

★  
NAVELEX 0967-292-9010

TECHNICAL MANUAL  
for  
**RADIO TRANSMITTING SET**  
**AN/FRT - 83 (V)**

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\* P/O Separate Operator's Handbook

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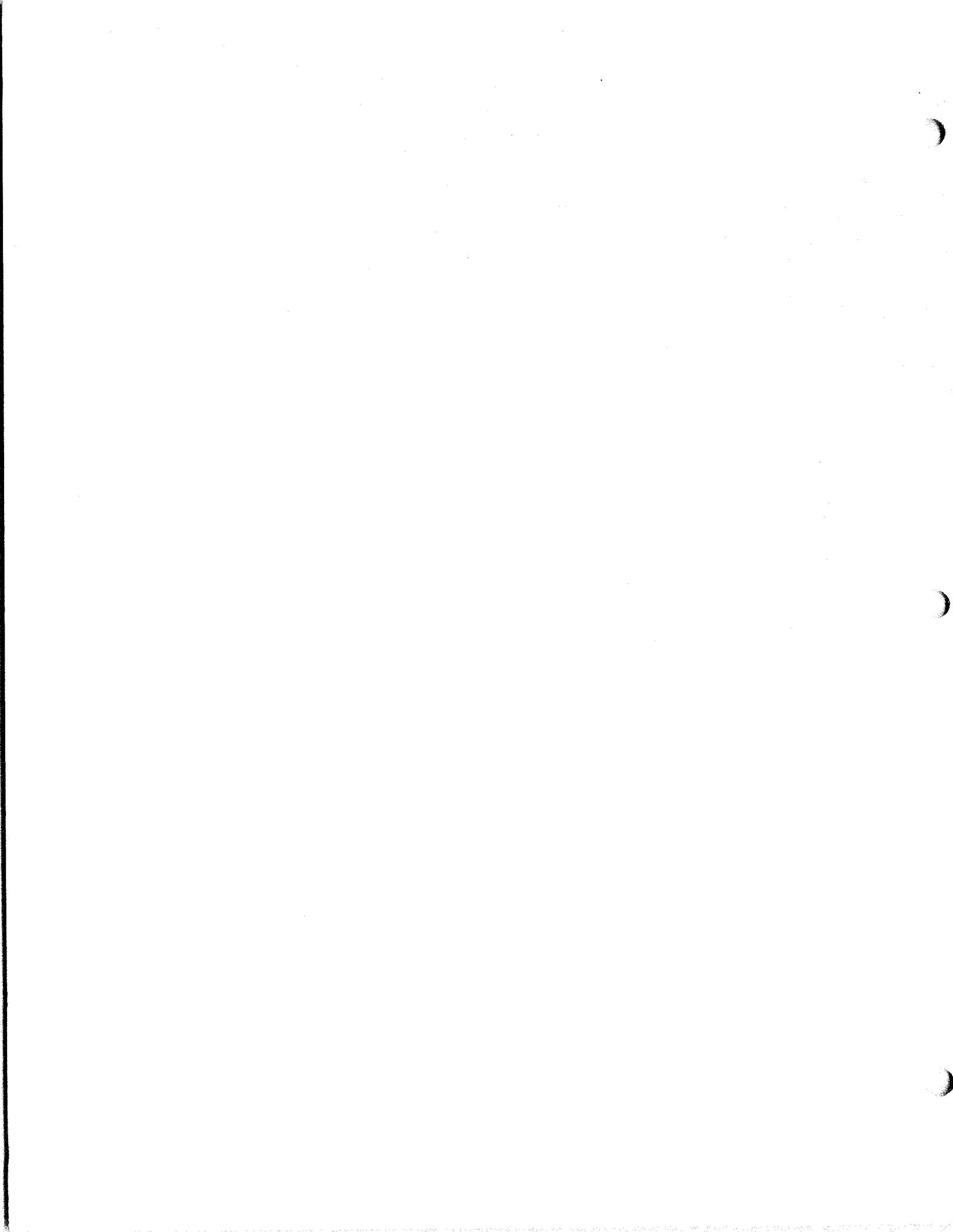
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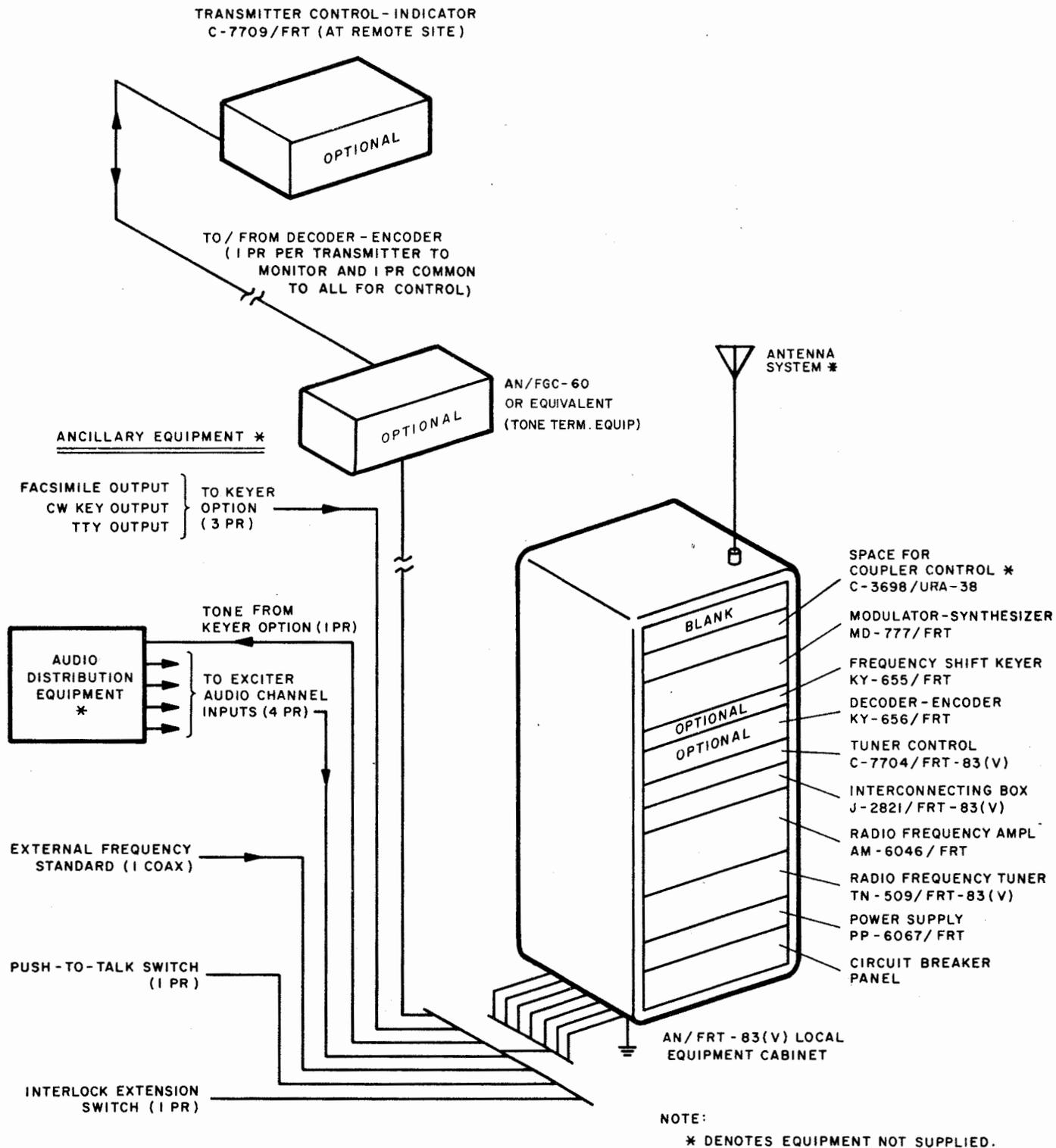


Figure 1-1. Radio Transmitting Set AN/FRT-83(V), Relationship of Units

## SECTION I

## GENERAL INFORMATION

1-1 SCOPE.

1-2 This technical manual is in effect upon receipt. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.

1-3 Radio Transmitting Set AN/FRT-83(V) is designed for use in various configurations, as denoted by the (V) inclusion in its nomenclature.

1-4 Table 1-1 lists the units of the AN/FRT-83(V) Radio Transmitting Set and their common names. Hereinafter, references in this manual will be to the AN/FRT-83(V) and to common names applied to the various units which the

AN/FRT-83(V) comprises. For the sake of brevity, full nomenclature will not be used. Units are identified in figure 1-1, which shows a representative AN/FRT-83(V) with all optional units.

1-5 This technical manual provides overall system information, and it also provides detailed technical information for units which are not optional or are not in common with other Transmitting Sets of the AN/FRT-83(V) series. Units so covered are specifically identified in table 1-1.

1-6 Detailed technical coverage of units not provided in this technical manual is provided in separate technical manuals for those individual units. Preventive maintenance information for all units is

TABLE 1-1. AN/FRT-83(V) UNIT NAMES

COMMON NAME	UNIT NO.	FULL NOMENCLATURE
* 1 KW PA	1	Amplifier, Radio Frequency AM-6046/FRT
* 1 KW Power Supply	2	Power Supply PP-6067/FRT
Exciter	3	Modulator-Synthesizer MD-777/FRT
Keyer	4	Keyer, Frequency Shift KY-655/FRT
Decoder-Encoder	5	Decoder-Encoder KY-656/FRT
Remote Control	6	Transmitter Control-Indicator C-7709/FRT
* I. Box	7	Interconnecting Box J-2821/FRT-83(V)
* Tuner	9	Tuner, Radio Frequency TN-509/FRT-83(V)
* Tuner Control	10	Control Tuner C-7704/FRT-83(V)
* Indicates units which are covered by detail technical information in this technical manual.		

provided in maintenance standards books. These publications are listed in table 1-2.

1-7 Sections 1 and 2 of this technical manual (General Information and Installation) provide system coverage. Operation, Section 3, is supplied as a separate system Operator's Handbook (NAVELEX 0967-292-9060). Section 4 covers Troubleshooting at two levels: first it covers the 1 KW PA, 1 KW Power Supply, Tuner, and Tuner Control units within functional section discussions; then it concludes with a discussion of the system aspects of troubleshooting and gives detailed coverage of system power input and interfacing of system units with the I. Box. Section 5 (Maintenance) covers the removal and replacement of system units and gives detailed maintenance and repair instructions for the units listed above. Section 6 is a Parts List for the units listed above.

#### 1-8 GENERAL DESCRIPTION.

1-9 Radio Transmitting Set AN/FRT-83(V), herein called AN/FRT-83(V), is a synthesized frequency, independent sideband, automatically tuned, HF Radio Transmitting Set for fixed or transportable use. This equipment transmits with a 1 KW PEP power level on any one of 280,000 communications channels spaced at 100 CPS intervals in the 2.0 to 29.9999 MC frequency range. Voice, CW, and FSK intelligence is transmitted on the selected HF channel using an upper, lower, or independent sideband mode of operation. With independent sideband operation, two audio subchannels can be transmitted on one HF channel simultaneously.

1-10 The various configurations of the AN/FRT-83(V) all have an Exciter unit, a 1 KW Power Supply unit, a 1 KW PA unit, a Tuner unit, a Tuner Control unit, and an I. Box unit. Together with the cabinet, these units form the basic transmitter.

Incorporation of optional units extends the capabilities of the basic transmitter as follows: (1) Keyer unit increases variety of input device types which can be used and (2) Remote Control unit and associated Decoder-Encoder unit provide remote control/remote monitoring capability.

1-11 The AN/FRT-83(V) is also designed to allow interface with the AN/URA-38 Antenna Coupler Group, and cabinet space is provided for installation of the C-3698/URA-38 Antenna Coupler Control unit. The AN/URA-38 may be considered as associated output equipment and is not a part of the AN/FRT-83(V).

1-12 The basic transmitter provides for voice-type independent sideband and compatible AM communications. The equipment is phase-delay compensated to permit high speed data transmission. Incorporation of the Keyer unit allows teletypewriter, facsimile, and CW communications to be transmitted in addition to voice; thus the input devices usable with a particular transmitter are defined by the specific AN/FRT-83(V) configuration.

1-13 Normal control of the AN/FRT-83(V) is accomplished by using operating controls on the Exciter unit. However, control of this transmitting equipment from a remote location is possible by incorporation of an optional Remote Control unit along with its associated (locally-mounted) Decoder-Encoder unit. The remote operator can select the desired local transmitter to be controlled.

#### 1-14 RADIO FREQUENCY AMPLIFIER AM-6046/FRT.

1-15 The 1 KW PA is a two-stage, 40 DB gain linear power amplifier which produces an output of 1 KW PEP with a maximum input of 100 MW. Nineteen frequency bands, selected in response to a five-wire code from the Exciter, cover the 2.0 to 29.9999 MC operating frequency range. Automatic control circuit, in conjunction with the Exciter, compensate for

variations in system gain, mode of operation, or loading to optimize performance and protect the unit against overload. Low supply voltages are internally produced. High voltage requirements for the tubes in the amplifier stages are supplied by the 1 KW Power Supply.

1-16 The 1 KW PA has eight major sub-assemblies. These are secured to a chassis and panel assembly which is slide-mounted to allow it to be extended and rotated to a vertical position for servicing. During normal operation, all control is exercised from the Exciter. Maintenance controls and indicators are located on the front panel. Connections are provided for at the rear of the unit. The four electron tubes in the amplifier stages and the associated interstage transformer assemblies are cooled by forced-air.

1-17 POWER SUPPLY PP-6067/FRT.

1-18 The 1 KW Power Supply produces the high voltages for the 1 KW Amplifier and operates from a three phase, 220 or 460 volt, 47-63 CPS source. All components of the 1 KW Power Supply, except power transformers, are mounted on a chassis and panel assembly which is hinge-mounted in a metal case. Loosening five front panel captive screws allows the chassis and panel assembly to be dropped to a horizontal position for servicing and troubleshooting. The power transformers are constructed as an integral part of the case to provide adequate heat dissipation. Two indicating type fuse holders and a POWER ON indicator are located on the front panel; there are not controls. Connections to the 1 KW Power Supply are made at the rear of the case.

1-19 RADIO FREQUENCY TUNER  
TN-509/FRT-83(V).

1-20 The Tuner is a servo-tuned passive-network device which is inserted into the RF transmission path between the 1 KW PA and the antenna system to provide an additional 40 DB attenuation of the harmonics of the operating frequency and to reduce the antenna system VSWR to an acceptable value. The Tuner operates in conjunction with the Tuner Control unit to automatically tune any 50 ohm antenna system of 4:1 or lower VSWR to match it to the output stage of the 1 KW PA. Manual tuning is also provided to allow tuning in the event of a partial failure of associated control equipments.

1-21 The Tuner consists of three basic tuning elements plus twelve major sub-assemblies which are mounted on a chassis assembly. The front panel and chassis assembly is slide mounted, allowing it to be extended and rotated to a vertical position for servicing. Normal operation is automatically accomplished by operating the Exciter. An RF output meter and its associated controls are mounted on the front panel. All necessary connections to the Tuner are provided for at the rear of the Tuner. Front and rear panel connectors are provided for monitoring the output of the Tuner.

1-22 TUNER CONTROL C-7704/FRT-83(V).

1-23 The Tuner Control contains control circuitry which, in conjunction with the I. Box, controls the operation of the Tuner unit. Circuitry in the Tuner Control allows automatic, semi-automatic, and manual operation of the Tuner. All maintenance controls and indicators of the Tuner Control are located on its front panel. Normal operation is automatically accomplished by operating the Exciter. Four major subassemblies are mounted on a panel and chassis assembly,

which is hinged to the case assembly to allow the chassis to swing out horizontally for servicing. All necessary connections to the Tuner Control are provided at the rear of its case assembly.

1-24 INTERCONNECTING BOX  
J-2821/FRT-83(V).

1-25 The I. Box contains system control circuitry for sequencing and activation of various system units as required during operation. This unit also contains portions of the control circuitry for the Tuner.

1-26 The primary functions of the I. Box are to provide a central location for interfacing of various system units and to provide coordination of system operations. Thus, the I. Box is considered as the system-logic center.

1-27 The I. Box has seven subassemblies. These are mounted to the chassis and panel assembly which is slide-mounted to allow it to be extended and rotated to a vertical position for servicing. Operation is automatic. Maintenance controls and indicators are located on the front panel. All necessary I. Box connections are provided for at the rear of the chassis assembly.

1-28 MODULATOR-SYNTHESIZER  
MD-777/FRT.

1-29 The Exciter tunes from 2 to 30 MC in 100-cycle increments in response to the setting of six front-panel digital tuning controls. It synthesizes the selected frequency and provides the means of modulating this frequency in the following modes; A0, A1, A2, A3a, A3b, A3e, A3j, A9b (optional), F1, and F4. (Refer to paragraph 1-46c for mode definitions.) The modulating signals are received by the Exciter through two audio inputs and can be used depending on the mode selected.

Maximum Exciter output RF power is a total of 250 milliwatts. Individual channel gain controls are provided to adjust the RF power allocated to each of the independent sideband channels.

1-30 Exciter front panel controls and push-button/indicator switches control the operation of the Exciter and associated units. Automatic control circuits provide for the control of peak power output (PPC), audio level (ALC), transmitter RF gain (TGC), and voice frequency gate keying (VFG). All RF injection frequencies for Exciter circuit operation are developed from an internal (or external) 1 MC frequency standard.

1-31 Circuit test devices located on the front panel are used to monitor the Exciter DC operating voltages, audio input levels, and RF injection voltages to verify optimum Exciter performance and aid in maintenance evaluation procedures. Panel indicators monitor the status of operation at the Exciter and at the 1 KW PA, Tuner Control, and Tuner.

1-32 The Exciter's major circuit modules are designed as plug-in subassemblies for ease of maintenance and are exposed for examination or service by extending the Exciter chassis from its case on its slides. All operating control and indicators and commonly used maintenance indicators are located on the front panel, and setup/maintenance controls are mounted on a sub-panel within the chassis. All necessary connection to the Exciter are provided at the rear of its case assembly. Monitor connectors are provided on both the front and rear panels.

1-33 FREQUENCY SHIFT KEYER KY-655/FRT.

1-34 The Keyer is an electronic keying device which accepts CW, teletypewriter (FSK), and facsimile (analog) keying at speeds up to 400 bauds. This unit operates in conjunction with the Exciter. Front panel controls and indicators are provided for operation setup and circuit testing.

1-35 The Keyer generates a 1000 CPS tone for CW keying and generates frequency-shift tones for teletypewriter and facsimile operations. The frequency shift of the tones is adjustable about any of four selectable center frequencies. An automatic control circuit disables the Keyer output and unkeys the transmitter when the input signals are unmodulated for an extended period.

1-36 The Keyer chassis assembly is slide mounted within its case, allowing it to be extended and rotated to a vertical position for servicing. Set up and maintenance controls and indicators are located on the front panel and all necessary connections to the unit are provided for at the rear of its case. A front panel output monitor connector allows connection of test equipment for troubleshooting.

1-37 TRANSMITTER CONTROL-INDICATOR  
C-7709/FRT.

1-38 This Remote Control unit utilizes digital signals to effect remote control of the transmitter local equipment, and it receives and displays status information from the transmitter. It operates in conjunction with the Decoder-Encoder unit mounted in the transmitter cabinet. A single Remote Control can be used to control and monitor up to ten transmitters. The signalling is selectably either 60MA, 130V ungrounded, or  $\pm 6V$  polar.

1-39 Front panel controls on the Remote Control provide selection and remote activation of the desired transmitter local equipment and selection of frequency, class of emission, and sideband channel(s). Readback indicators on the front panel display supervisory status signals which are received from

the various transmitters. Thus, the operator can detect at a glance the standby/operate status of the selected transmitter and the class of emission, sideband channel(s), and frequency in use. An alarm system in the Remote Control provides an audible alarm to indicate a fault in any of the associated transmitters, and one of ten station fault indicators lights to indicate which transmitter has a fault condition. Determination of local or remote modes of operation is under the control of the operator at the local equipment.

1-40 The Remote Control is an individually packaged unit with its chassis slide mounted in a case enclosure. All operating controls and indicators are located on the front panel and the only external connections (interconnecting telephone lines and power input) are located on the rear panel. Primary power is supplied at the remote site as 115 VAC,  $\pm 10\%$ , 47-63 CPS, single phase, 90 watts.

1-41 DECODER-ENCODER KY-656/FRT.

1-42 The Decoder-Encoder is the part of the remote control system which is mounted with the other transmitter units in the local equipment cabinet. It operates in conjunction with the Remote Control unit to decode digital commands and to digitally encode transmitter status information and send it to the Remote Control Unit.

1-43 The Decoder-Encoder chassis is mounted in a rack mounting cabinet with chassis slides to allow chassis extension and tilting for maintenance. Monitor indicators are mounted on the front panel, and all connections are made at the rear of the unit.

1-44 TONE TERMINAL EQUIPMENT  
AN/FGC-60.

1-45 The use of AN/FGC-60 tone terminal equipment is determined by the individual site requirement, established in part by the distance from the transmitter to the C-7709/FRT Transmitter Control-Indicator. The AN/FGC-60 (NAVSHIPS 0967-002-1000) is used for multi-channel transmission and reception of telegraphic or binary data over nominal voice frequency transmission facilities.

1-46 REFERENCE DATA. The following listing contains data on the electrical and physical characteristics of the AN/FRT-83(V).

a. Frequency Range: 2.0000 to 29.9999 MC in 0.1 KC increments (280,000 channels).

b. Type of Frequency Control: Frequency synthesizer referenced to a 1 MC internal or external frequency standard.

c. Types of Emission: Unmodulated carrier (A0), CW (A1), modulated CW (A2), compatible AM (A3e), USB/LSB reduced carrier (A3a), two independent sidebands (A3b), USB/LSB suppressed carrier (A3j), FSK (F1), and facsimile (F4).

d. Power Output for Each Type of Emission: A0, A1, F1, and F4 provide 1 KW P.E.P. and average; A2 and A3e provide a modulated 250 watt carrier; A3a, A3b, A3j, provide 1 KW P.E.P.

e. Carrier Insertion: Selectable, -10DB, -20DB, or -40DB (A3a or A3b).

f. Full Carrier Suppression: 60 DB below full rated output.

g. Harmonic Rejection: 80 DB below full rated output.

h. Other Spurious Emissions: 80 DB below full rated output.

i. Intermodulation Distortion: 43 DB below full rated output (white-noise loaded per DCAC-330-175). 35 DB below full rated output (two-tone loaded).

j. Adjacent Channel Interference: Unwanted sidebands 70 DB below the level of those selected for use.

k. Frequency Stability: 1 part in  $10^8$  per day and 1 part in  $10^7$  per 100 days.

l. Tuning Procedure and Interval: Tuning automatic with selection of frequency; 10 seconds maximum tuning time.

m. Number of Audio Channels: Two ISB channels (A1, B1 - 250 to 3040 CPS).

n. Envelope Delay Distortion: Less than 500 microseconds.

o. Audio Channel Input Characteristics: 600 ohm balanced input with input signal level for each channel independently adjustable from -25 DBM to +10 DBM.

p. Output Levels: RF power amplification automatically controlled within  $\pm 1$  DB of full rated outputs (as listed in item d) at all frequencies.

q. Output Impedance: 50 ohms.

r. VSWR Protection: Capable of operation to VSWR of 4:1 and protected from damage above this level.

s. Primary Power:  $220 \pm 22$  VAC or  $460 \pm 23$  VAC, 47-63 CPS, 3 phase.  $115 \pm 11.5$  VAC, 50-60 CPS, 1 phase, 220 watts. (Remote control unit requires separate  $115 \pm 11.5$  VAC, 47-63 CPS, 1 phase, 90 watts.)

- t. Power Consumption: 4000 watts.
- u. Heat Dissipation: 3000 watts.
- v. Ambient Operating Temperature Limits: 0° C to +54° C.
- w. Cooling: Ambient air, no ducts required.
- x. Acoustic Noise: 60 DB (B weighting, ASA S1.4-1961).
- y. Humidity: 0-95% relative humidity.
- z. Elevation: Sea level to 10,000 ft.
- aa. Radiation Hazard: None.
- ab. Remote Control: Frequency and mode selection, carrier reinsertion, and standby/operate. Multiple address for control of up to 10 transmitters from one remote station.

1-47 EQUIPMENT SUPPLIED.

1-48 Equipment which may be supplied as a part of the AN/FRT-83(V) is listed in table 1-2. Note is made in this table of items which may not be supplied, depending on the particular equipment configuration procured.

1-49 EQUIPMENT AND PUBLICATIONS NOT SUPPLIED.

1-50 The equipment and publications required or optional but not supplied as part of AN/FRT-83(V) are listed in table 1-3.

1-51 EQUIPMENT SIMILARITIES

1-52 The AN/FRT-83(V) is one of a family of four radio transmitting sets which are similar in that they utilize

the following identical units: (1) MD-777/FRT Exciter, (2) KY-655/FRT Keyer, (3) KY-656/FRT Decoder-Encoder, and (4) C-7709/FRT Remote Control.

1-53 Each type of radio transmitting set of this family is differentiated by its nomenclature, its output power, and by the overall physical and electrical requirements dictated by its power output capability. The reference designations for the various family members and their power output levels are given in table 1-4.

1-54 Installation requirements and procedures are different for each type of transmitter. Consult the applicable technical manual (table 1-4) for installations instructions.

1-55 The AN/FRT-83(V) and AN/FRT-84(V) have a commonality beyond that shared by all four members of the family as described above. Specifically, the AN/FRT-83(V) and AN/FRT-84(V) utilize identical AM-6046/FRT 1 KW PA units and PP-6067/FRT 1 KW Power Supply units.

1-56 FACTORY OR FIELD CHANGES.

1-57 At the time of publication of this manual, there have been four field changes issued, and they are incorporated in this manual. Refer to table 1-5 for identification of these field changes. Table 1-5 also provides space for future field change information.

1-58 PREPARATION FOR RESHIPMENT.

1-59 The AN/FRT-83(V), exclusive of Remote Control C-7709/FRT, is shipped complete in one shipping container. To prepare the AN/FRT-83(V) for reshipment, remove all external interconnecting

cables and accessories connected to the units. Pack small parts in the storage drawer at the rear of the local equipment cabinet. Pack instruction manuals and

cable connectors separately. Crate the equipment in accordance with applicable specifications.

TABLE 1-2. EQUIPMENT SUPPLIED

QTY PER EQUIP	NOMENCLATURE		OVERALL DIMENSIONS (IN.)			VOLUME (CU FT)	WEIGHT (LB)
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	Radio Transmitting Set consisting of 1 each: Radio Freq. Amplifier Power Supply Modulator-Synthesizer Frequency Shift Keyer* Decoder-Encoder* Interconnecting Box Cabinet Assembly Radio Frequency Tuner Tuner Control	AN/FRT-83(V) AM-6046/FRT PP-6067/FRT MD-777/FRT KY-655/FRT KY-656/FRT J-2821/FRT-83(V) TN-509/FRT-83(V) C-7704/FRT-83(V)	78 5/16	21 1/4	24	21.6	800
*1	Transmitter Control-Indicator	C-7709/FRT	8 3/4	19	20	1.42	65
2	Technical Manual, Radio Transmitting Set AN/FRT-83(V)	NAVELEX 0967-292-9010	10 3/4	8 1/4			
2	Technical Manual, Modulator-Synthesizer MD-777/FRT	NAVELEX 0967-292-9030					
*2	Technical Manual, Frequency Shift Keyer KY-655/FRT	NAVELEX 0967-292-9020					
*2	Technical Manual, Decoder-Encoder KY-656/FRT	NAVELEX 0967-292-9050					
*2	Technical Manual, Transmitter Control-Indicator C-7709/FRT	NAVELEX 0967-292-9040					
2	Operator's Handbook, AN/FRT-83(V)	NAVELEX 0967-292-9060					
1	Local Operator Instruction Chart, AN/FRT-83(V)	NAVSHIPS 0967-292-9070					
*1	Remote Operator Instruction Chart, AN/FRT-83(V)	NAVSHIPS 0967-293-5010					
1	Performance Standards Sheet, AN/FRT-83(V)	NAVSHIPS 0967-292-9080					
1	Maintenance Standards Book, AN/FRT-83(V)	NAVSHIPS 0967-292-9090					
1	Maintenance Standards Book, MD-777/FRT	NAVSHIPS 0967-293-3010					
*1	Maintenance Standards Book, KY-655/FRT	NAVSHIPS 0967-293-4010					
*1	Maintenance Standards Book, KY-656/FRT	NAVSHIPS 0967-293-6010					
*1	Maintenance Standards Book, C-7709/FRT	NAVSHIPS 0967-293-5020	10 3/4	8 1/4			

TABLE 1-2. EQUIPMENT SUPPLIED (Cont)

QTY PER EQUIP	NOMENCLATURE		OVERALL DIMENSIONS (IN.)			VOLUME (CU FT)	WEIGHT (LB)
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	Maintenance Kit consisting of 1 each:	<u>Part No./FMC**</u>					
	PCB Extender, 1 KW PA	6049-3015/14304					
	PCB Extender, 1 KW PA	6049-3020/14304					
	PCB Extender, I. Box	6049-2564/14304					
	PCB Extender, Tuner Control	6049-4014/14304					
	PCB Extender, Tuner Control	6049-4015/14304					
	PCB Extender, Tuner Control	6049-4016/14304					
	PCB Extender, Exciter	D45183G1/42498					
	PCB Extender, Exciter	D45170G1/42498					
	PCB Extender, Exciter	D46422G1/42498					
	PCB Extender, Exciter	D46422G2/42498					
	PCB Extender, Remote Control*	D44183G4/42498					
	PCB Extender, Remote Control*	D44183G6/42498					
	PCB Extender, Decoder-Encoder*	D44183G2/42498					
	PCB Extender, Decoder-Encoder* and Remote Control*	D44183G1/42498					
	PCB Extender, Decoder-Encoder* and Remote Control*	D44183G3/42498					
	Module Extender, Exciter	C45138G1/42498					
	Module Extender, Exciter	C45148G1/42498					
	Module Extender, Exciter	C45149G1/42498					
	Module Extender, Exciter	C45149G2/42498					
	Module Extender, Keyer*	C45629G1/42498					
	Module Extender, Keyer*	C45630G1/42498					
	Module Puller Handle, Exciter	B43412G1/42498					
	Module Puller Handle, Exciter	B45837G1/42498					
1	Connector, Exciter	MS3116F14-19S					
*1	Connector, Keyer	MS3116F14-15SW					
*1	Connector, Decoder-Encoder	MS3116F12-10S					
*1	Connector, Remote Control	MS3116E20-39S					
*1	Connector, Remote Control	MS3108R14S-7S					

\*Optional equipment items, not supplied with all configurations.

\*\*FMC 14304 - RF Communications, Inc.; FMC 42498 - National Radio Co., Inc.

TABLE 1-3. EQUIPMENT AND PUBLICATIONS NOT SUPPLIED

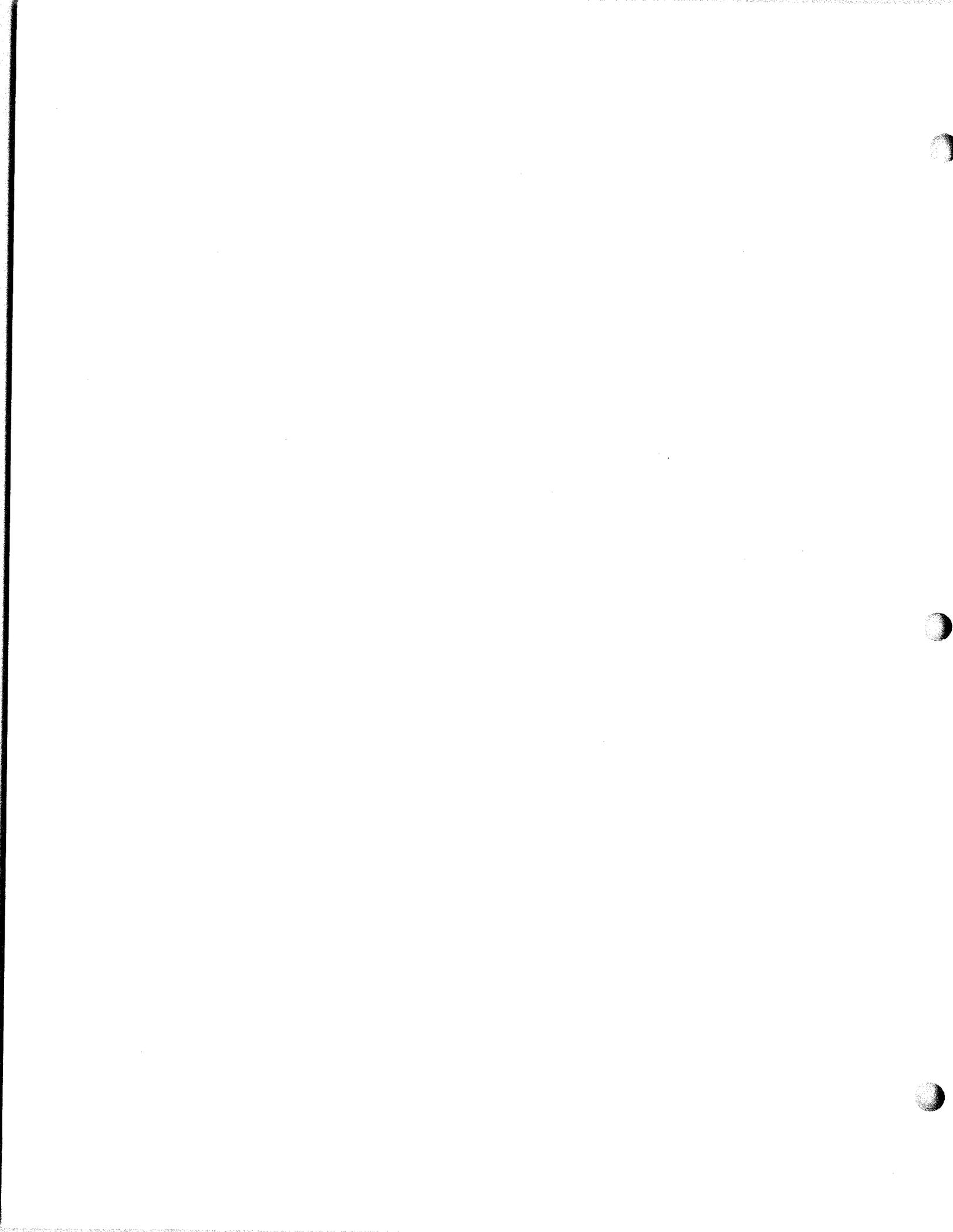
QTY PER EQUIP	NOMENCLATURE		REQUIRED USE	REQUIRED EQUIPMENT CHARACTERISTICS
	NAME	DESIGNATION		
1	Antenna System	-----	Radiation of signal	Frequency Range: 2-30 MCS Characteristic Impedance: 50 ohms Maximum VSWR (for full output): 3/1 Power Handling Capability: 1 KW Average CCS
1**	Antenna Coupler Group	AN/URA-38	Allows use of whip antenna for above antenna system	
1	Primary Power Feeder Line	-----	Supply power to transmitter	220 ± 22 VAC or 460 ± 23 VAC, 50-60 CPS +5%, 3-phase, with proper overload protection for 4.7 KVA (4000 watts required at full output, power factor = 0.85)
1**	Audio Distribution Equipment	-----	Optional station accessory to allow patching various audio sources into the transmitter audio input lines	600 ohm balanced pair line compatibility
1**	Frequency Standard	-----	Optional station accessory provide standby frequency standard signal and to allow checking of internal frequency standard.	1 MC, 1.0V RMS, 50 ohm output, frequency accuracy equal to or better than 1 part in 10 <sup>8</sup> per day and 1 part in 10 <sup>7</sup> per 100 days.
1**	Push-to-talk Switch	-----	Optional accessory to allow silencing transmitter when not required to be on the air.	Dry contact closure to key transmitter to "on the air" condition.
1**	Interlock Extension Switch	-----	Optional accessory to allow power shutdown from a short distance away from the transmitter	Isolated dry contact closure to maintain operation; open to prevent operation.
1	Overhaul and Repair Manual, AN/FRT-83(V)	NAVSHIPS 0967-292-9100	General transmitter overhaul except units below	
1	Overhaul and Repair Manual, MD-777/FRT	NAVSHIPS 0967-293-3020	Exciter overhaul	
1	Overhaul and Repair Manual, KY-655/FRT	NAVSHIPS 0967-293-4020	Keyer overhaul	
1	Overhaul and Repair Manual, KY-656/FRT	NAVSHIPS 0967-293-6020	Decoder-Encoder overhaul	
1	Overhaul and Repair Manual, C-7709/FRT	NAVSHIPS 0967-293-5030	Remote Control unit overhaul	
<p>*Test equipment and special adapters required for servicing are listed in table 4-5. See also, test equipment list in Overhaul and Repair Manual, NAVSHIPS 0967-292-9100. **Refer to figure 1-1 to determine relationship of optional items to transmitter.</p>				

TABLE 1-4. RADIO TRANSMITTING SET FAMILY

RADIO TRANSMITTING REF DESIGNATION	OUTPUT POWER	TECHNICAL MANUAL
AN/FRT-83(V)	1 KW	NAVELEX 0967-292-9010
AN/FRT-84(V)	10 KW	NAVELEX 0967-293-0010
AN/FRT-85(V)	40 KW	NAVELEX 0967-293-1010
AN/FRT-86(V)	200 KW	NAVELEX 0967-293-2010

TABLE 1-5. FIELD CHANGE RECORD

FIELD CHANGE NUMBER	FIELD CHANGE TITLE AND PURPOSE	SERIAL NO. AFFECTED	INDICATION OF ACCOMPLISHMENT
1-AN/FRT-83(V) NAVSHIPS 0967-292-9110	Replacement of Side Carrier Generator (A9) with Side Carrier Generator Simulator (A20) in MD-777/FRT.	All	Side Carrier Generator simulator installed in Side Carrier Generator position in MD-777/FRT.
2-AN/FRT-83(V) NAVSHIPS 0967-292-9120	Addition of circuit breaker 8A1CB4 to provide independent protection and control to Terminal Strip 8A3.	All	Presence of external 115V circuit breaker on circuit breaker panel.
3-AN/FRT-83(V) EIB 818, 826	Modification of Keyer, KY-655/FRT allowing CW operation in all input signal levels of TTY input selector switch.	All	CW mode operation is permitted in any input signal level indicated on TTY input selector switch.
4-AN/FRT-83(V) NAVSHIPS 0967-292-9130	Modification of MD-777/FRT to provide for external 1 MHz frequency source as normal standard.	All	STD FAIL alarm lights when external standard is disconnected.



## SECTION II

## INSTALLATION

2-1 GENERAL.

2-2 This section contains procedures for installation and initial setup for the AN/FRT-83(V). This equipment is shipped in one crate except when the system is to include a Remote Control unit. The Remote Control unit is packaged separately and includes its individual Technical Manual, NAVSHIPS 0967-292-9040, containing installation instructions for that unit.

2-3 The following instructions apply to the uncrated AN/FRT-83(V) local equipment cabinet with all optional units (Keyer and Decoder-Encoder). Consideration is also given to the possible use of a GFM AN/URA-38 Antenna Coupler Group, for which provisions have been made in the AN/FRT-83(V). Procedures for installation of the GFM AN/URA-38 Antenna Coupler Group are given in the Technical Manual for that equipment. Mounting space is provided in the local equipment cabinet for the C-3698/URA-38 Coupler Control unit as shown in figure 2-1, and cable connection required from that unit to the AN/FRT-83(V) local equipment are described in paragraph 2-24. Disregard instructions given for optional units not included in your particular installation. Also disregard installation instructions in the Exciter and Keyer technical manuals except as referenced herein. Table 2-1 is supplied as a guide to items required for installation.

2-4 Unpacking requires the normal care given to electronic equipment. Avoid rough handling and use care to protect

panel mounted controls and connectors.

2-5 INSTALLATION REQUIREMENTS.

2-6 POWER REQUIREMENTS. The AN/FRT-83(V) local equipment operates from primary power sources of  $220 \pm 22$  VAC or  $460 \pm 23$  VAC, 50-60 CPS  $\pm 5\%$ , 3 phase and  $115 \pm 11.5$  VAC, 50-60 CPS, single-phase. Power consumption is 4 KW, of which 1 KW is the rated output and 3 KW represents heat losses. Power factor is nominally 0.85. Direct connections are made from the building power distribution panel to screw terminals in the AN/FRT-83(V) cabinet.

2-7 Power distribution inside the AN/FRT-83(V) is illustrated in figures 2-2 and 2-3. The Exciter and its blower and the optional Keyer and Decoder-Encoder units are supplied with  $115 \pm 11.5$  VAC, 50-60 CPS, single-phase power from outlet strip 8A3 in the AN/FRT-83(V) cabinet. Power connections are described in paragraph 2-17.

2-8 EQUIPMENT LOCATION. Figure 2-1 shows the dimensions of the local equipment cabinet which are necessary for installation. The cabinet is designed for floor mounting, with input cables routed through floor ducts. The exact location should include minimum clearances as shown to allow access to the cabinet and the units. Cooling air flow requirements shown in figure 2-1 should be provided. Normally, it is necessary simply to prevent obstructions to the air intake and exhaust to allow circulation of ambient air.

**2-9 INSTALLATION PROCEDURES.**

**2-10 CABINET MOUNTING.** After the mounting location for the local equipment cabinet has been selected, refer to figure 2-1 to determine mounting holes required. Prepare the mounting holes, and ensure that a floor duct opening is provided in alignment with the entry port in the cabinet base. Set the cabinet in place, and secure with four 0.5 inch OD lag bolts. Base plate is accessible through rear door.

**NOTE**

Care should be taken to assure that any cabinets which are to be bolted together have mating faces parallel

within 1/8 of an inch before installing lag bolts. Adjustment for vertical alignment should be made by shimming the mounted based.

**2-11 PREPARATION OF WIRING ENTRY PORT.** The cable entry port cover plate should be removed and cut out as much as necessary to fit the cables used for the installation. After cables have been routed properly, reinstall cover plate. If necessary, excess opening should be caulked to prevent entry of rodents and small pests.

**2-12 SIGNAL, CONTROL, AND POWER WIRING INPUTS.** Table 2-1 describes the signal and control input wiring provisions of the AN/FRT-83(V) local equipment.

**TABLE 2-1. INSTALLATION TOOLS AND MATERIALS REQUIRED**

QUANTITY	ITEM	NOTES
1	Fork lift, 1000 lb	Placement of transmitter
1 set	Socket wrenches, 1/4 in. to 5/8 in.	Bolting cabinet down
1 set	Electrician tools	Wiring connections
1	1/2 in. electric drill	Drilling mounting holes
1 set	Twist drills	Drilling mounting holes
1	Sheet metal cutter	See paragraph 2-11
1 set	Caulking gun and compound	See paragraph 2-11
1 lot	Power cables	Determine from paragraph 2-17 and site plans
1 lot	Signal cables	Determine from paragraph 2-13 and site plans
1 set	RF output cable and connector	Determine from paragraph 2-23 and site plans
4 sets	1/2 in. diameter lag screws or bolts	As required for mounting cabinets on floor or platform
1	AN/PSM-4B Multimeter	Line voltage checks
REF	Test equipment	See paragraph 2-30b

Location and identification of connectors and cable routing are shown in figure 2-1. Paragraph 2-13 provides details for the interconnection of the local equipment to the external equipment in the system. Paragraph 2-17 provides information for connection of primary power wiring to the local equipment cabinet.

2-13 SIGNAL AND CONTROL WIRING INSTALLATION PROCEDURES. Required connectors, as listed in table 2-2, are supplied with the local equipment. All signal wiring near the set, the antenna, or other sources of RF energy should be done with shielded cable, the shield of which should be securely connected to the shell of the plug. Allow 8 feet of cable inside the cabinet to provide for routing to the required connection points, except that the ground wire and the interlock extension wires require only about two feet. The signal and control wiring to the various units in the upper part of the cabinet should be routed and slamped as necessary within the cabinet so that it will not interfere with the movement of slide out drawers or their cable retractors.

2-14 After routing and securing the cables and pairs as required, individual connections should be made by cutting wires to final length and attaching the required connectors. The ground cable is connected to the cabinet, using the 1/4-20 x 1/2 inch bolt provided in the staked-in nut at the lower left-rear corner of the cabinet base plate.

