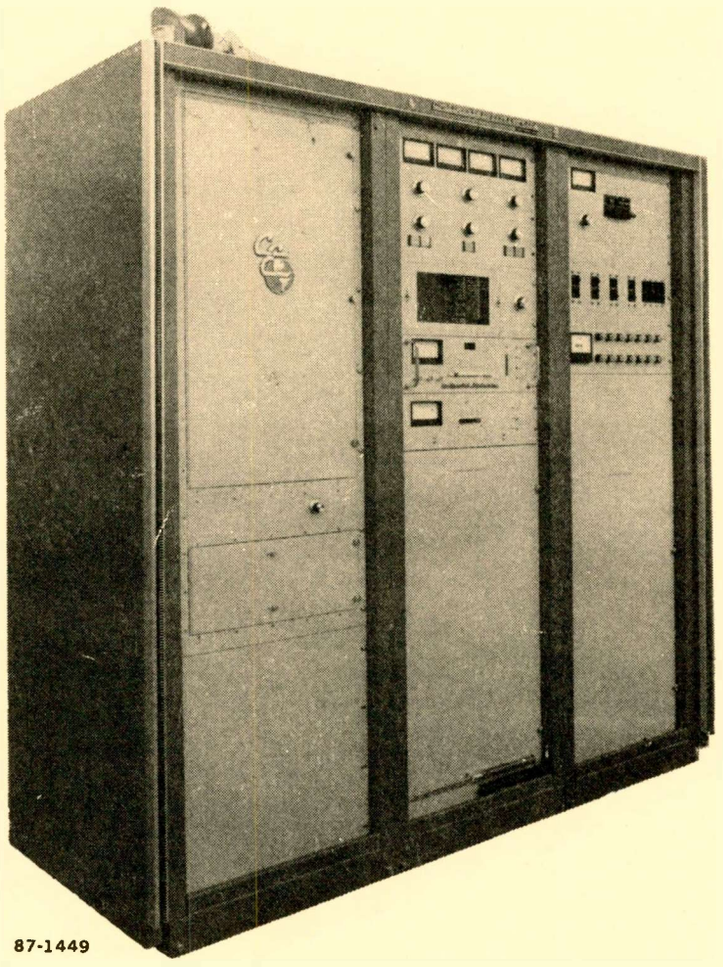
TYPE 816R-3B

FM BROADCAST TRANSMITTER

WITH SOLID STATE EXCITER 802A

INSTRUCTION MANUAL



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varian

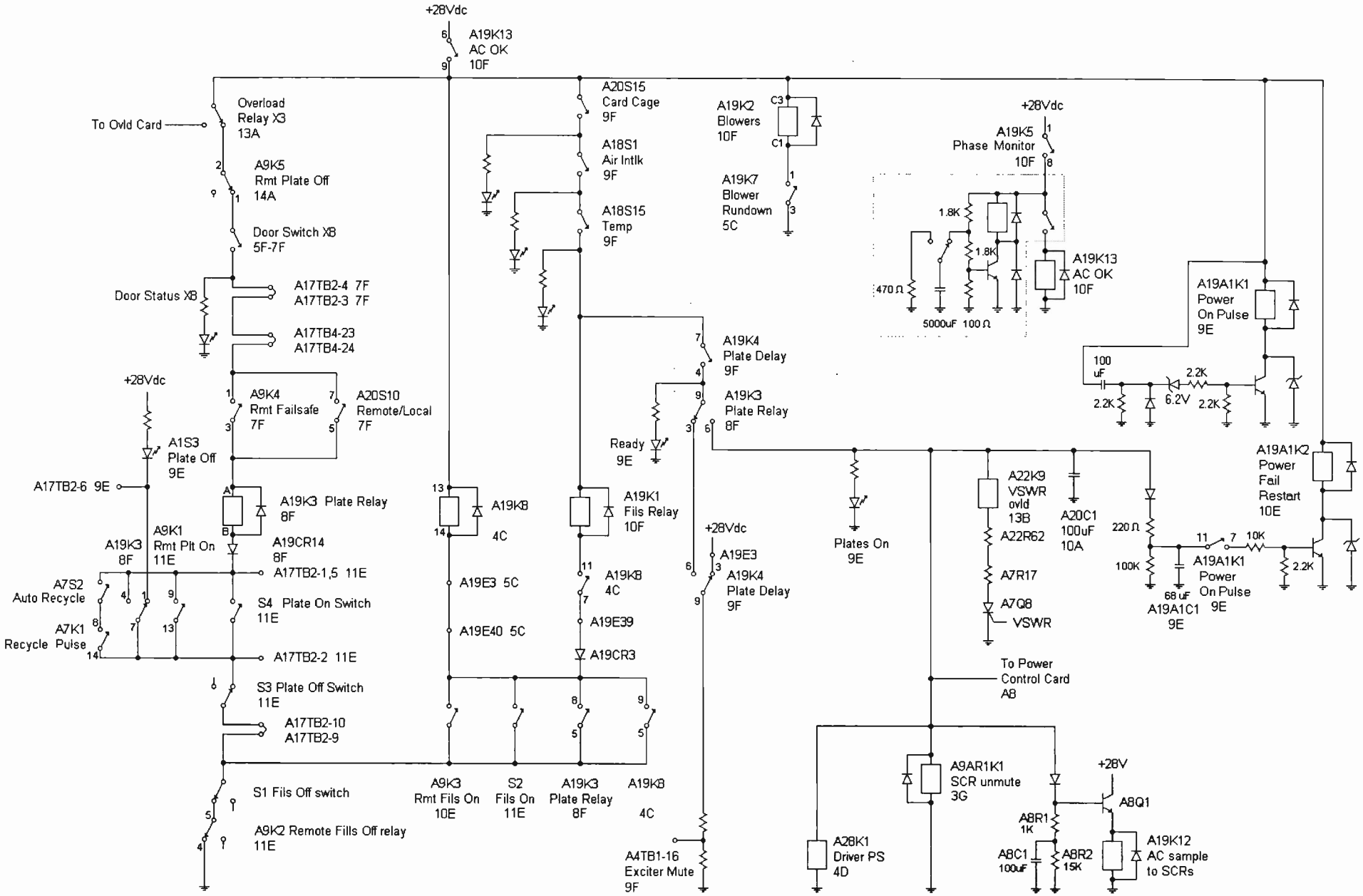
continental electronics division

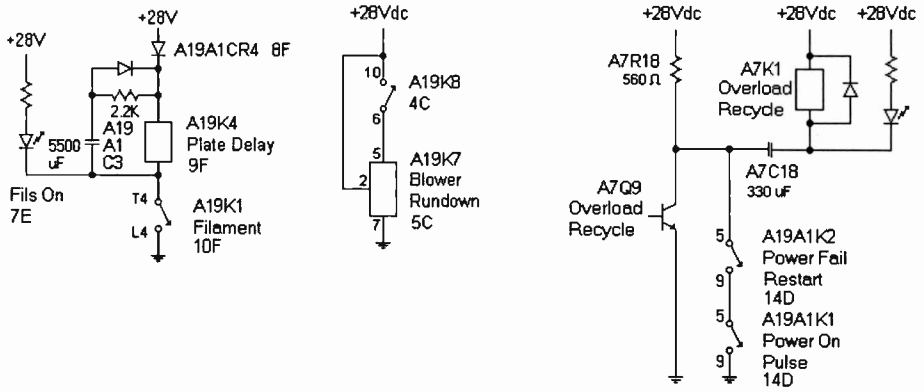
PT1-1

P.O. BOX 270879 DALLAS, TEXAS 75227 (214) 381-7161
CABLE ADDRESS: CONTRONICS TELEX ADDRESS: 73 - 398

RECORD OF CHANGE

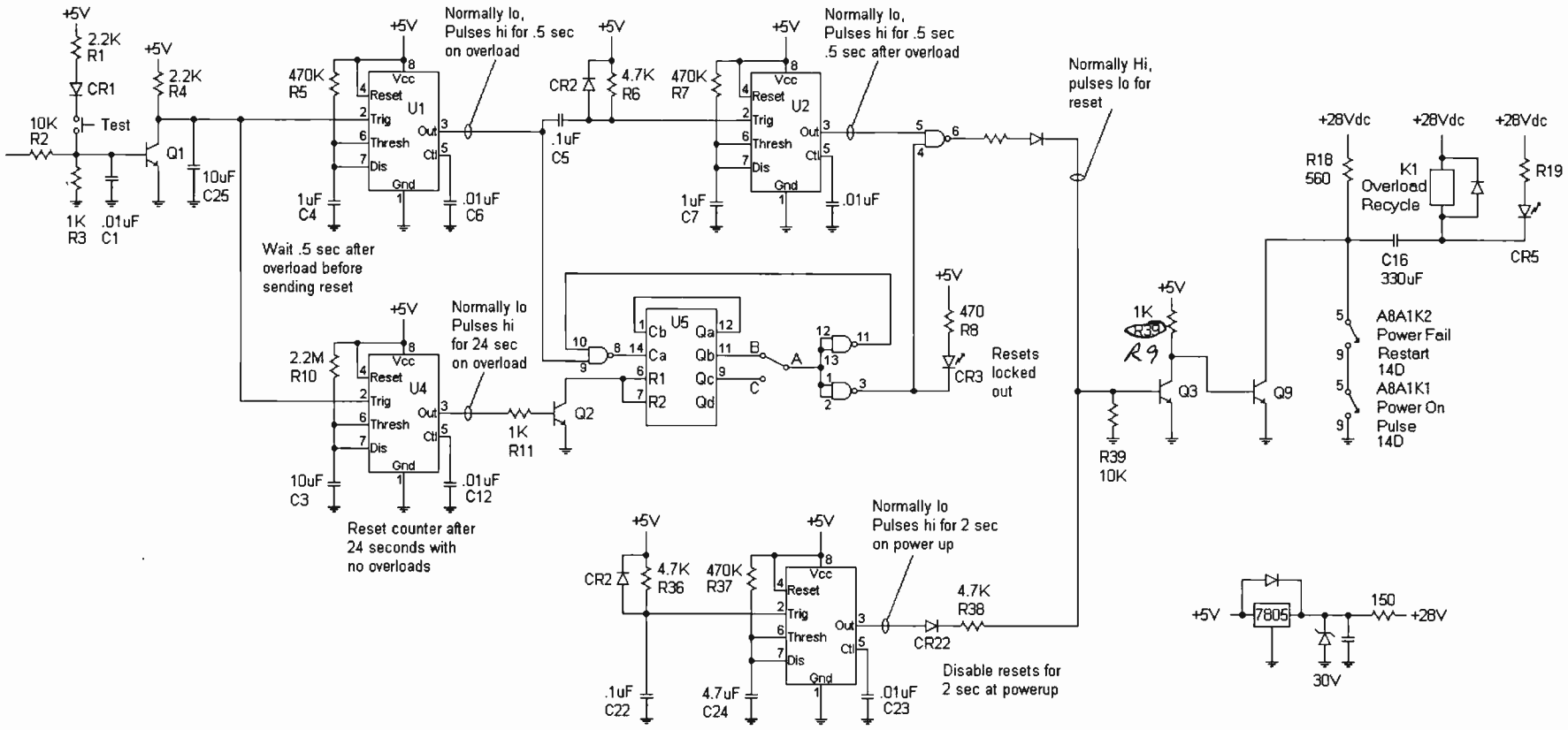
CHANGE NO.	DATE	EFFECTIVITY
1	14 July 1988	All Transmitters


+28Vdc
A19K13
AC OK
10F
To Ovld Card
Overload
Relay X3
13A
A9K5
Rmt Plate Off
14A
Door Switch X8
5F-7F
Door Status X8
A17TB2-4 7F
A17TB2-3 7F
A17TB4-23
A17TB4-24
+28Vdc
A9K4
Rmt Failsafe
7F
A20S10
Remote/Local
7F
A1S3
Plate Off
9E
A17TB2-6 9E
A19K3 Plate Relay
8F
A19K3
8F
A9K1
Rmt Plt On
11E
A19CR14
8F
A17TB2-1,5 11E
A7S2
Auto Recycle
A7K1
Recycle Pulse
S4 Plate On Switch
11E
A17TB2-2 11E
S3 Plate Off Switch
11E
A17TB2-10
A17TB2-9
S1 Fils Off switch
A9K2 Remote Fills Off relay
11E
A20S15
Card Cage
9F
A18S1
Air Intlk
9F
A18S15
Temp
9F
A19K2
Blowers
10F
A19K7
Blower
Rundown
5C
A19K8
4C
A19E3 5C
A19E40 5C
A19K1
Fils Relay
10F
A19K8
4C
A19E39
A19CR3
A9K3
Rmt Fils On
10E
S2
Fils On
11E
A19K3
Plate Relay
8F
A19K8
4C
A19K4
Plate Delay
9F
A19K3
Plate Relay
8F
Ready
9E
+28Vdc
A19E3
A19K4
Plate Delay
9F
A4TB1-16
Exciter Mute
9F
Plates On
9E
+28Vdc
A19K5
Phase Monitor
10F
1.8K
1.8K
470 Ω
5000uF
100 Ω
A19K13
AC OK
10F
A19A1K1
Power
On Pulse
9E
100
uF
2.2K
6.2V
2.2K
2.2K
A19A1K2
Power
Fail
Restart
10E
A22K9
VSWR
ovld
13B
A22R62
A7R17
A7Q8
VSWR
A20C1
100uF
10A
220 Ω
100K
68 uF
A19A1C1
9E
A19A1K1
Power
On Pulse
9E
10K
2.2K
To Power
Control Card
A8
A9AR1K1
SCR unmute
3G
+28V
A8Q1
A8R1
1K
A8C1
100uF
A8R2
15K
A19K12
AC sample
to SCRs
A28K1
Driver PS
4D

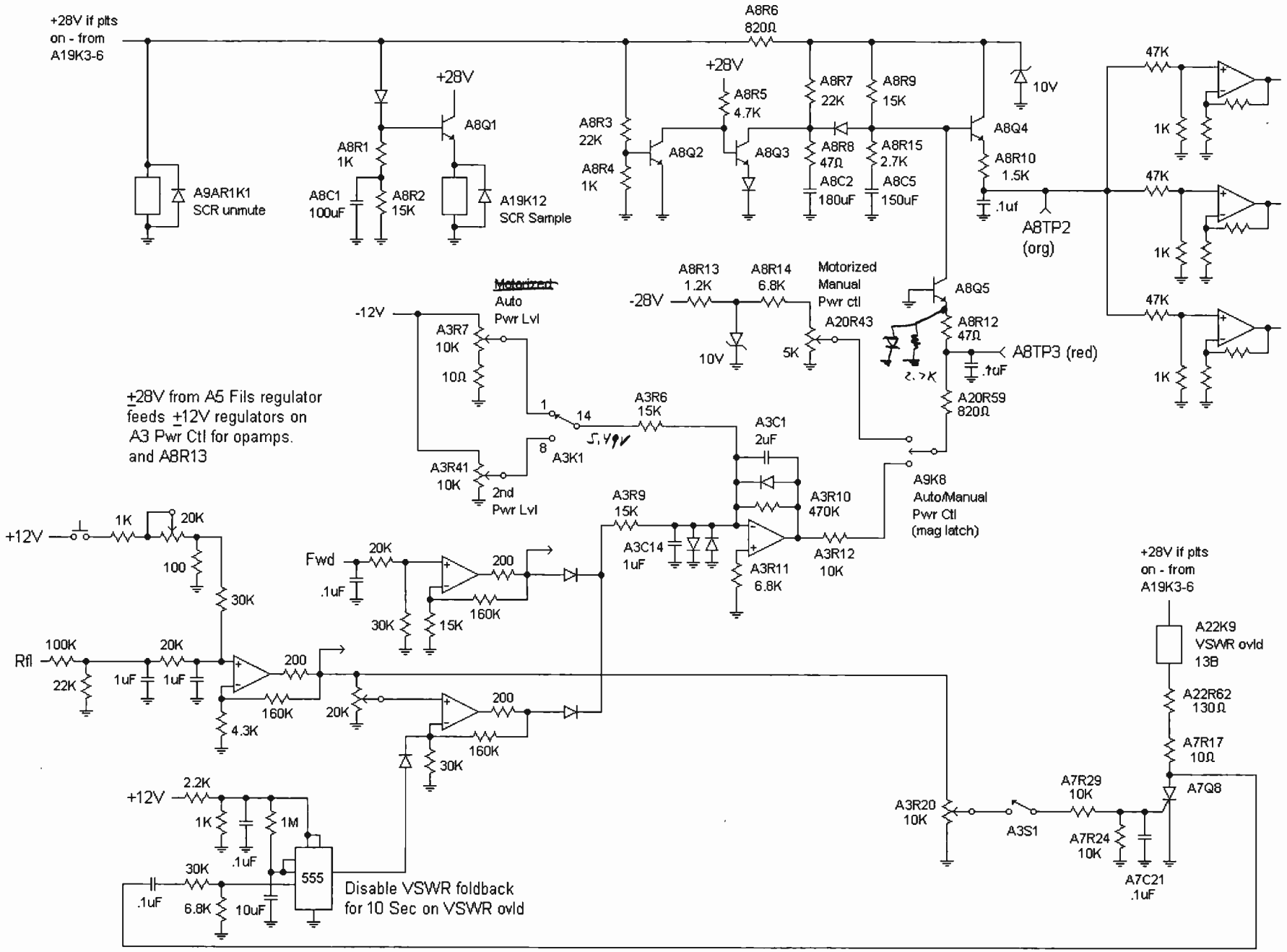


Delay circuit installed in series with phase relay Dec 98 - incoming AC would glitch for 20 sec bursts - none long enough for transfer switch to start the generator, but cumulatively enough for phase rotator to slow slightly, killing cabinet and cavity blowers.

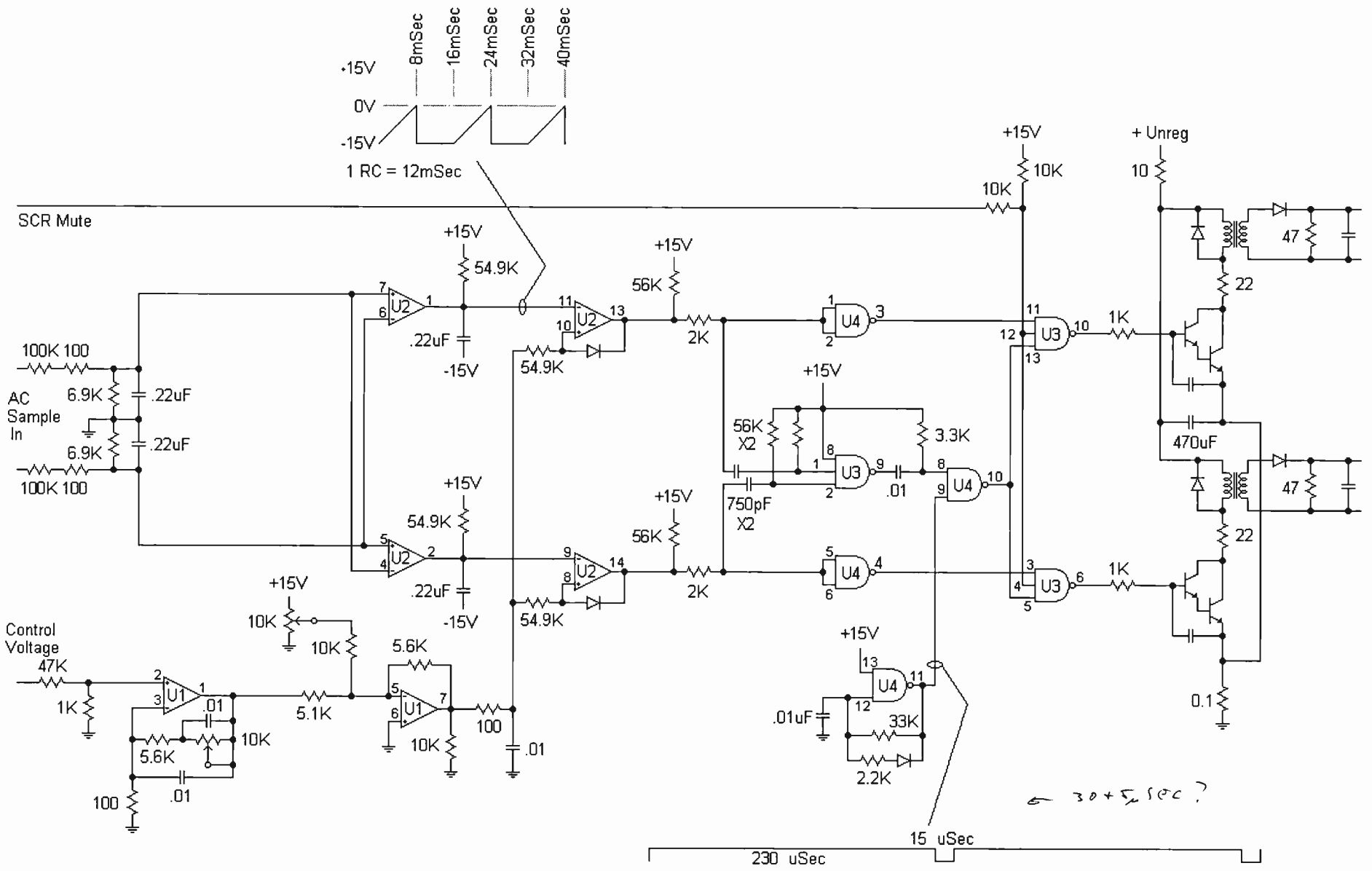
Replaced A19A1C1 (68uF) Jan 02, with 2200 uF cap - allows power fail restart to still function after 30 sec delay in "AC OK" relay... actually allows more than 5 minutes for generator start, phase OK and AC OK.



C16 replaced with 500uF cap Jan 02 - original capacitor had burst.



KXXO 20 KW Contintenal Power Control - Jan 02



U2 is a LM399(?) with open collector output - internal transistor pulls down to -15Vdc, only pull up is external resistor.

KXXO 20 KW Contintenal SCR Control - Jan 02

TABLE OF CONTENTS

SECTION 1 - GENERAL

Paragraph Title — Page

SECTION 1 - GENERAL

SECTION 2 - INSTALLATION

SECTION 3 - OPERATION

SECTION 4 - THEORY OF OPERATION

TABLE OF CONTENTS

SECTION 4 - THEORY OF OPERATION - Continued

SECTION 5 - MAINTENANCE

TABLE OF CONTENTS

SECTION 5 - MAINTENANCE

SECTION 6 - PARTS LIST

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1 - GENERAL INFORMATION

WARNING

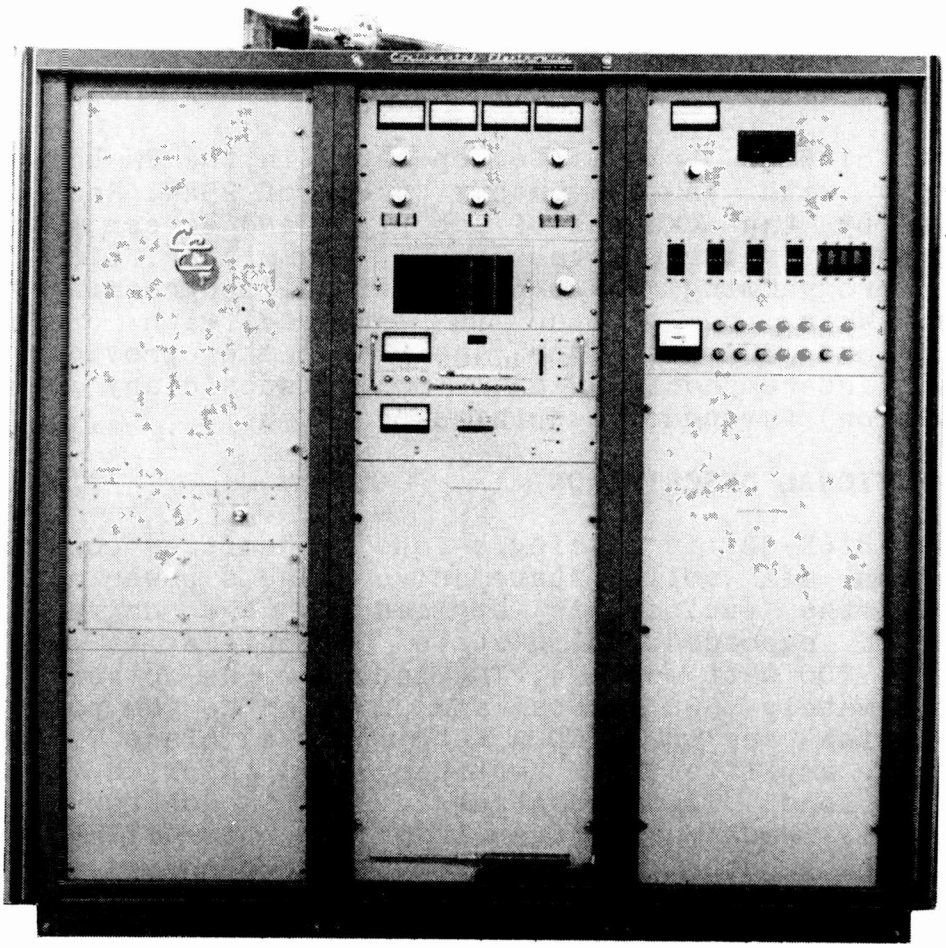
DISCONNECT PRIMARY POWER BEFORE SERVICING THIS TRANSMITTER. SHORT ALL CAPACITORS AND POWER SUPPLIES WITH GROUNDING STICK. VOLTAGES IN THIS TRANSMITTER ARE DEADLY TO HUMAN LIFE.

1-1. INTRODUCTION

The 816R-3B transmitter operates in the FM broadcast range (88-108MHz) with an RF output power of 25kW. Reduced power is available by tap changes of the plate and screen transformer to meet customer requirements. The FM Transmitter, 816R-3B provides monaural programming or other optional programming as customer requires. When the exciter is inputted 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 816R-3B is a single-tube transmitter consisting of an exciter, an all solid state driver, and a power amplifier. The output of the exciter is applied to the driver. The driver consists of cascaded solid-state amplifiers (a 150 watt unit driving a 700 watt module). The input to the driver is amplified to approximately 500 watts and applied to the power amplifier that contains one 4CX15000A tube operated class C. The input to the power amplifier is amplified and applied to a 50-ohm unbalanced load. Power control circuits monitor the RF output power level. When a change in output power is detected, these circuits change the plate voltage to compensate. Other control circuits within the transmitter monitor reflected power, forward power, operating voltage, air pressure and exhaust air temperature within the power amplifier section. They protect the transmitter by removing power when excessive currents, VSWR, loss of air pressure, or excessive air exhaust temperature occur.



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PT1-2

Figure 1-1. 816R-3B FM Transmitter

1-3. PHYSICAL DESCRIPTION

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

TABLE 1-1. TECHNICAL CHARACTERISTICS

MECHANICAL

Weight	2082 lbs
Size - Transmitter	Height: 69" (175 cm) (Not Including Directional Cplr) Width: 72" (183 cm) Depth: 28" (71 cm)
Ventilation:	Squirrel cage type blower mounted under the cavity. Axial fan that provides positive air pressure within the entire cabinet.
Ambient Temperature Range:	-20°C to +50°C (-4°F to +122°F) operating
Relative Humidity Range:	0 to 95% relative humidity
Altitude:	Up to 7500 feet (2285m) at +40°C (104°F) Up to 10000 feet (3046m) at +40°C (104°F) (With Optional High Alt. Blower)
Shock and Vibration:	Normal handling & transportation
Finish:	Front Panel: Tan Cabinet: Brown

ELECTRICAL

Frequency Range:	88 to 108 MHz
Output Power:	10,000 watts to 25,000 watts
Output Impedance:	50 ohms, VSWR 2:1 Maximum
Standing Wave Ratio:	Not to exceed 2:1 (Refer to Figure 3-9)

TABLE 1-1. TECHNICAL CHARACTERISTICS - Continued

ELECTRICAL - Continued	
Power Source:	200 to 250 volts, 60 Hz, 3 phase Available voltage taps on transformer: 200, 210, 220, 230, 240 and 250. 50 Hz operation available on special order
Power Line Variations:	±5% overall power line variations; in addition, the phase angle and voltage unbalance shall be within 5% of the average of all three phases.
Harmonic & Spurious Radiation:	Any emission appearing on a frequency removed from the Carrier by between 120 kHz and 240 kHz inclusive is attenuated at least 25 dB below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz is attenuated at least 35 dB below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 600 kHz is attenuated at least 80 dB below the level of the unmodulated carrier.
Modulation Characteristics:	Wideband direct FM
Input Power Requirements: at 25 kW output:	40kW at 0.9 Power Factor (Nom.)
Excitation Source:	Continental 802A exciter capable of accepting an input signal of from 20 Hz to 100 kHz.
Output Impedance:	50 Ohms, unbalanced

TABLE 1-1. TECHNICAL CHARACTERISTICS - Continued

ELECTRICAL - Continued

Carrier Frequency Stability:	Frequency will not vary more than ±250 Hz for an ambient temperature range of 0 to +55°C.
Modulation Input:	Monaural: 600 Ohms, balanced, +10 dBm ±2 dB, for ±75 kHz deviation Composite: 5,000 Ohms, balanced or unbalanced, 1.25 Vrms, for ±75kHz deviation SCA: (2 ea) 15,000 Ohms, balanced or unbalanced, 1.25 Vrms, for ±7.5 kHz deviation
Audio Frequency Response	Monaural: ±0.5 dB; flat, 25, 50, 75 microsecond pre-emphasis, 20 Hz to 15 kHz.
Audio Frequency Distortion:	Monaural: Not more than 0.08%, 20 Hz to 15 kHz (Measured with spectrum analyzer)
FM Noise Level:	75 dB below 100% modulation (±75kHz)
AM Noise Level:	Asynchronous: 55 dB below equivalent 100% AM modulation Synchronous: 50 dB below equivalent 100% AM modulation

SECTION 2 - INSTALLATION

2-1. PRE-INSTALLATION INFORMATION

The transmitter requires three phase 200 to 250 volts, 50 or 60 Hz, AC primary power of either Wye or Closed Delta configuration. Line to line balance must be within five percent both for voltage and phase.

Figure 2-1 shows the location of the input power terminals and the openings in the top and floor of the transmitter that can be used to bring the power cables into the transmitter. You may choose to bring the power cables through a two-inch knockout in the top of the cabinet or through a two-inch round opening in the floor of the transmitter. The size of the power wiring is determined by local electrical code and good engineering practice. In no case should the wiring be smaller than number 1/0 AWG wire where the wire length is up to 100 feet. The wall breaker or fuses should be 150 ampere capacity. The transmitter will require no more than 130 amperes depending on line voltage and transmitter power output. The transmitter has a 150 ampere primary power disconnect breaker.

The RF output termination is a 3-1/8" EIA flange.

Refer to Figure 2-1 for location of air ports, wire ports, and cabinet dimensions. The transmitter should be located to allow access to front and rear.

AC line transient suppressors are suggested for the primary lines. For recommendation of installation, call Broadcast Products Field Service.

2-1.1 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 +50°C [122°F]) is required. See Table 2-1 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:

1. If the exhaust air is ducted away from the transmitter, the duct work must not create any back pressure that is greater than 0.1 inches of water at the transmitter exhaust output.

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

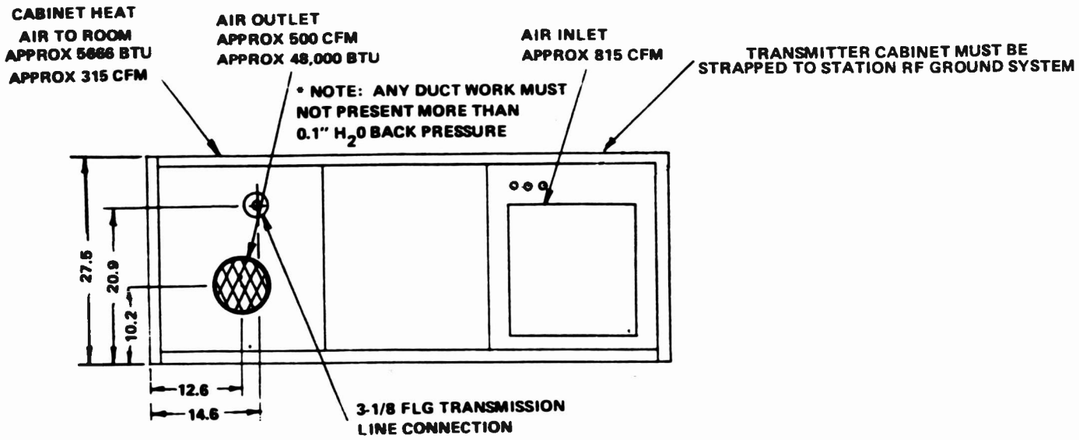
3. If both intake and exhaust ducts are used, locate the duct openings in the same wall of the building to equalize wind pressure effects. However, do not allow the exhaust to recirculate into the intake causing heat buildup.

2-2. UNPACKING AND INSPECTING

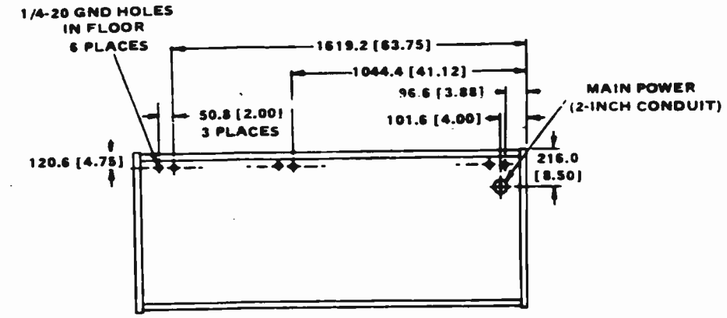
2-2.1 DOMESTIC SHIPMENTS

The uncrated transmitter cabinet and power supply cabinet are 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, the chassis, the transformer, and all choke windings.

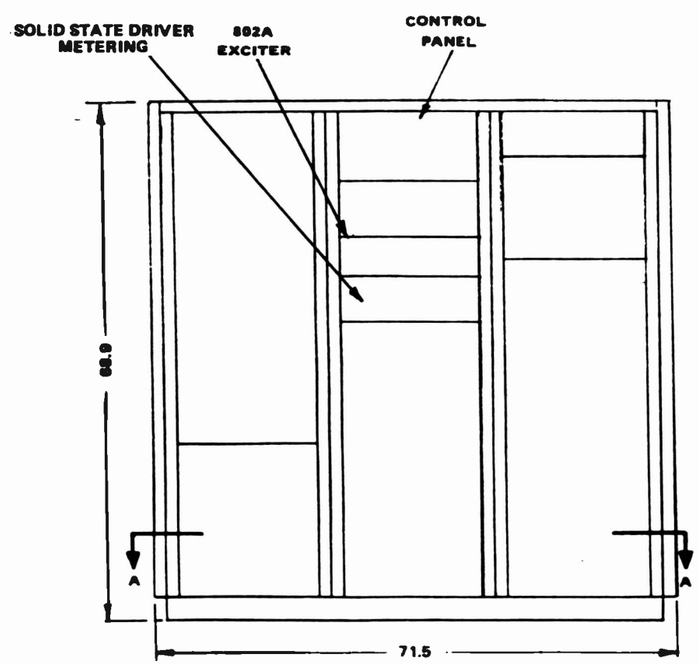
If any received item is freight damaged, the customer should accept the equipment, note the damage on the shipping documents and immediately file a freight claim. All boxes and packing material should be retained for the freight inspector. Refusal to accept delivery of damaged equipment removes the evidence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



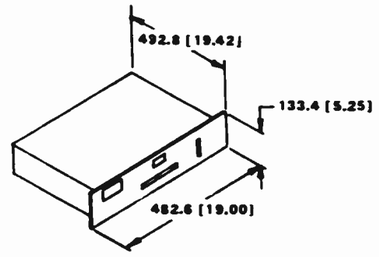
TOP VIEW OF TRANSMITTER



SECTION A – A

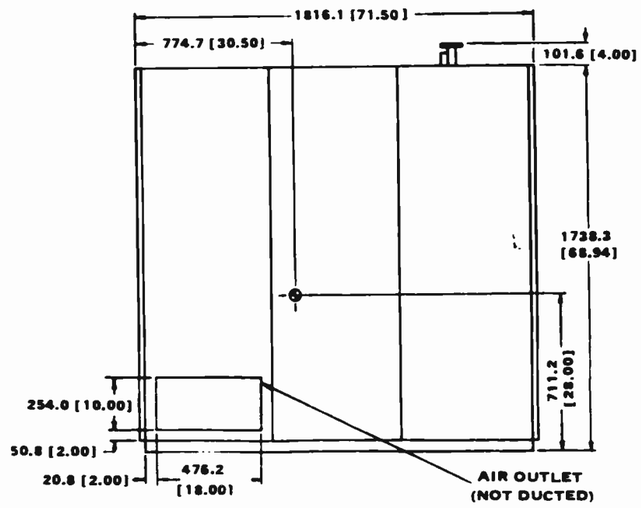


FRONT VIEW OF TRANSMITTER



802A EXCITER

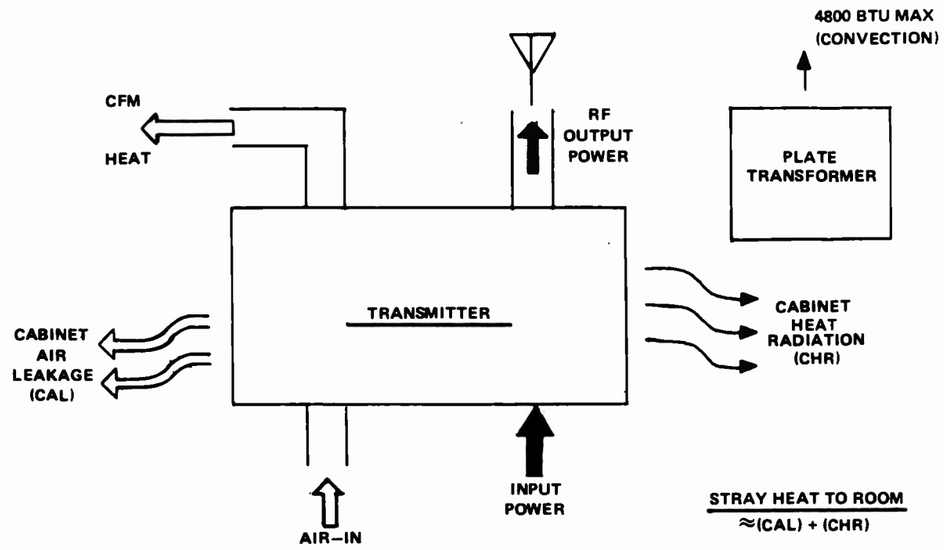
NORMALLY INSTALLED IN TRANSMITTER
MAY BE INSTALLED IN EQUIPMENT RACK
OR CONSOLE.

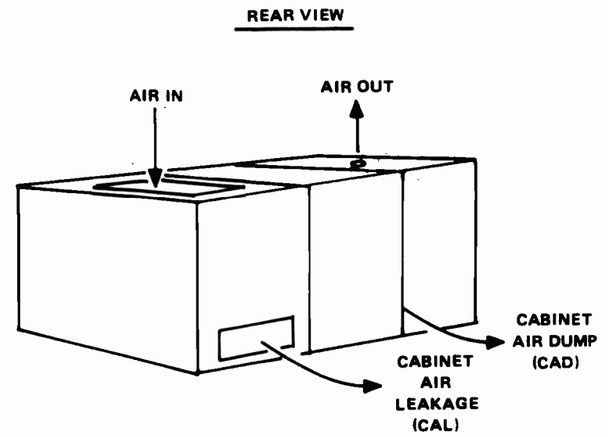


REAR VIEW OF TRANSMITTER

REF. DWG. 159421

Figure 2-1. FM Transmitter Outline and Installation Drawing





TRANSMITTER TYPE	RATED POWER OUTPUT	OPERATING POWER OUT	INPUT POWER KW	INPUT KVA	AIR–IN CFM		AMBIENT TEMP MAXIMUM	AMBIENT TEMP OPTIMUM	AIR OUT CFM	AIR–OUT HEAT KW / BTU	AIR–OUT TEMP °F / °C	AIR TEMP RISE °F / °C	STRAY AIR TO ROOM CFM	STRAY HEAT TO ROOM KW / BTU	BLOWER CFM CAP / USE	FAN CFM CAP / USE	AIR–IN SUPPLY PRESSURE (MIN)	AIR–OUT BACK PRESSURE (MAX)
816R-3B	25KW	25KW	40	43.5	850		+45.°C	+22.2°C	535	13.1 / 44710	149 / 65.3	77 / 43.1	315	1.9 / 6485	750 / 535	1000 / 850	+0.1" H_2O	0.1" H_2O
		20KW	32.1	34.9	850		+45°C	+22.2°C	535	11.4 / 38908	139 / 59.7°	67 / 37.5°	315	1.6 / 5461	750 / 535	1000 / 850	+0.1" H_2O	0.1" H_2O
		15KW	27.5	30.6	850		+45°C	+22.2°C	535	10.9 / 37202	137 / 58.1	65 / 35.9	315	1.6 / 5461	750 / 535	1000 / 850	+0.1" H_2O	0.1" H_2O
		10KW	18.8	20.5	850		+45°C	+22.2°C	535	10.2 / 34813	132 / 55.8	60 / 33.6	315	1.8 / 6143	750 / 535	1000 / 850	+0.1" H_2O	0.1" H_2O

TABLE 2-1 816R-2B NOMINAL POWER AND HEAT BALANCE CHART

Table 2-1. FM Transmitter, Nominal Heat Balance

2-2.2 FOREIGN SHIPMENTS

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.

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

2-3. ASSEMBLY

1. Plan the placement of the transmitter and its external wiring carefully before beginning installation. (Refer to Figure 2-1). Six knockout holes are located on the top of the transmitter section that contains the power supplies. The holes accommodate cabling for 3-phase input voltage and the remote control wiring. A 2-inch conduit entry is also provided in the floor of the power supply section. (See Figure 2-1.)

2. Connect the transmitter and the transformer enclosure to the station ground system using 4-inch copper strap. Holes are provided for this purpose in the floor of the transmitter.

3. Connect the input power wiring from the customer supplied fuse or circuit breaker panel with a 150 Amp rating. Using a 1/0 AWG cable, connect 3-phase power to transmitter terminal board A17TB3 in accordance with Schematic Diagram No. 159433. Connect the power AC GND to the GND terminal adjacent to A17TB3. Do not turn on power at this time.

4. Mounting 802A Exciter

   a. If the 802A exciter was not factory installed, mount it in the area provided in the transmitter center section. Connect an RF cable from the exciter output through the 3dB attenuator to the driver input (A26AR1-P7). Attach the MUTE voltage leads from A4TB1-6 to A19E6 (right side panel of transmitter) and from A26TB2-6 to A4TB1-6. The yellow wire tied to the RF cable is used for this purpose. Connect the 117-volt ac power cable from the exciter to connector J3 (Figure 6-1.) Refer to the 802A exciter instruction book for installation of audio input cables.

b. If the 802A Exciter is to be mounted separate from the transmitter, extend the power cable from J3 at the rear of the center cabinet. The exciter mute voltage from A19E6 and A26TB2-6 must also be connected to the 802A Exciter TB1-6. The RF output from J2 will be connected to A26AR1-J1, the RF input connector on the driver assembly using 50 ohm cable such as RG-223.

5. 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.

6. If output tube 4CX15000A was removed for shipping, install it using the procedure outlined in Paragraph 5-5.1

7. If remote control is used, run the external wiring from the remote unit into the transmitter and connect it to TB4 as shown on Figure 2-2 and on Figure 2-3.

NOTE

The positive plate current sample, TB4-30, must be connected to the ground side of the remote metering circuits if one side of the remote metering is grounded. The negative plate current sample, TB4-29, will then be connected to the remote metering input. The open circuit voltage at TB4-29, 30 will be approximately 8.4 Vdc when plate current is 3.5 Amperes. An external voltage divider may be required to obtain a sample that is within allowable limits for the remote control.Refer to Figure 2-2.

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

CAUTION

DAMAGE MAY 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.

NOTE

For 60 Hz operation only, the transformer primary taps must not be set to a tap that is more than two taps lower than the highest line voltage expected. For example, if line voltage is 245 volts, the screen transformer primary taps can be set to the 230,240 or 250 volt taps. If line voltage is 240 volts, the screen transformer could be set to the 220 volt taps if necessary to increase transmitter power. Transformer taps cannot be set to a lower tap than the highest expected line voltage where 50 Hz primary power source is used.

11. Set Transformer Taps

The Transmitter is shipped with all transformers on the highest voltage taps unless specific instructions are given regarding line voltage. This is done to prevent damage where line voltage may be higher than transformers are tapped and power is applied without changing taps.

The broad range of allowable voltage sources (200 to 250 volts is made possible by the availability of different tap connections of power transformers T1, T2, T4, and A28T1 and power supply transformers A10T1 and A10T2. Tables 2-2, 2-3, and 2-4 show the details of the proper primary line connections for various line voltages.

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

Six connections are made on power supply transformer A10T2. Three of these connections (at Terminals 1,4 and 7) are made regardless of the source voltage. The other three connections are made to correspond with the power source voltage. These wires are connected according to instructions supplied in Table 2-2.

Two connections are made at power supply transformer A10T1. One connection is made at Terminal No. 1 regardless of the source voltage. The second wire is connected to correspond with the power source voltage and is connected according to instructions supplied in Table 2-2.

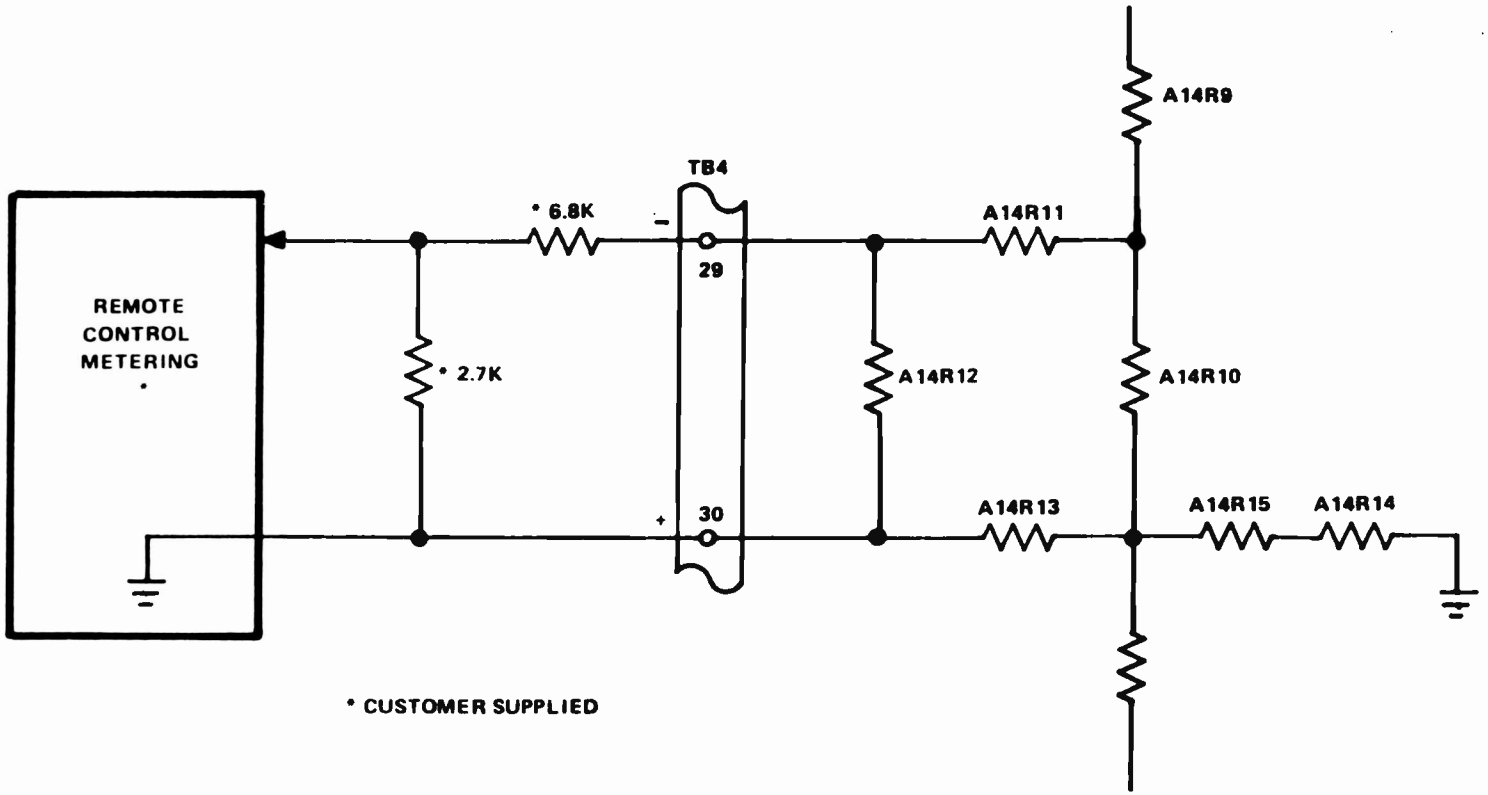
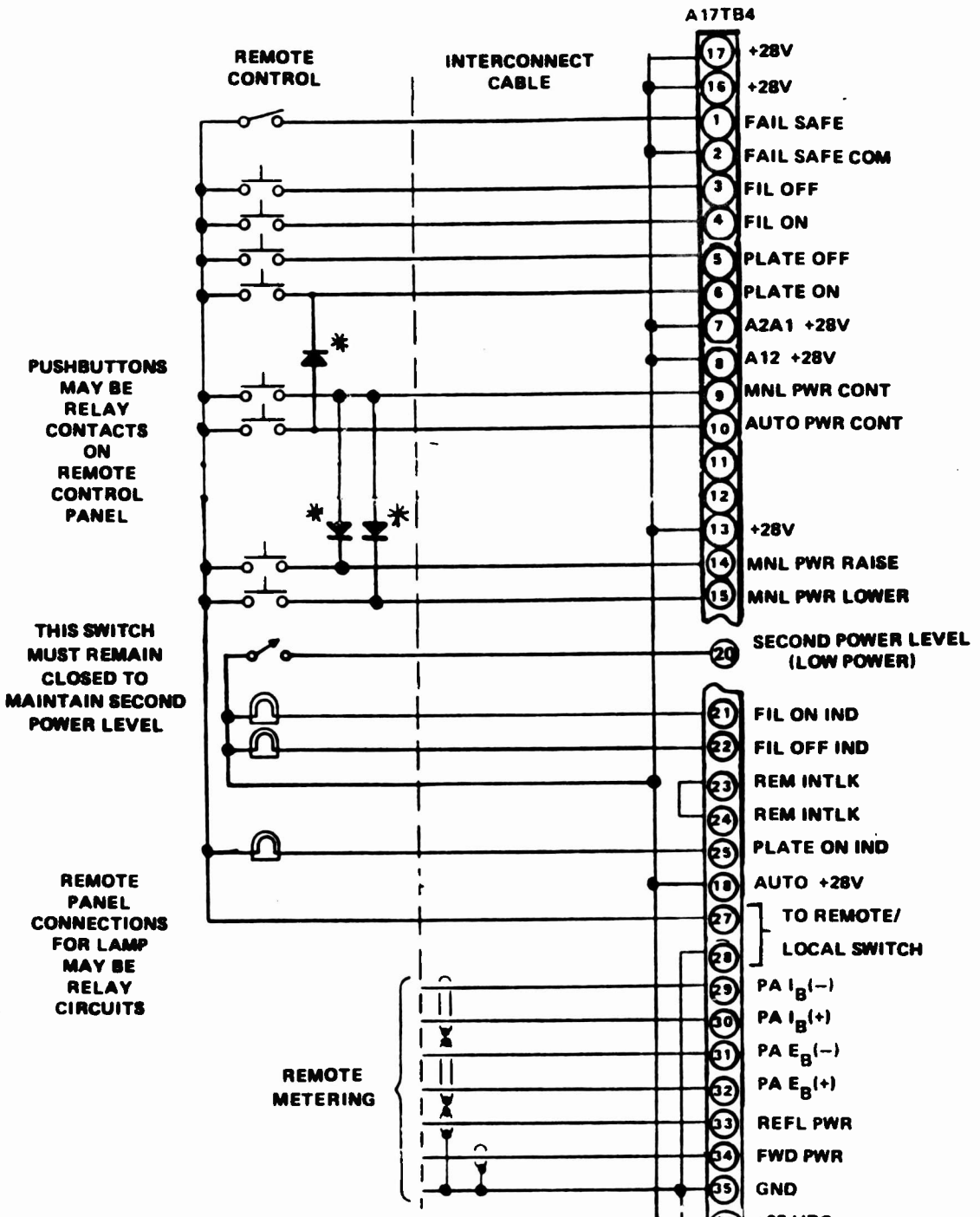


Figure 2-2. Remote Plate Current Sample Circuit



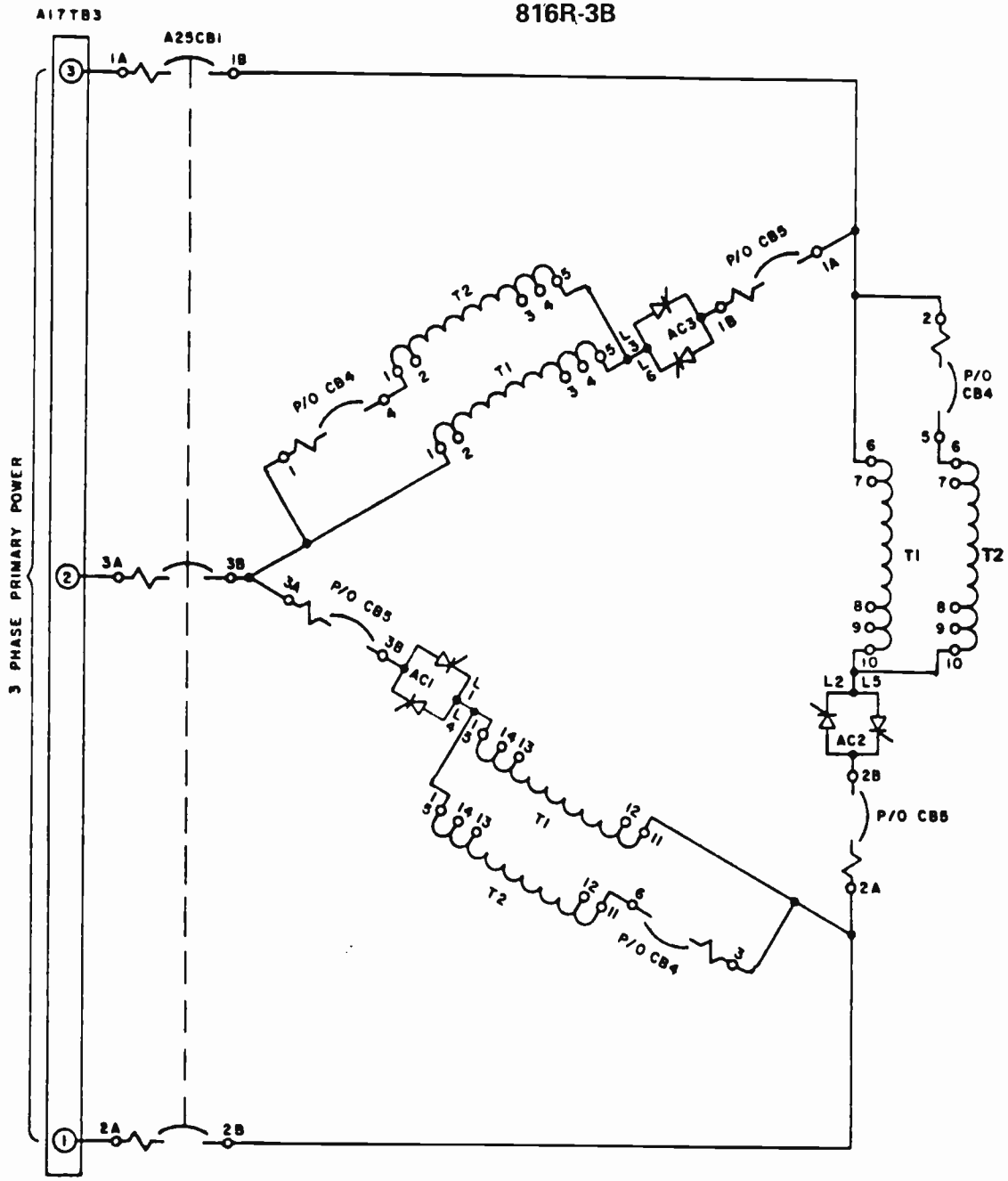
CHANNEL	CONTROL FUNCTION	METER FUNCTION
1	FIL OFF/ON	–
2	PLATE OFF/ON	PLATE VOLTS
3	MANUAL/AUTO	PLATE CURRENT
4	PWR RAISE/LOWER	FWD PWR
5		REFL PWR

TYPICAL REMOTE CONTROL CHANNEL ASSIGNMENT

✱

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 WHEN EITHER THE MANUAL POWER RAISE OR MANUAL LOWER CONTROL IS ENERGIZED. ALL DIODES ARE 1N4007 OR EQUIVALENT (CE NO. 353-6442-070).

