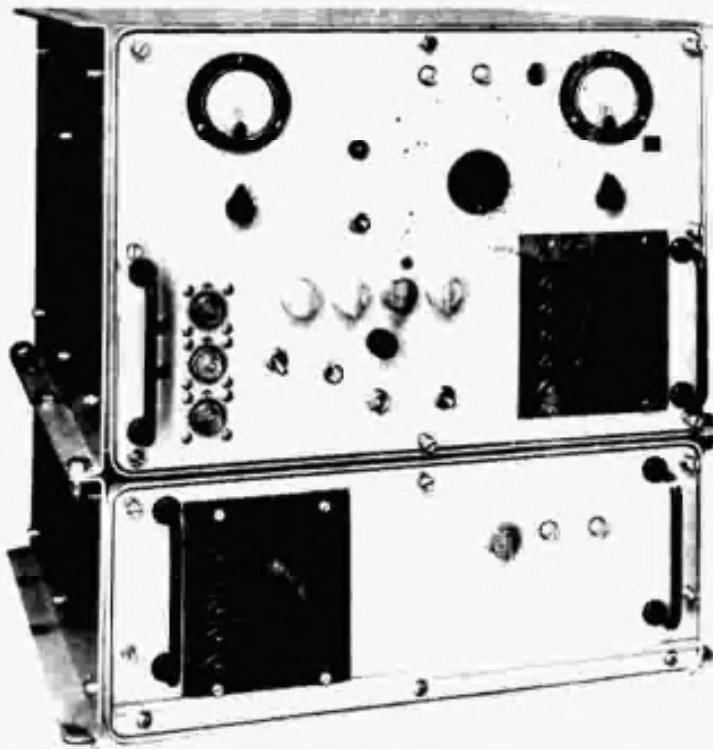


INSTRUCTION MANUAL 1932-0005

PUBLICATION NUMBER 1915



**RF-110A  
RADIO  
FREQUENCY  
AMPLIFIER**

**and**

**RF-112A  
POWER  
SUPPLY**

HARRIS-INTERTYPE CORPORATION • RF COMMUNICATIONS DIVISION

**HARRIS RF COMMUNICATIONS**

1680 UNIVERSITY AVENUE - ROCHESTER, N.Y. 14610 U.S.A. • PHONE (716) 583-1838 • CABLE: RRCOM • CHESTER, N.Y. • TWX 910 713 770 • TELETYPE 970342

## **WARRANTY**

RF Communications warrants the equipment purchased hereunder to be free from defect in material and workmanship under normal use and service, when used for the purpose for which the same was designed, for a period of one year from the date of delivery, provided that notice of such defect is given to RF Communications within sixty (60) days after the discovery thereof and provided that inspection by RF Communications indicates the parts are defective to RF Communications' reasonable satisfaction. RF Communications' obligations under this warranty are limited to the repair or replacement of defective parts and the return of such repaired or replaced parts to the purchaser F.O.B. factory. At RF Communications' option, any defective part shall be returned to RF Communications' factory for inspection, properly packed and all expenses prepaid. No parts shall be returned unless the purchaser first obtains a return authorization number, which will be furnished on request. Electron tubes are warranted in accordance with the manufacturer's standard tube warranty policy, which will be furnished on request. Equipment furnished by RF Communications, but manufactured by another, bears only the warranty given by such other manufacturer, which will be furnished on request. No warranties other than those set forth in this section are given or are to be implied with respect to the equipment furnished hereunder and RF Communications shall in no event be liable for consequential damages, or for loss, damage, or expense directly or indirectly arising from the use of the products, or any inability to use them either separately or in combination with other equipment.

## **CORRESPONDENCE AND PARTS ORDERING**

Whenever writing about this unit or ordering parts, always refer to the model number, serial number, and date of purchase. Special parts should be ordered by the RF part number and the part's schematic reference number. Standard parts can be obtained from your local parts distributor.

## **ACCESSORIES**

From time to time, new accessories are added to our product line. Often, these are a result of particular customer needs. Our sales department will be happy to discuss your requirements and suggest possible solutions.

## **DO YOU HAVE THE PROPER MANUAL?**

The versatility of the RF-110A allows it to be used, with minor variations or changes in plug-in components, with a wide variety of equipments. To be sure you are looking in the correct manual for the information on the equipment you have, always start with the systems manual, which will clearly define any variations made from the standard RF-110 equipment. For instance, the system manual will list the power supply used, when operating from a primary power source other than 440/208V, 3 $\phi$ , 60 Hz, and a separate manual for that power supply will be provided. When operating from an RF-130 system, differences in power control circuits will be discussed in the systems manual. When using an RF-121 system, limitations placed on the frequency range, etc, by the exciter used, will be covered in the systems manual.

## **INITIAL START-UP NOTICE**

The tubes used in the final amplifier stage of the RF-110A Power Amplifier may occasionally liberate minute amounts of gas during prolonged storage, according to the manufacturer. To prevent degradation of performance, it is advisable to run the tubes without high voltages applied following storage periods, to remove any gas from the tubes.

Therefore, it is strongly recommended that upon installation of this system, or following any period of three or more months duration without operating the system, that the system be run for at least 30 minutes in the STANDBY mode before going to any operate mode.

## **MAINTENANCE PARTS INFORMATION**

Replacement maintenance parts supplied to the customer may vary slightly in size, shape or color from the original part. These minor variations are due to obtaining parts to RF Communications Specifications from different vendors, or due to differences in production runs. Electrically, replacement parts will be the same or better.

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# SECTION I

## GENERAL INFORMATION

### 1.1 SCOPE

This technical manual describes installation, operation, troubleshooting, and maintenance of the RF Communications RF-110A Radio Frequency Amplifier and RF-112A Power Supply. (Military nomenclature assignments to these equipments are AM-3924A(P)/URT and PP-3916A/UR, respectively.) Hereinafter, these two units will be referred to as the RF-110A and RF-112A.

### 1.2 DESCRIPTION

#### 1.2.1 GENERAL

The RF-110A/RF-112A Radio Frequency Amplifier and Power Supply combination is a compact, versatile equipment for linear amplification of low level signals in the 2 – 30 MHz range. Compatible with any low level exciter, the RF-110A will deliver 1 kW of PEP (or average) RF power into a nominal 50 ohm load with only 100 mW of drive. The RF-112A provides the necessary high voltage from a 3 phase 208 or 440 volt source. Originally intended for military applications, this equipment was designed with reliability, ruggedness and maintainability in mind.

#### 1.2.2 RADIO FREQUENCY AMPLIFIER RF-110A

The RF-110A consists of two stages having an overall power gain of 40 db. A "broadbanding" technique is utilized which (other than band selection) eliminates the need for any front panel tuning on the part of the operator. The interstage and

output coupling networks in the RF-110A consist of special bandpass filters, one set for each of nineteen bands. Band selection is by means of motor driven bandswitch assemblies controlled either locally (from the RF-110A front panel) or remotely (with a 5-wire digital code).

Some additional features of the RF-110A are: a built-in directional RF power detector for front panel monitoring of forward and reflected output power; an antenna transfer relay; and PPC (peak power control) and APC (average power control) control voltage outputs for use by an external exciter. Sufficient protective circuits are utilized in the RF-110A to virtually eliminate damage due to operator error, overdriving the final tubes, or loss of the output load.

#### 1.2.3 POWER SUPPLY RF-112A

The RF-112A develops the high voltage necessary for operation of the RF-110A from a 3 phase, 60 cycle 208/440V line-to-line primary power source. All high voltage and control functions between the RF-110A and RF-112A are made via a single multiconductor interconnecting cable. No operating controls are located on the RF-112A. The unit can be either stack mounted under the RF-110A or mounted in a standard 19 inch relay rack.

Other power supplies available to suit individual installation requirements are the RF-111A for operation from a 3 phase, 400 Hz, 115V source and the RF-124 for operation from a single phase 50/60 Hz, 230V source.

TABLE 1-1. REFERENCE DATA RF-110A/RF-112A

PARAMETER	CHARACTERISTICS
Frequency Range	2 – 30 MHz in 19 pretuned bands
Power Output	1 kilowatt PEP or average
Driving Power	100 milliwatts nominal into 50 ohms
Intermodulation Products	40 db below full output
Primary Power	3 phase, 3 wire, 208V $\pm$ 10% or 440V $\pm$ 10%, 60 Hz $\pm$ 5%
Power Consumption	4500 watts maximum at full output
Ambient Temperature, Operating	0 to 50 degrees C
Shock	Withstands MIL-S-901 tests when used with RF-115 shock mount. (20 G's for 1 ms along any major axis without shock mount.)
Input Impedance	50 ohms unbalanced
Load Impedance	50 ohms nominal, 4:1 max Vswr (see para. 2.5)
RF-110A diode, transistor and tube complement	87 diodes, 33 transistors, 4 tubes
RF-112A diode and transistor complement	7 diodes, 2 transistors

TABLE 1-2. ANCILLARY AND OPTIONAL EQUIPMENT AVAILABLE FOR USE WITH THE RF-110A/RF-112A

EQUIPMENT	DESCRIPTION
RF-111A Power Supply	Allows operation of the RF-110A from 3 phase, 3 wire, 115V $\pm$ 10% line-to-line, 400 Hz $\pm$ 5% primary source. (RF-112A not required when using the RF-111A.)
RF-115 Shock Mounting Kit	Reduces transmission of shock and vibration into the RF-110A/RF-112A. Primarily for portable or shipboard installations.
RF-124 Power Supply	Allows RF-110A operation from single phase, 230V $\pm$ 10%, 50/60 Hz primary power source (RF-112A not required when using the RF-124).
RF-125 Noise Silencer	Fits over RF-110A air intake on front panel, and reduces blower noise.
RF-131 Exciter	2 – 30 MHz (100 Hz steps) digitally tuned exciter. Modes of operation include USB, LSB, ISB (2 to 4 channel), AM, CW and RATT (F1) and FAX (F4). Nominal 100 mW PEP RF power into 50 ohms. (External modems required for RATT and FAX.)



TABLE 1-2. ANCILLARY AND OPTIONAL EQUIPMENT AVAILABLE  
FOR USE WITH THE RF-110A/RF-112A (Cont)

EQUIPMENT	DESCRIPTION
<b>RF-301E</b> Transceiver	2 – 15 MHz ( 1 kHz steps) digitally tuned transceiver, USB, LSB, AM, CW, RATT. Receiver sensitivity 1 microvolt for 10 db S+N/N. When used with RF-110A, it forms a 1 kW transceiver system.
<b>RF-601A</b> Antenna Coupler	Fully automatic, 1 kW Antenna Coupler, matches a 15–35 foot (4.6 to 10.7 meter) whip antenna to 50 ohms from 2 to 30 MHz.
<b>RF-610</b> Antenna Coupler	Remote controlled, manually operated, 1 kW Antenna Coupler. Matches a 15–35 foot (4.6 to 10.7 meter) whip antenna to 50 ohms from 2 to 30 MHz.

TABLE 1-3. ITEMS SUPPLIED

ITEM	RF COMMUNICATIONS PART NO.
With the RF-110A	
1 kW Linear Amplifier	1932-1000
Stack mounting brackets (2 ea)	399-1007
Connector M/W J6	10-109620-27P
Connector M/W J5	10-109620-19S
Connector M/W J2	10-109628-12P
Connector M/W J4	UG-21D/U
Connector M/W J3	UG-21D/U
Connector M/W J9	UG-88E/U
Connector M/W J7	10-109628-21P
Connector M/W J8	10-108618-1P
Instruction Manual RF-110A/RF-112A	1932-0005
With the RF-112A	
Power Supply, 60 Hz, 3 phase	1932-0112
Stack mounting brackets (2 ea)	399-1004
RF-110A/RF-112A Cable Assembly (W3)	399-0027
Jumper Assembly	391-8200 (208V Assembly)
	391-8300 (440V Assembly)

## SECTION II

### INSTALLATION

#### 2.1 UNPACKING AND INSPECTION

The units are shipped in a single crate weighing approximately 300 pounds (136 kg). Other than the customary amount of care and common sense, no special procedures are required for unpacking. Check off all items on the packing list as they are unpacked. Each item should be examined carefully for any obvious physical damage. Save the packing material and containers to substantiate claim with the transportation agency should any damage be found. If it is known that the units might be reshipped, save the container and packing material for future use.

#### 2.2 MOUNTING

The RF-110A and RF-112A can be stack mounted or mounted in a standard 19 inch relay rack enclosure. Stack mounting (shown in figure 2-2) is the usual method for "desk-top" installations. Using this arrangement, the RF-112A is simply bolted to a flat mounting surface with six bolts through the side bracket flanges. Do not slide the RF-110A out of its case until the stack is securely mounted. The use of the RF-115 shock mounting kit (figure 2-2) is recommended in installations subject to shock and vibration.

Figure 2-3 illustrates the fabrication details for rack mounting brackets suitable for mounting the units in a 19 inch relay rack. If this type of mounting is used, additional support should be provided inside of the rack enclosure to take the strain off of the front mounting brackets.

#### 2.3 PRIMARY POWER

There are two primary power options for the RF-110A Power Amplifier, when using the RF-112A Power Supply. These two options are 440 volts, or 208 volts, three-phase, 60 Hz. The RF-110A and RF-112A are wired at the factory to provide for the voltage option selected by the customer at time of purchase. The RF-110A may

be operated from a single-phase 60 Hz, or a three-phase 400 Hz power supply. (Different power supplies are substituted for the RF-112A, see table 2-1.)

Field conversion to a different primary power input is easily accomplished by exchanging the fuses and the jumper strips as indicated in table 2-1, restrapping transformer 1A1T1 in the RF-110A, and if necessary, changing the power supply.

#### 2.4 COOLING

The RF-110A fan handles 140 cubic feet per minute ( $4 \text{ m}^3/\text{min}$ ) of cooling air. Temperature at the exhaust is about  $60^\circ\text{C}$  greater than at the inlet; consequently if the RF-110A is used in a confined space (like an enclosed rack) the hot exhaust air must be ducted out. It is imperative that any ducting used shall not increase the pressure that the RF-110A fan works against. That is, when the duct is handling 140 cubic feet of air per minute, the pressure at the inlet of the duct must not exceed ambient pressure. This requires ducting of large cross section, or a booster fan in the duct, or both. See figure 2-2, especially Note 3.

The RF-112A fan is a low-pressure, low-volume device, and the exhaust air temperature is only a few degrees higher than the inlet. Therefore, ducting should not be required. No provision has been made for attaching a duct to the RF-112A.

#### CAUTION

If it is desired to duct the RF-112A exhaust, do not use the same duct with the RF-110A, or the high volume of air from the RF-110A may be forced back into the RF-112A.

In situations where the blower noise of the RF-110A is objectionable, it can be reduced considerably by installing an RF-125 Noise Silencer on the

TABLE 2-1. PRIMARY POWER OPTIONS

PRIMARY POWER SOURCE	RF-110A	POWER SUPPLY
440V, 3 $\phi$ , 60 Hz	1A1T1 strapped for 440V; 1A1P5 on 1A1TB2; 7 ampere time delay fuses in primary power line	RF-112A, with 2A2P1 on 2A2TB1
208V, 3 $\phi$ , 60 Hz	1A1T1 strapped for 208V; 1A1P5 on 1A1TB2; 15 amp primary power fuses	RF-112A, with 2A2P2 on 2A2TB1
115V, 3 $\phi$ , 400 Hz	1A1T1 strapped for 230V; 1A1A8P1 on 1A1TB1; 1A1A8P2 on 1A1TB2; 25 amp primary power fuses	RF-111A
230V, 1 $\phi$ , 50/60 Hz	1A1TB1 strapped for 230V; 1A1P5 on 1A1TB2; 25 amp primary power fuses	RF-124

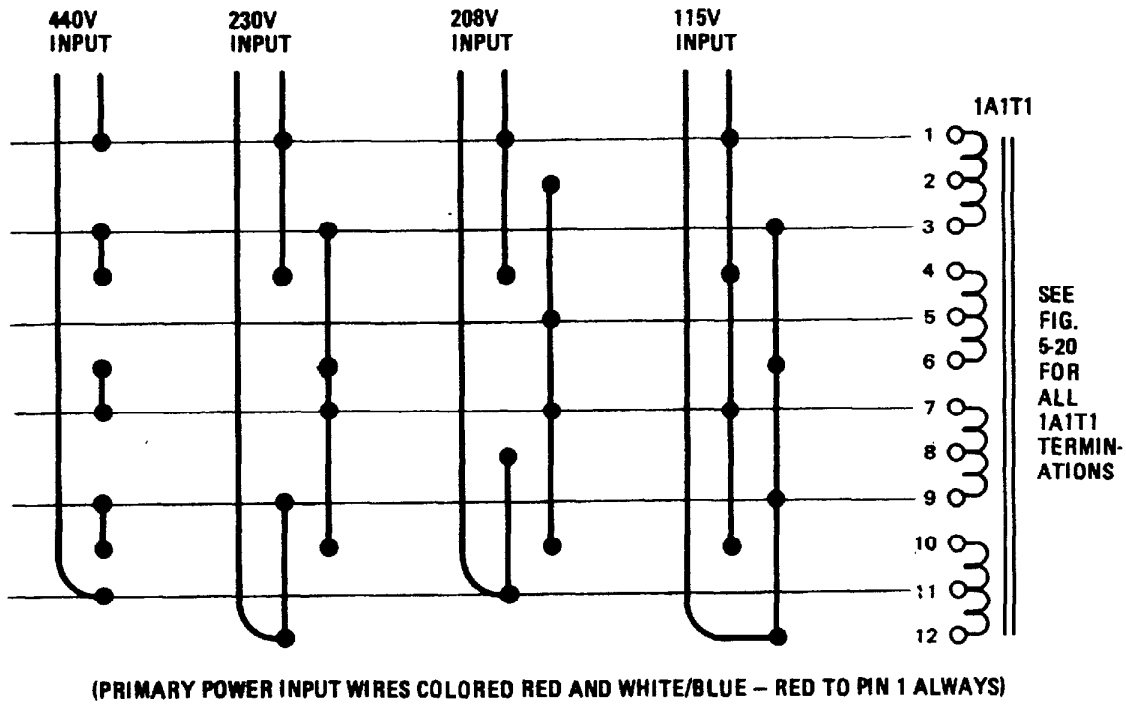


Figure 2.1. Primary Power Strapping

front of the RF-110A. The RF-125 is available from RF Communications; contact your distributor for price and availability information.

## 2.5 RF LOAD REQUIREMENTS

The nature of the broadband output circuits in the RF-110 makes it desirable to work into RF load impedances yielding VSWR's of 1.5:1 or less referred to 50 ohms. Although no damage can occur with VSWR's high as 4:1, it is in the interest of amplifier efficiency and intermodulation level that the VSWR be less than 1.1:1. Acceptable VSWR's can be obtained over relatively narrow bands of frequencies using resonant antennas such as the quarter wave ground plane or half wave dipole. The use of a single antenna (long wire or whip) over the entire frequency range of 2 – 30 MHz requires the use of an antenna coupler.

As optional equipment, RF Communications has available a complete line of antenna couplers to suit any installation requirement. Couplers available vary from simple manually operated units to ones which are fully automatic.

## 2.6 INTERCONNECTION REQUIREMENTS

The basic interconnections require for the RF-110A to perform its intended function are: Primary power input, RF input, RF output and external control connections (see below). However, the RF-110A has the ability to serve as a central interconnection point in complex installations involving remote operator positions, transmitter/operator switchboards, remote automatic antenna couplers etc. Therefore, the actual number of interconnections will depend upon user requirements. For these reasons, only one fabricated cable (RF-110A/RF-112A Interconnection, W3) is supplied. All remaining mating connectors are supplied with the RF-110A to facilitate cable fabrication.

Refer to tables 2-2 through 2-8 and figure 5-25 (Main Case Schematic) for interconnection information. Note that most of the connections entering at J2 (transmitter patch panel input) on figure 5-23 are merely jumpered through the RF-110A to J7 for use by the external exciter.

## CAUTION

When the RF-110A auxiliary voltage outputs are used to power external equipment, be sure that total current drain for all external equipments does not exceed the RF-110A capability. For example, the total drain on the auxiliary outputs should not exceed the following:

115 Vac single phase	1.6 Amperes (185 watts)
28 Vdc	0.5 Amperes
12 Vdc	0.9 Amperes

Table 2-2 lists the four basic control functions needed by the RF-110A. These functions are intended to be supplied by the mode selector switch on the exciter with which the RF-110A is used. This type of interconnection will yield the simplest operating procedure for the overall system because operation remains essentially the same as it would for the exciter alone.

If control independent of the exciter is more desirable, it can be obtained with a simple control box which provides:

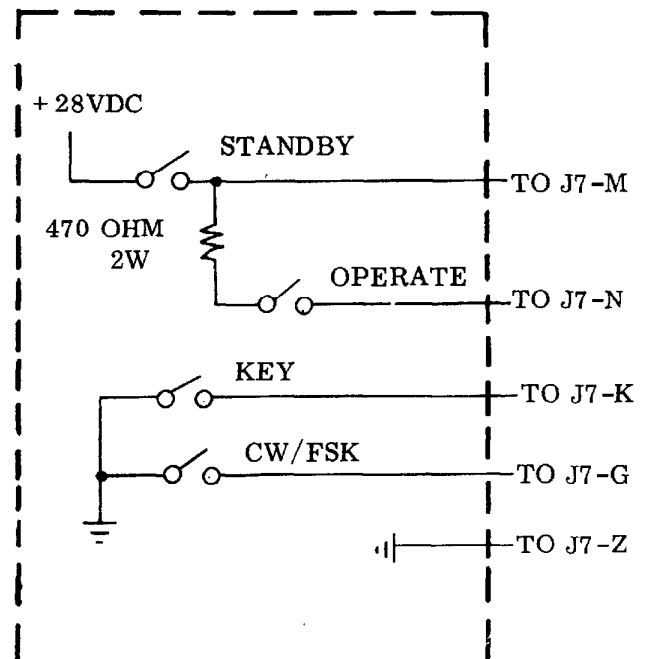


TABLE 2-2. INTERCONNECTION DATA

ACTION	RESULT
Apply +28 Vdc to J7-M	Places the RF-110A in a standby condition. The following items become energized: all tube filaments; blower; bias supplies; 3 minute time delay.
Connect J7-N to J7-M through a 470 ohm 2 watt resistor.	If 3 minute delay mentioned above has expired, the RF-110A high voltage contactor closes. High voltage comes "on". HIGH VOLTAGE indicator illuminates.
Ground J7-K (J8-B must be jumpered to J8-D)	Blocking bias is removed from the driver and final tubes. All plate currents at normal idle. Antenna relay energizes. Amplifier is now keyed and operable. (Can also be accomplished by the front panel LOCAL KEY switch.)
Ground J7-G (optional)	Causes a bias shift on the driver and final tubes which yields a higher operating efficiency with reduced linearity. Intended for modes not requiring high linearity such as CW and RATT.

Placing a "ground" on J7-K (normally accomplished by the exciter's push-to-talk circuit) energizes the antenna transfer relay and removes the blocking bias from the driver and final tubes. The time constant inherent in keying the bias is designed to prevent "hot switching" of the antenna transfer relay. That is, the tube require about 0.2 seconds to reach full conduction after J7-K is grounded. This is more than enough time for the antenna transfer relay to properly energize. Therefore no special sequencing is required between the exciter and the RF-110A. The RF-110A may be keyed with normal RF drive present at the input terminals without damage.

NOTE

1. The RF 110A keyline is not intended to follow CW keying characters. The amplifier keyline must be held closed during CW transmission while the CW keying is accomplished at the exciter.
2. As supplied, the RF-110A has a series diode in its keyline circuitry which prevents the unit from being keyed externally unless FREQ MHZ knob is placed in the AUTOMATIC position. The diode (CR14 in figure 5-20, also see figure 4-7 ) is short circuited when the FREQ MHZ knob is in AUTOMATIC. Should it be necessary for an RF-110A to have local frequency

selection and remote keying, the diode must be shorted out. Solder a short length of hook-up wire across its leads. The diode is found directly behind the front panel on the last wafer of the FREQ MHZ switch.

**2.7 INITIAL ADJUSTMENT**

The RF-110A PPC and/or APC controls should be adjusted to suit exciter requirements at the time of installation. This is necessary to prevent overdriving of the RF-110A and also to keep the average "talk power" high during SSB operation. The PPC is a fast time constant, peak detection type circuit which senses the output RF envelope. Its output goes more positive with increasing power level and is available at J7-e. The sensitivity level for the development of PPC voltage is adjusted by 1A1R11. The APC is a longer time constant, averaging circuit that delivers a positive going output proportional to average RF level. The slope of the DC output vs power curve is adjustable with the APC ADJ control 1A1R12.

Since requirements differ for the various exciters which can be used with the RF-110A, no attempt is made in this manual to describe specific adjustment procedures. The PPC/APC voltages have the following characteristics:



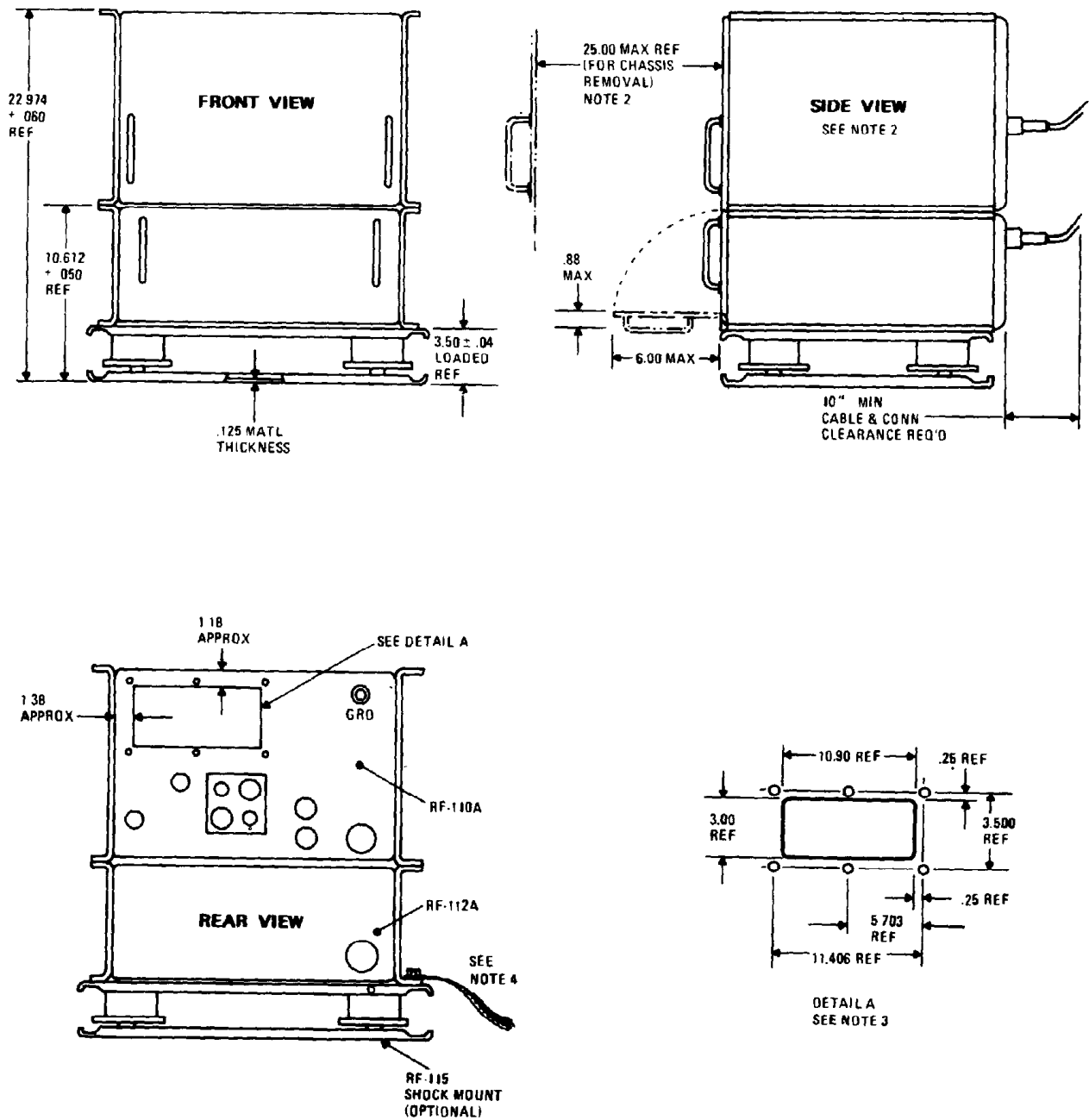
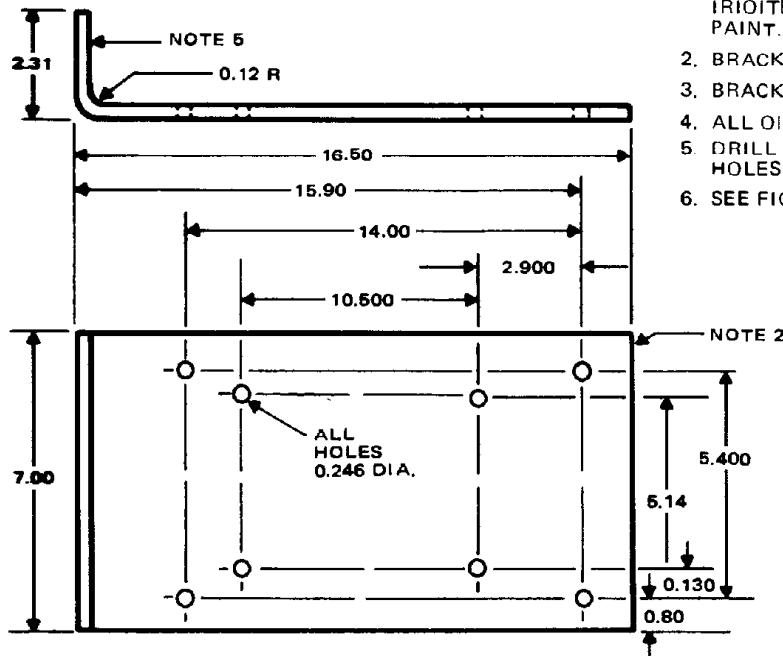
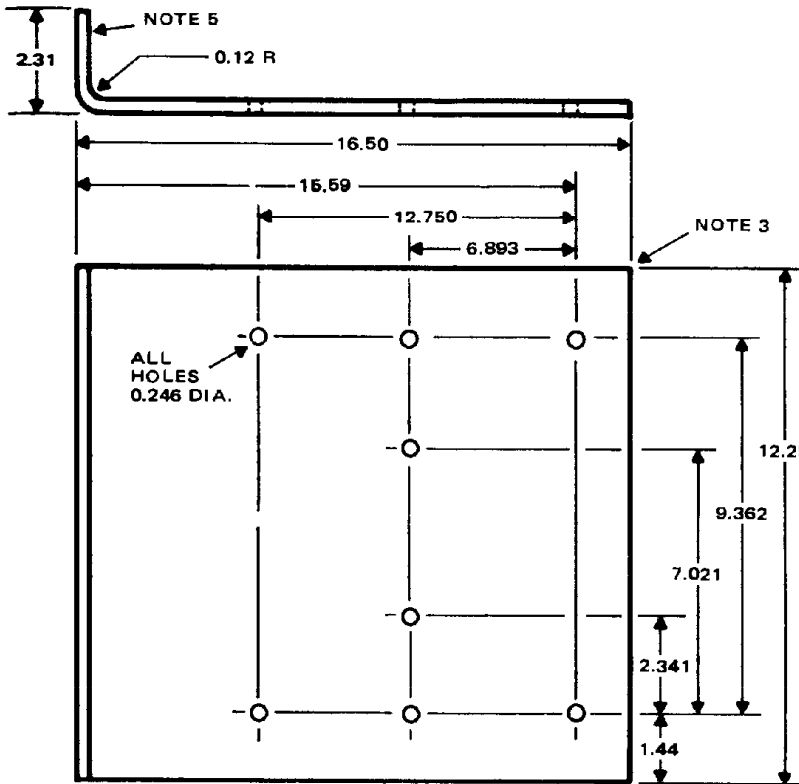


Figure 2-2. Outline and Mounting Dimensions (Sheet 2 of 2)



- NOTES:
1. MATERIAL, 0.125 IN. THICK ALUMINUM ALLOY SHEET, IRIOITE, PRIME WITH ONE COAT ZINC CHROMATE, AND PAINT.
  2. BRACKET FOR RF-112A.
  3. BRACKET FOR RF-110A.
  4. ALL DIMENSIONS ARE IN INCHES. TOLERANCE  $3 \pm .01$  IN.
  5. DRILL AS REQUIRED TO MATE WITH RACK MOUNTING HOLES.
  6. SEE FIGURE 2-1 FOR INCH/CENTIMETER CONVERSIONS.

Figure 2-2. Rack Mounting Bracket Fabrication Details



- PPC output has a minimum value of about +3.5V. When the RF amplitude exceeds a threshold determined by 1A1R11, the PPC voltage increases linearly with RF voltage at a rate also dependent on 1A1R11. Maximum voltage available is about 9V; however at about 8V, internal PPC commences (see below).
- APC output has a minimum value of about +4.4V. When the RF amplitude exceeds a threshold, the APC voltage increases linearly with RF voltage; threshold and slope are determined by 1A1R12. Maximum voltage attainable is about +8V. The averaging properties of the APC detector can be removed by grounding J7-G, which also places the RF-110A in the high efficiency mode (see table 2-2).

Normally, for exciters having a single gain control input, the PPC output is used as the controlling voltage. In general, PPC adjustment is as follows:

- Set PPC control to minimum sensitivity. This is done by rotating the PPC ADJ control (1A1R11) fully CW.

- With the RF output terminated in a 50 ohm dummy load, increase the drive level (steady carrier) from the exciter until a forward power indication of 1 kW is obtained on the front panel meter.

- Slowly rotate the PPC ADJ control CCW to point where further rotation causes a decrease in RF output. Carefully lock the adjustment at this point.

Additional protection from overdriving is provided by the RF-110A internal PPC loop. This loop returns a controlling voltage to the driver amplifier. The threshold power level for the internal PPC loop is inherently set at a PPC voltage of about +8V. Therefore, if the exciter is adjusted to control on a PPC voltage below +8V, the internal control never reaches its threshold value, and so it serves only a precautionary function. If the exciter with which the RF-110A is used does not have an automatic gain control input, then the amplifier's internal loop should be adjusted to begin limiting at 1 kW. The procedure is exactly the same as given above.

TABLE 2-3. CABLE NO. W2, EXCITER/CONTROL INTERCONNECTION

RF-110A J7 (PIN)	FUNCTION	REMARKS	RECOM- MENDED WIRE SIZE
A	Remote band selection (1)	Apply a pattern of grounds or opens to these five wires for band selection. See paragraph 4-10.	22
B	Remote band selection (2)		22
C	Remote band selection (3)		22
D	Remote band selection (4)		22
E	Remote band selection (5)		22
G	CW/RATT GND	Grounding Pin G will transfer final amplifier bias from class AB to class B, for CW or RATT operation. Averaging circuit is removed from APC detector.	22
H	Shield ground for R,S, and U		
J	INTLK +28V	+28V output except when keying is inhibited; used to inhibit exciter keying.	22
K	GND KEYLINE	Grounding Pin K will unblock the driver and final amplifiers.	22
M	+28V STBY and OPERATE	Applying +28V to Pin M will turn on RF-110A filament and bias supplies.	22

TABLE 2-3. CABLE NO. W2, EXCITER/CONTROL INTERCONNECTION

RF-110A J7 (PIN)	FUNCTION	REMARKS	RECOM- MENDED WIRE SIZE
N	+20V OPERATE	Applying +20V at Pin N will turn on all high voltages.	22
P	GND PULSE	Momentary ground used by antenna coupler RF-601A to initiate automatic tune cycle.	22
R	115 VAC	115 VAC, 1 $\emptyset$ output for external exciter.	22 Shielded
S	115 VAC Common	Comes ON with RF-110A PRIMARY POWER switch.	22 Shielded
T	+20V CARR. INSERT	+20V is present at J7-T when RF-110A front panel key switch is placed at "TUNE KEY", or when an associated antenna coupler (e.g., RF-601A) requests tune carrier. Used by an exciter to deliver a steady carrier "tune" signal for tuning an antenna coupler.	22
U	115 VAC REMOTE	115 VAC supplied to transmitter switch board from the exciter for auxiliary use.	22 Shielded
V	-30 VDC	-30V Supply (see comments)	22
Z	Shield Grd.	For f, g, q, p and r	22
a	SPARE		22
b	SPARE		22
c	CW/RATT KEY	CW/RATT keyline from transmitter patch panel to exciter.	22
d	APC	See paragraph 2.7	22 Shielded
e	PPC	See paragraph 2.7	22 Shielded
f } g }	REMOTE 600 ohm LSB	Balanced LSB audio from transmitter patch panel to exciter LSB audio input.	22 Shielded
h	SHLD GND d, e	Shield ground for d and e	
j	TTY (-)	TTY input from transmitter patch panel to exciter.	22
k	PTT +12V KEY	Push-to-talk, +12V from transmitter patch panel to exciter.	22
m	SPARE		

TABLE 2-3. CABLE NO. W2, EXCITER/CONTROL INTERCONNECTION (Cont)

RF-110A J7 (PIN)	FUNCTION	REMARKS	RECOM- MENDED WIRE SIZE
P r s	REMOTE 600 ohms USB/AM	Balanced USB/AM audio from transmitter patch panel to exciter USB/AM audio input.	22 Shielded
	TTY (+)	TTY input from transmitter patch panel to exciter.	22
X	EARPHONE AUDIO	Receiver Audio from transmitter patch panel.	22
n	12V Negative	RF-110A 12V supply	22

TABLE 2-4. POWER SUPPLY CONNECTIONS

RF-110A J1 (PIN)	FUNCTION	REMARKS	RECOM- MENDED WIRE SIZE
A	ØA	Delivers ØA to RF-112A	14
B	ØB	Delivers ØB to RF-112A	14
C	ØC	Delivers ØC to RF-112A	14
D	ØB-T2 INPUT	Used by RF-112A to develop blower power and 115 VAC for auxiliary equipment.	22
E	ØA-T2 INPUT		22
F	115V 60 Hz Com	115 VAC from RF-112A for auxiliary equipment and bandswitch motor.	22
G	115V 60 Hz Hot		22
H J	24V Switched 24V Hot	Jumpering J1-H to J1-J activates RF-112A inverter which provides RF-110A blower power. This is accomplished by the RF-110A STBY relay. Inverter creates 115 volts, 400 Hz at J1-K and J1-L.	22
K	115V 400 Hz Hot	From inverter in RF-112A to blower and time meter in RF-110A.	22
L	115V 400 Hz Com		22
M	+500 VDC	Driver plate and screen voltage from RF-112A	22
N	COM GND	High voltage ground return.	22
P	PWR SUP. INTLK	Goes to ground via RF-112A panel interlock switch and thermal switch.	22
R	+2250 VDC	PA plate voltage from RF-112A	18

TABLE 2-5. PRIMARY POWER CONNECTIONS

RF-110A J5 (PIN)	FUNCTION	REMARKS	RECOM- MENDED WIRE SIZE
A	Phase A		12 (600V)
B	Phase B		12 (600V)
C	Phase C		12 (600V)

TABLE 2-6. ANTENNA COUPLER CONNECTIONS

RF-110A J6 (PIN)	FUNCTION	REMARKS	RECOM- MENDED WIRE SIZE
A	Com. GND	Ground Return	22
B	Keyline	Grounding J6-B will unblock the driver and final amplifiers. (J8-B to D jumper required).	22
E	GND PULSE	Momentary ground used by antenna coupler (RF-601A) to initiate automatic tune cycle.	22
F	Tune Pwr	Grounding J6-F will limit the RF-110A power output to 200 watts (with proper APC connections to external exciter).	22
G H I	SPARES		22
J	Key Interlock	Grounding J6-J will inhibit RF-110A keying.	22
L M	115 VAC Hot 115 VAC Com.	115 VAC, single phase auxiliary power for antenna coupler.	22 22

TABLE 2-7. TRANSMITTER PATCH PANEL CONNECTIONS

RF-110A J2 (PIN)	FUNCTION	REMARKS	RECOM- MENDED WIRE SIZE
A	COM. GND	Ground Return.	22
B	12V POSITIVE	12V source to patch panel	22
C	SHLD GND	Shield Ground for T, U, V, W	
D	115 VAC COM.	115 VAC COM to patch panel	22
E F	TTY (+) TTY (-)	Teletype loop input from patch panel	22

TABLE 2-7. TRANSMITTER PATCH PANEL CONNECTIONS (Cont)

RF-110A J2 (PIN)	FUNCTION	REMARKS	RECOM- MENDED WIRE SIZE
G	PTT +12V KEY	Push-to-talk +12V from patch panel	22
H	115 VAC REMOTE	115 VAC hot to patch panel	22
S	CW/RATT KEY	Remote CW/RATT Keyline from patch panel.	22
T	REMOTE 600 ohm	Balanced Audio input (LSB) from patch panel.	22
U	LSB AUDIO INPUT		Shielded (2)
V	REMOTE 600 ohm USB/	Balanced Audio input (USB/AM) from patch panel.	22
W	AM AUDIO INPUT		Shielded (2)
Z	12V NEGATIVE	12V Source to patch panel	22
a	SPARES		22
b			
d			
J	EARPHONE AUDIO	Receive Audio from patch panel.	

TABLE 2-8. ACCESSORY CONNECTIONS

RF-110A J8 (PIN)	FUNCTION	REMARKS	RECOM- MENDED WIRE SIZE
A	COM. GRD	Ground Return	22
B	KEYLINE	J8-B and J8-D must be jumpered in order to key the RF-110A.	22
D	KEYLINE INTLK		
C	+28V	+28 VDC for accessory use.	22
E	CW/RATT GRD	Grounding J8-E will transfer PA bias from class AB to class B, for CW or RATT operation.	22
F	SPARES		
G			
H			
I			
J			

## SECTION III

### OPERATION

#### 3.1 GENERAL DESCRIPTION

The RF-110A/RF-112A is a complete 1 kW linear amplifier designed for simple operation and ease of adjustment. It will amplify an RF signal from a 100 milliwatt level to a 1000 watt level for application to an antenna or antenna coupler. The broadband nature of the interstage and output RF circuits eliminates the need for tuning and loading adjustments. To set up the RF-110A on a desired frequency the operator is required only to set the RF-110A FREQUENCY MHZ switch to the desired band. If a compatible exciter is used, RF-110A tuning can be effected merely by selecting the frequency at the exciter.

#### 3.2 DESCRIPTION OF CONTROLS AND INDICATORS

Table 3-1 lists and describes the front panel controls and indicators found on the RF-110A. There are no operating controls located on the RF-112A front panel.

#### 3.3 OPERATION

Operation of the RF-110A is as follows:

##### NOTE

The following procedure assumes that the RF-110A is driven from a simple low level RF source capable of delivering 0–100 milliwatts of steady carrier into 50 ohms. It assumes the exciter does not have a PPC input. In actual operation, with a particular exciter, the operating procedure will probably be modified according to the particular installation (e.g., the amount of interfacing with external equipments). Sufficient logic and control input/output connections exist on the RF-110A for a large variety of installation possibilities with external exciters or antenna couplers.

Read through this entire procedure and become familiar with tables 3-1 and 3-2 before equipment turn-on.

- a. Place the PRIMARY POWER switch on the RF-110A front panel at ON.
- b. Set the RF-110A FREQUENCY MHZ knob to the desired frequency range. If frequency selection is to be done remotely, set the FREQUENCY MHZ knob to AUTOMATIC.
- c. Place the RF-110A in an operate condition by meeting the requirements of table 2-2.
- d. With no RF input to the RF-110A, rotate the Multimeter switch to PA PLATE 1 AMPERES then to PA PLATE 2 AMPERES. Note the lesser of the two readings. Adjust the lesser to a value of 240 mA with the PA BIAS Adjustment. Now check the greater value. If the greater value exceeds 280 mA, the screen voltage should be adjusted. (See paragraph 5.2).
- e. Rotate the PWR control on the RF-110A front panel to full CW.
- f. If the RF-110A is directly connected to a low VSWR load (see paragraph 2.5), increase the RF drive level from the exciter while observing the forward and reflected power levels on the front panel power meter. A forward reading of 1000 watts with a reflected reading of 40 watts corresponds to an output VSWR of 1.5:1. The RF-110A is now ready for use.

##### 3.3.1 OPERATION WITH MANUAL ANTENNA COUPLER.

If a simple manually operated antenna coupler is used between the RF-110A and the antenna, increase the drive level until a value of 20 or 30 watts of reflected power is indicated on the RF-110A reflected power meter, but do not exceed 1000W

forward power. Tune the coupler for a zero indication on the reflected power meter. When the antenna is tuned, increase the drive level to 1000 watts forward.

### 3.3.2 OPERATION WITH RF-601A ANTENNA COUPLER

Operation of the RF-110A with the RF-601A antenna coupler is achieved as follows:

- Set the exciter drive level to zero watts. Set the exciter to a mode which produces a single tone (e.g., AM with no modulation or SSB with single tone audio drive).
- Do not key the RF-110A yet.
- Press the RETUNE button on the coupler control panel. (This drives the tuning elements in the RF-601A to a "homing" position.)
- Key the RF-110A.
- Slowly increase the exciter drive level, but do not exceed a FORWARD POWER reading of 250 watts as indicated on the RF-110A panel meter. A point will be reached (before 250 watts) where the yellow TUNING lamp of the RF-601A comes on. (This is where the RF-601A senses an antenna mismatch and begins tuning it out.) Vary the exciter drive as required to maintain between 50W and 250W until the RF-601A TUNING lamp extinguishes and the READY lamp comes on.
- Unkey; set exciter to desired mode. Transmitter is ready for operation.

#### NOTE

With proper interfacing between the exciter, RF-110A and RF-601A (using the PPC, TUNE POWER, and +20 CARR

INSERT at J6 and J7), the above procedure can be shortened to simply pressing the RETUNE button on the RF-601A coupler control unit and keying the transmitter. Refer to the RF-601A instruction manual for further information.

Protective circuits in the RF-110A will activate the front panel OVERLOAD indicator if any of the following situations occur:

- a. Excessive plate current in one or both of the final tubes. (Possibly due to overdriving or loss of bias.)
- b. Excessive RF voltages at the plates of the final tubes. (Possibly due to overdriving or high VSWR loads.)
- c. Loss of cooling air.
- d. RF-110A or RF-112A HV interlocks open or excessive temperature in the RF-112A.

The protective circuits are reset by momentarily placing the overload switch (figure 3-1) at the RESET position. If the indication repeats upon releasing the overload switch then the problem is something other than transitory and must be looked into. Check the above mentioned items. Unkey the RF-110A and reduce the RF drive to zero. If the overload persists (after reset) the problem may be in the air sensing or interlock circuits, or maybe loss of bias. If the overload only occurs when the RF-110A is keyed (with no RF input) then the problem is most likely a faulty final amplifier tube or insufficient final amplifier bias. An overload indication occurring with the application of RF drive (within RF-110A ratings) could mean that a problem exists in the output load (an open or shorted RF connector for example), in the final transformer assembly, or the VSWR bridge.

TABLE 3-1. RF-110A OPERATING CONTROLS AND INDICATORS

CODE NO.	CONTROL/INDICATOR	FUNCTION/INDICATION
2	Multimeter	Provides indications of voltage, currents and RF input power as selected with the multimeter switch.
1	Multimeter switch  DRIVER 2 AMPERES DRIVER 1 AMPERES PA PLATE 2 AMPERES PA PLATE 1 AMPERES INPUT PWR 0-150 MW PA PLATE VOLTS  DRIVER PLATE VOLTS  PA-DRIVER SCRNS VOLTS	Selects the final and driver amplifier parameters to be monitored with the multipurpose meter: Cathode current of driver amplifier tube V2. Cathode current of driver amplifier tube V1. Cathode current of final amplifier tube V2. Cathode current of final amplifier tube V1. RF level applied to input of driver amplifier. DC voltage applied to plates of final amplifier tubes V1 and V2. DC voltage applied to plates of driver amplifier tubes V1 and V2. DC voltage at the 287 volt point on the final/driver screen voltage supply.
4	Power meter	Provides an indication of forward or reflected output power in the ranges selected with the Power meter switch.
3	Power meter switch	Selects range of forward or reflected power to be monitored with Power meter.
5	Primary power fuses (three used, with indicators)	Provides overload protection to each phase of the primary power input. If the fuse in any phase opens, the associated indicator will light.
6	BLOWER 1.0A fuse (with indicator)	Protects the blower against overload; indicator lights if fuse opens.
7	EXCITER COUPLER 3.0A fuse (with indicator)	Protects the 115 volt single phase primary power output. Indicator lights when fuse opens.
8	500 VDC 1.5A fuse (with indicator)	Protects the 500 VDC supply from overload. Indicator lights if fuse opens.
18	28 VDC 3A fuse (with indicator)	Protects the 28 VDC supply from overload. Indicator lights if fuse opens.
9	PRIMARY POWER switch	When set at ON, primary power is supplied to the control circuits in the RF-110A and RF-112A.
10	PWR control	Enables RF power output to be varied without disturbing APC and PPC adjustments. Normally set maximum CW.
11	PA BIAS control	Enables bias voltage to final amplifier tubes V1 and V2 to be adjusted.



TABLE 3-1. RF-110A OPERATING CONTROLS AND INDICATORS (Cont)

CODE NO.	CONTROL/INDICATOR	FUNCTION/INDICATION
12	OVERLOAD indicator	Lights to provide a visual indication when an overload occurs.
13	OVERLOAD switch NORMAL RESET (spring-loaded)	Determines condition of overload circuit. Overload circuit is in normal condition. Resets overload circuit.
14	POWER indicator lamp	Lights when RF-110A has primary power supplied and PRIMARY POWER switch is ON.
15	HIGH VOLTAGE indicator lamp	Lights when high voltage is applied to plate circuits.
16	FREQUENCY MHZ selector switch	When set at AUTOMATIC, an external five wire code can be used to automatically tune the RF-110A to the selected band. When set at any one of the other nineteen positions, a five wire code is internally generated to automatically tune the RF-110A to the selected band.
17	Key switch NORMAL TUNE KEY (spring-loaded)  LOCAL KEY	Determines method by which RF-110A is keyed. Keying of RF-110A is accomplished from Exciter. RF-110A is keyed; a command signal is generated for exciter to produce a low power carrier for tuning purposes. RF-110A is keyed.
19	Elapsed Time Meter	Indicates elapsed time in hours that equipment is energized.

TABLE 3-2. NORMAL MULTIMETER INDICATION (WITH AMPLIFIER IN THE LINEAR MODE)

METER SWITCH POSITION	READING	CONDITIONS
DRIVER 2	200–280 mA	Idle (no RF)
DRIVER 1	200–280 mA	Idle
PA PLATE 2	200–280 mA	Idle
PA PLATE 1	200–280 mA	Idle
INPUT POWER	25–100 mW	at normal RF output
PA PLATE VOLTS	2250 ± 225 VDC	Unkeyed
DRIVER PLATE VOLTS	500 +100, –50 VDC	Unkeyed
PA, DRIVER, SCREEN VOLTS	290 ± 50 VDC	Unkeyed

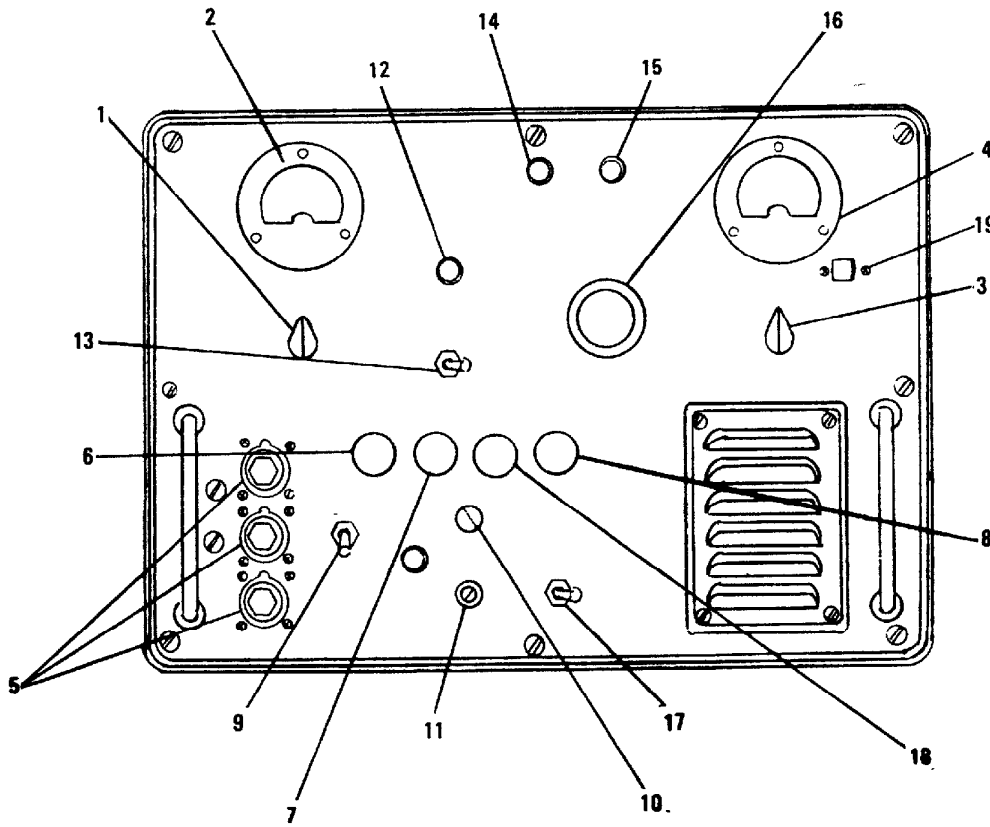


Figure 3-1. RF-110A Front Panel Controls and Indicators.

## SECTION IV

# TROUBLESHOOTING

### 4.1 GENERAL

A low level (nominal 100 mW) RF signal from an external exciter is used to drive the RF-110A. Two stages of amplification, a driver and a final, linearly amplify this input to a level of 1 kW. Each stage consists of two parallel-connected electron tubes and operates into a bandswitched transformer assembly containing nineteen pretuned broadband transformers.

The 1 kW output from the final amplifier stage is applied through the VSWR bridge and the antenna transfer relay to a 50 ohm coaxial output connector. (The output of the RF-110A is usually applied to an antenna through an antenna coupler, such as the RF-601A.) The antenna transfer relay connects the RF transmission line (connected to RF output connector 1A2J3) to the RF-110A final amplifier stage when the transmitter is keyed, or to a coaxial connection for an auxiliary receiver when the RF-110A is not keyed.

The driver and final transformer assembly bandswitches are set to the correct band by a motor and geared transmission assembly. The motor is controlled from a decoding switch deck in the driver transformer assembly. The motor is energized (by a relay) whenever a ground path to the relay is completed through the decoding switch and the five code wires, and an encoding switch. The motor runs, changing the setting of the driver and final band switches, and the coding switch, until a position is found which interrupts the ground. At this point, the two band switches are in the proper position for the selected frequency. The encoding switch is connected to the FREQUENCY MHZ control in the RF-110A, or the associated exciter may have provisions for duplicating the encoding switch. Selecting a new frequency sets up a new ground path through the switches and wires, energizing the band switch motor until the new ground is interrupted. RF output level is monitored by the VSWR bridge assembly. The assembly provides two DC signals, one representative of forward power, and one representative of

reflected power. These two signals are applied to a front panel meter for measurement and monitoring of forward and reflected power at the RF output. The VSWR bridge also supplies to the APC-PPC circuit a signal which is, in essence, the envelope of the RF output from the RF-110A. This signal is used to develop two control signals – one proportional to the peak power output from the RF-110A, and one proportional to the average power output. Both control voltages are available for the external exciter, to adjust the exciter output level as required to maintain the power output from the transmitting system at a constant 1 kW PEP. This “closed loop” method of using the sampled output to control the input ensures that the RF power output of the system is maintained at the rated level, and in the process prevents it from exceeding safe limits.

In addition, the PPC voltage is applied to the RF-110A bias circuit, where by controlling the bias to the driver amplifier, it reduces the gain of the RF-110A. This protects the RF-110A if the APC-PPC circuits in the exciter malfunction. It also provides a means of RF output control in systems which use exciters that do not have output control capabilities. Normally an exciter is adjusted to respond to PPC voltages below that at which the internal PPC control loop becomes active.

If the RF output of the RF-110A increases beyond the threshold of the internal PPC control loop, the bias of the driver amplifier stage is increased to reduce RF output.

The APC-PPC circuit can also be commanded to reduce the power output to a level safe for tuning an antenna coupler. This can be accomplished either manually, with the front panel TUNE KEY switch, or remotely. At the same time, a carrier insert signal is made available to an external exciter requesting the unmodulated carrier output required for tuning the antenna coupler. If desired, a resistor in the PPC circuit can be changed in value to enable the tune power level to be set to values other than the 200W set at the factory.

(R25 at the base of Q8, see figure 5-22.) Increased amplifier efficiency in the CW and RATT modes can be realized by applying a "ground" input at J7-G. This will change the final amplifier biasing from class AB to class B. At the same time the averaging circuit in the APC detector is bypassed.

An overload detector is used to continually monitor the cathode currents of the two final amplifier tubes, the final amplifier plate RF voltage, and blower operation. If a dangerous condition occurs in any of these areas, the overload circuit trips and provides an inhibit signal to the keying circuit, unkeying RF-110A until the overload has been cleared. When the overload circuit trips, an indicator lamp is energized to provide an overload indication that an overload condition has occurred. The overload circuit can be reset through the front panel RESET switch. However, if the overload was not of a momentary nature, the overload circuit will again immediately trip to prevent keying. In addition, the keying circuit remains inhibited whenever the overload switch is held in the reset position, thus preventing an operator from forcing operation in an overload condition.

The RF-110A is keyed on and off through the bias levels applied to the four electron tubes in the final and driver amplifiers. Keying is accomplished by grounding the keyline at any of the external units or by setting the RF-110A front panel Key switch at TUNE KEY or LOCAL KEY. In any case the keying circuit switches the bias voltage for the driver and final amplifier electron tubes from cut-off to operate levels. The keying circuit is inhibited (bias is maintained beyond cutoff) whenever the tuning motor is energized, an overload occurs, the overload switch is held at RESET, or the ground key interlock signal is supplied by the external antenna coupler (a "ground" at J6-J). The exciter is unkeyed by removal of the 28 VDC interlock voltage that the RF-110A normally supplies to a keying relay in the external exciter via J7-J.

A metering circuit allows any one of eight parameters of the amplifier tubes to be connected to a meter for measurement or monitoring. These parameters consist of the cathode current of each of the four electron tubes, the input RF power to the driver amplifier, the plate supply voltages, and a voltage in the screen supply.

Turn-on is initiated by setting the PRIMARY POWER switch at ON. This action supplies phases A and B of the primary power to the RF-112A. The power supply converts this voltage to 115 VAC single phase power which is supplied as auxiliary power to J6 and J7 for powering an antenna coupler and exciter respectively. In addition, phases A and B of the primary power are applied to an open contact of the standby relay K2. A 28 VDC standby-operate signal is used to energize the standby relay in the RF-110A.

One set of the relay contacts switches 24 volts to the 400 Hz inverter in the RF-112A which in turn produces 115 VAC, 400 Hz output to the RF-110A blower and time meter. The other set of relay contacts completes the circuit for phases A and B to the filament transformer. This transformer provides the following outputs: 6.0 VAC filament voltages for the final amplifier tubes, 13.5 VAC filament voltage for the driver amplifier tubes and the AC inputs to the bias,  $\pm 12$  VDC remote, and 11, 20, and 28 VDC supplies. The bias supply develops operating and cutoff biases for the final and driver amplifier tubes. In addition, a  $-30$  VDC signal is derived from the bias circuit for use by the external exciter. The  $\pm 12$  VDC output for remote use. All low DC voltages required to power the RF-110A control circuits are produced by the 11, 20, and 28 VDC supplies. The 28 VDC is also supplied to the time delay relay heater in the operate circuit and, if the primary power source is 400 Hz, to the 60 Hz inverter in the RF-112A power supply.

When a 20 VDC operate signal is received from the exciter, the operate relay is energized, and the three phase primary power is applied to the RF-112A Power Supply.

The RF-112A converts the three phase primary power to 2250 and 500 VDC. The DC voltages are used for plate power for the final and driver amplifier tubes respectively. In addition, the 500 VDC drives a regulated screen supply to the RF-110A for both the final and driver amplifier tube screen grids. The 500 VDC supplies lights the HIGH VOLTAGE indicators on both the RF-110A and RF-112A. The system is now energized for operation.

## 4.2 DRIVER AMPLIFIER

The driver amplifier circuit linearly amplifies the input from the exciter to a level sufficient to drive the final amplifier (paragraph 4.3). All of the components for the stage are located on two subassemblies – Driver Tube Assembly 1A1A1, which contains the two driver tubes and associated components, and Driver Transformer Assembly 1A1A4, which contains 19 interstage transformers for the nineteen bands, and the (frequency) decoding and bandswitches.

The RF input at case connector 1A2J9 is applied through connectors 1A2P1 and 1A1J1 and terminal 12 of terminal board 1A1A1TB1 to a nominal 50-ohm input load consisting of inductor 1A1A1L2 and resistor 1A1A1R6 in the driver amplifier assembly. Inductor 1A1A1L2 helps compensate for the input capacitance of the two electron tubes. The RF input is also applied to the metering circuit (paragraph 4-11). From the input load, the RF is coupled by capacitor 1A1A1C1 to the grids of the two electron tubes. The two parallel connected electron tubes are operated as a class A linear amplifier stage that provides a nominal 14 db of power gain.

One of nineteen broadband interstage transformer assemblies is used to couple the RF output from the driver amplifier to the input of the final amplifier. The nineteen transformer assemblies are mounted around a motor-driven bandswitch which is switched according to the selected operating frequency to automatically connect the correct transformer assembly into the signal path (paragraph 4.10). Each transformer assembly above 8 MHz consists of a double tuned circuit which uses capacitive top coupling. This type of circuit provides a wide flat passband with sharp skirts, i.e., broadband tuning. Below 8 MHz conventional single tuned circuits are used. The voltage drops developed across cathode resistors 1A1A1R1 and 1A1A1R2 are applied to the metering circuit for monitoring and measurement (paragraph 4.11). Each of the power supply input lines (bias, plate, and screen) is filtered to provide RF decoupling. Capacitors 1A1A1C2 through 1A1A1C12 and 1A1A1C19 are local RF bypasses. Resistor 1A1R24 is used for parasitic suppression.

## 4.3 FINAL AMPLIFIER

The final amplifier (figure 5-20) consists of two electron tubes, an output transformer assembly, and various other parts. The function of this circuit

is to linearly amplify the output from the driver amplifier to a level of 1 kW for application to an antenna system. The two final amplifier tubes, 1A1V1 and 1A1V2 are mounted directly on the main chassis. The nineteen final transformer assemblies with their associated components, and the bandswitch which selects the proper one for the desired frequency are all mounted on subassembly 1A1A2.

The RF output from the driver amplifier is applied through parasitic suppressors 1A1R16 and 1A1R17 to the grid of electron tube 1A1V1 and through parasitic suppressors 1A1R18 and 1A1R19 to the grid of electron tube 1A1V2. The two parallel-connected electron tubes are operated class AB<sub>1</sub> during voice operation (class B during CW or RATT operation) to provide a nominal 26 db of power gain. The class of operation is determined by the bias voltage applied by the bias power supply (paragraph 4.8). One of the nineteen broadband output transformers is used to couple the RF output from the final amplifier to a 50 ohm transmission line.

The nineteen transformer assemblies are mounted around a motor-driven bandswitch which is switched according to the operating frequency to automatically connect the correct transformer assembly into the signal path (paragraph 4.10). Each transformer assembly consists of a double tuned circuit which uses capacitive bottom coupling. In addition, the secondary winding is tapped such that the top of the secondary winding and the secondary tuning capacitor form a series resonant circuit to trap second harmonics.