2-15 The AN/FRT-83(V), as supplied, has a jumper installed between interlock extension terminals 8A2TB3 - 1 & 2. If an external power interlock switch is to be used to provide external shutdown of power to the various units of the local equipment cabinet, the jumper should be removed and

replaced by wires to an external normally-closed interlock switch.

2-16 Although some of the cable connections listed in table 2-2 are not required for normal operation, it is recommended that a study of possible future uses of some of these options be made. If thought desirable, these cables should be provided (labelled and tied out of the way in the cabinet) for future use, since future installation of these cables may be difficult.

2-17 PRIMARY POWER WIRING. The AN/FRT-83(V) local equipment cabinet utilizes either 460 VAC or 220 VAC primary power (paragraph 2-6). As shipped, internal connections are usually made for 460 VAC operation, and 1 KW PA primary power fuses are supplied for 460 VAC. Alternate connections and fuses must be used for 220 VAC operation. Table 2-3 shows connections for 460 VAC schematically, and figure 2-3 shows connections for 220 VAC.

2-18 After determining the primary power voltage to be used, check the fuses and jumper connections listed in table 2-3, and make changes if necessary.

#### WARNING

Dangerous voltages are present. Before changing jumpers or connecting primary power cables, be sure that the power source is turned off.

#### CAUTION

Serious damage to the equipment could result by improper connections. Double check jumpers to be sure that correct terminals are jumpered.

TABLE 2-2. INPUT SIGNAL AND CONTROL WIRING PROVISIONS OF AN/FRT-83(V) LOCAL EQUIPMENT

LOCAL UNIT TERMINALS	MATING CONNECTOR TYPE	WIRE TYPE**	CONNECTS TO	SIGNAL/CONTROL FUNCTION
<u>Keyer*:</u> 4FL2J1-E(+),D(-) 4FL2J1-A(+),B(-) 4FL2J1-G,H 4FL2J1-K,R  4FJ2J1-M,N	MS-3116F14-15SW	1 pair 1 pair 1 pair 1 twisted pair  1 pair	GFM Facsimile Mach.* GFM Teletypewriter* GFM CW Key* GFM Audio Distribution Equipment GFM Key Switch***	Facsimile Signal Teletypewriter Signal CW Key Signal Keyer Audio Tone Output  Transition Relay Key
<u>Exciter:</u> 3FL3J1-E,F 3FL3J1-C,D 3FL3J1-G,H 3FL3J1-A,B 3FL3J1-J,K  3FL3J1-L 3FL3J1-M 3FL3J1-N 3FL3J1-P 3FL3J1-R 3FL3J1-S	MS-3116F14-19S	1 twisted pair } 1 twisted pair } 1 twisted pair } 1 twisted pair } 1 pair }  1 conductor } 1 conductor } 1 conductor } 1 conductor } 1 conductor } 1 conductor }	GFM Audio Distribution Equipment GFM Push-to-talk switch*  GFM Status Indicators ****	Audio Input, Channel A1 Audio Input, Channel B1 Audio Input, Channel A2* Audio Input, Channel B2* Push-to-talk Keyline  Common A2,B2 Readback B1 Readback A1 Readback B+ on (operate) readback RF on (keyed) readback
3J4	UG-88C/U (BNC)	RG-58/U	GFM External Frequency Standard*	External 1 MC Frequency Standard Input
3J5	UG-88C/U (BNC)	RG-58/U	GFM External Test Jack*	External Test Point for Exciter Internal Frequency Standard.
<u>1 KW PA:</u> 1J10	UG-88C/U (BNC)	RG-58/U	GFM External Test Jack*	External Test Point for 1 KW PA RF Input (Exciter output)
<u>Tuner:</u> 9J5	UG-88C/U (BNC)	RG-58/U	GFM External Test Jack*	External Test Point for Tuner RF Output
<u>Decoder-Encoder*:</u> 5FL2J1-F(+),D(-) 5FL2J1-B(+),H(-)	MS-3116F12-10S	1 twisted pair 1 twisted pair	Remote Control* Remote Control*	Control Readback
<u>Cabinet:</u> 8A2TB3 - 1 & 2  1/2 in. dia. ground bolt on cabinet base	Spade Lugs  Spade Lug	1 pair  #8 wire	GFM External Interlock Switch* Good earth ground	Power Interlock Extension (normally closed) RF and Safety Ground

\*Indicates optional equipment.

\*\*Use shielded cables near source of RF energy.

\*\*\*Transition relay in Keyer automatically unkeys transmitter and disables Keyer audio output when input signal is sustained without keying. Refer to Keyer technical manual for internal jumper connections required to allow manual transition relay operation.

\*\*\*\*Connections for optional remote status indicators. Contact closure to common to indicate condition. Current capacity of contacts is 0.5 AMP.

TABLE 2-3. ITEMS AFFECTED BY LINE VOLTAGE SELECTION

UNIT	ITEM AFFECTED	LOCATION SHOWN IN
Autotransformer Assy 8A2 Circuit Breaker Panel Assy 8A1 1 KW PA	8A2A1TB2 Jumpers 8A1CB1 Connections	Figure 5-8 Figure 5-8
1 KW Power Supply	1A1TB1 Jumpers Primary Power Fuses 2A2TB1 Fanning Strip	Figure 5-11 (Front Panel) Figure 5-23

2-19 With either line voltage, connect the phase A, B, and C wires of the primary power cable to terminals 1, 2, and 3 of terminal block 8A1TB1 on the rear of the circuit breaker panel (figure 2-1). The wire size depends on the particular installation, and should be determined by factors such as current requirements, and length of run. For typical installations, #14 AWG wire is generally sufficient. The circuit breaker panel rack screws can be removed to tilt the panel forward for access. The protective cover must be removed to expose the terminal block and circuit breaker 8A1CB1.

2-20 After connections have been made to the terminal block, refer to figures 2-2 and 2-3 to determine the correct set of output terminals on circuit breaker 8A1CB1 to be used for the selected primary power voltage. Check the connections, and change them over to the other set of terminals if necessary.

2-21 Connect wires of 115 VAC power cable to line terminals of circuit breaker 8A1CB4 (figure 2-2 or 2-3).

2-22 Check all connections on the circuit breaker panel for tightness; then

reinstall the protective cover, and secure the panel to the cabinet with the rack screws previously removed.

2-23 RF OUTPUT CONNECTION. The RF output of the AN/FRT-83(V) is supplied through a type "N" jack at the top of the cabinet (figure 2-1). The output connection to the antenna system (to the Antenna Coupler if used) should be made with 50 ohm coaxial cable and a UG-21E/U or similar type "N" plug selected to fit the particular cable.

2-24 COUPLER CONTROL CONNECTIONS. Space and necessary control and power connection provisions have been included in the local equipment cabinet for an optional GFM C-3698/URA-38 Coupler Control unit. The power and control cable for connection to J1 on the rear of the Coupler Control unit is supplied tied to the cable harness for storage. When used, the cable should be untied and connected to J1 on the rear of the Coupler Control unit.

2-25 Other connection and installation information for the AN/URA-38 Antenna Coupler group is given in the technical manual supplied with that equipment.

2-26 REMOTE CONTROL CONNECTIONS. Control and readback lines between the Decoder-Encoder and the associated Remote Control unit or tone terminal equipment should be connected as described in the Technical Manual for the Remote Control unit, NAVSHIPS 0967-292-9040. That technical manual should also be consulted for other remote control system installation instructions.

## 2-27 INSPECTION AND ADJUSTMENT.

2-28 INSPECTION. After the equipment has been installed, and before energizing it for the first time, make a thorough inspection to ensure that the AN/FRT-83(V) is electrically and mechanically ready to be operated. The following checklist covers the items to be inspected. Replacement or repairs should be made if necessary.

- a. Inspect mounting hardware throughout the equipment for correct installation and tightness.
- b. Inspect installation wiring and all cable connections to ensure that connections are made to the proper connectors and terminals and that all connections are complete, properly seated, and tightened.
- c. Inspect for proper grounding. The cabinet should be connected through a short cable to a good earth ground.
- d. Inspect all front panel controls and indicators for mechanical damage, looseness, and proper mechanical action.
- e. For each unit with slide-out or swing-out chassis mounting; loosen the front panel screws, slide unit forward, and inspect for signs of damage. Check interlock switches when reclosing units.

f. Check primary power connections and line voltage jumpers.

g. Check all fuse holders to ensure that each contains a fuse of the proper rating (figure 2-2 and 2-3 and figure 3-1, Operator's Handbook).

h. If the AN/URA-38 is used, refer to Section II of the Technical Manual for that equipment and perform the inspection procedures required after installation.

2-29 SYSTEM PERFORMANCE AND ADJUSTMENTS. After installation and inspection, perform initial test of exciter, keyer, decoder-encoder, and remote control units. Refer to Section II for the individual equipment for required adjustment procedures.

2-30 Following checkout of the above units, perform initial checkout and adjustment of the transmitter according to the following procedure:

- a. Before operating the set at full power, perform TGC and PPC adjustments in paragraph 5-42 and 5-46.
- b. Perform initial performance checks listed in Maintenance Standards Book NAVSHIPS 0967-292-9090, and record required data.

### WARNING

High DC voltages are applied in various units when the set is placed in the operate condition; and high AC voltages are present in many units, even in standby or amplifier off condition. Do not reach into units or the cabinet with primary power applied to the cabinet. Do not touch or reach near any high voltage circuits until a shorting stick has been used to ensure circuits are discharged.

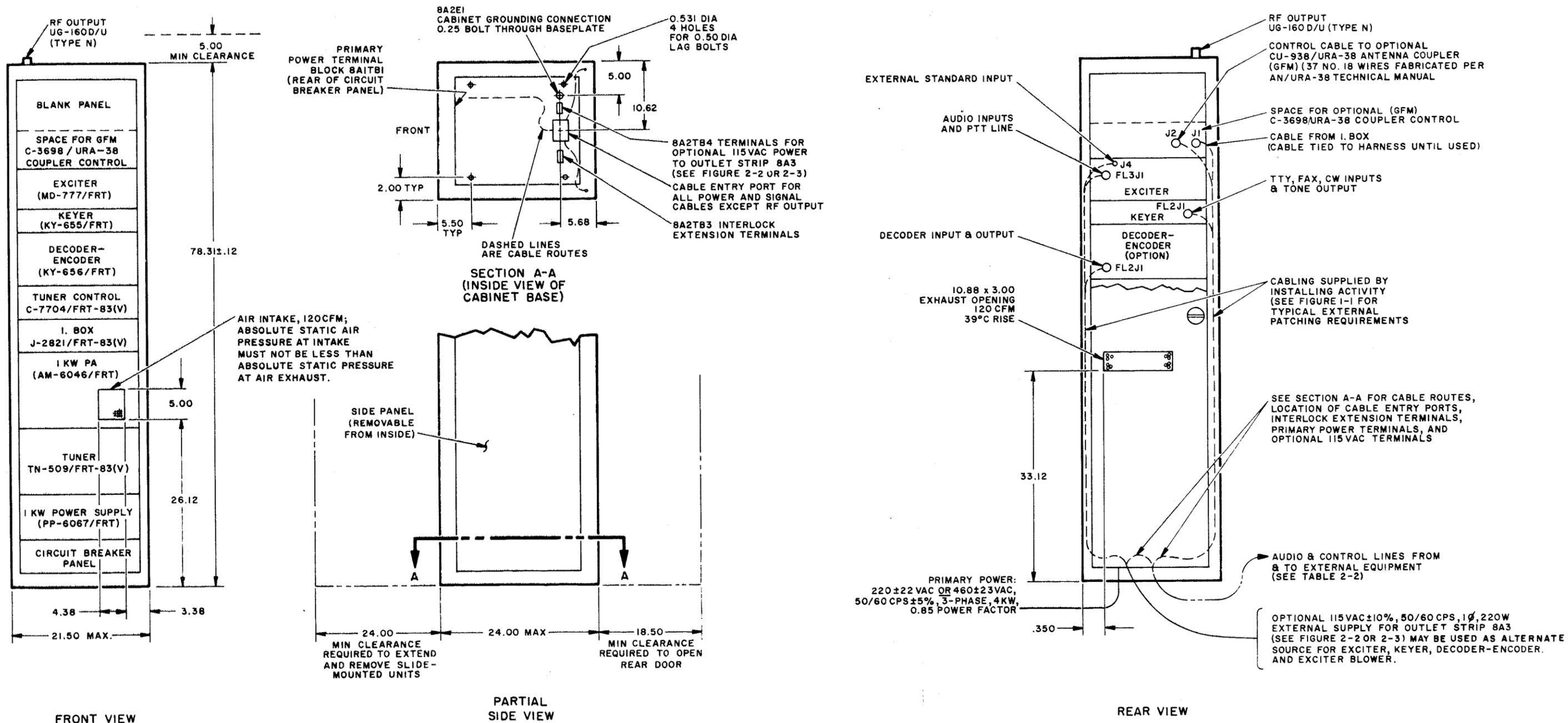


Figure 2-1. Radio Transmitting Set AN/FRT-83(V) Local Equipment Cabinet, Outline Drawing

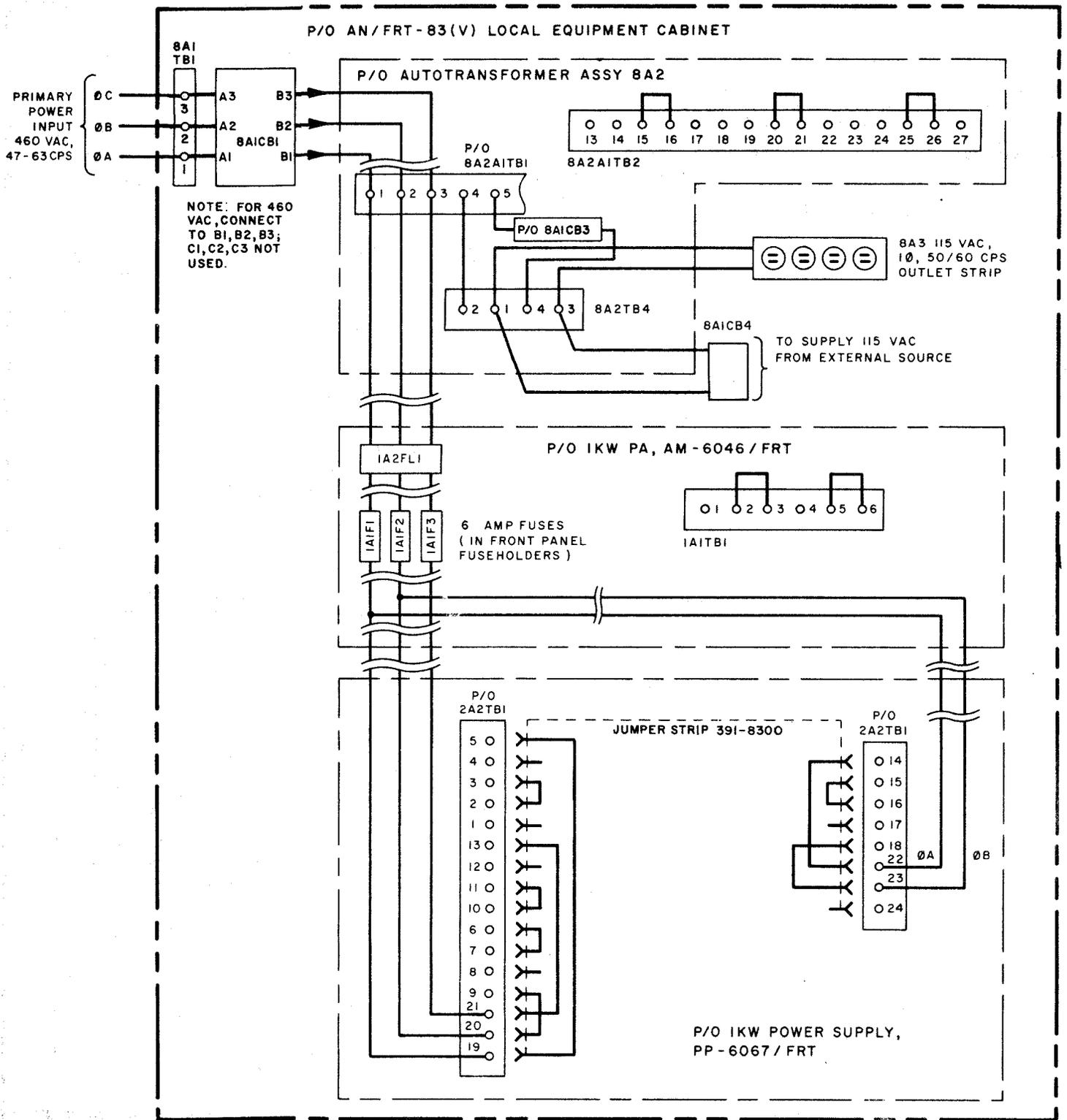


Figure 2-2. 460 VAC Primary Power Fusing and Jumpering Scheme

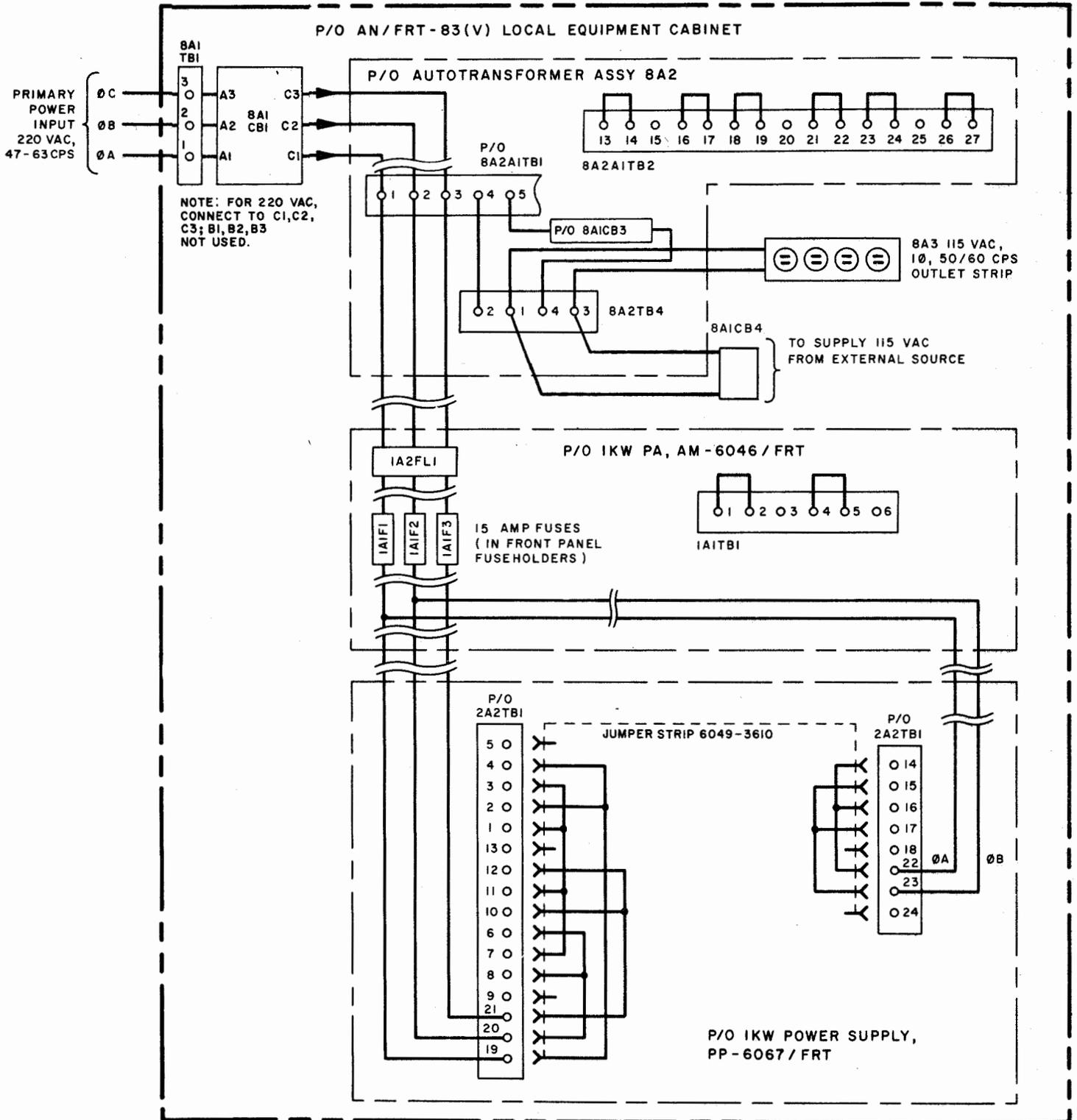


Figure 2-3. 220 VAC Primary Power Fusing and Jumpering Scheme

c. Set controls as listed in table 2-4. Those not listed may be in any position or are spring return type.

#### NOTE

The number appearing in [ ] corresponds to the index number of figure 3-1 of Operator's Handbook for location purposes.

d. Turn on building power to transmitter cabinet. Momentarily depress the Exciter STANDBY pushbutton [9]. The following indicators should immediately illuminate: the Exciter FREQUENCY KC indicators [18]; TUNE indicator [10]; and STD OVEN indicator [3A]; the Keyer STANDBY indicator [35]; the Tuner Control POWER indicator [76]; the I. Box POWER indicator [64]; The Coupler Control POWER indicator; and the 1 KW Power Supply POWER ON indicator [58]. The Exciter STANDBY indicator [9] will illuminate after a three minute time delay has elapsed; and other indicators may illuminate, depending on the status of the equipment.

e. Note Exciter TUNE pushbutton [10]; if it is illuminated, depress it momentarily.

f. Place the set in the operate condition by momentarily depressing the Exciter OPERATE pushbutton [8]. The STANDBY indicator [9] will extinguish, and the OPERATE indicator [8] will illuminate.

#### CAUTION

Excessive plate current (above 330 MA) with no RF signal will damage the 1 KW PA final amplifier tubes. Do not place the set in OPERATE for long per-

iods until step j. is properly completed. If necessary, place the set in STANDBY between steps.

g. Set 1 KW PA Multipurpose Meter switch [42] at PA DRIVER SCRNS VOLTS. Multipurpose Meter [43] should indicate  $287 \pm 15$  VDC.

h. Set Multipurpose Meter switch [42] at DRIVER PLATE VOLTS. Multipurpose Meter [43] should indicate  $600 \pm 60$  VDC.

i. Set Multipurpose Meter switch [42] at PA PLATE 1 VOLTS and then at PA PLATE VOLTS. Meter [43] should indicate  $2400 \pm 240$  VDC.

j. Set Multipurpose Meter switch [42] at PLATE 1 AMPERES and then at PA PLATE 2 AMPERES. Note Multipurpose Meter [43] indication at both settings.

k. If the indications obtained in step j. were 200 to 280 MA, with not more than 40 MA difference between tubes, proceed with step L. If not, refer to paragraph 5-5 for corrective procedure.

l. Set 1 KW PA Multipurpose Meter switch [42] to DRIVER 1 AMPERES and then DRIVER 2 AMPERES. If the indications are 260 to 400 MA, proceed with operation. If not, refer to paragraph 5-5 for corrective procedure.

m. Apply normal level audio signals to the two active audio input channels. Slide the Exciter out of the case.

n. Set the INPUT LEVEL selector [19] to A1, and the CIRCUIT TEST selector [1] to A1-ALC. Advance internal input level control A1 (figure 3-1) [25] from a starting position at the counterclockwise end until ALC action is indicated by a slight occasional deflection of the

TABLE 2-4. PRELIMINARY CONTROL SETTINGS

UNIT	CONTROL	SETTING
All units	Circuit breakers [20, 41, 60, 61, 62, 62A, 79, 84]	RESET or NORMAL
Exciter	REMOTE/LOCAL selector [4] INPUT LEVEL selector [3, 19] CHANNEL GAIN RATIO selectors [5] CLASS OF EMISSION selector [7] SIDEBAND SELECTOR [6]	LOCAL/REMOTE* OFF 0 (fully CCW)# SSB ( $\infty$ ) (2) ISB
1 KW PA	PWR control [52] FREQUENCY MEGACYCLES selector [46] Key switch [51]	Fully CW AUTOMATIC NORMAL
Tuner Control	Mode Selector [80]	AUTOMATIC
Tuner	PEAK/AVG selector [70]	PEAK
Coupler Control (if used)	OVERLOAD switch POWER switch BYPASS switch Mode Selector	ALARM ON NORMAL AUTO
Keyer	FUNCTION TEST selector [32]	OPERATE
Remote Control (RCU) (if used)	ADDRESS SELECT STANDBY OPERATE FREQUENCY SELECT CLASS OF EMISSION SIDE BAND SELECTION ACTIVATE XMTR READY	0-9 as determined locally Released Released Selected Frequency Selection, Depressed Selection, Depressed Depressed Illuminated
Decoder-Encoder Local Control Unit (LCU) (if used)	MODE SWITCH	As selected

Note:

\* Do not use REMOTE position at any time unless the set has a Decoder-Encoder unit, and then only when operating by remote control.

# If Remote Control is being utilized, set at 100 (fully CW).

CIRCUIT TEST meter [2]. Then reduce the setting slightly until no ALC action is apparent. Check the INPUT LEVEL meter [3] to ensure that input to Exciter audio channel is no greater than 0 VU.

For single tone, set level to not greater than 0 VU indication, ALC action will not occur at this level.

NOTE

The nominal level for proper operation is 0 VU for a single-tone, sine-wave signal. For a complex waveform input signal, the VU meter indication will be lower, depending on the peak to RMS voltage ratio of the input signal. The peak of the signal is the significant factor, since distortion and overload in the transmitter depends on the signal peaks.

o. Set the INPUT LEVEL selector [19] to B1, and the CIRCUIT TEST selector [1] to B1-ALC; and adjust input level control B1 [25] as in step n.

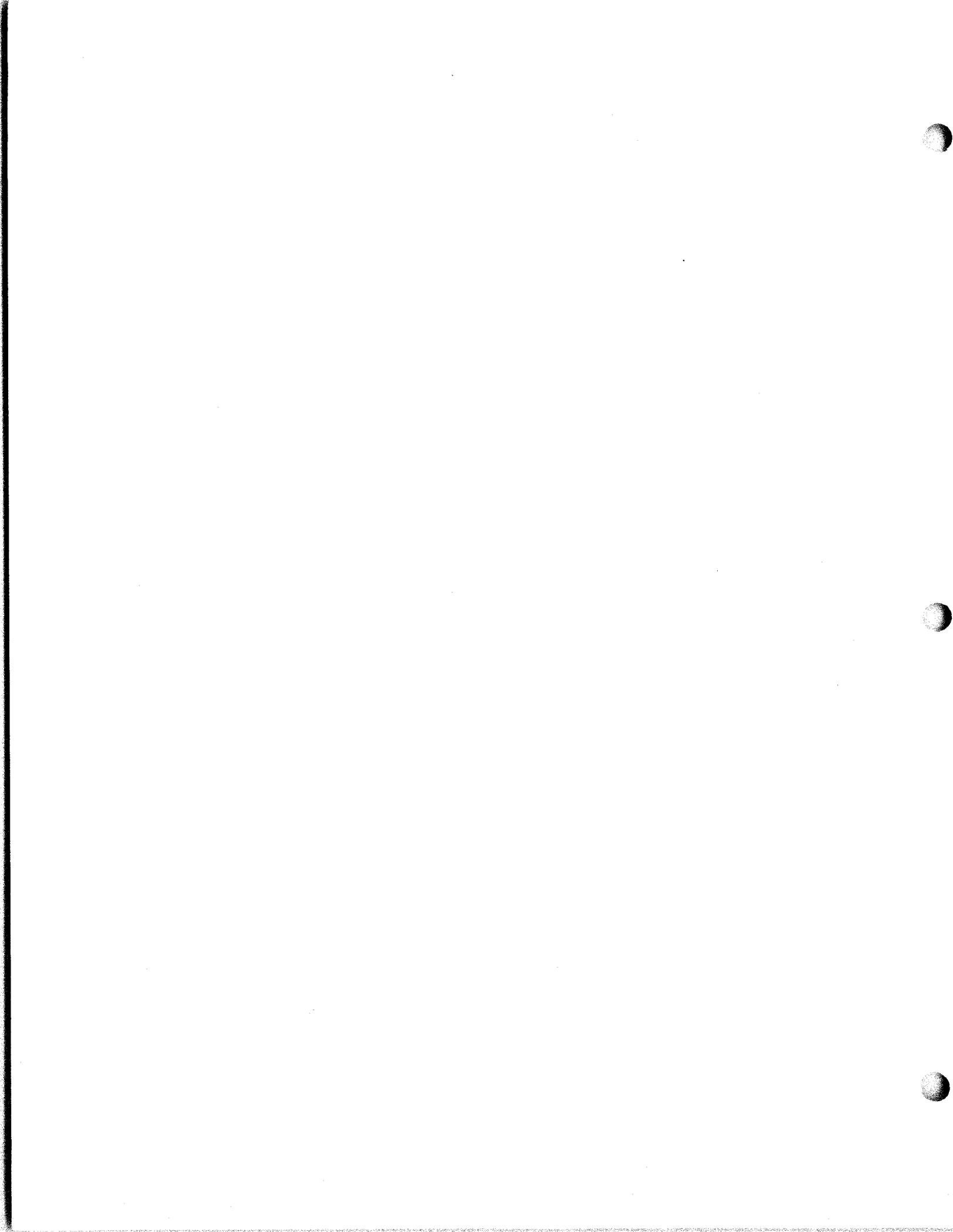
p. Depress STANDBY pushbutton [9]. Slide Exciter chassis back into its case

and secure.

2-31 INTERFERENCE REDUCTION. To reduce the possibility of RF interference, the system should be operated with all units bolted securely in their cases. Cable shielding and ground connections in all fabricated cables should be carefully inspected to ensure proper terminations. The complete bonding system should also receive careful attention during installation. In addition, to assure a good ground reference for the antenna, the system must be installed close to an effective, permanent ground termination. Ground connections should be clean and tight to ensure good bonding.

2-32 HIGH VOLTAGE WARNING LIGHT. Optional high voltage warning light installation allows operating personnel to determine high voltage condition of each transmitter without inspection of front panel. A red light mounted on top of the cabinet is illuminated when high voltage is on. See figure 5-43, sheet 2 of 2.

2-33 Standard installation plans (NAVELEX drawing 0100315) contains the wiring diagrams and list of material required for high voltage warning light.

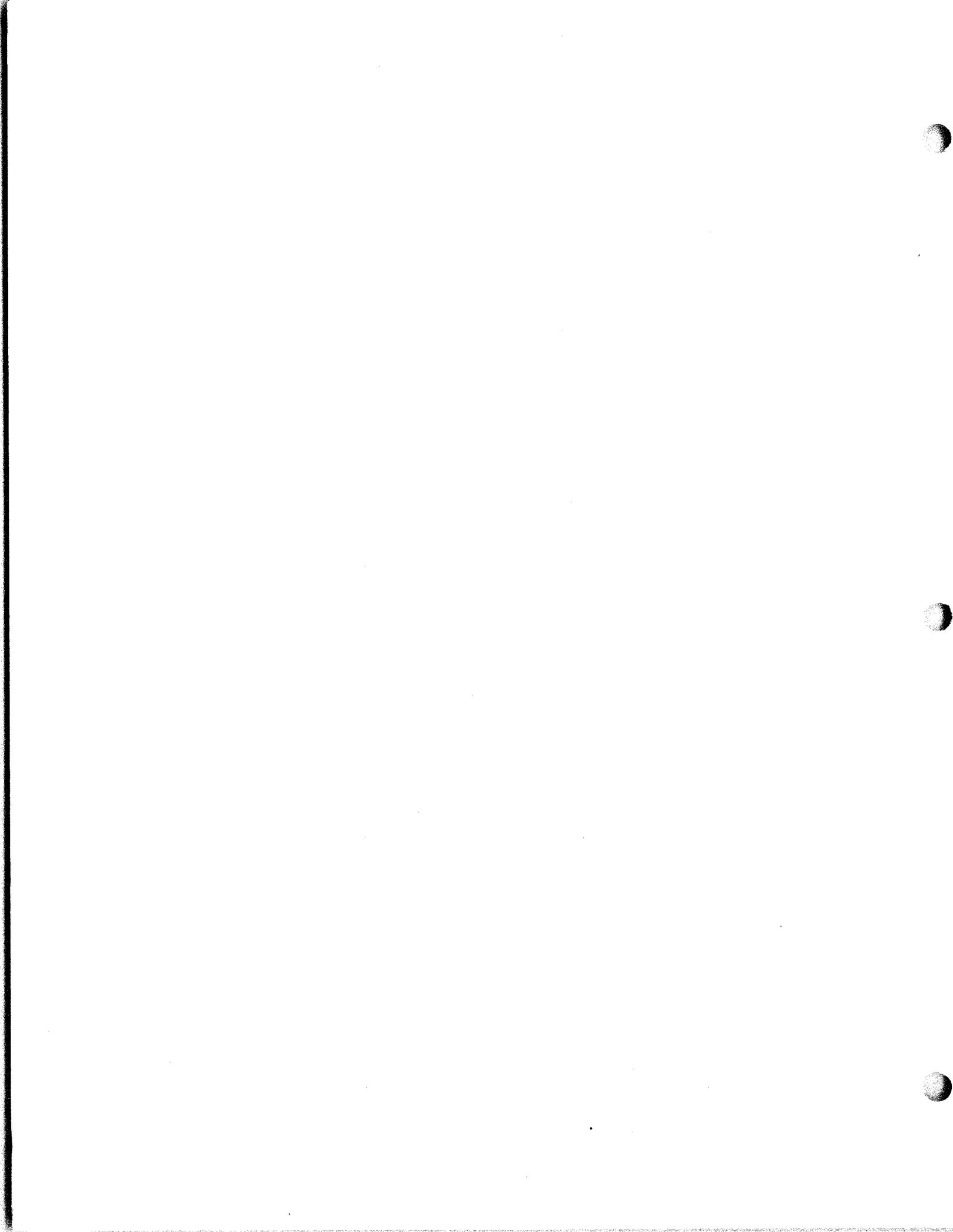


SECTION III

OPERATION

Note

This section is bound as a separate volume, Refer to Operator's Handbook, for Radio Transmitting Set AN/FRT-83(V), NAVELEX 0967-292-9060, dated 1, September, 1973, for operation of this equipment.



## SECTION IV

## TROUBLESHOOTING

4-1 INTRODUCTION.

4-2 Troubleshooting information is provided in various forms in this section. Paragraph 4-6 consists of a functional description of the system with emphasis on the interrelation of the various units. Following the general information are three major paragraphs, each covering a particular functional section of the system in two levels: first, a detailed functional description of the section with emphasis on relationships between circuit groups, and second, a compilation of circuit descriptions for peculiar circuits within the section. Paragraph 4-21 covers the 1 KW PA and the 1 KW Power Supply. Paragraph 4-107 covers the Tuner and Tuner Control. Paragraph 4-224 covers the remainder of the system, including system power distribution, control signals, and circuits not previously described in detail - particularly in the I. Box unit and the Autotransformer assembly. Refer to table 1-2 for a list of related publications containing detailed information for units described in separate manuals.

4-3 Following the text portion of this section are test data and servicing diagrams for the units covered in detail in previous paragraphs, located together in one area for convenient reference. Servicing diagrams are intended to be used in localizing the fault to a particular circuit; and therefore, details of inter-

assembly and intercircuit connections are shown in detail in these illustrations. The simplified schematic diagrams, which are included with the text to support circuit descriptions, are not intended for signal tracing between circuit groups; so connector pin connections and most terminal connections are represented therein only by breaks for the sake of clarity and simplicity.

WARNING

Lethal voltages are found in many places while the transmitter is in operation, especially in the 1 KW Power Supply and 1 KW PA units which have DC voltages up to 2400 volts. High RF voltages are also present, especially in the Tuner unit. Use adequate safety precautions when servicing. Even after power is removed, high voltage DC circuits may still have voltage applied from filter capacitors, so they should be shorted to ground before touching them.

4-4 LOGICAL TROUBLESHOOTING.

4-5 General troubleshooting technique are based on six logical troubleshooting steps. If adequate field data of equipment faults is not available as a guide, a troubleshooting procedure similar to these steps should be followed.

4-6 SYMPTOM RECOGNITION. This is the first step in a logical troubleshooting procedure and requires a complete familiarity with the equipment and its operating characteristics. Some troubles, which are not a

direct result of component failure, are only apparent as a condition of less than optimum performance. This type of trouble is usually discovered during performance of the preventive maintenance steps contained in the Maintenance Standards Book (NAVSHIPS 0967-292-9090). It is important to recognize performance deterioration in addition to more apparent symptoms. More obvious troubles such as low output power or a complete equipment breakdown are readily discerned.

**4-7 SYMPTOM INVESTIGATION.** When a trouble symptom occurs and is recognized, the situation should be investigated to elaborate the symptom and further identify the trouble. Equipment controls can be adjusted and panel meter readings noted in an attempt to identify the symptom with a particular equipment function or mode of operation.

**4-8 PROBABLE FAULTY CIRCUIT.** The next step in a logical troubleshooting procedure is to make a tentative decision, based on results of the symptom investigation, as to the most likely circuit at fault. The decision should be based upon the trouble symptom and a thorough knowledge of the equipment circuits, and should be limited to those circuits which, if defective, could probably cause the trouble. The functional block diagram (figure 4-1) together with the over-all functional descriptions should be used to aid in the determination of the possible faulty circuit.

**4-9 LOCALIZING THE FAULTY CIRCUIT.** To localize the trouble to a particular circuit, tests should be made in an order which requires the least testing time. The test sequence should be based on validating the tentative decisions in the order of test difficulty. If the first circuit tested is not at fault, the next circuit must be tested, and

so on, until the faulty circuit is located. Refer to the functional circuit descriptions, service block diagrams, and test data for the particular circuit being tested. Perform tests and checks which will either eliminate the circuit or pinpoint the trouble.

**4-10 ISOLATING THE FAULTY COMPONENT.** When the faulty circuit section or module has been identified, the trouble should be pinpointed to the particular parts at fault.

**4-11 FAULT ANALYSIS.** When the faulty component has been isolated by circuit tests and measurements, review the tentative decisions and the troubleshooting procedure employed, to establish the reason for component failure. Make sure that the defective component is the actual cause of trouble and not just the result of an undiscovered malfunction, perhaps in another circuit. For example, a short-circuited capacitor in a power supply decoupling circuit can cause a resistor, located in another module, to overheat and burn out. A fault analysis of this trouble would consider the following aspects when establishing the reason for the resistor failure; otherwise, replacement of the burned out resistor would not only fail to solve the problem, but would result in another burned out resistor.

- a. Only an abnormally high current could have caused the resistor to overheat and burn out.
- b. Current of this magnitude could only occur if a short circuit existed at the load terminal and not the supply terminal of the resistor.
- c. Circuit measurements at the resistor would verify this analysis and lead to discovery of the short-circuited capacitor in another module.

**4-12 SYSTEM DESCRIPTION.**

**4-13 RADIO TRANSMITTING SET AN/FRT-83(V).** Figure 4-1 illustrates the functional interrelation of units in a typical AN/FRT-83(V) configuration.

The Exciter allows the operator to select the transmission frequency, type of sideband and mode (USB-PTT, USB-VFG, USB, LSB, (2) ISB, and class of emission (A0, A1-F1-F4, A2-A3e, and SSB with various levels of carrier). When the operator selects one of the 280,000 frequencies available in the 2.0 to 29.9999 MC range, the Exciter supplies a five-wire code to the I. Box; and the I. Box in turn supplies a five-word code to the 1 KW PA to automatically tune it to the correct operating band. The Exciter and the 1 KW PA then operate to apply a low-power tune signal to the (optional, GFM) AN/URA-38 Antenna Coupler equipment. (This tune signal is routed through the Tuner, but bypasses the Tuner circuits at this time.) With the tune signal present, the Antenna Coupler matches the antenna impedance to the output impedance of the 1 KW PA. Next, the Tuner's circuits are inserted into the RF transmission path (Tuner un-bypassed) and are tuned to match the transmission path requirements. Then the four major units in the RF transmit path - Exciter, 1 KW PA, Tuner, and Antenna Coupler - are properly tuned and ready for full-power transmission. If the optional Antenna Coupler equipment is not used, the Tuner is not bypassed, and the Tuner is tuned immediately upon application of the tune power signal.

4-14 Voice inputs may be supplied to the Exciter either directly or through a distribution system, such as a patch panel. Facsimile, FSK, and CW inputs enter the AN/FRT-83(V) at the Keyer. The Keyer processes these signals and sends them to the external distribution equipment, which routes them to the Exciter input.

4-15 Once the system is keyed, the Exciter applies a nominal 0.1 watt RF output through the 4-DB Pad Assembly to the 1 KW PA. The linear amplifica-

tion provided by the 1 KW PA produces a 1 KW PEP or average output RF signal (depending on mode) which is applied through the Tuner to the resonant antenna system or through an optional (GFM) Antenna Coupler to a non-resonant antenna. The 4-DB Pad Assembly provides level compensation for some modes of operation requiring more 1 KW PA driving power.

4-16 During operation, fault circuits continually monitor the equipment for abnormalities. If a fault is detected, the equipment is unkeyed and held inoperative until the condition is corrected. Fault indicators on the Exciter, Keyer, 1 KW PA, Tuner Control, and optional Coupler Control aid in determining fault location.

4-17 The 1 KW PA develops and applies DC control signals to the Exciter to maintain the level of transmitted power at a constant predetermined value, thus compensating for overall gain variations and preventing the RF power output from exceeding safe limits. The majority of control functions are routed through the I. Box. This unit acts upon the control information supplied to it from various other units to provide sequencing for interrelated functions and to assure that control of operational steps is handled in a predetermined and orderly manner. Additional control functions, such as between the Exciter and 1 KW PA or between the Tuner and Tuner Control, are not routed through the I. Box. However, the results of these control activities are furnished to the I. Box so that sequencing is maintained.

4-18 For those AN/FRT-83(V) configurations which include optional remote control equipment, the additional units supplied are the Decoder-Encoder (mounts in local equipment cabinet) and the

Remote Control unit, which can be located up to ten miles from the local equipment. The installation site of the Remote Control unit is dependent only upon the availability of a suitable primary power source and a

two-pair circuit such as telephone lines to connect it to the local equipment(s) it controls. With suitable circuit connections, a single Remote Control unit can control and monitor up to ten local

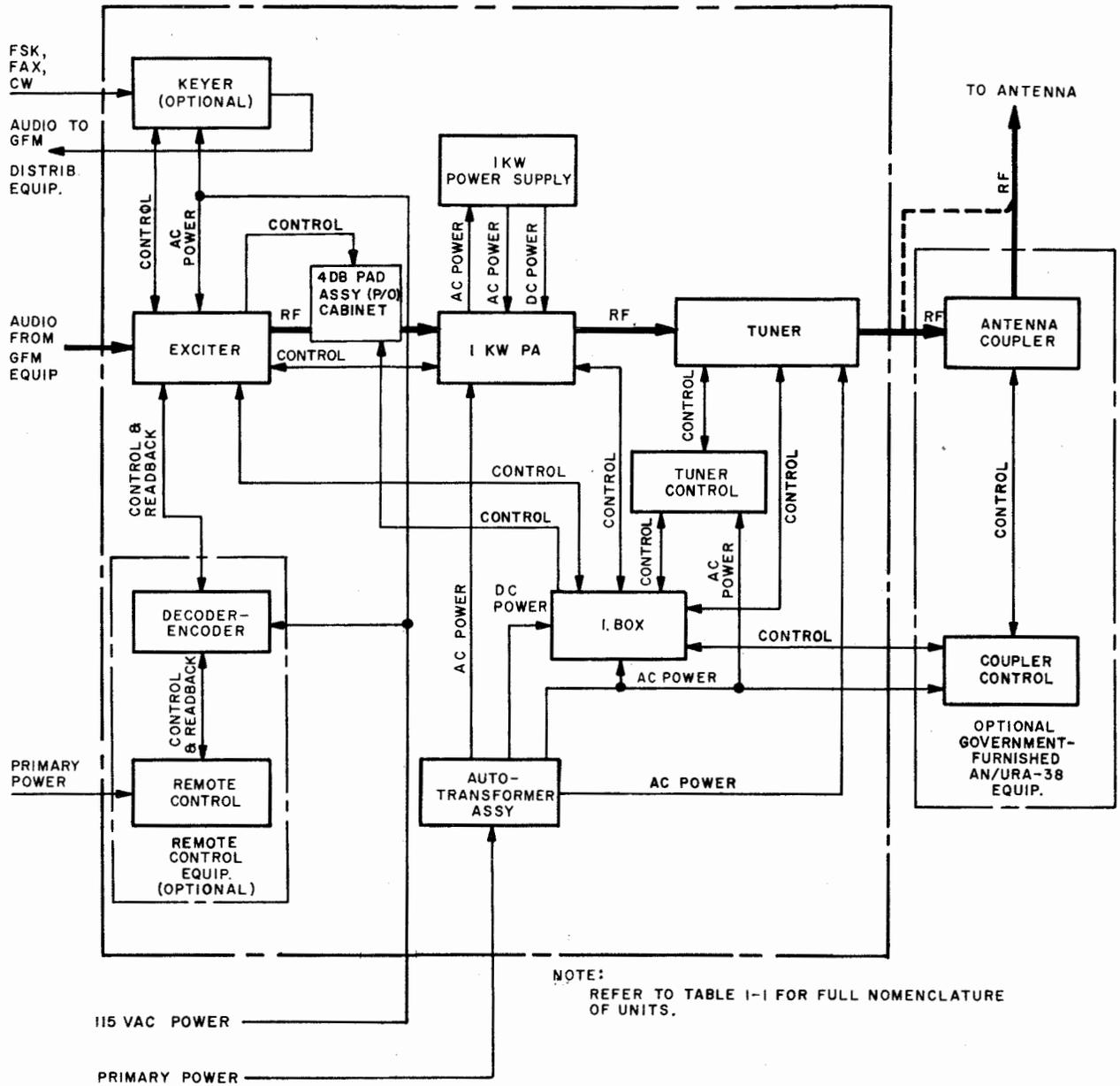


Figure 4-1. Radio Transmitting Set AN/FRT-83(V), Overall Functional Block Diagram

AN/FRT-83(V) (or AN/FRT-84, 85, or 86) sets equipped with individual Decoder-Encoder units.