Figure 2-3. Remote Control Connections to Terminal Board, A17TB4



LINE VOLTAGE	T1, T2 TERMINALS	T4 TERM. CONN.	A10T2 TERM. CONN.	A10T1 TERM CONN.
200V	2-3,7-8,12-13	1 & 2	1&2, 4&5, 7&8	1 & 2
210V	2-4,7-9,12-14	1 & 3	↓	1 & 2
220V	2-5,7-10,12-15	1 & 4	↓	1 & 2
230V	1-3,6-8, 11-13	1 & 5	7&9 1&3,4&6,	1 & 3
240V	1-4,6-9,11-14	1 & 6	↓	1 & 3
250V	1-5,6-10,11-15	1 & 7	↓	1 & 3

T1 PLATE TRANSFORMER
T2 SCREEN TRANSFORMER
T4 EXCITER/CONTROLS TRANSFORMER
A10T2 28 VOLT SUPPLY
A10T1 PA BIAS SUPPLY

Table 2-2. Transformer Connection Schedule

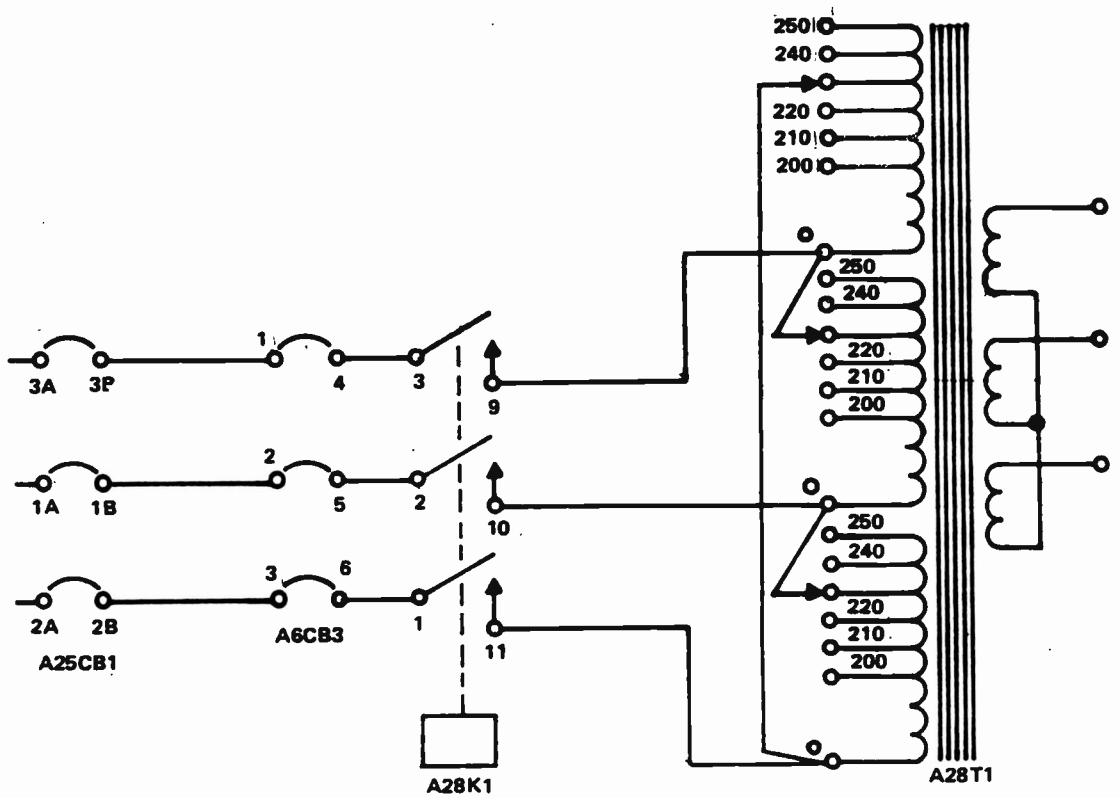


Table 2-3. Driver Transformer Connection

TABLE 2-4. SCREEN VOLTAGE TRANSFORMER TAP SCHEDULE

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

DC SCREEN VOLTAGE

SECTION 3 - OPERATION

3-1. GENERAL

The transmitter can be operated from the control panel or by remote control. Once the transmitter has been installed and properly tuned, it is only necessary to monitor meter indications and to make minor tuning and loading adjustments (Figure 3-1). Instructions for the 802A exciter are found in the Exciter Instruction Manual. (Figures 3-2 thru 3-6 are detailed areas of Figure 3-1.)

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; Table 3-3, right cabinet.

TABLE 3-1. LEFT CABINET

REF DES	CONTROLS AND INDICATORS	FUNCTION
A18C2	PA GRID TUNING	A vacuum variable capacitor used to set the resonant frequency of the PA grid circuit.

TABLE 3-2. CENTER CABINET

REF DES	CONTROLS AND INDICATORS	FUNCTION
A1M1	TEST METER	Displays 5 internal operational voltage or current readings.
A1S1	TEST METER SELECTOR	Rotary switch that selects parameters to be displayed 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.
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.

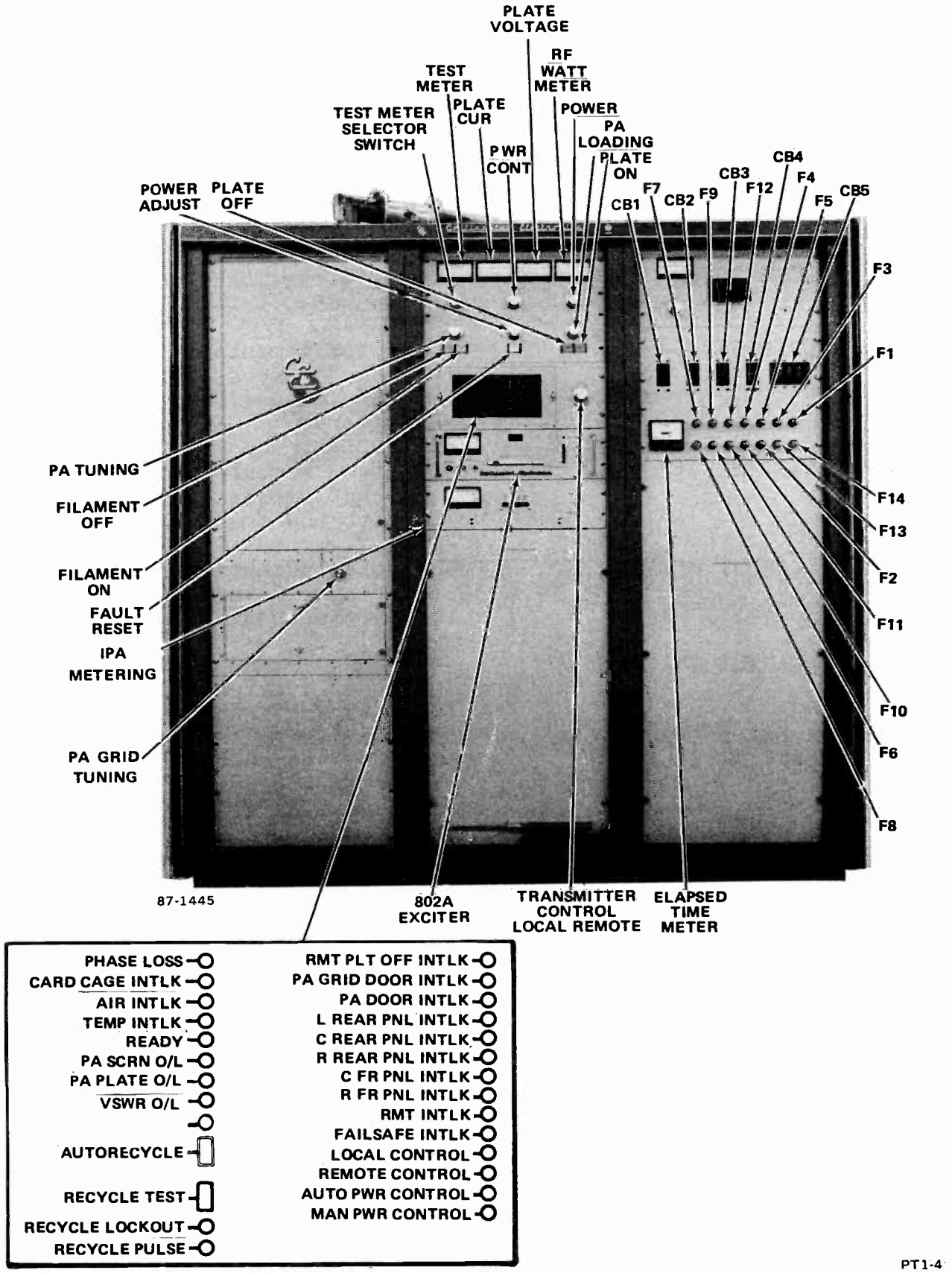


Figure 3-1. FM Transmitter, 816R-3B Controls & Indicators

TABLE 3-2. CENTER CABINET - continued

REF DES	CONTROLS AND INDICATORS	FUNCTION
A1S3	PA TUNING RAISE/LOWER	Spring-loaded momentary switch that positions tuning capacitor C50.
A1S4	PA LOADING RAISE/LOWER	Spring-loaded momentary switch that positions loading capacitor C51.
A1S7	PLATE OFF	Push-button momentary indicator switch that removes all operating voltage from the transmitter.
A1S8	PLATE ON	Push-button momentary indicator switch that applies operating voltage to the transmitter.
A1S9	FILAMENT OFF	Push-button momentary indicator switch that removes filament voltage from the transmitter.
A1S10	FILAMENT ON	Push-button momentary indicator switch that applies filament voltage to the transmitter.
A1S11	FAULT RESET	Push-button 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

TABLE 3-2. CENTER CABINET - Continued

REF DES		CONTROLS AND FUNCTION INDICATORS
A7CR9		Not Used
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
A12CR7	PA DOOR INTLK	PA Door Interlock Indicator
A12CR8	L REAR PANEL INTLK	Left Rear Panel Interlock Indicator
A12CR9	C REAR PNL INTLK	Center Rear Panel Interlock Indicator
A12CR10	R REAR PNL INTLK	Right Rear Panel Interlock Indicator
A12CR11	C FR PNL INTLK	Center Front Panel Interlock Indicator
A12CR12	R FR PNL INTLK	Right Front Panel Interlock Indicator
A12CR13	RMT INTLK	Remote Interlock Indicator
A12CR14	FAILSAFE INTLK	Remote Fail Safe Relay Interlock Indicator
A12CR15	LOCAL CONTROL	A1S10 Local Control Position Indicator
A12CR16	REMOTE CONTROL	A1S10 Remote Control Position Indicator
A12CR17	AUTO PWR CONTROL	A1S5 Automatic Power Control Position Indicator

TABLE 3-2. CENTER CABINET - Continued

REF DES		CONTROLS AND FUNCTION INDICATORS
A12CR18	MAN PWR CONTROL	A1S5 Manual Power Control Position Indicator
A27M1	IPA METER	Displays IPA and DRIVER operational parameters.
A27S1-A	E_c	Push button switch selects IPA supply voltage for measurement.
A27S1-B	I_c	Push button switch selects IPA or DRIVER current for measurement.
A27S1-C	FWD	Push button switch selects IPA forward power for measurement.
A27S1-D	REFL	Push button switch selects IPA reflected power for measurement.
A27S2	DRIVER CURRENT	Push button switch selects DRIVER current for measurement when I_c (A27S1-B) is set to measure IPA current.
A27CR1	POWER	IPA power on indicator.
A27CR2	VSWR	High IPA load VSWR indicator.
A27CR3	IPA FAULT	IPA module fault indicator.

TABLE 3-3. RIGHT CABINET

REF DES	CONTROLS AND INDICATORS	FUNCTION
A6CB1	28 VDC POWER SUPPLY	1 Ampere magnetic circuit breaker that protects the 28-Vdc power supply.
A6CB2	BLOWERS	15-Ampere magnetic circuit breaker that protects blower and fan.
A6CB3	DRIVER POWER SUPPLY	10-Ampere magnetic circuit breaker That protects the driver power supply.
A6CB4	PA SCREEN POWER SUPPLY	15-Ampere magnetic circuit breaker that protects the PA screen power supply.
A6CB5	PA PLATE POWER SUPPLY	70-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	15 Ampere fuse.
A6F2/F11	EXCITER	3-Ampere fuse.
A6F13/F14	FILAMENT METER	2-Ampere fuse.

3-3. INITIAL TURN-ON PROCEDURE

WARNING

DISCONNECT PRIMARY POWER BEFORE SERVICING THIS TRANSMITTER. SHORT ALL CAPACITORS AND POWER SUPPLIES WITH GROUNDING STICK. VOLTAGES IN THIS TRANSMITTER ARE DEADLY TO HUMAN LIFE.

1. Ensure that the transmitter has been properly assembled and connected according to instructions provided in Paragraphs 2-1 thru 2-3.

2. Open access panel to the control circuit cards. Check the circuit cards for proper installation.

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

4. Ensure that all transmitter circuit breakers are OFF.

5. Apply primary power to transmitter.

6. Set the 28 VDC POWER SUPPLY and BLOWER circuit breaker to ON. Check the phase loss/phase rotation indicator on A7, top LED (see Figure 6-1). If this indicator is not on, remove primary power and the right front bay access panel. Locate K5 (the phase loss/phase rotation monitor) and turn its control to minimum (full counterclockwise). Replace the access panel and restore primary power. If the phase loss/ phase rotation indicator is still not on, remove primary power and interchange any two primary input leads at A17TB3 (figure 6-1). Restore primary power and check indicator.

7. Adjust the Phase Monitor phase loss threshold.

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. DEATH ON CONTACT MAY OCCUR IF EXTREME CARE IS NOT EXERCISED WHEN PERFORMING THE FOLLOWING PROCEDURES.

a. Remove primary power and the right front bay access panel.

b. Block the interlock grounding switch open.

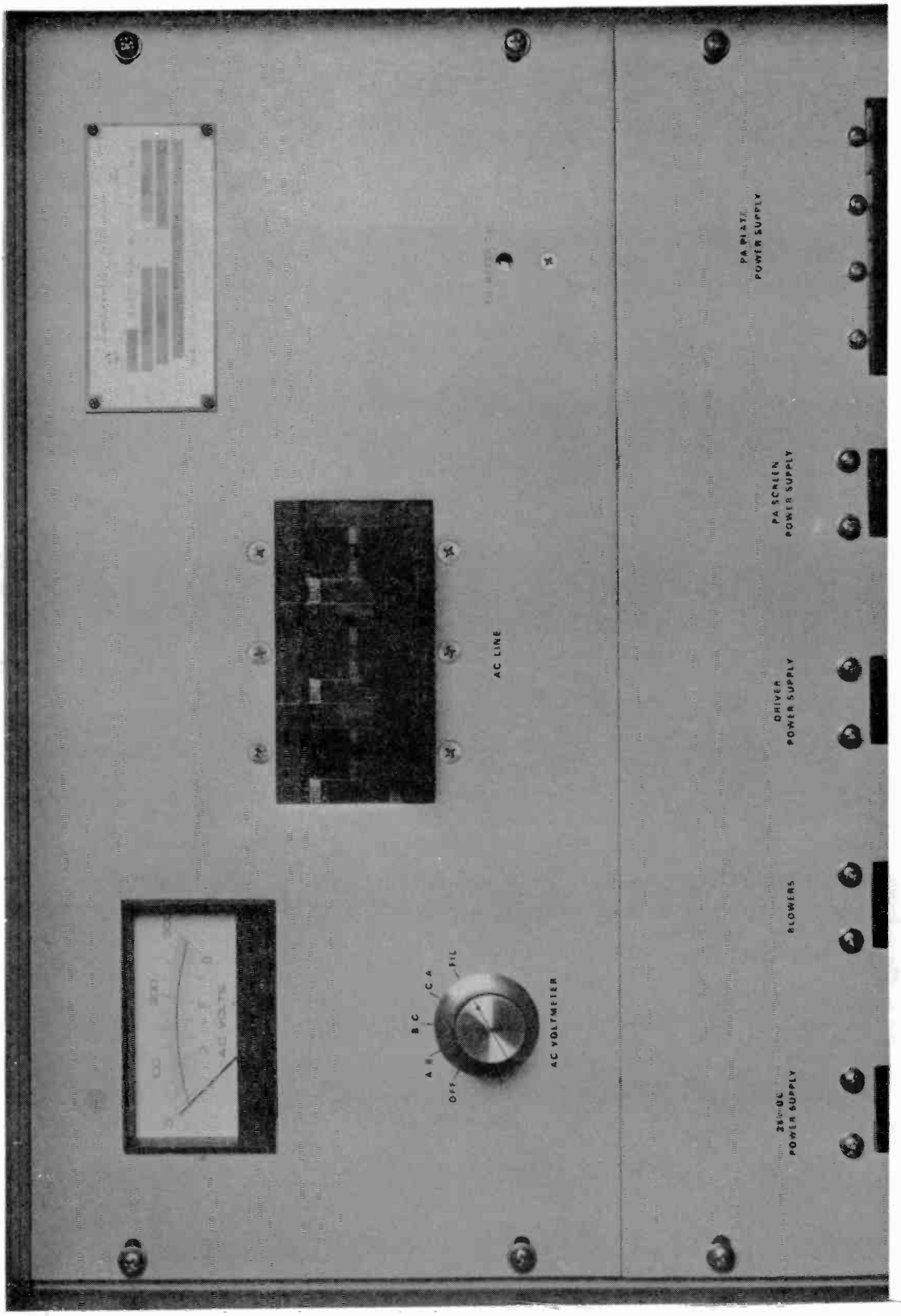
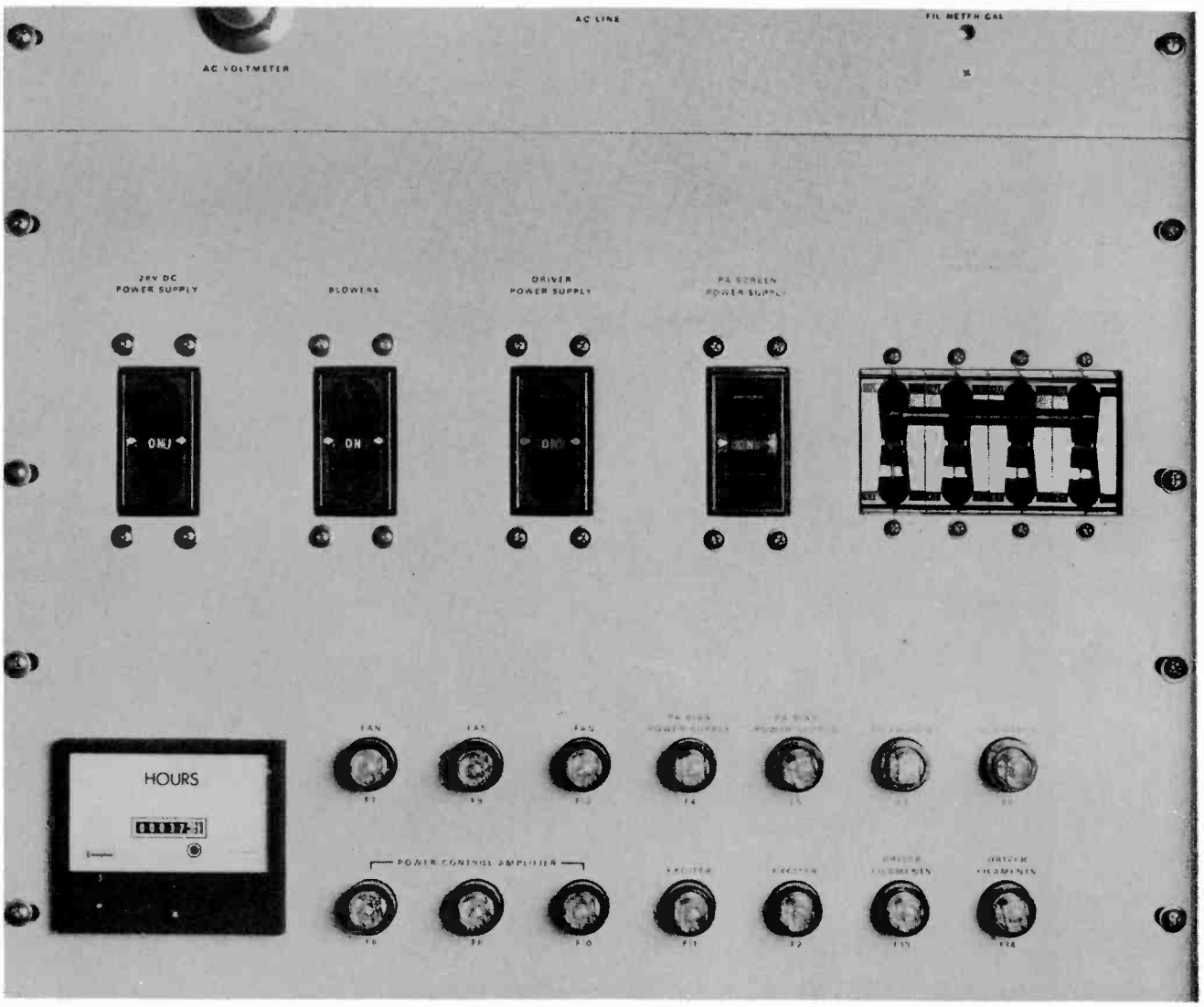


Figure 3-2. AC Power Control Panel



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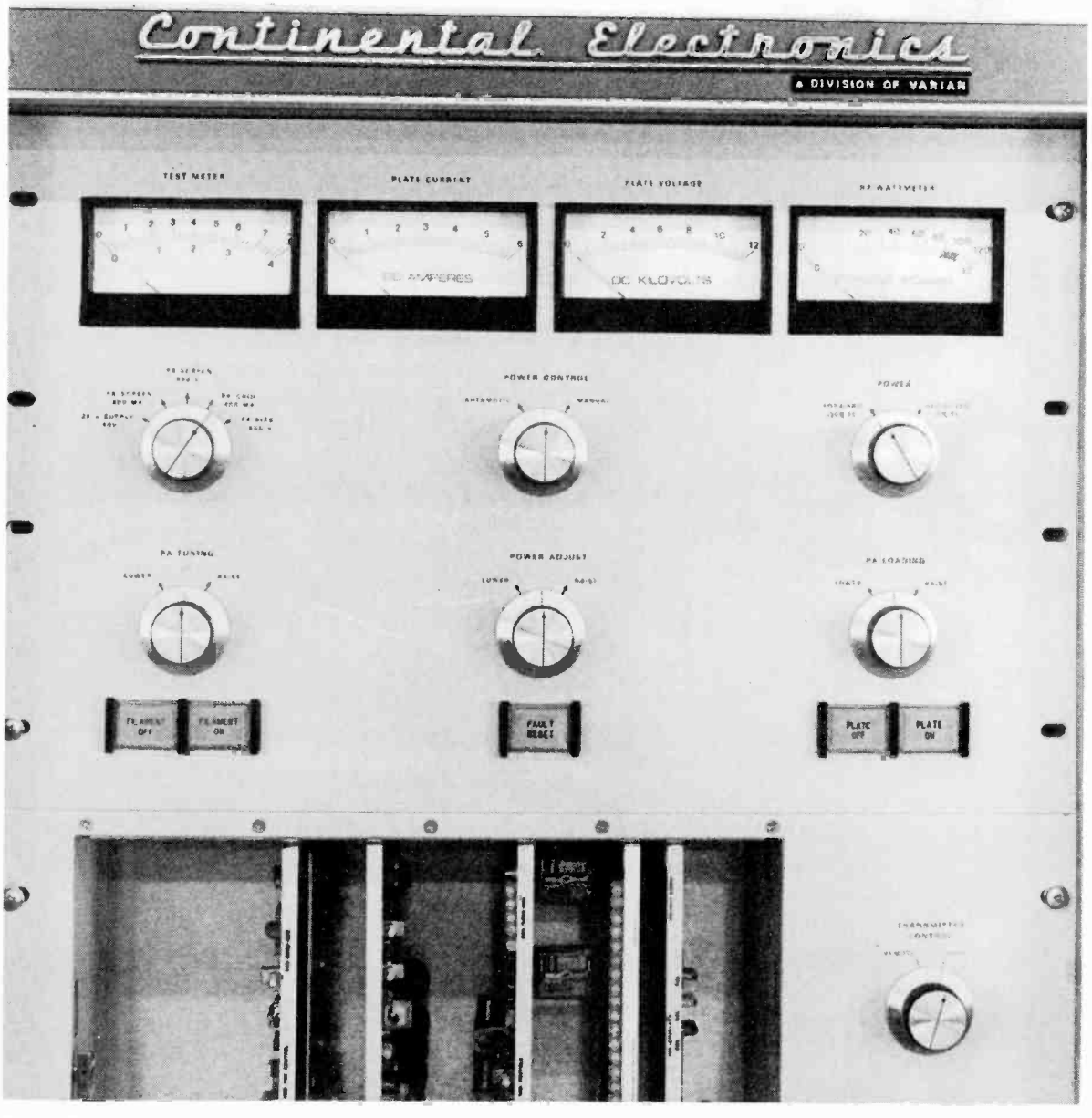
PT1-6

Figure 3-3. Power Circuit Breaker Panel



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PT1-7

Figure 3-4. PA Control Panel

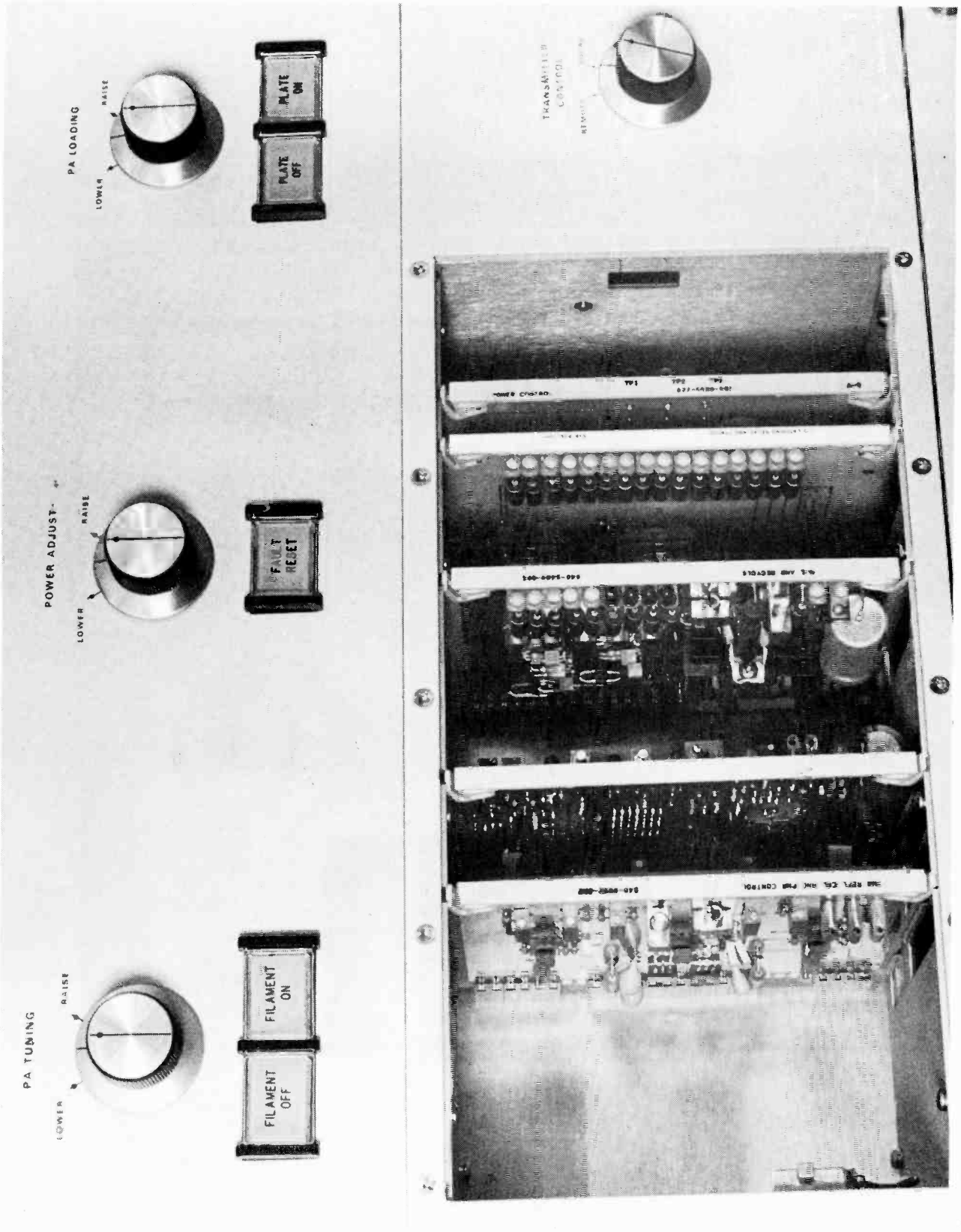

Figure 3-5. Card Racks, Door Open

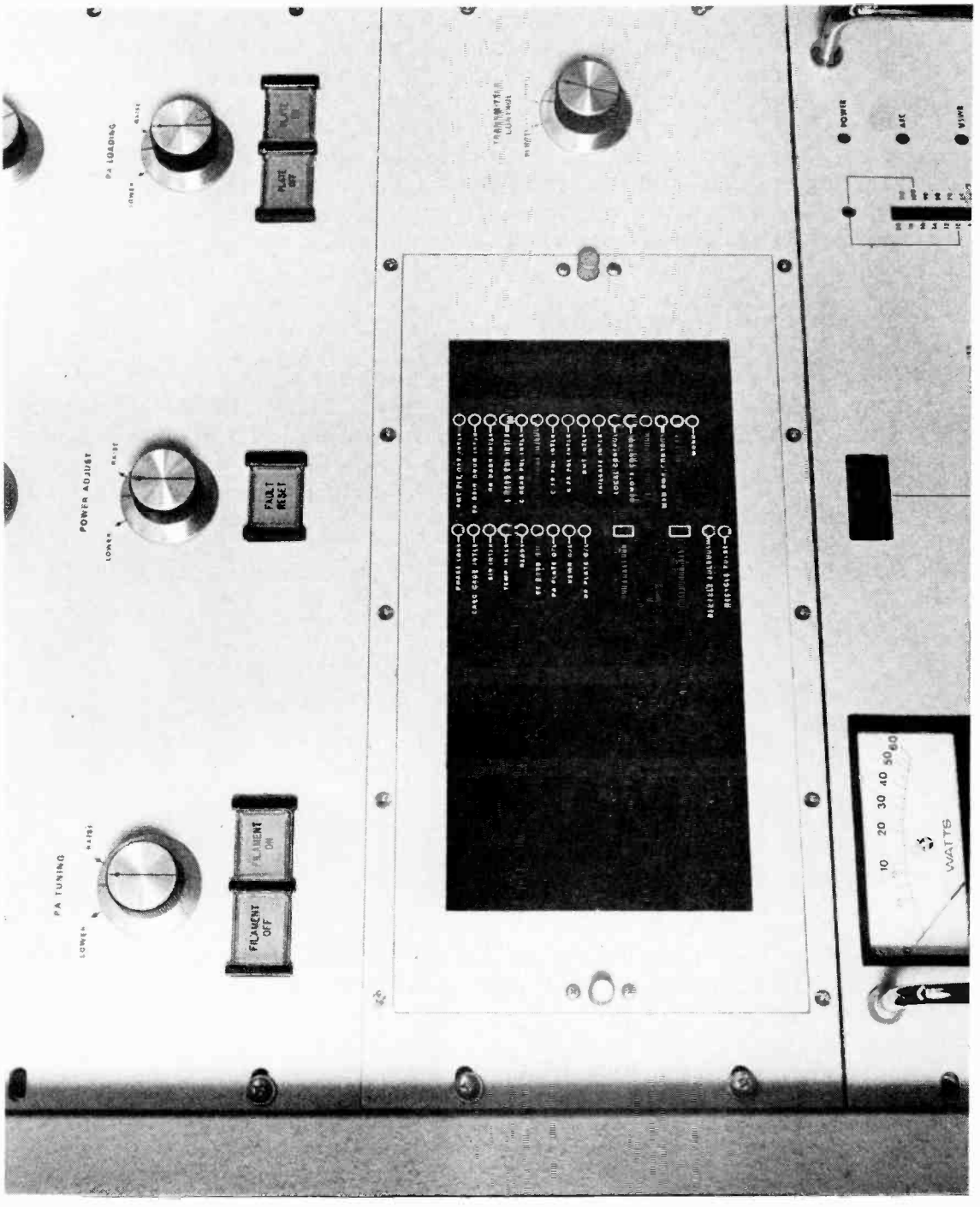

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Figure 3-6. Card Racks, Door Closed

NOTE

The phase loss/phase rotation monitor will shut the transmitter off when phase loss or incorrect sequence is detected. A phase loss will be detected if the line voltage drops below the threshold voltage level which is set by turning the control on K5. The threshold voltage range is 190-270V and it must be set below your lowest expected line voltage. To accomplish this, the line voltage should be at the lowest expected level when performing the following adjustment.

c. Restore primary power.

d. Increase the phase loss threshold voltage by turning the control on K5 clockwise until the LED on K5 goes out. Turn the control counterclockwise slightly past the point where the LED comes back on.

e. Remove primary power.

f. Remove block from interlock/grounding switch.

g. Replace access panel.

WARNING

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

8. Loosen the two retaining bolts at the bottom of the left cabinet side panel. Grip the panel securely and lift it from place.

9. Apply primary power and press filament on button.

10. Remove primary power and observe direction of rotation of the PA cavity blower and the cabinet fan as they come to a stop. Cabinet fan rotation may be observed by lifting the foam filter from the top right side of the cabinet. PA cavity blower rotation should be counter-clockwise when viewed from the left side. Cabinet fan rotation should be counterclockwise when viewed from the top. Replace cabinet side panel.

CAUTION

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

11. Set all circuit breakers to ON and apply primary power. Press filament on button.

12. Set the test meter selector switch to 28V SUPPLY (40V SCALE). The test meter will indicate 28 +/-2.0 VDC.

13. Set the AC Meter Panel selector switch to FIL. The test meter should indicate 6.3 +/-0.1 volts. Adjust Filament Voltage if it is not correct, using procedures in Paragraph 5-7.2. These adjustments are required to be made at customer's normal line voltage.

14. Ascertain that the exciter POWER Switch is ON. The power indicator on the exciter should light when the transmitter filament on switch is depressed. This switch is on the back of the exciter. Remove transmitter primary power before removing access panel.

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 14 thru 25 are adequate to ensure proper transmitter operation. However, if the transmitter is to be operated at a frequency, or power output, that is different from the frequency or power output designated in the factory test data supplied with the transmitter, perform the complete RF tuning and power adjustment procedures listed in Paragraphs 5-8 and 5-9.

15. Set the POWER CONTROL switch to MANUAL.

16. Set the RF POWER switch to FORWARD.

17. Set the TRANSMITTER CONTROL switch to LOCAL.

18. Press the PLATE switch. The PLATE ON switch lamp will light.

19. Adjust PA GRID TUNING and the COUPLING control for minimum IPA reflected power.

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

21. As the transmitter warms up, the IPA reflected power will rise. Retune the PA GRID TUNING as needed to keep the reflected power below 75 watts (final value is less than 20 watts). Once the IPA reflected power appears stabilized, repeat steps 19 & 20. The final setting should be established after the transmitter has been on for at least 30 minutes. Do not retune the grid after the final setting has been established.

NOTE

In this transmitter, operating parameters will become stable within 15-20 minutes. All fine tuning and recording of operating parameters should be performed only after the transmitter has stabilized.

22. RAISE or LOWER the POWER ADJUST control until the RF WATTMETER displays the station's authorized power level. If specified, the RF WATTMETER was calibrated to indicate 100% at this power.

23. Compare meter readings with those listed in the the factory test data located at the back of this manual. If additional tuning or transformer tap adjustment is required, refer to the adjustment procedures listed in Section 5.

24. Set POWER CONTROL switch to AUTOMATIC. On the transmitter Power Control Adjust Module, A3 (see Figure 6-1), adjust A3R7 for 100% output power if necessary.

NOTE

Do not perform this procedure unless the power amplifier is neutralized. See paragraph 5-9.3.

25. PA TUNING AND LOADING (FOR BEST EFFICIENCY). There is not likely to be a plate current dip within the normal range of tuning control. There are, however, three indicators to be observed for proper PA TUNE. Power output will be maximum and screen current will be nearly so. PA plate current will be changing as the tuning is changed. Plate current will increase when the tuning control is held in the lower position. When the shorting plane is positioned correctly, the PA screen current and power output will go through a peak. Make certain that screen current and power output actually go through a peak, and that power reduces if the tuning control is held in one position or the other, past the point of maximum PA screen current and power output. Refer to Figure 3-7 for an indication of what to expect as the tuning control is run through its total mechanical range, from one limit to the other. Notice that power output is the same at point A and point B, but that plate current is greater at point B. The proper tuning point is at point A which results in maximum output and also the least amount of plate current (not plate current dip). The loading control is adjusted for maximum RF output. You will notice that PA screen current decreases when loading is raised and increases when loading is lowered. Normally, screen current will be between about 150 and 550 mA. The screen current is dependent upon loading, power output requirements, plate and screen voltage, and individual tube characteristics. When the PA tube is replaced, screen voltage may have to be changed in order to obtain the desired power output.

26. MAXIMUM POWER OUTPUT ADJUSTMENT.

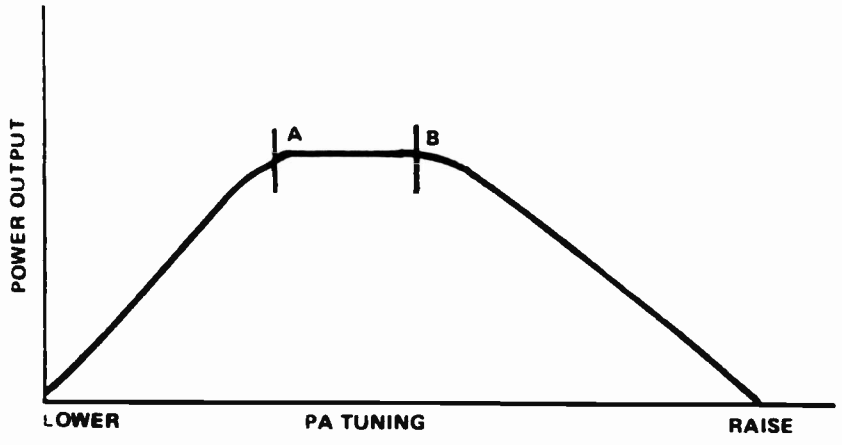
NOTE

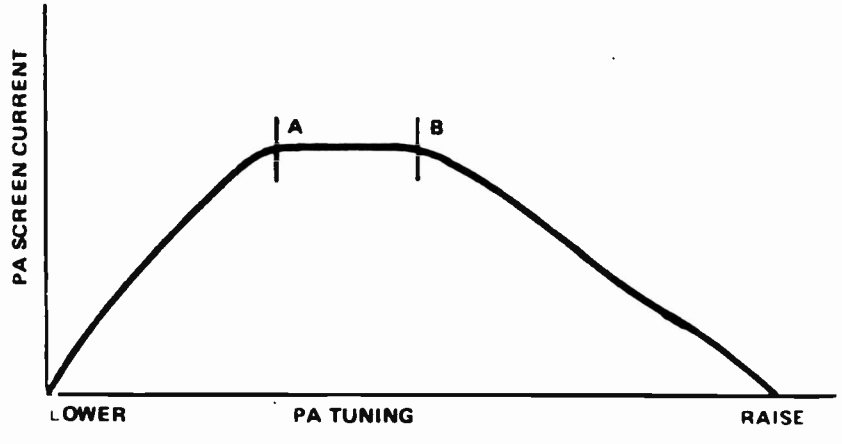
This procedure is intended to maintain authorized station maximum power output with line voltage variations.

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 5% above the authorized station maximum output, skip to step h. If the maximum power output is more than 5% of the authorized station maximum output, proceed to step c.

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





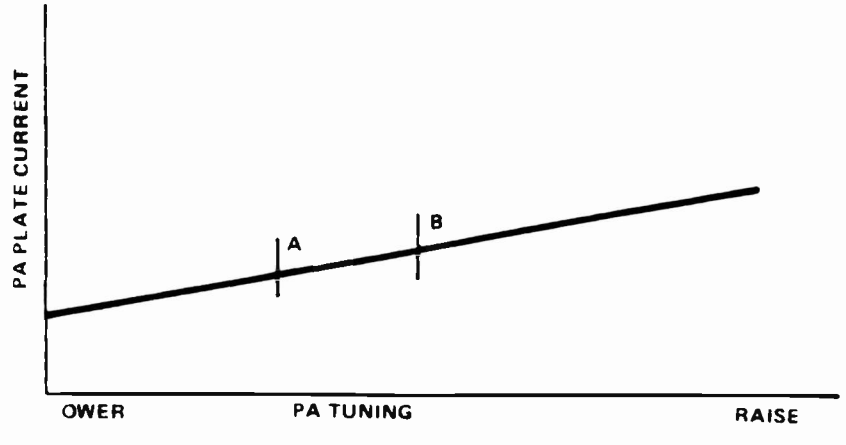


Figure 3-7. PA Tuning & Loading

d. Turn off primary power to the transmitter.

e. Refer to Tables 2-2 and 2-4, and change wires to the screen transformer terminals to decrease screen voltage.

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

g. Repeat steps c thru f until the maximum transmitter output is approximately 5% above the authorized station maximum output.

h. Compare the PLATE VOLTAGE reading with the plate voltage listed in Tables 3-4 and 3-5 for the authorized station maximum power output. (Linear interpolation of tabulated values may be necessary.) If the compared voltages differ by more than 10%, proceed to step i. If the compared voltages differ by less than 10%, skip to step n.

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

j. Turn off primary power to the transmitter.

k. Refer to Table 2-2. If the transmitter plate voltage exceeds the tabulated voltage, change wires on transformer T1 to the terminals listed for the next higher line voltage. If the tabulated voltage exceeds the transmitter plate voltage, change wires on transformer T1 to the terminals listed for the next lower line voltage.

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

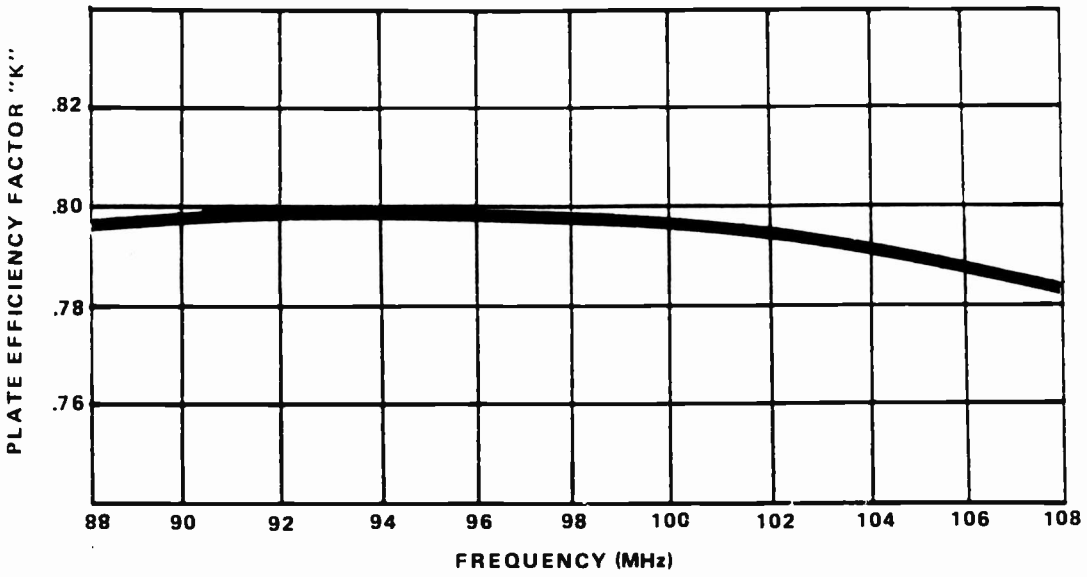
m. Repeat step a.

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

NOTE

Use curves and equations in Figure 3-8 for indirect power output determination.

27. ANTENNA SYSTEM VSWR CHECK. The RF WATTMETER and the graph in Figure 3-9 can be used for this purpose if other means are not available. Typically, VSWR is less than 1.1:1 and it must not exceed 2:1.



POWER OUTPUT = I_p E_p "K"

WHERE I_p = PLATE CURRENT IN AMPS

E_p = PA PLATE VOLTAGE IN VOLTS

"K" = EFFICIENCY FACTOR FROM CHART

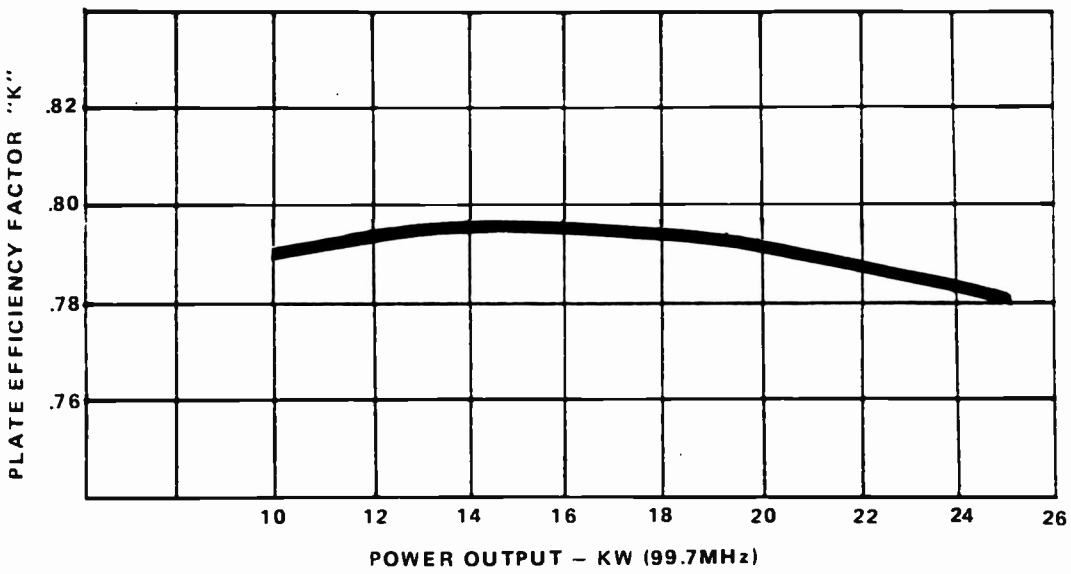


Figure 3-8. Amplifier Efficiency vs Frequency and Power

TABLE 3-4. NOMINAL OPERATING PARAMETERS VS. POWER LEVELS
(99.7 MHz)

816R2B OPERATING PARAMETERS	RF OPERATING POWER - kW				
	10	15	20	22.5	25.0
Plate Voltage (kV)	7.82	8.40	8.50	8.53	8.48
Plate Current (Amps)	1.60	2.21	2.92	3.34	3.77
Screen Voltage (V)	375	500	610	675	710
Screen Current (mA)	190	298	400	450	510
Grid Bias Voltage (V)	-608	-607	-585	-585	-566
Grid Current (mA)	106	107	100	107	118
Forward Power (%)	40	60	80	90	100
Reflected Power (%)	<0.2	<0.2	<0.2	<0.2	<0.2
Filament Voltage (VRMS)	6.30	6.30	6.30	6.30	6.30
DRIVER					
IPA Voltage (Volts)	44	44	44	44	44
IPA Current (Amps)	18.5	21.5	19.5	21.5	18.5
DR Current (Amps)	2.2	2.6	2.3	2.6	2.2
FWD Power (watts)	440	520	480	520	440
RFL Power (watts)	<15	<15	<15	<15	<15
PA Efficiency Factor "F" (%)	78.9	79.4	79.3	79	78.2
AC POWER ANALYZER					
Phase A-B (VRMS)	210	207	206	205	205
Phase B-C (VRMS)	204	203	202	202	200
Phase C-A (VRMS)	208	206	205	206	204

TABLE 3-5. NOMINAL OPERATING PARAMETERS VS. FREQUENCY

816R2B OPERATING PARAMETERS	FREQUENCY - MHz					
	88.1	92.1	96.1	99.71	104.1	107.9
Plate Voltage (kV)	8.48	8.41	8.40	8.48	8.40	8.41
Plate Current (Amps)	3.70	3.70	3.72	3.73	3.85	3.79
Screen Voltage (V)	710	740	730	710	700	700
Screen Current (mA)	450	482	510	510	450	490
Grid Bias Voltage (V)	-515	-556	-574	-566	-488	-535
Grid Current (mA)	110	115	115	118	95	103
Forward Power (%)	100	100	100	100	100	100
Reflected Power (%)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Filament Voltage (VRMS)	6.3	6.3	6.3	6.3	6.3	6.3
Power Output (KW)	25.0	25.0	25.0	25.0	25.0	25.0
DRIVER						
IPA Voltage (Volts)	43.0	44.0	43.0	44.0	44.0	44.0
IPA Current (Amps)	21.0	21.0	21.0	18.5	22.0	22.0
DR Current (Amps)	2.70	2.90	2.70	2.20	3.00	1.70
FWD Power (Watts)	555	550	530	440	600	600
RFL Power (Watts)	<10	<10	<20	<10	<15	<20
PA Efficiency Factor "F"(%)	79.0	80.0	80.0	79.0	78.8	78.4

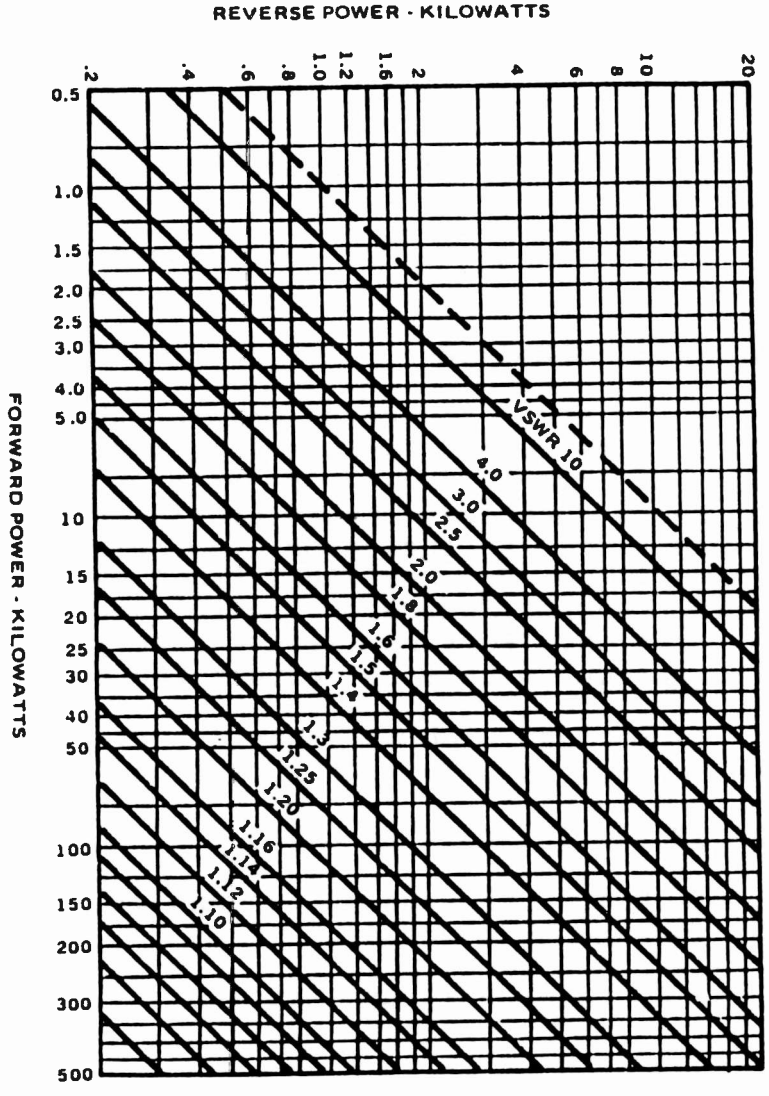


Figure 3-9. Power to VSWR Conversion Graphs

3-4. REMOTE OPERATION

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

3-5. 2nd POWER LEVEL (LOW POWER) ADJUSTMENT

1. Perform this step only if you will be using a second power level.
2. Switch transmitter to AUTO POWER CONTROL mode.
3. Apply 28 VDC to A17TB4, Terminal 20 (Remote Control), to activate relay A3K1.
4. Adjust R41 on A3 (Power Control Card) for the desired power level.

3-6. AUTOMATIC RECYCLE RESETTING

Automatic transmitter shutdown occurs when PA Screen, PA Plate, or VSWR is overloaded. An overload indicator A7CR6 thru A7CR8 illuminates on overload and recycle board A7. If the overload was of short duration, the automatic recycling circuits restart the transmitter. The indicator lamp remains on until the transmitter operator presses the FAULT RESET switch on the main control panel. The fault Indicator lamp cannot be RESET from Remote Control location. Perform maintenance procedures if the automatic recycling circuits fail to restart the transmitter.

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

3-7. NORMAL TURNOFF (AT TRANSMITTER SITE)

1. Press the PLATE OFF push-button and allow a few seconds for the voltage to decrease.
2. Press the FILAMENT OFF push-button.
3. Allow time (3 minutes or less) for the blower off delay circuit to turn blower off.
4. Set AC LINE circuit breaker A25CB1 OFF.
5. Open the primary disconnect switch. (Customer supplied wall disconnect switch.)

3-8. EMERGENCY TURNOFF

In the event of an emergency, remove power in any of the following ways:

1. Turn AC LINE circuit breaker A25CB1 OFF.
2. Press the FILAMENT OFF push-button.
3. Turn 28 VDC POWER SUPPLY circuit breaker, CB1 OFF.
4. Open the Primary Disconnect switch.

SECTION 4 - THEORY OF OPERATION

4-1. GENERAL

The FM Transmitter, 816R-3B, operates in the 88 to 108 MHz range at a maximum rated RF output OF 25 kW. A CE 802A solid-state FM wideband exciter provides excitation. The transmitter is equipped with circuits that maintain constant power output and protect the transmitter from overload conditions. A control panel provides complete transmitter metering and tuning controls. Refer to the overall schematic diagrams for detailed circuit information.

4-2. BLOCK DIAGRAM DISCUSSION

Referring to Figure 4-1, an input signal (monaural, stereo composite, or SCA is supplied to the exciter. The exciter's RF output drives a three stage power amplifier. The first stage, the driver, raises the exciter power to approximately 40 to 50 Watts. The following stage, the IPA (intermediate power amplifier), raises the driver output to a level of 500 Watts. The last stage, the RF power amplifier, raises the IPA output to the transmitter's rated power output. The power amplifier is followed by a low pass filter and a directional coupler which is connected to the station's antenna system. A dc sample of the forward power from the directional coupler (DC1) is monitored by the auto power control circuit. If a change in output power is detected, a signal is sent to the power control unit that increases or decreases the plate and screen power supply input voltage to compensate. A sample of the reflected power is also monitored by the power control circuits. If an excessive amount of reflected power is detected, the control circuits remove all plate voltage from the transmitter. The 28-Volt power supply provides power for the control circuits.

