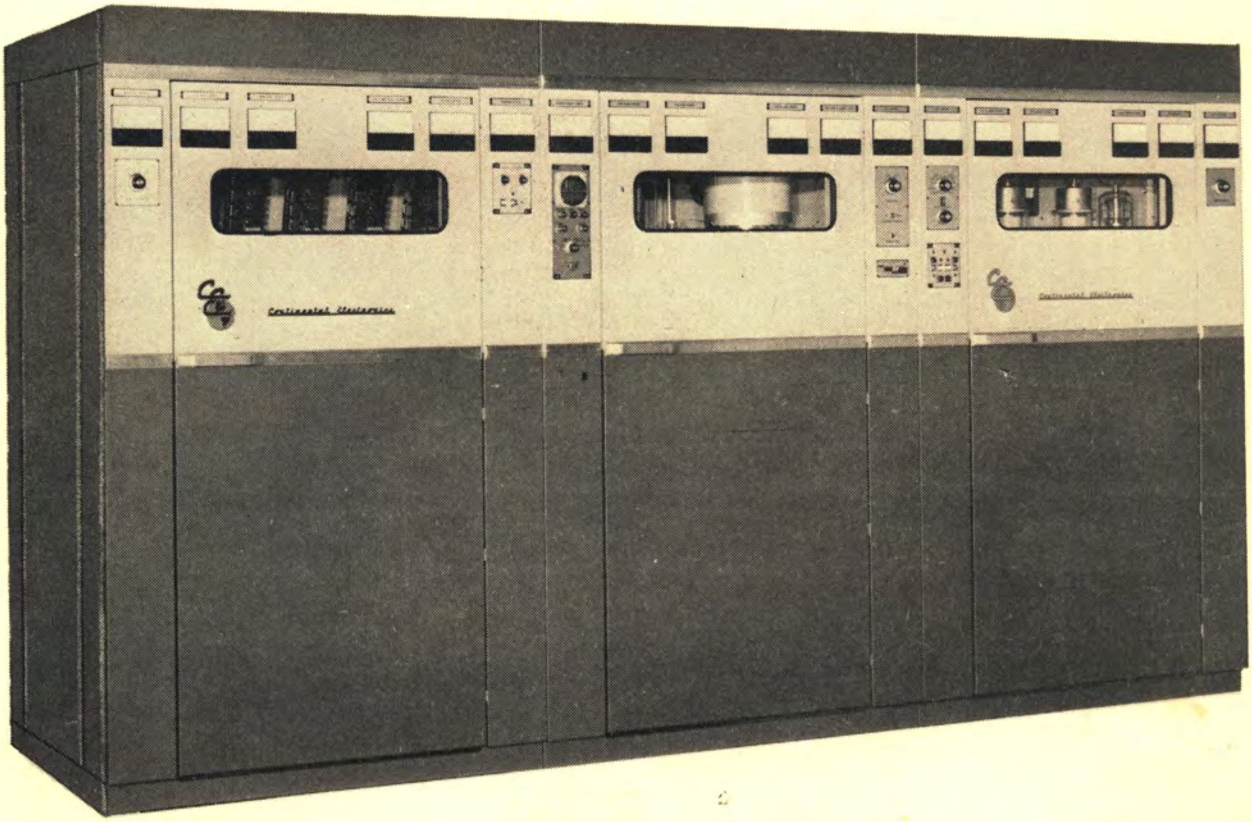
317C-2 AM BROADCAST TRANSMITTER

INSTRUCTION MANUAL



80-1045

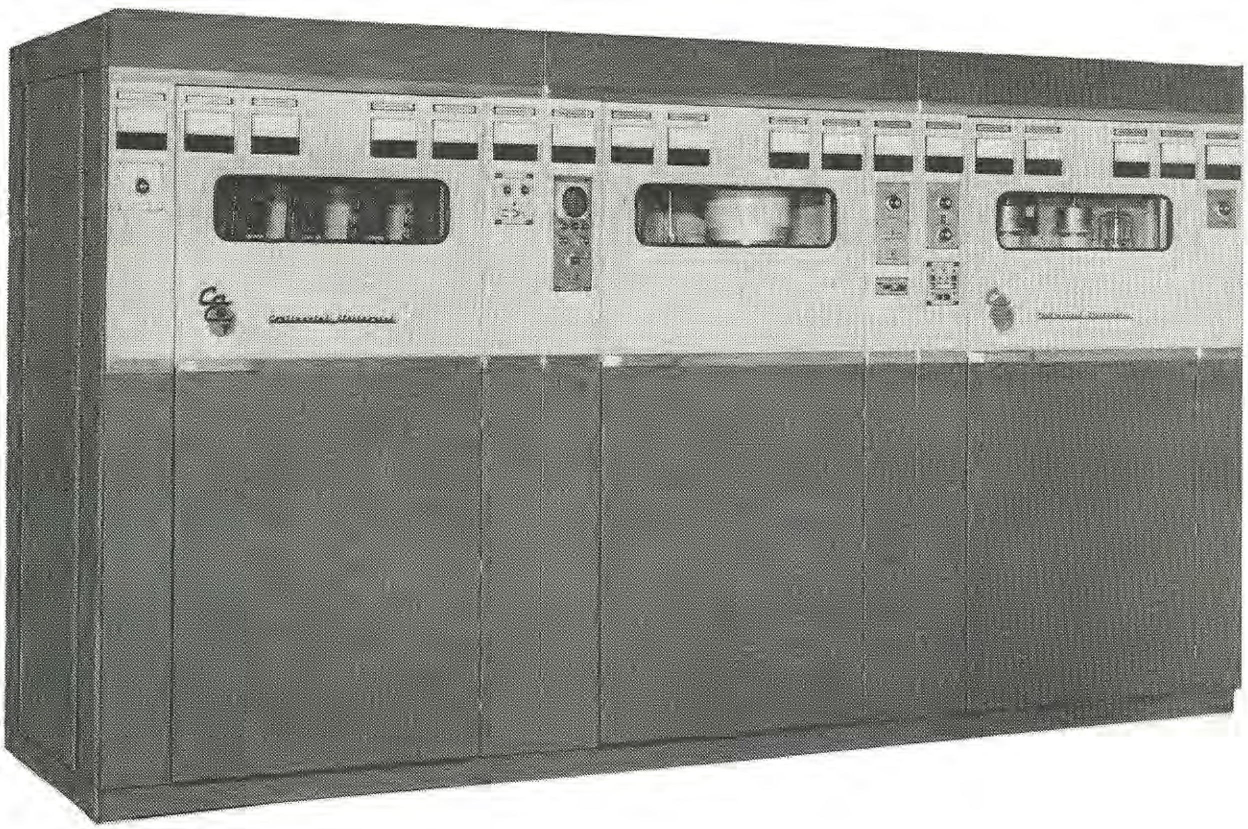
PUBLICATION DATE, 1 NOVEMBER 1980

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

REV C EQ1-27

317C-2 AM BROADCAST TRANSMITTER

INSTRUCTION MANUAL



80-1045

PUBLICATION DATE, 1 NOVEMBER 1980

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

REV C EQ1-27

RECORD OF CHANGES ENTERED

CHANGE NO.	DATE	EFFECTIVE FOR SERIAL NUMBERS
1	12 January 1981	All 317C-2 Transmitters
2 & 3	4 March 1981	All 317C-2 Transmitters
4	26 March 1981	All 317C-2 Transmitters
5	24 June 1981	S/N 227 and Above
6	15 September 1981	All 317C-2 Transmitters
7	2 October 1981	All 317C-2 Transmitters
8	22 December 1981	S/N 227 and Above
9	4 January 1982	S/N 243 and Above
10	21 April 1982	S/N 243 and Above
11	10 May 1982	S/N 243 and Above
12	4 August 1982	S/N 243 and Above
13	9 October 1982	S/N 243 and Above
14	10 October 1982	S/N 243 and Above
15	16 October 1982	N/S 243 and Above
16	25 August 1983	S/N 268 and Above
17	1 September 1983	S/N 268 and Above
18	21 September 1983	S/N 268 and Above
19	6 October 1983	S/N 268 and Above
20	10 November 1983	S/N 268 and Above
21	19 December 1983	S/N 268 and Above
22	27 January 1984	S/N 268 and Above
23	2 April 1984	S/N 278 and Above
24	10 May 1984	S/N 278 and Above

TABLE OF CONTENTS

TABLE OF CONTENTS - Cont.

TABLE OF CONTENTS - Cont.

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS - Continued

LIST OF TABLES

SECTION 1 - DESCRIPTION

1-1. INTRODUCTION

This handbook contains instructions for the installation, operation and maintenance of the Continental Electronics Type 317C-2 50 kW AM Broadcast Transmitter. It is effective on S/N 202 and above.

The Type 317C-2 Transmitter can be tuned to operate on any fixed frequency between 535 and 1620 kHz.

The Type 317C-2 Transmitter consists of a main cabinet group and the associated High Voltage Transformer and Regulator cabinet (Figure 1-1 and 1-2).

The main cabinet group consists of three separate cabinets each of which is 48" wide, 54" deep and 78" high. These cabinets are located side-by-side and are bolted together. The right end cabinet housed the Driver and Power Distribution which is designated Unit 2. The center cabinet housed the Power Amplifier and is designated Unit 1. The left end cabinet houses the H.V. Rectifier and Harmonic Filter and is designated Unit 3. The H.V. Transformer and Regulator cabinet is designated Unit 4 and is generally located adjacent to the Rectifier and Harmonic Filter cabinet, although it may be located wherever the customer desires.

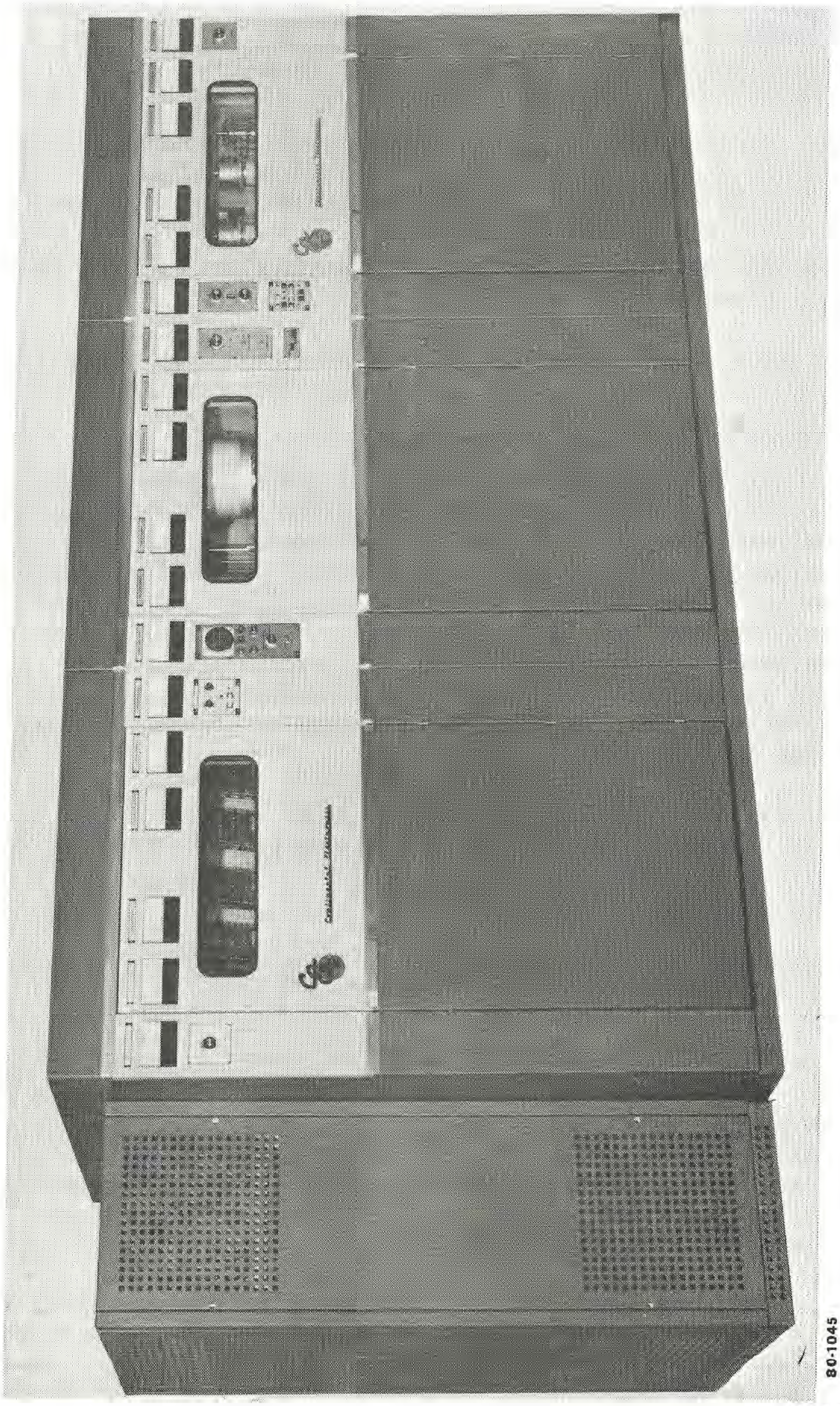
The Type 317C-2 Transmitter is completely self-contained, in that no external driver or exciter unit is required. Only an audio input, a transmitting antenna, and a source of three phase, primary power are required for operation.

Electrical parts lists and other supplementary data are supplied within this handbook.

Throughout the descriptive pages of this handbook, a symbol number, when referred to, will carry the unit number as a prefix to the symbol number in order to simplify location on one of the schematics or Electrical Parts Lists. Separate schematics and Electrical Parts Lists are used for each of the three units.

1-2. GENERAL DESCRIPTION OF CIRCUITRY (Figure 1-3)

a. RF Circuits. Solid state circuitry is employed in the low level stages which consists of an oscillator, RF switch, RF amplifier and RF output. A 4-400C is used as a Driver Amplifier for the Final Power Amplifier. The final power amplifier configuration



80-1045

JS1-1-(11)

Figure 1-1. Type 317C-2 AM Broadcast Transmitter.

is a combination of the screen-grid modulated amplifier and the high-efficiency Doherty amplifier.

Overall rf feedback is tapped from the output of the transmitter, rectified and applied as negative feedback to the first audio amplifier stage to reduce noise and improve linearity.

b. Tetrode Final Amplifier. The use of tetrode tubes in the final power amplifier stage offers many advantages:

(1) A minimum of rf driving power is required, since a tetrode is inherently a high gain tube.

(2) Modulator power requirements are greatly reduced. Constant rf excitation is applied to the control grid of the tetrode tube while audio modulation is applied to the screen grid. Since rf output is controlled linearly by screen grid potential, with relatively low values of screen current, an excellent method of modulation is possible with very little power being consumed in the modulator.

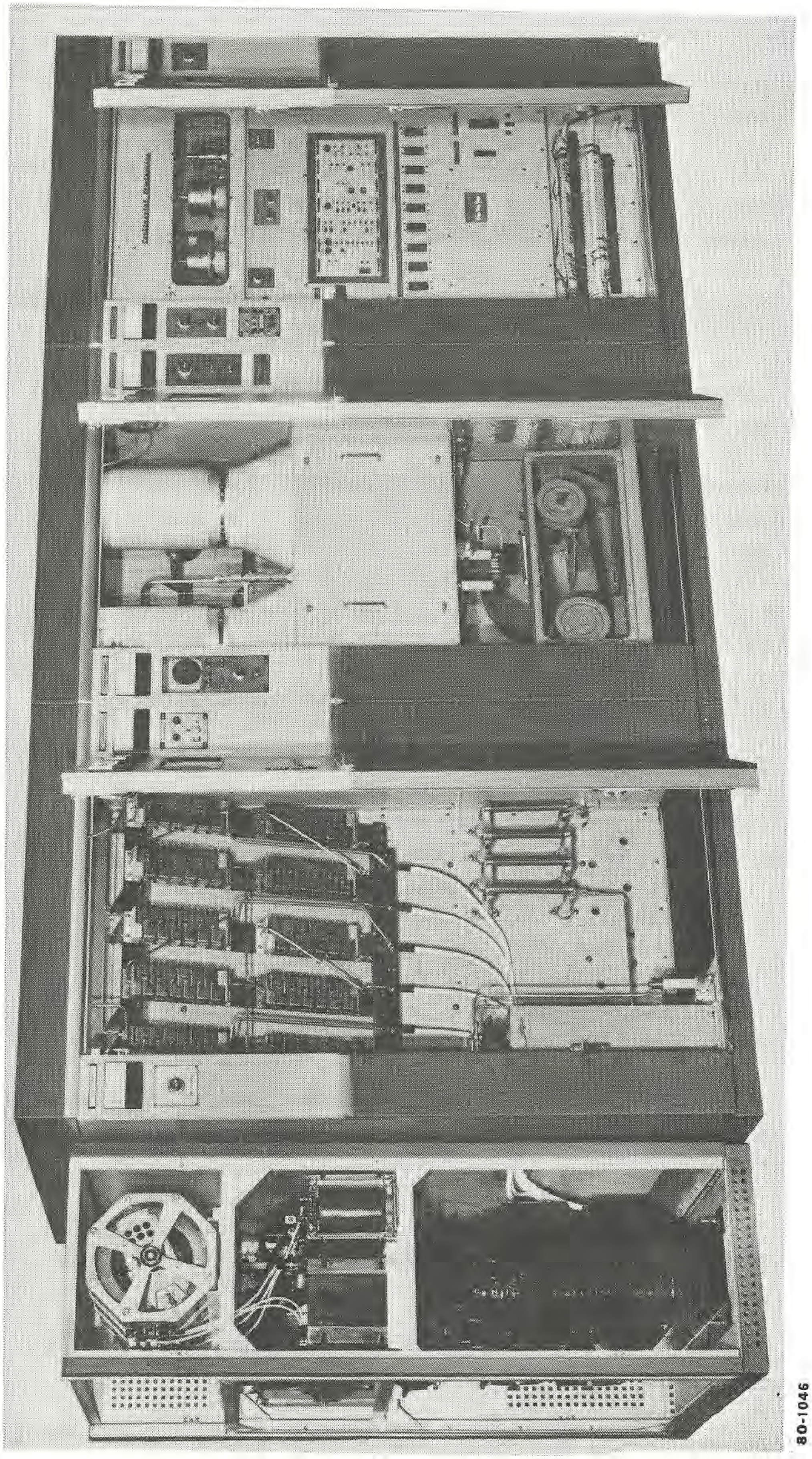
(3) The screen grid is operated at ground potential with respect to the rf signal and serves as a shield between the control grid and the plate of the tube, thereby eliminating the necessity of a great amount of neutralization.

(4) Slightly higher efficiency than that obtained from a high-level plate modulated transmitter is possible through the use of a tetrode tube in the high efficency Doherty amplifier circuit.*

c. Screen Grid Modulation. Screen grid modulation as used in the Type 317C-2 Transmitter offers the following advantages:

(1) Since the required modulation power is very low, small audio components may be used. Large transformers and chokes are not used in the resistance-coupled audio system. Harmonic distortion and distortion due to intermodulation are very low, therefore better transmitter performance is realized.

*Patent Nos. U.S. - 3,314,024, Canada - 764,605, Great Britain - 1,044,479, France - 1,432,543.



80-1046 JS1-1-(1)

Figure 1-2. Type 317C-2 Front Doors Open

(2) Through the use of screen grid modulation, the audio and modulation system can be designed with full control of phase-shift characteristics, making possible the use of overall feedback in the transmitter. Transmitter performance is thereby further improved. Overall feedback can not be used in high-level plate-modulated transmitters.

d. Power Supplies. Semiconductor rectifiers are used in the high voltage, low voltage and bias power supplies. Semiconductor rectifiers require no warmup, and can be operated efficiently at temperatures below 32 degrees Fahrenheit. The semiconductor rectifiers produce a minimum amount of heat, can be packaged more compactly, and have very long life characteristics.

In unattended or remote operation, the semiconductor characteristics become even more attractive.

Since semiconductor rectifiers are used in the Continental Electronics broadcast transmitters, no damage will result when the equipment is turned on from a cold start.

Continental Electronics AM broadcast transmitters are also well suited for high ambient temperature operation and tropical climates.

1-3. OPTIONAL EQUIPMENT AND CIRCUITRY

The necessary circuitry for connection of optional equipment is provided in the Type 317C-2 Transmitter.

The Type 317C-2 can easily be connected to operate with any remote control, automatic logging and sub-audible telemetering equipment currently available.

The Type 317C-2 can be supplied with automatic Power Cutback to 25 kW or 10 kW.

The Type 317C-2 can be supplied for operation with 380 V to 600 V, 3 phase, 50 Hz or 60 Hz primary power source.

1-4. TECHNICAL CHARACTERISTICS

The performance of the 317C-2 Transmitter meets, and in most cases, exceed the requirements of the FCC, DOC and CCIR. See Table 1-1.

TABLE 1-1. TECHNICAL CHARACTERISTICS

	AF Input Impedance	150/600 ohms
*	AUDIO DISTORTION:	Less than 2.5%, 20 to 10 KHz at 95% Modulation
	AF FREQUENCY RESPONSE:	
*	0 to -0.5 dB	10 to 7500 Hz.
*	1.5 dB	15,000 Hz (Ref to 1000 Hz at 70% Modulation
*	CARRIER SHIFT:	2% or less at 100% Modulation
*	PROGRAM INPUT LEVEL:	+10 dBm ±2.0 dB at 100%
*	INTERMODULATION DISTORTION:	3.5% at 90% total modulation by SMPTE test method using 60 and 7000 Hz in 4:1 ratio
*	PHASE RESPONSE:	$\pm 2^{\circ}$ from 10 to 1000 Hz and phase linear to 30 kHz with output lagging 45° at 15 kHz.
	TILT AND OVERSHOOT:	
*	Clipped Sinewave:	3% variation in modulation percentage using 6 dB symmetrical clipping, 90% modulation 30 to 10,000 Hz.
	Squarewave:	5% variation in modulation percentage, 60% modulation with squarewave frequencies from 30 to 7500 Hz.
*	MODULATION CAPABILITY:	100% continuous at any frequency 20 - 10,000 Hz +125% Positive Peak with asymmetrical input.

TABLE 1-1. TECHNICAL CHARACTERISTICS - Continued

Noise, unweighted (below 100% Modulation at 1,000 cps)	60 dB
SPURIOUS & HARMONIC EMISSION:	-80 dB
Modulation Type	High Level Screen Grid/ Impedance Modulation
Type of Emission	A3
Frequency Range	535-1620 KHz
Frequency Stability	±5 Hz
Output Impedance	40 ohm to 300 ohms (as specified by customer)
CARRIER POWER:	
Power Output Capability	60,000 watts
Power Rated	50,000 watts
Power Reduction	25kW or 10kW
Ambient Temperature	-4° to 122°F (-20° to 50°C)
Altitude	7500 feet (Higher by special order)
Power Supply	460 volts, 3 phase, 3 wire, 50/60 Hz (Other voltages optional)
* Power Consumption at	
0% Modulation	82kW
(100% Modulation)	120kW
Control Power External or Internal	120 VAC (Selected by wiring jumpers)
Power Factor	0.95 (approximately)
Overall Efficiency	Better than 60% at any depth of modulation
Permissible Combined Voltage Variation and Regulation	±5% Voltage ±2.5% Frequency

TABLE 1-1. TECHNICAL CHARACTERISTICS - Continued

DIMENSION:

UNIT	WIDTH	HEIGHT	DEPTH
Power Amplifier Unit	48"	78"	54"
Driver and Power Distribution Unit	48"	78"	54"
Rectifier and Harmonic Filter Unit	48"	78"	54"
HV Transformer and Regulator Unit	24"	72"	46"

NET WEIGHT OF MAIN CABINET GROUP	4,891 lbs.
NET WEIGHT OF HV TRANSFORMER AND REGULATOR UNIT	1,990 lbs.
EXPORT SHIPPING	
Gross Weight	9,700 lbs. (4400 Kilos)
Size	800 cubic feet (22.65 cubic meters)

REMOTE CONTROL - See Table 2-1 for connection information

TABLE 1-2. EQUIPMENT REQUIRED BUT NOT FURNISHED

1. 4" copper strap to reach from station to back of Unit 1, Unit 2, Unit 3. Also as noted for Unit 4 and to Note B in Unit 2. See Drawing 142010.

2. Air inlet for blower.

3. Air duct for Unit 1 air output.

4. Optional-air exhaust fan - needed in some vent configurations.

5. Conduit and 4/0 cable for power connection.

6. Conduit and #12 wire for lighting and service plugs.

SECTION 2 - INSTALLATION

2-1. GENERAL

The Typical Equipment Layout, Drawing D14210 and 73011, shows the realtive location of the units which comprise the Type 317C-2 Transmitter and the proper positioning of other items which should be included in the transmitter building. Dimensions, wiring conduit holes, air plenums, ground straps and air filters are shown in the Assembly Diagram, Drawing D142010. The relative positions of components are shown in figures in the Maintenance Section of this handbook.

2-2. TRANSMITTER BUILDING REQUIREMENTS

The size and typical entrance requirements of the transmitter building are shown on Drawing D142010. Make sure that the available electric-power facilities are adequate.

2-3. CONDUIT AND WIRING

The required primary supply voltage for the Type 317C-2 Transmitter is normally 460-volts, 3-phase, 3-wire, 60 Hertz. The transmitter primary power should be routed through a customer-furnished panel-board disconnect switch with a capacity of approximately 300 amperes. It should be fused with 200-ampere super-lag 600-volt fuses.

The wiring from the panel board to transmitter must be in accordance with the local electrical code for the type of panel-board disconnect switch in use. Do not use wire smaller than #4/0 for transmitter primary power connections using 380-volts and 460-volts. If 600-volts is used, then #3/0 is adequate.

The 460-volt power feed is terminated in the Driver and Power Distribution Unit of the transmitter on the line-side studs of circuit breaker 2CB11. A 4-3/4 inch hole is provided in the base and a 3-1/2 inch hole in the top of this unit for entrance of these leads. The conduit must be properly terminated at this hole. Refer to Drawing D142010 for location.

Provision is also made near the entrance of the 460V primary feed to connect a 4-inch copper ground strap to the station ground. Ground UNIT 4 with a ground strap. Refer to Drawing D142010, Notes A and B. Provision is made at the back of UNITS 1, 2 and 3 for a 4-inch ground strap connection. Refer to Drawing D142010, Note P.

Three primary #2/0 cables to the plate transformer are designed to be routed out the rear bottom of the left end of the Rectifier and Harmonic Filter Unit and the six secondary HV leads are routed out the center front of the left end of the Rectifier and Harmonic Filter Unit as shown on View X-X on Drawing D142010. If UNIT 4 is relocated a hole is usually added in the floor below 2K10 or at the rear top left corner of UNIT 2 for the three primary #2/0 cables to the plate transformer. A hole for the six HV leads is usually routed in the floor behind 3C1-3C2 in UNIT 3 or at the front top left corner of UNIT 3.

No trenches or inter-cubicle conduit are required, since the inter-unit wiring is contained within the transmitter. This wiring is furnished by the manufacturer.

A small customer-furnished wall disconnect switch should be provided for the transmitter cabinet lights circuit. When this is used, make sure jumper from 2TB1-3 to 2TB1-8 for internal 115 VAC is removed.

The speech input and monitor wiring is routed into the Driver and Power Distribution Unit at the right front corner. Two 2-inch diameter holes are provided at the bottom and one 2-inch diameter hole at the top for conduit connections to the customer-furnished equipment rack. One conduit is required for the speech and monitoring lines and the other for remote control lines. Connections for all these functions are provided on the transmitter terminal boards. Refer to drawing D142010 for hole locations.

2-4. TRANSMITTER COOLING AND AIR EXHAUST

The cooling-air exhaust from the transmitter should be removed from the building by duct work and a plenum housing above the transmitter. This type installation provides two separate air exhausts, whereby the PA air is exhausted out a separate duct through the roof of the building, and the driver air and cooling of the cubicles which are not provided with forced-air are exhausted via a plenum to an outside wall. This type installation requires a 2000 cfm fan to assure the forced driver air (approximately 900 cfm) is pulled from the building, in addition to pulling air through the other exhausts for component cooling. Refer to drawing 73011, sheets 1 and 2.

An alternate method is to pressurize the rear of the transmitter by utilizing a 300 cfm fan pulling air into the building. The PA air (center unit) should still be exhausted through a separate duct, and the plenum housing on top of the transmitter should be ducted to outside, but would not require an exhaust fan.

A filter bank should be used in the outside wall. The main transmitter blower inlet is filtered at the rear of the Power Amplifier Unit (center) and the two rear doors of the Drive and Power Distribution Unit, however, there is no filtering provided for air entering the louvers on the rear doors of the Rectifier Unit.

Heat dissipated by the transmitter cooling system can be used to supplement heating of the transmitter building during the wintertime. This is accomplished by the use of louvers attached to the exhaust duct work of the power amplifier cabinet. The total heat available from the transmitter is approximately 21 kW/hour or 72,000 btu/hour (no modulation required).

2-5. UNPACKING AND ASSEMBLY

Components which are fragile or might be damaged in shipment are removed from the cabinets at the factory and packed in separate boxes. Heavy items such as transformers and chokes are removed and shipped separately. Inspect all units of the shipment. If there is any evidence of damage to any part of the shipment, a claim should be filed with the transportation company.

Customer-furnished 4-inch copper ground straps should be set in place before the cabinets are set in place. Refer to drawing D142010 for ground locations and cabinet measurements.

It is usually necessary to shim the corners of the cabinets for leveling. Use the 2-inch square shim material that is provided. These are placed under the necessary corners (usually the shims are split between the inter cabinet corners).

Use the 2-inch square material with the 3/8-inch hole as washers to bolt the cabinets together (one on each side). To bolt the top rear corners of UNIT 1 to UNIT 2 and UNIT 3 the left and right top RF shield mounting brackets must be removed. It will be helpful to leave these brackets out until interplate coil 1L5 has been installed.

After the main cabinet group is placed in position and bolted together, the other items can be located and positioned.

2-6. COMPONENTS REMOVED FOR SHIPMENT

The following components are normally removed for shipment. These may be relocated by reference to photographs in Section 5. See Table 2-2. For overseas shipments additional components may also be removed for shipping. Connect all tagged wiring to the appropriate terminals. All components which were removed for shipment are tagged with their component symbol numbers and their unit numbers such as 4T5, 3C2, 3L5, etc.

If the variable vacuum capacitors in the plate and output networks were removed for shipping, install these carefully. These components have been factory adjusted to have the proper reactance for the customer's operating frequency and antenna impedance. When removed from the transmitter for shipment, these capacitors are taped so that their factory settings will not be changed. Set the position indicators for these capacitors to the settings listed in the Factory Test Data, which is supplied with the transmitter, then remove the tape from the capacitors and install them, being careful not to change their factory settings during installation. Use extreme care in handling and installing the glass vacuum padding capacitors. The shorting taps on the inductors are factory set and shipped in the proper position. This information ia also recorded in the Factory Test Data. To install the inter plate coil, 1L5, remove the bottom mounting bracket for the top RF shield on UNIT 1. Refer to figure 5-3. Center the notch on the left end of 1L5 to the top cover mounting bracket and roll coil inward. Center the notch on the right end of 1L5 to the top RF cover bracket and roll inward. The mounting brackets on 1L5 mount directly to the insulated standoffs. Flat washer, lock washer, nut and acorn nut are then installed. The three top RF shield mounting brackets may now be installed. Refer to the relative positions of components shown in Figures 5-1 through 5-39 of this handbook.

NOTE

> The chimney for the carrier tube has three holes that must face forward toward the overtemperature switch, 1S5.

After the assembly is complete, the following items must be checked before attempting transmitter operation:

1. Check all wiring which connects to the terminal boards and components to make sure that it is tightened securely.

NOTE

Make sure plug-on oscilloscope 1P5 is engaged to all pins.

2. Check all bus work in the plate output networks for tightness.

3. Make sure that the 5-inch diameter sleeve connecting the shielded compartments of the Power Amplifier and Harmonic output networks cabinets is centered between the two cabinets and tightly installed.

4. Set all tuning-capacitor position indicators to the values indicated in the Factory Test Data which is provided with each transmitter. For motor driven capacitors, wait until power is applied.

2-7. INITIAL ADJUSTMENTS

1. Make sure that all circuit breakers are in the OFF position.

2. Apply the 460VAC primary power to the transmitter.

3. Set 230 VOLT SUPPLY circuit breaker 2CB10 to the ON position and check the meter indications on 230 VOLT SUPPLY meter 2M6 for each phase as switched and indicated by LINE VOLTMETER switch 2S4. There are taps on 2T1 for setting this voltage near your factory test data figures. Unless this voltage is unreasonably high (over 245V) it is best to wait until full power is on transmitter to determine if resetting is necessary. Also check the meter indications on 460 VOLT SUPPLY meter 3M1 for each phase as switched and indicated by LINE VOLTMETER switch 3S1.

4. Check for 115 VAC on terminal 1 of 115 VOLT SUPPLY circuit breaker 2CB1 using the cabinet ground for reference.

5. Check for 115 VAC on terminal 1 of 3 of 12/28 volt circuit breaker 2CB2, using the cabinet ground for reference.

6. If the voltmeter indications listed in Steps 4 and 5 of this procedure are not obtained, check the wiring of the secondary of 230-volt distribution transformer 2T1.

WARNING

REMOVE 460 VOLT PRIMARY POWER BEFORE REMOVING THE COVER FROM THE DISTRIBUTION TRANSFORMER, CIRCUIT BREAKERS AND PLATE CONTACTOR 2K10. IF CABINET LIGHTING VOLTAGE SOURCE IS FROM TRANSMITTER, REMOVE 460 VOLT PRIMARY POWER BEFORE REMOVING GROUND WIRES FROM BOTTOM OF CABINETS. IF EXTERNAL LIGHTING SOURCE IS USED, TURN OFF BREAKER. WHEN GROUND IS LIFTED, 115 VAC WOULD BE ON GROUND RETURN WIRE.

7. Set 115 VOLT SUPPLY circuit breaker 2CB1 to the ON position.

8. Set 12/28V control circuit breaker 2CB2 to the ON position and make sure that all indicator lamps provide the indications listed in paragraph 3-1, CONTROLS AND INDICATORS of this handbook. On test meter 2M1, check for correct voltage with 2S7 in the +12V Control, +12V AUDIO and -12V AUDIO position.

9. Check the operation of the motor-driven variable tuning capacitors. Observe the associated position-indicating counters and record the points. Refer to the Factory Test Data.

CAUTION

THE TUNING CAPACITOR DRIVE MECHANISMS ARE NOT EQUIPPED WITH LIMIT STOP SWITCHES. DO NOT DRIVE THE CAPACITORS BEYOND THE LIMITS OF MAXIMUM OR MINIMUM CAPACITY. THE CAPACITORS AND THEIR DRIVE MECHANISMS CAN BE DAMAGED IF THEY ARE DRIVEN BEYOND THESE LIMITS.

10. Set BLOWER circuit breaker 2CB3 to the ON position. Depress MASTER ON switch 2A8S1. The blower should start. If blower does not start check the phase failure relay 2A13K1 for proper adjustment. The red light on 2A14K1 should be off when properly adjusted. Adjust pot on 2A13K1 CCW to decrease sensitivity. It may be necessary to reverse two phases on 2A13TB1-5 and 6. Make sure that the blower motor is rotating in the proper direction. If it is not rotating in the proper direction, depress the MASTER OFF switch, 2A8S3. The blower will remain energized until blower holdover timer 2A2U1 times out.

When the blower stops, open Building 460 volt primary breaker and reverse any two of the three-phase primary power connections of the 460 volt input at 2CB11. It is necessary to reverse the phases at 2CB11 because the correct phase was selected for noise reduction at the factory. This may require changing phases on the phase failure relay as outlined above.

11. Depress the MASTER ON switch, 2A8S1. Recheck the blower for proper direction of rotation. Make sure Blower lamp 2A2DS1 is lighted green to indicate air flow.

12. Check for 28 VDC on TEST METER 2M1 with 2S7 in the +28V position.

13. Set LOW LEVEL FILA circuit breaker 2CB4 to the ON position. Using a volt-ohm-milliammeter, check the filament voltages at the sockets of tubes 2V1, 2V2, 2V3 and 2V4. The filament voltage applied to 2V1 and 2V2 should be approximately 5 VAC. The filament voltage applied to 2V3 and 2V4 should be 7.2 VAC. If the meter indications on 2V1, 2V2, 2V3 and 2V4 show deviations greater than ±2.5%, set circuit breaker 2CB3 to the OFF position and reconnect the primary taps on filament transformers 2T12, 2T11, 2T9 and 2T10 respectively, to obtain the proper filament voltage of the sockets of these tubes. Reset 2CB4 to ON. Filament lamps 2A2DS2 is lighted green to indicated filament ON. Plenum door interlock 2S8 must be closed to take above voltage readings.

14. Set FILAMENT VOLTMETER switch 1S10 to the PEAK position. Set PEAK FILA circuit breaker 2CB5 to the ON position. PWR AMP FILAMENT VOLTS meter 1M5 should indicate approximately 0.5 volts. Taps are provided on transformer 2T8 for ±2-1/2, 5 and 7-1/2 percent adjustment of the filament voltage. Record the exact indication on PWR AMP FILAMENT VOLTS meter 2M5 for future reference.

15. Set FILAMENT VOLTMETER switch 1S10 to the CARRIER position. Set CARRIER FILA circuit breaker 2CB6 to the ON position. PWR AMP FILAMENT VOLTS meter 1M5 should indicate approximately 9.5 volts. Taps are provided for ±2-1/2, 5 and 7-1/2 percent adjustment of the filament voltage. Record the indication on PWR AMP FILAMENT VOLTS meter 1M5 for future reference.

16. Turn MASTER OFF. Close all cabinet doors and make sure that the door indicator lamp for each door is lighted green. Open each door and check that its lamp is extinguished.

17. Set TEST SWITCH 2S13 to the TEST POSITION. This is the up position which grounds the carrier tube screen and closes 2S11 and 2S12. Closing 2S11 and 2S12 defeats the plate supply switch 2CB11 interlock which is in the OFF position. 2A6DS4 and 2A6DS5 will light red indicating TEST POSITION and BREAKER TRIPPED. Make sure Bias 2CB6, Screen 2CB8, LV 2CB9 and Plate Switch 2CB11 are OFF. At this point all control circuits may be checked without any high or low voltage DC supplies ON. It is necessary to have 2CB1, 2CB2, 2CB3, 2CB4, 2CB5 and 2CB10 ON. Depress MASTER ON and allow plate delay timer 2A2U2 to time out. When 2A2U2 times out 3KV/5.5KV Step/Start lamp 2A3DS8 will light green. Depress PLATE ON switch 2A8S2. PLATE ON lamp will light green. It is necessary to have a jumper or external interlock at 2TB1-78 to 2TB1-79. The transmitter should be in the LOCAL position by Depressing 2A8S4. LOCAL lamp 2A8DS4 will light red. Depress PLATE OFF 2A8S6. PLATE OFF lamp 2A8DS7 will light yellow. Step 17 may be used for trouble shooting any interlock problems in the future.

18. Set BIAS SUPPLY circuit breaker 2CB7 to the ON position. PA and MOD BIAS meter 2M5 should indicate approximately 850 volts.

19. Set SCREEN SUPPLIES circuit breaker 2CB8 to the ON position. CARRIER SCREEN VOLTAGE Meter 2M4 should indicate approximately 710 volts in high power.

NOTE

> This voltage may vary considerably, since it is adjusted simultaneously with the plate voltage to control transmitter power output. The voltage will be lower when transmitter is in low power.

An indication of approximately 220 volts should be obtained on PEAK SCREEN VOLTAGE meter 2M3. When transmitter is in low power the voltage is approximately 140 volts.

20. Set LV SUPPLY Circuit breaker 2CB9 to the ON position. 5000 VOLT SUPPLY Meter 3M3 should indicate approximately 5.2 KV and 300 VOLT SUPPLY meter 3M2 should indicate approximately 2.8 KV. It may be necessary to turn MASTER ON to set 2CB9 due to current surge.

21. Adjust MODULATOR BIAS controls 2R35 and 2R36 to obtain an indication of 0.58 amperes on MODULATOR PLATE CURRENT meters 2M8 and 2M9. (There may be a small amount of inter-aciton between the two control.) The current will be lower when transmitter is in low power.

22. Check that PLATE SUPPLY SWITCH 2CB11 is OFF. Set 1A1S1 on oscilloscope to PA Grid position. Depress 2A3S4, High Power Select. Depress PLATE ON 2A8S2 and check for the following:

    a. Excessive redness of 4-400 IPA tube. Set 2S7 to IPA GRID CURRENT position and tune IPA GRID CAPACITOR 2C17 for a peak indication on TEST METER 2M1. Resonate IPA CATHODE CURRENT by tuning IPA PLATE CURRENT CAPACITOR 2C28 for a dip on 2M2 IPA CATHODE CURRENT Meter.

    b. The PEAK and CARRIER GRID CURRENT on 1M3 and 1M4 should be under 200 MA and an elliptical pattern on the oscilloscope in the PA GRID and INTERGRID position. These grid currents may be higher than the factory test data and the elliptical grid patterns on the oscilloscope may tilt to the left while in the test position. This is normal until plate voltage is applied and transmitter in high power. Since there is no plate voltage on the PA tubes, there will be no patterns on the CARRIER PLATE, PEAK PLATE and POWER ADJUST position of the oscilloscope. Depress PLATE OFF 2A8S6 and MASTER OFF 2A8S3.

    Set 2S13 to the OPERATE position. This removes the ground from the carrier screen.

    Set PLATE SUPPLY SWITCH 2CB11 to the ON position. Lamps 2A6DS4 and 2A6DS5 will now be extinguished.

23. The transmitter is now ready for application of plate voltage. Depress LOW POWER switch 2A3S3. Set TUNING SELECTOR switch 1A1S1 to the POWER ADJUST position. Move the switch 1A1S2 left and adjust the plate voltage variac fully CCW for minimum voltage. Depress MASTER ON 2A8S1 and wait for 3KV/5.5KV Step/Start lamp 2A3DS8 to light green. Depress HIGH VOLTAGE switch 2S8S2. Check quickly for "Self oscillation" and other malfunctions. Check the power amplifier plate voltage on 18KV VOLT SUPPLY meter 3M4. An indication of approximately 9 to 10 KV is normal.

24. Check all positions of TEST METER switch 2S7 for readings on TEST METER 2M1 as listed in the factory test data. Some meter readings will be lower than normal, since the 750 Volt Power Supply and Plate Supply Varias is set to a relatively low position. The IPA 4-400 tube may show some redness due to lower screen voltage when in low power.

25. Check the tuning patterns of the oscilloscope and make the necessary adjustments to obtain the proper patterns listed in the TUNING PROCEDURE.

NOTE

In High Power these patterns will be as described in the TUNING PROCEDURE but in low power the grid currents will be lower and the grid scope patterns will have some tilt.

26. Depress HIGH POWER switch 2A3S4. Check the patterns on the oscilloscope to make sure they are correct. Perform any necessary tuning adjustments. Use Test Data for setting carrier screen voltage, plate voltage, modulator currents and counter dial settings. Check all other meter indications using the factory test data. It is important that the plate and carrier screen voltage are correct, then they may be adjusted simultaneously to raise or lower power.

2-8. OSCILLOSCOPE TUNING PATTERNS

Check the tuning patterns on the built-in oscilloscope and make any necessary adjustments. The following lists the oscilloscope tuning patterns for the various positions of TUNING SELECTOR switch 1A1S1.

TUNING SELECTOR SW POS		
PA GRID	(1)	The oscilloscope will display an elliptical pattern. A sample of the carrier-tube RF drive voltage is applied to the oscilloscope cathode-ray tube vertical deflection plates. A sample of the peak-tube RF drive voltage is applied to the oscilloscope cathode-ray tube horizontal deflection plates. Since the peak grid voltage is 90° out of phase with the carrier grid voltage, the pattern will be an upright ellipse. Operating TUNING switch 1A1S2 will activate tuning motor 1B2 which will vary the capacitance 1C22 in the carrier-tube grid circuit. Adjust the carrier tube-grid circuit to obtain a vertical ellipse.
INTERGRID	(2)	The oscilloscope will display the same elliptical patterns as it displays when switch 1S1 is in the PA GRID position. However, TUNING switch 1A1S2 will energize the tuning motor 1B4 which varies intergrid capacitor 1C21. Adjust capacitor 1C21 to obtain factory test data indications on PEAK GRID CURRENT meter 1M3 and CARRIER GRID CURRENT meter 1M4, then repeat step one (1) of this procedure.
CARRIER PLATE	(3)	The oscilloscope will display a diagonal line pattern. A sample of the carrier-tube RF plate voltage is applied to the oscilloscope cathode-ray tube vertical deflection plates. A sample of the carrier-tube RF grid voltage is applied to the oscilloscope cathode-ray tube horizontal deflection plates. There will be a 180° phase difference so that a diagonal line oscilloscope pattern should be displayed on the oscilloscope.

CARRIER PLATE (Cont.) Operate the TUNING switch 1A1S2 left or right until a straight line pattern is obtained. A dip will also be obtained in the indication on TOTAL PLATE CURRENT meter 1M2.

PEAK PLATE (4) The oscilloscope will display an upright ellipse pattern. A sample of the carrier-tube RF plate voltage is applied to the oscilloscope cathode-ray tube vertical deflection plates. A sample of the peak-tube RF plate voltage is applied to the oscilloscope cathode-ray tube horizontal deflection plates. In this position TUNING switch 1A1S2 will energize the tuning motor for peak-plate capacitor 1C19.1. Operate switch 1A1S2 left or right to obtain an upright ellipse pattern on the oscilloscope.

NOTE

The oscilloscope patterns for all positions of TUNING SELECTOR switch 1A1S1 should be checked after an adjustment has been made in any one position.

POWER ADJUST (5) The oscilloscope will display the same upright ellipse pattern as displayed when switch 1A1S1 is in the PEAK PLATE position. In this position TUNING switch 1A1S2 will energize the plate-voltage and carrier screen-voltage motor controls to adjust the output power of the transmitter. Check that plate voltage and carrier screen voltage raise and lower together. Operate TUNING switch 1A1S2 left or right to obtain an output of 50 KW.

TABLE 2-1. EXTERNAL CONNECTIONS TO 317C-2 TRANSMITTERS

All monitoring, telemetering, program input and remote control connections are made on Terminal Board 2TB1 located on the lower front panel of the right end cabinet. These wires can be brought in either through the floor hole below the terminal board or through the roof and down the right front side to the terminal board. The external connections, their functions, other data and terminal numbers are listed below.

TERMINALS ON 2TB1

46 & 47	RF output to modulation monitor. Output is adjustable from 10 volts P-P to 40 volts P-P into 50 ohm resistive load. Wire out with RG-58/U 50 ohm co-axial cable. Terminal 46 is the shield ground.
48 & 49	Another separately adjustable RF sample. Same output level as 46 & 47. Terminal 48 is ground.
* 50	Remote plate voltage. +1000 ohms/volt sample for remote plate voltmeter or for CEMC automatic power controller.
51	Remote plate current. +1.0 volts DC/ampere of plate current for remote plate current metering.
52 & 53	Output to frequency monitor. 3 volts P-P square wave into 50 ohm load. Wire out with 50 ohm RF-58/U coax. Terminal 52 is ground.
54 & 55	Input from external RF source such as stereo generator or RF oscillator. Input level is 2.0 volts P-P sine or square wave minimum to 10 volts P-P maximum into 50 ohm load. Wire with RG-58/U coax. Terminal 54 is ground.
56, 57 & 58	Program input line. Use twisted shielded pair. Terminal 56 is ground. Input level is +10 dBM ±1.0 dB, 600 ohm balanced.

TABLE 2-1. EXTERNAL CONNECTIONS TO 317C-2 TRANSMITTER (Cont.)

TERMINALS ON 2TB1

59	Connection for remote control ground (or common) buss. All remote functions require a momentary closure to this common terminal which is grounded when the transmitter local/remote selector is in the remote mode. In local control the ground connection is opened, which disables all remote control functions.
60	Remote RF excitation cut-off. Excitation is removed for as long as a ground is held on this terminal. Use this function in antenna pattern switching logic.
61	Remote selection of No. 1 crystal oscillator. A momentary ground will switch from No. 2 to No. 1 crystal oscillator.
62	Remote selection of No. 2 crystal oscillator. A momentary ground will switch from No. 1 to No. 2 crystal oscillator.
63	Remote master ON. A momentary ground on this terminal will start the transmitter and cycle it up to plate ready.
64	Remote master OFF. A momentary ground on this terminal will shut down the transmitter.
65	This terminal can be used either for turning off the transmitter plate voltage upon loss of remote control fail-safe logic or for a remote indication of local selection of the local/remote control selection. There is a jumper connection on the plate control module (2A4) near pin 13 on the PC board connector. This jumper is factory connected between points 1 & 2 which assumes the use of the plate fail-safe option. In this case, a sustained ground must be held on 2TB1-65 in order to keep the HV plate supply interlock closed. Loss of this ground due to loss of fail-safe logic will turn the plate off. When the transmitter is in local control, 2TB1-65 is grounded by contacts on the local/remote relay 2A10K2. If this fail-safe function is not used, the jumper on 2A4 can be connected between 1 and 3. In this case, 2TB1-65 will become

TABLE 2-1. EXTERNAL CONNECTIONS TO 317C-2 TRANSMITTER (Cont.)

<u>TERMINALS ON 2TB1</u>

65 (Cont.)	grounded when the local/remote selector is in the <u>local</u> selection and can be used as a remote indicator of this condition.
* 66	Remote plate on. A momentary ground on this terminal will turn the HV plate supply on provided that the fail-safe function described previously (2TB1-65) has been utilized in a manner which closes the plate interlock circuit.
67	Remote Plate off. A momentary ground on this terminal will turn the plate off.
68	Remote high power select. When transmitter is in low power, a momentary ground on this terminal will switch up to high power provided that the high power lockout interlock circuit is closed. This is described with the 2TB1-87 function.
69	Remote low power select. A momentary ground on this terminal will switch down from high to low power.
70	Remote overload indication. Operation of any overload relay will put a sustained ground on this terminal.
71	Remote magniphase disabled indication. Disabling the magniphase protection unit will hold a sustained ground on this terminal.
72	Remote magniphase operate indication. This terminal will become grounded on the first magniphase operation. After lockout due to eight operations in the four minute timeperiod, the ground will cycle on and off at the same rate as the magniphase operate lamp on the 2A6 module.
73	Remote transmitter reset. A momentary ground on this terminal will turn the HV plate supply back on after lockout due to either (1) low voltage overload, (2) high voltage overload, (3) magniphase lockout or (4) overtemperature lockout. It will also reset the remote overload indication by removing the ground from 2TB1-70.

TABLE 2-1. EXTERNAL CONNECTIONS TO 317C-2 TRANSMITTER (Cont.)

TERMINALS ON 2TB1

74	Remote indication of transmitter in site testing mode. This terminal will be grounded when the plate circuit breaker is tripped and the transmitter test switch is in the test position for on-site testing.
75, 76 & 77	These are the three terminals of a SPDT switch on the main plate contactor and can be used for remote indication of plate contactor position. Terminal 75 is the common pole, 76 is normally open when plate contactor is open and 77 is normally closed.
78 & 79	External plate interlock. A contact opening between these two terminals will drop out the plate contactor. This is a 120 VAC circuit. It is normally used as a phasor, tuning hut or dummy load interlock. If not used, jumper the two terminals together.
80	Output to start dummy load cooling. 120 VAC will be sustained here for as long as the transmitter blower is running. Can be used to start fan or pump on dummy load or to start transmitter air handling system.
81	Remote indication of cabinet lights and oscilloscope status. This terminal is grounded when cabinet lights and oscilloscope are turned on.
82, 83 & 84	These are the three terminals of a SPDT switch on the power change contactors and can be used for remote indication.
85	Remote power adjust (lower). The power adjust motors will run in the lower direction while a ground is held on this terminal.
86	Remote power adjust (raise). The power adjust works will run in the raise direction while a ground while a ground is held on this terminal.

TABLE 2-1. EXTERNAL CONNECTIONS TO 317C-2 TRANSMITTER (Cont.)

TERMINALS ON 2TB1	
87	High power lockout interlock. If the transmitter is to be used at low power into a 10KW Phasor or low power emergency antenna, it should be interlocked to prevent inadvertent high power operation in this mode. This is accomplished by removing the jumper buss which grounds the coil (terminal A) of relay 2A3K5, located just above the relay socket on the 2A3 P.C. board. The relay can now be switched to the high power position only by grounding 2TB1-87 and operating the normal high/low function. The external switching logic should remove this ground when operating at reduced power into a load not designed for 50KW operation.
OTHER TERMINALS ON 2TB1	
1 & 2	For external 115 VAC control, without using the 115 VAC derived from the main 380 - 600 V, 3-phase supply. Remove the normal jumper between terminals 2 and 3 and connect 115 VAC from building power to terminals 1 and 2. Terminal 1 is grounded in the transmitter.
6	If it is deemed useful to retain overload indications without building power, a 12 VDC battery can be connected here (+12V). Current load is approximately 0.3 ampere with all lamps lighted. If used remove jumper from 2TB1-6 to 2TB1-5.
7 & 8	Connect 115 VAC here (terminal 7 is grounded in the transmitter) for transmitter cabinet lights and convenience outlets. If used remove the jumper from 2TB1-3 to 2TB1-8.

INPUT POWER

The main power input (380V, 460V or 600V, 3-phase) is routed into the right hand cabinet either through a hole in the floor or through the roof (right rear corner) and is connected to the line terminals on the plate supply switch, 2CB11. Use 4/0 cable. 3/0 cable may be used with 600V input.

EXTERNAL LOW VOLTAGE REGULATOR

If it is necessary to regulate the three-phase power to the filament and low voltage supplies, a 230-volt regulator can be connected in the 230 volt buss by removing the three jumper links on 2TB4 (inside rear wall of right end cabinet) and connecting the three input and three output wires to and from the regulator to 2TB4, 1 thru 6. Approximate load is 20 KVA.

TABLE 2-2. COMPONENTS REMOVED FOR SHIPMENT

Item	Qty.
Transformer, Variable, Consisting of 4T4, 4T6, 4T8	1
Transformer, 4T5, 4T7, 4T9	3
Transformer, 4T3 Type 512-0759(Rev.D) or 512-0808 (Rev.A)	1
Tube, 4-400C, 2V1, & 2V2	2
Chimney, SK406	2
P-C Cards, 2A1 thru 2A7, Extender Card	8
Transformer, 2T4	1
Inductor, 3L4 & 3L5	2
Transformer, 2T1, Type 512-0725	1
No. 2/0 Plate Supply Leads	3
Tubes, 2V3 & 2V4 3CX3000A1	2
Floor Mat, Unit 2	1
Resistor, 2R60 & 2R61	2
Resistors, 2R57, 2R58 & 2R59	3
Peak Plate Parasitic Choke Assembly	1
Capacitor, 3C1 & 3C2	2
Transformer, 1T1	1
Carrier Plate Parasitic Choke Assembly	1
Surge Relay 4K1	1
Resistor, 3R5	6
Resistor, 3R1	1

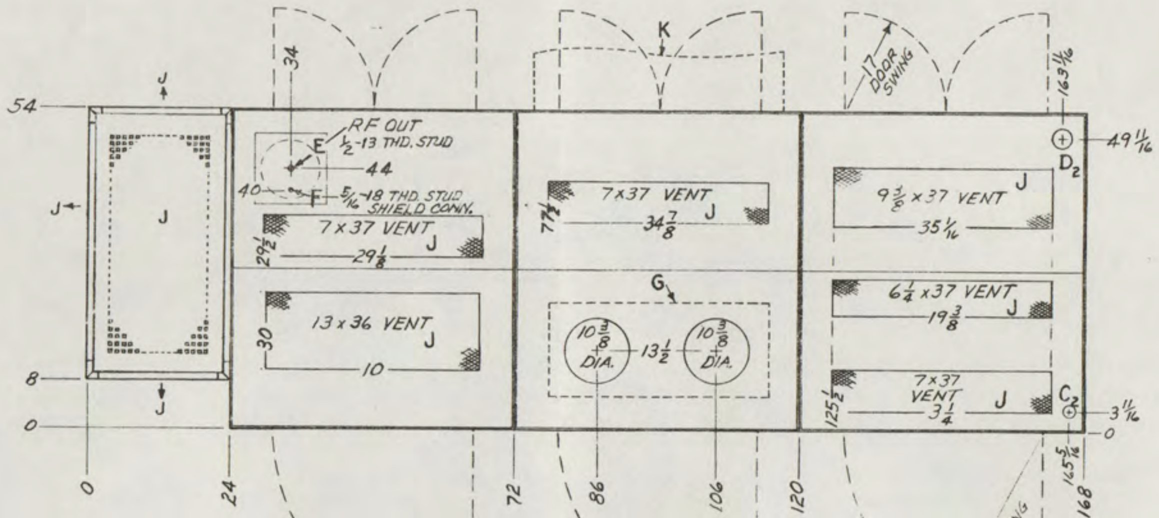
TABLE 2-2. COMPONENTS REMOVED FOR SHIPMENT (Continued)

Item	Qty.
High Voltage Cable	6 pcs.
Capacitor, 2C2	1
*Capacitor, 3C4.2, 3C4.3 & 3C6.3(Type MLC 1000-30)	3
*Capacitor, 3C5.2 (Type MLC 750-30S)	1
Resistors, 3R6, 3R7, 3R8 & 3R9	4
8 Pieces Buss, Unit 3	1 lot
*Capacitor, 1C10.3 (Type MLC 500-30)	1
Oscilloscope, Unit 1	1
Inductor, 1L5 & 1L7	2
Resistor, 1R9	1
Tube, Peak, 4CX35000C	1
Tube, Carrier, 4CX35000C	1
Exhaust Chimney, Peak, 1V1	1
Exhaust Chimney, Carrier, 1V2	1
Plate Connectors, 1V1 & 1V2	2
Cover, Grid Section	1
Neutralizing Circuit Assembly, Unit 1 (Carrier Tube)	1
2 Pieces Buss, Unit 1	1 lot
Misc. Hardware, Assembly	1 box
Paint	2 cans

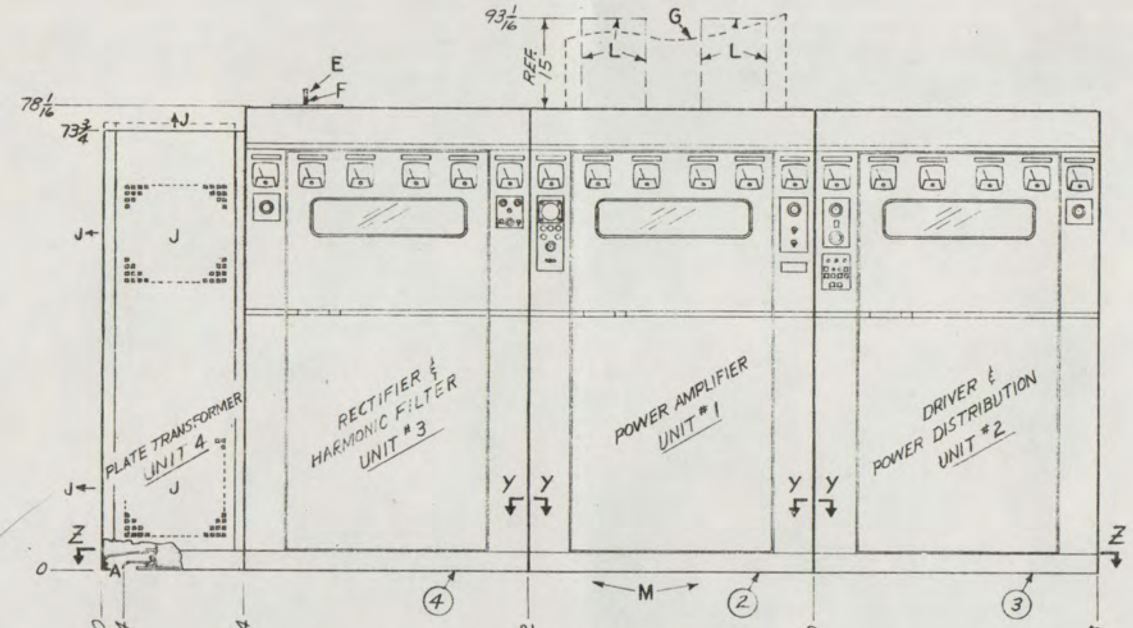
* Items may or may not be used as noted

TABLE 2-2. COMPOMPONENTS REMOVED FOR SHIPMENT (Continued)

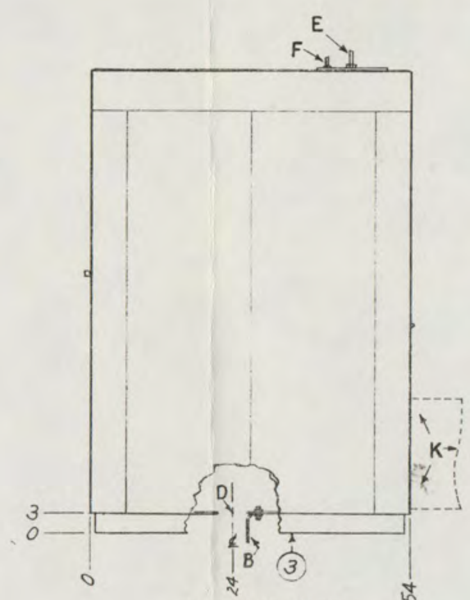
Item	Qty.
Instruction Manuals	2
Air Filters, Unit 1	3
Air Filters, Unit 2	2
RF Shield for Unit 3, Top	1
RF Shield for Unit 3, Bottom	1
Floor Mat, Unit 3	1
RF Shield for Unit 1, Top	1
RF Shield for Unit 1, Bottom	1



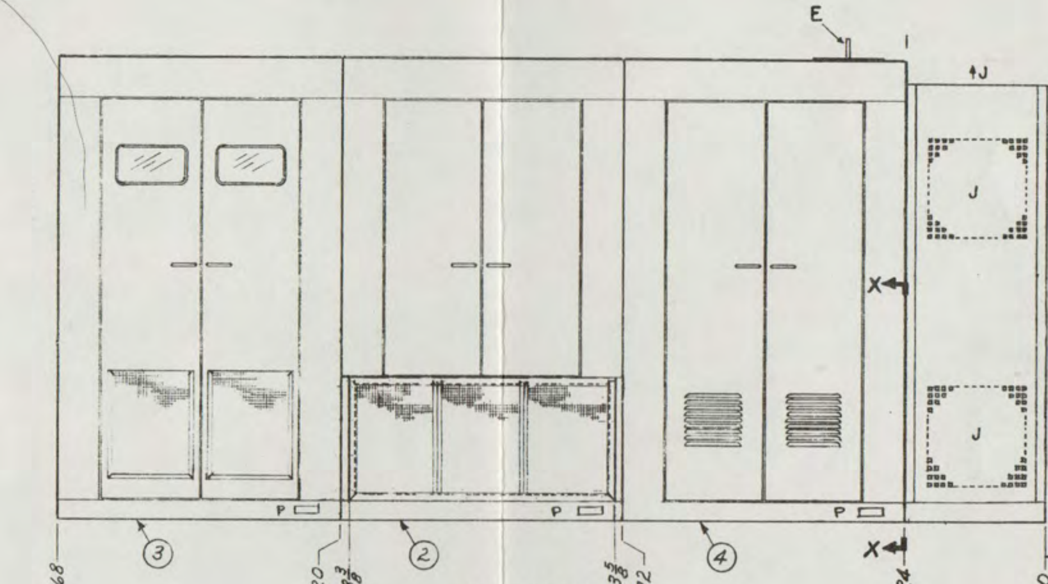
PLAN VIEW



FRONT VIEW



RT END VIEW



REAR VIEW

INSTALLATION INFORMATION

A – TO STATION GROUND, 1/32 x 4 WD. COPPER STRAP 18 INCHES FREE LENGTH ABOVE STATION FLOOR.

B – TO STATION GROUND, 1/32 x 4 WD. COPPER STRAP 8 INCHES FREE LENGTH ABOVE STATION FLOOR.

C_1 – TO RACK, CONDUIT FROM TWO 2 INCH DIA. HOLES.

C_2 – OPTIONAL C_1 EXIT (1) 2 INCH DIA. HOLE

D_1 – TO MAIN DISCONNECT BOX, CONDUIT FROM 4 3/4 DIA. HOLE.

D_2 – OPTIONAL D_1 EXIT (1) 3 1/2 INCH DIA. HOLE.

E – TO ANTENNA OR PHASOR, 3 1/8" EIA END TERMINAL STANDARD. PLATE WITH 1/4-20 STUD CONNECTION FURNISHED ON REQUEST.

F – ~~TRANSMISSION LINE SHIELD CONNECTION.~~

G – TO EXTERIOR, AIR DUCT FOR EXHAUST FROM PWR AMP FORCED AIR COOLED COMPONENTS 16 x 37 DUCT CROSS-SECTION PLACED SYM. ABOUT 10 3/8 DIA HOLES (2).

J – TO EXTERIOR, AIR FROM CONVECTION COOLED COMPONENTS BY STATION EXHAUST FAN.

~~K – TO EXTERIOR, AIR DUCT FOR INTAKE TO BLOWER 19 x 43 1/2 DUCT CROSS-SECTION PLACED SYM. ABOUT 18 1/2 x 43 CUTOUT. USE EXISTING HOLE PATTERN (FOR 24 #10 SHEET METAL SCREWS). 3/8 MAX DUCT FLANGE EXTENTION BEYOND HOLE PATTERN.~~

L – TO BE FREE OF OBSTRUCTION, 15 INCHES ABOVE 10 3/8 DIA. HOLES (2).

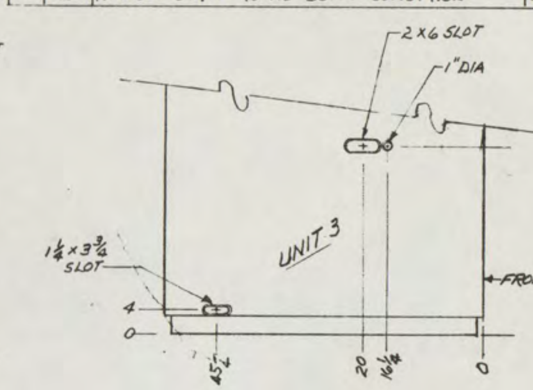
M – TO BE PLACED AS SHOWN, UNIT #3, 1, & 2; UNIT #4 MAY BE PLACED ELSEWHERE; SEE VIEW X-X FOR CABLE HOLE LOCATIONS.

N – 3 1/2 DIA. HOLE FOR PLATE TRANSFORMER PRIMARY LEADS WHEN UNIT 4 IS NOT LOCATED AS SHOWN.

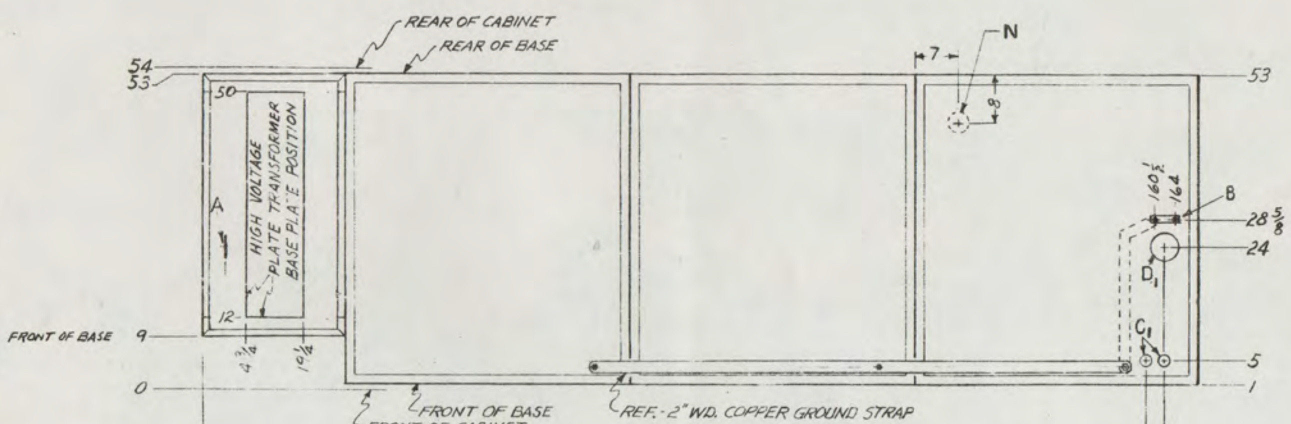
P – TO STATION GROUND 1/32 THK x 4" WIDE COPPER STRAP TYPICAL 3 PLACES

REVISIONS

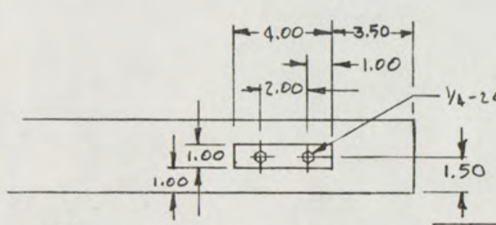
SYM	ZONE	DESCRIPTION	DATE	APPROVED
	A	ADDED NOTE P AND GND PAD LOCATIONS	1-30-81	[illegible]
	B	ADDED 3 1/8" END TERMINAL TO INSTALLATION INFO LETTER "E". DELETED LETTER "F".	5-13-81	SKIP
	C	DELETE NOTE K	10-14-81	[illegible]
	D	DELETE ΔY SWITCH	12-21-81	[illegible]
	E	REVISED DET "P" TO AS BUILT CONDITION	11/16/83	R.G.