4-19 Control and readback between the Remote Control unit and the Decoder-Encoder and the Exciter allows the remote operator to signal the selected local transmitter to change its mode of operation, frequency, and standby/operate status. Display functions on the front panel of the Remote Control unit advise the remote operator of the identity of the local transmitter being monitored and its frequency, mode of operation, transmitter ready status, and standby/operate status. Additionally, fault displays show when there is a fault at any transmitter to which the Remote Control is connected or within the Remote Control unit.

4-20 Primary power to all AN/FRT-83(V) units (except the Remote Control unit) is supplied at the Autotransformer assembly in the equipment rack, which converts three phase power to single phase 115 VAC power for the Keyer, Exciter, Decoder-Encoder, Tuner, Tuner Control, and Coupler Control units, and single phase 220 VAC power for the Tuner. Provisions are made to allow 115 VAC single phase power to be supplied to the Keyer, Exciter, and Decoder-Encoder from an external source if desired. Three-phase AC power at 220 or 460 VAC is applied directly from the input of the Autotransformer assembly through the 1 KW PA to the 1 KW Power Supply. Transformed AC power and high voltage DC power from the 1 KW Power Supply is delivered back to the 1 KW PA. A rectifier-filter circuit in the Autotrans-

former assembly provides 28 VDC power to the I. Box unit.

#### 4-21 FUNCTIONAL DESCRIPTION.

4-22 RADIO FREQUENCY AMPLIFIER AM-6046/FRT (1 KW PA) AND POWER SUPPLY PP-6067/FRT 1 KW POWER SUPPLY. The 100 MW (nominal) input to the 1 KW PA is amplified by two successive linear power amplifier stages: a driver amplifier and a final amplifier. Refer to figure 4-2. The nominal output power of the final amplifier stage is 1 KW peak envelope power (PEP) or average power, depending on the mode of emission. The driver and final amplifier stages each consist of a pair of parallel-connected electron tubes. The output of each stage is tuned to one of nineteen operating bands by pretuned transformer assemblies, which are automatically switched into the signal path by a tuning circuit controlled by five-wire code signals from the I. Box. Additionally, the tuning circuit applies a tuning key inhibit signal to the keying circuit to prevent keying while tuning.

4-23 An overload circuit monitors the final amplifier plate current in each tube and samples the RF voltage at the plates of the final amplifier tubes. If an abnormal condition occurs in either area in the 1 KW PA or in the 1 KW Power Supply, the overload circuit trips to provide an inhibit signal to the keying circuit to prevent further transmission until the trouble is remedied. The overload circuit also supplies an external 1 KW PA fault signal to the I. Box, which in turn activates an indicator at the Exciter and prevents continued transmitter operation. If the trouble was momentary or when it is cleared up, operation of the front panel overload switch will restore normal operation.

4-24 The 1 KW PA is keyed on and off by means of the bias levels applied to the four electron tubes in the driver and final amplifier circuits. Keying is accomplished by grounding the system keyline at the Exciter or by placing the Key switch on the front panel of the 1 KW PA in either LOCAL KEY position. The keying circuit switches the bias voltage for the driver and final amplifier electron tubes from cutoff to operate level. The keying circuit is inhibited (bias maintained at cutoff) whenever the tuning circuit is energized, an overload occurs, or an RF mute signal is received from the I. Box.

4-25 Operating power for the bias circuit is received from the standby power distribution circuit, which is activated by a standby signal from the I. Box. The bias circuit converts this input to provide the bias voltages for the driver and final amplifiers. The key input to the bias supply, mode command signal from the Exciter, key inhibit signal from the keying circuit, and internal PPC signal all control the operational application of these bias voltages to the amplifiers.

4-26 The 1 KW output from the final amplifier is applied through the VSWR bridge to the Tuner. The VSWR bridge supplies signals to the TGC-PPC circuit which are, in essence, the envelope of the RF output of the transmitter and the envelope of the reflected signal.

4-27 Four RF envelope signals to the TGC-PPC circuit (forward and reflected from the 1 KW PA VSWR bridge and external forward and reflected from the Tuner VSWR bridge) are used to develop one control voltage (PPC) which is proportional to the excess peak power output. Another signal (TGC) which is proportional to the peak power output of

the Tuner, is generated from the external (Tuner) forward envelope signal. Both control voltages are applied to the Exciter to control its output level and thereby control the output level of the transmitter. The PPC (peak power control) signal is applied to the Exciter PPC circuit to control the peak power of the system during operation to a level suitable for the mode of emission. The TGC (transmitter gain control) signal is applied to the TGC circuit in the Exciter to provide a reference for the Exciter to set the drive level required when changing to a new frequency. Thus, the TGC action compensates for gain variations which are inherent in the system over the 2 - 30 MCS frequency range.

4-28 METERING CIRCUIT AND POWER DISTRIBUTION. The metering circuit allows selection of test circuits for measurement of any one of eight parameters of the amplifier tubes. 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 the screen supply voltage.

4-29 The power distribution circuits deliver the power required by the 1 KW PA for various operating conditions, i.e., initial turn-on, standby, and operate. Primary distribution is initiated by turning on primary power to the cabinet. The three-phase primary power is supplied to the operate distribution circuit and single-phase ( $\phi A - \phi B$ ) power is supplied to the standby distribution circuit.

4-30 The standby distribution circuit, in addition to the inputs received from the initial distribution circuit, receives a 28 VDC signal from the I. Box when the Exciter is placed in a standby condition. This signal causes the standby

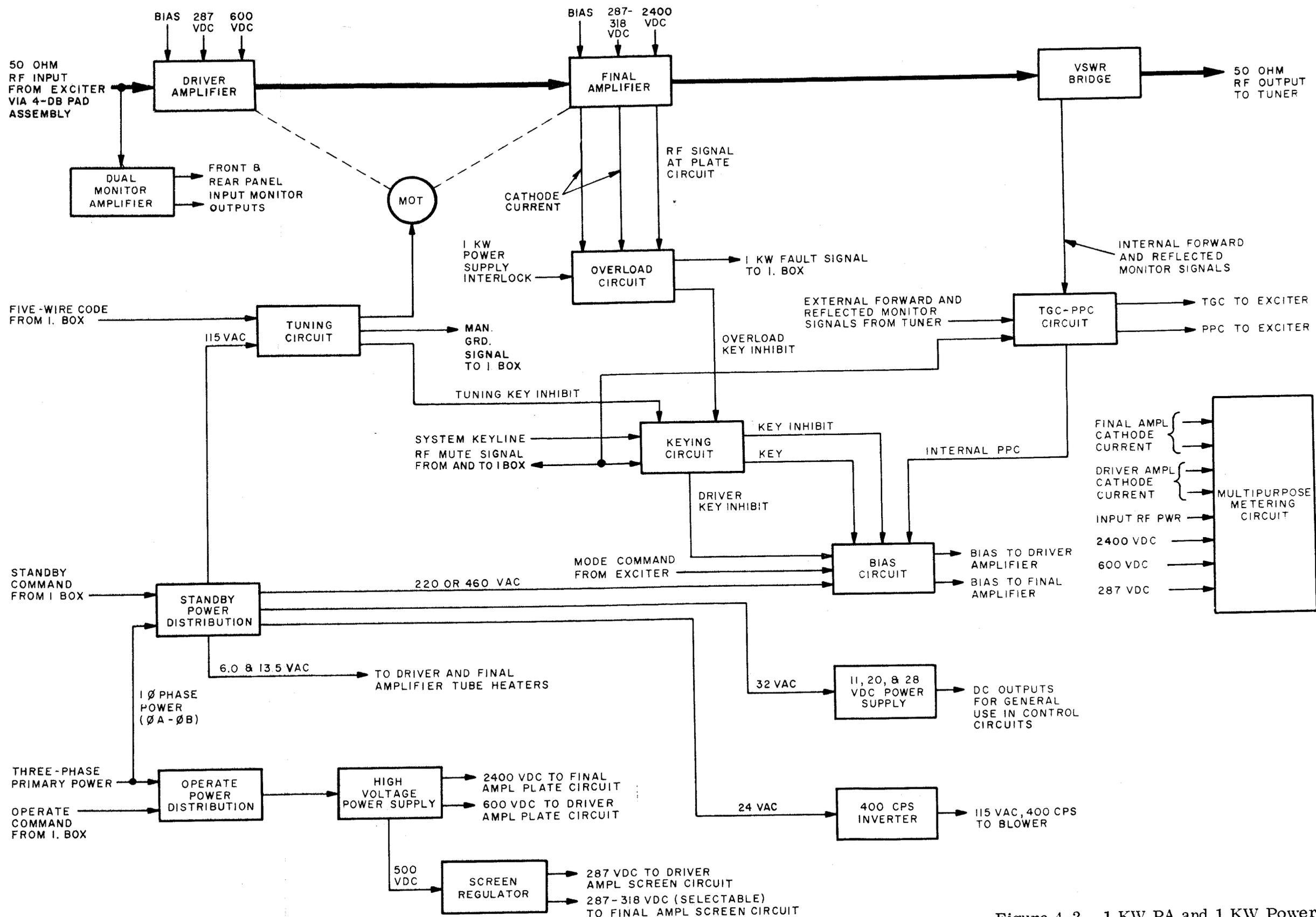


Figure 4-2. 1 KW PA and 1 KW Power Supply, Functional Block Diagram

distribution circuit to supply 28 VDC to the 400 CPS inverter for the blower, heater voltages to the driver and final amplifiers, 115 VAC to the bias circuit, and 32 VAC to the 11, 20, and 28 VDC power supply circuit.

4-31 Three minutes after the application of filament power, closure of a time delay relay in the I. Box allows the 1 KW PA to be placed in the operate condition. The Exciter supplies an operate signal to the I. Box which in turn supplies a ground signal to the 1 KW PA to turn on the operate distribution circuit. Three-phase power is then applied to the 1 KW Power Supply for conversion to the high voltages required by the driver and final amplifiers.

#### 4-32 CIRCUIT DESCRIPTIONS.

4-33 DRIVER AMPLIFIER. The driver amplifier (figure 4-3) consists of two electron tubes, an interstage transformer assembly, and various other components. The function of this circuit is to amplify the input from the Exciter in a linear manner to a level sufficient to drive the final amplifier.

#### WARNING

This circuit contains high voltages up to 600 VDC. Use appropriate precautions when servicing.

4-34 The RF input from the Exciter is applied through a 4 DB Pad Assembly (paragraph 4-278) to a nominal 50-ohm load network in the 1 KW PA driver amplifier. The load network, consisting of R6, L1, R10, R8, R9, and C20, compensates for the input capacitance of the two electron tubes and provides a VSWR for the Exciter of 1.3:1 or less over the entire operating frequency range. The RF input is also coupled

through R5 to a broadband amplifier circuit for monitor outputs and through a voltage doubler-detector circuit formed by CR1, C18, CR2, and C17 to the metering circuit.

4-35 From the input load, the RF input signal is applied through coupling capacitor C1 to the control grids of the two driver electron tubes. The two parallel connected electron tubes are operated as a class A linear amplifier stage which provides a nominal power gain of 20 DB. One of nineteen broadband tuned circuits is selected for a particular band to provide selectivity and to couple the RF output from the driver amplifier to the input of the final amplifier.

4-36 The nineteen tuned circuits are mounted on a motor-driven bandswitch assembly which selects the proper one automatically according to the operating frequency. Each one above 8 MC consists of a double-tuned circuit transformer which uses capacitive top coupling. This type of circuit provides a wide, flat-response passband with very sharp skirts, i.e., broadband tuning. Below 8 MC, conventional single-tuned circuits are employed.

4-37 The voltages developed across cathode resistors R1 and R2 due to screen and plate current drawn through the resistors and the cathodes are applied to the metering circuit for monitoring and measurement.

4-38 Each of the power supply input lines (bias, screen, and plate) is filtered to provide RF decoupling. Capacitors C2 through C12 and C19 are local bypasses. Resistor 1A1R24 is used for parasitic suppression.

4-39 The applicable servicing diagram for this circuit is figure 4-46. Biasing adjustments are described in paragraph 5-7 and transformer alignment is described in paragraph 5-17. Complete circuit details are shown in schematic diagram figures 5-45, sheet 1 and 5-46.

4-40 FINAL AMPLIFIER. The final amplifier (figure 4-4) consists of two electron tubes, an output transformer assembly, and various other components. The function of this circuit is to amplify the output from the driver amplifier in a linear manner to a level of 1 KW for application to the Tuner.

**WARNING**

This circuit contains high voltages up to 2400 VDC. Use appropriate precautions when servicing.

4-41 The RF output from the driver amplifier is applied through parasitic suppressors R16 and R17 to the grid of electron tube V1 and through parasitic suppressors R18 and R19

to the grid of electron tube V2. The two-parallel-connected electron tubes are operated class AB<sub>1</sub> in normal multitone modes and class B in single tone (A0, A1, F1, F4) modes to provide a nominal power gain of 25 DB. The class of operation is determined by the bias voltage applied by the bias power supply. One of nineteen broadband output transformers is used to provide selectivity and couple the RF output from the final amplifier through a 50 ohm coaxial line to the Tuner. The voltage at the input to the final transformer assembly is also applied to the overload circuit for monitoring.

4-42 The nineteen transformers are mounted on a motor-driven bandswitch assembly which is switched according

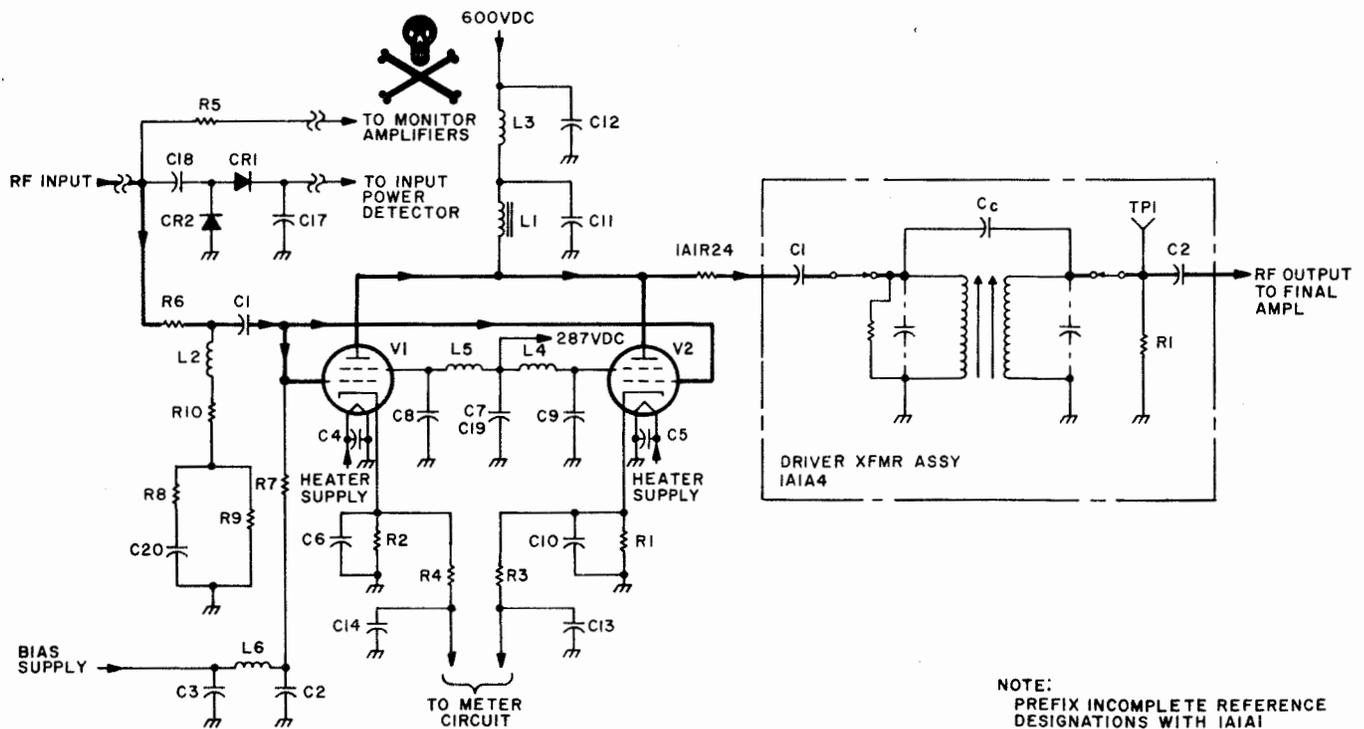


Figure 4-3. Driver Amplifier, Simplified Schematic Diagram.

to the operating frequency to automatically connect the proper transformer into the signal path. Each transformer 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 harmonic frequencies.

4-43 The voltage drops developed across cathode resistors R25-R26 and R27-R28 by the screen and plate currents drawn through the cathode circuits are applied to the metering circuit for monitoring and measurement and to the overload circuit for monitoring. Each of the power supply input lines (bias, screen, and plate) is filtered to provide RF decoupling. The cathode resistors are bypassed by capacitors  $C_A - C_B$  and  $C_C - C_D$ . Parallel connected resistors R5 and R6 provide grid loading to swamp the non-linear input impedance of the electron tubes, thus preventing distortion. Inductor L6 and resistor R21 serve as a parasitic suppressor. L6 presents a high impedance to VHF parasitics and R21 swamps L6 to prevent its resonance from causing oscillations. Capacitors C10 and C20 are RF bypasses for the tube heaters. Plugs P6 and P7 allow the screen voltages to be selected independently at the screen regulator to balance the idling currents of the two tubes.

4-44 The applicable servicing diagram for this circuit is figure 4-46. Screen supply voltage adjustment for balancing is described in paragraph 5-8. Transformer alignment is described in paragraph 5-17. Bias supply adjustment is a front panel control described in Operator's Handbook, NAVELEX 0967-292-9060. Complete circuit details are

shown in schematic diagram figures 5-45 and 5-46, sheet 1.

4-45 VSWR BRIDGE. VSWR Bridge Assembly 1A2A3 in the 1 KW PA and VSWR Bridge Assembly 9A1A5 in the Tuner are essentially identical except that the Tuner VSWR Bridge has additional outputs. Both VSWR bridges consist of a toroidal transformer and various voltage divider, detector, and filter networks. The function of 1 KW PA VSWR Bridge Assembly 1A1A3 is to provide outputs related to forward and reflected power for application to the TGC-PPC circuits to protect against overdrive and high VSWR conditions. The discussion of the transformer and detector circuits which follows applies to both VSWR bridges. See figure 5-45, sheet 1 and 5-46.

4-46 The center conductor of the output transmission line passes through the center of toroidal transformer T1 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 acts as a Faraday shield to prevent undesired capacitive coupling between the center conductor and the secondary winding on the toroid. Current through the transmission line induces equal voltages in 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 C6-L2-C1 provides a compensated 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 C6 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. In this case, the vector sum of the voltages between terminal 3 of transformer T1 (reflected

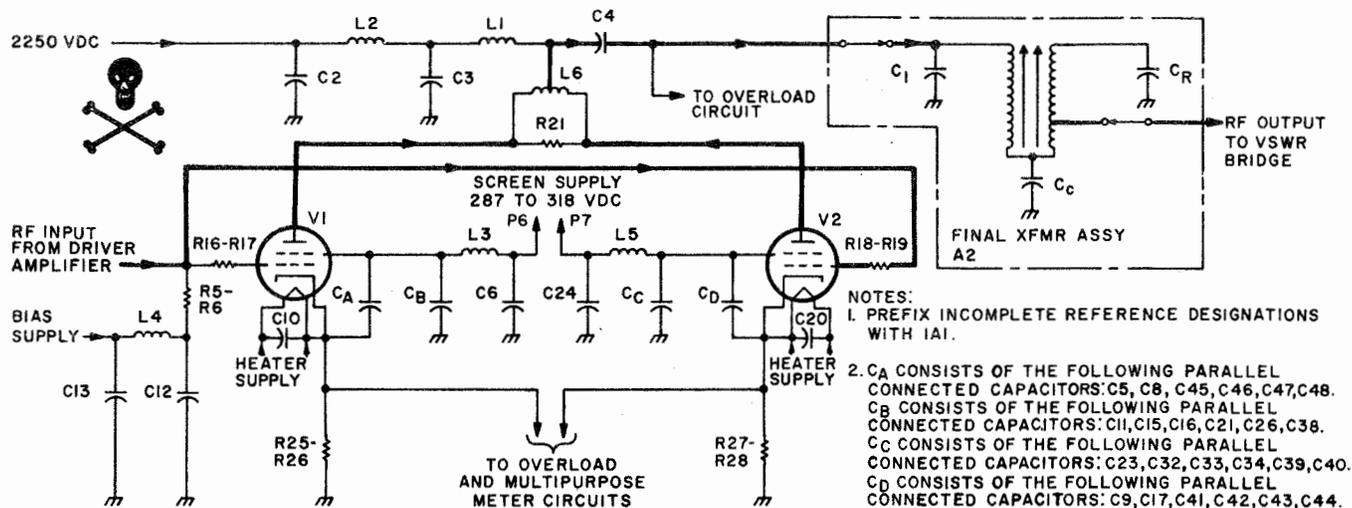


Figure 4-4. Final Amplifier, Simplified Schematic Diagram.

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. At the same time, the vector sum of the voltages between terminal 1 of T1 (forward power side of the bridge) and ground is at a maximum, since the induced voltage is in phase with the reference voltage at that side of the bridge.

4-47 As the load changes to something other than 50 ohms resistive, causing reflected power on the line, the two voltages are no longer exactly equal. Since the voltages at the reflected side of the bridge no longer cancel, an output is produced at terminal 3 of T1. The output at the forward side also changes accordingly.

4-48 The signals at terminals 1 and 3 are peak detected and filtered by CR2-C3 and CR3-C4, respectively, to provide output signals for application through isolating resistors R5 and R6 to the TGC-PPC circuit. These signals are essentially rectified envelopes of the RF signal. Inductor L1

provides a DC path to ground from the center tap of toroidal transformer T1. Resistor R9 prevents the coupling capacitor in final transformer assembly 1A1A2 from holding a DC charge.

4-49 The applicable servicing diagram for the 1 KW PA VSWR bridge is figure 4-46. Adjustment of balance capacitor C6 is described in paragraph 5-9. Complete circuit details are shown in schematic diagram figure 5-45, sheet 1.

4-50 DUAL MONITOR AMPLIFIER CIRCUIT. The dual monitor amplifier circuit (figure 4-46) consists of two RF amplifier modules 1A8A1Z1-Z2. The function of this circuit is to provide isolated monitor signals to front and rear panel monitor jacks to allow easy testing of the RF input signal from the Exciter.

4-51 Each amplifier module provides a gain of about 23 DB. The nominal output level of the amplifier modules is 1 volt (with 100 MW RF input to the 1 KW PA). The amplifier modules are considered to be replaceable parts, since repair is impractical.

4-52 The dual monitor amplifier circuit requires no adjustments. Complete circuit connections are shown in schematic diagram figure 5-45, sheet 2.

4-53 TGC-PPC CIRCUIT. The TGC-PPC circuit (figure 4-6) consists of eight transistor stages. The function of this circuit is to generate control voltages which are used internally and in the Exciter to prevent overdrive and to compensate for system gain variations over the 2-30 MC frequency range. The control voltages are primarily derived from the outputs of 1 KW PA VSWR bridge 1A1A3 and VSWR bridge 9A1A5 in the Tuner. Those outputs are, in essence, the rectified envelopes of the forward and reflected RF signals at the 1 KW PA and at the Tuner. Back up features are incorporated to maintain safe operating conditions in case of partial system failure.

4-54 The forward output of the 1 KW PA

VSWR Bridge is applied to the input of the PPC circuit at a voltage divider consisting of R26 and Internal Power Set potentiometer 1A1R12. This potentiometer is adjusted for sufficient sensitivity at the input of threshold detector Q9 so that the output of the 1 KW PA cannot exceed a safe level (approximately 1 KW) with front panel PWR control potentiometer 1A1R13 set for full output. The reflected output of the 1 KW PA VSWR bridge is applied across the voltage divider formed by R25 and R19. The output from this divider, when at a level greater than that at the voltage divider for the forward input, is applied to the base of threshold detector Q9 through diode gate CR9. Thus, whichever voltage divider output is greater will control the system power level. The reflected input voltage divider attenuates the reflected signal less than the forward input is attenuated so that less reflected power is required to exert control than forward power. Whenever the VSWR exceeds approximately 3:1, the reflected input exerts control.

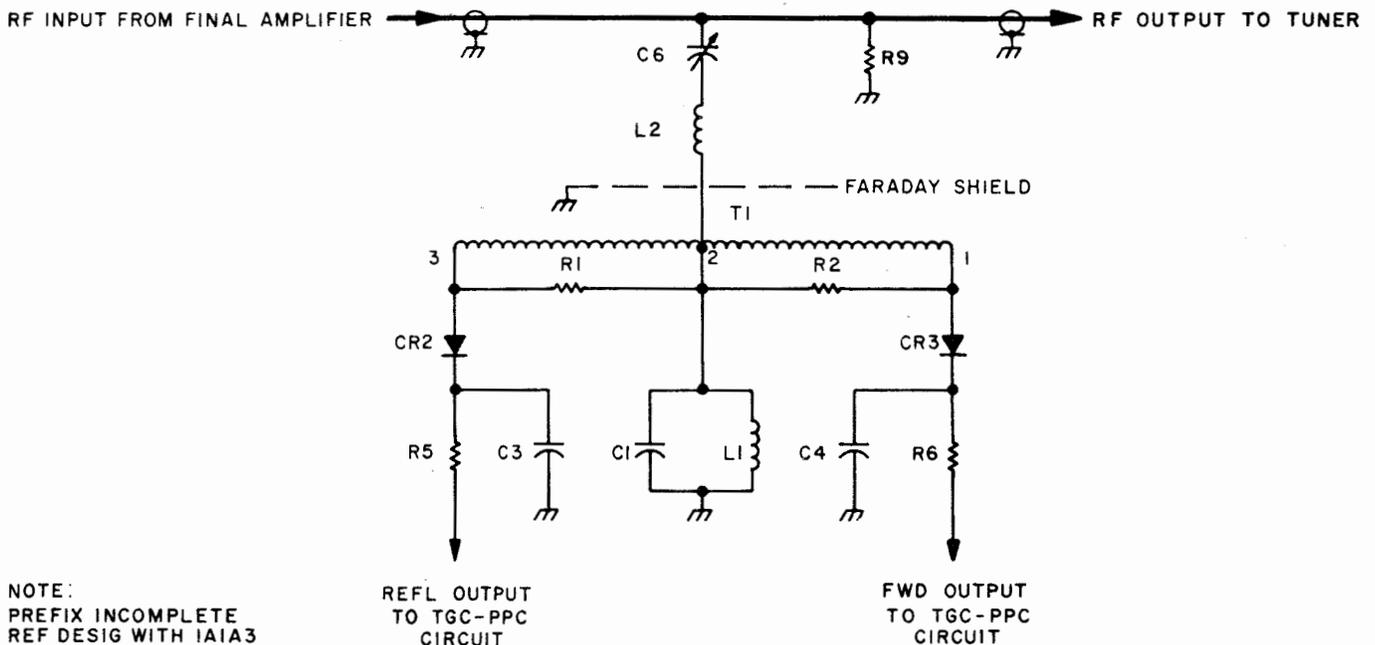


Figure 4-5. VSWR Bridge, Simplified Schematic Diagram

4-55 In a like manner, the external forward and reflected signals from the Tuner VSWR Bridge are applied to the base of threshold detector Q8 through the forward signal voltage divider, consisting of R16 and External Power Set potentiometer 1A1R11, and the reflected signal voltage divider and diode gate, consisting of R17, R18 and CR8.

4-56 The two threshold detectors, Q8 and Q9, are connected in parallel so that any of the four input signals can control the system, depending on which has the higher voltage. The external forward and reflected inputs are normally the controlling elements in the PPC circuit. The internal inputs take over control when the 1 KW PA is used alone or during a failure of the external inputs from the Tuner VSWR bridge. The threshold level is determined by threshold reference stage Q7, which develops a reference voltage across emitter resistor R21. The threshold voltage is set initially by a voltage from PWR control potentiometer 1A1R13, which is applied through diode gate CR14 to Q7 base voltage divider R23-R24. Reducing the setting of PWR control potentiometer 1A1R13 reduces the output level of the transmitter by lowering the threshold and thus the level of the input signal required to generate a PPC output signal.

4-57 When the output of any of the input voltage dividers reaches a level greater than the preset threshold reference voltage at the emitter plus the base to emitter junction voltage drop, the corresponding threshold detector conducts and draws current through the base of amplifier Q10. The amplified signal from the collector of Q10

drives cascade emitter follower stage Q12-Q11, which provides a low impedance source to drive the PPC line to the Exciter. The output from Q11 charges output capacitor C5 quickly through low value series resistor R39; but C5 discharges slowly through high value shunt resistor R31. The result is a fast attack, slow release time constant, which is required for proper control of SSB voice and similar signals which have recurring peaks. Capacitor C6 is used to prevent oscillations in amplifier stage Q10. Other capacitors are bypasses.

4-58 Some of the output at the emitter of Q11 is applied through R28 to the base of threshold reference stage Q7 to provide negative feedback for stabilizing the amplifier circuits. The output at the emitter of Q11 is also applied through zener diode CR17 and diode gate CR13 to PPC amplifier Q4 in the bias circuit. If the PPC circuit in the Exciter fails, the PPC voltage will rise higher than normal, and Q4 will be biased partially off to increase the bias to the driver stage and consequently reduce the power of the 1 KW PA to a safe level. Therefore, the 1 KW PA is always protected against excessive drive to the final amplifier tubes. Zener diode CR17 allows internal PPC to take effect only if the PPC voltage is greater than that at which the Exciter PPC circuit should take effect.

4-59 The external forward input from the Tuner VSWR Bridge is also fed directly to the base of emitter follower Q6. The low impedance output from the emitter of Q6 is essentially a duplicate of the rectified envelope input signal. This signal is applied to the TGC circuit in the Exciter and is used during the transmitter tune cycle to adjust the drive level required to compensate for variations in system gain which occur over the operating frequency range.

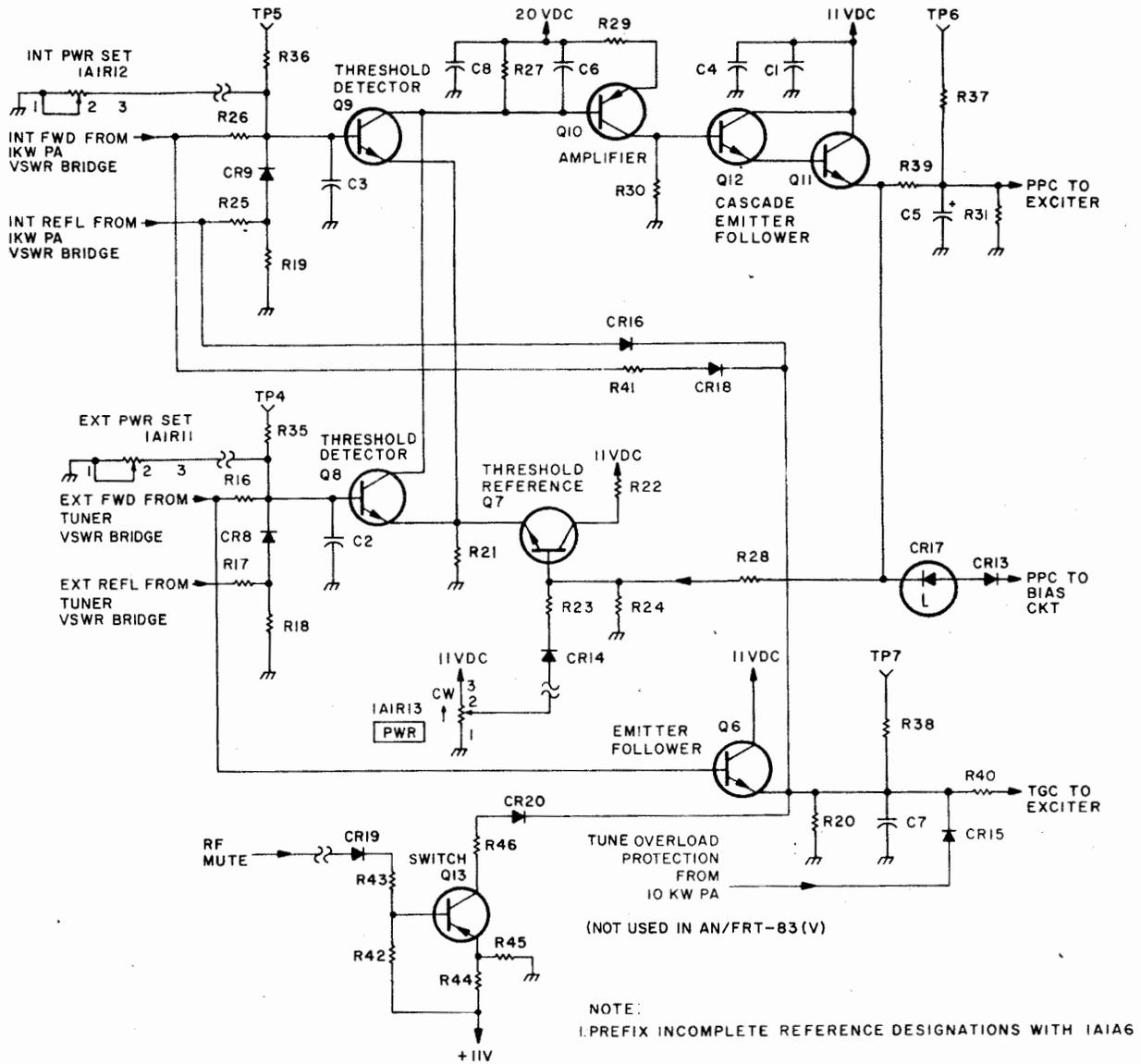


Figure 4-6. TGC-PPC Circuit, Simplified Schematic Diagram

4-60 Resistor R41 and diode gate CR18 provide an auxiliary TGC input from the internal forward line from the 1 KW PA VSWR bridge. Diode gate CR16 provides a similar input from the internal reflected line. These auxiliary TGC inputs ensure limiting to power levels of about 280 watts forward power or 250 watts reflected power, regardless of the inputs from the Tuner VSWR bridge. This feature is employed during the Tuner tune-up cycle before the matching network transfers sufficient power to the

Tuner VSWR bridge. It also ensures power limiting in the event of failure of the Tuner VSWR bridge or the interconnecting cables.

4-61 Diode gate CR15 provides an auxiliary TGC input which is used for operation of the 1 KW PA in an AN/FRT-84(V) Radio Transmitting Set configuration. This input is not used in the AN/FRT-83(V).

4-62 When an Antenna Coupler is used in the

system, an RF mute pulse is generated during the tune up cycle while the Tuner is being unbypassed. Normally, the TGC motor in the Exciter would run toward maximum RF gain during the RF mute period, since the 1 KW PA would have no output and thus the TGC circuit in the 1 KW PA would have no output. The relatively slow response of the TGC motor would therefore permit a momentary overdrive condition when the RF mute was released. In order to prevent the loss of TGC signal during an RF mute period, switch Q13 is turned on by the RF mute signal to provide a dummy positive TGC signal. This signal is applied to the TGC line through diode gate CR20. Its effect is to hold the Exciter TGC motor near the position in which it would normally be if no RF mute pulse was generated during this period.

4-63 The applicable servicing diagram for this circuit is figure 4-47. Adjustments relating to the TGC and PPC systems are described in paragraphs 5-42 and 5-46. Complete circuit details are shown in schematic diagram figure 5-45 sheet 1.

4-64 KEYING CIRCUIT. The keying circuit (figure 4-7) consists of a key driver, a keying stage, and various key inhibit interlocks. The function of this circuit is to activate the amplifier stages on command by causing the bias circuit to remove cutoff bias whenever the system keyline is grounded -- unless an overload exists, the 1 KW PA tuning circuit is energized, or an RF mute signal is applied by another part of the system.

4-65 Key driver Q5 is normally biased off through R18; therefore, key stage Q6 is turned off. When the system keyline is grounded, current is drawn through R23 and R24, and the base voltage at key

driver Q5 is pulled down (less positive) to make Q5 conduct. The Q5 collector current drawn through the emitter of key stage Q6 causes Q6 to conduct, and the resultant current flow in the collector circuit of Q6 pulls the bias circuit voltage down to the operating value required for operation of the RF driver and final amplifier stages.

4-66 The output of 20 VDC switch Q4 in the overload circuit is connected through R17 and CR16 to the base of key driver Q5. When an overload occurs, a key inhibit voltage from Q4 in the overload circuit biases Q5 off to unkey the bias circuit until the overload is cured and the overload circuit is reset.

4-67 An external RF mute line input is provided to allow the I. Box system logic RF mute circuit to unkey the bias circuit. The RF mute line is connected through CR13 and R20 to the emitter of key driver Q5. When a ground is applied to the RF mute line, the voltage at the emitter of Q5 is pulled down to the extent that grounding the system keyline will not make Q5 conduct. The RF mute line is also interlocked through CR15 directly to the emitter of PPC amplifier 1A1A6Q4 in the bias circuit. Thus, in case of key circuit failure, the RF driver stage is still biased off.

4-68 A ground is also applied to the RF mute line through CR2 from the tuning circuit to prevent keying when the bandswitch motor in the 1 KW PA is energized. In addition to preventing operation of key driver Q5, the tuning circuit ground signal is also applied directly to the key inhibit output to the bias circuit.

4-69 A driver key inhibit line is provided from the bottom of R24 through isolation diode CR14 to the base of PPC amplifier 1A1A6Q4 in the bias circuit. When the system keyline is ungrounded, +11 volts

is applied through CR14 to the PPC amplifier to ensure that it is biased off fully.

4-70 The applicable servicing diagram for this circuit is figure 4-48. Complete circuit details are given in schematic diagram, figure 5-45, sheet 1.

4-71 BIAS CIRCUIT. The bias circuit (figure 4-8) consists of a full-wave bridge rectifier and filter, a voltage regulator and divider, and various switching circuits to provide the required control-grid bias voltages for operation of the electron tubes. Until the system is keyed, the outputs from the bias power supply are at a high negative level to bias the electron tubes beyond cutoff. When the system is keyed, the bias voltages

are reduced 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 single-tone operation. The value of driver bias is such that the tubes operate class A. However, the driver bias can also be regulated by the PPC circuit according to the 1 KW PA power output requirements (auxiliary internal PPC).

4-72 The output from secondary winding 13-14 of transformer 1A1T1 is full-wave rectified by diodes CR1 through CR4, filtered by capacitor 1A1C29, and applied to a voltage regulator and divider circuit consisting of current limiting resistor R4, zener diodes

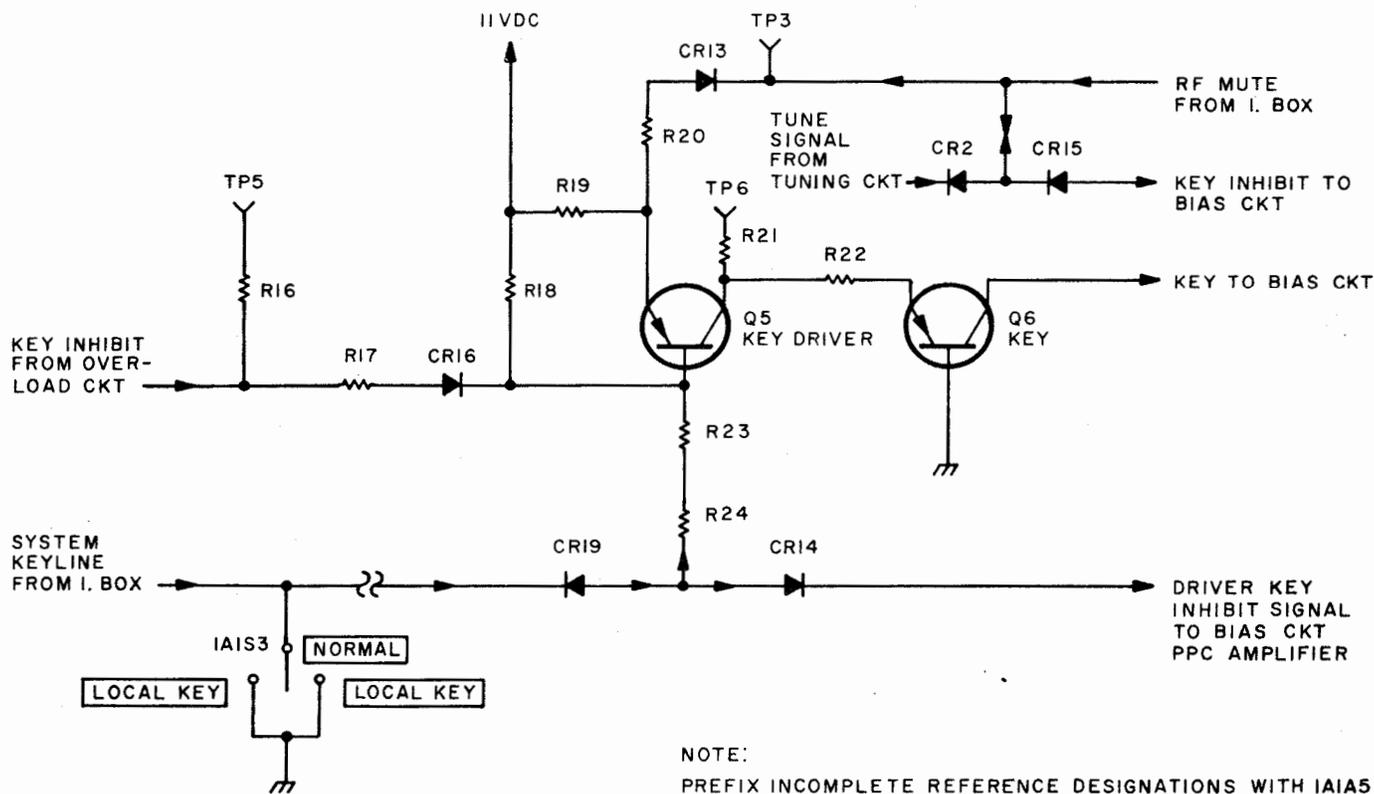


Figure 4-7. Keying Circuit, Simplified Schematic Diagram

CR5 and CR6, and resistor R5. When the system is unkeyed, the voltage drop across the relatively high resistance of R5 allows the bias levels to be sufficiently negative to bias both RF amplifier stages to cutoff. When the system is keyed, key stage transistor 1A1A5Q6 conducts, effectively placing a short circuit across R5 and grounding the voltage regulator circuit positive return. Thus, the bias voltages are reduced to their normal operating levels.