4-3. RF CIRCUITS

4-3.1 EXCITER

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

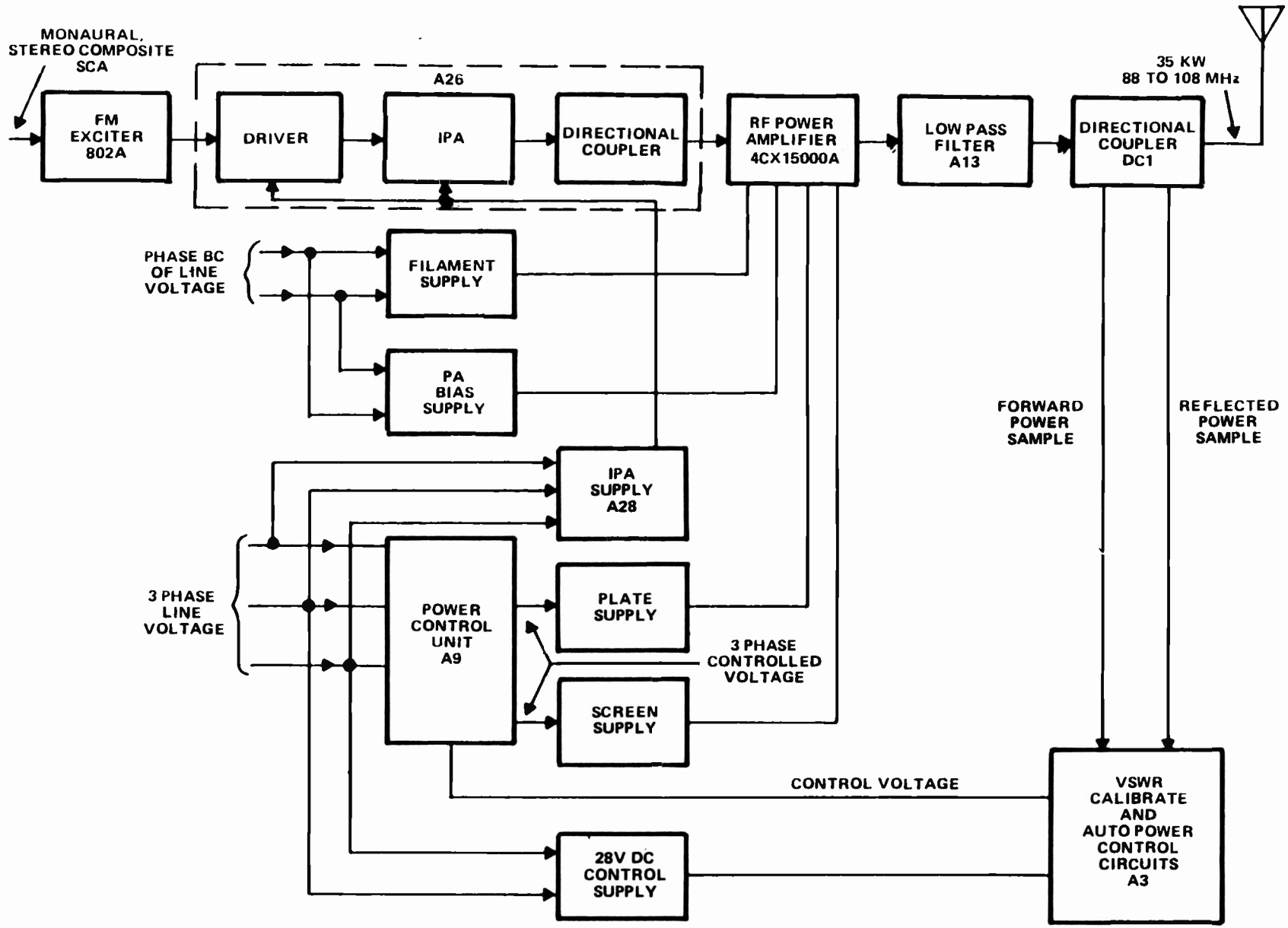


Figure 4-1. FM Transmitter 816R-3B, Block Diagram

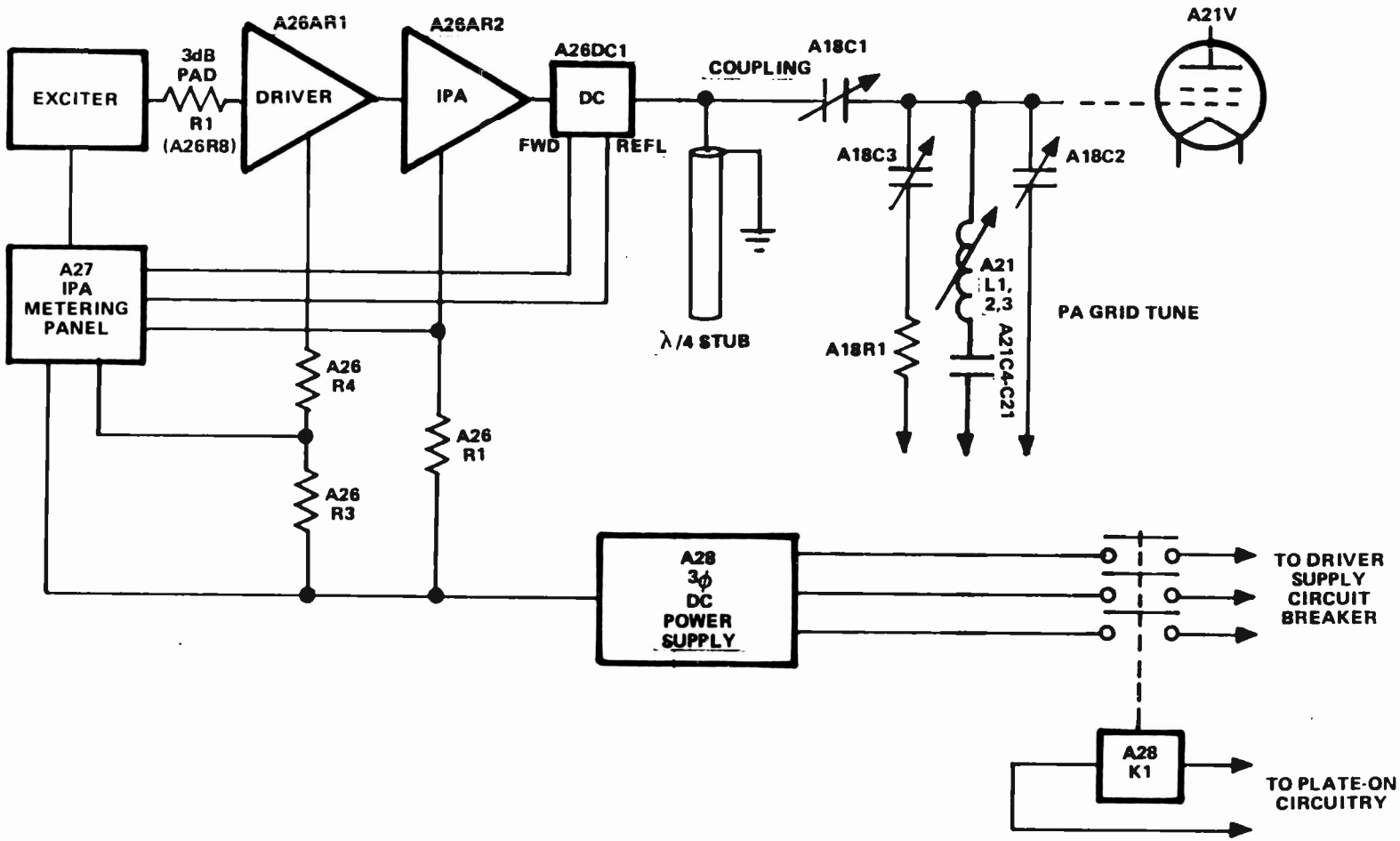


Figure 4-2. Basic RF Chain

4-3.2 SOLID-STATE DRIVER

4-3.2.1 DRIVER (A26AR1)

The exciter RF output is applied to the driver amplifier module through a 3dB pad (This pad may be located within the driver enclosure and is rated at 50 watts) located at the rear of the exciter, as shown in Figure 4-2. Since this pad is rated for 15 watts, the exciter output power should not exceed this. The pad is used to assure a good load to the exciter under all operating conditions.

The amplifier features two MOSFET devices in a broadband, push-pull configuration which is rated for 150 Watts of output. The driver receives its power from a 45-Volt dc supply which is also used to supply the IPA and its metering circuitry. A resistor, in series with the supply, limits the driver's maximum output power. The driver is thermally protected by a temperature sensitive switch mounted to the driver heat sink. The amplifier's supply current is metered on the front panel through meter shunt resistor A26R3. The output of the driver is fed to the IPA module.

4-3.2.2 IPA (A26AR2)

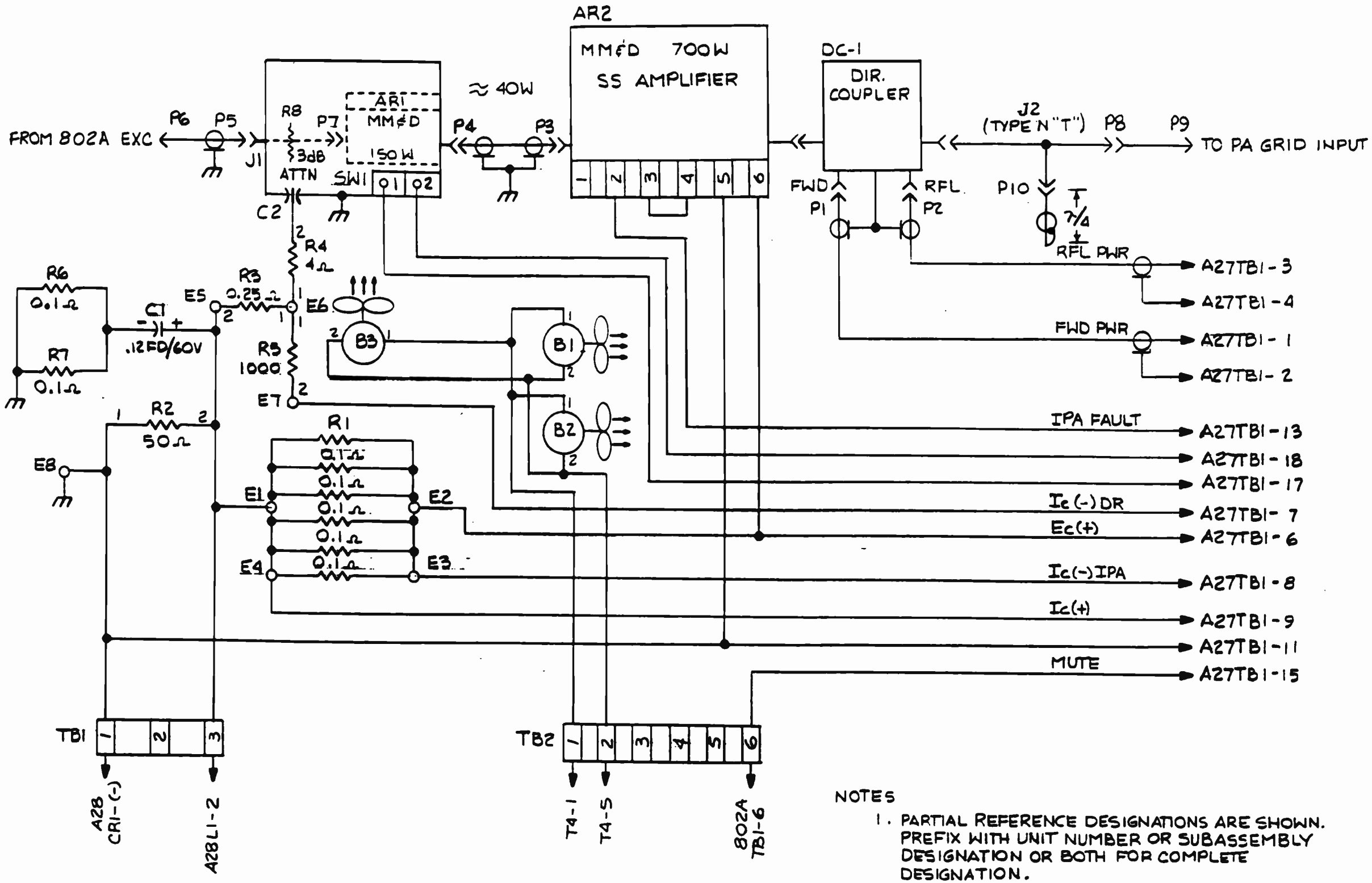
The IPA is a modular amplifier (schematic diagram Figure 4-3) mounted on top of the IPA shelf. The amplifier has the following features.

1. Broadband. Solid state (MOSFET) design, rated to 700 Watts.

2. Redundancy. The amplifier module contains two separate amplifiers and a 90-degree combiner. Should one of the amplifiers fail, the other would continue to produce power.

3. Internal protection. If supply voltage, RF drive power, or heat sink temperature exceed preset limits, the protection circuit will shut the module off until the above parameters return to normal.

The IPA receives its dc power from a 45-Volt supply which also serves the driver and the IPA metering board. the IPA is followed by a directional coupler. The coupler drives the IPA RF power meter and provides a reflected power signal which is used to protect the IPA from high load VSWR. This is done by reducing the exciter power output when a high VSWR is detected, thus reducing the stress on the IPA, while keeping the transmitter on the air. The VSWR lamp on the IPA metering panel will light when this condition occurs. The RF output of the directional coupler is connected to the RF power amplifier cavity.



NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION OR BOTH FOR COMPLETE DESIGNATION.

Figure 4-3. IPA Shelf, Schematic Diagram

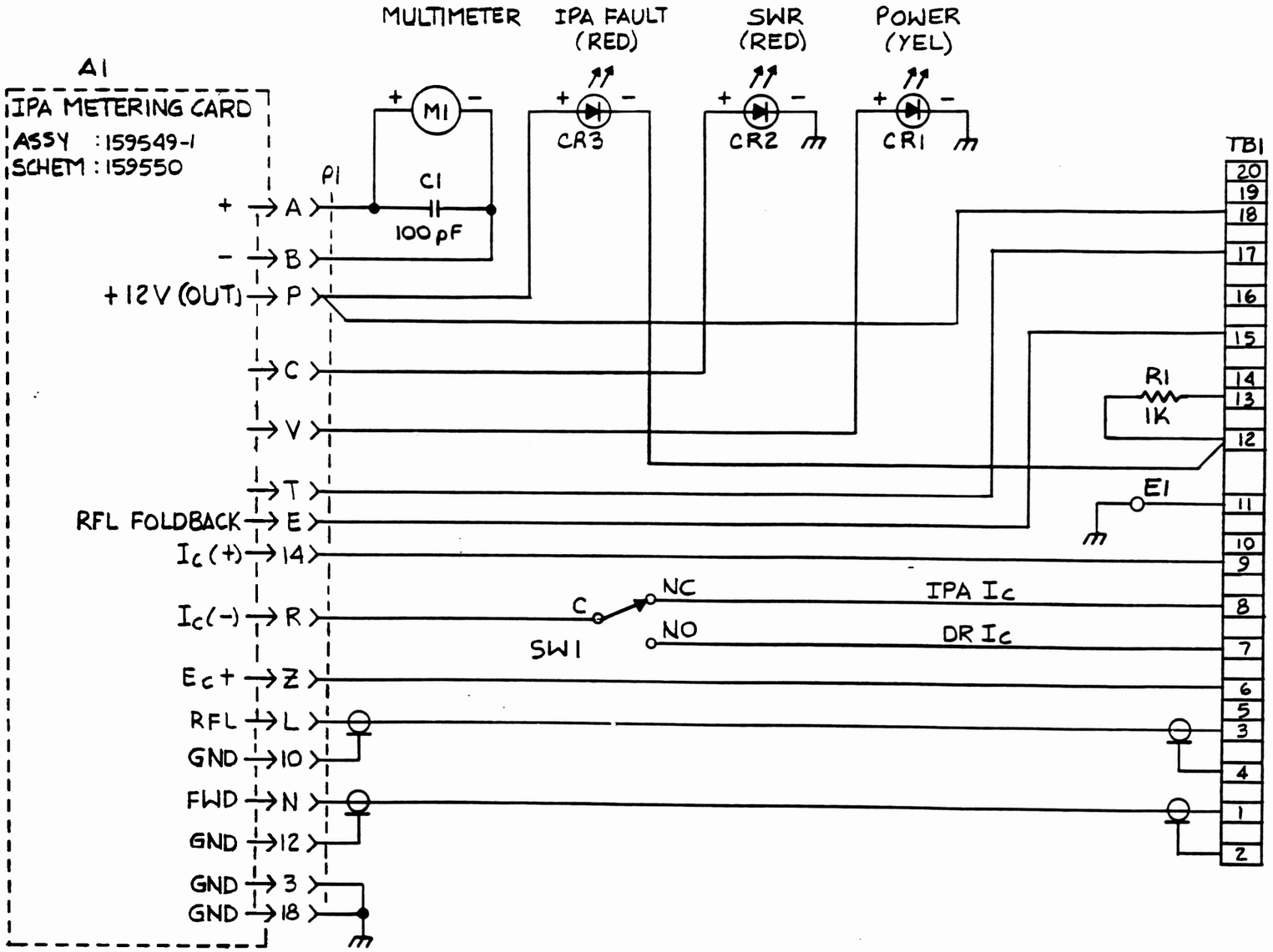


Figure 4-4. IPA Metering Panel

NOTES:
1. SWITCH S1 IS SHOWN IN ENERGIZED POSITION.

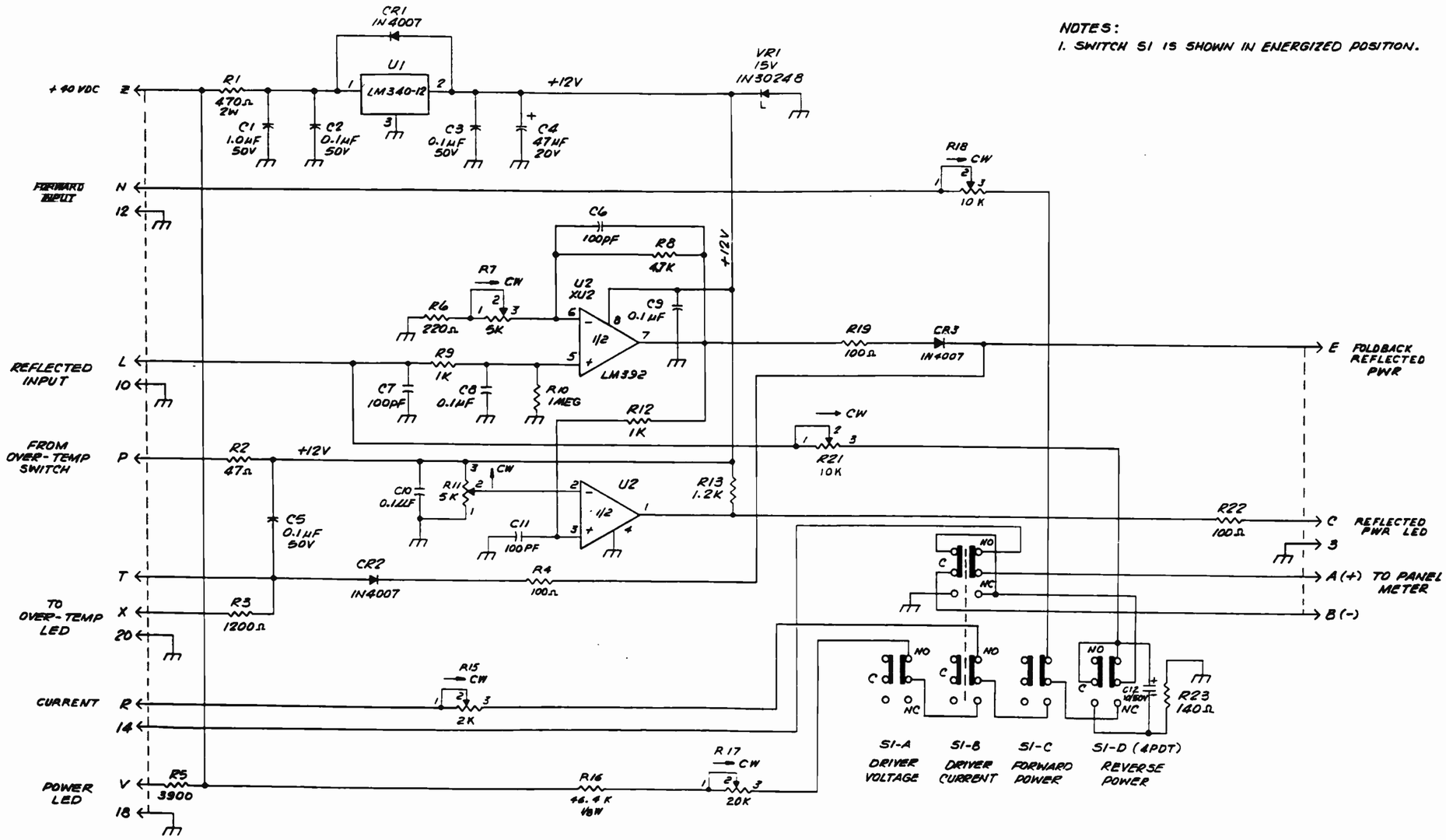


Figure 4-5. IPA Metering Card
4-9/4-10

4-3.2.3 IPA METERING PANEL (A27)

Refer to Figures 4-4 and 4-5 IPA metering schematic diagrams for the following discussion. The IPA metering panel permits measurement of driver current, IPA supply voltage, current, forward RF power, and reflected RF power. Additionally, the panel has three LED's which indicate power on, high VSWR, and IPA module fault. The module fault lamp lights when the module's internal protection circuitry shuts the module off. The metering panel printed circuit board contains all meter calibration pots, a voltage regulator (U1), an op amp/comparator (U2), and the metered parameter select switch (S1). The op amp amplifies the reflected power signal (U2-5) from the IPA directional coupler. This amplified signal (U2-7) is used to reduce (foldback) the exciter power output under high IPA load VSWR conditions. This signal is also compared to a reference voltage using the comparator of U2. When the reflected power signal (U2-3) exceeds the reference voltage (U2-2), U2-1 goes high, causing the VSWR LED to light. The metering circuitry is powered from the 45-Volt IPA supply through R1 and U1 on the card. U1 is a 12-Volt regulator.

4-3.3 RF POWER AMPLIFIER (A21)

The RF power amplifier is driven by the IPA through a matching network consisting of the COUPLING control (C1), the PA GRID TUNE control (C2), and L1,2,3(See Figure 4-2). Capacitor C3 and resistor R1 de-Q the power amplifier grid circuit and provide a more uniform impedance to the IPA under varying drive conditions. Inductor A18L14 and the distributed capacity of resistor A18R75 couple A18R75 to the cavity, forming a suppressor that dampens the higher order cavity resonances that can occur near the third harmonic of the output frequency. Cathode tuning (or peaking) capacitor A21C39 improves the bypass action at the operating frequency. Resistors A21R76 & A21R77 broaden the frequency response and minimize synchronous amplitude modulation products. Inductor A21L5 is the power amplifier grid bias feed choke.

The power amplifier is a plate tuned 4cx15000A tube that is operated Class C. The tube screen is grounded and the cathode is placed 750 Volts (nominal) below ground to provide screen bias, as shown in Figure 4-6. A fixed bias from the power amplifier bias power supply is applied to the control grid through terminal board A22TB8-19, resistor A22R37, and terminal board A22TB8-20. When an input signal is present, grid current flows and develops grid leak bias across resistors A18R35, A18R36 & A18R80. The increased negative potential on the grid causes the diode in the power amplifier 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 course tuned from 88 to 108 MHz by resonating an adjustable coaxial resonator, Figure 4-7. The resonator is the area between the tube shelf and the sliding shorting plane. Two motor-driven capacitors permit more precise tuning (capacitor A18C51) and loading (capacitor A18C50).

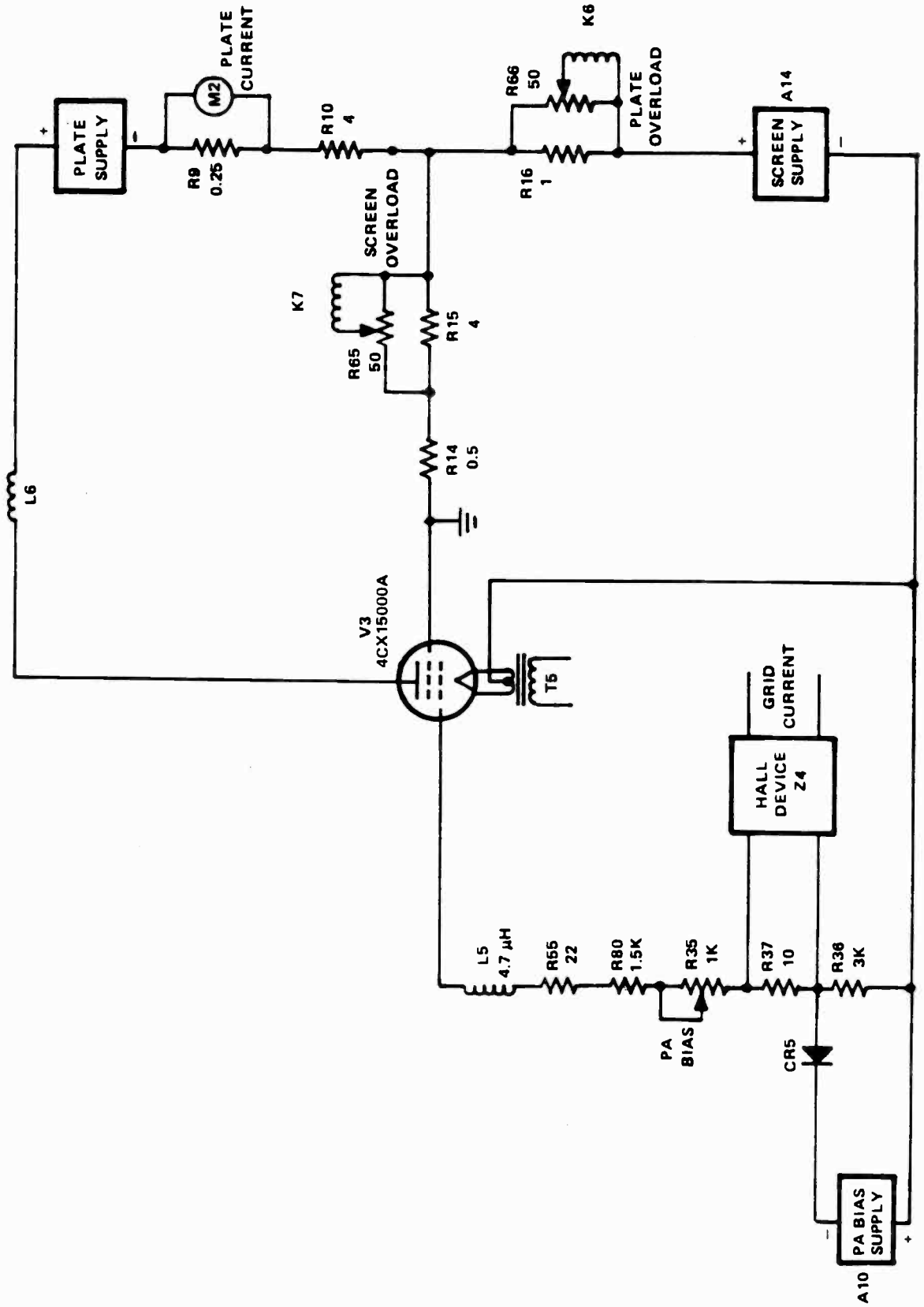


Figure 4-6. Power Amplifier DC Bias Circuitry Simplified Schematic

RAISE/LOWER switches S3 (PA TUNING) and S4 (PA LOADING) on control panel A1, control capacitor drive motors. The dc blocking capacitor A18C45 is located between the top of power amplifier tube and input to the air chimney. Figure 4-8 shows the electrical equivalence of the plate tuning circuit.

4-3.4 LOW-PASS FILTER A13

Low Pass filter A13 (Figures 6-1 & 6-11) consists of two coaxial filters in tandem. The first filter has a cutoff frequency of 130 MHz, while the second has a cutoff frequency of 300 MHz.

4-3.5 DIRECTIONAL COUPLER DC1

The directional coupler provides a proportional dc voltage to both the forward and reflected circuits of A3. The output of each is then routed to, and can be displayed on, the Forward/ Reflected Meter (M4). Also, a sample of forward power is routed from A3 to the A9 power control gating cards that control SCR's for the power amplifier plate HV supply.

4-4. POWER SUPPLIES AND POWER CONTROL CIRCUITS

4-4.1 GENERAL

There are five separate power supplies in the transmitter. Three of the five, the plate, screen and power amplifier bias power supplies provide voltages to the power amplifier. The IPA supply, furnishes voltage to the IPA stage. The 28-Volt dc power supply provides power to the control circuits.

4-4.2 28-VOLT DC POWER SUPPLY, P/O A10

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 T2 to 3-phase bridge rectifier assembly CR6. The 28-Volt dc output of the bridge is filtered by RC circuits and applied to the control circuits.

4-4.3 POWER AMPLIFIER BIAS POWER SUPPLY, P/O A10

The power amplifier 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 inductor L1 and capacitor C2.

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

4-4.4 PA PLATE POWER SUPPLY

The power amplifier 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 transformer 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 line voltage.

4-4.5 POWER CONTROL UNIT A9

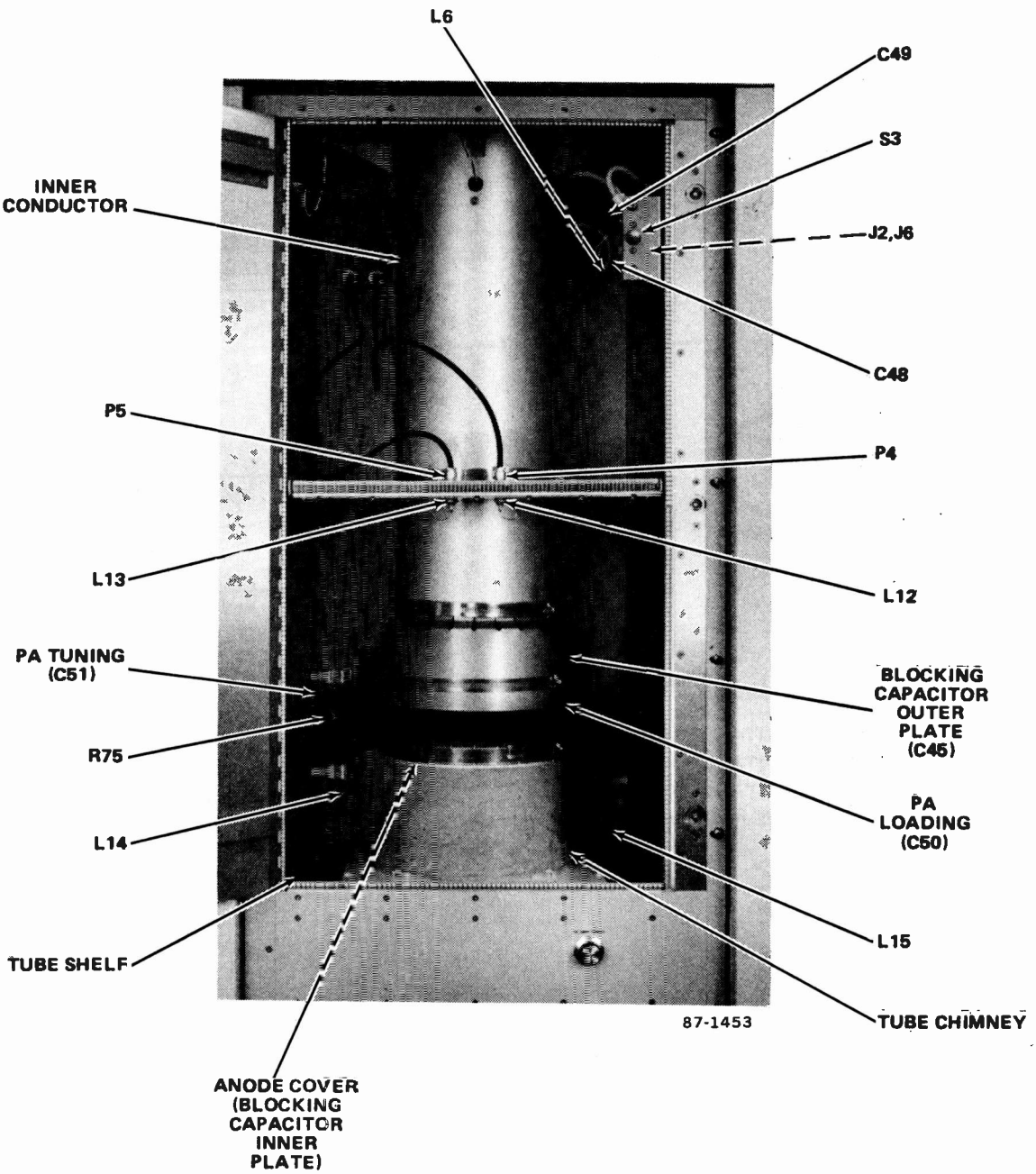
Power control unit A9 regulates the 3-phase ac power input to the power amplifier plate and the power amplifier screen transformer. Unit A9 consists of two major component assemblies - SCR assembly A9Z1 and firing control unit A9AR1. SCR assembly A9Z1 has three SCR pairs; one pair in series with each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

A common 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. Upon receipt of a PLATE OFF control signal, relay A9AR1K1 de-energizes disabling the three SCR gate driving cards shown in Figure 4-9.

4-4.6 POWER CONTROL REGULATOR A8

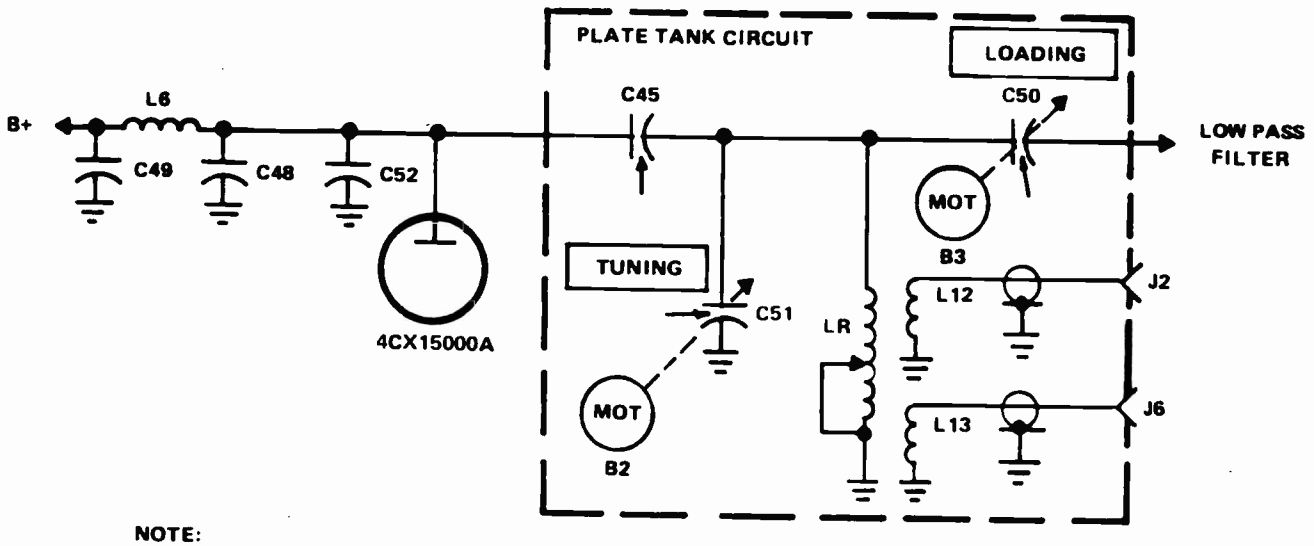
Power control regulator A8 provides the necessary control signals to operate power SCR control unit A9. A8 supplies a soft-start power amplifier plate supply turn-on signal, a negative voltage for manual power control, and amplifier mixer functions for automatic power control.

When the PLATE ON switch is pressed, +28 Volts dc is supplied to XA8-27. The +28 Volts activates transistor A8Q1 to turn on relay A19K12. Relay K12 in turn supplies 3-phase ac control power to resistor A9AR1. An RC time delay circuit formed by resistor A8R2 and capacitor 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, resistors R8 and R9, and capacitor C2 modify this signal to soft-start the high voltage power amplifier plate power supply. Zener regulator A8VR2 provides -10 Volts dc to MANUAL power adjust resistor A20R43.



PT1-8

Figure 4-7. Plate Cavity



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 4-8. FM Transmitter 816R-3B Output Network

When the MANUAL/AUTOMATIC switch is in AUTOMATIC position, transistors A8Q5 and A8Q4 amplify the automatic control signal from unit A3 and apply the signal to terminal board A9AR1TB2-1. Capacitor A8C5 and resistor 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 silicon 3-phase full-wave bridge rectifier assembly Z2 in the power amplifier 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.

4-4.8 IPA POWER SUPPLY, A28

The IPA power supply is a 3-phase full-wave type using a single section choke input filter. It nominally delivers 45 Volts at 25 Amps to its load which consists of the driver, IPA, and the metering panel. The supply's primary power is switched through relay A26K1 which is operated by the PLATE ON circuitry. The supply is protected through circuit breaker A6CB3.

4-4.9 FILAMENT VOLTAGE REGULATOR, A5

(See Schem. Diag. 159703 at the end of this Section)

When the Filament Regulator Card is in the automatic mode, the filament voltage regulator detects and compensates for sustained fluctuations in the input ac voltage. The fluctuations are detected by a true RMS detection circuit which in conjunction with associated circuitry, including motor control circuits, adjusts the setting of variable transformer A19A2T1. The output voltage of the variable transformer is then applied to the primary of power amplifier filament transformer A18T5. The variable transformer voltage is also applied to the primary of detector circuit transformer A20T8.

Voltage for the power supply circuits on the filament regulator board is derived from sampling transformer A20T8 via contacts 52 and 48 on the card edge connector. This ac voltage is rectified by diodes CR1-CR4 and applied to voltage dropping resistor R33. Capacitors C25 and C26 provide filtering, and zener diode CR5 provides a voltage drop to approximately 18 Volts. Three-terminal 15-Volt regulator U9 supplies voltage to the 15-Volt circuits with additional regulation provided by capacitors C27 and C28. Voltage dropping resistor R34 feeds three-terminal 5-Volt regulator U10 while capacitors C29 and C30 provide additional voltage regulation. LED DS5 indicates voltage present on the 5-Volt line which implies that the 15-Volt circuits are powered also. Negative supply voltage is provided via diodes CR1 and CR2 via resistor R3 and capacitor C24 to card edge connection 42 for distribution to other circuit cards in the transmitter. Fuse F1 is in series with the primary of transformer A20T8, and is located on the filament voltage regulator board.

A sample of the voltage feeding the power amplifier tube filament transformer is applied via transformer A20T8 through card edge connector 26. This ac signal is applied to RF filtering components inductor L1 and capacitor C14. L1 is a 4.7 uH inductor whose parallel resonance falls in the FM broadcast band providing a high impedance path for frequency modulated RF signals. Capacitor C14 is a 100 pF capacitor whose series resonance falls in the FM broadcast band providing a low impedance shunt path for frequency modulated RF signals. These filtering components are used in several locations in the filament regulator card, and provide the same filtering functions as described here.

The filament voltage sample signal is then applied to the RMS-to-dc converter circuit via voltage divider resistors R1 and R2, and through capacitor C15. This RMS-to-dc converter circuit is based around U7, an Analog Devices AD536A true RMS-to-dc Converter integrated circuit. The AD536A directly computes the true RMS of any complex input waveform containing ac components. It has crest factor compensation which allows very accurate measurements up to 300 kHz. The crest factor of a waveform is the ratio of the peak signal swing to the RMS value. Components C17, R17, R18, C18, R19, and C20 provide time constant and filtering functions for the AD536A.

Test point 3 (TP3) provides easy access to the dc voltage representation of the filament RMS voltage. During normal operation of the filament voltage regulator, resistor R2 is adjusted so the output of the RMS-to-dc converter circuit is 5.00 Volts dc when the filament voltage has been preset to the nominal value by the operator. The output voltage is then fed to window comparator composed of U8 (LM339) and related devices. The voltage references for the window comparator are provided by U11 (LH0070-0H), a very high precision 10-Volt regulator, and voltage divider components R20, R21, R22, and R23. In normal operation, resistor R20 is adjusted to provide 5.00 Volts at test point 2 (TP2). The reference voltages are then applied to their respective comparators. Pin 5 of U8 has 5.05 Volts applied, and pin 10 of U8 has 4.95 Volts applied. These voltages will be correct if resistor R20 has been properly adjusted for 5.00 Volts on test point 2 (TP2). The 5 mV voltage drops are provided by voltage divider resistors R21 and R22. This 10 mV total window provides a total $\pm$ 1% window for the voltage comparator, and hence for the voltage regulator circuitry.

If the voltage from the RMS-to-dc converter circuit is within the 4.95 - 5.05-Volt window, the outputs of the comparators will both be high and the output of AND gate (7408) U4C will go high illuminating green LED DS4 indicating proper filament voltage is present. If the voltage from the RMS-to-dc converter is not within the 4.95 - 5.05-Volt window, the circuit will then operate to make the necessary corrections if switch S2 is in the AUTO position.

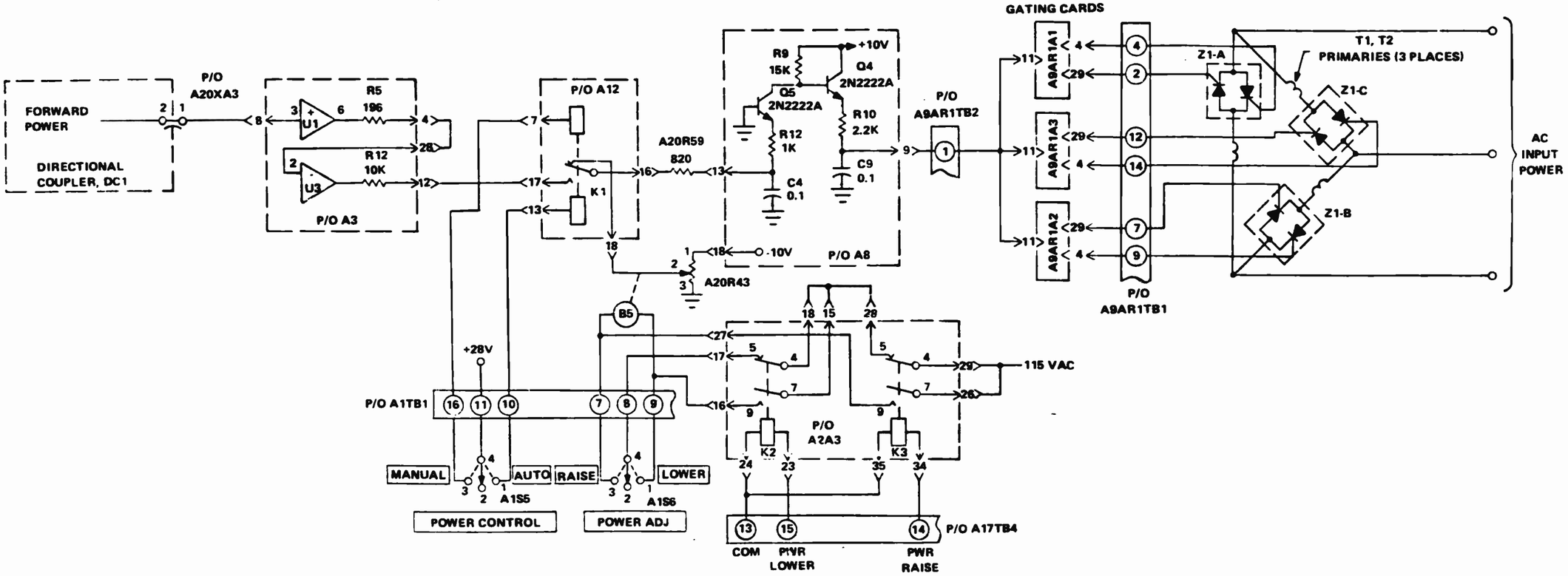


Figure 4-9. Power Control Circuits, Simplified Diagram

Assuming that switch S2 is in the AUTO position, if the filament voltage rises above +1% of the nominal value setting, the following actions are taken. The output of the 5.05-Volt comparator will go low at pin 2 of U8 causing the output of U4 to go low and DS4, the "LOCK" LED, will extinguish. U8 (7400) pin 11 will go high bringing pin 13, the input of U1 (7400), high. When either of the comparators goes low, indicting a correction is necessary, U2B, U2D, and U2C (7400) in combination act as an OR gate forcing pin 10 of U1 high which in turn triggers 555 timer U6. When U6 is timing, the output pin 3 goes high illuminating yellow LED DS1. At the same time, U1 output pin 3 goes low which takes the input pin 1 of U4A low. This output is fed through switch S1A to inputs U1 pin 9, U1 pin 12 and U2 pin 1 bringing them all low. Hence, while the 555 timer is in its timing state, the outputs of U1C, U1D, and U2A are all high, inhibiting the actuation of relays K1, K2, and K3 respectively. Once the 555 timer U6 has timed out, the inputs of U1C, U1D, and U2A fed from switch S1A are brought high. At this point if the filament voltage is still above the +1% nominal value, both inputs of U1 will be high providing an actuation of relay K1 and the clutch assembly on the filament voltage adjust variac motor. Simultaneously, both inputs of U1D will go high forcing the output (pin 11) to go low. The LOWER LED (DS2) will be illuminated and relay K2 will be activated which in turn actuates the lower winding in the motor driving the filament voltage control variac. Once the variac brings the filament voltage back inside the range of nominal operation, the comparator output of U8 (pin 2) will go high, and the above logic actions are reversed removing power from the filament voltage regulator variac motor.

The raise function operates just as the lower function described above, but instead activates the raise circuits. It may be noted that if future adjustments by the operator are required in the automatic mode, resistor A5R2 may be used as a simple filament voltage adjustment control.

The timing period of 555 timer U6 is provided to guard from constantly correcting momentary excursions in the filament voltage This timing period is adjustable from nearly no delay to approximately 12 seconds via resistor R7.

If automatic operation of the filament voltage regulator circuit is not desired, switch S1 can be put in the MAN (manual) position. This effectively takes the regulator out of the circuit, but the green LED "lock" indicator will still show if the filament voltage is within nominal range.

While in the manual mode, momentary switches S2 and S3 can be used to manually activate the clutch and raise or lower circuits respectively. Other than the timer not being active in this mode, these switches simulate the output of the comparators per the operators command, thus manually raising or lowering the filament voltage. This provides a convenient way to determine if most of the digital logic and the solid state relays are functioning properly should a problem occur.

U3A and U3B are provided to insure that the raise and lower functions are not activated simultaneously by circuit failure or accidentally by the operator using the manual control. While in the manual mode, the operator may depress both the raise and lower switches simultaneously and the only action to take place is the timing of U6 as noticed by the illumination of yellow LED DS1. This allows the operator a convenient way to set the time delay of U6 without effecting the other circuits.

Solid state relays K1, K2 and K3 provide a return for the ac voltages already on the windings of the clutch, and the lower and raise circuits of the variac drive motor. Relays K2 and K3 also have the return path for the ac voltages routed through microswitches S1 and S2 on the variac assembly. This provides a secondary measure against operating the filament voltage regulator outside of the prescribed range provided by the mechanical stops on the variac drive motor.

4-4.10 FILAMENT VOLTAGE DISTRIBUTION

The filament voltage distribution is shown in Figure 4-10. Filament voltage regulator A5 maintains a constant rms voltage on the filaments as discussed in paragraph 4-4.9.

4-5. PRIMARY POWER DISTRIBUTION CONTROL AND OVERLOAD CIRCUITS

4-5.1 PRIMARY POWER DISTRIBUTION

The 60 Hz, 3-phase primary power is distributed to the various circuits of the transmitter via circuit breakers and fuses mounted on circuit breaker panel A6, Figure 4-11. Circuit breaker A6CB5 is connected inside the delta of plate transformer T1. It also serves to interrupt primary power to the PA screen transformer T2 through associated circuit breaker, A6CB4. Circuit breaker A6CB3 controls power to driver power supply (IPA) transformer A28T1. Ac line voltage metering is provided by ac meter panel A25. In addition to the three phase-to-phase voltages, a fourth position of switch A25S1 is used to monitor the power amplifier filament voltage. BLOWERS circuit breaker A6CB2 controls application of primary power to cavity blower B1 through filament-on relay A19K2 and FAN fuses A6F7, F9, and F12. Relay A19K2 is energized when the filaments switch (S10) is turned on. Application of primary power to the filament circuits, the exciter, the power amplifier bias power supply, and the power amplifier 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 autotransformer A19A2T1. Relay A19K1 also controls application of power to 802A exciter A4, to power amplifier bias power supply, P/O A10, and to the power amplifier 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 power amplifier bias supply input power circuits are protected by associated fuses. These circuits receive power from the blowers circuit breaker, A6CB2.

4-5.2 TRANSMITTER TURN-ON

The transmitter is energized by pressing FILAMENT ON switch A1S10 on the A1 control panel, Figure 4-12. Relay A19K2 is energized and is applied to the blower motors. After sufficient air pressure is created in the power amplifier cabinet, air switch A18S1 is closed and relay A19K1 is energized.

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

The transmitter may also be energized by pressing the PLATE ON switch which latches relay A19K3, and energizes relay A19K2 through contacts 8 and 5. Pressing this single switch (PLATE ON) enables the transmitter to go through the above sequence of blower, filament, time delay and plate on.

4-5.3 EXCITER POWER CONTROL OVERRIDE

An output override voltage is supplied to the 802A exciter when the plate voltage is turned OFF. This mutes the output of the exciter while the power amplifier plate voltage is turned OFF (Figure 4-12). 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 FWD/REFL CALIBRATE AND AUTO POWER CONTROL UNIT, A3

4-5.4.1 FUNCTION

The A3, FWD/REFL CALIBRATE AND AUTO POWER CONTROL card performs these functions:

1. The forward power signal from the directional coupler is buffered and amplified to provide a panel power meter reading of 100% at the customer's specified TPO (Transmitter Power Output). Full scale meter indication is 120% in the FORWARD POWER position.

2. The forward power signal from the directional coupler is compared against either of two internal, adjustable voltages for automatic power control. Two discrete levels of power control are remotely selectable and maintain the desired power to within 1%.

3. The reflected power signal from the directional coupler is buffered and amplified to provide a full scale reading of 12% of the customer's specified TPO on the panel power meter in the REFLECTED POWER position.

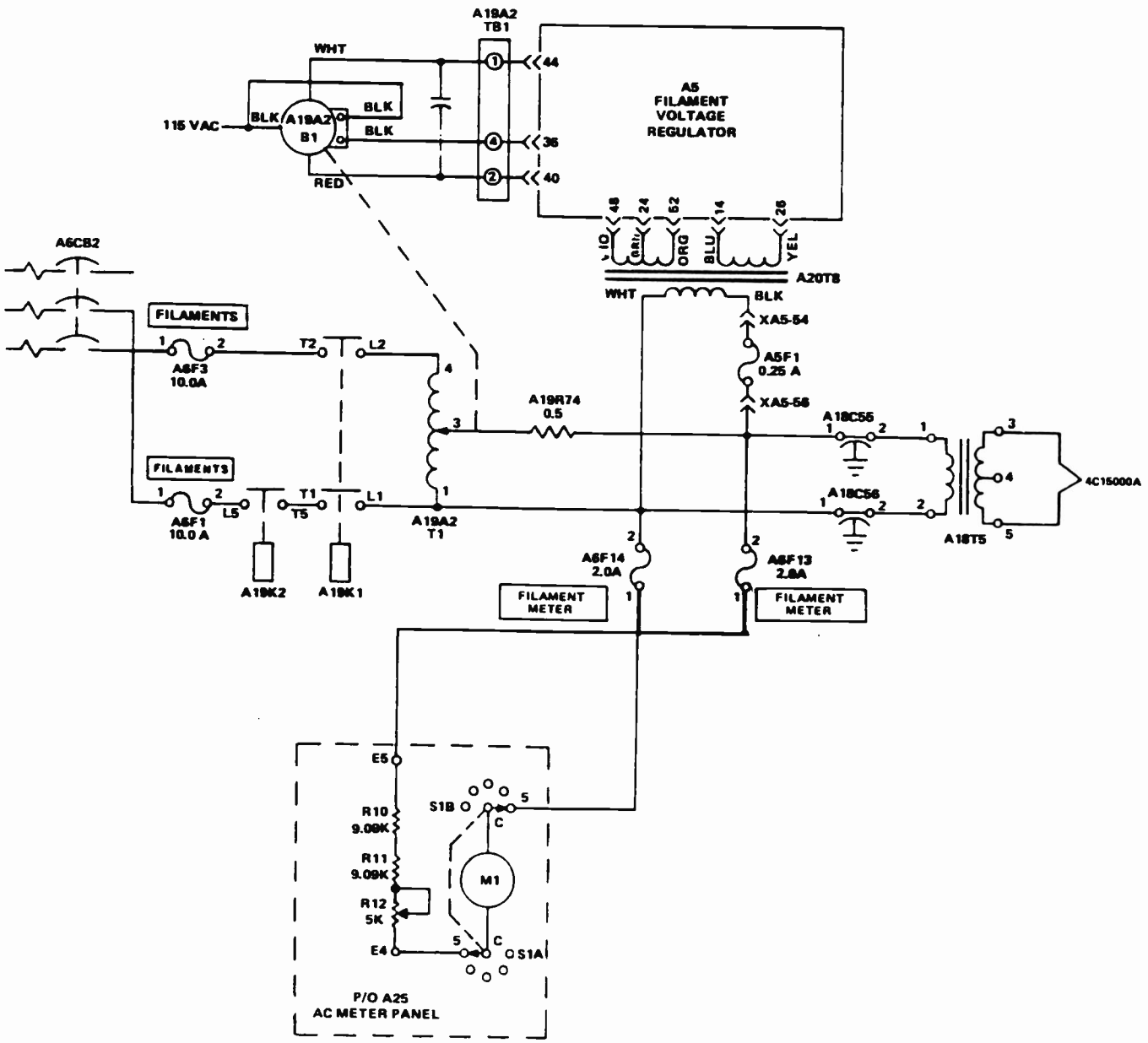


Figure 4-10. Filament Voltage Distribution

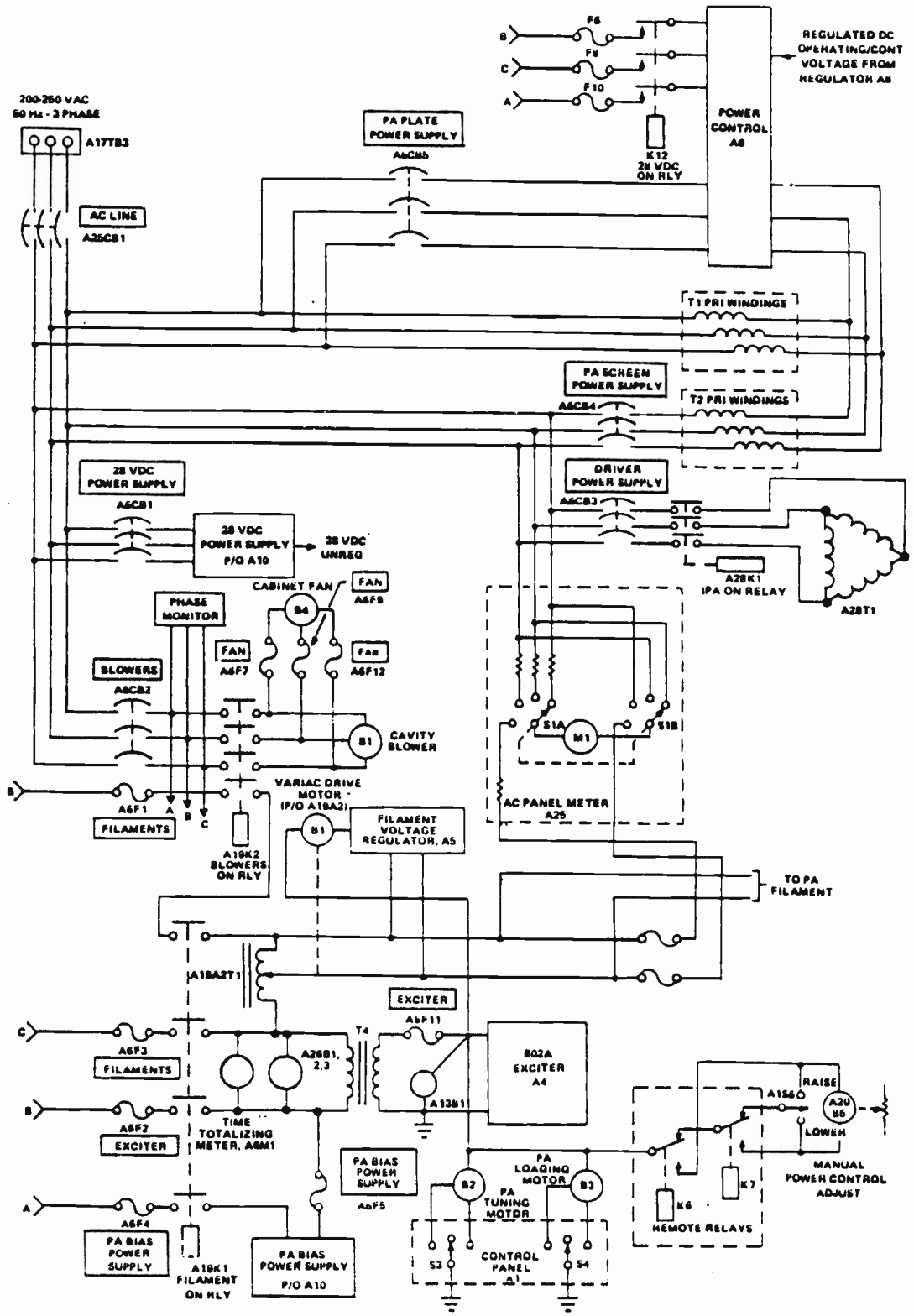


Figure 4-11. AC Power Distribution

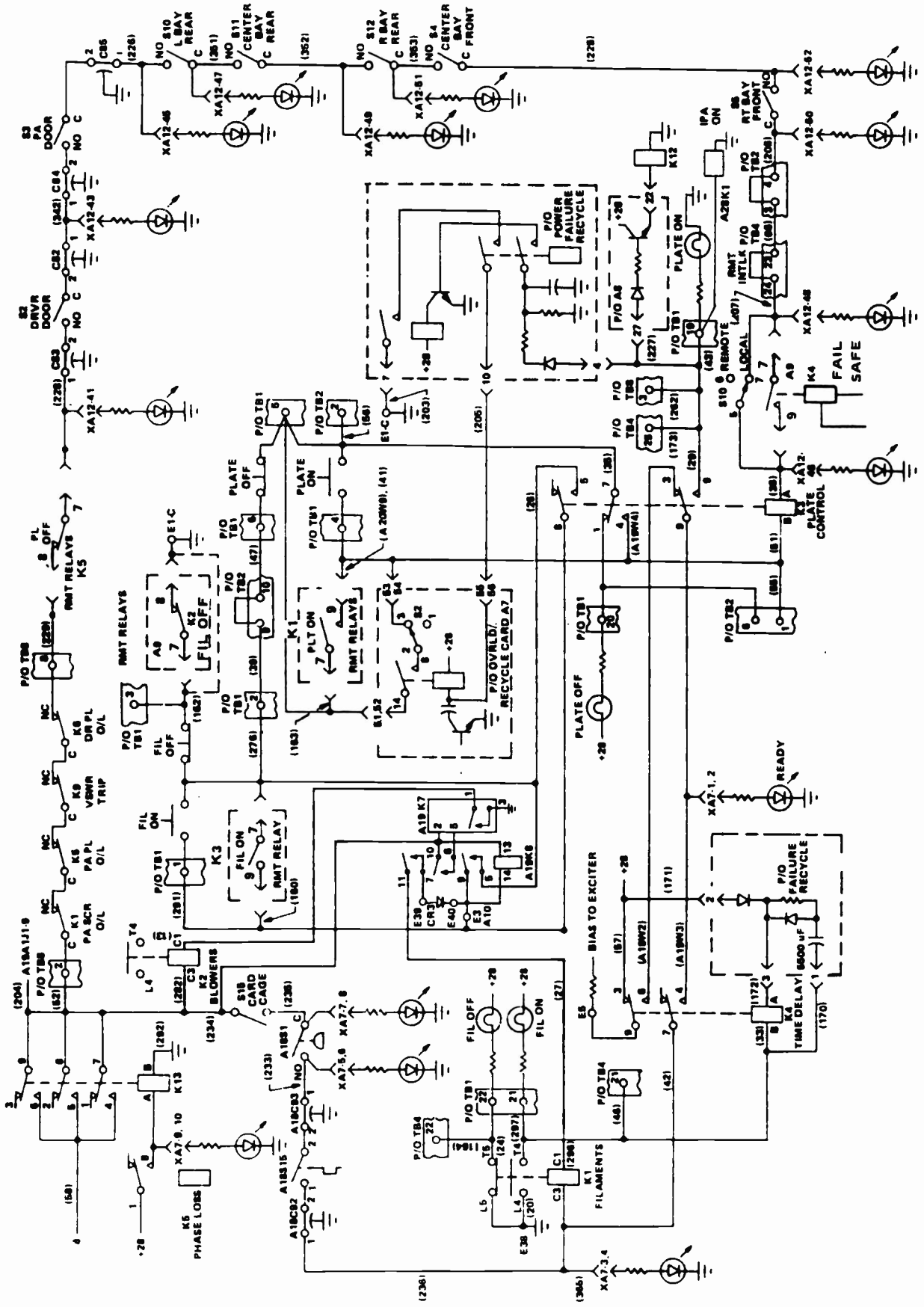


Figure 4-12. Interlock and Control Circuits

4. The reflected power signal from the directional coupler is compared against an internal limit to smoothly fold the forward power level back when a slowly rising VSWR level is detected. Forward power is reduced to keep the reflected power at 5-6% of the customer's specified TPO.

