

AN 16-45-418

**HANDBOOK
SERVICE INSTRUCTIONS**

RADIO TRANSMITTER

MODEL WRL-400B

WORLD RADIO LABORATORIES

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Links for Plug-in Tank Coils

80M	10 Turns
40M	6 Turns
20M	3 Turns
15M	2 Turns
10M	1 Turn

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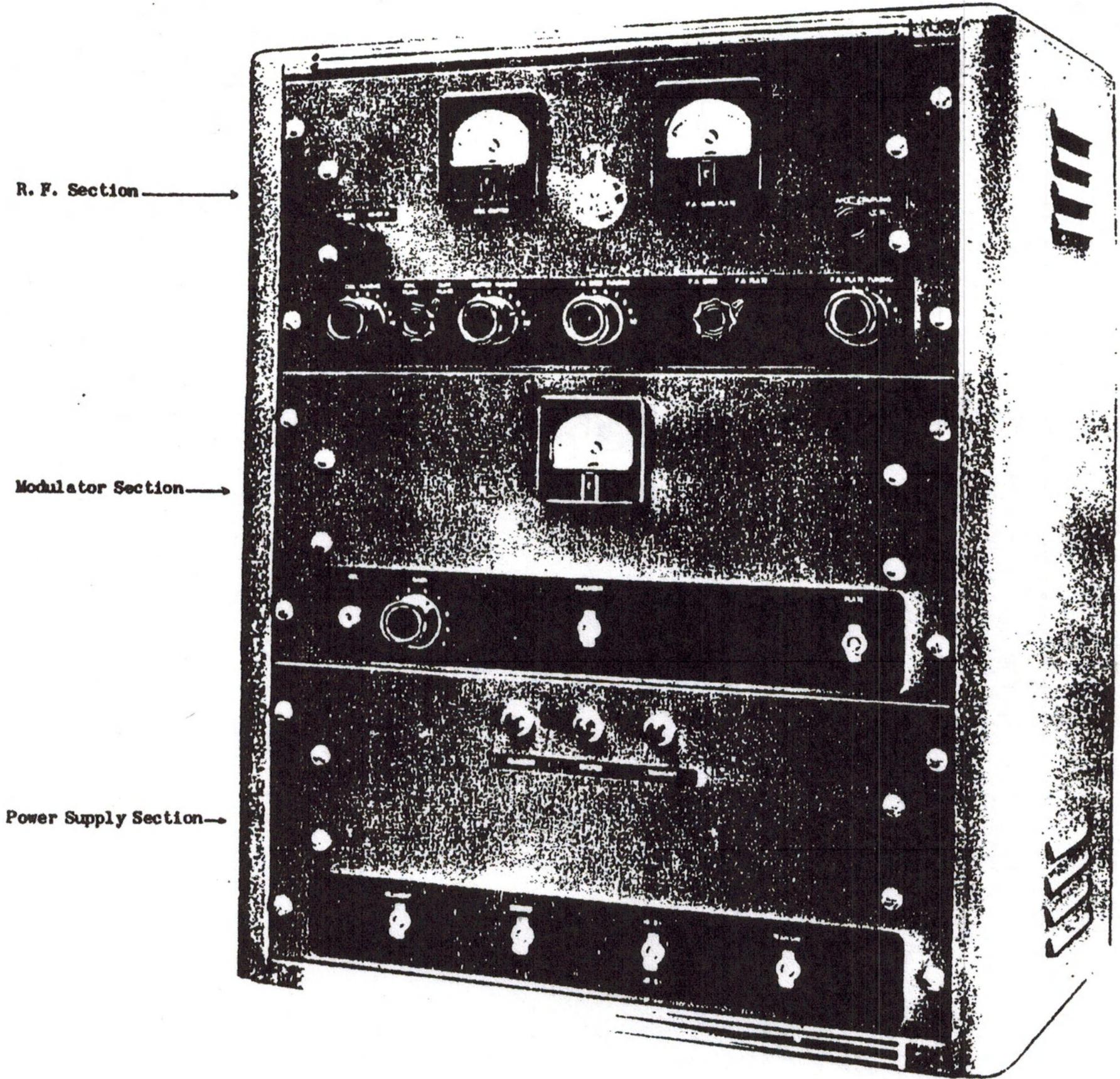


Figure 1-1. Front View of the 100B Globe King Transmitter

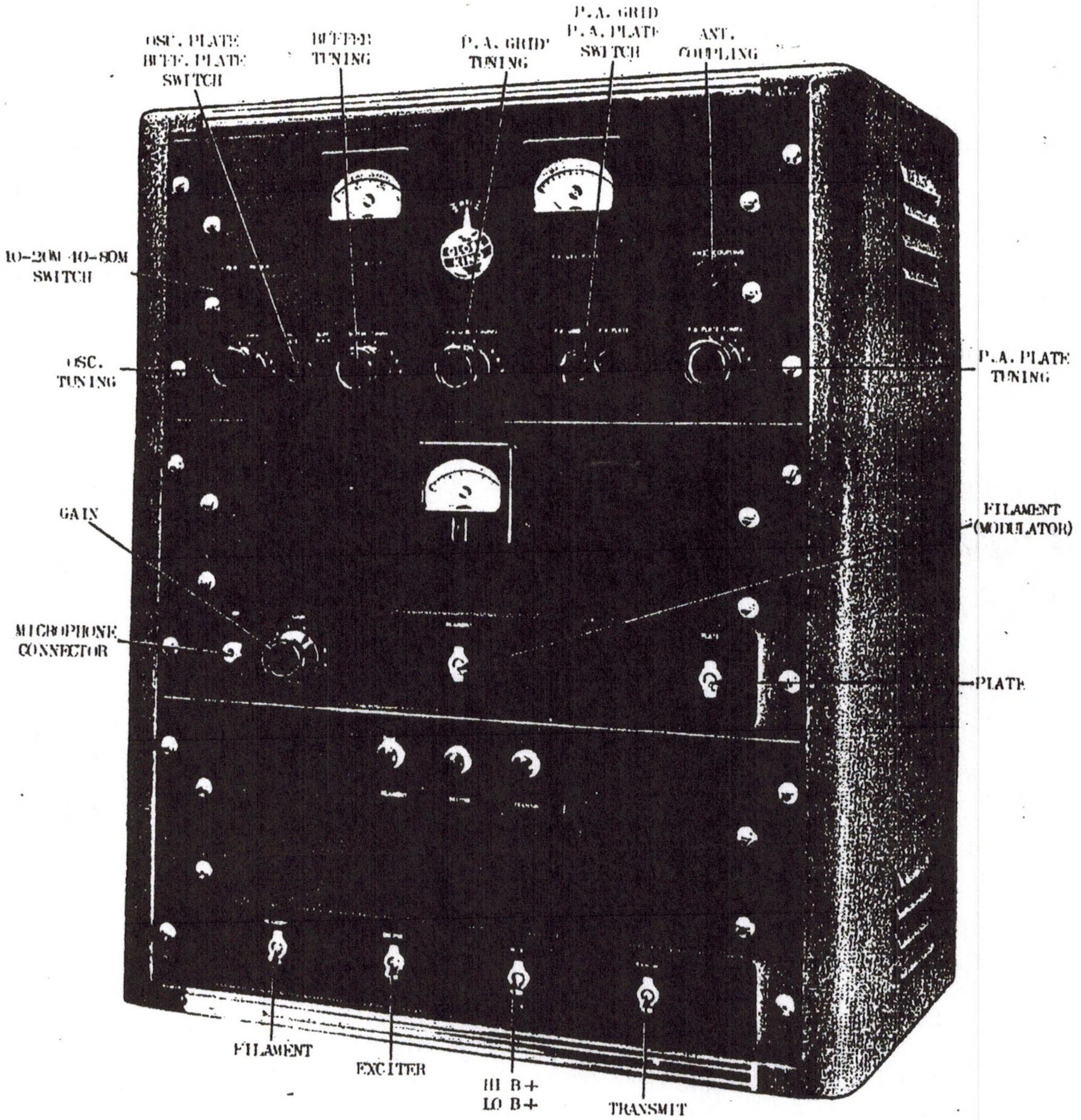


Figure 1-2. Panel Controls of the 400B Globe King Transmitter

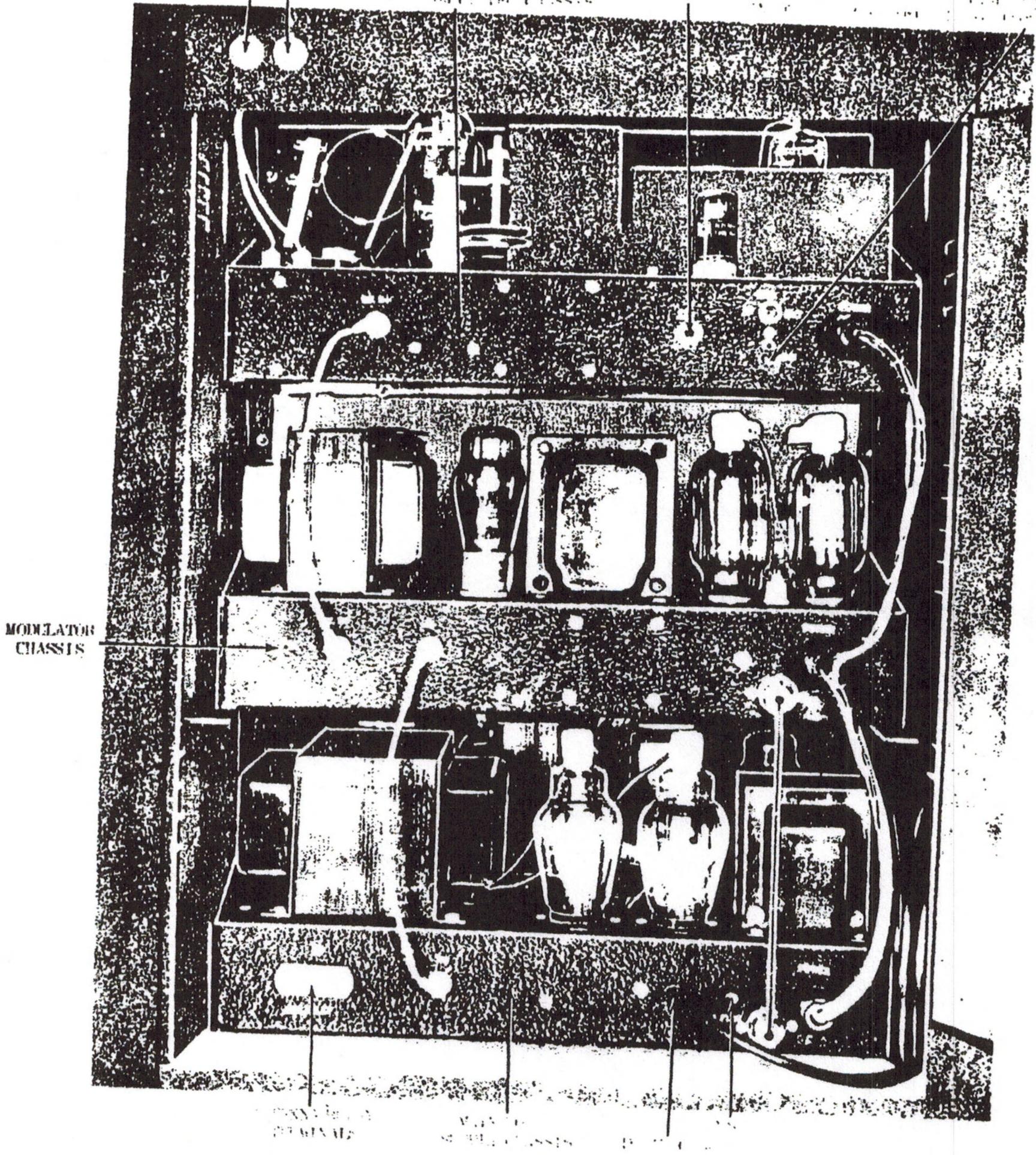


Figure 1-3. Rear View of 400B Globe King Transmitter

INTRODUCTION

This publication comprises service instructions for the Globe King transmitter, model 400B. The purpose of this transmitter is to establish point to point communications where needed. Limitations of this equipment are primarily those of atmospheric conditions unfavorable to the frequency of transmission being used for a given location. Under favorable conditions, the 400 watt input power of

the transmitter is adequate for communications of distances up to 30,000 miles. The selection of the proper operating frequency, an efficient antenna system and proper operation of the equipment will enable operating personnel to maintain reliable communications over most any distance with favorable atmospheric conditions prevailing.

SECTION I

GENERAL DESCRIPTION

1-1. GENERAL.

1-2. The Globe King, 400B, radio transmitter is manufactured by World Radio Laboratories, of Council Bluffs, Iowa. The transmitter is rated at 400 watts input power to the final amplifier, either radio telegraphy, or radio telephony operation.

1-3. DESCRIPTION.

1-4. The transmitter is completely self contained in a metal relay rack cabinet. The size of the cabinet is 28-3/16" high, 14-3/4" deep, and 22" wide. Weight is approximately 186 pounds. Ventilating louvres are provided in the cabinet to assure adequate heat dissipation.

1-5. The components of the transmitter are so arranged that semi-unit construction is possible and are broken down into three units as follows.

- a. Exciter Buffer and Power Amplifier.
- b. Modulator with integral power supply.
- c. Main Power Supply.

Each unit may be removed from the cabinet independently for inspection and servicing. Power requirements are 115 volts ac, 50-60 cycles single phase. Tube complement is shown in Table I.

TABLE I. TUBE COMPLEMENT.

QUANTITY	TYPE	FUNCTION
2	V70D	R. F. Power Amplifier
1	807	Buffer Amplifier
1	7C5	Oscillator
1	6S17	First Speech Amplifier
1	6C5	Second Speech Amplifier
1	6N7	Audio Phase Inverter
2	6F6	Audio Drivers
2	5514 or T740	Modulators
1	5Y3GT	Audio Low Voltage Rectifier
2	866 Jr.	Modulator Rectifiers
1	5U4G	Exciter Rectifier
2	866A	Power Amplifier Rectifiers
2	VR-150	Exciter Voltage Regulators

1-6. The equipment is protected by the insertion of a fuse in the primary line. This fuse protects the entire transmitter against overload and component failures. The fuse is rated at 15 amperes, 115 volts, manufacturers type AGS.