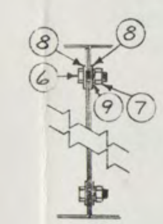
VIEW X-X



SECT. Z-Z



DETAIL P
TYP 3 PLACES



SECT. Y-Y
SCALE 1/4 = 1
TYP. 20 PLACES; UNIT #1 TO #2 & 3

LIST OF MATERIALS OR PARTS LIST

QUANTITY REQUIRED -1	ITEM NO.	ZONE	PART OR IDENTIFYING NO.	DWG SIZE	NOMENCLATURE OR DESCRIPTION
20	9		MS 35338-140	A	SPLIT LOCKWASHER 5/16, CRES
40	8		MS 15795 812	A	FLATWASHER 5/16, CRES
20	7		MS 51971-2	A	HEXNUT 5/16 x 18, CRES
20	6		MS 35307-332	A	SCREW 5/16 x 18 x 3/4 LG., HEXAGON HD., CRES
1	5		142004-1	E	UNIT #4 - PLATE TRANSFORMER
1	4		125751-1	E	UNIT #3 - RECTIFIER & HARMONIC FILTER
1	3		142002-1	E	UNIT #2 - DRIVER & POWER DISTRIBUTION
1	2		142001-1	E	UNIT #1 - POWER AMPLIFIER
X	1		142010-1	D	ASSEMBLY - TYPE 317C-2 50 KW MW TRANSMITTER

NEXT ASSY	DWG SIZE	USED ON
142000	B	2538

UNLESS OTHERWISE SPECIFIED
TOLERANCES ON: FRAC ± ~
2 PLACE DEC ± ~ 3 PLACE DEC ± ~ ANGLES ± ~
MACHINED SURFACE FINISH 125
ALL DIMENSIONS ARE IN INCHES AND INCLUDE APPLIED FINISH.
REMOVE ALL BURRS AND SHARP EDGES.

DRAWN	C.A. ONEY	DATE 1 JUNE 80
CHECKED		
MECH DSGN		
ELEC ENGR	J. SAINTON	
APPROVED		

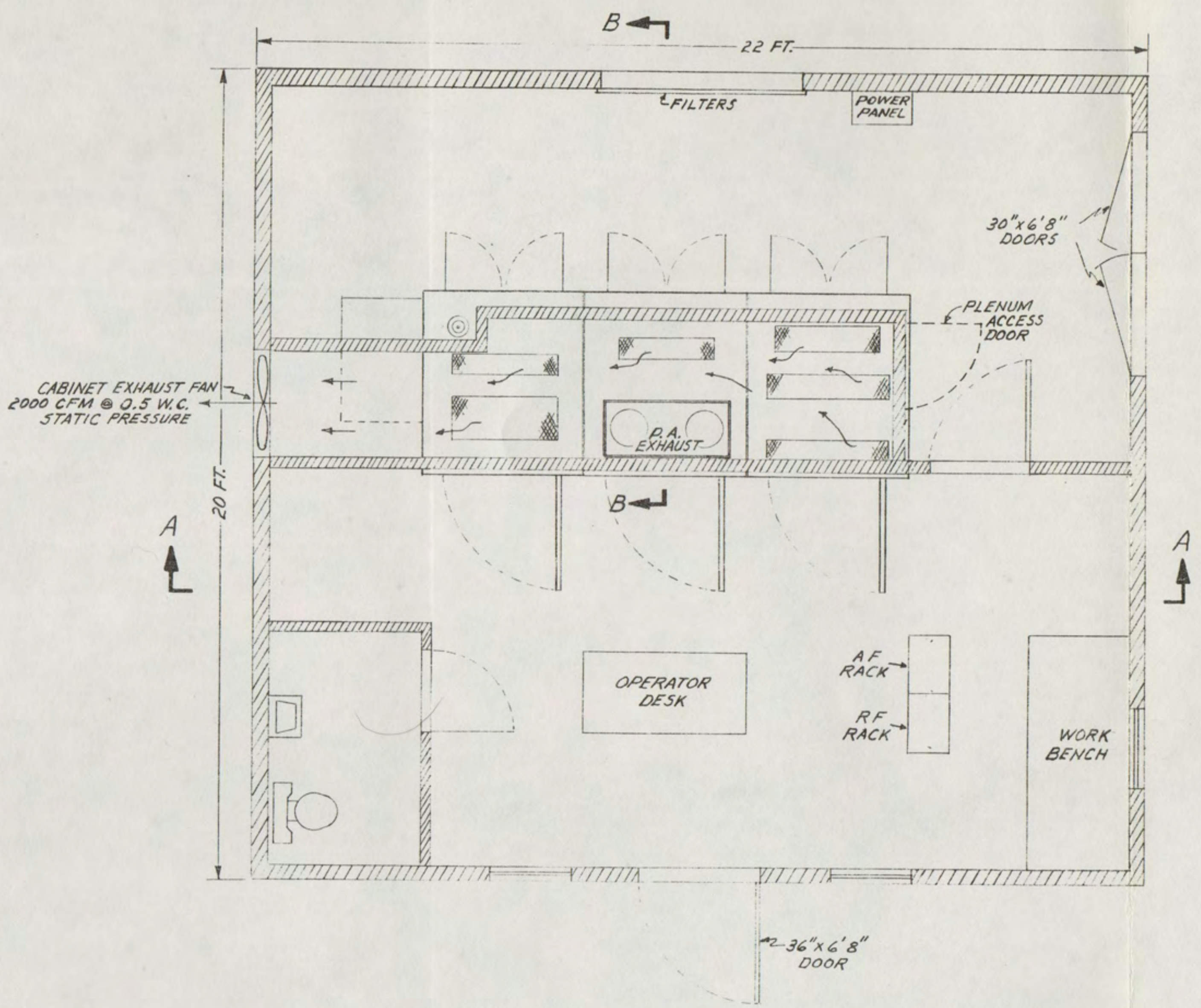
Continental Electronics
CONTINENTAL ELECTRONICS MFG CO. DALLAS, TEXAS

ASSEMBLY TYPE 317C-2 50 KW MW TRANSMITTER

CODE IDENT NO. 52151 | SIZE D | 142010
SCALE: | REV | SHEET 1 OF 1

C E - FORM

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
A		REVISED	9-9-70	R. TUCKER



PLAN VIEW

QUANTITY REQUIRED	ITEM NO.	ZONE	PART OR IDENTIFYING NO.	DWG SIZE	NOMENCLATURE OR DESCRIPTION

LIST OF MATERIALS OR PARTS LIST

NEXT ASSY	DWG SIZE	USED ON
73010-1	D	515

UNLESS OTHERWISE SPECIFIED
TOLERANCES ON: FRAC ±
2 PLACE DEC ± 3 PLACE DEC ± ANGLES ±
MACHINED SURFACE FINISH 125✓
ALL DIMENSIONS ARE IN INCHES AND INCLUDE APPLIED FINISH.
REMOVE ALL BURRS AND SHARP EDGES.

		DATE
DRAWN	R. TUCKER	10-16-64
CHECKED		
MECH DSGN		
ELEC ENGR		
APPROVED		

Continental Electronics
CONTINENTAL ELECTRONICS MFG. CO. DALLAS, TEXAS

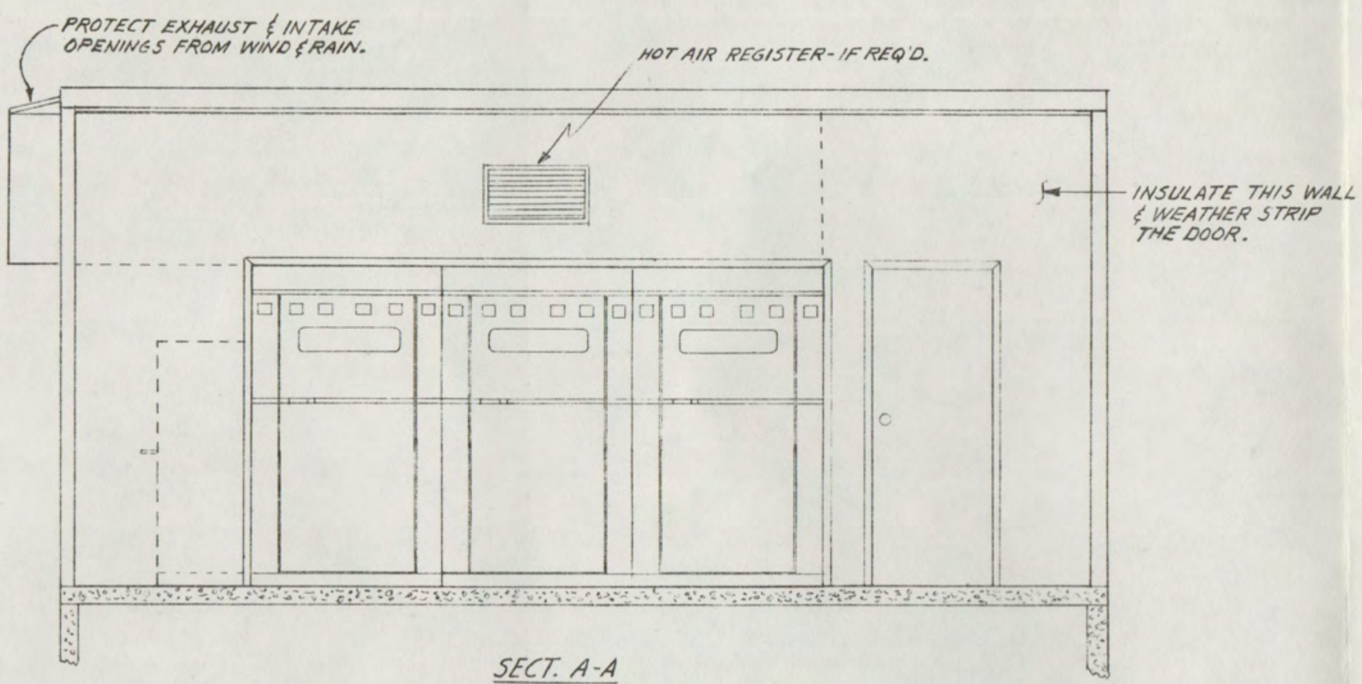
TYPE 317C TRANSMITTER
TYPICAL INSTALLATION

CODE IDENT NO.	SIZE	
52151	D	73011

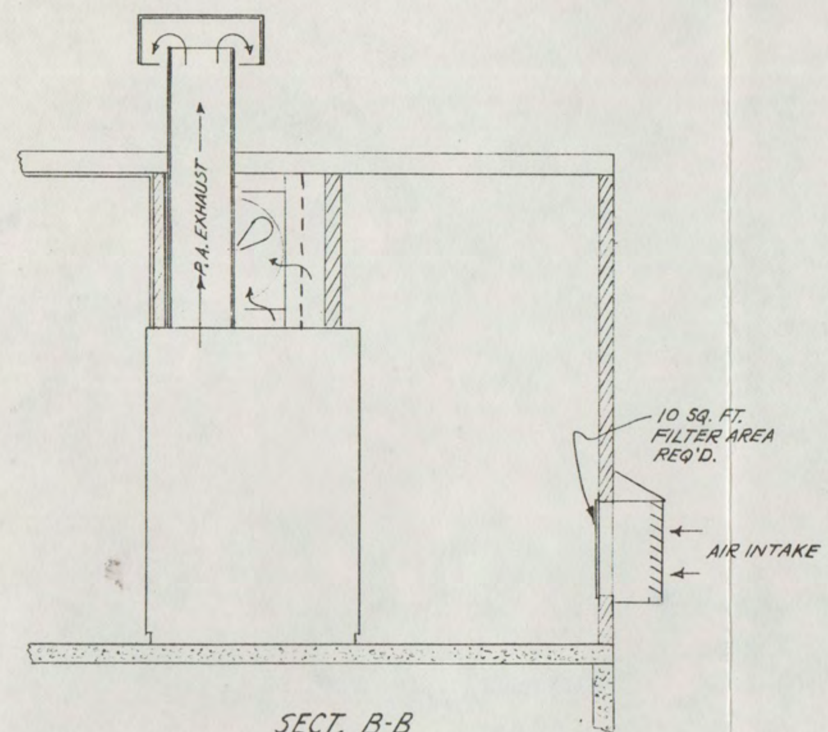
SCALE: 1/2"=1' REV SHEET 1 OF 2

C.E. FORM 343

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
A		REVISED	9-9-70	R. TUCKER



SECT. A-A



SECT. B-B

QUANTITY REQUIRED	ITEM NO.	ZONE	PART OR IDENTIFYING NO.	DWG SIZE	NOMENCLATURE OR DESCRIPTION

LIST OF MATERIALS OR PARTS LIST

NEXT ASSY	DWG SIZE	USED ON
SEE SHT 1		

UNLESS OTHERWISE SPECIFIED
TOLERANCES ON: FRAC ±
2 PLACE DEC ± 3 PLACE DEC ± ANGLES ±
MACHINED SURFACE FINISH 125√
ALL DIMENSIONS ARE IN INCHES AND INCLUDE APPLIED FINISH.
REMOVE ALL BURRS AND SHARP EDGES.

		DATE
DRAWN	R. TUCKER	10-16-64
CHECKED		
MECH DSGN		
ELEC ENGR		
APPROVED		

Continental Electronics
CONTINENTAL ELECTRONICS MFG. CO. DALLAS, TEXAS

TYPE 317C TRANSMITTER
TYPICAL INSTALLATION

CODE IDENT NO.	SIZE	
52151	D	73011
SCALE: 1/2" = 1'	REV	SHEET 2 OF 2

C E FORM 343

SECTION 3 - OPERATION

3-1. CONTROLS AND INDICATORS

Figures 3-1 through 3-12 and Tables 3-1 through 3-11 denote the controls and indicators for the Type 317C-2 Transmitter. The Tables give the function of each control and indicator.

80-1050 JS1-1-(32)

Figure 3-1. LV Distribution & Driver, Unit 2

TABLE 3-1. POWER DISTRIBUTION CONTROLS & INDICATORS

Control or Indicator	Function
CONTROL PANEL	See separate Table.
IPA PLATE TUNING capacitor, 2C28	Tunes plate circuit of IPA amplifier, 2V1.
TEST METER switch, 2S7	Switches TEST meter 2M1 into the appropriate circuits to obtain the following indications:

NOTE

The full scale indications listed in the various positions of 2S7 must be used to obtain realistic readings on TEST METER 2M1.

Position:

I_d RF DRIVER 0-1 AMP

IPA GRID CURR 0-50 mA

28V SUPPLY 0-50 V

I_c AUDIO AMP 0-100 mA

V_{cc} AUDIO AMP 0-500 V

I_k AUDIO DRIVER 0-100 mA

FEEDBACK RECT 0-10 mA

+12V CONTROL 0-50 V

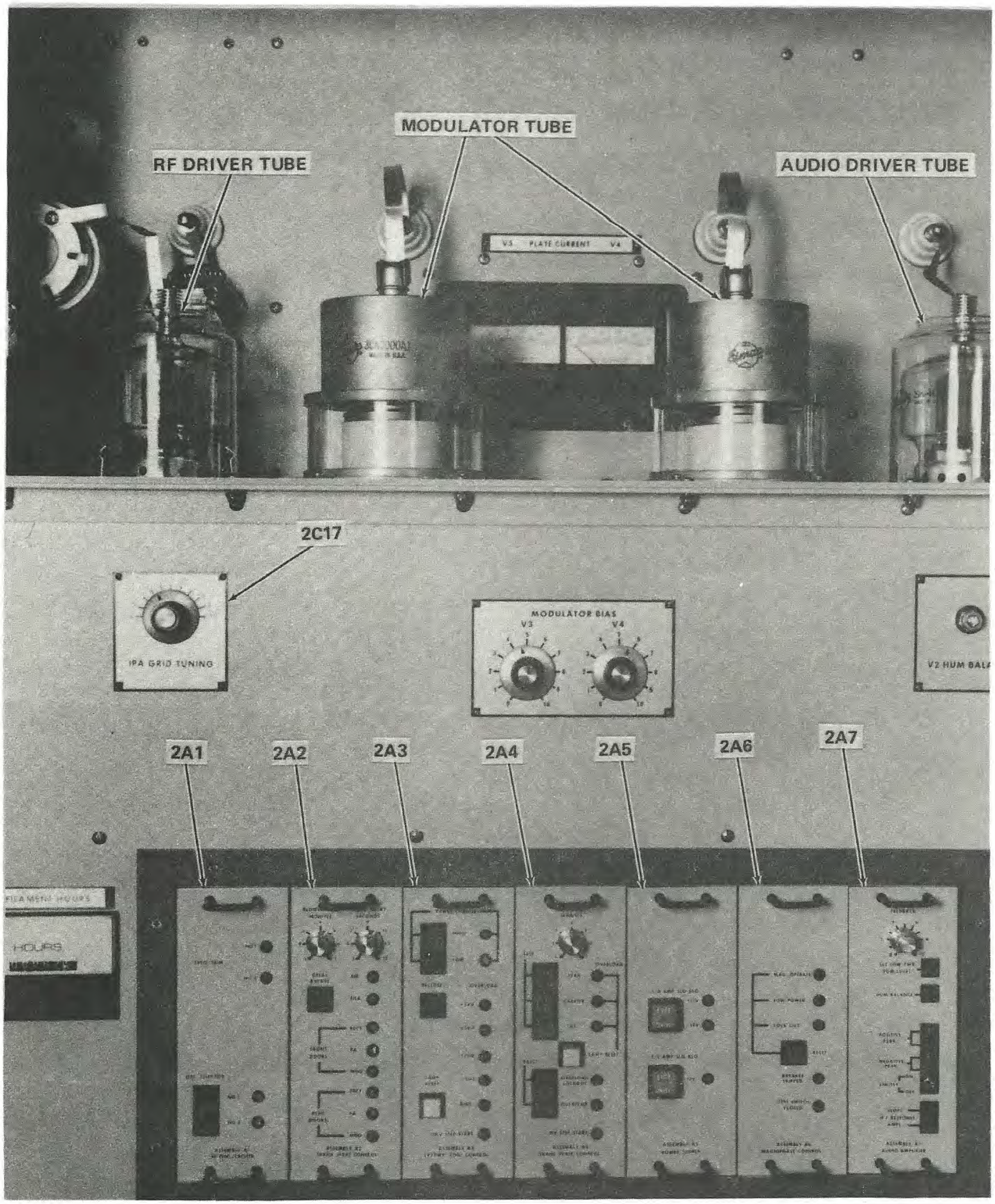
+12V AUDIO 0-50 V

-12V AUDIO 0-50 V

TEST METER meter, 2M1	Indicates currents and voltages designated and switched by TEST METER switch 2S7. Meter face marked 0-10 and 0-5 (two scales).

TABLE 3-1. POWER DISTRIBUTION CONTROLS & INDICATORS - Continued

Control or Indicator	Function
IPA CATHODE CURRENT meter, 2M2	Indicates cathode current of the RF driver amplifier tube. Meter range 0-1 ampere DC.
PEAK SCREEN VOLTAGE meter, 2M3	Indicates screen grid voltage of peak tube 1V1. Meter range 0-600 VDC.
CARRIER SCREEN VOLTAGE meter, 2M4	Indicates screen grid voltage of carrier tube 1V2. Meter range 0-1 KVDC.
PA & MOD BIAS meter, 2M5	Indicates power-amplifier and modulator bias power supply voltage. Meter range 0-1 KVDC.
230 VOLT SUPPLY meter, 2M6	Indicates line to line voltage voltage designated and switched by LINE VOLTMETER switch 2S4. Meter range 0-300 VAC.
LINE VOLTMETER switch, 2S4	Switches 230 VOLT SUPPLY meter 2M6 into the appropriate circuits to obtain the following indications:
Position:	
OFF	Disconnects meter.
A-B	Indicates line voltage phases A to B.
B-C	Indicates line voltage phases B to C.
C-A	Indicates line voltage phases C to A.



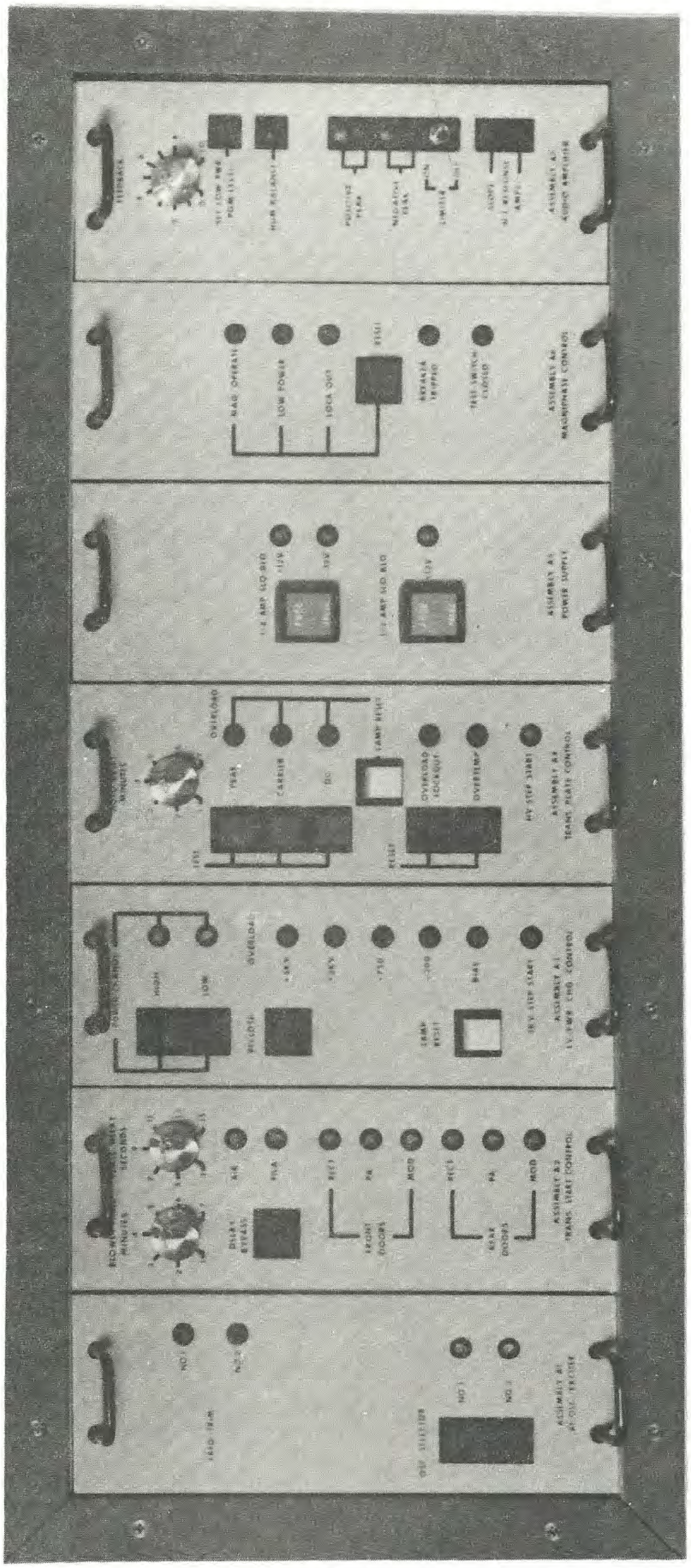
83-0650

JS1-1(52)

Figure 3-2. LV Distribution Inside Top View

TABLE 3-1. POWER DISTRIBUTION CONTROLS & INDICATORS - Continued

Control or Indicator	Function
INSIDE PANEL	
PLATE CURRENT meters 2V3, meter 2M8 2V4, meter 2M9	Denotes total plate current of each modulator tube. Scale 0-10 amperes.
2R21 HUM BALANCE	Adjust 60 cycle hum balance in 2V2 audio tube.
FILAMENT HOURS meter, 2M7	Totalizing of filament operating time of PA tubes.
IPA GRID TUNING capacitor, 2C17	Adjust tuning on IPA grid circuit, 2V1.



83-0560

Figure 3-3. Printed Circuit Cards

JS1-1(53)

TABLE 3-2. PRINTED CIRCUIT CARDS CONTROLS & INDICATORS

Control or Indicator	Function
RF OSC/EXCITER, A1	
OSC SELECTED NO. 1 switch, S1 NO. 2 switch, S2 NO. 1 lamp, DS1 NO. 2 lamp, DS2	Depress to select oscillator No. 1 or No. 2. One lamp lights to denote oscillator selected. May also be selected remotely if remote circuit installed.
FREQ TRIM NO. 1 NO. 2	Oscillator adjustment Trim capacitors. Use insulated tool and adjust as required to insure correct operating frequency.
TRANS START CONTROL, A2	
BLOWER HOLD MINUTES Adjust, R22	Set to adjust blower Hold ON after transmitter turn-off. 1-7 minutes.
PLATE DELAY SECONDS Adjust, R23	Set to adjust Bias Power Supply delay after energizing Master ON circuit. 3-15 seconds.
DELAY BYPASS switch, S1	Depress to bypass the Bias DELAY timer to energize the Bias Power Supply.
AIR INTERLOCK lamp, DS1	Lamp lights green to denote blower is operating properly.
FILA ON lamp, DS2	Lamp lights green to denote Tube Filaments are ON.
FRONT DOORS RECT lamp, DS3 PA lamp, DS4 MOD lamp, DS5	Lamps light green to denote doors are closed.
REAR DOORS RECT lamp, DS6 PA lamp, DS7 MOD lamp, DS8	Lamps light green to denote doors are closed.

TABLE 3-2. PRINTED CIRCUIT CARDS CONTROLS & INDICATORS - Continued

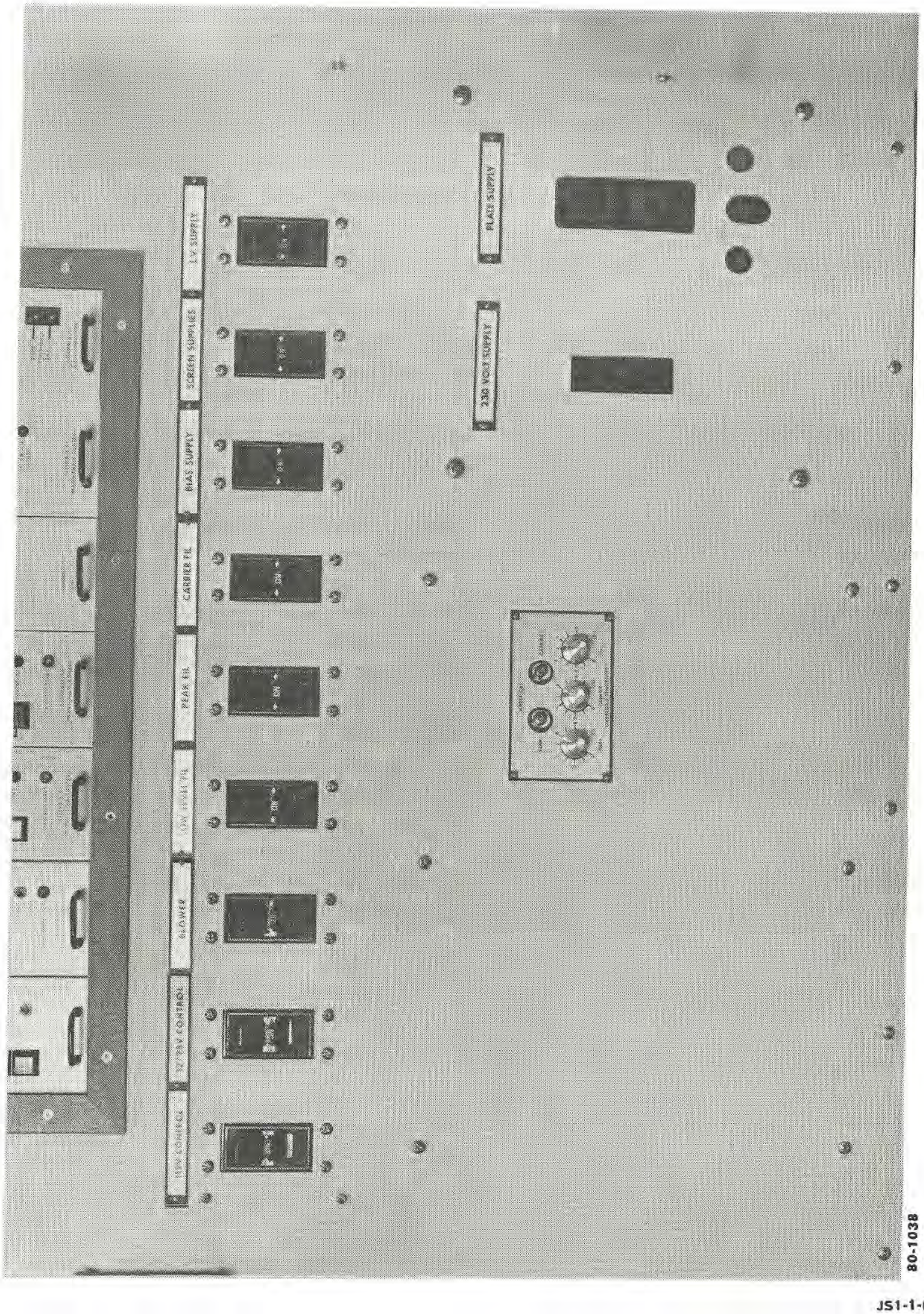
Control or Indicator	Function
LV/PWR CHG CONTROLS, A3	
POWER CHANGE HIGH switch, S3 HIGH lamp, DS6 LOW switch, S4 LOW lamp, DS7	Depress to change power level. Lamp lights green to denote power level, high or low selected.
RECLOSE switch	Depress to reclose LV power circuits after overload trips transmitter OFF.
OVERLOAD +5KV lamp +3KV lamp +750 lamp -200 lamp BIAS lamp	Lights red to denote an overload in the appropriate circuit,
LAMP RESET switch, S2	Depress to reset to OFF the overload lamps.
3KV/5.2KV STEP START lamp, DS8	Lights green to denote 3KV/5.2KV power is applied to transmitter.
TRANS PLATE CONTROL, A4	
AUTO RESET MINUTES Adjust, R14	Set to adjust the overload reset circuit adjustable 1-7 minutes.
PEAK TEST switch, S3 OVERLOAD lamp, DS3	Depress Test switch to test overload circuit. Lamp lights red to denote Peak Tube overload.
CARRIER TEST switch S2 OVERLOAD lamp, DS2	Depress Test switch to test overload circuit. Lamp lights red to denote Carrier Tube overload.

TABLE 3-2. PRINTED CIRCUIT CARDS CONTROLS & INDICATORS - Continued

Control or Indicator	Function
DC	
TEST switch, S1 OVERLOAD lamp, DS1	Depress Test switch to test overload circuit. Lamp lights red to denote DC power overload.
LAMP RESET switch, S4	Depress to extinguish overload lamps.
OVERLOAD LOCKOUT lamp, DS4 OVERLOAD LOCKOUT RESET Switch, S5	Lamp lights red to denote an overload lockout and HV is OFF. Reset switch resets counter.
OVERTEMP lamp, DS5 OVERTEMP RESET switch, S6	Lamp lights red to denote a cooling overtemperature condition. Reset switch removes 12V lockin on overtemperature latch relay coil.
HV STEP START lamp, DS6	Lamp lights green to denote the 115VAC interlock for HV surge relay 4K1 coil has been completed.
POWER SUPPLY, A5	
Fuse, F2 Lamp, DS3	Protects control +12 VDC power supply input circuit. 1/2 ampere, slo-blo.
Fuse, F1 Lamp, DS1,DS2	Protects audio and RF +12V/-12V power supply input circuit. 1/8 ampere, slo-blo.
MAGNIPHASE CONTROL, A6	
MAG OPERATE lamp, DS1	Lights red to denote Magniphase has operated.
LOW POWER lamp, DS2	Lamp lights red to denote Transmitter is operating at Low Power.
LOCK OUT lamp, DS3	Lamp lights red and blinks to denote Magniphase has locked out High Voltage and RF.
RESET switch, S1	Depress to reset Magniphase lockout condition of transmitter.

TABLE 3-2. PRINTED CIRCUIT CARDS CONTROLS & INDICATORS - Continued

Control or Indicator	Function
BREAKER TRIPPED lamp, DS4	Lights red to denote Transmitter HV switch is tripped OFF.
TEST SWITCH CLOSED lamp, DS5	Lights red to denote Test switch is closed.
AUDIO AMPLIFIER, A7	
FEEDBACK, R75	Set to adjust input feedback to audio amplifier. Set in factory to be used at Max. (10 on dial)
SET LOW PWR PGM LEVEL, R19	Adjust to set Low Power Program Level into audio amplifier.
HUM BALANCE AMPL, R81	Adjust as required to remove Transmitter 120 cycle hum.
POSITIVE PEAK lamp, DS1 Adjustment, R43	Adjust to set positive peak levels. Lamp lights yellow to denote Positive peaks. Clockwise decreases clipping.
NEGATIVE PEAK lamp, DS2 Adjustment, R52	Adjust to set Negative Peak levels. Lamp lights yellow to denote Negative peaks. Clockwise decreases clipping.
HF RESPONSE SLOPE, R79 AMPL, R78	Adjust to set High Frequency Amplitude and Slope.

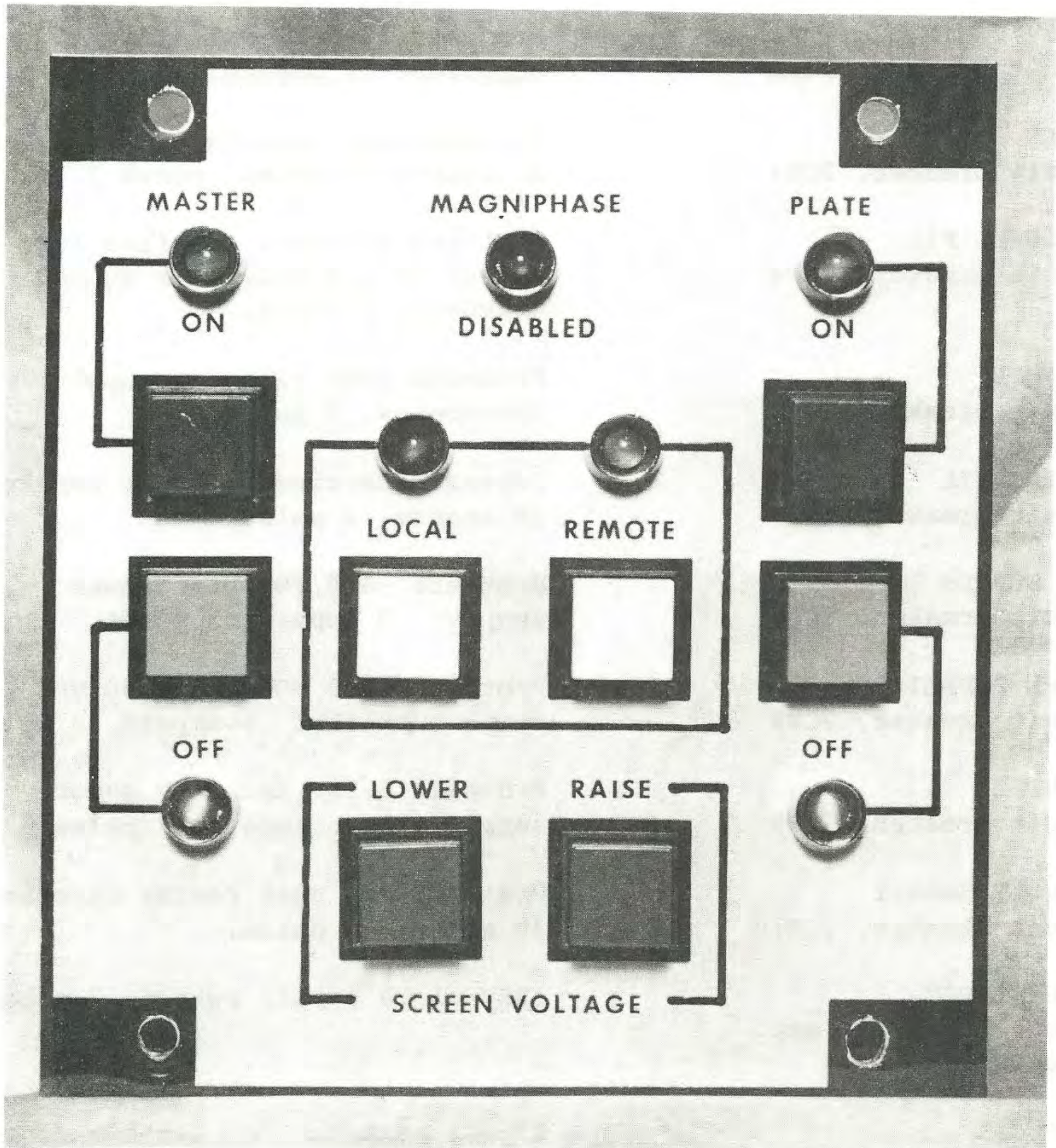


JS1-1-(26)

Figure 3-4 Circuit Breaker Panel.

TABLE 3-3. CIRCUIT BREAKER PANEL CONTROLS

Control	Function
115V CONTROL, circuit breaker, 2CB1	Protects circuits. 2 ampere, 1 pole.
12/28V CONTROL circuit breaker, 2CB2	Protects 12 & 28 volt power supplies. 1 ampere, 2 poles.
BLOWER circuit breaker, 2CB3	Protects air cooling blower. 20 ampere, 3 poles, curve 1.
LOW LEVEL FIL circuit breaker, 2CB4	Protects filament supplies for Driver RF and Modulator tubes. 8 ampere, 2 poles.
PEAK FIL circuit breaker, 2CB5	Protects peak filament supply. 20 amperes, 2 poles.
CARRIER FIL circuit breaker, 2CB6	Protects carrier filament supply. 20 ampere, 2 poles.
BIAS SUPPLY circuit breaker, 2CB7	Protects -820 VDC bias power supply. 3 ampere, 3 poles.
SCREEN SUPPLIES circuit breaker, 2CB8	Protects -200 VDC and +750 VDC power supplies. 5 ampere, 3 poles.
LV SUPPLY circuit breaker, 2CB9	Protects 5.5KV and 3 KV power supplies. 25 ampere, 3 poles.
230 VOLT SUPPLY circuit breaker, 2CB10	Protects 230 volt feeder circuits. 30 ampere, 3 poles.
PLATE SUPPLY switch, 2CB11 and aux. contacts.	18KV plate supply switch, 3 poles.
METER CAL PEAK, 2A11R5 CARRIER, 2A11R4	Adjust peak/carrier cathode current Test Meter reading.
OVERLOAD SENSITIVITY ADJUSTMENTS PEAK, 2A11R3 CARRIER, 2A11R2 DC, 2A11R1	Set as denoted on Factory Test Data for overload sensitivity.



80-909

JS1-1-(24)

Figure 3-5. Control Panel

TABLE 3-4. CONTROL PANEL CONTROLS AND INDICATORS, 2A8

Control or Indicator	Function
MASTER ON, switch S1 MASTER ON, lamp DS1 MASTER OFF, switch S3 MASTER OFF, lamp DS6	Depress ON switch to energize Master Start circuit. ON lamp lights and Plate OFF lamp lights. Tube Filaments energizes and blower runs. Low voltage power supplies become energized. Depress Master OFF switch to de-energize circuits. OFF lamp lights.
LOCAL, switch S4 LOCAL, lamp DS4 REMOTE, switch S5 REMOTE, lamp DS5	Depress LOCAL or REMOTE for control location. Appropriate lamp lights to denote control location selected.
PLATE ON, switch S2 PLATE ON, lamp DS3 PLATE OFF, switch S6 PLATE OFF, lamp DS7	Depress ON to apply Plate power to Carrier and Peak tubes. ON lamp lights. Depress OFF switch to remove Plate power. OFF lamp lights.
MAGNIPHASE DISABLED lamp	Lights to denote Magniphase circuit has been turned OFF.
SCREEN VOLTAGE LOWER, switch S7 RAISE, switch S8	Depress LOWER or RAISE switch to adjust Screen voltage to Carrier Tubes.

80-1052 JS1-1-(34)

Figure 3-6. Power Amplifier, Unit 1

TABLE 3-5. POWER AMPLIFIER, CONTROLS & INDICATOR UNIT 1

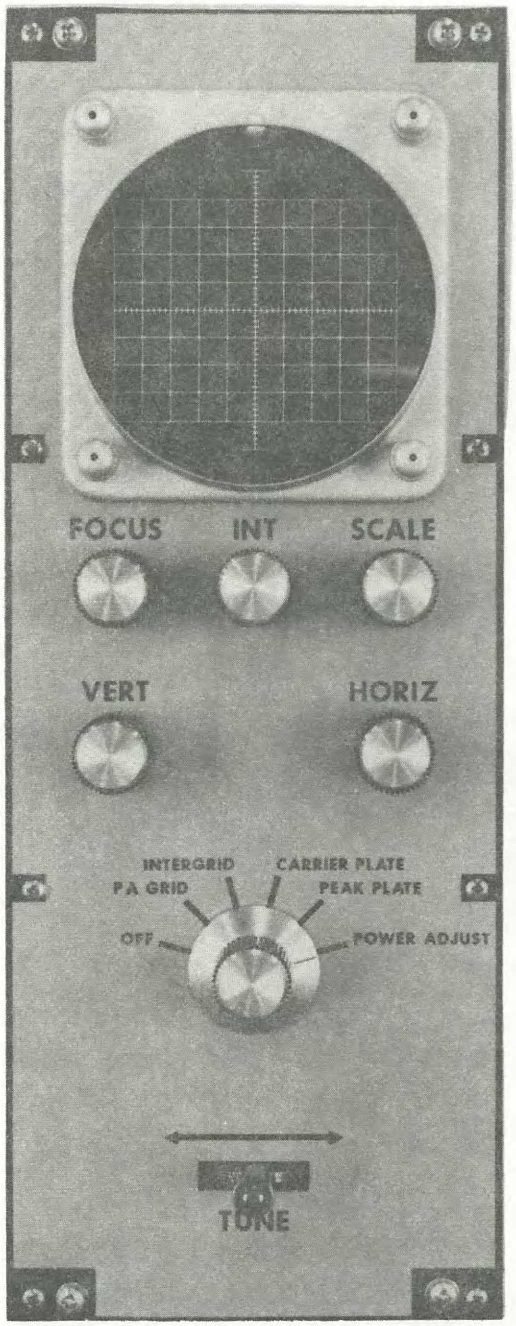
Control or Indicator	Function
OSCILLOSCOPE	See Table 3-6.
CARRIER SCREEN CURRENT meter, M1	Indicates screen current of RF power amplifier carrier tube. Meter range 0-2 amperes DC.
TOTAL PLATE CURRENT meter, M2	Indicates plate current of both carrier and peak tubes in RF power amplifier. Meter range 0-10 amperes DC.
PEAK GRID CURRENT, meter M3 CARRIER GRID CURRENT, meter M4	Indicates control grid current of RF power amplifier tubes. Meters range 0-500 mA DC.
PWR AMP FILAMENT VOLTS, meter M5 FILAMENT VOLTMETER, switch S10 PEAK CARRIER	Indicates filament voltage of power amplifier tubes as selected. Meter range 0-15 VAC.
TEST METER, meter M6 TEST METER, switch S7 $I_{K_{5a}}$ PEAK $I_{K_{10a}}$ CARRIER	Selects cathode current of RF power amplifier peak tube 1V1 or carrier tube 1V2.
CABINET LIGHTS switch S6	Turns ON/OFF cabinet lights in Units 1, 2 & 3 and oscilloscope.

TABLE 3-6. OSCILLOSCOPE CONTROLS & INDICATORS 1A1

TUNING SELECTOR switch 1A1S1	Switches oscilloscope into the appropriate circuits to obtain standard oscilloscope patterns to facilitate transmitter tuning. Also, connects TUNING switch 1A1S2 to energize tuning-capacitor drive motors selected and indicated by switch 1A1S1.
Position:	
OFF	Disconnects oscilloscope and TUNING switch 1A1S2 from all circuits.

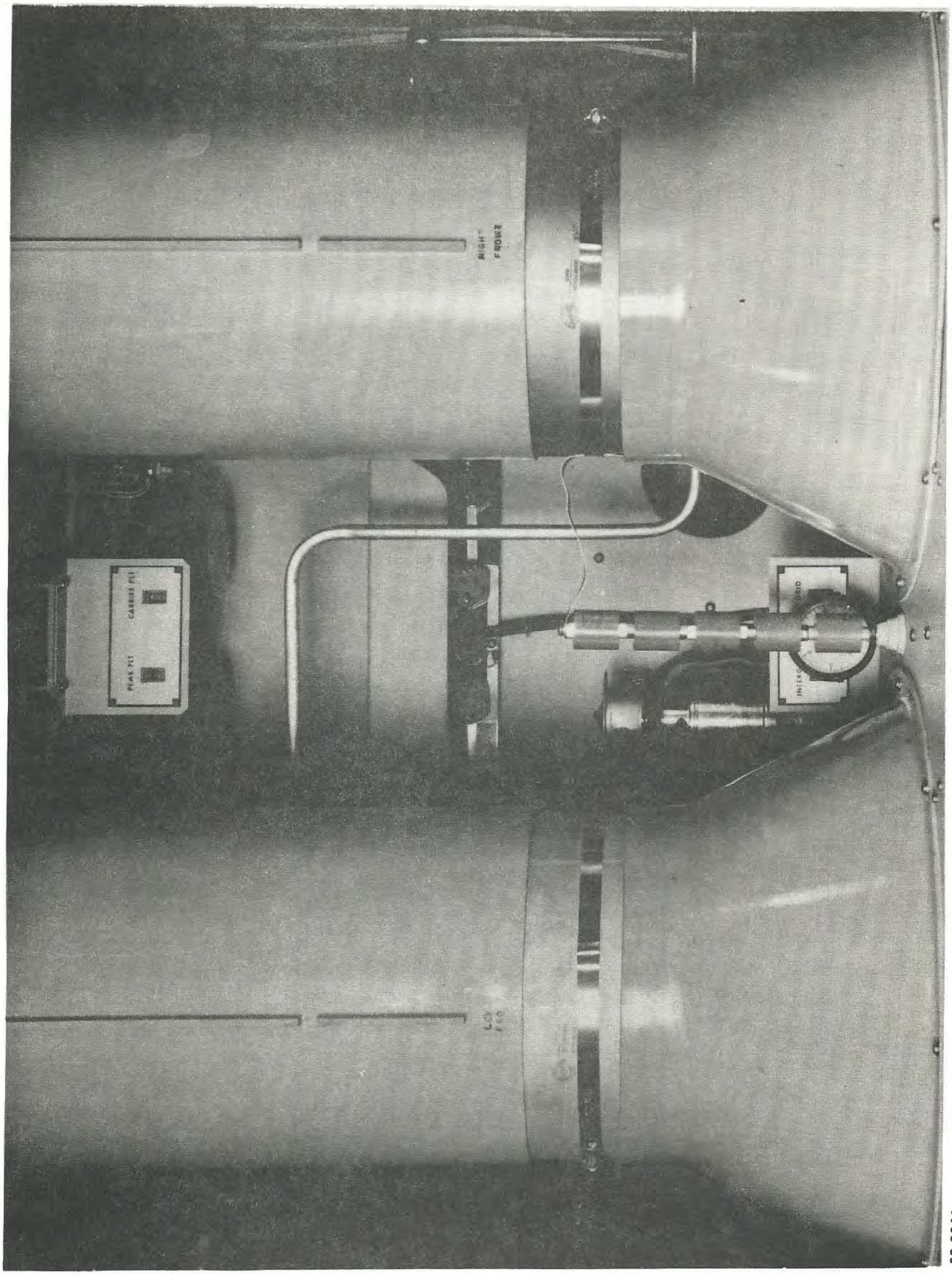
TABLE 3-6. OSCILLOSCOPE CONTROLS & INDICATORS 1A1

Control or Indicator	Function
PA GRID	Connects TUNING switch 1A1S1 to energize motor 1B2 to vary the capacity of 1C22 in carrier-grid network. Connects oscilloscope to display power amplifier RF voltage pattern.
INTERGRID	Connects TUNING switch 1A1S2 to energize motor 1B4 to vary the capacity of K21 in the intergrid network. Connects oscilloscope to display power amplifier RF voltage pattern.
CARRIER PLATE	Connects TUNING switch 1A1S2 to energize motor 1B1 to vary the capacity of 1C20 in the RF power-amplifier carrier-tube plate tank circuit. Connects oscilloscope to display carrier-tube RF plate voltage vs. Carrier-tube RF grid voltage.
PEAK PLATE	Connects TUNING switch 1A1S2 to energize drive motor 1B3 which varies the capacity of 1C19.1 in the pi network. Connects oscilloscope to display peak-tube RF plate voltage vs. carrier-tube RF plate voltage.
POWER ADJUST	Connects TUNING switch 1A1S2 to energize motor 2B1 and the motor control of 4B1 for adjusting power output. Connects oscilloscope to display peak tube RF plate voltage vs. carrier-tube RF plate voltage.
TUNING switch 1S2	Energizes tuning motors as selected by TUNING selector switch 1A1S1.



JS1-1-(47)

Figure 3-7. Oscilloscope



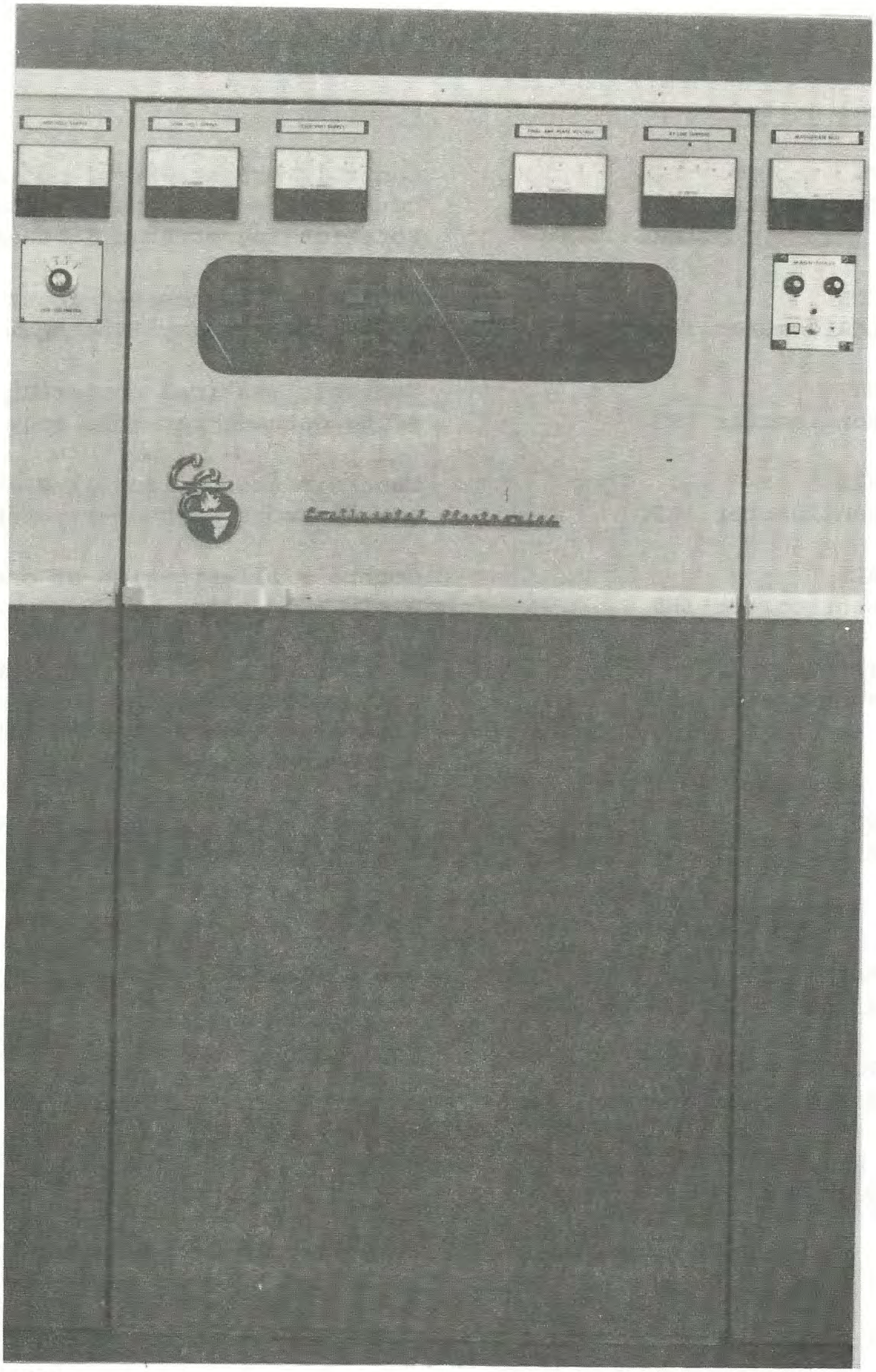
83-0648

Figure 3-8. PA Tuning Capacitor Indicators

JS1-1(51)

TABLE 3-6. OSCILLOSCOPE CONTROLS AND INDICATORS 1A1

Control or Indicator	Function
INT potentiometer 1R5	Controls brightness of oscilloscope cathode-ray tube beam. Clockwise rotation increases brightness.
FOCUS potentiometer 1R4	Controls sharpness-of-focus of oscilloscope cathode-ray tube beam.
VERT potentiometer 1R3	Controls vertical centering of oscilloscope cathode-ray tube beam.
HORIZ potentiometer 1R2	Controls the horizontal centering of oscilloscope cathode-ray tube beam.
SCALE potentiometer 1R6	Controls illumination of oscilloscope scale gradicule.
ASTIG potentiometer 1R1	(Located rear of scope). Operates in conjunction with the focus control to control the shape of oscilloscope cathode-ray tube beam.
PEAK PLT indicator	Denotes relative position of appropriate tuning capacitor. See factory test data for proper setting.
CARRIER PLT indicator	See Table 3-5.
INTEGRID indicator	
PA GRID indicator	



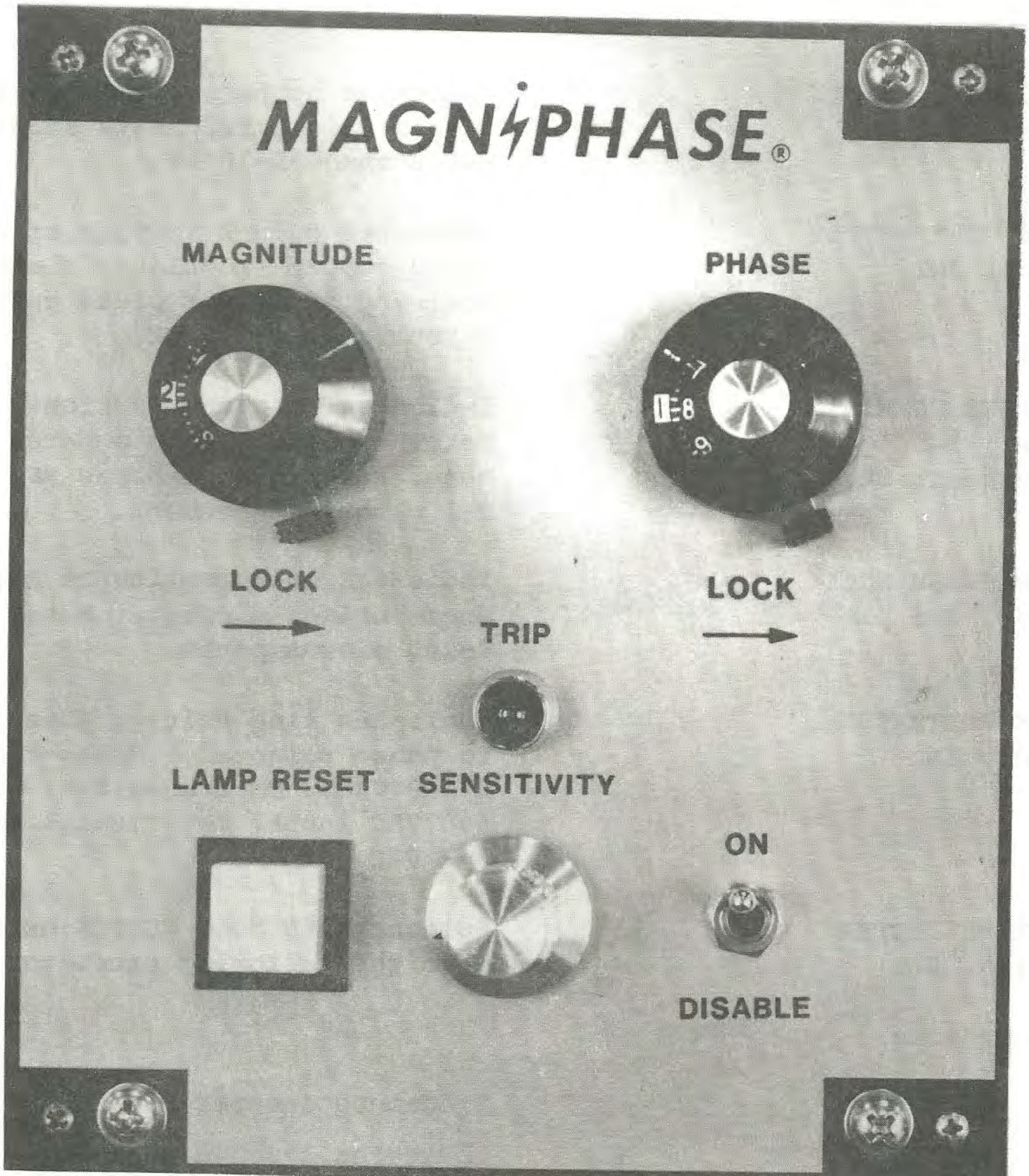
83-0649

JS1-1-(49)

Figure 3-9. HV Rectifier & Power Supply, Unit 3

TABLE 3-8. RECTIFIER AND HARMONIC FILTER, CONTROLS & INDICATOR Unit 3

Control or Indicator	Function
FINAL AMP PLATE VOLTAGE meter, 3M4	Indicates output voltage of high Voltage Power Supply. Meter range 0-20 KVDC.
5500 VOLT SUPPLY meter, 3M3	Indicates output voltage of 5500V (Audio Driver 2V2 plate supply). Meter range 0-10 KV.
3000 VOLT SUPPLY meter, 3M2	Indicates output voltage of 3000V power supply (modulator plate voltage) and RF driver plate supply. Meter range 0-5 KVDC.
RF LINE CURRENT meter, 3M5 Adjustment 3R12, 3L9	Indicates RF output current. Meter range 0-50 amp amperes RF. Meter range 0-50 amperes RF. 0-1 mA basic movement.
MAGNIPHASE NULL meter, 3M6	Indicates null setting of Magniphase bridge circuit. Meter range 0-200 microamperes.
LINE VOLTMETER meter, 3M1	Indicates line voltage phase to to phase selected. Meter range 0-600 VAC. On transmitter with 600 VAC input, meter range is 0-7 VAC.
LINE VOLTMETER switch, 3S1	Switches 460 VOLT SUPPLY meter 3M1 into the following circuits:
Position:	
OFF	Disconnects meter
A-B	Indicates line voltage phase A to B
B-C	Indicates line voltage phase B to C
C-A	Indicates line voltage phase C to A



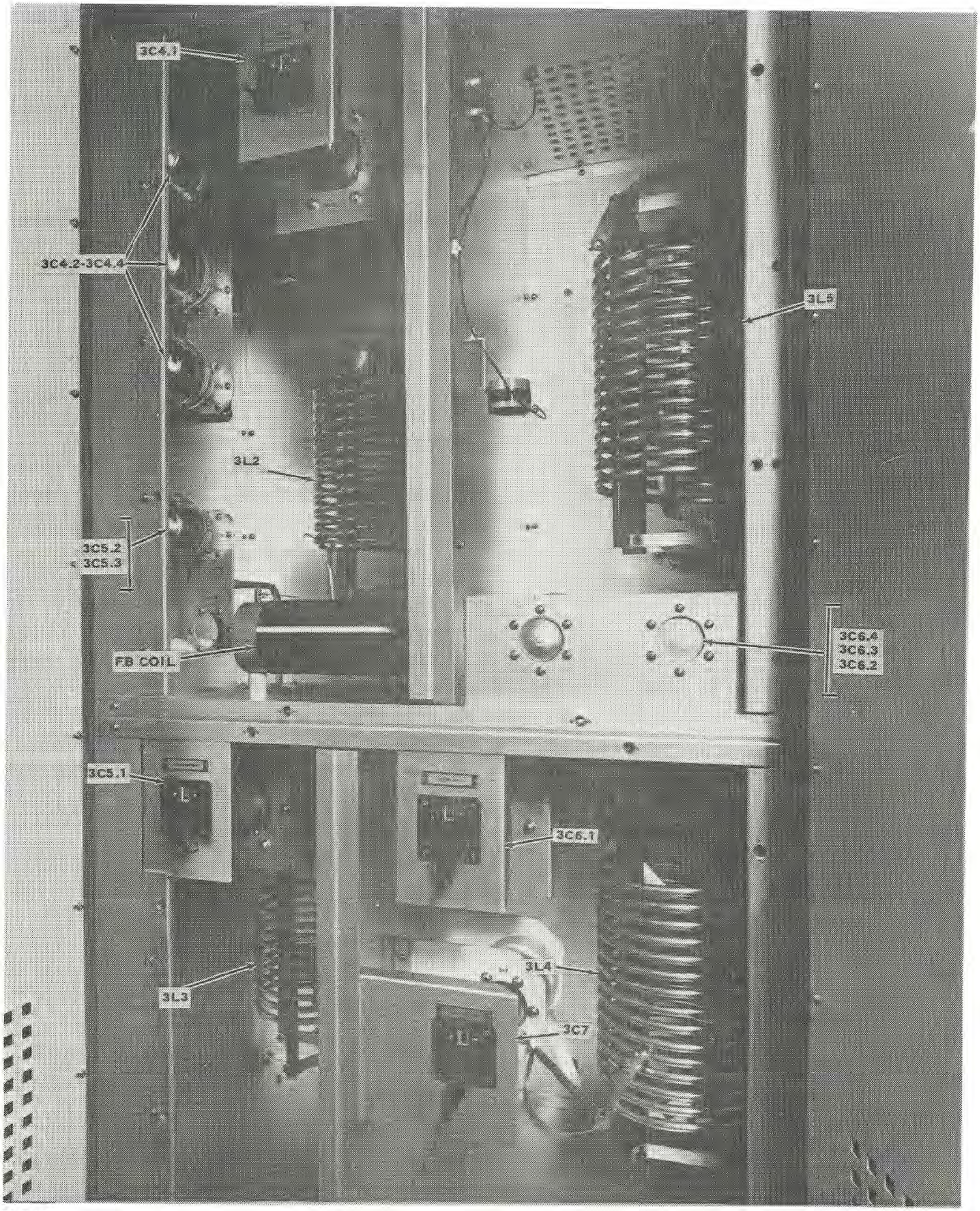
83-0647

JS1-1-(50)

Figure 3-10. Magniphase Control & Indicators

TABLE 3-9. Magniphase Controls and Indicators

CONTROL	FUNCTION
PHASE capacitor 3A2C1	Adjusts the phase of the Magniphase bridge input signal for a balance across the bridge circuit.
MAGNITUDE capacitor 3A2C2	Adjusts the amplitude of the Magniphase input signal for balance across the Magniphase bridge circuit.
TRIP LAMP lamp 3A2DS1	Lamp lights when a magniphase unbalance occurs.
LAMP RESET switch 3A2S1	Resets trip lamp after magniphase unbalance has occured.
SENS resistor 3A2R3	Adjusts sensitivity of input circuit by loading base of input transistor. CW makes it more sensitive.
DISABLE switch 3A2S2	When set in down position, disables Magniphase unit operation and allows a test feature of checking the trip point on 3M6 by adjusting either phase or magnitude capacitor and observing 3A2DS1 without transmitter interference. Leave in up position, enable.



80-927

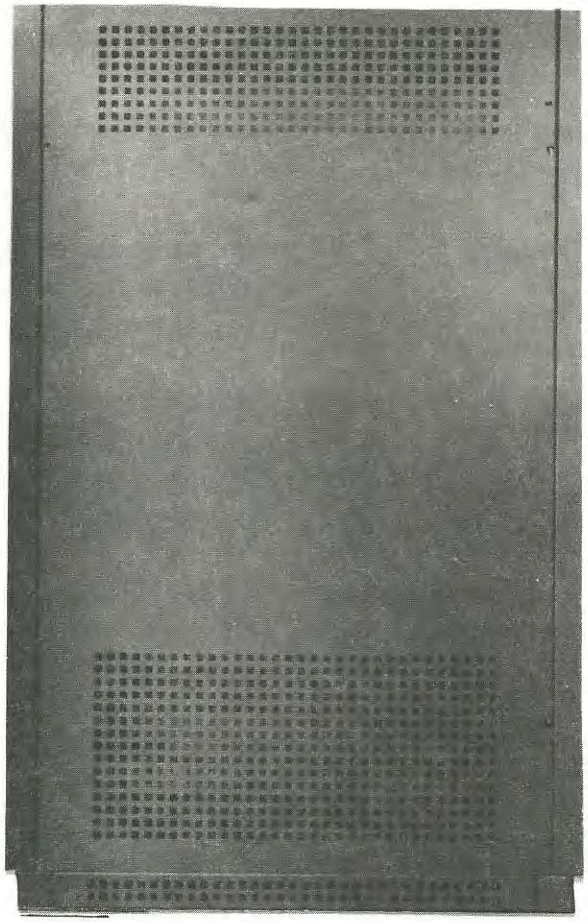
JS1-1-(30)

Figure 3-11. Harmonic Filter, Capacitor Tuning Indicators

TABLE 3-10. RECTIFIER & HARMONIC FILTER UNIT CONTROLS & INDICATORS

NOTE: The following controls are located in the rear of the rectifier and Harmonic Filter Unit, Unit 3.

Control or Indicator	Function
PI NETWORK capacitor 3C4.1	Varies capacity of 3C4.1 for loading adjusting on output of pi network.
SECOND HARMONIC TRAP capacitor 3C5.1	Varies capacity of 3C5.1 for resonance with inductor 3L3 at second harmonic of operating frequency.
TEE NETWORK CAPACITOR capacitor 3C6.1	Varies capacity of 3C6.1 for adjustment of shunt arm of Tee network.
THIRD HARMONIC TRAP capacitor 3C7	Varies capacity of 3C7 for resonance with a part of inductor 3L4 at the third harmonic of operating frequency.



'JS1-1-(48)

Figure 3-12. HV Transformer & Regulator Unit, Controls

TABLE 3-11. HV TRANSFORMER & REGULATOR UNIT, CONTROLS

Control or Indicator	Function
High Power/Low Power Contactor 4K2	Connects primary windings of HV transformer 4T3 in delta configuration for normal operation and in wye configuration or reduced voltage delta configuration for operation at reduced power for tuning and test purposes.

3-2. TURN ON PROCEDURE

For LOCAL CONTROL, use the following steps to energize the transmitter.

(1) Set all circuit breaker to their ON position.
(2) Depress LOCAL switch 2A8S4. LOCAL lamp 2A80S4 will lighr red.
(3) Depress MASTER ON switch 2A8S1. The following sequence will occur.

   (a) MASTER ON lamp 2A8DS1 will light green.
   (b) Blower motor will start.
   (c) Air flow lamp 2A2DS1 will light green.
   (d) Filament lamp 2A2DS2 will light green.
   (e) ± 12VDC power supply lamps 2A5DS1, 2A5DS2 and 2A5DS3 will light green.
   (f) After Plate Delay determined by customer setting of 2A2R23 all power supplies but HV will be ON and step/start lamp 2A3DS8 will light green. This delay may be bypassed by pressing 2A2S1 DELAY BYPASS switch. If any OV overload lamps are lit and LV power supply voltages missing depress LV overload RECLOSE switch 2A3S2 and LAMP RESET switch 2A3S1.

(4) Select desired crystal on 2A1 OSC. card.
(5) Select HIGH or LOW POWER on 2A3 card.
(6) Enable magniphase switch 3A2S2. Lamp 2A8DS2 will be extinguished.
(7) Depress PLATE ON switch 2A8S2. PLATE ON lamp 2A8DS3 will light green. After 100 millisec. delay step/start light 2A4DS6 will light green.
(8) Check all meter readings using factory test data.

For REMOTE CONTROL, use the following steps to energize the transmitter.

(1) Before leaving transmitter building:

   (a) Set all circuit breakers to their ON position.

(b) Depress REMOTE switch 2A8S5. REMOTE lamp 2A8DS5 will light green.

(c) Depress PLATE ON switch 2A8S2. PLATE ON switch 2A8S2 must be left in the ON position when transmitter is in REMOTE position since its interlock is in series with the REMOTE PLATE interlock. The REMOTE PLATE ON/OFF switch will have control of transmitter PLATE ON/OFF. PLATE ON lamp 2A8DS3 will be extinguished until REMOTE PLATE ON switch requiring a sustained voltage is in the ON position.

(d) Enable MAGNIPHASE switch 3A2S2. Lamp 2A8DS2 will be extinguished.

(e) Turn CABINET LIGHT switch 1S6 to the OFF position if desired. This also turns oscilloscope tube voltage OFF.

(2) Refer to TABLE 2-1. EXTERNAL CONNECTIONS FOR REMOTE CONTROL FUNCTIONS AND INDICATIONS.

3-3. TURN-OFF PROCEDURE

For Local Control use the following steps to de-energize the transmitter.

CAUTION

DO NOT USE THE MAIN PRIMARY POWER DISCONNECT SWITCH TO SHUT THE TRANSMITTER DOWN EXCEPT IN AN EMERGENCY. REMOVAL OF COOLING AIR AT THE SAME TIME THE TRANSMITTER IS SHUT DOWN CAN DAMAGE THE AIR COOLED COMPONENTS.

(1) Depress PLATE OFF switch 2A8S6. PLATE OFF lamp 2A8DS7 will light yellow.

(2) Depress MASTER OFF switch 2A8S3. MASTER OFF lamp 2A8DS6 will light yellow, blower will continue to run until Blower Hold-down relay times out.

3-4. TYPICAL METER READINGS

A. General. Specific meter readings are found in the Factory Test Data supplied with each transmitter. The following table lists typical values of voltage and current as read on the panel meters of the Type 317C-2 Transmitter. These readings are approximations and are intended as average readings in a normal situation, with the transmitter operating CW at 50 kW average power (no modulation applied) except when otherwise specified.

TABLE 3-12. TYPICAL METER READINGS

Type 317C-2 IMPEDANCE 50 ohm Freq.