5. The reflected power signal from the directional coupler is compared to a second internal limit that can remove power from the transmitter and light the VSWR tally LED when a rapidly rising reflected power level greater than 10% of the customer's specified TPO is detected.

4-5.4.2 THEORY OF OPERATION

The forward power signal from the directional coupler, DC1, is amplified and buffered by U1. Resistor R25 is an offset null adjusted for zero output at TP1 when no input signal is present. Resistor R14 is adjusted to provide a 100% forward power indication on the panel power meter (A1M4) at the customer's specified TPO. The output of U1 is also present on terminal board A17TB4, terminal 34, through a 2.2K ohm isolation resistor, R13, to provide remote metering of forward power. The positive output of U1 is coupled through diode CR6 and compared at the inverting input of U3 against the negative voltage from either resistor R17 (Normal Power) or resistor R41 (Second Power) in the automatic mode. The output of U3 is used to raise or lower the transmitter plate voltage, as necessary, to maintain the selected power level. The input to U3 is switched from resistor R17 to resistor R41 by relay A3K1 which is activated by applying +28 Vdc to relay A3K1 coil through terminal board A17TB4, terminal 20. Normally, resistor R17 sets the normal operating TPO reference while resistor R41 is adjusted for some lower value, perhaps necessary during emergency operation with a generator unable to supply the full power load.

The reflected power signal from directional coupler DC1 is amplified and buffered by U2. Resistor R26 is an offset null adjustment for zero output at TP2 when no input signal is present. Resistor R24 is adjusted to cause a 10% reflected power indication on the panel power meter, A1M4, when the reflected power reaches 10% of the customer's specified TPO. Resistor R27 is adjusted to simulate that 10% reflected power level when the TEST switch, S2, is depressed. This allows testing of the VSWR protection and metering circuits. The output of U2 is fed through resistor R20 to the gate of the VSWR overload SCR, A7Q8, when the VSWR protect switch, S1, is in the ON position. Resistor R20 is adjusted to fire SCR A7Q8 when the reflected power reaches 10% of the customer's specified TPO. When SCR A7Q8 fires, VSWR overload relay A22K9 activates, removing power from the transmitter and illuminating the VSWR OVERLOAD LED. The output of U2 is also present on terminal board A17TB4, Terminal 33, through 2.2K ohm resistor R23 to provide remote metering of reflected power.

U6 and U7 form the VSWR foldback circuit. A sample of the buffered reflected power signal from U2 is fed to U6 through resistor R32. Resistor R33 is the offset null adjustment for U6 and is adjusted to give zero output at Pin 6 of U6 when no input signal is present. The output of U6 is coupled through diode CR4 to the automatic power comparator, U3. Resistor R32 sets the gain so that the output voltage of U6 will exceed that of U1 - causing the power to be reduced - when the reflected power exceeds 5-6% of the normal TPO. The VSWR foldback circuit is defeated by the circuitry of the ten second timer, U7. The timer is triggered by sampling the anode voltage of VSWR overload SCR, A7Q8. The response time of the VSWR foldback circuit is relatively slow. A sudden significant increase in VSWR - as in an arc - would cause the VSWR overload SCR to fire. Power to the transmitter is removed, the VSWR OVERLOAD LED is illuminated and the VSWR foldback circuit is disabled for ten seconds. The VSWR foldback circuit is disabled to allow the VSWR overload circuit to sample the VSWR at full power thereby preventing operation into a dangerously deficient load.

4-5.5 OVERLOAD PROTECTION

Relays A22K6, A22K7, and A22K9 are adjusted to energize and remove power from the transmitter when an overload occurs in the plate or screen supply or when the VSWR exceeds a preset level. Screen current through resistor A14R15 produces a voltage that is applied to relay A22K7 through resistor A22R65. Plate current through resistor A14R16 produces a voltage that is applied to relay A22K6 through resistor A22R66. When SCR A7Q8 is gated on, a ground is applied and relay 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 relay 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 or VSWR circuits, a 28-Volt dc 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, or A22K9. The 28-Volt pulse that triggers the SCR is simultaneously routed to the recycle circuit via diode CR10, CR11 or CR12 to be used to automatically restart the transmitter.

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

The auto recycle begins when the 28-Volt pulse is applied to the base of transistor Q1 causing it to conduct. The output of Q1 is fed to timers U1 and U4. Timer U1 provides a 0.5-second delay, then triggers timer U2 which generates a 0.5-second output pulse. This pulse is fed through gate U3A to inverter Q3 which causes Q9 to conduct and charge capacitor C16. The charging current of capacitor C16 momentarily energizes relay K1 which closes the PLATE ON circuit through switch S2. The charging current of capacitor C16 also flows through RECYCLE PULSE indicator LED 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 LED CR3 will light to indicate this condition. When the 30-second period of time U4 has elapsed, a pulse is generated, inverted by transistor Q2, and applied to U5 to reset it to zero. This clears the memory and allows another sequence to begin. If the maximum count of two or four pulses has not been received in the 30-second period, the timer will also reset the counter automatically.

AUTO-RECYCLE 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 circuit. The PHASE LOSS indicator LED CR14 is lighted when phase monitor relay A19K5 provides a 28-Volt signal indicating all three primary power phases are present, balanced, not too low and of the proper sequence. CARD CAGE INTLK indicator LED CR15 is lighted when the card cage cover is in place. AIR INTLK indicator LED CR16 is lighted when sufficient cooling air to the power amplifier tube is flowing. TEMP INTLK indicator LED CR17 is lighted when the power amplifier tube exhaust air temperature is at or above 240 degrees F $\pm$10 degrees F. The switch will reclose when the exhaust air returns to 200 $\pm$ 10 degrees F temperature operating range of the power amplifier tube.

The READY indicator is lighted when the 30-second filament warm-up time has expired and the transmitter is ready for the application of plate voltage. These indicators are in series and in sequence from top to bottom as they are connected in the circuit. Therefore, an interlock must be satisfied before its status indicator will light or any indicator that follows it will light.

4-5.7 POWER FAILURE RECYCLE BOARD A19A1

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

4-5.8 LATCHING RELAY AND STATUS INDICATOR BOARD A12

The latching relays permit local or remote selection of manual or automatic power control.

The latching relay is connected to the remote control panel through terminal board A17TB4, Figure 4-13. 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 LED CR17 indicates automatic power control is selected and MAN PWR CONTROL indicator LED CR18 indicates manual power control is selected.

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

Plate control circuit interlock status indicators are provided on the A12 board. RMT PLT OFF INTLK indicator LED CR5 is lighted when remote relay A2A9K5 is de-energized. PA GRID DOOR INTLK indicator LED CR6 is lighted when the PA grid compartment door is closed. PA DOOR INTLK indicator LED CR7 is lighted when the power amplifier plate compartment door is closed. L REAR PNL INTLK indicator LED CR8, C REAR PNL INTLK indicator LED CR9, R REAR PNL INTLK indicator LED CR10, C FR PNL INTLK indicator LED CR11 and R FR PNL INTLK indicator LED 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 LED CR13 is lighted when continuity exists between remote control interface terminal board terminals 23 and 24.

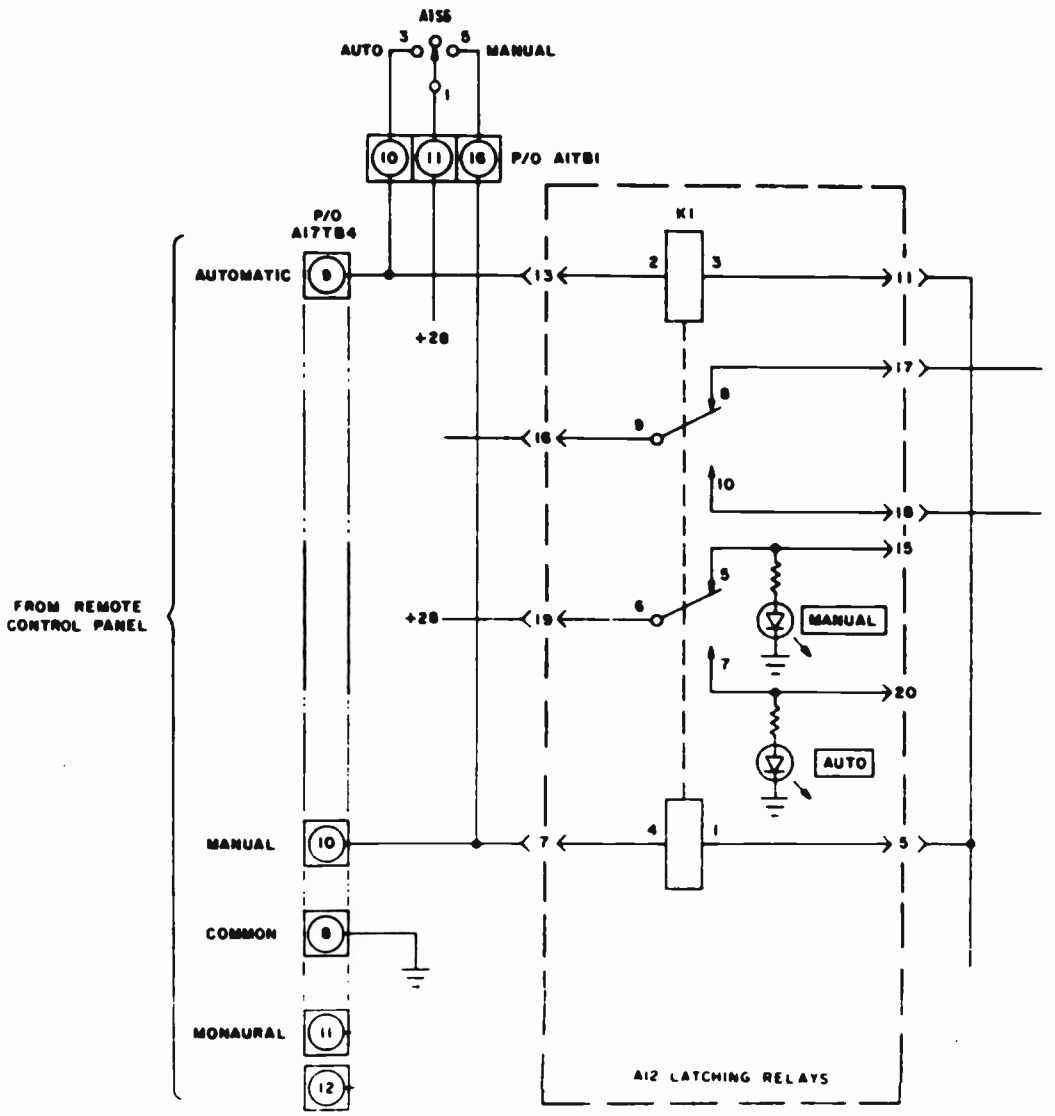


Figure 4-13. Latching Relays A12, Simplified Schematic

FAILSAFE INTLK indicator LED CR14 is lighted when remote relay A2A1K1 is energized. Indicator LEDs 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 LED will light, or any that follow it will light.

4-5.9 BLOWER OFF DELAY

A blower off delay circuit maintains power to the cooling blower after the transmitter is turned off for a set time delay of up to 3 minutes to allow the transmitter to cool down for component protection. Relays A19K7 and A19K8 are part of this circuit.

4-5.10 POWER CONTROL RELAYS P/O A9

Unit A9 provides remote manual power lower and raise control . When power is decreased at the remote control panel, relay A9K6 is energized, Figure 4-14. Closed contacts 7 and 9 provide 115 Vac to motor A20B5 which adjusts the resistance of resistor A20R43 to decrease the transmitter power output. When the power is increased at the remote control panel, relay A9K7 is energized and closed contacts 7 and 9 provide 115 Vac to motor A20B5 which adjusts the resistance of resistor A20R43 to increase the transmitter power output.

4-5.11 REMOTE RELAYS P/O A9

Remote relays in Unit A9 parallel the front panel control operations. All relays, except A9K4 and A3K1, and switches are momentary in operation. Failsafe relay A9K4 is energized only when +28 Volts dc is present in the control circuit. If the +28 Volts is lost, the relay de-energizes and removes plate power from the transmitter. Second power level (low power) relay A3K1 must also be energized continuously (+28V) to maintain this function.

4-5.12 REMOTE CONNECTIONS

Typical remote interconnections to remote control terminal board TB4 are given in Figure 4-15.

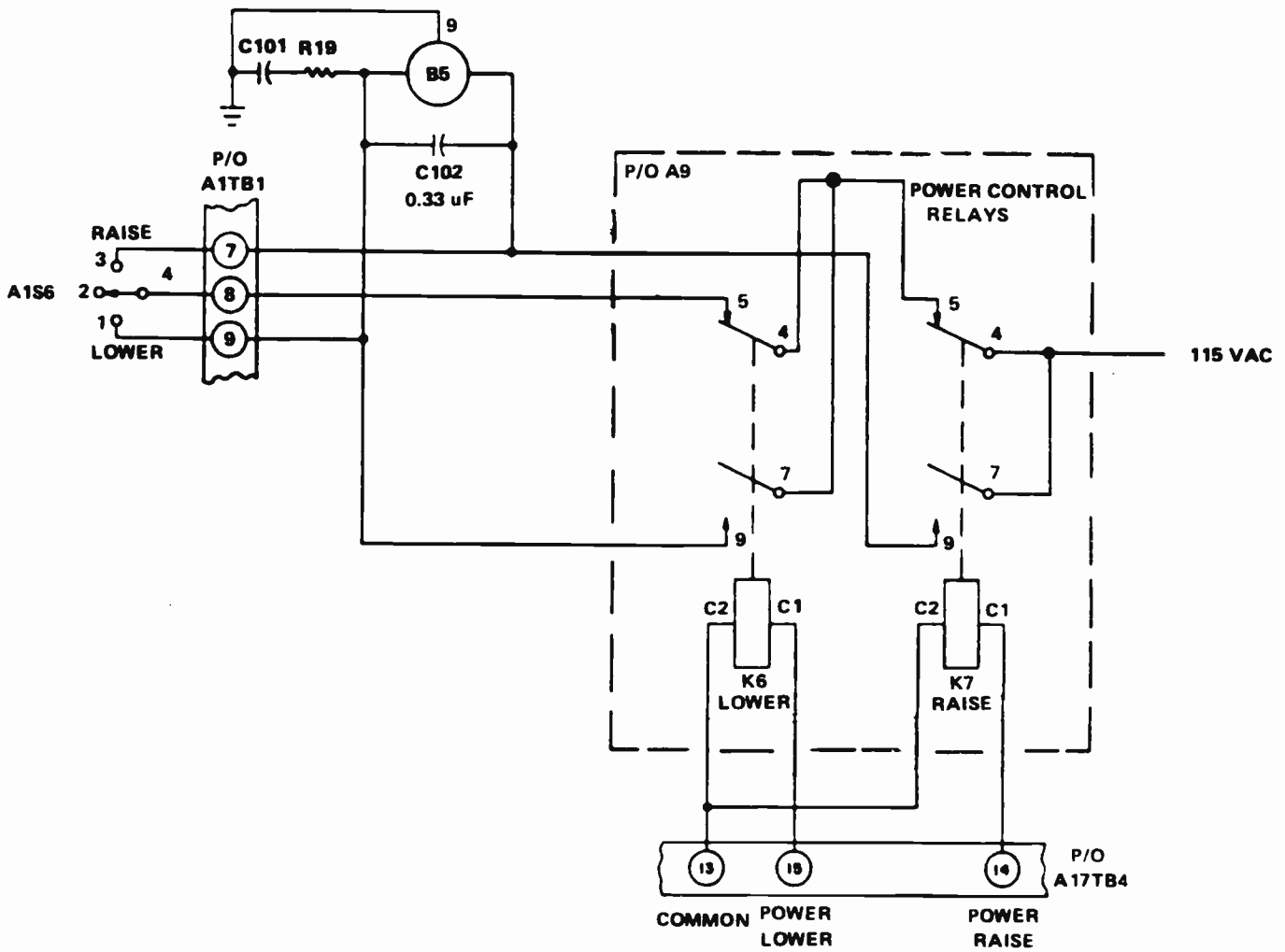
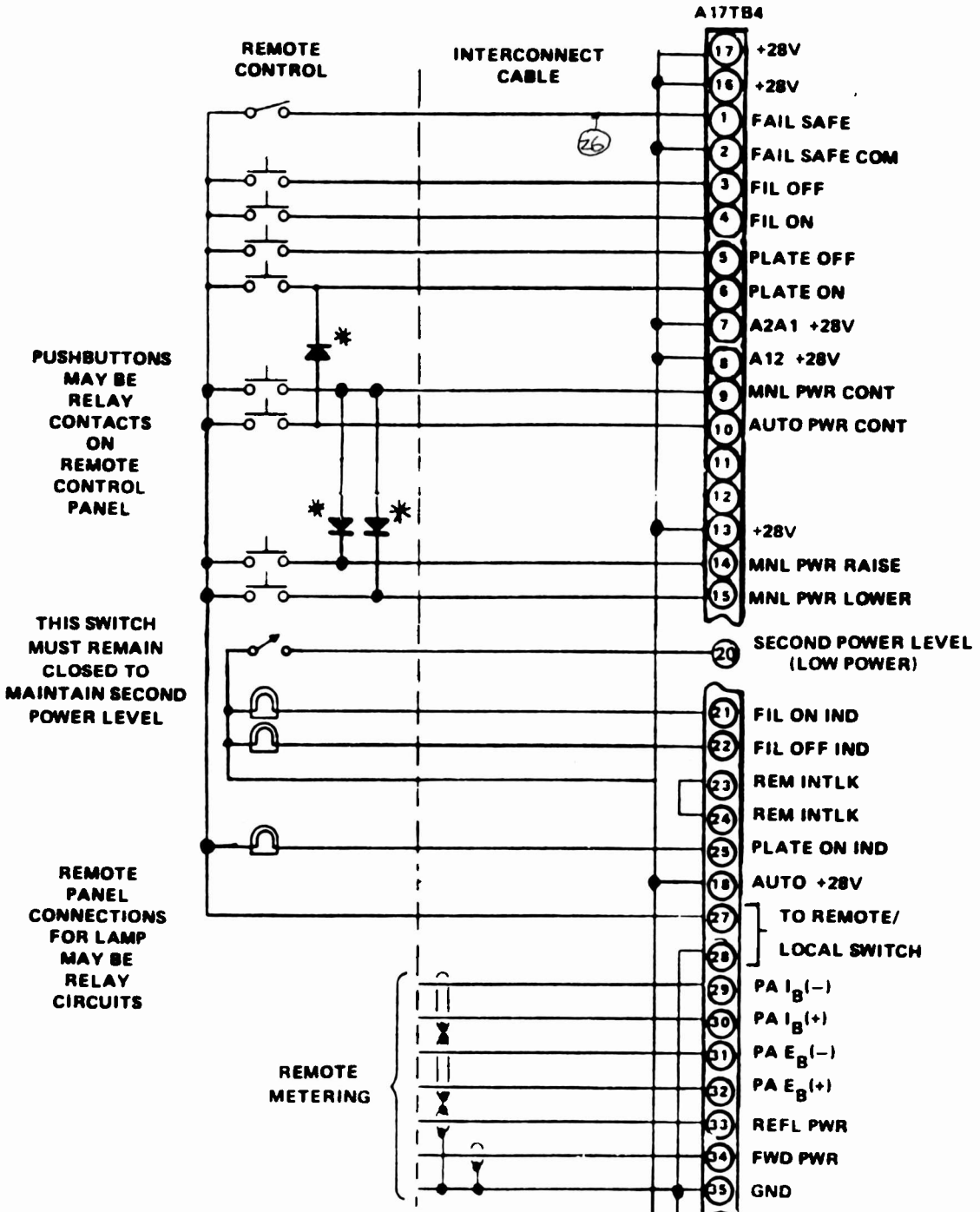


Figure 4-14. Power Control Relays P/O A9, Simplified Schematic



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

TYPICAL REMOTE CONTROL CHANNEL ASSIGNMENT

✱

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 WHEN EITHER THE MANUAL POWER RAISE OR MANUAL LOWER CONTROL IS ENERGIZED. ALL DIODES ARE 1N4007 OR EQUIVALENT (CE NO. 353-6442-070).

Figure 4-15. Remote Control Connections to Terminal Board A17TB4

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	REV PER ECN COM-0203	87-7-1	L. MADLEY

CR5
U9 MC7815CT
U10 MC7805CT
+15VDC
+5VDC
CR3 IN4007
CR1 IN4007
CR2 IN4007
CR4 IN4007
R33 100Ω 6.5W
R34 68Ω,1W
R4 330Ω
DS5 YELLOW
C25 1000μF
C26 0.1μF
C27 0.1μF
C28 100μF
C29 0.1μF
C30 100μF
52
42
48
R3 330Ω 1W
C24 100μF
AUTO
MAN
9 SIA
+5VDC
C7 0.1μF
C9 0.1μF
U1 XU1
U4, XU4
R8 1K
R6 4.7K
U6, XU6
555
C5 0.1μF
C6 0.1μF
C4 220μF
R7 50K
R5 1K
R9 330Ω
DS1 YELLOW
C8 0.1μF
U3, XU3
U3 7400
U1
CLUTCH
K1, XK1
R12 330Ω
L2 4.7μH
C11 100pF
RV2 AC GND
36
K2, XK2
R14 330Ω
L3 4.7μH
C12 100pF
RV3 AC GND
40
38
K3, XK3
R16 330Ω
L4 4.7μH
C13 100pF
RV4 AC GND
44
46
DS2 RED
LOWER
R13 330Ω
C10 0.1μF
U2 XU2
DS3 RED
RAISE
R15 330Ω
R10 390Ω
R11 390Ω
U2 7400
S2 LOWER
S3 RAISE
SIB AUTO
SIC AUTO
MAN
NO
NC
L1 4.7μH
R1 2.2K ½W
RV1
C14 100pF
AC GND
R2 5K
C15 1μF
C16 1μF
U7, XU7 AD536A
C19 0.1μF
R18 20K
C20 0.1μF
R19 10K
R17 22K
C17 2.2μF
C18 2.2μF
TP3
TP2
C21 0.1μF
C31 100pF
C22 0.1μF
C32 100pF
U11 LH0070-0H
IN
OUT
R20 50K
C23 0.1μF
R21 100Ω 1%
R22 100Ω 1%
R23 10K
R24 10K
R25 10K
R26 10K
R27 10K
U8 XU8
R28 2.2M
R29 2.2M
R30 1K
R31 1K
U4 7408
R32 330
DS4 GREEN
TP1
10
12
14
24
F1
1A
56
54
U4
U1
U4
U4

ITEM	ZONE	PART OR IDENTIFYING NO	DWG SIZE	NOMENCLATURE OR DESCRIPTION	CODE IDENT	QTY REQD PER DASH NO
				LIST OF MATERIAL OR PARTS LIST		

159702		9053	
NEXT ASSY	DWG SIZE	USED ON	

UNLESS OTHERWISE SPECIFIED
TOLERANCE ON FRAC
2 PLACE DEC 3 PLACE DEC ANGLES
MACHINED SURFACE FINISH 125
ALL DIMENSIONS ARE IN AND INCLUDE APPLIED FINISH
REMOVE ALL BURRS AND SHARP EDGES

DRAWN	James Ivey	DATE 87-5-12
CHECKED		
MECH DSGN		
ELEC ENGR	L HA	
APPROVED		

Continental Electronics
a Division of Varian Associates, Inc.
P.O. BOX 270070 DALLAS, TEXAS 75227 (214) 381-7161

SCHEMATIC DIAGRAM, FILAMENT REGULATOR

SIZE	CODE IDENT NO	
D	52151	159703
SCALE ~	WT ~	SHEET 1 OF 1

159703 B

VC FORM 387B

SECTION 5 - MAINTENANCE

5-1. ROUTINE MAINTENANCE

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 of trichlorethylene may be used as a cleaning material.

5-2.1 GENERAL CLEANING PROCEDURES

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

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

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

5-2.2 AIR FILTER

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

1. Remove the cross-wire brace that holds the filter in place.
2. Remove the filter.
3. Use a vacuum cleaner to remove heavy dust accumulation from the filter.
4. Blow a stream of air through the filter in a direction opposite to normal air flow.
5. Wash the filter in a solution of hot water and detergent.
6. Replace the filter when dry.

5-2.3 TUBE CLEANING

The power amplifier tube should be cleaned when a visible quantity of dust accumulates on the cooling fins of the tube. Carefully remove the tube from the socket and clean with a dry, oil free jet of air.

5-3. INSPECTION

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

5-4. LUBRICATION

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

5-5. PARTS REPLACEMENT

The following paragraphs present general descriptions for the removal and replacement of certain component parts.

5-5.1 4CX15000A PA TUBE

1. Remove air guides (tube chimney) between the PA blocker and the cabinet base. Loosen the two bands (top and bottom only, never loosen the center band) on PA blocking capacitor and slide it down over the PA tube.

2. Remove the anode lead.

3. Carefully lift the tube and PA blocking capacitor out of its socket, using care to not bend or break the socket's finger contacts. They are fragile!

4. Reverse the procedure to replace the tube.

5-5.2 CONTROL PANEL INDICATOR LAMPS

1. Pull the switch out and rotate it 90 degrees ccw; the lamp assembly should pop out.

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

3. Insert a new bulb and replace the assembly.

5-5.3 FUSE REPLACEMENT

Turn AC line breaker off before removing or installing fuses.

5-6. 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 Tables 3-4 and 3-5. Efficiency graphs are provided in Figure 3-8.

5-6.1 ACCESS PANEL INTERLOCK SWITCH

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

5-6.2 TEST EQUIPMENT

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

TABLE 5-1. REQUIRED TEST EQUIPMENT

NAME	DESCRIPTION	MANUFACTURER AND MODEL
Volt-ohm-milliammeter	Test Meter	Triplett 630-N
AC Voltmeter	0 to 10 volts, 1% to1	Weston 433 (true RMS)
Power Supply	0 to 28 volts DC, 6 amps	
RF Wattmeter	2.5kW and 25kW elements, 50 to 125 MHz	Bird Thruline (or equivalent)
Thruline	0-1kW element, 0-100 W Wattmeter	Bird 43 (or equivalent)
DC Voltmeter	0 to 10 kV, 1% tol	
DC Ammeter	0 to 5 amperes, 1% tol	

5-7. 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 28V supply breaker and ac line breaker are ON.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.

5-7.1 SWITCH ADJUSTMENTS

5-7.1.1 AIR INTERLOCK SWITCH S1

1. Press the PLATE OFF and FILAMENT ON switches on control panel A1.
2. Remove the rear panel behind the plate cavity.
3. Adjust the tension bolt on switch S1 so that the green filament light goes out when the PA grid compartment door is opened approximately 1 inch.

5-7.1.2 TUNING MOTOR LIMIT SWITCHES S11, S12, S13, AND S14

1. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.
2. Remove the rear panel behind the plate cavity, or the side panel next to the cavity.

3. Loosen the mounting screws on the limit switch.

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

5-7.2 FILAMENT VOLTAGE ADJUSTMENT

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

2. Open the power amplifier grid compartment and connect a 0 - 10 Volt true RMS ac one percent meter to the power amplifier filament rings on the tube socket.

3. Run the meter leads out the corner of the compartment and close the power amplifier compartment door.

4. Remove the cover from the control circuits card cage and pull the plunger on the card cage interlock all the way out. Turn main circuit breaker A25CB1 OFF.

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.

5. Loosen motor coupling set screws on variable transformer A19A2T1 (Right side panel) end of coupling, and turn the main circuit breaker ON.

6. With A5S1 (Filament Regulator Card) in MANUAL position, run variable transformer drive motor until limit switch actuator arm is against the upper (CW) limit switch.

7. Press FILAMENT ON switch on control panel A1.

8. Adjust variable transformer A19A2T1 with an insulated rod for an indication of 6.4 Volts ac. Note the filament meter reading - if filament meter does not agree with calibration meter, adjust A20A1R1 (Filament Meter Calibration) until it does.

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

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

11. Place switch A5S1 (Filament Regulator Card) in MANUAL position.

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

13. Using the RAISE or LOWER switches on the filament regulator card adjust the filament voltage to the desired voltage indicated on the true rms voltmeter.

14. Check the comparator window voltage on the filament regulator card. It should be preset to 5.00 Volts. If it is not, adjust resistor R20 observing the voltage on BLUE test point 2 (TP2) and adjust for 5.00 Volts. Once this voltage is set, it should not need be reset unless a component change is made.

15. Adjust resistor R2 for 5.00 Volts by observing the voltage on RED test point 3 (TP3). At this point the GREEN "LOCK" LED DS4 should illuminate.

16. To adjust the timer, while still in the MANUAL position of switch S1, push both RAISE and LOWER switches (SW3 and SW2) simultaneously and notice how long the timer yellow indicator LED DS1 stays illuminated before it extinguishes. Normally this delay is set at the factory for 5 seconds. This prevents momentary changes in the power line voltage from constantly effecting a correction. To increase time delay adjust resistor R7 CCW, to decrease time delay adjust resistor R7 CW. Repeating the above will verify your action. The range of the time delay is approximately 0 - 12 seconds.

17. Once the above adjustments are made, activate the automatic mode of filament voltage regulation by placing switch S1 in the AUTO position. RAISE and LOWER switches S3 and S2 only operate in the MAN (manual) mode of operation.

18. The life of the PA tube can be greatly enhanced by using the filament voltage management program described in EIMAC Application Bulletin AB-18. A reprint of this bulletin titled "Extending Transmitter Tube Life" is included in this manual under the Tube Data Sheet tab.

5-7.3 DC OVERLOAD ADJUSTMENT

1. 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.

2. Remove the front panel beneath the PA grid compartment door.

PA PLATE OVERLOAD ADJUSTMENT

3. Connect an ammeter from the positive terminal of an adjustable 28-Volt dc power supply to resistor A14R15-1.

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

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

6. If overload does not occur, then adjust PA PLATE OVLD ADJ resistor 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.) If overload trip occurs at less than 4.5A, adjust resistor A22R66 to raise trip point to 4.5A.

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

PA SCREEN OVERLOAD ADJUSTMENT

8. Connect a milliammeter from the positive terminal of an adjustable 28-Volt dc power supply to terminal board TB8-5.

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

10. Raise the power supply current to 800 mA.

11. If overload does not occur, then adjust PA SCREEN OVLD ADJ resistor A22R65 to trip relay A22K7 at this current. (The PA SCRN O/L fault indicator LED on A7 lights when the relay trips.) If over load trip occurs at less than 800 mA, adjust resistor A22R65 to raise trip point to 800 mA.

12. Disconnect the milliameter and remove the jumper from the dc power supply to terminal board TB8-4.

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

5-7.4 PA GRID CURRENT

1. 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.

2. Remove the front panel beneath the PA grid compartment door.

3. Connect the negative terminal of an adjustable 28-Volt dc power supply to A22E78 and the positive terminal to A22E77.

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

5. Set the TEST METER selector switch to PA GRID 400 mA.

6. Adjust PA GRID MTRG CAL CONTROL resistor A22R72 for a 400 mA reading on the test meter.

7. Remove the dc power supply test leads.

5-7.5 HIGH VOLTAGE POWER SUPPLY 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.

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

2. Press the MUTE button on the exciter.

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

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

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

6. Press the PLATE OFF and FILAMENT OFF switches on control panel A1 and Mute on the exciter.

7. Replace all panels and close all compartment doors.

5-7.6 IPA METERING BOARD CALIBRATION

1. General.

Press the PLATE OFF switch and remove the four screws holding the IPA meter panel to the front of the transmitter to gain access to the metering circuit board. Preset resistor R7 to maximum CCW and resistor R11 to maximum CW. Also preset the two pots inside the IPA directional coupler, A26DC1, by prying off the two hole plugs which cover them. Turn the pot nearest the IPA module, A26AR2, to maximum CCW and the other pot to maximum CW. Replace the hole plugs.

2. IPA Voltage

Connect a voltmeter across the supply terminals of the IPA module. Push the PLATE ON switch and adjust resistor R17 until the correct voltage is indicated on the IPA panel meter when IPA voltage is selected. Press the PLATE OFF switch.

3. IPA Current

Connect a dc ammeter in series with the positive supply line to the IPA module and press the PLATE ON switch. Adjust resistor R15 until the correct current is indicated on the IPA panel meter when IPA current is selected. Press the PLATE OFF switch.

4. IPA Forward Power Calibration

Connect a 50 ohm, 500 Watt dummy load and a directional wattmeter (minimum full scale range of 500 Watts forward power, 100 Watts reflected) to the load side of the IPA directional coupler (A26DC1). Press the PLATE ON switch and note the IPA current. Remove the four screws holding the exciter to the front of the transmitter and pull the exciter out enough to reach the power set control on the top of the exciter. Adjust the exciter power set control (exciter power output must not exceed 15 Watts) for 500 Watts forward power as indicated on the wattmeter attached to the dummy load. Now adjust resistor R18 until the IPA panel meter indicates 500 Watts when forward power is selected.

5. IPA Reflected Power Calibration

Adjust the exciter power set control for 100 Watts forward power as indicated on the wattmeter attached to the dummy load. Press the PLATE OFF switch and take the directional coupler (A26DC1) out of the line and reinstall it so that power is flowing through it in the opposite direction. Adjust resistor R21 until the IPA panel meter indicates 100 Watts when reflected power is selected.

6. IPA High VSWR Foldback

With directional coupler (A26DC1) connected as above, adjust Resistor R7 to the point where forward power just starts to decrease, as indicated on the wattmeter attached to the dummy load.

7. IPA High VSWR Indicator

With directional coupler (A26DC1) connected as above, adjust the exciter power set control for 90 Watts reflected power, as indicated on the IPA front panel meter, and adjust resistor R11 to the point where the VSWR lamp just starts to light. Press the PLATE OFF switch and restore the directional coupler (A26DC1) to its original direction. Press the PLATE ON switch and adjust the exciter power set control to return the IPA current to its previously recorded value. Press the PLATE OFF switch and reconnect the IPA to the PA cavity.

5-7.7 A3 FWD/REFL CAL AND POWER CONTROL CARD ALIGNMENT PROCEDURE

NOTE

Routine maintenance is not required and will be necessary only if major part damage has occurred. Adequate test equipment is required for proper, accurate alignment.

A. Offset Nulls

1. Place the A3 card on the extender board. Turn ON only the transmitter filaments and allow the components to temperature stabilize for at least fifteen minutes.

2. Use a high impedance dc voltmeter to measure the voltage at test point TP1. Adjust resistor R25, FWD OFFSET, set for zero voltage at test point TP1.

3. Use a high impedance dc voltmeter to measure the voltage at test point TP2. Adjust resistor R26, REFL OFFSET, for zero voltage at test point TP2.

4. Use a high impedance dc voltmeter to measure the voltage at pin 6 of U7, most easily accessible at either end of resistor R37. Adjust resistor R33, OFFSET ADJUST, for zero voltage at pin 6 of U7.

B. Forward Power Calibration

1. Adjust the transmitter to normal power output using the manual power control. An indirect power calculation may be used if an external power meter is not available.

2. Adjust resistor R14, FWD CAL, to indicate 100% on the output power meter, A1M4. DO NOT ADJUST THIS CONTROL AGAIN. Increase the power control to maximum output power. Refer to the test data for proper plate screen and driver transformer taps if the maximum power output exceeds 105%. The maximum power should not exceed 105% unless unusual circumstances exist.

3. Switch to AUTO power control and adjust resistor R7, PWR CNTRL ADJ for 100% power in the AUTO mode.

4. Apply +28 Vdc to terminal board A17TB4, terminal 20, to activate relay A3K1.

5. Adjust resistor R41, LP ADJUST, to the desired second power level.

C. Reflected Power and VSWR Protection Calibration

1. Remove transmitter primary supply. Remove the Thyrector Protection Assembly, VR1, from across the high voltage filter reactor, L1, to prevent damage to the thyrectors. Restore transmitter primary supply.

2. Use the manual power control to reduce the power output to 10% of the desired operating TPO.

3. Turn the VSWR PROT switch, S1, OFF and reverse the direction of the top element in the directional coupler, DC1.

NOTE

Reflected Power (VSWR) trip point is factory adjusted to 10% of rated transmitter power or 10% of TPO if factory is advised of TPO. This level may not be desired and must be set by station engineer to the desired safe level.

4. Adjust resistor R24, REFL CAL, to indicate 10% reflected power. Full scale is 12% when reflected power is selected. DO NOT ADJUST THIS CONTROL AGAIN.

5. With plates OFF, depress TEST switch, S2, and adjust resistor R27, REFL ADJ, for desired reflected (VSWR) level indication on panel power meter, A1M4. Full scale is 12%. Nuisance trips may occur if the trip level is set for less than 5%.

6. Turn VSWR PROT switch, S1, ON and adjust resistor R20, VSWR PROT CAL,until a VSWR Overload occurs.

7. Remove all voltage, return the top element and VSWR PROT switch to normal. Reconnect the High Voltage Filter Reactor Thyrector Assembly, VR1, and return the transmitter to normal operation.

D. VSWR Foldback Adjustment

1. Turn VSWR PROT switch, S1, OFF and switch to AUTO power control. (Resistor A3A1R32 should be max CCW).

2. Turn on plate voltage in the AUTO power mode.

3. Set FWD/RFL switch to RFL power position.

4. Depress switch A3S2 and adjust resistor A3R27 for 5 to 6 percent reading on RFL power meter (12% FS).

5. Set FWD/RFL switch to FWD position (reading should be at or near 100%) and while holding switch A3S2 closed adjust resistor A3A1R32 to a point where FWD power just begins to reduce.

NOTE

This threshold may be quite abrupt. Adjust resistor A3A1R32 to the threshold of FWD Power Reduction.

6. Turn transmitter OFF and return VSWR PROT switch S1 to ON.

5-7.8 PHASE MONITOR ADJUSTMENT

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. DEATH ON CONTACT MAY OCCUR IF EXTREME CARE IS NOT USED IN PERFORMING THE FOLLOWING PROCEDURES.

1. Remove primary power and the right front bay access panel.

2. Block the interlock grounding switch open.

NOTE

The phase loss/phase rotation monitor will shut the transmitter off when phase loss or incorrect sequence is detected. A phase loss will be detected if the line voltage drops below the threshold voltage level which is set by turning the control on relay K5. The threshold voltage range is 190-270V, and it must be set below your lowest expected line voltage. To accomplish this, the line voltage should be at the lowest expected level when performing the following adjustment.

3. Restore primary power.

4. Increase the phase loss threshold voltage by turning the control on relay K5 clockwise until the LED on relay K5 goes out. Turn the control counterclockwise slightly past the point where the LED comes back on.

5. Remove primary power.

6. Remove block from interlock/grounding switch.

7. Replace access panel.

5-7.9 BLOWER OFF DELAY ADJUSTMENT

1. Shut off the main ac line circuit breaker, A25CB1.

2. Remove the right front bay access panel.

3. Set the control on relay A19K6 (near Phase Monitor Module A19K5) for a minimum of 1 minute. It can be set for up to 3 minutes of turn-off delay.

4. Replace the access panel.

5-8. CHANGING POWER

The power output is changed by changing taps on the screen transformer T2. The PA plate voltage is maintained high (8.3 to 8.5 kV) to keep efficiency high. Using the data supplied in Section 3.0 as a guide, Tables 3-4 and 3-5, and Screen Voltage Transformer Tap Schedule, Tables 2-2 and 2-4, adjust the screen voltage to obtain the desired output power. To complete the power change, refer to paragraphs 5-7.7, 5-9.3, and 3.3, step 25.

5-9. CHANGING FREQUENCY

NOTE

If power and frequency are to be changed, refer to Power Change, Paragraph 5-8, and change transformer taps as directed, then return to this paragraph to complete the frequency change procedure. 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 3-3 steps 19 thru 24) 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 5-9.2, steps 1 thru 10. If the operating frequency is different from the frequency specified in the production test data supplied with the transmitter, perform the procedures in paragraphs 5-9.1 thru 5-9.3.

NOTE

The data presented in the graphs (Figures 5-1, 5-2 and 5-3) is approximate and is intended only to get the transmitter tuning "in the ballpark".

5-9.1 SHORTING PLANE, PA NEUTRALIZATION, PA GRID TUNING SLIDERS, PA GRID SWAMPING CAPACITOR, EFFICIENCY CAPACITOR, COUPLING CAPACITOR, PA BIAS PRELIMINARY ADJUSTMENT AND IPA TO PA CABLE LENGTH

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.

1. SHORTING PLANE

   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 4-7) to the desired frequency in accordance with the graph in Figure 5-1.

2. PA NEUTRALIZATION

   Adjust the PA neutralization bars to the desired frequency in accordance with the graph in Figure 5-2.

3. PA GRID TUNING SLIDER

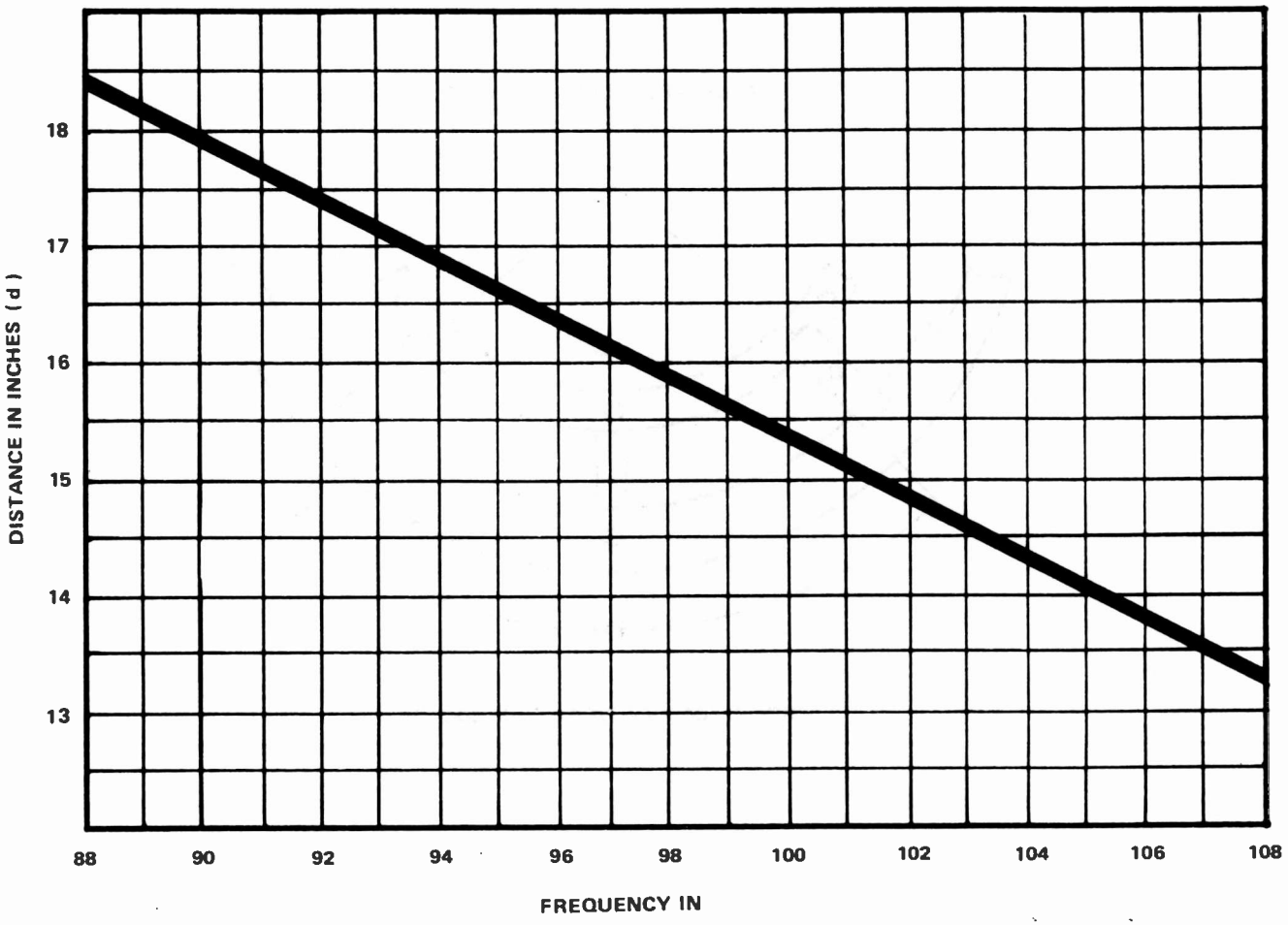
   a. Open the PA grid compartment door.

   b. Adjust the PA grid tuning sliders (Figures 5-3 and 5-4, L1,2,3) in accordance with the graph shown in Figure 5-3 for the desired frequency.

4. PA GRID SWAMPING CAPACITOR

   a. Swamping capacitor C3 consists of two aluminum plates separated by some distance. The position of the plate nearest the front of the transmitter is adjustable, thus making it possible to set the distance between the two plates. Referring to Figure 5-5, loosen the screw on the adjustable plate and position it to obtain the plate to plate spacing indicated in figure 5-5 for the desired operating frequency. The spacing may be checked using a "feeler gauge" or a similar device inserted between the plates.

   b. Tighten the screw on the adjustable plate.



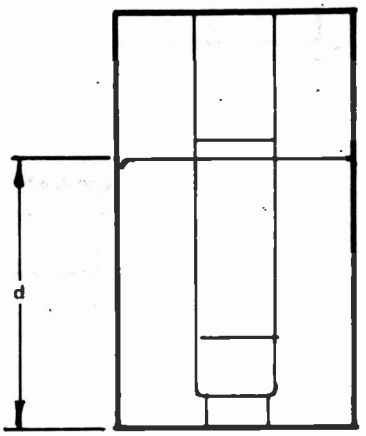
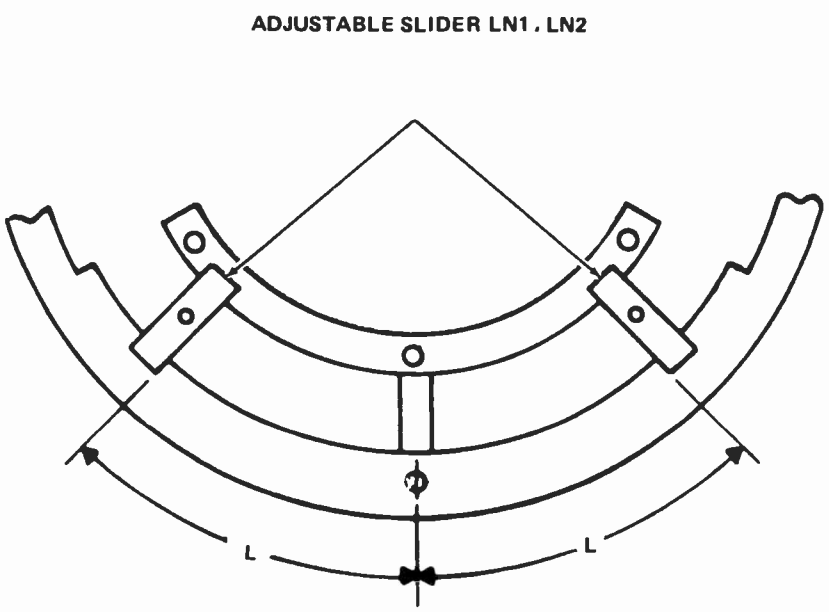


Figure 5-1. PA Plate Tuning Cavity Slider Approximate Adjustment



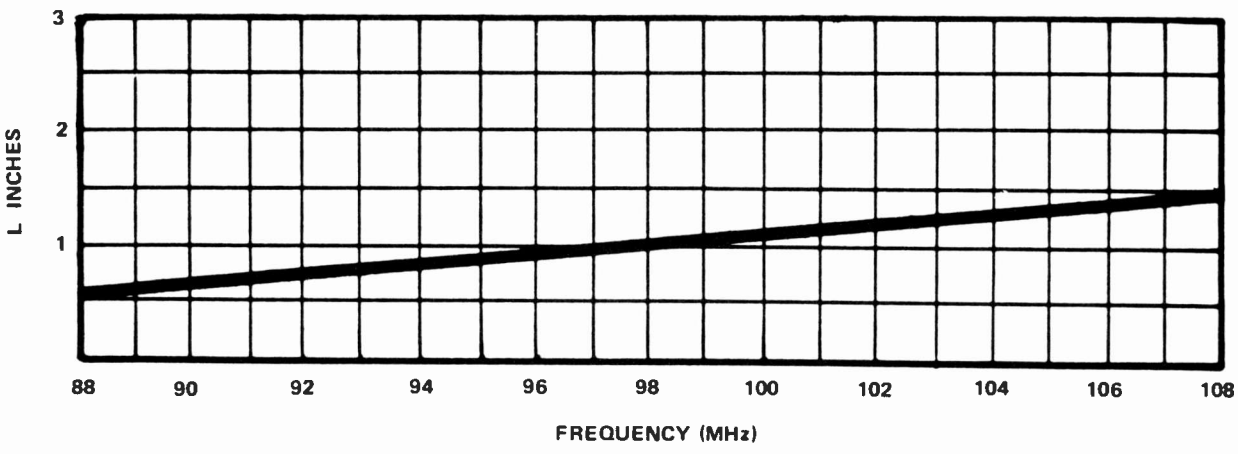
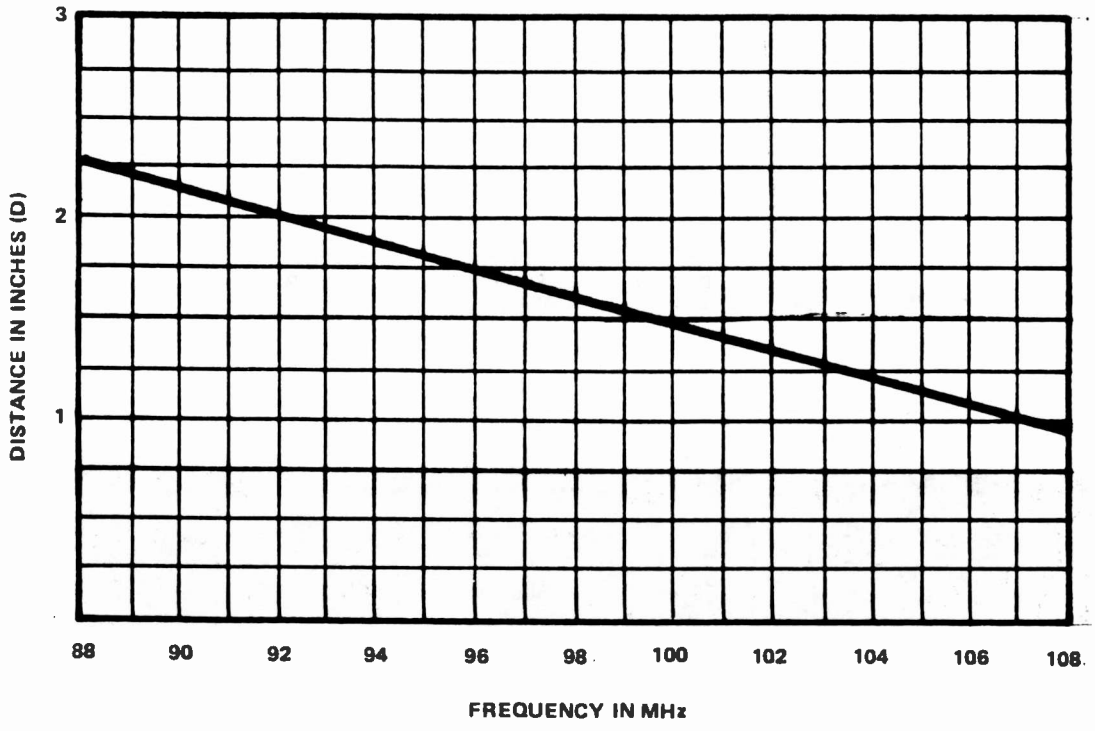


Figure 5-2. PA Neutralizing Adjustment



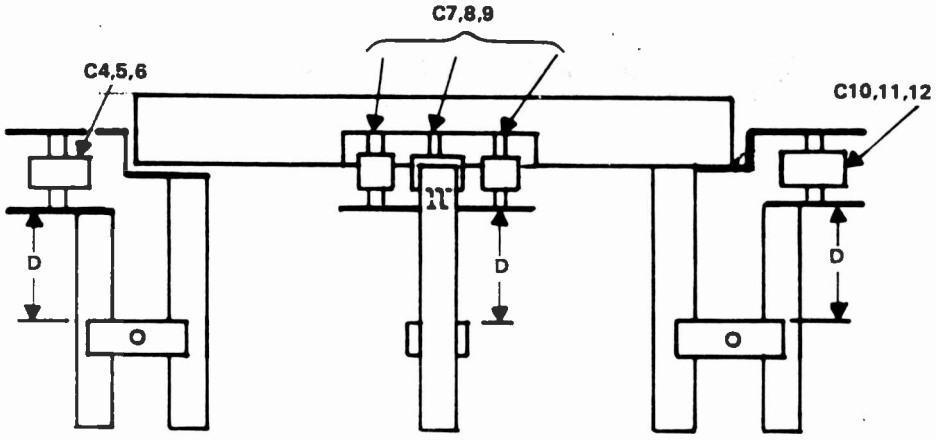
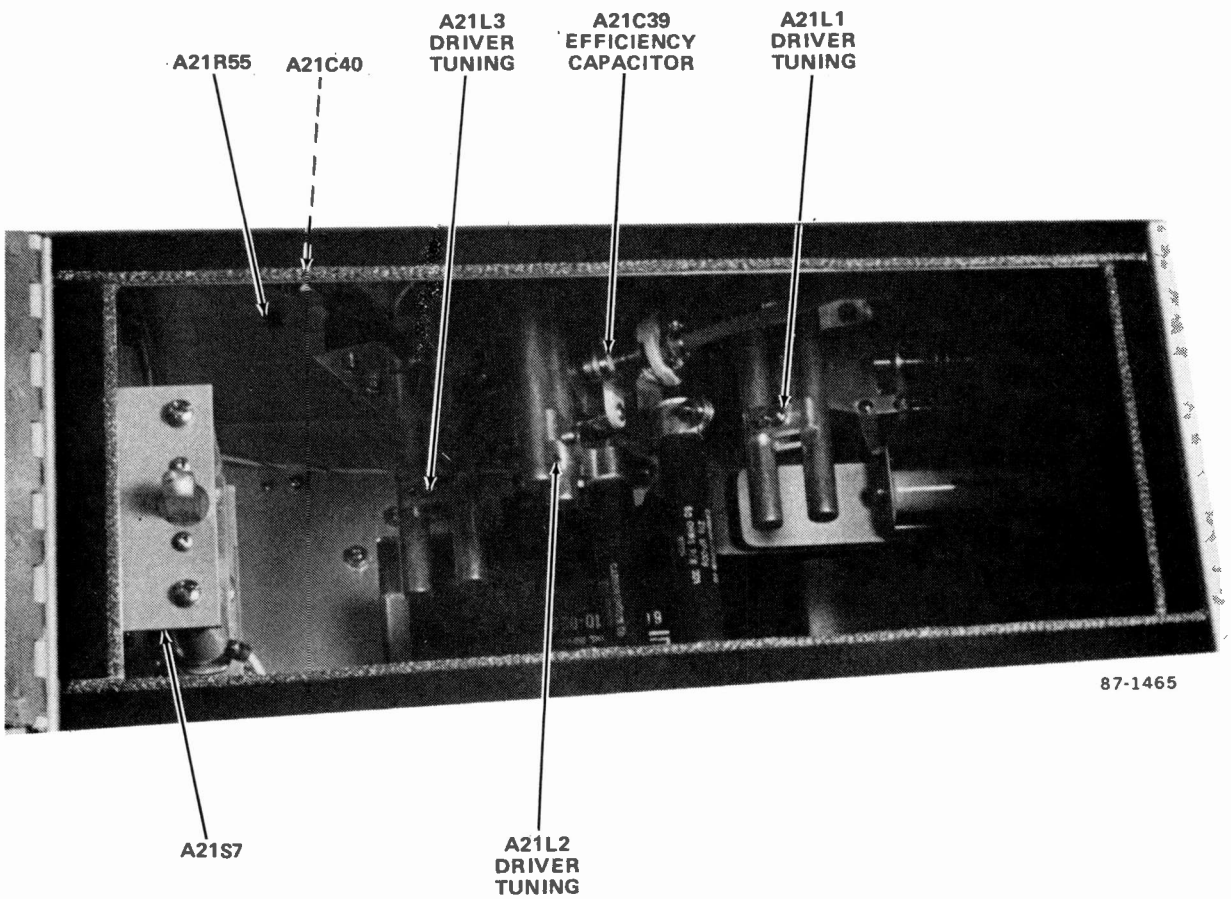


Figure 5-3. Graph for Approximate Setting of PA Grid Tuning Inductors



PT1-11

Figure 5-4. Power Amplifier Socket, A21

5. EFFICIENCY CAPACITOR

Preset the efficiency capacitor C39 for MINIMUM capacitance. The capacitor plate should be completely unmeshed.

6. COUPLING CAPACITOR

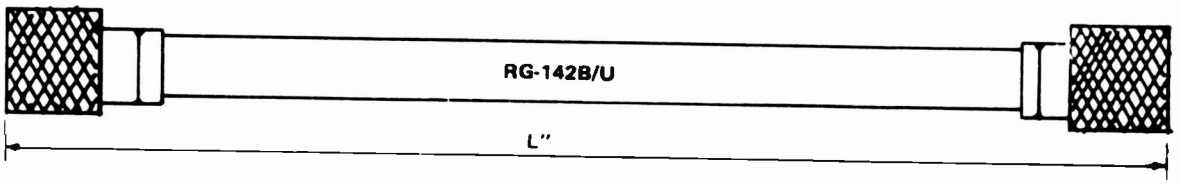
Preset the coupling capacitor (C1) for minimum capacitance. The capacitor plate should be completely unmeshed. Close the grid compartment door.