4-73 PA BIAS potentiometer 1A1R10 is adjusted for normal class AB<sub>1</sub> operation of the final amplifier stage. The level established by the PA BIAS potentiometer controls the bias voltage which is applied to the final amplifier by emitter follower action of Q2.

4-72 During normal operation, PPC amplifier Q4 is conducting sufficiently to bias clamp Q5 into saturation. Therefore, the one end of Driver Bias Adj potentiometer 1A1R9 is clamped to ground through Q5 and 1A1A5Q6. In this condition, the potentiometer can be adjusted over the normal range of class A operating bias for the driver amplifier electron tubes (0 to -24 VDC).

4-75 Normally, the PPC circuit in the Exciter performs the function of limiting the output level of the 1 KW PA. However, should the Exciter PPC circuit fail, the PPC voltage in the 1 KW PA will rise higher than normal in an attempt to reduce the output power. The increasing level is applied through isolation diode CR13 to gradually cut off PPC amplifier Q4. As the voltage at the collector of Q4

becomes more negative, so does the base voltage of clamp Q5. By emitter follower action, the voltage at the bottom of Driver Bias Adj potentiometer 1A1R9 also becomes more negative, thus reducing the gain of the driver stage electron tubes until the proper output is obtained. Diode CR7 keeps any reverse base-to-emitter voltage at clamp Q5 from exceeding safe limits.

4-76 When the tuning circuit is energized or when the RF mute line to the keying circuit is grounded at the I. Box, a ground is applied through diode 1A1A5CR15 to the emitter of PPC Amplifier Q4 to turn Q4 off. With Q4 off, clamp Q5 is non-conducting, and the driver stage is biased to cutoff, thus preventing operation until tuning is completed or the RF mute signal from the I. Box is removed.

4-77 A driver key inhibit line is provided from the system keyline input in the keying circuit through isolation diode 1A1A5CR14 to the base of PPC amplifier Q4. With the system keyline ungrounded, +11 volts is applied from the keying circuit through the diode to the base of Q4. This ensures that Q4 is turned off, thereby keeping clamp Q5 turned off so that maximum bias is applied to the driver tubes to keep them biased off.

4-78 The applicable servicing diagram for this circuit is figure 4-48. The driver bias adjustment is described in paragraph 5-7. Final amplifier bias adjustment is a front panel control described in Operator's Handbook, NAVELEX 0967-292-9060. Complete circuit details are shown in schematic diagram figure 5-45, sheet 1.



4-79 OVERLOAD CIRCUIT. The overload circuit (figure 4-9) consists of an overload detector, a 20 VDC switch, an overload indicator, an overload switch, and various gates. The function of this circuit is to monitor the cathode current of the two final amplifier electron tubes, the RF output voltage from the final amplifier, and the temperature of the 1 KW Power Supply. If any of these is higher than allowed, the overload circuit trips, unkeying the system, energizing an overload indicator in the 1 KW PA, and energizing a relay in the I. Box system logic circuit; which in turn lights the XMTR FAIL indicator in the Exciter and prevents continued operation. The overload circuit can be reset with a front panel overload switch.

4-80 Four inputs to the circuit are used to sense overload conditions as follows:

a. The RF output voltage from the plates of the final amplifier electron tubes is sampled by capacitive voltage

divider 1A1C35-C36 and detected by diode 1A1CR13; and a DC voltage proportional to the RF output voltage is developed across base resistor R9. Resistor 1A1R20 completes the DC path for diode 1A1CR13, and 1A1C37 is an RF bypass capacitor.

b. The DC voltage developed across the cathode resistor for final amplifier tube 1A1V1 as a function of the current drawn by the screen and plate is applied to base resistor R9 through decoupling network 1A1R7-1A1C27-R6-C2 and diode gate CR11.

c. The DC voltage developed across the cathode resistor for final amplifier tube 1A1V2 as a function of the current drawn by the screen and plate is applied to base resistor R9 through decoupling network 1A1R8-1A1C28-R7-C1 and diode gate CR10.

d. When the temperature of the 1 KW Power Supply is within safe limits, ground

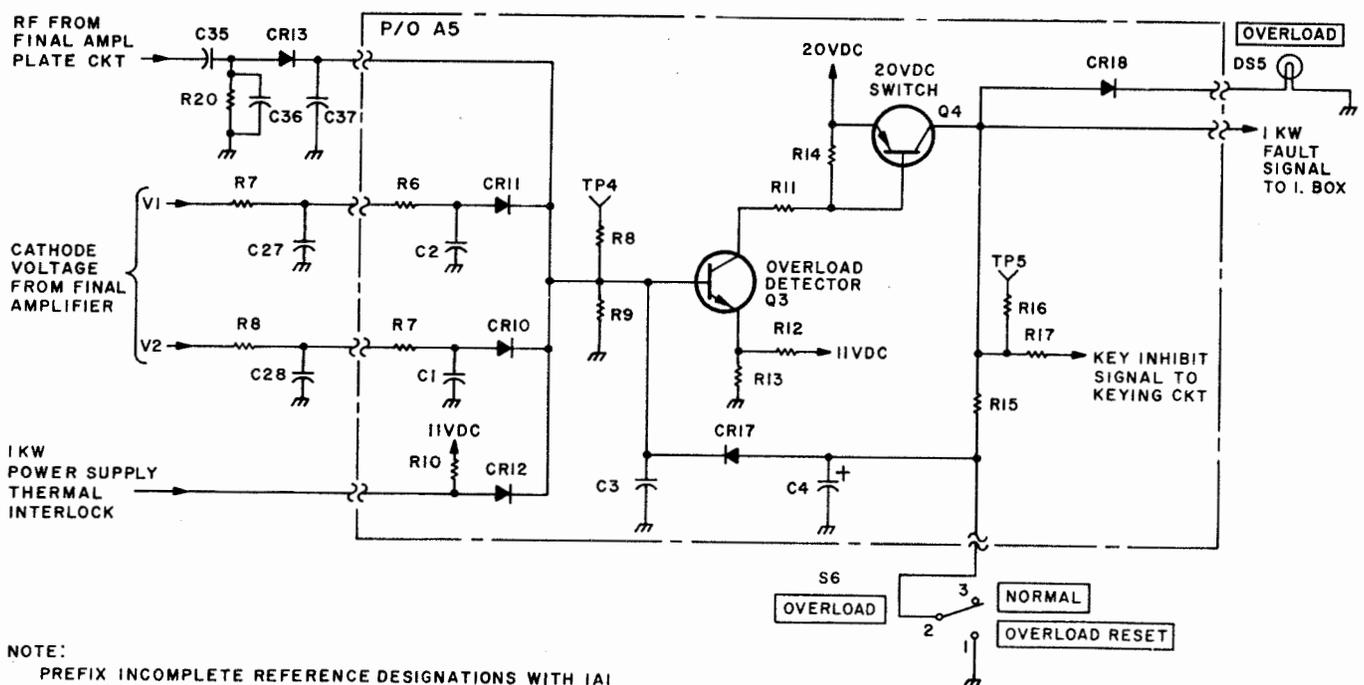


Figure 4-9. Overload Circuit, Simplified Schematic Diagram

is applied to the power supply interlock line by the thermal switch in the 1 KW Power Supply. Therefore, the full 11 VDC applied to resistor R10 is dropped across the resistor. If the thermal switch in the 1 KW Power Supply opens (temperature too high), the ground is removed by the thermal switch, and part of the 11 VDC applied through R10 is connected across base resistor R9 through gate CR12.

e. When the voltage on any one of these input lines exceeds the threshold voltage established by resistors R12 and R13, overload detector Q3 is forward biased, thereby turning on 20 VDC switch Q4. With Q4 energized initially, overload detector Q3 is latched on by the voltage at the collector of Q4 which is fed back through R15 and isolation diode CR17 to the base of Q3. The time constant of R15-C4 provides a one millisecond delay in latching to allow extremely short overloads to occur without latching the circuit.

f. With Q4 turned on, 20 VDC is applied through the 1 KW fault line to the I. Box to energize a relay, through isolation diode CR18 to OVERLOAD indicator light 1A1DS5, and through R17 to key driver Q5 in the keying circuit to unkey the bias circuit for deactivation of the RF amplifier stages. Once energized, the overload circuit will remain latched on until the overload is discontinued and overload switch 1A1S6 is momentarily placed in the reset position or the primary power is removed. Grounding the feedback loop with the overload switch will not short out the overload input signal which turns on the overload detector initially; and as long as the overload circuit is turned on, it will again latch when the overload switch is released.

g. The applicable servicing diagram for this circuit is figure 4-48. Complete circuit details are shown in schematic diagram figure 5-45, sheet 1.

4-81 TUNING CIRCUIT. The tuning circuit (figure 4-10) consists of a decoder, an encoder, two bandswitches, a motor, a motor relay, and a gating circuit. The function of this circuit is to automatically position the bandswitches in the final and driver transformer assemblies according to the selected operating frequency.

4-82 An open-seeking circuit that employs a five-wire coding scheme is used to automatically position the bandswitch assemblies in the driver and final transformer assemblies according to the selected operating frequency. Nineteen bands are used to cover the 2.0 to 30.0 MC frequency range, and thus nineteen different five-wire codes are required for tuning (table 4-1). The code is generated either externally (FREQUENCY MEGACYCLES switch S7 set at AUTOMATIC) by an encoder switch wafer in the I. Box decoder-encoder assembly (paragraph 4-272) or internally by an encoder deck in switch S7 (FREQUENCY MEGACYCLES switch S7 set at one of the nineteen manual band select positions). In either case, a series of opens and grounds is applied to the five code lines, through which the code is connected to decoder switch deck A4S1C. This establishes a ground path through contact 3 of A4S1C-front, terminal 6 of A4TB1, and gate A5CR1 to pin 6 of motor drive relay K3. Thus relay K3 energizes, completing the 115 VAC circuit through motor B2. The motor rotates the decoder switch and the two bandswitches until the decoder code is the complement of the code generated by the encoder.

At this time, the ground path to relay K3 is broken, de-energizing motor B2.

4-83 Both the encoder and the decoder 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 positions.

4-84 Figure 4-10A shows the circuit tuned for an operating frequency in the 2.0 to 2.5 MC band. This can be seen by noting that decoder master A4S1C pattern (1, 1, 1, 1, 0) is the complement of encoder master S7A pattern (0, 0, 0, 0, 1). Suppose, however, that the 1 KW PA had previously been tuned to the 2.5 to 3.0 MC band (one position clockwise), and that FREQUENCY MEGACYCLES switch S7 had just been set at the 2.0 to 2.5 MC 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 K3, since code lines 1 through 3 are not grounded by encoder S7 master. Instead, the ground path is provided through the image decks: from S7A-20 front to S7A-1 front to A4S1C-5 rear to A4S1C-6 rear to S7A-2 rear to S7A-3 rear to A4S1C-7 front to A4S1C-3 front to terminal 6 of the relay. Thus the relay energizes, and motor B2 turns

the decoder and bandswitches. The masters 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.

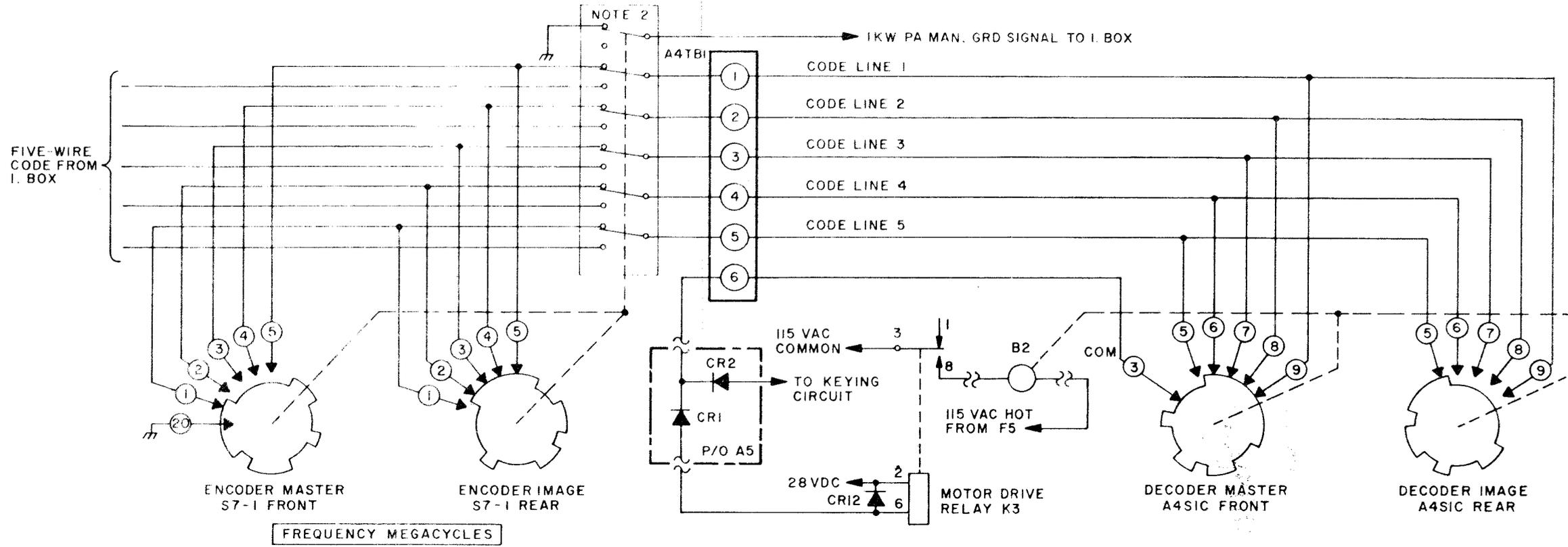
4-85 The same process occurs when FREQUENCY MEGACYCLES switch S7 is set to AUTOMATIC, except that the tuning code originates at the Exciter. The Exciter code operates a decoder-encoder (band information repeater) in the I. Box (paragraph 4-272). An encoder switch wafer in the I. Box decoder-encoder performs the function of S7A front and rear.

4-86 When FREQUENCY MEGACYCLES switch S7 is not set to AUTOMATIC, section D rear sends a ground signal to the I. Box via the manual ground line. The I. Box in turn activates an indicator lamp in the I. Box and sends a local override signal to the Exciter when the manual ground line is grounded.

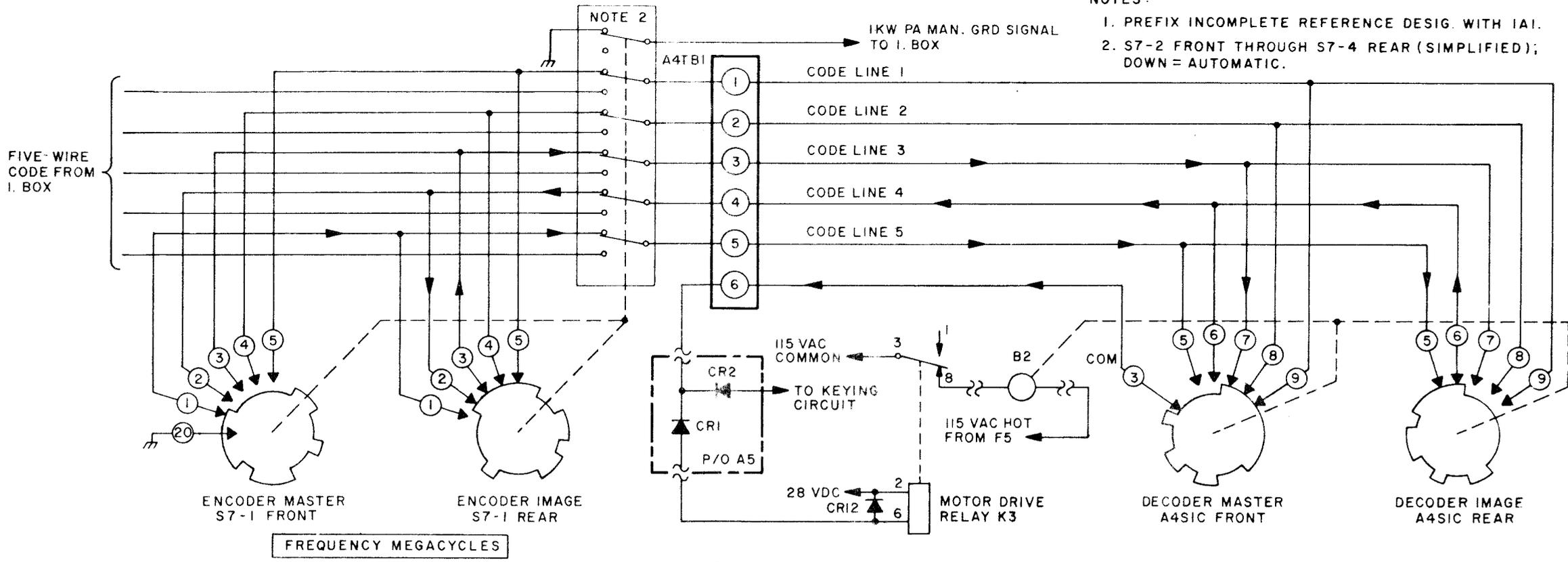
TABLE 4-1. ENCODER TUNING CODE CHART

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

Note: "0" = Open, "1" = Ground



- NOTES:
- 1. PREFIX INCOMPLETE REFERENCE DESIG. WITH IAI.
  - 2. S7-2 FRONT THROUGH S7-4 REAR (SIMPLIFIED); DOWN = AUTOMATIC.



B. CIRCUIT SHOWN IN PROCESS OF TUNING

Figure 4-10. Tuning Circuit, Simplified Schematic Diagram

4-87 The applicable servicing diagram for this circuit is figure 4-46. Complete circuit details are shown in schematic diagram figure 5-45, sheet 2.

4-88 MULTIPURPOSE METER CIRCUIT. The multipurpose meter circuit (figure 4-11) consists of a meter, switch, detector circuit and various voltage dividers. The function of this circuit is to allow the important parameters of the RF amplifier stages to be monitored.

WARNING

This circuit contains high voltages of up to 2400 VDC. Use appropriate precautions when servicing.

4-89 Eight parameters are monitored as follows:

- a. When the Multipurpose Meter switch 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 A1B3 and contacts 1 and 9 of switch S5 to meter M1.
- b. When the Multipurpose Meter 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.
- c. When the Multipurpose Meter 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.
- d. When Multipurpose Meter 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.

e. The RF input to the driver tube grids is coupled through 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 signals are then detected by diode A1CR1, filtered by capacitor A1C17, and developed across base resistor A6R1, resulting in a DC signal 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 A6R2 and contacts 5 and 9 of switch S5 to meter M1. When Multipurpose Meter 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 A6R3 serves as a load for transistor A6Q1 when switch S5 is in some other position.

f. The 2400 VDC output from the 1 KW Power Supply is applied to the plates of final amplifier electron tubes V1 and V2 and through meter calibrating resistors A7R16 through A7R20 and A7R22 to meter M1 when Multipurpose Meter switch S5 is set at PA PLATE VOLTS. Resistor A7R21 prevents the voltage at terminal 6 of the switch from rising to 2400 VDC when the switch is not set at PA PLATE VOLTS.

g. The 600 VDC output from the 1 KW Power Supply is applied through fuse F7 to the plates of the driver amplifier electron tubes. The 600 VDC is also applied through parallel connected current limiting resistors A7R1 through A7R3 to the screen regulator and through meter calibrating resistors A7R13 and A7R14 to meter M1 when Multipurpose Meter switch S5 is set at DRIVER PLATE VOLTS. Resistor A7R15 prevents the voltage at

terminal 7 of the switch from rising to 600 VDC when the switch is not set at DRIVER PLATE VOLTS.

h. The 287 VDC at the J6 output of the screen voltage regulator is applied through

meter calibrating resistors A7R7 and A7R8 to meter M1 when Multipurpose Meter switch S5 is set at PA-DRIVER SCRNS VOLTS. Resistor A7R9 prevents the voltage at terminal 8 of the switch from rising to 287 VDC when the switch is not set at PA-DRIVER SCRNS VOLTS.

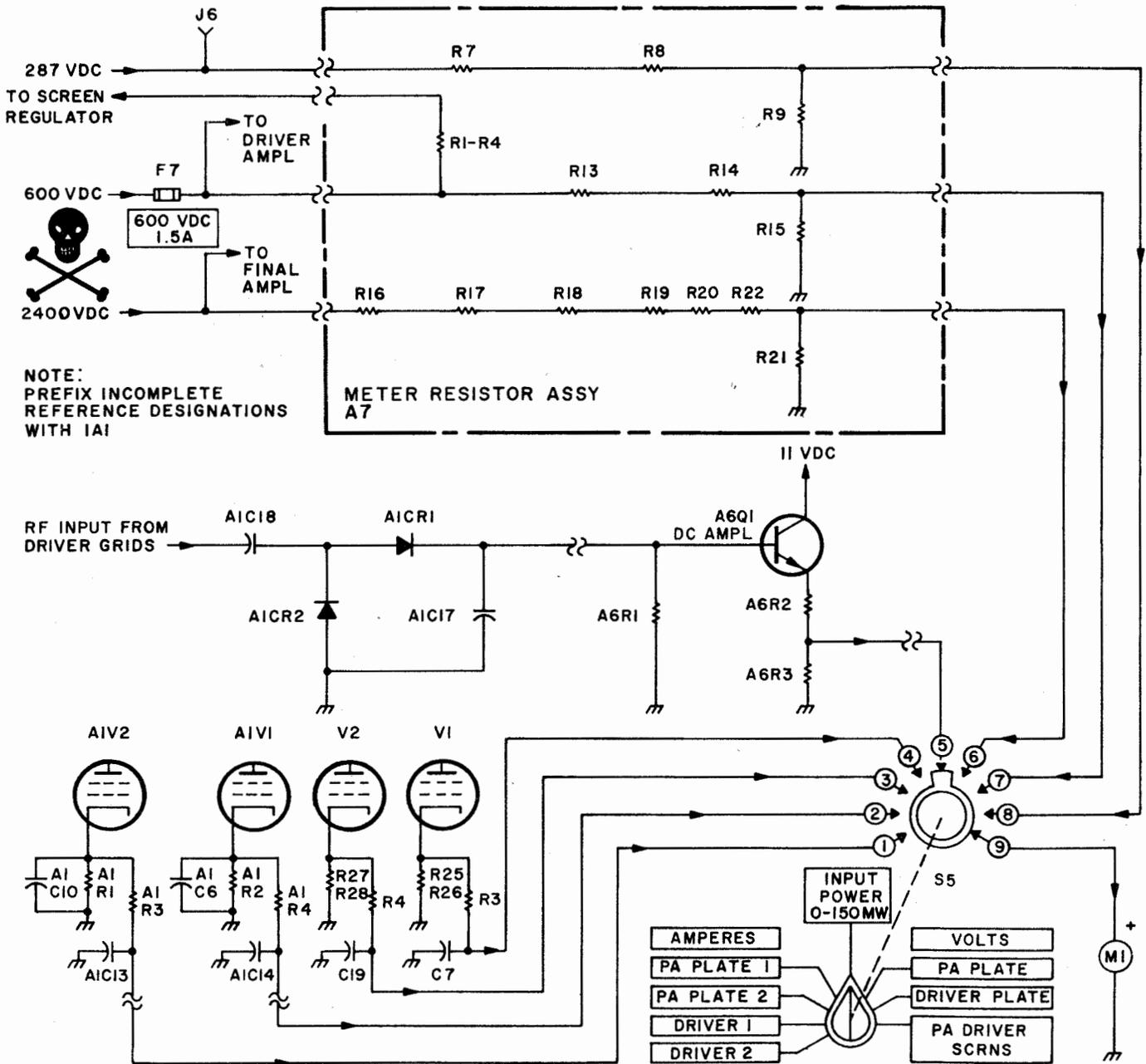


Figure 4-11. Multipurpose Meter Circuit, Simplified Schematic Diagram

4-90 The applicable servicing diagram for this circuit is figure 4-46. Complete circuit details are shown in schematic diagram figure 5-45, sheet 1.

4-91 11, 20, AND 28 VDC POWER SUPPLY. The 11, 20, and 28 VDC power supply (figure 4-12) consists of a bridge rectifier, a filter, and a voltage regulator. The function of this circuit is to provide the low DC voltages required for the operation of the 1 KW PA control circuits.

4-92 The 32 VAC output of secondary winding 6-8 of transformer 1A1T1 (activated when standby relay 1A1K2 is energized) is full-wave bridge rectified by diodes CR4 through CR7, producing an unfiltered DC output with an average value of 28 VDC.

4-93 Because one side of the secondary winding of transformer 1A1T1 is always grounded through CR4 or CR6 during any particular half-cycle of AC output from the winding and the other side is always positive with respect to the grounded side, a positive voltage equal to one-half the voltage across the full secondary is presented at the center tap. Diodes CR5 and CR7 are not a part of this circuit, since only CR4 and CR6 in the ground return path are required for full-wave rectification. The positive full-wave rectified output from the center tap of the secondary winding is routed through isolation diode CR3 to charge capacitor 1A1C311. The isolation diode allows the capacitor to charge to the peak value of the voltage from the center tap, which is about 20 volts.

4-94 In addition to being applied to some of the control circuitry, the 20 VDC is also applied to the 11 VDC regulator. Voltage divider R2-CR8-CR9 provides a stable reference voltage at the base of the first emitter follower Q1. By emitter follower

action, the voltage at the emitters of Q1 and Q2 must remain fixed with relation to the voltage at the base of Q1, regardless of normally varying load conditions. Q1 and Q2 provide current gain to allow a relatively large current to be controlled by the lower current zener diode regulator at the base of Q1. The output of the 11 VDC supply is taken through two current paths, consisting of R3-Q2 and R4 in parallel. Voltage in excess of the desired 20 volt output is dropped across R4 and the combination of R3 and the collector-base junction of Q2. The dynamic resistance in Q2 changes with load current and input voltage variations to maintain regulation of the output voltage. R3 is connected in series with Q2 so that the entire voltage drop of about 9 volts does not take place in Q2, thereby reducing the power dissipation in the transistor. Resistor R4 is used so that with minimum load current, very little current is drawn through Q2; thus providing a further reduction in transistor power dissipation.

4-95 The applicable servicing diagram for this circuit is figure 4-48. Complete circuit details are shown in schematic diagram figure 5-45, sheet 1.

4-96 400 CPS INVERTER. The 400 CPS inverter (figure 4-13) is a saturable core oscillator. The function of this circuit, which forms a part of the 1 KW Power Supply, is to produce 115 VAC, 400 CPS, single phase power for the blower in the 1 KW PA and the POWER ON indicator lamp in the 1 KW Power Supply.

4-97 The 400 CPS inverter utilizes a saturable-core transformer oscillator circuit to develop a 115 VAC, 400 CPS output from the 24 VAC, 60 CPS input supplied by the secondary of transformer 2A2T2. When standby relay 1A1K2 is energized,  $\phi$  A and  $\phi$  B primary power

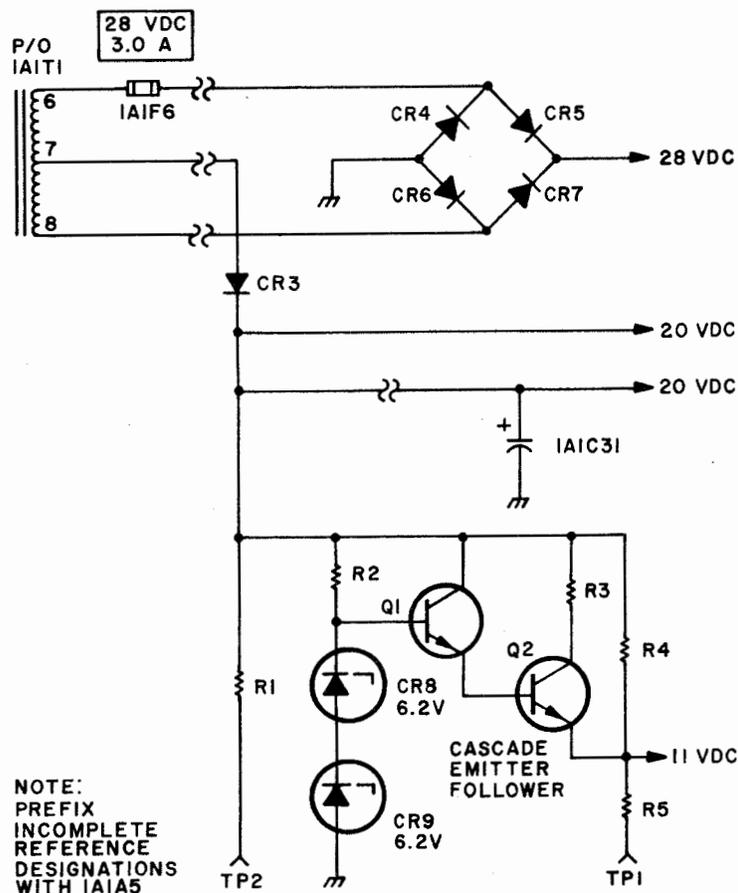


Figure 4-12. 11, 20, and 28 VDC Power Supply, Simplified Schematic Diagram

inputs are applied to the primary of 2A2T2. The 24 VAC output of 2A2T2 is full-wave rectified by a diode bridge consisting of CR4 through CR7. This bridge delivers its DC output to the center tap on the primary winding of transformer T1. Capacitors C2 and C3 provide filtering of the bridge rectifier output.

4-98 Resistors R3 and R4 pull the bases of transistors Q1 and Q2 toward ground, tending to turn both transistors on. Because the two sides of the circuit are never precisely balanced, one transistor will conduct more than the other. Assume that transistor Q1 conducts more initially, causing the voltage across winding 3-4 to be more positive at terminal 3 than at terminal 4. By transformer action, terminal 4 will be more positive than terminal 5, terminal 2 more

positive than terminal 3, and terminal 1 more positive than terminal 2. Therefore, transistor Q2 becomes reverse biased and transistor Q1 becomes more forward biased. Due to the positive feedback loop between base and emitter through feedback winding 4-5, the collector-to-emitter current flow will increase regeneratively until the transistor is driven into saturation. When this occurs, the primary voltage can no longer increase and a condition of unstable equilibrium is attained. At this equilibrium point, the voltage drop across the transistor is small, and essentially the full 24 VDC is dropped across winding 3-4 of transformer T1. With a constant voltage across the winding, both the current and the magnetic flux increase until the core reaches saturation, a process requiring about 8.3 mSEC. At this time, the excitation

current required by the transformer exceeds that which can be supplied by the transistor, so the current can no longer rise. Therefore, transistor Q1 is regeneratively turned off, ending the first half cycle. As the flux of the transformer collapses, the polarity of the voltages induced in the transformer windings is opposite to that originally induced. Thus, transistor Q2 becomes turned on and is regeneratively driven into saturation as Q1 was initially. Transistor Q2 continues to conduct until the transformer core is driven into negative saturation. The flux again collapses, regeneratively turning transistor Q2 off and transistor Q1 back on, completing a full cycle. This switching action continues at a 400 CPS rate, as determined by the magnetic and electrical characteristics of transformer T1 and the value of the supply voltage. The peak voltage from the emitter of either transistor to ground is approximately twice the supply voltage.

4-99 As the transistors turn on and off, switching spikes are produced in the circuit. Diodes CR8 and CR9 prevent possible transistor damage by preventing these spikes from exceeding the emitter-collector reverse voltage rating of the transistors. Similarly, diodes CR10 and CR11 provide protection against excessive reverse base-to-emitter voltage. Resistors R1-R2 and R5-R6 limit the base current in transistors Q1 and Q2 to the required value.

4-100 The AC voltage induced in the primary of transformer T1 is coupled by transformer action to secondary winding 6-7. The 115 VAC, 400 CPS developed in the secondary is applied to POWER ON indicator DS1 and to blower 1A1B1 in the 1 KW PA.

4-101 The applicable servicing diagram for this circuit is figure 4-49. Complete cir-

cuit details are shown in schematic diagram figure 5-48.

4-102 HIGH VOLTAGE POWER SUPPLY. The high voltage power supply (figure 4-14) consists of a three-phase transformer, three three-phase diode blocks, and various other parts. The function of this circuit is to produce the 2400 and 600 VDC required by the four electron tubes in the driver and final amplifiers.

#### WARNING

This circuit contains high voltages up to 24000 VDC. Use appropriate precautions when servicing.

4-103 When operate relay 1A1K1 is energized, 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 in which each leg consists of two windings. The windings are jumpered together according to the voltage of the three phase input. The output from transformer 2A2T1 consists of three secondary windings: two wye type and one delta type.

4-104 The output from wye winding 19-20-21 is full-wave rectified by three-phase diode stack CR1 to produce 600 VDC. This 600 VDC is filtered by inductor 2A2L1 and capacitor C1, and applied through fuse F2 to the 1 KW PA. The 600 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.

4-105 The output from wye winding 22-23-24 is full-wave rectified by three-phase diode stack CR2 to produce 1200 VDC. This 1200 VDC is used as the

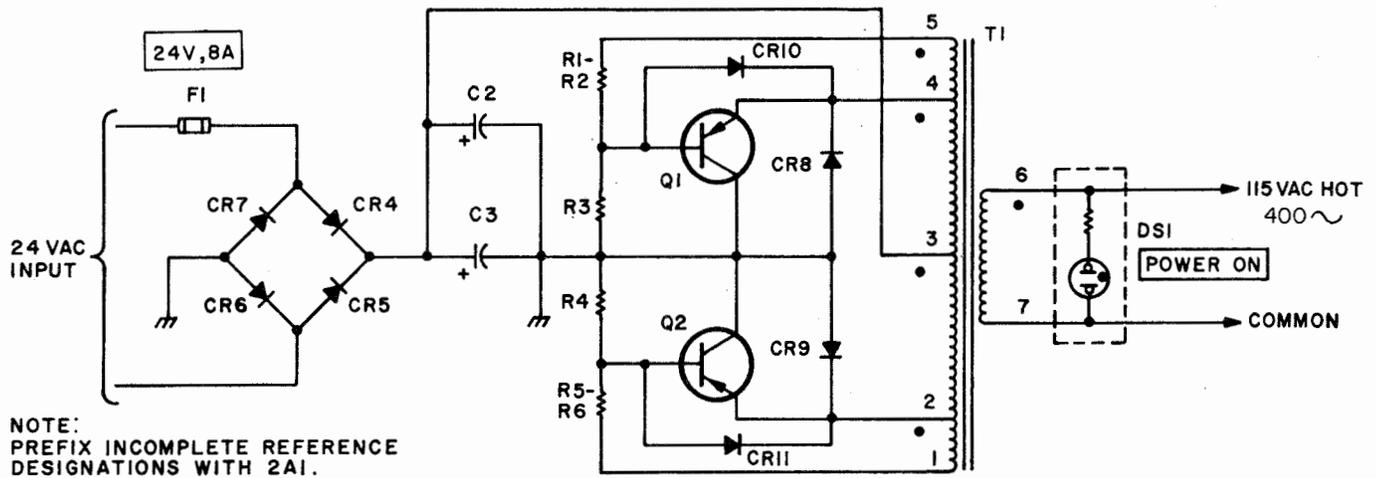


Figure 4-13. 400 CPS Inverter, Simplified Schematic Diagram

return for three phase diode stack CR3. The output from delta winding 25-26-27 is full-wave rectified by three-phase diode stack CR3, producing 1200 VDC that is added to the 1200 VDC output from three phase diode stack CR2. This results in the required 2400 VDC that is applied to the 1 KW PA. This 2400 VDC is filtered by capacitors 1A1C49 and 1A1C50 in the 1 KW PA and is used as plate voltage for the two electron tubes in the final amplifier. A wye and a delta winding are used together to produce the 2400 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 requiring less filtering.

4-106 The applicable servicing diagram for this circuit is figure 4-49. Complete circuit details are shown in schematic diagram figure 5-48.

4-107 RADIO FREQUENCY TUNER TN-509/FRT-83(V), TUNER CONTROL C-7704/FRT-83(V), AND RELATED PARTS OF INTERCONNECTING BOX J-2821/FRT-83(V). This functional section consists of the circuitry performing harmonic attenuation of the transmitter RF output and the control circuitry required for its proper operation. As shown in figure 4-15, this functional section consists of the entire Tuner and Tuner Control units and parts of the I. Box unit which are functionally related to the Tuner.

4-108 The Tuner contains tuning elements in a T-matching network configuration which is connected in series with the RF output from the 1 KW PA to the antenna system. It also contains the motors and drive mechanisms used for servo operation of the tuning elements. The Tuner Control unit contains the manual and automatic control circuits which operate the variably tuned elements, which will be referred to by short form designators C1 and L2. The other tuning elements in the Tuner, L1 and L3, are inserted in fixed steps, by

circuitry in the I. Box, according to programmed conditions.

4-109 The Tuner Control contains the power supply used for the control circuits in that unit and many of the circuits in the Tuner. The control circuits contained in the I. Box are powered by 28 VDC from the Auto-transformer Assembly.

4-110 In operation, variable inductor L1 is automatically positioned to one of eight inductance values, according to operating frequency band information from the Exciter. The value is predetermined (during alignment) to force the rest of the matching network to provide the desired selectivity for the chosen operating frequency. The continuously variable elements C1 and L2 are adjusted either automatically, semiautomatically, or manually to tune with L1 and the antenna system to provide a resistive 50 ohm load impedance for the output of the 1 KW PA. With certain loading conditions, the maximum inductance value of L2 is too low for proper tuning in the 2.0-2.5 MC band. Such a condition is determined automatically, resulting in the addition of the fixed inductance of L3 to the inductance provided by variable inductor L2.

4-111 In addition to providing harmonic attenuation, the Tuner matching network can also provide some degree of compensation (line flattening) for imperfect load conditions at the antenna. This is necessary only when the optional AN/URA-38 Antenna Coupler Group is not used. The Tuner matching network will accommodate VSWR conditions up to 4:1 by transforming the antenna system impedance to a 50 ohm resistive load impedance for proper matching to the output of the 1 KW PA.

4-112 The Tuner also contains a VSWR

bridge at the output of the matching network to monitor the antenna system load conditions and power level. It supplies forward-and reflected-power control signals to the 1 KW PA TGC-PPC circuit for power level regulation and protection, and it supplies similar signals to the peak/average power meter circuit in the Tuner.

#### 4-113 AUTOMATIC MODE OF OPERATION.

An automatic tuning cycle is initiated by one of the following: changing Exciter operating frequency, changing Exciter from a single-tone to a multi-tone mode of transmission or vice-versa, occurrence of a fault in the transmitter, or L2 running to its far end stop. In any case, a ground pulse signal is applied to the home logic, thus applying home signals to the L2 and C1 servo amplifiers, the TUNED light logic, and the RF mute logic. Consequently, the TUNED light is extinguished, the system is held off the air by the RF mute signal from the keying logic, and the L2 and C1 servo amplifiers drive their respective tuning elements to a home position. The home signal to the C1 servo amplifier is switched to home at either minimum capacitance (high frequencies) or maximum capacitance (low frequencies) by a frequency band switch in the I. Box so that the C1 tuning element starts tuning from either minimum or maximum capacitance depending upon the frequency band. When the motor control circuits are activated to home the tuning elements, a motor-on signal is fed back to the brake logic circuits to release the motor brakes.

4-114 At the time the L2 and C1 tuning elements are being driven to home positions, if the frequency was changed to a different "tuner band", the L1 servo loop control circuit supplies a different reference signal to the L1 servo amplifier to reposition the L1 tuning element. The L1 servo amplifier drives the L1 motor control circuit in the maximum inductance direction until the L1 servo loop control

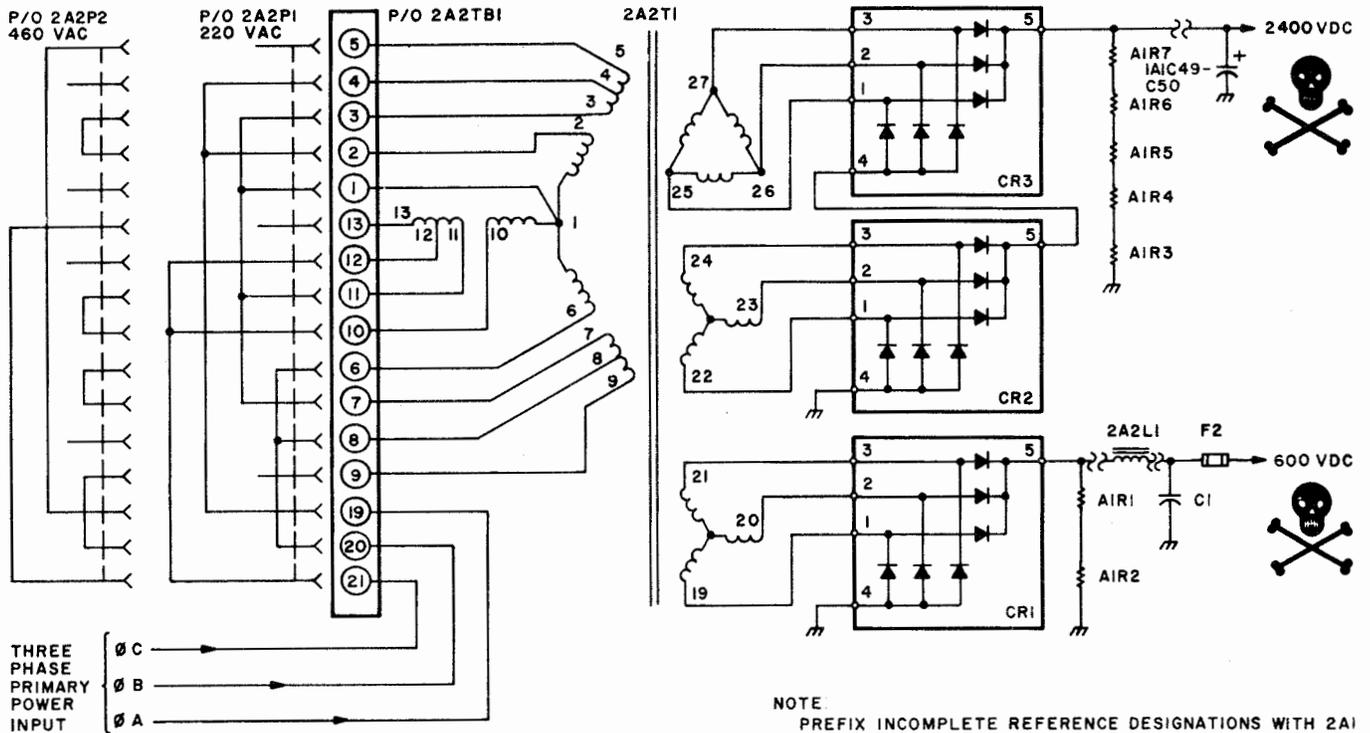


Figure 4-14. High Voltage Power Supply, Simplified Schematic Diagram

circuit receives the correct L1 element position signal readback.

4-115 When the L2 and C1 tuning elements reach their home positions, their motor control circuits remove the motor-on signals from the motor-on logic. At the same time, the L2 motor control provides a reset signal to the tune logic and the TUNED light logic. The tune logic, in response, supplies a tune power request signal to the I. Box system logic to indicate that the tune cycle should begin. It also generates a tune sensitivity drive signal which is applied to the L2 and C1 servo amplifiers to increase their sensitivity so they can operate with the low level tune power RF signal which is applied to the Tuner during the tune cycle. Removal of the motor-on signal results in removal of the home signal by the home logic and thereby removes the RF mute signal from the I. Box system logic.

4-116 At this point, the transmitter tuning

cycle stops until the operator depresses the Exciter Tune pushbutton. If the AN/URA-38 Antenna Coupler Group is used with the system, it has performed similar functions, i.e., it homes and then applies a tune power request signal to the I. Box system logic. The Coupler Control tune power request signal is also applied to the tuner bypass logic circuit which switches the Tuner matching network out of the RF signal path and bypasses the Tuner to allow the Antenna Coupler to tune first. The Tuner will not tune without RF power, so it remains inactive until the Coupler Control removes its tune power request signal to allow the Tuner to become bypassed.

