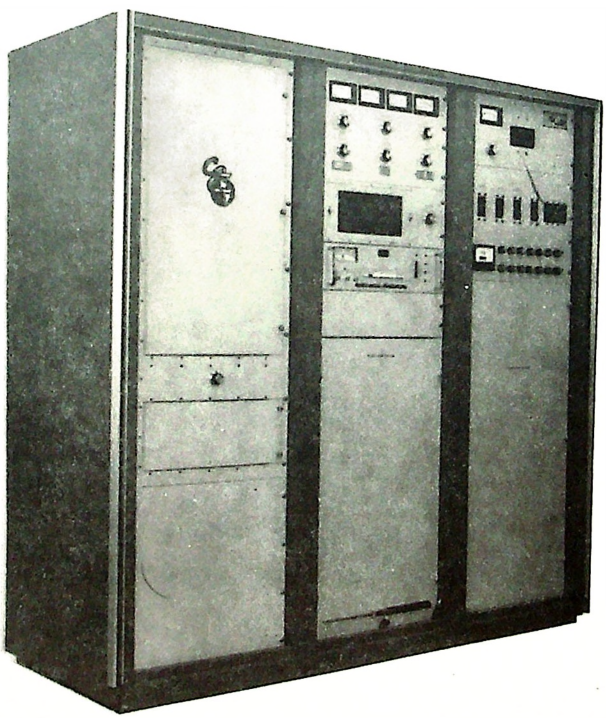
TYPE 816R-3

FM BROADCAST TRANSMITTER

WITH SOLID STATE EXCITER 802A

INSTRUCTION MANUAL



83-0753

KO1-(6)

Continental Electronics MFG. CO.
4212 S. BUCKNER BLVD. DALLAS, TEXAS 75227-4299
10 NOVEMBER 1983

CHANGE NOTICE

CHANGE NO. 18

TO

816R-3

FM BROADCAST TRANSMITTER

INSTRUCTION MANUAL

This Change No. 18 for the 816R-3 FM Broadcast Transmitter Instruction Manual is effective for all transmitters. This Change Notice should be filed just after the Title Page.

NEW PAGE		OLD PAGE	
6-11/6-12	C13/C18	6-11/6-12	C13/C13
6-15/6-16	C18/-	6-15/6-16	C4/-
6-79/6-80	C18/C13	6-79/6-80	C10/C13

30 August 1984

Continental Electronics Mfg. Co.
4212 South Buckner Blvd.
Dallas, Texas 75227-4299

RECORD OF CHANGES - 816R-3

CHANGE NO.	DATE	EFFECTIVITY
1	2 January 1981	All Transmitters
2	20 November 1981	All Transmitters
3	25 May 1982	All Transmitters
4	16 August 1982	SN 329 and Above
5	15 October 1982	All Transmitters
6	3 January 1983	All Transmitters
7	8 February 1983	SN 344 and Above
8	10 March 1983	All Transmitters
9	10 March 1983	All Transmitters
10	22 July 1983	All Transmitters
11	26 August 1983	All Transmitters After Date
12	9 September 1983	All Transmitters After Date
13	10 November 1983	SN 360 & Above & All Transmitters with 802A Exciter
14	5 January 1984	SN 360 & Above & All Transmitters with 802A Exciter
15	11 January 1984	SN 365 & above & All Transmitters with 802A Exciter
16	27 February 1984	SN 360 & Above & All Transmitters with 802A Exciter
17	17 July 1984	SN 360 & Above & All Transmitters with 802A Exciter

		Page
Section 1	General Description	1-1
1.1	Introduction	1-1
1.2	Functional Description	1-1
1.3	Physcial Description	1-1
1.4	Technical Characteristics	1-1
1.4.1	Mechanical	1-1
1.4.2	Electrical	1-2
Section 2	Installation	2-1
2.1	Unpacking and Inspecting	2-1
2.1.1	Domestic Shipments	2-1
2.1.2	Foreign Shipments	2-1
2.2	Assembly	2-1
2.3	Primary Power	2-2
2.3.1	General	2-2
2.3.2	Transformer Connections	2-2
2.4	Transmitter Cooling	2-6
2.5	Initial Turn-on Procedure	2-6
2.6	Remote Operation	2-10
2.7	Frequency Change	2-10
Section 3	Operation	3-1
3.1	General	3-1
3.2	Controls and Indicators	3-1
3.3	Turn-on Procedure	3-1
3.4	Shutdown Procedures	3-7
3.4.1	Normal Turnoff	3-7
3.4.2	Emergency Turnoff	3-7
3.5	Power Readings	3-7
3.6	Automatic Recycle Resetting	3-9
Section 4	Principles of Operation	4-1
4.1	General	4-1
4.2	Block Diagram Discussion	4-1
4.3	RF Circuits	4-1
4.3.1	Exciter	4-1
4.3.2	RF Driver	4-1
4.3.3	RF Power Amplifier	4-2
4.3.4	Low-Pass Filter A13	4-4
4.3.5	Directional Coupler A16	4-4
4.4	Power Supplies and Power Control Circuits	4-4
4.4.1	General	4-4

table of contents (cont.)

		Page
4.4.2	28-Volt DC Power Supply PSI	4-4
4.4.3	PA Bias Power Supply PS2	4-5
4.4.4	PA Plate Power Supply	4-5
4.4.5	Power Control Unit A9	4-5
4.4.6	Power Control Regulator A8	4-5
4.4.7	PA Screen Power Supply	4-9
4.4.8	Driver Power Supply	4-9
4.4.9	Filament Voltage Regulator A5	4-9
4.4.10	Filament Voltage Distribution	4-10
4.5	Primary Power Distribution Control and Overload Circuits	4-10
4.5.1	Primary Power Distribution	4-10
4.5.2	Transmitter Turn-on	4-11
4.5.3	Exciter Power Control Override	4-11
4.5.4	VSWR Calibrate and Auto Power Control Unit A3	4-15
4.5.5	Overload Protection	4-15
4.5.6	Overload and Recycle Board A7	4-16
4.5.7	Power Failure Recycle Board A19A1	4-17
4.5.8	Latching Relay and Status Indicator Board A12	4-17
4.5.9	Power Control Relays A2A3	4-19
4.5.10	Remote Relays A2A1	4-19
4.5.11	Remote Connections	4-19
Section 5	Maintenance	5-1
5.1	General	5-1
5.2	Cleaning	5-1
5.2.1	General Cleaning Procedures	5-1
5.2.2	Air Filter	5-1
5.2.3	Tube Cleaning	5-2
5.3	Inspection	5-2
5.4	Lubrication	5-2
5.5	Troubleshooting	5-2
5.5.1	Access Panel Interlock Switch	5-2
5.5.2	Test Equipment	5-2
5.6	Adjustments	5-2
5.6.1	Switch Adjustments	5-3
5.6.1.1	Air Interlock Switch S1	5-3
5.6.1.2	Timing Motor Limit Switches S11, S12, S13 and S14	5-3
5.6.2	Filament Voltage Adjustment	5-4
5.6.3	Driver Filament Voltmeter Adjustment	5-5
5.6.4	DC Overload Adjustment	5-5
5.6.5	PA Grid Current and Driver Screen Current Meter Calibration	5-6
5.6.6	High-Voltage Power Supply Adjustments	5-6
5.6.7	RF Tuning Procedure	5-7

TABLE OF CONTENTS - Continued

Paragraph	Title	Page
	SECTION 5 - MAINTENANCE - Continued	
5.6.7.1	Shorting Plane, Driver Loading Slider, Driver Tuning Slider, Driver Grid Slider, and PA Neutralization Preliminary Adjustments	5-7
5.6.7.2	Driver Grid Tuning	5-10
5.6.7.3	PA Tuning	5-11
5.6.7.4	Driver Neutralization	5-14
5.6.7.5	Neutralization	5-14
5.6.7.6	Maximum Power Adjustment	5-15
5.6.8	Board A3, Offset Zero Adjustment	5-16
5.6.9	Automatic Power Control Adjustment	5-17
5.6.10	VSWR Trip	5-18
5.6.11	VSWR Protect Test Circuit	5-18
5.6.12	Phase Monitor Adjustment	5-19
5.7	Parts Replacement	5-19
5.7.1	4CX15000A PA Tube	5-19
5.7.2	Control Panel Indicator Lamps	5-19
5.7.3	Replacement Parts	5-20
Section 6	Parts List	6-1
6.1	General	6-1
6.2	REF DES	6-1
6.3	Description	6-1
6.4	Collins Part Number	6-1
6.5	Illustrations	6-1
6.6	List of Equipment	6-2
Section 7	Schematic Diagrams	7-1

list of illustrations

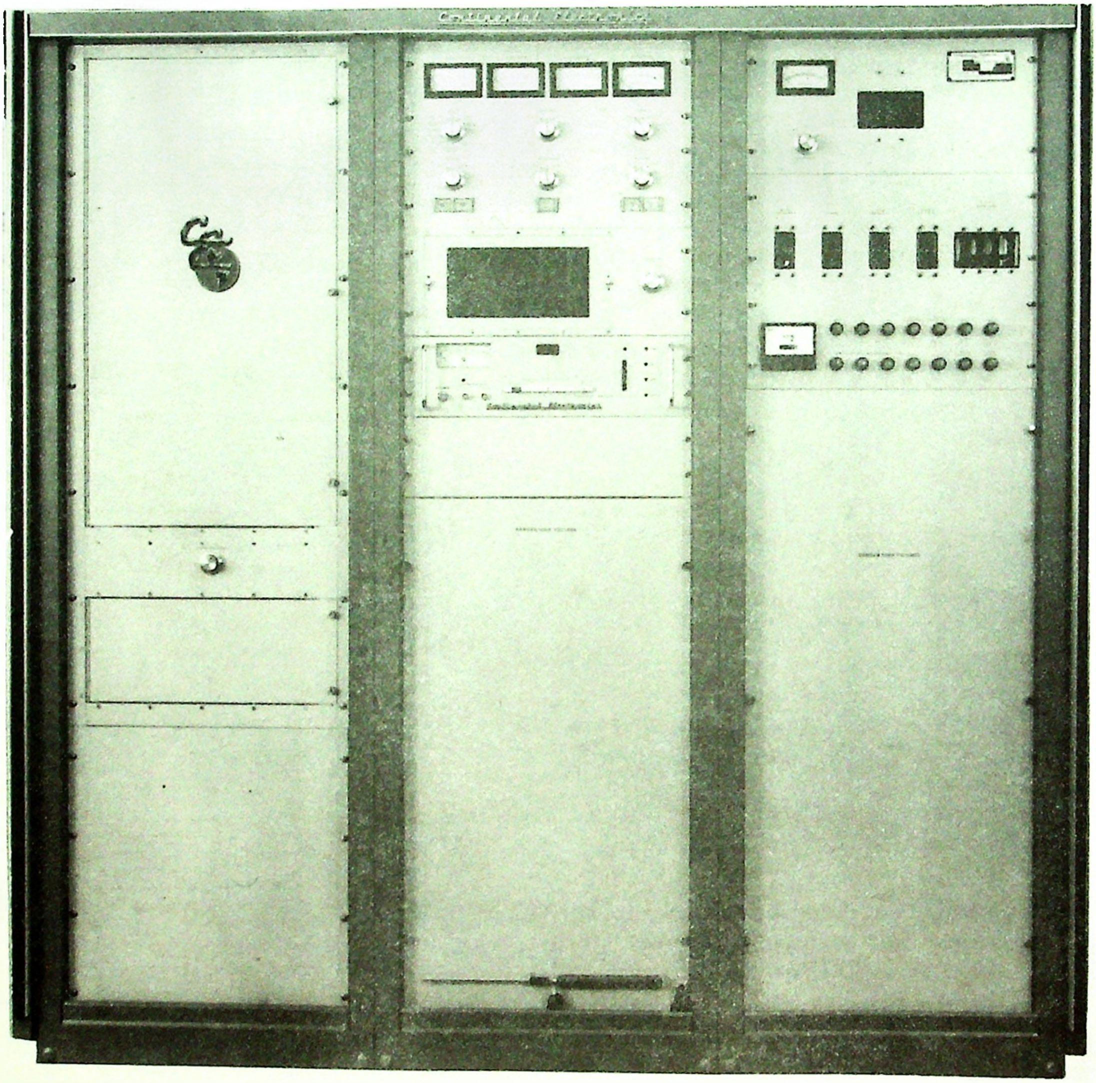
Figure		
1-1	816R-3 25-kW FM Transmitter	1-0
2-1	816R-3 25-kW FM Transmitter, Outline and Installation Drawing	2-3
3-1	816R-3 25-kW FM Transmitter, Controls and Indicators	3-2
4-1	816R-3 25-kW FM Transmitter, Block Diagram	4-2
4-2	Plate Cavity	4-3
4-3	816R-3 25-kW FM Transmitter, Schematic Diagram Output Network	4-4
4-4	Power Control Circuits, Simplified Diagram	4-7
4-5	Filament Voltage Distribution	4-12
4-6	Primary Power Distribution	4-13
4-7	Power ON-OFF Control Circuits	4-14

LIST OF ILLUSTRATIONS - Continued

Figure	Title	Page
4-8	Latching Relays A12, Simplified Schematic................	4-18
4-9	Power Control Relays A2A3, Simplified Schematic..........	4-20
4-10	Typical Remote Interconnections to Remote Control Terminal Board TB4..................................	4-21
5-1	PA Plate Cavity Shorting Plane Approximate Adjustment....	5-8
5-2	Graph for Approximate Setting of Driver Loading, Driver Tuning, and Driver Grid Sliders.........................	5-9
5-3	PA Neutralizing Adjustment...............................	5-10
* 5-4	816R-3 Amplifier Efficiency Vs Frequency Graph...........	5-21
* 5-5	816R-3 Amplifier Efficiency Vs Output Level..............	5-21
5-6	Power to VSWR Conversion Graph...........................	5-17
6-1	816R-3 25 kW FM Transmitter..............................	6-3
6-2	Control Panel, A1..	6-10
6-3	Remote Control Assembly, A2..............................	6-14
6-4	Fwd/Refl Cal and Pwr Control, A3.........................	6-16
6-5	Filament Regulator, A5...................................	6-19
6-6	Circuit Breaker Panel, A6................................	6-22
6-7	Overload and Recycle Board, A7...........................	6-24
6-8	Power Control Regulator, A8..............................	6-28
6-9	Power Control Panel, A9..................................	6-31
6-10	SCR Gate Drive Card, A9AR1 A1-A3.........................	6-33
6-11	2-kV Power Supply, A10...................................	6-35
6-12	RF Driver Assembly, A11..................................	6-37
6-13	Latching Relay and Status Board, A12.....................	6-41
6-14	RF Output Low-Pass Filter, A13...........................	6-43
6-15	Power Supply Filter, A14.................................	6-45
6-16	Metering Multiplier Board, A15...........................	6-49
6-17	Directional Coupler, A16.................................	6-51
6-18	Bleeder Resistor Panel, A17..............................	6-53
6-19	Power Amplifier Cavity, A18..............................	6-56
6-20	Component Panel, A19.....................................	6-62
6-21	Power Failure Recycle Board, A19A1.......................	6-65
6-22	Variable Transformer Drive Assembly, A19A2...............	6-67
6-23	Card Cage Assembly, A20..................................	6-69
6-24	Power Amplifier Socket, A21..............................	6-72
6-25	Overload and Meter Calibrate Panel, A22..................	6-75
6-26	AC Metering Panel, A25...................................	6-78
6-27	Resistor Board Assembly, A25A1...........................	6-80
6-28	28-Volt Power Supply, PS1................................	6-82
6-29	PA Bias Power Supply, PS2................................	6-84

LIST OF TABLES

Table	Title	Page
2-1	Transformer Connection Schedule........................	2-5
2-2	816R-3 25-kW FM Transmitter, Nominal Heat Balance.......	2-7
3-1	Left Cabinet...	3-1
3-2	Center Cabinet...	3-1
3-3	Right Cabinet..	3-5
* 3-4	Typical Indications, 25-Kilowatt Power Output...........	3-6
3-5	Nominal Readings, Reduced Power Operation...............	3-8
5-1	Required Test Equipment................................	5-3
5-2	Screen Voltage Transformer Tap Schedule.................	5-20



83-0754

KO1-(5)

Figure 1-1. 816R FM Transmitter

SECTION 1 - GENERAL INFORMATION

1-1. INTRODUCTION

The transmitter operates in the FM broadcast range (88-108MHz) with an RF output power of 25,000 watts. Reduced power is available by tap changes of the plate and screen transformer to meet customer requirements. The FM Transmitter, 816R, provides monaural programming or other optional programming as customer requires. When the exciter
* is inputed with optional stereo generator and SCA generator, the transmitter provides continuous monaural, stereophonic, and SCA (subsidiary communication authorization) frequency-modulated programs.

1-2. FUNCTIONAL DESCRIPTION

The transmitter consists of an exciter, a driver, and power amplifier. The output of the exciter is applied to the driver. The driver stage consists of two 4CX250B tubes operated class C. The input to the driver is amplified to approximately 400 watts and applied to the power amplfiier that contains one 4CX15000A tube operated class C. The input to the power amplifier is amplified and applied to a 50-ohm unbalanced load. Power control circuits monitor the rf output power level. When a change in output power is detected, these circuits change the plate voltage to compensate. Other control circuits within the transmitter monitor reflected power, forward power, operating voltage, air pressure and exhaust air temperature within the power amplifier section. They protect the transmitter by removing power when excessive currents, VSWR, loss of air pressure, or excessive air exhaust temperature occur.

1-3. PHYSICAL DESCRIPTION

The transmitter is housed in a basic unistrut cabinet that contains all transmitter components. (Refer to figure 1-1.) The transmitter contains three sections. The section on the left in figure 1-1 contains the power amplifier and driver circuits. The center section houses the control panel, exciter, and control circuits. The section on the right contains the power supplies, the circuit breaker, and fuse panel.

1-4. TECHNICAL CHARACTERISTICS

1-4.1 MECHANICAL

Weight:	890 kg (1962 pounds)
Size:	
Height:	1752.6 mm (69 inches)
Width:	1816.1 mm (71-1/2 inches)

Depth
698.5 mm (27-1/2 inches)

Ventilation (2 Sources):
Squirrel-cage type blower mounted under the cavity
Axial fan that provides positive air pressure within the entire cabinet of the transmitter.

Ambient Temperature Range:
* $+15^{\circ}$ to $+40^{\circ}C$ operating

Relative Humidity Range:
* 0 to 95% relative humidity

Altitude:
* Up to 7500 feet at $30^{\circ}C$ ($86^{\circ}F$)

Shock and Vibration:
Normal handling and transportation

Finish:
Front Panel: Tan
Cabinet: Brown

1.4.2 ELECTRICAL

Frequency Range:
88 to 108 MHz

Maximum Power Output:
25,000 watts into a 50-ohm unbalanced line

Standing Wave Ratio:
Not to exceed 2:1 (Refer to Figure 5-6)

Power Source:
200 to 250 volts, 60 Hz, 3-phase (closed delta or 208V wye)
Available voltage taps on transformer: 200, 210, 220, 230, 240, and 250
50-Hz operation available on special order

Power Line Variation:
±5% overall power line variations; in addition, the phase angle and voltage unbalance shall be within 5% of the average of all three phases

Harmonic and Spurious Radiation:
Any emission appearing on a frequency removed from the carrier by between 120 kHz and 240 kHz inclusive is attenuated at least 25 dB below the level of the unmodulated carrier.
Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz is attenuated at least 35 dB below the level of the unmodulated carrier.

Any emission appearing on a frequency removed from the carrier by more than 600 kHz is attenuated at least 80 dB below the level of the unmodulated carrier.

Modulation Characteristics:
Wideband direct fm; standard audio preemphasis is incorporated

Input Power Requirements:
40-kW nominal for 25-kW output (44.4 kVA at 0.90 power factor)

Excitation Source:
* A CEMC 802A Exciter

Output Impedance:
50 ohms, unbalanced

Carrier Frequency Stability:
Frequency will not vary more than ±500 Hz for an ambient temperature range of +15 to +45°C (59° to 113°F) and a line voltage variation of ±5%

Audio Input Impedance:
600 ohms, balanced

Audio Input Level:
+10 dBm ±2 dB

Audio Frequency Response:
Complies with FCC standard 75-microsecond preemphasis curve (other available on request)

Audio Frequency Distortion:
Stereo
Not more than 0.5%, 50 Hz to 15 kHz
Monaural
Not more than 0.25%, 50 Hz to 15 kHz

FM Noise Level
65 dB below 100% modulation (±75 kHz)

AM Noise Level:
55 dB below equivalent 100% am modulation

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

2.1 Unpacking and Inspecting

2.1.1 Domestic Shipments

a. The uncrated transmitter is shipped on a shipping skid. The transmitter is not attached to the skid. Inspect for loose screws and fasteners. Ensure that all controls operate freely. Examine the cabinet for dents or scratches. Ensure that cable and wiring connections are tight and situated clear of each other and the chassis.

b. If any received item is freight damaged, the customer should accept the equipment, note the damage on the shipping documents and immediately file a freight claim. All boxes and packing material should be retained for the freight inspector. Refusal to accept delivery of damaged equipment removes the evidence and makes freight-damage reimbursement complicated or impossible.

2.1.2 Foreign Shipments

a. The transmitter is shipped in a skid-type crate with unpacking instructions stenciled on the side. Heavy iron components are crated separately, bolted down to a 2-inch solid base. Uncrate the transmitter carefully to avoid damage. Inspect for loose screws and fasteners. Ensure that all controls operate freely. Examine the cabinet for dents or scratches. Ensure that cable and wiring connections are tight and situated clear of each other and the chassis.

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

2.2 Assembly

a. Plan the placement of the transmitter and its external wiring carefully before beginning installation. (refer to figure 2-1 and paragraph 2-4.) Four knockout holes are located on the top of the transmitter section that contains the power supplies. The holes accommodate cabling for 3-phase input voltage, audio input signal, and the remote control unit. A 2-inch conduit entry is also provided in the floor of the power supply section.

b. If optional modulation and frequency monitoring equipment is used, remove the center rear panel before positioning the transmitter. Determine the length of cable needed to connect the transmitter sample output to the monitoring equipment. Once the length is determined, connect the cable to the monitor jacks, and run the cable out of the transmitter through a previously unused knockout hole.

* c. If the 802A exciter was not factory installed, mount it in the area provided in the transmitter center section. Connect an rf cable from exciter output to the driver input. Attach the override voltage lead from A4TB1-16 to A19E6 and the mono/stereo leads from XA12-39 to A4TB1-14 and XA12-40 to A4TB1-13. Connect the 117-volt ac power cable from the exciter to connector J3 (figure 2-1). Refer to the 510R-1 exciter instruction book for installation of audio input cables. Replace the rear cover and place the transmitter in its permanent location.

d. Connect primary power according to instructions supplied in paragraph 2.3.1

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

e. Transformers T1 and T2, filters L1 and L2, and filter capacitor C3 may have been removed to facilitate shipping. Install these components if they were shipped separately.

f. Check the transformer taps for proper connection. Refer to paragraph 2.3.2 and table 2.1.

g. If output tube 4CX15000A was removed for shipping, install it using the procedure outlined in paragraph 5.7.1.

h. If a remote control panel is used, run the external wiring from the remote unit into the transmitter and connect it to TB4 (figure 2-1). Also install the appropriate optional remote control relay cards, A2A3 and A2A1.

i. Connect the customer-supplied 50-ohm transmission line to the rf output connector mounted on top of the transmitter cabinet.

CAUTION

DAMAGE WILL RESULT FROM AN IMPROPER IMPEDANCE MATCH BETWEEN THE TRANSMITTER AND THE TRANSMISSION LINE. ENSURE THAT THE TRANSMISSION LINE AND ANTENNA PRESENT A 50-OHM IMPEDANCE AND A VSWR NOT GREATER THAN 2:1 TO THE TRANSMITTER AT THE OPERATING FREQUENCY.

2.3 Primary Power

2.3.1 General

The transmitter requires a 200 to 250 volt ±5%, 3-phase, 60-Hz ac power source (closed delta or 208V wye). A 200 amp fused disconnect should be provided with
* 150 amp fuses and not more than 100 feet of No. 1/0 AWG wiring to the transmitter. AC line transient suppressors are suggested for the primary lines. For recommendation of installation, call Broadcast Products Field Service.

2.3.2 Transformer Connection

The broad range of allowable voltage sources (200 to 250 volts) is made possible by the availability of different tap connections of power transformers T1, T2, T3, and T4 and power supply transformers PS1T1 and PS2T1. Table 2-1 shows the details of the proper primary line connections for various line voltages.

NOTE

The initial connections on transformers T1 and T2 may be changed after tuning to reduce am noise and to maintain authorized station maximum power output. (See paragraph 5.6.7.6) T1 connections are selected to provide a power output approximately 10 percent above the authorized station rating. T3 connections are selected to give 1800 to 2000 volts of driver voltage at the authorized station output.

Two connections are made at transformer T4. One connection is made at Terminal No. 1 regardless of the source voltage. The second wire is connected to correspond with the power source voltage and is connected to instructions supplied in table 2-1.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

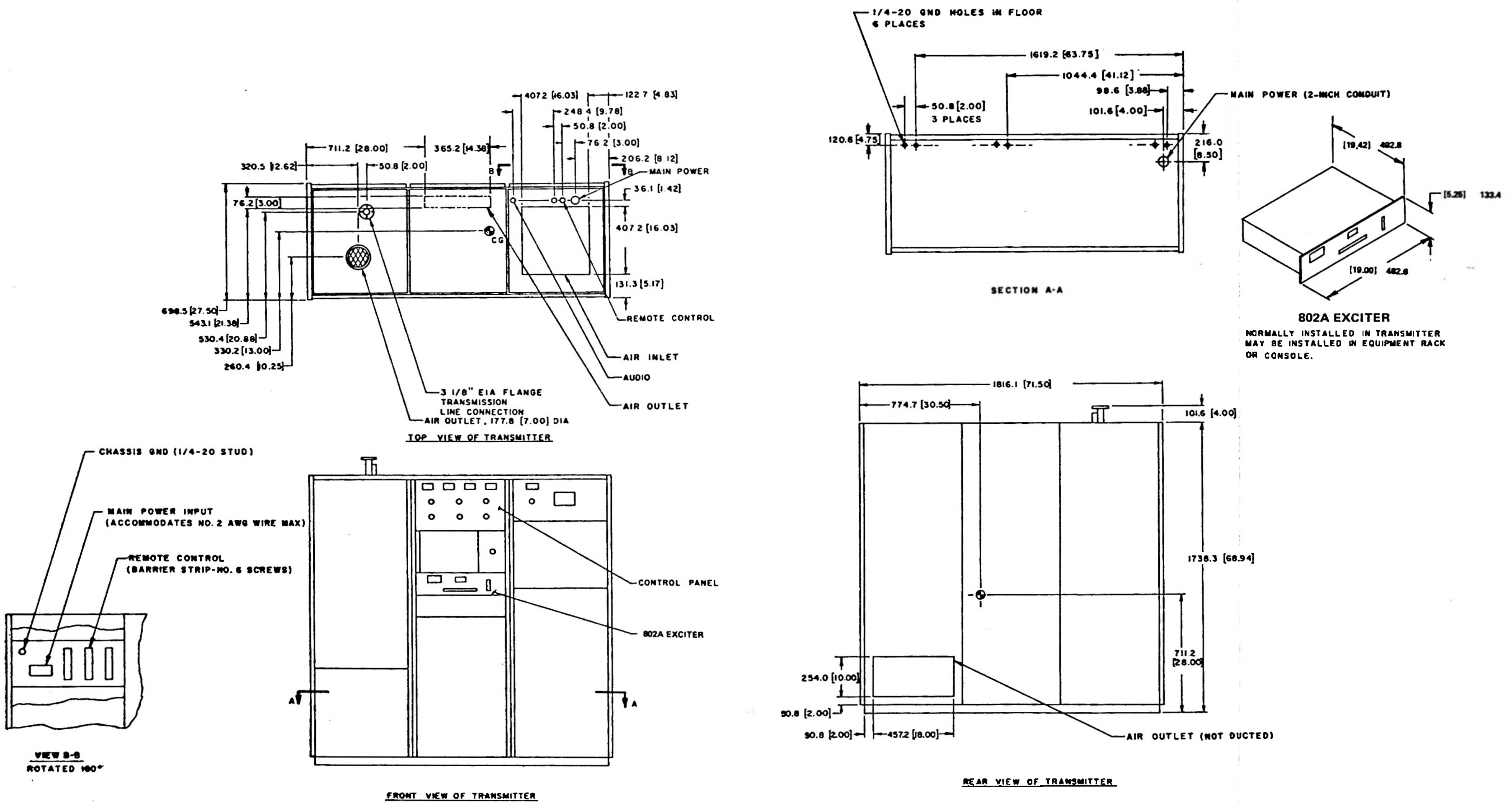
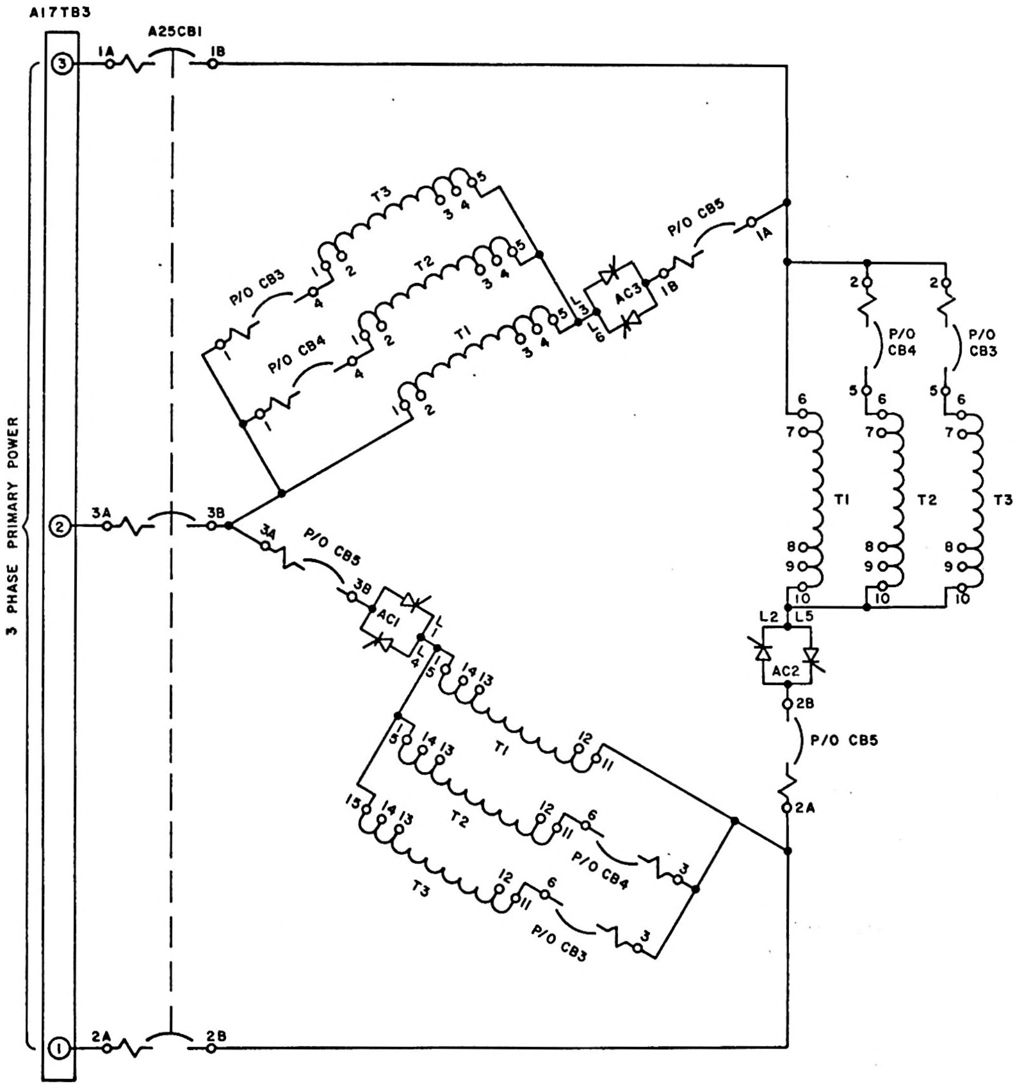


Figure 2-1. FM Transmitter
Outline and Installation Drawing



LINE VOLTAGE	T1,T2,T3 TERMINALS	T4 TERM.CONN.	PS1 TB1 TERM.CONN.	PS2 TB2 TERM CONN.
200V	2-3,7-8,12-13	1 & 2	1&2,4&5,7&8	1 & 2
210V	2-4,7-9,12-14	1 & 3		1 & 2
220V	2-5,7-10,12-15	1 & 4		1 & 2
230V	1-3,6-8,11-13	1 & 5	1&3,4&6,7&9	1 & 3
240V	1-4,6-9,11-14	1 & 6		1 & 3
250V	1-5,6-10,11-15	1 & 7		1 & 3

Table 2-1
Transformer Connection Schedule

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING

Six connectins are made on power supply transformer PS1T1. Three of these connections (at Terminals 1,4 and 7) are made regardless of the source voltage. The other three connections are made to correspond with the power source voltage. These wires are connected according to instructions supplied in table 2-1.

Two connections are made at power supply transformer PS2T1. One connection is made at Terminal No. 1 regardless of the source voltage. The second wire is connected to correspond with the power source voltage and is connected according to instructions supplied in table 2-1.

2.4 Transmitter Cooling

Adequate cooling of the transmitter is imperative to reduce downtime, to extend component reliability, and to provide longer tube life. An adequate supply of cool clean uncontaminated ambient air (temperature must not exceed +45°C) is required. See Table 2-2 for nominal heat balance readings. Consult a qualified air-conditioning engineer for recommendations on ducting and cooling requirements. When designing the cooling system, observe the following rules:

a. If the exhaust air is ducted away from the transmitter, the duct work must not create any back pressure on the transmitter exhaust system. Use a fan or blower to compensate for duct losses when the exhaust is ducted outdoors or when back pressure is present (1200-cfm capacity).

b. If intake air is ducted in from the roof, raise the intake sufficiently high above the surface to prevent intake of air heated by sun reflection from the roof.

c. If both intake and exhaust ducts are used, locate the duct openings in a common area of the building to equalize wind pressure effects. However, do not allow the exhaust to recirculate into the intake causing heat build-up.

2.5 Initial Turn-on Procedure

a. Ensure that the transmitter has been properly assembled and connected according to instructions provided in paragraphs 2-2 through 2-4.

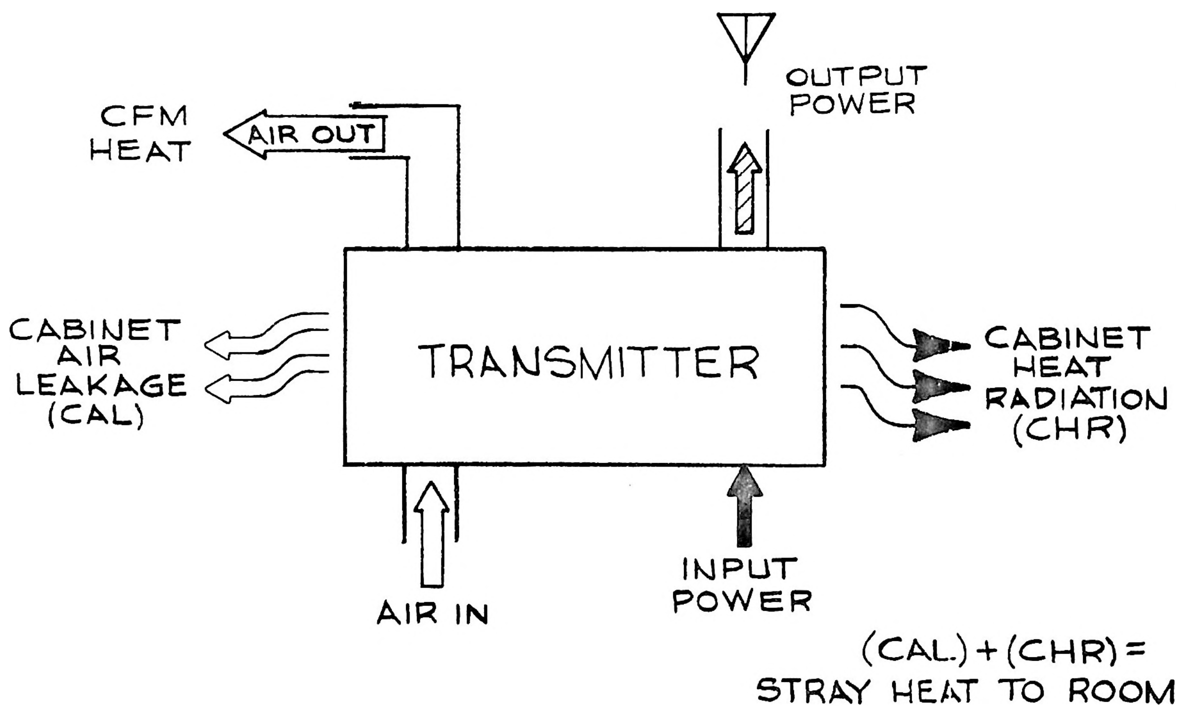
b. Open access panels to the control circuit cards and exciter circuit cards. Check the circuit cards for proper installation.

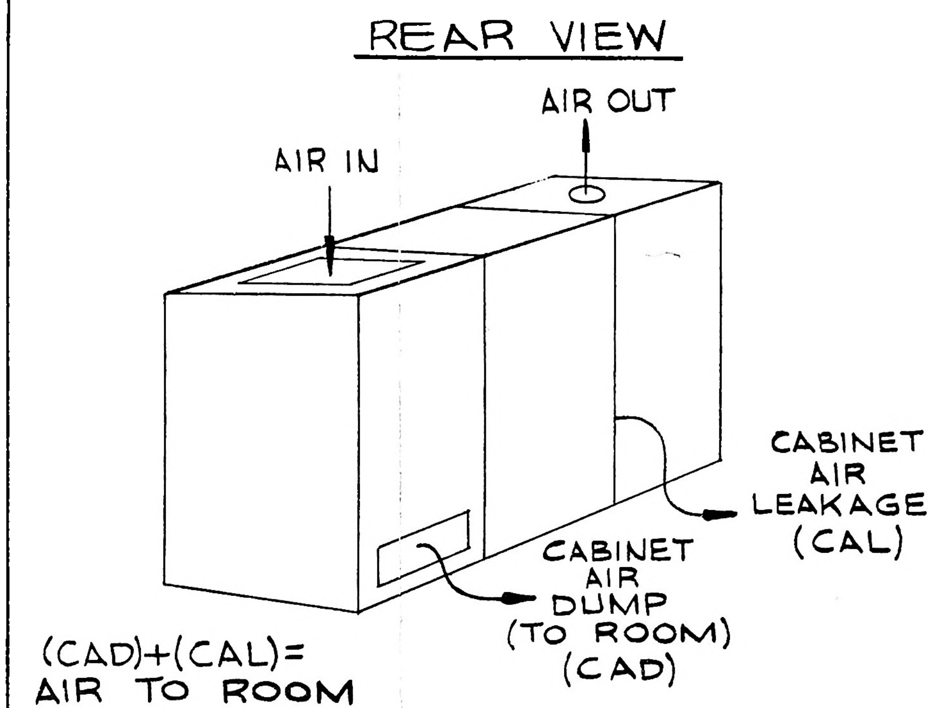
c. Replace all access panels and ensure that all doors and panels are properly closed.

d. Ensure that all transmitter circuit breakers are OFF.

e. Apply primary power to transmitter.

f. Set the 28 VDC POWER SUPPLY and BLOWER circuit breaker to ON.
Check the phase loss/phase rotation indicator on A7 (top LED). If phase loss /phase rotation indicator is not on, interchange any two primary power input leads at A17TB3.





TRANSMITTER TYPE	RATED POWER OUTPUT	OPERATING POWER OUT	INPUT POWER KW	INPUT KVA	AIR IN CFM	AMBIENT TEMP. MAX.	AMBIENT TEMP. OPTIMUM	AIR OUT CFM	AIR OUT KW / BTU	AIR OUT TEMP. °F / °C	AIR TEMP. RISE °F / °C	STRAY AIR TO ROOM CFM	STRAY HEAT TO ROOM KW / BTU	BLOWER CFM CAP. / USE	FAN CFM CAP. / USE	AIR IN SUPPLY PRESSURE (MIN.)	AIR OUT BACK PRESSURE (MAX.)
816R-3	25KW	25KW	40	44.4	850	+45°C	+22.2°C	535	13.1 / 44710	149 / 65.3	77-81 / 43.1	315	1.9 / 6485	750 / 535	1000 / 850	+0.1" H_2O	+0.1" H_2O
		20KW	33	36.7	850	+45°C	+22.2°C	535	11.4 / 38908	139 / 59.7	67 / 37.5	315	1.6 / 5461	750 / 535	1000 / 850	+0.1" H_2O	+0.1" H_2O
		15KW	27.5	30.6	850	+45°C	+22.2°C	535	10.9 / 37202	137 / 58.1	65 / 35.9	315	1.6 / 5461	750 / 535	1000 / 850	+0.1" H_2O	+0.1" H_2O
		10KW	22	24.4	850	+45°C	+22.2°C	535	10.2 / 34813	132 / 55.8	60 / 33.6	315	1.8 / 6143	750 / 535	1000 / 850	+0.1" H_2O	+0.1" H_2O

Table 2-2. 816R-3 25-kW FM Transmitter, Nominal Heat Balance

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

g. Press the FILAMENT ON pushbutton. The power amplifier blower will start.

WARNING

DEADLY VOLTAGES ARE EXPOSED WHEN SIDE COVER IS REMOVED. USE EXTREME CAUTION TO PREVENT OPERATOR INJURY.

h. Loosen the two retaining bolts at the bottom of the left cabinet side panel. Grip the panel securely and lift it from place. Check the rotation of the blower. Rotation should be counterclockwise when viewed from the left side. Replace the side panel, reapply primary power and press the FILAMENT ON pushbutton.

* i. Check the cabinet fan rotation by lifting the foam filter from the top right side of the cabinet. Rotation should be counter-clockwise when viewed from the top. Replace the filter, reapply primary power, and press the FILAMENT pushbutton.

CAUTION

DO NOT PERFORM THE REMAINDER OF THIS PROCEDURE IF THE TRANSMITTER IS NOT CONNECTED TO AN ANTENNA WITH A 50-OHM IMPEDANCE OR A DUMMY LOAD CAPABLE OF DISSIPATING AT LEAST THE RATED RF OUTPUT OF THE TRANSMITTER.

j. Set all circuit breakers to ON.

* k. Set the test meter selector switch to 28V SUPPLY (40V scale). The test meter will indicate 28 ±2.0 volts DC.

l. Set the AC Meter Panel selector switch to FIL. The test meter should indicate 6.0 ±0.1 volts. Adjust Filament Voltage using procedures in Paragraph 5.6.2 and 5.6.3. These adjustments are required to be made at customer's normal line voltage.

m. Ascertain that the exciter POWER Switch is ON.

NOTE

The transmitter is adjusted and pretuned at the factory for specific customer power output and frequency requirements. In normal applications, the fine-tuning and adjustment procedures provided in steps n. through 7. are adequate to esnure proper transmitter operation. However, if the transmitter is to be operated at a frequency or power output different from the frequency or power output designated in the production test data supplied with the transmitter, perform the complete rf tuning and power adjustment procedures listed in Paragraph 5.6.7.

n. Set the POWER CONTROL switch to MANUAL.

o. Set the POWER switch to FORWARD.

p. Set the TRANSMITTER CONTROL switch to LOCAL.

q. Press the PLATE switch. The PLATE ON switch will light.

r. Slightly adjust the PA LOADING and PA TUNING controls until maximum power output is displayed on the RF WATTMETER.

s. RAISE or LOWER the POWER ADJUST control until the RF WATTMETER displays the station's authorized power level.

t. Compare meter readings with those listed in table 3-4 or 3-5. If additional tuning is required, refer to the adjustment procedures listed in section 5.

* u. Set POWER CONTROL switch to AUTOMATIC. On the transmitter Power Control Adjust panel adjust A3R7 for 100% output power if necessary.

2.6 Remote Operation

To initiate remote operation, set the TRANSMITTER CONTROL switch to REMOTE. When operating with the control panel, this switch must be in the LOCAL position.

* 2.7 Frequency Change

The Transmitter operating frequency is changed by changing the Exciter operating frequency and performing the transmitter RF Tuning procedure as outlined in paragraph 5.6.7.

3.1 GENERAL

* The transmitter can be operated from the control panel or by Remote Control. Once the transmitter has been installed and properly tuned, it is only necessary to monitor meter indications and to make minor tuning and loading adjustments (figure 3-1). Instructions for the 802A exciter are found in the Exciter Instruction Manual.

3.2 Controls and Indicators

Refer to the following tables for a general description of the operating controls found on the front panels of the transmitter cabinets: table 3-1, left cabinet; table 3-2, center cabinet; and table 3-3, right cabinet.

3.3 Turn-on Procudure

a. Ensure that steps a. through m. in paragraph 2.5 have been performed.

b. Observe the control panel meters after plate voltage is applied and ensure * that the transmitter readings agree with those in table 3-4, table 3-5, or manufacturer Data Sheet.

Table 3-1. Left Cabinet

REF DESIG	CONTROLS AND INDICATORS	FUNCTION
C37	DRIVER PLATE TUNING	A variable capacitor that adjusts driver tuning.

