9.5
STRAP 6 (TURNS ABOVE GROUND)		3.7

FACTORY TEST DATA

TYPE 314R-1 SERIAL NUMBER 352 DATE 1-20-82

ADDITIONS, CHANGES AND DELETIONS

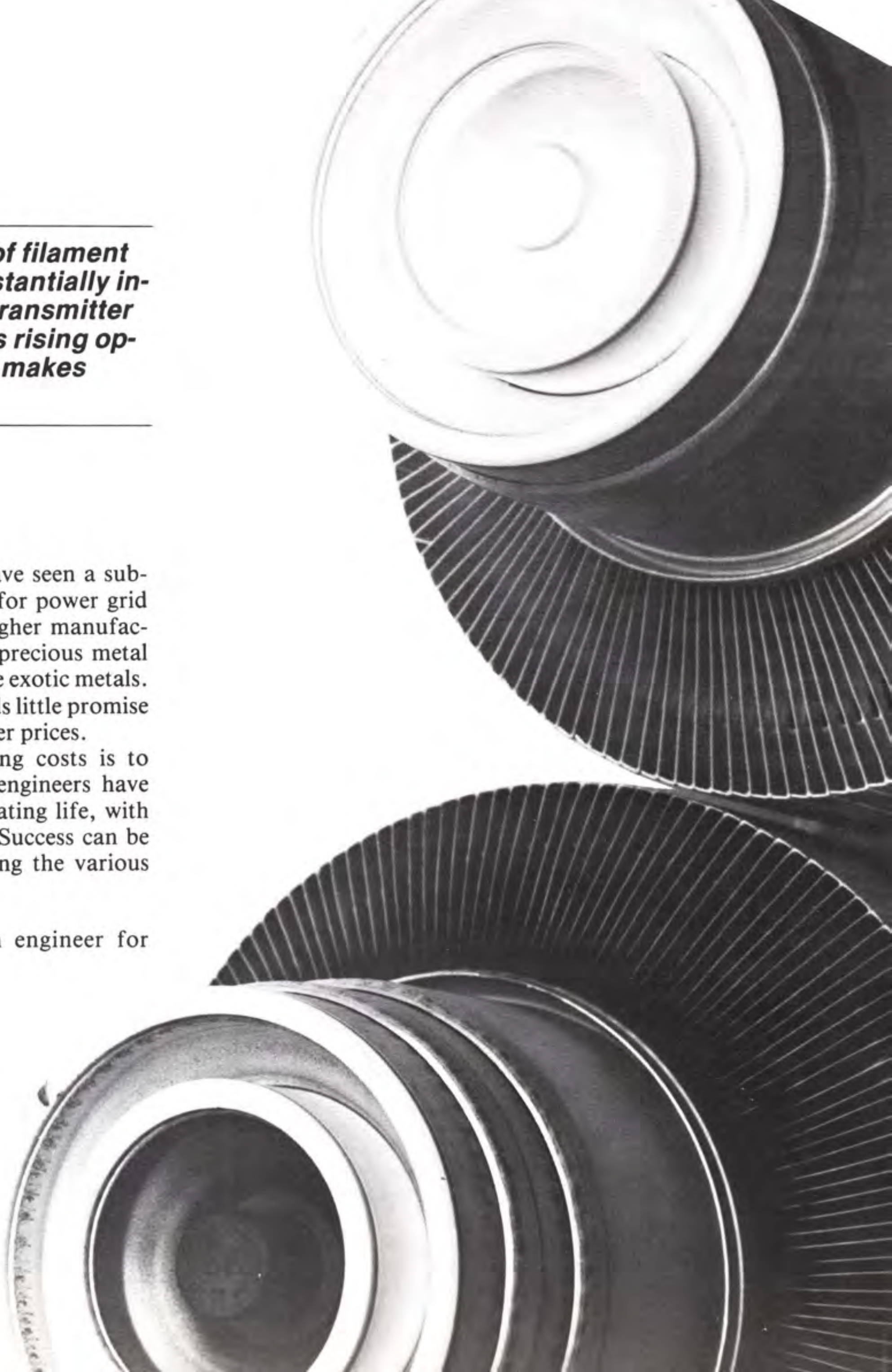
Changed A1C81 to 820PF.

TUBE DATA SHEETS

EXTENDING TRANSMITTER TUBE LIFE

By Robert Artigo

A carefully followed program of filament voltage management can substantially increase the life expectancy of transmitter power grid tubes. With today's rising operating costs, such a program makes good financial sense.



IN RECENT YEARS station managers have seen a substantial increase in replacement costs for power grid tubes. The blame can be placed on higher manufacturing costs due to inflation, volatile precious metal prices, and an uncertain supply of some exotic metals. The current outlook for the future holds little promise for a reversal in this trend toward higher prices.

One way to offset higher operating costs is to prolong tube life. For years station engineers have used various tricks to get longer operating life, with greater and lesser degrees of success. Success can be maximized, however, by understanding the various

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EIMAC Application Bulletin AB-18
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March, 1982

factors that affect tube life and implementing a program of filament voltage management.

A number of factors can aid maximum tube life in your transmitter. For example, are the maximum ratings given on the tube manufacturer's data sheet being exceeded? Data sheets are available upon request from most companies. Most tube manufacturers have an application engineering department to assist in evaluating tube performance for a given application. Make use of these services!

Headroom

Is the final power tube of the transmitter capable of delivering power in excess of the desired operating level? Or is the demand for performance so great that minimum output power levels can only be met at rated nominal filament voltage?

Figure 1 can be used as a basic guide to determine if a given transmitter and tube combination has a good probability of giving extended life service. Extended life service is defined as useful operating life beyond that normally achieved by operating at rated nominal filament voltage. The amperes/watt ratio is obtained by dividing average plate current by the product of filament voltage and filament current. If the amperes/watt ratio falls in the "good" to "excellent" range, excess emission is sufficient to permit filament voltage derating. At a lower filament voltage, the filament temperature is lowered, thus extending life. A typical FM transmitter on the market today may have an amperes/watt filament ratio of 0.002 to 0.003. This equipment would be considered an excellent choice to achieve extended tube life. On the other hand, if the amperes/watt ratio falls in the "poor" range, it is unlikely that filament derating is possible due to limited emission. Note that this guideline should be used for thoriated tungsten emitters only, and does not apply to oxide cathode-type tubes.

Instrumentation

Are all tube elements metered in the transmitter? Elements should be metered for both voltage and current, and meters should be redlined to define operation within safe limits. More modern transmitters may incorporate a microprocessor-controlled circuit to monitor all pertinent parameters.

In addition, the following controls are necessary if an effective filament voltage management program is to be undertaken: power output metering for an FM transmitter or a distortion level meter for AM equipment; *accurate* filament voltage metering (an iron-vane instrument is preferred over the more common average responding RMS calibrated type; the filament voltage measurement must be made at the tube socket terminals); filament voltage control, capable of being adjusted to 0.1 V secondary voltage change; and a filament current meter—desirable but optional.

A means must be provided to hold filament voltage constant. If the filament voltage is permitted to vary in accordance with primary line voltage fluctuation, the effect on tube life can be devastating. An acceptable solution is the use of a ferroresonant transformer or line regulator. This accessory is offered by some transmitter manufacturers as an option and should be seriously considered if a tube life extension program is planned.

Transmitter housekeeping

Once the transmitter has been place in operation, tube life is in the hands of the chief engineer. The first action to prolong tube life falls into the category of routine maintenance. Most transmitter manufac-

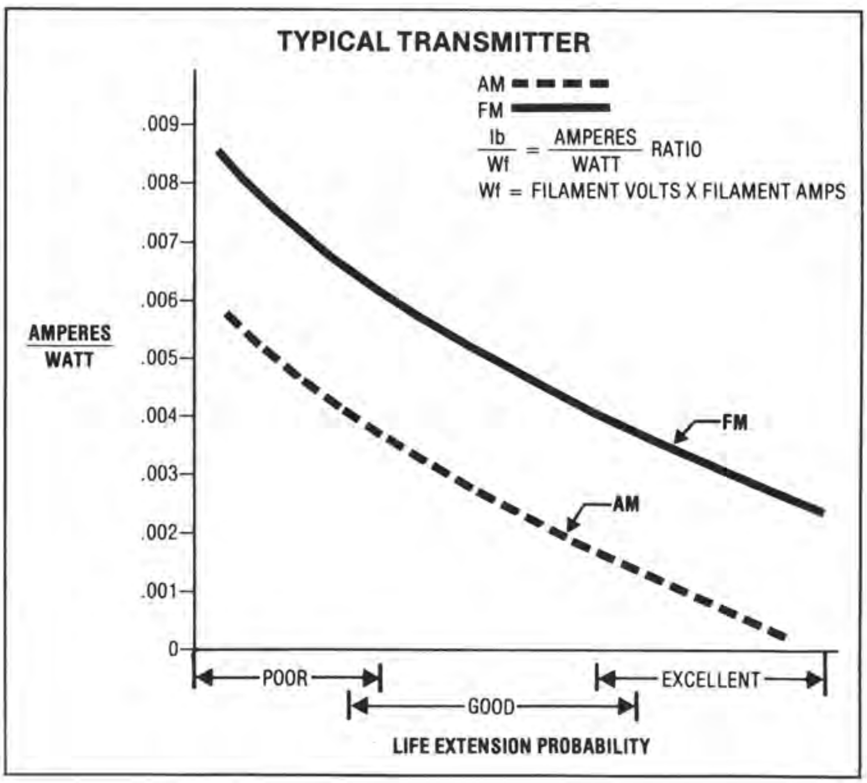


***Fig. 1.** Probability of extended life service can be determined from this graph. Divide the average p.a. plate current in amperes by the product of filament voltage and current. The resulting amperes/watt ratio (Y-axis) is projected horizontally to the appropriate curve. The vertical projection to the X-axis indicate the life extension probability.*

Extending Transmitter Tube Life

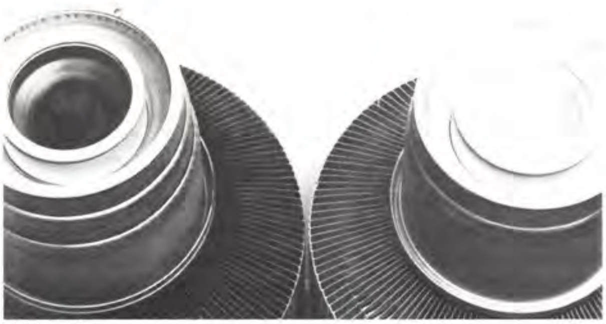


Figure 2

Figure 3

Figure 4

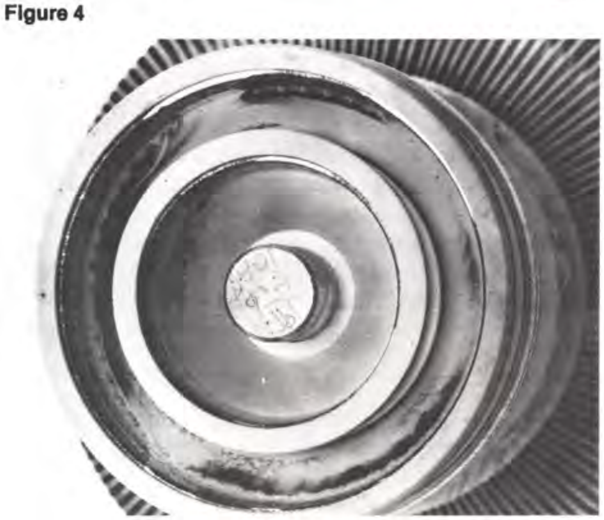


Figure 5

turers have a routine maintenance schedule established in the equipment manual. This procedure must be followed carefully if operating costs are to be held to a minimum. During routine maintenance it is very important to look for tube and socket discoloration, either of which can indicate overheating.

