523-0603031-001A3A
20 March 1979

Rockwell
International

instruction manual

828E-1 5-kW AM Transmitter

Collins Transmission Syste

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list of illustrations

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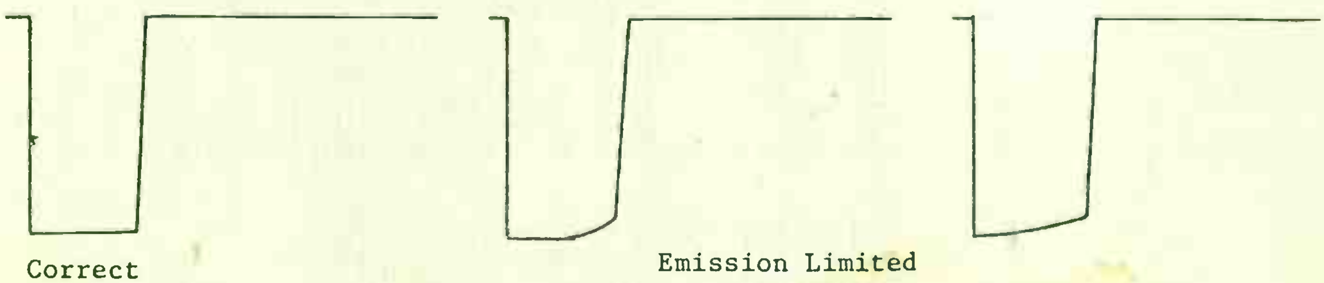
the transmitter off the air. When the RF tube is severly emission limited, the efficiency may suffer, carrier shift will be excessive, and distortion will be high.

6.12.3 RF TUBE EMISSION CHECK

Checking for low emission in the RF tube is simple. All that is necessary is to observe distortion and positive modulation peaks while the filament voltage is changed. If the emission is sufficient there will be no observable change in performance within the rated filament voltage range. Assume that the filament voltage is 7.5 volts and if the distortion or the positive peak capability improves as voltage is increased, then the tube is suspect. Conversly, it should be possible to reduce filament voltage one or two tenths of a volt below normal operating voltage without affecting performance.

6.12.4 SWITCH TUBE EMISSION CHECK

First review what happens with the switch tube during operation. A shaped 70 KHz waveform is applied to the Switch tube grid that either turns the tube full on or full off. During the time that the tube is off, there is no power dissipation and while the tube is full on, the dissipation is low, providing that the filament emission is sufficient to saturate the tube. If the emission is limited, the tube will not be in saturation during the period that the grid is positive and there will be excessive dissipation in the switch tube and distortion in the modulated DC voltage that is applied to the RF tube. The most reliable method of checking the Switch tube requires an oscilloscope observation of the Switch tube anode waveform. The RF sample may be moved from the RF compartment and installed in the cover of the Switch tube compartment. Make the scope connection to the sample pickup and with the transmitter unmodulated and operating at 5500 watts, observe the negative portion of the waveform. The bottom line represents the voltage across the tube during the time that the tube is supposed to be saturated. It should be a straight line with little or no slope. Figure 1 illustrates the possible indications that may be obtained. Change the filament voltage and observe the waveform. It should be possible to get the correct waveform within the rated filament voltage range which is 7.5 volts + or - 5%. [Note: If the tube requires 7.9 volts (7.5 + 5%) that particular tube may be near the end of its life and a replacement tube should be available. However, do not take the tube out of service as long as increasing filament voltage restores proper performance characteristics.]



Correct

Emission Limited

Figure 1.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING

6.12.5 NEW TUBE STABILIZATION

It is important to "break in" a new tube and to maintain proper filament voltage throughout the tube's life. Eimac recommends that new tubes be operated at rated voltage for 200-300 hours and then reduce filament voltage until filament is just above the emission limited point but not reduced more than 5%. As the tube ages and the emission decreases the filament voltage can be increased, always keeping about one or two tenths of a volt more than is needed. For the tubes used in the 315R-1, the filament voltage can be as low as 7.1 or as high as 7.9 volts and still be within the five percent tolerance that Eimac allows. Operating tubes outside these limits will void Eimac's warranty and must be avoided during the first 3000 hours of tube operation to protect the tube warranty. After the initial stabilization period, the filament voltage sequence will be one of operating near the -5% limit and gradually increasing the filament voltage as the life is expended.

6.12.6 FILAMENT VOLTAGE MEASUREMENT

WHEN MEASURING FILAMENT VOLTAGE, TURN HIGH VOLTAGE BREAKER OFF
The Switch tube filament transformer has 15,000 volts and the RF filament transformer has 5,000 volts applied when in normal operation.

The filament voltage should be measured at the secondary of the filament transformer with an accurate True RMS meter each time a tube is replaced. Only a True RMS meter should be used since a measurement of voltage that represents the heating power is required. Most Volt-Ohm-Milliamp meters are average responding and RMS calibrated which means that they will present an RMS indication only on an undistorted sine wave. Where harmonic type regulators are used and where high current filament circuits are involved the waveform may be distorted.

6.12.7 RF DRIVE

Adequate drive to the RF tube is necessary to get 125% positive peak modulation. Many times an engineer will replace tubes thinking that emission is low when the real problem is either insufficient drive or marginal drive. If drive is marginal, replacing tubes will temporarily restore the positive peaks but the tubes will appear to be in need of replacement sooner than normal. Low RF drive will cause most of the same symptoms that low emission causes, poor efficiency, positive peak limiting, distortion, and carrier shift. So don't be premature in declaring a tube bad without making the checks outlined previously.

Normal Driver collector current will be between 2.6 and 3.0 amps. depending on frequency. The most common cause of drive problems in the 315R-1 are the grid resistors. These resistors, A9R8 and A9R10, are located on the right wall under the RF tube. They are intended to be 150 ohms each, making a total of 300 ohms in the grid current path. Tests in our factory indicate that the required value of these resistors may vary from one tube to another. If low drive is suspected to be the source of a problem, check the total value of these two resistors and grid current as described later. In no case should the total value be more than 300 ohms.

CONTINENTAL ELECTRONICS has prepared a modification kit consisting of two fixed value 100 ohm resistors, one adjustable 100 ohm resistor and a mounting plate. These resistors are wired in series and replace A9R8 and A9R10 in the grid circuit. The value of the adjustable resistor is determined by measuring RF tube grid current and setting to 780-820 Milliamps. The grid current meter should be a one (1) ampere full scale meter. The meter is inserted between the bottom end of A9L13 and the center tap of the RF tube filament transformer, A9T4.

To obtain information about this kit and the current price, contact the CONTINENTAL Field Service or Parts Department.

6.12.8 GRID CURRENT MEASUREMENT

CAUTION

WHEN MEASURING GRID CURRENT, TURN HIGH VOLTAGE BREAKER OFF The filament transformer and the tube grid have more than 5,000 volts applied when the transmitter is in normal operation.

It will be necessary to jumper the rear end of the Driver fuse, F6, to the center input terminal of the High Voltage Breaker, CB3, in order to get primary voltage to the driver supply without the High Voltage Breaker being on. (Make sure that jumper is removed after test)

CAUTION: MAKE SURE THAT WALL BREAKERS ARE OFF BEFORE OPENING TRANSMITTER DOOR. BEFORE ANY ADJUSTMENTS OR CONNECTIONS ARE MADE, USE GROUNDING ROD TO DISCHARGE ALL CAPACITORS IN RF COMPARTMENT AND ASCERTAIN THAT THE BUILT-IN SHORTING SWITCHES ARE OPERATIONAL

Procedure

1. Connect meter in place of wire that connects betwen the bottom end of A9L13 and the center tap of T4.
2. Place clip lead between rear end of F6 and center terminal of CB3. (Input to CB3 is closest to top edge of access panel.)
3. Make certain that the HV breaker does not get turned on during test. Turn LV and BIAS breaker ON.
4. Turn filaments ON. Driver collector current and an indication of grid current on the meter should be present.
5. If the grid resistor modification has been installed, adjust the 100 ohm adjustable resistor for a grid current indication of approximately 800 milliamps.
6. If the two original 150 ohm resistors are in use and the grid current indication is greater than 700 milliamps, it may not be necesary to change the resistors. (Note: The 800 milliamp grid current will drop to approximately 750 milliamps in either high or low power.)

6.12.9 HIGH VOLTAGE REQUIREMENTS

The high voltage supply must be at least 13.7KV in order to reach 125% positive modulation peaks. This voltage is determined by the available line voltage and the transformer tap setting. In no case should the High Voltage be greater than 15,000 volts.

6.12.10 DISTORTION CHECKS

Make a distortion check at the usual audio frequencies, check efficiency and carrier shift at full power. If not within limits, the transmitter loading or exciter pulse width may be at fault. Set the output pulse from the exciter to 120 degrees as described in section 5.3.2. Observe the plate voltage and plate current without modulation. The ratio of plate voltage to plate current should be 4000/1 or slightly less. For frequencies below about 910 KHz, the ratio may be as low as 3600/1. Change the tap setting of L3 in the RF network to get the desired ratio. Experiment with the setting of L3 to get the best distortion figures. Each time that L3 is changed, it will be necessary to readjust the plate tuning. Plate tuning should be adjusted in the clockwise direction for plate current increasing out of dip by about 50-100 milliamps for best efficiency. Adjust taps on L3 to get best distortion and exciter pulse width and plate tuning for best efficiency. If distortion is good at all frequencies except above 7.5 KHz, check the negative trough of the RF envelope with a scope while modulating at 7.5 KHz and 110% positive modulation. If the negative part of the waveform does not pinch off in a smooth manner, the loading will need to be increased by changing tap setting on L3.

6.12.11 70 KHZ FILTER

The 70 KHz filter is often suspected of causing distortion problems but is seldom the reason. However if there is reason to suspect the 70 KHz filter, it is easy to check. First make a visual check of each coil, L10, L11, and L12. If any section of a coil is discolored or a different color than other sections, the coil is probably defective. When the coils are at room temperature, the resistance of L10 is 19 ohms and coils L11 and L12 is 23 ohms. Coil resistance will be approximately four ohms higher when transmitter is at normal operating temperature. Make a visual and bridge check of the filter capacitors.

6.12.12 BIAS SUPPLY

The bias supply provides plus 125 volts DC to turn the switch tube fully on during the positive part of the 70 KHz switch signal, and negative 125 volts DC during the remaining period. When there is a problem obtaining sufficient positive modulation peaks, the bias supply should be checked for proper operation.

6.12.13 PWM MODULE ADJUSTMENTS

The adjustments in the PWM module are not likely to change and adjustment of these controls to correct a modulation problem should be delayed until the checks described here are performed. Many times PWM module adjustments are taken out of adjustment in attempt to correct a problem not related to the PWM module. These adjustments are described in section 5.4.1 if adjustment is found necessary.

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SECTION 1
GENERAL DESCRIPTION

SECTION 1
GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction book contains the information necessary to install, operate, maintain, and service the 828E-1 5-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 828E-1 transmitter is a high-efficiency 5-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.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

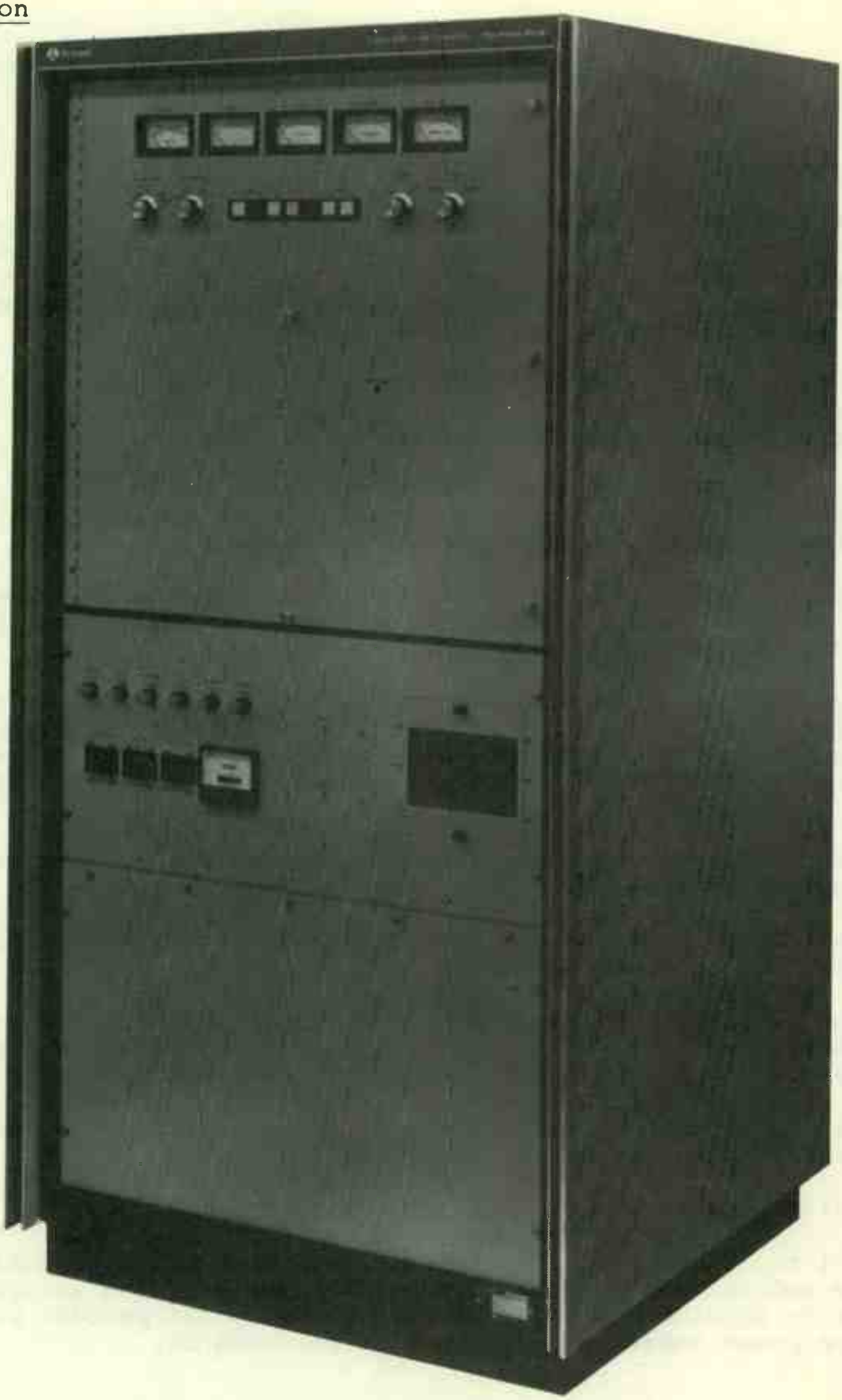

Figure 1-1. 828E-1 5-kW AM Transmitter.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

1.3 PHYSICAL DESCRIPTION

The transmitter is housed in a single cabinet, which requires only 2.3 m^2 (7.6 ft^2) of floor space. The cabinet is painted with a gray, light-diffusing, abrasion-resistive paint. The top front panel, which contains meter and control switches, has a piano hinge and opens as a door to permit front access to interior components. Just below this meter door, the circuit breaker panel also has a piano hinge that permits it to be opened downwards or the lower panel to open upwards. The rear cover is removable to permit rear access to interior components. The meter door, the lower panel, and the rear panel are electrically interlocked. Shown below is a list of the 828E-1 subassemblies.

SYMBOL	NAME	PART NUMBER
A1	RF Exciter Card	636-8434-001
A2	PWM Card	636-8480-001
A3	Control Logic Card	636-8467-001
A4	Logic PS Card	636-8471-001
A5	Meter Panel/Door	636-8427-001
A5A1	Meter Terminal Board	636-9673-001
A6	Circuit Breaker Panel	636-9680-001
A6A1	Backplane	636-8490-001
A7	Power Control Chassis	636-8502-001
A7A1	Control Relay Board	636-8510-001
A7A2	LVPS Board	636-8503-001
A7A3	Bias PS Board	636-9674-001
A7A4	Remote Control (Optional)	627-9721-002
A8	HVPS Chassis	636-8494-001
A9	RF Compartment	636-9690-001
A9A1	Feedback Divider	636-8417-001
A9A2	Not Used	
A9A3	Switchmod Driver	636-8457-001
A9A4	RF Driver	636-9688-001
A9A5	HV Meter Driver	636-8413-001
A9A6	RF Power Meter	636-9687-001
A10	HV Bleeder Assy	640-9677-001
A10A1	HV Sample Divider	636-8418-001
A11	Signal Access Card	640-9699-001

The transmitter output connection is nominally a 50-ohm, 41.275-mm (1-5/8 in.) EIA flange. 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 dual crystal oscillator feeds the solid-state RF driver. The desired oscillator output can be selected by front-panel switches.

The RF driver operates at a 500-watt power level to drive the RF power amplifier. The power amplifier uses a high-efficiency circuit with a third harmonic resonator to increase its efficiency to nearly 90 percent for significant power costs savings. 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 a single low-cost, high mu triode tube, Eimac 3CX3000F7. 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.

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 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; this permits use of much smaller than usual components in the output network.

The transmitter can be controlled locally by controls on the meter door, or through an (optional) extended control panel, or remotely through an (optional) remote control interface assembly. 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 828E-1 transmitter:

DESCRIPTION	PART NUMBER
Filament Regulator (60 Hz)	662-0292-070
Filament Regulator (50 Hz)	662-0292-080
RF Ammeter	640-3432-001
Extended Control Panel	636-7171-002
Remote Control Interface Assembly A7A4	627-9721-001

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. However, since they provide only momentary contact closures, they usually require optional remote control interface assembly A7A4 (PN 627-9721-001). This unit, installed in the transmitter, uses the control signals to operate relays that apply 28 volts to the appropriate transmitter control circuits.

For short distances [up to 60.9 m (200 ft)], the optional extended control panel (PN 636-7171-002) 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.

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Table 1-1. 828E-1 Physical and Electrical Characteristics.

ITEM	CHARACTERISTICS
1. Size	1752.6 mm (69 in.) high 838.2 mm (33 in.) wide 838.2 mm (33 in.) deep
2. Weight	523 kg (1150 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 or 345 to 415 volts
b. Frequency	50 or 60 Hz, 3-phase, 3- or 4-wire
c. Wattage	9.3 kW (carrier), 0.95 power factor; 12.7 kW (100% modulation), 0.95 power factor
5. RF Power Output	250 to 5500 watts
6. Frequency Range	540 to 1600 kHz; exact operating frequency determined by oscillator crystals
7. RF Output Impedance	50 ohms, 41.2 mm (1-5/8 in.) EIA (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
10. Modulation Capability	+125%, -100%
11. Harmonic Suppression	Greater than -80 dB below carrier
12. Audio Input Level	+10 dBm ±2 dB or 0 dBm ±2 dB

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SECTION 2
INSTALLATION

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 523-kg (1150-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 rear covers and open the meter door and the circuit breaker 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 523-kg (1150-lb) capacity. Some components may be damaged if the transmitter is dropped or severely jarred.

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 rear covers and open the meter door and the circuit breaker 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 828E-1 transmitter may be installed in either an attended or, with remote control options installed, 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 that 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 828E-1 transmitter requires 152.4 m^3/min (500 ft^3/min) 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 5500 watts or 18,772 Btu.

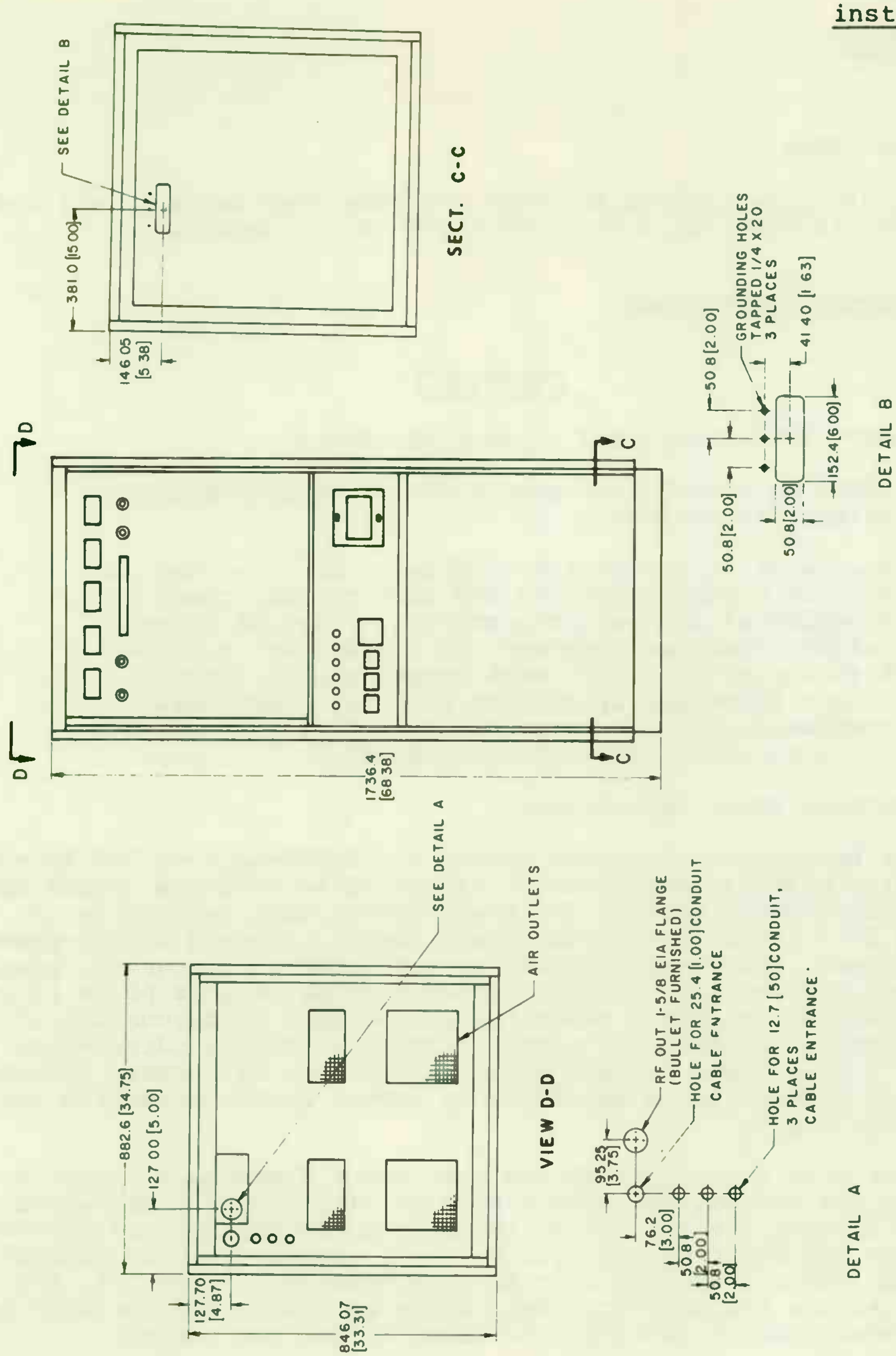

Figure 2-1. Outline and Installation Drawing.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

2.3.3 Air Flow

The total air flow through the 828E-1 transmitter cabinet is 152.4 m^3/min (500 ft^3/min) at 1.97 kg/m^2 (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, do 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 828E-1 transmitter requires either a 200/250-volt or 345/435-volt, 3- or 4-wire primary power source. It should be either a closed delta or wye primary power source. The power source must be capable of supplying 13.7 kVA at 95 percent power factor. Since a single-phase blower is used, the phase rotation is not important. However, open delta power sources are not recommended because of poor phase balance and high harmonic voltages generated in the open delta configuration. 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 60 amperes for a 200/250-volt input, or at 35 amperes for a 345/435 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 floor inside the cabinet.

Connections are as follows:

Phase A	A7TB1-1	(phase rotation is not important)
Phase B	A7TB1-2	
Phase C	A7TB1-3	
Neutral or Power Ground	A7TB1-4	

When a 3-wire delta primary power source is used, a safety power ground of number 8 AWG wire should be connected from the station or building power ground to the transmitter frame ground. This frame ground (E1) is located on the floor of the transmitter cabinet at the left side, near terminal board A7TB1. The ground wire is connected to one of the 1/4-20 tapped holes provided for this purpose in the transmitter floor.

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.

2.4.1.1 Transformer Taps

The taps on all transformers are connected at the factory for 250-volt, 3-phase operation. If any other primary power source is to be used, the transformer taps must be changed to the nearest tap to the supply voltage. Table 2-1 lists the correct taps for each supply voltage on each transformer.

NOTE

In table 2-1, A, B, and C refer to phase A, phase B, and phase C. N refers to neutral.

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 15.0 kV at any line voltage variation during a normal day's operation, move connections to the next higher line voltage connection.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Table 2-1. Transformer Taps for Each Voltage.

TRANSFORMER TAP	LINE-TO-LINE VOLTAGE											
	200	210	220	230	240	250	345	360	380	400	415	435
T1-HVPS												
1				A	A	A				A	A	A
2	A	A	A				A	A	A			
3	J7			J7			J8			J8		
4		J7			J6			J9			J9	
5			J7			J6			J10			J10
6				B	B	B				B	B	B
7	B	B	B				B	B	B			
8	J12			J11			J13			J13		
9		J12			J11			J14			J14	
10			J12			J11			J15			J15
11				C	C	C				C	C	C
12	C	C	C				C	C	C			
13	J2			J1			J8			J8		
14		J2			J1			J9			J9	
15			J2			J1			J10			J10
A7T1-28-Volt PS												
COM	B	B	B	B	B	B	N	N	N	N	N	N
208	A	A					A	A				
230			A	A					A	A		
240					A	A					A	A
A7T2-Driver PS												
1	A	A	A	A	A	A	N	N	N	N	N	N
2	B						B					
3		B						B				
4			B						B			
5				B						B		
6					B						B	
7						B						B

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Table 2-1. Transformer Taps for Each Voltage (Cont).

TRANSFORMER TAP	LINE-TO-LINE VOLTAGE											
	200	210	220	230	240	250	345	360	380	400	415	435
A10T1-Logic PS												
A10TB1-6	B	B	B	B	B	B	N	N	N	N	N	N
A10TB1-7	A	A	A				A	A	A			
A10TB1-8				A	A	A				A	A	A
A9T4-PA Fil*												
1	A	A	A	A	A	A	N	N	N	N	N	N
2	C	C	C				C	C	C			
3				C	C	C				C	C	C
A9T5-Mod Fil*												
1	A	A	A	A	A	A	N	N	N	N	N	N
2	C	C	C				C	C	C			
3				C	C	C				C	C	C
A7T3 Bias PS												
1	J5	J5	J5	J6	J6	J6	N	N	N	N	N	N
2	A	A	A				A	A	A			
3				A	A	A				A	A	A
4	J8	J8	J8	J9	J9	J9	J1	J1	J1	J1	J1	J1
5	B	B	B				B	B	B			
6				B	B	B				B	B	B
7	J2	J2	J2	J3	J3	J3	J4	J4	J4	J4	J4	J4
8	C	C	C				C	C	C			
9				C	C	C				C	C	C

*If the filament regulator option is used, the filament transformers must be connected for 240 volts regardless of the line voltage.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

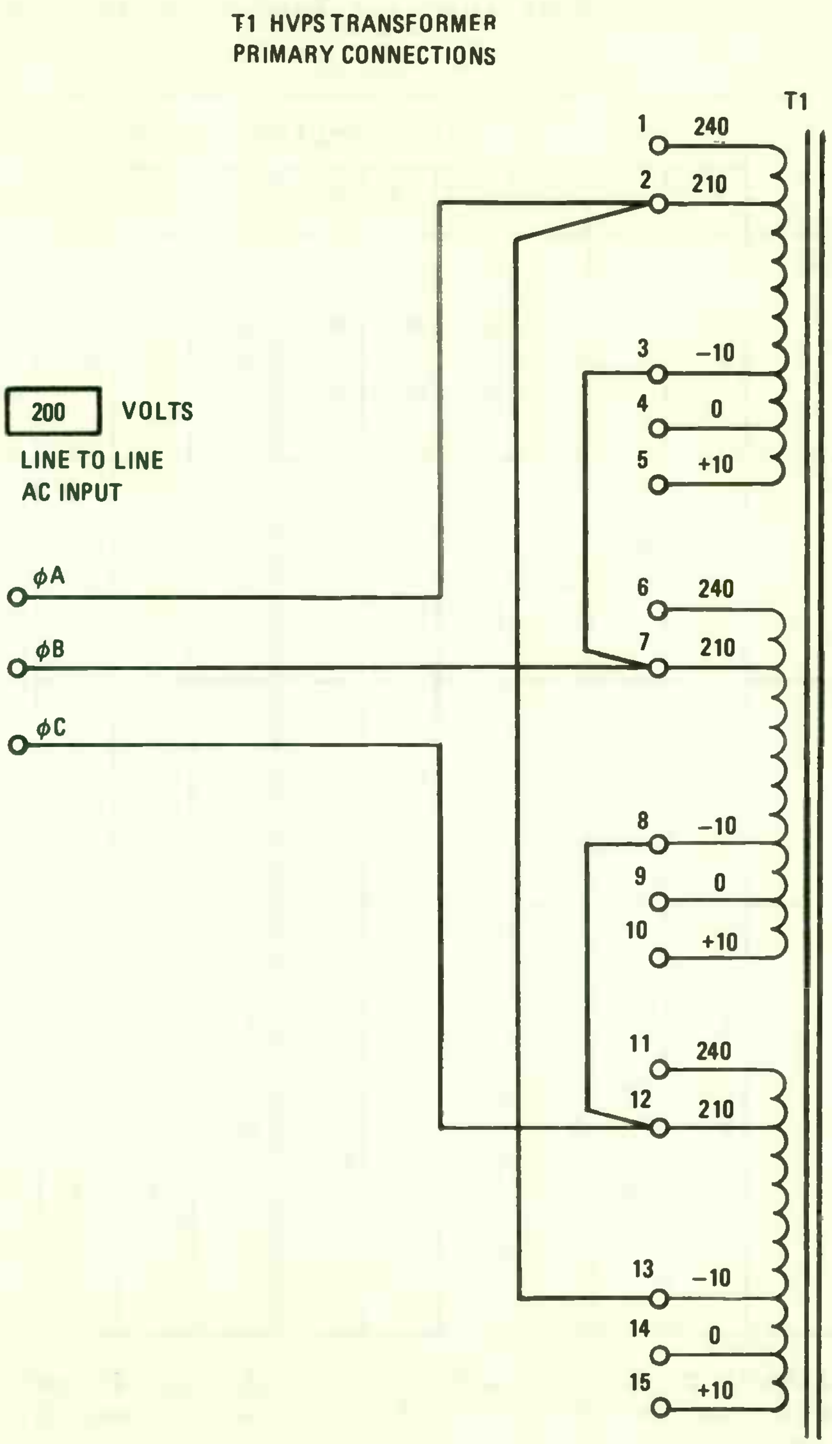

Figure 2-2. High-Voltage Power Supply Transformer Taps, 200-Volt Input.

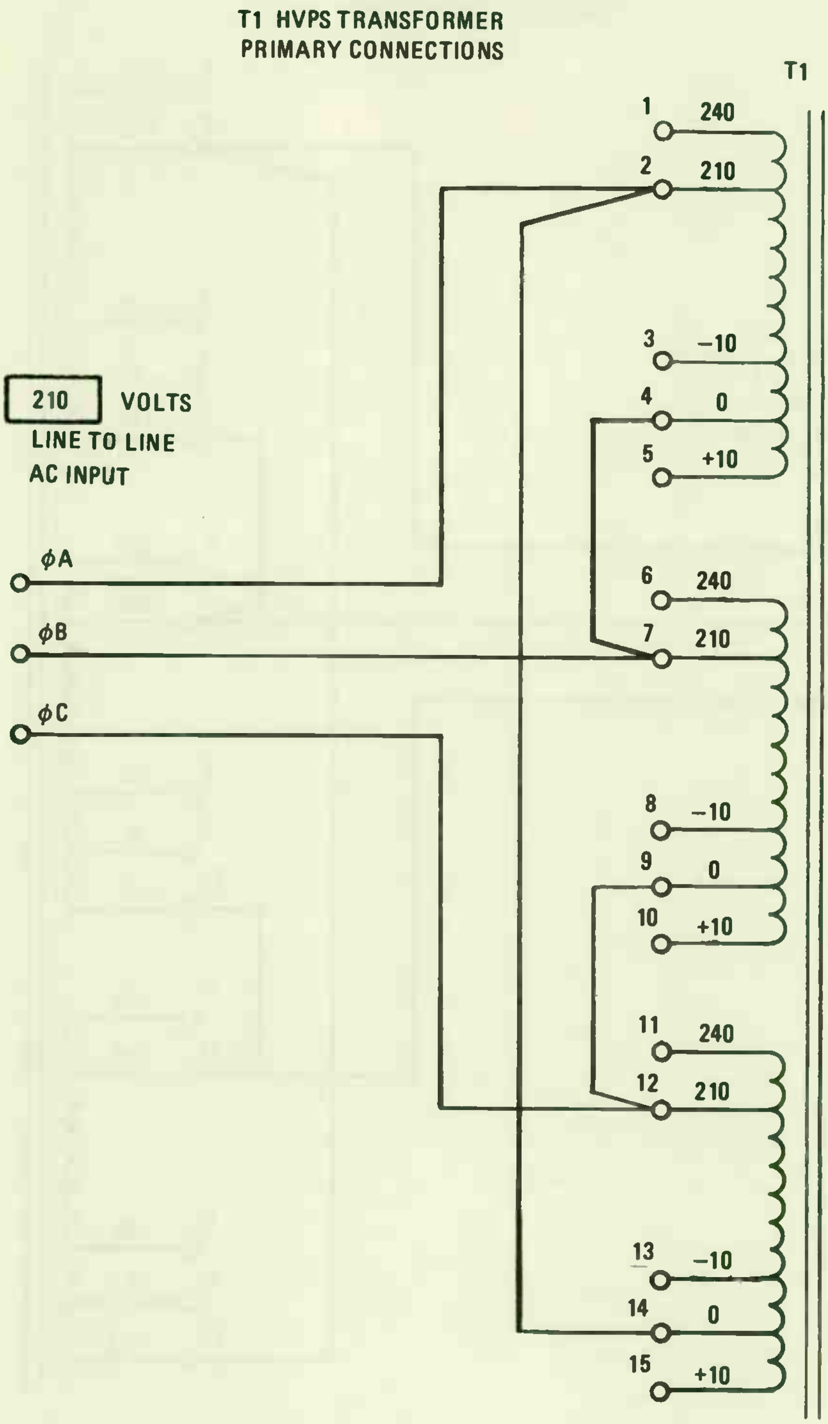

Figure 2-3. High-Voltage Power Supply Transformer Taps, 210-Volt Input.

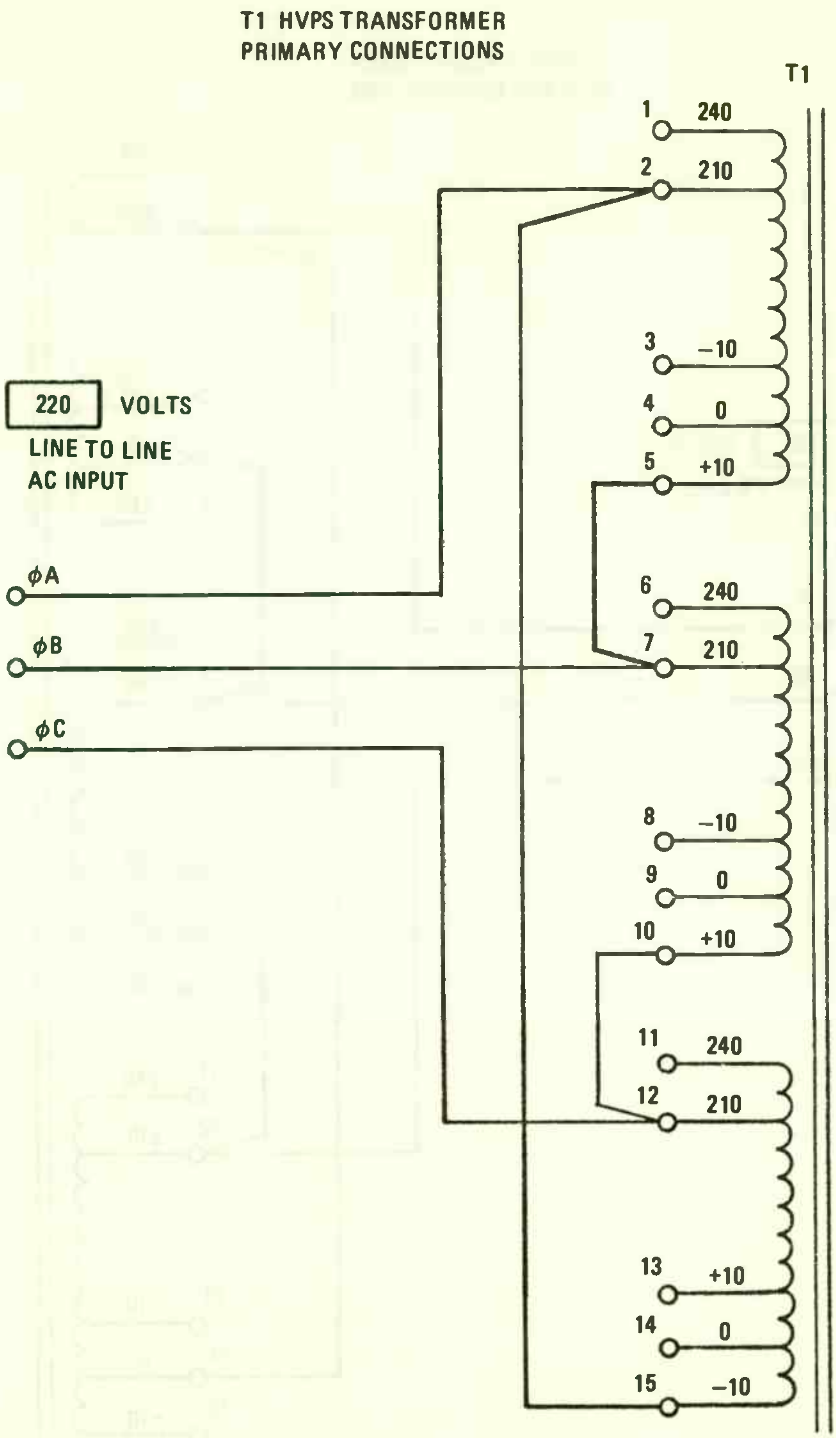

Figure 2-4. High-Voltage Power Supply Transformer Taps, 220-Volt Input.

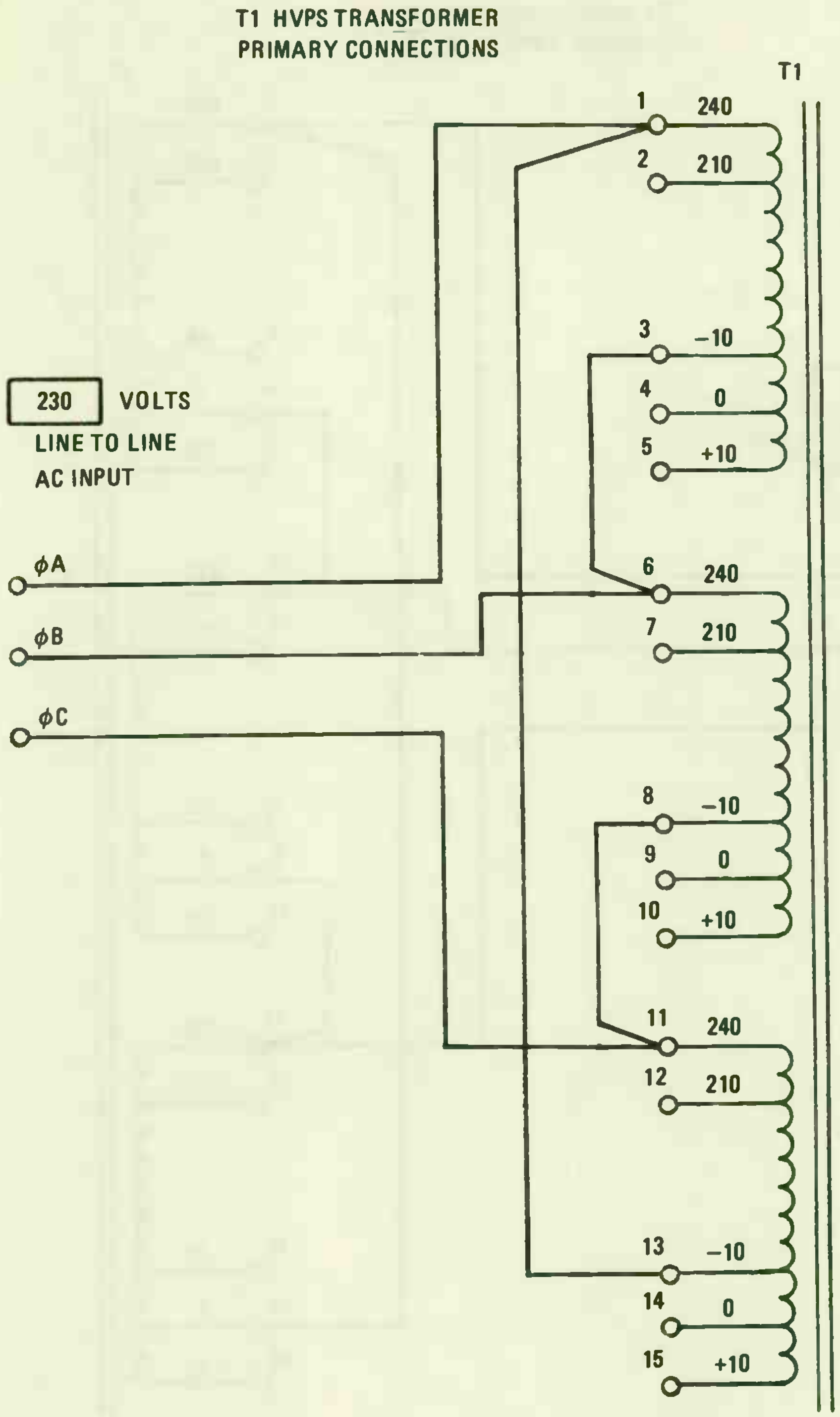

Figure 2-5. High-Voltage Power Supply Transformer Taps, 230-Volt Input.

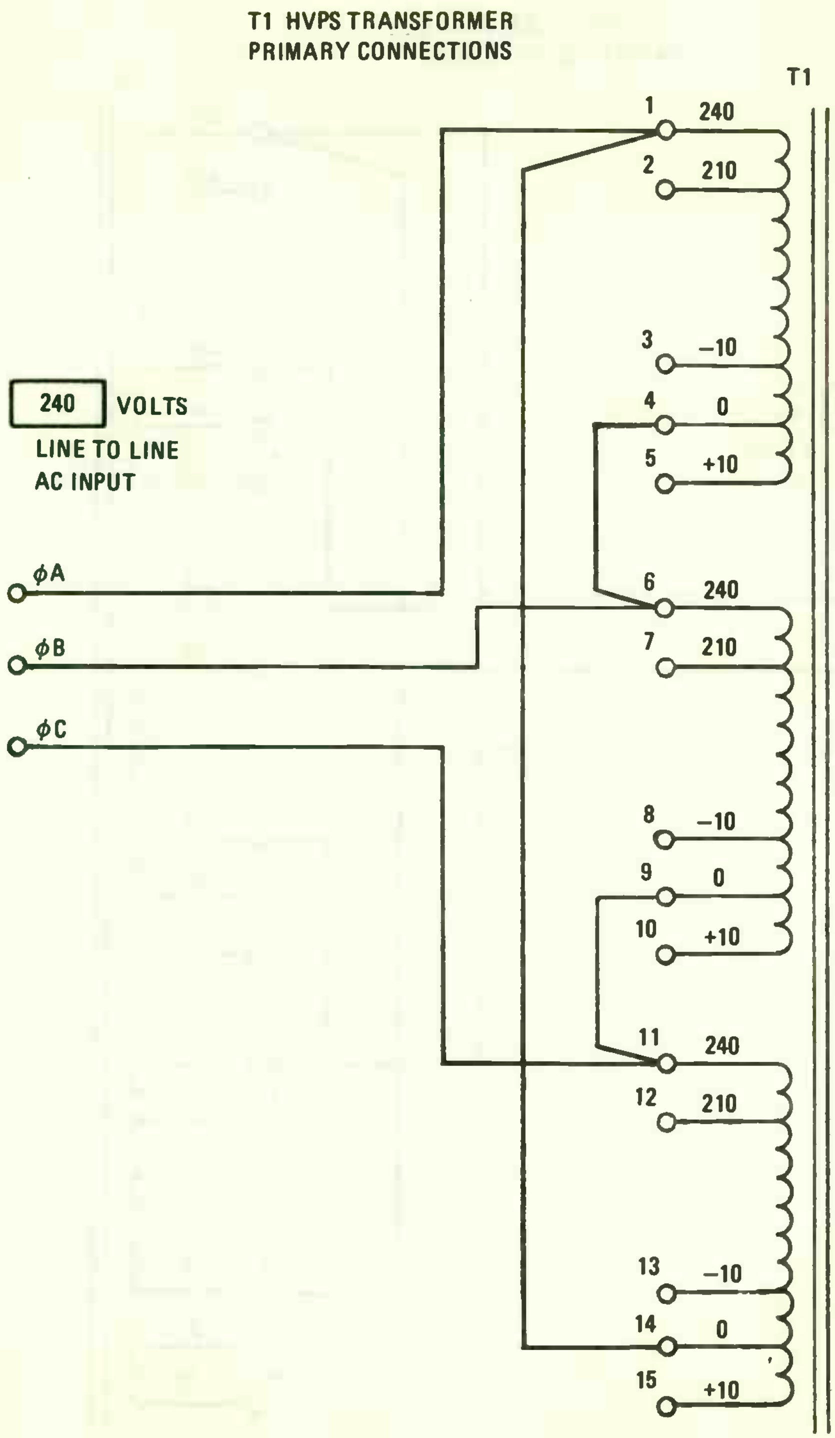

Figure 2-6. High-Voltage Power Supply Transformer Taps, 240-Volt Input.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

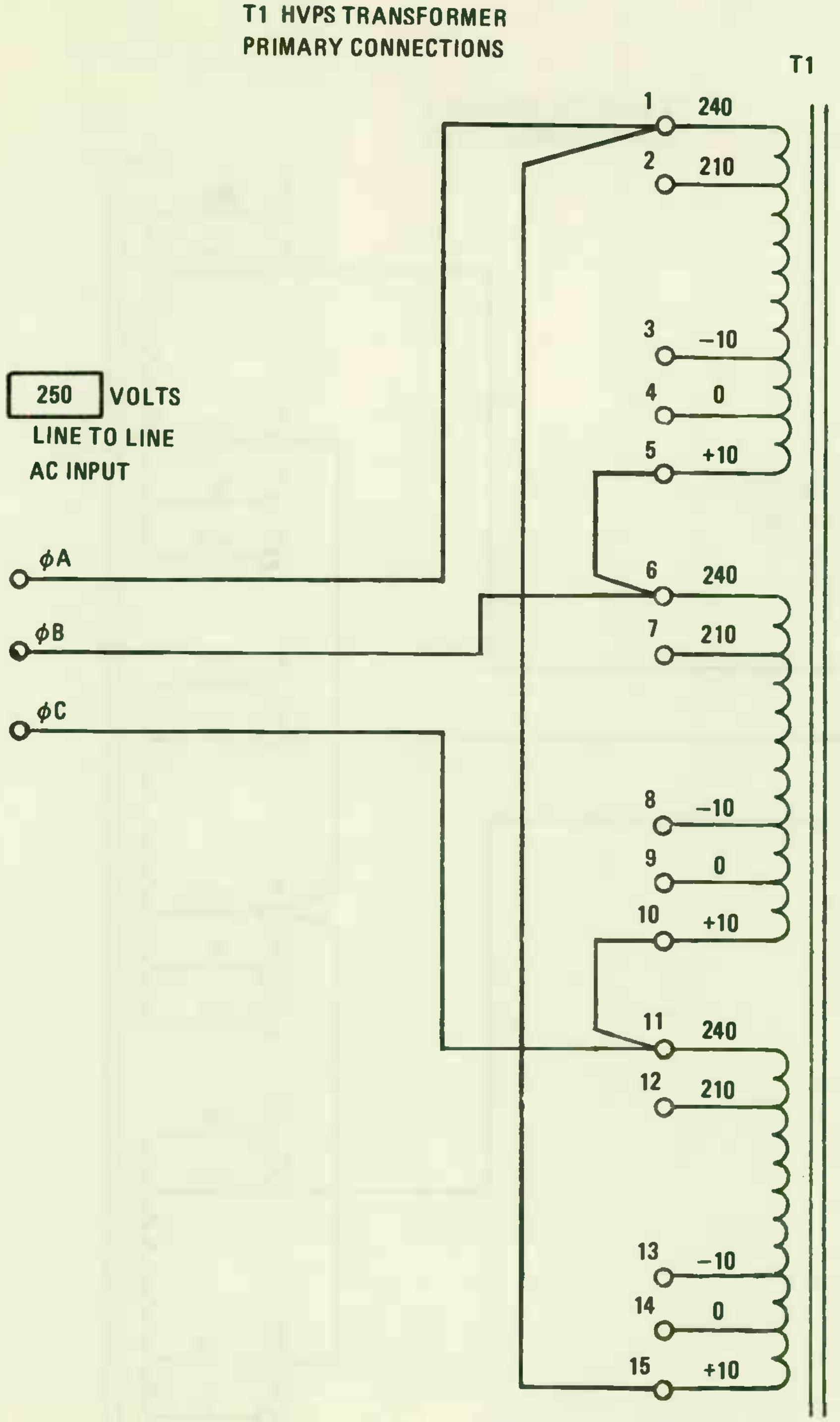

Figure 2-7. High-Voltage Power Supply Transformer Taps, 250-Volt Input.

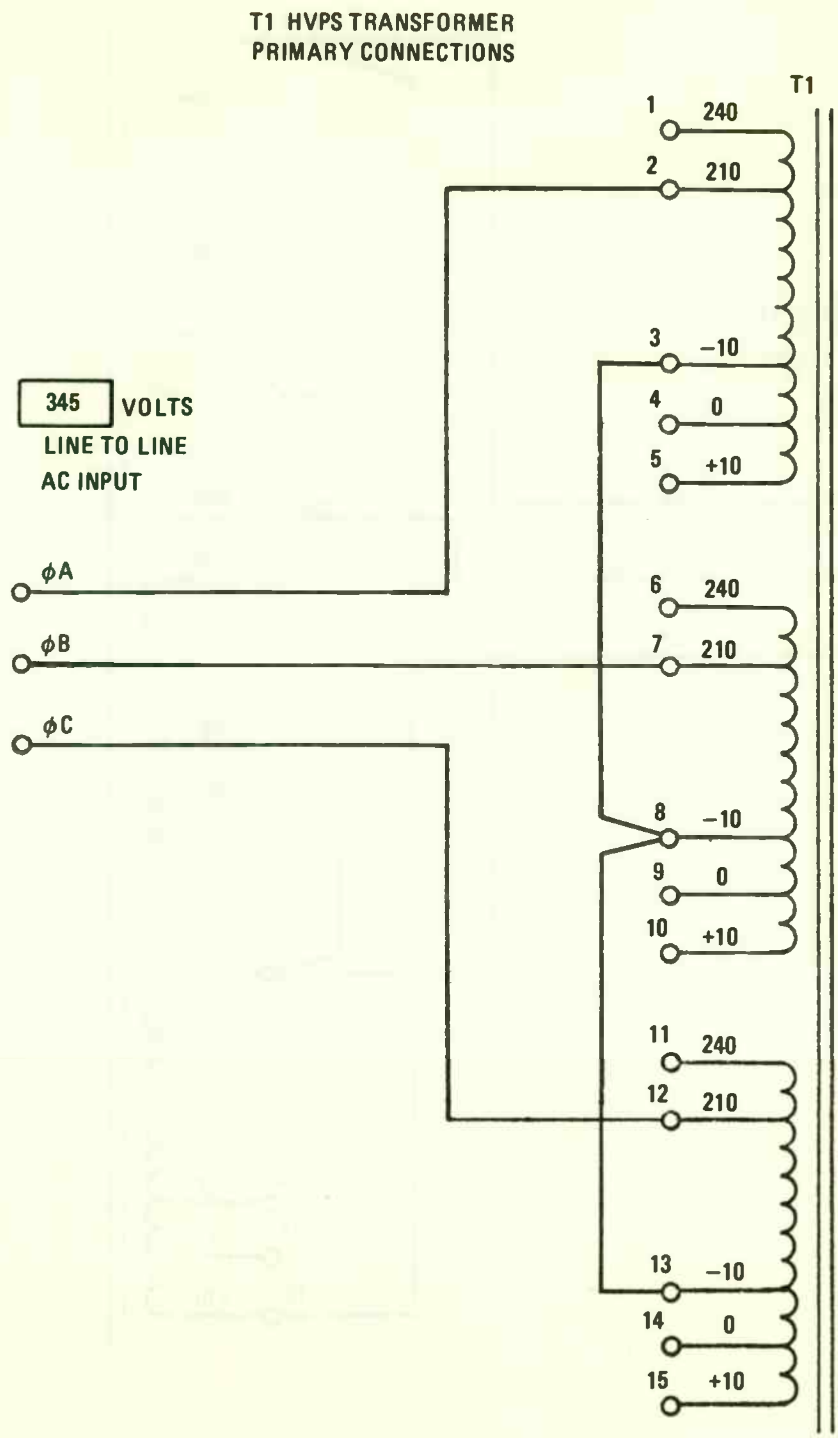

Figure 2-8. High-Voltage Power Supply Transformer Taps, 345-Volt Input.

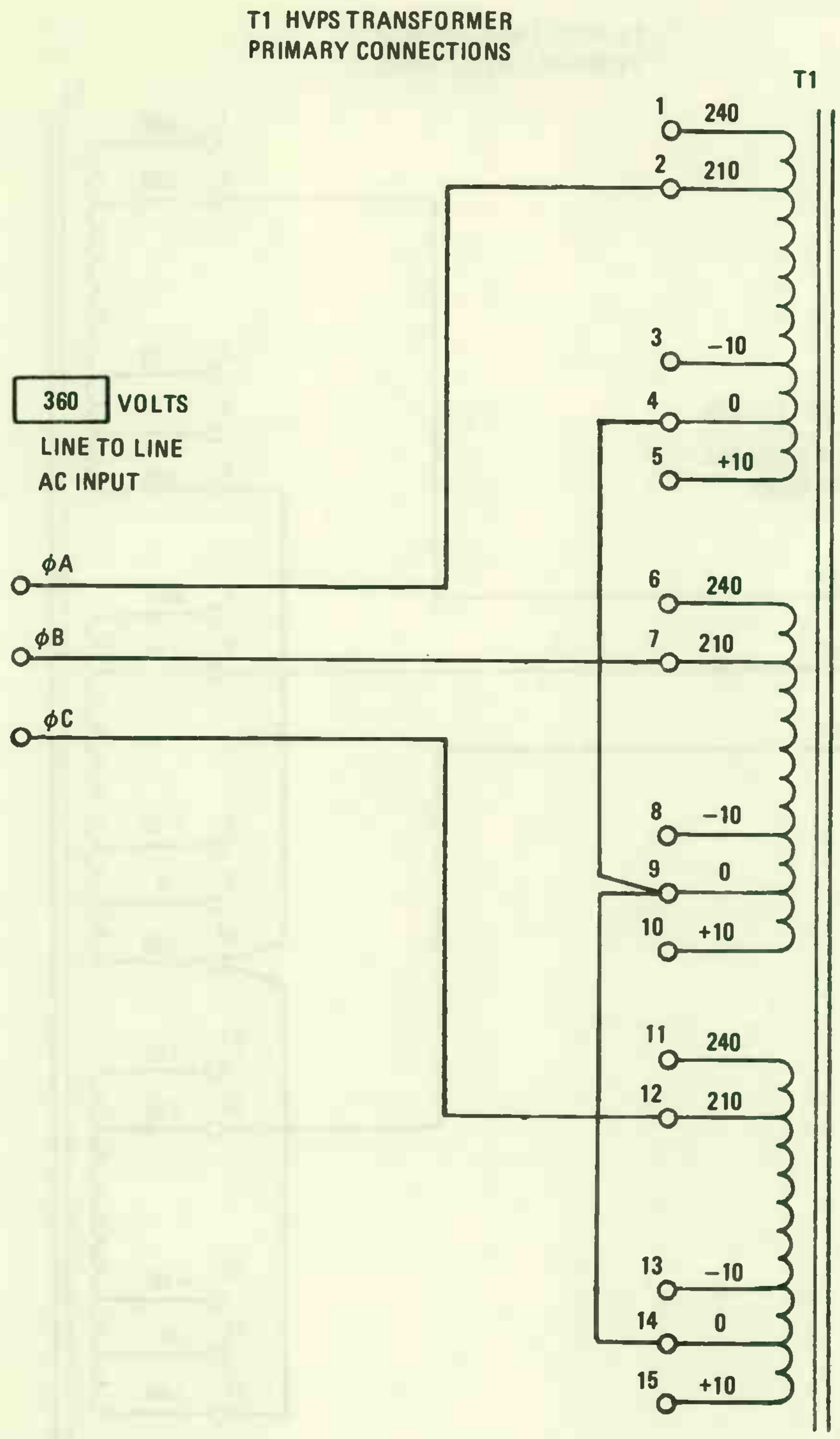

Figure 2-9. High-Voltage Power Supply Transformer Taps, 360-Volt Input.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

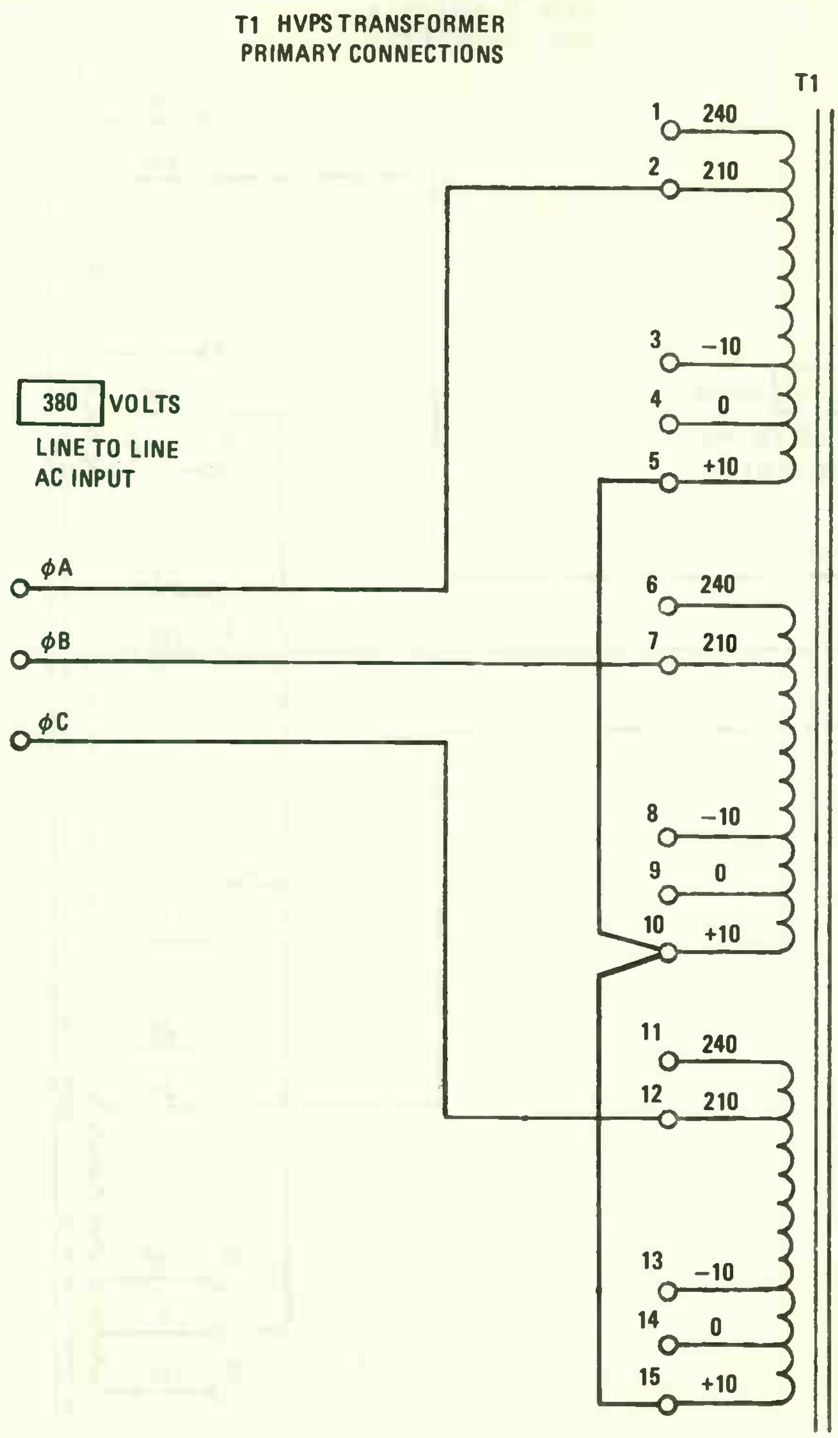

Figure 2-10. High-Voltage Power Supply Transformer Taps, 380-Volt Input.

