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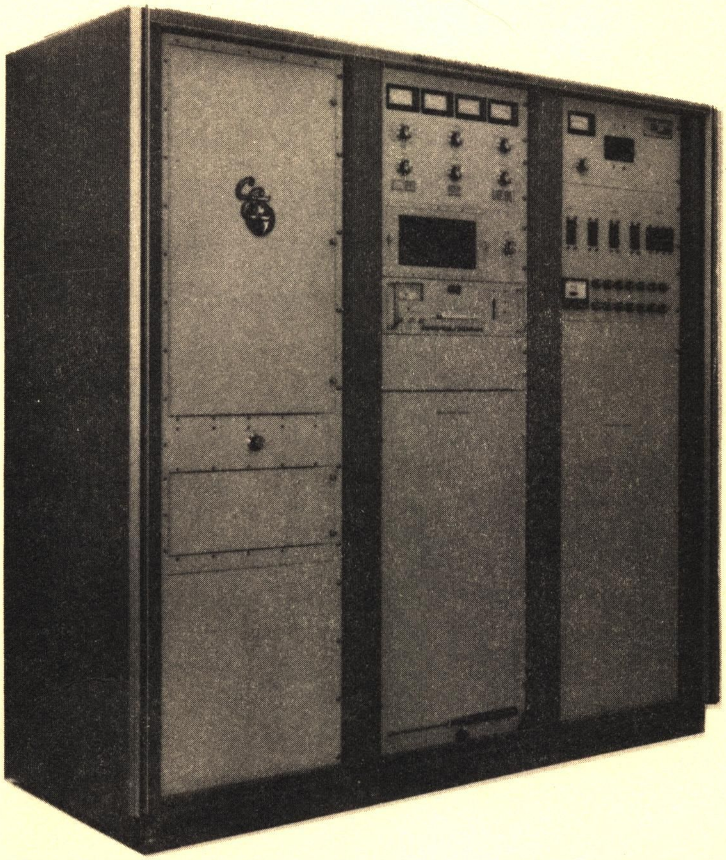
TYPE 816R-1A

FM BROADCAST TRANSMITTER
WITH SOLID STATE EXCITER 802A

INSTRUCTION MANUAL



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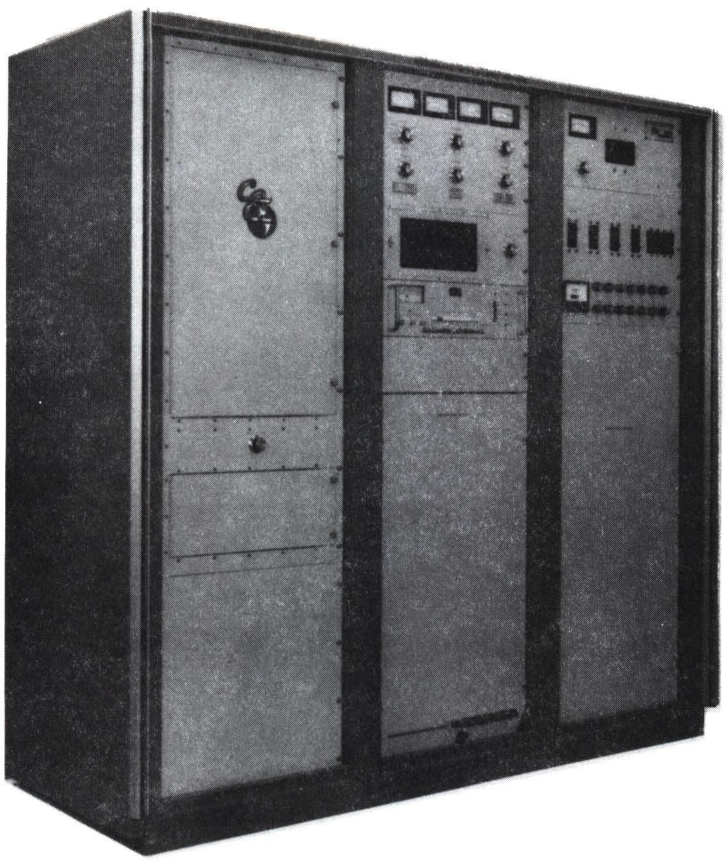

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LIST OF EFFECTIVE CHANGES

CHANGE NO.	DATE	EFFECTIVITY
1	16 August 1982	S/N 405 and Above
2	15 October 1982	All Transmitters
3	10 January 1983	S/N 408 and Above
4	10 March 1983	All Transmitters
5	26 August 1983	All Transmitters
6	9 September 1983	All Transmitters
7	10 November 1983	All Transmitters S/N 413 and Above with 802A Exciters
8	24 January 1984	All Transmitters S/N 413 and Above with 802A Exciters
9	1 March 1984	All Transmitters S/N 413 and Above with 802A Exciters
10	18 July 1984	All Transmitters S/N 413 and Above with 802A Exciters
11	28 August 1984	All Transmitters
12	12 October 1984	S/N 417 and Above
13	2 January 1985	S/N 419 and Above
14	20 February 1985	S/N 420 and Above
15	27 February 1985	S/N 420 and Above
16	10 April 1985	S/N 422 and Above
17	24 May 1985	All Transmitters
18	16 July 1985	All Transmitters
19	21 August 1985	S/N 423 and Above
20	14 November 1985	All Transmitters

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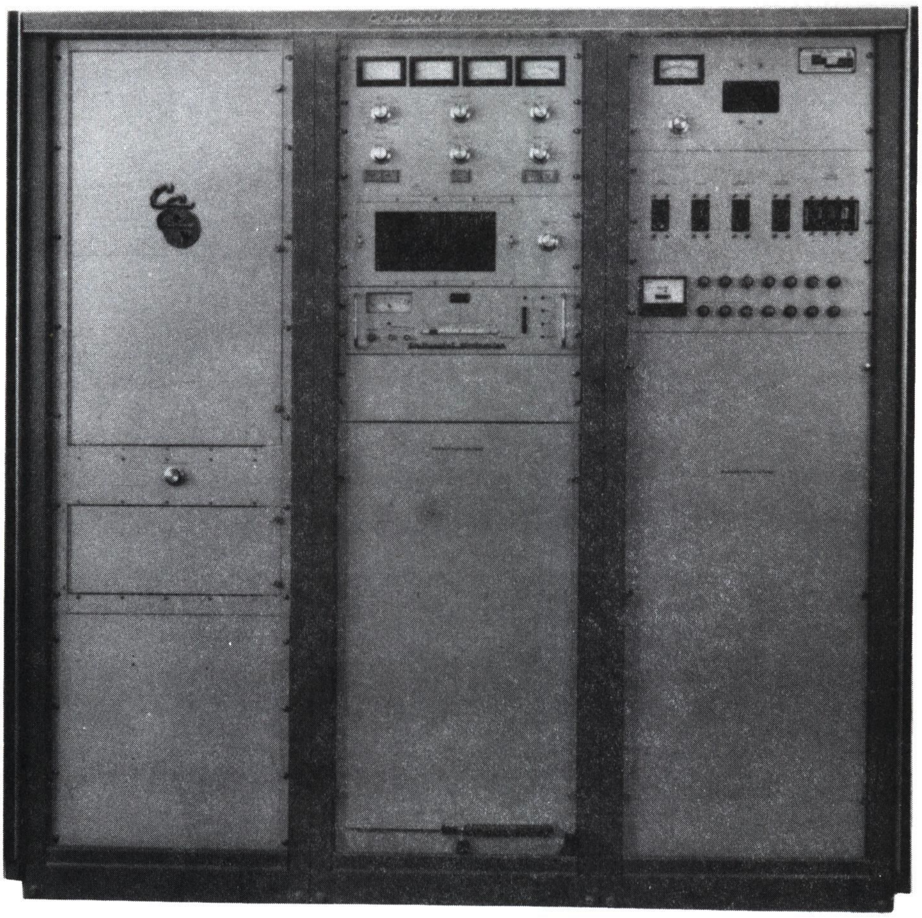

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SECTION 1 - GENERAL INFORMATION

1-1. INTRODUCTION

The transmitter operates in the FM broadcast range (88-108 MHz) with RF output power of 11,000 watts. Reduced power is available by tap changes of the plate and screen transformers to meet customer requirements. The 816R-1A transmitter 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 on the exact frequency as specified by the customer, 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 amplifier that contains one 4CX10000D 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. These control circuits protect the transmitter by removing plate voltage 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. The transmitter contains three sections. The section on the left as viewed from the front of the transmitter 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 as viewed from the front contains the power supplies, the circuit breaker, and fuse panel.

Mechanical and electrical interlocks are provided on all front and rear access panels, power amplifier plate cavity door, and grid tuning door.

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1-4. TECHNICAL CHARACTERISTICS

1-4.1 Electrical:

Frequency Range:	88 to 108 MHz.
Maximum Power Output:	11,000 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 3 phases.
Harmonic & 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.

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Modulation Characteristics:	Wideband direct FM; standard audio pre-emphasis is incorporated.
Input Power Requirements:	17.7 KW nominal for 10 KW output (19.9 KVA at 0.89 power factor).
* Excitation Source:	A CEMC 802A exciter capable of 0-50 watts output.
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^{o}C (59^{o} to 113^{o}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 pre-emphasis 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.

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1-4.2 Mechanical.

Weight:	850 kg (1875 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 816R-1A.
* Temperature Range:	+10° to +40°C (14° to 113°F) ambient operating.
Relative Humidity Range:	0 to 90% relative humidity.
Altitude:	Up to 10,000 feet (3048 m) at 30°C (86°F).
Shock and Vibration:	Normal handling and transportation.
Finish:	
Front Panels:	Tan.
Cabinet:	Brown.

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TABLE 1-2. EQUIPMENT SUPPLIED

		816R-1A 10KW FM
	A1	Control Panel
	A2	Remote Control Assembly
	A3	Fwd/Refl Cal and Pwr Control
*	A4	Exciter, 802A
	A5	Filament Regulator
	A6	Circuit Breaker Panel
	A7	Overload and Recycle Board
	A8	Power Control Regulator
	A9	Power Control Panel
	A9AR1 A1-A3	SCR Gate Drive Card
	A10	2KV Power Supply
	A11	RF Driver Assembly
	A12	Latching Relay and Status Board
	A13	RF Output Low-Pass Filter
	A14	Power Supply Filter
	A15	Metering Multiplier Board
	A16	Directional Coupler
	A17	Bleeder Resistor Panel
	A18	Power Amplifier Cavity
	A19	Component Panel
	A19A1	Power Failure Recycle Board
	A19A2	Variable Transformer Drive Assembly
	A20	Card Cage Assembly
	A21	Power Amplifier Socket
	A22	Overload and Meter Calibrate Panel
	A25	AC Metering Panel
	A25A1	Resistor Board Assembly
	PS1	28-Volt Power Supply
	PS2	PA Bias Power Supply

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TABLE 1-3. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1. Tower and Transmission Line
   50-ohm Impedance to Transmitter

2. Dummy Load for Testing - Optional Available

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1-5. OPTIONS AVAILABLE

a. Exciter Options. See Exciter Instruction Manual

b. Remote Control. Now Furnished As Part of Transmitter.

* c. Power Source: 50 Hz power.

d. Dummy Load for Transmitter Testing.

e. Modulator and Frequency Monitoring Equipment.

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SECTION 2 - INSTALLATION

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 power, audio input signal, and the remote control unit. A 2-inch conduit entry is also provided in the floor of the power supply section.

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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 connect J3 (Figure 2-1).
* Refer to the 802A 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

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 4CX10000D 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.

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.

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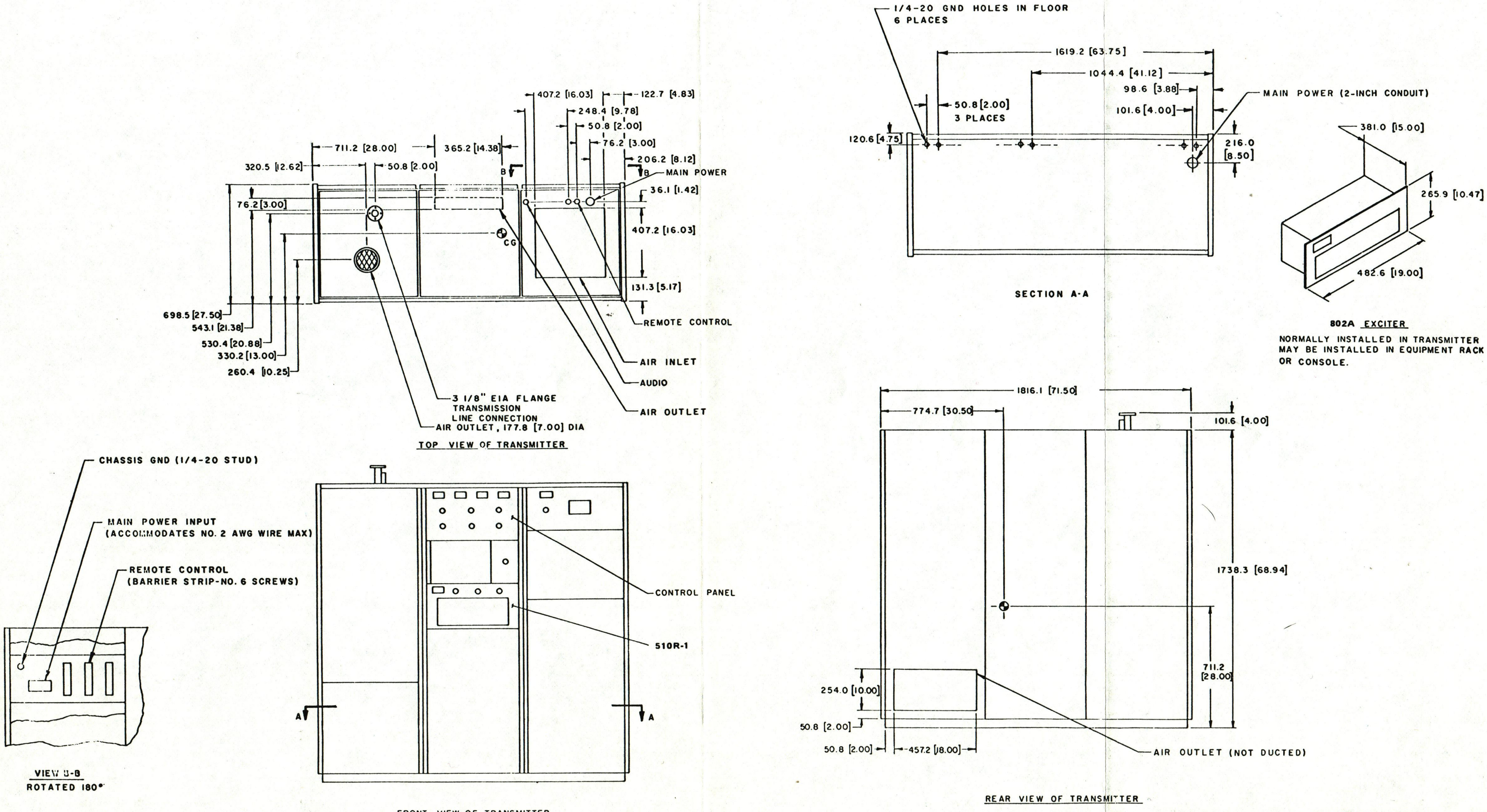

Figure 2-1. 816R-1A 10 kW FM Transmitter, Outline and Installation Drawing

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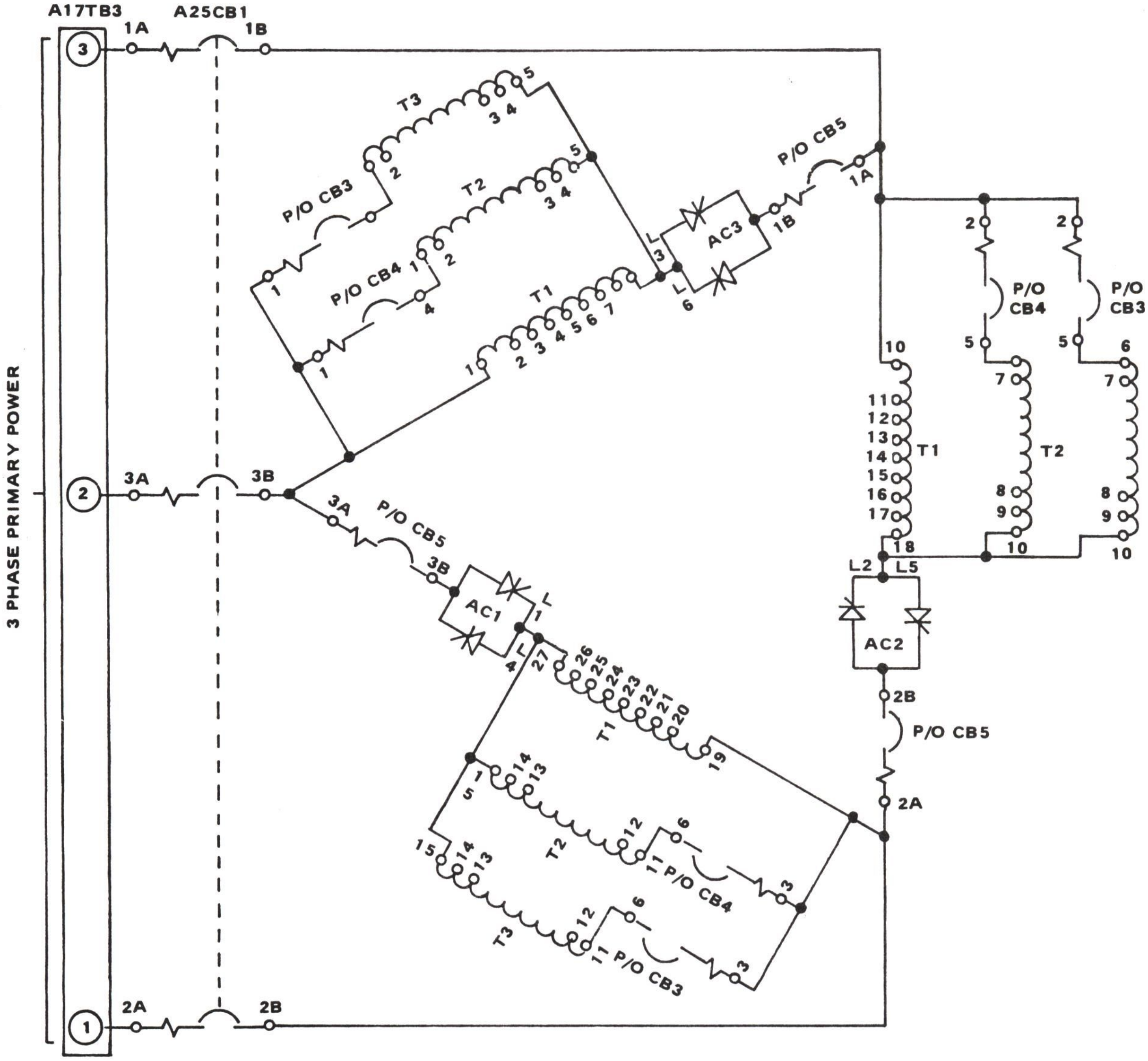
TABLE 2-1. TRANSFORMER CONNECTION SCHEDULE



LINE VOLTAGE	T1 TERMINALS	T2, T3 TERMINALS	T4		PS1 TB1		PS2 TB2	
			WIRE LABEL	TERM CONN	WIRE LABEL	TERM CONN	WIRE LABEL	TERM CONN
200 V	1-4, 10-13, 19-22	2-3, 7-8, 12-13	A	2	A,B,C,	2,5,8	A	2
210 V	1-5, 10-14, 19-23	2-4, 7-9, 12-14	A	3	A,B,C,	2,5,8	A	2
220 V	1-6, 10-15, 19-24	2-5, 7-10, 12-15	A	4	A,B,C,	2,5,8	A	2
230 V	1-7, 10-16, 19-25	1-3, 6-8, 11-13	A	5	A,B,C,	3,6,9	A	3
240 V	1-8, 10-17, 19-26	1-4, 6-9, 11-14	A	6	A,B,C,	3,6,9	A	3
250 V	1-9, 10-18, 19-27	1-5, 6-10, 11-15	A	7	A,B,C,	3,6,9	A	3

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

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 100 ampere fused disconnect should be provided with not more than 100 feet of #2 AWG wiring to the transmitter. AC line transient suppressors are suggested for the primary lines. For recommendation of installation, call Continental Electronics Field Service.

