

# TM 11-5820-532-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

---

## ORGANIZATIONAL, DS, GS, AND DEPOT MAINTENANCE MANUAL AMPLIFIER

### RF AM-3979/FRC-93 (COLLINS MODEL 30L-1)

---



HEADQUARTERS, DEPARTMENT OF THE ARMY

JANUARY 1965

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 28 January 1965

This manual is published for the use of all concerned.

By Order of the Secretary of the Army:

HAROLD K. JOHNSON  
*General, United States Army,  
Chief of Staff.*

Official:

J. C. LAMBERT  
*Major General, United States Army,  
The Adjutant General.*

Distribution:

Active Army:

Seventh USA (10)  
USAREUR (177)  
GEN DEP (Europe) (5) except  
E2-3971 (10)

Sig Sec, GENDEP (Europe) (5)  
Sig Dep (Europe) (12)  
Sig Fld Maint Shops (Europe) (1)

NG: None.

USAR: None.

For explanation of abbreviations used, see AR 320-50.

# TABLE OF CONTENTS

Section		Page
<b>A</b>	<b>INTRODUCTION</b> . . . . .	1-0.1
<b>I</b>	<b>INSTALLATION</b> . . . . .	1-1
	1.1 Unpacking . . . . .	1-1
	1.2 Power Transformer Connections . . . . .	1-1
	1.3 Cabling . . . . .	1-1
	1.3.1 Traveling Station . . . . .	1-1
	1.3.2 Home Station . . . . .	1-1
	1.3.3 KWM-1 Serial Numbers Above 861 . . . . .	1-1
	1.3.4 KWM-1 Serial Numbers Below 861 . . . . .	1-5
	1.4 Installation with Other Makes of Exciters . . . . .	1-5
<b>II</b>	<b>OPERATION</b> . . . . .	2-1
	2.1 Operation in Amateur Bands . . . . .	2-1
	2.2 Operation with Other Makes of Exciters . . . . .	2-1
	2.3 Operation Outside Amateur Bands . . . . .	2-1
<b>III</b>	<b>PRINCIPLES OF OPERATION</b> . . . . .	3-1
	3.1 General . . . . .	3-1
	3.2 Input Circuits . . . . .	3-1
	3.3 Output Circuits . . . . .	3-1
	3.4 Power Supply Circuits . . . . .	3-1
	3.5 Safety Interlock Circuits . . . . .	3-1
	3.6 Power Control Circuits . . . . .	3-1
	3.7 ALC Circuits . . . . .	3-1
	3.8 Metering Circuits . . . . .	3-2
<b>IV</b>	<b>MAINTENANCE</b> . . . . .	4-1
	4.1 General . . . . .	4-1
	4.2 Removal of Cabinet and Covers . . . . .	4-1
	4.3 Blower Lubrication . . . . .	4-1
	4.4 Alignment of R-F Input Circuits . . . . .	4-1
	4.5 Meter Lamp Replacement . . . . .	4-2
	4.6 Tube Replacement . . . . .	4-2
	4.7 Tune Meter Adjustment . . . . .	4-2
	4.8 ALC Threshold Adjustment . . . . .	4-2
<b>V</b>	<b>SPECIFICATIONS</b> . . . . .	5-1
<b>VI</b>	<b>PARTS LIST</b> . . . . .	6-1
<b>VII</b>	<b>ILLUSTRATIONS</b> . . . . .	7-1
<b>VIII</b>	<b>OPERATOR'S MAINTENANCE</b> . . . . .	8-1
<b>IX</b>	<b>ORGANIZATIONAL MAINTENANCE</b> . . . . .	9-1
<b>Appendix.</b>	<b>REFERENCES</b> . . . . .	10-1

## LIST OF ILLUSTRATIONS

Figure		Page
1-1	Interconnections with KWM-2/2A Traveling Station (C724-06-5) . . . . .	1-0
1-2	Interconnections with KWM-2/2A Home Station (C724-04-5) . . . . .	1-2
1-3	Interconnections with KWM-1 (C724-05-5) . . . . .	1-3
1-4	Interconnections with S-Line (C724-07-5) . . . . .	1-4
2-1	30L-1 Operating Controls (C724-08-P) . . . . .	2-0
3-1	30L-1 Block Diagram (C724-02-4) . . . . .	3-0
3-2	Control and Interlock Circuits (C724-03-4) . . . . .	3-2
4-1	Location of Adjustments (C724-10-P) . . . . .	4-1
6-1	R-F and Power Supply Compartments, Parts Location (C724-12-P) . . . . .	6-2
6-2	Input Circuitry, Parts Location (C724-11-P) . . . . .	6-3
7-1	Connector Assembly Instructions (C724-14-X) . . . . .	7-1
7-2	30L-1 Schematic Diagram (C724-01-6) . . . . .	7-3

## LIST OF TABLES

Table		Page
1-1	Equipment Furnished with 30L-1 . . . . .	1-1
2-1	Multimeter Scale Values . . . . .	2-1
4-1	Frequency Coverage Allowable by Realignment . . . . .	4-2

## SECTION A

### INTRODUCTION

#### A.1. Scope

This manual describes Amplifier, RF AM-3979/FRC-93 (fig. 2-1) and contains instructions for installation, operation and principles of operation, service instructions for direct support, general support, and depot maintenance. Instructions for cleaning, inspection, and operator and organizational maintenance of Amplifier, RF AM-3979/FRC-93 are also included. This is a first-edition manual containing preliminary and unreviewed information compiled by the manufacturer of the equipment. Judicious caution should be exercised in using the information in this manual until it is replaced by a revised edition. Sections VIII and IX have been added to include the preventive maintenance checks and services.

#### A.2. Index of Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to this equipment. Department of the Army Pamphlet No. 310-4 is an index of current technical manuals, technical bulletins, supply manuals (types 4, 6, 7, 8, and 9), supply bulletins, lubrication orders, and modification work orders available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc) and the latest changes to and revisions of each publication.

#### A.3. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions in TM 38-750.

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700-58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71-4 (Air Force).

c. Reporting of Equipment Manual Improvements. The direct reporting, by the individual user, of errors, omissions, and recommendations for improving this equipment manual is authorized and encouraged. DA Form 2028 will be used for reporting these improvements. This form may be completed by the use of pencil, pen, or typewriter. DA Form 2028 will be completed in triplicate and forwarded by the individual using the manual. The original and one copy will be forwarded direct to: Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-MR-MPP, Fort Monmouth, New Jersey, 07703. One information copy will be furnished to the individual's immediate supervisor (officer, noncommissioned officer, supervisor, etc).

# SECTION I

## INSTALLATION

### 1.1 UNPACKING.

Carefully lift the amplifier out of the packing material. Examine for visible damage. If the amplifier has been damaged in shipment, save box and packing material and notify the transportation company. Fill out and mail the equipment registration card. Check tuning controls and switches for freedom of action. Check

the equipment included with the amplifier against table 1-1.

Lift the amplifier cabinet lid. Loosen the ten screws in the r-f compartment cover, slide it forward, and lift off. Remove the packing material around the tubes. Replace the cover and tighten screws. Lower the lid.

TABLE 1-1. EQUIPMENT FURNISHED WITH 30L-1

QUANTITY	DESCRIPTION	FUNCTION	PART NUMBER
2	Shielded cables, 4 feet long, with phono plug on each end	Alc and antenna relay cables	426-2027-00
1	RG-58C/U cable, $\frac{1}{4}$ feet long, with phono plug on each end	R-f input cable	426-5079-00
6	Fuses, 8-ampere	Spares	264-4110-00
1	A-c power plug adapter	A-c power	368-0138-00
1	UG-21D/U coaxial plug	R-f output connector	357-9261-00
1	Number 6 Bristo wrench	Knob removal	024-9730-00
1	Number 8 Bristo wrench	Knob removal	024-0019-00
1	Coaxial plug (Amphenol type 82-835)	Right-angle cable plug	357-9113-00

### 1.2 POWER TRANSFORMER CONNECTIONS.

The 30L-1 is shipped with the transformer primary connected for 115 volts a-c. If 230-volt a-c operation is planned, the primary connections must be changed on terminal board TB1. Refer to figure 7-2. This board is located at the bottom of the power supply compartment. The a-c power cord is connected to this board. To obtain access, refer to paragraph 4.2.

#### WARNING

DO NOT BLOCK INTERLOCK SWITCHES. Dangerous voltages are present in this equipment. The high voltage is interlocked with the amplifier covers. Make no attempt to put the amplifier into service until all compartment covers are in place.

### 1.3 CABLING.

Interconnections with other station equipments are described in the following paragraphs. Assembly instructions for type N connectors, such as the UG-21D/U, are shown in figure 7-1.

#### 1.3.1 TRAVELING STATION.

The 30L-1 is particularly applicable to traveling station use in conjunction with portable transceivers such as the KWM-2/2A. Refer to figure 1-1. IN THIS SERVICE, MAKE SURE THE TRANSFORMER PRIMARY IS CONNECTED FOR PROPER LINE VOLTAGE.

#### 1.3.2 HOME STATION.

Connect to KWM-2/2A, KWM-1, or S-Line as shown in figures 1-2, 1-3, and 1-4.