Table 3-2. Center Cabinet

REF DESIG	CONTROLS AND INDICATORS	FUNCTION
A1M1	TEST METER	Displays 11 internal operational voltage or current readings.
A1S1	TEST METER SELECTOR	Rotary switch that selects one of 11 readings to display on the test meter. The value below each switch position is the full-scale reading for that position

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

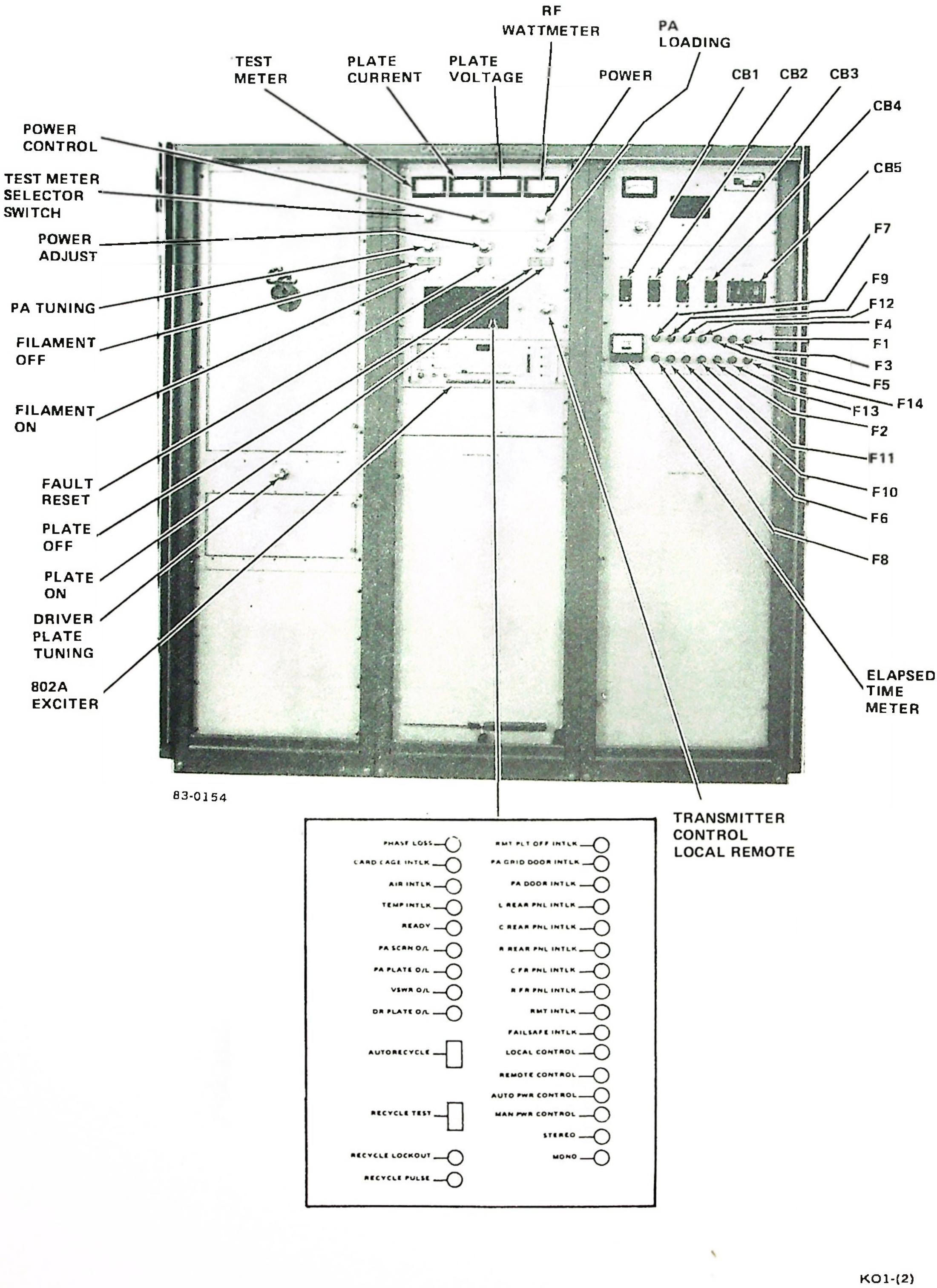


Figure 3-1. FM Transmitter, 816R, Controls & Indicators

Table 3-2. Center Cabinet. (Cont)

REF DESIG	CONTROLS AND INDICATORS	FUNCTION
A1M2	PLATE CURRENT	Displays power amplifier plate current.
A1M3	PLATE VOLTAGE	Displays power amplifier plate voltage.
A1M4	RF WATTMETER	Displays transmitter forward and reflected power.
A1S2	POWER FORWARD/ REFLECTED	2-position switch that selects forward or reflected power for display on the RF WATTMETER
A1S5	POWER CONTROL AUTOMATIC/MANUAL	Spring-loaded momentary switch that selects automatic or manual power control.
A1S6	POWER ADJUST LOWER/RAISE	Spring-loaded momentary switch that lowers or raises power when POWER CONTROL switch S5 is in MANUAL.
A1S3	PA TUNING RAISE/LOWER	Spring-loaded momentary switch that positions tuning capacitor C50.
A1S4	PA LOADING RAISE/LOWER	Spring-loaded momentary switch that positions loading capacitor C51.
A1S7	PLATE OFF	Pushbutton momentary indicator switch that removes all operating voltage from the transmitter.
A1S8	PLATE ON	Pushbutton momentary indicator switch that applies operating voltage to the transmitter.
A1S9	FILAMENT OFF	Pushbutton momentary indicator switch that removes filament voltage from the transmitter.
A1S10	FILAMENT ON	Pushbutton momentary indicator switch that applies filament voltage to the transmitter.
A1S11	FAULT RESET	Pushbutton momentary switch that resets the fault indicators.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

Table 3-2. Center Cabinet. (Cont)

REF DESIG	CONTROLS AND INDICATORS	FUNCTION
A20S10	TRANSMITTER CONTROL LOCAL/REMOTE	2-position switch that selects local or remote operation.
A7CR14	PHASE LOSS	Phase Loss/Phase Sequence/Phase Unbalance Indicator.
A7CR15	CARD CAGE INTLK	CARD CAGE interlock Indicator.
A7CR16	AIR INTLK	PA Cooling Indicator
A7CR17	TEMP INTLK	Exhaust Air Temp Indicator
A7CR18	READY	Filament Time Delay Indicator
A7CR6	PA SCREEN O/L	PA Screen Fault Indicator
A7CR7	PA PLATE O/L	PA Plate Fault Indicator
A7CR8	VSWR O/L	VSWR Fault Indicator
A7CR9	DR PLATE O/L	Driver Plate Fault Indicator
A7S2	AUTO RECYCLE	Automatic Recycle ON/OFF Switch
A7S1	RECYCLE TEST	Automatic Recycle Circuit Test Switch
A7CR3	RECYCLE LOCKOUT	Recycle Circuit Lockout Indicator
A7CR5	RECYCLE PULSE	Recycle Circuit Pulse Indicator
A12CR5	RMT PLT OFF INTLK	Remote Plate Off Relay Indicator
A12CR6	PA GRID DOOR INTLK	PA Grid Door Interlock Indicator
A12CR7	PA DOOR INTLK	PA Door Interlock Indicator
A12CR8	L REAR PNL INTLK	Left Rear Panel Interlock Indicator
A12CR9	C REAR PNL INTLK	Center Rear Panel Interlock Indicator
A12CR10	R REAR PNL INTLK	Right Rear Panel Interlock Indicator
A12CR11	C FR PNL INTLK	Center Front Panel Interlock Indicator

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

Table 3-2. Center Cabinet. (Cont)

REF DESIG	CONTROLS AND INDICATORS	FUNCTION
A12CR12	R FR PNL INTLK	Right Front Panel Interlock Indicator
A12CR13	RMT INTLK	Remote Interlock Indicator
A12CR14	FAILSAFE INTLK	Remote Fail Safe Relay Interlock Indicator
A12CR15	LOCAL CONTROL	A1S10 Local Control Position Indicator
A12CR16	REMOTE CONTROL	A1S10 Remote Control Position Indicator
A12CR17	AUTO PWR CONTROL	A1S5 Automatic Power Control Position Indicator
A12CR18	MAN PWR CONTROL	A1S5 Manual Power Control Position Indicator
A12CR19	STEREO	Stereo Mode Position Indicator
A12CR20	MONO	Mono Mode Position Indicator

Table 3-3. Right Cabinet.

REF DESIG	CONTROLS AND INDICATORS	FUNCTION
A6CB1	28 VDC POWER SUPPLY	1 ampere magnetic circuit breaker that protects the 28-V dc power supply.
A6CB2	BLOWERS	10-ampere magnetic circuit breaker that protects blower and fan.
A6CB3	DRIVER POWER SUPPLY	4.5-ampere magnetic circuit breaker that protects the driver power supply.
A6CB4	PA SCREEN POWER SUPPLY	15-ampere magnetic circuit breaker that protects the pa screen power supply.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

Table 3-3. Right Cabinet. (Cont)

REF DESIG	CONTROLS AND INDICATORS	FUNCTION
A6CB5	PA PLATE POWER SUPPLY	70-ampere magnetic circuit breaker with a series trip feature that allows the circuit breaker to be tripped from a remote location.
A6F7/F9 F12	FAN	2-ampere fuse.
A6F6/F8 F10	CONTROLLER	1-ampere fuse.
A6F4/F5	PA BIAS POWER SUPPLY	0.25-ampere fuse.
A6F1/F3	FILAMENTS	10-ampere fuse.
A6F2/F11	EXCITER	3-ampere fuse.
A6F13/F14	DRIVER FILAMENT	2-ampere fuse.

Table 3-4. Typical Indications, 25-Kilowatt Power Output.

TYPICAL METER READINGS	
Power output	25.0 kilowatts
* PA plate volts	8500 to 8900 volts
* PA plate current	3.6 to 3.75 amperes
* PA screen voltage	640 to 670 volts
* PA grid current	90 to 120 mA
Left dvr. cath. 1	170 to 220 mA
Right dvr. cath. 1	170 to 220 mA

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

Table 3-4. Typical Indications, 25-Kilowatt Power Output. (Cont)

TYPICAL METER READINGS	
* Dvr. screen 1	30 to 40 mA
Dvr. grid 1	0 to 10 mA
Dvr. plate volts	1800 to 2000 volts
Dvr. screen volts	270 to 290 volts
* 802A Output Power	5 to 10 watts
* PA plate efficiency	76 to 78%
Control Voltage	26 to 28 volts

3.4 Shutdown Procedures

3.4.1 Normal Turnoff

a. Press the PLATE OFF pushbutton and allow a few seconds for the voltage to decrease.

b. Press the FILAMENT OFF pushbutton.

c. Set AC LINE circuit breaker A25CB1 OFF.

d. Set 28 VDC POWER SUPPLY circuit breaker CB1 OFF.

e. Open the primary disconnect switch. (Customer supplied wall disconnect switch)

3.4.2 Emergency Turnoff

In the event of an emergency, remove power in any of the following ways: turn AC LINE Circuit Breaker A25CB1 OFF, press the FILAMENT OFF pushbutton, turn 28 VDC POWER SUPPLY circuit breaker CB1 OFF, or open the primary disconnect switch.

3.5 Power Readings

The transmitter control panel RF WATTMETER indicates percent of authorized station forward and reflected power. It does not indicate percent true power. To obtain percent true power using the wattmeter, subtract percent reflected power from percent forward power.

Table 3-5. Nominal Readings, Reduced Power Operation.

POWER OUTPUT	PLATE VOLTAGE		PLATE CURRENT		SCREEN VOLTAGE		SCREEN CURRENT		CONTROL GRID CURRENT		EFFICIENCY (%)	
	Recorded	Nominal	Recorded	Nominal	Recorded	Nominal	Recorded	Nominal	Recorded	Nominal	Recorded	Nominal
24,000		8650		3.6		610		475		100		77
22,000		8400		3.4		590		435		98		76.8
20,000		8150		3.25		575		395		96		76.3
18,000		7900		3.05		555		360		94		75.2
16,000		7650		2.9		540		320		90		73.2
14,000		7450		2.7		520		280		85		70.6
12,000		7200		2.5		500		240		80		69
10,000		6950		2.35		485		205		75		67.8

Note: The above are approximations. The individual transmitters will vary with source voltage and installation.

3.6 Automatic Recycle Resetting

Automatic transmitter shutdown occurs when pa screen, pa plate, driver, or vswr is
* overloaded. An overload indicator A7CR6 through A7CR9 lights on Overload and Recycle board A7. If the overload was of short duration, the automatic recycling circuits restart the transmitter. The indicator light remains on until the trans-
* mitter operator presses the FAULT RESET switch on the main control panel. The Fault Indicator lamp cannot be RESET from Remote Control location. Perform maintenance procedures if the automatic recycling circuits fail to restart the transmitter.

The fault recycling circuits may be disabled for tuning or maintenance by switching the AUTO RECYCLE switch A7S2 to OFF.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

4.1 General

The FM Transmitter, 816R, operates in the 88- to 108-MHz range at a maximum
* rated RF output. A CEMC 802A solid-state fm wideband exciter provides excitation. The transmitter is equipped with monitoring circuits that check and correct changes in power output and overload conditions. A control panel provides complete transmitter metering and tuning controls. Refer to the overall schematic diagrams in Section 7 for detailed circuit information.

4.2 Block Diagram Discussion

Refer to figure 4-1. A 10-dBm input signal (monaural, stereo, or SCA) modulates the
* exciter. The output of the exciter is 0-50 watts, which is applied to the driver stage. The output of the driver is applied to the power amplifier. The power amplifier output is applied via a low-pass filter and directional coupler to a 50-ohm antenna.

A DC sample of the forward power from the directional coupler (A16) is monitored by
* the auto power control circuit. If a change in output power is detected, a signal is sent to the power control unit that increases or decreases the plate and screen power supply input voltage to compensate. A sample of the reflected power is also
* monitored by the power control circuits. If an excessive amount of reflected power is detected, the control circuits remove plate voltage from the power amplifier. The 28-volt power supply provides power for the control circuits.

4.3 RF Circuits

4.3.1 Exciter

* Refer to the 802A instruction manual, principles of operation.

4.3.2 RF Driver

The exciter output is applied to the driver stage that consists of two 4CX250B tetrodes in parallel (A11V1 and A11V2). The stage operates class C with adjustable cathode bias provided by R40 and R44 and grid leak bias by R50. The driver grid swamping resistor, R57, provides wide bandwidth and minimized plate-to-grid feedback.

* The input circuit is a tuned transmission line with resistance loading. Neutralization Capacitor C_N is a short piece of wire with a paddle on the end physically placed in parallel with the anodes of V1 and V2. The location of the paddle provides sufficient capacitance to neutralize the stage. A sample of the screen current flows through a transformer winding connected across pins 9 and 12 inside Hall-effect probe A22Z5 for screen current monitoring. Using the principle of the Hall effect, the stationary magnetic field around the transformer produces a current through the

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

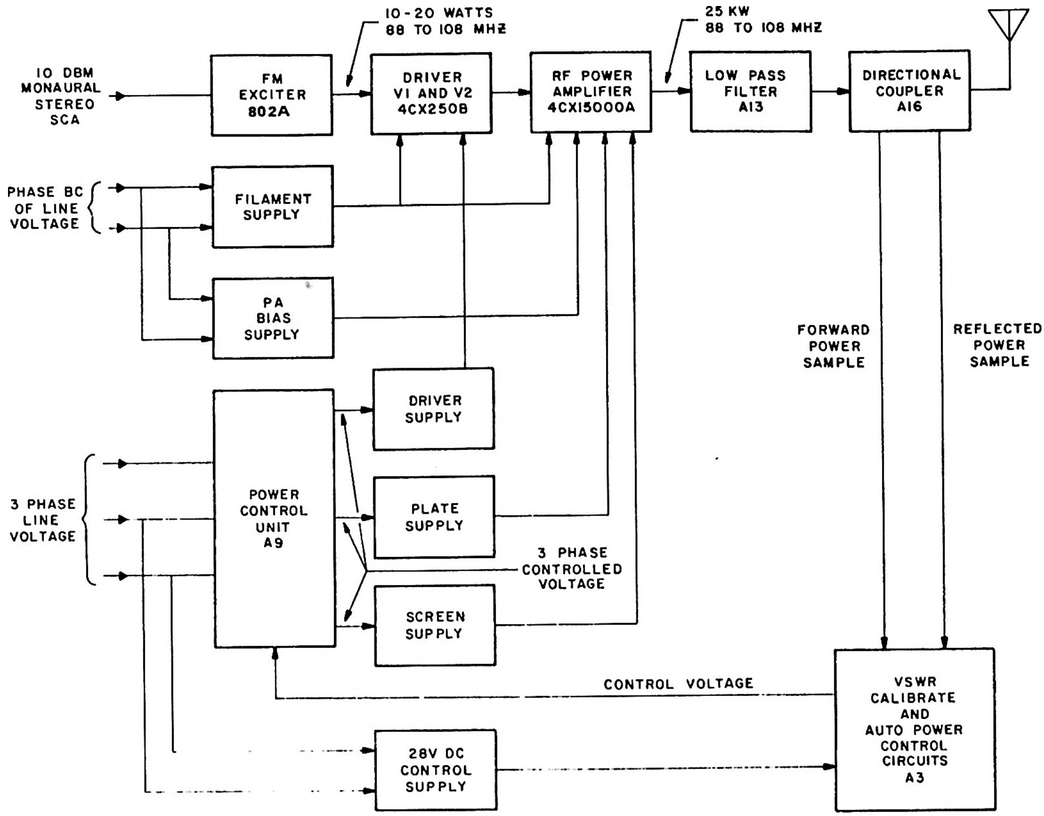


Figure 4-1. FM TRANSMITTER, 816R,
Block Diagram.

* control panel meter connected across pins 3 and 4 of A22Z5. A control current that is adjusted to calibrate the control panel meter flows through pins 1 and 2. A22Z5 output (pins 1 and 2) is connected to Driver Screen meter calibration resistor A22R73.

4.3.3 RF Power Amplifier

* The driver output is coupled through C57A and C57B capacitors to the grid of the power amplifier tube V3. A tuned circuit composed of A21L7 and A18C37 provides impedance matching. Loading of the driver amplifier is accomplished by adjusting A21L7 (tuning) and A21L8 (loading). Inductor A21L8 is used to cancel a portion of the input capacity. Inductor A18L14 and the distributed capacity of A18R75 are strapped to the cavity wall, forming a suppressor that dampens the higher order cavity resonances that can occur near the third harmonic of the output frequency. Cathode tuning (or peaking) capacitor A21C39 improves the bypass action at the operating frequency. Resistors A21R76 and A21R77 broaden the frequency response and minimize synchronous amplitude modulation products. Inductors A11L4 and A21L5 are the driver plate and the pa grid chokes and A18LN1 and A18LN2 provide neutralization.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

The power amplifier is a plate-tuned 4CX15000A that is operated class C. The tube screen is grounded and the cathode is placed -750 volts below ground. A fixed bias from the pa bias power supply is applied to the control grid through A22TB8-19, A22R37, and A22TB8-20. When an input signal is present, grid current flows and develops grid leak bias across A18R35, A18R36 and A18R80. The increased negative potential on the grid causes the diode in the pa bias supply to reverse bias, preventing grid current flow through the supply. Hall-effect probe A22Z4 monitors the amount of grid current for control panel metering.

The power amplifier plate circuit is coarse tuned from 88 to 108 MHz by resonating an adjustable coaxial resonator. (See figure 4-2.) The resonator is the area between the tube shelf and the sliding shorting plane. Two motor-driven capacitors permit more precise tuning (A18C51) and loading (A18C50). RAISE/LOWER switches S3 (PA TUNING) and S4 (PA LOADING) on control panel A1 control capacitor drive motors.

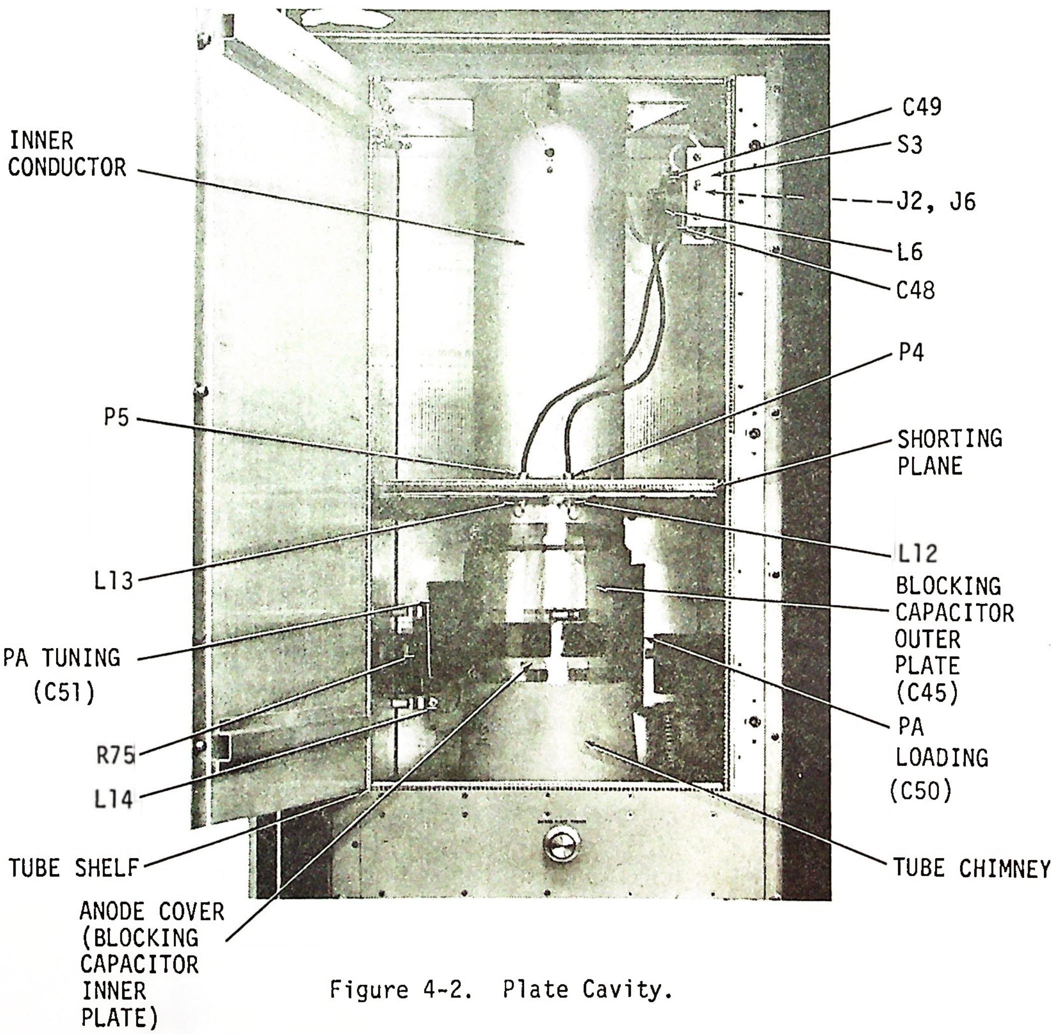


Figure 4-2. Plate Cavity.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

principles of operation

* The DC blocking capacitor A18C45 is located between the top of PA tube and input to air chimney. Figure 4-3 shows the electrical equivalence of the plate tuning circuit.

4.3.4 Low-Pass Filter A18

* Low-Pass filter A13, (See Figure 6-1), consists of two coaxial filters in tandem. The first filter has a cutoff of 130 megahertz, while the second has a cutoff of 300 megahertz.

4.3.5 Directional Coupler A16

* The Directional Coupler (A16) provides a DC voltage to both Forward and Reflected circuit of A3 and the output is then routed and can be displayed on Forward/ Reflected Meter (M4). Also, a sample of Forward power is routed from A3 to A9 gating cards to control SCR's for PA Plate HV supply.

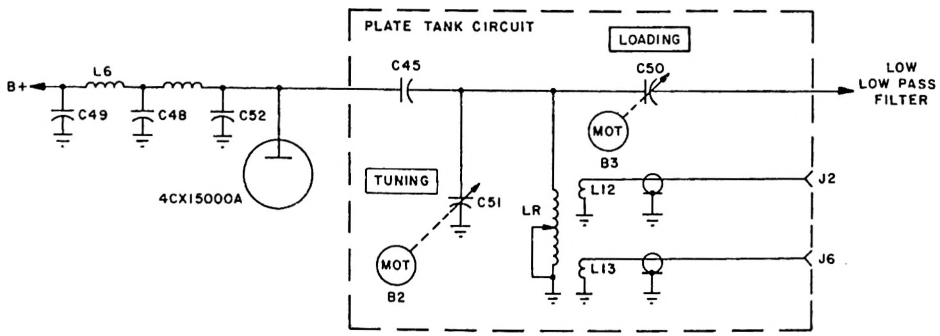
4.4 Power Supplies and Power Control Circuits

4.4.1 General

* There are five separate power supplies in the transmitter. Three of the five, the plate, screen and bias power supplies, provide voltage to the power amplifier. The two remaining, the driver power supply, furnishes voltage to the driver stage and the 28-volt dc power supply, provides power to the control circuits.

4.4.2 28-Volt DC Power Supply PS1

The 28-volt dc supply receives its 3-phase 60-Hz input from the unregulated line voltage. The input is applied through circuit breaker A6CB1 and stepdown transformer T1 to 3-phase bridge rectifier assembly CR1. The 28-volt dc output of the bridge is filtered by the RC circuits and applied to the control circuits.



NOTE:
C45 is the capacitance between tube anode and the cavity center conductor
C50 is the capacitance between movable plate 1 and the tube anode
C51 is the capacitance between movable plate 2 and the tube anode
LR is the lumped constant equivalent of the shortened 1/4 wave resonator

Figure 4-3. FM Transmitter, 816R, Schematic Diagram, Output Network.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

4.4.3 PA Bias Power Supply PS2

The pa bias power supply provides the power amplifier with fixed grid bias that holds the tube near cutoff when no signal is present on the grid. Single-phase primary power is applied through contactor A19K1 and step-up transformer T1 to a bridge rectifier network. An L-section filter is formed by L1 and C2.

The power supply output is applied to the grid of the power amplifier through CR5.
* CR5 blocks grid current flow through the supply when the grid leak bias exceeds the fixed bias. A sample of the bias voltage is applied through R3 to front panel meter A1M1 for monitoring.

4.4.4 PA Plate Power Supply

The pa plate power supply provides plate voltage to the power amplifier. Primary components of the supply are transformer T1, 3- phase bridge rectifier assembly Z1, filter choke L1, and filter capacitor C3. A meter multiplier board, A15, samples plate voltage and allows constant monitoring. Input power to T1 is controlled by scr (silicon-controlled rectifier) power control unit A9. This unit, connected as a closed loop regulator, maintains constant power output to offset conditions of varying input power.

4.4.5 Power Control Unit A9

* Power control unit A9 regulates the 3-phase ac power input to the pa plate, the pa screen, and the driver power supplies through transformers T1, T2, and T3 respectively. Unit A9 consists of two major component assemblies-scr assembly A9Z1 and firing control unit A9AR1. Scr assembly A9Z1 has three scr pairs; one pair in series with each primary winding of the 3-phase power transformers. Each pair is connected within the delta circuit of the transformer primaries. Scr firing control unit A9AR1 consists of three control cards. Each control card controls the firing (turn-on) point of one scr pair.

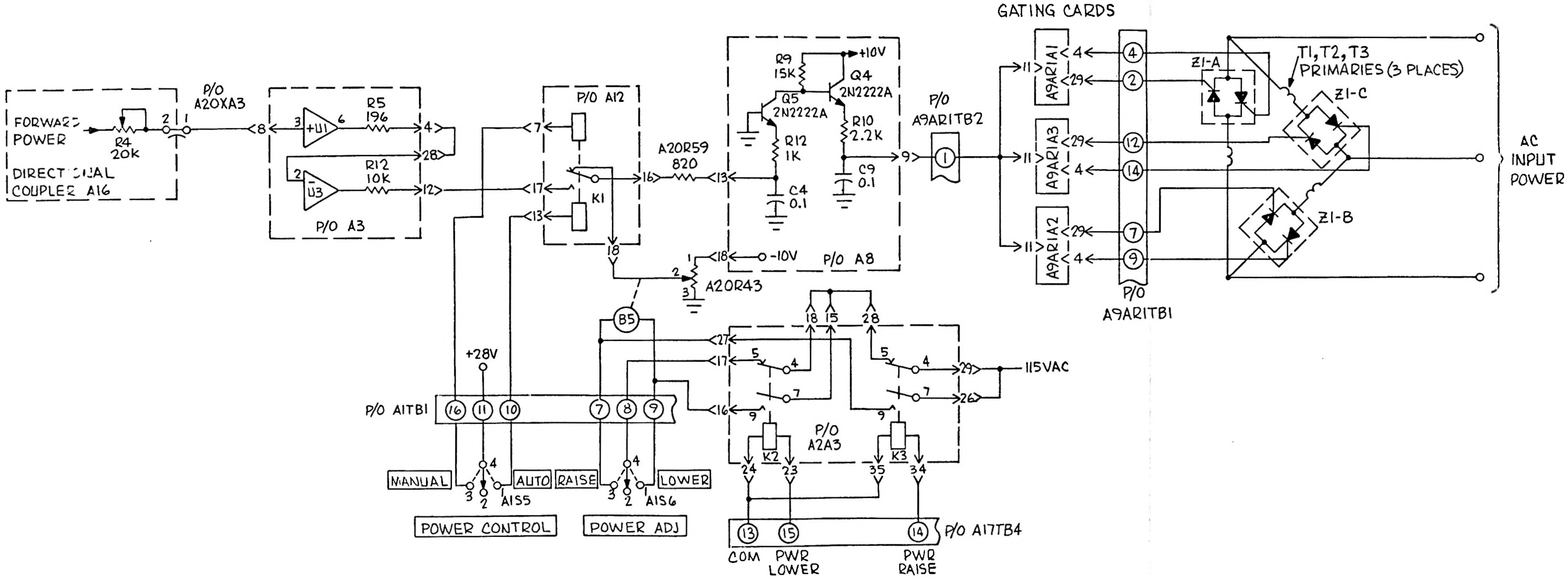
* A common d.c. control signal from power control regulator A8 is fed simultaneously to each control card. This control signal governs the firing of the scr pairs that regulate the input power applied to the power supplies. Relay A9AR1K1 deenergizes on PLATE OFF, disabling the three scr gate driving cards. (See figure 4-4).

4.4.6 Power Control Regulator A8

* Power control regulator A8 provides the necessary control signals to operate power SCR control unit A9. A8 supplies a soft-start pa plate supply turn-on signal, a negative voltage for manual power control, and amplifier-mixer functions for automatic power control.

When the PLATE ON switch is pressed, +28 volts is supplied to XA8-27. The +28 volts
* activates transistor A8Q1 to turn on relay K12. Relay A19K12 supplies 3-phase ac control power to A9AR1. An RC time delay circuit formed by A8R2 and A8C1 maintains K12 closed for a short interval after the PLATE OFF switch is pressed. Transistors A8Q2, Q3, and Q4, also energized by the +28 volts, provide the dc turn-on signal to unit A9AR1. On power control regulator A8, R8, R9, and C2 modify this signal to soft-start the high-voltage pa plate power supply. Zener regulator A8VR2 provides a -10- volt voltage to MANUAL power adjust resistor A20R43.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.



WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

Transistors A8Q5 and A8Q4 amplify the automatic control signal from A3 and apply the signal to A9AR1TB2-1 when the MANUAL/AUTOMATIC switch is in AUTOMATIC. A8C5 and A8R5 phase-compensate the power control servo loop.

4.4.7 PA Screen Power Supply

The 3-phase regulated voltage from the power control unit is applied through transformer T2 to a silicon 3-phase full-wave bridge assembly, Z2, in the pa screen power supply. The output of Z2 is filtered and applied to the cathode circuit of the power amplifier at the secondary center tap of filament transformer A18T5. The pa screen power supply also provides -28 volts, obtained from the junction of resistors A17R4 and A17R18, for manual power control.

4.4.8 Driver Power Supply

The driver power supply provides plate and screen voltages for the driver stage. The 3-phase ac power for the primary of T3 is supplied by power control A9. The output of T3 is applied to a silicon 3-phase full-wave bridge assembly, Z3. The output of the rectifier bridge is filtered and applied to the driver plate circuit. The driver screen voltage, developed at the junction of A17R34 and A17R25 is applied
* through a metering resistor A22R1 to the driver screen circuit. Gaseous protector A17E2B shorts excessive transient voltages to ground. Driver plate and screen metering samples are obtained from A14R32 and A17R3 respectively.

4.4.9 Filament Voltage Regulator A5

* When the Filament Regulator is in automatic mode, the filament voltage regulator detects and compensates for sustained fluctuations in the input ac voltage. The fluctuations are detected by a balanced bridge circuit, which in conjunction with a motor control circuit, adjusts the setting of variable transformer A19A2T1. The output voltage of the variable transformer (A19A2T1) is then applied to the primary of the Driver (A11T6) and PA (A18T5) Filament Transformer.

The variable transformer output is also applied to the primary of detector circuit transformer A20T8. Secondary (1) of this transformer is applied to a resistive bridge circuit consisting of lamps A5DS1, A5DS2, A5R1 and A5R2 and filament voltage
* adjust potentiometer A5R3. While observing PA filament meter, A5R3 can be adjusted for the required filament voltage.

* When the input primary ac voltage increases, the voltage dropped across the bridge circuit increases, which causes more current to flow through the components located in the legs of the bridge circuit. The increased current flow causes the filament resistance of A5DS1 and A5DS2 to increase. The increased resistance of the filaments unbalances the bridge circuit and applies an ac signal, in phase with the ac voltage dropped across the bridge circuit, to the junction of A5C1 and A5R17. From A5C1 and A5R17, the ac signal is coupled to the base of transistor A5Q1. Transistor A5Q1 amplifies and phase shifts the ac signal 180°. From A5Q1, the inverted ac signal is routed through capacitor A5C3 to the gate circuits of controlled rectifiers A5Q2 and A5Q3.

Another sample of the input ac voltage is applied from secondary (2) of A20T8 through diodes A5CR1 and A5CR2 to RAISE relay A5K1 and LOWER relay A5K2, respectively. Be-

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

cause of A5CR1 and A5CR2, only positive half cycles of the ac voltage are applied to A5K1 and A5K2. As the input ac voltage increases, positive half cycles are connected through A5K2 to the cathode of A5Q3. The in-phase ac signal present at the gate of A5Q3 allows A5Q3 to conduct, energizing A5K2. Capacitor A5C6 discharges during negative half cycles keeping A5K2 energized. The ac signal present at the gate of A5Q2 is out of phase with the half cycles connected through A5K1 to the cathode of A5Q2, preventing A5Q2 from conducting. This action prevents A5K1 from energizing.

Operation of the detector circuit under low input ac voltage condtions is similar to the operation during high-voltage conditions, with the following exceptions. The sample ac voltage dropped across the resistive bridge circuit is 180° out of phase with the ac signal at the junction of A5C1 and A5R17. The out-of-phase ac signal prevents A5Q3 from conducting, but allows A5Q2 to conduct. This action energizes A5K1, but not A5K2.

If A5DS1 or A5DS2 burns out, a large ac signal will appear at the base of A5Q1. As a result, the drive motor would run to either end stop, trying to compensate for an erroneous indication of a very high or low ac filament voltage. To prevent this type of malfunction, a protective circuit is connected to the output of A5Q1. When a large ac signal is applied to the base of A5Q1, the same ac signal is applied to the protective circuit which consists of voltage divider A5R17 and A5R16 and controlled rectifier A5Q4. From the junction of A5R17 and A5R16, the ac signal is connected to the gate of A5Q4 causing it to conduct. When A5Q4 conducts, the output of A5Q1 is shunted to ground preventing A5K1 or A5K2 from energizing. This action prevents the drive motor from operating.

The motor control circuits which operate to lower or raise the ac filament voltage are similiar; therefore, only the raise control circuit is discussed in detail. Under low ac filament conditions, raise relay A5K1 energizes, connecting +28 volts dc through contacts 8 and 9 to a time-delay circuit, consisting of resistor A5R19 capacitors A5C8 and A5C9. Relay A5K1 must remain energized for 1.5 seconds before the time-delay circuit allows A5K3 to energize. The time delay assures that only sustained fluctuations of the ac filament voltage will allow the drive motor to operate. After 1.5 seconds, A5K3 energizes, applying 115 vac through contacts 11 and 12 and limit switches A9A2S1 to variac drive motor A19A2B1.

* The variac drive motor operates, driving the rotor on variable transformer A19A2T1 until the input ac voltage is raised to a value to provide filament voltage determined by A5.

4.4.10 Filament Voltage Distribution

The filament voltage distribution is shown in figure 4-5. Filament voltage regulator A5 maintains a constant rms voltage on the filaments as discussed in paragraph 4.4.9.

4.5 Primary Power Distribution Control and Overload Circuits

4.5.1 Primary Power Distribution

The 60-Hz, 3-phase primary power is distributed to the various circuits of the transmitter via circuit breakers and fuses mounted on circuit breaker panel A6 (figure 4-6). *

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

* PA PLATE POWER SUPPLY circuit breaker A6CB5 is connected inside the delta of plate transformer T1. It also serves to interrupt primary power to the PA screen transformer T2 and driver plate transformer T3 through additional associated circuit breakers, A6CB4 (PA SCREEN SUPPLY) and A6CB3 (DRIVER POWER SUPPLY).

AC line voltage metering is provided by AC meter panel A25. In addition to the
* three phase-to-phase voltages, a fourth position of A25S1 is used to monitor PA filament voltage.

BLOWERS circuit breaker, A6CB2, controls application of primary power to cavity blower B1 through filament-on relay A19K2 and FAN fuses A6F7, F9, and F12. Relay
* A19K2 is energized when the filaments switch (S10) is turned on.

Application of primary power to the filament circuits, the exciter, the pa bias power supply, and the pa tuning and loading motors is relay controlled. Filament-on relay A19K1 and blower-on relay A19K2 control application of power to the regulated filament circuit through auto-transformer A19A2T1. Relay A19K1 also controls app-
* lication of power to 802A exciter A4, to pa bias power supply PS2, and to the pa tuning and loading motors (B2 and B3 respectively). Power to the exciter and the motors is through isolation transformer T4. Time-totalizing meter A6M1 is placed across the load side of filament on relay A19K1.

The filament, exciter, and pa bias supply input power circuits are protected by associated fuses.

4.5.2 Transmitter Turn-on

The transmitter is energized by pressing FILAMENT ON switch S10 in the A1 control panel (figure 4-7). Relay A19K2 is energized and power is applied to the blower motors. After sufficient air pressure is created in the power amplifier cabinet, air switch A18S1 is closed and relay A19K1 is energized.

After the 30-second delay, relay A19K4 is energized. The PLATE ON switch is pressed and relay A19K3 is energized and +28 volts is supplied to the base of transistor A8Q3. This turns on control amplifier A9AR1, which applies input voltage to the plate, screen, and driver power supplies.

* The transmitter may also be energized by pressing the PLATE ON switch which latches A19K3 and energizes A19K2 through contacts 8 and 5. By pressing a single switch (PLATE ON) will enable the transmitter to go through the above sequence of Blower Filament, Time Delay and Plate On.

4.5.3 Exciter Power Control Override

* An output override voltage is supplied to the 802A exciter when the plate voltage is turned off. This mutes the output of the exciter while the pa plates are off (figure 4-7). The voltage is applied from the 28-volt power supply through contacts 3 and 9 of relay A19K4 to the 802A exciter power supply regulator.

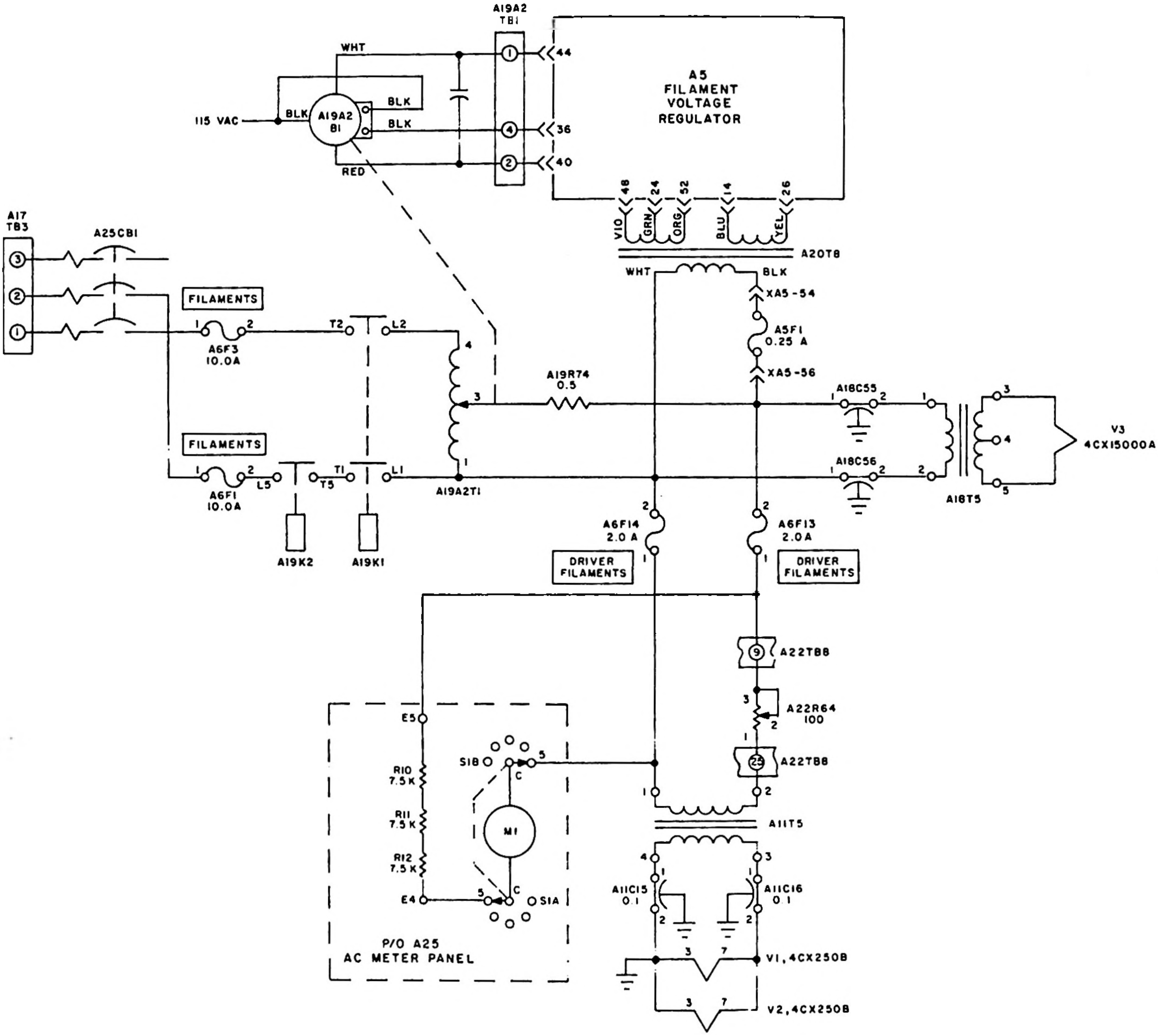


Figure 4-5. Filament Voltage Distribution.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

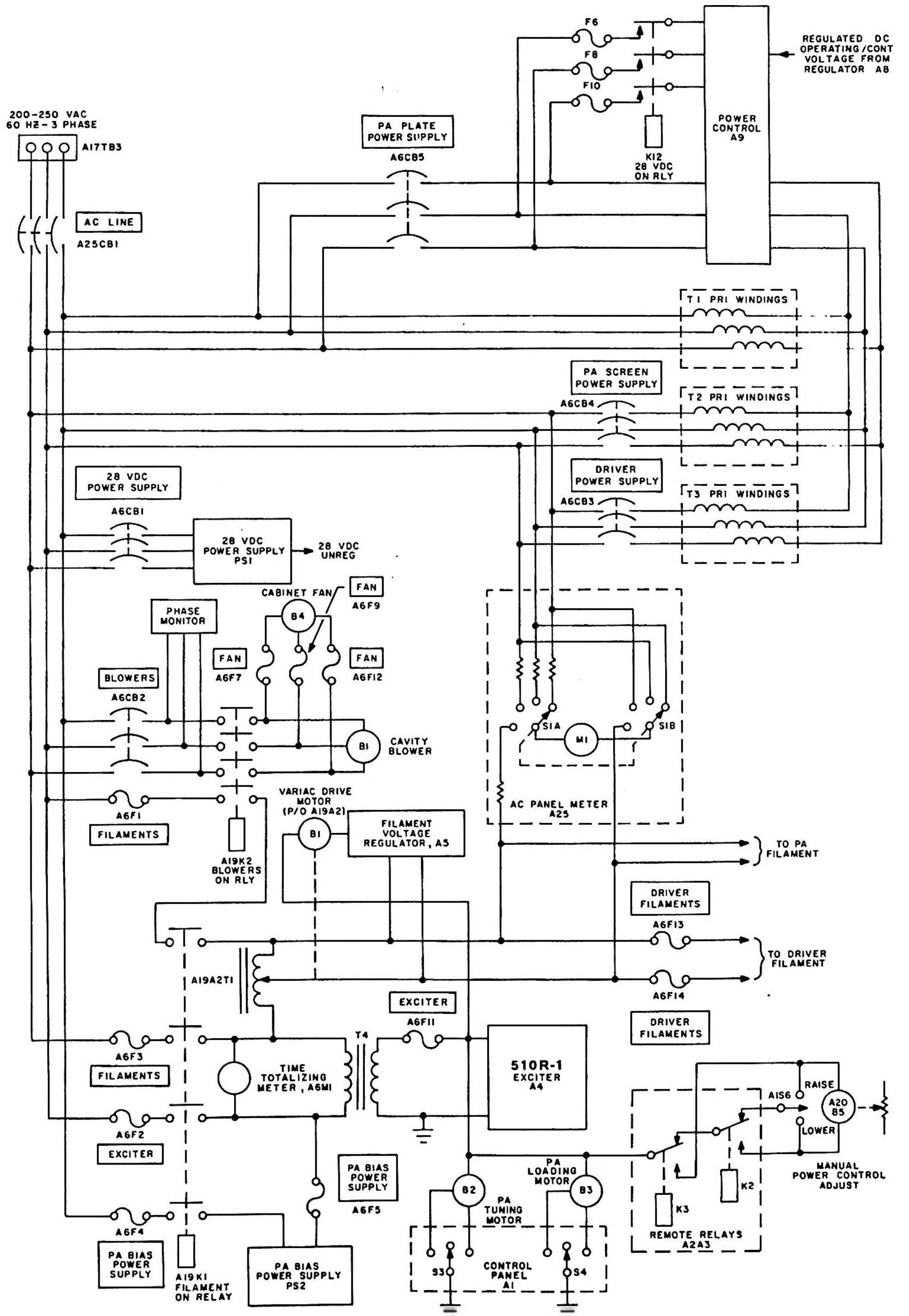


Figure 4-6. Primary Power Distribution.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

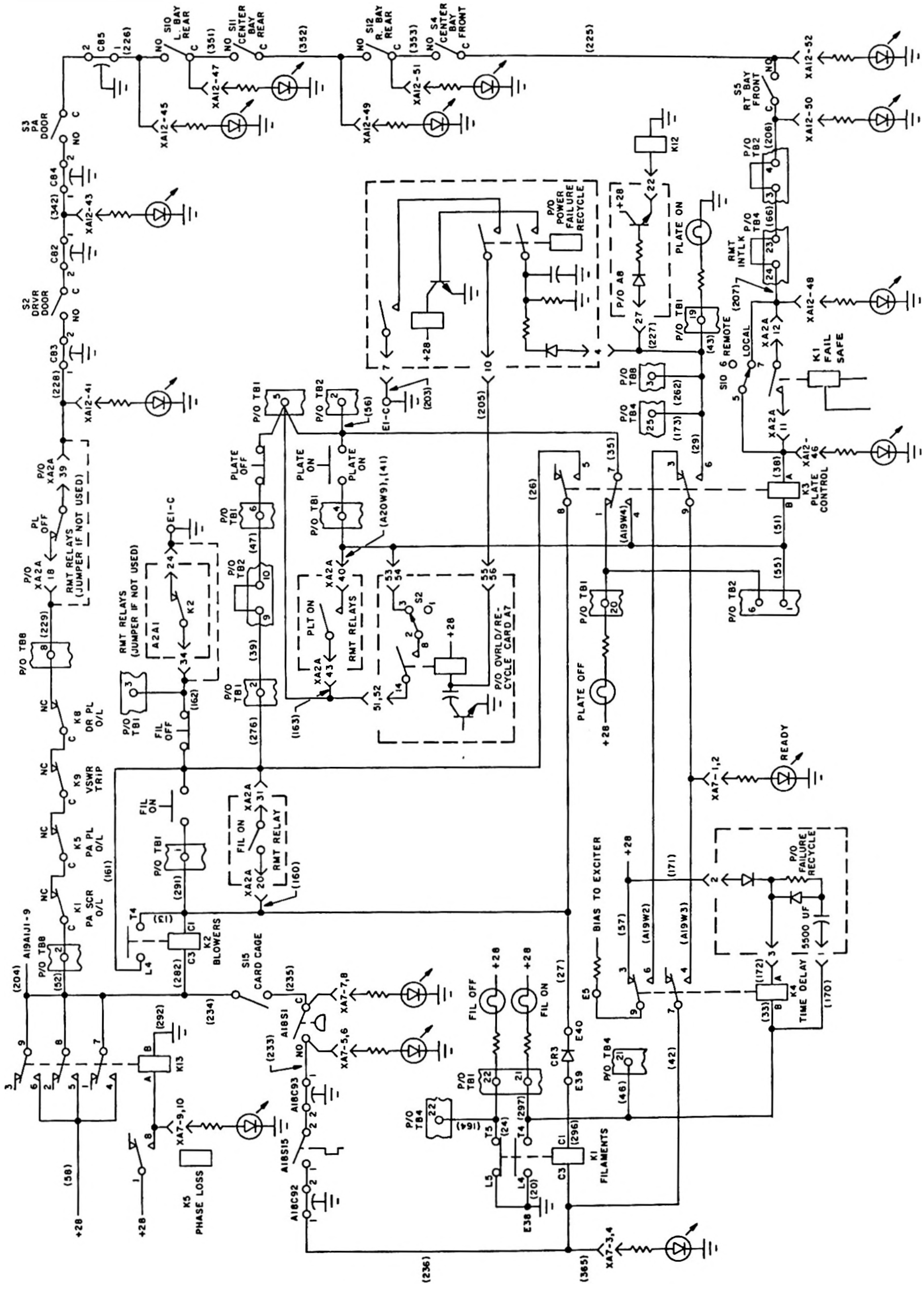


Figure 4-7. Power ON-OFF Control Circuits

4.5.4 Fwd/Refl Calibrate and Auto Power Control Unit A3

The vswr calibrate and auto power control unit, A3, monitors the forward and reflected power received from directional coupler A16. A forward power sample is applied through R1 to pin 3 of operational amplifier U1. The output on pin 6 of U1 is applied to the control panel RF WATTMETER through FWD CAL potentiometer R14 and to A17TB4-34 for remote monitoring.