2-3.2 Transformer Connection.

The broad range of allowable voltage sources (200 to 250 V) 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 provide more accurate meter readings. (See paragraph 5-6.7.6) T1 connections are selected to provide a power output approximately 10% 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 pin 1 regardless of the source voltage and the wire at this pin is labeled with its connecting pin #1. The second wire (A) is connected to correspond with the power source voltage. Wire (A) is connected according to instructions supplied in Table 2-1.

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Six connections are made on power supply transformer PS1T1. Three of these connections (at pins 1, 4 and 7) are made regardless of the source voltage. The wires at these connections are labeled with their connecting pin number. The other three connections are made to correspond with the power source voltage. The wires at these connections are labeled A, B or C. 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 pin 1 regardless of the source voltage and the wire at this pin is labeled with its connecting pin #1. The second wire (A) is connected to correspond with the power source voltage. Wire (A) 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.

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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, turn off primary power and interchange any two primary power input leads at A17TB3.

WARNING

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

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

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

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 ON pushbutton.

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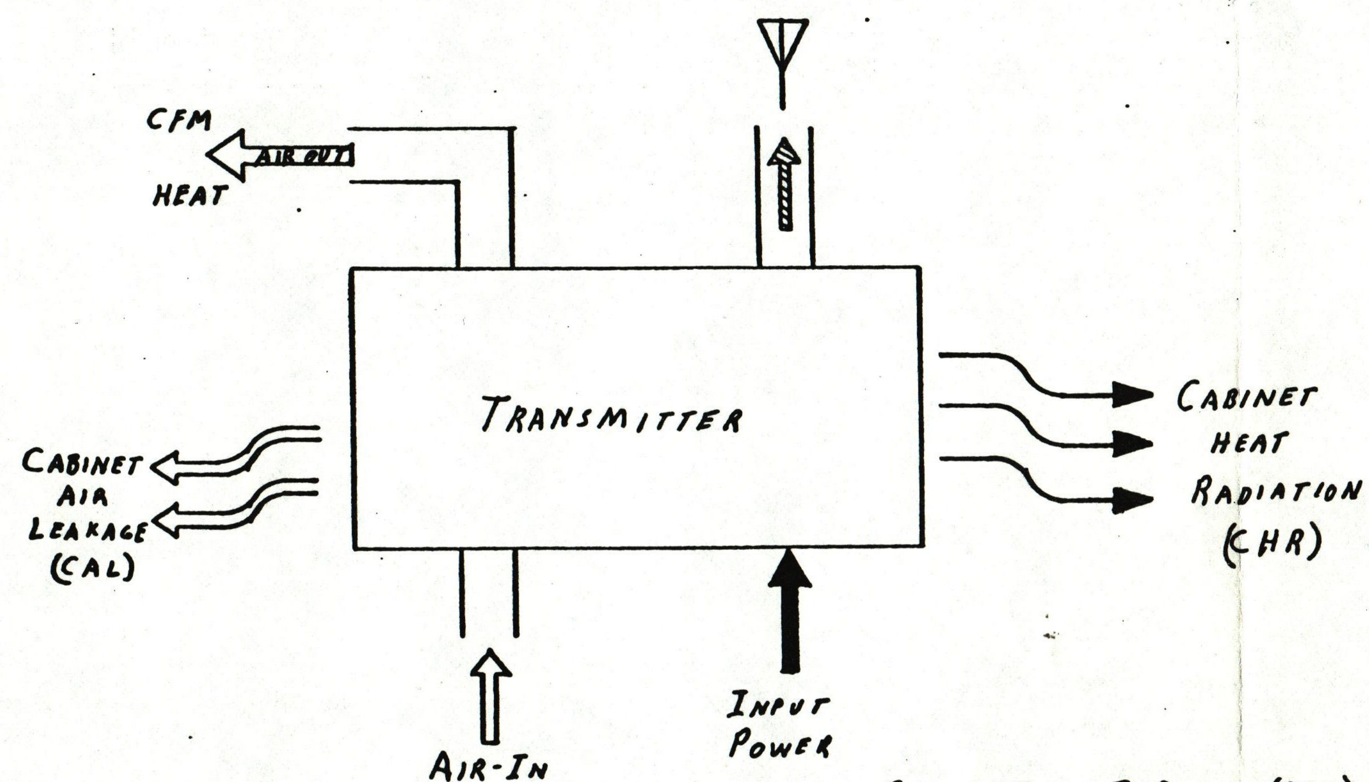

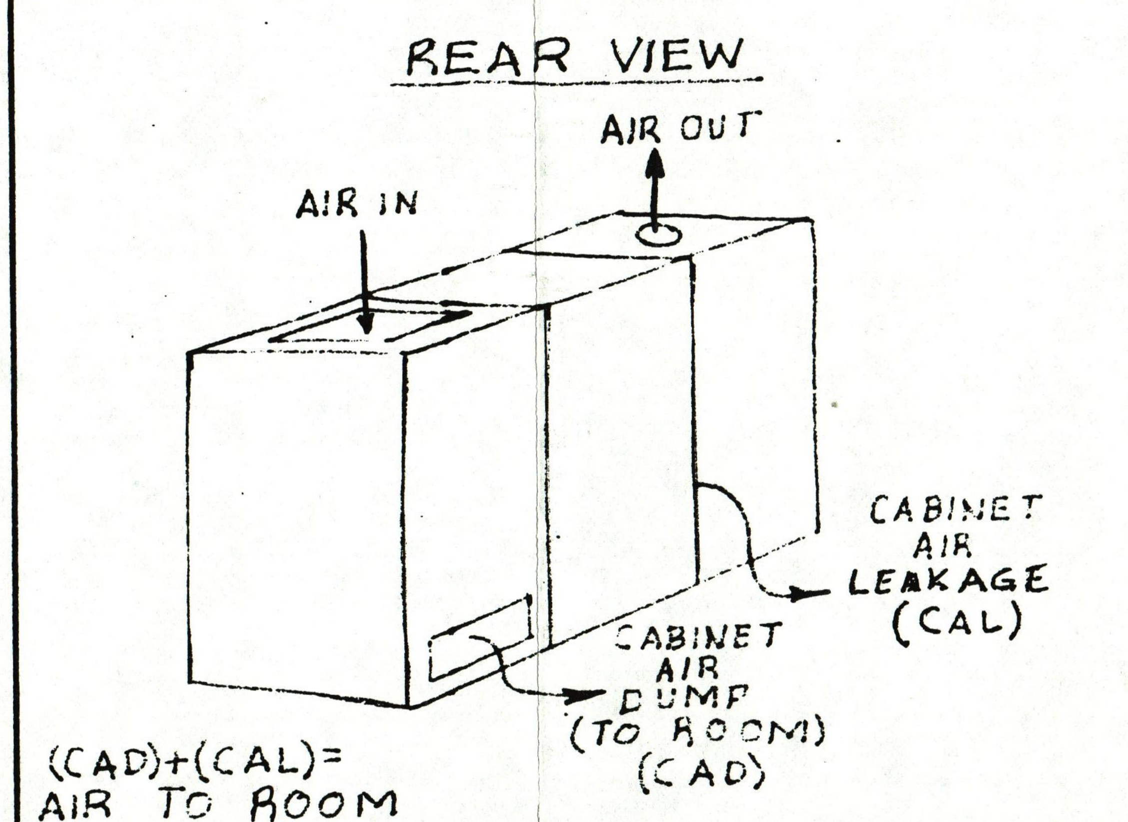

TRANSMITTER TYPE	RATED POWER OUTPUT	OPERATING POWER OUTPUT	INPUT POWER KW	INPUT KVA	AIR-IN CFM		AMBIENT TEMP. MAX.	AMBIENT TEMP. OPT.	AIR-OUT CFM	AIR-OUT HEAT KW	AIR-OUT HEAT BTU	AIR-OUT TEMP. °F	AIR-OUT TEMP. °C	AIR TEMP. RISE °F	AIR TEMP. RISE °C	STRAY AIR TO ROOM CFM	STRAY HEAT TO ROOM KW	STRAY HEAT TO ROOM BTU	BLOWER CFM CAP.	BLOWER CFM USE	FAN CFM CAP.	FAN CFM USE	AIR-IN SUPPLY PRESSURE (MIN.)	AIR-OUT BACK PRESSURE (MAX.)
816R-1A	11 KW	11 KW	19.3 KW	21.4	715		+40°C	+22.2°C	400	7.2	24574	129	54	57	32	315	1.1	3754	750	400	1000	715	+0.1" H_2O	+0.1" H_2O
		10 KW	17.8 KW	19.8	715		+40°C	+22.2°C	400	6.7	22867	125	52	53	30	315	1.1	3754	750	400	1000	715	"	"
		9 KW	16.3	18.1	715		+40°C	+22.2°C	400	6.3	21502	122	50	50	28	315	1.0	3413	750	400	1000	715	"	"
		8 KW	14.8	16.4	715		+40°C	+22.2°C	400	5.8	19795	118	48	46	26	315	1.0	3413	750	400	1000	715	"	"
		7 KW	13.3	14.8	715		+40°C	+22.2°C	400	5.5	18772	115	46	43	24	315	0.8	2730	750	400	1000	715	"	"
		6 KW	11.8	13.1	715		+40°C	+22.2°C	400	5.1	17406	112	44	40	22	315	0.7	2389	750	400	1000	715	"	"
		5 KW	10.3	11.4	715		+40°C	+22.2°C	400	4.6	15700	108	42	36	20	315	0.7	2389	750	400	1000	715	"	"
		5 KW	10.8	12.0	715		+40°C	+22.2°C	400	4.9	16724	111	44	39	22	315	0.9	3072	750	400	1000	715	"	"
		4 KW	8.8	9.8	715		+40°C	+22.2°C	400	4.2	14335	105	41	33	19	315	0.6	2048	750	400	1000	715	"	"
		3 KW	7.0	7.8	715		+40°C	+22.2°C	400	3.5	11946	100	38	28	16	315	0.5	1707	750	400	1000	715	"	"

Table 2-2. 816R-1A 10-kW FM Transmitter, Nominal Heat Balance.

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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 10KW.

j. Set all circuit breakers to ON.

k. Set the test meter selector switch to 28V SUPPLY, full scale is 40 VDC. The test meter will indicate 28 ±2 VDC.

l. Set the AC Meter Panel selector switch to FIL, full scale is 8 VAC. The test meter will indicate 7.2 ±0.1 volts.

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 u. are adequate to ensure 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 ON switch. The PLATE ON switch lamp will light.

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

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s. RAISE or LOWER the POWER ADJUST contol until the RF WATTMETER displays the stations's authorized power level. (Factory set to 100%).

t. Compare meter readings with those listed in Table 3-4 or 305. If additional tuning is required, refer to the adjustment procedures listed in Section 5.

u. Set POWER CONTROL switch to AUTOMATIC.

* 2-6. REMOTE OPERATION OR EXTENDED LOCAL OPERATION

* To initiate remote or extended local operation, set the TRANSMITTER CONTROL switch to REMOTE. When operating with the control panel, this switch must be in the LOCAL position. For extended local wiring or remote control connections, refer to Figure 4-11.

2-7. FREQUENCY CHANGE

The transmitter operating frequency is changed by changing the exciter operating frequency and performing the RF tuning procedure in paragraph 5-6.7. (See the 802A exciter instruction manual for exciter frequency changes.)

* Extended local control by direct connection of the extended control panel to the transmitter can be accomplished at a distance up to 200 feet. Twenty number 22 AWG wires are required, and connected as shown in Figure 4-11. Extended local metering of the transmitter parameters as denoted on Figure 4-10 may be routed over four pair of shielded wires.

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SECTION 3 - OPERATION

3-1. GENERAL

The transmitter is operated from the control panel. 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). See the 802A exciter instruction manual for 802A operation.

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, as viewed from the front of the transmitter.

3-3. TURN-ON PROCEDURE

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 or Table 3-5.

c. If minor tuning is required, perform steps n. through u. of paragraph 2-5.

TABLE 3-1. LEFT CABINET

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

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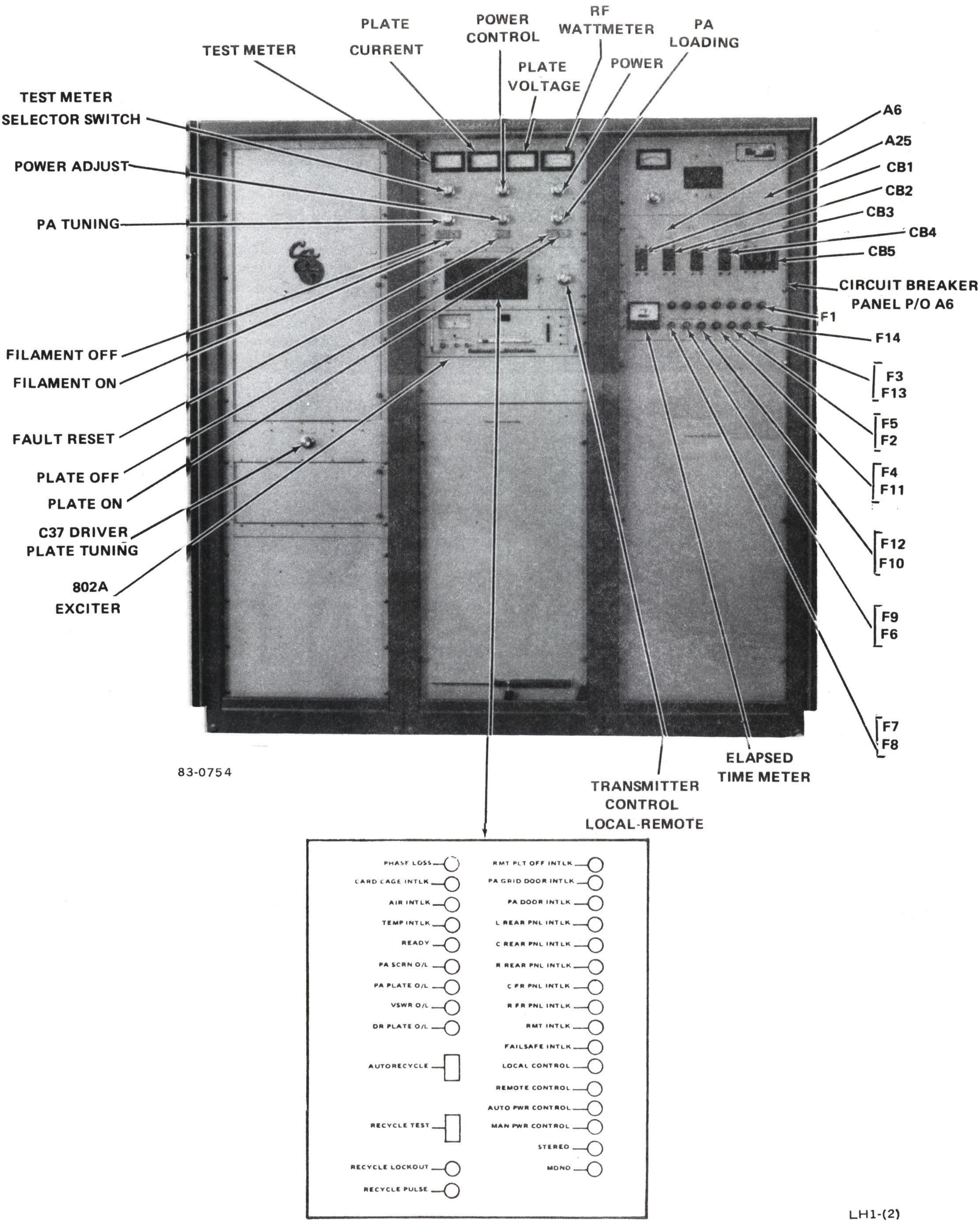

Figure 3-1. 816R-1A 10KW FM Transmitter

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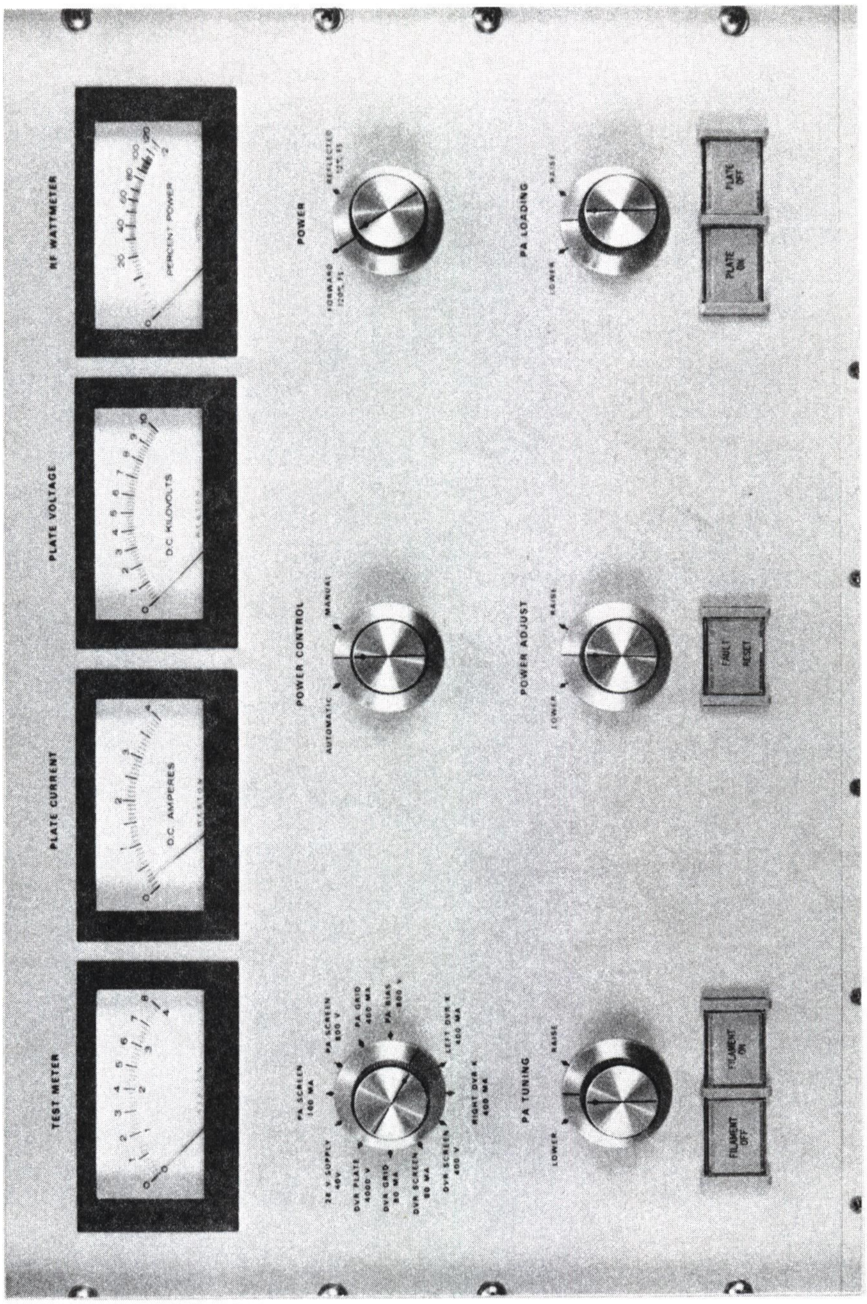

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Figure 3-2. Meter Panel

LG1-1(57)