SECTION I  
Installation

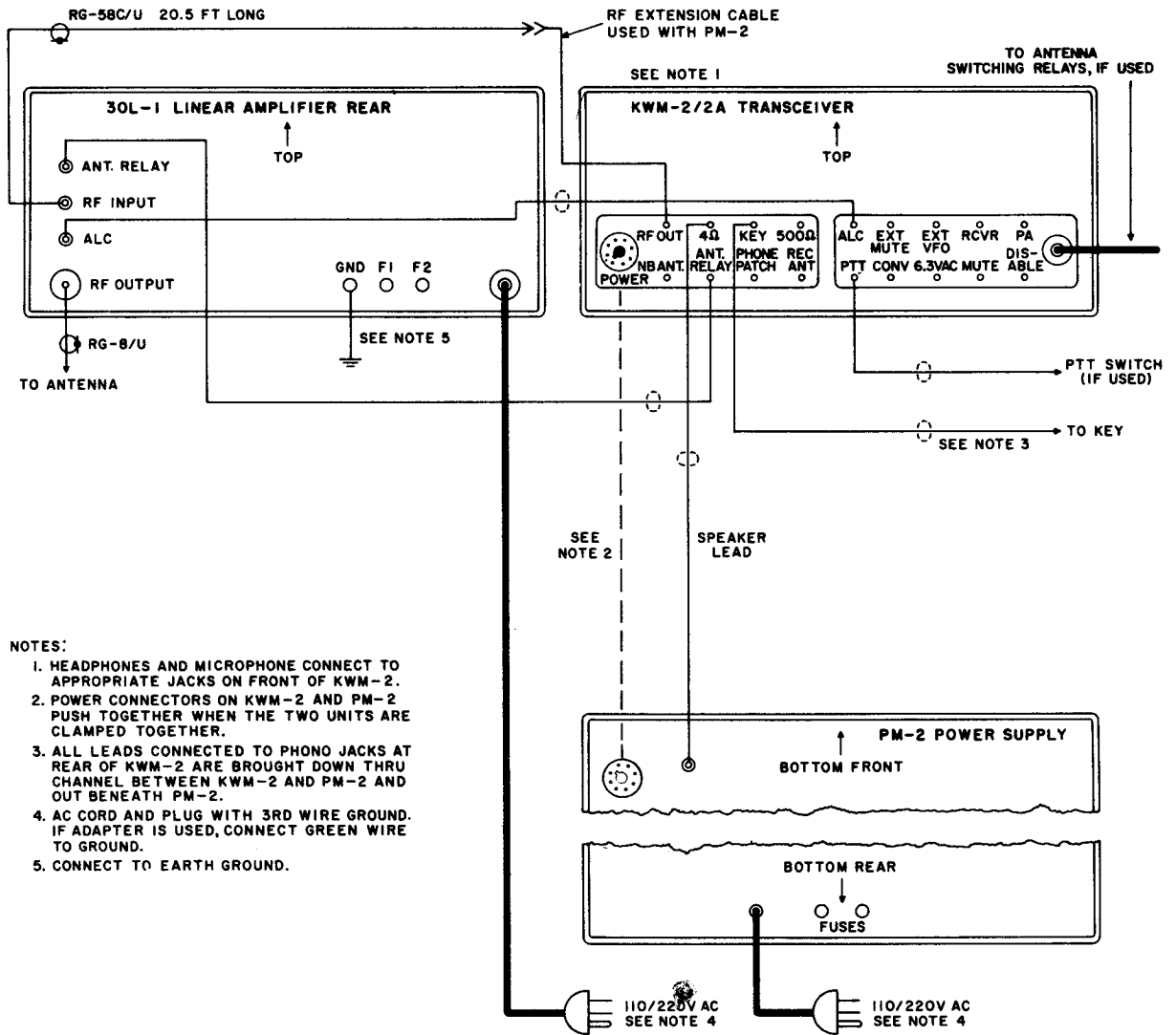


Figure 1-1. Interconnections with KWM-2/2A Traveling Station

SECTION I  
Installation

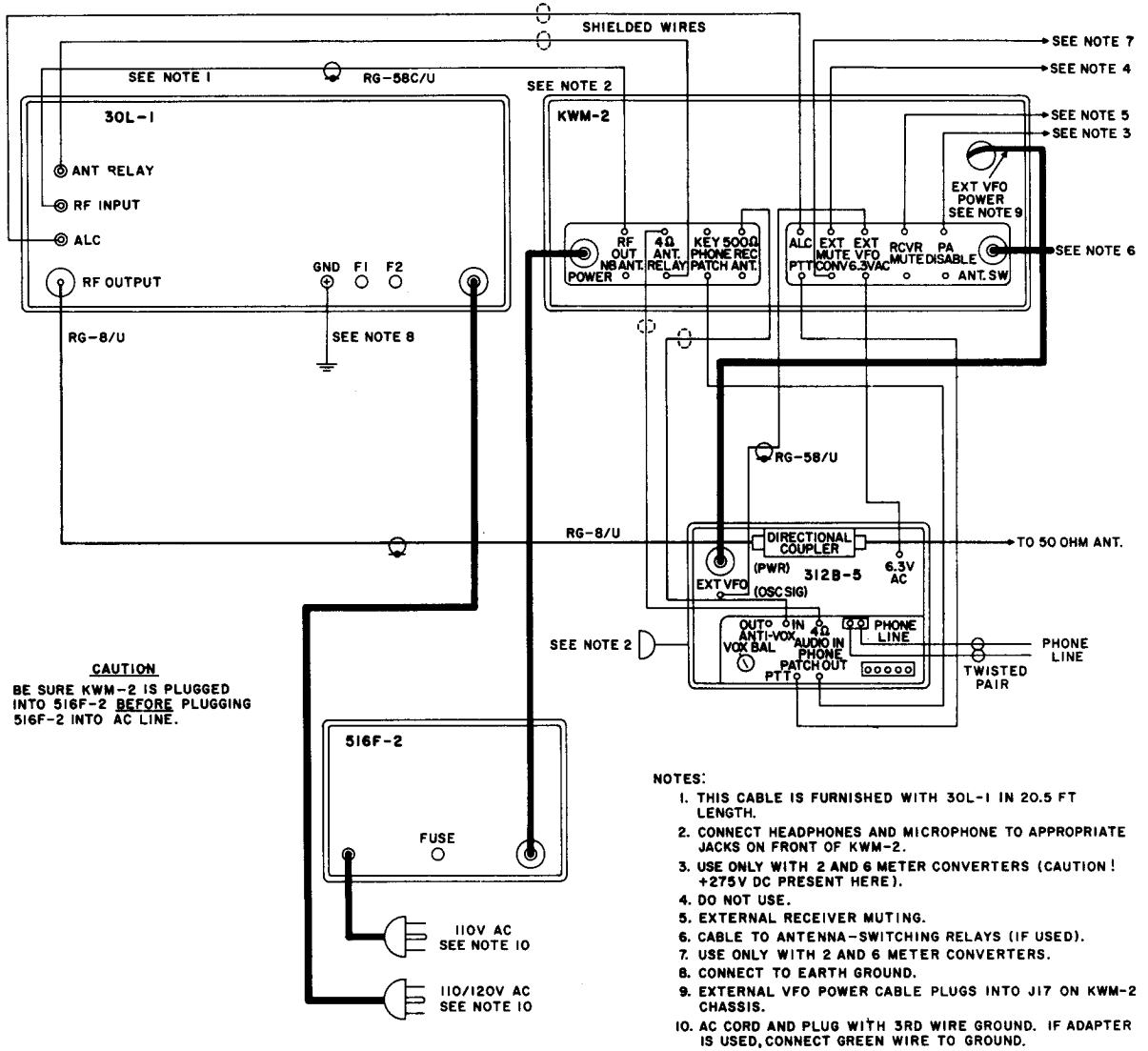


Figure 1-2. Interconnections with KWM-2/2A Home Station



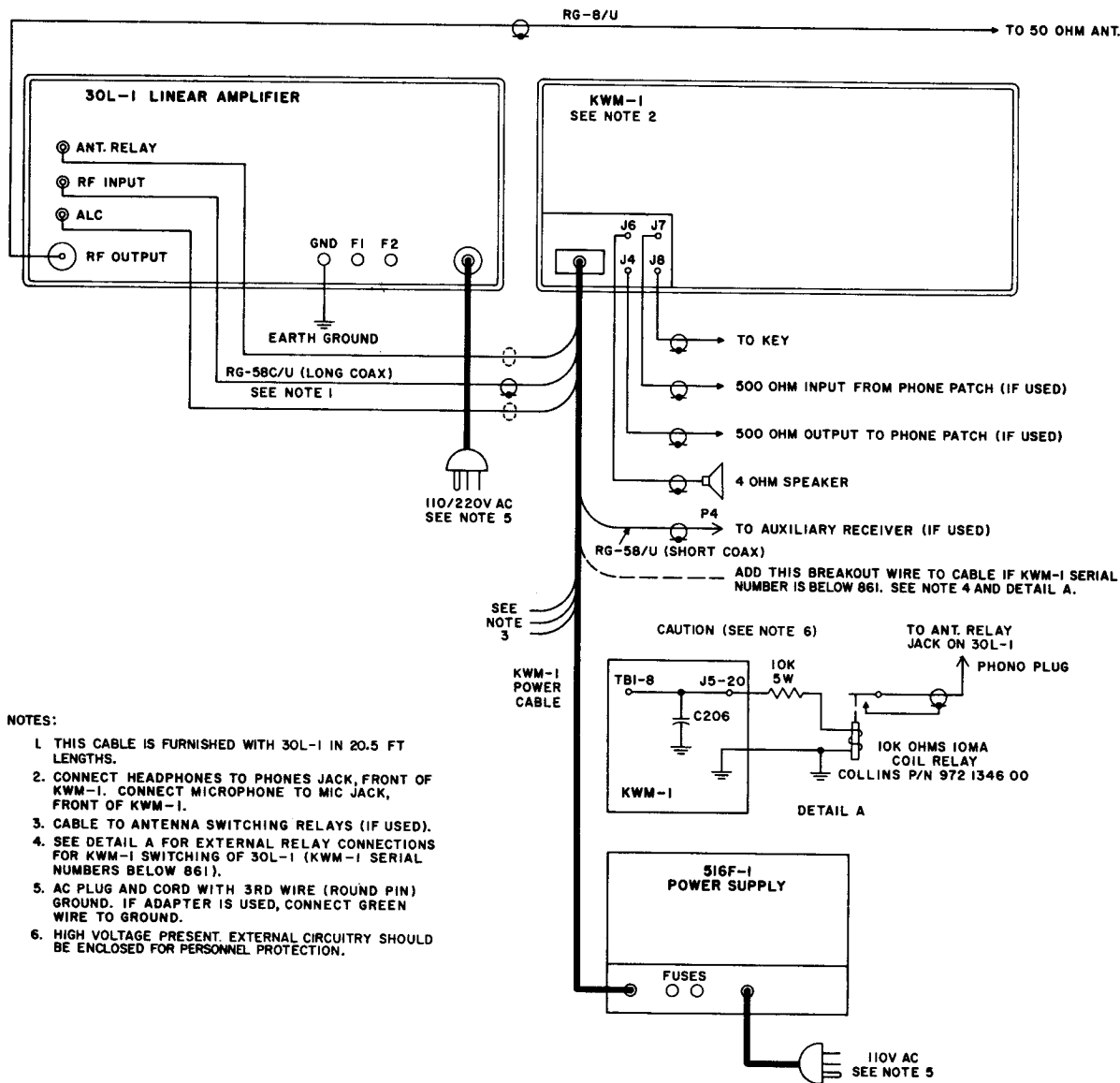
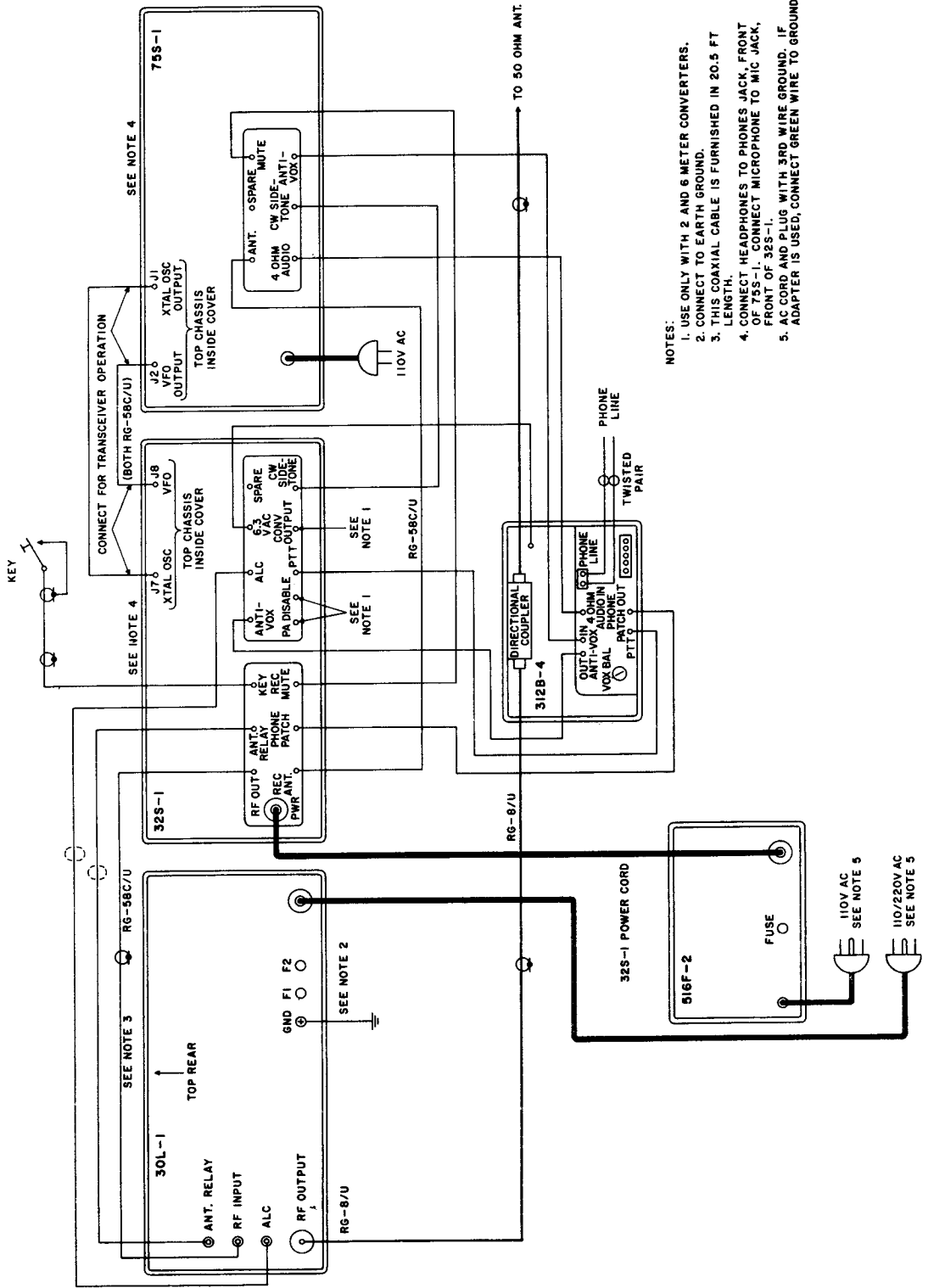


Figure 1-3. Interconnections with KWM-1

SECTION I  
Installation



- NOTES:
1. USE ONLY WITH 2 AND 6 METER CONVERTERS.
  2. CONNECT TO EARTH GROUND.
  3. THIS COAXIAL CABLE IS FURNISHED IN 20.5 FT LENGTH.
  4. CONNECT HEADPHONES TO PHONES JACK, FRONT OF 75S-1. CONNECT MICROPHONE TO MIC JACK, FRONT OF 32S-1.
  5. AC CORD AND PLUG WITH 3RD WIRE GROUND. IF ADAPTER IS USED, CONNECT GREEN WIRE TO GROUND.

Figure 1-4. Interconnections with S-Line

### 1.3.3 KWM-1 SERIAL NUMBERS ABOVE 861.

If KWM-1 models above serial number 861 are used with the 30L-1, it will be necessary to bring out alc and "ground-on-transmit" connections from the 516F-1 power cable plug, P-1, as shown in figure 1-3. Make the alc connection to terminal 19, and the "ground-on-transmit" connection to terminal 20. Use a shielded wire, and connect to 30L-1 ALC and ANT. RELAY jacks with phono plugs.

### 1.3.4 KWM-1 SERIAL NUMBERS BELOW 861.

If models below serial number 861 are used with the 30L-1, it is necessary to make connections inside the KWM-1 for alc and antenna relay control.

- a. Use an ohmmeter to locate the feedthrough capacitor, C169, which is connected to pin 19 of J5.
- b. Connect a wire from this feedthrough capacitor to pin 7 of tube socket XV10.
- c. Using an ohmmeter to trace the wiring, locate the feedthrough capacitor, C206, which is connected to terminal 20 of J5 in KWM-1.
- d. Connect a wire from terminal 8 of TB1 in KWM-1 to C206.
- e. Make corresponding breakout connection to P1 terminal 19 with shielded wire, and connect to the 30L-1 ALC jack with a phono plug.
- f. Refer to figure 1-3, Detail A. External to the KWM-1, connect a 10,000-ohm, 5-watt resistor and a relay coil in series from J5 terminal 20 to a ground on the rear of the KWM-1 chassis. Use a relay, such as Collins part number 972-1346-00, with a 10,000-ohm, 10-ma coil, and a set of normally open contacts.

- g. Connect the normally open contacts through a piece of shielded wire and a phono plug to the 30L-1 ANT. RELAY jack.

## WARNING

BE CAREFUL to protect the operator from the 260-B+ present on the relay coil and resistor connections. It is recommended that this circuitry be enclosed in a suitable shield box.

## NOTE

The r-f cable supplied for connecting the 32S-1, KWM-2/2A, or KWM-1 to the 30L-1 is 20.5 feet long. This length results in slightly lower system distortion than normally is obtained with other lengths of cable; however, a shorter length can be used for convenience.

## 1.4 INSTALLATION WITH OTHER MAKES OF EXCITERS.

Connect the r-f output of the exciter to the RF INPUT jack on the 30L-1. Existing antenna switching equipment between receiver and exciter may be left intact. To transmit, a ground must be supplied to the ANT. RELAY jack on the 30L-1. This removes blocking bias from the 811A tubes and energizes the internal antenna relay. Due to the variety of circuits involved, specific instructions for use of alc cannot be given. A detailed study of paragraph 3.7 will be helpful if it is desired to utilize the alc provisions in the 30L-1.