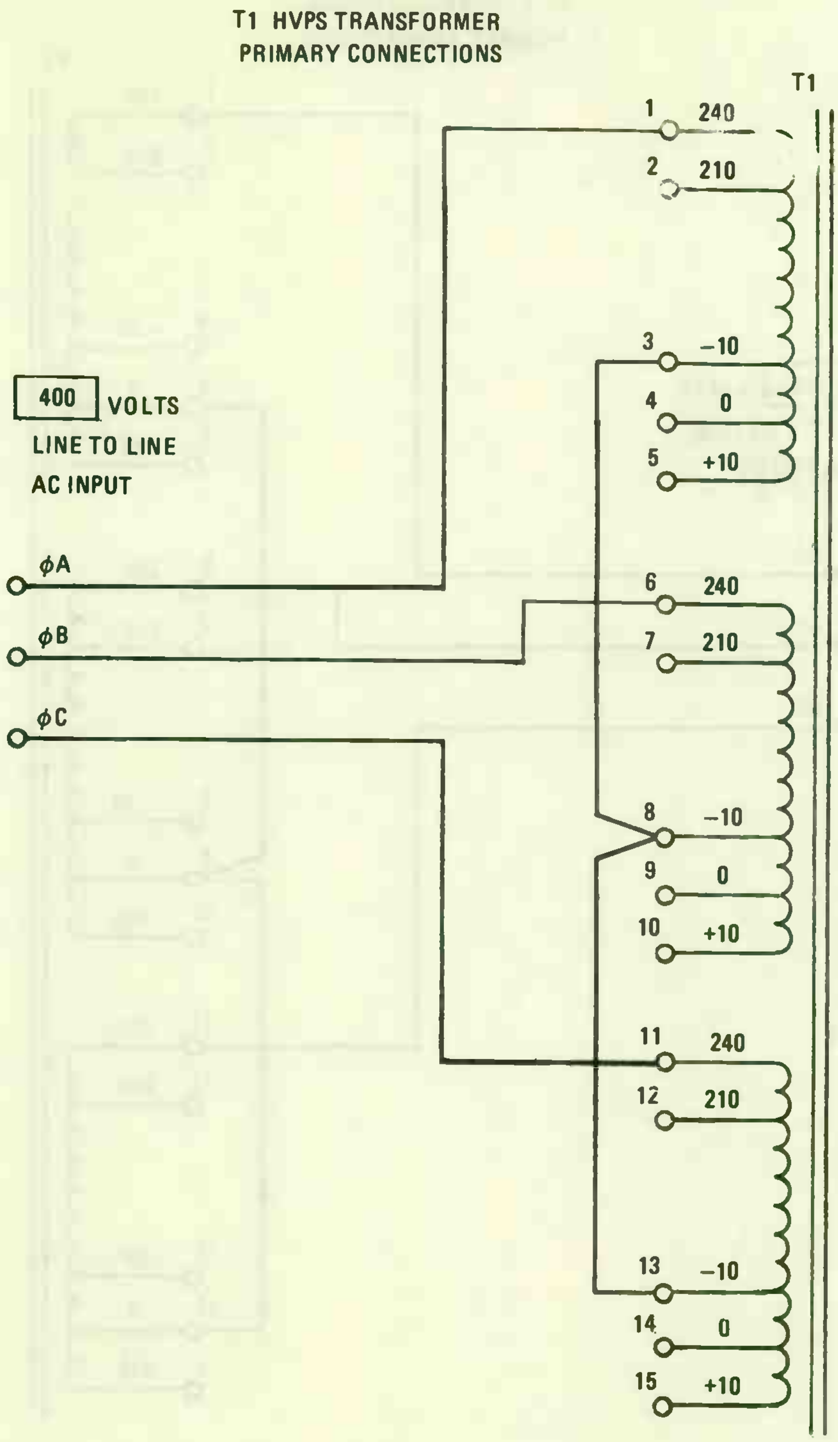

Figure 2-11. High-Voltage Power Supply Transformer Taps, 400-Volt Input.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

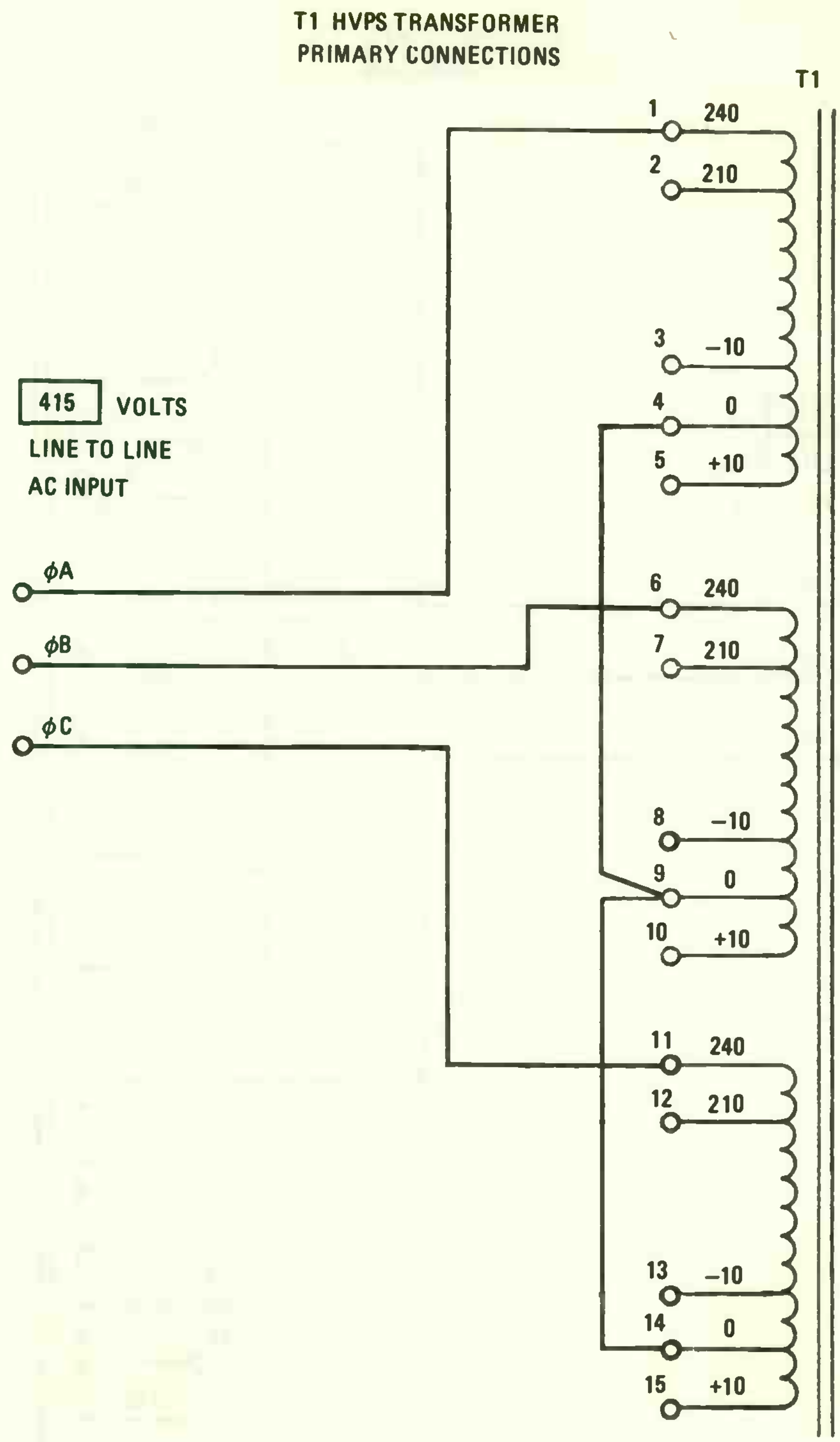

Figure 2-12. High-Voltage Power Supply Transformer Taps, 415-Volt Input.

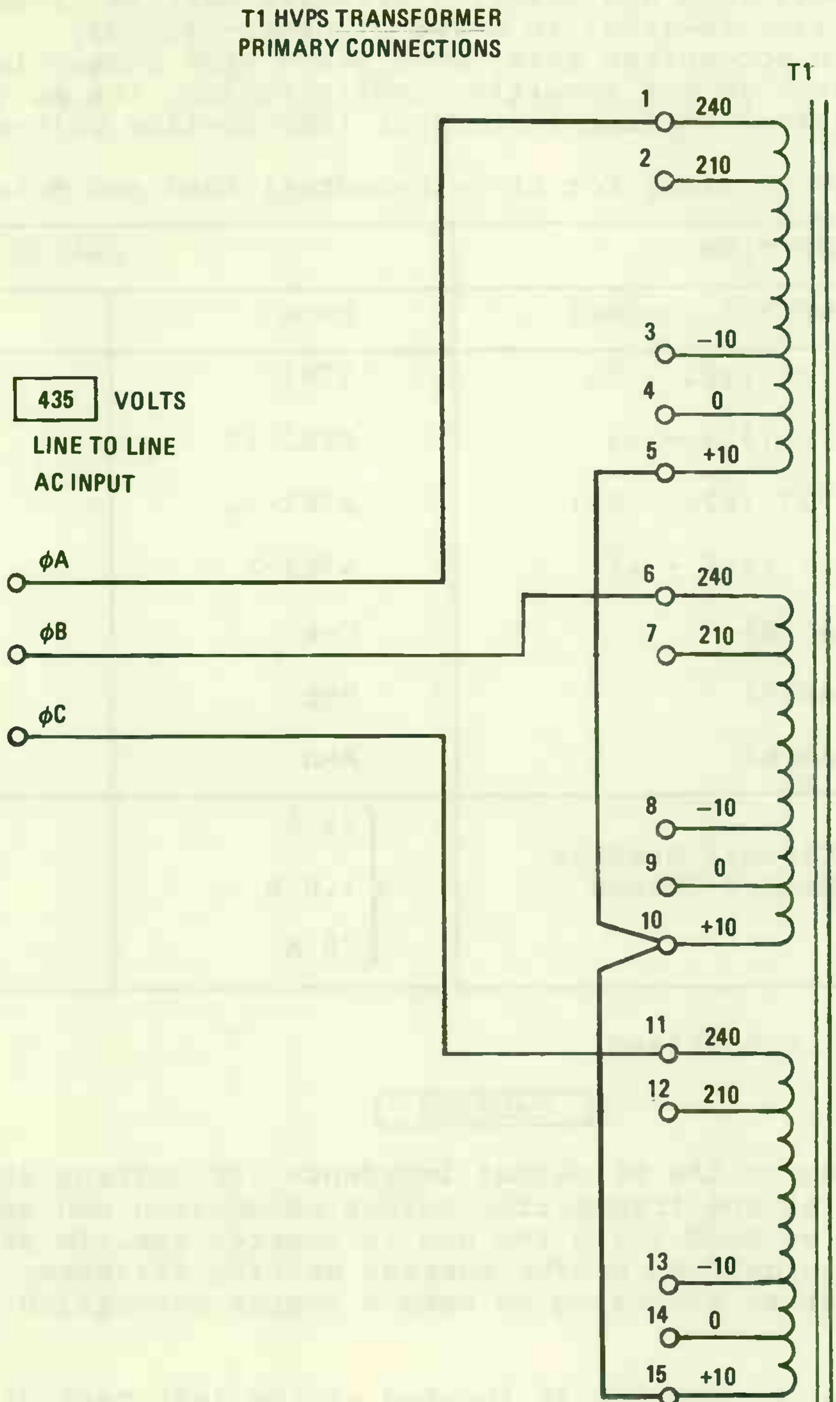

Figure 2-13. High-Voltage Power Supply Transformer Taps, 435-Volt Input.

2.4.1.2 Connections for 345/435-Volt Operation

For operation at line-to-line voltages of from 345 to 435 volts, the normal 200/250-volt load and metering circuits must be reconnected, from the delta (line-to-line) to a wye (line-to-neutral) configuration. To accomplish this, move seven wire connections as shown in table 2-2. In the resulting configuration, the AC TEST meter reads line-to-neutral voltage instead of line-to-line voltage.

Table 2-2. Connections for Line-to-Neutral Load and Metering.

WIRE CONNECTION		CHANGE	
NAME	NUMBER (color)	FROM	TO
A7T1-COM	721 (#22 - 7)	A7K1	A7E1
A7T2-COM	12 (#22 - 3)	A7K2-12	A7E1
A7TB1-16	737 (#22 - 95)	A7K2-12	A7E1
B1-COM	17 (#18 - 6)	A7K2-2	A7E1
JUMPER	A6TB1	C-F	F-J
JUMPER	A6TB1	B-E	E-H
JUMPER	A6TB1	A-D	D-G
A6CB1	Circuit Breaker Rating Change	15 A	10 A
A6CB2	Circuit Breaker Rating Change	1.0 A	0.75 A
A6CB3	Circuit Breaker Rating Change	50 A	35 A

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 2000 volts rms and 20 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 5-kW RF output connection is located at the left rear of the top of the transmitter cabinet (refer to figure 2-1). It is either a standard EIA 41.275-mm (1-5/8-in.) coax connection, or a sleeve with a 1/4-20 tapped hole. An adapter to 22.2-mm (7/8-in.) Heliax is also available (PN 124-3023-170).

2.4.3 Audio Input Connections

The 828E-1 transmitter accepts audio input, at a level of +10 dBm ± 2 dB, from a source requiring a load impedance of either 150 or 600 ohms. The transmitter is wired at the factory for operation with an input impedance of 600 ohms. If 150-ohm input impedance is desired, connect the jumper provided on the PWM card, A2, 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 A7TB2-1, -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 10 and 11 on terminal board A7TB2 are provided to interlock the carrier for purposes of pattern switching. Terminal 11 has plate-controlled +28 volts, which passes through the carrier interlock circuit and returns to terminal 10. From here it goes to PWM card A2, where it controls the PWM signal. If there is no connection between terminals 10 and 11, 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 in 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 10 and 11 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 (located on the rear of the backplane) works in series with the carrier interlock. If the RF driver current drops below approximately 1.5 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 828E-1 transmitter can be accomplished in either of two ways. For relatively short distances, the (optional) extended control panel can be connected directly to the control relay card in the transmitter. For longer distances, remote control can be exercised through (optional) remote control interface assembly A7A4.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

2.4.5.1 Direct Remote Control connections

Remote control by direct connection of the extended control panel to A7A1TB1 on the control relay card in the transmitter can be accomplished at distances up to 61 m (200 ft). Twenty-two number 22 AWG wires are required, connected as shown in figure 2-14. The jumpers between A7A1TB1-3 and -4 and A7A1TB1-7 and -8 must be removed when the extended control panel is connected.

The extended control panel (figure 2-15) for the 828E-1 transmitter can be connected to function directly in parallel with the local transmitter controls, or only when LOCAL-REMOTE switch A5S10 on the 828E-1 is in the REMOTE position.

When the FILAMENT OFF (pin 7) is connected to A7A1TB1-1, the extended control panel receives +28 volts only when the LOCAL-REMOTE switch is in REMOTE. In this condition, the local transmitter FILAMENT OFF and FILAMENT ON switches are disabled. However, the other local transmitter controls function normally.

By connecting to A7A1TB1-3, all controls are operational at all times, except the extended RAISE-LOWER control. Power output can be raised or lowered on the extended control panel only when the transmitter LOCAL-REMOTE switch is in the REMOTE position.

2.4.5.2 Remote control Interface Assembly

If optional remote control interface assembly (figure 2-17) A7A4 (PN 627-9721-001) is used, the remote control connections are connected to terminal board A7A4TB1 on the remote control interface assembly (see schematic, figure 2-16), instead of A7A1TB1. The output control signals from the remote control interface assembly are connected to A7A1TB1. The transmitter internal +28-volt supply is used to power the remote control panel; connections to A7A4TB1 are as shown in figure 2-18.

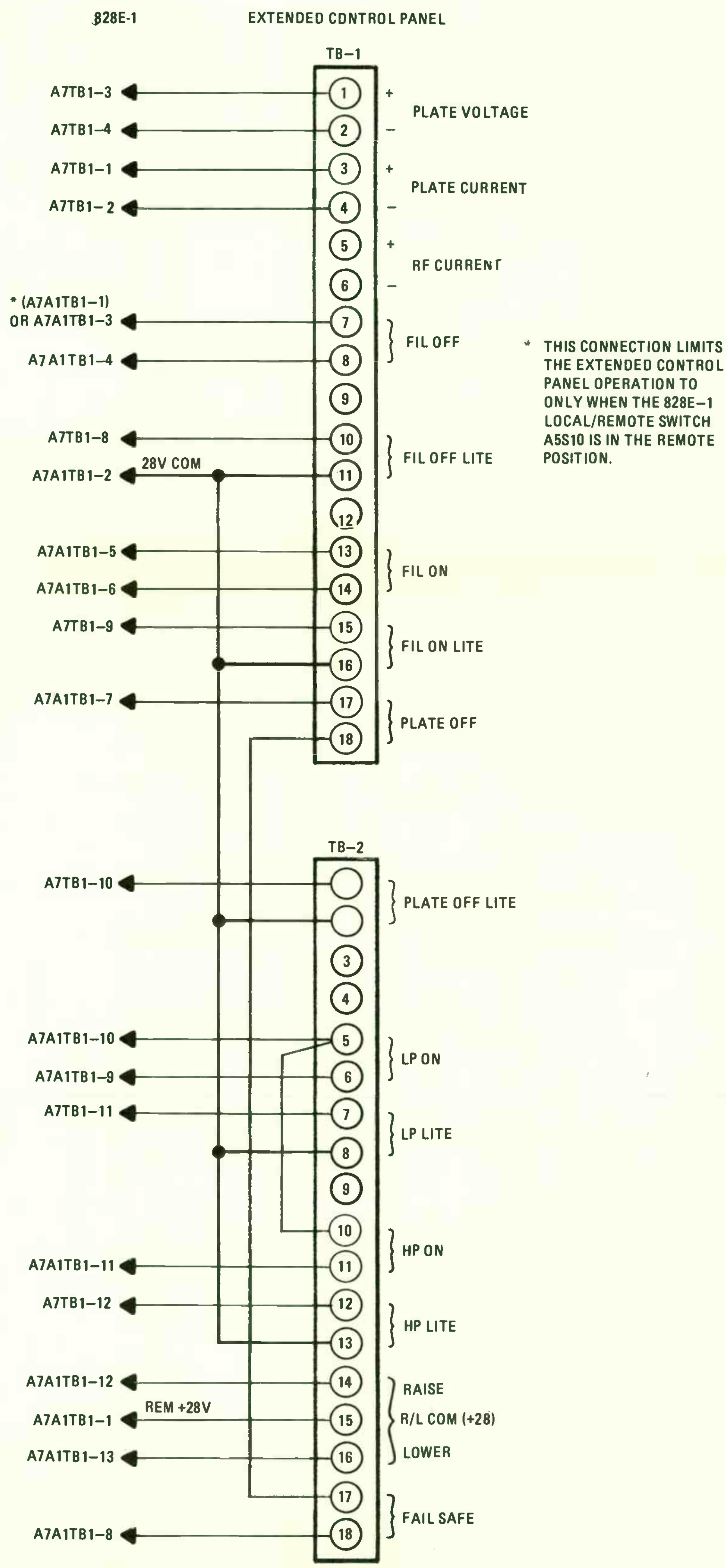

Figure 2-14. 828E-1 Interconnect Wiring for Extended Control Panel.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

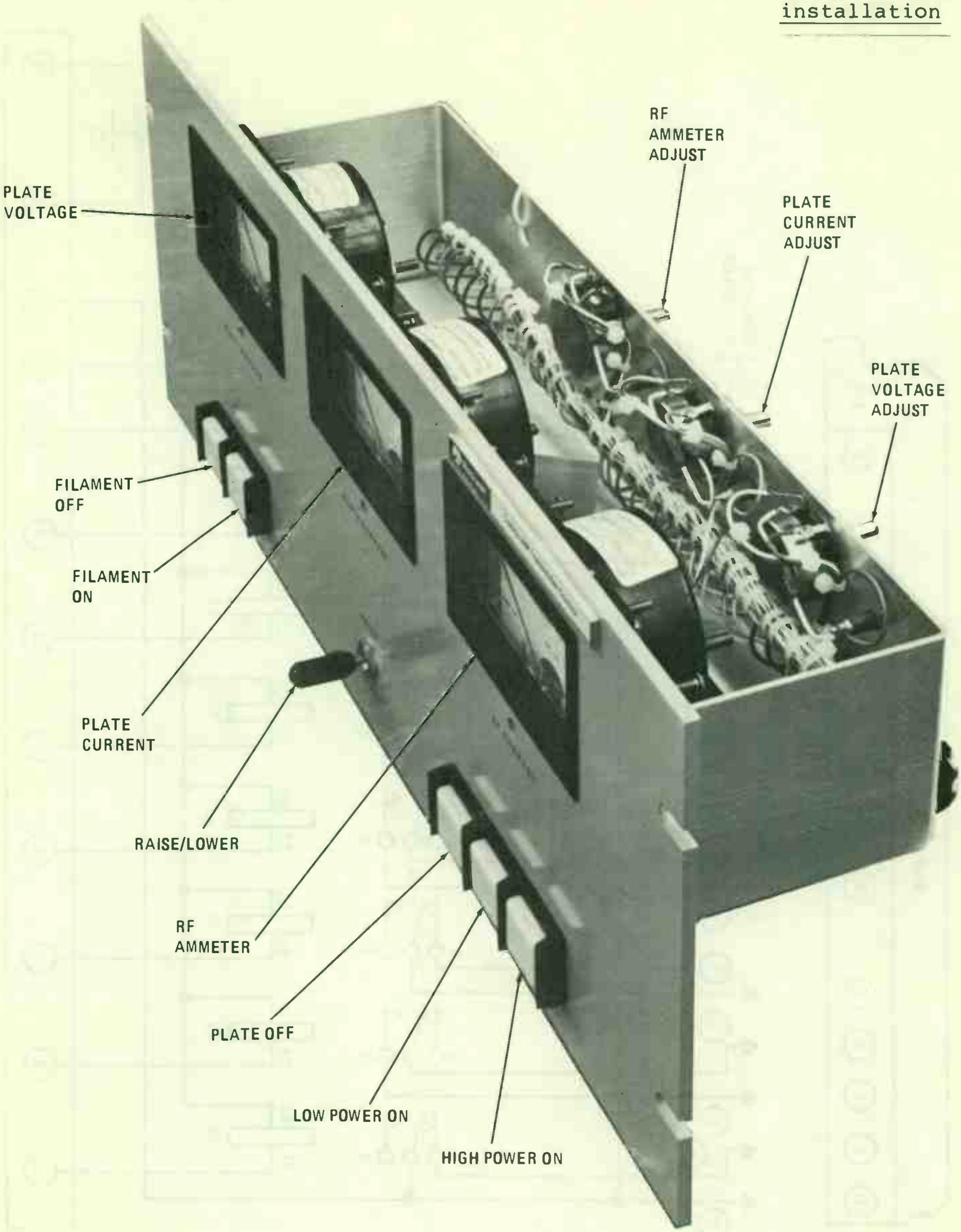

Figure 2-15. Extended Control Panel.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

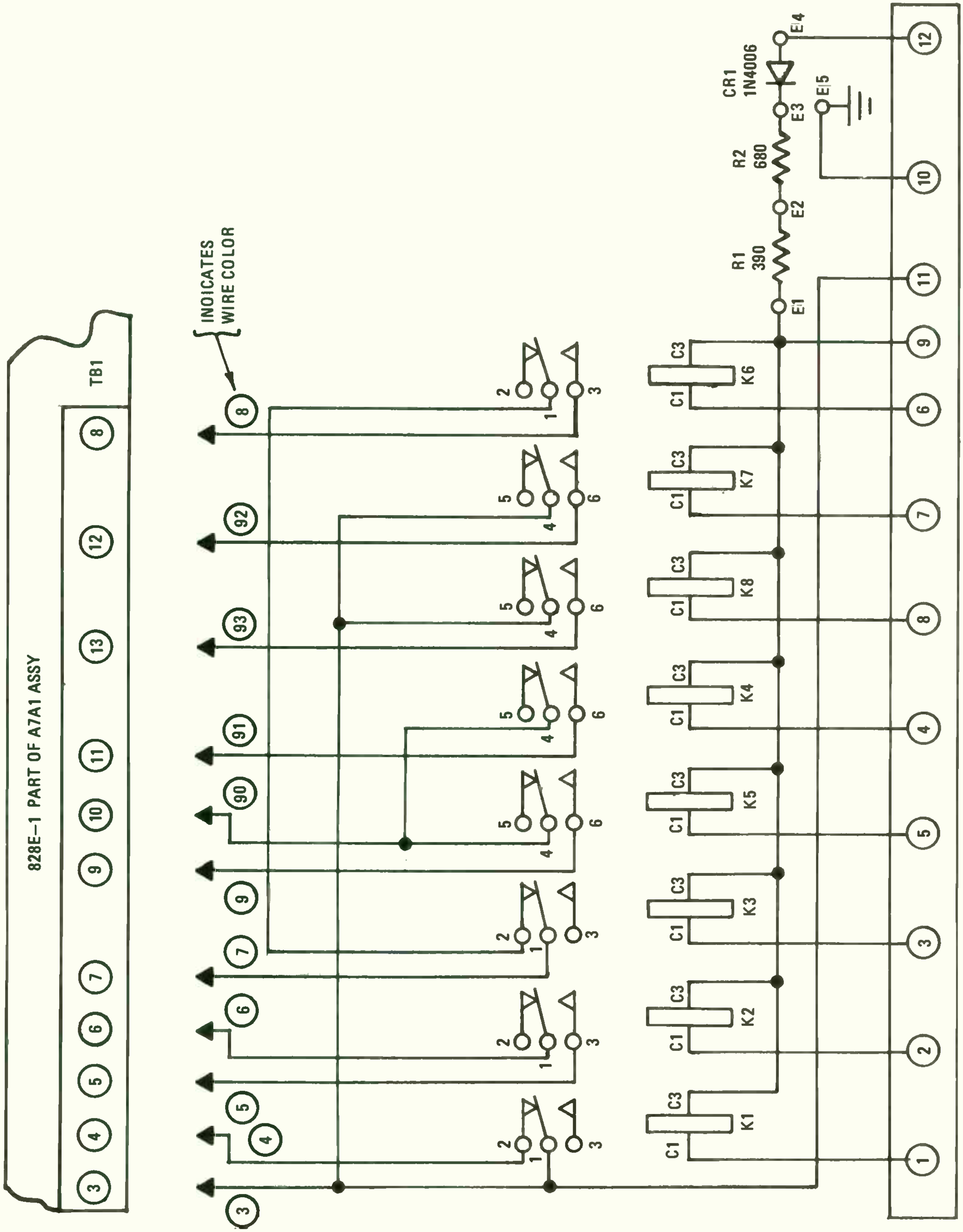

Figure 2-16. Remote Control Interface Assembly Schematic.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

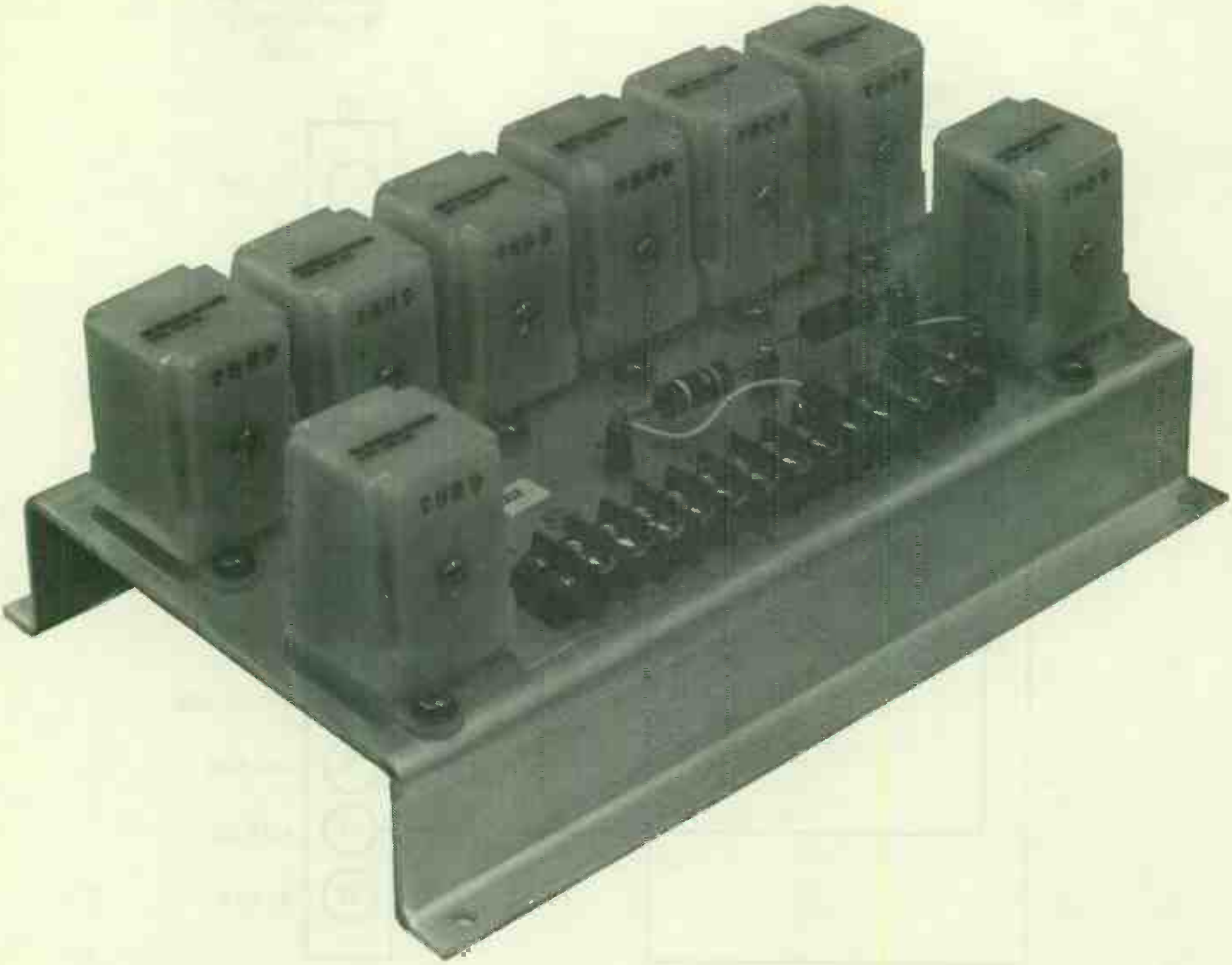

Figure 2-17. Remote Control Interface.

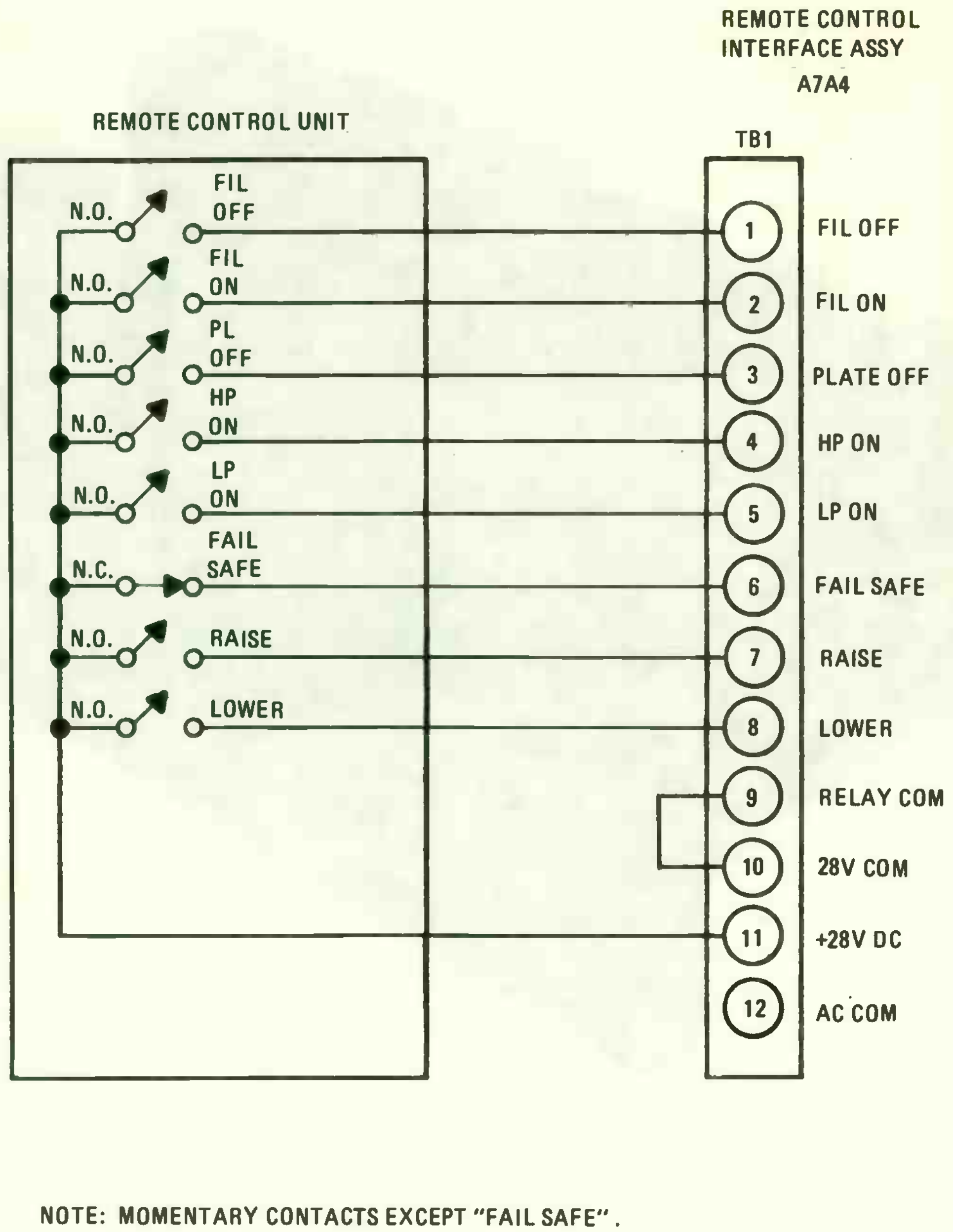

Figure 2-18. Connections Using Internal +28 Volts to Power Remote Panel.

2.4.5.3 Remote Monitor Connections

The 828E-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-mA 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 2-19 shows the required connections to A7TB2 on the power control chassis in the transmitter. Full-scale readings for each remote meter are also shown.

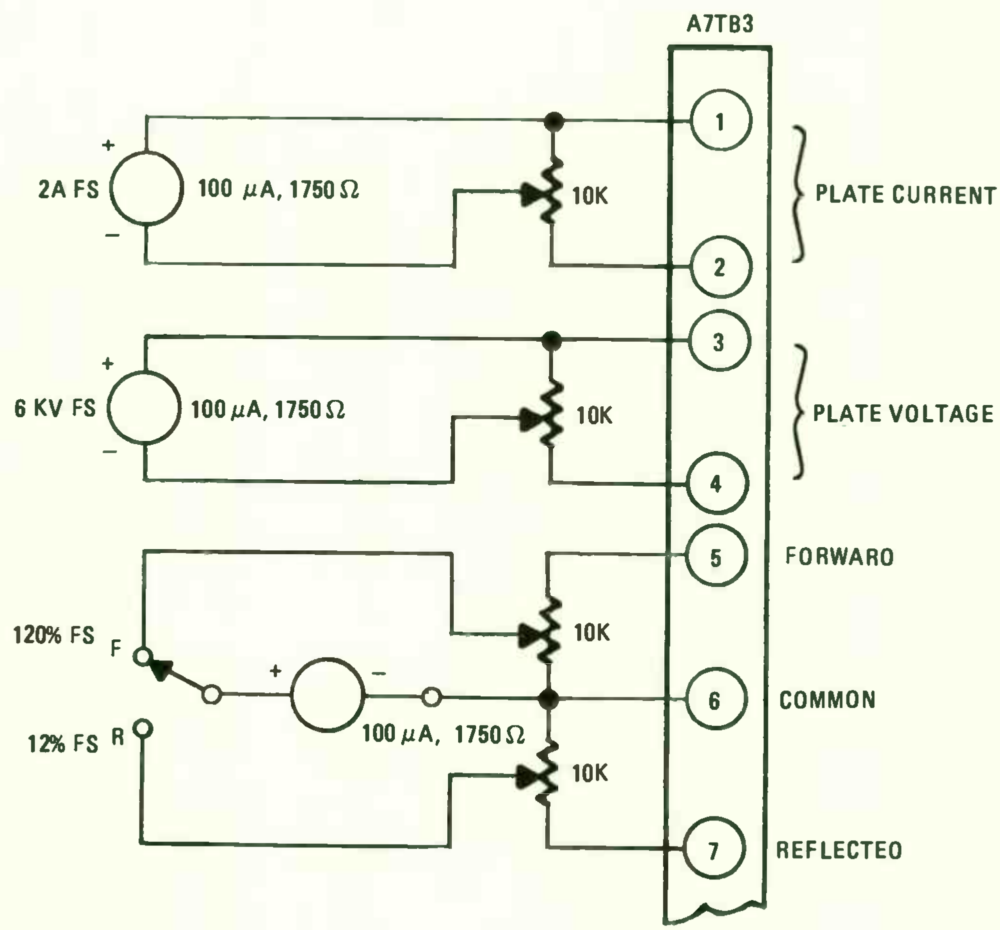

Figure 2-19. Remote Monitor Connections.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

SECTION 3
OPERATIONS

SECTION 3
OPERATIONS

3.1 INTRODUCTION

This section contains information pertaining to the identification, location, and function of the controls and indicators on the 828E-1 5-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.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

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

CONTROL/INDICATOR	FUNCTION
FILAMENT:	
OFF (A5S1/A5DS1)	Removes power from both blower relay A7K1 and filament relay A7K2 by interrupting holding contact 4 and 12 on relay A7K1. When lighted, shows filament power is off.
ON (A5S2/A5DS2)	Applies 28-volt power to blower relay A7K1, which then energizes filament relay A7K2 through air interlock switch A9S3. When lighted, shows filament and blower power are on.
PLATE:	
OFF (A5S3/A5DS3)	Disconnect high voltage from plate circuit by interrupting holding contacts 9 and 10, and 5 and 6 on high-voltage-on relay A7A1K3. In series with three door interlock switches A7S1, A7S2, A9S1; temperature switch A9S4; and with overload relay A7A1K2. When lighted, indicates that no high voltage is applied to plate, three door interlocks are closed, and overload relay is not energized, and the temperature interlock is closed.
LP (A5S4/A5DS4)	Applies 28-volt power to low-power latch relay A7A1K1B through diode A7A1CR2, and to high-voltage-on A7A1K3 through diode A7A1CR4; also energizes filament on sequence through diode A7A1CR17. When lighted, indicates that power is applied to low-power relay A2K1 and modulation monitor relay A9K1.

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

CONTROL/INDICATOR	FUNCTION
HP (A5S5/A5DS5)	Applies 28-volt power to high-power latch relay A7A1K1A through diode A7A1CR1 and to high-voltage-on relay A7A1K3 through diode A7A1CR3; also energizes filament on sequence through diode A7A1CR17. When lighted, indicates that high-power latch relay A7A1K1A is energized.
POWER:	
RAISE (A5S6)	Applies 28-volt power to raise relay A7A1K5 through normally closed contacts on lower relay A7A1K4.
LOWER (A5S7)	Applies 28-volt power to lower relay A7A1K4 through normally closed contacts on raise relay A7A1K5.
PA TUNING (A9C6)	Screwdriver adjustment; sets PA tuning capacitor A9C6 to resonate node 1 of the output network.
CONTROL-LOCAL/REMOTE (A5S10)	In LOCAL position, connects jumper between "remote plate off" and "fail-safe" circuits. In REMOTE position, applies 28-volt power to remote control terminal board A7A1TB1-1.
PA FIL (A6R1)	Screwdriver adjustment to set PA filament voltage.
MOD FIL (A6R2)	Screwdriver adjustment to set modulator filament voltage.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Table 3-2. Internal Controls and Indicators.

CONTROL/INDICATOR	FUNCTION
Oscillator 1 Select (A1S1)	Operates A1K1 latching relay to select RF oscillator 1.
Oscillator 2 Select (A1S2)	Operates A1K1 latching relay to select RF oscillator 2.
Oscillator 1 Frequency (A1C2)	Screwdriver adjustment to set frequency of oscillator 1.
Oscillator 2 Frequency (A1C9)	Screwdriver adjustment to set frequency of oscillator 1.
Oscillator 1 Indicator (A1CR7)	LED on module A1 showing that oscillator 1 has been selected.
Oscillator 2 Indicator (A1CR6)	LED on module A1 showing that oscillator 2 has been selected.
RF Indicator (A2S1)	LED on module A1 showing that there is RF output from the module.
IPL On/Off (A2S1)	Connects instantaneous peak limiter (positive and negative af clippers) into the circuit.
Carrier Interlock (A2CR8)	LED on module A2 showing that carrier interlock (A7TB10 and 11) is closed, plate contactor (A8K1) is energized, and RF drive loss circuit is not energized.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Table 3-2. Internal Controls and Indicators (Cont).

CONTROL/INDICATOR	FUNCTION
Low-Power Adjust (A2R37)	Screwdriver adjustment to set low-power output to desired fraction of high-power output.
Negative Clipper (A2R73)	Screwdriver adjustment to set level of negative af clipper.
Positive Clipper (A2R76)	Screwdriver adjustment to set level of af positive af clipper.
Indicator Reset (A3S1)	Removes +28-V power from overload indicators to reset them to "off" condition.
VSWR (A3CR1)	LED on module A3 showing that reflected power overload circuit has been tripped.
ARC (A3CR2)	LED on module A3 showing that arc sensor circuit has been tripped.
HVPS (A3CR3)	LED on module A3 showing that HVPS overload circuit has been tripped.
HVPS O/L (A3R1)	Screwdriver adjustment to set trip level for HVPS overload circuit.
VSWR O/L (A3R5)	Screwdriver adjustment to set trip level for reflected power overload circuit.
RF Drive Loss (A6A1CR6)	LED on backplane showing that RF driver current is greater than 1.5 A.
RF Driver Overcurrent (A9A4R103)	Screwdriver adjustment to set level of driver current that will cause RF drive to be removed from driver.

Table 3-3. Meters on the Transmitter.

METER	FUNCTION
AC TEST (A5M1)	Provides iron vane front-panel metering of ac power line voltages (line-to-line in 200- to 250-V operation and line-to-neutral for 345- to 435-V operation) and both PA and modulator filament voltages.
DC TEST (A5M2)	Provides front-panel metering of all power supply voltages except switching modulator bias. Also shows RF driver current.
PLATE VOLTAGE (A5M3)	Indicates PA plate-to-cathode dc voltage.
PLATE CURRENT (A5M4)	Indicates PA plate current.
RF POWER (A5M5)	Indicates forward or reflected RF power at transmitter power output terminals.
RF CURRENT (A9M1)	Optional meter to read RF current at transmitter power output terminals.

Table 3-4. Typical Meter Readings.

METER	SWITCH POSITION	FULL-SCALE READING	TYPICAL READING
AC TEST	0A 0B 0C PA Fil MOD Fil	300 V 300 V 300 V 9 V 9 V	210 V 210 V 210 V 7.3 V 7.3 V
DC TEST	-12 V -6 V +5 V +12 V +28 V DR Ec DR Ic HVPS	15 V 15 V 15 V 15 V 30 V 300 V 15 A 15 kV	12.0 V 6.0 V 5.0 V 12.0 V 28.0 V 200.0 V 3.0 A 14.0 kV
PLATE VOLTAGE PLATE CURRENT RF POWER	 Forward Reflected	6 kV 2 A 120% 12%	5.0 kV 1.25 A 100% (5 kW) 0
RF Current		15 A	10 A (Unmodulated)

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

3.3 OPERATING PROCEDURE

Read and study this complete section before trying to operate the 828E-1 transmitter.

3.3.1 Primary Power

Apply 3-phase power to the transmitter by closing the fused-disconnect wall switch.

Close all three 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, the modulator thermal interlock is closed, and the overload relay is not operated, 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 PWM module (A2R37) 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 in high power 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 7.3 $\pm$0.1 volts as indicated on the AC TEST METER on the front panel. Filament voltage specified on the manufacturer's data sheets for the 3CX3000F7 is 7.5 volts rms. However, tube life can be increased significantly by operating a slightly reduced filament voltage. Performance in the 828E-1 transmitter is not degraded by reduction of 2 to 3 percent below specified filament voltage and tube life is increased appreciably.

NOTE

> In no case should the filament voltage be reduced more than 5 percent (below 7.13 volts) because the "gettering" action of the tubes will be impaired, causing filament "poisoning" and consequent tube failure

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 828E-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 (A9L3) must be repositioned to accommodate the changed condition. If the plate voltage required for the proper "common point" current exceeds the range of 4.8 to 5.2 kV, or if the plate current exceeds the range of 1.2 to 1.3 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, Lower 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 PWM card (A2R37) 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 PWM card (A2S1) 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 (A2R58) is always active and is set at the factory to limit the positive peaks to +130% modulation of the 5.5-kW carrier. If this circuit needs readjustment, follow the procedure outlined in section 5, paragraph 5.4.1.3.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

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 (A2R76) until it just prevents the negative 100% indicator on the modulation monitor from indicating (conterclockwise lowers the limiting level). Now adjust the positive limiter (A2R76) until it just prevents the +125% indicator on the modulation 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 828E-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 828E-1 this means that the ratio of plate voltage to plate current must be equal to 4000 ohms:

$$\frac{E_{BB}}{I_B} = 4000\Omega \quad .$$

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 828E-1, the HVPS should be about 13.7 kV under load (high-power carrier at 95-percent modulation) and it will rise to about 14.5 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 15.0 kV!

Power supply components may be damaged if the HVPS is operated with the voltage above 15.0 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 13.7 kV at high power (5.0- to 5.5-kW carrier) under program modulation. This will provide adequate positive peak capability if the transmitter is properly loaded (E_{BB}/I_B = 4000) and the IPL limiters are set properly.

Again, in no case should the HVPS voltage be allowed to rise above 15.0 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 828E-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 (A9C6) is a screwdriver adjustment available through the hole in the meter door. It should be adjusted to the "dip" in plate current, as indicated on PLATE CURRENT meter A5M3. 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 cw (high-frequency side) from the plate current dip. Under no conditions should the plate be detuned more than 50 mA from the dip in plate current.

3.3.6 Maintenance Adjustments

The following controls, although available on the front of the 828E-1 transmitter, are maintenance adjustments and should only be adjusted by qualified personnel with the proper test equipment following the proceedures 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 1 Frequency	5.3.1

CONTROL	PROCEDURE PARAGRAPH NO.
Oscillator 2 Frequency	5.3.1
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, BIAS PS, 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, BIAS PS, and LOW VOLTAGE circuit breakers

or

c. Open primary power disconnect switch.

SECTION 4
PRINCIPLES OF OPERATION

4.1 INTRODUCTION

This section presents the principles of operation for the 828E-1 5-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 828E-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 dual crystal oscillator feeds the solid-state driver circuit. The RF driver operates at a 500-watt power level to drive the high-efficiency RF power amplifier. The power amplifier uses a third harmonic resonator in its plate circuit to approximate square-wave or switching operation; this increases the RF power amplifier efficiency from about 82 percent to nearly 90 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 4-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

Plate voltage for the RF power amplifier is provided by a series-regulated high-voltage power supply (HVPS). 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 13.7 kV) down to the level reqired for the normal 5-kW carrier (about 5 kV). This is done by allowing the tube to be "on" for approximately 40 percent of

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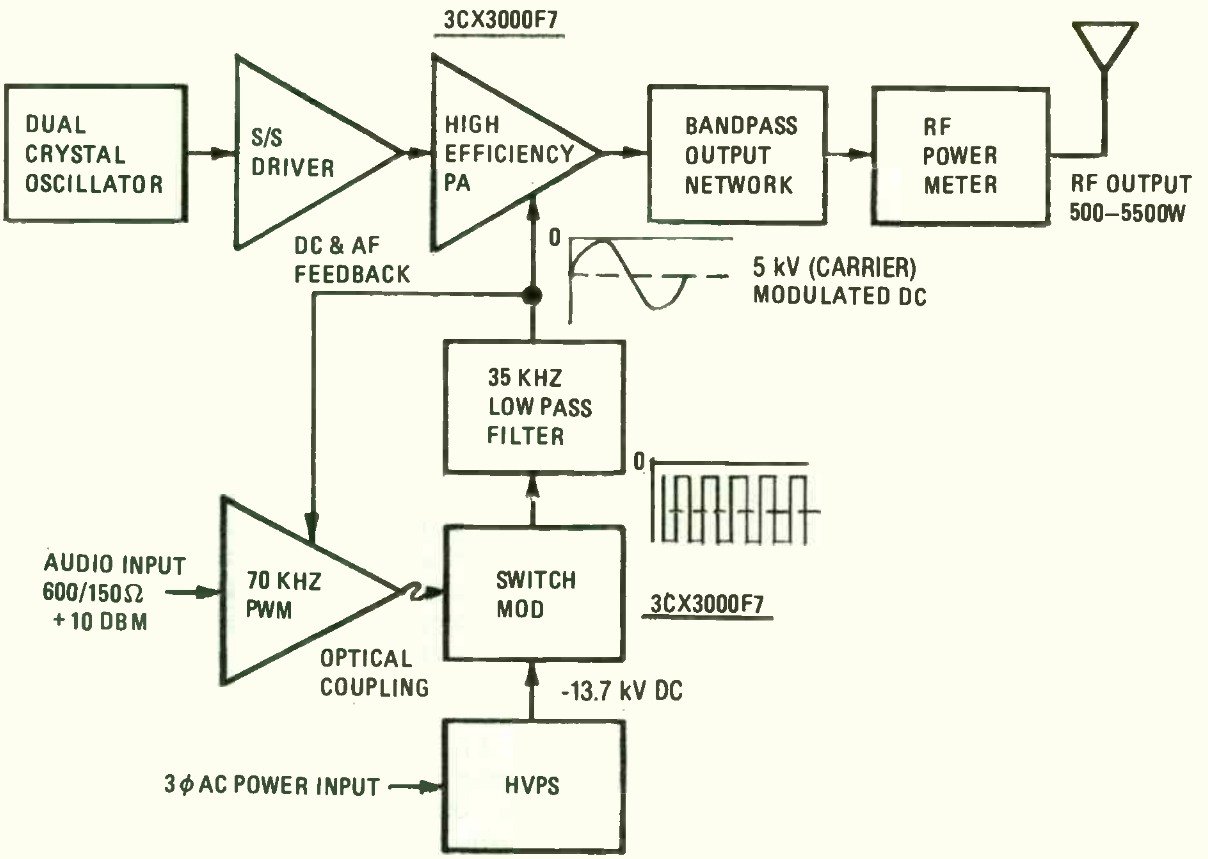

Figure 4-1. 828E-1 Simplified Block Diagram.

the time and "off" for about 60 percent of the time. This on/off cycle operates at a 70-kHz rate.

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 modulation. On maximum (125 percent) positive modulation peaks, the voltage increases to 11.25 kV, which means that the modulator is on nearly all the time. In the negative modulation trough, the voltage decreases to 0 volt, 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-level 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 828E-1 transmitter control circuits can be operated either locally at the front panel, from an optional extended control panel, or from an optional remote control interface assembly. Remote control is established by setting the front-panel CONTROL switch to REMOTE; however, the local 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.

4.3.1 RF Circuits

The RF circuits are a dual crystal oscillator, a solid-state RF driver, an RF power amplifier, a 4-node bandpass network, and an RF power meter.

4.3.1.1 RF Exciter Module A1

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

Each 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 oscillators operate at four times the output frequency; if the frequency is 1080 kHz or above, the oscillators operate at twice the output frequency. The desired oscillator output is selected by double-coil latching relay K1, which is operated by the OSC 1 SEL or OSC 2 SEL pushbutton switches on the RF exciter module front panel. The relay can also be operated from the remote control panel by applying +28 volts either to A7TB2-6 to select oscillator 1 or to A7TB2-9 to select oscillator 2. The LED indicators (CR7 and CR8) on the module front panel indicate which oscillator has been selected. Remote indication is provided by a +28-volt signal, either on A7TB2-7 for oscillator 1, or on A7TB2-8 for oscillator 2.

Relay K1 couples the output of the selected oscillator to buffer amplifier Q3, 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 (R20) 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 Q9 to provide a frequency monitor output to A7J1. The output from pin 6 of U2 is applied through buffer amplifier Q8 to output amplifiers Q4, Q5, and Q6 to

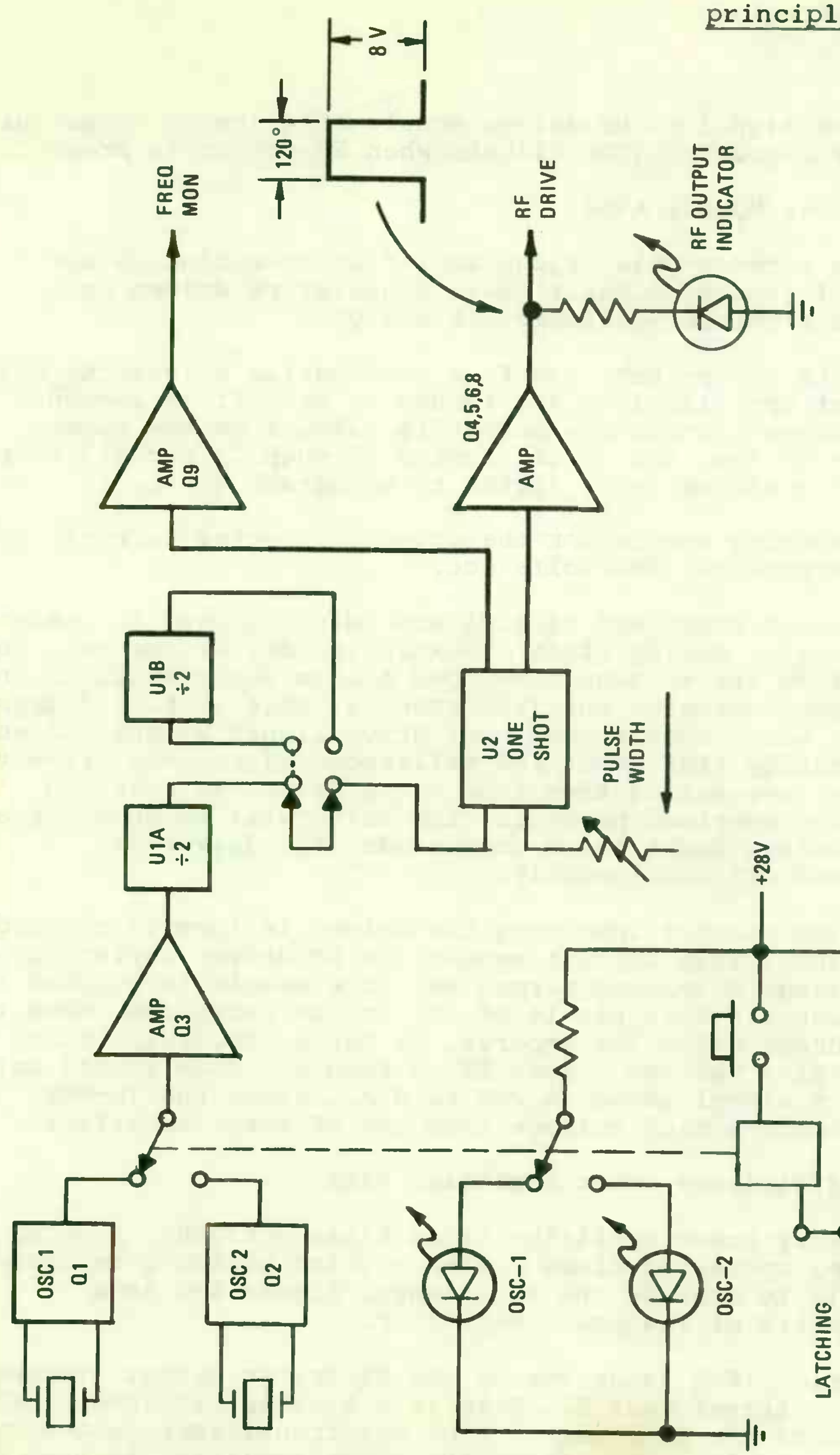

Figure 4-2. RF Exciter Block Diagram.

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provide the drive signal to RF driver module A9A4 (refer to paragraph 4.3.1.2). The RF INDICATOR (CR6) lights when RF output is present.

4.3.1.2 RF Driver Module A9A4

The RF driver is a totem-pole bridge amplifier operating in the switching mode. It contains eight power transistors driven by complementary pair emitter-follower Q10 and Q11.

A transformer with one primary and four secondaries drives the bridge amplifier so that opposite legs are turned on and off in sequence by the 120 degree drive signal. The output is taken from the common junctions in the bridge, and is ac coupled through C3 and C13 to power amplifier grid transformer A9T1 (refer to paragraph 4.3.1.3).

R1 provides a metering sample for the driver collector current. Normal current is 3.0 amperes at 200 volts Ecc.

A protection circuit comprised of U101 and Q101 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 R1 and using it to trigger one-shot multivibrator U2. This in turn drives transistor Q101, which shunts the input drive signal at the collector of Q9 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 card cage backplane A6A1. This circuit senses the RF driver current by sampling the voltage developed across R1. This sample is coupled from the driver through pin 6 to pin 14 of XA1 on the backplane. When the driver current drops below 1.5 amperes, Q1 turns off, which turns off drive loss indicator CR6 and allows Q2 to turn on. This shorts out the carrier interlock signal going to PWM card A2, stops the 70-kHz switching, and removes high voltage from the RF power amplifier.

4.3.1.3 High-Efficiency Power Amplifier A9V1

The high-efficiency power amplifier is an Eimac 3CX3000F7 high mu, zero-bias triode, operating class C with a third harmonic resonator in its plate circuit to enhance the efficiency. 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 T1. Grid leak bias is provided by C25 and R10. L13 limits the RF power in R10. The transformer secondary is center-tapped to permit neutralizing the power amplifier through C14, C15, C16, C17, C18, and C29.

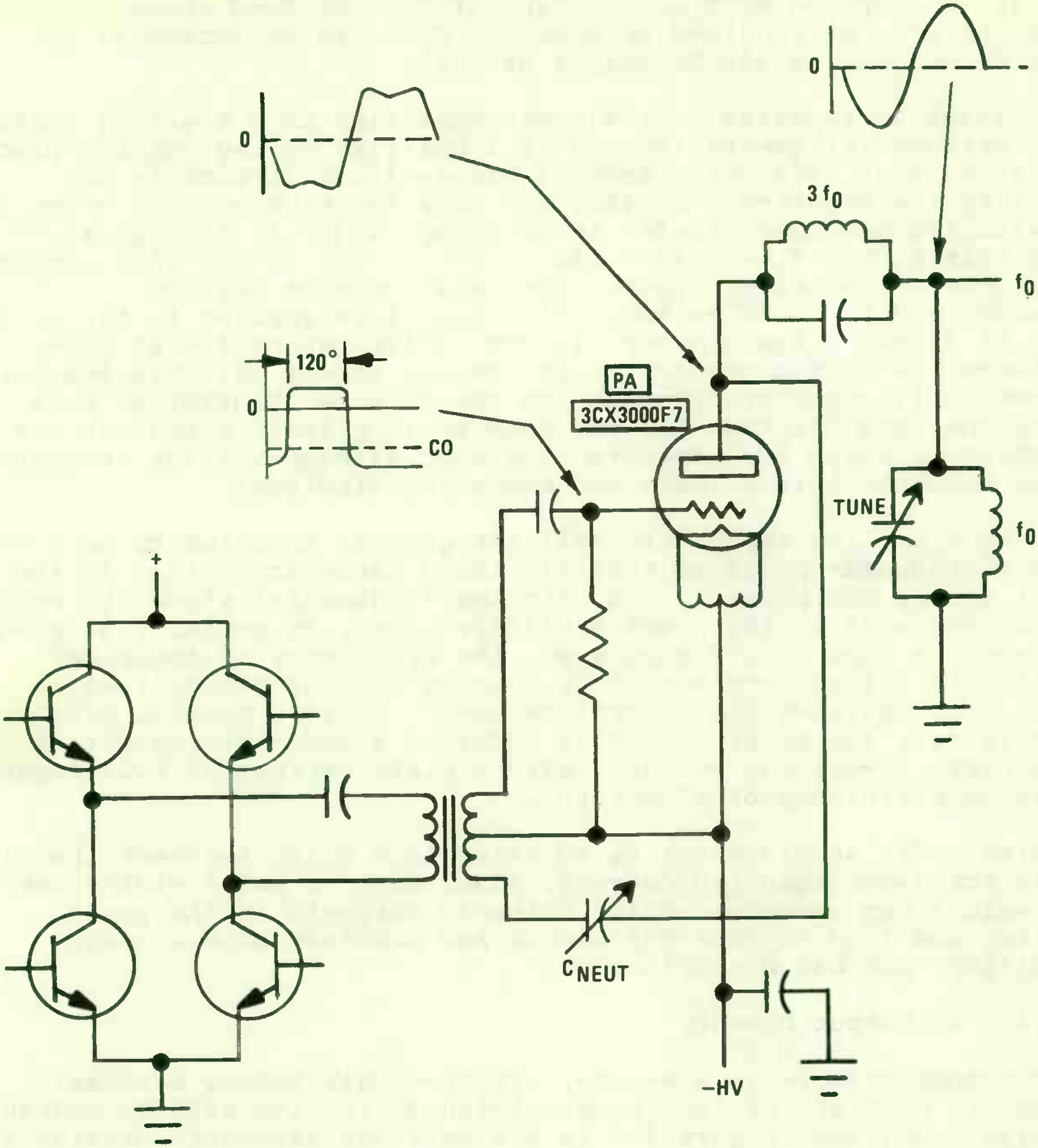

Figure 4-3. Power Amplifier, Simplified Schematic.

The power amplifier plate circuit is coupled to the RF output network through the third harmonic resonator, which consists of C10 and L7. 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 11.25 kV on modulation peaks) is applied to the center tap of PA filament transformer T4. The center tap of the PA grid transformer is also connected to the center tap of T4. 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.

The drive signal on the power amplifier grid is adjusted to be a 120 degree rectangular pulse so that its third harmonic content is the correct amount and phase to add with the fundamental signal to produce a semisquare wave at the power amplifier plate. By properly shaping this waveform (refer to figure 4-4), the efficiency of the power amplifier is raised from normal 82 percent to approximately 88 percent. With pulse-width control on the RF exciter module, A2R20, correctly set, the power amplifier supplies a 5500-watt output at 5.0-kV plate-to-cathode voltage, with a plate current of 1.25 amperes. This is an efficiency of 88 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 bad distortion.

4.3.1.4 RF Output Network

The RF output network is a 4-node, synchronously tuned, bandpass network. It consists of four 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. Node 3 is bottom-coupled to node 4, 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 and between nodes 3 and 4 is achieved by tapping one coil on the other

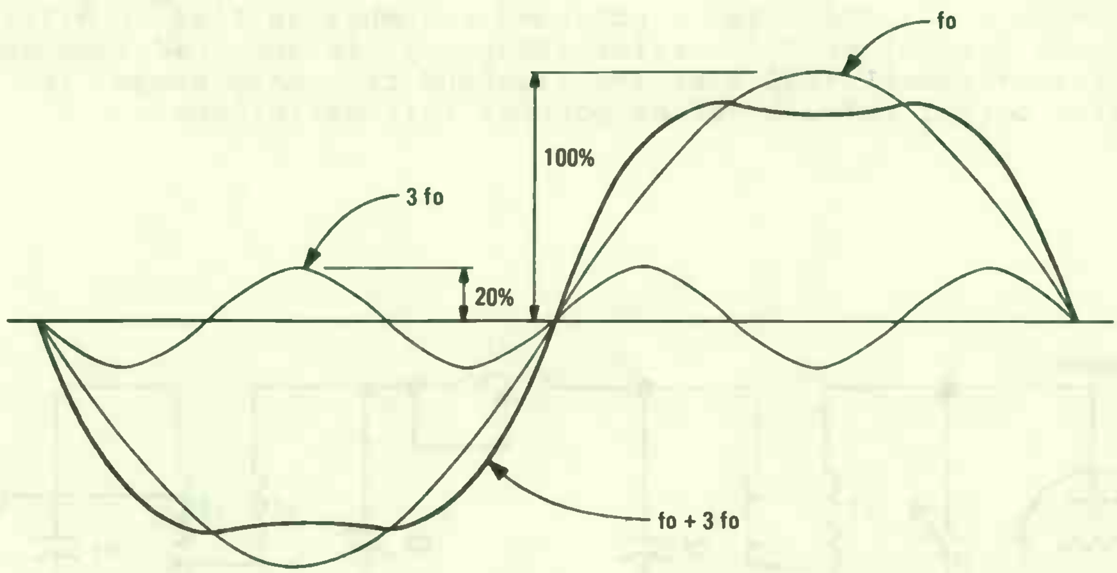

Figure 4-4. High-Efficiency Waveform.

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as shown in figure 4-5. 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 Qs taper downward to node 4. 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.

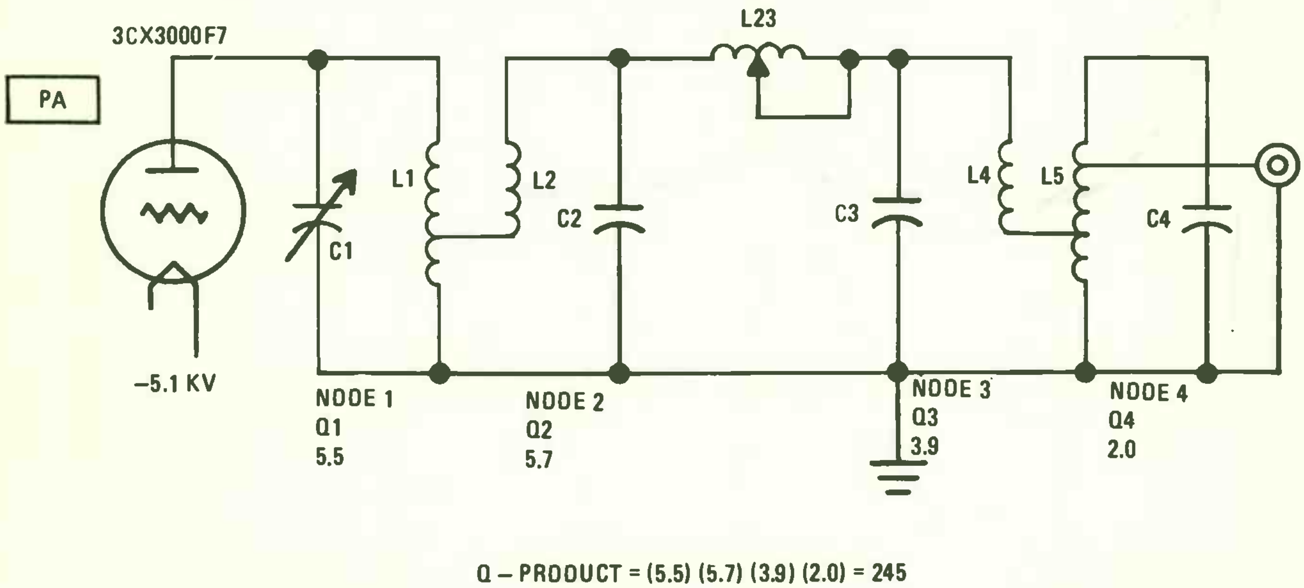

Figure 4-5. 4-Node RF Output Network.

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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 4-6 provides a comparison of the response curves of a Q Taper™ bandpass network and the low-pass network.

The Q product (Q1 X O2 X O3 X O4) determines the steepness of the skirts of the passband. With four nodes and three inductive couplings, the Q product required to obtain 80-dB attenuation of the second and higher harmonics is 245. The Q required for each individual node to attain this product is quite low, as shown in figure 4-5. This results in low circulating current, which translates to low component stress. The network components in the 828E-1 transmitter may appear to be very small for a 5-kW transmitter, but they are completely adequate, because the unique Q Taper™ network reduces component stress to levels far below those in other 5-kW transmitters.