Look for discoloration around the top of the cooler near the anode core and at the bottom of the tube stem where the filament contacts are made. Review Figures 2 and 3 for examples of a tube operating with inadequate cooling. It is possible for discoloration to appear in the areas mentioned if the transmitter has to operate in a dirty environment. If this is the case, the tube should be removed and cleaned with a mild detergent. After cleaning, the tube should be rinsed thoroughly to remove any detergent residue and blown dry with compressed air. If the discoloration remains, this is an indication that the tube has operated at too high a temperature. Check inlet and outlet air ducting and filters for possible air restriction. It may also be necessary to verify that the air blower is large enough to do the job in the present environment and that it is operating at rated capacity.

With the tube removed, the socket should be blown or wiped clean and carefully inspected. Any discoloration in the socket finger stock caused by overheating could contribute to early tube failure. A finger stock that loses its temper through prolonged operation at high temperature will no longer make contact to the tube elements (Figure 4). A well-maintained socket will score the tube contacts when the tube is inserted. If all fingers are not making contact, more currect flows through fewer contacting fingers, causing additional overheating and possible burnout (Figure 5).

Filament voltage management

The useful operating life of a thoriated tungsten emitter can vary widely with filament voltage. Figure 6 describes the relative life expectancy with various filament voltage levels. Obviously, a well-managed filament voltage program will result in longer life expectancy. Improper management, on the other hand, can be very costly.

For a better understanding of this sensitive aging mechanism, the filament itself must be understood. Most filaments in high-power, gridded tubes are a mixture of tungsten and thoria with a chemical com-

Fig. 2. *Improper cooling means short tube life (left). Discoloration of metal around inner filament stem and anode fins indicates poor cooling or improper operation of tube. Properly cooled and operated tube (right) shows no discoloration after many hours of use. In both cases, good socketing is indicated by scoring on circular connector rings.*

Fig. 3. *Dirty and discolored cooler of amplifier tube at left indicates combination of discoloration due to heating and lack of cleaning. Tube has operated too hot and dust has collected in anode louvres.*

Fig. 4. *Minute scoring in base contact rings indicates that socket finger stock has made good, low-resistance contact to tube elements. Well-maintained socket will score the tube contacts when tube is inserted. If all fingers do not make contact, more current will flow through fewer contact fingers, causing additional overheating and burning, as shown in Fig. 5.*

Fig. 5. *High resistance socket contacts has caused severe burning of contact area in the base. Overheated base caused early demise of tube.*

position of W + THO_2. A filament made of this wire is not a suitable electron emitter for extended life applications until it is processed. Once the filament is formed into the desired shape and mounted, it is heated to approximately 2100°C in the presence of a hydrocarbon. The resulting thermochemical reaction forms di-tungsten carbide on the filament's surface. Life is proportional to the degree of carburization. If the filament is overcarburized, however, it will be brittle and easily broken during handling and transporting. Therefore, only approximately 25% of the cross-sectional area of the wire is converted to di-tungsten carbide. Di-tungsten carbide has a higher resistance than tungsten; thus, the reaction can be carefully monitored by observing the reduction in filament current as the carburizing process proceeds.

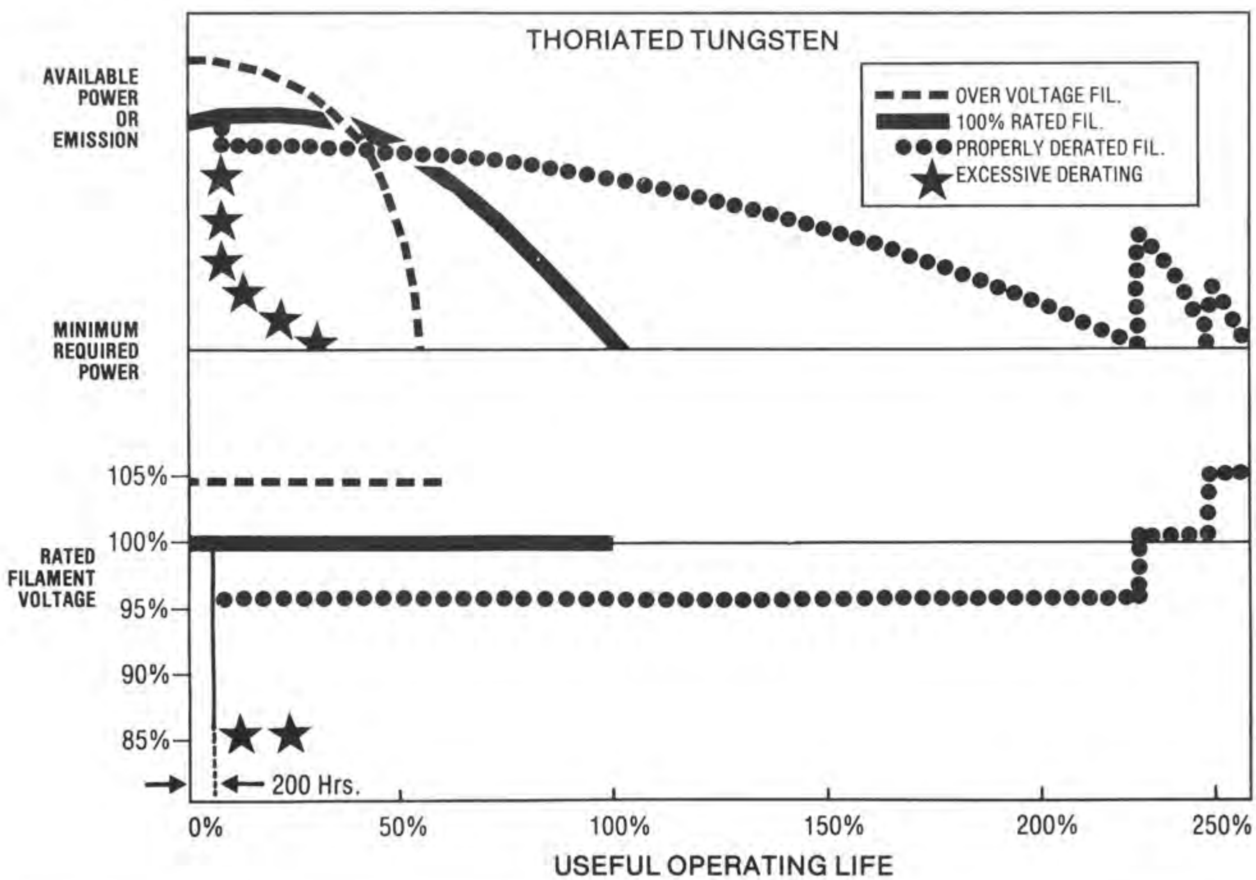
As the tube is used the filament slowly decarburizes. At some point in life, all of the di-tungsten carbide layer is depleted and the reduction of thoria to free thorium stops. The filament is now decarburized and is no longer an effective electron emitter.

The key to extending the life of a thoriated tungsten filament emitter is to control operating temperature. Emitter temperature is a function of the total RMS power applied to the filament. Thus, filament voltage control is temperature control. Temperature varies directly with voltage. As the emitter temperature rises the de-carburizing process is accelerated and tube life shortened. Figure 6 shows that useful tube life can vary significantly with only a 5% change in filament voltage. *If the filament voltage cannot be regulated to within ±3%, the filament should always be operated at the rated nominal voltage.* The danger of operating on the "cold" temperature side is that the emitter may be "poisoned." A cold filament acts as a getter; that is, it attracts contaminants. When a contaminant becomes attached to the surface of the emitter, that area is rendered inactive and loss of emission results. Operation of the filament at slightly below rated nominal voltage, however, can extend tube life if done properly.

FILAMENT VOLTAGE MANAGEMENT (Figure 6)

Filament voltage management allows extended tube life when accompanied by a continuing housekeeping program. When filament voltage is too high (dashes), power tube looses emission rapidly and normal operating life is not achieved. When filament is operated at rated voltage (black curve) normal tube life is achieved in a majority of cases. With a filament voltage management program (bullets), extended tube life may be achieved. When the minimum required output power level is finally reached (right-hand portion of curve), the filament voltage may be raised to rated value, or above, to achieve additional useful operating life. If filament is run "cool" (stars), extremely short life will result. Note that filament voltage management program does not take effect until about 200 hours of operating time have passed.

If voltage management program is not undertaken, tube should be run at rated filament voltage.



Extending Transmitter Tube Life

Of great importance to long tube life is the temperature of the elements and the ceramic-to-metal seals. Element temperature can be held within proper limits by observing the maximum dissipation ratings listed in the data sheet. Seal temperature should be limited to 200°C at the lower anode seal under worst-case conditions. As element temperature rises beyond 200°C, the release of contaminants locked in the materials used in tube manufacturing increases rapidly. These contaminants cause a rapid depletion of the di-tungsten carbide layer of the filament.

When a new power tube is installed in a transmitter, it must be operated at rated nominal filament voltage for the first 200 hours. This procedure is very important for two reasons. First, operation at normal temperature allows the getter to be more effective during the early period of tube life when contaminants are more prevalent. This break-in period conditions the tube for operation at lower filament voltage to obtain longer filament life. Secondly, during the first 200 hours of operation filament emission increases. It is necessary for the life extension program to start at the peak emission point.

A chart recorder or other device should be used to monitor variations in primary line voltage for several days of transmitter operation. The history of line voltage variations during on-air time must be reviewed prior to derating filament voltage. Plan to establish the derated voltage during the time period of historically low line voltage, as this is the worst-case condition. If line variation is greater that ±3%, filament voltage must be regulated.

Record output power (FM) or distortion level (AM) with the tube operating at rated nominal filament voltage. Next, reduce filament voltage in increments of 0.1 V and record power or distortion levels at each increment. Allow one minute between each increment for the filament emission to stabilize.

When a noticeable change occurs in output power or the distortion level changes, the derating procedure must stop. Obviously, operation at this point is unwise since there is no margin for a drop in line voltage. It is safer to raise the voltage 0.2 V above the critical voltage at which changes are observed to occur. If this new filament voltage setting is more than 5% below the nominal rated level, filament voltage must be raised to the 95% level. Operation below this point is unpredictable and life expectancy is uncertain. Finally, recheck power output or distortion to see if they are acceptable at the chosen filament voltage level. Recheck again after 24 hours to determine if emission is stable and that the desired performance is maintained. If performance is not repeatable, the derating procedure must be repeated.

Continuing the program

The filament voltage should be held at the properly derated level as long as minimum power or maximum distortion requirements are met. Filament voltage can be raised to reestablish minimum requirements as necessary. This procedure will yield results similar to those shown in the illustration, to achieve as much as 10% to 15% additional life extension. When it becomes necessary to increase filament voltage, it is a good time to order a new tube. Filament voltage can be increased as long as the increase results in maintaining minimum level requirements.

When an increase fails to result in meeting a level requirement, filament emission must be considered inadequate and the tube should be replaced. Don't discard it or sell it for scrap! Put it on the shelf and save it. It will serve as a good emergency spare and may come in very handy some day. Also, in AM transmitters, a low-emission RF amplifier tube can be shifted to modulator use where the peak filament emission requirement is not as severe.

Start planning for longer tube life now! Review the following steps you can take:

- Investigate the manufacturer's ratings on the power tubes in your present equipment, or the transmitter you plan to buy.
- Check that your transmitter has sufficient headroom. Is there a margin of safety in tube operation?
- Look for important instrumentation in the next transmitter you buy. Are all tube elements monitored for voltage and current in the transmitter?
- Whether your transmitter is new or old, start a filament life extension program.