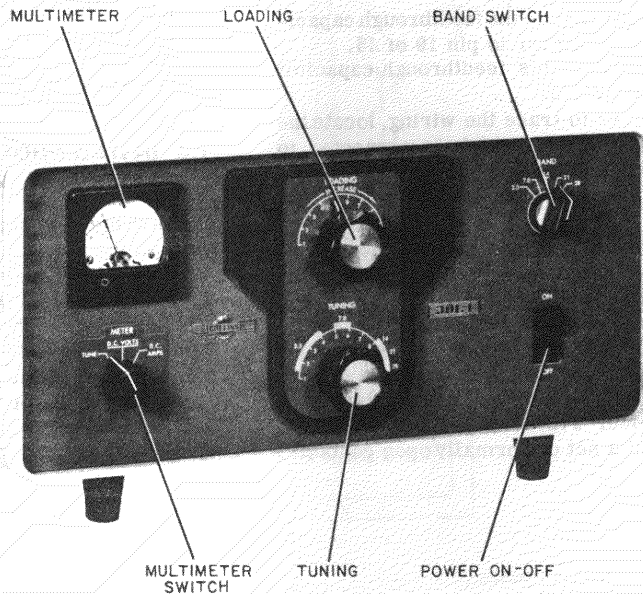


Figure 2-1. 30L-1 Operating Controls

## SECTION II OPERATION

### 2.1 OPERATION IN AMATEUR BANDS.

Table 2-1 shows normal and full-scale meter readings. If the exciter is a KWM-2/2A or S-line, set exciter BIAS ADJUST to produce an idling plate current of 50 ma. Tune and load according to exciter instruction book.

a. Connect the antenna for the band in use to the RF OUTPUT jack on the 30L-1. (When the ON-OFF switch is in the OFF position, the transfer relay in the 30L-1 connects the antenna to the exciter.)

b. Make sure the ON-OFF switch in the 30L-1 is in the OFF position as shown in figure 2-1.

c. Tune and load the exciter into the antenna. If the antenna does not present a nearly 50-ohm resistive load, the exciter can be tuned and loaded into a 50-ohm dummy load, such as the DL-1. When switched to the input of the 30L-1, the exciter will then remain in tune.

d. If using a Collins exciter, switch back to TUNE position, and set MIC GAIN to off position.

e. Set the 30L-1 METER switch to the TUNE position.

f. Set BAND switch to same band as that of the exciter, LOADING control to 1 on the dial, and TUNING control to white area for the band in use.

g. Press the 30L-1 ON-OFF switch to the ON position.

h. Set MIC GAIN to about 3/4 of full scale. (When using exciters other than KWM-2/2A or S-Line types, set microphone gain or carrier insertion control to provide approximately 20 watts drive to the 30L-1.)

i. Immediately adjust TUNING control for multi-meter dip.

j. Alternately adjust TUNING and LOADING controls for zero multimeter reading. The meter will indicate zero at the dip when the amplifier is properly tuned and loaded. Always make the TUNING adjustment for meter dip as the last adjustment.

k. Switch the exciter to the desired sideband or to CW, and reduce exciter MIC GAIN control to normal

operating level. The station is now ready to operate at rated power input.

1. Once the equipment has been tuned up on a given frequency, the 30L-1 may be switched in or out of the circuit at will by operating the ON-OFF switch. Output power from the amplifier is available instantly with no warm-up period required.

#### CAUTION

DO NOT operate the 30L-1 into a load presenting a vswr greater than 2 to 1. The equipment may not function properly and damage may result. DO NOT operate the amplifier in continuous key-down condition at full input for more than 30 seconds. The power supply may be damaged. DO NOT use the 30L-1 in FSK, AM, or FM service. DO NOT use slow-blow fuses, or fuses larger than the 8-ampere type supplied.

### 2.2 OPERATION WITH OTHER MAKES OF EXCITERS.

Tune according to the procedure outlined in paragraph 2.1. If alc is not used, be careful not to overdrive either the exciter or the final amplifier. Normal plate current meter readings for the 30L-1 are from 300 to 350 ma on voice peaks. Actual plate current under these conditions will peak at approximately 600 to 700 ma. Be sure the exciter is capable of producing the required drive without excessive distortion. If not, the amplifier may be operated at reduced level.

### 2.3 OPERATION OUTSIDE AMATEUR BANDS.

Operation outside amateur band limits requires retuning of the 30L-1 input circuits. This is necessary to present the proper load impedance to the exciter. For procedure, refer to paragraph 4.4.

TABLE 2-1. MULTIMETER SCALE VALUES

METER SWITCH SETTING	FULL-SCALE INDICATION	NORMAL INDICATION
Tune	Not applicable	Zero when 30L-1 is properly loaded
D. C. VOLTS	2000 volts	1800 volts (No modulation) 1600 volts (At rated load)
D. C. AMPS	1.0 amp (1000 ma)	600 ma (Key down CW) 300-350 ma (SSB voice peaks) 110 ma (Keyed, no excitation)

SECTION III  
Principles of Operation

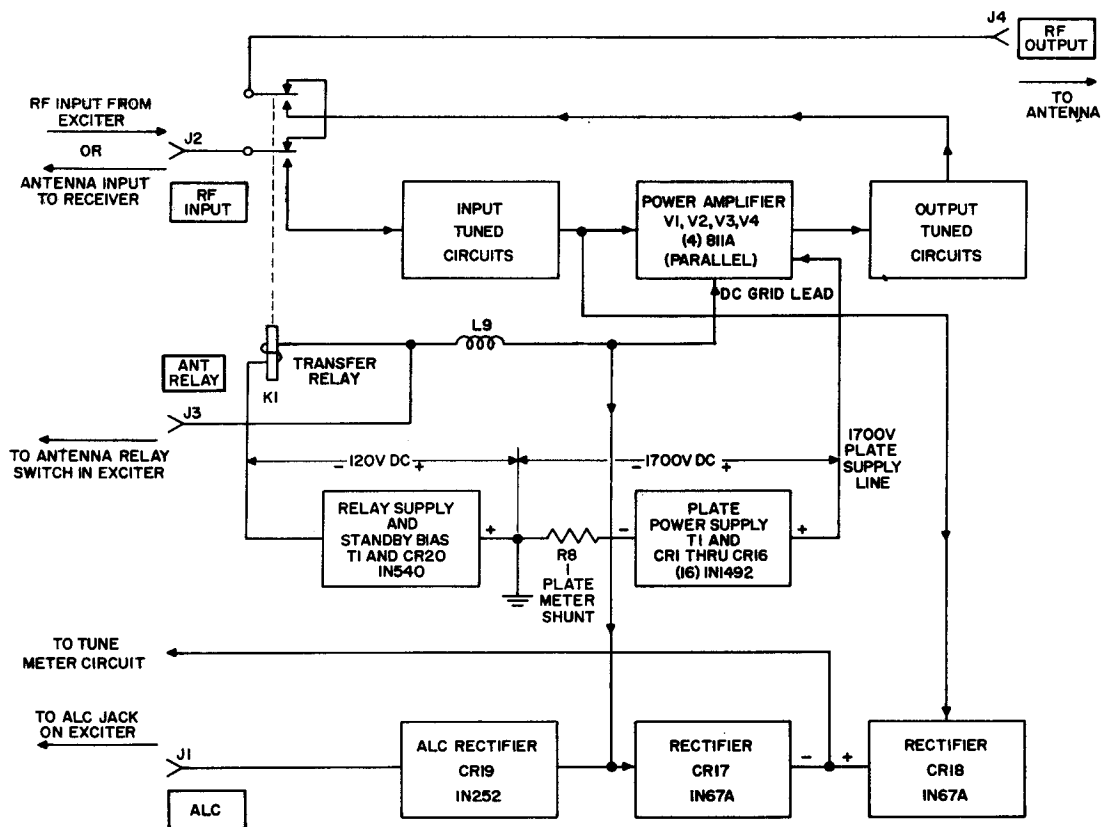


Figure 3-1. 30L-1 Block Diagram

## SECTION III PRINCIPLES OF OPERATION

### 3.1 GENERAL.

The 30L-1 is a portable r-f linear power amplifier, including plate power and bias supplies. It is capable of 1000 watts PEP input power in SSB or 1000 watts d-c input in CW service with any exciter (such as the KWM-1, KWM-2/2A, or 32S-1) capable of 70 watts PEP output. It covers the amateur bands between 3.5 and 29.7 mc. In addition, the amplifier may be operated outside the amateur bands over certain ranges of frequency. These ranges are specified in table 4-1. The power amplifier stage uses four 811A triodes connected in parallel with cathode drive.

### 3.2 INPUT CIRCUITS.

Refer to figures 3-1 and 7-2. Broadband pi-network circuits couple the exciting signal into the cathode circuits of the power amplifier tubes. The tuned input circuits provide increased efficiency, reduced distortion, and a better impedance match for the exciter than normally would be obtained with an untuned input. Tuning adjustments are not required except for operation outside the amateur bands.

### 3.3 OUTPUT CIRCUITS.

The plate circuit of the power amplifier is tuned by a pi network consisting of C32, L9, L10, and C33. Capacitor C32 resonates the tank circuit at the frequency in use. It is adjusted by the TUNING control on the front panel. The four-gang capacitor, C33, is adjusted by the LOADING control to match the pi-network circuit to the impedance presented by the antenna and feed system in use. Output from the plate tank circuit is connected through the contacts of antenna changeover relay, K1, to the antenna when the control circuits are energized.

### 3.4 POWER SUPPLY CIRCUITS.

Two d-c power supplies and one a-c filament supply are included in the 30L-1. The amplifier may be connected to a 115-volt single-phase or to a 230-volt, three-wire, single-phase source. Where practical, the 230-volt, three-wire connection is recommended. Power transformer T1 has two primary windings. These windings are connected in parallel for 115-volt operation, and in series for 230-volt operation. The 6.3-volt secondary winding provides filament power for the 811A tubes through r-f choke L8. It also powers the pilot lamp in the meter. Another secondary winding applies voltage through surge resistor R9 to semiconductor rectifier CR20. This is a half-wave circuit connected to furnish blocking bias to the amplifier tubes under receive conditions and operating bias when transmitting. It also furnishes power for changeover relay K1. Voltage from the third secondary winding is

applied to two semiconductor rectifier strings connected in a full-wave voltage doubler configuration. These strings consist of CR1-CR8, C44-C51 in one string, and CR9-CR16, C52-C59 in the other. The parallel capacitors equalize the reverse voltages impressed across the diode junctions and protect against damage by transients. The output of this supply provides approximately 1600 volts d-c under load for the amplifier tube plates.

### 3.5 SAFETY INTERLOCK CIRCUITS.

The r-f and power supply compartment covers operate safety interlock switches for operator protection. Switch S5 is located in the power supply compartment. Switches S6 and S7 are located in the r-f compartment. Cover removal closes these switches and shorts the high voltage to ground. This arrangement protects the operator from accidentally coming in contact with high-voltage d-c which is present in either compartment.

### WARNING

DO NOT BLOCK INTERLOCK SWITCHES.  
Contact with voltages in this equipment can be fatal. Be sure to disconnect the a-c power plug before removing any of the covers.

### 3.6 POWER CONTROL CIRCUITS.

Refer to figure 3-2. The front-panel ON-OFF switch breaks one side of the a-c line in the OFF position. When operated to the ON position, a-c power is applied to the power transformer primaries and the tube-cooling fan B1. Overload protection is provided by eight-ampere fuses F1 and F2. These are used for both 115-volt a-c and 230-volt a-c operation.

### 3.7 ALC CIRCUITS.

Automatic load control (alc) is a compressor circuit operating at radio frequencies. In the 30L-1, the grid-to-plate capacitances of the amplifier tubes in conjunction with capacitors C22, C23, C24, and C25 form capacitive voltage dividers. Under modulation, an r-f voltage is developed across these dividers and L3. It is coupled to the alc rectifier CR19 through capacitor C72. The r-f voltage is rectified and filtered to produce a negative d-c control voltage which is proportional to the modulation level. (The load resistor for CR19 must be provided by the exciter alc circuits.) This voltage is applied to the control grid of a low-level r-f amplifier tube or tubes in the exciter. The time constants of these circuits have a fast

**SECTION III**  
Principles of Operation

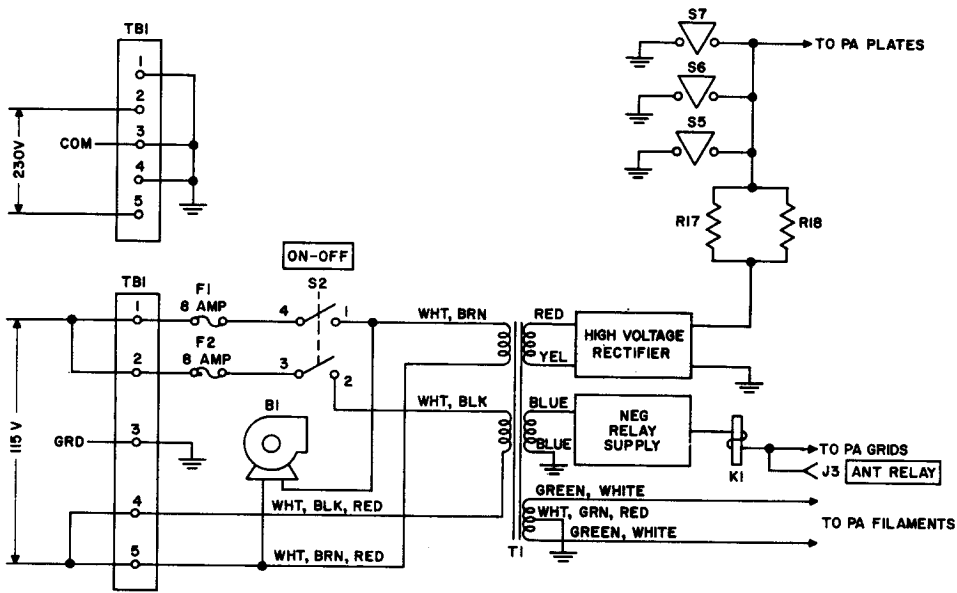


Figure 3-2. Control and Interlock Circuits

attack, slow-release characteristic. The alc threshold is controlled by the amount of reverse bias on CR19. This voltage is developed across R7 in the plate supply bleeder network, and varied by potentiometer R16. It is adjusted at the factory for optimum operation in conjunction with the internal alc circuits of excitors such as the KWM-1, KWM-2/2A, or 32S-1. Normally it will not need readjustment.

This system allows a high average level of modulation and optimum power output from the amplifier, within the rated limits of distortion.

**3.8 METERING CIRCUITS.**

One section of the METER switch, S3, selects the output voltage from a tuning and loading bridge circuit.

This circuit consists of the power amplifier tubes, CR17, CR18, and the associated load resistors and filter networks. The bridge is balanced when the plate circuit TUNING and LOADING controls are adjusted to present the proper load impedance to the power amplifier plates. The meter then will read zero.