1-7. The frequency range of the transmitter is 1500 kc to 30,000 kc. with the proper coils and crystals. The operating frequency is determined by the crystal frequency, or may be set with an external variable frequency oscillator, if desired. Frequency stability will be determined by the crystal or variable frequency oscillator used. Refer to Table III for coil and crystal selection chart.

1-8. At the specified input voltage of 115 volts, the standby position consumption is 2-1/2 amps. Total normal operating current is 12-1/2 amps. Maximum starting current is 12-1/2 amps.

1-9. OPERATING AND ADJUSTMENT CONTROLS.

1-10. Table II identifies each control and gives the location and function.

TABLE II. LOCATION AND FUNCTION OF CONTROLS.

Control	Location	Function
10-20M 40-80M	P.A. Panel	Allows straight through or crystal harmonic operation, depending upon selected frequency.
ANT. COUPLING	P.A. Panel	Varies coupling between power amplifier and antenna.
OSC. TUNING	P.A. Panel	Tunes oscillator plate circuit to resonance at proper frequency.
OSC. PLATE	P.A. Panel	Switches meter to oscillator or buffer plate circuit.
BUFF. PLATE	P.A. Panel	Tunes buffer plate circuit to resonance at proper frequency.
P.A. GRID TUNING	P.A. Panel	Tunes P.A. grid circuit to resonance at proper frequency.
P.A. GRID	P.A. Panel	Switches meter from P.A. Grid to P.A. plate circuit.
P.A. PLATE	P.A. Panel	Tunes power Amplifier plate circuit to resonance at proper frequency.
P.A. PLATE TUNING	P.A. Panel	Tunes power Amplifier plate circuit to resonance at proper frequency.
GAIN	MOD. Panel	Controls percentage of modulation.
FILAMENT	MOD. Panel	Controls primary current of modulator section only.
PLATE	MOD. Panel	Controls modulation section high voltage.
FILAMENT	Main Power Supply Panel	Controls all power to transmitter.
EXCITER	Main Power Supply Panel	Controls plate voltage for oscillator and buffer.

SECTION I
Paragraph 1-11

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TABLE II. (CONT.)

Control	Location	Function
HIGH B+ LOW B+	Main Power Supply Panel	Reduces primary current on high voltage transformer for tune-up.
TRANSMIT OSC. IN OUT	Main Power Supply Panel Rear of R.F. Chassis	Controls all high voltage circuits. Disables oscillator circuit for variable frequency oscillator input.

1-11. Section I through VII of this handbook applies to the Globe King 400B, contract number AF 33(600)-20298. Additional models will be covered in Section VIII by the use of difference data sheets. Service instructions in Section VIII are the same as the procedures given in Sec-

tions I through VII, except for the specific differences noted by the applicable difference data sheets.

TABLE III. COIL AND CRYSTAL CHART.

Band	Crystal	Osc. Coil 12	Buf. Plt. Coil 14	P.A. Grid Coil 16	P.A. Plt. Coil 18
160 Meters	1800-2000kc	170MFL *25µmf	160MFL *25µmf	160JVL *65µmf	160TVL *65µmf
80 Meters	3500-4000kc	80MFL	80MFL	80JVL *7µmf	80TVL
40 Meters	7000-7300kc	40MFL	40MFL	40JVL	40TVL
20 Meters	7000-7175kc	20MFL 62 turn	20MFL	20JVL	20TVL
15 Meters	7000-7150kc	15MFL	15MFL	15JVL	15TVL
10 Meters	7000-7425kc	20MFL 63 turn	20MFL 62 turn	10JVL 62 turn	10TVL

NOTE: *Capacity added across coil. @Number of turns removed from plate end of coil.

10M: 40M xtal

~~OSC~~ OSC COIL - 20 (END LINK) MEL
 BUFF PLATE - 10 (END LINK) MEL
 PA GRID - 10 (CTR LINK) JVL
 PA FINAL - 10 (CTR LINK) TVL

SECTION II

SPECIAL TEST EQUIPMENT AND SPECIAL TOOLS

2-1. TEST EQUIPMENT.

2-2. This section lists the tools and test equipment required for the disassembly, assembly, and testing of the equipment. Common types of tools, such as screwdrivers, pliers, soldering irons, etc., are not listed.

TABLE IV. SPECIAL TEST EQUIPMENT REQUIRED FOR MAINTENANCE.

Name	Manufacturers Type Designation	Alternate	Use
Volt-Ohmmeter-20,000 Ohms per Volt.	Simpson 260	Triplet 630	To measure voltages, resistances, & currents.
Tube Tester	Hickok 533-AP	Triplet 3423	To check performance of tubes.
Neutralization Lamp Loop	Make up from bulk. See Figure 2-1, Paragraph 2-4.	None	To indicate if final amplifier stage is neutralized.

2-3. SPECIAL TOOLS REQUIRED FOR MAINTENANCE. (NONE).

2-4. The neutralization lamp loop is easily fabricated. The indicator consists of two turns of insulated copper wire, approximately two and one half inches in diameter. A number 49 pilot lamp is connected to the ends of the wire as shown in figure 2-1.

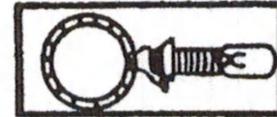


Figure 2-1. Neutralizing Lamp Loop

2-5. CABLE FABRICATION.

2-6. All cables required to operate the equipment are supplied with the equipment and cable fabrication is not required.

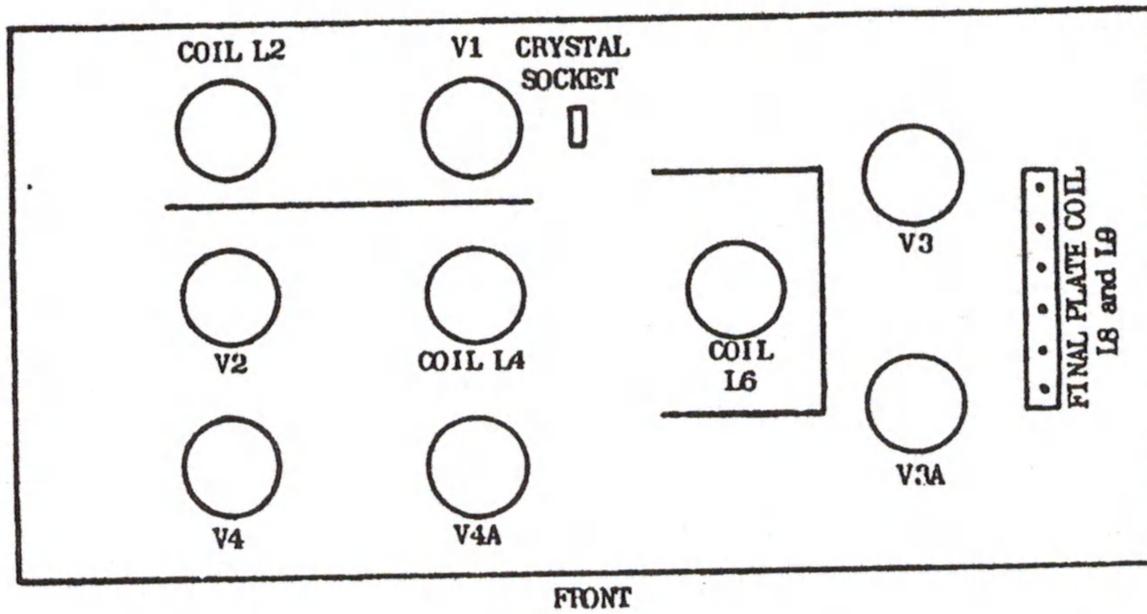


Figure 3-1. Tube and Coil placement diagram-P.A. Chassis Top view.

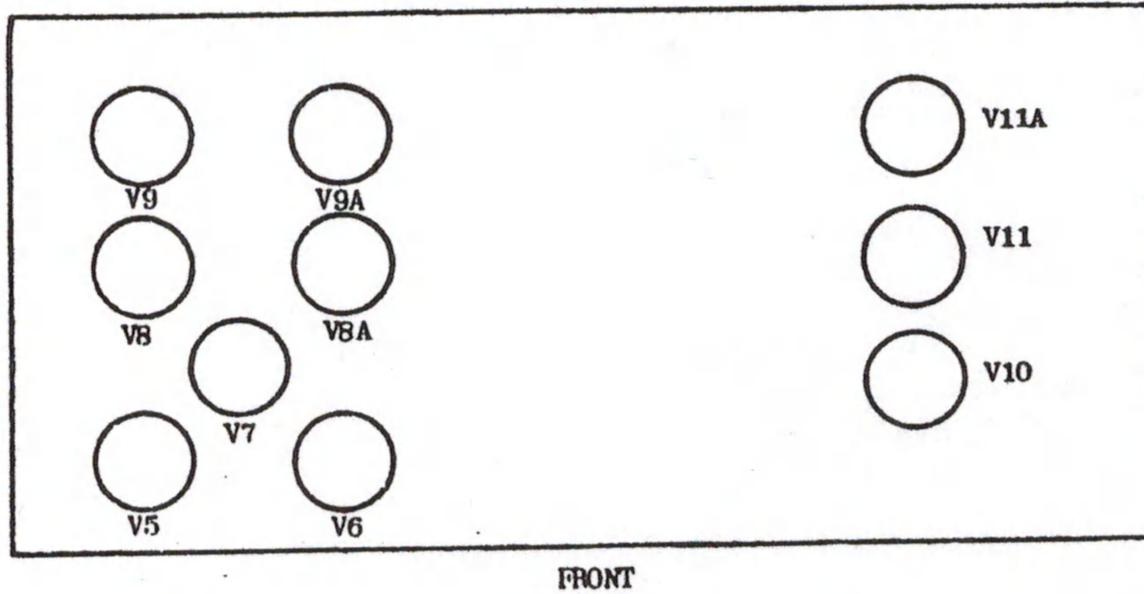


Figure 3-2. Tube placement diagram-Modulator Chassis. Top view.

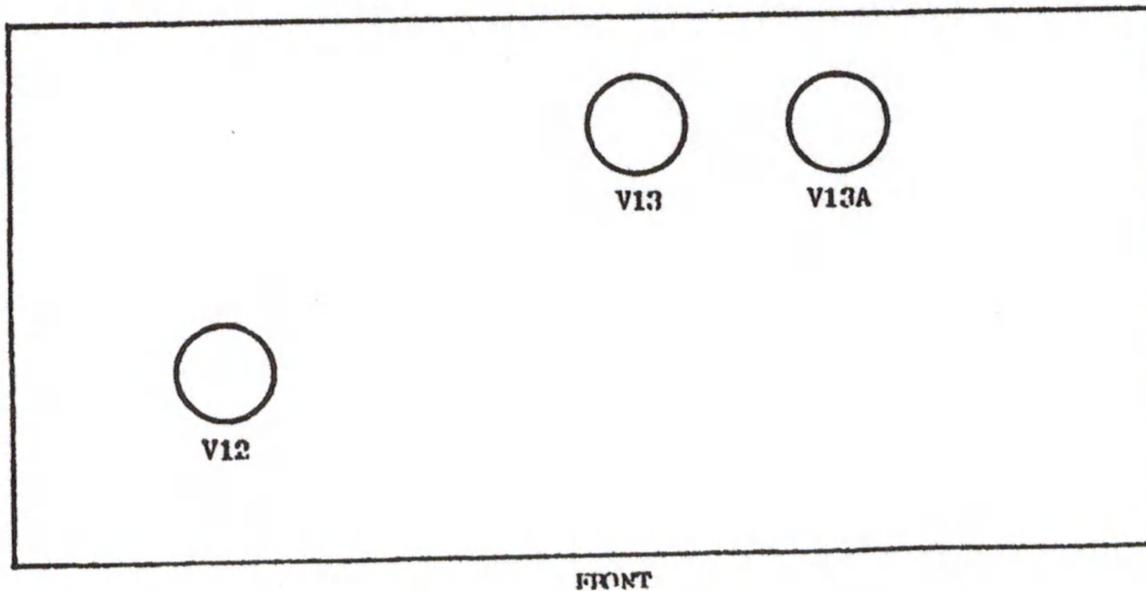


Figure 3-3. Tube placement diagram-Main Power Supply Chassis. Top view.

SECTION III

PREPARATION FOR USE AND RESHIPMENT

3-1. PREPARATION FOR USE AND RESHIPMENT.

3-2. Remove the WRL 400B transmitter from the crate. Open the rear door of the transmitter and remove the components in the transmitter which are wrapped or in cartons. Tubes and coils are individually wrapped. Inspect the interior carefully to determine that all loose components have been removed. Care should be exercised when unwrapping coils and tubes to prevent damage. The ac line cord is coiled into the lower right hand corner of the cabinet for shipment. Place the tubes in the proper sockets, referring to the tube and coil placement diagrams, figures 3-1, 3-2, and 3-3. Press the tubes straight down into the socket with gentle but firm pressure to avoid damage to the tube prongs. Select the proper coils and crystals for the frequency to be used, referring to Table III. Connect microphone or key as use prescribes. Connect antenna to proper terminals. Refer to figure 1-2 for location of microphone connector, figure 1-3 for location of key jack

and antenna terminals. If an antenna relay is used it is to be connected to the terminals shown in figure 1-3.

3-3. For reshipment, disconnect antenna, microphone, key and other attachments. Remove all coils and tubes from their sockets. Tubes and coils are to be individually wrapped and placed in the interior of the transmitter securely. Place in crate and secure.

3-4. OPERATING SITES.

3-5. When selecting an operating site, the following considerations should be kept in mind. Accessibility of rated source voltage as specified. Adequate shelter for the transmitter, to prevent moisture from entering. Antenna supports, which should be as high as possible. Range and effectiveness will depend a great deal on the antenna positioning.