7. PA BIAS

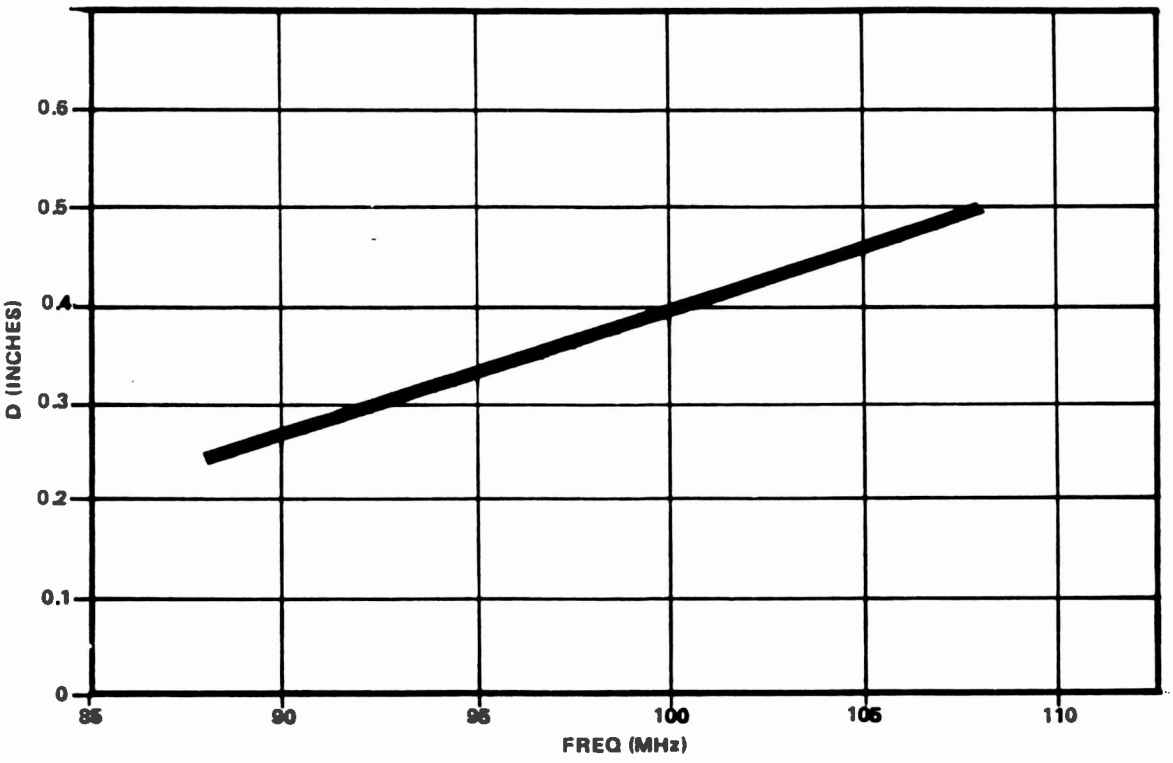
Preset the bias resistor (R35), located behind the power amplifier cavity, to the middle of its range.

8. IPA TO PA CABLE LENGTH

The length of the coaxial cable between the IPA directional coupler (A26DC1) and the PA cavity input connector (J1) should be cut to the length (as illustrated below) for the desired operating frequency. The cable must be type RG-14B/U. It can be obtained from CE by ordering part number 425-1132-000.



88-95 MHz	95-102 MHz	102-108 MHz
L = 44 INCHES	L = 40 INCHES	L = 36 INCHES



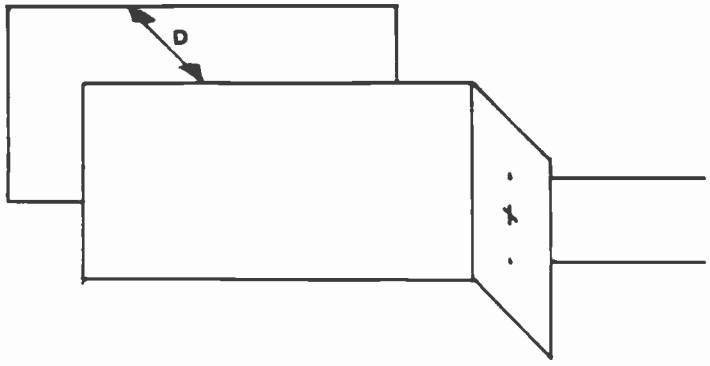
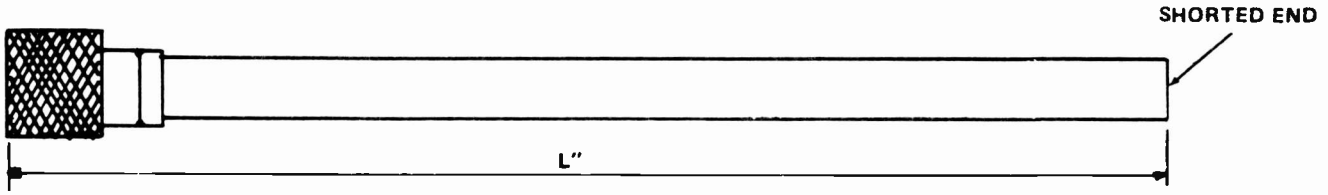


Figure 5-5. PA Grid Swamping Capacitor

9. IPA OUTPUT QUARTER-WAVE STUD

The length of the coaxial $\lambda/4$ stub on the output of the IPA directional coupler A26DC1 should be cut to length as illustrated below. The cable must be type RG-142BU.



88 - 95 MHz	95 - 102 MHz	102 - 108 MHz
L = 22 INCHES	L = 20 INCHES	L = 18 INCHES

5-9.2 PA TUNING

1. Press PLATE OFF and FILAMENT OFF switches on control panel A1.

2. If possible, connect the transmitter to an RF Wattmeter/dummy load combination or a calorimeter capable of measuring and dissipating 25 kilowatts at 88 to 108 MHz. If these devices are unavailable, refer to the RF WATTMETER on the control panel for power output measurement.

CAUTION

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

3. Turn the PA GRID TUNING control fully counterclockwise. Then turn the control ten turns clockwise (Full CCW is maximum capacity. The full range of the capacitor is covered in 20 turns.)

4. Open the plate cavity access door and observe PA tuning and loading capacitors A18C51 and A18C50. (See Figure 4-7.) Adjust the PA TUNING and PA LOADING controls on the control panel until the two capacitors are positioned approximately midrange. Close the plate cavity door.

NOTE

An easier way to determine position of capacitors A18C51 and C50 is to look at the capacitor motor drive units. Each has a limit switch actuator bar that travels with the capacitor plate. When it is in the middle of its range so are the capacitors. Left side and center rear covers must be removed.

5. Set PA SCREEN circuit breaker to OFF. Ascertain that the exciter POWER switch and all other breakers are ON.

CAUTION

DO NOT EXCEED THE FOLLOWING MAXIMUM RATINGS:

PA SCREEN CURRENT:	600 mA
PA PLATE CURRENT:	4.0 A

6. Place power control in MANUAL mode

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

CAUTION

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

8. Alternately adjust the PA GRID TUNING (A21C2) and COUPLING (A21C1) for minimum reflected IPA reflected power. The power amplifier grid current should be at least 80 mA.

9. Adjust the PA TUNING and PA LOADING controls for a maximum output power indication.

10. Repeat steps 8 and 9 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.

CAUTION

MAXIMUM PA TUBE PLATE DISSIPATION IS 15KW. PROLONGED OPERATION WITH THE PLATE IMPROPERLY TUNED MAY DAMAGE THE POWER AMPLIFIER. PLATE DISSIPATION MAY BE CALCULATED AS FOLLOWS: PLATE DISSIPATION (WATTS) = DC PLATE CURRENT (AMPERES) X DC PLATE VOLTAGE (VOLTS) - RF POWER OUTPUT (WATTS).

NOTE

Because of the relatively high output capacity of the 4CX15000A tube 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.

11. Check for power amplifier neutralization. Refer to paragraph 5-9.3.

NOTE

Compare the transmitter operating parameters with those in Tables 3-4 and 3-5. Some fine tuning of the previously pre-set adjustments may be needed to bring operating parameters into agreement with those found in the data. If efficiency needs improvement, adjustment of the efficiency capacitor (A21C39) may be needed.

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

13. Determine if plate tuning capacitor A18C50 is approximately halfway between its limits.

14. If plate tuning capacitor A18C50 is not approximately half way between its limits, adjust the PA plate cavity shorting plane (paragraph 5-9.1, step 1) and repeat steps 3 through 14 of this paragraph.

5-9.3 PA NEUTRALIZATION

A. NEUTRALIZING PROCEDURE

NOTE

Check the transmitter for proper neutralization. If neutralization is correct, do not perform this procedure.

1. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.
2. Open the PA cavity door. Short all high voltage terminals with grounding stick.
3. Remove front half of tube air guide to gain access to screen sliders.
4. Refer to Figure 5-2 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.)
5. Replace the tube air guide.
6. Close the cavity door and apply power to the transmitter.
7. Check for proper neutralization again. If incorrect, repeat steps 2 through 6.

The power amplifier of the transmitter can be found in one of three possible states of neutralization (neut). These are:

a. REGENERATIVE (Positive Feedback)
b. PERFECTLY NEUTRALIZED (No Feedback)
c. DEGENERATIVE (Negative Feedback)

The state of neutralization can be identified by observing the control grid current while raising the plate tuning.

IF GRID CURRENT:	STATE OF NEUT:
Rises	Regenerative
Doesn't change	Perfect
Drops	Degenerative

Experience has shown that it is best to adjust the neutralization slightly beyond the point of perfect neutralization into the region of degeneration. Moving the neutralization bars out slightly (1/16" - 1/8") from the point of perfect neutralization will place the PA into the degenerative region.

B. ALTERNATIVE NEUTRALIZING PROCEDURE

It is time consuming, however, to locate the perfect neutralization point. The following is an alternative approach.

1. Pre-set neut per tuning chart.

2. Get the power amplifier running and determine the present state of neut.

3. If the neutralization is regenerative or perfect, then move the neutralization bars out slightly (1/16" - 1/8" and go back to step 2. If the neutalization is Degenerative then you are done for now. Proceed with tune up.

4. Repeat steps 8, 9 and 10 of paragraph 5-9.2.

SECTION 6 - PARTS LIST

6-1. GENERAL

This section contains a list of all repairable/replaceable electrical, and critical mechanical parts for the 816R-3B FM Transmitter.

6-2. REF DES

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

6-3. DESCRIPTION

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

6-4. CONTINENTAL ELECTRONICS PART NUMBER

The CE radio specification or drawing number, for each item in the parts list, is reflected in this column.

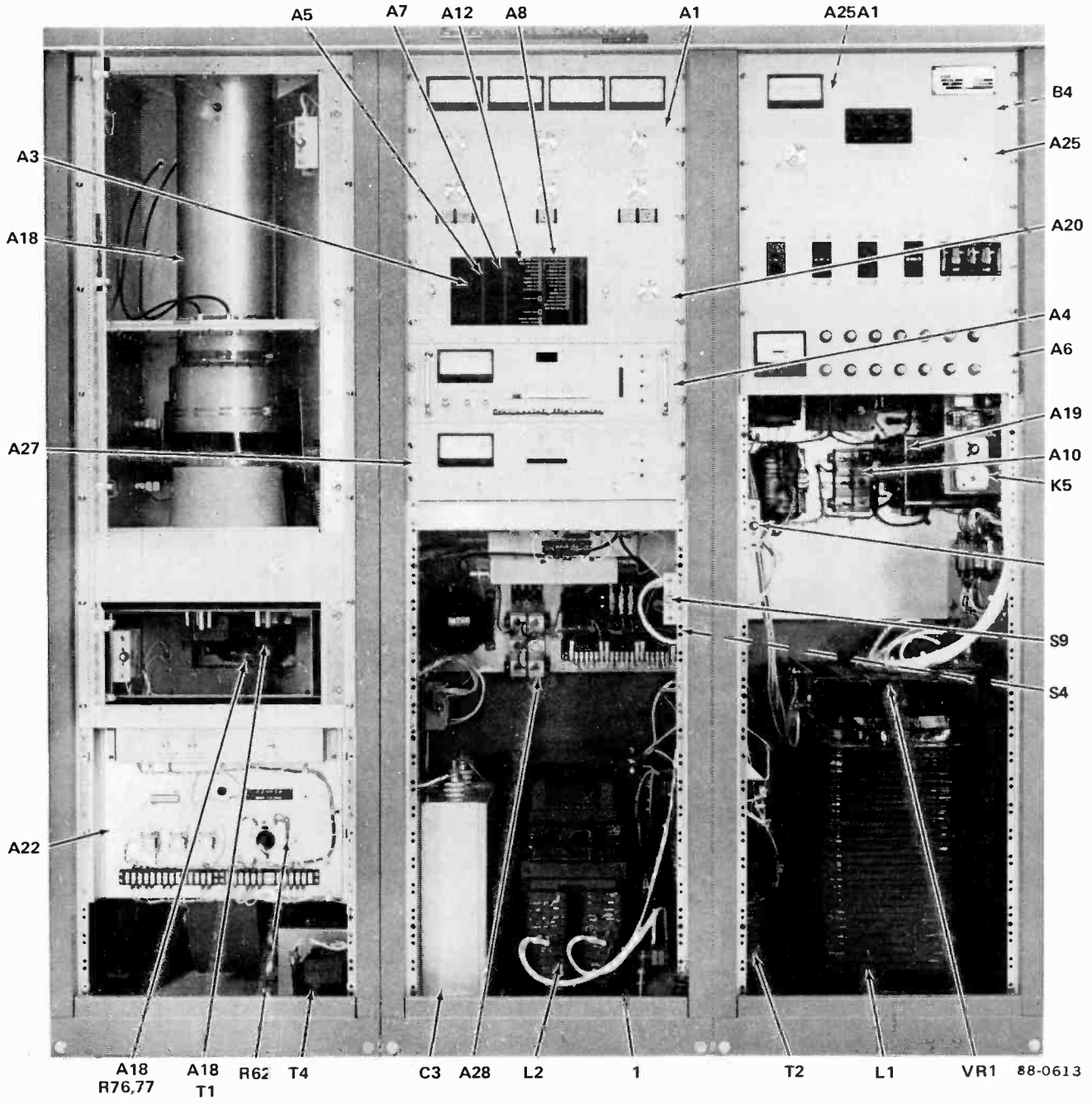
6-5. ILLUSTRATIONS

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

6-6. LIST OF EQUIPMENT

An index of equipment is given in Table 6-1.

TABLE 6-1. LIST OF EQUIPMENT



PT1-12

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

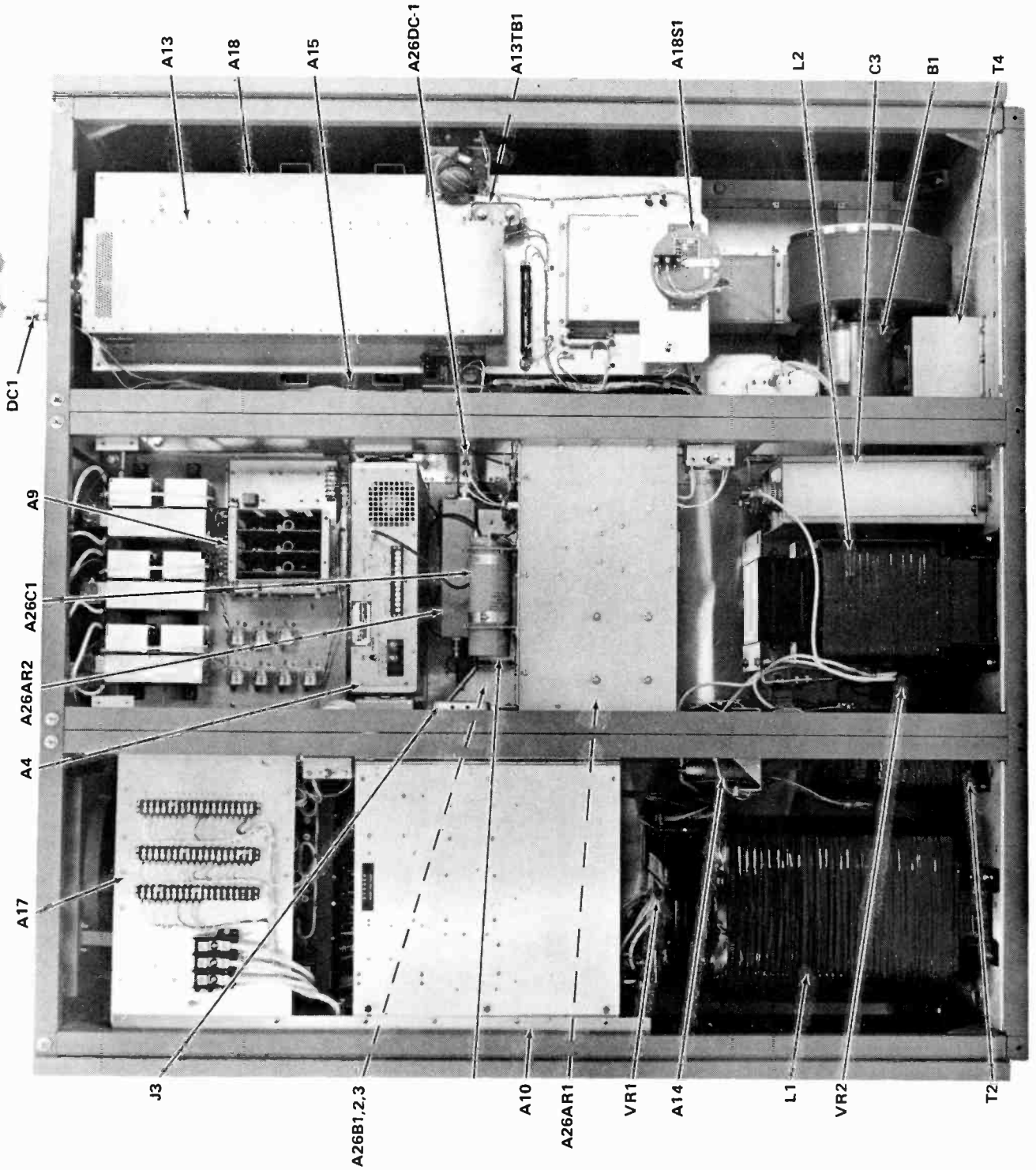


Figure 6-1. 816R-3B FM Transmitter (Sheet 2 of 2)

PT1-13

816R-3B FM Transmitter, Reference Designators

REF DES	DESCRIPTION	CE PART NUMBER
	816R-3B 25.0 KW FM Transmitter	172053-1
A1	Control Panel	786-3243-008
A2	Not Used	
A3	Fwd/Refl Cal and Pwr Control Board	648-8092-002
A4	802A FM Exciter	643-0001-001
A5	Filament Regulator	159702-1
A6	Circuit Breaker Panel	786-3416-007
A7	Overload & Recycle Board	640-5380-001
A8	Power Control Regulator	627-6683-001
A9	Power Control Panel	789-4342-002
A10	Power Supplies	159142-3
A11	Not Used	
A12	Latching Relay and Status Board	648-8082-001
A13	RF Output Low-Pass Filter	786-3451-003
A14	Power Supply Filter	786-3583-005
A15	Metering Multiplier Board	786-3168-001
A16	(Now DC1)	
A17	Bleeder Resistor Panel	786-3154-003
A18	Power Amplifier Cavity	786-3335-006
A19	Component Panel	648-8124-001
A20	Card Cage Assembly	786-3301-002
A21	Power Amplifier Socket	786-3686-003

816R-3B FM Transmitter, Reference Designators (Cont.)

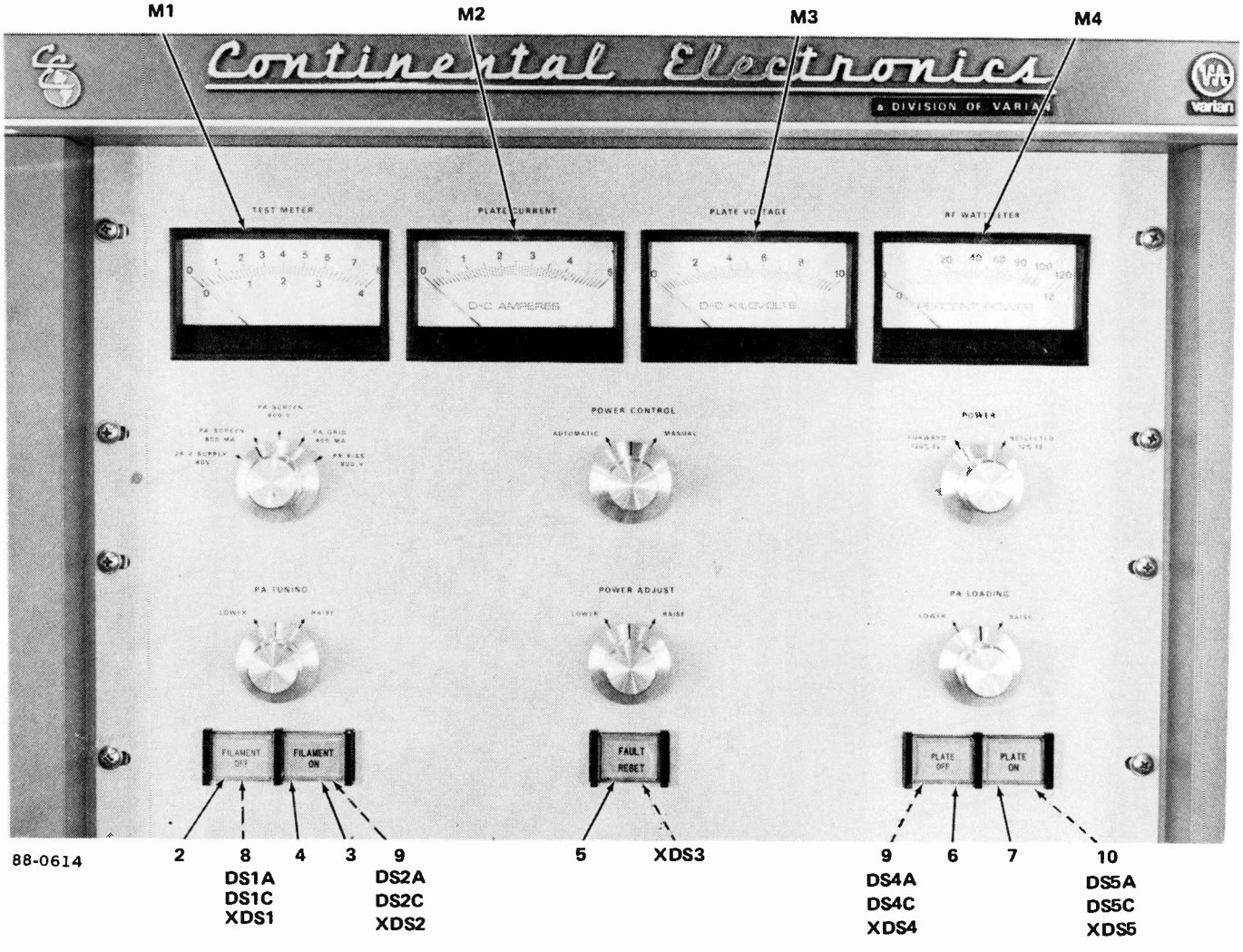
REF DES	DESCRIPTION	CE PART NUMBER
A22	Overload and Meter Calibrate Panel	786-3666-003
A23	Extender Card	771-9168-001
A24	Not Used	
A25	AC Metering Panel	636-7263-001
A26	Driver Shelf Assy	159711-1
A27	IPA Front Panel Assy	159712-1
A28	Driver Power Supply	159713-1
B1	Fan, Centrifugal, Complete Assembly	009-0167-010
	Fan, Centrifugal, Motor Only	009-0167-020
B4	Cabinet Fan Motor, 0.5A, 208/220 VAC	230-0593-010
C1	Not Used	
C2	Not Used	
C3	Capacitor, Fxd, Paper 20 mfd. 10% To1, 10 KVDCW	930-0781-040
C4 Through C49	Not Used	
C50	PA Loading Capacitor	786-3048-001
C51	PA Tuning Capacitor	786-3049-001
C52 Through C56	Not Used	
DC1	Line Section, 3-1/8 Dual Socket	124-9004-010
J1	Not Used	
J2	Not Used	
J3	Connector, Electrical, Receptacle Single Outlet, Grounding Type	368-0139-010
L1	Plate Supply Filter Choke 4H Inductance	668-0199-010
L2	Screen Supply Filter Choke 1H Inductance	668-0200-010
P1 - P5	Not Used	
P6	Plug Adapter, Right Angle, Bnc	357-9339-000

816R-3B FM Transmitter, Reference Designators (Cont.)

REF DES	DESCRIPTION	CE PART NUMBER
R1	Not Used	
R2 - R34	Not Used	
R35	Resistor, Var, Wirewound, 1.0K ohms, 10% Tol, 50 W	749-1026-000
R36	Resistor, Fixed, Wirewound, 3.0K ohms, 5% Tol, 80 W	710-9294-000
S1-S3	Not Used	
S4, S5	Switch, Sensitive	260-0025-000
	SPDT Contact Arrangement includes	
	Actuator, Switch	260-0026-000
S6, S7	Not Used	
S8, S9	Shorting Switch	627-9743-004
	Includes	
	Spring, Shorting Switch	540-5342-002
	Strap, Grounding	304-6000-000
	Strip, Shorting	632-1149-001
	Contact, Shorting	542-1773-002
	Shaft, Flat, Straight	627-9786-001
	Insulator, Standoff	190-0026-000
S10 Through S12	Same as S4	
S13,S14,	Shorting Switch	627-9743-008
T1	Transformer, PWR, Step-Up	664-0124-020
T2	Transformer, PWR, Step-Up	664-0123-020
T3	Not Used	
T4	Transformer, PWR, Step-down	662-0043-000
TB1	Terminal Board, 3 Terminals	367-1188-000
TB2	Same As TB1	
VR1	Suppressor, Plate	625-8349-002
	Includes	
	Absorber, Overvoltage -CR1 thru CR5-	353-0283-140
VR2	Suppressor, Screen	625-8348-001
	Includes	
	Absorber, Overvoltage, -CR6, CR7-	353-0283-100
Z1	Complete Rectifier (Includes Rectifier Column)	353-6596-010

816R-3B FM Transmitter, Reference Designators (Cont.)

REF DES	DESCRIPTION	CE PART NUMBER
1	Shorting Stick	547-6572-002
	Includes	
	Rod, Shorting	547-6574-002
	Spring, Compression	547-6575-002
	Cord, Shorting Stick	427-0004-000
2	Clamp, Neutralizing -Qty 2-	786-3236-001
3	Clamp, Neutralizing -Qty 2-	786-3237-001
4	Impeller, Fan	009-3118-010
5	Knob	757-0228-001
6	Bearing Assembly, Panel	015-3437-010
7	Joint, Universal	233-0132-000
8	Shaft	789-4365-001
9	Coupling, Insulator	015-3438-010
10	Filter	786-3457-001
11	Retainer, Upper	786-3537-001
12	Deflector	786-5842-001
13	Clamp	013-1309-420



PT1-14

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

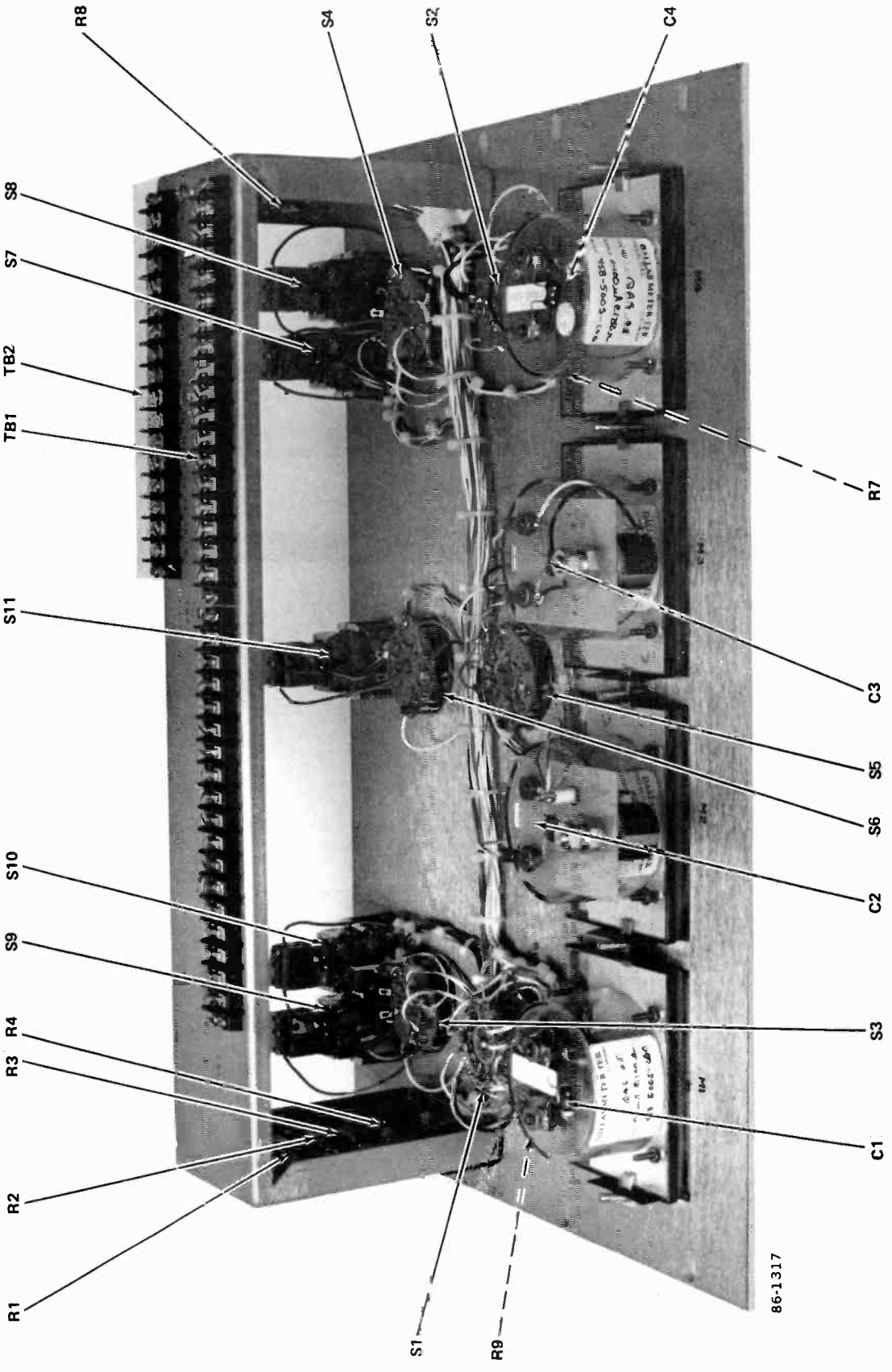


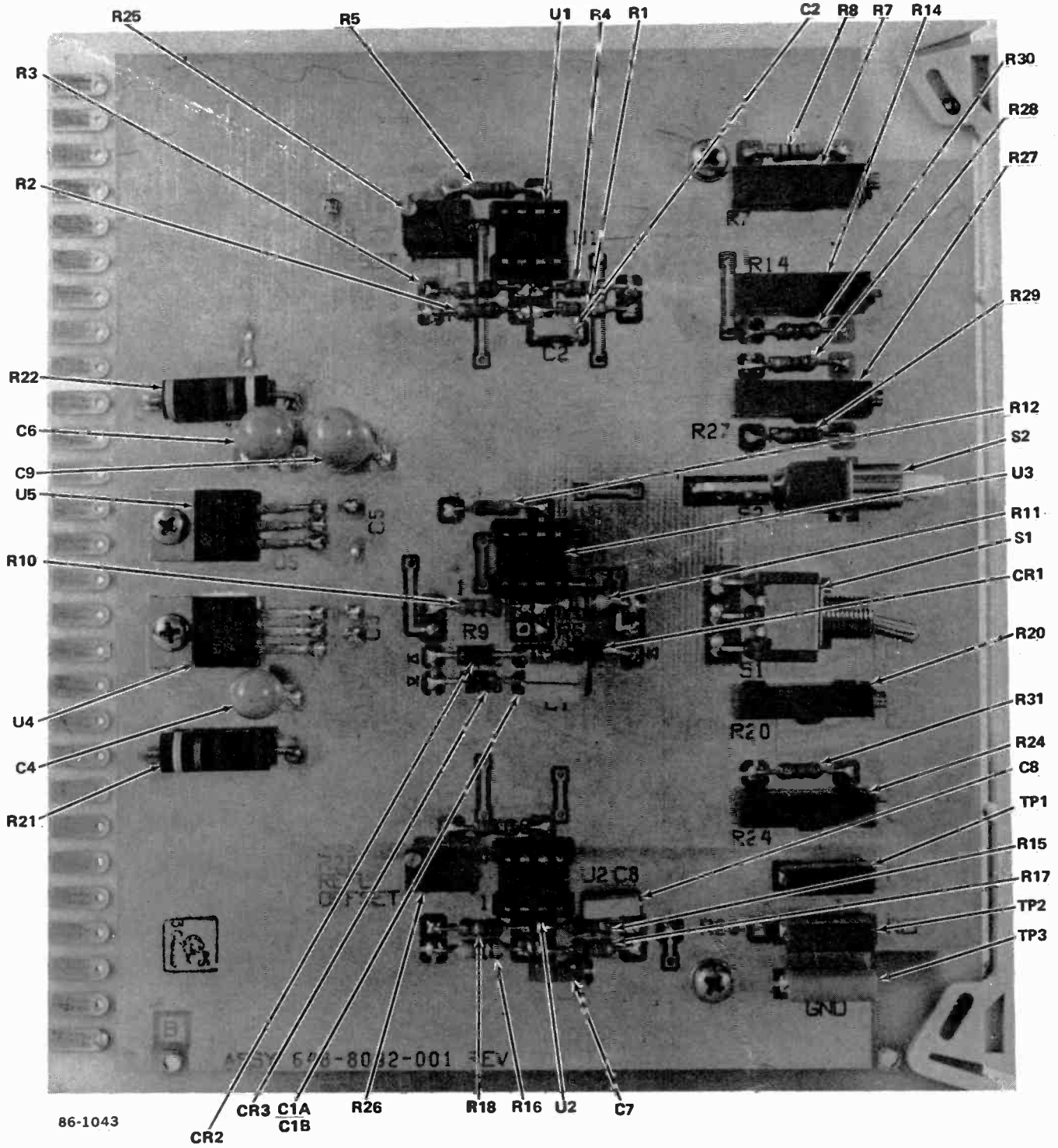
Figure 6-2. Control Panel, A1 (Sheet 2 of 2)

CONTROL PANEL, A1 786-3243-008

REF DES	DESCRIPTION	CE PART NUMBER
C1	Capacitor, Fxd, Mica, 100 pf., 5% To1, 500 VDCW	912-2816-000
C2	Same as C1	
C3	Same as C1	
C4	Same as C1	
DS1A	Lamp, Incandescent, 0.04A, 28 volts	262-0179-010
DS1C	Same as DS1A	
DS2A	Same as DS1A	
DS2C	Same as DS1A	
DS4A	Same as DS1A	
DS4C	Same as DS1A	
DS5A	Same as DS1A	
DS5C	Same as DS1A	
M1	Meter, DC Test +/-1% 0 to 1 mA	458-5005-060
M2	Meter, DC Plate Current +/-1% 0 to 1 mA	458-5005-050
M3	Meter, DC Plate Voltage +/-1% 0 to 2 mA	458-5005-070
M4	Meter, DC Wattmeter +/-2% 0 to 100 micro amp	458-5005-100
R1	Resistor, Fxd, Composition, 180 ohms, 10% To1, 1 Watt	745-5621-000
R2 Through R4	Same as R1	
R5, R6	Not Used	
R7	Resistor, Fxd, Film, 1740 Ohms, 1% To1, 1/4 Watt	705-6758-000
R8	Resistor, Fxd, Composition, 39K ohms, 10% To1, 1 Watt	745-3419-000
R9	Resistor, Fxd, Film, 301 Ohms, 1% To1, 1/2 Watt	705-7071-000
R10, R11	Not Used	
S1	Switch, Rotary DP12T Contact Arrangement	259-2219-010
S2	Switch, Rotary DPDT Contact Arrangement	259-2759-010
S3	Switch, Rotary DP3T Contact Arrangement	259-1980-000

CONTROL PANEL, A1 (Cont.) 786-3243-008

REF DES	DESCRIPTION	CE PART NUMBER
S4 Through S6	Same as S3	
S7	Switch, Push, Illuminated SPDT Contact Arrangement	266-6806-110
S8 Through S11	Same as S7	
TB1	Strip, Terminal 17 Terminals -Qty 2-	367-0025-000
TB2	Strip, Terminal 16 Terminals	367-0024-000
XDS1	Switch, Push, Illuminated	266-6806-010
XDS2 Through XDS5	Same as XDS1	
1	Knob, Round, Skirted -Qty 6-	757-0233-003
2	Barrier, Vertical Mounting -Qty 8-	266-6806-030
3	Lens, Engraved Filament Off	266-6806-270
4	Lens, Engraved Filament On	266-6806-280
5	Lens, Engraved Fault/Reset	266-6806-800
6	Lens, Engraved Plate Off	266-6806-740
7	Lens, Engraved Plate On	266-6806-790
8	Boot, Bulb White -Qty 2-	266-6268-000
9	Boot, Bulb Green -Qty 4-	266-6806-040
10	Boot, Bulb Red -Qty 2-	266-6806-060



PT1-16

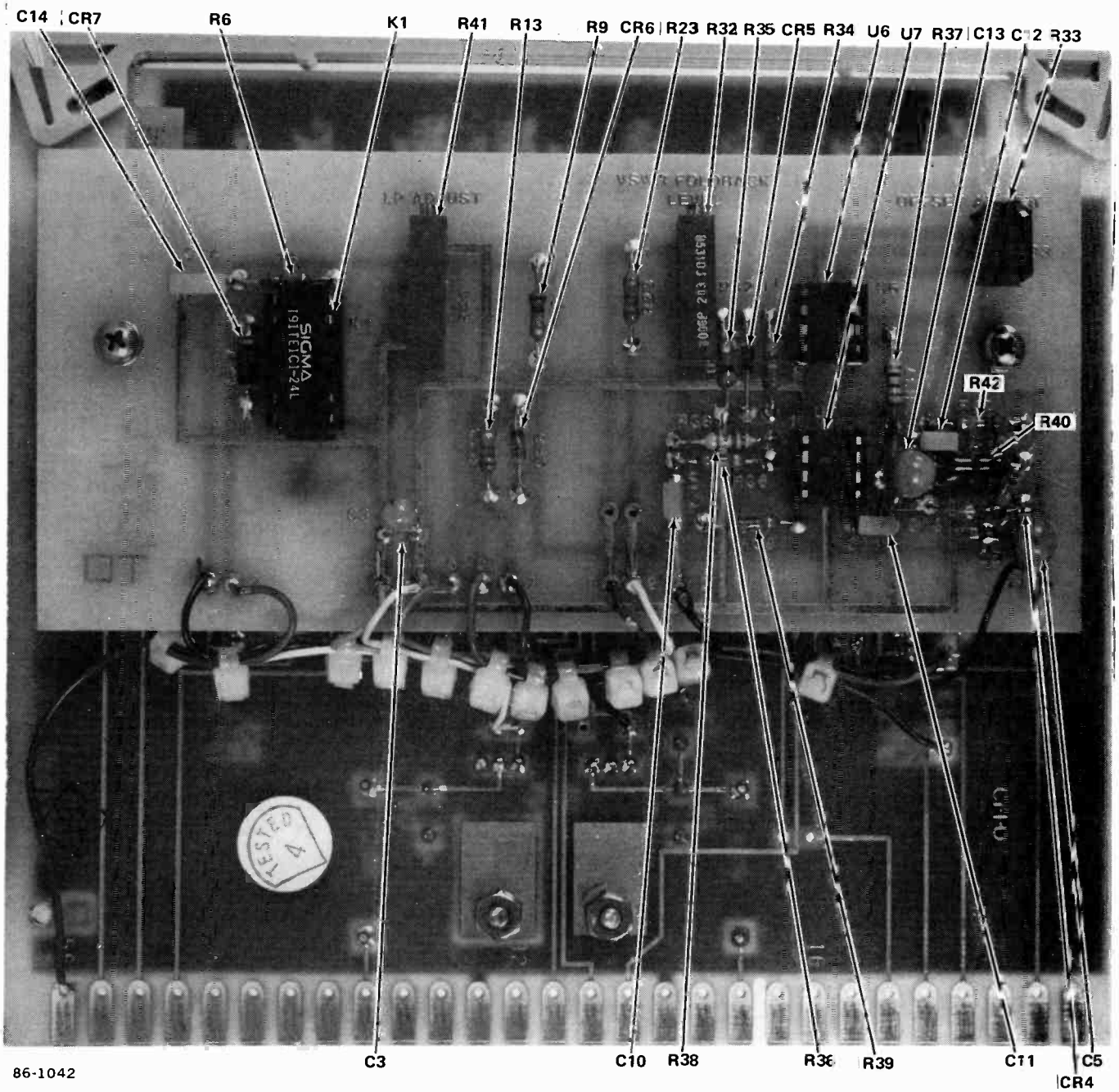
Figure 6-3. Fwd/Refl Calibration and Power Control Board, A3

FWD/REFL CAL AND PWR CONTROL BOARD, A3 648-8092-002

REF DES	DESCRIPTION	CE PART NUMBER
C1A	Capacitor, Fxd, Ceramic, 1.0 mfd. 20%, To1, 50 VDC	913-5019-840
C1B	Same as C1A	
C2	Capacitor, Fxd, Ceramic, 0.1 mfd., 20% To1, 50 VDC	913-5019-720
C4	Capacitor, Fxd, Solid Tantalum 10.0 mfd., +20%, To1, 35 VDC	184-9102-410
C6	100 mfd., 20V	184-9102-200
C7	Same as C1A	
C8	Same as C1A	
C9	Same as C6	
C10	Same as C1A	
CR1 Through CR3	Diode, 1N4003	353-6442-030
R1	Resistor, Fxd, Carbon Film 20K ohms, 5% To1, 1/4 Watt	745-0910-960
R2	Resistor, Fxd, Carbon Film 15K ohms, 5% To1, 1/4 Watt	745-0910-930
R3	Resistor, Fxd, Carbon Film 160K ohms, 5% To1, 1/4 Watt	745-0911-190
R4	Resistor, Fxd, Carbon Film 30K ohms, 5% To1, 1/4 Watt	745-0911-010
R5	Resistor, Fxd, Carbon Film 200 Ohms, 5% To1, 1/4 Watt	745-0910-480
R7	Resistor, Var, 15 Turn 10K ohms, 10% To1, 3/4 Watt	382-0012-290
R8	Resistor, Fxd, Carbon Film 10 Ohms, 5% To1, 1/4 Watt	745-0910-170
R10	Resistor, Fxd, Carbon Film 470K ohms, 5%, To1, 1/4 Watt	745-0911-300
R11	Resistor, Fxd, Carbon Film 6.8K ohms, 5% To1, 1/4 Watt	745-0910-850
R12	Resistor, Fxd, Carbon Film 10K ohms, 5% To1, 1/4 Watt	745-0910-890
R14	Resistor, Var, 15 Turn 50K ohms, 10% To1, 3/4 Watt	382-0012-320
R15	Same as R4	
R16	Resistor, Fxd, Carbon Film 4.3K ohms, 5% To1, 1/4 Watt	745-0910-800
R17	Same as R1	
R18	Same as R3	
R19	Same as R5	

FWD/REFL CAL & PWR CONTROL BOARD, A3(Cont.) 648-0092-002

DES	DESCRIPTION	CE PART NUMBER
R20	Same as R7	
R21	Resistor, Fxd, Composition 100 Ohms, 10% To1, 1 Watt	745-3310-000
R22	Resistor, 4790 Ohms, 1 W	745-3337-000
R24	Same as R14	
R25	Resistor, Var, 25 Turn 10K ohms, 10%, To1, 1/2 Watt	382-1405-070
R26	Same as R25	
R27	Resistor, Var, 15 Turn 20K ohms, 10% To1, 3/4 Watt	382-0012-300
R28	Resistor, Fxd, Carbon Film 100 Ohms, 5% To1, 1/4 Watt	7450910-410
R29	Resistor, Fxd, Carbon Film 1K ohms, 5% To1, 1/4 Watt	745-0910-650
R30	Resistor, Fxd, Carbon Film 330 Ohm, 5% To1, 1/4 Watt	745-0910-530
R31	Same as R30	266-5321-980
S1	Switch, SPST, Toggle	266-5404-190
S2	Switch, SPDT, Push	360-0495-020
TP1	Test Point, Brown	360-0495-030
TP2	Test Point, Red	360-0495-040
TP3	Test Point, Orange	351-1110-020
U1	Integrated Circuit, 741	
U2	Same as U1	
U3	Same as U1	
U4	Integrated Circuit, LM320T-12	351-1124-130
U5	Integrated Circuit, LM340T-12	351-1120-040



PT1-17

Figure 6-4. VSWR Fold Back & Two Level Auto Power Control, A3A1

VSWR FOLD BACK & TWO LEVEL AUTO PWR CTRL ASSY, A3A1 643-7576-001

REF DES	DESCRIPTION	CE PART NUMBER
C3	Capacitor, 4.7 mfd.	184-9102-390
C5	Capacitor, 150 mfd.	184-9102-160
C10 Through C12	Capacitor, .1 mfd.	913-5019-720
C13	Capacitor, 10 mfd.	184-9102-410
C14	Capacitor, 1 mfd.	913-5019-840
CR4 Through CR6	Diode, 1N5711	353-3691-010
CR7	Diode, 1N4004	353-6442-040
K1	Relay	410-0572-010
R6, R9	Resistor, 15K, 1/4 W	745-0910-930
R13, R23	Resistor, 2.2K, 1/4 W	745-0910-730
R32	Resistor, Variable, 20K	382-0012-300
R33	Resistor, Variable, 10K	382-1405-070
R34	Resistor, 160K, 1/4 W	745-0911-190
R35, R36	Resistor, 30K, 1/4W	745-0911-010
R37	Resistor, 200, 1/4 W	745-0910-480
R38	Resistor, 6.8K, 1/4 W	745-0910-850
R39	Same as R13	
R40	Resistor, 1 Meg, 1/4 W	705-6740-000
R41	Resistor, Variable, 10K	382-0012-290
R42	Resistor, 1K, 1/4 W	745-0910-650
U6	I. C., 741	351-1110-020
U7	I. C., 555	351-1137-020
XK1	Socket, 14 Pin	220-0049-010
XU6, XU7	Socket, 8 Pin	220-0049-100

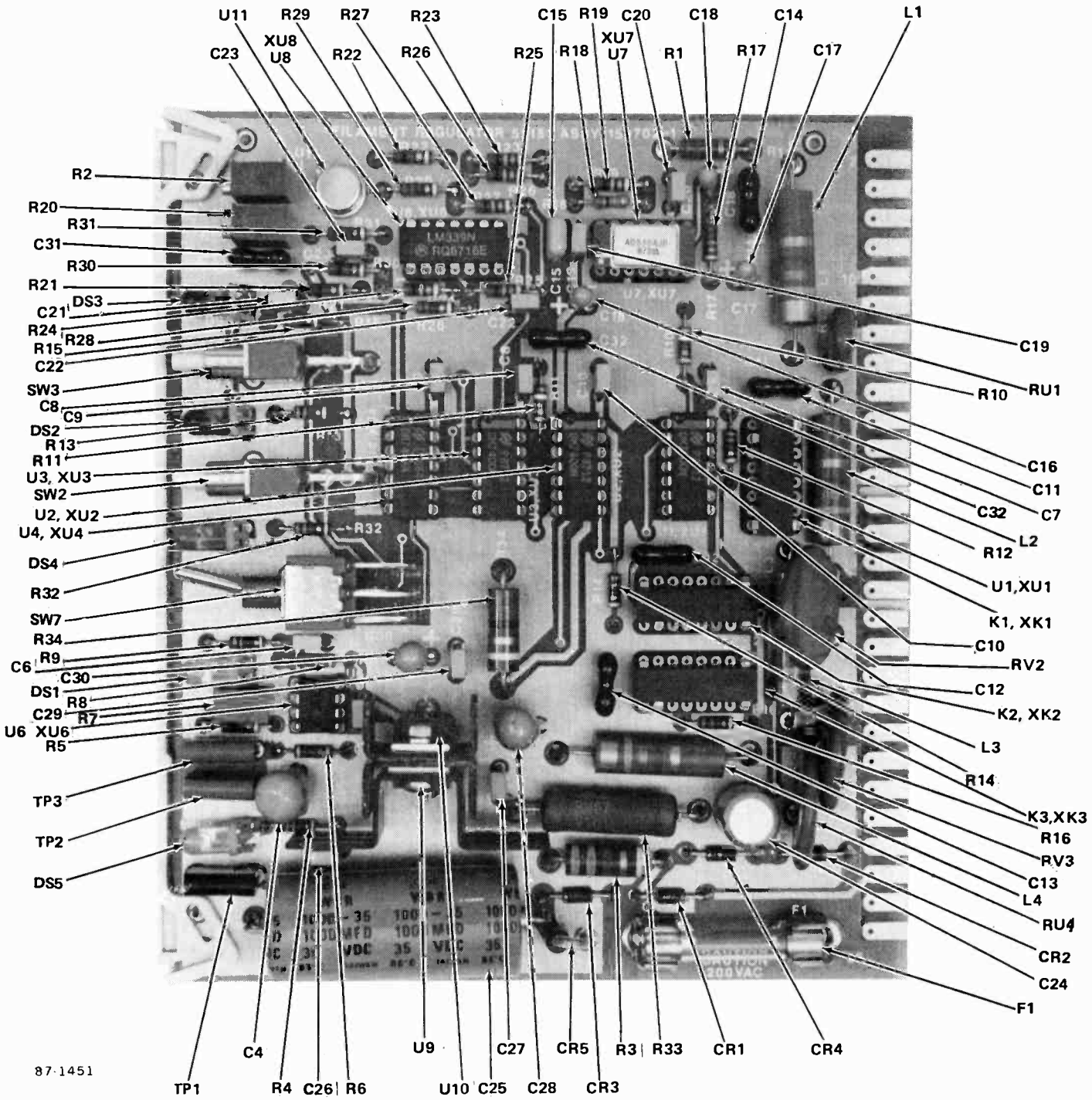


Figure 6-5. Filament Regulator, A5

FILAMENT REGULATOR BOARD, A5 159702-1

REF DES	DESCRIPTION	CE PART NUMBER
C1-C3	NOT USED	
C4	Capacitor, Fixed, Tantalum 220 mfd., 10 VDC	184-9102-550
C5-C10	Capacitor, Fixed, Ceramic 1000K pf, 50 VDC	913-5019-720
C11-C14	Capacitor, Fixed, Mica 100 pf, 500 VDC	912-2816-000
C15	Capacitor, Fixed, Ceramic	913-3279-590
C16	Capacitor, Fixed, Tantalum 1 mfd., 35 VDC	184-9102-350
C17, C18	Capacitor, Fixed, Tantalum 2.2 mfd., 35 VDC	184-9102-370
C19-C23	Same as C5	
C24	Capacitor, Fixed, Electrolytic 100 mfd., 50 VDC	183-5005-030
C25	Capacitor, fixed, Electrolytic 1000 mfd., 35 VDC	183-5003-010
C26, C27	Same as C5	
C28	Capacitor, Fixed, Tantalum 100 mfd., 20 VDC	184-9102-200
C29	Same as C5	
C30	Capacitor, Fixed, Tantalum 100 mfd., 10 VDC	184-9102-100
C31, C32	Same as C11	
CR1-CR4	Diode, SI, RECT, IN4007	353-6442-070
CR5	Diode, Zener 18V, 5W	353-6550-230
DS1	LED, Yellow	353-0293-020
DS2, DS3	LED, Red	353-0293-040
DS4	LED, Green	353-0293-010
DS5	Same as DS1	
F1	Fuse, 1 amp	264-0721-000
K1-K3	Relay, Crydon	410-6009-010
L1-L4	Coil, RF, 4.7 uH	240-1611-000

FILAMENT REGULATOR CARD ASSEMBLY, A5 (Cont.) 159702-1

Ref Des	Description	CE PART NUMBER
R1	Resistor, Fixed, Composition 2.2K Ohms, 1/2 W	745-1365-000
R2	Resistor, Variable 5K Ohms	382-1405-210
R3	Resistor, Fixed, Composition 330 Ohms, 1 W	745-3330-000
R4	Resistor, Fixed, Composition 330 Ohms, 1/4 W	745-0730-000
R5	Resistor, Fixed, Composition 1K Ohms, 1/4 W	745-0748-000
R6	Resistor, Fixed, Composition 4.7K Ohms, 1/4 W	745-0772-000
R7	Resistor, Variable 50K Ohms	382-1405-250
R8	Same as R5	
R9	Same as R4	
R10, R11	Resistor, Fixed, Composition 390 Ohms, 1/4 W	745-0733-000
R12-R16	Same as R4	
R17	Resistor, Fixed, Composition 22K Ohms, 1/4 W	745-0796-000
R18	Resistor, Fixed, Composition 20K Ohms, 1/4 W	745-0910-960
R19	Resistor, Fixed, Composition 10K Ohms, 1/4 W	745-0784-000
R20	Same as R7	
R21, R22	Resistor, Fixed, Composition 100 Ohm, 1/4 W	745-0712-000
R23-R27	Same as R19	
R28, R29	Resistor, Fixed, Composition 2.2M Ohms, 1/4 W	745-0868-000
R30, R31	Same as R5	
R32	Same as R4	
R33	Resistor, Fixed, Wirewound 100 Ohms, 6.5 W	745-5440-000
R34	Resistor, Fixed, Composition 68 Ohms, 1 W	745-3302-000
RV1	Varistor, Sens, 40V	714-7015-010
RV2-RV4	Varistor, Sens	714-7008-010

FILAMENT REGULATOR CARD ASSEMBLY, A5 (Cont.) 159702-1

REF DES	DESCRIPTION	CE PART NUMBER
S1	Switch, Toggle	266-5415-670
S2, S3	Switch, Pushbutton	266-5404-190
TP1	Jack, Tip, Black	360-0495-010
TP2	Jack, Tip, Blue	360-0495-070
TP3	Jack, Tip, Red	360-0495-030
U1-U3	IC, Logic Gate, DM7400N	351-7629-010
U4	IC, Logic Gate, Quad 2-Input	351-7634-010
U5	NOT USED	
U6	IC, Timer, MC 1455P1	351-1137-020
U7	IC	351-4714-020
U8	IC, Linear	351-1122-010
U9	IC, Regulator, UA7815UC	351-1120-050
U10	IC, Regulator, UA7805CT	351-1120-010
U11	Voltage Regulator, 10V	351-4801-010
XK1-XK3	Socket, 16 Pin	220-6017-040
XU1-XU4	Socket, 14 Pin	220-6017-030
XU6	Socket, 8 Pin	220-6017-020
XU7, XU8	Same as XU1	