The modulation monitor sample is provided by coil L6. It has adjustable taps for high and low power settings. The sample is obtained from a tap on node 4 coil L5.

4.3.1.5 RF Power Meter A9A6

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 two capacity dividers 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 samples and rectified. One output provides a reading proportional to forward power and the other provides a reading proportional to reflected power. The voltage samples are 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 values of A9A6C3 and C4 may have to be changed. For higher impedance lines, these capacitors 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 logic module A3 isolate the metering circuit from the detectors. The reflected power signal is used to actuate an overload circuit in control logic module A3 when the reflected power reaches a predetermined level. The meters are calibrated at the factory to read 100% (120% full scale) at 5.0 kW in the forward power position and 10% (12% full scale) at 500 watts in the reflected position. The vswr overload is set to trip at 500 watts reflected power, which represents a 2:1 vswr with 5.0-kW forward power.

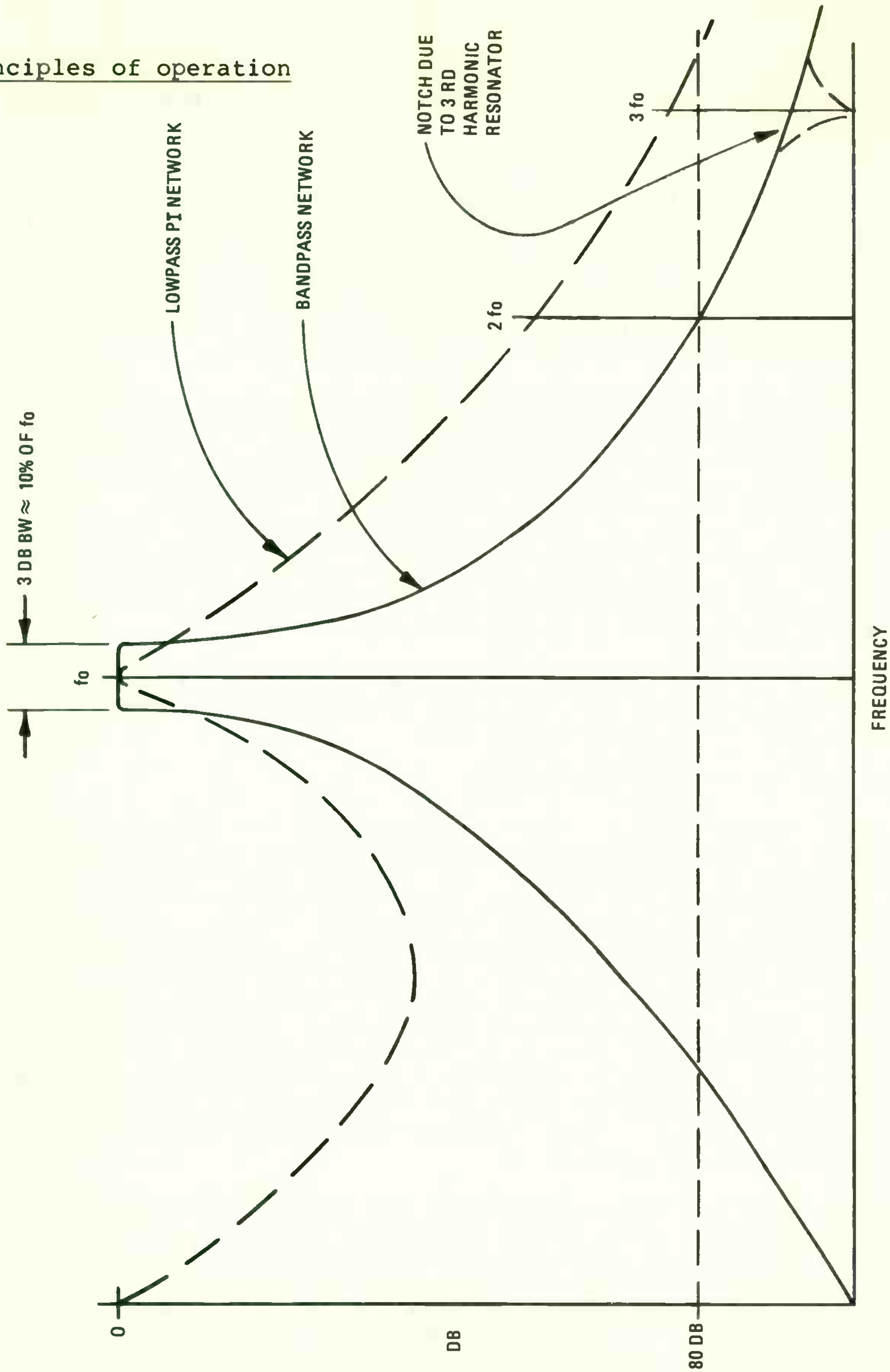

Figure 4-6. Comparison of Q Taper™ Bandpass and Usual Low-Pass (PI) Network Response.

Switch S1 permits reversing the current sample, which in turn reverses the forward and reflected readings (forward now reads reflected power and vice versa). This permits balancing both forward and reflected power and setting the vswr overload without physically turning the vswr detector around. Remember that the reflected power (now reading forward) is only 500 watts full scale and will trip the vswr overload. Transmitter power must be reduced below 500 watts during these adjustments.

4.3.2 Modulator Circuits

The modulator in the 828E-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 4-7 is a simplified schematic diagram of the 828E-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.

4.3.2.1 Pulse-Width Modulator (PWM) Module A2

The pulse-width modulator 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 U9, which is a comparator amplifier. The comparator output is a PWM waveform, as illustrated in figure 4-8. This is a series of pulses at a 70-kHz rate whose widths vary 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 Q1, which controls an LED mounted on the backplane behind the A2 module.

The LED light output is coupled through a fiber optic cable to a photodiode mounted on switching driver module A9A3 (refer to paragraph 4.3.2.2). Fiber optic coupling is used for high-voltage isolation. The PWM module (A2) is low-level circuitry, very close to ground potential. Switching driver module A9A3 floats on the negative high-voltage power supply, which feeds the cathode of the switching modulator. This approximately 13.7-kV difference in potential is isolated by the fiber optic cable.

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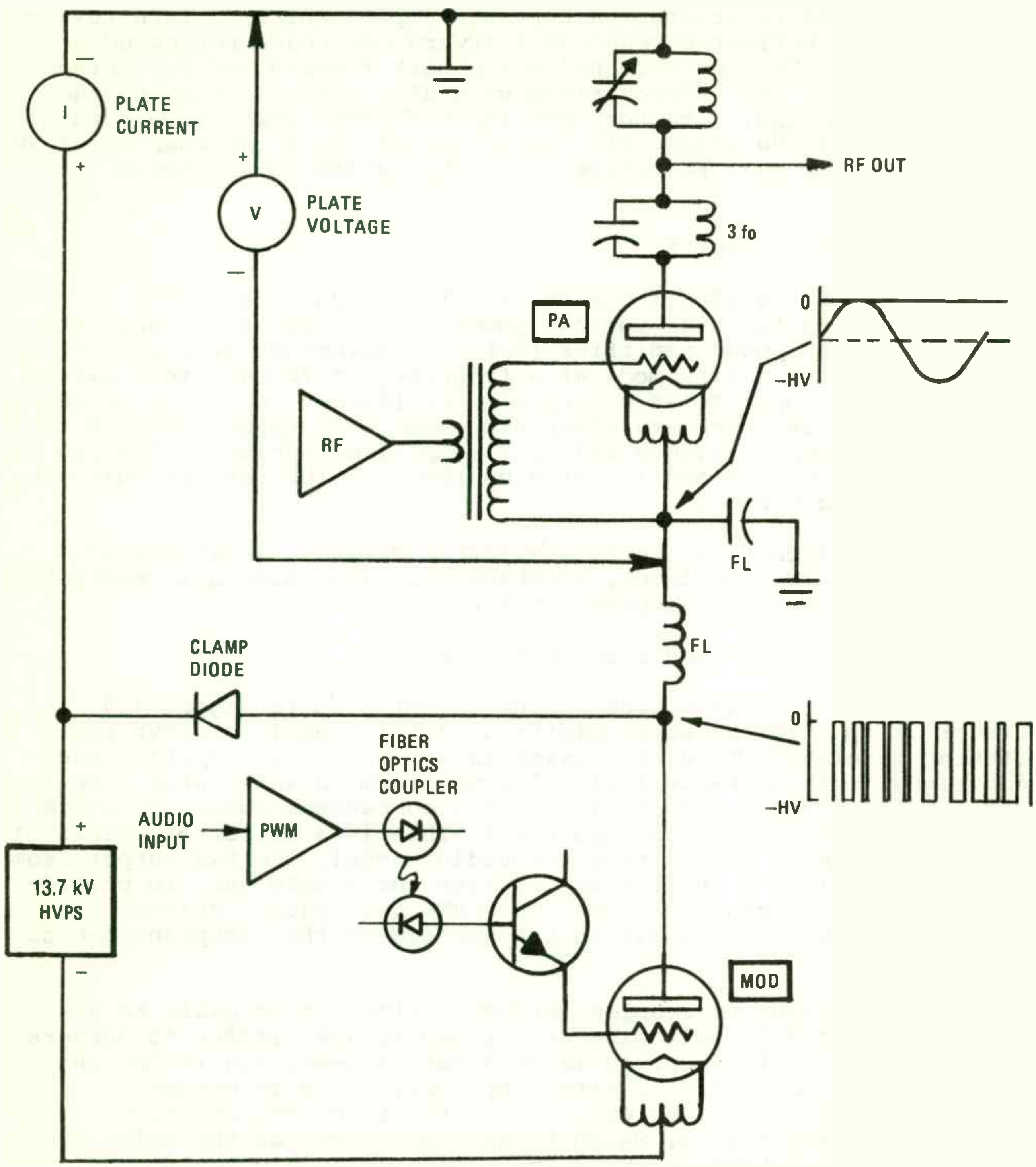

Figure 4-7. Transmitter Simplified Schematic.

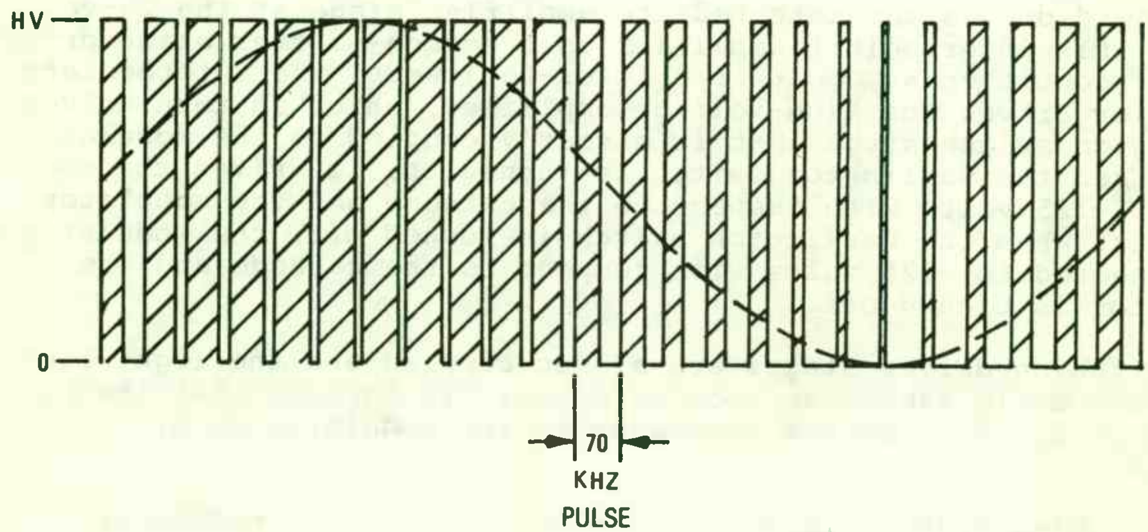

Figure 4-8. Typical PWM Waveform.

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4.3.2.2 Switching Driver Module A9A3

The switching driver is a solid-state amplifier that amplifies the PWM signal output to the level necessary to drive switching modulator A9V2 (refer to paragraph 4.3.2.3). Figure 4-9 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 on, it drives the modulator grid to +125 volts with respect to the cathode and the modulator conducts. 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.

4.3.2.3 Switching Modulator A9V2

The switching modulator is an Eimac 3CX3000F7 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 4-10 is a simplified schematic of the switching modulator circuit.

The -13.7-kV high-voltage supply output is applied to the switching modulator cathode. The switching driver drives the modulator grid

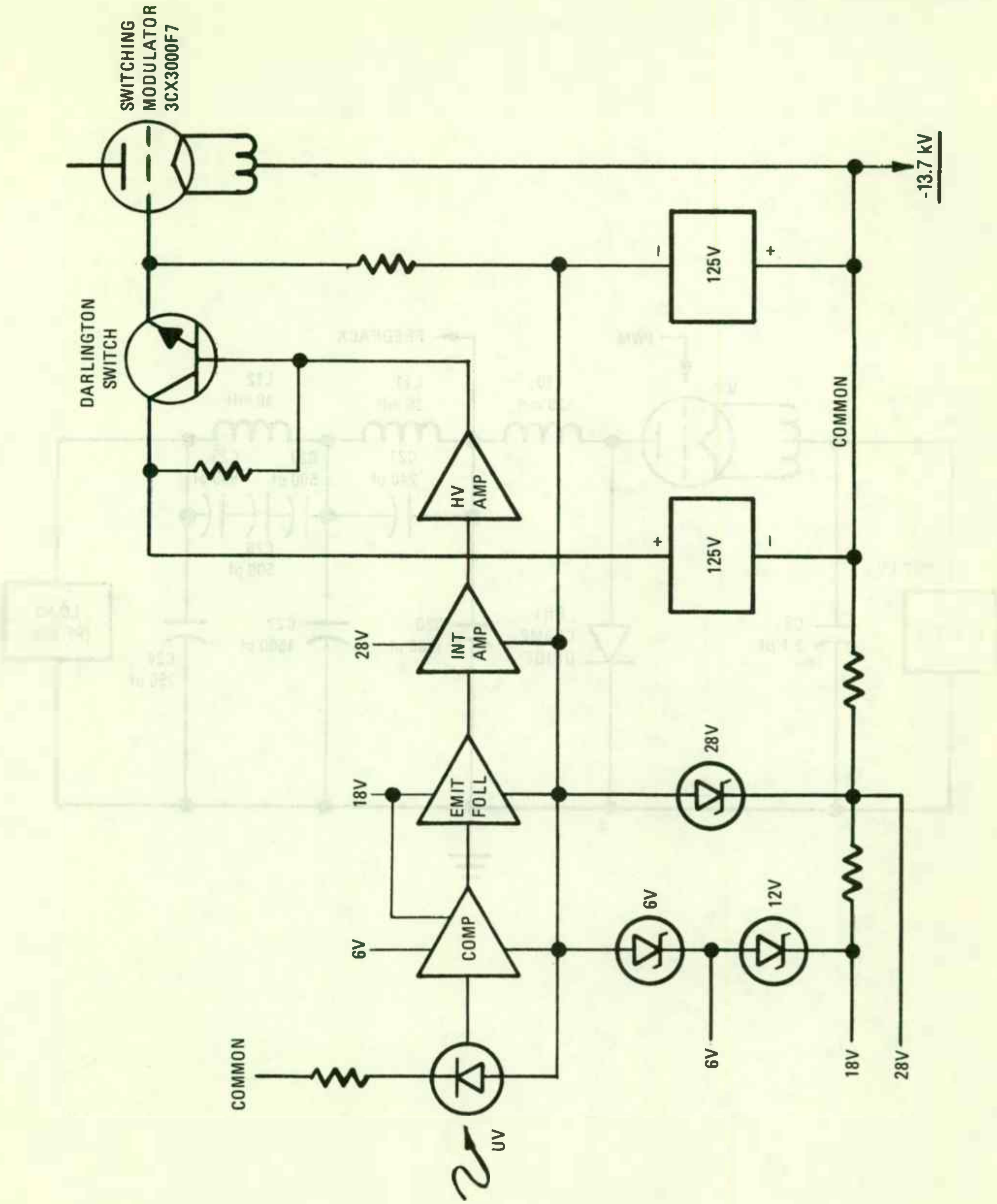

Figure 4-9. Switching Driver Operation, Block Diagram.

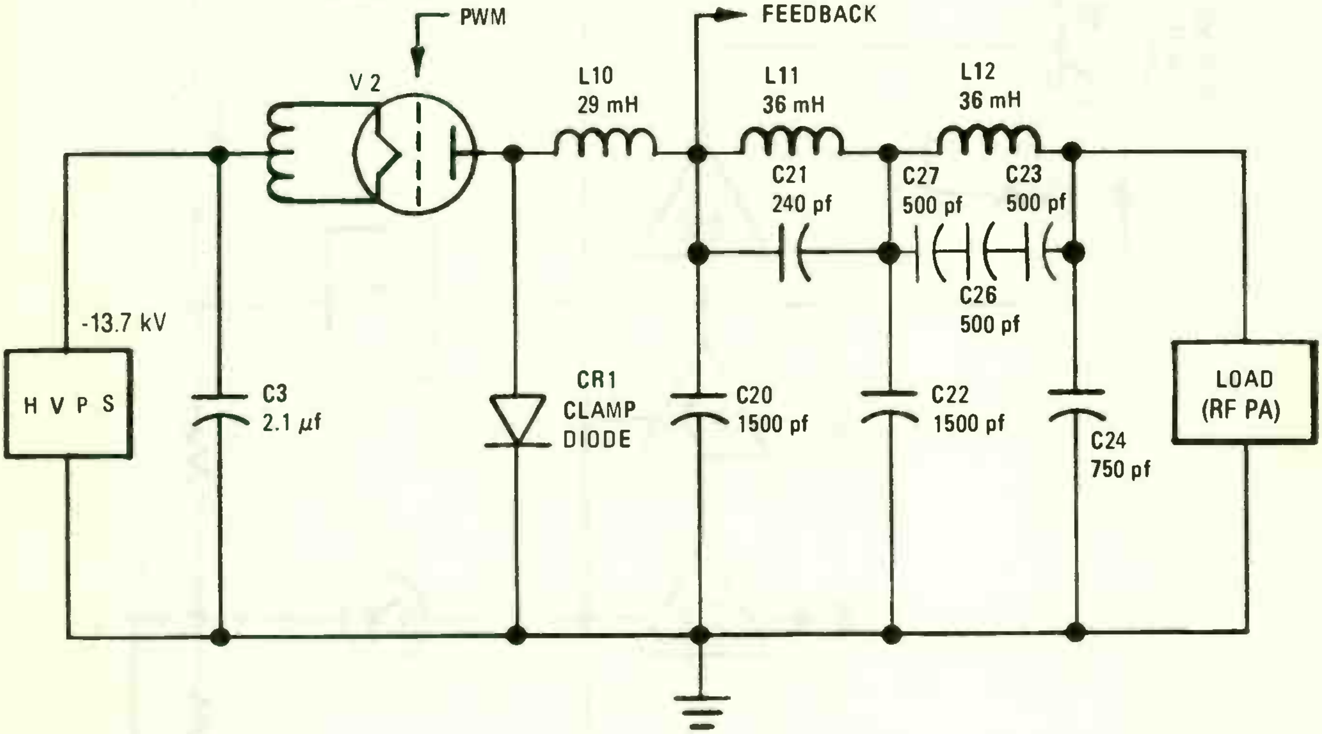

Figure 4-10. Switching Modulator Circuit.

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 -13.7 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 sidebands and harmonics. This low-pass filter is very important in the performance of the switching modulation system. It is designed to terminate in a impedance of 4000 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 (A9A1) delivers a feedback signal at the -4-volt level to PWM module A2. A low-level filter in the PWM module 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.

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 828E-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 828E-1 transmitter is a 12-phase power supply, in which the ripple frequency is doubled and the filtering requirements are reduced to the point where a filter choke is unnecessary. Only a filter capacitor is required. Elimination of the filter choke also eliminates low audio frequency resonances that occur in most high-voltage power supply filters. Figure 4-11 is a simplified schematic diagram of the high-voltage power supply.

The high-voltage power supply is composed of two 3-phase full-wave bridge rectifiers, each operating at half the output voltage, connected in series to obtain the full output voltage. A special power transformer is required, which has two separate 3-phase secondary windings, one for each of the 3-phase full-wave rectifiers. One secondary is a wye circuit and the other is a delta circuit. Each secondary has a ripple frequency six times the line frequency (6 X 60 = 360 Hz). Since the two secondary outputs are 60 degrees out of phase, the ripple frequencies are additive in series (360 + 360 = 720 Hz). This is 12 times the line frequency; hence the name, 12-phase power supply. The ripple magnitude at this frequency is very small (nearly 40 dB down from the dc output level), so the filtering required is minimal.

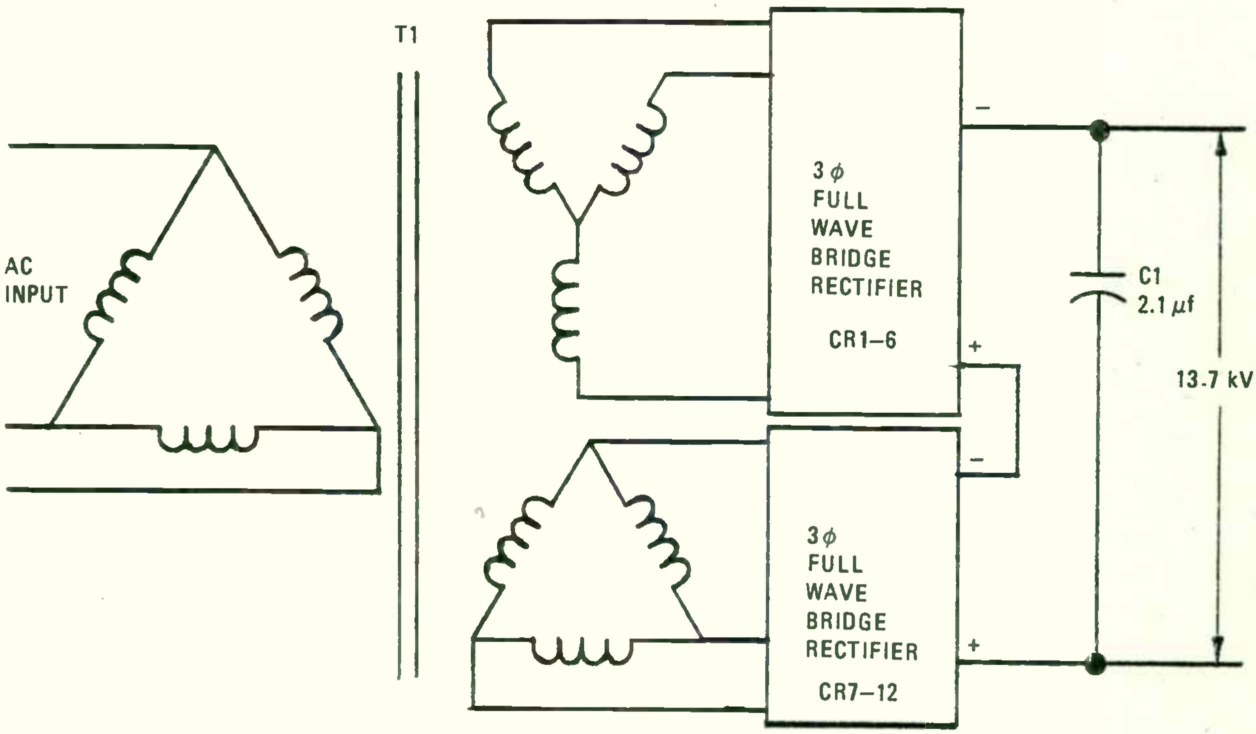

Figure 4-11. High-Voltage Power Supply Circuit.

In this power supply, adequate filtering is provided by a capacitance of only 4.2 microfarads, A10C1 and A9C3.

The nominal output voltage of the high-voltage power supply is 13.7 kV, and the normal load current at carrier conditions is about 500 mA. At 100 percent modulation, the current increases to about 750 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 (1.25 A X 40% = 500 mA). The difference current, between 1.25 A and 500 mA, flows through the clamping diode. Note that these numbers represent no modulation 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 in delta or from 345 to 435 volts in a wye connection. 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 828E-1 transmitter uses only two 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 module A4, the 28-volt power supply, the RF driver power supply, and the modulator bias power supply.

4.3.4.1 Logic Power Supply Module A4

The logic power supply module provides the +5, -6, and ±12 volts required by the various low-level circuits. The transformer for this power supply is mounted on the bottom of the RF box at the left rear; it supplies 24 volts ac to the full-wave rectifier in the module. the transformer center-tap is also carried through to provide ±18-volt outputs. Integrated circuit regulators provide the regulated +5-, -6-, and ±12-volt outputs. The regulators are mounted on heat sinks in the module 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 module shield. The LED indicators on the module front panel indicate the presence of each of the four voltages and the DC 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, followed by a regulator on the A7A2 card and power transistors A7Q1 and A7Q2. It is capable of supplying about 4 amperes of output current.

NOTE

Caution should be exercised to ensure that the 28-volt power supply is not loaded with external loads in excess of 2 amperes.

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 driver module A9A4. A 28-volt output is also available at the remote control terminal strip A7TB2 for use in remote control of the transmitter.

4.3.4.3 RF Driver Power Supply

The RF driver power supply is a single-phase, full-wave bridge circuit that supplies 3.0 amperes at 200 volts to the solid-state RF driver module. A single LC filter section, consisting of A7L1 and A7C2, provides adequate filtering of the ripple frequency.

The transformer for this power supply has a 1:1 turns ratio, primary to secondary. It supplies 208 volts rms to RF driver-rectifier A7CR2. Additional taps on the secondary provide 115 volts rms to furnish power for RAISE/LOWER motor A6B1 and cabinet fan B2.

4.3.4.4 Modulator Bias Power Supply

The modulator bias power supply is a 3-phase, 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 (-13.7 kV), which is connected to the modulator (A9V2) 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 13.7-kV potential between them. Note also that the printed circuit board containing the rectifiers and filters is isolated electrically from the chassis because of the 13.7-kV differential.

4.3.5 Control and Monitor Circuits

The control circuits operate from an internal +28-volt power source. The local controls are always active, regardless of the position of LOCAL/REMOTE switch A5S10. With the switch in the REMOTE position, the +28-volt power source, in addition to operating the local controls, is connected to A7A1TB1-7 to furnish power for optional remote control interface assembly A7A4 (PN 627-9721-001). In the LOCAL position, the LOCAL/REMOTE switch connects a jumper across the remote fail-safe terminals at A7A1TB1-7 and -8.

4.3.5.1 Power Control Circuits

The power control circuits include the indicating control pushbutton switches on the front door of the transmitter, the low-level 28-volt relays located on the control relay printed circuit board on the rear of the left side panel, the blower and filament contactors on the left side panel, and the high-voltage contactor on the right side panel. Three door interlock switches are connected in series to prevent application of high voltage if the front door is open or if either the lower front panel or the rear cover is removed. 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 A6CB1 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, overload relay A7A1K2 on the control relay card is not energized, 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 A7K1, which is then held in through its holding contacts, 4 and 12. These contacts are in series with the FILAMENT OFF switch and the remote FILAMENT OFF switch (or if the LOCAL/REMOTE switch is in the LOCAL position, the jumper on A7A1TB1-3 and -4). When the blower contactor is operated, it applies ac power to blower B1 and cabinet fan B2. 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 A9S3, located on the bottom of the power amplifier grid compartment, closes and applies 28 volts to filament contactor A7K2. When the filament contactor is operated, it connects ac power 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 (both local and remote on A7TB1-8 and -9).

   The FILAMENT OFF switch is normally closed. When it is pressed, it causes the holding circuit on the blower contactor to be interrupted, deenergizing 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 no filament time-delay circuit because the filaments in both the power amplifier and modulator tubes are thoriated tungsten and require 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, the bias circuit breaker is on, the thermal interlock is closed, and overload relay A7A1K2 is not energized before 28-volt power is available for the plate-on sequence.

The plate-on sequence is started by pressing either the PLATE LP or the PLATE HP switch. Because there is choice of either low power or high power, latching relay A7A1K1 is provided on the control relay 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 module A2 and also energizes HV ON relay A7A1K3 on the control relay card. When the HV ON relay is energized, through either diode A7A1CR3 (LP ON) or CR4 (HP ON), it holds itself through holding contacts 9, 10 and 5, 6 in series with the overload relay, the door interlocks, and the PLATE OFF switches(local and remote at A7A1TB-7 and -8). It also applies 28-volt power to high-voltage contactor A8K1. This connects 3-phase power to the high-voltage plate transformer and 28-volt power to the carrier interlock terminal on terminal board A7TB2-11. This terminal is connected through any desired external interlock circuit and returned to A7TB2-10, where it allows the PWM signal in PWM module A2 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 PLATE LP or PLATE HP, is also coupled back to the FILAMENT ON circuit through diode A7A1CR17 to enable a complete turn-on sequence by merely pressing either the PLATE LP switch or the PLATE HP 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 A7A1 card indicate which relays are actuated to aid in troubleshooting the power control circuits.

4.3.5.2 Overloads and Recycle

Control logic module A3 contains the overload and recycle circuits. The three overload circuits are the high-voltage power supply overload, the arc sensor, and the vswr overload. Each overload circuit is connected to a separate LED indicator on the front panel of the control logic module. If any one of the overload circuits is actuated, it lights its indicator. It also sends a signal through the U1 logic gate to one-shot multivibrator U2. The $\overline{Q}$ output from U2 is coupled to U10B in PWM card A2. 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 S1 on the control logic module front panel is pushed to reset the SCR and extinguish the LED.

The $\overline{Q}$ signal from U2 is also applied to the input of counter U3. The signal through logic gate U1 that causes U2 to operate is also coupled through a section of U6 to timer U5 and starts a timing cycle of about 20 seconds. The output of timer U5 is coupled through a section of U6 back to counter U3. The counter counts only during the timing cycle of timer U5. If it counts four overloads during the 20-second timing cycle, it then has an output on pin 9 of U3.

If RECYCLE switch A3S2 is in the ON position, the output on pin 9 of U3 is coupled to the second one-shot multivibrator, the output operates overload relay driver A7A1K2 on control relay card A7A1, 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 U1 is coupled directly to U4 to operate overload relay driver Q4 and cuts off the high voltage on the first overload.

The circuit of Q5 and Q6 is an integrator, which also can operate overload relay A7A1K2. If the RECYCLE switch is ON, but a single extended (long time) overload occurs, integrator C20 charges, operating Q5, 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.

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

The AC TEST meter has an iron vane movement, which allows rms readings of the three ac input lines and the power amplifier and modulator filament voltages. The voltage shown on the meter is selected by the associated 5-position rotary AC TEST meter switch. In normal line voltage operation (200 to 250 volts), the input line voltage is measured line-to-line. In high-voltage operation (345 to 435 volts), the input line voltage is measured line-to-neutral. The filament voltages are measured at the primaries because the secondaries are floating at the high-voltage potential of -13.7 kV.

The DC TEST meter reads the logic power supply output voltages, the 28-volt dc power supply voltage, the RF driver supply voltage and current, and the high-voltage power supply voltage. The voltage shown on this meter is selected by the associated 8-position rotary DC 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.

The RF POWER meter reads either the forward power or the reflected power at the transmitter output to the antenna. Choice of forward or reflected power reading is chosen by operation of an associated 2-position rotary RF POWER-FORWARD/REFLECTED switch.

In the FORWARD position, the meter reads up to 120 percent power; in the REFLECTED position up to 12 percent.

SECTION 5
MAINTENANCE

SECTION 5
MAINTENANCE

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 828E-1 Maintenance.

Voltohmmeter
Oscilloscope
Audio Oscillator
Audio Distortion Analyzer
RF Dummy Load (10 kW)
Frequency Counter
Variable DC Power Supply (1.1 A)

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 cover 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.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

The air interlock switch, A9S3, located on the bottom of the PA grid compartment behind the card cage, 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 meter 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 diaphragm 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 828E-1 transmitter requiring lubrication are the bearings of the blower motor. 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 (100°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 828E-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 one-half division (25 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 PWM module A2R37 to set the low power to the desired level.

As long as the antenna and/or dummy load impedance at the transmitter (measured at jack A9J1 in the rear of the RF box) 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 4000 ohms:

$$\frac{E_{BB}}{I_B} = 4000\,\Omega.$$

At full power (5400 watts), this should nominally be a plate voltage of 5000 volts at a plate current of 1.25 amperes. If the loading varies enough to cause the plate voltage to go below 4800 volts or above 5200 volts, or if the plate current goes below 1.2 amperes or above 1.3 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 PWM module A2. 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 (A2R73) 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 (A2R76) 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 regularly and adjusted as required to stay within the desired operating range of 7.3 to 7.5 volts.

Adjust both the PA and modulator filament voltage rheostats (A6R1 and R2) to 7.3 $\pm$0.1 volts as indicated on the AC TEST meter on the front panel. Filament voltage specified on the manufacturer's data sheets for the 3CX3000F7 is 7.5 volts rms. However, tube life can be increased significantly by operating at slightly reduced filament voltage. Performance in the 828E-1 transmitter is not degraded by reduction of 2 to 3 percent below specified filament voltage of 7.5 volts and tube life is increased appreciably.

In no case should the filament voltage be reduced more than 5 percent (below 7.13 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 828E-1 transmitter to protect various components from excessive voltages during fault conditions. The A9E11 and A9E13 gaps are located to the left of the modulator tube and should be set to a gap of 7.92 mm (5/16 in.) from the center post to negative high voltage (E13) and set to a gap of 6.35 mm (1/4 in.) from the center post to ground (E11).

The A9E9 and A9E10 gaps are located on PA grid transformer A9T1 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 A9E5 is mounted to the right of the PA tube on the front of the neutralizing capacitors (A9C14-18) and is connected to an arc sensor circuit. This gap should be adjusted to 7.92 mm (5/16 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 (A2) contains two separate crystal oscillators. Either oscillator circuit may be used, or if a spare crystal is installed, both oscillators can be used interchangeably. Each oscillator has an adjustment for setting the frequency of operation available from the front panel of the RF exciter module. A frequency monitor output of 5 volts p-p into 50 ohms is provided at A7J1, located on the left rear of the transmitter. This is adequate to drive most 50-ohm counters. If oscillator 1 is selected, as indicated by the LEDs on the front of the module, adjust C2. If oscillator 2 is selected, adjust C9. 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 circuits are temperature-compensated to have less than 20-Hz change in frequency over a temperature range of -10° to +50°C ambient.

5.3.2 RF Pulse Width

The RF pulse-width adjustment (R20) 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 approximately 120 degrees. This provides the proper amount of third harmonic content in the RF drive signal to make the high-efficiency Tyler circuit function properly. The output of the RF exciter module can be monitored with a scope by observing the waveform on pin 14 of the RF exciter module while it is operating on the card extender. This signal should be approximately 8 volts p-p and should show a positive-going pulse of about 120 degrees (one-third duty cycle). With the proper setting of the pulse width, the PA anode waveform on C45 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 the 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.

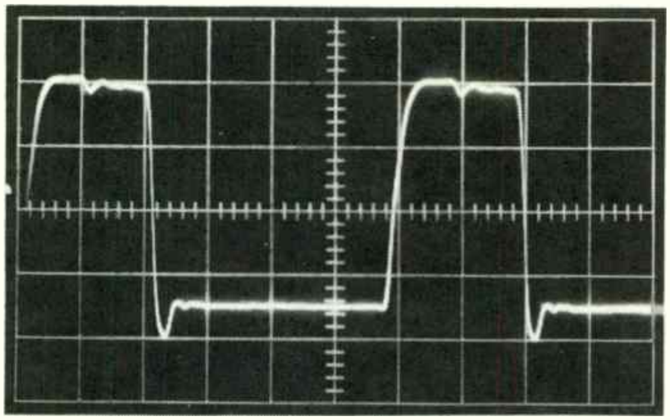

Figure 5-1. RF Exciter Output Waveform.

5.3.3 RF Driver Protection Circuit

The RF driver protection circuit 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 the driver input stage to ground. To adjust the protect circuit, slowly increase the sensitivity by turning R103 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-half 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 (A2R3), located on the front of the PWM module (A2), 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.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

If distortion measuring equipment is not available, adjusting the LF distortion control for minimum audio at TP3 on the PWM module, 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 module (A2) 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, A2R26, is located on the front of the PWM module and should be adjusted as follows:

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

b. Switch to a convenient low-power level of approximately 1 kW or less.

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 now 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.

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, A2R49, is located on the front of the PWM module (A2). 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, A3R1, is located on the front of the control circuit module (A3). The HVPS overload sensor, A10R1, is located on the A10 subassembly mounted on the rear bottom of the RF network compartment. 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 HVPS 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 A10E9 and ground with the negative side grounded. Adjust the variable LVPS to produce 1.1 amperes of current flow in A10R1. With this connection, the plate current meter on the transmitter front panel, A5M4, will read the correct current of 1.1 amperes. Turn on only the low-voltage circuit breaker, A6CB1, 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 A3S1, 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, A3R1, until it trips at 1.1 amperes.

5.3.8 VSWR Overload

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

a. Reflected power balance, A9A6C6

b. Forward power balance, A9A6C5

c. Reflected power calibrate, A9A6R10

d. Forward power calibrate, A9A6R9

e. Vswr overload, A3R5.

The balance and calibrate controls for both forward and reflected power are located in the RF power meter sensor and can be accessed from the top of the transmitter. The vswr overload is located on the front of control circuits module A3. In order to make the first four 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 than ±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

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

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, A9A6. If the calibration is adequate, the vswr overload may be set as follows:

a. Set the transmitter power output to 500 watts.

b. Place the NORMAL-REVERSE switch, A9A6S1, in the REVERSE (down) position.

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

d. Adjust the vswr overload, A3R5, 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 (up) 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 A9L3 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 A9L3 has a fairly large effect on loading. Never change its value by more than one turn in a step. After each change of A9L3, 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 and that the third harmonic resonator is properly tuned. If either one of these adjustments 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 4000 ohms,

$$\frac{E_{BB}}{I_B} = 4000\Omega$$

with the proper power output and PA efficiency. The efficiency is normally about 86 to 88 percent and the readings in table 5-2 or 5-3 are typical.

5.3.10 PA Neutralizing

The PA neutralizing is adjusted by varying the position of "clam-shell" neutralizing capacitor (A9C29) mounted behind and to the left of the PA tube. 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 BIAS and HVPS circuit breakers.

Table 5-2. 828E-1 Typical Meter Readings.

POWER OUTPUT (Watts)	E_{BB} (Volts)	I_C (Amperes)	EFFICIENCY (%)
5500	5000	1.25	88
5400	4975	1.24	88
5000	4800	1.20	87
2500	3400	0.85	87
1000	2200	0.53	86
500	1500	0.40	84
250	1100	0.27	84

Table 5-3. 828D-1 Typical Meter Readings.

POWER OUTPUT (Watts)	E_{BB} (Volts)	I_C (Amperes)	EFFICIENCY (%)
2750	3500	0.90	87
2500	3400	0.85	87
1000	2200	0.53	86
500	1500	0.40	84
250	1100	0.27	84

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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. The most convenient location to connect the resistor is from the J-plug connector to ground after removing the J-plug, which will disconnect the antenna from the transmitter output.

Remove the rear transmitter panel and the output network cover.

CAUTION

There are 250 volts ac present at exposed terminals in the bottom of 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. Loosen the setscrew that locks the neutralizing capacitor in place. Connect an oscilloscope to the modulation monitor sample (A9J2). With the front door closed, press the FIL ON pushbutton, which will apply filament voltage and will turn on the RF driver. Change the distance of the neutralizing to the PA tube while observing and adjusting 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. Use an insulated rod or dowel for adjusting capacitor A9C29 to minimize any shock hazard and to eliminate the effect your hand will have on the circuit. If A9C29 does not have the range to neutralize the PA tube, it may be necessary to replace A9C19 with another value.

Neutralization is factory adjusted and does not require adjustment unless there have been major changes in the output network, the third harmonic resonator, or when the PA tube is changed.

5.3.11 Third Harmonic Resonator

The third harmonic resonator coil, A9L7, located above and behind the PA tube, is adjusted to give the proper waveform at the anode of the PA tube. This waveform can be observed with an oscilloscope connected to test point A9C46, mounted in the wall to the right of the PA tube. If the transmitter installation does not permit access to the outside of the cabinet at that point, test point A9C46 and its small pickup plate can be remounted in the top of the RF box above the PA, but not directly in the hot-air stream. Make adjustments to the resonator coil in very small increments, no larger than 12.7 mm (one-half inch), until the waveform looks like that shown in figure 5-2. The pulse width must also be adjusted properly to 120 $\pm 10°$ to achieve this waveform.

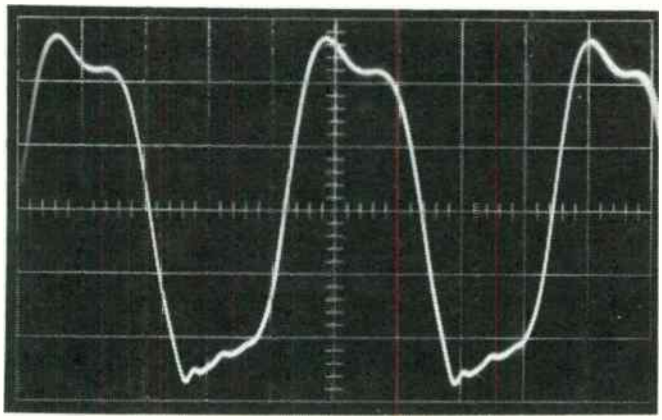

Figure 5-2. High-Efficiency PA Anode Waveform.

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 module is on the extender card with its top cover removed. 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 TP5 in the PWM module. Adjust switch frequency R62 to obtain a frequency of 70.0 $\pm$0.5 kHz. The waveform at TP5 should be a 70-kHz symetrical 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 TP1 with an oscilloscope and adjust R17 for minimum audio signal at TP1. 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 5-3, or reaches +130 percent positive modulation. Adjust clamp R58 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 U4 from its socket and connect the positive lead from a variable LVPS to TP3. Connect the negative lead to ground. With no audio input, observe the dc voltage at TP2 with an oscilloscope. With the variable LVPS set to 0 volt, adjust amplifier offset R42 for 0-volt dc at TP2. With the variable LVPS set to +6.0 volts at TP3, adjust control offset R40 for 0-volt dc at TP2. Repeat the above two steps until zero volt appears at TP2 under both conditions; that is, with either 0 or +6.0 volts at TP3. The voltage at TP2 may go either positive or negative and must be adjusted very carefully to be exactly zero volt.

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 TP3 and adjust audio offset R41 to obtain minimum audio voltage at TP2. Remove the variable LVPS and reinstall U4.

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 transmitter output A9J1 are within ±5 ohms of these values, the vswr is 1.22:1 or

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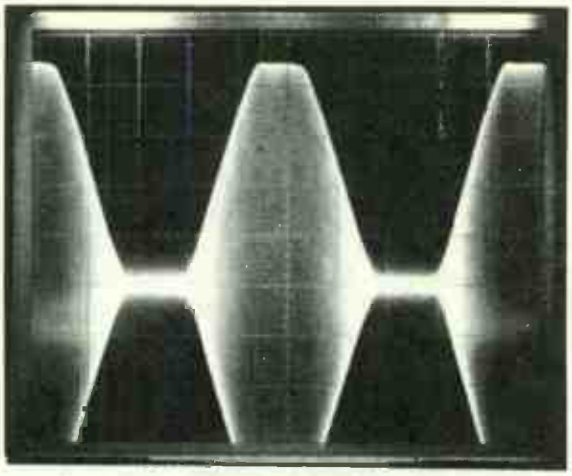
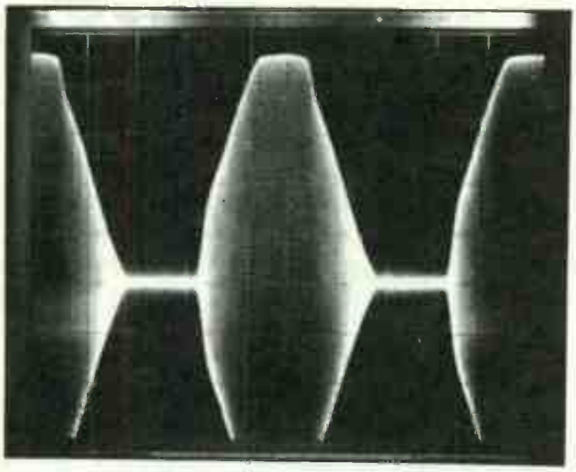
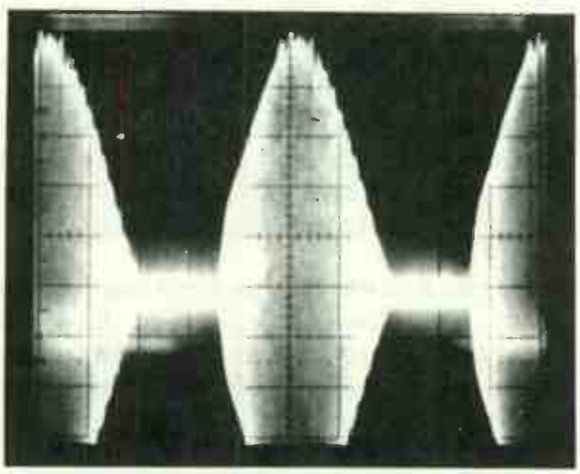


A. WITH THE IPL ON AND PROPERLY ADJUSTED.



B. IPL OFF WITH CLAMP PROPERLY SET.



C. IPL OFF WITH CLAMP SET TOO HIGH.

Figure 5-3. Audio Waveforms.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

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 Reflected Power Balance

Operate the transmitter into the desired load at the 5-kW power level with no modulation. Adjust the reflected power balance, A9A6C6, located on top of the transmitter, for minimum indication of the REFLECTED position of the RF power meter, A5M5, located on the front panel. The NORMAL-REVERSE switch, A9A6S1, located behind the back cover of the RF output network compartment on the RF power meter subassembly, must be in the NORMAL (up) position.

5.4.2.2 Forward Power Balance

Reduce the transmitter power output to 500 watts. Place the NORMAL-REVERSE switch, A9A6S1, in the REVERSE (down) position. Adjust forward power balance A9A6C5, located on top of the transmitter, for minimum indication on the FORWARD position of RF power meter A5M5. Return the NORMAL-REVERSE switch to its NORMAL (up) position.

5.4.2.3 Reflected Power Calibrate

Set the transmitter power output to 500 watts. Place the NORMAL-REVERSE switch, A9A6S1, in the REVERSE (down) position. Adjust reflected power calibrate A9A6R10, located on top of the transmitter, to obtain a reading of 10 percent (full scale is 12 percent) in the REFLECTED position of RF power meter A5M5. Return the NORMAL-REVERSE switch to its NORMAL (up) position.

5.4.2.4 Forward Power Calibrate

Set the transmitter power output to 5000 watts. Place the NORMAL-REVERSE switch, A9A6S1, in the NORMAL (up) position. Adjust forward power calibrate A9A6R9, located on top of the transmitter, to obtain a reading of 100 percent (full scale is 120 percent) in the FORWARD position of RF power meter A5M5.

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 table 5-4 indicates the coil and capacitor values required for each of the four bands. The parts list in section 7 might also be helpful in verifying the correct components.

The RF output network used in the 828E-1 consists of four parallel-tuned circuits, all tuned to the carrier frequency, coupled together to form a bandpass filter between the power amlifier 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 high-efficiency power amplifier. The other function is to match the antenna or load impedance to the plate of the power amplifier. Figure 5-4 shows a simplified schematic of the RF output network, including the third harmonic resonator in series with the PA anode. To tune the RF output network, the third harmonic resonator must be tuned to the third harmonic of the carrier frequency; the four parallel tuned circuits, or nodes, must be tuned to resonance at the carrier frequency; and finally 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 coil as they were set in the original factory test.

5.4.3.1 Third Harmonic Resonator

Tuning of the third harmonic resonator can be accomplished two ways. If the transmitter is operational, the value of the capacitor in the third harmonic resonator, A9C10, can be verified in the tuning chart of table 5-4. The taps on the third harmonic resonator coil, A9L7, can be set in accordance with the curves of figure 5-5. This sets the coarse tuning of the third harmonic resonator. The final fine-tuning is accomplished by operating the transmitter and fine-tuning the resonator coil in accordance with paragraph 5.3.11.

If the transmitter is not operational, the fine-tuning can be done by driving an RF signal at exactly the third harmonic frequency into the PA mode circuit through a 10-kilohm resistor. Observe the signal on the PA anode with an oscilloscope or RF voltmeter, and tune the resonator for maximum signal.

5.4.3.2 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 network tuning chart of table 5-4 and the curves of figures 5-6, 5-7, 5-8, and 5-9.

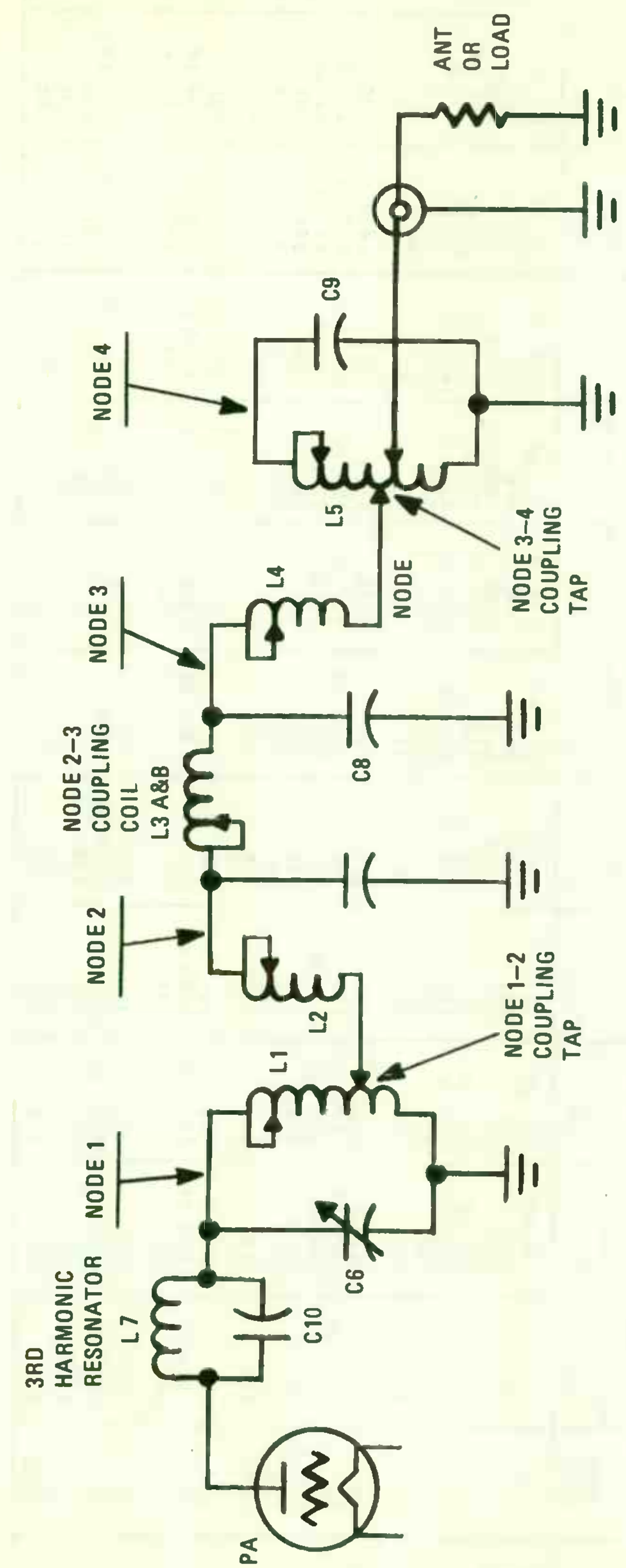


Figure 5-4. RF Output Network, Simplified Schematic.

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WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Table 5-4. 828E-1 Network Tuning Chart.

NOM R_{NN}	BAND FREQ	1			2			3			4		
		540	620	700	710	820	930	940	1080	1230	1240	1400	1600
3rd	C10	330 pF	330 pF	330 pF	220 pF	220 pF	220 pF	139 pF	130 pF	130 pF	82 pF	82 pF	82 pF
3rd	L7	20t	16t	13t	18t	13t	9t	16t	12t	9t	14t	11t	8t
3000	R11	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
	C6	541 pF	471 pF	417 pF	411 pF	356 pF	314 pF	311 pF	270 pF	237 pF	236 pF	209 pF	183 pF
	L1	120 µH	120 µH	120 µH	120 µH	120 µH	120 µH	120 µH	120 µH	120 µH	82 µH	82 µH	82 µH
	L1	46t	41t	35t	45t	37t	30t	43t	34t	28t	40t	33t	26t
	L2T	7t	5t	4t	7t	5t	4t	7t	5t	4t	7t	5t	4t
1250	R22	1400	1240	1070	1270	1110	980	1270	1110	980	1400	1240	1070
	C7	1200 pF	1200 pF	1200 pF	1000 pF	1000 pF	1000 pF	750 pF	750 pF	750 pF	510 pF	510 pF	510 pF
	L2	120 µH	120 µH	120 µH	82 µH	82 µH	82 µH	82 µH	82 µH	82 µH	82 µH	82 µH	82 µH
	L2	35t	28t	23t	34t	28t	23t	28t	23t	18t	23t	20t	16t
	L3A	56t	30t	6t	25t	6t	48t	56t	48t	42t	47t	41t	35t
	L3B	56t	56t	56t	56t	56t	0t	0	0	0	0	0	0
625	R44	660	580	500	730	640	560	660	570	500	660	580	500
	C8	1500 pF	1500 pF	1500 pF	1200 pF	1200 pF	1200 pF	1000 pF	1000 pF	1000 pF	750 pF	750 pF	750 pF
	L4	44t	36t	28t	34t	27t	22t	24t	19t	15t	19t	16t	13t
400	R55	400	350	300	400	350	300	400	350	300	400	350	300
	C9	2000 pF	2000 pF	2000 pF	1200 pF	1200 pF	1200 pF	1000 pF	1000 pF	1000 pF	750 pF	750 pF	750 pF
	L5	46t	35t	23t	36t	29t	23t	31t	23t	16t	26t	20t	13t
	L4T	33t	22t	12t	24t	18t	12t	19t	12t	7t	16t	10t	5t
	50ΩT	24t	18t	12t	20t	15t	11t	16t	11t	7t	14t	10t	6t

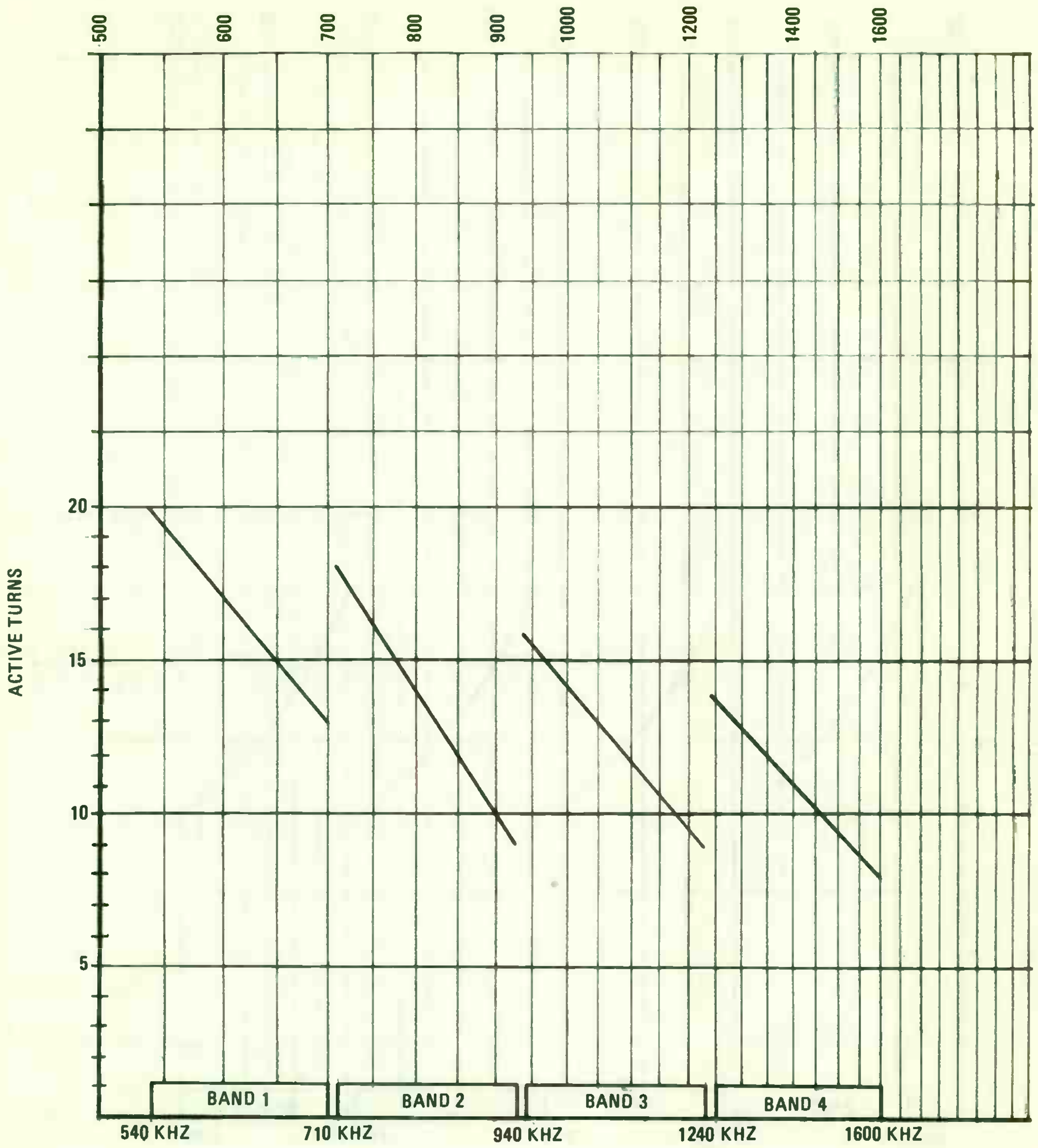

Figure 5-5. 828E-1 Third Harmonic Resonator Coil A9L7.

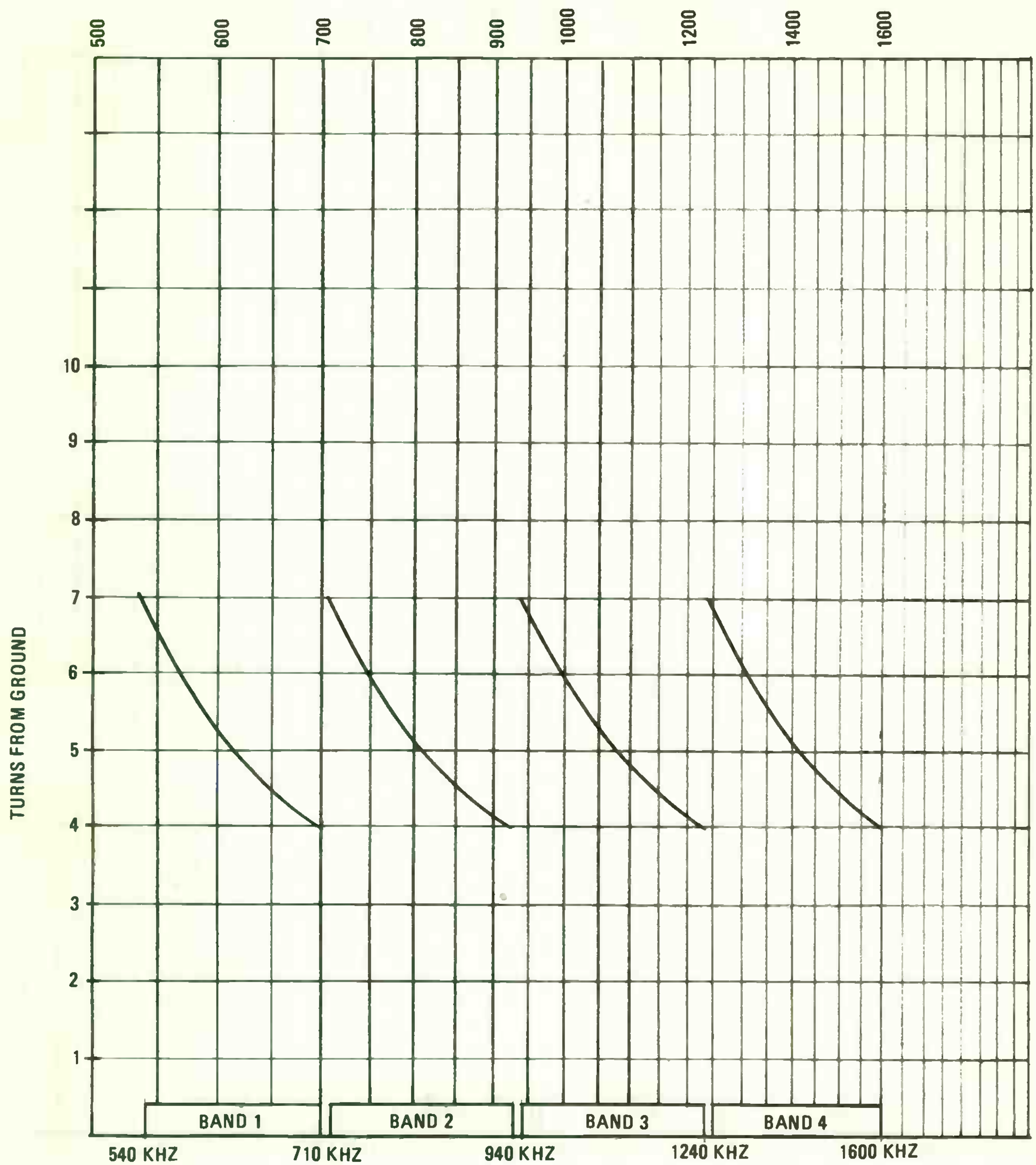

Figure 5-6. 828E-1 Node 1-2 Coupling Tap (on A9L5).

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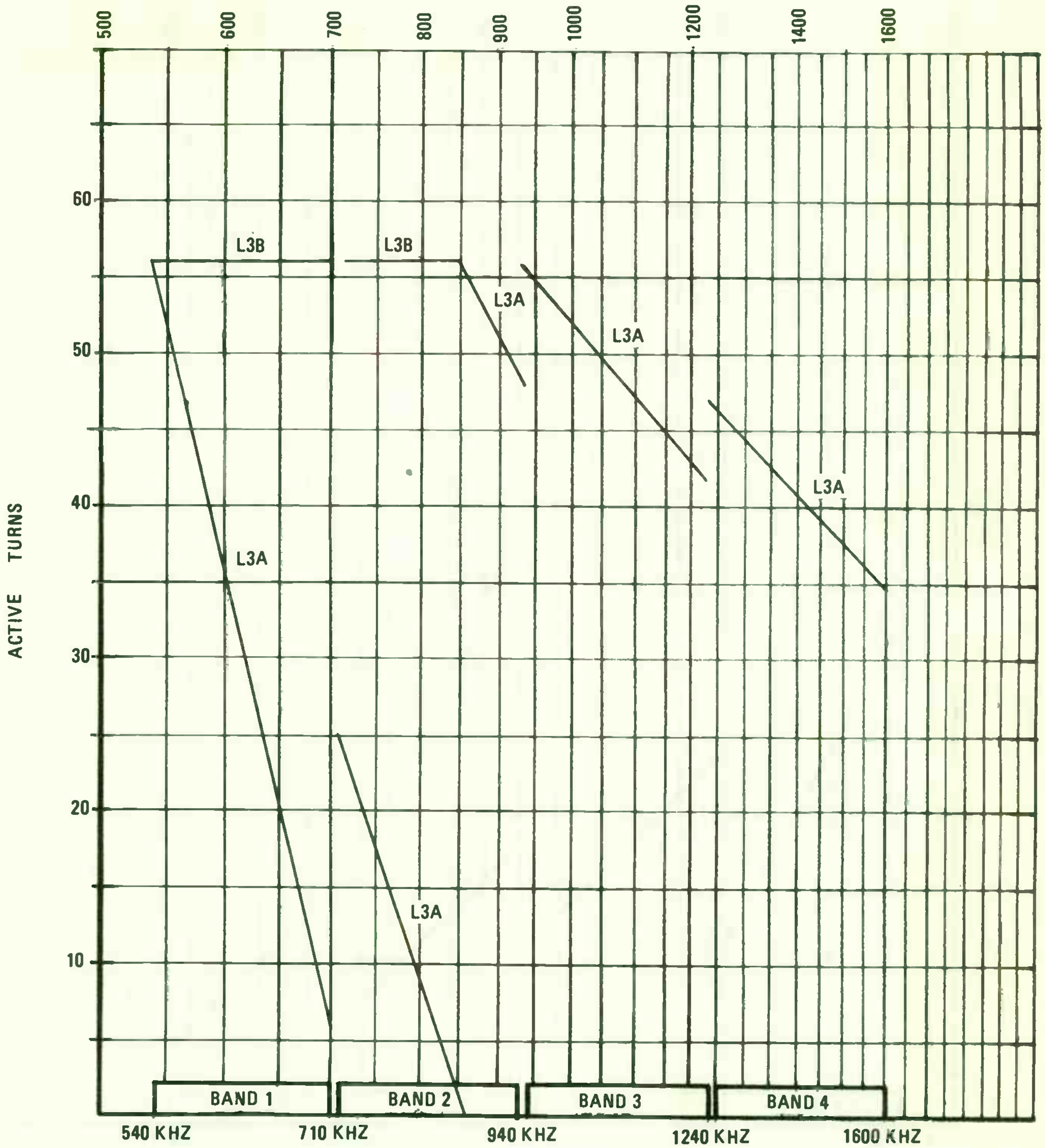

Figure 5-7. 828E-1 Node 2-3 Coupling Coil A9L3.