Meter	Meter readings Switch Position	0% Mod.	Reading 100% Mod. (Req'd.) Where Noted *)
460V Supply	A-B	480	
	B-C	480	
	C-A	480	
3000V Supply		2700	
5500V Supply		5100	
Final Amp Plate Voltage		16800	16600 *
RF Line Current		31.7	
Magniphase Null		0	
Carrier Screen Current		250 ma	550 ma *
Total Plate Current		3.8	6 *
Peak Grid Current		160	155 *
Carrier Grid Current		160	155 *
Pwr. Amp. Fil. Volts	Peak	9.5	
	Carrier	9.5	
Testmeter	I_k Peak	0.45	*
	I_k Carrier	4.15	
Test Meter	I_d RF DRV.	550 ma	
	IPA GRID CURRENT	20 ma	
	28 V SUPPLY	28	
	I_C AUDIO AMP	37 ma	
	V_{CC} AUDIO AMP	120	
	I_k AUDIO DRV	68 ma	
	FEEDBACK RECT.	2.4 ma	
	+ 12 V CONTROL	12	
	+ 12 V AUDIO	12	
	- 12 V AUDIO	12	
IPA Cath. Current		300 ma	
Peak Screen Voltage		220	
Carrier Screen Voltage		700	680 *
PA & Modulator Bias		850	
230V Supply	A-B	233	
	B-C	233	
	C-A	233	
Left Mod. Plate Current		0.6	0.7 *
Right Mod. Plate Current		0.6	0.7 *

3-5. TUNING PROCEDURE.

A. General. The initial tuning procedure outlined in this handbook begins with the output networks, and proceeds back to the interplate and intergrid networks. The Tee Network, Third Harmonic Trap, L Network and Second Harmonic Trap were tuned at the factory with an RF bridge on the customers operating frequency and output impedance and need never be touched unless the frequency or impedance is changed.

An RF impedance bridge with an oscillator and detector capable of operating on the operating frequency is required for the initial tuning procedure. A grid-dip meter may be used to adjust the third-harmonic trap close to its proper setting, then a field strength meter can be used to tune this trap to the exact frequency.

Initially the counter dial for PEAK PLATE, PA GRID, INTERGRID, PI Network, L Network and Tee Network capacitors were set for zero when the capacitors were at maximum capacitance. Maximum capacitance can be determined by turning capacitor shaft CCW until blue housing is barely loose then turn CW until blue housing first tightens. The CARRIER PLATE and IPA PLATE capacitors counter dial were set for zero when capacitors were at minimum capacitance (fully CW). If any capacitor fails in the future, they may be replaced as outlined above and then set per factory test data. Without bridging networks.

B. Tee Network. Connect the transmitter output to the antenna or dummy load if matched to the antenna. Disconnect the Tee Network from the L Network at the lower end of inductor 3L4. If the operating frequency is remaining the same leave Third Harmonic Trap capacitor 3C7 connected. Measure the impednace at the input to the Tee Network by connecting the bridge leads from inductor 3L4 (where the bus was removed) to ground. This impedance should be 100 ohms +j0. All arms of this network are adjustable; therefore, the correct impedance of 100 ohms with zero reactance should be obtainable. If the load resistance has no reactive component, inductors 3L5 and 3L4 should have the same number of turns in use, since this network is designed to have a phase shift of 90°. Any reactive component in the load or antenna will be in series with inductor 3L5, therefore its inductance must be increased or decreased to include the load reactance. The resistance value is set by adjusting 3C6.1.

If changing the operating frequency use Table 3-13 for selecting Third Harmonic Trap capacitor 3C7 tap connection to 3L4. Adjust the capacitor 3C7 for resonate at the third harmonic using a grid-dip meter.

Record the number of turns shorted on 3L4, 3L5, tap on 3L4 for third harmonic, the dial reading of Tee Network Capacitor 3C6.1 and Third harmonic capacitor 3C7 for future reference. Reconnect the bus to inductor 3L4. Make sure all clamps and connections are tight

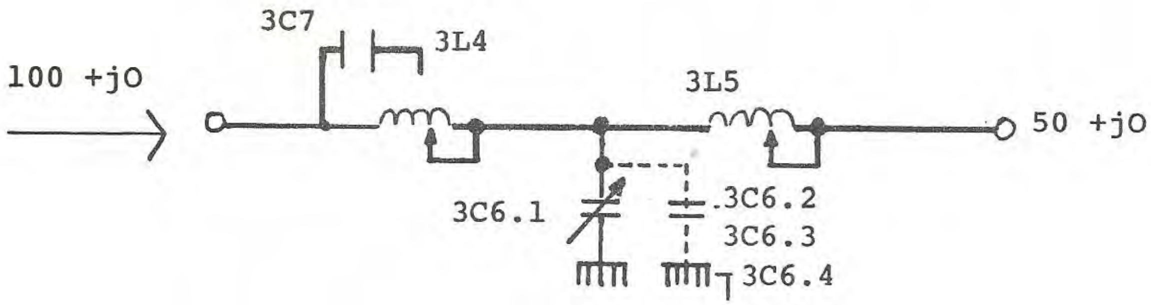


TABLE 3-13. THIRD HARMONIC TAP CONNECTION

Frequency KH	Inductor Type	Turns from Bottom	Antenna Impedance
535-570	CE30-40A	7	50 ohm
570-650	CE30-40A	6	50 ohm
650-1000	CE30-40A	5	50 ohm
1000-1100	CE18-40A	4	50 ohm
1100-1620	CE18-40A	3	50 ohm

c. L Network. Remove the bus and connections to all capacitors from the top end of inductor 3L2. This in the input to the L section. Connect a short across second harmonic inductor 3L3. Measure the impedance at the input of the L network. Adjust inductor 3L2 and capacitor 3C5 to obtain an impedance of 50 ohms with zero reactance. Disconnect the bus from the bottom end of inductor 3L3 and, with inductor 3L3 still shorted, measure the capacitive reactance of the shunt arm of the L network. This is the reactance at which the shunt arm must be maintained. The capacitive reactance must be increased to maintain the proper total reactance at the operating frequency after the inductance is inserted and resonated to the second harmonic of the operating frequency. Divide the reactance of the shunt arm by 0.75. Decrease the capacity until this value is reached with a short connected across inductor 3L3, then adjust the tap until the shunt arm reactance is adjusted to its original value. At this point the reactance of the shunt arm at the second harmonic should be zero or very near zero. Adjust this arm to obtain zero reactance at the second harmonic. If any change is made in these components at any time be sure to check the reactance at both the operating frequency and the second harmonic.

Reconnect the bus to the lower end of inductor 3L3. Check the impedance at the input of the L network. If necessary make minor adjustments to bring the impedance to 50 ohms +j0.

d. Peak Plate Network. Connect the bridge leads to the plate connector of the peak tube 1V1 and ground. Ground the carrier plate with a clip lead. Adjust capacitors 1C19-1, 3C4-1 and inductor 1L7 for an impedance of 500 ohms with zero reactance.

PI Network capacitor 3C4-1 is adjusted from the rear of the Rectifier and Harmonic Filter Unit. Capacitor 1C19-1 is adjusted by motor control from the front panel of the Power Amplifier Unit. Set TUNING SELECTOR switch 1A1S1 to the PEAK PLATE position and operate TUNING switch 1A1S2 left or right to adjust motor-driven capacitor 1C19-1. Inductor 1L7 is adjusted from the rear of the Power Amplifier Unit by means of an adjustable tap. Capacitor 3C4-1 and inductor L17 sets the resistance value and 1C19-1 tunes out the reactance. Adding more of inductor 1L7 or adding more capacitance of 3C4-1 raise the peak plate resistance. Shorting out more of 1L7 or reducing the capacitance of 3C4-1 lowers the peak plate resistance. Remove clip lead from the carrier plate.

e. Carrier Plate Network and Interplate Network. Connect the bridge leads to the plate connector of the carrier tube 1V2 and ground. Adjust Interplate Inductor L15 and Carrier Plate Capacitor 1C20 for an impedance of 2500 ohms with zero reactance. Set TUNING SELECTOR switch 1A1S1 to the Carrier Plate position and operate TUNING switch 1A1S2 left or right to adjust motor-driven capacitor 1C20. Raise the impedance by adding more turns of 1L5 and tuning out the reactance with 1C20. Lower the impedance by shorting out turns of 1L5 and tuning out the reactance with 1C20.

If the bridge being used will not measure beyond 1000 ohms, connect 1000 ohm non-inductive resistor (a small composition resistor is suitable) from the carrier plate connector to ground. The ohms measured is the net resistance of 2500 ohms in parallel with 1000 ohms.

f. Intergrid and PA Grid Networks. Use factory test data or Table 3-14 for approximate coil setting of 1L3 and 1L4. Place 2S13 to the test position and turn Plate Switch 2CB11 to its OFF position to disable plate voltage. Set oscilloscope to the PA Grid position. Push 2A3S4 for high power. Push 2A8S1 Master ON and 2A8S2 Plate ON since +28VDC is interlocked thru 4K1 for excitation. Resonate IPA grid and IPA cathode current. If IPA tube 2V1 runs hot turn transmiter Plate ON and OFF while tuning for resonate to allow IPA tube to cool. It is necessary to have @700VDC carrier screen voltage. This voltage will be set later for best results. Peak and carrier grid current should be @160mA.

Check oscilloscope for elliptical waveform and make necessary PA Grid and Intergrid adjustments. If more grid current is necessary raise tape 1/4 turn at a time on IPA Plate inductor 2L9. It is necessary to resonate IPA Plate capacitor 2C28 after each tap change. After correct current is achieved to determine if correct drive tap on 1L3 is used the peak grid current should peak at the same time the IPA cathode current dips by tuning 2C28. This can be achieved by trying different drive and shorting taps on 1L3.

TABLE 3-14. Component Adjustment vs. Frequency

NOTE: These are approximate settings.

FREQUENCY KH	INDUCTOR TYPE	1L3 TURNS SHORTED	1L3 DRIVE TAP FROM TURNS SHORTED	1L4 TURNS SHORTED
540	232-620	2.5	3.9	5.5
580	232-620	4.5	5	8.5
621	232-620	7.5	5	13.5
650	232-620	11.5	4	13.5
660	232-620	13.5	4	13.5
680	232-620	14.5	3	15.5
702	232-620	15.5	3.5	15.5
710	232-620	16	3.5	15.5
740	232-620	17.5	4.5	17.5
760	232-620	18.5	4.5	17.5
810	232-620	20.5	4.5	20.5
820	232-620	20.5	4.5	22
850	232-620	22.5	4.5	22
860	232-620	22.5	4.5	22.5
940	232-620	24.5	4.5	26.5
950	232-620	25.5	4.5	27.5
980	232-610	6	8	5.5
1010	232-610	6.5	8.5	5.5
1020	232-610	6.5	8.5	6.5

Table 3-14. Component Adjustment vs. Frequency (Cont.)

NOTE: These are approximate settings.

FREQUENCY KH	INDUCTOR TYPE	1L3 TURNS SHORTED	1L3 DRIVE TAP FROM TURNS SHORTED	1L4 TURNS SHORTED
1060	232-610	7.5	5	5.5
1070	232-610	7.5	5	5.5
1080	232-610	8.5	5	6.5
1090	232-610	9.5	5	7.5
1110	232-610	10.5	5	11.5
1140	232-610	11.5	5	11.5
1170	232-610	12.5	5	12.5
1190	232-610	14.5	5	12.5
12	232-610	15.5	5	13.5
1270	232-610	16.5	5	13.5
1280	232-610	16.5	5	13.5
1320	232-610	17	5	15
1350	232-610	17.5	5	16.5
1500	232-610	21.5	4	19.5
1520	232-610			
1530	232-610	21.5	4	19.5
1550	232-610	22.5	4	21.5

3-6. Procedure for Setting Oscilloscope Patterns

On the peak plate pattern and the PA grid patterns the height is the carrier tube and the width is the peak tube.

Use the following steps to set these patterns.

(1) Short out grid and plate same coils 1L8, 1L9, 1L10, 1L11 with a clip lead. Be careful that these leads do not touch the cabinet or the plate sample capacitors.

(2) Put transmitter in low power.

(3) Try to have a pattern about four centimeters high and two centimeters wide in the peak plate position. This is due to when you go to high power the size will double. The scope switch can be damaged if too much RF is applied. If the pattern is ever too large, shut the transmitter off. The pattern will look ragged with the coils shorted and the carrier plate diagonal line will be in the reverse direction.

NOTE

Make sure scope tube is straight in holder by moving the dot vertically.

(4) The PA grid and intergrid position should display an elliptical pattern about six centimeters high and three centimeters wide on both low and high power.

(5) On the PA grid pattern the height is set by the carrier grid sample and the width by the peak grid sample. On the peak plate pattern position, the height is set by the carrier plate sample and the width by the peak plate sample. To make the pattern smaller with the coils shorted add more capacitance at 1C31 for the peak plate position and for the PA grid position 1C49. If the height needs to be larger, use less capacitance on these samples. If the width needs to be smaller, add more capacitance at 1C33 for the peak plate position. Add more capacitance at 1C48 if the PA grid position needs to be smaller. If these patterns need to be larger, use less capacitance.

After the correct size patterns are made on low power, put the transmitter on high power with the coils still shorted. The peak plate height should be about 8 centimeters and the width 4 centimeters. (2 to 1 ratio.) If the patterns are too large add capacitance to make them smaller. Resonate the patterns on the scope. The total plate current should dip approximately the same time the diagonal line on the scope in the carrier plate position closes. The peak plate, PA grid patterns should display an elliptical pattern. After these are accomplished, take the shorts off the coils. Do not tune the motor drive networks until the networks are corrected as shown below.

Turn the transmitter on. The peak plate position should be an upright elipse pattern. The height can be increased by less capacitance at 1C31 or adding less inductance at 1L11. The height can be decreased by adding more capacitance at 1C31 or add more inductance at 1L11. If necessary, a small capacitor can be added at 1C46. (.0001 MFD or .0005 MFD). If the peak plate width is too large, add more capacitance at 1C33 or more inductance at 1L10. If necessary, a small capacitor can be added at 1C47. (.0001 MFD or .0005 MFD).

When the right size pattern is accomplished and if the carrier plate pattern is open, use a resistor (about 2.7K, 2 W or larger) as required at the carrier grid, 1C49 to ground to close the pattern. If the PA grid pattern is tilted to the left, use a resistor (about 2.7 K, 2 W or smaller) at 1C48 to ground to straighten the PA grid pattern.

SECTION 4 - THEORY OF OPERATION

4-1. RF EXCITER AND RF AMPLIFIER

The solid state RF Exciter and RF Amplifier is located on the front mounted printed circuited card. Local switches allow selection of Oscillator No. 1 or Oscillator No. 2 for operation. Both oscillators are on the same frequency and the second oscillator is used if the first oscillator malfunctions. See Schematic 142219.

a. RF OSCILLATOR

A high accuracy, high frequency crystal is used in the oscillator circuit. The frequency range is 5.040 MHz to 7.5 MHz. The frequency stability is .005% over a range of -10^{o} $+60^{o}C$.

The oscillator is a Motorola integrated circuit crystal oscillator, MC12061. This oscillator chip requires only two external components in addition to the crystal and trimmer capacitors.

The output of this oscillator is compatible with ECL or TTL logic. The output is on the crystal fundamental frequency.

The oscillator is followed by two integrated circuit dividers. The first is a 4 bit binary counter, SN-74931, programmed to divide by 2, 4, 6, or 8 depending on the operating frequency. trap connections are provided to connect for any of these divide-by ratios. The final integrated circuit, a S-7476, is a dual J-K flip-flop with both clock inputs tied together.

This circuit provides a divide-by ratio of 2 at all times giving a final output on the operating frequency.

b. RF SWITCH

The oscillator is followed by an RF switch which utilizes a quad 2-input "Nand" gate integrated circuit, an SN-7400. This gate will allow one oscillator signal to pass on to the RF amplifier. When no signal is present on one input of this card, pull down resistors hold this input to logical zero allowing the other signal to toggle the switch. By using this method of switching, no mechanical contacts are involved in the RF signal path.

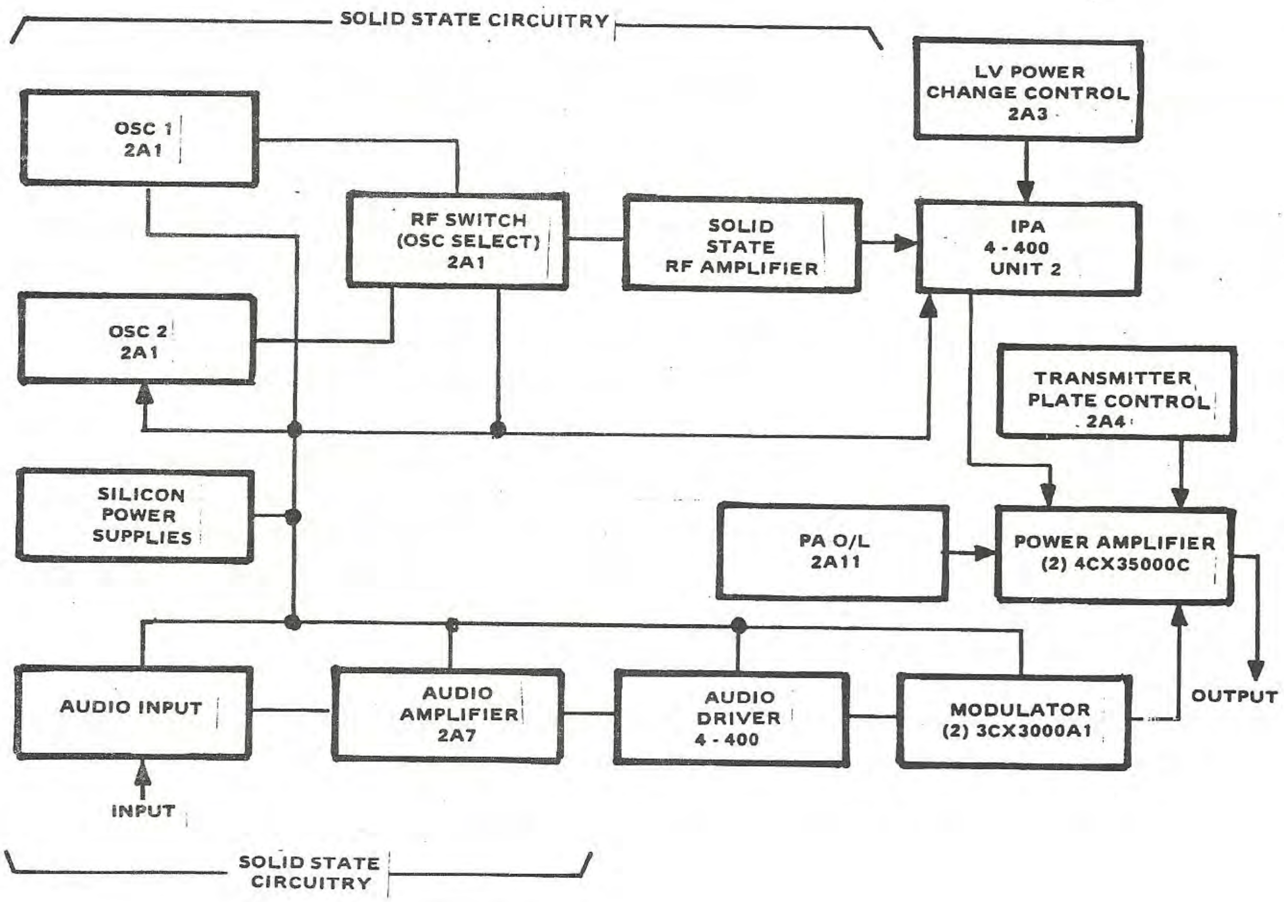


Figure 4-1. Simplified Block Diagram, Type 317C-2 AM Broadcast Transmitter

c. EXTERNAL INPUT

Provision is made for external RF Input with a mechanical selector switch to select Internal or External RF Oscillator. A solid state amplifier MM74CO4N stage is provided to increase the external oscillator input level.

d. LOW LEVEL AMPLIFIER AND INHIBIT SWITCH

The oscillator drive as selected is routed to a low level amplifier, MM74CO4N. Output from this low level amplifier is routed to a solid state Inhibit switch, MM74COON. This switch acts to turn-off the RF on command from a Magniphase Input, when changing Internal Oscillators, or when an Excitation Enable circuit is interrupted. The Magniphase command signal is isolated and amplified through a 2N2102 transistor stage.

e. RF AMPLIFIER

The RF Amplifier consists of three stages of amplfication. RF is received from the inhibit switch and amplified class A by a 2N2102 transistor stage. It's output is coupled to the bases of two parallel transistors, a 2N2102 and 2N4036. The combined output from this stage feeds a transformer and the input of one lRF330 transistor. The stage of two lRF330 transistor operates push pull with its output capacitor coupled to drive the IPA RF Amplifier, a 4-400C tube.

f. FREQUENCY MONITOR STAGE

A frequency monitor is fed from a 2N2102 transistor emitter follower which also isolates the monitor from the RF output.

4-2. RF DRIVER AMPLIFIER (Schematic 142012)

The rf driver amplifier stage utilizes a type 4-400C tube. The plate circuit of this stage is shunt feed with 3000 VDC Power. Coupling to the grids of the final power amplifier stage is accomplished by tapping the inductor in the tuned driver plate circuit. The cathode current of the driver stage is monitored on IPA CATHODE CURRENT meter 2M2. The grid current (approximately 13 MA) of this stage is monitored on TEST METER 2M1 when TEST METER switch 2S7 is in the IPA GRID CURRENT position.

4-3. FINAL POWER AMPLIFIER (Schematic 142011)

The rf power amplifier stage utilizes two type 4CX35000 ceramic tetrode tubes connected in a high-efficiency screen-modulated amplifier configuration*. The output of one tube is connected directly to the load. This tube is referred to as the peak tube, since it supplies power on the positive peaks of modulation. The output of the second tube, which is referred to as the carrier tube, is separated from the load by a quarter wave line or 90^{o} network. The carrier tube is a conventional grounded cathode class C amplifier that supplies the full 50-kw of carrier power when no modulation is applied. The screen of this tube is maintained at +750 Vdc by a separate low voltage power supply. When modulation is applied, the positive portion of the audio signal has no effect on the carrier tube, since the plate "swing" cannot be increased with an increase in screen voltage. The negative portion of the modulating signal will cause a linear decrease in the plate "swing". In order to completely cut the tube off for 100% negative modulation, the screen must be modulated pass zero volts or cathode potential. Carrier cut-off occurs with approximately -150 volts applied to the screen grid, thus, a negative going half since wave of 900 volts peak amplitude is sufficient to modulate the carrier tube.

The same dc plate voltage and rf grid excitation which is applied to the carrier tube is also applied to the peak tube, but the peak tube delivers no power at carrier condition, as its plate current is cutoff by the -150 volts screen potential. As the modulating signal starts its "swing" above carrier level toward peak positive condition, the peak tube begins to deliver power to the load until, at peak positive crest, the tube is delivering twice the

*Patent Nos. U.S. - 3,314,024, Canada - 764-605, Great Britain - 1,044,479, France 1,432,543.

carrier level power into the load. The impedance inverting characteristic of the 90° plate network reflects an impendance of one-half that of the carrier tube at carrier conditions to the carrier tube. The carrier tube plate swing remains the same as at carrier level because the impedance is effectively halved. With both tubes delivering twice carrier power to the load, the necessary four-times-carrier-power for 100% modulation is obtained.

Since the voltage contribution by the carrier tube undergoes a 90° phase lag by the time it appears across the load, it is necessary to introduce a 90° phase advance in the carrier-tube grid driving voltage so that the power output of both tubes will combine in the proper phase relationship. This is accomplished by a leading 90° grid network. This network has a 1:1 transformation ratio so that both tubes receive equal drive.

Individual power amplifier grid current meters (PEAK GRID CURRENT meter 1M3 and CARRIER GRID CURRENT meter 1M4) are located on the front door of the Power Amplifier unit.

A combination of fixed and grid-leak bias is used in the power amplifier stage. The fixed bias is sufficient to protect the tubes in the event of loss of excitation.

The carrier tube is operated as a class C amplifier. This is possible, since the linearity of the positive peaks is dependent upon the linearity of the screen-grid, rather than the control-grid operating conditions. Since the plate voltage "swing" does not increase with positive modulation, a much higher dc plate voltage can be used than in a plate-modulated transmitter. With 16 kVdc, a plate efficiency of 75% is achieved. The final power amplifier tubes are rated at a plate dissipation of 35,000 watts each; however, only 14 kW is dissipated with this efficiency. A smaller tube would not be satisfactory because there must be filament emission sufficient for 100-kW output on positive modulation peaks.

An improvement in carrier shift is accomplished by adding 10 ohms resistance in the cathode of the carrier tube. This small amount of degeneration does not affect other performance.

Cooling requirements for the final power amplifier are reduced due to the high efficiency of the stage. A single low-pressure blower is quite sufficient to cool both power amplifier tubes, the rf driver amplifier tube and the modulator tubes.

4-4. MODULATOR (FIGURE 1-3)

The Modulator stage utilizes two (2) type 3CX3000A1 tubes connected in a conventional cathode follower circuit. Grid voltage of -800 volts is attenuated with separate controls for each tube. A bias potential of -150 volts is applied to the cathode of the modulator tubes. The Modulator audio output is coupled through capacitors to the RF power-ampoifier carrier-tube screen grid and connected directly to the RF power-amplifier peak-tube screen grid. The modulation transformer direct currents in the time reactors are in opposite directions and since they are wound on a common core, there is partial cancellation of the DC flux allowing for increased AC flux density at the lower audio frequencies. The Input/Output voltage of 1:1 ratio and the coils are wound bifilar, resulting in the lowest possible leakage inductance.

4.4.1 Audio Driver Stage.

Output from the Audio Solid State Amplifier is RC coupled to the 4-400C Audio Driver Tube. The output of the audio driver is resistance coupled to the grids of the modulator tubes. With a cathode follower type modulator, the Audio Driver Amplifier is required to develop a large audio voltage "swing".

4-5. FEEDBACK AND NOISE REDUCTION

To offset a slight amount of droop on the flat-topped portion of a low frequency square wave, one of the low level solid state amplifiers is compensated to provide a rising low frequency response which gives a slight amount of ramp-up on a low frequency square wave. This correction is further augmented by about 6 dB of negative feedback from the rectified RF output envelope to the stage following the compensated amplifier. The overall result is a modulated waveform exhibiting practically no tilt at square wave frequencies down to 20 Hz. Reference down to 10 Hz is within about .1 dB and two or three degrees.

Feedback circuits optimize the phase response at the higher modulating frequencies. The demodulated output wave lags the program input due to phase shift in the audio amplifiers and to envelope delay caused by output network and load bandwidth limitation. Load bandwidth is unpredictable so overall envelope feedback is not used in an attempt to correct envelope delay.

Overall feedback is used for the lower and mid-range audio frequencies. High frequency feedback is used only from the modulator output to audio input. The two feedback sources have response curves that complement each other so that the overall putput is flat from about 10 Hz to about 100 KHz with a cross-over point of about 2000 Hz. The degrees of phase shift is very small.

4-6. POWER SUPPLIES

All power supplies in the Type 317C-2 Transmitter employ semi-conductor rectifiers. The power supplies are protected by magnetic circuit breakers. The contactors which energize these power supplies have auxiliary contacts which are connected in series to form an interlock sequence for protection of equipment and operating personnel.

a. The High Voltage Power Supply. The high voltage power supply provides plate voltage for the RF power amplifier tubes. The power transformer for the high voltage power supply is located in the HV Transformer and Regulator Cabinet. Three-phase 460-volt primary power is applied to the primary windings of the HV transformer. Two relays are provided on the HV Transformer and Regulator Unit to connect the primary windings of the plate transformer in a WYE configuration for reduced power operation or in a DELTA configuration for normal operation at full power. In the WYE position approximately 12 KVDC is applied to the RF power amplifier tubes. This reduced plate voltage is useful in preliminary tuning and testing. In the DELTA position, full plate voltage of 18 KV is applied to the RF power amplifier tubes.

Power amplifier plate voltage and power-amplifier carrier-tube screen voltage are varied simultaneously to adjust (regulate) transmitter output power. This is accomplished by motor-driven variable transformers which supply input voltage to the High Voltage Power Supply and to the +750-Volt Power Supply. The drive motors of these variable transformers are controlled simultaneously by front panel controls on the Power Amplifier Unit.

DC overload protection is provided in the negative lead of the high voltage power supply. The total RF power-amplifier plate current is metered in the negative lead.

The High Voltage Power Supply Transformer has dual secondaries which are 12 phase rectified to provide greater filtering while supplying Plate Power at greater currents.

With the additional secondary winding to the Plate Transformers and eliminating the filter reactor, the low frequency current is drawn directly from the transformer-rectifier circuit. A small amount of filter capacitance is used to provide a low supply impedance for frequencies above the resonant point of the supply and to reduce output ripple. Power Supply capability permits 100% modulation down to 10 Hz with less than 2% distortion.

b. <u>5500V/3000V Power Supply</u>. The 3000 volt power supply provides plate voltage for the modulator tubes and the RF driver stage. The 5500 volt power supply provides plate voltage for the second audio amplifier stage. These power supplies utilize a single three-phase transformer. The 3000 volt power supply secondary winding is wye connected to a three-phase bridge rectifier. The current capabity of the 3000 volt supply is sufficient to operate as the "lower half" of the 5500 volt power supply. The 5500 volt power supply is composed of a 3000 volt delta-connected secondary with the negative side of its three-phase bridge rectifier connected to the positive side of the 3000 volt supply to obtain a total of 5500 volt.

c. <u>The +750-Volt Power Supply</u>. The +750-Volt Power Supply utilizes a three-phase transformer with both the primary and secondary windings connected in a delta configuration. The secondary windings of this transformer are connected to a full-wave bridge rectifier. This power supply provides +750 volts for the RF power-amplifier carrier-tube screen grid. A motor-driven three-phase variable transformer is connected to the input of this power supply which is controlled simultaneously with the plate voltage for transmitter output power adjustment.

d. <u>The -800-Volt Power Supply</u>. The -800-Volt Power Supply provides fixed bias voltages for the RF power amplifier and RF driver tubes. (These tubes are also connected to obtain some grid-leak bias.) This supply also provides fixed bias for the modulator tubes. PA and MOD BIAS meter 2M5 indicates the fixed bias voltage applied to the RF power amplifier and modulator tubes. The -800-Volt Power Supply utilizes a three-phase full-wave rectifier. Both the primary and secondary windings of the power transformer are connected delta.

e. The -200-Volt Power Supply. The -200-Volt Power Supply provides screen voltage for the RF power amplifier peak tube. This power supply utilizes a three-phase full-wave bridge rectifier with the primary and secondary of the power transformer connected delta. Primary power is supplied to the -200-Volt Power Supply through SCREEN SUPPLIES circuit breaker 2CB8 and contactor 2K5. Primary power is also supplied through circuit breaker 2CB8 and relay 2K8 to the +750-Volt Power Supply which supplies screen voltage for the RF power amplifier carrier tube. The power supply has taps to provide -200-volt for the RF power amplifier peak tube as is used on some transmitters. Check Test Data for your setting.

4-7. MAGNIPHASE LINE PROTECTION SYSTEM

The Magniphase Line Protection System protects the radio frequency transmission lines, antennas, and antenna tuning equipment from damage due to line faults, or to arcs and overloads at any of these points. An arc-over is usually caused by a lightning discharge, which in itself may do little damage. The major damage occurs if the transmitter is allowed to remain on, supplying energy to sustain this arc. The energy may be a small percent of the total output of the transmitter, and damage may occur before the arc-over is "detected" by overload devices in the transmitter.

The Magniphase System detects an impedance change in the load presented to the transmitter. The most common disturbance in an antenna system is an arc-over caused by a nearby lightning discharge. Such an arc-over will cause an impedance change which is sensed by the Magniphase System as an unbalance condition at the input of the Magniphase bridge circuit. The Magniphase System will then initiate control circuit functions to shut the transmitter down for a period of approximately 60 milliseconds. The transmitter will then be re-energized, but if the arc still exists, it will be shut down again. An arc of this type should burn itself out very rapidly without sustaining RF energy.

The Magniphase Line Coupler consists of a capacitor and an inductor which samples transmission line voltage and current respectively. The two RF samples from the coupler are fed to a balanced bridge circuit which is located in the Rectifier and Harmonic Filter Unit on the right side of the front door. The two RF samples are balanced by means of controls on the front panel of the Magniphase Unit so no direct current flows in the bridge output circuit unless there is a change in one or both of the samples. In this manner, the bridge is sensitive to either a change in voltage and current magnitude or to a change in phase. An arc or other disturbance at any point in the system will cause either or both of these changes to occur.

The diode current is drawn through a resistor R6 in a direction that causes a positive pulse to be applied to the base of the fault pulse amplifier Q2.

4-8. PROTECTIVE CIRCUITS

The protective circuits incorporated in the Type 317C-2 Transmitter are of three basic types.

(1) Fully automatic circuit breakers provide AC overload protection for the filament, low voltage, high voltage and control circuitry and for the bias power supplied. The 230-volt AC distribution circuit is also protected. The magnetic circuit breakers can be reset immediately after an overload tripoff. Magnetic circuit breakers protect the following circuits.

(2) DC overcurrent relays protect the individual power amplifier tubes and the High Voltage Power Supply. Eight (8) DC overcurrent relays protect the RF power-amplfiier carrier and peak tube and the High Voltage Power Supply. Also bias, +3KV, +5.5KV, +750V, -200V power supplies.

(3) Phase Failure Detector, 2A13, detects the failure of any one of the Input Power Phases. A relay is actuated on detection of a Phase Failure and a set of its contacts interrupts the High Voltage Interlock circuit, causing the Transmitter to be shut down.

4-9. CONTROL CIRCUITS

a. General. An understanding of the control circuits of the Type 317C-2 Transmitter will be helpful when it is necessary to locate control malfunctions. Refer to paragraph 3-1, CONTROLS AND INDICATORS, of this handbook which lists the operating controls and indicators and their functions. Also refer to Control Ladder Diagram E142016, Power Change Ladder Diagram C142018, Lamp Circuit Ladder Diagram D142239, Plate and Screen Variac Control Ladder Diagram C142017, and Excitation and Audio Cutoff Ladder Diagram D142019.

b. Control Voltage. A center tapped winding on 230-volt distribution transformer 2T1 provides 115 VAC control voltage, which is applied to the control circuitry when 115V CONTROL circuit breaker 2CB1 is set to the ON position. External 115 VAC control voltage may be used. See 2 TB1 for jumper removal and connection. When CONTROL circuit breaker 2CB2 is set to the ON position, 115 VAC control voltage is applied to the 28 VDC power supply and to the 12 VDC power supplies. Control voltages are supplied to all units in the transmitter.

c. Transmitter Starting. Refer to Control Ladder 142016 and Lampholder 142239. When 115V CONTROL circuit breaker 2CB1 and 12/28V CONTROL circuit breaker 2CB2 are closed, MASTER OFF lamp 2A8DS6 will light yellow. The other indicator lamps will provide the indications listed in paragraph 3.1 CONTROLS AND INDICATORS of this handbook for "transmitter shut-down" conditions.

When MASTER ON switch 2A8S1 is depressed, the "on" coil of latching relay 2A2K1 will be energized. Normally-open contacts 7 and 4 of 2A2K1 will close, applying +12V to Blower and Hold-over Timer 2A2U4 and to Blower Auxiliary relay control transistor 2A2Q1. The Blower Auxiliary Relay 2A2K2 is energized. Contacts 5 and 9 of relay 2A2K2 close, applying 115 VAC to the coil of Blower Contactor 2K1. Air Flow Switch 1S4 closes as the blower runs and applies +12VDC to Air Flow Auxiliary Relay 2A2K3. Relay 2A2K3 energizes and its contacts 9 and 5 close applying +12VDC to pin 9 of IC 2A2U3. With pin 10 of 2A2U3 already having +12VDC applied from the MASTER ON relay 2A2K1, IC 2A2U3 trigger IC2A2U4 which triggers transistor 2A2Q2 which energized Filament Auxiliary Relay 2A2K4. Relay 2A2K4 energizes and its contacts 5 and 9 close applying 115 VAC to Power Amplifier Contactor 2K3 and through Plenum Door Interlock switch S8 to Low Level Filament Contactor 2K2. Power of 115 VAC is also applied to the 28VDC power supply and to the oscilloscope. At the same time IC 2A2U3 triggered 2A2U4 ON it also triggered Bias Delay Circuit IC 2A2U2 and after delay it also triggered transistor 2A2Q3 which energized BIAS AUX relay 2A2K5.

Contacts of relay 2A2K5 close and applies 115VAC through contacts 12 and 8 of Rectifier Front Door relay 2A2K6, through contacts 12 and 9 of Power Amplifier Door relay 2A2K8, through contacts 12 and 8 of Driver Front Door relay 2A2K10, through contacts 8 and 12 of Driver Rear Door relay 2A2K11, through contacts 8 and 12 of Power Amplifier Rear Door relay 2A2K9, through contacts

8 and 12 of Rectifier Rear Door relay 2A2K7, through contacts 9 and 1 of Bias Overload Auxiliary Relay 2A3K2 to energize Bias Contactor 2K4. The door relays are energized when the individual referenced doors are closed.

With Bias relay 2K4 energized, contacts 12 and 11 apply 115 VAC through contacts 9 and 1 of Low Voltage Supply overloads relay 2A3K1 to +750V and -150V contactor 2K5 and to 3KV/5.5KV contactor 2K6. Power is also routed through contacts 12 and 8 of Step/Start Auxiliary Relay 2A3K6 to energize 3KV/5.5KV Step/Start Relay 2K7. Note that Relay 2A8K6 3KV/5.5KV Step/Start Auxiliary relay is energized by +12V applied through contacts 12 and 11, through the 3KV/5.5KV Step/Start Timer, and switching on Transistor 2A3Q3. The transistor completes the +12V to energize relay 2A3K6.

d. High/Low Power Circuit. High Power or Low Power is selected by depressing switches 2A3S4 and 2A2S3 as desired. High Power being 50KW with low power position dropping power to a customer selected level. This is accomplished by changing screen voltage and audio level and leaving plate voltage at its same level.

High Power Auxiliary Relay 2A3K4 or Low Power Auxiliary Relay 2A3K3 are momentarily energized when the High Power or Low Power switch is depressed. The Low Power Auxiliary Relay 2A3K3 may also be energized by contacts 12 and 8 of Magniphase Low Power Select Relay 2A6K6. Note that Relay 2K10, 18KV Plate Contactor is momentarily de-energized by opening the HV Interlock circuit contacts 9 and 3 of Low Power Select Relay 2A3K5 are closed during Low Power Selection and applies +12VDC to energize Low Power Audio Level Relay 2A7K1.

e. Plate Voltage ON. Plate ON/OFF Auxiliary Relay 2A13K3 is a latching relay which latches when the Plate ON switch 2A8S2 is depressed. Relay 2A10K3 unlatches when the Plate OFF switch 2A8S6 is depressed. With relay 2A10K3 latched, contacts 9 and 6 apply 115 VAC to the HV Interlock string. Power is routed through the following to energize Plate Auxiliary Relay 2A10K1 which must remain energized.

Relay or Switch	Contacts	Title
2A6K5	12 & 4	Magniphase Lockout
2A4K1	4 & 12	Power Amplifier O/L Interlock
2A4K2	4 & 12	Power Amplifier O/L Lockout
2A4K3	8 & 12	R/C Plate ON/OFF
2A10K2	6 & 9	Local/Remote Select
2A4K4	4 & 12	Overtemperature
2A3K4	1 & 9	High Power Auxiliary
2A3K3	1 & 9	Low Power Auxiliary
2K5	10 & 9	+750/-150 Contactor
2K6	10 & 9	3KV/5.5KV Contactor
2K4	10 & 9	Bias Contactor
2A11K1	11 & 3	DC Overload
2A11K2	11 & 3	Carrier Overload
2A11K3	11 & 3	Peak Overload
--	--	External Plate Interlock

As Plate Auxiliary Relay 2A10K1 is energized, its contacts 3 and 1 close and apply 230 VAC to 18 KV Plate Contactor 2K10.

As Relay 2A10K1 is energized power is also applied through contacts 8 and 12 of Plate Step-Start Relay 2A4K6 to Relay 4K1 bridge to energize plate surge contactor 4K1. The Plate Surge Contactor shorts out the surge resistors which are in series with power being applied to the 18KV Plate Contactor contacts. The Plate Surge Contactor is delayed momentarily before energizing.

f. <u>Transmitter Plate Control Auto Reset Adjust</u>. On the TRANS Plate control, 2A4 PC Card Panel, set the Overload reset R14 to 5 minutes. This ensures that after each 5 minutes from an overload, the overload counting circuit will be reset to "O" unless the number of overloads has reached 4 and the transmitter is switched to Low Power. The transmitter is locked out when a total of 8 overloads is reached.

g. <u>Overload Adjustments</u>. The following are overload adjustments:

PEAK OVERLOAD	6 amperes
CARRIER OVERLOAD	7 amperes
DC OVERLOAD	9 amperes

The overloads may be set initially by setting the controls fully clockwise for the most sensitivity and fully counter-clockwise for less sensitivity. For low frequency modulation, the controls should be set for less sensitivity. Refer to Test Date for setting made at the factory during testing.

k. <u>Excitation Cut-off</u>. A +28 volts is applied through 2CB11 Auxiliary Switch Normal open contacts when the circuit breaker is closed, through 2TB1-60 to a remote set of contacts and back to 2TB1-59 and jumpered to 2TB1-42, routed to 3TB1-11, to 3TB2-11, to 4TB1-11, through a set of normally open contacts of Relay 4K1 and back to 4TB1-10 to 3TB2-10, to 3TB1-10, to 2TB1-43 to 2XA1-10 and through normally closed contacts 2A1K2-3/11 and through 2A1K3-4/12 to a divider network which applies approximately 11 volts to 2A1U10 pin 9 which then allows the Exciter signal to be routed through 2A1U10. Thus the Exciter signal is not applied to the 1st RF Amplifier if the Plate Contactor 4K1 is open, if the Plate Circuit Breaker 2CB11 is open, or if the remote set of contacts being opened will cause a loss of RF excitation.

l. Low Power/High Power Circuit. The output voltage of the High Voltage Power Supply can be reduced to facilitate transmitter tuning. The primary windings of the high voltage plate transformer are connected to two relays. The primary windings of the high voltage transformers are connected in a wye configuration for operation with reduced plate voltage and in the DELTA configuration for operation at normal plate voltage. These relays are operated by pushbutton HIGH POWER 2A3S4 and LOW POWER 2A3S3.

m. Overtemperature Switch. Overtemperature switch 1S5 is located about the carrier tube to protect against over dissipation of the tube. A sample of the cooling air exhaust actuates this switch when the air temperature exceeds a preset value. When an overtemperature condition occurrs, switch 1S5 energizes overtemperature relay 2A4K4. Normally-open contacts 11 and 7 of relay 2A4K4 close, applying a holding voltage to the relay to keep it closed. Normally-closed contacts 12 and 4 of relay 2A4K4 open in the high voltage interlock circuit, thus removing plate voltage. Contacts 5 and 9 of relay 2A4K4 are closed to apply +12V to OVERTEMP lamp 2A4DS5. Lamp 2A4DS5 lights red. A set of normally-closed contacts of overtemperature reset switch 2A4S6, and normally closed contacts 1 and 4 of remote control plate-reset relay 2A4K5 are connected in series with the holding contacts of the overtemp relay 2A4K4. Switch 2A4S6 and relay 2ArK5 remove the holding voltage from overtemp relay 2A4K4, allowing plate voltage to be reapplied. If the overtemperature condition still exists the overtemp relay cannot be reset.

4-10. AIR COOLING SYSTEM

A single large high-pressure low-speed blower is provided to supply cooling air to the rf driver, rf power amplifier, audio driver and modulator tubes. This blower is located in the lower front portion of the Power Amplifier Unit.

Inlet air for this blower can be provided from behind the transmitter or from under the floor of the power amplifier unit as a customer option. The power amplifier air should be exhausted outside through a duct placed over the exhaust opening of the final tubes. See "G" on Drawing No. D142010.

A separate exhaust duct should be placed over the driver tube section of the power distribution unit. See "J" on Drawing No. D142010.

4-11. LV OVERLOAD CIRCUITS

Set the overload resistors as denoted below:

Relay K14	3KV	7 amperes
Relay K12	-200V	7 amperes
Relay K13	+750V	3 amperes
Relay K11	Bias	.8 amperes
Relay K15	5KV	.17 amperes

4-12. PEAK OVERLOAD CIRCUIT

Connect 12VDC supply with 0-15 ampere DC standard meter from peak filament transformer center tap to ground. Set peak overload sensitivity to 10 on dial. Set DC supply to 3 amperes DC and calibrate peak cathode test meter. Slowly run current to 5 amperes. Peak overload relay should operate at 4.2 to 4.7 amperes. Set overload sensitivity potentiometer to 0. Overload should operate at 7-9 amperes.

4-13. CARRIER OVERLOAD CIRCUIT

Check carrier overload by putting 12V supply from carrier filament transformer center tap to ground. Short out 10 ohm cathode resistor bank (R10-R14). Set standard meter to 5 amperes DC and calibrate test meter. Overload sensitivity should be same as peak overload.

4-14. DC OVERLOAD CIRCUIT

Check DC overload by putting 12V supply from plate current meter shunt 3R2-1 to ground. Set DC overload sensitivity potentiometer to 10. Set standard meter to 5 amperes and check reading of plate current meter (1M2). Meter should read 4.9 to 5.1 amperes. If out of this range, reject meter and shunt. Overload relay should operate at 8.0 to 9.0 amperes.

SECTION 5 - MAINTENANCE

5-1. PREVENTIVE MAINTENANCE

a. General. Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdown and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles from occurring. A regular schedule of preventive maintenance items should be established based on transmitter use, location, and available manpower.

The relative positions of components are shown in Figures 5-1 through 5-24 of this handbook. Also, refer to the schematic diagrams.

b. Preventive Maintenance Techniques. Use #000 sandpaper to remove corrosion from the cabinet or other metal parts. Use a clean, dry, lint-free cloth or a dry brush for cleaning. If the dry cloth or brush will not remove the dirt, use a high-quality commercial solvent such as Chlorothene. When cleaning electrical contacts, use a cloth or brush moistened with Chlorothene; when the contacts are clean, wipe them dry with a dry cloth. If available, dry compressed air may be used at a line pressure not exceeding 60 psi to remove dust from any accessible places.

CAUTION

WHEN USING COMPRESSED AIR FOR CLEANING PURPOSES BE CAREFUL NOT TO DAMAGE DELICATE PARTS WITH THE AIR BLAST. WHEN USING COMPRESSED AIR, ALWAYS DIRECT THE FIRST BLAST OF THE AIR LINE TOWARD THE FLOOR TO CLEAR CONDENSED MOISTURE FROM THE LINE.

c. Exterior Items.

(1) Check the completeness and general condition of the equipment.

(2) Inspect the control panels, and where necessary, clean jacks, plugs, knobs, etc., and remove dirt or stains from the panels.

(3) Inspect the seating of all accessible indicator lamps and fused. Check external coaxial connectors for looseness. Repair or replace faulty components.

(4) Operate all controls used in the normal operational procedure, and check for looseness, binding, sticking, etc. Lubricate or replace faulty controls, as necessary.

(5) Check the performance of the equipment for normal operation of the system. Take corrective measures as necessary.

(6) Check for loose screws or bolts on the exterior of the equipment (mounting screws large hardware etc.), and tighten loose fasteners. Check door panels and control panels.

CAUTION

TIGHTEN SCREWS, NUTS AND BOLTS CAREFULLY. FITTINGS TIGHTENED BEYOND THE PRESSURE FOR WHICH THEY WERE DESIGNED WILL BE DAMAGED OR BROKEN.

(7) Check the exterior of all units for scratches. clean marred areas with sandpaper and the repaint.

(8) Check external cabling for kinks, breaks, cuts or fraying. Replace or repair damaged cables.

(9) Inspect the antenna system for damaged components. Replace damaged cables, broken insulators, etc.

(10) Tighten loose lock nuts (switches, jacks, indicator lamps, etc.), and tighten loose knobs.

(11) Clean all air filters using the procedure outlined in paragraph 5-2 of this handbook.

(12) Inspect meters for broken glass or cracked cases. Replace damaged parts.

d. Interior Items.

WARNING

SHUTDOWN OR DISCONNECT ALL POWER INPUT TO THE EQUIPMENT BEFORE PERFORMING THE FOLLOWING PROCEDURES. UPON COMPLETION RECONNECT POWER AND CHECK FOR SATISFACTORY OPERATION OF THE SYSTEM.

(1) Inspect electron tubes for loose envelopes, connectors, cracked sockets, or insufficient socket spring tension. Check receiving type tubes in a standard tube checker. Replace faulty components.

(2) Inspect fixed capacitors for leaks, bulges or discoloration. Replace faulty components.

(3) Clean the glass envelopes of vacuum capacitors and tubes when necessary.

(4) Inspect resistors and resistor mountings for cracks, chipping, blistering, discoloration. Replace faulty resistors or mountings.

(5) Inspect terminals of large fixed capacitors and resistors for corrosion, dirt, and loose contacts. Clean, tighten and repair as necessary.

(6) Clean and tighten mountings of larger interior equipment.

(7) Inspect terminal boards for loose connections, cracks, and breaks. Replace faulty terminal boards.

(8) Lubricate moving parts as necessary.

(9) Tighten mounting bolts on large transformers and chokes.

(10) After the equipment has been in operation, inspect transformers, chokes, potentiometers,

etc., for leakage or overheating. Determine the cause of the trouble and take corrective measures.

(11) Examine sliding or moving coil contacts, replace and contacts that are worn, bent or broken.

(12) Check all meters for correct zero setting. Adjust as necessary.

(13) Check all door interlocks. Repair if inoperative.

(14) Lubricate each motor drive mechanism when necessary.

During long periods of normal service, the character of the emitted signals from the Type 317C Transmitter should be checked periodically. Indication of trouble during these checks often will lead to the discovery of impending equipment failure before it occurs.

(15) Check operation of air pressure switch 1S4 by starting from a cold start, push master on and then trip blower breaker 2CB3. Watch that filaments go off within approximately 5 to 10 seconds.

e. Lubrication of Blower Shaft Bearings. The shaft bearings of cooling air blower 1MB1 of the 317C Transmitter is initially lubricated at the factory. If subjected to continuous service or exposed to water, dirt or corrosive chemicals these bearings must be lubricated every six months. For normal service they must be lubricated once each year.

Use a neutral grease which is free from moisture and acid, and is non-separable under service conditions. For normal 180°F, LUBRICO M-21, KEYSTONE 44, ALEMITE 38 or equivalent greases are suitable.

A grease-fitting hole is provided in the bearing housing for a customer furnished grease fitting.

5-2. AIR FILTERS

The Air Filters located on the back of the transmitter should be checked every 30 days and changed if required. Filters are FARR Type 16" x 20" x 2" throw-away.

5-3. TROUBLE SHOOTING

Trouble shooting must be systematic to be effective. It is seldom possible to observe a symptom and diagnose the trouble immediately. Generally, a sequence of operational checks, observations, and measurements are required before the reason for the fault is apparent.

The first step in servicing defective equipment is to localize the fault. Observe the meter readings and indicator lamps for abnormal indications. A log of meter readings should be kept to locate minor troubles before they can cause serious loss-of-air time. Once the fault is localized, it becomes a problem of replacing the defective part and, if necessary, re-alignment of the section.

5-4. ADJUSTMENTS

The following list of components are adjustable. They were factory adjusted; however, on replacement, the new component should be adjusted to the values indicated.

Component	Adjustment
Circuit Breaker, 2CB11	See Factory Test Data & Data Sheet
PA Overload Assembly, 2A11	
DC	See Factory Test Data
CARRIER	See Factory Test Data
PEAK	See Factory Test Data
TRANSMITTER START ASSEMBLY, 2A2	
PLATE DELAY SECONDS, R23	8-10 seconds
BLOWER HOLD MINUTES, R22	5-7 minutes
TRANS PLATE CONTROL, A4	
AUTO RESET MINUTES, R14	2-3 minutes
AUDIO AMPLIFIER, A7	
FEEDBACK	Adjust as required
LOW POWER PGM LEVEL	Adjust as required

Component	Adjustment
AUDIO AMPLIFIER, A7 - Continued	
HUM BALANCE AMPL	Adjust for minimum noise
POSITIVE PEAK	
NEGATIVE PEAK	
HF RESPONSE SLOPE AMPL	Use a 5000 cycle square wave at 50% modulation and adjust any tilt on the positive peak with the AMPL and adjust any tilt on the negative peak with the SLOPE adjust.
2A7R12	With no audio input adjust the 0 output voltage using a scope or digital voltmeter at 2A6U1 pin 6. Allow 15 minute warm-up before adjusting.
2A7R25	Adjust for 35 to 40 MA on 2M1 with 2S7 set to I_C Audio Amp. position. Allow 15 minute warm-up before adjusting.
2A7R72	With transmitter brought up to Master ON get current reference on 2M1 with 2S7, set to feedback rectifier current position, turn plate on and current should be the same as the reference. If not adjust 2A6R72 and go through above procedure until there is no change. Allow 15 minute warm-up before adjusting.

5-5. ADJUSTMENT OF OVERTEMPERATURE SWITCH

During factory tests of the Type 317C-2 Transmitter, the overtemperature switch has been adjusted. Generally this setting will be sufficient for operation at most locations. However, since the adjustment depends on the ambient temperature, the sensitivity of the switch may need to be decreased under some conditions. Since the setting made at the factory leaves a good safety margin before over-dissipation occurs, it will always be safe to decrease the sensitivity by at least a half turn of the adjustment knob in a clockwise rotation. If, however, a complete calibration is desired, the following procedure may be used.

1. Remove the knob from overtemperature switch 1S5.

2. With filaments on for at least 10 minutes, adjust overtemp switch to point just where switch operates. This can be noted by observing OVERTEMP lamp.

NOTE

> Counter-clockwise rotation of the adjusting screw of the overtemp switch increases sensitivity.

When the OVERTEMP lamp lights RED, this indicates the OVERTEMP switch has operated. Reset by pressing OVERTEMP RESET switch.

3. When adjustment is made whereby the switch just operates as mentioned above, replace knob, aligning the index of the knob at zero on the calibration dial.

4. Now adjust switch one complete turn clockwise.

5. Disconnect buss from bottom of carrier tube grid leak resistor 1R9 which connects to 1L13 and 1R8. Ground 1L13 and 1R8 where buss was disconnected.

6. Before changing the carrier screen voltage, note SCREEN VOLTAGE meter and record. This should be done with the transmitter in a "ready" condition, no plate voltage. This will allow the carrier screen voltage to be reset to the same place after overtemp switch adjustment is made.

7. Decrease screen voltage to 50 volts or less by screen voltage lower switch 2A8S7.

8. Remove excitation from the transmitter by removing oscillator card 2A1.

9. Depress Low Power Switch 2A3S3.

10. With transmitter in ready condition, press PLATE ON switch 2A8S2 to ON.

11. Observe FINAL AMP PLATE VOLTAGE and TOTAL PLATE CURRENT meters. The PLATE VOLTAGE meter should read approximately 9 KV and the TOTAL PLATE CURRENT meter approximately 2 amperes.

By multiplying plate voltage times the total place current will give the power input to the carrier tube. Since there is no power taken from the tube, this is the power being dissipated by the tube. Raise the carrier screen voltage by operating the power adjust switch for a power input of 25 KW.

If the OVERTEMP indicator lamp lights immediately, the overtemp switch must be made less sensitive by rotating the knob clockwise from zero to one. If the overtemp will not reset, extinguish the lamp, the sensitivity of the OVERTEMP switch must be further decreased. This should be done by clockwise rotation of the knob one number at a time and again checking.

12. The adjustment is complete when the setting has been found whereby the overtemp switch does not operate with 25 KW input. Allow the transmitter to operate for 15 minutes under this condition to insure the temperature has stabilized.

If the overtemp switch operates before 15 minutes of operation, decrease the sensitivity by again rotating the knob to the next highest number. Generally, the point for 25 KW dissipation will be found to be between 1-1/4 turn to 1-3/4 turn from the initial setting as described in Step 3 above.

13. A good check of the setting after completion of Step 12 is to raise the power to 30-33 KW input and the overtemp switch should operate within one minute.

5-6. PROCEDURE FOR REPLACING SCREEN BY-PASS CAPACITORS FOR TYPE 4CX35000 TUBES

1. Remove tube, air skirt and tube socket. Due to the various connections to the tube socket, note orientation so that it can be re-installed in the same position.

2. Thoroughly clean both surfaces where the insulating rings mount. Remove any abrasions or sharp points that may be found.

3. Clean each of the teflon spacers and each socket mounting bolt.

4. Either 2 or 3 insulating rings are used to form the screen bypass capacitor. The rings are supplied in .010" and .005" thickness. Since .015" should be used, this can be made up by using 3 each of the .005" type or, 1 each of the .005" type and 1 each of the .010" type.

5. Make sure that the insulating rings to be used are free of punctures or any foreign matter.

6. Align the new rings over the socket mounting holes and hold in place by temporarily inserting the mounting bolts through the ring into the mounting hole.

7. With the rings in place as above, align the socket over the insulating rings. Make sure the orientation is the same as when removed.

8. Remove one mounting bolt at a time and install each teflon spacer and mounting bolt before installing the mounting bolt, coat the threads of the bolt with DC4 compound.

9. After all teflon spacers and bolts are installed as above, install all hardware to mounting bolts and tighten.

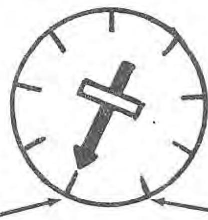
10. Wipe clean all surplus DC4 from the top of each teflon spacer.

11. Re-install <u>all</u> connections to bottom of tube socket.

12. Re-install tube air skirt and tube. Re-connect plate of tube.

5-7. PLATE CIRCUIT BREAKER, 2CB11, ADJUSTMENTS

Each of the three poles of this breaker is provided with adjustment of the magnetic trip. They are accessible from the front of the power and distribution unit. See Figure 15. If a replacement breaker is ordered, it is shipped with these adjustments at maximum and, further, since the breaker is designed with a ±15% tolerance, it is necessary that the following procedure be followed to ensure proper adjustment. This procedure is described for a transmitter known to be in proper operating condition. Each adjustment screw is provided with 9 detents as shown in the enlarged view below.



With the adjustment screw adjusted to the maximum pount as shown above, the magnetic trip of the breaker is at maximum current. Set each adjustment screw to minimum (clockwise 8 detents from that shown).

NOTE

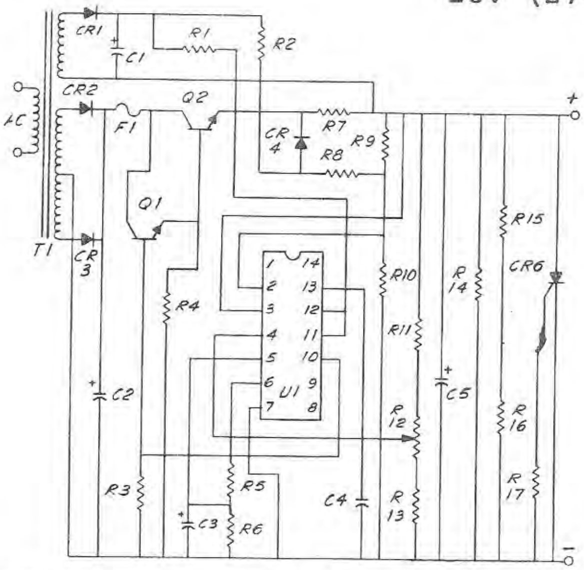
> The adjustment screw does not stop at minimum or maximum, however, the spacing is wider between the maximum and minimum detents and is easily located since these two points are at the bottom of the adjustment circle.

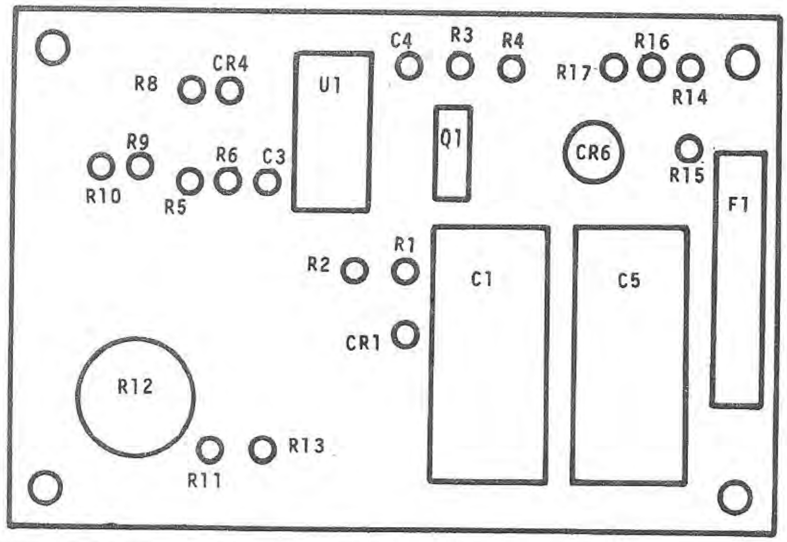
With the transmitter set for full power, turn on. If the breaker trips, move each adjustment screw counterclockwise to the next detent. Again, try the transmitter at full power. This procedure should be followed until the breaker will not trip on turn on.

The proper adjustment is defined as the minimum setting of the three adjustments which will allow the transmitter to come on as outlined above without nuisance tripping of the plate breaker. The transmitter should be turned off and on at least fifteen times to assure there will be no tripping due to the surge current which occurs on turn on. If the breaker trips one time in the fifteen times, the adjustment screws should again be rotated one detent counterclockwise.

Due to the tolerance on the breaker, the setting of the magnetic trips vary widely from breaker to breaker; however, past experience has found the point described above usually to be from the third detent above minimum to the 6th detent above minimum.