The voltage drops developed across cathode resistor 1A1R25 – R26 and 1A1R27 – R28 are applied to the metering circuit for monitoring and measurement (paragraph 4.11) and to the overload circuit for monitoring (paragraph 4.9). Each of the power supply input lines (bias, plate, and screen) is filtered to provide RF decoupling. The RF voltage at the input to the final transformer assembly is also applied to the overload circuit for monitoring (paragraph 4.9). The cathode resistors are bypassed by capacitors (indicated by notes 8 and 9 on the schematic). The parallel connected resistors 1A1R5 and 1A1R6 provide grid loading to swamp the non-linear input impedance of the electron tubes, thus preventing distortion. Resistor 1A1R21 serves as a parasitic suppressor. Inductor 1A1L6 provides a low frequency bypass around 1A1R21. Capacitors 1A1C10 and 1A1C20 are RF bypasses for the tube filament. Plugs 1A1P6 and 1A1P7

allow the screen voltages to be adjusted independently to balance the idling currents of the two tubes.

#### 4.4 VSWR BRIDGE

The VSWR Bridge (figure 5-20) consists of a toroidal transformer and various voltage divider, detector, and filter networks. The function of this circuit is to provide outputs for power meter 1A1-M2 proportional to the forward and reflected power on the output transmission line. In addition, a single output related to both reflected and forward power is applied to the APC-PPC circuits (paragraph 4.6).

The center conductor of the output transmission line passes through the center of toroidal transformer 1A1A3T1 and constitutes its single turn primary; the walls of the assembly serve as the shield for the transmission line. The short shield around the center conductor, grounded at only one end, does not serve as a part of the transmission line, but merely prevents undesired capacitive coupling between the center conductor and the secondary winding on the toroid. Current through the transmission line induces equal voltages in the two parts of the center tapped secondary winding, one voltage being in phase with the line current and the other 180 degrees out of phase with the line current. Voltage divider 1A1A3C6 – 1A1A3C1 provides a reference voltage at the center tap of toroidal transformer T1 that is in phase with the line voltage. When the load on the transmission line is 50 ohms resistive so that there is no reflected power, the line voltage and current are in phase. Trimmer 1A1A3C6 is adjusted so that the reference voltage is equal in magnitude to the induced voltage when the load on the transmission line is 50 ohms resistive. Therefore, the vector sum of the voltages between terminal 3 of the transformer 1A1A3T1 (reflected power side of the bridge) and ground is zero, since the induced voltage is equal in magnitude and 180 degrees out of phase with the reference voltage. As the load changes to something other than 50 ohms resistive, causing reflected power on the line, the two voltages no longer exactly cancel and output is produced at terminal 3 of transformer 1A1A3T1. This level is peak detected by diode 1A1A3CR1 and capacitor 1A1A3C2, and applied through calibrating resistor 1A1A3R7 to contact 2 of power meter switch 1A1S8 and through calibrating resistor 1A1A3R8 to contact 4 of power meter switch 1A1S8. Either range of reflected power can then be selected by

the power meter switch for application to power meter 1A1M2 for measurement or monitoring. Similarly, the voltage at terminal 1 of transformer 1A1A3T1, the reference voltage and the induced voltage across resistor 1A1A3R2 add vectorially to produce a signal related to forward power. This voltage is peak detected by diode 1A1A3CR4 and capacitor 1A1A3C5, and applied to voltage divider 1A1A3R4 – 1A1R14. Potentiometer 1A1R14 allows the power meter to be calibrated for a known amount of peak forward power (normally 1 kW). The output from the voltage divider is applied through calibrating resistor R3 to contact 3 of Power meter switch 1A1S8. Inductor 1A1A3L1 provides a DC path to ground from the center tap of toroidal transformer 1A1A3T1. Resistor 1A1A3R9 is a DC pull-down resistor to prevent the coupling capacitor in final transformer assembly 1A1A2 from holding a charge after the +2250V is turned off.

The signal at terminal 1 (forward power side) of transformer 1A1A3T1 is detected by diode 1A1A3T1 is detected by diode 1A1A3CR3 and applied through isolating resistor 1A1A3R6 to the APC-PPC circuit. This output is, in essence, the envelope of the RF output from the RF-110A and is used to derive the automatic peak and average power control voltages (paragraph 4.6). Any output from the reflected power side of transformer 1A1A3T1 is detected by diode 1A1A3CR2 and applied through resistor 1A1A3R5 and diode 1A1A3CR5 to the APC-PPC circuit. The value of resistor 1A1A3R5 is chosen so that little or no control voltage will be generated by the APC-PPC circuit due to reflected power until the reflected power levels reaches approximately 360 watts (4:1 VSWR at 1 kW forward power). As the VSWR, and therefore the reflected power, increases above this point, the additional input to the APC-PPC circuit results in an increased output from the APC-PPC circuit to reduce the output from the RF-110A. Therefore, the equipment is protected against over-dissipation that would result from excessive VSWR on the transmission line. When the tune line is grounded, diode 1A1A3CR6 grounds out the bottom of resistor 1A1A3R5, preventing reflected power limitation during tuning. Diode 1A1A3CR5 prevents resistor 1A1A3R6 from being grounded by the tune line. At high frequencies, the leads of 1A1A3C1 will be inductive. 1A1A3L2 is used to provide a corresponding amount of inductive reactance in series with capacitor 1A1A3C6 so that the output of the capacitive voltage divider will not be frequency sensitive.

## 4.5 ANTENNA TRANSFER RELAY

The Antenna transfer relay (figure 5-25) connects the antenna to the receiver input or the transmitter output depending on the condition of the system.

One side of the relay coil is connected permanently to 28 VDC, while the other side is connected to the system keyline. The system can be keyed (keyline grounded) from 1A2J7-K (exciter), 1A2J6-B (antenna coupler) or with the front panel key switch. When the system is keyed, RF output from the VSWR bridge is applied through connectors 1A1A3J2, 1A2P4, and 1A2P5, the contacts of relay 1A2K1, and connectors 1A2P6 and 1A2J3 to the antenna. Whenever the keyline is not grounded, the antenna is connected to receiver input connector 1A2J4 through connectors 1A2J3 and 1A2P6, the contacts on relay 1A2K1, and connector 1A2P7.

## 4.6 APC-PPC CIRCUIT

(Prefix all incomplete reference designations with 1A1A6.) The APC-PPC circuit (figure 4-2) generates control voltages that are applied to the Exciter (or used internally) to maintain the peak and average power levels of the rf output from the system at a constant predetermined value (normally 1 kW). The output of the VSWR bridge forward power detector, 1A1A3CR3, is developed across a voltage divider consisting of 1A1A3R6, R23, PWR adjust potentiometer 1A1R13 and transistor Q7. During normal operation, transistor Q7 is saturated, grounding the bottom of PWR potentiometer 1A1R13. The output from the voltage divider is taken from the top of R23, where it will be applied to the APC and PPC input transistors Q12 and Q8. The APC and PPC circuits function essentially as amplifiers. Therefore, adjusting PWR potentiometer 1A1R13 varies the amount of voltage required at forward power detector 1A1A3CR3 to cause a particular output from the APC and PPC circuits. Normally, PWR potentiometer 1A1R13 is set at minimum resistance (fully clockwise), and the APC and PPC circuits are then set to control the Transmitter output power at 1 kW PEP. If PWR potentiometer 1A1R13 is turned counterclockwise (more resistance), more voltage will be applied to the APC and PPC circuits, and the Transmitter output power will be controlled at a lower value.

The PPC circuit consists of transistors Q8 through Q11 and Q22. Threshold detector Q8 turns on when its base voltage exceeds the voltage developed by R27 and 1A1R11 at the base of Q11. When enough base voltage is present to turn Q8 on, Q8 through Q10 form a feedback amplifier (feedback path is voltage divider R56, PPC adjust control 1A1R11, and Q11). The output from Q10 is applied through CR22 and emitter follower Q22 to the Exciter PPC circuit. Diode CR11 provides temperature compensation for amplifier Q9. Emitter follower Q22 provides a low impedance source to drive the line to the Exciter. Resistors R58 and R59 bias Q22 so that the PPC voltage to the Exciter can never fall much below about 3.8 volts; this minimizes delays when reduced power is required.

The APC circuit commences with feedback amplifier Q12 and Q13 and voltage divider R62 and APC adjust control 1A1R12. Emitter follower Q23 buffers switchable voltage divider R63 and R64. Another emitter follower Q14, acts as buffer for modulation wiper R38, R39, CR13, and C3. Emitter follower Q15 drives the APC line to the Exciter.

The modulation wiper fulfills two requirements. In the AM mode, it keeps the carrier level approximately constant with or without modulation (250W assuming PWR control 1A1R13 is fully clockwise). It also prevents excessive Transmitter dissipation by limiting average power to about 500W in voice modes. (This does not interfere with the ability to obtain 1 kW PEP.) Bear in mind that the signal presented to the APC circuit from the VSWR bridge represents the envelope of the Transmitter output; that is, it has both DC and audio components when the Transmitter is being modulated. If the modulation wiper were a simple R-C averaging circuit, its DC output (AM mode with a 250W carrier and modulation to 1 kW PEP with a single tone audio) would be somewhat higher than it would be with just a 250W carrier. However, the APC voltage to the Exciter controls carrier power. Consequently, this changing APC voltage would make the carrier power vary. Therefore, the discharge path (C3, CR13, and R38) has a slightly faster time constant than the charging path (R39 and C3). Typically, the system produces APC voltages of about +5V. This means about +6V at C3. Therefore, when transmitting a

250W AM carrier only, a voltage of about +6V is found at the emitter of Q14. If modulation is added to produce 1 kW PEP the voltage at Q14's emitter will have peaks of about +12V but the voltage on C3 will remain at +6V.

Now consider CW and RATT modes, where 1 kW average is required and where the relatively slow response of the modulation wiper is not desirable. The CW/RATT ground from the Exciter at P1-U is used to turn on Q16, which bypasses the modulation wiper.

Also, one end of R64 is grounded, inserting a 2:1 divider between Q23 and Q14. Thus, the voltage at Q14's emitter will now be only +6V at 1 kW, as compared to +12V in other modes, thus maintaining proper APC voltage.

Resistors R40 and R66 keep the APC voltage from falling below about  $\pm 4.4V$ .

Whenever normal power control is inoperative (either because of failure in the Exciter or because of the use of an exciter without power control capabilities), the PPC voltage will continue to rise in an effort to reduce the Exciter output power. When the PPC voltage rises sufficiently, diodes CR31 and CR5 start to turn off the internal PPC circuit (transistor Q3 in the bias supply) causing the bias on the driver amplifier tubes to go more negative and thus reduce the rf power to the desired level. Therefore, the PA is always protected against excessive signal level in the amplifier tubes and the transformer assemblies.

When a low-power rf signal is required for tuning an antenna coupler, the Tune Ground line at P1-S is grounded either automatically by the RF-601A, if used, or by the front panel Tune Key switch on the PA. In either case, the ground turns on switch Q17, resulting in the +40V generated by diode CR2 and capacitor C1 being applied to voltage divider R1, CR38, CR26, and CR25, producing four effects.

a. The base voltage on Q7 is raised sufficiently to cut it off, Q24 is turned on, removing the PWR control 1A1R13 from the circuit and inserting R25 instead. As a result, the generation of APC and PPC voltages starts at a level of rf power output not affected by the PWR control. As shipped, the value of resistor R25 is chosen such that a nominal 200W rf output from the system is available for tuning. If desired, the value of resistor

R25 can be changed to provide a tune power level other than 200W. Thus, the tune power requirements of any antenna coupler can be satisfied by changing the value of a single resistor.

b. In order to provide a single continuous tone on which to tune the antenna coupler, +20V is applied through diode gate CR19 to the Exciter, causing the carrier to be inserted into the rf output.

c. A +10V level developed across zener diode CR25 is applied through R16 to the PPC output. This prevents any modulation from being generated during a tune cycle.

d. Transistor Q24 not only grounds one end of R25, but also turns on Q16 switch through CR35 and R68, bypassing the modulation wiper to ensure the rapid response required during automatic antenna tuning.

If PPC exceeds about +8V, it raises the APC line voltage by way of CR31 and R57. This prevents a possible latchup condition; i.e., the Exciter producing full output and the PA controlling internally, which would be possible under certain misadjustments of the APC and PPC potentiometers.

#### 4.7 KEYING CIRCUIT

(Prefix incomplete reference designators with 1A1A5.) The keying circuit (figure 4-3) consists of a key interlock, a key driver, a keying stage, a 28 VDC switch, and various gates and switches. The function of this circuit is to cause the bias power supply to lower the bias voltage for the four electron tubes in the RF-110A from a cut-off to an operate level when the keyline is grounded and to control a 28 VDC power source for external transmit/receive relays (located in the exciter and/or antenna coupler). The keying will be inhibited (keying prevented) if an overload exists or the OVERLOAD switch is held at RESET, or tuning motor is energized, or a ground is placed on 1A2-A1J6-J from an external source. When the system is grounded (to key the system), a ground is applied to the cathode of diode CR11. This grounds one end of R16 in voltage divider R12-R28-R16, dropping the voltage at the base of key driver Q5 below the voltage produced by voltage divider R13/R14 in the emitter circuit, causing Q5 to conduct. Turning on Q5 will also turn on Keyer Q6, shorting out resistor 1A1A6R8 on the bias circuit thereby reducing the bias on the driver and final tubes to permit them to conduct (paragraph 4.8).





When an inhibit, in the form of a ground, is placed on one of the inputs to the base of Key Interlock switch Q4, Q4 will shut off clamping the base of Key Driver Q5 to about +11V, turning off Q5. Diode CR12 provides an auxiliary cutoff to the bias circuit. Diode CR34 prevents the base of Q5 from being pulled too positive by the 20 VDC through R17.

28 VDC switch Q8 will normally conduct (i.e., when Q4 is saturated), providing 28 VDC through CR35 and the emitter and collector of Q8, as operate voltages for T/R relays in the external exciter. When an inhibit cuts off Key interlock switch Q4, the base of Q8 rises to +28V, turning off Q8 to interrupt the 28 VDC to the external T/R relays.

When the Transmitter is in Standby mode, the exciter does not supply +20V operate. Since all base bias current for turning on Key Interlock transistor Q4 comes through R10 from the +20V operate line, it follows that in standby mode all keying in both the exciter and the PA is inhibited.

When FREQUENCY MHZ switch 1A1S7 is not set at AUTOMATIC, diode 1A1CR14 prevents the RF-110A from being keyed from the system key-line; in this condition the RF-110A can be keyed only with Key switch 1A1S3.

#### 4.8 BIAS POWER SUPPLY

(Prefix incomplete reference designators with 1A1A6.) The bias power supply (figure 4-4) consists of a full-wave bridge rectifier and filter, a voltage regulator and divider, and various switching circuits. The function of this circuit is to provide the required grid bias voltages for operation of the electron tubes. Until the system is keyed, the outputs from the bias power supply are at the correct level to bias the electron tubes beyond cutoff. When the system is keyed, the bias voltages change to the values required to establish proper plate currents in the electron tubes according to the mode of operation. That is, the final amplifier bias is changed to the value required for class AB<sub>1</sub> operation of the tubes during voice operation or to the value required for class B operation during CW or RATT operation. The value of driver bias is such that the tubes operate class A. However, the driver bias can be controlled by the PPC circuit according to the RF-110A power output requirements (internal PPC).

The output from winding 20-21 of transformer 1A1T1 is full-wave rectified by diodes CR14 through CR17, filtered by capacitor 1A1C29, and applied to a voltage regulator and divider circuit consisting of current limiting resistor R42, zener diodes CR4 and CR3, and resistor R8. When the system is keyed, transistor 1A1A5Q6 of the keying circuit (paragraph 4.7) shorts out resistor R8, grounding the bottom side of the voltage regulator. In any mode of operation except CW and RATT, switch Q20 is saturated (due to resistor R48), connecting the bottom of PA BIAS potentiometer 1A1R10 to -36 volts. Therefore, PA BIAS control 1A1R10 can be adjusted between -36 and -72V which covers the normal class AB<sub>1</sub> range of operating bias for the final amplifier tubes. The output from PA BIAS control 1A1R10 is applied through transistor Q21 to the final amplifier tubes by emitter follower action. During CW or RATT operation, a CW/RATT ground at P1-U turns on Q19, which turns switch Q20 off. With Q20 cut off the adjustment range of the PA BIAS control is insignificant, causing the full output from the regulator-driver circuit (-72 volts) to be applied by the emitter follower action of transistor Q21 to the final amplifier tubes. Emitter follower Q21 is used to allow grid current to be drawn by the amplifier tubes without losing regulation. If emitter follower Q21 were not used, this current would create a voltage drop across PA BIAS control 1A1R10, thus destroying the regulation and biasing the tubes further toward cutoff. However, with emitter follower Q21 in the circuit, the grid current is now drawn through the small collector-emitter resistance of the transistor resulting in essentially no shift of the bias voltage. During normal operation, PPC amplifier Q3 is conducting sufficiently to saturate clamp Q2. Therefore, the one end of driver bias adj 1A1R9 is clamped to ground through transistors Q2 and 1A5Q6. In this condition, the potentiometer can be adjusted over the range of 0 to -24 VDC, which covers the normal range of class A operating bias for the driver amplifier electron tubes.

When the system is not keyed, 1A1A5Q6 cuts off, removing the short from across resistor R8. The voltage drop that appears across the resistor in this condition drives the bias voltages for the four electron tubes into the cutoff region. Thus, the RF-110A is keyed on and off through the bias voltages applied to the four electron tubes. Resistor R46 is a pull-down resistor which prevents the



cutoff bias applied to the driver tubes from exceeding the grid-to-cathode voltage rating. Normally, the APC-PPC output to the exciter maintains the output power at 1 kW (paragraph 4.6). However, if there is a failure in the exciter APC-PPC circuits, the PPC voltage will rise beyond its normal level in an attempt to reduce the output power. This increasing level is applied through isolation diode CR5 to gradually cut off PPC amplifier Q3. As the voltage at the collector of PPC amplifier Q3 falls (becomes more negative), so also does the base voltage of clamp Q2. By emitter follower action, then the voltage at the bottom of Driver Bias Adj. potentiometer 1A1R9 also falls, reducing the gain of the driver tubes until proper power output is obtained. Diode CR18 keeps any reverse bias-to-emitter voltage at clamp Q2 from exceeding safe limits. Whenever the keying circuit interlocks (paragraph 4.7), a key interlock signal is applied to the base of PPC amplifier Q3. This cuts off transistor Q3, and clamp Q2. Therefore, the driver electron tubes will be biased at cutoff preventing operation until the interlock is removed. Resistor R6 and diode CR1 provide -30 VDC for use by an external exciter.

#### 4.9 OVERLOAD CIRCUIT

(Prefix incomplete reference designators with 1A1A5.) The overload circuit (figure 4-5) consists of an overload detector, an inverter, a 20 VDC switch, and various gates, switches and indicators. The function of this circuit is to prevent keying of the RF-110A when certain overload conditions occur. To do this, the overload circuit monitors the cathode current of the two final amplifier tubes, the RF output voltage from the final amplifier tubes, the flow of cooling air, and the temperature of the RF-112A, plus mechanical interlock switches in the RF-110A and RF-112A.

Four inputs to the circuit are used to monitor for an overload condition as follows:

a. The RF output voltage from the plates of the final amplifier tubes is sampled by capacitive voltage divider 1A1C35-1A1C36, detected by diode 1A1CR13 and developed across base resistor R8. Resistor 1A1R20 completes the DC path for diode 1A1CR13. Capacitor 1A1C37 is an RF bypass capacitor.

b. The voltage developed across the cathode resistor for final amplifier tube 1A1V1 is applied to base resistor R8 through RF decoupling network 1A1R7-1A1C27-C5 and diode CR15.

c. The voltage developed across the cathode resistor for final amplifier tube 1A1V2 is applied to base resistor R8 through RF decoupling network 1A1R8-1A1C28-C4 and diode CR16.

d. When the temperature of the RF-112A is within safe limits and cooling air is being circulated through the RF-110A, and the cover over the final tube compartment is in position (holding interlock switch 1A1S9 closed), a ground is applied through the thermal switch in the RF-112A, interlock switch 1A1S9, air vane switch 1A1S1, and the mechanical interlocks in the RF-110A and the RF-112A to the emitter of operate switch Q7. When thermal time delay relay 1A1K4 is closed, 20 VDC will be applied to the base of Q7 through the time delay relay turning on Q7. The ground through the interlock switches will be applied to operate relay 1A1K1. Also, conducting Q7 will prevent most of the 20 VDC operate from the thermal relay from being presented to R21.

If any of the interlock switches mentioned above is actuated, (or in cases like the air vane switch allowed to deactivate) the ground to the base of Q7 will be interrupted, and Q7 will be turned off. The 20 VDC operate signal will then be applied through CR33, R19, R21 and CR14 to develop enough voltage across R8 to turn on overload detector Q3.

Overload detector Q3 also receives inputs from the Final Amplifier tube cathodes, and the high voltage detector, as well as the operate switch.

When the voltage on any one of the input lines exceeds the threshold voltage developed by resistors R30 and R8, overload detector Q3 is forward biased. This turns on 20 VDC switch Q2. Resistor R3 maintains 20 VDC switch Q2 cut-off when overload detector Q3 is not energized. When 20 VDC switch Q2 energizes, overload detector Q3 is locked on through diode CR6. Switch Q2 also turns on Q9 which prevents the PA from being keyed. Also, 20 VDC is applied through diode CR32 to OVERLOAD indicator lamp 1A1DS5. This energizes the indicator, providing an indication that an overload exists. Resistor R9 and capacitor C6 provide a millisecond delay in the latching of the circuit allowing extremely short overloads to pass without unkeying the system. Once energized, the overload circuit will remain on until primary power is removed or Overload switch 1A1S6 is momentarily set at RESET. When Overload switch 1A1S6 is set at RESET, clamp CR6 is disabled. If the overload was of a momentary nature, the overload circuit will be reset, releasing the key interlock and

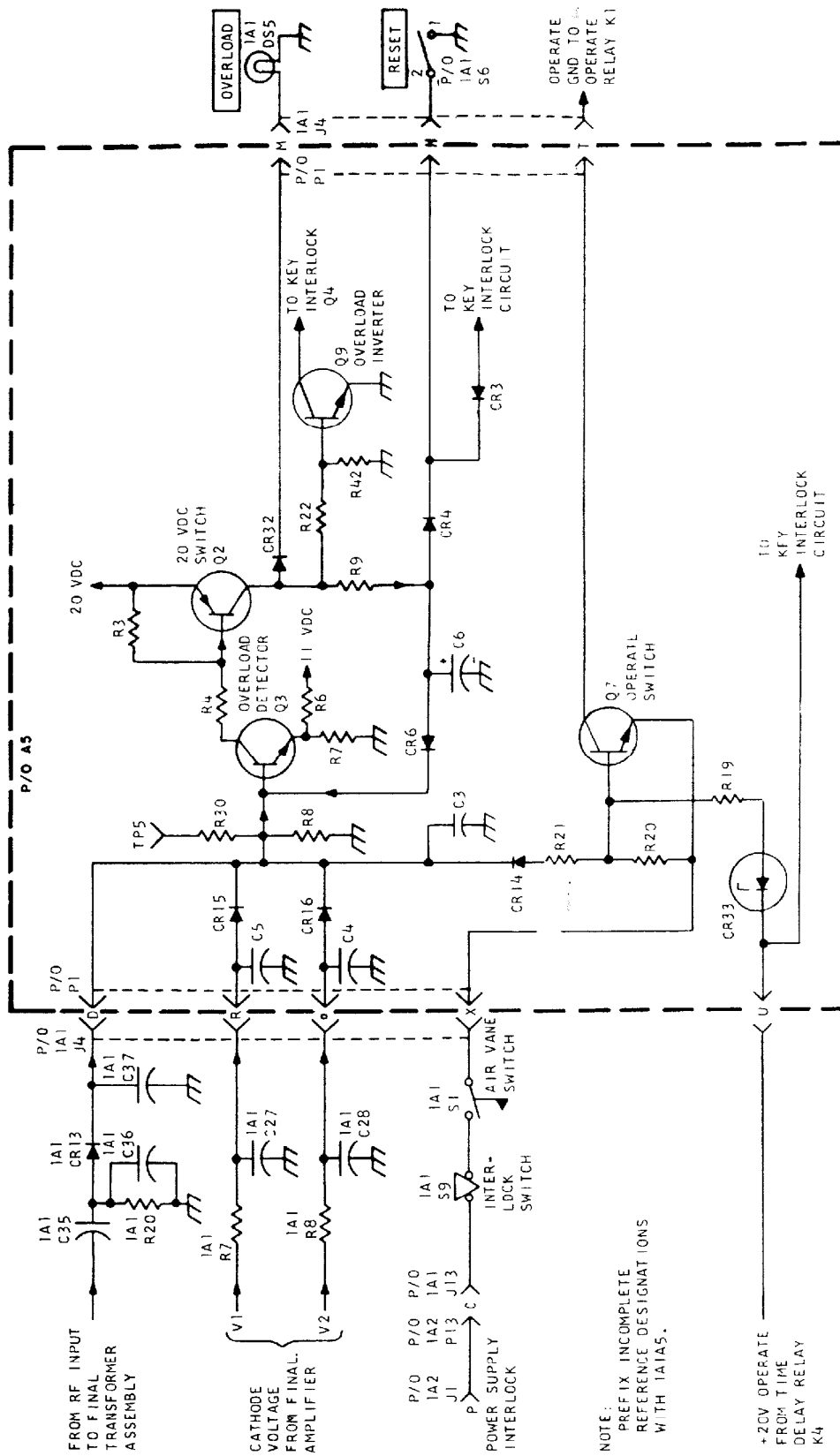


Figure 4-5. Overload Circuit Simplified Schematic

allowing operation to be resumed. However, if the overload remains the circuit will again pick up and prevent operation until the overload is located and removed. CR3 maintains the system in an unkeyed condition while 1A1S6 is in the RESET position.

#### 4.10 TUNING CIRCUITS

(Prefix all reference designators with 1A1). The operating frequency of the RF-110A is established by selecting one of nineteen broadband transformers for the interstage (Driver Transformer Assembly) and output (Final Transformer Assembly). The Transformers for the desired band are switched into the circuit by separate bandswitches, one in the driver transformer assembly and one in the final transformer assembly, gear driven by a common motor (1A1B2). Bandswitch motor 1A1B2 is controlled by relay 1A1K3, which is in turn energized when a ground return for the relay coil is provided through a five wire "coding system", using an encoder and a decoder switch. The decoder switch consists of the front and rear sections of driver transformer assembly bandswitch deck 1A1A4S1C. The Encoder switch consists of FREQUENCY MHZ switch 1A1A7-A. When the FREQUENCY MHZ switch is set to a desired band, a ground path is set up between the encoder switch and the decoder switch and the five interconnecting wires, energizing relay 1A1K3, (which in turn energizes bandswitch motor 1A1B2) (see figure 4-6). The coding system is set up so that only one unique position of the driver transformer bandswitch will interrupt the ground path and de-energize the bandswitch motor (see table 4-1). The FREQUENCY MHZ switch has 20 positions – nineteen for the nineteen frequency bands and a position labeled AUTOMATIC. In this position, the encoder switch deck of 1A1S7 is disconnected, and the five code wires are connected to five external inputs, permitting the RF-110A frequency band to be selected from a remote position.

#### NOTE

When the RF-110A is used with an exciter having the tuning code shown in table 4-1, setting the exciter frequency selector controls to a desired frequency will automatically cause the RF-110A to tune to the proper band, when the FREQUENCY MHZ switch is set at AUTOMATIC.

Both the encoder and the decoder switch consist of a "master" section and an "image" section which is the mirror image of the master. The image sections are required to complete the ground path in certain combinations of encoder-decoder position.

TABLE 4-1. TUNING CODE CHART

BAND	CODE LINES				
	1	2	3	4	5
2.0 to 2.5	0	0	0	0	1
2.5 to 3.0	0	0	0	1	1
3.0 to 3.5	0	0	1	1	1
3.5 to 4.0	0	1	1	1	1
4.0 to 5.0	1	1	1	1	0
5.0 to 6.0	1	1	1	0	1
6.0 to 7.0	1	1	0	1	1
7.0 to 8.0	1	0	1	1	1
8.0 to 10.0	0	1	1	1	0
10.0 to 12.0	1	1	1	0	0
12.0 to 14.0	1	1	0	0	1
14.0 to 16.0	1	0	0	1	0
16.0 to 18.0	0	0	1	0	0
18.0 to 20.0	0	1	0	0	1
20.0 to 22.0	1	0	0	1	1
22.0 to 24.0	0	0	1	1	0
24.0 to 26.0	0	1	1	0	0
26.0 to 28.0	1	1	0	0	0
28.0 to 30.0	1	0	0	0	0

1 Represents Ground  
0 Represents an Open

#### NOTE

On figure 4-6, notice that the encoder and decoder image switches always strap the "0" lines together. This is a necessary condition for operation.

Figure 4-6A shows the circuit tuned for an operating frequency in the 2.0 to 2.5 MHz band. This can be seen by noting that decoder master 1A1A4-S1C pattern (1, 1, 1, 1, 0) is the complement of encoder master 1A1S7A pattern (0, 0, 0, 0, 1). Suppose, however, that the RF-110A had previously been tuned to the 2.5 to 3.0 MHz band (one position clockwise) and that FREQUENCY MHZ

switch 1A1S7 has just been set at the 2.0 to 2.5 MHz band (figure 4-10B). In this situation contacts 3 and 7-8-9 of the decoder master are connected, but this does not complete the ground path to relay 1A1K3 since code lines 1 through 3 are not grounded by encoder 1A1S7 master. Instead, the ground path is provided through the image decks: from 1A1S7A-20 front to 1A1S7A-1 front to 1A1A4S1C-5 front to 1A1A4A1C-6 front to 1A1S7A-2 rear to 1A1S7A-3 rear to 1A1A4S1C-7 rear to 1A1A4S1C-3 rear to terminal 6 of the relay. Thus the relay energizes and motor 1A1B2 turns the decoder and bandswitches. The master and images ensure that there will always be a ground path for any combination of encoder and decoder positions until the decoder reaches the unique position corresponding to that of the encoder.

While the bandswitching motor is energized, an inhibit signal is applied to the keying circuit to prevent keying. The power for driving the motor is 115 VAC, 60 Hz sine-wave if the 60 Hz Supply is used: or 130 VAC, 60 Hz square-wave the 400 Hz Supply is used.

#### 4.11 MULTIMETER CIRCUIT

(Prefix all reference designators with 1A1.) The multimeter circuit (figure 5-20) consists of a meter, switch, detector circuit, and various voltage dividers. The function of this circuit is to allow the important parameters of the amplifier to be monitored.

Eight parameters are monitored as follows:

a. When the Multimeter switch S5 is set at DRIVER 2 AMPERES, the voltage developed across resistor A1R1 by the cathode current of electron tube A1V2 is applied through calibrating resistor A1R3 and contacts 1 and 9 of switch S5 to meter M1. Therefore, the cathode current of electron tube A1V2 can be measured or monitored. Capacitor A1C13 is an RF bypass.

b. When the Multimeter switch is set at DRIVER 1 AMPERES, the voltage developed across resistor A1R2 by the cathode current of electron tube A1V1 is applied through calibrating resistor A1R4 and contacts 2 and 9 of switch S5 to meter M1. Therefore, the cathode current of electron tube A1V1 can be measured or monitored. Capacitor A1C14 is an RF bypass.

c. When the Multimeter switch is set at PA PLATE 2 AMPERES, the voltage developed across

resistor R27-R28 by the cathode current of electron tube V2 is applied through calibrating resistor R4 and contacts 3 and 9 of switch S5 to meter M1. Therefore, the cathode current of electron tube V2 can be monitored or measured. Capacitor C19 is an RF bypass.

d. When the Multimeter switch is set at PA PLATE 1 AMPERES, the voltage developed across resistor R25-R26 by the cathode current of electron tube V1 is applied through calibrating resistor R3 and contacts 4 and 9 of switch S5 to meter M1. Therefore, the cathode current of electron tube V1 can be monitored or measured. Capacitor C7 is an RF bypass.

e. The RF input to the RF-110A is coupled by capacitor A1C18 to voltage doubler-detector circuit A1CR1-CR2. The negative peaks of the RF input signal are clamped to ground by diode A1CR2. The positive peaks of the RF input signal are then detected by diode A1CR1, filtered by capacitor A1C17, and developed across base resistor A6R4, resulting in a DC signal nearly equal to the peak-to-peak input voltage. Emitter follower A6Q1 provides the current gain required to operate the meter. Its output is applied through dropping resistor A6R3 and contacts 5 and 9 of switch S5 to meter M1. When Multimeter switch S5 is set at INPUT POWER 0-150 MW, meter M1 indicates RF input voltage on a scale calibrated in terms of RF power. Resistor A6R2 serves as a load for transistor A6Q1 when switch S5 is in some other position.

f. The 2250 VAC output from the RF-112A (1A2J1-R) is applied to the plates of final amplifier electron tubes V1 and V2 and to meter dropping resistors A7R16 through A7R20. Therefore, the plate voltage for the final amplifier tubes can be measured or monitored when the Multimeter switch is set at PA PLATE VOLTS. Resistor A7R21 prevents the voltage at terminal A7E6 from rising to 2250 VDC when switch S5 is not set at PA PLATE VOLTS.

g. The 500 VDC output from the RF-112A (1A2J1-M) is applied through fuse F7 to terminal 1 of A1TB1 for application to the plates of the driver amplifier electron tubes. The 500 VDC is also applied through current limiting resistor R29 to the screen regulator and to meter dropping resistors A7R13 and A7R14. Therefore, the plate voltage for the driver amplifier electron tubes can be measured or monitored when the Multimeter switch is set at DRIVER PLATE VOLTS. Resistor

A7R15 prevents the voltage at terminal A7E1 from rising to 500 VDC when switch S5 is not set at DRIVER PLATE VOLTS.

h. The 287 VDC at the J6 output of the screen voltage regulator is applied to meter dropping resistors A7R7 and A7R8. Therefore, the screen voltage to the final and driver amplifier electron tubes can be measured or monitored when the Multimeter switch is set at PA-DRIVER SCRNS VOLTS. Resistor A7R9 prevents the voltage at terminal A7E5 from rising to 287 VDC when switch S5 is not set at PA-DRIVER SCRNS VOLTS.

#### 4.12 ARC PROTECTOR ASSEMBLY

High power vacuum tubes occasionally develop momentary arcs between plate and screen. (Observe the caution note inside the front cover to minimize this problem.) The arc protector assembly 1A1A9 protects the screen power supply diodes in the event of such an arc. When an arc occurs, the current passes through zener diodes 1A1CR3-CR11. This current causes a voltage drop across 1A1A9R1-R2 which fires silicon controlled rectifier 1A1A9Q1. This shorts to ground three points: the two final amplifier screens (through 1A1A9CR1-CR2) and the highest voltage point on the screen supply 1A1J11 (through 1A1A9CR3). This shunts the arc currents around the screen supply zener diodes to ground, protecting the zener diodes.

The silicon controlled rectifier may remain on after the arc has cleared, preventing further operation since there will be no screen voltage. In this case, switch the transmitter to standby (remove 20V operate from 1A2A1J7-N) for a few seconds. When using a high voltage power supply with a fuse on the 2250V line (such as the RF-124 single-phase power supply) the fuse will probably blow and will have to be replaced.

#### 4.13 PRIMARY POWER DISTRIBUTION

When PRIMARY POWER switch 1A1S4 is set at ON, phases A and B (figure 5-20, sheet 3) of the primary power are applied to transformer 1A1T1 to energize the internal power supply. These two phases are interlocked ahead of 1A1S4 by 1A1S10, 1A1S11 to prevent operation when the chassis is extended from the case. Also, from 1A1S4, phases A and B of the primary power are applied to the RF-112A.

Phases A and B of the primary power are applied to terminals 22 and 23 (figure 5-26) on the RF-112A terminal board 2A2TB1. Both phases A and B are applied through one of two jumpering schemes to the primary of transformer 2A2T2. The jumpering scheme used depends on whether the primary line-to-line voltage is 440 or 208. Transformer 2A2T2 has two 60 Hz outputs: 115 volts and 24 volts. The 115 volt output from winding 31-30 is applied through the interconnecting cabling to the RF-110A, from which it is supplied (figure 5-25 and 5-20) as primary power through connector 1A2A1J7 to the exciter and through connector 1A2A1J6 to the antenna coupler. The 24 volt output from transformer 2A1T2 is applied to the 400 Hz inverter, one side first being switched by standby relay 1A1K2.

Applying +28 VDC to J7-M (figures 5-25 and 5-20, sheet 3) will energize the standby relay, 1A1K2. This connects phase A of the primary power through contacts 7 and 4 to terminal 1 of transformer 1A1T1. (Phase B of the primary power was directly applied to the other end of 1A1T1 at the time that the PRIMARY POWER switch was set at ON. The primary windings of 1A1T1 are jumpered together according to the voltage of the primary power source (208 or 440V).

Transformer 1A1T1 has six secondary windings: windings 24-25 and 22-23 provide the 6.0 VAC required by the filaments of the two electron tubes in the final amplifier. Winding 16-17 is used to produce the 13.5 VAC required by the filaments of the two electron tubes in the driver amplifier. Winding 18-19 produces the AC input voltage required by 12 VDC remote power supply (paragraph 4.15). Winding 13-14-15 produces the AC input voltage required by the 11, 20, 28 VDC power supply (paragraph 4.14). Winding 20-21 produces the AC input voltage required by the bias power supply (paragraph 4.8).

The RF-110A time elapsed meter and blower require 115 VAC, 400 Hz single phase power for operation. This power is developed when the system is placed in standby as follows: 24 VAC output from the RF-112A is applied to the standby relay at the time of initial turn-on (paragraph 4.12). This 24 VAC is applied through contacts 3 and 8 of standby relay 1A1K2, terminal board 1A1TB2, fanning strip 1A1P5, and the inter-connecting cabling to the full wave rectifier bridge in the



RF-112A, 400 Hz inverter. The 115 VAC, 400 Hz output produced by the inverter (paragraph 4.16) is applied to the RF-110A blower and time elapsed meter.

Thus, when the system is placed in standby, all voltages required for operation of the tuning, protection, control, filament, blower, and time elapsed meter circuits are available. The only voltages not yet available are the high voltages required for powering the plates and screens of the electron tubes of the final and driver amplifiers.

The operate power distribution circuit consists of two relays, a relay driver transistor, a regulator circuit a high voltage power supply. The function of this circuit is to produce the 2250 and 500 VDC voltages required by the plate and screen circuits of the final and driver amplifiers.

Three minutes after application of heater power (when the system is placed in standby), time delay relay 1A1K4 energizes (figure 5-21) allowing the 20 VDC Operate to reach voltage divider 1A1A5-CR33-R19-R20. The time delay is provided to allow the cathodes of the electron tubes to reach operating temperature prior to application of plate and screen voltages. Since the emitter of relay driver 1A1A5Q7 is at ground through the power supply interlock line (paragraph 4.9), the voltage applied to divider 1A1A5CR33-R19-R20 turns relay driver 1A1A5Q7 on and saturates it, effectively grounding terminal 2 of relay 1A1K1 (figure 5-20, sheet 3). This energizes operate relay 1A1K1. Therefore, three phase primary power is applied to high voltage power supply. The high voltage power supply converts the three phase primary power to 2250 VDC and 500 VDC. These DC voltages are applied to the plate circuits of the electron tubes in the final and driver amplifiers, respectively. Screen voltages are derived from the 500 VDC in 6.2 volt steps between 287 and 318 VDC for both the final and driver amplifiers. The HIGH VOLTAGE lamp comes on with the presence of 500 VDC.

#### **4.14 11, 20, AND 28 VDC POWER SUPPLY**

(Prefix incomplete reference designator with 1A1A5.) The 11, 20, and 28 VDC power supply (figure 5-21) consists of two full wave rectifiers, a regulator, and a filter. The function of these circuits is to produce all the low DC voltage required for operation of the RF-110A control circuits.

The output from winding 13-15 of transformer 1A1T1 is full wave rectified by diodes CR22 through CR25, producing an unfiltered DC output whose average value is 28V. This voltage is used to energize the RF-110A relays, and is applied through the 28 VDC switch circuit (paragraph 4.7) to energize the exciter T/R relays. The 28 VDC connection to the relays is interlocked through pin b of connector P1 and 1A1J4 and pins a and z of connectors 1A1J5 and 1A1A6P1. This interlock is provided so that the system can not be energized if either printed circuit board is removed from the equipment, therefore, preventing operation in the absence of the control circuits.

Since a bridge rectifier such as CR22 through CR25 always grounds whichever side of the transformer is instantaneously the negative side, the other side of the transformer (the side not grounded at any instant) must always be positive with respect to ground. Since terminal 14 of transformer 1A1T1 is the centertap of a transformer which feeds a bridge rectifier, it follows that it also must always be positive with respect to ground, but with a voltage equal to one-half that of the full winding. Therefore, the voltage at terminal 14 is a full-wave rectified signal that is one-half of the full (28 VDC average) output. Diode CR21 allows capacitor 1A1C31 to charge up to the peak value of the voltage present at terminal 14. This constitutes the 20 VDC supply. Its output is applied to the 11 VDC regulator, the overload circuit, and the keying circuit, and through 1A1J4-f and 1A1J5 k to the APC/PPC circuits.

Voltage divider R25-CR19 provides a stable +12 VDC reference for the two emitter followers (Q11 and Q10) which constitute the 11 VDC regulator. The output voltage from the regulator is normally about 11 VDC because 0.6 VDC is lost across each silicon transistor. Resistors R34 and R35 absorb some of the power which is dissipated by the regulator circuit, allowing the transistors to run cooler than would otherwise be possible.

#### **4.15 REMOTE 12 VDC POWER SUPPLY**

(Prefix incomplete reference designators with 1A1A5.) The remote 12 VDC power supply (figure 5-21) consists of a full wave rectifier and filter, and a two stage current amplifier regulator circuit. This circuit provides a floating regulated 12 VDC which is available at transmitter switchboard connector 1A2A1J2 for remote use.

The output from winding 18-19 of transformer 1A1T1 is full wave rectified by diodes CR26 through CR29, filtered by capacitor 1A1C30, and applied to the voltage reference circuit (R26, R27, R36, CR30, CR31). Zener diodes CR30 and CR31 provide a stable 12.4 VDC reference for two emitter followers (Q12 and 1A1Q1) which constitute the 12 VDC regulator. Capacitor C2 filters the current for Zener diodes CR30 and CR31 so the reference voltage will be essentially ripple-free, thus assuring low ripple at the regulator output.

#### **4.16 400 HZ INVERTER**

(Prefix incomplete reference designator with 2A1.) The 400 Hz inverter, which is part of the RF-112A, (figure 5-26) is a saturable core oscillator. The function of this circuit is to produce a 115 VAC, 400 Hz, single phase, output to power the blower and time elapsed meter when operating from a 60 Hz primary power source.

When the system is placed in standby, the 24 volt output from 2A2T1 is switched through the RF-110A standby relay to full wave rectifier bridge CR4 through CR7. The resulting 25 VDC output is filtered by capacitors C1 and C2 and applied to the center tap of transformer T1.

#### **4.17 60 HZ HIGH VOLTAGE POWER SUPPLY**

(Prefix incomplete reference designators with 2A1.) The 60 Hz high voltage power supply (figure 5-26) consists of a three-phase transformer, three-phase diode blocks, and various other parts and connections. The function of this circuit is to produce the 2250 and 500 VDC required by the four electron tubes in the driver and final amplifiers when operating from a 60 Hz primary power source.

When the system is placed in an operate condition (paragraph 4.13), the three phase primary power is applied to pins A, B and C of connector 2A2J1, from which it is routed through one of

two jumpering schemes to the primary windings of transformer 2A2T1. The primary is a wye type winding in which each leg consists of two windings. The windings are jumpered together according to the magnitude of the three phase voltage. The output from transformer 2A2T1 consists of three secondary windings: two wye type and one delta type.

The output from wye winding 19-20-21 is full wave rectified by three phase diode stack CR3 to produce 500 VDC. This 500 VDC is filtered by capacitor 2A2C1, and applied to pin M of connector 2A2J1 from which it is connected to the RF-110A. The 500 VDC is used as plate voltage for the two electron tubes in the driver amplifier and as input to the screen regulator to provide screen voltage for all four final and driver amplifier electron tubes.

The output from wye winding 22-23-24 is full wave rectified by three phase diode stack CR1 to produce 1125 VDC. This 1125 VDC is used as the return for three phase diode stack CR2. The output from delta winding 25-26-27 is full-wave rectified by three phase diode stack CR2, producing an 1125 VDC that is added to the 1125 VDC output from three phase diode stack CR1. This results in the required 2250 VDC that is applied through pin R of connector 2A2J1 of the RF-110A. This 2250 VDC is used as plate voltage for the two electron tubes in the final amplifier.

A wye and delta winding are used to produce the 2250 VDC rather than a single winding since the phase relationships inherent in this combination produce one-quarter the ripple amplitude and twice the ripple frequency as compared with a single winding, thus minimizing filter requirements.

#### **4.18 SYSTEM TROUBLESHOOTING**

Table 4-2 is not intended to be a complete troubleshooting chart. However, it provides information that may isolate a problem area without the requirement of a detailed analysis.

TABLE 4-2. TROUBLESHOOTING

SYMPTOM	PROBABLE FAULT
No RF output; final plate current increases with increased RF input.	Short to ground or an open circuit in final transformer assembly 1A1A2.
High reflected power	<ol style="list-style-type: none"> <li>1. Mistuned antenna coupler.</li> <li>2. Open or shorted transmission line.</li> </ol>
Impossible to reach 1 kW circuit; driver current decreases with increased RF input	<ol style="list-style-type: none"> <li>1. PPC ADJ 1A1R11 or PWR control 1A1R13 misadjusted.</li> <li>2. Faulty screen regulator circuit.</li> </ol>
Essentially no RF output; no increase final plate current with increase in RF input	<ol style="list-style-type: none"> <li>1. Driver amplifier assembly 1A1A1 not properly seated, or fault in assembly.</li> <li>2. Driver transformer assembly 1A1A4 not properly seated, or fault in assembly.</li> <li>3. Open resistor 1A1R24.</li> </ol>
Final Transformer Assembly 1A1A2 stops out of position.	<ol style="list-style-type: none"> <li>1. The coupling on driver transformer assembly 1A1A4 has slipped.</li> <li>2. Open, shorted, or mis-wired code line between case connector 1A2A1J7 and switch S1 in driver transformer assembly 1A1A4.</li> <li>3. Faulty 1A1S7.</li> </ol>
System does not energize.	<ol style="list-style-type: none"> <li>1. Misaligned interlock switch 1A1S10, 1A1S11, 2A2S1 or 2A2S2.</li> <li>2. No primary power.</li> <li>3. F1-F2-F3 blown.</li> <li>4. Exciter fuses blown.</li> </ol>
Motor 1A1B2 does not de-energize.	<ol style="list-style-type: none"> <li>1. Shorted or miswired code line between case connector 1A2A1J7 and switch S1 in driver transformer assembly 1A1A4.</li> <li>2. Coupling on driver transformer assembly 1A1A4 does not pick up the mating coupling.</li> <li>3. Shorted diode 1A1A5CR2 (if antenna coupler is connected).</li> <li>4. Driver Transformer Assembly (1A1A4) latch nut loose.</li> </ol>
Can't key system from exciter	<ol style="list-style-type: none"> <li>1. Jumper missing between pins B and D of connector 1A2A1J8.</li> <li>2. Frequency switch S7 not in automatic.</li> </ol>
Low RF power output.	<ol style="list-style-type: none"> <li>1. Mistuned transformer assembly in driver transformer assembly 1A1A4 or final transformer assembly 1A1A2.</li> <li>2. Misadjustment of APC and PPC circuits.</li> </ol>
Excessive final plate current	<ol style="list-style-type: none"> <li>1. Mistuned transformer assembly on final transformer assembly 1A1A2.</li> <li>2. Open coupling capacitor in final transformer assembly 1A1A2.</li> </ol>

TABLE 4-2. TROUBLESHOOTING (Cont)

SYMPTOM	PROBABLE FAULT
Low screen voltage	Diode (1A1CR3 through 1A1CR11) in screen regulator shorted.
System will not go to operate	<ol style="list-style-type: none"> <li>1. Printed circuit board 1A1A5 and/or 1A1A6 not properly seated in the chassis connectors.</li> <li>2. Faulty 1A1K4.</li> <li>3. If overload trips, then airvane switch 1A1S1, high voltage interlock 1A1S9, or power supply interlock 2A2S3 or 2A1S1 may be faulty.</li> </ol>

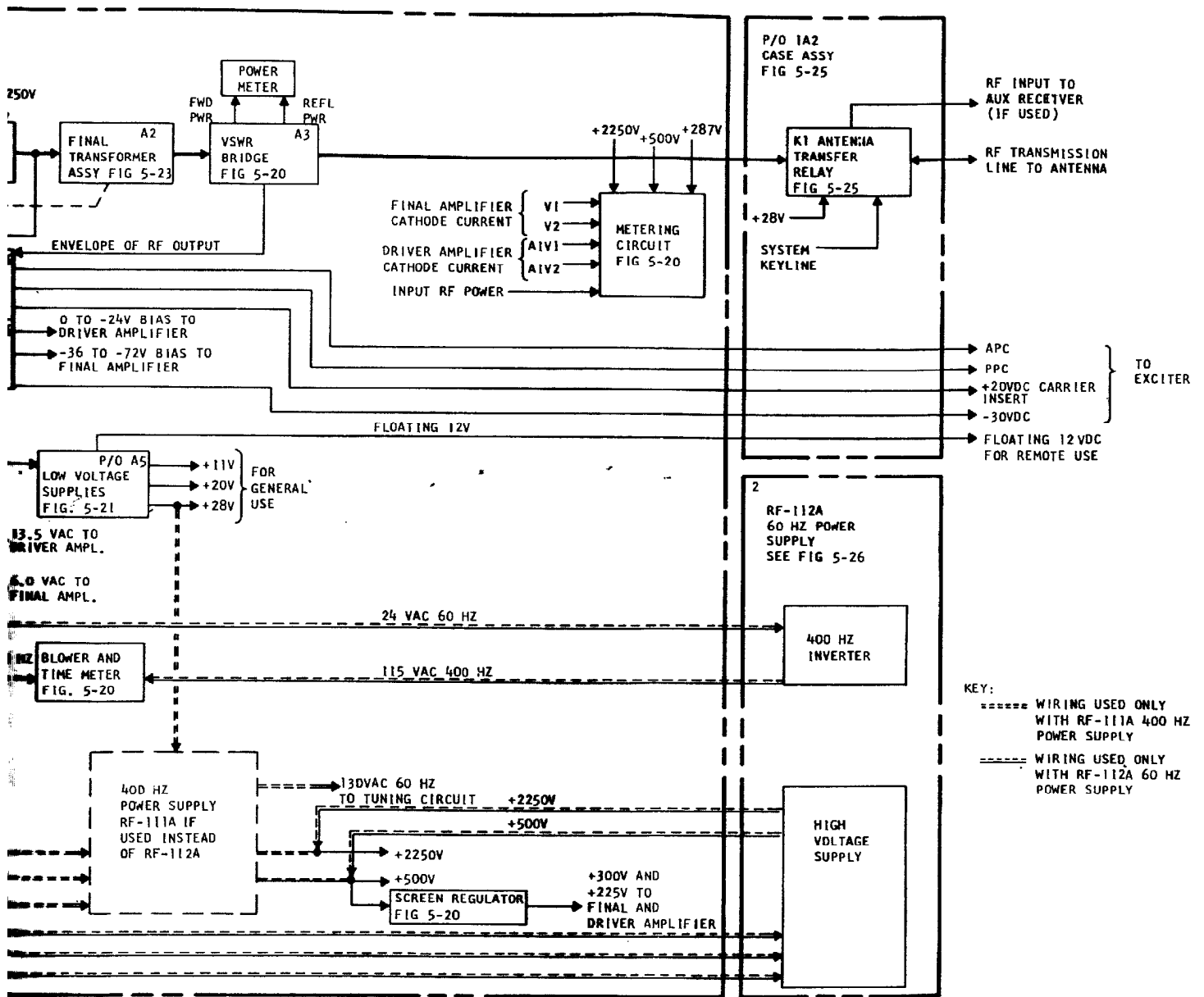
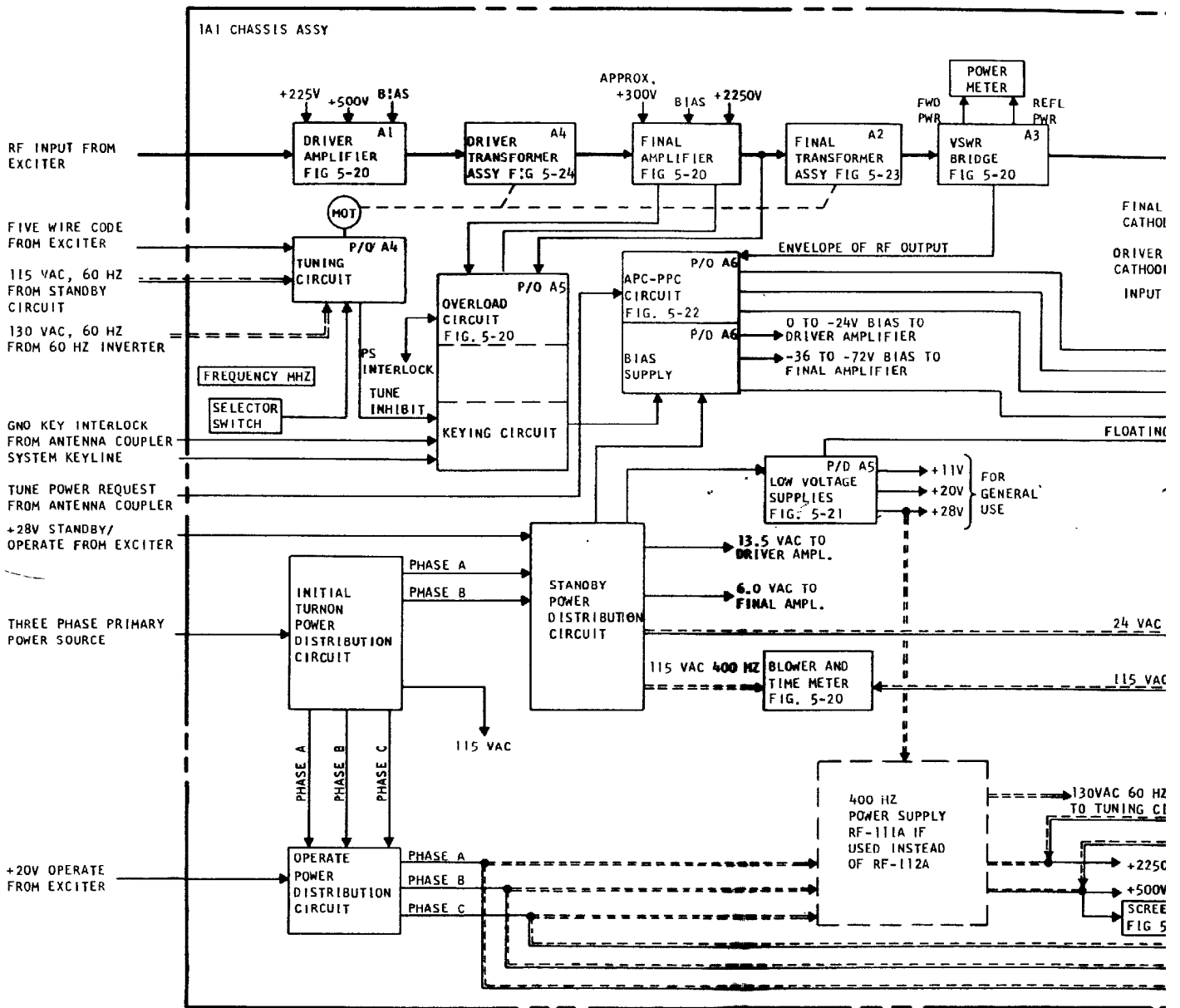