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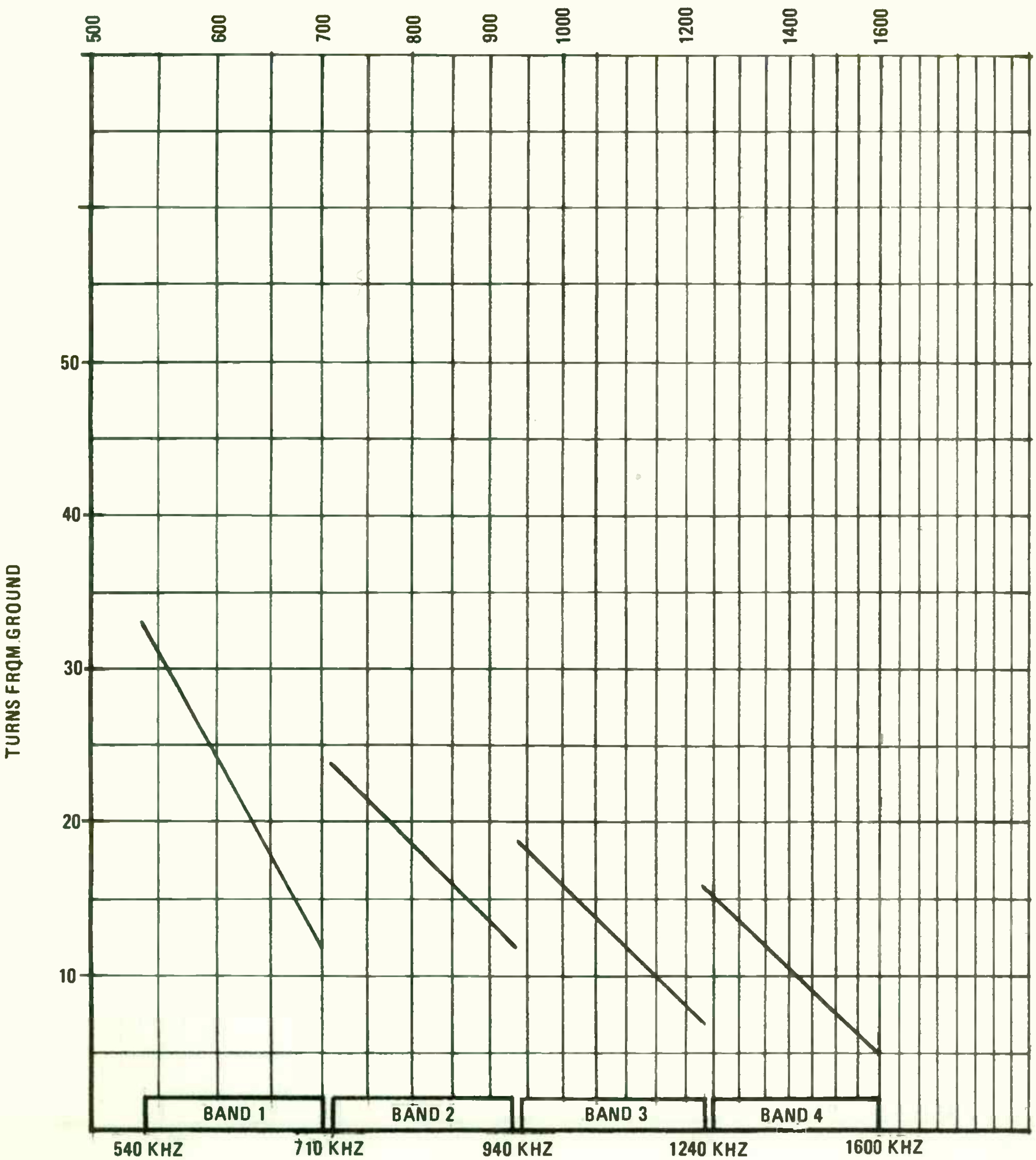

Figure 5-8. 828E-1 Node 3-4 Coupling Tap (on A9L5).

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

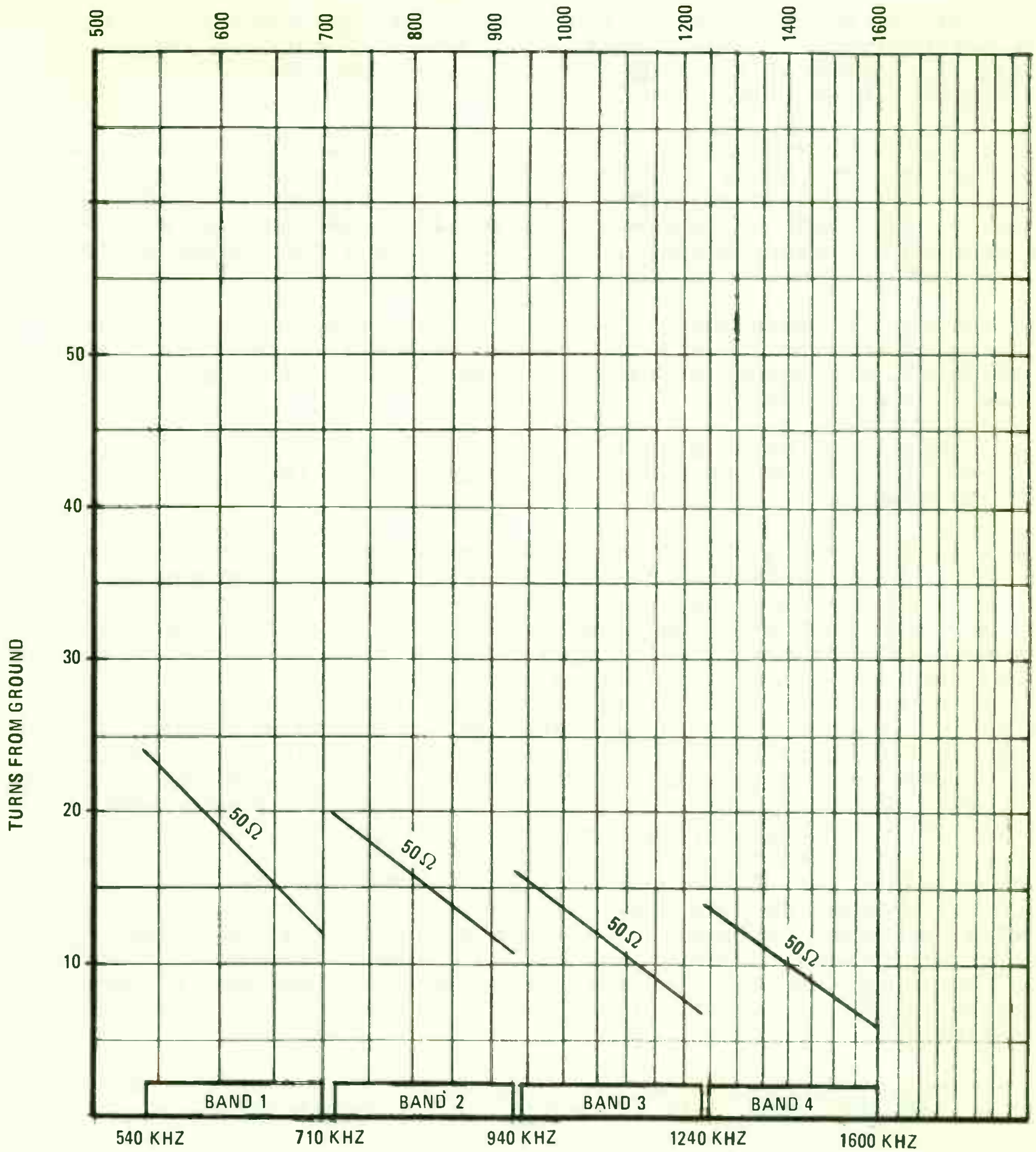

Figure 5-9. 828E-1 Output Tap (on A9L5).

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

The coupling between nodes 1 and 2 is set by the position of the connection from the node 2 coil, A9L2, where it taps the node 1 coil, A9L1. The number of turns up from ground on the node 1 coil is shown in the curves of figure 5-6.

The coupling between nodes 2 and 3 is set by the active (used) turns in coupling coil A9L3. In bands 1 and 2, L3 is actually two coils, L3A and L3B. Coil L3B is used up to 850 kHz, but between 850 and 930 kHz, only L3A is required, so L3B either should be shorted out completely or removed. In bands 3 and 4, only L3A is used. The number of active turns required in L3 is shown in figure 5-7.

The coupling between nodes 3 and 4 is set by the position of the connection from the node 3 coil, A9L4, to where it taps the node 4 coil, A9L5. The number of turns up from ground on the node 4 coil is shown in figure 5-8.

The output coupling is also a tap on node 4 coil A9L5. 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 than ±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 between it and the PA tube anode in an alternating fashion. That is, if the node 3-to-4 coupling is increased, the relative voltage at node 2 will increase, the relative voltage at node 3 will decrease, the relative voltage at node 4 will increase, and the output 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.

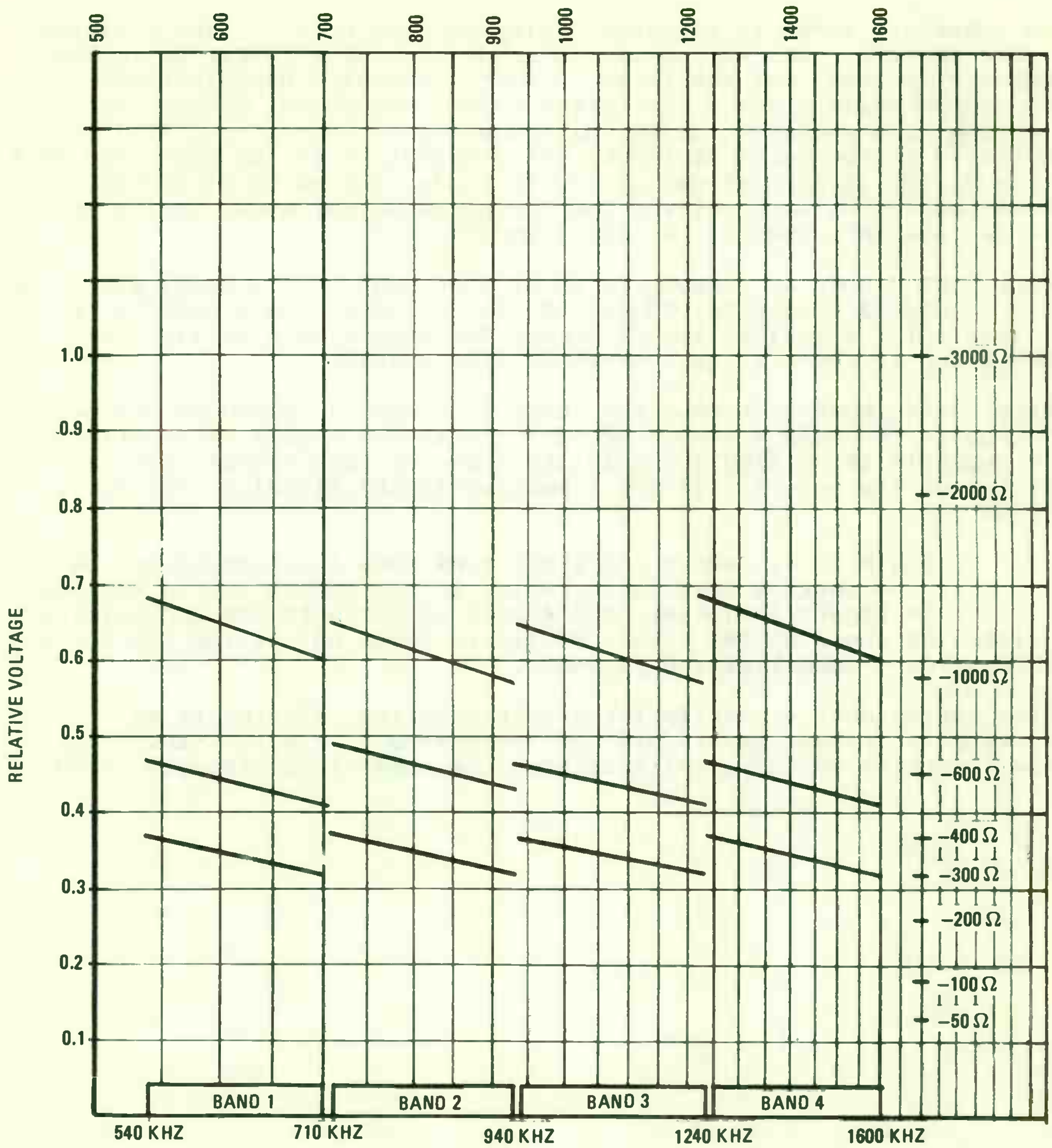

Figure 5-10. 828E-1 Relative Nodal Voltages.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

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 10-kilohm resistor. Temporarily short out the third harmonic resonator capacitor, A9C10. Also 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 A9L1 set as indicated on the curve of figure 5-11, adjust PA tuning capacitor A9C6 for a maximum (peak) signal at the PA anode. The curve of figure 5-12 shows the approximate setting for tuning capacitor A9C6. Tuning should not deviate more than 10 percent from this curve.

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 A9L2 for a minimum (dip) signal at the PA anode. The approximate setting for the node 2 tap is shown in the curves of figure 5-13.

After tuning node 2, remove the short from node 3 to ground and place the short from node 4 to ground. Set the tap on node 3 coil A9L4 to the approximate setting shown in the curve of figure 5-14. Now, adjust the tap on the node 3 coil for a maximum (peak) signal at the PA anode.

After tuning node 3, remove the short from node 4 to ground and be sure that the correct load is connected to the output tap on the node 4 coil (see figure 5-9). Set node 4 coil A9L5 tap to its approximate position as shown on the curves of figure 5-15. Adjust the tap for a minimum (dip) signal at the PA anode.

After tuning node 4, 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.

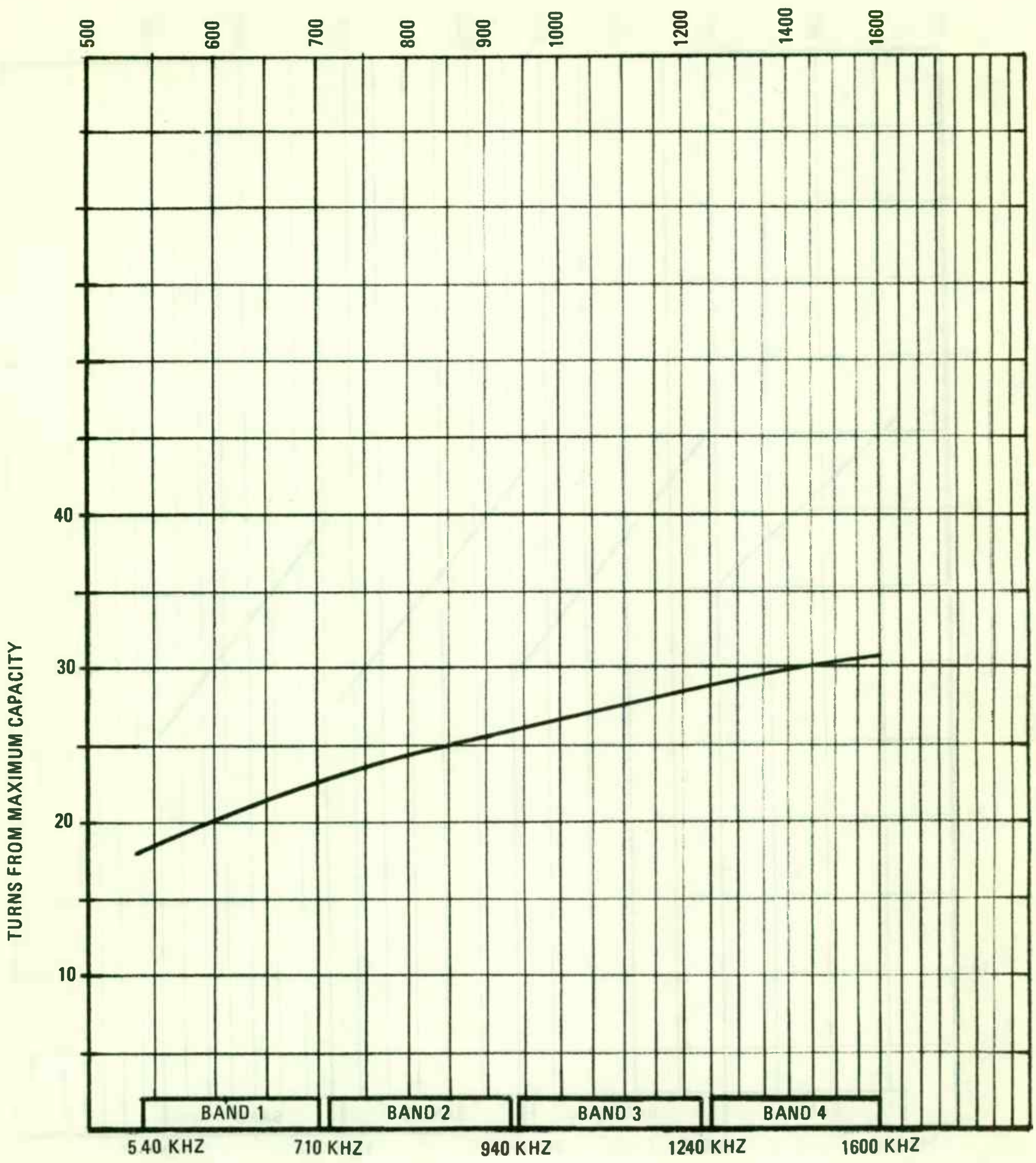

Figure 5-11. 828E-1 Tuning Capacitor A9C6.

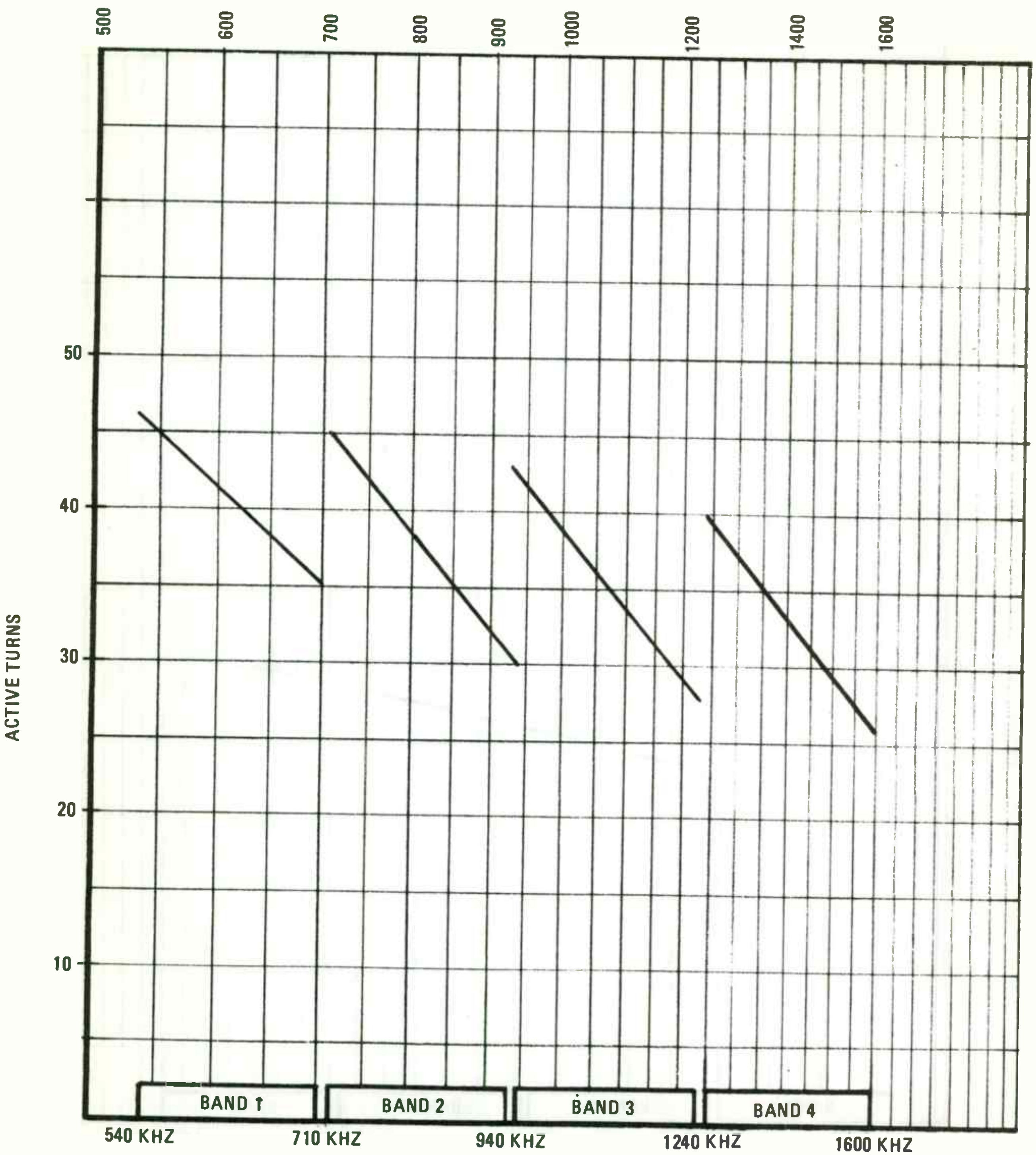

Figure 5-12. 828E-1 Node 1 Coil A9L1.

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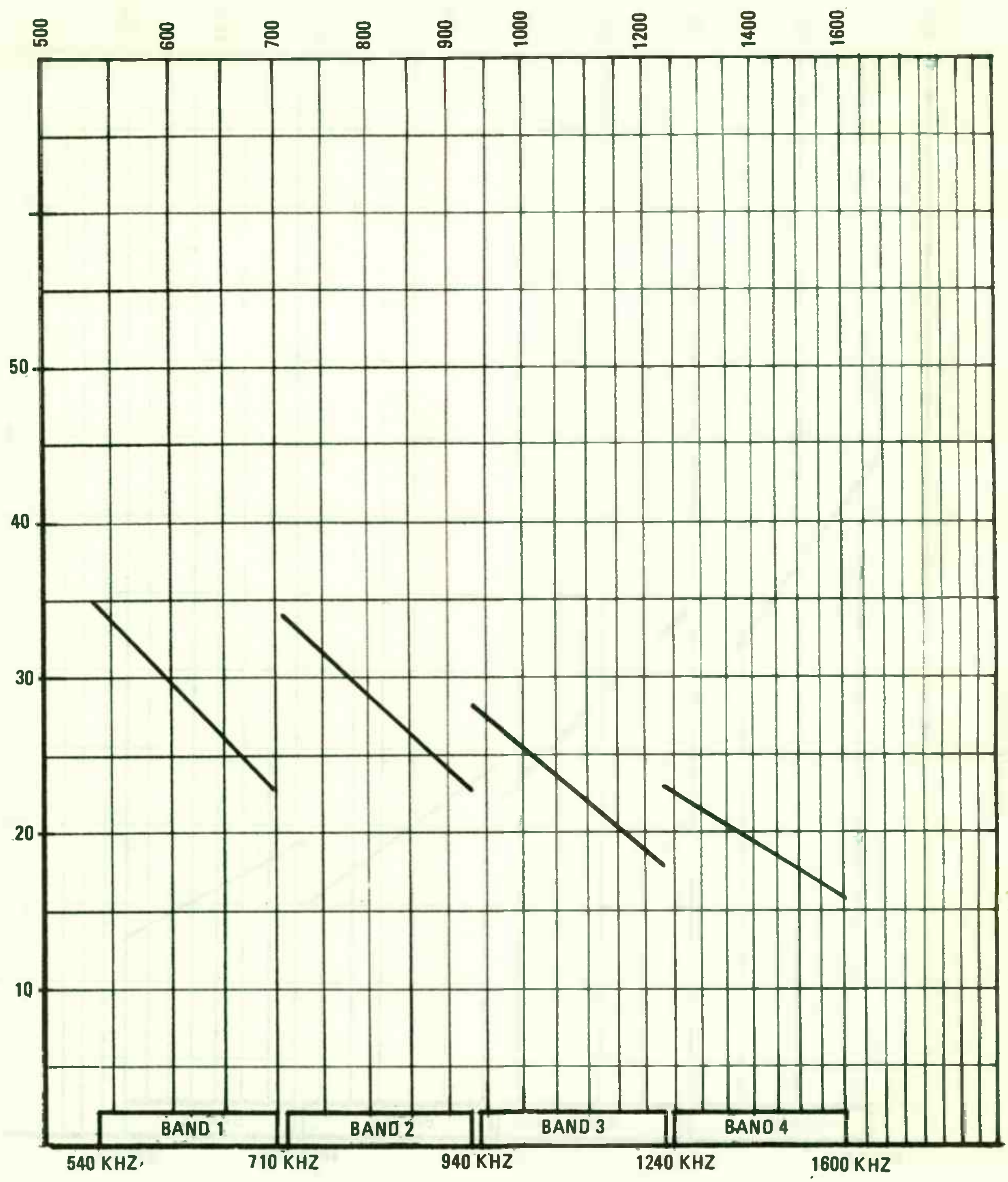

Figure 5-13. 828E-1 Node 2 Coil A9L2.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

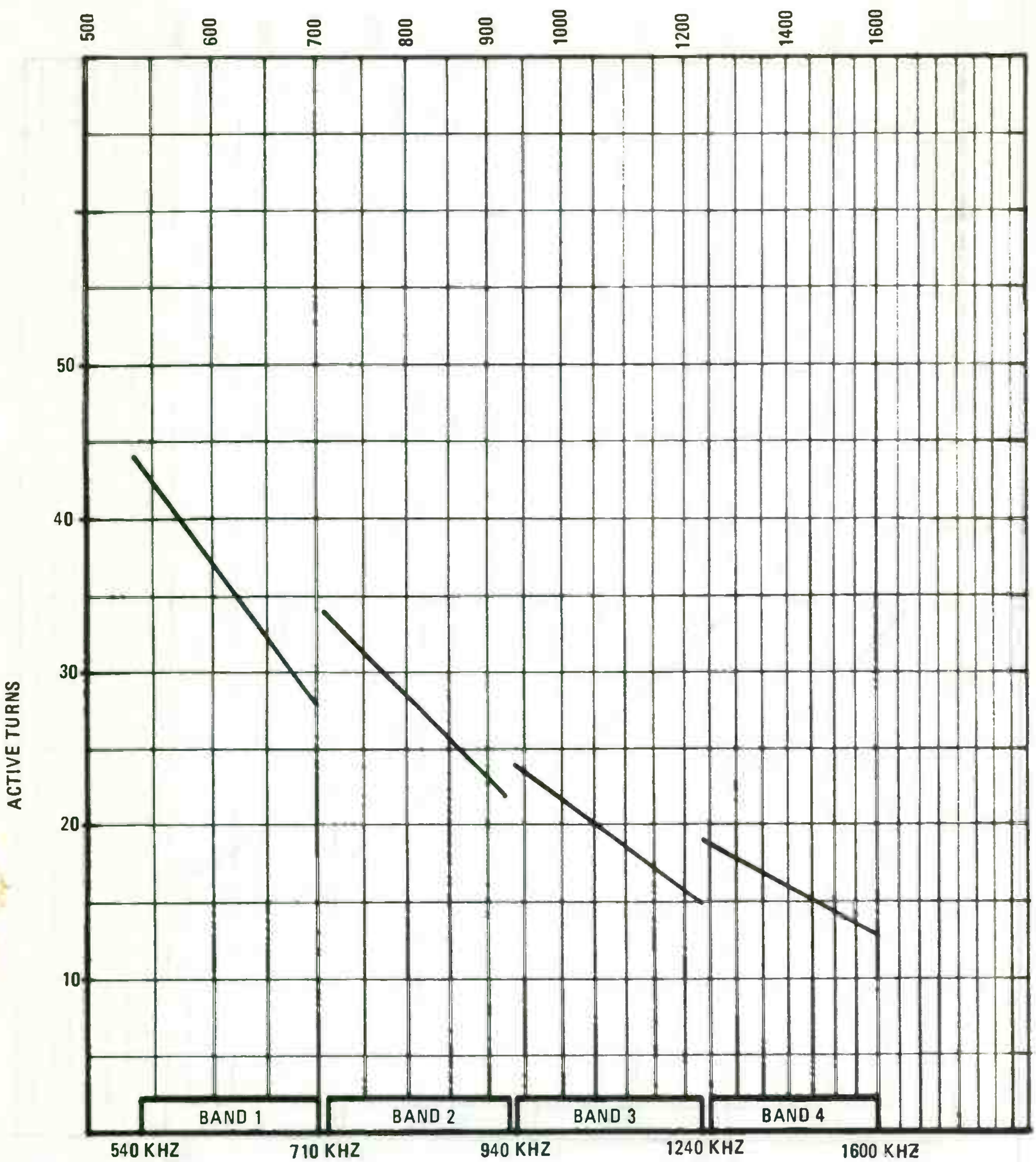

Figure 5-14. 828E-1 Node 3 Coil A9L4.

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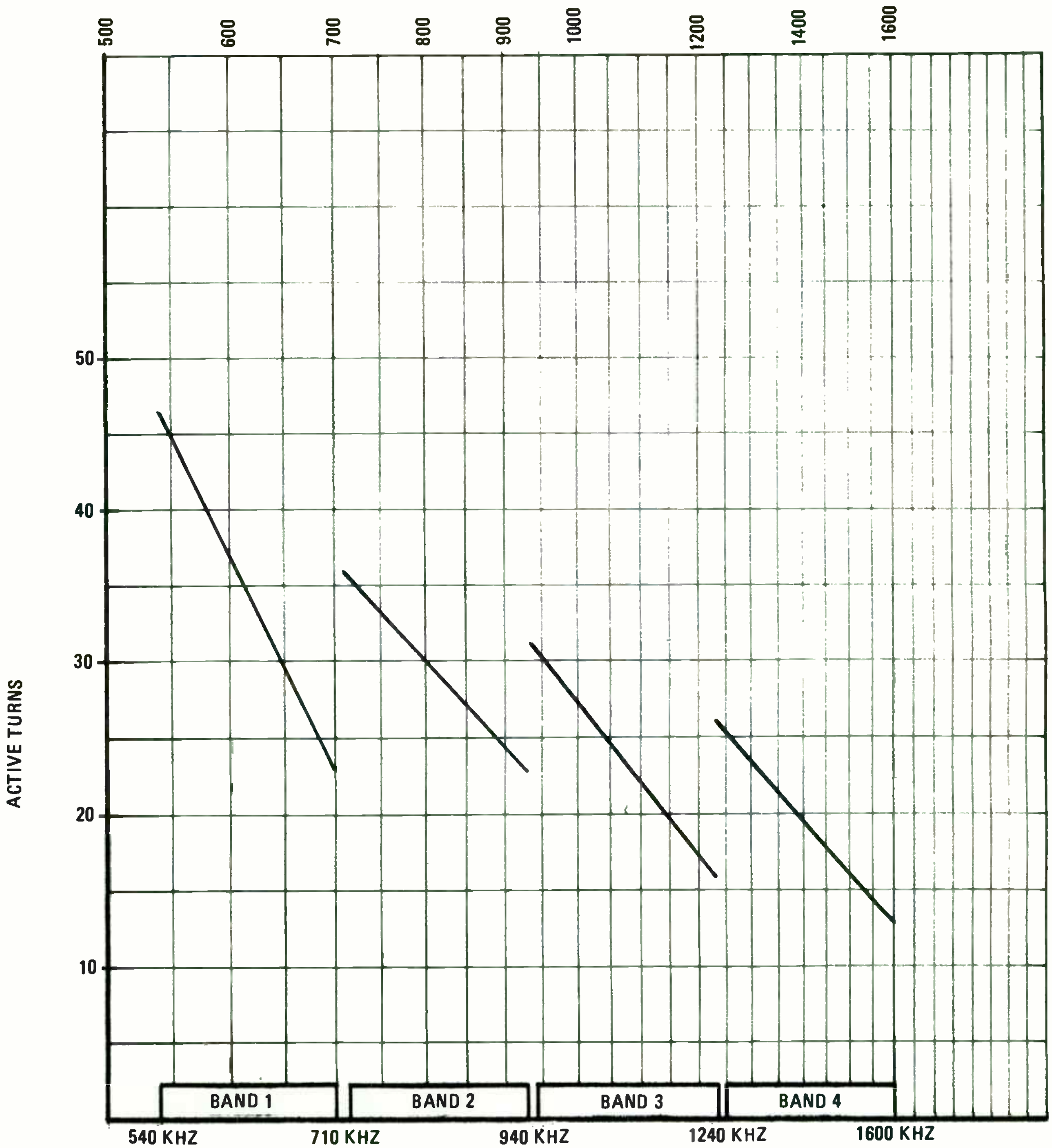


Figure 5-15. 828E-1 Node 4 Coil A9L5.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

SECTION 6
TROUBLESHOOTING

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 6.12 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 four major cables. *

6.2 CONTROL CIRCUITS

Figure 6-1 is a simplified schematic of the control circuits for the 828E-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 PWM module.

A typical problem of the control circuit may be an interruption in the carrier interlock circuit between terminals A7TB2-10 and -11 or interruptions in the interlock chain feeding the high/low-power-on circuits. Interruption of the carrier interlock between A7TB2-10 and -11 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 PWM card.

A loss of RF driver current will also interrupt the carrier interlock control circuit, which can be diagnosed quickly by observing the LED, A6A1CR6, mounted on the card cage backplane. 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 diode CR17 on the A7A1 control relay 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 A7A1 control relay card to indicate operation of the various relays to assist in troubleshooting.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

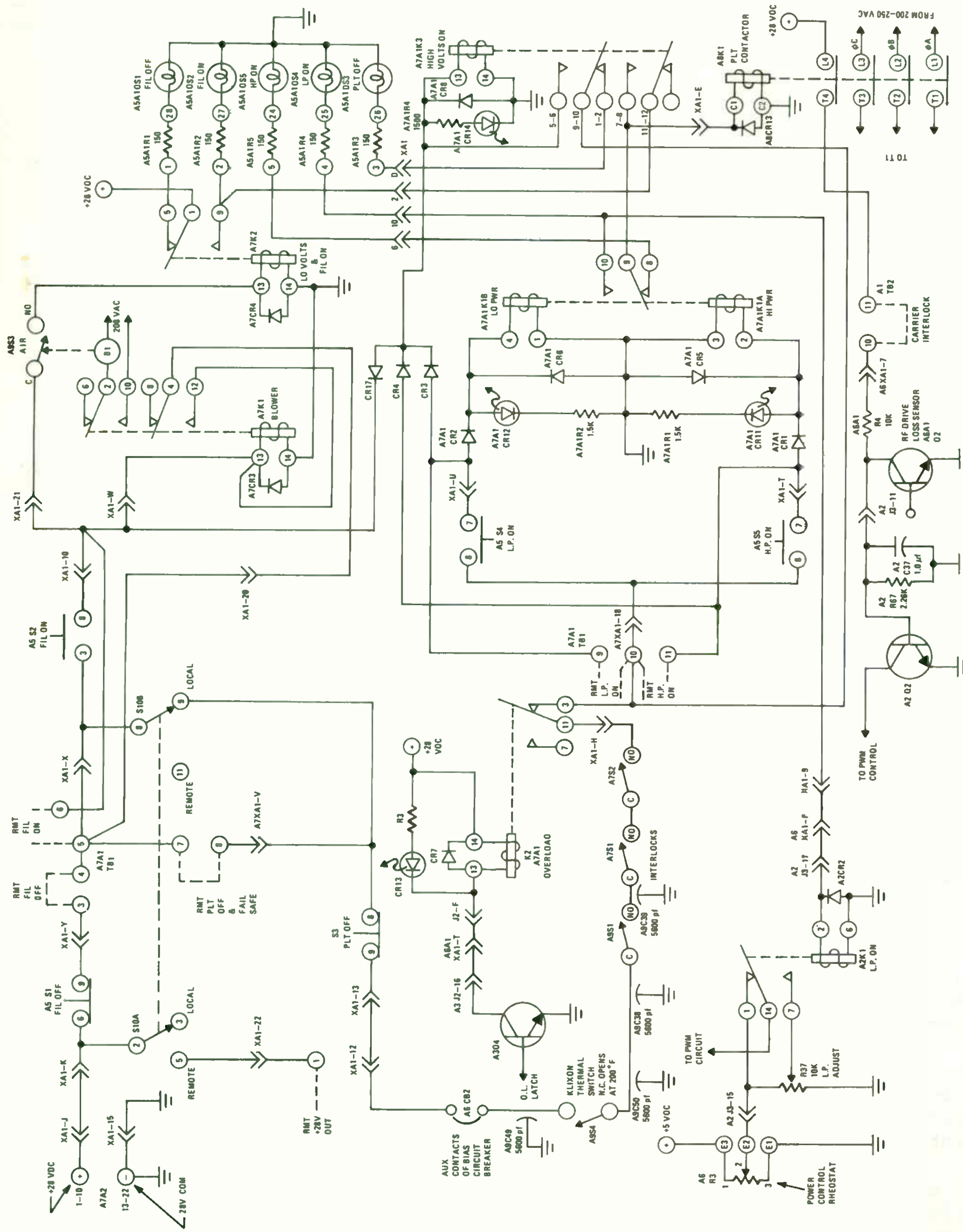


Figure 6-1. 828E-1 5-kW Control Circuit.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

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 on the card extender and should be 120 degrees wide (one-third duty cycle) and 8 volts peak to peak at pin 14.

With the proper adjustment of the 120-degree pulse width, the waveform at PA anode A (on C46 test point) will be the proper high-efficiency waveform if the third harmonic resonator in the PA anode circuit is also tuned properly to the third harmonic (see paragraph 5.3.11). The waveform shown in figure 6-3 shows the correct high-efficiency waveform along with typical examples of incorrect adjustment of either the pulse width or the third harmonic resonator tuning.

The RF driver operation usually can be verified by noting the I_C (driver-collector current) on the dc multimeter. It normally reads between 2.5 and 3.0 amperes depending on frequency of operation. Lower frequencies usually have lower current. The driver has a protective circuit (U101) that acts to short out its own drive signal if the driver I_C gets too high. Also, if fuse F1 in the driver blows, the driver I_C goes to zero. If F1 opens, it nearly always indicates a shorted transistor(s) in the driver card. It should be noted that arc gaps E9 and E10 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 -5 kV modulated to -11.25 kV, while the primary is at approximately 200 volts.

CAUTION

> The 828E-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 tube itself. Remove the drive by removing the RF driver module. Connect the PA anode directly to the chassis using a short [not longer

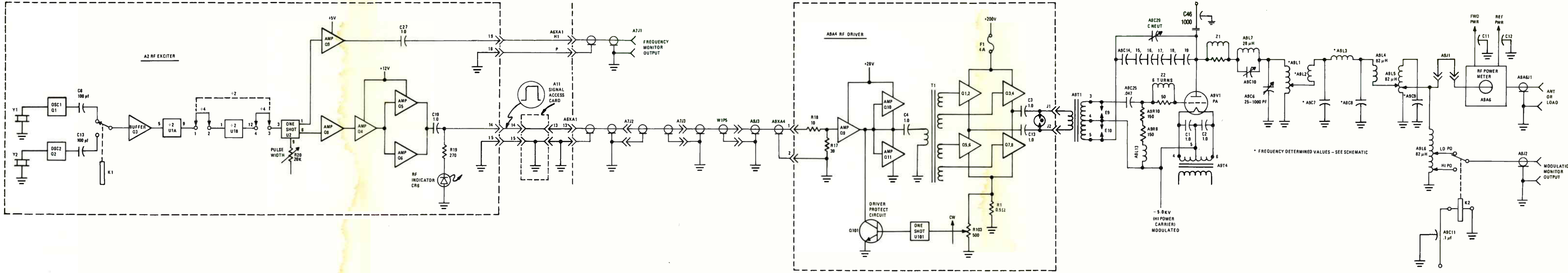
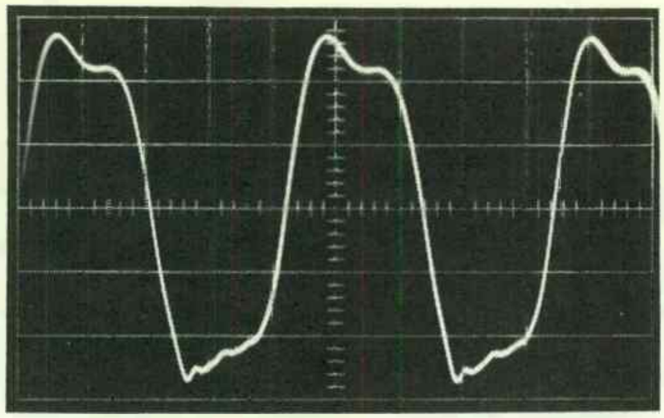
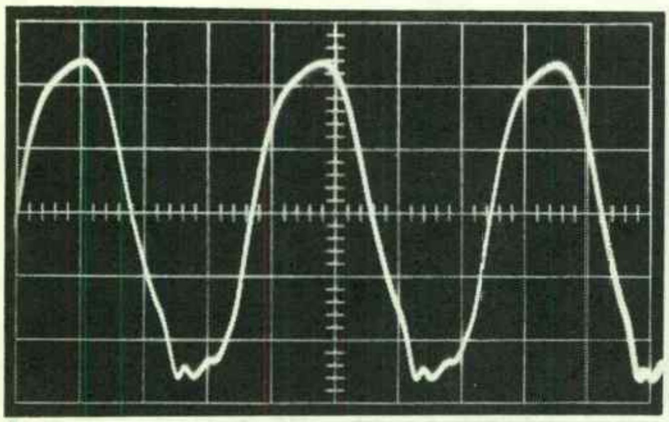


Figure 6-2. RF Signal Path.

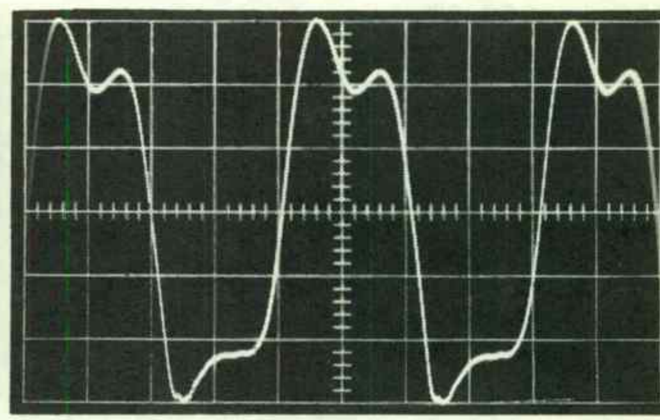
WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.



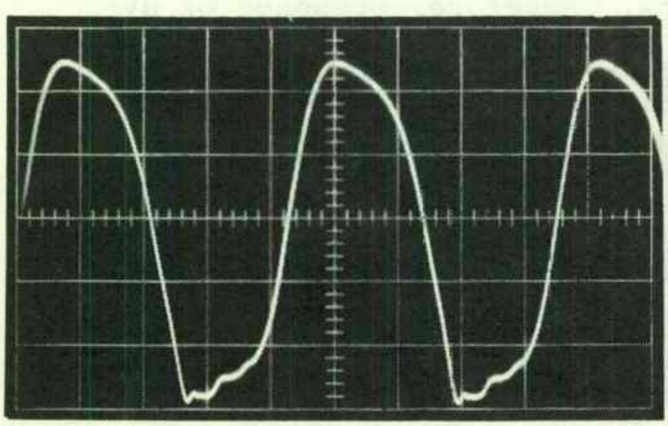
A. CORRECT ADJUSTMENT



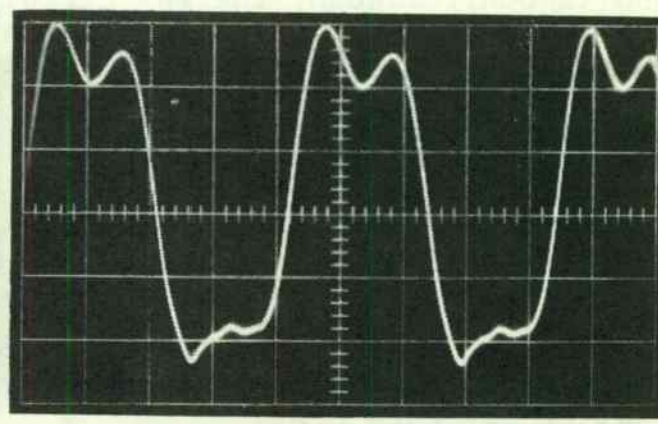
B. PULSE WIDTH TOO NARROW



C. PULSE WIDTH TOO WIDE



D. RESONATOR TOO LOW



E. RESONATOR TOO HIGH

Figure 6-3. PA Anode Waveforms.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

than 152-mm (6-in.)] test lead. The collector of A2Q2 in the PWM card will have to be shortened 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 0.5 ampere for 5 kV of plate voltage.

The output network is not like the networks in older, conventional transmitters. It contains a third harmonic resonator in the PA anode, and 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 ouput network theory of operation and tuning. Ammeter jack A9J1 is provided for two reasons: (1) to allow insertion of an RF ammeter in the line at this point, and (2) to provide a convenient point to attach an RF bridge to measure the actual load impedance presented to the transmitter.

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 6-4 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 -13.7 kV and is controlled by the plate contactor, but the plate voltage is approximately -5.0 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 module on pin 9. The waveform here is normally a 70 kHz square wave from 0 to +1.5 volts (see figure 6-5). Zero volt turns plate voltage off and +1.5 volts turns it on. So, if the voltage at pin 9 is low (zero volt) and the plate voltage is missing, the fault is probably in the PWM card. However, if the voltage at pin 9 is high (+1.5 volts) and the plate voltage is missing, the fault is probably in the LED on the backplane (A6A1CR1), the fiber optic cable, or in switching modulator (switchmod) card A9A3.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

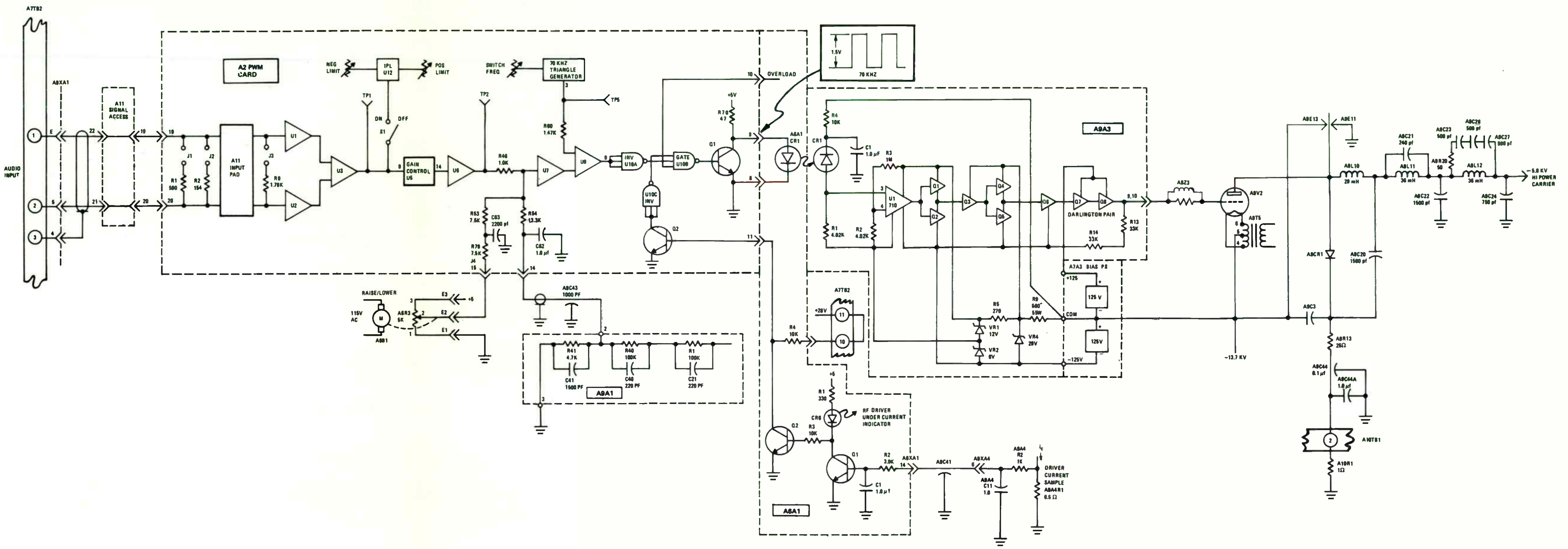
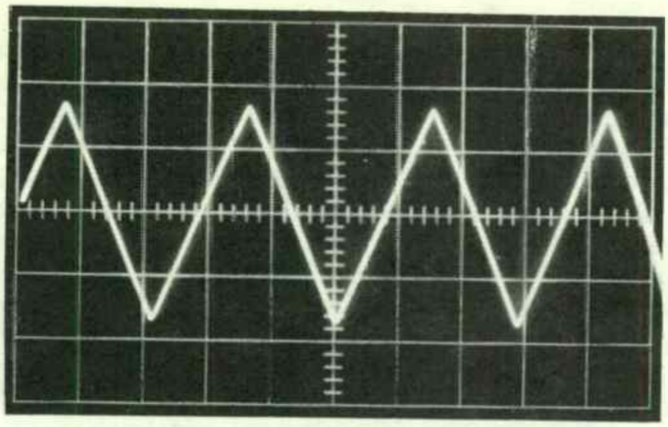
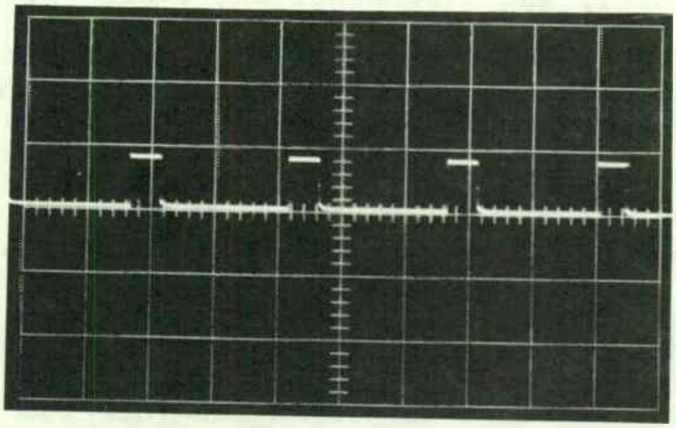


Figure 6-4. PWM Circuits.

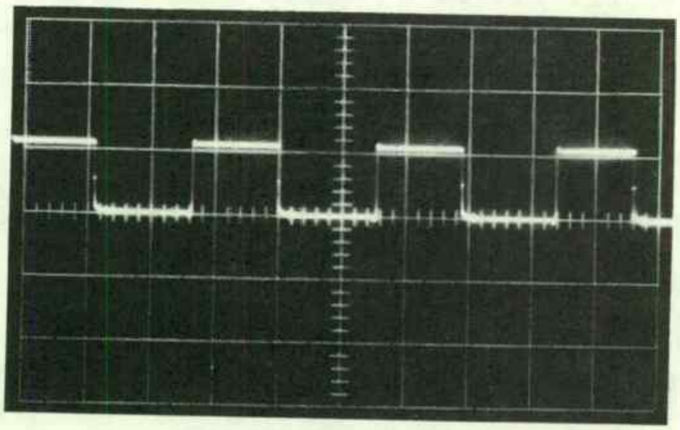
WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.



A. WAVEFORM AT A2TP5



B. WAVE FORM AT XA2-9, LOW POWER



C. WAVE FORM AT XA2-9, HIGH POWER

Figure 6-5. PWM Waveforms.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

To test the PWM card output, it is necessary to operate the power controller to its minimum position and bypass the carrier interlock by grounding the case (collector) of Q2 in the PWM card. The PWM card may then be tested with only the LOW VOLTAGE circuit breaker on. The positive voltage from the power control resistor, A6R3, offsets part of the -4.5 volts from the feedback divider, A9A1, to control the width of the pulses and thus the amount of plate voltage. Without feedback, the output of the PWM card 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 -13,700 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 left-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.

Improper setting of arc gaps A9E11 and 13, located to the left of switching modulator tube A9V2, 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. Normally, this will trip bias circuit breaker A6CB2, which has an auxiliary contact in the high-voltage interlock chain. This will in turn open the interlock chain and remove the HVPS. If, for some reason, the bias is lost without tripping the bias circuit breaker, 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 5 kV. No control of the voltage is present and no modulation occurs.

CAUTION

> The "class A" regulator is dissipating nearly 10 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 higher audio frequencies like 5 kHz and above. Input coil A9L10 is slightly different from the other two, A9L11 and 12. The dc resistance of each coil is approximately 21 to 22 ohms. Any deviation of more than 10 percent from this value probably indicates a damaged coil.

Clamp diode A9CR1, 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 A9E13. To test this diode, it takes approximately 35 to 40 volts in the forward direction to cause it to conduct, because there are many diode junctions in series in it. Its reverse voltage is 25 kV.

6.5 POWER SUPPLIES

There are only five power supplies in the 828E-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, -13,700 Volts

The simplified diagram of figure 6-6 shows the connections of the logic power supply. Figure 6-7 shows the distribution of the loads on the 28-volt power supply.

Figure 6-8 shows the connections of the 200-volt driver power supply and how the 120-volt ac is used for the cabinet fan and the raise/lower motor.

Figure 6-9 shows the connections of the HVPS and how the ±125-volt bias power supply is connected to it.

NOTE

> The bias power supply floats on the negative high voltage and is therefore 13,700 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 deenergize the transmitter, connect the voltmeter, and then turn the filament on to read the voltage. Deenergize the transmitter again to remove the voltmeter.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

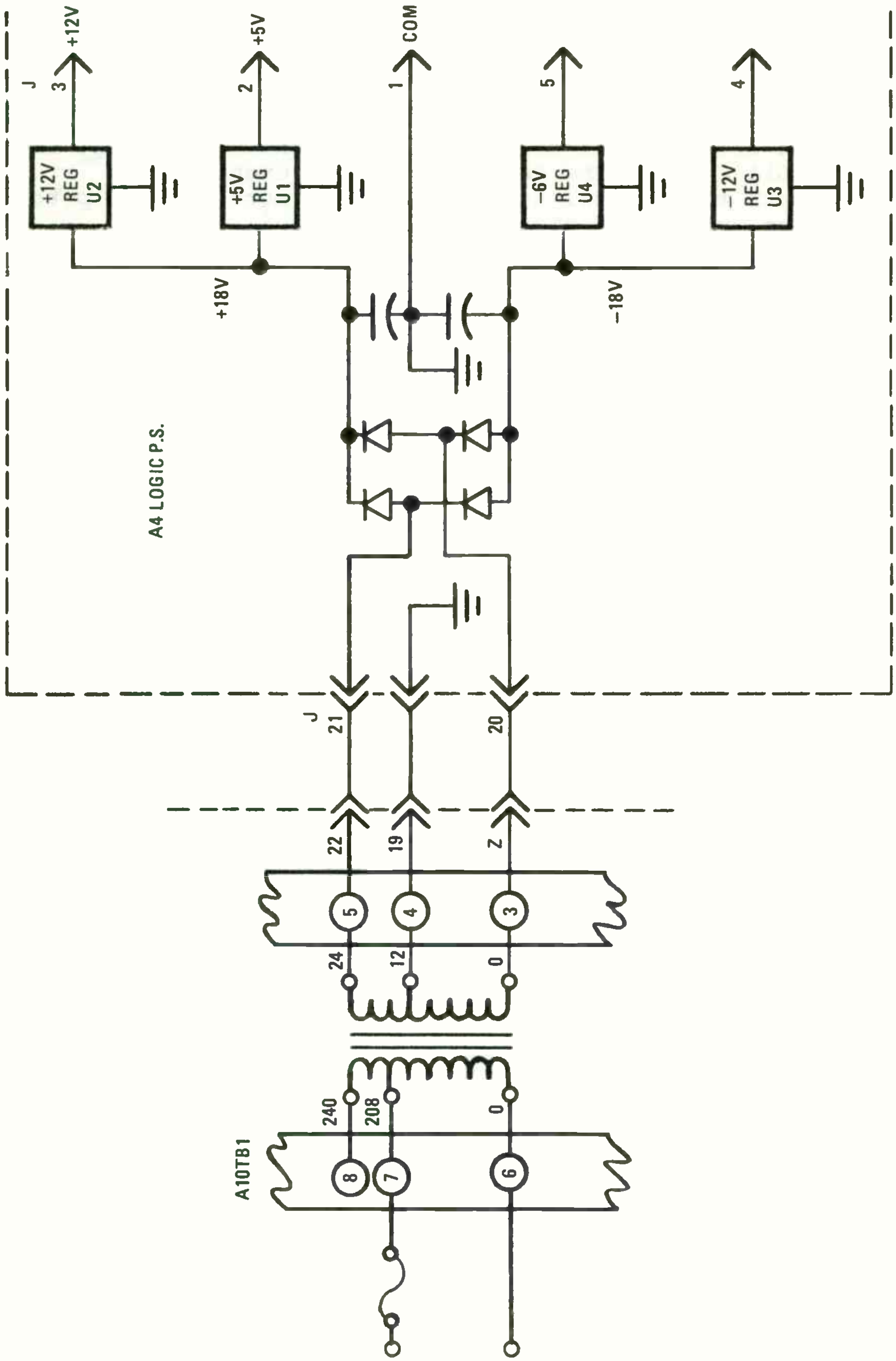


Figure 6-6. Logic Power Supply.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

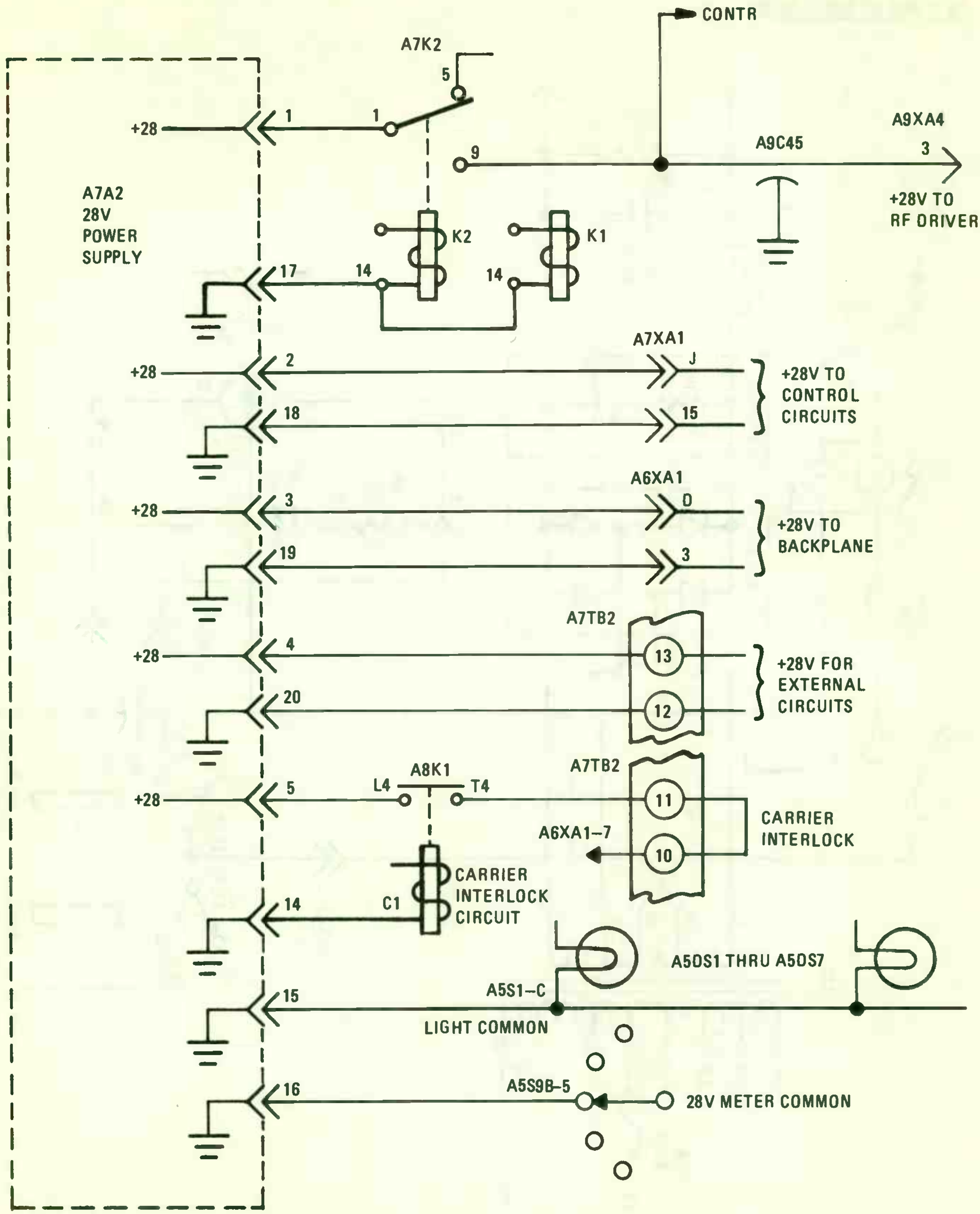


Figure 6-7. 28-Volt Power Supply Distribution.