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





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

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

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

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

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

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

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

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

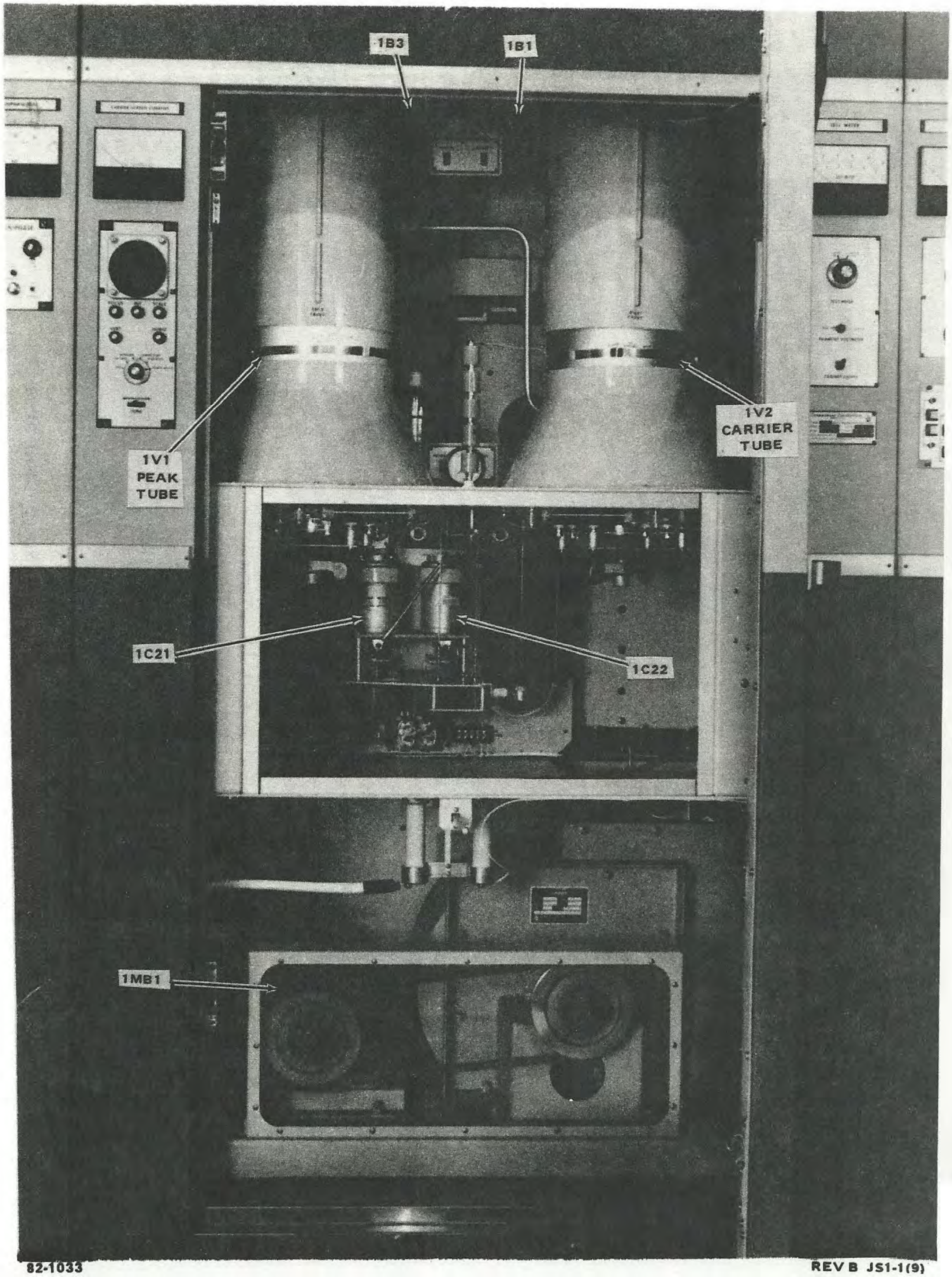


Figure 5-1. Power Amplifier

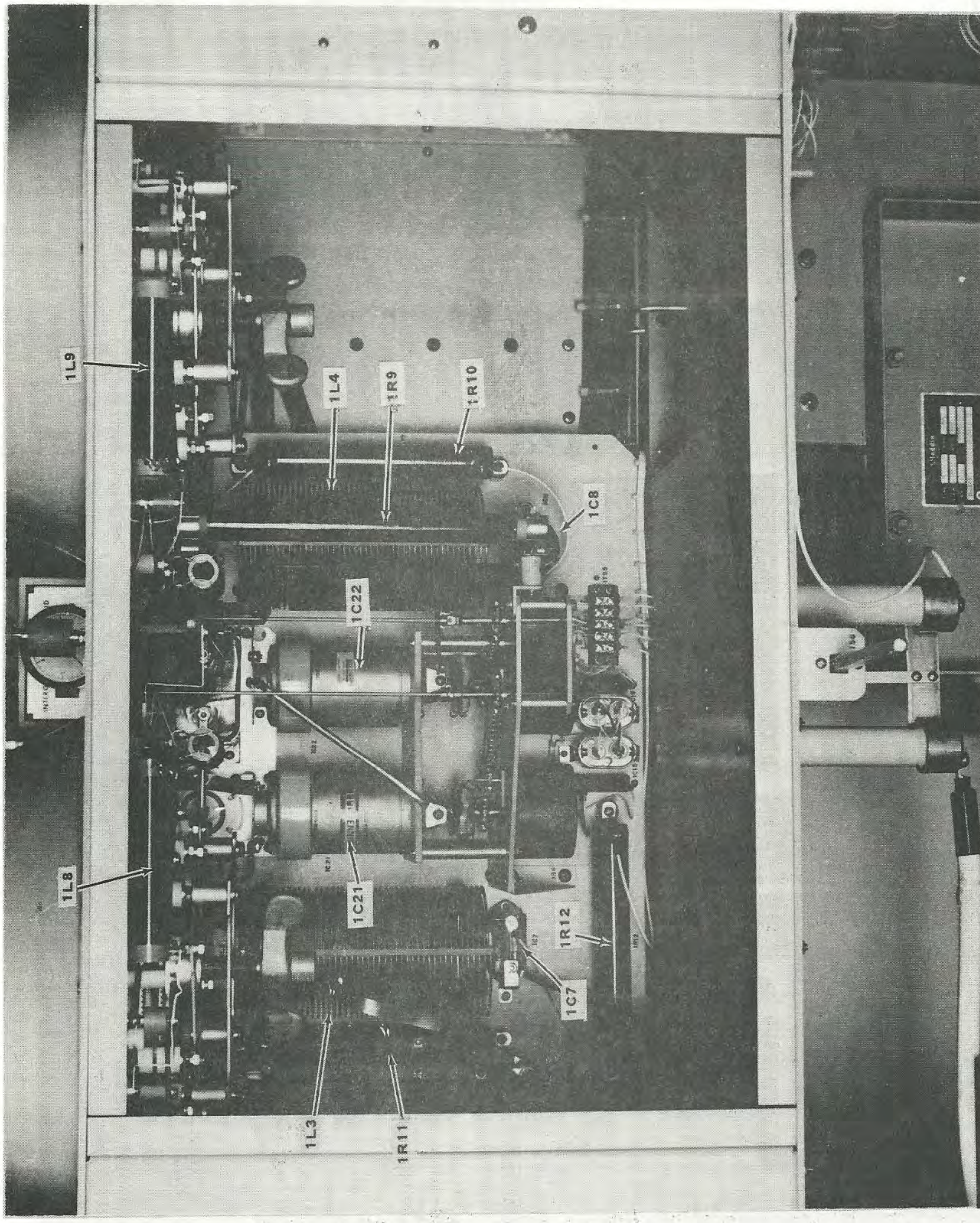
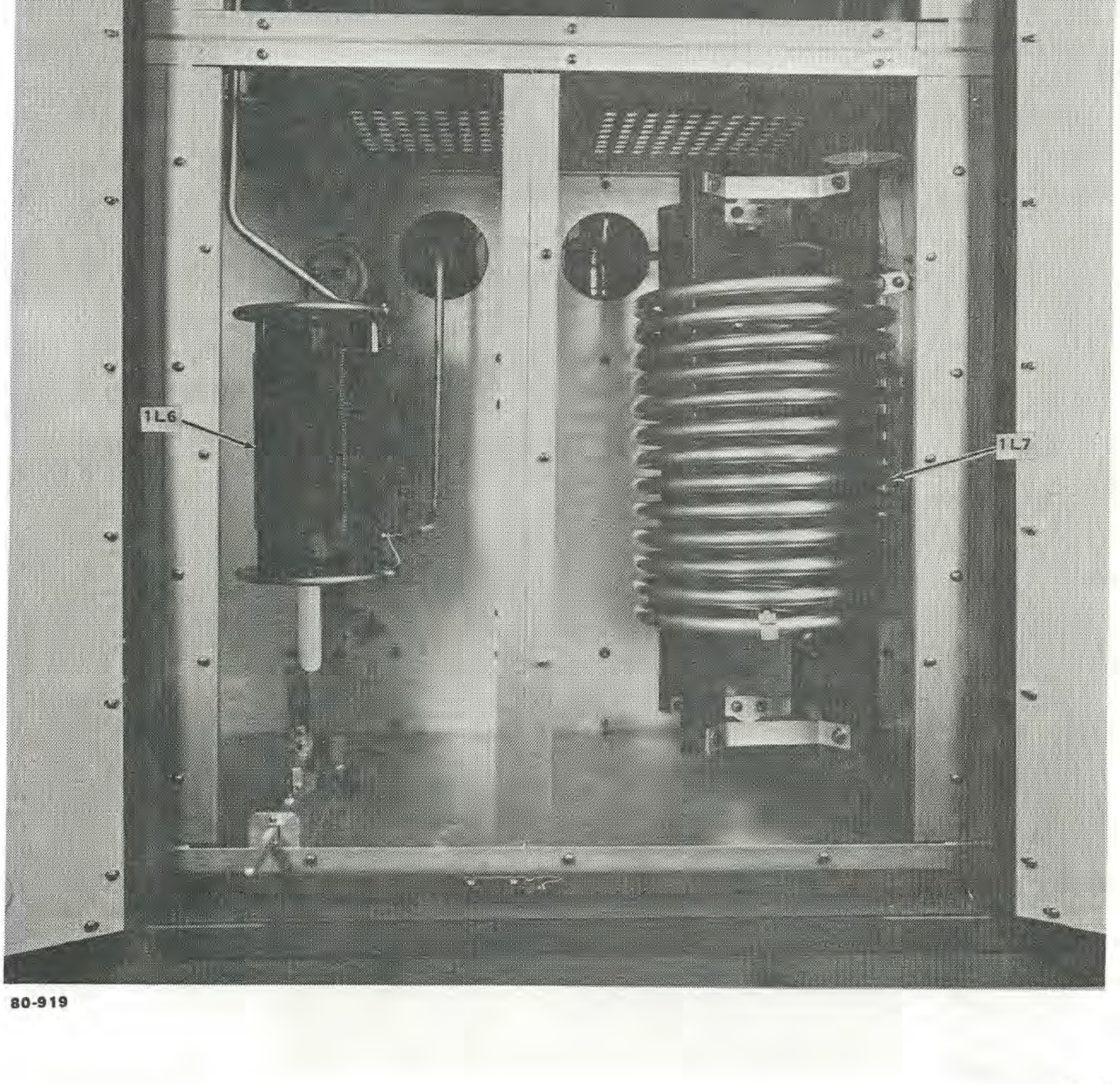


Figure 5-2. Power Amplifier INput Components

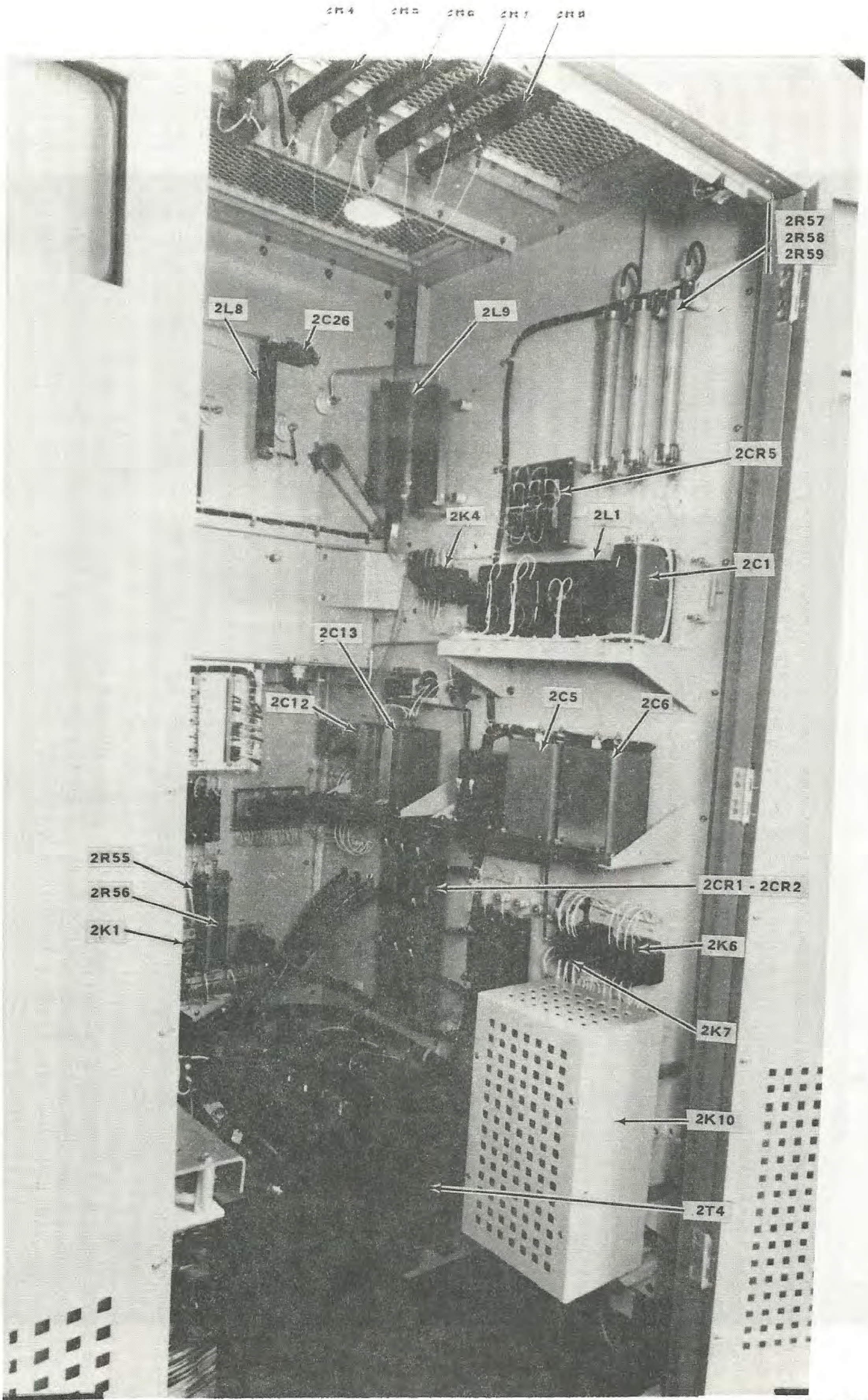
REV A JS1-1(6)



80-919

JS1-1-(5)

Figure 5-3. P.A. Cabinet, Rear



82-1031

REV A JS1-1(4)

Figure 5-4. LV Distribution, Rear Right View

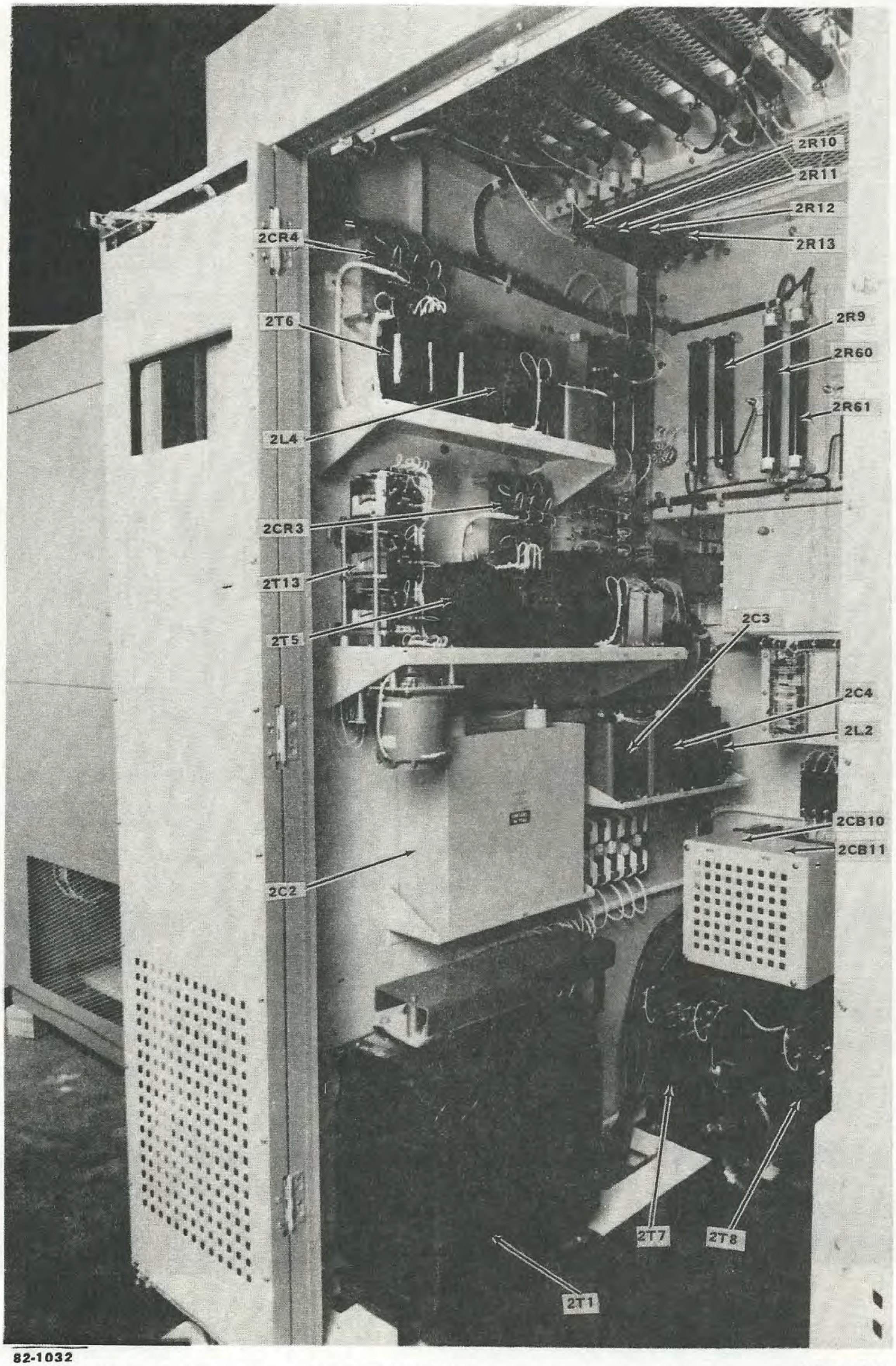


Figure 5-5. LV Distribution, Rear Left View

REV A JS1-1(7)

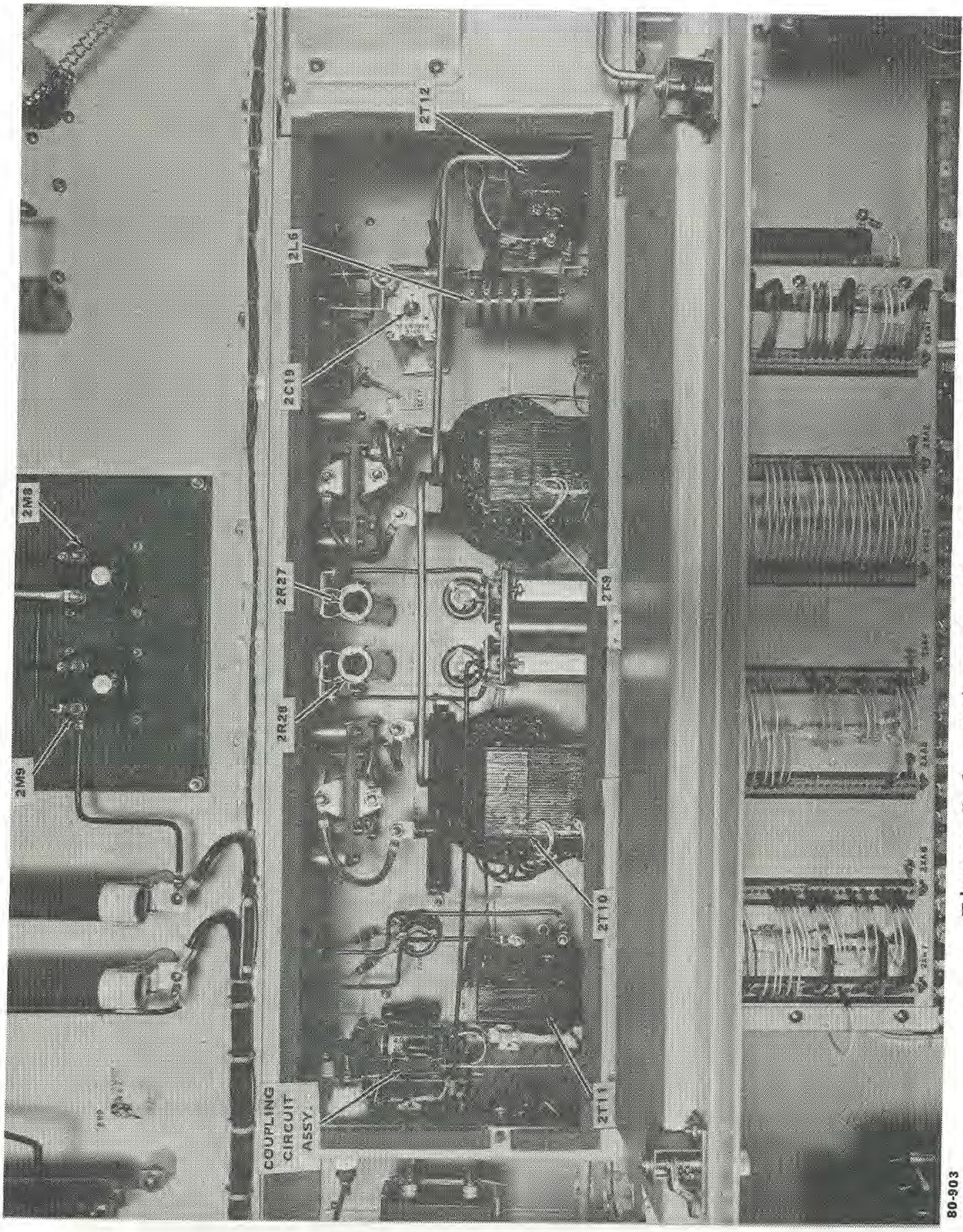
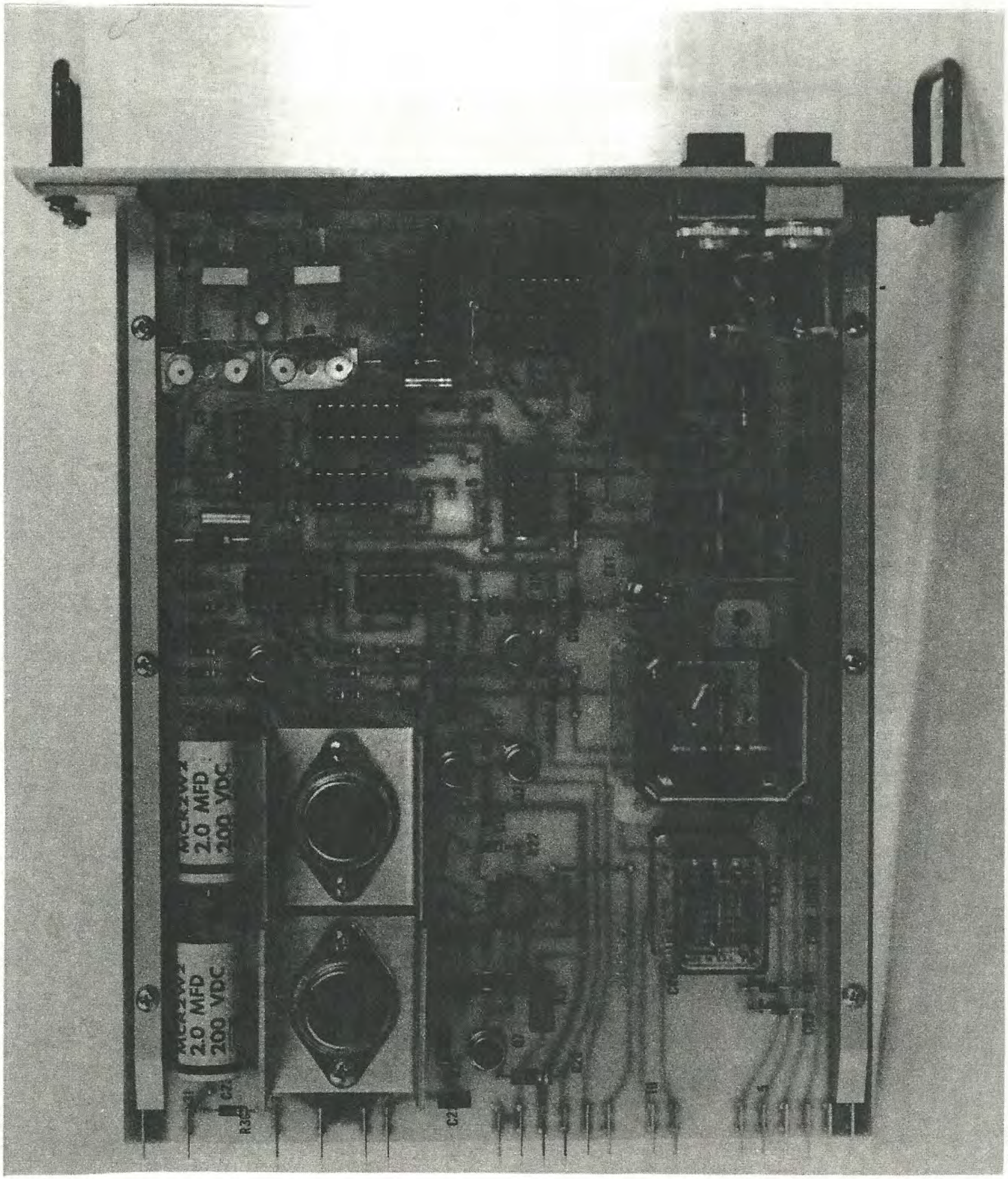


Figure 5-6. Driver Input Components

JS1-1(6)



83-351

Figure 5-7. Oscillator-Exciter P.C. Card, 2A1

JS1-1-(41)

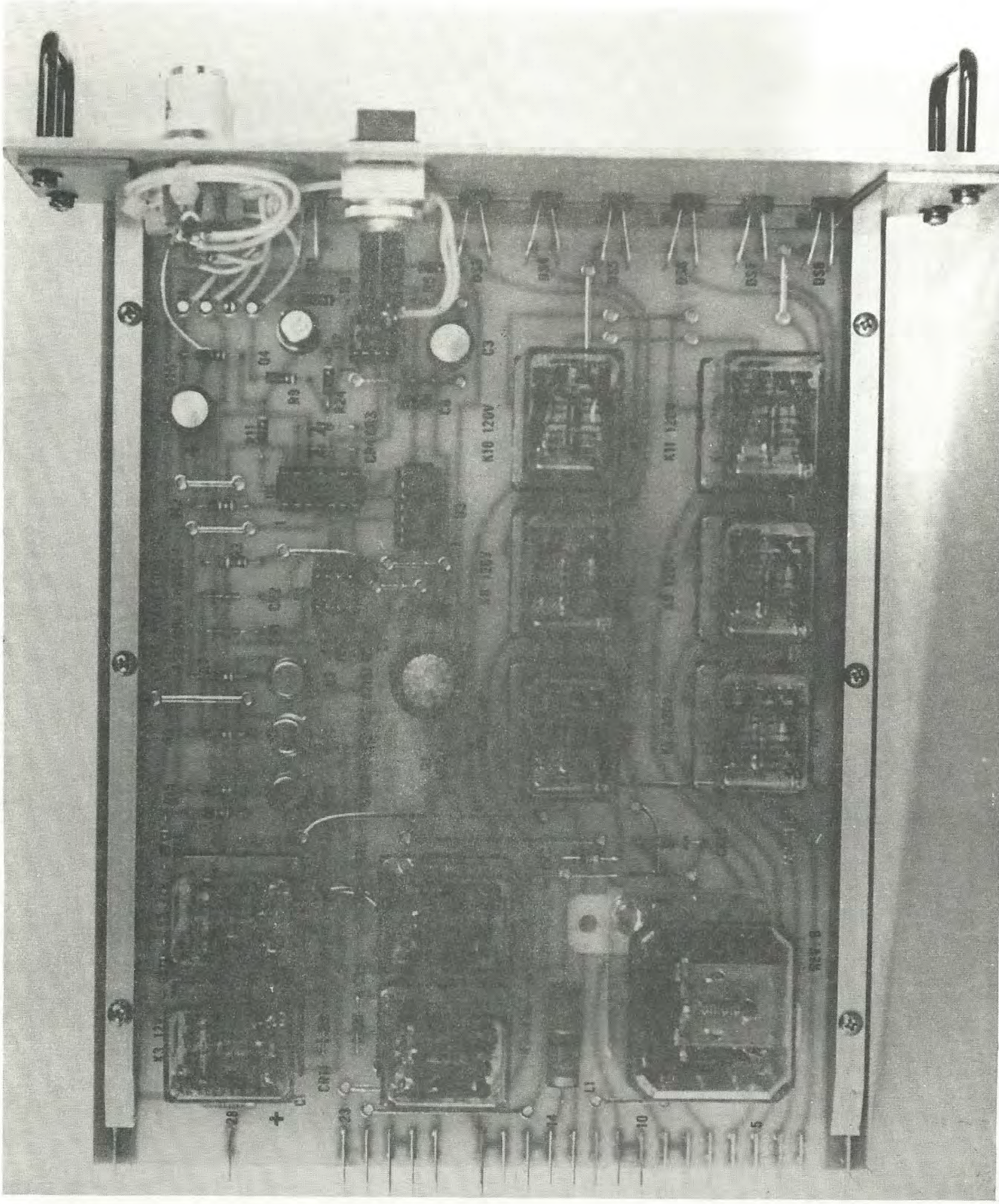
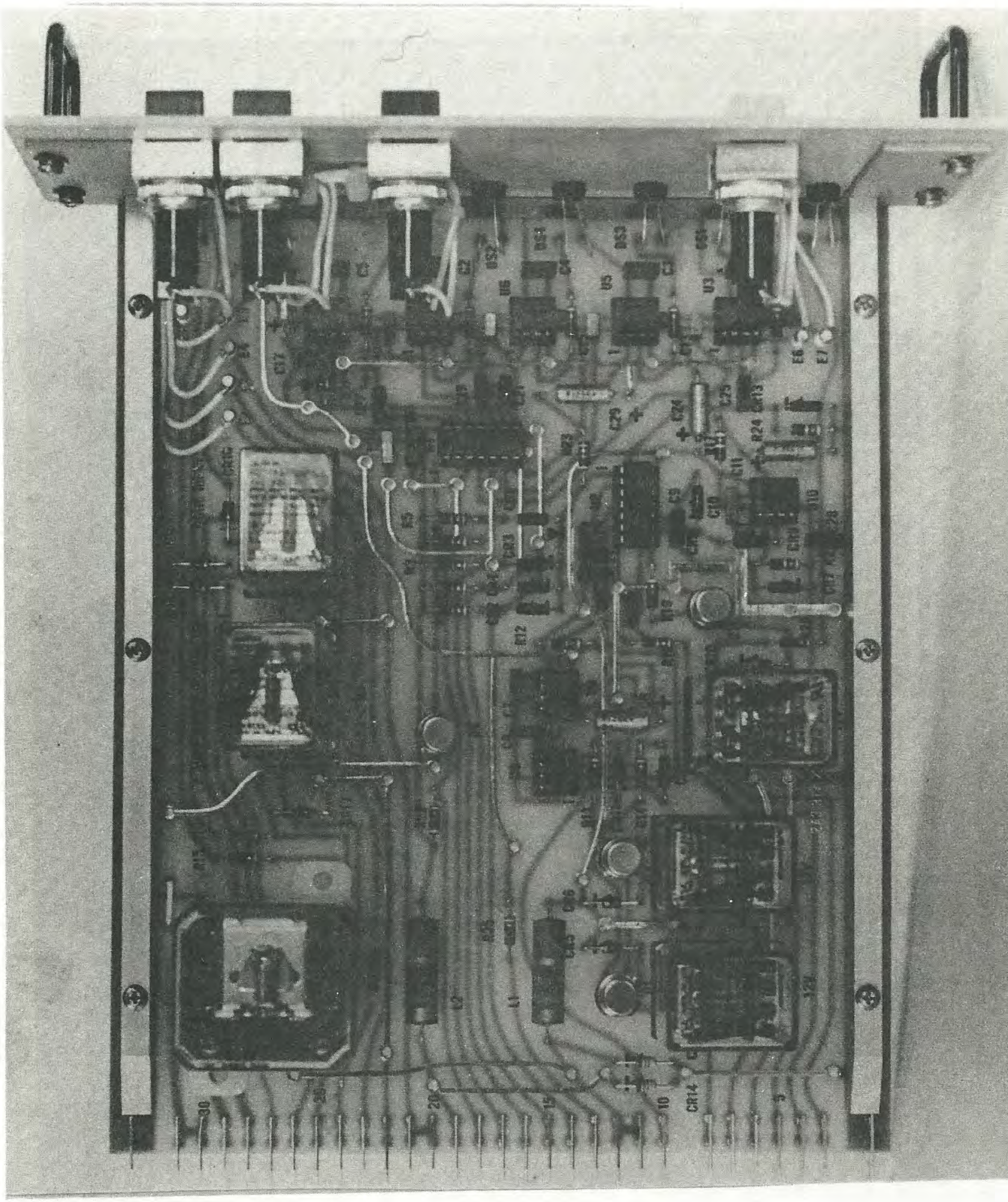


Figure 5-8. Transmitter Start Control P.C. Card, 2A2

83-353

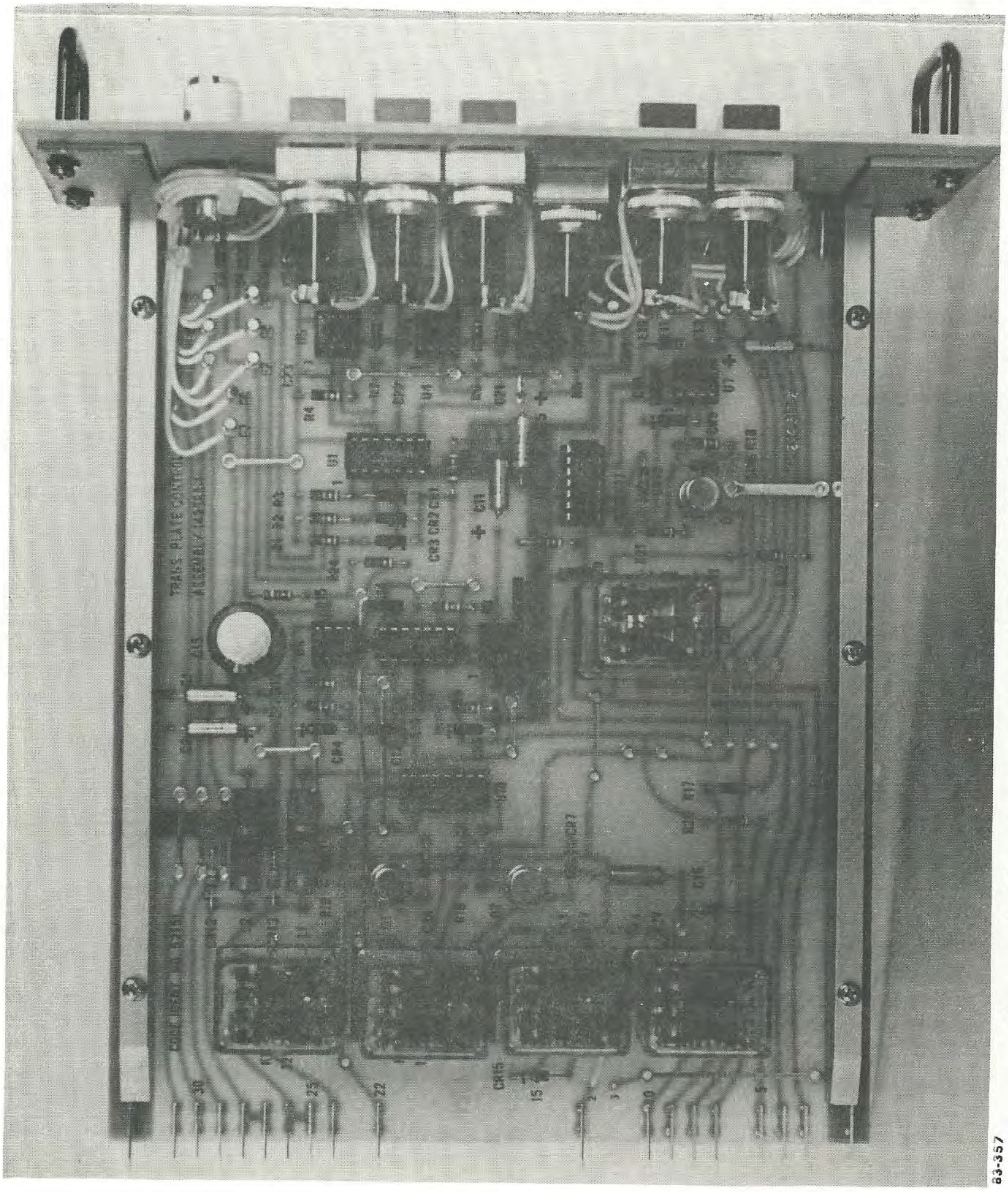
JS1-1-(44)



83-355

Figure 5-9. LV Overload/Power Change, P.C. Card, 2A3

JS1-1-(45)



83-357

Figure 5-10. Transmitter Plate Control P.C. Card, 2A4

JS1-1-(46)

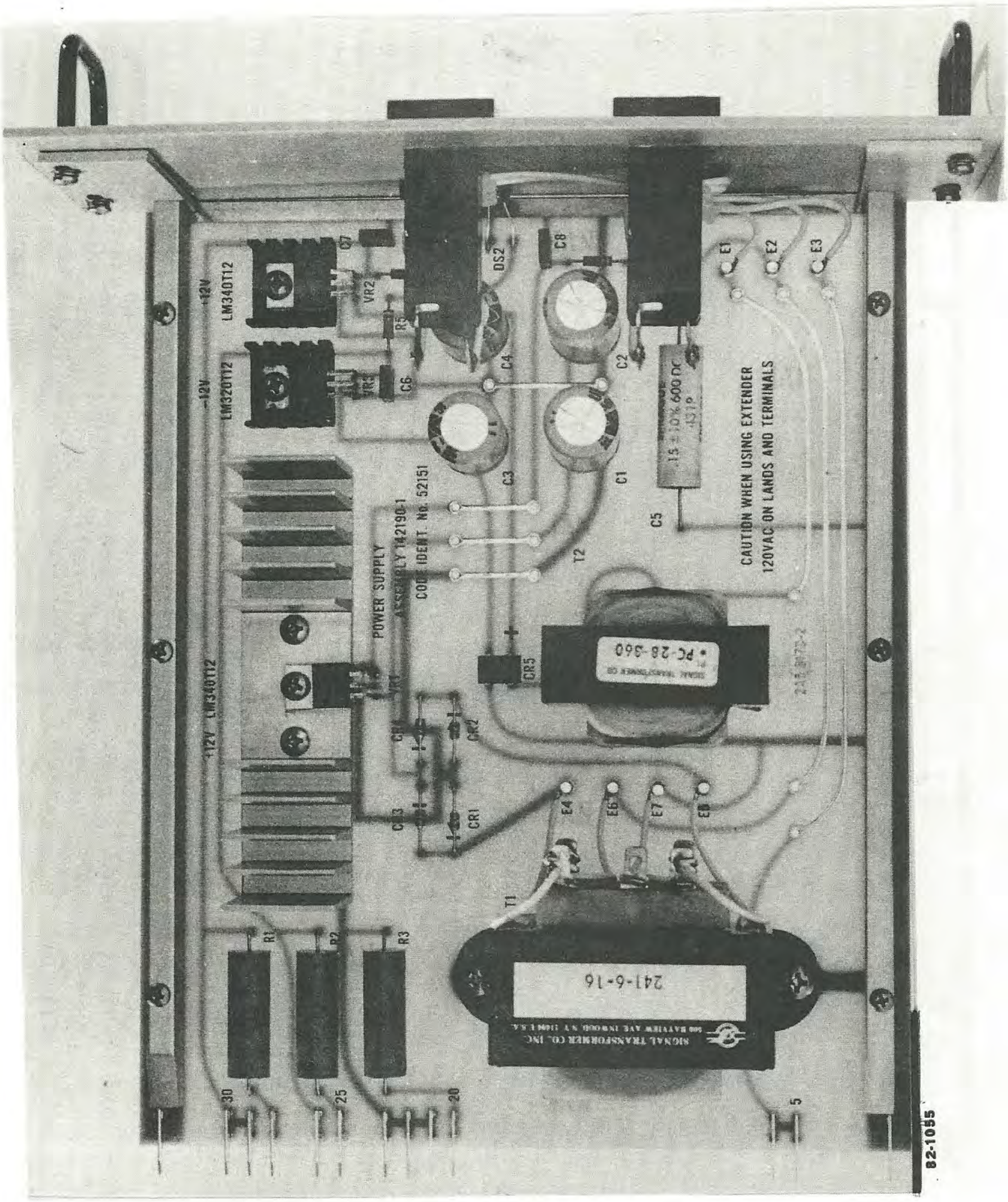


Figure 5-11. Power Supply P.C. Card, 2A5

REV A JS1-1-(8)

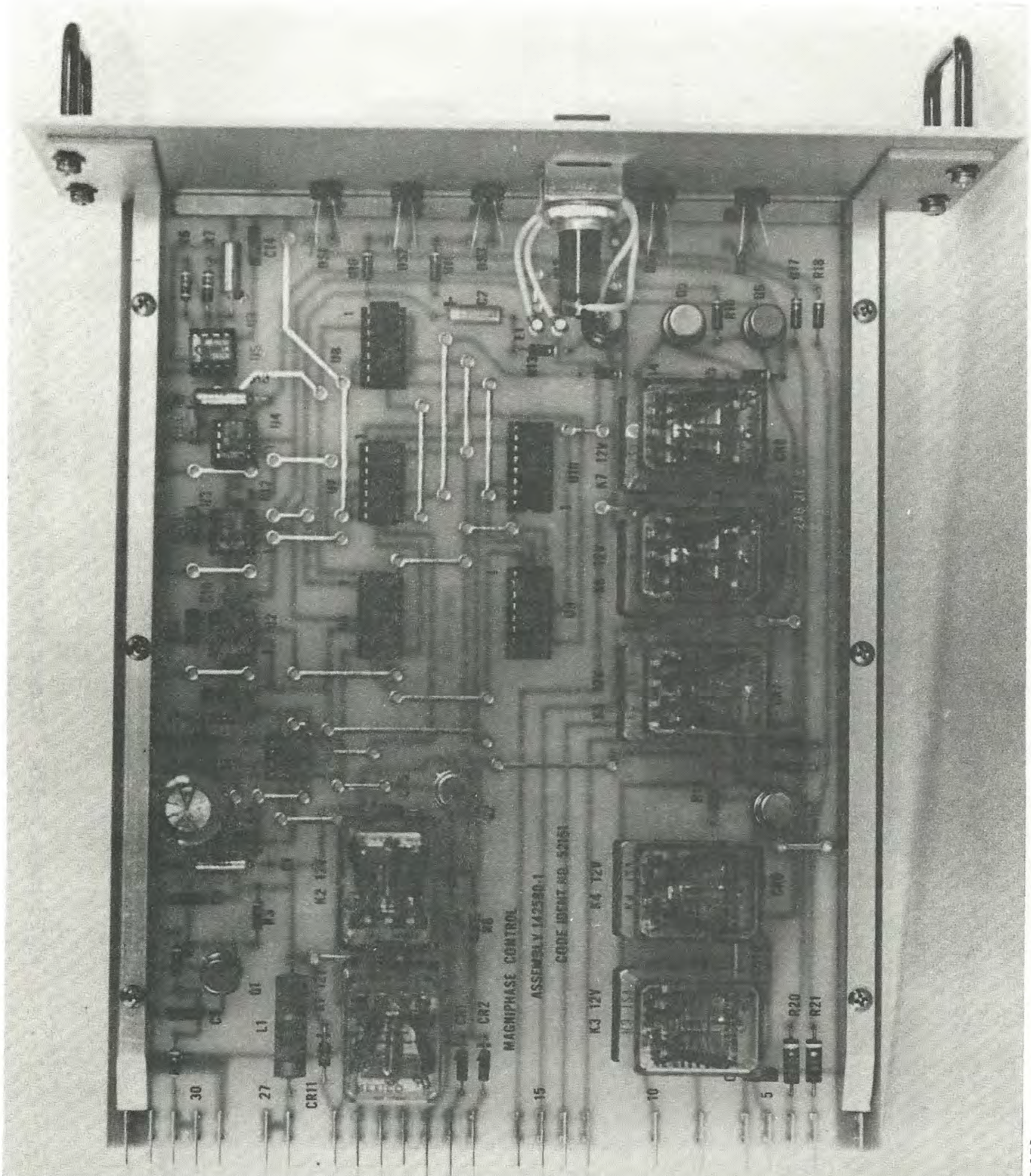
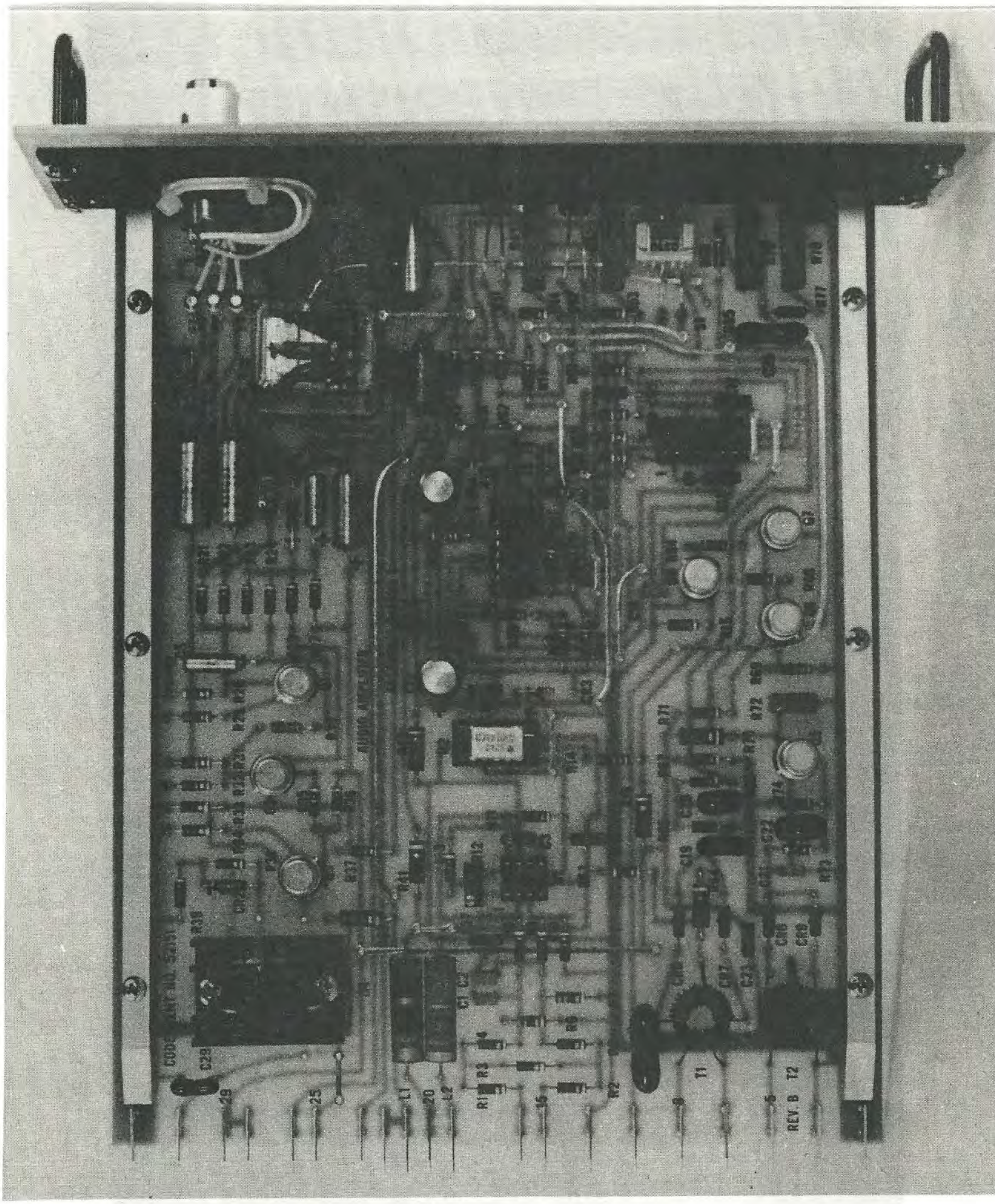


Figure 5-12. Magniphase Control P.C. Card, 2A6

83-359

JS1-1-(43)



83-361

Figure 5-13. Audio Amplifier P.C. Card, 2A7

JS1-1-(42)

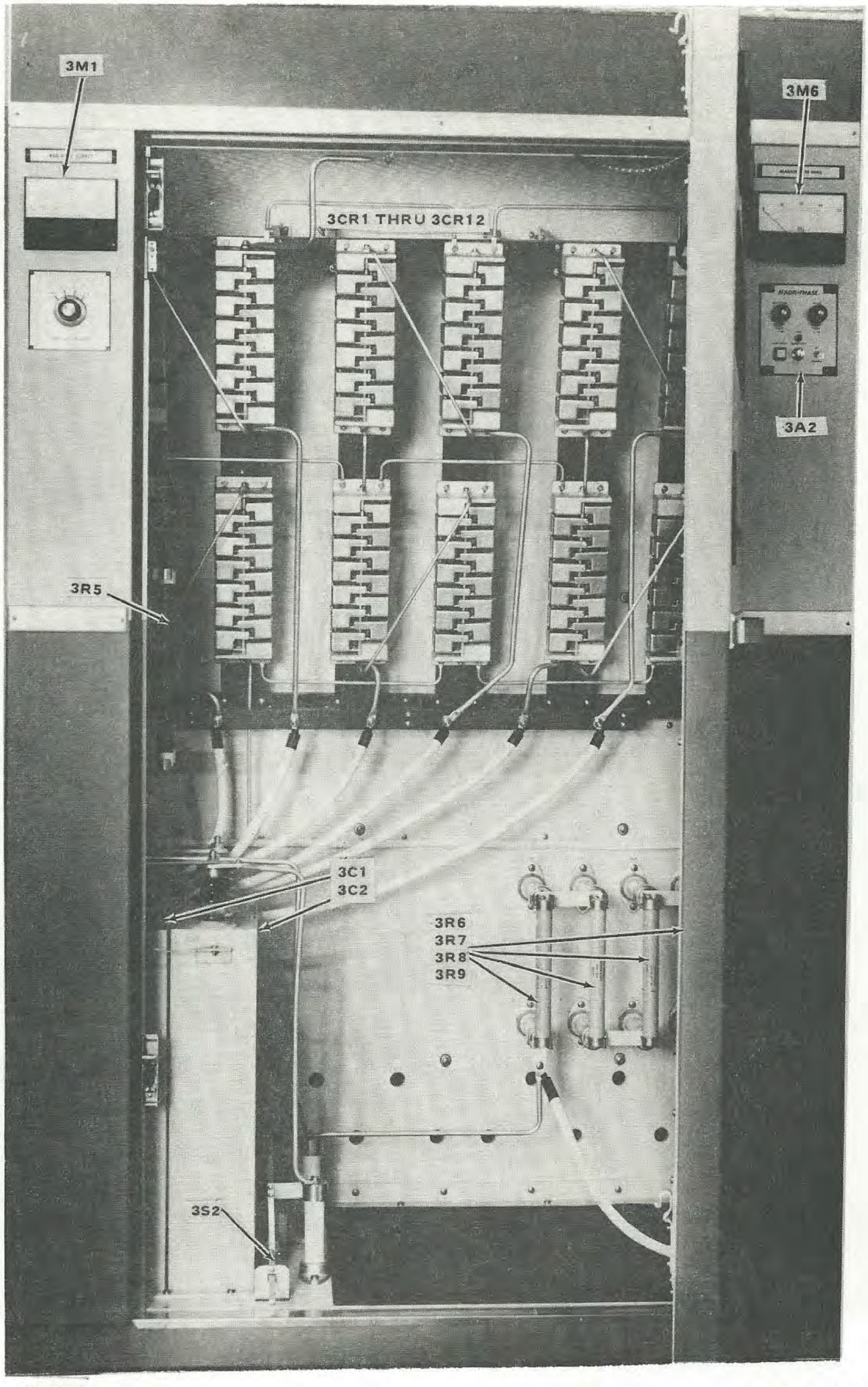


Figure 5-14. Rectifier and Harmonic Filter Cabinet, Front

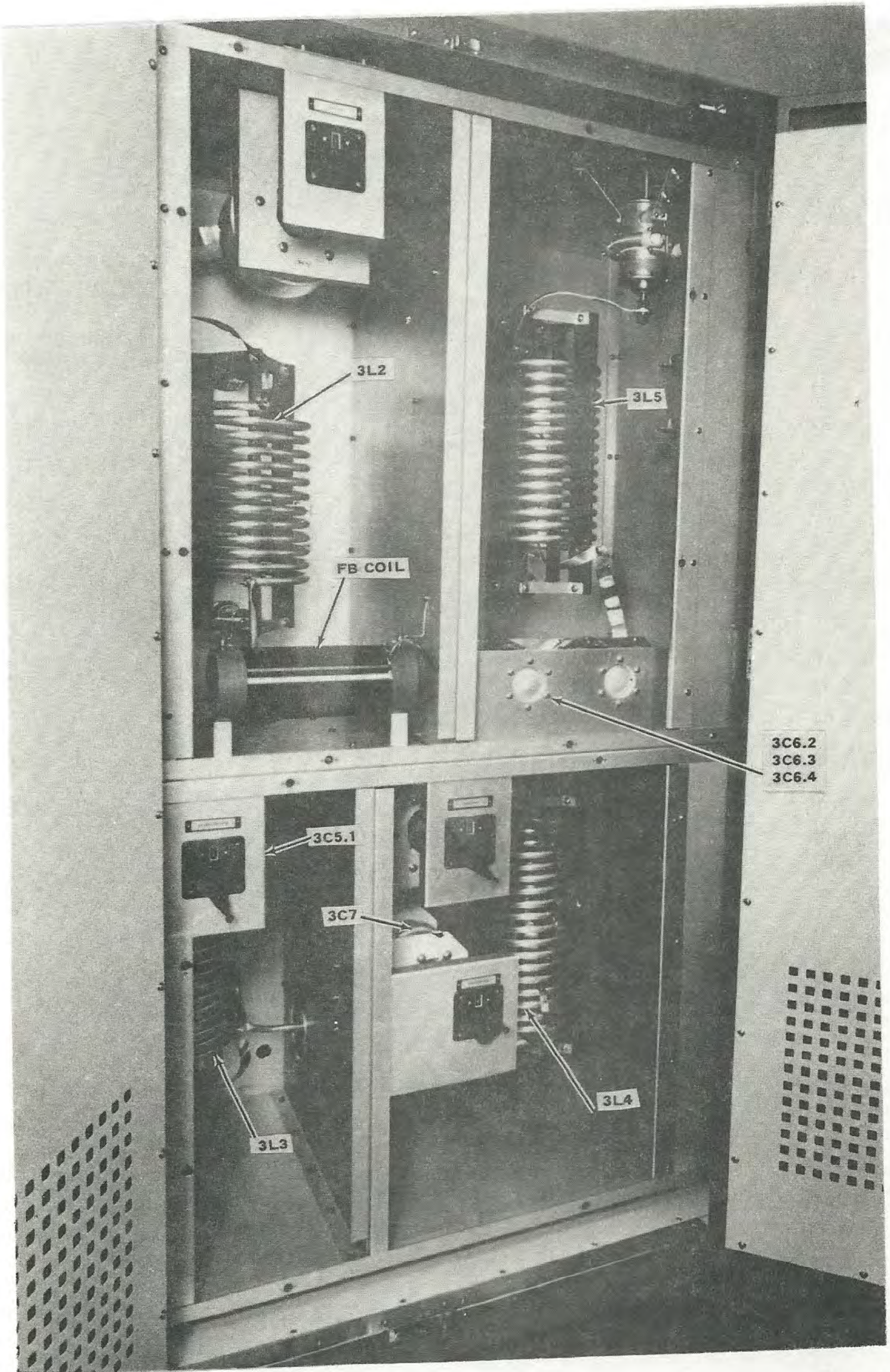


Figure 5-15. Harmonic Filter, Right Rear

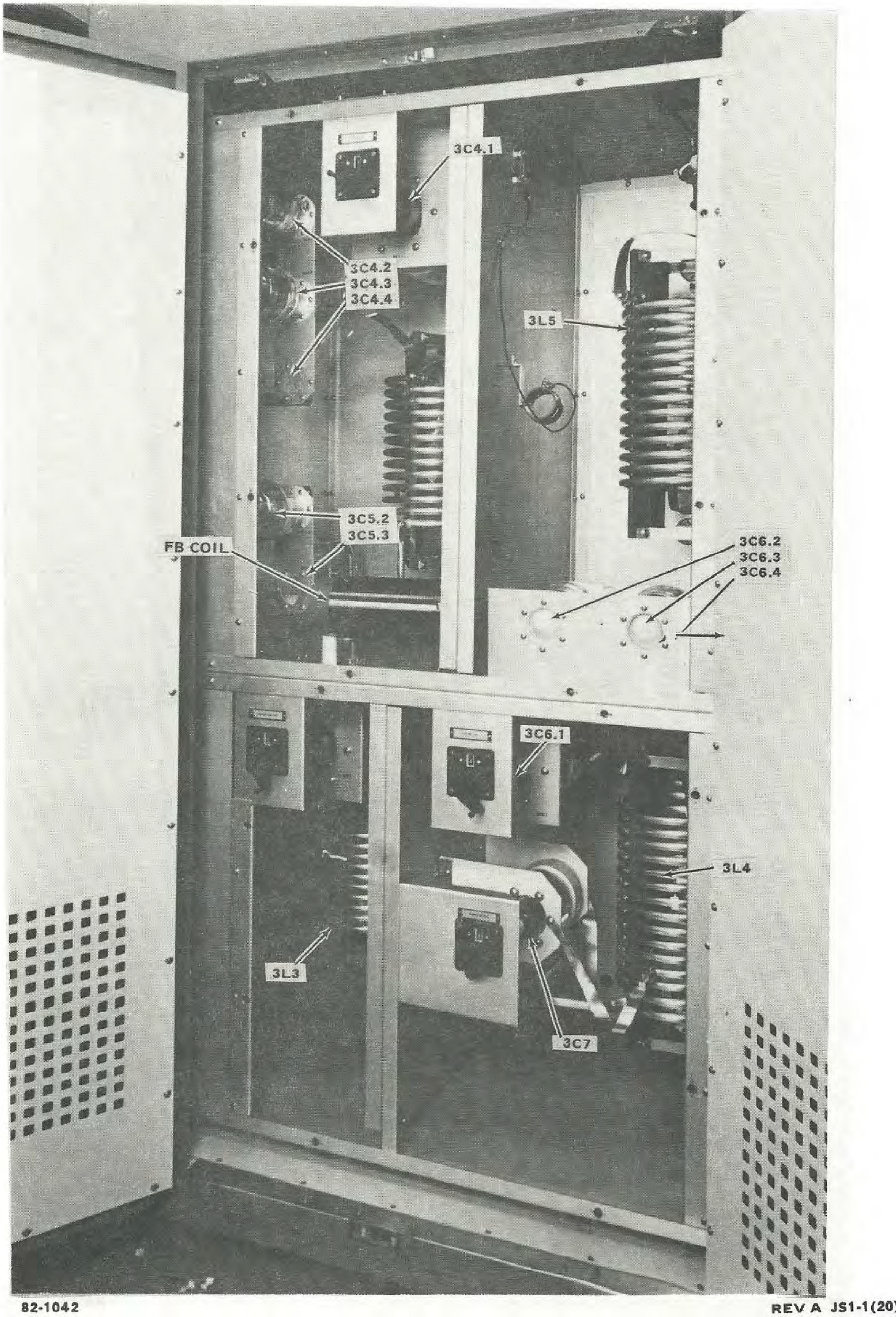
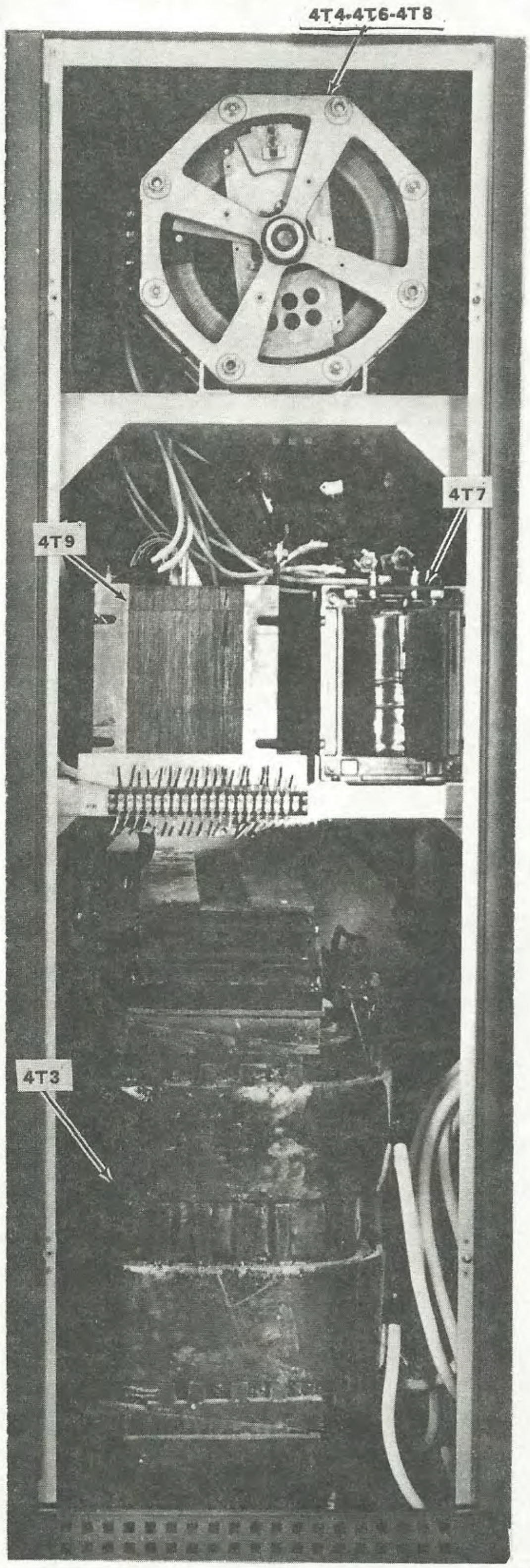


Figure 5-16. Harmonic Filter, Left Rear



82-1049

REV A JS1-1(19)

Figure 5-17. Plate Transformer Cabinet, Front

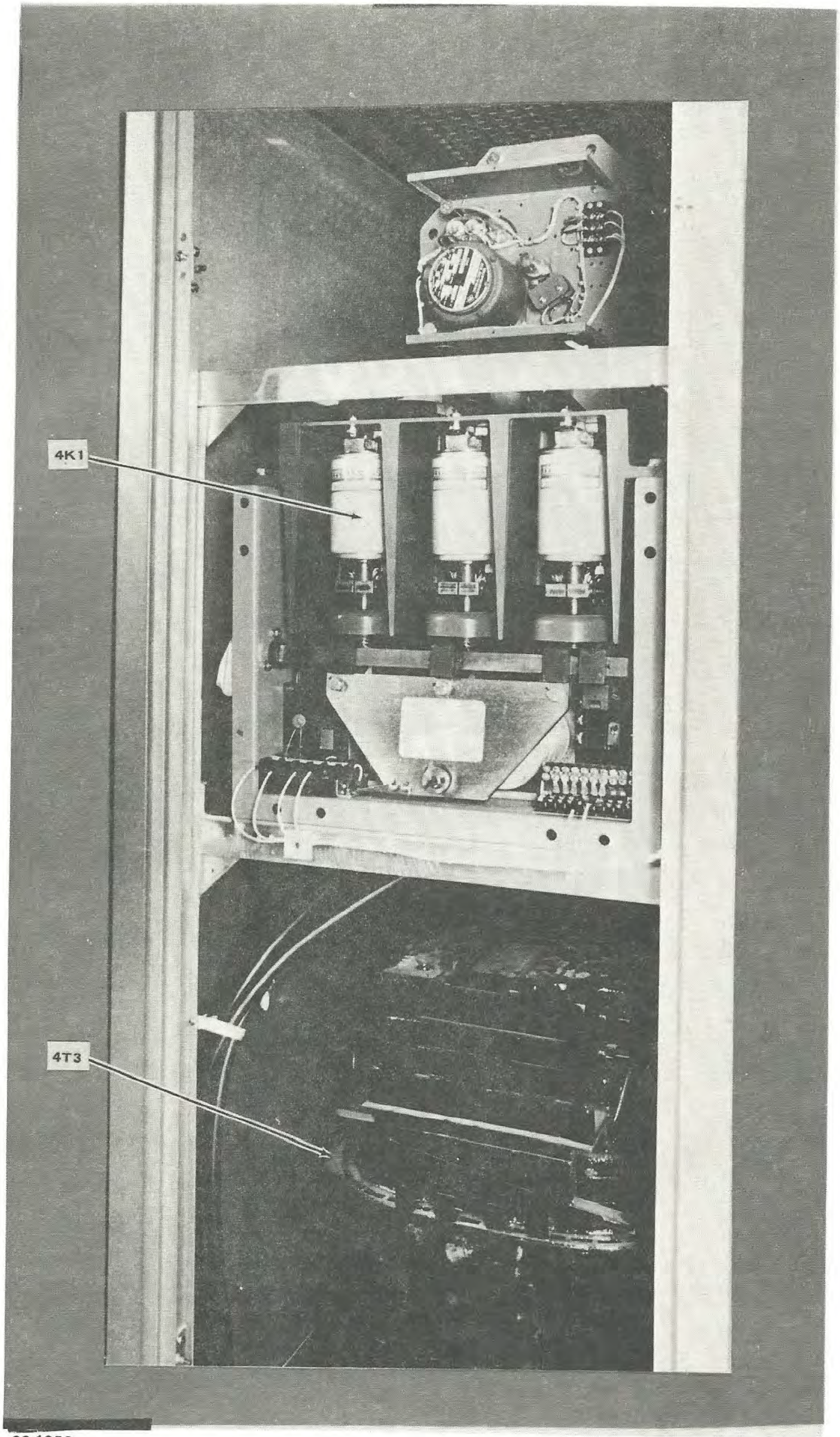
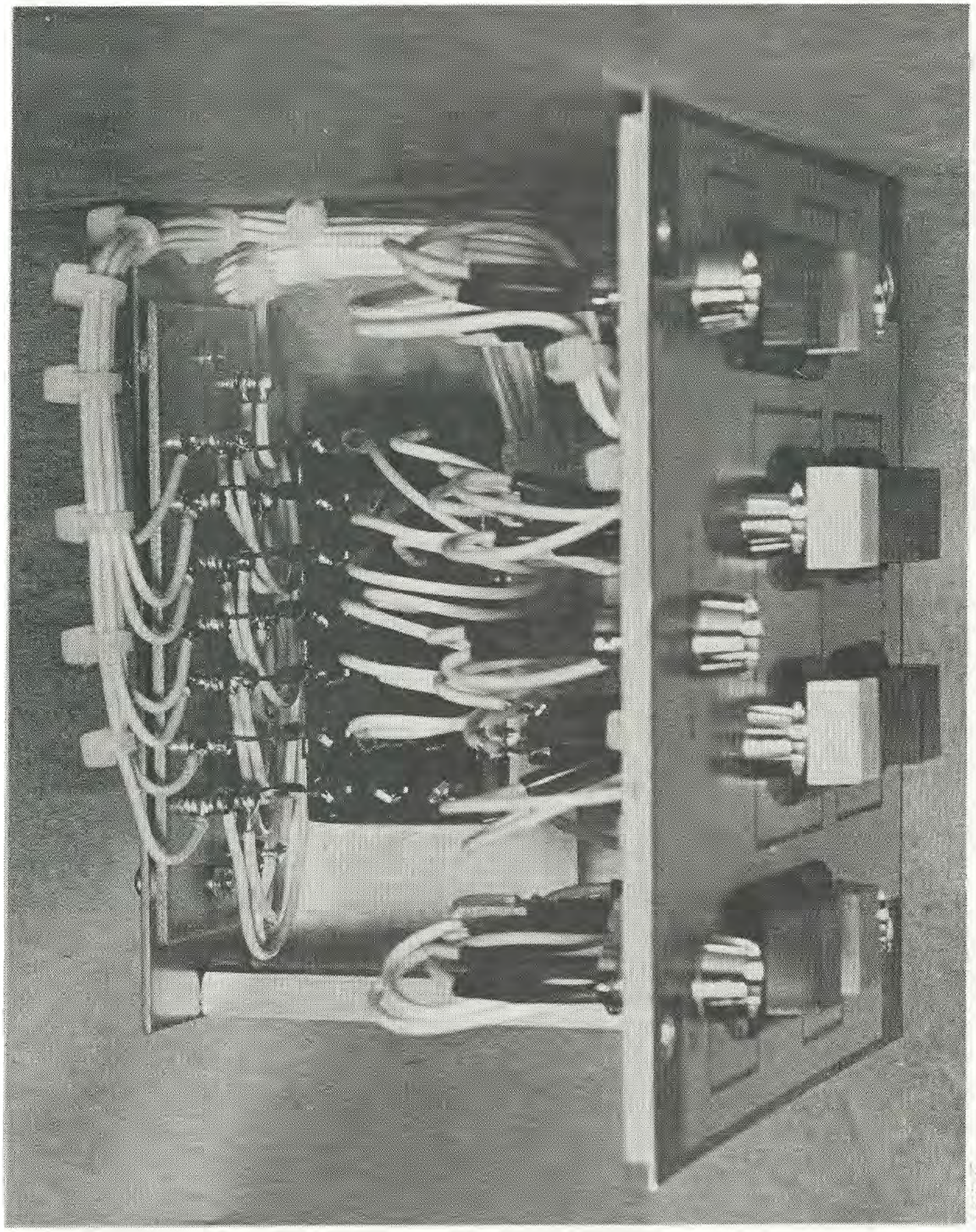


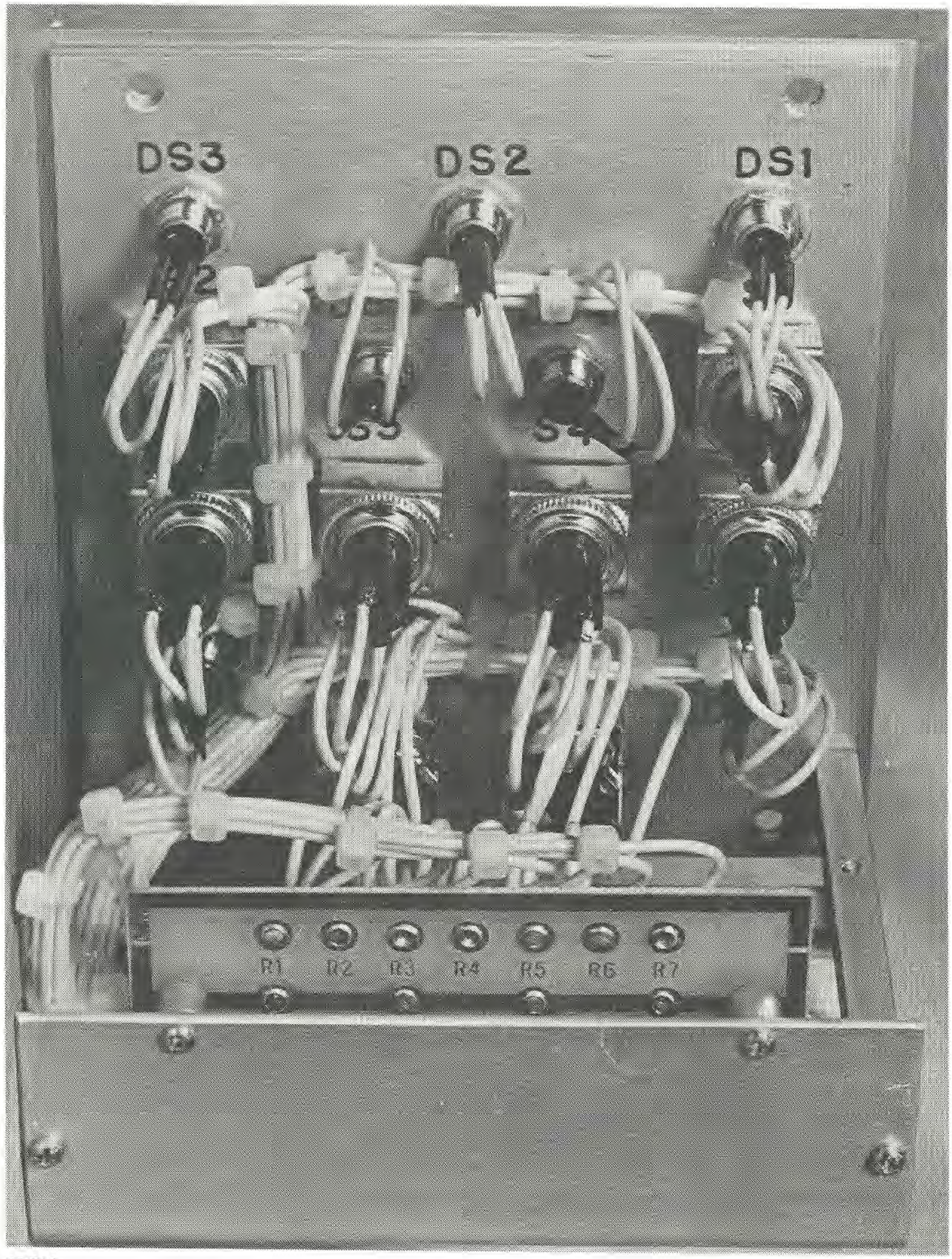
Figure 5-18. Plate Transformer Cabinet, Rear



80-910

Figure 5-19. Control Panel, Bottom

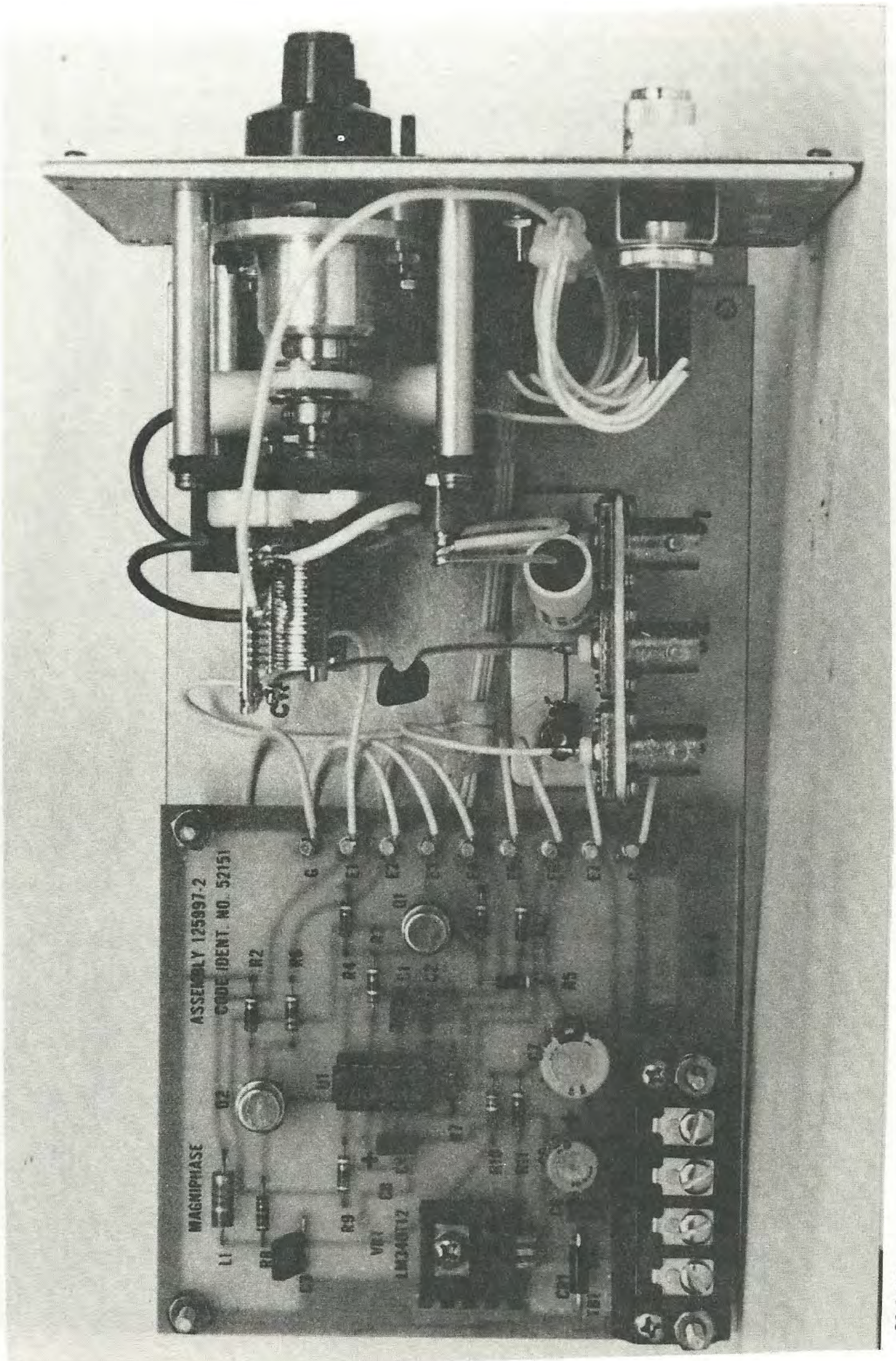
JS1-1-(16)



80-911

JS1-1-(15)

Figure 5-20. Control Panel, Rear



82-1045

Figure 5-21. Magniphase P.C. Card

REV A JS1-1(14)