Figure 4-1. Functional Block Diagram





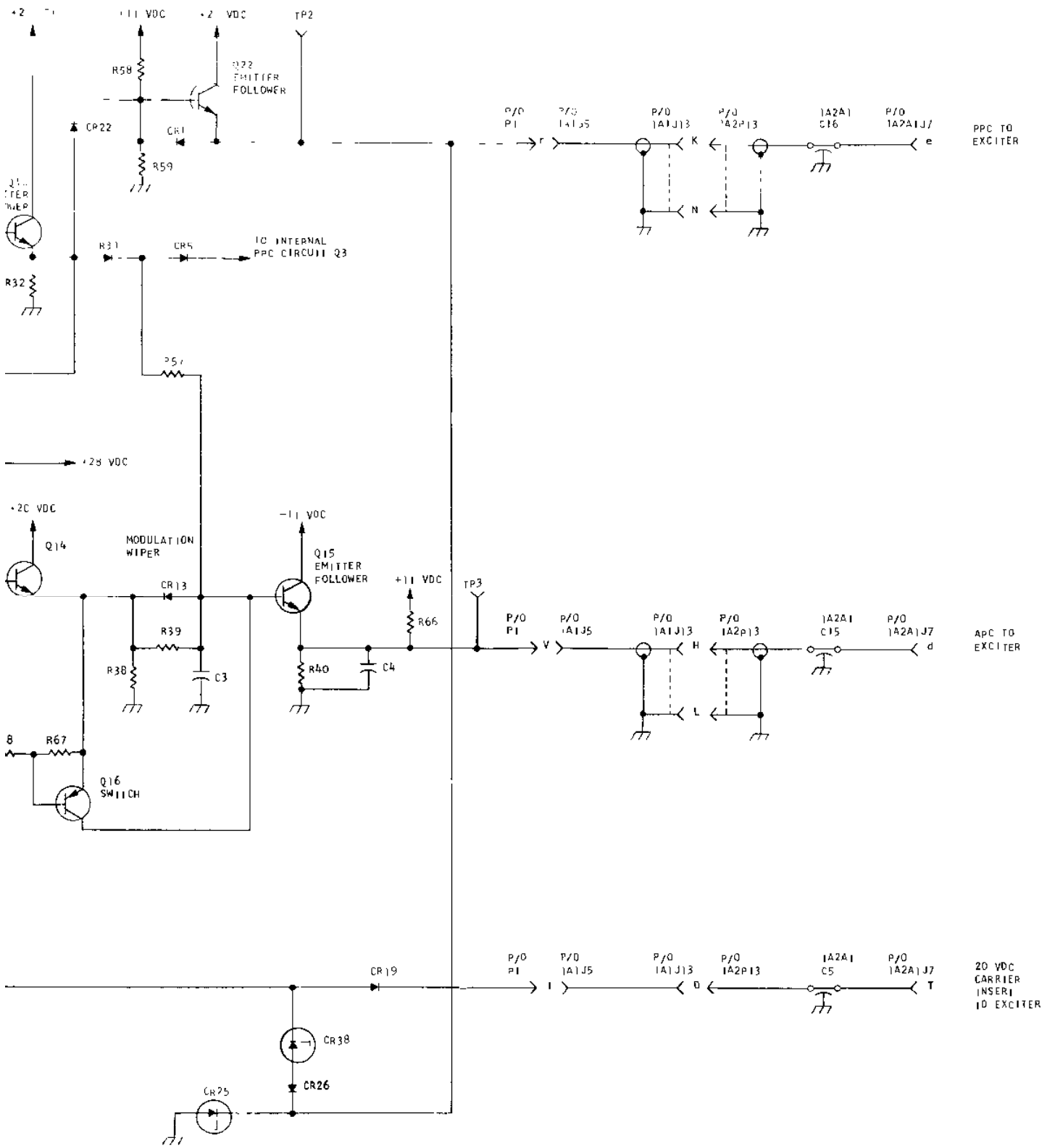


Figure 4-2 APC/PPC Simplified Schematic



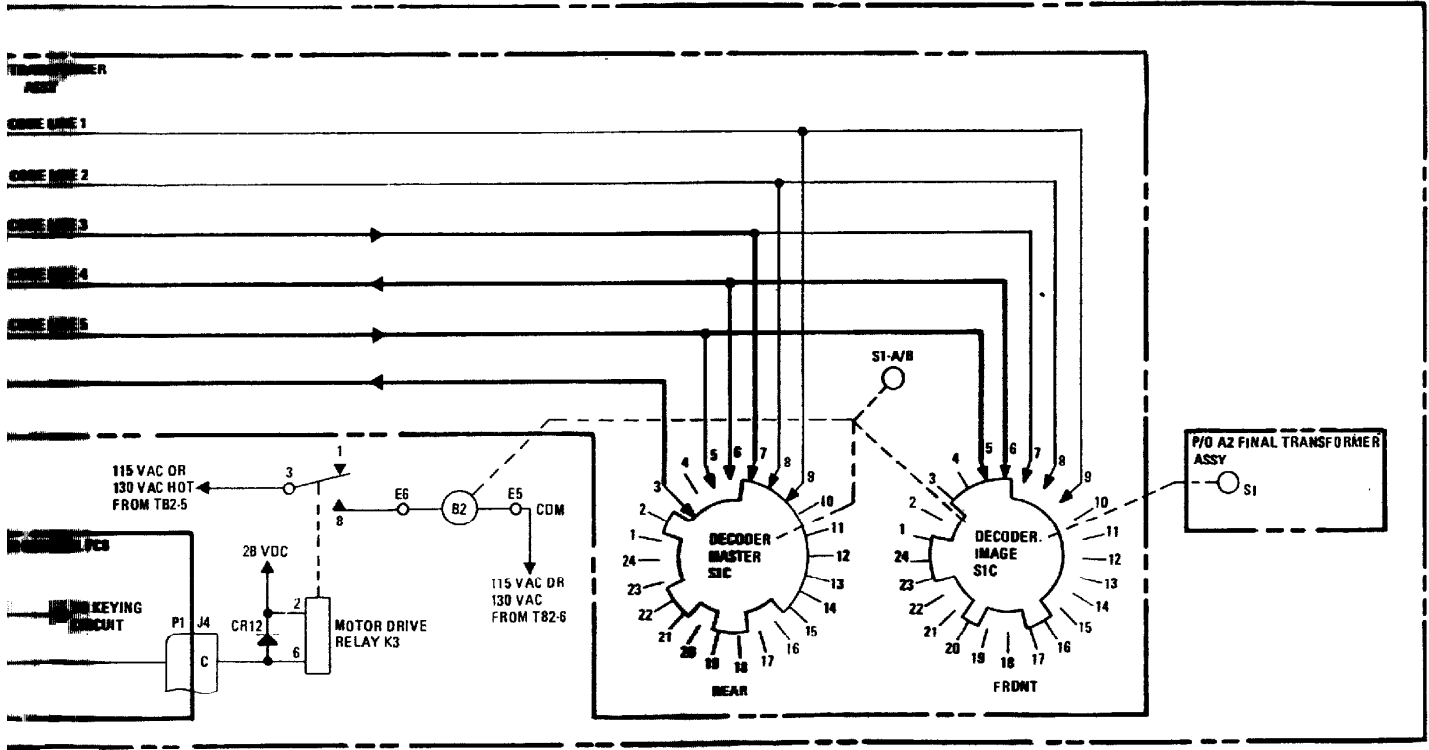
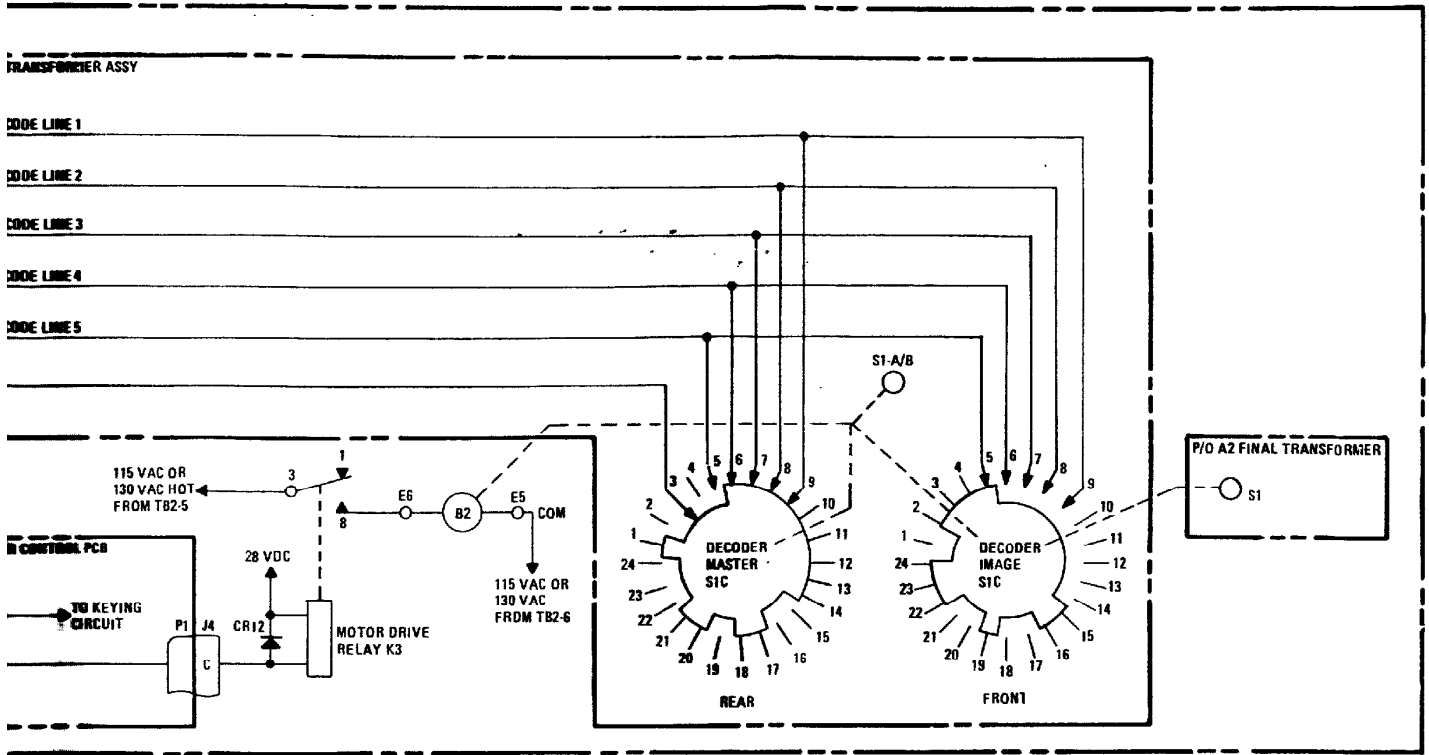
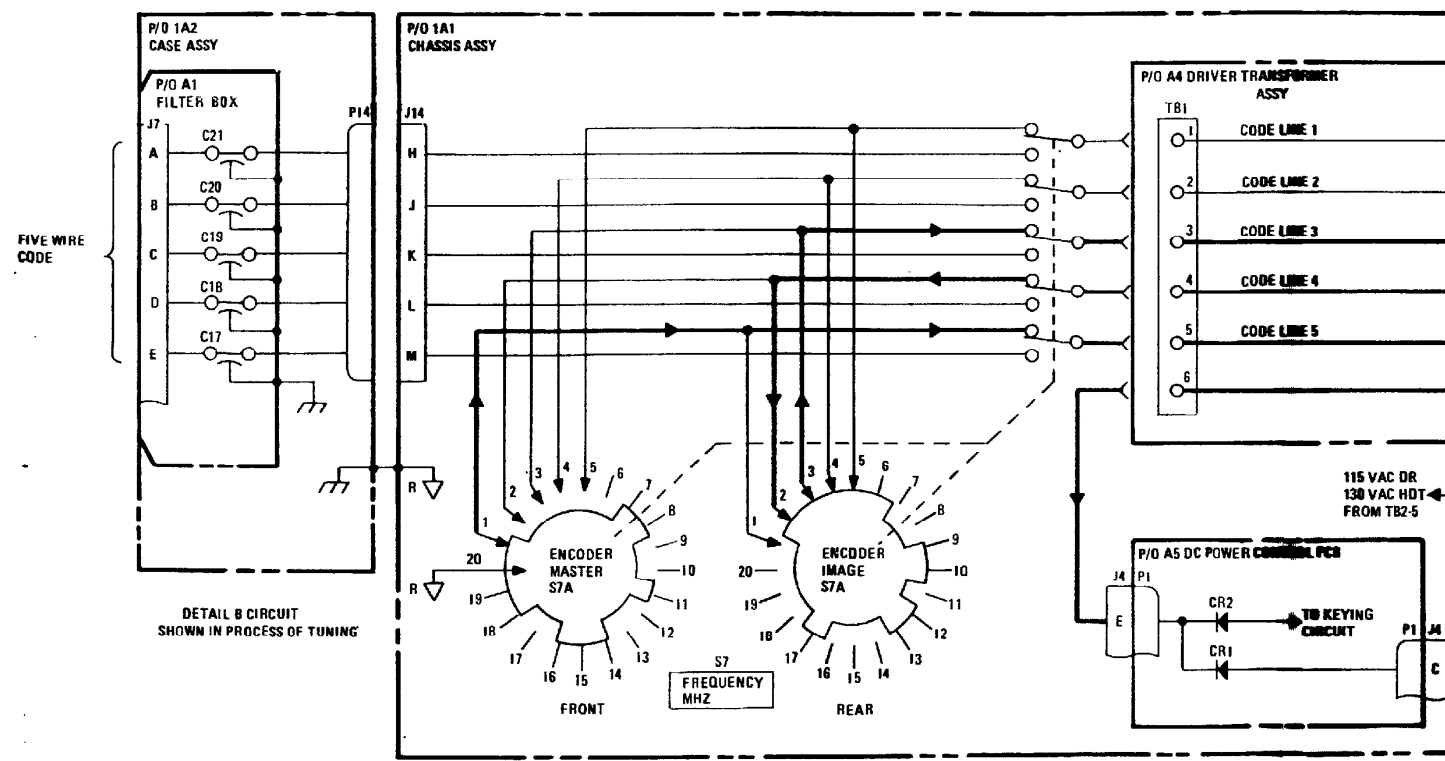
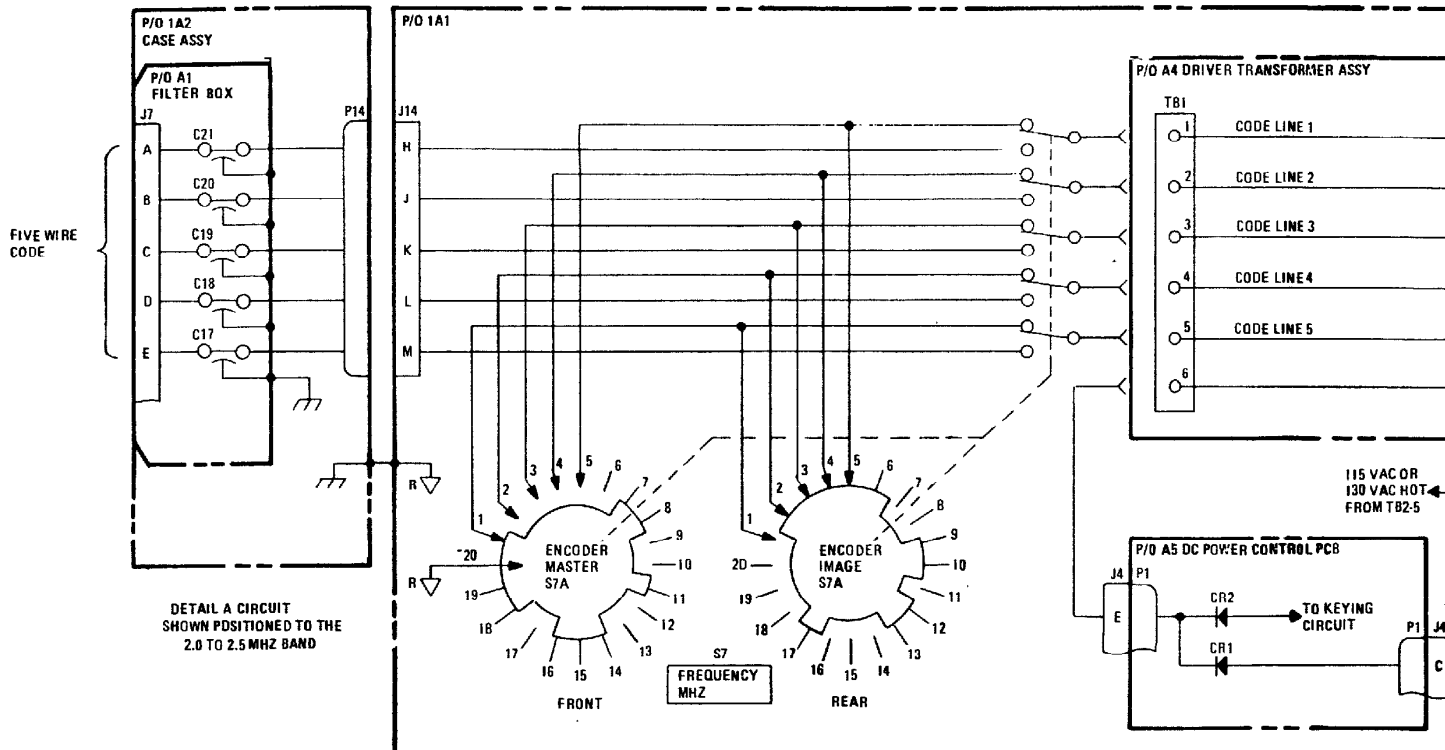
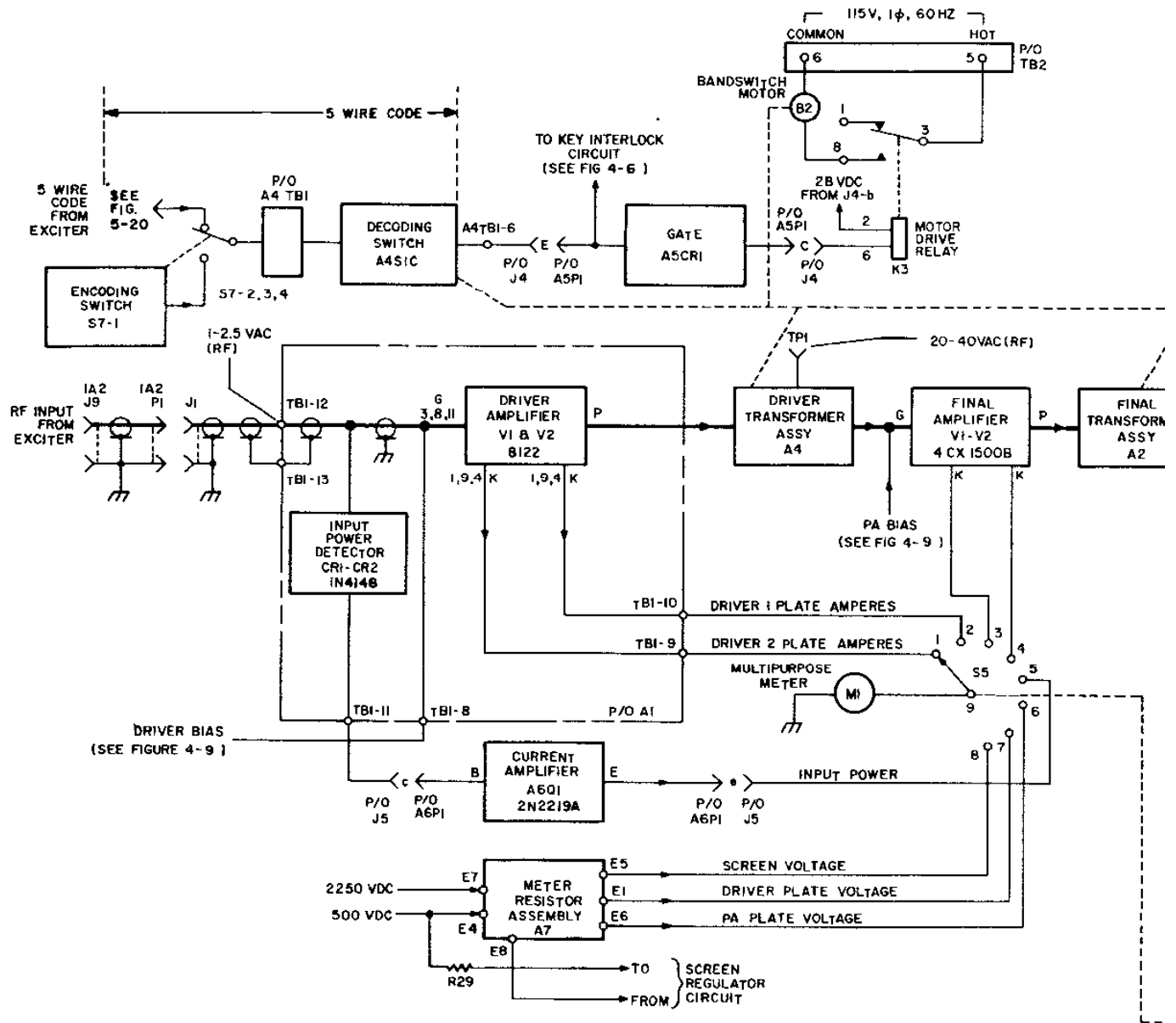


Figure 4-6. Tuning Circuit, Simplified Schematic





NOTES

1. PREFIX INCOMPLETE REFERENCE DESIGNATIONS WITH IA1 AND APPROPRIATE SUBASSEMBLY PREFIX, IF ANY.
2. HEAVY LINES INDICATE MAIN SIGNAL FLOW.
3. LETTERS OUTSIDE TRANSISTOR AND TUBE BLOCKS INDICATE ELEMENT.
4. VOLTAGE MEASURED WITH EQUIPMENT KEVED, IN CW MODE, WITH 1 KW OUTPUT.

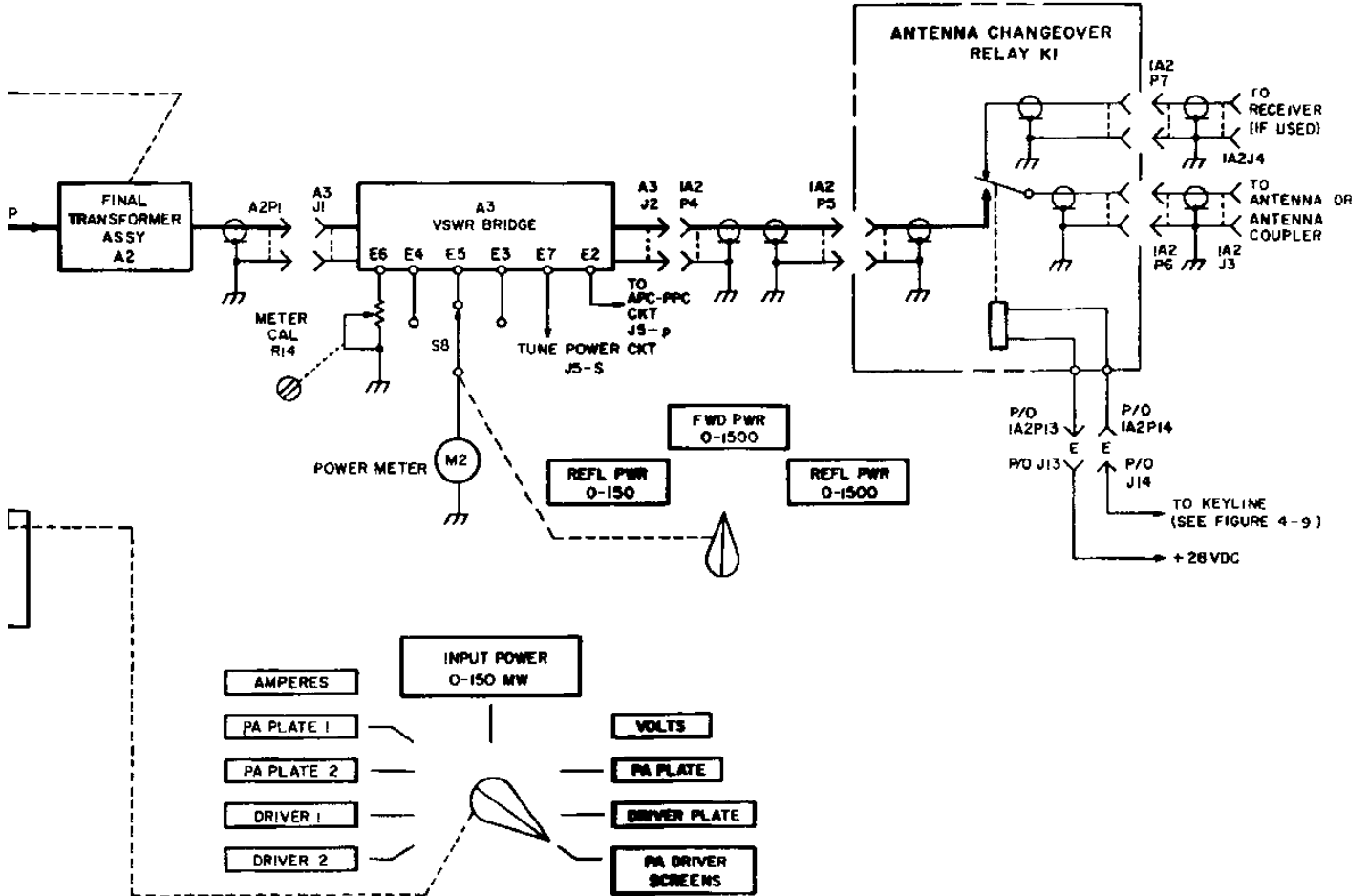
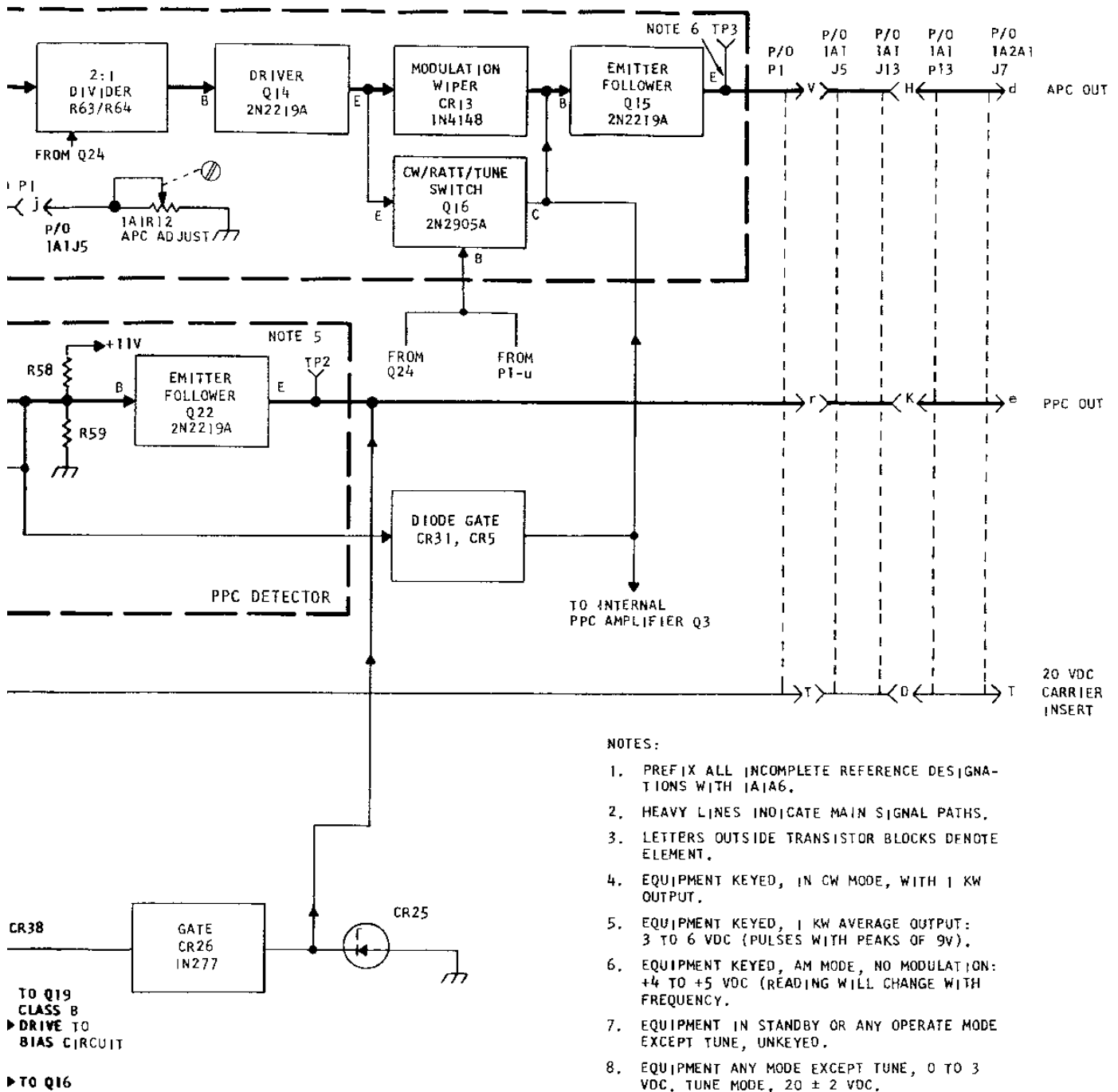


Figure 4-7. RF Amplifier Main Signal Flow





NOTES:

1. PREFIX ALL INCOMPLETE REFERENCE DESIGNATIONS WITH 1A1A6.
2. HEAVY LINES INDICATE MAIN SIGNAL PATHS.
3. LETTERS OUTSIDE TRANSISTOR BLOCKS DENOTE ELEMENT.
4. EQUIPMENT KEYED, IN CW MODE, WITH 1 KW OUTPUT.
5. EQUIPMENT KEYED, 1 KW AVERAGE OUTPUT: 3 TO 6 VDC (PULSES WITH PEAKS OF 9V).
6. EQUIPMENT KEYED, AM MODE, NO MODULATION: +4 TO +5 VDC (READING WILL CHANGE WITH FREQUENCY).
7. EQUIPMENT IN STANDBY OR ANY OPERATE MODE EXCEPT TUNE, UNKEYED.
8. EQUIPMENT ANY MODE EXCEPT TUNE, 0 TO 3 VDC, TUNE MODE, 20 ± 2 VDC.

Figure 4-8. APC-PPC Circuit Servicing Block Diagram

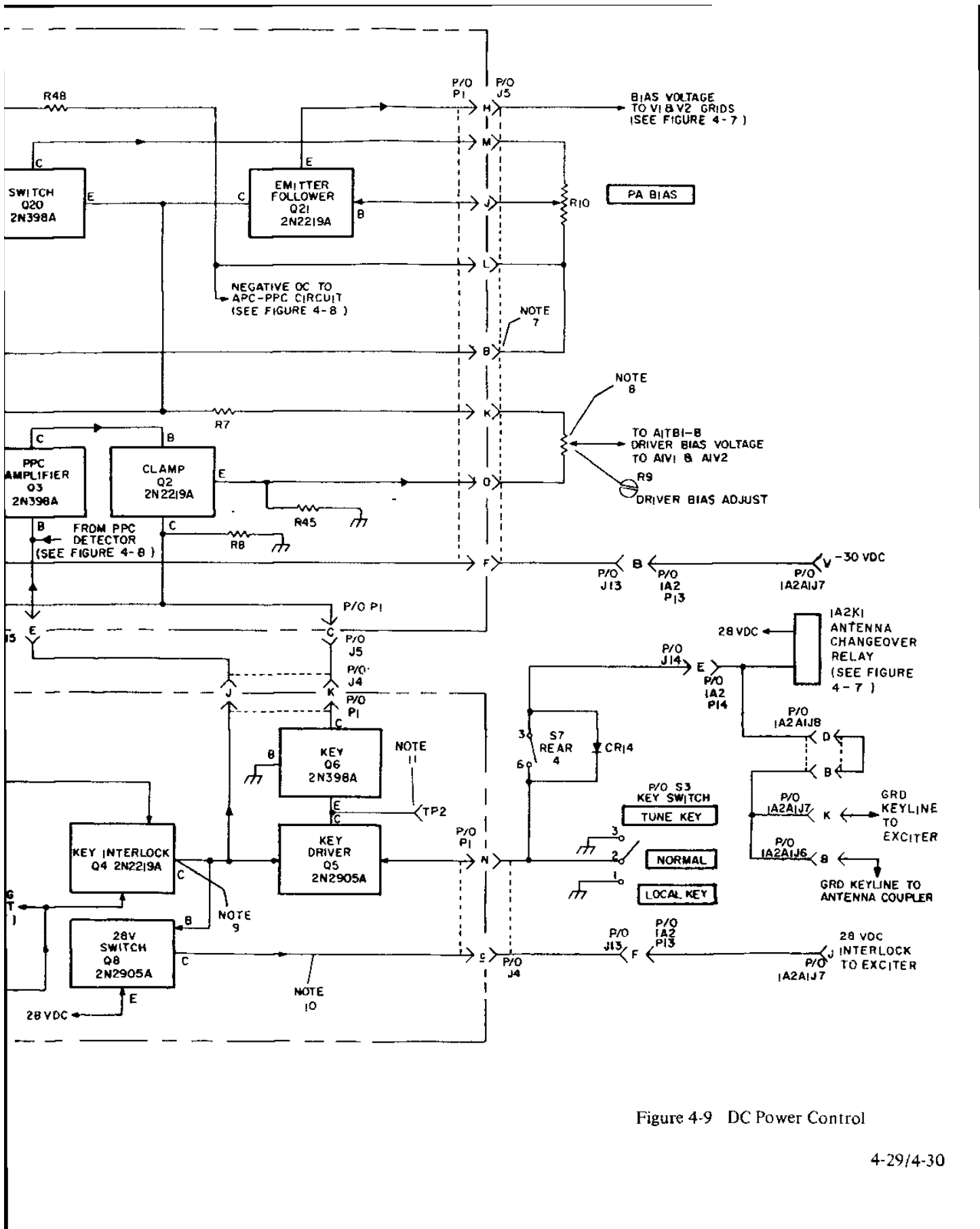
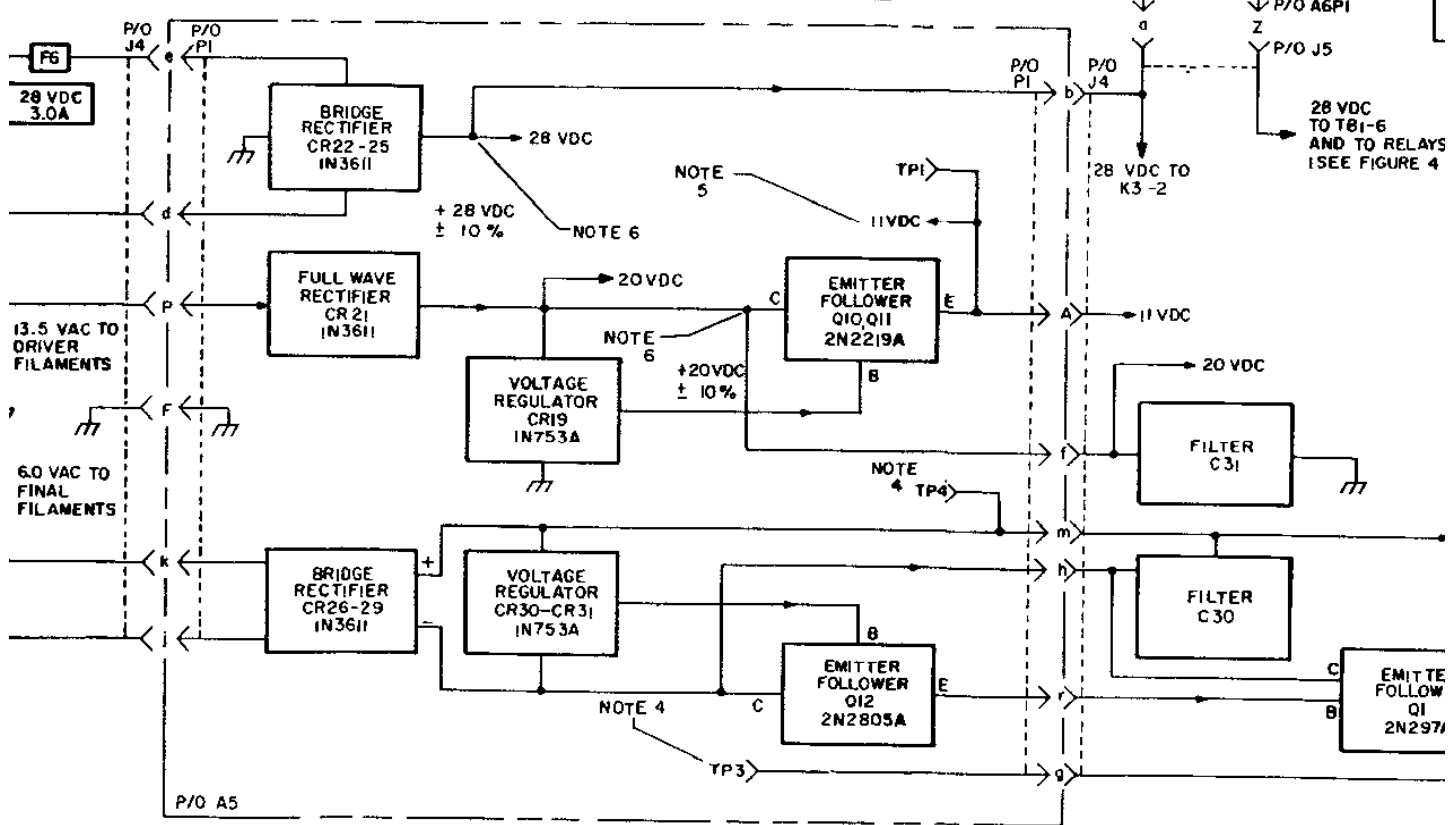
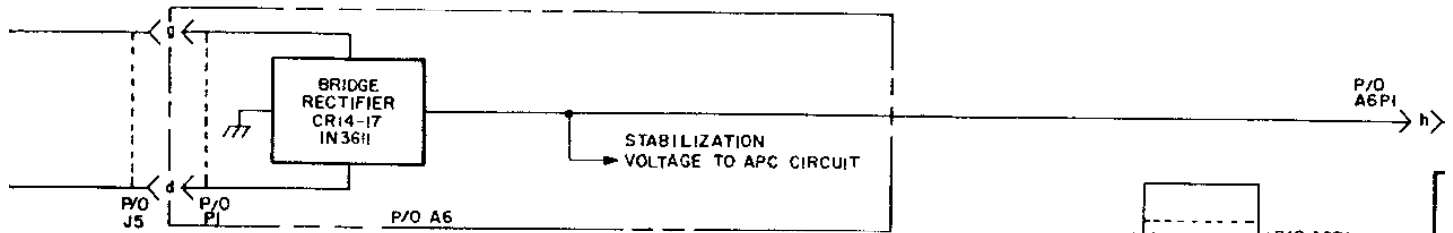
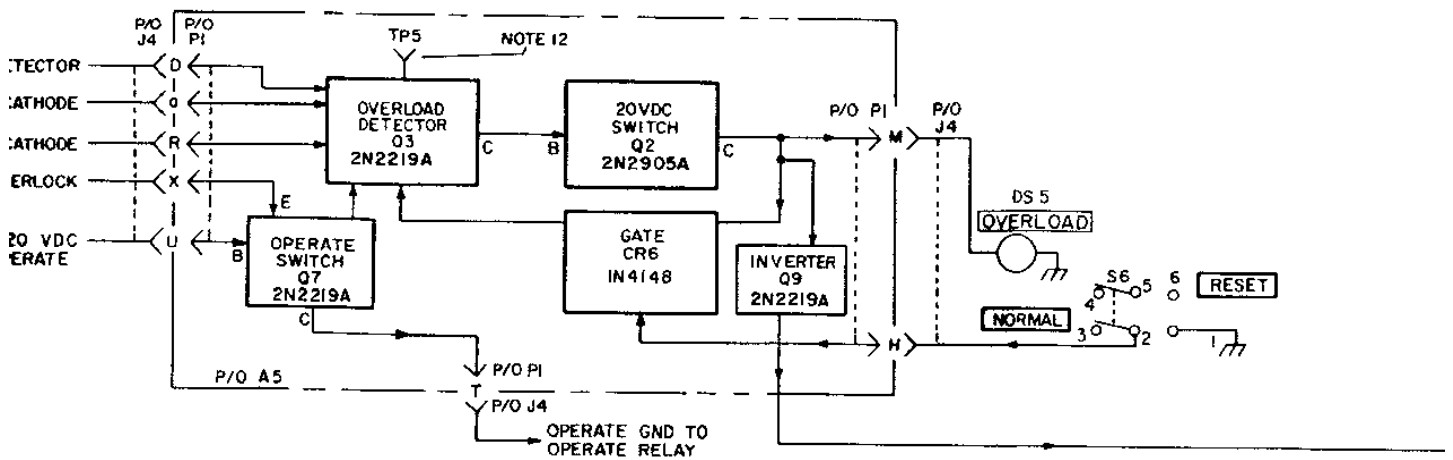


Figure 4-9 DC Power Control

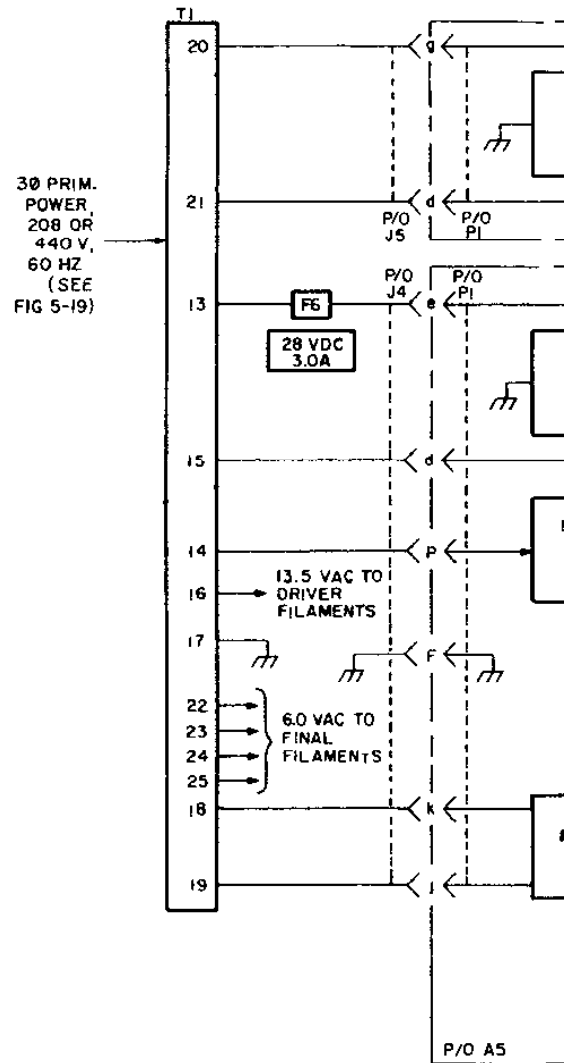
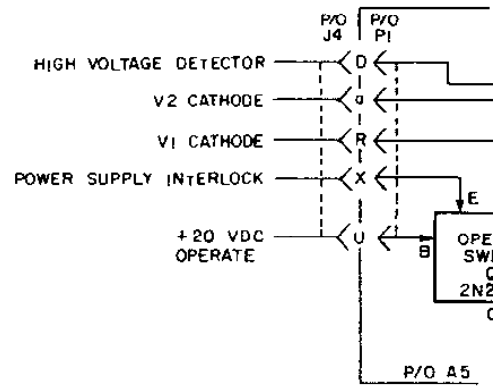






NOTES

1. Prefix incomplete reference designations with 1A1 and applicable subassembly prefix; if any.
2. Letters outside transistor blocks indicate element.
3. Numbers on coils and transformers indicate terminal numbers.
4. Output from floating 12 volt supply, RF-110A in any operate mode, positive meter lead connected to A5TP4, negative lead connected to A5TP3,  $11.8 \pm 0.5$  VDC.
5. Equipment in any operate mode, unkeyed,  $11 \pm 0.5$  VDC.
6. Equipment in standby or any operate mode.
7. Equipment in standby or any mode: key up,  $-130$  VDC  $\pm 20\%$ , key down,  $-72$  VDC  $\pm 5\%$ .
8. Equipment in standby or operate, key up,  $-90 \pm 10$  VDC; operate, key down  $-5 \pm 2$  VDC, depending on setting of R9; key down, interlocked (motor relay energized, overload circuit tripped, coupler interlock grounded, or alarm switch held at reset)  $-33 \pm 4$  VDC.
9. Equipment interlocked (motor relay energized, overload circuit tripped, coupler interlock grounded, or alarm switch held at reset)  $10 \pm 1$  VDC, equipment not interlocked,  $0.5 \pm 1$  VDC.
10. Equipment interlocked by energizing motor relay or grounding coupler interlock only,  $0 \pm 1$  VDC; otherwise,  $27 \pm 2$  VDC.
11. Equipment in operate, key up,  $-0.1$  VDC; key down,  $+4.5$  VDC.
12. Equipment in standby or operate, unkeyed,  $0$  VDC; key down, in any AM or SSB mode, no signal,  $1.0 \pm 0.5$  VDC; key down, any mode with signal,  $1.0 - 4.0$  VDC; overload condition,  $9.9 \pm 1.0$  VDC.



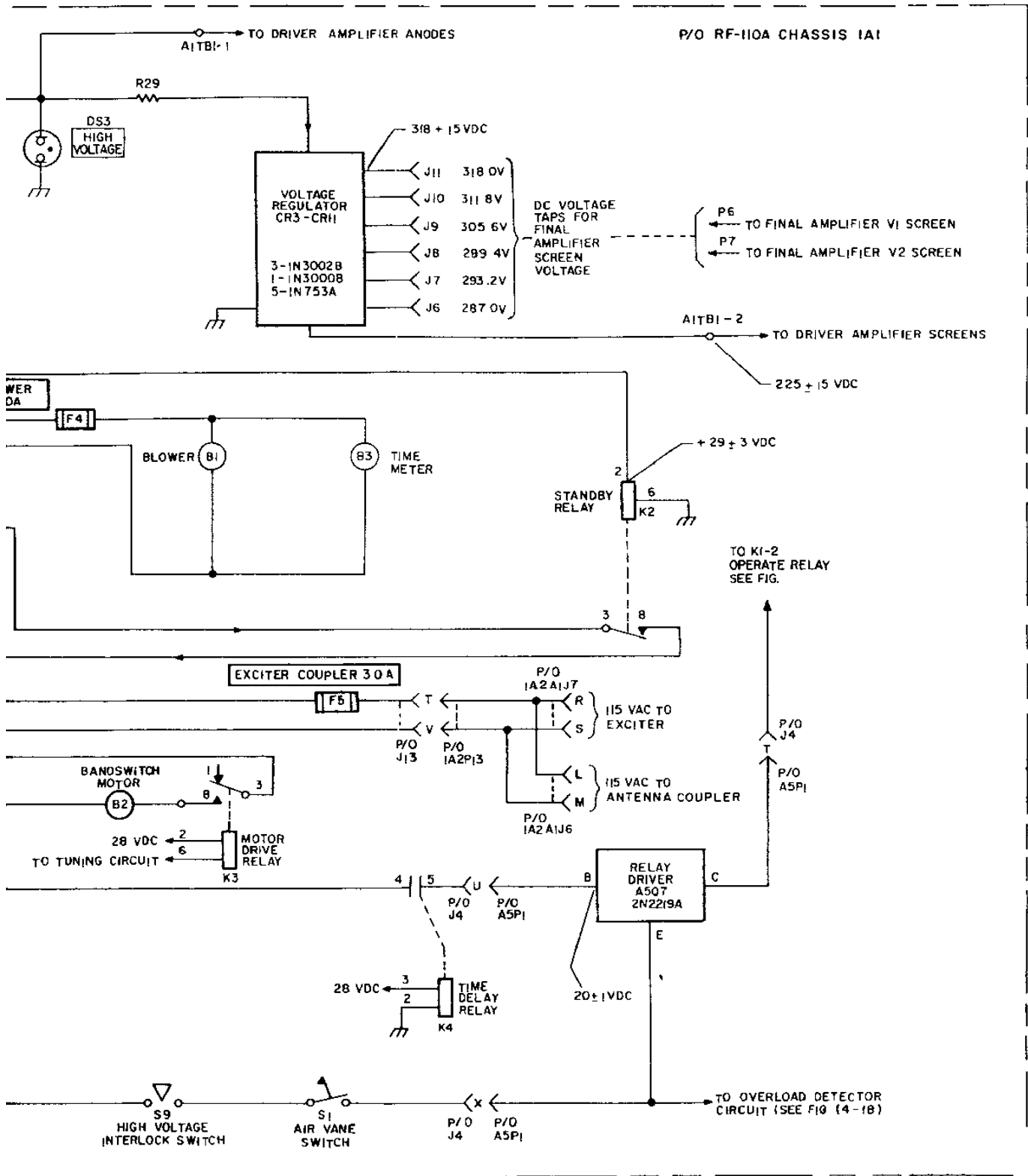
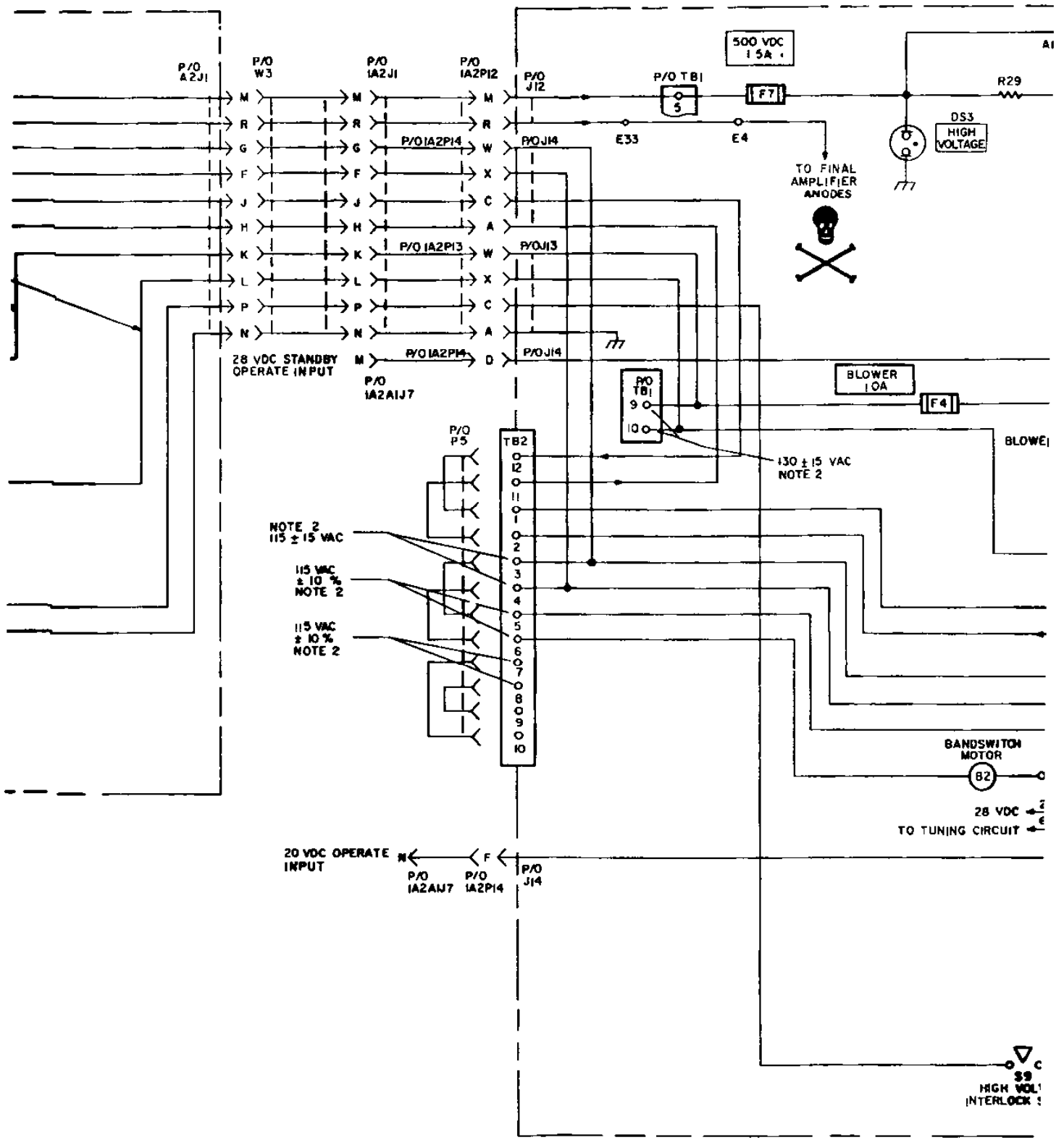


Figure 4-10. 60 Hz High Voltage Distribution Servicing Block Diagram

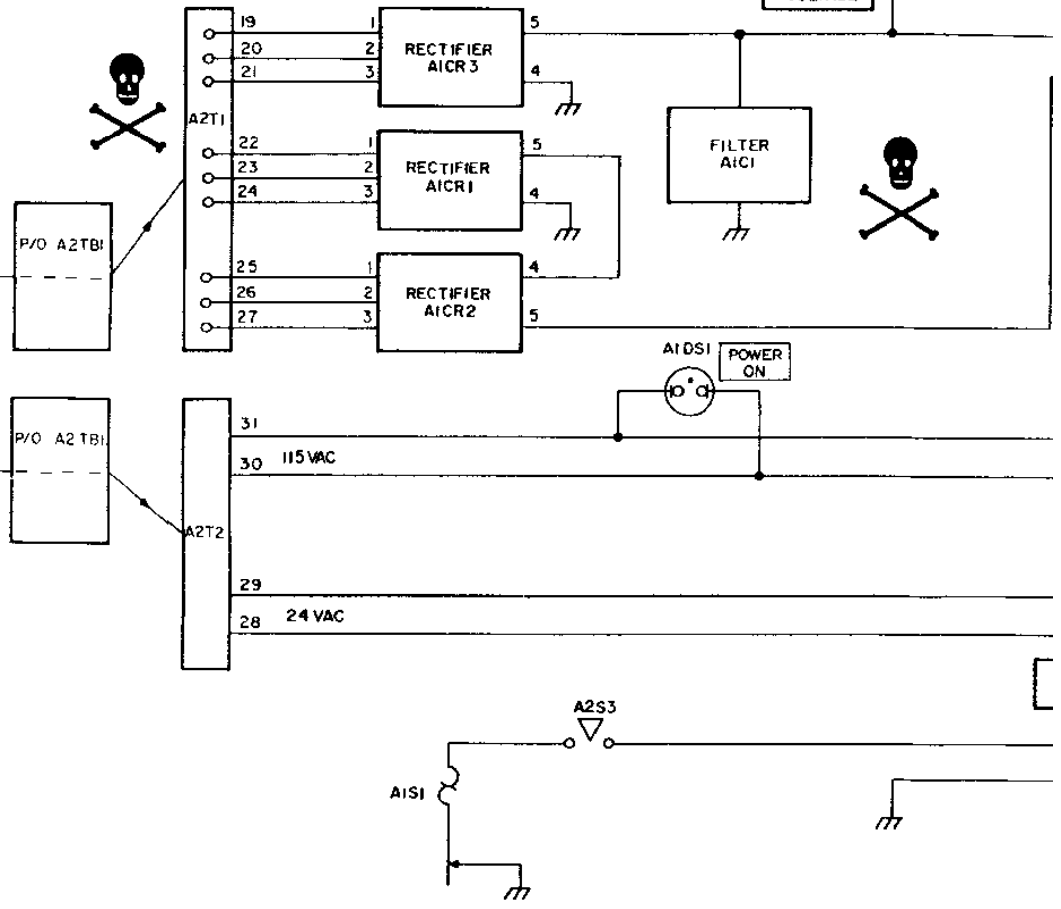




RF-112A UNIT 2

3 $\phi$  60 HZ  
PRIMARY POWER  
FROM RF-110A  
(SEE FIG 5-19 FOR  
PRIMARY PWR DISTR)

1 $\phi$  60 HZ  
SWITCHED PRIMARY  
POWER FROM  
RF-110A



## CHAPTER V

### MAINTENANCE

#### 5.1 DRIVER TUBES, BIAS ADJUSTMENT

When the plate current of either driver tube is greater than 300 milliamperes, or less than 200 mA, while the RF-110A is keyed, the driver tube bias requires adjustment. To adjust the bias proceed as follows (refer to figure 5-6 for parts location).

a. Set DRIVER BIAS ADJ (1A1R9) for 200 milliamperes on the tube drawing the lowest plate current.

b. When tube indicating lowest plate current is set for 200 milliamperes, plate current of other tube should be between 200 and 280 milliamperes. If it is not, a tube is defective and should be replaced, or there is a defect in the circuit.

#### 5.2 FINAL AMPLIFIER TUBES, SCREEN VOLTAGE ADJUSTMENT

The difference between the idling plate currents of final amplifier tubes should not exceed 40 milliamperes. When the difference exceeds 40 milliamperes, compensating adjustments in screen voltages should be made to reduce the difference, in order to maintain equal load sharing between the two tubes. To adjust the screen voltages proceed as follows:

a. With the RF-110A keyed in its linear mode (J7-G ungrounded) and with no RF input, observe PA PLATE 1 AMPERES and PA PLATE 2 AMPERES.

b. Set PA BIAS control so that higher of two meter indications in step a is 240 milliamperes.

c. Carefully note which final tube is drawing the higher plate current, and the difference in plate current between the two tubes.

d. Set RF-110A Key switch at NORMAL.

e. Locate screen voltage adjustment jacks J6 through J11 on left side of chassis (figure 5-6).

#### WARNING

Lethal voltages exist within the RF-110A during operation. Screen voltage (300 VDC) is present at jacks J6 through J11. Turn off all high voltage before touching the screen voltage adjustment jacks. To turn off high voltage, plate RF-110A in standby by removing 20V Operate from 1A2A1J7-N. Then check DS3 (HIGH VOLTAGE) to be sure it is turned off.

f. Observe position of two plugs coded P6 (brown) and P7 (red), screen voltage taps for tubes 1A1V1 and 1A1V2 respectively.

#### NOTE

Increasing the screen voltage will increase the plate current. Jacks J6 through J11 provide connections to a voltage divider network. Moving a screen voltage plug (P6 and P7) to a higher numbered jack will increase the plate current for that tube.

g. Determine which plug should be moved, from observation of relative position, and the difference in plate current noted in step c.

h. Move selected plug P6 or P7 to decrease plate current which is highest, or to increase current which is lowest.

i. Restore high voltage, then repeat a through c.

j. Repeat this procedure until difference between plate currents is less than 40 milliamperes.

#### 5.3 VSWR BRIDGE, REPAIR AND ADJUSTMENT

#### NOTE

VSWR bridge balance adjustment (C6) is a factory adjustment and should not

require field adjustment unless the bridge is disturbed by circuit repairs.

### 5.3.1 CRITICAL LEAD DRESS

Critical positioning requirements of the components of the VSWR Bridge Assembly 1A1A3 requires that corrective maintenance be performed at depot level. The following is the positioning information for the components listed:

- 1A1A3C1: 1) Body must be within 45° of vertical, i.e. at least 45° away from underside of shelf.  
2) 1/8 inch maximum lead length.  
3) Capacitor should be mounted as close as possible to the base of the terminal.

- 1A1A3T1: 1) Leads as short as possible without strain.  
2) No service loops on leads

- 1A1A3C6: 1) Body must be vertical.  
2) Squarely below access hole.  
3) Minimum length leads.

- 1A1A3R9: 1) Leads length 1/4 inch maximum, each lead.

### 5.3.2 ALIGNMENT

a. Terminate the RF-110A in a 50-ohm dummy load capable of dissipating 1 kW continuous power.

b. With the RF-110A withdrawn from its cabinet and with the cabinet interlock switches defeated, set up the exciter and RF-110A to deliver 1 kW of RF output at 21 MHz into the dummy load. (Use HP-410B + probe T to indicate power).

c. Rotate and hold the front panel power meter switch 1A1S8 to REFL PWR 0-150.

d. Insert a non-metallic screwdriver through the access hole in the VSWR bridge assembly and carefully adjust the BAL TRIMMER (C6) for minimum indication of the power meter.

e. Release power meter switch, (it will return to FWD PWR 0-150W position) and adjust 1A1R14 for true forward power.

f. This completes the adjustment.

## 5.4 BROADBAND TRANSFORMERS, TROUBLESHOOTING, AND ALIGNMENT

### NOTE

Alignment of the broadband transformers is very important to the overall performance of the RF-110A. Therefore, indiscriminate adjustment of the circuits without eliminating other possible causes of trouble or without proper test equipment should not be attempted.

Use logical troubleshooting procedures to eliminate all other possible sources of trouble. For example, if rated power output cannot be obtained using tubes known to be good, then the following checks and substitutions will aid in localizing the problem.

### NOTE

The following checks are accomplished with the RF-110A in its linear mode (i.e., J7-G ungrounded). When an RF input is required it is single tone.

a. The idling (no RF) PA PLATE CURRENT front panel multimeter should indicate between 240 and 280 mA each tube, key-down. (This is a check for proper bias voltage).

b. The PA PLATE CURRENT should not exceed approximately 750 mA per tube in linear mode. Typical plate currents will be 550 to 650 mA, but they can go as high as 720 mA at some frequencies in class B mode.

c. PA PLATE VOLTS and PA-DRIVER SCREEN VOLTS on the multimeter should indicate 2000 volts minimum and  $290 \pm 50$  volts respectively, with the RF-110A delivering its maximum obtainable output. Screen voltages of less than 290 volts under this condition may be indicative of excessive screen current (especially if there is a change from key-up to key-down). Excessive screen current can be caused by component failure in the broadband tank circuits, misadjustment of the broadband tank circuits, of high VSWR loads.

d. Connect a 50 ohm dummy load and a "through-line" type of wattmeter (BIRD model 43 for example) in place for the output load. This will confirm the accuracy of the front panel meter indication as well as insure a "known" load. If the RF-110A performs normally after this substitution, an investigation of the antenna system is called for.



e. If the problem persists, check operation on other bands. Attempt to isolate the problem to one band or to a group of bands. If the problem can be isolated in this manner, the assembly schematic will reveal the components which are common to the band(s) in question.

Parts replacement within one of the broadband transformer assemblies 1A1A2 and 1A1A4 may require a realignment of the band(s) to which the part is common. This is due to tolerance variation of the replacement part. Determine the need for realignment by comparing equipment performance at the low, middle and high frequencies of each band affected with items b. and c. above. If these requirements cannot be met while delivering 1 kW of RF output into a 50 ohm dummy load, then a realignment is indicated.

#### 5.4.1 CONTINUITY CHECK

To check for proper continuity between the final transformer assembly switch and coil connections proceed as follows:

##### WARNING

Lethal voltages exist in the vicinity of the input terminal of final transformer assembly 1A1A2 and the anodes of final amplifier tubes 1A1V1 and 1A1V2. Observe the following precautions.

1. Remove all power before removing cover over final tubes.
2. Short to ground all terminals before touching with bare hands, using a heavy screwdriver with insulated handle, or a shorting stick.
3. Ensure that 20V operate cannot be applied to 1A2A1J7-N.
4. Always check that DS3 (High Voltage) is extinguished before touching anything in the vicinity of the final tubes.

a. Connect an ohmmeter between center lead of coaxial cable and input terminal on Final Transformer Assembly 1A1A2 top plate. Check for continuity with Final Transformer Assembly 1A1A2 switch in positions one through nineteen (20 through 24 are not used).

b. Connect an ohm meter between center lead of coaxial cable and ungrounded end of capacitor 1A1A2C10 (figure 5-23), check continuity for switch positions one through nineteen.

c. Connect an ohm meter between center lead of coaxial cable and top or bottom plate of final transformer nineteen again. Switch positions one through nineteen should check open (infinity).

#### 5.4.2 TEST EQUIPMENT REQUIRED

The following test equipment will be required for alignment:

a. Dummy Load, 2–30 MHz, 1 kW continuous rating.

b. Alignment Tools (standard non-metallic 0.100 inch hex with undercut shaft, and a 1/4 inch nut driver).

c. RF Detector Test Fixture (figure 5-1). This test fixture may be purchased from RF Communications (part no. 1001-0041) or fabricated from standard parts. If fabricated, the components should be mounted on a surface no larger than 1/2 by 3/4 inches, with lead lengths no longer than 1/4 inch.

d. Swept RF Signal Generator and scope.

The following alignment procedures are described for use with a Texscan Model VS30 Signal generator and a dual trace oscilloscope. However, any equipment having the following characteristics will be adequate:

0.5V RMS RF output from 2–35 MHz.

Sweep widths up to 5 MHz.

Markers at 0.5 MHz and 1.0 MHz increments.

Remote Flattening Input\*.

\*Remote flattening is an AGC type of input. It is used to maintain the RF voltage at a constant level at some point in the circuit being swept. An RF detector is placed at the point in question and its DC output is returned as an AGC voltage to the sweep generator.

e. An electronic voltmeter (such as the Hewlett Packard model HP-410B) capable of measuring 2–30 MHz, 300V RMS.

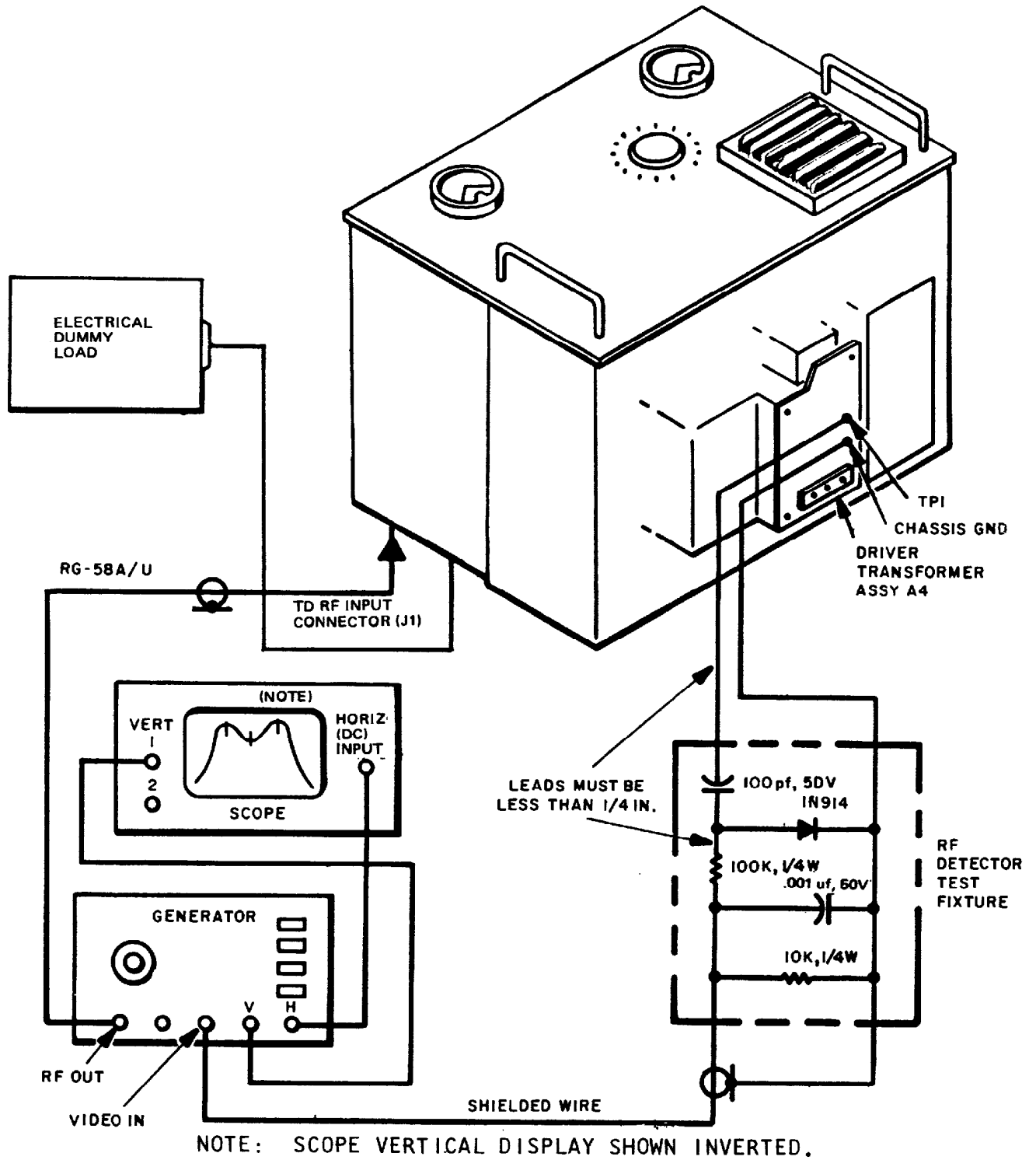


Figure 5-1. Driver Transformer Alignment, Test Setup

### 5.4.3 DRIVER TRANSFORMER ALIGNMENT

To align one of the driver broadband transformers, proceed as follows:

- a. Loosen front panel screws, and slide the RF-110A chassis out from the case until the slides lock. Tilt 90° to expose the underside. Do not turn the RF-110A on yet.
- b. Disconnect the cables from the RF input (1A1J1) and the RF output (1A1A3J2).
- c. Connect the 1 kW 50-ohm dummy load to the RF output connector (1A1A3J2 on the VSWR Bridge Assembly) via a length of 50-ohm coaxial cable.
- d. Connect the Sweep/Generator RF output to the RF input of the RF-110A (connector 1A1J1 on the rear chassis).

#### NOTE

This alignment is made with the RF-110A in its linear mode (i.e., J7-G ungrounded) and with a single tone RF input. If an exciter is connected to the set, use AM or single sideband mode, with no exciter RF input to the RF-110A (the signal generator will provide the RF signal).

e. Disable the final tubes by unplugging and grounding (with clip leads) the final screen plugs P6 and P7. (Be sure the RF-110A is turned off.) These are located on the left side of the unit just forward of the RF connectors. Note which jack each plug is located in (J6-J11) so they can later be returned to the same jacks. Be sure both plugs are grounded.

f. Locate TP1 on the Driver Transformer Assembly (bottom rear of the unit). Connect the RF detector to TP1 as shown in figure 5-1. The output from the RF detector is delivered to the sweep generator VIDEO IN via shielded wire or coaxial cable.

g. With the generator RF output set at minimum, defeat interlock switches 1A1S10 and 1A1S11. Place the RF-110A in standby and wait about 10 minutes for warm-up.

h. Energize the high voltage circuits. See front panel key switch at LOCAL KEY. Check

DRIVER 1 AMPERES and DRIVER 2 AMPERES from front panel multimeter. Set the lower of the two currents to 200 mA using the Bias Adjust pot 1A1R9, (left side of chassis). The greater of the two currents should then not exceed 280 mA. Unkey the amplifier.

#### NOTE

Driver bands 1–8 (2–8 MHz) consist of single tuned circuits. The coils for bands 1 and 2 have individual coil forms (A1 and A2 respectively); however, bands 3 and 4, 5 and 6, 7 and 8 are each mounted two bands per coil form on A3, A4 and A5 respectively. Insert the alignment tool “shallow” for low band adjustment and “deep” for high band adjustment on these three coil forms. Bands 9–19 are double tuned circuits, with both the primary and secondary windings on the same form (A6–A16 respectively). Insert alignment tool shallow for primary and deep for secondary.

i. Set sweep generator and the RF-110A to band to be aligned. Adjust the generator RF output level to approximately 0.5 volts.

j. Adjust the generator sweep range, sweep speed and marker amplitude for a convenient display. The display should show a band of frequency one and a half to two times wider than the band being aligned.