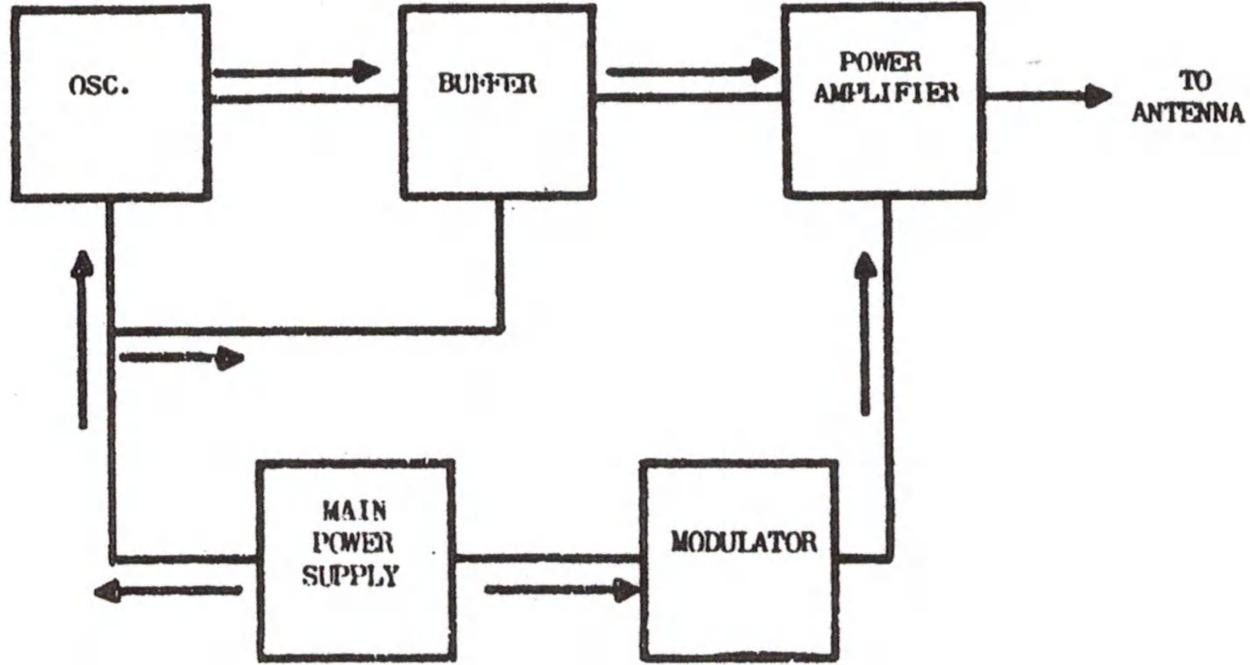


Figure 4-1. Block Diagram of Transmitter.

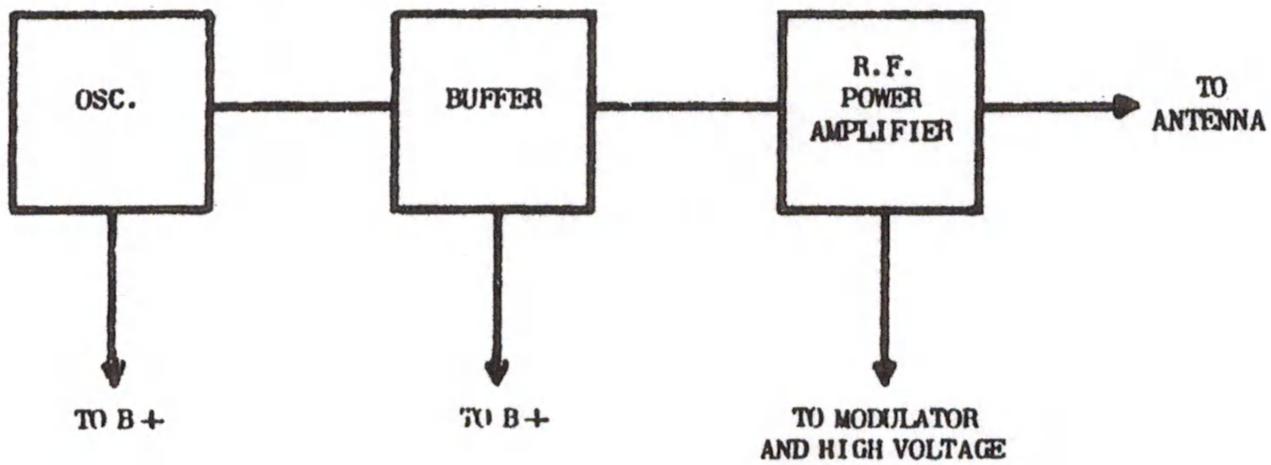


Figure 4-2. Block Diagram of Power Amplifier Chassis.

SECTION IV

THEORY OF OPERATION

4-1. THEORY OF OPERATION.

4-2. The following paragraphs are written to enable the maintenance technician to understand the functioning of the transmitter more fully.

4-3. Reference to the various diagrams, tables and charts will help in understanding the overall circuitry.

4-4. GENERAL SYSTEM OPERATION.

4-5. The block diagram in figure 4-1 illustrates the paths followed by the signals and voltages. Waveforms are all sine wave. The waveform of the rf section remains constant in frequency, whereas the waveform of the audio varies in frequency.

4-6. The main power supply furnishes high voltage to the power amplifier, through the secondary winding of the modulation transformer, where the audio information is impressed on the signal in telephony operation. The main power supply also furnishes filament voltage to the oscillator and buffer stages.

4-7. FUNCTIONAL OPERATION OF COMPONENTS.

4-8. POWER AMPLIFIER CHASSIS.

4-9. The oscillator, buffer and amplifier are all located on the same chassis. This chassis is the top one in the cabinet. Figure 4-2 illustrates the three stages in block diagram form.

4-10. OSCILLATOR STAGE.

4-11. A 7C5 tube is employed as the oscillator. The oscillator stage is capacitively coupled to the 807, buffer stage. Rich harmonic output of the oscillator insures complete coverage of from 1,500 kc through 30,000 kc. Voltage regulation of the oscillator insures complete stability at all times. A keying jack in the oscillator circuit allows break-in operation. The front panel switch, marked 10-20M 40-80M, retains, or shorts out the oscillator cathode choke. This allows harmonic or straight through operation, also preventing accidental tuning to a harmonic of the desired frequency. See figure 4-3.

4-12. BUFFER STAGE.

4-13. The buffer stage employs an 807 tube which has fixed bias. The tube operates as a class C amplifier allowing straight-through operation or doubling of the oscillator stage output frequency. Fixed bias causes the plate current to drop to zero, or a safe level, with the removal of excitation. Voltage regulation of the 807 screen grid assures maximum tube stability. See figure 4-4.

4-14. POWER AMPLIFIER STAGE.

4-15. The power amplifier makes use of the easy to drive V70D tubes in a conventional push-pull circuit. The tubes are biased to operate at maximum efficiency. The fixed bias supply incorporated, supplies the necessary bias, and insures complete cut-off of the power amplifier plate current with the removal of excitation. Neutralization is not extremely critical, but must be balanced at all times. See figure 4-5.

4-16. MODULATOR CHASSIS.

4-17. The modulator chassis incorporates the speech amplifier, phase inverter, driver and modulator stages. Two separate power supplies, also mounted on the chassis, supply all necessary voltages to the various stages. Figure 4-6 illustrates the various stages on the modulator chassis.

4-18. AUDIO CIRCUITS.

4-19. The first speech amplifier is a 6SJ7, followed by a 6C5, second speech amplifier. A 6N7 tube is utilized as a phase inverter. The drivers consist of a pair of triode connected 6F6 tubes. The drivers supply more than enough drive to operate the 5514 or TZ-40 modulator tubes to full output, which is in the vicinity of 200 watts. Two 866Jr. tubes supply approximately 1000 volts at 300 Ma. to the modulator tubes. A 5Y3GT supplies approximately 400 volts at 150 Ma to the speech amplifier and driver stages. Utmost speech quality, with the least distortion, is obtained by connecting the 6F6 tubes as triodes.

4-20. A shorting relay across the secondary of the modulation transformer automatically keeps the secondary of that transformer shorted when the modulator is not in use, thus providing a safety factor when the modulator is not in use. The modulator plate switch, in conjunction with the transmit switch controls this relay.

4-21. MAIN POWER SUPPLY CHASSIS.

4-22. The main power supply has two sections. The high voltage section supplies 1,400 volts at 300 ma. to the rf amplifier tubes. The low voltage section supplies 500 volts at 200 ma to the oscillator and buffer stages. See figures 4-7, 4-8, and 4-9.

4-23. Two 866A tubes are utilized in the high voltage supply. A 5U4G tube is used in the low voltage supply.

4-24. A high-low B plus switch is incorporated in the high voltage supply to enable the operator to tune the power amplifier stage without danger of damaging the rf amplifier tubes, or the panel meters due to excessive current. This switch places a resistor in series with the primary of the high voltage transformer, in the low B plus position, reducing the voltage on the primary to such an extent that there is insufficient voltage on the amplifier tubes for them to draw over 100 ma current.

4-25. The exciter switch may be operated independently of the transmit switch, and this allows the exciter stages to be turned on independently of the final amplifier tubes. The exciter stages are automatically turned on when the transmit switch is placed in the on position.

4-26. A terminal strip on the rear of the power supply chassis, part E1, will provide 115 vac when the transmit switch is turned on. This voltage may be utilized to operate an antenna relay, a receiver disabling relay, or both when the transmitter is turned on.

4-27. DETAILED SYSTEM OPERATION.

4-28. Figure 4-10 illustrates the overall relationship of components in block diagram form.

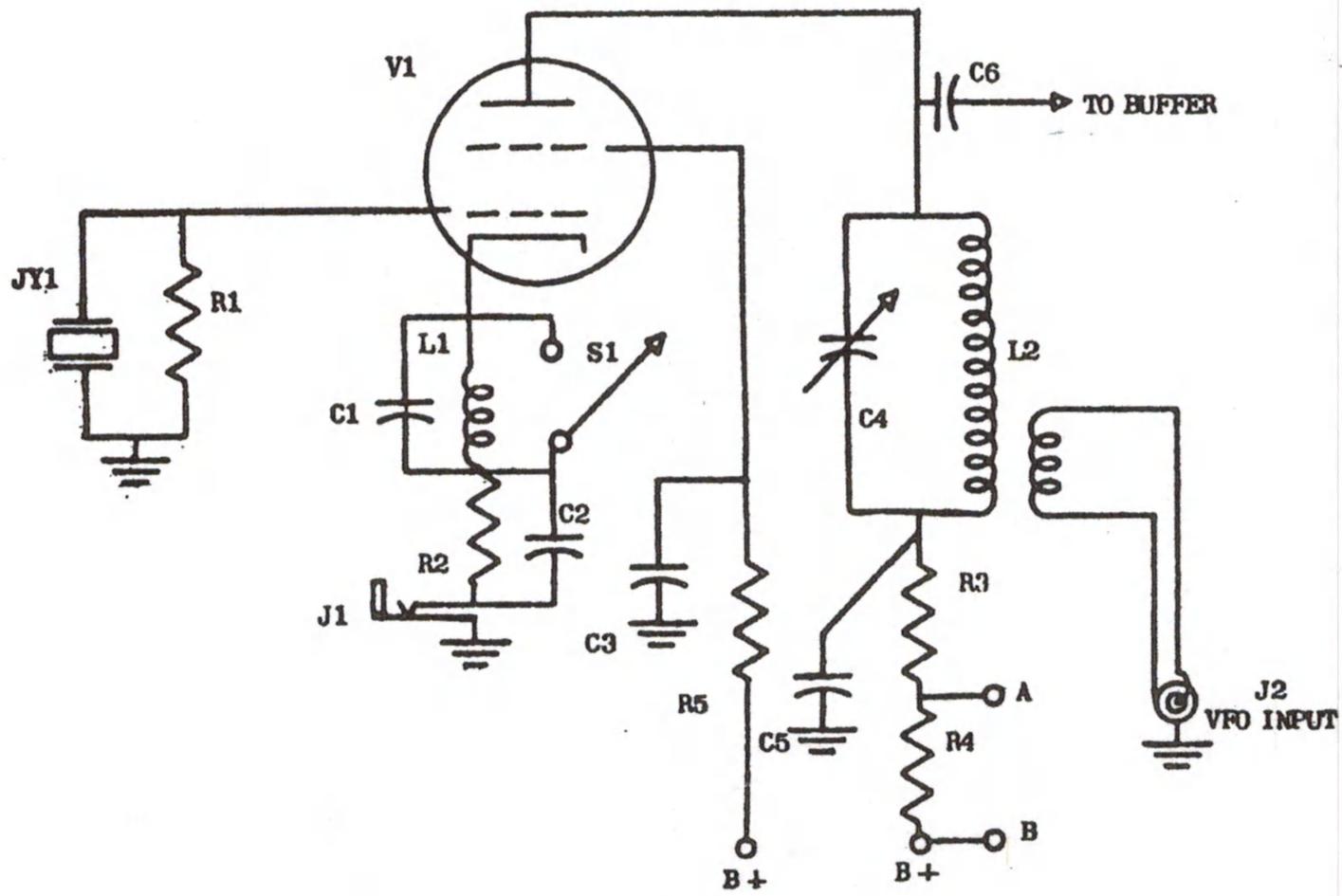


Figure 4-3. Oscillator Circuit Diagram.