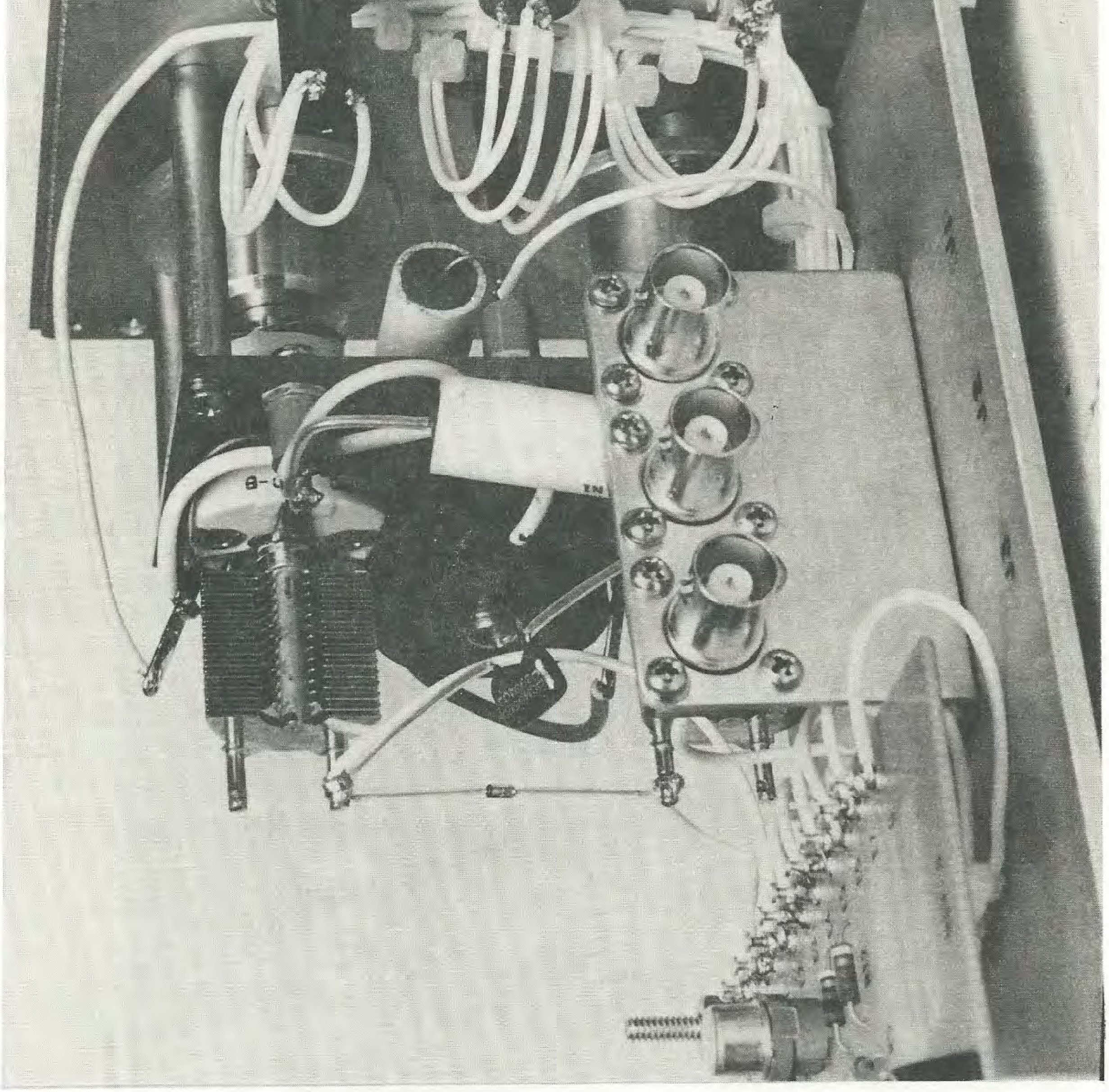
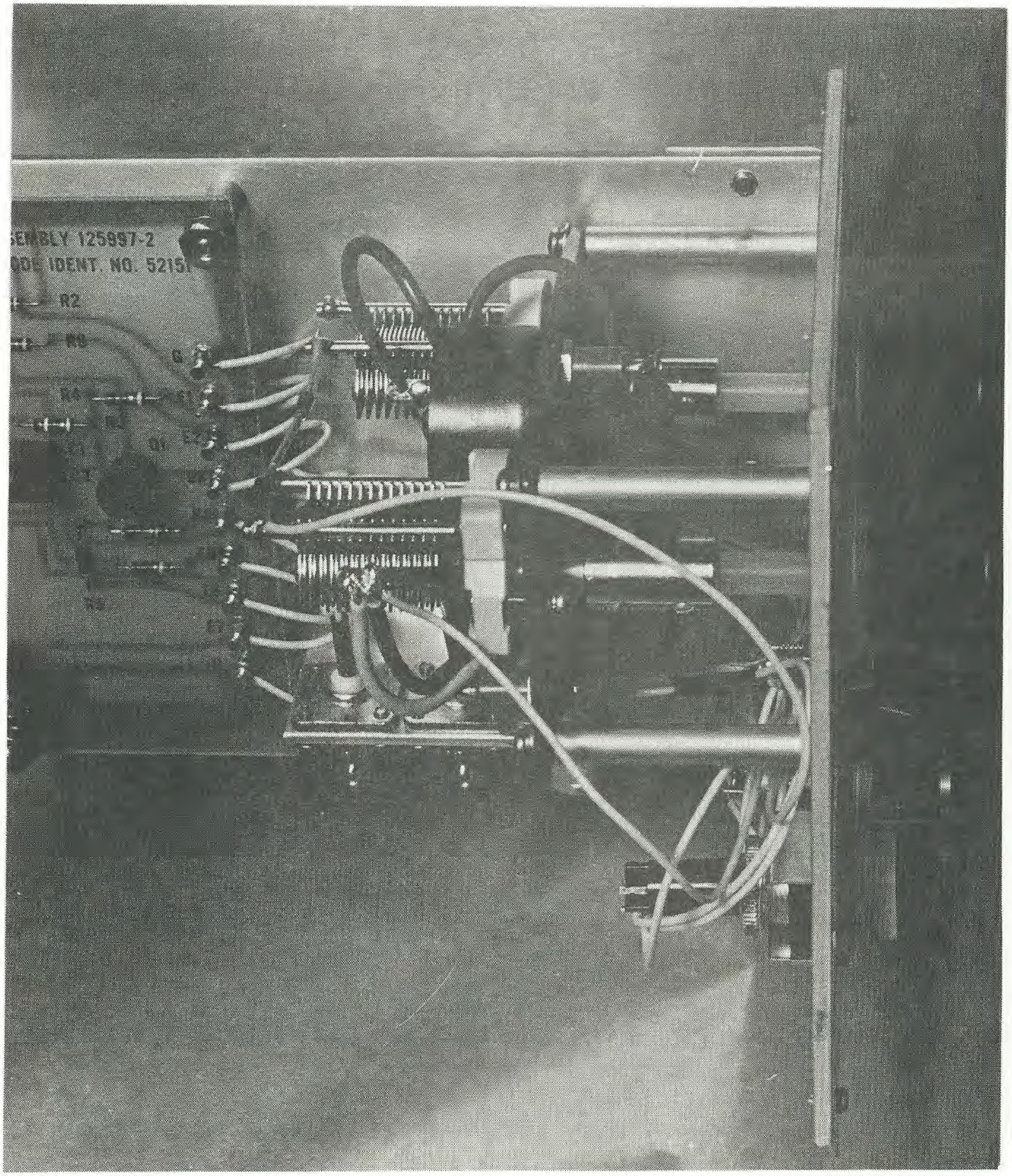


Figure 5-22. Magniphase Components, Side View

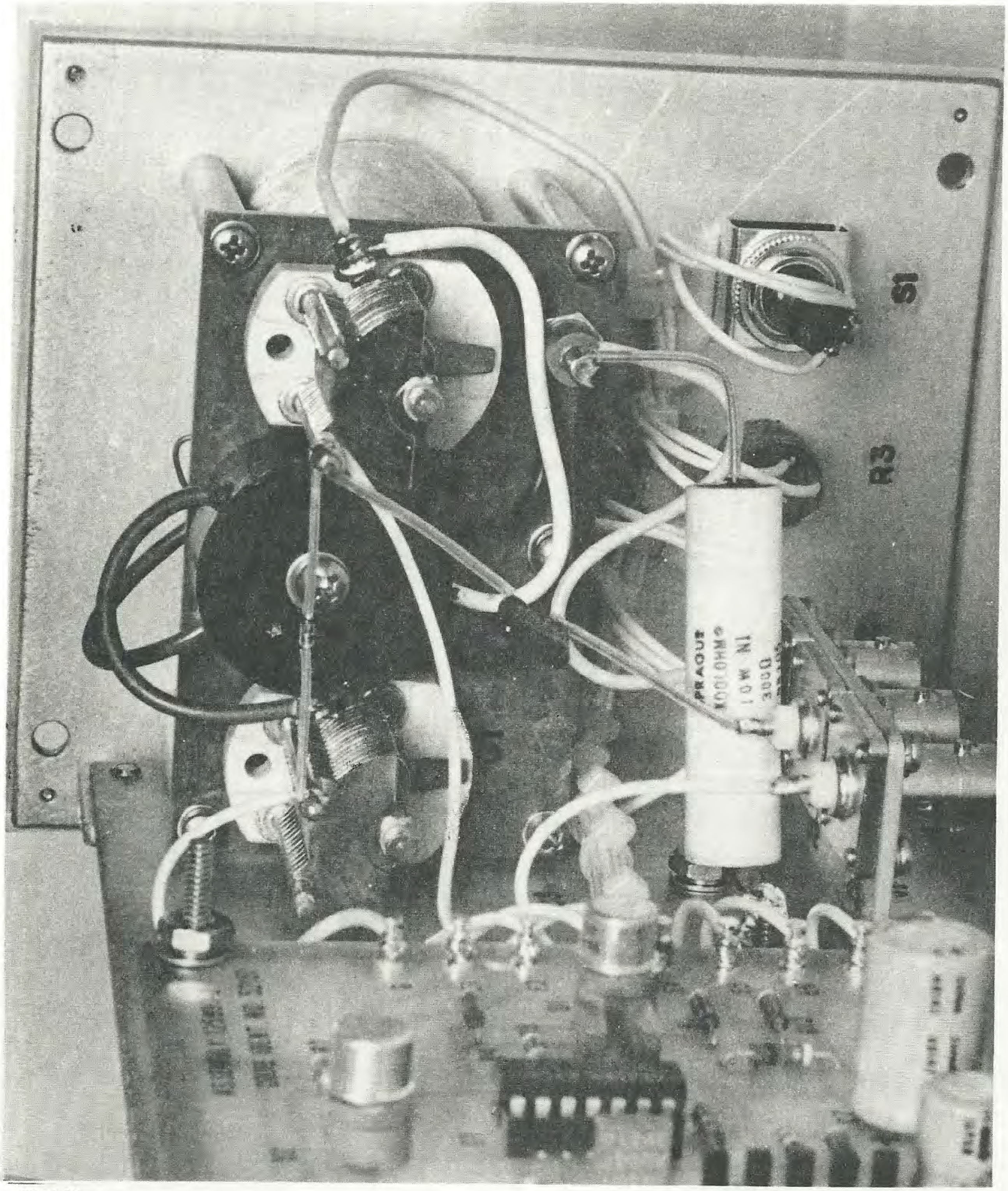
REV A JS1-1(18)



80-923

JS1-1-(13)

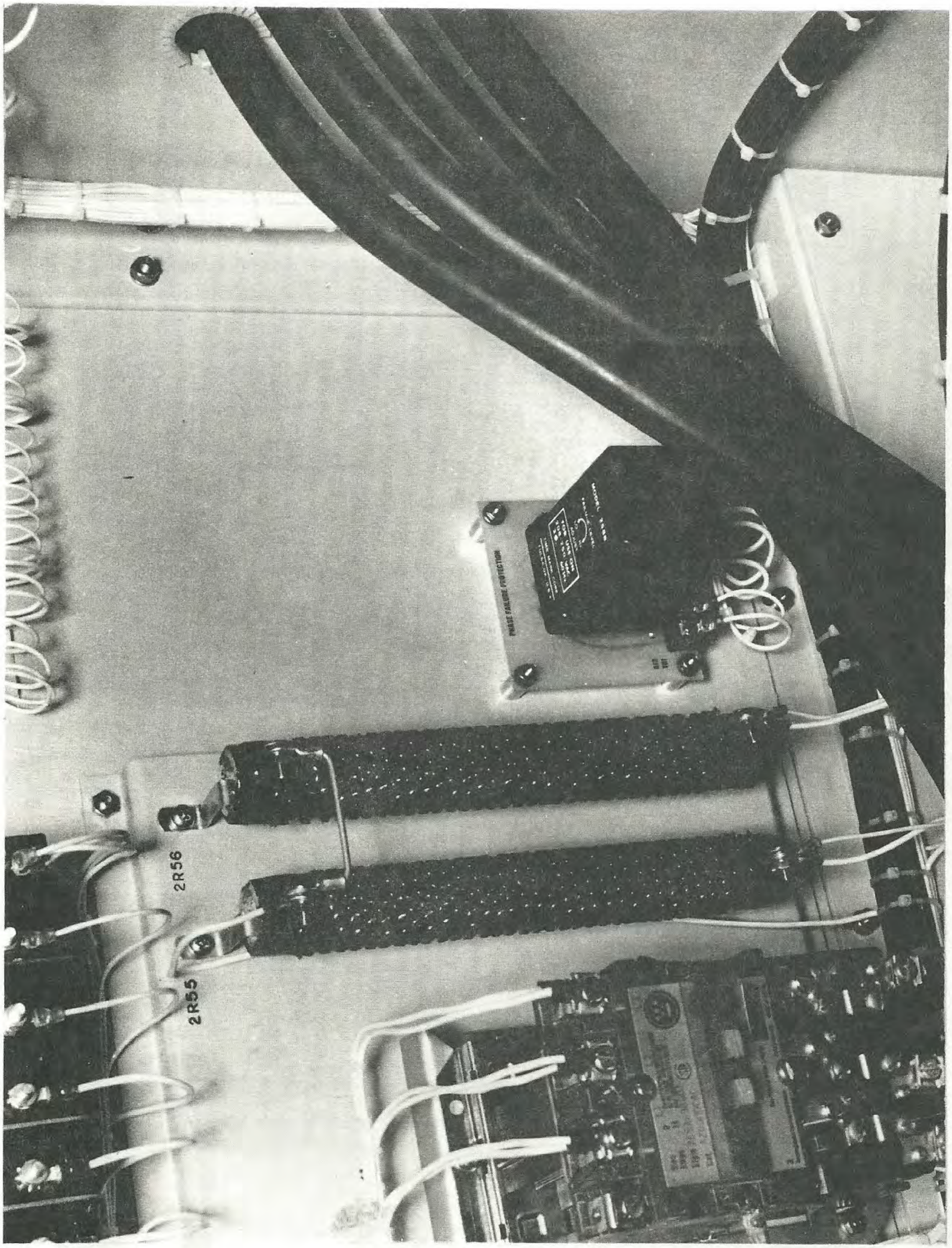
Figure 5-23. Magniphase Components, Top



82-1048

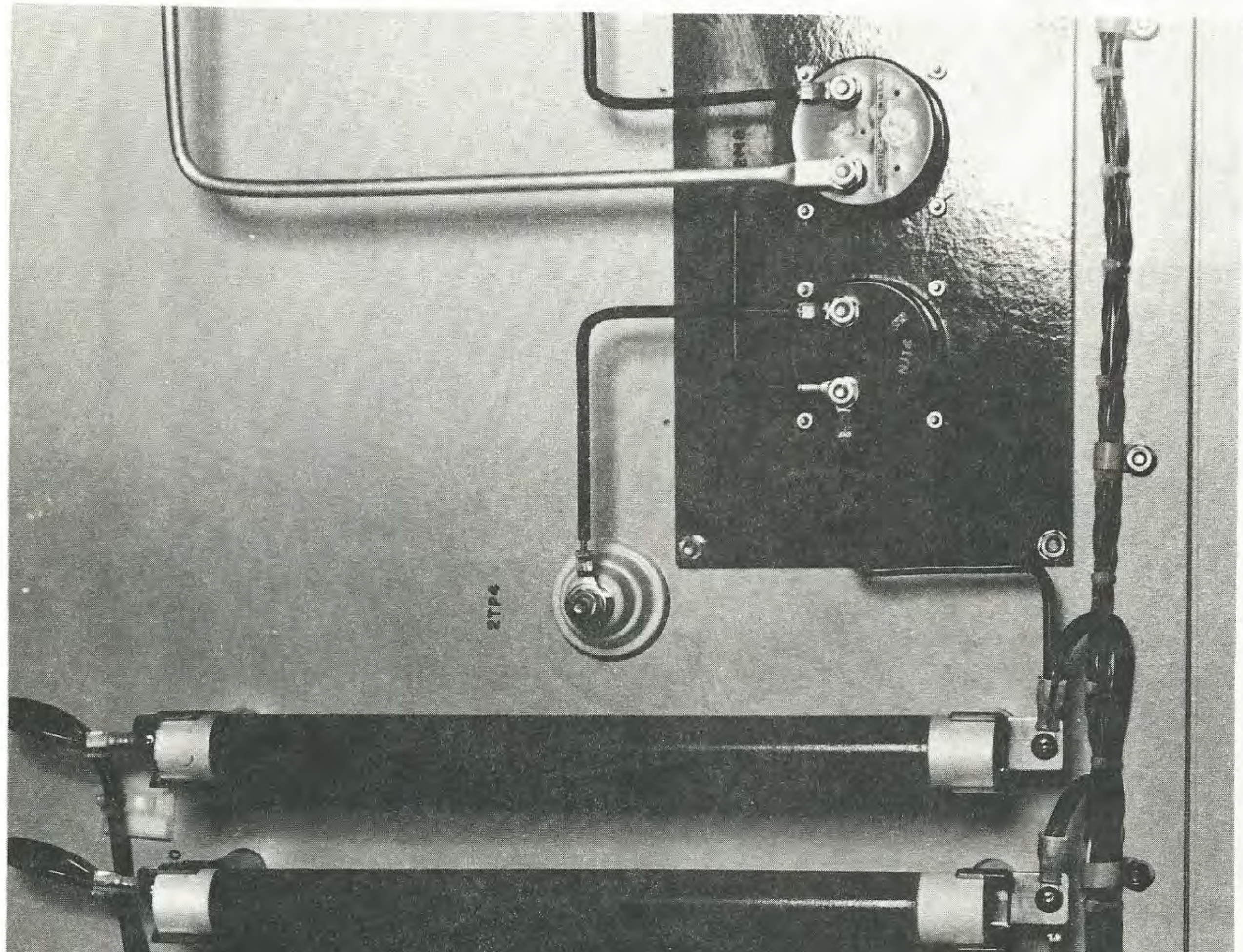
REV A JS1-1(12)

Figure 5-24. Magniphase, Rear



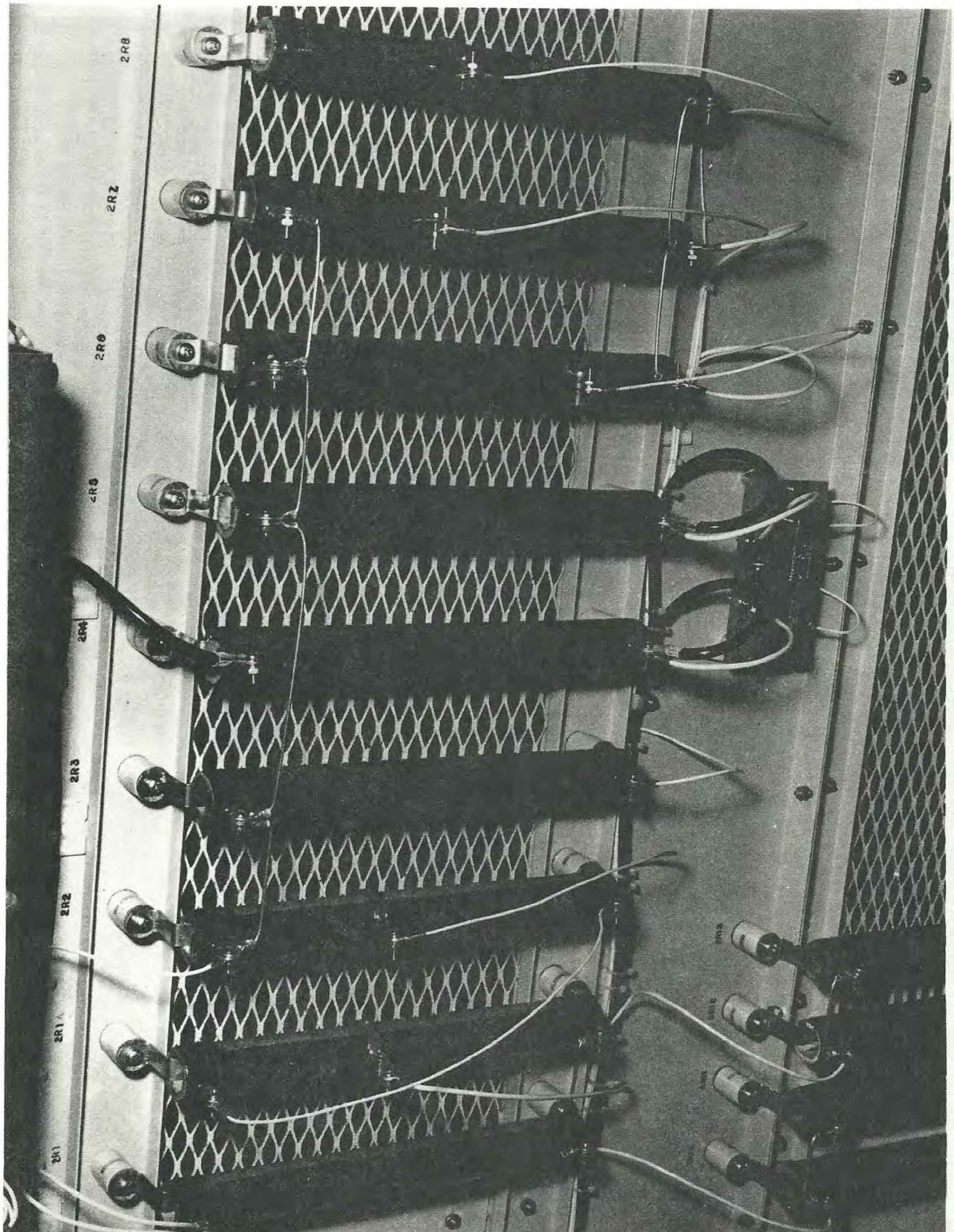
JS2-1(13) 82-175

Figure 5-25. Resistors 2R55 and 2R56.



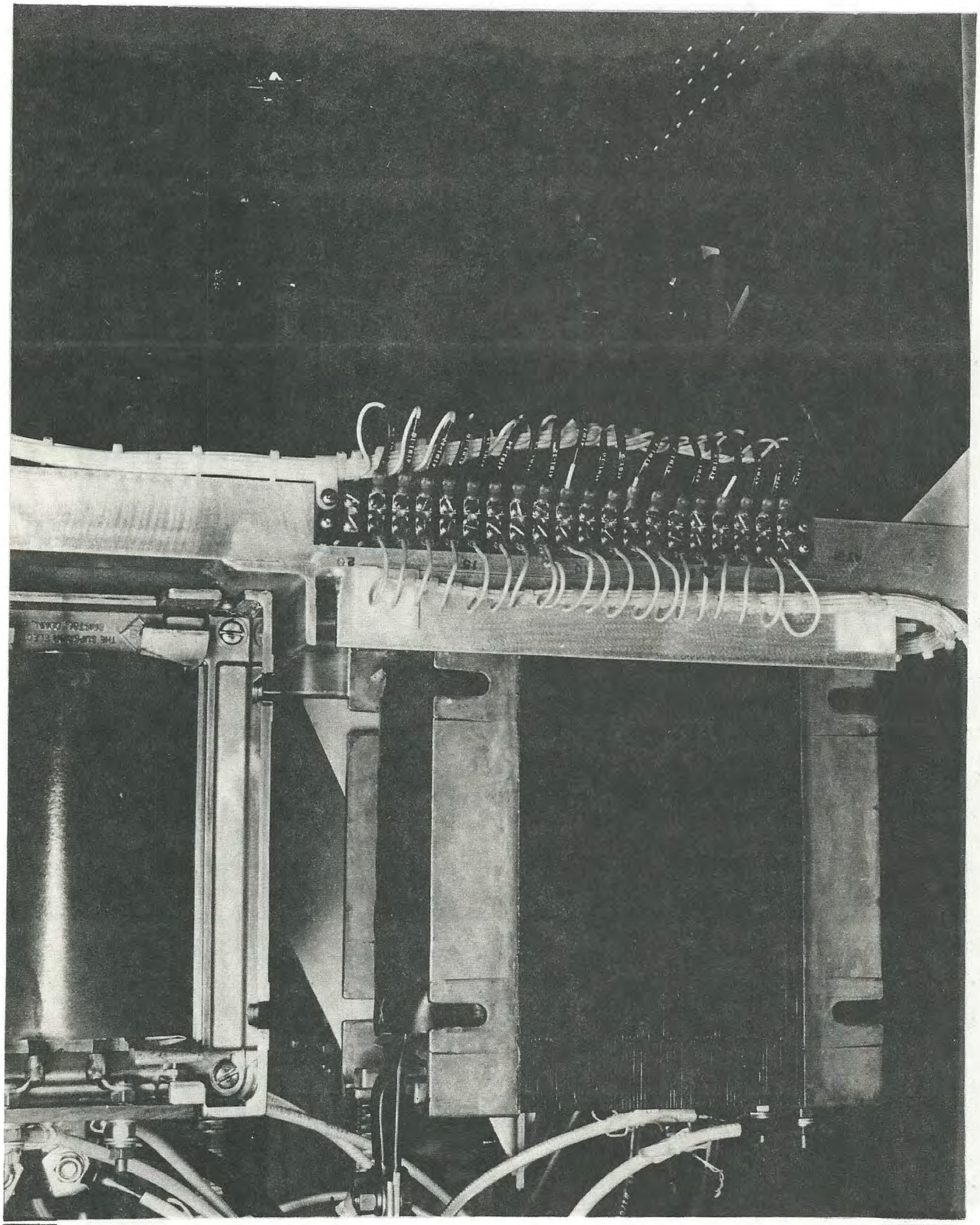
JS2-1(12) 82-172

Figure 5-26. Resistors 2R9 and 2R10.



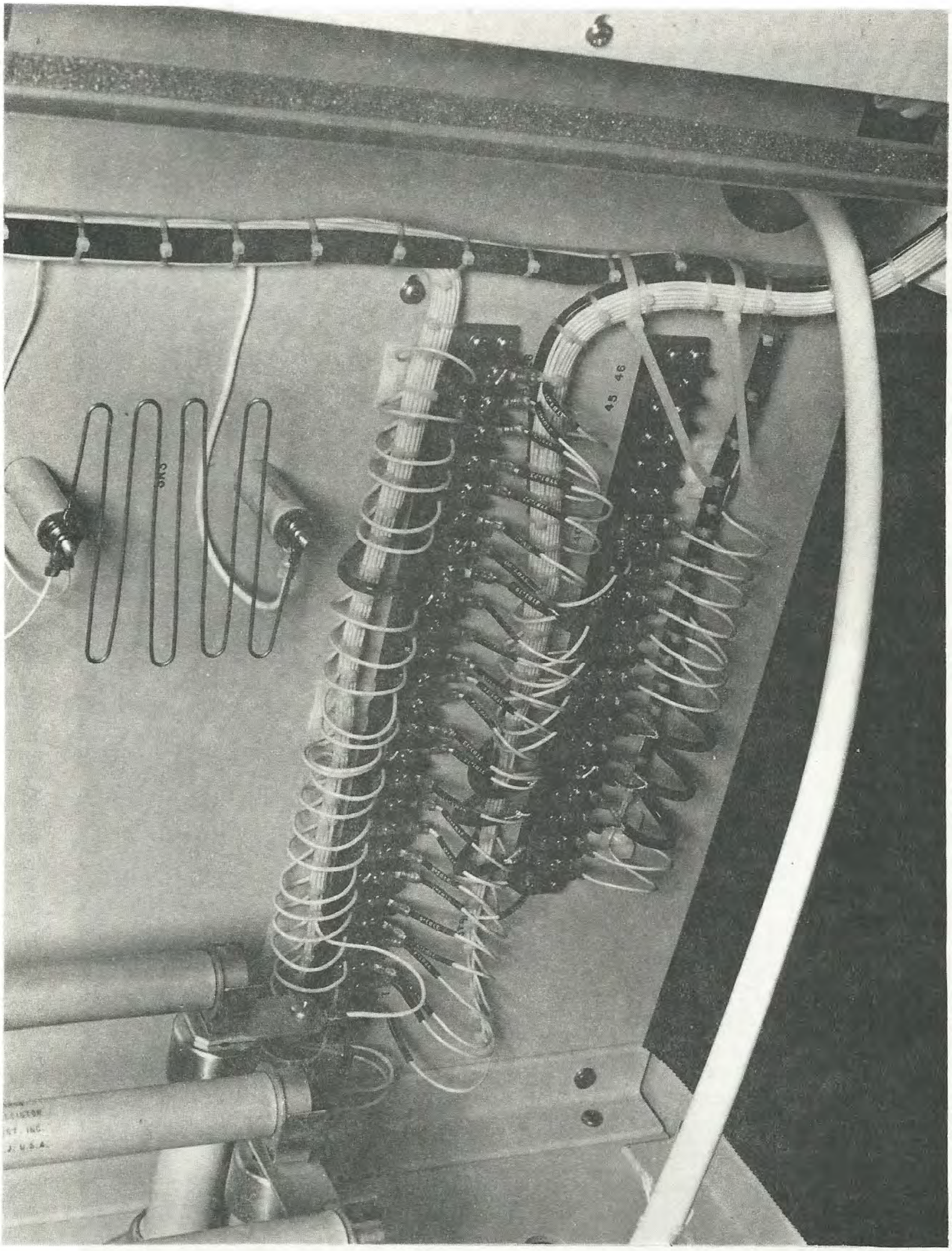
JS2-1(11) 82-173

Figure 5-27. Resistors 2R1 through 2R13



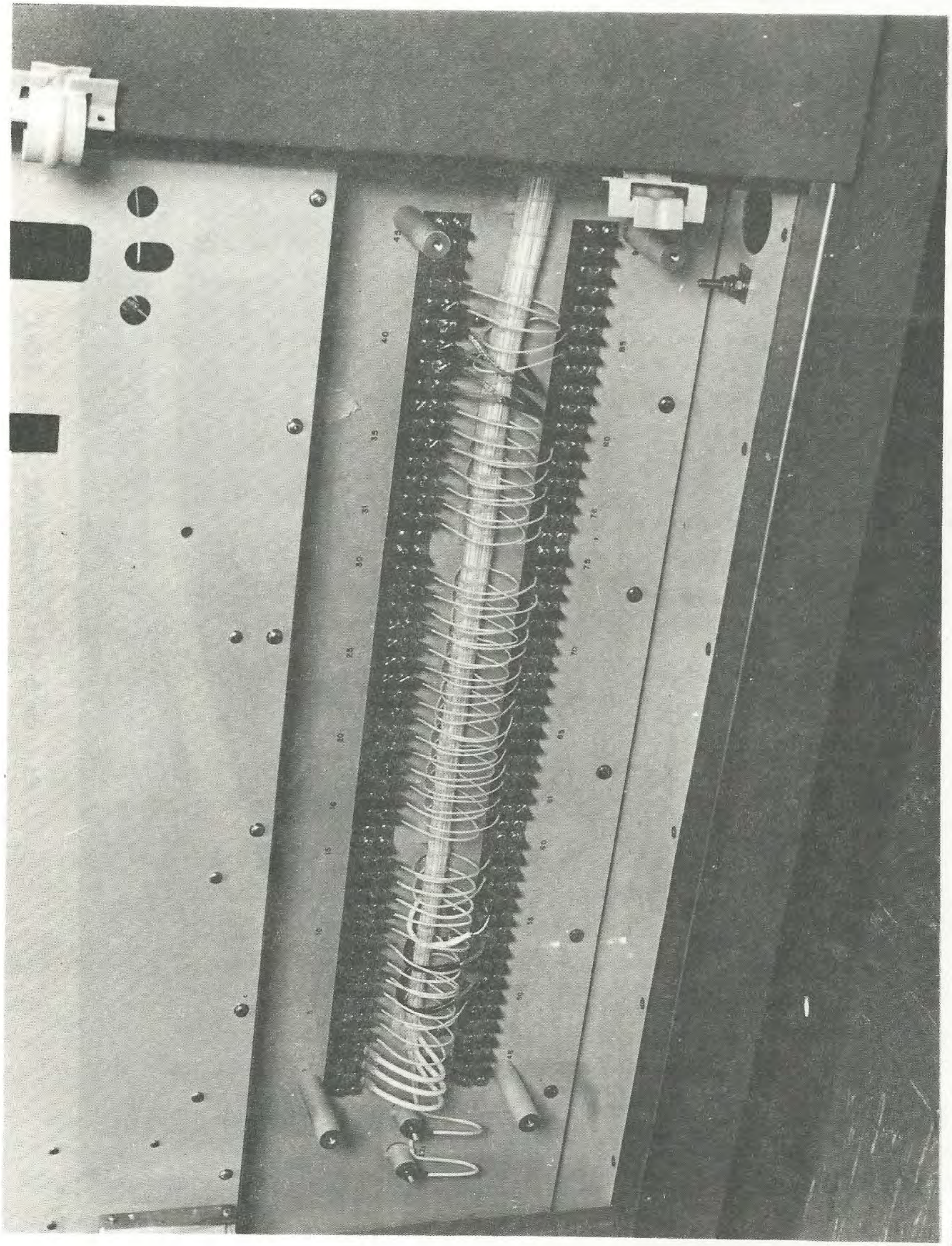
82-178 JS2-1(10)

Figure 5-28. Terminal Board 4TB1



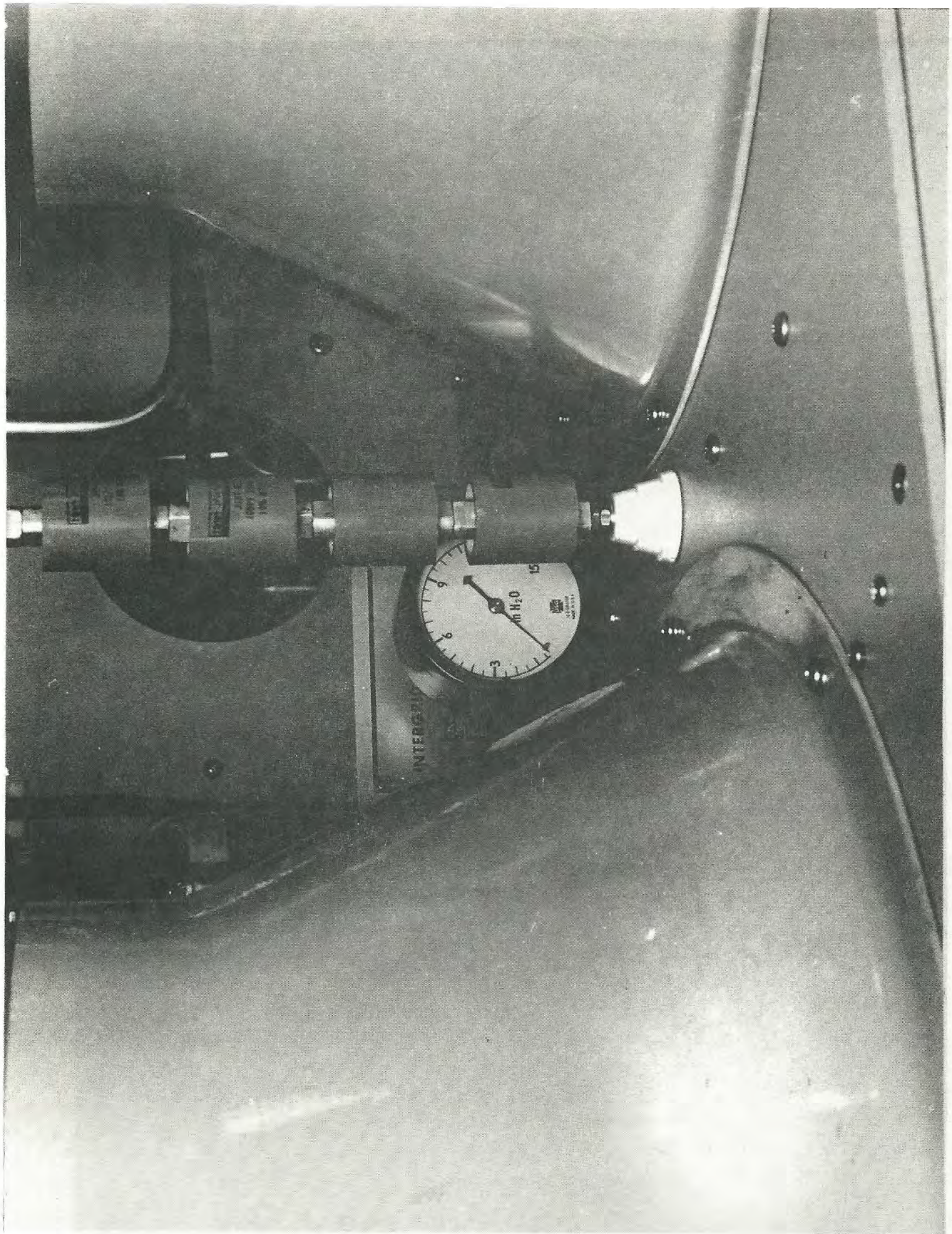
JS2-1(9) 82-176

Figure 5-29. Terminal Board 3TB1



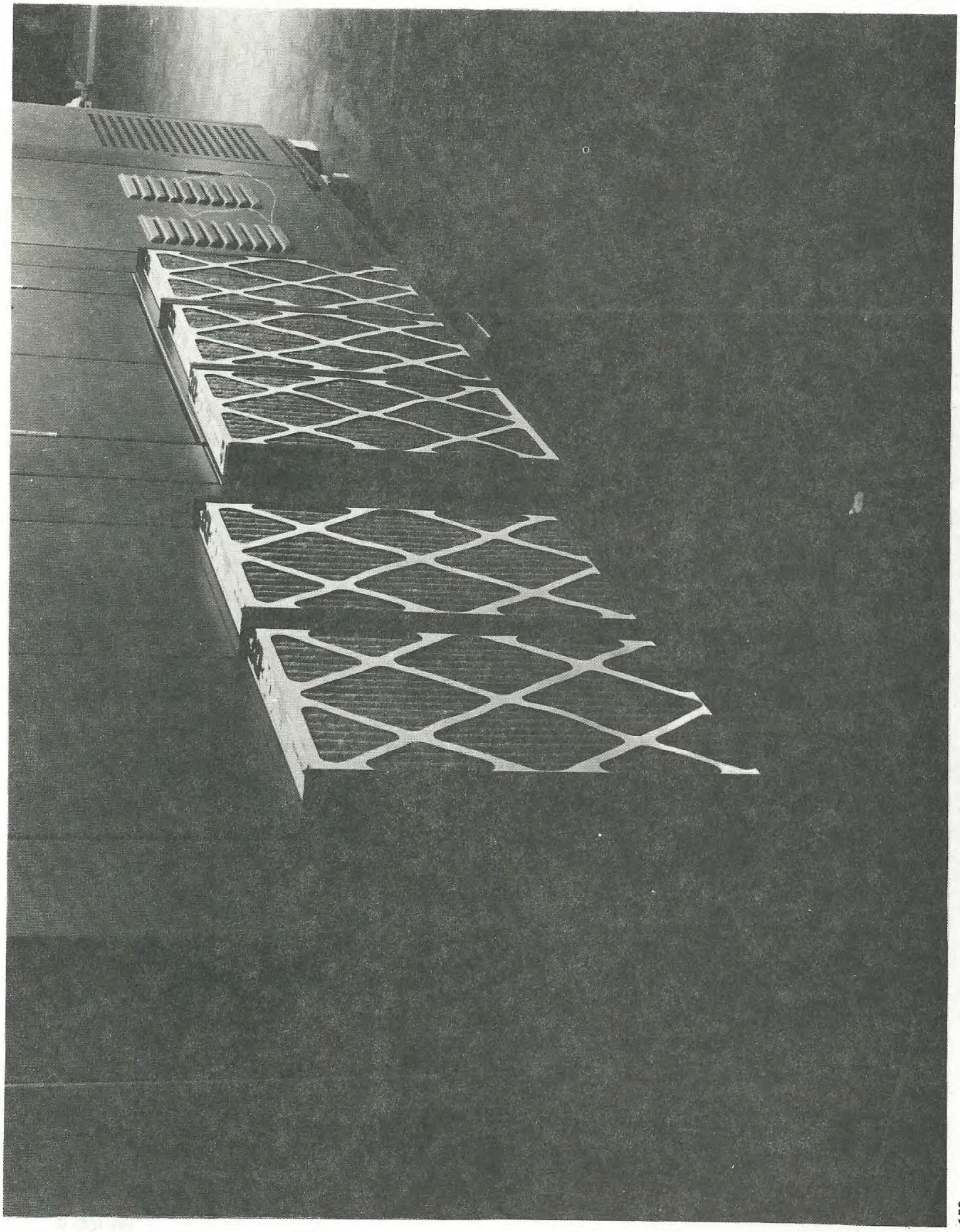
JS2-1(8) 82-174

Figure 5-30. Terminal Board 2TB1



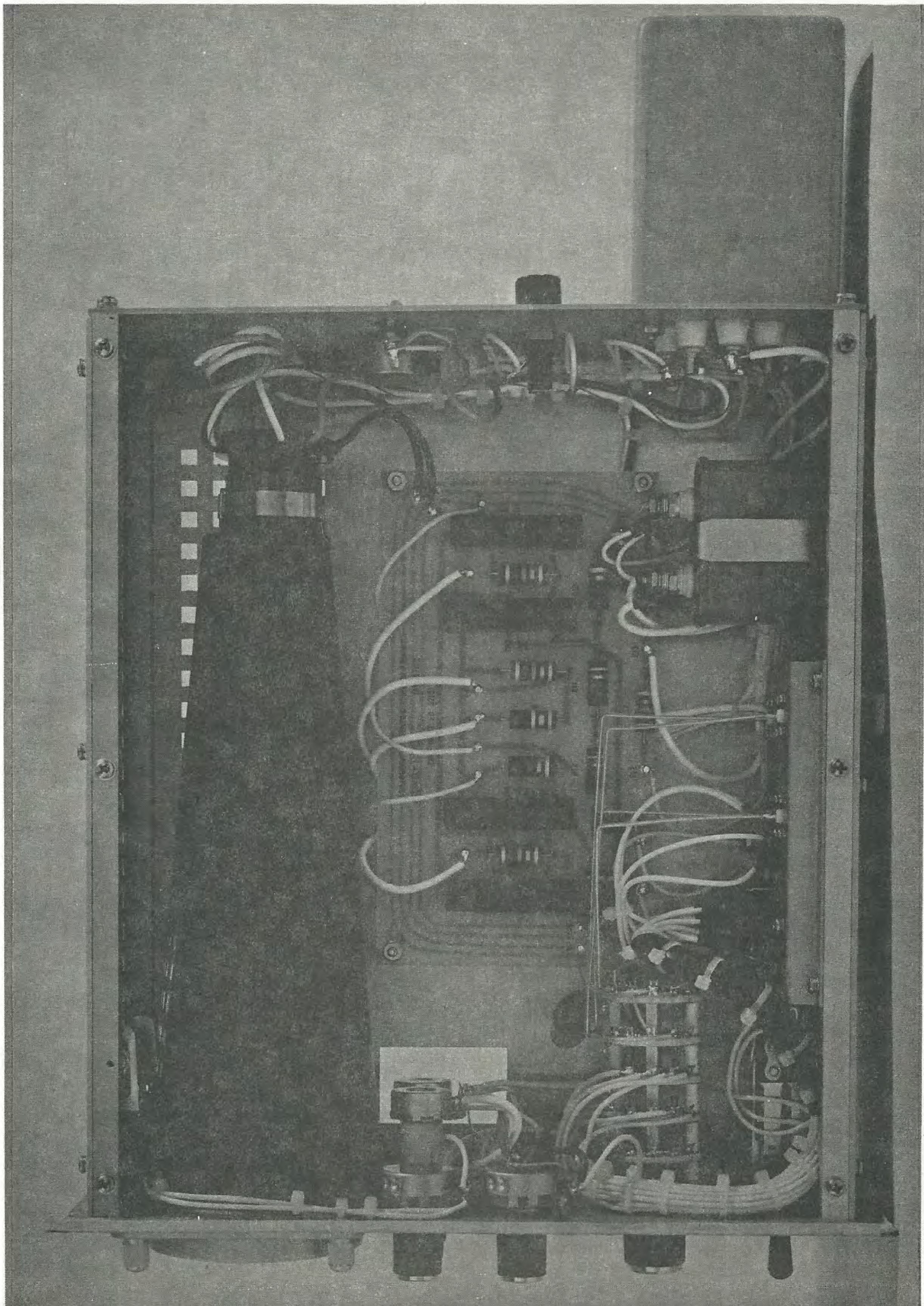
JS2-1(7) 82-171

Figure 5-31. PA Cabinet Pressure Indicator



JS2-1(6) 82-170

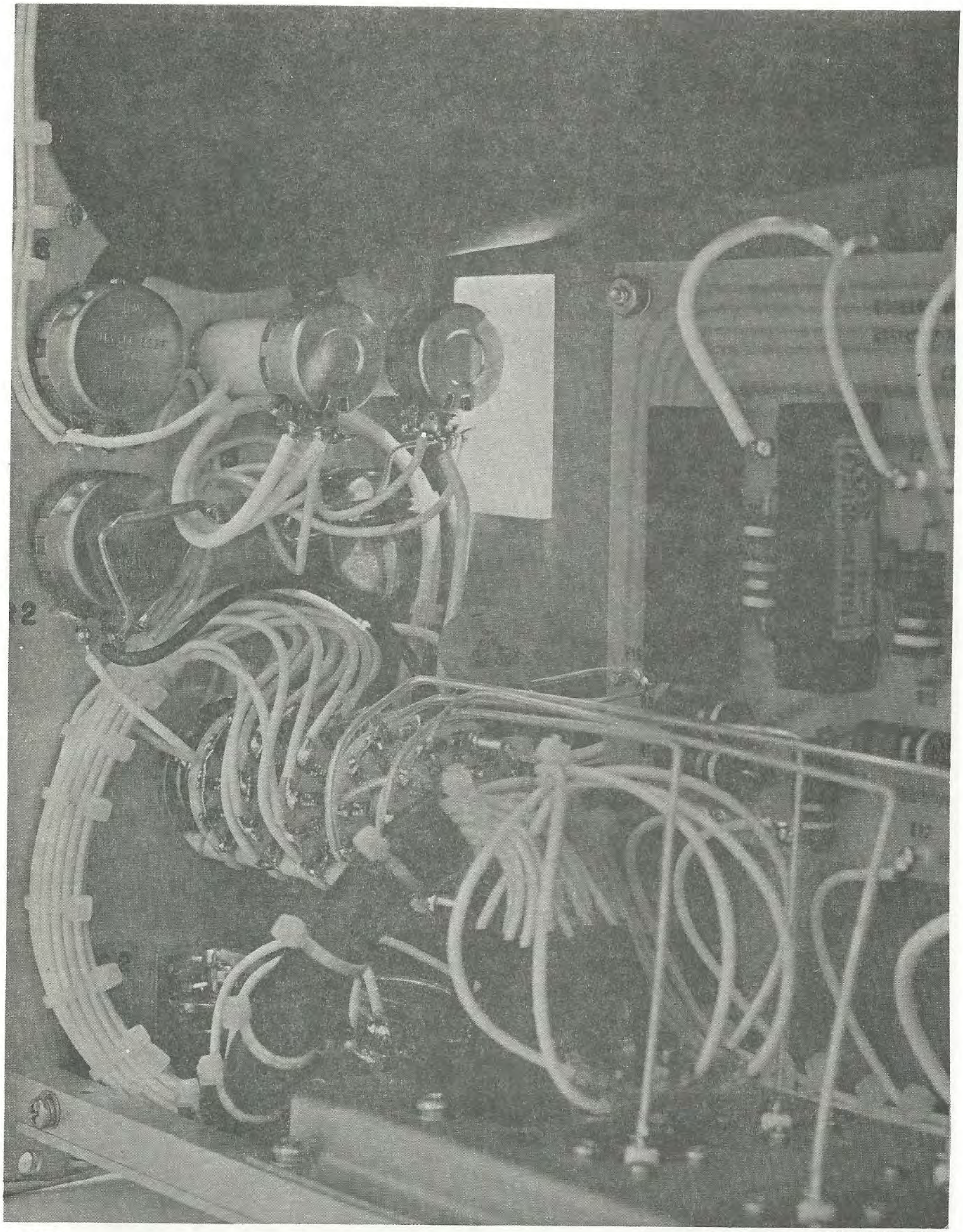
Figure 5-32. Transmitter Air Filter



84-0471

JS2-1(14) REV A

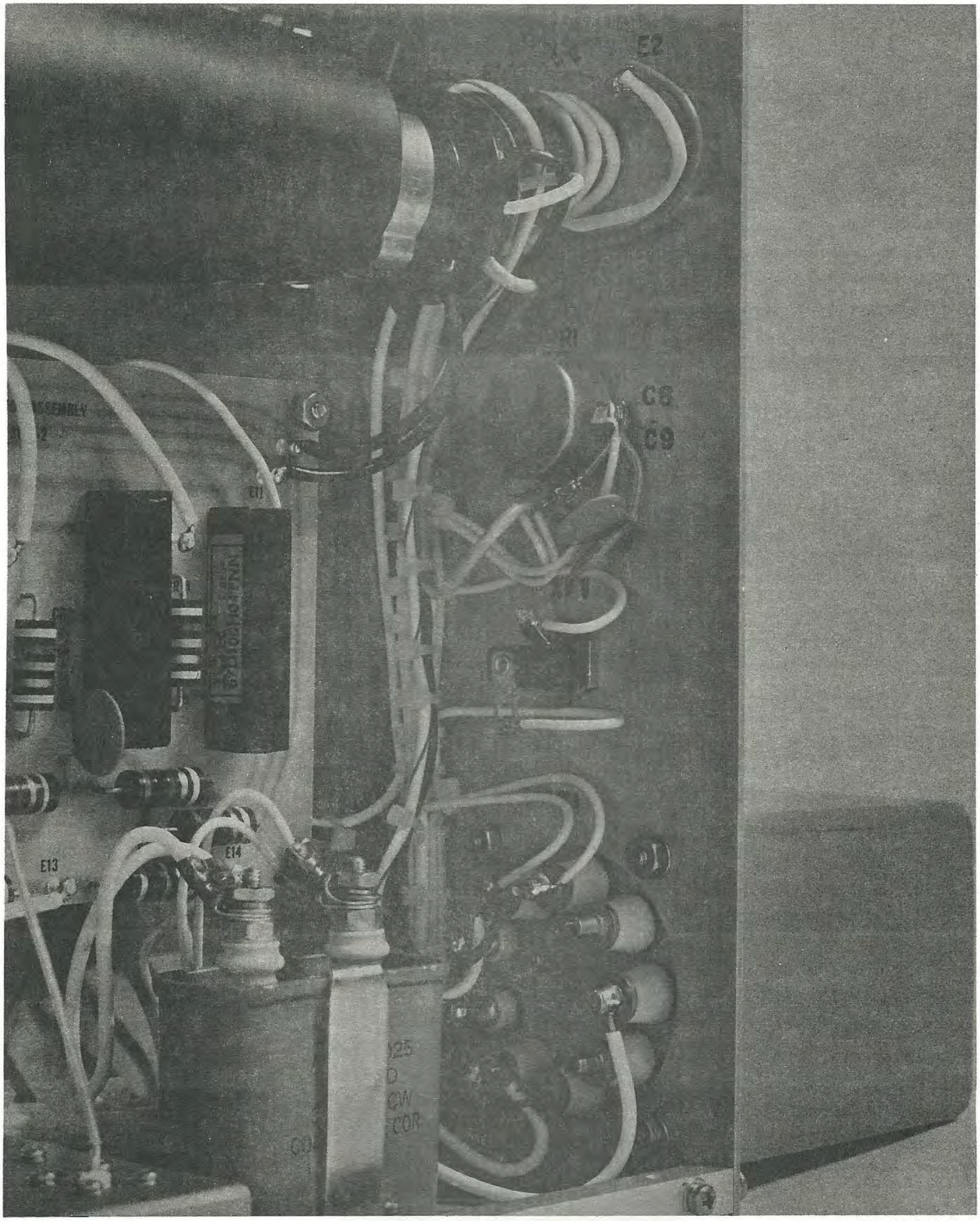
Figure 5-33. Oscilloscope, Right Side



84-0473

JS2-1(15) REV A

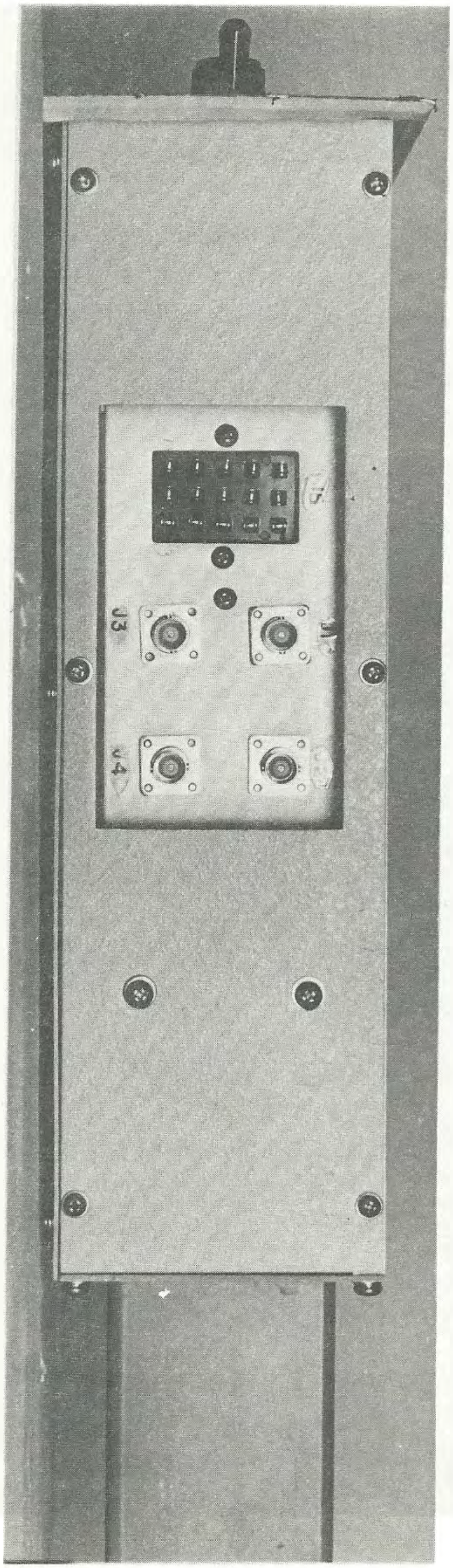
Figure 5-34. Oscilloscope, Right Side, Front



84-0472

JS2-1(16) REV A

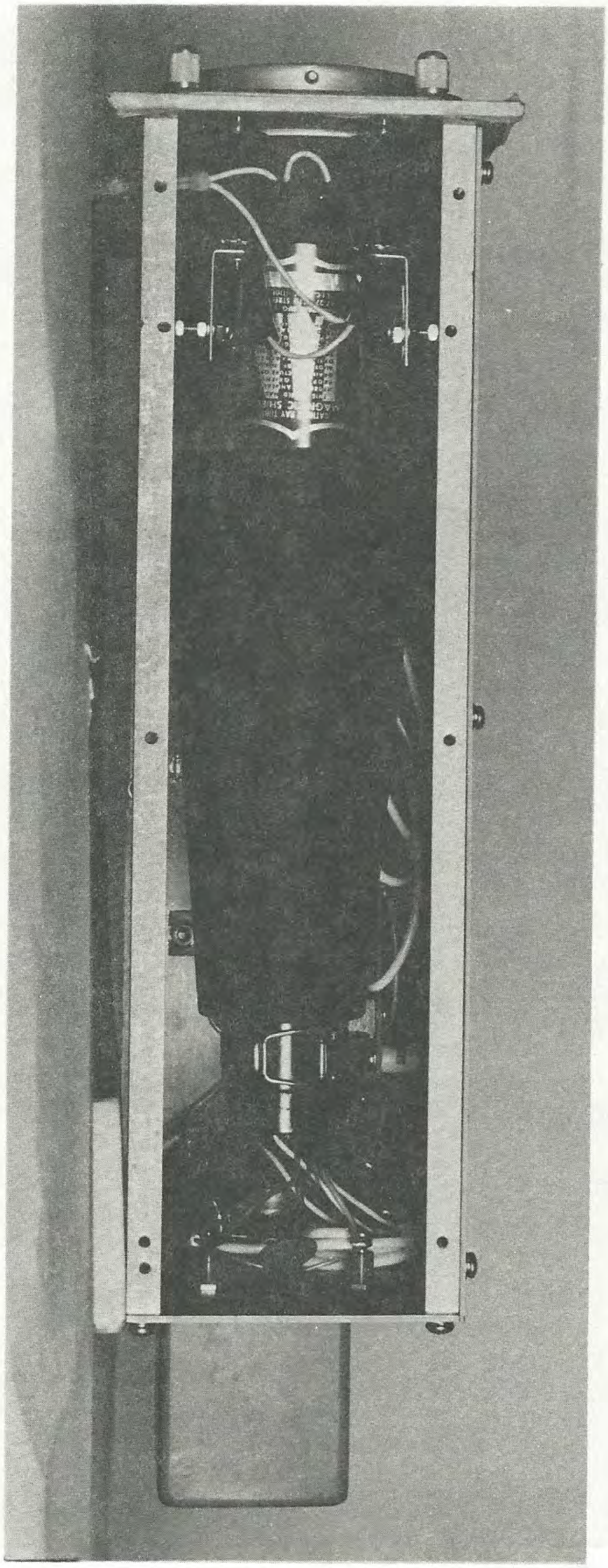
Figure 5-35. Oscilloscope, Right Side, Rear



82-207

JS2-1(16)

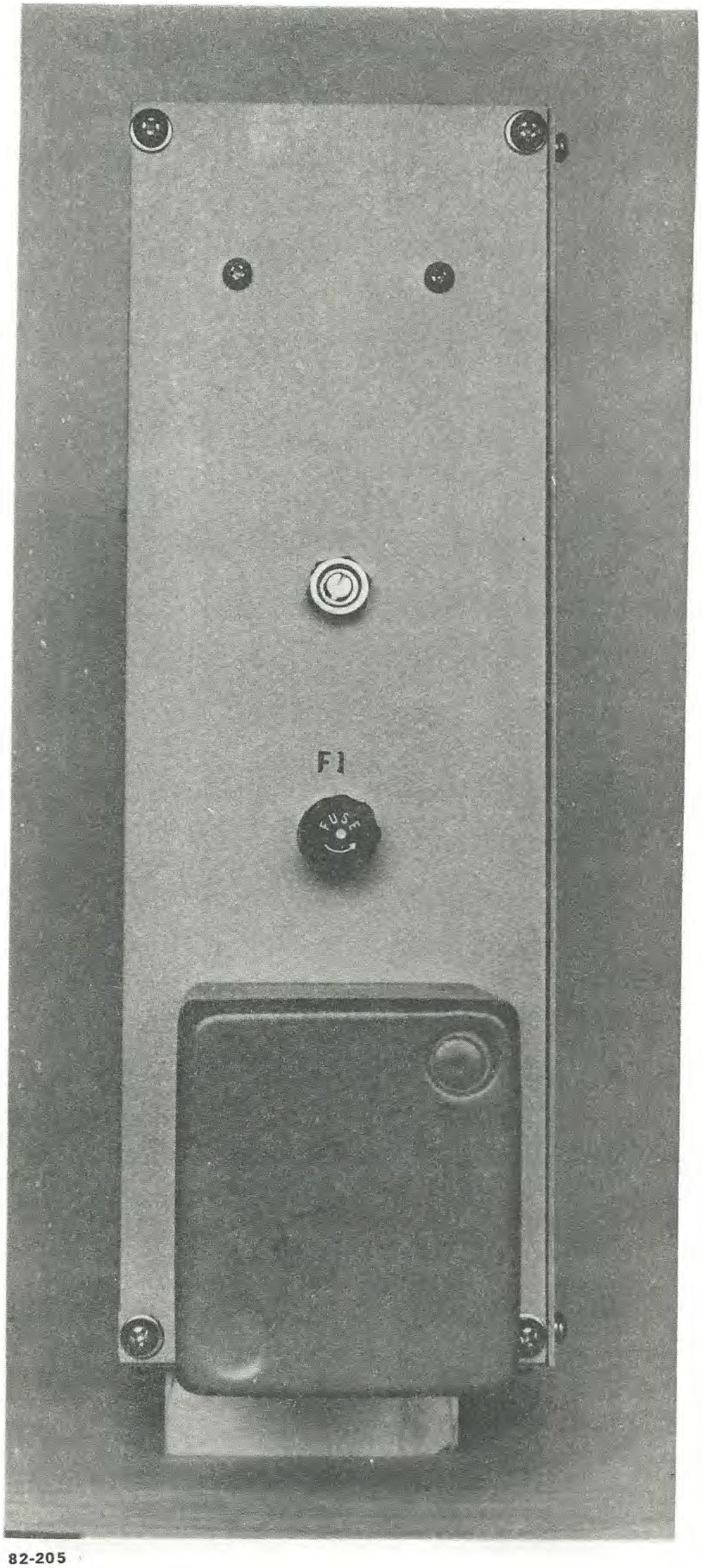
Figure 5-36. Oscilloscope, Bottom



82-206

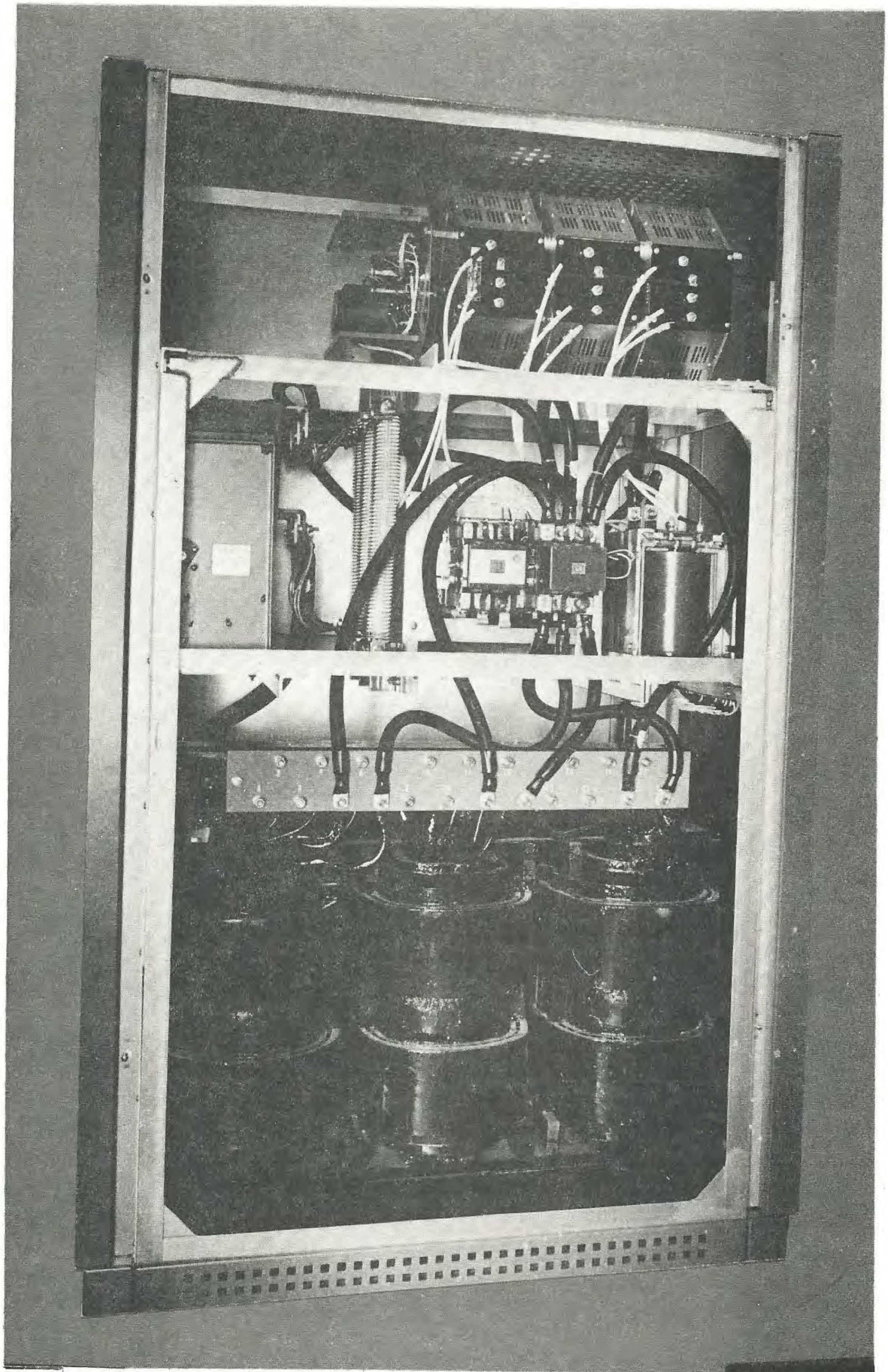
JS2-1(17)

Figure 5-37. Oscilloscope, Top



82-205

Figure 5-38. Oscilloscope, Rear

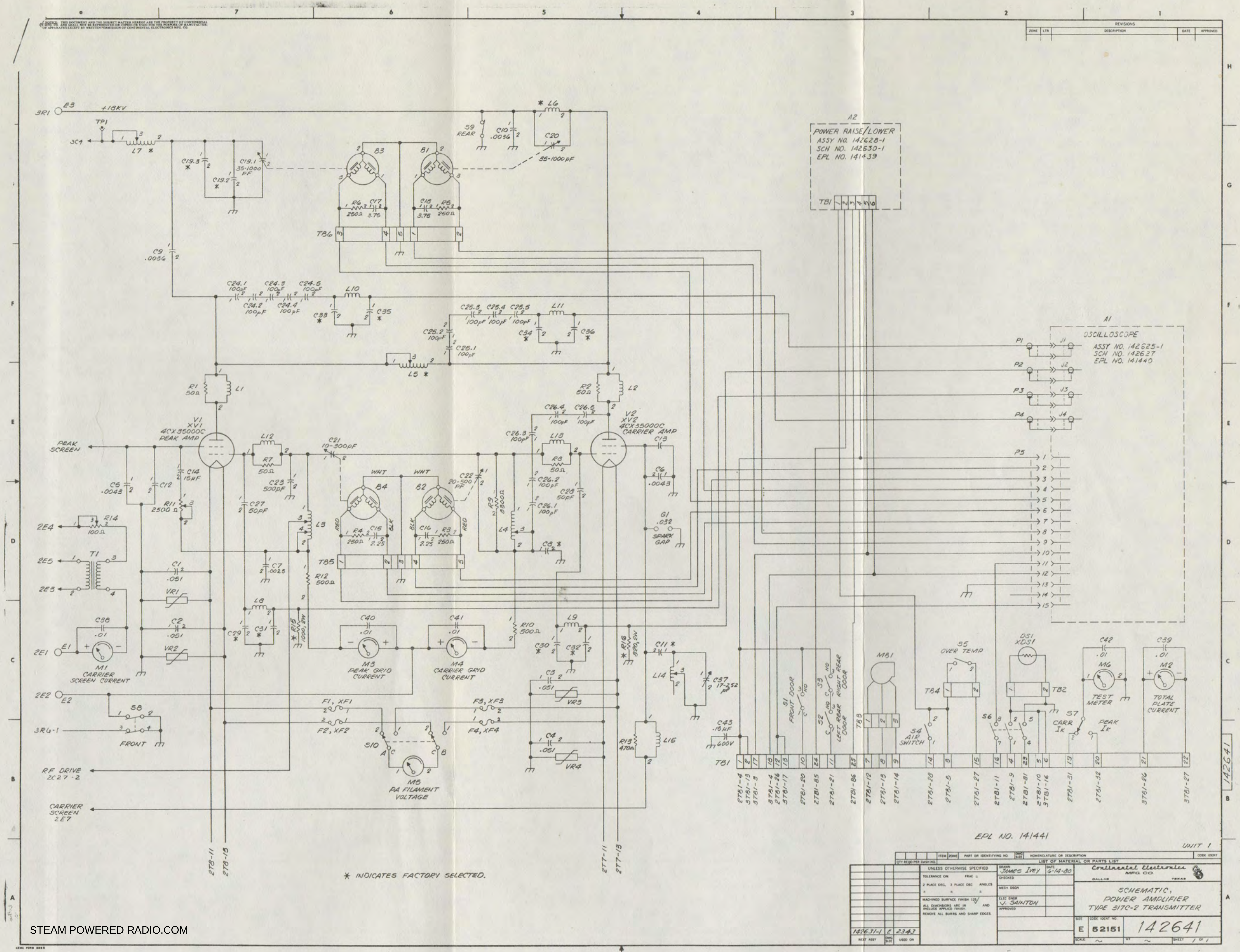


82-1051 JS2-1(21)