#### NOTES

1. If it is difficult to determine which marker is which, connect a calibrated signal generator to EXT MARKER IN on the swept generator. This provides a variable marker of known frequency.

2. Insure that sweep speed is slow enough for detector to accurately follow the RF envelope skirts.

k. Locate the coil to be aligned, and adjust for the following pattern on the display scope. The pattern should be symmetrical about the center frequency, with the band edge markers at equal amplitudes. Band edges are given in table 5-1. On double-tuned circuits, adjust the primary winding (shallow adjustment) first. When adjusting coil

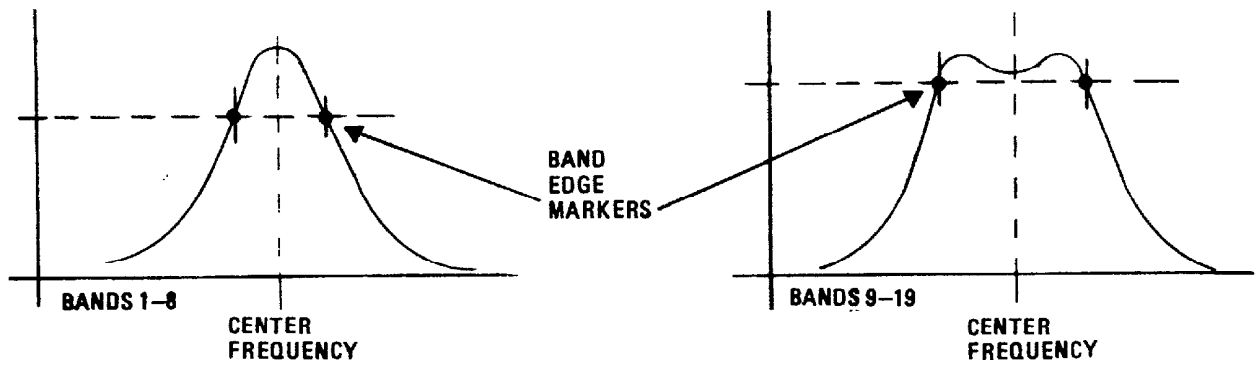


TABLE 5-1. DRIVER TRANSFORMER, BAND EDGES

BAND	COIL FORM	LOW EDGE	CENTER FREQUENCY	HIGH EDGE
1	A1	2.00 MHz	2.25 MHz	2.50 MHz
2	A2	2.50 MHz	2.75 MHz	3.00 MHz
3	A3	3.00 MHz	3.25 MHz	3.50 MHz
4	A3	3.50 MHz	3.75 MHz	4.00 MHz
5	A4	4.00 MHz	4.50 MHz	5.00 MHz
6	A4	5.00 MHz	5.50 MHz	6.00 MHz
7	A5	6.00 MHz	6.50 MHz	7.00 MHz
8	A5	7.00 MHz	7.50 MHz	8.00 MHz
9	A6	8.00 MHz	9.00 MHz	10.00 MHz
10	A7	10.00 MHz	11.00 MHz	12.00 MHz
11	A8	12.00 MHz	13.00 MHz	14.00 MHz
12	A9	14.00 MHz	15.00 MHz	16.00 MHz
13	A10	16.00 MHz	17.00 MHz	18.00 MHz
14	A11	18.00 MHz	19.00 MHz	20.00 MHz
15	A12	20.00 MHz	21.00 MHz	22.00 MHz
16	A13	22.00 MHz	23.00 MHz	24.00 MHz
17	A14	24.00 MHz	25.00 MHz	26.00 MHz
18	A15	26.00 MHz	27.00 MHz	28.00 MHz
19	A16	28.00 MHz	29.00 MHz	30.00 MHz

When alignment is completed, unkey the RF-110A, turn off the high voltage, remove test equipment, replace the final screen plugs in their previous jacks and restore the chassis into the case.

forms with two windings, do not position either slug between the windings.

#### 5.4.4 FINAL TRANSFORMER ALIGNMENT

Alignment of the final broadband transformers is accomplished as follows:

a. Loosen front panel screws, and slide the RF-110A chassis out from the case until the slides lock. Defeat interlocks 1A1S10 and 1A1S11. (Do not apply power to RF-110A.) Tilt 90° to expose the underside.

b. Disconnect the cables from the RF input (1A1J1) and the RF output (1A1A3J2).

c. Connect the 1 kW 50-ohm dummy RF load to the RF output connector (1A1A3J2 on the VSWR Bridge Assembly) via a length of 50-ohm coaxial cable (RG-58A/U or RG-58C/U).

d. Connect the Sweep Generator RF output to the RF input of the RF-110A (connector 1A1J1 on the rear of the chassis).

e. Finish connecting the test setup as shown in figure 5-2.

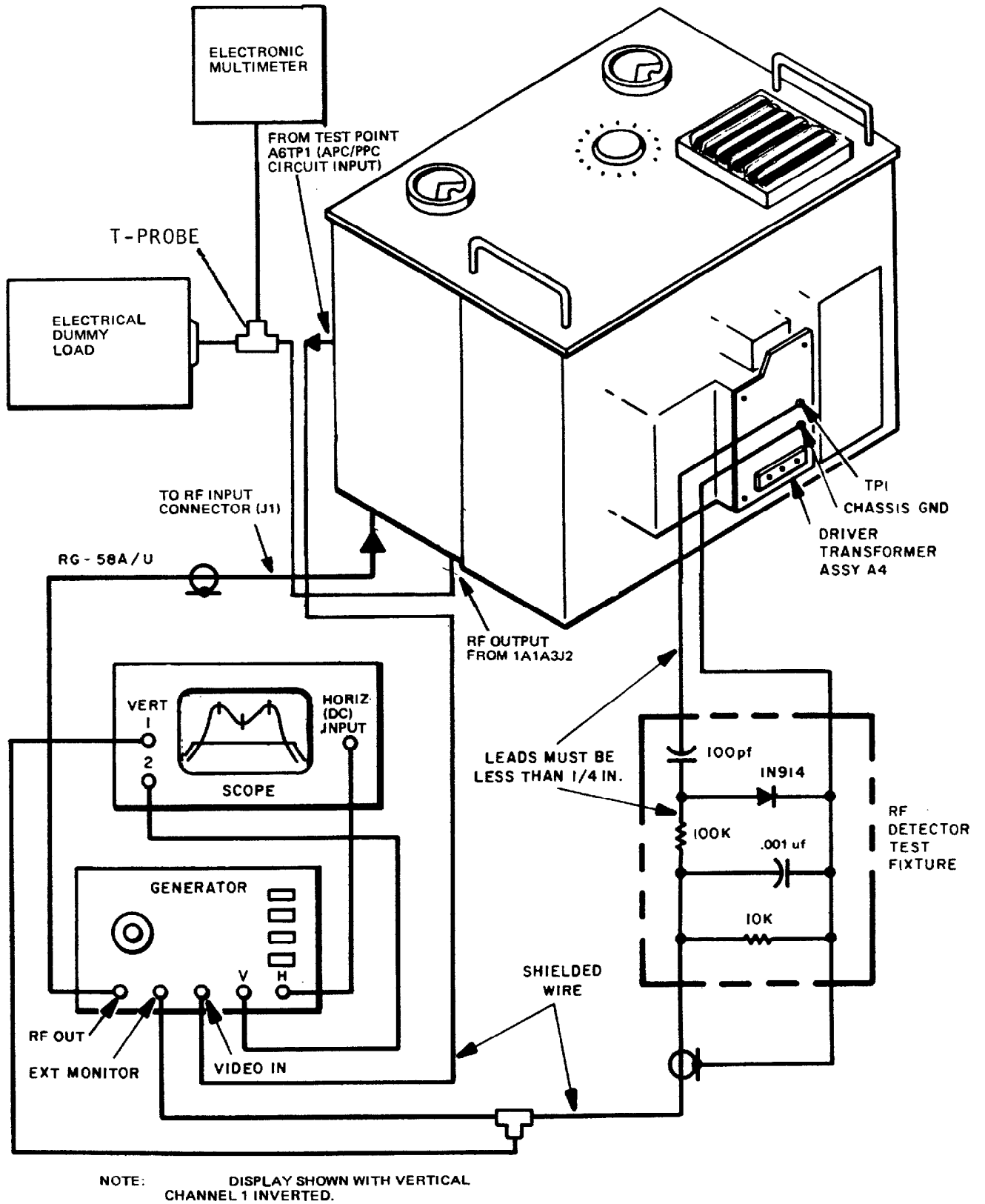


Figure 5-2. Final Transformer Alignment, Test Setup

The detector test fixture may be purchased from RF Communications or fabricated (see paragraph 5.4.2).

#### NOTE

This alignment is made with the RF-110A in its linear mode, that is, with J7-G ungrounded.

f. Set PRIMARY POWER switch ON. Apply 28V Standby/Operate to 1A2A1J7-M to put RF-110A into standby mode.

g. Turn on all test equipment and allow fifteen minutes for warmup.

h. Set up the RF signal generator for approximately 0.5V RF output

#### CAUTION

To avoid getting into internal PPC control insure that front panel power pot is at max CW rotation and do not let power output exceed about 100 watts

#### NOTE

Measure RF power at the dummy load with the voltmeter, using formula.

$$\text{Watts} = \frac{(\text{voltmeter reading})^2}{50 \text{ ohms}}$$

(70.7V is 100 watts, 100V is 200 watts)

i. Set up the oscilloscope to display both channels. Invert vertical channel 1 to obtain waveform shown.

j. Final transformer circuits for bands 1 and 2 must be aligned together; they are mounted on coil forms 1 and 2. Similarly, bands 3 and 4 must be aligned together, they are mounted on coil forms 3 and 4. To align bands 1 and 2 or 3 and 4, proceed as follows

(1) Set the RF-110A Frequency MHz controls to the higher of the two bands to be aligned according to table 5-2 (either 2.5 - 2.0 MHz or 3.5 - 4.0 MHz).

(2) Set up sweep generator and oscilloscope to sweep the same band.

(3) Set Key Switch at LOCAL KEY.

#### NOTES

The second trace on the oscilloscope will display the flat topped waveform of the remote flattening (AGC) input to the sweep generator. The flat portion of the wave must always be one and a half to two times wider than the band being aligned. This may necessitate reducing signal generator output.

If realignment is considered necessary, preset black coded adjustment on A1 (or A3) maximum clockwise, plain adjustment on A1 (or A3) maximum counterclockwise, and black adjustment on A2 (or A4) maximum counterclockwise.

(4) Insert marker frequencies as indicated for higher hand according to table 5-2

(5) Turn black color coded adjustments on A2 (or A4) and uncoded adjustment on A1 (or A3) for maximum amplitude and linearity between band edge markers. Table 5-2 indicates typical waveforms.

(6) Set KEY switch at NORMAL.

(7) Set FREQUENCY MHZ switch to lower band (i.e., 2.0 to 2.5 MHz or 3.0 to 3.5 MHz).

(8) Set up signal generator and scope to sweep lower band.

(9) Insert marker frequency for high and low ends of band as indicated in table 5-2.

(10) Set Key switch at LOCAL KEY.

(11) Tune black colored adjustment on A1 (or A3) for maximum amplitude and linearity between band edge markers. Table 5-2 indicates typical waveforms

(12) Set Key switch at NORMAL.

(13) Repeat steps (1) through (12) above until best compromise is obtained between two bands.

(14) If no other final transformer bands are to be aligned, restore the set to normal and proceed to alignment check procedure paragraph 5.4.5.

k. Coil forms 5 through 19, for frequency bands 5 through 19 (table 5-2), each contain two coils which form a double-tuned circuit. To align any one of these bands proceed as follows:

(1) Set the RF-110A FREQUENCY MHZ control at the band to be aligned.

(2) Set up Signal Generator and scope to sweep band to be aligned.

(3) Insert marker frequencies at high and low ends of band to be aligned as called out in table 5-2.

#### NOTE

On the top of the coil forms, the primary coil adjustment is color coded black, the secondary coil adjustment has no color coding. Before starting alignment, preset secondary coil adjustment fully counter-clockwise and primary adjustment fully clockwise.

(4) Set Key switch to LOCAL KEY.

(5) Tune coil form primary and secondary for maximum amplitude and linearity between band edge markers as shown. Table 5-2 indicates typical waveforms.

(6) Set Key switch at NORMAL.

l. Set RF Generator Output to zero.

m. If no other final transformer bands are to be aligned, restore the set to normal and proceed to paragraph 5.4.4 and perform the alignment check.

#### 5.4.5 FINAL TRANSFORMER ALIGNMENT CHECK

The following procedure will check the final transformer assembly after an alignment has been performed.

a. Connect a signal generator at a frequency of 2.000 MHz to RF input jack 1A1J1.

b. Connect a 50-ohm 1 kW dummy load and an RF voltmeter (HP-410B) to RF output connector 1A1A3J2.

c. Set the RF-110A FREQUENCY MHZ control to its lowest channel.

d. Set the Key Switch at LOCAL KEY to key the RF-110A at 2.000 MHz in a linear mode (1A2-A1J7-G not grounded).

e. Adjust the output level from the signal generator until the RF voltmeter connected to the dummy load indicates 224V (1000W RF output).

f. Check the plate current for 1A1V1 for 1A1V2 and the RF input power. The RF input power from the signal generator should not exceed 100 mW and the plate current for each final tube should be less than 750 mA.

g. Set the Key switch at NORMAL.

h. Following the procedure above, select the band edges for each band in table 5-1 and check RF drive and final plate currents at each frequency. Record any band which requires RF drive of more than 100 mW. Also record any band in which the plate current for either tube exceeds 750 mA or the difference in plate current for one tube exceeds 40 mA between band edge frequencies for the same band.

#### NOTE

Minor adjustment of primary tuning slugs may be made to balance currents at band edges. Do not readjust secondary tuning slugs.

i. After all nineteen bands have been checked, repeat the final transformer alignment procedure (paragraph 5.4.3), for any band which exceeded the limits specified in step h.

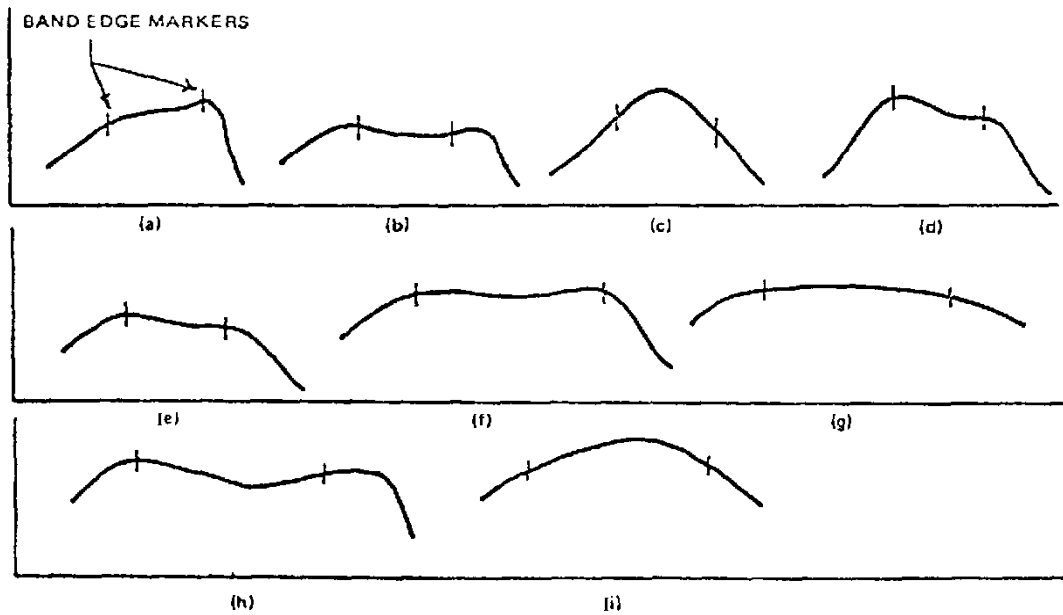
#### 5.5 GENERAL PARTS REPLACEMENT TECHNIQUES

##### 5.5.1 RF-112A TRANSFORMER

If either transformer 2A2T1 or 2A2T2 on the RF-112A requires replacement, the complete transformer and case assembly must be replaced. Remove the components from the discarded assembly and install them on the new transformer and case assembly.

TABLE 5-2. FINAL TRANSFORMER BAND EDGES

BAND	APPLICABLE ADJUSTMENT	REMARKS	SWEEP PATTERN	EDGE MARKERS MHz
1	A1 (black)	Align band 2 first	(a)	2, 2.5
2	A2 (black) and A1 (plain)		(b)	2.5, 3
3	A3 (black)	Align band 4 first	(c)	3, 3.5
4	A4 (black) and A3 (plain)		(d)	3.5, 4
5	A5, both screws	Adjust primary first (black screw)	(d)	4, 5
6	A6, both screws		(d)	5, 6
7	A7, both screws		(e)	6, 7
8	A8, both screws		(e)	7, 8
9	A9, both screws		(f)	8, 10
10	A10, both screws		(f)	10, 12
11	A11, both screws		(f)	12, 14
12	A12, both screws		(f)	14, 16
13	A13, both screws		(g)	16, 18
14	A14, both screws		(f)	18, 20
15	A15, both screws		(h)	20, 22
16	A16, both screws		(i)	22, 24
17	A17, both screws		(i)	24, 26
18	A18, both screws		(i)	26, 28
19	A19, both screws		(i)	28, 30





### 5.5.2 RF-110A FRONT PANEL

The socket-mounted electrolytic capacitors 1A1C29, 1A1C30, and 1A1C31, and front-panel-mounted components on the RF-110A will be more accessible if the front panel is loosened. The front panel is secured to the chassis by two machine screws on each side and one in the center panel. If the top machine screw on each side and one screw in panel center are removed, and the bottom ones loosened, the panel can be tipped forward slightly.

#### CAUTION

If all five mounting screws are removed and the front panel is allowed to hang without other support the interconnecting wires may be damaged.

### 5.5.3 DRIVER AND FINAL TRANSFORMER ASSEMBLY SWITCHES

The switches used for band selection on the Final and Driver transformer assemblies are 24 position switches (only 19 positions are used for the nineteen bands). These switches require accurate indexing to assure proper band selection. Also, the switches are located in the center of the assemblies surrounded by transformer assemblies. Lead dress to some of the transformer assemblies is critical, and will affect alignment of other nearby assemblies. For these reasons, the removal and replacement of the switches or any of the transformer assemblies should only be attempted by factory trained personnel. Return the transformer assemblies to the factory for repair or replacement of a switch or a transformer.

### 5.5.4 FINAL TRANSFORMER ASSEMBLY REMOVAL

When removing the final transformer assembly (1A1A2) in the RF-110A, observe the following:

The RF input connection (strap), from the tube compartment must first be disconnected. Remove the cover plate from over the tube compartment, then remove the screw securing the strap to the contact block.

#### WARNING

Lethal voltages may be present in this area. Disconnect all power to the RF-110A. Short tops (plates) of tubes to ground with a heavy screwdriver with insulated handle to discharge capacitors before attempting to loosen strap.

Disconnect the Final Transformer Assembly output coaxial cable from connector 1A1A3J2 on the VSWR bridge. Remove the screw securing the cable clamp on the Final Transformer Assembly output coaxial cable located near motor relay 1A1K3. Loosen the final transformer assembly by loosening the four mounting screws at the base of the assembly, accessible through holes in the top plate. A long shank blade type screwdriver will be required.

When reinstalling, loosen the small angle brackets, one at each corner of the top plate. After installation push them firmly against the walls and tighten the screws. Be sure the rubber grommet on the output coaxial cable is properly installed in the slot in the chassis position.

#### CAUTION

The coupling will properly mate the first time the bandswitching motor is energized and rotates one full revolution. Do not attempt to rotate transformer assembly rotor by hand, in order to properly index it. You may damage the switch. Before operating the transmitter, be sure to run the bandswitch motor through at least one full revolution.

### 5.5.5 ACCESS TO TUBE SOCKET AREA

To obtain access to Power Amplifier tubes 1A1V1 and 1A1V2 socket assembly, proceed as follows.

- a. If circuitry around tube sockets require repair, remove tube 1A1V1 and 1A1V2 (paragraph 5.7). Be sure and tag each tube for replacement in the socket from which it was removed (screen voltage taps are set up independent for each tube to balance plate current).

## WARNING

Lethal RF and DC voltages exist on the connections and tube terminations. Determine that the equipment is fully de-energized and secured at the primary power source. Then short all exposed terminals to ground.

- b. Remove screws holding two cable clamps to edge of chassis near Driver Amplifier Assembly 1A1A1 and Driver Transformer Assembly 1A1A4.
- c. Remove the Driver Amplifier Assembly 1A1A1 (steps c. through f. of paragraph 5.8).
- d. Disconnect 6 wires to Driver Transformer Assembly 1A1A4.
- e. Remove Driver Transformer Assembly 1A1A4.
- f. Remove protective cover over 1A1TB1 and 1A1TB2.
- g. Remove nine screws securing bottom plate to chassis.
- h. Swing bottom plate out of the way (wires need not be unsoldered).

## 5.6 PRINTED CIRCUIT BOARD PARTS REPLACEMENT

### CAUTION

Before removing or installing PC Boards, turn off primary power to P.A.

When removing DC Power Control Assembly 1A1A5 or APC-PPC Assembly 1A1A6, lift up on both retaining levers simultaneously, to prevent tilting of the board which could damage the board or socket.

To remove either printed circuit board, grasp the two levers and simultaneously swing them upward and out. The action will automatically release the board, and extract it from its socket. When repairing the printed circuit boards, the procedures below should be carefully followed to avoid damage.

- a. Use a pencil-type soldering iron with 25 watt maximum capacity. If only AC operated

irons are available, use an isolating transformer. Do not use a soldering gun; excessive heating can occur and voltages can be induced into the components.

- b. When soldering transistors or diodes, solder quickly; where wiring permits, use a heat sink (such as long nosed pliers) between the soldered joint and the body of the part being replaced.

- c. Excessive heat or pressure can lift the copper strip from the board. Copper that lifts off from the board should be cemented in place with a quick drying acetate base cement having good electrical insulating properties.

- d. Use only high quality rosin core solder when repairing printed circuit boards. NEVER USE ACID CORE SOLDER OR PASTE FLUX.

- e. A break in the copper traces of a printed circuit board should be repaired by soldering a short length of tinned copper wire across the break.

- f. When removing parts from the printed circuit board, apply heat sparingly to the lead of the part to be replaced. Remove the part from the printed circuit board as the iron heats the lead. Use an awl to carefully clean the inside of the holes left by the old part.

- g. When the part is replaced, tin the leads on the new part. Bend the clean tinned leads on the new part and carefully insert them through the holes in the printed circuit board. Bend the leads onto the foil and cut so that approximately one-sixteenth of an inch of lead is left. Hold part against the board and quickly solder the leads.

## 5.7 POWER AMPLIFIER TUBES REPLACEMENT

To remove either of the final power amplifier tubes from the RF-110A proceed as follows:

- a. Set PRIMARY POWER switch to OFF.
- b. Loosen eight captive screws on the front panel and slide chassis out from the case until chassis slides lock.
- c. Remove and set aside ten machine screws which secure safety cover over tubes on top rear of chassis (figure 5-7).
- d. Remove cover

## WARNING

Lethal RF and DC voltages exist on the connections and tube terminations. Determine that the equipment is fully de-energized and secured at the source. Then carefully short all exposed terminals to ground.

- e. Use a screwdriver with a well insulated handle or a shorting stick to short metal tops of both tubes to ground.
- f. Carefully release tube clamp snap. Lift tube clamp off tube.
- g. Without lifting, carefully rotate tube counter clockwise approximately sixty degrees until tube is free in socket. (Further rotation will be prevented by a hidden pin on bottom of socket).

## CAUTION

When lifting the tube out of the socket proceed slowly. If the tube catches, rock the tube gently to free it. Excessive force can damage tube and socket contacts.

- h. Lift tube straight up from socket and set it aside. To install a final power amplifier tube proceed as follows:

## NOTE

Before replacing tube, carefully inspect tube contacts on the tube and in the tube socket for signs of damage, or for signs of arcing which could indicate loose or improperly meshing contacts.

To reinstall either of the final power amplifier tubes proceed as follows:

- a. Observe guide pin in hole in base of tube, and orient tube so that guide pin mates with one of the slots in center guide post in tube socket.
- b. Gently lower tube over guide post and into socket until tube touches bottom.
- c. Carefully rotate tube clockwise. Tube should rotate approximately sixty degrees, with moderate mechanical resistance as contacts mesh, until a hidden pin prevents further rotation.

- d. Push tube clamp down over tube end.
- e. Lock tube clamp snap.
- f. Replace safety cover over tubes securing it with ten machine screws which were previously removed.
- g. Record the elapsed time meter reading so that an accurate record of the elapsed operating time for the new tubes may be maintained. (For highest performance, it is advisable to change the tubes in the final amplifier stage after 1000 hours of operation otherwise operation may be continued until high plate current, or other circuit malfunctioning becomes apparent.)
- h. Refer to paragraph 5.2 and perform the complete screen voltage adjustment.

## 5.8 DRIVER AMPLIFIER TUBE REPLACEMENT

To remove either of the RF-110A driver amplifier tubes proceed as follows:

- a. Set PRIMARY POWER switch at OFF.
- b. Loosen eight captive screws on front panel and slide RF-110A chassis from case until chassis slides lock.
- c. Release chassis slide tilt locks and swing chassis up to vertical position.

## WARNING

Lethal RF and DC voltages exist on the connections and tube terminations. Determine that the equipment is fully de-energized and secured at the primary power source. Then carefully short all exposed terminals to chassis ground.

- d. Remove shield from over terminal board 1A1A1TB1 on bottom of Driver Amplifier Assembly (figure 5-8).
- e. Remove wires from terminal board 1A1A1TB1.
- f. Loosen two captive screws and carefully lift Driver Amplifier Assembly out from chassis. (Do not snag contact fingers on left side.)

- g. Release tube clamp snap on tube to be removed.
- h. Place a blunt tool against base of tube through underside of socket and push tube out. (These tubes fit very tightly in their sockets; be prepared to catch tube when it suddenly pops out.)

To install a driver amplifier tube, proceed as follows:

- a. Orient tube to properly align pins and plug it into socket.
- b. Engage and lock tube clamp snap.

#### CAUTION

While installing the Driver Amplifier Assembly observe that the sprint contacts located between driver tube assembly 1A1A1 and driver transformer assembly 1A1A4 mate properly.

- c. Carefully guide Driver Amplifier Assembly into position on bottom of the main chassis and secure by tightening two captive screws. Ensure that edges of Driver Amplifier Assembly mate properly with their slots in main chassis.
- d. Reconnect wires removed from 1A1A1TB1.
- e. Replace shield over terminal board 1A1A1-TB1.
- f. Perform driver tube bias adjustment (paragraph 5.1).

### 5.9 TRANSMISSION ASSEMBLY MOTOR REPLACEMENT

#### CAUTION

The RF-110A final and driver transformer assemblies will not properly tune if the two couplings on the transmission assembly are not properly indexed after motor replacement.

To small indexing blocks, constructed according to paragraph 5.14, will be required to properly index the couplings on the unit during reassembly. To replace the transmission assembly drive motor, proceed as follows:

- a. Remove final tubes (paragraph 5.7).
- b. Disconnect 1A1A2P1 from VSWR bridge assembly 1A1A3J1.
- c. Remove cable clamp on coaxial cable near 1A1A2P1.
- d. Loosen screw from strap on contact block on final transformer assembly 1A1A2.
- e. Loosen four captive screws and remove final transformer assembly.
- f. Unsolder two handswitch motor leads at standoff terminals on side of chassis plenum.
- g. Remove ten wires from 1A1A1TB1 on Driver Amplifier Assembly.
- h. Remove Driver Amplifier Assembly 1A1A1.
- i. Remove six wires from 1A1A4TB1 on Driver Transformer Assembly.
- j. Remove Driver Transformer Assembly 1A1A4.
- k. Remove nine screws securing bottom plate and swing plate aside for access to air seal plate.
- l. Remove the three screws securing the air seal plate over the transmission assembly and remove plate.
- m. Remove transmission assembly from main chassis by removing four screws which secure assembly chassis (two in cavity for Final Transformer Assembly 1A1A2 and one accessible through each final tube cooling chimney).
- n. Remove screws securing cover to side of transmission assembly and remove cover.

#### CAUTION

Mechanical support must be provided when installing or driving out pins to prevent damage to the bearing.

- o. Remove retaining ring that secures final transformer coupling to motor shaft. Remove coupling.

- p. Drive out pin at end of motor shaft and remove spring and flat washers (note order of removal in order to assist in later reassembly).
- q. Drive out pin securing gear to motor shaft. If necessary, rotate the gears to expose pins by hand, or by inserting a screwdriver in end of driver transformer coupling shaft and turning counter-clockwise.
- r. Remove retaining ring securing bearing on motor shaft.
- s. Remove three screws securing motor to transmission assembly; remove and discard defective motor.
- t. Put sprocket and gear into transmission assembly in line with the hole in the housing. Position gear to mesh with adjacent gear.
- u. Install motor by passing shaft through assembly opening, sprocket, and gear.
- v. Seat motor and secure with three screws removed in steps.
- w. Push bearing down on motor shaft and snap into hole in housing. (Bearing may remain in housing on some assemblies, eliminating the need for this step.)
- x. Install bearing retaining ring on motor shaft.
- y. Install two spring washers and one flat washer on motor shaft in same order removed.

NOTE

If pin is damaged, replace pin in end of motor shaft with type MS35677-3.

- z. Reinstall coupling drive pin removed in step p.
- aa. Slip coupling over drive pin and secure with coupling retaining ring removed in step o.
- ab. Position the two indexing blocks (constructed according to paragraph 5.14 and figure 5-3) over the two couplings on the transmission assembly so that the slots in the two couplings are pointed in the same direction.

ac. Temporarily install (but do not tighten) a No. 4 set screw in large gear on motor shaft.

ad. With gears engaged, hold transmission assembly with motor on bottom, and apply pressure to rotate large gear on motor shaft clockwise (as viewed from shaft end) to absorb backlash. (Indexing blocks will prevent gear from turning.) Maintain clockwise pressure on gear while tightening set screw to lock gear position.

ae. Drill and pin gear on motor shaft, using a 1/16 inch drill and pin removed in step q. (Drill new pin hole at right angles to old hole in gear to prevent breaking drill.) When pinning is complete remove set screw.

NOTE

If pin for either gear or sprocket was damaged during removal, replace with a type MS51987-70.

af. Hold sprocket firmly against gear to ensure clearance at transmission assembly wall. Drill a 1/16 inch hole through sprocket hub shaft and pin.

ag. Remove indexing blocks.

ah. Install transmission assembly cover removed in step n.

ai. Install transmission assembly by positioning assembly under chassis and replacing four screws removed in step m.

aj. Replace air seal plate.

ak. Replace bottom plate.

al. Solder two motor leads removed in step f, to standoff terminals on side of chassis plenum.

am. Reinstall Driver Transformer Assembly 1A1A4.

an. Reinstall Driver Amplifier Assembly 1A1A1

ao. Reconnect the chassis cable connections to 1A1A4TB1 (on Driver Transformer Assembly 1A1A4) and 1A1A1TB1 (on Driver Amplifier Assembly 1A1A1).

ap. Reinstall Final Transformer Assembly 1A1A2 (paragraph 5.5.4).

aq. Reinstall two final tubes. (Be sure to replace each tube in socket from which it was originally removed or readjustment of screen voltage taps, to equalize tube plate currents, will be necessary.)

### **5.10 FINAL TRANSFORMER COUPLING INSTALLATION AND ALIGNMENT**

This procedure is required when the switch has been replaced, or when any other repair has been made which would affect alignment between the coupling and the switch contacts.

#### **NOTE**

Due to critical indexing between broad band transformer switches and the code switch, repair of the switches or the transformer assemblies is not advised in the field.

- a. Place the driver coupling on the switch shaft.
- b. Place the indexing jig (figure 5-3 on the assembly, and rotate the coupling so its pin drops into the slot in the jig.
- c. With the jig pressed firmly against the assembly, the coupling should be snug against the jig. Increase or decrease the thickness of the brass laminated shim washers as required (laminations can be peeled off) so that the coupling rests against the jig  $\pm .010$  inch. Remove jig.
- d. Manually rotate the switch to the 2.0 to 2.5 MHz band. Adjust the position so that the rotor fingers are precisely centered on the stator contacts for this band.
- e. Without disturbing the switch, locate the coupling so that its pin is toward the 1A1A2A10 coil assembly (10–12 MHz coil), then orient the indexing jig in the same direction and put it in place. Be sure the coupling pin drops into the jig slot.
- f. Drill a  $.063 +.003, -.000$  diameter inch hole through the coupling hub and the shaft. (If either the coupling or shaft has a previous pinning hole, drill this hole at about a  $45^\circ$  angle to the existing holes.) Keep the jig in position while drilling to prevent coupling or switch rotation.
- g. Install an MS171435 spring pin in the hole.

h. Verify that the switch contacts are still precisely aligned in the 2.0 to 2.5 MHz position with the coupling positioned by the jig as in step e.

i. Be sure that all metal clips are removed from the assembly.

### **5.11 MECHANICAL ALIGNMENT OF DRIVER TRANSFORMER 1A1A4 CODE DECK**

#### **NOTE**

Due to critical indexing between broad band transformer switches and the code switch, repair of the Driver Transformer Assembly in the field is not advised.

The following procedure is used to ensure that the contacts of decks A and B of driver transformer switch 1A1A4S1 position properly during band changing. This procedure is used only when improper driver transformer switch positioning is observed, or when repairs make realignment necessary.

#### **NOTE**

This procedure is not to be used for ensuring proper positioning of final transformer assembly switch 1A1A2S1; see paragraphs 5.12 and 5.13.

- a. Tune the RF-110A to the 2.0 to 2.5 MHz frequency band with the front panel FREQUENCY MHZ selector.
- b. Set PRIMARY POWER switch at OFF.
- c. Release front panel captive screws and withdraw P.A. chassis from case until slide mount locks.
- d. Release tilt locks and tilt up chassis to expose bottom until locks engage.
- e. Remove six wires from 1A1A4TBI.
- f. Release two captive screws and remove assembly from chassis.
- g. Visually check deck A (front) and deck B (front) (switch wafers nearest drive coupling) and notice the positioning of the rotor tabs and the switch stator contact clips.

h. If the rotor tabs are accurately centered on the stator clips for the 2 to 2.4999 MHz band, no adjustment is required. Proceed to paragraph 5.12 and/or 5.13 if applicable.

i. If the rotor tabs are not properly centered, the positioning may be corrected by turning the decoding deck as follows.

j. Remove the plastic dust cover plate by removing the two retaining nuts and washers securing it to the assembly top plate.

k. Remove the four screws securing the assembly top plate, and the screw securing the top plate to the input terminal plate, and tilt the top plate down to expose the rear of the switch.

l. Remove the spacer washers between the top plate and the rear deck of the switch.

m. Prior to moving decoding deck switch wafer, scribe a line across the saddle mounting and switch wafer to use as a guide for moving the decoding deck.

n. Loosen hardware on decoding deck saddle mount, using a 1/4 inch open end ignition wrench.

o. Rotate decoding deck switch wafer in its saddle mount, by the same amount and in the same direction that the rotor of the A and B decks would have to move for proper contact positioning. (The rotors will not actually move.)

p. Tighten hardware on decoding deck saddle mount.

q. Reassemble spacer washers on rear of switch and replace assembly top plate. Be careful of component dress.

r. Replace Driver Transformer Assembly 1A1-A4 in chassis. Tighten two captive screws.

s. Reconnect 6 wires to 1A1A4TB1.

t. Defeat interlock switches on side of chassis by pulling plungers straight out.

u. Turn PRIMARY POWER switch ON.

v. Set FREQUENCY MHZ switch to the 2.5 to 3.0 MHz band for a few seconds, then set it to the 2.0 to 2.5 MHz band.

w. Allow a few seconds for the tuning sequence to be completed, then set the PRIMARY POWER switch OFF.

x. Repeat steps e. through g.

y. If necessary, repeat steps h. through y. until satisfactory alignment is obtained.

z. Replace the plastic dust cover plate removed in step j.

aa. Repeat steps r. and s.

ab. Perform the Coupling Alignment procedure, paragraph 5.13, before returning the RF-110A to service.

## **5.12 FINAL TRANSFORMER ASSEMBLY 1A1A2 INDICATOR DISC ALIGNMENT**

a. Remove Final Transformer Assembly 1A1A2.

b. Using the coupling on the bottom of the assembly, manually rotate the switch until the outer contact fingers of all three decks are accurately centered on the contact buttons for the 2 to 2.5 MHz band.

### **NOTE**

Rotate switch in the direction marked on the top plate.

c. Note whether the arrow on the top plate points to the center of the band on the indicator disc.

d. Repeat steps b. and c. for 28 to 30 MHz band.

e. In each position, when the contacts are accurately centered, the arrow should point to the center of the band on the indicator disc, and contact should be properly maintained within scribed band limits. If acceptable, proceed to step h.

f. If adjustment is necessary, loosen the set screw on the indicator disc, reposition the disc as required, and retighten set screw.

g. Repeat steps b. through f. as required to obtain correct adjustment.

- h. Reinstall Final Transformer Assembly 1A1A2.
- i. Perform Coupling Alignment, paragraph 5.13, before returning the Transmitter to service.

### 5.13 COUPLING ALIGNMENT (DRIVER/FINAL TRACKING ADJUSTMENT)

- a. Final and Driver Transformer assemblies must be properly aligned before performing this procedure. See paragraph 5-11 and 5-12, if required.
- b. Loosen eight front panel screws on RF-110A and slide chassis out until slides lock.
- c. Defeat chassis interlocks by pulling plungers straight out.
- d. Turn PRIMARY POWER switch ON and apply 28V Standby/Operate command to 1A2A1-J7-M.
- e. Step RF-110A FREQUENCY MHZ switch through all bands, starting with the lowest, pausing at each position to note reading on indicator disc on top of Final Transformer Assembly 1A1A2.
- f. In each band, the arrow should lie between the two lines on the indicator disc for that band.
- g. If the positioning is correct on all bands, no adjustment is required; proceed to step t.
- h. If the positioning is not correct, set RF-110A FREQUENCY MHZ switch to 2.0 to 2.5. When motor stops set PA PRIMARY POWER switch OFF.
- i. Tilt chassis up to expose the bottom.
- j. Remove the small plastic dust cover on the Driver Transformer Assembly 1A1A4.
- k. Loosen switch shaft clutch nut on Driver Transformer Assembly 1A1A4 while holding double-flatted shaft to prevent rotation.
- l. Disconnect wire from 1A1A4TB1-6. Connect one end of a clip lead (approximately two feet long) to the wire and lug removed from 1A1A4TB1-6.

### NOTE

Grounding the clip lead will cause the bandswitch motor to energize.

- m. Tilt chassis back to horizontal position being careful that neither the loose wire nor the clip lead becomes grounded.
- n. Set PA PRIMARY POWER switch at ON. Ground clip lead as required to run bandswitch motor until Final Transformer Assembly 1A1A2 switch indicator disc is in exact center of 2 to 2.49999 MHz band.
- o. Set RF-110A PRIMARY POWER switch at OFF. Tilt chassis up to expose bottom.
- p. Tighten switch shaft clutch nut (while holding double flatted shaft to prevent rotation) to  $6.0 \pm .5$  inch pounds torque.
- q. Reconnect wire to 1A1A4TB1-6.
- r. Tilt chassis back to horizontal position and set PA PRIMARY POWER switch at ON. Repeat steps e. through g. and h. through r. as required.

### NOTE

In steps k. and e., preventing the double-flatted shaft from rotating is difficult. Several sequences of steps l. through e. may be necessary.

- s. Set PRIMARY POWER switch at OFF. Replace plastic dust cover removed in step k.
- t. Return chassis to case and tighten eight front-panel screws on RF-110A.

### 5.14 INDEXING JIG FABRICATION

In order to align the components in the transmission assembly, or the switch in either of the transformer assemblies, small indexing jigs will be required. These small jigs orient the couplings on the switch (or gear) shaft so that the driver transformer assembly (1A1A4) switch will be indexed to the same channel by the bandswitching motor. Both switches have 24 positions, only one of which is used, therefore, even a small error in layout or





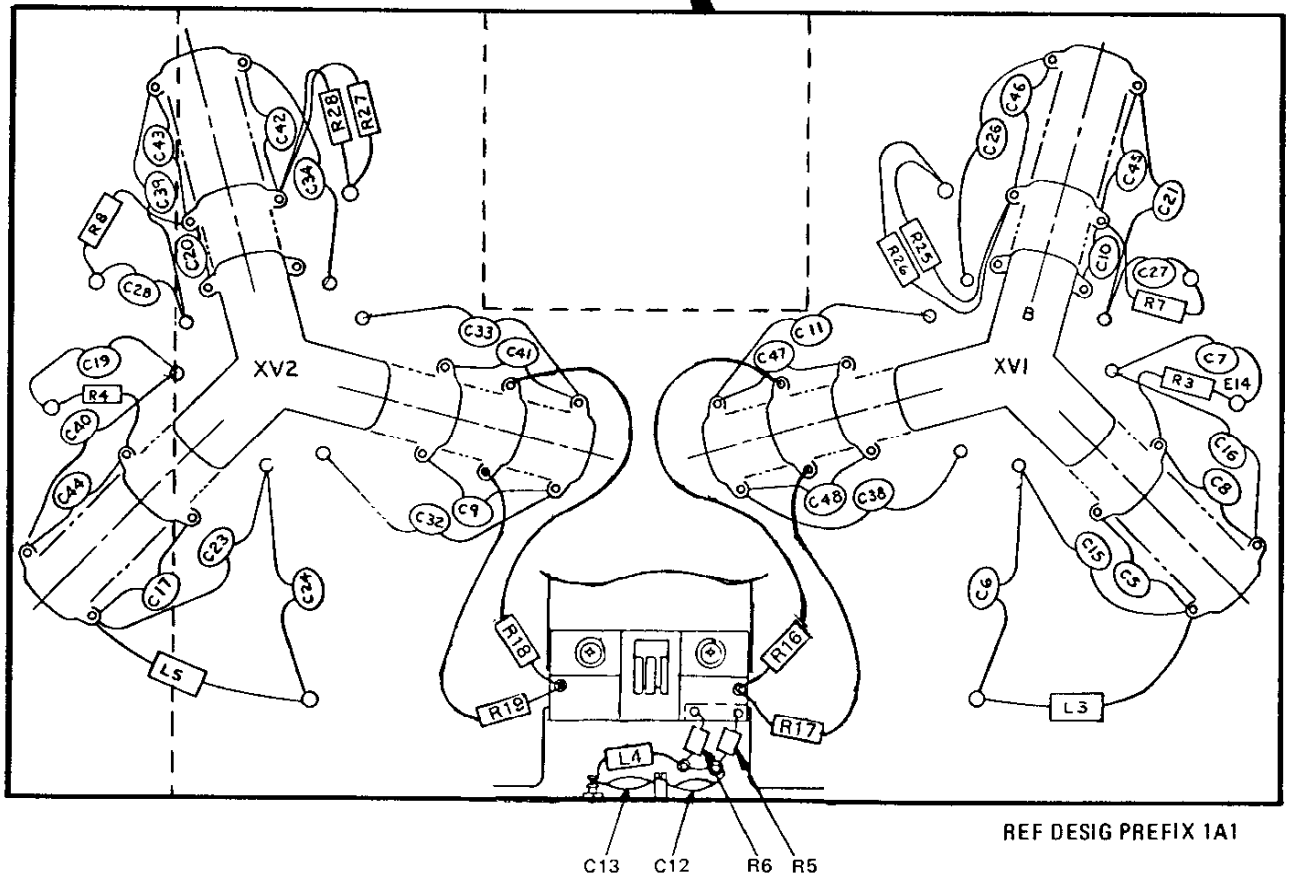
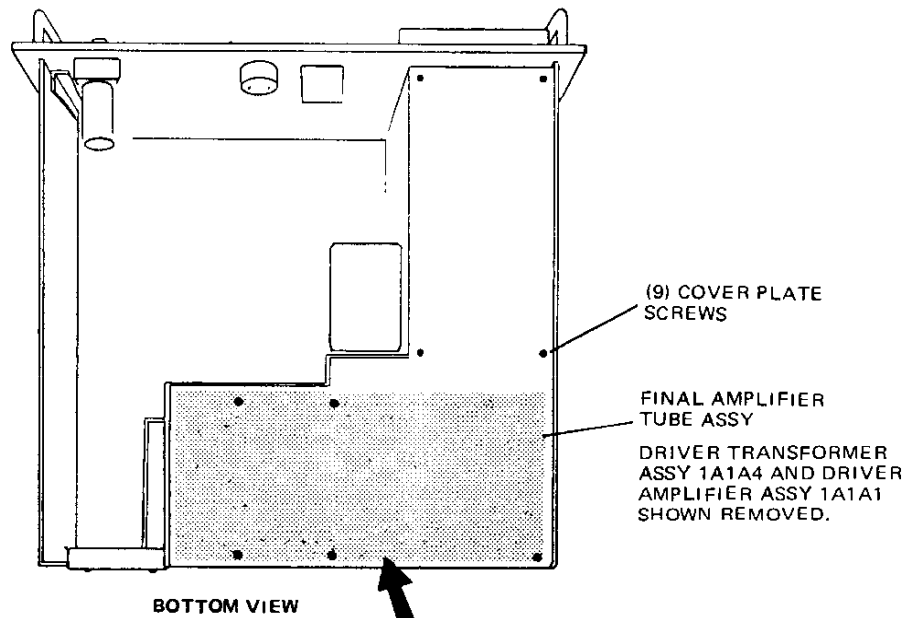
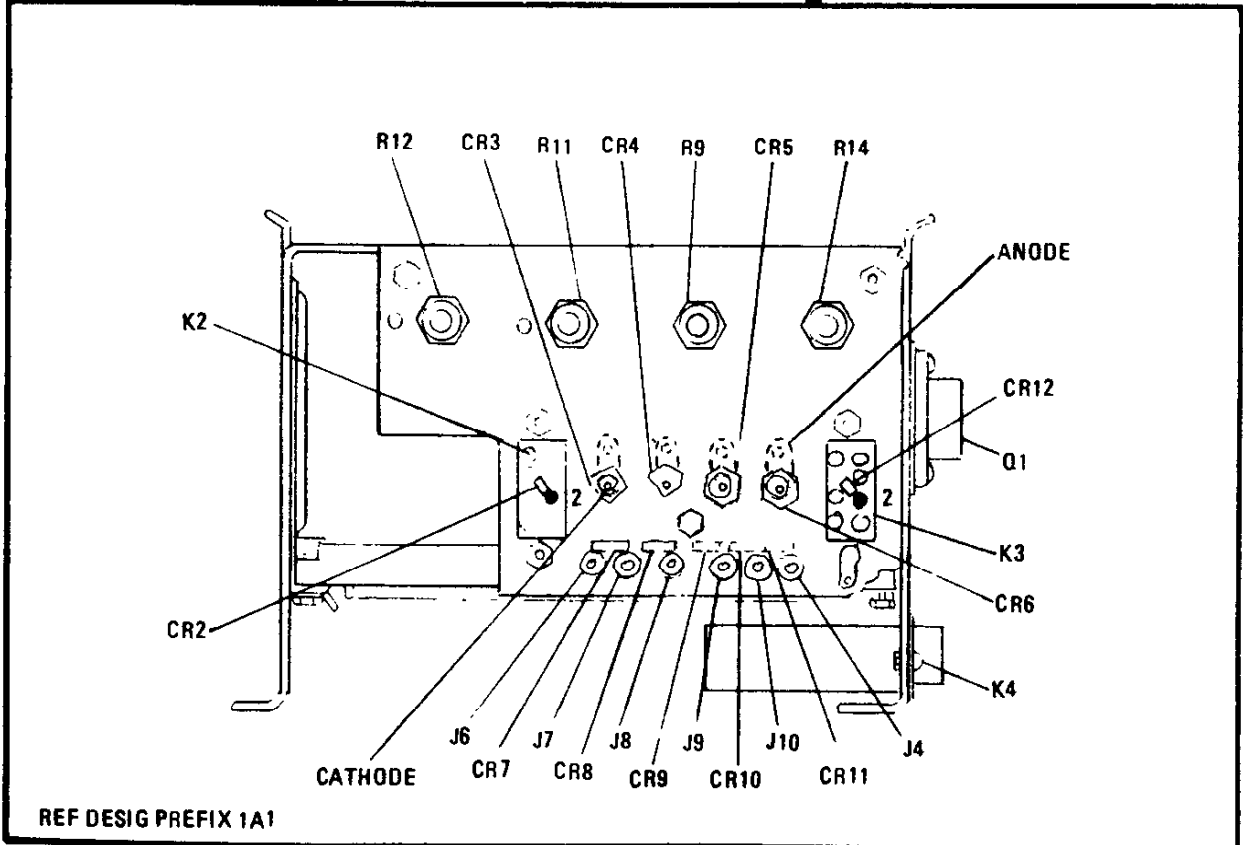
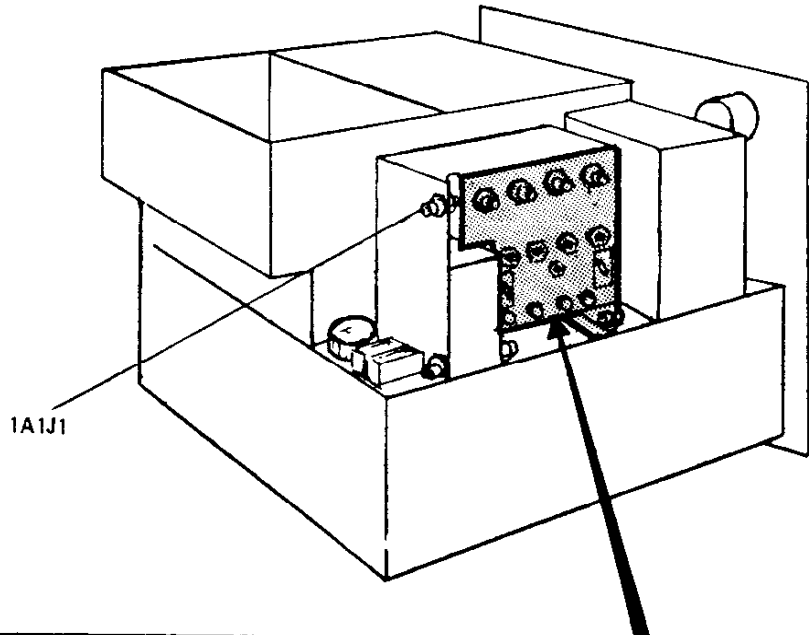
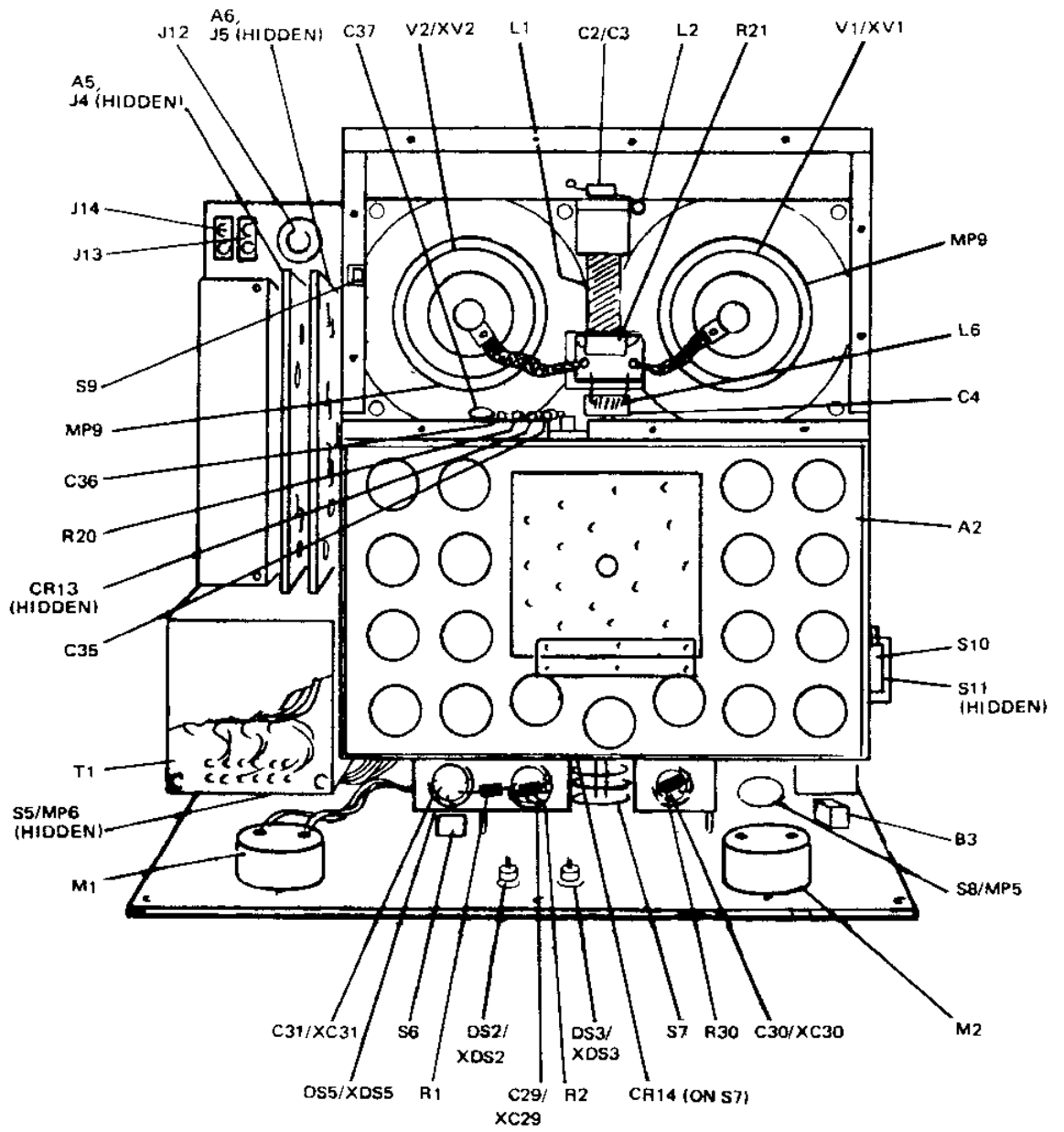


Figure 5-5. PA Stage, Tube Socket Detail



SIDE VIEW

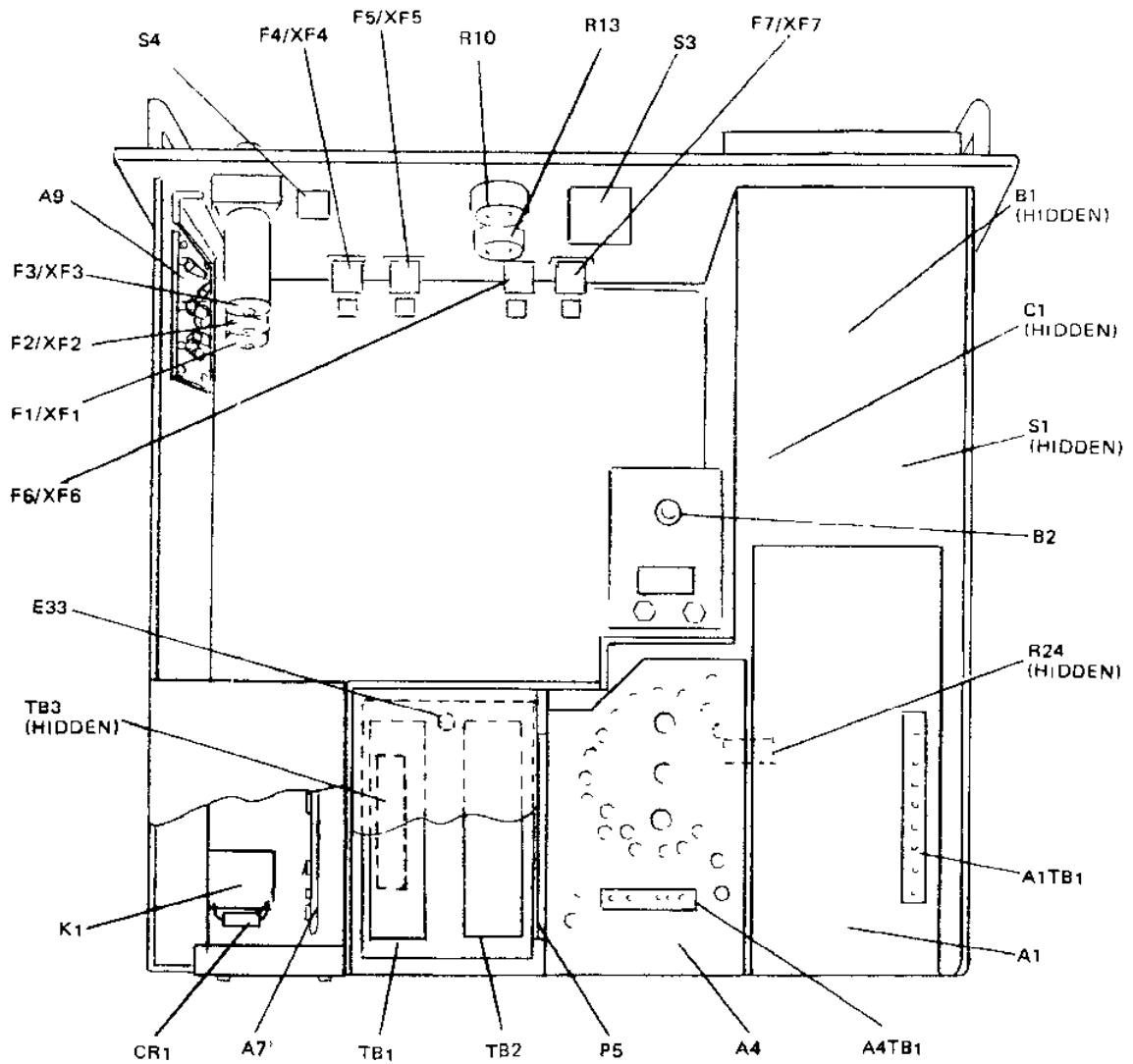
Figure 5-6. RF-110A Rear View, Component Locations



REF DESIG PREFIX 1A1

TOP VIEW

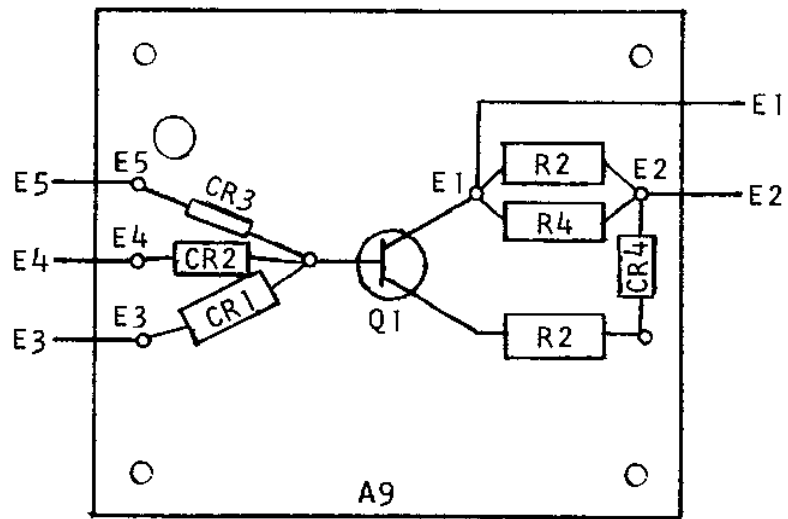
Figure 5-7 RF-110A Top View, Component Locations