4-117 When the operator depresses the TUNE pushbutton (and after the Antenna Coupler tunes), RF power is applied to the Tuner matching network through the  $\phi$  and R discriminators. The discriminators supply error signals to the C1 and L2 servo amplifiers through the C1-L2 servo loop switching

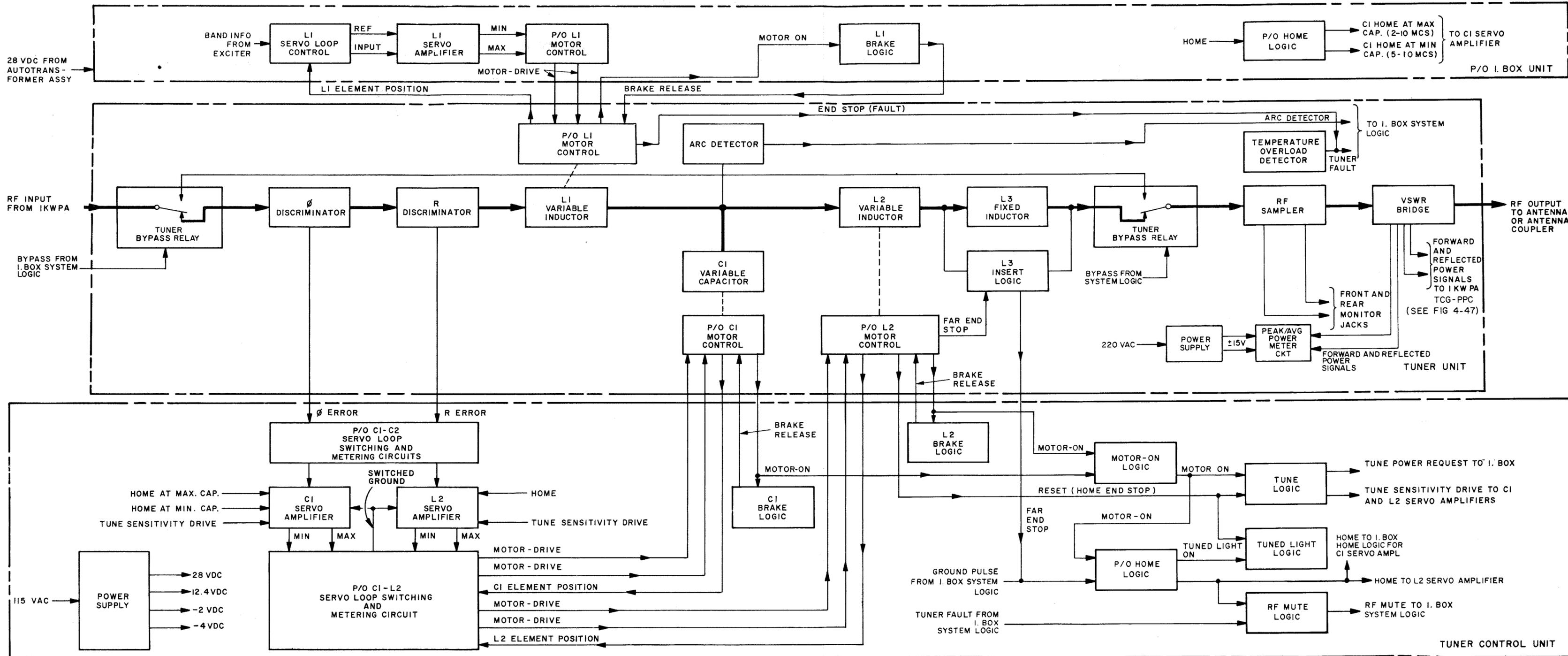


Figure 4-15. Tuner, Tuner Control, and Related Parts of I. Box; Functional Block Diagram

and metering circuits. The servo amplifiers, in turn, activate the C1 and L2 motor control circuits to drive those tuning elements to the required positions. While the servo motors in the C1 and L2 motor control circuits are activated, motor-on signals are applied to the brake logic circuits, which release the motor brakes, and to the motor-on logic. The motor-on logic maintains the tune power request and tune sensitivity drive signals until the servo motors cease running for a minimum of 1/2 second; then, these signals are removed. Removal of the tune power request deactivates the RF signal and allows the transmitter status to change to READY. Removal of the tune sensitivity drive signal from the C1 and L2 servo amplifiers reduces their sensitivity to allow full-power tuning should the load impedance change during operation on the air. The system is now ready for normal operation.

4-118 During normal transmissions, the C1 and L2 servo amplifiers can make adjustments to maintain tuning if the load characteristics of the antenna change for some reason. This is accomplished without homing or otherwise disturbing the system transmitting status.

4-119 If the tune cycle is unsuccessful (due to a special set of load conditions which can be encountered in the 2.0-2.5 MC band), and the L2 tuning element runs to its far end stop because it does not have enough inductance; the L2 far end stop switch provides signals to the home logic and L2 insert logic circuits to start a new home/tune cycle and insert the extra inductance of fixed inductor L3 in the matching network, so that a second tuning attempt is made with more inductance. The Exciter TUNE pushbutton is then depressed a second time to start the new tune cycle.

4-120 MANUAL MODE OF OPERATION. Manual tuning is accomplished by the operator with front panel controls. RF tune power is supplied by setting the I. Box MANUAL TUNE POWER REQUEST switch to the ON position. During this mode of operation, the outputs of the  $\phi$  and R discriminators are switched to the DISCRIMINATOR NULL meter, one at a time, by the C1-L2 servo loop metering and switching circuits, as determined by the L2-C1 selector. The selected tuning element is adjusted by depressing the LEFT and RIGHT pushbutton as required until a null is indicated. The L2 and C1 elements are alternately adjusted until null indications are obtained for both settings of the L2-C1 switch.

4-121 The L2 and C1 servo amplifiers and most of the logic circuitry are disabled for this mode of operation. The RF mute logic is maintained in the manual mode to avoid damage if a tuner fault occurs, and the L1 and L3 functions remain essentially the same as for automatic operation.

4-122 Once proper tuning is obtained, the element positions for L2 and C1 can be recorded by observing the ELEMENT POSITION meter indications which are provided by the L2-C1 servo loop metering and switching circuits and the element position signals from the L2 and C1 motor control circuits. Thereafter, when returning to the same frequency or a nearby frequency, the elements can be rough tuned by resetting them to recorded positions and fine tuned using the DISCRIMINATOR NULL meter.

4-123 SEMI-AUTOMATIC MODE OF OPERATION. Initial semi-automatic tuning is accomplished without using RF power. The L1 and L3 functions are essentially the same as for automatic operation, and the L2 and C1 elements are preset as in manual operation using the ELEMENT POSITION meter and

WARNING

pre-recorded data for the operating frequency. When the transmission begins, the RF signal causes automatic tuning adjustment, as after initial tuning in the automatic mode of operation. The tuning adjustment occurs during the normal transmission and does not require a special low power RF signal. As in manual operation, the RF mute logic provides an RF mute signal if a Tuner fault occurs. The TUNED light logic is disabled in this mode of operation.

4-124 POWER SUPPLIES. The Tuner Control power supply provides the +28, +12.4, -2, and -4 volts DC required for operation of the Tuner Control circuits, most of the Tuner, and some of the related I. Box circuits. Primary power to the Tuner Control power supply is 115 VAC from the autotransformer. Most of the related I. Box circuitry and the L1 motor control and L3 insert logic circuits in the Tuner are supplied with 28 VDC separately from the Autotransformer assembly.

4-125 Another power supply in the Tuner unit provides the  $\pm 15$  VDC required for the peak/average power meter circuit. Primary power to this supply is 220 VAC single-phase direct from the autotransformer in the AN/FRT-83(V) cabinet.

#### 4-126 CIRCUIT DESCRIPTIONS.

4-127 MATCHING NETWORK. The matching network (figure 4-16) consists of variable inductors A2L1 and A4L2, variable capacitor A6C1, and fixed inductor A8L3. The variable elements are motor driven. The function of these components is to provide harmonic attenuation in the transmitter RF output signal path. Other components and assemblies in figure 4-16 are shown to illustrate their relationships to the matching network components.

High RF voltages are present in the matching network circuitry when transmitting. Contact can result in severe burns. Use appropriate precautions when servicing in this area.

4-128 The matching network is basically a "T" configuration, which has a 50 ohm input and a 50 ohm output. A T matching network can be thought of as two L networks, each transforming a low impedance at its outside terminal to a higher impedance at the center junction (at C1). The series inductors transform the impedances and the shunt capacitor cancels the inductive reactances of the inductors. The matching network in the Tuner is not used primarily to change impedances or cancel reactances in the antenna system, although some amount of compensation for imperfect load characteristics can be accomplished. The primary function of the Tuner matching network is to provide selectivity for harmonic frequency attenuation, which is accomplished due to the Q of the tuned circuit. The two halves of the T network each provide selectivity, the amount of which is related to the Q of that section.

4-129 To control the Q of the T network, the value of inductance to be inserted by A2L1 is programmed in the I. Box unit. Positioning of this inductor is a function of the frequency band in use. The values of reactance of A4L2 and C1 are adjusted, after positioning of A2L1, to provide the proper series output inductance and shunt capacitance to transform back down to 50 ohms and resonate the T network respectively. Thus, providing that a non-reactive 50 ohm load is connected to the output, the halves of the T network will be symmetrical and the output side Q will be the same as the input side Q. It can be seen, then, that the positioning of A2L1 establishes the Q of the matching network and thus its selectivity and efficiency.

4-130 In a special case in which the load impedance is less than 50 ohms and the operating frequency is at the low end of the 2.0 to 2.5 MC band, the inductance available in variable inductor A4L2 is insufficient for proper tuning and the initial tune cycle fails. Such a condition requiring additional inductance is subsequently determined by the L3 insert logic which then actuates relay A8K3. When A8K3 is actuated, its normally closed contacts unshort series fixed inductor A8L3, which adds a fixed inductance to that provided by variable inductor A4L2, thus extending its tuning range.

4-131 Whenever the AN/URA-38 Antenna Coupler Group is used, it is necessary to bypass the Tuner matching network until the Antenna Coupler is tuned so that a 50 ohm non-reactive load will be present before the Tuner unit attempts tuning. It is also desirable, in the case of a Tuner failure, to be able to bypass the matching network in the Tuner for emergency operation (and accept the resultant loss of its harmonic attenuation). This is the function of the Tuner bypass logic circuit (part of I. Box system logic) and relays K1 and K2, which disconnect the matching network and make a direct connection through the Tuner instead.

4-132 The applicable servicing diagram for this circuit is figure 4-50. Complete circuit details are shown in schematic diagram figure 5-50, sheet 1.

4-133  $\phi$  DISCRIMINATOR. The function of the  $\phi$  discriminator (figure 4-17) is to provide a DC output to the C1 servo amplifier indicative of the reactive component of the Tuner line impedance. The output is zero when there is no reactive component, positive when there is a capacitive reactance, and negative when

there is an inductive reactance on the line. The servo amplifier tunes the variable capacitor to the point at which zero output is obtained from the  $\phi$  discriminator.

4-134 The line current induces a voltage in transformer T1; half of this voltage is applied across resistor R2 and half across resistor R1. Taking the junction of resistors R1 and R2 as a reference, the voltages across resistors R1 and R2 are in opposite phase, so that the voltage across resistor R2 is in phase with the line current and the voltage across resistor R1 is 180 degrees out of phase with the line current. (It is as if the junction of resistors R1 and R2 were connected to a center-tap on the transformer.) Divider C1/R3, R10 produces a reference voltage at the junction of resistors R1 and R2 which is 90 degrees out of phase with the line voltage.

4-135 Consider only the RF portions of the circuit now and the RF voltages which appear under various conditions. The circuitry shown below R1 and R2 consists of detectors and DC load resistors, the voltages at which depend on the values of the peak RF voltages which are detected on each side of the discriminator. The detected voltage is the vector sum of the induced voltage and the reference voltage at the junction of R1 and R2, since the induced voltage applied to R1 and R2 is added in series with the voltage applied across R3 and R10 to ground. The principle which applies is that the vector sum is greatest when the two voltages are in phase, since the two voltage peaks of same polarity are coincident, and least when the two voltages are 180 degrees out of phase, since two peaks of opposite polarity are coincident. Accordingly, between these extremes, the closer the

two voltages are to be in phase, the higher the resultant sum will be; and the farther they are from being in phase, the lower the resultant sum will be.

4-136 The phase of the voltage at the junction of R1 and R2 is closer to the phase of the induced voltage applied across R2 when the line impedance becomes somewhat inductive and thus farther from the phase of the voltage across R1. The opposite effect is obtained when the line impedance becomes somewhat capacitive; the phase of the reference voltage at the junction of R1 and R2 is closer to the phase of the induced voltage applied across R1 and further from the phase of the induced voltage applied across R2. Thus the voltage at R2-CR2 will be greater than the voltage at R1-CR1 when the line impedance contains an inductive component; and conversely, the voltage at R1-CR1 will be greater than the voltage at R2-CR2 when the line impedance contains a capacitive component. When the line impedance is purely resistive, the

phase differences will be equal in both sides of the discriminator, and the voltages at R1-CR1 and R2-CR2 will be equal.

4-137 The RF voltages on each side of the discriminator are rectified by CR1 and CR2 which are connected in opposite directions. The resultant DC voltages are filtered by C2 and C3 and applied across R11 and R12 to ground, respectively. Note that the DC outputs on each side of the discriminator are of opposite polarity. The two DC voltages thus developed are summed in the output network consisting of resistors R4 and R5 and potentiometer R6. Potentiometer R6 is adjusted so that with equal voltages from CR1 and CR2 applied across the output network (a condition resulting from operation with a purely resistive impedance on the transmission line), the output at the wiper of R6 is zero, thus compensating for any unbalance in the discriminator circuit. Thereafter, the output will be zero during purely resistive transmission line conditions, positive with a capacitive component on the line, and negative with an inductive component.

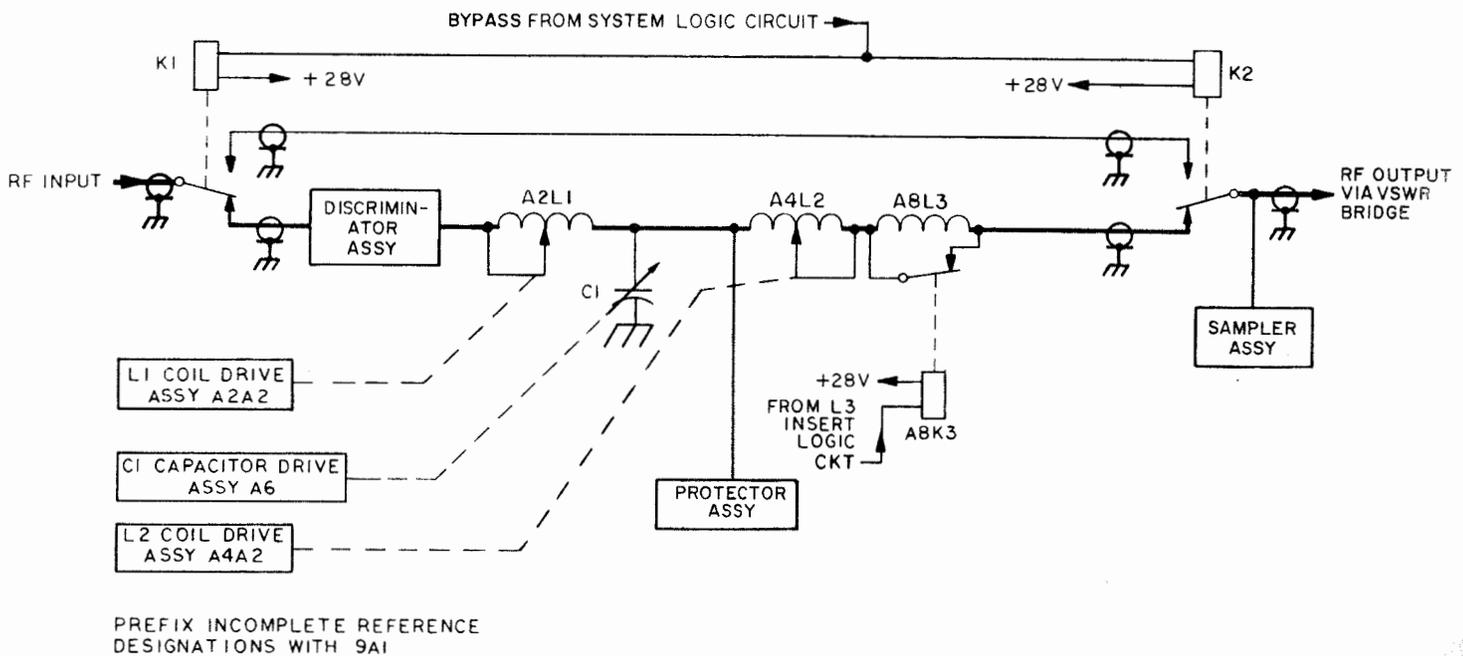


Figure 4-16. Matching Network, Simplified Schematic Diagram

4-138 The error signal described above is applied to one side of a differential amplifier in C1 servo amplifier 10A1A5. The other side of the differential amplifier input is connected to ground through resistor R13. Resistor R13 is used instead of a short circuit to ground so that both sides of the differential amplifier will have the same source impedance. This resistor is located in the discriminator assembly rather than the C1 servo amplifier assembly so that both sides of the differential amplifier will have the same length of lead, and therefore, the same amount of any stray hum or noise pickup. Since a differential amplifier responds only to differences in signal level between its two input, hum or noise signals present equally at both inputs will not be amplified. Capacitors

C4 and C11 are RF bypasses.

4-139 The applicable servicing diagram for this circuit is figure 4-50. Adjustment of balance potentiometer R6 is described in paragraph 5-25. Complete circuit details are shown in schematic diagram figure 5-50, sheet 1.

4-140 R DISCRIMINATOR. The function of the R discriminator (figure 4-18) is to provide a DC output to the L2 servo amplifier indicative of the resistive component of the line impedance. The output is zero with a 50 ohm resistive component greater than 50 ohms, and negative with a resistive component less than 50 ohms. The magnitude of the output increases as the resistive component of the line impedance gets farther from 50 ohms. The L2 servo

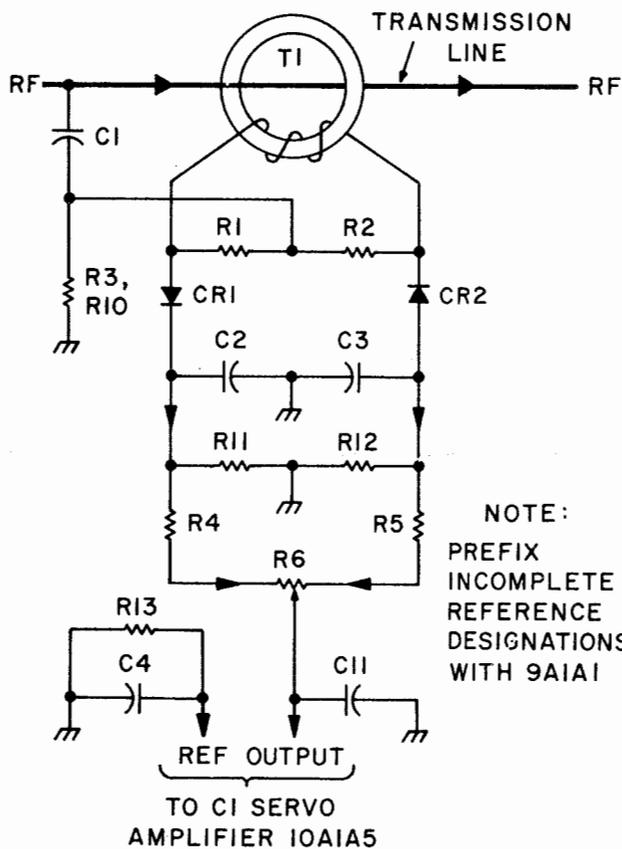


Figure 4-17.  $\theta$  Discriminator Simplified Schematic Diagram

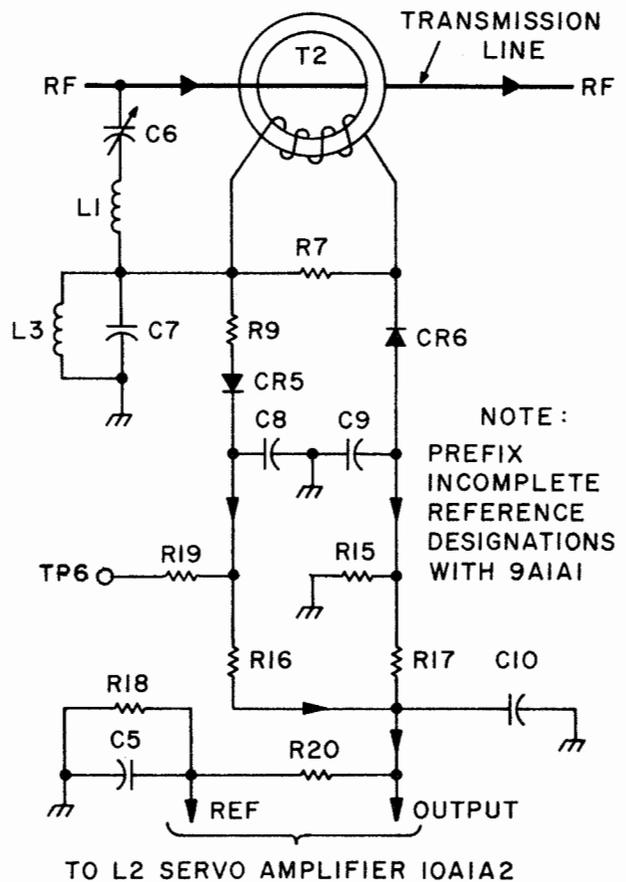


Figure 4-18. R Discriminator, Simplified Schematic Diagram

amplifier tunes L2 to the point at which zero output is applied from the R discriminator.

4-141 Ignoring L1 and L3 which have other functions, it can be seen that capacitive divider C6-C7 produces an RF voltage at the junction of R7 and R9 which is proportional to and in phase with the RF voltage in the transmission line. This voltage is detected by diode CR5 and filtered by capacitor C8, producing a positive DC voltage which is proportional to the transmission line voltage. The transmission line current induces a voltage in the secondary of transformer T2 which, when the line impedance is 50 ohms resistive, is 180 degrees out of phase with and twice the amplitude of the voltage at the junction of C6-C7. The vector sum of the voltage at the junction of C6-C7 and the voltage induced in the secondary of T2 is detected by diode CR6 and filtered by capacitor C9, producing a negative DC voltage across resistor R15. The two voltages are summed at the junction of R16 and R17 and applied to one side of the L2 servo amplifier.

4-142 If the line impedance is 50 ohms resistive, the DC voltages across C8 and C9 will be equal and opposite; and the sum of the two voltages at the output will be zero, indicating that coil L2 is correctly tuned. If the resistive component of the line impedance is greater than 50 ohms, the voltage induced in T2 will be less than that for 50 ohms because there is less current in the transmission line. Therefore, the output of CR6 will be less than the output of CR5, and the sum of the DC voltages will be positive. If the resistive component is less than 50 ohms, there will be a greater transmission line current than with 50 ohms and, therefore, more induced voltage in T2, greater output from CR6 and CR5, and a negative sum of DC voltages at the output to the L2 servo amplifier.

4-143 R20 sets the sensitivity of the R discriminator. Resistor R18 and capacitors C5 and C10 have the same functions as the corresponding parts in the  $\phi$  discriminator (paragraph 4-133). Inductor L3 provides DC return for detectors CR5 and CR6. Resistor R7 is the load resistor for transformer T2. Resistor R9 provides detector CR5 with the same source impedance that resistor R7 provides to detector CR6, thus maintaining balance. At the high end of the operating frequency range, C7 has a small inductive reactance; therefore, L1 is used to provide a corresponding amount of inductive reactance in series with capacitor C6 so that the output from divider C6-C7 will be frequency insensitive. Capacitor C6 is adjusted so that the voltage output from divider C6-C7 will be exactly half of that developed across transformer T2 when the line impedance is 50 ohms resistive. R19 and TP6 are used only for alignment purposes. R15 increases the unbalance of the discriminator when the impedance is greater than 50 ohms but has negligible effect when at 50 ohms or less.

4-144 The applicable servicing diagram for this circuit is figure 4-50. Adjustment of balance capacitor C6 is described in paragraph 5-25. Complete circuit details are shown in schematic diagram figure 5-50, sheet 1.

4-145 VSWR BRIDGE. VSWR Bridge Assembly 9A1A5 in the Tuner is the same as VSWR bridge 1A1A3 in the 1 KW PA, except that the Tuner VSWR bridge has additional outputs. Refer to paragraph 4-45 for a description of the basic bridge circuitry. The functions of the Tuner VSWR bridge are to provide forward and reflected power monitor signals to the peak/power meter circuit in the Tuner for output measurement and to provide similar output signals to the 1 KW PA TGC-PPC circuit for primary control of the transmitter RF power level.

4-146 Refer to figure 4-19. The forward and reflected signals from R6 and R5, respectively, are applied to the PPC input of the 1 KW PA TGC-PPC circuit. The forward output line only is connected to the TGC input of the TGC-PPC circuit, so diode CR5 is employed to allow a high reflected power signal to cross over to the forward output and thereby control the TGC system in cases in which the output of the reflected side of the bridge is greater than the output of the forward side of the bridge. Such a case occasionally occurs during tuning when the matching network elements are far from the correct tuning point.

4-147 The forward and reflected outputs to the peak/average power meter circuit are taken from separate detectors, CR4 and CR1, and through series resistors R3 and R8. DC load resistors R4 and R7 are employed for these detectors only, since the peak/average power meter circuit provides a relatively high resistance load to the detector and fast discharge of filter capacitors C5 and C2 is necessary for proper power meter operation.

4-148 The applicable servicing diagram for this circuit is figure 4-50. Adjustment of balance capacitor C6 is described in paragraph 4-45. Complete circuit details are shown in schematic diagram figure 5-50, sheet 1.

4-149 ARC DETECTOR CIRCUIT. The arc detector circuit (Protector Assembly 9A1A3) consists of an arc gap between two electrodes, a transformer, a detector, and a limiter. The function of this circuit is to supply a momentary positive trigger voltage to the fault section of the I. Box system logic if the RF voltage at the center of the matching network (highest impedance point) reaches an excessive level. The I. Box system logic, in turn, deactivates the

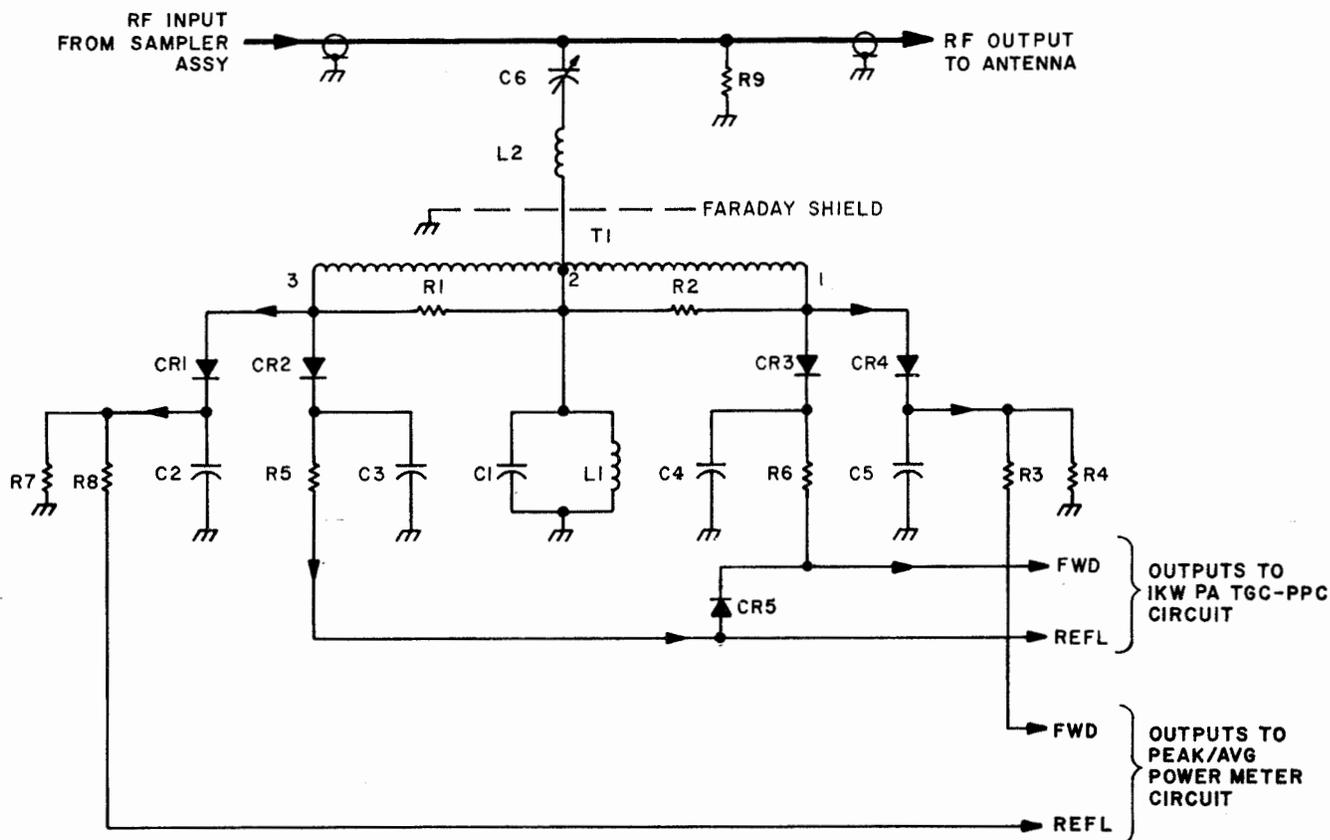
transmitter and applies fault signals to the Tuner Control and Exciter units. The result is to prevent damage from arcing in the Tuner matching network.

4-150 Refer to figure 4-20. When the RF voltage (or even a static voltage which might come back from the antenna) reaches a level great enough to arc across the spherical electrodes of spark gap E3, a current flow through the primary of transformer T1 induces a voltage in the secondary. The voltage is detected by A1CR1, filtered by A1C1, and limited in amplitude by A1CR2-CR3. The resulting DC output triggers a latching SCR in the I. Box system logic fault circuit. The SCR in that circuit must then be reset to resume normal operation.

4-151 There are no adjustments necessary for the circuit. If repairs are made to spark gap electrodes (E3), they should be spaced as originally done at the factory. The applicable servicing diagram for this circuit is figure 4-50. Complete circuit details are shown in schematic diagram figure 5-50, sheet 1.

4-152 SAMPLER CIRCUIT. The sampler circuit (RF Sampler Assembly 9A1A9, figure 5-50) consists of a capacitive RF voltage divider and two isolation resistors. The function of the circuit is to allow the output of the 1 KW PA and the Tuner to be monitored at front and rear panel monitor jacks.

4-153 SERVO AMPLIFIERS. Three basically identical servo amplifiers are used; the L2 and C1 servo amplifiers are located in the Tuner Control unit and the L1 servo amplifier is located in the I. Box unit. Refer to figure 4-21. Each consists of a differential amplifier (Q3, Q5), a cross-coupled amplifier (Q4, Q6), four drivers (Q1, Q2, Q7, and Q8), and two capacitor discharge transistors (Q9, Q10). The



NOTE:  
PREFIX INCOMPLETE REFERENCE  
DESIGNATIONS WITH 9AIA5

Figure 4-19. Tuner VSWR Bridge, Simplified Schematic Diagram

function of these circuits is to provide signals to the L1, L2, and C1 motor control circuits to direct positioning of the variable tuning elements in the matching network. The three servo amplifiers are basically the same, with slight differences due to individual tuning requirements. The L2 and C1 servo amplifiers are used only for automatic or semi-automatic operation. The L1 servo amplifier is used for all types of operation, including manual operation.

4-154 The input to the C1 servo amplifier is provided by the  $\phi$  discriminator. The input to the L2 servo amplifier is provided by the R discriminator. These two servo amplifiers respond to the output signals of the discriminators (which are either positive or negative at any instant with respect to the reference line) by activating the motor control circuits to drive the tuning elements in the proper direction until a zero error signal is received.

4-155 The L1 servo amplifier receives its reference line and input signals from a bandswitched potentiometer arrangement in the I. Box and the position indicating potentiometer (9A1A2A2R1) in the Tuner, respectively. The DC signal from the selected I. Box potentiometer (7A1A4R1-R8) is compared with the position indicating signal from the Tuner; and the L1 motor control circuit is activated to drive the variable inductor to the preset position, i. e., the position corresponding to the potentiometer setting established for that frequency during alignment.

4-156 In each of the servo amplifiers, the input circuit is a differential amplifier which compares the signal on the input line with the signal on the reference line and corrects the positioning of the tuning elements until input and reference line signals are identical in magnitude and polarity. In the case of the L1 servo amplifier, two positive signals are compared. In the cases of C1 and L2 servo amplifiers, a discriminator output signal is essentially compared to ground; but the reference input is tied to ground through a wire running back to the discriminator and a resistor in the discriminator so that both sides of the differential amplifier input have the same line length and impedance and thus the same stray noise or hum pickup. The R and  $\phi$  discriminators are connected to the L2 and C1 servo amplifiers only during automatic and semi-automatic operation through the respective servo loop switching and metering circuits.

4-157 In the L2 and C1 servo amplifiers, the emitters of differential amplifier transistors Q3 and Q5 are returned to -4 VDC through a potentiometer which is used to balance the two transistors in the stage, and both transistors are normally conducting. The polarity of the

discriminator output signal determines which of the two transistors will conduct most, and thus which side of the cross-coupled amplifier will turn on. In the L1 servo amplifier, the emitters of Q3 and Q5 are returned through a balancing potentiometer to a constant current source stage to maintain uniform sensitivity over the somewhat wider range of input voltages which is used with the L1 servo amplifier. The input transistor which has the most positive input signal applied to it will conduct most and thus turn on the corresponding side of the cross-coupled amplifier.

4-158 Assuming that the input line is supplied with a signal more positive than the reference signal, Q5 turns on harder than Q3. Then Q4 in the cross-coupled amplifier stage will be forward biased and Q6 will be reverse biased, so Q4 conducts and turns on emitter follower Q2 which, in turn, biases driver Q1 into saturation to apply a ground to the home line to the motor control circuit. Q7 and Q8 are turned off because Q6 is reverse biased. Similarly, if the input signal was less positive than the reference signal, transistors Q3, Q6, Q7, and Q8 would conduct, applying a ground on the tune line to the motor control circuit, and Q4, Q2, and Q1 would be turned off.

4-159 The tune and home lines are so named because the home line makes the motor control circuit drive the tuning element toward the end stop normally used for home position, and the tune line makes the tuning element drive in the direction away from that home. In tuning, however, the tuning element can actually be driven in either direction depending on the input signal polarity and consequently which output line is grounded. Also, in the case of the C1 servo amplifier, at the higher frequencies it is necessary to home at the opposite end of

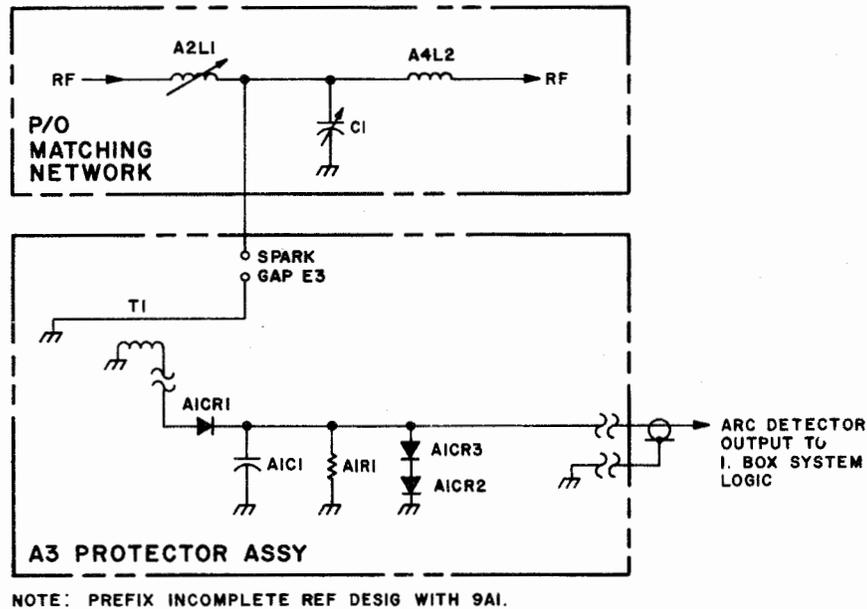


Figure 4-20. Arc Detector Circuit, Simplified Schematic Diagram

the capacitor range; so that circuit can home in either direction, i.e., home at either minimum or maximum capacitance. In the L1 servo amplifier, which is used for prepositioning according to a program, the inductor is never homed; it is driven directly to its final position.

4-160 Capacitors C2 and C3 are audio by-passes for Q4 and Q6. They prevent the servo amplifier from trying to follow modulation of the RF signal. Capacitor discharge transistors Q9 and Q10 are employed to rapidly discharge C2 and C3 when the correct tune point is reached to prevent over-travel due to the stored charge in the capacitors. As long as the appropriate transistor of the cross-coupled amplifier is turned on, the capacitor discharge transistor is cut off, since the corresponding diode (CR6 or CR7) is conducting and thus the emitter and base are at the same potential. But when the tuning point is reached and the cross-coupled amplifier transistor is turned off, the diode is

reverse biased to isolate the base and emitter of the capacitor discharge transistor, and the emitter is held at a higher positive voltage than the base; therefore, the transistor conducts heavily to ground to rapidly discharge the capacitor. When the capacitor is discharged, the transistor again turns off.

4-161 Resistors R6 and R12 are the normal loads for the cross-coupled amplifier transistors. When fine tuning at high power with the L2 and C1 servo amplifiers, the tune logic circuit grounds the tune sensitivity drive line input which causes additional load resistors R26 and R27 to be connected through isolation diodes CR8 and CR9. The result is to reduce the sensitivity by lowering the effective load resistance at the collectors of Q5 and Q6. Such action is necessary due to the increased output of the discriminators at high power levels. In the L1 servo amplifier, CR9 and R27 are not used. The input to CR8 is grounded by the decoder-encoder assembly in the I. Box when its rotary

NOTES:

1. Prefix incomplete reference designations with 10A1A5.
2. C1 servo amplifier shown is typical of all three circuits - C1, L1, and L2 servo amplifiers - with few exceptions.
3. Both home signal inputs are used only in C1 servo amplifier. Designator of potentiometer 10A1R7 changes for other circuits. R24 is replaced by constant current source stage for L1 servo amplifier. Refer to schematic diagrams, figures 5-49 and 5-51, for variations.

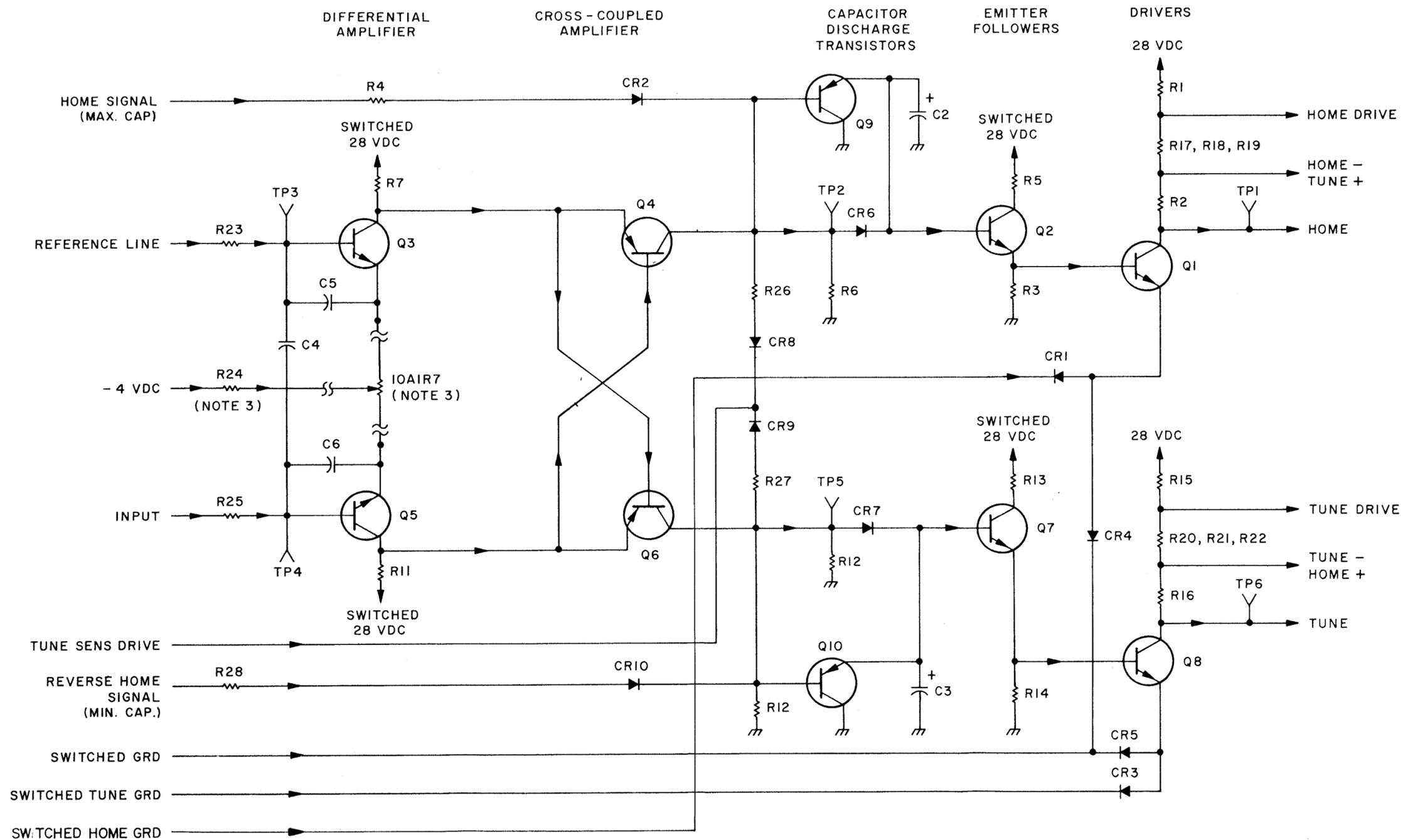


Figure 4-21. C1 Servo Amplifier, 10A1A5 Simplified Schematic Diagram

solenoid is running. The effect is to force L1 toward the maximum inductance end while the solenoid is running, so that when the solenoid stops, the rotor on L1 will be away from the minimum inductance end. Thus, for the highest frequency bands, which are critical, L1 will always position in the same direction to allow overshoot to be compensated for in the original alignment. The ground returns for the emitters of Q1 and Q8 are provided only at desired times through switched ground lines and isolation diodes (CR1, CR3, CR4, CR5). For the L2 and C1 servo amplifiers, the servo loop switching and metering circuits (paragraphs 4-164 and 4-169) supply a ground in automatic and semi-automatic operation to both emitters through the switched ground line and diodes CR4 and CR5. In manual and semi-automatic operation, ground is switched individually to the emitters of Q1 and Q8 through the normally closed contacts of the LEFT and RIGHT pushbutton switches, the switched home ground and switched tune ground lines, and CR1 and CR3. For the L1 servo amplifier, ground does not have to be removed at any time; so a constant ground is applied to both emitters through the switched ground line, and the switched tune ground and switched home ground lines are not used.

4-162 Home signal lines are provided in the servo amplifier through R4 and CR2 to the collector of Q4 and through R28 and CR10 to the collector of Q6, respectively. These lines are not used in the L1 servo amplifier, as no homing, as such, is necessary. In the L2 servo amplifier, only one home signal line is used; and in the C1 servo amplifier, both home signal lines are used. When a tuning cycle is first initiated, the home logic circuit provides a positive signal through the home line to the base of the emitter follower to

force the tuning element to home by turning on the appropriate driver transistor. In the case of the C1 servo amplifier, the home logic signal is applied to either home signal line depending on switching in the decoder-encoder circuit bandswitch in the I. Box, which directs the home signal to one home signal line for some frequency bands and to the other home signal line for other bands.

4-163 The applicable servicing diagrams for the servo amplifiers are figure 4-50, sheets 1 and 2. Servo balance adjustments are described in paragraph 5-28. Complete circuit details are shown in schematic diagrams: figure 5-51, sheet 2 and figure 5-49, sheet 2.