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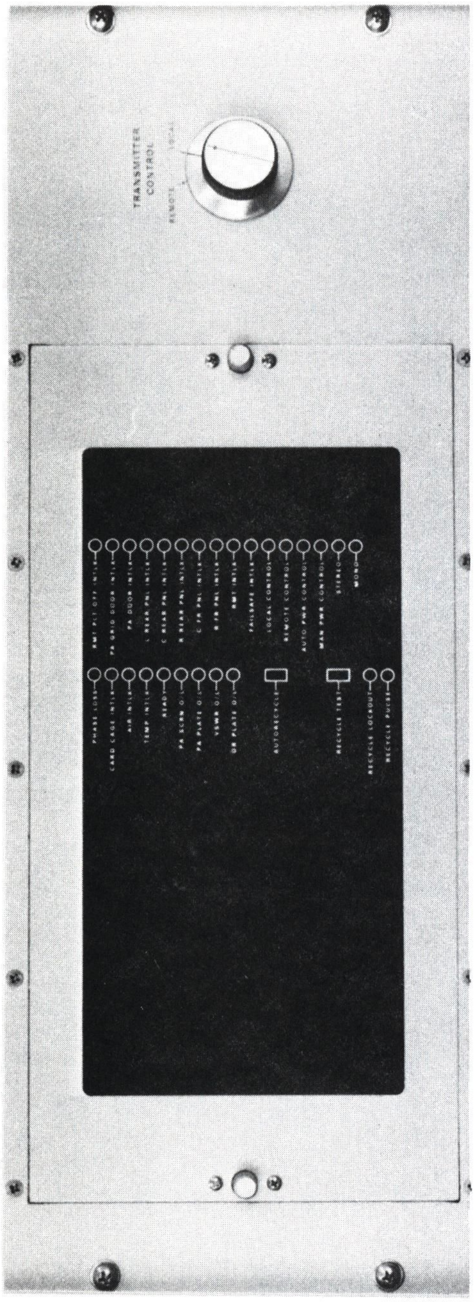

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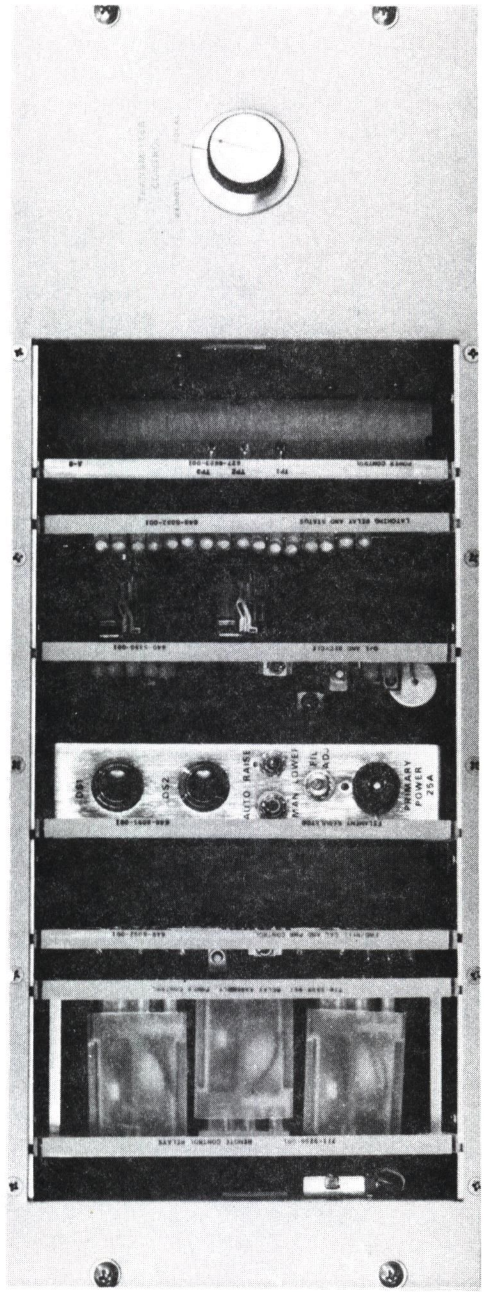

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Figure 3-3. Card Cage

LG1-1(58)

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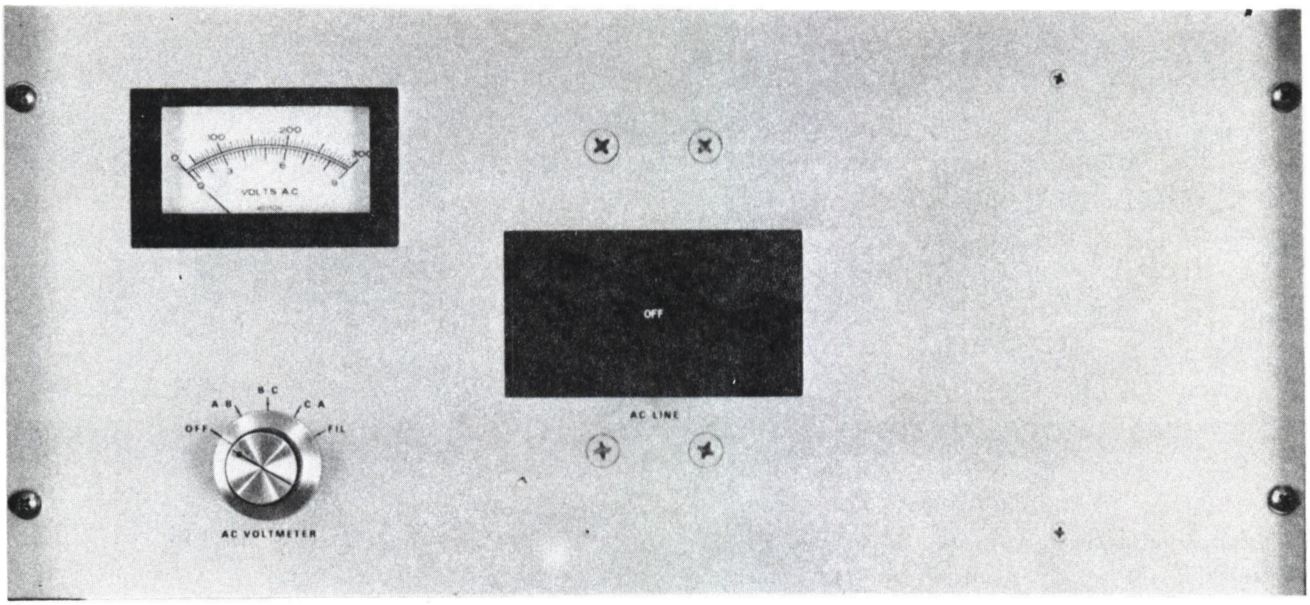

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Figure 3-4. AC Metering Panel, A25

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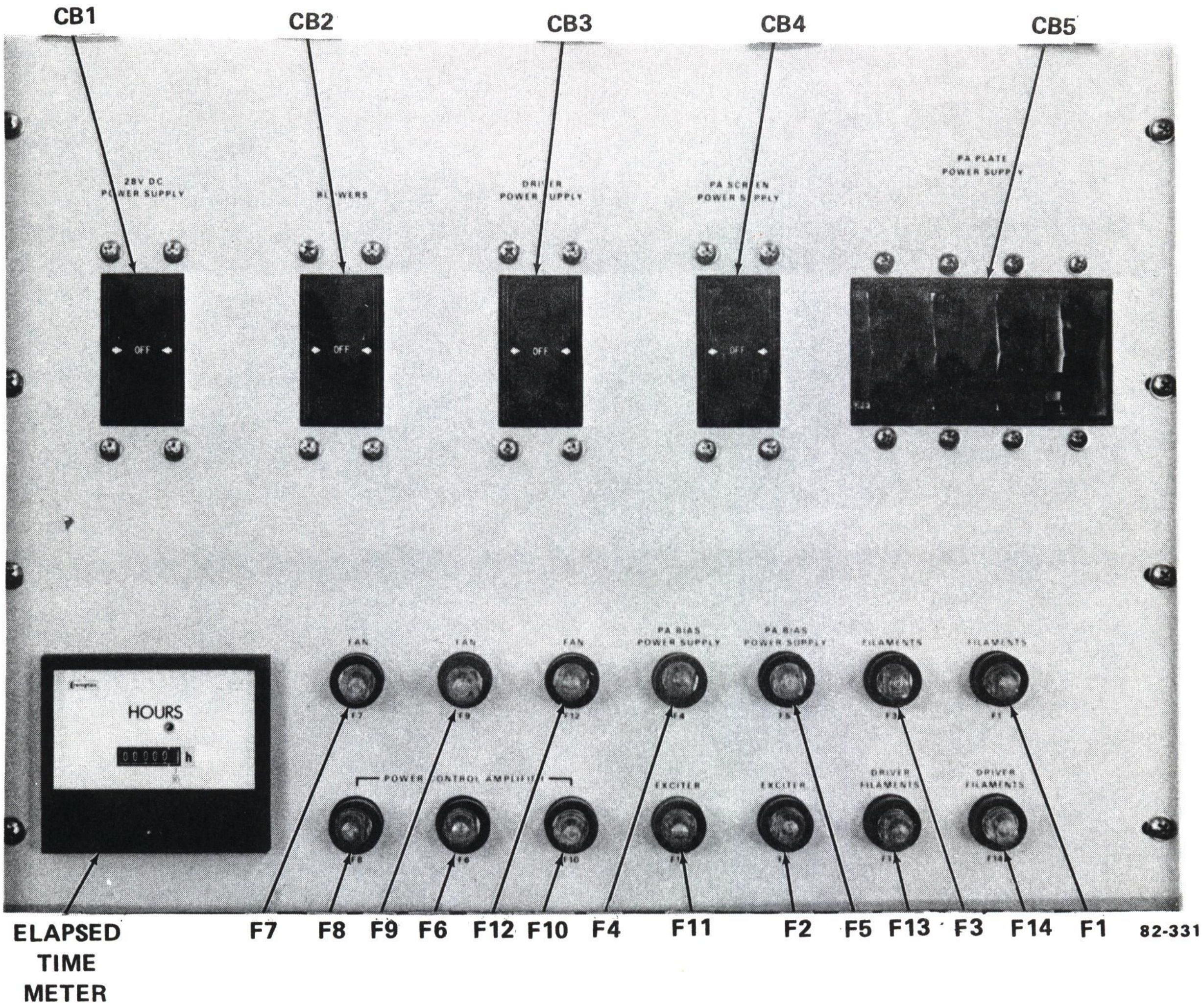

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Figure 3-5. Circuit Breaker Panel, A6

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TABLE 3-2. CENTER CABINET

REF. DESIG.	CONTROLS & 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.
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 in percent. (Customers TPO equals 100%)
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.

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TABLE 3-2. CENTER CABINET - Continued

REF. DESIG.	CONTROLS & INDICATORS	FUNCTION
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.
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.

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TABLE 3-2. CENTER CABINET - Continued

REF. DESIG.	CONTROLS & INDICATORS	FUNCTION
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 (As viewed from front)	Left Rear Panel Interlock Indicator.
A12CR9	C REAR PNL INTLK	Center Rear Panel Interlock Indicator.
A12CR10	R REAR PNL INTLK (As viewed from front)	Right Rear Panel Interlock Indicator.
A12CR11	C FR PNL INTLK	Center Front Panel Interlock Indicator.
A12CR12	R FR PNL INTLK (As viewed from front)	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.

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TABLE 3-2. CENTER CABINET - Continued

REF. DESIG.	CONTROLS & INDICATORS	FUNCTION
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.

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TABLE 3-3. RIGHT CABINET

REF. DESIG.	CONTROLS & INDICATORS	FUNCTION
A6CB1	28 VDC POWER SUPPLY	1 ampere magnetic circuit breaker that protects the 28 VDC 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	10-ampere magnetic circuit breaker that protects the PA screen power supply.
A6CB5	PA PLATE POWER SUPPLY	50-ampere magnetic circuit breaker.
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.

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TABLE 3-4. TYPICAL INDICATIONS, 10-KILOWATT POWER OUTPUT

TYPICAL METER READINGS

Power output:	10.0 kilowatts.
PA Plate Volts:	6500 volts.
PA Plate Current:	2.12 ampere.
PA Screen Current:	122 milliampere.
PA Grid Current:	30 milliampere.
Left Driver Cathode I:	170 to 220 milliampere.
Right Driver Cathode I:	170 to 220 milliampere.
Driver Screen I:	10 to 60 milliampere.
Driver Grid I:	0 to 10 milliampere.
Driver Plate Volts:	1800 to 2000 volts.
Driver Screen Volts:	270 to 290 volts.
* 802A Output Power: (On the Exciter)	5 to 10 watts.
PA Plate Efficiency:	(See Fig. 5-4 & 5-5, page 5-20)
Control Voltage:	26 to 28 volts.

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TABLE 3-5. NORMAL CONTROL PANEL METER READINGS AT VARIOUS OUTPUT POWER LEVELS

METER \ LEVEL	3 kW	4 kW	5 kW	5 kW	8 kW	10 kW	11 kW
PLATE CURRENT	0.97 A	1.33 A	1.75 A	1.09 A	1.7 A	2.12 A	2.27 A
PLATE VOLTAGE	4300 V	4300 V	4300 V	6500 V	6500 V	6500 V	6650 V
TEST METER positions							
PA SCREEN 400 MA	98 mA	98 mA	95 mA	80 mA	140 mA	122 mA	132 mA
PA SCREEN 800 V	475 V	575 V	680 V	465 V	665 V	765 V	800 V
PA GRID 80 MA	30 mA	30 mA	30 mA	30 mA	30 mA	30 mA	30 mA
PA FIL 8 V	7.2 ± 0.1 V	7.2 ± 0.1 V	7.2 ± 0.1 V	7.2 ± 0.1 V	7.2 ± 0.1 V	7.2 ± 0.1 V	7.2 ± 0.1 V
DVR K LFT. 400 MA	170 to 220 mA	170 to 220 mA	170 to 220 mA	170 to 220 mA	170 to 220 mA	170 to 220 mA	170 to 220 mA
DVR K RT. 400 MA	170 to 220 mA	170 to 220 mA	170 to 220 mA	170 to 220 mA	170 to 220 mA	170 to 220 mA	170 to 220 mA
DVR SCREEN 400 V	270 to 290 V	270 to 290 V	270 to 290 V	270 to 290 V	270 to 290 V	270 to 290 V	270 to 290 V
DVR GRID 80 MA	0 to 10 mA	0 to 10 mA	0 to 10 mA	0 to 10 mA	0 to 10 mA	0 to 10 mA	0 to 10 mA
DVR PLATE 4000 V	1800 to 2000 V	1800 to 2000 V	1800 to 2000 V	1800 to 2000 V	1800 to 2000 V	1800 to 2000 V	1800 to 2000 V
28 V SUPPLY	26 to 28 V	26 to 28 V	26 to 28 V	26 to 28 V	26 to 28 V	26 to 28 V	26 to 28 V

NOTE: EXCEPT WHERE SPECIFIC TOLERANCES ARE GIVEN, THE ABOVE ARE APPROXIMATIONS. THE INDIVIDUAL TRANSMITTERS WILL VARY WITH SOURCE VOLTAGE AND INSTALLATION.

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3-4. SHUTDOWN PROCEDURES

3-4.1 Normal Turn-Off.

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 Turn-Off.

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. (Normally the meter is set to read 100% at the stations authorized transmitter power output.)

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 transmitter operator presses the FAULT RESET switch on the main control panel. 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.

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SECTION 4 - PRINCIPLES OF OPERATION

4-1. GENERAL

The 816R-1A 10KW FM Transmitter operates in the 88- to 108-MHz
* range at a maximum output of 11,000 watts. A CEMC 802A solid-state FM wideband exciter, with provision for optional stereo and/or SCA
* input, 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 10 to 20 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 sample of the forward power in the coupler is sent to the auto power control circuit for monitoring. 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 sent to the power control circuits for monitoring. 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 Exciter Instruction Manual for 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.

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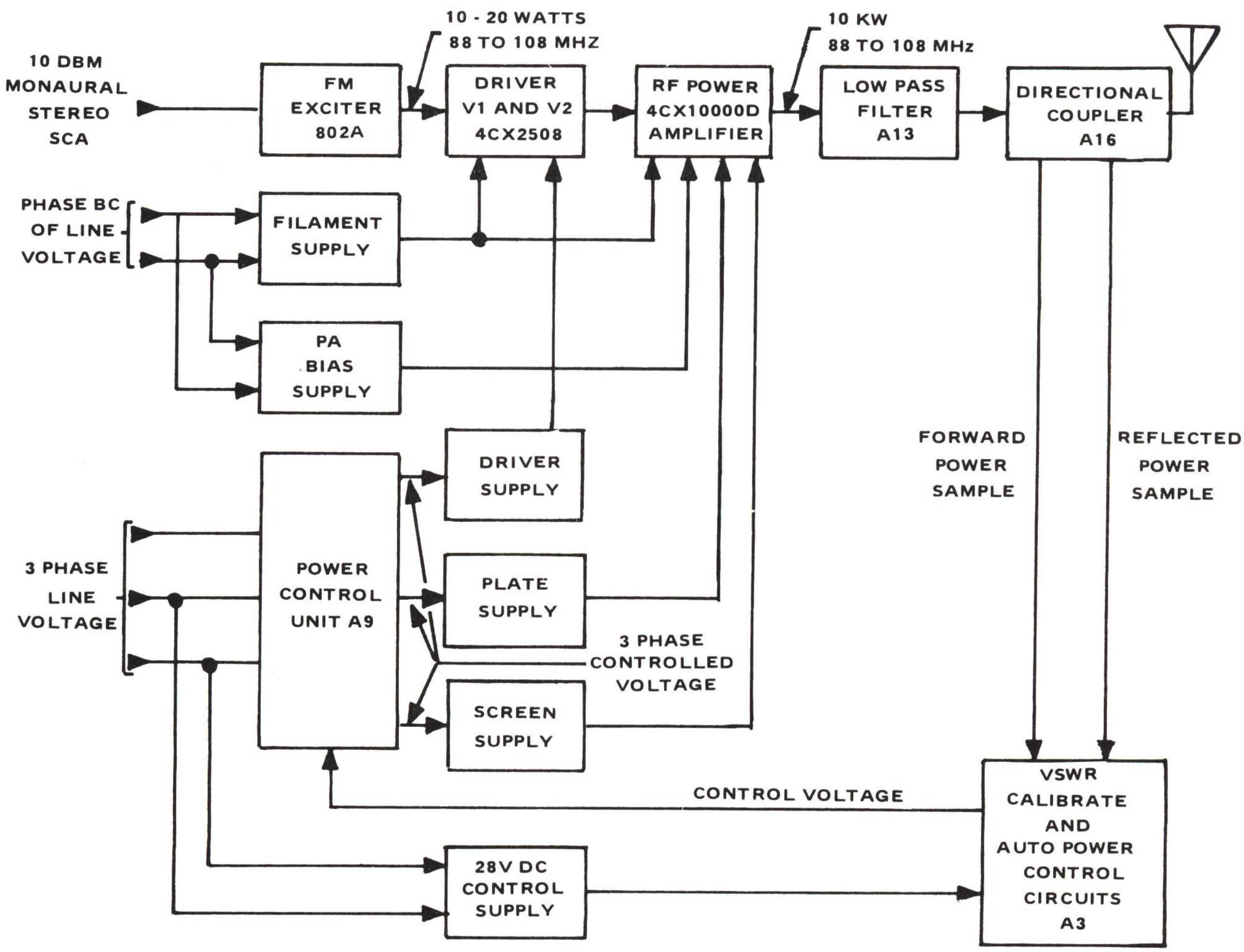

Figure 4-1. 816R-1A 10KW FM Transmitter
Block Diagram

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The input circuit is tuned transmission line with resistance loading. 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 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.

4-3.3 RF Power Amplifier.

The driver output is coupled to the grid of power amplifier tube A18V3. A tuned circuit composed of A21L7 and A11C37 provides impedance matching. Cavity damping resistor A18R75 is connected behind PA plate tuning capacitor A18C51. Strap inductor A18L14 and capacitor A18C89 dampen the higher order cavity resonances that can occur near the third harmonic of the output frequency. Cathode tuning (or peaking) capacitor A21C60 improves the bypass action at the operating frequency. Resistor A21R78 and coupling capacitor A21C61 broaden the frequency response. Inductors A11L4 and A21L5 keep RF out of the power supplies, and A18LN1 and A18LN2 provide neutralization.

The power amplifier is a plate-tuned 4CX10,000D tube 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 and A18R36. 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 prove, 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.

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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.