REF DESIG PREFIX 1A1

**BOTTOM VIEW**

Figure 5-8 RI-110A Bottom View, Component Locations



REF DESIG PREFIX 1A1A9

Q1 IS SCR

E1 – CHASSIS GROUND

E2 – FROM CR6, LOW VOLTAGE END OF  
SCREEN VOLTAGE DIVIDER

E3 – FROM P6, 1A1V1 SCREEN VOLTAGE

E4 – FROM P7, 1A1V2 SCREEN VOLTAGE

E5 – FROM J11, HIGH VOLTAGE END OF  
SCREEN VOLTAGE DIVIDER

Figure 5-9. ARC Protector Assembly, Component Locations

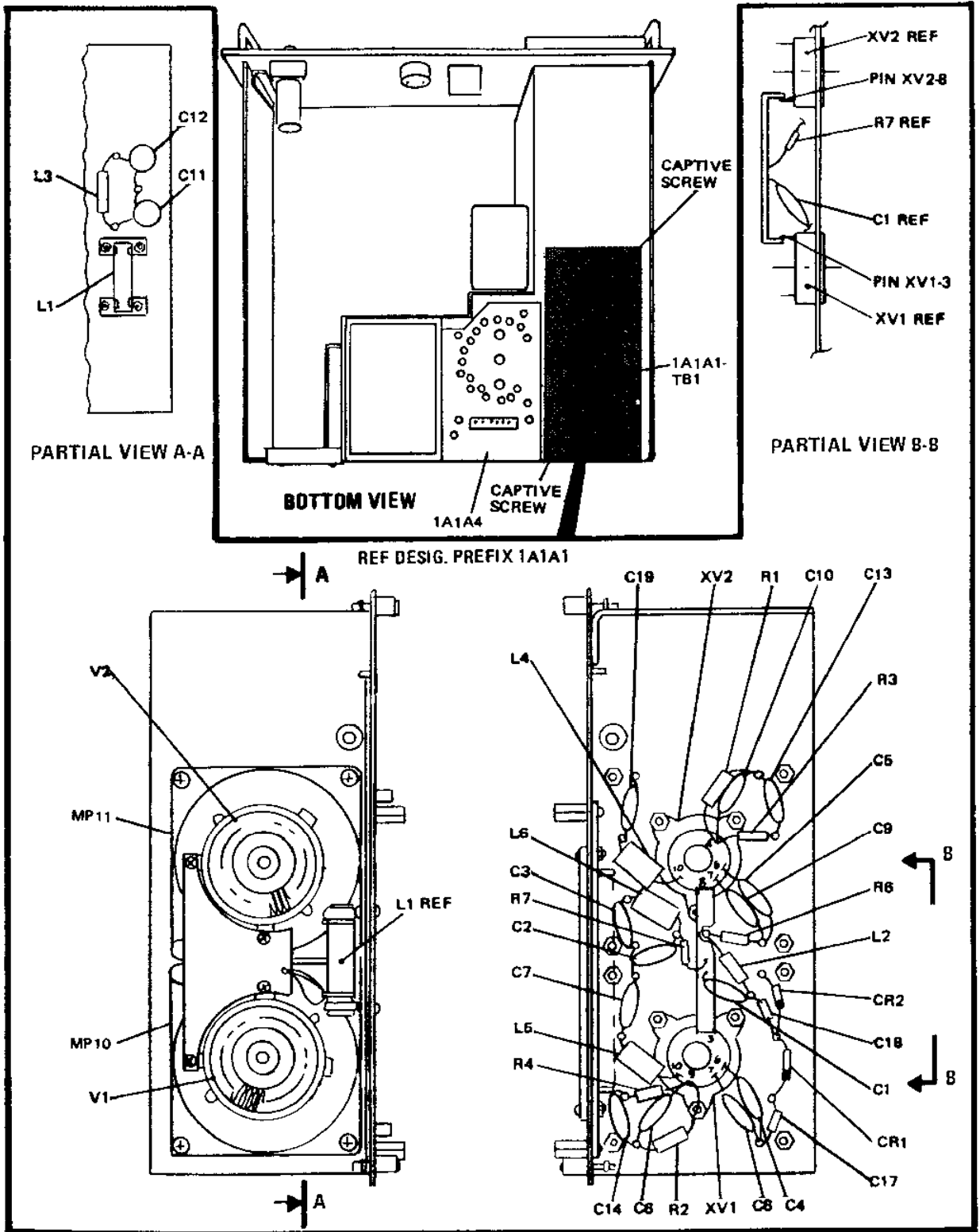


Figure 5-10 Driver Tube Assembly, Component and Test Point Locations

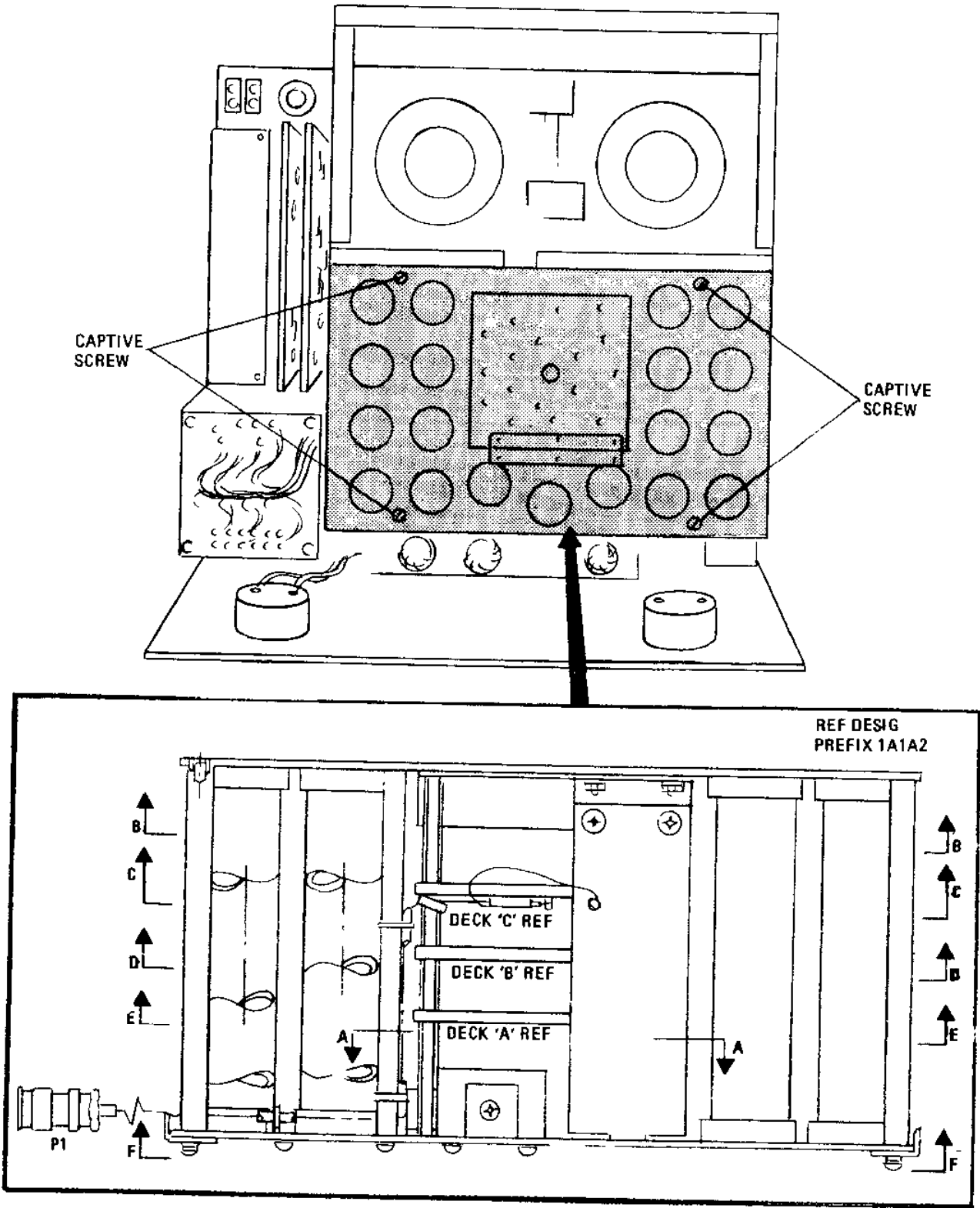
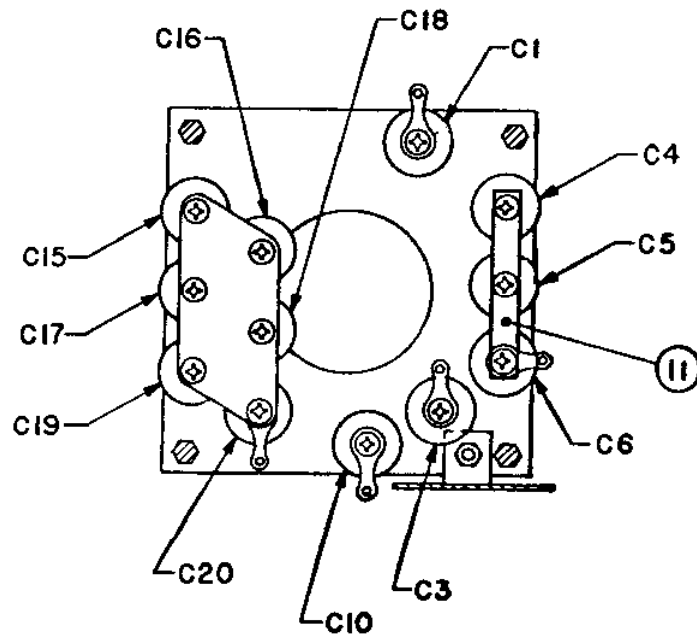
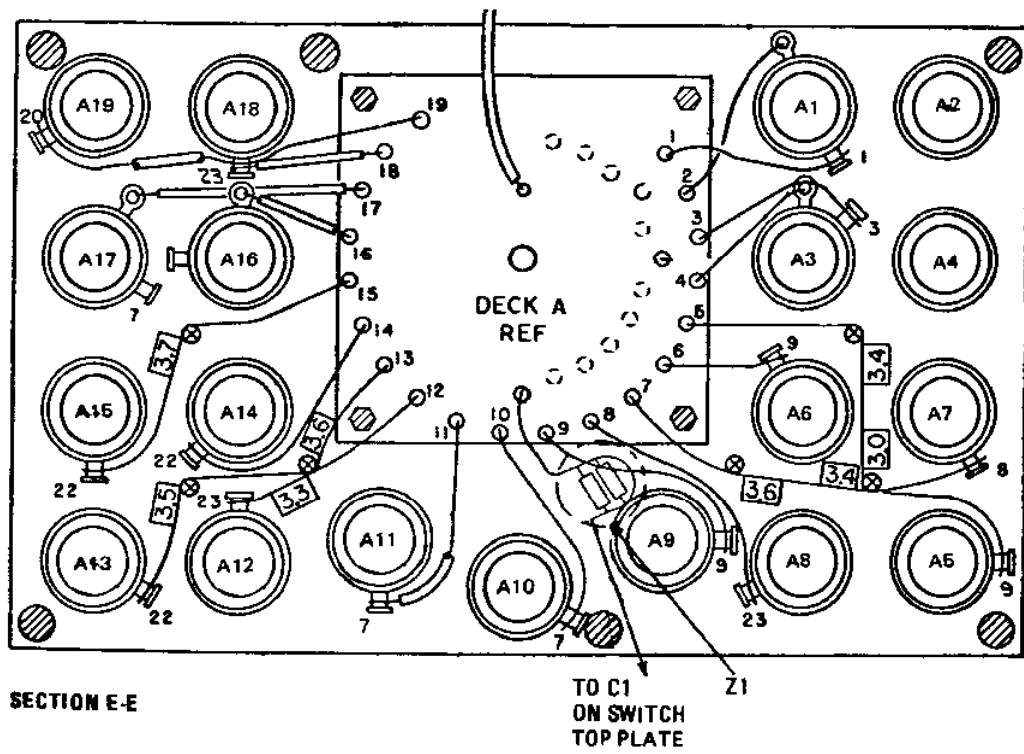


Figure 5-11 PA Transformer Assembly. Component Locations (Sheet 1 of 2)





**PARTIAL SECTION A-A**



**SECTION E-E**

TO C1  
ON SWITCH  
TOP PLATE

Figure 5-11. PA Transformer Assembly, Component Locations (Sheet 2 of 2)

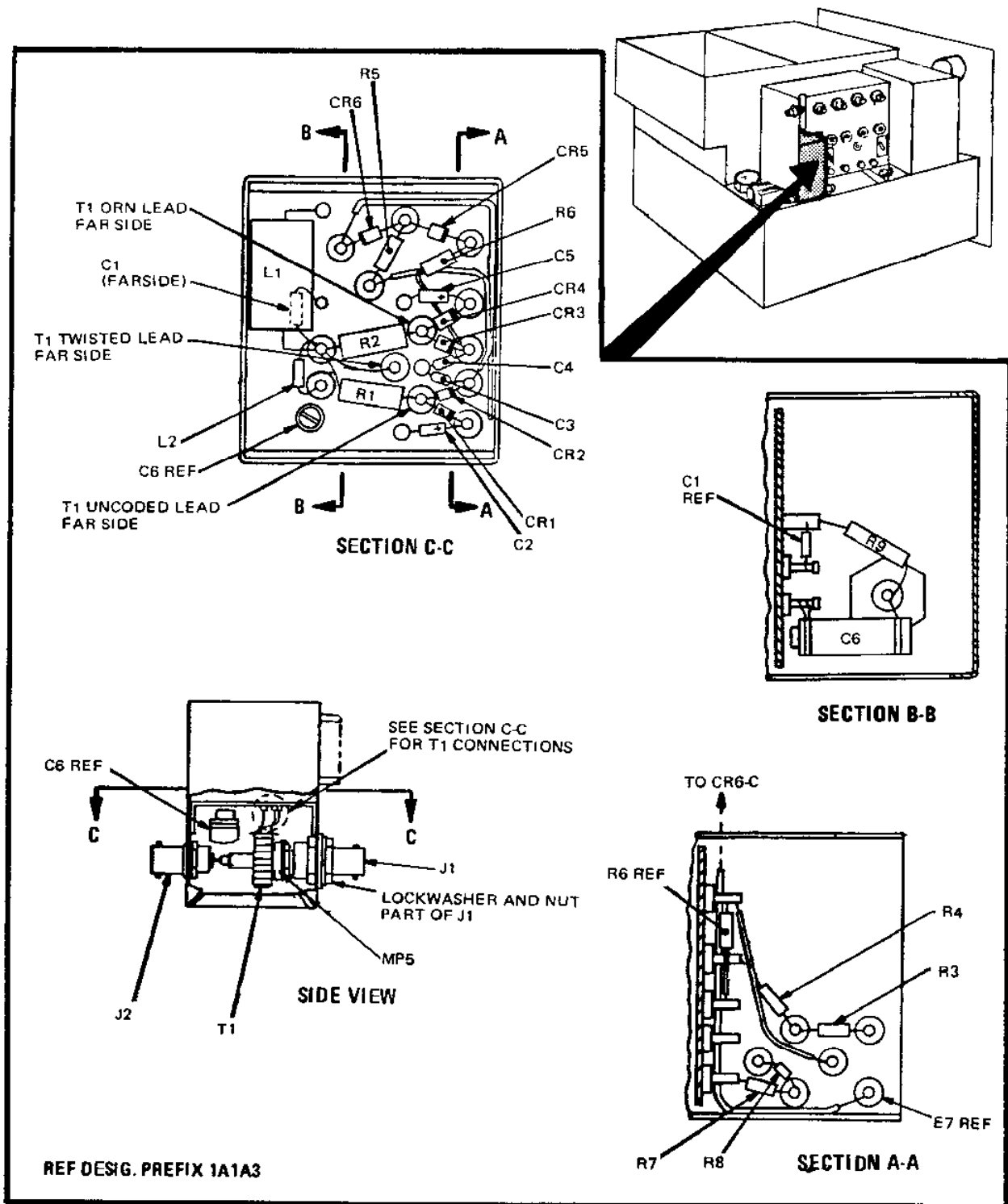
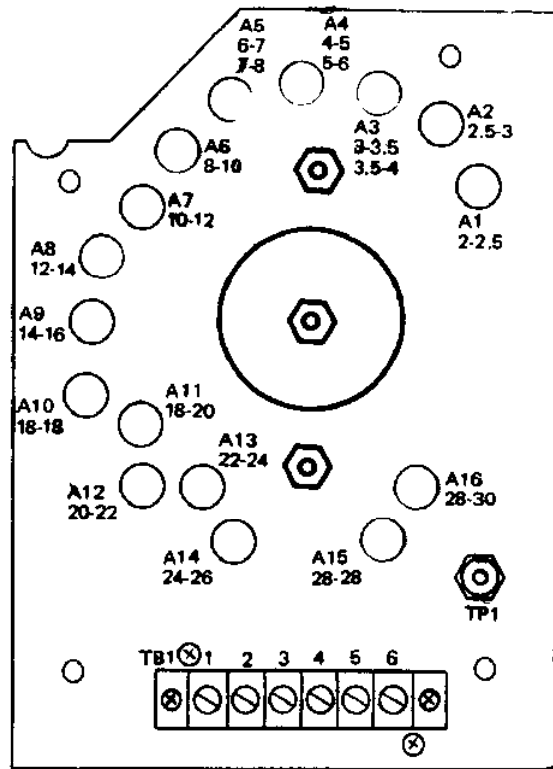
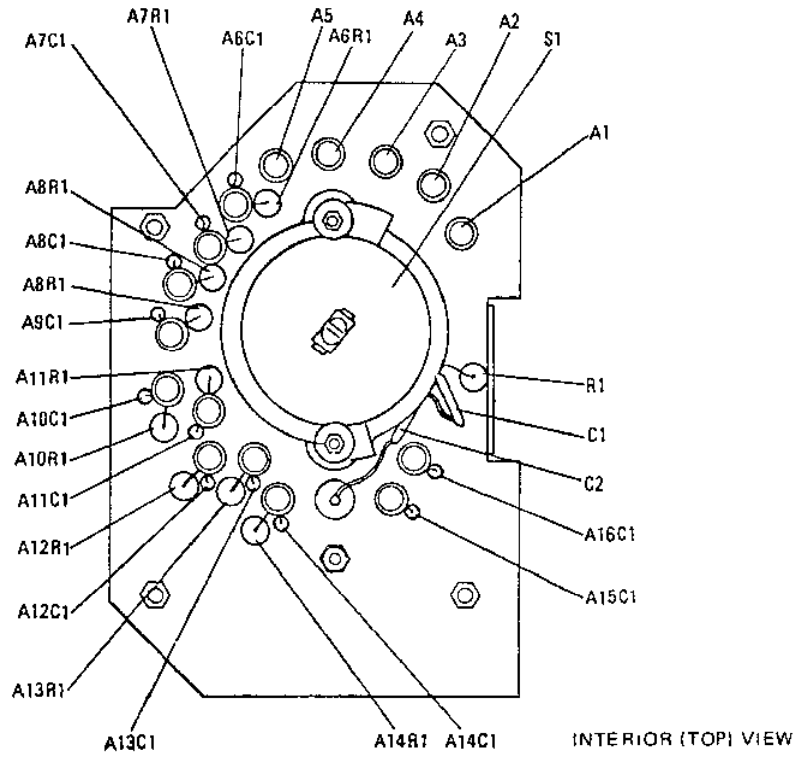
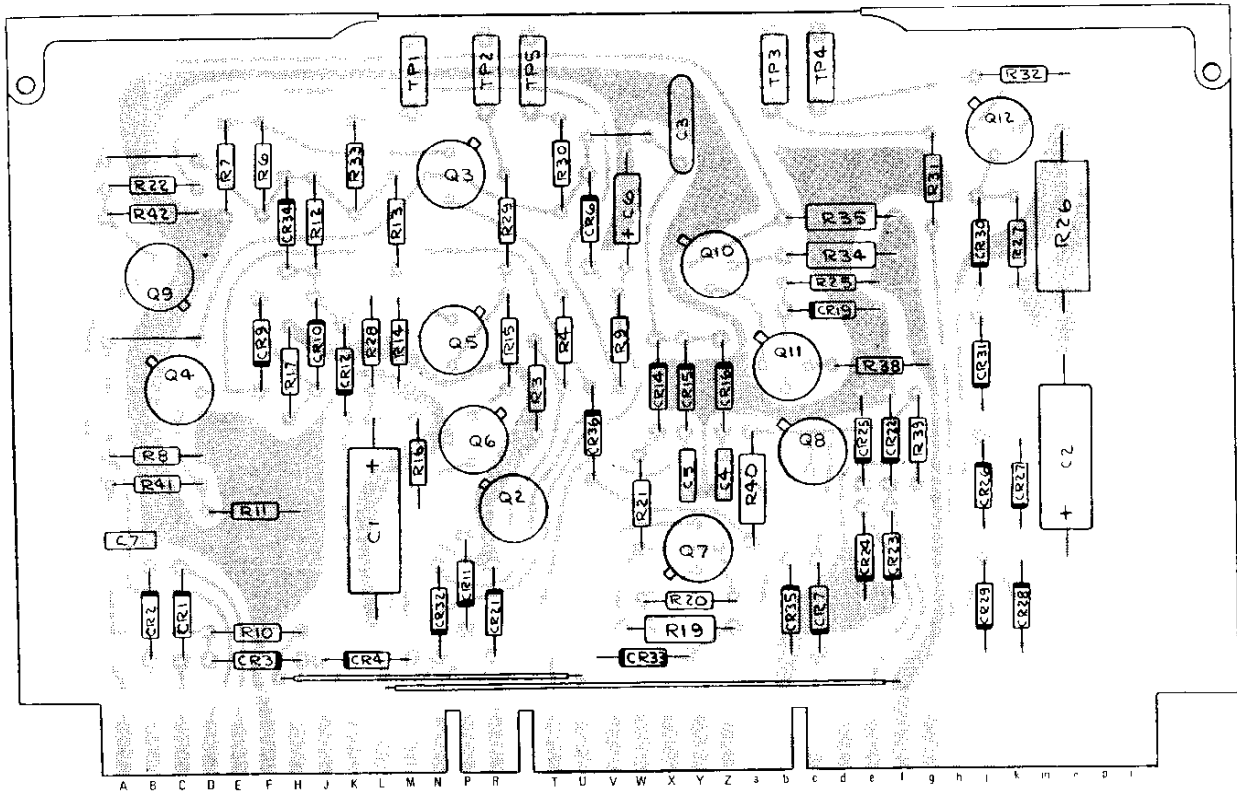


Figure 5-12. VSWR Bridge Assembly, Component Locations



REF DESIG PREFIX 1A1A4 TOP VIEW

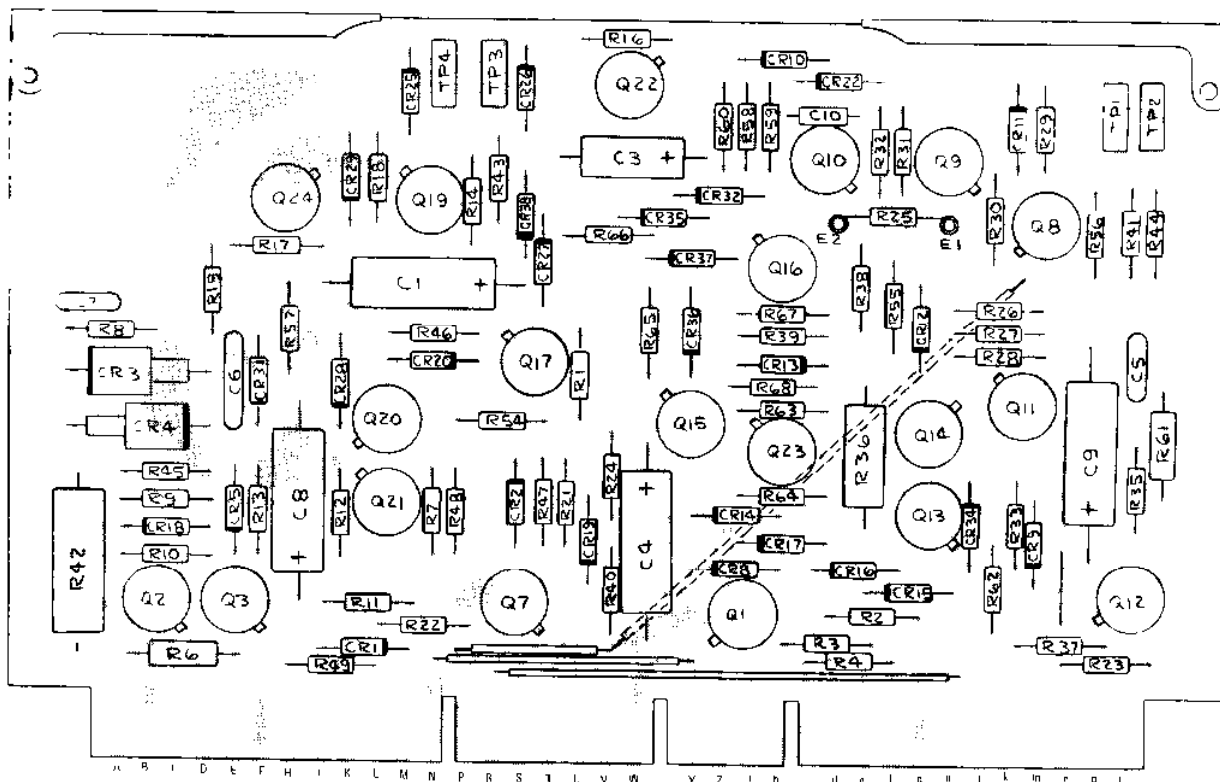
Figure 5-13 Driver Transformer Assembly, Component Locations



### PIN CALLOUTS

- |                             |  |
|-----------------------------|--|
| A – Positive 11 VDC         | W – Not used                             |
| B – Coupler Interlock       | X – Power Supply Interlock               |
| C – Motor Relay Coil        | Y – Not used                             |
| D – High Voltage Detector   | Z – Not used                             |
| E – Decoder Ground          | a – 1A1V2 Cathode Monitor                |
| F – Chassis Ground          | b – Positive 28 VDC Output               |
| H – Reset                   | c – Positive 28 VDC Interlock            |
| J – Bias Interlock          | d – 32 VAC                               |
| K – Keyer Output            | e – 32 VAC                               |
| L – Not used                | f – Positive 20 VDC                      |
| M – Overload Circuit        | g – 12 VDC Remote (negative)             |
| N – Keyline                 | h – Positive 12 VDC Remote Reg.          |
| P – 16 VAC                  | j – 16 VAC                               |
| R – 1A1V1 Cathode Monitor   | k – 16 VAC                               |
| S – (S is Keyway)           | m – 12 VDC Remote (Positive)             |
| T – Operate Relay Coil      | n – Not used                             |
| U – Positive 20 VDC Operate | p – Not used                             |
| V – Not used                | r – Positive 12 VDC Remote Reg.<br>Drive |

Figure 5-14. A5 Board, Component and Test Points



### PIN CALLOUTS

- |                                |                               |
|--------------------------------|-------------------------------|
| A – Negative 160V from 1A1C29  | W – Chassis GND               |
| B – Negative 150V/Negative 72V | X – (X is Keyway)             |
| C – Keyer Input                | Y – Positive 11V input        |
| D – Driver Bias Control        | Z – Interlock                 |
| E – Bias Interlock             | a – Interlock                 |
| F – Negative Bias to Exciter   | b – (Not used)                |
| H – Bias to PA Grids           | c – From Input Power Detector |
| J – PA Bias Control Output     | d – 115 VAC In                |
| K – Driver Bias Control (NEG)  | e – To Input Power Meter      |
| L – Negative 150V/Negative 72V | f – Chassis GND               |
| M – PA Bias Control Switched   | g – 115 VAC                   |
| N – Chassis Ground             | h – Negative 160V to 1A1C29   |
| P – From Power Adjust Control  | j – To APC Adjust Control     |
| R – Positive 28 VDC input      | k – Positive 20 VDC Input     |
| S – Tune Switch Input          | m – To PPC Adjust Control     |
| T – +20 VDC Carrier Insert     | n – To Power Adjust Control   |
| U – CW/RATT Ground             | p – VSWR Bridge, Input From   |
| V – APC Output                 | r – PPC Output                |

Figure 5-15. A6 Board, Component and Test Point Locations



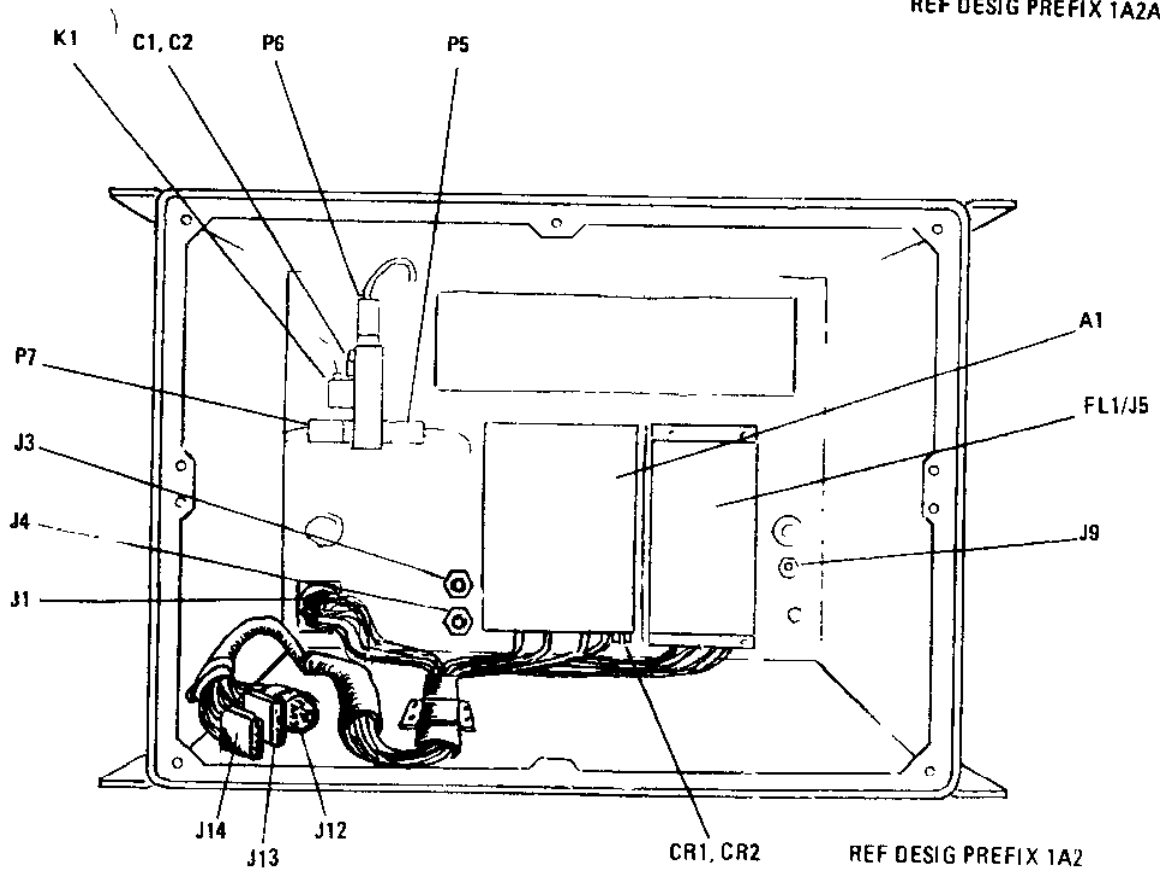
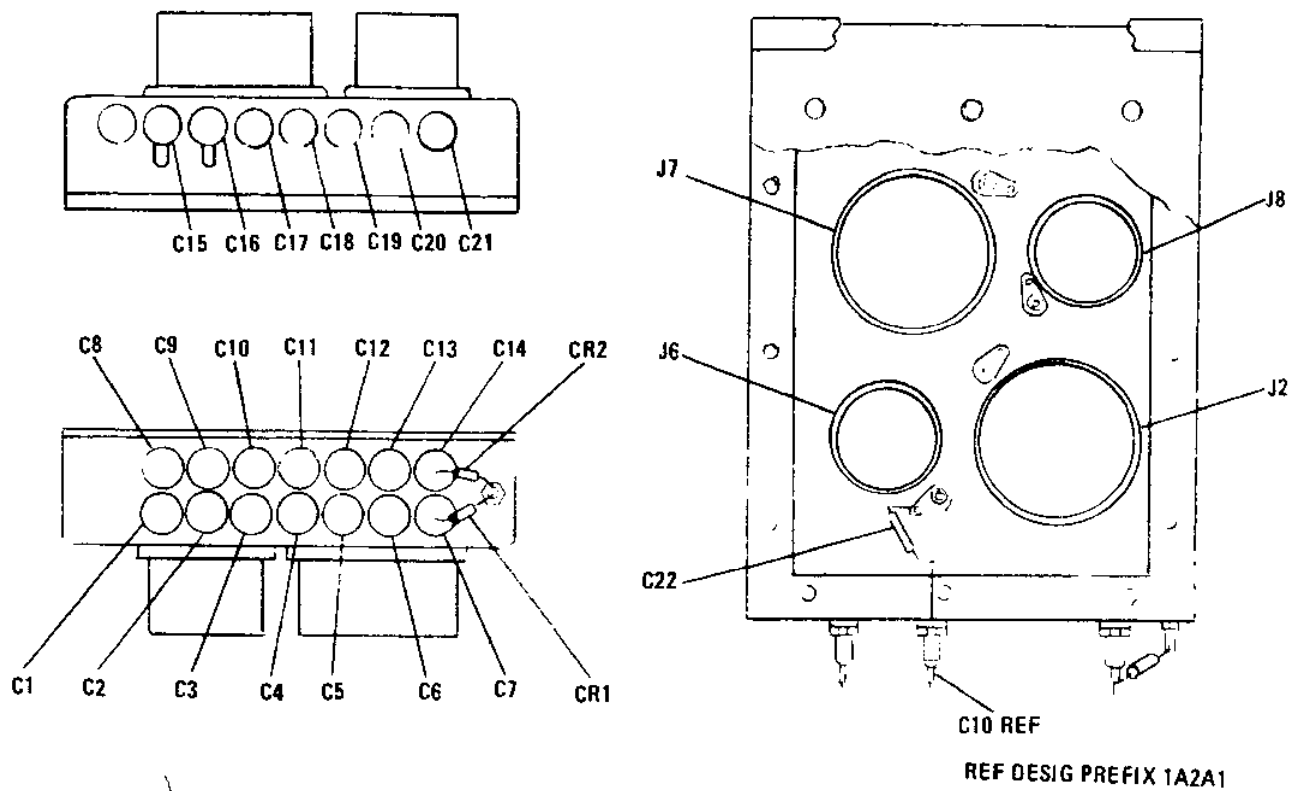
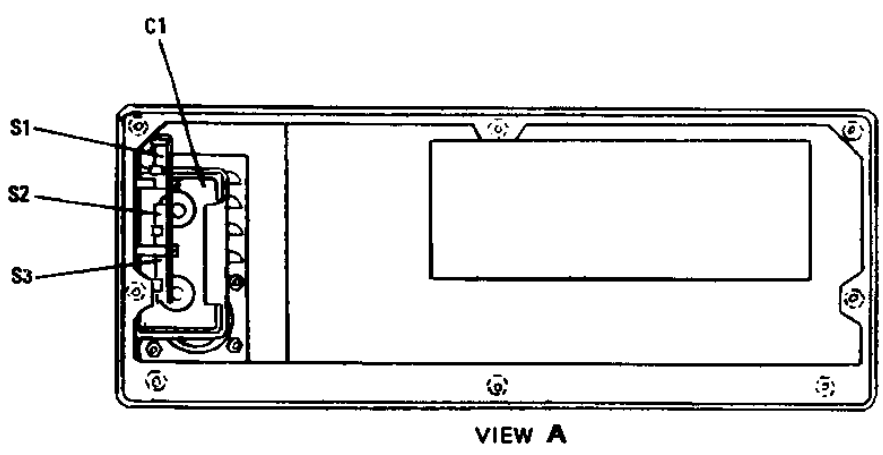
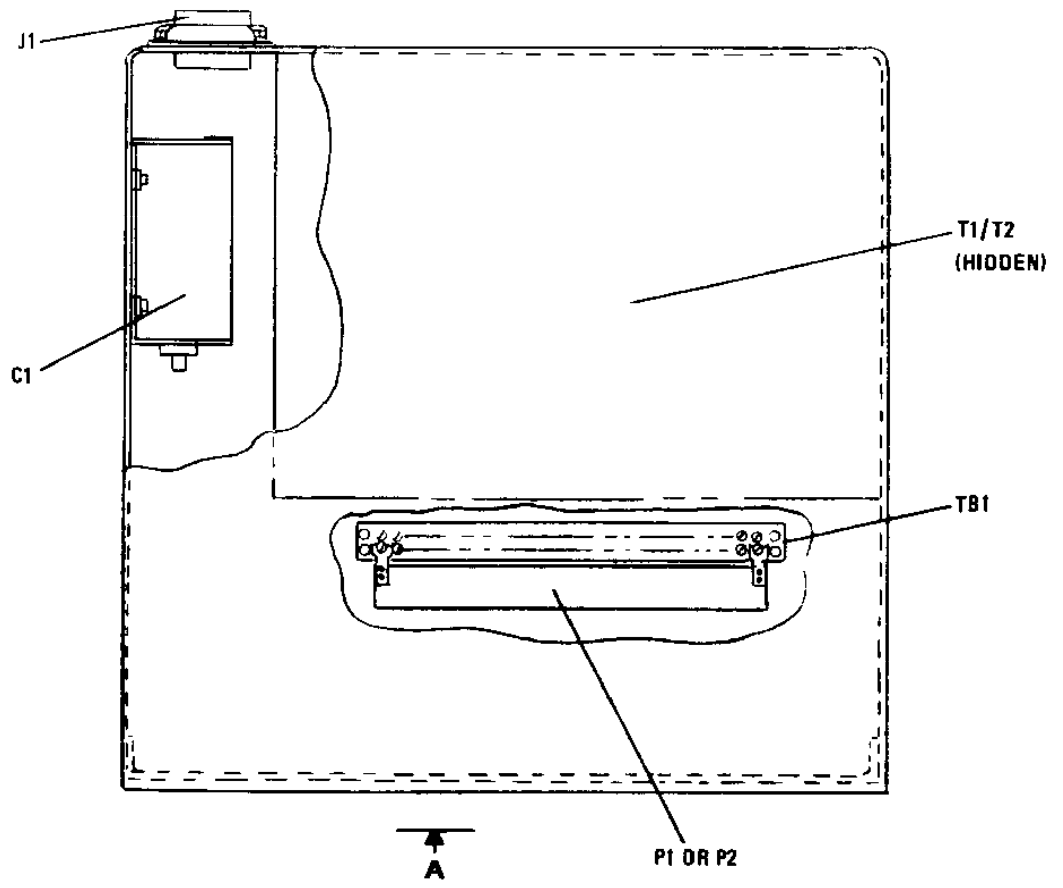


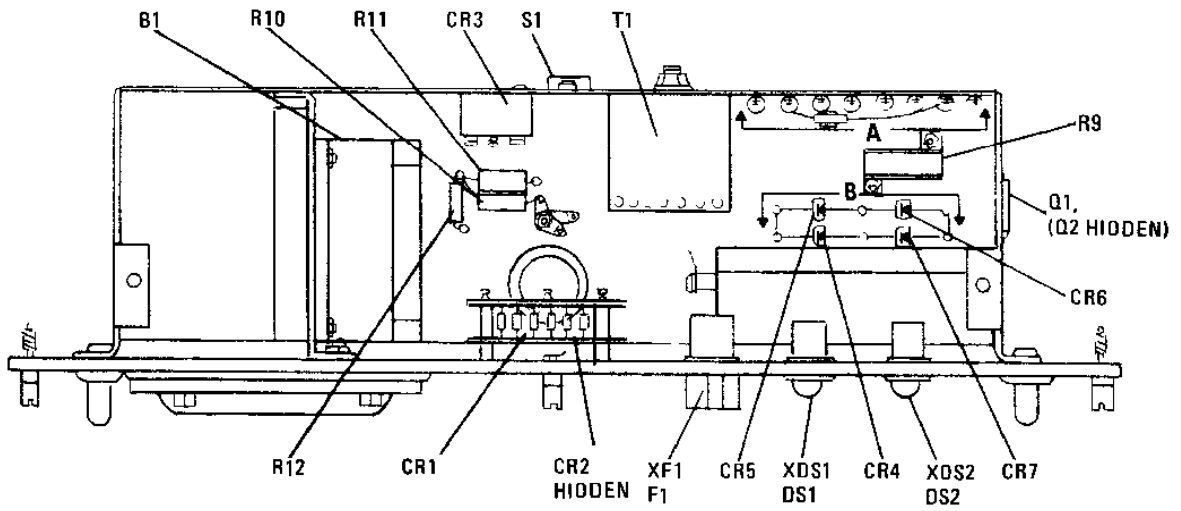
Figure 5-17 RF-110A Case, Component Locations



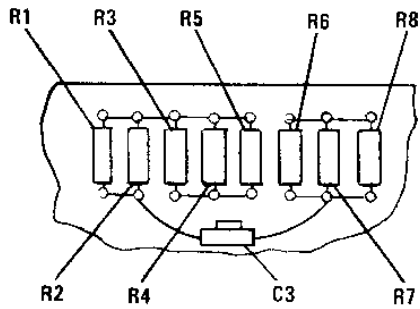
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Figure 5-18. RF-112A Power Supply, Component Locations (Sheet 1 of 2)

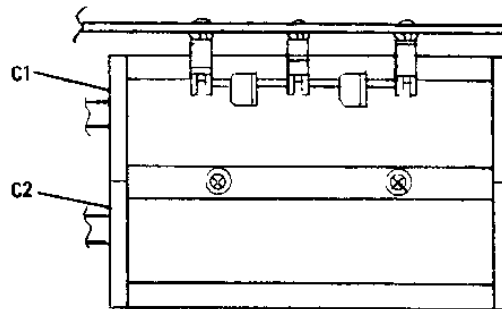




TOP VIEW



VIEW A



VIEW B

REF DESIG PREFIX 2A1

Figure 5-18. RF-112A Power Supply, Component Locations (Sheet 2 of 2)

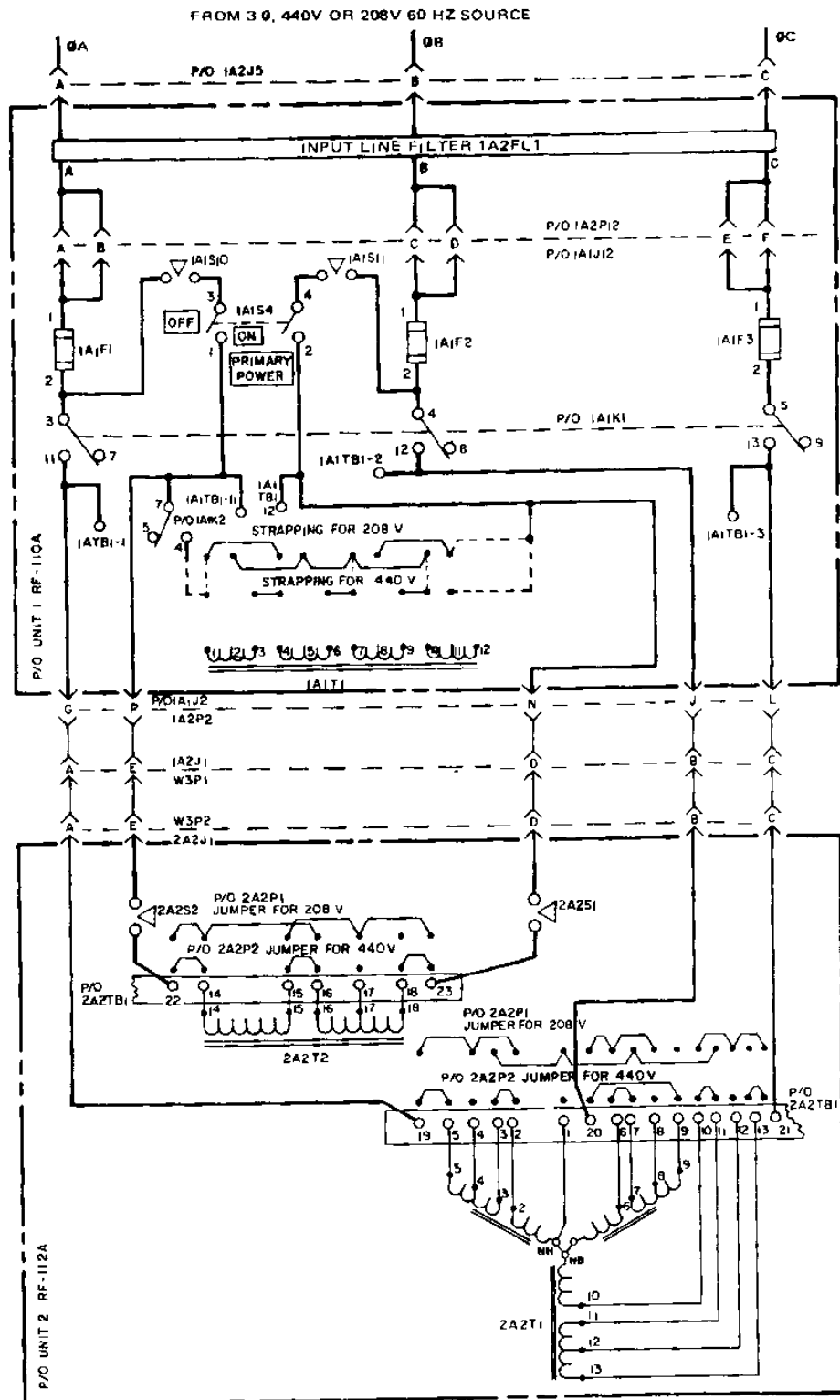


Figure 5-19. Primary Power Distribution

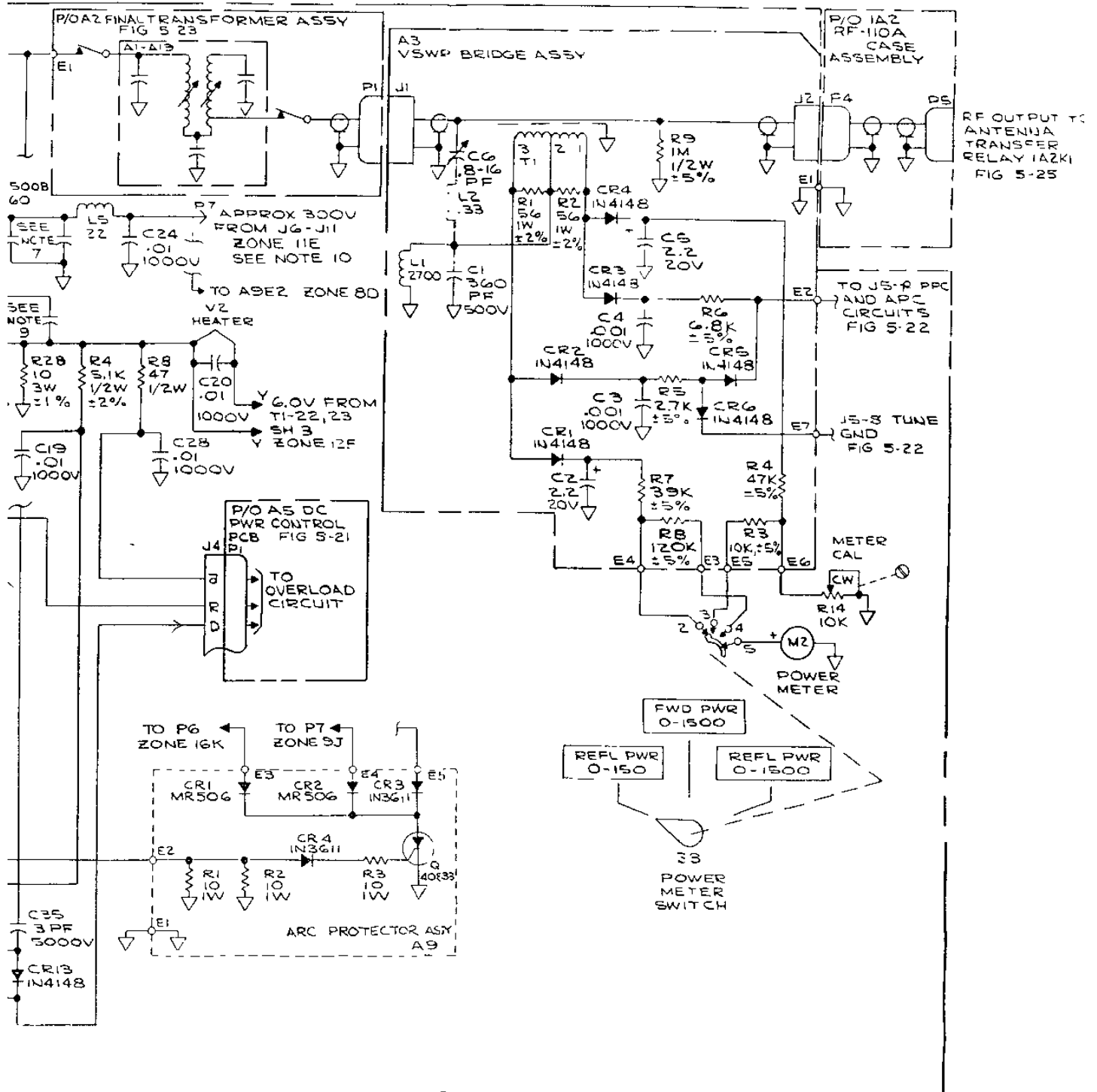
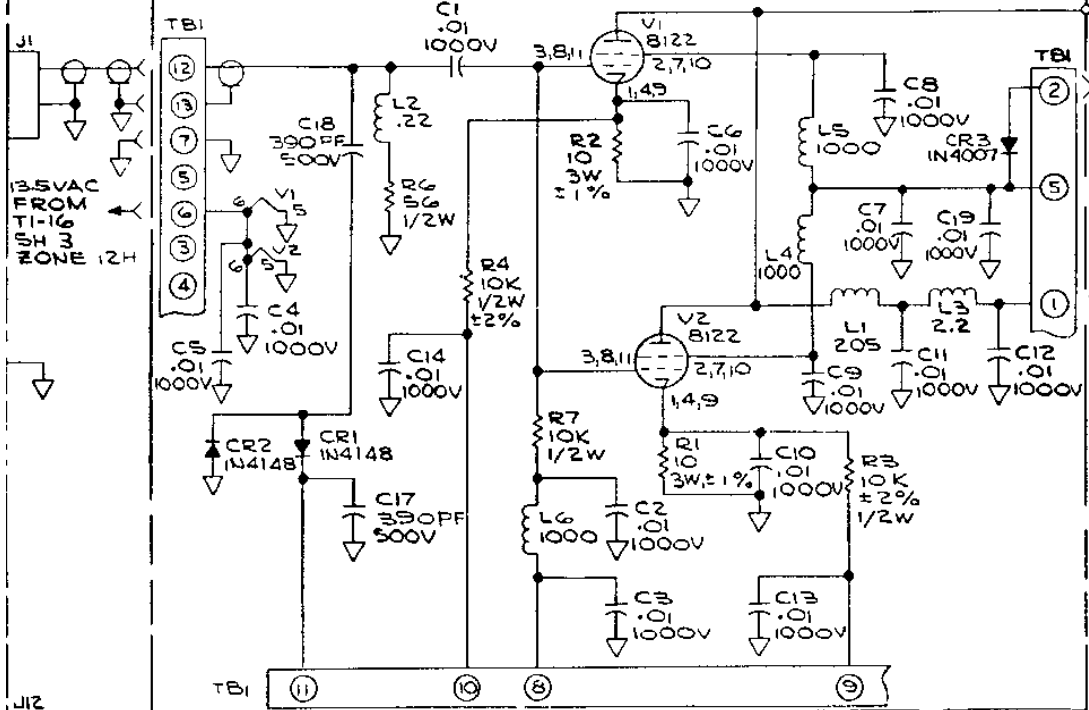


Figure 5-20. RF-110A Chassis, Schematic Diagram (Sheet 1 of 3)

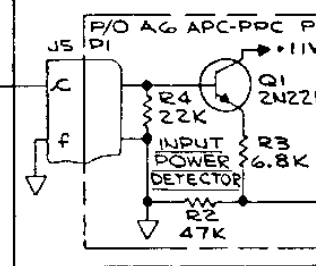
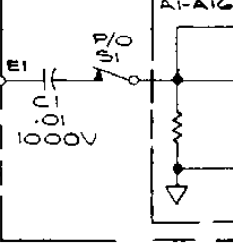


P/O 1A1 RF-110A CHASSIS ASSY

AI DRIVER AMPLIFIER ASSY



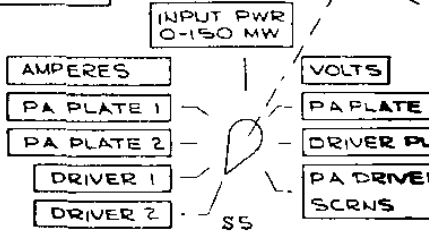
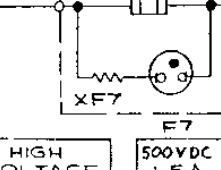
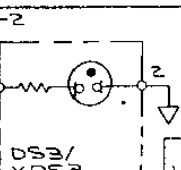
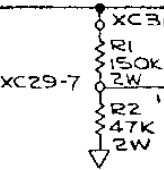
P/O A4 DRIVER TRANSFORMER FIG 5-24



TO E4 OF FINAL AMP ZONE 16K

DRIVER BIAS TO JS-K FIG 5-22 TO JS-O FIG 5-22

+500V FROM TBI-5 SEE SH 3 ZONE 9H

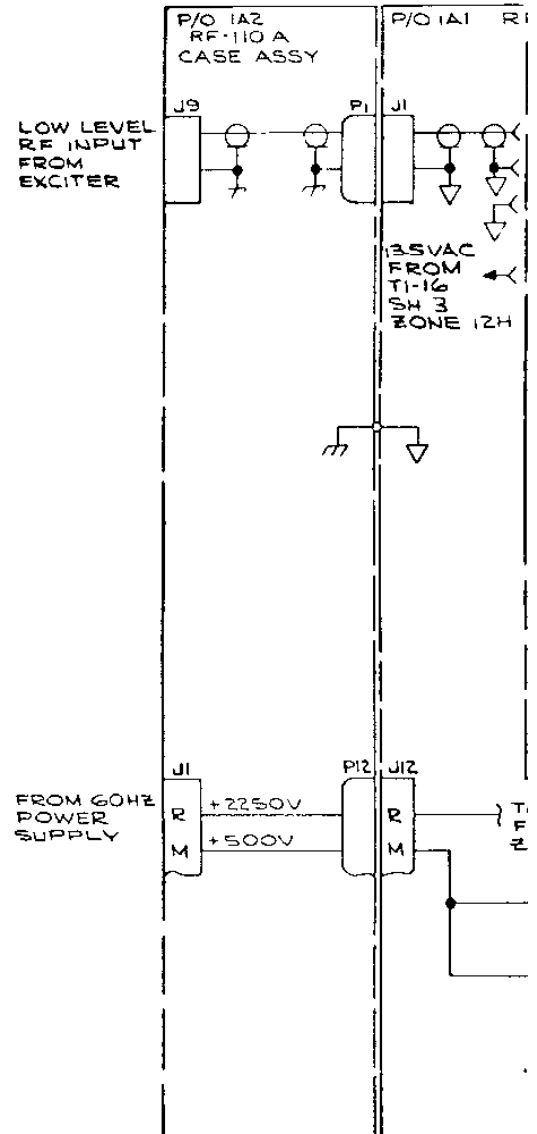


- AMPERES
- PA PLATE 1
- PA PLATE 2
- DRIVER 1
- DRIVER 2
- VOLTS
- PA PLATE
- DRIVER PA
- PA DRIVE
- SCRNS

NOTES

UNLESS OTHERWISE SPECIFIED

1. PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH APPLICABLE UNIT, ASSEMBLY AND/OR SUBASSEMBLY DESIGNATORS.
2.  INDICATES EQUIPMENT MARKING.
3. CAPACITORS ARE IN UF.
4. RESISTORS ARE IN OHMS, 1/4W, ±10%.
5. INDUCTORS ARE IN UH.
6. CONSISTS OF SIX 0.01 UF CAPACITORS C11, C15, C16, C21, C26, C38.
7. CONSISTS OF SIX 0.01 UF CAPACITORS C23, C32, C33, C34, C39, C40.
8. CONSISTS OF SIX 0.01 UF CAPACITORS C5, C8, C45, C46, C47, C48.
9. CONSISTS OF SIX 0.01 UF CAPACITORS C9, C17, C41, C42, C43, C44.
10. P6 AND P7 CONNECTIONS TO J6-J11 ARE SELECTED TO BALANCE PLATE CURRENTS FOR FINAL AMPLIFIER TUBES 1A1V1 AND 1A1V2.
11. CONNECT T1 PRIMARY ACCORDING TO PRIMARY POWER
  - 115 VAC - CONNECT 1-4-7-10, 3-6-9-12; INPUT TO 1 AND 12.
  - 208 VAC - CONNECT 1-4, 2-5-7-10, 8-11; INPUT TO 1 AND 11.
  - 230 VAC - CONNECT 1-4, 3-6-7-10, 9-12, INPUT TO 1 AND 12.
  - 440 VAC - CONNECT 3-4, 6-7, 9-10, INPUT TO 1 AND 11.
12. 1A1F1-F3
  - 25A FOR 115 VAC PRIMARY POWER.
  - 25A FOR 230 VAC PRIMARY POWER.
  - 15A FOR 208 VAC PRIMARY POWER.
  - 7A SLD FOR 440 VAC PRIMARY POWER.
13. 1A1P5 INSTALLED WHEN USING RF-112A. RF-111A, WHEN USED, CONNECTS TO 1A1TB2 DIRECTLY IN PLACE OF 1A1P5.
14.  INDICATES GROUND.



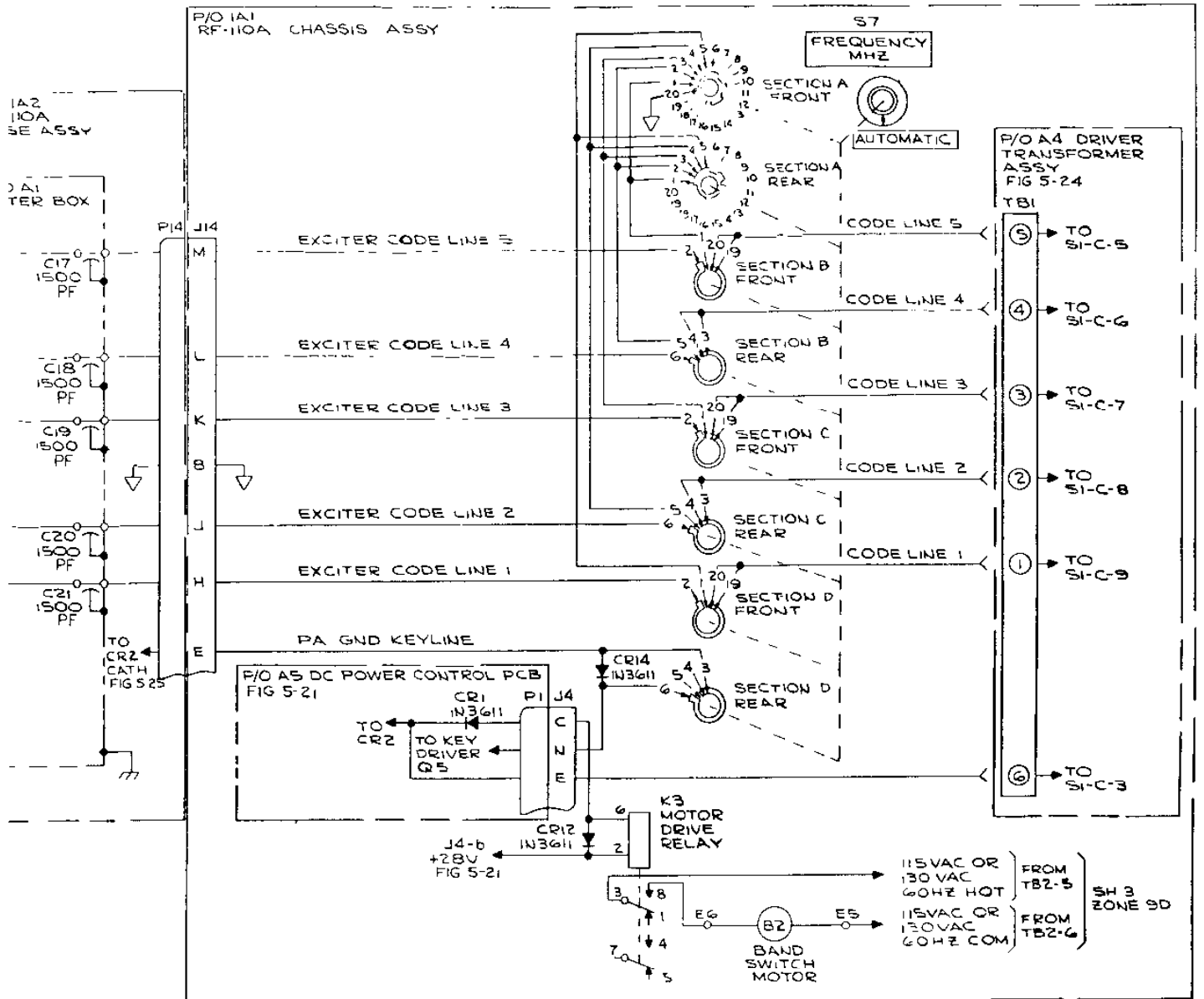
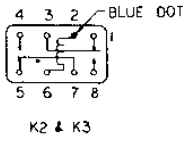
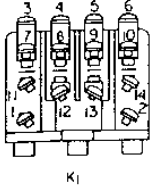


Figure 5-20 RF-110A Chassis, Schematic Diagram (Sheet 2 of 3)

NOTES



RELAY COIL	NOMINAL		
	OHMS	DC VOLTS	MILLI-AMPS
K1	50	24	540
K2 & K3	250	26.5	100
K4	392	28	70

VOLTAGE AND RESISTANCE MEASUREMENTS ARE TAKEN TO GROUND WITH SIMPSON MODEL 260

TYPICAL DC VOLTAGES

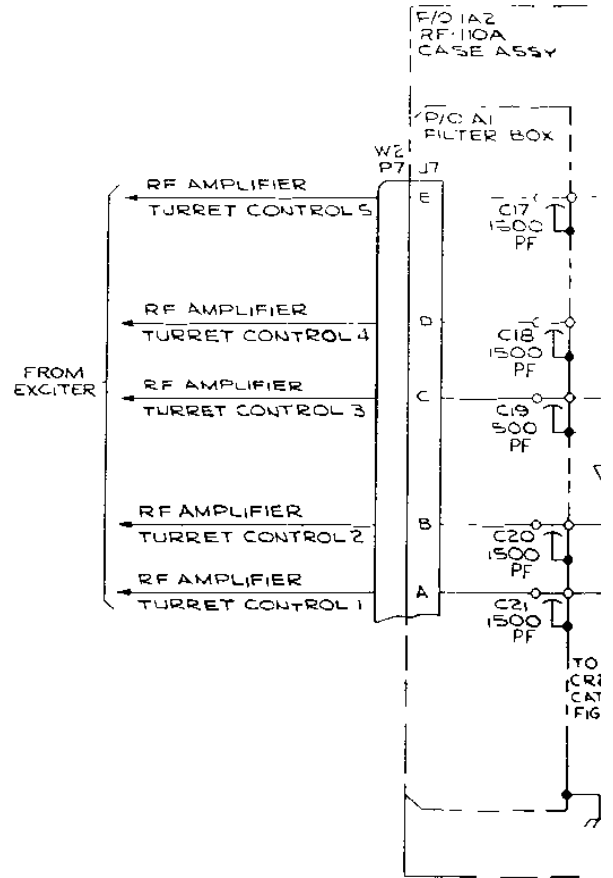
NOTE

THE VOLTAGE MEASUREMENTS FOR THE DRIVER AMPLIFIER ARE MADE BETWEEN TERMINAL BOARD 1A1A1TB1 AND GROUND. IF THE DRIVER ASSEMBLY WERE REMOVED TO GAIN ACCESS DIRECTLY TO THE TUBE SOCKETS COOLING AIR TO BOTH THE DRIVER AND FINAL AMPLIFIER TUBES WOULD BE LOST.