Figure 5-39. Plate Transformer Cabinet, Side View

TABLE 5-1. LIST OF SCHEMATICS

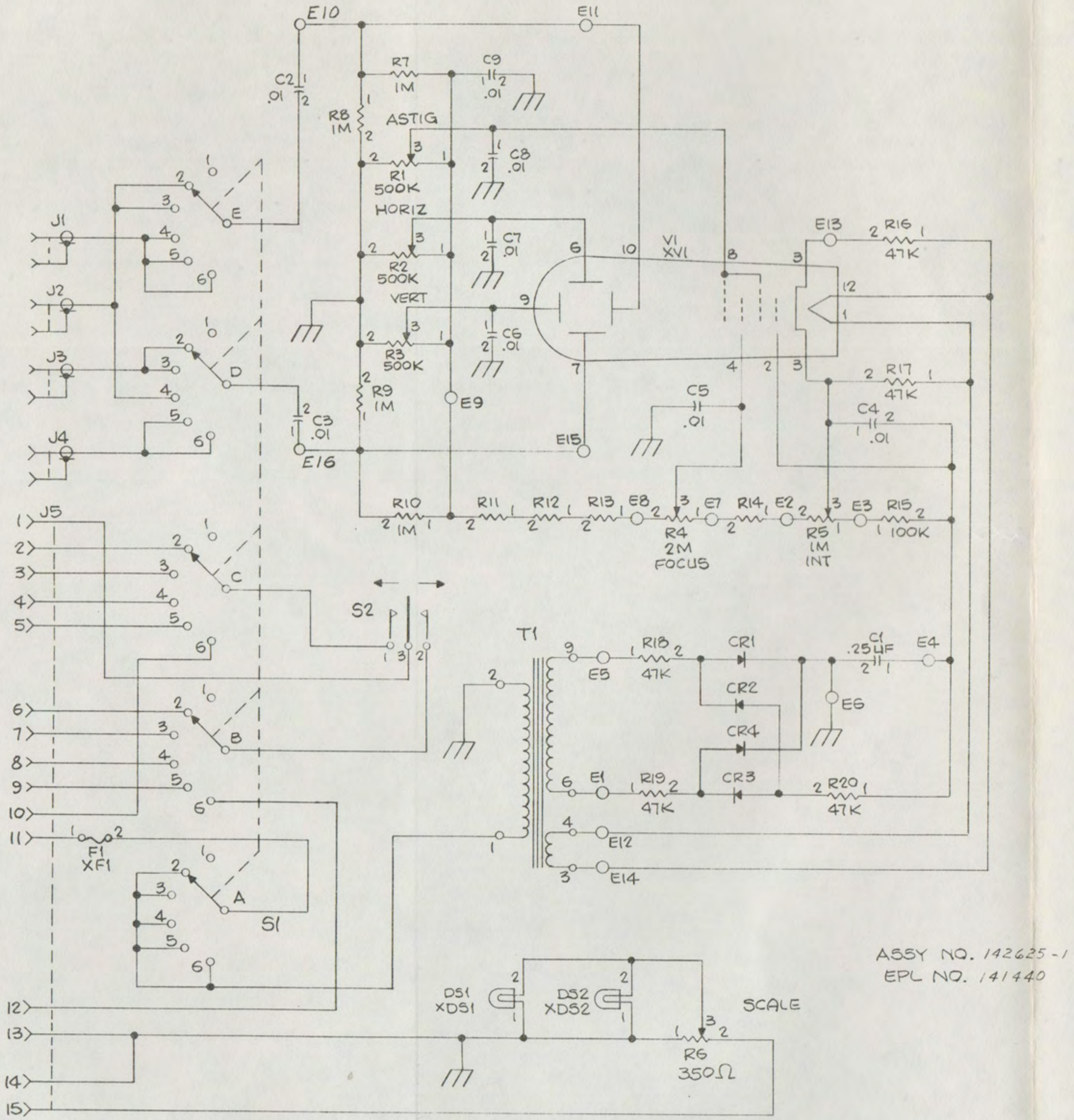
	Unit	Title	Drawing No.
	1	Power Amplifier	E142641
	1A1	Oscilloscope	D142627
	1A2	Remote Control Power Raise/Lower	D142630
*	2	Driver and Power Distribution	E142654
	2A1	RF Oscillator/Exciter	D142588
	2A2	Transmitter Start Control	E142591
	2A3	Low Voltage/Power Change Control	D142594
	2A4	Transmitter Plate Control	D142585
	2A5	Power Supply	C142597
	2A6	Magniphase Control	D142582
	2A7	Audio Amplifier	D142600
	2A8	Control Unit	D142603
	2A9	Hum Balancing Assembly	B142606
	2A10	Relay Assembly	C142609
	2A11	PA Overload Assembly	D142612
	2A13	Phase Failure Protection	B142618
	3	Rectifier and Harmonic Filter	E142643
	3A1	Magniphase Coupler	E142643
	3A2	Magniphase	C142621
	3A2A1	Magniphase Board	C142621
	4	Plate Transformer	D142644
*	-	Ladder (Control)	E142653
	-	Ladder (Power Change)	C142638
	-	Lamp Ladder	D142636
	-	Plate & Screen Ladder	C142637
	-	Terminal Layout/Relay & Contactors	D142635
	-	Excitation & Audio Cutoff Ladder	D142639
*	-	Ladder (External Connections)	D142646
	-	Magniphase Totalizer (OPTIONAL)	B142408



STEAM POWERED RADIO.COM

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
B6	A	REVERESED CATHODE OF CR4	4-2-84	IVEY



ASSY NO. 142625-1
EPL NO. 141440

ITEM	ZONE	PART OR IDENTIFYING NO	DWG SIZE	NOMENCLATURE OR DESCRIPTION	CODE IDENT

QTY REQD PER DASH NO — LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	DWG SIZE	USED ON
142625	D	2343

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: SKIP KOWAL — DATE: 8-6-82
CHECKED
MECH DSGN
ELEC ENGR
APPROVED

Continental Electronics MFG. CO.
DALLAS TEXAS

SCHEMATIC, OSCILLOSCOPE

SIZE: D — CODE IDENT NO: 52151 — 142627
SCALE: — WT SHEET OF

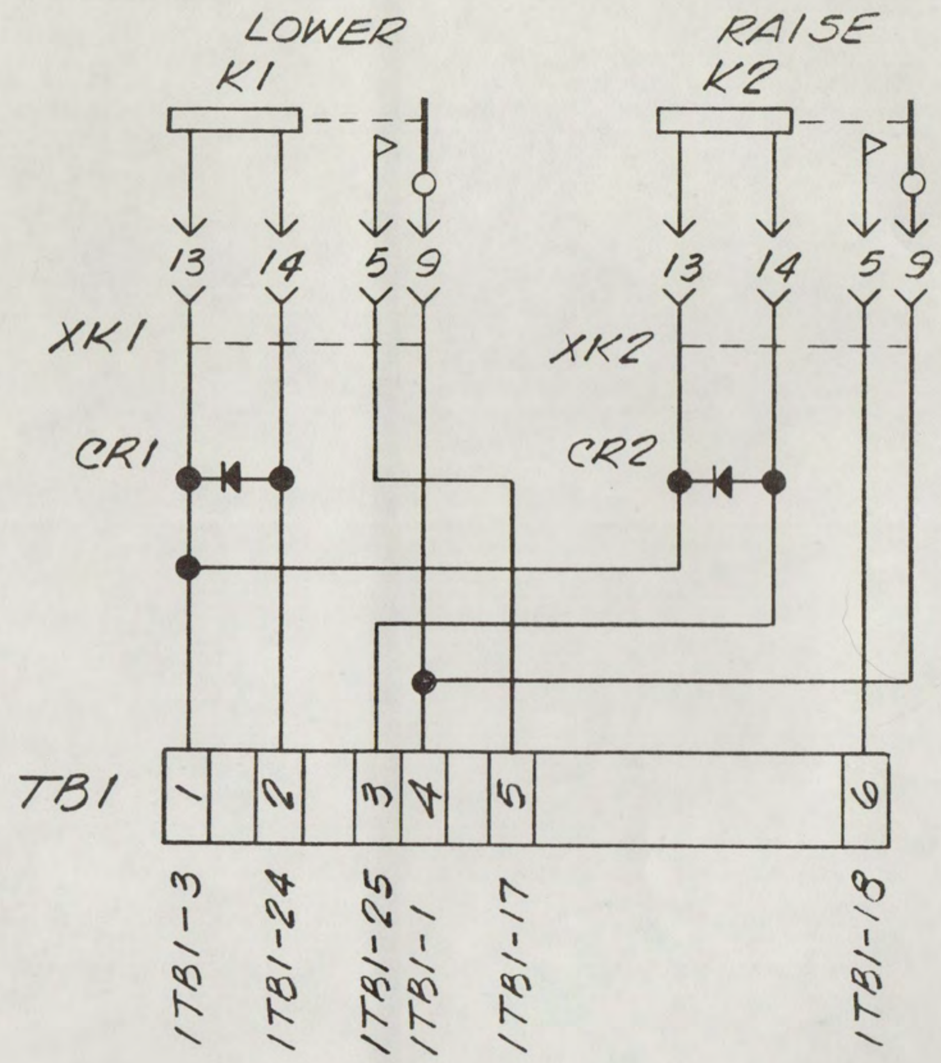
142627

STEAM POWERED RADIO.COM

C.WC FORM 3678

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

142630



EPL NO. 141439

1A2

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

NEXT ASSY	DWG SIZE	USED ON
142628		2343

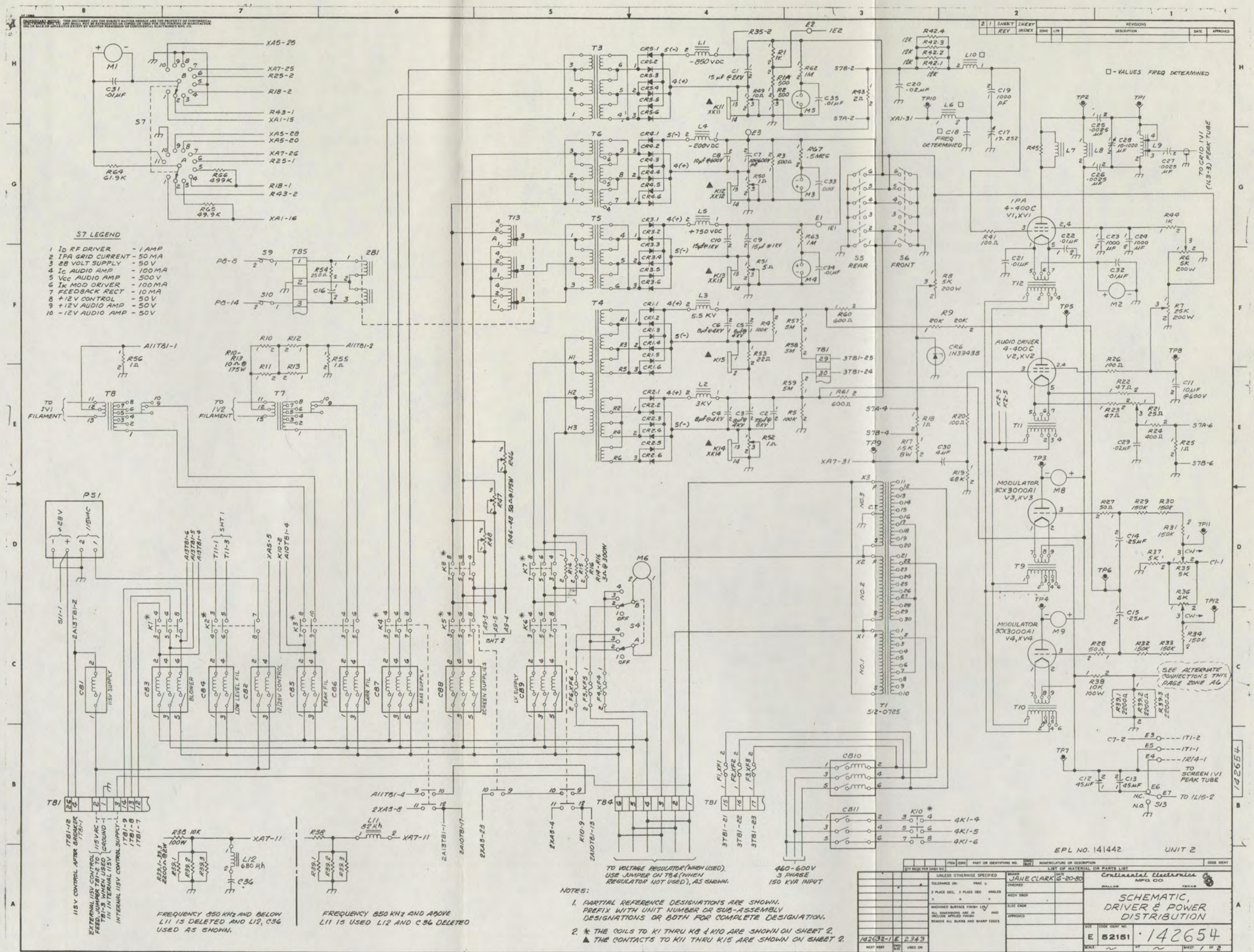
UNLESS OTHERWISE SPECIFIED
TOLERANCE ON: FRAC ± 2 P DEC ± 3 P DEC ± ANGLES ±
MACH. SURFACE FIN. 125√
ALL DIM. ARE IN AND INCLUDE APPLIED FIN.
REMOVE ALL BURRS AND SHARP EDGES.

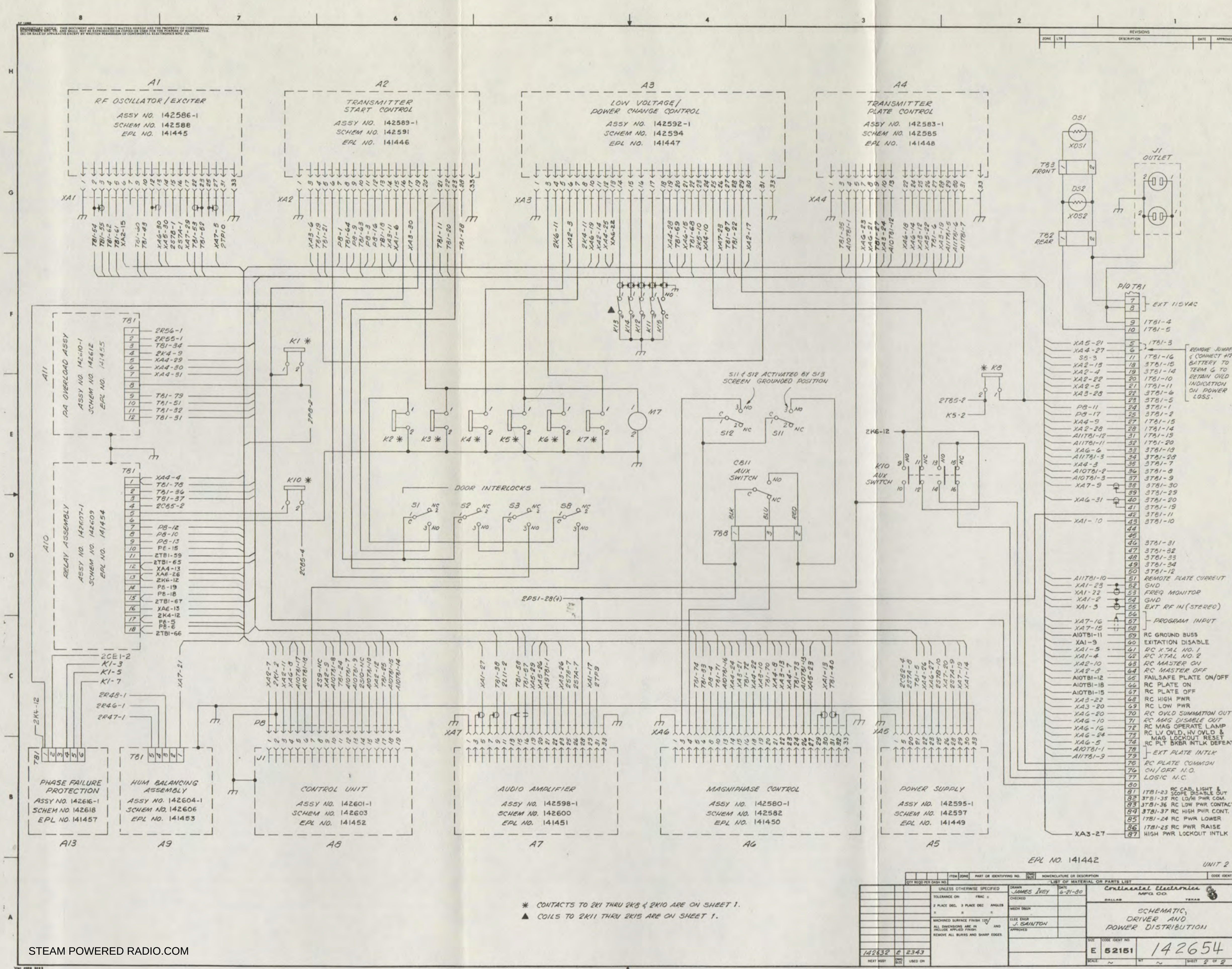
		DATE
DRAWN	IVEY	3-15-83
CHECKED		
ENGR		

Continental Electronics MFG. CO.
DALLAS TEXAS

SCHEMATIC, REMOTE CONTROL POWER RAISE/LOWER

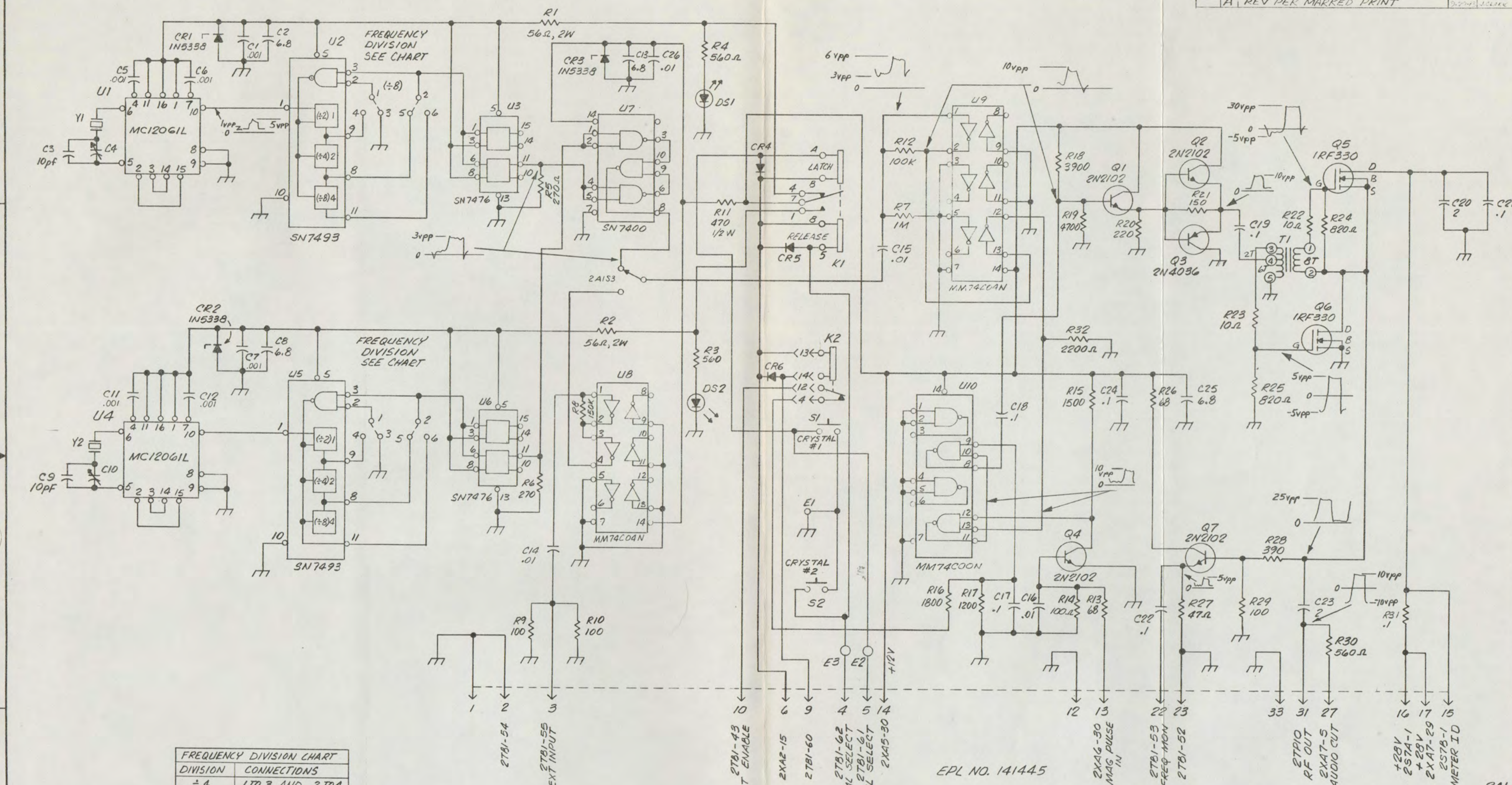
SIZE	CODE IDENT NO.	
B	52151	142630
SCALE: ~	WT ~	SHEET 1 OF 1


S7 LEGEND
1 ID RF DRIVER - 1 AMP
2 IPA GRID CURRENT - 50 MA
3 28 VOLT SUPPLY - 50 V
4 IC AUDIO AMP - 100 MA
5 Vcc AUDIO AMP - 500 V
6 IK MOD DRIVER - 100 MA
7 FEEDBACK RECT - 10 MA
8 +12V CONTROL - 50 V
9 +12V AUDIO AMP - 50V
10 -12V AUDIO AMP - 50V
□-VALUES FREQ DETERMINED
FREQUENCY 850 KHz AND BELOW L11 IS DELETED AND L12, C36 USED AS SHOWN.
FREQUENCY 850 KHz AND ABOVE L11 IS USED L12 AND C36 DELETED
TO VOLTAGE REGULATOR (WHEN USED). USE JUMPER ON TB4 (WHEN REGULATOR NOT USED), AS SHOWN.
460-600V 3 PHASE 150 KVA INPUT
NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH UNIT NUMBER OR SUB-ASSEMBLY DESIGNATIONS OR BOTH FOR COMPLETE DESIGNATION.
2. * THE COILS TO K1 THRU K8 & K10 ARE SHOWN ON SHEET 2. ▲ THE CONTACTS TO K11 THRU K15 ARE SHOWN ON SHEET 2.
EPL NO. 141442
UNIT 2
JANE CLARK 6-20-80
Continental Electronics MFG. CO. DALLAS TEXAS
SCHEMATIC, DRIVER & POWER DISTRIBUTION
E 52161 142654
142654



A1
RF OSCILLATOR / EXCITER
ASSY NO. 142586-1
SCHEM NO. 142588
EPL NO. 141445
A2
TRANSMITTER START CONTROL
ASSY NO. 142589-1
SCHEM NO. 142591
EPL NO. 141446
A3
LOW VOLTAGE/ POWER CHANGE CONTROL
ASSY NO. 142592-1
SCHEM NO. 142594
EPL NO. 141447
A4
TRANSMITTER PLATE CONTROL
ASSY NO. 142583-1
SCHEM NO. 142585
EPL NO. 141448
J1 OUTLET
TB3 FRONT
TB2 REAR
P/O TB1
EXT 115VAC
A11
PA OVERLOAD ASSY
ASSY NO. 142610-1
SCHEM NO. 142612
EPL NO. 141455
A10
RELAY ASSEMBLY
ASSY NO. 142607-1
SCHEM NO. 142609
EPL NO. 141454
DOOR INTERLOCKS
S11 & S12 ACTIVATED BY S13 SCREEN GROUNDED POSITION
CB11 AUX SWITCH
K10 AUX SWITCH
REMOVE JUMPER & CONNECT 412V BATTERY TO TERM 6 TO RETAIN OVLD INDICATION ON POWER LOSS.
REMOTE PLATE CURRENT
FREQ MONITOR
EXT RF IN (STEREO)
PROGRAM INPUT
RC GROUND BUSS
EXITATION DISABLE
RC XTAL NO. 1
RC XTAL NO. 2
RC MASTER ON
RC MASTER OFF
FAILSAFE PLATE ON/OFF
RC PLATE ON
RC PLATE OFF
RC HIGH PWR
RC LOW PWR
RC OVLD SUMMATION OUT
RC MAG DISABLE OUT
RC MAG OPERATE LAMP
RC LV OVLD, HV OVLD & MAG LOCKOUT RESET
RC PLT BKBR INTLK DEFEAT
EXT PLATE INTLK
RC PLATE COMMON
ON/OFF N.O.
LOGIC N.C.
A13
PHASE FAILURE PROTECTION
ASSY NO. 142616-1
SCHEM NO 142618
EPL NO 141457
A9
HUM BALANCING ASSEMBLY
ASSY NO. 142604-1
SCHEM NO. 142606
EPL NO. 141453
A8
CONTROL UNIT
ASSY NO. 142601-1
SCHEM NO. 142603
EPL NO. 141452
A7
AUDIO AMPLIFIER
ASSY NO. 142598-1
SCHEM NO. 142600
EPL NO. 141451
A6
MAGNIPHASE CONTROL
ASSY NO. 142580-1
SCHEM NO. 142582
EPL NO. 141450
A5
POWER SUPPLY
ASSY NO. 142595-1
SCHEM NO. 142597
EPL NO. 141449
EPL NO. 141442
UNIT 2
* CONTACTS TO 2K1 THRU 2K8 & 2K10 ARE ON SHEET 1.
▲ COILS TO 2K11 THRU 2K15 ARE ON SHEET 1.
Continental Electronics MFG. CO.
DALLAS TEXAS
DRAWN James Ivey 6-21-80
J. SAINTON
SCHEMATIC, DRIVER AND POWER DISTRIBUTION
E 52151 142654
SHEET 2 OF 2

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REV PER MARKED PRINT		



FREQUENCY DIVISION CHART	
DIVISION	CONNECTIONS
÷4	1 TO 3 AND 2 TO 4
÷6	1 TO 4 AND 2 TO 5
÷8	1 TO 3 AND 2 TO 5
÷10	1 TO 4 AND 2 TO 6

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

LIST OF MATERIAL OR PARTS LIST

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 J. Egrew DATE 6-13-80
CHECKED
MECH DSGN
ELEC ENGR J. SAINTON
APPROVED

NEXT ASSY	DWG SIZE	USED ON
142586-1	D	2343

Continental Electronics MFG. CO. DALLAS TEXAS

SCHEMATIC, RF OSCILLATOR/EXCITER

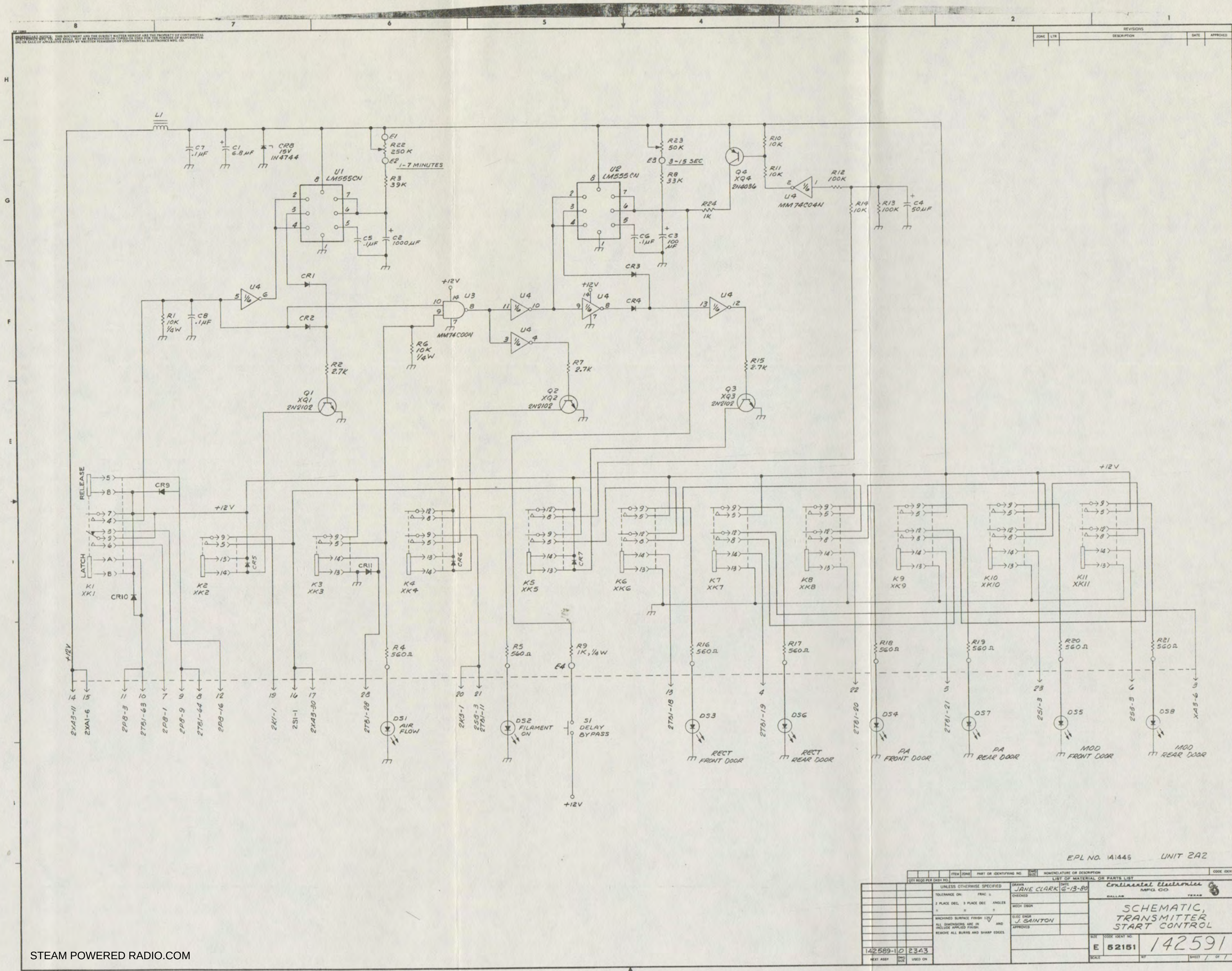
SIZE D CODE IDENT NO 52151 142588

SCALE WT SHEET 1 OF 1

142588

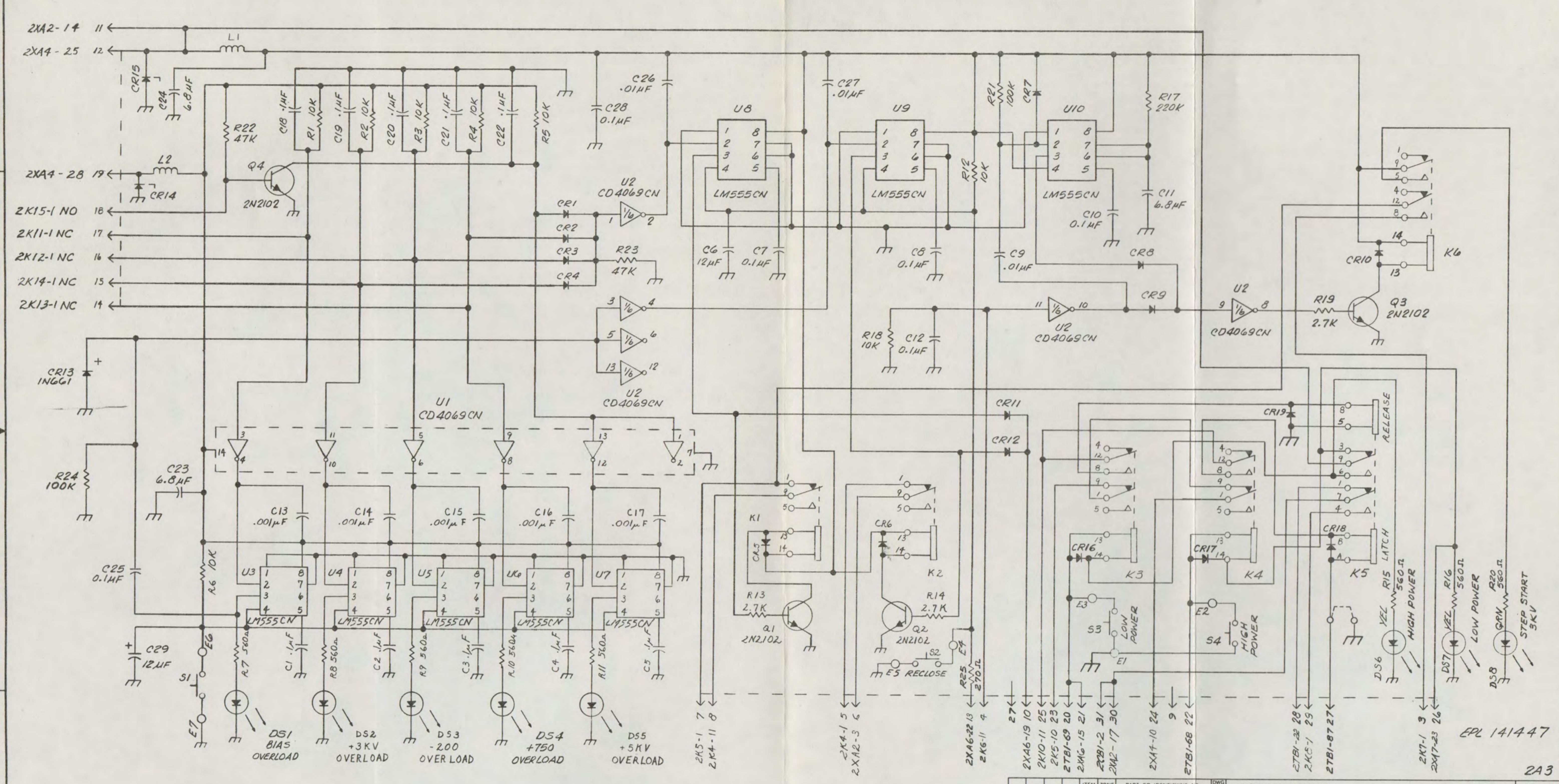
STEAM POWERED RADIO.COM

CWC FORM 387B



EPL NO. 141446
UNIT 2A2
Continental Electronics MFG. CO
DALLAS TEXAS
JANE CLARK 6-13-80
J. SAINTON
SCHEMATIC, TRANSMITTER START CONTROL
E 52151 142591
142589-1.0 2343
1-7 MINUTES
3-15 SEC
RECT FRONT DOOR
RECT REAR DOOR
PA FRONT DOOR
PA REAR DOOR
MOD FRONT DOOR
MOD REAR DOOR
AIR FLOW
FILAMENT ON
DELAY BYPASS
RELEASE
LATCH

ZONE	LTR	DESCRIPTION	DATE	APPROVED



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

LIST OF MATERIAL OR PARTS LIST

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	JANE CLARK
DATE	1-21-82
CHECKED	
MECH DSGN	
ELEC ENGR	J. SAINTON
APPROVED	

Continental Electronics MFG. CO.
DALLAS TEXAS

SCHEMATIC, LOW VOLTAGE / POWER CHANGE CONTROL

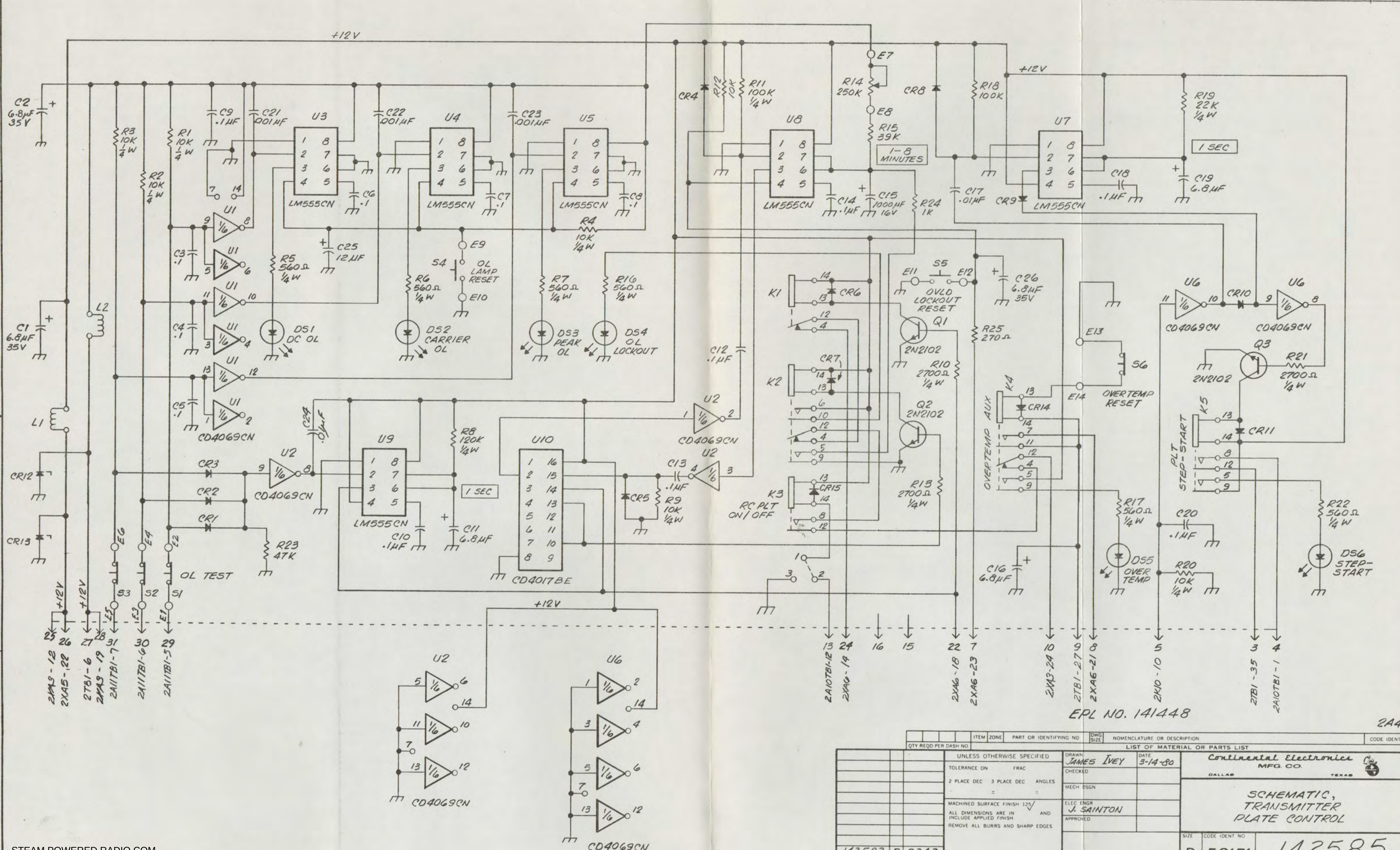
NEXT ASSY	DWG SIZE	USED ON
142592	D	2343

SIZE D CODE IDENT NO 52151 142594
SCALE ~ WT ~ SHEET 1 OF 1

C.W.C FORM 3878

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
C3	A	ADDED C26	7/30/82	IVEY



2A4

QTY REQD PER DASH NO.	ITEM	ZONE	PART OR IDENTIFYING NO.	DWG SIZE	NOMENCLATURE OR DESCRIPTION	CODE IDENT

LIST OF MATERIAL OR PARTS LIST

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

NEXT ASSY	DWG SIZE	USED ON
142583	D	2343

DRAWN: JAMES IVEY — DATE: 3-14-80
CHECKED:
MECH DSGN:
ELEC ENGR: J. SAINTON
APPROVED:

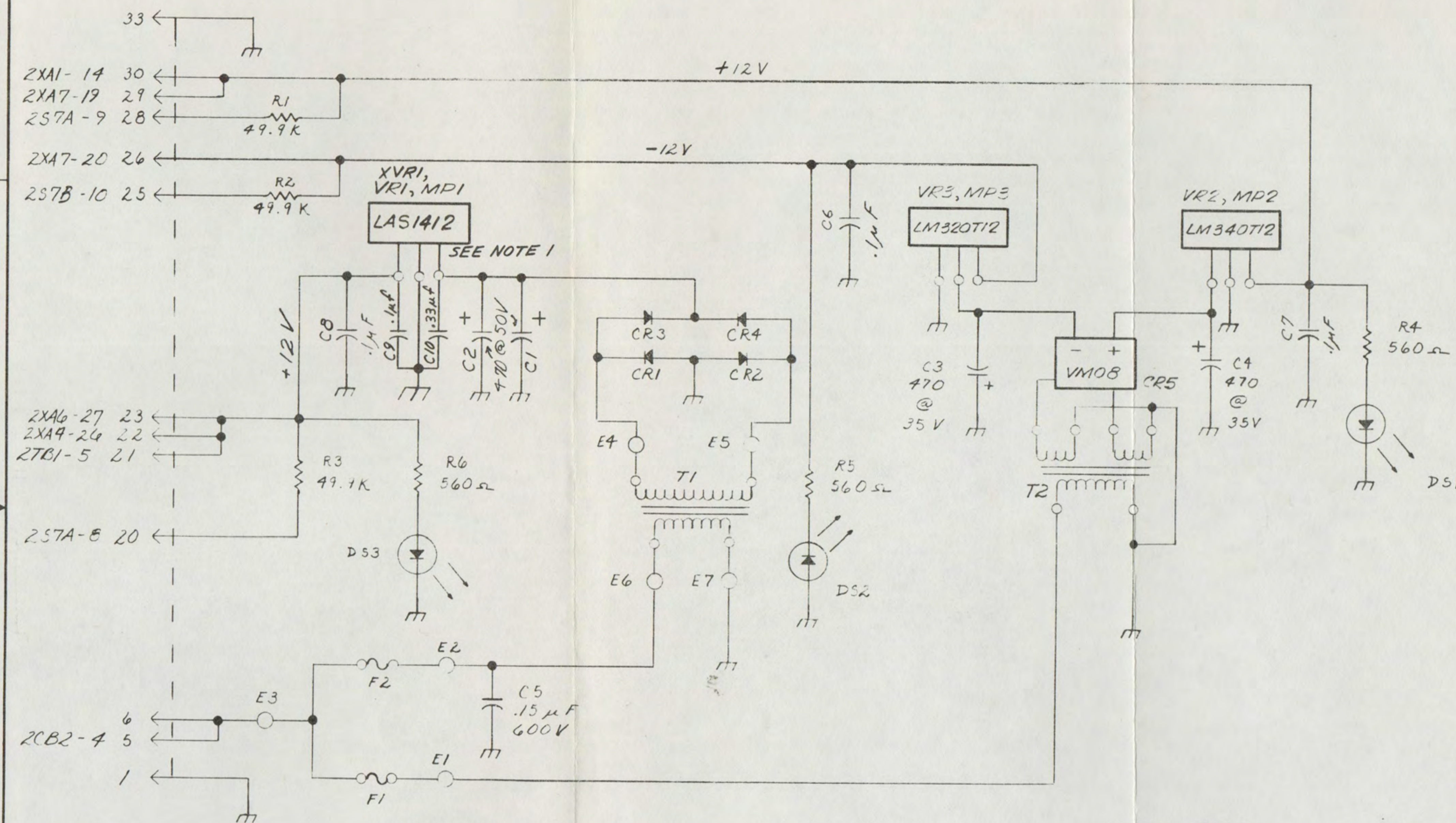
Continental Electronics MFG. CO.
DALLAS TEXAS

SCHEMATIC, TRANSMITTER PLATE CONTROL

SIZE: D — CODE IDENT NO: 52151 — 142585
SCALE: ~ — WT: ~ — SHEET 1 OF 1

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
C3	A	REV PER MKD PRINT. C10 WAS .22uF	8-31-83	J. CLARK



EPL 141449

2A5

NOTE:
1. MOUNT C9 & C10 ON XVR1 SOCKET.

ITEM	ZONE	PART OR IDENTIFYING NO	DWG SIZE	NOMENCLATURE OR DESCRIPTION	CODE IDENT

QTY REQD PER DASH NO — LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	DWG SIZE	USED ON
142595	D	2343

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

		DATE
DRAWN	L.C. FERNICOLA	6-20-80
CHECKED		
MECH DSGN		
ELEC ENGR	J. SAINTON	
APPROVED		

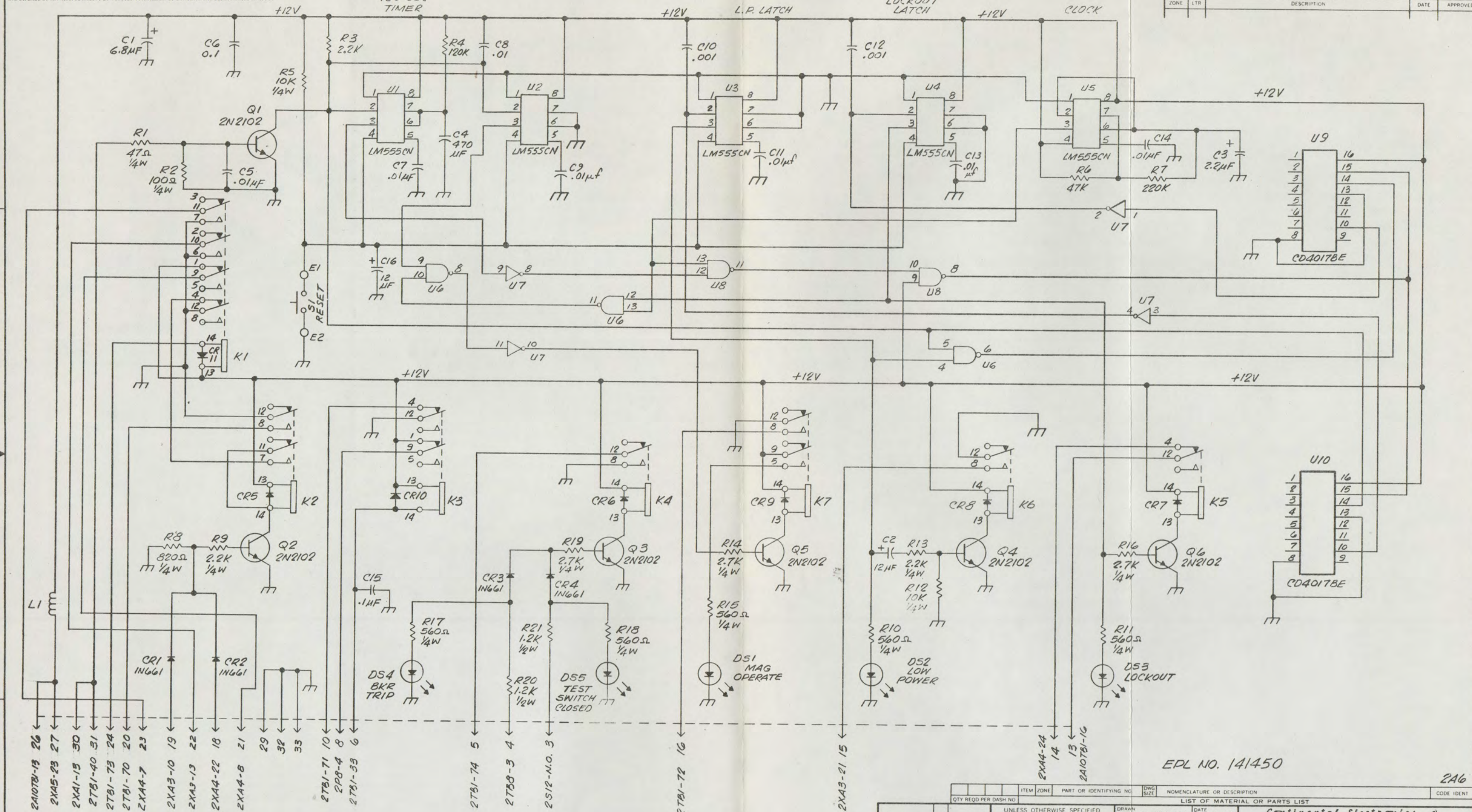
Continental Electronics MFG. CO.
DALLAS TEXAS

SCHEMATIC, POWER SUPPLY

SIZE	CODE IDENT NO.	
C	52151	142597

SCALE: ~ WT. ~ SHEET 1 OF 1

142597



NOTES:

1. ALL DIODES IN4004 UNLESS OTHERWISE STATED.
2. U6 AND U8 ARE MM74C00N.
3. U7 IS A CD4069CN.

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED

LIST OF MATERIAL OR PARTS LIST

QTY REQD PER DASH NO	ITEM	ZONE	PART OR IDENTIFYING NO.	DWG SIZE	NOMENCLATURE OR DESCRIPTION	CODE IDENT

2A6

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

NEXT ASSY	DWG SIZE	USED ON
142580	D	2343

DRAWN: JANE CLARK DATE: 1-18-82
CHECKED
MECH DSGN
ELEC ENGR: J. SAINTON
APPROVED

Continental Electronics MFG. CO.
DALLAS TEXAS

SCHEMATIC, MAGNIPHASE CONTROL

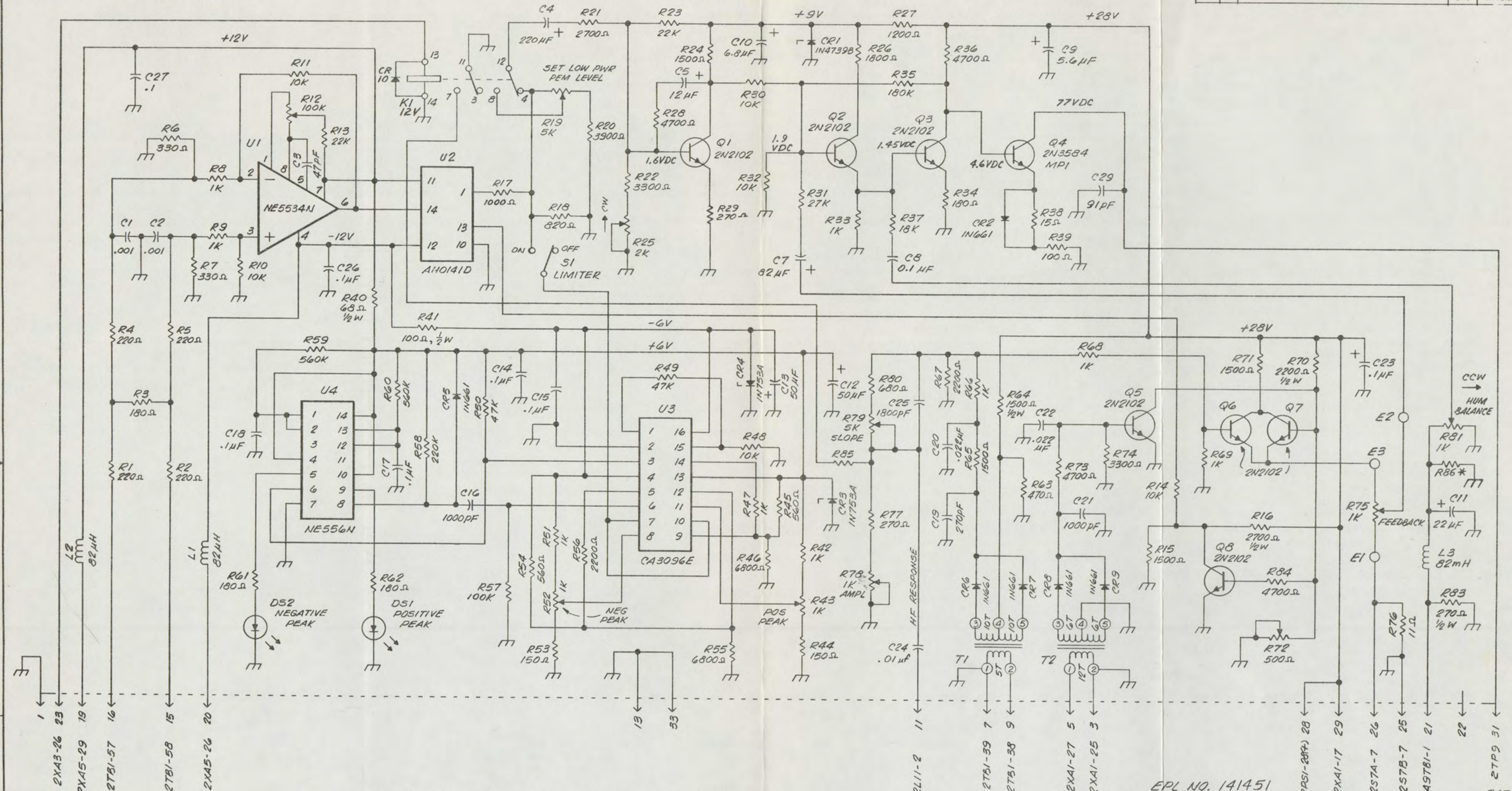
SIZE	CODE IDENT NO	
D	52151	142582

SCALE ~ WT ~ SHEET 1 OF 1

142582

C. WC FORM 387 B

ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED



VOLTAGES AT BASE OF Q1 THRU Q4 ARE TYPICAL AND MAY VARY ON SOME TRANSMITTERS.

* FACTORY SELECT

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

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

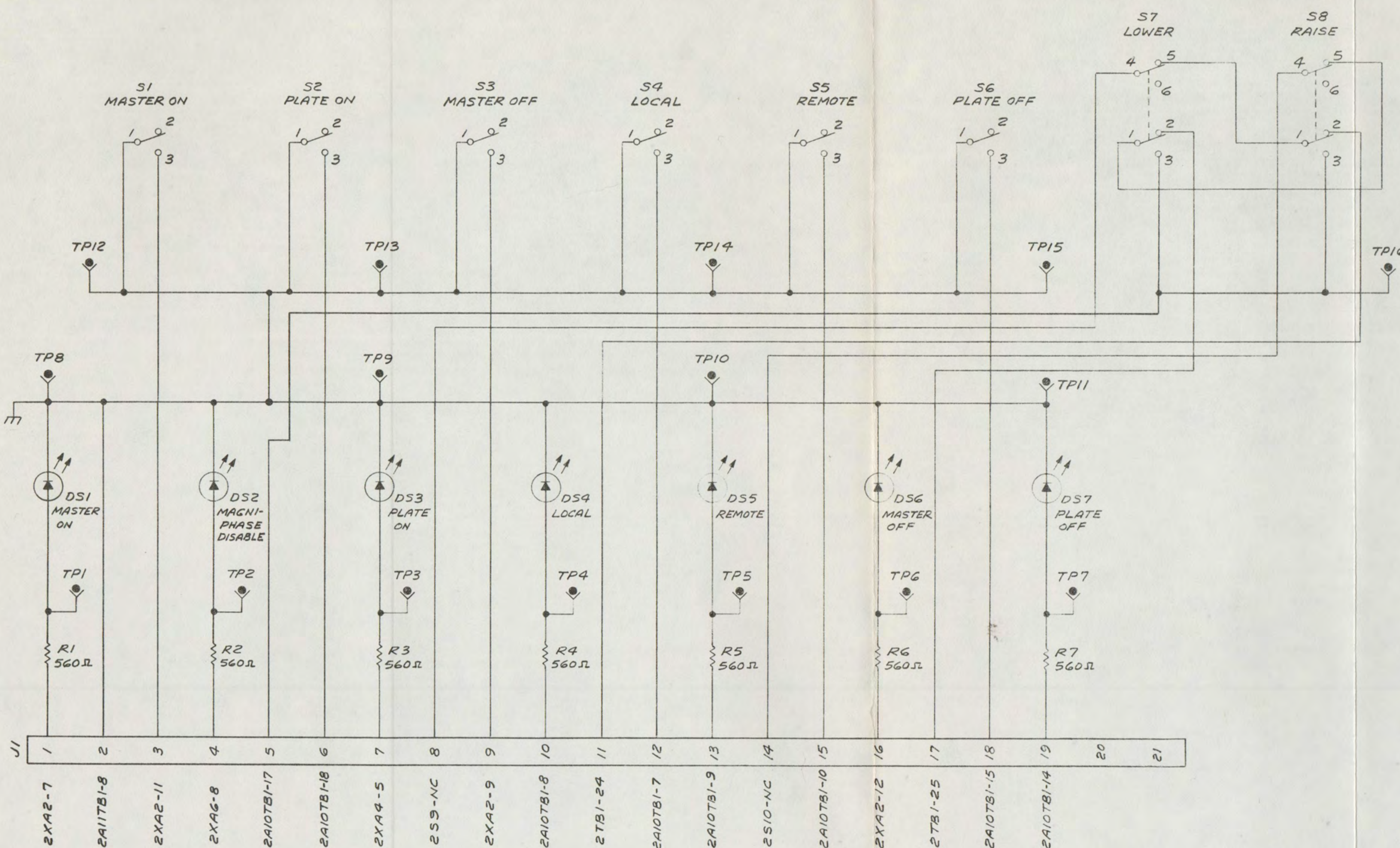
DRAWN James Ivey — DATE 7-14-80
CHECKED
MECH DSGN
ELEC ENGR J. Sainton
APPROVED

Continental Electronics MFG. CO.
DALLAS TEXAS

SCHEMATIC, AUDIO AMPLIFIER

NEXT ASSY	DWG SIZE	USED ON
142598	D	2343

SIZE D — CODE IDENT NO 52151 — 142600
SCALE ~ — WT ~ — SHEET 1 OF 1



EPL NO. 141452 2A8

QTY REQD PER DASH NO.	ITEM	ZONE	PART OR IDENTIFYING NO.	DWG SIZE	NOMENCLATURE OR DESCRIPTION	CODE IDENT

LIST OF MATERIAL OR PARTS LIST

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 JANE CLARK DATE 7-11-80
CHECKED
MECH DSGN
ELEC ENGR
APPROVED

Continental Electronics MFG. CO. DALLAS TEXAS

SCHEMATIC CONTROL UNIT

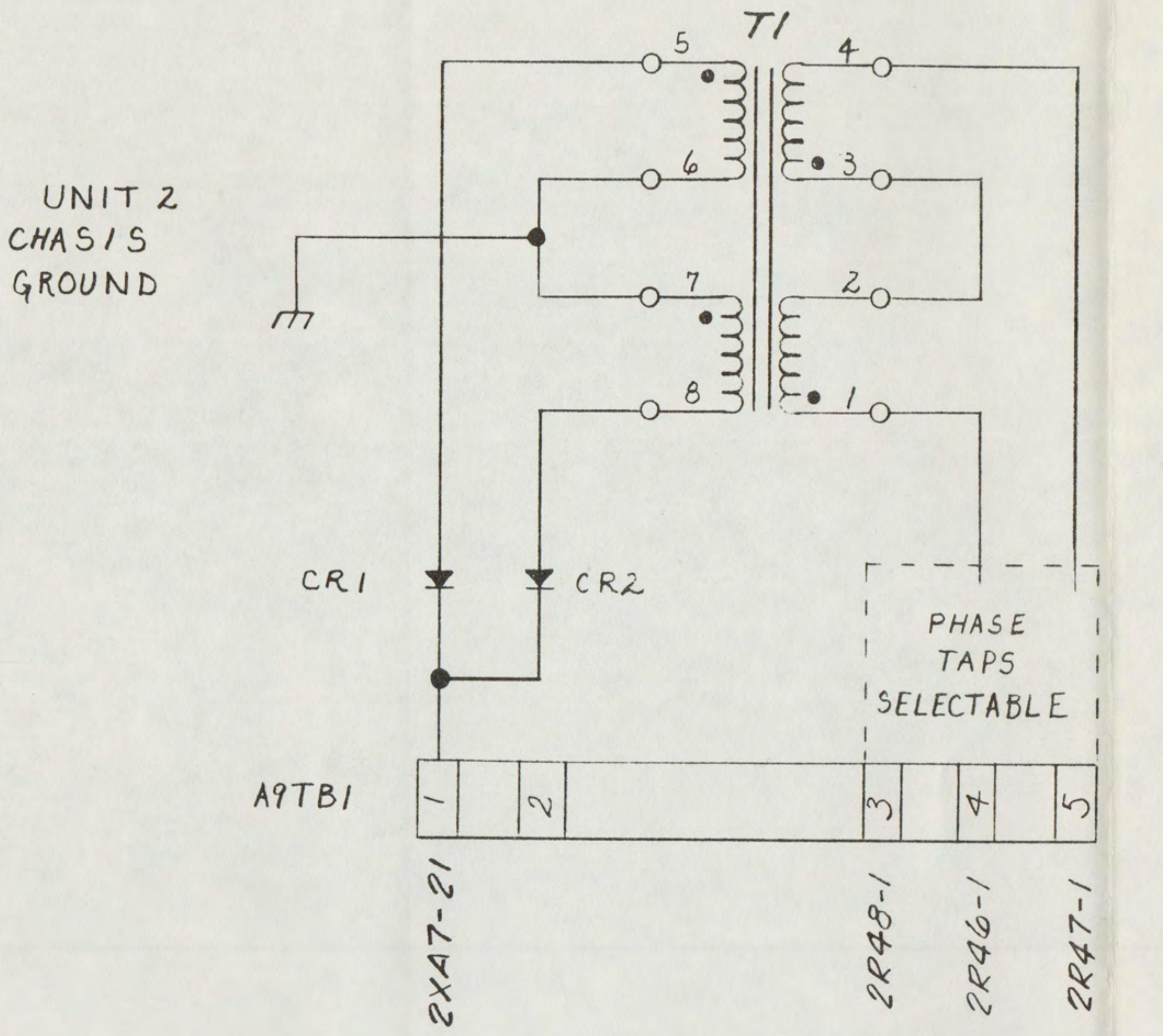
SIZE D CODE IDENT NO. 52151 142603
SCALE ~ WT ~ SHEET 1 OF 1

NEXT ASSY	DWG SIZE	USED ON
142601	B	2343

142603

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED



EPL NO. 141453

2A9

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

UNLESS OTHERWISE SPECIFIED
TOLERANCE ON: FRAC ± 2 P DEC 3 P DEC ANGLES ± ± ±
MACH. SURFACE FIN. 125√
ALL DIM. ARE IN AND INCLUDE APPLIED FIN.
REMOVE ALL BURRS AND SHARP EDGES.

DRAWN L.C. FERNICOLA DATE 6-17-80
CHECKED
ENGR J. SAINTON

Continental Electronics MFG. CO.
DALLAS TEXAS

SCHEMATIC,
HUM BALANCING ASSEMBLY

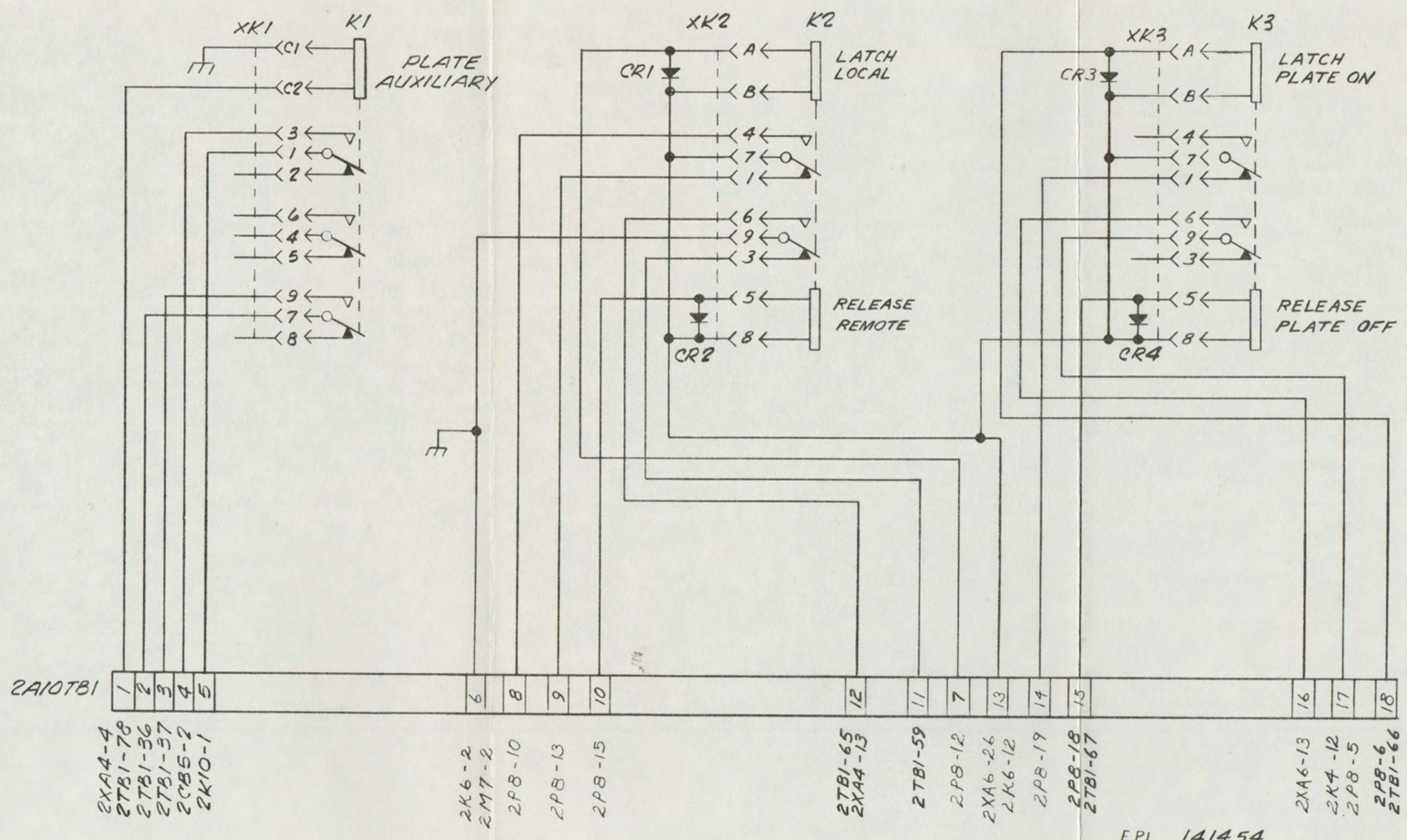
SIZE B | CODE IDENT NO. 52151 | 142606
SCALE: ~ | WT ~ | SHEET 1 OF 1

NEXT ASSY	DWG SIZE	USED ON
142604	C	2343

CEMC FORM 385 B

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED



EPL 141454

2A10

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

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	DWG SIZE	USED ON
142607	C	2343

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: L.C. FERNICOLA DATE: 6-18-80
CHECKED
MECH DSGN
ELEC ENGR: J. SAINTON
APPROVED

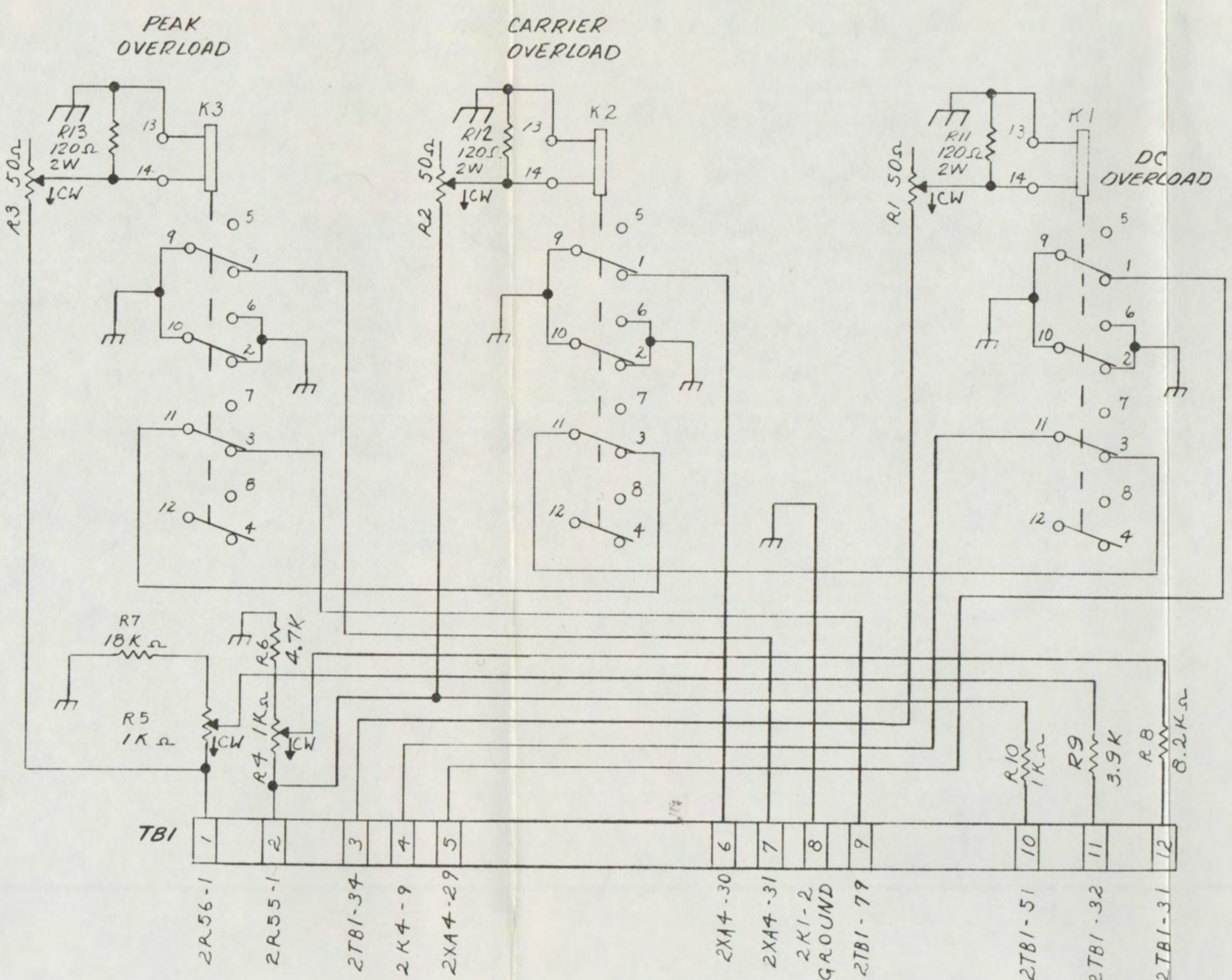
Continental Electronics MFG. CO.
DALLAS TEXAS

SCHEMATIC, RELAY ASSEMBLY

SIZE: C | CODE IDENT NO.: 52151 | 142609
SCALE: | WT: | SHEET 1 OF 1

142609

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



EPL 141455

2A11

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

LIST OF MATERIAL OR PARTS LIST

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 L.C. FERNICOLA DATE 6-18-80
CHECKED
MECH DSGN
ELEC ENGR J. SAINTON
APPROVED

Continental Electronics MFG. CO. DALLAS TEXAS

SCHEMATIC, P.A. OVERLOAD ASSEMBLY

SIZE C CODE IDENT NO 52151 142612

SCALE WT SHEET 1 OF 1

NEXT ASSY	DWG SIZE	USED ON
142610	D	2343

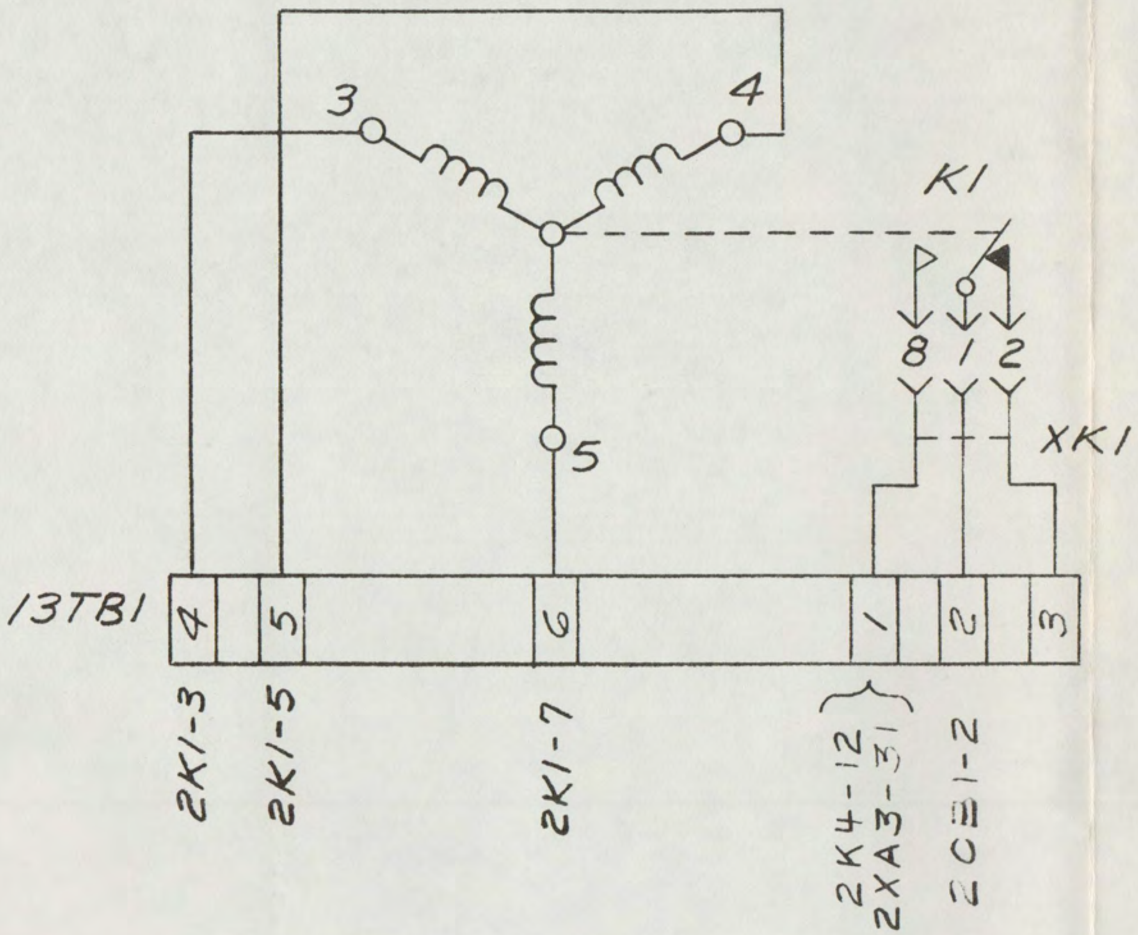
142612

STEAM POWERED RADIO.COM

CEMC FORM 3868

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
A	CHG 13TB1-1 FROM 2K1-1 CHG 13TB1-2 FROM 2XA2-19	3/20/84	CJA



EPL NO. 141457

2A13

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

NEXT ASSY	DWG SIZE	USED ON
142616		2343

UNLESS OTHERWISE SPECIFIED
TOLERANCE ON: FRAC ±
2 P DEC 3 P DEC ANGLES
± ± ±
MACH. SURFACE FIN. 125√
ALL DIM. ARE IN
AND INCLUDE APPLIED FIN.
REMOVE ALL BURRS AND SHARP EDGES.