Operational amplifier U3 is connected as an integrator. Feedback is supplied by the parallel combination of capacitor C1 and resistor R10. During automatic power operation, the output of U3 is connected to power control A9 through relay A12K1 and power control regulator A8. PWR CNTRL ADJ potentiometer R7 in the input of U3 increases or decreases the transmitter output power during automatic power operation by increasing or decreasing the output of U3.

A reflected power sample is applied to pin 3 of U2 through R17. The output on pin 6 of U2 is applied to the control panel RF WATTMETER through REFL CAL potentiometer R24 and to A17TB4-33 for remote monitoring. The output of U2 is also applied to the gate of A7Q8. When excessive reflected power exists and switch A3S1 is closed, U2 produces an output that triggers scr A7Q8. Scr A7Q8 conducts and energizes relay A22K9 which removes power from the transmitter. (See paragraph 4.5.5)

FWD OFFSET potentiometer R25 and REFL OFFSET potentiometer R26 are adjusted for zero output at TP1 and TP2 respectively when no input exists at pin 3 of the related amplifier.

REFL ADJ potentiometer R27 and TEST switch S2 are used to test the VSWR protect circuit operation during maintenance operation. By pressing the push TEST switch S2, a simulated reflected power sample is applied to pin 3 of U2. With A1M4
* calibrated for 10% of forward power output full scale in the REFLECTED position, R27 is adjusted to the desired reflected power trip level. Then VSWR PROT CAL potentiometer R20 is adjusted to trip at this level.

4.5.5 Overload Protection

Relays A22K6, A22K7, A22K8, and A22K9 are adjusted to energize and remove power from the transmitter when an overload occurs in the plate, screen, or driver supply or when the vswr exceeds a preset level. Screen current through A14R15 produces a voltage that is applied to relay A22K7 through A22R65. Plate current through A14R16 produces a voltage that is applied to relay A22K6 through A22R66. Driver current through A17R33 produces a voltage that is applied to relay A22K8 through A22R60. When scr A7Q8 is gated on, a ground is applied and A22K9 is energized. Each relay is adjusted to trip at a factory preset current level. The relay contacts are in series with plate control relay A19K3. If an overload occurs, the corresponding relay trips and de-energizes A19K3, removing plate power from the transmitter.

4.5.6 Overload and Recycle Board A7

Overload and recycle board A7 contains circuits that provide overload indication and memory, automatic power on recycling and filament control circuit interlock status.

When an overload occurs in the pa plate pa screen, vswr, or driver plate, a 28-volt pulse is supplied to the appropriate scr (Q4 through Q7). The scr latches and lights its associated LED indicator (CR6 through CR9) to indicate which overload has occurred. All indicators that have been lighted by an overload function remain lighted until FAULT RESET switch A1S11 on the main control panel is pressed. Plate voltage is removed by overload relays A22K6, A22K7, A22K8 or A22K9. The 28-volt pulse that triggers the scr is simultaneously routed to the recycle circuit via diode CR10, CR11, CR12 or CR13 to be used to automatically restart the transmitter.

The automatic recycle circuit provides a timed, automatic restart pulse up to four times in a 30-second period. The supplied card is connected so only two restart pulses will occur in a 30-second period; but may be reconnected to allow four restart pulses in a 30-second period. Conversion from the 2-pulse to the 4-pulse production may be accomplished by removing the jumper between terminals A and B on the card and replacing it between A and C.

The auto recycle begins when the 28-volt pulse is applied to the base of transistor Q1 causing it to conduct. The output of Q1 is fed to timers U1 and U4. Timer U1 provides a 0.5-second delay, then triggers timer U2 which generates a 0.5-second output pulse. This pulse is fed through gate U3A to inverter Q3 which causes Q9 to conduct and charge capacitor C16. The charging current of C16 momentarily energizes K1 which closes the PLATE ON circuit through S2. The charging current of C16 also flows through RECYCLE PULSE indicator CR5 giving an indication of the recycle circuit operation.

Gate U3D conducts the output pulse from timer U1 to counter U5. Counter U5 counts the number of recycle pulses and provides a logic 1 output at terminal C when four pulses have been received. Depending on which terminal has been strapped to terminal A, two or four recycle attempts in a 30-second period will close gates U3A, U3B, U3C, and U3D preventing any further attempts by the card to restart the transmitter. RECYCLE LOCKOUT indicator CR3 will light to indicate this condition. When the 30-second period of time U4 has elapsed, a pulse is generated, inverted by Q2, and applied to U5 to reset it to zero. This clears the memory and allows another sequence to begin. If the maximum count of two or four pulses has not been received in the 30-second period, the timer will also reset the counter automatically.

AUTORECYCLE switch S2 may be used to disable the auto recycle card when desired. This is usually done during tune-up or maintenance procedures. RECYCLE TEST switch S1 may be used to test the automatic recycle circuit during maintenance procedures by simulating an overload pulse at the input to the recycle circuit.

Filament control circuit interlock status indicators provide a visual indication of the condition of the filament protection circuit. The PHASE LOSS indicator C14 is lighted when phase monitor A19K5 provides a 28-volt signal indicating all three primary power phases are present, balanced, not too low and of the proper

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

sequence. CARD CAGE INTLK indicator CR15 is lighted when the card cage cover is in place. AIR INTLK indicator CR16 is lighted when sufficient cooling air to the pa tube is flowing. TEMP INTLK indicator CR17 is lighted when the pa tube exhaust air temperature is below 240°F ±10°F. The switch will reclose at 200°F temperature operating range of the PA tube. The READY indicator is lighted when the 30-second filament warm-up time has expired and the transmitter is ready for the application of plate voltage. These indicators are in series and in sequence from top to bottom as they are connected in the circuit. Therefore, an interlock must be satisfied before its status indicator will light or any indicator that follows it will light.

4.5.7 Power Failure Recycle Board A19A1

In the event of momentary loss of primary power, the power failure recycle circuit will restore the transmitter to operational status. Capacitor C3 maintains current flow through time delay relay A19K4 keeping the time delay circuit active for short term power outages and a separate circuit provides a momentary ground at pin 10 when power is restored. The momentary ground is applied to A7C16 and the charging current of A7C16 pulls relay A7K4 in and initiates the power on command.

4.5.8 Latching Relay and Status Indicator Board A12

The latching relays permit local or remote selection of manual or automatic power control and local or remote selection of stereo or monaural excitation.

The latching relays are connected to the remote control panel through A17TB4 (figure 4-8). A +28-volt signal applied by local control switch A1S5 or through remote control interface terminal board A17TB4 will latch relay K1 in one of two stable states. AUTO PWR CONTROL indicator CR17 indicates automatic power control is selected and MAN PWR CONTROL indicator CR18 indicates manual power control is selected. A +28-volt signal applied through remote control interface terminal board A17TB4 will latch relay K2 in one of two stable states. STEREO indicator CR19 indicates the stereo mode and MONO indicator CR20 indicates selection of the mono mode.

Visual indication of TRANSMITTER CONTROL REMOTE/LOCAL switch A20S10 is given by status indicators CR15 and CR16. CR15 lights when local control is selected and CR16 lights when remote control is selected.

Plate control circuit interlock status indicators are provided on the A12 board. RMT PLT OFF INTLK indicator CR5 is lighted when optional remote relay A2A1K4 is de-energized. (If optional remote relays are not used, this relay will be jumpered and CR5 will always be lighted.) PA GRID DOOR INTLK indicator CR6 is lighted when the pa grid compartment door is closed. PA DOOR INTLK indicator CR7 is lighted when the pa plate compartment door is closed. L REAR PNL INTLK indicator CR8, C REAR PNL INTLK indicator CR9, R REAR PNL INTLK indicator CR10, C FR PNL INTLK indicator CR11 and R FR PNL INTLK indicator CR12 are panel interlock status indicators that are lighted when the respective panels are in place. Panel designations refer to the three bays of the transmitter cabinet (left, center and right) as viewed from the front of the transmitter. RMT INTLK indicator CR13 is lighted when continuity exists between remote control interface terminal board terminals 23 and 24.

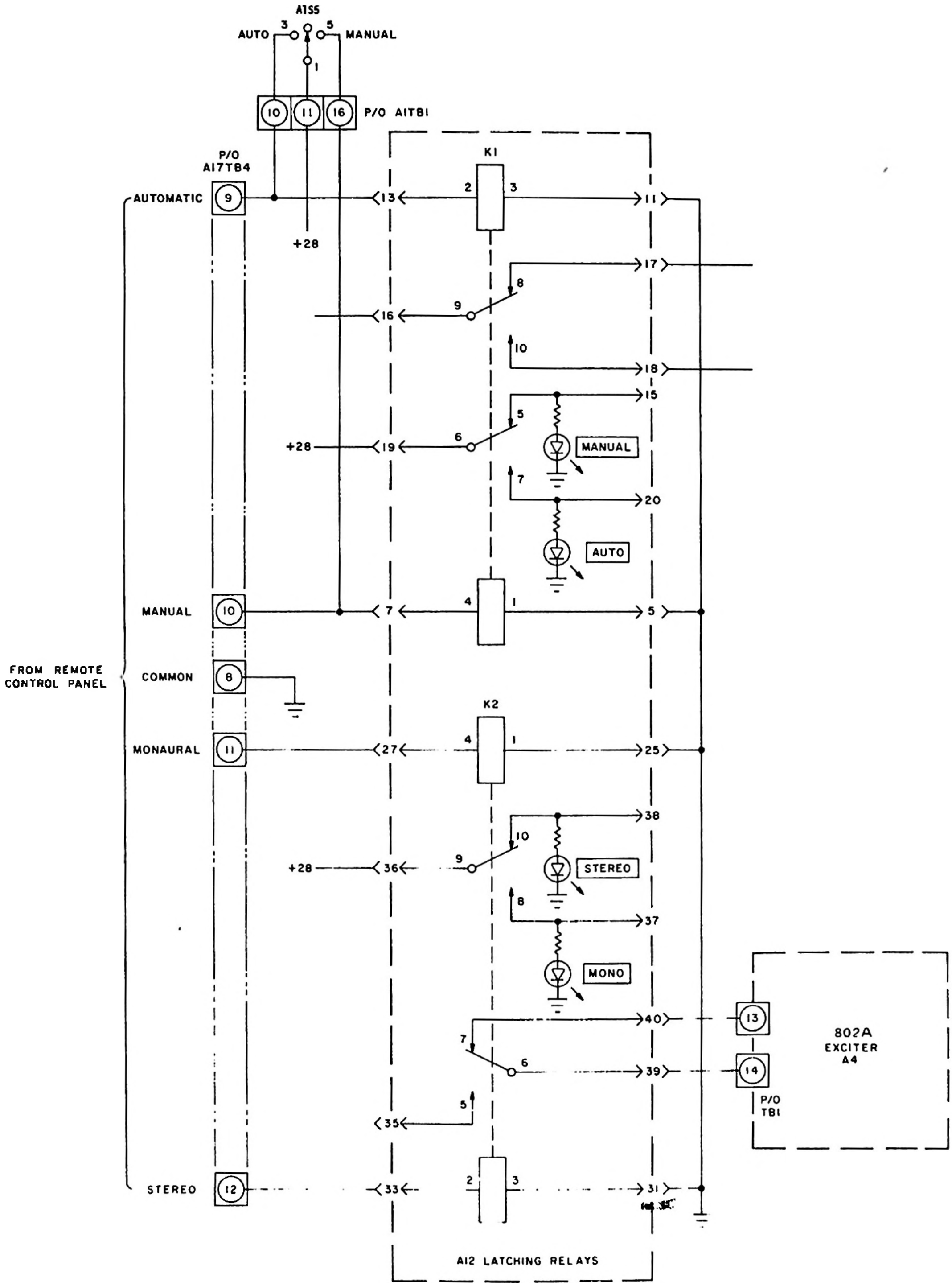


Figure 4-8. Latching Relays A12, Simplified.

FAILSAFE INTLK indicator CR14 is lighted when optional remote relay A2A1K1 is energized. (If optional remote relays are not used, LOCAL/REMOTE switch A20S10 will bypass this interlock in the LOCAL position.) Indicators CR5 through CR14 are in series and in sequence from top to bottom as they are connected in the circuit. Therefore, an interlock must be satisfied before its status indicator will light or any that follow it will light.

4.5.9 Power Control Relays A2A3

Unit A2A3 provides remote manual power lower and raise control (figure 4-9). When power is decreased at the remote control panel, relay A2A3K2 is energized and closed contacts 7 and 9 provide 115 VAC to motor A20B5 which adjusts the resistance of A20R43 to decrease the transmitter power output. When the power is increased at the remote control panel, relay A2A3K3 is energized and closed contacts 7 and 9 provide 115 VAC to motor A20B5 which adjusts the resistance of A20R43 to increase the transmitter power output.

4.5.10 Remote Relays A2A1

Remote relays unit A2A1 parallels the front panel control operations. All relays and switches are momentary in operation. Failsafe relay A2K1 is energized only when +28-volts is present in the control circuit. If +28-volts is lost, the relay deenergizes and removes power from the transmitter.

4.5.11 Remote connections

Typical remote interconnections to remote control terminal board TB4 are given in figure 4-10.

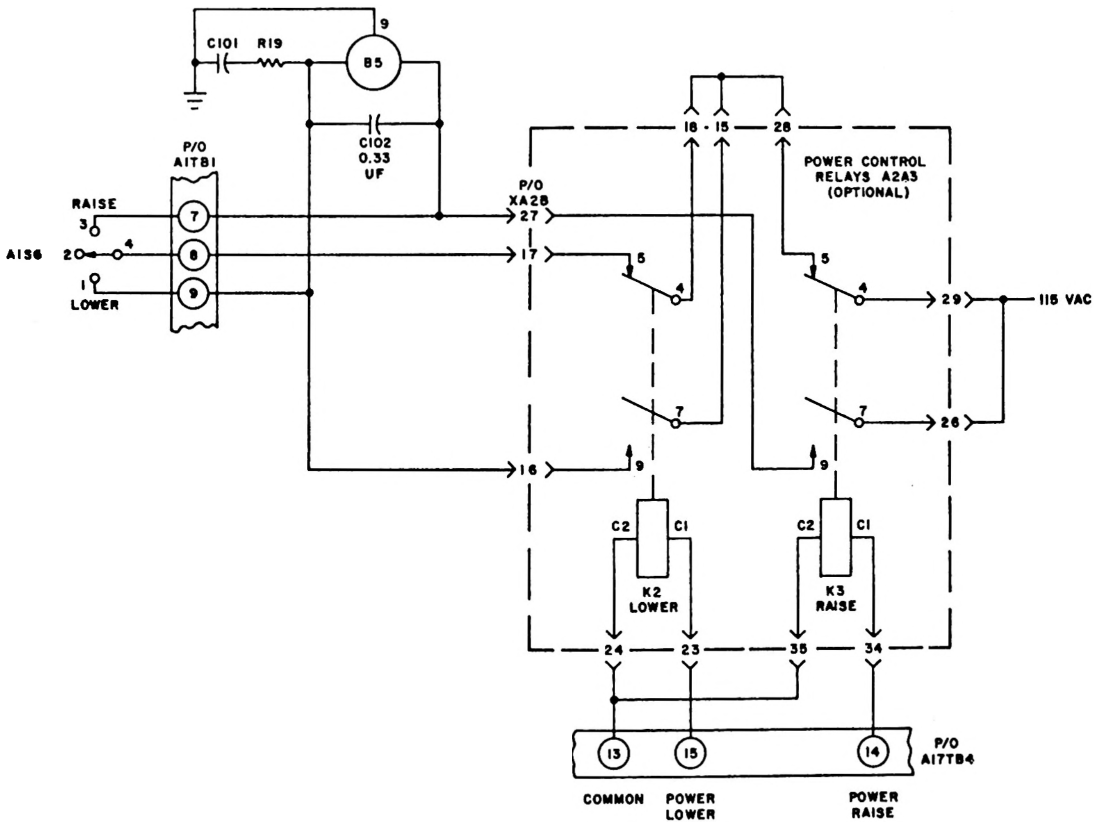
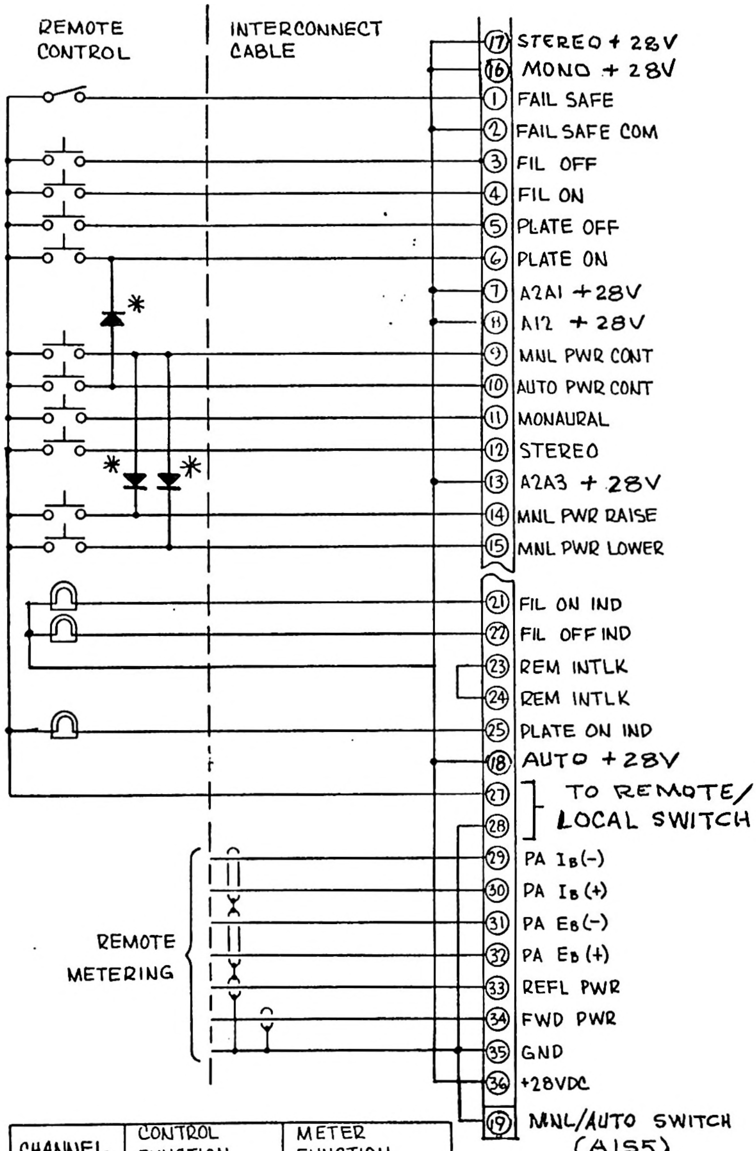


Figure 4-9. Power Control Relays A2A3 Simplified Schematic.



CHANNEL	CONTROL FUNCTION	METER FUNCTION
1	FIL OFF/ON	————
2	PLATE OFF/ON	PLATE VOLTS
3	MANUAL/AUTO	PLATE CURRENT
4	PWR RAISE/LOWER	FWD PWR
5	MONO/STEREO	REFL PWR

*NOTE: As shown, the steering diodes (not supplied) ensure that the transmitter is placed in the AUTOMATIC power control mode when the PLATE ON control is energized and also that the transmitter is placed in MANUAL power control when either the MANUAL POWER RAISE or MANUAL POWER LOWER control is energized.

Figure 4-10. Typical Remote Interconnections to Remote Terminal Board A17TB4

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

5.1 General

The transmitter is carefully inspected and adjusted at the factory to reduce maintenance to a minimum. To ensure peak performance, adhere to a regular schedule of periodic checks and maintenance procedures. Refer to the parts list, section 6, for component location in the transmitter.

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. DEATH ON CONTACT MAY OCCUR 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. ALWAYS SHORT ALL HIGH-VOLTAGE TERMINALS TO GROUND WITH THE GROUNDING STICK PROVIDED.

5.2 Cleaning

Clean the transmitter when dust accumulation occurs anywhere inside the equipment. A solvent composed of 25 percent methylene chloride, 5 percent perchloroethylene, and 70 percent dry cleaning fluid may be used as a cleaning material.

5.2.1 General Cleaning Procedures

a. Remove dust from chassis, panels, and components with a soft-bristled brush.

b. Remove foreign matter from flat surfaces and accessible areas with a lintless cloth moistened with solvent. Dry with a clean, dry, lintless cloth.

c. Wash switch and relay contacts with relay contact cleaner and less accessible areas with solvent lightly applied with a small soft-bristled brush.

5.2.2 Air Filter

The air filter, on the 816R-3 transmitter, should be cleaned whenever a perceptible quantity of dust and dirt accumulates on the filter element. Remove and clean the filter as follows:

a. Remove the cross-wire brace that holds the filter in place.

b. Remove the filter.

c. Use a vacuum cleaner to remove heavy dust accumulation from the filter.

d. Blow a stream of air through the filter in a direction opposite to normal airflow.

e. Wash the filter in a solution of hot water and detergent.

f. Replace the filter when dry.

5.2.3 Tube Cleaning

The power amplifier and driver tubes should be cleaned when a visable quantity of dust accumulates on the cooling fins of the tubes. Carefully remove the tubes from their sockets and clean each with a dry, oil-free jet of air.

5.3 Inspection

Inspect the transmitter at least once a week. Check all metal parts for corrosion and general deterioration. Examine wiring and components for signs of overheating. Ensure that all controls are operating smoothly. Inspect all connections and tighten any nuts, screws, or bolts found loose. Examine the blower and cabinet fans for normal operation.

5.4 Lubrication

The tuning and loading motor and the manual power increase/decrease motor are sealed and do not require lubrication. The cabinet inlet fan motor (B4) and the pa cavity blower motor (B1) should be lubricated with SAE 10 oil as required. *

5.5 Troubleshooting

If the transmitter fails to operate properly, check each circuit in the order that it is made operative. Use the simplified schematics in section 4 and the overall schematic in section 7 when needed. Normal control panel meter readings are provided in table 3-4 and an efficiency vs frequency graph is provided in figure 5-4.

5.5.1 Access Panel Interlock Switch

The access panel interlock switches must be blocked open to perform certain adjustment procedures. To block the panel switch open, push in on the plunger and insert two insulated blocks between the swith contactors. Remove the insulated blocks before replacing the panel.

5.5.2 Test Equipment

Table 5-1 lists the test equipment necessary to maintain the transmitter.

5.6 Adjustments

All transmitters are factory adjusted and pretuned to specific customer requirements. No adjustments are required by the customer unless a broken part is replaced, a specific assembly does not display meter readings within allowable tolerances, or the transmitter is operated at a frequency or power output different from the frequency or power output specified in the production test data supplied with the transmitter.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

Table 5-1. Required Test Equipment.

NAME	DESCRIPTION	MANUFACTURER AND MODEL
Volt-ohm-milliammeter	Test Meter	Triplett 630-N
Ac Voltmeter	0 to 10 volts, 1% tol (true Rms)	Weston 433
Power supply	0 to 28 volts dc, 5 amperes	
Rf wattmeter	2.5- and 25-kW elements, 50 to 125 MHz	Bird 460
Thruline wattmeter	25 watts	Bird 43
Dc Voltmeter	0 to 10 kV	
Dc ammeter	0 to 5 amperes	

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. DEATH ON CONTACT MAY OCCUR IF YOU ARE NOT EXTREMELY CAREFUL WHEN YOU PERFORM THE FOLLOWING PROCEDURES.

NOTE

The 28-volt power supply is on when both the filament and plate voltages are off.

Unless otherwise indicated, the POWER CONTROL switch is set to MANUAL, the POWER switch is set to FORWARD, the AUTO RECYCLE switch is set to OFF, and all circuit breakers are set to ON during adjustment procedures.

5.6.1 Switch Adjustments

5.6.1.1 Air Interlock Switch S1

a. Press the PLATE OFF and FILAMENT ON switches on control panel A1.

b. Remove the rear panel behind the plate cavity.

c. Adjust the tension bolt on switch S1 so that the green filament light goes out when the pa grid compartment door is opened approximately 1 inch.

5.6.1.2 Tuning Motor Limit Switches S11, S12, S13, and S14

a. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

b. Remove the rear panel behind the plate cavity, or the side panel next to the cavity.

c. Loosen the mounting screws on the limit switch.

d. Position the limit switches so that the peg mounted to the rack gear causes the switch to trip before the peg runs into either end-stop. The tuning and loading paddles must never be closer than 5/8 inch from the blocking capacitor.

5.6.2 Filament Voltage Adjustment

a. Press the PLATE OFF and FILAMENT OFF switches on the control panel A1.

b. Open the pa grid compartment and connect a 0- to 10-volt true rms ac 1 percent meter to the pa filament rings on the tube socket.

c. Run the meter leads out the corner of the compartment and close the pa compartment door.

d. Remove the cover from the control circuits and pull the plunger on the card cage interlock all the way out.

* e. Loosen motor coupling set screws on variable transformer end of coupling.

* f. With A5S1 in MANUAL position, run variable transformer drive motor until limit switch actuator arm is against the Upper (CW) limit switch.

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. THE SHAFT OF VARIABLE TRANSFORMER A19T7 HAS HAZARDOUS VOLTAGE TO GROUND WHEN FILAMENT CONTACTOR IS ENERGIZED. DEATH ON CONTACT MAY OCCUR IF YOU ARE NOT EXTREMELY CAREFUL WHEN YOU PERFORM THE FOLLOWING PROCEDURES.

* g. Press FILAMENT ON switch on control panel A1.

* h. Adjust variable transformer A19T7 with an insulated rod for an indication of 6.4 volts ac. Note the filament meter reading - if filament meter does not agree with calibration meter, then adjust A20A1R1 until it does.

* i. Press FILAMENT OFF switch on control panel A1. Turn OFF Main circuit Breaker (A25CB1).

j. Tighten set screws on variable transformer end of motor coupling.

* k. Turn Main Breaker (A25CB1) back on. Press FILAMENT ON switch on control panel A1.

l. Place A5S1 in AUTOMATIC position.

m. Adjust A5R3 for an indication of 6.0 volts ac.

5.6.3 Driver Filament Voltage Adjustment

NOTE

This procedure should be performed only after procedure in 5.6.2 has been completed.

a. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

b. Remove the front panel beneath the grid compartment door.

c. Connect an ac voltmeter across terminals 3 and 4 of driver filament transformer A11T6 and adjust DVR FIL VOLTS ADJUST control A11R64 to produce an indication of 5.8 ±0.1 volts on the ac voltmeter when PA Filament is at 6 volts AC.

5.6.4 DC Overload Adjustment

a. Press the PLATE OFF and FILAMENT OFF switches on control panel A1. Turn DRIVER POWER SUPPLY, PA SCREEN POWER SUPPLY and PA PLATE POWER SUPPLY circuit breakers OFF.

b. Remove the front panel beneath the pa grid compartment door.

DRIVER OVERLOAD ADJUSTMENT

c. Connect a milliammeter from the positive terminal of a 28-volt dc power supply to TB8-6 on the transmitter.

d. Connect the negative terminal of the dc power supply to the transmitter chassis.

e. Raise the power supply current to 600mA and note to see if overload occurs.

f. If overload does not trip then adjust DVR OVLD ADJ A22R60 to trip relay A22K8 at this current. (The DR PLATE O/L fault indicator on the overload/recycle board lights when the relay trips.)

g. Disconnect the milliammeter and remove the jumper from the dc power supply to the chassis.

PA PLATE OVERLOAD ADJUSTMENT

h. Connect an ammeter from the positive terminal of a 28-volt dc power supply to A14R15-1.

i. Connect the negative terminal of the dc power supply to A14R16-1.

j. Raise the dc power supply current to 4.5 amperes.

k. If overload does not occur, then adjust PA PLATE OVLD ADJ A22R66 to trip relay A22K6 at this current. (The PA PLATE O/L fault indicator on the overload/recycle board lights when the relay trips.)

maintenance

l. Disconnect the ammeter and remove the jumper from the dc power supply to A14R16-1.

PA SCREEN OVERLOAD ADJUSTMENT

m. Connect a milliammeter from the positive terminal of a 28-volt power supply to TB8-5.

n. Connect the negative terminal of the dc power supply to TB8-4.

o. Raise the power supply current to 900mA.

p. If overload does not occur, then adjust PA SCREEN OVLD ADJ A22R65 to trip relay A22K7 at this current. (The PA SCRN O/L fault indicator on A7 lights when the relay trips.)

q. Disconnect the milliameter and remove the jumper from the dc power supply to TB8-4.

r. Press the FAULT RESET switch on control panel A1.

5.6.5 PA Grid Current and Driver Screen Current Meter Calibration

a. Press PLATE OFF and FILAMENT OFF switches on control panel A1. Turn DRIVER POWER SUPPLY, PA SCREEN POWER SUPPLY and PA PLATE POWER SUPPLY circuit breakers OFF.

b. Remove the front panel beneath the pa grid compartment door.

c. Connect the negative terminal of a 28-volt dc power supply to Z4-9(E78) and the positive terminal to Z4-12(E77).

d. Adjust the dc power supply current to 400 mA.

e. Set the TEST METER selector switch to PA GRID 400 MA.

f. Adjust PA GRID MTRG CAL control A22R72 for a 400 mA reading on the test meter.

g. Remove the dc power supply test leads.

h. Attach the positive terminal of the dc power supply to E76 and the negative terminal to E75 and adjust the DC Power Supply current to 80 milli-amps. *

i. Set the TEST METER selector switch to DVR SCREEN 80 MA.

j. Adjust the DVR SCREEN MTRG CAL control A22R73 for an 80-mA driver screen current reading on the TEST METER.

k. Remove the dc power supply test leads.

5.6.6 High-Voltage Power Supply Adjustments (Static Check - No Drive)

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. DEATH ON CONTACT MAY OCCUR IF YOU ARE NOT EXTREMELY CAREFUL WHEN YOU PERFORM THE FOLLOWING PROCEDURES.

a. Remove the lower front panel below the exciter and block open the interlock switch.

b. Set the exciter POWER switch to OFF.

c. Press the FILAMENT ON and PLATE ON switches on control panel A1.

d. Raise or lower the POWER ADJUST control until approximately 8000 volts is indicated on the PLATE VOLTAGE meter.

e. Set TEST METER select switch to PA SCREEN 800 V. Observe that approximately 750 volts is indicated on the TEST METER.

f. Set TEST METER select switch to DVR SCREEN 400 V. Observe that 280 ± 10 volts is indicated on the TEST METER.

* g. Set TEST METER select switch to DVR PLATE 4000 V. Observe that 1800 to 2000 volts is indicated on the TEST METER.

* h. Set the TEST METER selector switch to the LEFT DVR K 400 MA position.

i. Adjust the LEFT BIAS control on the driver box A11 until the TEST METER indicates 125 mA.

j. Set the TEST METER selector switch to the RIGHT DVR K 400 MA position.

k. Adjust the RIGHT BIAS control on driver box A11 until the TEST METER indicates 125 mA.

NOTE

The two bias controls interact and should be adjusted several times to acquire a constant 125 mA in both tubes.

l. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

m. Replace all panels and close all compartment doors.

5.6.7 RF Tuning Procedure

NOTE

Major rf tuning is required only when components in the rf circuit are replaced or when the operating frequency is changed. Refer to the initial turn-on procedures (paragraph 2.5) for minor tuning instructions.

The following paragraphs provide procedures for major rf tuning of the transmitter. If the operating frequency is the same as the frequency specified in the production test data supplied with the transmitter, perform the procedures in paragraphs 5.6.7.3 through 5.6.7.6. If the operating frequency is different from the frequency specified in the production test data supplied with the transmitter, perform the procedures in paragraphs 5.6.7.1 through 5.6.7.6.

5.6.7.1 Shorting Plane, Driver Loading Slider, Driver Tuning Slider, Driver Grid Slider, and PA Neutralization Preliminary Adjustments

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

NOTE

These adjustments are not necessary if the related components have not been replaced and the operating frequency is the same as the frequency specified in the production test data supplied with the transmitter.

a. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

b. Open the plate cavity and grid compartment doors.

c. Adjust the plate cavity shorting plane (figure 4-2) to the desired frequency in accordance with the graph in figure 5-1.

d. Adjust driver loading slider A21L8, driver tuning slider A21L7, and driver grid slider A11L9 to the desired frequency in accordance with the graph in figure 5-2.

e. Adjust the pa neutralization bar to the desired frequency in accordance with the graph in figure 5-3.

f. Remove the panel located beneath the exciter.

WARNING

* HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. DEATH ON CONTACT MAY OCCUR IF YOU ARE NOT EXTREMELY CAREFUL WHEN YOU PERFORM THE FOLLOWING PROCEDURES.

g. Discharge all large capacitors.

h. Remove the driver box access panel.

i. Adjust driver grid slider A11L9 to the desired frequency in accordance with the graph in figure 5-2.

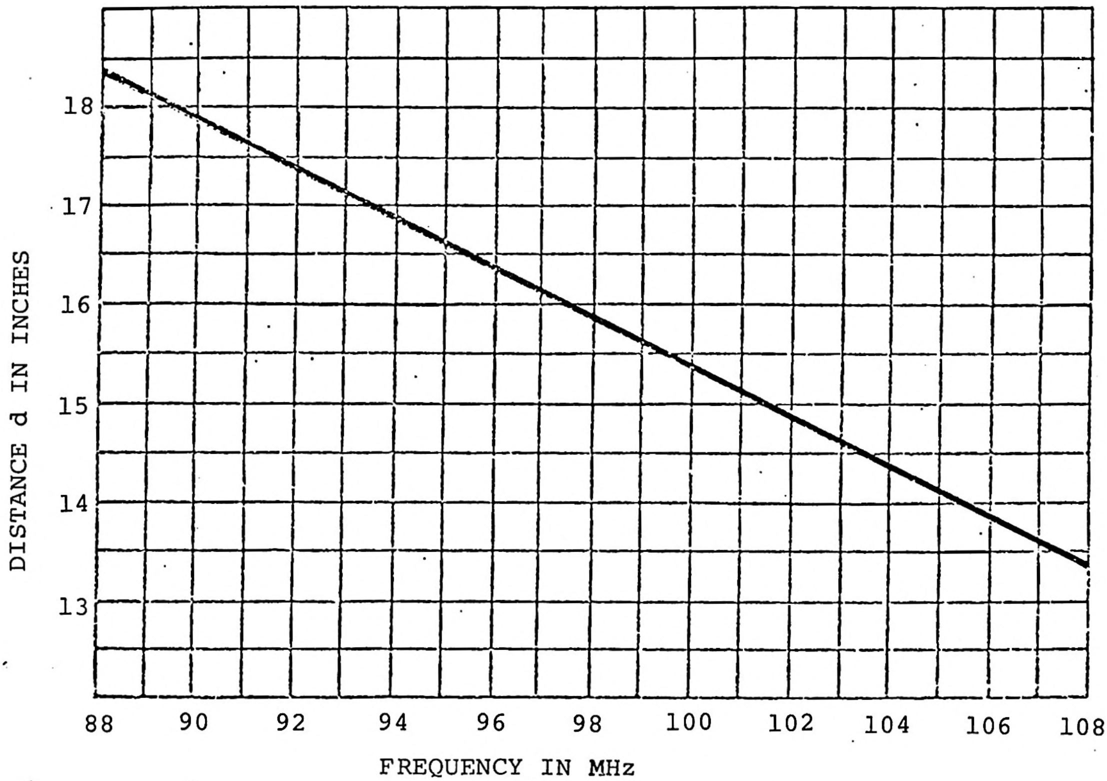
5.6.7.2 Driver Grid Tuning

NOTE

This procedure is not necessary if the related components have not been replaced and the operating frequency is the same as the frequency specified in the production test data supplied with the transmitter.

* a. Perform the preliminary adjustments in paragraph 5.6.7.1 before proceeding.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.



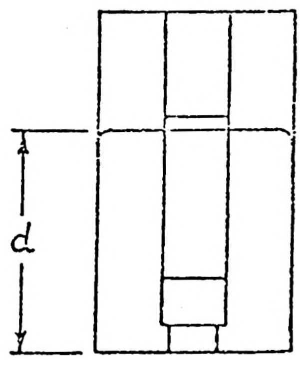
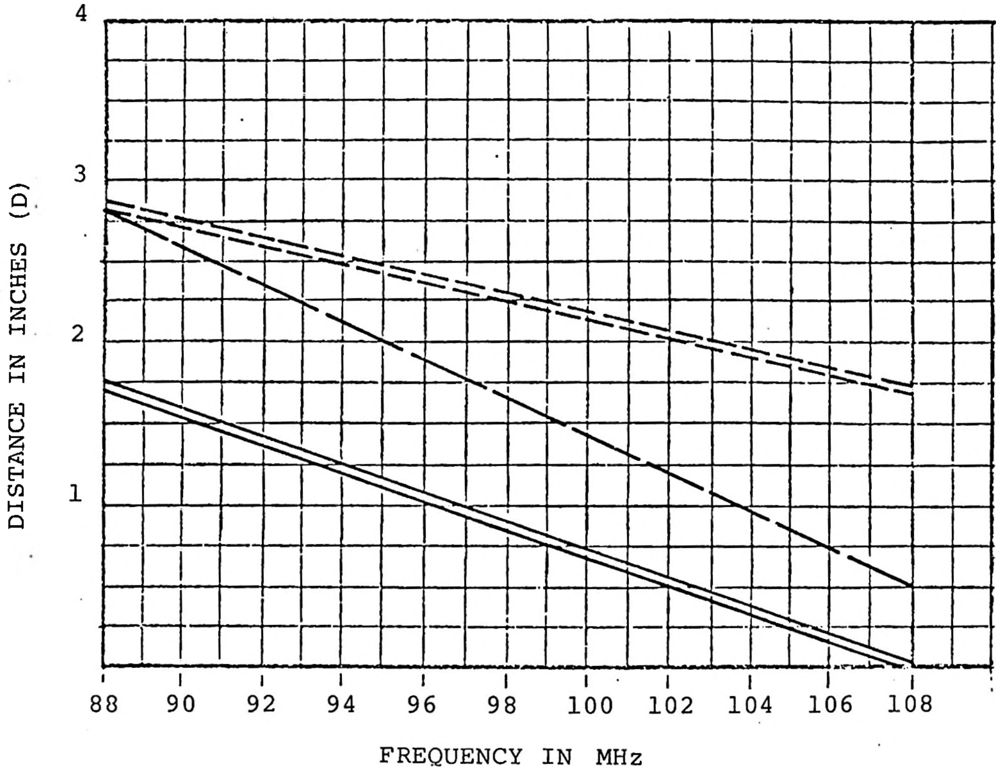


Figure 5-1. PA Plate Tuning Cavity
Slider Approximate Adjustment



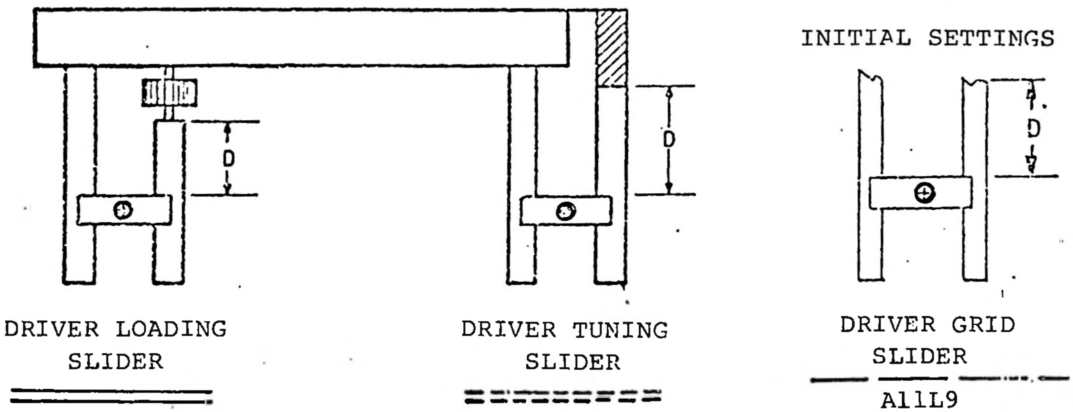
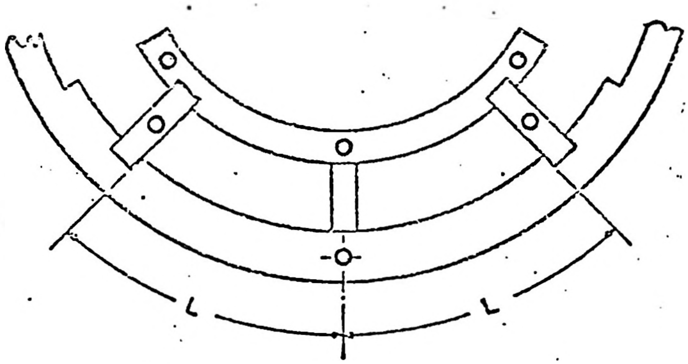


Figure 5-2. Graph for Approximate Setting of Driver Loading, Driver Tuning, and Driver Grid Slider.

b. Tune the 802A exciter to the desired operating frequency. Refer to the 802A exciter instruction book.

*
*



PA NEUTRALIZING ADJUSTMENT

NOTE: A NEUT. SETTING OF "L" BEING GREATER THAN INDICATED ON CHART RESULTS IN A MORE STABLE AMPLIFIER.

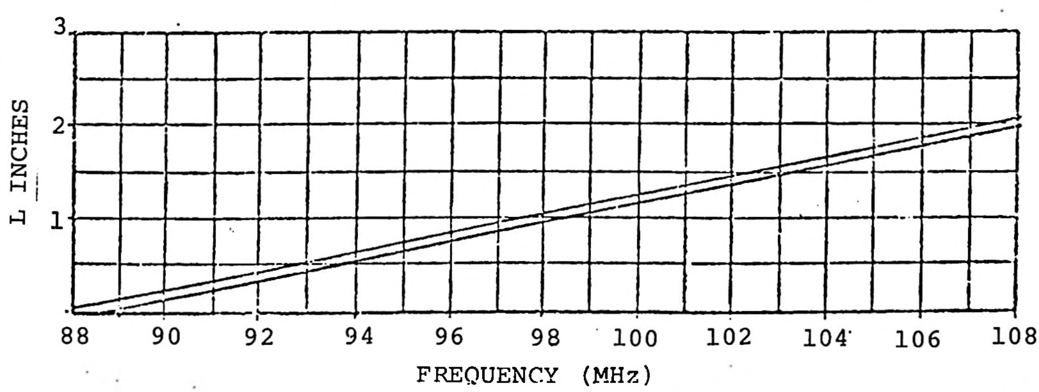


Figure 5-3. PA Neutralizing Adjustment

c. Block the interlock grounding switch open.

d. Set DRIVER, PA SCREEN, and PA PLATE POWER SUPPLY circuit breakers A6CB3, A6CB4, and A6CB5 to OFF.

e. Press the FILAMENT ON and PLATE ON switches.

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. DEATH ON CONTACT MAY OCCUR IF YOU ARE NOT EXTREMELY CAREFUL WHEN YOU PERFORM THE FOLLOWING PROCEDURES.

f. Adjust exciter POWER OUTPUT control until 15-watt forward power is indicated on exciter forward meter. Switch FWD/REFL switch of 802A exciter to read REFL POWER.

g. Adjust TUNE and COUPLE capacitors A11C33 and A11C34 on the driver box for minimum reflected power. Should be "0" or near "0".

h. Check that the TUNE and COUPLE capacitors are approximately one-half mesh when they are adjusted for minimum reflected power.

i. If either control is not approximately midrange, remove power from the transmitter, adjust A11L9, and repeat steps e through h.

j. Turn transmitter OFF and replace all panels and close all compartment doors.

5.6.7.3 PA Tuning

a. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

b. If possible, connect the transmitter to an rf wattmeter/dummy load combination or a calorimeter capable of measuring and dissipating 25 kilowatts at 50 to 125 MHz. If these devices are unavailable, refer to the RF WATTMETER on the control panel for power output measurement.

CAUTION

DO NOT PERFORM THE REMAINDER OF THIS PROCEDURE IF THE TRANSMITTER IS NOT CONNECTED TO AN ANTENNA WITH A 50-OHM IMPEDANCE OR A DUMMY LOAD CAPABLE OF DISSIPATING AT LEAST 25 KILOWATTS.

* c. Turn the DRIVER PLATE TUNING control fully counterclockwise. Then turn the control six turns clockwise (30 percent from maximum capacity).

d. Open the plate cavity access door and observe pa tuning and loading capacitors A18C51 and A18C50. (See figure 4-2.) Adjust the PA TUNING and PA LOADING controls on the control panel until the two capacitors are positioned approximately midrange. Close the plate cavity door.

e. Open the tube socket access door located beneath the DRIVER PLATE TUNING control.

f. Turn filament peaking capacitor A21C39 to near minimum capacity.

g. Set PA SCREEN circuit breaker to OFF. Ascertain that the exciter POWER switch is ON.

CAUTION

DO NOT EXCEED THE FOLLOWING MAXIMUM RATINGS:

LEFT DRIVER CATHODE CURRENT:	250 mA
RIGHT DRIVER CATHODE CURRENT:	250 mA
PA SCREEN CURRENT:	600 mA
PA PLATE CURRENT:	4.0 AMPERES

h. Press the FILAMENT ON and PLATE ON switches on control panel A1.

CAUTION

PROLONGED OPERATION WITH THE PLATE POORLY TUNED MAY DAMAGE THE POWER AMPLIFIER.

i. If an rf output from the transmitter is indicated when power is applied, quickly adjust the PA TUNING and PA LOADING controls for a maximum output power indication.

j. If an rf output is not present when power is applied, adjust the DRIVER PLATE TUNING control until an output is indicated.

k. Repeat steps i. and j. until maximum output power is obtained. If the PA TUNING control encounters an end-stop while in the LOWER position, lower the shorting plane and retune. If an end-stop is encountered in the RAISE position, raise the shorting plane and retune.