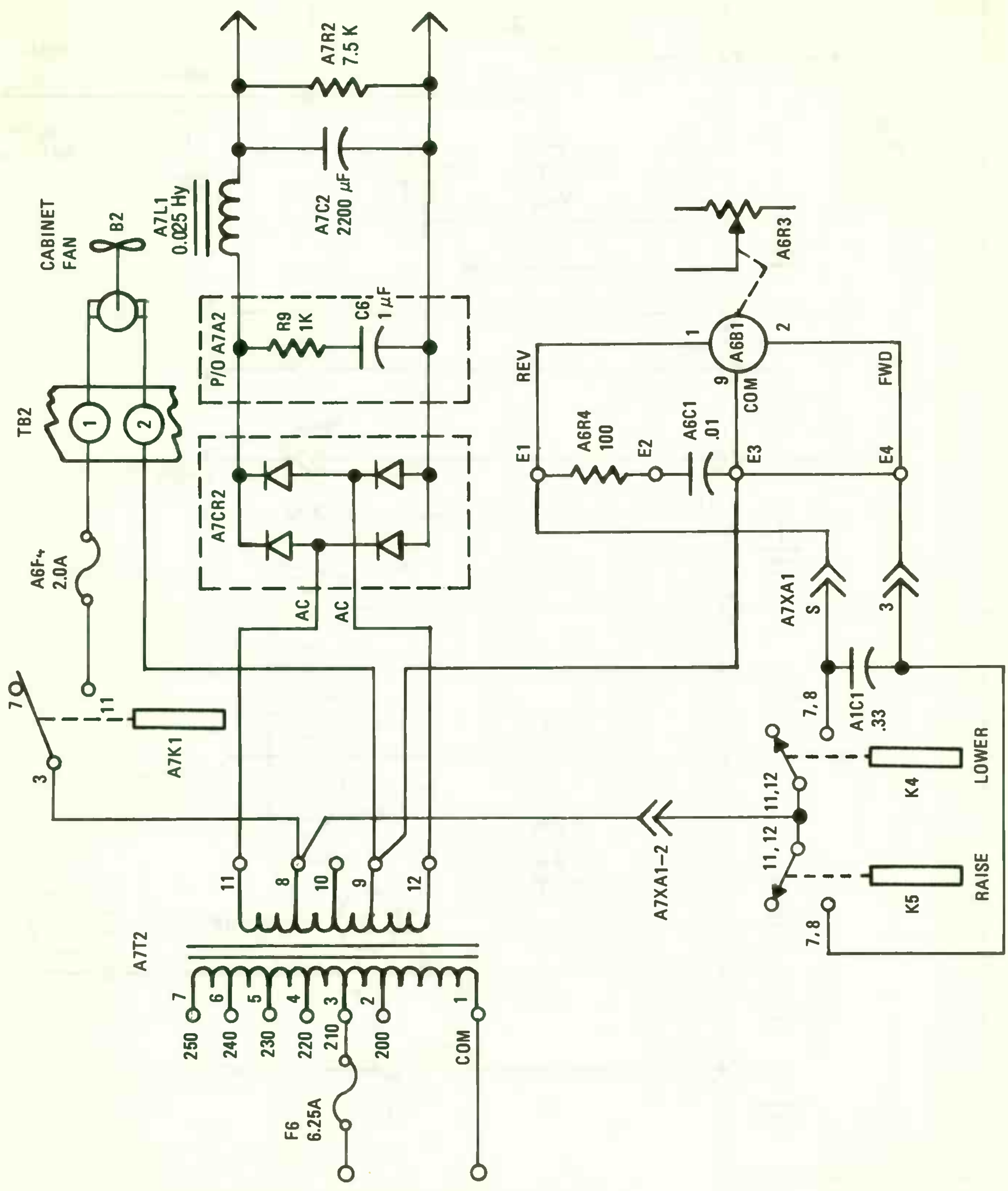


Figure 6-8. Driver Power Supply.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

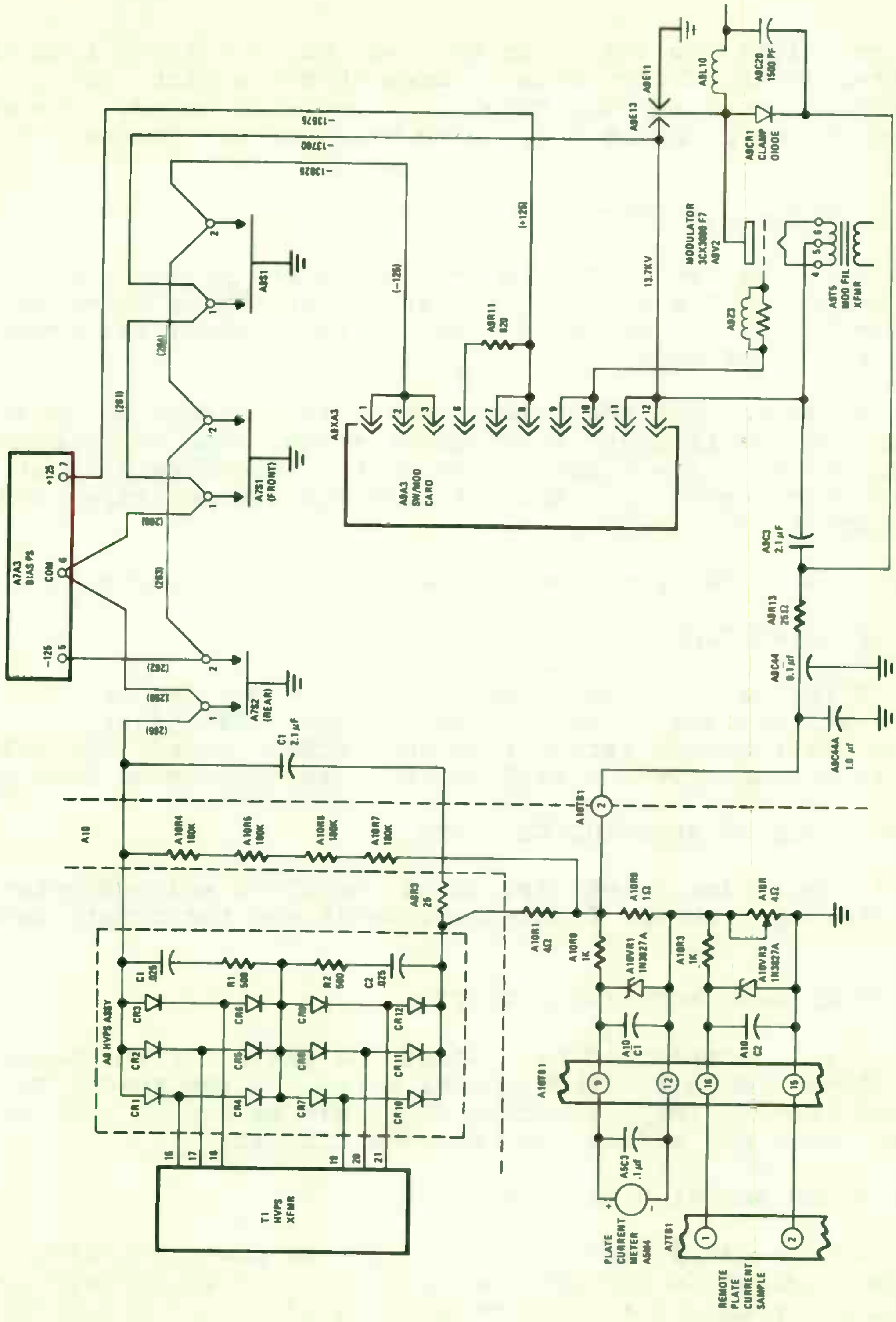


Figure 6-9. High-Voltage Power Supply Distribution.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

The plus and minus 125 volts can be measured by turning high-voltage circuit breaker A6CB3 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, with bias circuit breaker A6CB2 closed.

6.6 AC METERING CIRCUITS

The simplified diagram of figure 6-10 shows the connections of the ac metering circuits. The metering resistors for the ac metering circuits are all located on the metering terminal board under the cover on the inside of the front door.

It should be noted that the filament metering circuit actually meters the primary of the filament transformer rather than the secondary, because of the negative high voltage on the secondary circuits. The metering always connects to the 208-volt transformer taps regardless of line voltage.

The meter is a 10-mA iron vane movement and reads true rms.

6.7 DC METERING CIRCUITS

Figure 6-11 is a simplified diagram of the dc multimeter circuits. Unlike the ac metering circuits, the dc meter multipliers are all located at their source rather than on a common board. The meter movement is a 1-mA movement with internal resistance of 1500 ohms.

6.8 PLATE VOLTAGE METERING CIRCUITS

Figure 6-12 is a simplified circuit of the plate voltage metering circuits showing both the front-panel meter and the remote metering connections.

6.9 PLATE CURRENT METERING CIRCUITS

Figure 6-13 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.

6.10 RF POWER METERING CIRCUITS

Figure 6-14 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 in the control circuits module due to availability of supply voltages and the fact that the reflected power signal is used for the vswr

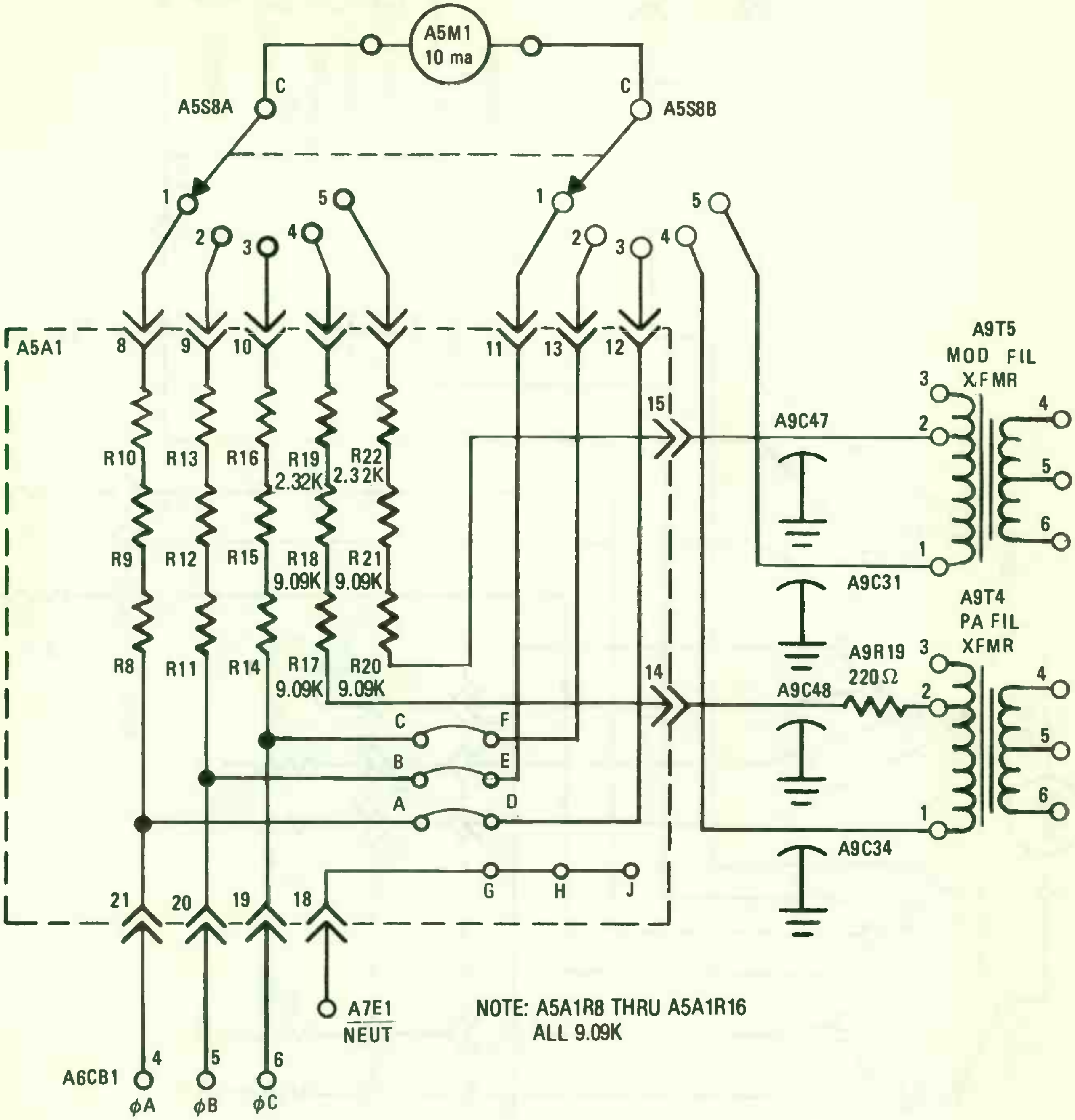


Figure 6-10. AC Metering Circuits.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

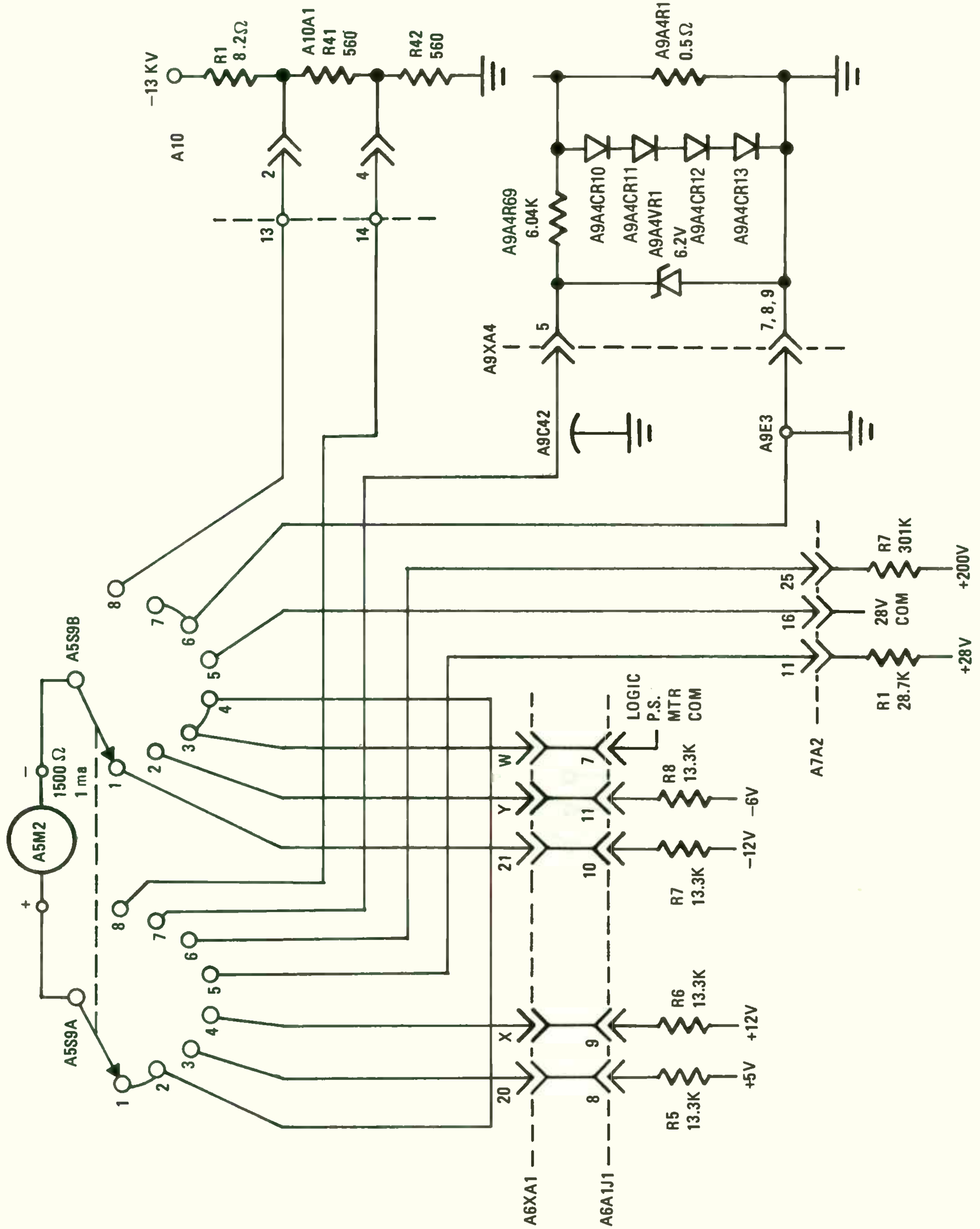


Figure 6-11. DC Metering Circuits.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

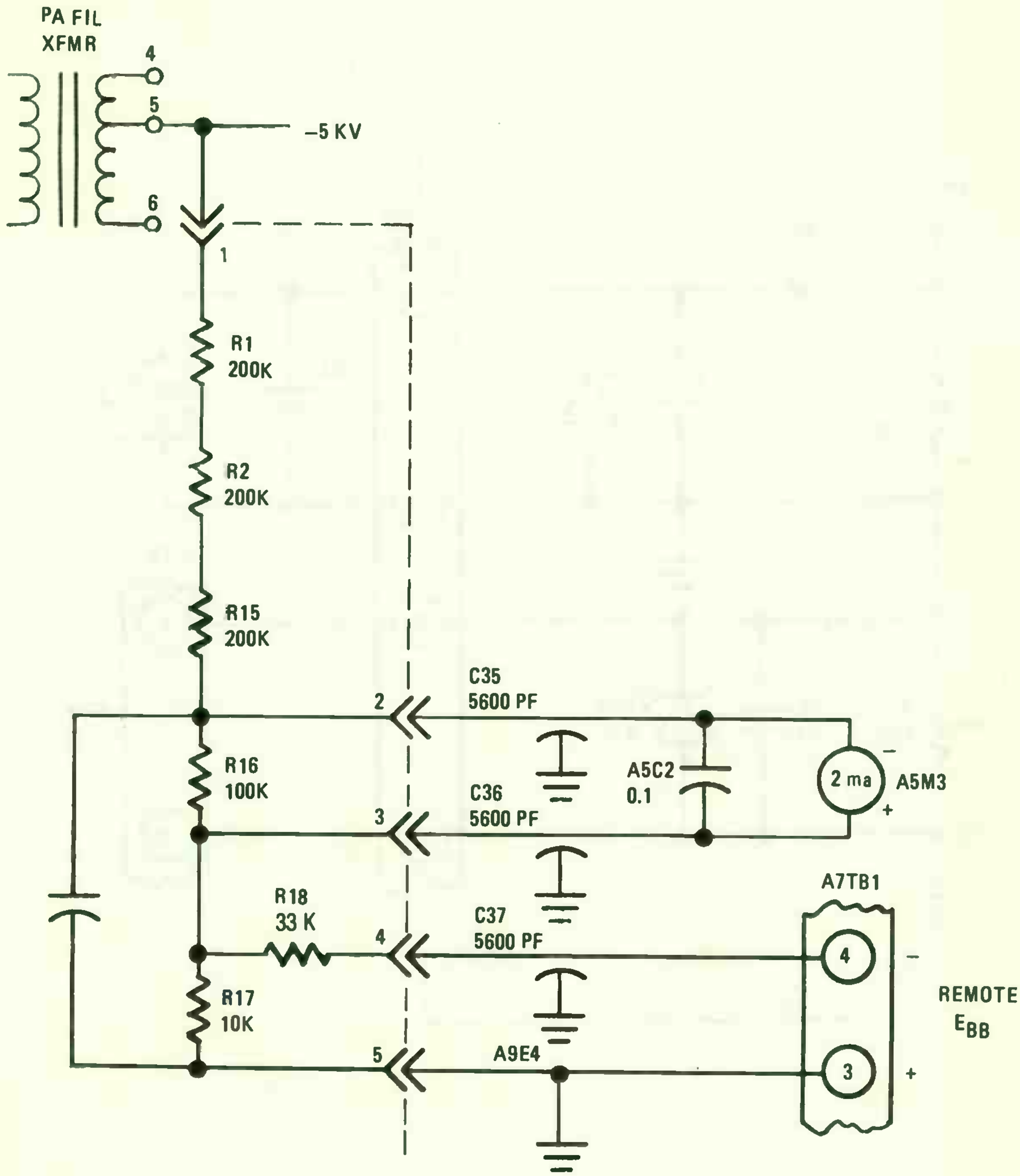


Figure 6-12. Plate Voltage Metering Circuits.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

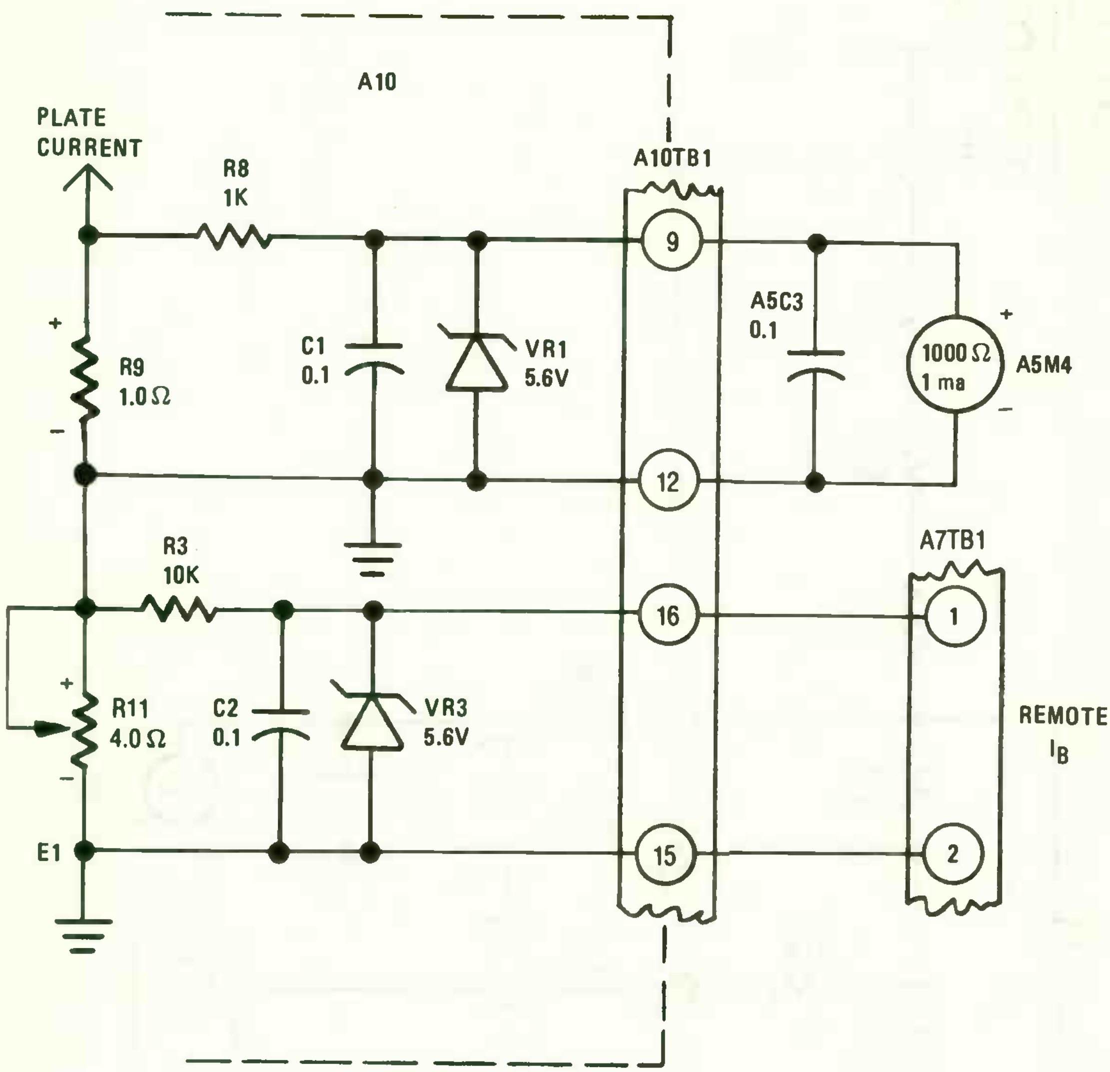


Figure 6-13. Plate Current Metering Circuits.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

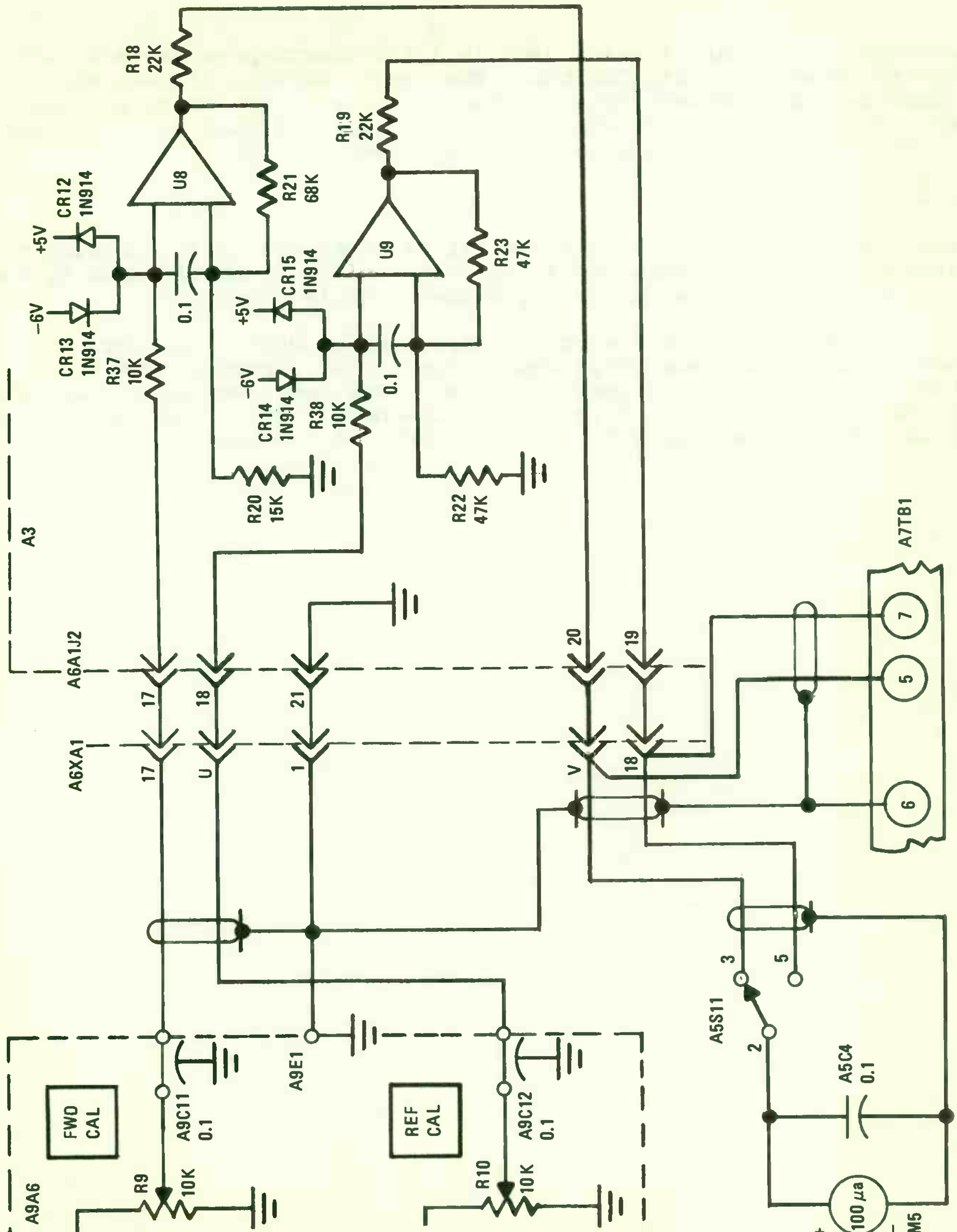


Figure 6-14. RF Power Metering Circuits.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

overload. The internal meter used is a 100-microampere movement with internal resistance of 1750 ohms. The remote meters, if desired, should be 100 microamperes also. Downscale readings, or no readings at all, usually indicate failure of operational amplifier U8 or U9 used in the control circuits module as amplifiers.

6.11 BACKPLANE

Figure 6-15 is a simplified schematic of backplane A6A1, showing the interconnections between cards, the high-voltage turnoff circuit, and the protective zeners on the logic power supply buses.

The high-voltage turnoff circuit senses the RF driver current, and when the current drops below approximately 1.5 amperes, causes Q2 to shunt out the carrier interlock voltage. The LED, CR6, is visible when the A6 panel is down, and indicates presence of driver current. It is on when the driver current is higher than 1.5 amperes.

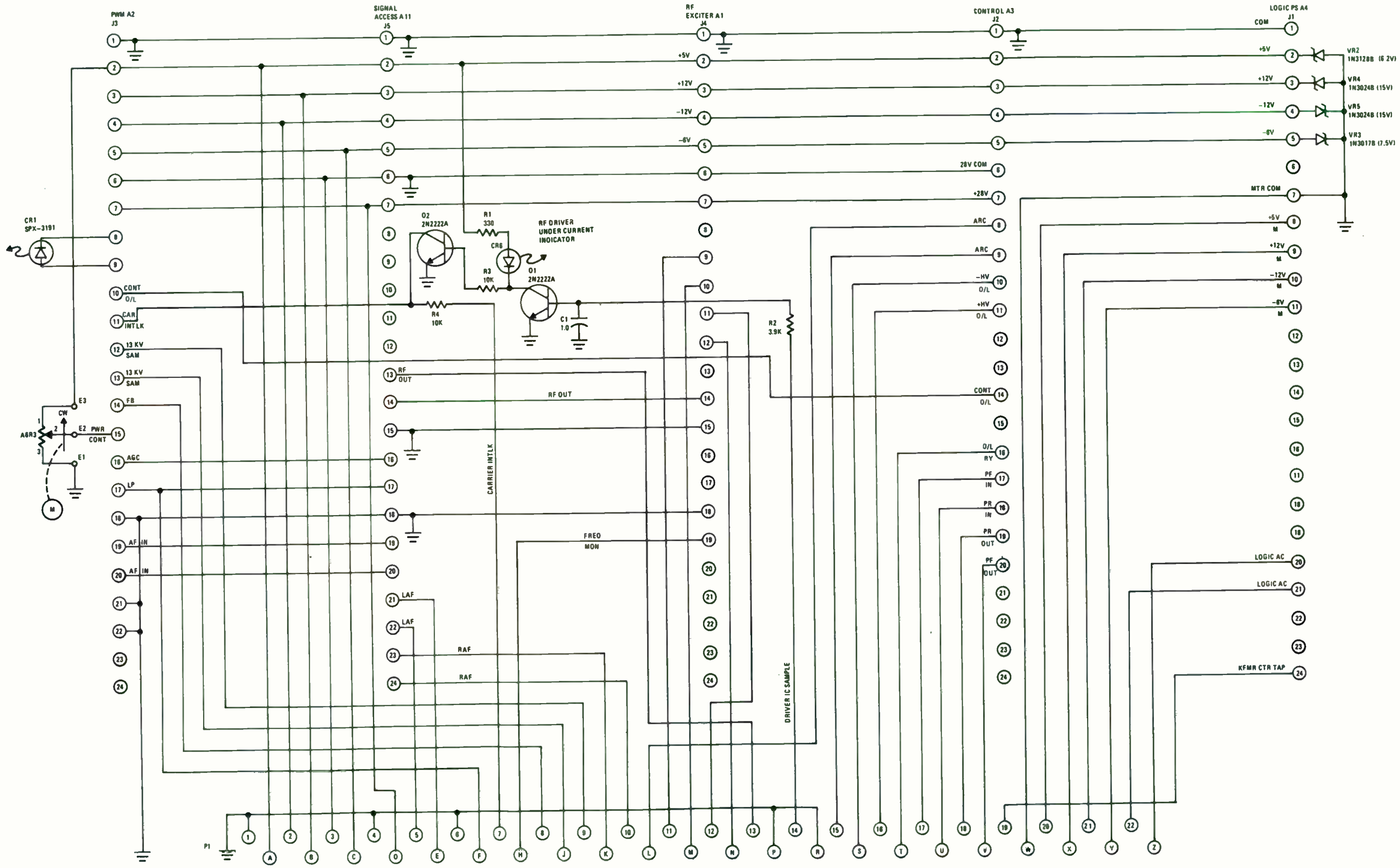


Figure 6-15. Backplane Schematic.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

6.12 WIRE LIST

Following is the wire list for the 828E-1 transmitter. The terminals are shown in alphanumeric order in the FROM column.

828E-1 5-kW AM Transmitter Wire List.

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
43	A5A1-1	A7K2-5	FIL OFF Light	A22PB-92
44	A5A1-2	A7K2-9	FIL ON Light	A22PB-913
45	A5A1-3	A7XA1-D	PLATE Off Light	A22PB-912
46	A5A1-4	A7XA1-10	LP ON Light	A22PB-906
47	A5A1-5	A7XA1-6	HP ON Light	A22PB-905
48	A5A1-6	A7XA1-B	RAISE Light	A22PB-903
49	A5A1-7	A7XA1-C	LOWER Light	A22PB-902
520	A5A1-8	A5S8A-1		A22PB-8
521	A5A1-9	A5S8A-2		A22PB-9
522	A5A1-10	A5S8A-3		A22PB-90
525	A5A1-11	A5S8B1-1		A22PB-91
527	A5A1-12	A5S8B-1		A22PB-92
526	A5A1-13	A5S8B-2		A22PB-93
66	A5A1-14	A9C48	PA Fil Meter	A22PB-1
68	A5A1-15	A9C47	Mod Fil Meter	A22PB-2
524	A5A1-16	A5S9A-5		A22PB-96
523	A5A1-17	A5S8A-4		A22PB-97
71	A5A1-18	A7E1	Neutral (AC Meter)	A22PB-93
65	A5A1-19	A7K2-2	Line C Meter	A22PB-6
64	A5A1-20	A7K2-3	Line B Meter	A22PB-7
63	A5A1-21	A7K2-4	Line A Meter	A22PB-5
501	A5A1-22	A5S7-A		A22PB-7
502	A5A1-23	A5S6-A		A22PB-6
503	A5A1-24	A5S5-A		A22PB-5
504	A5A1-25	A5S4-A		A22PB-4
505	A5A1-26	A5S3-A		A22PB-3
506	A5A1-27	A5S2-A		A22PB-2
507	A5A1-28	A5S1-A		A22PB-1
530	A5M1-(-)	A5S8B-C		A22PB-0
531	A5M1-(+)	A5S8A-C		A22PB-2
528	A5M2-(-)	A5S9B-C		A22PB-0
529	A5M2-(+)	A5S9A-C		A22PB-2
90	A5M3-(-)	A9C35	Plate Voltage Mtr (-)	A22PB-4
91	A5M3-(+)	A9C36	Plate Volt Mtr, Com (-)	A22PB-5
94	A5M4-(-)	A10TB1-12	Plt Curr Mtr, Com (-)	A22PB-92
93	A5M4-(+)	A10TB1-9	Plate Curr Mtr (+)	A22PB-9
96-S	A5M5-(-)	A6XA1-1	Chassis Gnd Mon	Shield
535	A5M5-(+)	A5S11-2		A22PB-2
507	A5S1-A	A5A1-28		A22PB-1
508	A5S1-C	A5S2-C		22 Slv Bus
62	A5S1-C	A7A2-15	Light, 28-V Common	A22PB-0

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
532	A5S1-8	A5S10-2		A22PB-2
32	A5S1-9	A7XA1-Y	Local Fil Off NC	A22PB-5
26	A5S10-2	A7XA1-K	+28-V DC Supply	A22PB-2
532	A5S10-2	A5S1-8		A22PB-2
28	A5S10-5	A7XA1-22	+28-V DC Remote	A20PB-1
533	A5S10-8	A5S2-8		A22PB-4
534	A5S10-9	A5S2-8		A22PB-6
535	A5S11-2	A5M5-(+)		A22PB-2
96-9	A5S11-3	A6XA1-V	Fwd Pwr Mtr	STP-22PB-9
96-6	A5S11-5	A6XA1-18	Ref Pwr Mtr	STP-22PB-6
506	A5S2-A	A5A1-27		A22PB-2
508	A5S2-C	A5S1-C		22 Slv Bus
509	A5S2-C	A5S3-C		22 Slv Bus
34	A5S2-7	A7XA1-19	Local Fil On, No	A22PB-3
33	A5S2-8	A7XA1-X	Local Fil On, Com	A22PB-4
533	A5S2-8	A5S10-8		A22PB-4
505	A5S3-A	A5A1-26		A22PB-3
509	A5S3-C	A5S2-C		22 Slv Bus
510	A5S3-C	A5S4-C		22 Slv Bus
35	A5S3-8	A7XA1-V	Local Plate Off, Com	A22PB-6
534	A5S3-8	A5S10-9		A22PB-6
36	A5S3-9	A7XA1-13	Local Plate Off, NC	A22PB-1
504	A5S4-A	A5A1-25		A22PB-4
510	A5S4-C	A5S3-C		22 Slv Bus
511	A5S4-C	A5S5-C		22 Slv Bus
38	A5S4-7	A7XA1-U	Local LP On, No	A22PB-936
37	A5S4-8	A7XA1-18	Local HP/LP On, Com	A22PB-90
514	A5S4-8	A5S5-8		A22PB-90
503	A5S5-A	A5A1-24		A22PB-5
511	A5S5-C	A5S5-C		22 Slv Bus
512	A5S5-C	A5S6-C		22 Slv Bus
39	A5S5-7	A7XA1-T	Local HP On, No	A22PB-935
514	A5S5-8	A5S4-8		A22PB-90
502	A5S6-A	A5A1-23		A22PB-6
512	A5S6-C	A5S5-C		22 Slv Bus
513	A5S6-C	A5S7-C		22 Slv Bus
40	A5S6-7	A7XA1-N	Local Raise	A22PB-926
515	A5S6-8	A5S7-8		A22PB-7

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
27	A5S6-8	A7XA1-L	Raise/Lower, Com	A22PB-7
501	A5S7-A	A5A1-22		A22PB-7
513	A5S7-C	A5S6-C		22 Slv Bus
41	A5S7-7	A7XA1-M	Local Lower	A22PB-925
515	A5S7-8	A5S6-8		A22PB-7
531	A5S8A-C	A5M1-(+)		A22PB-2
520	A5S8A-1	A5A1-8		A22PB-8
521	A5S8A-2	A5A1-9		A22PB-9
522	A5S8A-3	A5A1-10		A22PB-90
523	A5S8A-4	A5A1-17		A22PB-97
524	A5S8A-5	A5A1-16		A22PB-96
530	A5S8B-C	A5M1-(-)		A22PB-0
526	A5S8B-2	A5A1-13		A22PB-93
527	A5S8B-3	A5A1-12		A22PB-92
67	A5S8B-4	A9C34	PA Fil Mtr, Com	A22PB-9
69	A5S8B-5	A9C31	Mod Fil Mtr, Com	A22PB-92
525	A5S8B1-1	A5A1-11		A22PB-91
529	A5S9A-C	A5M2-(+)		A22PB-2
519	A5S9A-1	A5S9A2		22 Bus
518	A5S9A-2	A5S9B-3		22 Slv Bus
519	A5S9A-2	A5S9A-1		22 Bus
82	A5S9A-5	A7A2-11	+28-V Mtr	A22PB-1
186	A5S9A-8	A10TB1-14	13-kV Mtr, Com	A22PB-97
76	A5S9A-30	A6XA1-20	5-V Mtr	A22PB-8
79	A5S9A-4	A6XA1-X	+12-V Mtr	A22PB-90
85	A5S9A-6	A7A2-25	Ecc +100-V Mtr	A22PB-905
88	A5S9A-7	A9C42	Dr Ic Mtr	A22PB-3
528	A5S9B-C	A5M2-(-)		A22PB-0
70	A5S9B-1	A6XA1-21	-12-V Mtr	A22PB-5
73	A5S9B-2	A6XA1-Y	-6-V Mtr	A22PB-6
517	A5S9B-3	A5S9B-4		22 Bus
518	A5S9B-3	A5S9A-2		22 Slv Bus
517	A5S9B-4	A5S9B-3		22 Bus
83	A5S9B-5	A7A2-16	+28-V Mtr, Com	A22PB-0
516	A5S9B-6	A5S9B-7		22 Bus
516	A5S9B-7	A5S9B-6		22 Bus
187	A5S9B-8	A10TB1-13	13-kV Mtr	A22PB-93
77	A5S9B-3	A6XA1-W	Mtr, Com	A22PB-9
86	A5S9B-7	A9E-3	Ecc Ic Mtr, Com	A22PB-91
609	A6CB1-1	A6CB3-1		A16PB-9
610	A6CB1-2	A6CB3-2		A16PB-9

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
611	A6CB1-3	A6CB3-3		A16PB-9
1	A6CB1-4	7K2-4	LV Input A	A16PB-5
601	A6CB1-4	A6F2-1		A18PB-5
2	A6CB1-5	A7K2-3	LV Input B	A16PB-7
3	A6CB1-6	A7K2-2	LV Input C	A16PB-6
55	A6CB2-C	A7XA1-12	Door Interlock	A22PB-90
194	A6CB2-No	A9C49		A22PB-902
4	A6CB2-1	A7K2-12	Bias PS Input A	A20PB-3
5	A6CB2-2	A7K2-11	Bias PS Input B	A20PB-91
605	A6CB2-2	A6F6-1		A18PB-91
6	A6CB2-3	A7K2-10	Bias PS Input C	A20PB-4
604	A6CB2-3	A6F5-1		A16PB-4
7	A6CB2-4	A7T3-2	Bias PS Input A	A20PB-92
8	A6CB2-5	A7T3-5	Bias PS Input B	A20PB-93
9	A6CB2-6	A7T3-8	Bias PS Input C	A20PB-95
250	A6CB3-1	TB1-1	AC Input, A Phase	A08VA-9
609	A6CB3-1	A6CB1-1		A16PB-9
251	A6CB3-2	TB1-2	AC Input, B Phase	A08VA-9
610	A6CB3-2	A6CB1-2		A16PB-9
252	A6CB3-3	TB1-3	AC Input, C Phase	A08AV-9
611	A6CB3-3	A6CB1-3		A16PB-9
254	A6CB3-4	A8K1-L1	HVPS Input, A Phase	A10PB-1
255	A6CB3-5	A8K1-L2	HVPS Input, B Phase	A10PB-2
256	A6CB3-6	A9K1-L3	HVPS Input, C Phase	A10PB-3
61	A6E1	A7XA1-S	Motor Rev (Lower)	A22PB-91
59	A6E3	A7T2-9	Motor, Common	A18PB-92
60	A6E4	A7XA1-3	Motor Fwd (Raise)	A22PB-8
602	A6F1-1	A6F2-1		A18PB-5
20	A6F1-2	A10TB1-7	5/12-V PS Input, A/N	A20PB-1
601	A6F2-1	A6CB1-4		A18PB-5
602	A6F2-1	A6F1-1		A18PB-5
21	A6F2-2	A7T1-2	28-V PS Input, A	A18PB-5
15	A6F3-1	A7K1-10	Blower, AC, B	A18PB-1
16	A6F3-2	B1-L1	Blower, AC, B	A18PB-2
10	A6F4-1	A7K1-11	Fan, AC, 115-V	A18PB-90
18	A6F4-2	TB2-1	Fan, AC, 115-V	A18PB-3
604	A6F5-1	A6CB2-3		A16PB-4
11	A6F5-2	A7TB1-14	Filament, Pwr DC	A18PB-1
603	A6F5-2	A6M1-2		A22PB-1

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
605	A6F6-1	A6CB2-2		A18PB-91
14	A6F6-2	A7T2-3	Dr PS Input B	A20PB-90
12	A6M1-1	A7K2-12	Fil Hr A/N	A22PB-3
603	A6M1-2	A6F5-2		A22PB-1
606	A6R1-1	A6R2-1		A18PB-6
24	A6R1-2	A9C33	PA Fil C	A18PB-4
607	A6R1-2	A6R1-3		20 Ga Bus
607	A6R1-3	A6R1-2		20 Ga Bus
13	A6R2-1	A7TB1-15	Filament Pwr, DC	A22PB-6
606	A6R2-1	A6R1-1		A18PB-6
22	A6R2-2	A9C32	Mod Fil C	A18PB-5
608	A6R2-2	A6R2-3		20 Ga Bus
608	A6R2-3	A6R2-2		20 Ga Bus
145	A6TB2-6	A6XA1-11	Osc 1 Select	A22PB-96
135	A6XA1-D	A7A2-3	+28-V DC Supply to B/P	A20PB-2
144-9	A6XA1-E	A7TB2-1	Audio Input	Stp 22PB-9
132	A6XA1-F	A7XA1-9	LP On to PWM Card	A22PB-95
189	A6XA1-H	A7J1	Freq Mon	RG-223 Cntr
54	A6XA1-J	A10TB1-1	-13-kV Sample Com	A22PB-1
190-9	A6XA1-K	A7TB2-5	Stereo AF	Stp 22PB-9
191	A6XA1-L	P4	Arc Sensor	RG-223 Cntr
148	A6XA1-M	A7TB2-9	Osc 2 Select	A22PB-905
147	A6XA1-N	A7TB2-8	Osc 2 Readout	A22PB-903
189S	A6XA1-P	A7J1	Shield	RG-223 Shld
191S	A6XA1-P	P4	Shield	RG-223 Shld
101S	A6XA1-R	A7J2	Shield	RG-223 Shld
99S	A6XA1-R	P4	Shield	RG-223 Shld
50	A6XA1-T	A7XA1-F	Overload	A22PB-956
42-1	A6XA1-U	A9A6C12	Ref Pwr Sig	Stp-22PB-1
156-9	A6XA1-V	A7TB1-5	Rem Fwd Pwr	Stp 22PB-9
96-9	A6XA1-V	A5S11-3	Fwd Pwr Mtr	Stp-22PB-9
77	A6XA1-W	A5S9B-3	Mtr Com	A22PB-9
79	A6XA1-X	A5S9A-4	+120-V Mtr	A22PB-90
73	A6XA1-Y	A5S9B-2	-6-V Mtr	A22PB-6
130	A6XA1-Z	A1TB1-3	AC to Logic PS	A22PB-3
156-S	A6XA1-1	A7TB1-6	Rem Pwr Com	Stp Shield
42-S	A6XA1-1	A9A6E1	Chassis Gnd	Shield
96-S	A6XA1-1	A5M5-(-)	Chassis Gnd Mon	Shield
136	A6XA1-3	A7A2-19	28-V DC Com to B/P	A20PB-0
144-S	A6XA1-4	A7TB2-3	Shield	Stp Shield
190-S	A6XA1-4	A7TB2-3	Shield	Stp Shield

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
144-2	A6XA1-5	A7TB2-2	Audio Input	Stp 22PB-2
100S	A6XA1-6	A9E2	Shield	Shield
149	A6XA1-7	A7TB2-10	Carrier Interlock	A22PB-906
100	A6XA1-8	A9C43	Feedback	SS 22PB-2
97	A6XA1-8	A10TB1-11	HVPS O/L	A22PB-91
53	A6XA1-9	A10TB1-14	-13-kV Sample	A22PB-97
190-2	A6XA1-10	A7TB2-4	Stereo AF	Stp 22PB-2
145	A6XA1-11	A6TB2-6	Osc 1 Select	A22PB-96
146	A6XA1-12	A7TB2-7	Osc 1 Readout	A22PB-902
101	A6XA1-13	A7J2	RF Signal Out	RG-223 Cntr
102	A6XA1-14	A9C41	RF Drive Control	A22PB-91
99	A6XA1-15	P3	Arc Sensor	RG-223 Cntr
98	A6XA1-16	A10TB1-10	HVPS O/L	A22PB-90
42-9	A6XA1-17	A9A6C11	Fwd Pwr Sig	Stp-22PB-9
156-6	A6XA1-18	A7TB1-7	Rem Ref Pwr	Stp-22PB-6
96-6	A6XA1-18	A5S11-5	Ref Pwr Mtr	Stp-22PB-6
163	A6XA1-19	A10TB1-4	Logic PS, Com C/T	A22PB-4
76	A6XA1-20	A5S9A-3	+5-V Mtr	A22PB-8
70	A6XA1-21	A5S9B-1	-12-V Meter	A22PB-5
131	A6XA1-22	A10TB1-5	AC to Logic PS, Com	A22PB-5
701	A7A2-1	A7K2-1		A20PB-2
81	A7A2-2	A7XA1-J	+28-V DC Supply	A22PB-2
135	A7A2-3	A6XA1-D	+28-V DC Supply to B/P	A20PB-2
702	A7A2-4	A7TB2-13		A22PB-2
185	A7A2-5	A8K1-L4	+28 Volts	A22PB-2
192	A7A2-6	A9C45	Driver, +28 Volts	A20PB-2
82	A7A2-11	A5S9A-5	+28-V Mtr	A22PB-1
703	A7A2-12	A7R1-3		A20PB-912
704	A7A2-13	A7CR1-(-)		A20PB-0
51	A7A2-14	A8K1-C1	HV Contactor Coil (-)	A20PB-0
62	A7A2-15	A5S1-C	Light, 28-V Common	A22PB-0
83	A7A2-16	A5S9B-5	+28-V Mtr, Com	A22PB-0
705	A7A2-17	A7K2-14		A20PB-0
95	A7A2-18	A7XA1-15	28-V Com	A20PB-0
136	A7A2-19	A6XA1-3	28-V DC Com to B/P	A20PB-0
706	A7A2-20	A7TB2-12		A22PB-0
707	A7A2-23	A7CR2-(+)		A22PB-3
708	A7A2-24	A7L1-1		A22PB-6

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
85	A7A2-25	A5S9A-6	Ecc +200-V Mtr	A22PB-905
137	A7A2-26	A9C40	+200 V DC to Driver	A22PB-902
709	A7A2-27	A7C2-(+)		A22PB-4
138	A7A2-28	A9E3	+200 V DC Com	A22PB-91
710	A7A2-29	A7C2-(-)		A22PB0-5
711	A7A2-30	A7CR2-(-)		A22PB-7
712	A7A2-31	A7Q2-E		A20PB-96
713	A7A2-32	A7Q2-B		A22PB-95
714	A7A2-33	A7Q2-C		A20PB-92
715	A7A2-34	A7Q1-B		A22PB-90
262	A7A3-5	A7S2-2	+125 V to Rear Intlk	A16LE-9
259	A7A3-6	A7S2-1	13.7 kV to Bias PS, Com	A16LE-9
260	A7A3-6	A7S1-1	13.7 kV to Front Intlk	A16LE-9
258	A7A3-7	A9R11-2	-125 V to Sw Card	A16LE-9
717	A7CR1-DC	A7T1-5		A20PB-2
733	A7CR1-DC	A7T1-6		A20PB-92
704	A7CR1-(-)	A7A2-13		A20PB-0
716	A7CR1-(+)	A7R1-1		A20PB-3
718	A7CR2-AC	A7T2-12		A20PB-3
719	A7CR2-AC	A7T2-11		A20PB-4
711	A7CR2-(-)	A7A2-3		A22PB-7
707	A7CR2-(+)	A7A2-23		A22PB-3
710	A7C2-(-)	A7A2-29		A22PB-5
709	A7C2-(+)	A7A2-27		A22PB-4
720	A7C2-(+)	A7L1-2		A22PB-4
253	A7E1	TB1-4	AC Input, Neutral	A08VA-9
71	A7E1-18	A5A1-18	Neutral, (AC Meter)	A22PB-93
189	A7J1	A6XA1-H	Freq Mon	RG-223 Cntr
189S	A7J1	A6XA1-P	Shield	RG-223 Shld
101	A7J2	A6XA1-13	RF Signal	RG-223 Cntr
101S	A7J2	A6XA1-R	Shield	RG-223 Shld
188	A7J3	P5	Stereo RF In	RG-223 Cntr
188S	A7J3	P5	Shield	RG-223 Shld
721	A7K1-1	A7T1-1		A22PB-7
723	A7K1-3	A7T2-8		A18PB-95
15	A7K1-10	A6F3-1	Blower AC Ob	A18PB-1
10	A7K1-11	A6F4-1	Fan, AC, 115 V	A18PB-90
734	A7K1-12	A7K1-13		A22PB-916
734	A7K1-13	A7K1-12		A22PB-916
74	A7K1-13	A7XA1-W	Blower Relay, Control	A22PB-916
724	A7K1-14	A7K2-14		A18PB-0
124	A7K1-4	A7XA1-20	Blower Relay, Holding	A22PB-923
701	A7K2-1	A7A2-1		A20PB-2
17	A7K2-2	B1-L2	Blower AC, C/N	A18PB-6
3	A7K2-2	A6CB1-6	LV Input C	A16PB-6

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
65	A7K2-2	A5A1-19	Line C Meter	A22PB-6
722	A7K2-2	A7K2-3		A18PB-1
2	A7K2-3	A6CB1-5	LV Input B	A16PB-7
64	A7K2-3	A5A1-20	Line B Meter	A22PB-7
722	A7K2-3	A7K1-2		A18PB-1
1	A7K2-4	A6CB1-4	LV Input A	A16PB-5
63	A7K2-4	A5A1-21	Line A Meter	A22PB-5
43	A7K2-5	A5A1-1	FIL OFF Light	A22PB-92
725	A7K2-5	A7TB1-8		A22PB-92
44	A7K2-9	A5A1-2	FIL ON Light	A22PB-913
726	A7K2-9	A7TB1-9		A22PB-913
6	A7K2-10	A6CB2-3	Bias PS Input C	A20PB-4
5	A7K2-11	A6CB2-2	Bias PS Input B	A20PB-91
12	A7K2-12	A6M1-1	Fil Hr A/N	A22PB-3
4	A7K2-12	A6CB2-1	Bias PS Input A	A20PB-3
727	A7K2-12	A7TB1-16		A22PB-3
129	A7K2-13	A9S3-NO	Air Intlk Fil RF Cont	A22PB-1
705	A7K2-14	A7A2-17		A20PB-0
724	A7K2-14	A7K1-14		A18PB-0
78	A7K2-9	A7XA1-5	Fil Controlled, +28 V	A22PB-913
708	A7L1-1	A7A2-24		A22PB-6
720	A7L1-2	A7C2-(+)		A22PB-4
715	A7Q1-B	A7A2-34		A22PB-90
728	A7Q1-C	A7Q2-C		A22PB-92
729	A7Q1-E	A7Q2-B		A22PB-95
713	A7Q2-B	A7A2-32		A22PB-95
729	A7Q2-B	A7Q1-E		A22PB-95
714	A7Q2-C	A7A2-33		A20PB-92
728	A7Q2-C	A7Q1-C		A22PB-92
712	A7Q2-E	A7A2-31		A20PB-96
716	A7R1-1	A7CR1-(+)		A20PB-3
730	A7R1-1	A7R1-2		A20PB-3
730	A7R1-2	A7R1-1		A20PB-3
703	A7R1-3	A7A2-12		A20PB-912
56	A7S1-C	A9C39	Door Intlk/Fr Pnl	A22PB-96
731	A7S1-NO	A7S2-C		A22PB-902
260	A7S1-1	A7S3-6	13.7 kV to Front Intlk	A16LE-9
261	A7S1-1	A9S1-1	13.7 kV to RF Intlk	A16LE-9
263	A7S1-2	A7S2-2	13.8 kV to Front Intlk	A16LE-9
264	A7S1-2	A9S1-2	13.8 kV to RF Intlk	A16LE-9
731	A7S2-C	A7S1-NO		A22PB-902

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
58	A7S2-NO	A7XA1-H	Rear Pnl Intlk	A22PB-93
259	A7S2-1	A7A3-6	13.7 kV to Bias PS, Com	A16LE-9
265	A7S2-1	C1-1	13.7 kV PS Output	A16LE-9
262	A7S2-2	A7A3-5	12.7 kV to Rear Intlk	A16LE-9
263	A7S2-2	A7A1-2	13.8 kV to Front Intlk	A16LE-9
152	A7TB1-1	A10TB1-15	Remote IB (+)	A22PB-95
153	A7TB1-2	A10TB1-16	Remote IB Com (-)	A22PB-96
154	A7TB1-3	A9E4	Remote EBB, Com (+)	A22PB-0
155	A7TB1-4	A9C37	Remote EBB (-)	A22PB-936
156-9	A7TB1-5	A6XA1-V	Rem Fwd Pwr	Stp 22PB-9
156-S	A7TB1-6	A6XA1-1	Rem Pwr, Com	Stp Shield
156-6	A7TB1-7	A6XA1-18	Rem Ref Pwr	Stp 22PB-6
725	A7TB1-8	A7K2-5		A22PB-92
726	A7TB1-9	A7K2-9		A22PB-913
159	A7TB1-10	A7XA1-4	Rem Plate Off Ind	A22PB-923
160	A7TB1-11	A7XA1-11	Rem LP-On Ind	A22PB-916
161	A7TB1-12	A7XA1-7	Rem HP-On Ind	A22PB-915
11	A7TB1-14	A6F5-2	Filament Pwr, DC	A18PB-1
13	A7TB1-15	A6R2-1	Filament Pwr, DC	A22PB-6
23	A7TB1-16	A7C31	Mod Fil, Com, A/N	A22PB-3
727	A7TB1-16	A7K2-12		A22PB-3
732	A7TB1-16	A7T2-1		A22PB-3
144-9	A7TB2-1	A6XA1-E	Audio Input	Stp 22PB-9
144-2	A7TB2-2	A6XA1-5	Audio Input	Stp 22PB-2
144-S	A7TB2-3	A6XA1-4	Shield	Stp Shield
190-S	A7TB2-3	A6XA1-4	Shield	Stp Shield
190-2	A7TB2-4	A6XA1-10	Stereo AF	Stp 22PB-2
190-9	A7TB2-5	A6XA1-K	Stereo AF	Stp 22PB-9
146	A7TB2-7	A6XA1-12	Osc 1 Readout	A22PB-902
147	A7TB2-8	A6XA1-N	Osc 2 Readout	A22PB-903
148	A7TB2-9	A6XA1-M	Osc 2 Select	A22PB-905
149	A7TB2-10	A6XA107	Carrier Interlock	A22PB-906
184	A7TB2-11	A8K1-T4	Plate, Controlled +28 V	A22PB-3
706	A7TB2-12	A7A2-20		A22PB-0
702	A7TB2-13	A7A2-4		A22PB-2
126	A7T1-1	A10TB1-6	Logic PS Xfmr, Com	A22PB-7
721	A7T1-1	A7K1-2		
21	A7T1-2	A6F2-2	28-V PS Input A	A18PB-5

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
717	A7T1-5	A7CR1-AC		A20PB-2
733	A7T1-6	A7CR1-AC		A20PB-92
732	A7T2-1	A7TB1-16		A22PB-3
14	A7T2-3	A6F6-2	Dr PS Input B	A20PB-90
134	A7T2-8	A7XA1-2	Raise/Lwr, 115 V AC	A22PB-915
723	A7T2-8	A7K1-3		A18PB-95
19	A7T2-9	TB2-2	Fan, AC, 115 V	A18PB-92
59	A7T2-9	A6E3	Motor, Common	A18PB-92
719	A7T2-11	A7CR2-AC		A20PB-4
718	A7T2-12	A7CR2-AC		A20PB-3
736	A7T3-1	A7T3-5		A20PB-93
7	A7T3-2	A6CB2-4	Bias PS Input A	A20PB-92
735	A7T3-2	A7T3-7		A20PB-92
737	A7T3-4	A7T3-8		A20PB-95
736	A7T3-5	A7T3-1		A20PB-93
8	A7T3-5	A6CB2-5	Bias PS Input B	A20PB-93
735	A7T3-7	A7T3-2		A20PB-92
737	A7T3-8	A7T3-4		A20PB-95
9	A7T3-8	A6CB2-6	Bias PS Input C	A20PB-95
48	A7XA1-B	A5A1-6	RAISE Light	A22PB-903
49	A7XA1-C	A5A1-7	LOWER Light	A22PB-902
45	A7XA1-D	A5A1-3	PLATE OFF Light	A22PB-912
52	A7XA1-E	A8K1-C3	HV Contactor Coil (+)	A22PB-92
50	A7XA1-F	A6XA1-T	Overload	A22PB-956
58	A7XA1-H	A7S2-NO	Rear Pnl Intlk	A22PB-93
81	A7XA1-J	A7A2-2	+28-V DC Supply	A22PB-2
26	A7XA1-K	A5S10-2	+28-V DC Supply	A22PB-2
27	A7XA1-L	A5S6-8	Raise/Lower, Com	A22PB-7
41	A7XA1-M	A5S7-7	Local Lower	A22PB-925
40	A7XA1-N	A5S6-7	Local Raise	A22PB-926
61	A7XA1-S	A6E1	Motor Rev (Lower)	A22PB-91
39	A7XA1-T	A5S5-7	Local HP On, No	A22PB-935
38	A7XA1-U	A5S4-7	Local LP On, No	A22PB-936
35	A7XA1-V	A5S3-8	Local Plate Off, Com	A22PB-6
74	A7XA1-W	A7K1-13	Blower Relay Control	A22PB-916
33	A7XA1-X	A5S2-8	Local Fil On, Com	A22PB-4
32	A7XA1-Y	A5S1-9	Local Fil Off, NC	A22PB-5
134	A7XA1-2	A7T2-8	Raise/Lwr, 115-V AC	A22PB-915
60	A7XA1-3	A6E4	Motor Fwd (Raise)	A22PB-8

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
159	A7XA1-4	A7TB1-10	Rem Plate Off Ind	A22PB-923
78	A7XA1-5	A7K2-9	Fil, Controlled +28 V	A22PB-913
47	A7XA1-6	A5A1-5	HP ON Light	A22PB-905
161	A7XA1-7	A7TB1-12	Rem HP On Ind	A22PB-915
162	A7XA1-8	A9C11	LP On to Mod Mon Relay	A22PB-913
132	A7XA1-9	A6XA1-F	LP On to PWM Card	A22PB-95
46	A7XA1-10	A5A1-4	LP ON Light	A22PB-906
160	A7XA1-11	A7TB1-11	Rem LP On Ind	A22PB-916
55	A7XA1-12	A6CB2-C	Door Interlock	A22PB-90
36	A7XA1-13	A5S3-9	Local Plate Off, NC	A22PB-1
95	A7XA1-15	A7A2-18	28-V, Com	A20PB-0
37	A7XA1-18	A5S4-8	Local HP/LP On, Com	A22PB-90
34	A7XA1-19	A5S2-7	Local Fil On, No	A22PB-3
124	A7XA1-20	A7K1-4	Blower Relay Holding	A22PB-923
75	A7XA1-21	A9S3-C	Air Intlk, Com	A22PB-915
28	A7XA1-22	A5S10-5	+28 V DC, Remote	A20PB-1
300	A8CR1-C	T1-16	HV Ad	A16LE-9
310	A8CR11-C	A08C2-2	Damper	A16LE-9
301	A8CR2-C	T1-17	HV Bd	A16LE-9
314	A8CR3-A	A8C1-1		A16LE-9
302	A8CR3-C	T1-18	HV Cd	A16LE-9
313	A8CR7-A	A8R2-1	Damper	A18PB-2
303	A8CR7-C	T1-19	HV Ay	A16LE-9
304	A8CR8-C	T1-20	HV By	A16LE-9
305	A8CR9-C	T1-21	HV Cy	A16LE-9
306	A8C1-1	C1-1	13 kV to Rear Intlk	A16LE-9
314	A8C1-1	A8CR3-A		A16LE-9
308	A8C1-2	A8R1-1	Damper	A16LE-9
309	A8C2-1	A8R2-2	Damper	A16LE-9
310	A8C2-2	A08CR11-C	Damper	A16LE-9
312	A8C2-2	A8R3-2	Damper	A16LE-9
51	A8K1-C1	A7A2-14	HV Contactor Coil (-)	A22PB-0
52	A8K1-C3	A7XA1-E	HV Contactor Coil (+)	A22PB-92
254	A8K1-L1	A6CB3-4	HVPS Input, A Phase	A10PB-1
255	A8K1-L2	A6CB3-5	HVPS Input, B Phase	A10PB-2
256	A8K1-L3	A6CB3-6	HVPS Input, C Phase	A10PB-3
185	A8K1-L4	A7A2-5	+28 Volts	A22PB-2
400	A8K1-T1	T1-2	HVPS Input, A Phase	A10PD-4
401	A8K1-T2	T1-7	HVPS Input, B Phase	A10PD-5
402	A8K1-T3	T1-12	HVPS Input, C Phase	A10PD-6
184	A8K1-T4	A7TB2-11	Plate, Controlled +28 V	A22PB-3
308	A8R1-1	A8C1-2	Damper	A16LE-9

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
313	A8R2-1	A8CR7-A	Damper	A18PB-2
309	A8R2-2	A8C2-1	Damper	A16LE-9
312	A8R3-2	A8C2-2	Damper	A16LE-9
42-9	A9A6C11	A6XA1-17	Fwd Pwr Sig	Stp-22PB-9
42-1	A9A6C12	A6XA1-U	Ref Pwr Sig	Stp-22PB-1
42-S	A9A6E1	A6XA1-1	Chassis Gnd	Shield
162	A9C11	A7XA1-8	LP On to Mod Mon Relay	A22PB-913
23	A9C31	A7TB1-16	Mod Fil, Com A/N	A22PB-3
25	A9C31	A9C34	PA Fil, Com A/N	A16PB-3
69	A9C31	A5S8B-5	Mod Fil Mtr, Com	A22PB-92
22	A9C32	A6R2-2	Mod Fil C	A18PB-5
24	A9C33	A6R1-2	PA Fil C	A18PB-4
25	A9C34	A9C31	PA Fil, Com, A/N	A18PB-3
67	A9C34	A5S8B-4	PA Fil Mtr, Com	A22PB-9
90	A9C35	A5M3-(-)	Plate Voltage Mtr (-)	A22PB-4
91	A9C36	A5M3-(+)	Plate Volt Mtr, Com (-)	A22PB-5
155	A9C37	A7TB1-4	Remote EBB (-)	A22PB-936
193	A9C38	A9C50	Plate Interlock	A22PB-903
56	A9C39	A7S1-C	Door Intlk/Fr Pnl	A22PB-96
137	A9C40	A7A2-26	+200 V DC to Driver	A22PB-902
102	A9C41	A6XA1-14	RF Drive Control	A22PB-91
88	A9C42	A5S9A-7	Dr Ic Mtr	A22PB-3
100	A9C43	A6XA1-8	Feedback	SS 22PB-2
114	A9C44	A10TB1-2	HV Filter Return	A18PB-91
192	A9C45	A7A2-6	Driver, +28-V	A20PB-2
68	A9C47	A05A1-15	Mod Fil Mtr	A22PB-2
66	A9C48	A05A1-14	PA Fil Meter	A22PB-1
194	A9C49	A06CB2-NO		A22PB-902
193	A9C50	A09C38	Plate Interlock	A22PB-903
86	A9E-3	A5S9B-7	Ecc Ic Mtr, Com	A22PB-91
100S	A9E2	A6XA1-6	Shield	Shield
138	A9E3	A7A2-28	+200-V DC, Com	A22PB-91
154	A9E4	A7TB1-3	Remote EBB, Com (+)	A22PB-0
258	A9R11-2	A07A3-7	13.8 kV to Sw Card	A16LE-9
261	A9S1-1	A7S1-1	13.7 kV to RF Intlk	A16LE-9
264	A9S1-2	A7S1-2	13.8 kV to RF Intlk	A16LE-9
75	A9S3-C	A7XA1-21	Air Intlk, Com	A22PB-915
129	A9S3-NO	A7K2-13	Air Intlk Fil RF Cont	A22PB-1
1006	A10A1	A10R4-1		A16LE-9
1012	A10A1	A10E1		A22PB-0
1026	A10A1-2	A10TB1-13		A22PB-93
1012	A10E1	A10A1-E3		A22PB-0
1033	A10A1-4	A10TB1-14		A22PB-0
1022	A10E10	A10TB1-11		A18PB-91
1023	A10E11	A10TB1-10		A22PB-90

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
1019	A10E17	A10TB1-16		A22PB-96
1024	A10E13	A10TB1-9		A22PB-9
1020	A10E19	A10TB1-15		A22PB-95
1017	A10R1-1	A10E9		A22PB-4
1042	A10R1-1	A8CR10-C		A16LE-9
1041	A10R4-1	A8CR3-A		A16LE-9
1021	A10E8	A10TB1-12		A22PB-92
1032	A10TB1-1	E1		A22PB-0
54	A10TB1-1	A6XA1-J		A22PB-0
1031	A10TB1-2	A10E3	-13.7-kV Sample, Com	A22PB-2
1030	A10TB1-3	A10T1-0 (Sec)		A22PB-3
130	A10TB1-3	A6XA1-Z	AC to Logic PS	A22PB-3
1029	A01TB1-4	A10T1-12		A22PB-4
163	A10TB1-4	A6XA1-19	Logic PS, Com, C/T	A22PB-4
1028	A10TB1-5	A10T1-24		A22PB-5
131	A10TB1-5	A6XA1-22	AC to Logic PS, Com	A22PB-5
1027	A10TB1-6	A10T1-0 (Pri)		A22PB-6
126	A10TB1-1	A7T1-1	Logic PS, Xfmr, Com	A22PB-7
1026	A10TB1-7	A10T1-208		A22PB-7
20	A10TB1-7	A6F1-1	5/12-V PS Input A/N	A20PB-1
1025	A10TB1-8	A10T1-240		A22PB-8
1024	A10TB1-9	A10E13		A22PB-9
93	A10TB1-9	A5M4-(+)	Plate Curr Mtr (+)	A22PB-9
1023	A10TB1-10	A10E11		A22PB-90
98	A10TB1-10	A6XA1-16	HVPS O/L	A22PB-90
1022	A10TB1-11	A10E10		A18PB-91
97	A10TB1-11	A6XA1-8	HVPS O/L	A22PB-91
1021	A10TB1-12	A10E8		A22PB-92
94	A10TB1-12	A5M4-(-)	Plt Curr Mtr, Com (-)	A22PB-92
1034	A10TB1-13	A10A1-2		A22PB-93
187	A10TB1-13	A5S9B-8	13-kV Mtr	A22PB-93
1033	A10TB1-14	A10A1-4		A22PB-0
186	A10TB1-14	A5S9A-8	13-kV Mtr, Common	A22PB-97
53	A10TB1-14	A6XA1-9	-13-kV Sample	A22PB-97
1020	A10TB1-15	A10E19		A22PB-95
152	A10TB1-15	A7TB1-1	Remote IB (+)	A22PB-95
1019	A10TB1-16	A10E17		A22PB-96
153	A10TB1-16	A7TB1-2	Remote IB, Com (-)	A22PB-96
114	A10TB1-2	A9C44	HV Filter Return	A18PB-91
1027	A10T1-0 (Pri)	A10TB1-6		A22PB-6
1030	A10T1-0 (Sec)	A10TB1-3 A10TB1-3		A22PB-3

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

828E-1 5-kW AM Transmitter Wire List (Cont).