DRAWN	JANE CLARK	DATE 1-18-82
CHECKED		
ENGR	J. SAINTON	

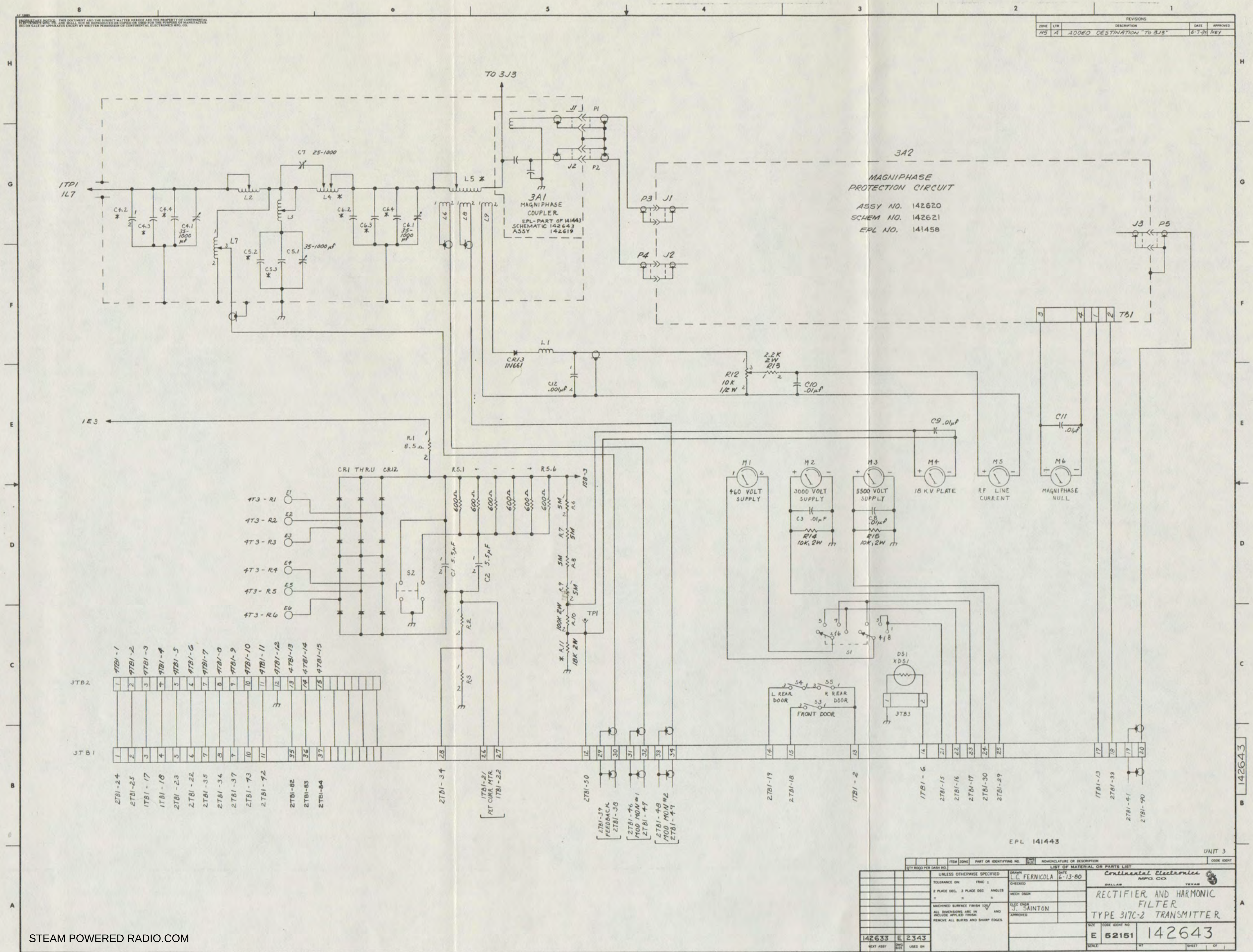
Continental Electronics MFG. CO.
DALLAS TEXAS

SCHEMATIC, PHASE FAILURE PROTECTION

SIZE	CODE IDENT NO.	
B	52151	142618

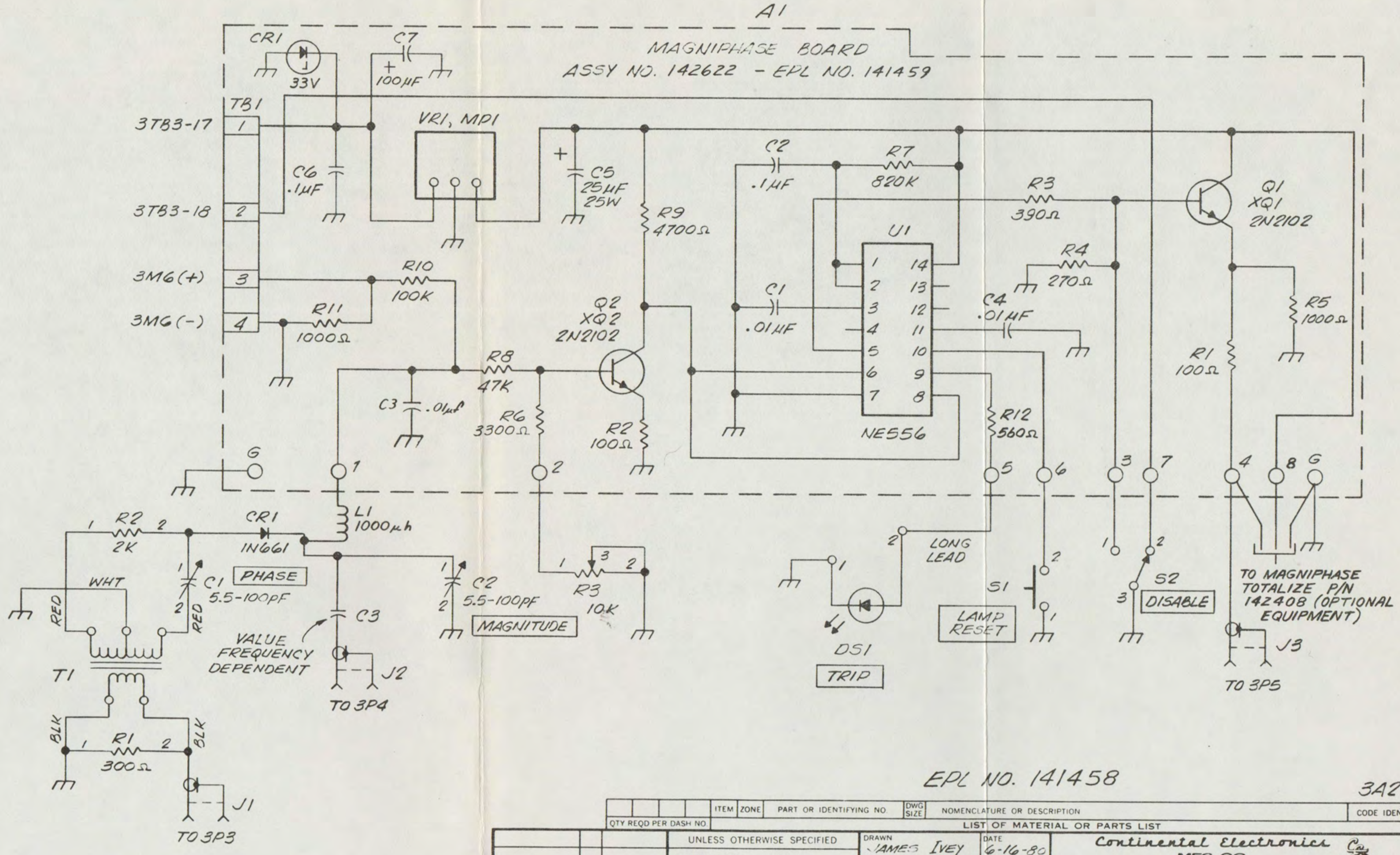
SCALE: ~ WT ~ SHEET 1 OF 1

CEMC FORM 385 B



STEAM POWERED RADIO.COM

ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED



3A2

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

NEXT ASSY	DWG SIZE	USED ON
142620	D	2343

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 6-16-80
CHECKED		
MECH DSGN		
ELEC ENGR	J. SAINTON	
APPROVED		

Continental Electronics MFG. CO.
DALLAS TEXAS

SCHEMATIC, MAGNIPHASE

SIZE	CODE IDENT NO.	
C	52151	142621
SCALE: ~	WT ~	SHEET 1 OF 1

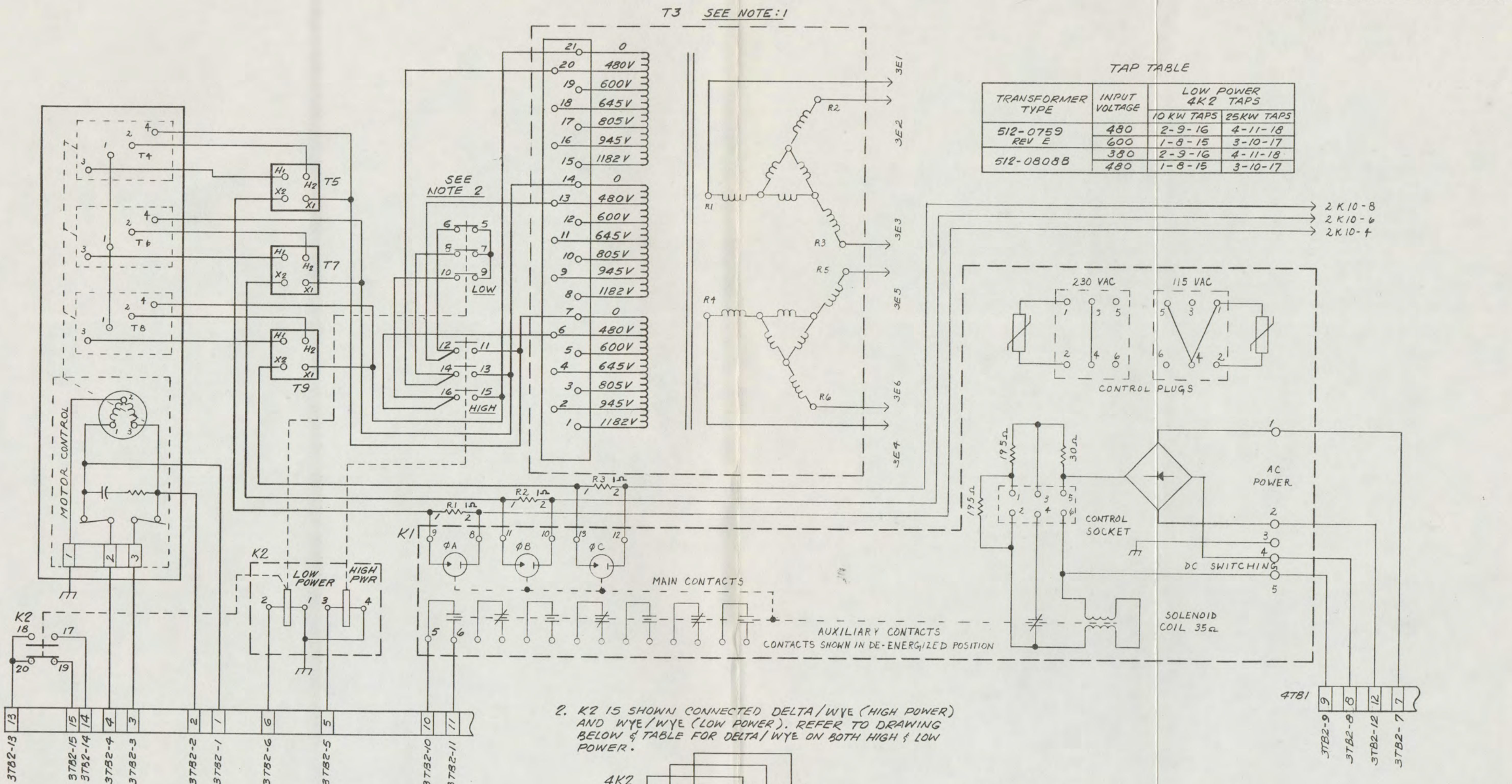
142621

STEAM POWERED RADIO.COM

CEMC FORM 3868

PROPRIETARY NOTICE: THIS DOCUMENT AND THE SUBJECT MATTER HEREOF ARE THE PROPERTY OF CONTINENTAL ELECTRONICS MFG. CO. AND SHALL NOT BE REPRODUCED OR COPIED OR USED FOR THE PURPOSE OF MANUFACTURING OR SALE OF APPARATUS EXCEPT BY WRITTEN PERMISSION OF CONTINENTAL ELECTRONICS MFG. CO.

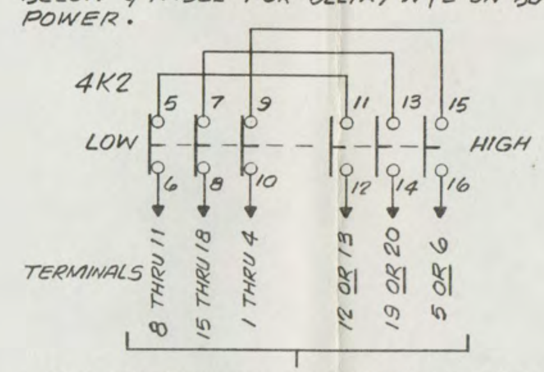
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REV K2; ADDED NOTE 2	6-16-83	IVEY
	B	REVISED PER MARKED PRINT		



TAP TABLE

TRANSFORMER TYPE	INPUT VOLTAGE	LOW POWER 4K2 TAPS	
		10 KW TAPS	25KW TAPS
512-0759 REV E	480	2-9-16	4-11-18
	600	1-8-15	3-10-17
512-08088	380	2-9-16	4-11-18
	480	1-8-15	3-10-17

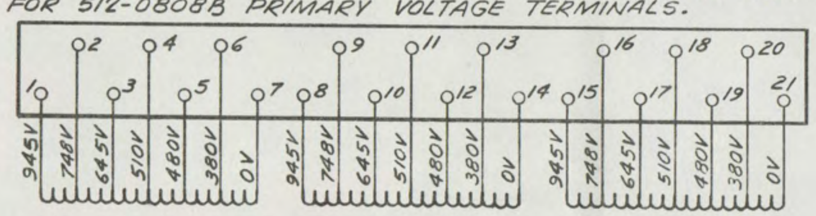
2. K2 IS SHOWN CONNECTED DELTA/WYE (HIGH POWER) AND WYE/WYE (LOW POWER). REFER TO DRAWING BELOW & TABLE FOR DELTA/WYE ON BOTH HIGH & LOW POWER.



SELECT VOLTAGE TERMINAL REQUIRED FOR PROPER OUTPUT POWER

NOTES:

1. PRIMARY VOLTAGES SHOWN ON T3 ARE FOR 512-0759 REV E TRANSFORMER ONLY. REFER TO DRAWING BELOW FOR 512-08088 PRIMARY VOLTAGE TERMINALS.



UNIT 4

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

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	JANE CLARK
DATE	7-2-81
CHECKED	
MECH DSGN	
ELEC ENGR	J. SAINTON
APPROVED	

NEXT ASSY	DWG SIZE	USED ON
142634		2343

Continental Electronics MFG. CO.
DALLAS TEXAS

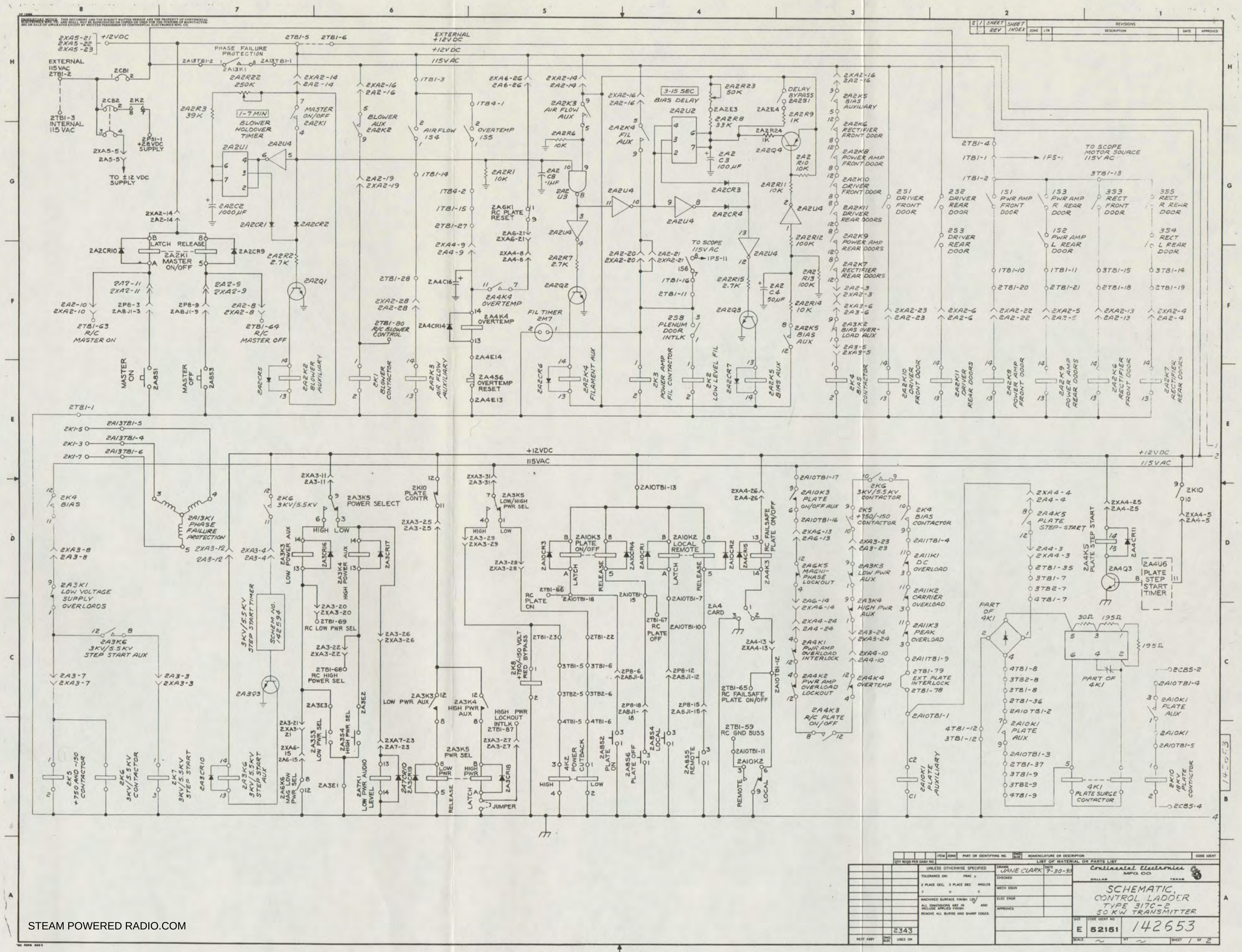
SCHEMATIC, PLATE TRANSFORMER UNIT.

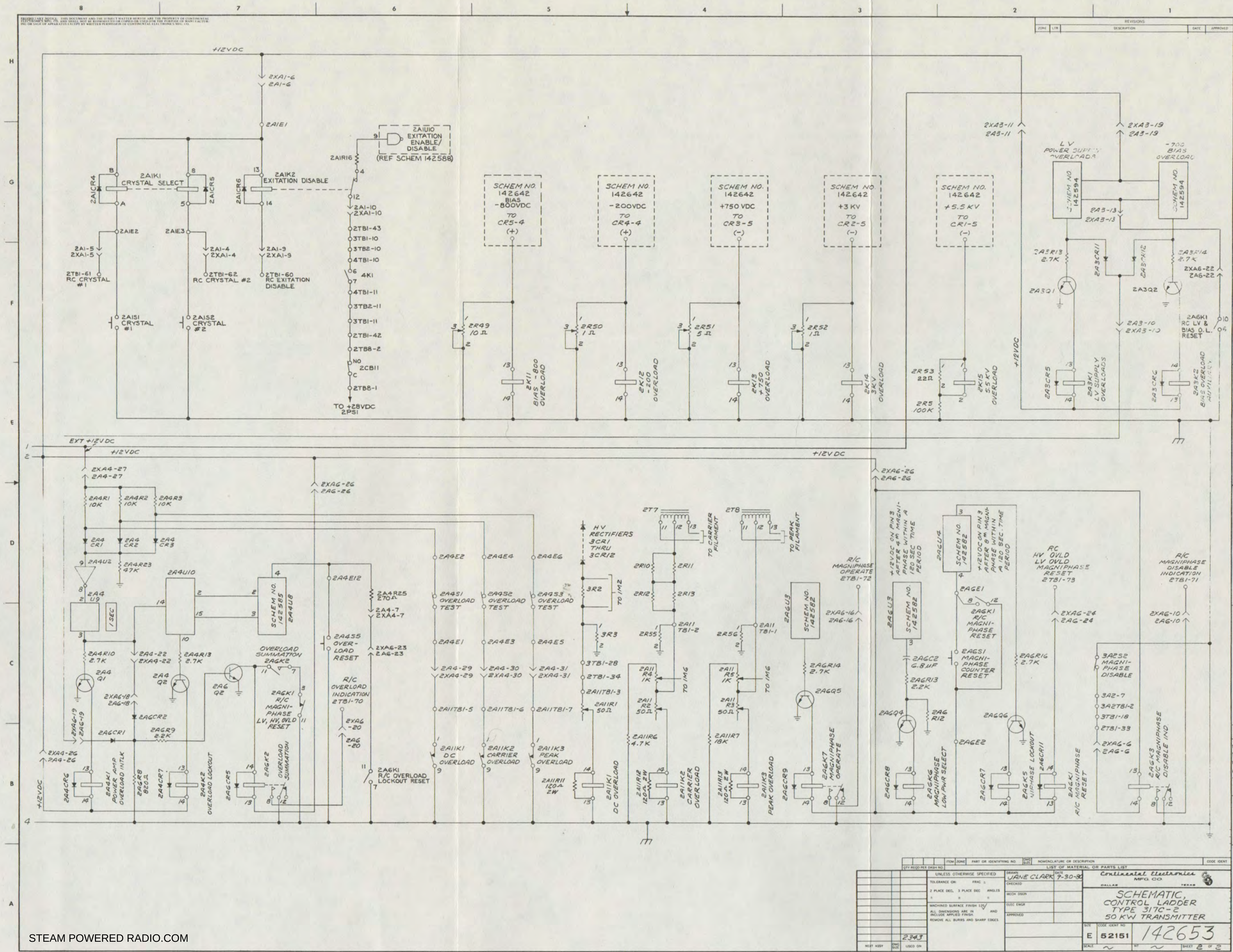
SIZE	CODE IDENT NO	
D	52151	142644

SCALE ~ WT ~ SHEET 1 OF 1

142644

C.WC FORM 387 B

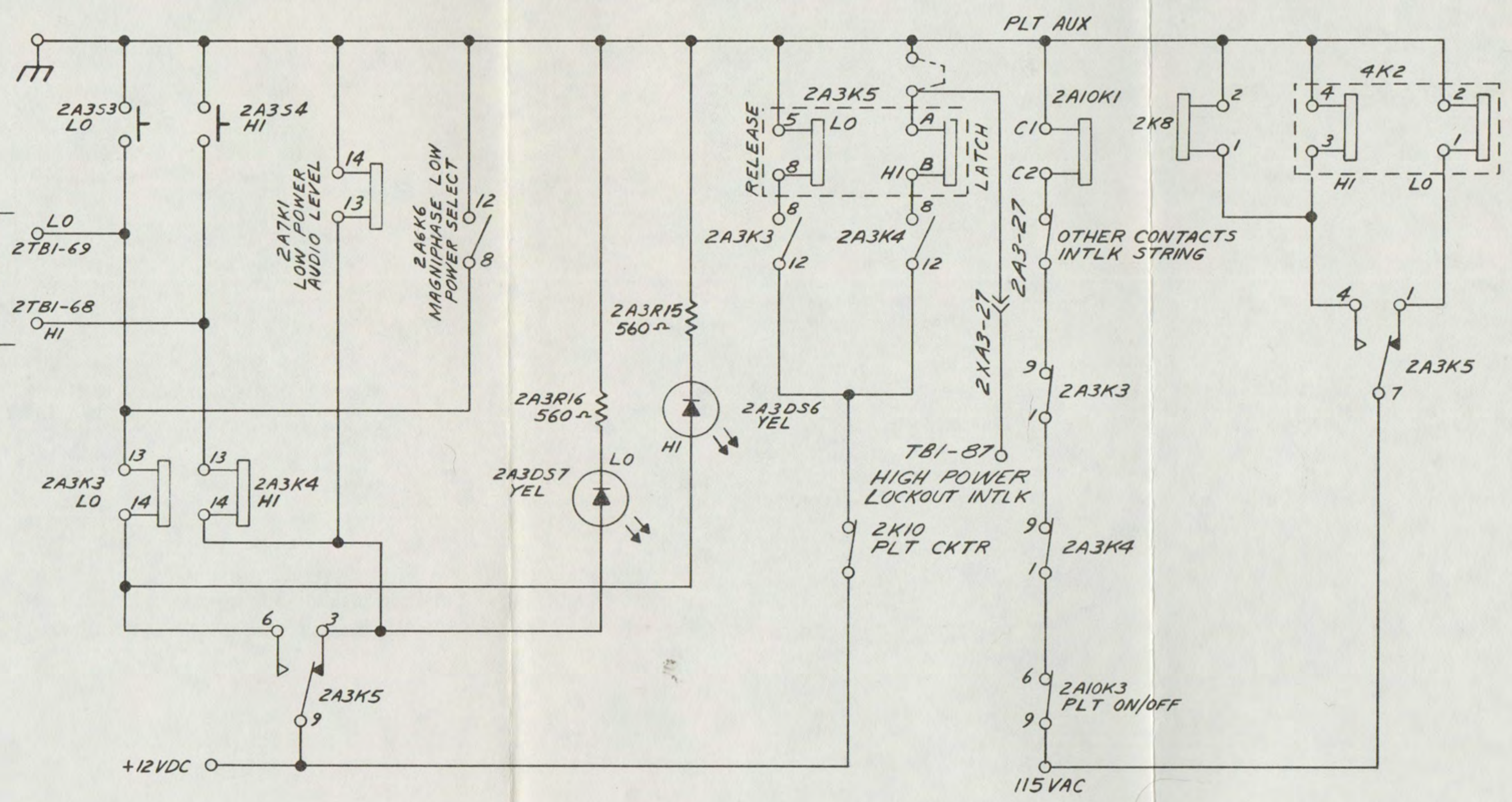

SCHEMATIC, CONTROL LADDER TYPE 317C-2 50 KW TRANSMITTER
Continental Electronics MFG. CO.
DALLAS TEXAS
DRAWN JANE CLARK
E 52151 142653
2343


+12VDC
2XA1-6
2A1-6
2A1E1
2A1U10 EXITATION ENABLE/ DISABLE
(REF SCHEM 142588)
2A1R16
2A1K1 CRYSTAL SELECT
2A1K2 EXITATION DISABLE
2A1CR4
2A1CR5
2A1CR6
2A1E2
2A1E3
2A1-5 2XA1-5
2A1-4 2XA1-4
2A1-3 2XA1-9
2TB1-61 RC CRYSTAL #1
2TB1-62 RC CRYSTAL #2
2TB1-60 RC EXITATION DISABLE
2A1S1 CRYSTAL #1
2A1S2 CRYSTAL #2
2A1-10 2XA1-10
2TB1-43
3TB1-10
3TB2-10
4TB1-10
4K1
4TB1-11
3TB2-11
3TB1-11
2TB1-42
2TB8-2
2CB11
2TB8-1
TO +28VDC 2PS1
SCHEM NO. 142642 BIAS -800VDC TO CR5-4 (+)
SCHEM NO. 142642 -200VDC TO CR4-4 (+)
SCHEM NO. 142642 +750 VDC TO CR3-5 (-)
SCHEM NO. 142642 +3 KV TO CR2-5 (-)
SCHEM NO. 142642 +5.5 KV TO CR1-5 (-)
2R49 10Ω
2R50 1Ω
2R51 5Ω
2R52 1Ω
2K11 BIAS -800 OVERLOAD
2K12 -200 OVERLOAD
2K13 +750 OVERLOAD
2K14 3KV OVERLOAD
2R53 22Ω
2R5 100K
2K15 5.5KV OVERLOAD
2XA3-11 2A3-11
2XA3-19 2A3-19
LV POWER SUPPLY OVERLOAD
-700 BIAS OVERLOAD
SCHEM NO 142594
2A3-13 2XA3-13
2A3R13 2.7K
2A3R14 2.7K
2A3Q1
2A3Q2
2XA6-22 2A6-22
2A3-10 2XA3-10
2A6K1 RC LV & BIAS O.L. RESET
2A3CR5
2A3K1 LV SUPPLY OVERLOADS
2A3CR6
2A3K2 BIAS OVERLOAD AUXILIARY
EXT +12VDC
+12VDC
2XA4-27 2A4-27
2A4R1 10K
2A4R2 10K
2A4R3 10K
2A4 CR1
2A4 CR2
2A4 CR3
2A4U2
2A4R23 47K
2A4 U9
1 SEC
2A4U10
SCHEM NO. 142585 2A4U8
2XA6-26 2A6-26
2A4E12
2A4R25 270Ω
2A4-7 2XA4-7
2A4S5 OVERLOAD RESET
2XA6-23 2A6-23
R/C OVERLOAD INDICATION 2TB1-70
2XA6 -20
2A6 -20
2A6K1 R/C OVERLOAD LOCKOUT RESET
2A4R10 2.7K
2A4 Q1
2A4-22 2XA9-22
2A4R13 2.7K
2A4 Q2
2A6 Q2
OVERLOAD SUMMATION 2A6K2
2A6K1 R/C MAGNI-PHASE LV, HV, OVLD RESET
2XA4-18 2A4-18
2A6CR2
2A6CR1
2A6R9 8.2K
2XA6-19 2A6-19
2XA4-26 2A4-26
+12VDC
2A6CR6
2A6K1 POWER AMP OVERLOAD INTLK
2A6R8 82Ω
2A4CR7
2A6K2 OVERLOAD LOCKOUT
2A6CR5
2A6K2 OVERLOAD SUMMATION
2A4E2
2A4E4
2A4E6
2A4S1 OVERLOAD TEST
2A4S2 OVERLOAD TEST
2A4S3 OVERLOAD TEST
2A4E1
2A4E3
2A4E5
2A4-29 2XA4-29
2A4-30 2XA4-30
2A4-31 2XA4-31
2A11TB1-5
2A11TB1-6
2A11TB1-7
2A11K1 DC OVERLOAD
2A11K2 CARRIER OVERLOAD
2A11K3 PEAK OVERLOAD
HV RECTIFIERS 3CR1 THRU 3CR12
3R2
TO 1M2
3R3
3TB1-28
2TB1-34
2A11TB1-3
2A11R1 50Ω
2A11R11 120Ω 2W
2A11K1 DC OVERLOAD
2T7
TO CARRIER FILAMENT
2T8
TO PEAK FILAMENT
2R10
2R11
2R12
2R13
2R55
2R56
2A11 TB1-2
2A11 TB1-1
2A11 R4 1K
2A11 R2 50Ω
2A11R6 4.7K
2A11R12 120Ω 2W
2A11K2 CARRIER OVERLOAD
TO 1M6
2A11 R5 1K
2A11 R3 50Ω
2A11R7 18K
2A11R13 120Ω 2W
2A11K3 PEAK OVERLOAD
R/C MAGNIPHASE OPERATE 2TB1-72
2XA6-16 2A6-16
2A6U3
SCHEM NO. 142582
2A6R14 2.7K
2A6Q5
2A6CR9
2A6K7 MAGNIPHASE OPERATE
+12VDC
2XA6-26 2A6-26
+12VDC ON PIN 3 AFTER 4 MAGNIPHASE WITHIN A 120 SEC TIME PERIOD
2A6U3
SCHEM NO. 142582
2A6C2 6.8µF
2A6R13 2.2K
2A6Q4
2A6 R12
2A6CR8
2A6K6 MAGNIPHASE LOW PWR SELECT
2A6U4
SCHEM NO. 142582
+12VDC ON PIN 3 AFTER 8 MAGNIPHASE WITHIN A 120 SEC TIME PERIOD
2A6E1
2A6K1 R/C MAGNIPHASE RESET
2A6S1 MAGNIPHASE COUNTER RESET
2A6E2
RC HV OVLD LV OVLD MAGNIPHASE RESET 2TB1-73
2XA6-24 2A6-24
2A6R16 2.7K
2A6Q6
2A6CR7
2A6K5 MAGNIPHASE LOCKOUT
2A6K1 R/C MAGNIPHASE RESET
R/C MAGNIPHASE DISABLE INDICATION 2TB1-71
2XA6-10 2A6-10
3A2S2 MAGNIPHASE DISABLE
3A2-7
3A2TB1-2
3TB1-18
2TB1-33
2XA6-6 2A6-6
2A6K3 R/C MAGNIPHASE DISABLE IND.
142653
REVISIONS
ZONE
LTR
DESCRIPTION
DATE
APPROVED
ITEM
ZONE
PART OR IDENTIFYING NO.
DWG SIZE
NOMENCLATURE OR DESCRIPTION
CODE IDENT
QTY REQD PER DASH NO.
LIST OF MATERIAL OR PARTS LIST
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 JANE CLARK
DATE 9-30-80
CHECKED
MECH DSGN
ELEC ENGR
APPROVED
Continental Electronics MFG CO
DALLAS TEXAS
SCHEMATIC, CONTROL LADDER TYPE 317C-2 50 KW TRANSMITTER
SIZE E
CODE IDENT NO 52151
142653
SCALE ~
WT ~
SHEET 2 OF 2
2343
NEXT ASSY
DWG SIZE
USED ON

PROPRIETARY NOTICE. THIS DOCUMENT AND THE SUBJECT MATTER HEREOF ARE THE PROPERTY OF CONTINENTAL ELECTRONICS MFG. CO. AND SHALL NOT BE REPRODUCED OR COPIED OR USED FOR THE PURPOSE OF MANUFACTURING OR SALE OF APPARATUS EXCEPT BY WRITTEN PERMISSION OF CONTINENTAL ELECTRONICS MFG. CO.

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	ADDED 2A3-27 & TB1-87	7-20-83	



ITEM	ZONE	PART OR IDENTIFYING NO.	DWG SIZE	NOMENCLATURE OR DESCRIPTION	CODE IDENT

QTY REQD PER DASH NO. — LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	DWG SIZE	USED ON
		2343

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.

		DATE
DRAWN	PAT JOHNSON	3/28/83
CHECKED		
MECH DSGN		
ELEC ENGR		
APPROVED		

Continental Electronics MFG. CO.
DALLAS TEXAS

LADDER DIAGRAM POWER CHANGE

SIZE	CODE IDENT NO.	
C	52151	142638

SCALE: ~ WT SHEET 1 OF 1

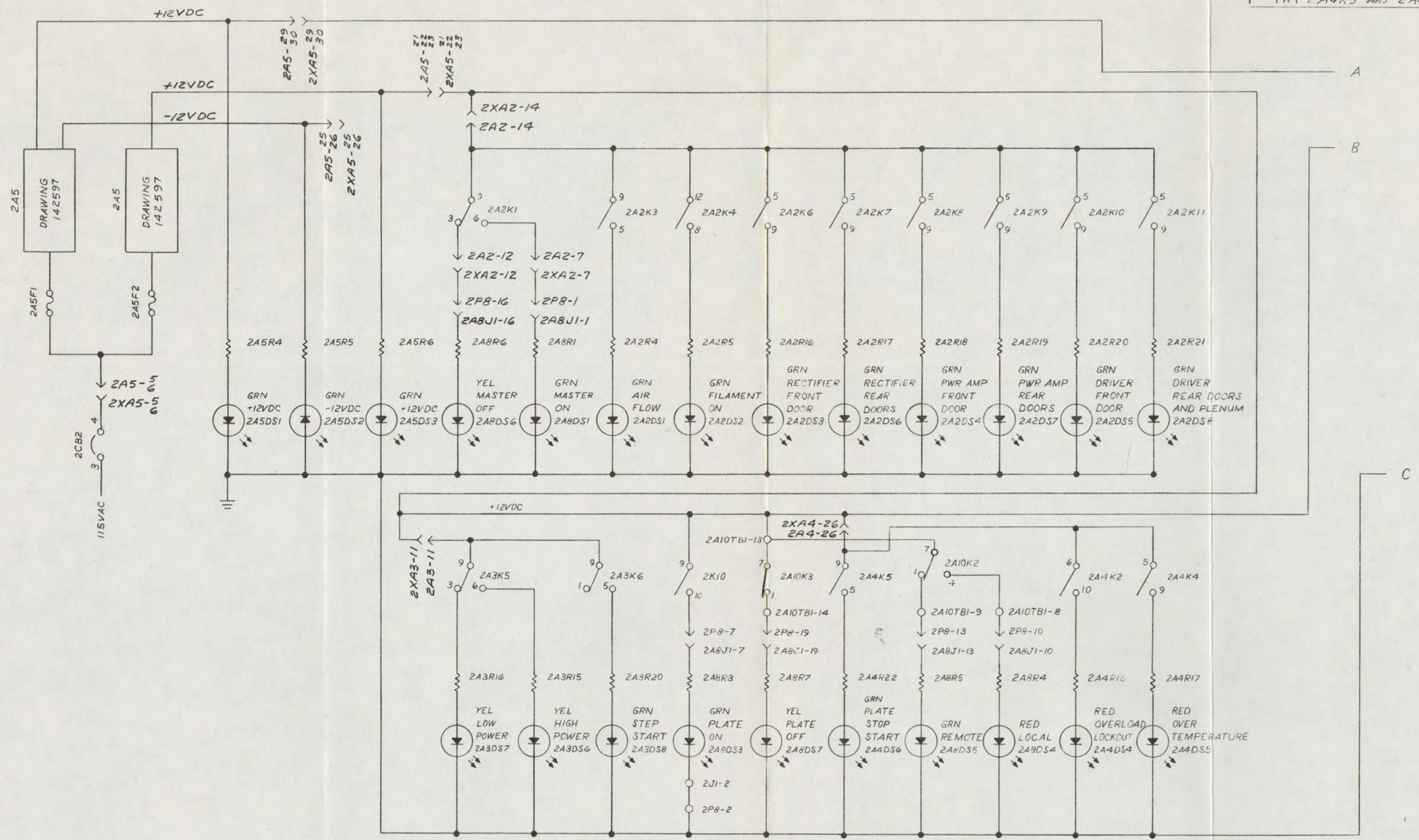
142638

CEMC FORM 3868

2	1	SHEET
A	REV	SHEET INDEX

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	2A4K5 WAS 2A4K6	7-20-83	RJ



LIST OF MATERIAL OR PARTS LIST

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

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

NEXT ASSY	DWG SIZE	USED ON
		2343

DRAWN	S A KEPLAR	DATE 9-4-80
CHECKED		
MECH DSGN		
ELEC ENGR	R TUCKER	
APPROVED		

Continental Electronics MFG. CO.
DALLAS TEXAS

LADDER DIAGRAM
LAMP CIRCUIT

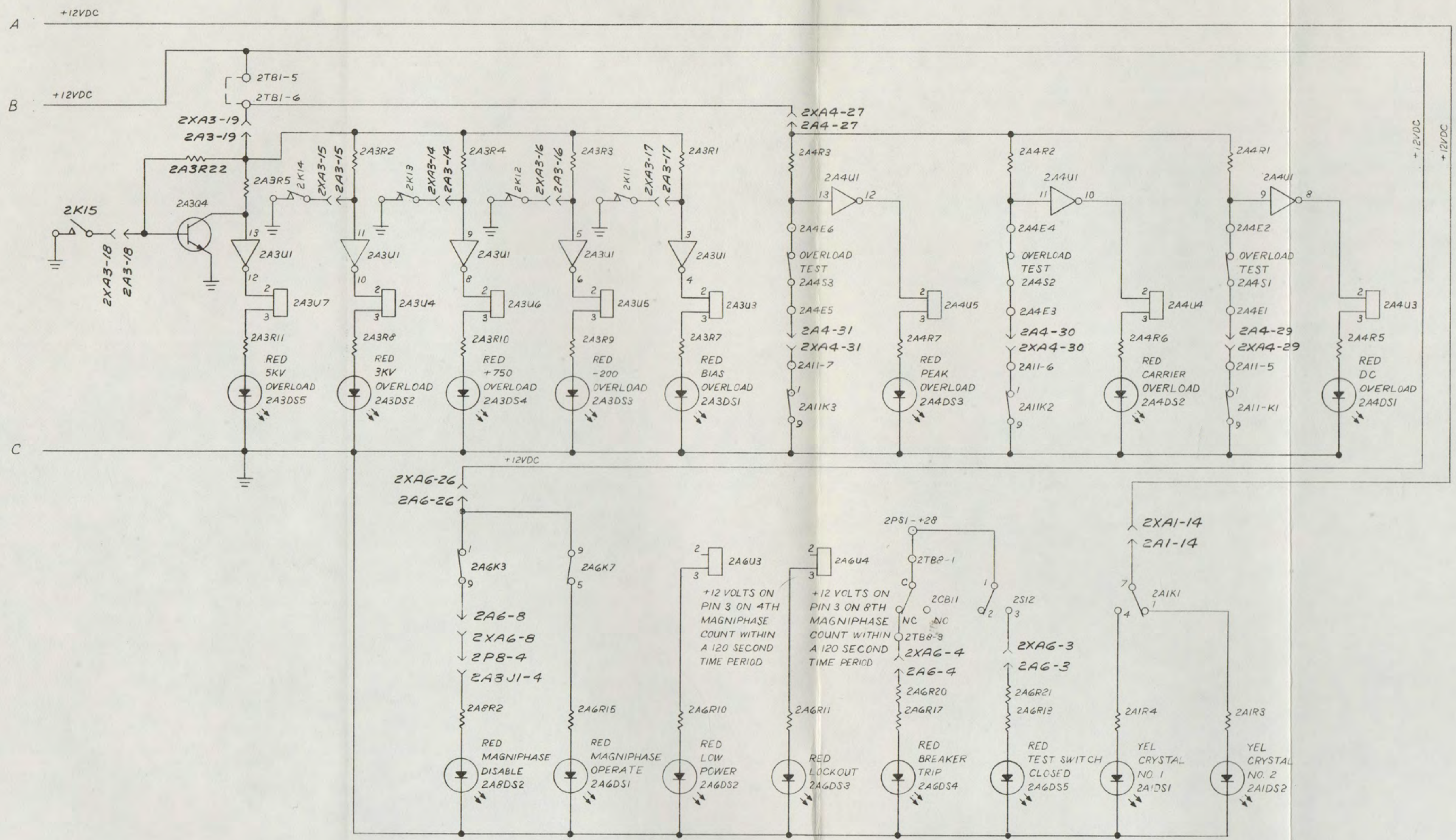
SIZE	CODE IDENT NO	
D	52151	142636
SCALE ~	WT ~	SHEET 1 OF 2

142636

STEAM POWERED RADIO.COM

C.WC FORM 387B

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



ITEM	ZONE	PART OR IDENTIFYING NO	DWG SIZE	NOMENCLATURE OR DESCRIPTION	CODE IDENT

QTY REQD PER DASH NO — LIST OF MATERIAL OR PARTS LIST

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: S.A KEPLAR — DATE: 9-9-80
CHECKED
MECH DSGN
ELEC ENGR: R TUCKER
APPROVED

Continental Electronics MFG. CO.
DALLAS TEXAS

LADDER DIAGRAM
LAMP CIRCUIT
TYPE 317C-2 XMTR

SIZE: D — CODE IDENT NO: 52151 — 142636
SCALE: ~ — WT: ~ — SHEET 2 OF 2

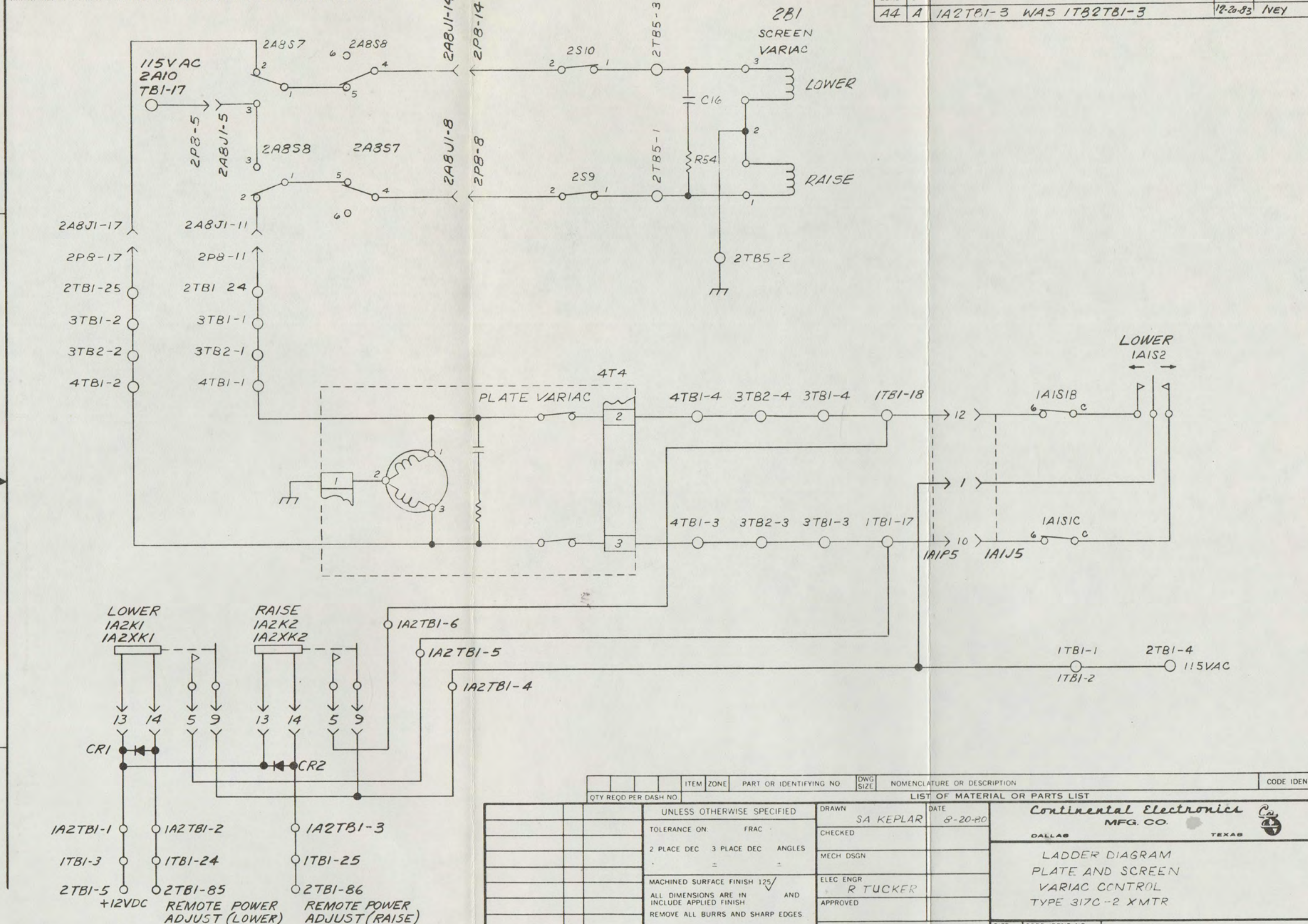
NEXT ASSY: 2343 — USED ON

142636

C.MC FORM 387B

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
A4	A	1A2TB1-3 WAS 1TB2TB1-3	12-20-83	IVEY



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

LIST OF MATERIAL OR PARTS LIST

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	SA KEPLAR	DATE 8-20-80
CHECKED		
MECH DSGN		
ELEC ENGR	R TUCKER	
APPROVED		

NEXT ASSY	DWG SIZE	USED ON
		2343

Continental Electronics MFG. CO.
DALLAS TEXAS

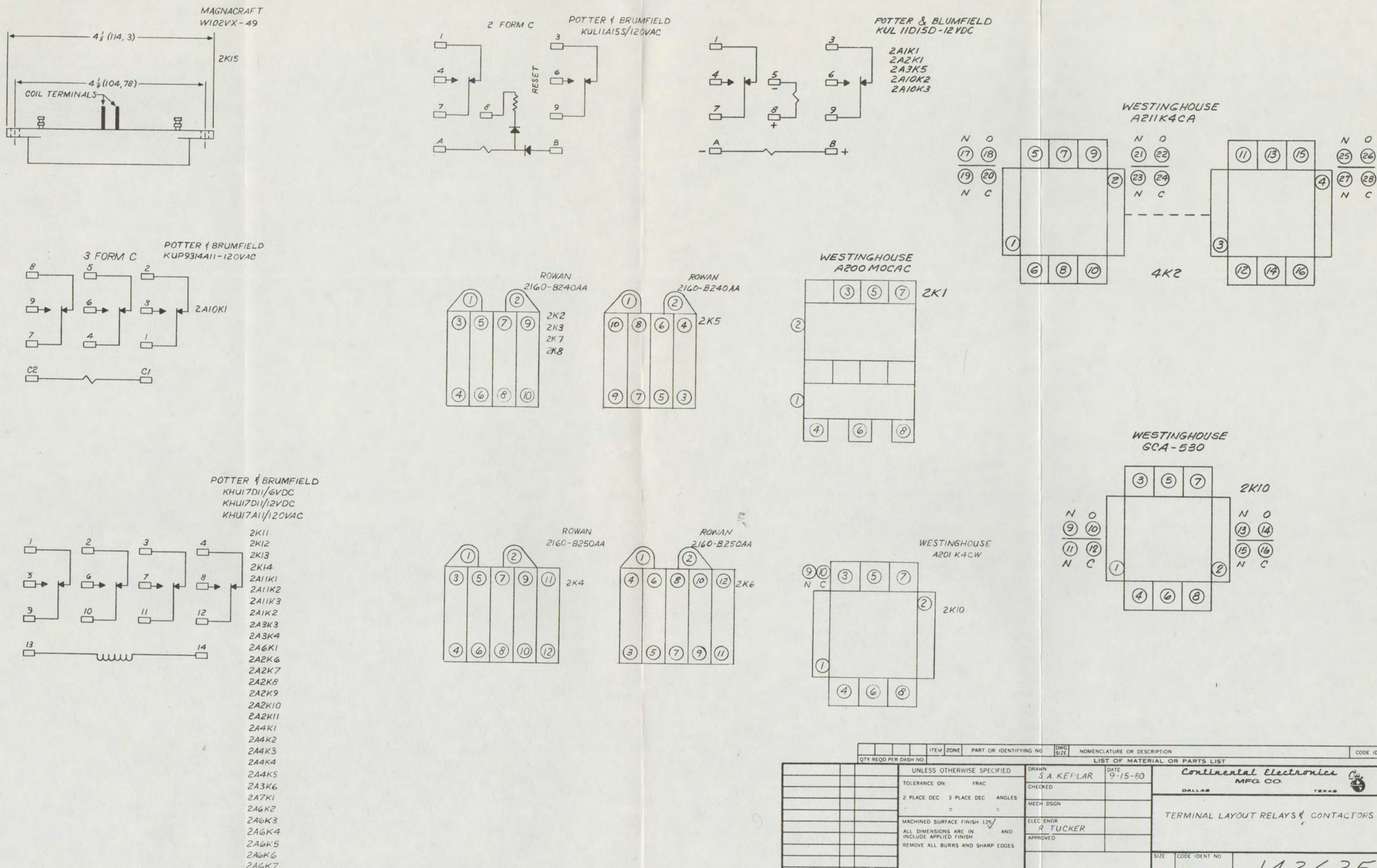
LADDER DIAGRAM
PLATE AND SCREEN
VARIAC CONTROL
TYPE 317C-2 XMTR

SIZE	CODE IDENT NO	
C	52151	142637
SCALE ~	WT ~	SHEET 1 OF 1

142637

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED



ITEM	ZONE	PART OR IDENTIFYING NO	DWG SIZE	NOMENCLATURE OR DESCRIPTION	CODE IDENT

QTY REQD PER DASH NO — LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	DWG SIZE	USED ON
		2343

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: S A KEPLAR — DATE: 9-15-80
CHECKED
MECH DSGN
ELEC ENGR: R TUCKER
APPROVED

Continental Electronics MFG. CO.
DALLAS TEXAS

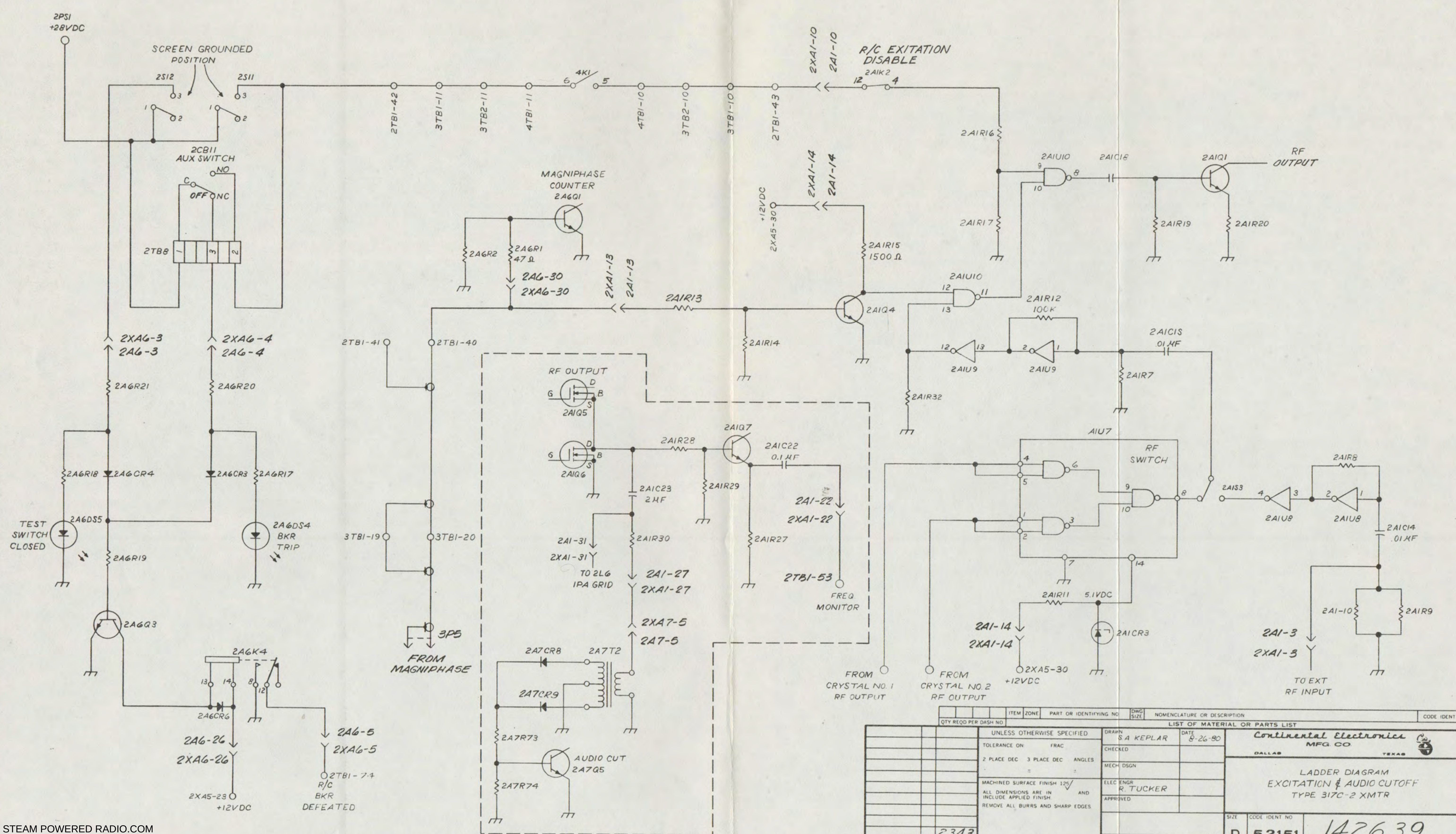
TERMINAL LAYOUT RELAYS & CONTACTORS

SIZE: D — CODE IDENT NO: 52151 — 142635
SCALE: ~ — WT: ~ — SHEET 1 OF 1

142635

C-WC FORM 387 B

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	MISC CHGS	5-1-84	CJA



ITEM	ZONE	PART OR IDENTIFYING NO	DWG SIZE	NOMENCLATURE OR DESCRIPTION	CODE IDENT

QTY REQD PER DASH NO — LIST OF MATERIAL OR PARTS LIST

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	S.A KEPLAR	DATE 8-26-80
CHECKED		
MECH DSGN		
ELEC ENGR	R. TUCKER	
APPROVED		

2343
NEXT ASSY | DWG SIZE | USED ON

Continental Electronics MFG. CO.
DALLAS TEXAS

LADDER DIAGRAM
EXCITATION & AUDIO CUTOFF
TYPE 317C-2 XMTR

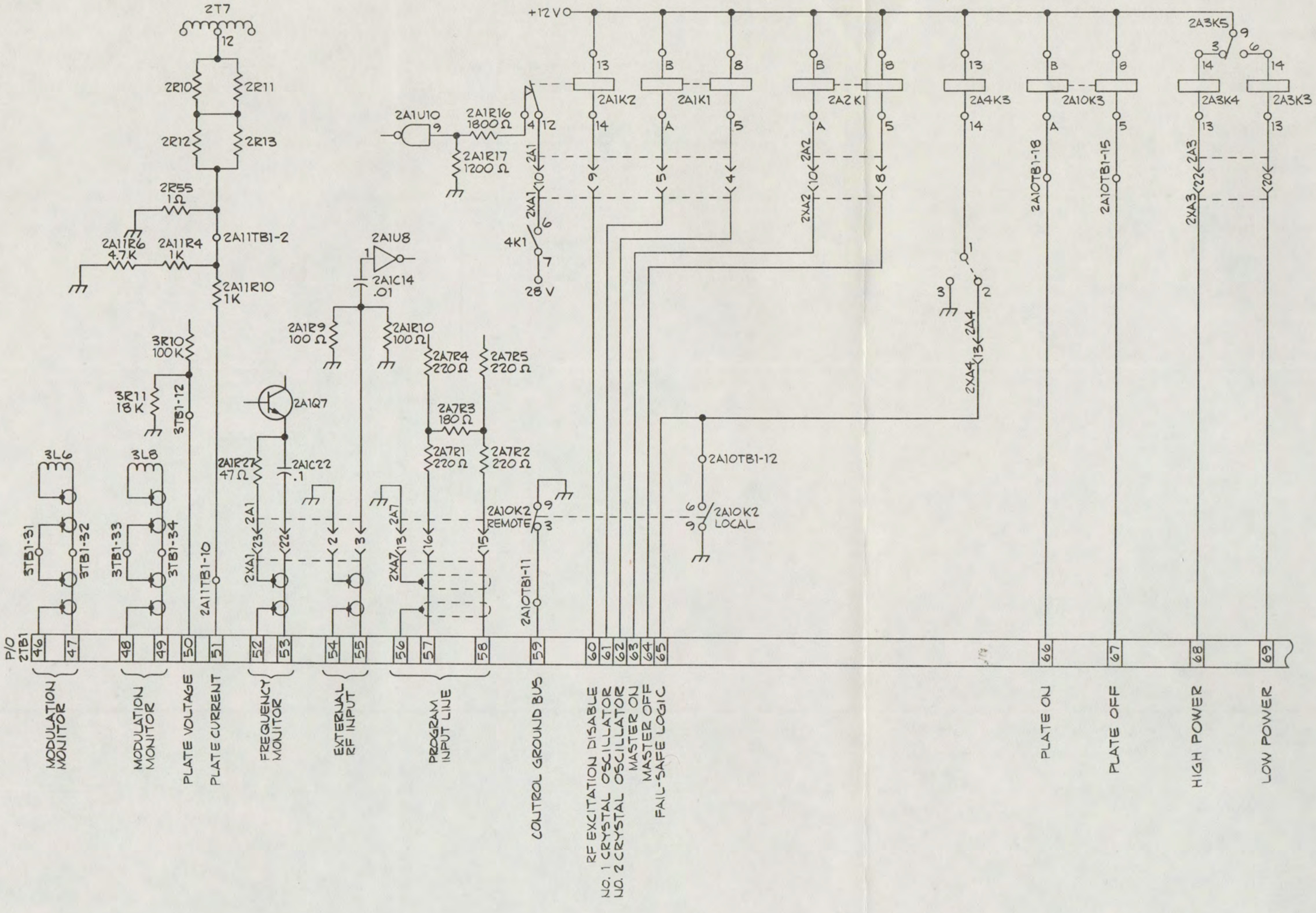
SIZE	CODE IDENT NO	
D	52151	142639
SCALE ~	WT ~	SHEET 1 OF 1

142639

2	1	SHEET	SHEET
		REV	STATUS

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED



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

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	DATE
M.J. BALL	3-14-84
CHECKED	
MECH DSGN	
ELEC ENGR	
APPROVED	

Continental Electronics MFG. CO
DALLAS TEXAS

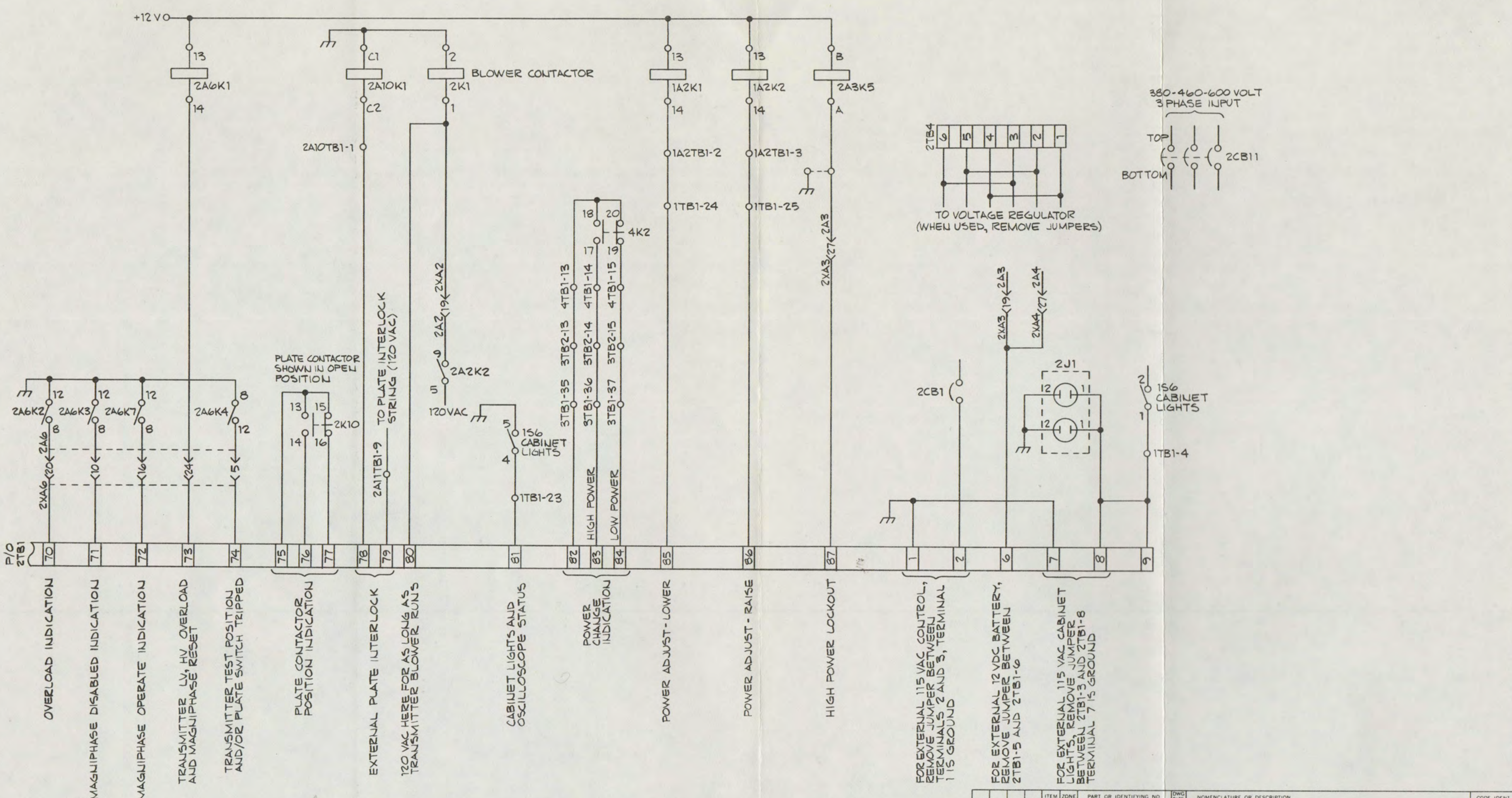
LADDER DIAGRAM, EXTERNAL CONNECTIONS, TYPE 317C-2 50 KW TRANSMITTER

SIZE	CODE IDENT NO	
D	52151	142646

SCALE ~ WT ~ SHEET 1 OF 2

NEXT ASSY: 2370 — USED ON

142646



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

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED

DRAWN: M. J. BALL — DATE: 3-15-84

Continental Electronics MFG. CO. — DALLAS, TEXAS

LADDER DIAGRAM, EXTERNAL CONNECTIONS, TYPE 317C-2 50 KW TRANSMITTER

SIZE: D — CODE IDENT NO: 52151 — 142646

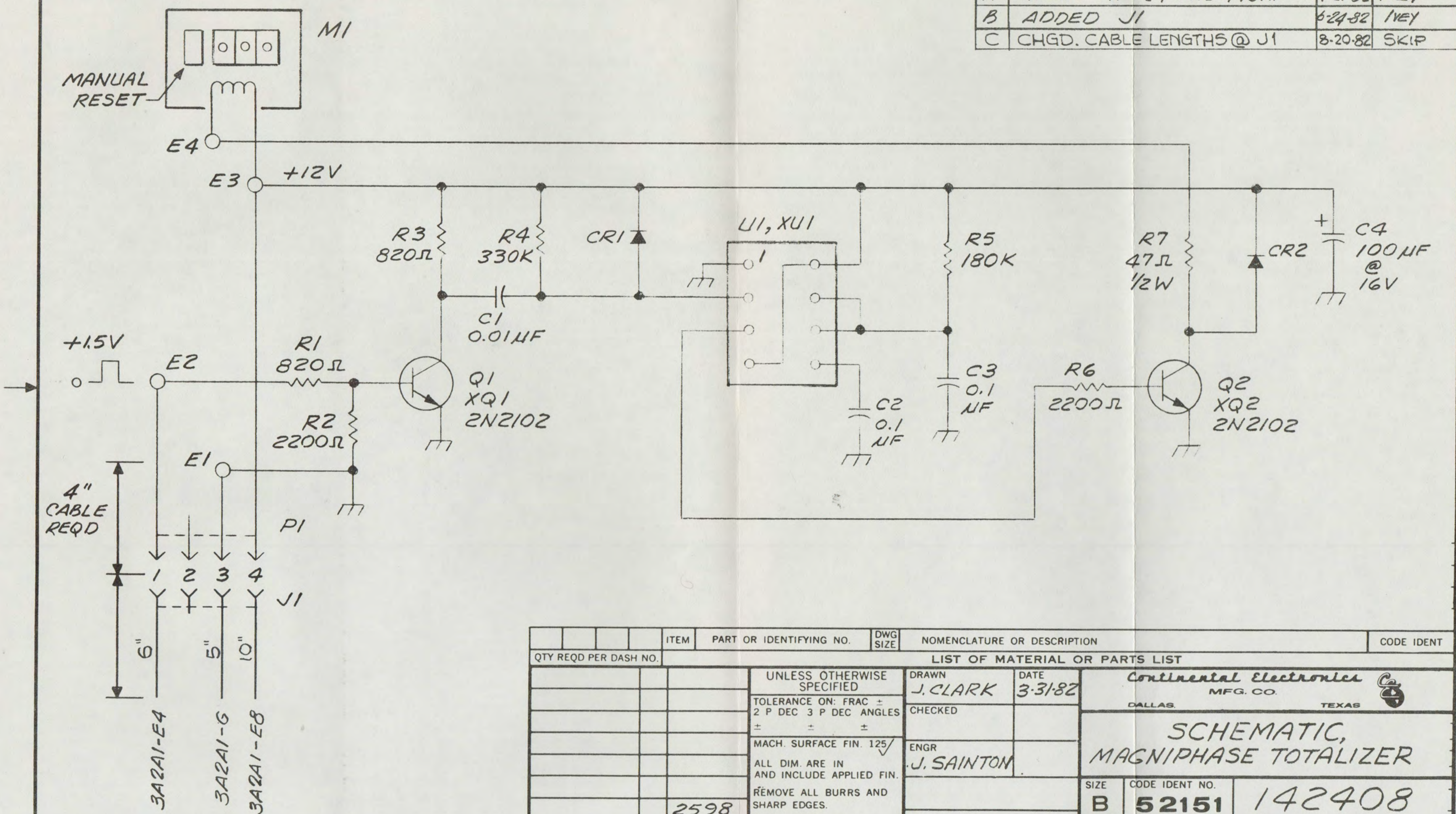
NEXT ASSY: 2370 — USED ON

SCALE: ~ — WT: ~ — SHEET 2 OF 2

142646

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
A	ADDED M1. C4 WAS 470µF	4-21-82	IVEY
B	ADDED J1	6-24-82	IVEY
C	CHGD. CABLE LENGTHS @ J1	8-20-82	SKIP



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

NEXT ASSY	DWG SIZE	USED ON
		2598

UNLESS OTHERWISE SPECIFIED
TOLERANCE ON: FRAC ± 2 P DEC 3 P DEC ANGLES ± ± ±
MACH. SURFACE FIN. 125
ALL DIM. ARE IN AND INCLUDE APPLIED FIN.
REMOVE ALL BURRS AND SHARP EDGES.