Remember that each time you replace a power tube, the recommended derating procedure must be rerun. Voltage levels required with one tube do not apply to a replacement tube.

When purchasing a tube, insist on a new tube that carries the full, original manufacturer's warranty. Only tubes manufactured by the company of origin have to perform to published data. This is the important reason that transmitter manufacturers buy new, warranted tubes from the original manufacturer. **BM/E**

Thanks to William Barkley, William Orr, William Sain, and Bob Tornoe, all of Varian EIMAC, for their help and suggestions in preparing this paper.

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TECHNICAL DATA

The EIMAC 3-500Z is a compact power triode intended to be used as a zero-bias Class AB2 amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 3-500Z in a cathode-driven circuit.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

FILAMENT: Thoriated Tungsten (see FILAMENT OPERATION)	
Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	14.6 A
Amplification Factor (Average)	130
Direct Interelectrode Capacitances (grounded filament)[2]	
Input	8.3 pF
Output	0.07 pF
Feedback	4.7 pF
Direct Interelectrode Capacitances (grounded grid)[2]	
Input	8.3 pF
Output	4.7 pF
Feedback	0.07 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. Varian, EIMAC Division should be consulted before using this information for final equipment design.

2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	6.10 in; 154.94 mm
Diameter	3.44 in; 87.33 mm
Net Weight	7.0 oz; 198.5 gm
Operating Position	Vertical, base down or up
Maximum Operating Temperature:	
Plate Seal	225°C
Base Seals	200°C
Cooling	Radiation and forced air
Base	5 Pin Special

3928 (Revised 8-5-80) Printed in U.S.A.

varian EIMAC division/301 industrial way/san carlos/california 94070

Recommended Socket .... EIMAC SK-410
Recommended Chimney .... EIMAC SK-406
Recommended Hear-Dissipating Connector;
Plate HR-6

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

(Frequencies to 110 MHz)

Class AB_2

MAXIMUM RATINGS:

DC PLATE VOLTAGE .... 4000 VOLTS
DC PLATE CURRENT .... 0.4 AMPERE
PLATE DISSIPATION .... 500 WATTS
GRID DISSIPATION .... 20 WATTS

1. Zener diode positive bias used at plate potentials of 3 kV and above.
2. Approximate value.
3. Currents listed correspond to SSB, or "Two-tone" average current at peak of signal envelope.
4. Single-tone current for 3500 Vdc operation may reach this value during short periods of circuit adjustment only.
5. Intermodulation distortion products are referenced against one tone of a two tone signal.

TYPICAL OPERATION
Class AB_2, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1500	2000	2500	3000	3500	Vdc
Cathode Voltage[1]	0	0	0	+10	+15	Vdc
Zero Signal Plate Current[2]	65	95	130	62	53	mAdc
Single-Tone Plate Current, CW[3,4]	400	400	400	400	400	mAdc
Two-Tone Plate Current	260	270	280	268	262	mAdc
Single-Tone Grid Current[2]	130	130	120	108	108	mAdc
Two-Tone Grid Current[2]	80	80	70	60	58	mAdc
Single-Tone Power Input	600	800	1000	1200	1400	W
Useful Output Power, CW or PEP	330	500	600	740	890	W
Resonant Load Impedance	1600	2750	3450	4200	5000	Ω
Intermodulation Distortion Products[5]						
3rd Order	-46	-38	-33	-40	-40	db
5th Order	---	---	---	-46	-45	db
Driving Impedance	94	102	100	115	115	Ω
Maximum Signal Driving Power[2]	49	49	46	46	46	W

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR GRID DRIVEN, CATHODE DRIVEN

Class AB_2 and C Telegraphy or FM
(Key-Down Conditions)
(Frequencies to 110 MHz)

MAXIMUM RATINGS:

DC PLATE VOLTAGE .... 4000 VOLTS
DC PLATE CURRENT .... 0.35 AMPERE
PLATE DISSIPATION .... 500 WATTS
GRID DISSIPATION .... 20 WATTS

TYPICAL OPERATION

	Grid Driven		Cathode Driven		
Plate Voltage	3000	3500	3000	3500	Vdc
Grid Voltage	-10	-75	-10	-75	Vdc
Plate Current	350	300	333	350	mAdc
Grid Current	115	115	108	118	mAdc
Peak rf (Cathode) (Grid) Voltage	110	187	95	200	v
Approx. Driving Power	14	22	35	81	W
Plate Input Power	1050	1050	1000	1225	W
Plate Dissipation	330	200	300	305	W
Useful Output Power	720	850	700	920	W
Resonant Load Impedance	4200	5700	4800	5500	Ω

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE .... 3000 VOLTS
DC PLATE CURRENT .... 0.275 AMPERE
PLATE DISSIPATION[1] .... 330 WATTS
GRID DISSIPATION[2] .... 20 WATTS

1. Corresponds to 500 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage .... 3000 Vdc
Grid Voltage .... -100 Vdc
Plate Current .... 275 mAdc
Grid Current[1] .... 120 mAdc
Peak rf Grid Voltage[1] .... 200 v
Calculated Driving Power .... 25 W
Plate Input Power .... 825 W
Plate Dissipation .... 185 W
Plate Output Power .... 640 W

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB_2, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE[1]	4000 VOLTS
DC PLATE CURRENT	0.4 AMPERE
PLATE DISSIPATION	500 WATTS
GRID DISSIPATION	20 WATTS

1. See zero-bias operation in Application Section.
2. Approximate value.
3. Per tube.
4. Nominal drive power is one-half peak power.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	3000 Vdc
Grid Voltage	0 Vdc
Zero-Signal Plate Current[2]	300 mAdc
Max. Signal Plate Current	770 mAdc
Max. Signal Grid Current[2]	244 mAdc
Peak af Grid Voltage[3]	100 v
Peak Driving Power[4]	25 w
Plate Input Power	2310 W
Max. Signal Plate Dissipation	890 W
Plate Output Power	1420 W
Load Resistance (plate to plate)	8600 Ω

HIGH-LEVEL MODULATED RADIO-FREQUENCY AMPLIFIER PULSE-WIDTH MODULATION – Grid Driven

ABSOLUTE MAXIMUM RATINGS:

	RF Amplifier	Switching Modulator	
DC Plate Voltage	4	10	KILOVOLTS
DC Plate Current	0.4	0.4	AMPERES
DC Grid Voltage	–200	–200	VOLTS
Plate Dissipation	500	500	WATTS
Grid Dissipation	20	20	WATTS

TYPICAL OPERATION (Carrier Conditions)[1]

	RF Amplifier	Switching Modulator	
Plate Voltage	3.0	9.0	kVdc
Plate Current	250	180	mAdc
Grid Voltage	–85	–120	Vdc
Grid Current[2]	170	125	mAdc
Useful Power Output[2]	550	1500	W

1. These conditions assume rectangular drive waveform and a third harmonic, high-efficiency "Tyler" circuit.
2. Approximate value.

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves or actual measurement. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 5.0 volts	13.8	15.0	A
Interelectrode Capacitances[1] (grounded filament connection)			
Input	6.5	10.0	pF
Output	---	0.18	pF
Feedback	4.2	5.2	pF
Interelectrode Capacitances[1] (grounded grid connection)			
Input	6.5	10.0	pF
Output	4.2	5.2	pF
Feedback	---	0.18	pF
Zero Signal Plate Current: (Ec = 0 Vdc, Eb = 2500 Vdc)	90	180	mAdc

1. In Shielded Fixture.

APPLICATION

MECHANICAL

MOUNTING - The 3-500Z must be operated vertically, base up or down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit. The tube must be protected from severe vibration and shock.

SOCKET - The EIMAC SK-410 air system socket and SK-406 chimney are recommended for use with the 3-500Z. When a socket other than the SK-410 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate lead.

If a socket other than the EIMAC SK-410 is employed, the user should assure himself that strong lateral pressure is not applied to the tube base pins. Otherwise, even though the base of the tube is reinforced, damage to the base seals may result.

CAUTION-GLASS IMPLOSION - The EIMAC 3-500Z is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. Air flow requirements to maintain the above maximum temperatures are tabulated below. (For operation below 30 MHz)

Base-to-Anode Air Flow		
Anode Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (inches-H_2O)
300	6.6	0.023
400	10.3	.052
500	13.0	.082

The anode of the 3-500Z operates at a visibly red color at its maximum rated dissipation of 500 watts.

In all cases, air flow rates in excess of the minimum requirements will prolong tube life. NOTE: Two 3-500Z tubes in a single amplifier, chassis mounted, may be adequately cooled by use of a fan so mounted as to pressurize the space below the sockets. Fans suitable for use at or near sea level are Pamotor Model 2000, or Model 6500. The Rotron "Spartan" fan (3200 rpm) is also suitable, as is a #3, 3-inch squirrel cage blower (3100 rpm).

In all cases, the only criteria of proper cooling is the temperature of the tube seals. Tube temperatures may be measured with the aid of temperature sensitive paint, spray, or crayon.

Suitable products are manufactured by the Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield, New Jersey 07080.

ZERO-BIAS OPERATION - Operation at zero-bias is not recommended with plate voltages over 2500 since plate dissipation may be exceeded. A zener diode placing positive bias on the cathode or other constant voltage source may be used to reduce zero signal plate current at plate potentials over 2500 volts.

CLASS-C OPERATION - Although specifically designed for linear amplifier service, the 3-500Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-500Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-resistor bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 3-500Z is 5.0 volts. Filament voltage, as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

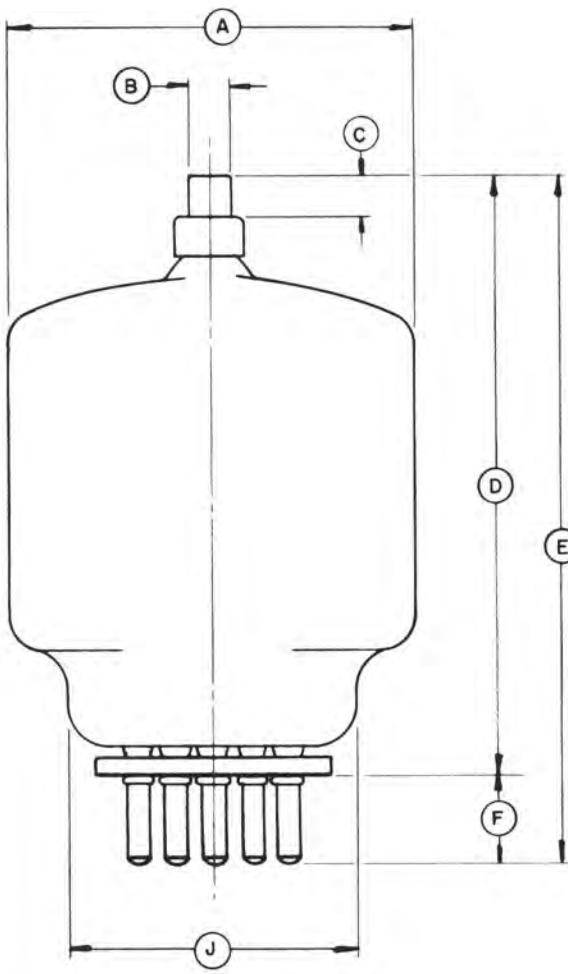
For best tube life the inrush current to the filament should be limited to two times normal current during turn-on. This will minimize thermal stress on the thoriated-tungsten filament wire, which can cause internal tube geometry changes with repeated cycling.

CAUTION-HIGH VOLTAGE - Operating voltage for the 3-500Z can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERMODULATION DISTORTION - Typical operating conditions with distortion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted.