4-164 MOTOR CONTROL CIRCUITS. Each motor control circuit (figure 4-22) consists of four drivers, a servo motor, two end stop switches, and various isolation diodes. With the exception of reference designations and connections, three identical motor control circuits are used: one in the L1 servo loop, one in the L2 servo loop, and one in the C1 servo loop. The circuit components are located partly in the Tuner and partly in the Tuner Control and the I. Box. The function of the motor control circuits is to energize the servo motors with the correct polarity to run them in the desired direction. Reference designations used in the following discussion are for the C1 motor control circuit.

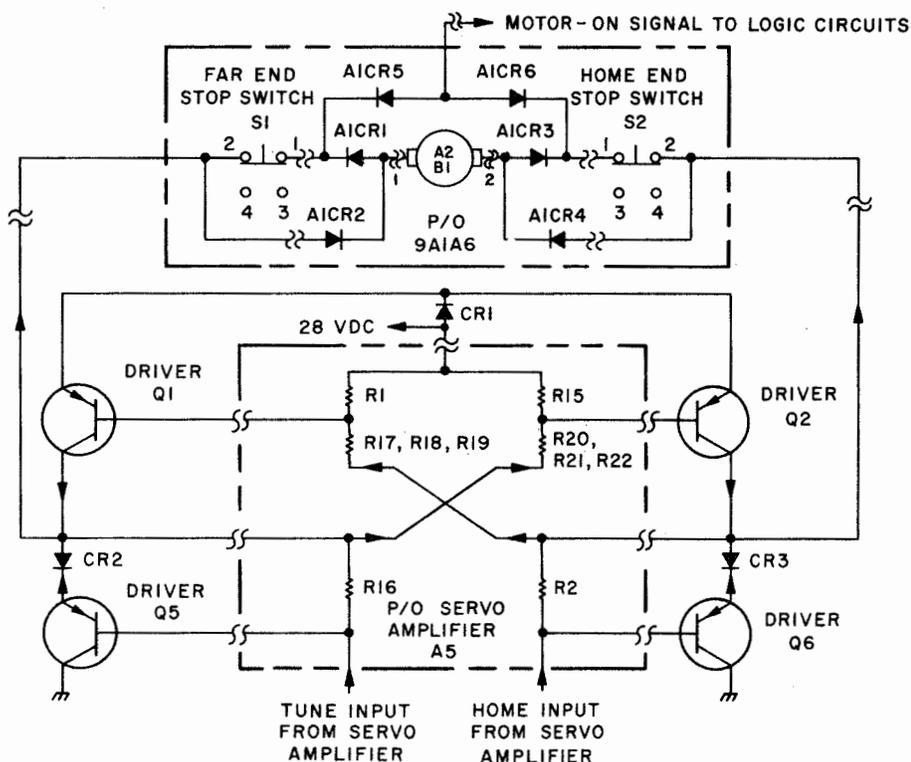
4-165 If we wish to energize the C1 servo motor in a minimum capacity direction of rotation, the tune output from the C1 servo amplifier will be at ground, applying a ground signal to the base of transistor Q5. This ground turns transistor Q5 on, resulting in the application of ground to terminal 1 of C1 servo motor 9A1A6A1B1. This ground is also applied through diode

9A1A6A1CR5 to energize the brake logic to release the motor brake. Turning transistor Q5 on also grounds the bottom of voltage divider A5R15-R20-R21-R22, causing transistor Q2 to conduct. Therefore, 28 VDC is applied through transistor Q2 and diode 9A1A6A1CR3 to terminal 2 of C1 servo motor 9A1A6A2B1. This establishes current flow through the servo motor in the correct polarity for a tune direction of rotation.

4-166 If the maximum capacity direction of rotation is needed, the C1 servo amplifier home output grounds the base of transistor Q6. Therefore, ground is applied to terminal 2 of C1 servo motor 9A1A6A2B1 and through diode 9A1A6A1CR6 to the brake logic. Transistor Q1 is energized by voltage divider A5R1-R17-R18-R19 to apply 28 VDC to terminal 1 of C1 servo motor

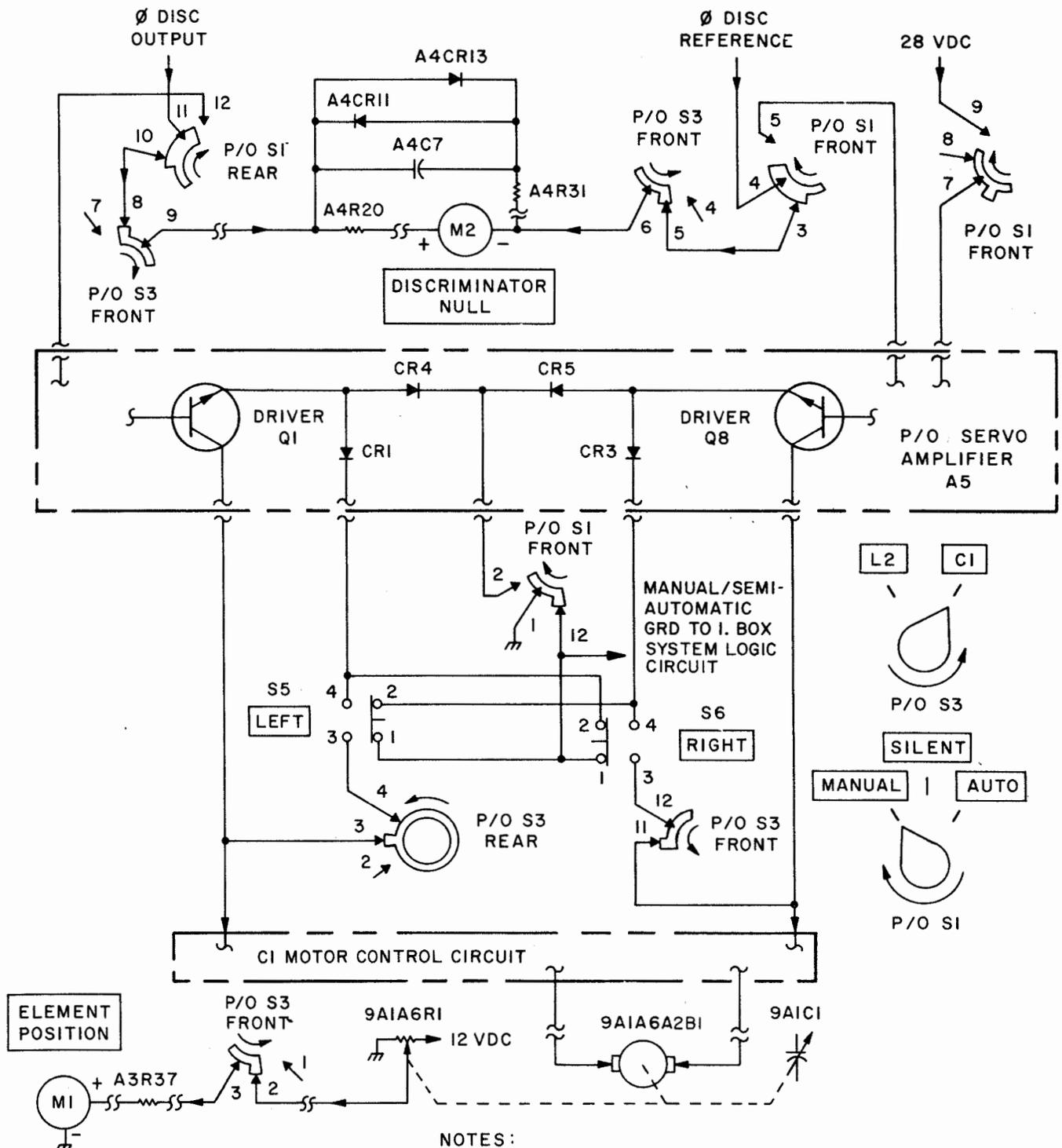
9A1A6A2B1. This produces current flow through the servo motor with the correct polarity for a home direction of rotation.

4-167 The home and far end stop switches serve as limit switches to stop the motors and protect the tuning elements from being driven too far. For example, during a tuning cycle, the L2 and C1 servo motors drive those tuning elements to a home position. When the home position is reached, the normally closed end stop switch contacts open to break the motor energizing circuits. In addition, the normally open contacts of the L1 and L2 end stop switches provide ground signals to the logic circuits to indicate that those tuning elements have reached the end of their travel. The normally open contacts of the C1 end stop switches are not used.



- NOTES:
1. PREFIX INCOMPLETE REFERENCE DESIGNATIONS WITH 10A1.
  2. C1 MOTOR CONTROL CIRCUIT SHOWN IS TYPICAL OF ALL THREE CIRCUITS - C1, L1, AND L2 MOTOR CONTROL CIRCUITS - WITH THE EXCEPTION OF REFERENCE DESIGNATIONS.

Figure 4-22. C1 Motor Control Circuit, Simplified Schematic Diagram



- NOTES:
1. PREFIX INCOMPLETE REFERENCE DESIGNATIONS WITH IOAI.
  2. L2 SERVO LOOP SWITCHING AND METERING CIRCUIT IS THE SAME AS SHOWN WITH APPROPRIATE SWITCH AND REFERENCE DESIGNATION CHANGES.

Figure 4-23. C1 Servo Loop Switching and Metering Circuit, Simplified Schematic Diagram

4-168 The applicable servicing diagrams for these circuits are figure 4-50, sheets 1 and 2. Complete circuit details are shown in schematic diagrams; figure 5-50, sheet 1; figure 5-51, sheet 2; and 5-49, sheet 2.

4-169 C1 SERVO LOOP SWITCHING AND METERING CIRCUIT. The C1 servo loop switching and metering circuit (figure 4-23) provides switching and metering to allow variable capacitor 9A1C1 to be adjusted automatically or manually according to the mode of operation.

4-170 During automatic operation, mode selector switch S1 provides all the necessary switching. (The tuning cycle is completely automatic.) The input from the  $\phi$  discriminator is applied through contacts 11 and 12 of S1-rear to C1 Servo Amplifier A5. The  $\phi$  discriminator reference signal is applied to A5 through contacts 4 and 5 of S1-front. The ground for terminating the emitters of transistors A5Q1 and A5Q8 is applied through contacts 1 and 2 of S1-front and diodes A5CR4 and A5CR5. During this mode of operation, pushbuttons S5 and S6 are disabled by breaking the ground path through contacts 1 and 12 of S1-front. This avoids the possibility that accidentally depressing one of the pushbuttons while the set is automatically tuning could cause both a home and a tune output to be supplied to the motor control circuit at the same time.

4-171 Semi-automatic operation allows variable capacitor 9A1C1 to be prepositioned without the use of RF power. During automatic or manual operation, the indication of ELEMENT POSITION meter M1 can be recorded for each allocated operating channel. Variable capacitor 9A1C1 can then be adjusted (in semi-automatic mode) for each operating channel without using RF power by setting the L2-C1 switch at C1 and depressing the LEFT and RIGHT pushbuttons as required until the ELEMENT POSITION meter indicates the prerecorded position for that channel. Depressing LEFT push-

button S5 connects ground through contacts 1 and 12 of S1-front, normally closed contacts 1 and 2 of S6, normally open contacts 4 and 3 of S5, and contacts 3 and 4 of S3-rear to the home input to the C1 motor control circuit. depressing RIGHT pushbutton S6 applies ground through contacts 1 and 12 of S1-front, normally closed contacts 1 and 2 of S5, normally open contacts 4 and 3 of S6, and contacts 12 and 11 of S3-front to the tune input to the C1 motor control circuit. Therefore, depressing a pushbutton energizes servo motor 9A1A6A2B1 in either a home or tune direction of rotation. As the motor adjusts capacitor 9A1C1, the setting of potentiometer 9A1A6R1 is also changed. This varies the voltage applied through contacts 2 and 3 of S3-front and A3R37 to ELEMENT POSITION meter M1. Thus, ELEMENT POSITION meter M1 provides an indication of element position, allowing the element to be preset to any desired position. When the transmitter is keyed, variable capacitor 9A1C1 is automatically fine-tuned as required to compensate for tuning errors. The required connections are as follows. The output and reference leads from the  $\phi$  discriminator are applied to C1 Servo Amplifier A5 through contacts 11 and 12 of S1-rear and contacts 4 and 5 of S1-front, respectively. Ground for terminating the emitter of transistor A5Q8 is applied through contacts 1 and 12 of S1-front, normally closed contacts 1 and 2 of S6, and diode A5CR1. The ground path for the emitter of each transistor passes through the contacts of that pushbutton which causes rotation in a direction opposite to that produced when the transistor is turned on. This interlocks the home and tune lines so that accidental depressing of a pushbutton cannot cause both a home and a tune input to be applied to the motor control circuit at the same time during fine-tuning. Similarly, this interlock prevents accidental keying of the transmitter from causing a home and a tune output from being applied to the motor control circuit at the same time while rough positioning with the pushbutton.

4-172 Manual operation allows variable capacitor 9A1C1 to be adjusted if a failure occurs in the logic or C1 servo amplifier circuits. When the Mode Selector switch is set at MANUAL and the L2-C1 switch is set at C1, the  $\phi$  discriminator output is connected through contacts 11 and 10 of S1-rear, contacts 8 and 9 of S3-front, and resistor A4R20 to one side of DISCRIMINATOR NULL meter M2. The  $\phi$  discriminator reference lead is connected through contacts 4 and 3 of S1-front and contacts 5 and 6 of S3-front to the other side of DISCRIMINATOR NULL meter M2. With RF power applied to the Tuner, DISCRIMINATOR NULL meter M2 provides a relative indication of the polarity and magnitude of the discriminator error signal. Using this indication as a guide, the servo motor can be energized using the push-buttons (as was explained for semi-automatic operation) to position capacitor 9A1C1 to obtain a null indication on DISCRIMINATOR NULL meter M2. The magnitude of the error signal applied to DISCRIMINATOR NULL meter is limited by diodes A4CR13 and A4CR11 to prevent damage to the meter. Capacitor A4C7 is an RF bypass. During manual operation, the servo amplifier is not used, and therefore the 28 VDC normally applied to the servo amplifier through contacts 9 and 7 of S1-front is not supplied.

4-173 The applicable servicing diagram for this circuit is figure 4-50. Complete circuit details are shown in schematic diagrams: figure 5-50, sheet 1, and figure 5-51, sheet 1 and 2.

4-174 L2 SERVO LOOP SWITCHING AND METERING CIRCUIT. The L2 servo loop switching and metering circuit provides switching and metering to allow variable inductor 9A1A4L2 to be adjusted automatically or manually according to the

mode of operation. This circuit is identical to that used in the C1 servo loops, with the exception of switch contacts and reference designations.

4-175 The applicable servicing diagram for this circuit is figure 4-50. Complete circuit details are shown in schematic diagrams: figure 5-51, sheet 2 and figure 5-50, sheet 1.

4-176 L1 SERVO LOOP CONTROL CIRCUIT. The L2 servo loop control circuit (figure 4-24), which is housed in the I. Box unit, consists of element position potentiometer 9A1A2A2R1, rotary switch wafers S1-BF and S1-CF and position potentiometers R1-R8. The function of this circuit is to provide the necessary servo loop signals to L1 servo amplifier assembly 7A1A1A4 so that variable inductor 9A1A2L1 will be positioned according to inductance requirements for various frequency bands. The same function occurs in manual, semi-automatic, and automatic operating modes.

4-177 When the transmitting set is activated and a frequency is selected, rotary solenoid S1L1 (part of Encoder-Decoder Assembly 7A1A4) rotates switch wafers S1-BF and S1-CF select one of eight position potentiometers (R1-R8). Some switch contacts are jumpered so that one potentiometer may be used for more than one frequency band of the 1 KW PA. A DC voltage is thus produced at the wiper of the selected potentiometer. The potentiometer is set during alignment to correctly position variable inductor 9A1A2L1 for the corresponding frequency band. The reference signal from the selected position potentiometer is applied to L1 Servo Amplifier 7A1A1A4 along with a DC input signal from element position potentiometer 9A1A2A2R1. The servo amplifier compares the input and reference signals and, together with the L1 motor control circuit, operates motor 9A1A2A2B1 to tune the variable inductor in the required

direction until the input signal from the element position potentiometer is of identical amplitude with the reference signal from the selected position potentiometer.

4-178 The applicable servicing diagram for this circuit is figure 4-50. Adjustment of L1 position potentiometers R1-R8 is described in paragraph 5-28. Complete circuit details are shown in schematic diagrams: figure 5-49, sheet 2 and figure 5-50, sheet 1.

4-179 PEAK/AVERAGE POWER METER CIRCUIT. The peak/average power meter circuit (figure 5-50, sheet 2) consists of six stages of signal processing, employing amplifiers, detectors, and shaping networks, and a meter and associated selector switches. The function of the circuit is to convert envelope signals from the relatively high impedance outputs of the VSWR bridge to true peak and average power DC signals with a relatively low source impedance to drive the power meter on the Tuner panel.

4-180 Refer to figure 4-25. The input amplifier consists of a pair of transistors connected to operate as an emitter follower, but with a higher input impedance than with a single transistor emitter follower. The output signal is applied simultaneously to the peak and average processing circuits. The outputs of the peak and average processing circuits are connected selectively through PEAK/AVG switch 9A1A11S2 to the power meter. The switch also reverses the meter connections to accommodate the positive output voltage of the peak circuit and the negative output of the average circuit.

4-181 The peak detector circuit consists of two cascaded differential amplifiers, with the single output of the second stage connected in such a manner that it can rapidly charge C14 to a positive level, but

not discharge it. One input to the first differential amplifier (Q4-Q7) is supplied from the output of the emitter follower input stage which is essentially an envelope of the transmitted signal waveform. The input to the other side of the differential amplifier is connected to C14, a capacitor which supplies the signal to the meter. Because of the common mode element (R44 in the emitter circuits of both Q4 and Q7), the two emitters are always at close to the same potential. One of the transistors will usually be turned on at any particular time, depending on which base has a voltage sufficiently higher than the common emitter voltage.

4-182 Q4 can conduct only when the voltage at its base is greater than the voltage on C14, since by emitter-follower action C14 and Q7 regulate the emitter voltage of Q4, and thus the cut-off voltage for the base of Q4. Q5 conducts to charge C14 whenever Q4 conducts.

4-183 Because of the common mode emitter action at R42, whenever the voltage at the base of Q4 drops below that at the base of Q7, Q7 and Q6 conduct to cut off Q5 and prevent discharge of C14. A fast attack, slow release time constant results from the extremely fast charging of C14 through the high gain amplifier circuit and the slow discharge through the relatively light loading of R45 and the power meter in parallel with the Q7 base circuit.

4-184 Diode CR42 protects C14 against the possibility of reverse voltage application from the emitter circuit of Q7. Diodes CR8 and CR9 protect against reverse voltage breakdown from emitter to base in transistors Q4 and Q7. Potentiometer 9A1A11R57 in series with the meter signal line is adjusted for proper full scale reading on the 1500 watt range. When using the REFL PWR 0-150 watt range, switch 9A1A11S1 bypasses the potentiometer to lower the voltage required for full scale meter deflection.

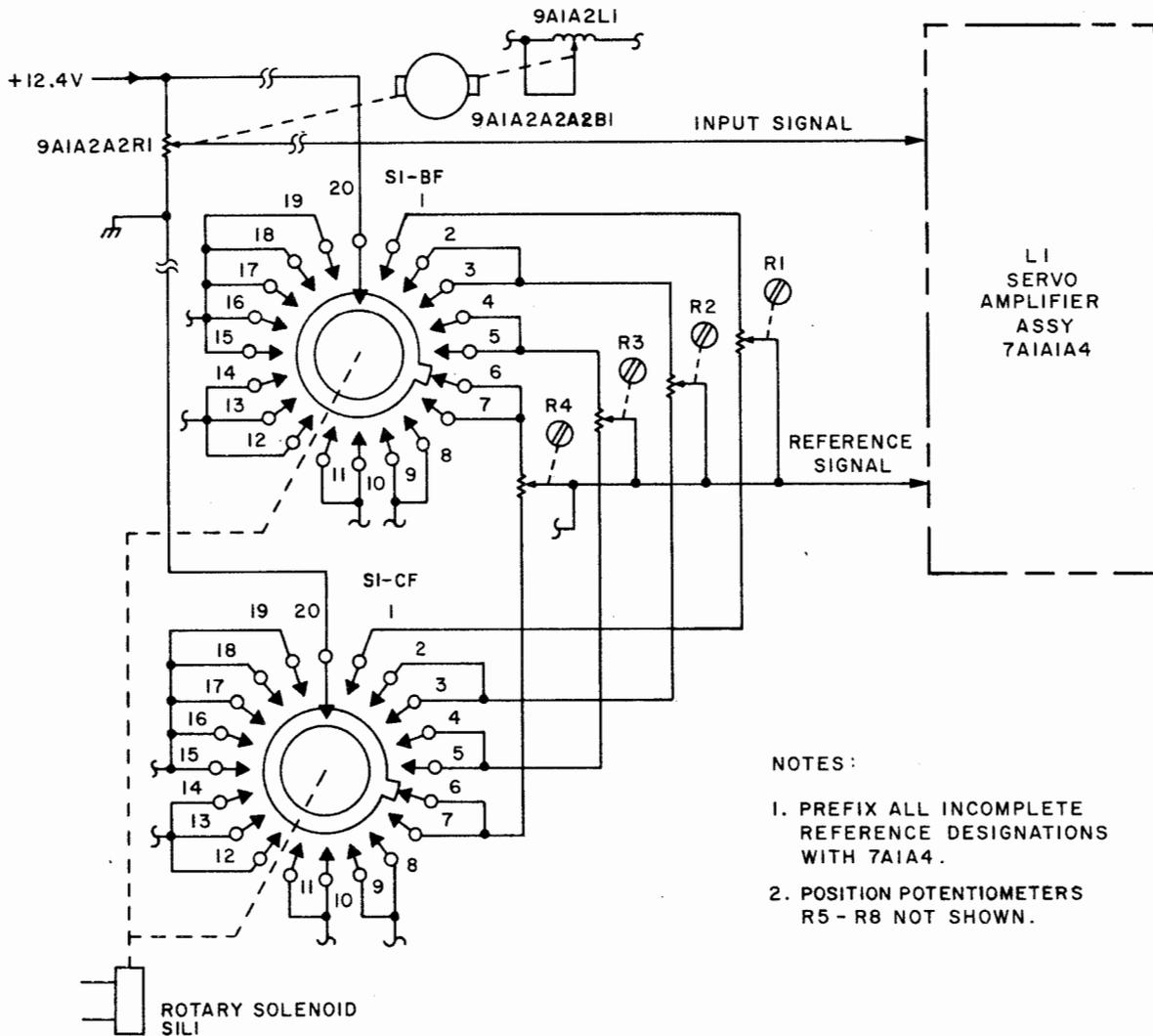


Figure 4-24. L1 Servo Loop Control Circuit, Simplified Schematic Diagram

4-185 Refer to figure 4-26. The average power section consists of integrator IC1 and its associated input and output shaping networks. The integrator stage requires an input signal which has a voltage directly proportional to the RF power level at the output of the transmitter. However, the output of the VSWR bridge, and thus the output of the emitter-follower input amplifier, is approximately proportional to the

square root of the output power. Therefore, a shaping network (to be discussed later) is used before the integrator to compensate for the response of the VSWR bridge. Since the original response is of the type desirable to operate the meter (providing a compression at high power levels), additional shaping networks are used at the output of the integrator. Separate ones are used due to the use of different scales on the meter

for the 150 watt and 1500 watt ranges.

amplifier, which is employed in a fashion which allows it to respond to the average value of the input signal. The device has a

4-186 Integrator IC1 is an operational

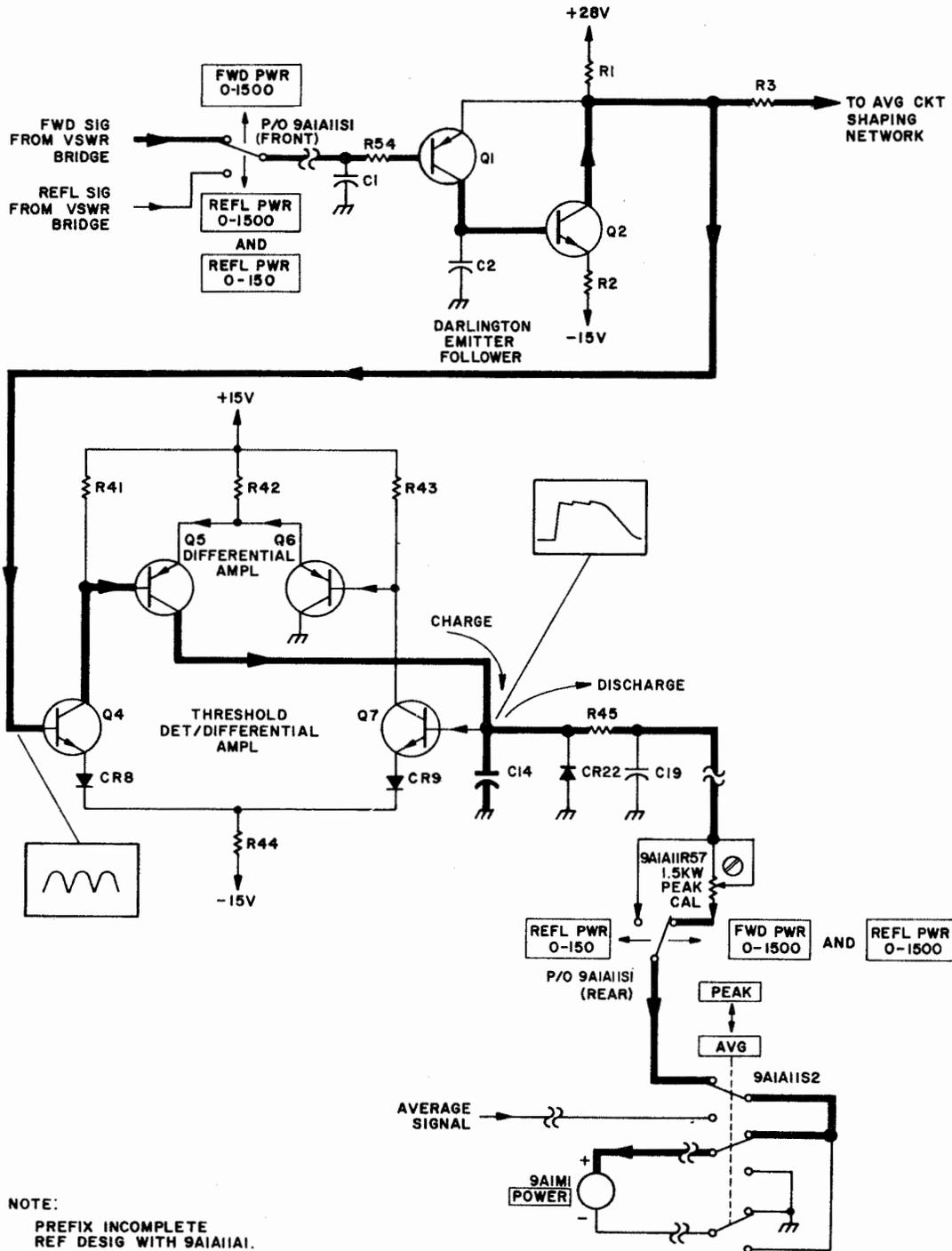


Figure 4-25. Peak/Average Meter Circuit; Input Amplifier, Peak Detector, and Meter; Simplified Schematic Diagram

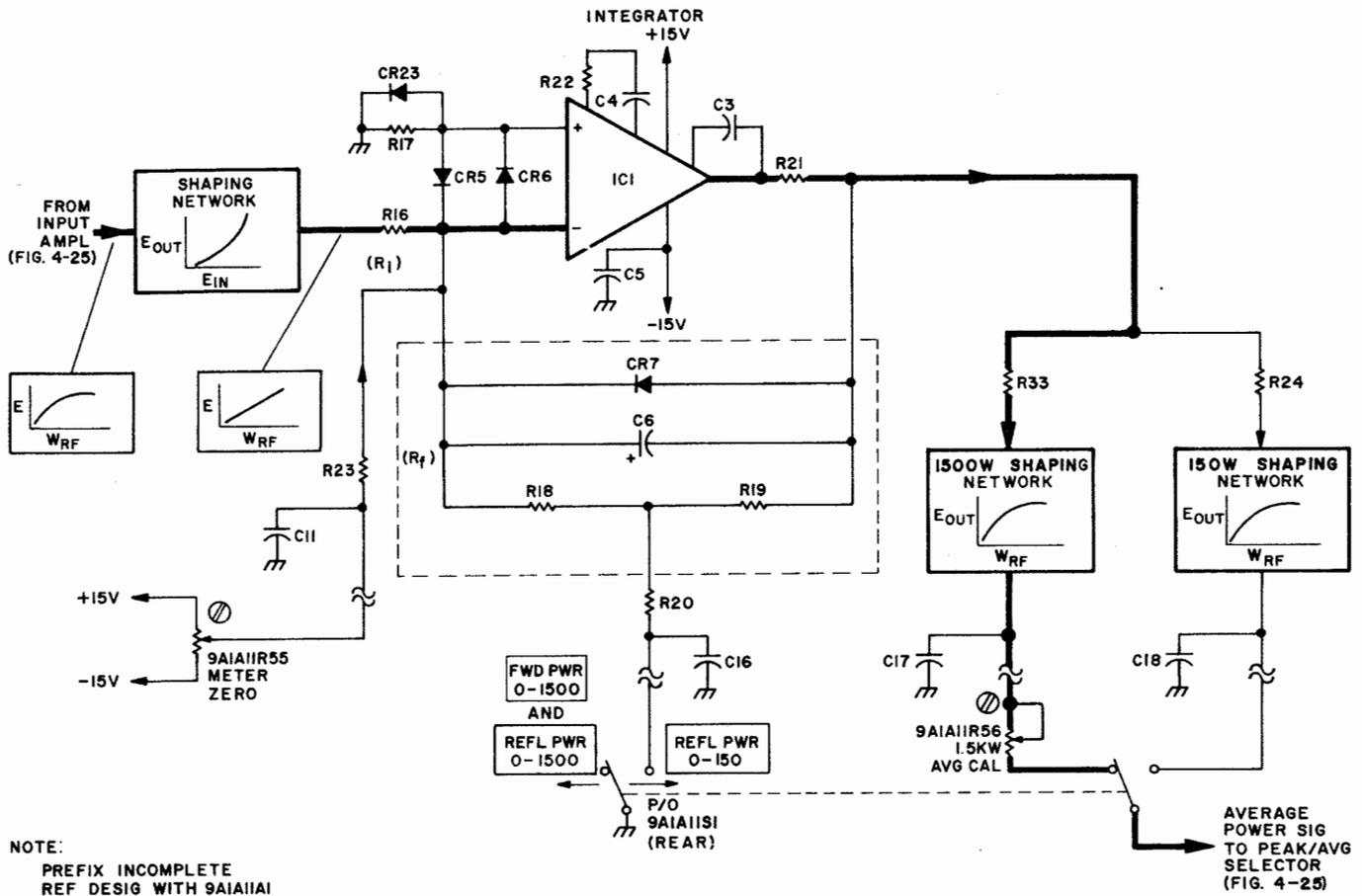


Figure 4-26. Peak/Average Power Meter Circuit, Average Section, Simplified Schematic Diagram

very high input impedance, a low output impedance, high current gain, and an inverted output (positive signal applied to inverting input port). The voltage gain of the stage is determined by the feedback and input networks. The voltage gain is normally 1; and it is increased to 10 for the 150 watt range.

4-187 The normal voltage gain is determined by the impedance of the feedback network ( $R_f$ ) divided by the impedance of the input resistance ( $R_i$ ). Consider-

ing the parts of  $R_f$ , it is evident that the DC voltage gain is established by the ratio of  $R_{18}$  and  $R_{19}$  (in series) to  $R_{16}$ .  $R_{18} + R_{19} = R_{16}$ , so the gain is normally 1. For AC signals,  $C_6$  provides a very low impedance compared to  $R_{16}$ , so there is essentially no voltage developed due to the AC component of the input envelope signal. The output of the integrator, therefore, only responds to the DC component of the envelope signal. The output is a slowly varying DC voltage which follows the average power, regardless of the wave-

form characteristics of the RF signal. Diode CR7 protects C6 against reverse polarity. Resistor R20 is grounded when 9A1A11S1 is set to the REFL PWR 0-150 watt range to increase the gain of the integrator stage. R18, R19 and R20 then act as a "T" pad attenuator to reduce the feedback and thus increase the DC gain.

4-188 A bias voltage, set by meter zero potentiometer 9A1A11R55, is applied through R23 to the input port of the IC to balance the idling output of the stage. Diodes CR5 and CR6 protect the amplifier by limiting the input. Diode CR23 prevents latch up if the positive supply is applied momentarily sooner at turn on than the negative supply. The capacitors which have not been discussed as yet are for RF bypassing and protection against oscillation. R21 is a current limiter.

4-189 Refer to figure 4-27 during the following discussion of the input shaping network. The network consists of three diode-resistor voltage dividers, a constant current source, and a temperature compensating transistor stage. The compressed signal from the input emitter follower amplifier is applied to the network through R3, which is considered as half of a voltage divider. The three diode-resistor networks are the other half.

4-190 The example voltages marked at the junctions of the biasing networks for the diodes and the response curves illustrate how the biased diodes turn off at progressively increasing voltages at the input of R3 to lighten the loading at the "bottom" part of the voltage divider. Starting at 0 volts applied to R3, all diodes are conducting, and thus load the output side of R3. As the voltage at the cathode of each diode approaches the bias voltage applied at the anode, the diode begins to

gradually turn off. The degree to which each diode circuit loads the output of R3, when the diode is fully conducting, is dependent upon the values of the resistors in the biasing voltage divider (R4-R5, R6-R7, or R8-R9). As the diode begins to cut off, its resistance increases and adds to that of the biasing resistors to increase the load resistance. At cut-off, the diode no longer loads the output of R3; therefore the voltage at the output of the shaping network can increase faster with respect to the increase in R3 input voltage. Values of resistance and bias are selected to provide the results shown at the bottom curve, to compensate for the compression of the signal applied to the input of R3.

4-191 The bottom of each biasing network is tied to ground through Q3, which compensates for changes in diode conductance with temperature. The transistor base-emitter junction is connected in a manner such that its change with temperature offsets that in the diodes. Constant current source transistor Q8 is provided to absorb the idling current which flows from the diodes circuits into the shaping network output line. This operates in conjunction with the meter zero potentiometer in the integrator stage to set the input to the integrator to zero volts with no input signal at R3. Diode CR4 in the constant-current-source stage temperature compensates transistor Q8.

4-192 The two output shaping networks (not shown) each have slightly different characteristics due to the separate meter scales for the high and low ranges, and they operate in a similar but reverse manner from the input shaping network. The diodes are connected and biased to turn on in progression, rather than turn off, to provide the opposite response and thus convert back to a non-linear voltage to RF power relationship. A temperature compensating transistor is provided, as in the input shaping network. However, because the diodes are used in

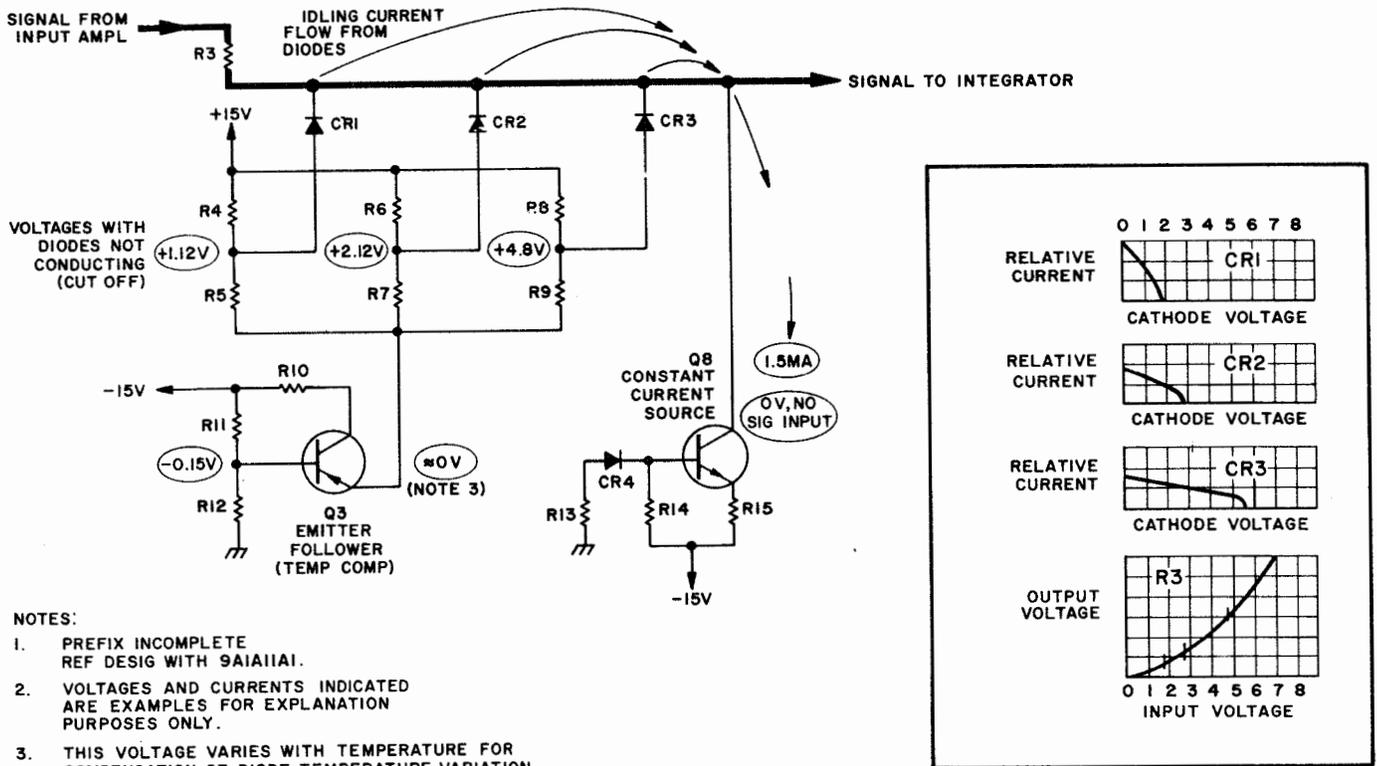


Figure 4-27. Input Shaping Network, Simplified Schematic Diagram

opposite manner, the emitter-base junction temperature effect of the compensating transistor adds to the temperature problem, in this case, instead of compensating. Therefore, two series diodes are used in the compensating transistor base-biasing circuit; one to cancel the base-emitter effect and one to provide the desired compensation.

4-193 The +28V power for the metering circuit is provided from the Tuner Control unit. The 15V power is supplied by a separate power supply in the Tuner unit. Refer to figure 4-28. 220 VAC power from the autotransformer in the cabinet is applied to the primary of 9A1T1. The low voltage AC from the

secondary is bridge rectified, and the transformer secondary is center-tapped to provide both positive and negative voltages. The DC voltages are filtered by 9A1C1 and 9A1C2, and supplied to the load through emitter-follower pass transistors Q1 and Q2. The base voltages are regulated by a combination of zener diodes and conventional diodes, utilizing the zener characteristics of the zener diodes and the forward voltage drops of the conventional diodes to provide regulation and temperature compensation. Since Q1 is not rated for as great a collector dissipation as Q2, R1 is added in its collector circuit so that the entire excess voltage is not dropped in the transistor, thus reducing the heating in Q1.

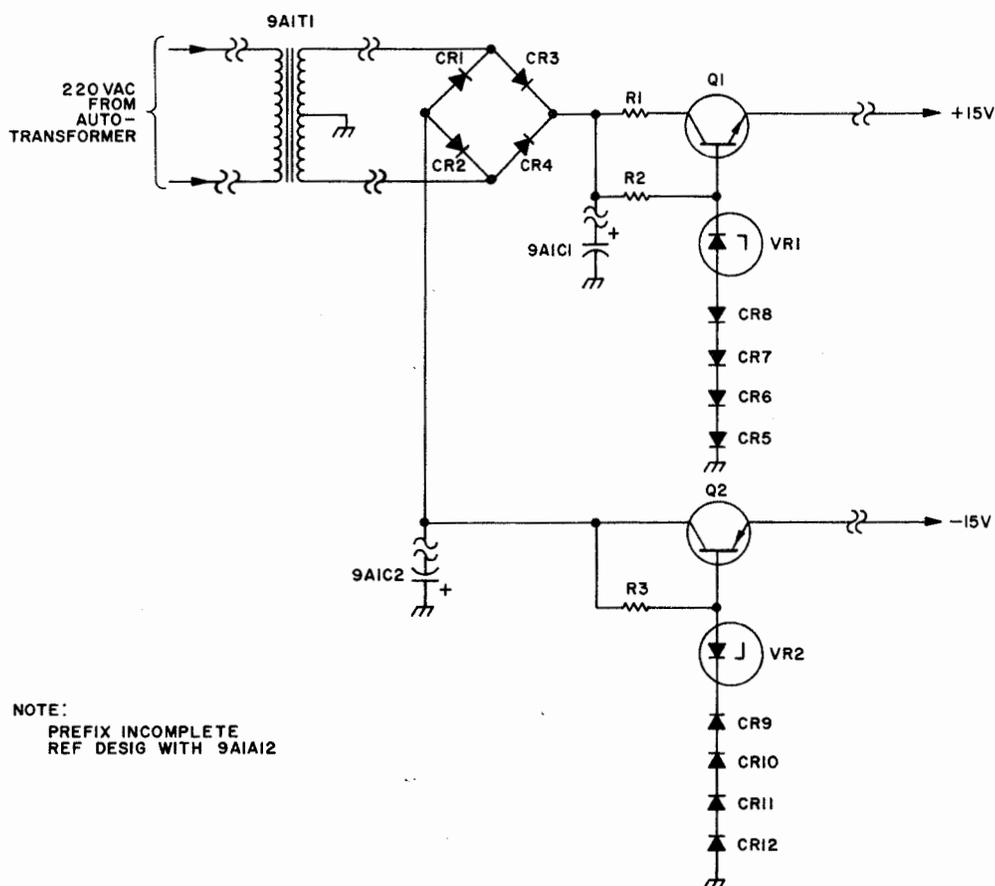


Figure 4-28. Peak/Average Meter Circuit, Low Voltage Power Supply, Simplified Schematic Diagram

4-194 The applicable servicing diagram for these circuits is figure 4-50. Adjustments are described in paragraph 5-34. Complete circuit details are shown in schematic diagram figure 5-50, sheet 2.

#### 4-195 LOGIC CIRCUITS.

4-196 The logic circuits provide the necessary control signals in the proper sequence to automatically position the tuning elements for any selected operating frequency. They also protect the Tuner by interrupting the tuning cycle and muting the transmitter output if an

overload or malfunction occurs. Table 4-2 illustrates the entire tuning cycle, and paragraphs 4-197 through 4-221 describe the individual logic circuits. All of the logic circuits are shown together in servicing diagram figure 4-51 and details are shown in schematic diagram figure 5-51, sheet 2. A logic timing diagram for the system is given in figure 4-54. Most of the logic circuits are located in the Tuner Control; however, the L3 insert logic circuit is located in the Tuner unit. The Tuner bypass logic circuit is considered as a part of the I. Box system logic, and as such is described in paragraph 4-260 along with other related system logic circuits.

TABLE 4-2. TUNER AND TUNER CONTROL, AUTOMATIC TUNING SEQUENCE

1. Home/Tune cycle is initiated by:
  - a. Turning on Tuner Control primary power initially.
  - b. Changing frequency.
  - c. Changing from multi-tone to single-tone mode or vice-versa.
  - d. Transmitter fault.
  - e. Turning on Exciter primary power initially.
2. Home logic activates, energizing:
  - a. Brake logic to release L2 and C1 servo motor brakes.
  - b. L2 and C1 servo motors toward home.
  - c. RF mute to I. Box system logic circuits.
  - d. TUNED light logic to extinguish TUNED indicator.
3. When L2 and C1 tuning elements reach home:
  - a. L2 and C1 servo motors are de-energized.
  - b. Brake logic applies L2 and C1 motor brakes.
  - c. Reset signal is generated by L2 home end stop switch.
4. Reset signal generated above energizes and maintains:
  - a. Tune power request signal to I. Box system logic circuits.
  - b. Tune sensitivity drive signal to L2 and C1 servo amplifiers.
5. Home cycle ends.
6. Tune cycle begins when operator depresses TUNE pushbutton at Exciter.
  - I. Box applies tune enable to Exciter to obtain RF power.
7. If AN/URA-38 Antenna Coupler Group is used, its tune power request signal causes bypass of Tuner until Antenna Coupler is tuned.
8. RF signal through discriminators results in discriminator error output signals to energize: L2 and C1 servo amplifiers, L2 and C1 motor control circuits, L2 and C1 motor brakes, and L2 and C1 servo motors.
9. Motor control circuits apply motor-on signals.