The second section of the meter switch connects the meter to the plate supply through a four-megohm multiplier resistor to indicate the d-c voltage output. It is read on the D.C. KILOVOLT scale.

The third section of the meter switch connects the meter, through R10, across shunt, R8. This indicates power amplifier plate current. It is read on the D.C. AMPS scale.



## SECTION IV MAINTENANCE

### 4.1 GENERAL.

Adjustment of the r-f input circuits requires the following equipment:

a. R-f wattmeter and directional coupler, such as are included in the 312B-4 or 312B-5 Station Controls, or the 302C-3 Directional Wattmeter.

b. 50-ohm, 500-watt, nonreactive dummy load. (For short tests where key-down conditions do not exceed 30 seconds, the DL-1 Dummy Load can be used when applicable.)

The filament circuit in the 30L-1 is fused with a length of number 30 wire in the center-tap ground return of the filament winding on T1. The fuse is connected between the two outer lugs of a terminal strip located near R11 in the power supply compartment (refer to figure 6-1). Under some conditions, the amplifier may appear to function normally even though this fuse has blown; however, this causes hum to appear on the output signal. Check for shorts in the filament circuit.

### 4.2 REMOVAL OF CABINET AND COVERS.

a. Lift the cabinet lid, and remove the two Phillips-head screws located at the top-front edge of the cabinet. Remove the four feet and the Phillips-head screw located midway between the rear feet. Push the amplifier forward from the rear until the front panel projects from the cabinet about a half inch. Grasping the front panel at the edges, carefully slide the amplifier out of the cabinet, making sure the a-c power cord clears.

b. To remove the r-f compartment upper cover, loosen the ten screws about three turns, slide the cover toward the front panel, and lift off.

c. To remove the power supply compartment upper cover, remove screws located about the edges of the cover.

d. To remove the bottom cover, remove two round Phillips-head screws from each end of the cover and three flat-head screws near the middle of the cover, and lift off.

### 4.3 BLOWER LUBRICATION.

Every 1000 hours of operation (or 6 months, whichever comes first), lubricate the blower motor bearings with three or four drops of sewing machine oil. Do not overlubricate.

### 4.4 ALIGNMENT OF R-F INPUT CIRCUITS.

Remove the amplifier from its cabinet as outlined in paragraph 4.2. Do not remove any of the covers. To align for amateur band coverage, observe the following procedure:

a. Connect the directional wattmeter between the exciter output and the 30L-1 R-F INPUT jack. Connect the dummy load to the R-F OUTPUT jack on the 30L-1. Set up the equipment on 28.5 megacycles. Set the exciter EMISSION switch to LOCK KEY, and 30L-1 METER switch to TUNE.

b. With 30L-1 power off, tune and load the exciter to approximately 30 watts output as indicated on the wattmeter (forward power).

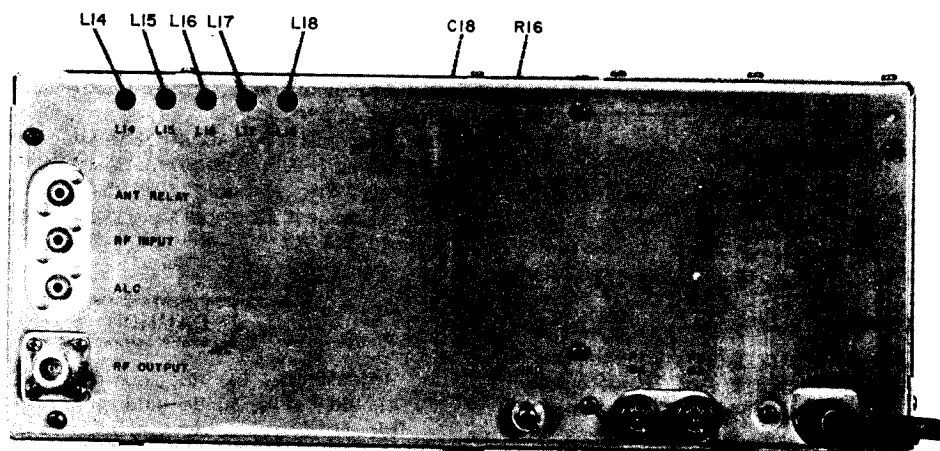


Figure 4-1. Location of Adjustments

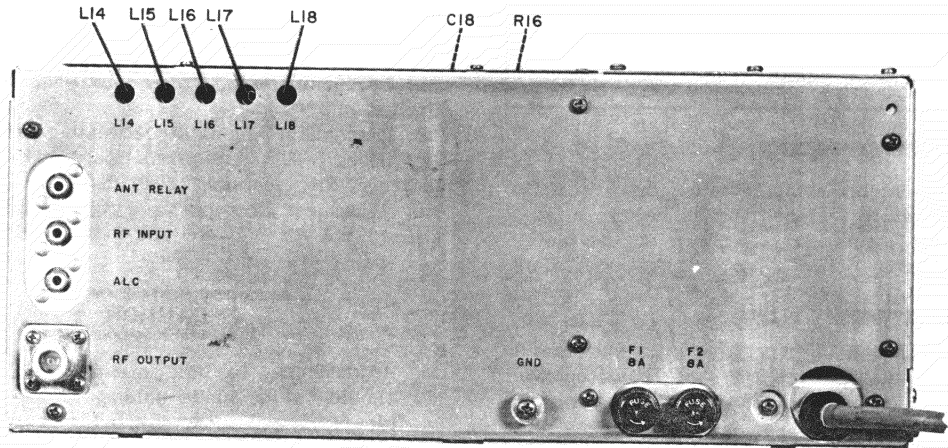


Figure 4-1. Location of Adjustments

**SECTION IV**  
**Maintenance**

c. Press the 30L-1 power switch to ON. Tune and load the 30L-1 into the dummy load. The exciter is now loaded into the 30L-1 input circuits. Retune and reload the exciter, if necessary, to 30 watts forward power output.

d. Watch the wattmeter in the exciter r-f output line, and with a nonmetallic tuning tool, tune L14 for minimum reflected power. Readjust the exciter as necessary to maintain 30 watts forward. Continue adjustment of L14 for minimum vswr (not to exceed 2.0 to 1, or 11 percent reflected power).

e. Repeat the above procedures at 21.3, 14.3, 7.2, and 3.9 mc, adjusting L15, L16, L17, and L18 respectively. These adjustments are accessible through the holes in the rear cover of the r-f compartment. Do not remove the cover. Refer to figure 4-1.

For general coverage, use the same procedure as above, except set exciter to a frequency which is in the middle of the desired band. Useful bandwidth at the new alignment frequencies is approximately the same as that for the amateur bands. Do not attempt alignment to place the new operating bands outside the ranges listed in table 4-1 for the BAND switch positions indicated. Also do not attempt amateur-band operation on a BAND switch position for which the tuned circuits have been realigned for out-of-band operation.

**TABLE 4-1**  
**FREQUENCY COVERAGE ALLOWABLE**  
**BY REALIGNMENT**

BAND SWITCH SETTINGS	LOWER LIMIT (mc)	UPPER LIMIT (mc)
3.5	3.4	5.0
7.0	6.5	9.5
14	9.5	16.0
21	16.0	22.0
28	22.0	30.0

**4.5 METER LAMP REPLACEMENT.**

To replace the meter lamp, remove the bracket to which the socket is fastened. It is held by a small machine screw located at the rear of the meter. Replace the lamp with a type 51 or equivalent.

**4.6 TUBE REPLACEMENT.**

The tubes may be replaced without removing the amplifier cabinet by removing the r-f compartment top cover and installing new tubes from the top. The following is an alternate method which provides better access to the tube sockets.

Remove the cabinet, r-f compartment top cover, and bottom cover as outlined in paragraph 4.2. Disconnect

plate connectors and remove old tubes. Install the upper pair of replacements from the top of the amplifier. Install the lower pair from the bottom. The locating pin on the base of each of the tubes should point away from the power supply compartment. Attach plate leads, making sure they clear other components. Replace covers and cabinet.

**WARNING**

**DO NOT BLOCK INTERLOCK SWITCHES.** Dangerous voltages are present in this equipment. The high voltage is interlocked with the amplifier covers. Make no attempt to put the amplifier into service until the procedure outlined above has been completed.

**4.7 TUNE METER ADJUSTMENT.**

a. Make normal connections between exciter and 30L-1.

b. Connect 50-ohm dummy load to 30L-1 output jack.

c. Connect vertical input of a wide-band oscilloscope across dummy load.

d. Connect a two-tone audio oscillator of about 15 mv rms output to exciter input.

e. Using normal procedure, tune and load exciter and amplifier into dummy load at 3.9 mc. Leave 30L-1 METER switch in TUNE position, and remove excitation.

f. Using USB or LSB emission, and monitoring output waveform on oscilloscope, increase drive until output ceases to increase or peaks begin to flatten.

g. Make fine adjustments to drive level and 30L-1 tuning and loading for maximum output without peak flattening. Output voltage across dummy load should be not less than 450 volts peak to peak or 160 volts rms, and CW (single tone) plate current should not exceed 700 ma.

h. Switch exciter to TUNE (approximately 20 watts drive) and adjust C18 with insulated tuning tool to produce reading of zero on 30L-1 multimeter.

**4.8 ALC THRESHOLD ADJUSTMENT.**

a. Perform steps a, b, d, and e of paragraph 4.7. Omit step c.

b. Disconnect alc cable between exciter and 30L-1.

c. Using USB or LSB emission, increase drive until indicated alc is about 4 db (S-4) on exciter meter.

d. Reconnect alc cable, and adjust R16 with insulated tuning tool for a 3-db (one S-unit) increase in alc.

**CAUTION**

Adjustments to tune meter and alc circuits should not be made unless the need has been clearly determined. If trouble is experienced, check PA tubes and exciter first. Improper adjustments can result in damage to amplifier and a distorted output signal. Do not attempt to make adjustments without proper test equipment.

## SECTION V SPECIFICATIONS

- Size . . . . . 6-9/16 in. high, 14-3/4 in. wide, 13-3/4 in. deep (overall).
- Weight . . . . . 38 pounds.
- Frequency range . . . . . 3.5-29.7 mc, covering all amateur bands. By retuning input coils as necessary, the following general-coverage bands may be covered:

<u>FREQUENCY BAND</u>	<u>TOTAL COVERAGE</u>
3.5 mc	3.4-5.0 mc
7.0 mc	6.5-9.5 mc
14 mc	9.5-16.0 mc
21 mc	16.0-22.0 mc
28 mc	22.0-30.0 mc

- Mode . . . . . SSB or CW
- Type of Service . . . . . SSB - continuous voice modulation.  
CW - 50-percent duty cycle (continuous key-down conditions not to exceed 30 seconds duration).
- Plate power input . . . . . CW - 1000 watts.  
SSB - Nominal PEP input of 1000 watts with speech. Third order distortion products at this level are at least 30 db down from signal.
- Drive power requirements . . . . . 70 watts.
- Primary power requirements . . . . . 230 volts a-c  $\pm 10\%$ , 3-wire, single phase, at 7.5 amperes max, or 115 volts a-c  $\pm 10\%$  at 15 amperes max, 50-400 cps. Operation from a line frequency other than 50-60 cps requires an auxiliary 60-cps supply for fan motor.
- Input impedance . . . . . 52 ohms.
- Output impedance . . . . . 52 ohms unbalanced with vswr not to exceed 2 to 1 on the amateur bands.
- Noise level . . . . . 40 db down from output signal with 1-kw single-tone input.
- Harmonic output . . . . . All harmonics at least 40 db down from output signal.
- Vacuum tubes . . . . . Type 811A triodes (4).
- Available accessories . . . . . Model 351E-4 mounting plate (Collins part number 522-1482-003). This plate can be used when installing the 30L-1 in an airplane, boat, or similar location requiring a rigid mount. A luggage-type carrying case is also available.

SECTION VI  
Parts List

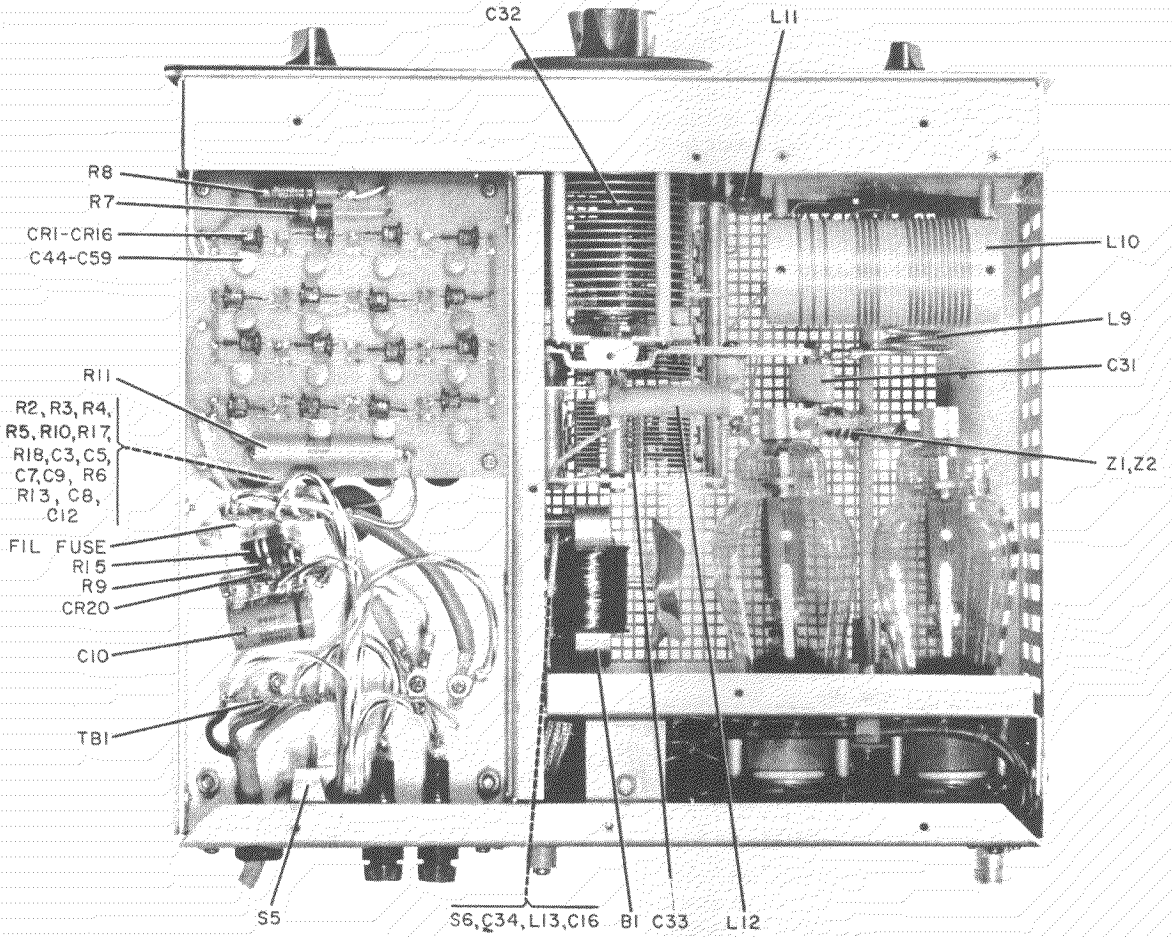


Figure 6-1. R-F and Power Supply Compartments, Parts Location

Note: This parts list should not be used for requisitioning through Army channels, but should be retained for reference only.