* l. Adjust the exciter output to produce 30 to 40 mA of Driver Screen current.

m. Check for pa neutralization. Refer to paragraph 5.6.7.5.

n. Check driver neutralization. Refer to paragraph 5.6.7.4.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

NOTE

Because of the relatively high output capacity of the 4CX15000A and the resulting low cavity inductance, no plate current dip will be noted at highter power levels. Tuning and loading should be adjusted in steps for maximum output power.

o. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

p. Open the pa cavity door and ensure that plate tuning capacitor A18C50 is approximately halfway between its limits.

q. If plate tuning capacitor A18C50 is not approximately halfway between its limits, adjust the pa plate cavity shorting plane (paragraph 5.6.7.1) and repeat steps c. through p. of this paragraph.

r. Remove the rear access panel behind the plate cavity.

s. Remove the access panel directly below the exciter. Block open the interlock switch.

t. Press the FILAMENT ON and PLATE ON switches on the control panel.

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. DEATH ON CONTACT MAY OCCUR IF YOU ARE NOT EXTREMELY CAREFUL WHEN YOU PERFORM THE FOLLOWING PROCEDURES.

u. Using an insulated screwdriver, adjust PA BIAS ADJ resistor A18R35 for proper output currents. The PA grid drive level determines the amount of bias required, and with higher drive levels an increase in bias results in greater amplifier efficiency. Compare the efficiency with the efficiency graphs, figure 5-4 and figure 5-5.

NOTE

Efficiency is calculated using the following formula:

$$\text{Efficiency} = \frac{\text{Power Output (watts)}}{\text{Plate Voltage} \times \text{Plate Current}}$$

v. Adjust L DVR BIAS ADJ control A11R40, and R DVR BIAS ADJ control A11R44 until the pa is saturated. (LEFT DVR K 400 MA and RIGHT DVR K 400 MA test meter (M1) indications are not to exceed 250 mA.)

w. Adjust the power output as described in paragraph 5.6.7.6.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

5.6.7.4 Driver Neutralization

a. Check for proper driver neutralization by adjusting the tuning of the transmitter and noting that the DVR SCREEN current peak is coincident with the peak of PA GRID current, and a dip of DVR K current. If neutralization is correct, do not perform the remiander of this procedure.

b. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

c. Open the tube socket access door directly beneath the DRIVER PLATE TUNING control.

d. Slightly adjust the paddle, C_N, attached to capacitor A11C35.

e. Close the access door and recheck the driver neutralization.

f. Repeat steps b. through e. until proper neutralization is obtained.

5.6.7.5 Neutralization

a. Check the transmitter for proper neutralization by tuning the transmitter for a pa screen current peak and observing that maximum output power occurs at the same time. If neutralization is correct, do not perform the remainder of this procedure.

NOTE

A minimum value of pa plate current also occurs when neutralization is correct.

b. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

c. Open the pa cavity door. Short all high voltage terminals with grounding stick.

d. Remove front half of tube air guide to gain access to screen sliders.

e. Refer to figure 5-3 and adjust the screen sliders, LN1 and LN2. The sliders should not require an adjustment greater than ±1/4 inch from the initial setting. (A setting on the plus side is preferred.)

f. Replace the tube air guide.

g. Close the cavity door and apply power to the transmitter.

h. Check for proper neutralization again. If incorrect, repeat steps b. through g.

5.6.7.6 Maximum Power Output Adjustment

NOTE

This procedure is intended to maintain authorized station maximum power output with line voltage variations and should be performed using a 50-ohm load capable of dissipating 25 kilowatts.

Do not make this adjustment until the pa tuning procedure in paragraph 5.6.7.3 is accomplished.

a. Set the POWER ADJUST control to RAISE until maximum power output is displayed on the RF WATTMETER.

b. If the maximum power output is not more than 10 percent above the authorized station maximum output, skip to step h. If the maximum power output is more than 10 percent of the authorized station maximum output, proceed to step c.

c. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

d. Turn off primary power to the transmitter.

e. Refer to table 2-1. Change wires to the transformer terminals for the next higher line voltage connection. (Example: If the wires are originally connected for a line voltage of 240 volts, reconnect the wires for a line voltage of 250 volts.) To change screen voltage only, refer to table 5-2.

f. Reapply primary power and press the FILAMENT ON and PLATE ON switches on control panel A1.

g. Repeat steps b. through f. until the maximum transmitter output is not more than 10 percent above the authorized station maximum output.

h. Compare the PLATE VOLTAGE reading with the plate voltage listed in table 3-5 for the authorized station maximum power output. (Linear interpolation of tabulated values may be necessary.) If the compared voltages differ by more than 10 percent, proceed to step i. If the compared voltages differ by less than 10 percent, skip to step m.

i. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

j. Turn off primary power to the transmitter.

NOTE

In addition, the desired power setting may be achieved by changing the pa loading.

k. Refer to table 2-1. If the transmitter plate voltage exceeds the tabulated voltage, change wires on transformer T3 to the terminals listed for the next higher line voltage. If the tabulated voltage exceeds the transmitter plate voltage, change wires on transformer T3 to the terminals listed for the next lower line voltage.

l. Repeat steps h. through k. until the transmitter and the tabulated plate voltages differ by less than 10 percent.

m. Adjust the POWER ADJUST control until the RF WATTMETER displays the authorized station maximum power output.

n. Refer to figure 5-6. Check the forward and reflected power levels and determine the vswr. If the vswr exceed 2:1, check the antenna impedance.

NOTE

The vswr on a properly tuned antenna is 1.1:1, or less.

5.6.8 Board A3, Offset Zero Adjustment

a. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

b. Remove cover from the control circuits and pull the plunger on the card cage interlock all the way out.

c. Set the exciter POWER switch to off.

d. Place board A3 on a card extender.

e. Press the FILAMENT ON switch.

f. Connect a dc voltmeter from TP2 (red) and TP3 (orange). Set VSWR PROT switch to OFF.

g. Adjust REFL OFFSET control A3R26 until 0 volt is indicated on the dc voltmeter.

h. Remove the dc voltmeter from TP2 (red) and connect it to TP1 (brown).

i. Adjust FWD OFFSET control A3R25 until 0 volt is indicated on the dc voltmeter.

j. Press the FILAMENT OFF switch.

k. Replace board A3 in its proper place. Replace cover on the control circuits.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

5.6.9 Automatic Power Control Adjustment

a. Set the POWER CONTROL switch to AUTOMATIC.

b. Remove the panel covering the control circuits and disable the interlock switch.

c. Press the FILAMENTS ON and PLATE ON switches on control panel A1.

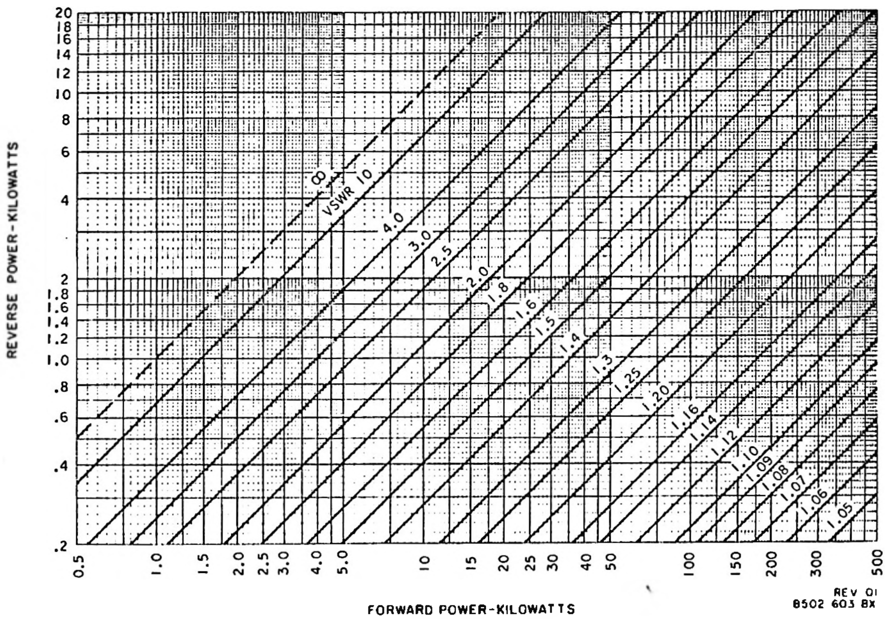


Figure 5-6. Power to VSWR Conversion Graph.

d. Adjust POWER CONTROL ADJ A3R27 until the authorized station output is displayed on the RF WATTMETER. (100%)

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. DEATH ON CONTACT MAY OCCUR IF YOU ARE NOT EXTREMELY CAREFUL WHEN YOU PERFORM THE FOLLOWING PROCEDURES.

e. Adjust filament peaking capacitor A21C39 until minimum plate current is displayed on the PLATE CURRENT meter. (Power output should remain near maximum.)

f. Replace all panels and close all compartment doors.

5.6.10 VSWR Trip

a. Press the FILAMENT ON and PLATE ON switches on control panel A1.

b. Place the POWER CONTROL switch in the MANUAL position.

c. With the POWER ADJUST control, lower the maximum output power to 2500 watts.

d. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

* e. Carefully loosen the base clamps on directional coupler A16 and reverse the assembly and re-tighten base clamps.

f. Remove cover from the control circuits and pull out the plunger on the card cage interlock.

g. Set the VSWR PROT switch on A3 to ON and the AUTO·RECYCLE switch on A7 to OFF.

h. Press the FILAMENT ON and PLATE ON switches on control panel A1.

i. Adjust VSWR PROT CAL A3R20 until vswr trip relay A22K9 is energized and plate voltage is removed. (The VSWR fault indicator on A7 will light.)

j. Set the VSWR PROT switch to OFF and press the PLATE ON switch.

k. Set the VSWR PROT switch to ON. If the transmitter fails to turn off, repeat steps a. through j.

l. Press the FILAMENT OFF switch and the FAULT RESET switch. Set AUTO RECYCLE switch to ON.

m. Replace the directional coupler in its normal position.

n. Adjust the transmitter power output to authorized station power output with the POWER ADJUST control.

5.6.11 VSWR Protect Test Circuit

a. Remove cover from the control circuits and pull out the plunger on the card cage interlock.

b. Press the FILAMENT ON switch on control panel A1.

c. Set control panel POWER switch to the REFLECTED position.

d. Press A3 Test switch S2 and adjust REFL ADJ potentiometer R27 for a reading of 100%. Adjust VSWR PROT CAL to trip at this level. (Note 100% meter reading in the REFLECTED position is 2500 watts.)

e. Note: For greater VSWR trip sensivity, press A3 TEST switch S2 and adjust REFL ADJ potentiometer R27 for a reading less than 100%. (50% reading corresponds to 1250 watts.) Then adjust A3R20 to trip at the new level.
Caution: Nuisance tripping may occur if the sensitivity is increased too far.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

5.6.12 Phase Monitor Adjustment

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. DEATH ON CONTACT MAY OCCUR IF YOU ARE NOT EXTREMELY CAREFUL WHEN YOU PERFORM THE FOLLOWING PROCEDURES.

a. Remove the right front bay access panel.

b. Block the interlock grounding switch open.

c. Set potentiomenter A19K5 to system operating voltage. (Voltage indicated on the dial is the normal operating phase-to-phase voltage of the three phase primary input power.)

d. For close protection, increase the adjustment until A19K5 drops out. (Red LED will go out.) Back adjustment down slightly until relay picks up.

e. Replace access panel.

5.7 Parts Replacement

5.7.1 4CX15000A PA TUBE

* a. Remove air shields (tube chimney) between the PA blocker and the cabinet base. Loosen the two bands on PA blocking capacitor and slide the blocking capacitor down over the PA tube.

b. Remove the anode lead.

* c. Carefully lift the tube and PA blocking capacitor out of its socket.

d. Reverse the procedure to replace the tube.

5.7.2 Control Panel Indicator Lamps

a. Pull the switch out and rotate it 90° ccw; the lamp assembly should pop out.

b. Remove the defective lamp by pressing down on the bulb.

c. Reinsert new bulb and replace the assembly.

TABLE 5-2. SCREEN VOLTAGE TRANSFORMER TAP SCHEDULE

	PRI TAPS	LINE VOLTAGE 200	210	220	230	240	250
SECONDARY TAPS 100% WYE	200	800	840	880			
	210	762	800	838	876		
	220	727	764	800	836	873	
	230	696	730	765	800	835	870
	240	667	700	733	767	800	833
	250	640	672	704	736	768	800
SECONDARY TAPS 85% WYE	200	680	714	748			
	210	648	680	712	745		
	220	618	649	680	711	742	
	230	591	621	650	680	710	739
	240	567	595	623	652	680	708
	250	544	571	598	625	653	680
SECONDARY TAPS 70% WYE	200	560	588	616			
	210	533	560	587	613		
	220	509	535	560	585	611	
	230	487	511	536	560	584	609
	240	467	490	513	537	560	583
	250	448	470	493	515	538	560
SECONDARY TAPS 100% DELTA	200	462	485	508			
	210	440	462	484	506		
	220	420	441	462	483	504	
	230	402	422	442	462	482	502
	240	385	404	424	443	462	481
	250	370	388	407	425	444	462

DC SCREEN VOLTAGE

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

maintenance

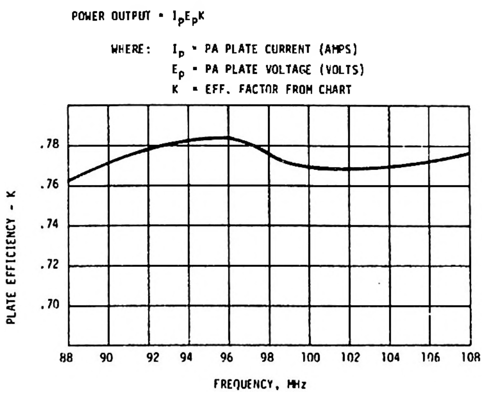


Figure 5-4. 816R-3 Amplifier Efficiency vs Frequency Graph

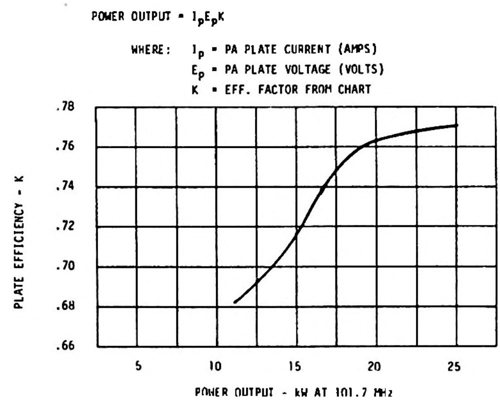


Figure 5-5. 816R-3 Amplifier Efficiency vs Output Level

6.1 General

This section contains a list of all repairable/replaceable electrical, and criti-
* cal mechanical parts for the 816R FM Transmitter.

6.2 REF DES

This column contains the electrical reference designators of all parts that have been assigned on schematics or wiring diagrams, and/or index numbers for all parts for which reference designators have not been assigned. When a reference designator, within a series of reference designators, has not been assigned a part number, the unassigned reference designator will be reflected as "NOT USED" in the DESCRIPTION column.

6.3 Description

This column contains the identifying noun or item name followed by a brief de-description. The description for electrical/electronic parts includes the application ratings and tolerances. For consecutively listed identical parts within an assembly, "SAME AS ---" is reflected in the description of subsequent listings, referencing to the first listing within the assembly.

6.4 CEMC Part Number

The CEMC Radio Specification or drawing number, for each item in the parts list, is reflected in this column.

6.5 Illustrations

All parts listed in the REF DES column are located on corresponding illustrations. The illustration always precedes the parts list. When a replacable electrical item is hidden from view by structural parts of wiring, a dotted leader line is used to show the locations of the item on the illustration.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

6.6 List of Equipment

	Page
* 816R FM Transmitter	6-3
Control Panel, A1	6-10
Remote Control Assembly, A2	6-14
Fwd/Refl Cal and Pwr Control, A3	6-16
Filament Regulator, A5	6-19
Circuit Breaker Panel, A6	6-22
Overload and Recycle Board, A7	6-24
Power Control Regulator, A8	6-28
Power Control Panel, A9	6-31
SCR Gate Drive Card, A9AR1 A1-A3	6-33
2-kV Power Supply, A10	6-35
RF Driver Assembly, A11	6-37
Latching Relay and Status Board, A12	6-41
RF Output Low-Pass Filter, A13	6-43
Power Supply Filter, A14	6-45
Metering Multiplier Board, A15	6-49
Directional Coupler, A16	6-51
Bleeder Resistor Panel, A17	6-53
Power Amplifier Cavity, A18	6-56
Component Panel, A19	6-62
Power Failure Recycle Board, A19A1	6-65
Variable Transformer Drive Assembly, A19A2	6-67
Card Cage Assembly, A20	6-69
Power Amplifier Socket, A21	6-72
Overload and Meter Calibrate Panel, A22	6-75
AC Metering Panel, A25	6-78
Resistor Board Assembly, A25A1	6-80
28-Volt Power Supply, PS1	6-82
PA Bias Power Supply, PS2	6-84

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

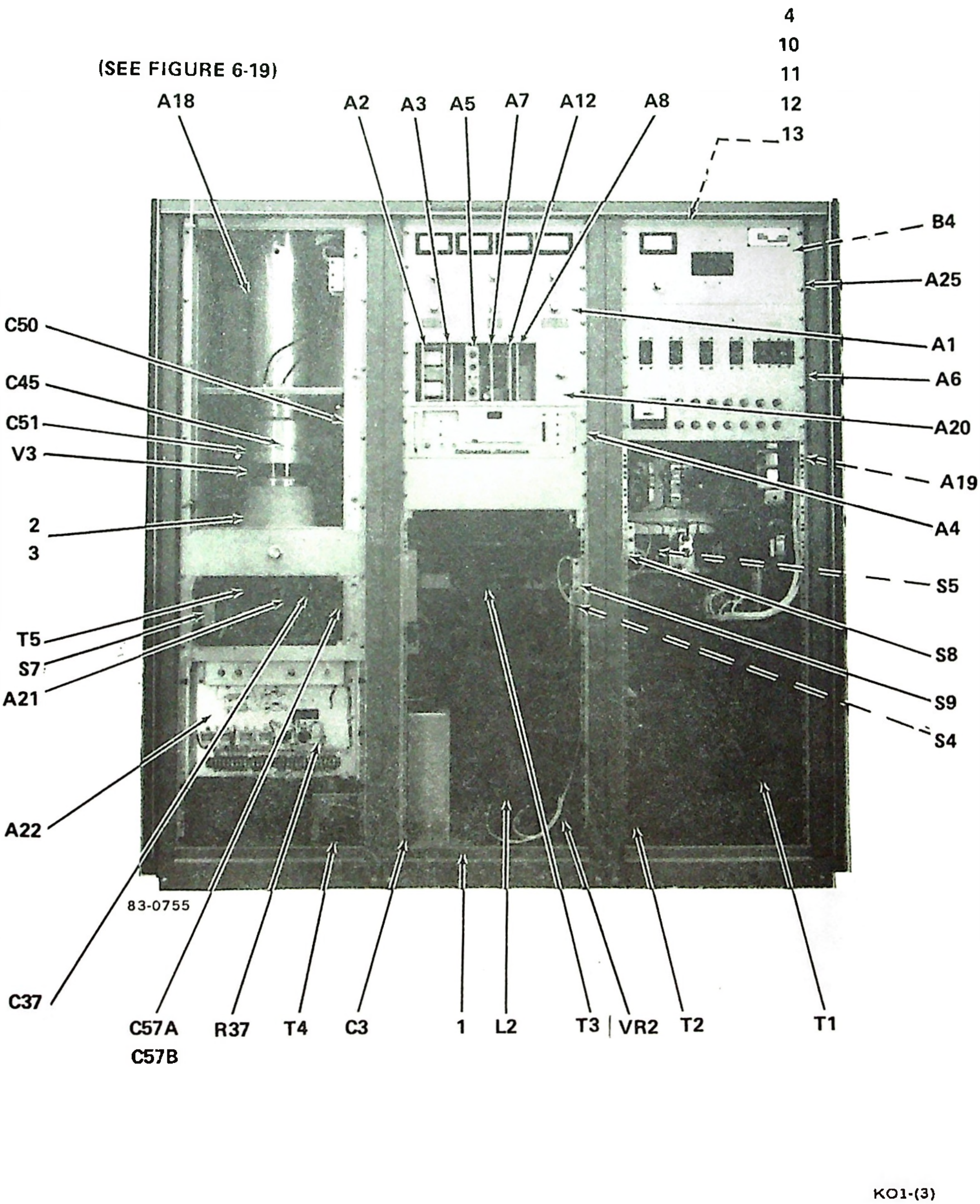


Figure 6-1. 816R FM Transmitter (Sheet 1 of 3)

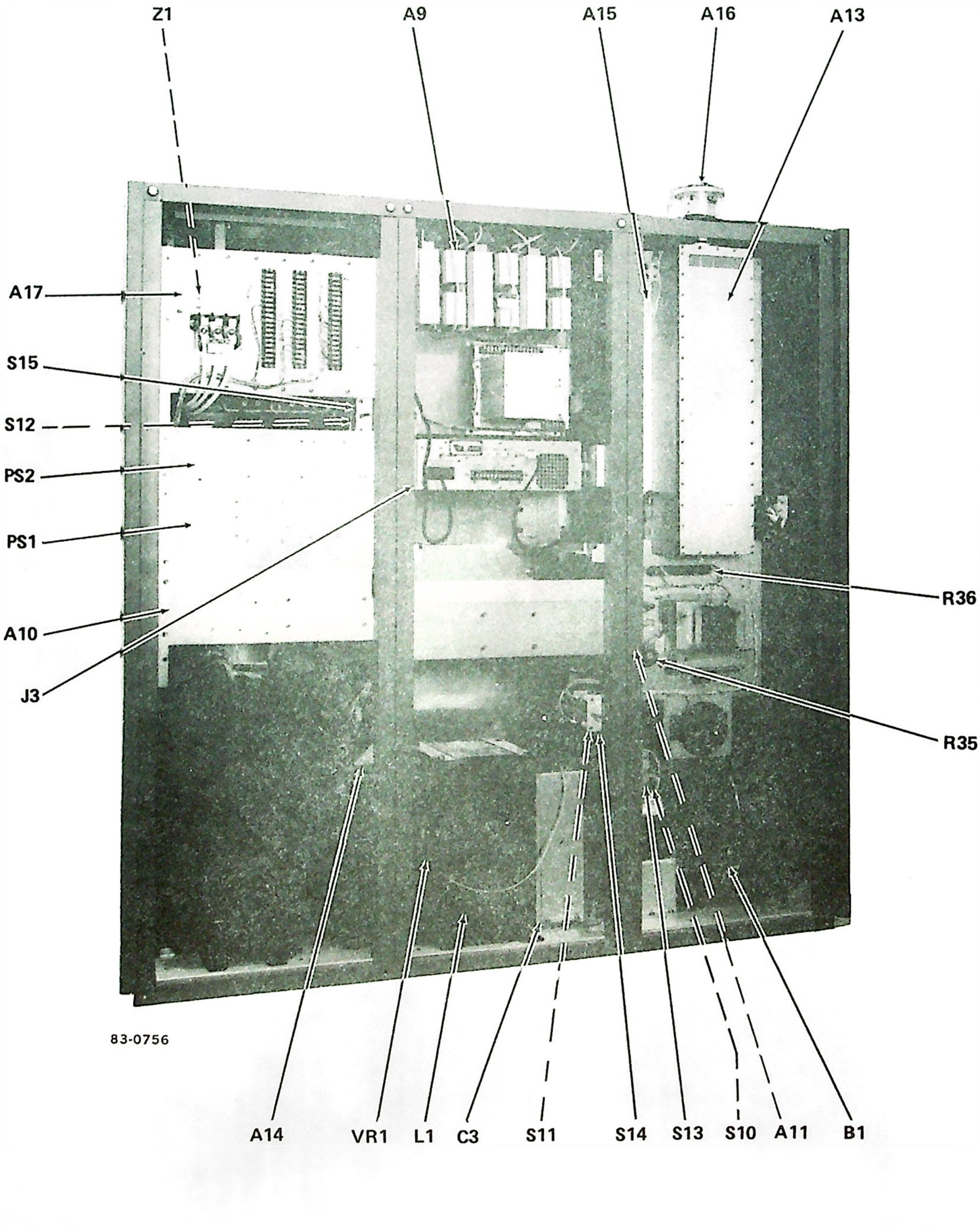
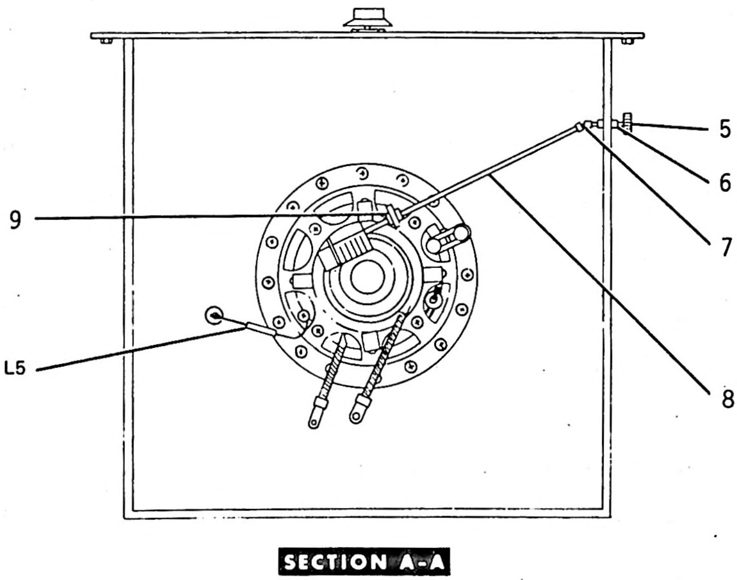


Figure 6-1. 816R FM Transmitter (Sheet 2 of 3)



* Figure 6-1. FM Transmitter (Sheet 3 of 3).

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
*	816R-3 25 kW FM TRANSMITTER	640-3540-006
A1	Control Panel	786-3243-006
A2	Remote Control Assembly - Optional equipment-	786-3327-001
A3	Fwd/Refl Cal and Pwr Control Board	648-8092-001
* A4	802A FM Exciter	643-0001-001
A5	Filament Regulator	648-8095-001
A6	Circuit Breaker Panel	786-3416-005
A7	Overload & Recycle Board	640-5380-001
A8	Power Control Regulator	627-6683-001
A9	Power Control Panel	789-4342-002
A10	2 KV Power Supply	789-4358-001
A11	RF Driver Assembly	786-3309-002
A12	Latching Relay and Status Board	648-8082-001
A13	RF Output Low-Pass Filter	786-3451-002
A14	Power Supply Filter	786-3583-001
A15	Metering Multiplier board	786-3168-001
A16	Directional Coupler	786-3264-001
A17	Bleeder Resistor Panel	786-3154-002
A18	Power Amplifier Cavity	786-3335-003
A19	Component Panel	648-8124-001
A20	Card Cage Assembly	786-3301-002
A21	Power Amplifier Socket	786-3686-001
A22	Overload and Meter Calibrate Panel	786-3666-002
A23	Extender Card	771-9168-001
A24	Not Used	
A25	AC Metering Panel	636-7263-001

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
B1	Fan, Centrifugal	009-0167-010
B4	Motor, Alternating Current 0.5A, 208/220 VAC	230-0593-010
C1	Not Used	
C2	Not Used	
C3	Capacitor, Fxd, Paper 20 μF, 10% Tol, 10 KVDCW	930-0781-040
C4 Through C36	Not Used	
C37	Driver Tuning Capacitor, Vacuum Var. 3-30 pF, 7.5 KVP	919-0301-010
C38 Through C44	Not Used	
C45	Blocking Capacitor	786-3597-001
C46 Through C49	Not Used	
C50	PA Loading Capacitor	786-3048-001
C51	PA Tuning Capacitor	786-3049-001
C52 Through C56	Not Used	
C57A	Capacitor, Fxd, Ceramic, 100 pF, 10% Tol, 5 KVDCW	913-0821-000
C58B	Same as C57A	
J1	Not Used	
J2	Not Used	
J3	Connector, Electrical, Receptacle Single Outlet, Grounding Type	368-0139-010
L1	Plate Supply Filter Choke 4H Inductance	668-0199-010
L2	Screen Supply Filter Choke 1H Inductance	668-0200-010
L3	Not Used	
L4	Not Used	
L5	PA Grid RFC 4.7 UH, 10% Tol	240-1611-000
PS1	28 Volt Power Supply	786-3013-001
PS2	PA Bias Power Supply	786-3081-001
R1 Through R34	Not Used	
R35	Resistor, Var, Wirewound, 1.0 Kilohm, 10% Tol, 50 Watts	749-1026-000
R36	Resistor, Fxd, Wirewound, 3.0 Kilohms, 5% Tol, 80 Watts	710-9294-000
R37	Resistor, Fxd, Wirewound, 10 ohms, 5% Tol, 3 Watts	747-5320-000

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
S1	Not Used	
S2	Not Used	
S3	Not Used	
S4	Switch, Sensitive	260-0025-000
	SPDT Contact Arrangement	
	Includes	
	Actuator, Switch	260-0026-000
S5	Same as S4	
S6	Not Used	
S7	Not Used	
S8	Shorting Switch	627-9743-004
	Includes	
	Spring, Shorting Switch	540-5342-002
	Strap, Grounding	304-6000-000
	Strip, Shorting	632-1149-001
	Contact, Shorting	542-1773-002
	Shaft, Flat, Straight	627-9786-001
	Insulator, Standoff	190-0026-000
S9	Same as S8	
S10	Same as S4	
S11	Same as S4	
S12	Same as S4	
S13	Shorting Switch (Same as S4 Except Shaft, Flat, Straight CPN 627-9786-007)	627-9743-008
S14	Same as S13	
S15	Same as S13	
T1	Transformer, PWR, Step-Up	664-0124-020
T2	Transformer, PWR, Step-Up	664-0123-020
T3	Transformer, PWR, Step-Up	664-0125-010
T4	Transformer, PWR, Step-Down	662-0043-000
T5	Transformer, PWR, Step-Down	662-0410-020
V1	Not Used	
V2	Not Used	
V3	Electron Tube	256-0157-000
VR1	Suppressor, Plate	625-8349-002
	Includes	
	Absorber, Overvoltage	353-0283-140
	-CR1 thru CR5-	
VR2	Suppressor, Screen	625-8348-001
	Includes	
	Absorber, Overvoltage	353-0283-100
	-CR6, CR7-	
Z1	Complete Rectifier	
	Includes	
	Rectifier Column	353-6596-010
	-Qty 3-	
1	Shorting Stick	547-6572-002
	Includes	
	Rod, Shorting	547-6574-002
	Spring, Compression	547-6575-002
	Cord, Shorting Stick	427-0004-000
2	Clamp, Neutralizing	786-3236-001
	-Qty 2-	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
3	Clamp, Neutralizing -Qty 2-	786-3237-001
4	Impeller, Fan	009-3118-010
5	Knob	757-0228-001
6	Bearing Assembly, Panel	015-3437-010
7	Joint, Universal	233-0132-000
8	Shaft	789-4365-001
9	Coupling, Insulator	015-3438-010
10	Filter	786-3457-001
11	Retainer, Upper	786-3537-001
12	Deflector	786-5842-001
13	Clamp	013-1309-420

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

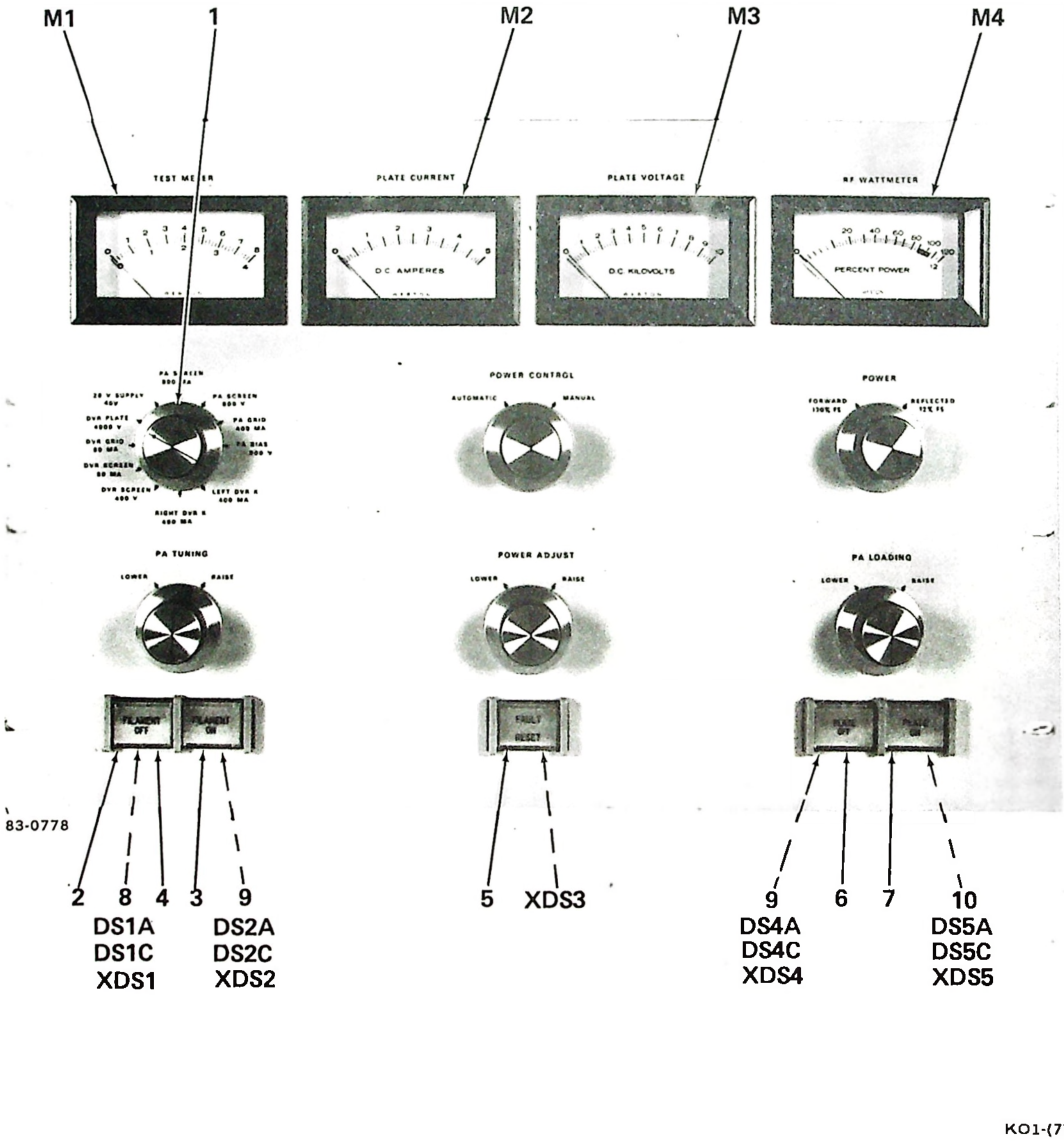
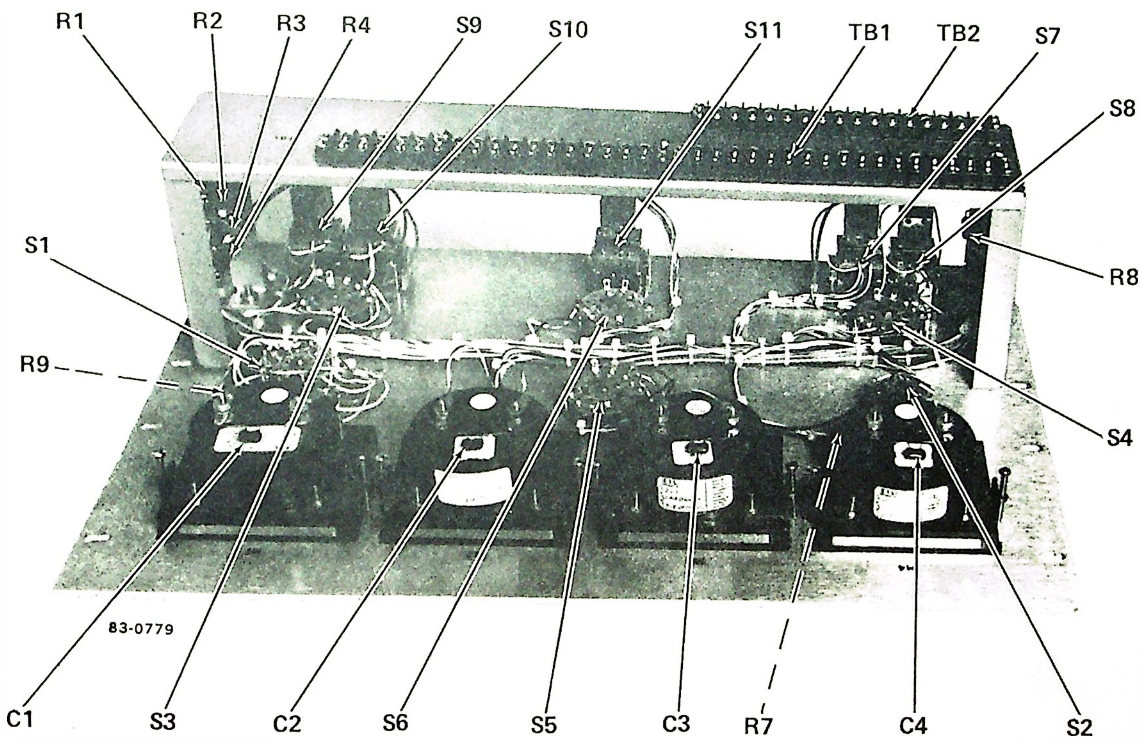


Figure 6-2. Control Panel, A1 (Sheet 1 of 2)



KO1-(8)

Figure 6-2. Control Panel, A1 (Sheet 2 of 2)

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
	CONTROL PANEL, A1	786-3243-006
C1	Capacitor, Fxd, Mica, 100 pF 5% Tol, 500 VDCW	912-2816-000
C2	Same as C1	
C3	Same as C1	
C4	Same as C1	
DS1A	Lamp, Incandescent, 0.04A, 28 volts	262-0179-010
DS1C	Same as DS1A	
DS2A	Same as DS1A	
DS2C	Same as DS1A	
DS4A	Same as DS1A	
DS4C	Same as DS1A	
DS5A	Same as DS1A	
DS5C	Same as DS1A	
* M1	Meter, DC Test ±1% 0 to 1 mA	458-5005-060
* M2	Meter, DC Plate Current ± 1% 0 to 1 mA	458-5005-050
* M3	Meter, DC Plate Voltage ±1% 0 to 2 mA	458-5005-070
* M4	Meter, DC Wattmeter ±2% 0 to 100 μA	458-5005-100
R1	Resistor, Fxd, Composition, 180 Ohms, 10% Tol, 1 Watt	745-5621-000
R2 Through R4	Same as R1	
R6	Not Used	
R7	Resistor, Fxd, Film, 1740 Ohms, 1% Tol, 1/4 Watt	705-6758-000
R8	Resistor, Fxd, Composition, 39 Kilohms, 10% Tol, 1 Watt	745-3419-000
R9	Resistor, Fxd, Film, 301 Ohms, 1% Tol, 1/2 Watt	705-7071-000
S1	Switch, Rotary DP12T Contact Arrangement	259-2219-010
S2	Switch, Rotary DPDT Contact Arrangement	259-2759-010
S3	Switch, Rotary DP3T Contact Arrangement	259-1980-000
S4 Through S6	Sames as S3	
S7	Switch, Push, Illuminated SPDT Contact Arrangement	266-6806-100
S8 Through S11	Same as S7	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
TB1	Strip, Terminal 17 Terminals -Qty 2-	367-0025-000
TB2	Strip, Terminal 16 Terminals	367-0024-000
XDS1	Switch, Push, Illuminated	266-6806-010
XDS2 Through XDS5	Sames as XDS1	
1	Knob, Round, Skirted -Qty 6-	757-0233-003
2	Barrier, Vertical Mounting -Qty 8-	266-6806-030
3	Lens, Engraved Filament Off	266-6806-270
4	Lens, Engraved Filament On	266-6806-280
5	Lens, Engraved Fault/Reset	266-6806-800
6	Lens, Engraved Plate Off	266-6806-740
7	Lens, Engraved Plate On	266-6806-790
8	Boot, Bulb White -Qty 2-	266-6268-000
9	Boot, Bulb Green -Qty 4-	266-6806-040
10	Boot, Bulb Red -Qty 2-	266-6806-060

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

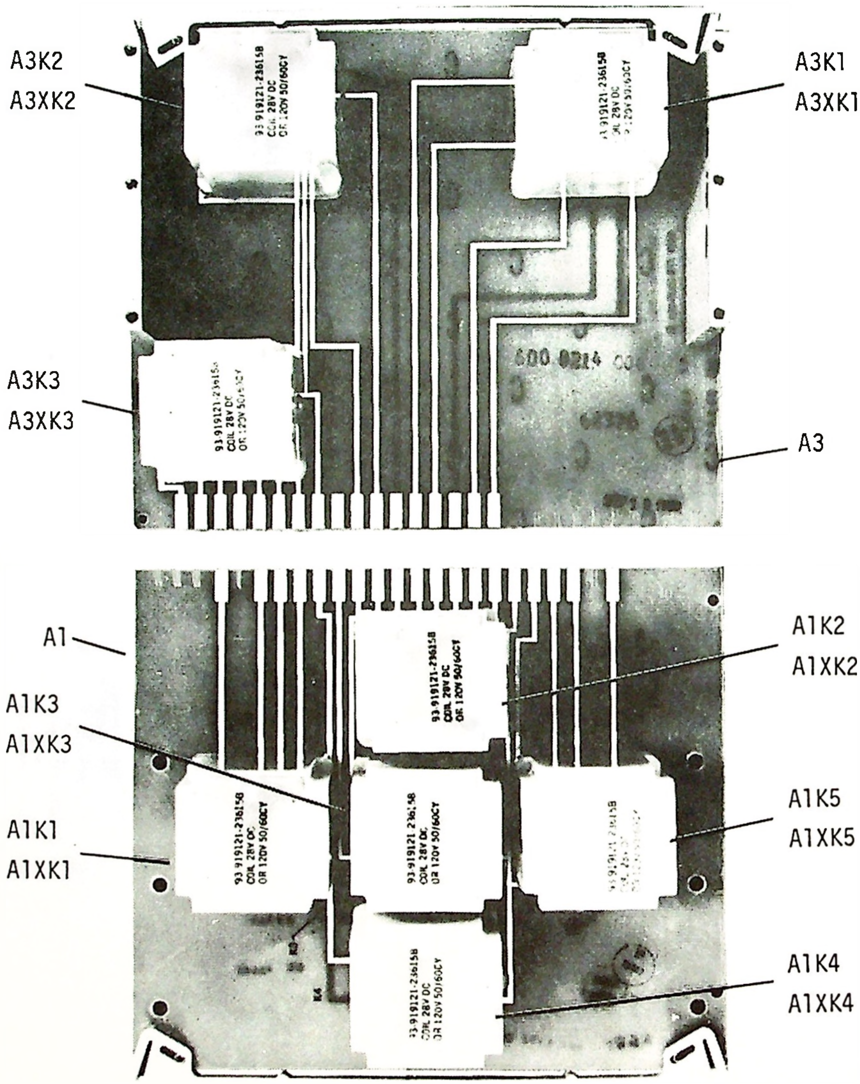


Figure 6-3. Remote Control Assembly, A2.