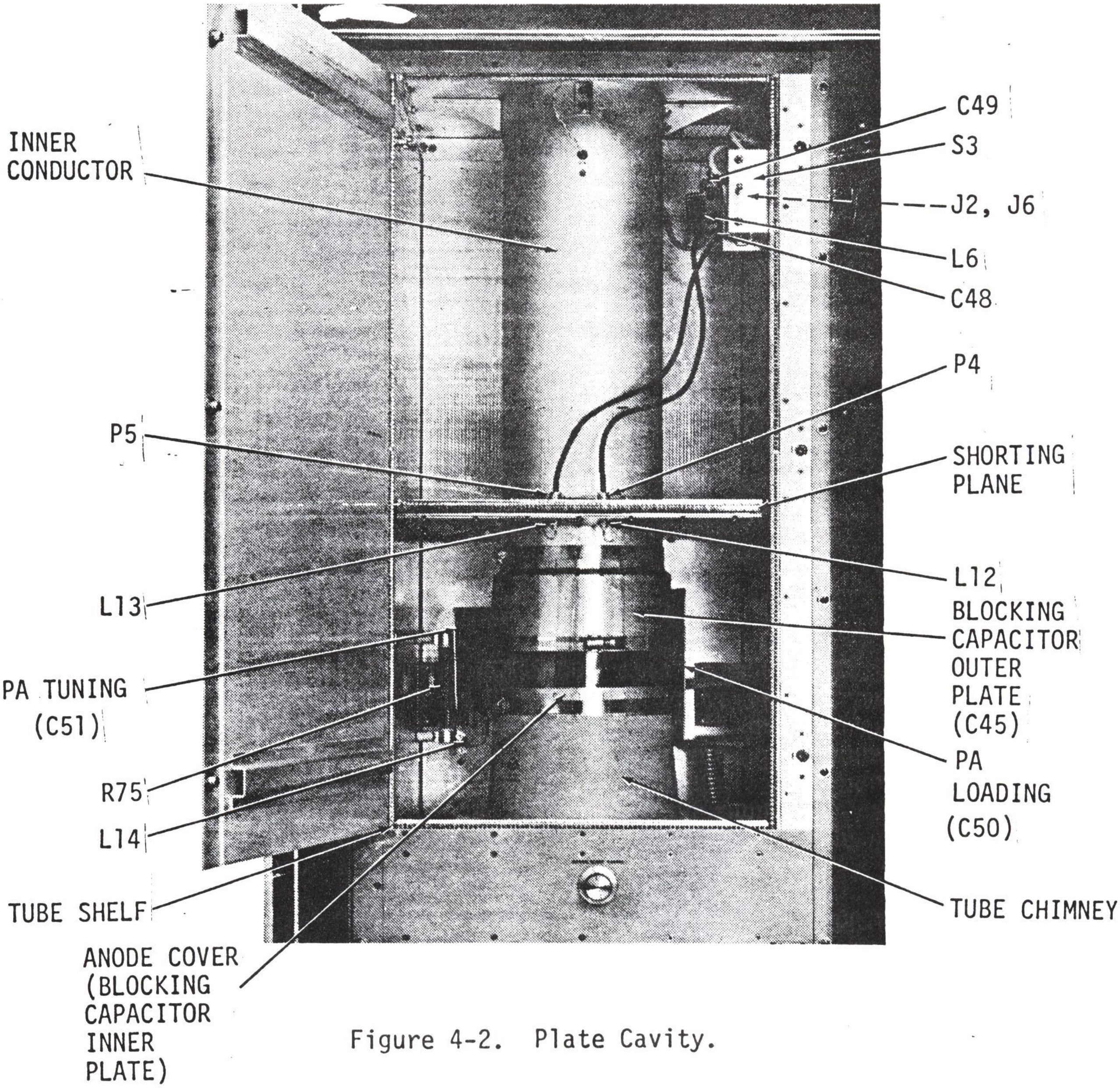

Figure 4-2. Plate Cavity.

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DC blocking capacitor A18C45 is formed by placing a dielectric cylinder over the PA anode cover and then a metal cylinder over the dielectric cylinder. Figure 4-3 shows the electrical equivalence of the plate tuning circuit.

4-3.4 Low-Pass Filter A13.

Low-pass filter A13 consists of two coaxial filters in tandem. The first filter has a cutoff of 140 MHz, while the second has a cutoff of 300 MHz.

4-3.5 Directional Coupler A16.

Directional coupler A16 provides monitor samples for Auto Power Control Unit A3. Forward power from C3 is rectified by CR2, filtered, and applied to amplifier U1 and U3 in Auto Power Control Unit A3. Reflected power is acquired in the same manner through C1 and applied to amplifier U2.

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. One of the remaining two, the driver power supply, furnished voltage to the driver stage. The remaining one, the 28-VDC 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.

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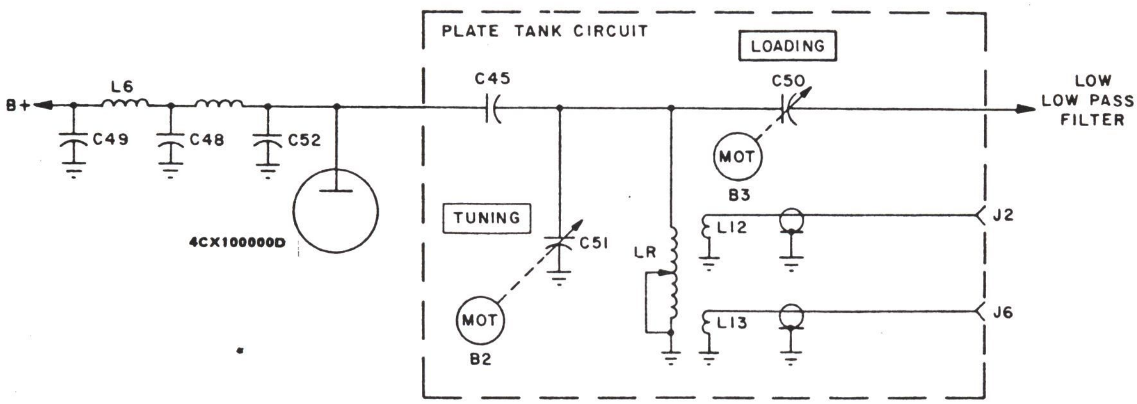

NOTE:
C45 is the capacitance between tube anode and the cavity center conductor
C50 is the capacitance between movable plate 1 and the tube anode
C51 is the capacitance between movable plate 2 and the tube anode
LR is the lumped constant equivalent of the shortened 1/4 wave resonator

Figure 4-3. 816R-1A 10KW FM Transmitter, Schematic Diagram, Output Network

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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 also blocks grid current flow through the supply when the grid leak bias exceeds the fixed bias. A sample of the bias voltage is also applied through R3 to front panel meter A1M1 for monitoring. Variable resistor R2 allows adjustment of the no-drive PA idling current.

4-4.4 PA Plate Power Supply, PS

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 adjusts 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. Relay A9AR1K1 de-energizes on PLATE OFF, disabling the three SCR gate driving cards. (See Figure 4-4.)

A common DC 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.

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4-4.6 Power Control Regulator A8.

Power control regulator A8 provides the necessary control signals to operate power 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 K12 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.

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 circuit to the driver screen circuit. Gaseous protector, A17E2B, shorts excessive transient voltages to ground. Resistive voltage dividers provide driver plate voltage (from across A14R32) and screen voltage (from across A17R3) monitoring.

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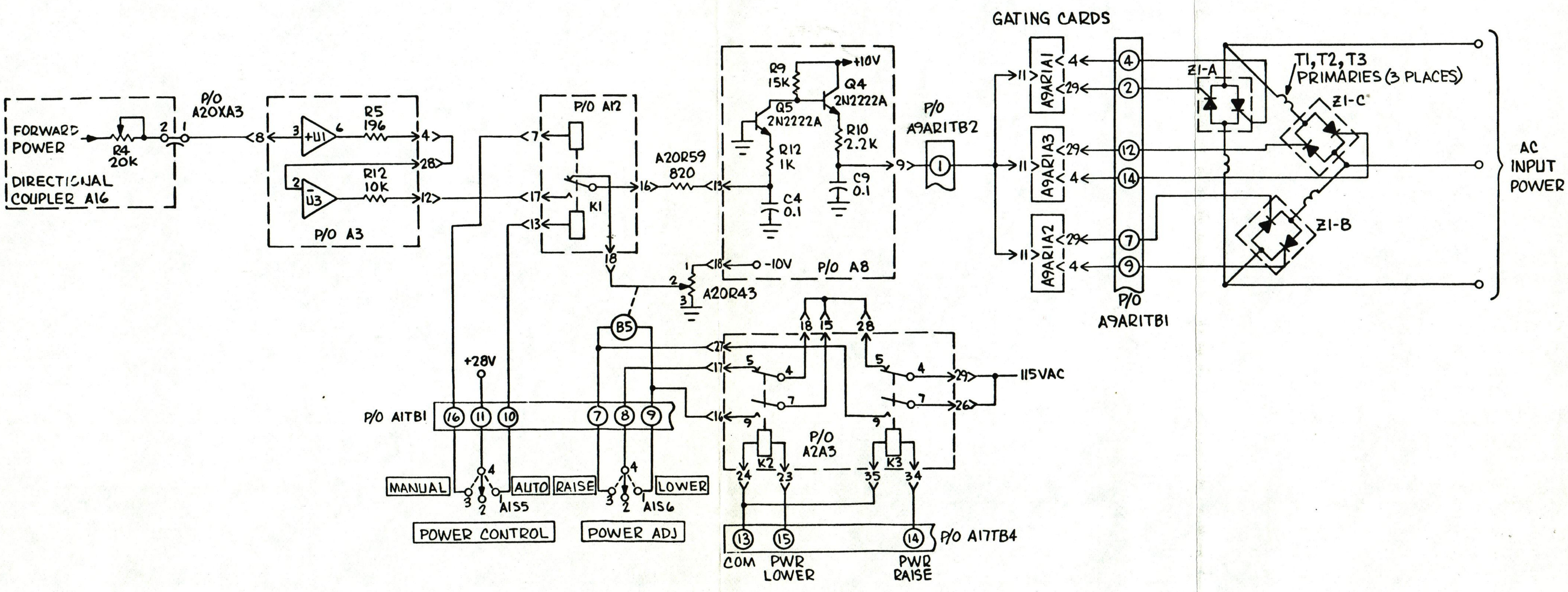

Figure 4-4. Power Control Circuits, Simplified Diagram

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4-4.9 Filament Voltage Regulator, A5.

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 for an output of 166 volts. The 166 VAC is applied to the primary of filament transformers A11T6 and A18T5.

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. Potentiometer A5R3 is set for no signal at the junction of A5C1 and A5R17 with respect to ground when the output of variable transformer A19A2T1 is 166 VAC.

When the input 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 votlage is applied from secondary #2 of A20T8 through diodes A5CR1 and A5CR2 to RAISE relay A5K1 and LOWER relay A5K2, respectively. Because 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.

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Operation of the detector circuit under low input AC voltage conditions 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 similar; 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 runs, driving the rotor on variable transformer A19A2T1 until the input AC voltage is raised to 166 VAC. The motor control circuit which lowers the input AC voltage operates in a similar manner.

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.

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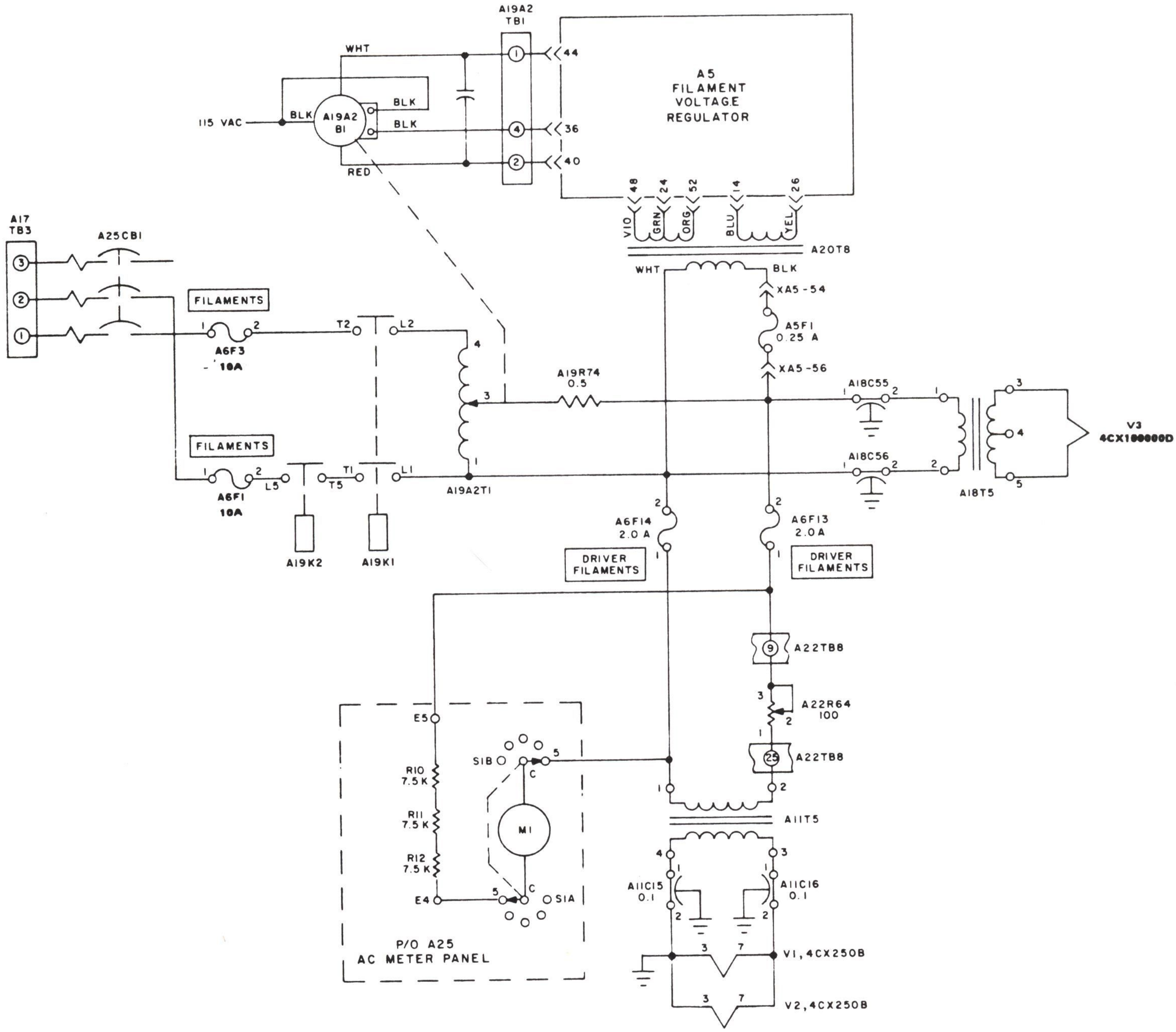

Figure 4-5. Filament Voltage Distribution

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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). PA PLATE POWER SUPPLY circuit breaker A6CB5 connects power phase to phase to 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 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 are turned on by the operator during equipment turn 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
* application 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 Control Panel, A1 (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.

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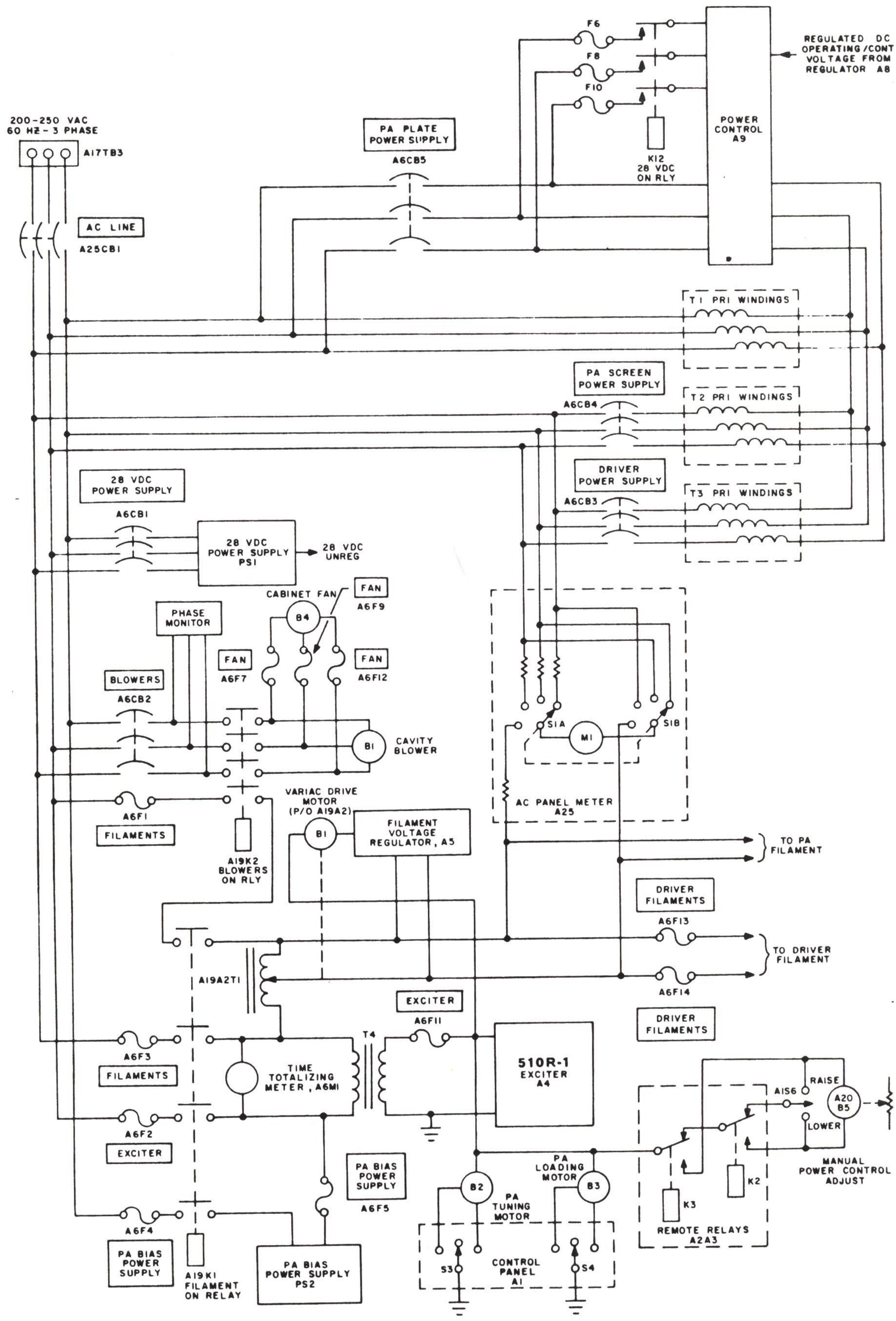

Figure 4-6. Primary Power Distribution

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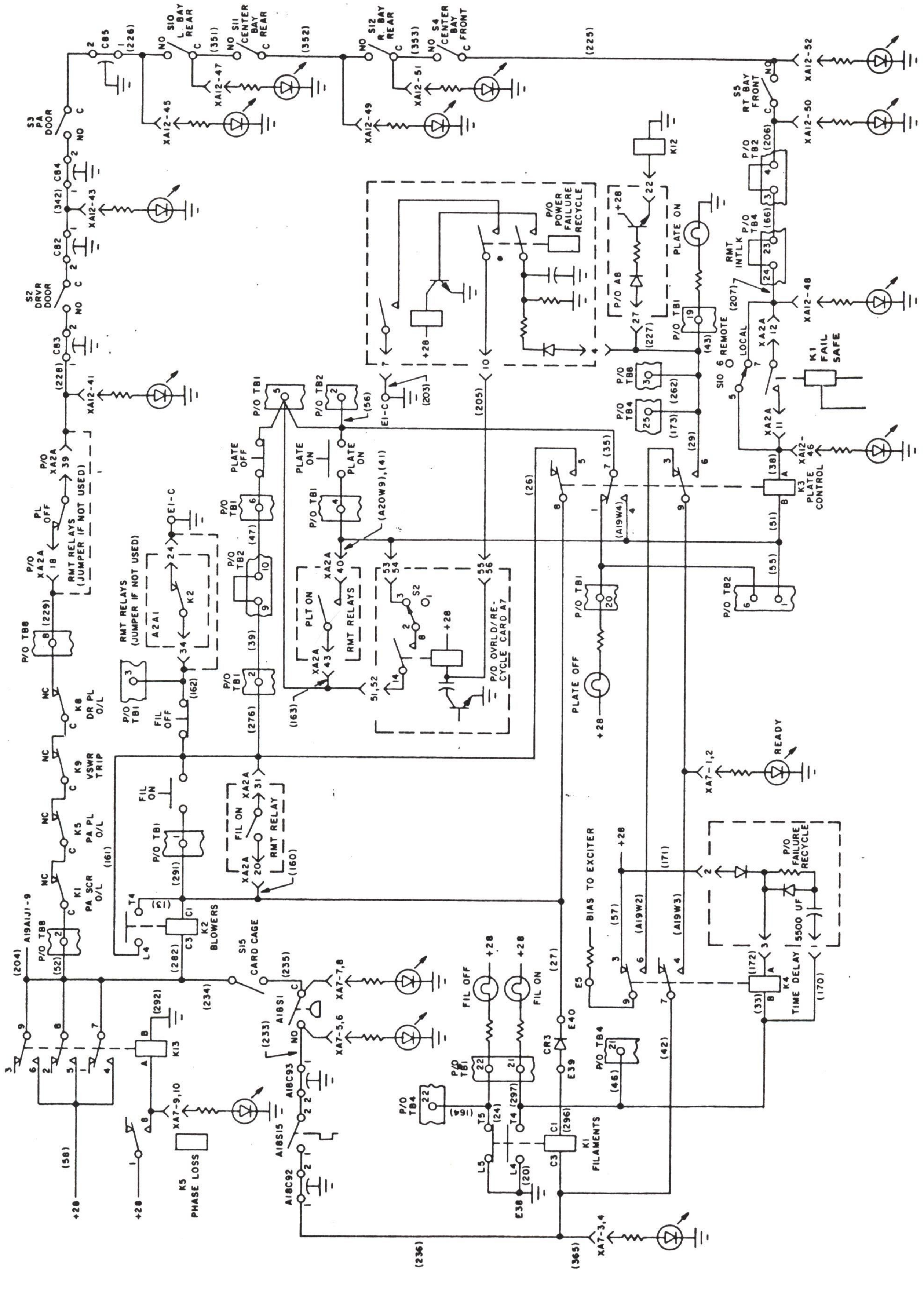

Figure 4-7. Power ON-OFF Control Circuits

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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 energized A19K2 through contacts 8 and 5. The transmitter goes through the above sequence of blower, filament, time delay and plate-on by pressing a single switch.