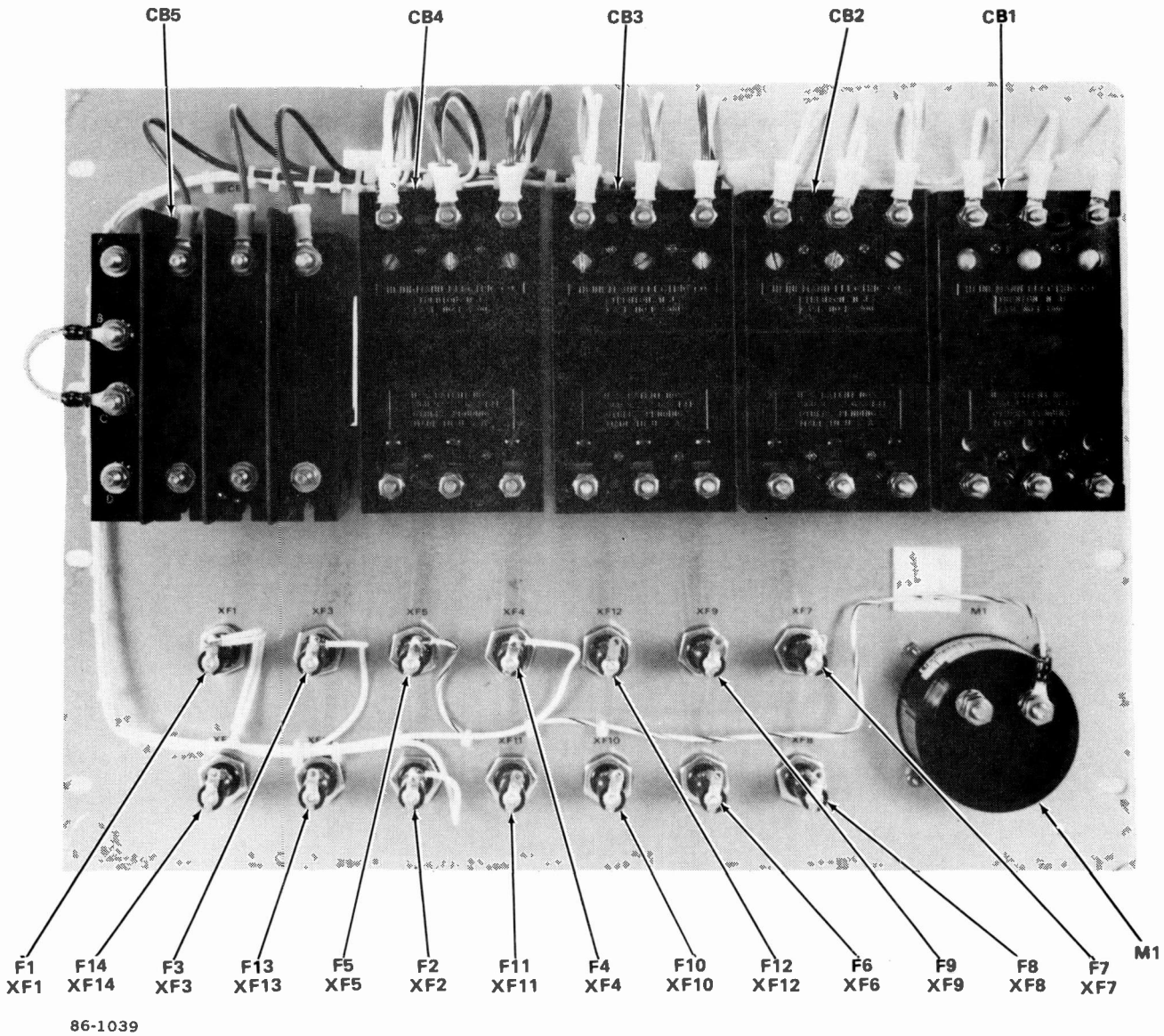
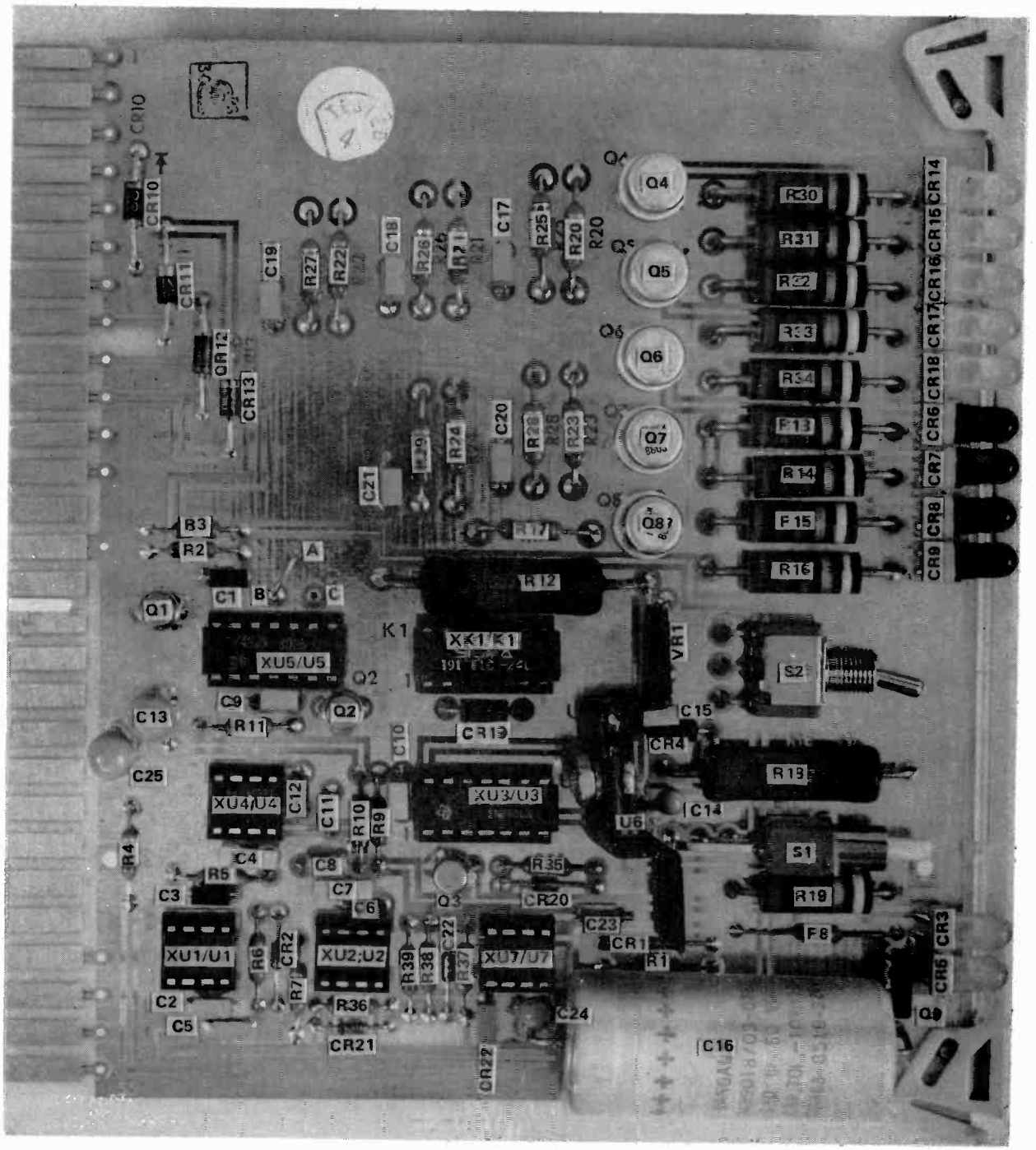


Figure 6-6. Circuit Breaker Panel, A6

CIRCUIT BREAKER PANEL, A6, 786-3416-005

REF DES	DESCRIPTION	CE PART NUMBER
CB1	Circuit Breaker 1A 3 Pole	260-4038-150
CB2	Circuit Breaker 15A 3 Pole	260-0409-000
CB3	Circuit Breaker 10A 3 Pole	260-0407-000
CB4	Circuit Breaker 15A 3 Pole	260-0409-000
CB5	Circuit Breaker 70A 4 Pole	260-0972-030
F1	Fuse, Cartridge 15A Current Rating	264-1184-000
F2	Fuse, Cartridge 3A Current Rating, Slow Blow	264-0009-000
F3	Same as F1	
F4	Fuse, Cartridge 0.25A Current Rating, Slow Blow	264-0291-000
F5	Same as F4	
F6	Fuse, Cartridge 1A Current Rating	264-4280-000
F7	Fuse, Cartridge 2A Current Rating, Slow Blow	264-0008-000
F8	Same as F6	
F9	Same as F7	
F10	Same as F6	
F11	Same as F2	
F12	Same as F7	
F13	Same as F7	
F14	Same as F7	
M1	Meter, Time Totalizing	458-0860-020
F1	Fuseholder 20A Current Rating	265-1241-090
XF2 Through XF14	Same as XF1	



86-1044

PT1-20

Figure 6-7. Overload & Recycle Board, A7

O/L AND RECYCLE BOARD, A7, 640-5380-001

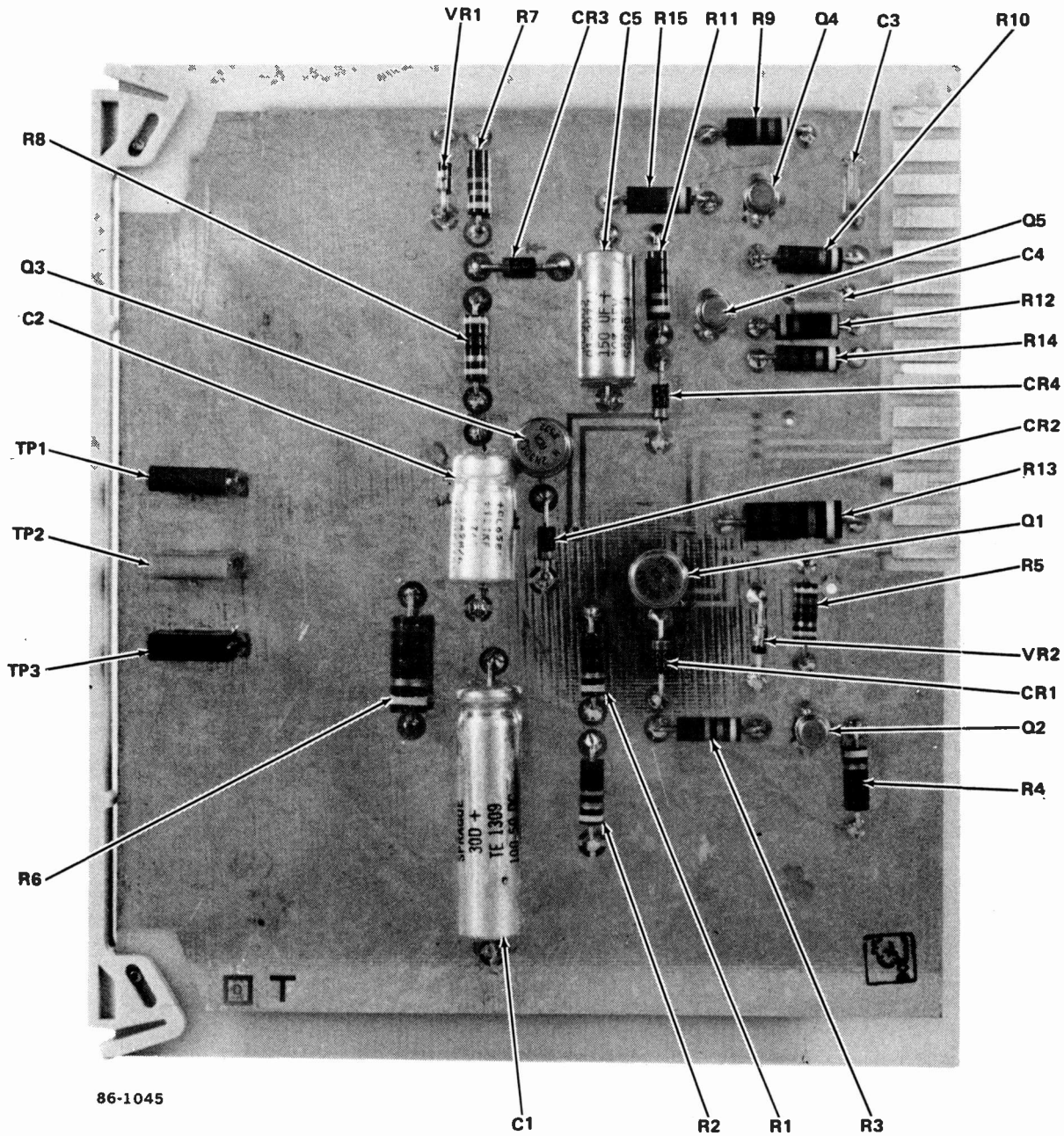
REF DES	DESCRIPTION	CE PART NUMBER
C1	Capacitor, Fxd, Ceramic 0.01 mfd., 20% To1, 100 VDC	913-5019-660
C2	Capacitor, Fxd, Ceramic 0.1 mfd., 20% To1, 50 VDC	913-5019-720
C3	Same as C1	
C4	Capacitor, Fxd, Ceramic 1.0 mfd., 20% To1, 50 VDC	913-5019-840
C5	Same as C2	
C6	Same as C1	
C7	Same as C4	
C8	Same as C2	
C9	Same as C2	
C10	Same as C2	
C11	Same as C2	
C12	Same as C1	
C13	Capacitor, Fxd, Solid Tantalum 10 mfd., +20% To1, 35 VDC	184-9102-410
C14	Capacitor, Fxd, Solid Tantalum 2.2 mfd., +2-0% To1, 35 VDC	184-9102-370
C15	Same as C2	
C16	Capacitor, Fxd, Electrolytic 330 mfd., minus 10% plus 75%, 50 VDC	184-5102-040
C17	Same as C2	
C18	Same as C2	
C19	Same as C2	
C20	Same as C2	
C21	Same as C2	
C22	Same as C2	
C23	Same as C1	
C24	Capacitor, Fxd, Solid Tantalum 4.7 mfd., +20% To1, 35 VDC	184-9102-390
C25	Same as C13	
CR1	Diode, 1N914	353-2906-000
CR2	Same as CR1	
CR3	LED, Yellow	353-0293-020
CR4	Diode, 1N4004	353-6442-040
CR5	Same as CR3	
CR6	LED, Red	353-0293-040
CR7	Same as CR6	
CR8	Same as CR6	
CR9	Same as CR6	
CR10	Diode, 1N4003	353-6442-030
CR11	Same as CR10	
CR12	Same as CR10	

O/L AND RECYCLE BOARD, A7 (Cont.) 640-5380-001

REF DES	DESCRIPTION	CE PART NUMBER
CR13	Same as CR10	
CR14	Same as CR3	
CR15	Same as CR3	
CR16	Same as CR3	
CR17	Same as CR3	
CR18	Same as CR3	
CR19	Same as CR4	
CR20	Same as CR1	
CR21	Same as CR1	
CR22	Same as CR1	
K1	Relay, Reed, SPDT	410-0572-010
Q1	Transistor, 2N2222A	352-0661-020
Q2	Same as Q1	
Q3	Same as Q1	
Q4	SCR, GEC6F	353-6468-010
Q5	Same as Q4	
Q6	Same as Q4	
Q7	Same as Q4	
Q8	Same as Q4	
Q9	Transistor, MJE243	352-1104-010
R1	Resistor, Fxd, Carbon Film 2.2K ohms, 54% To1, 1/4 Watt	745-0910-730
R2	Resistor, Fxd, Carbon Film 10K ohms, 5% To1, 1/4 Watt	745-0910-890
R3	Resistor, Fxd, Carbon Film 1K ohm, 5% To1, 1/4 Watt	745-0910-650
R4	Same as R1	
R5	Resistor, Fxd, Carbon Film 470K ohms, 5% To1, 1/4 Watt	745-0911-300
R6	Resistor, Fxd, Carbon Film 4.7K ohms, 5% To1, 1/4 Watt	745-0910-810
R7	Same as R5	
R8	Resistor, Fxd,Carbon Film 470 Ohms, 5% To1, 1/4 Watt	745-0910-570
R9	Same as R3	
R10	Resistor, Fxd, Composition 2.2 Megohms, 10% To1, 1/4 Watt	745-0869-000
R11	Same as R3	
R12	Resistor, Fxd, Wirewound 150 Ohms, 5% To1, 6.5 Watt	747-5498-000
R13	Resistor, Fxd, Composition 2.7K ohms, 10% To1, 1 Watt	745-3370-000
R14	Same as R13	
R15	Same as R13	
R16	Same as R13	

O/L AND RECYCLE BOARD, A7 (Cont.) 640-5380-001

REF DES	DESCRIPTION	CE PART NUMBER
R17	Resistor, Fxd, Carbon Film 10 Ohms, 5% To1, 1/2 Watt	745-0914-170
R18	Resistor, Fxd, Wirewound 560 Ohms, 5% To1, 6.5 Watt	747-5455-000
R19	Same as R13	
R20	Resistor, Fxd, Carbon Film 220 Ohms, 5% To1, 1/2 Watt	745-0914-490
R21	Same as R20	
R22	Same as R20	
R23	Same as R20	
R24	Resistor, Fxd, Carbon Film 10K ohms, 5% To1, 1/2 Watt	745-0914-890
R25	Resistor, Fxd, Carbon Film 4.7K ohms, 5% To1, 1/2 Watt	745-0914-810
R26	Same as R25	
R27	Same as R25	
R28	Same as R25	
R29	Same as R24	
R30	Same as R13	
R31	Same as R13	
R32	Same as R13	
R33	Same as R13	
R34	Same as R13	
R35	Same as R6	
R36	Same as R6	
R37	Same as R5	
R38	Same as R6	
R39	Same as R2	
S1	Switch, SPDT Push	266-5404-190
S2	Switch, SPDT Toggle	266-5321-980
U1	Integrated Circuit, MC1455P1 (NE555V)	351-1137-020
U2	Same as U1	
U3	Integrated Circuit, MC7400P	351-7629-010
U4	Same as U1	
U5	Integrated Circuit, MC7492	351-7771-010
U6	Integrated Circuit, LM340-5	351-1120-010
U7	Same as U1	
VR1	Diode, 1N4751A, 30 V 1 Watt ZENER	353-6481-470
XK1	Socket, Relay	220-0075-020
XU1	Socket, IC	220-0075-010
XU2	Same as XU1	
XU3	Same as XK1	
XU4	Same as XU1	
XU5	Same as XK1	
U6	Not Used	
XU7	Same as XU1	



PT1-21

Figure 6-8. Power Control Regulator, A8

POWER CONTROL REGULATOR, A8 627-6683-001

REF DES	DESCRIPTION	CE PART NUMBER
C1	Capacitor, Fxd, Electrolytic, 100 mfd., Minus 10%, Plus 75%, 50 VDCW	183-1281-080
C2	Capacitor, Fxd, Electrolytic, 180 mfd., 20% To1, 25 VDCW	184-8664-000
C3	Capacitor, Fxd, Ceramic, 0.1 mfd. Plus 80% minus 20%, 25 VDCW	913-3806-000
C4	Same as C3	
C5	Capacitor, Fxd, Electrolytic, 47 mfd., 20% To1, 20 VDCW	184-9086-080
CR1	Diode, 1N4003	353-6442-030
CR2	Same as CR1	
CR3	Same as CR1	
CR4	Same as CR1	
Q1	Transistor, 2N3053	352-0613-010
Q2	Transistor, 2N2222A	352-0661-020
Q3	Same as Q1	
Q4	Same as Q2	
Q5	Same as Q2	
R1	Resistor, Fxd, Composition, 1000 ohms, 10% To1, 1/2 Watt	745-1352-000
R2	Resistor, Fxd, Composition, 15K ohms, 10% To1, 1/2 Watt	745-1401-000
R3	Resistor, Fxd, Composition, 22K ohms, 10% To1, 1/2 Watt	745-1408-000
R4	Same as R1	
R5	Resistor, Fxd, Composition, 4700 Ohms, 10% To1, 1/2 Watt	745-1380-000
R6	Resistor, Fxd, Composition, 820 Ohms, 10% To1, 1 Watt	745-3349-000
R7	Same as R3	
R8	Resistor, Fxd, Composition, 47 Ohms, 10% To1, 1/2 Watt	745-1296-000
R9	Same as R2	
R10	Resistor, Fxd, Composition, 1500 Ohms, 10% To1, 1/2 Watt	745-1359-000
R11	Resistor, Fxd, Composition, 2700 Ohms, 10% To1, 1/2 Watt	745-1370-000
R12	Same as R8	
R13	Resistor, Fxd, Composition, 1200 Ohms, 10% To1, 1 Watt	745-3356-000
R14	Resistor, Fxd, Composition, 6800 Ohms, 10% To1, 1/2 Watt	745-1387-000
R15	Same as R11	

POWER CONTROL REGULATOR, A8 (Cont.) 627-6683-001

REF DES	DESCRIPTION	CE PART NUMBER
TP1	Jack, Tip Red	360-0495-030
TP2	Jack, Tip Orange	360-0495-040
TP3	Jack, Tip Black	360-0495-010
VR1	Diode, 1N4740	353-6481-260
VR2	Same as VR1	

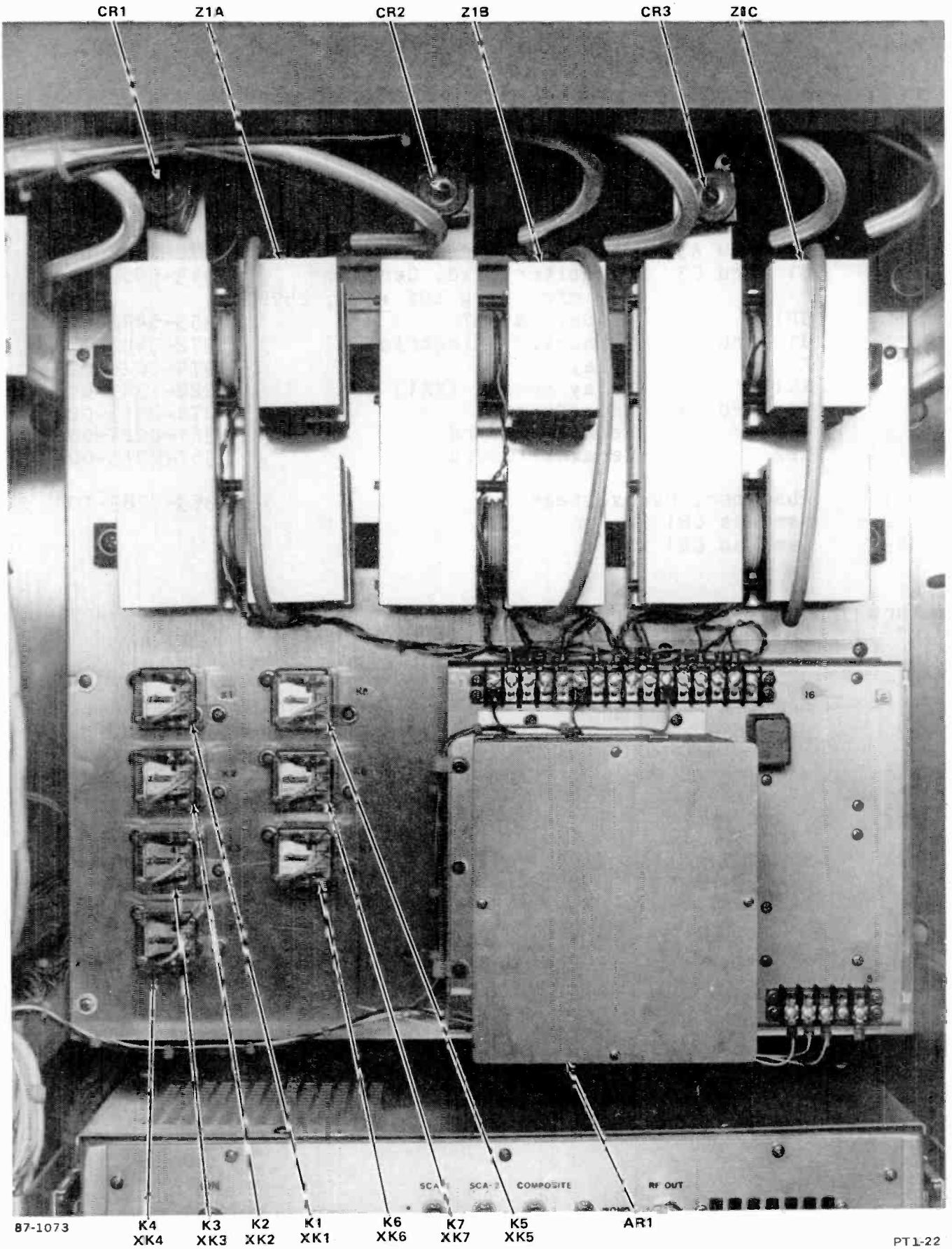


Figure 6-9. Power Control Panel, A9

POWER CONTROL PANEL, A9 789-4342-002

REF DES	DESCRIPTION	CE PART NUMBER
AR1	SCR Gate Drive Assembly	627-5140-001
	Includes	
	A1 thru A3 Card, Gate Drive	270-0313-040
	C1 Thru C3 Capacitor, Fxd, Ceramic 0.1 mfd. Plug 80% ±20%, 25VDCW	913-3806-000
	CR1 Diode, 1N4007	353-6442-070
	J1 Thru J3 Connector, Electrical	372-5906-010
	K1 Relay	974-0076-020
	XK1 Relay Socket (XK1)	220-1543-000
	T1 Thru T3 Transformer	270-0313-020
	TB1 Terminal Board	367-0024-000
	TB2 Terminal Board	367-0013-000
CR1	Absorber, Overvoltage	353-0283-100
CR2	Same as CR1	
CR3	Same as CR1	
K1 Thru K7	Relay	970-2454-270
Q1- thru Q6	P/O Z1A-Z1C	(Not Purchased Separately)
XK1 Thru XK7	Relay Socket 220-1399-010	
Z1A	SCR Assembly 353-6551-010	
Z1B	Same as Z1A	
Z1C	Same as Z1A	

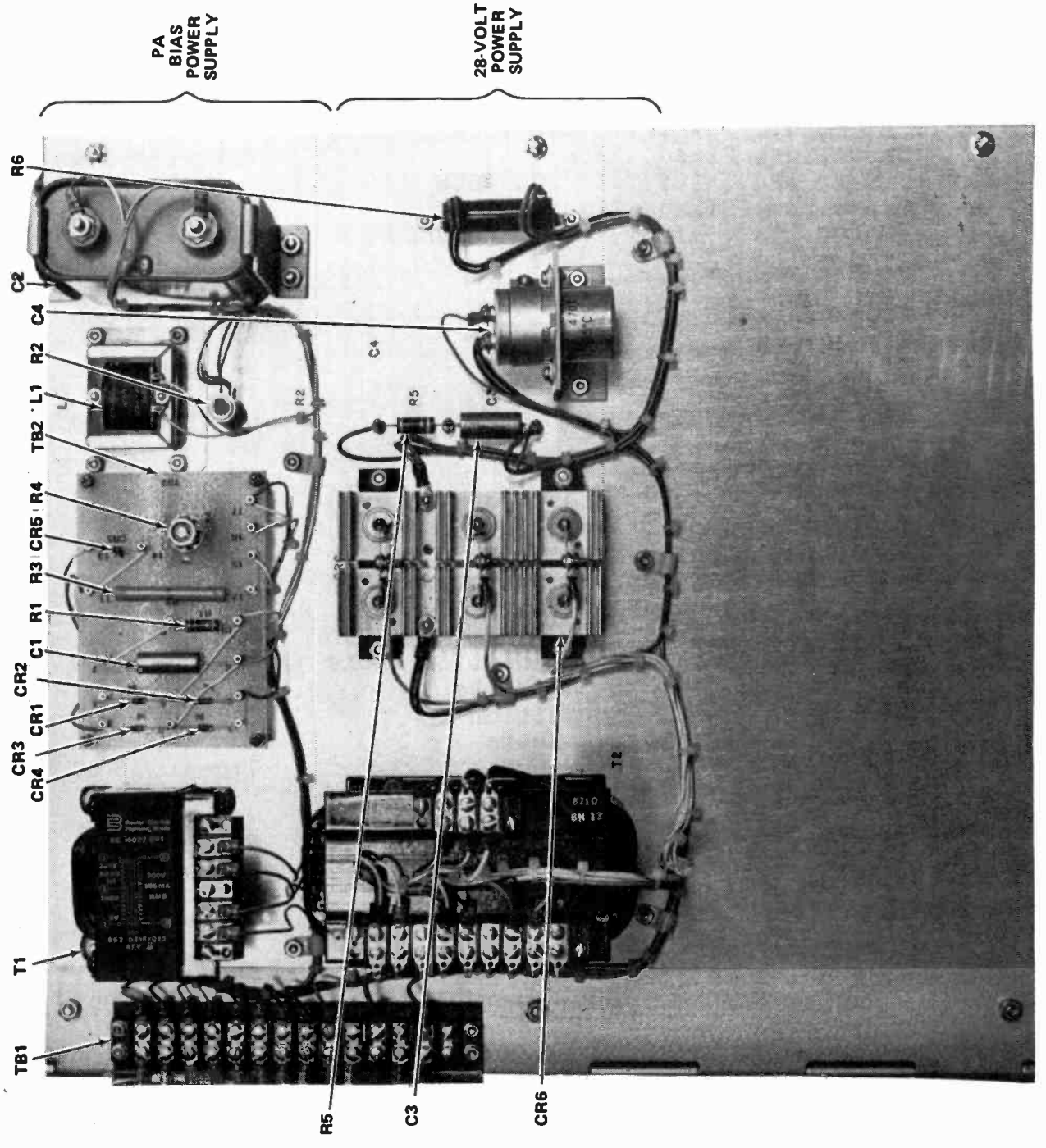


Figure 6-10. Power Supplies, A10

POWER SUPPLIES, A10 159142-3

REF DES	DESCRIPTION	CE PART NUMBER
C1	Capacitor, Fixed, Paper (Note 1) 0.047 mfd., 20% To1, 600 VDCW	931-8592-000
C2	Capacitor, Fixed, Paper 10 mfd., 10% To1, 1000 VDCW	930-0038-000
C3	Capacitor, Fixed, Paper 0.68 mfd., 20% To1, 200 VDCW	951-0118-000
C4	Capacitor, Fixed, Electrolytic 1400 mfd., +100%, -10%, 50 VDCW	184-2516-000
CR1 Through CR5	Diode, 1N4586 (Note 1)	353-6467-050
CR6	Rectifier	353-6327-000
L1	Reactor 5H Inductance	687-0584-000
R1	Resistor, Fixed, Composition (Note 1) 330 Ohms, 10%, 1 Watt	745-3331-000
R2	Resistor, Fixed, Wirewound 10K ohms, 5% To1, 14 Watts	746-9131-000
R3	Resistor, Fixed, Film (Note 1) 1 Megohm, 1% To1, 2 Watts	705-4254-000
R4	Resistor, Variable, Composition (Note 1) 2500 Ohms, 10% To1, 2 Watts	380-2768-000
R5	Resistor, Fixed, Composition 47 Ohms, 10% To1, 2 Watts	745-5596-000
R6	Resistor, Fixed, Wirewound 150 Ohms, 5% To1, 25 Watts	710-3150-100
T1	Transformer, Power, Step-Up	662-0218-010
T2	Transformer, Power, Step-Down	664-0096-010
TB1	Terminal Board 14 Terminals	367-4140-000
TB2	Terminal Board (Component Board) With components	786-3139-001 786-3132-001

Note 1: Components mounted on Terminal Board, TB2

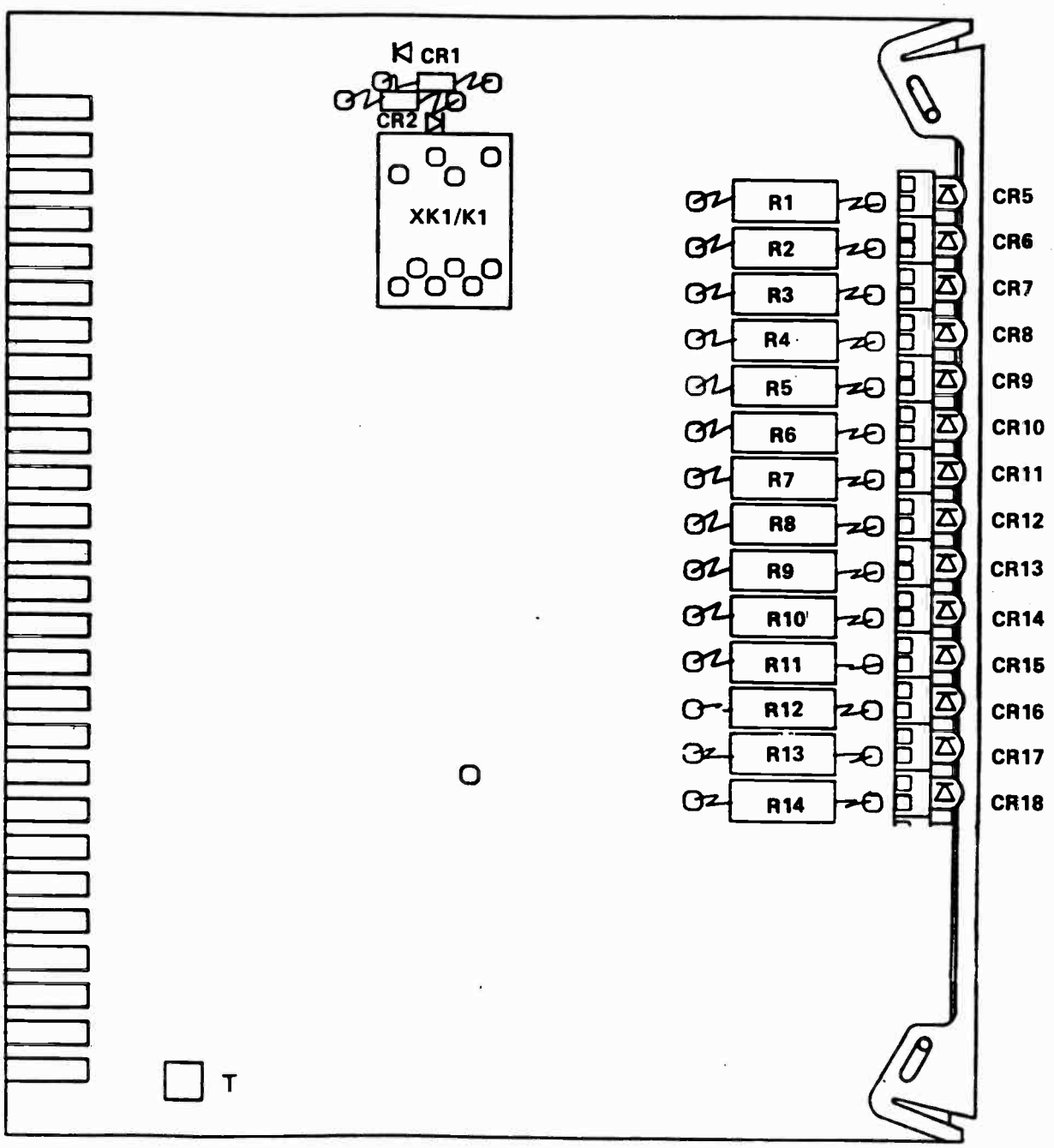
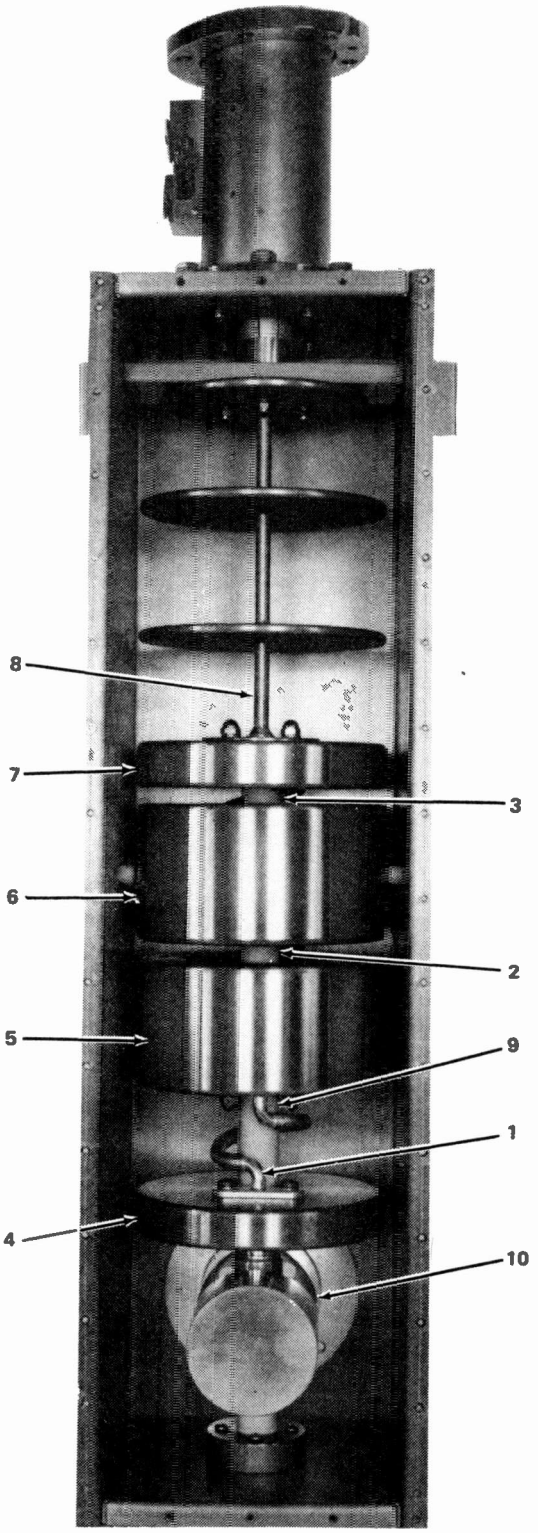


Figure 6-11. Latching Relay and Status Board, A12

LATCHING RELAY AND STATUS BOARD, A12 648-8082-001

REF DES	DESCRIPTION	CE PART NUMBER
CR1	Diode, 1N4004	353-6442-040
CR2	Same as CR1	
CR3	NOT USED	
CR4	NOT USED	
CR5	LED, Yellow	353-0293-020
CR6 Through CR18	Same as CR5	
CR19,20	NOT USED	
K1	Relay, Latching, 2C, 24V	970-0004-030
K2	NOT USED	
R1	Resistor, Fxd, Composition 2.7K ohms 10% To1, 1 Watt	745-3370-000
R2 Through R14	Same as R1	
R15,R16	NOT USED	
XK2	NOT USED	



86-1041

PT1-24

Figure 6-12. RF Output Low-Pass Filter, A13

RF OUTPUT LOW-PASS FILTER, A13 786-3451-003

REF DES	DESCRIPTION	CE PART NUMBER
B1	Fan	009-1766-020
TB1	Terminal Board, 2 Terminals	367-4020-000
1	Coil Assy	786-3367-001
2	Coil Assy	786-3369-001
3	Coil Assy	786-3371-001
4	Capacitor	786-3372-001
5	Capacitor	786-3373-001
6	Capacitor	786-3374-001
7	Capacitor	786-3375-001
8	Capacitor	786-3448-001
9	Capacitor, Rod	786-3435-001
10	Insulator, Disc	786-3469-001

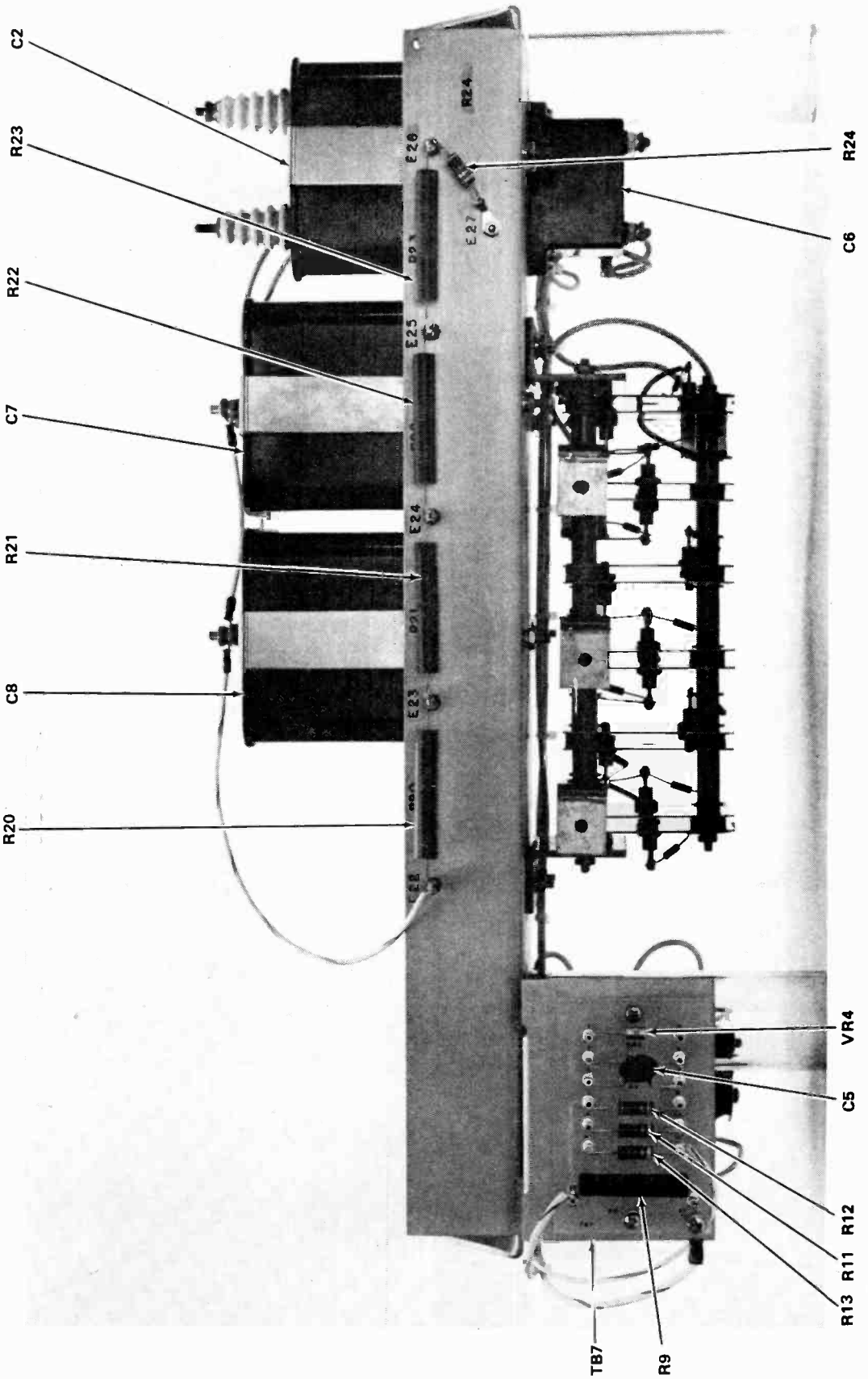


Figure 6-13. Power Supply Filter, A14 (Sheet 1 of 3)

PT1-25

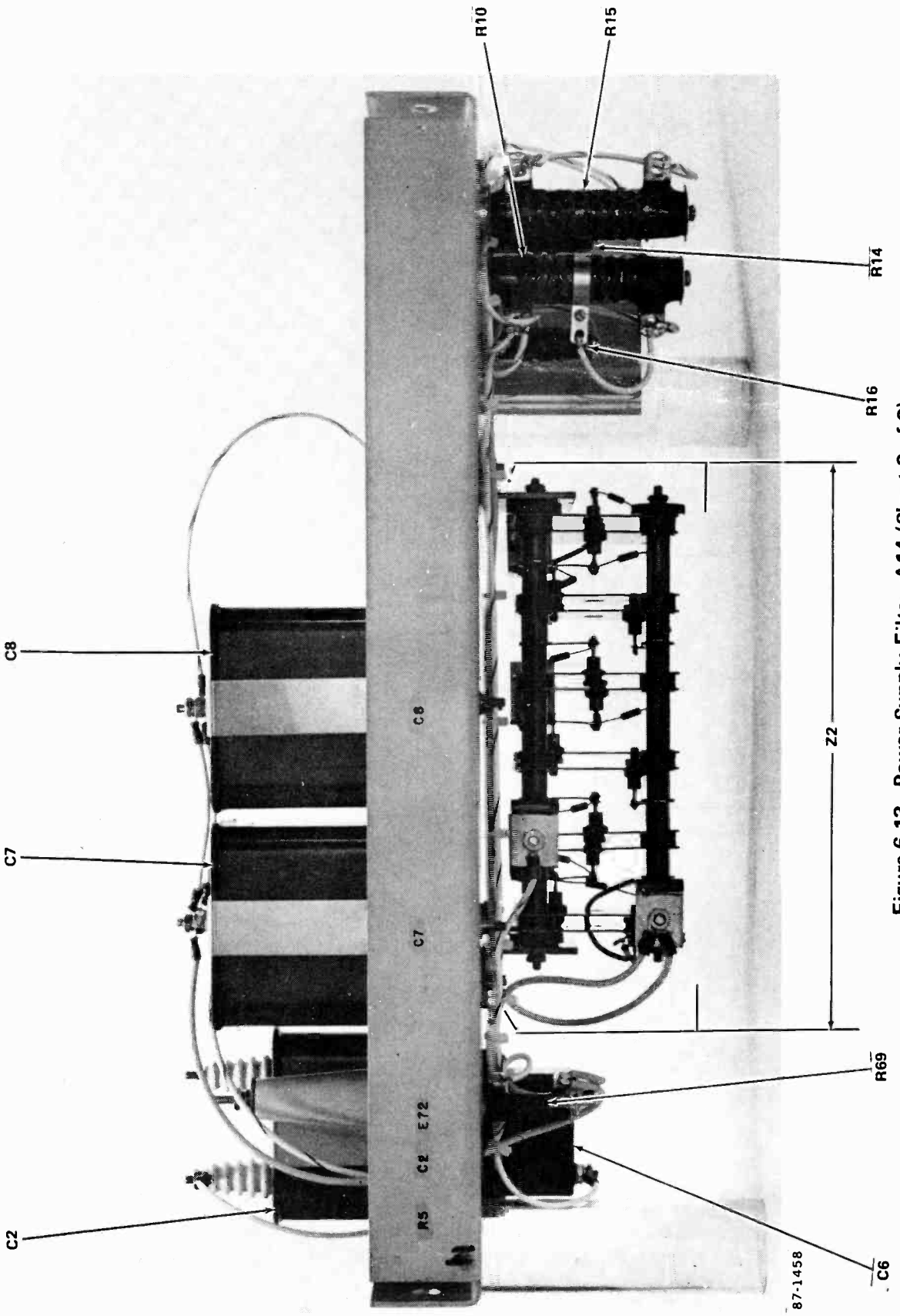
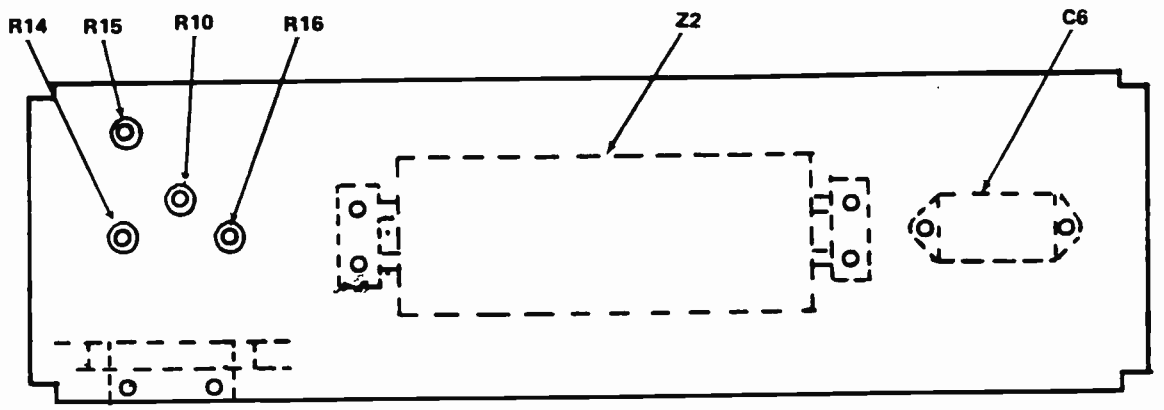
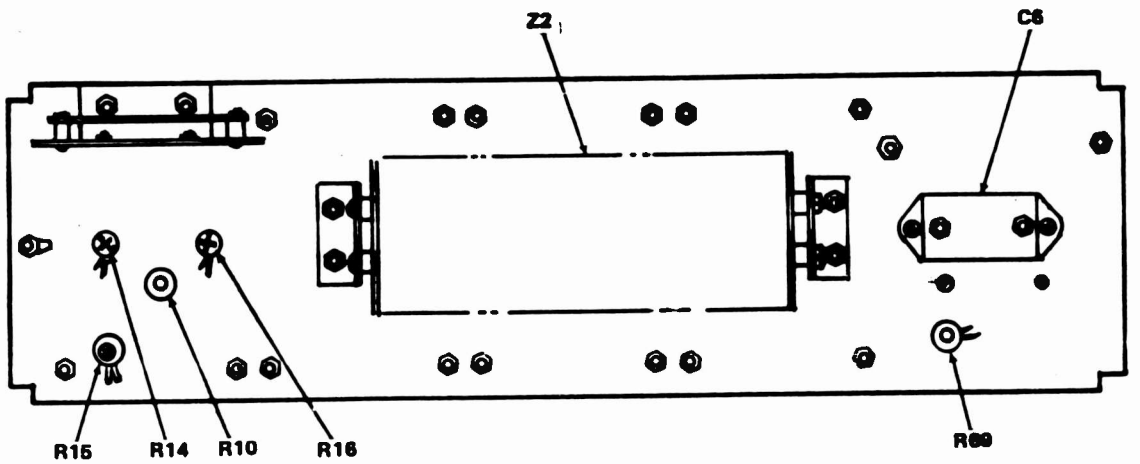


Figure 6-13. Power Supply Filter, A14 (Sheet 2 of 3)



TOP VIEW



BOTTOM VIEW

(ALTERNATE MOUNTING OF R10,R14,R15 & R16)

Figure 6-13. Power Supply Filter, A14 (Sheet 3 of 3)

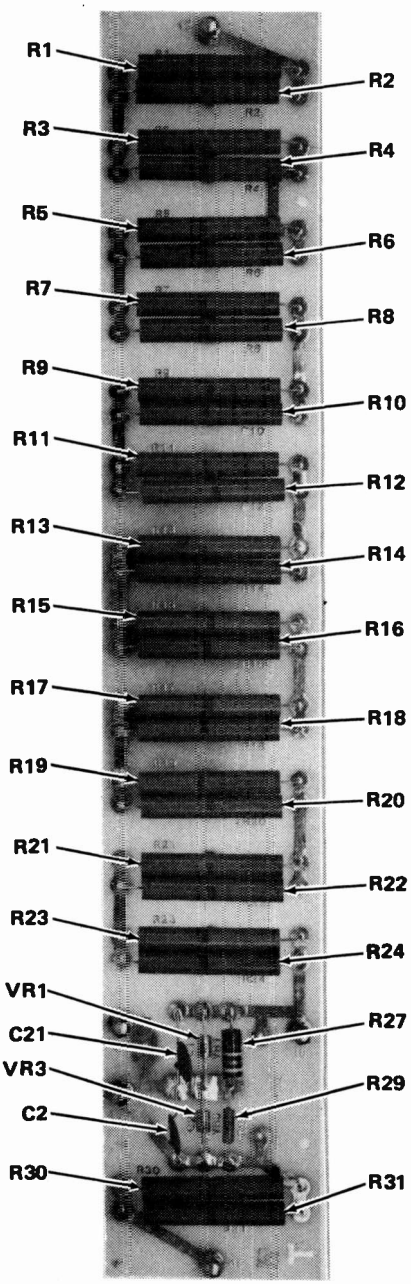
POWER SUPPLY FILTER, A14 786-3583-004

REF DES	DESCRIPTION	CE PART NUMBER	
C1	Not Used		
C2	Not Used		
C3	Not Used		
C4	Not Used		
C5	Capacitor, Fxd, Ceramic, 0.01 mfd., 20% To1, 500 VDCW	913-1188-000	
C6	Capacitor, Fxd, 0.05 mfd. ,2% To1, 2000 VDCW	938-5016-010	
C7	Capacitor, Fxd, Paper, 12 mfd., 10% To1, 1500 VDCW	962-4246-000	
C8	Same as C7		
C9	Not Used		
R1 Through R4	Not Used		
R5	Not Used		
R6	Not Used		
R7	Not Used		
R8	Not Used		
R9	Resistor, Fxd, Wirewound, 0.25 Ohms, 1% To1, 10 Watts	747-9451-000	
R10	Resistor, Fxd, Wirewound, 4 Ohms, 10% To1, 100 Watts	710-5076-060	
R11	Resistor, Fxd, Composition, 1200 Ohms, 5% To1, 1 Watt	745-3355-000	
R12	Resistor, Fxd, Composition, 3600 Ohms, 5% To1, 1 Watt	745-3375-000	
R13	Same as R11		
R14	Resistor, Fxd, Wirewound, 0.5 Ohms, 1% To1, 36 Watts	710-5076-030	
R15,	Same as R10		*
R16	Not Used		
R17	Not Used		
R18	Not Used		
R19	Not Used		
R20	Resistor, Fxd, Film 200K ohms, 1% To1, 2 Watts	705-1493-050	
R21	Same as R20		
R22	Same as R20		
R23	Same as R20		
R24	Resistor, Fxd Composition, 47K ohms, 10% To1, 1 Watt	745-3422-000	

POWER SUPPLY FILTER, A14 (Cont.) 786-3583-001

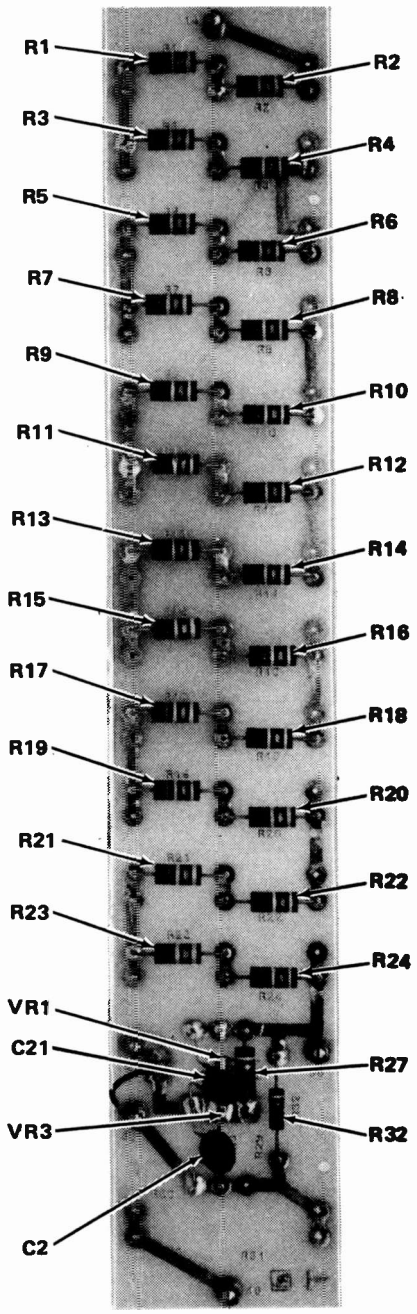
REF DES	DESCRIPTION	CE PART NUMBER
R25	Not Used	
R26	Not Used	
R27	Not Used	
R28	Not Used	
R68		
R69	Resistor, Fxd, Wirewound 310 Ohms, 5% To1, 14 Watts	747-0754-000
TB1		
Through	Not Used	
TB6		
TB7	Board, Terminal	786-3126-001
VR1	Not Used	
VR2	Not Used	
VR3	Diode	353-3121-000
VR4	Same as VR3	
Z1	Not Used	
Z2	Rectifier	353-0434-010

A15 A



86-1034

A15 B



86-1033

PT1-27

Figure 6-14. Metering Multiplier Board, A15

METERING MULTIPLIER BOARD, A15 (A) 643-7445-001

REF DES	DESCRIPTION	CE PART NUMBER
C21	Capacitor, Fxd, Ceramic, 0.01 mfd., 20% To1, 500 VDCW	913-1188-000
C2	Same as C1	
R1	Resistor, Fxd, Film, 750K ohms, 1% To1, 2 Watts	705-1493-020
R2 Through R24	Same as R1	
R25,R26	Not Used	
R27	Resistor, Fxd, Composition, 180K ohms, 10% To1, 2 Watt	745-5746-000
R28	Not Used	
R29	Resistor, Fxd, Film, 5110 Ohms, 1% To1, 1/2 Watt	705-7130-000
R30,R31	Resistor, Fxd, Film, 1.0 Megohm, 1% To1, 2 Watts	705-4254-000
VR1,VR3 VR2	Diode, 100V ZENER	

REMOTE METERING MULTIPLIER BOARD, A15 (B) 643-7446-001

C1	Capacitor Fxd, Ceramic, 0.01 mfd., 20% To1, 500 VDCW	913-1188-000
C2	Same as C1	
R1 Through R24	Resistor, Fxd, Carbon, 180K ohms, 5% To1, 2 Watts	745-5746-000
R25,R26	Not Used	
R27	Resistor, Fxd, Composition, 1800 ohms, 10% To1, 2 Watt	745-5662-000
R28 Through R31	Not Used	
R32	Resistor, Fxd, Composition, 10K Ohms, 1W	745-3393-000
VR1	Zener Diode, 100V	353-1339-000
VR2	Not Used	
VR3	Zener, Diode, 6.8V	353-3121-000