DRIVER AMPLIFIER ASSEMBLY VOLTAGE MEASUREMENTS

1A1A1TB1 TERMINAL NO	1	2	6	7	8	9	10	11	13
CONDITION	PLATES	SCRNS	FILAMENTS	GND	GRID BIAS	V2 CATHODE TO MULTI PURPOSE METER	V1 CATHODE TO MULTI PURPOSE METER	INPUT PWR TO MULTI-PURPOSE METER	GND
OPERATE, UNKEYED	+530	+218	135 VAC	0	-98	0	0	0	0
KEYED, NO SIGNAL	+510	+220	135 VAC	0	-50	+2*	+2*	0	0
KEYED, 1 KW AVG (CW MODE)	+500	+227	135 VAC	0	50	+2*	+2*	+3.6**	0

\*MULTIPURPOSE METER SWITCH MUST NOT BE IN DRIVER 1 AMPERES OR DRIVER 2 AMPERES POSITIONS  
 \*\*VARIES CONSIDERABLY WITH FREQUENCY





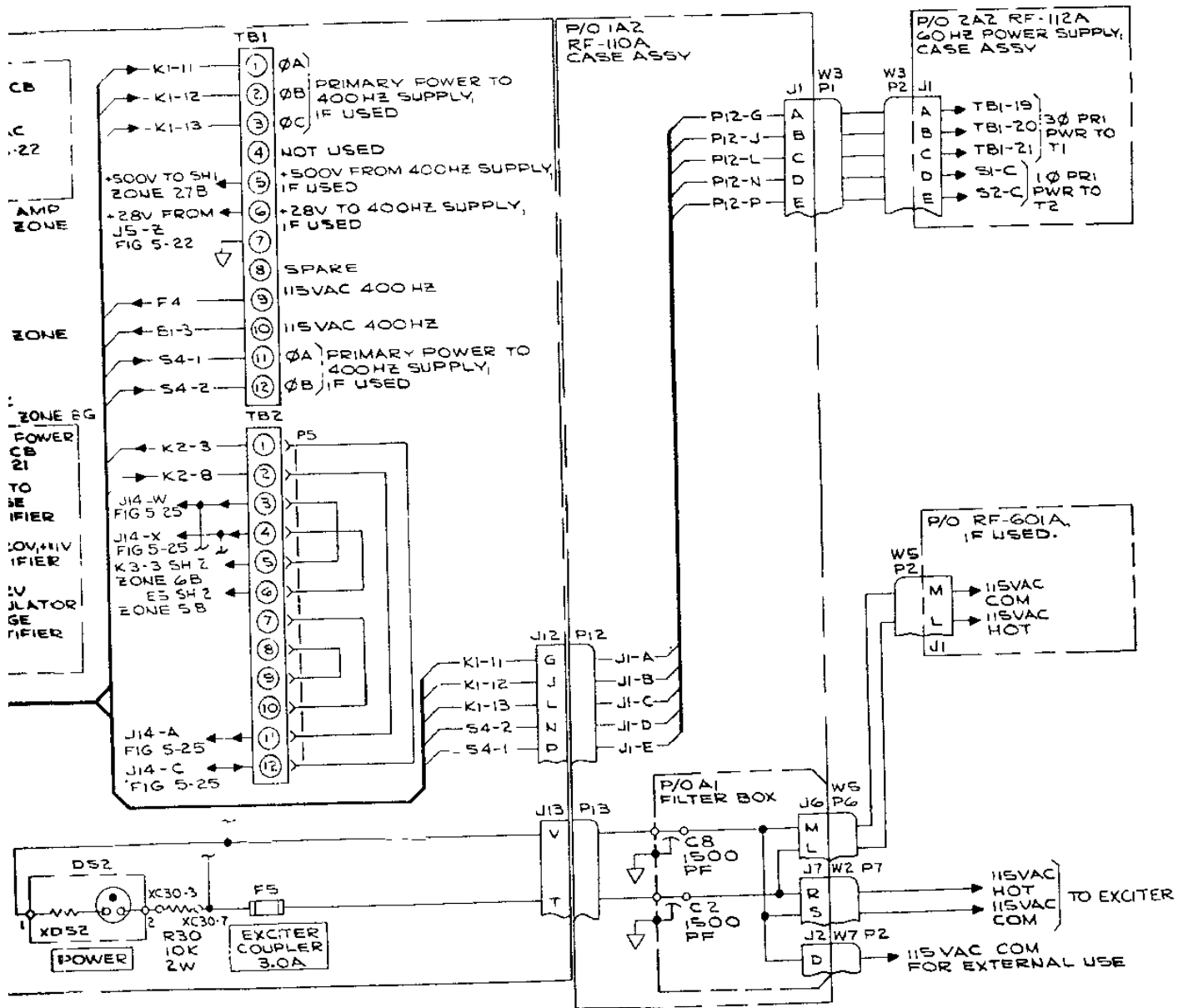
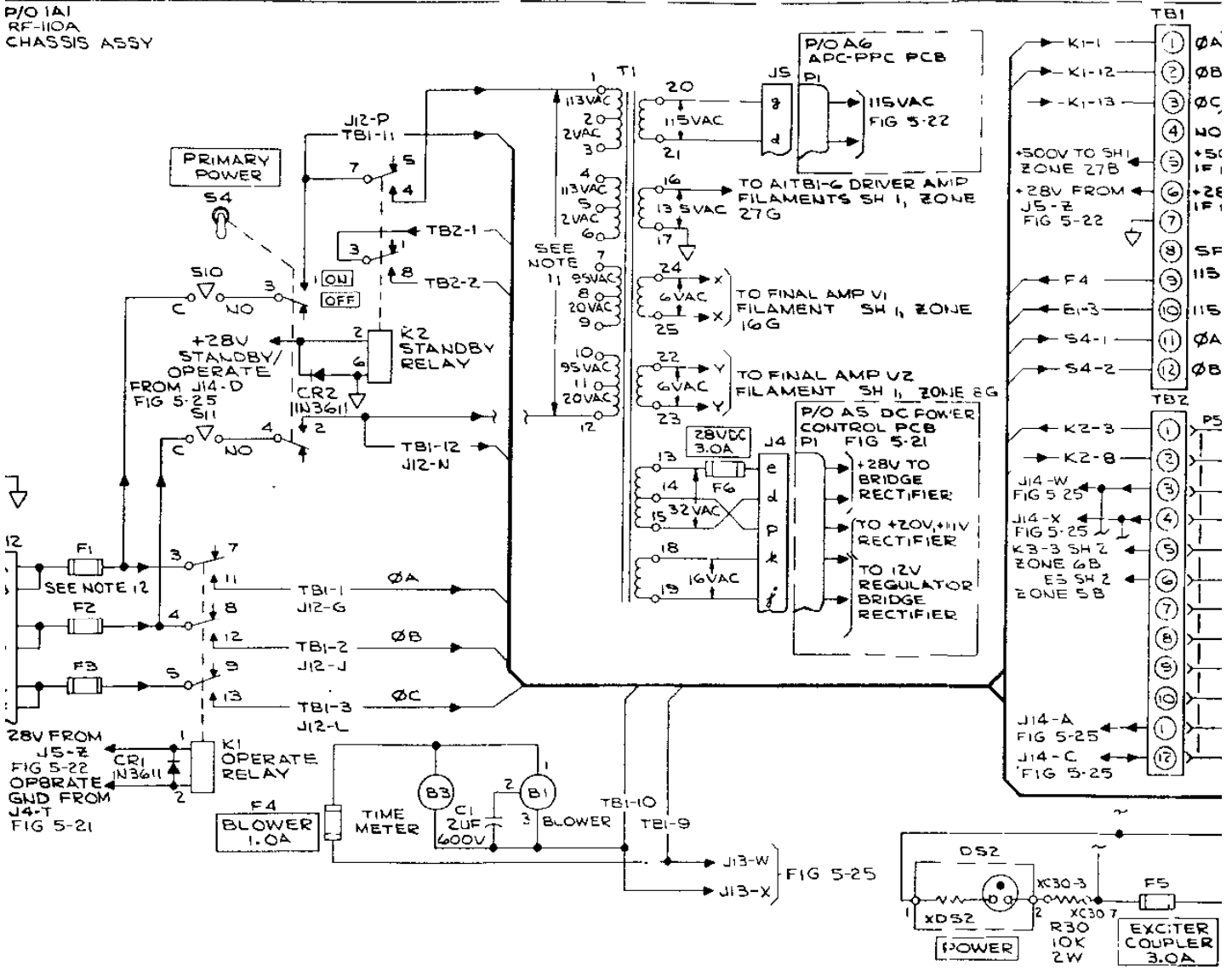


Figure 5-20. RF-110A Chassis, Schematic Diagram (Sheet 3 of 3)

P/O 1A1  
RF-110A  
CHASSIS ASSY

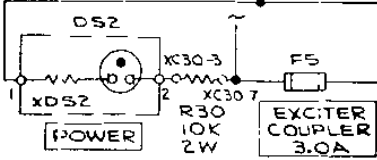


SEE NOTE 7

P/O AG  
APC-PPC PCB  
PI  
113VAC  
FIG 5-22

P/O AS DC POWER  
CONTROL PCB  
PI  
FIG 5-21

FIG 5-25



NOTES

DRIVER TUBE RESISTANCE CHECKS

NOTE

RESISTANCES MEASURED WITH TRANSMITTER DE ENERGIZED AND MODULE WITHDRAWN FROM, BUT STILL CONNECTED TO CHASSIS

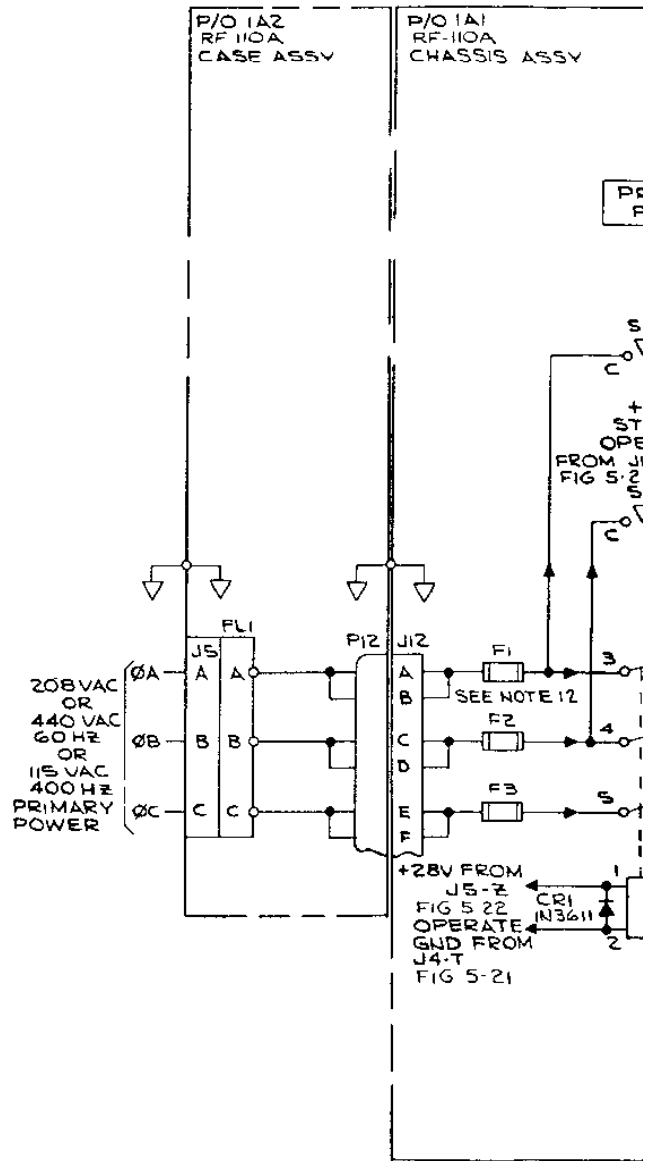
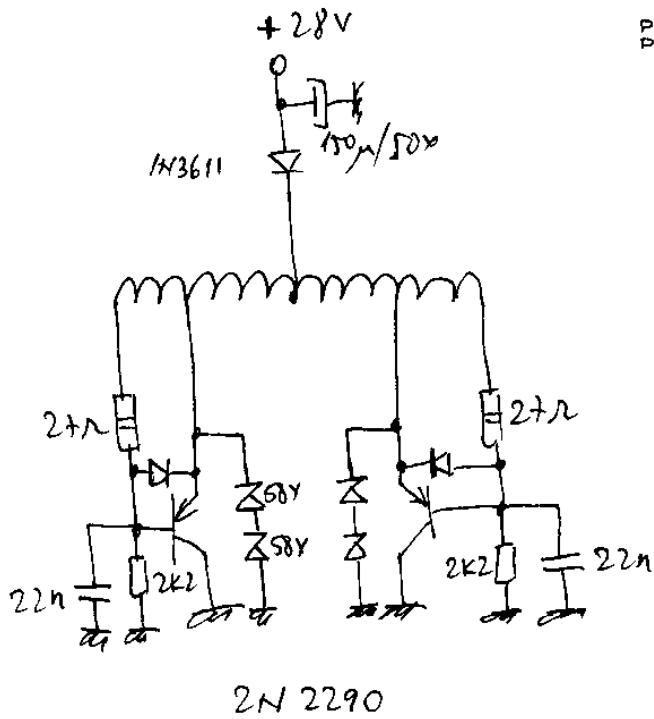
	1	2	3	4	5	6	7	8	9	10	11	PLATE
1A1A1V1/V2(+)	10 0	220K	23K	10 0	0	0 2	220K	23K	10 0	220K	23K	1M
1A1A1V1/V2(-)	10 0	40K	23K	10 0	0	0 2	40K	22K	10 0	40K	22K	1M

NOTE

VOLTAGE MEASUREMENTS ARE NOT PROVIDED FOR THE FINAL AMP LIFIER DUE TO THE EXTREME HAZARDS INVOLVED IN SUCH MEASUREMENTS THIS CIRCUIT CAN BE SAFELY CHECKED WITH THE FRONT PANEL MULTIMETER AND THE RESISTANCE MEASUREMENTS ALL RESISTANCE MEASUREMENTS SHOULD BE MADE WITH THE TUBES IN THEIR SOCKETS

FINAL TUBE RESISTANCE CHECKS

	FILAMENT	GRID	SCREEN	PLATE	CATHODE
1A1V1/V2(3)	5 4	5 5K	175K	800K	5
1A1V1/V2(-)	5 4	16K	70K	125K	5



OVER CONTROL PCB

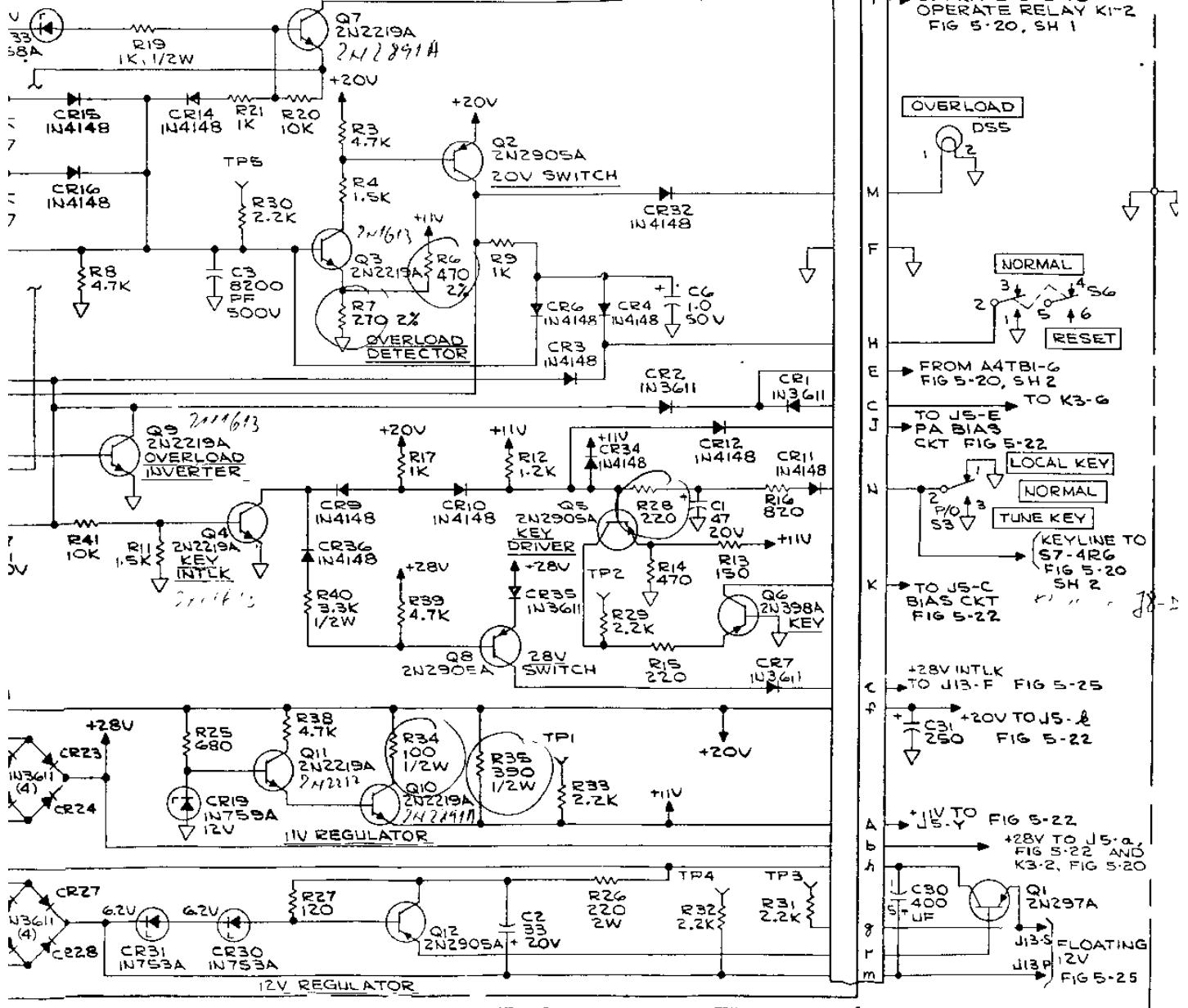


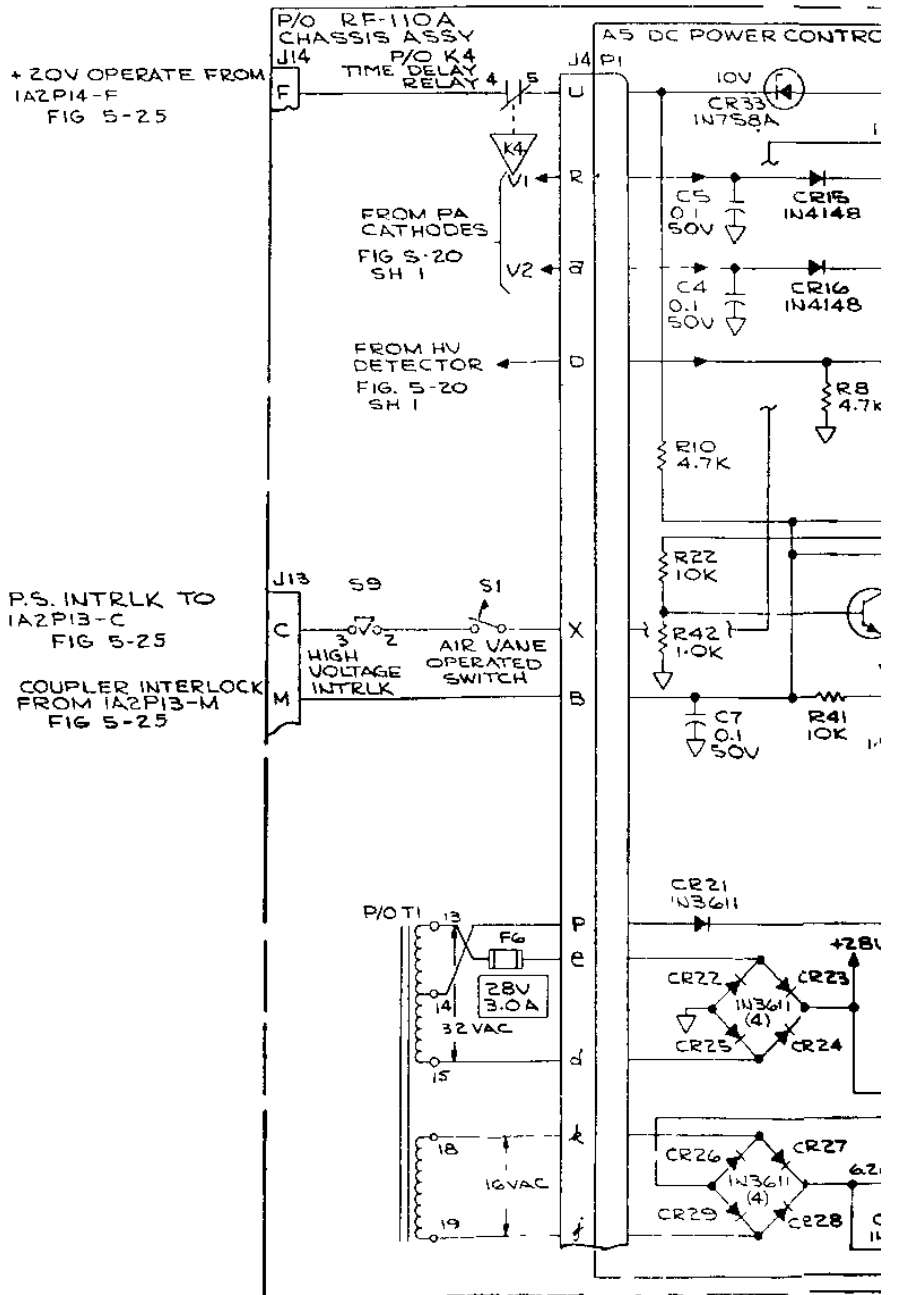


Figure 5-21 DC Power Control PC Board A5. Schematic Diagram

# Y09F2J

## NOTES

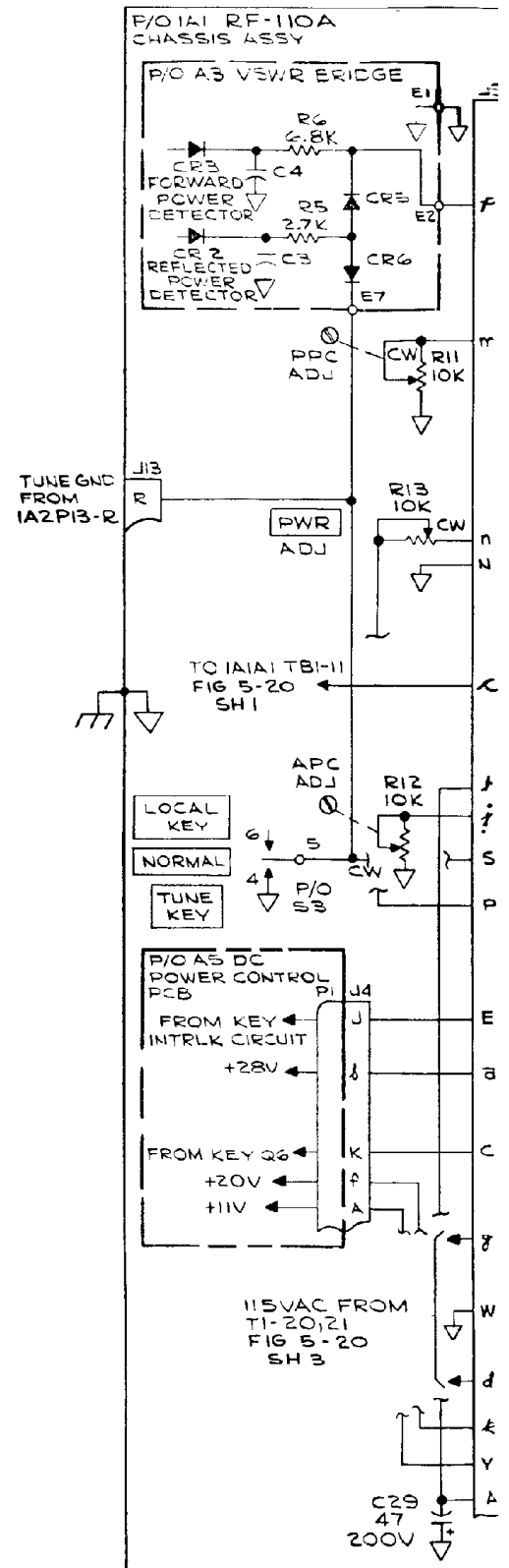
1. UNLESS OTHERWISE SPECIFIED
  - A. ALL RESISTORS ARE IN OHMS, 1/4 WATT, 10%.
  - B. ALL CAPACITORS ARE IN MICROFARADS.
2.  INDICATES FRONT PANEL MARKING,
3.  INDICATES CHASSIS GROUND.
4. PREFIX ALL INCOMPLETE REFERENCE DESIGNATORS WITH 1A1.



*Handwritten notes:*  
 P/O RF-110A  
 PA = 100  
 HV = 1000  
 HV = 1000  
 HV = 1000  
 HV = 1000  
 HV = 1000

NOTES:

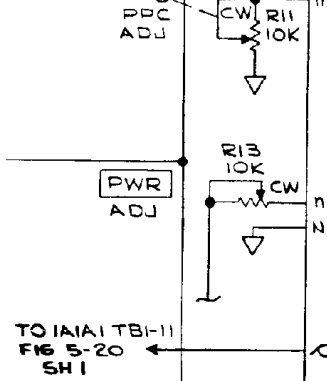
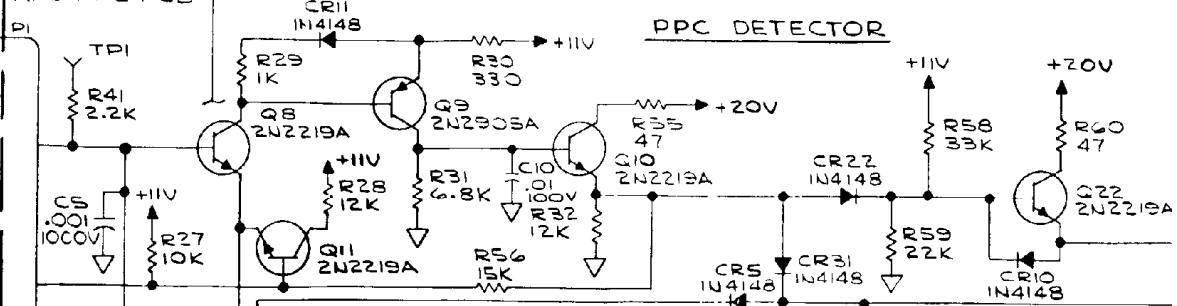
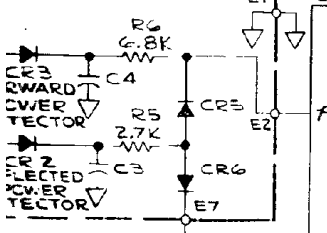
1. UNLESS OTHERWISE SPECIFIED:
  - A. ALL RESISTORS ARE IN OHMS, 1/4 WATT, ±10%.
  - B. ALL CAPACITORS ARE IN MICROFARADS.
2.           INDICATES FRONT PANEL MARKINGS.
3.           INDICATES CHASSIS GROUND.
4. VALUE OF R25 CAN BE SELECTED TO DETERMINE TUNE POWER LEVEL. VALUE SHOWN (2.2K) PROVIDES APPROXIMATELY 200 WATTS TUNE POWER. INCREASE R25 TO DECREASE TUNE POWER. TO PREVENT TUNE POWER FROM EXCEEDING MAXIMUM OUTPUT RATINGS, DO NOT INSTALL LESS THAN 1.8K.
5. PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH 1A1, AND APPROPRIATE SUBASSEMBLY DESIGNATOR, IF ANY.



1A1 RF-110A  
SSIS ASSY

3A3 VSWR BRIDGE

AG  
APC-PPC PCB



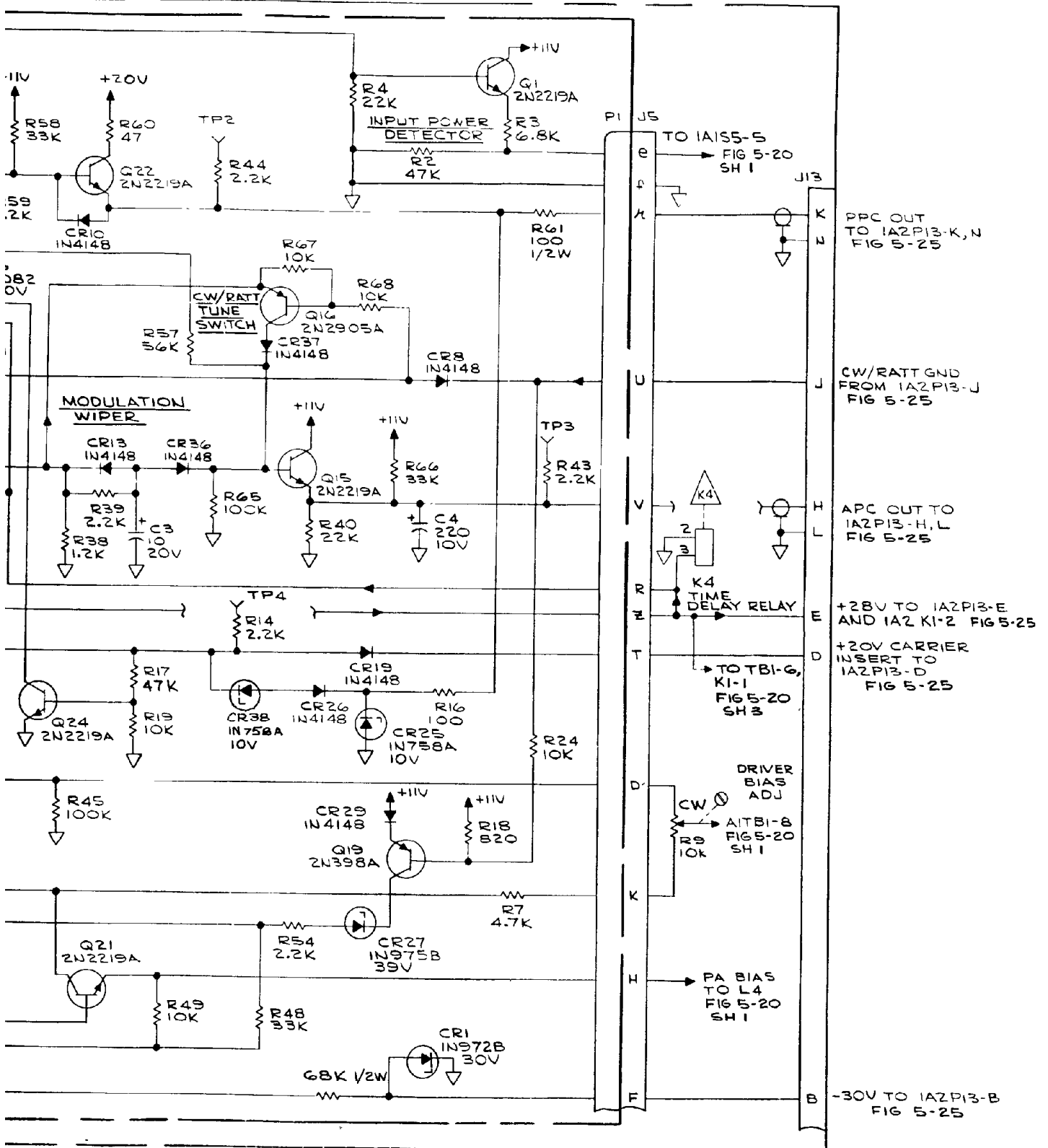


Figure 5-22. APC-PPC Circuit PC Board A6, Schematic Diagram



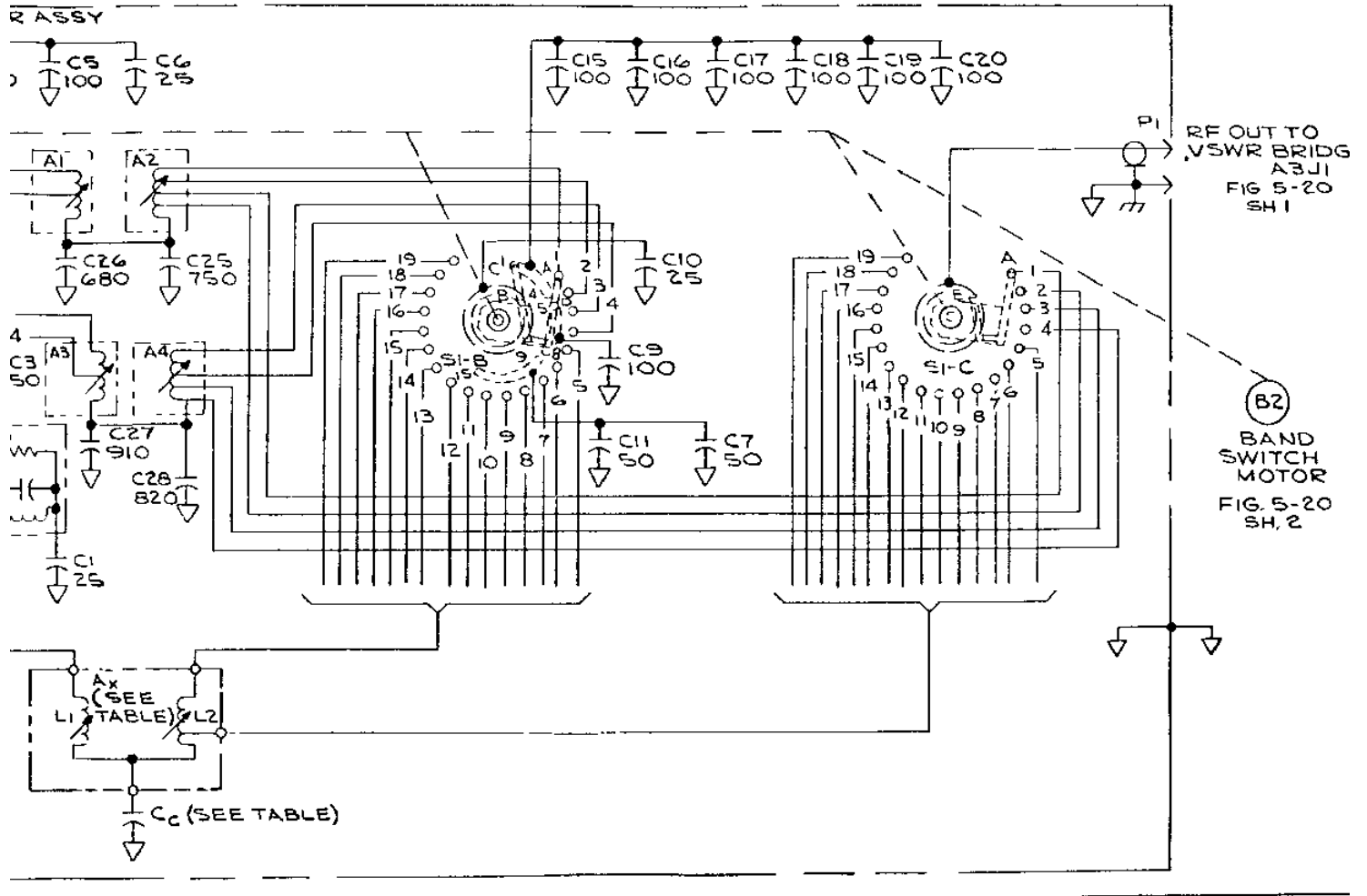
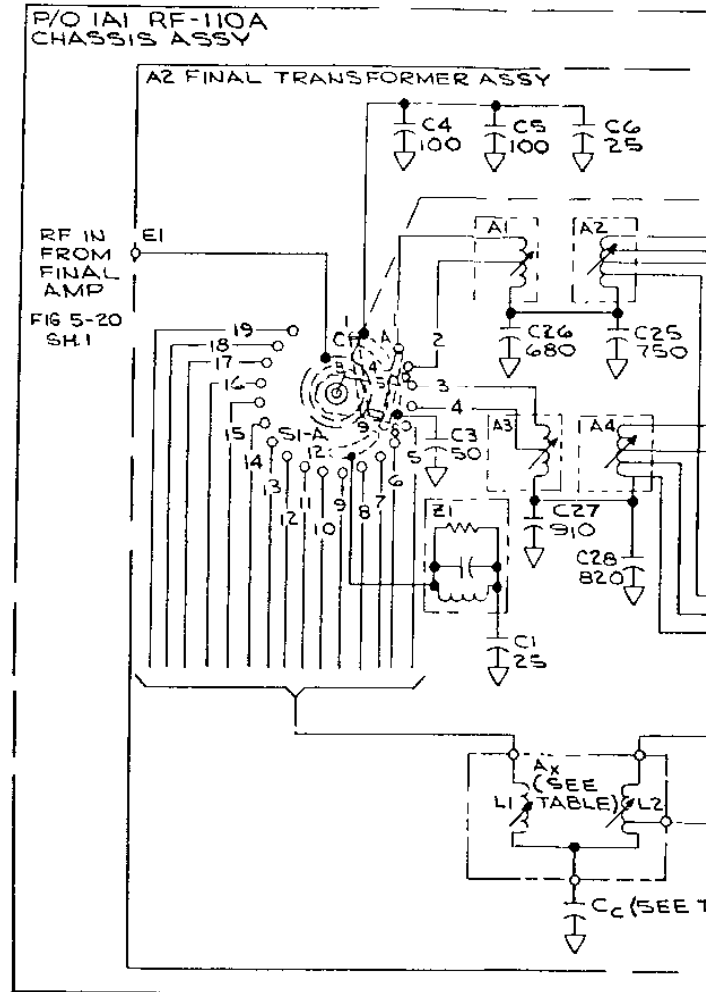


Figure 5-23. PA Transformer Assembly,  
Schematic Diagram

NOTES:

1. UNLESS OTHERWISE INDICATED ALL CAPACITORS ARE IN PICOFARADS AND RESISTORS ARE IN OHMS.
2. SWITCH IS SHOWN IN 2.0 - 2.5 MC POSITION.

SWITCH POSITION	AX	C <sub>C</sub>	C <sub>C</sub> VALUE (PF)	FREQUENCY (MHZ)
5	A5	C29	180	4 - 5
		C30	200	
		C70	180	
		C71	200	
6	A6	C31	300	5 - 6
		C32	270	
7	A7	C33	300	6 - 7
		C34	270	
8	A8	C35	180	7 - 8
		C36	180	
		C37	150	
9	A9	C38	200	8 - 10
		C40	180	
10	A10	C72	220	10 - 12
		C73	300	
11	A11	C45	110	12 - 14
		C46	110	
		C47	110	
		C48	150	
12	A12	C72	220	14 - 16
		C73	300	
13	A13	C53	75	16 - 18
		C54	75	
		C55	75	
		C56	75	
14	A14	C69	220	18 - 20
		C57	220	
15	A15	C74	150	20 - 22
		C75	150	
16	A16	C68	180	22 - 24
		C68	180	
17	A17	C68	180	24 - 26
		C68	180	
18	A18	C68	180	26 - 28
		C68	180	
19	A19	C68	180	28 - 30



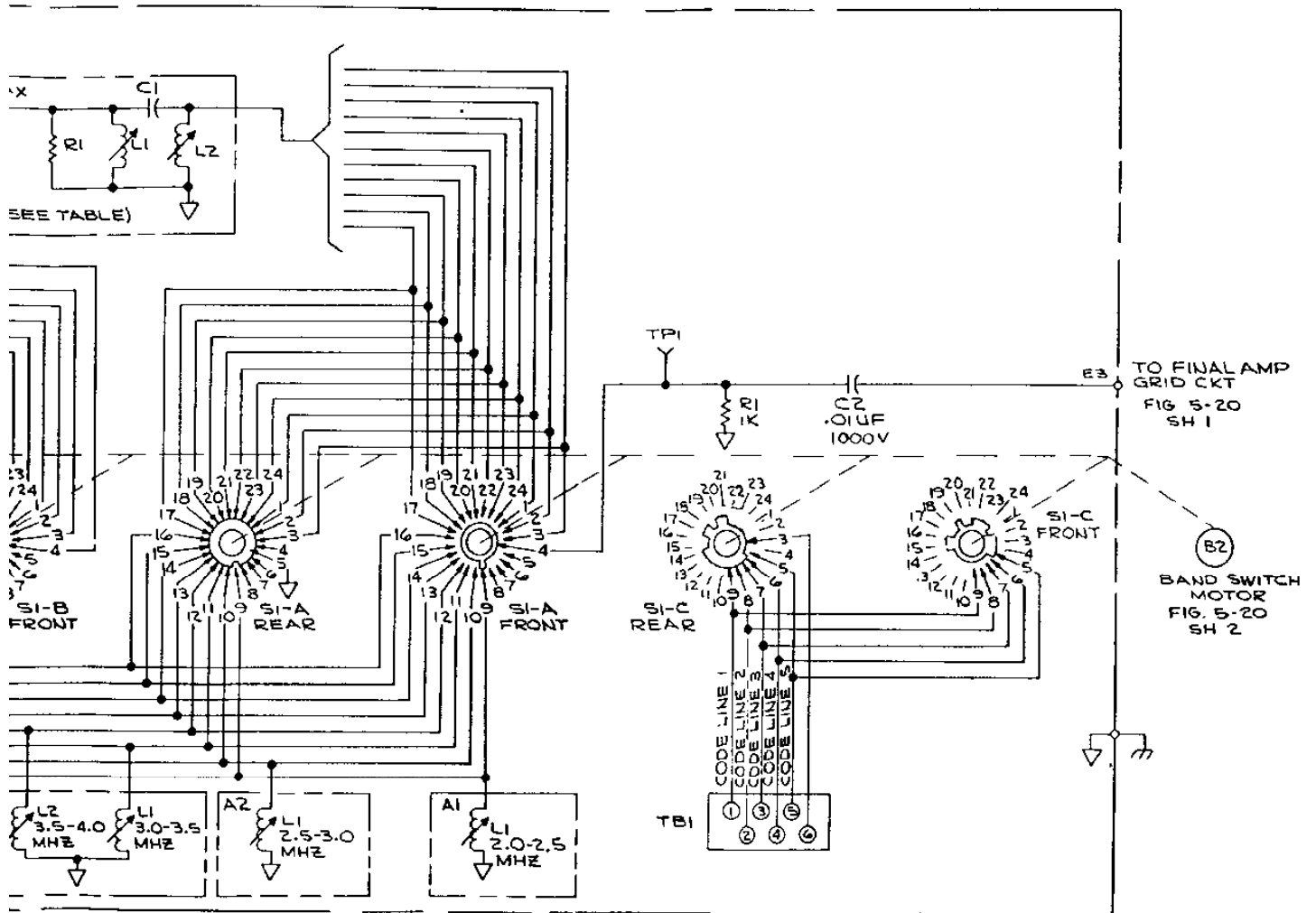


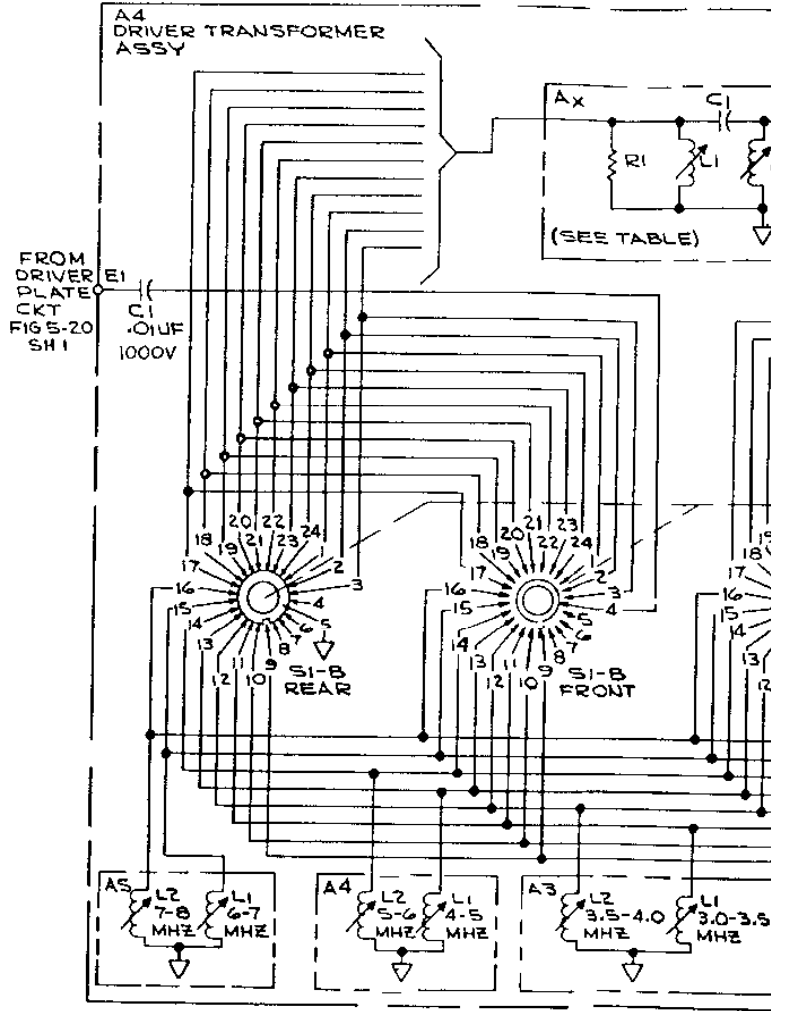
Figure 5-24. Driver Transformer Assembly, Schematic Diagram

NOTES:

1. PREFIX PARTIAL REFERENCE DESIGNATIONS WITH JATA4.
2. UNLESS OTHERWISE SPECIFIED
  - A. ALL RESISTORS ARE IN OHMS.
  - B. ALL CAPACITORS ARE IN PICOFARADS.
3. SWITCH S1 IS SHOWN IN 2.0 - 2.5 MHZ POSITION.

SI-A, B TERM	AX	C1 (PF)	R1 (2W, 10%)	FREQUENCY (MHZ)
9	A1	-	-	2.0 - 2.5
10	A2	-	-	2.5 - 3.0
11	A3	-	-	3.0 - 3.5
12	A3	-	-	3.5 - 4.0
13	A4	-	-	4 - 5
14	A4	-	-	5 - 6
15	A5	-	-	6 - 7
16	A5	-	-	7 - 8
17	A6	39	2.2K	8 - 10
18	A7	33	2.2K	10 - 12
19	A8	30	2.2K	12 - 14
20	A9	27	2.2K	14 - 16
21	A10	27	2.7K	16 - 18
22	A11	27	2.7K	18 - 20
23	A12	24	2.7K	20 - 22
24	A13	24	4.7K	22 - 24
1	A14	27	8.2K	24 - 26
2	A15	27	-	26 - 28
3	A16	27	-	28 - 30

RF-110A CHASSIS ASSY



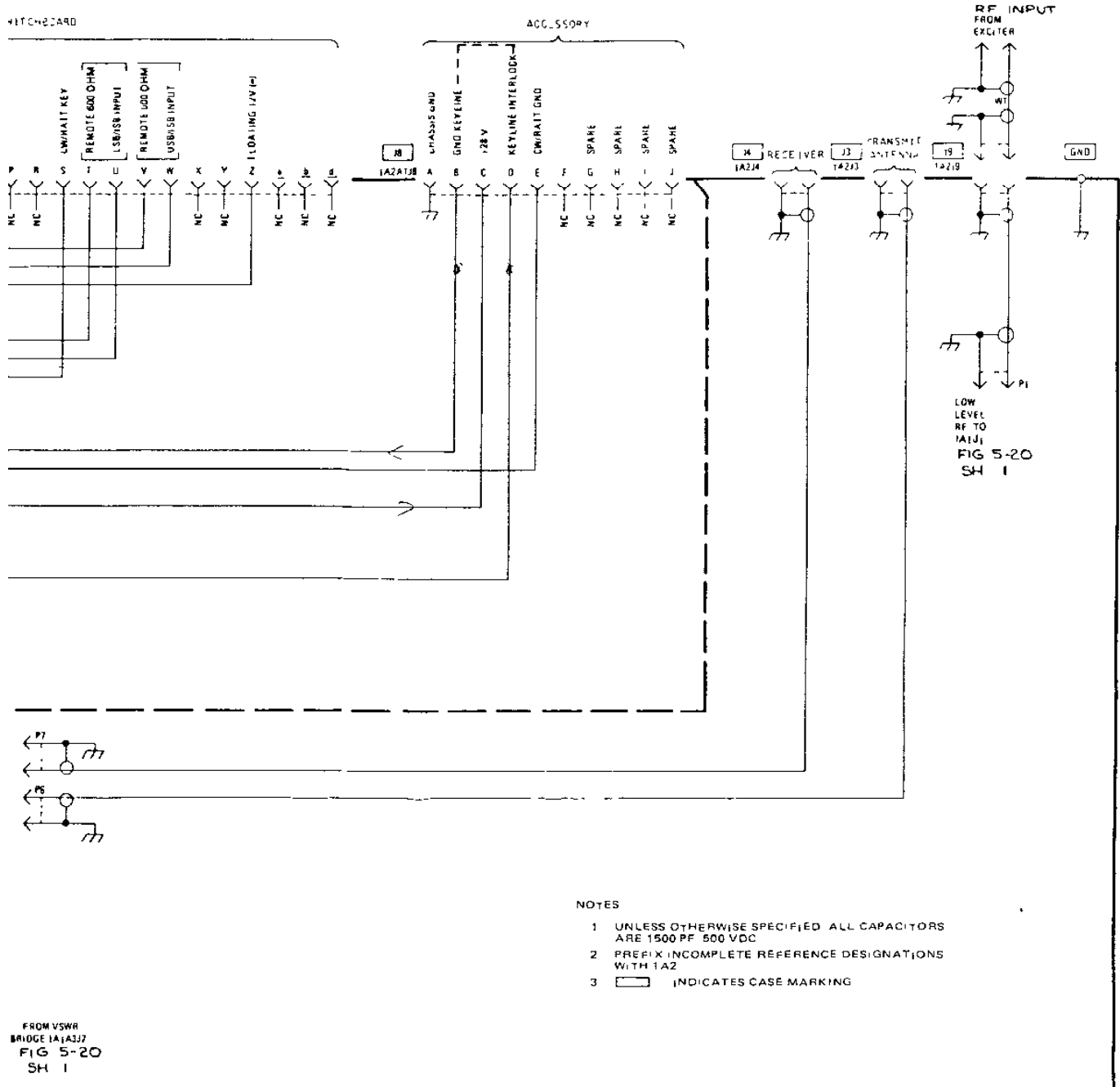
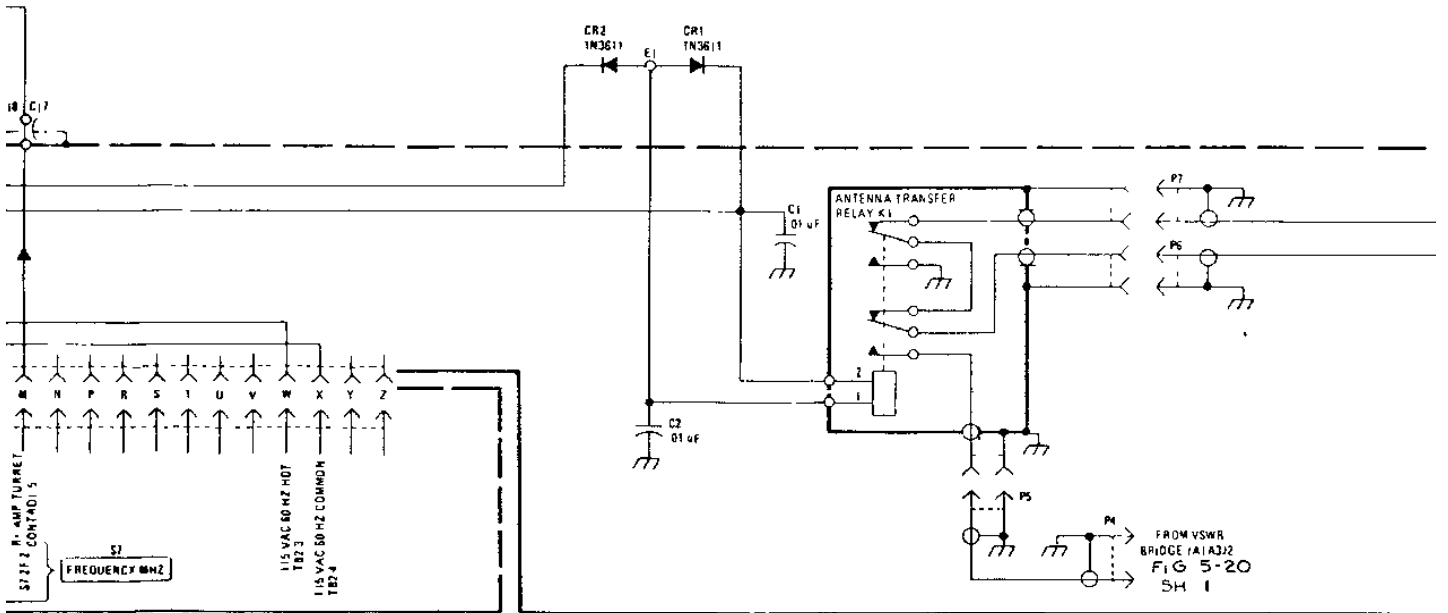
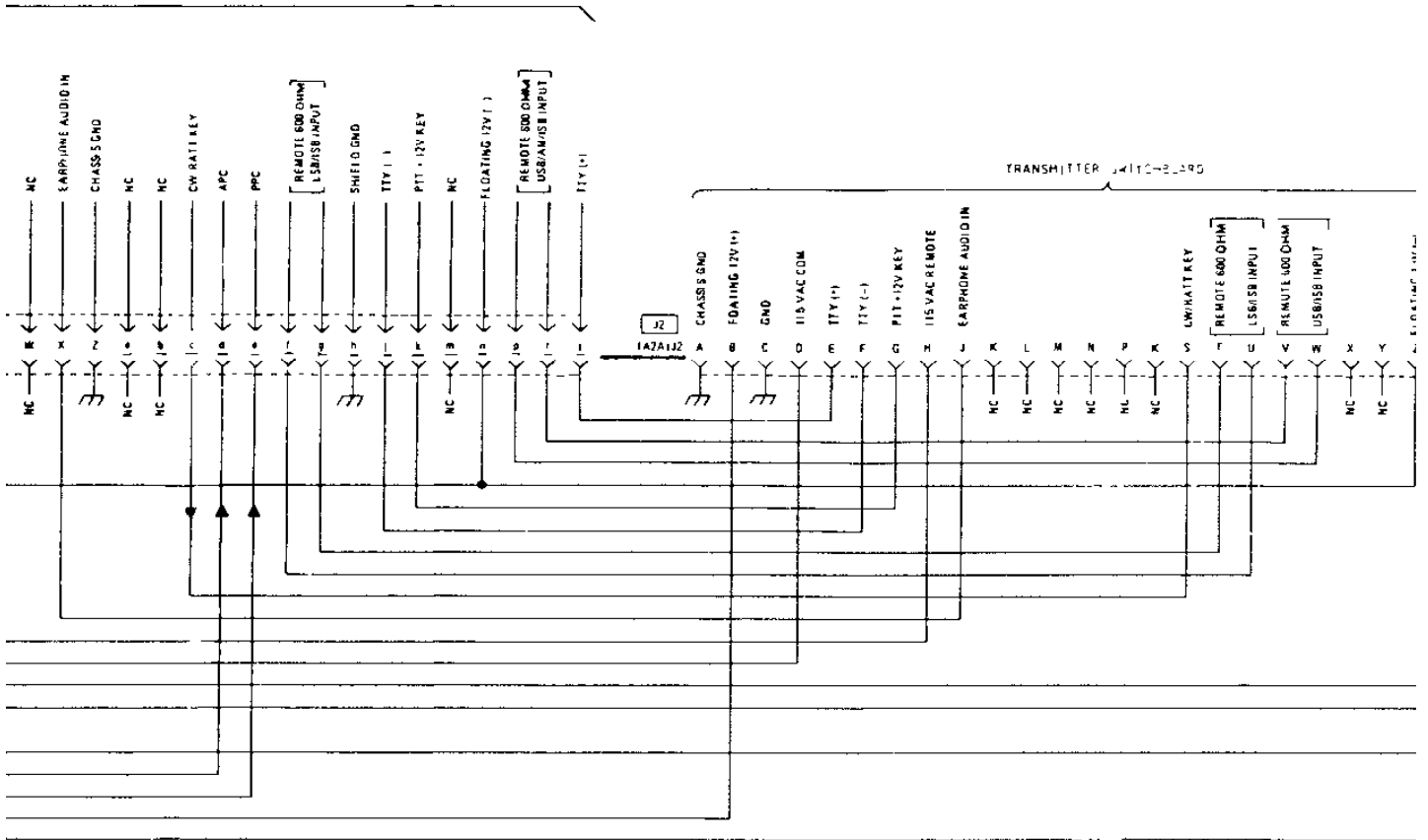
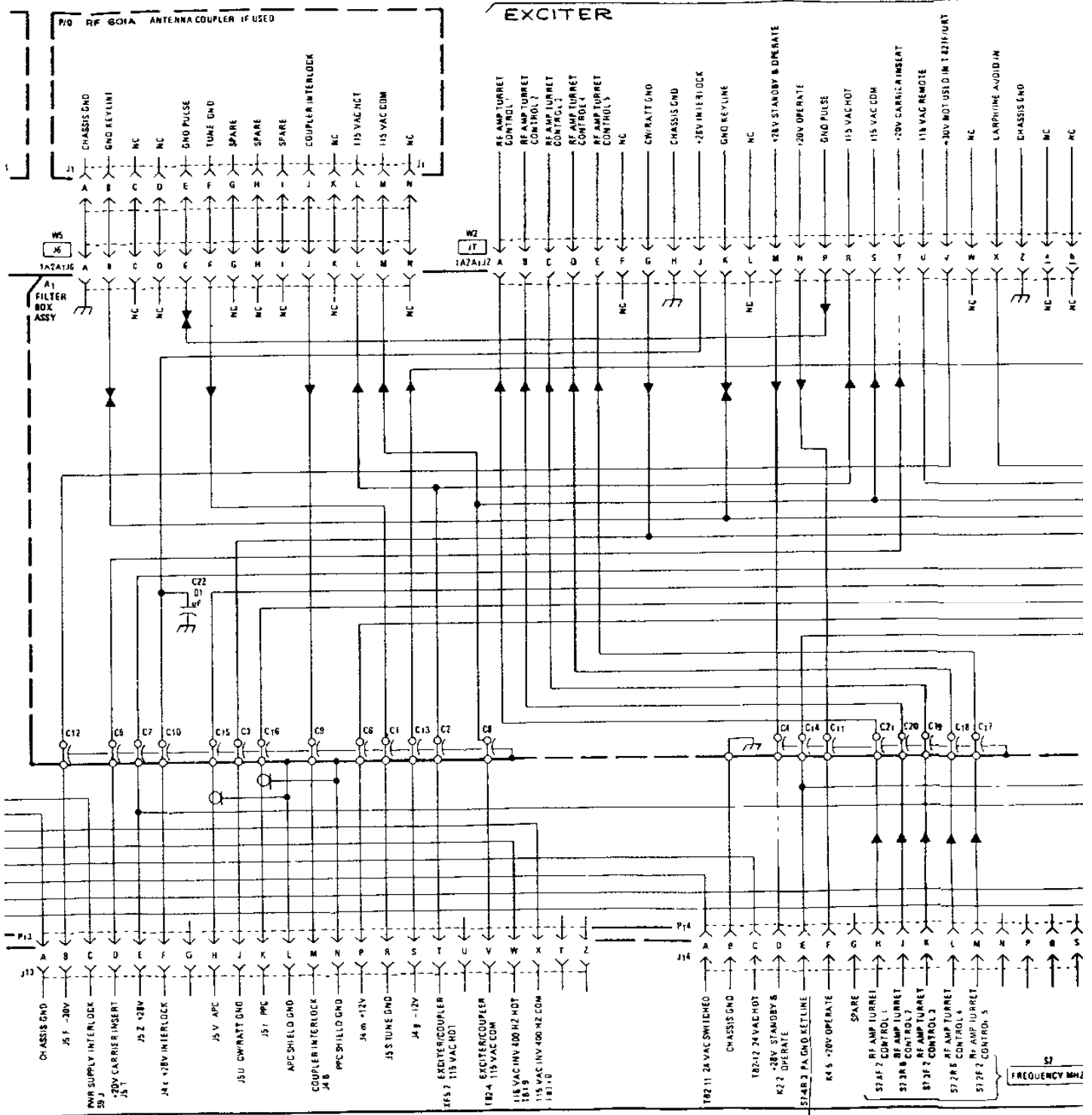


Figure 5-25. RF-110A Case, Schematic Diagram

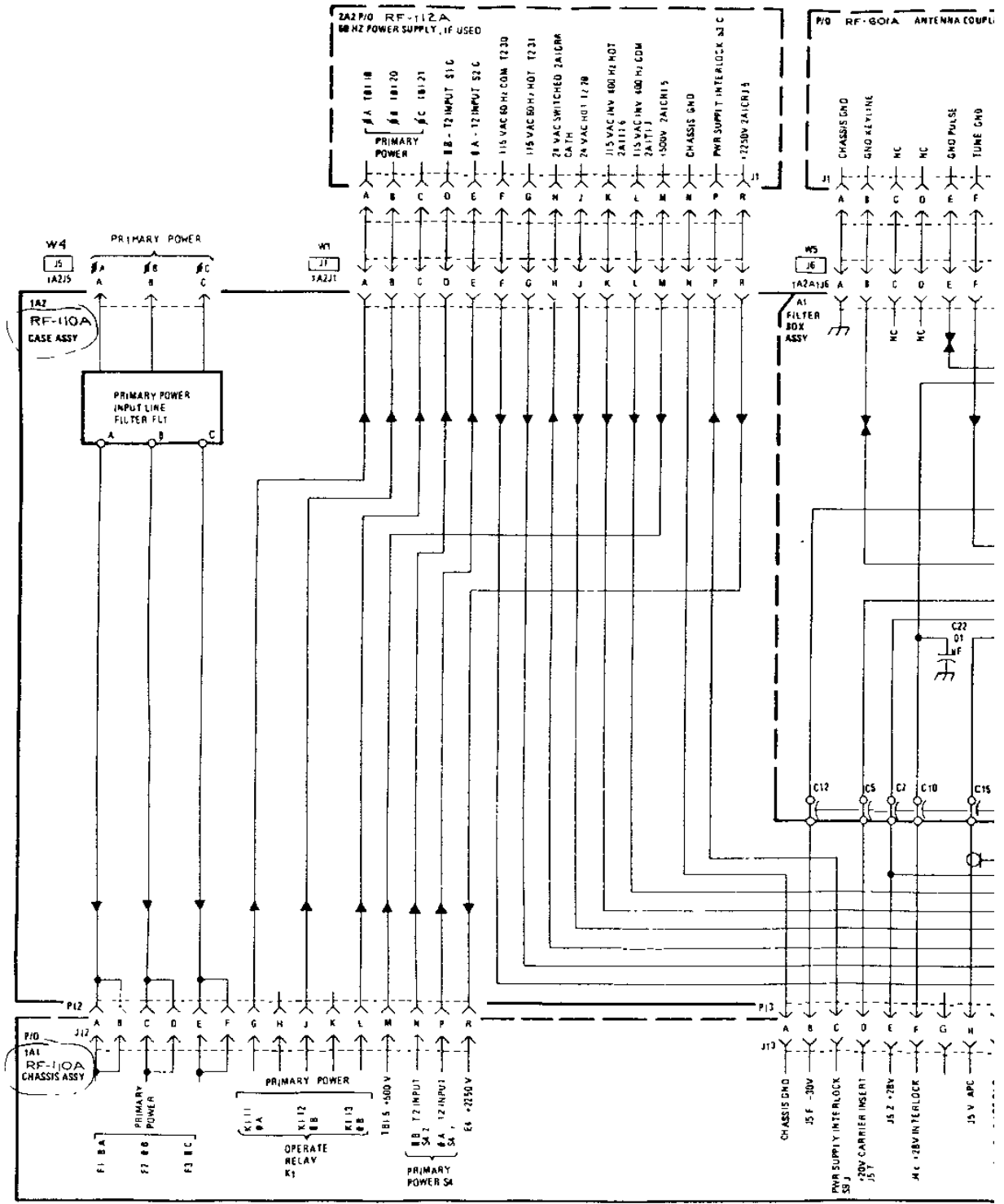




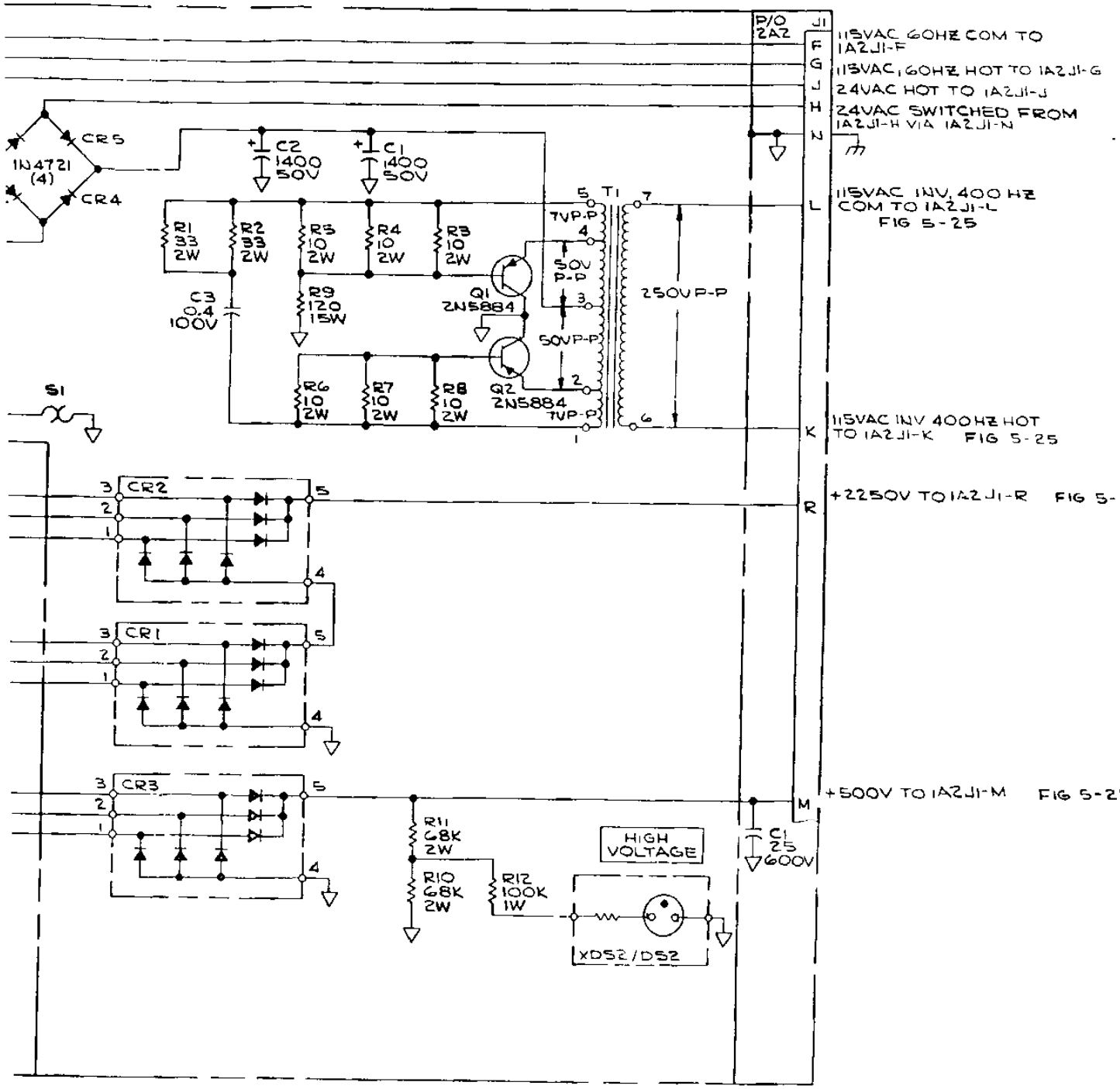
**EXCITER**

FREQUENCY MHz

N-4







- P/O 2A2
- J1
- F 115VAC 60HZ COM TO 1A2J1-F
- G 115VAC 60HZ HOT TO 1A2J1-G
- H 24VAC HOT TO 1A2J1-J
- I 24VAC SWITCHED FROM 1A2J1-H VIA 1A2J1-N
- N
- L 115VAC INV, 400 HZ COM TO 1A2J1-L FIG 5-25
- K 115VAC INV 400HZ HOT TO 1A2J1-K FIG 5-25
- R +2250V TO 1A2J1-R FIG 5-
- M +500V TO 1A2J1-M FIG 5-2'



## SECTION VI

### PARTS LIST

#### 6.1 REFERENCE DESIGNATIONS

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

Example 1:

3 R 1

Read as: First (1) resistor (R) of third unit (3).