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 turns off 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. *

4-5.4 Forward/Reflected 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).

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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 S1 are used to test the VSWR protect circuit operation during maintenance operation. By pressing the push TEST switch S1, a simulated reflected power sample is applied to pin 3 of U2. With A1M4 calibrated for 1000 watts at indicated 10% (full scale is 12%) 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.

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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 Q3, 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

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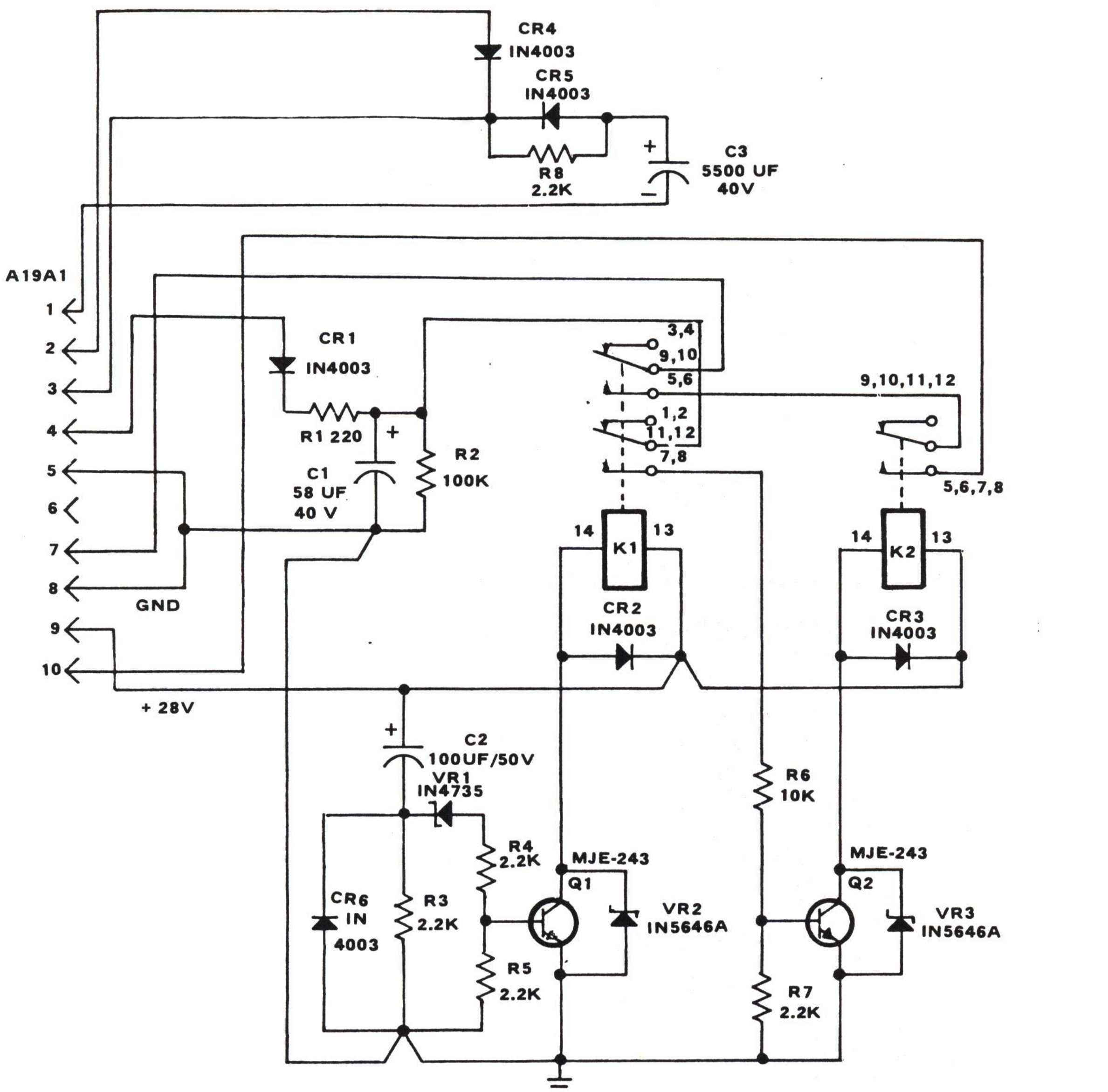

Figure 4-8. Power Recycle Schematic Diagram

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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 within the safe exhaust air 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 that follow 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. See Figure 4-8.

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 4-9). 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.

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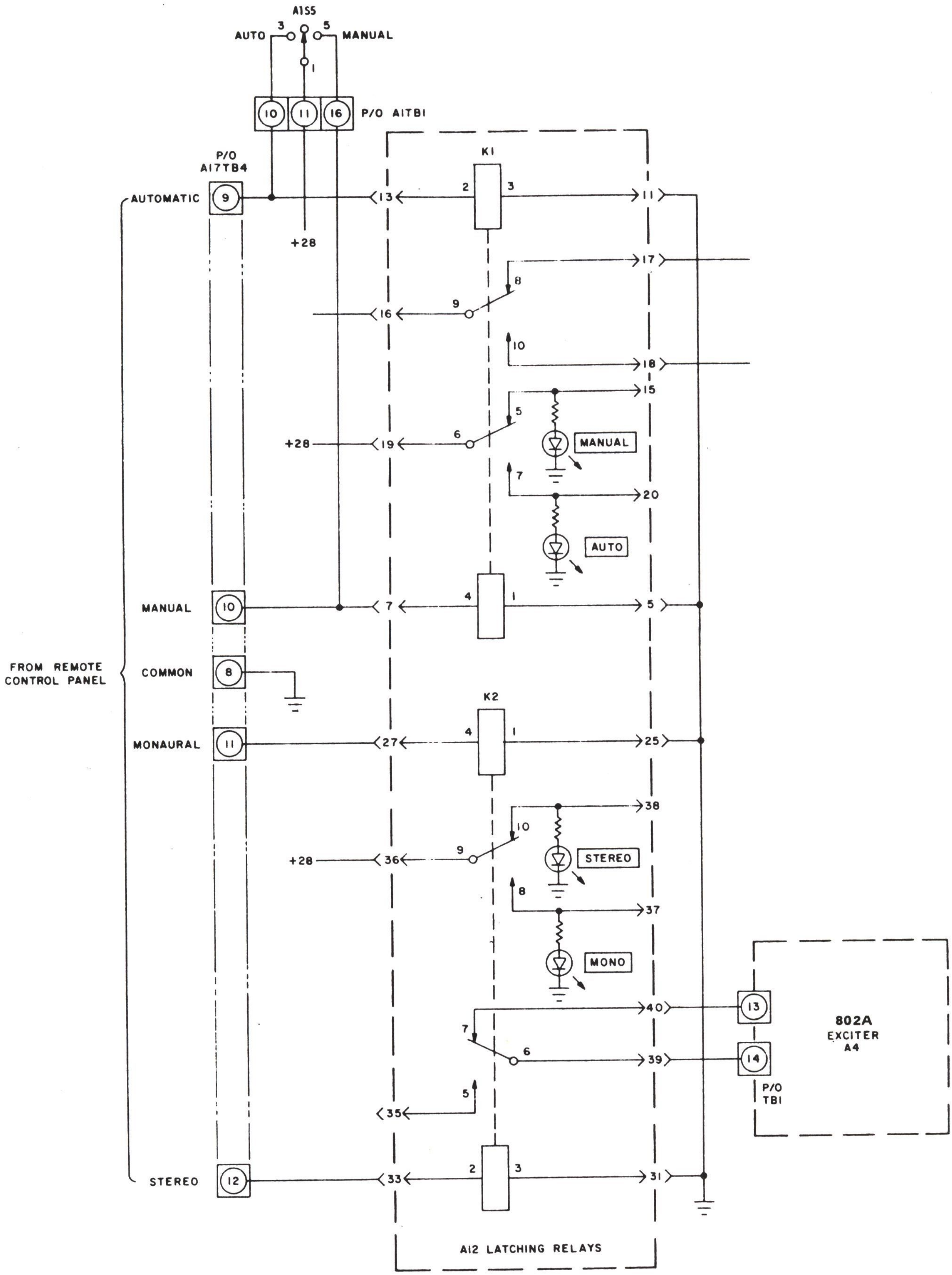

Figure 4-9. Latching Relays A12, Simplified

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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.

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 4-10). 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.

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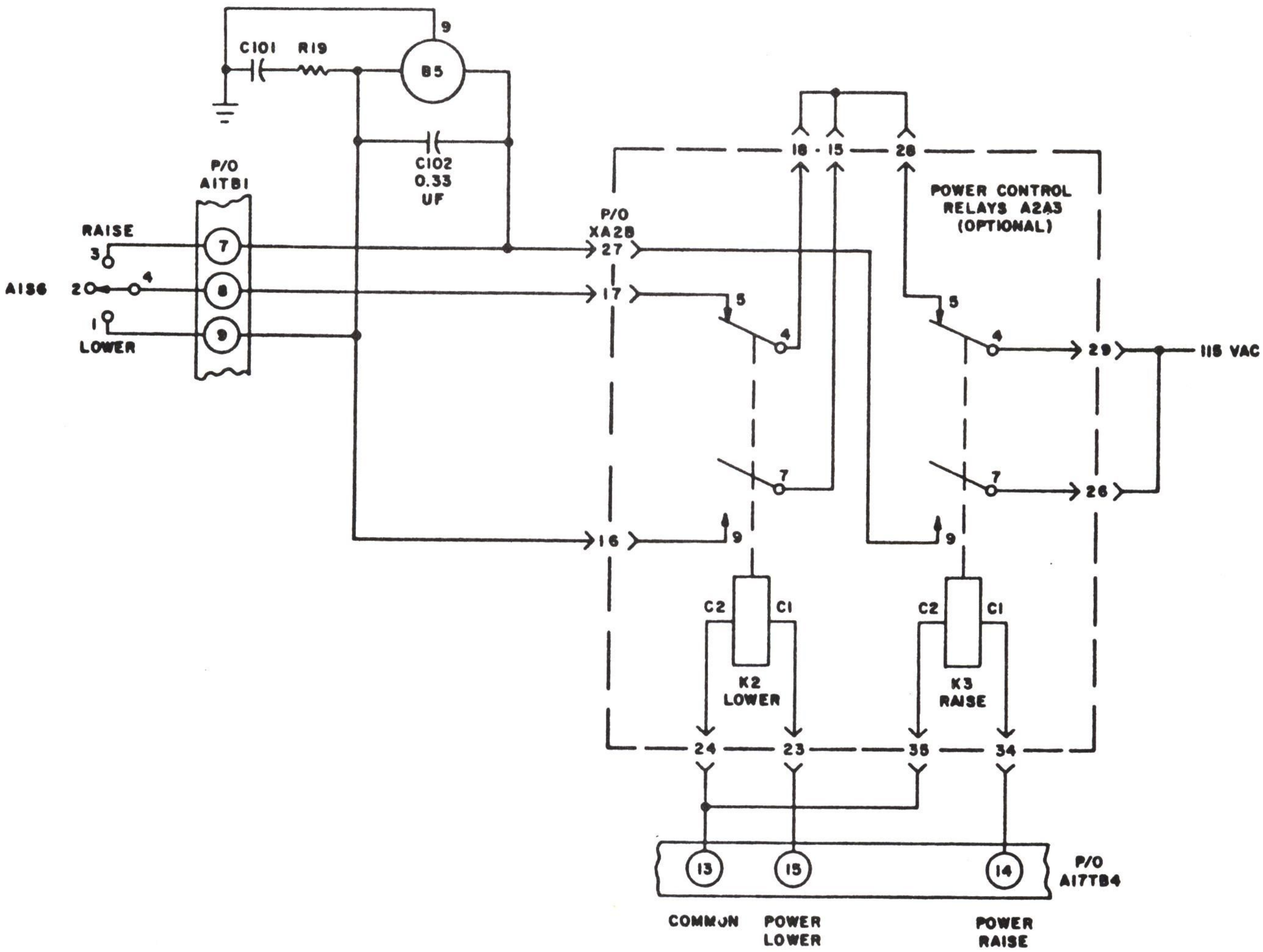

Figure 4-10. Power Control Relays A2A3 Simplified Schematic

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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 de-energizes and removes power from the transmitter.

4-5.11 Remote Connections.

Typical remote interconnections to remote control terminal board TB4 are given in Figure 4-11.

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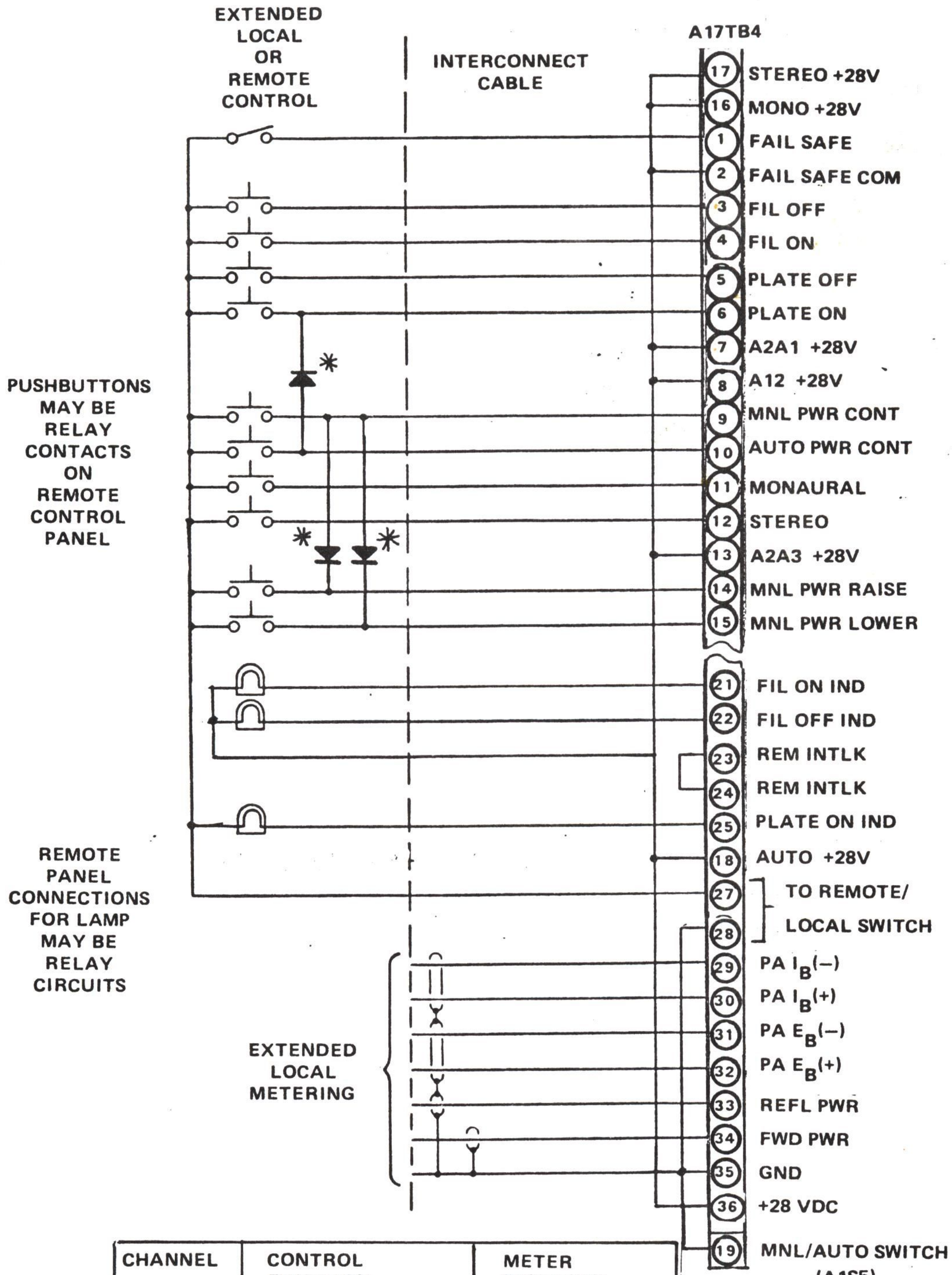

CHANNEL	CONTROL FUNCTION	METER FUNCTION
1	FIL OFF/ON	–
2	PLATE OFF/ON	PLATE VOLTS
3	MANUAL/AUTO	PLATE CURRENT
4	PWR RAISE/LOWER	FWD PWR
5	MONO/STEREO	REFL PWR

*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 LOWER control is energized.

Figure 4-11. Typical Extended Local and Interconnections to Terminal Board A17TB4

WARNING: DISCONNECT PRIMARY POWER SOURCE BEFORE SERVICING.

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SECTION 5 - MAINTENANCE

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% methylene chloride, 5% perchloroethylene, and 70% 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.

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5-2.2 Air Filter.

The air filter, on the 816R-1A 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 visible quantity of dust accomulates 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. Clean blades with damp cloth.

5-4. LUBRICATION

The tuning and loading motor and the manual power increase/decrease motor are sealed and do not require lubrication. The cabinet air inlet motor and the PA cavity blower motor should be lubricated with SAE 10 oil each 3 months or as required.

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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 switch 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

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.

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TABLE 5-1. REQUIRED TEST EQUIPMENT

NAME	DESCRIPTION	MFR. & MODEL
Volt-ohm-milliammeter		Triplett 630-N
AC Voltmeter	0 to 10 volts, 1% tolerance (true RMS)	Weston 433
Power Supply	0 to 28 VDC, 5 amperes	
RF Wattmeter	1.0 and 10 KW elements, 50 to 125 MHz	Bird 460
Thruline Wattmeter	25 watt element 50 to 125 MHz	Bird 43
DC Voltmeter	0 to 10 KV	
DC Ammeter	0 to 3 amperes	

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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 lamp extinguishes 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" 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% meter to the PA filament rings on the tube socket.

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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 and adjust variable transformer A19T7 to maximum CCW position.

f. Press FILAMENT ON switch on control panel A1.

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. Adjust variable transformer A19T7 with an insulated rod for an indication of 7.6 VAC.

h. With A5S1 in MANUAL position, run variable transformer drive motor until limit switch actuator arm is against the CW limit switch.

i. Press FILAMENT OFF switch on control panel A1.