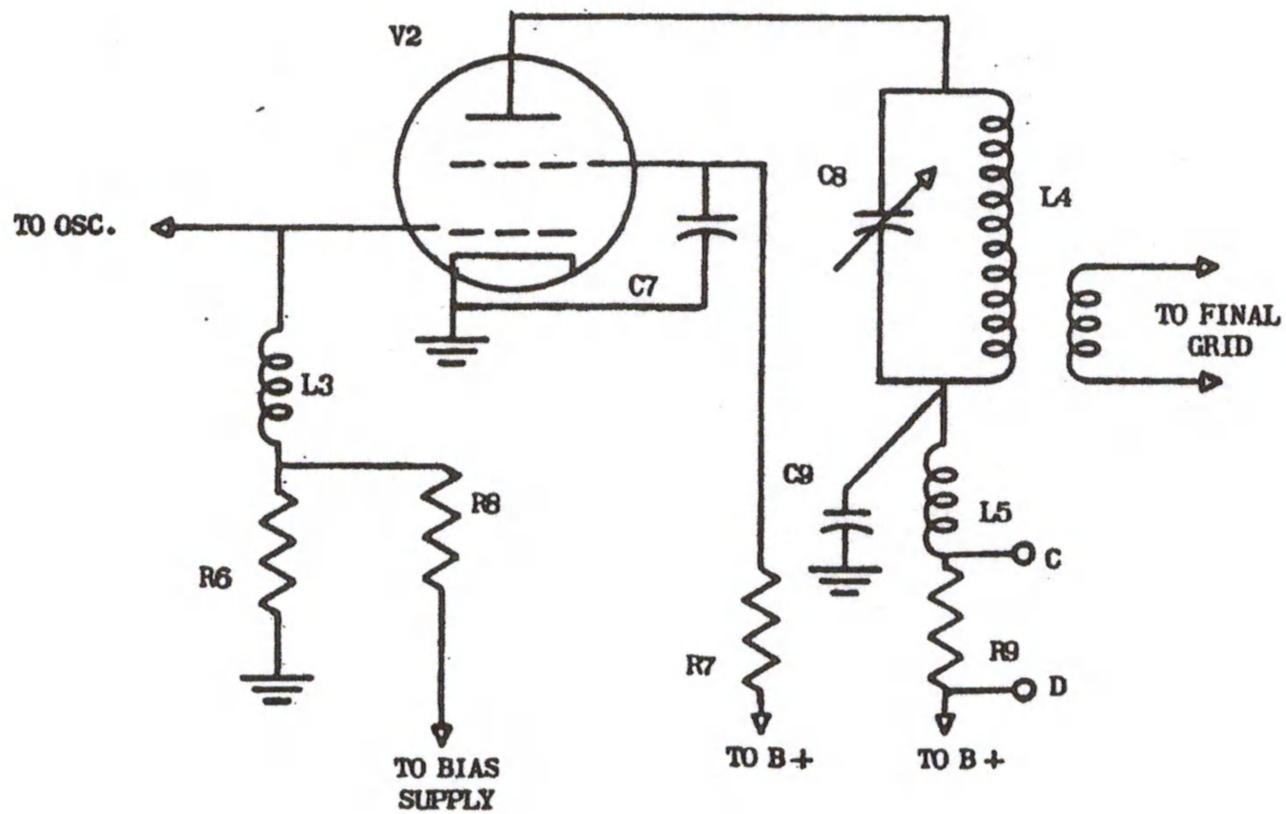


Figure 4-4. Buffer Circuit Diagram.

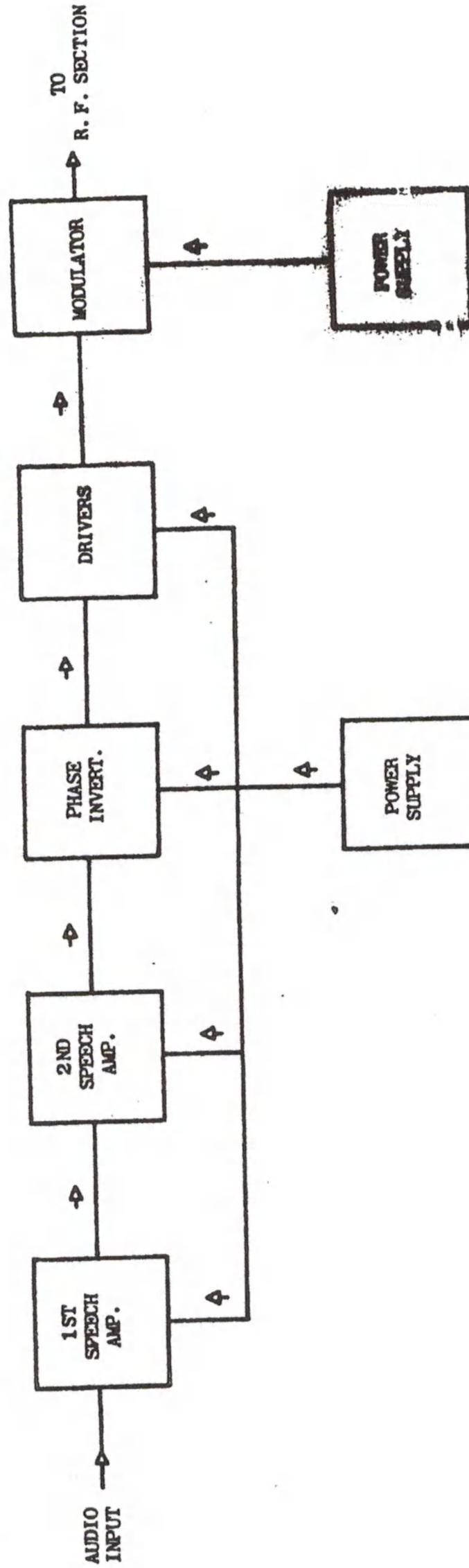


Figure 4-6. Modulator Chassis.

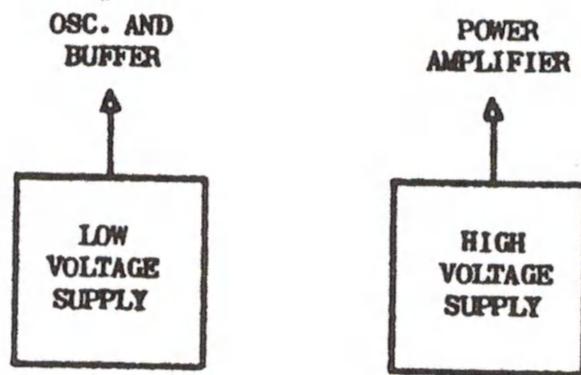


Figure 4-7. Main Power Supply Chassis.

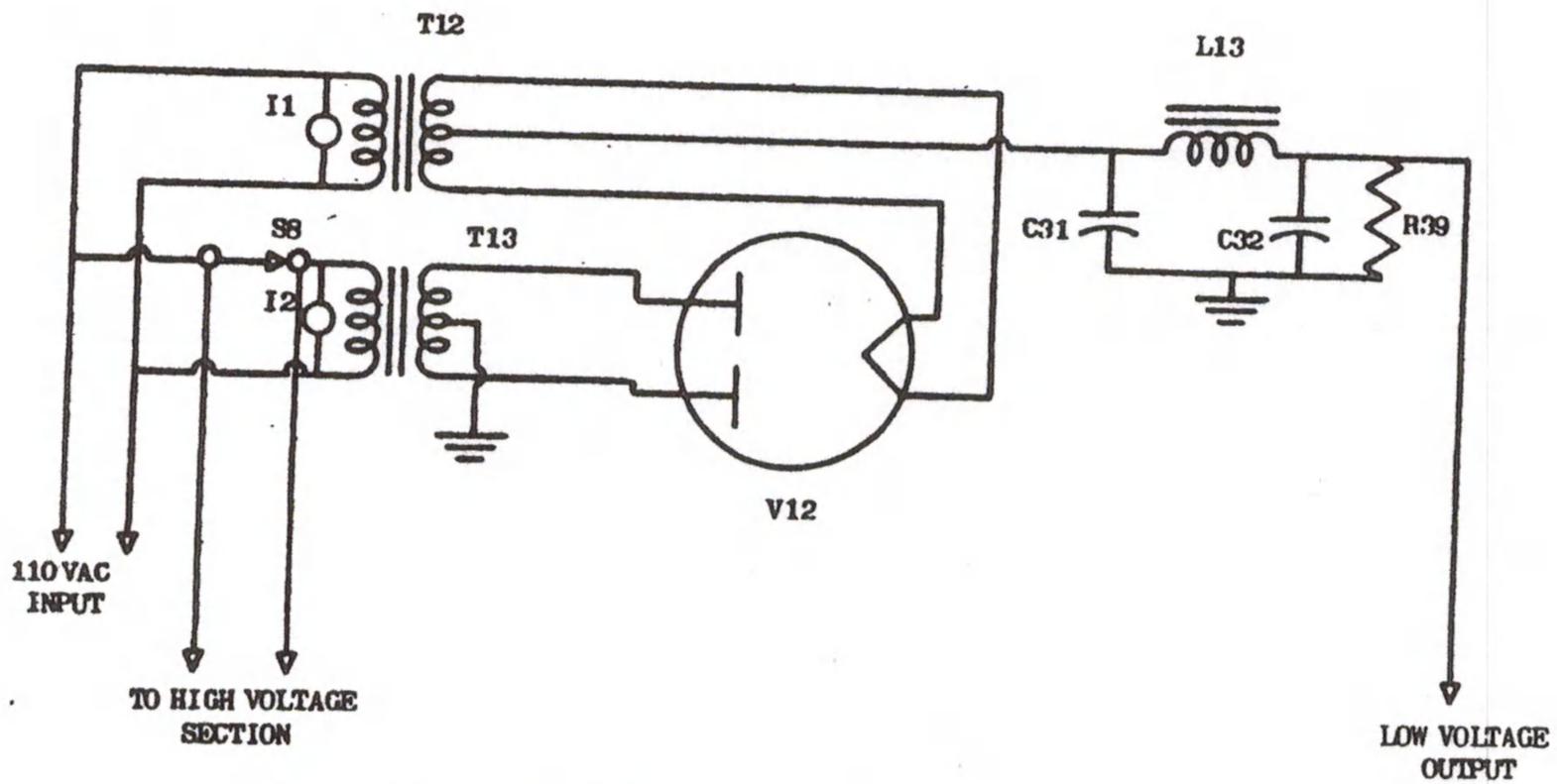


Figure 4-8. Low Voltage Section on Main Power Supply Chassis.

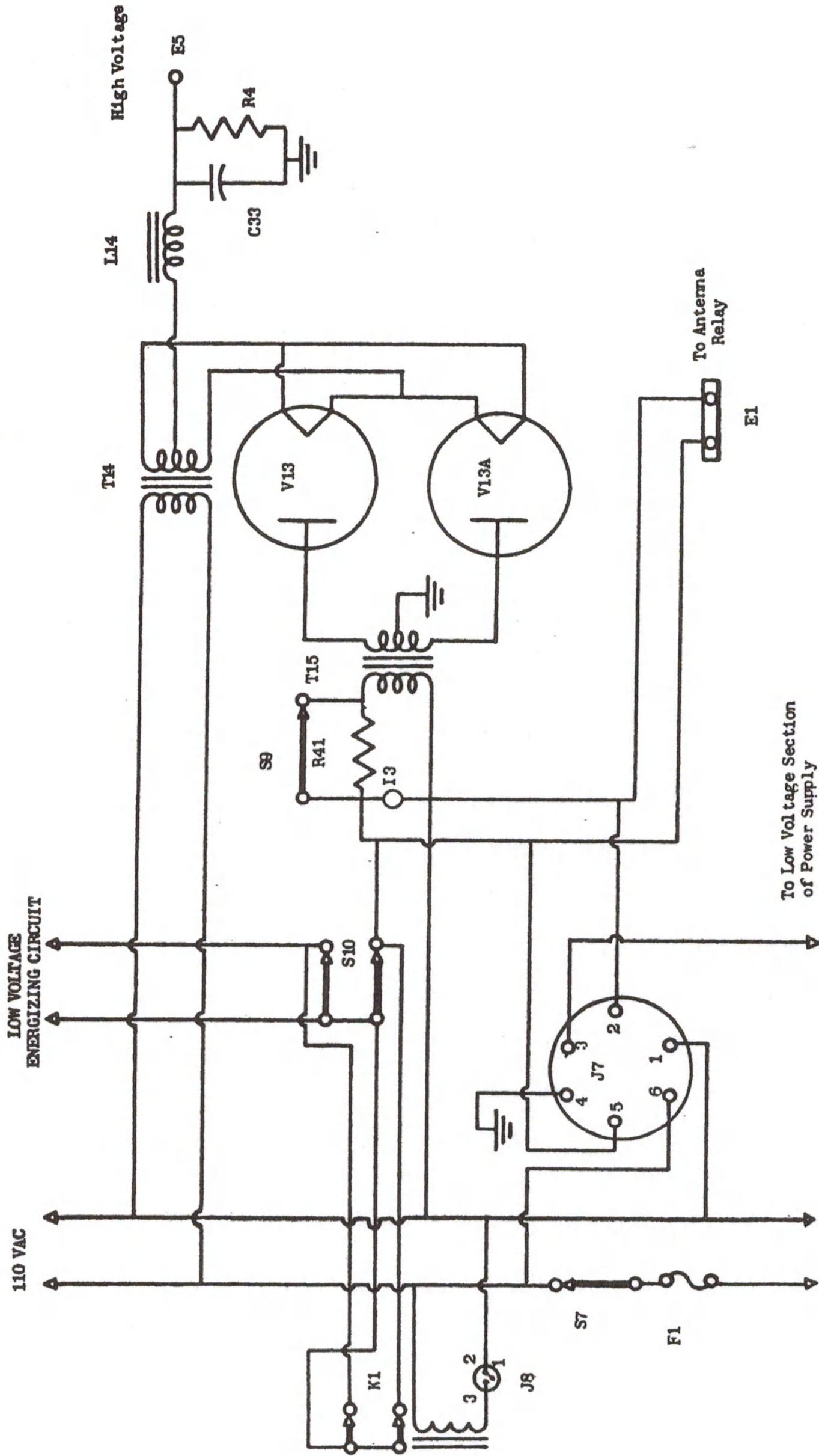


Figure 4-9. High Voltage Section on Main Power Supply Chassis.