TABLE 4-2. TUNER AND TUNER CONTROL, AUTOMATIC TUNING SEQUENCE (Cont)

10. Motor-on Signals:
  - a. Lock on tune sensitivity drive signals to L2 and C1 servo amplifiers.
  - b. Lock on tune power request signal to I. Box system logic.
  - c. Illuminate TUNING indicator.
11. If tuning is not accomplished, in the 2.0-2.5 MC band, and the L2 tuning element goes to its far end stop, extra inductance is added by the L3 insert logic and the home logic starts another tuning sequence from step 2 due to L2 far end stop input to home logic.
12. When L2 and C1 tuning elements reach a tuned position:
  - a. L2 and C1 servo motors de-energize.
  - b. L2 and C1 brakes are applied.
  - c. Tune sensitivity drive signal is released.
  - d. TUNING indicator is extinguished.
  - e. TUNED indicator is illuminated.
  - f. Tune power request signal is removed.
  - g. I. Box applies ready signal to Exciter in response to (f).
13. System is tuned and ready for full power operation. While transmission is in process, corrective tuning may be accomplished by the Tuner and Tuner Control, if necessary, without interrupting transmission.

4-197 HOME LOGIC CIRCUIT. The home logic circuit (figure 4-29) consists of two inverters (Q1 and Q2) and a clamp (CR2) which function as a flip-flop. This circuit is used only for automatic or semi-automatic modes of operation. When a home cycle is initiated, the home logic circuit produces the necessary output to drive the L2 and C1 tuning elements home (to the predetermined starting position).

4-198 A home cycle is normally initiated by turning on the Tuner Control primary power, changing the Exciter frequency, changing the Exciter mode from a single tone to a multi-tone mode or vice-versa, by occurrence of a transmitter fault, or by variable inductor 9A1A4L2 reaching its far

end stop. Applying primary power initially results in the base of Q2 being momentarily pulled to ground by the charging current necessary to charge capacitor C3. Any of the other causes of triggering result in application of a ground pulse trigger signal being applied to the base of Q2. In all of these cases, the base of Q2 receives a ground pulse, forcing Q2 off if it was on. When Q2 is turned off, the positive level at its collector is raised to produce a positive home signal. The home signal is applied to the L2 and C1 servo amplifier (paragraph 4-149) to energize the servo motors to drive those tuning elements to the required home positions. The C1 servo amplifier home signal is switched to either of two servo amplifier home lines to home C1 at maximum capacitance for the

2-10 MC range or at minimum for the 10-30 MC range. In addition, the home signal is applied to the RF mute logic to prevent the system from being driven with RF during the home cycle.

4-199 When the motor energize, the motor-on logic is turned on, thus applying a positive level to the base of Q1. This turns on Q1, which in turn grounds the base of Q2. Therefore, Q2 and the tuned light logic are clamped at ground until the tuning elements reach home. At that time, both servo motors de-energize (by tripping their end stop switches), and removes the positive motor on signal from the base of Q1. This turns Q1 off, allowing the positive voltage thus developed at its collector to turn Q2 on again. When Q2 is on, the base of Q1 is clamped to ground through the essentially grounded collector of Q2 and clamp diode CR2. This prevents the motor-on signal generated during the subsequent tuning and operating cycles from re-energizing the home logic.

4-200 The L2 far end stop switch (9A1A4A1S1) normally open contacts will apply a ground signal to the ground pulse input in the event that the first tuning cycle was unsuccessful and variable inductor 9A1A4L2 was driven to its far end stop. This action will initiate a new home cycle. This is necessary to allow retuning after automatic insertion of fixed inductor 9A1A8L3 (for cases in the 2.0-2.5 MC band where the load impedance requires more inductance than is available with the variable inductor). To initiate the second tune cycle, it is necessary to momentarily depress the Exciter's TUNE pushbutton.

4-201 During manual operation, the output from the home logic is inhibited by

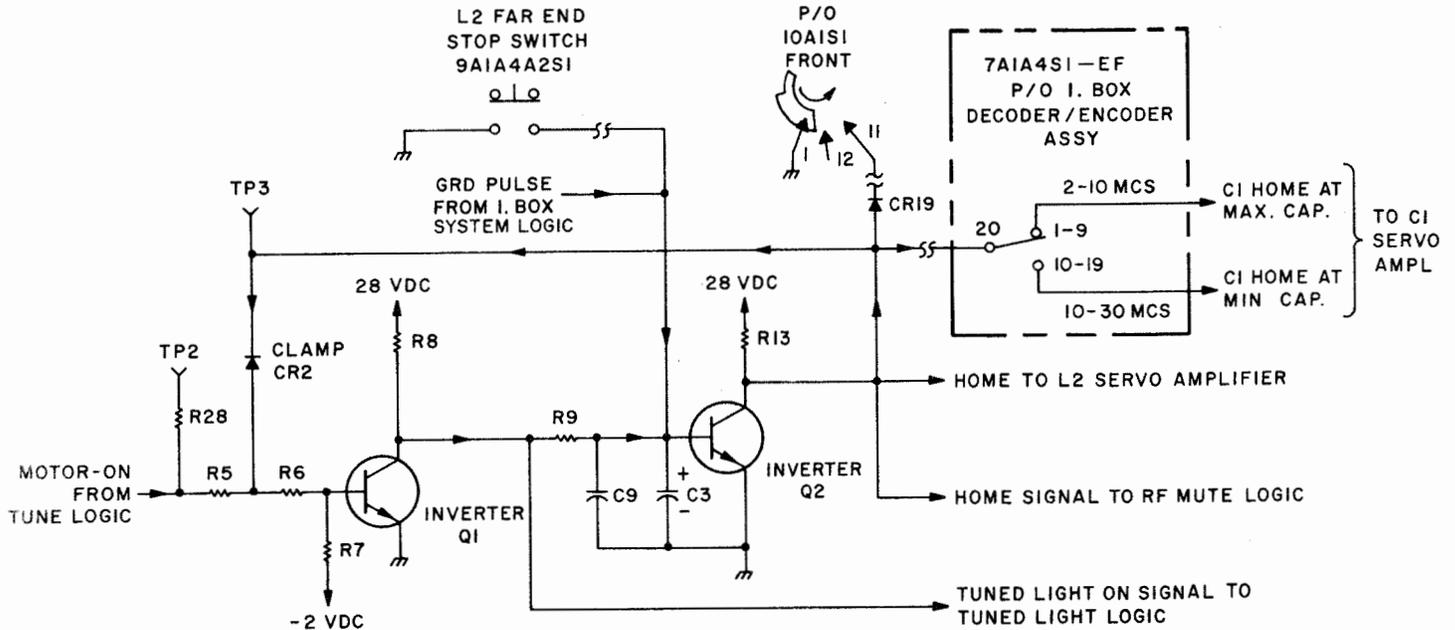
the ground applied through contacts 1 and 11 of switch 10A1S1-front and diode CR19. Capacitor C9 is an RF by-pass.

4-202 MOTOR-ON LOGIC CIRCUIT. The motor-on logic circuit (figure 4-30) consists of a driver (Q9), an inverter (Q3), and various diodes. The function of this circuit is to generate a positive signal for application to the tune logic and home logic circuits whenever either or both of the servo motors have an energizing voltage applied. This circuit is used only during automatic and semi-automatic modes of operation.

4-203 When the servo motors are not energized, zener diode VR4 draws current through R35, R36, and R10. This forward biases driver Q9, thus turning on inverter Q3. The collector of Q3 effectively goes to ground, keeping the positive level from R8 from being applied to the home and tune logic. The two inputs to the motor-on logic are also used as signals for the brake logic. They originate at the L2 and C1 motor control circuits in the form of a ground whenever the L2 and C1 servo motors are energized.

4-204 This ground signal is applied to the orgate input of the motor-on logic circuit and through isolation diode CR12 to the junction of resistors R36 and R10. This turns off zener diode VR4 and transistors Q9 and Q3, allowing the voltage at the collector of inverter Q3 to rise to a high positive level as a motor-on input signal to the home and tune logic circuits.

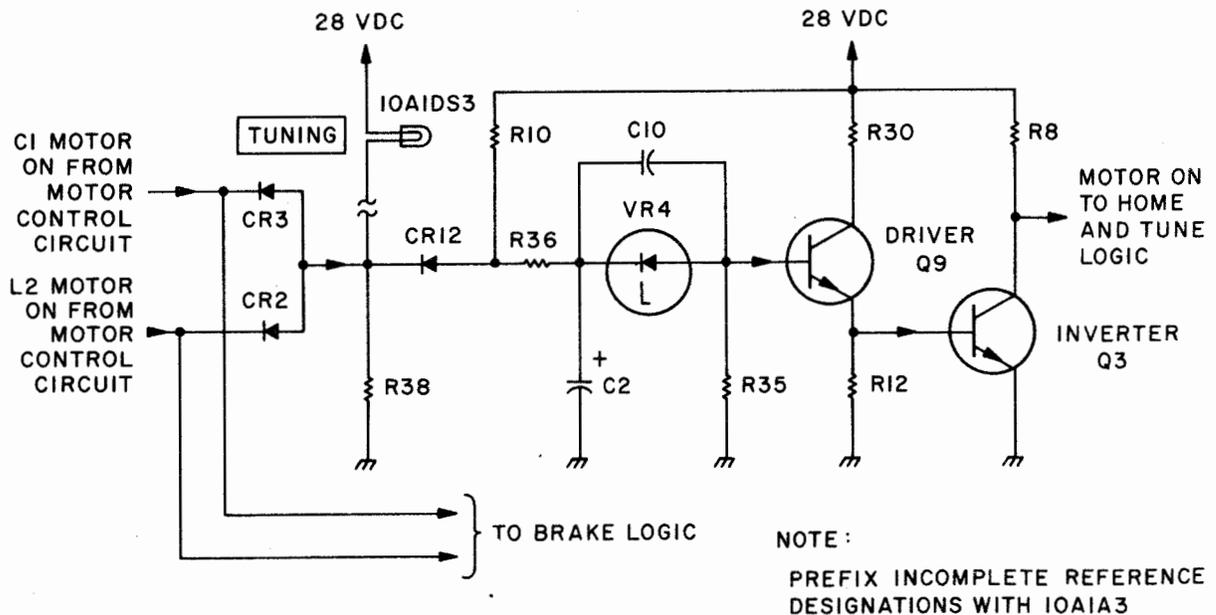
4-205 Zener diode VR4 is employed to ensure proper cut-off to driver Q9, since the motor-on input signals do not go all the way to ground but remain a few volts positive because of the diode junction drops in the motor control circuits. The 6.2 volt drop across the zener diode requires a



NOTES:

1. PREFIX INCOMPLETE REFERENCE DESIGNATIONS WITH 10A1A4.
2. SWITCH 10AISI SHOWN IN AUTO POSITION.

Figure 4-29. Home Logic, Simplified Schematic Diagram



NOTE:

PREFIX INCOMPLETE REFERENCE DESIGNATIONS WITH 10A1A3

Figure 4-30. Motor-On Logic, Simplified Schematic Diagram

high positive signal to keep driver Q9 turned on. Therefore, even though the motor-on input signals do not go all the way to ground, they are low enough to turn off Q9.

4-206 Capacitor C2 and resistor R10 delay the turn-on of driver Q9 for a short time after the servo motors are de-energized, thereby preventing the motor-on signal from de-energizing when the motors repeatedly reverse direction while approaching the tune point. This assures that the home logic and tune logic circuits do not become locked off prematurely before the actual tune point is reached. Resistor R35 provides a discharge path for capacitor C2. Capacitor C10 is an RF bypass. TUNING indicator 10A1DS3 is connected to the output of the motor-on logic input or gate so that it will be illuminated when either motor-on signal is present.

4-207 BRAKE LOGIC CIRCUIT. The brake logic circuit (figure 4-31) consists of three essentially identical circuits: one each for controlling the brakes on servo motors 9A1A2A2A2B1, 9A1A6A2B1, and 9A1A4A2A2B1. In each case, the circuit consists of one inverter stage and one driver stage. The L2 and C1 servo motor brake logic circuits are part of PC Board Assembly 10A1A3 in the Tuner Control unit; and the L1 servo motor brake logic circuit is contained in PC Board Assembly 7A1A1A3 in the I. Box unit. For discussion, reference will be made to the L2 brake logic circuit.

4-208 Each of the servo motors has an electro-mechanical brake which is released when current flows through its actuating winding. When L2 servo motor 9A1A4A2A2B1 is not energized, the L2 motor-on signal is absent; therefore, zener

diode VR5 conducts, turning on inverter Q2, which saturates. With Q2 in saturation, the ground at its collector turns off driver Q7, preventing conduction through the motor brake winding. Thus the brake is engaged.

4-209 When the motor is energized, a motor-on ground signal is applied to zener diode VR5 (at the same time it is applied to the motor on logic). This ground signal turns off zener diode VR5 and inverter Q2, allowing the collector of Q2 to rise to a high positive level and forward bias Q7. Driver Q7 is thus turned on; and it conducts through the motor brake winding to release the brake and allow the motor to rotate. As soon as the motor-on signal is removed from the input of the brake logic, the original conditions again apply, and the brake quickly stops rotation of the motor.

4-210 Zener diode VR5 assures that inverter Q2 is completely turned off by the motor-on signal, which is not a perfect ground but somewhat positive (as described in the motor-on logic discussion, paragraph 4-202). R9 and C9 form a transient suppressor to prevent high voltage transients (produced by the rapid collapse of the brake winding flux) from damaging the driver transistor when the brake winding is de-energized. C11 and C12 are RF bypasses.

4-211 TUNE LOGIC CIRCUIT. The tune logic circuit (figure 4-32) consists of two inverters (Q4 and Q5) and various other associated components. The function of this circuit is to apply a tune power request signal to the I. Box system logic to initiate activation of a low level RF signal for tuning, to provide a tune sensitivity drive signal to the L2 and C1 servo amplifiers for increased sensitivity of the L2 and C1 servo amplifiers during the low power tune cycle, and to provide a reset

signal to the TUNED light logic circuit. This circuit is used only during automatic operation.

4-212 When variable inductor 9A1A4L2 reaches its home position, the normally open contacts of end stop switch 9A1A4A2S2

are closed to produce ground signals to the tune power request line to the I. Box, to the reset line to the TUNED light logic, and to the collector of inverter Q4. The ground at the collector of Q4 is applied to the base of inverter Q5 through isolation diode CR10 and resistor R24. Thus, normally conducting

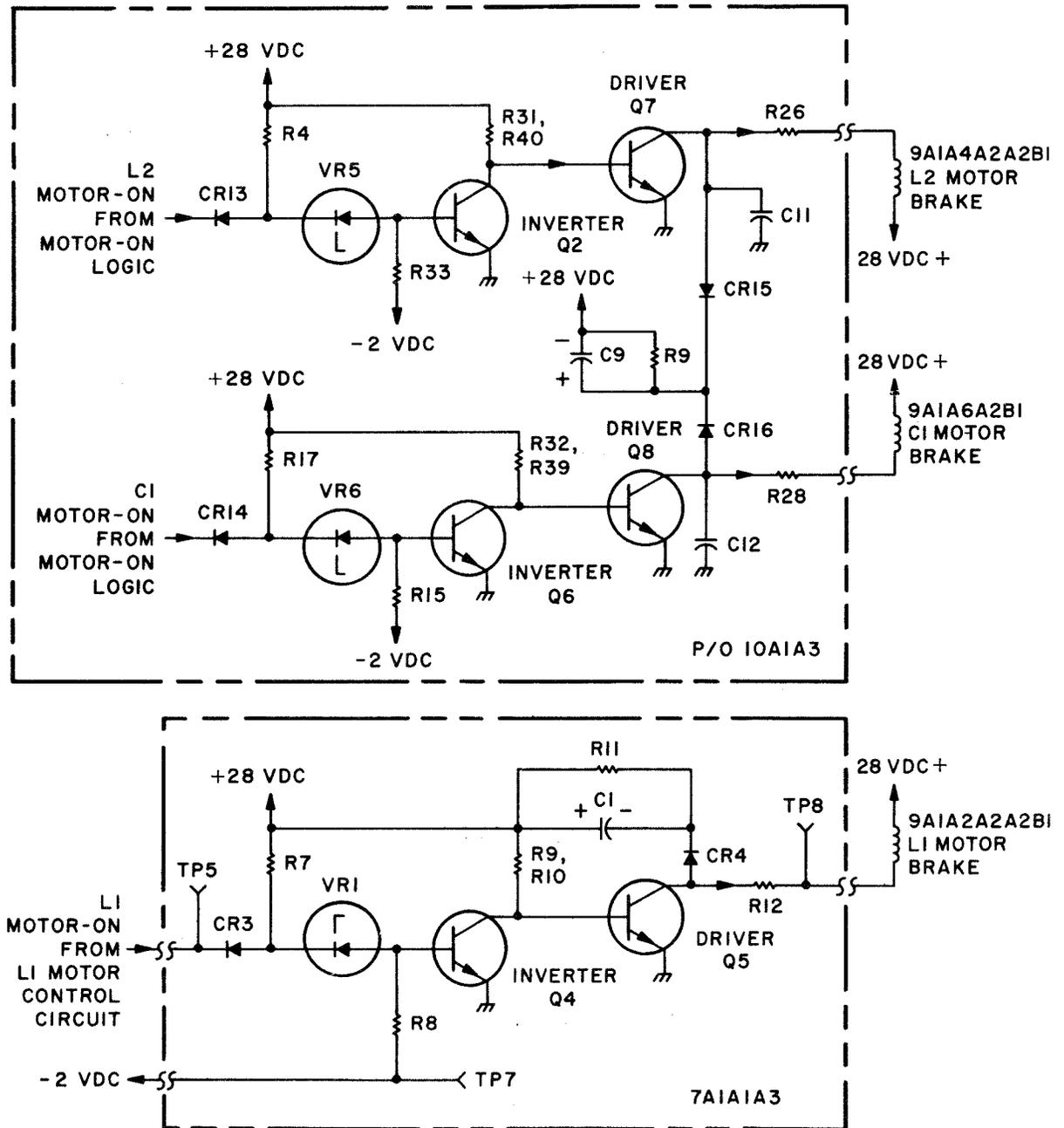
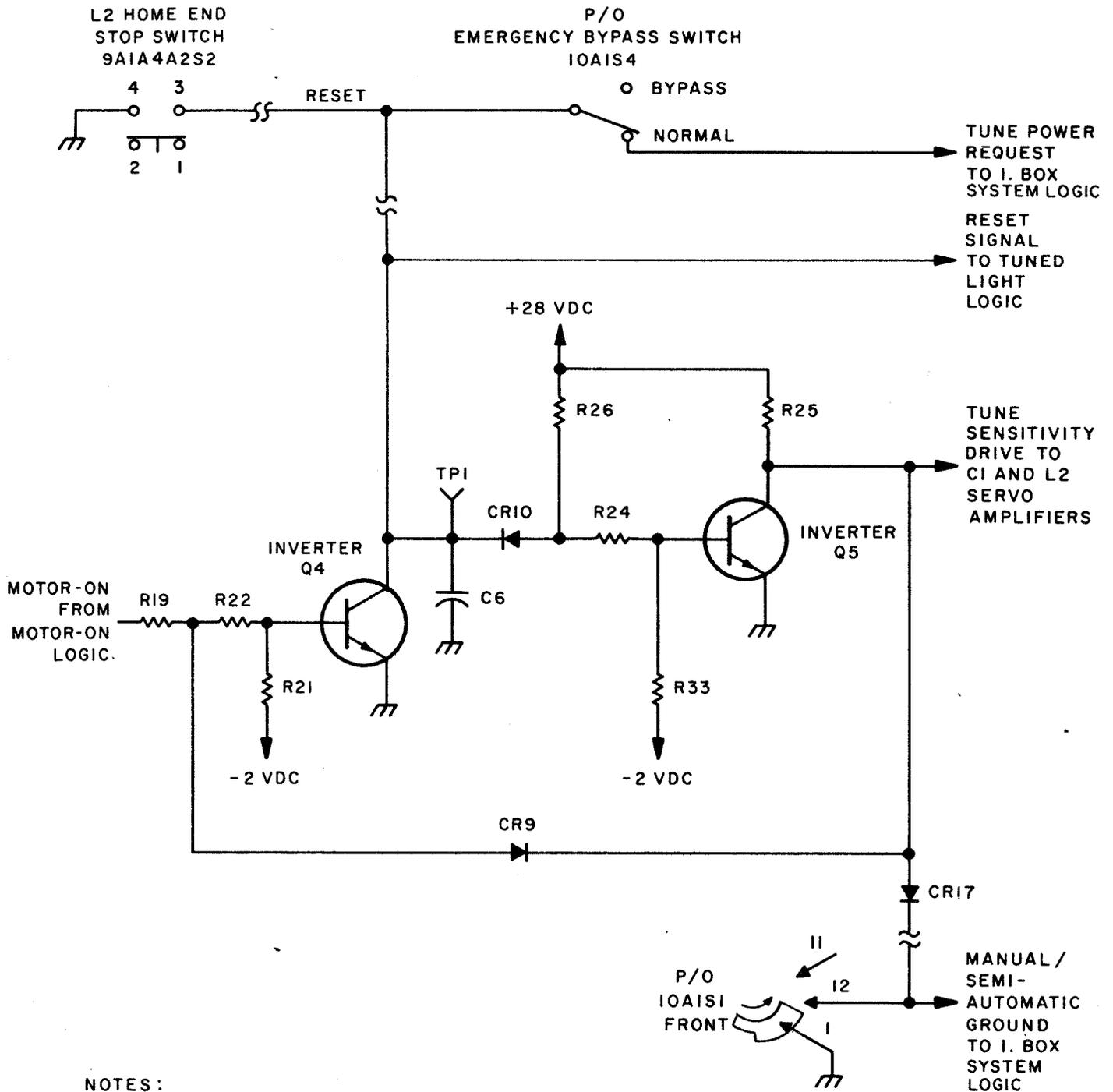


Figure 4-31. Brake Logic, Simplified Schematic Diagram



NOTES:

1. PREFIX INCOMPLETE REFERENCE DESIGNATIONS WITH 10A1A4.
2. SWITCH 10A1S1 IS SHOWN IN AUTO POSITION.

Figure 4-32. Tune Logic, Simplified Schematic Diagram

lector rises to a high positive level, which is applied to the L2 and C1 servo amplifiers as a tune sensitivity drive signal to increase their sensitivity.

4-213 The tune power request signal is applied to the I. Box when variable inductor 9A1A4L2 reaches home; and if the operator responds to the TUNE light signal at the Exciter and initiates the tune cycle by depressing the TUNE pushbutton, application of RF power causes the R and  $\phi$  discriminators to provide error signals to the L2 and C1 servo amplifiers. This energizes the motors, and thus the motor-on signals to the motor-on logic circuit cause that circuit to apply a positive motor-on signal to the tune logic input at R19. This positive signal is applied to the base of inverter Q4 through R19 and R22 to turn on Q4 and lock off inverter Q5. This action subsequent to the initial application of a tune power request signal to the I. Box system logic maintains the tune sensitivity drive signal to the L2 and C1 servo amplifiers and the tune power request signal to the I. Box system logic until the tuning cycle is finished.

4-214 At the completion of the tuning cycle, the servo amplifiers de-energize the tuning motors. The motor-on signal is removed from Q4, and Q5 turns on again. Thus, the tune power request and tune sensitivity drive signals are removed. The conduction of Q5 also grounds the Q4 base circuit through clamp diode CR9 to hold Q4 off until a new tune cycle is initiated by the L2 end stop switch. As long as the Q4 base circuit is clamped to ground, the motor-on signal, which may be present during full power fine tuning, cannot trigger the tune logic circuit.

4-215 During manual or semi-automatic operation, the tune and keying logic circuits are inhibited by the ground applied to the clamp circuit through contacts 12 and 1 of switch 10A1S1-front and isolation diode CR17.

4-216 RF MUTE LOGIC CIRCUIT. The RF mute logic circuit (figure 4-33) consists of inverter Q3 and various related components. The function of this circuit is to provide an RF mute signal to the I. Box system logic circuit to prevent application of RF power when a Tuner fault has occurred or while the C1 or L2 motors are being driven to home positions.

4-217 Inverter Q3 is normally biased off by -2V applied to the base through resistor R18. When the home logic applies a positive home signal through isolation diode CR5 and resistor R17 to the base of Q3, the collector to emitter junction of Q3 conducts, effectively grounding the RF mute line, thus preventing application of RF power from the 1 KW PA to the Tuner matching network. Capacitor C5 is an RF bypass.

4-218 If a temperature overload occurs in the Tuner, variable inductor 9A1A2L1 runs to either end stop, an arc occurs in the Tuner arc detector circuit, the Tuner does not complete tuning within the 15 seconds allowed, the Tuner covers are open, or the decoder-encoder rotary solenoid in the I. Box runs longer than 15 seconds, the Tuner fault section of the I. Box system logic fault circuit (paragraph 4-53) is triggered and supplies a positive Tuner fault signal to FAULT indicator 10A1DS5 and through resistor R27 and isolation diode CR8 to turn on inverter Q3. Therefore, such faults result in an RF mute signal such as is generated due to presence of a

home signal. The RF mute signal remains until the home signal is removed or the I. Box system logic fault circuit is reset to remove the Tuner fault signal.

4-219 TUNED LIGHT LOGIC CIRCUIT. The tuned-light logic circuit (figure 4-34) consists of switch stage Q6 and various related components. Its function is to energize TUNED light 10A1DS4 when the tuning cycle has been completed. This circuit is used only in the automatic mode of operation.

4-220 During the home cycle, the base of switch Q6 is held at ground level through R10, R11, and inverter Q1 in the home logic circuit (paragraph 4-197). At the completion of the home cycle, this line rises to a positive level. However, the reset line holds the base of Q6 at ground through isolation diode CR4 for the duration of the tuning cycle (initially through the home end stop switch when variable inductor 9A1A4L2 is home, and then through inverter Q4 in the tune logic circuit). The ground signals applied inhibit the positive turned-light-on signal from the home logic from turning on switch Q6. At the completion of the tuning cycle, the inhibits are removed, allowing the positive tuned-light-on signal to turn on switch Q6, thus illuminating TUNED light 10A1DS4.

4-221 L3 INSERT LOGIC. The L3 insert logic circuit (figure 4-35) consists of two relays (9A1A10K4 and 9A1A8K3) in the Tuner unit and various related components. The function of this circuit is to normally short out fixed inductor 9A1A8L3 in the matching network and unshort it (insert the added inductance) only when extra inductance is required in the output side of the matching network. This circuit is only operative when using the

2.0-2.5 MC band.

4-222 Assuming that a condition exists in which the maximum inductance of 9A1A4L2 is insufficient for proper tuning (using a load impedance of much less than 50 ohms at the low frequency end of the 2.0-2.5 MC band), the normal tune cycle will be unsuccessful. Variable inductor 9A1A4L2 will be driven to its far end stop without tuning properly. Far end stop switch 9A1A4A2S1 normally open contacts will provide a closure to ground, thus initially energizing relay 9A1K4. A ground signal from the 2.0-2.5 MC band contacts of switch wafer 7A1A4S6-front is applied through a pair of normally open contacts on relay 9A1K4 to latch that relay in the energized position. With 9A1K4 latched, another pair of its normally open contacts energize relay 9A1A8K3, thus removing the short from fixed inductor 9A1A8L3. The circuit, once latched in this fashion, will not re-apply the short across 9A1A8L3 until the Exciter is set to another frequency band (higher than 2.5 MC) or the Tuner Control power supply is turned off.

4-223 If a condition occurs in which the extra inductance of 9A1A8L3 is added in the manner described, the home logic will automatically begin another home cycle after the L3 insert logic latches in. Then, the Exciter's TUNE pushbutton must be depressed to initiate the new tune cycle. (See paragraph 4-197).

#### 4-224 SYSTEM POWER AND CONTROL SECTIONS.

4-225 This section describes those portions of the system power and control circuits which are not described elsewhere in discussions of other units.

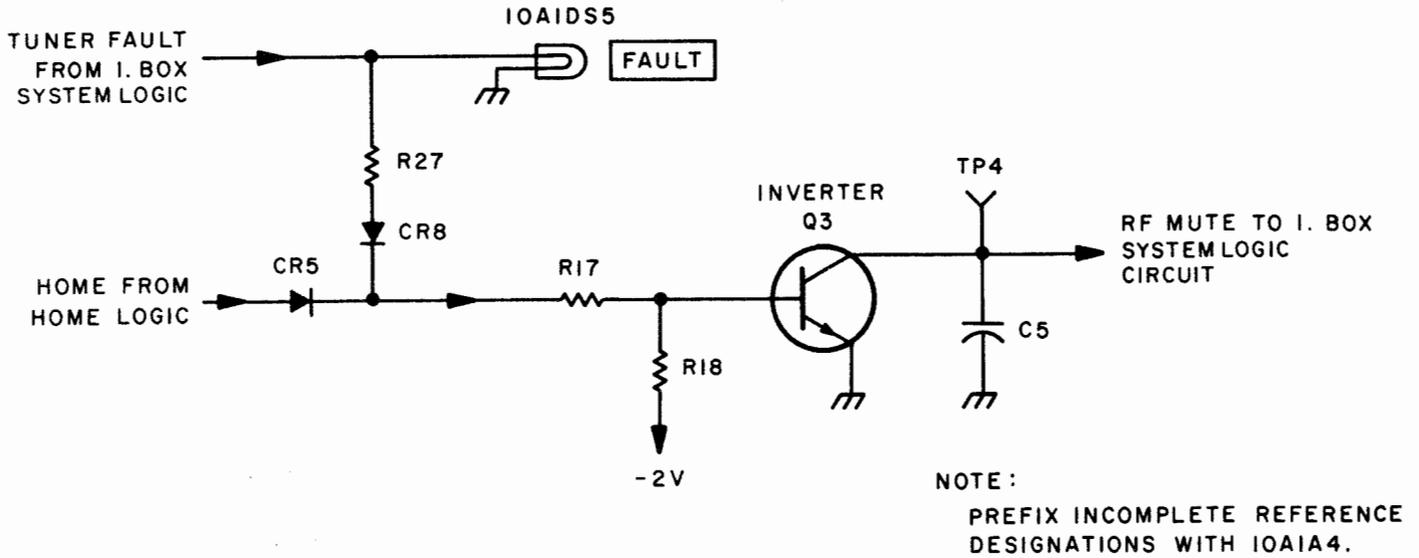


Figure 4-33. RF Mute Logic, Simplified Schematic Diagram

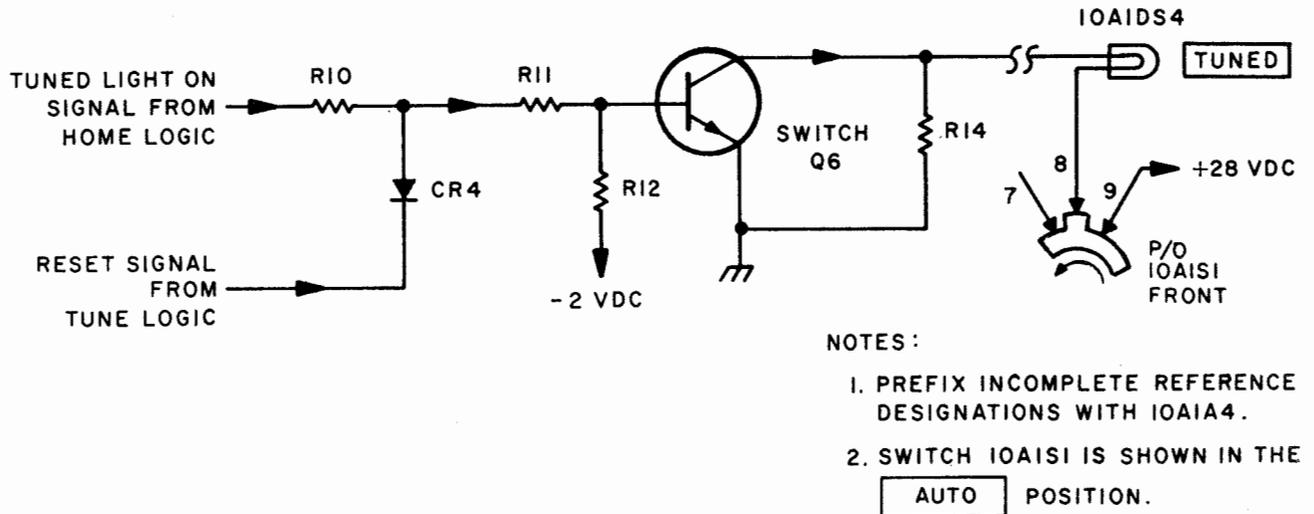


Figure 4-34. Tuned Light Logic, Simplified Schematic Diagram

The system power distribution section consists of an Autotransformer Assembly and related circuits which are part of the local equipment cabinet. Standby and operate control and system logic sections are housed in the I. Box unit.

With the exception of control connections which are made directly between operational units, all system control and interface between units is done at the I. Box unit.

4-226 Some of the I. Box circuitry is related only to the Tuner unit and is discussed in the Tuner Section (paragraph 4-107). It is housed in the I. Box because of space limitations in the Tuner Control unit, and is not considered a part of the system control section.

4-227 SYSTEM POWER DISTRIBUTION SECTION. System power distribution circuitry (figure 4-49) in the bottom of the local equipment cabinet receives three phase, 50-50 CPS, 220 or 460 volt primary power from the building power distribution mains. The three phase power is routed through primary power circuit breaker 8A1CB1 (in the bottom panel) into autotransformer 8A2A1T1 and is also branched off to the 1 KW PA. Taps are provided at the primary of the autotransformer and the primaries of power transformers in the 1 KW PA and 1 KW Power Supply to select either line voltage. One autotransformer primary winding supplies 220 VAC to the Tuner unit. Autotransformer secondary windings provide single phase 115 VAC power to the I. Box, Tuner Control, and GFM Coupler Control units and through outlet strip 8A3 to the Exciter unit, to the Exciter's blower, and to the optional Decoder/Encoder and Keyer units. A low voltage secondary winding feeds into a +28 VDC power supply circuit which supplies DC operating power for the control circuits in the I. Box unit. A circuit breaker (8A1CB2) for the 28 VDC power supply is located on the bottom panel in the cabinet.

4-228 EXCITER/I. BOX INTERFACES. Functional block diagram figure 4-36 illustrates the control sections to be discussed in the remaining text for this functional section. The area of concern is that labelled "I. Box" with the portion labelled "Exciter" provided as a simplified representation of interfacing functions of the Exciter. The Exciter Technical Manual (NAVELEX 0967-292-9030) should be con-

sulted for precise and complete information when troubleshooting the Exciter unit; however, this functional illustration of pertinent portions of the Exciter will aid in understanding functional descriptions which follow.

4-229 Following is a functional description of the interface signals between the Exciter and the I. Box. Refer to figure 4-36.

a. STANDBY COMMAND, from Exciter to I. Box to turn on 1 KW PA tube heaters and control circuits. Remains activated except in amplifier off condition.

b. STANDBY INDICATOR, from I. Box to Exciter to indicate three minute warmup period has elapsed and transmitter has achieved standby status (ready to go to operate). Remains activated except in operate or amplifier off condition.

c. OPERATE COMMAND, from Exciter to I. Box to turn on remaining 1 KW PA and 1 KW Power Supply power (high voltage) and render the transmitter operable. Remains activated until STANDBY or AMPLIFIER OFF pushbutton is depressed or transmitter fault occurs.

d. OPERATE INDICATOR, from I. Box to Exciter to indicate operate condition achieved. Remains activated as described above for operate command.

e. STANDBY/OPERATE COMMON, from I. Box to Exciter; +28V supply line common to both standby and operate command circuits. Returned as switched at Exciter for STANDBY and OPERATE COMMAND signals.

#### NOTE

All other interface signals are a function of ground. Most are ground as the active or "logical 1" state, but XMTR FAULT and LOCAL OVERRIDE are normally ground (opened for active of "logical 1" state).

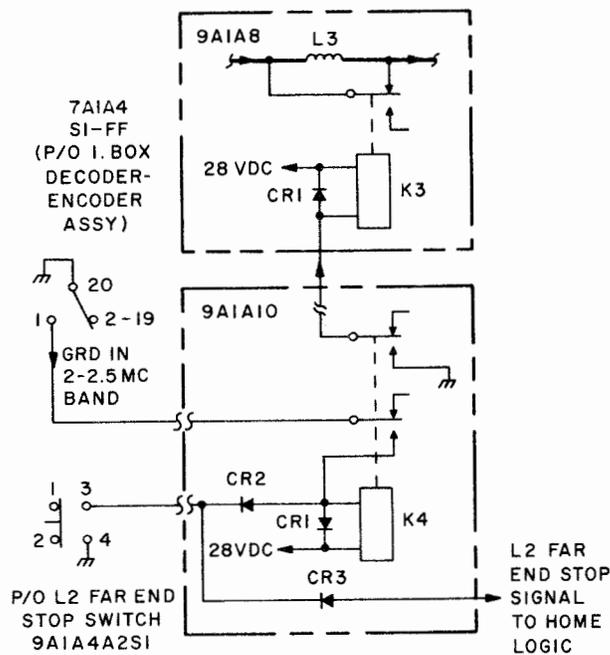


Figure 4-35. L3 Insert Logic, Simplified Schematic Diagram

f. LOCAL OVERRIDE, from I. Box to Exciter, indicates manual or semi-automatic tuning condition at transmitter (1 KW PA or Tuner Control unit).

g. TUNE COMMAND 1, from Exciter to I. Box, contact closure in Exciter returns TUNE COMMAND 2 signal (see sub-paragraph h. below) to indicate that TUNE pushbutton has been depressed and Exciter is ready to supply tune power carrier for tune cycle completion. Remains activated until TGC motor starts to run toward more power.

h. TUNE COMMAND 2, from I. Box to Exciter, present whenever there is no RF mute or transmitter fault at I. Box. Returned as TUNE COMMAND 1 to activate tuning with power.

i. TUNE ENABLE, from I. Box to Exciter to energize tune power carrier as required during tune cycle. May be applied either by request of Exciter or

by independent action of transmitter. Automatically removed by transmitter fault, RF mute, or completion of tune cycle.

j. INHIBIT, from Exciter to I. Box, indicates normal operation is discontinued due to need for tuning. Conditions transmitter to home variable elements as first part of tune cycle. Remains activated until TUNE ENABLE is received.

k. READY, from I. Box to Exciter, indicates tuning completed and transmitter ready for full power transmit. Removed by XMTR FAULT or INHIBIT during operation or while tuning; otherwise always present.

l. XMTR FAULT, from I. Box to Exciter, indicates fault in 1 KW PA, 1 KW Power Supply, or Tuner. Causes Exciter XMTR FAIL indicator illumination, activation of inhibit circuit, and

removal of OPERATE COMMAND signal. (Keyer also activates XMTR FAIL indicator, but the signal does not go through the I. Box)

m. KEYLINE, from Exciter to I. Box, keys 1 KW PA unit when required by operating conditions at Exciter.

4-230 STANDBY AND OPERATE CONTROL SECTION. The standby and operate control section (top of figure 4-36), which is a part of the I. Box unit, relays standby and operate commands from the Exciter to the 1 KW PA unit. In addition it provides filament and plate elapsed time indications on panel mounted elapsed time meters. Readback signals from the 1 KW PA unit are provided to the Exciter to operate STANDBY and OPERATE indicators.

4-231 Standby and operate commands from the Exciter to the I. Box are effectively contact closures to +28 VDC. When the standby command is given, it actuates a standby relay in the 1 KW PA to turn on the 1 KW PA blower, filament, and control circuit power supplies. At the same time, the filament time meter and a three-minute time delay circuit are energized in the I. Box. After the three-minute time delay has elapsed to allow 1 KW PA unit tube warm up, a relay latches in the I. Box; and provided that the operate relay in the 1 KW PA is de-energized, a standby indicator signal is provided through the 1 KW PA operate relay, the latched I. Box standby relay, and the energized 1 KW PA standby relay to the Exciter to illuminate the Exciter STANDBY indicator and enable some of the Exciter's control circuit. Note that although the Exciter STANDBY and OPERATE push-buttons are depressed only momentarily, latching circuits in the Exciter maintain the standby and operate commands when given.

4-232 After the three-minute standby time delay has elapsed, momentary operation of the Exciter OPERATE pushbutton will energize an operate relay in the I. Box to provide an operate command to the 1 KW PA operate relay. Thus, the high voltage power supplies are activated, and the operate relay in the 1 KW PA breaks the standby indicator signal to the Exciter. An operate indicator signal is applied to the Exciter through the 1 KW PA operate relay. The I. Box operate relay energizes the PLATE elapsed time meter on the I. Box front panel, and it allows the tune enable section of the system logic to apply a tune enable signal to the Exciter only while in operate status.

4-233 Once the transmitter is fully activated in this manner, depressing the STANDBY pushbutton on the Exciter will remove the operate command and the control circuitry in the I. Box and the 1 KW PA will revert to a standby condition (drop out of operate). If the Exciter AMPLIFIER OFF control is depressed, both the operate and standby command signals from the Exciter are removed; and the I. Box and 1 KW PA will drop out of both standby and operate.

#### NOTE

The elapsed time meters are 60 CPS synchronous devices. When operating with primary power frequencies other than 60 CPS, the time indicated must be multiplied by a correction factor (1.2 for 50 CPS) to determine the correct elapsed time.

4-234 SYSTEM LOGIC SECTION. The function of the system logic section is system coordination and monitoring. It generates signals to activate the various operational units in programmed sequences, provides indicating signals for system status monitoring, and automatically deactivates units as required in cases of malfunction of one or

more units.

4-235 Referring to the functional diagram of the system logic section (bottom of figure 4-36) and assuming a typical automatic mode tuning cycle, the following sequence of events can be visualized. With the system in the operate condition, changing settings of the Exciter (or Remote Control) FREQUENCY KC controls, occurrence of a transmitter fault, or changing the CLASS OF EMISSION control setting from a single-tone to a multi-tone class of emission or vice-versa initiates a new tune cycle by:

- a. deactivating Exciter's normal output,
- b. resetting the TGC circuit in the Exciter to minimum gain,
- c. illuminating the Exciter's TUNE indicator to signal that retuning is necessary, and
- d. applying an inhibit signal to the I. Box system logic.

4-236 The inhibit applied to the system logic causes removal of the ready signal to the Exciter and generates ground pulse signals, which initiate homing and other preliminary tune cycle conditioning of the Tuner Control and Coupler Control units. While homing, the Tuner Control and Coupler Control units apply RF mute and key interlock signals, respectively, to the system logic section. Either signal is sufficient to make the I. Box:

- a. unkey the 1 KW PA by applying an RF mute signal to it, and
- b. prevent application of a tune enable signal to the Exciter, until homing is completed, by removing the tune command

2 signal from the Exciter and the tune enable section of the system logic.

4-237 If the 1 KW PA bandswitch motor runs because the frequency band has been changed, the 1 KW PA also applies an RF mute signal to the I. Box, which has the same effect as a Tuner Control RF mute or Coupler Control key interlock.

4-238 After the tuning elements are homed and ready to tune, removal of RF mute and key interlock signals and simultaneous absence of a transmitter fault signal causes a tune command 2 signal to be applied to the Exciter and to the tune enable section of the system logic. Depressing the TUNE pushbutton at the Exciter extinguishes the TUNE indicator and allows the tune command 2 to be returned to the tune enable section of the system logic as a tune command.

4-239 The tune command 1 signal together with presence of a tune power request from the Tuner Control or Coupler Control causes the tune enable logic to latch, thus providing a tune enable signal to cause the Exciter to activate a tune power carrier and allow the TGC motor to run toward more power output. Application of a tune enable also unlatches the inhibit signal. When the RF tune power carrier is applied to the transmitter, the Coupler unit tunes, if used, and then the Tuner unit tunes. Once the tune enable signal is generated, it is latched on providing that the tune command 2 (no fault, no RF mute) signal remains and the tune power request is maintained. The Exciter remains in a tune condition until the ready signal is restored by the system logic, and the Exciter puts out a tune power carrier whenever the tune enable is applied.