SECTION VI  
Parts List

## SECTION VI PARTS LIST

30L-1 R-F Linear Amplifier

ITEM	DESCRIPTION	COLLINS PART NUMBER
LINEAR AMPLIFIER		522-2375-00
B1	FAN: 115 v ac, 60 cps, single phase	547-3702-00
C1	CAPACITOR, FIXED, CERAMIC: 10,000 uuf +100% -20%, 500 v dc	913-3013-00
C2	CAPACITOR, FIXED, CERAMIC: same as C1	913-3013-00
C3	CAPACITOR, FIXED, ELECTROLYTIC: 100 uuf -10% +100%, 450 v dc	183-1567-00
C4	CAPACITOR, FIXED, CERAMIC: 10,000 uuf ±20%, 1000 v dc	913-3922-00
C5	CAPACITOR, FIXED, ELECTROLYTIC: same as C3	183-1567-00
C6	CAPACITOR, FIXED, CERAMIC: same as C4	913-3922-00
C7	CAPACITOR, FIXED, ELECTROLYTIC: same as C3	183-1567-00
C8	CAPACITOR, FIXED, ELECTROLYTIC: same as C3	183-1567-00
C9	CAPACITOR, FIXED, ELECTROLYTIC: same as C3	183-1567-00
C10	CAPACITOR, FIXED, ELECTROLYTIC: 10 uuf -10%, +100%, 150 v dc	183-1568-00
C11	NOT USED	
C12	CAPACITOR, FIXED, ELECTROLYTIC: same as C3	183-1567-00
C13	CAPACITOR, FIXED, MICA: 47 uuf ±5%, 500 v dc	912-2792-00
C14	CAPACITOR, FIXED, MICA: 100 uuf ±5%, 500 v dc	912-2816-00
C15	CAPACITOR, FIXED, CERAMIC: same as C1	913-3013-00
C16	CAPACITOR, FIXED, CERAMIC: 0.005 uuf ±20%, 3000 v dc	913-4329-00
C17	CAPACITOR, FIXED, CERAMIC: same as C1	913-3013-00
C18	CAPACITOR, VARIABLE, CERAMIC: 8.0 uuf min 75.0 uuf max, 350 v dc	917-1075-00
C19	CAPACITOR, FIXED, MICA: 270 uuf ±5%, 500 v dc	912-2846-00
C20	CAPACITOR, FIXED, CERAMIC: same as C1	913-3013-00
C21	CAPACITOR, FIXED, CERAMIC: same as C1	913-3013-00
C22	CAPACITOR, FIXED, MICA: 220 uuf ±5%, 500 v dc	912-2840-00
C23	CAPACITOR, FIXED, MICA: same as C22	912-2840-00
C24	CAPACITOR, FIXED, MICA: same as C22	912-2840-00
C25	CAPACITOR, FIXED, MICA: same as C22	912-2840-00
C26 thru C30	CAPACITOR, FIXED, CERAMIC: same as C1	913-3013-00
C31	CAPACITOR, FIXED, CERAMIC: 1000 uuf ±20%, 5000 v dc	913-0101-00
C32	CAPACITOR, VARIABLE AIR: 15 uuf min 353.0 uuf max	920-0066-00
C33	CAPACITOR, VARIABLE AIR: 14 uuf min 432 uuf max	921-0018-00
C34	CAPACITOR, FIXED, CERAMIC: same as C16	913-4329-00
C35	CAPACITOR, FIXED, CERAMIC: feedthrough type, 1000 uuf +80% -20%, 500 v dc	913-1292-00
C36 thru C43	CAPACITOR, FIXED, CERAMIC: same as C35	913-1292-00
C44	CAPACITOR, FIXED, CERAMIC: 1000 uuf +100% -20%, 500 v dc	913-3009-00
C45 thru C59	CAPACITOR, FIXED, CERAMIC: same as C44	913-3009-00
C60	CAPACITOR, FIXED, MICA: 82 uuf ±5%, 500 v dc	912-2810-00
C62	CAPACITOR, FIXED, MICA: 510 uuf ±5%, 300 v dc	912-2867-00
C63	CAPACITOR, FIXED, MICA: same as C22	912-2840-00
C64	CAPACITOR, FIXED, MICA: same as C22	912-2840-00
C65	CAPACITOR, FIXED, MICA: 180 uuf ±5%, 500 v dc	912-2834-00
C66	CAPACITOR, FIXED, MICA: 330 uuf ±5%, 500 v dc	912-2852-00
C67, C68	CAPACITOR, FIXED, MICA: same as C22	912-2840-00
C69	CAPACITOR, FIXED, MICA: 150 uuf ±5%, 500 v dc	912-2828-00
C70	CAPACITOR, FIXED, MICA: same as C65	912-2834-00
C71	CAPACITOR, FIXED, CERAMIC: same as C35	913-1292-00
C72	Same as C13	912-2792-00
C73	Same as C14	912-2816-00
C74	Same as C1	913-3013-00
C75	CAPACITOR, FIXED, MICA: same as C69	912-2828-00
C76	CAPACITOR, FIXED, MICA: 100 uuf ±5%, 500 v dc	912-2816-00
CR1	DIODE: silicon; type 1N1492	353-1661-00
CR2 thru CR16	DIODE: same as CR1	353-1661-00
CR17	DIODE: silicon; type 1N252	353-2940-00
CR18	DIODE: same as CR17	353-2940-00
CR19	DIODE: 1N458	353-0205-00
CR20	DIODE: silicon; type 1N540	353-1546-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
F1	FUSE, CARTRIDGE: 8 amp, 250 v dc; ferrule type terminal	264-4110-00
F2	FUSE, CARTRIDGE: same as F1	264-4110-00
J1	JACK, PHONO-TYPE: accommodates 1/8 in. plug; ceramic insulation	360-0088-00
J2	JACK, PHONO-TYPE: same as J1	360-0088-00
J3	JACK, PHONO-TYPE: same as J1	360-0088-00
J4	CONNECTOR, RF TYPE N: UG-58A/U	357-9003-00
K1	RELAY: dpdt; 2 amps, coil resistance, 10,000 ohms	970-2140-00
L1	NOT USED	
L2	NOT USED	
L3	COIL, RADIO FREQUENCY: single layer wound, solenoid, #21 or #22 AWG copper wire 39.0 uh, 0.80 ohms dc	240-0189-00
L4	Part of Z1	547-3654-002
L5	Part of Z2	547-3654-002
L6	NOT USED	
L7	NOT USED	
L8	COIL, RADIO FREQUENCY: single layer wound, no. 14 AWG, formvar insulation; 7.5 uh	240-1244-00
L9	COIL, RADIO FREQUENCY: single layer wound; 6.5 turns no. 8 AWG	547-3718-002
L10	COIL, RADIO FREQUENCY: single layer wound; 17 turns no. 14 AWG	547-3708-003
L11	COIL, RADIO FREQUENCY: 4 sections; 2.5 mh, 35 to 50 ohms, 0.125 amp	240-0059-00
L12	COIL, RADIO FREQUENCY: single layer wound, 44 uh at 2.5 mc inductance, 3.54 ohm dc resistance, 1.6 amps current capacity	240-0807-00
L13	COIL, RADIO FREQUENCY: single layer wound, 2.2 uh, 1980 ma current; 0.20 ohms	240-0174-00
L14	COIL, RADIO FREQUENCY: single layer wound, 4 turns	547-3659-003
L15	COIL, RADIO FREQUENCY: single layer wound, 6 turns no. 22 AWG	547-3666-003
L16	COIL, RADIO FREQUENCY: single layer wound, 8 turns no. 22 AWG	547-3661-003
L17	COIL, RADIO FREQUENCY: single layer wound, 14 turns no. 22 AWG	547-3662-003
L18	COIL, RADIO FREQUENCY: single layer wound, 6 turns no. 22 AWG	547-3663-003
L19	COIL, RADIO FREQUENCY: 1.5 uh	240-0173-00
M1	METER, ELECTRICAL: 200-0-500 ua meter range, 190 ohms, ±2%, 2-1/2 in. sq	458-0592-00
O1	KNOB-METER	544-0779-004
O2	KNOB-BAND	544-0779-004
O3	KNOB, TUNING	547-3656-002
O4	KNOB, LOADING	547-3656-002
R1	RESISTOR, FIXED, COMPOSITION: 4700 ohms ±10%, 1/2 w	745-1380-00
R2	RESISTOR, FIXED, WIRE WOUND: 25,000 ohms ±5%, 26 w	746-9155-00
R3	RESISTOR, FIXED, WIRE WOUND: same as R2	746-9155-00
R4	RESISTOR, FIXED, WIRE WOUND: same as R2	746-9155-00
R5	RESISTOR, FIXED, WIRE WOUND: same as R2	746-9155-00
R6	RESISTOR, FIXED, WIRE WOUND: same as R2	746-9155-00
R7	RESISTOR, FIXED, COMPOSITION: 1500 ohms ±10%, 2 w	745-5659-00
R8	RESISTOR, FIXED, WIRE WOUND: 1.0 ohms ±1%, 5 w	747-9716-00
R9	RESISTOR, FIXED, COMPOSITION: 47 ohms ±10%, 2 w	745-5596-00
R10	RESISTOR, FIXED, FILM: 1,960 ohms 1%, 1/4 w	705-7110-00
R11	RESISTOR, FIXED, FILM: 4,000,000 ohms ±1%, 2 w	705-4260-00
R12	RESISTOR, FIXED, WIRE WOUND: 2,000 ohms ±10%, 7 w	710-9010-00
R13	RESISTOR, FIXED, WIRE WOUND: same as R2	746-9155-00
R14	NOT USED	
R15	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 2 w	745-5694-00
R16	RESISTOR, VARIABLE, COMPOSITION: 5,000 ohms ±20%, 0.3 w	376-0205-00
R17	RESISTOR, FIXED, COMPOSITION: 10 ohms ±10%, 2 w	745-5568-00
R18	RESISTOR, FIXED, COMPOSITION: same as R17	745-5568-00
R19	RESISTOR, FIXED, COMPOSITION: 39,000 ohms ±10%, 1/2 w	745-1419-00

**SECTION VI**  
**Parts List**

30L-1 R-F Linear Amplifier

ITEM	DESCRIPTION	COLLINS PART NUMBER
R20	RESISTOR, FIXED, COMPOSITION: same as R19	745-1419-00
R21	RESISTOR, FIXED, COMPOSITION: 47 ohms ±10%, 1 w	745-3296-00
R22	RESISTOR, FIXED, COMPOSITION: same as R21	745-3296-00
R23	RESISTOR, FIXED, COMPOSITION: same as R21	745-3296-00
R24	RESISTOR, FIXED, COMPOSITION: same as R21	745-3296-00
R25	Part of Z1	745-5610-00
R26	Part of Z2	745-5610-00
R27	NOT USED	
R28	RESISTOR, FIXED, COMPOSITION: 39 ohms, ±10%, 1/2 w	745-1293-00
S1	SWITCH, ROTARY: 2 circuit (2 pole), 18 position, 1 section	259-1385-00
S2	SWITCH, ROCKER: dpst; 20 amps, 125 v ac, 10 amps, 250 v ac	266-6020-00
S3	SWITCH, ROTARY: 2 circuit (2 pole), 3 position, 1 section	259-1368-00
S4	SWITCH, ROTARY: 3 circuit (3 pole), 5 position, 1 section	259-1386-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
S5	INTERLOCK ASSEMBLY: copper, silver plated; 1 1/16 in. by 3/4 in. by 1.312 in.	547-3632-002
S6	Same as S5	547-3632-002
S7	Same as S5	547-3632-002
T1	POWER TRANSFORMER:	662-0010-00
V1	ELECTRON TUBE: triode; type 811A	256-0053-00
V2 thru V4	ELECTRON TUBE: same as V1	256-0053-00
XF1	FUSE HOLDER: 15 amps-250 v	265-1019-00
XF2	FUSE HOLDER: same as XF1	265-1019-00
XV1	SOCKET, ELECTRON TUBE: 5 amps 2000 v rms	220-1451-00
XV2 thru XV4	SOCKET, ELECTRON TUBE: same as XV1	220-1451-00
Z1	SUPPRESSOR, PARASITIC: 4 turns no. 16 AWG wire, 100 ohms, 2 w resistor	547-3654-002
Z2	SUPPRESSOR, PARASITIC: same as Z1	547-3654-002