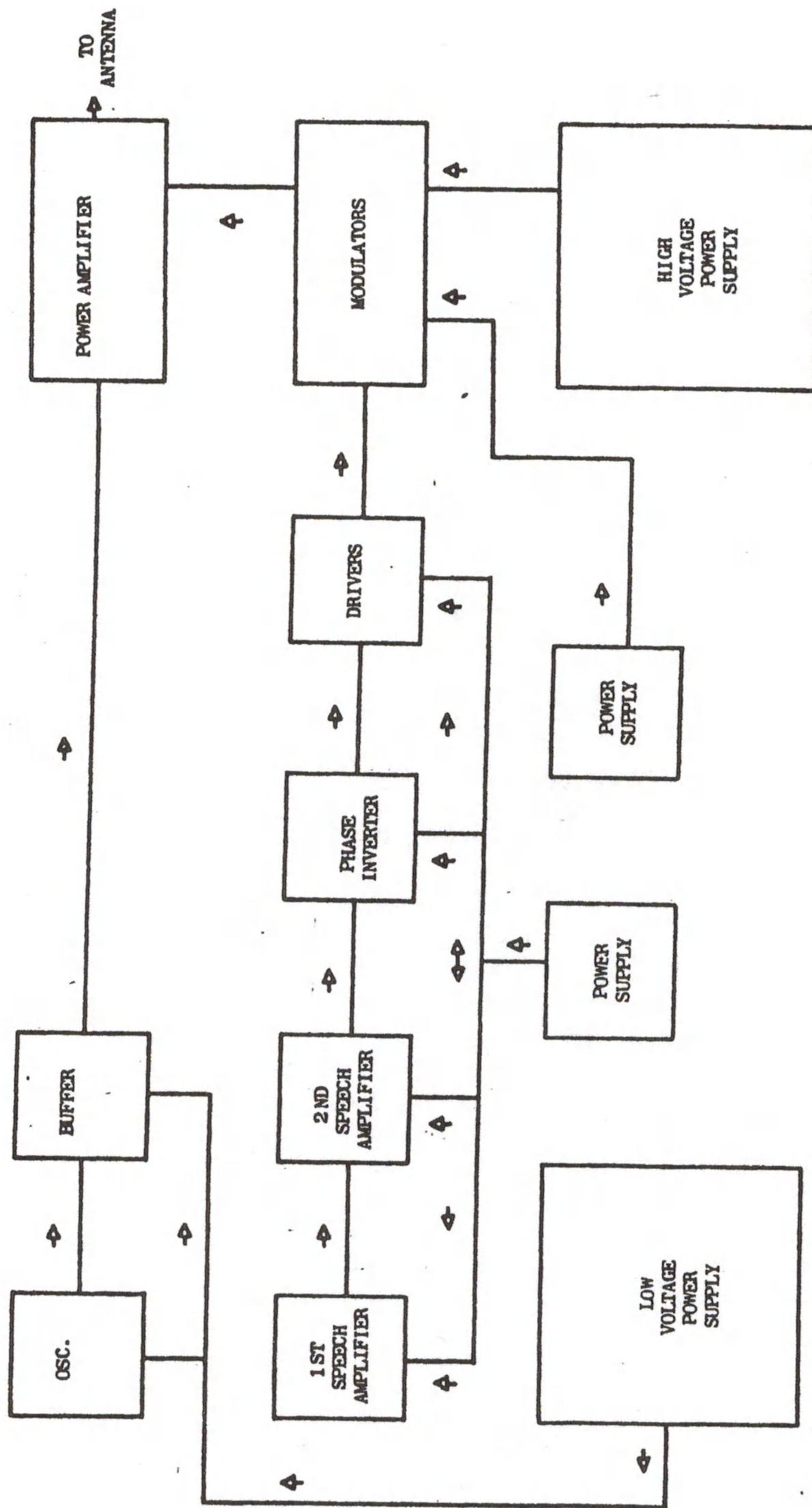


Figure 4-10. Detailed System Block Diagram.

Step	Test Points	Test Equipment	WRL 400B Control Settings and Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
1		AC Voltmeter 500 volt scale	All Filaments on	115 vac	Step 2	Check power supply source
2		DC Voltmeter 1000 volt scale	Filaments on, Exciter on, Modulator Plate off.	550 vdc	Step 3	Check tube V12
3		DC Voltmeter 5000 volt scale	Transmit Switch on	1400 vdc	Step 4	Check V13 and V13A
4		AC Voltmeter 500 volt scale	All Filaments on	115 vac	Step 5	Check power supply source. If satisfactory check S7.
5		Visual check	All Switches in Operate or On position.	Relay K3 opens and Relay K2 should close	Step 6	Check Relay K4 which should close
6		DC Voltmeter 10 volt scale	All Filaments on	7.5 vdc to chassis	Step 7	Check for same voltage at 
7		Ohmmeter RX1 scale	Power line disconnected	Fuse F1 shows continuity or short	Step 8	Replace Fuse F1
8		DC Voltmeter 1000 volt scale	Filaments on, Exciter on.	550 vdc	Step 9	Check S8
9		AC Voltmeter 500 volt scale	Filament Switch S7 on.	115 vac	Refer to Field Maintenance	

Figure 5-1. Organizational System (Trouble) Analysis Chart.

TABLE V. MINIMUM PERFORMANCE STANDARDS.

Step	Switch	Position	Tuning Control	Position	Osc.-Buff. Meter Reading	P.A. Plate-Grid Meter Reading	Modulator Meter Reading	Antenna Coupling
1	10-20M 40-80M	10-20M						
2	Osc. Plate Buff. Plate	Osc. Plt.	Osc. Plate	2.4	20 ma.			Min.
3	Osc.-Buff.	Buff.	Buff. Plate	2.1	20 ma.			Min.
4	P.A. Grid-Plate	P.A. Grid	P.A. Grid	2.8	68 ma.	50 ma.		Min.
5	P.A. Grid-Plate	P.A. Plt.	P.A. Plate	2.2	68 ma.	50 ma.		Min.
6	P.A. Grid-Plate	Plate	Plate	2.2	68 ma.	300 ma.		Max.
7	Mod. Fil. Mod. Plate	On				300 ma.	60-240 ma.	Max.

SECTION V

ORGANIZATIONAL MAINTENANCE

5-1. ORGANIZATIONAL MAINTENANCE.

5-2. Table V illustrates the minimum performance standards for the WRL 400B transmitter. Chart I describes a few preliminary checks which may show up the trouble without going into more complicated tests. No test equipment is necessary to determine the minimum performance standards. Readings of the transmitter panel meters will indicate whether or not performance is satisfactory. Panel meter readings will also help to localize trouble, should it develop. The minimum performance readings are taken with the transmitter crystals controlled at a frequency of 29,000 kc, plus or minus 200 kc. The antenna or dummy load should present a non-reactive 72 ohm load to the transmitter. Refer to table III for the proper coils. If meter readings are below minimum performance standards, consult the trouble analysis chart.

5-3. SYSTEM (TROUBLE) ANALYSIS.

5-4. Should a circuit, or a group of circuits fail, the faulty section or sections should be determined by visual observation first, if possible.

5-5. Should visual observation fail to locate the faulty section, the steps outlined in figure 5-1 should be followed, using a 20,000 ohm-per-volt meter, for voltage and continuity measurements.

5-6. Figure 5-1 gives major and secondary test points and will locate trouble most frequently encountered. The symptoms are a lack of power to sections shown in figures 6-1, 6-2, and 6-3.

5-7. REMOVAL.

5-8. Should it be necessary, for any reason, to remove any of the sections from the cabinet the procedure outlined in paragraph 5-9a through 5-9f should be used.

WARNING

Make certain the transmitter is disconnected from the 110vac line before any work is attempted on the transmitter.

5-9. REMOVAL PROCEDURE.

- Remove any leads that are connected to antenna relay terminal E1.
- Disconnect power and control cables.
- Disconnect all leads between the three sections.
- Remove the two leads from the swinging link going to the antenna feed through insulators. Disconnect at the antenna feed through insulators.
- Remove the 12 panel holding bolts, the top two on each panel have nuts on them, the lower two fastening to the cabinet flange only.
- Remove caps from amplifier tube plates and all sections may then be removed by pulling them forward.

CAUTION

Exercise extreme care in removing the r.f. section, which has very slight clearance between the plate caps of tubes V3 and V3A, and the inner flange of the cabinet.

5-10. MINOR REPAIR AND ADJUSTMENT.

5-11. Under normal operating conditions there are several parts that may need to be replaced periodically. This work is within the capability of organizational personnel.

5-12. REPLACEMENT PROCEDURE.

a. Fuse E1 is removed from the rear of the power supply section by turning holder cap counter-clockwise. Remove fuse from holder cap and inspect visually for open fuse element.

b. Pilot lamps I1, I2, and I3 are removed and replaced by first referring to applicable steps in paragraph 5-9. The defective bulb is removed by unscrewing counter-clockwise, and the new bulb is inserted by screwing clockwise.

c. Tubes are removed by first removing the plate cap, if applicable. The tube is grasped by the base and lifted vertically, with a very slight rocking motion. When replacing tubes, grasp base and push down until firmly seated in socket.

WARNING

Do not lift a tube by the glass, as it may shatter, causing serious personnel injury.

5-13. LUBRICATION.

5-14. No lubrication is necessary, or should be used on the WRL 400B transmitter.

5-15. INSPECTION SCHEDULE.

5-16. Table VI lists the items which should be periodically checked, the symptoms to look for and the time interval.

TABLE VI. INSPECTION SCHEDULE.

Component	Inspection	Time
All tubes	Corrosion at pins and plate caps	6 Months
Capacitors C4, C8, C11, C14	Dust or lint	6 Months
Coils	Bent or shorted turns	When put in use

5-17. BENCH TEST SET-UP.

5-18. The R.F., Modulator and Power Supply sections do not need special bench racks or connecting cables. The three sections should be laid on a bench on their left sides, as viewed from the front panels. The cables supplied should be used to connect the sections together for test purposes. Figure 5-2 shows a bench test set-up, allowing accessibility to all circuits.

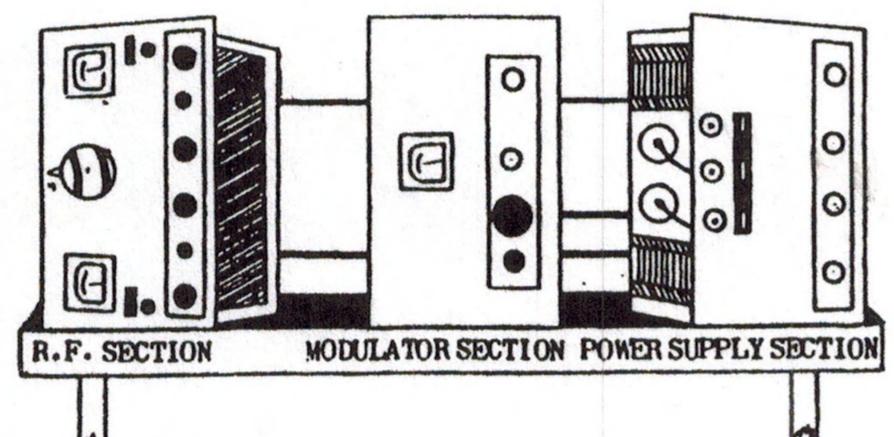
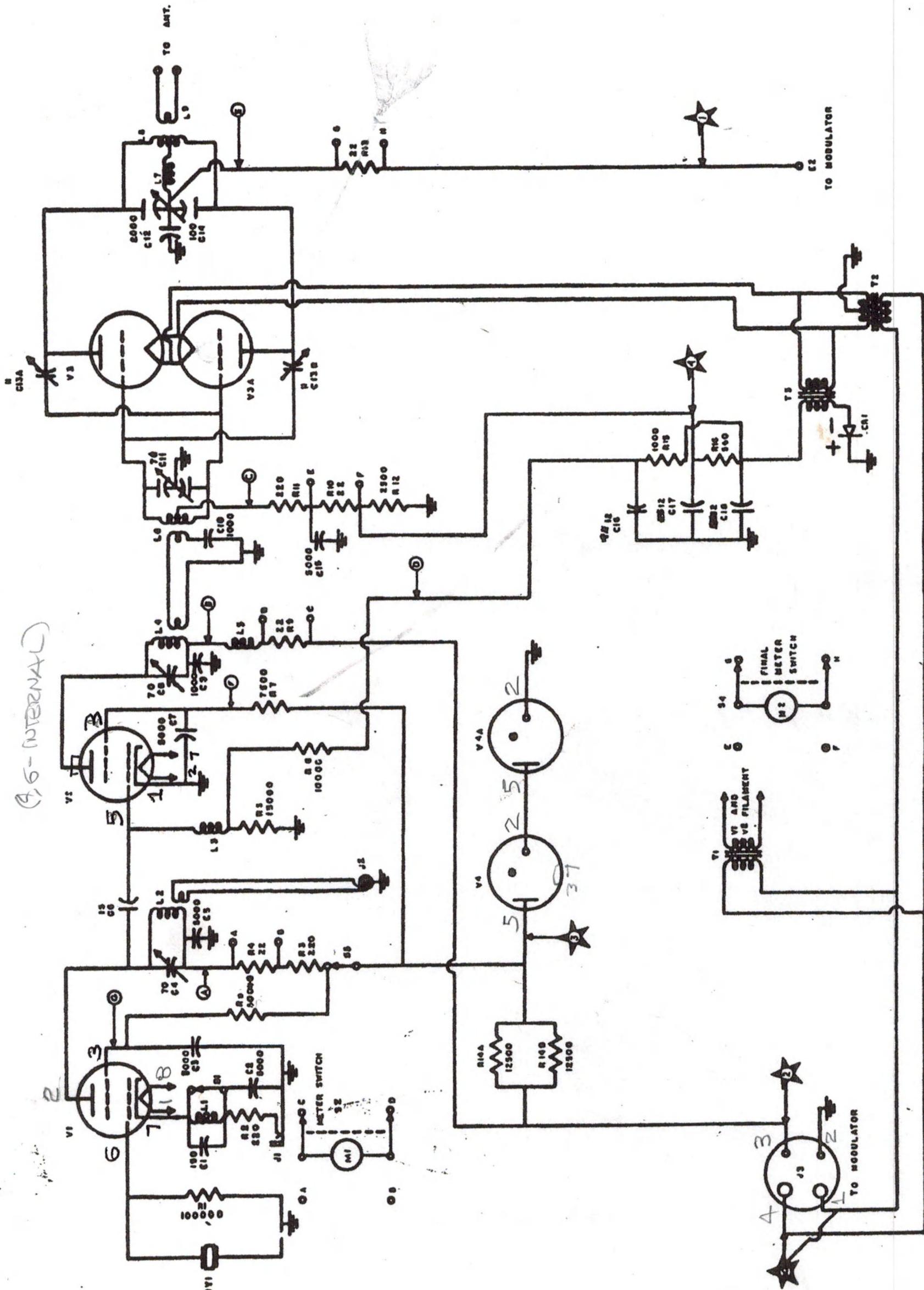


Figure 5-2. Bench Test Set-Up.



Note: All capacitance values in micro-micro-farads unless noted
 Note: All resistance values in ohms unless noted
 25 Micro-farads
 2500 ohms

Figure 6-1. R. F. Section Schematic

SECTION VI
FIELD MAINTENANCE

6-1. FIELD MAINTENANCE.

6-2. This section gives in greater detail, tests that will be used to repair any failure that may be encountered. Various check points are given in order to locate a defective part, which is not visually recognizable as such.

6-3. MINIMUM PERFORMANCE STANDARDS.