INPUT CIRCUIT - When the 3-500Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a Q or two or more.

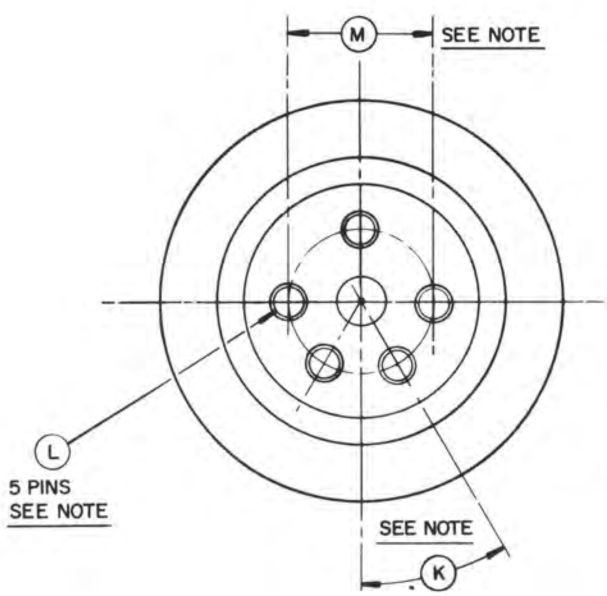
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, Varian, EIMAC Division, 301 Industrial Way, San Carlos, California 94070 for information and recommendation.

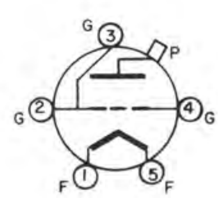


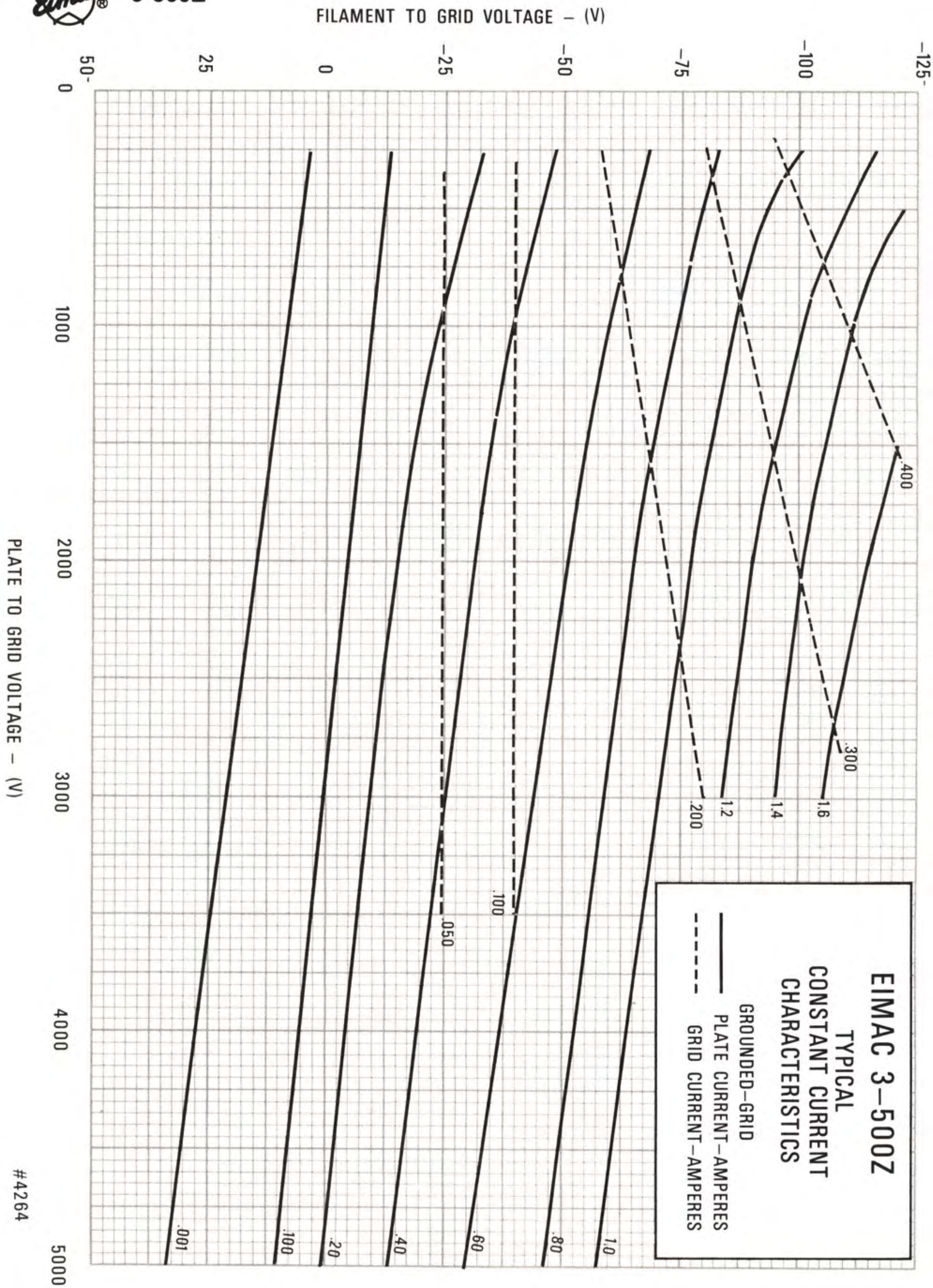
DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A		3.438			87.33	
B	.350	.365		8.89	9.27	
C	.328	.359		8.33	9.12	
D		5.200			132.1	
E	5.500	6.100		139.7	154.94	
F	.700			17.78		
G						
H						
I						
J		2.500			63.5	
K			30°			
L	.185	.191		4.7	4.85	
M			1.250			31.75

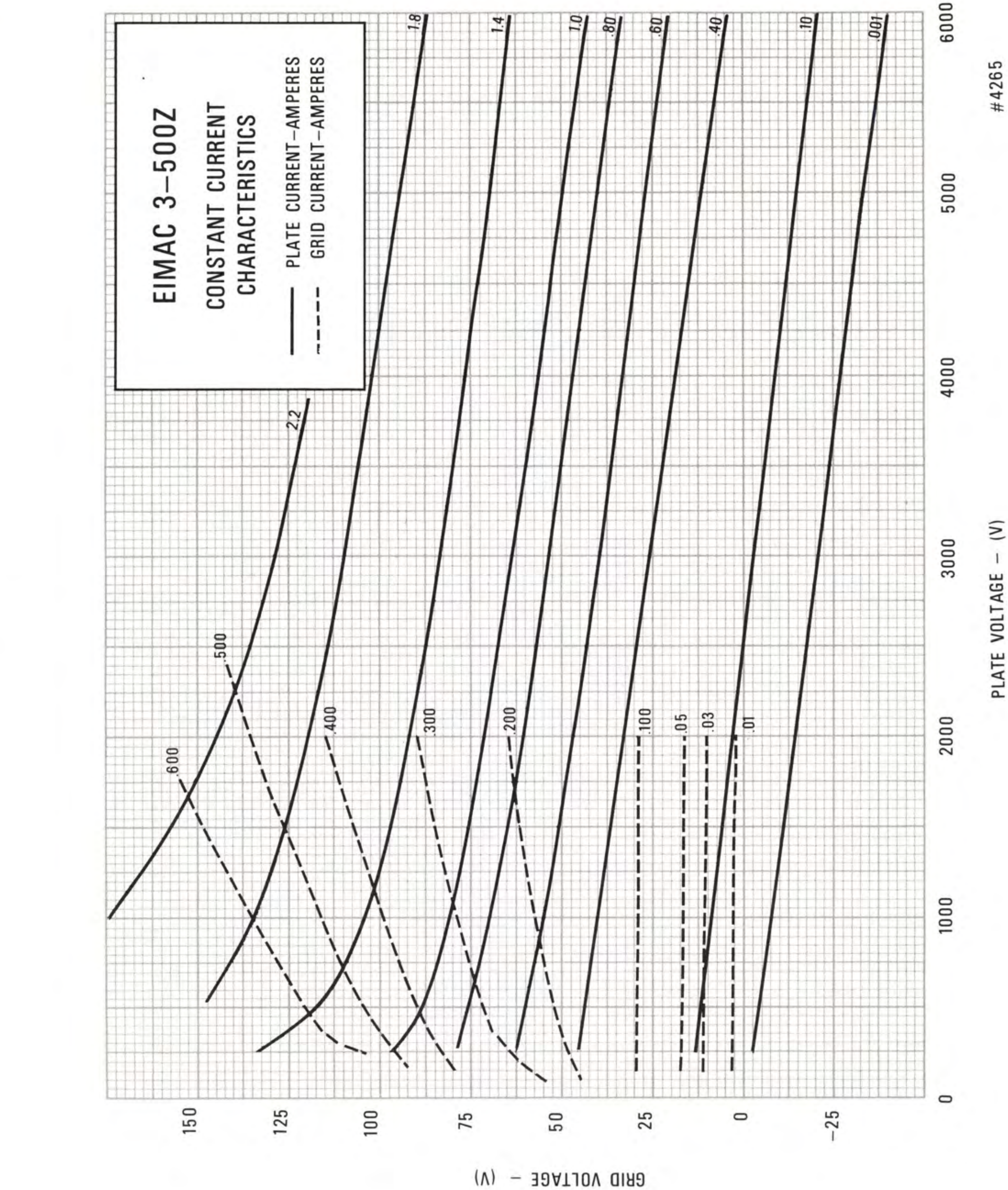
NOTES:

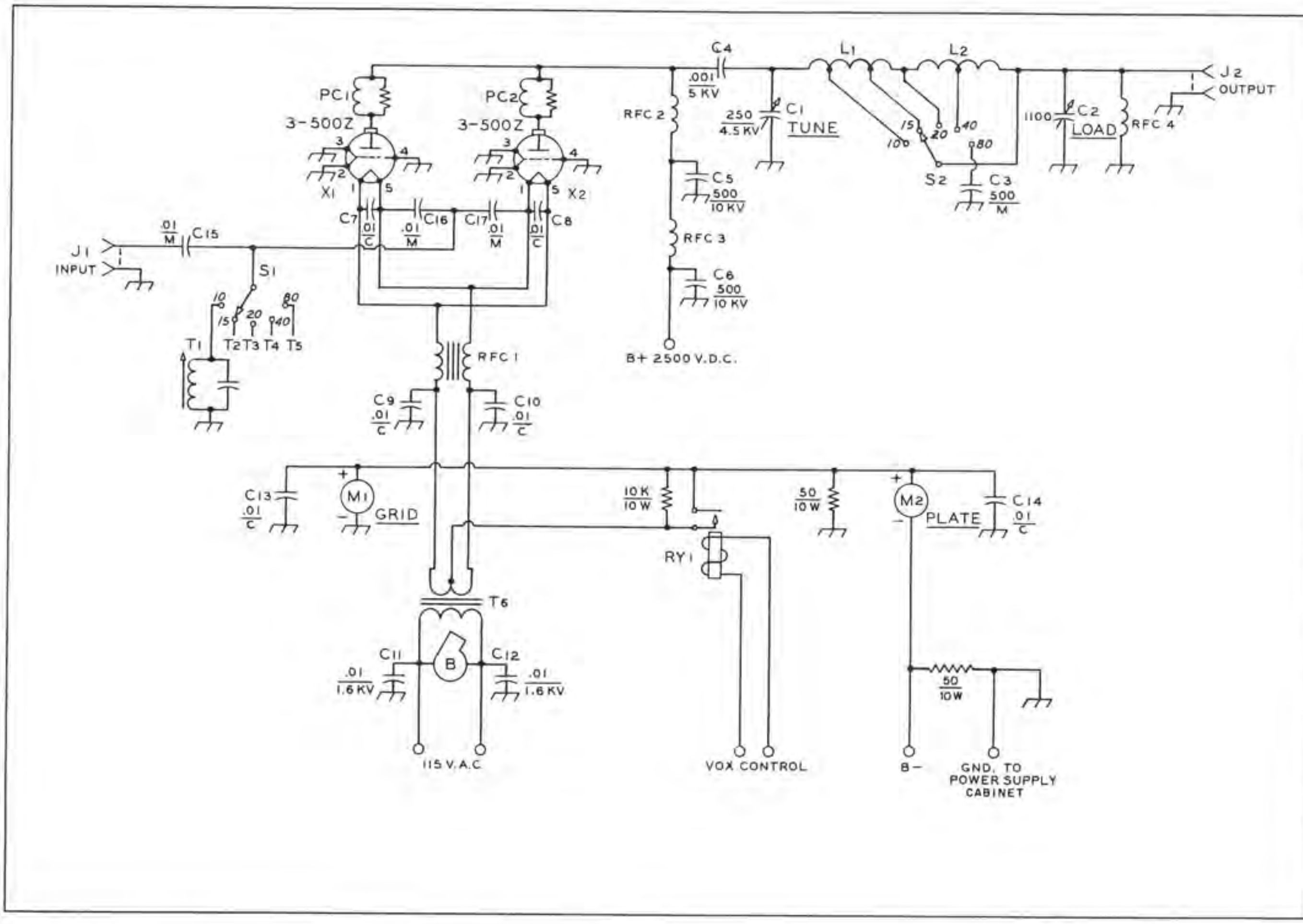
1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. METRIC EQUIVALENTS TO THE NEAREST .01mm, ARE GIVEN FOR GENERAL INFO ONLY & ARE BASED ON 1 INCH=25.4mm.
3. BASE PINS (L) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAGE 1/4" THK. WITH HOLE DIAS. OF .204 LOCATED ON TRUE CENTERS BY THE GIVEN DIMS. (K) & (M)






FILAMENT TO GRID VOLTAGE – (V)
50
25
0
–25
–50
–75
–100
–125
0
1000
2000
3000
4000
5000
PLATE TO GRID VOLTAGE – (V)
EIMAC 3–500Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED–GRID
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
.400
.300
.200
.100
.050
1.6
1.4
1.2
1.0
.80
.60
.40
.20
.100
.001
#4264


EIMAC 3–500Z
CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
2.2
1.8
1.4
1.0
.80
.60
.40
.10
.001
.600
.500
.400
.300
.200
.100
.05
.03
.01
PLATE VOLTAGE – (V)
0
1000
2000
3000
4000
5000
6000
GRID VOLTAGE – (V)
150
125
100
75
50
25
0
–25
#4265



TYPICAL CATHODE DRIVEN (GROUNDED GRID) AMPLIFIER CIRCUIT FOR TWO 3-500Z TUBES

C-1--250 pF, 4.5 kV (Johnson 154-16).
C-2--1100 pF, 3 section. Jackson Bros. LE-3-4595-380. (M. Swedgal, 258 Broadway, N.Y. 10007).
C-3-500 pF, 2.5 kV mica, Sangamo H-5347.
C-4--.001 μF, 5kV. Centralab 858S-1000.
C-5, C-6--500 pF, 10 kV, TV "door knob" capacitor.
C-7 thru C-10--.01μF, 600V ceramic capacitor (Centralab DD-103).
C-11, C-12--.01 μF, 1.6 kV ceramic capacitor (Centralab DD16-103).
C-13, C-14--.01 μF, 600V ceramic capacitor (Centralab DD-103).
C-15 thru C-17--.01 μF, 1 kV mica capacitor (Sangamo H-2210).
M-1--500 mAdc.
M-2--1000 mAdc.
RFC-1--50 μH. 14 bifilar turns #10 AWG enamelled wire wound on ferrite core, Q-1 material, 5 inches long, ½ inch diameter. (Permag Central Corp., 1213 Estes Avenue, Elk Grove Village, IL 60007; Catalog #S-206-Q1). Notch core with file and break to length.
RFC-2-100μH, 1 Adc, 112 turns #26 AWG, spacewound wire diameter on 1" diam., 6" long ceramic from (Centralab X-3022H insulator). Series resonant with terminals shorted to 24.5 MHz.
RFC-3--20 ohm, 50 watt wirewound resistor used as choke.
RY-1--VOX operated SPST relay. Energized when transmit.
PC-1, PC—2--Three 100 ohm, 2W carbon resistors in parallel. Three turns #14 AWG, ½" diam., ¾" long in parallel with resistors. (Equivalent: Ohmite P-300 reduced to 3 turns).
J-1, J-2--Coaxial receptacle, UG-58A/U, for type N connector.
T-6--5 V at 30 amp. Chicago-Stancor P-4648.
X-1, X-2--EIMAC SK-410 socket and EIMAC SK-406 chimney.
B-Blower--13 cubic feet at 0.2 inch back pressure. Use #3 impeller at 3100 rpm. (Ripley 8472, Dayton 1C-180 or Redmond AK-2H-01AX).

CATHODE CIRCUIT COMPONENTS:

T-1 (10 meters)--0.15μH. 4 turns #14 AWG on ½-inch form, ½-long. Parallel capacitance: 200 pF, 1 kV silver mica capacitor. Resonant at 28.7 MHz.
T-2 (15 meters)--0.15 μH, same as T-1. Resonant at 21.3 MHz with 470 pF, 1 kV silver mica capacitor.
T-3 (20 meters)--0.31 μH. 6 turns #14 AWG on ½-inch form, ½-inch long, slug tuned (National XR-50). Resonant at 14.2 MHz with 470 pF, 1 kV silver mica capacitor.
T-4 (40 meters)--0.31 μH, same as T-3. Resonant at 7.2 MHz with 940 pF. (Two 470 pF 1 kV silver mica capacitors in parallel).
T-5 (80 meters)--1.3 μH. 13 turns #18 AWG on ½-inch diameter form, ½-inch long, slug turned (National XR-50). Resonant at 3.8 MHz with 940 pF, same as T-4.

PLATE CIRCUIT COMPONENTS (for plate potential of 2500 Vdc), R_L=1725 Ω:

The 10, 15 and 20 meter inductor (L_1) may be 10½ turns #8 AWG copper wire (or 3/16" tubing) 2" diam., 3" long. Ten meter tap is 5¼ turns from plate end: 15 meter tap is 7¼ turns from plate end. The 40-80 meter coil (L_2) may be 16 turns #10 AWG, 2½" diam., 4" long. 40 meter tap is 8 turns from junction with coil L-1.

S-2--Single pole ceramic switch, high voltage 30° index. Radio Switch Corp. Model 86-A.

NOTE: For additional data on plate circuit design, write for Amateur Service Bulletin #30, "Pi and Pi-L Networks for Linear Amplifier Service".

NOTE: B- of power supply is floating and grounded only through plate meter M_2 and the 50 ohm safety resistor. Cabinet of power supply should be grounded to amplifier cabinet as safety measure.

CHANGE NOTICE

CHANGE No. 3

TO

TYPE 314R-1

ONE KILOWATT

AM BROADCAST TRANSMITTER

EFFECTIVE FOR ALL

DESIGNATED TRANSMITTERS

5 January 1981

Continental Electronics Mfg. Co.
4212 South Buckner Blvd.
Dallas, Texas 75227

Change 3 reflects changes to parts made during Factory Build. This Change 3 is effective on all units designated 314R-1. The old pages should be removed and the new pages inserted.

NEW PAGES			OLD PAGES		
7-5/7-6	C3/ -		7-5/7-6	- / -	
7-7/7-8	C3/ -		7-7/7-8	- / -	
7-11/7-12	- /C3		7-11/7-12	- /C2	
7-25/7-26	C3/ -		7-25/7-26	- / -	
Schematic		Rev.	Schematic		Rev.
650-2901-001	Sh.1 of 2(1)	E	650-2901-001	Sh.1 of 2(1)	C
650-2901-001	Sh.1 of 2(2)	E	650-2901-001	Sh.1 of 2(2)	C
650-2901-001	Sh.2 of 2(1)	E	650-2901-001	Sh.2 of 2(1)	C
650-2901-001	Sh.2 of 2(2)	E	650-2901-001	Sh.2 of 2(2)	C

CHANGE NOTICE

CHANGE NO. 4

TO

TYPE 314R-1

ONE KILOWATT

AM BROADCAST TRANSMITTER

EFFECTIVE FOR ALL

DESIGNATED TRANSMITTERS

Remove the old Pages and Insert
the new Pages.

New Page	Old Page
7-11/7-12 -/C4	7-11/7-12 -/C3

26 March 1981

Continental Electronics Mfg. Co.
4212 South Buckner Blvd.
Dallas, Texas 75227

CHANGE NOTICE

CHANGE NO. 5

TO

TYPE 314R-1

ONE KILOWATT

AM BROADCAST TRANSMITTER

EFFECTIVE ON SN 317 AND ABOVE

15 JUNE 1981

Continental Electronics Mfg. Co.
4212 South Buckner Blvd.
Dallas, Texas 75227

This Change 5 is effective on all units with Serial Numbers 317 and above. The old pages should be removed and the new pages inserted.

NEW PAGES		OLD PAGES	
6-17/6-18	-/C5	6-17/6-18	-/-
6-19/6-20	-/C5	7-19/6-20	-/-
6-21/6-22	C5/C5	6-21/6-22	-/-
6-23/6-24	C5/-	6-23/6-24	-/-
7-5/7-6	C5/C5	7-5/7-6	C3/-
7-7/7-8	C5/-	7-7/7-8	C3/-
<u>Schematics</u>	<u>REV</u>.	<u>Schematics</u>	<u>REV.</u>
650-2901-001 Sh.1 of 2	H	650-2901-001 Sh.1 of 2(1)	E
Deleted		650-2901-001 Sh.1 of 2(2)	E
650-2901-001 Sh.2 of 2	H	650-2901-001 Sh.2 of 2(1)	E
Deleted		650-2901-001 Sh.2 of 2(2)	E

CHANGE NOTICE

CHANGE NO. 6

TO

TYPE 314R-1

ONE KILOWATT

AM BROADCAST TRANSMITTER

EFFECTIVE ON S/N 327 AND ABOVE

3 August 1981

Continental Electronics Mfg. Co.
4212 South Buckner Blvd.
Dallas, Texas 75227

CHANGE NOTICE

This Change No. 6 is effective on all units with Serial Numbers 327 and above. The old pages should be removed and the new pages inserted.

NEW PAGE		OLD PAGE	
Title Page/Blank	C6/-	Title Page/Blank	-/-
iii/iv	C6/C6	i/ii	-/-
v/vi	C6/C6	iii/iv	-/-
1-1/1-2	-/C6	1-1/1-2	-/-
1-3/1-4	C6/-	1-3/1-4	-/-
2-5/2-6	C6/-	2-5/2-6	-/-
5-7/5-8	C6/C6	5-7/5-8	-/-
5-11/5-12	C6/-	5-11/5-12	-/-
7-1/7-2	-/C6	7-1/7-2	-/-
7-3/7-4	C6/-	7-3/7-4	-/-
7-21/7-22	-/C6	7-21/7-22	-/-
7-27/7-28	C6/-	7-27/7-28	-/-

CHANGE NOTICE

CHANGE NO. 7

TO

314R-1

ONE KILOWATT

AM BROADCAST TRANSMITTER

EFFECTIVE ON S/N 327 AND ABOVE

11 SEPTEMBER 1981

Continental Electronics Mfg. Co.
4212 South Buckner Blvd.
Dallas, Texas 75227

This Change No. 7 is effective on all Units with Serial Numbers 327 and above. The old pages should be removed and the new pages inserted. This Change Notice should be filed just after the Title Page.