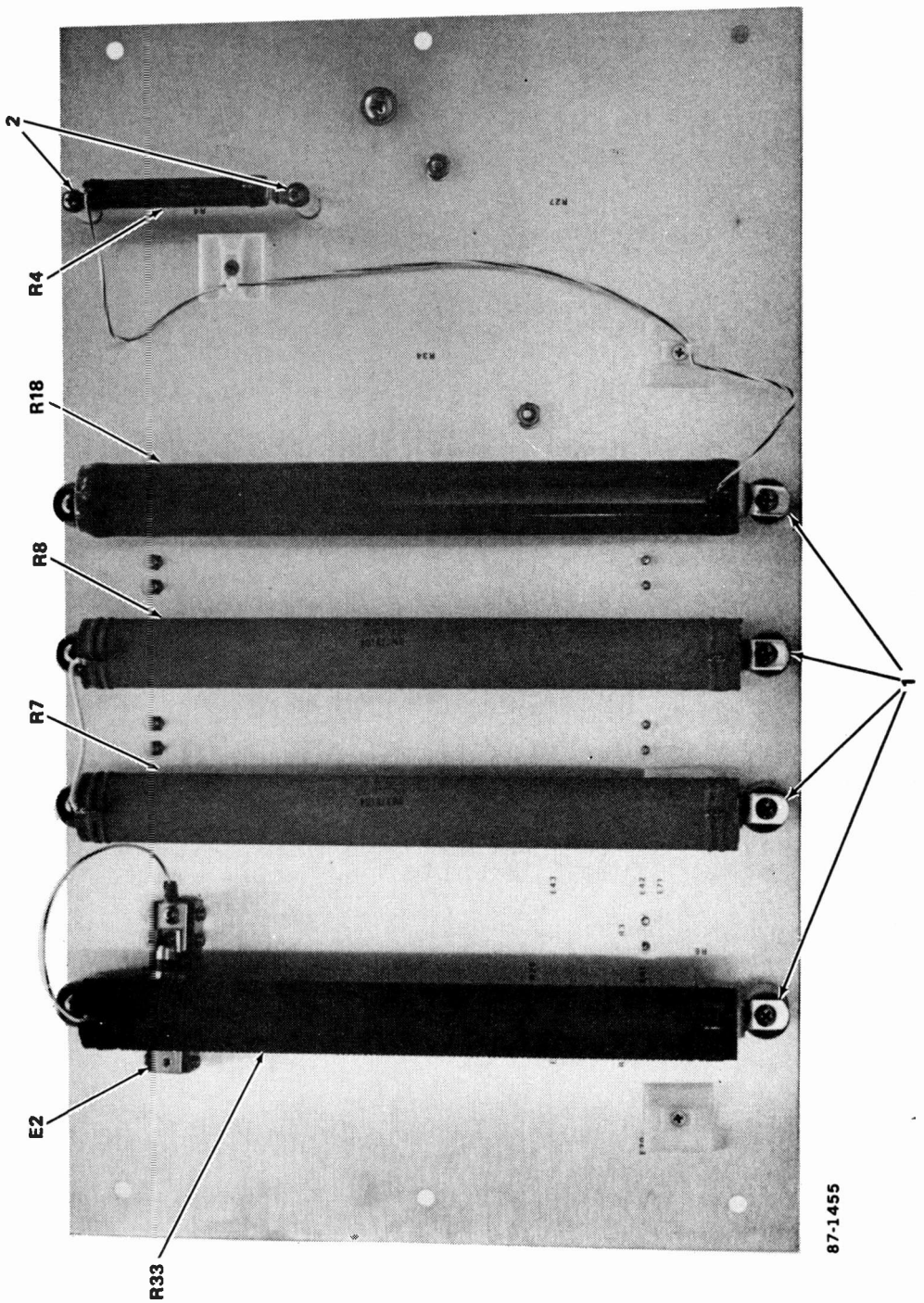


Figure 6-15. Bleeder Resistor Panel, A17, Front

PT1-28

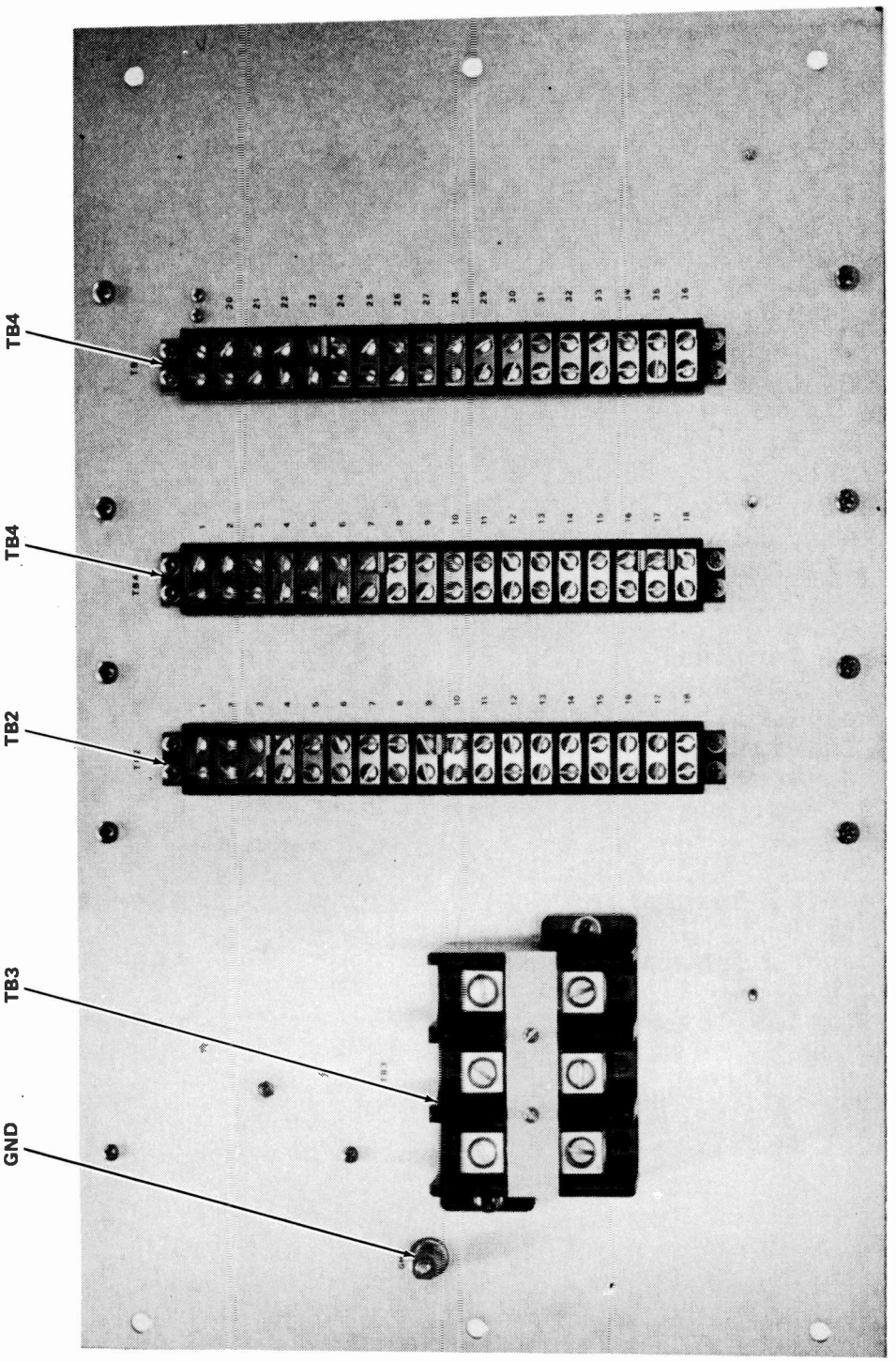
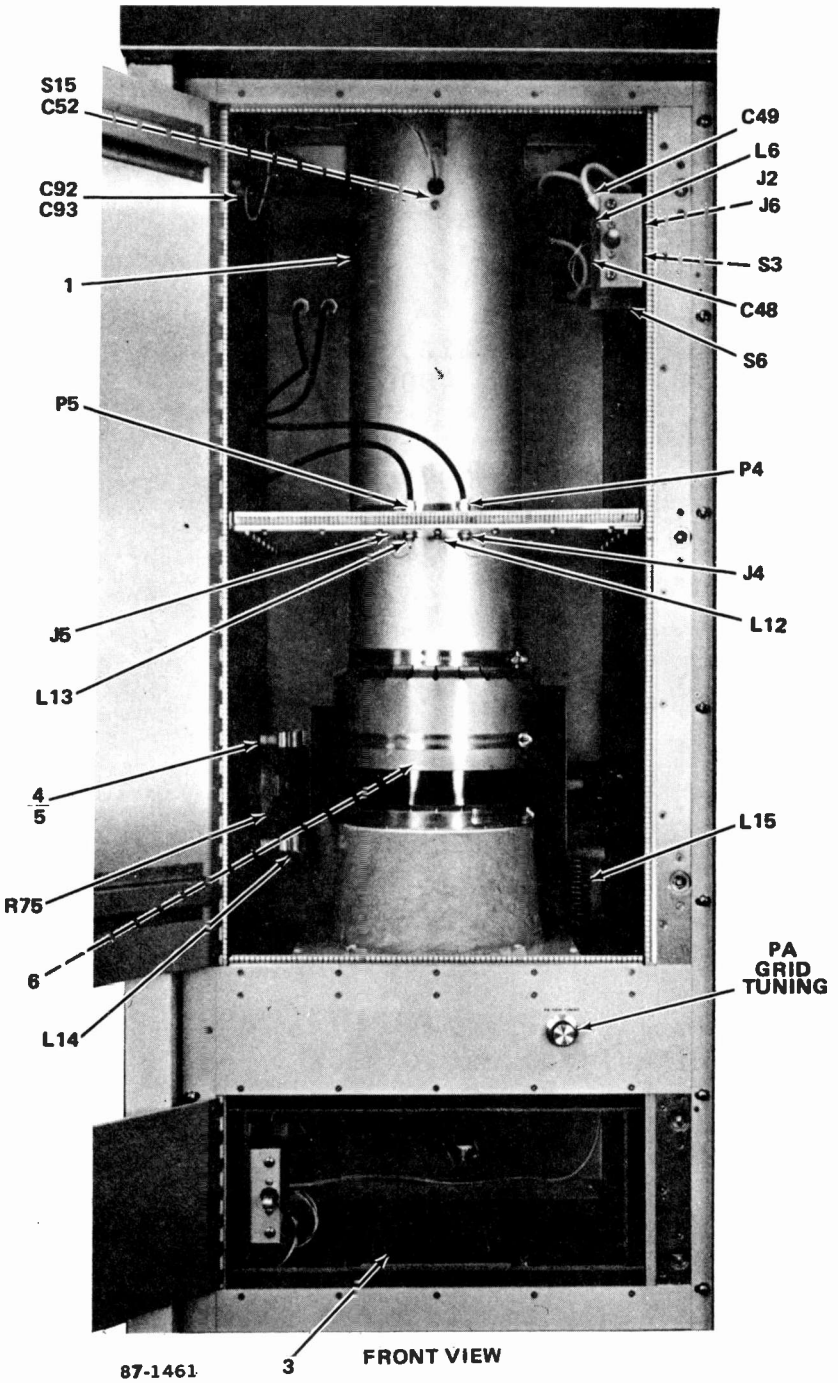


Figure 6-15. Bleeder Resistor Panel, A17, Back

PT1-29

BLEEDER RESISTOR PANEL, A17 786-3154-003

REF DES	DESCRIPTION	CE PART NUMBER
E1	Not Used	
E2	Arrestor, Lightning	013-1332-020
R1	Not Used	
R2, R3	Not Used	
R4	Resistor, Fxd, Wirewound, 330 Ohms, 5% To1, 26 Watts	747-1790-000
R5	Not Used	
R6	Resistor, Fxd, Wirewound 18 Ohms, 5% To1, 210 Watts	746-6662-000
R7	Resistor, Fxd, Wirewound, 100K ohms, 5% To1, 210 Watts	746-6737-000
R8	Same as R7	
R9 Through R17	Not Used	
R18	Resistor, Fxd, Wirewound 5.1K ohms, 5% To1, 210 Watts	746-6817-000
TB1	Not Used	
TB2	Board, Terminal 18 Terminals	367-4180-000
TB3	Board, Terminal 3 Terminals	367-1188-000
TB4	Board, Terminal 18 Terminals -Qty 2-	367-4180-000
1	Standoff, Insulator -Qty 8-	190-0025-000
2	Standoff, Insulator -Qty 2-	190-1145-000
3	Plexiglass Cover	648-8101-001



PT1-30

Figure 6-16. Power Amplifier Cavity, A18

POWER AMPLIFIER CAVITY, A18 786-3335-005

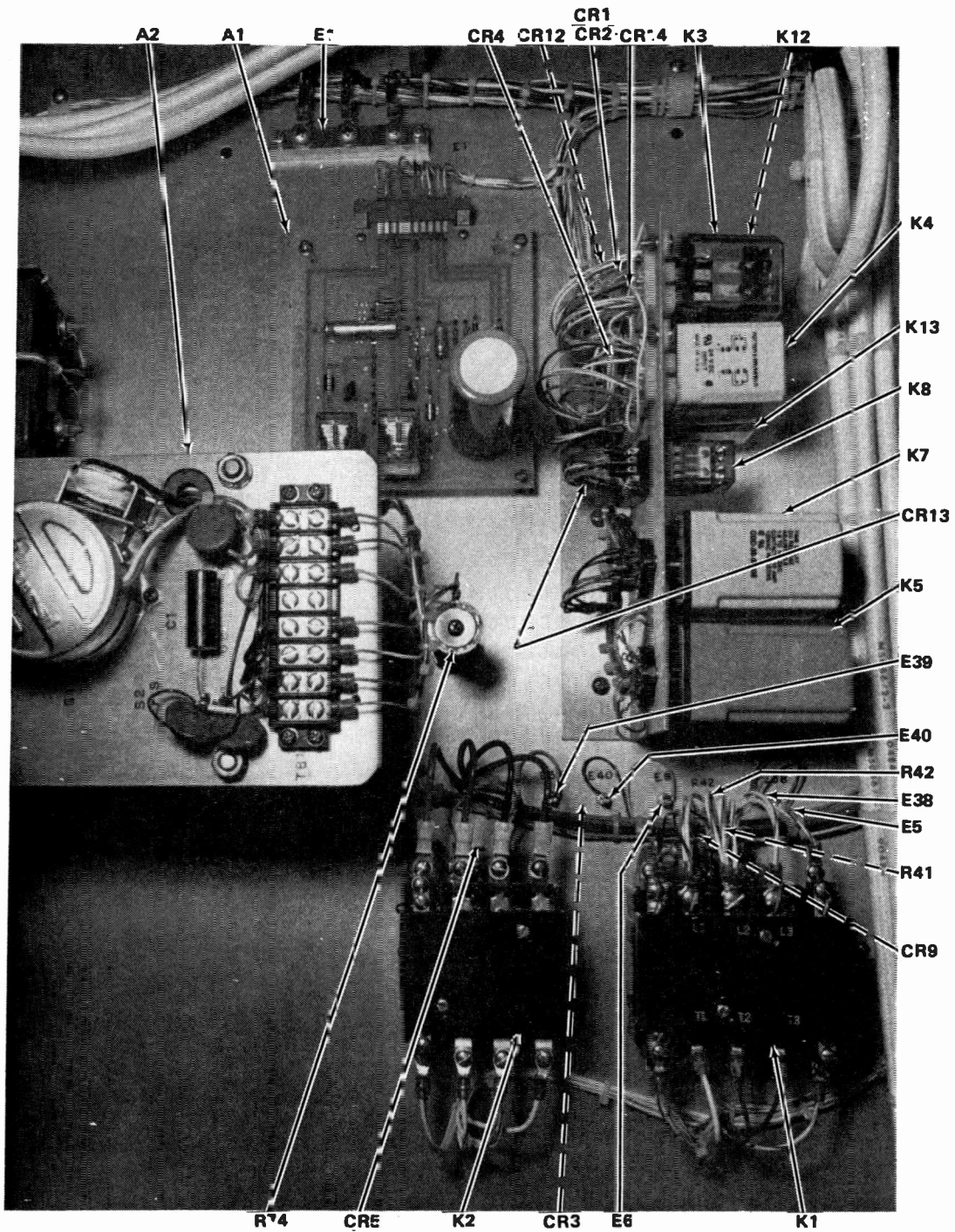
REF DES	DESCRIPTION	CE PART NUMBER
B1	Not Used	
B2	Motor, AC 115 VAC	230-0581-010
B3	Same as B2	
C1	Capacitor, Air Var, 5.5-10.2 pf	922-8011-010
C2	Capacitor, Vacuum, Var 3-30 pf, 7.5 kV	919-0301-010
C3	Mechanical Assy.	
C4-C31	Not Used	
C32	Capacitor, Fxd, Ceramic, 1000 mfd. 20% To1, 4000 VDCW	913-3120-020
C33 - C39	Not Used	
C40	Capacitor, Fxd, Ceramic 310 pf, 5% To1, 2500 VDCW	913-0845-000
C41	Capacitor, Fxd, Paper 0.47 mfd., 20% To1, 400 VDCW	931-6849-000
C42	Same as C41	
C43	Not Used	
C44	Not Used	
C45	Capacitor, Blocking	159422-1
C46	Capacitor, Fxd, Paper 10 mfd., 10% To1, 1 KVDCW	930-0038-000
C47	Not Used	
C48	Capacitor, Fxd, Ceramic 500 pf, Plus 50% Minus 20%, 20,000 VDCW	913-1101-000
C49	Same as C48	
C50, C51	Not Used	
C52	Capacitor, Fxd, Ceramic 100 pf, 10% To1, 15,000 VDCW	913-5113-050
C53	Not Used	
C54	Capacitor, Fxd, Ceramic 1000 pf, 20% To1, 2000 VDCW	913-4843-000
C55	Capacitor, Fxd, Paper 0.1 mfd., 10% To1, 600 VDCW	241-0090-000
C56	Same as C55	
C57A	Capacitor, Fxd., Ceramic, 100 pf, 5kV	913-0821-000
C57B	Same as C57A	
C58 - C80	Not Used	
C81	Capacitor, Fxd, Ceramic 1000 pf, 20% To1, 5000 VDCW	913-0101-000
C82	Capacitor, Fxd, Ceramic 1000 pf, 20% To1, 500 VDC	913-4064-000
C83 - C85	Same as C82	

POWER AMPLIFIER CAVITY, A18 (Cont.) 786-3335-006

REF DES	DESCRIPTION	CE PART NUMBER
C86	Capacitor, Fxd, Ceramic 0.1 mfd., Plus 80% Minus 20%, 500 VDCW	913-3152-000
C87 - C91	Same as C86	
C92, C93	Same as C82	
J1	Connector, Type N	357-9003-000
J2	Connector, Electrical 1 Contact	357-9248-010
J3	Not Used	
J4	Connector, Electrical 1 Contact	357-9670-000
J5	Same as J4	
J6	Same as J2	
L1 - L4	Not Used	
L5	PA Grid RFC, 4.7 uH	240-1611-000
L6	Choke, RF	786-3548-001
L7 Through L11	Not Used	
L12	Inductive Coupling Loop, 1" #20 Buss	421-2020-000
L13	Same as L12	
L14	Choke, RF	786-3673-001
L15	Choke, Static Drain	640-3527-000
P1 - P3	Not Used	
P4	Connector, Electrical 1 Contact	357-9292-000
P5	Same as P4	
R1	Resistor, 50 Ohm	712-4236-000
R2 Through R34	Not Used	
R35	Resistor, Var, Wirewound, 1.0K ohm, 10%, To1, 50 Watts	749-1026-000
R36	Resistor, Fxd, Wirewound, 3.0K ohms, 5%, To1, 80 Watts	710-9294-000
R37 - R54	Not Used	
R55	Resistor, Fxd, Composition 22 Ohms, 10% To1, 2 Watts	745-5582-000

POWER AMPLIFIER CAVITY, A18 (Cont.) 786-3335-005

REF DES	DESCRIPTION	CE PART NUMBER
R56, R57	Not Used	
R58	Not Used	
R59 - R74	Not Used	
R75	Resistor, Fxd., 50 Ohms, 60W	712-0070-000
R76 - R79	Not Used	
R80	Resistor, Fxd., Wirewound 1.5K Ohm	710-3372-000
S1	Switch, Pressure SPDT Contact Arrangement	266-8384-090
S2	Switch, Sensitive SPDT Contact Arrangement Includes	260-0025-000
	Actuator	260-0026-000
S3	Same as S2	
S4	Not Used	
S5	Not Used	
S6	Shorting Switch Includes	627-9743-004
	Spring, Shorting Switch	540-5342-002
	Strap, Grounding	304-6000-000
	Contact, Shorting	542-1773-002
	Shaft, Flat, Straight	627-9786-001
	Insulator, Standoff	190-0026-000
S7	Same as S6	
S8	Not Used	
S9	Not Used	
S10	Not Used	
S11	Switch, Sensitive SPDT Contact Arrangement	266-3081-000
S12	Same as S11	
S13	Same as S11	
S14	Same as S11	
S15	Switch, Thermostatic	267-0243-100
T1	Transformer, PWR, Step-down	662-0410-020
V1	Electron Tube, 4CX15000A	256-0157-000
1	Conductor, Center, Cavity	786-3124-001
2	Duct, Blower	786-3026-001
3	Shield, RF	786-3095-001
4	Ceramic Post -Qty 2-	190-1149-000
5	Clamp -Qty 2-	516-6730-001
6	Tube Clip	265-9020-000



PT1-31

Figure 6-17. Component Panel, A19

COMPONENT PANEL, A19 — 648-8124-001

REF DES	DESCRIPTION	CE PART NUMBER
A1	Power Failure Recycle Board See Breakdown on page 6-65	640-3466-001
A2	Variac Drive Assembly See breakdown on page 6-67	648-8104-001
CR1	Diode, 1N645	353-2607-000
CR2	Same as CR1	
CR3	Diode, 1N4007	353-6442-070
CR4	Same as CR1	
CR5	Same as CR1	
CR6	Not Used	
CR7	Not Used	
CR8	Not Used	
CR9	Same as CR1	
CR10	Not Used	
CR11	Not Used	
CR12	Same as CR1	
CR13,14	Diode 1N4007	353-6442-070
K1	Relay, Contactor, 28V Coil 3A 40 Amp Contacts 1B 10 Amp Contact 1C 10 Amp Contact	401-1607-000
K2	Relay, Contactor, 28V Coil 5A 10 Amp Contacts 1C 10 Amp Contact	401-1614-000
K3	Relay, 24 VDC Coil 3C Low Level Contacts	970-0007-180
K4	Relay, Time Delay, 30 sec. 24V Coil, 2C 10 Amp Contacts	402-0489-190
K5	Relay, Phase Monitor 190-270V, SPDT 10A Contacts	403-0038-010
K6, K7 Through K11	Not Used	
K8	Relay, 24VDC	970-0002-030
K12	Same as K3	
K13	Same as K3	
R1-R40	Not Used	
R41	Resistor, Fxd, Composition 820 Ohms, 10% To1, 2 Watt	745-5649-000
R42	Same as R41	
R43-R73	Not Used	
R74	Resistor, Fxd, Wirewound 0.5 Ohm, 10% To1, 100 Watts	710-5076-050

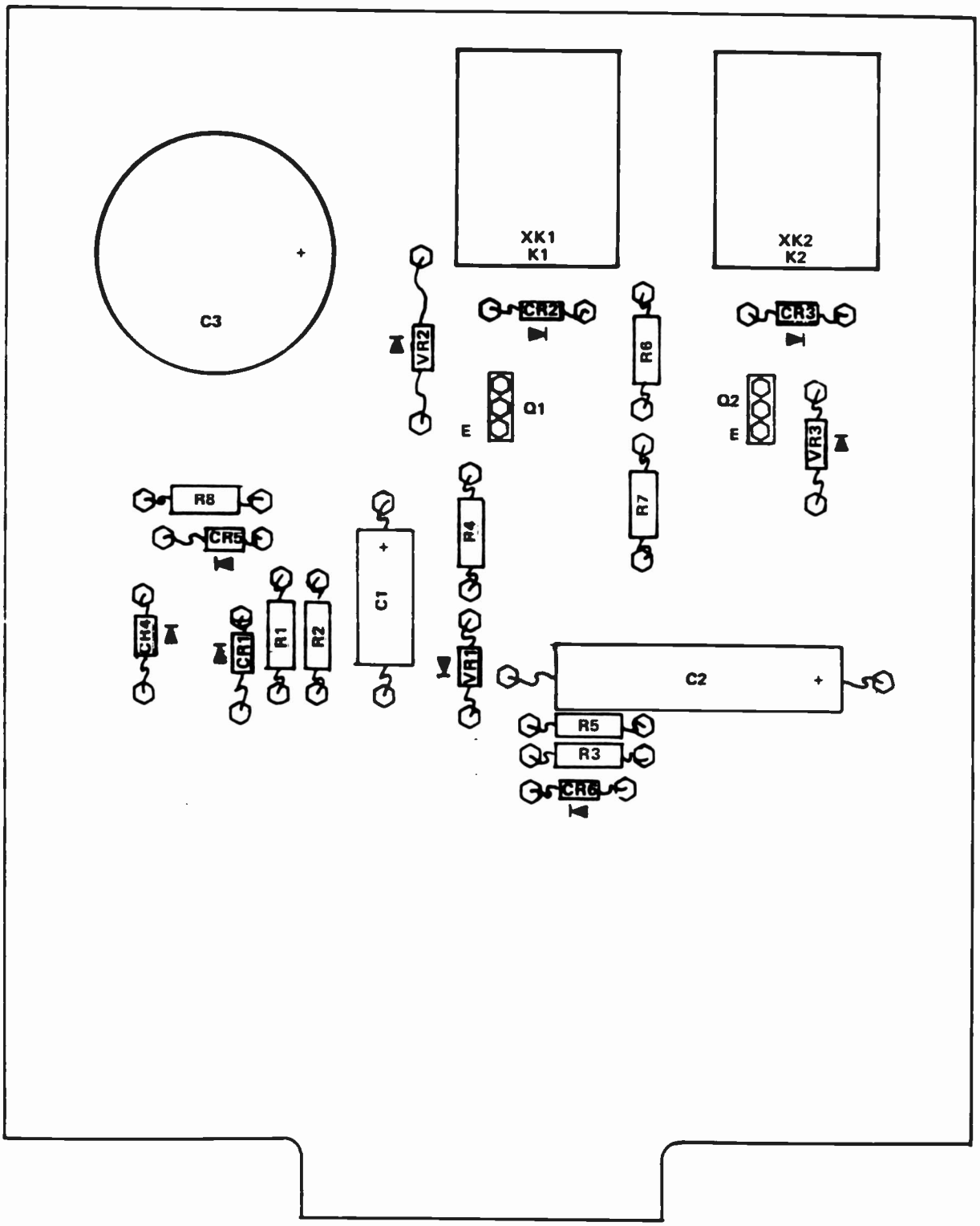


Figure 6-18. Power Failure Recycle Board, A19A1

POWER FAILURE RECYCLE BOARD, A19A1 640-3466-001

REF DES	DESCRIPTION	CE PART NUMBER
C1	Capacitor, Fxd, Electrolytic 68 mfd., 20% To1, 40 VDCW	184-6330-360
C2	Capacitor, Fxd, Electrolytic 100 mfd., Minus 10% Plus 75%, 50 VDC	183-1281-080
C3	Capacitor, Fxd, Electrolytic 5500 mfd., +100%, -10%, 40 VDCW	183-1278-180
CR	Diode, 1N4003	353-6442-030
CR2 Through CR6	Same as CR1	
K1	Relay, 24 V Coil 4C 3 Amp Contacts	970-0002-030
K2	Same as K1	
Q1	Transistor, MJE-243	352-1104-010
Q2	Same as Q1	
R1	Resistor, Fxd, Carbon Film 220 Ohms, 5% To1, 1/2 Watt	745-0914-490
R2	Resistor, Fxd, Carbon Film 100K ohms, 5% To1, 1/2 Watt	745-0915-140
R3	Resistor, Fxd, Carbon Film 2.2K ohms, 5% To1, 1/2 Watt	745-0914-730
R4	Same as R3	
R5	Same as R3	
R6	Resistor, Fxd, Carbon Film 10K ohms, 5% To1, 1/2 Watt	745-0914-890
R7	Same as R3	
R8	Same as R3	
VR1	Diode, 1N4735, 6.2V, 1W Zener	353-6481-160
VR2	Diode, 1N5646A, 36V, 1W Zener	353-0221-360
VR3	Same as VR2	
XK1	Relay Socket	220-1582-010
XK2	Same as XK1	

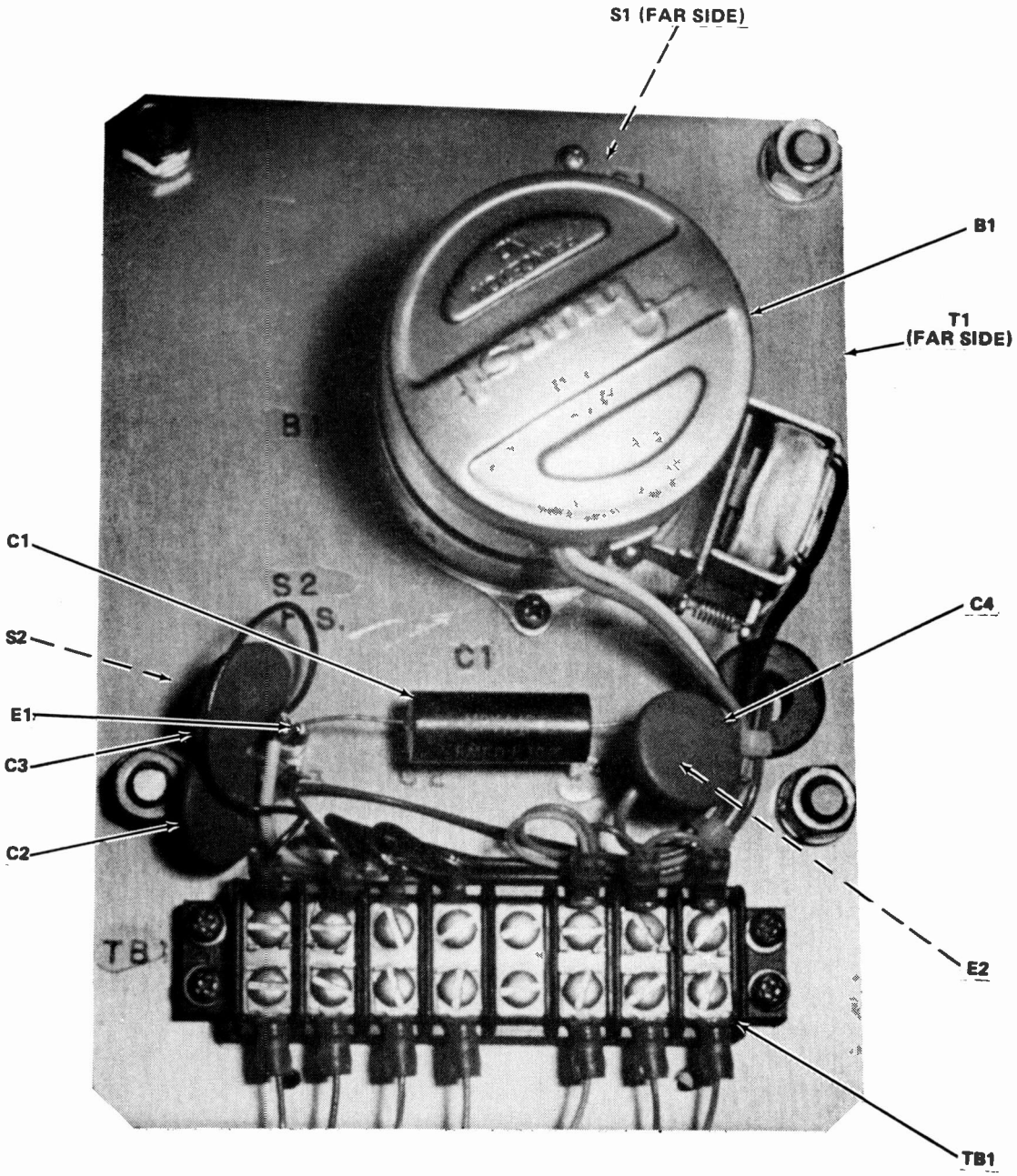


Figure 6-19. Variable Transformer Drive Assembly, A19A2

VARIABLE TRANSFORMER DRIVE ASSEMBLY, A19A2 648-8104-001

REF DES	DESCRIPTION	CE PART NUMBER
B1	Motor, AC, 115V	230-0581-010
C1	Capacitor, Fxd, Paper 0.47 mfd., 20% To1, 400 VDCW	913-6849-000
C2	Capacitor, Fxd, Ceramic 0.1 mfd., plus 80% Minus 20%, 500V	913-3234-000
C3	Same as C2	
C4	Same as C2	
S1	Switch, SPDT Snap Action 2.5 Amp Contacts	260-2293-000
S2	Same as S1	
T1	Transformer, Pwr, Variable	664-4010-020
TB1	Terminal Board, 8 Terminals	367-4080-000

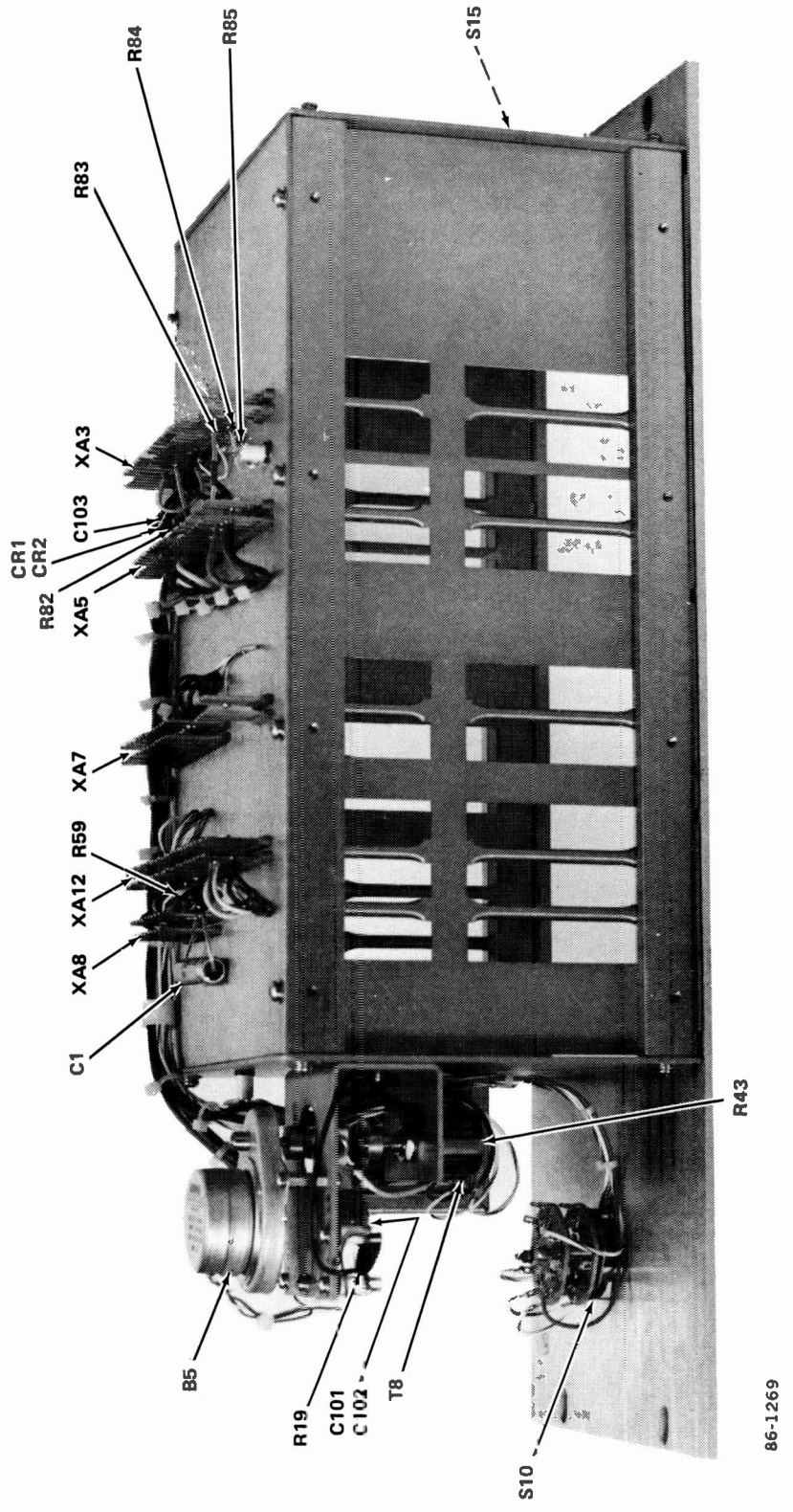


Figure 6-20. Card Cage Asembly, A20

PT1-33

CARD CAGE ASSEMBLY, A20 786-3301-002

REF DES	DESCRIPTION	CE PART NUMBER
B1 Through B4	Not Used	
B5	Motor, Reversible, 115 VAC	230-5006-010
C1	Capacitor, Fxd, Electrolytic 100 mfd., Minus 10%, Plus 75%, 50 VDC	183-1281-080
C2 Through C100	Not Used	
C101	Capacitor, Fxd, Ceramic 0.01 mfd., 20% To1, 500 VDCW	913-1188-000
C102	Capacitor, Fxd, Paper 0.33 mfd., 20% To1, 600 VDCW	933-5005-010
C103	Capacitor, Fxd, Electrolytic 100 mfd., Minus 10% Plus 75% 50 VDC	183-1281-080
CR1	Diode, 1N4003	
CR2	Same as CR1	
R1 Through R18	Not Used	
R19	Resistor, Fxd, Composition 100 Ohms, 10% To1, 1 Watt	745-3310-000
R20 Through R42	Not Used	
R43	Resistor, Var, Wirewound, 10 Turn 5K Ohms, 3# To1, 2 Watts	381-1648-020
R44 Through R58	Not Used	
R59	Resistor, Fxd, Composition 820 Ohms, 10% To1, 1/2 Watt	745-1349-000
R60 - R81	Not Used	
R82	Resistor, Fxd, Carbon Film 470 Ohms, 5% To1, 1/2 Watt	745-0914-570
R83	Same as R82	
R84	Resistor, Fixed Comp, 22K, 1/4 W	745-0796-000
R85	Resistor, Fxd, Composition 100K Ohms, 1/4 Watt	745-0820-000

CARD CAGE ASSEMBLY, A20 (Cont.) 786-3301-002

REF DES	DESCRIPTION	CE PART NUMBER
S1 - S9	Not Used	
	CARD CAGE ASSEMBLY, A20	786-3301-002
S10	Switch, Rotary DPDT Contact Arrangement	259-2694-010
S11 Through S14	Not Used	
S15	Switch, Interlock SPDT Contact Arrangement	266-8000-000
T1 Through T7	Not Used	
T8	Transformer, Pwr, Single Phase 50/60 Hz 166 V RMS Pri, 24 V RMS Sec (1) 56V RMS C.T. Sec (2)	662-0898-010
XA1	Not Used	
XA3	Connector, Electrical 4 Contacts -Qty 11-	
XA4	Not Used	
XA5	Same as XA3	
XA6	Not Used	
XA7	Same as XA2A	
XA8	Same as XA2B	
XA9	Not Used	
XA10	Not Used	
XA11	Not Used	
XA12	Connector, Electrical 4 Contacts -Qty 13-	372-2426-010

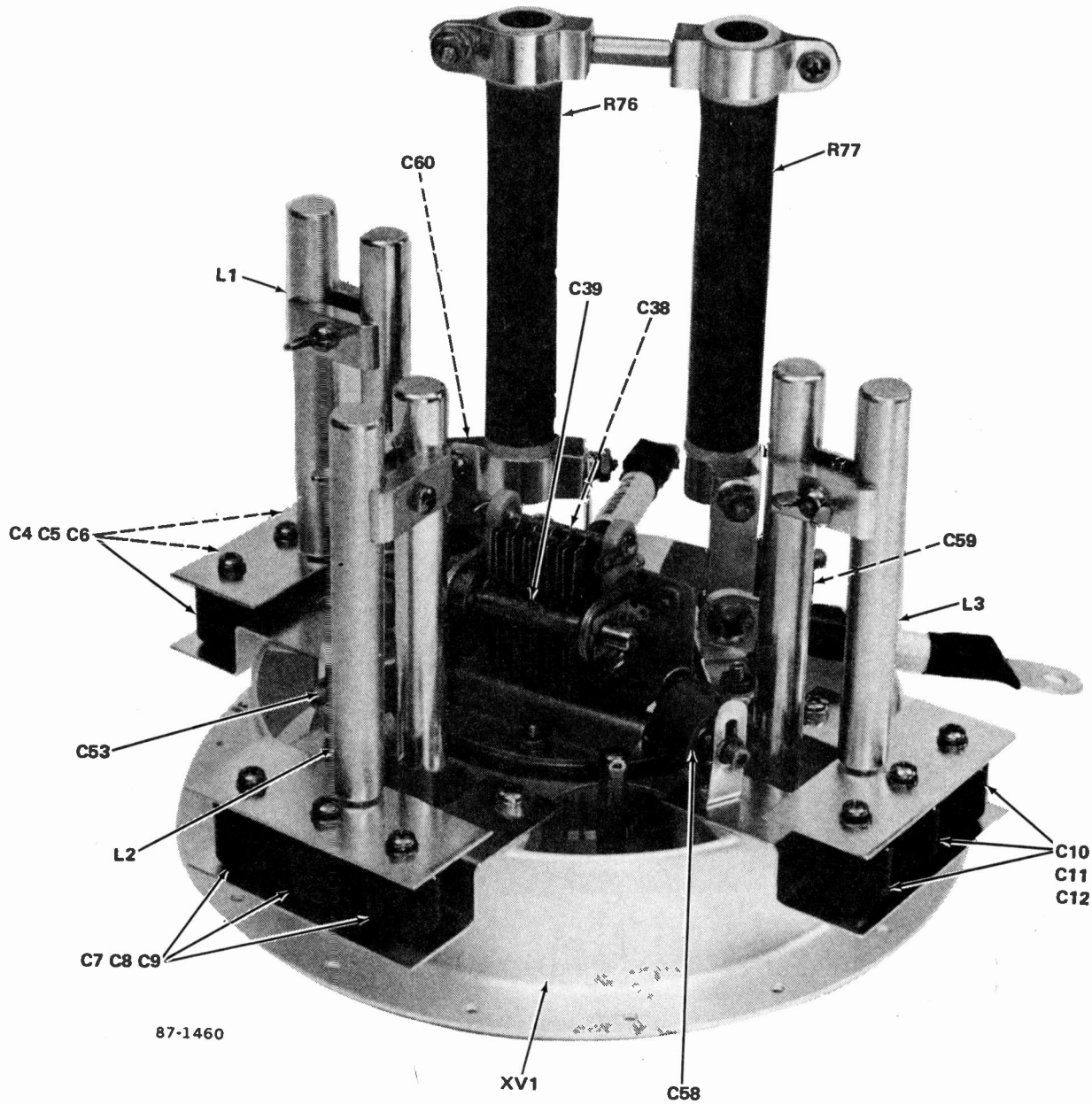
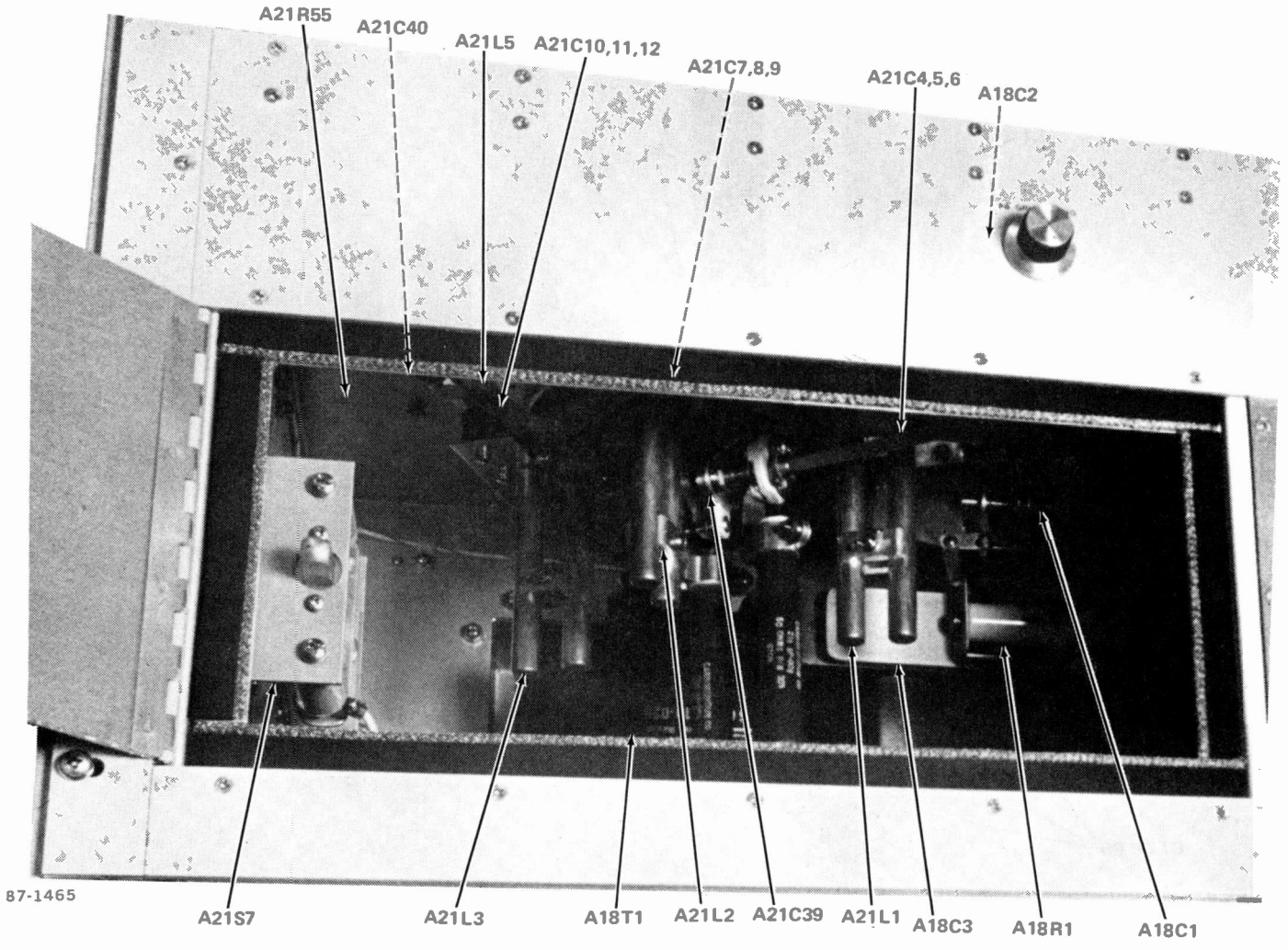
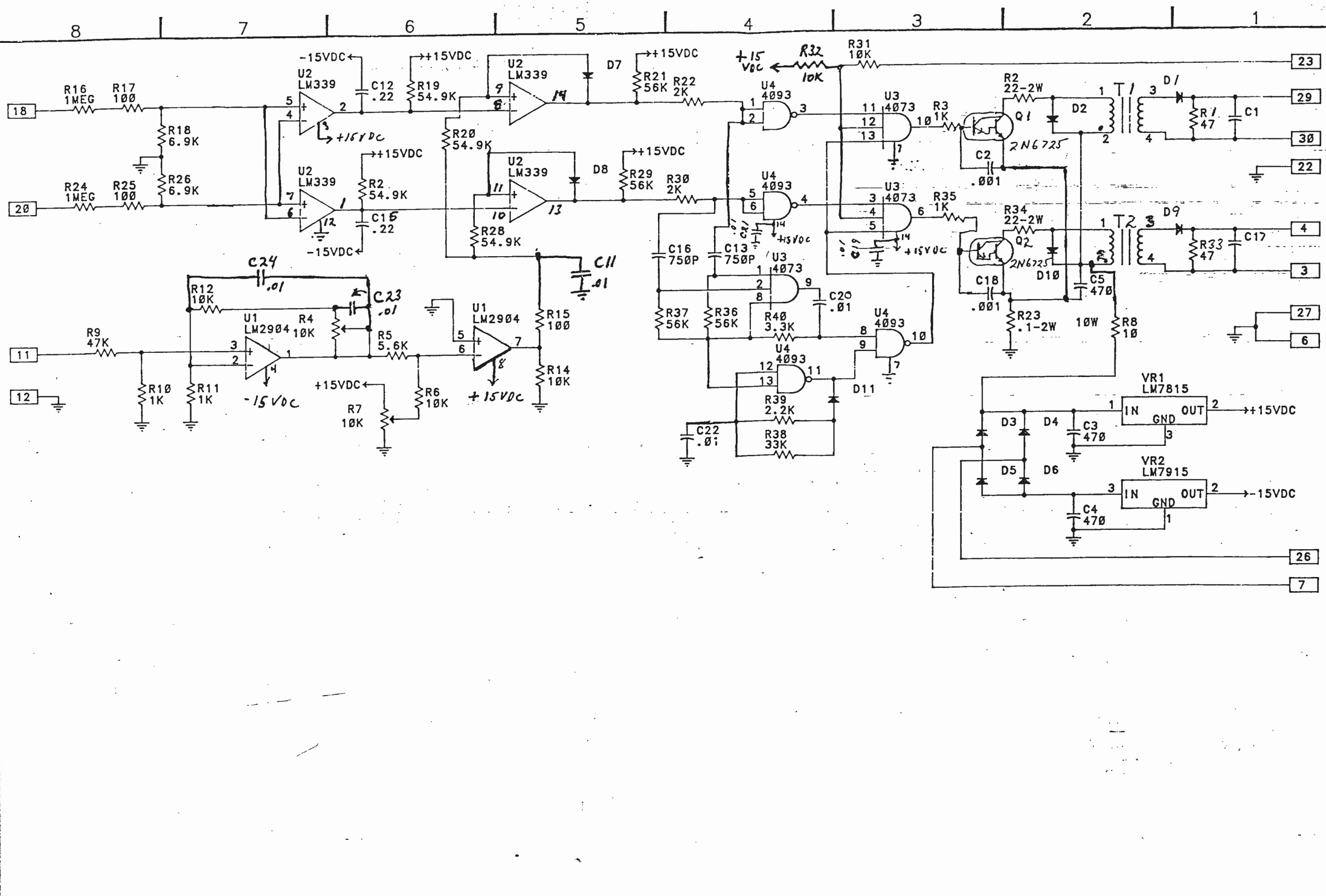


Figure 6-21. Power Amplifier Socket, A21 (Sheet 1 of 2)



PT1-35

Figure 6-21. Power Amplifier Socket, A21 (Sheet 2 of 2)


8
7
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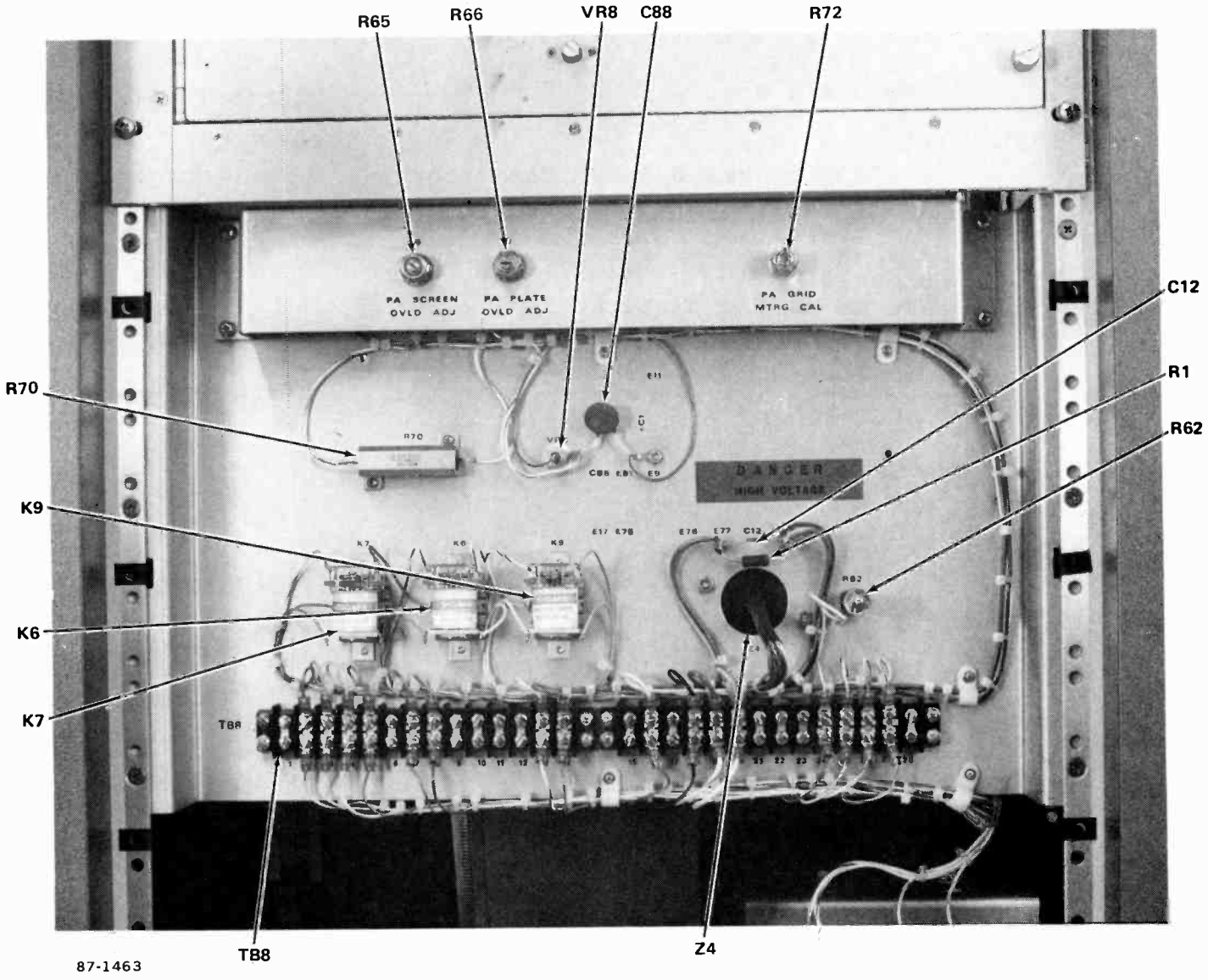
3
2
1
D
C
B
18
20
11
12
23
29
30
22
4
3
27
6
26
7
R16 1MEG
R17 100
R18 6.9K
R24 1MEG
R25 100
R26 6.9K
U2 LM339
-15VDC
+15VDC
C12 .22
C15 .22
R19 54.9K
R20 54.9K
R2 54.9K
R28 54.9K
D7
D8
R21 56K
R22 2K
R29 56K
R30 2K
C11 .01
C24 .01
C23 .01
R12 10K
R4 10K
R5 5.6K
U1 LM2904
R9 47K
R10 1K
R11 1K
R7 10K
R6 10K
R15 100
R14 10K
U4 4093
U3 4073
R31 10K
R32 10K
R3 10K
R35 1K
R2 22-2W
Q1 2N6725
Q2 2N6725
D1
D2
D9
D10
T1
T2
R1 47
R33 47
C1
C17
C2 .001
C18 .001
C5 470
R23 .1-2W 10W
R8 10
C16 750P
C13 750P
C20 .01
R37 56K
R36 56K
R40 3.3K
R39 2.2K
R38 33K
C22 .01
D11
VR1 LM7815
VR2 LM7915
IN
GND
OUT
D3
D4
D5
D6
C3 470
C4 470

POWER AMPLIFIER SOCKET, A21 786-3686-003

REF DES	DESCRIPTION	CE PART NUMBER
C1 - C3	Not Used	
C4-C12	Capacitor, Fxd, Ceramic 100 pf, 10% To1, 5000 VDCW	913-0821-000
C13-C37	Not Used	
C38	Capacitor, Fxd, Ceramic 1000 pf, Plus 40% Minus 20%, 2500 VDCW	913-2831-000
C39	Capacitor, Var, Air	922-8010-010
C40 - C42	Not Used	
C43, C44	Filament Socket By-pass Capacitor	220-1500-000
C45 - C49	Not Used	
C50 - C52	Not Used	
C53	Same as C4	
C54 - C57	Not Used	
C58	Same as C4	
C59	Capacitor, Fxd, Ceramic, 75 pf, 5% Tol, 3500 WVDC	913-0830-000
C60	Capacitor, Fxd, Ceramic, 500 pf, 20% Tol, 5000 WVDC	913-5113-250
L1 - L3	PA Grid Tuning Inductors (Mechanical Parts)	
R1 - R75	Not Used	
R76	Resistor, Fxd, Composition 50 Ohms, 20% To1, 60 Watts	712-0070-000
R77	Same as R76	
XV1	Socket, Electron Tube	220-1491-000
	P/O XV3:	
	Outer Filament Collet	220-1494-000
	Inner Filament Collet	220-1495-000
	Control Grid Collet	220-1496-000
	Screen Grid Collet	220-1501-000
	Post Insulator	220-1498-000
	Screen Spring	220-1506-000
	Sleeve Insulator	220-1498-000
	Filament Bypass	220-1500-000



PT1-36

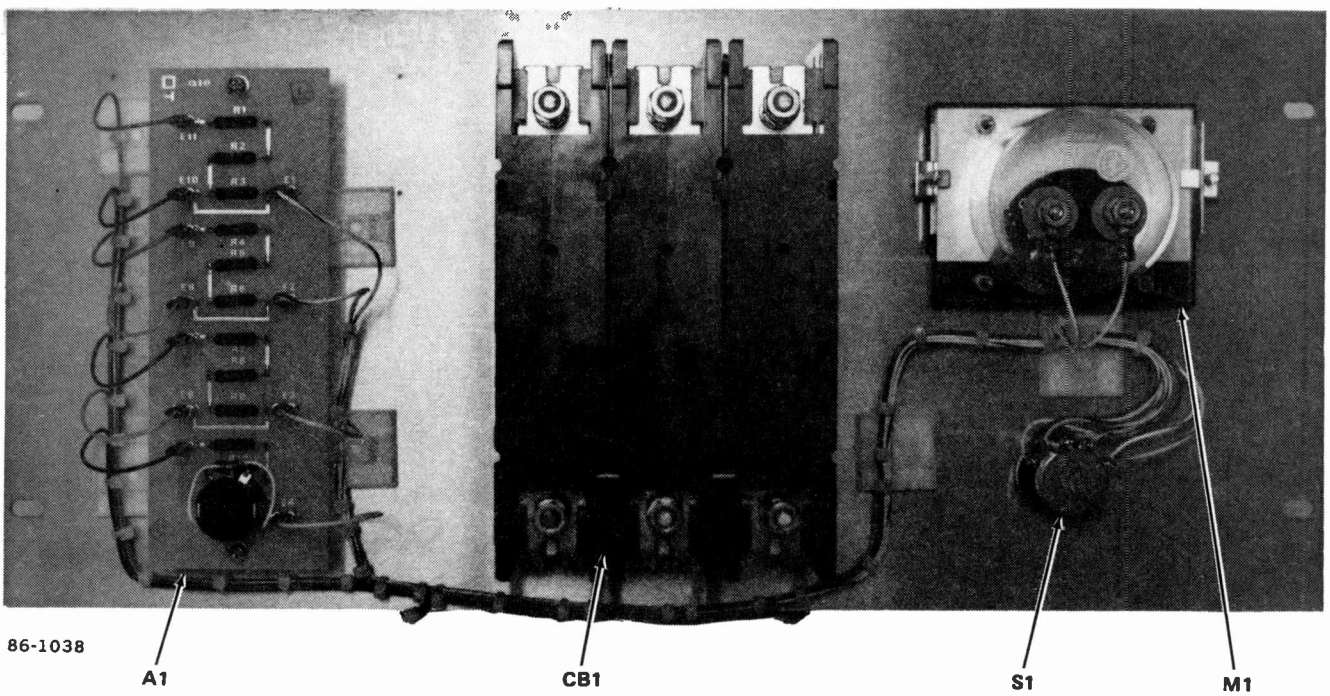
Figure 6-22. Overload and Meter Calibrat Panel, A22

OVERLOAD AND METER CALIBRATE PANEL, A22 786-3666-003

REF DES	DESCRIPTION	CE PART NUMBER
C1 Through C11	Not Used	
C12,	Capacitor, Fxd, Ceramic 1000 pf, 20% Tol, 1000 VDCW	913-1186-000
C13 Through C87	Not Used	
C88,	Capacitor, Fxd, Ceramic 0.1 mfd., Plus 80%, Minus 20%, 200 VDCW	913-3681-000
K1 Through K5	Not Used	
K6, K7, K9	Relay, Armature 1C Contact Arrangement	408-1114-000
K8	Not Used	
R1 Through R36	Not Used	
R37	Resistor, Fxd, Wirewound 10 Ohms, 5% Tol, 3 watts	747-5320-000
R38 Through R60	Not Used	
R61	Not Used	
R62	Resistor, Fxd, Wirewound 150 Ohms, 5% Tol, 1 Watt	746-6145-000
R63 Through R64	Not Used	
R65	Resistor, Variable, Wirewound	377-0619-000
R66	Same as R65	
R67 Through R69	Note Used	
R70	Resistor, Fxd, Wirewound 60.4 Ohms, 1% Tol, 30 Watts	747-0990-730
R71	Not Used	
R72	Resistor, Var, Wirewound 50 Ohms, 10% Tol, 4 Watts	377-0716-040

OVERLOAD AND METER CALIBRATE PANEL, A22 786-3666-003
Cont.