WIRE NO.	FROM	TO	FUNCTION	WIRE CODE
1029	A10T1-12	A10TB1-4		A22PB-4
1026	A10T1-208	A10TB1-7		A22PB-7
1028	A10T1-24	A10TB1-5		A22PB-5
1025	A10T1-240	A10TB1-8		A22PB-9
16	B1-L1	A6F3-2	Blower, AC, B	A18PB-2
17	B1-L2	A7K2-2	Blower, AC, C/N	A18PB-6
182	B2-1	TB2-1	Jumper	A18PB-3
183	B2-2	TB2-2	Jumper	A18PB-92
265	C1-1	A7S2-1	13.7-kV PS Output	A16LE-9
306	C1-1	A8C1-2	13 kV to Rear Intlk	A16LE-9
1028	E1	A10TB1-1		A22PB-0
99	P2	A6XA1-15	Arc Sensor	RG-223 Cntr
99S	P3	A6XA1-R	Shield	RG-223 Shld
191	P4	A6XA1-L	Arc Sensor	RG-223 Cntr
191S	P4	A6XA1-P	Shield	RG-223 Shld
188	P5	A7J3	Stereo RF In	RG-223 Cntr
188S	P5	A7J3	Shield	RG-223 Shld
1029	R1-2	A10TB1-2		A22PB-2
250	TB1-1	A6CB3-1	AC Input, A Phase	A08VA-9
183	TB1-2	B2-2	Jumper	A18PB-92
251	TB1-2	A6CB3-2	AC Input, B Phase	A08VA-9
252	TB1-3	A6CB3-3	AC Input, C Phase	A08VA-9
253	TB1-4	A7E1	AC Input, Neutral	A08VA-9
18	TB2-1	A6F4-2	Fan AC, 115 V	A18PB-3
182	TB2-1	B2-1	Jumper	A18PB-3
19	TB2-2	A7T2-9	Fan AC, 115 V	A18PB-92
400	T1-2	A8K1-T1	HVPS Input, A Phase	A10PD-4
403	T1-2	T1-14	Jumper	A10PD-4
404	T1-4	T1-7	Jumper	A10PD-5
401	T1-7	A8K1-T2	HVPS Input, B Phase	A10PD-5
404	T1-7	T1-4	Jumper	A10PD-5
405	T1-9	T1-12	Jumper	A10PD-6
402	T1-12	A8K1-T3	HVPS Input, C Phase	A10PD-6
405	T1-12	T1-9	Jumper	A10PD-6
403	T1-14	T1-2	Jumper	A10PD-4
300	T1-16	A8CR1-C	HV Ad	A16LE-9
301	T1-17	A8CR2-C	HV Bd	A16LE-9
302	T1-18	A8CR3-C	HV Cd	A16LE-9
303	T1-19	A8CR7-C	HV Ay	A16LE-9
304	T1-20	A8CR8-C	HV By	A16LE-9
305	T1-21	A8CR9-C	HV Cy	A16LE-9

SECTION 7
PARTS LIST

SECTION 7
PARTS LIST

7.1 INTRODUCTION

The following paragraphs include the 828E-1 5-kW AM Transmitter main frame parts list (paragraph 7.2), the subassembly list and photos (paragraph 7.3), the semiconductor list (paragraph 7.4), and the suggested spare parts list (paragraph 7.5).

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

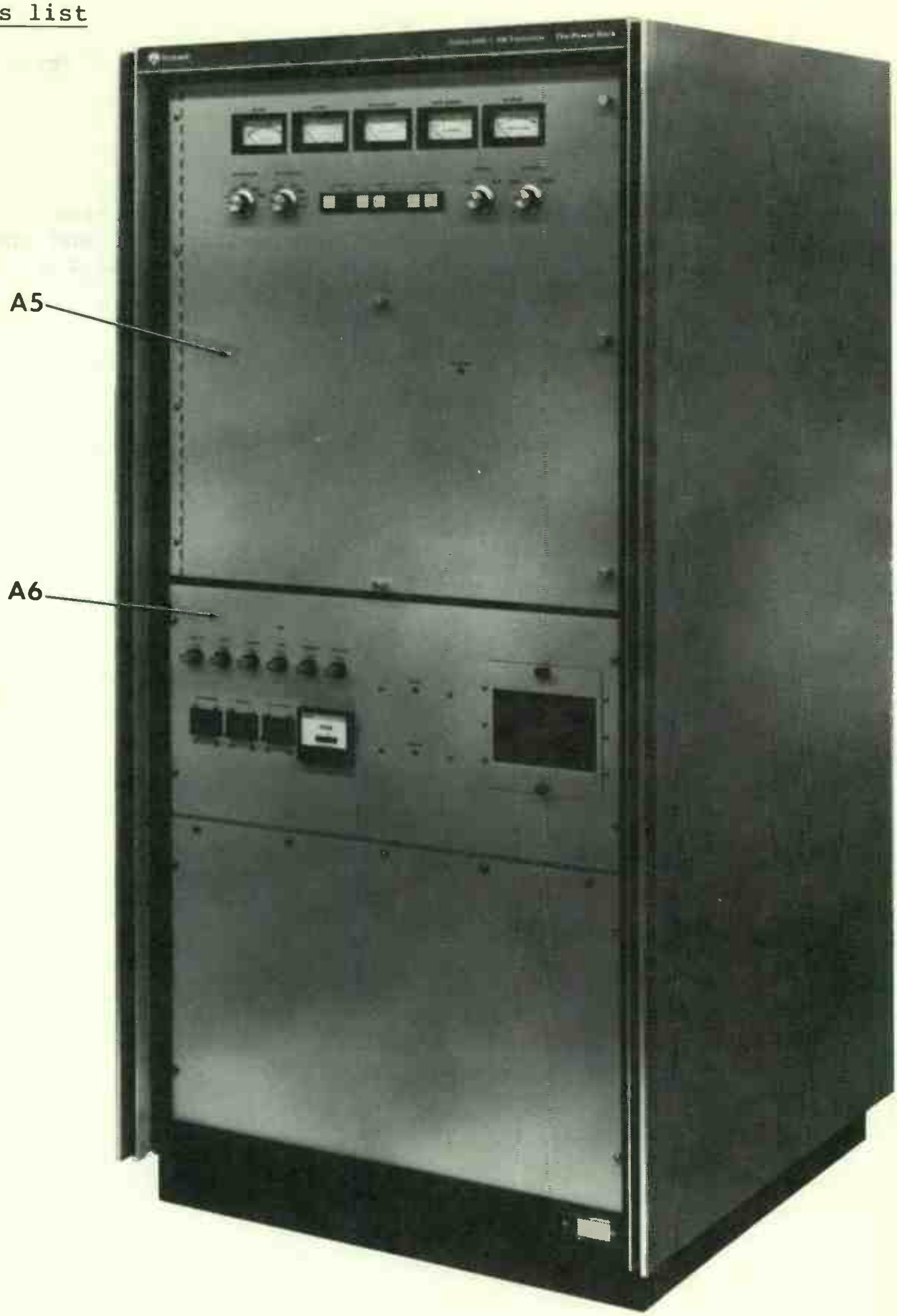


Figure 7-1. 828E-1 Main Frame (Front View).

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

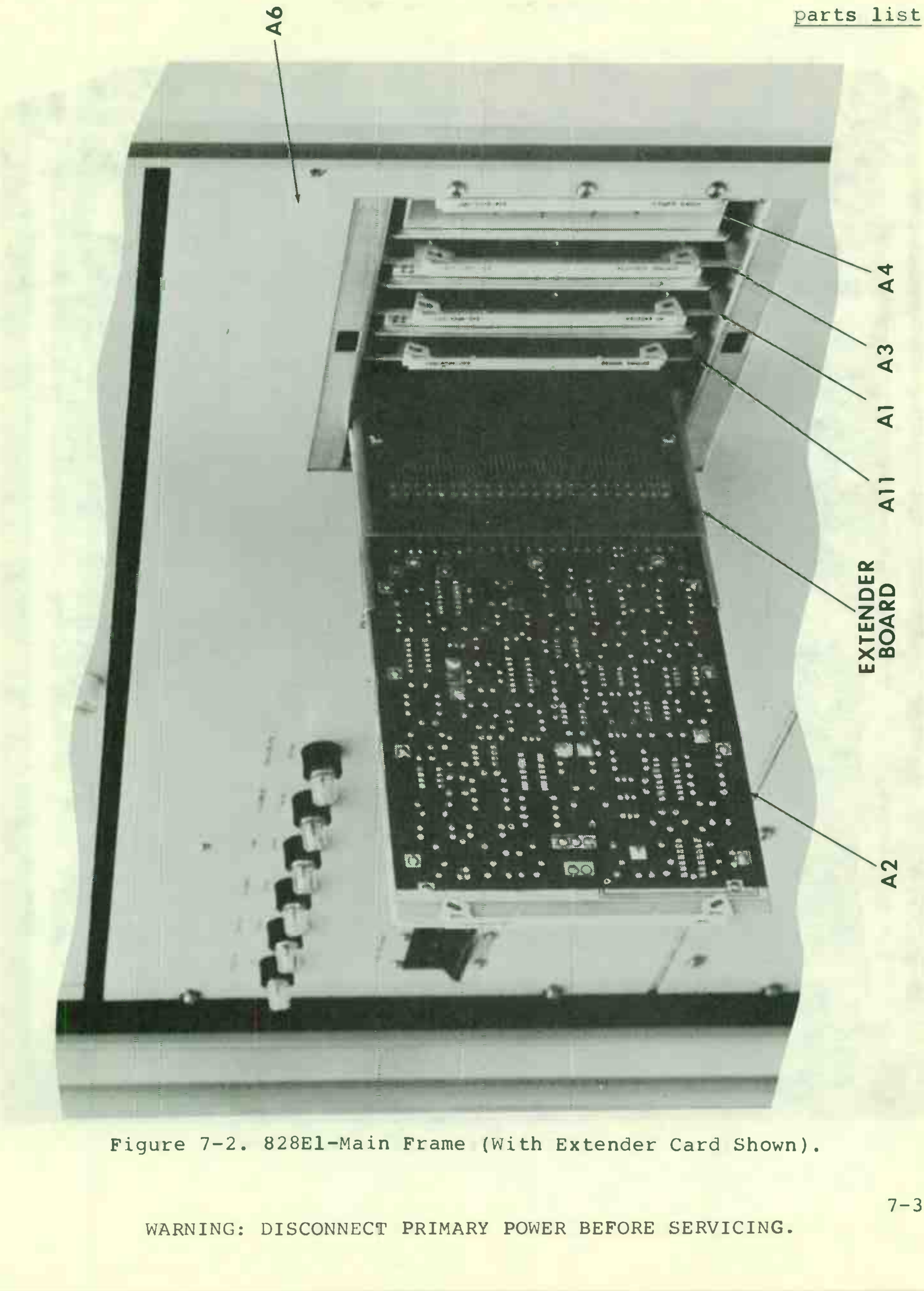


Figure 7-2. 828E1-Main Frame (With Extender Card Shown).

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

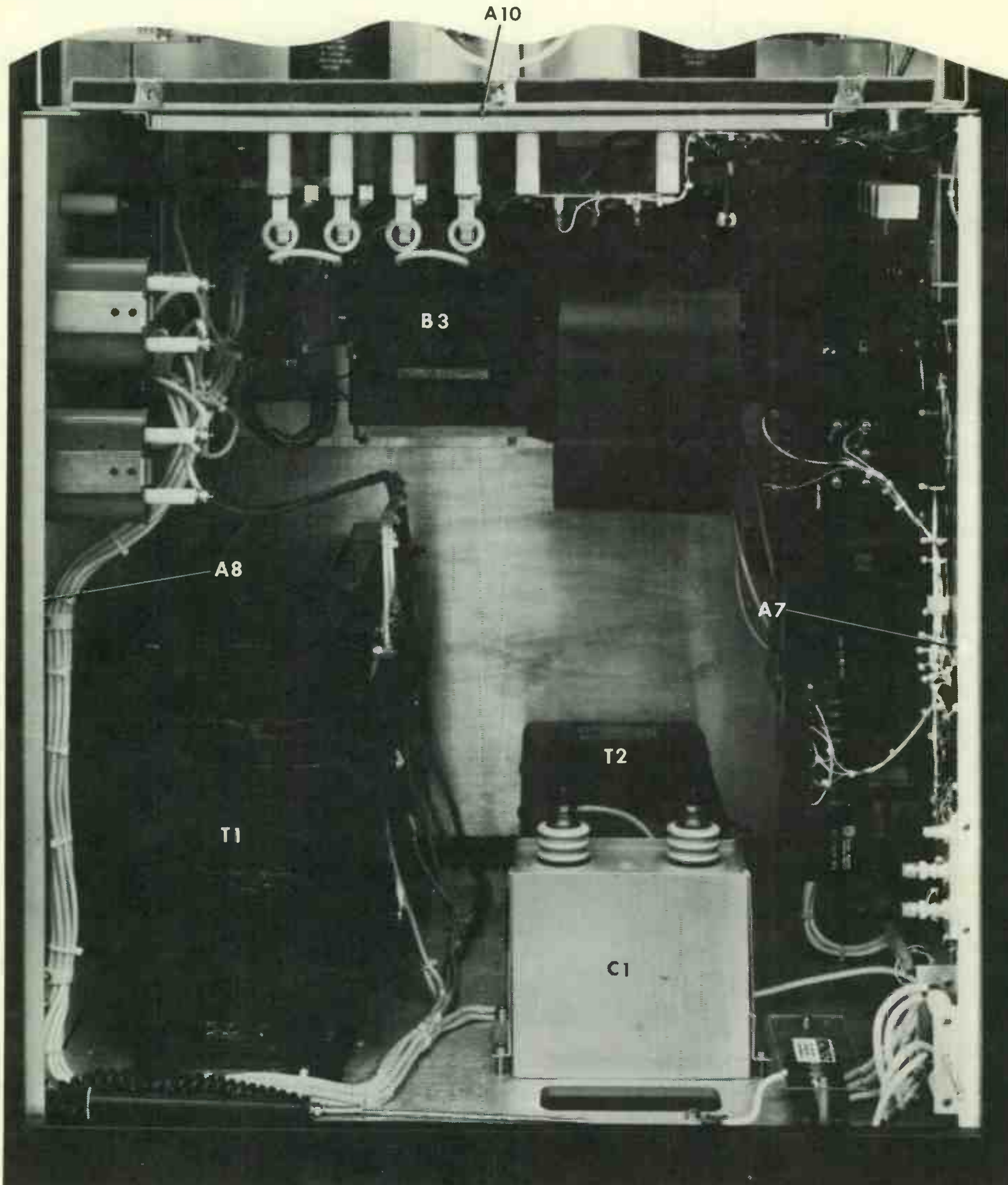


Figure 7-3. 828E-1 Main Frame (Rear View).

7.2 828E-1 MAIN FRAME PARTS LIST

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A1	636-8438-001	PC Assy	1	RF Exciter
A2	636-8480-001	PC Assy	1	PWM Card
A3	636-8467-001	PC Assy	1	Control Logic Card
A4	636-8471-001	PC Assy	1	Logic PS Card
A5	636-8427-001	Assy	1	Meter Panel/Door
A6	636-9680-001	Assy	1	Circuit Breaker Panel
A7	636-8502-001	Assy	1	Power Control Chassis
A8	636-8494-001	Assy	1	High-Voltage Power Supply Chassis
A9	636-9690-001	Assy	1	RF Compartment
A10	640-9677-001	Assy	1	High-Voltage Bleeder
A11	640-9699-001	Assy	1	Signal Access Card
B1	230-0651-010	60 Hz, 1/3 HP	1	Motor, 60 Hz
B1	230-0651-020	50 Hz, 1/3 HP (Option)	0	Motor, 50 Hz
B1	009-1938-010	480 CFM	1	Blower, Dayton 2 C889
B2	009-1933-010	750 CFM	1	Cabinet Fan
C1	930-0766-040	2.1 µF, 15 kV	1	HVPS Filter
R1	712-4230-000	20, 100 W	1	Current Limiting
T1	662-0606-010	13.7 kV at 0.7 A	1	Plate Xfmr, 12-Phase
T2	662-0292-070	190-260/236 V (Option)	0	Filament Reg, 60 Hz
T2	662-0292-080	190-260/236 V (Option)	0	Filament Reg, 50 Hz
TB1	306-0778-000	4 Term, 600 V	1	AC Input TB
TB2	367-4020-000	2 Term	1	Cabinet Fan
W1J1	357-9248-010	BNC Jack	1	Frequency Monitor
W1J2	357-9248-010	BNC Jack	1	RF Drive Out
W1J3	357-9248-010	BNC Jack	1	RF Drive In
W1P1-4	----------Not Used----------			
W1P5	357-9292-000	BNC Plug	1	RF Drive
XA6A1	372-7499-050	44-Pin Plug	1	Backplane
XA7A1	372-7499-050	44-Pin Plug	1	Control Relay Card
	270-0547-050	SPX 3130-201	1	Fiber Optic Cable

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

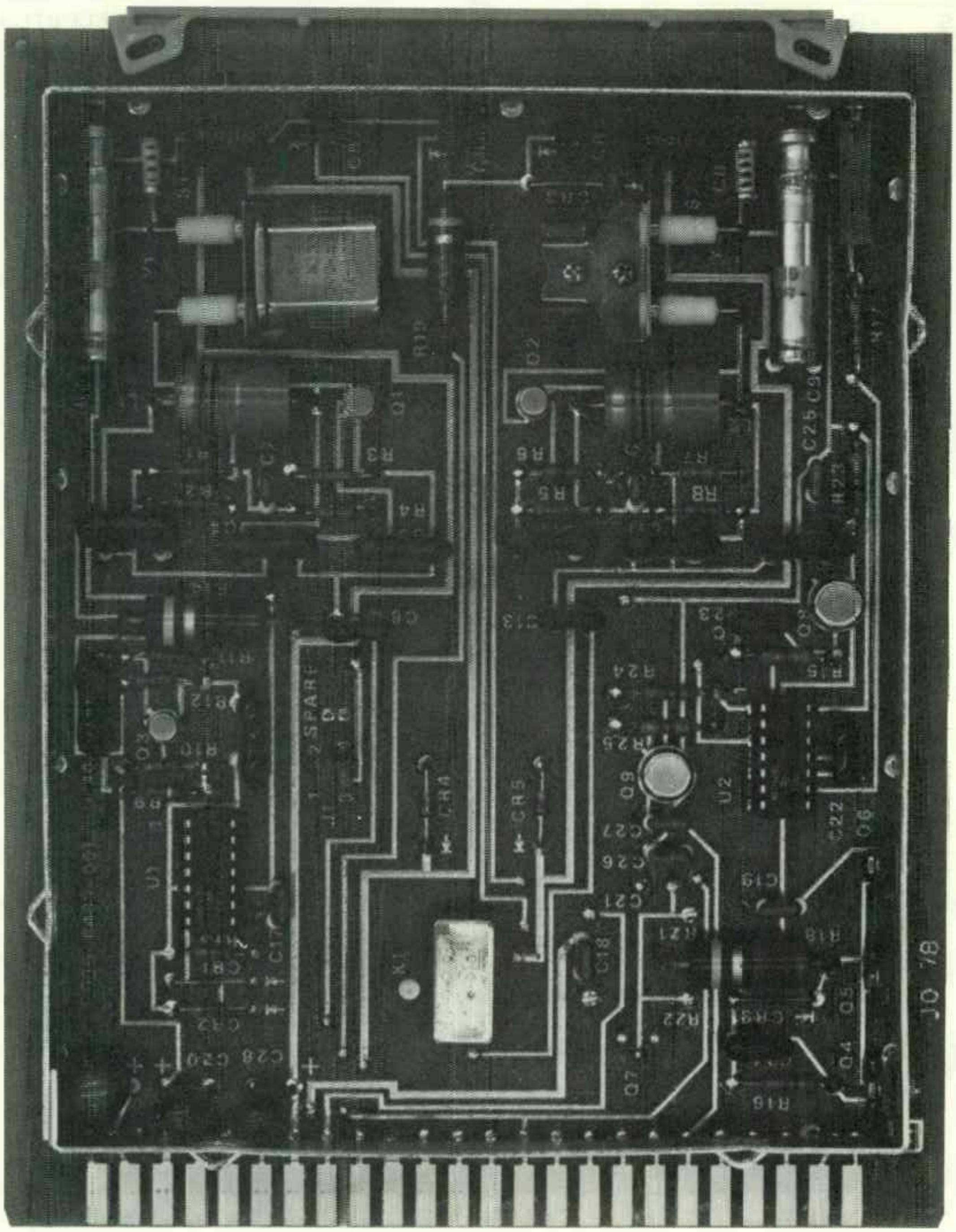


Figure 7-4. RF Exciter Card Al.

7.3 SUBASSEMBLY PARTS LIST

RF Exciter Card.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A1	636-8434-001	PC Assy	1	RF Exciter Card
A1C1	916-0671-000	15 pF, 500 V	1	Y1 Pad
A1C2	922-0609-000	1-60 pF Var	1	Osc 1 Adj
A1C3	912-3025-000	2200 pF, 500	1	Q1 Base
A1C4	912-2980-000	510 pF, 500 V	1	Q1 Emitter
A1C5	912-2980-000	510 pF, 500 V	1	Q1 Emitter
A1C6	912-2816-000	100 pF, 500 V	1	Q1 Emitter
A1C7	913-3279-200	0.1 µF, 50 V	1	Q1 Bypass
A1C8	916-0671-000	15 pF, 500 V	1	Y2 Pad
A1C9	922-0609-000	1-60 pF Var	1	Osc 2 Adj
A1C10	912-3025-000	220 pF	1	Q2 Base
A1C11	912-2980-000	510 pF	1	Q2 Emitter
A1C12	912-2980-000	510 pF	1	Q2 Emitter
A1C13	912-2816-000	100 pF	1	Q2 Emitter
A1C14	913-3279-200	0.1 µF, 50 V	1	Q2 Bypass
A1C15	912-3025-000	2200 pF, 500 V	1	Q3 Collector
A1C16	912-3025-000	2200 pF, 500 V	1	Q3 Emitter
A1C17	913-3279-270	1.0 µF, 50 V	1	U1 Bypass
A1C18	913-3279-270	1.0 µF, 50 V	1	Q5 Bypass
A1C19	913-3279-270	1.0 µF, 50 V	1	Q5/Q6 Coupling
A1C20	184-9102-160	150 µF, 15 V	1	12-V Bypass
A1C21	--------------------Not Used----------------------			
A1C22	912-2786-000	39 pF, 500 V	1	U2 Timing 05
A1C23	912-2828-000	150 pF, 500 V	1	Q8 Coupling
A1C24	912-2858-000	390 pF, 500 V	1	Q4 Coupling
A1C25	913-3279-270	1.0 µF, 50 V	1	U2 Bypass
A1C26-27	913-3279-270	1.0 µF, 50 V	2	Q9 Bypass
A1C28	184-9102-440	33 µF, 35 V	1	28-V Bypass
A1C29	184-9102-110	220 uF, 10 V	1	5-V Bypass
A1CR1	353-2906-000	1N914	1	+5-V Clamp
A1CR2	353-2906-000	1N914	1	Gnd Clamp
A1CR3	353-2906-000	1N914	1	RF Det
A1CR4	353-6442-040	1N4004	1	K1 Sup
A1CR5	353-6442-040	1N4004	1	K1 Sup
A1CR6	636-6171-001	Red LED	1	RF Output Ind
A1CR7	636-6171-001	Red LED	1	Osc 1 Ind Assy
A1CR8	636-6171-001	Red LED	1	Osc 2 Ind Assy
A1CR9	353-2906-000	1N914	1	Clamp Diode
A1L1	240-0844-000	10 µH	1	Osc 1
A1L2	240-0844-000	10 µH	1	Osc 2
A1L3	--------------------Not Used-------------------------			
A1K1	408-0003-010	28-V Latch Coil	1	Oscillator Select
A1Q1	352-0661-020	2N2222A	1	Osc 1
A1Q2	352-0661-020	2N2222A	1	Osc 2

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RF Exciter Card (Cont).

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A1Q3	352-0661-020	2N2222A	1	Buffer
A1Q4	352-1104-010	MJE-243	1	Output Amplifier
A1Q5	352-1104-010	MJE-243	1	Output Amplifier
A1Q6	352-1105-010	MJE-253	1	Output Amplifier
A1Q7	-----------Not Used-----------			
A1Q8-9	352-0646-010	2N2102	2	Pulse Amplifier
A1R1	745-0910-970	22 Kilohms, 1/4 W	1	Q1 Bias
A1R2	745-0910-850	6.8 Kilohms, 1/4 W	1	Q1 Bias
A1R3	745-0910-610	680, 1/4 W	1	Q1 Emitter
A1R4	745-0910-830	5.6 Kilohms, 1/4 W	1	Q1 Collector
A1R5	745-0910-970	22 Kilohms, 1/4 W	1	Q2 Bias
A1R6	745-0910-850	6.8 Kilohms, 1/4 W	1	Q2 Bias
A1R7	745-0910-610	680, 1/4 W	1	Q2 Emitter
A1R8	745-0910-830	5.6 Kilohms, 1/4 W	1	Q2 Collector
A1R9	745-0911-040	39 Kilohms, 1/4 W	1	Q3 Bias
A1R10	745-0910-830	5.6 Kilohms, 1/4 W	1	Q3 Bias
A1R11	745-0910-730	2.2 Kilohms, 1/4 W	1	Q3 Emitter
A1R12	745-0910-830	5.6 Kilohms, 1/4 W	1	Q3 Collector
A1R13	745-0910-730	2.2 Kilohms, 1/4 W	1	U1 Input
A1R14	745-5652-000	1 Kilohm, 2 W	1	CR7 and CR8 I Limit
A1R15	745-0914-770	3.3 Kilohms, 1/2 W	1	Q8 Base
A1R16	745-0914-690	1.5 Kilohms, 1/2 W	1	Q4 Base
A1R17	745-0914-650	1.0 Kilohm, 1/2 W	1	U2 Timing
A1R18	745-5610-000	100, 2 W	1	Q4 Collector
A1R19	745-5628-000	270, 1 W	1	CR6 I Limit
A1R20	382-0012-300	20 Kilohm Pot	1	Pulse Width
A1R21	-----------Not Used-----------			
A1R22	-----------Not Used-----------			
A1R23	745-0914-410	100, 1/2 W	1	Q8 Collector
A1R24	745-0914-650	1 Kilohm, 1/2 W	1	Q9 Base
A1R25	745-0914-410	100, 1/2 W	1	Q9 Emitter
A1S1	266-6943-020	Black Pushbutton	1	Osc 1 Select
A1S2	266-6943-020	Black Pushbutton	1	Osc 2 Select
A1U1	351-7640-010	SN7473N	1	Divider
A1U2	351-7645-010	SN74121	1	One-Shot
A1XU1-2	220-0075-020	14-Pin Socket	2	Socket for U1, U2
A1XY1	292-0305-020		1	Crystal 1 Holder
A1XY2	292-0305-020		1	Crystal 2 Holder
A1Y1	289-7274-XXX	See Crystal Table	1	Freq Crystal 1
A1Y2	289-7274-XXX	See Crystal Table	1	Freq Crystal 2
A1XK1	-----------Not Used-----------			
A1-01	372-0046-010	2-Pin Clip	2	Divider Connection
A1-02	352-9655-070	Insulator	3	Insulator for Q4, 5, 6

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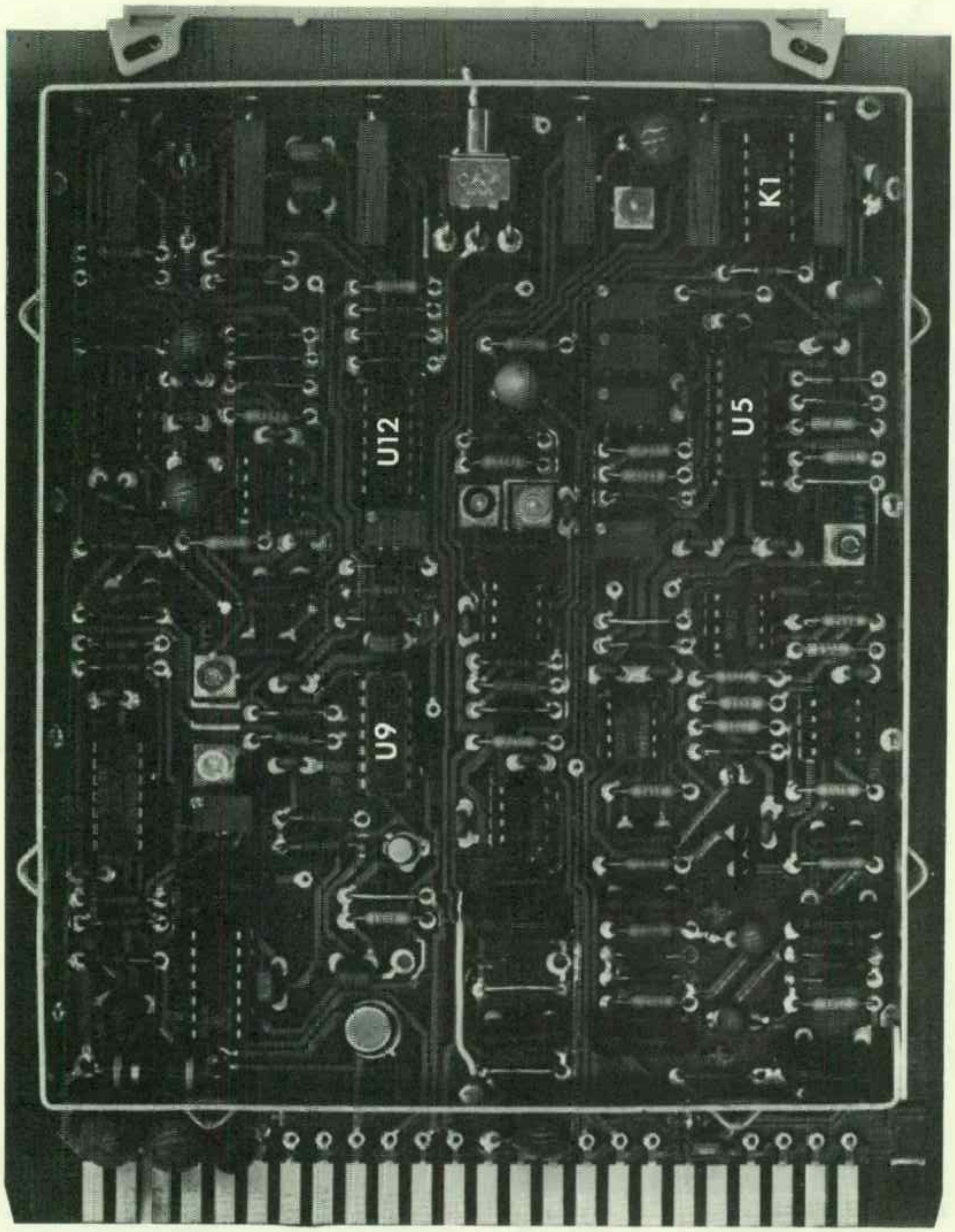

Figure 7-5. PWM Card A2.

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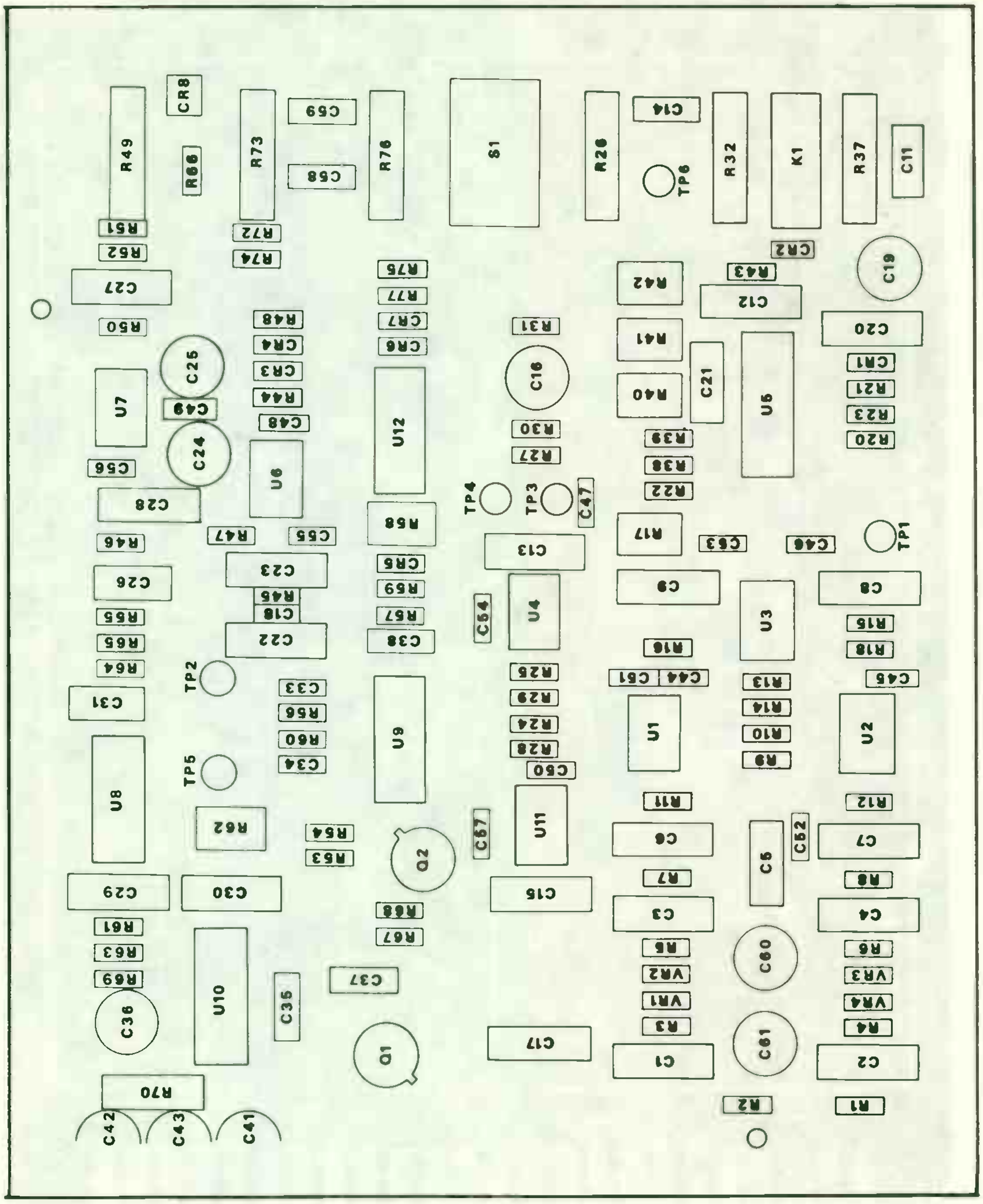

Figure 7-6. Silkscreen of PWM Card A2.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

PWM Card A2.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A2	636-8480-001	PC Assy	1	PWM Card
A2C1-2	912-3052-000	4700 pF, 500 V	2	U1, U2 Input Network
A2C3-4	912-2974-000	470 pF, 500 V	2	U1, U2 Input Network
A2C5	912-2816-000	100 pF, 500 V	1	U1, U2 Input Network
A2C6-7	912-2768-000	22 pF, 500 V	2	Feedback Cap
A2C8	912-2762-000	18 pF, 500 V	1	U3 Feedback Cap
A2C9	------------------------Not Used-------------------------			
A2C10	912-3019-000	Delete		
A2C11-12	913-3279-200	0.1 µF, 50 V	2	U4 Output Network
A2C13	912-2768-000	22 pF, 500 V	1	U4 Feedback Cap
A2C14	184-9102-110	220 µF, 10 V	1	U4 Input Network PS Sample
A2C15	912-2768-000	22 pF, 500 V	1	U11 Feedback Cap
A2C16	184-9102-630	47 µF, 20 V	1	U11 Output Network
A2C17	912-3013-000	1500 pF, 500 V	1	U11 Input Network
A2C18	------------------------Not Used-------------------------			
A2C19	184-9102-160	150 µF, 15 V	1	Pwr Control K1 Wiper
A2C20	913-3279-200	0.1 µF, 50 V	1	U5 +12-V Bypass
A2C21	913-3279-200	0.1 µF, 50 V	1	U5 -12-V Bypass
A2C22	912-2780-000	33 pF, 500 V	1	U6 Feedback Network
A2C23	912-2754-000	10 pF, 500 V	1	U6 Feedback Cap
A2C24-25	184-9102-410	10 µF, 35 V	2	U6 Output Network
A2C26	912-2858-000	390 pF, 500 V	1	U6 Output Network
A2C27	912-3013-000	1500 pF, 500 V	1	U7 Feedback Network Cap
A2C28	912-2754-000	10 pF, 500 V	1	U7 Feedback Cap
A2C29	913-3279-200	0.1 µF, 50 V	1	U8 +12-V Bypass
A2C30	912-3001-000	1000 pF, 500 V	1	U8, -12-V Blocking Cap
A2C31	913-3279-200	0.1 µF, 50 V	1	U8, -12-V Bypass
A2C32	------------------------Not Used----------------------			
A2C33	913-3279-200	0.1 µF, 50 V	1	U9, +12-V Bypass
A2C34	913-3279-200	0.1 µF, 50 V	1	U9, -6-V Bypass
A2C35	913-3279-270	1.0 µF, 50 V	1	U10A, +5-V Bypass
A2C36	184-9102-110	220 µF, 10 V	1	Q1, +5-V Bypass Collector
A2C37	913-3279-270	1.0 µF, 50 V	1	Q2 Bypass Base
A2C38	913-3279-270	1.0 µF, 50 V	1	U12C, +Input Bypass
A2C39	------------------------Not Used-------------------------			
A2C40	------------------------Not Used-------------------------			
A2C41	184-9102-110	220 µF, 10 V	1	-6-V Bus Bypass
A2C42	184-9102-200	100 µF, 20 V	1	+12-V Bus Bypass
A2C43	184-9102-200	100 µF, 20 V	1	-12-V Bus Bypass
A2C44-57	913-3279-200	0.1 µF, 50 V	14	Bypass U1-U4, U6, U7, U11

PWM Card A2 (Cont).

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A2C58	913-3279-270	1.0 µF, 50 V	1	U12A, +Input Bypass
A2C59	913-3279-270	1.0 µF, 50 V	1	U12B, +Input Bypass
A2C60-61	184-9102-370	4.7 µF, 35 V	2	AF Input Coupling
A2C62	913-3279-270	1.0 µF, 50 V	1	Ref Filter
A2C63	912-3019-000	1800 pF, 5%	1	FB Rolloff
A2CR1	353-3644-010	1N4454	1	U4 Output Network
A2CR2	353-6442-040	1N4004	1	K1 Coil Transient Suppressor
A2CR3-4	353-3644-010	1N4454	2	U6 Output Network
A3CR5-7	353-3691-010	1N5711	3	U12A, B, C, Output Iso Diode
A2CR8	636-6171-001	Red LED	1	Carrier Interlock
A2K1	410-0572-010	Relay, 28 V	1	Power Select
A2L1	-------------------------Not Used-------------------------			
A2Q1	352-0646-010	2N2102	1	LED Bias Driver
A2Q2	352-0661-020	2N2222A	1	Carrier Intlk Line Driver
A2R1	705-0985-000	590, 1%, 1/8 W	1	U1, U2 Input Network
A2R2	705-0957-000	154, 1%, 1/8 W	1	U1, U2, Input Network
A2R3-8	705-1044-000	10.0 Kilohms, 1%, 1/8 W	6	U1, U2 Input, Network
A2R9	705-1008-000	1.78 Kilohms, 1%, 1/8 W	1	Input Termination
A2R10	705-1044-000	10.0 Kilohms, 1%, 1/8 W	1	U1, U2 Input Network
A2R11-12	705-1020-000	3.16 Kilohms, 1%, 1/8 W	2	U1, U2 Feedback Resistor
A2R13-14	705-1061-000	22.6 Kilohms, 1%, 1/8 W	2	U1, U2 Output Load
A2R15	705-1076-000	46.4 Kilohms, 1%, 1/8 W	1	U3 Feedback Resistor
A2R16	705-1075-000	44.2 Kilohms, 1%, 1/8 W	1	U3 Input CM Adj
A2R17	382-1405-060	5 Kilohms, 25 T Var	1	Common Mode Adj Internal
A2R18	705-1059-000	20.5 Kilohms, 1%, 1/8 W	1	U3 Output Network
A2R19	-------------------------Not Used-------------------------			
A2R20	705-1044-000	10 Kilohms, 1%, 1/8 W	1	U3 Output Network
A2R21	705-0996-000	1.0 Kilohms, 1%, 1/8 W	1	U4 Output Network
A2R22	705-1067-000	30.1 Kilohms, 1%, 1/8 W	1	U5 Pullup Resistor

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PWM Card A2 (Cont).

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A2R23	705-1053-000	15.4 Kilohms, 1%, 1/8 W	1	Pullup Resistor
A2R24	705-0996-000	1.0 Kilohms, 1%, 1/8 W	1	U4 Output Network
A2R25	705-3605-820	52.3 Kilohms, 1%, 1/8 W	1	U4 Feedback Resistor
A2R26	382-0012-290	10.0 Kilohms, 15 T Var	1	PS Offset Adj Front Panel
A2R27	705-1087-000	78.7 Kilohms, 1%, 1/8 W	1	U4, +Input Iso Resistor +5 Bus
A2A28	705-1069-000	33.2 Kilohms, 1%, 1/8 W	1	U11 Input Network
A2R29	705-1072-000	38.3 Kilohms, 1%, 1/8 W	1	U11 Output Network
A2R30	705-1040-000	8.25 Kilohms, 1%, 1/8 W	1	U4, +Input From PS Sample
A2R31	705-1013-000	2.26 Kilohms, 1%, 1/8 W	1	U11 Output Network
A2R32	382-0012-280	5 Kilohms, 15 T Var	1	Audio Null Adj Internal
A2R33-36	-------------------------Not Used-------------------------			
A2R37	382-0012-290	10 Kilohms, 15 T Var	1	Low-Power Adj Front Panel
A2R38-39	705-1016-000	2.61 Kilohms, 1%, 1/8 W	2	U5 Output Network
A2R40	382-1405-070	10 Kilohms, 25 T Var	1	Audio Balance Adj Internal
A2R41	382-1405-070	10 Kilohms, 25 T Var	1	Control Balance Adj Internal
A2R42	382-1405-070	10 Kilohms, 25 T Var	1	Amplifier Balance Adj Internal
A2R43	705-1054-000	16.2 Kilohms, 1%, 1/8 W	1	U5 Pin 1 Load
A2R44	705-1053-000	15.4 Kilohms, 1%, 1/8 W	1	U6 Feedback Network
A2R45	705-1022-000	3.48 Kilohms, 1%, 1/8 W	1	U6 Output Network
A2R46	705-0996-000	1 Kilohm, 1%, 1/8 W	1	U6 Output Network
A2R47	705-1044-000	10.0 Kilohms, 1%, 1/8 W	1	U6 Output Network
A2R48	705-0917-000	22.6 ohms, 1%, 1/2 W	1	U6 Output Network Car Reg
A2R49	392-0012-290	10 Kilohms, 15 T Var	1	Carrier Regulator Adj Front Panel

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PWM Card A2 (Cont).

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A2R50	705-1092-000	100 Kilohms, 1%, 1/8 W	1	U7 Feedback Network
A2R51	705-1061-000	22.6 Kilohms, 1%, 1/8 W	1	U7 Input Network Carr Reg
A2R52	705-1006-000	1.62 Kilohms, 1%, 1/8 W	1	U7 Input Pin 3
A2R53	705-1038-000	7.5 Kilohms, 1%, 1/8 W	1	Feedback Input to U7
A2R54	705-1050-000	13.3 Kilohms, 1%, 1/8 W	1	Pwr Control Input to U7
A2R55	705-1012-000	2.15 Kilohms, 1%, 1/8 W	1	U7 Output Network
A2R56	705-1029-000	4.87 Kilohms, 1%, 1/8 W	1	U9 Input
A2R57	705-0997-000	1.05 Kilohms, 1%, 1/8 W	1	U12C Input
A2R58	382-1405-040	1 Kilohm, 25 T Var	1	Clamp Adj Internal
A2R59	705-3605-140	2.00 Kilohms, 1%, 1/8 W	1	U12C Input
A2R60	705-1004-000	1.47 Kilohms, 1%, 1/8 W	1	U8 Output Pin 3
A2R61	705-1005-000	1.54 Kilohms, 1%, 1/8 W	1	U8 Pin 6
A2R62	382-1405-030	500, 25 T Var	1	Switch Frequency Adj Internal
A2R63	705-0948-000	100 Ohms, 1%, 1/8 W	1	U8 Pin 4
A2R64	705-0948-000	100 Ohms, 1%, 1/8 W	1	U8 Pin 5
A2R65	705-1088-000	82.5 Kilohms, 1%, 1/8 W	1	U8 Pin 12
A2R66	705-0974-000	348 Ohms, 1%, 1/8 W	1	Anode of Carrier Intlk LED CR8
A2R67	705-1013-000	2.26 Kilohms, 1%, 1/8 W	1	Q2 Base
A2R68	705-1044-000	10.0 Kilohms, 1%, 1/8 W	1	Q2 Base
A2R69	705-0992-000	825 Ohms, 1%, 1/8 W	1	U10B Pin 6
A2R70	745-3296-000	47 Ohms, 10%, 1 W	1	Q1 Collector
A2R71	---------------------Not Used----------------------			
A2R72	705-1004-000	1.47 Kilohms, 1%, 1/8 W	1	U12A Input Neg Limit
A2R73	382-0012-270	2 Kilohms, 15 T Var	1	U12A Neg Limit Adj Front Panel
A2R74	705-0996-000	1 Kilohm, 1%, 1/8 W	1	U12A Input
A2R75	705-0900-000	10 Ohms, 1%, 1/8 W	1	U12B Input
A2R76	705-0012-270	2 Kilohms, 15 T Var	1	Pos Limit Adj Front Panel

PWM Card A2 (Cont).

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A2R77	705-0990-000	750 Ohms, 1%, 1/8 W	1	U12B Input
A2R78	705-1038-000	7.5 Kilohms, 1%	1	Feedback
A2VR1-4	353-2720-000	1N756A, 8.2 V	4	Audio Input Clamp, See U1, UA
A2S1	266-5321-980	SPDT Switch	1	IPC On-Off Front Panel
A2TP-1	360-0489-020	Red TP	1	Audio Output
A2TP-2	360-0489-040	Green TP	1	AGC Output
A2TP-3	360-0489-060	Yellow TP	1	Control Amplifier Output
A2TP-4	360-3489-030	Black TP	1	Ground
A2TP-5	360-0489-010	White TP	1	Switch Freq Output
A2TP-6	360-0489-080	Blue TP	1	PS Sample
A2U1	351-1339-010	NE5534AN	1	Audio Input
A2U2	351-1339-010	NE5534AN	1	Audio Input
A2U3	351-1339-010	NE5534AN	1	Audio Sum
A2U4	351-1339-010	NE5534AN	1	AGC Comp
A2U5	351-1116-010	MC-1494L	1	AGC Control
A2U6	351-1339-010	NE5534AN	1	AGC Amplifier
A2U7	351-1339-010	NE5534AN	1	PWM Sum
A2U8	351-1231-020	8038	1	Function Generator
A2U9	351-7189-050	710	1	PWM Generator
A2U10	351-7635-010	7410	1	PWM Gate
A2U11	351-1339-010	NE5534AN	1	Audio Null
A2U12	351-1223-020	3403	1	Limit Amplifier
A2XU1	220-0075-010	Socket	1	8-Pin Dip
A2XU2	220-0075-010	Socket	1	8-Pin Dip
A2XU3	220-0075-010	Socket	1	8-Pin Dip
A2XU4	220-0075-010	Socket	1	8-Pin Dip
A2XU5	220-0075-030	Socket	1	16-Pin Dip
A2XU6	220-0075-010	Socket	1	8-Pin Dip
A2XU7	220-0075-010	Socket	1	8-Pin Dip
A2XU8	220-0075-020	Socket	1	14-Pin Dip
A2XU9	220-0075-020	Socket	1	14-Pin Dip
A2XU10	220-0075-020	Socket	1	14-Pin Dip
A2XU11	220-0075-010	Socket	1	8-Pin Dip
A2XU12	220-0075-020	Socket	1	14-Pin Dip
A2XK1	220-0075-020	Socket	1	14-Pin Dip
A2-1	372-0046-010	Shorting Block	1	Blue 0.052 Pin

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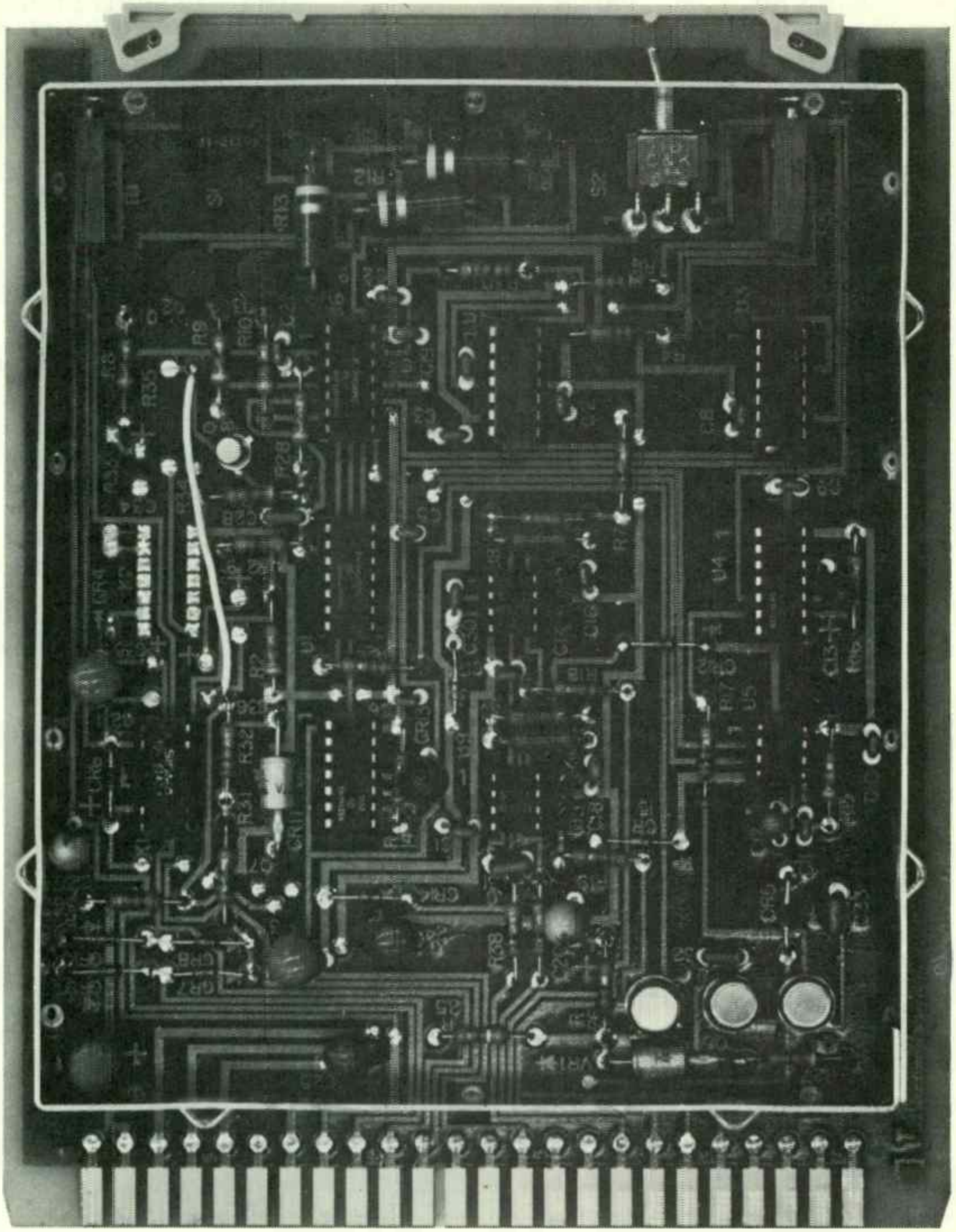

Figure 7-7. Control Circuits Card A3.

Control Circuits Card A3.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A3	636-8467-001	PC Assy	1	Control Logic Card
A3C1	913-3279-200	0.1 µF, 50 V	1	U9, -12-V Bypass
A3C2	913-3279-200	0.1 µF, 50 V	1	U7, +12-V Bypass
A3C3	913-3279-200	0.1 µF, 50 V	1	U7, -6-V Bypass
A3C4	913-3279-200	0.1 µF, 50 V	1	U6, +5-V Bypass
A3C5	913-3279-200	0.1 µF, 50 V	1	U1, +5-V Bypass
A3C6	913-3279-200	0.1 µF, 50 V	1	U2, +5-V Bypass
A3C7	184-9102-190	47 µF, 20 V	1	U2 Recycle Timing
A3C8	913-3279-200	0.1 µF, 50 V	1	U3, +5-V Bypass
A3C9	913-3279-200	0.1 µF, 50 V	1	U4, +5-V Bypass
A3C10	913-3279-200	0.1 µF, 50 V	1	U5, +5-V Bypass
A3C11	913-3279-200	0.1 µF, 50 V	1	U5 Bypass
A3C12	184-9102-240	10 µF, 50 V	1	U5 Timing
A3C13	184-9102-240	10 µF, 50 V	1	U4 Timing
A3C14	912-2816-000	100 pF 50 V	1	U8 Comp
A3C15	912-2816-000	100 pF 50 V	1	U9 Comp
A3C16	913-3279-200	0.1 µF, 50 V	1	U8, +12-V Bypass
A3C17	913-3279-200	0.1 µF, 50 V	1	U8, -12-V Bypass
A3C18	913-3279-200	0.1 µF, 50 V	1	U9, +12-V Bypass
A3C19	913-3279-300	0.1 µF, 50 V	1	U7 Input Filter
A3C20	184-9102-440	33 µF, 35 V	1	Integrator
A3C21	----------------------Not Used----------------------------			
A3C21-23	184-9102-110	220 µF, 10 V	3	5-V Bypass
A3C24-25	184-9102-160	150 µF, 15 V	2	12-V Bypass
A3C26	184-9102-440	33 µF, 35 V	1	28-V Bypass
A3C27	913-3279-200	0.1 µF, 50 V	1	Bypass
A3C28	913-3279-270	1.0 µF, 50 V	1	Bypass
A3C29,30	913-3279-200	0.1 µF, 50 V	2	Bypass
A3C31-33	913-3279-270	1.0 µF, 50 V	3	Bypass
33				
A3C34	184-9102-200	100 µF, 20 V	1	Int
A3C35-37	184-9102-110	220 pF, 10 V	3	K1 Filter
A3CR1	636-6171-001	Red LED	1	VSWR
A3CR2	636-6171-001	Red LED	1	Arc
A3CR3	636-6171-001	Red LED	1	HVPS
A3CR4	353-6442-040	400 V, 1 A	1	1N4004
A3CR5	353-6442-040	400 V, 1 A	1	1N4004
A3CR6	353-6442-040	400 V, 1 A	1	1N4004
A3CR7-10	353-2906-040	1N914	4	Diode
A3CR11	353-6316-000	1N3827A	1	Diode
A3CR12-15	353-2906-000	1N914	4	U8, 9
A3K1	410-0572-020	SPST, 5 V, 500	1	HVPS O/L
A3K2	410-0572-040	SPDT, 5 V, 200	1	Arc
A3Q1	353-6468-010	50 V, 100 mA	1	SCR C6F
A3Q2	353-6468-010	50 V, 100 mA	1	SCR C6F
A3Q3	353-6468-010	50 V, 100 mA	1	SCR C6F

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Control circuits Card A3 (Cont).

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A3Q4	352-0646-010	2N2102	1	O/L Driver
A3Q5	352-0646-010	2N2102	1	O/L Driver
A3Q6	352-0646-010	2N2102	1	Integrator
A3Q7	--------------------Not Used----------------------			
A3Q8	352-0661-020	2N2222A	1	Arc Sensor
A3R1	382-0012-260	1 Kilohm Pot 15 T	1	O/L Adj
A3R2	745-0914-810	4.7 Kilohms, 1/2 W	1	O/L Pullup
A3R3	745-0914-810	4.7 Kilohms, 1/2 W	1	Arc Pullup
A3R4	745-0914-730	2.2 Kilohms, 1/2 W	1	U7
A3R5	382-0012-280	5 Kilohms Pot 15 T	1	U7
A3R6	745-0914-650	1 Kilohm, 1/2 W	1	U7
A3R7	745-0914-890	10 Kilohms, 1/2 W	1	U7
A3R8	745-0914-570	470 Ohms, 1/2 W	1	U6
A3R9	745-0914-570	470 Ohms, 1/2 W	1	U6
A3R10	745-0914-570	470 Ohms, 1/2 W	1	U6
A3R11	745-3366-000	2.2 Kilohms, 1 W	1	CR1
A3R12	745-3366-000	2.2 Kilohms, 1 W	1	CR2
A3R13	745-3366-000	2.2 Kilohms, 1 W	1	CR3
A3R14	745-0914-970	22 Kilohms, 1/2 W	1	U2
A3R15	745-0915-300	470 Kilohms, 1/2 W	1	U5
A3R16	745-0914-970	22 Kilohms, 1/2 W	1	U4
A3R17	745-0914-650	1 Kilohm, 1/2 W	1	U4
A3R18	745-0914-730	2.2 Kilohms, 1/2 W	1	U8
A3R19	745-0914-730	2.2 Kilohms, 1/2 W	1	U9
A3R20	705-3602-460	15 Kilohms, 1/4 W, 1%	1	U8
A3R21	705-3601-080	150 Kilohms, 1/4 W, 1%	1	U8
A3R22	705-3602-680	47.5 Kilohms, 1/4 W, 1%	1	U9
A3R23	705-3602-680	47.5 Kilohms, 1/4 W, 1%	1	U9
A3R24	745-0914-730	2.2 Kilohms, 1/2 W	1	U1B
A3R25	745-0914-790	3.9 Kilohms, 1/2 W	1	Q6
A3R26	745-0914-270	27 Ohms, 1/2 W	1	Q6
A3R27	745-0914-810	4.7 Kilohms, 1/2 W	1	Q5
A3R28-29	745-0914-570	470 Ohms, 1/2 W	2	U1
A3R30	745-0914-410	100 Ohms, 1/2 W	1	U7
A3R31-32	745-0914-490	220 Ohms, 1/2 W	2	Q7
A3R33	-------------------------Not Used--------------------			
A3R34-35	745-0914-810	4.7 Kilohms, 1/2 W	2	Arc Sensor
A3R36	745-0914-650	1.0 Kilohm, 1/2 W	1	Arc Sensor
A3R37-38	745-0914-890	10 Kilohms, 1/2 W	2	U8, U9
A3S1	266-6943-020	NC Momentary	1	Reset
A3S2	266-5321-980	SPDT	1	Recycle
A3U1	351-7635-010	7410	1	NAND Gate

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Control Circuits Card A3 (Cont).

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A3U2	351-7645-010	74121	1	One-Shot
A3U3	351-7771-010	7492	1	Counter
A3U4	351-7645-010	74121	1	One-Shot
A3U5	351-1137-020	NE555V	1	Timer
A3U6	351-7630-010	7404	1	Hex Invertor
A3U7	351-7189-050	µA 710	1	Comparator
A3U8	351-1164-010	NE531U	1	Op Amp
A3U9	351-1164-010	NE531U	1	Op Amp
A3VR1	353-3129-000	1N3024B	1	15-V Zener
A3XU1-4	220-0075-020	14-Pin Socket	4	U1, 2, 3, 4
A3XU5	220-0075-010	8-Pin Socket	1	U5
A3XU6-7	220-0075-020	14-Pin Socket	2	U6, 7
A3XK1	220-0075-020	14-Pin Socket	1	K1 Socket
A3XU8-9	220-0075-010	8-Pin Socket	2	U8, 9

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

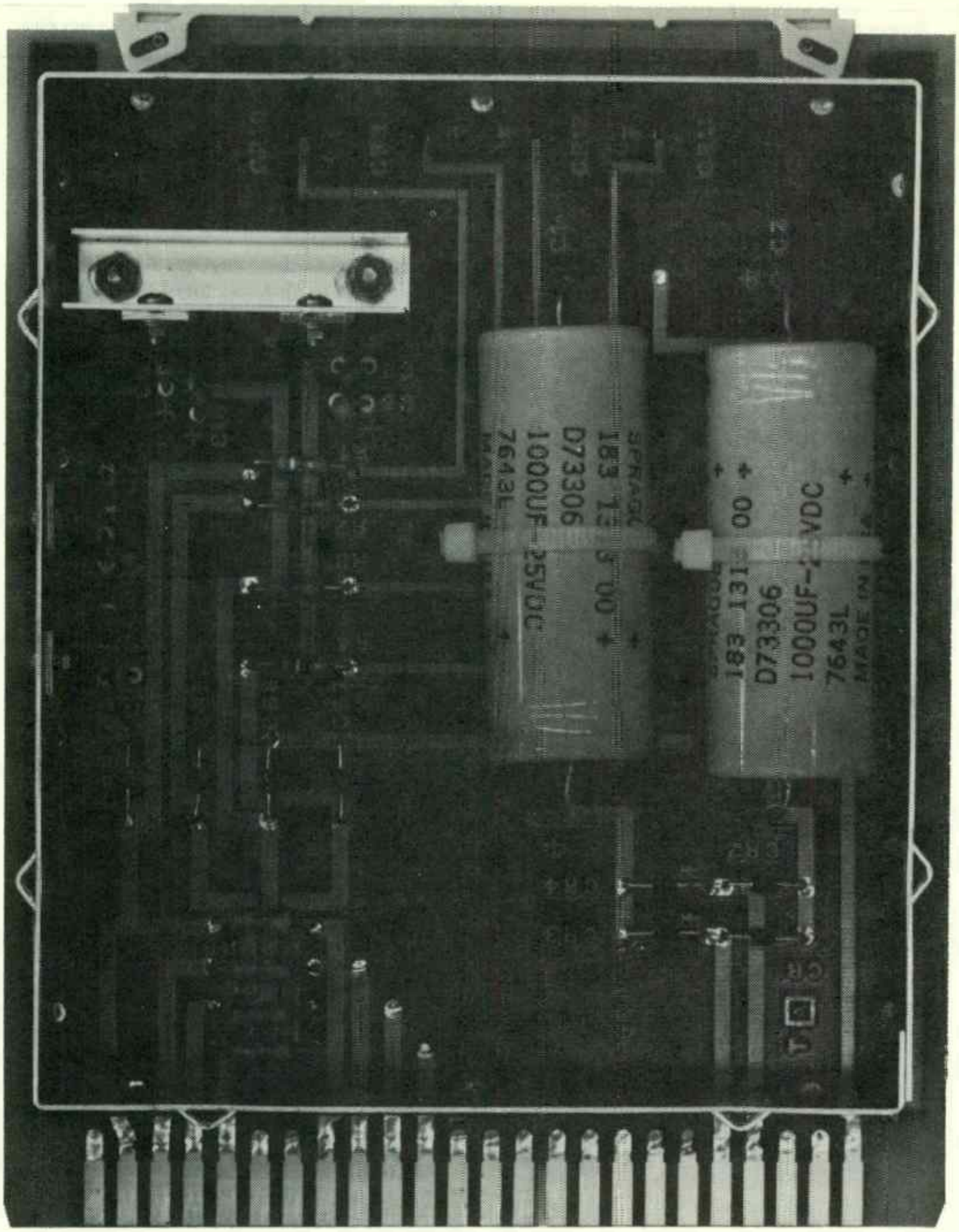

Figure 7-8. Logic Power Supply Card A4.