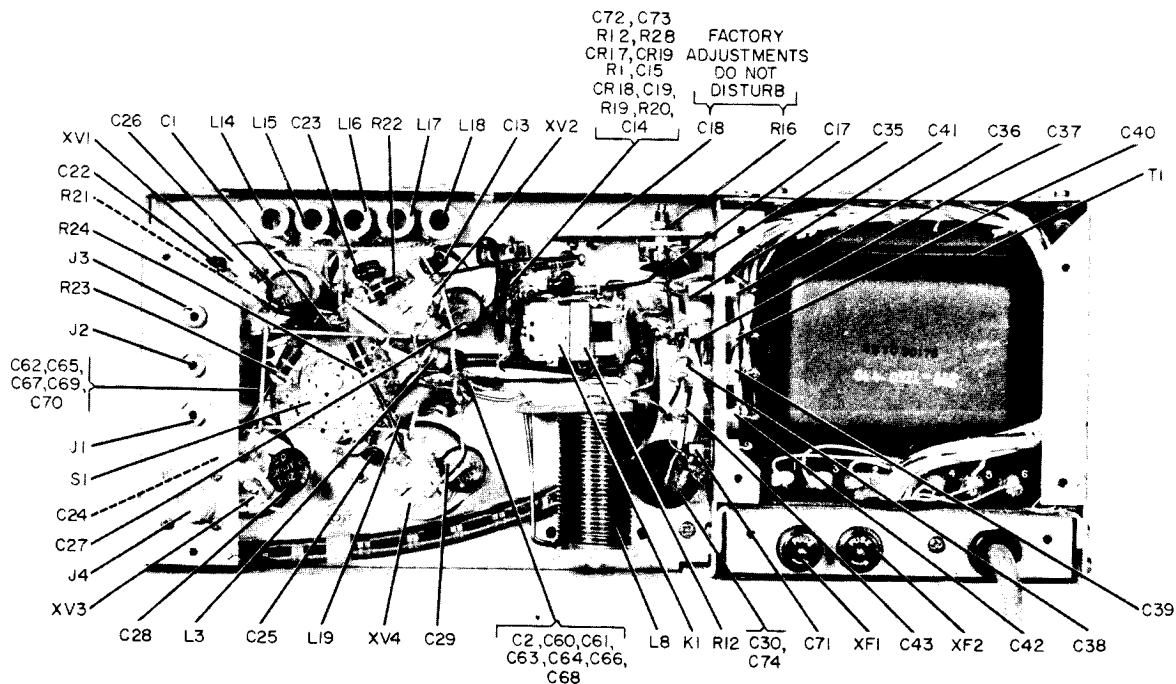


Figure 6-2. Input Circuitry, Parts Location

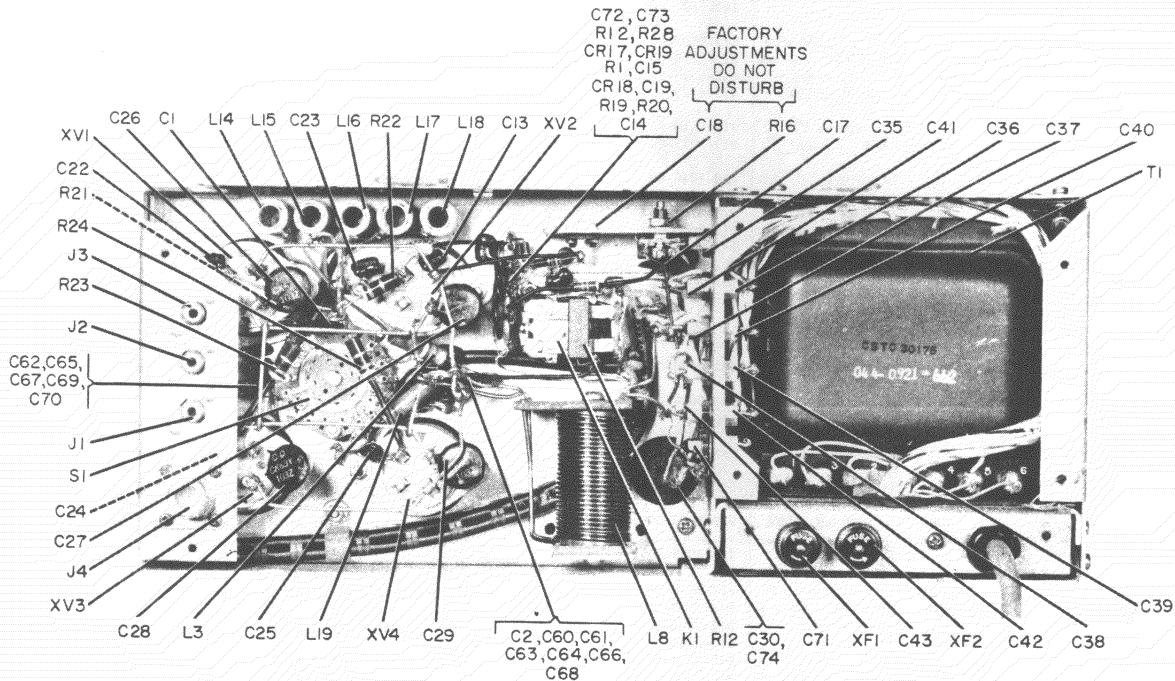


Figure 6-2. Input Circuitry, Parts Location



# SECTION VII ILLUSTRATIONS

SECTION VII  
Illustrations

## Connector Assembly Instructions

## IMPROVED SERIES N



Nut



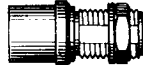
Gasket



Clamp



Female Contact



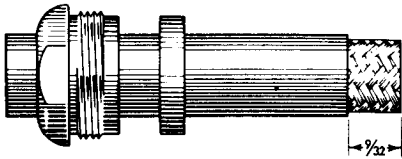
Jack Body



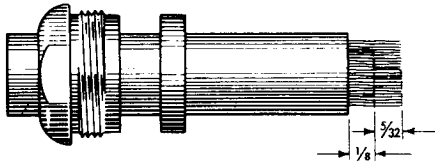
Male Contact



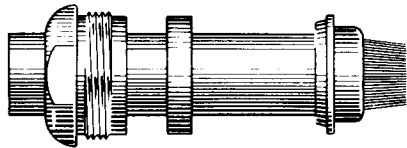
Plug Body



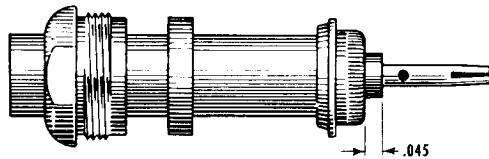
Place nut and gasket over cable and cut off jacket  $\frac{3}{32}$ " from end.



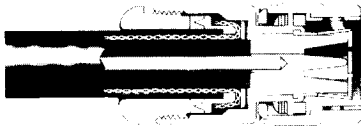
Comb out braid and fold out. Cut off cable dielectric flush  $\frac{1}{8}$ " from end of jacket.



Pull braid wires forward and taper toward center conductor. Place clamp over braid and push back against cable jacket.



Fold back braid wires as shown, trim to proper length and form over clamp as shown. Solder contact to center conductor.



Insert cable and parts into connector body. Make sure sharp edge of clamp seats properly in gasket. Tighten nut.

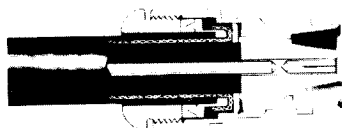
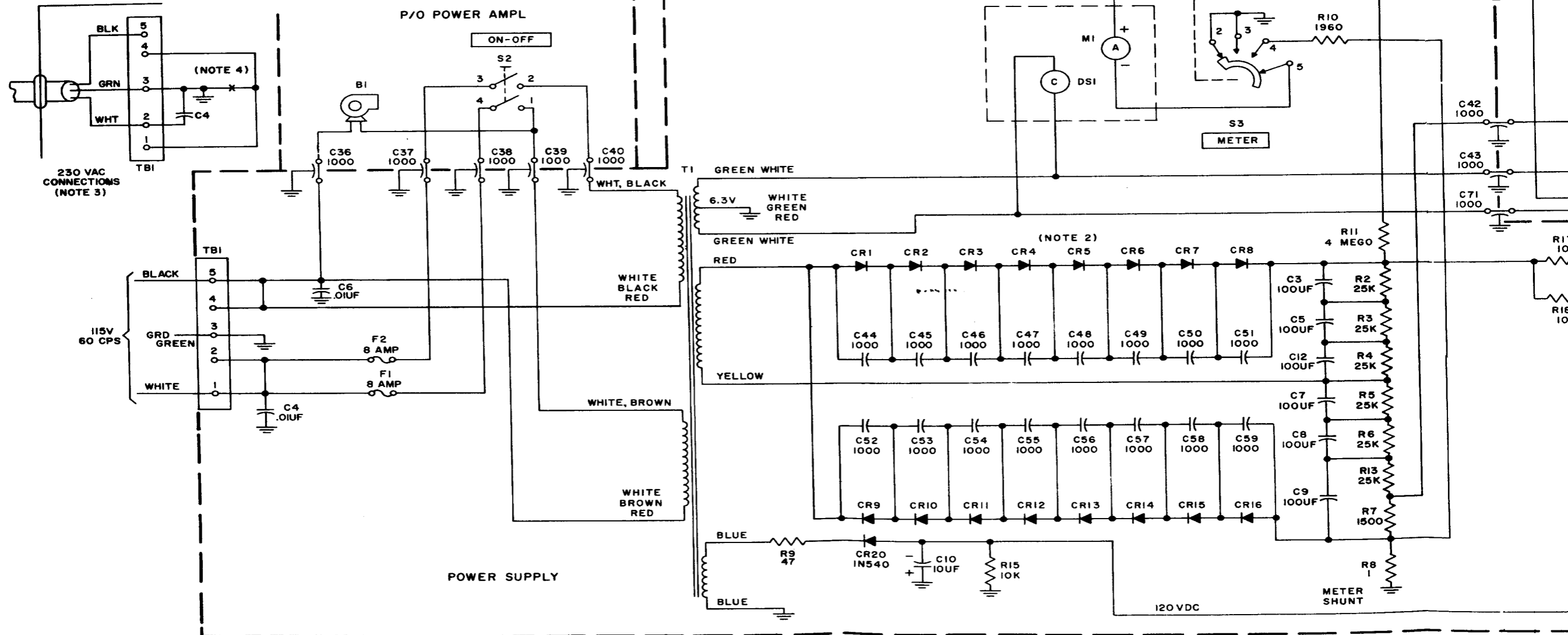


Figure 7-1. Connector Assembly Instructions

**NOTES:**

1. UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES IN UUF, ALL INDUCTANCE VALUES ARE IN UH.
2. CR1 THRU CR16 ARE ALL IN1492.
3. AMPLIFIER SHIPPED WITH PRIMARIES CONNECTED FOR 115VAC. TO CONNECT FOR 230 VAC, REMOVE JUMPERS ON TBI, TERMINALS 1 TO 2 AND 4 TO 5. MOVE WHITE WIRE OF POWER CORD AND UNGROUNDED LEAD OF C4 TO TERMINAL 2. ADD JUMPERS FROM TERMINALS 1 AND 4 TO 3.
4. BREAK AT POINT X FOR 230 VAC, 2 WIRE SYSTEMS.
5. ALTERNATE TYPE FOR CR17 AND CR18 IS IN252.



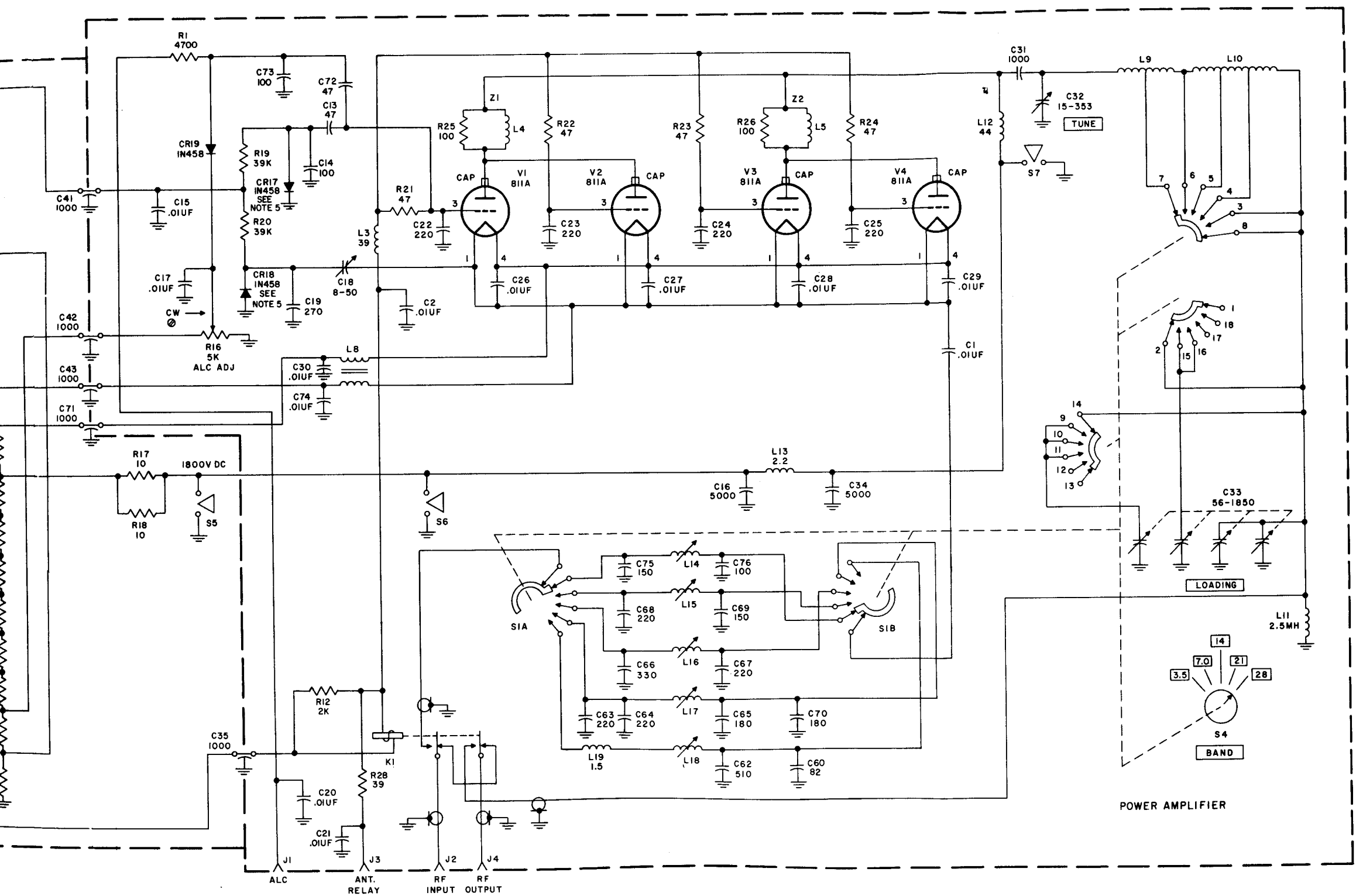


Figure 7-2. 30L-1 Schematic Diagram

## SECTION VIII

### OPERATOR'S MAINTENANCE

#### 8.1. Operator's Preventive Maintenance

Operator's preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

a. Systematic Care. The procedures given in paragraphs 8.3 and 8.4 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services. The daily preventive maintenance checks and services chart (para 8.3) outlines functions to be performed daily. These checks and services are to maintain Army electronic equipment in a combat-serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check, and the normal conditions; the References column lists the illustrations, paragraphs, or manuals that contain supplementary information. If the defect cannot be remedied by the operator, higher category of maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

#### 8.2. Preventive Maintenance Checks and Services Periods

Paragraph 8.3 lists preventive maintenance checks and services that must be accomplished daily or under the following conditions:

- a. When the equipment is initially installed.
- b. When the equipment is reinstalled after removal for any reason.
- c. At least once each week if the equipment is maintained in standby condition.