Example 2:

2 A 3 R 1

Read as: First (1) resistor (R) of third (3) subassembly (A) of second (2) unit.

2 A 1 A 2 R 1

Read as: First (1) resistor (R) of second (2) subassembly (A) of first (1) subassembly (A) of second (2) unit.

#### 6.2 REFERENCE DESIGNATION PREFIX

Partial reference designations are frequently used on the equipment and illustrations. The partial reference designations consist of the class letter(s) and the identifying item number. The complete reference designations may be obtained by placing the proper prefix before the partial reference designations. Prefixes are provided on illustrations following the notation "REF DESIG PREFIX".

#### 6.3 MAINTENANCE PARTS LIST

Table 6-1 and 6-2 list maintenance parts for the RF-110A and RF-112A, respectively. Maintenance parts for each unit are listed alphabetically-numerically by class of part following the unit designation. Thus the parts for each unit are grouped

together with the following information: (1) the complete reference designation of assembly, subassembly, or part, (2) reference to explanatory notes in paragraph 6.4, (3) part number name and description, and (4) identification of the illustration which shows location of the part. For common items, the standard part number is provided. For all other parts, RF Communications part number are used.

Printed circuit boards, assembly board modules, etc., are listed first as individual items in the maintenance parts list. In addition, at the completion of a parts listing for each unit, the individual circuit board, assembly board, module, etc., is then broken down by components into separate parts listing.

#### 6.4 NOTES

The following notes provide information as referenced in tables 6-1 and 6-2.

NOTE 1: The RF-110A is supplied with the primary power input fused and wired for 3 Ø, 440 or 208 Vac as specified by the customer. Jumper strip P5 is installed when using the RF-112A Power Supply.

NOTE 2: Value may be changed to obtain tune power other than normal 200W.

NOTE 3: 1A1P6 and 1A1P7 are plugged into a jack selected from 1A1J6 to 1A1J11 for desired final screen voltage.

NOTE 4: Removable Crimp Type Pins; pin 20 gauge, MS17804-16-20 (socket); pin 16 gauge, MS17804-16-16 (socket); pin 20 gauge, MS17803-16-20 (pin); pin 16 gauge, MS17803-16-16 (pin).

NOTE 5: Used with 208 Vac primary power, (1A1F1-3, 2A2P1).

NOTE 6: Used with 440 Vac primary power, (1A1F1-3 (2A2P2).

TABLE 6-1. MAINTENANCE PARTS LIST

Reference Designation	Name and Description	Figure Number (Item)	Reference Designation	Name and Description	Figure Number (Item)
I	AMPLIFIER, RADIO FREQUENCY RF-110A, part no. 1932-1000	5-7	IAICR7 thru IAICR11	SEMICONDUCTOR DEVICE, DIODE, ZENER: 6.2 Vdc, MIL type 1N753A	5-6
IAI	CHASSIS, PANEL ASSEMBLY part no. 1932-3100	5-7	IAICR12	SEMICONDUCTOR DEVICE, DIODE- MIL type 1N3611	5-6
IA1B1	FAN: 115 Vac, 400 Hz, 1Ø, part no. B22-0001-000	5-8	IAICR13	SEMICONDUCTOR DEVICE, DIODE- MIL type 1N4148	5-7
IA1B2	MOTOR, SYNCHRONOUS 115 Vac, 60 Hz, 1Ø, part no. B11-0004-000	5-8	IAICR14	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N3611	5-7
IA1B3	METER, TIME TOTALIZING, MINIATURE, DIGITAL: 115V, 400 Hz, square face, MIL type MS17322-10	5-7	IAIDS1	Not used	
IA1C1	CAPACITOR, FIXED, PAPER 2 uF, ±10%, 600V, MIL type CP53B1EF2D5K1	5-8	IAIDS2 and IAIDS3	LAMP, NEON, MIDGET FLANGED BASE: 110 to 125 Vac, ac-dc MIL type MS25252-C7A	5-7
IA1C2 and IA1C3	CAPACITOR, FIXED, CERAMIC .005 uF, ±20%, 3000 Vdc, .80 in. dia, part no. C11-0003-001	5-7	IAIOS4	Not used	
IA1C4	CAPACITOR, FIXED, MICA .01 uF, ±10%, 2500V, MIL type CM60BK1D3K03	5-7	IAIOS5	LAMP, INCANDESCENT, MIDGET FLANGED BASE, CLEAR: 28 Vdc, MIL type MS25237-327	5-7
IA1C5 thru IA1C13	CAPACITOR, FIXED, CERAMIC .01 uF, 1000 Vdc, MIL type CK63AY103X	5-5	IAIF1	FUSE, CARTRIDGE: 7A Time Delay, 500 Vac, part no. F10-0001-026 Note 5 FUSE CARTRIDGE: 15A, 500 Vac, MIL type F60C500V15AS Note 6	5-8
IA1C14	Not used		IAIF2	FUSE, CARTRIDGE: 7A Time Delay, 500 Vac, part no. F10-0001-026 Note 5 FUSE, CARTRIDGE: 15A, 500 Vac, MIL type F60C500V15AS Note 6	5-8
IA1C15 thru IA1C17	CAPACITOR, FIXED, CERAMIC .01 uF, 1000 Vdc, MIL type CK63AY103X	5-5	IAIF3	FUSE, CARTRIDGE: 7A Time Delay, 500 Vac, part no. F10-0001-026 Note 5 FUSE, CARTRIDGE: 15A, 500 Vac, MIL type F60C500V15AS Note 6	5-8
IA1C18	Not used		IAIF4	FUSE, CARTRIDGE: 1A, 250 Vac, MIL type F02A250V1AS	5-8
IA1C19 thru IA1C21	CAPACITOR, FIXED, CERAMIC .01 uF, 1000 Vdc, MIL type CK63AY103X	5-5	IAIF5 and IAIF6	FUSE, CARTRIDGE: 3A, 250 Vac, MIL type F02A250V3AS	5-8
IA1C22	Not used		IAIF7	FUSE, CARTRIDGE: 1.5A, 250 Vac, MIL type F02A250V1-1/2AS	5-8
IA1C23 and IA1C24	CAPACITOR, FIXED, CERAMIC .01 uF, 1000 Vdc, MIL type CK63AY103X	5-5	IAIJ1	CONNECTOR, COAXIAL RF: Series BNC (cabled), receptacle, female, jam nut mounted, class II, MIL type M39012/19-0004	5-6
IA1C25	Not used		IAIJ2 and IAIJ3	Not used	
IA1C26 thru IA1C28	CAPACITOR, FIXED, CERAMIC .01 uF, 1000 Vdc working, MIL type CK63AY103X	5-5	IAIJ4 and IAIJ5	CONNECTOR, PRINTED WIRING BOARD, 36 PIN: part no. J10-0007-008	5-7
IA1C29	CAPACITOR, FIXED, ELECTROLYTIC 47 uF, +50%, -10%, 200 Vdc working, MIL type CE51C470K	5-7	IAIJ6 thru IAIJ11	JACK, TEST, PRESS FIT, RED: part no. J60-0002-213	5-7
IA1C30	CAPACITOR, FIXED, ELECTROLYTIC 400 uF, +75%, -10%, 25 Vdc working, MIL type CE51C4DIF	5-7	IAIJ12	CONNECTOR, RECEPTACLE: Environment resistant, electrical, box mounting, solder contacts, MIL type MS3102R-28-17P Note 4	5-7
IA1C31	CAPACITOR, FIXED, ELECTROLYTIC 250 uF, +75%, -10%, 25 Vdc working, MIL type CE51C25IF	5-7	IAIJ13	INSERT, (INSULATOR), RECTANGULAR CONNECTOR: Electrical, 20-socket contacts crimp, removable, MIL type MS18177-1 Note 4	5-7
IA1C32 thru IA1C34	CAPACITOR, FIXED, CERAMIC .01 uF, 1000 Vdc working, MIL type CK63AY103X	5-5	IAIJ14	INSERT, (INSULATOR), RECTANGULAR CONNECTOR: Electrical, 20 pin contacts crimp, removable, MIL type MS18176-1 Note 4 CRIMP PIN, 20 GA (for IAIJ4) MIL type MS17803-16-20 Note 4 CRIMP PIN 16 GA (for IAIJ4) MIL type MS17803-16-16 Note 4	5-7
IA1C35	CAPACITOR, FIXED, CERAMIC 3 pF, ±.5%, 5000 Vdc working, part no. C15-0002-001	5-7			
IA1C36	CAPACITOR, FIXED, MICA 750 pF, 100 Vdc working, MIL type CM66F0751J03	5-7			
IA1C37 thru IA1C48	CAPACITOR, FIXED, CERAMIC .01 uF, 1000 Vdc working, MIL type CK63AY103X	5-5/5-7			
IAICR1 and IAICR2	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N3611	5-6/5-8			
IAICR3	SEMICONDUCTOR DEVICE, DIODE, ZENER: 62 Vdc, MIL type 1N3000B	5-6			
IAICR4 thru IAICR6	SEMICONDUCTOR DEVICE, DIODE, ZENER 75 Vdc, MIL type 1N3002B	5-6			

TABLE 6-1. MAINTENANCE PARTS LIST (Cont)

Reference Designation	Name and Description	Figure Number (Item)	Reference Designation	Name and Description	Figure Number (Item)
IAIK1	RELAY, POWER: 4 pdt, 25A, dc coil, part no. K30-0001-003	5-8	IAIR7 and IAIR8	RESISTOR, FIXED, COMPOSITION: 47 ohms, $\pm 10\%$ , 1/2 watt, MIL type RC20GF470K	5-5
IAIK2	RELAY, DC, CRYSTAL, Updt 26.5 Vdc, part no. K32-0002-001	5-6	IAIR9 thru IAIR12	RESISTOR, VARIABLE: 10k $\pm 10\%$ , 2 watt, MIL type RA20LASB103A	5-6, 5-8
IAIK3	RELAY, ELECTRICAL: 0pdt, 26.5 Vdc, MIL type M5757/23-001	5-6	IAIR13	RESISTOR, VARIABLE: 10k $\pm 10\%$ , 2 watt, MIL type RA20NASD103A	5-8
IAIK4	RELAY, TIME DELAY, THERMAL: Spst, 2A, MIL type M19648/1-127	5-6	IAIR14	RESISTOR, VARIABLE: 10k $\pm 10\%$ , 2 watt, MIL type RA20LASB103A	5-6
IAIL1	CHOKE, RF: 115 uH, part no. 8948-3307	5-7	IAIR15	Not used	
IAIL2 and IAIL3	COIL, FIXED, RF: 22 uH, MIL type MS16221-15	5-5/5-7	IAIR16 thru IAIR19	RESISTOR, FIXED, COMPOSITION: 2.2 ohms, $\pm 5\%$ , 1/2 watt, 3.380 in. lg x .138 in. dia, part no. R11-0001-001	5-5
IAIL4	COIL, FIXED, RF: 1000 uH, $\pm 10\%$ , MIL type MS75054-5	5-5	IAIR20	RESISTOR, FIXED, COMPOSITION: 4.7k $\pm 5\%$ , 1/2 watt, MIL type RC20GF472J	5-7
IAIL5	COIL, FIXED, RF: 22 uH, MIL type MS16221-15	5-5	IAIR21	RESISTOR, FIXED, COMPOSITION: 33 ohms, $\pm 10\%$ , 2 watt MIL type RC42GF33CK	5-7
IAIL6	COIL, FIXED, RF: .08 uH, part no. 391-3311	5-7	IAIR22 and IAIR23	Not used	
IAIM1	METER, VOLTS/CURRENT: Round, part no. 0082C-3677	5-7	IAIR24	RESISTOR, FIXED, COMPOSITION: 15 ohms, $\pm 10\%$ , 2 watt, MIL type RC42GF150K	5-8
IAIM2	METER, POWER: Round 0-150 watts and 0-1500 watts, part no. 391-3676		IAIR25 thru IAIR28	RESISTOR, FIXED, WIREWOUND: 10 ohms, $\pm 1\%$ , 3 watt, MIL type RW79U10R0F	5-5
IAIMP1 and IAIMP2	Not used		IAIR29	RESISTOR, FIXED, WIREWOUND, 12k ohms, $\pm 10\%$ , 50W, part no. R90-0004-C01	5-6
IAIMP3	KNOB-CONTROL, PLASTIC: 1/4 in. dia. shaft black, MIL type MS91528-1D2B	5-8	IAIR30	RESISTOR, FIXED, COMPOSITION, 10k $\pm 10\%$ , 2 watt, MIL type RC42GF103K	5-7
IAIMP4	Not used		IAIS1	SWITCH AIR VANE: Spst part no. 391-3590	5-8
IAIMP5 and IAIMP6	KNOB-CONTROL, PLASTIC: Plain pointer, 1/4 in. dia shaft black, MIL type MS91528-1P2B	5-7	IAIS2	Not used	
IAIMP7	KNOB-CONTROL, PLASTIC: Round dial skirt with white arrow, 1/4 in. dia shaft, black, MIL type MS91528-3F2B	5-7	IAIS3	SWITCH, TOGGLE: MIL type MS35059-31	5-8
IAIMP8	TRANSMISSION ASSEMBLY: part no. 391-3250	5-8	IAIS4	SWITCH, TOGGLE: MIL type MS25100-22	5-8
IAIMP9 and IAIMP10	CHIMNEY PLASTIC, for IAIV1, IAIV2, part no. 391-3490	5-7	IAIS5	SWITCH, ROTARY: 1 section, part no. 391-3673	5-7
IAIP1 thru IAIP4	Not used		IAIS6	SWITCH, TOGGLE: MIL type MS35059-31	5-7
IAIP5	JUMPER, TB PLENUM: part no. 391-3603 Note 1	5-8	IAIS7	SWITCH, ROTARY: 4 sections, part no. 0082D-3660	5-7
IAIP6	PLUG, MINATURE, BROWN: part no. J20-0002-101 Note 3		IAIS8	SWITCH, ROTARY: 1 section, part no. 391-3672	5-7
IAIP7	PLUG, MINATURE, RED: part no. J20-0002-201 Note 3		IAIS9 thru IAIS11	SWITCH, INTERLOCK: Spdt, MIL type MS16106-4	5-7
IAIQ1	TRANSISTOR, PNP: MIL type 2N297A	5-6	IAIT1	TRANSFORMER, POWER: 48-420 Hz, 115-440 Vac, part no. 391-3562	5-7
IAIR1	RESISTOR, FIXED, COMPOSITION: 150k $\pm 10\%$ , 2 watt, MIL type RC42GF154K	5-7	IAITB1 and IAITB2	TERMINAL BLOCK: 12 terminals, MIL type 37TB-12	5-8
IAIR2	RESISTOR, FIXED, COMPOSITION: 47k $\pm 10\%$ , 2 watt, MIL type RC42GF473K	5-7	IAITB3	TERMINAL BLOCK: part no. 391-3596	5-8
IAIR3 and IAIR4	RESISTOR, FIXED, FILM: 5.1k $\pm 2\%$ , 1/2 watt, MIL type RL20S512G	5-5	IAIV1 and IAIV2	ELECTRON TUBE: type 4CX1500B/8660 Part no. V12-0002-000	5-7
IAIR5	RESISTOR, FIXED, COMPOSITION: 2.2k $\pm 10\%$ , 2 watt, MIL type RC42GF222K	5-5	IAIXC1 thru IAIXC28	Not used	
IAIR6	RESISTOR, FIXED, COMPOSITION: 1.8k $\pm 10\%$ , 2 watt, MIL type RC42GF182K	5-5	IAIXC29 thru IAIXC31	SOCKET, OCTAL: 8 contacts, MIL type M12883/01-04	5-7
			IAIXDS1	Not used	
			IAIXOS2	LAMPHOLDER: Clear, MIL type LH74/1-LC13CN	5-7
			IAIXOS3	LAMPHOLDER: Clear, MIL type LH74/1-LC13CN	5-7
			IAIXDS4	Not used	
			IAIXDS5	LAMPHOLDER: Red, MIL type LH73/1-LC12RT2	5-7
			IAIXF1 thru IAIXF3	FUSEHOLDER: Clear indicating, MIL type FHL12U	5-7
			IAIXF4 and IAIXF5	FUSEHOLDER, INDICATOR: part no. J50-0004-001	5-7

TABLE 6-1. MAINTENANCE PARTS LIST (Cont)

Reference Designation	Name and Description	Figure Number (Item)	Reference Designation	Name and Description	Figure Number (Item)
1A1XF6	FUSEHOLDER: amber indicating, part no. J50-0004-002	5-7	1A1A2C9	CAPACITOR, FIXED, CERAMIC: 100 pF, 5000 Vdc working, ±10%, part no. C15-0001-003	5-11
1A1XF7	FUSEHOLDER: Clear indicating, part no. J50-0004-001	5-7	1A1A2C10	CAPACITOR, FIXED, CERAMIC: 25 pF, ±10%, 7500 Vdc working, part no. C15-0001-001	5-11
1A1A1	DRIVER AMPLIFIER ASSEMBLY: part no. 1932-3850	5-10	1A1A2C11	CAPACITOR, FIXED, CERAMIC: 50 pF, ±10%, 7500 Vdc working, .89 in. lg x .81 in. w x .62 in. h, part no. C15-0001-002	5-11
1A1A1C1 thru 1A1A1C14	CAPACITOR, FIXED, CERAMIC: .01 uF, 1000 Vdc working, MIL type CK63AY103X	5-10	1A1A2C12 thru 1A1A2C14	Not used	
1A1A1C15 and 1A1A1C16	Not used		1A1A2C15 thru 1A1A2C20	CAPACITOR, FIXED, CERAMIC, 100 pF, ±10%, 5000 Vdc working, part no. C15-0001-003	5-11
1A1A1C17 and 1A1A1C18	CAPACITOR, FIXED, MICA: 390 pF, ±5%, 500 Vdc working, MIL type CMD5FD391J03	5-10	1A1A2C21 thru 1A1A2C24	Not used	
1A1A1C19	CAPACITOR, FIXED, CERAMIC: .01 uF, 1000 Vdc working, MIL type CK63AY103X	5-10	1A1A2C25	CAPACITOR, FIXED, PORCELAIN: 750 pF, ±5%, 500 Vdc working, part no. C50-0001-046	5-11
1A1A1CR1 and 1A1A1CR2	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-10	1A1A2C26	CAPACITOR, FIXED, PORCELAIN: 680 pF, ±5%, 500 Vdc working, part no. C50-0001-045	5-11
1A1A1CR3	SEMICONDUCTOR DEVICE, DIODE: type 1N4007	5-10	1A1A2C27	CAPACITOR, FIXED, PORCELAIN: 910 pF, ±5%, 500 Vdc working, part no. C50-0001-048	5-11
1A1A1L1	CHOKE, RF: 215 uH, ±15 uH, part no. 391-3860	5-10	1A1A2C28	CAPACITOR, FIXED, PORCELAIN: 820 pF, ±5%, 500 Vdc working, part no. C50-0001-047	5-11
1A1A1L2	COIL, FIXED, RF: .22 uH, ±10%, MIL type MS75008-22	5-10	1A1A2C29	CAPACITOR, FIXED, PORCELAIN: 180 pF, ±5%, 500 Vdc working, part no. C50-0001-031	5-11
1A1A1L3	COIL, FIXED, RF: 2.2 uH, ±10%, MIL type MS91189-17	5-10	1A1A2C30	CAPACITOR, FIXED, PORCELAIN: 200 pF, ±5%, 500 Vdc working, part no. C50-0001-032	5-11
1A1A1L4 thru 1A1A1L6	COIL, FIXED, RF: 1000 uH, ±10%, MIL type MS75054-5	5-10	1A1A2C31	CAPACITOR, FIXED, PORCELAIN: 300 pF, ±5%, 500 Vdc working, part no. C50-0001-036	5-11
1A1A1MP1 thru 1A1A1MP9	Not used		1A1A2C32	CAPACITOR, FIXED, PORCELAIN: 270 pF, ±5%, 500 Vdc working, part no. C50-0001-035	5-11
1A1A1MP10 and 1A1A1MP11	CHIMNEY, TUBE part no. 391-3869	5-10	1A1A2C33	CAPACITOR, FIXED, PORCELAIN: 300 pF, ±5%, 500 Vdc working, part no. C50-0001-036	5-11
1A1A1R1 and 1A1A1R2	RESISTOR, FIXED, WIREWOUND: 10 ohms, ±1%, 3 watt, MIL type RW79U10R0F	5-10	1A1A2C34	CAPACITOR, FIXED, PORCELAIN: 270 pF, ±5%, 500 Vdc working, part no. C50-0001-035	5-11
1A1A1R3 and 1A1A1R4	RESISTOR, FIXED, FILM: 10k, ±2%, 1/2 watt, MIL type RL20S103G	5-10	1A1A2C35 and 1A1A2C36	CAPACITOR, FIXED, PORCELAIN: 180 pF, ±5%, 500 Vdc working, part no. C50-0001-003	5-11
1A1A1R5	Not used		1A1A2C37	CAPACITOR, FIXED, PORCELAIN: 150 pF, ±5%, 500 Vdc working, part no. C50-0001-029	5-11
1A1A1R6	RESISTOR, FIXED, COMPOSITION: 56 ohms, ±10%, 1/2 watt, MIL type RC20SF560K	5-10	1A1A2C38	CAPACITOR, FIXED, CERAMIC: 200 pF, ±5%, 2500 Vdc working, part no. C11-0004-028	5-11
1A1A1R7	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/2 watt, MIL type RC20SF103K	5-10	1A1A2C39	Not used	
1A1A1TB1	TERMINAL BLOCK: 13 terminals, part number E31-0004-013	5-8	1A1A2C40	CAPACITOR, FIXED, CERAMIC: 180 pF, ±5%, 2500 Vdc working, part no. C11-0004-029	5-11
1A1A1V1 and 1A1A1V2	ELECTRON TUBE: type 8122, part no. V12-0001-001	5-10	1A1A2C41 thru 1A1A2C44	Not used	
1A1A1XV1 and 1A1A1XV2	SOCKET, TUBE: 11 pin, part no. J30-0001-000	5-10	1A1A2C45 thru 1A1A2C47	CAPACITOR, FIXED, PORCELAIN: 110 pF, ±5%, 500 Vdc working, part no. C50-0001-026	5-11
1A1A2	FINAL TRANSFORMER ASSEMBLY: part no. 0082E-3700	5-11	1A1A2C48	CAPACITOR, FIXED, PORCELAIN: 150 pF, ±5%, 500 Vdc working, part no. C50-0001-029	5-11
1A1A2C1	CAPACITOR, FIXED, CERAMIC: 25 pF, ±10%, 7500 Vdc working, part no. C15-0001-001	5-11	1A1A2C49 thru 1A1A2C52	Not used	
1A1A2C2	Not used				
1A1A2C3	CAPACITOR, FIXED, CERAMIC: 50 pF, 7500 Vdc, part no. C15-0001-002	5-11			
1A1A2C4 and 1A1A2C5	CAPACITOR, FIXED, CERAMIC: 100 pF, ±10%, 5000 Vdc working, part no. C15-0001-003	5-11			
1A1A2C6	CAPACITOR, FIXED, CERAMIC: 25 pF, ±10%, 7500 Vdc working, part no. C15-0001-001	5-11			
1A1A2C7	CAPACITOR, FIXED, CERAMIC: 50 pF, ±10%, 7500 Vdc working, part no. C15-0001-002	5-11			
1A1A2C8	Not used				

TABLE 6-1. MAINTENANCE PARTS LIST (Cont)

Reference Designation	Name and Description	Figure Number (Item)	Reference Designation	Name and Description	Figure Number (Item)
1A1A2C53 thru 1A1A2C56	CAPACITOR, FIXED, PORCELAIN: 75 pF, ±5%, 500 Vdc working, part no. C50-0001-022	5-11	1A1A2A18	TRANSFORMER ASSEMBLY: 26-28 MHz, part no. 0082E-3711-18	5-11
1A1A2C57	CAPACITOR, FIXED, CERAMIC: 220 pF, ±5%, 2500 Vdc working, part no. C11-0004-009	5-11	1A1A2A19	TRANSFORMER ASSEMBLY: 28-30 MHz, part no. 0082E-3711-19	5-11
1A1A2C58 thru 1A1A2C67	Not used		1A1A3	VSWR BRIDGE ASSEMBLY: part no. 0082E-3420	5-12
1A1A2C68	CAPACITOR, FIXED, CERAMIC: 180 pF, ±5%, 2500 Vdc working, part no. C11-0009-029	5-11	1A1A3C1	CAPACITOR, FIXED, MICA: 360 pF, ±5%, 500 Vdc working, MIL type CM05FD361J03	5-12
1A1A2C69	CAPACITOR, FIXED, CERAMIC: 220 pF, ±5%, 2500 Vdc working, part no. C11-0004-009	5-11	1A1A3C2	CAPACITOR, FIXED, TANTALUM: 2.2 uF, ±10%, 20 Vdc working, MIL type M39003/01-2043	5-11
1A1A2C70	CAPACITOR, FIXED, PORCELAIN: 180 pF, ±5%, 500 Vdc working, part no. C50-0001-031	5-11	1A1A3C3 and 1A1A3C4	CAPACITOR, FIXED, CERAMIC: .001 uF, ±20%, 1000 VDC working, MIL type CK60AW102M	5-12
1A1A2C71	CAPACITOR, FIXED, PORCELAIN: 200 pF, ±5%, 500 Vdc working, part no. C50-0001-032	5-11	1A1A3C5	CAPACITOR, FIXED, TANTALUM: 2.2 uF, ±10%, 20 Vdc working, MIL type M39003/01-2043	5-12
1A1A2C72	CAPACITOR, FIXED, CERAMIC: 220 pF, ±5%, 2500 Vdc working, part no. C11-0004-009	5-11	1A1A3C6	CAPACITOR, VARIABLE: 16 pF, MIL type PC51H160	5-12
1A1A2C73	CAPACITOR, FIXED, CERAMIC: 300 pF, ±5%, 2500 Vdc working part no. C11-0004-018	5-11	1A1A3CR1 thru 1A1A3CR6	SEMICONDUCTOR DEVICE, 0100E: MIL type IN4148	5-12
1A1A2C74 and 1A1A2C75	CAPACITOR, FIXED, CERAMIC: 150 pF, ±5%, 2500 Vdc working, part no. C11-0004-030	5-11	1A1A3J1	CONNECTOR, ELECTRICAL: MIL type MS35180-909A	5-12
1A1A2P1	CONNECTOR, PLUG MIL type M39012/16-0007	5-11	1A1A3J2	CONNECTOR, ELECTRICAL: MIL type MS27035-625B	5-12
1A1A2S1	SWITCH ASSEMBLY, ROTARY: 24 position, 3 decks, part no. 0082A-3732	5-11	1A1A3L1	COIL, FIXED, RF: 2700 uH, ±10%, MIL type MS75055-3	5-12
1A1A2Z1	TRAP ASSEMBLY: part no. 0082A-3796	5-11	1A1A3L2	COIL, FIXED, RF: .33 uH, ±20%, MIL type MS75008-23	5-12
1A1A2A1	TRANSFORMER ASSEMBLY: 2-3 MHz, part no. 0082E-3711-1	5-11	1A1A3R1 and 1A1A3R2	RESISTOR, FIXED, FILM: 56 ohms, ±2%, 1 watt, MIL type RL32S560G	5-12
1A1A2A2	TRANSFORMER ASSEMBLY: 2-3 MHz, part no. 0082E-3711-2	5-11	1A1A3R3	RESISTOR, FIXED, FILM: 10k, ±5%, 1/4 watt, MIL type RL07S103J	5-12
1A1A2A3	TRANSFORMER ASSEMBLY: 3-4 MHz, part no. 0082E-3711-3	5-11	1A1A3R4	RESISTOR, FIXED, FILM: 47k, ±5%, 1/4 watt, MIL type RL07S473J	5-12
1A1A2A4	TRANSFORMER ASSEMBLY: 3-4 MHz, part no. 0082E-3711-4	5-11	1A1A3R5	RESISTOR, FIXED, COMPOSITION: 2.7k, ±5%, 1/4 watt, MIL type RC07GF272J	5-12
1A1A2A5	TRANSFORMER ASSEMBLY: 4-5 MHz, part no. 0082E-3711-5	5-11	1A1A3R6	RESISTOR, FIXED, COMPOSITION: 6.8k, ±5%, 1/4 watt, MIL type RC07GF682J	5-12
1A1A2A6	TRANSFORMER ASSEMBLY: 5-6 MHz, part no. 0082E-3711-6	5-11	1A1A3R7	RESISTOR, FIXED, COMPOSITION: 39k, ±5%, 1/4 watt, MIL type RC07GF393J	5-12
1A1A2A7	TRANSFORMER ASSEMBLY: 6-7 MHz, part no. 0082E-3711-7	5-11	1A1A3R8	RESISTOR, FIXED, COMPOSITION: 120k, ±5%, 1/4 watt, MIL type RC07GF124J	5-12
1A1A2A8	TRANSFORMER ASSEMBLY: 7-8 MHz, part no. 0082E-3711-8	5-11	1A1A3R9	RESISTOR, FIXED, COMPOSITION: 1M, ±5%, 1/2 watt, MIL type RC20GF105J	5-12
1A1A2A9	TRANSFORMER ASSEMBLY: 8-10 MHz, part no. 0082E-3711-9	5-11	1A1A3T1	TRANSFORMER, DISCRIMINATOR TROIDAL: 31 uH, 50 Vrms, part no. 391-3426	5-12
1A1A2A10	TRANSFORMER ASSEMBLY: 10-12 MHz, part no. 0082E-3711-10	5-11	1A1A4	DRIVER TRANSFORMER ASSEMBLY: part no. 0082E-3800	5-13
1A1A2A11	TRANSFORMER ASSEMBLY: 12-14 MHz, part no. 0082E-3711-11	5-11	1A1A4C1 and 1A1A4C2	CAPACITOR, FIXED, CERAMIC: .01 uF, 1000 Vdc working, MIL type CK63AY103M	5-13
1A1A2A12	TRANSFORMER ASSEMBLY: 14-16 MHz, part no. 0082E-3711-12	5-11	1A1A4R1	RESISTOR, FIXED, COMPOSITION: 1k, ±10%, 2 watt, MIL type RC42GF102K	5-13
1A1A2A13	TRANSFORMER ASSEMBLY: 16-18 MHz, part no. 0082E-3711-13	5-11	1A1A4S1	SWITCH-DRIVER ASSEMBLY: part no. 0082D-3833	5-13
1A1A2A14	TRANSFORMER ASSEMBLY: 18-20 MHz, part no. 0082E-3711-14	5-11	1A1A4TB1	TERMINAL BLDCK: 6 terminals, part no. E31-0004-006	5-8
1A1A2A15	TRANSFORMER ASSEMBLY: 20-22 MHz, part no. 0082E-3711-15	5-11	1A1A4TP1	JACK, TIP: Red, MIL type MS16108-2A	5-13
1A1A2A16	TRANSFORMER ASSEMBLY: 22-24 MHz, part no. 0082E-3711-16	5-11	1A1A4A1	TRANSFORMER ASSEMBLY: 2-2.5 MHz, part no. 391-3807	5-13
1A1A2A17	TRANSFORMER ASSEMBLY: 24-26 MHz, part no. 0082E-3711-17	5-11			

TABLE 6-1. MAINTENANCE PARTS LIST (Cont)

Reference Designation	Name and Description	Figure Number (Item)	Reference Designation	Name and Description	Figure Number (Item)
1A1A4A2	TRANSFORMER ASSEMBLY: 2.5-3 MHz, part no. 391-3808	5-13	1A1A4A14R1	RESISTOR, FIXED, COMPOSITION: 8.2k, ±10%, 2 watt, MIL type RC42GF822K	5-13
1A1A4A3	TRANSFORMER ASSEMBLY: 3-4 MHz, part no. 391-3809	5-13	1A1A4A15	TRANSFORMER ASSEMBLY: 26-28 MHz, part no. 391-3821	5-13
1A1A4A4	TRANSFORMER ASSEMBLY: 4-6 MHz, part no. 391-3810	5-13	1A1A4A15C1	CAPACITOR, FIXED, CERAMIC: 27 pF, ±2%, 500 Vdc working, MIL type CC25CH270G	5-13
1A1A4A5	TRANSFORMER ASSEMBLY: 6-8 MHz, part no. 391-3811	5-13	1A1A4A16	TRANSFORMER ASSEMBLY: 28-30 MHz, part no. 391-3822	5-13
1A1A4A6	TRANSFORMER ASSEMBLY: 8-10 MHz, part no. 391-3812	5-13	1A1A4A16C1	CAPACITOR, FIXED, CERAMIC: 27 pF, ±2%, 500 Vdc working, MIL type CC25CH270G	5-13
1A1A4A6C1	CAPACITOR, FIXED, CERAMIC: 39 pF, ±2%, 500 Vdc working, MIL type CC25CH390G	5-13	1A1A5	DC POWER CONTROL PCB ASSEMBLY: part no. 00820-3360	5-14
1A1A4A6R1	RESISTOR, FIXED, COMPOSITION: 2.2k, ±10%, 2 watt, MIL type RC42GF222K	5-13	1A1A5C1	CAPACITOR, FIXED, TANTALUM: 47 uF, ±10%, 20 Vdc working, MIL type M39003/01-2055	5-14
1A1A4A7	TRANSFORMER ASSEMBLY: 10-12 MHz, part no. 391-3813	5-13	1A1A5C2	CAPACITOR, FIXED, TANTALUM: 33 uF, ±10%, 20 Vdc working, MIL type M39003/01-2052	5-14
1A1A4A7C1	CAPACITOR, FIXED, CERAMIC: 33 pF, ±2%, 500 Vdc working, MIL type CC25CH330G	5-13	1A1A5C3	CAPACITOR, FIXED, CERAMIC: .0082 uF, ±20%, 1500 Vdc working, MIL type CK62AW822M	5-14
1A1A4A7R1	RESISTOR, FIXED, COMPOSITION: 2.2k, ±10%, 2 watt, MIL type RC42GF222K	5-13	1A1A5C4 and 1A1A5C5	CAPACITOR, FIXED, CERAMIC: .1 uF, ±10%, 50 Vdc working, MIL type CK058X104K	5-14
1A1A4A8	TRANSFORMER ASSEMBLY: 12-14 MHz, part no. 391-3814	5-13	1A1A5C6	CAPACITOR, FIXED, TANTALUM: 1.0 uF, ±10%, 35 Vdc working, MIL type M39003/01-2116	5-14
1A1A4A8C1	CAPACITOR, FIXED, CERAMIC: 30 pF, ±2%, 500 Vdc working, MIL type CC25CH300G	5-13	1A1A5C7	CAPACITOR, FIXED, CERAMIC: .1 uF, ±10%, 50 Vdc working, MIL type CK058X104K	5-14
1A1A4A8R1	RESISTOR, FIXED, COMPOSITION: 2.2k, ±10%, 2 watt, MIL type RC42GF222K	5-13	1A1A5C81 and 1A1A5C82	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N3611	5-14
1A1A4A9	TRANSFORMER ASSEMBLY: 14-16 MHz, part no. 391-3815	5-13	1A1A5C83 and 1A1A5C84	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-14
1A1A4A9C1	CAPACITOR, FIXED, CERAMIC: 27 pF, ±2%, 500 Vdc working, MIL type CC25CH270G	5-13	1A1A5C85	Not used	
1A1A4A9R1	RESISTOR, FIXED, COMPOSITION: 2.2k, ±10%, 2 watt, MIL type RC42GF222K	5-13	1A1A5C86	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-14
1A1A4A10	TRANSFORMER ASSEMBLY: 16-18 MHz, part no. 391-3816	5-13	1A1A5C87	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N3611	5-14
1A1A4A10C1	CAPACITOR, FIXED, CERAMIC: 27 pF, ±2%, 500 Vdc working, MIL type CC25CH270G	5-13	1A1A5C88	Not used	
1A1A4A10R1	RESISTOR, FIXED, COMPOSITION: 2.7k, ±10%, 2 watt, MIL type RC42GF272K	5-13	1A1A5C89 thru 1A1A5C92	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-14
1A1A4A11	TRANSFORMER ASSEMBLY: 18-20 MHz, part no. 391-3817	5-13	1A1A5C93	Not used	
1A1A4A11C1	CAPACITOR, FIXED, CERAMIC: 27 pF, ±2%, 500 Vdc working, MIL type CC25CH270G	5-13	1A1A5C94 thru 1A1A5C96	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-14
1A1A4A11R1	RESISTOR, FIXED, COMPOSITION: 2.7k, ±10%, 2 watt, MIL type RC42GF272K	5-13	1A1A5C97 and 1A1A5C98	Not used	
1A1A4A12	TRANSFORMER ASSEMBLY: 20-22 MHz, part no. 391-3818	5-13	1A1A5C99	SEMICONDUCTOR DEVICE, DIODE, ZENER: 12 Vdc, MIL type 1N759A	5-14
1A1A4A12C1	CAPACITOR, FIXED, CERAMIC: 24 pF, ±2%, 500 Vdc working, MIL type CC25CH240G	5-13	1A1A5C920	Not used	
1A1A4A12R1	RESISTOR, FIXED, COMPOSITION: 2.7k, ±10%, 2 watt MIL type RC42GF272K	5-13	1A1A5C921 thru 1A1A5C929	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N3611	5-14
1A1A4A13	TRANSFORMER ASSEMBLY: 22-24 MHz, part no. 391-3819	5-13	1A1A5C930 and 1A1A5C931	SEMICONDUCTOR DEVICE, DIODE, ZENER: 6.2 Vdc, MIL type 1N753A	5-14
1A1A4A13C1	CAPACITOR, FIXED, CERAMIC: 24 pF, ±2%, 500 Vdc working, MIL type CC25CH240G	5-13	1A1A5C932	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-14
1A1A4A13R1	RESISTOR, FIXED, COMPOSITION: 4.7k, ±10%, 2 watt, MIL type RC42GF472K	5-13	1A1A5C933	SEMICONDUCTOR DEVICE, DIODE, ZENER: 10 Vdc, MIL type 1N758A	5-14
1A1A4A14	TRANSFORMER ASSEMBLY: 24-26 MHz, part no. 391-3820	5-13	1A1A5C934	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-14
1A1A4A14C1	CAPACITOR, FIXED, CERAMIC: 27 pF, ±2%, 500 Vdc working, MIL type CC25CH270G	5-13	1A1A5C935	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N3611	5-14
			1A1A5C936	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-14
			1A1A5Q1	Not used	
			1A1A5Q2	TRANSISTOR, PNP, MIL type 2N2905A	5-14



TABLE 6-1. MAINTENANCE PARTS LIST (Cont)

Reference Designation	Name and Description	Figure Number (Item)	Reference Designation	Name and Description	Figure Number (Item)
1A1A5Q3 and 1A1A5Q4	TRANSISTOR, NPN: MIL type 2N2219A	5-14	1A1A5R34	RESISTOR, FIXED, COMPOSITION 100 ohms, ±10%, 1/2 watt, MIL type RC20GF101K	5-14
1A1A5Q5	TRANSISTOR, PNP: MIL type 2N2905A	5-14	1A1A5R35	RESISTOR, FIXED, COMPOSITION: 390 ohms, ±10%, 1/2 watt, MIL type RC2DGF391K	5-14
1A1A5Q6	TRANSISTOR, PNP: MIL type 2N398A	5-14	1A1A5R36 and 1A1A5R37	Not used	
1A1A5Q7	TRANSISTOR, NPN: MIL type 2N2219A	5-14	1A1A5R38 and 1A1A5R39	RESISTOR, FIXED, COMPOSITION: 4.7k, ±10%, 1/4 watt, MIL type RC07GF472K	5-14
1A1A5Q8	TRANSISTOR, PNP: MIL type 2N2905A	5-14	1A1A5R40	RESISTOR, FIXED, COMPOSITION: 3.3k, ±10%, 1/2 watt, MIL type RC20GF332K	5-14
1A1A5Q9 thru 1A1A5Q11	TRANSISTOR, NPN: MIL type 2N2219A	5-14	1A1A5R41	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/4 watt, MIL type RC07GF103K	5-14
1A1A5Q12	TRANSISTOR, PNP: MIL type 2N2905A	5-14	1A1A5R42	RESISTOR, FIXED, COMPOSITION: 1k, ±10%, 1/4 watt, MIL type RC07GF102K	5-14
1A1A5R1 and 1A1A5R2	Not used		1A1A5TP1	TEST POINT: Brown, part no. J60-0001-008	5-14
1A1A5R3	RESISTOR, FIXED, COMPOSITION: 4.7k, ±10%, 1/4 watt MIL type RC07GF472K	5-14	1A1A5TP2	TEST POINT: Red, part no. J6D-0001-002	5-14
1A1A5R4	RESISTOR, FIXED, COMPOSITION: 1.5k, ±10%, 1/4 watt. MIL type RC07GF152K	5-14	1A1A5TP3	TEST POINT: Orange, part no. J60-0001-006	5-14
1A1A5R5	Not used		1A1A5TP4	TEST POINT: Yellow, part no. J60-0001-007	5-14
1A1A5R6	RESISTOR, FIXED, FILM: 470 ohms, ±2%, 1/4 watt, MIL type RL07S471G	5-14	1A1A5TP5	TEST POINT: Green, part no. J60-0001-004	5-14
1A1A5R7	RESISTOR, FIXED, FILM: 270 ohms, ±2%, 1/4 watt, MIL type RL07S271G	5-14	1A1A6	APC-PPC PCB ASSEMBLY: part no. DD82D-3340	5-15
1A1A5R8	RESISTOR, FIXED, COMPOSITION: 4.7k, ±10%, 1/4 watt, MIL type RC07GF472K	5-14	1A1A6C1	CAPACITOR, FIXED, TANTALUM: 15 uF, ±10%, 50 Vdc working, MIL type M39003/01-2137	5-15
1A1A5R9	RESISTOR, FIXED, COMPOSITION: 1k, ±10%, 1/4 watt, MIL type RC07GF102K	5-14	1A1A6C2	Not used	
1A1A5R10	RESISTOR, FIXED, COMPOSITION: 4.7k, ±10%, 1/4 watt, MIL type RC07GF472K	5-14	1A1A6C3	CAPACITOR, FIXED, TANTALUM: 10 uF, ±10%, 20 Vdc working, MIL type M39003/01-2046	5-15
1A1A5R11	RESISTOR, FIXED, COMPOSITION: 1.5k, ±10%, 1/4 watt, MIL type RC07GF152K	5-14	1A1A6C4	CAPACITOR, FIXED, TANTALUM: 220 uF, ±10%, 10 Vdc working, MIL type M39003/01-2025	5-15
1A1A5R12	RESISTOR, FIXED, COMPOSITION: 1.2k, ±10%, 1/4 watt, MIL type RC07GF122K	5-14	1A1A6C5	CAPACITOR, FIXED, CERAMIC: .001 uF, ±20%, 1000 Vdc working, MIL type CK60AW102M	5-15
1A1A5R13	RESISTOR, FIXED, COMPOSITION: 150 ohms, ±10%, 1/4 watt, MIL type RC07GF151K	5-14	1A1A6C6	CAPACITOR, FIXED, CERAMIC: .0082 uF, ±20%, 1500 Vdc working, MIL type CK62AW822M	5-15
1A1A5R14	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±10%, 1/4 watt, MIL type RC07GF471K	5-14	1A1A6C7	CAPACITOR, FIXED, CERAMIC: .001 uF, ±20%, 1000 Vdc working, MIL type CK60AW102M	5-15
1A1A5R15	RESISTOR, FIXED, COMPOSITION: 220 ohms, ±10%, 1/4 watt, MIL type RC07GF221K	5-14	1A1A6C8	CAPACITOR, FIXED, TANTALUM: 100 uF, ±10%, 10 Vdc working, MIL type M39003/01-2021	5-15
1A1A5R16	RESISTOR, FIXED, COMPOSITION: 820 ohms, ±10%, 1/4 watt, MIL type RC07GF821K	5-14	1A1A6C9	CAPACITOR, FIXED, TANTALUM: 15 uF, ±10%, 50 Vdc working, MIL type M39003/01-2137	5-15
1A1A5R17	RESISTOR, FIXED, COMPOSITION: 1k, ±10%, 1/4 watt, MIL type RC07GF102K	5-14	1A1A6C10	CAPACITOR, FIXED, CERAMIC: .01 uF, ±10%, 50 Vdc working, MIL type CK05BX103K	5-15
1A1A5R18	Not used		1A1A6CR1	SEMICONDUCTOR DEVICE, DIODE ZENER: 30 Vdc, MIL type IN972B	5-15
1A1A5R19	RESISTOR, FIXED, COMPOSITION: 1k, ±10%, 1/2 watt, MIL type RC20GF102K	5-14	1A1A6CR2	SEMICONDUCTOR DEVICE, DIODE MIL type IN3611	5-15
1A1A5R20	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/4 watt, MIL type RC07GF103K	5-14	1A1A6CR3 and 1A1A6CR4	SEMICONDUCTOR DEVICE, DIODE ZENER: 36 Vdc, MIL type IN3D33B	5-15
1A1A5R21	RESISTOR, FIXED, COMPOSITION: 1k, ±10%, 1/4 watt, MIL type RC07GF102K	5-14	1A1A6CR5	SEMICONDUCTOR DEVICE, DIODE: MIL type IN4148	5-15
1A1A5R22	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/4 watt, MIL type RC07GF103K	5-14	1A1A6CR6 and 1A1A6CR7	Not used	
1A1A5R23 and 1A1A5R24	Not used				
1A1A5R25	RESISTOR, FIXED, COMPOSITION: 680 ohms, ±10%, 1/4 watt, MIL type RC07GF681K	5-14			
1A1A5R26	RESISTOR, FIXED, COMPOSITION: 220 ohms, ±10%, 2 watt, MIL type RC42GF221K	5-14			
1A1A5R27	RESISTOR, FIXED, COMPOSITION: 120 ohms, ±10%, 1/4 watt, MIL type RC07GF121K	5-14			
1A1A5R28	RESISTOR, FIXED, COMPOSITION: 220 ohms, ±10%, 1/4 watt, MIL type RC07GF221K	5-14			
1A1A5R29 thru 1A1A5R33	RESISTOR, FIXED, COMPOSITION: 2.2k, ±10%, 1/4 watt, MIL type RC07GF222K	5-14			

**TABLE 6-1. MAINTENANCE PARTS LIST (Cont)**

Reference Designation	Name and Description	Figure Number (Item)	Reference Designation	Name and Description	Figure Number (Item)
1A1A6CR8 thru 1A1A6CR13	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-15	1A1A6R4	RESISTOR, FIXED, COMPOSITION: 22k, ±10%, 1/4 watt, MIL type RC07GF223K	5-15
1A1A6CR14 thru 1A1A6CR17	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N3611	5-15	1A1A6R5	Not used	
1A1A6CR18 thru 1A1A6CR20	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-15	1A1A6R6	RESISTOR, FIXED, COMPOSITION: 68k, ±10%, 1/2 watt, MIL type RC2DGF683K	5-15
1A1A6CR21	Not used		1A1A6R7	RESISTOR, FIXED, COMPOSITION: 4.7k, ±10%, 1/4 watt, MIL type RC07GF472K	5-15
1A1A6CR22	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-15	1A1A6R8	RESISTOR, FIXED, COMPOSITION: 27k, ±10%, 1/4 watt, MIL type RC07GF273K	5-15
1A1A6CR23 and 1A1A6CR24	Not used		1A1A6R9	RESISTOR, FIXED, COMPOSITION: 33k, ±10%, 1/4 watt, MIL type RC07GF333K	5-15
1A1A6CR25	SEMICONDUCTOR DEVICE, DIODE, ZENER: 10 Vdc, MIL type 1N758A	5-15	1A1A6R10	RESISTOR, FIXED, COMPOSITION: 6.8k, ±10%, 1/4 watt, MIL type RC07GF682K	5-15
1A1A6CR26	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-15	1A1A6R11	RESISTOR, FIXED, COMPOSITION: 270 ohms, ±10%, 1/4 watt, MIL type RC07GF271K	5-15
1A1A6CR27	SEMICONDUCTOR DEVICE, DIODE, ZENER: 39 Vdc, MIL type 1N975B	5-15	1A1A6R12	RESISTOR, FIXED, COMPOSITION: 1k, ±10%, 1/4 watt, MIL type RC07GF102K	5-15
1A1A6CR28 and 1A1A6CR29	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-15	1A1A6R13	RESISTOR, FIXED, COMPOSITION: 27k, ±10%, 1/4 watt, MIL type RC07GF273K	5-15
1A1A6CR30	Not used		1A1A6R14	RESISTOR, FIXED, COMPOSITION: 2.2k, ±10%, 1/4 watt, MIL type RC07GF222K	5-15
1A1A6CR31 and 1A1A5CR32	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-15	1A1A6R15	Not used	
1A1A6CR33	Not used		1A1A6R16	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±10%, 1/4 watt, MIL type RC07GF101K	5-15
1A1A6CR34	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N3611	5-15	1A1A6R17	RESISTOR, FIXED, COMPOSITION: 47k, ±10%, 1/4 watt, MIL type RC07GF473K	5-15
1A1A6CR35 thru 1A1A6CR37	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N4148	5-15	1A1A6R18	RESISTOR, FIXED, COMPOSITION: 820 ohms, ±10%, 1/4 watt, MIL type RC07GF821K	5-15
1A1A6CR38	SEMICONDUCTOR DEVICE, DIODE, ZENER: 10 Vdc, MIL type 1N758A	5-15	1A1A6R19	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/4 watt, MIL type RC07GF103K	5-15
1A1A6Q1 and 1A1A6Q2	TRANSISTOR, NPN: MIL type 2N2219A	5-15	1A1A6R20	Not used	
1A1A6Q3	TRANSISTOR, PNP: MIL type 2N398A	5-15	1A1A6R21	RESISTOR, FIXED, COMPOSITION: 27k, ±5%, 1/4 watt, MIL type RC07GF273J	5-15
1A1A6Q4 thru 1A1A6Q6	Not used		1A1A6R22	RESISTOR, FIXED, COMPOSITION: 120k, ±5%, 1/4 watt, MIL type RC07GF124J	5-15
1A1A6Q7	TRANSISTOR, PNP: MIL type 2N2905A	5-15	1A1A6R23	RESISTOR, FIXED, COMPOSITION: 1k, ±10%, 1/4 watt, MIL type RC07GF102K	5-15
1A1A6Q8	TRANSISTOR, NPN: MIL type 2N2219A	5-15	1A1A6R24	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/4 watt, MIL type RC07GF103K	5-15
1A1A6Q9	TRANSISTOR, PNP: MIL type 2N2905A	5-15	1A1A6R25	RESISTOR, FIXED, COMPOSITION: 2.2k, ±10%, 1/4 watt, MIL type RC07GF222K Note 2	5-15
1A1A6Q10 thru 1A1A6Q12	TRANSISTOR, NPN: MIL type 2N2219A	5-15	1A1A6R26	RESISTOR, FIXED, COMPOSITION: 2.7k, ±10%, 1/4 watt, MIL type RC07GF272K	5-15
1A1A6Q13	TRANSISTOR, PNP: MIL type 2N2905A	5-15	1A1A6R27	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/4 watt, MIL type RC07GF103K	5-15
1A1A6Q14 and 1A1A6Q15	TRANSISTOR, NPN: MIL type 2N2219A	5-15	1A1A6R28	RESISTOR, FIXED, COMPOSITION: 12k, ±10%, 1/4 watt, MIL type RC07GF123K	5-15
1A1A6Q16 and 1A1A6Q17	TRANSISTOR, PNP: MIL type 2N2905A	5-15			
1A1A6Q18	Not used				
1A1A6Q19 and 1A1A6Q20	TRANSISTOR, PNP: MIL type 2N398A	5-15			
1A1A6Q21 thru 1A1A6Q24	TRANSISTOR, NPN: MIL type 2N2219A	5-15			
1A1A6R1	RESISTOR, FIXED, COMPOSITION: 1.8k, ±10%, 1/4 watt, MIL type RC07GF182K	5-15			
1A1A6R2	RESISTOR, FIXED, COMPOSITION: 47k, ±10%, 1/4 watt, MIL type RC07GF473K	5-15			
1A1A6R3	RESISTOR, FIXED, COMPOSITION: 6.8k, ±10%, 1/4 watt, MIL type RC07GF682K	5-15			

TABLE 6-1. MAINTENANCE PARTS LIST (Cont)

Reference Designation	Name and Description	Figure Number (Item)	Reference Designation	Name and Description	Figure Number (Item)
1A1A6R29	RESISTOR, FIXED, COMPOSITION: 1k, ±10%, 1/4 watt, MIL type RC07GF102K	5-15	1A1A6R58	RESISTOR, FIXED, COMPOSITION: 33k, ±10%, 1/4 watt, MIL type RC07GF333K	5-15
1A1A6R30	RESISTOR, FIXED, COMPOSITION: 330 ohms, ±10%, 1/4 watt, MIL type RC07GF331K	5-15	1A1A6R59	RESISTOR, FIXED, COMPOSITION: 22k, ±10%, 1/4 watt, MIL type RC07GF223K	5-15
1A1A6R31	RESISTOR, FIXED, COMPOSITION: 6.8k, ±10%, 1/4 watt, MIL type RC07GF682K	5-15	1A1A6R60	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±10%, 1/4 watt, MIL type RC07GF470K	5-15
1A1A6R32	RESISTOR, FIXED, COMPOSITION: 12k, ±10%, 1/4 watt, MIL type RC07GF123K	5-15	1A1A6R61	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±10%, 1/2 watt, MIL type RC20GF101K	5-15
1A1A6R33	RESISTOR, FIXED, COMPOSITION: 5.6k, ±10%, 1/4 watt, MIL type RC07GF562K	5-15	1A1A6R62 and 1A1A6R63	RESISTOR, FIXED, COMPOSITION: 4.7k, ±10%, 1/4 watt, MIL type RC07GF472K	5-15
1A1A6R34	Not used		1A1A6R64	RESISTOR, FIXED, COMPOSITION: 3.3k, ±10%, 1/4 watt, MIL type RC07GF332K	5-15
1A1A6R35	RESISTOR, FIXED, COMPOSITION: 1k, ±10%, 1/4 watt, MIL type RC07GF102K	5-15	1A1A6R65	RESISTOR, FIXED, COMPOSITION: 100k, ±10%, 1/4 watt, MIL type RC07GF104K	5-15
1A1A6R36	RESISTOR, FIXED, COMPOSITION: 39k, ±10%, 1 watt, MIL type RC32GF393K	5-15	1A1A6R66	RESISTOR, FIXED, COMPOSITION: 33k, ±10%, 1/4 watt, MIL type RC07GF333K	5-15
1A1A6R37	RESISTOR, FIXED, COMPOSITION: 18k, ±10%, 1/4 watt, MIL type RC07GF183K	5-15	1A1A6R67 and 1A1A6R68	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/4 watt, MIL type RC07GF103K	5-15
1A1A6R38	RESISTOR, FIXED, COMPOSITION: 1.2k, ±10%, 1/4 watt, MIL type RC07GF122K	5-15	1A1A6TP1	TEST POINT: Brown, part no. J60-0001-008	5-15
1A1A6R39	RESISTOR, FIXED, COMPOSITION: 2.2k, ±10%, 1/4 watt, MIL type RC07GF222K	5-15	1A1A6TP2	TEST POINT: Red, part no. J60-0001-002	5-15
1A1A6R40	RESISTOR, FIXED, COMPOSITION: 22k, ±10%, 1/4 watt, MIL type RC07GF223K	5-15	1A1A6TP3	TEST POINT: Orange, part no. J60-0001-006	5-15
1A1A6R41	RESISTOR, FIXED, COMPOSITION: 2.2k, ±10%, 1/4 watt, MIL type RC07GF222K	5-15	1A1A6TP4	TEST POINT: Yellow, part no. J60-0001-007	5-15
1A1A6R42	RESISTOR, FIXED, COMPOSITION: 6.8k, ±10%, 2 watt, MIL type RC42GF682K	5-15	1A1A7	METER RESISTOR ASSEMBLY: part no. 0020-3400	5-16
1A1A6R43 and 1A1A6R44	RESISTOR, FIXED, COMPOSITION: 2.2k, 10%, 1/4 watt, MIL type RC07GF222K	5-15	1A1A7R1 thru 1A1A7R6	Not used	
1A1A6R45	RESISTOR, FIXED, COMPOSITION: 100k, ±10%, 1/4 watt, MIL type RC07GF104K	5-15	1A1A7R7 and 1A1A7R8	RESISTOR, FIXED, FILM: 1.2M, ±2%, MIL type RL42S125G	5-16
1A1A6R46	RESISTOR, FIXED, COMPOSITION: 1k, ±10%, 1/4 watt, MIL type RC07GF102K	5-15	1A1A7R9	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/2 watt, MIL type RC20GF103K	5-16
1A1A6R47	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/4 watt, MIL type RC07GF103K	5-15	1A1A7R10 thru 1A1A7R12	Not used	
1A1A6R48	RESISTOR, FIXED, COMPOSITION: 33k, ±10%, 1/4 watt, MIL type RC07GF333K	5-15	1A1A7R13 and 1A1A7R14	RESISTOR, FIXED, FILM: 1.2M, ±2%, 2 watt, MIL type RL42S125G	5-16
1A1A6R49	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/4 watt, MIL type RC07GF103K	5-15	1A1A7R15	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/2 watt, MIL type RC20GF103K	5-16
1A1A6R50 thru 1A1A6R53	Not used		1A1A7R16	RESISTOR, FIXED, FILM: 470k, ±2%, 1 watt, MIL type RL32S474G	5-16
1A1A6R54	RESISTOR, FIXED, COMPOSITION: 2.2k, ±10%, 1/4 watt, MIL type RC07GF222K	5-15	1A1A7R17 thru 1A1A7R21	RESISTOR, FIXED, FILM: 510k, ±2%, 1 watt, MIL type RL32S514G	5-16
1A1A6R55	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±10%, 1/4 watt, MIL type RC07GF470K	5-15	1A1A7R21	RESISTOR, FIXED, COMPOSITION: 10k, ±10%, 1/2 watt, MIL type RC20GF103K	5-16
1A1A6R56	RESISTOR, FIXED, COMPOSITION: 15k, ±10%, 1/4 watt, MIL type RC07GF153K	5-15	1A1A8	400 HZ POWER SUPPLY MODULE - Model RF-111A designed to fit large opening on chassis underside, and to provide operation of the RF-110A from 400 Hz, three phase 115 Vac primary power source (used instead of RF-112A). Operating instructions and parts list for this separately purchased item are provided with the power supply as an addendum to this manual.	
1A1A6R57	RESISTOR, FIXED, COMPOSITION: 56k, ±10%, 1/4 watt, MIL type RC07GF563K	5-15			

TABLE 6-1. MAINTENANCE PARTS LIST (Cont)

Reference Designation	Name and Description	Figure Number (Item)	Reference Designation	Name and Description	Figure Number (Item)
1A1A9	ARC PROTECTOR ASSEMBLY: part no. 1932-4002	5-8	2A1	CHASSIS, PANEL ASSEMBLY: mir 14304, part no. 0082E-8100	5-18
1A1A9CR1 and 1A1A9CR2	SEMICONDUCTOR DEVICE, DIODE: Type D22-0006-001	5-8	2A1B1	FAN, 115 Vac, 50/60 HZ, 10, part no. B22-0004-001	5-18
1A1A9CR3 and 1A1A9CR4	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N3611	5-8	2A1C1 and 2A1C2	CAPACITOR, FIXED, ELECTROLYTIC: 1400 uF, +75%, -10%, 50 Vdc working, MIL type CE71C142G	5-18
1A1A9R1 thru 1A1A9R3	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±5%, 1 watt, MIL type RC32GF100J	5-8	2A1C3	CAPACITOR, FIXED, TANTALUM: .4 uF, ±20%, 100 Vdc working, MIL type CL33BNOR4MNE	5-18
1A1A9Q1	TRANSISTOR, SCR: Type D29-0001-001	5-8	2A1CR1 and 2A1CR2	RECTIFIER-SILICON, 30, BRIDGE ASSEMBLY 2400 piv, 2A, part no. 8948-4015	5-18
1A2	CASE ASSEMBLY: part no. 0082D-2D00	5-17	2A1CR3	RECTIFIER, SILICON: 1000 piv, 0.9A, part no. D22-5001-000	5-18
1A2C1 and 1A2C2	CAPACITOR, FIXED, CERAMIC: .01 uF, 1000 Vdc working, MIL type CK63AY103X	5-17	2A1CR4 thru 2A1CR7	SEMICONDUCTOR DEVICE, DIODE part no. D22-0004-001	5-18
1A2FL1/J5	FILTER, POWER INPUT: part no. 391-2300	5-17	2A1DS1 and 2A1DS2	LAMP, NEON Midget inverted flanged base, 110-125 Vac, ac-dc, MIL type MS25252-C7A	5-18
1A2J1	CONNECTOR, RECEPTACLE, ELECTRICAL MIL type MS3102R-28-17S	5-17	2A1F1	FUSE, CARTRIDGE: 8A, 250 Vac, MIL type F03A250V8A	5-18
1A2J2	Not used		2A1MP1 thru 2A1MP4	Not used	
1A2J3 and 1A2J4	CONNECTOR, COAX: MIL type UG-556B/U	5-17	2A1MP43	AIR FILTER ASSEMBLY: part no. 0082C-1C15	5-18
1A2J5 thru 1A2J8	Not used		2A1Q1 and 2A1Q2	TRANSISTOR, NPN: type 2N5884	5-18
1A2J9	CONNECTOR, COAX: MIL type M39012/19-0004	5-17	2A1R1 and 2A1R2	RESISTOR, FIXED, COMPOSITION: 33 ohms, ±10%, 2 watt, MIL type RC42GF330K	5-18
1A2K1	RELAY, COAXIAL: 29 Vdc, 2 watt, spdt, part no. K80-0G01-000	5-17	2A1R3 thru 2A1R8	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±10%, 2 watt, MIL type RC42GF100K	5-18
1A2P1	CONNECTOR, PLUG, COAX: MIL type M39012/16-0005	5-17	2A1R9	RESISTOR, FIXED, COMPOSITION: 120 ohms, ±1%, 15 watt, MIL type RER50F1200M	5-18
1A2P2 and 1A2P3	Not used		2A1R10 and 2A1R11	RESISTOR, FIXED, COMPOSITION: 68k, ±10%, 2 watt, MIL type RC42GF683K	5-18
1A2P4 thru 1A2P6	CONNECTOR, PLUG, COAX: MIL type M39012/16-0007	5-17	2A1R12	RESISTOR, FIXED, COMPOSITION: 100k, ±10%, 1 watt, MIL type RC32GF104K	5-18
1A2P7	CONNECTOR, PLUG, COAX, MIL type M39012/16-0001	5-17	2A1S1	SWITCH, THERMAL, SPST: Opens at 185°F (85°C), part no. S70-0006-001	5-18
1A2P8 thru 1A2P11	Not used		2A1T1	TRANSFORMER, POWER INVERTER 250 Vp-p, 25%, 400 Hz, part no. 391-8405	5-18
1A2P12	CONNECTOR: MIL type MS3106A-28-17S	5-17	2A1X0S1	LAMP HOLDER: Clear, MIL type LH74/1-LC13CN	5-18
1A2P13	CONNECTOR, ELECTRICAL: 20 crimp removable pin contacts, MIL type MS18176-1 Note 4	5-17	2A1X0S1-A	HOLDER: MIL type LH74/1	5-18
1A2P14	CONNECTOR, ELECTRICAL: 20 crimp removable socket contacts, MIL type MS18177-1 NOTE 4	5-17	2A1X0S1-B	LENS: Clear, MIL type LC13CN	5-18
1A2A1	FILTER BOX ASSEMBLY: part no. 391-2100	5-17	2A1X0S2	LAMP HOLDER: Clear, MIL type LH74/1-LC13CN	5-18
1A2A1C1 thru 1A2A1C2	CAPACITOR, FIXED, CERAMIC: 1500 pF, ±20%, 500 Vdc working, MIL type CK70AW152M	5-17	2A1X0S2-A	HOLDER: MIL type LH74/1	5-18
1A2A1C22	CAPACITOR, FIXED, CERAMIC: .01 uF, 1000 Vdc working, MIL type CK63AY103X	5-17	2A1X0S2-B	LENS: Clear, MIL type LC13CN	5-18
1A2A1CR1 and 1A2A1CR2	SEMICONDUCTOR DEVICE, DIODE: MIL type 1N3611	5-17	2A1XF1	FUSE HOLDER, AMBER INDICATING: MIL type FHL18G2-2	5-18
1A2A1J2	CONNECTOR, ELECTRICAL: MIL type MS3102R-28-12S	5-17	2A2	CASE ASSEMBLY: part no. 0082D-8700	5-18
1A2A1J3 thru 1A2A1J5	Not used		2A2C1	CAPACITOR, FIXED, PAPER: 25 uF, ±10%, 600 Vdc working, part no. C30-0001-00C	5-18
1A2A1J6	CONNECTOR, ELECTRICAL: MIL type MS3102R-20-27S	5-17	2A2J1	CONNECTOR, RECEPTACLE, ELECTRICAL Solder connections, MIL type MS3102R-26-17P	5-18
1A2A1J7	CONNECTOR, ELECTRICAL: MIL type MS3102R-28-21S	5-17	2A2P1	JUMPER ASSEMBLY: part no. 391-8200 Note 5	5-18
1A2A1J8	CONNECTOR, ELECTRICAL: MIL type MS3102R-18-1S	5-17			
2	60 HZ POWER SUPPLY, RC-112A: part no. 1932-0112	5-18			

**TABLE 6-1. MAINTENANCE PARTS LIST (Cont)**

Reference Designation	Name and Description	Figure Number (Item)	Reference Designation	Name and Description	Figure Number (Item)
2A2P2	JUMPER ASSEMBLY: part no. 391-8300 Note 6	5-18	2A2T1/T2	TRANSFORMER: 208/440 Vac, 48 to 63 Hz input, part no. 0082E-7200	5-18
2A2S1 thru 2A2S3	SWITCH, INTERLOCK: Spst, MIL type MS16106-4	5-18	2A2TB1	TERMINAL BOARD: 24 terminal, MIL type 37TB24	5-18

# ADDENDUM TO INSTRUCTION MANUAL 1932-0005

for RF-110A Radio Frequency Amplifier

**Applies to:** RF-110A's with serial numbers 1169 and higher

L105

**PURPOSE:** This addendum provides description, parts lists, and service data for Final Transformer Assembly, part number 6725-3700, used in RF-110A Radio Frequency Amplifiers with serial numbers 1169 and higher.