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

k. Press FILAMENT ON switch on control panel A1.

l. Place A5S1 in AUTOMATIC position.

m. Adjust A5R3 for an indication of 7.2 VAC. (As indicated on meter connected to filament in Step b).

n. Adjust Filament calibrate A25A1R12 to make it read 7.2 VAC.

o. Tighten locking device on A25A1R12.

p. Remove voltmeter connected across PA filament.

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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 $\pm$0.5 volts on the AC voltmeter.

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.

c. Turn PA PLATE OVLD ADJ A22R66, PA SCREEN OVLD ADJ A22R65, and DVR (driver) PLATE OVLD ADJ A22R60 to their full CCW position.

d. Connect a milliammeter from the positive terminal of a 28 VDC power supply to TB8-6 on the transmitter.

* DRIVER OVERLOAD ADJUSTMENT

e. Connect the negative terminal of the DC power supply to the transmitter chassis.

* f. Adjust the power supply current to 500 milliampere.

g. 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.)

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h. Disconnect the milliammeter and remove the jumper from the DC power supply to the chassis.

* P.A. PLATE OVERLOAD ADJUSTMENT

i. Connect an ammeter from the positive terminal of a 28 VDC power supply to A14R15-1.

j. Connect the negative terminal of the DC power supply to A14R16-1.

k. Adjust the DC power supply current to 2.8 amperes.

l. 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.)

m. Disconnect the ammeter and remove the jumper from the DC power supply to A14R16-1.

* P.A. SCREEN OVERLOAD ADJUSTMENT

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

o. Connect the negative terminal of the DC power supply to TB8-4.

p. Adjust the power supply current to 400 milliampere.

q. 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.)

r. Disconnect the milliameter and remove the jumper from the DC power supply to TB8-4.

s. 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.

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

* d. Adjust the DC power supply current to 80 milliampere.

* e. Set the TEST METER selector switch to PA GRID 80 milliampere.

* f. Adjust PA GRID MTRG CAL control A22R72 for a 80 milliampere 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.

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

j. Adjust the DVR SCREEN MTRG CAL control A22R73 for an 80 milliampere 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.

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d. Raise or lower the POWER ADJUST control until approximately 6000 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 $\pm$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 milliampere position.

i. ADjust the LEFT BIAS control on the driver box All until the TEST METER indicates 125 milliampere.

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

k. Adjust the RIGHT BIAS control on driver box All until the TEST METER indicates 125 milliampere.

NOTE

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

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

m. Replace all panels and close all compartment doors.

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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.

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 tuning slider A21L7 and the driver grid slider A11L9 to the desired frequency in accordance with the graph in Figure 5-2.

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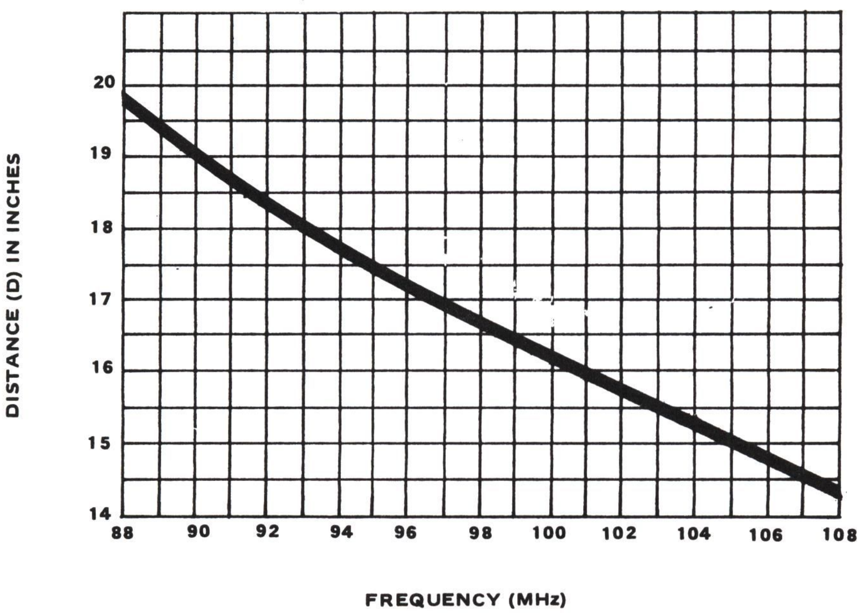

PA PLATE TUNING
CAVITY SLIDER
APPROXIMATE ADJUSTMENT

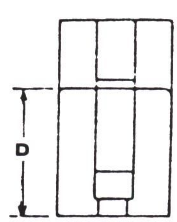

Figure 5-1. PA Plate Cavity Shorting Plane
Approximate Adjustment

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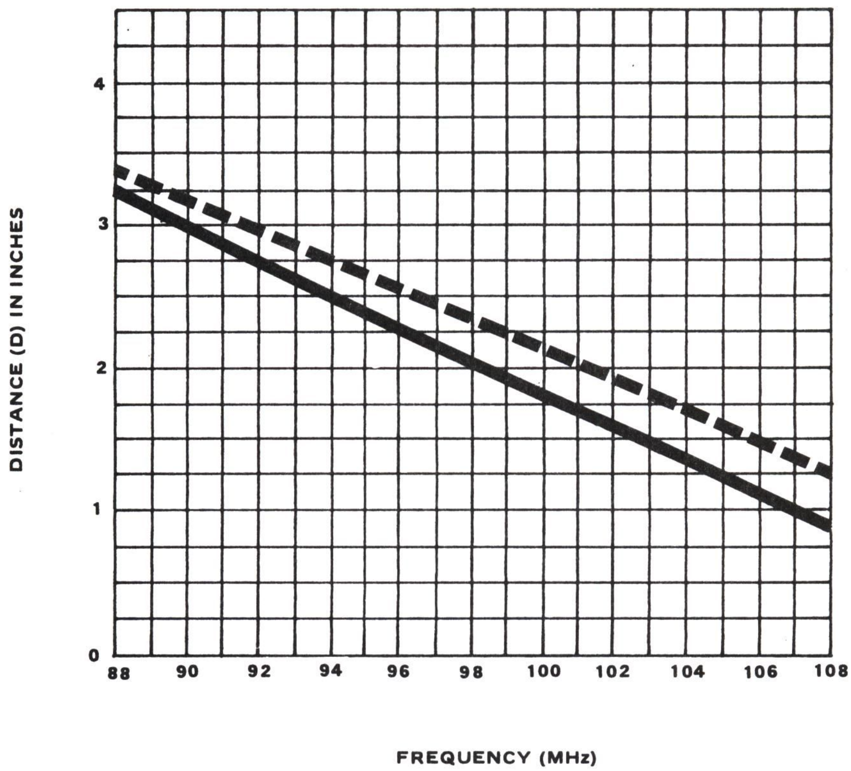

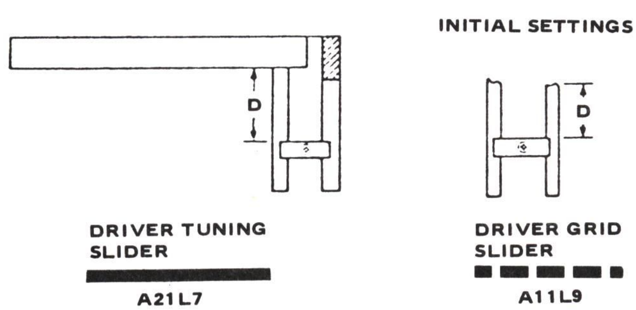

Figure 5-2. Graph for Approximate Setting of Driver Tuning and Driver Grid Sliders

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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.

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

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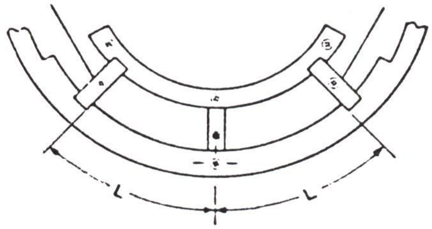

PA NEUTRALIZING ADJUSTMENT

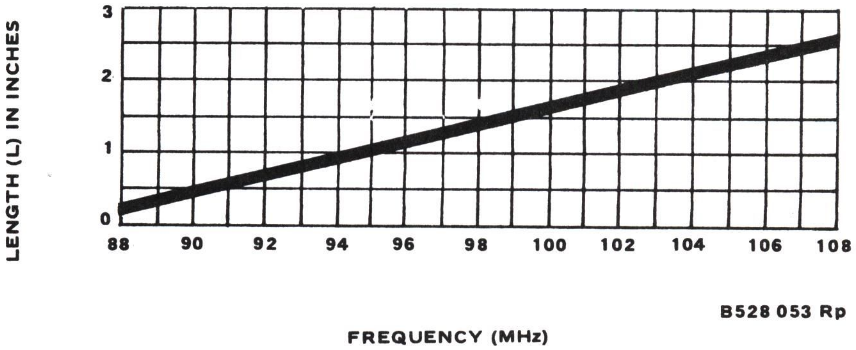

Figure 5-3. PA Neutralizing Adjustment

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c. Block the interlock grounding switch open. *

d. Set DRIVER, PA SCREEN and PA PLATE POWER SUPPLY circuit breakers A6CB3, 4 and 5 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 the 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 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, re-adjust A11L9 and repeat steps e through h. *

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

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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 10 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 10 KILOWATTS.

c. Turn the DRIVER PLATE TUNING control fully counter-clockwise. Then turn the control six turns clockwise (30% 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 mid-range. Close the plate cavity door.

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

f. Turn filament peaking capacitor A21C60 to 40% from maximum capacity.

g. Position the filament ring-to-ring bypass capacitor, A21C59, on its mounting bracket as follows:

Operating Frequency	Position
88.1 to 92.9 MHz	Maximum distance from socket
93.1 to 102.9 MHz	One-half distance from socket
103.1 to 107.9 MHz	Minimum distance from socket

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

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CAUTION

DO NOT EXCEED THE FOLLOWING MAXIMUM RATINGS:

LEFT DRIVER CATHODE CURRENT:	250 milliampere
RIGHT DRIVER CATHODE CURRENT:	250 milliampere
PA SCREEN CURRENT:	400 milliampere
PA PLATE CURRENT:	2.6 amperes

* Remove front access panel directly below circuit breaker panel. Block open the interlock switch.

* WARNING

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

* Turn OFF exciter. Turn P.A. plate ON. Using a long insulated screwdriver adjust PS2-R2 for Idle P.A. plate current of .5 amps.

* After P.A. plate current is set, turn transmitter OFF and replace access panel.

i. Press the FILAMENT ON and PLATE ON switches on control panel A1. (With Exciter TURN ON)

CAUTION

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

j. 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.

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

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l. 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.

m. Adjust the exciter output to produce 1 to 5 milliampere of grid current.

n. Check for PA neutralization. Refer to paragraph 5-6.7.7.

o. Check driver neutralization. Refer to paragraph 5-6.7.6.

NOTE

Because of the relatively high output capacity of the 4CX10,000D and the resulting low cavity inductance, no plate current dip will be noted at higher power levels. Tuning and loading should be adjusted in steps for maximum output power.

p. Press the PLATE OFF and FILAMENT OFF switches on Control Panel A1.

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

r. 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.

* 5.6.7.4 High-Voltage Power Supply Adjustments (Statis 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.

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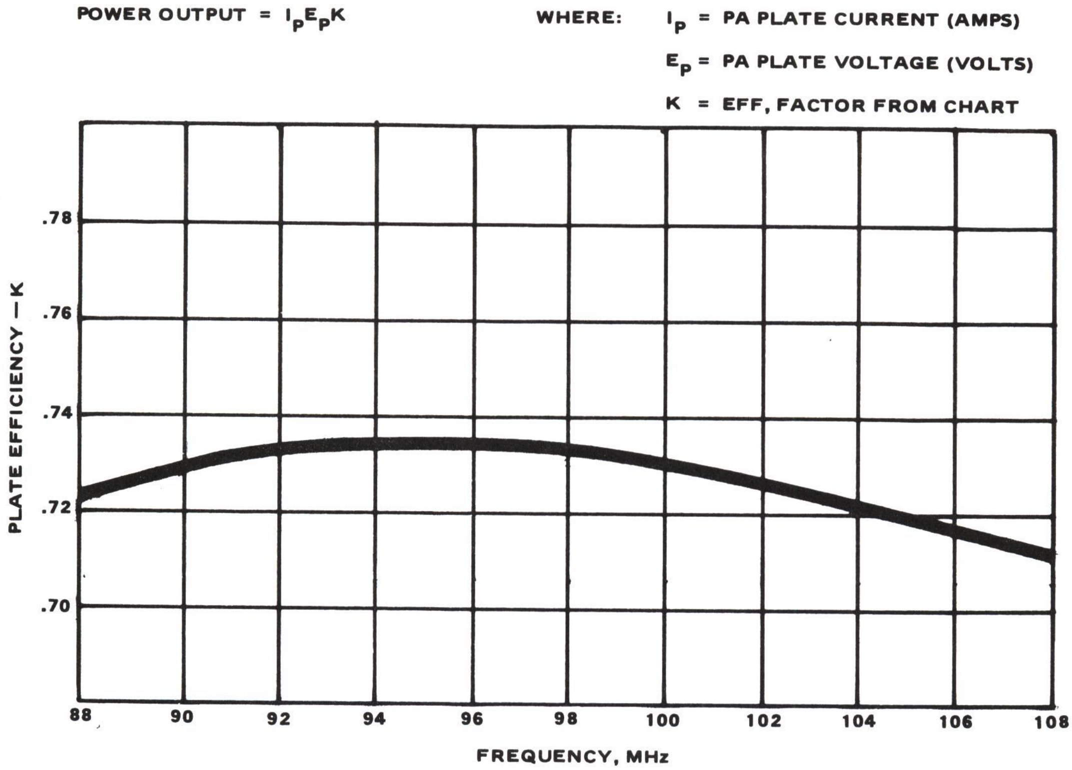

Figure 5-4. 816R-1A Amplifier Efficiency vs. Frequency Graph

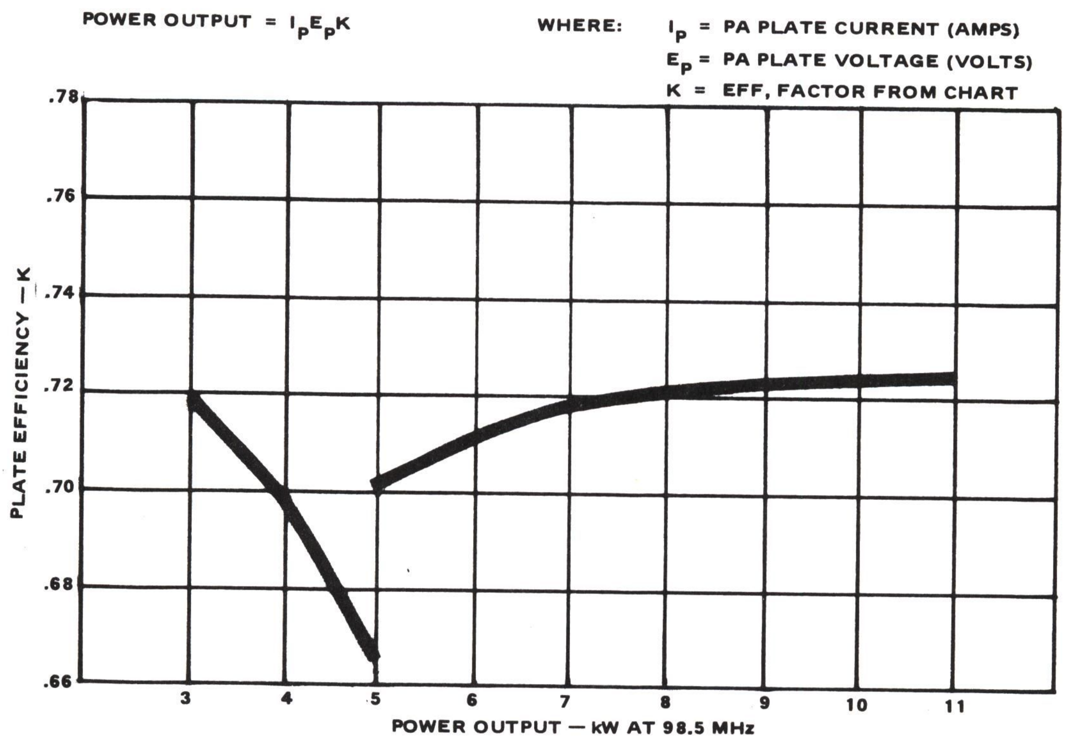

Figure 5-5. 816R-1A Amplifier Efficiency vs. Output Level

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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.

<u>NOTE</u>

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.

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5-6.7.5. 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 at least 10 killowatts. 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% above the authorized station maximum output, skip to step h. If the maximum power output is more than 10% 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 c. through f. until the maximum transmitter output is not more than 10% 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 ouput. (Linear interpolation of tabulated values may be necessary.) If the compared voltages differ by more than 10%, proceed to step i. If the compared voltages differ by less than 10%, skip to step m.

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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%.

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.

* 5-6.7.6 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 remainder of this procedure.

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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.

* 5-6.7.7 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.

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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%.

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.

* 5-6.7.6 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 remainder of this procedure.

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

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

5-6.8 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.

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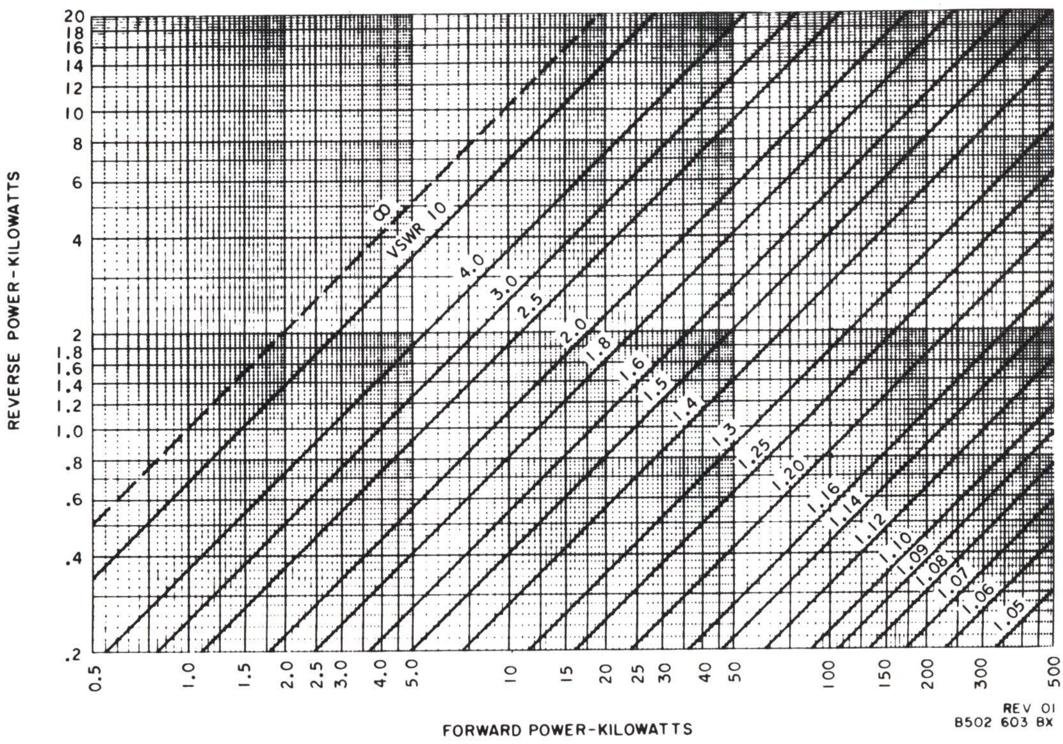

Figure 5-6. Power to VSWR Conversion Graph

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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.

5-6.9 Automatic Power Control Adjustment.

a. Set the POWER CONTROL switch to AUTOMATIC.

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.

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.

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

e. Adjust filament peaking capacitor A21C60 until minimum plate current is displayed on the PLATE CURRENT meter. (Power output sould remain near maximum.)

f. Replace all panels and close all compartment doors.

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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 1000 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.

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 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.