NEW PAGE		OLD PAGE	
6-17/Blank	-/-	6-17/6-18	-/C5
Deleted		6-19/6-20	-/C5
Deleted		6-21/6-22	C5/C5
Deleted		6-23/6-24	C5/-
Deleted		6-25/Blank	-/-
7-7/7-8	C7/-	7-7/7-8	C5/-
<u>Drawing</u>	<u>Rev.</u>	<u>Drawing</u>	<u>Rev.</u>
650-2901 Sh.1 & 2	I	650-2901 Sh.1 & 2	H

CHANGE NOTICE

CHANGE NO. 8

TO

314R-1

ONE KILOWATT

AM BROADCAST TRANSMITTER

EFFECTIVE ON S/N 327 AND ABOVE

2 November 1981

Continental Electronics Mfg. Co.
4212 South Buckner Blvd.
Dallas, Texas 75227

This Change No. 8 is effective on all Units with Serial Numbers 327 and above. The old pages should be removed and the new pages inserted. This Change Notice should be filed just after the Title Page.

NEW PAGE		OLD PAGE	
2-11/2-12	-/C8	2-11/2-12	-/-
3-7/3-8	C8/-	3-7/3-8	-/-
<u>Drawing</u>	<u>Rev.</u>	<u>Drawing</u>	<u>Rev.</u>
650-2901 Sh. 1 & 2	J	650-2901 Sh. 1 & 2	I

CHANGE NOTICE

CHANGE NO. 9

TO

314R-1

ONE KILOWATT

AM BROADCAST TRANSMITTER

EFFECTIVE ON S/N 327 and ABOVE

3 May 1982

Continental Electronics Mfg. Co.
4212 South Buckner Blvd.
Dallas, Texas 75227

This Change No. 9 is effective on all Units with Serial Numbers 327 and above. The old pages should be removed and the new pages inserted. This Change Notice should be fuled just after the Title Page.

NEW PAGE		OLD PAGE	
2-1/2-2	-/C9	2-1/2-2	-/-
7-5/7-6	C5/C9	7-5/7-6	C5/C5

CHANGE NOTICE

CHANGE NO. 10

TO

314R-1

ONE KILOWATT

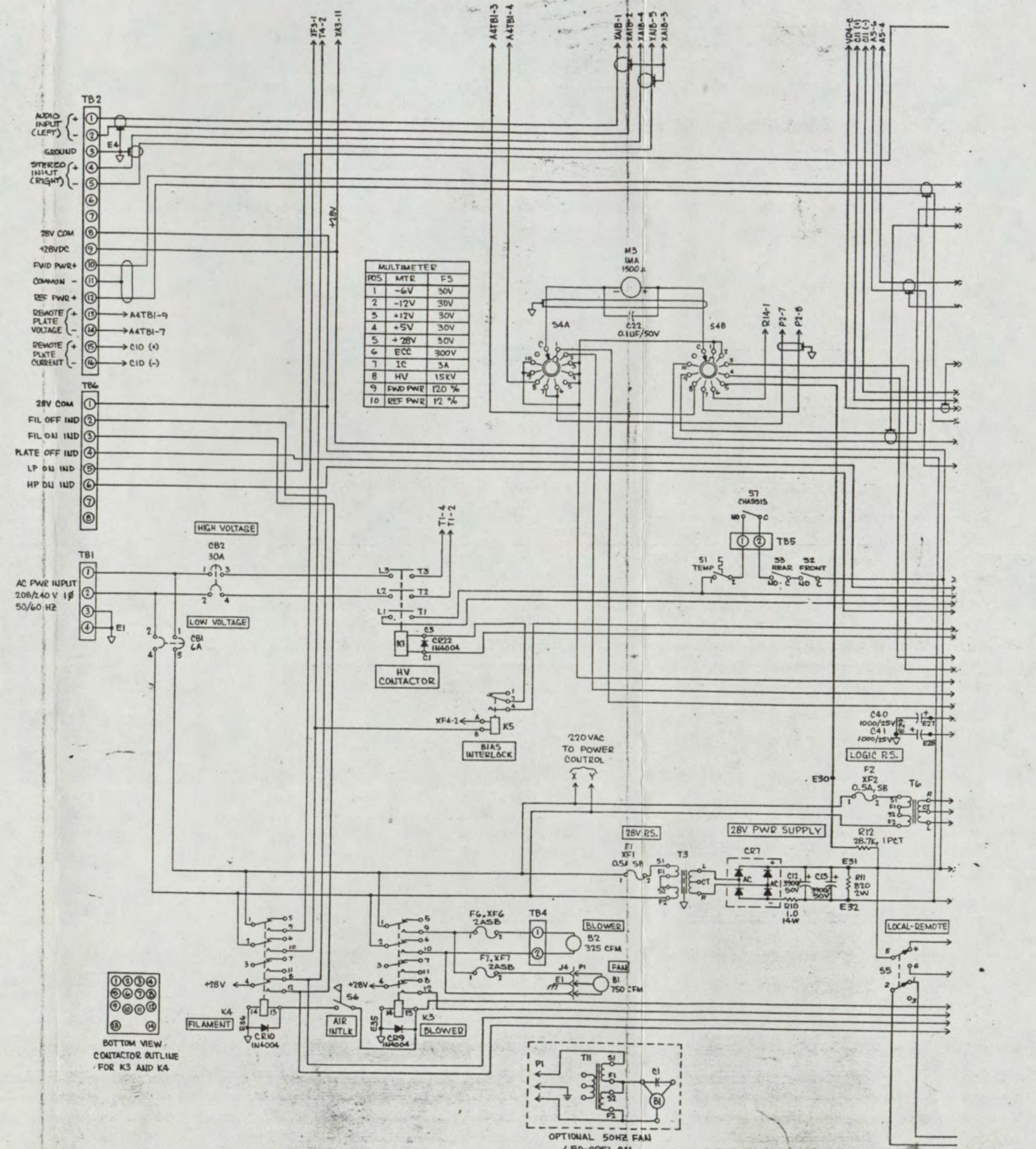
AM BROADCAST TRANSMITTER

This Change No. 10 is effective on all Units with Serial Numbers 327 and above. This Change Notice should be filed just after the Title Page.

NEW PAGE	OLD PAGE
Power Supply Schematic 55-28 (File just before Test Data Tab)	Added

1 September 1982

Continental Electronics Mfg. Co.
4212 South Buckner Blvd.
Dallas, Texas 75227



MULTIMETER		
POS	MTR	FS
1	-6V	30V
2	-12V	35V
3	+12V	30V
4	+5V	30V
5	+28V	30V
6	ECC	300V
7	IC	3A
8	HV	15KV
9	FWD PWR	120 %
10	REF PWR	12 %