## 8.3. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	End item equipment...	Inspect equipment for completeness.	Table 1-1.
2	Exterior surfaces....	Clean exterior surfaces, including panel and meter glass. Check meter glass and indicator lens for cracks.	Fig. 2-1 and para 8-4.
3	Connectors.....	Check tightness of all connectors.	Fig. 1-1, 1-2, 1-3, or 1-4.
4	Controls and indicators.	While making operating checks (item 5), observe that mechanical action of each knob, dial, and switch is smooth and free of external or internal binding, and that there is no excessive looseness. Also, check meter for sticking or bent pointer (fig. 2-1).	
5	Operation.....	Operate equipment according to section II. During operation, be alert for any unusual signs or conditions.	

#### 8.4. Cleaning

Inspect the exterior of the equipment. The exterior surfaces should be free of dust, dirt, grease, and fungus.

a. Remove dust and loose dirt with a clean, soft cloth.

Warning: Cleaning compound is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and ground-in dirt from the case; use a cloth dampened (not wet) with cleaning compound.

c. Remove dust or dirt from plugs and jacks and with a brush.

Caution: Do not press on the meter face (glass) when cleaning; the meter may become damaged.

d. Clean the front panel, meter, and control knobs; use a soft, clean cloth. If dirt is difficult to remove, dampen the cloth with water; use mild soap if necessary.

## SECTION IX

### ORGANIZATIONAL MAINTENANCE

#### 9.1. Organizational Preventive Maintenance

a. Organizational preventive maintenance is the systematic care, inspection, and servicing of equipment to maintain it in serviceable condition, prevent breakdowns, and assure maximum operational capability. Preventive maintenance is the responsibility of all categories concerned with the equipment and includes the inspection, testing, and repair or replacement of parts, subassemblies, or units that inspection and tests indicate would probably fail before the next scheduled periodic service. Preventive maintenance checks and services of the equipment at the organizational level are made at monthly intervals unless otherwise directed by the commanding officer. The preventive maintenance checks and services should be scheduled concurrently with the periodic service schedule of the carrying vehicle for all vehicular installations.

b. Maintenance forms and records to be used and maintained on this equipment are specified in TM 38-750.

#### 9.2. Monthly Maintenance

Perform the maintenance functions indicated in paragraph 9.3 once each month. A month is defined as approximately 30 calendar days of 8-hour-per-day operation. If the equipment is operated 16 hours a day, the monthly preventive maintenance checks and services should be performed at 15-day intervals. Adjustment of the maintenance interval must be made to compensate for any unusual operating conditions. Periodic daily services constitute a part of the monthly preventive maintenance checks and services and must be performed concurrently. Equipment maintained in a standby (ready for immediate operation) condition must have monthly preventive maintenance checks and services performed on it. Equipment in limited storage (requires service before operation) does not require monthly preventive maintenance.

9.3. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	Reference
1	Installation.....	See that the equipment is properly installed.	Sect. 1
2	Spare parts.....	Check all spare parts for general condition and method of storage. There should be no evidence of overstock, and all shortages must on valid requisitions.	
3	Interior cleaning....	Remove dust and dirt from the interior with a clean, lint-free cloth or soft brush.	
4	Preservation.....	Inspect all metal surfaces for rust and corrosion.	Para 9.4.
5	Publications.....	See that all publications are complete, serviceable, and current.	DA Pam 310-4.
6	Modifications.....	Determine if new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled.	DA Pam 310-4.
7	Pluckout items.....	Inspect clamps and seating of pluckout items. Check for wrong, bent, or broken parts.	Fig. 6-1 and 6-2.
8	Fuses.....	Check to see that fuses are of the correct rating. Fuses F1 and F2 are each 8 amperes. Check to verify that authorized spares are on hand.	



9.3. Monthly Preventive Maintenance Checks and Services Chart (cont)

Sequence No.	Item	Procedure	References
9	Cords, cables, and wire	Inspect all cords, cables, and wire for cuts, breaks, fraying, deterioration, kinks, and strains. Repair or replace as required.	Fig. 1-1, 1-2, 1-3, or 1-4.
10	Resistors.....	Inspect resistors for cracks, discoloration, and blistering.	Fig. 6-1 and 6-2.
11	Capacitors.....	Inspect fixed capacitors for leaks and bulges.	Fig. 6-1 and 6-2.
12	Transformers and chokes	Inspect transformers and chokes for evidence of overheating.	Fig. 6-1 and 6-2.
13	Terminal boards.....	Inspect terminal boards for cracks, loose connections, and breaks.	Fig. 6-2.

#### 9.4. Touchup Painting Instructions

Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TM 9-213.

CHANGE }  
No. 2 }

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 21 May 1970

**Organizational, DS, GS, and Depot Maintenance Manual  
Including Repair Parts and Special Tools List**

**AMPLIFIER, RF AM-3979/FRC-93 (COLLINS MODEL 30L-1)**

TM 11-5820-532-15, 28 January 1965, is changed as follows:

*Note.* The parenthetical reference to previous change (example: "page 1 of C 1" ) indicates that pertinent material was published in that change.

*Page 1-0.1*, paragraph A.2. Delete and substitute:

**A.2. Indexes of Publications**

*a. DA Pam 310-4.* Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

*b. DA Pam 310-7.* Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

Paragraph A.3 (page 1 of C 1). Delete and substitute:

**A.3. Forms and Records**

*a. Reports of Maintenance and Unsatisfactory Equipment.* Use equipment forms and records in accordance with instructions given in TM 38-750.

*b. Report of Packaging and Handling Deficiencies.* Fill out and forward DD Form

**6 (Report of Packaging and Handling Deficiencies) as prescribed in AR 700-58 (Army) NAVSUP Pub 378 (Navy), AFR 71-4 (Air Force), and MCO P4030.29 (Marine Corps).**

*c. Discrepancy in Shipment Report (DISREP) (SF 361).* Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38 (Army) NAVSUP Pub 459 (Navy), AFM 75-34 (Air Force), and MCO P4610.19 (Marine Corps).

*d. Reporting of Equipment Manual Improvements.* The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications) and forwarded direct to Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-ME-NMP-EM, Fort Monmouth, N. J. 07703.

\*This change supersedes that portion of the maintenance allocation chart of TM 11-5820-554-15 as pertains to the AM-3979/FRC-93.

## SECTION X

### DEPOT OVERHAUL STANDARDS

#### 10-1. Applicability of Depot Overhaul Standards

The tests outlined in this section are designed to measure the performance capability of a repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

#### 10-2. Applicable References

*a. Repair Standards.* Applicable procedures of the depots performing these tests and the general standards for repaired electronic equipment given in TB SIG 355-1, TB SIG 355-2, and TB SIG 355-3 form a part of the requirements for testing this equipment.

*b. Modification Work Orders.* Perform all modification work orders applicable to this equipment before making the tests specified. DA Pam 310-7 lists all available MWO's.

#### 10-3. Test Facilities Required

The following equipment or suitable equivalents will be used in determining compliance with the requirements of this specific standard.

*a. Test Equipment.* Spectrum Analyzer AN/URM-134A (spectrum analyzer) is the only test equipment required.

*b. Additional Equipment.*

<i>Equipment</i>	<i>Common name</i>
Transceiver RT-718/FRC-93	Transceiver
Electrical Dummy Load DA-75/U.	Dummy load
Power Supply PP-4151/FRC-93	Power supply
Radio Set Control C-6118/FRC-93.	Radio set control
Shielded cables with RCA phono plug on each end (W1, W2) (CPN 426-2027-00) <sup>a</sup> .	Cable

<i>Equipment</i>	<i>Common name</i>
RG-58C/U coaxial cable with RCA phono plug on each end (W3) (FSN 6145-542-6092) <sup>a</sup> .	Cable
RG-8/U coaxial cable with type N connectors, UG-21D/U (W4, W5, W6) (FSN 6145-161-0887) <sup>a</sup> .	Cable
Two-wire shielded cable with one PJ-068 connector on one end and three binding post type terminals on other end (W7) <sup>a</sup> .	Cable
Two-wire cable with RCA phono plug connectors (W8, W9) <sup>a</sup> .	Cable
Coaxial-T-connector, UG-107/U	Coaxial T-connector
High Impedance Probe PRB-2 (supplied with spectrum analyzer).	High impedance probe
60-db attenuator head (supplied with spectrum analyzer).	Attenuator
Probe test points: straight, hooked, or alligator clip (supplied with spectrum analyzer).	Probe test points

<sup>a</sup>Length of cable is not critical.

#### 10-4. General Test Requirements

Tests will be initiated under the conditions listed below and as shown in figure 10-1. The following tests will be performed consecutively. Testing will be simplified if the connections listed below are made initially and modifications are made as required for the individual tests.

*a.* Set the spectrum analyzer front panel controls as listed in table 10-1:

Table 10-1. Spectrum Analyzer Control Settings

Control	Setting
RF TEST . . . . .	OFF.
INPUT ATTENUATOR . . . . .	Maximum.
CAL OSC LEVEL . . . . .	OFF.
IF ATTEN . . . . .	0 DB.
SWEEP WIDTH SELECTOR . . . . .	VAR (100 kHz).
AMPLITUDE SCALE . . . . .	LOG.
AFC . . . . .	OFF.
CENTER FREQ . . . . .	To marker.
GAIN . . . . .	Maximum cw.
OUTPUT . . . . .	AB.
OUTPUT LEVEL DB BELOW METER READING.	For suitable modulation level of transmitter.
FREQUENCY RANGE . . . . .	As required.
MAIN TUNING . . . . .	As required.
OUTPUT LEVEL . . . . .	Redline on meter.

b. Connect the transceiver PHONE PATCH connector to the spectrum analyzer two-tone generator front panel binding posts with test cable W7.

c. Connect the transceiver ANT. RELAY and ALC jacks to the ANT. RELAY and ALC jacks on the RF amplifier with test cables W1 and W2.

d. Connect the transceiver RF OUT jack to the RF amplifier RF INPUT jack with test cable W3.

e. Connect the power supply 11-pin power plug direct to the transceiver power connector.

f. Connect the RF amplifier RF OUTPUT connector to one end of the coaxial T-connector; connect the opposite end of the T-connector to J2 on the directional coupler (mounted on rear of radio set control) with test cables W4 and W5.

g. Connect J1 on the directional coupler to J1 on the dummy load with test cable W6.

h. Connect the 6.3 VAC jack on the transceiver to J4 on the dummy load with test cable W9.

i. Connect J3 on the dummy load to the 6.3 VAC jack on the radio set control with test cable W8.

j. Connect P4 of the test probe (supplied with spectrum analyzer) to the spectrum

analyzer PROB POWER connector.

k. Connect P3 of the test probe to the spectrum analyzer SIGNAL INPUT connector.

**CAUTION**

An input signal of less than 20 mv is sufficient for all normal measurements. To avoid damage to equipment, under no circumstances should a signal exceeding 3 volts be coupled to the SIGNAL INPUT connector.

l. Connect the 60-db attenuator head (supplied with spectrum analyzer) to the cathode-follower section of the test probe. Connect the test probe tip (supplied with spectrum analyzer) to the 60-db attenuator head.

m. Connect the test probe tip to the junction of the T-connector. Connect the ground clip of the test probe to the ground side of the signal source.

n. Connect the power input plugs on the RF amplifier, power supply, and spectrum analyzer to the 115-volt ac power source.

**10-5. Tests on Amplifier, RF AM-3979/FRC-93**

*a. Output Power Test in Cw Mode.*

(1) Connect the equipment as outlined in paragraph 10-4 and as shown in figure 10-1.

(2) Adjust the amplifier and transceiver for 3.9-MHz operating frequency as outlined in paragraphs 2.1, 2.2, and 2.3.

(3) Set the transceiver PLATE-GRID-ALC switch at ALC.

(4) Set the dummy load REMOTE-DUMMY LOAD switch at DUMMY LOAD.

(5) Set the radio set control WATT-METER switch at FORWARD 2000.

(6) Set spectrum analyzer frequency output A for 1.0-kHz signal and frequency output B for 1.9-kHz signal. Set the output level for minimum.

**CAUTION**

Do not apply RF output to the dummy load for more than 30 seconds at a time. To stop transmitting, re-

move ground from the PTT jack.

(7) Ground the transceiver PTT jack.

(8) Adjust the spectrum analyzer two-tone generator control to obtain a 6-db ALC indication on the transceiver meter.

(9) The radio set control WATTMETER shall indicate 500 watts minimum.

(10) Repeat the procedures given in (1) through (9) above with the amplifier and transceiver adjusted for operating frequencies of 7.2 MHz, 14.3 MHz, 21.3MHz, and 28.6 MHz.

*b. ALC Override Margin Test.*

(1) Connect the equipment as outlined in paragraph 10-4 and as shown in figure 10-1.

**NOTE**

The radio set control is not required for this test. Connect the AM-3979/FRC-93 RF OUTPUT connector direct to J1 on the dummy load and remove connection from J3.

(2) Adjust the amplifier and transceiver for 14.3-MHz frequency as outlined in paragraphs 2.1, 2.2, and 2.3.

(3) Set the transceiver PLATE-GRID-ALC switch at ALC.

(4) Set the dummy load REMOTE-DUMMY LOAD switch at DUMMY LOAD.