REF DES	DESCRIPTION	CE PART NUMBER
TB1 Through TB7	Not Used	
TB8	Board, Terminal 14 Terminals	367-4140-000
VR1 Through VR7	Not Used	
V87	Diode	353-6230-000
Z1	Not Used	
Z2	Not Used	
Z3	Not Used	
Z4	Magnetic Circuit, Halltron	270-0080-040

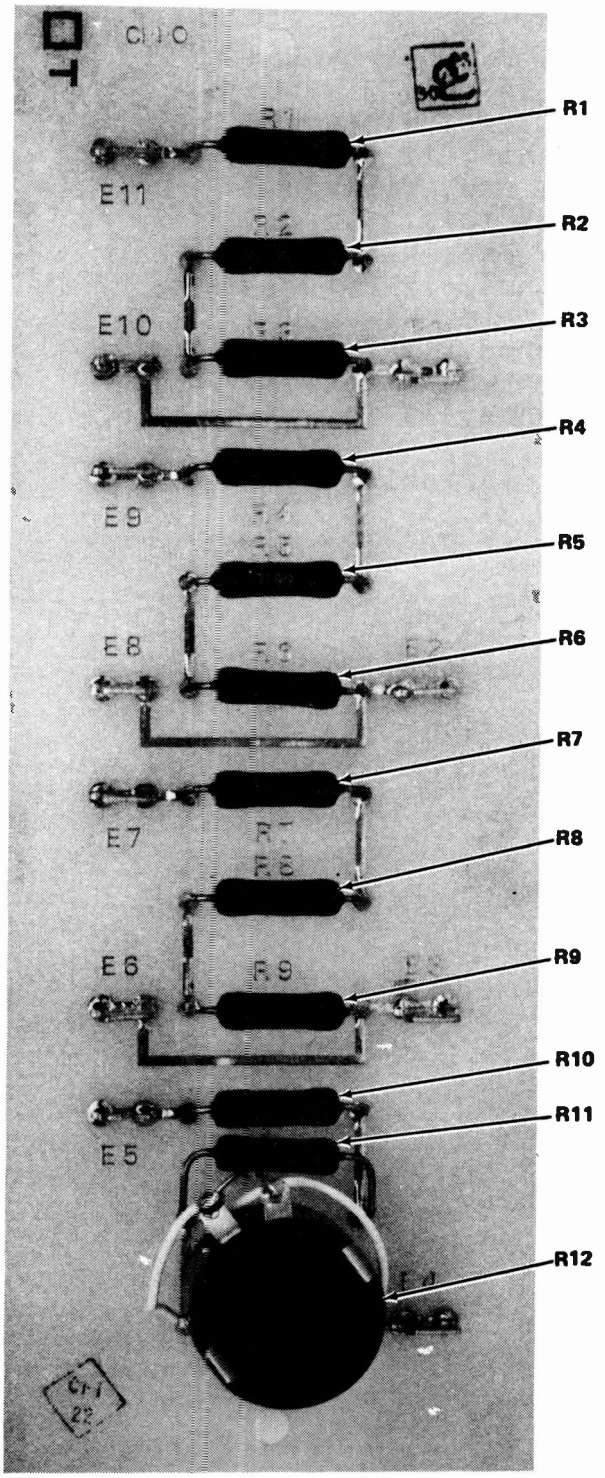


PT1-37

Figure 6-23. AC Metering Panel, A25

AC METERING PANEL, A25 636-7263-004

REF DES	DESCRIPTION	CE PART NUMBER
A1	Resistor Board Assy See Breakdown on page 6-80	636-7262-001
CB1	Circuit Breaker, 150 Amps, 3 Pole	260-4060-080
M1	Meter, Iron Vane 10mA. Movement, 2% Accuracy	458-5006-010
S1	Switch, Rotary, Wafer, 2 Sections 2 Pole, 5 Position	259-9475-150



86-1035

PT1-38

Figure 6-24. Resistor Board Assembly, A25A1

RESISTOR BOARD ASSEMBLY, A25A1 636-7262-001

REF DES	DESCRIPTION	CE PART NUMBER
R1	Resistor, Fxd, Wirewound 9.09K, 1% To1, 3 Watts	747-0998-960
R2,R3	Resistor, Fxd, Wirewound 9.09K ohms, 1% To1, 3 Watts	747-0998-960
R4	Resistor, Fxd, Wirewound 9.09, 1% To1, 3 Watts	747-0998-960
R5,R6	Resistor, Fxd, Wirewound 9.09K ohms, 1% To1, 3 Watts	747-0998-960
R7	Resistor, Fxd, Wirewound 9.09K ohms, 1% To1, 3 Watts	747-0998-960
R8 Through R11	Resistor, Fxd, Wirewound 9.09K ohms, 1% To1, 3 Watts	747-0998-960
R12	Resistor, Variable 5K, 2W, 3%	381-1648-020

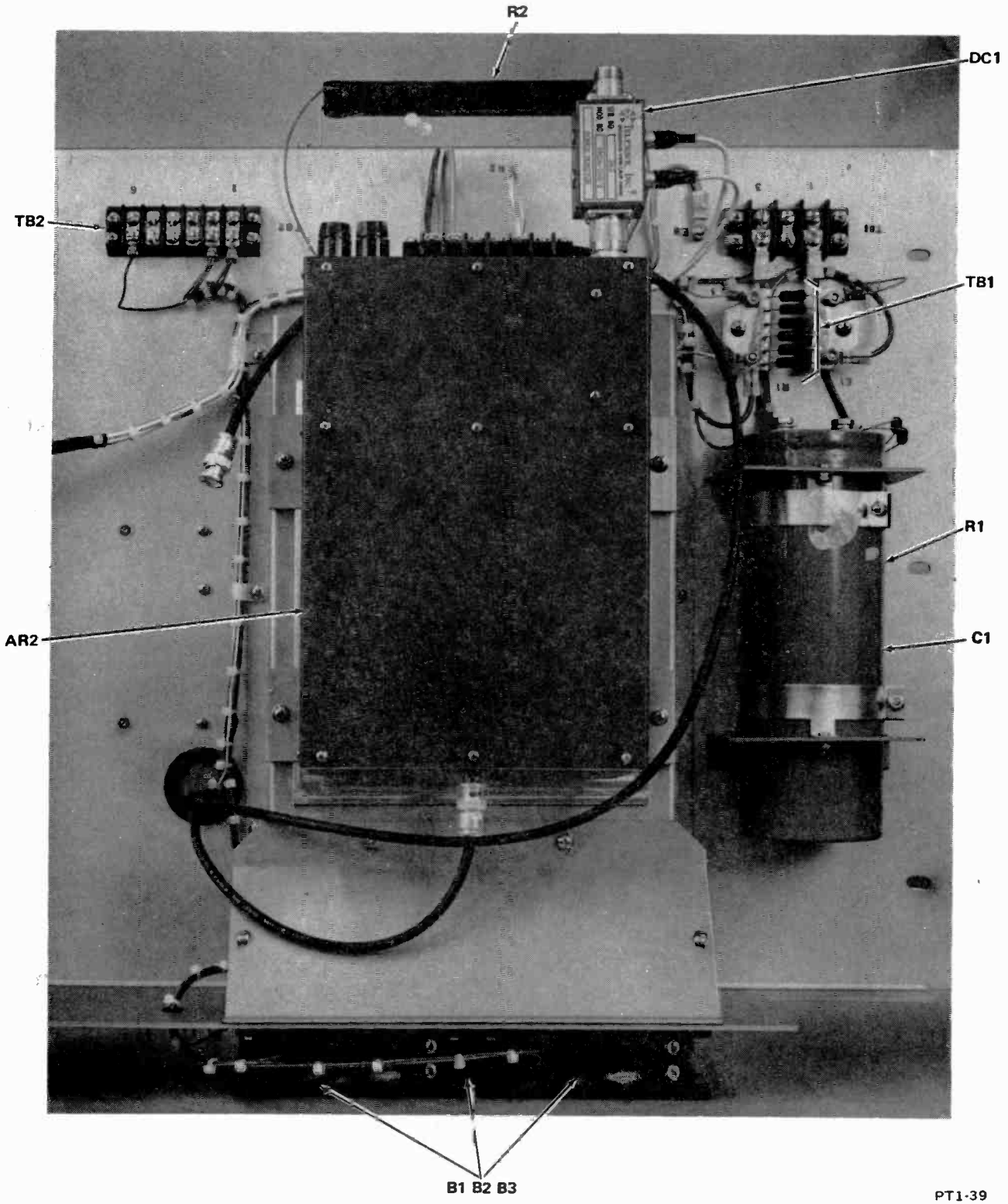
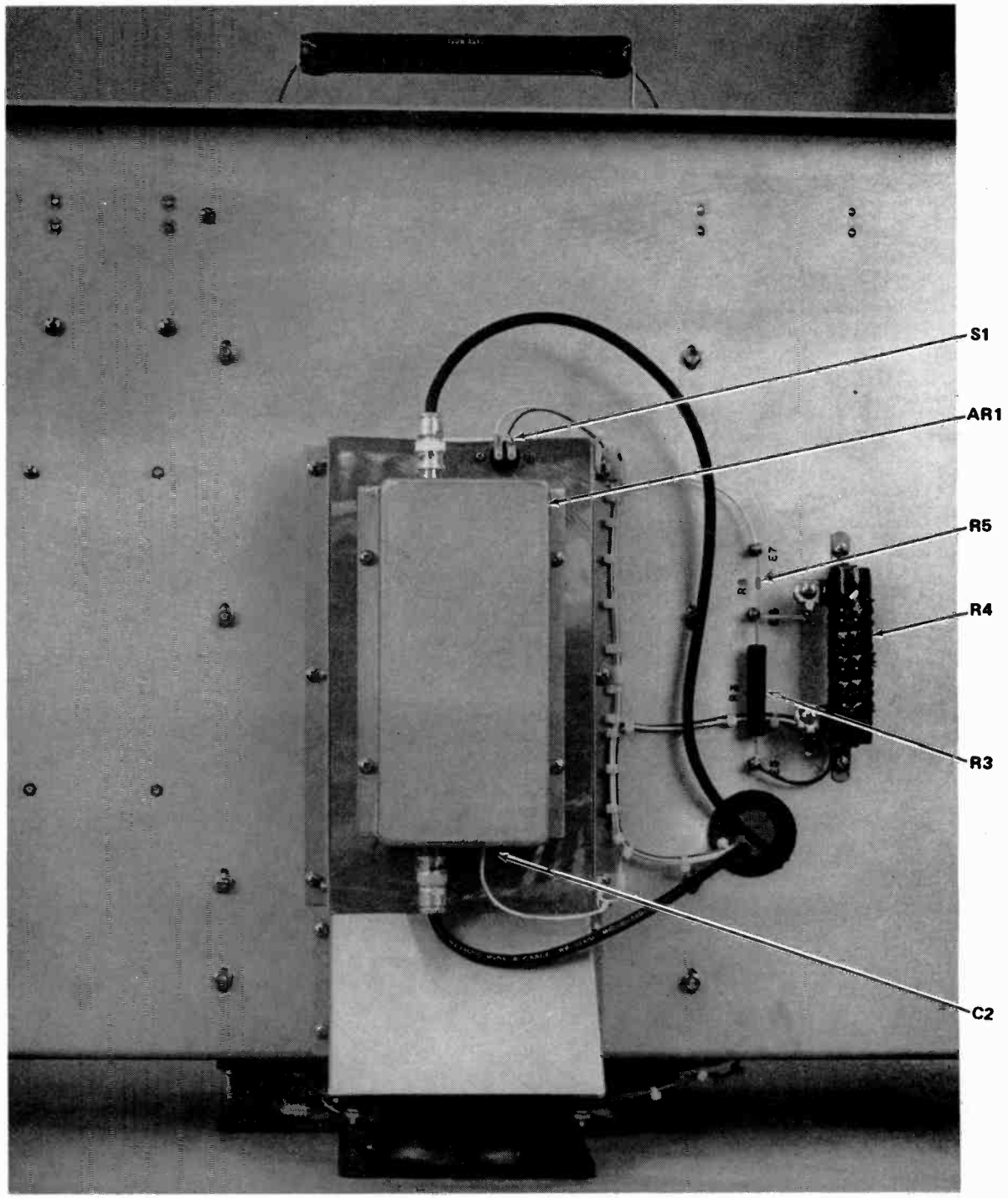


Figure 6-25. Driver Shelf Assembly, A26 (Sheet 1 of 2)

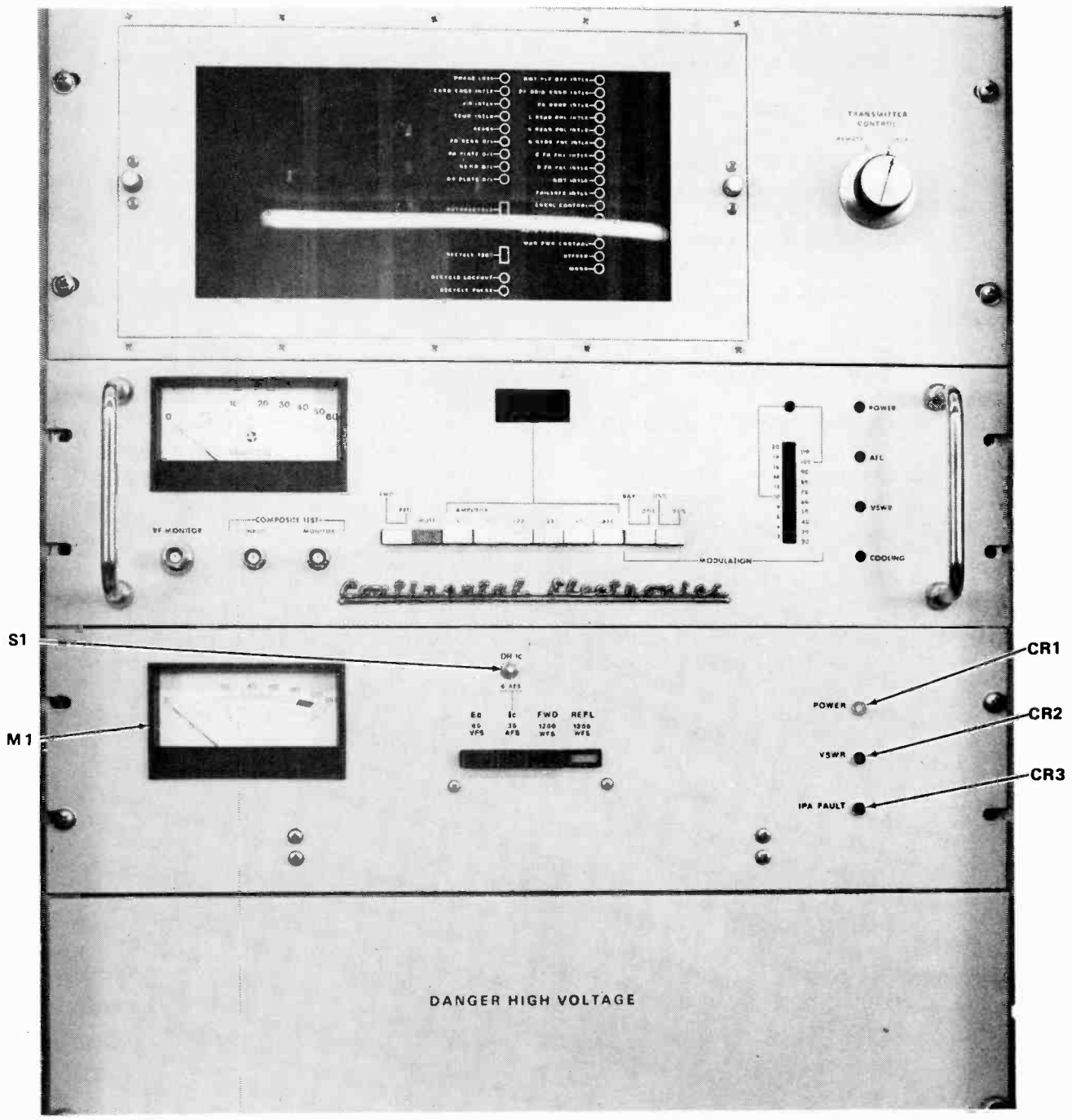


PT1-40

Figure 6-25. Driver Shelf Assembly, A26 (Sheet 2 of 2)

DRIVER SHELF ASSEMBLY, A26 — 159711-1

REF DES	DESCRIPTION	CE PART NUMBER
AR1	Amplifier, 150W	270-3008-010
AR2	Amplifier Module	172056-1
B1-B3	Fan, 220V	009-0259-002
C1	Capacitor, Fixed, Electrolytic 120,000 mfd, 60 VDC	183-1278-660
C2	Capacitor, 0.1 mfd., feedthru	241-0090-000
DC1	Directional Coupler	277-5003-020
J1	Connector, BNC Bulkhead	357-7093-000
J2	Tee, Type N	357-7033-000
P1, P2	Connector, Phono-Plug	361-5003-010
P3-P6	Connector, BNC	357-9292-000
P7	Connector, BNC	357-7279-010
P8,P9,	Connector, Type N	357-9519-000
P10	Connector, Type N, Crimp	357-0037-020
R1	Shunt, Assembly	159682-1
R2	Resistor, Fixed, Wirewound 50 Ohms, 10%, 100W	716-5003-020
R3	Resistor, Wirewound 0.25 Ohms, 10W	747-9471-000
R4	Resistor, 4 Ohm, 100W	710-5076-060
R5	Resistor, 1K Ohm, 1/8W, 1%	705-0996-000
R6, R7	Resistor, 0.1 Ohm, 3W	747-5115-000
R8	Attenuator, 3db, 100 W	379-5007-010
S1	Temperature Switch	267-5001-000
TB1	Terminal Board, 3 terminals	367-5552-030
TB2	Terminal Board, 6 terminals	367-0912-000



PT1-41

Figure 6-26. IPA Metering Panel, A27 (Sheet 1 of 2)

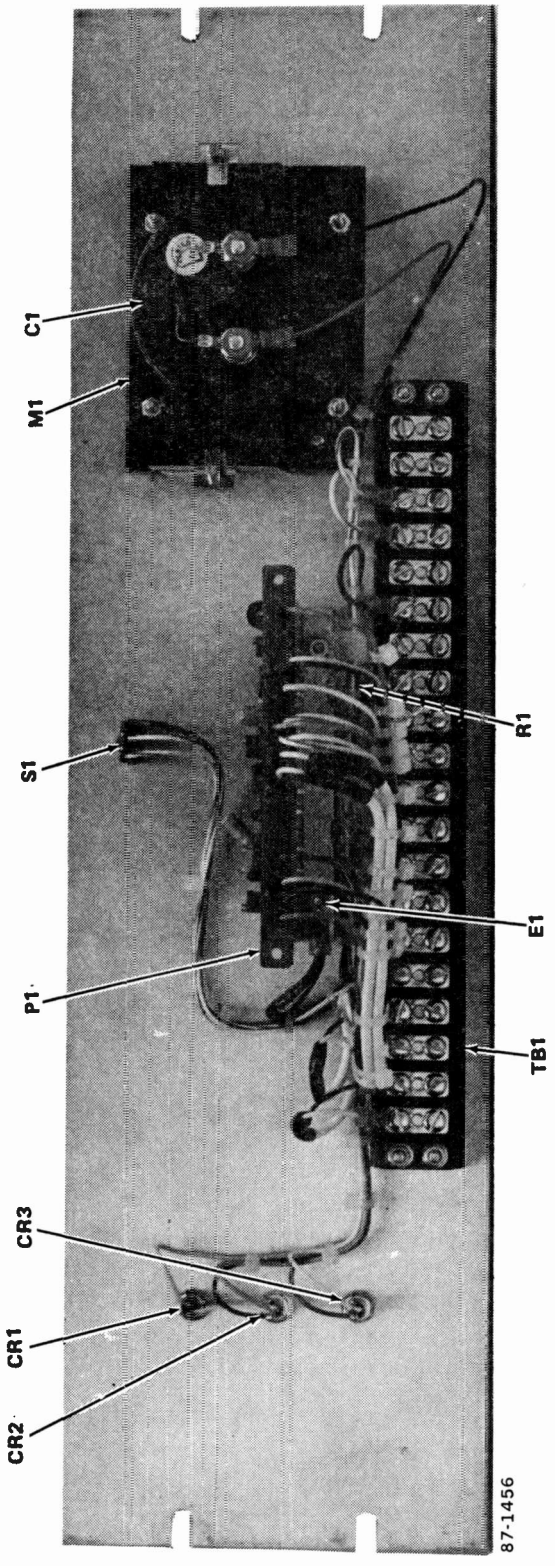
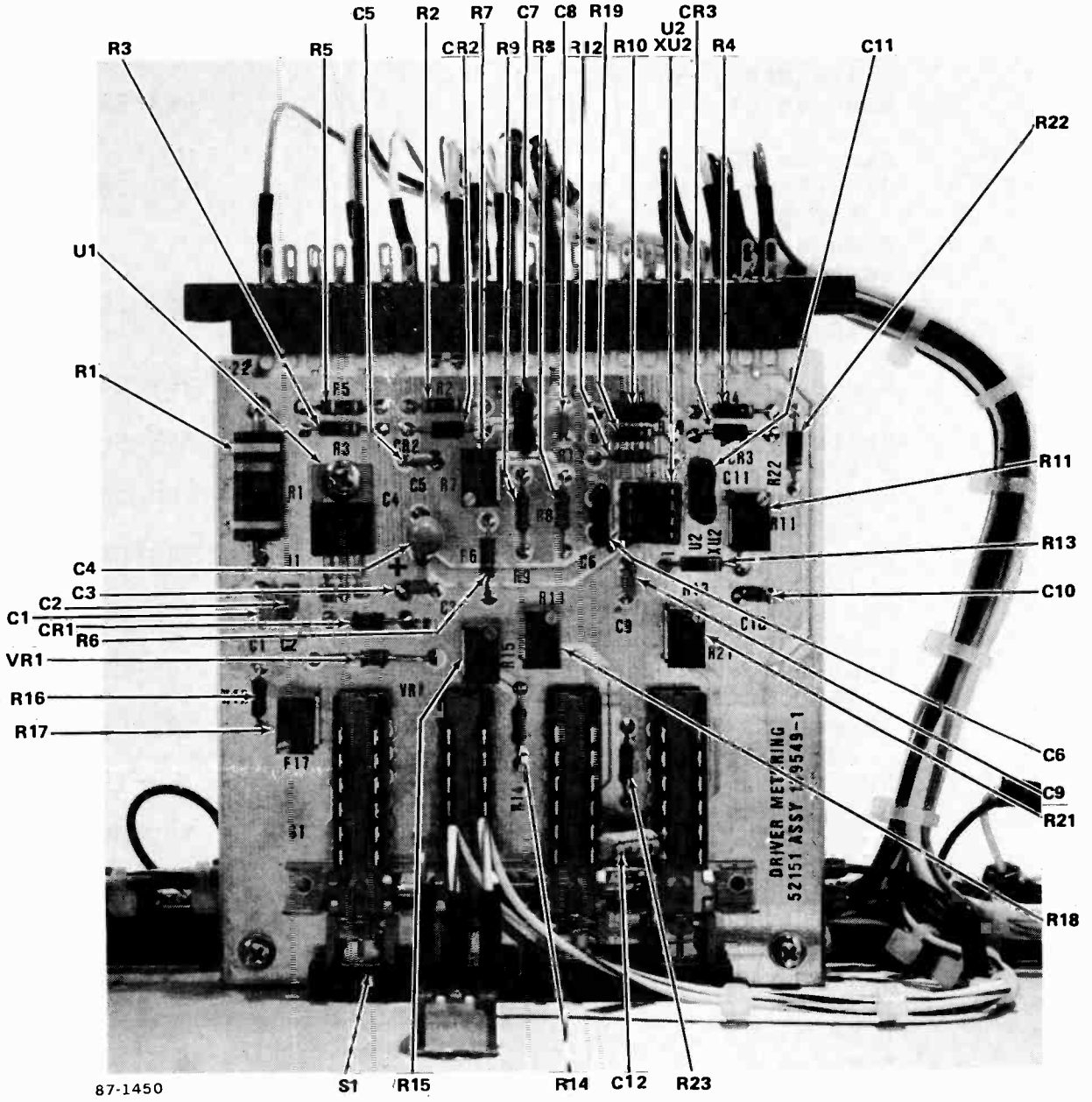


Figure 6-26. IPA Metering Panel, A27 (Sheet 2 of 2)

PT1-42

IPA Front Panel Assembly, A27 159712-1

REF DES	DESCRIPTION	CE PART NUMBER
A1	IPA Metering Board Assembly	159549-1
C1	Capacitor, Fixed, Mica	912-2816-000
CR1	LED, Yellow	353-5029-030
CR2, CR3	LED, Red	353-5029-020
M1	Meter, 0-120, 0-3	450-8023-010
P1	Connector, 18 position	372-7499-050
R1	Resistor, Composition	745-1351-000
S1	Switch, Pushbutton	266-5404-010
TB1	Terminal Board, 20 Terminals	367-0926-000



PT1-43

Figure 6-27. IPA Metering Board, A27A1

IPA Metering Board Assembly, A27A1 159549-1

	REF DES	DESCRIPTION	CE PART NUMBER
	C1	Capacitor, Fixed, 1.0 mfd., 50 VDC	913-3279-270
	C2, C3	Capacitor, Fixed, 0.1 mfd., 50 VDC	913-3279-200
*	C4	Same as C1	913-3279-270
	C5	Same as C2	
	C6, C7	Capacitor, Fixed, Mica 100 pf	912-2816-000
	C8 - C10	Same as C2	
	C11	Same as C6	
	C12	Capacitor, 10 mfd., 50V	183-5007-060
	CR1-CR3	Diode, 1N4007	353-6442-070
	R1	Resistor, Fixed, Composition 470 ohms, 2 W	745-5637-000
	R2	Resistor, Fixed, Composition 47 ohms, 1/4 W	745-0700-000
	R3	Resistor, Fixed, Composition 1200 ohms, 1/4 W	745-0751-000
	R4	Resistor, Fixed, Composition 100 ohms, 1/4 W	745-0712-000
	R5	Resistor, Fixed, Composition 3900 ohms, 1/4 W	745-0769-000
	R6	Resistor, Fixed, Composition 220 ohms, 1/4 W	745-0724-000
	R7	Resistor, Variable 5000 Ohms	382-1405-070
	R8	Resistor, Fixed, 4.7K Ohms, 1/4 W	745-0910-810
	R9	Resistor, Fixed, 1K Ohms, 1/4 W	745-0910-650
	R10	Resistor, Fixed 1 Megohm, 1/4 W	705-6740-000
	R11	Same as R7	
	R12	Same as R9	
	R13	Same as R3	
	R14	Resistor, Fixed, 10 Ohm	745-0910-170

IPA Metering Board Assembly, A27A1 Cont. 159549-1

REF DES	DESCRIPTION	CE PART NUMBER
R15	Not Used	
R16	Resistor, Fixed 46.2K Ohms	705-1076-000
R17	Resistor, Variable, 20K	382-1405-080
R18, R21	Resistor, Variable 10K Ohms	382-1405-070
R19	Same as R4	
R20	NOT USED	
R22	Same as R4	
R23	Resistor, Fixed Film, 1/8 W,	705-0955-000
S1	Switch, Pushbutton 140 Ohm	266-9731-010
U1	Voltage Regulator	351-1120-040
U2	I.C, OP/AMP	351-4719-030
VR1	Diode, Zener, 1N3024B	353-3129-000
XU2	Socket, 8 Pin	220-6017-020

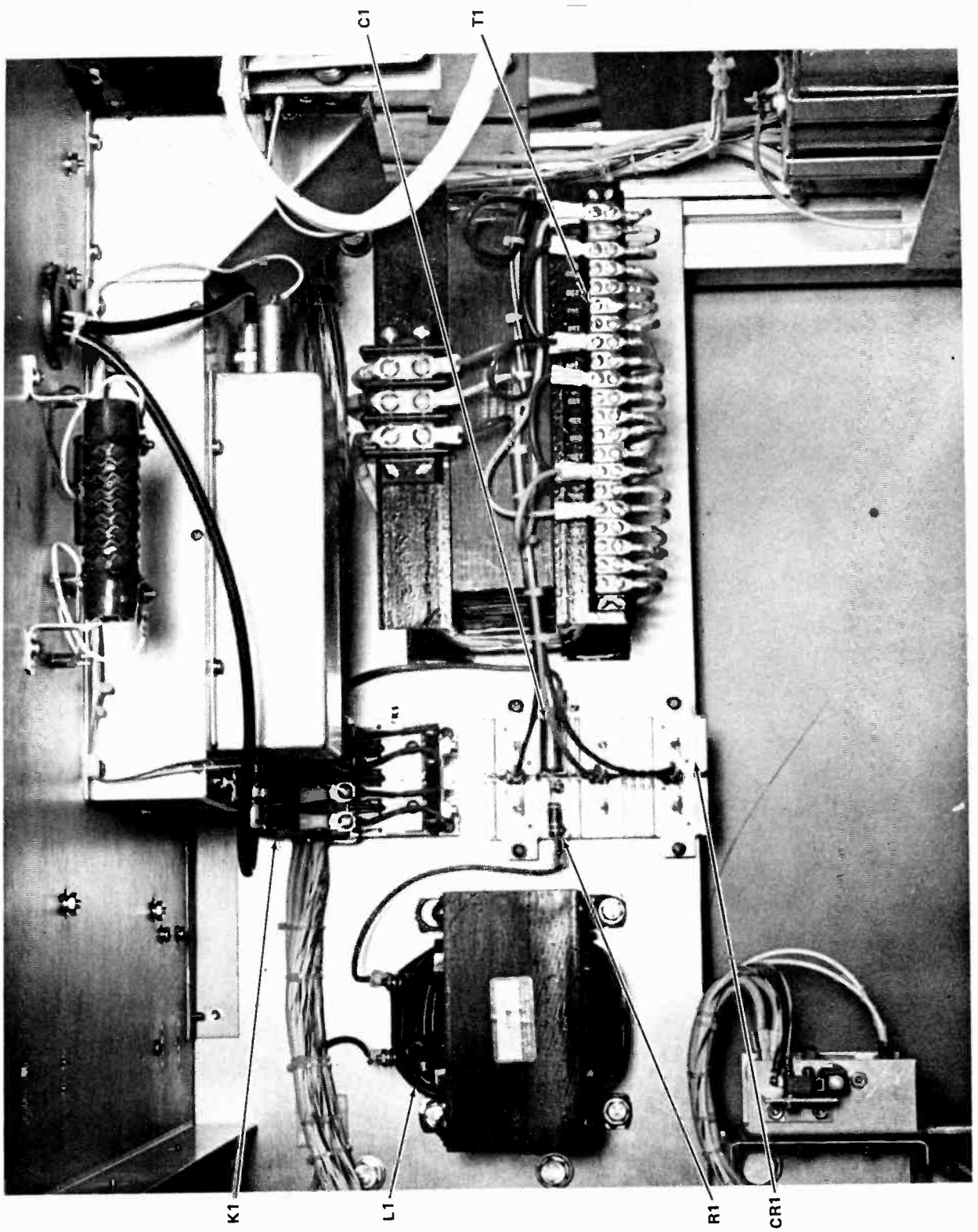


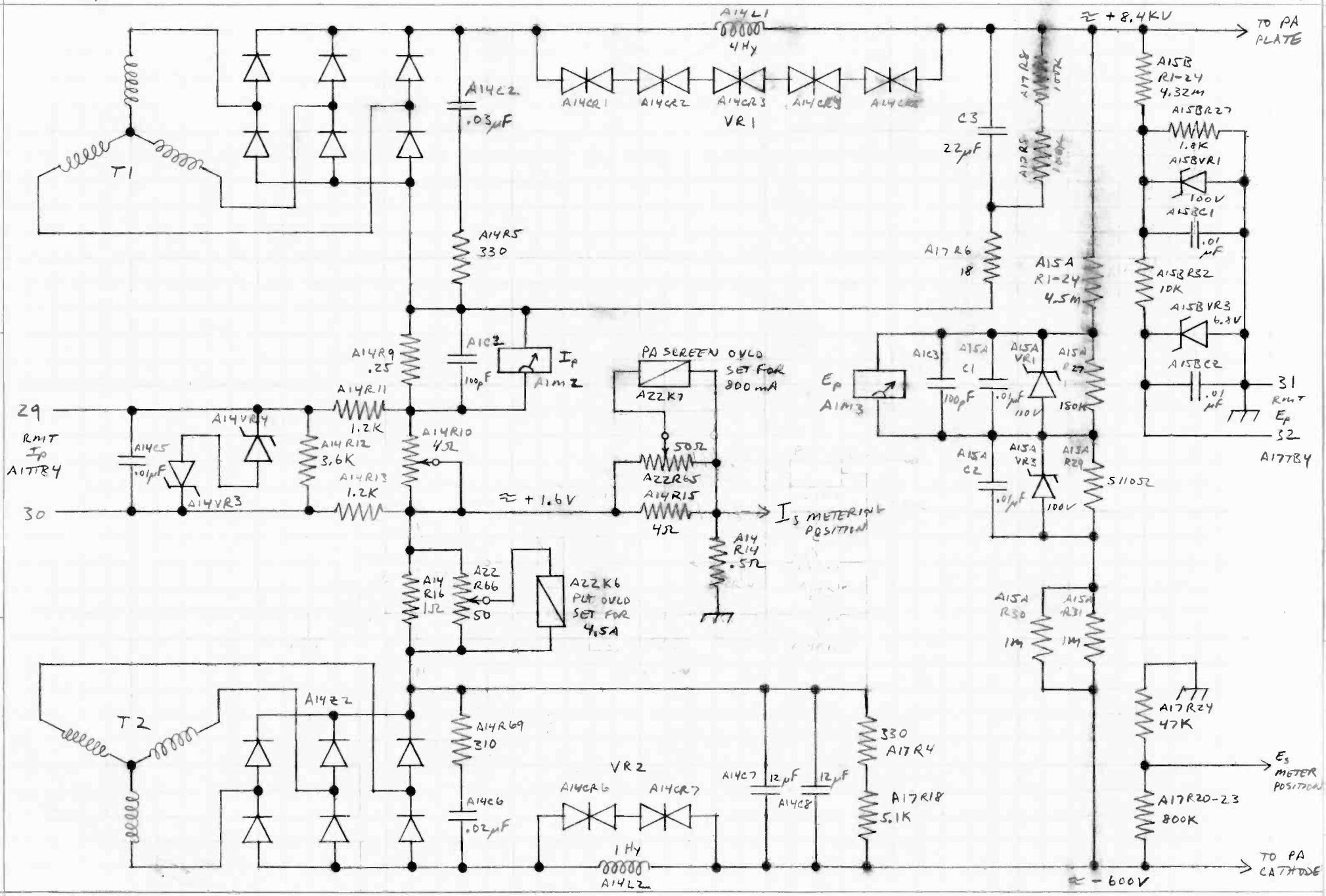
Figure 6-28. Driver Power Supply, A28

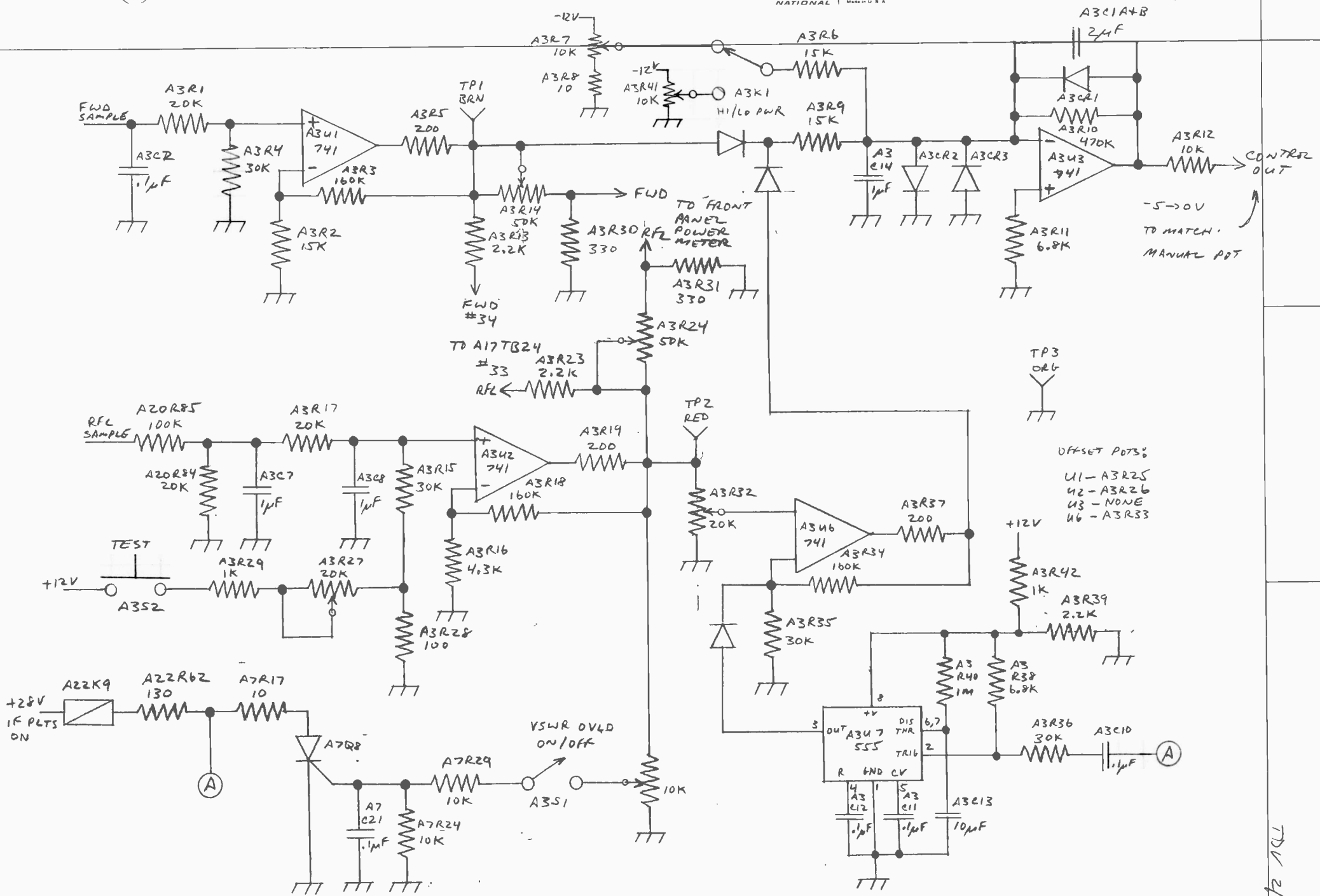
Driver Power Supply, A28 159713-1

REF DES	DESCRIPTION	CE PART NUMBER
C1	Capacitor, Fixed 0.68 mfd., 200V	951-0118-000
CR1	Rectifier, 3 Phase, Full wave	353-5067-010
CR2	Relay	353-6442-070
K1	Relay	970-2426-070
L1	Choke, DC, 5 mHY	240-4007-020
R1	Resistor, Fixed, 47 Ohm	745-5595-000
T1	Transformer, Step down	662-6024-010

TDV 2/90

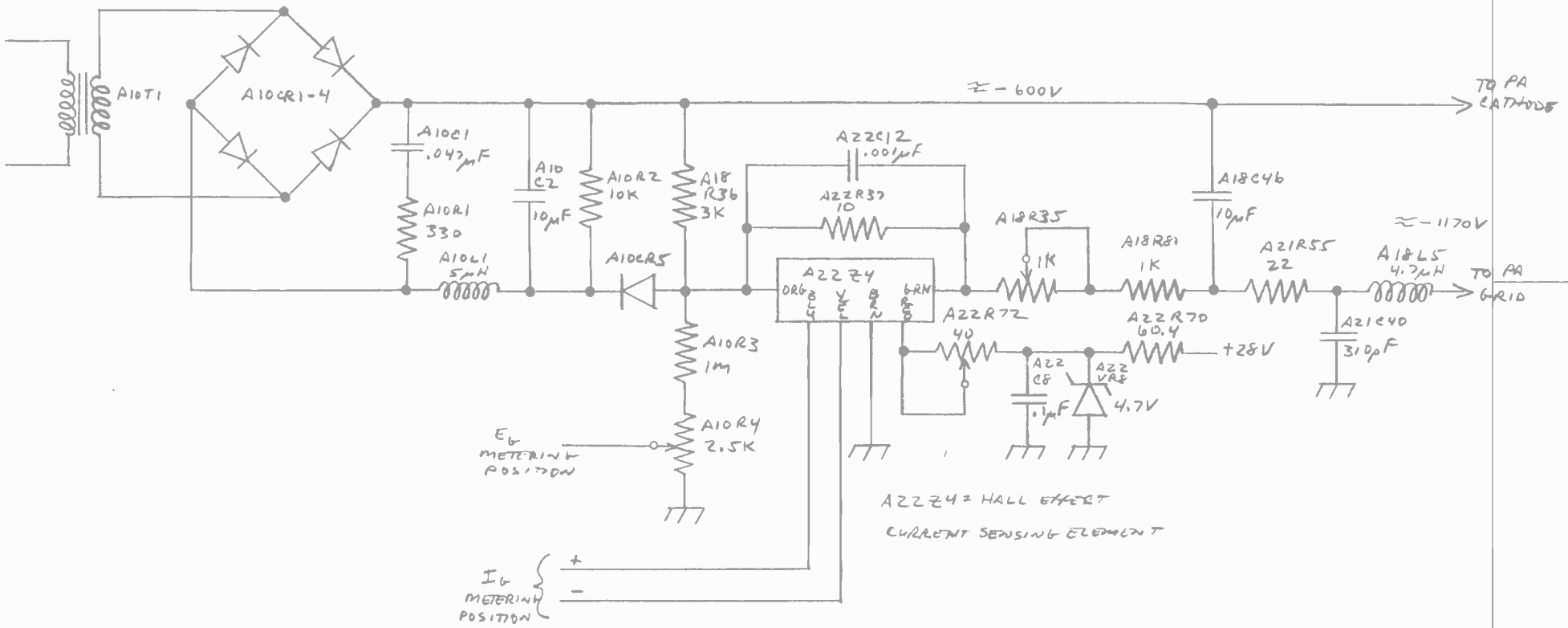
CONTINENTAL 816R-3B
25KW FM XMITTER
PLATE + SCREEN POWER SUPPLIES





CONTINENTAL 816R-3B
25 KW FM XMITTER
AUTOMATIC POWER CONTROL

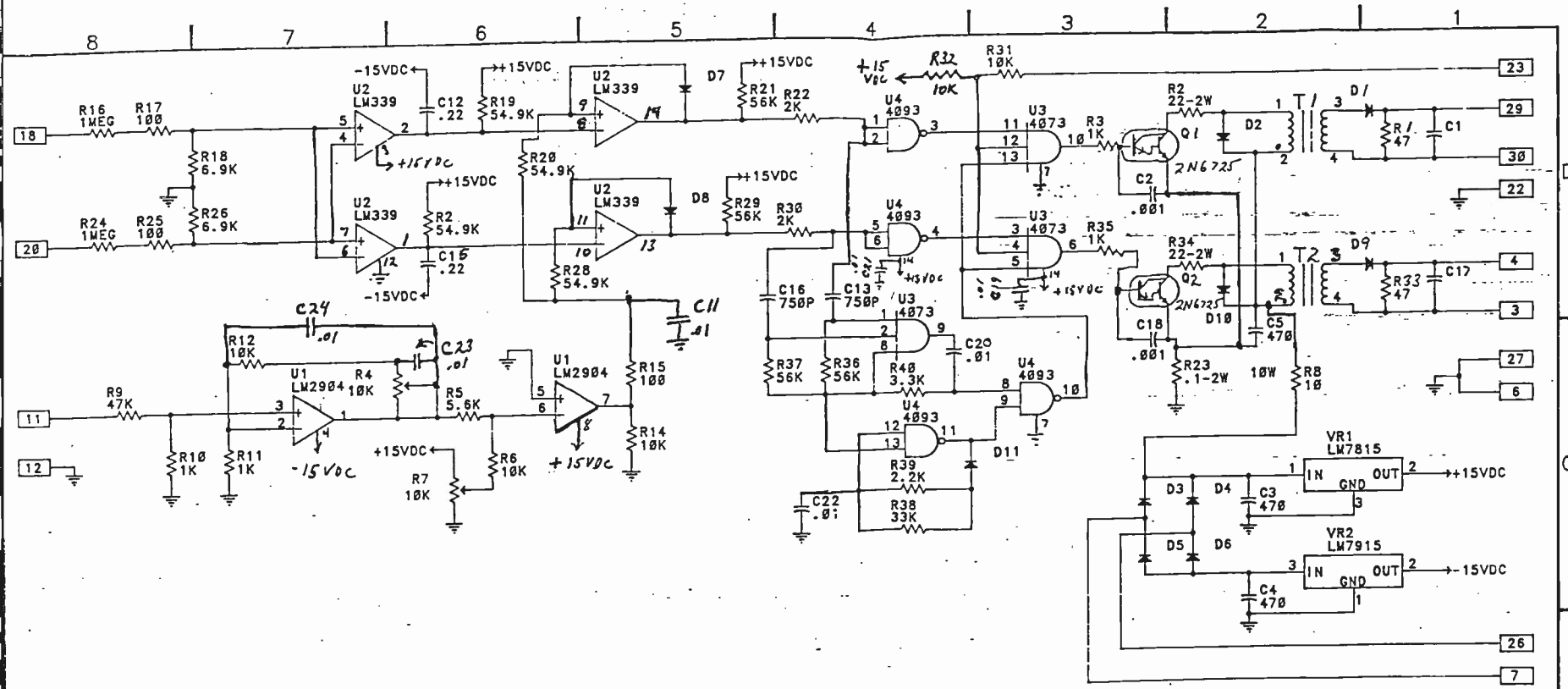
0812 ALL



A22Z4 = HALL EFFECT
CURRENT SENSING ELEMENT

CONTINENTAL 816R-3B
25KW FM XMTTER
GRID BIAS SUPPLY

TLV 2/90


8
7
6
5
4
3
2
1
D
C
B
R16 1MEG
R17 100
R18 6.9K
R24 1MEG
R25 100
R26 6.9K
U2 LM339
-15VDC
+15VDC
C12 .22
C15 .22
R19 54.9K
R20 54.9K
R28 54.9K
D7
D8
R21 56K
R22 2K
R29 56K
R30 2K
C11 .01
C24 .01
C23 .01
R12 10K
R4 10K
R5 5.6K
R9 47K
R10 1K
R11 1K
U1 LM2904
R6 10K
R7 10K
R15 100
R14 10K
U4 4093
U3 4073
C16 750P
C13 750P
C20 .01
C22 .01
R37 56K
R36 56K
R40 3.3K
R39 2.2K
R38 33K
D11
R31 10K
R32 10K
R3 1K
R35 1K
Q1 2N6725
Q2 2N6725
R2 22-2W
R34 22-2W
T1
T2
D1
D2
D9
D10
R1 47
R33 47
C1
C17
C2 .001
C18 .001
C5 470
R23 .1-2W 10W
R8 10
VR1 LM7815
VR2 LM7915
IN
OUT
GND
D3
D4
D5
D6
C3 470
C4 470
+15VDC
-15VDC
18
20
11
12
23
29
30
22
4
3
27
6
26
7

TYPE 816R- 2B

SERIAL NO. 854

STATION KXXO

TESTED BY P. LIGHTFOOT

FREQUENCY 96.1 MHz

LOCATION OLYMPIA WA.

DATE 9-6-89

UNIT METER READINGS

EXCITER	
FORWARD POWER	15 W
REFLECTED PWR	1 W
AMP VOLTAGE	15.7 V
AMP CURRENT	2.90 AMPS
AMP +22V	21.7 V
AMP -22V	22.0 V
AMP +5V	5.02 V
AMP AFC	7.5 V
DRIVER	
Ec	45 V
Ic	3.6 A
FORWARD PWR	460 WATTS
REFLECTED PWR	20 WATTS
DRIVER SERIAL NO.	2371
IPA	
Ic	18 A
IPA SERIAL NO.	543

SERIAL NO. 854

FREQUENCY 96.1 MHz

TESTED BY PAUL LIGHTFOOT

DATE 9-6-89

METER READINGS

TEST METER

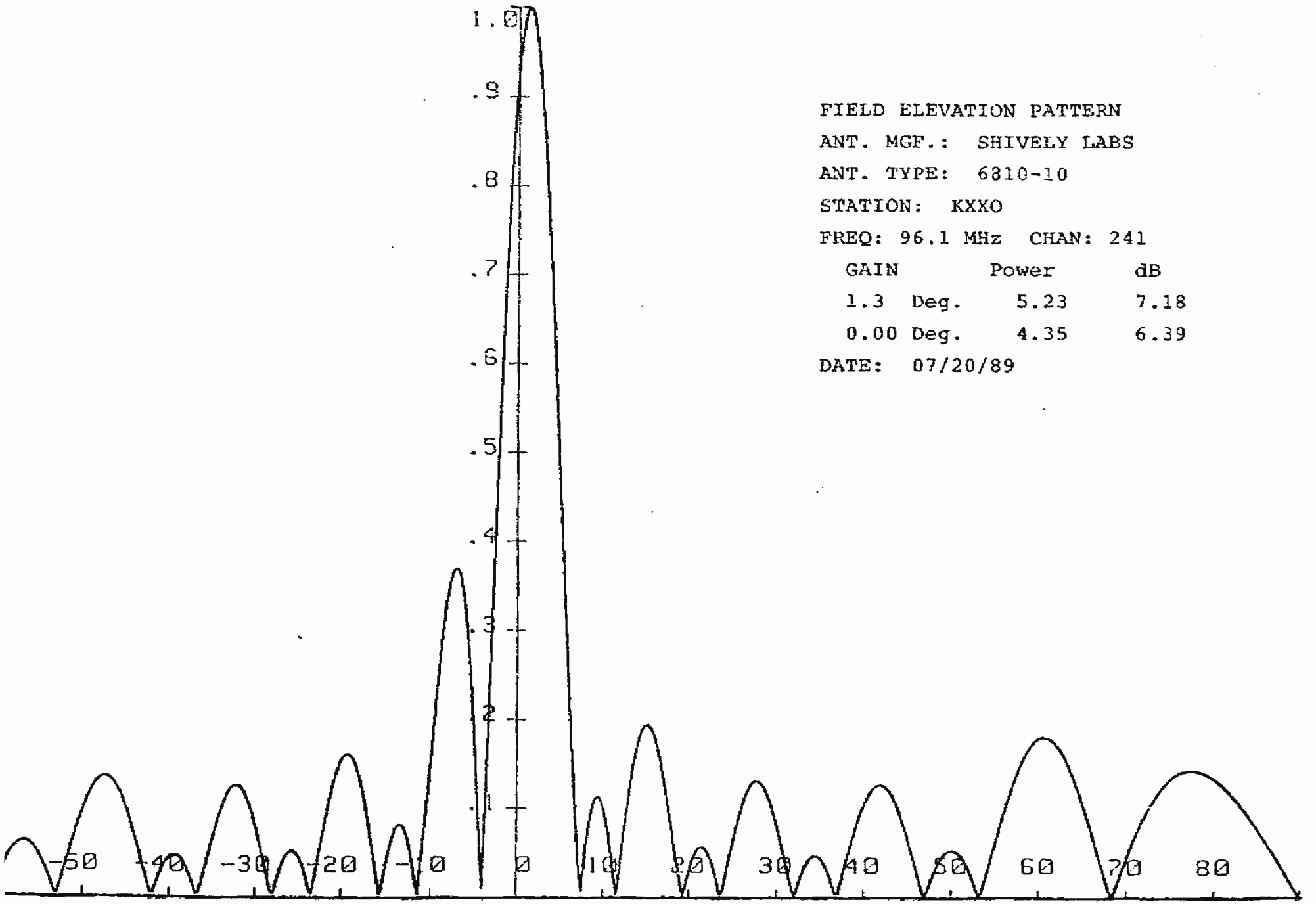
28 VOLT SUPPLY	24	V
PA SCREEN CURRENT	380	mA NMT 600Ma
PA SCREEN VOLTAGE	550	V
PA GRID CURRENT	90	mA NLT 90MA
PA BIAS VOLTAGE	530	V
PLATE CURRENT	2.95	A
PLATE VOLTAGE	8.2	kV
FORWARD POWER	100 % = 18.9	KW
REFL. POWER	.5%	W
AC VOLTMETER A - B	210	V
B - C	210	V
C - A	211	V
PA FILAMENT VOLTAGE (See note below)	6.3	V
FILAMENT HOURS	23.7	
EFFICIENCY	78.13 %	% NLT 76%
FINAL AMPLIFIER TUBE SERIAL NO.	EAQ 286 15A	

ADJUSTABLE SETTING

NEUTRALIZING SETTING	7/8	INCHES
P A CAVITY SHORTING PLANE	16 3/8	INCHES
PA GRID SLIDERS	1 5/8	INCHES
GRID SWAMPING	1/4	INCHES

NOTE

Transmitter tested at rated filament voltage. See EIMAC application bulletin AB18, titled "Extending Transmitter Tube Life" in tube data section of instruction manual.



FIELD ELEVATION PATTERN
ANT. MGF.: SHIVELY LABS
ANT. TYPE: 6810-10
STATION: KXXO
FREQ: 96.1 MHz CHAN: 241

GAIN		Power	dB
1.3	Deg.	5.23	7.18
0.00	Deg.	4.35	6.39

DATE: 07/20/89

Cablewave Systems

EFFICIENCY TABLE FOR HCC300-50, 95 TO 101 MHZ, IN PERCENT

ATTENUATION (Nominal) [DB/100FT]	.127	.127	.128	.129	.129	.13	.131
FREQ.[MHZ]	95	96	97	98	99	100	101
LENGTH [FEET]	**********	**********	**********	**********	**********	**********	**********
25	99.3	99.3	99.3	99.3	99.3	99.3	99.3
50	98.6	98.5	98.5	98.5	98.5	98.5	98.5
75	97.8	97.8	97.8	97.8	97.8	97.8	97.8
100	97.1	97.1	97.1	97.1	97.1	97.1	97
125	96.4	96.4	96.4	96.4	96.3	96.3	96.3
150	95.7	95.7	95.7	95.7	95.6	95.6	95.6
175	95	95	95	94.9	94.9	94.9	94.9
200	94.3	94.3	94.3	94.2	94.2	94.2	94.2
225	93.6	93.6	93.6	93.6	93.5	93.5	93.5
250	93	92.9	92.9	92.9	92.8	92.8	92.8
275	92.3	92.3	92.2	92.2	92.1	92.1	92.1
300	91.6	91.6	91.5	91.5	91.5	91.4	91.4
325	91	90.9	90.9	90.8	90.8	90.7	90.7
350	90.3	90.2	90.2	90.1	90.1	90.1	90
375	89.6	89.6	89.5	89.5	89.4	89.4	89.3
400	89	88.9	88.9	88.8	88.8	88.7	88.7
425	88.3	88.3	88.2	88.2	88.1	88.1	88
450	87.7	87.6	87.6	87.5	87.5	87.4	87.3
475	87.1	87	86.9	86.9	86.8	86.7	86.7
500	86.4	86.4	86.3	86.2	86.2	86.1	86
525	85.8	85.7	85.7	85.6	85.5	85.5	85.4
550	85.2	85.1	85	85	84.9	84.8	84.8
575	84.6	84.5	84.4	84.3	84.3	84.2	84.1
600	83.9	83.9	83.8	83.7	83.6	83.6	83.5
625	83.3	83.3	83.2	83.1	83	82.9	82.9
650	82.7	82.6	82.6	82.5	82.4	82.3	82.2
675	82.1	82	82	81.9	81.8	81.7	81.6
700	81.5	81.4	81.4	81.3	81.2	81.1	81
725	80.9	80.8	80.8	80.7	80.6	80.5	80.4
750	80.3	80.3	80.2	80.1	80	79.9	79.8
775	79.8	79.7	79.6	79.5	79.4	79.3	79.2
800	79.2	79.1	79	78.9	78.8	78.7	78.6
825	78.6	78.5	78.4	78.3	78.2	78.1	78
850	78	77.9	77.8	77.7	77.6	77.5	77.4
875	77.5	77.4	77.3	77.2	77.1	77	76.9
900	76.9	76.8	76.7	76.6	76.5	76.4	76.3
925	76.4	76.2	76.1	76	75.9	75.8	75.7
950	75.8	75.7	75.6	75.5	75.4	75.2	75.1
975	75.2	75.1	75	74.9	74.8	74.7	74.6
1000	74.7	74.6	74.5	74.4	74.2	74.1	74
1025	74.2	74	73.9	73.8	73.7	73.6	73.5
1050	73.6	73.5	73.4	73.3	73.1	73	72.9
1075	73.1	73	72.8	72.7	72.6	72.5	72.4
1100	72.6	72.4	72.3	72.2	72.1	71.9	71.8
1125	72	71.9	71.8	71.7	71.5	71.4	71.3
1150	71.5	71.4	71.2	71.1	71	70.9	70.8
1175	71	70.9	70.7	70.6	70.5	70.3	70.2
1200	70.5	70.3	70.2	70.1	69.9	69.8	69.7