## 1. GENERAL INFORMATION

Harris Corporation, RF Communications Division, is constantly striving to expand its product line and to improve the reliability of existing products. To that end, a new Final Transformer Assembly, part number 6725-3700, has been designed into the RF-110A Radio Frequency Amplifier. All RF-110A's with serial numbers 1169 and higher contain the new assembly.

The new Final Transformer Assembly is interchangeable with its predecessor, part number 0082-3700; however, when replacing an 0082 Assembly with a new one, the new Final Transformer Alignment Procedure described herein should be performed to ensure peak performance. This addendum provides information required to ensure successful part location, identification, and servicing information regarding the new assembly. In the following discussion, prefix all incomplete reference designations with 1A1A2.

## 2. MANUAL CHANGES

The following changes are to be made in the RF-110A Instruction Manual, part number 1932-0005.

Apply the sticky-back labels supplied with this addendum, "FOR INFORMATION ON THE FINAL TRANSFORMER ASSEMBLY USED IN THE RF-110A'S S/N 1169 AND HIGHER, SEE ADDENDUM L105 IN FRONT OF THIS MANUAL." to the bottom of the pages indicated below. Mark a vertical line in the margin next to the paragraphs, figure titles, or components indicated below.

- Page 5-2, BROADBAND TRANSFORMERS, Troubleshooting and Alignment
- Page 5-6, all of paragraph 5.4.4 FINAL TRANSFORMER ALIGNMENT
- Page 5-7, Figure 5-2 Final Transformer Alignment, Test Setup.
- Page 5-8, all of paragraph 5.4.4 FINAL TRANSFORMER ALIGNMENT.
- Page 5-9, all of paragraph 5.4.5 FINAL TRANSFORMER ALIGNMENT CHECK.
- Page 5-10, TABLE 5-2. FINAL TRANSFORMER BAND EDGES.
- Page 5-26, Figure 5-11. P.A. Transformer Assembly, Component Location (sheet 1 of 2)
- Page 5-27, Figure 5-11. P.A. Transformer Assembly, Component Locations (sheet 2 of 2)
- Page 5-47/5-48, Figure 5-23. P.A. Transformer Assembly, Schematic Diagram.
- Page 6-4, indicate change to all components with a 1A1A2 prefix.
- Page 6-5, indicate change to all components with a 1A1A2 prefix.

## 3. THEORY

### 3.1 THEORY OF OPERATION

The function of the Final Transformer Assembly is to transfer the power developed by the final amplifier tubes to a 50 ohm output load. This is accomplished using 19 individual bands to cover the 2 to 30 MHz frequency range of the RF-110A. Each of these bands provides a matching network which both tunes the plate circuit of the amplifier and transforms the 50 ohm load impedance of the RF-110A to the 600 ohm load impedance required by the tubes.

Each band consists of a tuned network which provides a parallel resonant response over the frequencies in the selected band. Frequencies outside the bands are sharply attenuated to reduce spurious emission. In addition, a low pass filter is provided to further reduce spurious signals. Selection of the correct band for any given frequency is accomplished via motor driven bandswitch S1.

Individual bands consist of networks similar to that shown in Figure 1. Each network has a primary inductor, a secondary inductor, and a coupling element attached between ground and the two inductors. The primary inductor is resonated by the internal tube capacitance of tubes 1A1V1 and 1A1V2 and in some cases by an additional capacitor(s). The secondary inductor is resonated by a separate tuning capacitor. Capacitive bottom coupling is used in all bands except the top four, which utilize an inductor as the coupling element. In either case the result is a double-tuned, over-coupled, parallel-resonant network. The tapped secondary winding and the two coupled tuned circuits provide the necessary impedance transformation to transform the 50 ohm output load impedance to the desired 600 ohm plate load impedance. This impedance defines the plate currents and plate voltage swing in the final amplifier tubes to maintain efficient operation of the transmitter.

The 19 bands are constructed using 12 coil assemblies, A1 through A12. Each of these coils, with the exception of A10, is tapped on the primary winding and on the secondary winding to provide two inductance values. This allows these coils to be used on two different bands, utilizing common tuning and coupling elements. Each secondary coil is also tapped for a 50 ohm output connection. The proper tuning taps and output taps on the various coils are selected by motor driven bandswitch S1.

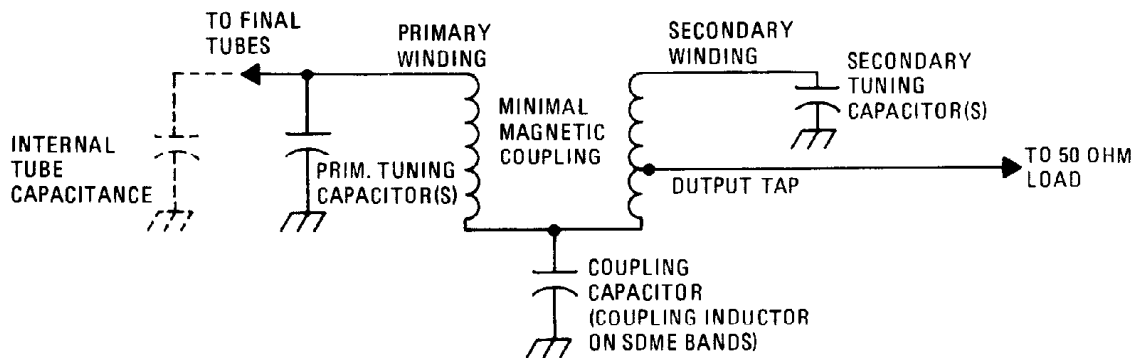


Figure 1. Final Transformer Simplified Schematic

Coils A1 and A3 are primary inductors and coils A2 and A4 are secondary inductors. These coils and their associated tuning capacitors are used for the first four bands. Separate primary and secondary coil assemblies are required to obtain the necessary inductances on these low frequency bands. See Figure 12 Final Transformer Assembly, Schematic Diagram.

Coil assemblies A5 through A12 each contain both a primary and a secondary winding. These coils are wound in such a manner as to minimize magnetic coupling between the primary and secondary windings.

The low pass filter consists of A20, C23, C24, and L3 and provides an approximately flat response to 30 MHz with rapidly increasing attenuation above that frequency.

3.2 THEORY OF ALIGNMENT

The Final Transformer Assembly, as its name implies, acts as a transformer within the frequency band selected. If the output is loaded with 50 ohms, it will present a 600 ohm load impedance to the tubes, across its input. Like an iron core transformer, a 600 ohm resistor across its input will transform to 50 ohms when measured at its output. The alignment is accomplished while placing 600 ohms across the input of the Final Transformer Assembly, since 50 ohm test equipment is more readily available than 600 ohm and also because the output is fitted with an ordinary coaxial cable with a BNC connector. The measurement of the impedance looking into the output, with the input terminated in 600 ohms, uses the concept of reflection and return loss as described below.

If a particular transmission line is terminated with a load impedance equal to its characteristic impedance, the load will absorb all the power from the transmission line. There is no power reflected. If there is a mismatch between the load impedance and the characteristic impedance of the transmission line, a portion of the forward (incident) power will be reflected back toward the source. The amount of reflected power will be determined by the amount of mismatch between the line and the load. In a worst case, where no load exists (infinite impedance or a short circuit), all the forward power would be reflected.

The impedance of the Final Transformer Assembly is measured by measuring the amount of reflected power when a signal is applied to the output through a 50 ohm transmission line. The amount by which the reflected power is less than the incident power is known as the return loss and is commonly expressed in dB. With the aid of Reflectivity Bridge, part number 6802-5100, reflected power can be monitored directly as shown in Figure 2.

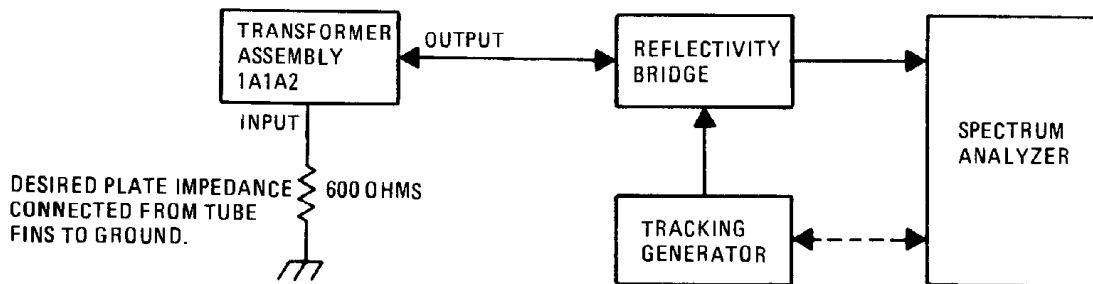


Figure 2. Return Loss Test Setup

In this test setup the 50 ohm tracking generator is the source signal to the Final Transformer Assembly. When the input to the Final Transformer Assembly is terminated in the desired 600 ohms tube plate impedance, a properly tuned Final Transformer Assembly will reflect this as 50 ohms at its output. With this condition present, the generator is properly terminated and the reflectivity bridge will not detect any significant reflected power. If however, the Final Transformer Assembly is not properly adjusted, a mismatch will exist and the reflected power will be detected by the reflectivity bridge and displayed by the spectrum analyzer.



In the case of Final Transformer Assembly, part number 6725-3700, the return loss requirement is -14 dB. Each band is adjusted as described in the Final Transformer Alignment Procedure to meet or exceed the -14 dB return loss specification.

The measurement of the return loss is accomplished as follows. Two 1200 ohm resistors are placed across the Final Transformer Assembly input, at the tubes, to simulate the desired 600 ohm plate load impedance. The Final Transformer Assembly is disconnected from the reflectivity bridge. This is the unterminated condition where all of the source (tracking generator) power is reflected and displayed by the spectrum analyzer. This is the 0 dB reference. The spectrum analyzer is adjusted to display the 0 dB reference on the top line of the spectrum analyzer display over the frequency range of the selected band.

The rf output of the Final Transformer Assembly is reconnected now to the reflectivity bridge. If the coil assembly alignment is correct, most of the source power will be transferred to the 600 ohm load with very little power reflected. The spectrum analyzer display (reflected power) will dip sharply within the frequency range of the selected band. Since a perfect impedance match is not realistic, some reflected power will exist. Therefore, a match is defined as a return loss of -14 dB within the frequency range of the selected band. A typical spectrum analyzer response is shown in figure 3.

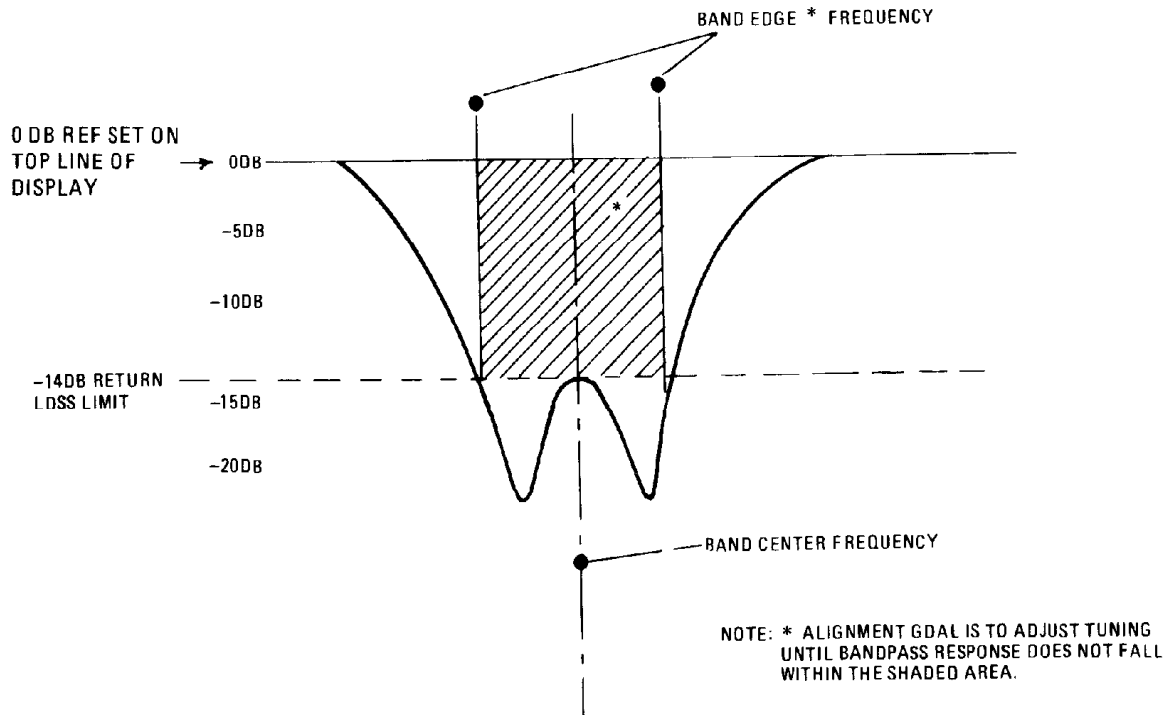


Figure 3. Typical Return Loss Diagram

The selected band matches the impedance only in its frequency range, therefore any frequencies outside this range are not matched and the return loss approaches 0 dB. It is important that the band response be centered about its center frequency and that all points within the passband meet or exceed the -14 dB requirement. The band edges shown in Figure 3 are for reference and may not be typical of all bands.

In general, tuning of the individual bands is accomplished by varying the primary and secondary inductances. This is implemented by positioning a ferrite core (slug) within each inductance coil. Each coil contains two tuning rods, which each control the position of a single ferrite core (slug). The top plate of each coil assembly has a "P" stamped next to one of the tuning rods. This indicates the adjustment for the top slug in that particular coil. The unmarked adjustment controls the bottom slug.

The Final Transformer Alignment Procedure refers to adjusting either the top slug or the bottom slug. For coil assemblies A5 through A12, the top slug changes the primary inductance and the bottom slug varies the secondary inductance. Each adjustment, with the exception of coil assembly A10, affects the tuning frequencies in both bands for which the coil assembly is used. e.g., the A5 coil assembly is used for both the 4 - 5 MHz band and the 5 - 6 MHz band. Therefore, any tuning that is done for the 4 - 5 MHz band also affects the 5 - 6 MHz band. A word of caution, any adjustment requires verification of performance in both associated bands.

Coil assemblies A1 through A4 tune as follows. Coil assemblies A1 and A3 are primary windings. The top slugs of A1 and A3 affects the tuning in the lower frequency band, while the bottom slugs of A1 and A3 affect the tuning in the higher frequency band. Similarly, coil assemblies A2 and A4 are secondary windings. Again the top slugs of A2 and A4 affects the tuning in the lower frequency band, while the bottom slugs affects the tuning in the higher frequency band.

#### 4. FINAL TRANSFORMER ALIGNMENT

Alignment of the broadband transformers is very important to the overall performance of the RF-110A. Therefore, indiscriminate adjustment of the circuits without eliminating other possible causes of trouble or without proper test equipment should not be attempted. Before attempting an alignment to solve an operational problem, logical troubleshooting techniques should be employed to detect S1 switch finger contact problems or component failures in the Final Transformer Assembly or component failures in other parts of the transmitter. Section 5.4.1 of the RF-110A Manual 1932-0005 describes a useful procedure for continuity checking in the Final Transformer Assembly. In case of difficulty, consult the Factory Field Service Group for assistance.

##### 4.1 INITIAL CHECK (Is an alignment required?)

For any band which does not meet the -14 dB specification, the following checks should be performed before an alignment is attempted.

- (a) A complete visual inspection for component failure, arcing, loose wiring, open switch contacts, or other abnormal conditions.
- (b) A measurement of total coupling capacitance and tuning capacitance capacitor values as indicated on the schematic diagram, see Figure 12. When measuring capacitor values, the band switch S1 must be rotated to a band which does not use the coil or capacitors being measured. In some cases, different combinations of coupling capacitors have been used from that which appears on the schematic. However, the total capacitance measured should fall within limits shown in Table 1.

TABLE 1. TOTAL COUPLING CAPACITANCE VALUES FOR ASSEMBLY 1A1A2

COIL ASSEMBLIES	COUPLING CAPACITORS	TOTAL ** NOMINAL CAPACITANCE
A1, A2	C25, C26, C27	1410 pF ± 5%
A3, A4	C30, C31, C32	1860 pF ± 5%
A5	C35, C36, C37	750 pF ± 5%
A6	C40, C41, C42	810 pF ± 5%
A7	C45, C46, C47	540 pF ± 5%
A8	C50, C51, C52, C53*	550 pF ± 5%
A9	C55, C56, C57, C58*	292 pF ± 5%
A10	C60, C61, C62, C63*	320 pF ± 5%

\*Some radios may use four capacitors in place of the three normally used.  
 \*\*When measuring capacitors, add 15 – 20 pF to values shown to account for stray capacitance.

(c) Alignment of the Final Transformer Assembly may be indicated if following conditions are noted: (All of the following steps require that the transmitter be connected to a 50 ohm dummy load.)

- Less than 900 watts of output power with more than 150 mW of input power.
- Plate current in excess of 720 mA in CW/RATT mode at 1 kW output.
- Screen notching (reduction of screen voltage) due to excessive screen current at any frequency within a band.
- Replacement of final tubes V1 or V2.
- A spare Final Transformer Assembly is installed in the radio.

(d) Alignment of the Final Transformer Assembly is required if any of the following conditions occur:

- A coil slug is replaced, or adjusted more than five turns.
- Any coil assembly (A1 through A12) is replaced.
- Any rework has been performed which could have changed the lead dress on any of the coil assemblies

## 4.2 TEST EQUIPMENT REQUIRED

- (a) Spectrum Analyzer\*
  - Hewlett Packard HP-140T Display
  - Hewlett Packard HP-8552B RF Section
  - Hewlett Packard HP-8553B IF Section
- (b) Tracking Generator\* for above listed Analyzer
  - Hewlett Packard HP-8443A
- (c) Reflectivity Bridge
  - RF Part Number 6802-5100
- (d) Resistors\* (2 each) 1200 ohm ± 5% 2W Carbon Composition with alligator clips attached. (Do not use wire wound or film resistors)
  - RF Part Number 6802-5110

\*Equivalent equipment may be substituted

## 4.3 TEST SETUP

- (a) Turn on all test equipment and allow adequate warmup time.
- (b) Calibrate the test equipment as required. (e.g., spectrum analyzer).
- (c) Temporarily remove AC power from RF-110A or secure at source. Switch RF-110A PRIMARY POWER switch to OFF.
- (d) Loosen the front panel screws on the RF-110A and slide the chassis out until it locks.

### WARNING

Lethal voltages exist in the vicinity of the input terminal of Final Transformer Assembly 1A1A2 and the anode of final amplifier tubes 1A1V1 and 1A1V2. Observe the following precaution.

Before touching with bare hands, short to ground all terminals using a heavy screwdriver with insulated handle, or a shorting stick.

- (e) Remove the Final Tube cover and install the two 1200 ohm resistors, RF Part Number 6802-5110, between the tube cooling fins and ground, per Figure 4.

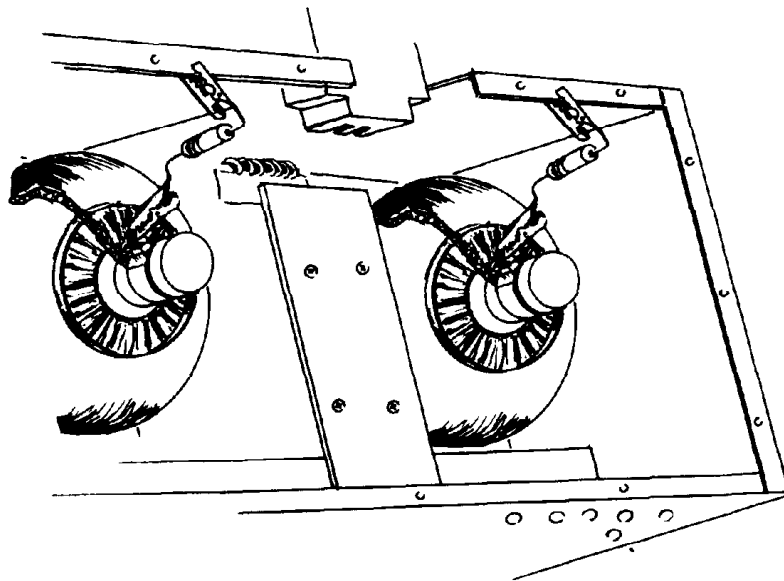


Figure 4. 1200 Ohm Resistor Installation

- (f) Connect the test equipment to the RF-110A as per Figure 5.
- (g) Set the spectrum analyzer for continuous sweep, 100 kHz bandwidth, scan width per division to 0.5 MHz or 1 MHz perdivision as required, 10 dB log display, and input attenuation to 10 dB.
- (h) Set the tracking generator for maximum output. (+10 dBm).
- (i) Defeat the RF-110A chassis interlock switches 1A1S10 and 1A1S11 by pulling out on the switches.
- (j) Rotate the FREQUENCY MHZ switch on the RF-110A to the frequency of question to select the particular band requiring alignment.

### WARNING

In the following steps during the Alignment Procedure, DO NOT go to OPERATE mode or apply HIGH VOLTAGE. Instant destruction of the two 1200 ohm resistors in the tube compartment and possible hazard to personnel will result.

- (k) Turn on the AC power and switch the PRIMARY POWER switch to ON. The bandswitch disc located on the top of the Final Transformer Assembly should rotate to the desired band and stop. Turn the AC power OFF. (In the RF-130 system, set the RF-131 mode switch to any position other than AMP OFF.)
- (l) Disconnect the cable to the UNKNOWN input of the reflectivity bridge. Set the spectrum analyzer display to the 0 dB reference at the top of the display. This step should be repeated each time a different band is displayed. Reconnect the cable to the UNKNOWN input of the reflectivity bridge.
- (m) The passband response of the selected band should now be displayed on the analyzer. All points within the passband should be lower than -14 dB on the display. If the condition is not met, before doing any alignment, recheck the test equipment calibration. Failure to meet the -14 dB requirement indicates an alignment is required. Proceed to the Alignment Procedure for the band in question.

## 4.4 ALIGNMENT PROCEDURE

In general, when tuning all of the bands, adjustment of the secondary inductance acts to center the passband, lower the mid-band response, and balance the band edges. Adjustment of the primary inductance acts as a coarse frequency adjustment and roughly determines the center frequency. Rotating the slug tuning screws clockwise raises the slugs, while rotating the slug tuning screws counterclockwise lowers the slugs. The frequency range of each band and the associated coil assembly (or assemblies) is shown in Table 2.

NOTE: In the following procedures, to select the frequency bands of the RF-110A, repeat steps j thru m.

### 4.4.1 Coil Assemblies A1 – A4 (2.0 MHz – 4.0 MHz)

On the bottom four bands coils A1 and A3 are primary windings and coils A2 and A4 are secondary windings. Each coil has two tuning slugs. Adjustment of the top (marked "P") slug primarily affects the lower frequency band. Adjustment of the lower (unmarked) slugs primarily affects the higher frequency band. Some interaction between the bands requires alternately adjusting the bands to balance the adjustments.

- Set the coil slug position as per Table 3.
- Select the higher frequency band on the RF-110A vandswitch and adjust the spectrum analyzer to display that band, resetting the spectrum analyzer 0 dB reference.
- Adjust the BOTTOM slug of the A1 or the A3 coil assembly (see Table 2) to obtain the correct center frequency
- Adjust the BOTTOM slug of A2 or A4 coil assembly (see table 3) to center the passband and balance the band edtes.
- Select the lower frequency band on the RF-110A bandswitch and adjust the spectrum analyzer to display that band, resetting the spectrum analyzer 0 dB reference.



- Adjust the TOP slug of the A1 or A3 coil assembly (see table 2) to obtain the correct frequency.
- Adjust TOP slug of the A2 or A4 coil assembly (see table 2) to center the passband and balance the band edges.
- Repeat all steps, except the first, until the return loss meets or exceeds the -14 dB return loss specification across the frequency range of both band.

TABLE 2. BAND FREQUENCIES

BAND	FREQUENCY RANGE (MHz)	COIL ASSY(S)
1	2.0 – 2.5	A1, A2
2	2.5 – 3.0	A1, A2
3	3.0 – 3.5	A3, A4
4	3.5 – 4.0	A3, A4
5	4.0 – 5.0	A5
6	5.0 – 6.0	A5
7	6.0 – 7.0	A6
8	7.0 – 8.0	A6
9	8.0 – 10.0	A7
10	10.0 – 12.0	A7
11	12.0 – 14.0	A8
12	14.0 – 16.0	A8
13	16.0 – 18.0	A9
14	18.0 – 20.0	A9
15	20.0 – 22.0	A10
16	22.0 – 24.0	A11
17	24.0 – 26.0	A11
18	26.0 – 28.0	A12
19	28.0 – 30.0	A12



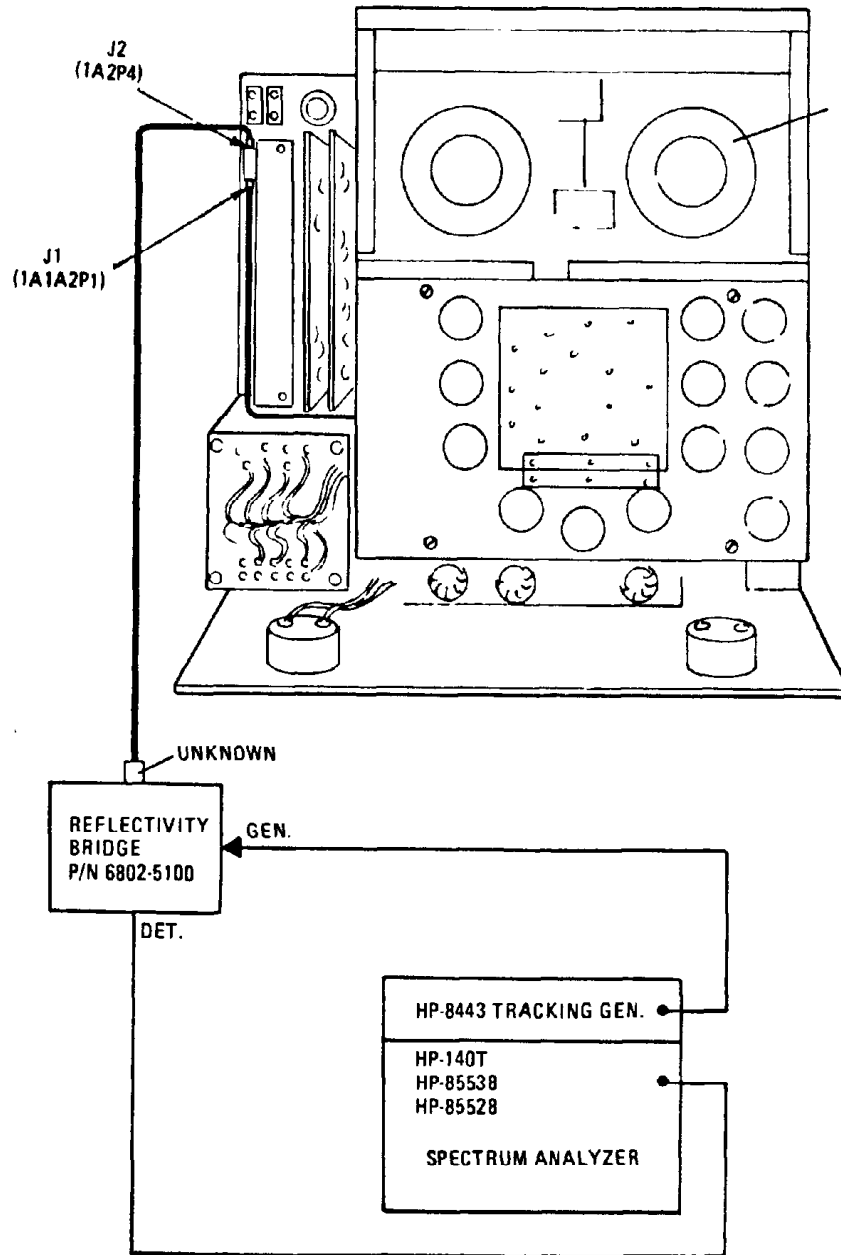


Figure 5. Final Transformer Assembly Alignment Test Setup

## 4.4.2 Coil Assemblies A5 – A12

- Set the coil slug positions as per Table 3.
- Select the band in question on the RF-110A bandswitch and adjust the spectrum analyzer to display that band, resetting the spectrum analyzer 0 dB reference.
- Adjust the TOP slug of the coil assembly for the band in question to obtain the correct center frequency.
- Adjust the BOTTOM slug of the coil assembly for the band in question to center the passband and balance the band edges.
- Alternately repeat the two previous steps until the  $-14$  dB return loss specification is met or exceeded throughout the passband.
- Select the other band that is tuned by the same coil assembly and repeat all steps but the first.
- Alternately repeat the alignment for each band until both bands meet the return loss specification.

## 4.4.3 Final Check

- After the return loss alignment has been completed, disconnect all test equipment, remove the two 1200 ohm resistors from the final tubes, and replace all covers.
- Connect a 50 ohm dummy load to the RF-110A XMTR OUT jack (1J3) and verify proper operation in the bands aligned.



TABLE 3. COIL SLUG PRESET POSITIONS

COIL REF DESIG	"A" TOP SLUG* (MARKED "P")	"B" BOTTOM SLUG* (UNMARKED)
A1	0.91 IN (2.3 CM)	1.10 IN (2.8 CM)
A2	0.51 IN (1.3 CM)	0.94 IN (2.4 CM)
A3	1.30 IN (3.3 CM)	1.18 IN (3.0 CM)
A4	0.87 IN (2.2 CM)	0.94 IN (2.4 CM)
A5	0.75 IN (1.9 CM)	0.59 IN (1.5 CM)
A6	0.87 IN (2.2 CM)	0.94 IN (2.4 CM)
A7	0.59 IN (1.5 CM)	0.59 IN (1.5 CM)
A8	0.67 IN (1.7 CM)	0.59 IN (1.5 CM)
A9	0.67 IN (1.7 CM)	0.55 IN (1.4 CM)
A10	0.59 IN (1.5 CM)	0.43 IN (1.1 CM)
A11	1.20 IN (3.0 CM)	0.75 IN (1.9 CM)
A12	0.79 IN (2.0 CM)	0.98 IN (2.5 CM)

\*Top slug positions are measured from the top plate of the assembly and bottom slugs are measured from the bottom plate. (See Figure 6) use of a paper clip or similar device and a ruler is very helpful if a depth gauge is not available.

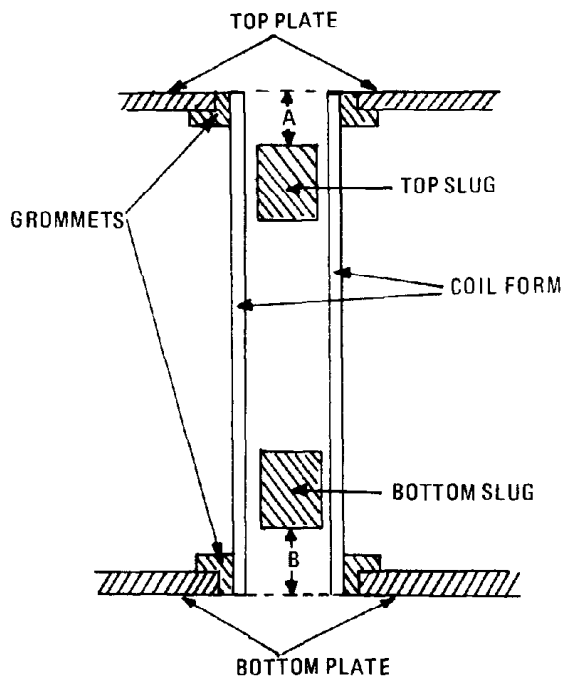


Figure 6. Coil Slug Measurement

# ADDENDUM TO INSTRUCTION MANUAL 1932-0005

(L105)

TABLE 4. FINAL TRANSFORMER ASSEMBLY, PARTS LIST

REF. DESIG.	NAME AND DESCRIPTION	FIG. NO.	REF. DESIG.	NAME AND DESCRIPTION	FIG. NO.
1A1A2	FINAL TRANSFORMER ASSY: part no. 6725-3700	7	1A1A2C43, 1A1A2C44	Not used	
1A1A2C1	CAPACITOR, FIXED, CERAMIC: 25 pF $\pm$ 10%, 7500 Vdc, part no. C15-0001-001	8	1A1A2C45 to 1A1A2C47	CAPACITOR, FIXED, CERAMIC: 180 pF $\pm$ 5%, 2500 Vdc, part no. C11-0004-029	9
1A1A2C2	Not used		1A1A2C48, 1A1A2C49	Not used	
1A1A2C3	CAPACITOR, FIXED, CERAMIC: 50 pF $\pm$ 10%, 7500 Vdc, part no. C15-0001-002	8	1A1A2C50	CAPACITOR, FIXED, CERAMIC: 240 pF $\pm$ 5%, 2500 Vdc, part no. C11-0004-024	9
1A1A2C4, 1A1A2C5	CAPACITOR, FIXED, CERAMIC: 100 pF $\pm$ 10%, 5000 Vdc, part no. C15-0001-003	8	1A1A2C51	CAPACITOR, FIXED, CERAMIC: 160 pF $\pm$ 5%, 2500 Vdc, part no. C11-0004-032	9
1A1A2C6	Not used		1A1A2C52	CAPACITOR, FIXED, CERAMIC: 150 pF $\pm$ 5%, 2500 Vdc, part no. C11-0004-030	9
1A1A2C7	CAPACITOR, FIXED, CERAMIC: 50 pF $\pm$ 10%, 7500 Vdc, part no. C15-0001-002	9	1A1A2C53, 1A1A2C54	(Optional) See Table 1	9
1A1A2C8	Not used		1A1A2C55	CAPACITOR, FIXED, CERAMIC: 110 pF $\pm$ 5%, 2500 Vdc, part no. C11-0004-015	9
1A1A2C9	CAPACITOR, FIXED, CERAMIC: 100 pF $\pm$ 10%, 5000 Vdc, part no. C15-0001-003	9	1A1A2C56, 1A1A2C57	CAPACITOR, FIXED, CERAMIC: 91 pF $\pm$ 5%, 2500 Vdc, part no. C11-0004-031	9
1A1A2C10	CAPACITOR, FIXED, CERAMIC: 25 pF $\pm$ 10%, 7500 Vdc, part no. C15-0001-001	9	1A1A2C58, 1A1A2C59	(Optional) See Table 1	9
1A1A2C11	CAPACITOR, FIXED, CERAMIC: 50 pF $\pm$ 10%, 7500 Vdc, part no. C15-0001-002	9	1A1A2C60, 1A1A2C61	CAPACITOR, FIXED, CERAMIC: 110 pF $\pm$ 5%, 2500 Vdc, part no. C11-0004-015	9
1A1A2C12	CAPACITOR, FIXED, CERAMIC: 25 pF $\pm$ 10%, 7500 Vdc, part no. C15-0001-001	9	1A1A2C62	CAPACITOR, FIXED, CERAMIC: 100 pF $\pm$ 5%, 2500 Vdc, part no. C11-0004-014	9
1A1A2C13, 1A1A2C14	CAPACITOR, FIXED, CERAMIC: 5 pF $\pm$ 5%, 5000V, NPO, part no. 20HT55T5090AA (FMC 21052, High Energy Co.)	10 11	1A1A2C63	(Optional) See Table 1	9
1A1A2C15 to 1A1A2C20	CAPACITOR, FIXED, CERAMIC: 100 pF $\pm$ 10%, 5000 Vdc, part no. C15-0001-003	8	1A1A2L1	COIL, COUPLING: part no. 6725-3713	9
1A1A2C21	CAPACITOR, FIXED, CERAMIC: 5 pF $\pm$ 5%, 5000V, NPO, part no. 20HT55T509DAA (FMC 21052, High Energy Co.)	11	1A1A2L2	COIL, COUPLING: part no. 6725-3714	9
1A1A2C22 to 1A1A2C24	Not used		1A1A2P1	CONNECTOR, BNC: Mil type M39012/16-0007	9
1A1A2C25 to 1A1A2C27	CAPACITOR, FIXED, CERAMIC: 470 pF $\pm$ 5%, 1200 Vdc, part no. C11-0004-010	9	1A1A2R1	RESISTOR, FIXED: 50 ohm $\pm$ 10%, 22W, part no. 884-SP500K (FMC 33437, Carborundum Co.)	11
1A1A2C28, 1A1A2C29	Not used		1A1A2R2	RESISTOR, FIXED, COMPOSITION: 18 ohm $\pm$ 5%, 2W, Mil type RCR42G180JM	10
1A1A2C30 to 1A1A2C32	CAPACITOR, FIXED, CERAMIC: 620 pF $\pm$ 5%, 1200 Vdc, part no. C11-0004-034	9	1A1A2R3	RESISTOR, FIXED, COMPOSITION: 56K $\pm$ 5%, 2W, Mil type RCR42G563JM	9
1A1A2C33, 1A1A2C34	Not used		1A1A2S1	SWITCH ASSEMBLY, ROTARY: part no. 6725-3732	7
1A1A2C35	CAPACITOR, FIXED, CERAMIC: 270 pF $\pm$ 5%, 2500 Vdc part no. C11-0004-027	9	1A1A2Z1	TRAP ASSEMBLY: part no. 0082A-3796	8
1A1A2C36, 1A1A2C37	CAPACITOR, FIXED, CERAMIC: 240 pF $\pm$ 5%, 2500 Vdc, part no. C11-0004-024	9	1A1A2Z2 to 1A1A2Z7	CORE, FERRITE: part no. 6725-3797	8
1A1A2C38, 1A1A2C39	Not used		1A1A2A1	TRANSFORMER ASSY: 2 - 3 MHz, part no. 6725-3711-1	9
1A1A2C40 to 1A1A2C42	CAPACITOR, FIXED, CERAMIC: 270 pF $\pm$ 5%, 2500 Vdc, part no. C11-0004-027	9	1A1A2A2	TRANSFORMER ASSY: 2 - 3 MHz, part no. 6725-3711-2	9
			1A1A2A3	TRANSFORMER ASSY: 3 - 4 MHz, part no. 6725-3711-3	9
			1A1A2A4	TRANSFORMER ASSY: 3 - 4 MHz, part no. 6725-3711-4	9



TABLE 4. FINAL TRANSFORMER ASSEMBLY, PARTS LIST (Continued)

REF. DESIG.	NAME AND DESCRIPTION	FIG. NO.	REF. DESIG.	NAME AND DESCRIPTION	FIG. NO.
1A1A2A5	TRANSFORMER ASSY: 4 – 6 MHz, part no. 6725-3711-5	9	1A1A2A9	TRANSFORMER ASSY: 16 – 20 MHz, part no. 6725-3711-9	9
1A1A2A6	TRANSFORMER ASSY: 6 – 8 MHz, part no. 6725-3711-6	9	1A1A2A10	TRANSFORMER ASSY: 20 – 22 MHz, part no. 6725-3711-10	9
1A1A2A7	TRANSFORMER ASSY: 8 – 12 MHz, part no. 6725-3711-7	9	1A1A2A11	TRANSFORMER ASSY: 22 – 26 MHz, part no. 6725-3711-11	9
1A1A2A8	TRANSFORMER ASSY: 12 – 16 MHz, part no. 6725-3711-8	9	1A1A2A12	TRANSFORMER ASSY: 26 – 30 MHz, part no. 6725-3711-12	9

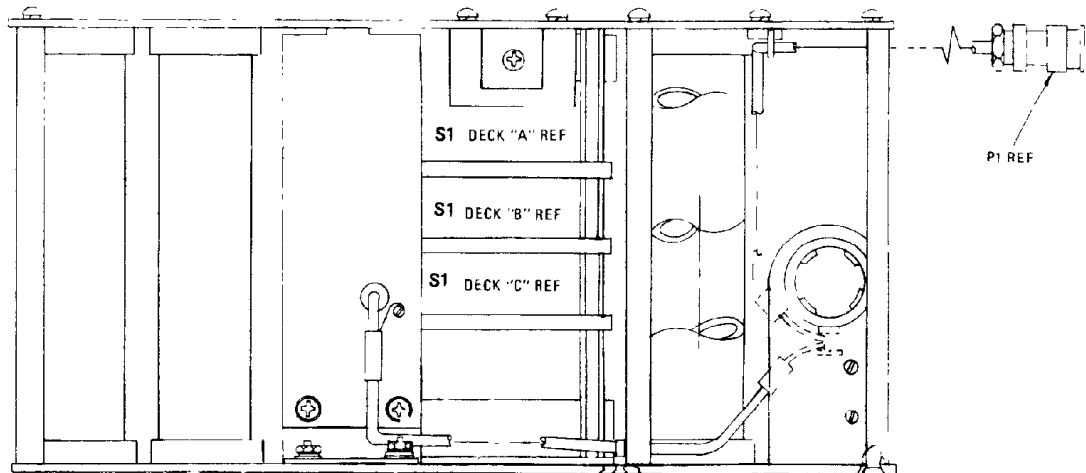


Figure 7. Final Transformer Assembly, Component Location Diagram (Back View)

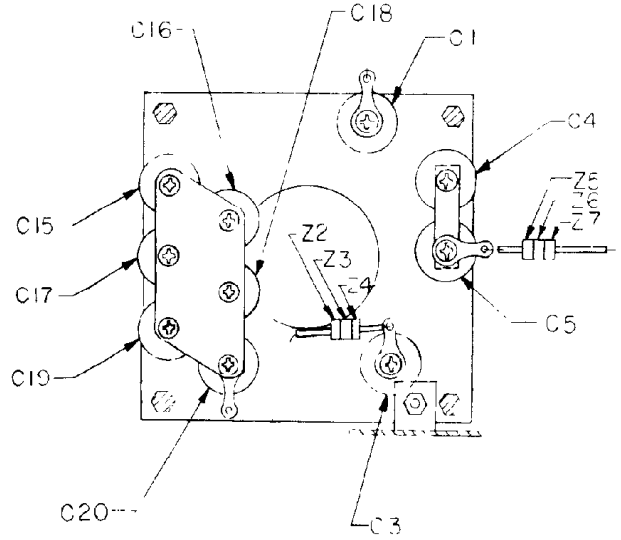


Figure 8. Bandswitch Lower Deck, Component Location Diagram

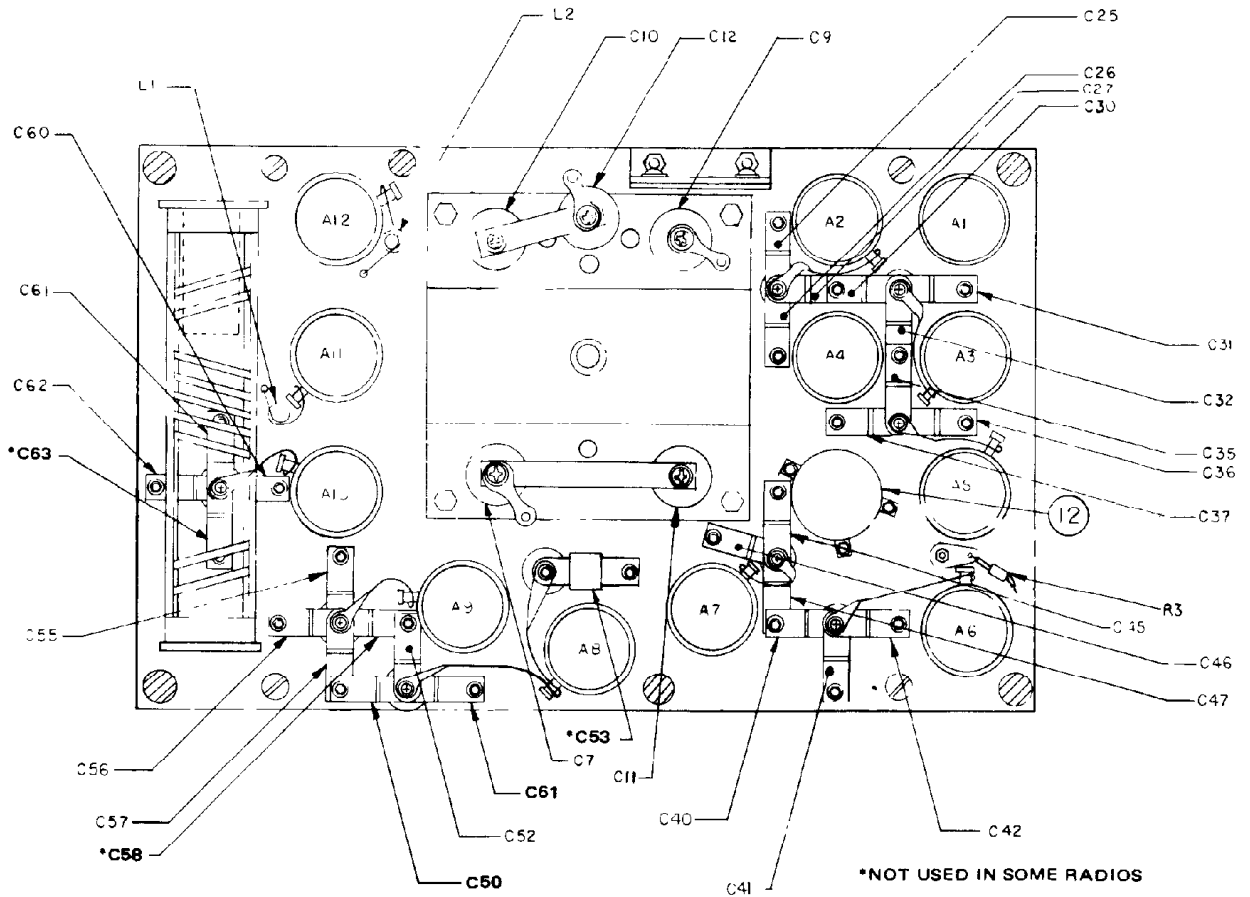


Figure 9. Final Transformer Assembly, Bandswitch Top View of Bottom Plate, Component Location Diagram

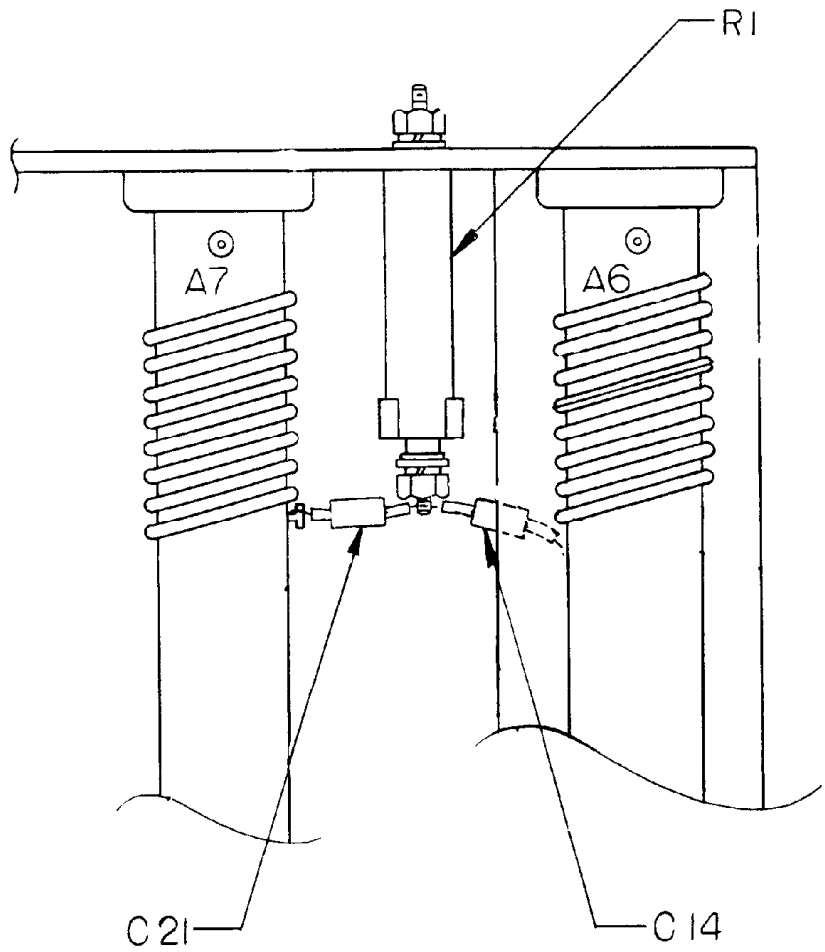


Figure 10. A6 and A7 Coil Assembly View, Component Location Diagram

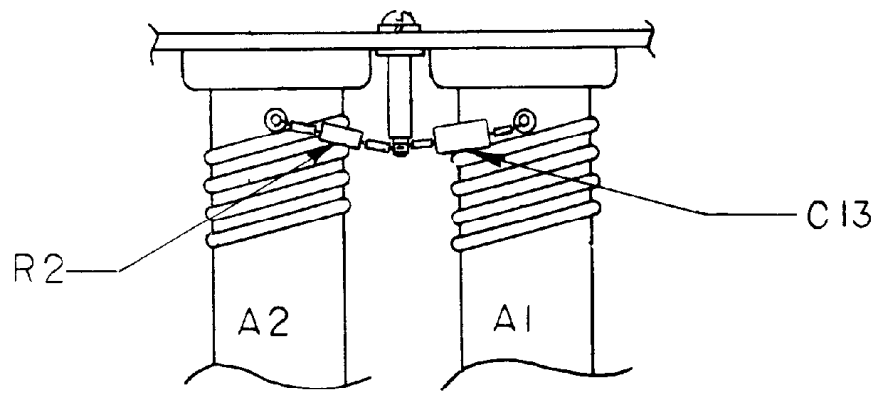


Figure 11. A1 and A2 Coil Assembly View, Component Location Diagram

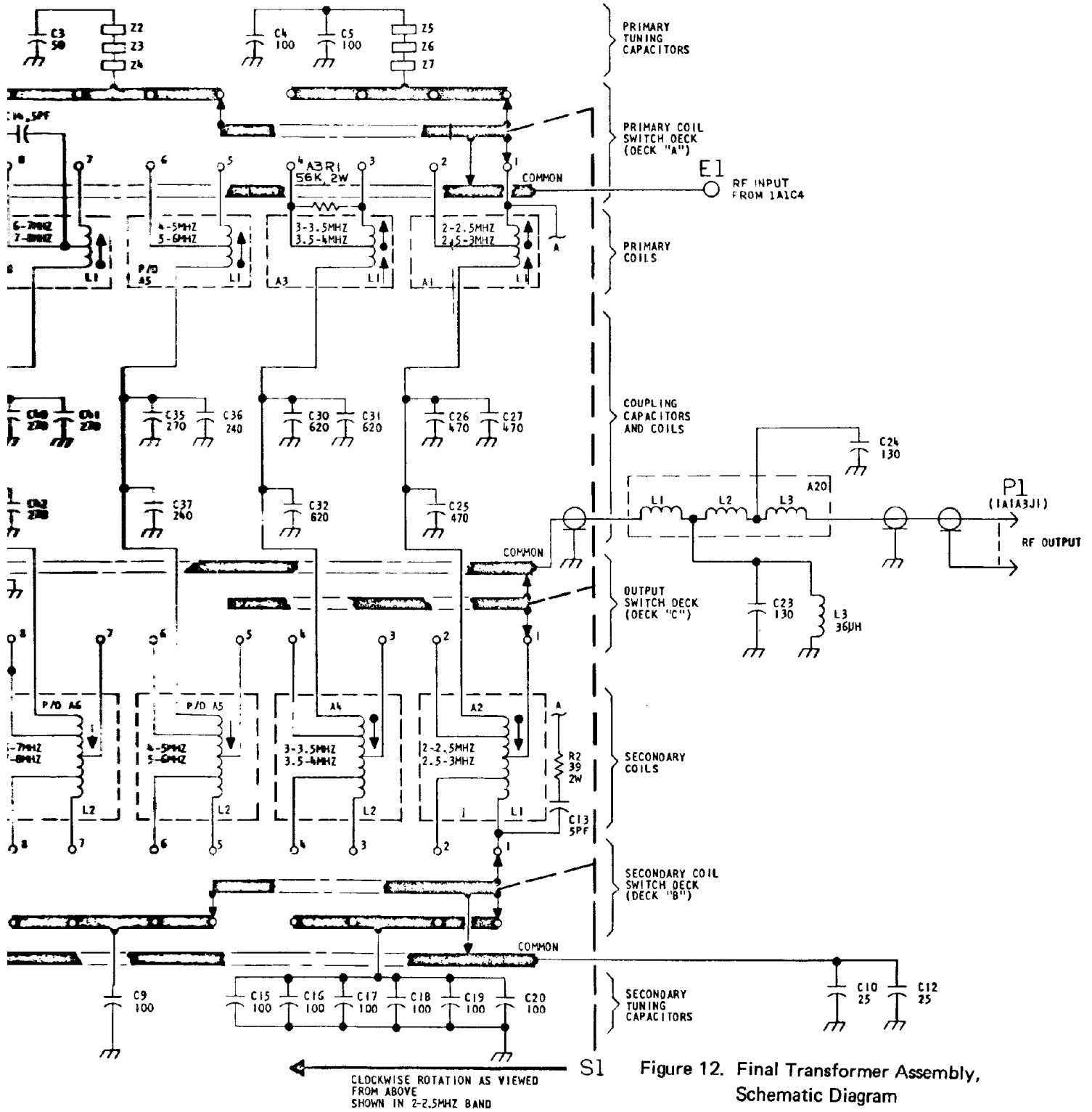
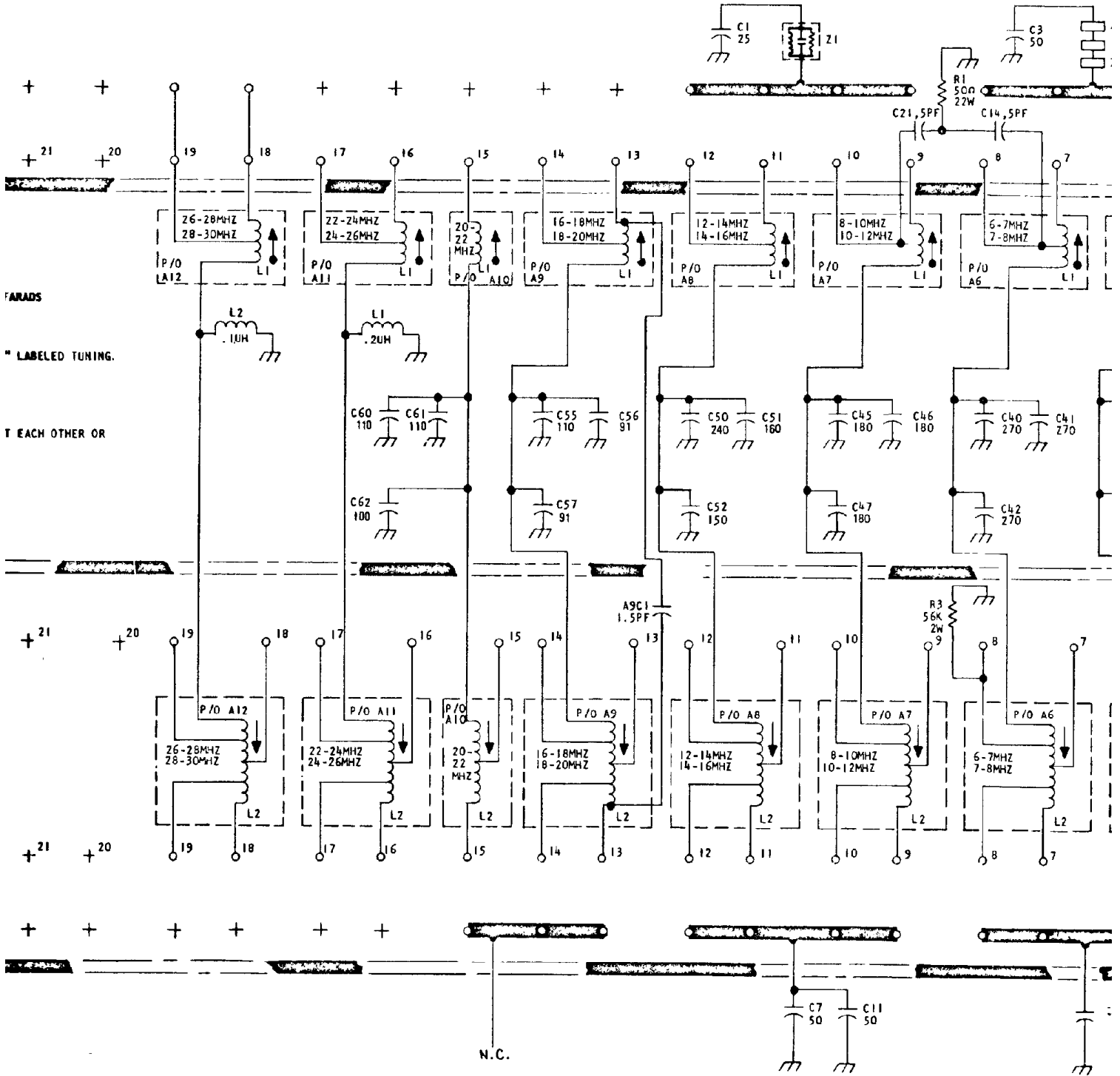
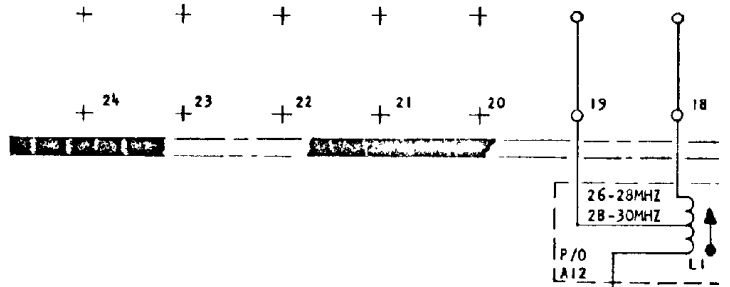


Figure 12. Final Transformer Assembly, Schematic Diagram

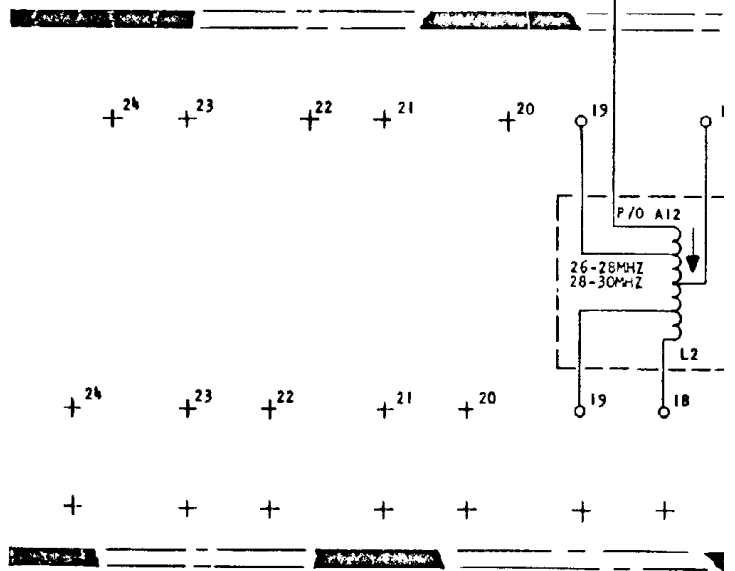


# ADDENDUM TO INSTRUCTION MANUAL



**NOTES:**

1. UNLESS OTHERWISE INDICATED ALL CAPACITORS ARE IN PICOFARADS AND RESISTORS ARE IN OHMS.
2. SWITCH IS SHOWN IN 2.0-2.5 POSITION.
3.  $\blacktriangle$  INDICATES DARK COLOR CODED TUNING NUT SCREW; OR "P" LABELED TUNING NUT. SEE TABLE 3.  
 $\blacktriangle$  INDICATES UNCODED SCREW. SEE TABLE 3.  
 TURN SLOWLY AND CAREFULLY TO NOT JAM THE SLUGS AGAINST EACH OTHER OR THEIR ENDSTOPS.
4. PREFIX PARTIAL REFERENCE DESIGNATIONS WITH IA1A2.



**HARRIS**

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