(5) With the spectrum analyzer frequency output A at 1.0 kHz and frequency output B at 1.9 kHz, set the output level for minimum.

**CAUTION**

Do not apply RF output to the dummy load for more than 30 seconds at a time. To stop transmitting, remove ground from the PTT jack.

(6) Ground the transceiver PTT jack.

(7) Adjust the spectrum analyzer two-tone generator output level until the ALC threshold is reached as observed on the transceiver meter.

(8) Disconnect the ALC line connected in paragraph 10-4c and set the RF amplifier power ON-OFF switch to OFF.

(9) Repeat the procedure given in (7)

above. Transceiver meter indication recorded in this procedure shall not be less than the indication recorded in (7) above.

*c. Noise and Distortion Test.*

(1) Connect the equipment as outlined in paragraph 10-4 and as shown in figure 10-1.

(2) Set the transceiver SSB-CW switch to SSB.

(3) Adjust the amplifier and transceiver for 3.9-MHz operating frequency as outlined in paragraphs 2.1, 2.2, and 2.3.

(4) Set the transceiver PLATE-GRID-ALC switch to ALC.

(5) Set the dummy load REMOTE-DUMMY LOAD switch to DUMMY LOAD.

(6) With the spectrum analyzer frequency output A at 1.0 kHz and frequency output B at 1.9 kHz signal, set the output level for minimum.

(7) Adjust the spectrum analyzer two-tone generator control until the ALC threshold is reached as observed on the transceiver meter.

(8) Adjust the SWEEP RATE and MAIN TUNING for spectrum display centered at 3.9 MHz.

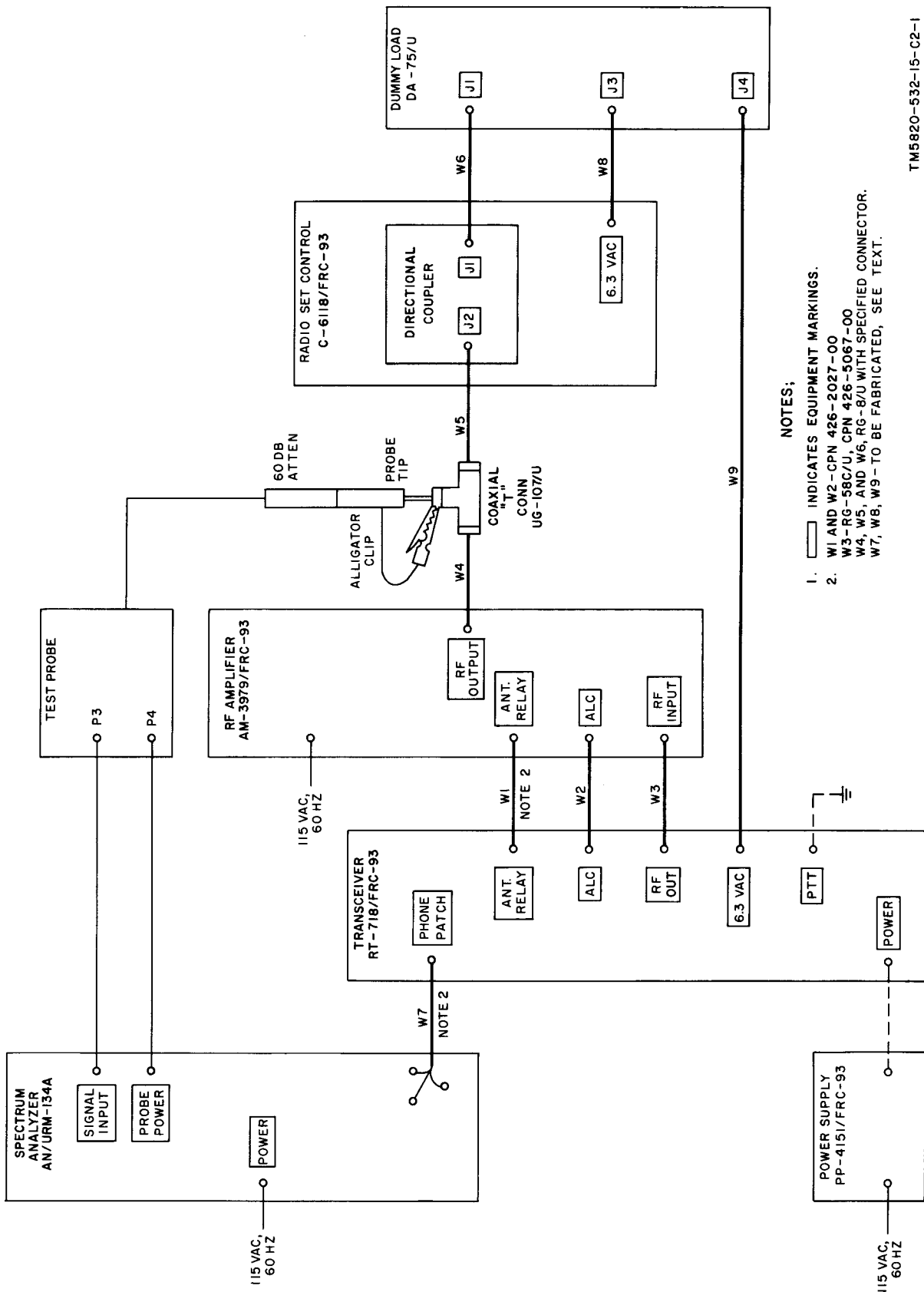
(9) Set the IF ATTEN to 20 DB. Adjust the INPUT ATTENUATOR switches to bring the highest pip on the calibrated screen to slightly above 0 db. Adjust the GAIN control to bring the highest pip to precisely 0 db.

(10) Measure and record the third and fifth order harmonic distortion products. Distortion amplitude shall not be less than 30 db below input level.

(11) Remove the PJ-068 connector from the PHONE PATCH connector. Connect a short-circuited PJ-068 connector to the PHONE PATCH connector. Measure and record noise level. Noise amplitude shall not be less than 40 db below input level.

(12) Repeat the procedures given in (1) through (11) above with the amplifier and transceiver adjusted for operating frequency of 14.3 MHz.

Add figure 10-1 at the end of section X:



- NOTES:**
1. [Symbol] INDICATES EQUIPMENT MARKINGS.
  2. W1 AND W2 - CPN 426-2027-00  
 W3 - RG-58C/U, CPN 426-5067-00  
 W4, W5, AND W6, RG-8/U WITH SPECIFIED CONNECTOR.  
 W7, W8, W9 - TO BE FABRICATED, SEE TEXT.

Figure 10-1. Amplifier, RF AM-3979/FRC-93, test setup.

Page 10-1 (page 1 of C 1). Delete appendix I and substitute:

## APPENDIX A REFERENCES

---

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	U.S. Army Equipment Index of Modification Work Orders.
SB 11-573	Painting and Preservation Supplies Available for Field Use for Electronics Command Equipment.
TB 746-10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TM 9-213	Painting Instructions for Field Use.
TM 11-5820-529-15	Organizational, DS, GS, and Depot Maintenance Manual: Transceiver RT-718/FRC-93 (Collins Model KWM-2 and KWM-2A), Power Supply PP-3990/FRC-93 (Collins Model PM-2), Power Supply PP-4151/FRC-93 (Collins Model 516F-2), Crystal Unit Set Quartz CK-31/FRC (Collins Crystal Packet CP-1) Including Repair Parts and Special Tool Lists, and Installation and Operating Instructions for Waters O-Multiplier/Notch Filter, Model 340-A.
TM 11-5820-530-15	Organizational, DS, GS, and Depot Maintenance Manual: Control, Radio Set C-6118/FRC-93 (Collins Models 312B-4 and 312B-5) Including Repair Parts and Special Tool Lists.
TM 11-5820-554-15	Organizational, DS, GS, and Depot Maintenance Manual: Radio Set AN/FRC-93 Including Repair Parts and Special Tool Lists.
TM 38-750	The Army Maintenance Management System (TAMMS).

Add appendix B after appendix A:

## APPENDIX B MAINTENANCE ALLOCATION

### Section I. INTRODUCTION

#### B-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for the AM-3979/FRC-93. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each

function. This appendix may be used as an aid in planning maintenance operations. This appendix is current as of 16 January 1970.

#### B-2. Maintenance Functions

Maintenance functions will be limited to and defined as follows:



a. **INSPECT.** To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

b. **TEST.** To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc. This is accomplished with external test equipment and does not include operation of the equipment and operator type tests using internal meters or indicating devices.

c. **SERVICE.** To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be solisted.

d. **ADJUST.** To rectify to the extent necessary to bring into proper operating range.

e. **ALIGN.** To adjust two or more components or assemblies of an electrical or mechanical system so that their functions are properly synchronized. This does not include setting the frequency control knob of radio receivers or transmitters to the desired frequency.

f. **CALIBRATE.** To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

g. **INSTALL.** To set up for use in an operational environment such as an encampment, site, or vehicle.

h. **REPLACE.** To replace unserviceable items with serviceable like items.

i. **REPAIR.** To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes, but is not limited to welding, grinding, riveting, straightening, and replacement of parts other than the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

j. **OVERHAUL.** Normally, the highest degree of maintenance performed by the Army in order to minimize time work in process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

k. **REBUILD.** The highest degree of materiel maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by operational considerations or other paramount factors and then only at the depot maintenance category. Rebuild reduces to zero the hours or miles the equipment, or component thereof, has been in use.

l. **SYMBOLS.** The uppercase letter placed in the appropriate column indicates the lowest level at which that particular maintenance function is to be performed.

### B-3. Explanation of Format

a. *Column 1, group number.* Column 1 lists group numbers, the purpose of which is to identify components, assemblies, sub-assemblies and modules with the next higher assembly.

b. *Column 2, functional group.* Column 2 lists the noun names of components, assemblies, subassemblies and modules on which maintenance is authorized.

c. *Column 3, maintenance functions.* Column 3 lists the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform that function at higher categories. The codes used represent the various maintenance categories as follows:

<i>Code</i>	<i>Maintenance Category</i>
C . . . . .	Operator/Crew
O . . . . .	Organizational Maintenance
F . . . . .	Direct Support Maintenance
H . . . . .	General Support Maintenance
D . . . . .	Depot Maintenance

*d. Column 4, tools and test equipment.* Column 4 specifies by code, those tools and test equipment required to perform the designated function. The numbers appearing in this column refer to specific tools and test equipment which are identified in table I.

*e. Column 5, Remarks.* Self-explanatory.

#### **B-4. Explanation of Format of Table I, Tool and Test Equipment Requirements**

The columns in Table I, Tool and Test Equipment Requirements are as follows:

*a. Tools and Equipment.* The numbers in this column coincide with the numbers used in the tools and equipment column of the Maintenance Allocation Chart. The numbers indicate the applicable tool for the maintenance function.

*b. Maintenance Category.* The codes in this column indicate the maintenance category normally allocated the facility.

*c. Nomenclature.* This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

*d. Federal Stock Number.* This column lists the Federal stock number of the specific tool or test equipment.

*e. Tool Number.* Not used.

SECTION II. MAINTENANCE ALLOCATION CHART

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS										TOOLS AND EQUIPMENT	REMARKS				
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL			REBUILD			
1	AMPLIFIER, RADIO FREQUENCY AM-3979/FRC-93	C	O F	C												2,11 1,3,4,5,6,7, 8,9,10,12,13, 14,15 2,11 1,9,10,12,13, 14,15 1,3,4,5,6,7, 8,9,10,12,13, 14,15	Continuity tests. Locate discrepant parts. Repair shorts and opens. Replace faulty parts.

TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL AND TEST EQUIPMENT REQUIREMENTS			
TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE	FEDERAL STOCK NUMBER
1	F, H, D	AM-3979/FRC-93 (cont.)	5985-280-3480
2	0	DUMMY LOAD, ELECTRICAL DA-75/u	6625-581-2036
3	F, H	MULTIMETER AM/URM-105 ( )	6625-553-0142
4	F, H	MULTIMETER TS-352/u	6625-913-9781
5	F, H	MULTIMETER ME-26D/u	6625-987-6603
6	F, H	OSCILLOSCOPE AM/USM-140A/u	6625-964-9680
7	F, H	OSCILLOSCOPE, SUBASSEMBLY VERTICAL CHANNEL HIGH-GAIN DIFFERENTIAL AMPLIFIER AM-3567/USM	6625-087-3442
8	F, H	OSCILLOSCOPE, SUBASSEMBLY, VERTICAL CHANNEL HIGH-GAIN WIDE-BAND AMPLIFIER AM-3568/USM	6625-788-5975
9	F, H, D	TEST PROD MY-4923/u	5180-605-0079
10	F, H, D	TOOL KIT, ELECTRONIC EQUIPMENT TK-120/G	5180-610-8177
11	0	TOOL KIT, ELECTRONIC EQUIPMENT TK-105/G	5180-064-5178
12	F, H, D	TOOL KIT, ELECTRONIC EQUIPMENT TK-101/G	6625-813-8430
13	F, H, D	WATTMETER AM/URM-120	5820-082-4080
14	F, H, D	TRANSCEIVER RT-718/FRC-93	5820-985-8099
15	F, H, D	POWER SUPPLY PP-4151/FRC-93	5820-082-4082
		CONTROL, RADIO SET C-6118/FRC-93	

By Order of the Secretary of the Army:

W. C. WESTMORELAND,  
General, United States Army,  
Chief of Staff.

Official:

KENNETH G. WICKHAM,  
Major General, United States Army,  
The Adjutant General.

Distribution:

Active Army:

DCA (8)	7th USA (10)
USASA (2)	8th USA (10)
CNGB (1)	USAREUR (10)
CofSptS (1)	USASCS (40)
ACSC-E (2)	Gen Dep (5)
USACDCCEA (1)	Sig Sec, Gen Dep (5)
USACDCCEA (Ft Huachuca) (1)	Sig Dep (12)
USAMC (2)	Sig FLDMS (2)
USAECOM (2)	MAAG (10)
USASTRATCOM (5)	USARYIS (5)
USASTRATCOM-CONUS (5)	USAJFKCENMA (5)

ARNG: None.

USAR: None.

For explanation of abbreviations used, see AR 310-50.

**TM 11-5820-532-15 AMPLIFIER RF AM-3979/FRC-93-1965**