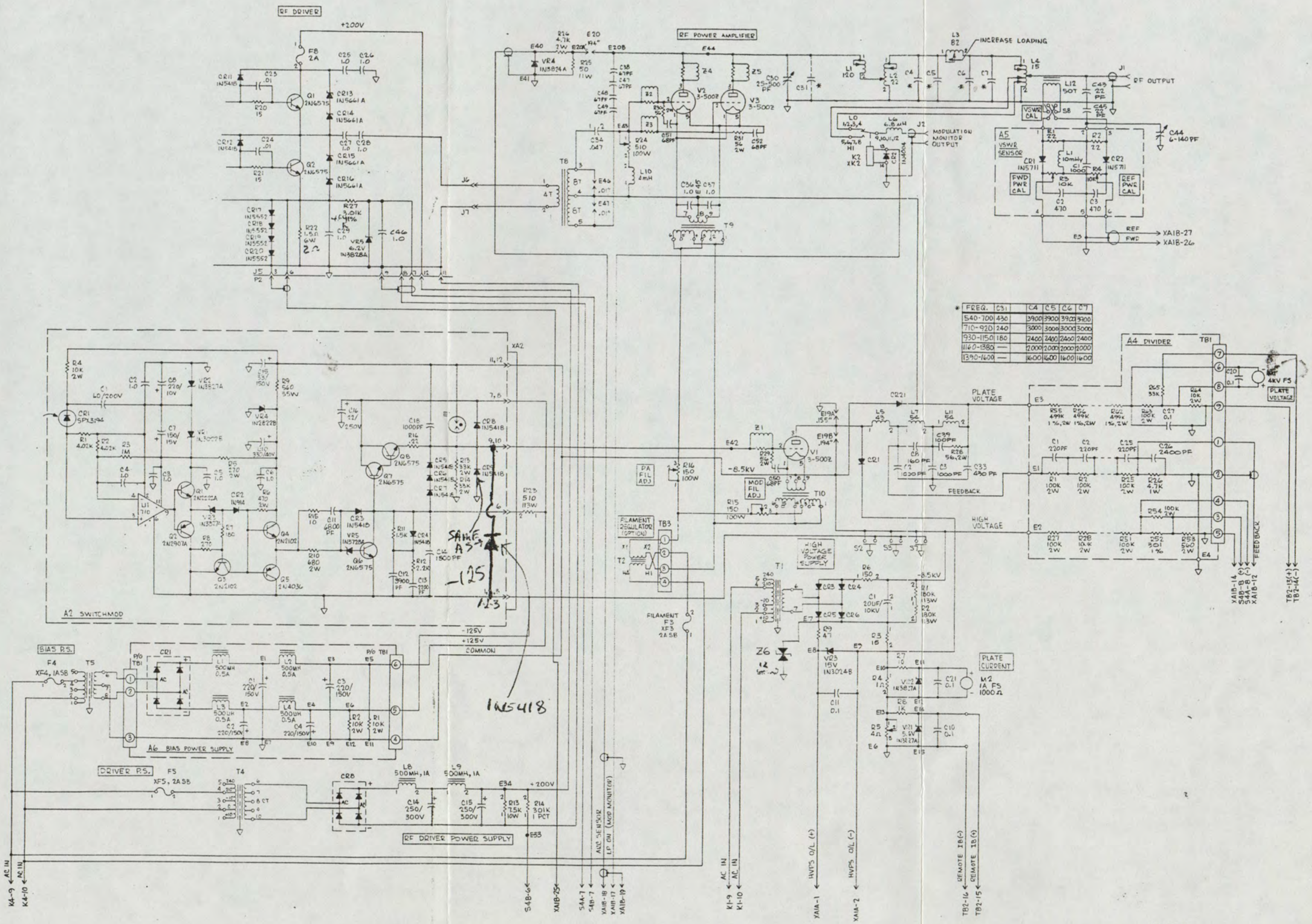
SHEET 1 650-2901-001

SPX3194 CptNum
270-0547-030
S

12-19-94

R 11 2700 3300

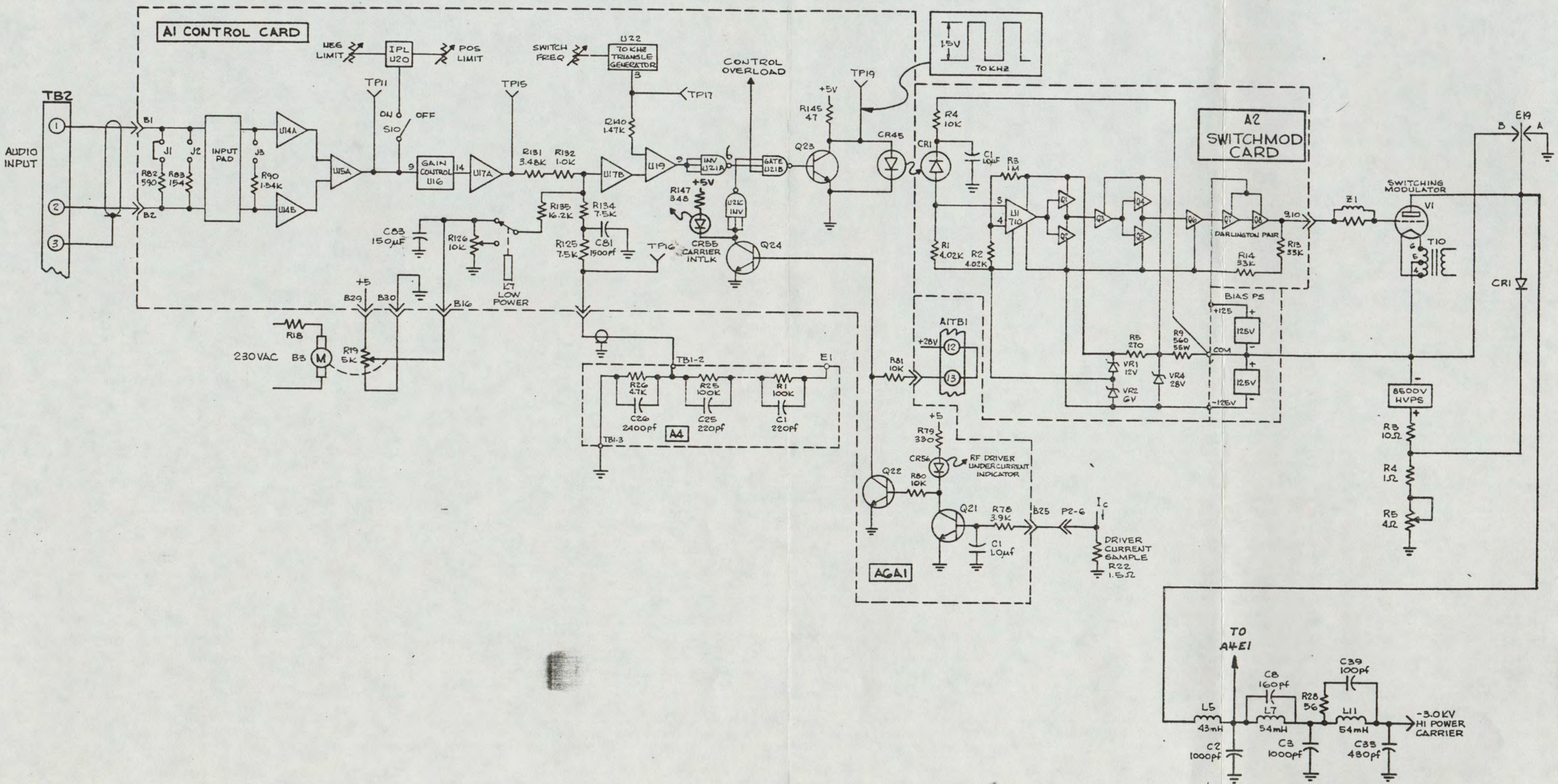
R 10 2)1500



* FREQ.	C31		C4	C5	C6	C7
540-700	430		3900	3900	3900	3900
710-920	240		3000	3000	3000	3000
930-1150	180		2400	2400	2400	2400
1160-1380	—		2000	2000	2000	2000
1390-1600	—		1600	1600	1600	1600

9-10-80
6-5-80
5-13-80

CONTRACT NO.	ROCKWELL INTERNATIONAL CORPORATION COLLINS DIVISIONS
PREP CRBingley 7-17-79	SCHEMATIC DIAGRAM, 828C-1
CHK F.M. Cummings 8-5-80	1KW AM TRANSMITTER
APVD	SIZE Dm · FSCM 13499 · DWG NO. 650-2901-001 · REV LTR
	SCALE NONE · SHEET 1 OF 2



WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Figure 6-3. PWM Circuits

Continental Electronics Corporation
A TECH-SYM COMPANY
P.O. BOX 270879 DALLAS, TEXAS 75227-0879 214-381-7161 FAX 214-381-4949

314R-1/828C-1 3-500Z TUBE PROBLEM

Some brands of 3-500Z tubes will run very hot in the Modulator position but will operate properly in the RF position. It is normal for the Modulator tube anode to appear red when operating at full power without modulation and can be expected to be yellow with full modulation. However it should never appear white hot with or without modulation.

The output pulse from the Switching Modulator Card has a fixed rise time going in the positive direction. If this rise time is too slow for the particular modulator tube used, there will be excessive anode dissipation. If the rise time is too fast, you can not achieve 100% modulation in the negative direction. It appears that some of the tubes that are available now, have different characteristics from those that were available when the transmitter was designed and this rise time must be changed in order to use these tubes in the Modulator position.

Continental has checked two commonly available brands of 3-500Z tubes in a 314R-1 and recommends the following changes to the Switching Modulator Card, A2, circuits:

1. Change R-12 to 2.7K, 2Watt Carbon Composition, Continental P/N 745-5669-000

2. Change C-13 to 1200pf, 500Volt, Plastic coated silver mica P/N CM06FD122JO3

3. Verify value of R-10. May be two parallel 1500 ohm, 2 Watt carbon composition.

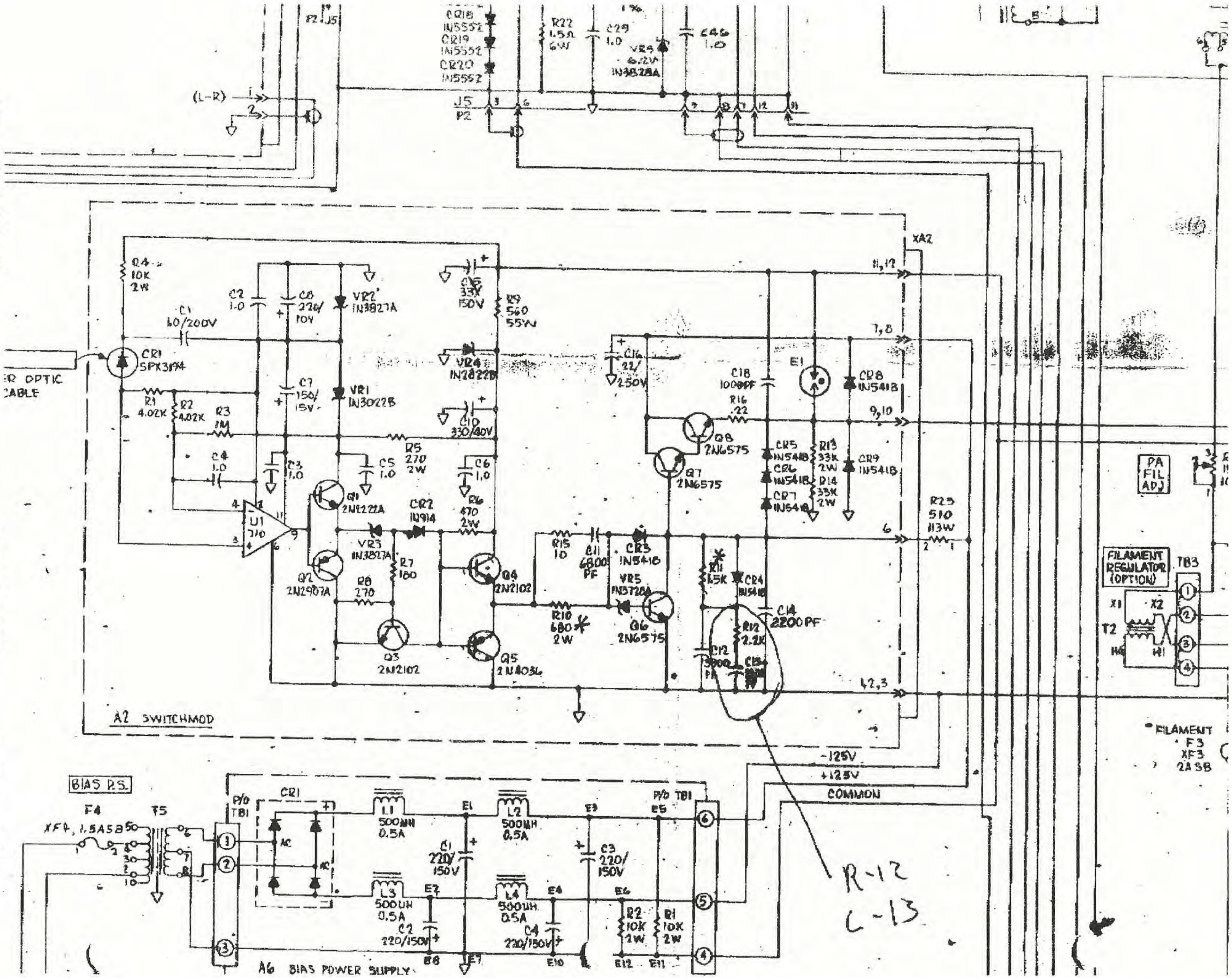
4. Verify value of R-11. Should be 3.9K if Q6 is IRF-330 or 1.5K if Q6 is 2N6575.

   NOTE: It is important that only **Non Inductive, Carbon Composition** resistors be used at R-10, R-11 and R-12.

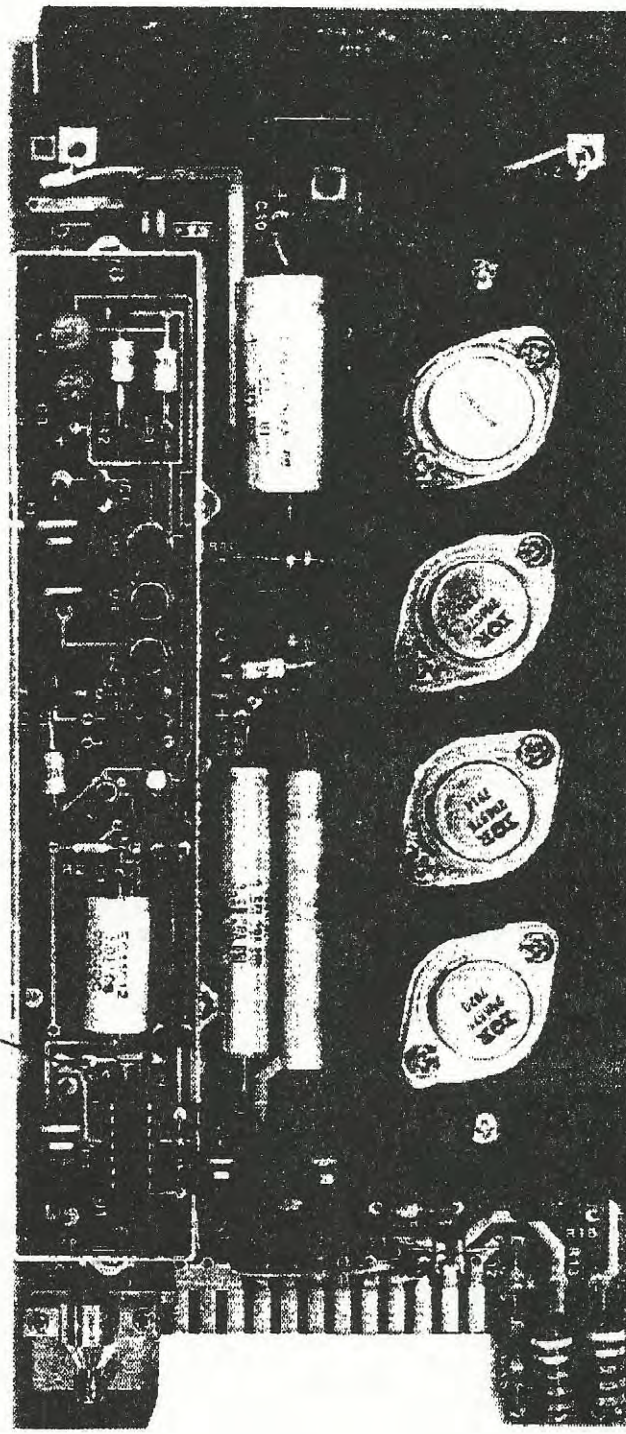
5. Add a Parasitic Suppressor in series with Modulator anode lead, Continental Part Number 650-2969-001

Please contact Continental Field Service at (214) 388-5800 if you have comments or questions about these changes. We would appreciate any comments about your experience with any brand of tube that you may be using in this transmitter and your results. Since this transmitter is out of production, we must depend on your input to us to help provide useful information to all users.