6-4. After any adjustments or repairs, the transmitter should be checked for operational performance, referring to table V, for minimum performance standards.

6-5. SYSTEM (TROUBLE) ANALYSIS.

6-6. Should a part become defective, causing improper operation, chart II gives a series of checks using test points, enabling personnel to rapidly locate common causes of trouble. Should a reading differ greatly from that listed as normal, a possible cause of the abnormal operation, or indication is listed with the part that could cause such an abnormal indication.

6-7. When a defective part is located, it should be replaced with a new part having the same ratings and specifications. The new part should occupy the same mounting position.

6-8. REMOVAL.

6-9. If necessary to remove the sections from the cabinet, the procedure as given in paragraph 5-9a. through 5-9f. should be used where applicable.

6-10. CIRCUIT BREAKDOWN.

6-11. The WRL 400B transmitter consists of three main sections.

a. The r.f. section, composed of oscillator, buffer-doubler and final r.f. amplifier, associated filament and bias circuits. The r.f. section is shown in figure 6-1.

b. The modulator section, composed of low level speech amplifier stages, high level modulator stage, and associated power supply circuits. See figure 6-2.

c. Power supply section, composed of high voltage circuit supplying high voltage to the amplifier tubes. A low voltage circuit supplying power to the oscillator, buffer-doubler stages. See figure 6-3.

6-12. SUPPLY VOLTAGE TABLE.

6-13. To carry power and control circuits between the sections, a cable and plug system is used. Tables VII through XIII give the voltages that should be found at the sockets under normal operating conditions, and the resistance readings that should be obtained with no power applied to the equipment. All measurements are made with a 20,000 ohm-per-volt meter unless noted.

WARNING

Extreme care should be taken when working on the equipment with high voltages on.

TABLE VII. POWER AND CONTROL VOLTAGE POINTS.

Note: -Indicates no terminal of that number. **Measured between pins 1 and 4. £Measured between pins 1 and 2. ££Measured between pins 1 and 5 and 2 and 4. Switch S6 closed. All other measurements made to negative chassis.

Measure with a 20,000 ohm-per-volt meter.

R. F. SECTION						
Part Number	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6
J3	**117vac	-	560vdc	**117vac	-	-
E2	140vdc	-	-	-	-	-
MODULATOR SECTION						
J5	0	59vac	59vac	-	-	-
J6££	115vac	115vac	0	115vac	115vac	-
J4	-	7.6vdc	-	-	-	-
E3	140vdc	-	-	-	-	-
E4	140vdc	-	-	-	-	-
POWER SUPPLY SECTION						
J7	59vac	59vac	780vdc	0	59vac	59vac
J8	0	59vac	59vac	-	-	-
E5	140vdc	-	-	-	-	-
E1£	115vac	115vac	-	-	-	-

6-14. Tables VIII through XIII give readings of voltages and resistances on normal sections to aid in system (trouble) analysis. Voltage readings are taken with the equipment in operation, except where specified. Resistance readings are taken with all power and control cables disconnected.

TABLE VIII. R. F. SECTION RESISTANCE READINGS.

Note: Set of coils in place. Oscillator switch on IN position. All readings in ohms, except when marked ** readings in meg-ohms. Measure with a 20,000 ohm-per-volt meter.

Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Plate Cap
V1	0.2	∞	∞	∞	∞	120,000	220	0.1	-
V2	0.1	∞	8000	0	0.1	-	-	-	∞
V3	0	2400	2400	0	-	-	-	-	∞
V3A	0	2400	2400	0	0	-	-	-	-
V4	∞	∞	∞	20**	20**	∞	∞	∞	-
V4A	20**	0	∞	∞	∞	∞	∞	20**	-

TABLE IX. MODULATOR SECTION RESISTANCE READINGS.

Note: Microphone disconnected. All readings in ohms, except where marked ** then read in meg-ohms.

Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	7	Pin 8	P.Cap
V5	0	0	22000	2**	22000	1.2	0.1	340000	-
V6	0	0	300000	∞	0.5**	300000	0.4	1500	-
V7	0	0	330000	400000	220000	300000	0.1	1500	-
V8	0	0*	38000	38000	260000	34000	0.1	700	-
V8A	0	0	40000	40000	270000	∞	0.1	700	-
V9	0.1	45	45	0.1	-	-	-	-	55000
V9A	0.1	45	45	0.1	-	-	-	-	55000
V10	∞	38000	∞	40	∞	39	∞	34000	-
V11	55000	150	150	55000	-	-	-	-	-
V11A	55000	150	150	55000	-	-	-	-	-

TABLE X. POWER SUPPLY SECTION RESISTANCE READINGS.

Note: All readings in ohms.

Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Plt. Cap
V12	∞	55000	∞	120	∞	120	∞	55000	-
V13	55000	∞	∞	55000	-	-	-	-	100
V13A	55000	∞	∞	55000	-	-	-	-	100

6-15. Tables XI through XIII show voltages as measured from the tube pins to ground, except where noted. Measurements are made with a 20,000 ohm-per-volt meter. A dash line in the column indicates no pin of that number.

TABLE XI. R.F. SECTION VOLTAGE READINGS.

Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Plt. Cap
V1	3.4vac	300vdc	180vdc	0	0	0	5vdc	14vac	-
V2	3.4vac	230vdc	-60vdc	0	3.4vac	-	-	-	560vdc
V3	3.9vac	-87vdc	0	3.9vac	-	-	-	-	1400vdc
V3A	3.9vac	-87vdc	0	3.9vac	-	-	-	-	1400vdc
V4	0	150vdc	0	0	300vdc	0	0	0	-
V4A	0	0	0	0	150vdc	0	0	0	-

WARNING

In table XII, high voltage to ground exists on pins 2 and 8 of tube V10, and pins 1 and 4 of tubes V11 and V11A.

TABLE XII. MODULATOR SECTION VOLTAGE READINGS.

Note: *indicates measured between pins 2 and 8. **indicates measured between pins 1 and 4.

Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Plt. Cap
V5	0	3vac	2.2 vdc	0	2.2vdc	50vdc	3vac	90 vdc	-
V6	0	3vac	50 vdc	0	0	50vdc	3vac	1.7 vdc	-
V7	0	3vac	115 vdc	0	0	112vdc	3vac	2.8 vdc	-
V8	0	3vac	360 vdc	360vdc	0	0	3vac	38 vdc	-
V8A	0	3vac	360 vdc	360vdc	0	0	3vac	38 vdc	-
V9	3.8vac	0	0	3.8vac	-	-	-	-	1080 vdc
V9A	3.8vac	0	0	3.8vac	-	-	-	-	1080 vdc
V10	0	5vac *	0	340vac	0	340vac	0	5 vac *	-
V11	2.5vac **	1200 vac	1200 vac	2.5vac **	-	-	-	-	-
V11A	2.5vac **	1200 vac	1200 vac	2.5vac **	-	-	-	-	-

WARNING

In table XIII, high voltage to ground exists on pins 2 and 8 of tube V12, and pins 1 and 4 of tubes V13 and V13A.

TABLE XIII. POWER SUPPLY SECTION VOLTAGE READINGS.

Note: Voltage measurements on the power supply are taken with this section disconnected from the other sections. The readings will be slightly lower under full load conditions. *Measured between pins 2 and 8. **Measured between pins 1 and 4.

Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Plate Cap
V12	0	5vac*	0	600vac	0	600vac	0	5vac*	-
V13	2.4vac **	0	0	2.4vac **	-	-	-	-	1700vac
V13A	2.4vac **	0	0	2.4vac **	-	-	-	-	1700vac

6-16. ALIGNMENT AND ADJUSTMENT.

6-17. In this transmitter there is but one alignment necessary. This is the neutralization of the final r.f. amplifier. This adjustment is normally only made in the event that one of the final r.f. amplifier tubes must be changed, or replaced, or in the event that there is rea-

son to doubt that the amplifier is properly neutralized.

6-18. For this adjustment the indicator shown in figure 2-1, and described in paragraph 2-4 is used. This adjustment is also described in handbook AN16-45-417.

6-19. Use coils and crystals for the 29,000 kc range, referring to table III.

6-20. NEUTRALIZATION PROCEDURE.

a. This adjustment can be done by either removing the high voltage lead from terminal E2, or by leaving this connected and simply turning on the exciter switch.

b. Release lock nuts on neutralizing condensers C13A and C13B. Close the condensers completely, until the plates touch.

c. Open each condenser two turns.

d. Apply power to oscillator and buffer-doubler stages and adjust controls in normal manner for 45ma grid drive to the final r.f. amplifier stage.

e. Hold loop of indicator, figure 2-1, against one end of the amplifier plate coil L8. The lamp of the indicator should light at this time.

f. Using an insulated screwdriver open each neutralizing condenser one quarter turn at a time until the indicator lamp is extinguished. The indicator should be tried at each end of coil L8 alternately, coupling as closely as possible between the indicator loop and the coil L8. At approximately three and one half turns open on each condenser plate it will not be possible to light the indicator bulb. This normally indicates correct neutralization.

g. Turn transmitter off, except for filament power.

h. Hold neutralizing condensers in place and tighten lock nuts. Connect high voltage lead to terminal E2, if this method of removing the high voltage was used.

6-21. It should now be possible to obtain a plate current reading of 30ma on the final r.f. amplifier stage, with this stage resonated, operating on low B plus, and the antenna disconnected. Should the plate current reading be higher than 45ma, the neutralization procedure should be repeated, as a higher reading indicates that the circuit is not electrically balanced. Care should be taken to keep the spacing of the neutralization equal.

6-22. LUBRICATION.

6-23. No lubrication is necessary or should be used on the WRL 400B transmitter.

6-24. MAINTENANCE AND INSPECTION SCHEDULE.

6-25. Refer to table VI for inspection requirements. Further maintenance not necessary.

6-26. OVERHAUL SCHEDULE.

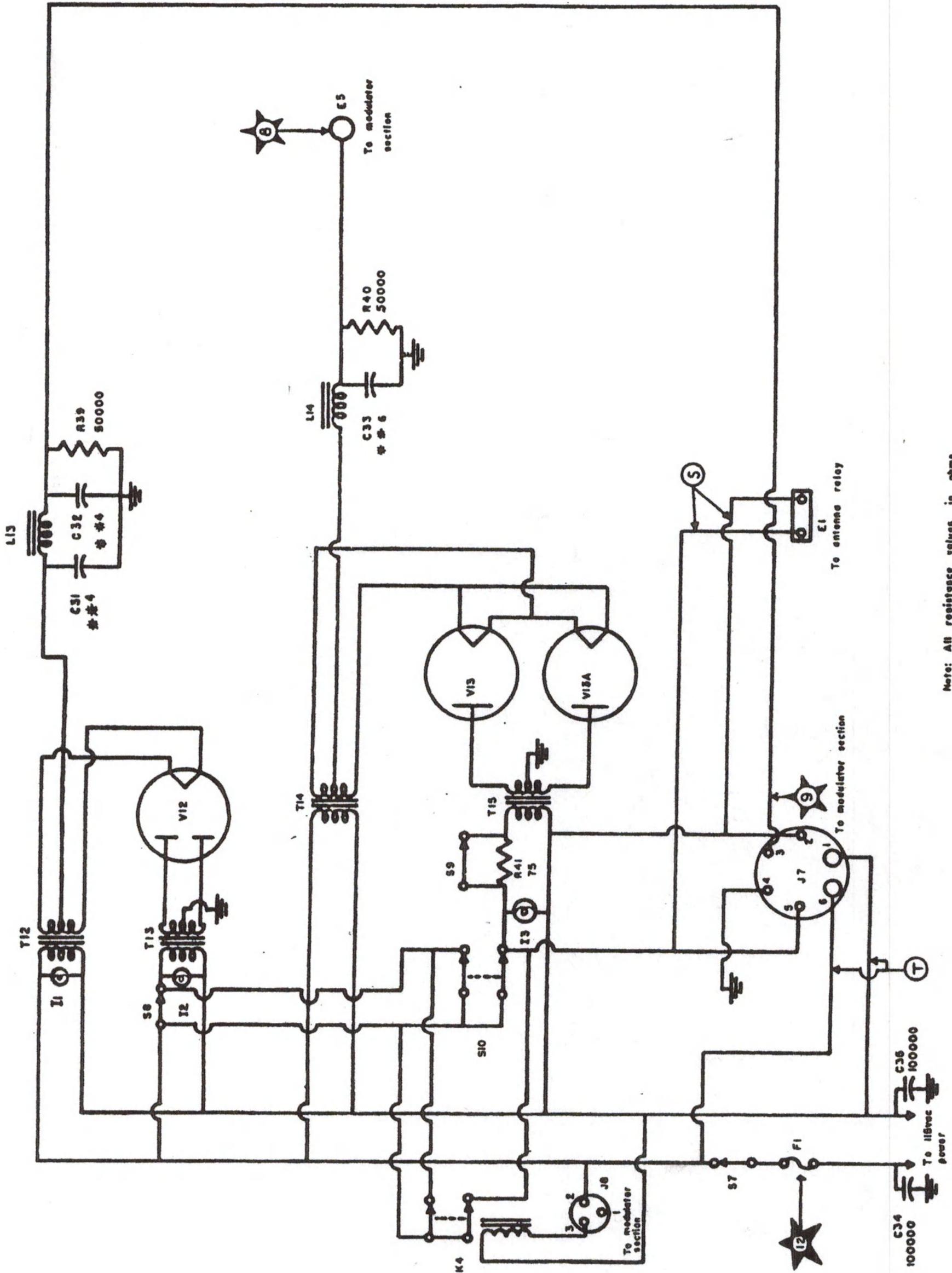
6-27. No overhaul required. Maintenance and inspection listed in table VI suffice.

6-28. BENCH TEST SET-UP.

6-29. Refer to figure 5-1 for proper bench test set-up.

6-30. TEST EQUIPMENT.

6-31. Refer to table IV for test equipment. Paragraph 2-3 and figure 2-1 illustrate special test equipment required.