REF DES	DESCRIPTION	CEMC PART NUMBER
	REMOTE CONTROL ASSEMBLY, A2	786-3327-001
A1	Remote Control Relay Board	771-9256-001
	Includes	
	Relay, Armature	970-2454-440
	2A, 1B Contact	
	Arrangement	
	-A1K1 Thru A1K5-	
	Socket, Relay	220-1399-020
	Includes	
	Pin, Socket	220-1399-030
	-Qty 24-	
	-A1XK1 Thru A1XK5-	
A2	Not Used	
A3	Power Control Relay Assembly	778-2539-001
	Includes	
	Relay, Armature	970-2454-440
	2A, 1B Contact	
	Arrangement	
	-A3K1, A3K2, A3K3-	
	Socket, Relay	220-1399-020
	Includes	
	Pin, Socket	220-1399-030
	-Qty 16-	
	-A3XK1, A3XK2, A3XK3-	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

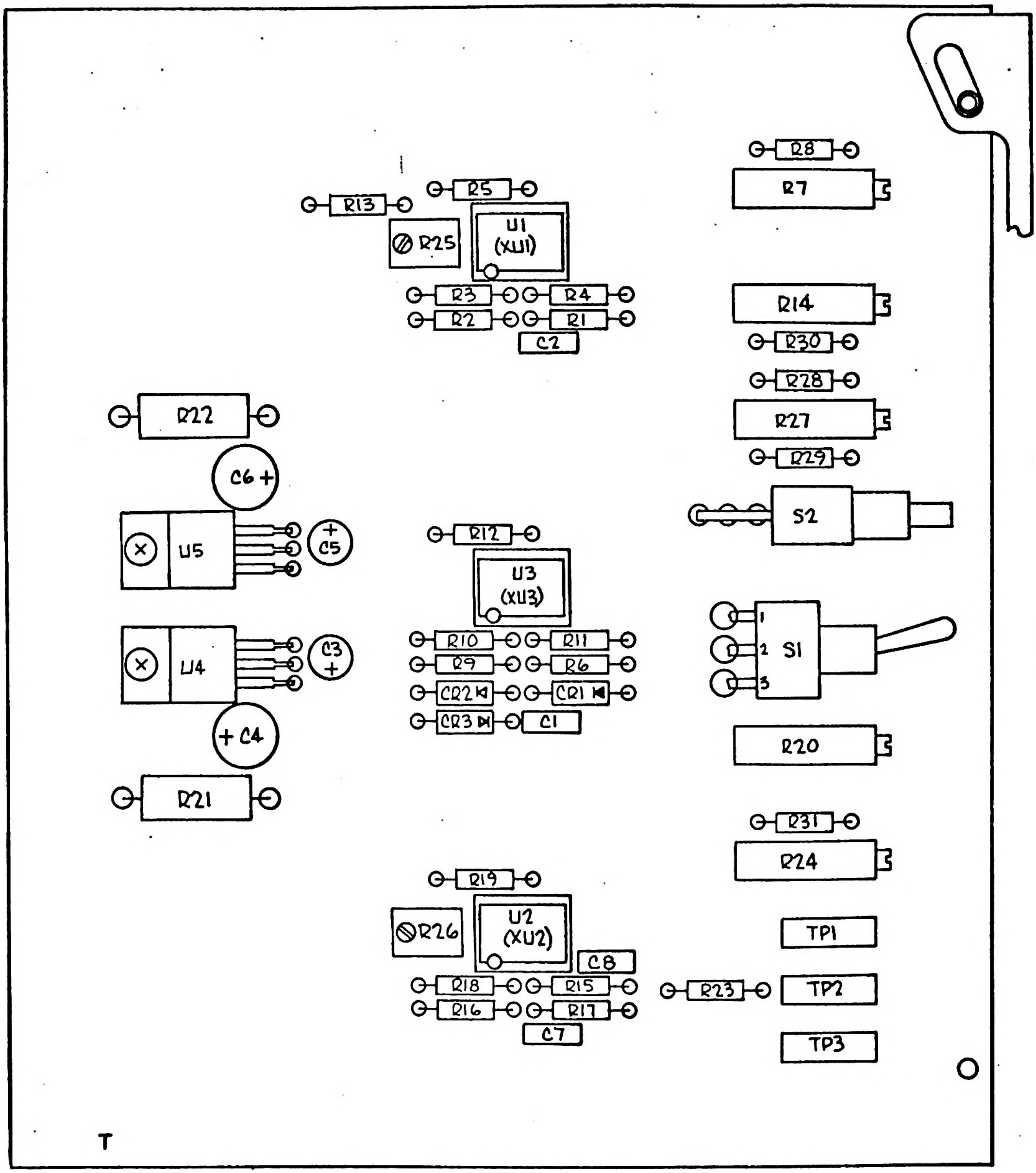


Figure 6-4. Fwd/Refl Cal and Pwr Control Board, A3.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
	FWD/REFL CAL AND PWR CONTROL BOARD, A3	648-8092-001
C1	Capacitor, Fxd, Ceramic, 1.0 μF, 20% Tol, 50 VDC	913-5019-840
C2	Capacitor, Fxd, Ceramic, 0.1 μF, 20% Tol, 50 VDC	913-5019-720
C3	Capacitor, Fxd, Solid Tantalum 4.7 μF, +20% Tol, 35 VDC	184-9102-390
C4	Capacitor, Fxd, Solid Tantalum 10.0 μF, +20% Tol, 35 VDC	184-9102-410
C5	Same as C3	
C6	100 μF, 20V	184-9102-200
C7	Same as C1	
C8	Same as C1	
C9	Same as C6	
CR1 thru CR3	Diode, IN4003	353-6442-030
R1	Resistor, Fxd, Carbon Film 20 Kilohms, 5% Tol, 1/4 Watt	745-0910-960
R2	Resistor, Fxd, Carbon Film 15 Kilohms, 5% Tol, 1/4 Watt	745-0910-930
R3	Resistor, Fxd, Carbon Film 160 Kilohms, 5% Tol, 1/4 Watt	745-0911-190
R4	Resistor, Fxd, Carbon Film 30 Kilohms, 5% Tol, 1/4 Watt	745-0911-010
R5	Resistor, Fxd, Carbon Film 200 Ohms, 5% Tol, 1/4 Watt	745-0910-480
R6	Same as R2	
R7	Resistor, Var, 15 Turn 10 Kilohms, 10% Tol, 3/4 Watt	382-0012-290
R8	Resistor, Fxd, Carbon Film 10 Ohms, 5% Tol, 1/4 Watt	745-0910-170
R9	Same as R2	
R10	Resistor, Fxd, Carbon Film 470 Kilohms, 5% Tol, 1/4 Watt	745-0911-300
R11	Resistor, Fxd, Carbon Film 6.8 Kilohms, 5% Tol, 1/4 Watt	745-0910-850
R12	Resistor, Fxd, Carbon Film 10 Kilohms, 5% Tol, 1/4 Watt	745-0910-890
R13	Resistor, Fxd, Carbon Film 2.2 Kilohms, 5% Tol, 1/4 Watt	745-0910-730
R14	Resistor, Var, 15 Turn 50 Kilohms, 10% Tol, 3/4 Watt	382-0012-320
R15	Same as R4	
R16	Resistor, Fxd, Carbon Film 4.3 Kilohms, 5% Tol, 1/4 Watt	745-0910-800
R17	Same as R1	
R18	Same as R3	
R19	Same as R5	
R20	Same as R7	

REF DES	DESCRIPTION	CEMC PART NUMBER
R21	Resistor, Fxd, Composition 100 Ohms, 10% Tol, 1 Watt	745-3310-000
R22	Same as R21	
R23	Same as R13	
R24	Same as R14	
R25	Resistor, Var, 25 Turn 10 Kilohms, 10% Tol, 1/2 Watt	382-1405-070
R26	Same as R25	
R27	Resistor, Var, 15 Turn 20 Kilohms, 10% Tol, 3/4 Watt	382-0012-300
R28	Resistor, Fxd, Carbon Film 100 Ohms, 5% Tol, 1/4 Watt	745-0910-410
R29	Resistor, Fxd, Carbon Film 1 Kilohm, 5% Tol, 1/4 Watt	745-0910-650
R30	Resistor, Fxd, Carbon Film 330 Ohm, 5% Tol, 1/4 Watt	745-0910-530
R31	Same as R30	
S1	Switch, SPST, Toggle	266-5321-980
S2	Switch, SPDT, Push	266-5404-190
TP1	Test Point, Brown	360-0495-020
TP2	Test Point, Red	360-0495-030
TP3	Test Point, Orange	360-0495-040
U1	Integrated Circuit, 741	351-1110-020
U2	Same as U1	
U3	Same as U1	
U4	Integrated Circuit, LM320T-12	351-1124-130
U5	Integrated Circuit, LM340T-12	351-1120-040

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

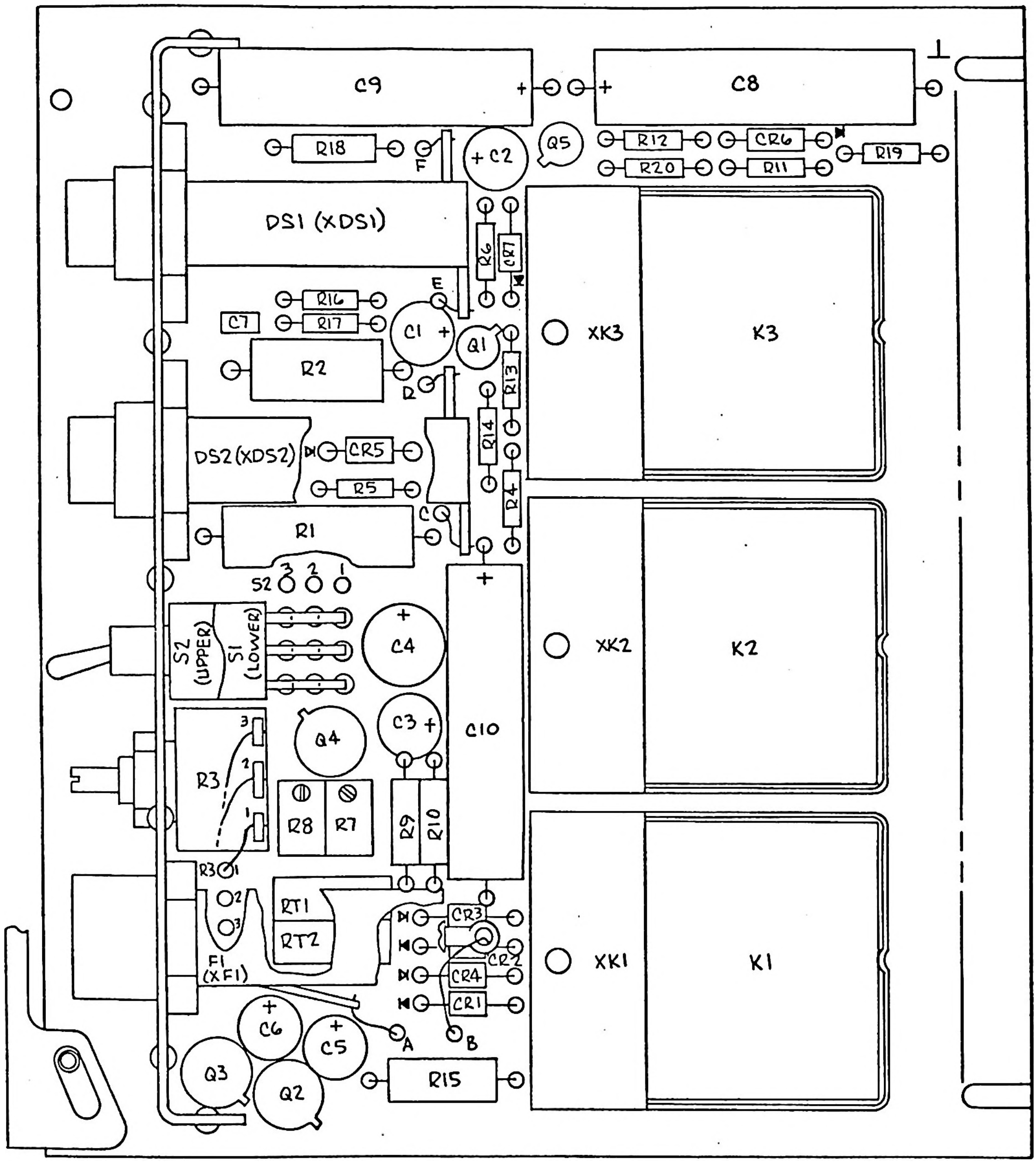


Figure 6-5. Filament Regulator, A5.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
	FILAMENT REGULATOR BOARD, A5	648-8095-001
C1	Capacitor, Fxd, Solid Tantalum 33 µF, +20%, 25 VDC	184-9102-260
C2	Capacitor, Fxd, Solid Tantalum 47 µF, +20%, 35 VDC	184-9102-890
C3	Same as C1	
C4	Same as C2	
C5	Same as C2	
C6	Same as C2	
C7	Capacitor, Fxd, Ceramic 0.1 µF, 20% Tol, 50 VDC	913-5019-720
C8	Capacitor, Fxd, Electolytic 100 µF, minus 10%, plus 75%, 50 VDC	183-1281-080
C9	Same as C8	
C10	Same as C8	
CR1	Diode, IN4003	353-6442-030
CR2	Same as CR1	
CR3	Same as CR1	
CR4	Same as CR1	
CR5	Diode, IN4748A, 22V 1 Watt ZENER	353-6481-410
CR6	Diode, IN4106, 12V 1/4 Watt ZENER	353-3591-080
CR7	Same as CR1	
DS1	Lamp, Incand.	262-3270-000
DS2	Same as DS1	
F1	Fuse, .25 Amp Cartridge, Slow Blow	264-0291-000
* K1	Relay, 4 C 800 Ohm, 24V	970-2420-100
K2	Same as K1	
K3	Same as K1	
Q1	Transistor, 2N2222A	352-0661-020
Q2	SCR, 2N2323A, 50V, .22A	353-3540-010
Q3	Same as Q2	
Q4	Same as Q2	
Q5	Same as Q1	
R1	Resistor, Fxd, Wirewound 120 Ohms, 5% Tol, 6.5 Watt	747-5442-000
R2	Resistor, Fxd, Composition 56 Ohm, 10% Tol, 2 Watt	745-5600-000
R3	Resistor, Var., Metal Film 100 Ohm, 20% Tol, 2 Watt	382-0006-020
R4	Resistor, Fxd, Carbon Film 5.6 Kilohms, 5% Tol, 1/4 Watt	745-0910-830
R5	Resistor, Fxd, Carbon Film 3.3 Kilohms, 5% Tol, 1/2 Watt	745-0914-770
R6	Resistor, Fxd, Carbon Film 100 Ohm, 5% Tol, 1/4 Watt	745-0910-410
R7	Resistor, Var, 25 Turn 50 Kilohms, 10% Tol, 1/2 Watt	382-1405-100

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
R8	Same as R7	
R9	Resistor, Fxd, Carbon Film 10 Kilohms, 5% Tol, 1/2 Watt	745-0914-890
R10	Same as R9	
R11	Resistor, Fxd, Carbon Film 100 Kilohms, 5% Tol, 1/4 Watt	745-0911-140
R12	Resistor, Fxd, Carbon Film 2.2 Kilohms, 5% Tol, 1/4 Watt	745-0910-730
R13	Resistor, Fxd, Carbon Film 10 Kilohms, 5% Tol, 1/4 Watt	745-0910-890
R14	Resistor, Fxd, Carbon Film 62 Kilohms, 5% Tol, 1/8 Watt	745-1863-920
R15	Resistor, Fxd, Composition 470 Ohms, 10% Tol, 1 Watt	745-3338-000
R16	Resistor, Fxd, Carbon Film 1.2 Kilohms, 5% Tol, 1/4 Watt	745-0910-670
R17	Resistor, Fxd, Carbon Film 18 Kilohms, 5% Tol, 1/4 Watt	745-0910-950
R18	Resistor, Fxd, Carbon Film 390 Ohms, 5% Tol, 1/2 Watt	745-0914-550
R19	Resistor, Fxd, Carbon Film 10 Kilohms, 5% Tol, 1/4 Watt	745-0910-890
R20	Same as R19	
RT1	Resistor, Thermal, 10 Kilohms	714-0182-000
RT2	Same as RT1	
S1	Switch, 3PDT, Toggle	266-5415-670
S2	Switch, SPDT, (ON)-OFF-(ON)	266-5321-180
XDS1	Lamp Socket	262-0919-000
XDS2	Same as XDS1	
XF1	Fuse Holder	265-1171-000
XK1	Relay Socket	220-0027-010
XK2	Same as XK1	
XK3	Same as XK1	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

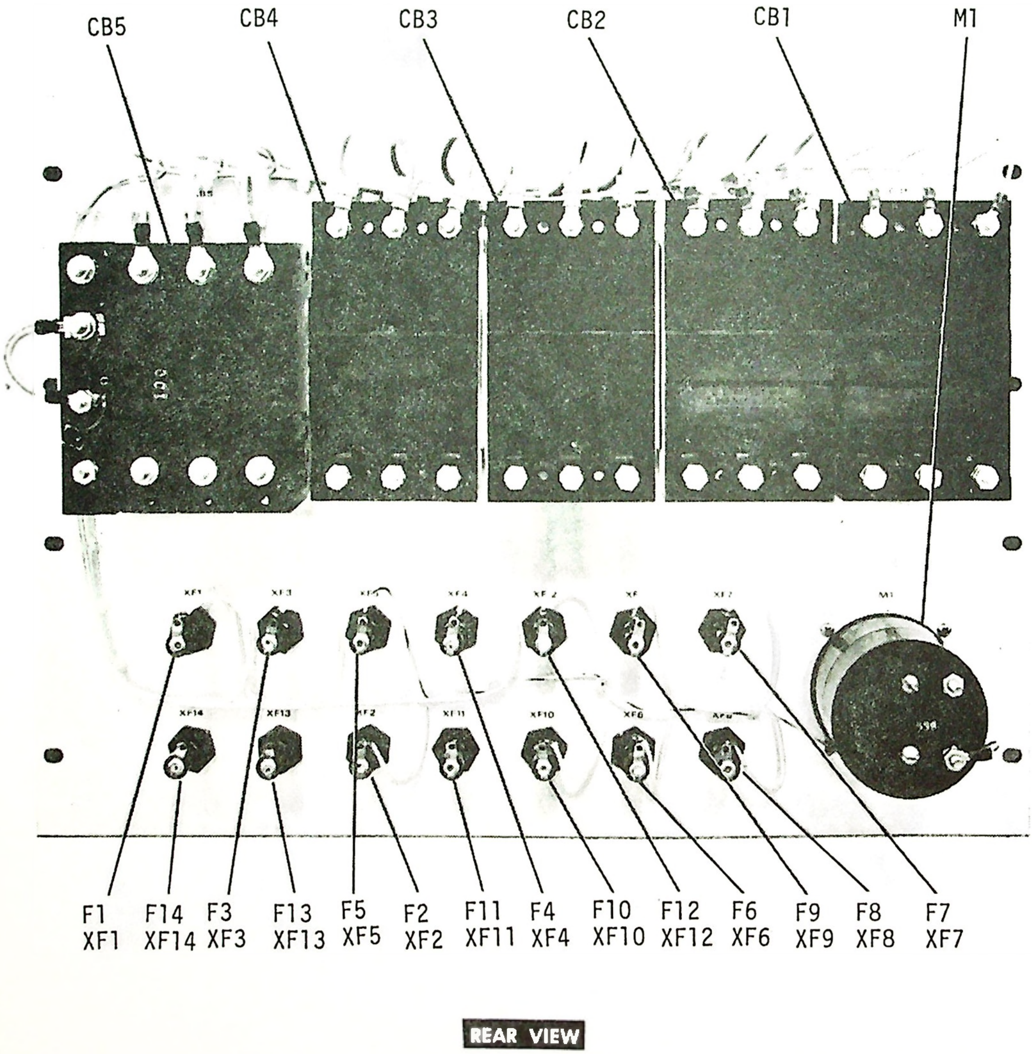


Figure 6-6. Circuit Breaker Panel, A6.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
	CIRCUIT BREAKER PANEL, A6	786-3416-005
CB1	Circuit Breaker 1A 3 Pole	260-4038-150
CB2	Circuit Breaker 10A 3 Pole	260-0407-000
CB3	Circuit Breaker 4.5A 3 Pole	260-4038-090
CB4	Circuit Breaker 15A 3 Pole	260-0409-000
CB5	Circuit Breaker 70A 4 Pole	260-0972-030
F1	Fuse, Cartridge 10A Current Rating	264-1182-000
F2	Fuse, Cartridge 3A Current Rating, Slow Blow	264-0009-000
F3	Same as F1	
F4	Fuse, Cartridge 0.25A Current Rating, Slow Blow	264-0291-000
F5	Same as F4	
F6	Fuse, Cartridge 1A Current Rating	264-4280-000
F7	Fuse, Cartridge 2A Current Rating, Slow Blow	264-0008-000
F8	Same as F6	
F9	Same as F7	
F10	Same as F6	
F11	Same as F2	
F12	Same as F7	
F13	Same as F7	
F14	Same as F7	
M1	Meter, Time Totalizing	458-0860-020
XF1	Fuseholder 20A Current Rating	265-1241-090
XF2 Through XF14	Same as XF1	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

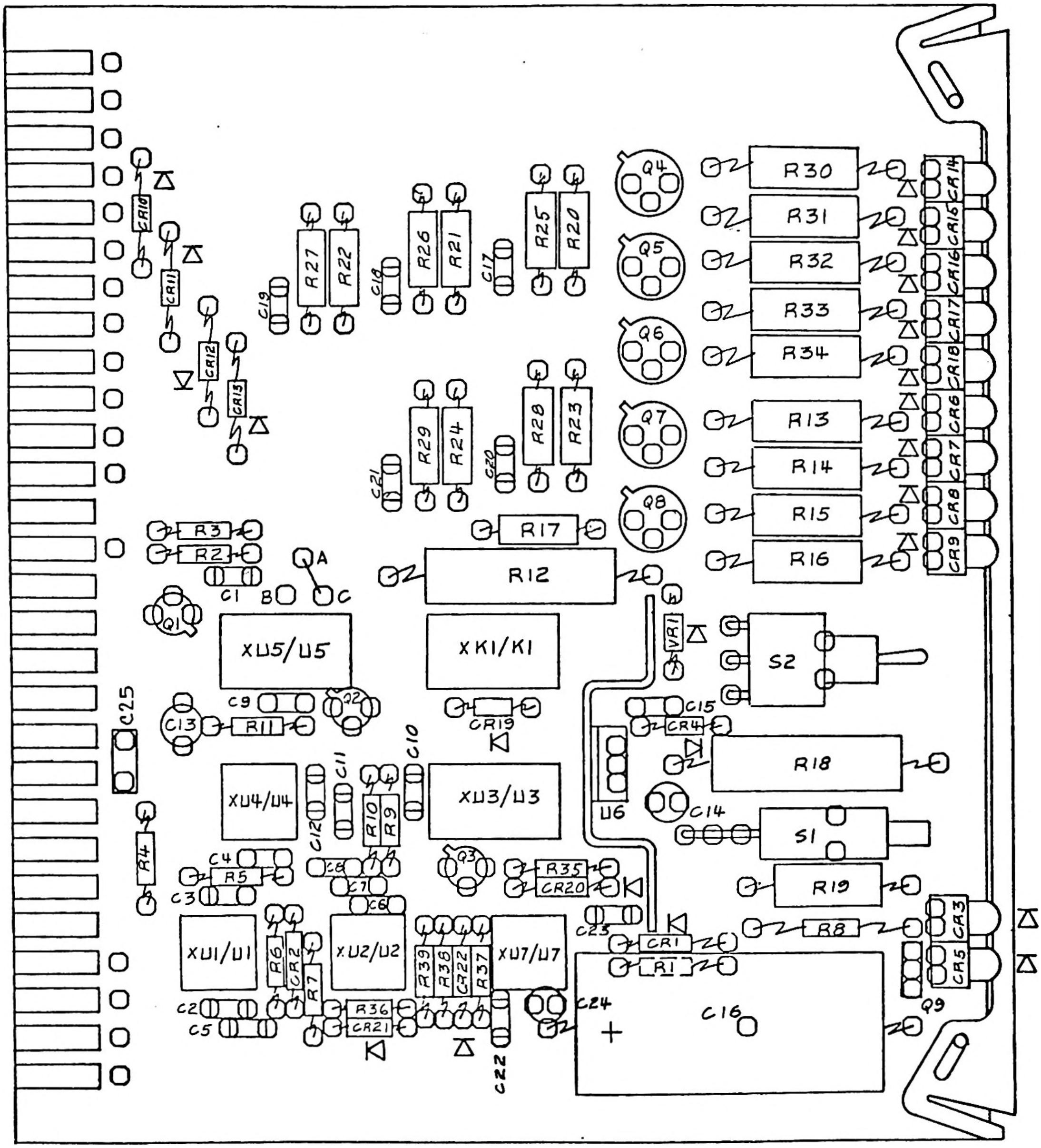


Figure 6-7. Overload & Recycle Board, A7.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
	O/L AND RECYCLE BOARD, A7	640-5380-001
C1	Capacitor, Fxd, Ceramic 0.01 μF, 20% Tol, 100 VDC	913-5019-660
C2	Capacitor, Fxd, Ceramic 0.1 μF, 20% Tol, 50 VDC	913-5019-720
C3	Same as C1	
C4	Capacitor, Fxd, Ceramic 1.0 μF, 20% Tol, 50 VDC	913-5019-840
C5	Same as C2	
C6	Same as C1	
C7	Same as C4	
C8	Same as C2	
C9	Same as C2	
C10	Same as C2	
C11	Same as C2	
C12	Same as C1	
C13	Capacitor, Fxd, Solid Tantalum 10 μF, ÷20% Tol, 35 VDC	184-9102-410
C14	Capacitor, Fxd, Solid Tantalum 2.2 μF, +20% Tol, 35 VDC	184-9102-370
C15	Same as C2	
C16	Capacitor, Fxd, Electrolytic 330 μF, Minus 10% Plus 75%, 50 VDC	184-5102-040
C17	Same as C2	
C18	Same as C2	
C19	Same as C2	
C20	Same as C2	
C21	Same as C2	
C22	Same as C2	
C23	Same as C1	
C24	Capacitor, Fxd, Solid Tantalum 4.7 μF, +20% Tol, 35 VDC	184-9102-390
C25	Same as C13	
CR1	Diode, IN914	353-2906-000
CR2	Same as CR1	
CR3	LED, Yellow	353-0293-020
CR4	Diode, IN4004	353-6442-040
CR5	Same as CR3	
CR6	LED, Red	353-0293-040
CR7	Same as CR6	
CR8	Same as CR6	
CR9	Same as CR6	
CR10	Diode, IN4003	353-6442-030
CR11	Same as CR10	
CR12	Same as CR10	
CR13	Same as CR10	
CR14	Same as CR3	
CR15	Same as CR3	
CR16	Same as CR3	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
CR17	Same as CR3	
CR18	Same as CR3	
CR19	Same as CR4	
CR20	Same as CR1	
CR21	Same as CR1	
CR22	Same as CR1	
K1	Relay, Reed, SPDT	410-0572-010
Q1	Transistor, 2N2222A	352-0661-020
Q2	Same as Q1	
Q3	Same as Q1	
Q4	SCR, GEC6F	353-6468-010
Q5	Same as Q4	
Q6	Same as Q4	
Q7	Same as Q4	
Q8	Same as Q4	
Q9	Transistor, MJE243	352-1104-010
R1	Resistor, Fxd, Carbon Film 2.2 Kilohms, 5% Tol, 1/4 Watt	745-0910-730
R2	Resistor, Fxd, Carbon Film 10 Kilohms, 5% Tol, 1/4 Watt	745-0910-890
R3	Resistor, Fxd, Carbon Film 1 Kilohm, 5% Tol, 1/4 Watt	745-0910-650
R4	Same as R1	
R5	Resistor, Fxd, Carbon Film 470 Kilohms, 5% Tol, 1/4 Watt	745-0911-300
R6	Resistor, Fxd, Carbon Film 4.7 Kilohms, 5% Tol, 1/4 Watt	745-0910-810
R7	Same as R5	
R8	Resistor, Fxd, Carbon Film 470 Ohms, 5% Tol, 1/4 Watt	745-0910-570
R9	Same as R3	
R10	Resistor, Fxd, Composition 2.2 Megohms, 10% Tol, 1/4 Watt	745-0869-000
R11	Same as R3	
R12	Resistor, Fxd, Wirewound 150 Ohms, 5% Tol, 6.5 Watt	747-5498-000
R13	Resistor, Fxd, Composition 2.7 Kilohms, 10% Tol, 1 Watt	745-3370-000
R14	Same as R13	
R15	Same as R13	
R16	Same as R13	
R17	Resistor, Fxd, Carbon Film 10 Ohms, 5% Tol, 1/2 Watt	745-0914-170
R18	Resistor, Fxd, Wirewound 560 Ohms, 5% Tol, 6.5 Watt	747-5455-000
R19	Same as R13	
R20	Resistor, Fxd, Carbon Film 220 Ohms, 5% Tol, 1/2 Watt	745-0914-490
R21	Same as R20	
R22	Same as R20	
R23	Same as R20	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
R24	Resistor, Fxd, Carbon Film 10 Kilohms, 5% Tol, 1/2 Watt	745-0914-890
R25	Resistor, Fxd, Carbon Film 4.7 Kilohms, 5% Tol, 1/2 Watt	745-0914-810
R26	Same as R25	
R27	Same as R25	
R28	Same as R25	
R29	Same as R24	
R30	Same as R13	
R31	Same as R13	
R32	Same as R13	
R33	Same as R13	
R34	Same as R13	
R35	Same as R6	
R36	Same as R6	
R37	Same as R5	
R38	Same as R6	
R39	Same as R2	
S1	Switch, SPDT Push	266-5404-190
S2	Switch, SPDT Toggle	266-5321-980
* U1	Integrated Circuit, MC1455P1 (NE555V)	351-1137-020
U2	Same as U1	
U3	Integrated Circuit, MC7400P	351-7629-010
U4	Same as U1	
U5	Integrated Circuit, MC7492	351-7771-010
U6	Integrated Circuit, LM340-5	351-1120-010
U7	Same as U1	
VR1	Diode, IN4751A, 30 V 1 Watt Zener	353-6481-470
XK1	Socket, Relay	220-0075-020
XU1	Socket, IC	220-0075-010
XU2	Same as XU1	
XU3	Same as XK1	
XU4	Same as XU1	
XU5	Sames as XK1	
XU6	Not Used	
XU7	Same as XU1	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

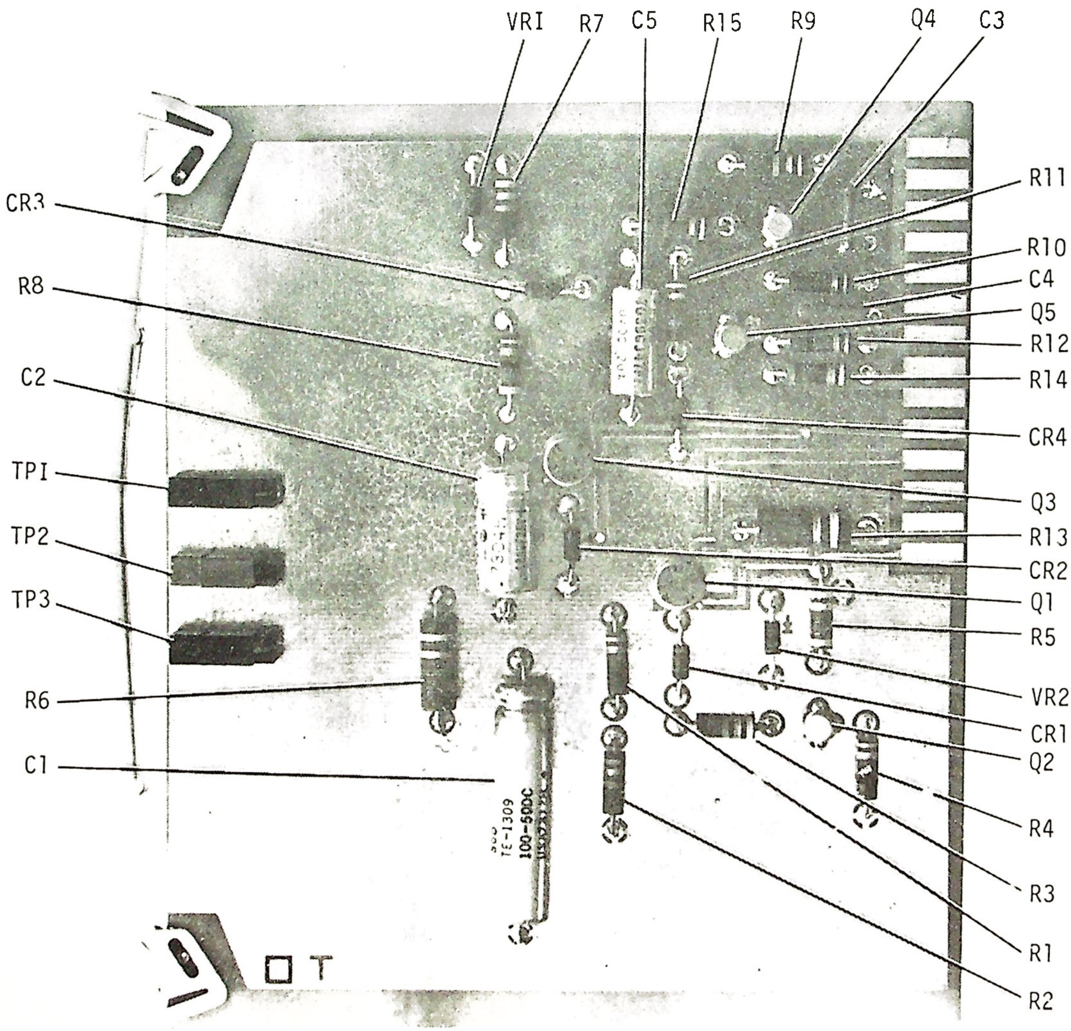


Figure 6-8. Power Control Regulator, A8.

REF DES	DESCRIPTION	CEMC PART NUMBER
	POWER CONTROL REGULATOR, A8	627-6683-001
C1	Capacitor, Fxd, Electrolytic, 100 μF, Minus 10%, Plus 75%, 50 VDCW	183-1281-080
C2	Capacitor, Fxd, Electrolytic, 180 μF, 20% Tol, 25 VDCW	184-8664-000
C3	Capacitor, Fxd, Ceramic, 0.1 μF, Plus 80% minus 20%, 25 VDCW	913-3806-000
C4	Same as C3	
C5	Capacitor, Fxd, Electrolytic, 47 μF, 20% Tol, 20 VDCW	184-9086-560
CR1	Diode, IN4003	353-6442-030
CR2	Same as CR1	
CR3	Same as CR1	
CR4	Same as CR1	
Q1	Transistor, 2N3053	352-0613-010
Q2	Transistor, 2N2222A	352-0661-020
Q3	Same as Q1	
Q4	Same as Q2	
Q5	Same as Q2	
R1	Resistor, Fxd, Composition, 1000 Ohms, 10% Tol, 1/2 Watt	745-1352-000
R2	Resistor, Fxd, Composition, 15 Kilohms, 10% Tol, 1/2 Watt	745-1401-000
R3	Resistor, Fxd, Composition, 22 Kilohms, 10% Tol, 1/2 Watt	745-1408-000
R4	Same as R1	
R5	Resistor, Fxd, Composition, 4700 Ohms, 10% Tol, 1/2 Watt	745-1380-000
R6	Resistor, Fxd, Composition, 820 Ohms, 10% Tol, 1 Watt	745-3349-000
R7	Same as R3	
R8	Resistor, Fxd, Composition, 47 Ohms, 10% Tol, 1/2 Watt	745-1296-000
R9	Same as R2	
R10	Resistor, Fxd, Composition, 1500 Ohms, 10% Tol, 1/2 Watt	745-1359-000
R11	Resistor, Fxd, Composition, 2700 Ohms, 10% Tol, 1/2 Watt	745-1370-000
R12	Same as R8	
R13	Resistor, Fxd, Composition, 1200 Ohms, 10% Tol, 1 Watt	745-3356-000
R14	Resistor, Fxd, Composition, 6800 Ohms 10% Tol, 1/2 Watt	745-1387-000
R15	Same as R11	
TP1	Jack, Tip Red	360-0495-030
TP2	Jack, Tip Orange	360-0495-040

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
TP3	Jack, Tip Black	360-0495-010
VR1	Diode, IN4740	353-6481-260
VR2	Same as VR1	

WARNING: DISCONNECT PRIMARY POWER SUPPLY BEFORE SERVICING.

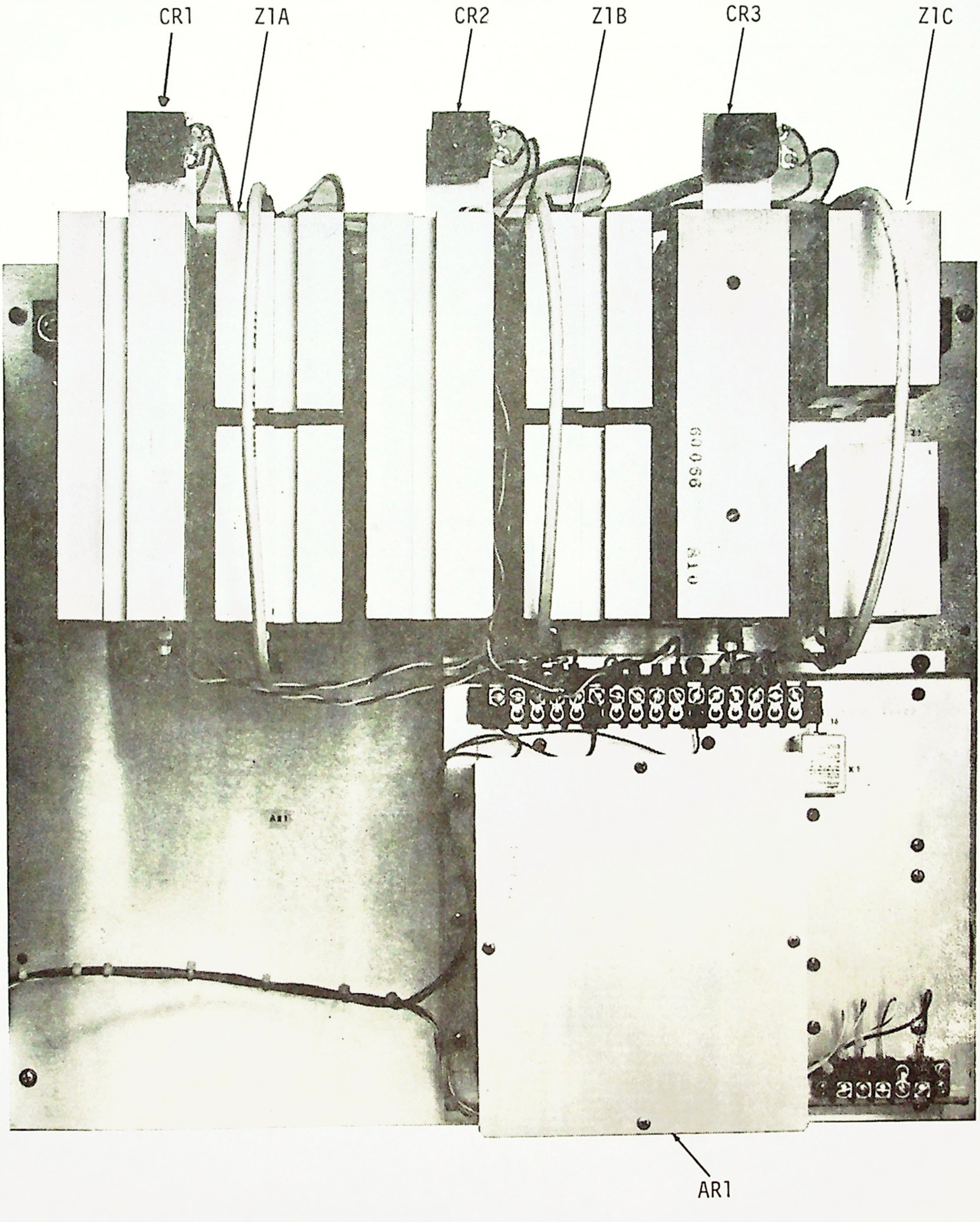


Figure 6-9. Power Control Panel, A9.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
	POWER CONTROL PANEL, A9	789-4342-002
AR1	SCR Gate Drive Assembly	627-5140-001
	Includes	
	Capacitor, Fxd, Ceramic 0.1 μF, Plus 80% Minus 20%, 25 VDCW -C1 Thru C3-	913-3806-000
	Connector, Electrical -J1 Thru J3-	372-5906-010
	Transformer -T1 Thru T3-	270-0313-020
	Terminal Board -TB1-	367-0024-000
	Terminal Board -TB2-	367-0013-000
	Card, Gate Drive -A1 Thru A3-	270-0313-030
K1	Relay	974-0076-020
XK1	Relay Socket	220-1543-000
CR1	Absorbor, Overvoltage	353-0283-100
CR2	Same as CR1	
CR3	Same as CR1	
Z1A	SCR Assembly	353-6551-010
Z1B	Same as Z1A	
Z1C	Same as Z1A	

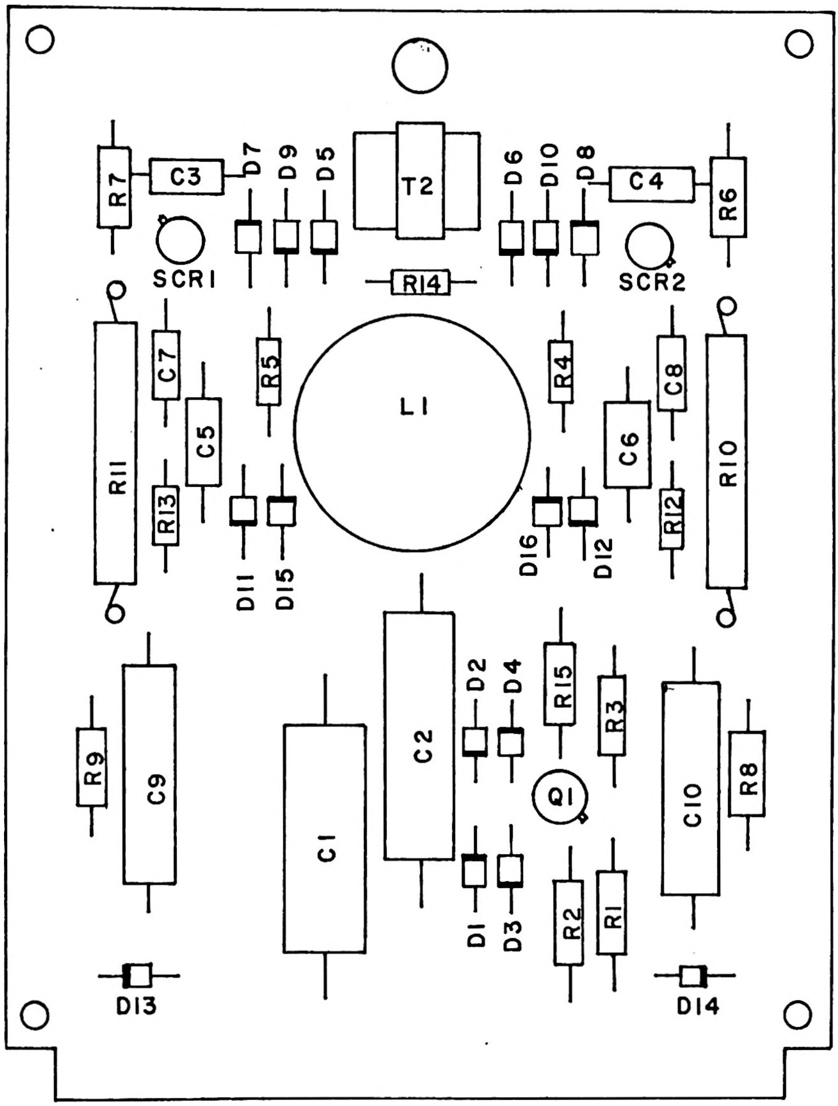


Figure 6-10. Gate Drive Card, A9AR1A1-A3

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
	GATE DRIVE CARD, A9AR1A1-A3	270-0313-030
C1	Capacitor, Fxd, Metallized Mylar 1.0 µF, 5% Tol, 200 VDC	933-0258-250
C2	Capacitor, Fxd, Metallized Mylar 2.0 µF, 5% Tol, 200 VDC	933-0258-290
C3	Capacitor, Fxd, Metallized Mylar 0.22 µF, 5% Tol, 200 VDC	933-0258-170
C4	Same as C3	
C5	Capacitor, Fxd, Electrolytic 10.0 µF, Minus 10% Plus 75%, 50V	183-1179-000
C6	Same as C5	
C7	Capacitor, Fxd, Electrolytic 2.7 µF, 10% Tol, 35 VDCW	184-7690-000
C8	Same as C7	
C9	Capacitor, Fxd, Electrolytic 220 µF, Minus 10% Plus 75%, 50 VDCW	184-5102-030
C10	Same as C9	
D1	Diode, IN4003	353-6442-030
D2 - D16	Same as D1	
L1	Reactor, Saturable	*C1-9028-315A
Q1	Transistor, 2N2219A	352-0661-010
R1	Resistor, Fxd, Metal Film 100 Ohm, 1% Tol, 1/2 Watt	705-7048-000
R2	Resistor, Fxd, Metal Film 2.21 Kilohm, 1% Tol, 1/2 Watt	705-7264-000
R3	Same as R2	
R4	Resistor, Fxd, Carbon Film 3.3 Kilohm, 10% Tol, 1/2 Watt	745-0914-770
R5	Same as R4	
R6	Resistor, Fxd, Composition 100 Ohm, 10% Tol, 1 Watt	745-3310-000
R7	Same as R6	
R8	Resistor, Fxd, Composition 4.7 Ohm, 5% Tol, 1 Watt	745-3542-000
R9	Same as R8	
R10	Resistor, Fxd, Wirewound 35 Ohm, 5% Tol, 14 Watt	747-8051-000
R11	Same as R10	
R12	Resistor, Fxd, Composition 5.6 Kilohm, 10% Tol, 1/2 Watt	745-1384-000
R13	Same as R12	
R14	Resistor, Fxd, Composition 120 Ohm, 5% Tol, 1/2 Watt	745-1314-000
R15	Resistor, Fxd, Metal Film 100 Kilohms, 1% Tol, 1/2 Watt	705-7192-000
SCR1	Silicon Controlled Rectifier 2N2323A	353-3540-010
SCR2	Same as SCR1	
T1	Not Used	
T2	Transformer	*A31-9010-4
		*Vendor Part Number

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

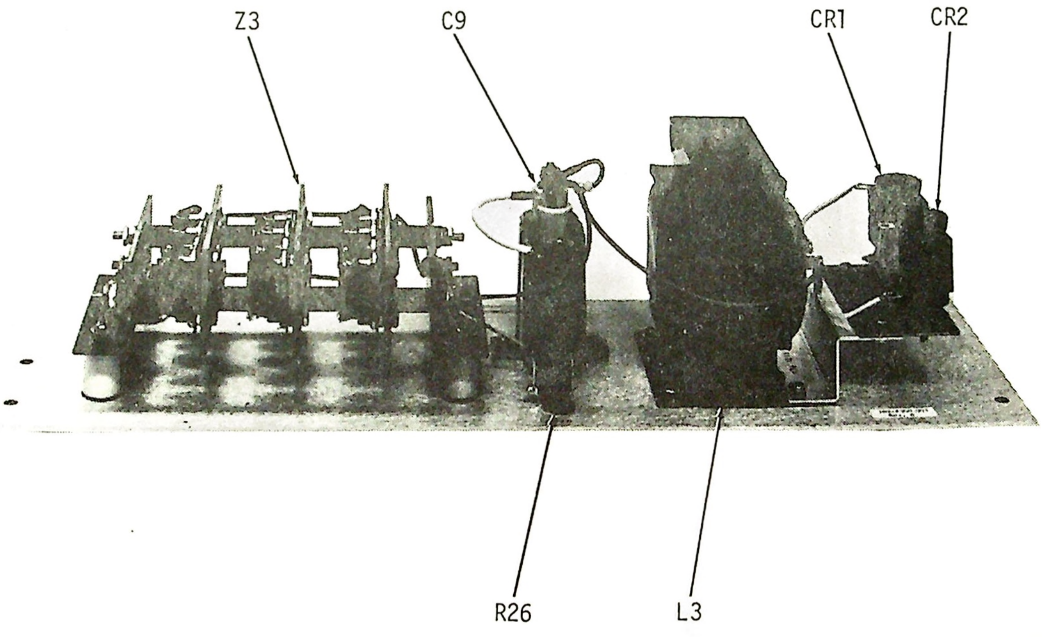


Figure 6-11. 2-kV Power Supply, A10.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	PART NUMBER
	2 KV Power Supply, A10	789-4358-001
C1 Through C8	Not Used	
C9	Capacitor, Fxd, Paper 0.05 μF, 10% Tol, 5000 VDCW	930-0728-000
L1	Not Used	
L2	Not Used	
L3	Choke, RF 1.5H Inductance	668-0201-010
R1 Through R25	Not Used	
R26	Resistor, Fxd, Wirewound 330 Ohms, 5% Tol, 26 Watts	747-1790-000
Z1	Not Used	
Z2	Not Used	
Z3	Rectifier	353-0435-010
1	Insulator, Standoff -Qty 4-	190-1156-000
CR1	Absorber, Overvoltage	353-0283-140
CR2	Same as CR1	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

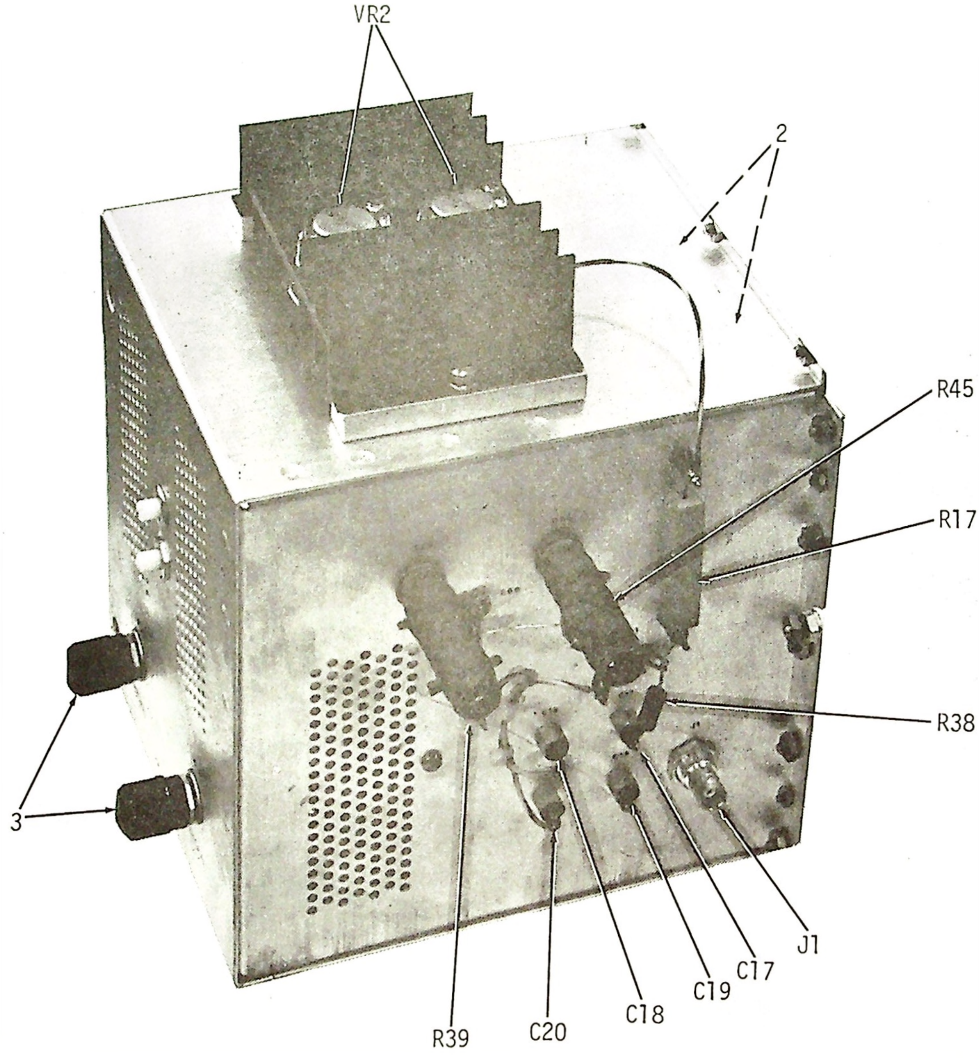


Figure 6-12. RF Driver Assembly, A11 (Sheet 1 of 2).