Mods. performed
9/16/99
(S.C.)


A2 SWITCHMOD
XA2
CR1 5PX3194
ER OPTIC CABLE
(L-R)
J5 P2
CR18 1N5552
CR19 1N5552
CR20 1N5552
R22 1.5Ω 6W
C29 1.0
VR4 6.2V 1N3828A
C46 1.0
R4 10K 2W
C1 60/200V
C2 1.0
C8 220/10V
VR2 1N3827A
C7 150/15V
VR1 1N3022B
R1 4.02K
R2 4.02K
R3 1M
C4 1.0
C3 1.0
U1 710
C5 1.0
R5 270 2W
Q1 2N2222A
Q2 2N2907A
CR2 1N914
VR3 1N3827A
R7 180
R8 270
Q3 2N2102
C15 33X 150V
R9 560 55W
VR24 1N2822B
C10 330/40V
C6 1.0
R6 470 2W
Q4 2N2102
Q5 2N4036
C16 22/250V
C18 1000PF
R16 .22
Q8 2N6575
Q7 2N6575
E1
CR8 1N5418
CR9 1N5418
CR5 1N5418
CR6 1N5418
CR7 1N5418
R13 33K 2W
R14 33K 2W
R15 10
C11 6800 PF
CR3 1N5418
VR5 1N3720A
R10 680 2W
Q6 2N6575
R11 1.5K
CR4 1N5418
R12 2.2K
C12 3900 PF
C13
C14 2200PF
R23 510 113W
11,12
7,8
9,10
6
12,3
-125V
+125V
COMMON
R-12
C-13
PA FIL ADJ
FILAMENT REGULATOR (OPTION)
TB3
X1
X2
T2
H1
FILAMENT F3 XF3 2ASB
BIAS P.S.
F4
XF4, 1.5ASB
T5
P/O TB1
CR1
L1 500MH 0.5A
L2 500MH 0.5A
L3 500UH 0.5A
L4 500UH 0.5A
C1 220/150V
C2 220/150V
C3 220/150V
C4 220/150V
E1
E2
E3
E4
E5
E6
E7
E8
E10
E11
E12
R1 10K 2W
R2 10K 2W
A6 BIAS POWER SUPPLY

parts list



R-10
680 Ω @ 2W
OR
2 ea. 1.2K @ 2W
IN PARALLEL

R-12
C-13

R-11*
*1.5K IF Q6 IS 2N6575
*3.9K IF Q6 IS IRF33

-12 CHANGE TO 2.7K @ 2W

-13 CHANGE TO 1200PF @ 500V

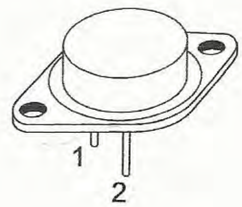
Fig. 7-5. Switchmod Card (A2)

<substitute for 2N6575>

2N6547

HIGH POWER NPN SILICON TRANSISTOR

- STMicroelectronics PREFERRED SALESTYPE
- NPN TRANSISTOR
- HIGH VOLTAGE CAPABILITY
- HIGH CURRENT CAPABILITY
- FAST SWITCHING SPEED



TO-3

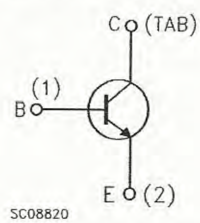
APPLICATIONS

- SWITCH MODE POWER SUPPLIES
- FLYBACK AND FORWARD SINGLE TRANSISTOR LOW POWER CONVERTERS

DESCRIPTION

The 2N6547 is a silicon Multiepitaxial Mesa NPN transistor mounted in TO-3 metal case. It is particulary intended for switching and industrial applications from single and tree-phase mains.

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CER}	Collector-Emitter Voltage (R_{BE} = 50 Ω)	850	V
V_{CES}	Collector-Emitter Voltage (V_{BE} = 0)	850	V
V_{CEO}	Collector-Emitter Voltage (I_B = 0)	400	V
V_{EBO}	Emitter-Base Voltage (I_C = 0)	9	V
I_C	Collector Current	15	A
I_{CM}	Collector Peak Current	30	A
I_B	Base Current	4	A
I_{BM}	Base Peak Current	20	A
P_{tot}	Total Dissipation at T_c = 25 °C	175	W
T_{stg}	Storage Temperature	-65 to200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case Max	1	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cut-off Current (V_{BE} = 0)	V_{CE} = 850 V V_{CE} = 850 V T_c = 100 °C			1 4	mA mA
I_{CER}	Collector Cut-off Current (R_{BE} = 10 Ω)	V_{CE} = 850 V T_c = 100 °C			5	mA
I_{EBO}	Emitter Cut-off Current (I_C = 0)	V_{EB} = 9 V			1	mA
$V_{CEO(sus)}$*	Collector-Emitter Sustaining Voltage (I_B = 0)	I_C = 100 mA L = 25 mH	400			V
$V_{CE(sat)}$*	Collector-Emitter Saturation Voltage	I_C = 10 A I_B = 2 A I_C = 15 A I_B = 3 A I_C = 10A I_B = 2 A T_c =100 °C			1.5 5 2.5	V V V
$V_{BE(sat)}$*	Base-Emitter Saturation Voltage	I_C = 10 A I_B = 2 A I_C = 10A I_B = 2 A T_c =100 °C			1.6 1.6	V V
h_{FE}*	DC Current Gain	I_C = 5 A V_{CE} = 2 V I_C = 10 A V_{CE} = 2 V	12 6		30	
f_T*	Transition Frequency	I_C = 0.5 A V_{CE} = 10 V f = 1 MHz	6		24	MHz
C_{CBO}	Collector-Base Capacitance (I_E = 0)	V_{CB} = 10 V f = 1 MHz			360	pF

* Pulsed: Pulse duration = 300 μs, duty cycle ≤ 2 %

RESISTIVE LOAD SWITCHING TIMES

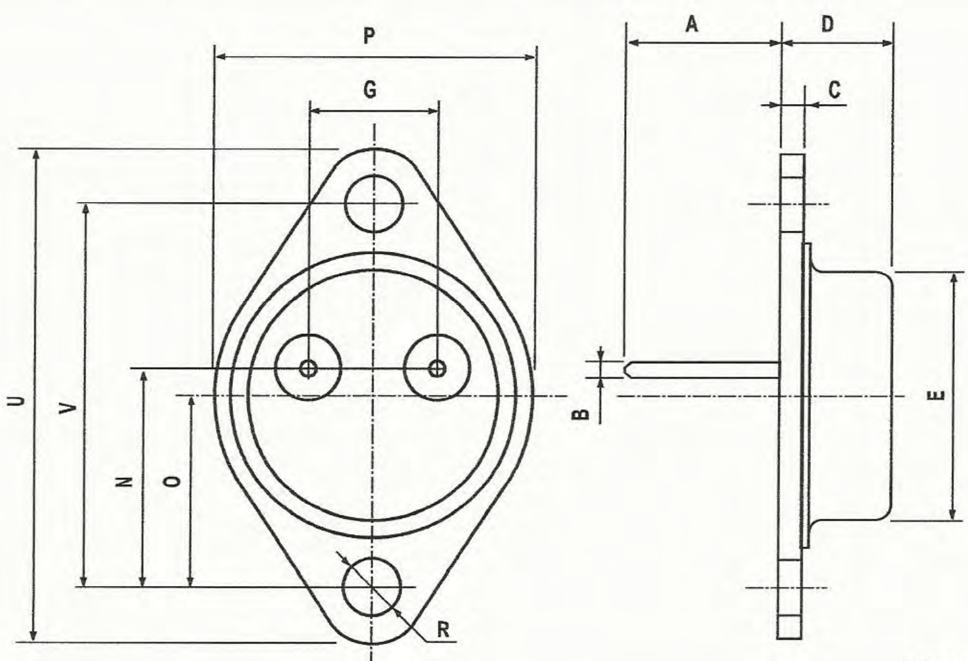
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on} t_s t_f	Turn-on Time Storage Time Fall Time	V_{CC} = 250 V I_C = 10 A I_{B1} = - I_{B2} = 2 A $T_p \geq$ 25 μs			1 4 0.7	μs μs μs

INDUCTIVE LOAD SWITCHING TIMES

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_s t_f	Storage Time Fall Time	V_{CL} = 450 V I_C = 10 A L_C = 180 μH I_{B1} = 2 A V_{BE} = -5 V T_c = 100 °C			5 1.5	μs μs

TO-3 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	11.00		13.10	0.433		0.516
B	0.97		1.15	0.038		0.045
C	1.50		1.65	0.059		0.065
D	8.32		8.92	0.327		0.351
E	19.00		20.00	0.748		0.787
G	10.70		11.10	0.421		0.437
N	16.50		17.20	0.649		0.677
P	25.00		26.00	0.984		1.023
R	4.00		4.09	0.157		0.161
U	38.50		39.30	1.515		1.547
V	30.00		30.30	1.187		1.193



P003F

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	D		11/11/80	CJA
	E		12/30/80	CJA
	F	Chg C56 TO 15C	3/19/81	CJA
	G	ADDED NOTE 1.	3-30-81	SKIP
	H	Chg 28V P.S. + MISC WIRING	5-20-81	CJA
	I		9-8-81	CJA
	J		11/10/81	RG
	K			

JUL 2 1992

WJNT

Continental Electronics MFG. CO. DALLAS, TEXAS

SCHEMATIC,
314R-1(828C-1) 1KW AM XMTR
S.N. 4?0 →

SIZE J | CODE IDENT NO. 52151 | 650-2901-001

SCALE: | WT | SHEET 2 OF 2

CEMCO FORM 389 B

L	A1R149 WAS 1.69K	4-14-83	CJA
M		8-24-84	CJA

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	D	CHG C14 TO 2200 PF	11-1?-80	CJA
	E		12/30/80	CJA
	F	CHG C56 TO 150 PF	3/1?/81	CJA
	G	ADDED NOTE 1.	3-30-81	SKIP
	H	CHG 28 V P.S. + MISC WIRING	5-20-8	CJA
	I		9-8-8	CJA
	J		11-10-81	R.G.
	K		9-?6-8?	CJA

NOTES:
1. A1J1 TO BE STRAPPED AT INITIAL ASSEMBLY. OTHERS TO BE STRAPPED DEPENDING ON FREQUENCY OF XMITTER AND THEREFORE WILL BE DICTATED BY XMITTER TEST ENGINEER

JUL 2 1992

WJNT

Continental Electronics MFG. CO. DALLAS, TEXAS

SCHEMATIC,
314R-1 (828C-1) 1KW AM XMTR.
S.N. 430 →

SIZE	CODE IDENT NO.	
J	52151	650-2901-001
SCALE: ~	WT ~	SHEET 1 OF 2

CEMC FORM 319 5