Note: All resistance values in ohms
 Note: All capacitance values in micromicrofarads unless noted
 * Micromicrofarads

Figure 6-3. Power Supply Section Schematic

Test Point	Meter Scale	Normal Indication	Possible Cause of Abnormal Operation
★ 2	1,000 vdc	no load 625 vdc load 550 vdc	Capacitor C9, tube V2
★ 3	1,000 vdc	300 vdc regulated	Resistor R14A, R14B, tube V1, V4, V4A, capacitor C5
ⓐ	250 vdc	150 vdc	Capacitor C3, tube V1, switch S3, resistor R5
ⓐ	1,000 vdc	300 vdc regulated	Resistor R3, R4, switch S3, capacitor C5
ⓕ	1,000 vdc	210 vdc	Capacitor C7, resistor R7, tube V2
ⓑ	1,000 vdc	550 vdc	Capacitor C9, resistor R9, choke L5, tube V2
ⓓ	250 vdc chassis positive	110 vdc	Resistor R15, capacitor C16
★ 4	250 vdc chassis positive	-125 vdc	Rectifier CR1, resistor R16, transformer T3, capacitor C17, C18
Ⓒ	250 vdc chassis positive	87 vdc (no drive) 125 vdc (drive)	Resistor R11, R10, R12, tube V3, V3A, capacitor C15
ⓔ	5,000 vdc	1,400 vdc	Capacitor C12, resistor R13
★ I	5,000 vdc	1,400 vdc	Main Power Supply
★ 5	1,000 vdc	400 vdc	Choke L12, tube V10, capacitor C27A, C27B, transformer T11
ⓐ	1,000 vdc	400 vdc	Transformer T4, tube V8
Ⓚ	1,000 vdc	400 vdc	Tube V8, transformer T4
Ⓛ	1,000 vdc	75 vdc	Resistor R28, R29, R30, tube V7, capacitor C21C
Ⓜ	1,000 vdc	75 vdc	Resistor R28, R29, R31, capacitor C21C, tube V7
Ⓝ	1,000 vdc	50 vdc	Resistor R24, R25, R26, tube V6, capacitor C21B
Ⓞ	1,000 vdc	50 vdc	Resistor R19, R21, R22, tube V5, capacitor C21A
Ⓟ	1,000 vdc	30 vdc	Resistor R20, R22, capacitor C20, C22
Ⓠ	10 vdc	7.5 vdc	Relay K1
★ 7	10 vdc	7.5 vdc	Choke L10, transformer T6, rectifier CR2, capacitor C29, C30
Ⓡ	R x 1	Short (make switch closed)	Relay K1 contact points
★ 6	5,000 vdc	1,000 vdc	Choke L11, transformer T9, T11, capacitor C28
★ 8	5,000 vdc	1,400 vdc	Choke L14, capacitor C33, tube V13, V13A, switch S9, S10, transformer T15
★ 9	1,000 vdc	625 vdc (no load)	Choke L13, transformer T13, tube V12, capacitor C31, C32, switch S8
Ⓢ	250 vac	115 vac (S10 on)	Switch S10

Figure 6-4. System (Trouble) Analysis Chart.

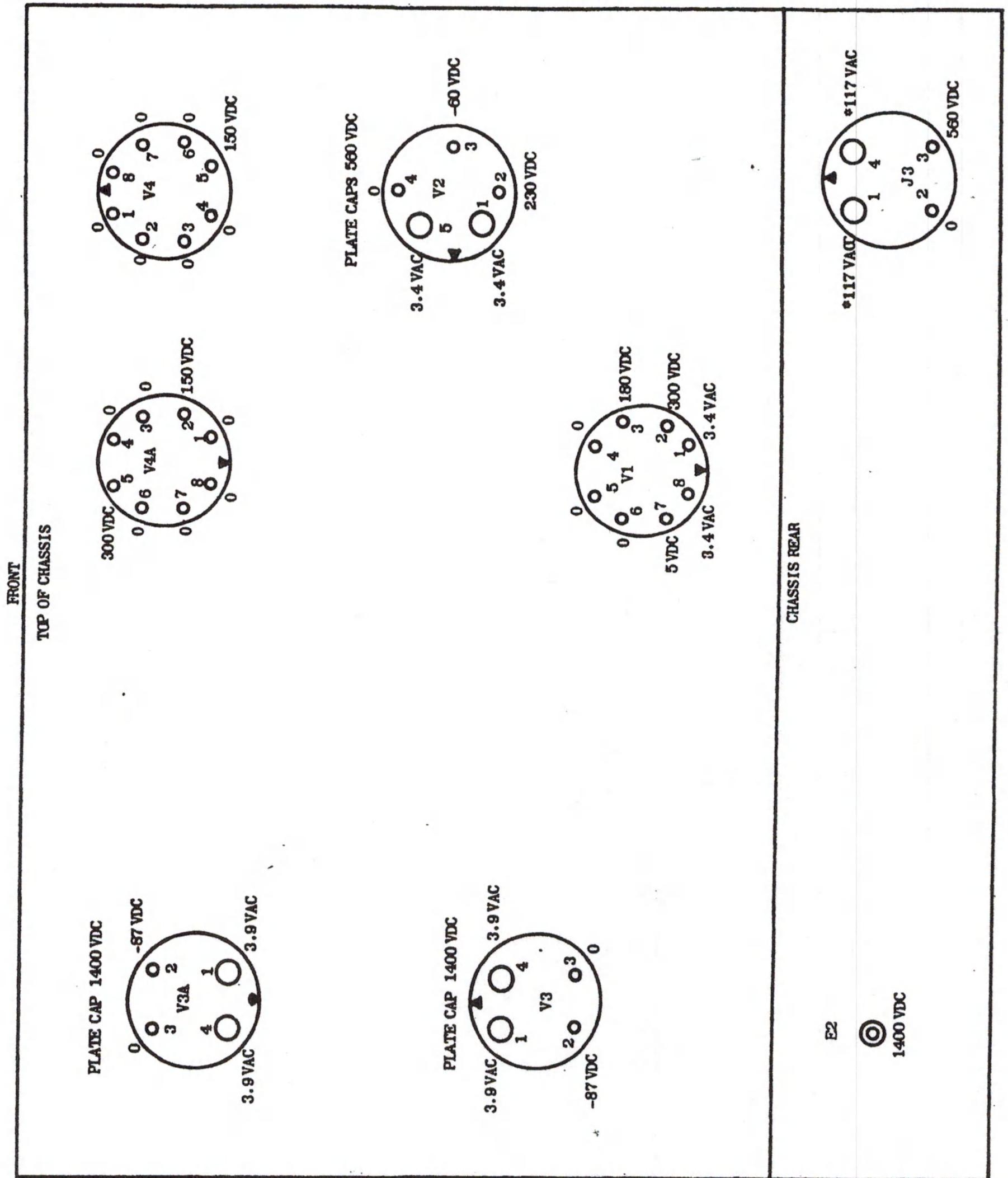


Figure 7-1. Terminal Voltages R.F. Section

NOTE: R.F. voltage readings under normal operating conditions. Measured with a 20,000 ohm-per-volt meter. Oscillator switch on "IN" position. Measured to chassis

ground except those marked * are measured between pins 1 and 4.

SECTION VII

DIAGRAMS

7-1. DIAGRAMS.

7-2. Diagrams are completely covered in this section. These diagrams will enable the technician to locate and correct any trouble that may develop in the equipment.

7-3. Figures 6-1, 6-2, and 6-3 are wiring diagrams of the three main components, making up the complete equipment.

7-4. The main power and control cable, interconnecting the three main components, has a different type connector for each component and it is therefore impossible to connect the cable improperly. The push-to-talk cable has the same type connector on each end, however reversing the connectors will not result in an improper connection. The two high voltage leads are single wires that are interchangeable in position.

7-5. All symbols are in accordance with JAN-STD-15.

7-6. All wave shapes in the equipment are sine wave. The radio frequency signals are constant frequency sine waves. The audio sine waves vary in frequency and amplitude in accordance with the operators voice.

7-7. The tolerance on parts is 10 percent. The tolerance on voltages may vary minus 20 percent, plus 10 percent.

7-8. TERMINAL VOLTAGE DIAGRAMS.

7-9. Figures 7-1, 7-2, and 7-3 are terminal voltage diagrams, giving the location of the various terminals and the voltages which should be found at these terminals. Refer to footnotes when making these measurements.

7-10. Figures 7-4, 7-5, and 7-6 are terminal resistance diagrams. Refer to footnotes before making measurements.

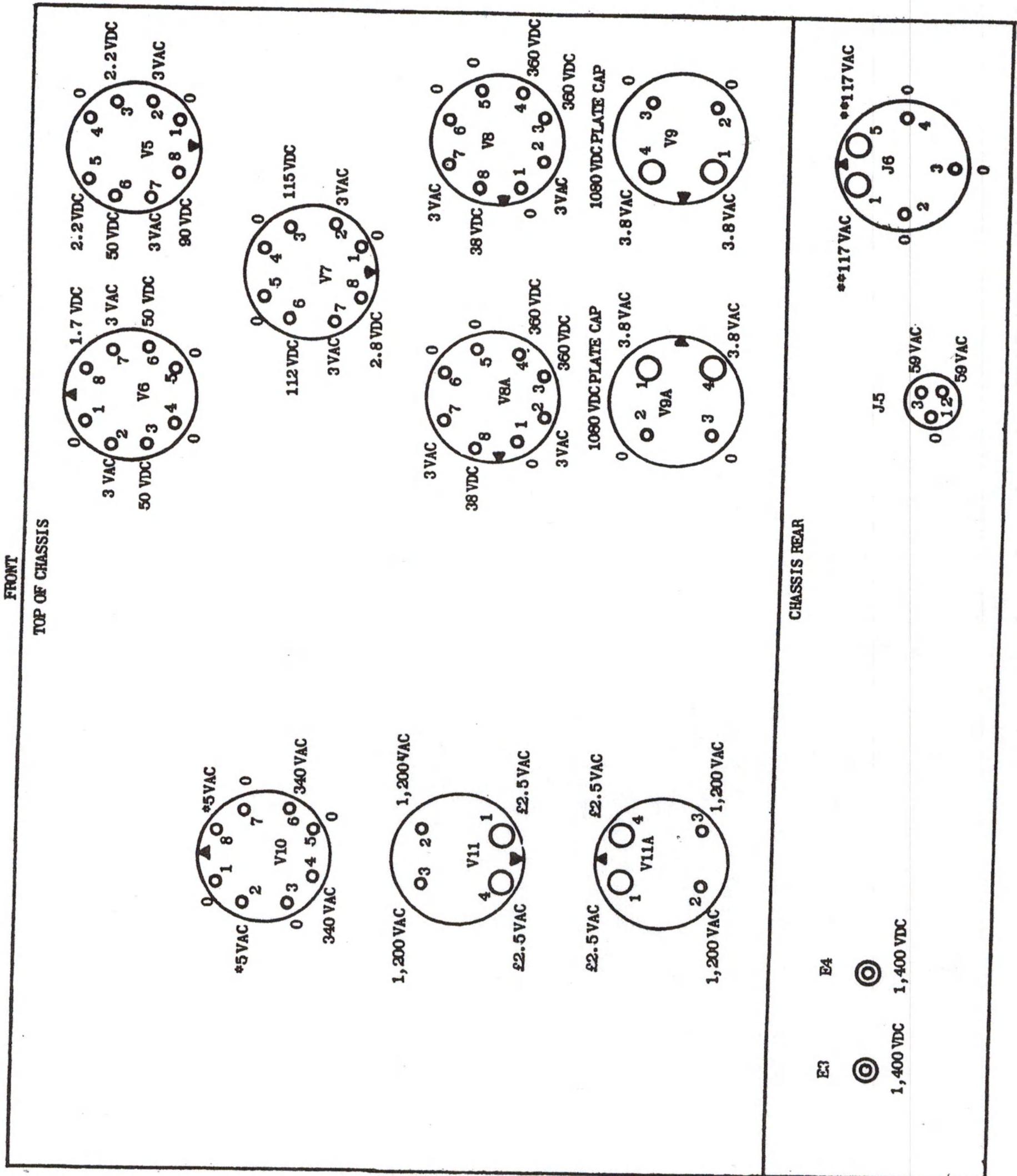


Figure 7-2. Terminal Voltages Modulator Section

NOTE: Modulator voltage readings under normal operating conditions except no audio input. Measured with a 20,000 ohm-per-volt meter. Filament and plate switches "ON". Measured to chassis ground unless noted. **Measured between pins 1 and 5.

WARNING

High voltages appear to ground from pins marked * and £. *Measured between pins 2 and 8. £Measured between pins 1 and 4.

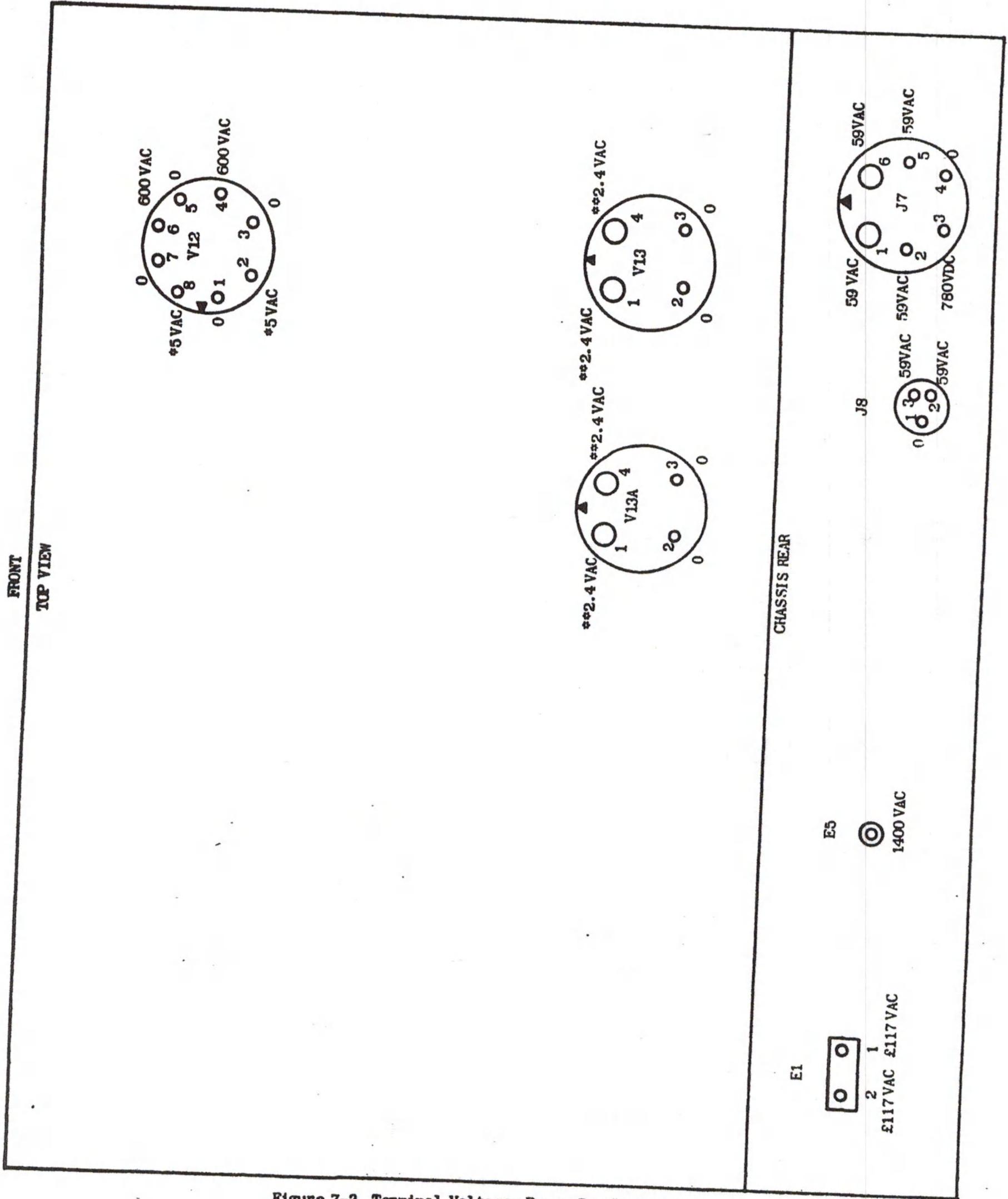


Figure 7-3. Terminal Voltages Power Supply Section

NOTE: Power and control cables disconnected. No load conditions. Measured with a 20,000 ohm-per-volt meter. Filament and transmit switches on HI B +. Measured to chassis ground unless noted. £Measured between terminals 1 and 2. *Measured between pins 2 and 8.