Logic Power Supply Card A4.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A4	636-8471-001	PC Assy	1	Logic PS Card
A4C1	183-1313-000	1000 µF, 25 V	1	+Filter
A4C2	183-1313-000	1000 µF, 25 V	1	-Filter
A4C3	184-9102-370	2.2 µF, 35 V	1	+5-V Filter
A4C4	184-9102-370	2.2 µF, 35 V	1	+12-V Filter
A4C5	184-9102-370	2.2 µF, 35 V	1	-12-V Filter
A4C6	184-9102-370	2.2 µF, 35 V	1	-6-V Filter
A4C7	913-5019-720	0.1 µF, 50 V	1	+12-V Bypass
A4C8	913-5019-720	0.1 µF, 50 V	1	+5-V Bypass
A4C9	184-9102-350	1 µF, 35 V	1	-6-V Bypass
A4C10	184-9102-350	1 µF, 35 V	1	-12-V Bypass
A4CR1	353-6442-040	400 V, 1 A	1	1N4004
A4CR2	353-6442-040	400 V, 1 A	1	1N4004
A4CR3	353-6442-040	400 V, 1 A	1	1N4004
A4CR4	353-6442-040	400 V, 1 A	1	1N4004
A4CR5	353-6442-040	1N4004	1	U2 Protect
A4CR6	353-6442-040	1N4004	1	U1 Protect
A4CR7	353-6442-040	1N4004	1	U4 Protect
A4CR8	353-6442-040	1N4004	1	U3 Protect
A4CR9	636-6171-001	Red LED	1	+12-V Indicator
A4CR10	636-6171-001	Red LED	1	+5-V Indicator
A4CR11	636-6171-001	Red LED	1	-6-V Indicator
A4CR12	636-6171-001	Red LED	1	-12-V Indicator
A4R1	745-0914-550	390 Ohms, 1/2 W	1	+5-V Indicator
A4R2	745-0914-650	1000 Ohms, 1/2 W	1	+12-V Indicator
A4R3	745-0914-650	1000 Ohms, 1/2 W	1	-12-V Indicator
A4R4	745-0914-550	390 Ohms, 1/2 W	1	-6-V Indicator
A4R5	705-6650-000	13.3 Kilohms, 1%, 1/4 W	1	+5-V Meter
A4R6	705-6650-000	13.3 Kilohms, 1%, 1/4 W	1	+12-V Meter
A4R7	705-6650-000	13.3 Kilohms, 1%, 1/4 W	1	-12-V Meter
A4R8	705-6650-000	13.3 Kilohms, 1%, 1/4 W	1	-6-V Meter
A4U1	351-1120-010	LM340T-5	1	+5-V Regulator
A4U2	351-1120-040	LM340T-12	1	+12-V Regulator
A4U3	351-1124-130	LM320T-12	1	-12-V Regulator
A4U4	351-1124-170	LM320T-6	1	-6-V Regulator

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

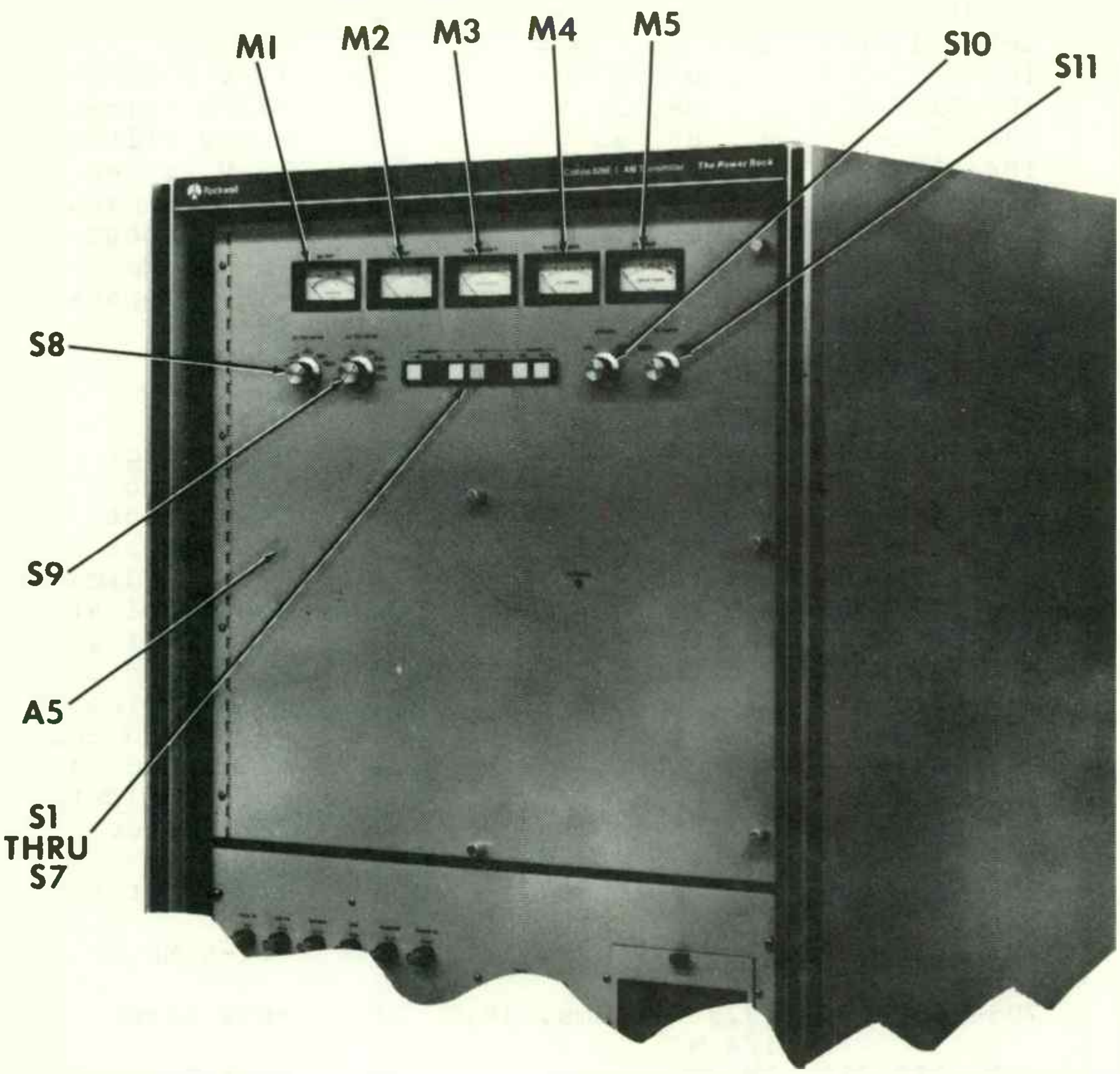

Figure 7-9. Meter Panel/Door A5.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Meter Panel/Door A5.

REF DES	PART NO.	VOLUME	QTY	DESCRIPTION
A5	636-8427-001	Assy	1	Meter Panel/Door
A5A1	636-9673-001	PC Assy	1	P/O A5 Meter Term Board
A5C1	913-3279-200	0.1 µF, 50 V	1	M2 Mtr Bypass
A5C2	913-3279-200	0.1 µF, 50 V	1	M3 Mtr Bypass
A5C3	913-3279-200	0.1 µF, 50 V	1	M4 Mtr Bypass
A5C4	913-3279-200	0.1 µF, 50 V	1	M5 Mtr Bypass
A5DS1	262-0179-010	28 V	1	Fil Off Lamp
A5DS2	262-0179-010	28 V	1	Fil On
A5DS3	262-0179-010	28 V	1	Plate Off
A5DS4	262-0179-010	28 V	1	LP On
A5DS5	262-0179-010	28 V	1	HP On
A5DS6	262-0179-010	28 V	1	Raise
A5DS7	262-0179-010	28 V	1	Lower
A5M1	452-0086-050	2550 Ohms, 10 mA	1	AC Test Meter
A5M2	458-0859-010	1500 Ohms, 2%, 1 mA	1	DC Test Meter
A5M3	458-0859-020	1000 Ohms, 1%, 2 mA	1	Plate Voltage
A5M4	458-0859-040	1000 Ohms, 1%, 1 mA	1	Plate Current
A5M5	458-0859-100	1750 Ohms, 2%, 100 µA	1	RF Power
A5-1	458-0859-260		6	Meter Bezel
A5S1	266-7509-020	Momentary Contact	1	Fil Off
A5S2	266-7509-020	Momentary Contact	1	Fil On
A5S3	266-7509-020	Momentary Contact	1	Plate Off
A5S4	266-7509-020	Momentary Contact	1	LP On
A5S5	266-7509-020	Momentary Contact	1	HP On
A5S6	266-7509-020	Momentary Contact	1	Raise
A5S7	266-7509-020	Momentary Contact	1	Lower
A5S8	259-9475-150	2P, 5 Pos, 30°	1	AC Test Meter
A5S9	259-9475-180	2P, 8 Pos, 30°	1	DC Test Meter
A5S10	259-2759-010	2P, 2 Pos, 60°	1	Local/Remote
A5S11	259-2759-010	2P, 2 Pos, 60°	1	RF Power
A5-1	266-7509-080	Button	4	White
A5-2	266-7509-060	Button	1	Green
A5-3	266-7509-050	Button	1	Red
A5-4	266-7509-070	Button	1	Yellow
A5-5	266-7509-030	Barrier	2	End
A5-6	266-7509-040	Barrier	12	Center

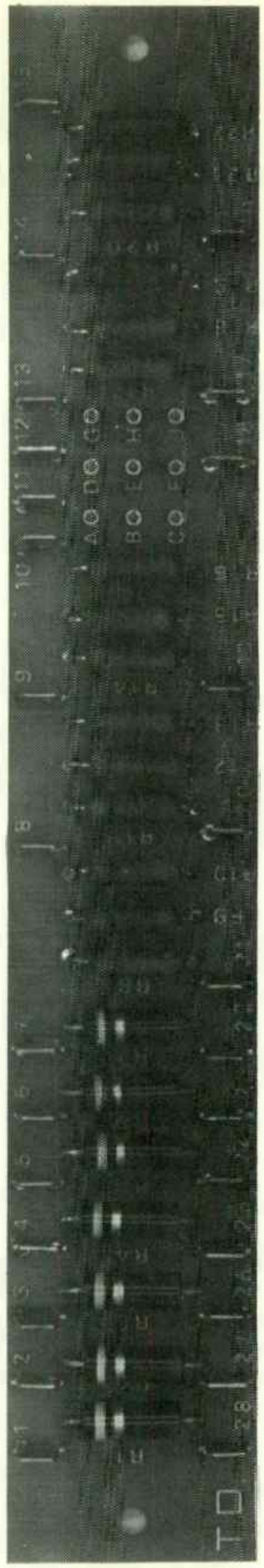

Figure 7-10. Metering Board A5A1.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Metering Board A5A1.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A5A1	636-9673-001	PC Assy		Meter Term Board
A5A1R1	745-3317-000	150 Ohms, 1 W	1	Fil Off
A5A1R2	745-3317-000	150 Ohms, 1 W	1	Fil On
A5A1R3	745-3317-000	150 Ohms, 1 W	1	Plate Off
A5A1R4	745-3317-000	150 Ohms, 1 W	1	LP On
A5A1R5	745-3317-000	150 Ohms, 1 W	1	HP On
A5A1R6	745-3317-000	150 Ohms, 1 W	1	Raise
A5A1R7	745-3317-000	150 Ohms, 1 W	1	Lower
A5A1R8	747-0998-960	9.09 Kilohms, 3 W, 1%	1	A Mtr
A5A1R9	747-0998-960	9.09 Kilohms, 3 W, 1%	1	A Mtr
A5A1R10	747-0998-960	9.09 Kilohms, 3 W, 1%	1	A Mtr
A5A1R11	747-0998-960	9.09 Kilohms, 3 W, 1%	1	B Mtr
A5A1R12	747-0998-960	9.09 Kilohms, 3 W, 1%	1	B Mtr
A5A1R13	747-0998-960	9.09 Kilohms, 3 W, 1%	1	B Mtr
A5A1R14	747-0998-960	9.09 Kilohms, 3 W, 1%	1	C Mtr
A5A1R15	747-0998-960	9.09 Kilohms, 3 W, 1%	1	C Mtr
A5A1R16	747-0998-960	9.09 Kilohms, 3 W, 1%	1	C Mtr
A5A1R17	747-0998-960	9.09 Kilohms, 3 W, 1%	1	PA Fil Mtr
A5A1R18	747-0998-960	9.09 Kilohms, 3 W, 1%	1	PA Fil Mtr
A5A1R19	747-0998-390	2.32 Kilohms, 3 W, 1%	1	PA Fil Mtr
A5A1R20	747-0998-960	9.09 Kilohms, 3 W, 1%	1	Mod Fil Mtr
A5A1R21	747-0998-960	9.09 Kilohms, 3 W, 1%	1	Mod Fil Mtr
A5A1R22	747-0998-390	2.32 Kilohms, 3 W, 1%	1	Mod Fil Mtr

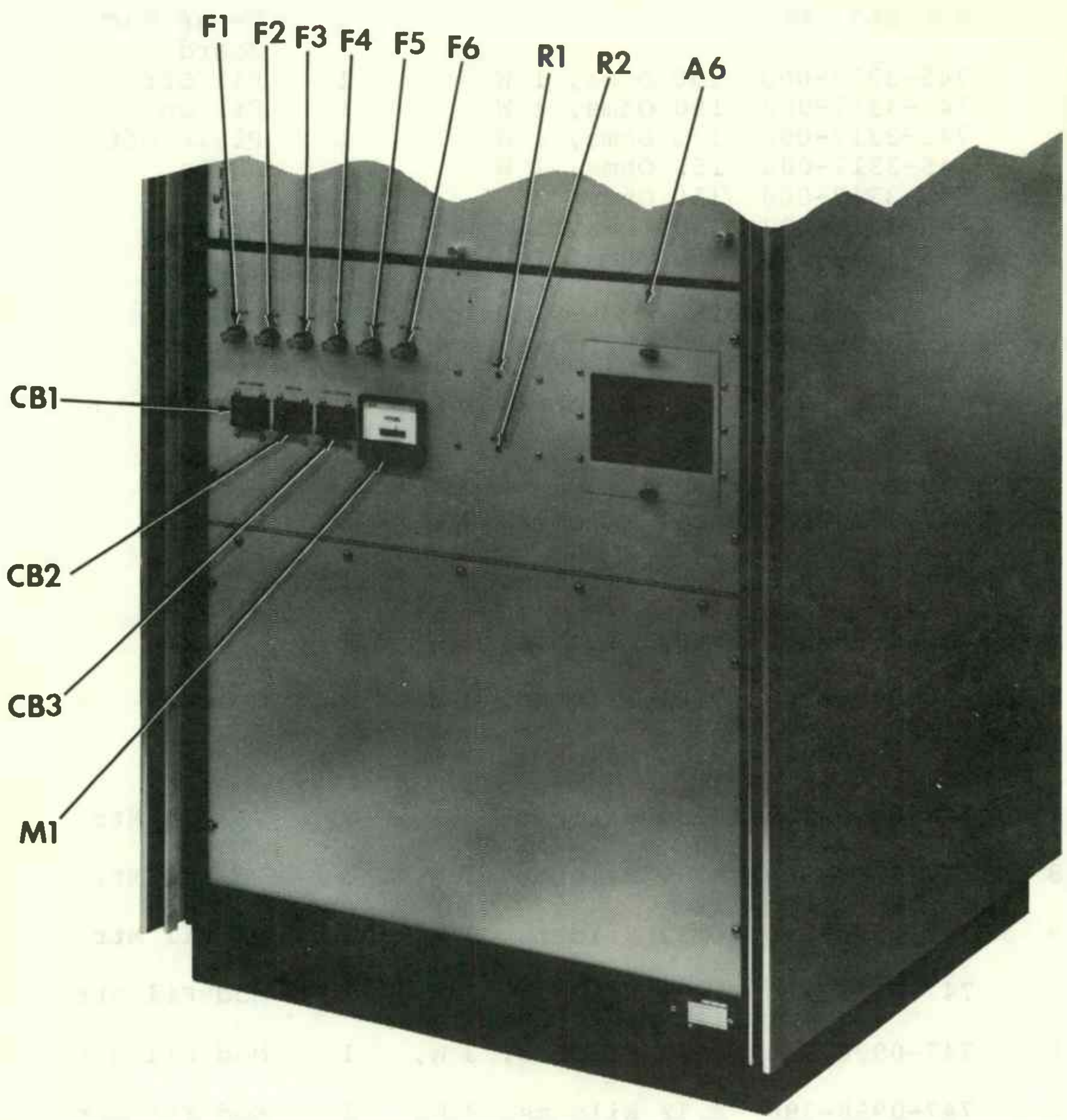

Figure 7-11. Circuit Breaker Panel A6 (Front View).

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

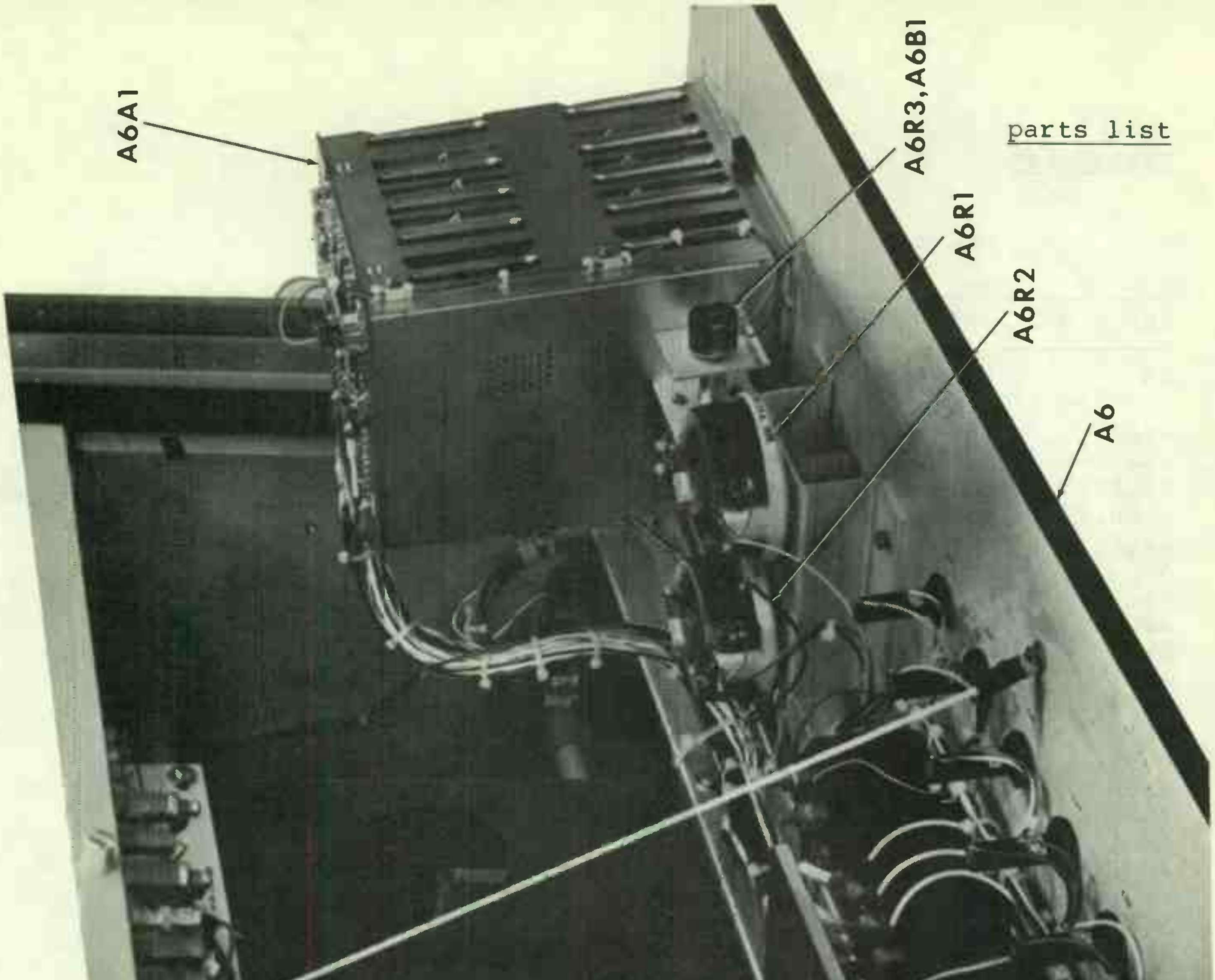

Figure 7-12. Circuit Breaker Panel A6 (Rear View).

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Circuit Breaker Panel A6.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A6	636-9680-001	Assy	1	Circuit Breaker Panel
A6A1	636-8490-001		1	Backplane
A6B1	230-0641-010	Split 0 115	1	Raise/Lower Motor
A6C1	913-1188-000	0.01 μF, 500 V	1	Filter
A6CB1	260-4011-720	3 P, 15 A, Curve 20	1	Low Voltage (240 V)
A6CB2	260-4014-110	3 P, 1.0 A, Curve 20	1	Bias PS (240 V)
A6CB3	260-4011-560	3 P, 50 A, Curve 20	1	High Vol (240 V)
A6CB1	260-4077-440	3 P, 10 A, Curve 20	1	Low Voltage (415 V)
A6CB2	260-4078-160	3 P, 1.0 A, Curve 20	1	Bias PS (415 V)
A6CB3	260-4077-640	3 P, 35 A, Curve 20	1	High Vol (415 V)
A6F1	264-0719-000	0.5 A	1	Logic PS
A6F2	264-0305-000	2-A SB	1	Control 28-V PS
A6F3	264-0219-000	6.25-A SB	1	Blower
A6F4	264-0305-000	2-A SB	1	Fan
A6F5	264-0112-000	8-A SB	1	Filament
A6F6	264-0219-000	6.2-A SB	1	Driver PS
A6M1	458-0860-020	240 V, 60 Hz	1	Fil Timer
A6M1	458-0860-010	240 V, 50 Hz (Option)	1	Fil Timer
A6R1	738-0052-000	25 Ohms, 100 W, Var	1	PA Fil Adj
A6R2	738-0052-000	25 Ohms, 100 W, Var	1	Mod Fil Adj
A6R3	381-1648-020	5 Kilohms, 2 W	1	Power Adjust
A6R4	745-3310-000	100 Ohms, 1 W	1	Filter
A6XF1-6	265-1241-090	Lighted	6	Fuseholder

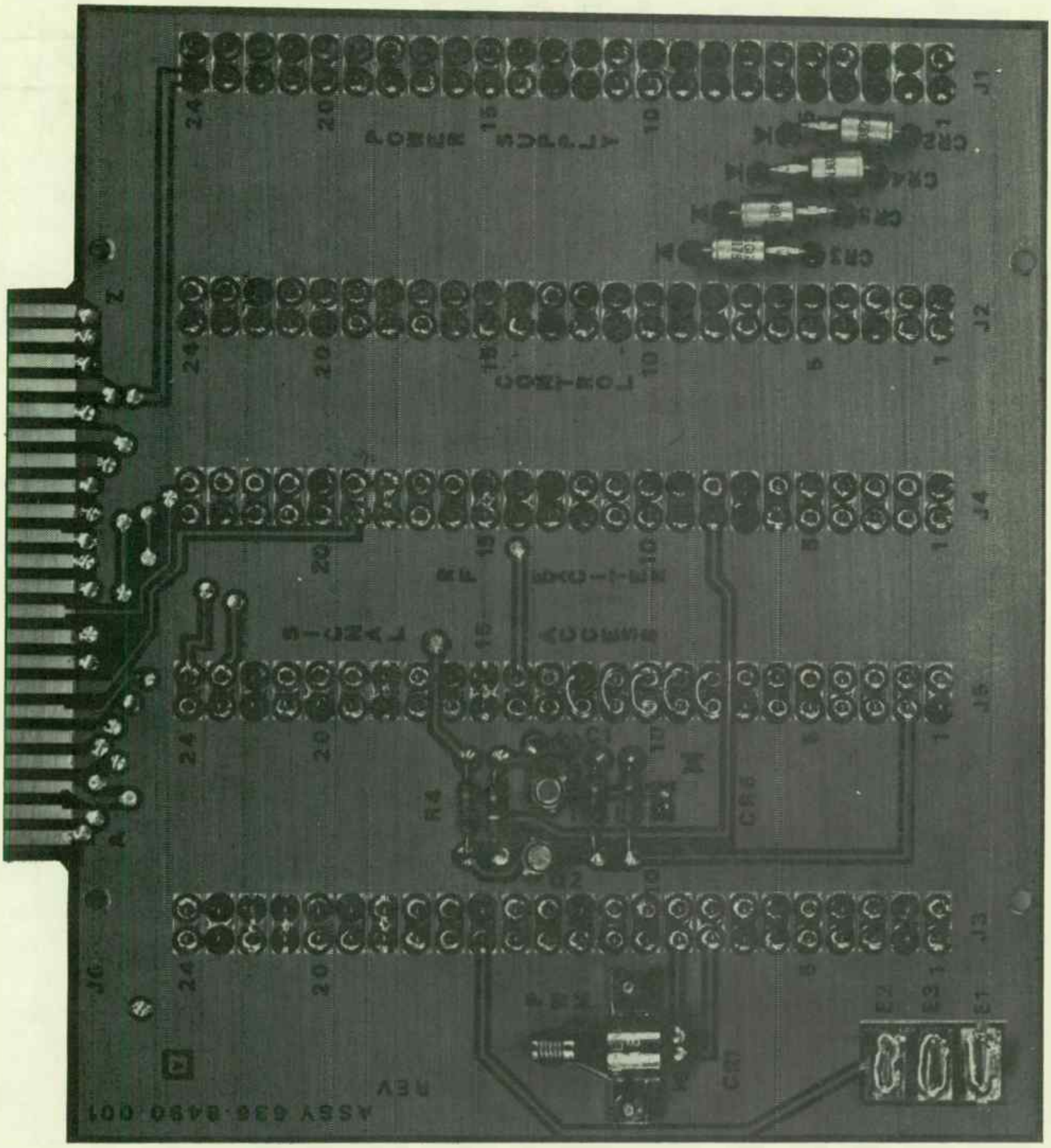

Figure 7-13. Backplane A6A1.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Backplane A6A1.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A6A1	636-8490-001		1	Backplane
A6A1C1	913-3279-270	1.0 μF, 50 V	1	Q1 Bypass
A6A1CR1	270-0547-010	SPX 3191	1	Optical LED
A6A1CR2	353-3725-010	Red LED	1	Drive Loss Ind
A6A1Q1-2	352-0661-020	2N2222A	2	Amplifier
A6A1R1	745-0914-530	330 Ohms	1	Q1 Collector
A6A1R2	745-0914-790	3.9 Kilohms	1	Q1 Base
A6A1R3	745-0914-890	10 Kilohms	1	Q1 Base
A6A1R4	745-0914-890	10 Kilohms	1	Q1 Collector
A6A1VR2	353-6317-000	1N3828A	1	6.2 V, 1-W Zener 5-V Protect
A6A1VR3	353-3122-000	1N3017B	1	7.5 V, 1-W Zener -6-V Protect
A6A1VR4-5	353-3129-000	1N3024B	2	15 V, 1-W Zener 12-V Protect
A6A1J1-5	372-7084-040	12-Pin	10	Card Jacks

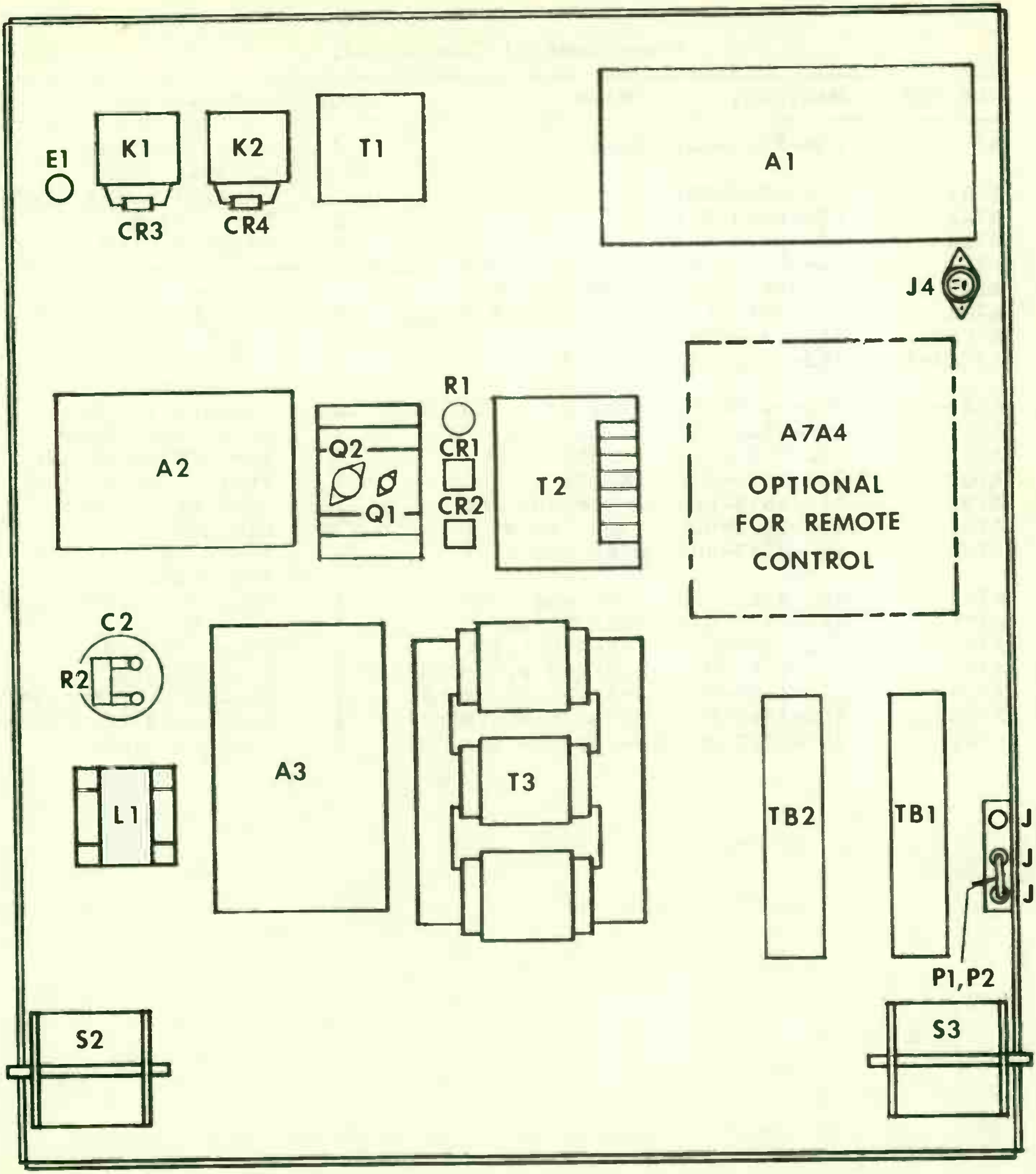

Figure 7-14. Power Control Chassis A7.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Power Control Chassis A7.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A7	636-8502-001	Assy	1	Power Control Chassis
A7A1	636-8510-001		1	Control Relay Card
A7A2	636-8503-001		1	LV PS Card
A7A3	636-9674-001		1	Bias PS Card
A7C1	-------------------------	Not Used	-------------------------	
A7C2	184-2531-000	2200 µF, 200 V	1	Filter
A7CR1	353-0417-130	200 V, 25 A Bridge	1	28-V PS Rect
A7CR2	353-0417-060	600 V, 22 A Bridge	1	200-V PS Rect
A7CR3-4	353-6442-040	1N4004 1 A, 400 V	2	Transient Suppressor
A7K1-K2	970-2426-070	4PDT 25 A, 230 V	2	Blower Filament
A7L1	668-0183-010	25 µH, 3 A,	1	Dr Filter Choke
A7Q1	352-0581-010	2N3054	1	28-V PS Amplifier
A7Q2	352-0690-020	2N3772	1	28-V PS Regulator
A7R1	710-5076-060	4 Tapped, 100	1	28-V PS I Limit
A7R2	710-2932-000	7500, 10 W	1	Bleeder
A7S1	627-9743-009	µ Sw and 2 HV	1	Front Door Interlock
A7S2	627-9743-009	µ Sw and 2 HV	1	Rear Door Interlock
A7T1	662-0290-010	208/230/240 V	1	28-V PS Xfmr
A7T2	662-0644-010	200-250/115 V	1	200-V PS Xfmr
A7T3	664-0185-010	208/240 V, 3-Phase	1	Bias PS Xfmr
A7TB1	367-4160-000	6-32, 16-Terminal	1	Control and Monitor
A7TB2	367-4160-000	6-32, 16-Terminal	1	Audio and Interlock
A7-1	367-1627-000	6-32, 16-Terminal	2	16-Term Marker

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

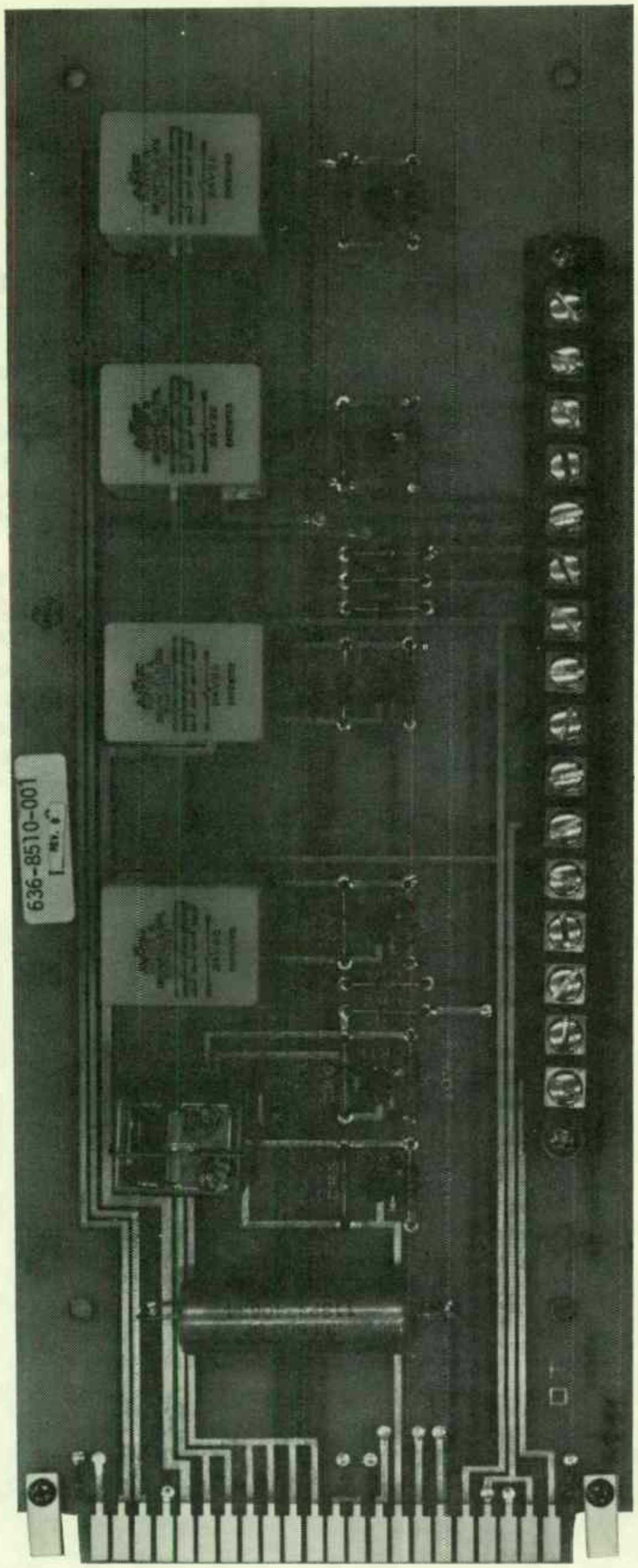

Figure 7-15. Control Relay A7A1.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Control Relay A7A1.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A7A1	636-8510-001	PC Assembly	1	Control Relay Card
A7A1C1	951-1066-000	0.33 μF, 600 V	1	Motor Cap
A7A1C2	913-3681-000	0.1 μF, 200 V	1	Bypass
A7A1CR1-7	352-6442-040	1N4004 400 V	7	Relay Suppressor
A7A1CR8	352-6442-070	1N4007,1000 V	1	Relay Suppressor
A7A1CR9,10	352-6442-040	1N4004, 400 V	2	Relay Suppressor
A7A1CR11-16	353-3725-010	Red LED	6	Indicator
A7A1CR17	353-6442-040	1N4004, 400 V	1	Fil On Gate
A7A1K1	970-0004-030	28 V, DPDT	1	LP/HP Latching
A7A1K2-5	970-0002-030	28 V, 4PDT	4	O/L, HV, Raise, Lower
A7A1R1-6	745-0914-690	1.5 Kilohms, 1/2 W	6	LED Current Limiter
A7A1TB1	367-0812-160	16-Term P/C	1	Remote Connections
A7A1XK1	220-1518-000		1	Socket for K1
A7A1XK2-5	220-1582-010		4	Socket for K2-K5

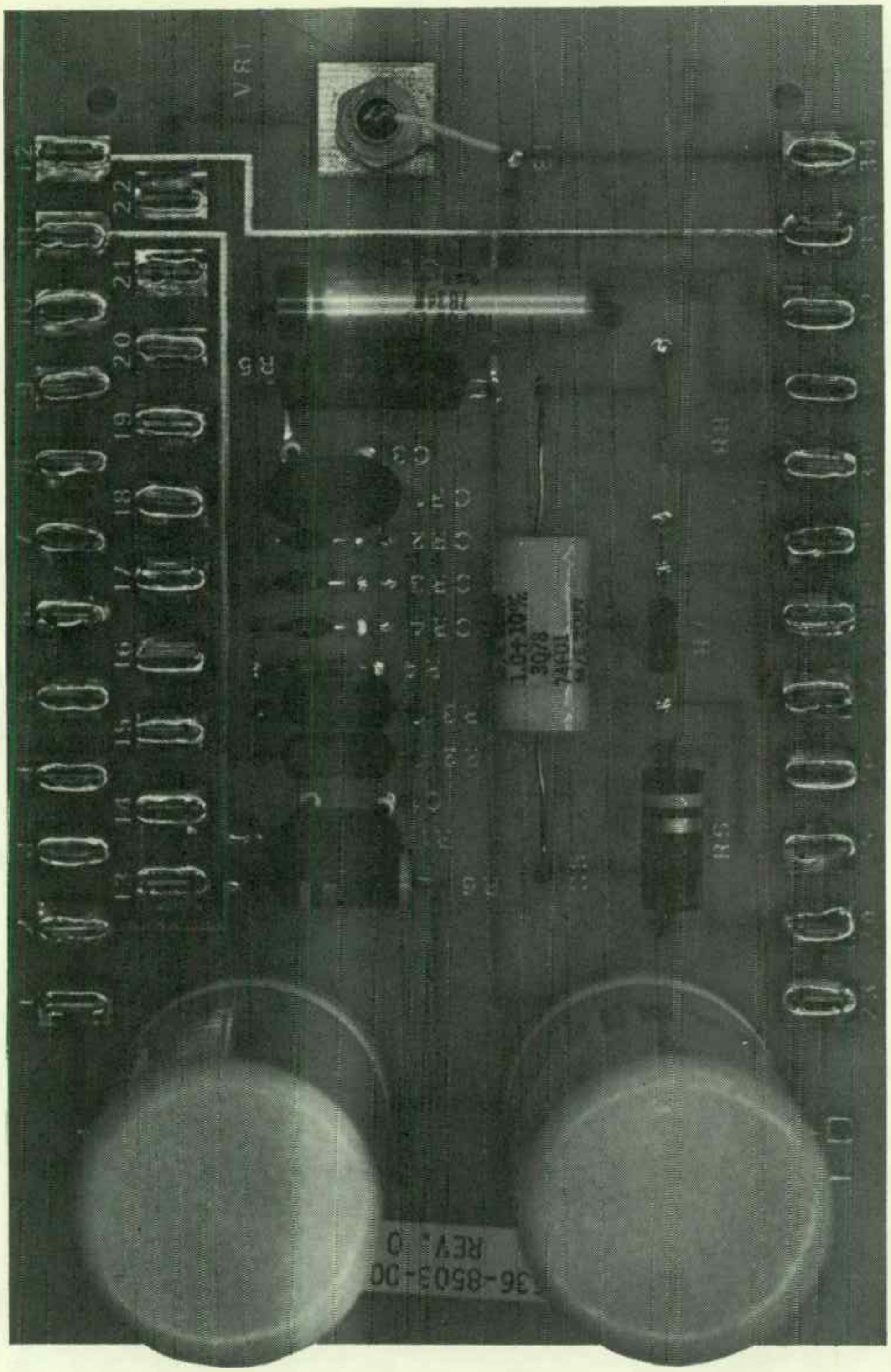

Figure 7-16. Low-Voltage Power Supply A7A2.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Low-Voltage Power Supply A7A2.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A7A2	636-8503-001		1	LV PS Card
A7A2C1	913-3681-000	0.1 μF, 200 V	1	Ref Filter
A7A2C2	183-1281-080	100 μF, 50 V	1	Ref Filter
A7A2C3	913-3681-000	0.1 μF, 200 V	1	Input Filter
A7A2C4	183-1278-370	3900 μF, 50 V	1	28-V PS Filter
A7A2C5	183-1278-370	3900 μF, 50 V	1	28-V PS Filter
A7A2C6	933-1059-050	1 μF, 200 V	1	Damper
A7A2CR1	353-3718-060	1N5552	1	28-V PS Limiter
A7A2CR2	353-3718-060	1N5552	1	28-V PS Limiter
A7A2CR3	353-3718-060	1N5552	1	28-V PS Limiter
A7A2CR4	353-3718-060	1N5552	1	28-V PS Limiter
A7A2R1	705-6666-000	28.7 Kilohms, 1%, 1/4 W	1	28-V Meter
A7A2R2	747-5115-000	0.10 Ohms, 3 W	1	I Limit
A7A2R3	747-5115-000	0.10 Ohms, 3 W	1	I Limit
A7A2R4	745-0914-450	150 Ohms, 1/2 W	1	I Limit
A7A2R5	747-5525-000	330 Ohms, 5.5 W	1	VR Limit
A7A2R6	745-5638-000	470 Ohms, 2 W	1	Bleeder
A7A2R7	705-6715-000	301 Kilohms, 1%, 1/4	1	300-V Meter
A7A2R8	------------Not Used------------			
A7A2R9	745-5652-000	1 Kilohms, 2 W	1	Damper
A7A2VR1	353-1369-000	1N2989B	1	Regulator

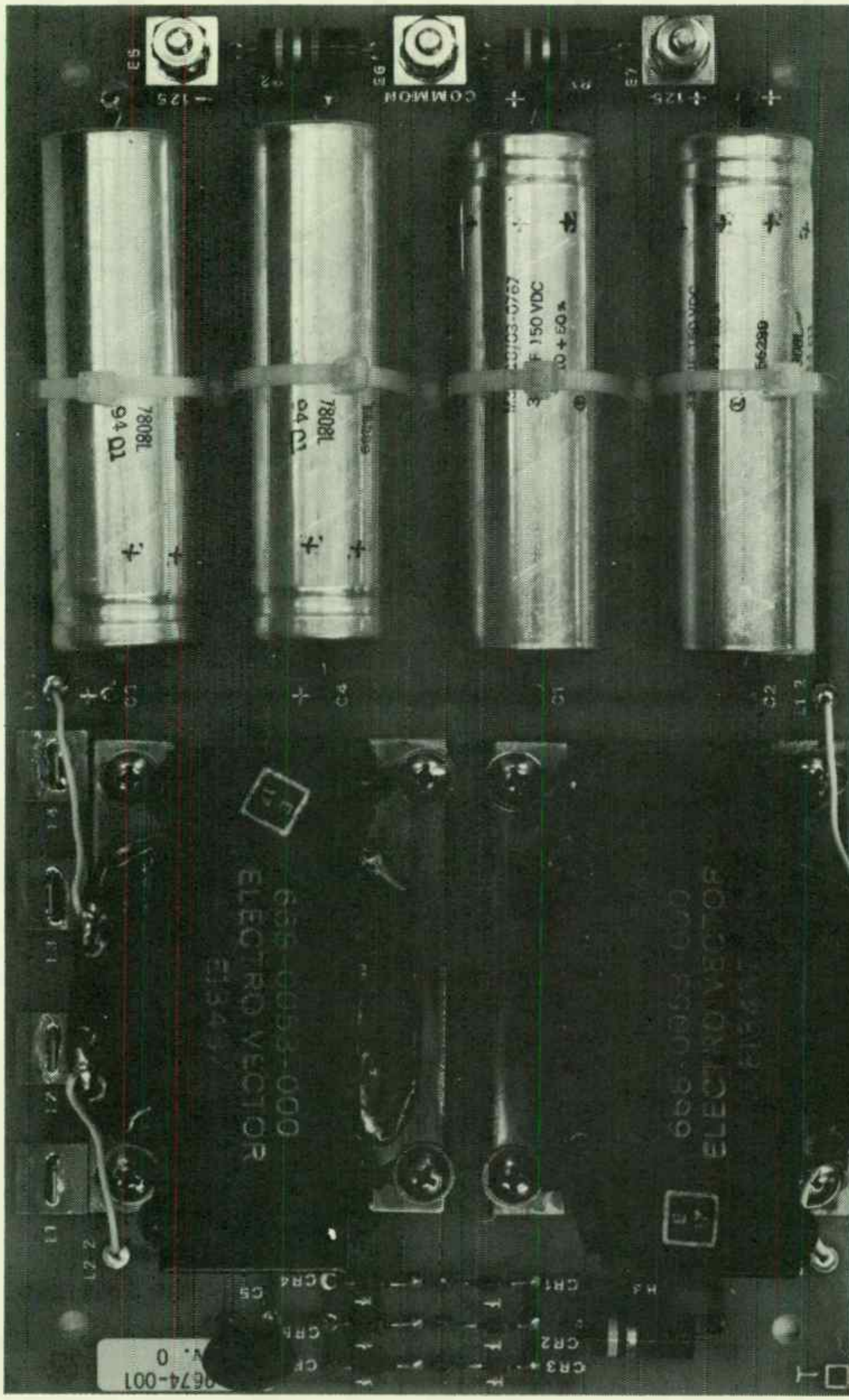

Figure 7-17. Bias Power Supply A7A3.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Bias Power Supply A7A3.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A7A3	636-9674-001	PC Assy	1	Bias PS Card
A7A3C1-4	184-5102-330	330 μF, 150 V	4	125-V Filter
A7A3C5	913-3013-000	0.01, 600 V	1	Damping
A7A3CR1-6	353-3718-060	1N5552, 3 A, 600 V	6	Rectifier
A7A3L1-2	668-0053-000	100 μH, 1.5 A	2	Filter
A7A3R1-2	745-5701-000	15 Kilohms, 2 W	2	Bleeder
A7A3R3	745-5652-000	1 Kilohm, 2 W	1	Damping

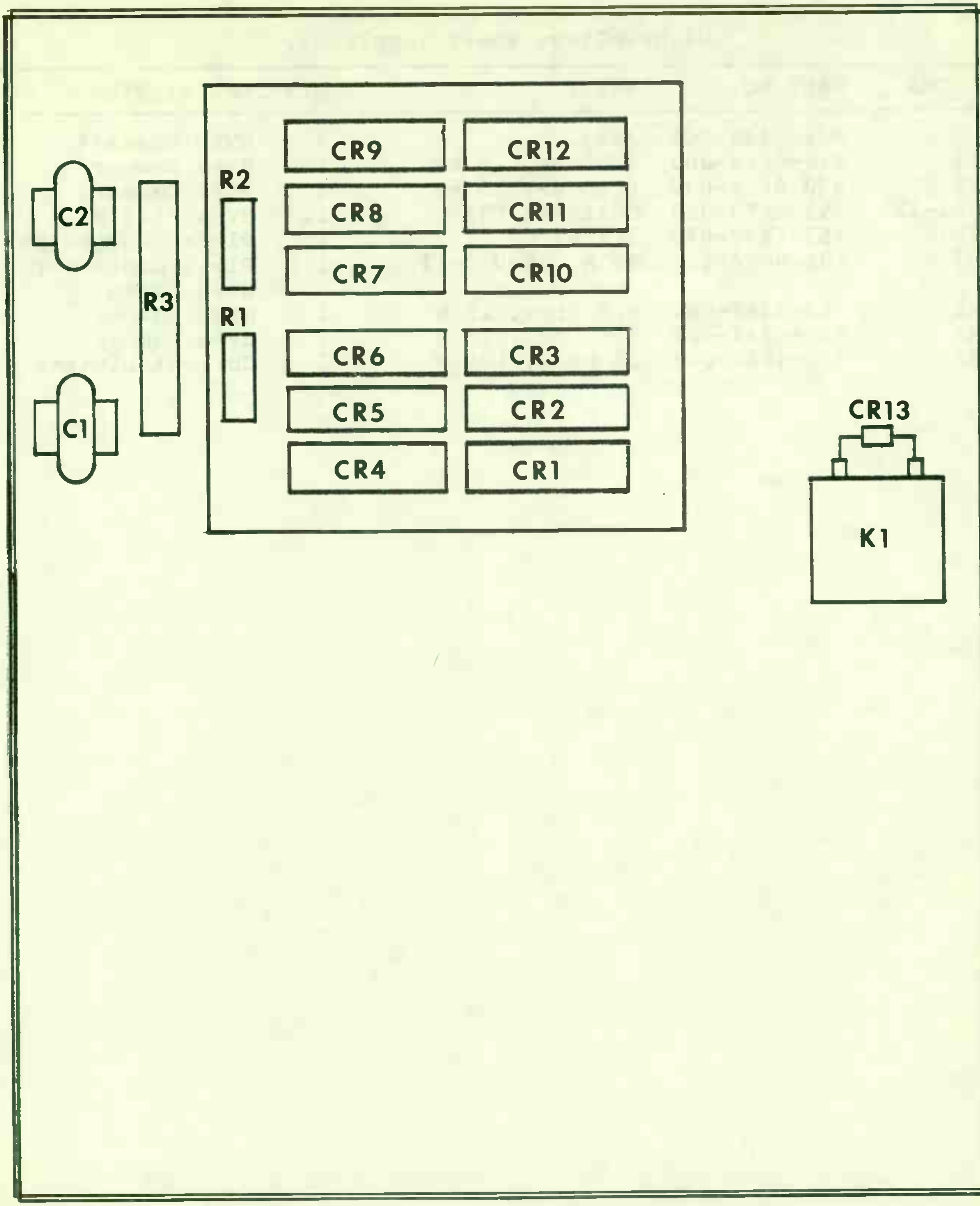

Figure 7-18. High-Voltage Power Supply A8.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

High-Voltage Power Supply A8.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A8	636-8494-001	Assy	1	HVPS Chassis
A8C1	930-0614-000	0.03 uF, 15 kV	1	HVPS Damper
A8C2	930-0614-000	0.03 uF, 15 kV	1	HVPS Damper
A8CR1-12	353-0413-020	Solitron F89	12	HV Rectifier
A8CR13	353-6442-040	1N4004	1	Plate Cont Damper
A8K1	401-0004-120	40 A, 28-V Coil	1	Plate Contactor Hold Plate
A8R1	712-4247-000	500 Ohms, 15 W	1	HVPS Damper
A8R2	712-4247-000	500 Ohms, 15 W	1	HVPS Damper
A8R3	712-4232-000	25 Ohms, 100 W	1	Current Limiter

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

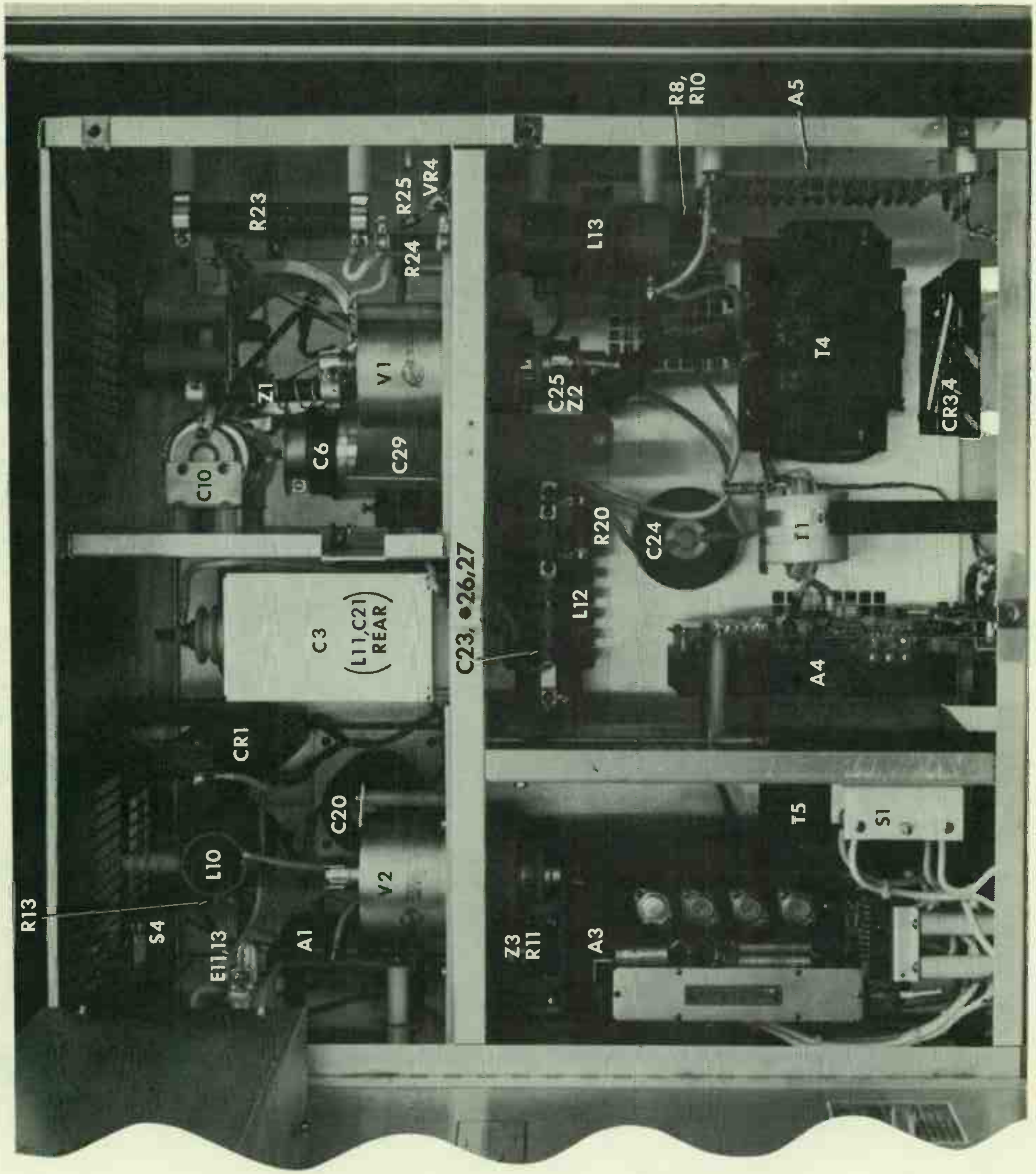

Figure 7-19. RF Compartment A9 (Front View).

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

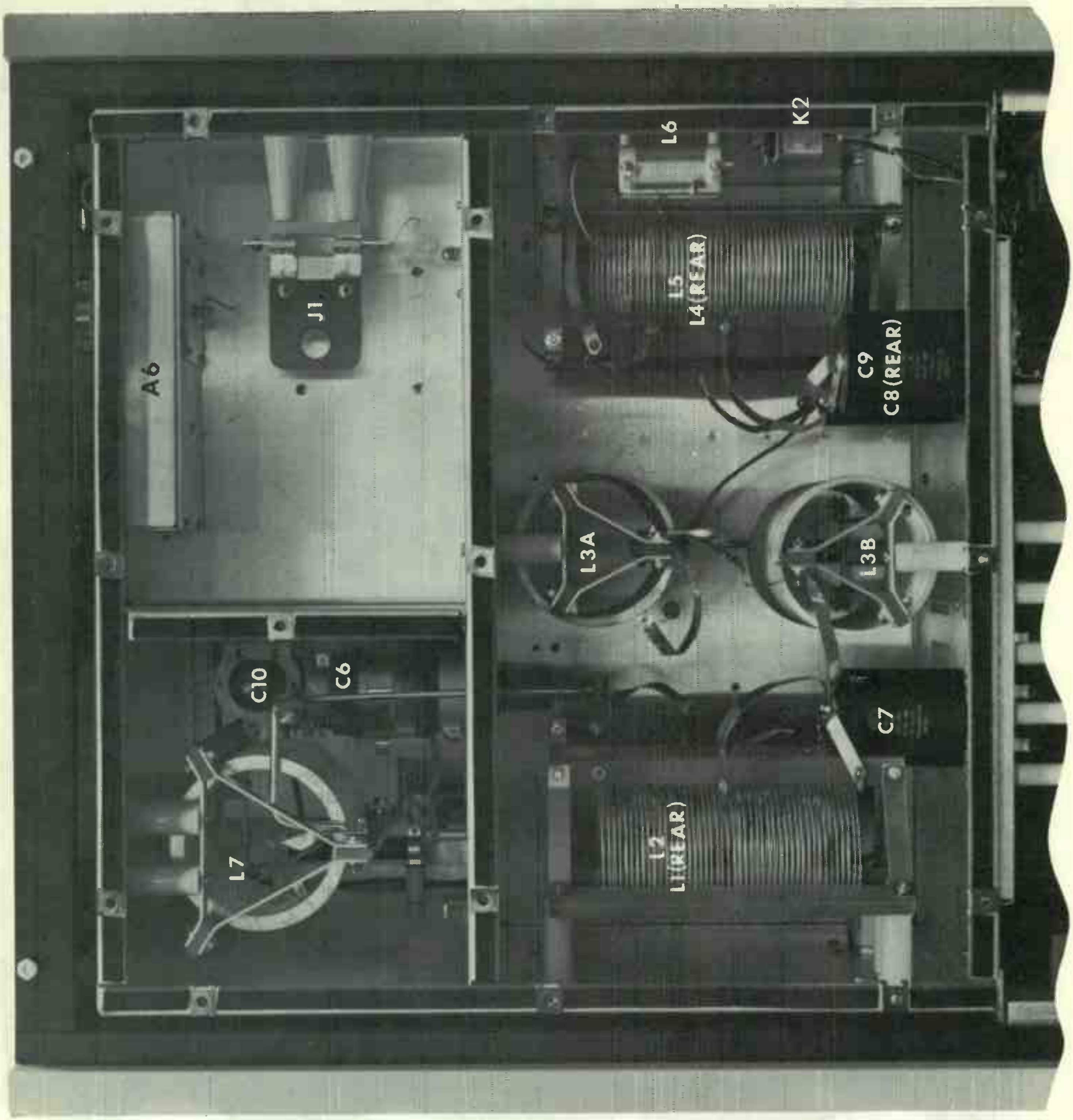

Figure 7-20. RF Compartment A9 (Rear View).

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

RF Compartment A9.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A9	636-9690-001	Assembly	1	RF Compartment
A9A1	636-8417-001	PC Assembly	1	Feedback Divider
A9A2	------------------------Not Used------------------------			
A9A3	636-9675-001	PC Assembly	1	Switchmod Card
A9A4	636-9688-001	PC Assembly	1	RF Driver
A9A5	636-8413-001	PC Assembly	1	HV Meter Divider
A9A6	636-9687-001	Assembly	1	VSWR Meter Assy
A9C1	933-1059-050	1.0 µF, 200 V	1	Fil Bypass
A9C2	933-1059-050	1.0 µF, 200 V	1	Fil Bypass
A9C3	930-0766-040	2.1 µF, 15 kV	1	HV Filter
A9C4	933-1059-050	1.0 µF, 200 V	1	Fil Bypass
A9C5	933-1059-050	1.0 µF, 200 V	1	Mtr Bypass
A9C6	919-0127-010	25-1000 pF, 15 kV	1	PA Tuning
A9C7		See Frequency Kit		Freq Node 2
A9C8		See Frequency Kit		Freq Node 3
A9C9		See Frequency Kit		Freq Node 4
A9C10	919-0293-060	10-400 pF, 15 kV	1	Plate Resonator
A9C11	241-0088-000	0.1 µF, 100 V F	1	Mod Mon Relay Bypass
A9C12	------------------------Not Used------------------------			
A9C13	------------------------Not Used------------------------			
A9C14	913-0833-000	100 pF, 5 kV	1	PA Neut
A9C15	913-0833-000	100 pF, 5 kV	1	PA Neut
A9C16	913-0833-000	100 pF, 5 kV	1	PA Neut
A9C17	913-0833-000	100 pF, 5 kV	1	PA Neut
A9C18	913-0833-000	100 pF, 5 kV	1	PA Neut
A9C19	913-0833-000	100 pF, 5 kV	1	PA Neut
A9C20	912-4128-060	1500 pF, 25 kV	1	70-kHz Filter
A9C21	912-4125-160	240 pF, 5 kV	1	70-kHz Filter
A9C22	912-4128-060	1500 pF, 25 kV	1	70-kHz Filter
A9C23	913-5113-250	500 pF, 5 kV	1	70-kHz Filter
A9C24	912-4127-020	750 pF, 20 kV	1	70-kHz Filter
A9C25	937-2068-000	0.047 µF, 600 V	1	PA Grid Leak
A9C26	913-5113-250	500 pF, 5 kV	1	70-kHz Filter
A9C27	913-5113-250	500 pF, 5 Kv	1	70-kHz Filter
A9C28	933-1059-050	1.0 µF, 200 V	1	Clamp Diode Bypass
A9C29	------------------------Not Used------------------------			
A9C29	636-9697-001	1-6 pF 3 X 6 Pl	1	PA Neut
A9C30	937-2068-000	0.047 µF, 600 V	1	PA Grid Leak
A9C31	241-0006-000	0.1 µF, 250 V AC	1	Mod Fil Filter
A9C32	241-0006-000	0.1 µF, 250 V AC	1	Mod Fil Filter
A9C33	241-0006-000	0.1 µF, 250 V AC	1	PA Fil Filter
A9C34	241-0006-000	0.1 µF, 250 V AC	1	PA Fil Filter
A9C35	913-1295-000	5600 pF	1	HV Div Filter
A9C36	913-1295-000	5600 pF	1	HV Div Filter
A9C37	913-1295-000	5600 pF	1	HV Div Filter
A9C38	913-1295-000	5600 pF	1	Intlk Filter

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

RF Compartment A9 (Cont).