DRAWN J. CLARK — DATE 3-31-82
CHECKED
ENGR J. SAINTON

Continental Electronics MFG. CO. DALLAS TEXAS

SCHEMATIC, MAGNIPHASE TOTALIZER

SIZE B — CODE IDENT NO. 52151 — 142408

SCALE: ~ — WT ~ — SHEET 1 OF 1

CEMC FORM 385 B

SECTION 6 - PARTS LIST

6-1. INTRODUCTION

This section contains the Electrical Parts Lists for the 317C-2 Transmitter.

6-2. ELECTRICAL PARTS LIST

a. General. The electrical parts list identified the apparatus called out on the unit schematics. The value of each component and the manufacturer are included.

The legend of each sheet of the electrical parts lists gives the title of the unit and the reference drawing number. Each electrical part is assigned a part number consisting of letters and numbers in accordance with American Standards Y32.16-1975. Other columns list the part name, brief description, manufacturer's part number, and manufacturer.

Partial reference designations (Symbol Column) are listed on the equipment and schematic diagrams. The partial reference designations consist of the class letter and the identifying item name.

b. Reference Designations. The unit numbering method of assigning reference designations has been used to identify units, assemblies, subassemblies, and parts. This method has been expanded as necessary to cover the various degrees of subdivision of the equipment. Examples of this unit numbering methods and typical expansions of the same are illustrated by the following:

Example 1

1 R 1

Unit No. — Class of Item — Item No. Within Class

Read as: First (1) resistor (R) of first (1) unit.

Example 2

4 A1 R1

Unit No. — Assembly Designation — Class and No. of Item

Read as: First (1) resistor (R) of first (1) assembly (A) of fourth (4) unit.

Example 3

3 A1 A1 R1

Unit No. | Assembly Designation | Subassembly Designation | Class and No. of Item

Read as: First (1) resistor (R) of first (1) subassembly (A) of first (1) assembly (A) of third (3) unit.

c. Usage. When ordering parts from this list, the assembly designation and the associated unit should prefix the part designation. The part number and assembly number and the equipment designation number should also be given.

d. Parts Listing. The electrical parts lists are filed in parts list number order. An index is included to locate an equipment's appropriate parts list.

TUBE DATA SHEETS

8349
4CX35,000C

TECHNICAL DATA

RADIAL-BEAM POWER TETRODE

The EIMAC 8349/4CX35,000C is a ceramic/metal, forced-air cooled power tetrode intended for use at the 50 to 150 kilowatt output power level. It is recommended for use as a Class-C rf amplifier or oscillator, a Class-AB rf linear amplifier, or a Class-AB push-pull af amplifier or modulator. The 8349/4CX35,000C is also useful as a plate and screen modulated Class-C rf amplifier.

The forced-air cooled anode is rated at 35 kilowatts maximum dissipation.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	10.0 V
Current, at 10.0 volts	295 A
Amplification Factor (Average):	
Grid to Screen	4.5
Direct Interelectrode Capacitances (grounded cathode)[2]	
Cin	440 pF
Cout	55 pF
Cgp	2.3 pF
Frequency of Maximum Rating:	
CW	30 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	17.34 in; 440.4 mm
Diameter	9.75 in; 247.7 mm
Net Weight	50 lb; 22.7 kg
Operating Position	Vertical, base up or down
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Forced Air
Base	Special, graduated rings
Recommended Socket	EIMAC SK-1500 Series

 Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB

MAXIMUM RATINGS:

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION	35,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

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

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	15.0	kVdc
Screen Voltage	1.5	kVdc
Grid Voltage [1]	-400	Vdc
Zero-Signal Plate Current	1.0	Adc
Single Tone Plate Current	5.7	Adc
Single-Tone Screen Current [2]	0.9	Adc
Peak rf Grid Voltage [2]	250	v
Peak Driving Power [2]	0	w
Plate Dissipation	30	kW
Plate Output Power	55	kW
Resonant Load Impedance	1280	Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION	35,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	10.0	15.0	19.0	kVdc
Screen Voltage	750	750	750	Vdc
Grid Voltage	-425	-480	-550	Vdc
Plate Current	7.5	6.8	6.96	Adc
Screen Current [1]	0.84	0.51	0.80	Adc
Grid Current [1]	0.29	0.23	0.35	Adc
Peak rf Grid Voltage [1]	600	660	730	v
Calculated Driving Power [1]	180	150	258	W
Plate Dissipation	19.3	19.0	21.0	kW
Plate Output Power	55.5	82.5	110	kW

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	14,000	VOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION [1]	23,000	WATTS
SCREEN DISSIPATION [2]	1750	WATTS
GRID DISSIPATION [2]	500	WATTS

1. Corresponds to 35,000 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	12.0	kVdc
Screen Voltage	750	Vdc
Grid Voltage	-600	Vdc
Plate Current	5.4	Adc
Screen Current [1]	0.52	Adc
Grid Current [1]	0.16	Adc
Peak af Screen Voltage [2] (100% modulation)	500	v
Peak rf Grid Voltage [1]	740	v
Calculated Driving Power	125	W
Plate Dissipation	13.2	kW
Plate Output Power	55.0	kW
Resonant Load Impedance	1120	Ω

1. Approximate value.

2. Approximate value, depending upon degree of driver modulation.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION	35,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	12.0	kVdc
Screen Voltage	1.5	kVdc
Grid Voltage[1/3]	-400	Vdc
Zero-Signal Plate Current	3.0	Adc
Max Signal Plate Current	9.2	Adc
Max Signal Screen Current[1]	1.8	Adc
Peak af Grid Voltage[2]	280	v
Max Signal Plate Dissipation[2]	20	kW
Plate Output Power	70	kW
Load Resistance (plate to plate)	2860	Ω

2. Per Tube
3. Adjust to give stated zero-signal plate current.

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

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 10.0 volts	280	310	A
Interelectrode Capacitances (grounded cathode connection)[2]			
Cin	410	470	pF
Cout	50	60	pF
Cgp	1.5	3.2	pF

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

APPLICATION

MECHANICAL

MOUNTING - The 4CX35,000C must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC sockets, type SK-1500, and SK-1510 have been designed especially for the concentric base terminals of the 4CX35,000C.

COOLING - The maximum temperature rating for the external surfaces of the 4CX35,000C is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air-flow requirements to maintain core temperature at 225°C in 40° ambient air are tabulated below (for operation below 30 megahertz.) These data are for air flowing in the base-to-anode direction.

	Base-to-Anode Air Flow			
	Sea Level		10,000 Feet	
Plate Dissipation * (Watts)	Air Flow (CFM)	Pressure Drop(Inches of Water)	Air Flow (CFM)	Pressure Drop(Inches of Water)
15,000	440	1.0	635	1.44
20,000	650	2.0	935	2.9
25,000	975	3.8	1400	5.5
30,000	1300	6.0	1870	8.6
35,000	1760	9.6	2535	13.8

* Since the power dissipated by the filament represents about 3000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 2250 watts, allowance has been made in preparing this tabulation for an additional 5250 watts dissipation.

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

Separate cooling of the tube base is required and is accomplished by directing approximately 120 cfm of air horizontally through the socket from the side. It is preferable to direct this air through three equally spaced ducts.

The well in the center of the baseplate of the tube is a critical area which requires cooling to maintain envelope temperatures less than 250°C. For most applications, 1 to 2 CFM of air directed through the center of the socket is sufficient for this purpose.

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

ELECTRICAL

FILAMENT OPERATION - The peak emission at rated filament voltage of the EIMAC 4CX35,000C is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 4CX35,000C by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not affect the operation of the equipment. This is done by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage is reduced on the 4CX35,000C. At some point in filament voltage there will be a noticeable reduction in plate current, or power output, or an increase in distortion. Operation may be at a filament voltage slightly higher than that point at which performance appears to deteriorate. This voltage should be measured at the socket with a 1% meter and periodically checked to maintain proper operation.

Filament starting current must be limited to a maximum of 900 amperes.

Voltage between filament and the base plates of tube and SK-1500 socket, must not exceed 100 volts.

GRID OPERATION - The 4CX35,000C grid has a maximum dissipation rating of 500 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

SCREEN OPERATION - The power dissipated by the screen of the 4CX35,000C must not exceed 1750 watts.

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

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 1750 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX35,000C is 35,000 watts. When the 4CX35,000C is operated as a plate-modulated rf amplifier, under carrier conditions, the maximum plate dissipation is 23,000 watts.

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

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

HIGH VOLTAGE - Normal operating voltages used with the 4CX35,000C are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

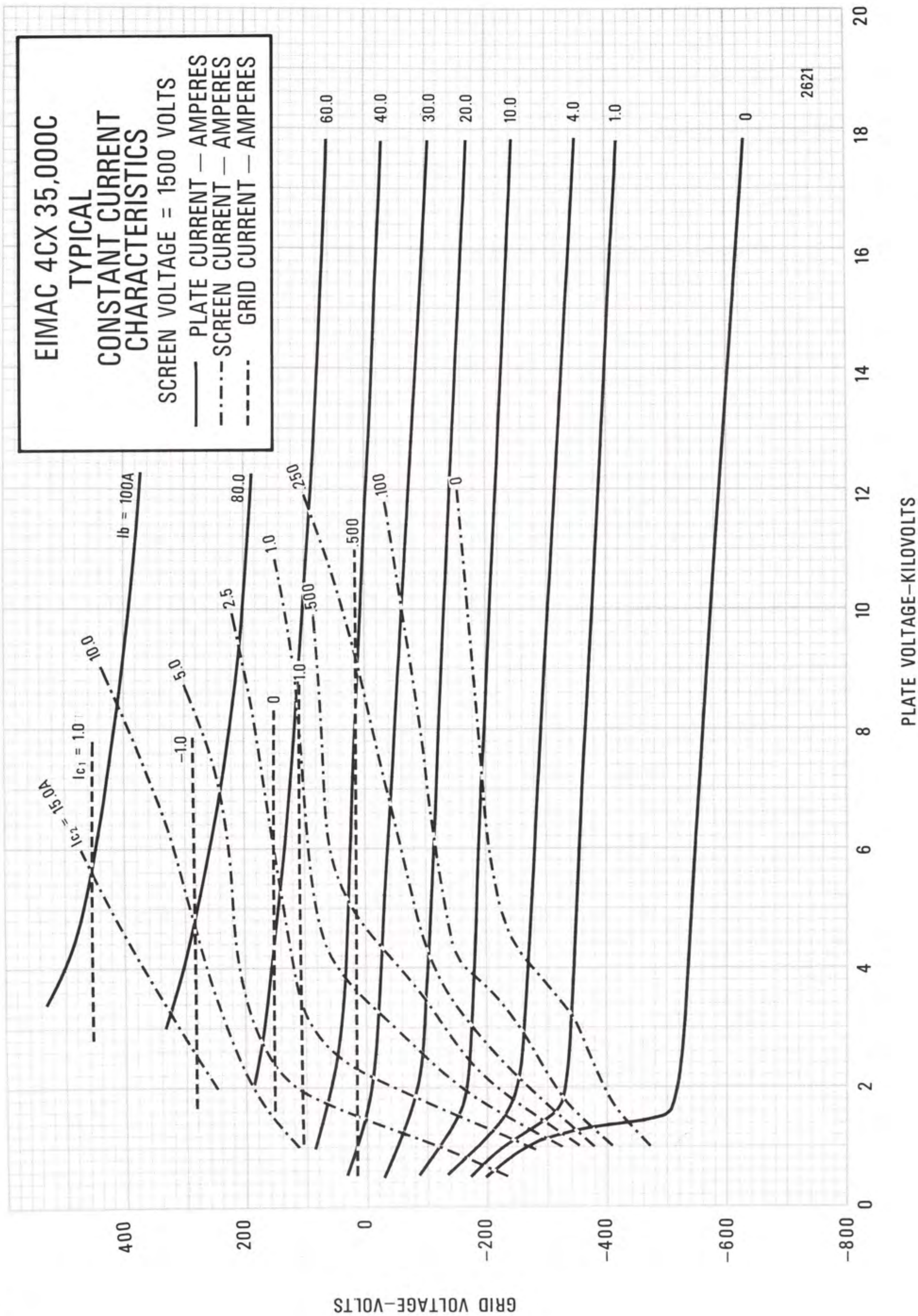
FAULT PROTECTION - In addition to normal cooling airflow interlock and plate and screen over-current interlocks, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high plate voltage.

In all cases some protective resistance, at least one or two ohms, should be used in series with the tube anode to absorb power supply stored energy in case a plate arc should occur. Where stored energy is high, it is recommended that some form of electronic crowbar be used which will discharge power supply capacitors in as short a time as possible following indication of start of a plate arc.

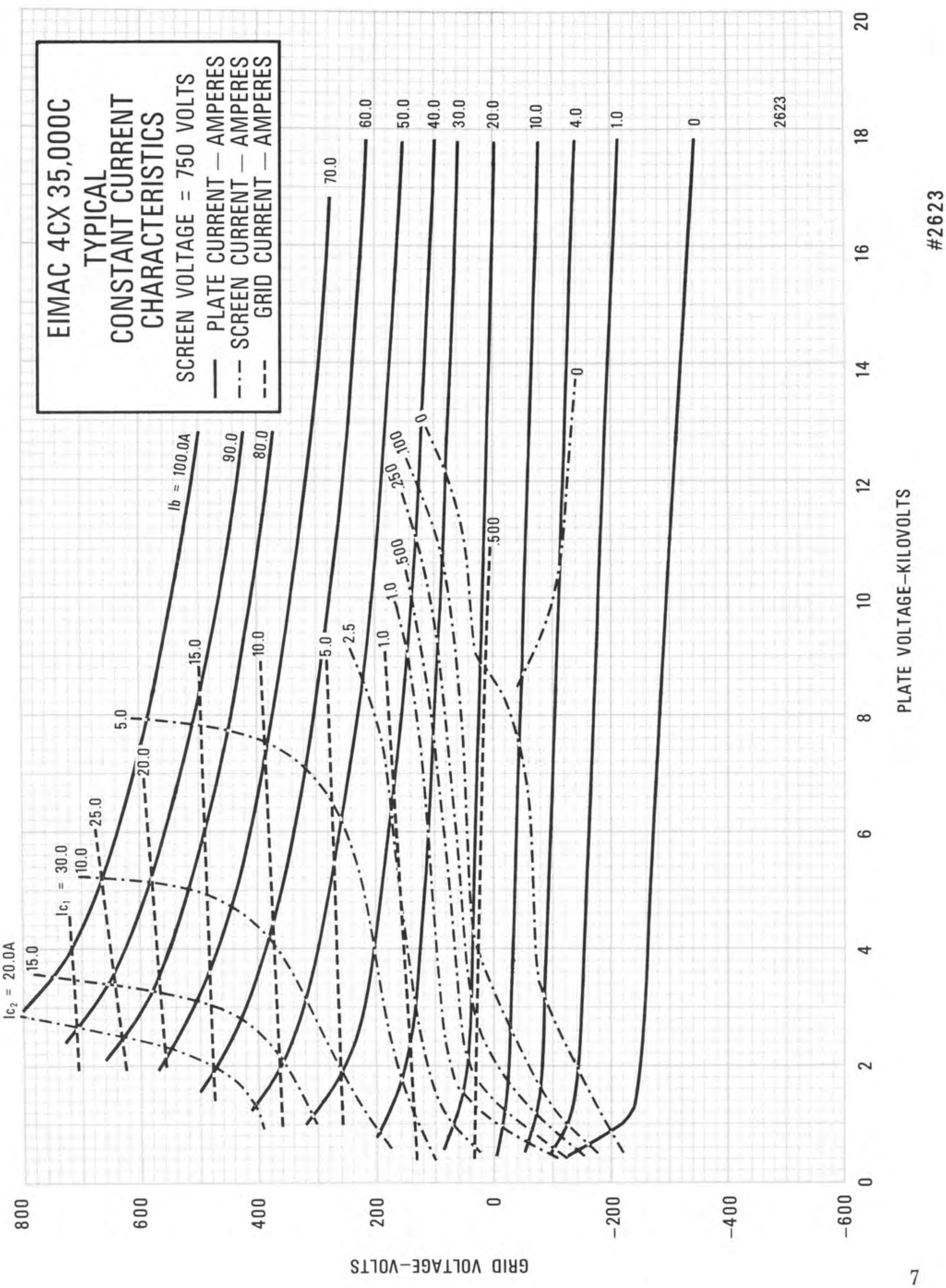
X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CX35,000C, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

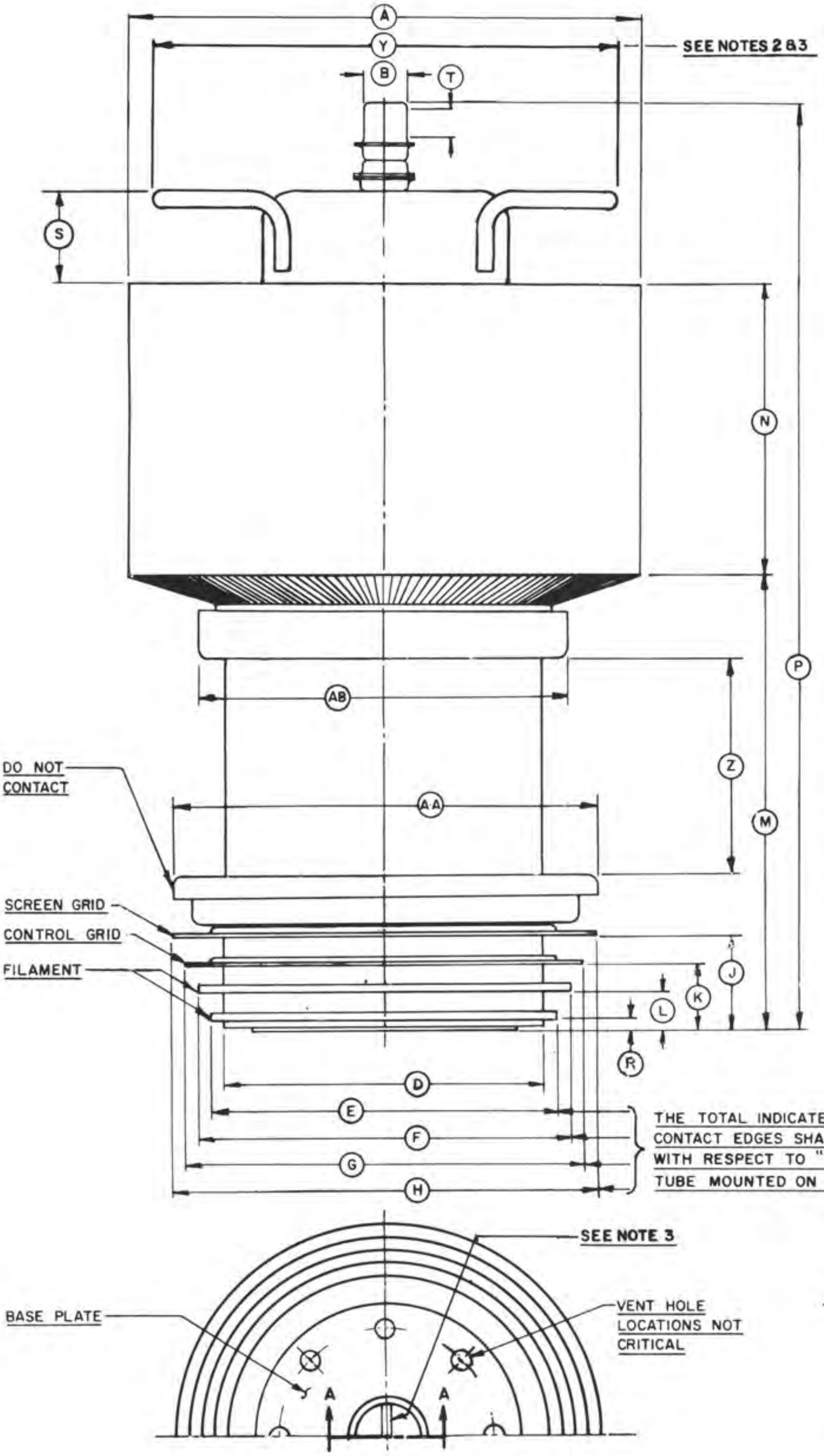
Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

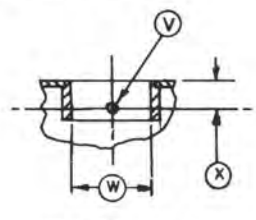
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Product Manager, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.


EIMAC 4CX 35,000C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
Ib = 100A
80.0
60.0
40.0
30.0
20.0
10.0
4.0
1.0
0
Ic2 = 15.0A
Ic1 = 1.0
10.0
5.0
2.5
1.0
.500
.250
.100
0
-1.0
2621
PLATE VOLTAGE-KILOVOLTS
GRID VOLTAGE-VOLTS

#2621


EIMAC 4CX 35,000C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
PLATE VOLTAGE—KILOVOLTS
GRID VOLTAGE—VOLTS
#2623





SECTION A-A

DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	9.500	9.750	241.30	247.65
B	0.860	0.890	21.84	22.60
D	5.980	6.020	151.89	152.91
E	6.510	6.560	165.35	166.62
F	6.980	7.020	177.29	178.31
G	7.480	7.520	189.99	191.01
H	7.975	8.015	202.57	203.58
J	1.750	1.800	44.45	45.72
K	1.220	1.270	30.99	32.26
L	0.690	0.740	17.53	18.80
M	8.442	8.692	214.43	220.78
N	5.375	5.625	136.52	142.88
P	17.070	17.340	433.58	440.44
R	0.173	0.213	4.40	5.41
S	1.750		44.45	
T	0.485	0.515	12.32	13.08
V	— —	0.135	— —	3.43
W	1.250	1.270	31.75	32.26
X	0.490	0.530	12.45	13.46
Y	— —	8.750	— —	222.25
Z	3.750		95.25	
AA	8.000		203.20	
AB	6.875		174.63	

NOTES:
1. REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. DIM. Y IS MAXIMUM DIA. ACROSS CORNERS
3. HANDLE LATERAL AXIS ORIENTATION WITH BASE LOCK PIN IS AS SHOWN.

EIMAC

TECHNICAL DATA

8238
3CX3000A1
8239
3CX3000F1

LOW-MU AIR COOLED POWER TRIODES

The EIMAC 3CX3000A1 and 3CX3000F1 are low-mu, all ceramic-and-metal, forced-air cooled, external anode power triodes with a maximum plate dissipation rating of 4000 watts. These tubes are intended for use as an audio amplifier or modulator.

Two of these tubes in Class AB1 service will deliver up to 10 kilowatts maximum-signal plate output power at 6000 plate volts without drawing grid current.

The 3CX3000A1 has coaxial base terminals, while the 3CX3000F1 is identical except for the addition of flexible leads for the grid and filament connections, which can simplify socketing in audio applications.

3CX3000A1

3CX3000F1

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	7.5 ± 0.37 V
Current @ 7.5 V	51.5 A
Amplification Factor (average)	5

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

MECHANICAL

Maximum Overall Dimensions:

Length (3CX3000A1)	9.000 In; 22.76 cm
(3CX3000F1, incl. fil. leads)	18.437 In; 46.83 cm
Diameter (both types)	4.156 In; 10.56 cm
Operating Position	Vertical, base up or down
Net Weight (approx.): 3CX3000A1	6.2 lb; 2.8 kg
3CX3000F1	7.0 lb; 3.2 kg
Cooling	Forced Air

Maximum Operating Temperature:

Anode Core & Ceramic/Metal Seals	250°C
3CX3000F1 Fil. Lead/Tube Base Junctions	150°C

4178 (Effective 7-1-79) Printed in U.S.A.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB_1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	4000	WATTS
GRID DISSIPATION	50	WATTS

*Adjust to stated Zero-Signal DC Plate Current. Can be expected to vary ± 15%. Effective grid-current resistance must not exceed 200,000 ohms.

TYPICAL OPERATION (Sinusoidal wave, two tubes)

Class AB_1

Plate Voltage	4.0	5.5	kVdc
Grid Voltage (approx.)*	-750	-1070	Vdc
Zero-Signal Plate Current	500	500	mAdc
Max-Signal Plate Current	2.75	2.2	Adc
Effective Load, Plate-to-Plate	2120	4000	ohms
Peak AF Grid Input Voltage (per tube)	750	1070	v
Max-Signal Driving Power	0	0	W
Max-Signal Plate Input Power	11.0	13.1	kW
Max-Signal Plate Dissipation (per tube)	2.75	2.55	kW
Max-Signal Plate Output Power	5.5	8.25	kW

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current @ 7.5 volts	48	54	A
Grid Bias Voltage, for anode voltage = 5000 Vdc and anode current = 0.4 Adc	-780	-990	V

APPLICATION

MECHANICAL

MOUNTING - The 3CX3000A1 and 3CX3000F1 must be mounted vertically, base down or up at the convenience of the circuit designer. The filament connections to the 3CX3000A1 should be made through spring collets. These are available from EIMAC, with the following part numbers:

149575 Inner Line Collet
149576 Outer Line Collet

Reasonable care should be taken that these collets do not impart undue strain to the terminals or the base of the tube.

COOLING - The maximum temperature rating for the anode core and the ceramic/metal seal areas of these tubes is 250°C, and sufficient forced-air cooling must be provided to assure operation at safe tube temperatures. Tube life is usually prolonged if cooling in excess of absolute minimum requirements is provided for cooler tube temperatures.

The filament leads of the 3CX3000F1 are attached to the tube with soft solder, and care must therefore be taken to supply sufficient cooling to this area of the tube to maintain temperatures below 150°C to avoid melting or loosening of these leads.

Minimum air flow requirements to maintain anode core and ceramic/metal seal areas below 225°C at sea level with an inlet-air temperature of 40°C are tabulated for air-flow in the base-to-anode and anode-to-base directions. At higher ambient temperatures, frequencies above 30 MHz, or at higher altitudes, a greater quantity of air will be required.

Base-to-Anode Air Flow				
	Sea Level		5,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop Inches water	Air Flow CFM	Pressure Drop Inches water
2500	36	0.60	43	0.72
4000	67	1.20	80	1.45
Anode-to-Base Air Flow				
2500	42	0.70	50	0.84
4000	84	1.70	101	2.00

With air flowing in a base-to-anode direction, and with the specified air also flowing past the base section of the tube, no additional base cooling of either type is normally required. With air flowing in an anode-to-base direction, both types require additional cooling air directed into the filament stem structure, between the inner and outer filament terminals, in the amount of 5 cfm minimum, directed by an appropriate air nozzle or pipe.

It it suggested that temperatures, especially in the base area of the tube, be monitored in any new installation to insure proper cooling. Temperatures may be measured with any of the available temperature-sensing paint or crayon materials.

ELECTRICAL

FILAMENT OPERATION - The filament voltage, as measured at the filament terminals, should be 7.5 volts, with maximum allowable variations due to line fluctuations of from 7.12 to 7.87 volts.

INTERLOCKS - An interlock device should be provided to insure that cooling air flow is established before application of electrical power, including the tube filament.

FAULT PROTECTION - In addition to the normal cooling airflow interlock and the plate over-current interlock it is good practice to protect the tube from internal damage which could result from a plate arc at high plate voltage. Protective resistance should be used in series with the tube anode to absorb power supply stored energy in case a plate arc should occur. EIMAC's Application Bulletin #17 titled, "FAULT PROTECTION" is available on request.

GRID OPERATION - The grid dissipation rating of the tube is 50 watts. This is the product of the peak positive grid voltage and average dc grid current. When tubes are used in parallel in amplifier or modulator service provision should be made for individual adjustment of bias voltage, in order to match the static current characteristics of the tubes.

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

SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, 94070, For information and recommendations.

OPERATING HAZARDS

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

The operation of power tubes involves one or more of the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel:

a. *HIGH VOLTAGE* - Normal operating voltages can be deadly.

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

c. *X-RAY RADIATION* - High voltage tubes can produce dangerous and possibly fatal x-rays.

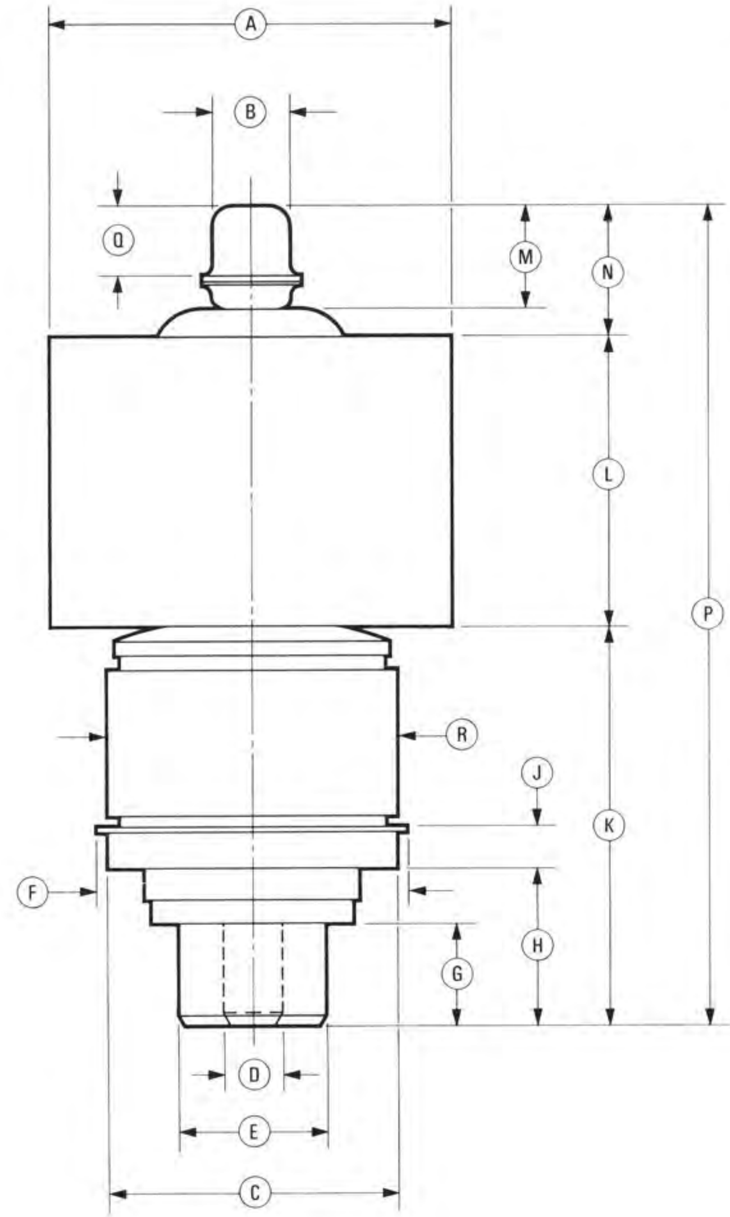
d. *BERYLLIUM OXIDE POISONING* - Dust or fumes from BeO ceramics used as thermal links with some conduction-cooled power tubes are highly toxic and can cause serious injury or death.

e. *GLASS EXPLOSION* - Many electron tubes have glass envelopes. Breaking the glass can cause an implosion, which will result in an explosive scattering of glass particles. Handle glass tubes carefully.

f. *HOT WATER* - Water used to cool tubes may reach scalding temperatures. Touching or rupture of the cooling system can cause serious burns.

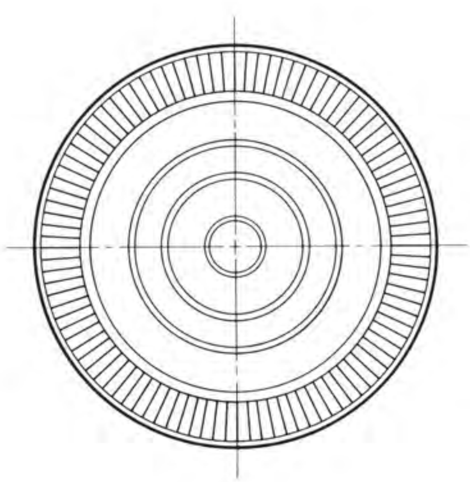
g. *HOT SURFACES* - Surfaces of air-cooled radiators and other parts of tubes can reach temperatures of several hundred degrees centigrade and cause serious burns if touched.

Please review the detailed operating hazards sheet enclosed with each tube or request a copy from the address shown below: Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070.

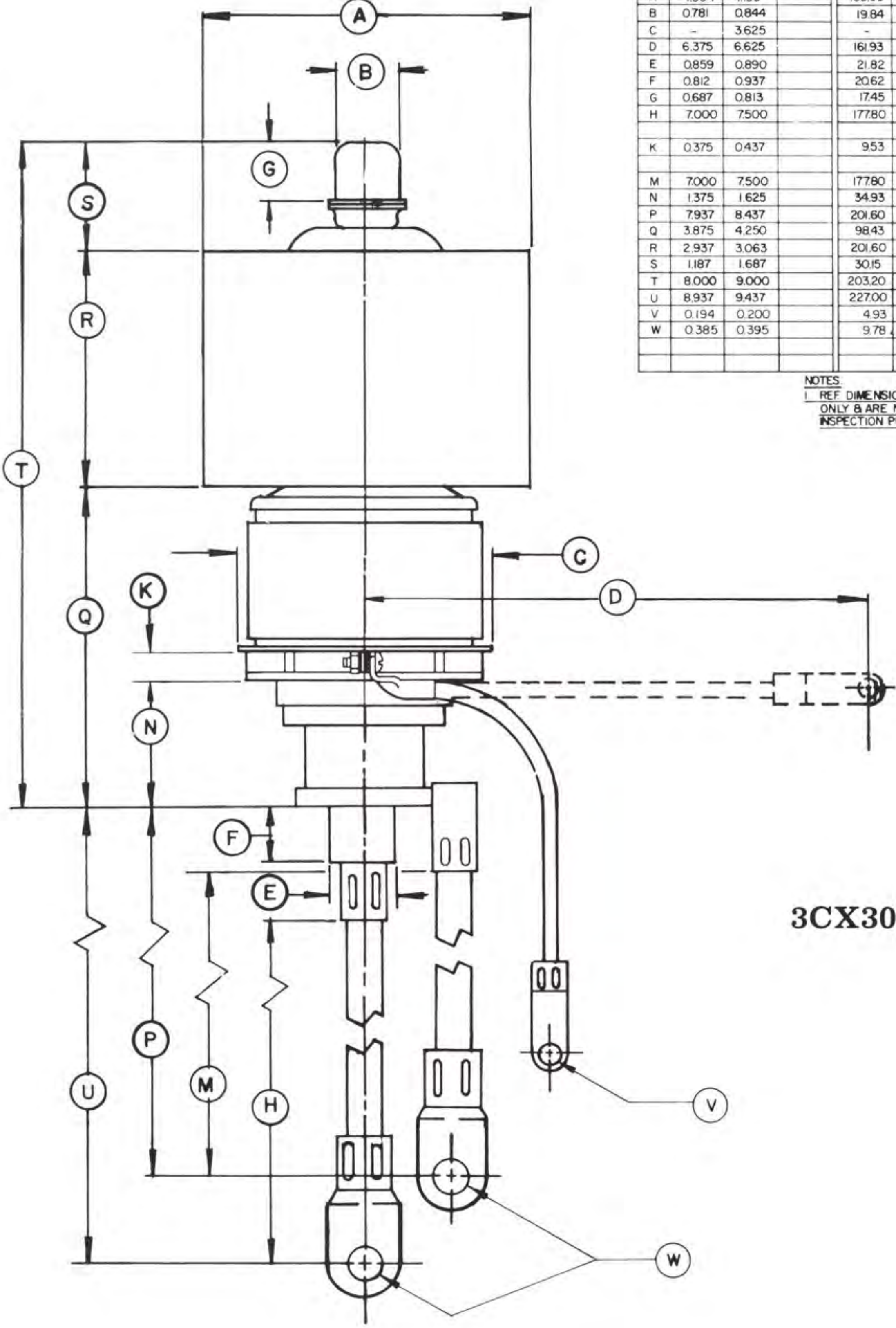


DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.094	4.156	- -	103.99	105.56	- -
B	0.781	0.844	- -	19.83	21.44	- -
C	2.990	3.010	- -	75.95	76.45	- -
D	0.615	0.635	- -	15.62	16.13	- -
E	1.490	1.510	- -	37.85	38.35	- -
F	- -	3.625	- -	- -	92.08	- -
G	0.813	0.937	- -	20.65	23.80	- -
H	1.375	1.625	- -	34.92	41.28	- -
J	0.391	0.422	- -	9.93	10.72	- -
K	3.875	4.250	- -	98.43	107.95	- -
L	2.937	3.063	- -	74.60	77.80	- -
N	1.187	1.687	- -	30.15	42.85	- -
P	8.000	9.000	- -	203.20	228.60	- -
Q	0.687	0.813	- -	17.45	20.65	- -

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



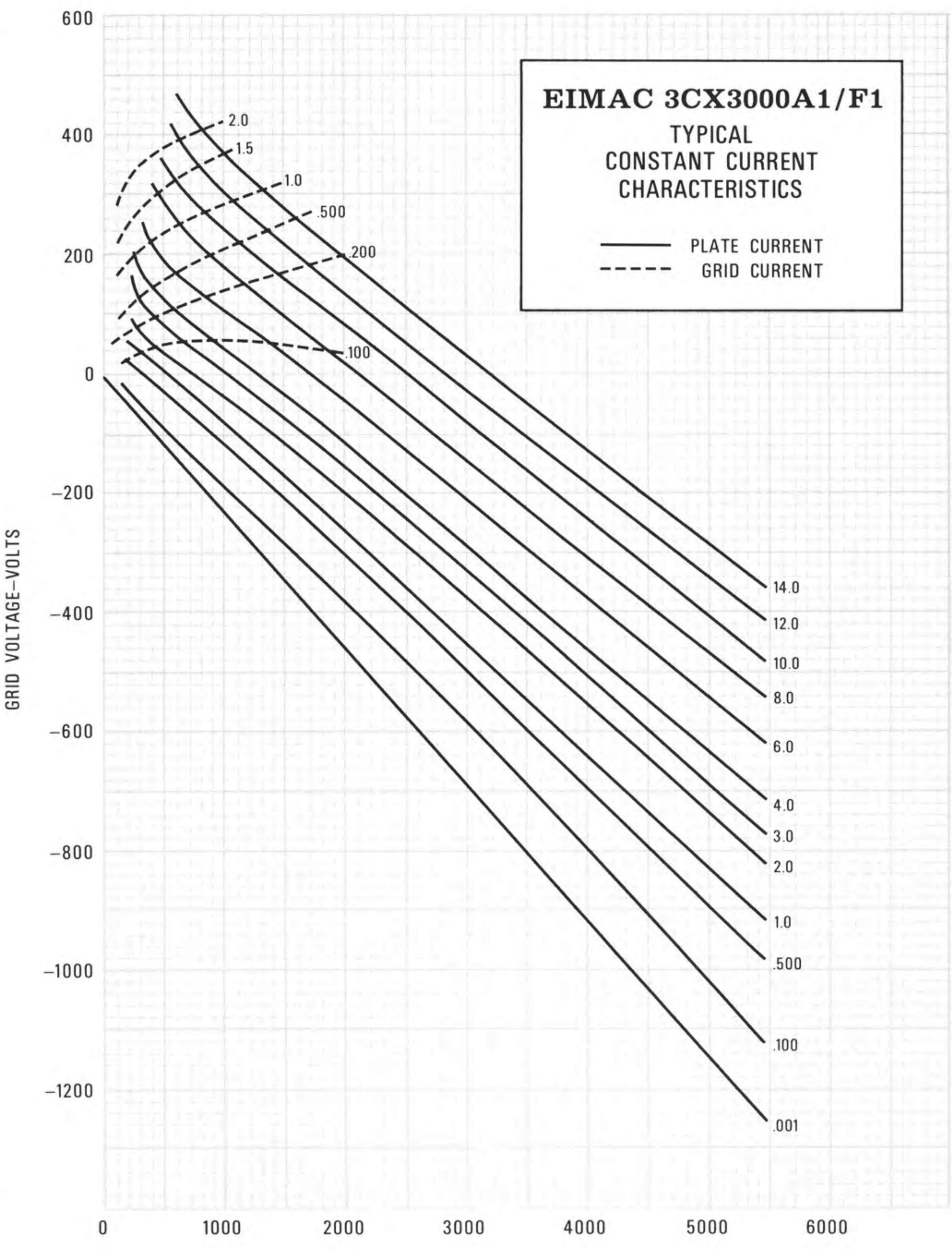
3CX3000A1



DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.094	4.156		103.99	105.56	
B	0.781	0.844		19.84	21.44	
C	–	3.625		–	92.08	
D	6.375	6.625		161.93	168.28	
E	0.859	0.890		21.82	22.61	
F	0.812	0.937		20.62	23.80	
G	0.687	0.813		17.45	20.65	
H	7.000	7.500		177.80	190.50	
K	0.375	0.437		9.53	11.10	
M	7.000	7.500		177.80	190.50	
N	1.375	1.625		34.93	41.28	
P	7.937	8.437		201.60	214.30	
Q	3.875	4.250		98.43	107.95	
R	2.937	3.063		201.60	214.30	
S	1.187	1.687		30.15	42.85	
T	8.000	9.000		203.20	228.60	
U	8.937	9.437		227.00	239.70	
V	0.194	0.200		4.93	5.08	
W	0.385	0.395		9.78	10.03	

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

3CX3000F1


EIMAC 3CX3000A1/F1
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE–VOLTS
600
400
200
0
−200
−400
−600
−800
−1000
−1200
PLATE VOLTAGE–VOLTS
0
1000
2000
3000
4000
5000
6000
2.0
1.5
1.0
.500
.200
.100
14.0
12.0
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.500
.100
.001

CURVE 3452

TECHNICAL DATA

6775 / 4-400C

RADIAL BEAM POWER TETRODE

The EIMAC 6775/4-400C is a compact, ruggedly constructed, broadcast-quality tetrode having a maximum plate dissipation rating of 400 watts. It is intended for use as an amplifier, oscillator, or modulator. The low grid-plate capacitance of this tetrode coupled with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

The 6775/4-400C is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope, and over the plate seal. Cooling can be greatly simplified by using an EIMAC SK-400 Series Air-System Socket, and its accompanying glass chimney. This socket is designed to maintain the correct balance of cooling air between the component parts of the tube.[1]

The 6775/4-400C is especially recommended for applications where long life and consistent performance are of prime consideration.[2]

GENERAL CHARACTERISTICS[3]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	14.7 A
Transconductance (Average):	
I_b = 100 mA, E_{c2} = 500 volts	4000 μmhos
Amplification Factor (Average):	
Grid to Screen	5.1
Direct Interelectrode Capacitances (grounded filament)[4]	
Cin	12.5 pF
Cout	4.7 pF
Cgp	0.12 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Guarantee applies only when the 4-400C is used as specified with adequate cooling air in the SK-400 or SK-410 Air-System Socket and associated chimney, or equivalents.
2. See FILAMENT VOLTAGE section for recommended operating conditions when long life and consistent performance are of prime concern.
3. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
4. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:
- Length . . . . 6.375 in; 161.93 mm
- Diameter . . . . 3.563 in; 90.50 mm

Net Weight . . . . 9.0 oz; 255 gm

Operating Position . . . . Any

Maximum Operating Temperature:
- Plate Seal . . . . 225°C
- Base Seals . . . . 200°C

Cooling . . . . Radiation and forced air

Base . . . . Special 5-pin

Recommended Socket . . . . EIMAC SK-400 Series

Recommended Chimney . . . . EIMAC SK-406

Recommended Heat-Dissipating Connectors:
- Plate HR-6

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB_1

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	800	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION	400	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	10	WATTS

TYPICAL OPERATION (Frequencies to 75 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	3000	Vdc
Screen Voltage	750	Vdc
Grid Voltage [1]	-130	Vdc
Zero-Signal Plate Current	80	mAdc
Single-Tone Plate Current	290	mAdc
Single-Tone Screen Current [2]	13	mAdc
Useful Output Power	470	w
Resonant Load Impedance	5000	Ω

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

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

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION	400	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	10	WATTS

TYPICAL OPERATION (Frequencies to 75 MHz)

Plate Voltage	2500	3000	4000	Vdc
Screen Voltage	500	500	500	Vdc
Grid Voltage	-200	-220	-220	Vdc
Plate Current	350	350	350	mAdc
Screen Current [1]	46	46	40	mAdc
Screen Dissipation	23	23	20	W
Grid Current [1]	18	19	18	mAdc
Peak rf Grid Voltage [1]	300	320	320	v
Grid Dissipation	1.8	1.9	1.8	W
Calculated Driving Power [2]	5.4	6.1	5.8	W
Plate Input Power	875	1050	1400	W
Plate Dissipation	235	250	300	W
Plate Output Power	640	800	1100	W

1. Approximate value.
2. Driving Power increases with frequency. At 75 MHz driving power is approximately 12 watts.

TYPICAL OPERATION (110 MHz, two tubes)

Plate Voltage	3000	4000	Vdc
Screen Voltage	500	500	Vdc
Grid Voltage	-170	-170	Vdc
Plate Current	500	540	mAdc
Screen Current	34	31	mAdc
Grid Current	20	20	mAdc
Driving Power [1]	20	20	W
Plate Output Power [1]	1300	1600	W
Useful Output Power	1160	1440	W

1. Approximate value

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

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	3200	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	0.275	AMPERE
PLATE DISSIPATION[1]	270	WATTS
SCREEN DISSIPATION[2]	35	WATTS
GRID DISSIPATION[2]	10	WATTS

1. Corresponds to 400 watts at 100% sine-wave modulation.

TYPICAL OPERATION (Frequencies to 75 MHz, Continuous Service)

Plate Voltage	2000	2500	3000	Vdc
Screen Voltage	500	500	500	Vdc
Grid Voltage	-220	-220	-220	Vdc
Plate Current	275	275	275	mAdc
Screen Current[1]	30	28	26	mAdc
Screen Dissipation	15	14	13	W
Grid Current[1]	12	12	12	mAdc
Grid Dissipation	1.1	1.1	1.1	W
Peak af Screen Voltage[1] (100% modulation)	350	350	350	v
Peak rf Grid Voltage[1]	290	290	290	v
Calculated Driving Power[1]	3.5	3.5	3.5	W
Plate Input Power	550	688	825	W
Plate Dissipation	170	178	195	W
Plate Output Power	380	510	630	W

1. Approximate value.

MAXIMUM RATINGS (Frequencies to 30 MHz, Intermittent Service)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	0.275	AMPERE
PLATE DISSIPATION[1]	270	WATTS
SCREEN DISSIPATION[2]	35	WATTS
GRID DISSIPATION[2]	10	WATTS

2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz, Intermittent Service)

Plate Voltage	2000	2500	3000	3650	Vdc
Screen Voltage	500	500	500	500	Vdc
Grid Voltage	-220	-220	-220	-225	Vdc
Plate Current	275	275	275	275	mAdc
Screen Current[1]	30	28	26	23	mAdc
Screen Dissipation	15	14	13	12	W
Grid Current[1]	12	12	12	13	mAdc
Grid Dissipation	1.1	1.1	1.1	1.2	W
Peak Screen Voltage (100% modulation)	350	350	350	350	v
Peak rf Grid Voltage[1]	290	290	290	315	v
Calculated Driving Power[1]	3.5	3.5	3.5	4.0	W
Plate Input Power	550	688	825	1000	W
Plate Dissipation	170	178	195	235	W
Plate Output Power	380	510	630	765	W

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR Class AB, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	800	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION	400	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	10	WATTS

TYPICAL OPERATION (Two Tubes) Class AB_1

Plate Voltage	2500	3000	3500	4000	Vdc
Screen Voltage	750	750	750	750	Vdc
Grid Voltage[1/4]	-130	-137	-145	-150	Vdc
Zero-Signal Plate Current	190	160	140	120	mAdc
Max.Signal Plate Current	635	635	610	585	mAdc
Zero-Signal Screen Current	0	0	0	0	mAdc
Max.Signal Screen Current[1]	28	26	32	40	mAdc
Peak af Grid Voltage[2]	130	137	145	150	v
Peak Driving Power[3]	0	0	0	0	w
Max Signal Plate Dissipation[2]	370	400	400	400	W
Plate Output Power	850	1100	1330	1540	W
Load Resistance (plate to plate)	6800	8900	11,500	14,000	Ω

TYPICAL OPERATION (Two Tubes) Class AB_2

Plate Voltage	2500	3000	3500	4000	Vdc
Screen Voltage	500	500	500	500	Vdc
Grid Voltage[1/4]	-75	-80	-85	-90	Vdc
Zero-Signal Plate Current	190	160	140	120	mAdc
Max.Signal Plate Current	700	700	700	638	mAdc
Zero-Signal Screen Current	0	0	0	0	mAdc
Max.Signal Screen Current	50	40	38	32	mAdc
Peak af Grid Voltage[2]	133	140	145	140	v
Peak Driving Power[3]	8.6	9.0	10.2	7.0	w
Max.Signal Plate Dissipation[2]	320	363	400	400	W
Plate Output Power	1110	1375	1650	1750	W
Load Resistance (plate to plate)	7200	9100	10,800	14,000	Ω

1. Approximate value.
2. Per Tube.
3. Nominal drive power is one-half peak power.
4. Adjust to give stated zero-signal plate current.

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

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 5.0 volts	14.0	15.3	A
Interelectrode Capacitances [1] (grounded filament connection):			
Cin	10.7	14.5	pF
Cout	4.2	5.6	pF
Cgp	----	0.17	pF

1. In Shielded Fixture, per EIA Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4-400C may be operated in any position. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube-base shell should be grounded by means of suitable spring fingers. The above requirements are met by the EIMAC SK-400 and SK-410 Air-System Sockets. A flexible connecting strap should be provided between the EIMAC HR-6 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

COOLING - Adequate forced-air cooling must be provided to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C.

When the EIMAC SK-400 or SK-410 Air-System Socket is used, a minimum air flow of 14 cubic feet per minute at a static pressure of 0.25 inches of water or less, as measured in the socket or plenum chamber at sea level, is required to provide adequate cooling under all conditions of operation. Seal temperature limitations may require that cooling air be supplied to the tube even when the filament alone is on during standby periods.

Tube temperatures may be measured with a temperature sensitive paint, spray or crayon, such as manufactured by Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield, N.J. 07080.

ELECTRICAL

FILAMENT VOLTAGE - Filament voltage should be measured at the tube base with an accurate meter. When operating at the nominal voltage, variations of ±5% are tolerable and should have little effect on electrical performance of the tube. However, when very long life and consistent performance are factors, voltage can often be reduced to a value lower than the nominal voltage, but should be regulated and held to ±1% when this is done. To achieve a regulated voltage and still have it adjustable, a typical procedure would involve a one-to-one regulating transformer, feeding a variable ratio transformer (such as a POWERSTAT or a VARIAC), which in turn feeds the filament transformer. The equipment is first operated with nominal filament voltage applied, and when stable operation is achieved, the voltage is then reduced in small steps (about 0.2 volt at a time) until the point is reached where performance of the tube is clearly affected. The voltage is then raised to a few tenths of a volt above this level for operation. Periodically (every 500 to 1000 hours) this procedure should be repeated and the operating value of the filament voltage readjusted if necessary.

BIAS VOLTAGE - The dc bias voltage for the 4-400C should not exceed 500 volts. If grid resistor bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 MHz, it is advisable to keep the bias voltage as low as is practicable.

SCREEN VOLTAGE - The dc screen voltage for the 4-400C should not exceed 800 volts. The screen voltages shown under Typical Operation are representative voltages for the type of operation involved.

PLATE VOLTAGE - The plate-supply voltage for the 4-400C should not exceed 4000 volts in CW and audio applications. In plate-modulated telephony service the dc plate-supply voltage should not exceed 3200 volts, except below 30 MHz, intermittent service, where 4000 volts may be used.

GRID DISSIPATION - Grid dissipation for the 4-400C should not be allowed to exceed 10 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{gk} \times I_c$$

where P_g = Grid dissipation

e_{gk} = Peak positive grid to cathode voltage, and

I_c = dc grid current

SCREEN DISSIPATION - The power dissipated by the screen of the 4-400C must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in event of circuit failure.

PLATE DISSIPATION - Under normal operating conditions, the plate dissipation of the 4-400C should not be allowed to exceed 400 watts. The anode operates at a visibly red color at its maximum rated dissipation of 400 watts.

In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 270 watts. The plate dissipation will rise to 400 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

MULTIPLE OPERATION - To obtain maximum power output with minimum distortion from tubes operated in multiple, it is desirable to adjust individual screen or grid bias voltages so that the peak plate current for each tube is equal at the crest of the exciting voltage. Under these conditions, individual dc plate currents will be approximately equal for full input signal for class AB1 operation.

CAUTION-GLASS IMPLOSION - The EIMAC 4-400C is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

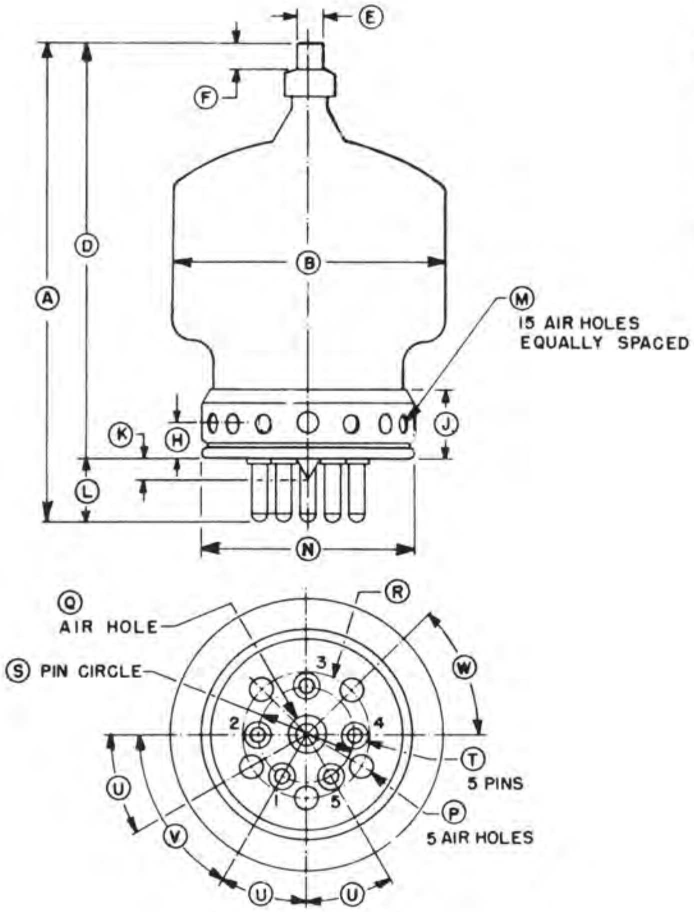
CAUTION-HIGH VOLTAGE - Operating voltage for the 4-400C can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

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

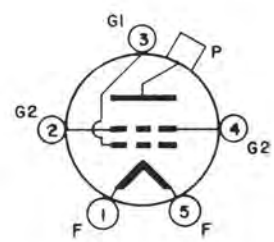
DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	5.875	6.375	--	149.23	161.93	--
B	--	3.563	--	--	90.50	--
D	5.125	5.625	--	130.18	142.88	--
E	0.350	0.365	--	8.89	9.27	--
F	0.328	--	--	8.33	--	--
H	--	--	0.438	--	--	11.13
J	--	0.969	--	--	24.61	--
K	--	0.250	--	--	6.35	--
L	--	--	0.750	--	--	19.05
M	--	--	0.250	--	--	6.35
N	--	2.750	--	--	69.85	--
P	--	--	0.312	--	--	7.92
Q	--	--	0.500	--	--	12.70
R	--	--	1.625	--	--	41.28
S	--	--	1.250	--	--	31.75
T	0.185	0.191	--	4.70	4.85	--
U	--	--	30°	--	--	30°
V	--	--	60°	--	--	60°
W	--	--	45°	--	--	45°

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

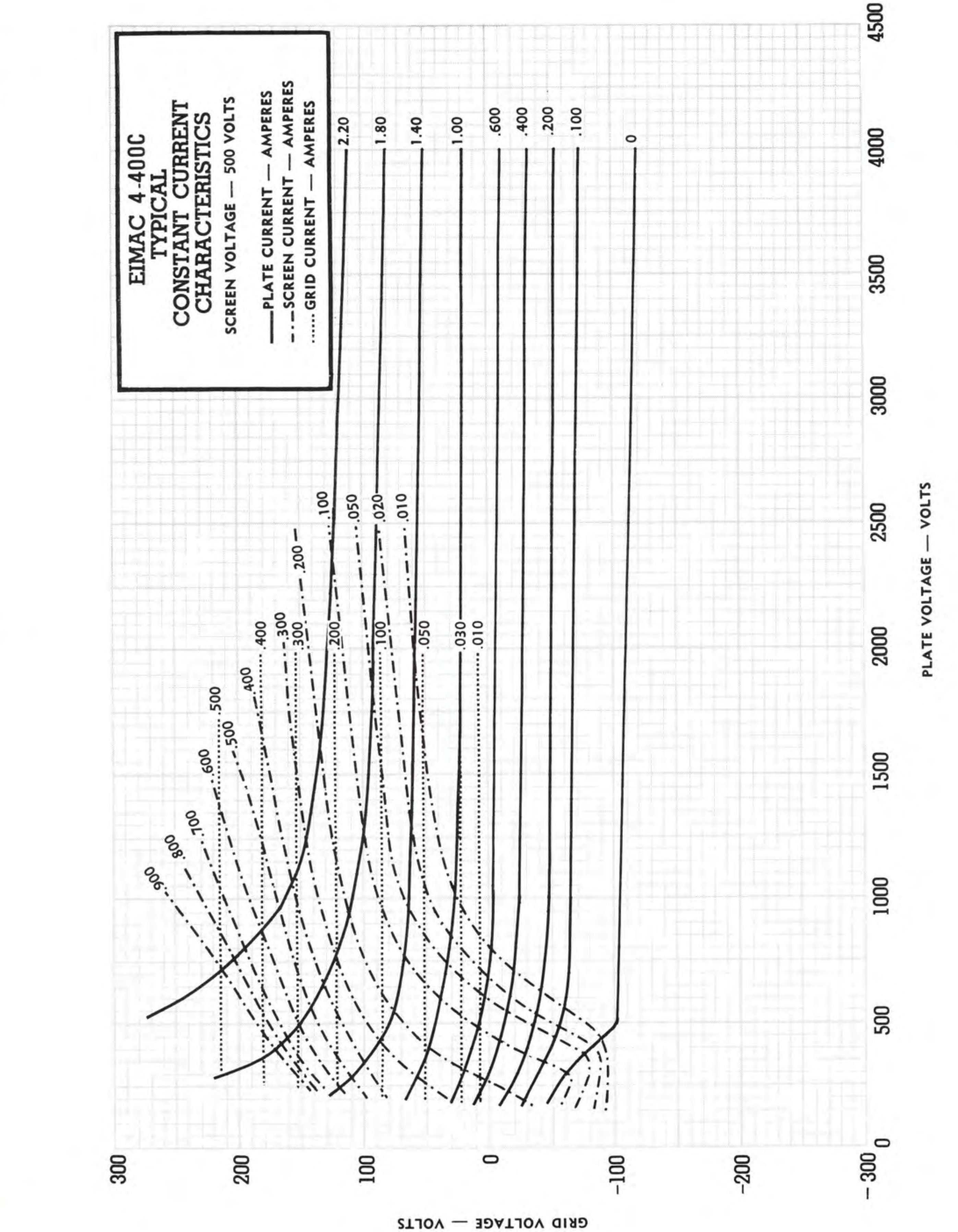


BOTTOM VIEW



NOTE:

Base pins T and tubulation K are so alined that they can be freely inserted in a gage ¼ inch (6.35 mm) thick with hole diameters of .204 (5.18 mm) and .500 (12.70 mm), respectively, located on the true centers by the given dimensions S, U, V.


EIMAC 4-400C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
PLATE VOLTAGE — VOLTS
GRID VOLTAGE — VOLTS

EXTENDING TRANSMITTER TUBE LIFE

By Robert Artigo

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

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

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

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

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

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

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

Headroom

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

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

Instrumentation

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

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

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

Transmitter housekeeping

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

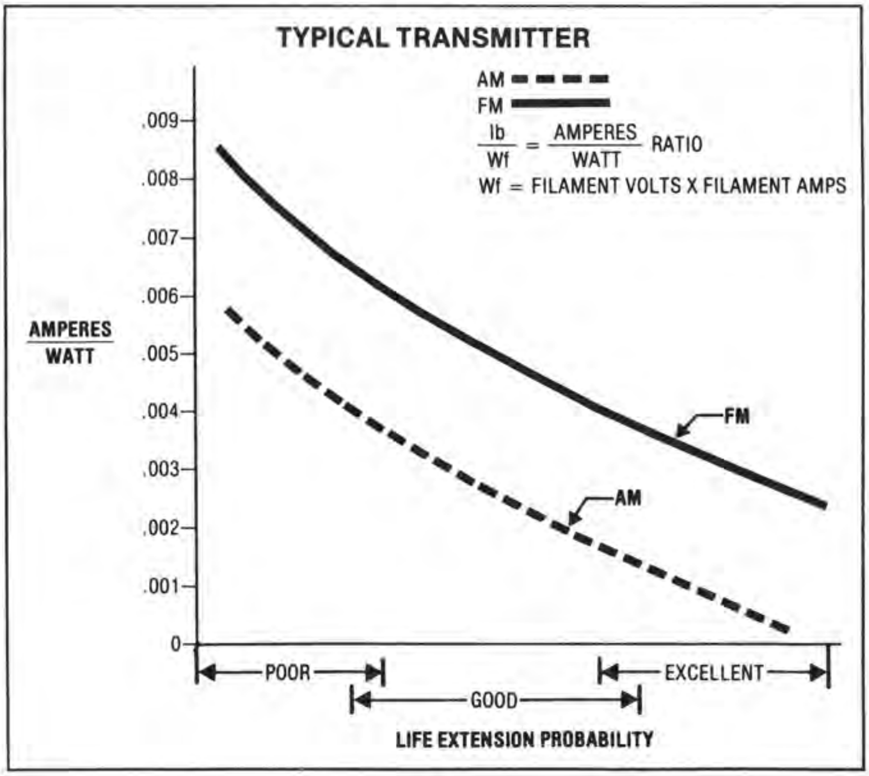


***Fig. 1.** Probability of extended life service can be determined from this graph. Divide the average p.a. plate current in amperes by the product of filament voltage and current. The resulting amperes/watt ratio (Y-axis) is projected horizontally to the appropriate curve. The vertical projection to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

Extending Transmitter Tube Life

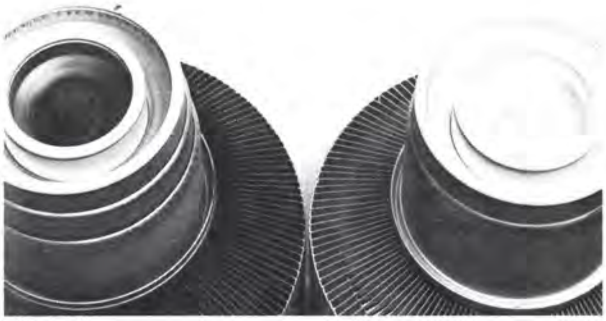


Figure 2

Figure 3

Figure 4

Figure 5

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

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

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

Filament voltage management

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

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

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

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

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

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

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

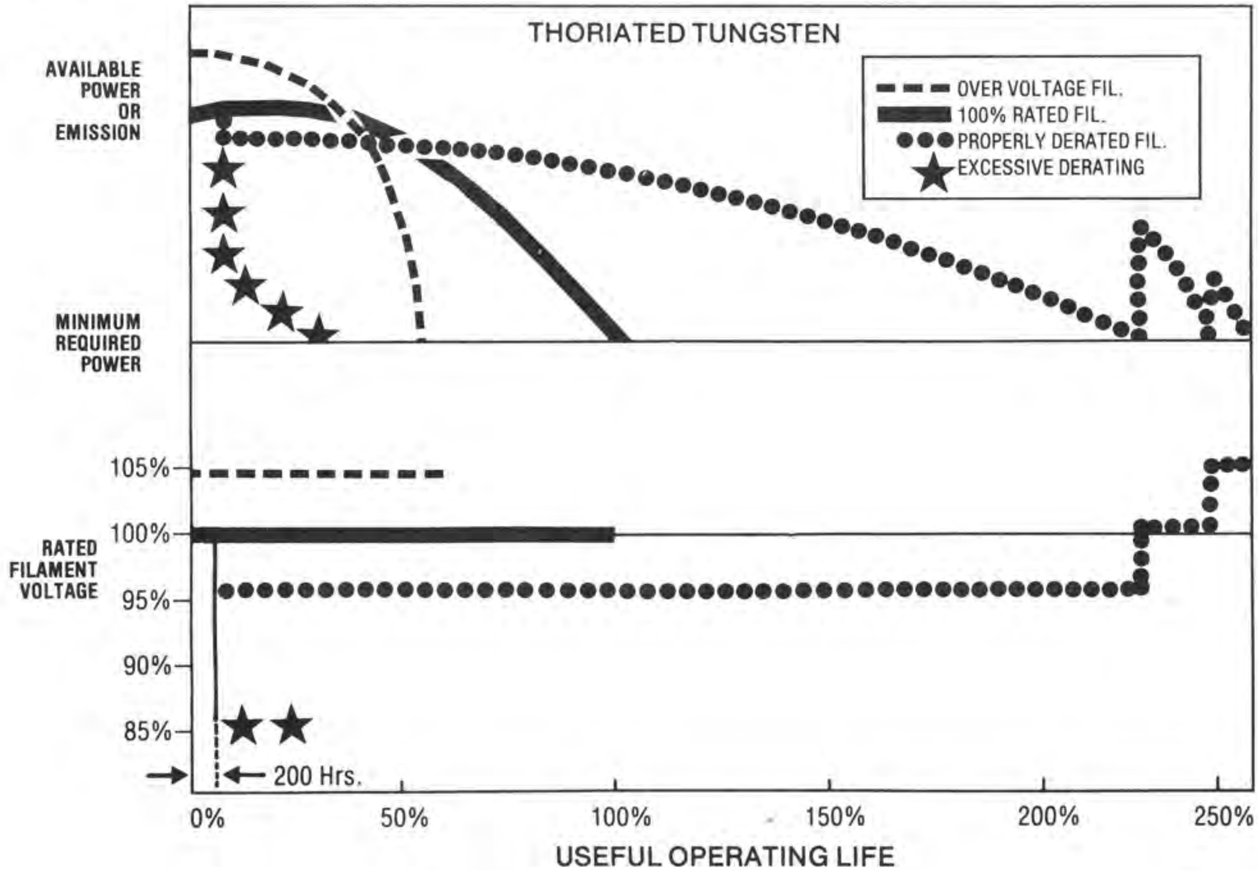
As the tube is used the filament slowly decarburizes. At some point in life, all of the di-tungsten carbide layer is depleted and the reduction of thoria to free thorium stops. The filament is now decarburized and is no longer an effective electron emitter.

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

FILAMENT VOLTAGE MANAGEMENT (Figure 6)

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

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



Extending Transmitter Tube Life

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

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

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

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

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

Continuing the program

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

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

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

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

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

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

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

Bibliography

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