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

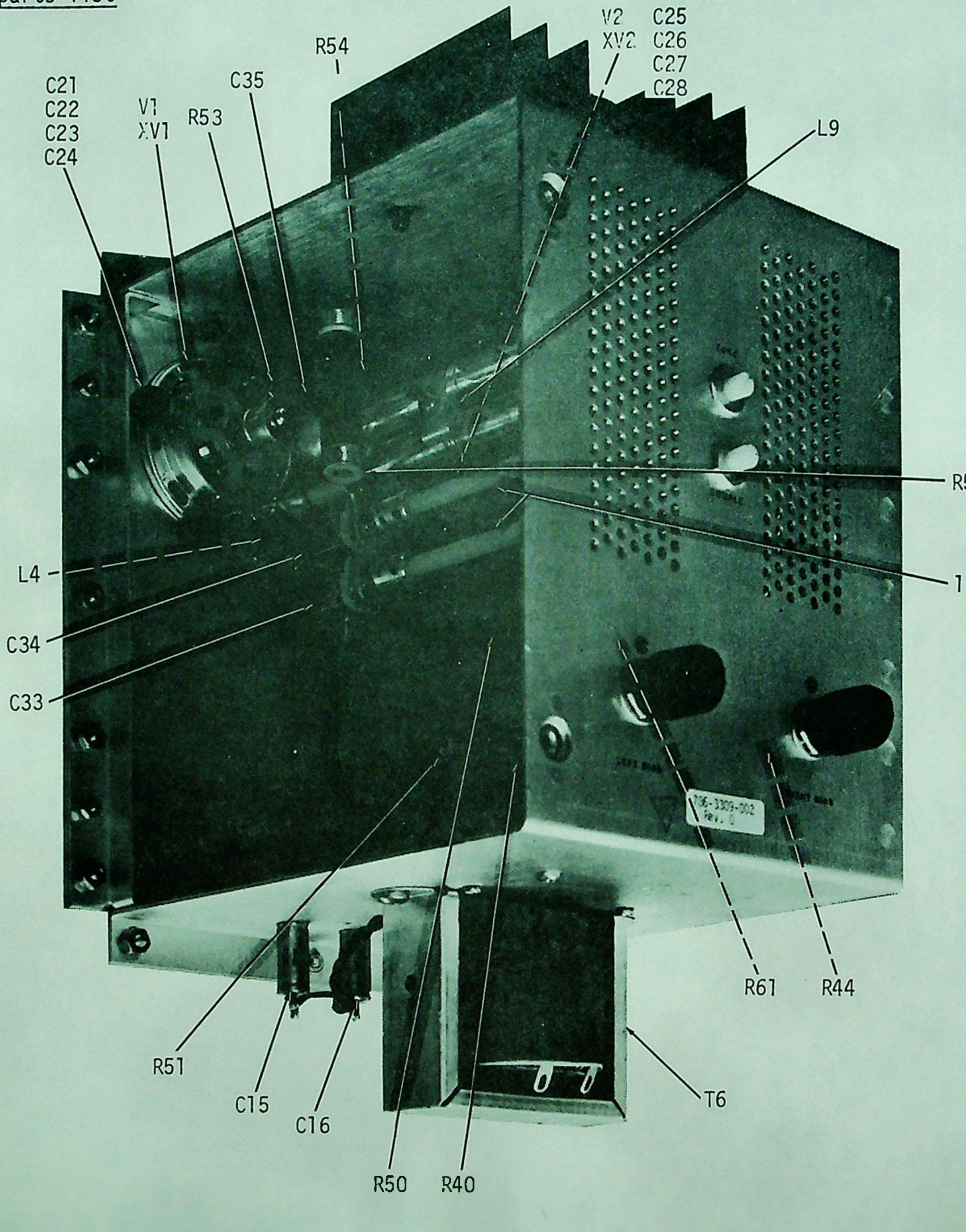


Figure 6-12. RF Driver Assembly, A11 (Sheet 2 of 2).

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
	RF DRIVER ASSEMBLY, A11	786-3309-002
C1 Through C14	Not Used	
C15	Capacitor, Fxd, Paper 0.1 µF, 10% Tol, 100 VDCW	241-0088-000
C16	Same as C15	
C17	Capacitor, Fxd, Ceramic 1000 pF, 20% Tol, 500 VDCW	913-4064-000
C18	Same as C17	
C19	Same as C17	
C20	Same as C17	
C21	Capacitor, Fxd, Ceramic 0.02 µF, 20% Tol, 500 VDCW	913-2142-000
C22 Through C28	Same as C21	
C29 Through C32	Not Used	
C33	Capacitor, Var, Air 3-18.7 pF, 1250 VDCW	922-0033-000
C34	Same as C33	
C35	Same as C17	
J1	Connector, Electrical 1 Contact	357-9248-010
L1	Not Used	
L2	Not Used	
L3	Not Used	
L4	Coil	786-3527-001
L5 Through L8	Not Used	
L9	Coil Includes	
	Rod (Qty 2)	786-3110-001
	Bar	786-3283-003
	Bar	786-3283-004
R1 Through R16	Not Used	
R17	Resistor, Fxd, Wirewound 200 Ohms, 10% Tol, 10 Watts	710-9054-000
R18 Through R37	Not Used	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
R38	Resistor, Fxd, Wirewound 5 Ohms, 1% Tol, 2.5 Watts	746-9441-000
R39	Resistor, Fxd, Wirewound 1 Ohm, 1% Tol, 36 Watts	710-5076-010
R40	Resistor, Var, Wirewound, 500 Ohms, 10% Tol, 50 Watts	735-1013-410
R41	Not Used	
R42	Not Used	
R43	Not Used	
R44	Same as R40	
R45	Same as R39	
R46 Through R49	Not Used	
R50	Resistor, Fxd, Wirewound 820 Ohms, 5% Tol, 11 Watts	746-6158-000
R51	Resistor, Fxd, Wirewound 160 Ohms, 5% Tol, 10 Watts	710-2921-000
R52	Not Used	
R53	Resistor, Fxd, Composition 47 Ohms, 10% Tol, 1 Watt	745-3296-000
R54	Same as R53	
R55	Not used	
R56	Not Used	
R57	Resistor, Fxd, Composition, 50 Ohms, 10% Tol, 16.5 Watts	712-0129-000
R58 Through R60	Not Used	
R61	Same as R51	
T1 Through T5	Not Used	
T6	Transformer, Pwr, Step-Down	662-0394-010
V1	Electron Tube, 4CX250B	256-0121-000
V2	Same as V1	
VR2	Semiconductor Device, Set	353-6015-000
XV1	Socket, Electron Tube 8 Pins	220-1294-000
XV2	Same as XV1	
1	Rod, Extension -Qty 2-	786-3312-001
2	Chimney, Air Socket -Qty 2-	220-1466-000
3	Knob, Plastic -Qty 2-	281-0122-000

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

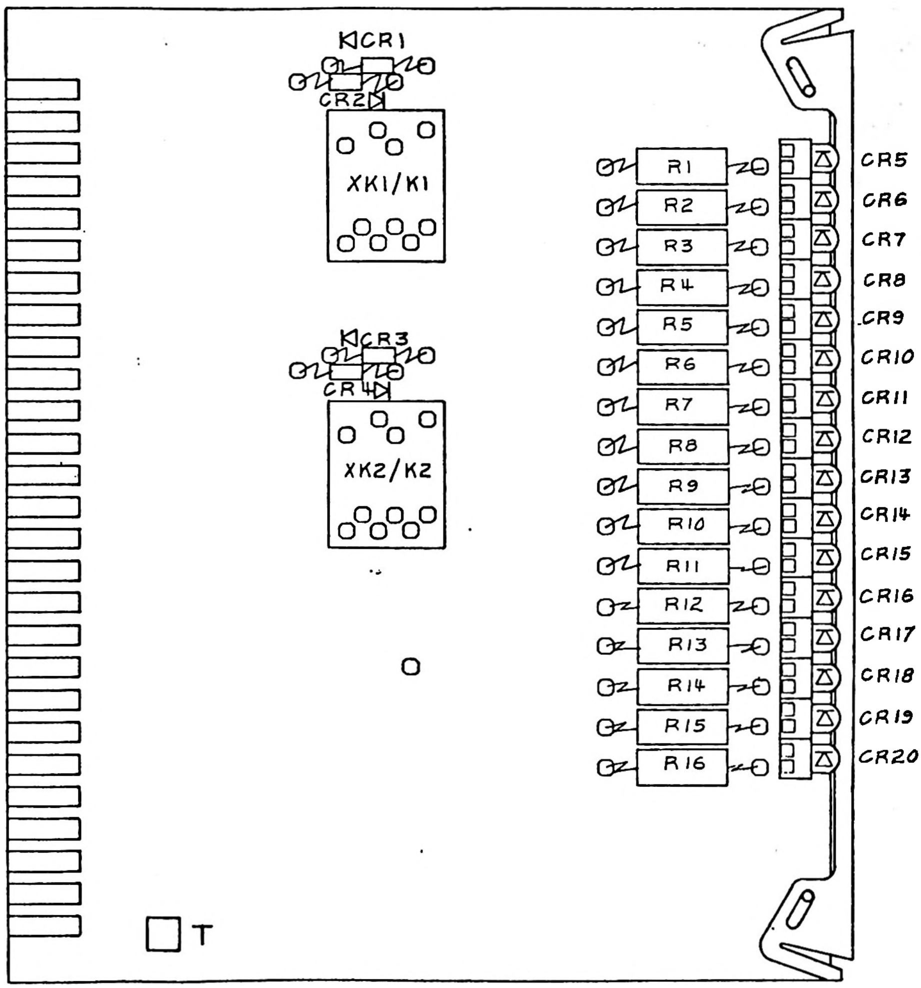


Figure 6-13. Latching Relay and Status Board, A12.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
	LATCHING RELAY AND STATUS BOARD, A12	648-8082-001
CR1	Diode, IN4004	353-6442-040
CR2	Same as CR1	
CR3	Same as CR1	
CR4	Same as CR1	
CR5	LED, Yellow	353-0293-020
CR6 Through CR20	Same as CR5	
K1	Relay, Latching, 2C, 24V	970-0004-030
K2	Same as K1	
R1	Resistor, Fxd, Composition 2.7 Kilohms, 10% Tol, 1 Watt	745-3370-000
R2 Through R16	Same as R1	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

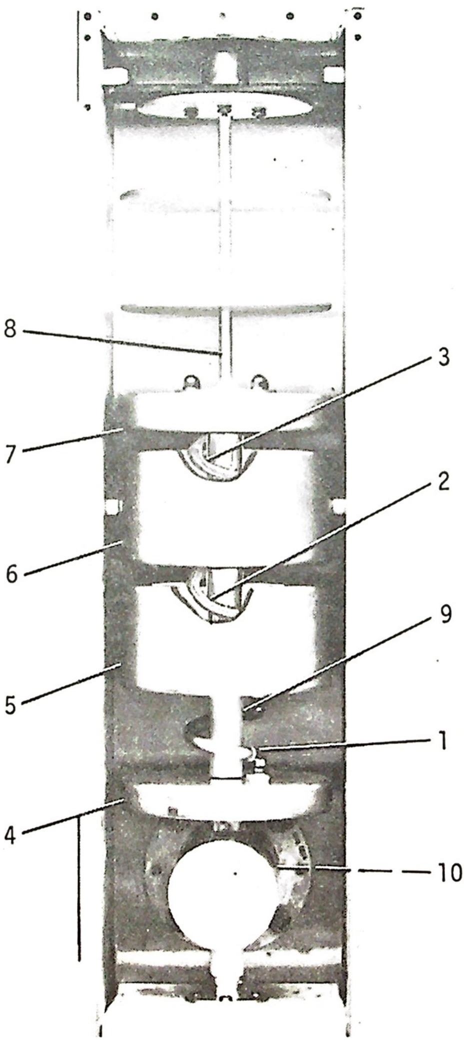


Figure 6-14. RF Output Low-Pass Filter, A13.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
*	RF OUTPUT LOW-PASS FILTER, A13	786-3451-001
1	Coil Assy	786-3367-001
2	Coil Assy	786-3369-001
3	Coil Assy	786-3371-001
4	Capacitor	786-3372-001
5	Capacitor	786-3373-001
6	Capacitor	786-3374-001
7	Capacitor	786-3375-001
8	Capacitor	786-3448-001
9	Capacitor, Rod	786-3435-001
10	Insulator, Disc	786-3469-001

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

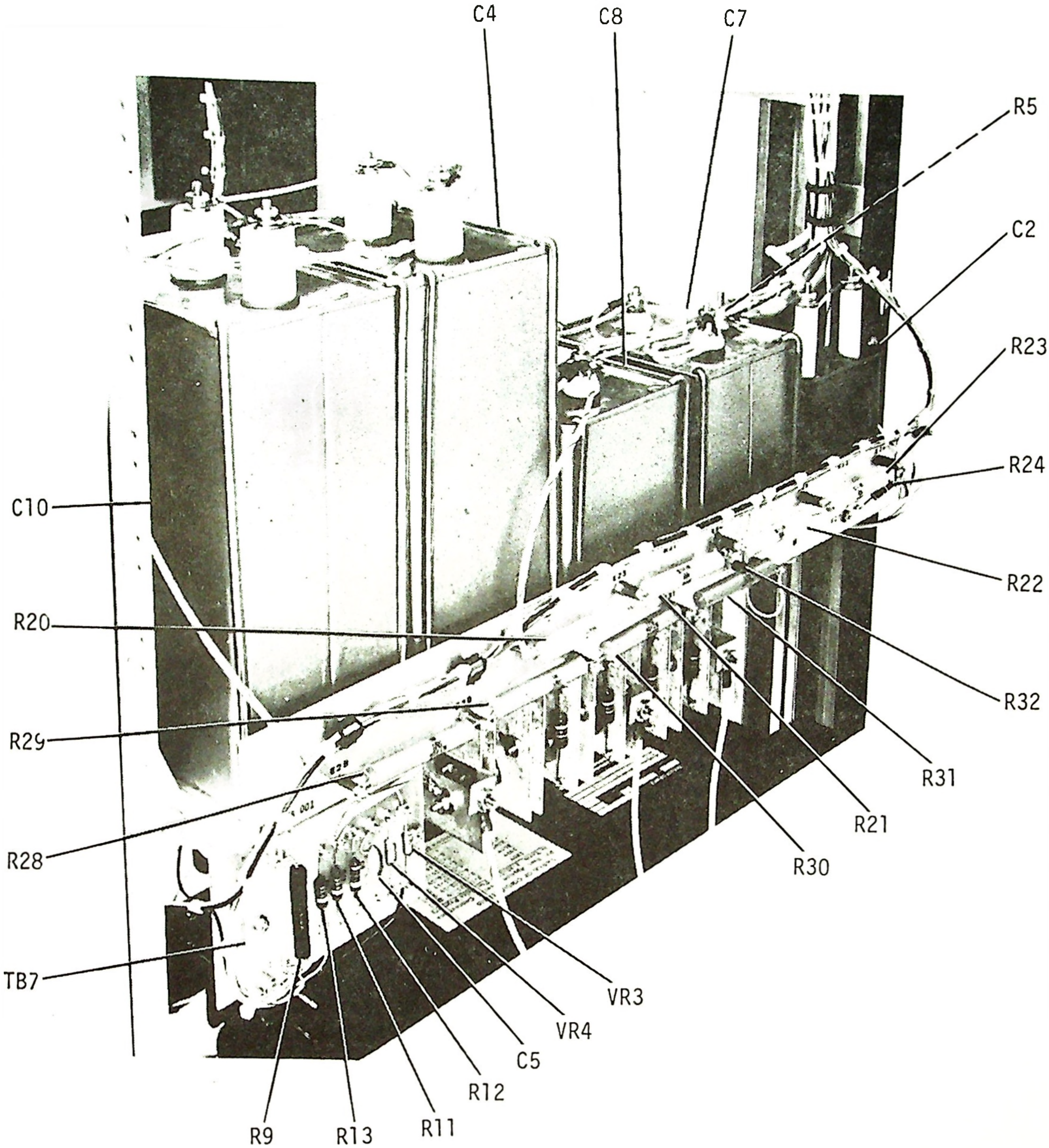


Figure 6-15. Power Supply Filter, A14 (Sheet 1 of 2).

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

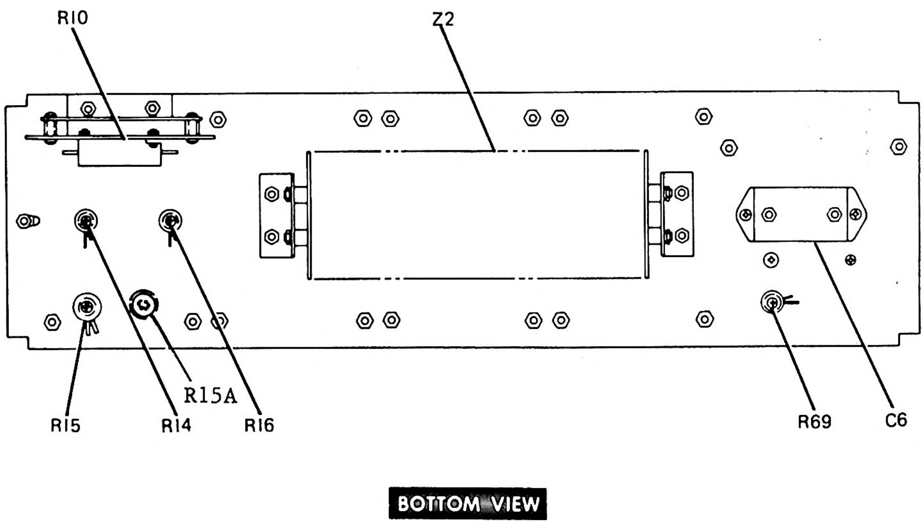


Figure 6-15. Power Supply Filter, A14 (Sheet 2 of 2).

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
	POWER SUPPLY FILTER, A14	786-3583-001
C1	Not Used	
C2	Capacitor, Fxd, Paper, 0.03 µF 10% Tol, 15,000 VDCW	930-0614-000
C3	Not Used	
C4	Capacitor, Fxd, Paper, 10 µF, 10% Tol, 2500 VDCW	962-4204-000
C5	Capacitor, Fxd, Ceramic, 0.01 µF, 20% Tol, 500 VDCW	913-1188-000
C6	Capacitor, Fxd, Mica, 0.022 µF, 2% Tol, 2000 VDCW	938-2129-000
C7	Capacitor, Fxd, Paper, 12 µF, 10% Tol, 1500 VDCW	962-4246-000
C8	Same as C7	
C9	Not Used	
C10	Same as C4	
R1 Through R4	Not Used	
R5	Resistor, Fxd, Wirewound 330 Ohms, 5% Tol, 26 Watts	747-1790-000
R6	Not Used	
R7	Not Used	
R8	Not Used	
R9	Resistor, Fxd, Wirewound, 0.25 Ohms, 1% Tol, 10 Watts	747-9451-000
R10	Resistor, Fxd, Wirewound, 4 Ohms, 10% Tol. 100 Watts	710-5076-060
R11	Resistor, Fxd, Composition, 1200 Ohms 5% Tol, 1 Watt	745-3355-000
R12	Resistor, Fxd, Composition, 3600 Ohms 5% Tol, 1 Watt	745-3375-000
R13	Same as R11	
R14	Resistor, Fxd, Wirewound, 0.5 Ohms, 1% Tol, 36 Watts	710-5076-030
R15, R15A	Same as R10	
R16	Resistor, Fxd, Wirewound, 1 Ohm, 1% Tol, 36 Watts	710-5076-010
R17	Not Used	
R18	Not Used	
R19	Not Used	
R20	Resistor, Fxd, Film 200 Kilohms, 1% Tol, 2 Watts	705-1493-050
R21	Same as R20	
R22	Same as R20	
R23	Same as R20	

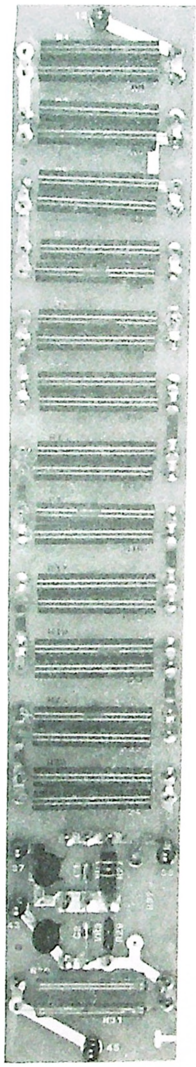
WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

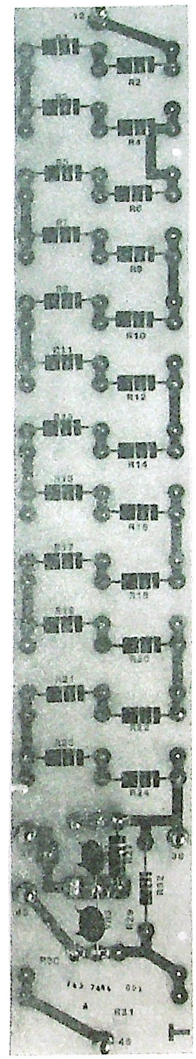
REF DES	DESCRIPTION	CEMC PART NUMBER
R24	Resistor, Fxd Composition, 47 Kilohms, 10% Tol, 1 Watt	745-3422-00
R25	Not Used	
R26	Not Used	
R27	Not Used	
R28	Resistor, Fxd, Film, 1.0 Megohm 1% Tol, 2 Watts	705-4254-000
R29	Same as R28	
R20	Same as R28	
R31	Same as R28	
R32	Same as R24	
R33 Through R68	Not Used	
R69	Resistor, Fxd, Wirewound 310 Ohms, 5% Tol, 14 Watts	747-0754-000
TB1 Through TB6	Not Used	
TB7	Board, Terminal	786-3126-001
VR1	Not Used	
VR2	Not Used	
VR3	Diode	353-3121-000
VR4	Same as VR3	
Z1	Not Used	
Z2	Rectifier	353-0434-010

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

A15 A



A15 B



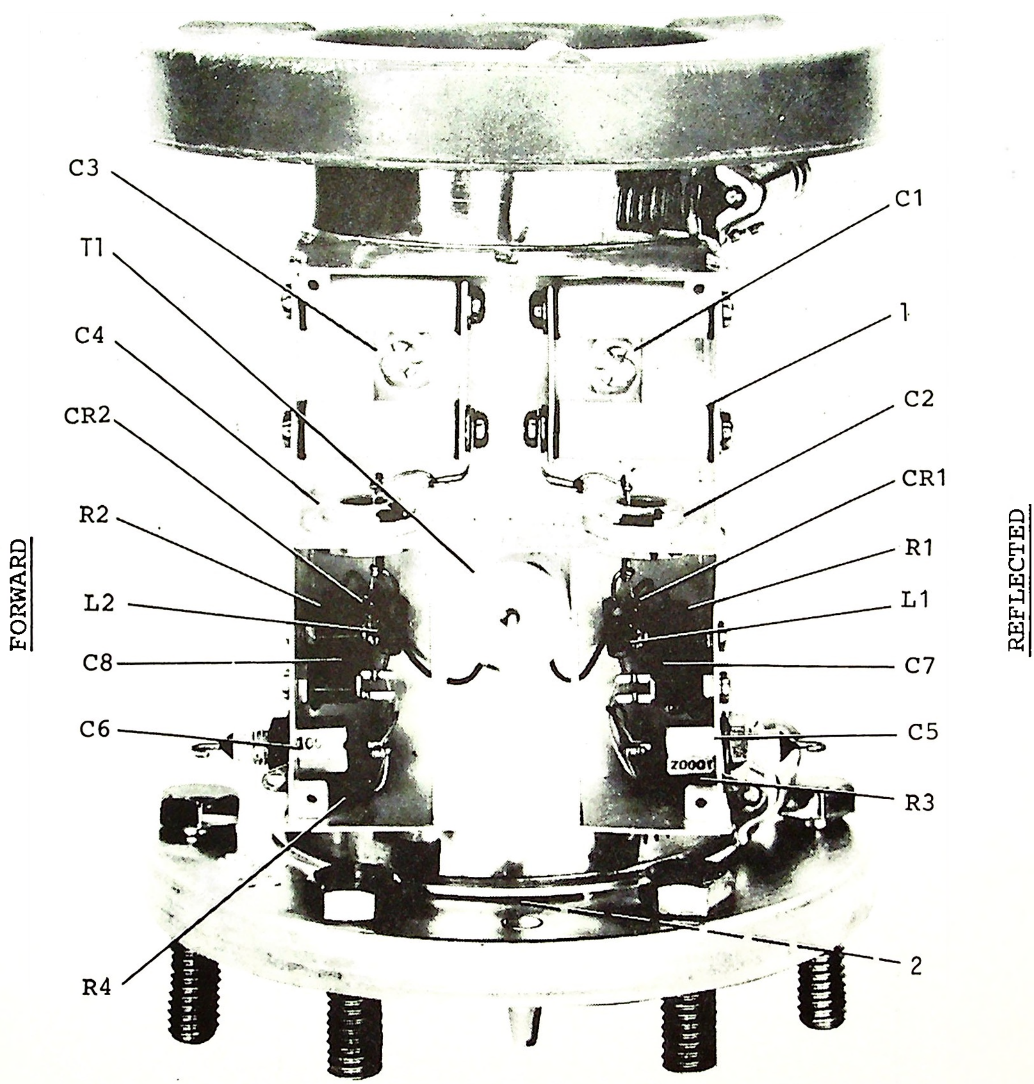
KO1-(9)

Figure 6-16. Metering Multiplier Board, A15

REF DES	DESCRIPTION	CEMC PART NUMBER
	METERING MULTIPLIER BOARD, A15(A)	643-7445-001
C1	Capacitor, Fxd, Ceramic, 0.C1μF 20% Tol, 500 VDCW	913-1188-000
C2	Same as C1	
R1	Resistor, Fxd, Film, 750 Kilohms, 1% Tol, 2 Watts	705-1493-020
Through R24	Same as R1	
R25, R26	Not Used	
R27	Resistor, Fxd, Composition, 180 kilohms 10% Tol, 2 Watt	745-5746-000
R28	Not Used	
R29	Resistor, Fxd, Film, 5110 Ohms, 1% Tol, 1/2 Watt	705-7130-000
R30, R31	Resistor, Fxd, Film, 1.0 Megohm, 1% Tol, 2 Watts	705-4254-000
VR1, VR3	Diode	353-1339-000
VR2	Not Used	

REF DES	DESCRIPTION	CEMC PART NUMBER
REMOTE	METERING MULTIPLIER BOARD, A15(B)	643-7446-001
C1	Capacitor, Fxd, Ceramic, O.01μF 20% Tol, 500 VDCW	913-1188-000
C2	Same as C1	
R1 Through R24	Resistor, Fxd, Carbon, 180 Kilohms, 5% Tol, 2 Watts	745-5746-000
R25, R26	Not Used	
R27	Resistor, Fxd, Composition, 1800 ohms 10% Tol, 2 Watt	745-5662-000
* R28 Through R31	Not Used	
R32	Resistor, Fxd, Composition, 10K ohms, 1W	745-3393-000
VR1	Zener Diode, 100V	353-1339-000
VR2	Not Used	
VR3	Zener, Diode, 6.8V	745-3393-000

TO ANTENNA



TO TRANSMITTER

Figure 6-17. Directional Coupler, A16.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
	DIRECTIONAL COUPLER, A16	786-3264-001
C1	Capacitor	786-3059-001
C2	Capacitor, Fxd, Mica, 250 pF, 2% Tol, 1000 VDCW	912-4133-030
C3	Same as C1	
C4	Same as C2	
C5	Capacitor, Fxd, Ceramic, 1000 pF, Plus 80% Minus 20%, 500 VDCW	913-1292-000
C6	Same as C5	
C7	Capacitor, Fxd, Mica, 10 pF, 10% Tol, 500 VDCW	912-2754-000
C8	Same as C7	
CR1	Diode	353-3691-010
CR2	Same as CR1	
L1	Coil, RF 3.3 mH, 10% Tol	240-0791-000
L2	Same as L1	
R1	Resistor, Fxd, Composition 33 Ohms, 5% Tol, 1/2 Watt	745-1288-000
R2	Same as R1	
R3	Resistor, Var, Wirewound, 20 Kilohms, 5% Tol, 3/4 Watt	381-1721-160
R4	Same as R3	
T1	Toroid	786-3075-001
1	Standoff, Insulator -Qty 4-	190-1144-000
2	Connector, Assy, Electrical	013-1876-020

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

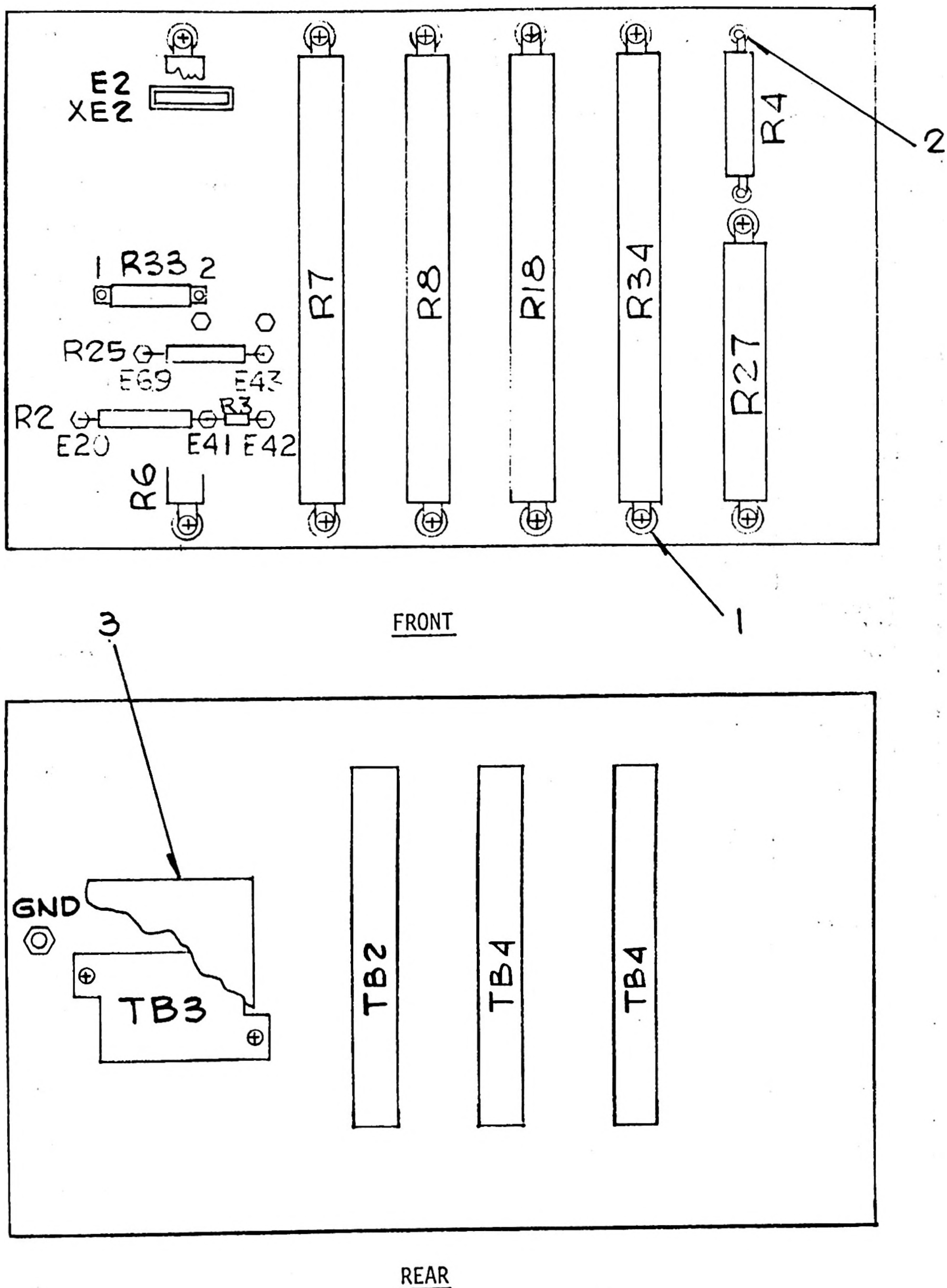


Figure 6-18. Bleeder Resistor Panel, A17.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

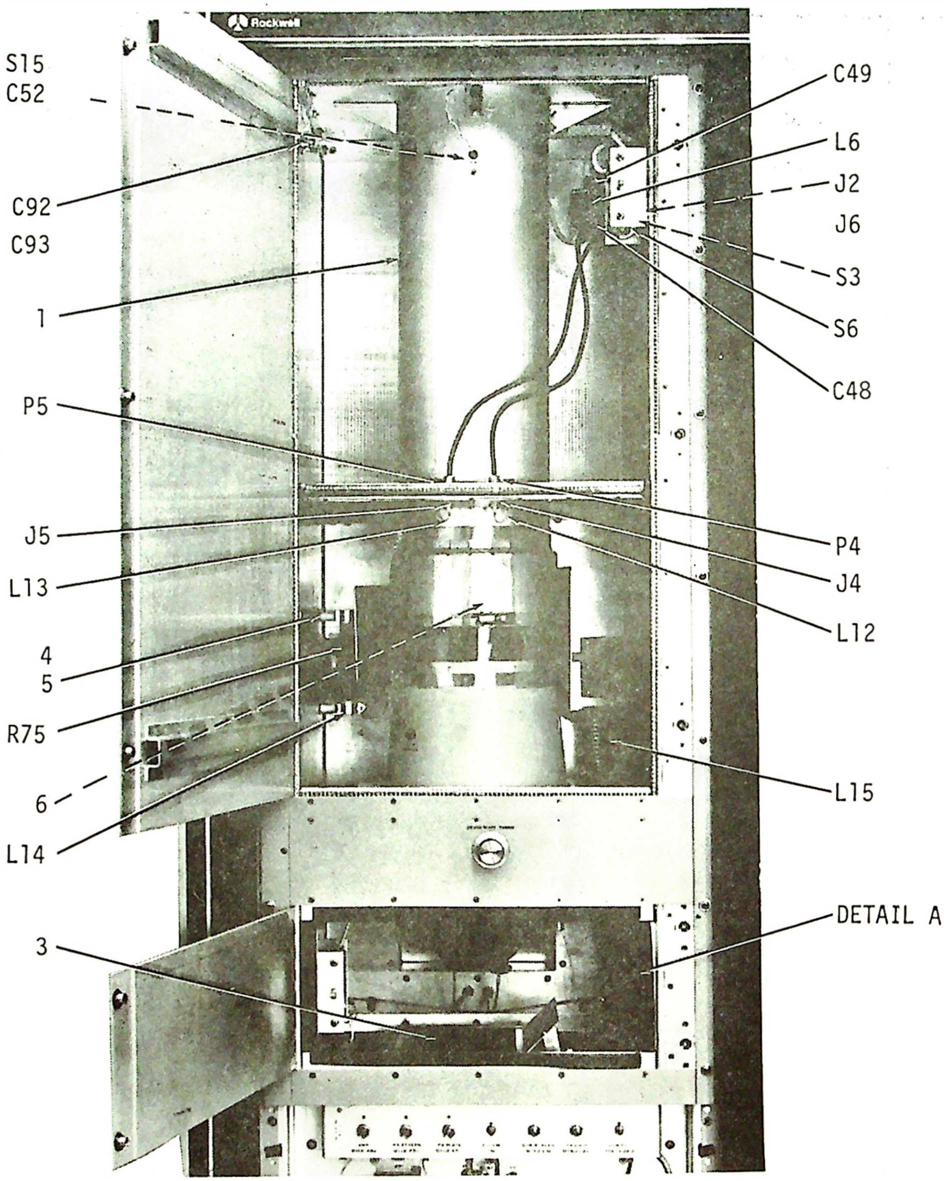
parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
	BLEEDER RESISTOR PANEL,A17	786-3154-002
E1	Not Used	
E2	Arrestor, Lightning	013-1332-020
R1	Not Used	
R2	Resistor, Fxd, Film, 400 Kilohms, 1% Tol, 2 Watts	705-1457-210
R3	Resistor, Fxd, Composition, 47 Kilohms, 10% Tol, 1 Watt	745-3422-000
R4	Resistor, Fxd, Wirewound, 330 Ohms, 5% Tol, 26 Watts	747-1790-000
R5	Not Used	
R6	Resistor Fxd, Wirewound 18 Ohms, 5% Tol, 210 Watts	746-6662-000
R7	Resistor, Fxd, Wirewound, 100 Kilohms, 5% Tol, 210 Watts	746-6737-000
R8	Same as R7	
R9 Through R17	Not Used	
R18	Resistor, Fxd, Wirewound 5.1 Kilohms, 5% Tol, 210 Watts	746-6817-000
R19 Through R24	Not Used	
R25	Resistor, Fxd, Wirewound, 20 Kilohms, 10% Tol, 10 Watts	710-9067-000
R26	Not Used	
R27	Resistor, Fxd, Wirewound, 82 Kilohms, 5% Tol, 113 Watts	747-3834-000
R28 Through R32	Not Used	
R33	Resistor, Fxd, Wirewound 10 Ohms, 1% Tol, 26 Watts	747-1646-000
R34	Resistor, Fxd, Wirewound, 20 Kilohms, 5% Tol, 210 Watts	746-6723-000
TB1	Not Used	
TB2	Board, Terminal 18 Terminals	367-4180-000
TB3	Board, Terminal 3 Terminals	367-1188-000
TB4	Board,Terminal 18 Terminals -Qty 2-	367-4180-000
XE1	Not Used	
XE2	Arrestor, Lightning, Mtg	013-1332-010

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
1	Standoff, Insulator -Qty 12-	190-0025-000
2	Standoff, Insulator -Qty 2-	190-1145-000
3	Plexiglass Cover	648-8101-001

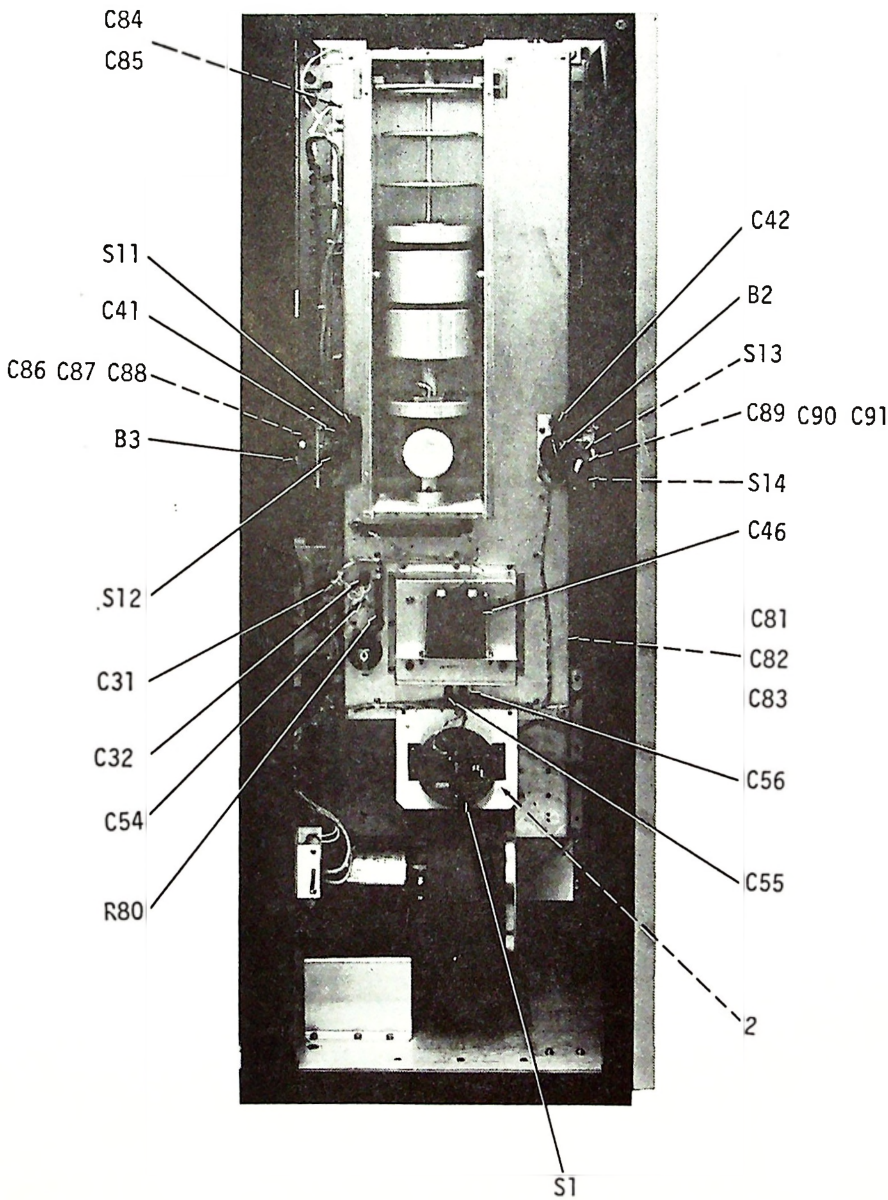
WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.



FRONT VIEW

Figure 6-19. Power Amplifier Cavity, A18 (Sheet 1 of 3).

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.



REAR VIEW

Figure 6-19. Power Amplifier Cavity, A18 (Sheet 2 of 3).

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

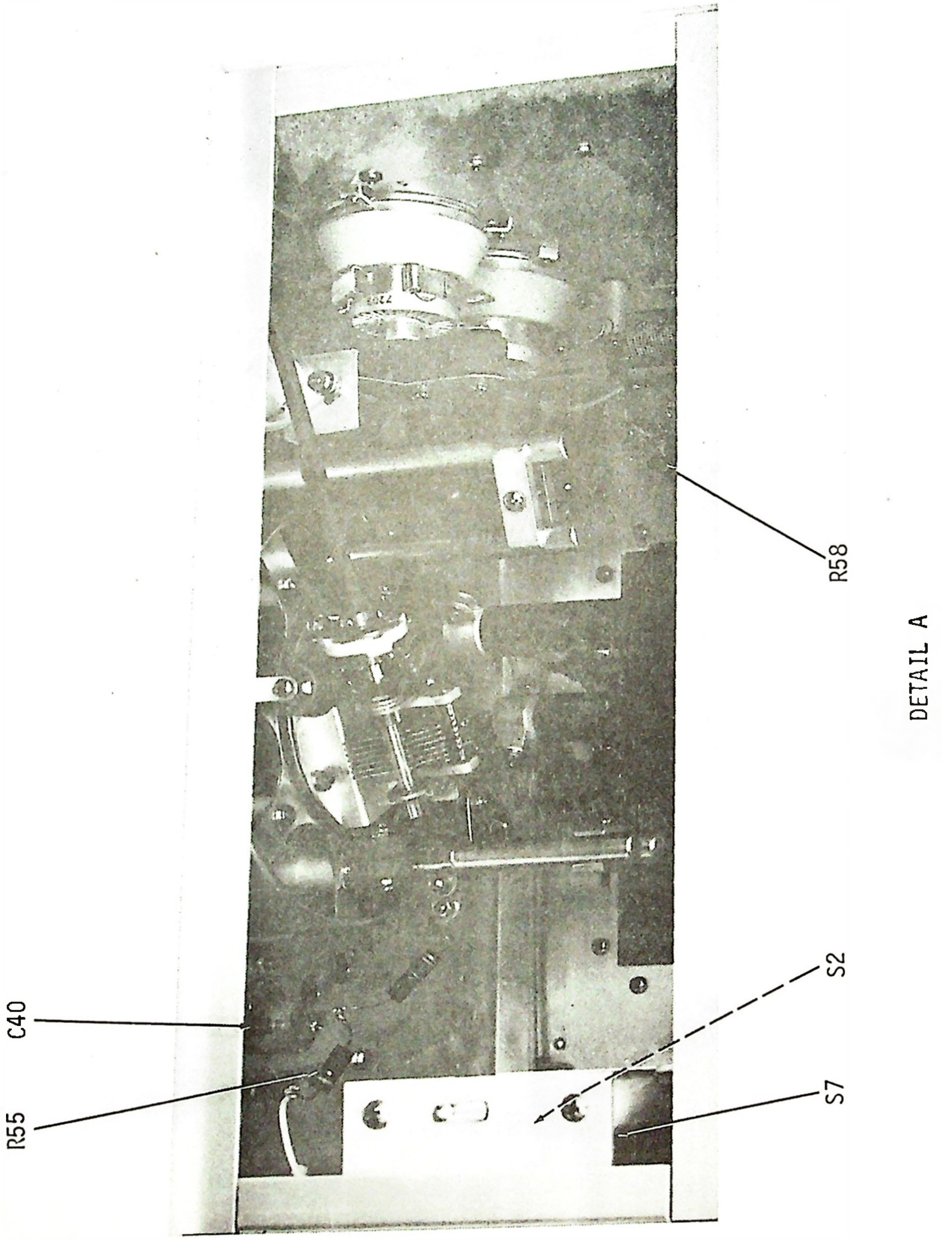


Figure 6-19. Power Amplifier Cavity, A18 (Sheet 3 of 3).