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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 10%. Adjust VSWR PROT CAL to trip at this level. (Note that full scale in Reflected is 12% and that a meter reading in the REFLECTED position is 1000 watts.) For greater VSWR trip sensitivity, press A3 TEST switch S2 and adjust REFL ADJ potentiometer R27 for a reading less than 10%. (5% reading corresponds to 500 watts.) Then adjust A3R20 to trip at the new level. Nuisance tripping may occur if the sensitivity is increased too far.

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 potentiometer 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 slightly until relay picks up.

e. Replace access panel.

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5-7. PARTS REPLACEMENT

5-7.1 4CX10000D PA Tube.

a. Slide the blocking capacitor up (Figure 4-2) to expose the tube. If the operating frequency is at the higher end of the FM band, remove the four nylon screws holding the air guide. Remove air guide and slide blocking capacitor down over tube.

b. Remove the anode lead.

c. Carefully lift the blocking capacitor and tube 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.

5-7.3 Replacement Parts

Order replacement parts from the following address:

CONTINENTAL ELECTRONICS MFG. CO.
P. O. BOX 270879
DALLAS, TEXAS 75227
TELEPHONE: 214-381-7161
TELEX: 73-398

FOR 24-HOUR PROFESSIONAL SERVICE
CALL: 214-327-4532 FOR PARTS
CALL: 214-327-4533 FOR SERVICE

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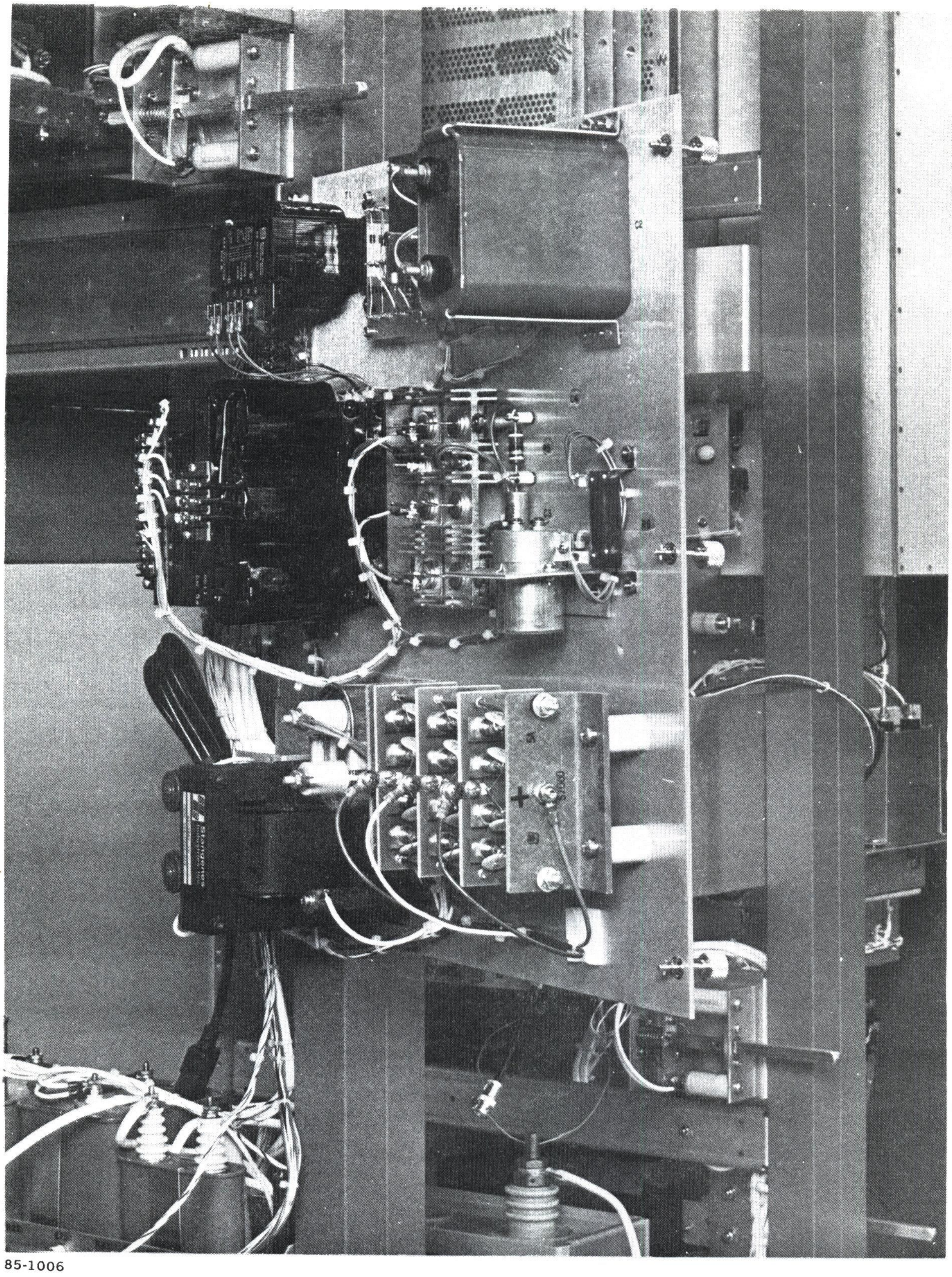

85-1006

Figure 5-7. Power Supply, A10

KO1-20

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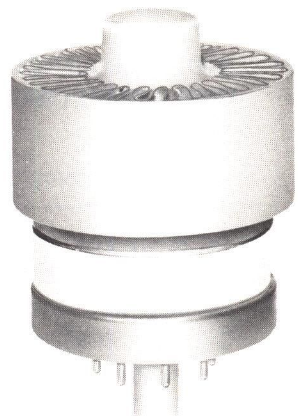
EIMAC

Division of Varian
SAN CARLOS
CALIFORNIA

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

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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.

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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

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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

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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.

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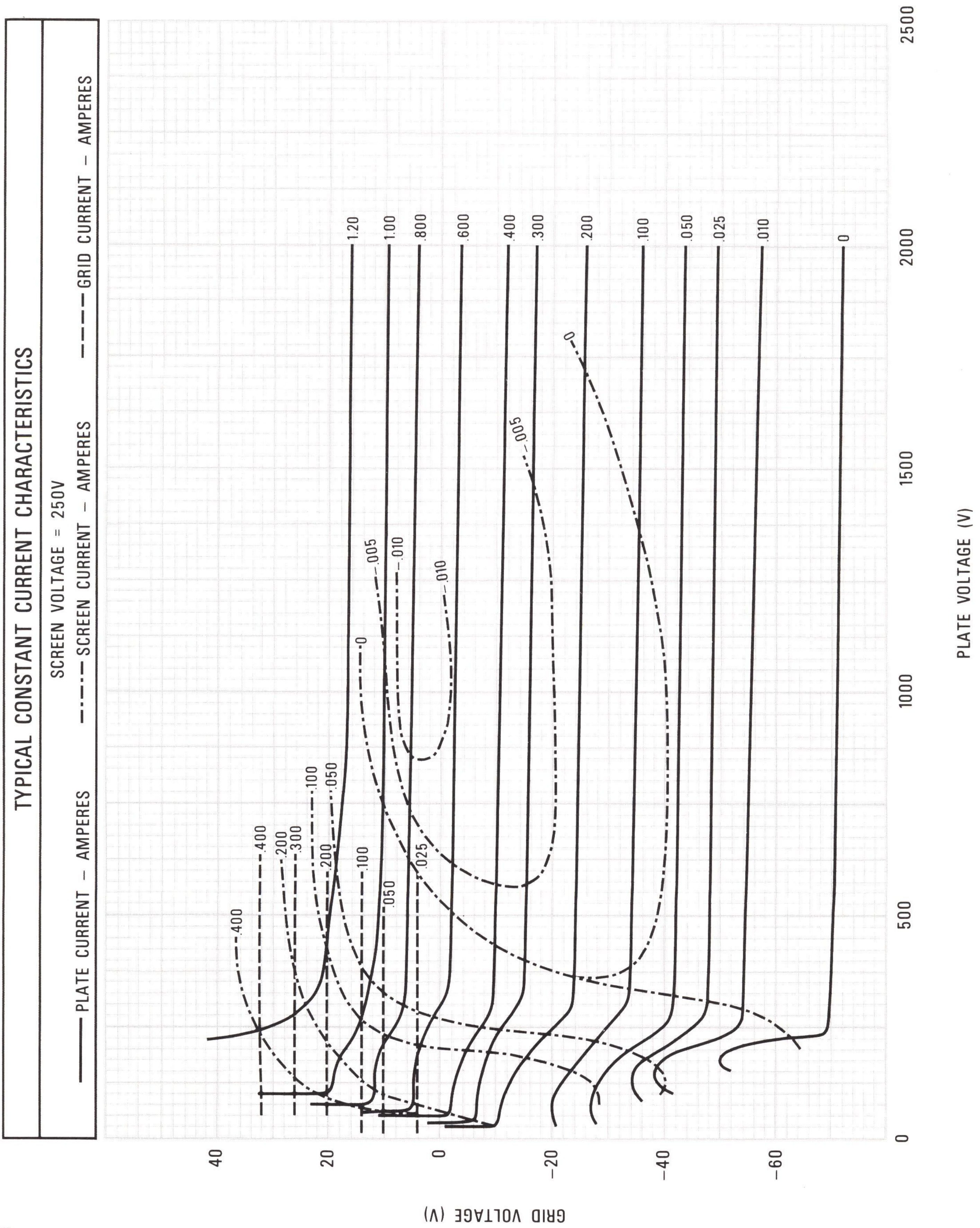

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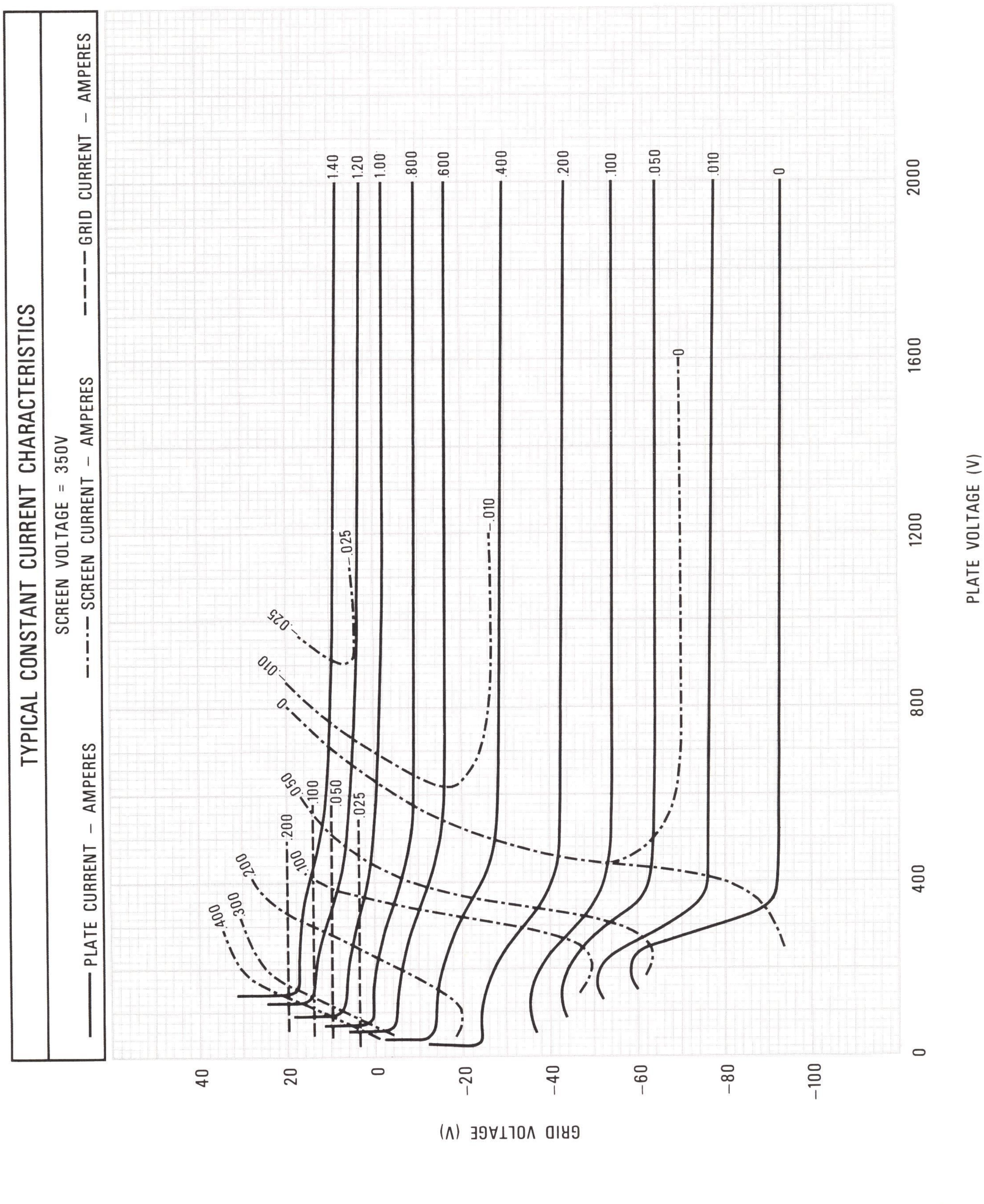

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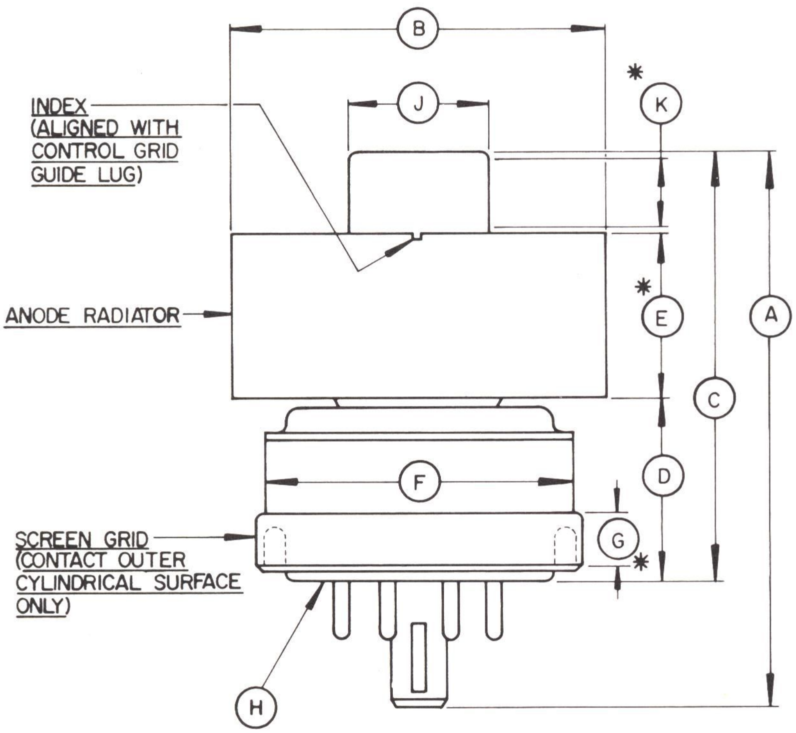
DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	2.342	2.464	59.03	62.59
B	1.610	1.640	40.89	41.66
C	1.810	1.910	45.97	48.51
D	0.750	0.810	19.05	20.57
E	0.710	0.790	18.03	20.07
F	--	1.406	--	35.71
G	0.187	--	4.75	--
H	BASE: B8-236 (JEDEC DESIGNATION)			
J	0.559	0.573	14.20	14.55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

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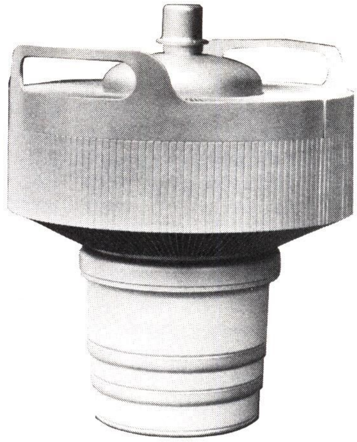
TECHNICAL DATA

8281
4CX15,000A
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 type of internal mechanical structure which results in high rf operating efficiency. Low rf losses in this structure permit operation at full ratings up to 110 MHz, and at reduced ratings up to 225 MHz.

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

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	6.3 ± 0.3	V
Current @ 6.3 volts	160	A
Amplification Factor, average		
Grid to Screen	4.5	
Direct Interelectrode Capacitance (cathode grounded)[2]		
Cin	160	pF
Cout	24.5	pF
Cgp	1.5	pF
Direct Interelectrode Capacitance (grid and screen grounded)[2]		
Cin	67.0	pF
Cout	25.5	pF
Cpk	0.2	pF
Maximum Frequency for Full 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. Varian EIMAC 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	9.37 In; 23.81 cm
Diameter	7.58 In; 19.25 cm
Net Weight (approximate)	12.8 Lb; 5.8 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 Sockets:	
LF or HF Applications	EIMAC SK-300A
VHF applications	EIMAC SK-360
Recommended Air Chimney, for use with SK-300A socket only	EIMAC SK-316
Available Screen Grid Bypass Capacitor Kit for SK-360 (8000 pF @ DCWV = 5000)	EIMAC SK-355

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN, Class AB1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	10	KILOVOLTS
DC SCREEN VOLTAGE	2.0	KILOVOLTS
DC GRID VOLTAGE	-1.5	KILOVOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	15	KILOWATTS
SCREEN DISSIPATION	450	WATTS
GRID DISSIPATION	200	WATTS

TYPICAL OPERATION
Peak Envelope or Modulation Crest Conditions

Plate Voltage	7.5	10.0	kVdc
Screen Voltage	1.5	1.5	kVdc
Grid Voltage #	-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 *	170	150	mAdc
Peak rf Grid Voltage *	330	340	v
Plate Dissipation *	12.2	14.0	kW
Single-tone Plate Output Power *	20.8	28.5	kW
Resonant Load Impedance	865	1260	Ohms

* Approximate value.
\# Adjust for specified zero-signal plate current.

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VA4618

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Varian EIMAC / 301 Industrial Way / San Carlos, CA 94070 / U.S.A.

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

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE . . .	10	KILOVOLTS
DC SCREEN VOLTAGE . .	2.0	KILOVOLTS
DC GRID VOLTAGE . . .	-1.5	KILOVOLTS
DC PLATE CURRENT . . .	5.0	AMPERES
PLATE DISSIPATION . .	15	KILOWATTS
SCREEN DISSIPATION . .	450	WATTS
GRID DISSIPATION . . .	200	WATTS

TYPICAL OPERATION

Plate Voltage	7.5	10.0	kVdc
Screen Voltage	750	750	Vdc
Grid Voltage	-510	-550	Vdc
Plate Current	4.65	4.55	Adc
Screen Current *	590	540	mAdc
Grid Current *	300	270	mAdc
Peak rf Grid Voltage *	730	790	v
Calculated Driving Power	220	220	W
Plate Dissipation *	8.1	9.0	kW
Plate Output Power *	26.7	36.5	kW

* Approximate value.

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

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE . . .	8.0	KILOVOLTS
DC SCREEN VOLTAGE . .	1.5	KILOVOLTS
DC GRID VOLTAGE . . .	-1.5	KILOVOLTS
DC PLATE CURRENT . . .	4.0	AMPERES
PLATE DISSIPATION . .	10.0	KILOWATTS
SCREEN DISSIPATION . .	450	WATTS
GRID DISSIPATION . . .	200	WATTS

* Approximate value.

TYPICAL OPERATION

Plate Voltage	6.0	8.0	kVdc
Screen Voltage	750	750	Vdc
Grid Voltage	-600	-640	Vdc
Plate Current	3.75	3.65	Adc
Screen Current *	450	430	mAdc
Grid Current *	180	180	mAdc
Peak audio freq.screen voltage * . for 100% modulation	740	710	v
Peak rf Grid Voltage	800	840	v
Calculated Driving Power	150	150	W
Plate Dissipation *	5.1	5.8	kW
Plate Output Power *	17.4	23.5	kW

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR - GRID DRIVEN
Class AB1 (sinusoidal wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE . . .	10	KILOVOLTS
DC SCREEN VOLTAGE . .	2.0	KILOVOLTS
DC GRID VOLTAGE . . .	-1.5	KILOVOLTS
DC PLATE CURRENT . . .	6.0	AMPERES
PLATE DISSIPATION . .	15	KILOWATTS
SCREEN DISSIPATION . .	450	WATTS
GRID DISSIPATION . . .	200	WATTS

* Approximate value.