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A9C39	913-1295-000	5600 pF	1	Intlk Filter
A9C40	241-0090-000	0.1 µF, 600 V	1	Driver Ecc
A9C41	241-0090-000	0.1 µF, 600 V	1	RF Drive Control
A9C42	241-0090-000	0.1 µF, 600 V	1	Dr Ic Mtr
A9C43	913-1292-000	1000 pF, 500 V	1	Feedback Divider
A9C44	241-0088-000	0.1 µF, 100 V	1	HV Return
A9C44A	933-1059-050	1 µF, 200 V	1	Bypass
A9C45	241-0090-000	0.1 µF, 600 V	1	Dr +28 V
A9C46	913-1292-000	1000 pF, 500 V	1	Plate RF Sample
A9C47	241-0089-000	0.1 µF, 400 V	1	Mod Fil Meter Filter
A9C48	241-0089-000	0.1 µF, 400 V	1	PA Fil Meter Filter
A9C49	913-1295-000	5600 pF, 500 V	1	Intlk Filter
A9C50	913-1295-000	5600 pF, 500 V	1	Intlk Filter
A9C51	914-2545-000	22 pF, 500 V	1	PA Grid Suppressor
A9C52	914-2563-000	39 pF, 500 V	1	PA Neut Balance
A9C53	913-1292-000	1000 pF, 500 V	1	Arc Sensor
A9CR1	353-6599-010	SA7586	1	Switchmod Clamp
A9CR2	353-6442-040	1N4004	1	Mod Mon Relay Suppressor
A9CR3	353-0413-020	15 kV	1	Transient Supp
A9CR4	353-0413-020	15 kV	1	Transient Supp
A9J1	542-4400-002	Mtr Jack	1	RF Ammeter
A9J2	357-9248-010	BNC	1	Mod Monitor
A9J3	357-9248-010	BNC	1	RF Drive
A9J4	Not Used			
A9J5-6	Not Used			
A9K1	970-0002-030	4PDT, 28-V Coil	1	Mod Mon Hi/Lo Pwr
A9L1		See Frequency Kit		Freq Node 1 Coil
A9L2		See Frequency Kit		Freq Node 2 Coil
A9L3A	980-0041-000	150 µH, 10 A	1	Coupling Coil
A9L3B	See Frequency Kit			
A9L4	980-0047-000	82 µH, 10 A	1	Node 3 Coil
A9L5	980-0047-000	82 µH, 10 A	1	Node 4 Coil
A9L6	549-5098-004	81 µH	1	Mod Mon Tap Coil
A9L7	980-0049-000	28 µH, 20 A	1	Plate Resonator
A9L8	Not Used			
A9L9	Not Used			
A9L10	640-3434-002	29 µH at 2.5 A	1	70-kHz Filter
A9L11	640-3434-001	36 µH at 2.5 A	1	70-kHz Filter
A9L12	640-3434-001	36 µH at 2.5 A	1	70-kHz Filter
A9L13	762-8800-003	4 mH	1	PA Grid Coil
A9M1	640-3432-001	15 A ES		Optional Output RF I

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

RF Compartment A9 (Cont).

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A9R1	-------------------------Not Used-------------------------			
A9R2	-------------------------Not Used-------------------------			
A9R3	-------------------------Not Used-------------------------			
A9R4	-------------------------Not Used-------------------------			
A9R5	-------------------------Not Used-------------------------			
A9R6	-------------------------Not Used-------------------------			
A9R7	-------------------------Not Used-------------------------			
A9R8	712-4401-420	150 Ohms, 100 W	1	PA Grid Leak
A9R9	745-5736-000	100 Kilohms, 2 W	1	Fil Cap Bleeder
A9R10	712-4401-420	150 Ohms, 100 W	1	PA Grid Leak
A9R11	747-3802-000	820 Ohms, 113 W	1	Switchmod Bias
A9R12	745-5596-000	47 Ohms, 2 W	1	Arc Gap Load
A9R13	712-4232-000	25 Ohms, 100 W	1	Current Limit
A9R17	-------------------------Not Used-------------------------			
A9R18	-------------------------Not Used-------------------------			
A9R19	745-5624-000	220 Ohms, 2 W	1	Fil Parasitic Suppressor
A9R20	712-0129-000	50 Ohms, 16.5 W	1	Parasitic Suppressor
A9R21	712-0129-000	50 Ohms, 16 W	1	PA Grid Suppressor
A9R22	712-0129-000	50 Ohms, 16 W	1	PA Plate Suppressor
A9R23	712-0129-000	50 Ohms, 100 W	1	PA Plate Suppressor
A9R24	712-0129-000	50 Ohms, 16 W	1	Arc Sensor
A9R25	745-5680-000	4.7 Kilohms, 2 W	1	Arc Sensor
A9S1	627-9743-004	u Sw and 2 HV	1	PA Door Shorting
A9S2	542-4396-002	J Plug	1	RF Output
A9S3	266-8384-060	0-2 Inches of Water	1	Air Interlock
A9S4	267-0243-100	Thermostat	1	Open 240°F, Close 200°F
A9T1	640-9707-001	BB RF Transformer	8	PA Grid Transformer
A9T2	-------------------------Not Used-------------------------			
A9T3	-------------------------Not Used-------------------------			
A9T4	662-0607-010	7.5 V at 51 A	1	PA Filament
A9T5	662-0607-010	7.5 V at 51 A	1	Mod Filament
A9T6	-------------------------Not Used-------------------------			
A9V1	256-0194-010	3CX3000F7	1	RF Power Amplifier
A9V2	256-0194-010	3CX3000F7	1	Switchmod
A9VR1	-------------------------Not Used-------------------------			
A9VR2	-------------------------Not Used-------------------------			
A9VR3	-------------------------Not Used-------------------------			
A9VR4	353-6344-000	1N3824	1	4.3 V, 1 W
A9XA4	640-9673-001	Conn/Bracket	1	RF Driver Card
A9XA3	640-9673-001	Conn/Bracket	1	Switchmod Card
A9XK1	220-1543-000		1	K1 Socket
A9Z1	640-9676-001	50 Ohms, 6 Turns	1	PA Plate Suppressor
A9Z2	762-8820-001	50 Ohms, 6 Turns	1	PA Grid Suppressor
A9Z3	640-5370-001	50 Ohms, 40 Turns	1	Mod Grid Suppressor
A9-1	372-2426-040	4-Pin Block	12	PCB Mt Bracket, 2 Ea

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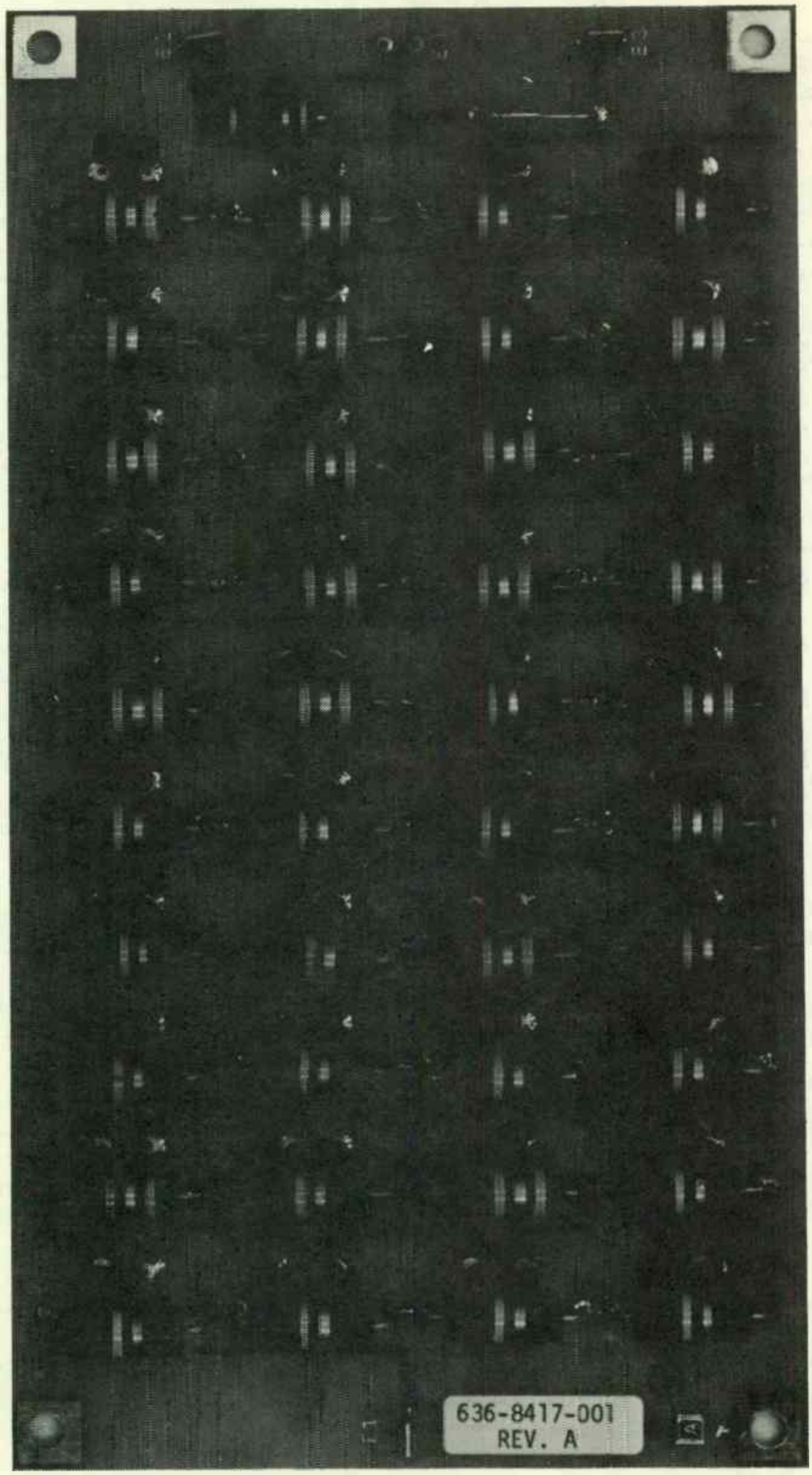

Figure 7-21. Feedback Divider, Component Layout, A9A1.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Feedback Divider, Component Layout, A9A1.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A9A1	636-8417-001	PC Assy	1	Feedback Divider
A9A1C1-40	912-2840-000	220 pF, 500 V	40	Divider, Mica
A9A1C41	912-3013-000	1500 pF, 500 V	1	Divider, Mica
A9A1R1-40	745-5736-000	100 Kilohms, 10%, 2 W	40	Divider Carbon
A9A1R41	745-3380-000	4.7 Kilohms, 10%, 1 W	1	Divider

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

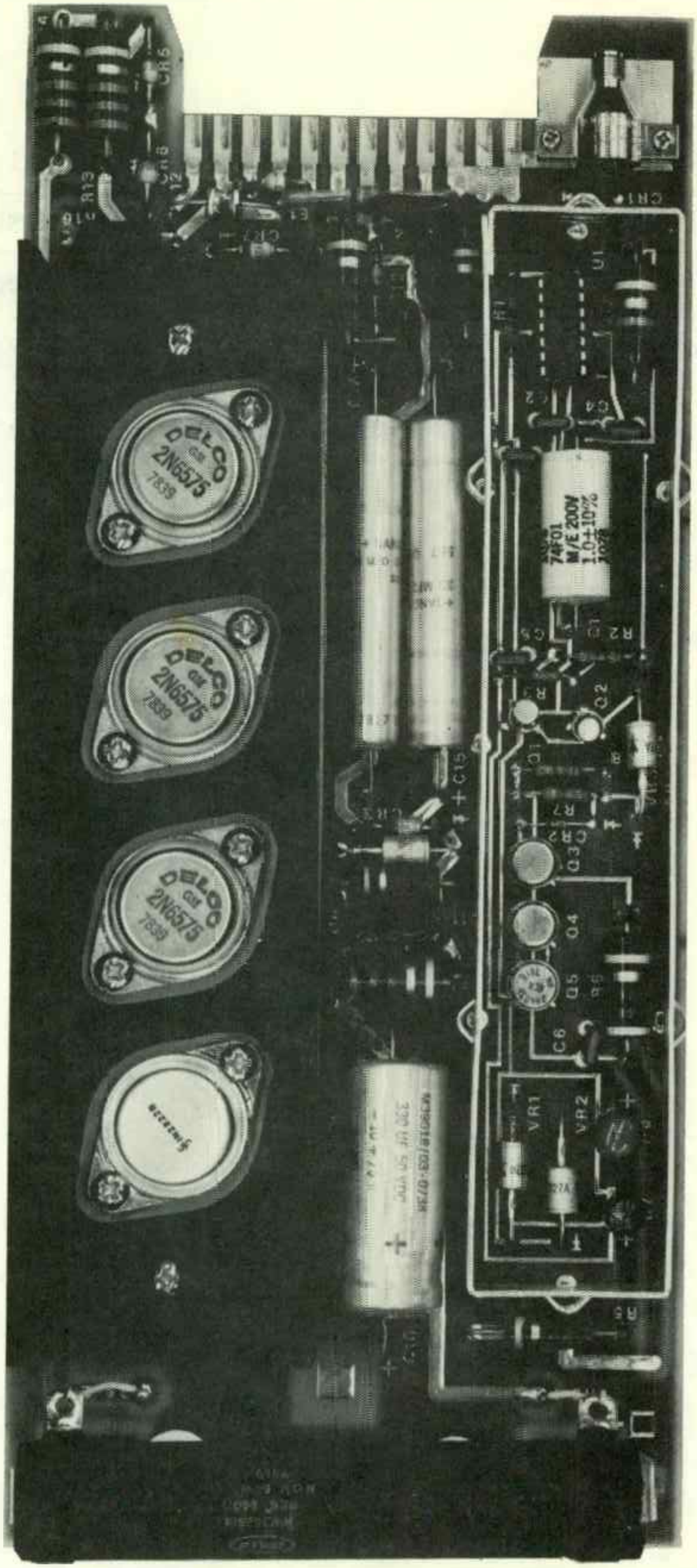

Figure 7-22. Switchmod Card A9A3.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Switchmod Card A9A3.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A9A3	636-9675-001	PA Assy	1	Switchmod Card
A9A3C1	933-1059-050	1.0 µF, 200 V	1	Diode Bypass
A9A3C2-6	913-3279-270	1.0 µF, 50 V	5	Bypass
A9A3C7	184-9102-160	150 µF, 15 V	1	VR1 Bypass
A9A3C8	184-9102-110	220 µF, 10 V	1	VR2 Bypass
A9A3C9	Not Used			
A9A3C10	184-5102-040	330 µF, 50 V	1	28-V Bypass
A9A3C11	912-2723-000	6800 pF, 500 V	1	Q6 Base
A9A3C12	912-3034-000	2700 pF, 500 V	1	Comp
A9A3C13	912-3025-000	2200 pF, 500 V	1	Comp
A9A3C14	912-2989-000	680 pF, 500 V	1	Comp
A9A3C15	183-1277-560	33 µF, 150 V	1	Common Bypass
A9A3C16	183-1277-900	22 µF, 250 V	1	+125 V Bypass
A9A3C17	Not Used			
A9A3C18	912-3001-000	1000 pF, 500 V	1	Transient Suppressor
A9A3CR1	270-0547-030	SPX-3194	1	Pin Photodiode
A9A3CR2	353-2906-000	1N914	1	Q3 Base
A9A3CR3-4	353-9009-440	1N5418	2	Gate
A9A3CR5-7	353-9009-440	1N5418	3	Current Limiter
A9A3CR8	Not Used			
A9A3CR9	353-9009-440	1N5418	1	Grid Clamping
A9A3E1	013-1455-040	Arc Gap	1	350 V Amplifier
A9A3Q1	352-0661-020	2N2222A	1	Amplifier
A9A3Q2	352-0551-010	2N2907A	1	Amplifier
A9A3Q3-4	352-0646-010	2N2102	2	Amplifier
A9A3Q5	352-0714-010	2N4036	1	Amplifier
A9A3Q6-8	352-1134-010	2N6575	3	Amplifier
A9A3R1-2	705-1025-000	4.02 Kilohms, 1%, 1/2 W	2	U1
A9A3R3	705-6740-000	1.0 Megohm, 1%, 1/4 W	1	U1
A9A3R4	745-5694-000	10 Kilohms, 2 W	1	Diode Limiter
A9A3R5	745-3328-000	270 Ohms, 1 W	1	18-V Regulator
A9A3R6	745-5638-000	470 Ohms, 2 W	1	Q3 Collector
A9A3R7	745-0914-470	180 Ohms, 1/2 W	1	Q3 Base
A9A3R8	745-0914-510	270 Ohms, 1/2 W	1	Q3 Base
A9A3R9	747-2742-000	560 Ohms, 55 W	1	28-V Reg
A9A3R10	745-5645-000	680 Ohms, 2 W	1	Q6 Base
A9A3R11	745-3359-000	1.5 Kilohms, 1 W	1	Q6 Comp
A9A3R12	745-3366-000	2.2 Kilohms, 1 W	1	Q6 Comp
A9A3R13-14	745-5715-000	33 Kilohms, 2 W	2	Mod Grid
A9A3R15	745-3268-000	10 Ohms, 1 W	1	Q6 Base
A9A3R16	747-5122-000	0.22 Ohm, 3 W	1	Current Limit
A9A3U1	351-7189-050	µA710	1	Line Rcvr

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

Switchmod Card A9A3 (Cont).

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A9A3VR1	353-3127-000	1N3022B	1	12-V, 1-W Zener
A9A3VR2-3	353-6316-000	1N3827A	2	5.6-V, 1-W Zener
A9A3VR4	353-1915-000	1N2822B	1	27-V, 50-W Zener
A9A3VR5	353-6316-000	1N3827A	1	5.6-V, 1-W Zener
A9A3XU1	220-0075-020	14-Pin Socket	1	U1
A9A3-01	353-9655-040	Insulator	4	Insulator for VR-4, Q6-8

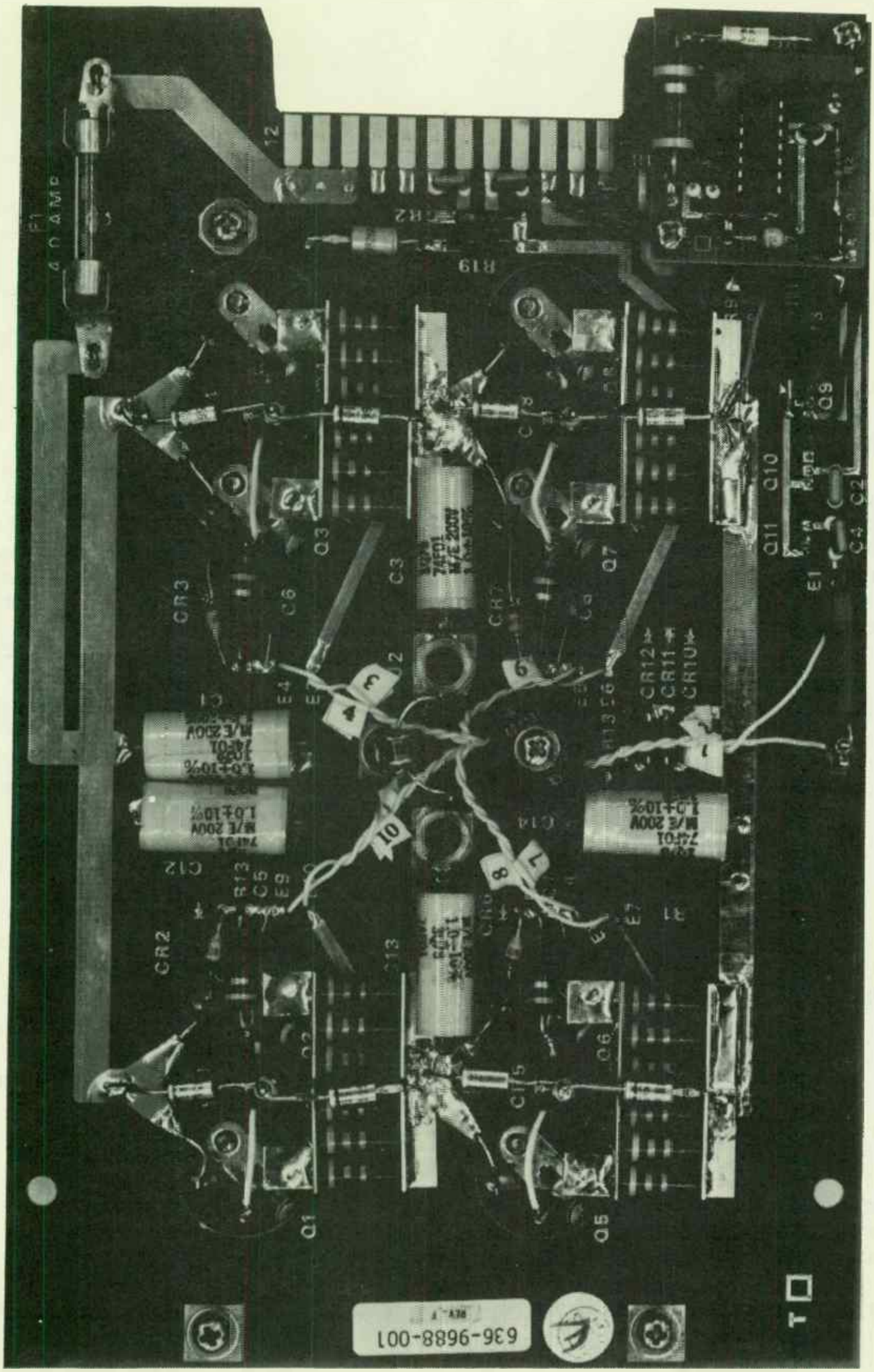

Figure 7-23. RF Driver A9A4.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

RF Driver A9A4.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A9A4	636-9688-001	Assy	1	RF Driver
A9A4C1	933-1059-050	1.0 μF, 200 V	1	200 V Bypass
A9A4C2	913-3279-270	1.0 μF, 50 V	1	Bypass
A9A4C3	933-1059-050	1.0 μF, 200 V	1	Coupling
A9A4C4	913-3279-270	1.0 μF, 50 V	1	Coupling
A9A4C5-8	913-5019-280	0.047 uF, 100 V	4	Base Speed
A9A4C9	912-2983-000	560 pF, 500 V	1	Q9 Collector
A9A4C10	913-3279-270	1.0 μF, 50 V	1	RF Bypass
A9A4C11	913-3279-270	1.0 μF, 50 V	1	28-V Bypass
A9A4C12-14	933-1059-050	1.0 μF, 200 V	3	Coupling, Bypass
A9A4C15-16	912-2852-000	330 pF, 500 V	2	Spike Suppressor
A9A4C101	913-3279-200	0.1 μF, 50 V	1	Protect Circuit
A9A4C102	184-9102-170	10 μF, 10 V	1	Protect Circuit
A9A4C103	184-9102-110	220 μF, 10 V	1	Protect Circuit
A9A4C104	913-3279-110	0.01 μF, 50 V	1	Bypass
A9A4CR1, 4,5,8	---------------------------Not Used------------------------			
A9A4CR2, 3,6,7	353-9009-440	1N5418	4	Base Protect
A9A4CR9	353-2906-000	1N914	1	Speed Up
A9A4CR10-13	353-3718-060	1N5552	4	Meter Protect
A9A4CR101	353-9009-440	1N5418	1	Protect Circuit
A9A4E1	013-1455-040	Arc Gap	1	Protect Circuit
A9A4F1	264-0449-000	Fuse, 4 A, Normal	1	Driver Ic
A9A4Q1-8	352-1134-010	2N6575	8	RF Drivers
A9A4Q9-10	352-1104-010	MJE-243	2	Input Amplifier
A9A4Q11	352-1105-010	MJE-253	1	Input Amplifier
A9A4Q101	352-1104-010	MJE-243	1	Protect Circuit
A9A4R1	747-5475-000	0.5 Ohm, 6.5 W	1	Ic Meter Shunt
A9A4R2	745-0914-650	1 Kilohm, 1/2 W	1	RF Filter
A9A4R3	747-5440-000	100 Ohms, 6.5 W	1	Q9 Collector
A9A4R4	745-0914-410	100 Ohms, 1/2 W	1	Q9 Base
A9A4R5-12	745-3533-000	2.7 Ohms, 1 W	24	Emitter
A9A4R13-16	745-3268-000	10 Ohms, 1 W	4	Base
A9A4R17	745-5593-000	39 Ohms, 2 W	1	Input Pad
A9A4R18	745-5568-000	10 Ohms, 2 W	1	Input Pad
A9A4R19	705-3602-280	6.04 Kilohms, 1/4 W	1	Ic Meter Cal
A9A4R20	747-5406-000	2.0, 6.5 W	1	Current Limit
A9A4R101	745-0911-020	33 Kilohms, 1/4 W	1	Protect Circuit
A9A4R102	745-0910-570	470 Ohms, 1/4 W	1	Protect Circuit
A9A4R103	382-0012-250	500 Ohms, Var	1	Protect Circuit
A9A4R104	745-5638-000	470 Ohms, 2 W	1	Protect Circuit
A9A4T1	640-9675-001	Transformer	1	3T Pri, 1T Sec Driver Input

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

RF Driver A9A4 (Cont).

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A9A4U101	351-7645-010	74121, IC	1	Protect Circuit
A9A4VR1	353-6317-000	1N3828A	1	Zener Diode 6.2 V, 1 W
A9A4VR2-9	353-0221-660	1N5661A	8	Transient Suppressor
A9A4VR101	353-6315-000	1N3826	1	Protect Circuit
A9A4XF1	265-1037-000	Fuse Block	1	Driver IC
A9A4XQ1-8	220-0968-010	TO-3 Socket	8	Q1-8
A9A4-01	352-9655-040	Insulator	8	Insulator for Q1-8
A9A4-02	352-9655-070	Insulator	3	Insulator for Q9, 10, 11
A9A4XU101	220-0075-020	Dip, Socket, 14-Pin	1	Protect Circuit

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

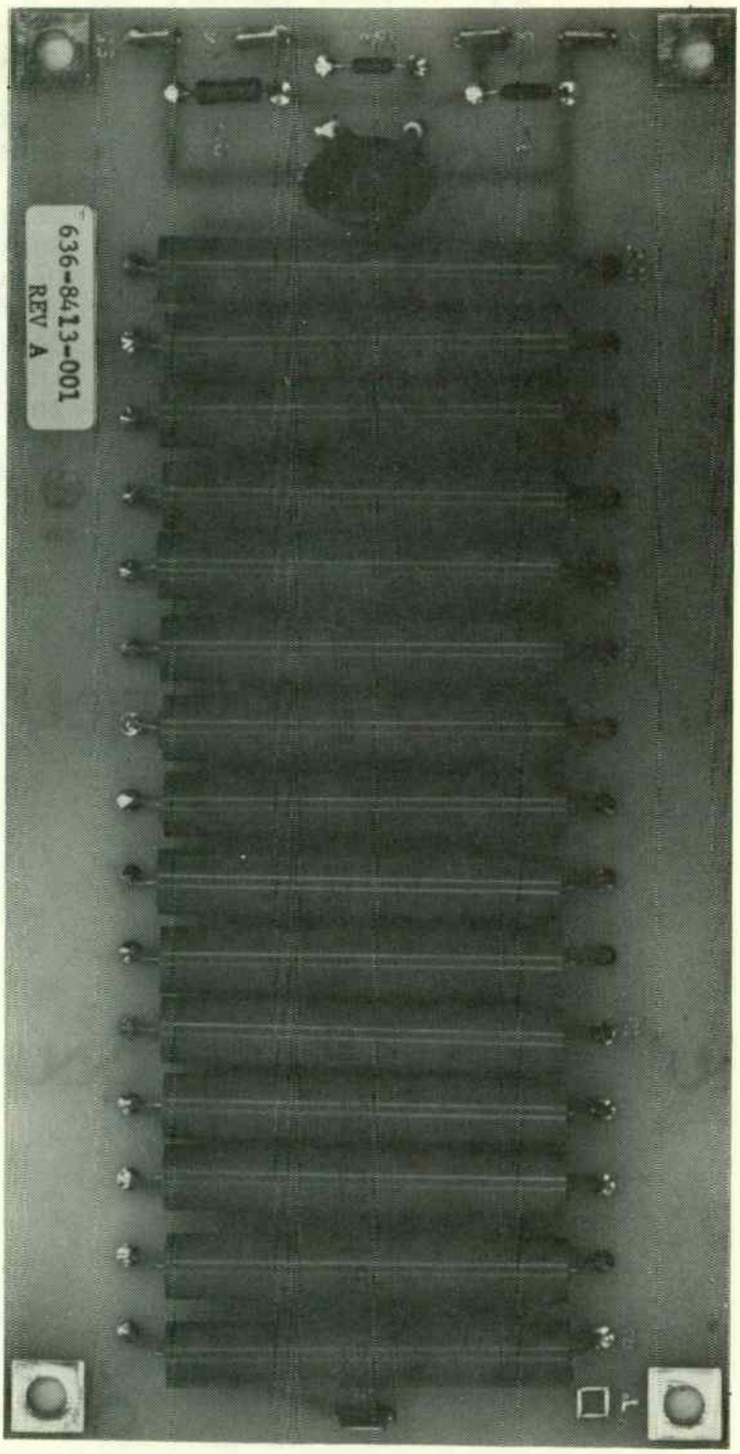

Figure 7-24. High-Voltage Divider, Component Layout, A9A5.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

High-Voltage Divider, Component Layout, A9A5.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A9A5	636-8413-001	PC Assy	1	HV Meter Divider
A9A5C1	913-3681-000	0.1 µF, 200 V	1	Filter
A9A5CR1	353-3134-000	Delete		
A9A5R1-15	705-1493-050	200 Kilohms, 1%, 2 W	15	Metering Resistor
A9A5R16	705-1092-000	100 Kilohms, 1/8 W,	1	Meter Protect
A9A5R17	705-6644-000	10 Kilohms, 1/4 W, 1%	1	Remote Ebb
A9A5R18	745-0911-020	33 Kilohms, 1/4 W	1	Remote Ebb

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

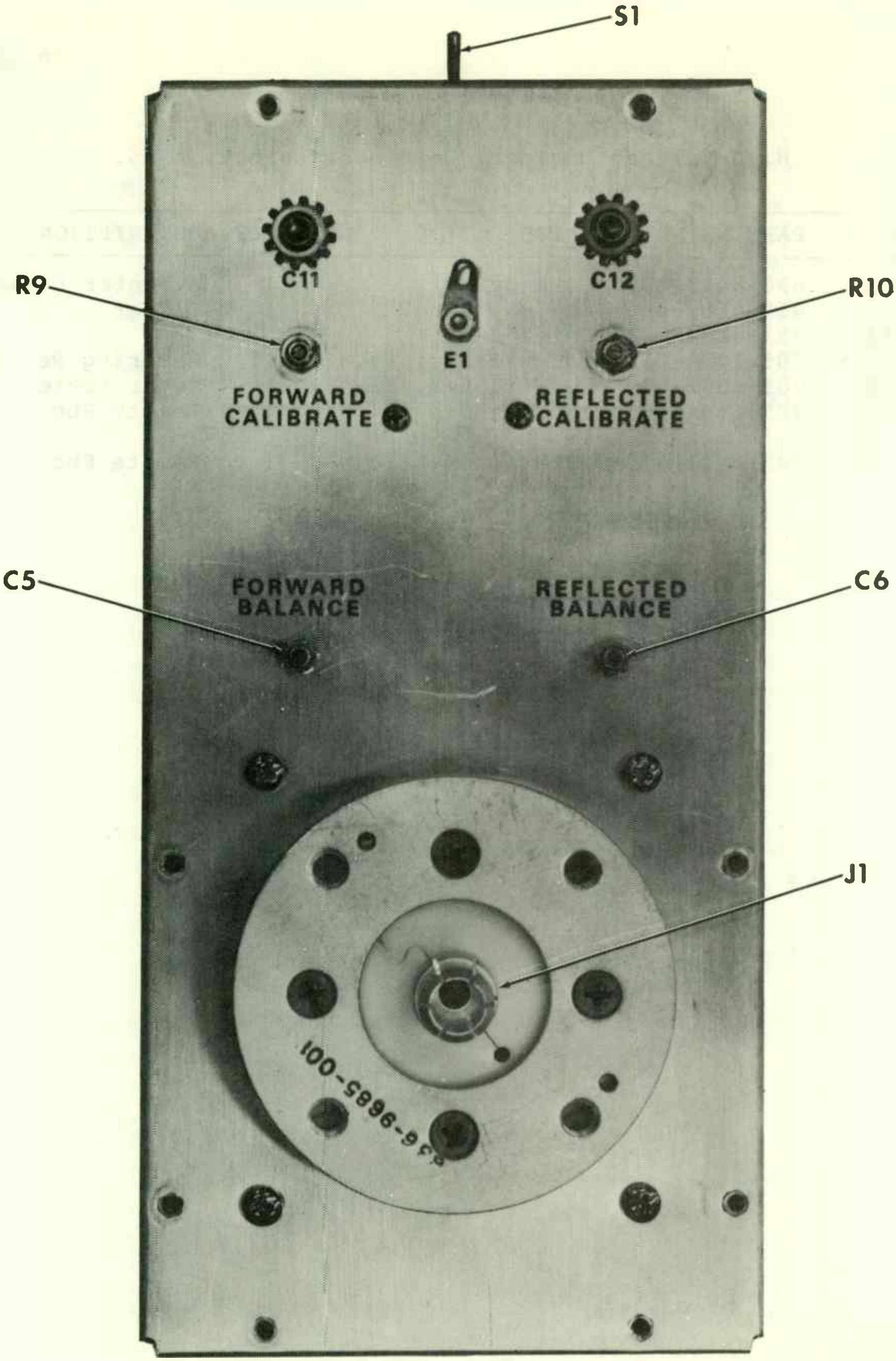

Figure 7-25. RF Power Meter (VSWR) A9A6 (Front View).

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

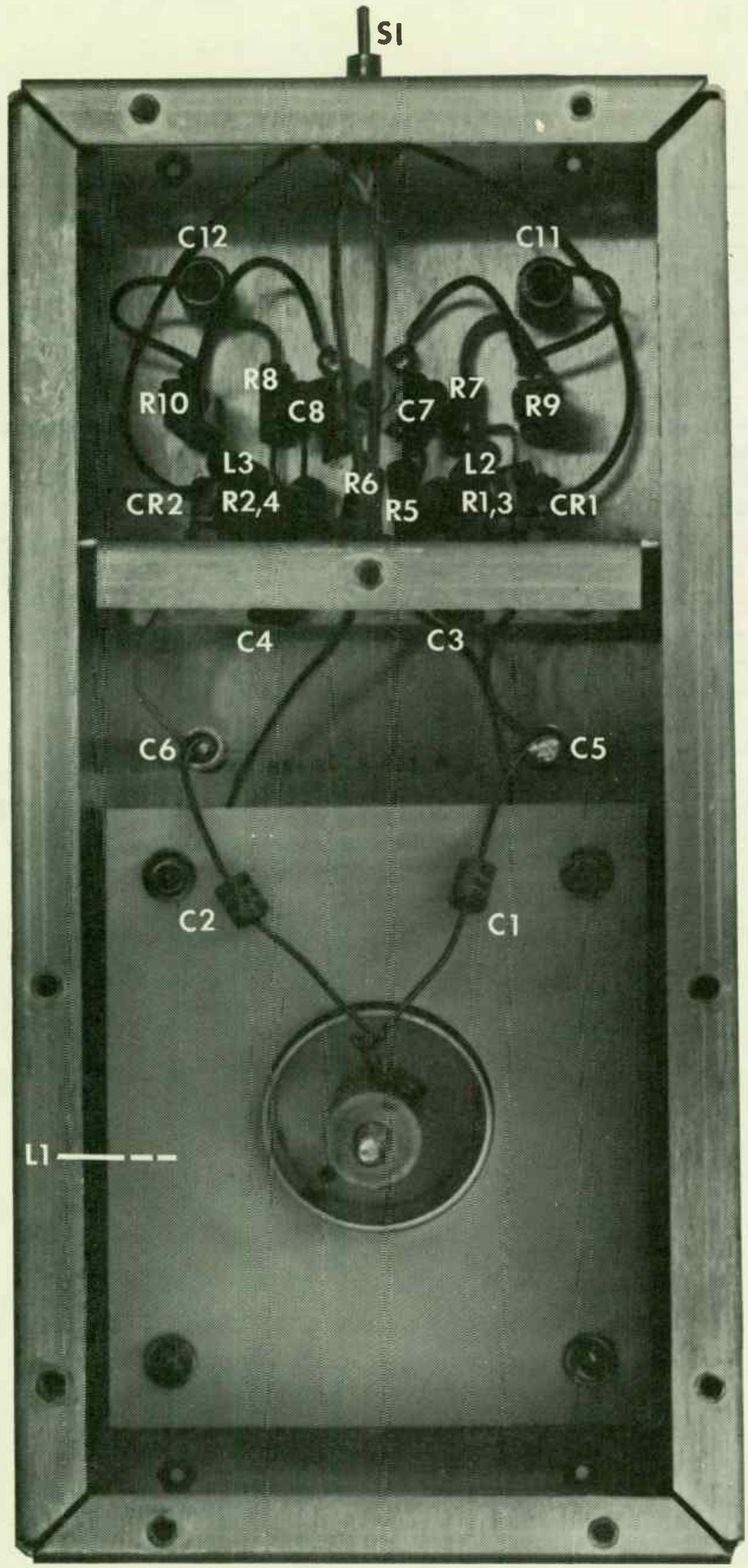

Figure 7-26. RF Power Meter (VSWR) A9A6 (Rear View).

WARINING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

RF Power Meter (VSWR) A9A6.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A9A6	636-9687-001	Assembly	1	VSWR Meter Assy
A9A6C1	913-0973-000	1 pF, 5 kV	1	E Divider
A9A6C2	913-0973-000	1 pF, 5 kV	1	E Divider
A9A6C3	912-2843-000	240 pF, 500 V	1	E Divider
A9A6C4	912-2843-000	240 pF, 500 V	1	E Divider
A9A6C5	922-3038-040	1-60 pF, 1000 V	1	Fwd Balance
A9A6C6	922-3038-040	1-60 pF, 1000 V	1	Ref Balance
A9A6C7-8	912-2974-000	470 pF, 500 V	2	Diode Load Bypass
A9A6C9-10	Not Used			
A9A6C11-12	241-0088-000	0.1 μF, 100 V	2	Feedthrough
A9A6CR1	353-3691-010	1N5711	1	RF Detector
A9A6CR2	353-3691-010	1N5711	1	RF Detector
A9A6L1	636-9686-001	270 μH, 250 mA	1	Toroid Pickup
A9A6L2	240-2548-000	2.2 μH	1	RFC
A9A6L3	240-2548-000	2.2 μH	1	RFC
A9A6R1-4	745-5582-000	22 Ohms, 2 W	4	Toroid Load
A9A6R5-6	745-3394-000	10 Kilohms, 1 W	2	Diode Load
A9A6R7-8	745-3384-000	5.6 Kilohms, 1 W	2	AF Filter
A9A6R9	377-0659-200	10 Kilohms, Pot 10 T	1	Fwd Cal
A9A6R10	377-0659-200	10 Kilohms, Pot 10 T	1	Ref Cal
A9A6R11	Not Used			
A9A6R12	Not Used			
A9A6S1	266-5321-200	DPDT Switch	1	Norm-Reverse

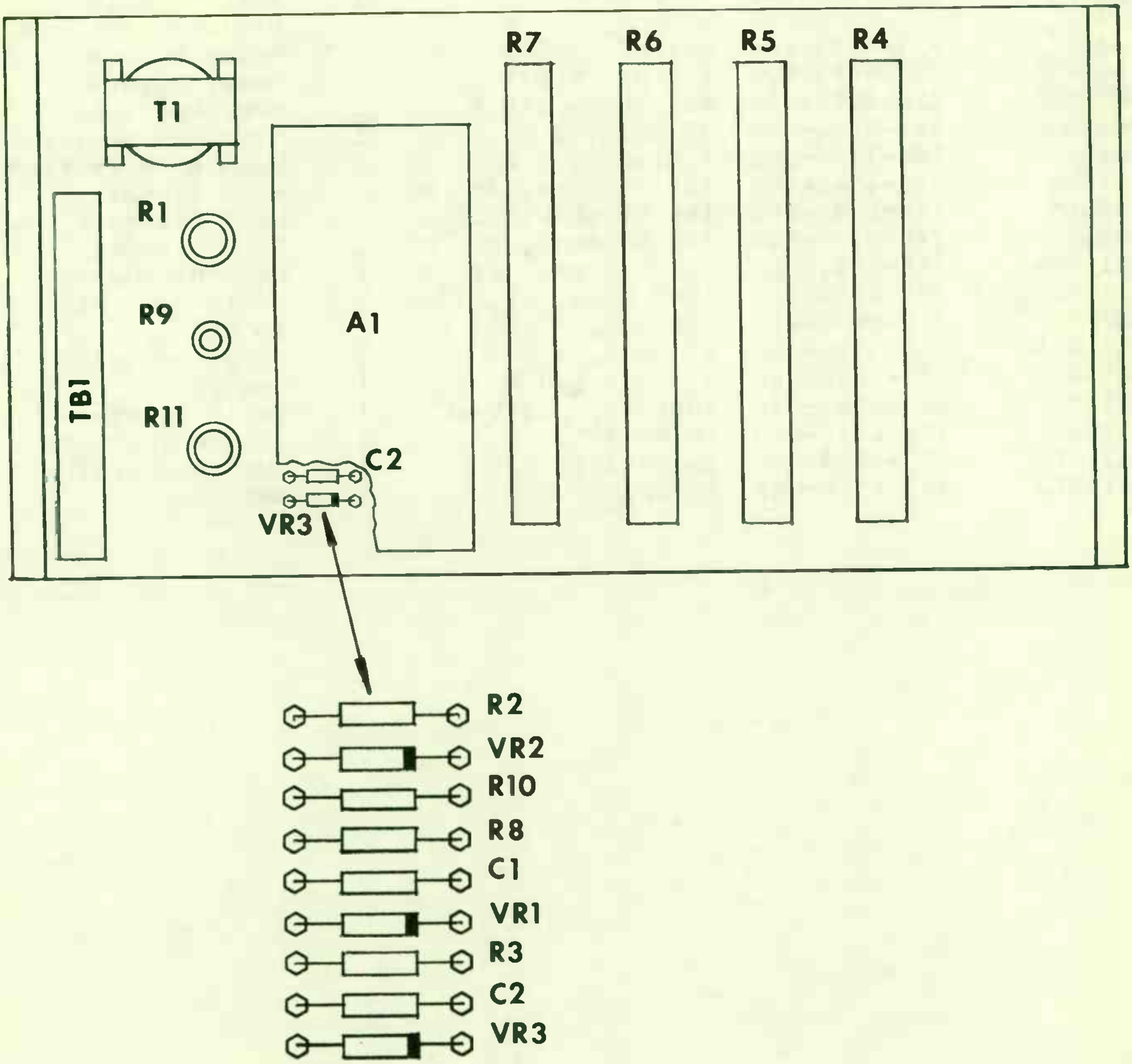

Figure 7-27. High-Voltage Bleeder A10.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

High-Voltage Bleeder A10.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A10	640-9677-001	Assembly	1	HV Bleeder
A10A1	636-8418-001	PC Assembly	1	13-kV Sample Divider
A10C1	913-3681-000	0.1 µF, 200 V	1	Meter Bypass
A10C2	913-3681-000	0.1 µF, 200 V	1	Meter Bypass
A10R1	710-2026-000	8.2 Ohms, 100 W	1	HVPS Overload
A10R2	745-5596-000	47 Ohms, 2 W	1	Overload Protect
A10R3	745-3352-000	1 Kilohm, 1 W	1	Remote Ib Protect
A10R4	746-6742-000	180 Kilohms, 210 W	1	HVPS Bleeder
A10R5	746-6742-000	180 Kilohms, 210 W	1	HVPS Bleeder
A10R6	746-6742-000	180 Kilohms, 210 W	1	HVPS Bleeder
A10R7	746-6742-000	180 Kilohms, 210 W	1	HVPS Bleeder
A10R8	747-0998-050	1000 Ohms, 1%, 3 W	1	Plate Curr Mtr
A10R9	710-5076-010	1.0 Ohm, 36 W, 1%	1	Ib Mtr
A10R10	745-5596-000	47 Ohms, 2 W	1	HVPS Overload
A10R11	710-5076-060	4 Ohms, 100 W	1	Remote Ib
A10T1	662-0601-010	208/240, 24 V AC	1	Logic PS Xfmr
A10VR1	353-6316-000	1N3827A 5.6 V	1	Ib Mtr Protect
A10VR2	353-3129-000	1N3024B 15 V	1	Overload Protect
A10VR3	353-6316-000	1N3827A 5.6 V	1	Remote Ib

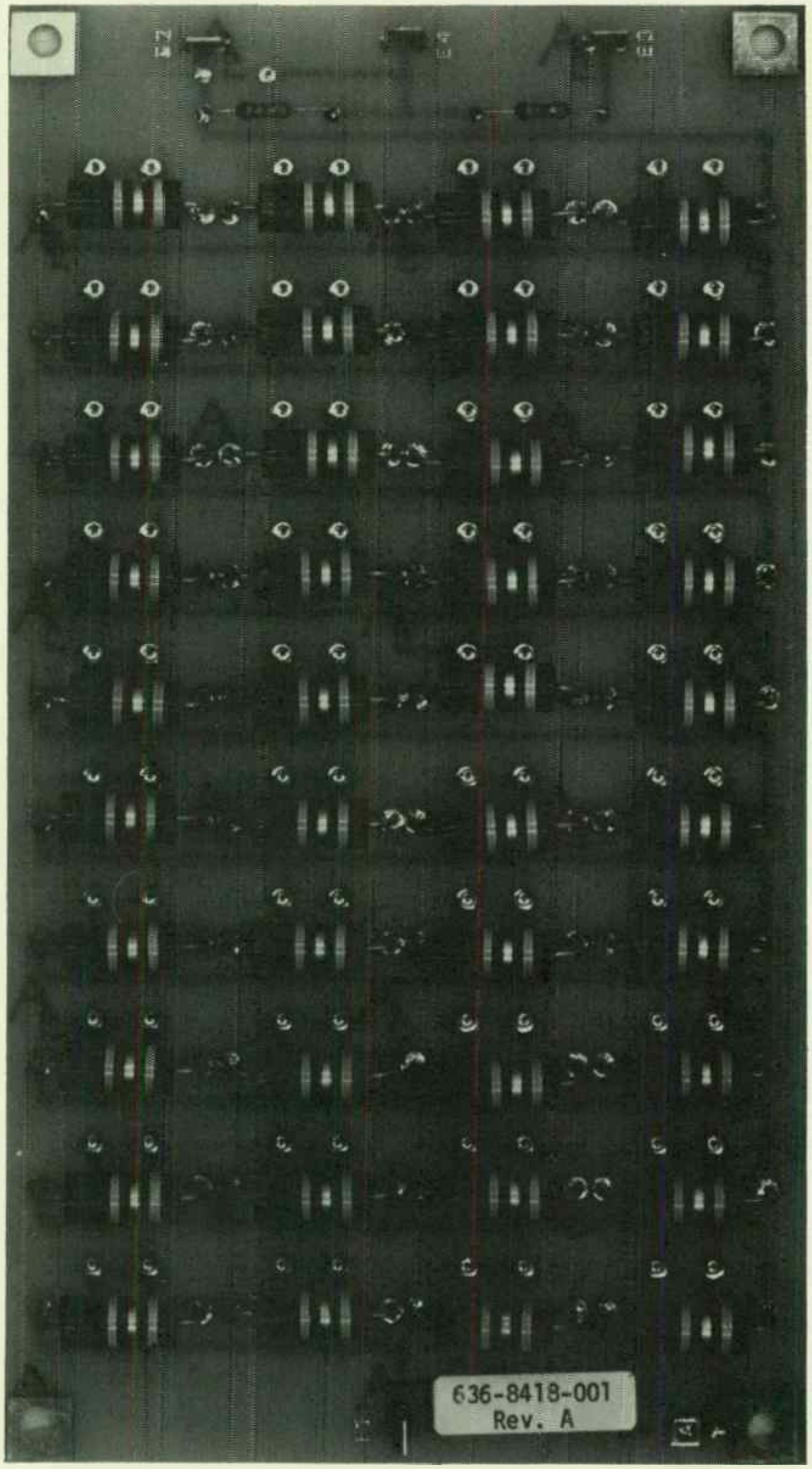

Figure 7-28. 13-kV Sample Divider, Component Layout, A10A1.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

13-kV Sample Divider A10A1.

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
A10A1	636-8418-001	PC Assy	1	13-kV Sample Divider
A10A1R1-40	745-5736-000	100 Kilohms, 10%, 2 W	40	Divider
A10A1R41	705-6582-000	511 Ohms, 1%, 1/4 W	1	Divider
A10A1R42	745-0914-590	560 Ohms, 1/2 W	2	Divider

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

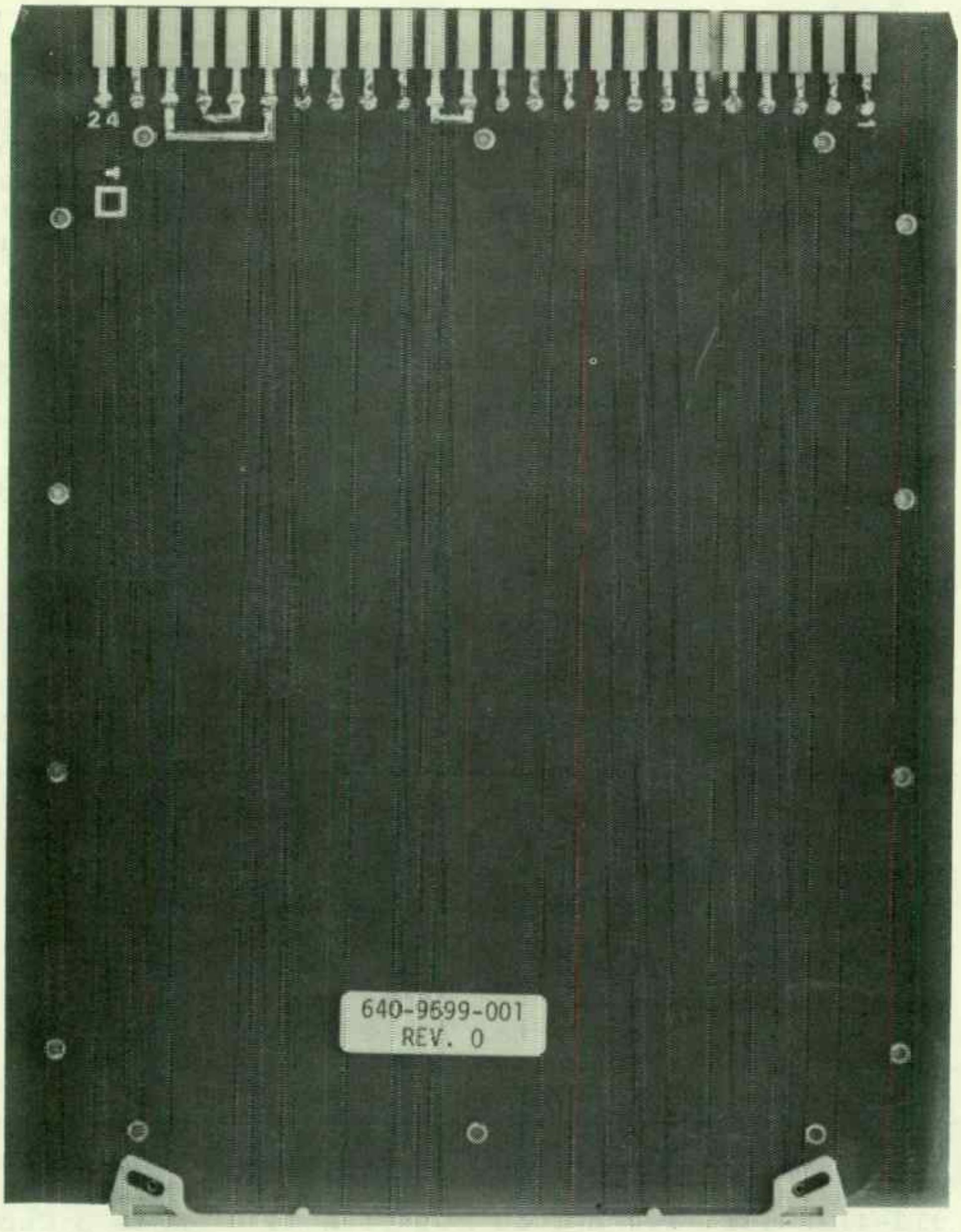

Figure 7-29. Signal Access Card All.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

FREQUENCY KIT FOR THE 828E-1 AND 828D-1

REF DES	PART NO.	VALUE	QTY	DESCRIPTION
		BAND 1, 540 TO 700 kHz		
A9C7	912-4128-050	1200 pF, 25 kV	1	Node 2 Cap
A9C8	912-4128-060	1500 pF, 25 kV	1	Node 3 Cap
A9C9	912-4128-070	2000 pF, 25 kV	1	Node 4 Cap
A9L1	980-0048-000	120 µH, 10 A	1	Node 1 Coil
A9L2	980-0048-000	120 µH, 10 A	1	Node 2 Coil
A9L3B	980-0041-000	150 µH, 10 A	1	Coupling Coil
A1Y1	289-7274-XXX	See Crystal Table	1	Osc 1 Crystal
A1Y2	289-7274-XXX	See Crystal Table	1	Osc 2 Crystal
		BAND 2, 710 TO 930 kHz		
A9C7	912-4828-040	1000 pF, 30 kV	1	Node 2 Cap
A9C8	912-4128-050	1200 pF, 25 kV	1	Node 3 Cap
A9C9	912-4128-050	1200 pF, 25 kV	1	Node 4 Cap
A9L1	980-0048-000	120 µH, 10 A	1	Node 1 Coil
A9L2	980-0047-000	82 µH, 10 A	1	Node 2 Coil
A9L3B	980-0041-000	150 µH, 10 A	1	Coupling Coil
A1Y1	289-7274-XXX	See Crystal Table	1	Osc 1 Crystal
A1Y1	289-7274-XXX	See Crystal Table	1	Osc 2 Crystal
		BAND 3, 940 TO 1230 kHz		
A9C7A	912-4178-190	390 pF, 30 kV, 11 A	1	Node 2 Cap
A9C7B	912-4178-190	390 pF, 30 kV, 11 A	1	Node 2 Cap
A9C8	912-4128-040	1000 pF, 30 kV	1	Node 3 Cap
A9C9	912-4128-040	1000 pF, 30 kV	1	Node 4 Cap
A9L1	980-0048-000	120 µH, 10 A	1	Node 1 Coil
A9L2	980-0047-000	82 µH, 10 A	1	Node 2 Coil
A1Y1	289-7274-XXX	See Crystal Table	1	Osc 1 Crystal
A1Y2	289-7274-XXX	See Crystal Table	1	Osc 2 Crystal
		BAND 4, 1240 TO 1600 kHz		
A9C7A	912-4128-150	270 pF, 30 kV, 9.1 A	1	Node 2 Cap
A9C7B	912-4128-150	270 pF, 30 kV, 9.1 A	1	Node 2 Cap
A9C8A	912-4128-190	390 pF, 30 kV, 11 A	1	Node 3 Cap
A9C8B	912-4128-190	390 pF, 30 kV, 11 A	1	Node 3 Cap
A9C9	912-4128-020	750 pF, 30 kV	1	Node 4 Cap
A9L1	980-0047-000	82 µH, 10 A	1	Node 1 Coil
A9L2	980-0047-000	82 µH, 10 A	1	Node 2 Coil
A1Y1	289-7274-XXX	See Crystal Table	1	Osc 1 Crystal
A1Y2	289-7274-XXX	See Crystal Table	1	Osc 2 Crystal

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

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
960	3800	289-7274-680
970	3840	289-7274-690
980	3880	289-7274-700
990	3920	289-7274-710
1000	3960	289-7274-720
1010	4000	289-7274-730
1020	4040	289-7274-740
1030	4080	289-7274-750
1040	4120	289-7274-760
1050	4160	289-7274-770
1060	4200	289-7274-780
1070	4240	289-7274-790
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	289-7274-090
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

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

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 SEMICONDUCTOR LIST

PART NO.	DESCRIPTION
270-0547-010	SPX3191
270-0547-030	SPX3194
351-1116-010	MC1494L
351-1120-010	LM340T-5
351-1120-040	LM340T-12
351-1124-130	LM320T-12
351-1124-170	LM320T-6
351-1137-010	NE555V
351-1164-010	531
351-1223-020	3403
351-1231-020	8038
351-1339-010	NE5534AN
351-7189-050	710
351-7630-010	7404
351-7635-010	SN7410
351-7640-010	SN7473N
351-7645-010	74121
351-7771-010	7492
352-0551-010	2N2907A
352-0581-010	2N3054
352-0646-010	2N2102
352-0661-020	2N2222A
352-0690-020	2N3772
352-0714-010	2N4036
352-1104-010	MJE243
352-1105-010	MJE253
352-1134-010	2N6575
352-9655-040	Insulator
352-9655-070	Insulator
353-0413-020	F89 Rectifier
353-0417-060	Rectifier
353-0417-130	Rectifier
353-1369-000	1N2989B
353-1915-000	1N2822B
353-2906-000	1N914
353-2938-000	1N746A
353-3122-000	1N3017B
353-3127-000	1N3022B
353-3129-000	1N3024B
353-3644-010	1N4454
353-3691-010	1N5711
353-3718-060	1N5552
353-3725-010	LED
353-6315-000	1N3826
353-6316-000	1N3827A

Semiconductor List (Cont).

PART NO.	DESCRIPTION
353-6317-000	1N3828A
353-6442-040	1N4004
353-6468-010	C6F
353-6599-010	SA7586
353-9009-440	1N5418
636-6171-001	LED

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING.

7.5 SUGGESTED SPARE PARTS LIST

QTY	DESCRIPTION
2	0.1 µF Feedthrough Cap A9C47, C31
2	5600-pF Feedthrough Cap A9C35, 36
1	Blower Motor (B3)
1	Fiber Optic Cable
1	Contactor A8K1
1	Contactor A3K1
1	Contactor N3K2
1	Low-Power Relay A2K1
1	Oscillator Select Relay A1K1
1	Power Control Variable Resistor A6R1
1	PWM Card A2
1	Switchmod Card A9A3
1	Driver Card A9A4
1	Switchmod Clamp Diode A9CR1
1	28-Volt Power Supply Transformer A7T1
1	240-pF Capacitor A9C21
3	500-pF Capacitor A9C26, C27, C23
3	100-pF Capacitor A9C14, 15, 16
1	HVPS Overload Resistor A10R1
2	PA Grid Leak Resistor A9R10
1	HVPS Damper A8R1
2	PA Filament Adjust Resistor A6R1
1	HVPS Bleeder A10R4
5	Relay A7A1K2
3	Low-Power A7A1K1
4	Blower Relay A7K1-K2
1	Coil Coupling A9L3A
1	Node Percent Coil A9L4-5
5	Recommended Spare Semiconductors 11902
3 sets	Spare Lamps and Fuses
5	415-V, 50-Hz Pilot Voltage Divider A9A5R1
1	415-V, 50-Hz Pilot Voltage Divider A9A5R16

T1 CONNECTIONS						
LINE VOLT.	L1	L2	L3	J	J	J
200	2	7	12	2-13	3-7	8-12
210	2	7	12	2-14	4-7	9-12
220	2	7	12	2-15	5-7	10-12
230	1	6	11	1-13	3-6	8-10
240	1	6	11	1-14	4-6	9-11
250	1	6	11	1-15	5-6	10-11
345	2	7	12	3-8	8-13	X
360	2	7	12	4-9	9-14	X
380	2	7	12	5-10	10-15	X
400	1	6	11	3-8	8-13	X
415	1	6	11	4-9	9-14	X
435	1	6	11	5-10	10-15	X

A7T3 CONNECTIONS						
LINE VOLT	L1	L2	L3	J	J	J
210	208	208	208	COM 208	COM 208	COM 208
240	240	240	240	COM 240	COM 240	COM 240
360	208	208	208	COM COM	COM COM	X
416	240	240	240	COM COM	COM COM	X

REVISED AND REDRAWN 4-4-79

CONTRACT NO.	ROCKWELL INTERNATIONAL CORPORATION COLLINS DIVISIONS DALLAS, TEX 75207 NEWPORT BEACH, CALIF 92663 CEDAR RAPIDS, IA 52406		
PREP C R Bing 4-11-79	828E-1 5KW AM SCHEMATIC		METRIC SI
CHK F M Cummings 11 APRIL 1979			
APVD T. C. Vieta 11 April 1979	SIZE	FSCM 13499	DWG NO. 640-9721-001 · REV LTR
	SCALE		SHEET 2 OF 2

FRO ☐ NFP ☐ REL ☐ CR__ NB__ DL__ TO__

* PA FREQUENCY DETERMINED COMPONENTS										
BAND	FREQ KHZ	L1 UH	L2 UH	C7A PF	C7B PF	L3A UH	L3B UH	C8A PF	C8B PF	C9 PF
1	540-700	120	120	1200	—	150	150	1500	—	2000
2	710-930	120	82	1000	—	150	150	1200	—	1200
3	940-1230	120	82	390	390	150	—	1000	—	1000
4	1240-1600	82	82	270	270	150	—	390	390	750

NOTES:
UNLESS OTHERWISE SPECIFIED–
RESISTANCE VALUES ARE OHMS
CAPACITANCE VALUES ARE MICROFARADS

REVISED AND REDRAWN 4-3-79

CONTRACT NO.	ROCKWELL INTERNATIONAL CORPORATION COLLINS DIVISIONS DALLAS, TEX 75207 NEWPORT BEACH, CALIF 92663 CEDAR RAPIDS, IA 52406			
PREP CRBiffy 4-11-79	828E-1 5KW AM SCHEMATIC			METRIC SI
CHK fmCummings 11 April 1979				
APVD L. C. Vinta 8 April 1979	SIZE	FSCM 13499	DWG NO. 640-9721-001	REV LTR
	SCALE		SHEET 1 OF 2	

FRO ☐ NFP ☐ REL ☐ CR__ NB__ DL__ TO__

✱. PA FREQUENCY DETERMINED COMPONENTS										
BAND	FREQ KHZ	L1 UH	L2 UH	C7A PF	C7B PF	L3A UH	L3B UH	C8A PF	C8B PF	C9 PF
1	540-700	120	120	1200	—	150	150	1500	—	2000
2	710-930	120	82	1000	—	150	150	1200	—	1200
3	940-1230	120	82	390	390	150	—	1000	—	1000
4	1240-1600	82	82	270	270	150	—	390	390	750

NOTES:
UNLESS OTHERWISE SPECIFIED—
RESISTANCE VALUES ARE OHMS
CAPACITANCE VALUES ARE MICROFARADS

REVISED AND REDRAWN 4-3-79

CONTRACT NO.	ROCKWELL INTERNATIONAL CORPORATION COLLINS DIVISIONS DALLAS, TEX 75207 NEWPORT BEACH, CALIF 92663 CEDAR RAPIDS, IA 52406
PREP CRBigby 4-11-79	828E-1 5KW AM SCHEMATIC
CHK fmCummings 11 April 1979	SIZE FSCM 13499 DWG NO. 640-9721-001 REV LTR
APVD L.C. Vinton 8 April 1979	SCALE SHEET 1 OF 2

FRO ☐ NFP ☐ REL ☐ CR__ NB__ DL__ TO__

REVISED AND REDRAWN 4-4-79

CONTRACT NO.	ROCKWELL INTERNATIONAL CORPORATION COLLINS DIVISIONS DALLAS, TEX 75207 NEWPORT BEACH, CALIF 92663 CEDAR RAPIDS, IA 52406
PREP C R Bixby 4-11-79	828E-1 5KW AM SCHEMATIC
CHK Fm Cummings 11 APRIL 1979	METRIC
APVD F. C. Vinta 11 April 1979	SIZE — FSCM 13499 — DWG NO. 640-9721-001 — REV LTR
	SCALE — SHEET 2 OF 2

FRO ☐ NFP ☐ REL ☐ CR__ NB__ DL__ TO__

REVISED AND REDRAWN 4-4-79

CONTRACT NO.	ROCKWELL INTERNATIONAL CORPORATION COLLINS DIVISIONS DALLAS, TEX 75207 NEWPORT BEACH, CALIF 92663 CEDAR RAPIDS, IA 52406			
PREP C R Bixby 4-11-79	828E-1 5KW AM SCHEMATIC			METRIC
CHK Fm Cummings 11 April 1979				
APVD T. C. Veith 11 April 1979	SIZE	FSCM 13499	DWG NO. 640-9721-001	REV LTR
	SCALE		SHEET 2 OF 2	

FRO ☐ NFP ☐ REL ☐ CR__ NB__ DL__ TO__