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
	POWER AMPLIFIER CAVITY, A18	786-3335-003
B1	Not Used	
B2	Motor, AC 115 VAC	230-0581-010
B3	Same as B2	
C1 Through C30	Not Used	
C31	Capacitor, Fxd, Ceramic, 1000 pF 20% Tol, 4000 VDCW	913-3120-020
* C32	Same as C31	
C33 Through C39	Not Used	
C40	Capacitor, Fxd, Ceramic 310 pF, 5% Tol, 2500 VDCW	913-0845-000
C41	Capacitor, Fxd, Paper 0.47 μF, 20% Tol, 400 VDCW	913-6849-000
C42	Same as C41	
C43	Not Used	
C44	Not Used	
C45	Not Used	
C46	Capacitor, Fxd, Paper 10 μF, 10% Tol, 1KVDCW	930-0038-000
C47	Not Used	
C48	Capacitor, Fxd, Ceramic 500 pF, Plus 50% Minus 20%, 20,000 VDCW	913-1101-000
C49	Same as C48	
C50	Not Used	
C51	Not Used	
C52	Capacitor, Fxd, Ceramic 100 pF, 10% Tol, 15,000 VDCW	913-5113-050
C53	Not Used	
C54	Capacitor, Fxd, Ceramic 1000 pF, 20% Tol, 2000 VDCW	913-4843-000
C55	Capacitor, Fxd, Paper 0.1 μF, 10% Tol, 600 VDCW	214-0090-000
C56	Same as C55	
C57 Through C80	Not Used	
C81	Capacitor, Fxd, Ceramic 1000 pF, 20% Tol, 5000 VDCW	913-0101-000
C82	Capacitor, Fxd, Ceramic 1000 pF, 20% Tol, 500 VDC	913-4064-000

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
C83	Same as C82	
C84	Same as C82	
C85	Same as C82	
C86	Capacitor, Fxd, Ceramic 0.1 µF, Plus 80% Minus 20%, 500 VDCW	913-3152-000
C87 Through C91	Same as C86	
C92	Same as C82	
C93	Same as C82	
J1	Not Used	
J2	Connector, Electrical 1 Contact	357-9248-010
J3	Not Used	
J4	Connector, Electrical 1 Contact	357-9670-000
J5	Same as J4	
J6	Same as J2	
L1 Through L5	Not Used	
L6	Choke, RF	786-3548-001
L7 Through L11	Not Used	
L12	Inductive Coupling Loop, 1" #20 Buss	421-2020-000
L13	Same as L12	
L14	Choke, RF	786-3673-001
L15	Choke, Static Drain	640-3527-00
P1	Not Used	
P2	Not Used	
P3	Not Used	
P4	Connector, Electrical 1 Contact	357-9292-000
P5	Same as P4	
R1 Through R54	Not Used	
R55	Resistor, Fxd, Composition 22 Ohms, 10% Tol, 2 Watts	745-5582-000
R56	Not Used	
R57	Not Used	
R58	Resistor, Fxd, Composition 22 Ohms, 20% Tol, 15 Watts	712-0002-000
R59 Through R74	Not Used	
R75	Resistor, Fxd, Composition 50 Ohms, 20% Tol, 60 Watts	712-0070-000
R80	Resistor, Fxd, Wirewound 1.0 Kilohm, 5% Tol, 26 Watts	747-1686-000

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
S1	Switch, Pressure	266-8384-090
	SPDT Contact Arrangement	
S2	Switch, Sensitive	260-0025-000
	SPDT Contact Arrangement	
	Includes	
	Actuator	260-0026-000
S3	Same as S2	
S4	Not Used	
S5	Not Used	
S6	Shorting Switch	627-9743-004
	Includes	
	Spring, Shorting Switch	540-5342-002
	Strap, Grounding	304-6000-000
	Contact, Shorting	542-1773-002
	Shaft, Flat, Straight	627-9786-001
	Insulator, Standoff	190-0026-000
S7	Same as S6	
S8	Not Used	
S9	Not Used	
S10	Not Used	
S11	Switch, Sensitive	266-3081-000
	SPDT Contact Arrangement	
S12	Same as S11	
S13	Same as S11	
S14	Same as S11	
S15	Switch, Thermostatic	267-0243-100
1	Conductor, Center, Cavity	786-3124-001
2	Duct, Blower	786-3026-001
3	Shield, RF	786-3095-001
4	Ceramic Post	190-1149-000
	-Qty 2-	
5	Clamp	516-6730-001
	-Qty 2-	
6	Tube Clip	265-9020-000

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

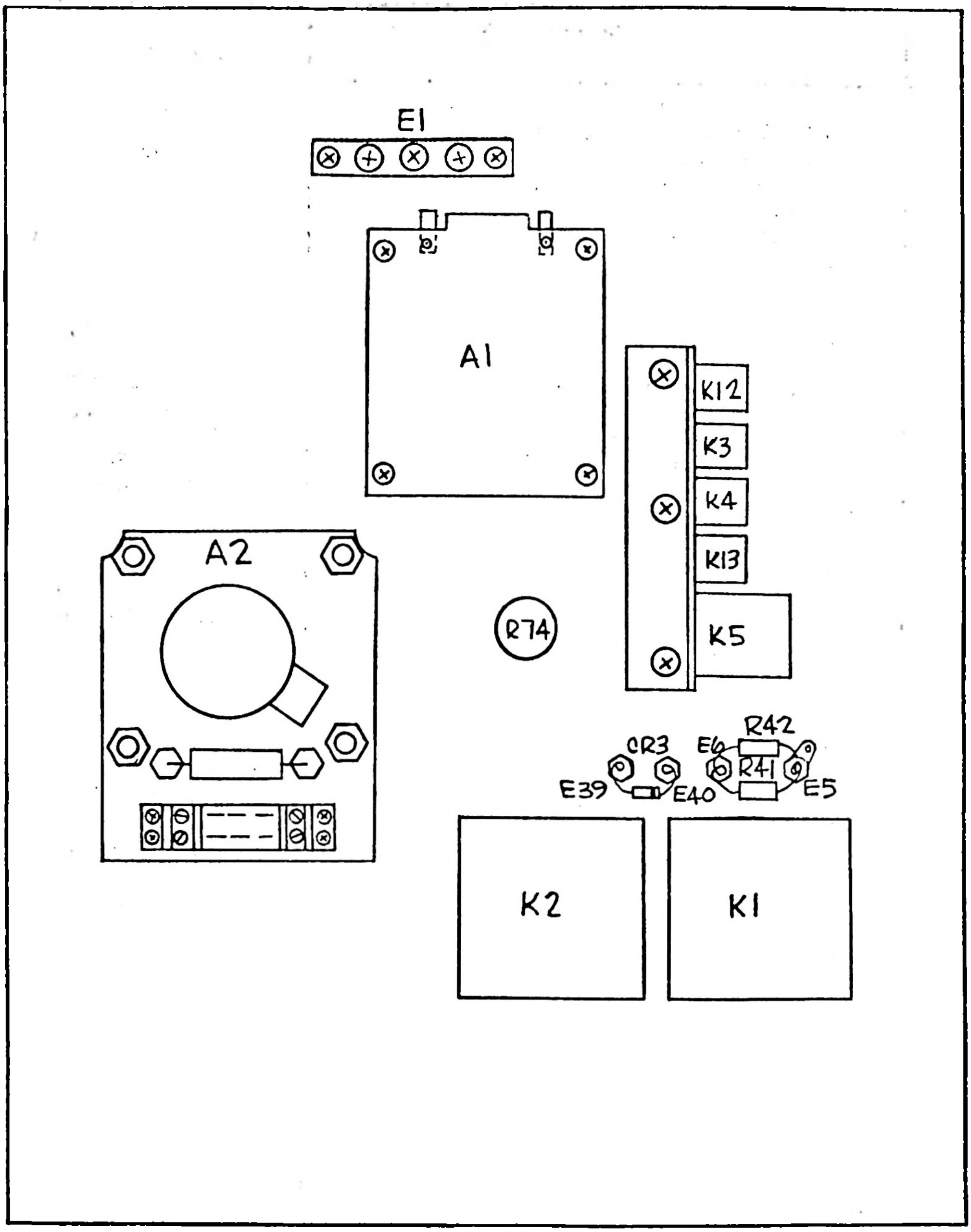


Figure 6-20. Component Panel, A19.

REF DES	DESCRIPTION	CEMC PART NUMBER
	COMPONENT PANEL, A19	648-8124-001
A1	Power Failure Recycle Board See breakdown on page 6-65	640-3466-001
A2	Variac Drive Assembly See breakdown on page 6-67	648-8104-001
CR1	Diode, IN645	353-2607-000
CR2	Same as CR1	
CR3	Diode, IN5550	353-3718-040
CR4	Same as CR1	
CR5	Same as CR1	
CR6	Not Used	
CR7	Not Used	
CR8	Not Used	
CR9	Same as CR1	
CR10	Not Used	
CR11	Not Used	
CR12	Same as CR1	
K1	Relay, Contactor, 28V Coil 3A 40 Amp Contacts 1B 10 Amp Contact 1C 10 Amp Contact	401-1607-000
K2	Relay, Contactor, 28V Coil 5A 10 Amp Contacts 1C 10 Amp Contact	401-1614-000
K3	Relay, 24 VDC Coil 3C Low Level Contacts	970-0007-180
K4	Relay, Time Delay, 30 sec. 24V Coil, 2C 10 Amp Contacts	402-0489-190
K5	Relay, Phase Monitor 190-270V, SPDT 10A Contacts	403-0038-010
K6 Through K11	Not Used	
K12	Same as K3	
K13	Same as K3	
R1 Through R40	Not Used	
R41	Resistor, Fxd, Composition 820 Ohms, 10% Tol, 2 Watt	745-5649-000
R42	Same as R41	
R43 Through R73	Not Used	
R74	Resistor, Fxd, Wirewound 0.5 Ohm, 10% Tol, 100 Watts	710-5076-050
XK1	Not Used	
XK2	Not Used	
XK3	Relay Socket	220-0010-010

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
XK4	Same as XK3	
XK5	Relay Socket, Octal	220-1121-000
XK6 Through XK11	Not Used	
XK12	Same as XK3	
XK13	Same as XK3	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

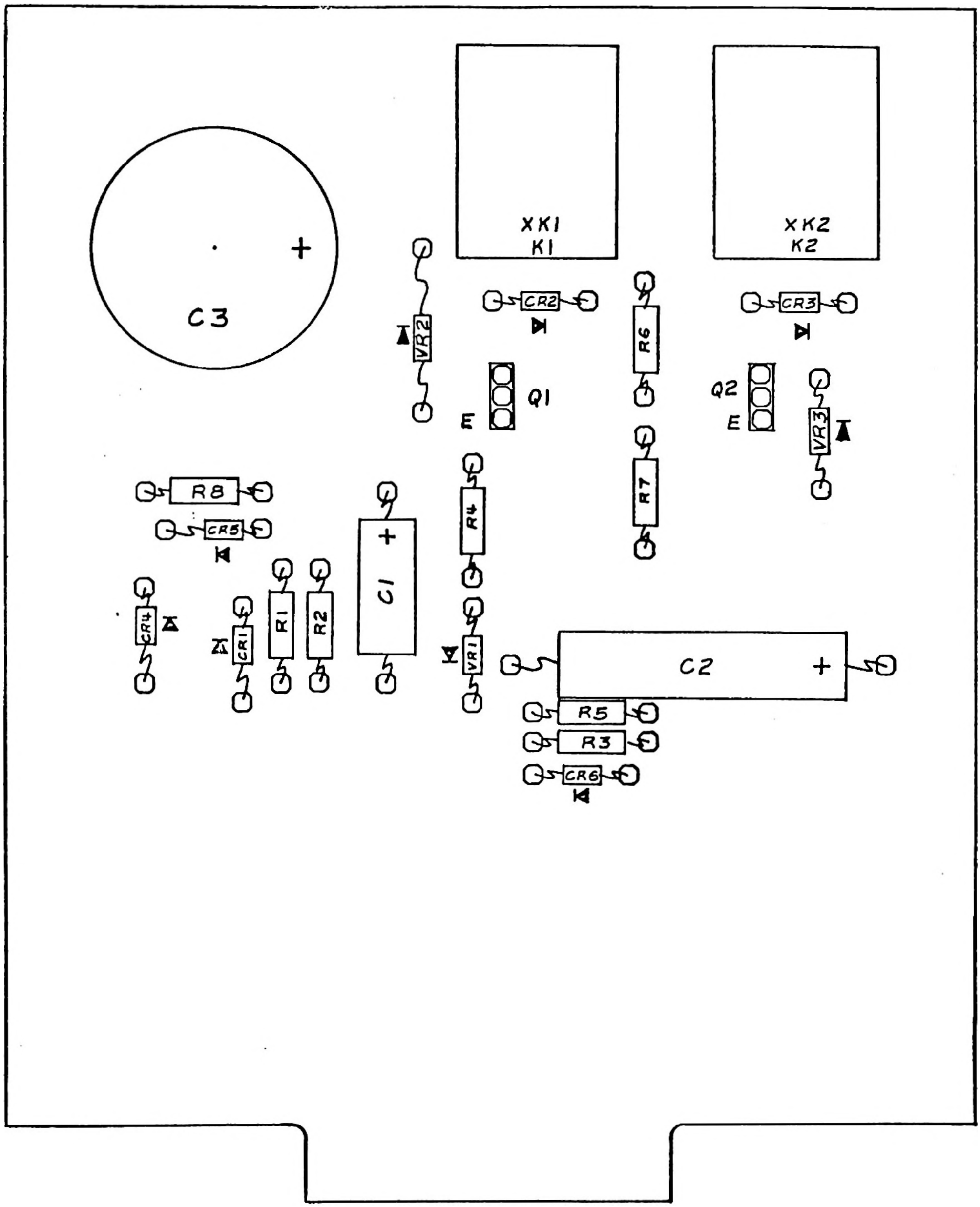


Figure 6-21. Power Failure Recycle Board, A19A1

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
	POWER FAILURE RECYCLE BOARD, A19A1	640-3466-001
C1	Capacitor, Fxd, Electrolytic 68 µF, 20% Tol, 40 VDCW	184-6330-360
C2	Capacitor, Fxd, Electrolytic 100 µF, Minus 10% Plus 75%, 50 VDC	183-1281-080
C3	Capacitor, Fxd, Electrolytic 5500 µF, Plus 100% Minus 10%, 40 VDCW	183-1278-180
CR1	Diode, IN4003	353-6442-030
CR2 Through CR6	Same as CR1	
K1	Relay, 24 V Coil 4C 3 Amp Contacts	970-0002-030
K2	Same as K1	
Q1	Transistor, MJE-243	352-1104-010
Q2	Same as Q1	
R1	Resistor, Fxd, Carbon Film 220 Ohms, 5% Tol, 1/2 Watt	745-0914-490
R2	Resistor, Fxd, Carbon Film 100 Kilohms, 5% Tol, 1/2 Watt	745-0915-140
R3	Resistor, Fxd, Carbon Film 2.2 Kilohms, 5% Tol, 1/2 Watt	745-0914-730
R4	Same as R3	
R5	Same as R3	
R6	Resistor, Fxd, Carbon Film 10 Kilohms, 5% Tol, 1/2 Watt	745-0914-890
R7	Same as R3	
R8	Same as R3	
VR1	Diode, IN4735,6.2V, 1W Zener	353-6481-160
VR2	Diode, IN5646A, 36V, 1W Zener	353-0221-360
VR3	Same as VR2	
XK1	Relay Socket	220-1582-010
XK2	Same as XK1	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

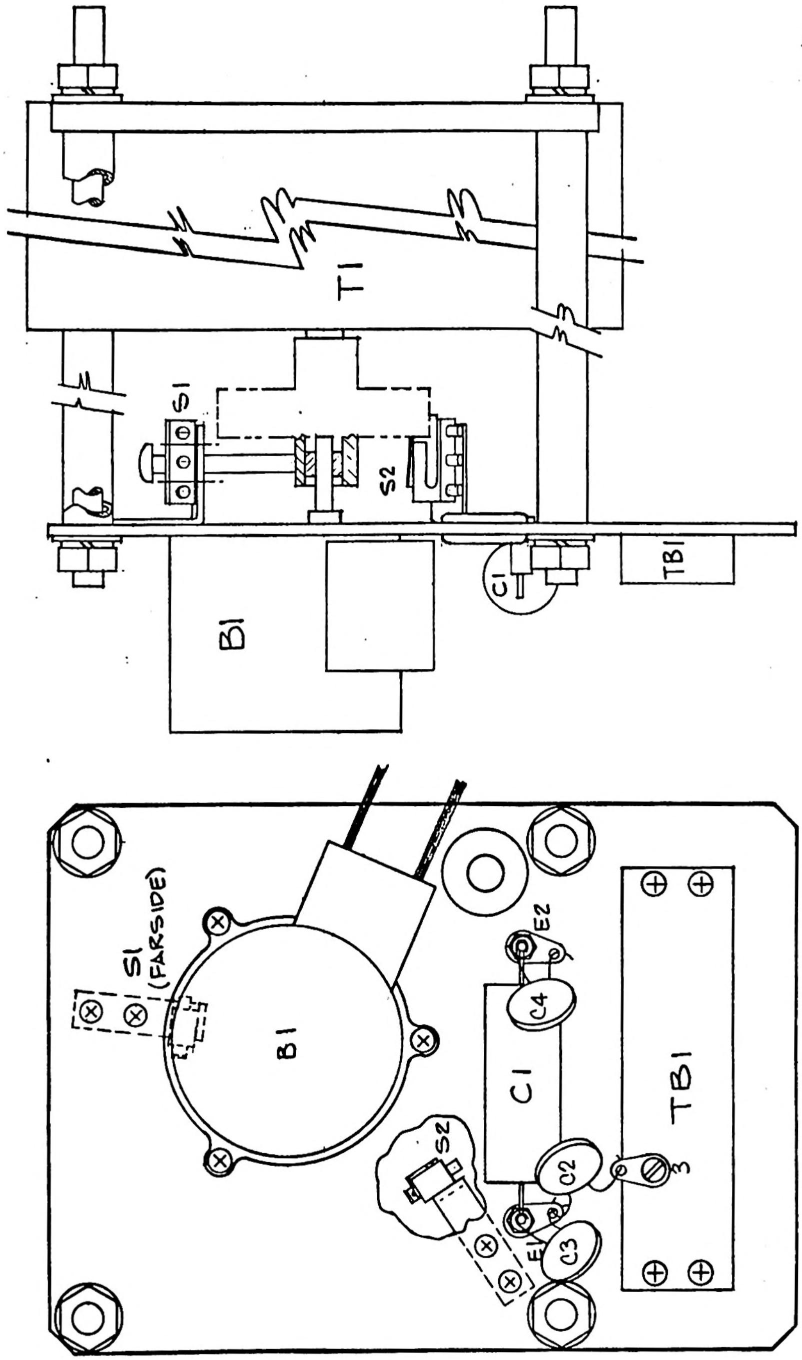


Figure 6-22. Variable Transformer Drive Assembly, A19A2.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
	VARIABLE TRANSFORMER DRIVE ASSEMBLY, A19A2	648-8104-001
B1	Motor, AC, 115V	230-0581-010
C1	Capacitor, Fxd, Paper 0.47 µF, 20% Tol, 400 VDCW	913-6849-000
C2	Capacitor, Fxd, Ceramic 0.1 µF, Plus 80% Minus 20%, 500V	913-3234-000
C3	Same as C2	
C4	Same as C2	
S1	Switch, SPDT Snap Action 2.5 Amp Contacts	260-2293-000
S2	Same as S1	
T1	Transformer, Pwr, Variable	664-4010-020
TB1	Terminal Board, 8 Terminals	367-4080-000

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

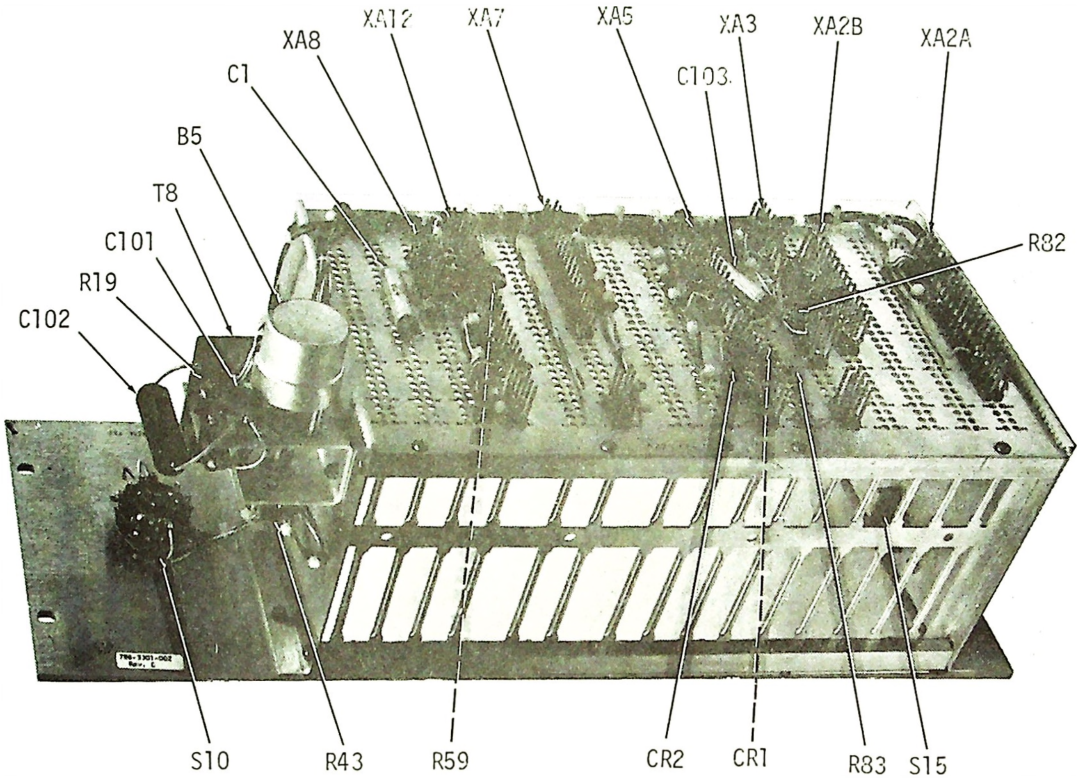


Figure 6-23. Card Cage Assembly, A20.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
	CARD CAGE ASSEMBLY, A20	786-3301-002
B1 Through B4	Not Used	
B5	Motor, Reversible, 115 VAC	230-0641-010
C1	Capacitor, Fxd, Electrolytic 100 µF, Minus 10% Plus 75%, 50 VDC	183-1281-080
C2 Through C100	Not Used	
C101	Capacitor, Fxd, Ceramic 0.01 µF, 20% Tol, 500 VDCW	913-1188-000
C102	Capacitor, Fxd, Paper 0.33 µF, 20% Tol, 600 VDCW	951-1066-000
C103	Capacitor, Fxd, Electrolytic 100 µF, Minus 10% Plus 75% 50 VDC	183-1281-080
CR1	Diode, IN4003	353-6442-030
CR2	Same as CR1	
R1 Through R18	Not Used	
R19	Resistor, Fxd, Composition 100 Ohms, 10% Tol, 1 Watt	745-3310-000
R20 Through R42	Not Used	
R43	Resistor, Var, Wirewound, 10 Turn 5K Ohms, 3% Tol, 2 Watts	381-1648-020
R44 Through R58	Not Used	
R59	Resistor, Fxd, Composition 820 Ohms, 10% Tol, 1/2 Watt	745-1349-000
R82	Resistor, Fxd, Carbon Film 1800 Ohms, 5% Tol, 1/2 Watt	745-0914-710
R83	Same as R82	
S1 Through S9	Not Used	
S10	Switch, Rotary DPDT Contact Arrangement	259-2694-010
S11 Through S14	Not Used	
S15	Switch, Interlock SPDT Contact Arrangement	266-8000-000
T1 Through T7	Not Used	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
T8	Transformer, Pwr, Single Phase 50/60 Hz 166 V_{RMS} Pri, 24 V_{RMS} Sec (1) 56V_{RMS} C.T.Sec (2)	662-0898-010
XA1	Not Used	
XA2	Connector, Consists of XA2A and XA2B	
XA2A	Connector, Electrical 4 Contacts -Qty 10-	372-2426-010
XA2B	Connector, Electrical 4 Contacts -Qty 5-	372-2426-010
XA3	Connector, Electrical 4 Contacts -Qty 11-	372-2426-010
XA4	Not Used	
XA5	Same as XA3	
XA6	Not Used	
XA7	Same as XA2A	
XA8	Same as XA2B	
XA9	Not Used	
XA10	Not Used	
XA11	Not Used	
XA12	Connector, Electrical 4 Contacts -Qty 13-	372-2426-010
1	Knob, Aluminum	757-0233-003
2	Plastic Fastener For Cover	769-0532-003
3	Pins for Cover	311-0438-000

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

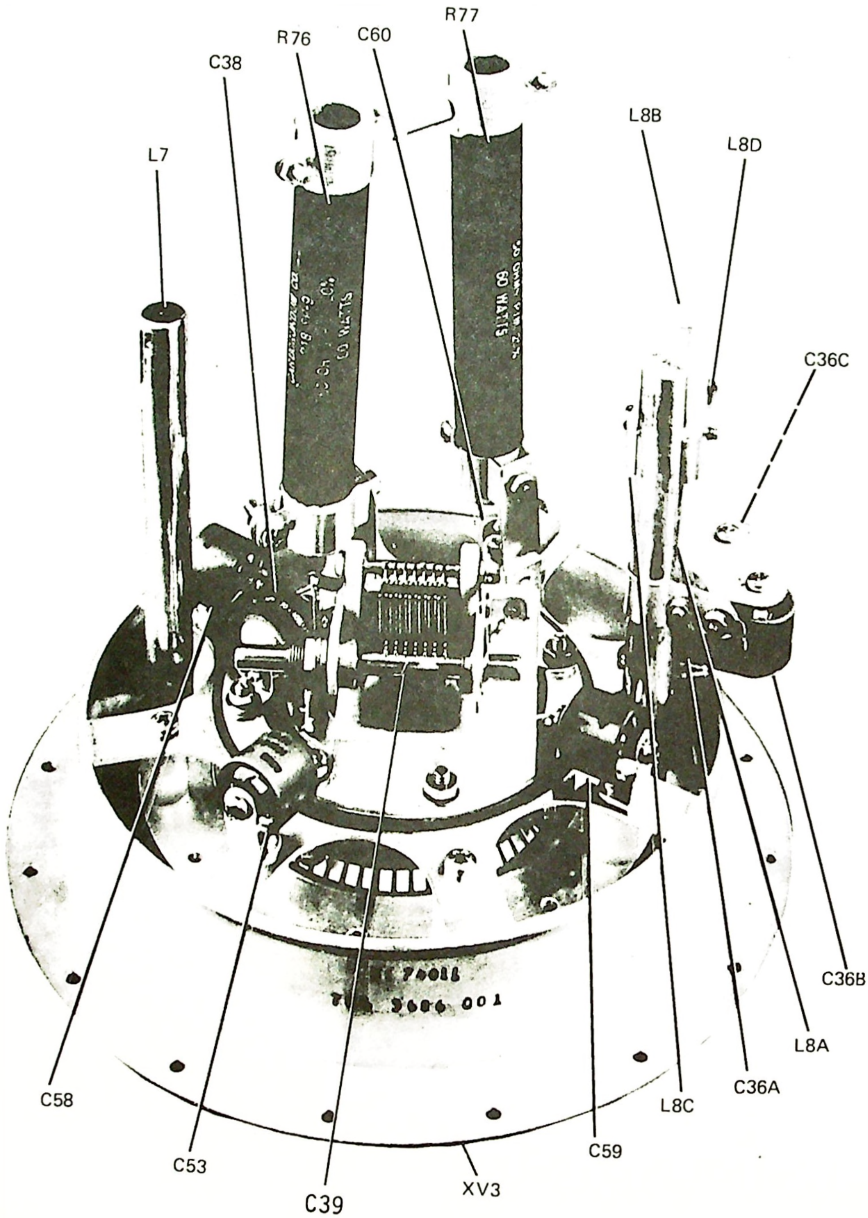


Figure 6-24. Power Amplifier Socket, A21.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
	POWER AMPLIFIER SOCKET, A21	786-3686-001
C1 Through C35	Not Used	
C36A	Capacitor, Fxd, Ceramic 100 pF, 10% Tol, 5000 VCDW	913-0821-000
C36B	Same as C36A	
C36C	Same as C36A	
C37	Not Used	
C38	Capacitor, Fxd, Ceramic 1000 pF, Plus 40% Minus 20%, 2500 VDCW	913-2831-000
C39	Capacitor, Var, Air 7-100 pF	922-0025-000
C40 Through C52	Not Used	
C53	Same as C36A	
C54 Through C57	Not Used	
C58	Same as C36A	
C59	Capacitor, Fxd, Ceramic 75 pF, 5% Tol, 3500 VDCW	913-0830-000
C60	Capacitor, Fxd, Ceramic 500 pF, 20% Tol, 5000 VDCW	913-5113-250
R1 Through R75	Not Used	
R76	Resistor, Fxd, Composition 50 Ohms, 20% Tol, 60 Watts	712-0070-000
R77	Same as R76	
L1 Through L6	Not Used	
L7	Driver Plate Inductor	
	Includes	
	Rod	786-3110-002
L8	Driver Loading Inductor	
	Includes	
	Rod -A-	786-3110-002
	Rod -B-	786-3110-006
	Bar -C-	786-3283-002
	Bar -D-	786-3283-001

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	PART NUMBER
XV1	Not Used	
XV2	Not Used	
XV3	Socket, Electron Tube	220-1491-000

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

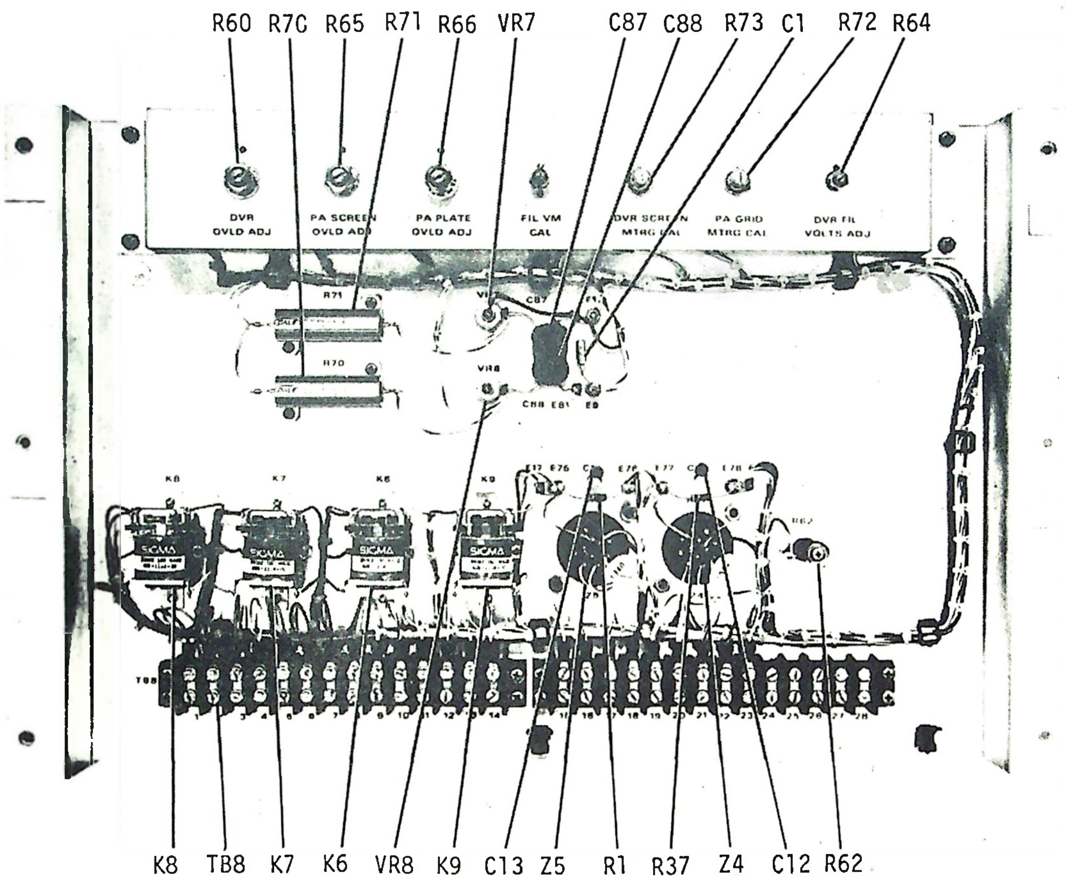


Figure 6-25. Overload and Meter Calibrate Panel, A22.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

parts list

REF DES	DESCRIPTION	CEMC PART NUMBER
	OVERLOAD AND METER CALIBRATE PANEL, A22	786-3666-001
C1 Through C11	Not Used	
C12	Capacitor, Fxd, Ceramic 1000 pF, 20% Tol, 1000 VDCW	913-1186-000
C13	Same as C12	
C14 Through C86	Not Used	
C87	Capacitor, Fxd, Ceramic 0.1 µF, Plus 80% Minus 20%, 200 VDCW	913-3681-000
C88	Same as C87	
K1 Through K5	Not Used	
K6	Relay, Armature 1C Contact Arrangement	408-1114-000
K7	Same as K6	
K8	Same as K6	
K9	Same as K6	
R1	Resistor, Fxd, Composition 1000 Ohms, 10% Tol, 1/2 Watt	745-1352-000
R2 Through R59	Not Used	
R60	Resistor, Var, Wirewound 50 Ohms, 10% Tol, 2 Watts	377-0619-000
R61	Not Used	
R62	Resistor, Fxd, Wirewound 150 Ohms, 5% Tol, 1 Watt	746-6145-000
R63	Not Used	
R64	Resistor, Var, Wirewound 100 Ohms, 10% Tol, 12.5 Watts	749-4512-000
* R65	Same as R60	
R66	Same as R60	
R67	Not Used	
R68	Not Used	
R69	Not Used	
R70	Resistor, Fxd, Wirewound 60.4 Ohms, 1% Tol, 30 Watts	747-0990-730
R71	Same as R70	
R72	Resistor, Var, Wirewound 40 Ohms, 10% Tol, 4 Watts	377-0033-000
R73	Sames as R72	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
TB1 Through TB7	Not Used	
TB8	Board, Terminal 14 Terminals	367-4140-000
VR1 Through VR6	Not Used	
VR7	Diode	353-6230-000
VR8	Same as VR7	
Z1	Not Used	
Z2	Not Used	
Z3	Not Used	
Z4	Magnetic Circuit, Halltron	270-0080-020
Z5	Same as Z4	

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

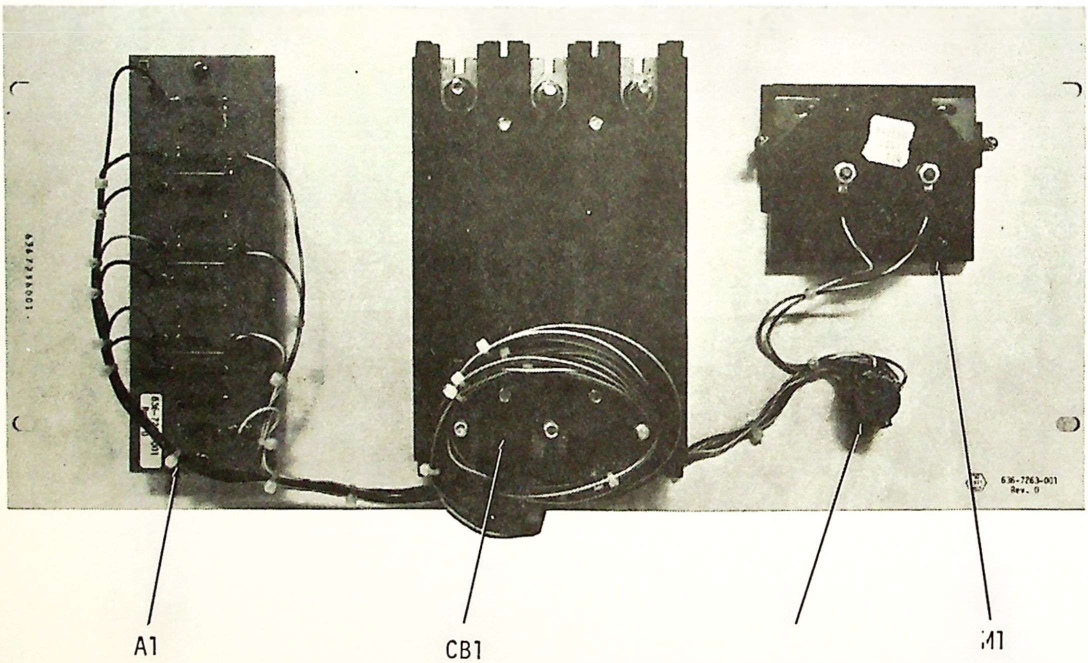
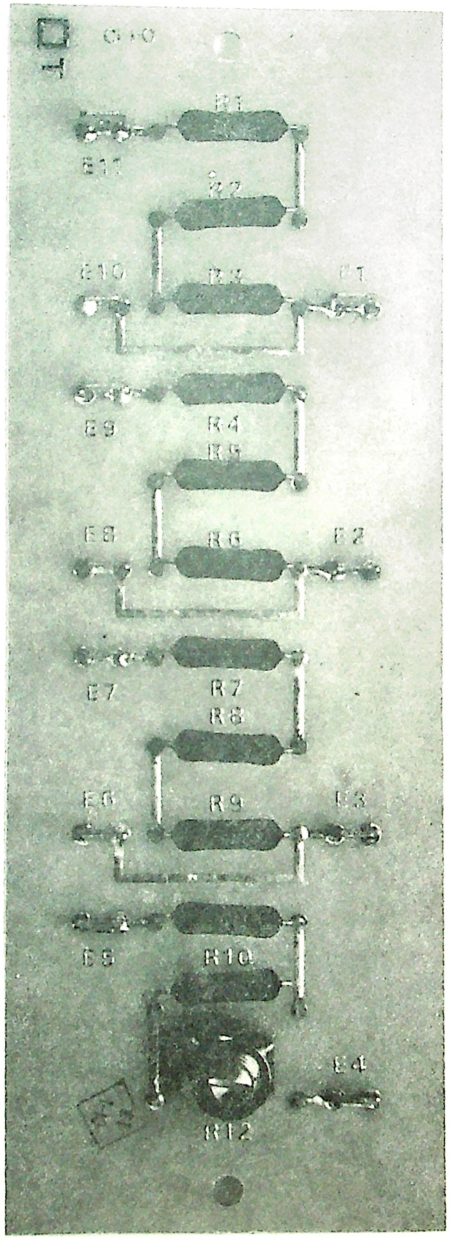


Figure 6-26. AC Metering Panel A25

WARNING: DISCONNECT PRIMARY SOURCE BEFORE SERVICING.

REF DES	DESCRIPTION	CEMC PART NUMBER
*	AC METERING PANEL, A25	636-7263-003
A1	Resistor Board Assy See breakdown on page 6-80	636-7262-001
*CB1	Circuit Breaker, 150 Amps, 3 Pole (OBSOLETE)	260-4055-020
	Circuit Breaker, 150 Amps, 3 Pole (Requires new A25 Panel for replacing 260-4055-020)	260-4060-080
* M1	Meter, Iron Vane 10mA. Movement, 2% Accuracy	458-5006-010
S1	Switch, Rotary, Wafer, 2 Sections 2 Pole, 5 Position	259-9475-150

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.



83-0760

KO1-(1)

Figure 6-27. Resistor Board Assembly, A25A1

REF DES	DESCRIPTION	PART NUMBER
	RESISTOR BOARD ASSEMBLY, A25A1	636-7262-001
R1	Resistor, Fxd, Wirewound 9.09 Kilohms, 1% Tol, 3 Watts	747-0998-960
R2 Through R11	Sames as R1	
R12	Resistor, Variable 5K, 2W, 3%	381-1648-020

*

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

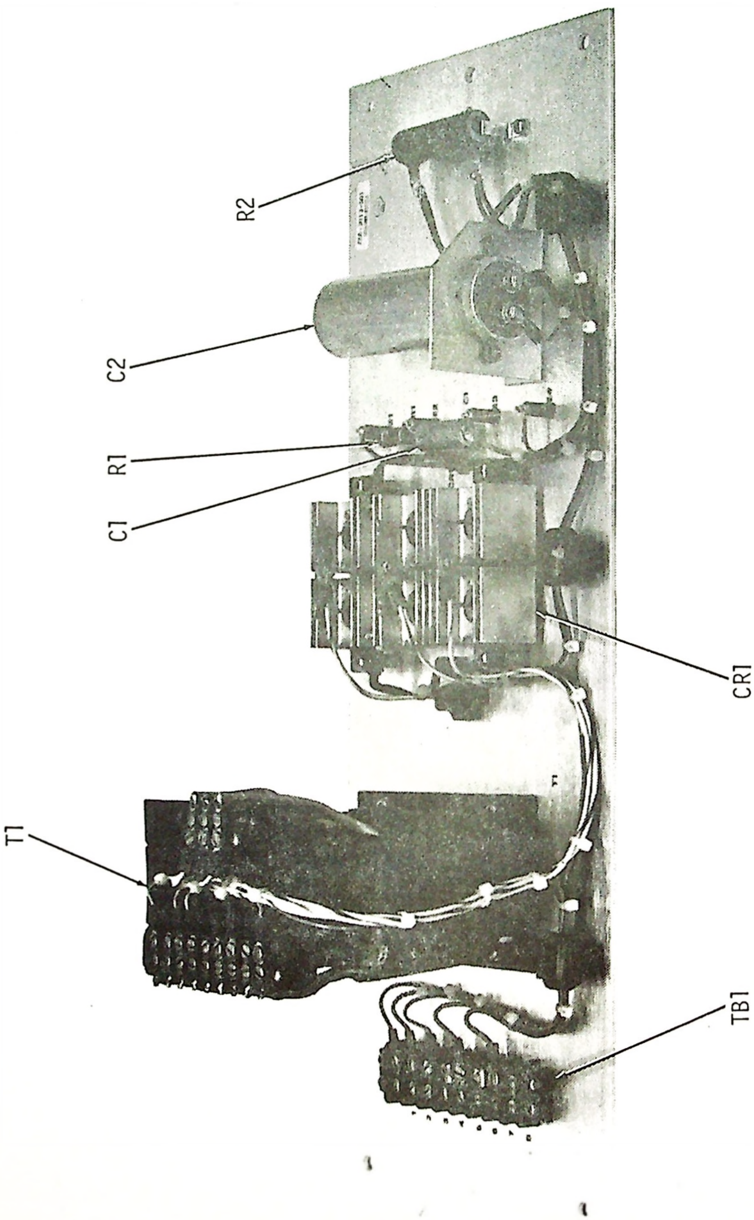


Figure 6-28. 28-Volt Power Supply, PS1.

REF DES	DESCRIPTION	PART NUMBER
	28 VOLT POWER SUPPLY, PS1	786-3013-001
C1	Capacitor, Fxd, Paper 0.68 μF, 20% Tol, 200 VDCW	951-0087-000
C2	Capacitor, Fxd, Electrolytic 1400 μF, Plus 100% Minus 10%, 50 VDCW	184-2516-000
CR1	Rectifier	353-6327-000
R1	Resistor, Fxd, Composition 47 Ohms, 10% Tol, 2 Watts	745-5596-000
R2	Resistor, Fxd, Wirewound 150 Ohms, 5% Tol, 25 Watts	710-3150-100
T1	Transformer, Pwr, Step-Down	664-0096-010
TB1	Board, Terminal 8 Terminals	367-4080-000

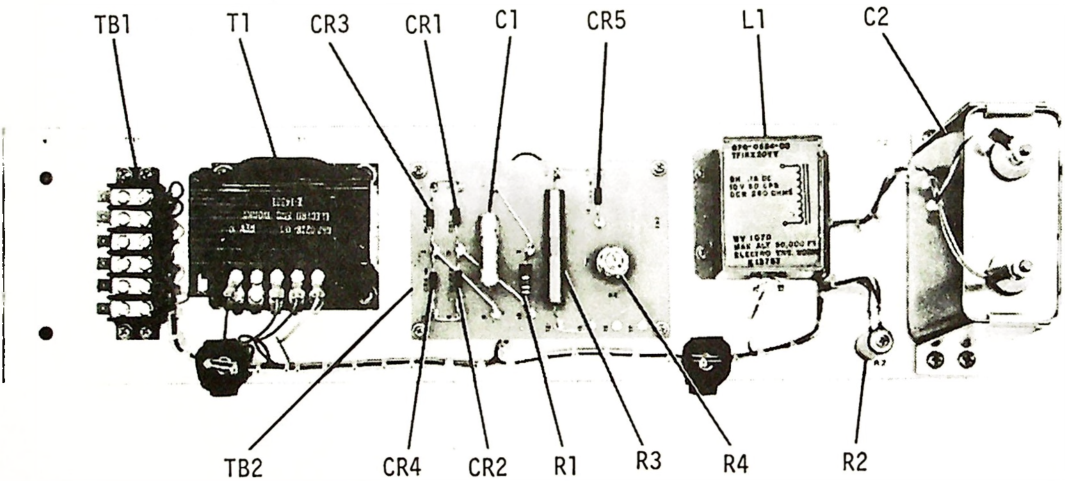


Figure 6-29. PA Bias Power Supply, PS2.

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

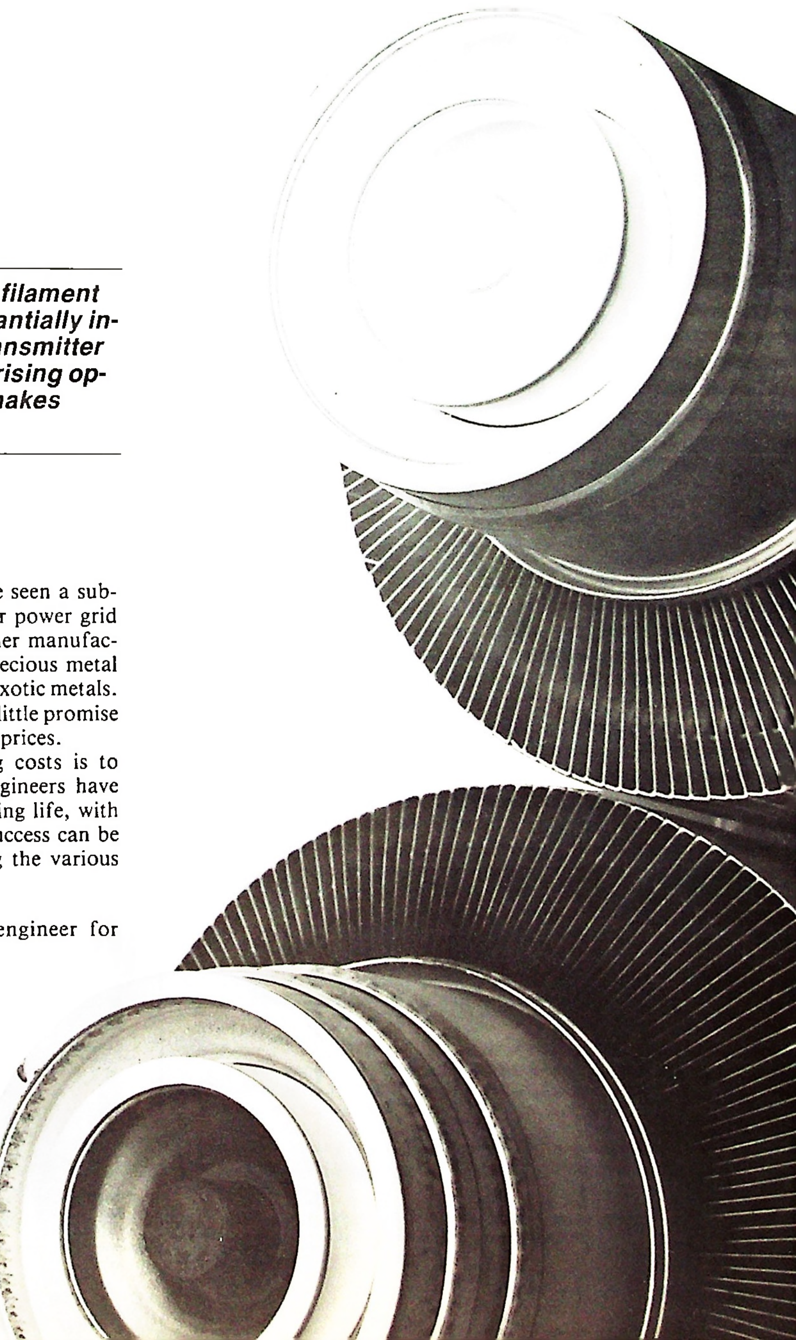
REF DES	DESCRIPTION	CEMC PART NUMBER
	PA BIAS POWER SUPPLY, PS2	786-3081-001
C1	Capacitor, Fxd, Paper 0.047 µF, 20% Tol, 600 VDCW	931-8592-000
C2	Capacitor, Fxd, Paper 10 µF, 10% Tol, 1000 VDCW	930-0038-000
CR1	Diode, IN4586	353-6467-050
CR2 Through CR5	Same as CR1	
L1	Reactor 5H Inductance	678-0584-000
R1	Resistor, Fxd, Composition 330 Ohms, 10% Tol, 1 Watt	745-3331-000
R2	Resistor, Fxd, Wirewound 10 Kilohms, 5% Tol, 14 Watts	746-9131-000
R3	Resistor, Fxd, Film 1000 Ohms, 1% Tol, 2 Watts	705-4254-000
R4	Resistor, Var, Composition 2500 Ohms, 10% Tol, 2 Watts	380-2768-000
T1	Transformer, Pwr, Step-Up	662-0218-010
TB1	Board, Terminal 6 Terminals	367-4060-000
TB2	Terminal Board	786-3139-001

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

Section 7
Schematic Diagrams

Overall schematic diagram for the FM Transmitter, 816R, is contained in the pocket attached within the back cover of this instruction manual.