TYPICAL OPERATION (Two tubes)

Plate Voltage	7.5	10.0	kVdc
Screen Voltage	1.5	1.5	kVdc
Grid Voltage #	-350	-370	Vdc
Zero-signal Plate Current ## . . .	1.0	1.0	Adc
Maximum-signal Plate Current . . .	8.8	8.5	Adc
Maximum-signal Screen Current * .	340	300	mAdc
Peak Audio Freq.Grid Voltage * . .	330	340	v
Maximum-Signal Plate Dissipation ##	12.2	14.0	kW
Plate Output Power *	41.6	57.0	kW
Load Resistance (plate to plate) .	1730	2520	Ohms

\# Adjust for specified zero-signal plate current.
\## Per Tube.

TELEVISION LINEAR AMPLIFIER
Cathode Driven

ABSOLUTE MAXIMUM RATINGS

110 MHz to 225 MHz

DC PLATE VOLTAGE . . .	6.5	KILOVOLTS
DC SCREEN VOLTAGE . .	1.5	KILOVOLTS
DC PLATE CURRENT . . .	5.0	AMPERES
PLATE DISSIPATION . .	15	KILOWATTS
SCREEN DISSIPATION . .	450	WATTS
GRID DISSIPATION . . .	200	WATTS

* Approximate value.

TYPICAL OPERATION, Composite Signal Black Level Unless Otherwise Stated

Plate Voltage	5.0	6.0	kVdc
Screen Voltage	500	700	Vdc
Grid Voltage *	-160	-180	Vdc
Plate Current (zero signal) . . .	500	650	mAdc
Plate Current	2.8	3.33	Adc
Grid Current *	75	35	mAdc
Screen Current *	60	40	mAdc
Peak Cathode Voltage (peak synch).	310	345	v
Cathode Driving Power (peak synch)	975	1350	w
Plate Output Power (peak synch) .	11.0	16.5	kw
Plate Load Resistance	600	600	Ohms

TYPICAL OPERATION values are obtained by calculation 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.

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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 & 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 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 up or down at the option of the circuit designer.

SOCKETS - The EIMAC air-system sockets SK-300A and SK-360 are designed especially for the concentric base terminals of the 4CX15,000A. The SK-300A is recommended for use through 30 MHz, while the SK-360 is recommended for applications in the VHF range. The use of recommended airflow rates though through the socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the base terminals of the tube, through an air chimney, and into the anode cooling fins.

COOLING - The maximum temperature rating for the external surfaces of the tube 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. Airflow requirements to maintain tube temperatures at 225°C with incoming cooling air at 50°C are shown for operation below 30 MHz. The data is for sea level with the tube mounted in an SK-300A socket with an SK-316 air chimney, and the pressure drop values should be considered approximate. At an altitude of 5000 feet both air flow and pressure drop must be increased by a factor of 1.2; at 10,000 feet the factor is 1.46.

Plate Dissipation (kW)	Air Flow (cfm)	Pressure Drop In.Water
7.5	230	0.7
12.5	490	2.7
15.0	645	4.6

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.
It is considered good practice to allow for such variables as dirty air filters, rf seal heating, and the fact that the anode cooling fins may not be clean if the tube has been in service for some time without cleaning. Temperature-sensitive paint is available for checking temperatures before any design is finalized, and Application Bulletin #20 titled TERMPERATURE MEASUREMENTS WITH EIMAC POWER TUBES is available on request.
Air flow must be applied before or simultaneously with the application of electrode voltages, including the filament, and normally should be maintained for a short period of time after all power is removed to allow for tube cooldown.
An air interlock system should be incorporated in the design to automatically remove all voltages from the tube in case of even partial failure of cooling air.

ELECTRICAL

ABSOLUTE MAXIMUM RATINGS - Values shown for each type of service are based on the "absolute system" and are not to be exceeded under any service conditions. These ratings are limiting values outside which the serviceability of the tube may be impaired. In order not to exceed absolute ratings the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by a safety factor so that the absolute values will never be exceeded under any usual conditions of supply-voltage variation, load variation, or manufacturing variation in the equipment itself. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

FILAMENT OPERATION - At rated (nominal) filament voltage the peak emission capability of the tube is many times that needed for communication service. A reduction in filament voltage will lower the filament temperature, which will substantially increase life expectancy. The correct value of filament voltage should be determined for the particular application. It is recommended the tube be operated at full nominal voltage for an initial stabilization period of 100 to 200 hours before any action is taken to operate at reduced voltage. Voltage should gradually be reduced until there is a slight degradation in performance (such as power output or distortion). The voltage should then be increased approximately two tenths of a volt above the value where performance degradation was noted for operation. The operating point should be rechecked after 24 hours. Filament voltage should be closely regulated when voltage is to be reduced below nominal in this manner, to avoid any adverse influence by normal line voltage variations.
Filament voltage should be measured at the tube base or socket, using an accurate rms-responding meter. Periodically throughout the life of the tube the procedure outlined above for reduction of voltage should be repeated, with voltage reset as required, to assure best tube life.

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

GRID OPERATION - The maximum control grid dissipation is 200 watts, determined approximately by the product of the dc grid current and the peak positive grid voltage. It is recommended that a protective spark-gap device should be connected between the control grid and the cathode to guard against excessive voltage.

SCREEN OPERATION - The maximum screen grid dissipation is 450 watts. With no ac applied to the screen grid, dissipation is simply the product of dc screen voltage and the dc screen current. With screen modulation, dissipation is dependent on rms screen voltage and rms screen current. Plate voltage, plate loading, or bias voltage must never be removed while filament and screen voltages are present, since screen dissipation ratings will be exceeded. A protective spark-gap device should be connected between the screen grid and the cathode to guard against excessive voltage.

HIGH VOLTAGE - Normal operating voltages used with this tube 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. 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 capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

FAULT PROTECTION - In addition to the normal plate over-current interlock, screen current interlock, and coolant interlock, the tube must be protected from internal damage caused by an internal plate arc which may occur at high plate voltage. A protective resistance should always be connected in series with the tube anode, to help absorb power supply stored energy if an internal arc should occur. The protection criteria for each electrode supply is to short each electrode to ground, one at a time, through a vacuum relay switch and a 6-inch length of #30 AWG copper wire. The wire willremain intact if protection is adequate.
EIMAC Application Bulletin #17 titled FAULT PROTECTION contains considerable detail, and is available on request.

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 300 MHz most of the energy will pass completely through the human body with little attenuation or heating affect. Public health agencies are concerned with the hazard even at these frequencies. OSHA (Occupational Safety and Health Administration) recommends that prolonged exposure to rf radiation should be limited to 10 milliwatts per square centimeter.

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 Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of a specially constructed test fixture which shields all external tube leads or contacts from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. The capacitance values shown in the technical data 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 the appliction. Measurements should be taken with the mounting which represents approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - When it is desired to operate this tube under conditions widely different from those listed here, write to Varian EIMAC; attn: Product Manager; 301 Industrial Way; San Carlos, CA 94070 U.S.A.

OPERATING HAZARDS

PROPER USE AND SAFE OPERATING PRACTICES WITH RESPECT TO POWER TUBES ARE THE RESPONSIBILITY OF EQUIPMENT MANUFACTURERS AND USERS OF SUCH TUBES. ALL PERSONS WHO WORK WITH OR ARE EXPOSED TO POWER TUBES OR EQUIPMENT WHICH UTILIZES SUCH TUBES MUST TAKE PRECAUTIONS TO PROTECT THEMSELVES AGAINST POSSIBLE SERIOUS BODILY INJURY. DO NOT BE CARELESS AROUND SUCH PRODUCTS.

The operation of this tube may involve the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel:

a. HIGH VOLTAGE - Normal operating voltages can be deadly. Remember that HIGH VOLTAGE CAN KILL.

b. LOW-VOLTAGE HIGH-CURRENT CIRCUITS - personal jewelry, such as rings, should not be worn when working with filament contacts or connectors as a short circuit can produce very high current and melting, resulting in severe burns.

c. RF RADIATION - Exposure to strong rf fields should be avoided, even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. CARDIAC PACEMAKERS MAY BE EFFECTED.

d. HOT SURFACES - Surfaces of tubes can reach temperatures of several hundred °C and cause serious burns if touched for several minutes after all power is removed.

Please review the detailed operating hazards sheet enclosed with each tube, or request a copy from: Varian EIMAC, Power Grid Application Engineering, 301 Industrial Way, San Carlos CA 94070.

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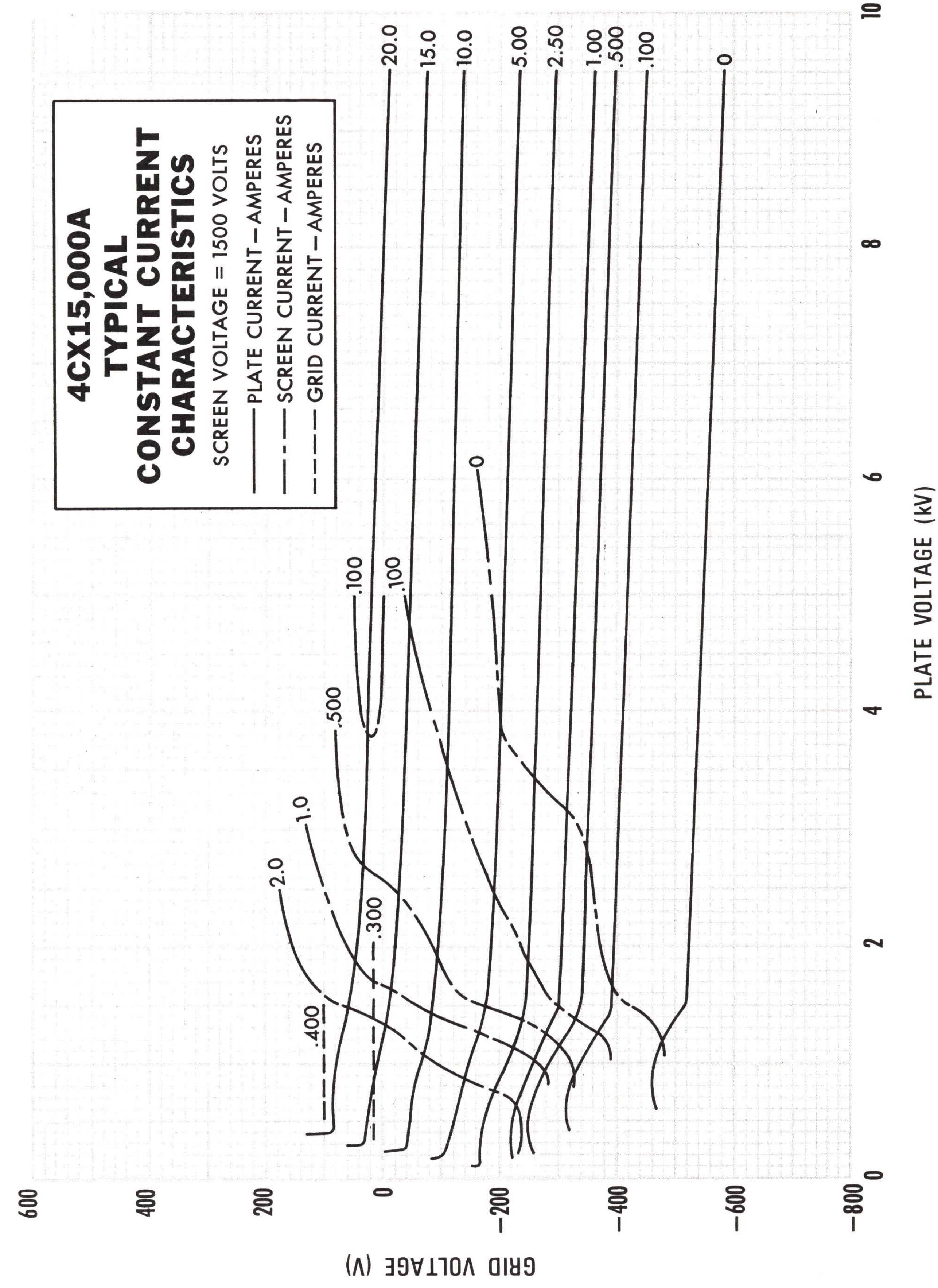

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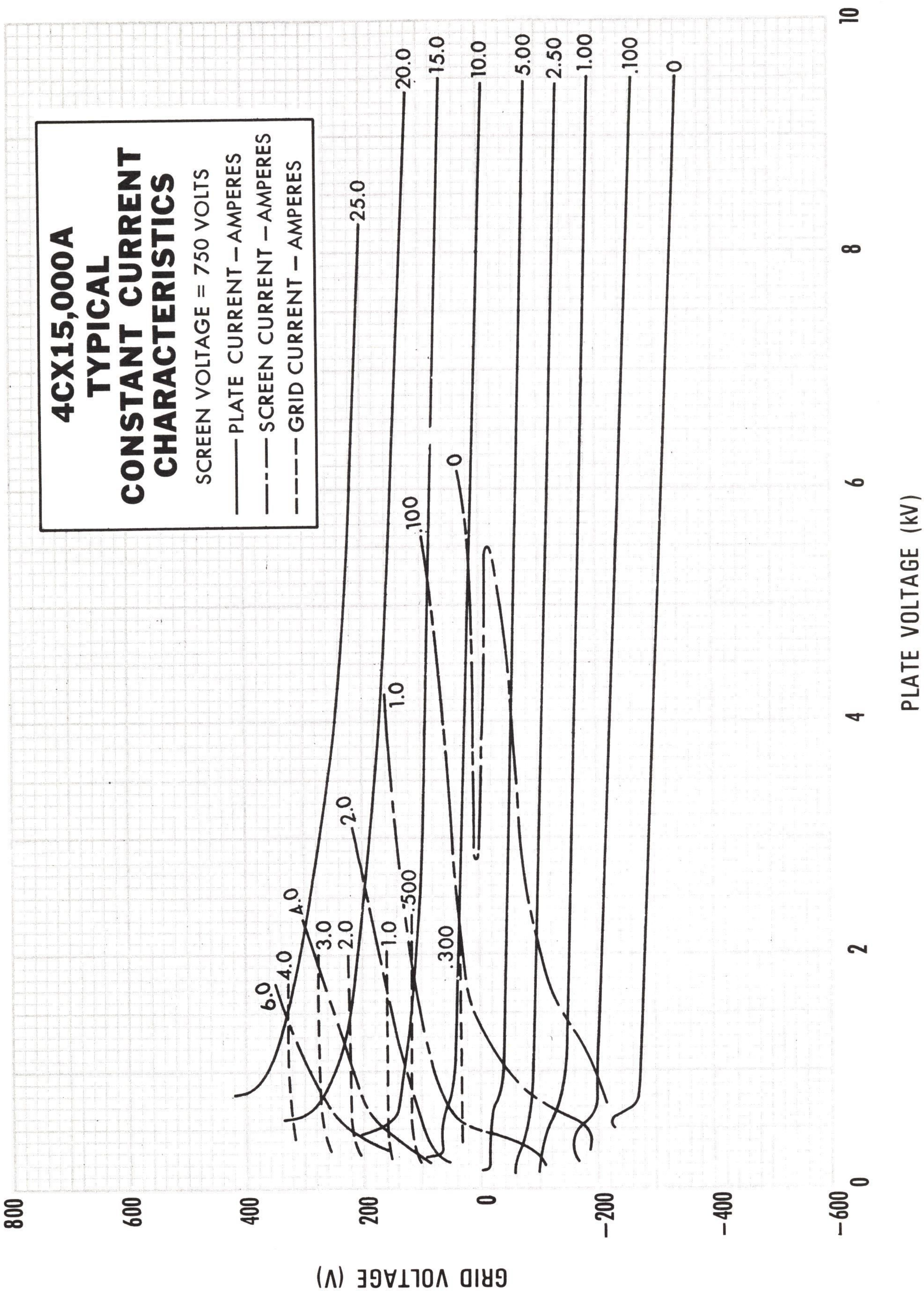

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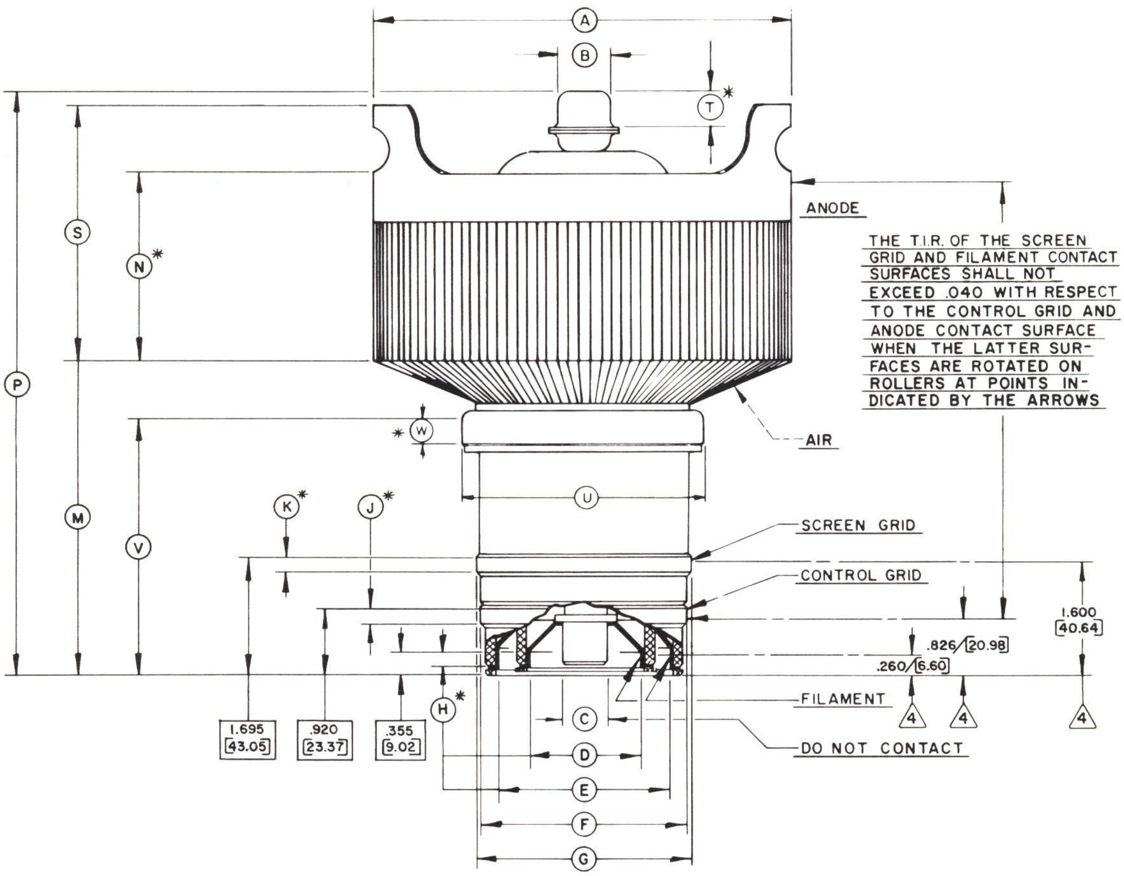
DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	7.460	7.580		189.48	192.53	
B	.855	.895		21.72	22.73	
C	.600	.760		15.24	19.30	
D	1.896	1.936		48.16	49.17	
E	3.133	3.173		79.58	80.59	
F	3.792	3.832		96.32	97.33	
G	3.980	4.020		101.09	102.11	
H	.188			4.78		
J	.188			4.78		
K	.188			4.78		
M	4.550	4.783		115.57	121.49	
N	2.412	2.788		61.26	70.82	
P	9.000	9.375		228.60	238.13	
S	3.560	3.684		90.42	93.57	
T	.375			9.53		
U	4.406	4.468		111.91	113.49	
V	3.718	3.781		94.44	96.04	
W	.219			5.56		

NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. DIMENSIONS IN [ ] ARE MILLIMETERS.
3. * CONTACT SURFACE.
4. OPTIMUM FILAMENT & GRID CONNECTOR HEIGHTS FOR SOCKET DESIGN PURPOSES.



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