WARNING

High voltage appears between chassis ground and pins marked **.

**Measured between pins 1 and 4.

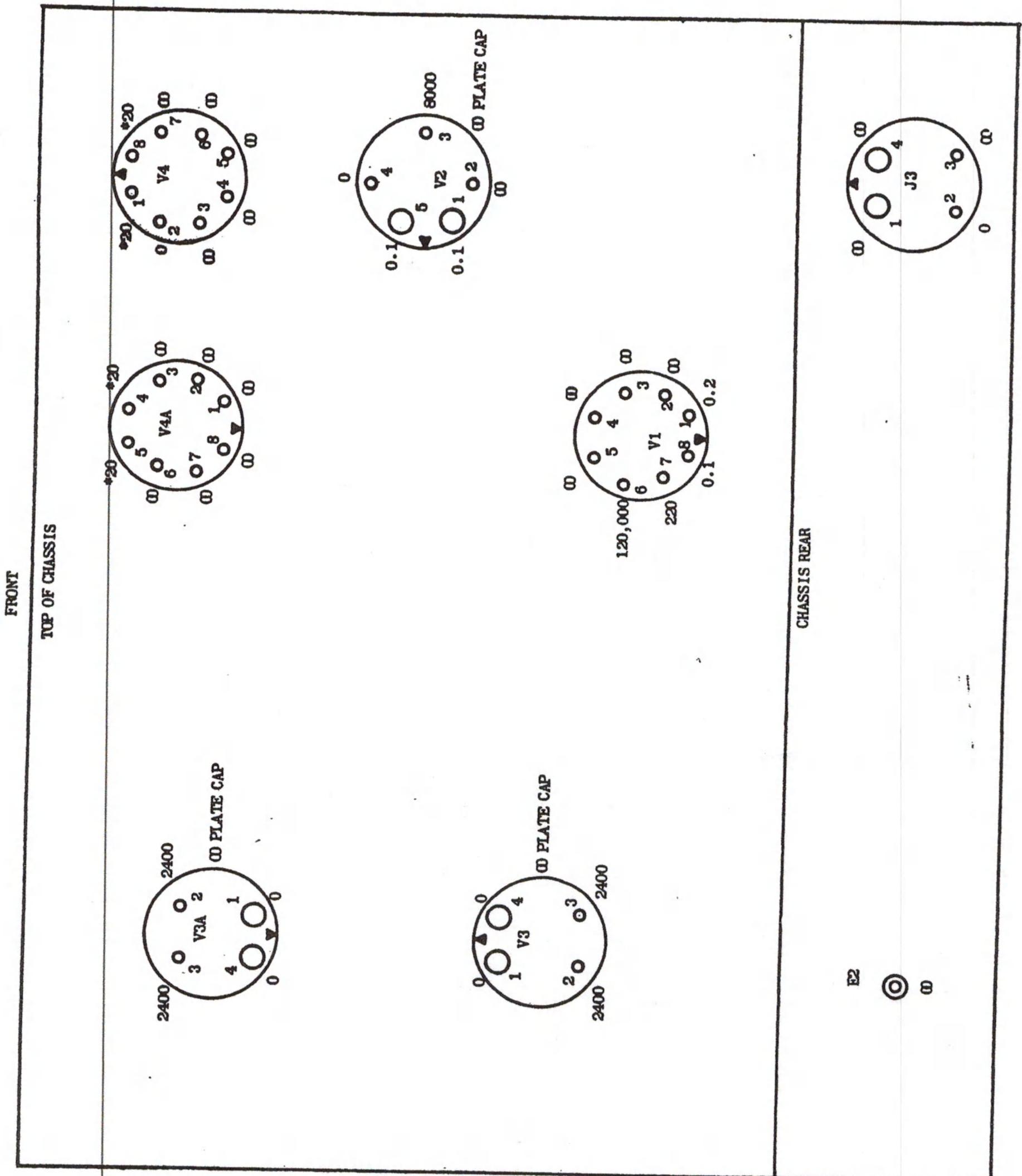


Figure 7-4. Terminal Resistances R.F. Section

NOTE: Resistance readings measured with a 20,000 ohm-per-volt meter. All interconnecting cables disconnected. Set of coils in place. Oscillator switch on "IN" po-

sition. Readings taken to chassis ground. *Readings in megohms. All other readings in ohms.

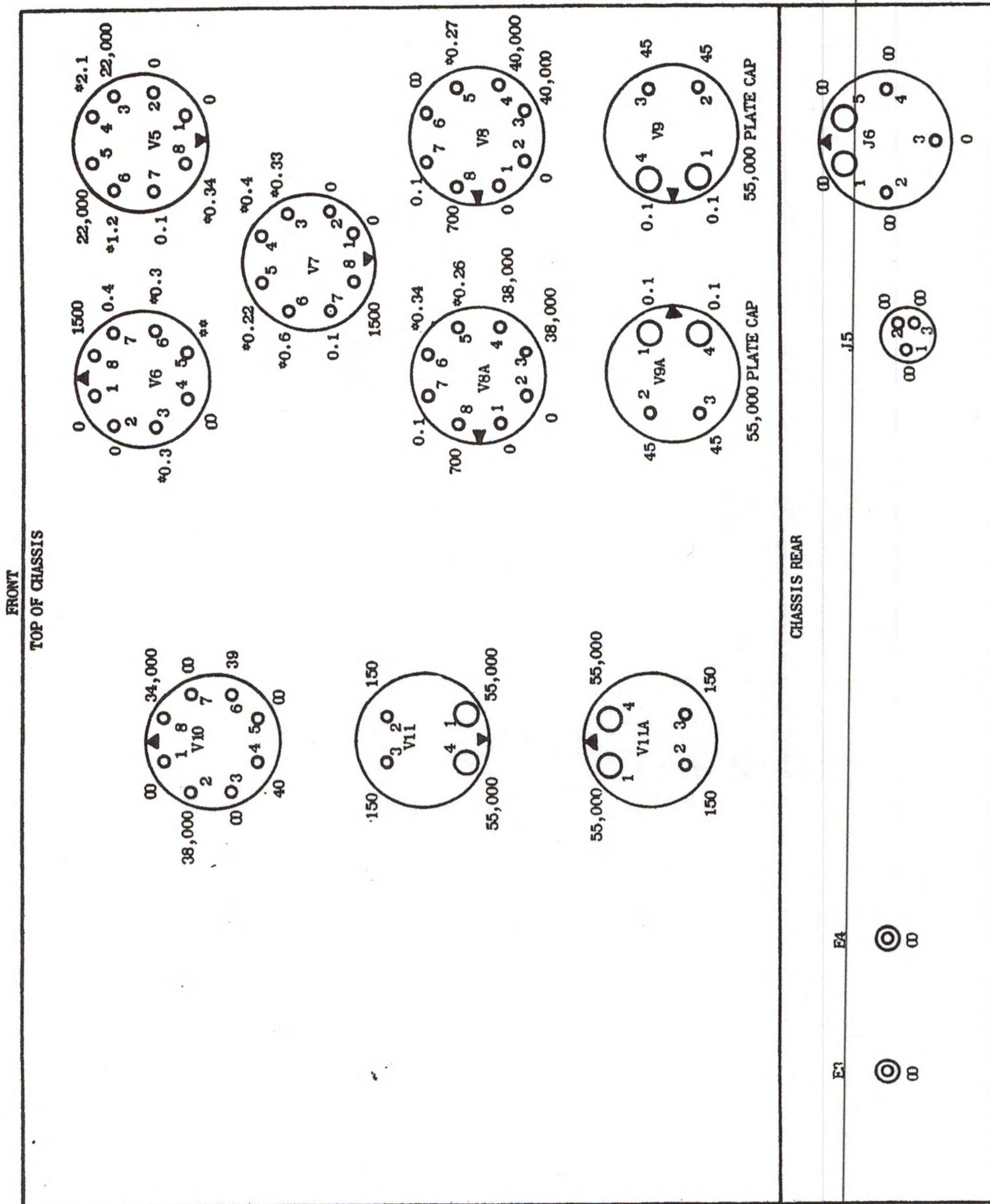


Figure 7-5. Terminal Resistances Modulator Section

NOTE: Resistance readings measured with a 20,000 ohm-per-volt meter. Power and control cables disconnected. All switches in "OFF" position. All readings to chassis

ground. All readings in ohms unless noted. *Readings in megohms. **Will vary from 0 to .5 megohms.

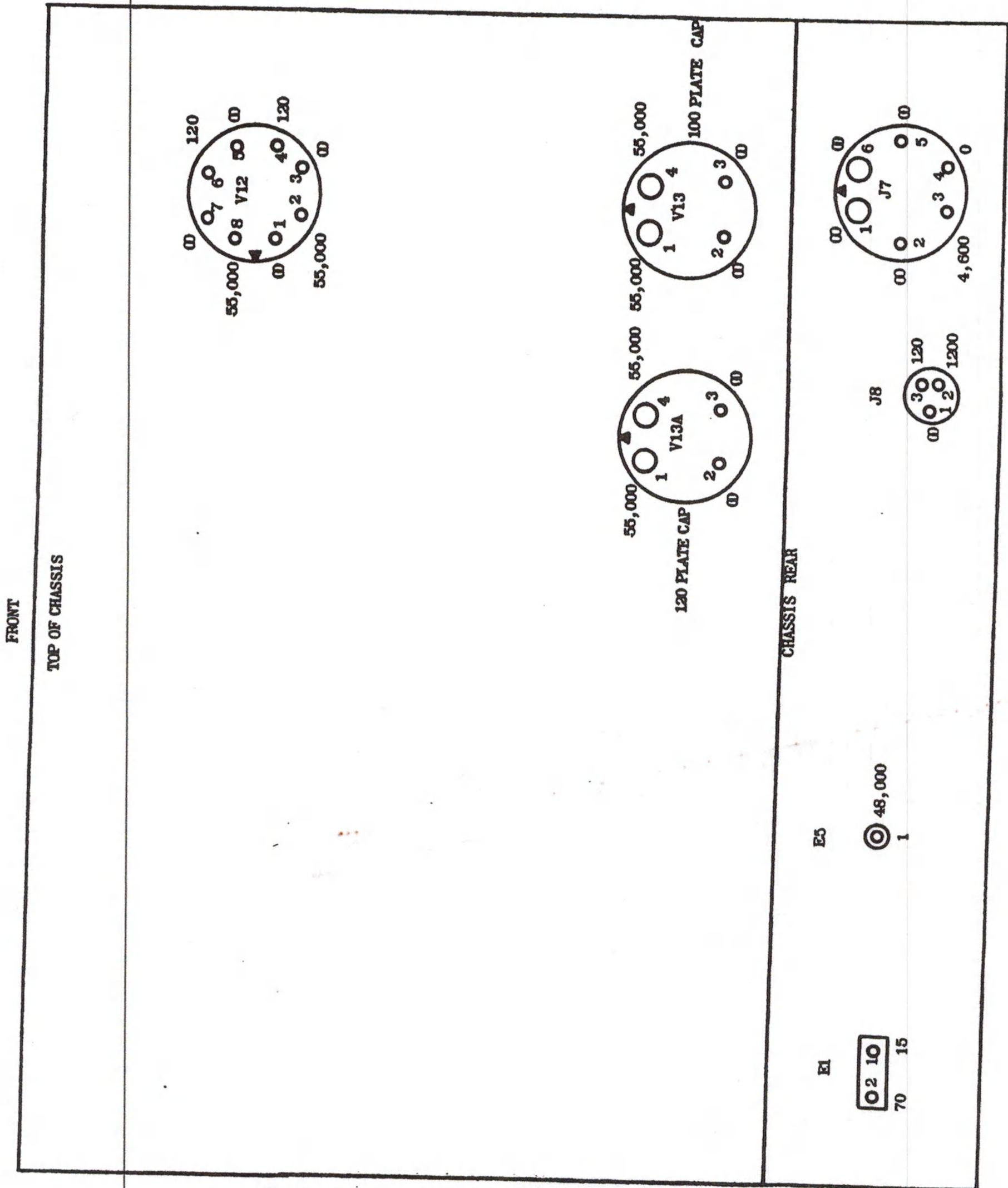


Figure 7-6. Terminal Resistances Power Supply Section

NOTE: Resistance readings measured with a 20,000 ohm-per-volt meter. Power and control cables disconnected.

All switches in "OFF" position. All readings in ohms unless noted.

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