EXTENDING TRANSMITTER TUBE LIFE



By Robert Artigo

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

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

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

Robert Artigo is senior application engineer for Varian Eimac, San Carlos, CA.

EIMAC Application Bulletin AB-18
Reprinted with permission from
Broadcast Management/Engineering
March, 1982

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

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

Headroom

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

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

Instrumentation

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

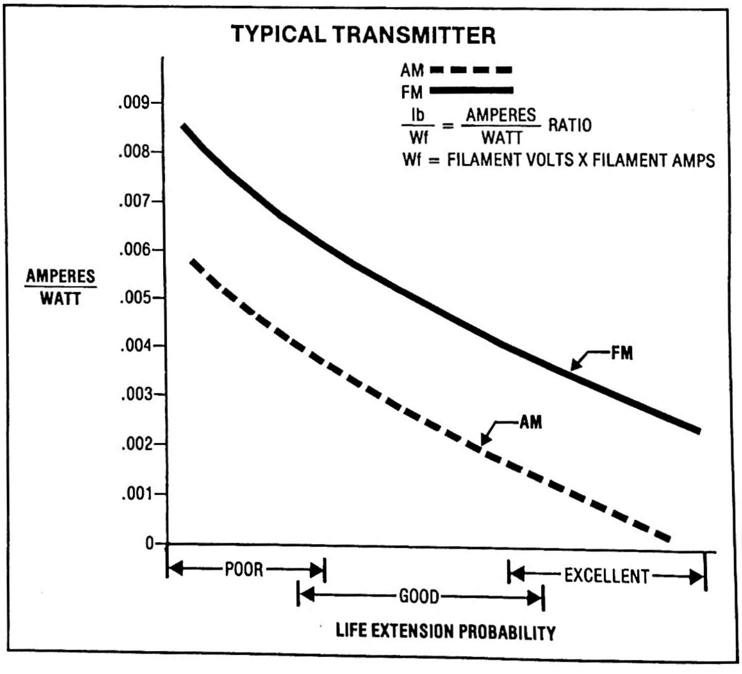
In addition, the following controls are necessary if an effective filament voltage management program is to be undertaken: power output metering for an FM transmitter or a distortion level meter for AM equipment; *accurate* filament voltage metering (an iron-vane instrument is preferred over the more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

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

Transmitter housekeeping

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

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



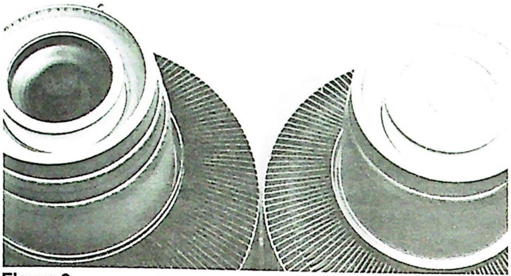


Figure 2

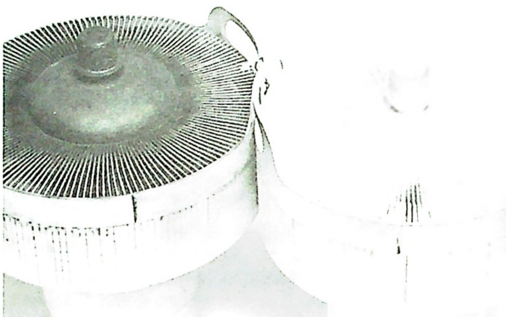


Figure 3

Figure 4

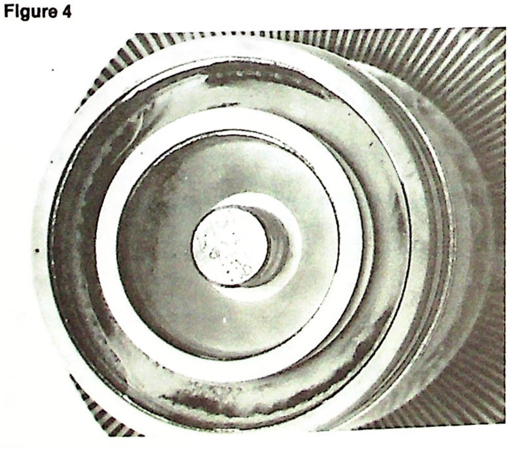


Figure 5

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

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

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

Filament voltage management

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

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

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

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

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

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

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

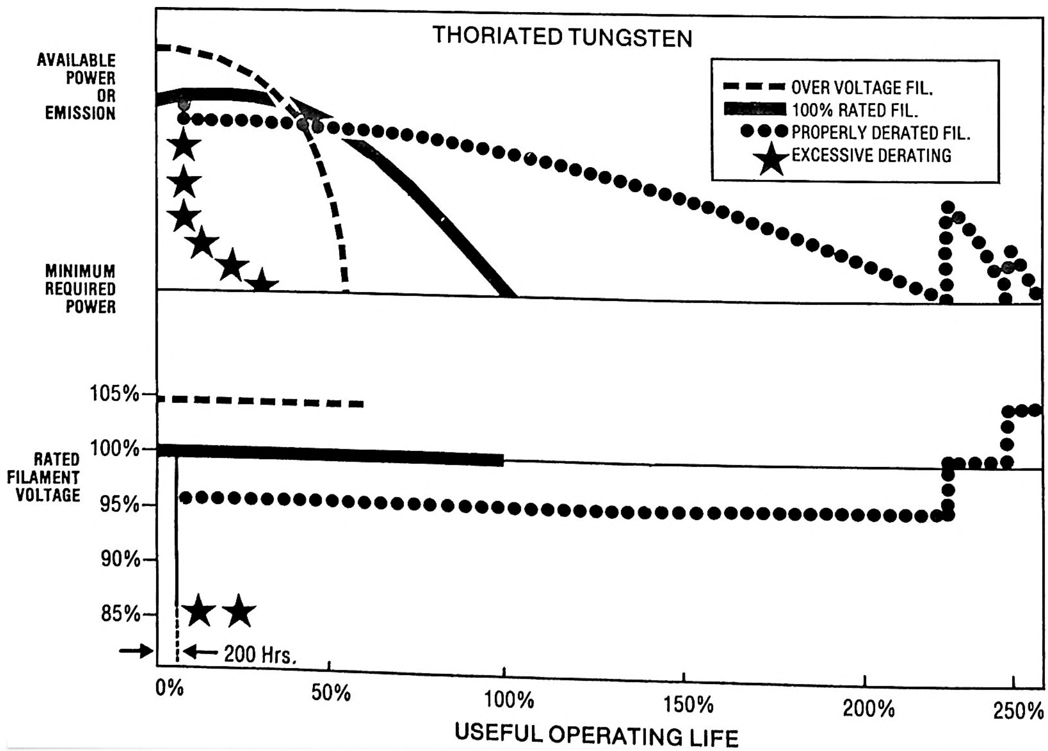
As the tube is used the filament slowly decarburizes. At some point in life, all of the di-tungsten carbide layer is depleted and the reduction of thoria to free thorium stops. The filament is now decarburized and is no longer an effective electron emitter.

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

FILAMENT VOLTAGE MANAGEMENT (Figure 6)

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

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



Extending Transmitter Tube Life

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

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

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

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

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

Continuing the program

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

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

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

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

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

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

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

Bibliography

1. Ayer, R.B., "Use of Thoriated-Tungsten Filaments in High Power Transmitting Tubes," *Proceedings of the I.R.E.*, page 591, May, 1952.
2. Kohl, Walter H., *Materials and Techniques for Electron Tubes*, Reinhold Publishing Corp., N.Y., 1960.
3. Horsting, C.W., "Carbide Structures in Carburized Thoriated-Tungsten Filaments," *Journal of Applied Physics*, Volume 18, Jan., 1947.
4. Langmuir, I., "The Electron Emission from Thoriated Tungsten Filaments," *Physical Review*, 1923, Page 357.
5. Walker, H.S., "High Power Transmitting Valves With Thoriated Filaments for Use In Broadcasting," The Institution of Electrical Engineers, Paper No. 3200E, March, 1960.

TECHNICAL DATA

7203 / 4CX250B
8621 / 4CX250FG
RADIAL-BEAM POWER TETRODE

The 7203/4CX250B and 8621/4CX250FG are ceramic/metal forced-air cooled, external-anode radial-beam tetrodes with a maximum plate dissipation rating of 250 watts and a maximum input-power rating of 500 watts. The 7203/4CX250B is designed to operate with a heater voltage of 6.0 volts, while the 8621/4CX250FG is designed for operation at a heater voltage of 26.5 volts. Otherwise, the two tube types have identical characteristics.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential

Heater: Voltage (4CX250B)	6.0 ± 0.3 V
Current, at 6.0 volts	2.6 A
Cathode-Heater Potential, maximum	±150 V
Heater: Voltage (4CX250FG)	26.5 ± 1.3 V
Current, at 26.5 volts	0.54 A
Cathode-Heater Potential, maximum	±150 V

Amplification Factor (Average):

Grid to Screen	5

Direct Interelectrode Capacitances (Grounded cathode)[2]

Input	15.7 pF
Output	4.5 pF
Feedback	0.04 pF

Direct Interelectrode Capacitances (grounded grid and screen)[2]

Input	13 pF
Output	4.5 pF
Feedback	0.01 pF

Frequency of Maximum Rating:

CW	500 MHz

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

MECHANICAL

Maximum Overall Dimensions:

Length	2.46 in; 62.5 mm
Diameter	1.64 in; 41.7 mm
Net Weight	4 oz; 113 gm
Operating Position	Any

4CX250B-4CX250FG

Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Forced Air
Base	Special 9-pin JEDEC-B8-236
Recommended Socket	EIMAC SK-600 Series
Recommended Chimney	EIMAC SK-600 Series

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN (SSB)

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage 1	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Single Tone Plate Current	250	250	250	mAdc
Two-Tone Plate Current	190	190	190	mAdc
Single-Tone Screen Current 2	10	8	5	mAdc
Two-Tone Screen Current 2	2	-1	-2	mAdc
Single-Tone Grid Current 2	0	0	0	mAdc
Peak rf Grid Voltage 2	50	50	50	v
Plate Output Power	120	215	300	W
Resonant Load Impedance	2000	3000	4000	Ω

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, CARRIER CONDITIONS

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB_1, Grid Driven

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage 1	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Carrier Plate Current	150	150	150	mAdc
Carrier Screen Current	-3	-4	-4	mAdc
Peak rf Grid Voltage 2	25	25	25	v
Plate Output Power	30	50	65	W

1. Adjust to specified zero-signal dc plate current

2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)					500 MHz 2	
Plate Voltage	500	1000	1500	2000	2000	Vdc
Screen Voltage	250	250	250	250	300	Vdc
Grid Voltage	-90	-90	-90	-90	-90	Vdc
Plate Current	250	250	250	250	250	mAdc
Screen Current 1	45	38	21	19	10	mAdc 2
Grid Current 1	35	31	28	26	10	mAdc 2
Peak rf Grid Voltage 1	114	114	112	112	---	v
Measured Driving Power 1	4.0	3.5	3.2	2.9	---	W
Plate Input Power	125	250	375	500	500	W
Plate Output Power	70	190	280	390	290	W 2
Heater Voltage (4CX250B)	6.0	6.0	6.0	6.0	5.5	V
Heater Voltage (4CX250FG)	26.5	26.5	26.5	26.5	24.3	V

1. Approximate value.
2. Measured values for a typical cavity amplifier circuit.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1500	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.20	AMPERE
PLATE DISSIPATION[1]	165	WATTS
SCREEN DISSIPATION[2]	12	WATTS
GRID DISSIPATION[2]	2	WATTS

1. Corresponds to 250 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 175 MHz)

Plate Voltage	500	1000	1500	Vdc
Screen Voltage	250	250	250	Vdc
Grid Voltage	-100	-100	-100	Vdc
Plate Current	200	200	200	mAdc
Screen Current	31	22	20	mAdc
Grid Current	15	14	14	mAdc
Peak rf Grid Voltage	118	117	117	v
Calculated Driving Power	1.8	1.7	1.7	W
Plate Input Power	100	200	300	W
Plate Output Power	60	145	235	W

3. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB , Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate value.
2. Per Tube.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage 1/3	-55	-55	-55	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Max Signal Plate Current	500	500	500	mAdc
Max Signal Screen Current[1]	20	16	10	mAdc
Max Signal Grid Current[1]	0	0	0	mAdc
Peak af Grid Voltage[2]	50	50	50	v
Peak Driving Power	0	0	0	W
Plate Input Power	500	750	1000	W
Plate Output Power	240	430	600	W
Load Resistance (plate to plate)	3500	6200	9500	Ω

3. Adjust to give stated zero-signal plate current.

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

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Nom.	Max.	
Heater: 4CX250B Current at 6.0 volts	2.3	---	2.9	A
Heater: 4CX250FG Current at 26.5 volts	0.45	---	0.62	A
Cathode Warmup Time	30	60	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)				
Input	14.2	---	17.2	pF
Output	4.0	---	5.0	pF†
Feedback	---	---	0.06	pF
Interelectrode Capacitances[1] (grounded grid and screen)				
Input	---	13.0	---	pF
Output	4.0	---	5.0	pF†
Feedback	---	0.01	---	pF

†Cout values shown are for 4CX250B; for 4CX250FG, values are .... 4.0 --- 5.3 pF

APPLICATION

MECHANICAL

MOUNTING - The 4CX250B and 4CX250FG may be operated in any position. An EIMAC Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

COOLING - Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the EIMAC SK-600 series and an EIMAC SK-606 chimney are used with air flow in the base to anode direction.

	SEA LEVEL		10,000 FEET	
Plate Dissipation (watts)	Air Flow (CFM)	Pressure Drop (In. of water)	Air Flow (CFM)	Pressure Drop (In. of water)
200	5.0	0.52	7.3	0.76
250	6.4	0.82	9.3	1 20

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

At 500 MHz or below, base cooling air requirements are satisfied automatically when the tube is operated in an EIMAC Air-System Socket and the recommended air flow rates are used. Experience has shown that if reliable long life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

VIBRATION - These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration more severe than this are expected, it is suggested that the EIMAC 4CX300A or 4CX250R be employed.

ELECTRICAL

HEATER - The rated heater voltage for the 4CX250B and 4CX250FG is 6.0 volts and 26.5 volts, respectively, and the voltage should be maintained as closely as practicable. Short-time changes of ± 10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within ± 5% to minimize these variations and to obtain maximum tube life.

At frequencies above approximately 300 MHz transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the table below;

Frequency MHz	4CX250B	4CX250FG
300 and lower	6.00 volts	26.5 volts
301 to 400	5.75 volts	25.3 volts
401 to 500	5.50 volts	24.3 volts

CATHODE OPERATION - The oxide coated unipotential cathode must be protected against excessively high emission currents. The maximum rated dc input current is 200 mA for plate-modulated operation and 250 mA for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

GRID OPERATION - The maximum rated dc grid bias voltage is -250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100 MHz region, driving-power requirements for amplifiers increase noticeably. At 500 MHz as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid-current values below approximately 15 mA.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 100,000 ohms.

SCREEN OPERATION - The maximum rated power dissipation for the screen is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an a equate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4CX250B or 4CX250FG.

PLATE OPERATION - The maximum rated plate dissipation power is 250 watts. In plate-modulated applications the carrier plate dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

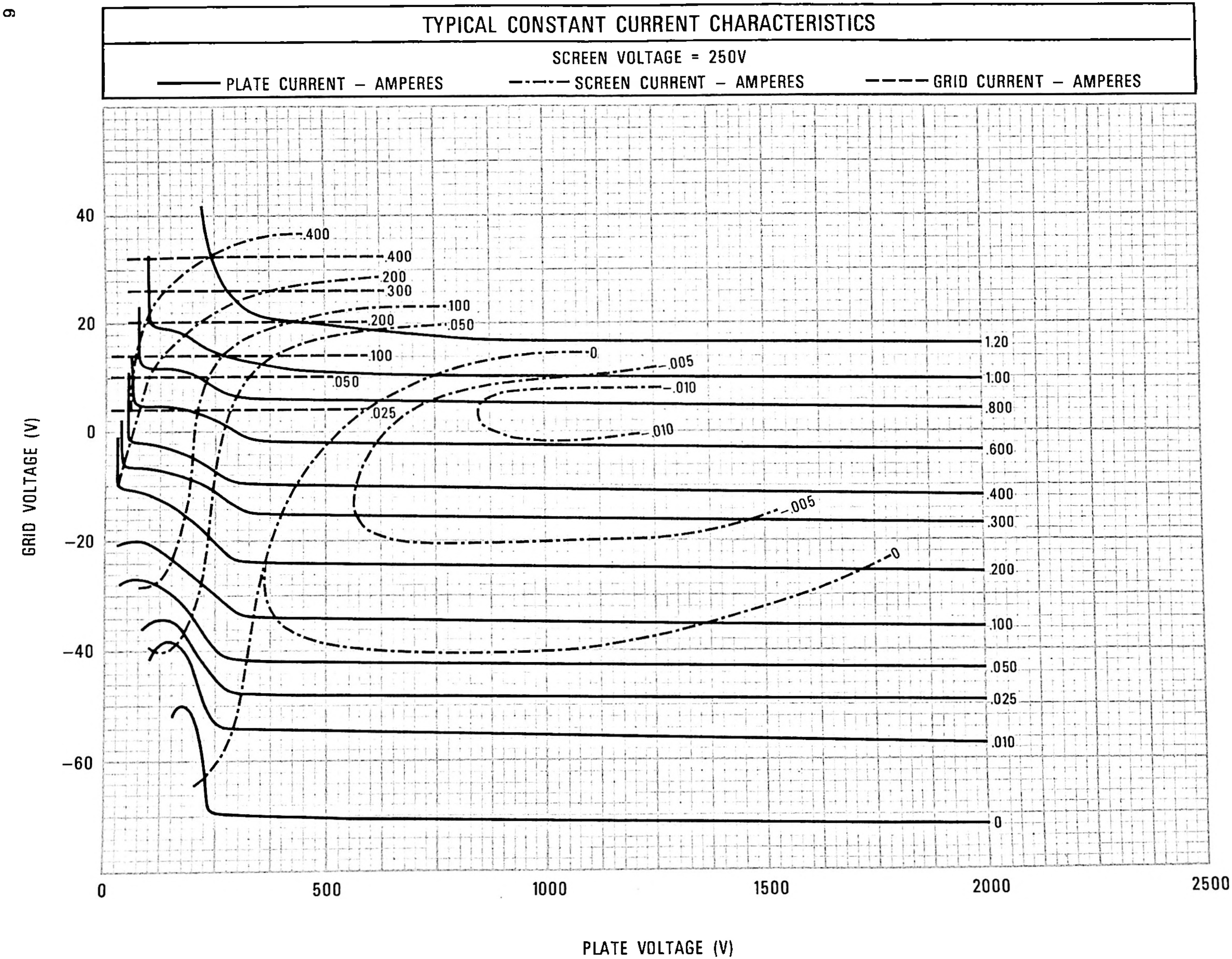
MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

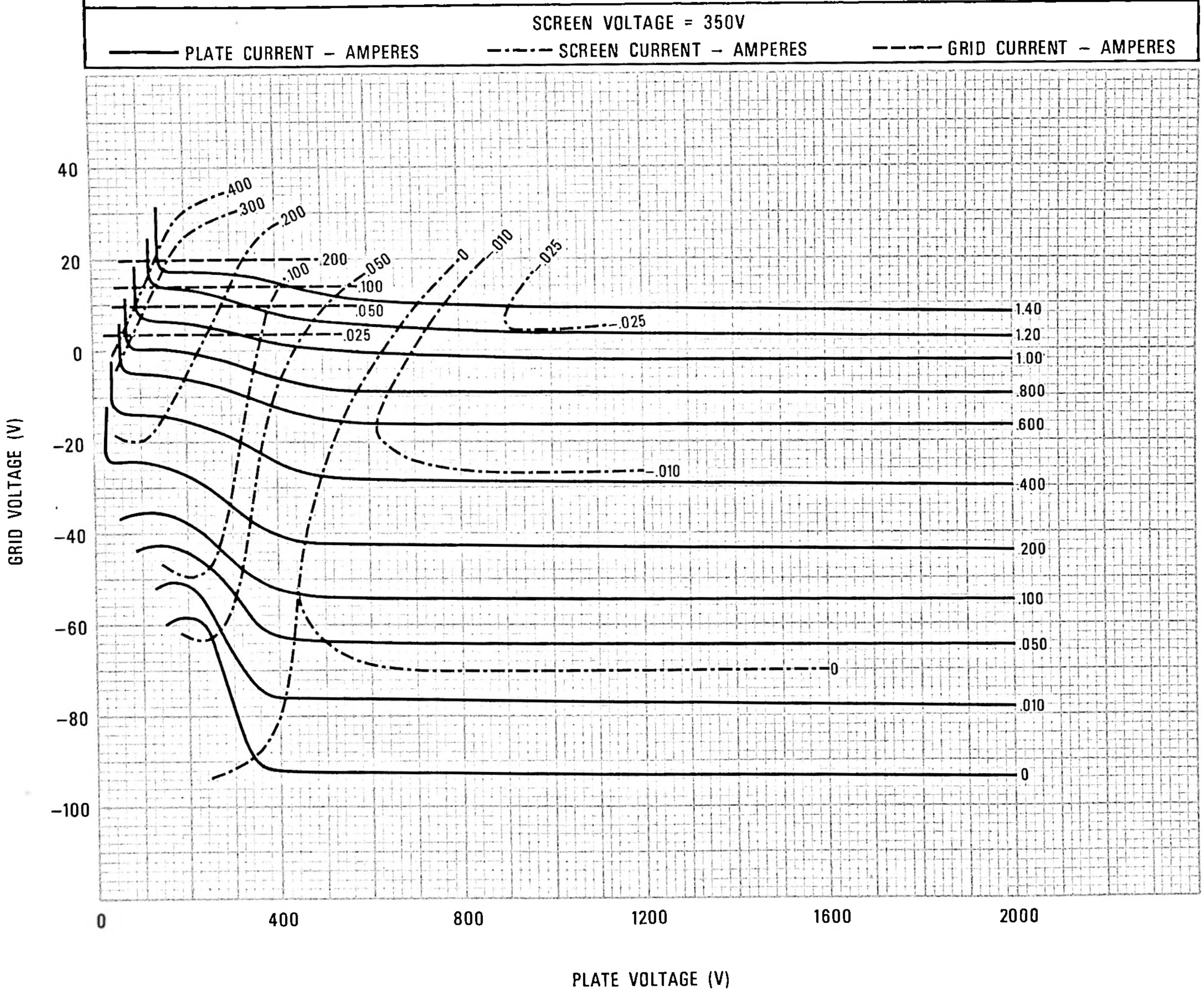
VHF OPERATION-The 4CX250B and 4CX250FG are suitable for use in the VHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

HIGH VOLTAGE - The 7203/4CX250B and 8621/4CX250FG operate at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

SPECIAL APPLICATIONS-If it is desired to operate these tubes under conditions widely different from those given here, write to Application Engineering Dept., EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.


TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 250V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (V)
40
20
0
-20
-40
-60
0
500
1000
1500
2000
2500
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.400
.400
.200
.300
.100
.200
.050
.100
.050
.025
0
.005
.010
.010
.005
0

TYPICAL CONSTANT CURRENT CHARACTERISTICS

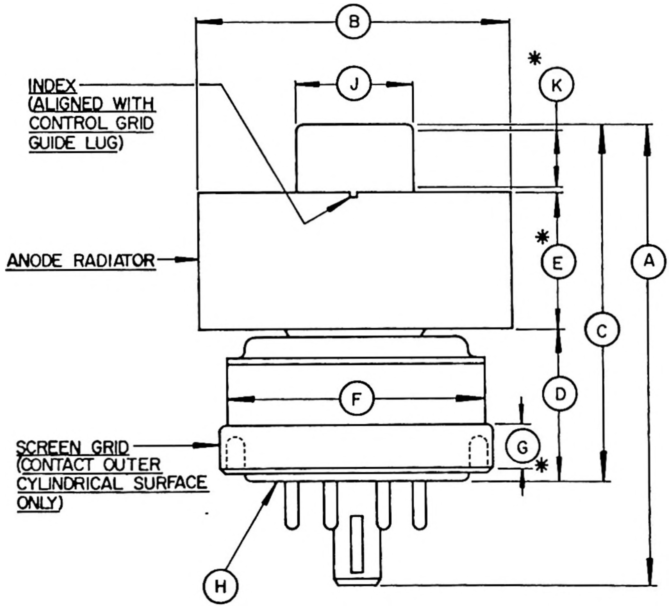


4CX250B-4CX250G

DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN	MAX.	MIN.	MAX.
A	2.342	2.464	59.03	62.59
B	1.610	1.640	40.89	41.66
C	1.810	1.910	45.97	48.51
D	0.750	0.810	19.05	20.57
E	0.710	0.790	18.03	20.07
F	--	1.406	--	35.71
G	0.187	--	4.75	--
H	BASE: B8-236 (JEDEC DESIGNATION)			
J	0.559	0.573	14.20	14.55
K	0.240	--	6.10	--

PIN DESIGNATION

PIN NO. 1 SCREEN GRID
PIN NO. 2 CATHODE
PIN NO. 3 HEATER
PIN NO. 4 CATHODE
PIN NO. 5 I.C. DO NOT USE FOR EXTERNAL CONNECTION.
PIN NO. 6 CATHODE
PIN NO. 7 HEATER
PIN NO. 8 CATHODE
CENTER PIN-CONTROL GRID



NOTES:
1. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQD. FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES.

TECHNICAL DATA

RADIAL BEAM POWER TETRODE

The EIMAC 8281/4CX15,000A is a ceramic/metal power tetrode intended for use in audio or radio frequency applications. It features a new type of internal mechanical structure which results in higher rf operating efficiency. Low rf losses in this mechanical structure permit operation of the 8281/4CX15,000A at full ratings up to 110 MHz, and at reduced ratings, to 225 MHz.

The 8281/4CX15,000A is also recommended for radio-frequency linear power amplifier service, and for VHF television linear amplifier service.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	160 A
Amplification Factor, average	
Grid to Screen	4.5
Direct Interelectrode Capacitances (cathode grounded):[2]	
Cin	160.0 pF
Cout	24.5 pF
Cgp	1.5 pF
Direct Interelectrode Capacitances (grid and screen grounded):[2]	
Cin	67.0 pF
Cout	25.5 pF
Cpk	0.2 pF
Maximum Frequency Ratings	
CW	110 MHz

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

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	9.375 in; 238.13 mm
Diameter	7.580 in; 192.53 mm
Net Weight	12.8 lb; 5.81 kg
Operating Position	Axis vertical, base up or down
Cooling	Forced air
Operating Temperature, maximum	
Ceramic/Metal Seals and Anode Core	250°C
Base	Special, concentric
Recommended Air System Socket	SK-300A
Recommended Air Chimney	SK-316

(Revised 12-15-73) Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN, Class AB1

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000	VOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	15,000	WATTS
SCREEN DISSIPATION	450	WATTS
GRID DISSIPATION	200	WATTS

1. Adjust for specified zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION
Peak Envelope or Modulation Crest Conditions

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	1,500	1,500	Vdc
Grid Voltage [1]	-350	-370	Vdc
Zero-Signal Plate Current	1.0	1.0	Adc
Single-Tone Plate Current	4.0	4.25	Adc
Single-Tone Screen Current [2]	170	150	mAdc
Peak rf Grid Voltage [2]	330	340	v
Plate Dissipation	12.2	14.0	kW
Single-Tone Plate Output Power	20.8	28.5	kW
Resonant Load Impedance	865	1,260	Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR
Class C Telegraphy or FM Telephony
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000	VOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	15,000	WATTS
SCREEN DISSIPATION	450	WATTS
GRID DISSIPATION	200	WATTS

TYPICAL OPERATION

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	750	750	Vdc
Grid Voltage	-510	-550	Vdc
Plate Current	4.65	4.55	Adc
Screen Current [1]	0.59	0.54	Adc
Grid Current [1]	0.30	0.27	Adc
Peak rf Grid Voltage [1]	730	790	v
Calculated Driving Power	220	220	W
Plate Dissipation	8.1	9.0	kW
Plate Output Power	26.7	36.5	kW

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER
GRID DRIVEN Class C Telephony
(Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC SCREEN VOLTAGE	1500	VOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	10,000	WATTS
SCREEN DISSIPATION	450	WATTS
GRID DISSIPATION	200	WATTS

TYPICAL OPERATION

Plate Voltage	6,000	8,000	Vdc
Screen Voltage	750	750	Vdc
Grid Voltage	-600	-640	Vdc
Plate Current	3.75	3.65	Adc
Screen Current [1]	0.45	0.43	Adc
Grid Current [1]	0.18	0.18	Adc
Peak af Screen Voltage [1] 100% modulation	740	710	v
Peak rf Grid Voltage [1]	800	840	v
Calculated Driving Power	150	150	W
Plate Dissipation	5.1	5.8	kW
Plate Output Power	17.4	23.5	kW

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
GRID DRIVEN, Class AB1 (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	10,000	VOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	15,000	WATTS
SCREEN DISSIPATION	450	WATTS
GRID DISSIPATION	200	WATTS

TYPICAL OPERATION (Two tubes)

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	1,500	1,500	Vdc
Grid Voltage [1]	-350	-370	Vdc
Zero-Signal Plate Current [3]	1.00	1.00	Adc
Maximum Signal Plate Current	8.80	8.50	Adc
Maximum Signal Screen Current [2]	0.34	0.30	Adc
Peak af Grid Voltage [2]	330	340	v
Maximum Signal Plate Dissipation [3]	12.2	14.0	kW
Plate Output Power	41.6	57.0	kW
Load Resistance (plate to plate)	1,730	2,520	Ω

1. Adjust for specified zero-signal plate current.
2. Approximate value.
3. Per Tube.

TELEVISION LINEAR AMPLIFIER
Cathode Driven

ABSOLUTE MAXIMUM RATINGS

110 MHz to 225 MHz

DC PLATE VOLTAGE	6500	VOLTS
DC SCREEN VOLTAGE	1500	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	15,000	WATTS
SCREEN DISSIPATION	450	WATTS
GRID DISSIPATION	200	WATTS

TYPICAL OPERATION, Composite Signal Black Level Unless Otherwise Stated

Plate Voltage	5000	6000	Vdc
Screen Voltage	500	700	Vdc
Grid Voltage [1]	-160	-180	Vdc
Plate Current (zero sig.)	.500	.650	Adc
Plate Current	2.800	3.335	Adc
Grid Current	.075	.035	Adc
Screen Current	.060	.040	Adc
Peak Cath. Volt. (pk synch.)	310	345	v
Cath. Driving Power (pk. synch.)	975	1350	w
Plate Output Power (pk. synch.)	11.0	16.5	kw
Plate Load Resistance	600	600	Ω

1. Approximate value.

TYPICAL OPERATION values are obtained by calculations from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to produce the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 6.3 volts	152	168	A
Interelectrode Capacitances, cathode grounded [1]			
Cin	154.0	167.0	pF
Cout	22.0	27.0	pF
Cgp	----	2.0	pF
Interelectrode Capacitances, grid and screen grounded [1]			
Cin	62.0	72.0	pF
Cout	23.0	28.0	pF
Cpk	----	0.3	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4CX15,000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC Air-System Socket Type SK-300A is designed especially for the concentric base terminals of the 4CX15,000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through the SK-316 Air Chimney, into the anode cooling fins.

COOLING - The maximum temperature rating for the external surfaces of the 4CX15,000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air-flow requirements to maintain seal temperatures at 225°C in 50°C ambient air are tabulated below (for operation below 30 megahertz). This data is for the tube mounted in an SK-300A socket with an SK-316 chimney.

SEA LEVEL			10,000 FEET	
Plate Dissipation * (Watts)	Air Flow (CFM)	Pressure Drop(Inches of Water)	Air Flow (CFM)	Pressure Drop(Inches of Water)
7,500	230	.7	336	1.0
12,500	490	2.7	710	4.1
15,000	645	4.6	945	7.0

*Since the power dissipated by the filament represents about 1000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 600 watts, allowance has been made in preparing this tabulation for an additional 1600 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 4CX15,000A is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

ELECTRODE DISSIPATION RATINGS - The maximum dissipation ratings for the 4CX15,000A must be respected to avoid damage to the tube. An exception is the plate dissipation which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

GRID OPERATION - The 4CX15,000A control grid has a maximum dissipation rating of 200 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

SCREEN OPERATION - The power dissipated by the screen of the 4CX15,000A must not exceed 450 watts.

Screen dissipation, in cases where there is no AC applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 450 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX15,000A is 15,000 watts.

When the 4CX15,000A is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 10,000 watt maximum plate dissipation rating will be exceeded.

HIGH VOLTAGE - Normal operating voltages used with the 4CX15,000A are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CX15,000A, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as the 4CX 15,000A, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry --- the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

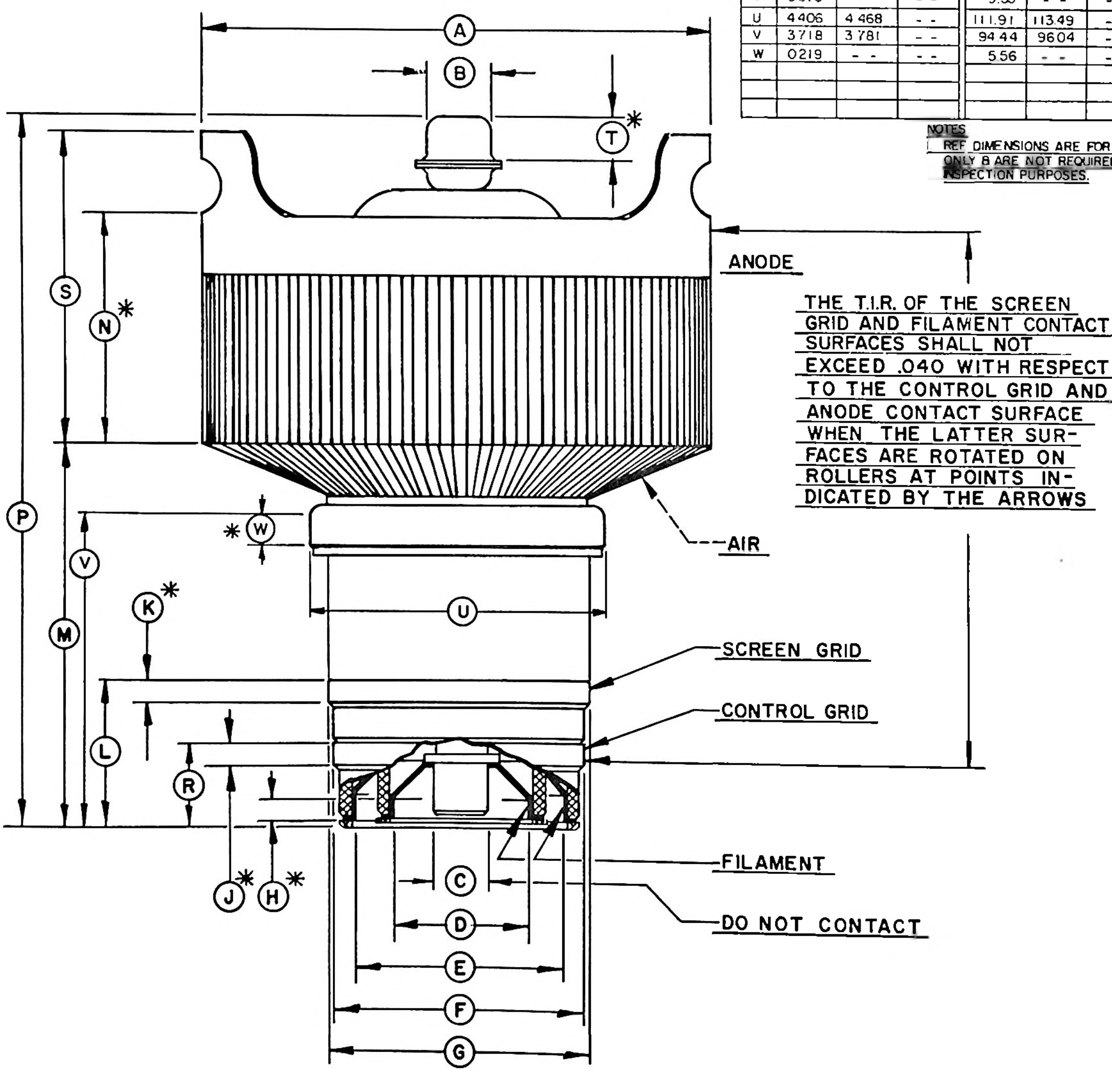
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

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

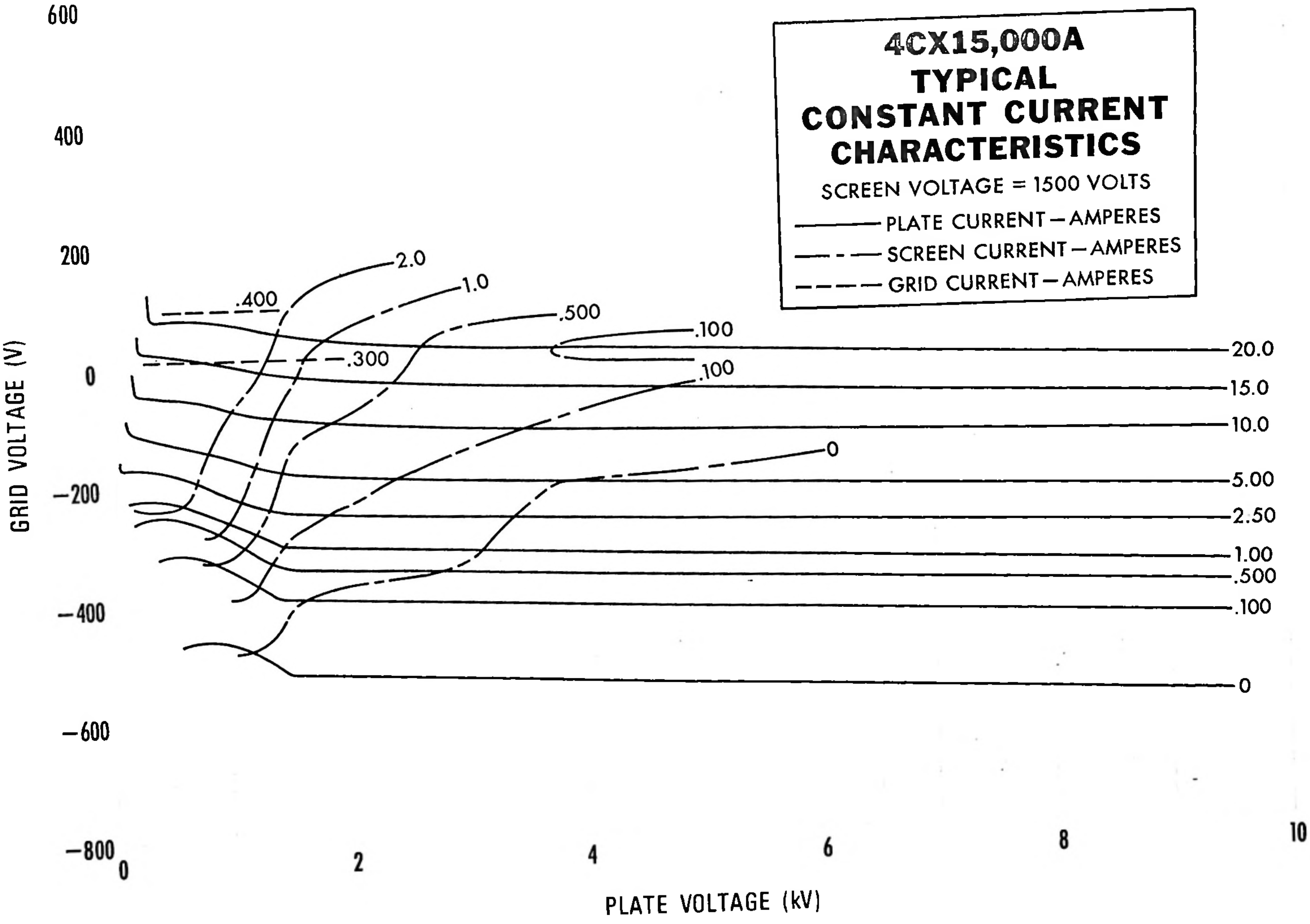
DIMENSIONAL DATA

DIM.	INCHES MIN.	INCHES MAX.	INCHES REF.	MILLIMETERS MIN.	MILLIMETERS MAX.	MILLIMETERS REF
A	7460	7.580	- -	189.48	192.53	- -
B	0855	0895	- -	21.72	22.73	- -
C	0720	0.760	- -	18.29	1930	- -
D	1896	1.936	- -	46 63	49.17	- -
E	3133	3.173	- -	79 58	8059	- -
F	3792	3.832	- -	96 32	97.33	- -
G	3980	4020	- -	101.09	102.11	- -
H	0188	- -	- -	4.78	- -	- -
J	0188	- -	- -	4.78	- -	- -
K	0188	- -	- -	4.78	- -	- -
L	1764	1826	- -	44 81	4638	- -
M	4659	4783	- -	118 34	121.49	- -
N	2412	2788	- -	61.26	70.82	- -
P	9000	9375	- -	228 60	238 13	- -
R	0986	1050	- -	25 04	26.67	- -
S	3560	3684	- -	90.42	9357	- -
T	0375	- -	- -	9.53	- -	- -
U	4406	4468	- -	111.91	113.49	- -
V	3718	3781	- -	94 44	9604	- -
W	0219	- -	- -	5.56	- -	- -

NOTES
1. REF DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.



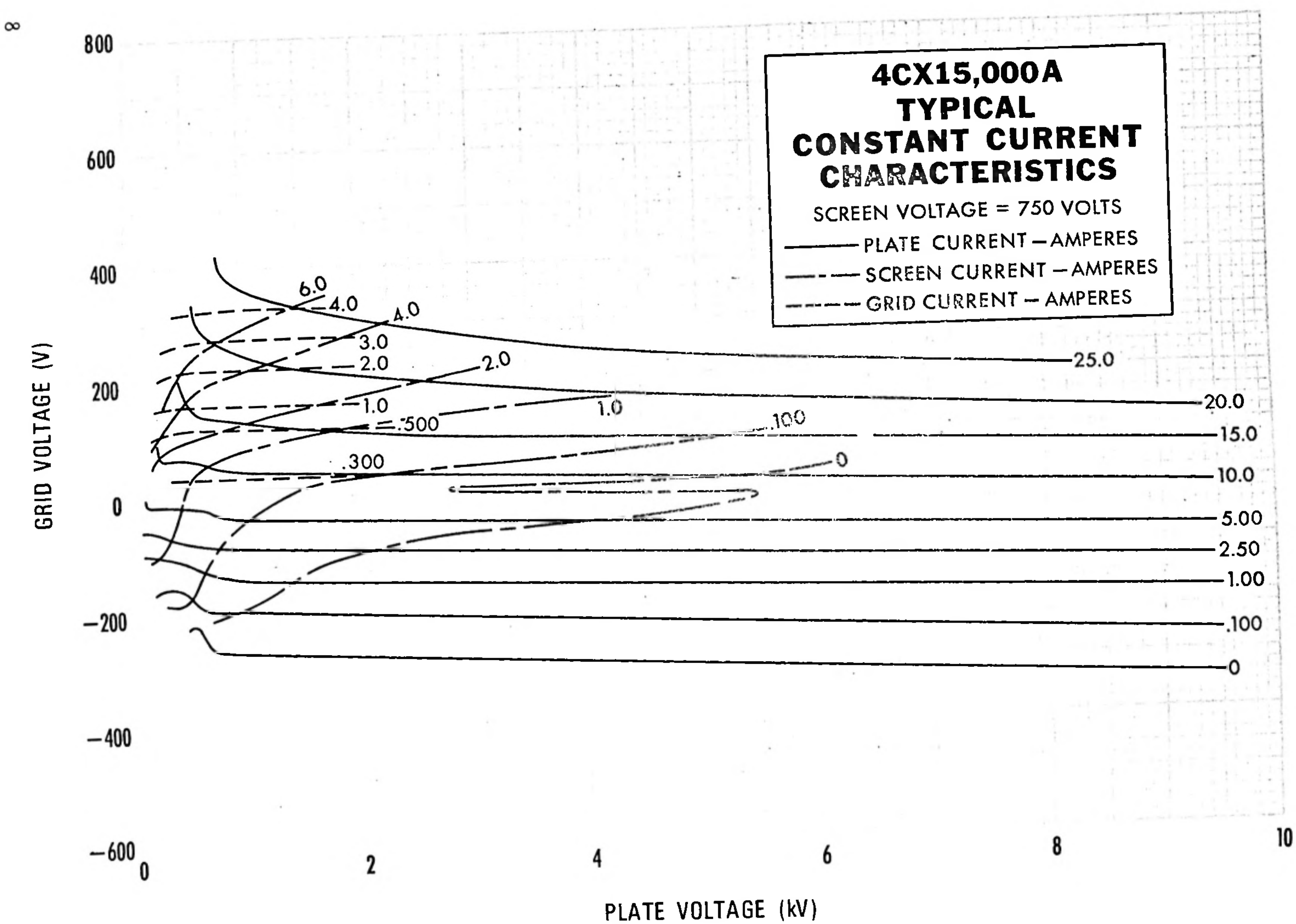
* CONTACT SURFACE



8281/4CX15,000A

Eimac®

7



8
8281/4CX15,000A
4CX15,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE (V)
800
600
400
200
0
−200
−400
−600
PLATE VOLTAGE (kV)
0
2
4
6
8
10
6.0
4.0
4.0
3.0
2.0
2.0
1.0
.500
1.0
.100
.300
0
25.0
20.0
15.0
10.0
5.00
2.50
1.00
.100
0

REVISIONS

LTR	DESCRIPTION	DATE	APVD
A	J-64810	1-3-80	DC
B		2-3-81	CJA
C	Chg A14 C2 From .05 µF to .03	6-23-81	CJA
D	Chg A22R72 & R73 from 30Ω. MISC WIRING Chgs. CHG A8R12 From 1K A8R10 From 22K	6-22-82	CJA
E	CHG A5R14 FROM 150K CHG A5CR5 FROM 27V	11-1-82	CJA
F	CHG A18C32 FROM .1 MF TO 1000 PF	8/24/83	CJA
G	CHG TITLE BLOCK	11/9/83	RG.
H	MODIFIED A15A ADD A15B	1/10/84	CJA

NOTES:
1. UNLESS OTHERWISE NOTED:
   a) ALL RESISTANCES ARE IN OHMS.
   b) ALL INDUCTANCES ARE IN MICROHENRYS.
   c) ALL CAPACITANCE VALUES ARE IN MICROFARADS.
2. P/O - PART OF

Continental Electronics MFG. CO. DALLAS, TEXAS

SCHEMATIC
816R-4 27.5 KW FM S/N 315 →
816R-3 25 KW FM S/N 365 →
816R-2A 20 KW FM S/N 440 →

SIZE	CODE IDENT NO.	
J	52151	648-8131-001
SCALE:	WT	SHEET OF

CEMC FORM 389 B