4-240 If an Antenna Coupler is used,

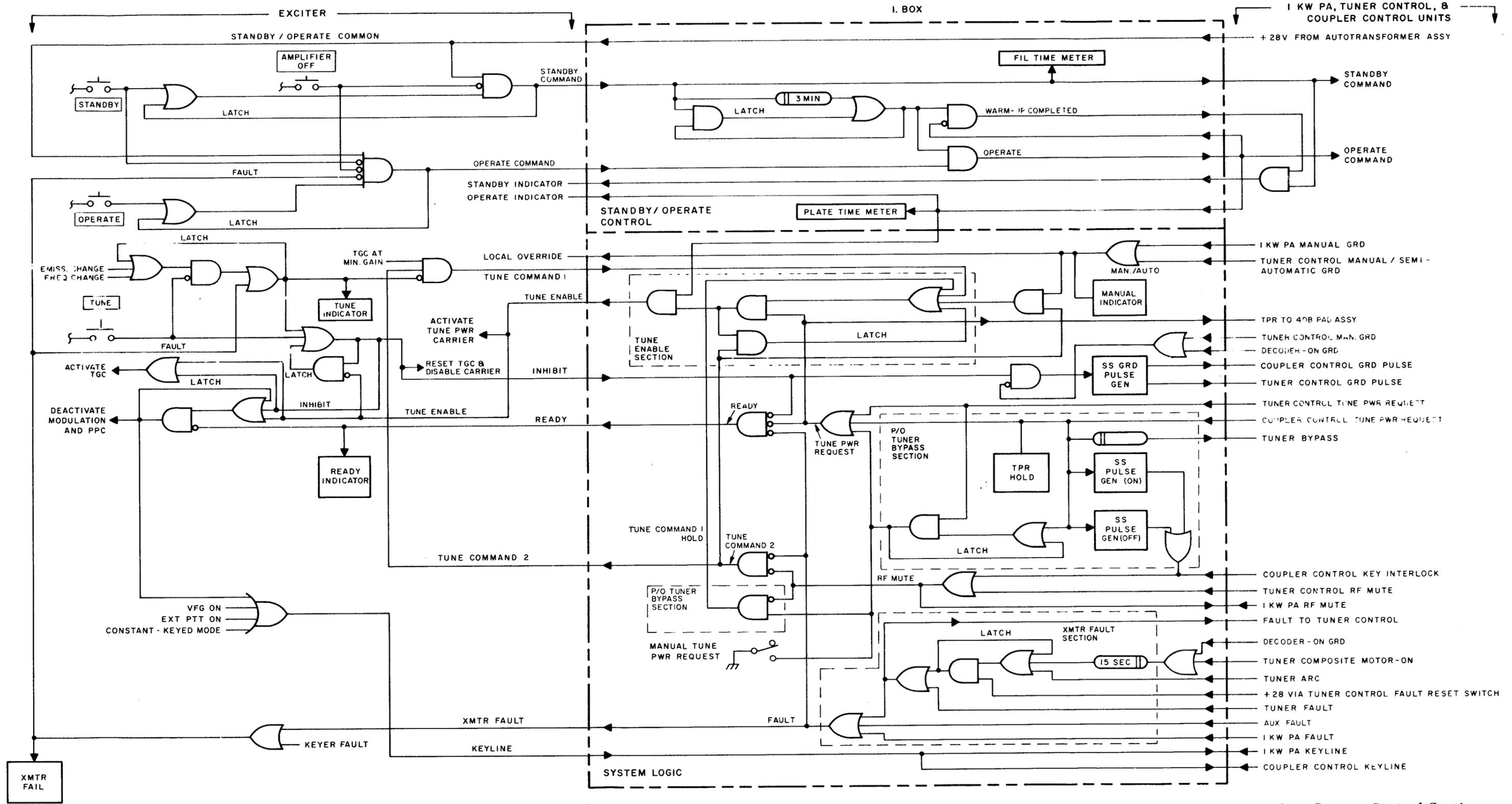


Figure 4-36. System Control Sections (Part of I. Box Unit), Functional Block Diagram

systemlogic allows the Coupler to take priority over the Tuner so that the Tuner is tuned only after the Coupler presents a 50-ohm load. The tuner bypass section accomplishes this by performing the following functions:

a. A TPR hold circuit maintains the Coupler Control tune power request during possible momentary interruptions to avoid erratic operation,

b. while the Coupler Control tune power request is present, a bypass signal is applied to the Tuner to switch it out of the RF path,

c. while coax replays in the Tuner are switching on or off, an RF mute pulse is generated to remove RF power from relay contacts, and

d. A tune command 1 hold signal is applied to the tune enable logic to relatch that circuit after the RF mute pulses in (c) are generated.

4-241 After the Antenna Coupler is tuned, the Tuner is bypassed, and the Tuner tunes. When tuning is completed, the Tuner Control tune power request and the tune command 1 hold signals are released. The tune enable is removed from the Exciter to deactivate the tune power carrier and TGC. Providing that there is no fault, the ready signal is restored to return the Exciter to its normal operating mode, ready to transmit.

4-242 While the transmitter is tuning, the Exciter applies a constant keyline signal to hold the transmitter keyed. When the ready signal is restored, the keyline status is determined according to the programmed operating mode; i.e., the transmitter is always keyed except in the USB-PTT and USB-VFG sideband modes, in which cases the keyline is

activated only when the push-to-talk circuit or voice-frequency-gate circuit is activated. In the A1, F1, F4 mode, the keyline can be held deactivated by the Keyer when a signal is sustained for longer than normal time.

4-243 If the 1 KW PA is set for manual operation or the Tuner Control unit is set for manual or semi-automatic operation, a local override signal is applied to the Exciter. During this mode of operation, the I. Box front panel MANUAL indicator is illuminated; and a tune enable is generated and the ready is removed whenever the MANUAL TUNE POWER REQUEST switch on the front panel of the I. Box is turned on. The same functions will also occur when the Coupler Control supplies a tune power request signal or, if the Tuner Control is in automatic mode and the 1 KW PA is operated manually, when the Tuner Control supplies a tune power request signal. Using the MANUAL TUNE POWER REQUEST switch, the transmitter will go to tune power condition whenever the switch is on, and it will revert to the normal operating mode and return to ready status when the switch is off and no other tune power request signals are applied.

4-244 Since all of these logic operations are off-on functions, troubleshooting is straight-forward with the aid of servicing diagram figure 4-53 and its accompanying truth table and timing diagram figure 4-54. Knowing the signals which are necessary to initiate and maintain system operation, the required input and intermediate signals can readily be determined and checked. Once the individual faulty circuit is isolated, refer to schematic diagram figure 5-49 for circuit details if necessary.

4-245 Paragraph 4-248 describes the operation of the transmitter fault sec-

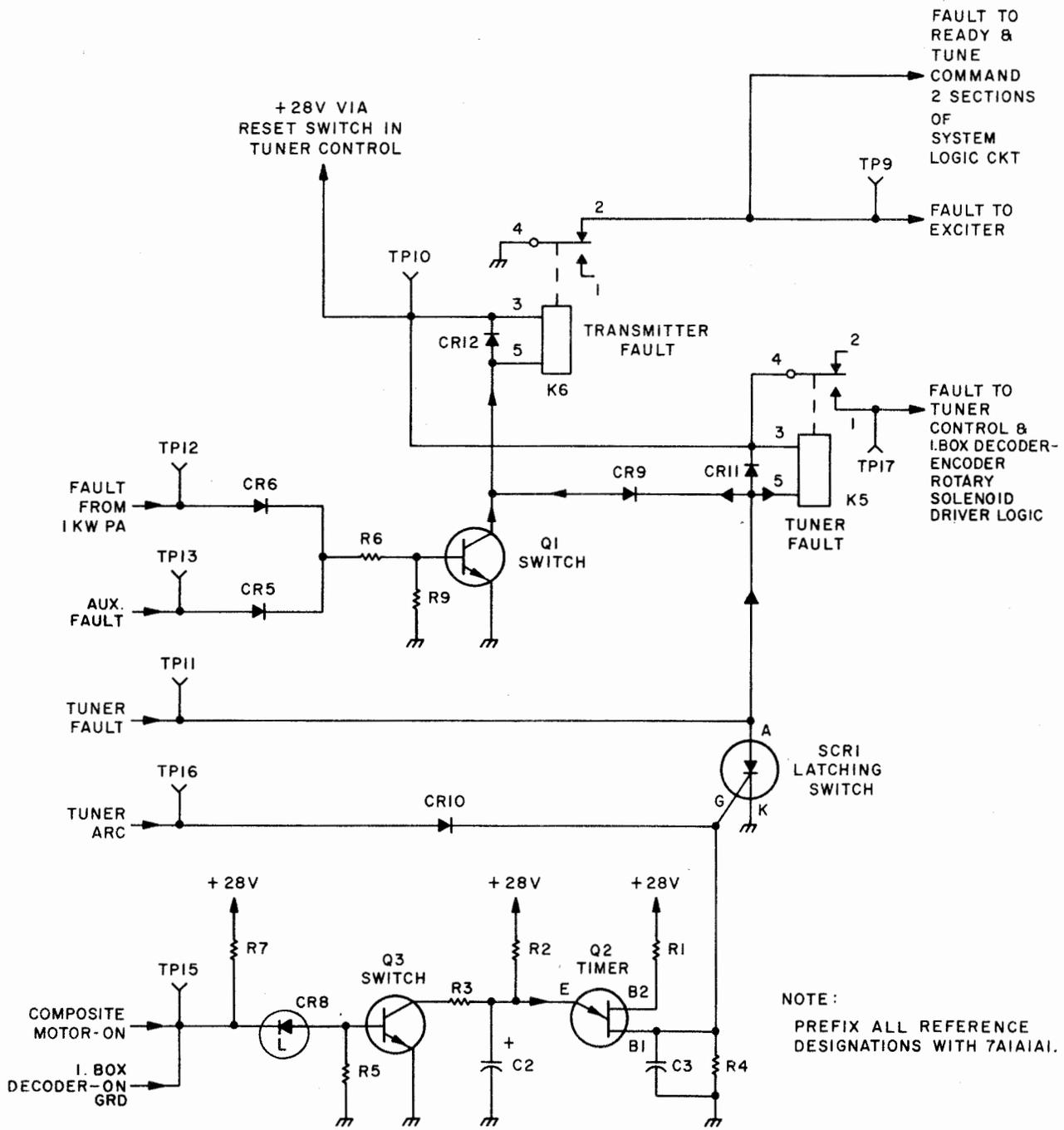


Figure 4-37. I. Box Fault Circuit, Simplified Schematic Diagram

tion in detail. Paragraph 4-252 describes the operation of the tuner bypass section in detail. The remaining circuits use only relays, so no detailed circuit descriptions are necessary for circuit understanding.

4-246 Paragraph 4-272 describes the logic circuitry used in conjunction with the I. Box decoder-encoder assembly rotary solenoid. Paragraph 4-278 describes the attenuator assembly which is part of the cabinet. These circuits are not considered as parts of system logic; however, they are considered in this section since they are most closely related to this function section.

#### 4-247 CIRCUIT DESCRIPTIONS.

4-248 TRANSMITTER FAULT SECTION. The transmitter fault section (part of system logic) consists of three transistors, a semiconductor (silicon) controlled rectifier, and two relays. The functions of this circuit are:

- a. to provide a tuner fault signal to the Tuner Control unit in response to any of three fault signals from the Tuner,
- b. to provide a transmitter fault signal to the Exciter in response to any of the three signals in a above or an auxiliary fault signal (normally not used) or a fault signal from the 1KW PA unit,
- c. To provide transmitter fault signals in response to malfunctions listed in b to be used in conjunction with the "ready" and "tune command 2" logic functions in other parts of the system logic.

4-249 Refer to figure 4-37. The output

signals to the Exciter and the Tuner Control are provided by contacts on relays K6 and K5 respectively. Diode gate CR9 allows K6 to actuate only when K5 is actuated. Note that the fault signal to the Exciter is of reversed sense, i.e., ground is the normal signal on the line; an open indicates a fault.

4-250 Relay K6 is energized by transistor switch Q1 whenever a positive fault signal is received from the 1 KW PA or an auxiliary equipment. It is also energized if a tuner fault (ground) signal is received or when latching switch SCR1 is conducting.

4-251 Relay K5 is energized by a ground signal produced in one of several ways.

- a. A temperature overload, one of two interlock switches having been activated, or L1 running to either end stop in the Tuner unit grounds the Tuner fault input, thus grounding K5 directly.

- b. When the RF voltage in the Tuner matching network becomes excessive, an arc occurs and is detected in the arc detector circuit in the Tuner. The resulting positive signal is applied to the gate of latching switch SCR1 through the tuner arc input line to trigger the SCR. The anode to cathode junction conducts, once the gate is triggered, thereby grounding K5. Latching switch SCR1 can be reset only by breaking the supply voltage (normally by momentarily actuating the Tuner Control FAULT RESET switch).

- c. When any of the three motors in the Tuner is running or the I. Box Decoder-Encoder Assembly rotary solenoid is running, a ground signal is applied to the composite motor-on input. This removes the bias from switch Q3. Normally Q3 is conducting,

thus holding the voltage at C2 near ground level. With Q3 turned off, C2 charges through R2. When the voltage across C2 reaches the required trigger level, (in approximately 15 seconds), timer (uni-junction transistor) Q2 produces a positive pulse to trigger the gate of latching switch SCR1. Thus, if tuning is not accomplished in the allotted period of time, a malfunction is indicated by the fault circuit.

4-252 TUNER BYPASS SECTION. The tuner bypass section (part of system logic) consists of four transistor logic circuits which provide the following functions. These circuits are used only when the transmitter is used in conjunction with the AN/URA-38 Antenna Coupler Group. Refer to figure 4-38.

4-253 The Coupler Control tune power request signal, upon which Tuner bypassing is dependent, may have brief momentary interruptions during tuning while servos are finishing fine tuning operations. The tune power request hold circuit provides a time delay before allowing the tune power request line to deactivate to prevent erratic or premature operation of Tuner bypassing. The TPR (tune power request) hold effect can be seen in the timing diagram, and it is explained in paragraph 4-257.

4-254 The tuner bypass circuit bypasses the Tuner by actuating coax relays in its matching network whenever the Coupler Control tune power request line is actuated. As seen in the timing diagram, a time delay is provided to allow muting prior to and during relay operation in either direction. The circuit is explained in paragraph 4-260.

4-255 The mute during bypass-transition logic provides RF mute pulses while the Tuner bypass relays are energizing or de-energizing to prevent

arcing of the relay contacts. Timing of the pulses is shown in the timing diagram. The circuit is described in paragraph 4-262.

4-256 Removal of tune command 2 during the RF mute pulses unlatches the tune enable logic. Subsequent restoration of the tune command 2 signal does not produce another tune command 1 from the Exciter to relatch the tune enable logic because the TGC motor is no longer at its home (minimum RF gain) position. The tune command 1 hold logic circuit substitutes a local signal for the tune command 1 from the Exciter to relatch the tune enable circuit. Circuit operation is described in paragraph 4-267.

4-257 TPR HOLD LOGIC CIRCUIT. The TPR (tune power request) hold logic circuit consists of two transistor switches operating with an R-C time delay network to maintain a Coupler Control tune power request for a nominal period of 1/2 second after the Coupler Control removes the actuating (ground) signal. This action prevents erratic operation of other circuits dependent upon the input signal. The circuit is a shunt type of arrangement, so the input and output are at the same point. Refer to figure 4-39.

4-258 Initially, the Coupler Control TPR line is H1, and transistors Q1 and Q2 are non-conducting. Capacitor C2 is fully charged at rest, so no current flows through the Q2 base-emitter circuit. When the TPR line is LO due to an input signal, Q1 conducts, since its base circuit is held at a positive bias level and current flows through the base-emitter junction to the TPR line. The voltage at the collector of Q1 is pulled down, and capacitor C2 is discharged through diode CR3.

4-259 When the input signal is removed, Q2 stops conducting, and the increasing voltage on its collector charges C2 through R4 and the base of Q2. With Q2 biased near saturation in this manner, its collector clamps the TPR line through CR2 until C2 is fully charged. At that time, Q2 is turned off, and the TPR line rises to its HI level. Diode gate CR2 ensures that Q1 is fully off when Q2 is conducting, and it protects the emitter-base junction of Q1 from reverse voltage breakdown. Diode gate CR1 prevents R2 loading of the TPR line when the line is HI.

4-260 TUNER BYPASS LOGIC CIRCUIT. The tuner bypass logic circuit consists of two transistor switches, an R-C time delay network, and a relay. Its function is to actuate the bypass coax relays in the Tuner while the Coupler Control TPR (tune power request) line is activated. Actuate and release time delays are provided to allow an RF mute pulse to begin before relay operation to remove RF power for contact protection. Timing is shown in figure 4-38 for reference.

4-261 Refer to figure 4-40 during the following circuit discussion. When the TPR line is actuated (grounded), capacitor C3 discharges through R13 and CR4 to provide a turn on time delay of 0.1 second. When the voltage at the base of Q6 falls below the threshold voltage set at the emitter by R15 and R16, Q6 conducts. When Q6 conducts, its collector circuit biases Q16 to saturation, and relay K1 energizes to actuate the bypass relays in the Tuner unit. When the TPR line is deactivated, C3 begins to charge, thus providing a turn off time delay of 0.25 second. When the voltage across C3 reaches

the level at which Q6 turns off, Q16 and K1 are turned off to de-energize the Tuner bypass relays. Diode gate CR4 isolates C3 from the TPR line when the TPR line is HI, thus allowing the charge time constant to be determined only by R5. Diode CR5 provides transient suppression across the K1 relay coil.

4-262 MUTE DURING BYPASS-TRANSITION LOGIC CIRCUIT. The mute during bypass-transition logic consists of two pulse generators and an inverter. The circuit applies pulses to the RF mute logic during the time the Tuner bypass coax relays are energized and de-energized to remove RF power from the contacts. Timing of the pulses is shown in figure 4-38 for reference.

4-263 Refer to figure 4-41 during the following circuit discussion. Inverter Q9 applies a ground to the RF mute logic when biased to saturation either through CR8 or CR11. Switches Q8 and Q11 both operate the same way to bias Q9 to saturation; so consider, for discussion, the operation of Q8. With Q8 biased off, full B+ is applied across C4 and R25; and assuming the C4 is already charged, no current flows. When Q8 is turned on, C4 discharges through Q8 and CR7. When Q8 is turned off again, C4 charges through R24 on the positive end and through R25 and CR8 on the ground end. The current flow through gate CR8 biases Q9 to saturation for the duration of the charging time; then Q9 turns off again. Thus, Q9 is turned on only when Q8 (or Q11) makes a transition from on to off.

4-264 With the Coupler Control TPR (tune power request) line deactivated (HI), Q7 applies a HI level signal to Q8

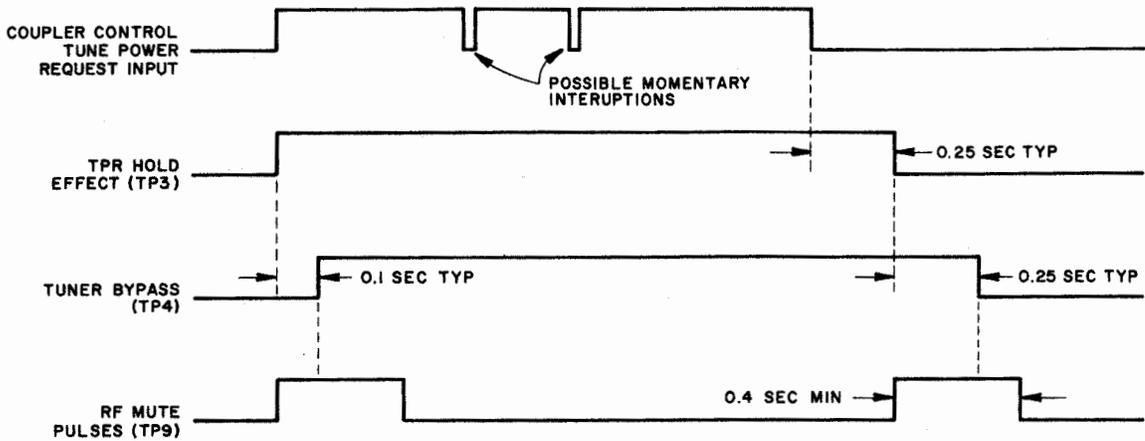
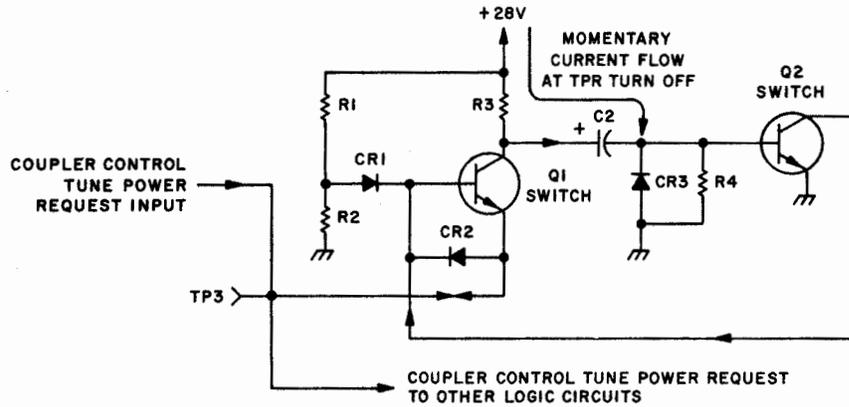


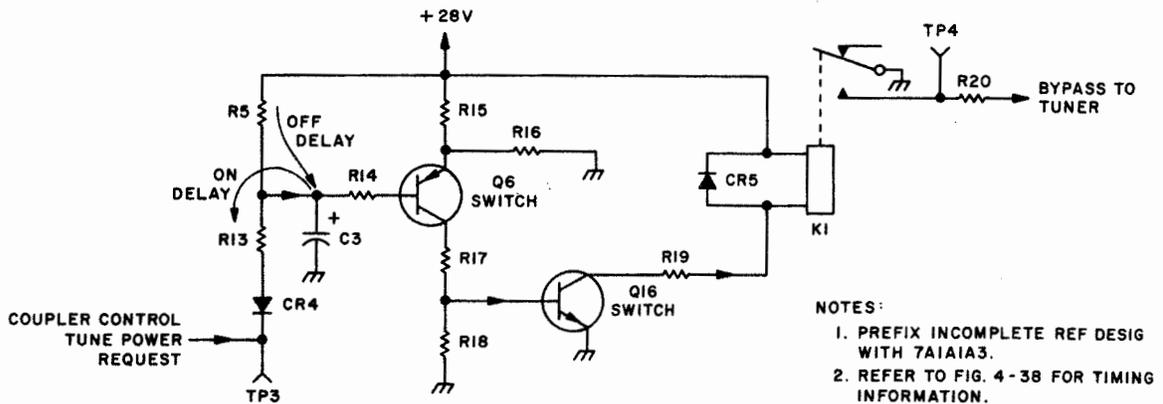
Figure 4-38. Timing Diagram, Tuner Bypass Operation



NOTES:

1. PREFIX INCOMPLETE REF DESIG WITH 7A1A1A3.
2. REFER TO FIG. 4-38 FOR TIMING INFORMATION.

Figure 4-39. Coupler Control Tune Power Request Hold Logic



NOTES:

1. PREFIX INCOMPLETE REF DESIG WITH 7A1A1A3.
2. REFER TO FIG. 4-38 FOR TIMING INFORMATION.

Figure 4-40. Tuner Bypass Logic, Simplified Schematic Diagram

through emitter-follower action. Thus, Q8 is initially on and C4 is discharged. When the TPR line is activated, it goes LO and Q8 is turned off. Thus, C4 charges and saturates Q9 to provide an RF mute pulse for the on transition of the Tuner bypass relays.

4-265 Transistor Q10 is connected as a common emitter configuration, rather than an emitter follower like Q7; so Q10 is non-conducting when the TPR line is HI. When the TPR line goes LO, Q10 conducts and turns Q11 on. When the TPR line is de-activated again, the TPR line returns to HI level, Q10 turns off, Q11 turns off, and C5 charges to provide an RF mute pulse through CR11 and Q9. Thus, Q10 and Q11 generate an RF mute pulse for the off transition of the Tuner bypass relays.

4-266 Diode gate CR6 allows Q7 to be completely turned off whenever the TPR line is LO, although the LO level may be slightly above ground. Diode gate CR9 provides isolation to prevent interaction with other circuits on the TPR line when the TPR line is HI. Diodes CR8 and CR11 form an OR gate.

4-267 TUNE COMMAND 1 HOLD LOGIC CIRCUIT. The tune command 1 hold logic circuit consists of a three-transistor latching gate circuit and an inverter which perform the logic functions shown in figure 4-53. It restores the tune command 1 signal by holding the manual tune power request line Lo, so that the tune enable is restored after an RF mute pulse. The circuit is turned on when both the Tuner Control and Coupler Control TPR (tune power request) lines are first activated, and it remains latched after the Coupler Control releases its TPR until the Tuner Control completes tuning and releases its TPR signal.

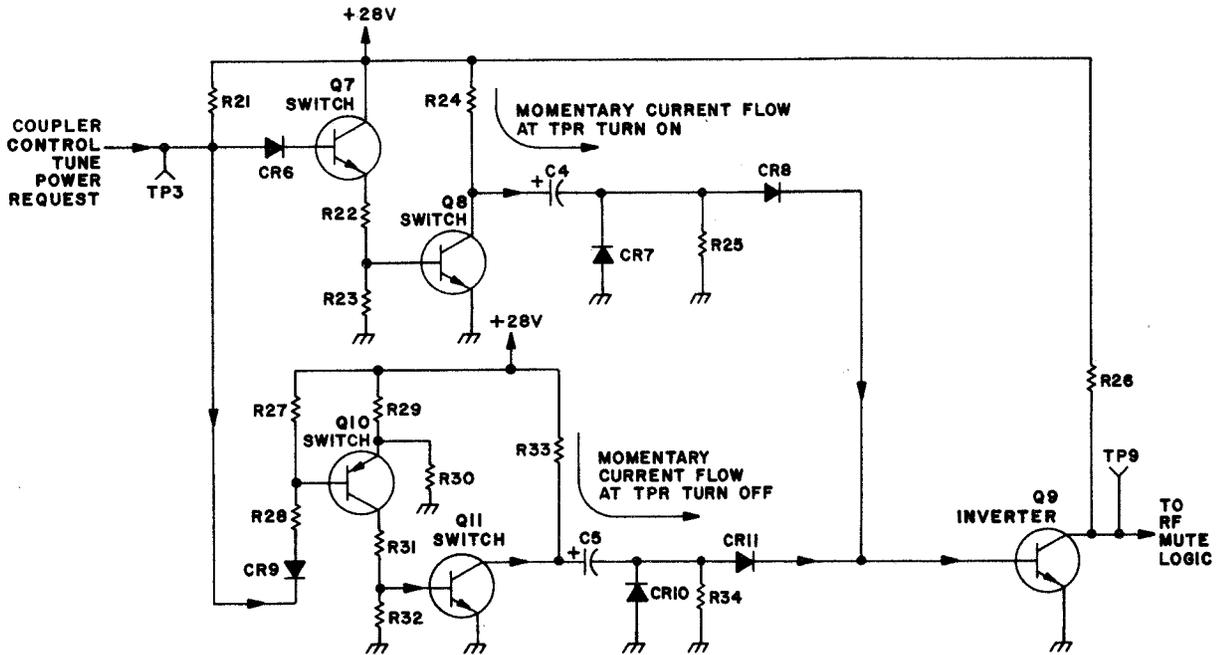
4-268 Refer to figure 4-42. Switch Q12 is normally biased off by voltage divider R38-R39 at its emitter. AND gate Q13 is normally biased off by -2V applied to the base. At the completion of homing during the tune cycle, LO (near ground) signals are applied to both input TPR lines. Q12 turns on to bias the base of Q13 positive, and the emitter circuit of Q13 is grounded, thereby turning on the AND gate. Switch Q14 turns on to provide a positive output, which turns on inverter Q15 and provides a latching signal fed back through CR14 and R43 to hold the base of Q13 positive.

4-269 The latching signal allows Q12 to be turned off again without deactivating Q13, Q14, and Q15. The circuit remains latched until the ground signal (Tuner Control TPR) is removed from the emitter of AND gate Q13. This period corresponds to the time during which the Coupler has finished tuning and the Tuner is tuning.

4-270 When the Tuner Control removes its TPR after the Tuner completes its tuning, AND gate Q13 is turned off, and the rest of the circuit is unlatched. The Q15 output to the manual TPR line is thereby removed.

4-271 Diode gate CR12 provides isolation to prevent interaction with other circuits on the CCTPR line when the CCTPR line is HI. Diode CR13 protects Q13 from reverse voltage breakdown of the base-emitter junction. Diode CR14 prevents Q15 turn on by Q12 collector current, which would otherwise flow through R43 and R48 when Q12 is on.

4-272 DECODER-ENCODER ASSY ROTARY-SOLENOID DRIVER LOGIC. The rotary-solenoid driver logic circuit (figure 4-43) consists of three transistors, three diodes, and related components.



NOTE:  
 1. PREFIX INCOMPLETE REF DESIG WITH 7A1A1A3.  
 2. REFER TO FIG. 4-38 FOR TIMING INFORMATION.

Figure 4-41. Mute During Bypass-Transition Logic

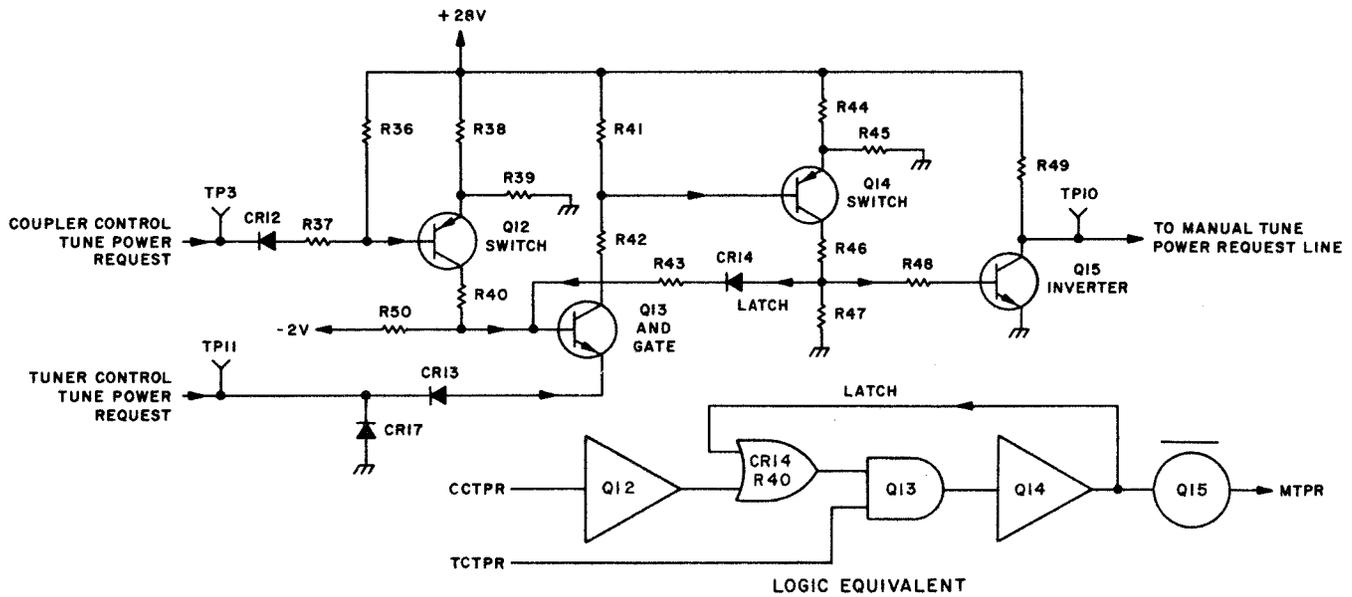


Figure 4-42. Tune Command 1 Hold Logic, Simplified Schematic Diagram

Its primary function is to drive the decoder-encoder assembly rotary solenoid (part of I. Box), acting as a buffer between the interrupting contacts and the solenoid coil. The functions of the rotary solenoid output switches are illustrated in the functional diagram section of figure 4-43.

4-273 The decoder-on ground signal is applied through CR2 to the input of the ground pulse generator in the inhibit logic circuit (system logic section of I. Box) to ensure that homing will occur after the decoder-encoder rotary solenoid stops cycling. This action prevents Tuner C1 servo homing completion until the C1 home direction switch (part of decoder-encoder output) ceases rotation and thereby indicates the correct home direction (minimum or maximum capacitance) for the band selected at the Exciter.

4-274 The decoder-on ground signal is applied through CR3 to the Tuner composite motor-on line at the fault logic circuit (system logic section of I. Box). The composite motor-on signal from the Tuner runs a 15 second timer in the fault circuit, which provides a transmitter fault (and a Tuner fault) if motors in the Tuner run for too long a time due to a malfunction. The decoder-on ground applied to the composite motor-on line provides the same fault protection in the event that the decoder-encoder rotary solenoid keeps running. This may occur due to faulty interface connections to the Exciter or decoding at the I. Box.

4-275 The Tuner fault line is connected to an AND gate in the driver logic circuit to disable the rotary solenoid should the fault described in paragraph 4-274 occur; thus preventing solenoid

coil, switch contact, or driver transistor damage.

4-276 The main driver logic circuitry consists of three transistor stages as follows. Inverter Q3 applies a positive input to the base of Q1 when no Tuner fault is received; and it removes the positive signal from the base of Q1 to disable the driver when a Tuner fault is received. AND gate Q1 provides a ground output only if its base receives the positive signal from Q3 and its emitter receives a ground through CR4 from the interrupted decoder-on line. When the solenoid coil is energized, the interrupter contacts mounted on the rotary solenoid break the ground to the emitter of Q1. The result of the interruption is rapid, repetitive solenoid actuation. The rotary motion required for stepping the switch wafers is obtained by ratchet action. The decoder-on ground is present (and thus the interrupted decoder-on ground is possible) only when the decoding wafer is not in the required position. Once the decoding wafer cycles to the correct position, the ground is removed from AND gate Q1, and the rotary solenoid stops.

4-277 Solenoid driver Q3 operates as an emitter follower to provide the current gain required to energize the solenoid coil. Diode CR1 provides transient voltage suppression across the solenoid coil. Diode CR4 protects against reverse voltage breakdown in the base-emitter junction of Q1. Resistors R2 and R3 ensure that a definite positive bias is applied to prevent interaction between circuits connected to that line.

4-278 ATTENUATOR ASSEMBLY. The Attenuator Assembly is housed in a shield box and mounted at the top rear of the



cabinet. Its function is to insert a 4DB loss in the RF line from the Exciter to the 1 KW PA during a tune condition when a single-tone mode (A0, A1, F1, or F4) has been selected. The insertion loss forces the TGC system to be set for 4DB additional Exciter output in these modes to compensate for the insertion loss in the pad. After the tune cycle, the TGC motor stops and holds the gain setting in the Exciter. The 4DB pad is then switched out of the RF path to provide 4DB more drive at the 1 KW PA. The extra drive is required because the 1 KW PA changes to class B operation for these modes.

4-279 Refer to figure 4-44. The 4DB pad, consisting of resistors R5, R6, and R7 in a "T" configuration, is switched into the RF path by actuating relay K1. The coil of the relay is energized by AND gate Q2 when a +28V signal is applied to the emitter by the tune power request (system) logic and a ground (approx.) signal is applied to the base by Q1. Switch Q1 is normally biased off by a negative voltage applied to the mode line by the bias circuit in the 1 KW PA, which also operates from the mode line. When the Exciter grounds the mode line (A0, A1, F1 or F4 mode), Q1 conducts and applies a ground (approx.) signal to R3 at the base of Q2. Diode CR1 prevents reverse voltage breakdown in the base-emitter junction of Q1.

4-280 TROUBLESHOOTING CHARTS. Table 4-3 provides a listing of some likely symptoms and possible corresponding faults which would cause the symptoms. It is not intended to be a complete troubleshooting chart, but rather a compilation of those items which might not be found directly through a logical troubleshooting procedure. This quick reference informa-

tion might help in isolating a problem area without the requirement of a detailed analysis.

4-281 Figure 4-45 provides a "flow chart" method of troubleshooting, wherein the system is activated and tested one step at a time. Decisions are made, and depending on whether or not a step is completed satisfactorily, the procedure may lead off to a possible fault to correct. To use the flow chart, start on the first page, with the system in AMPLIFIER OFF status. Proceed according to arrows. At each diamond shaped step, make the required decision, and follow the arrow for the answer obtained. Rectangles list possible faults. A small circle indicates corrective action may be necessary before proceeding. A large circle with a key in it is an "on-page connector" which indicates that you should proceed to the same circle at some other position on the page. An open arrow with a key in it is an "off-page connector", which leads to the starting step on the next (or a previous) page. In some cases a procedure may be repeated after corrective action is taken, as is designated by loops back to an earlier step. Remember that a chart such as this can only indicate the more common problems. You should always be alert to the possibility of other or related problems. Be sure to use all built in testing aids, servicing diagrams, alignment procedures, voltage charts, and other troubleshooting aids to the fullest possible extent to supplement information in the troubleshooting flow chart.

4-282 TEST DATA .

4-283 TEST EQUIPMENT AND SPECIAL ADAPTERS. Test equipment and special adapters required to perform

troubleshooting of transmitter units other than Exciter, Keyer, Decoder-Encoder, and Remote Control are listed in table 4-4. Equivalent substitutes may be used if determination of equipment characteristics shows that the substitute will effectively perform required functions. Refer to individual equipment technical manual for units excluded above.

tubes. Table 4-7 gives resistance measurements for the 1KW PA final amplifier tubes. The 1 KW PA final amplifier screen and plate voltages can be checked with the multipurpose meter on the front of the unit. No attempt should normally be made to check these directly, especially the 2400 VDC plate voltage.

4-284 VOLTAGE AND RESISTANCE MEASUREMENTS. Table 4-5 and 4-6 give expected voltage and resistance measurements for the 1 KW PA driver amplifier

WARNING

Use extreme caution when working on high voltage circuits. Use shorting stick to discharge circuit test points before making resistance measurements.

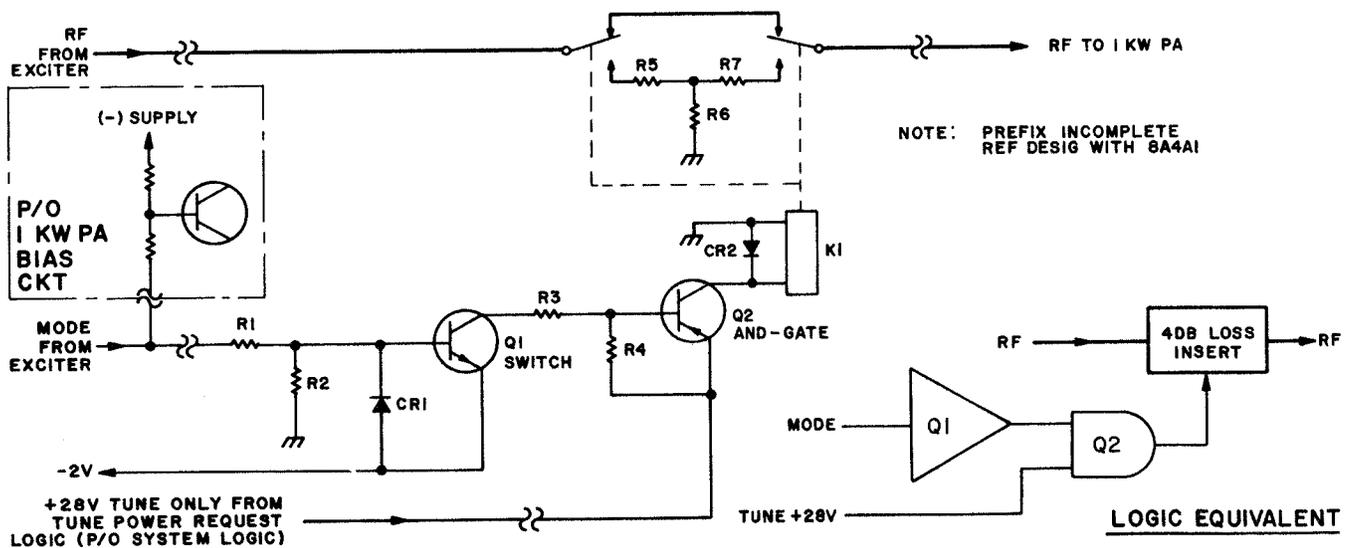


Figure 4-44. Attenuator Assembly, Simplified Schematic and Functional Diagrams

TABLE 4-3. TROUBLESHOOTING CHART

SYMPTOMS	POSSIBLE FAULT
EXC FAIL indicator illuminates.	<ul style="list-style-type: none"> <li>a. One of four injection signals low or dead.</li> <li>b. One of five power supply outputs low or dead.</li> </ul>
XMTR FAIL indicator illuminates, transmitter held inoperative.	<ul style="list-style-type: none"> <li>a. 1 KW PA excessive RF at plate.</li> <li>b. 1 KW PA excessive final amplifier cathode current.</li> <li>c. 1 KW Power Supply temperature excessive.</li> <li>d. Tuner matching network arc.</li> <li>e. Tuner L1 temperature excessive.</li> <li>f. Tuner L1 run to either end stop.</li> <li>g. Tuner taking over 15 seconds to tune or motors stalled.</li> <li>h. Decoder-Encoder running longer than 15 seconds.</li> <li>i. Tuner covers not secured.</li> </ul>
Tuner Control cannot be activated.	<ul style="list-style-type: none"> <li>a. Case interlock open</li> <li>b. Circuit breaker tripped.</li> </ul>
Exciter STANDBY pushbutton illuminated but 1 KW PA standby power not present.	<ul style="list-style-type: none"> <li>a. 1 KW PA case interlock open.</li> <li>b. 1 KW Power Supply case interlock open.</li> </ul>
Exciter STANDBY and OPERATE pushbuttons will not activate 1 KW PA, other Exciter indications normal.	Lack of 28 VDC power from Autotransformer Assembly to I. Box; check 28 VDC circuit breaker on bottom panel.
Transmitter will not go into operate.	<ul style="list-style-type: none"> <li>a. Lack of 1 KW PA air flow or sticky air flow interlock.</li> <li>b. 1 KW PA plate compartment interlock open.</li> <li>c. I. Box time delay or operate relay defective.</li> </ul>
Exciter READY indicator will not illuminate, TUNE pushbutton not illuminated, Tuner not tuning, possibly some RF output.	<ul style="list-style-type: none"> <li>a. XMTR FAIL fault (see above).</li> <li>b. Exciter not removing inhibit from I. Box after tuning.</li> <li>c. Tuner or coupler not completing tune cycle or</li> </ul>

TABLE 4-3. TROUBLESHOOTING CHART (Cont)

SYMPTOM	POSSIBLE FAULT
	<p>logic circuits faulty (isolate by checking tune power requests at I. Box)</p> <p>d. I. Box MANUAL TUNE POWER REQUEST switch left in ON position.</p> <p>e. L2 at home end stop due to L1 position misadjustment.</p>
Automatic tune cycle will not take place when depressing Exciter's TUNE pushbutton.	<p>a. XMTR FAIL fault.</p> <p>b. Faulty Tuner Control RF mute logic.</p> <p>c. Faulty Coupler Control keying logic.</p> <p>d. RF mute from 1 KW PA to I. Box.</p> <p>e. Transmitter not in operate.</p>
Tuner does not tune during automatic cycle, near full RF output regardless.	EMERGENCY BYPASS switch inside Tuner Control not off.
Exciter's READY indicator not illuminated after tuning stops in 2.0 - 2.5 MC band.	Normal function in this band with some load impedances. Insufficient inductance in Tuner L2 element. Second depression of TUNE pushbutton will cause another tune cycle with L3 element added.
I. Box MANUAL TUNE indicator illuminated.	<p>a. Tuner Control not set for automatic.</p> <p>b. 1 KW PA not set for automatic.</p>
High reflected power.	<p>a. Mistuned Antenna Coupler.</p> <p>b. Open or shorted transmission line.</p>
Excessive 1 KW PA final plate current.	<p>a. Mistuned transformer assembly in Final Transformer Assembly 1A1A2.</p> <p>b. Open coupling capacitor in Final Transformer Assembly 1A1A2.</p> <p>c. Bad bias supply.</p>
Low RF power output.	<p>a. Mistuned transformer assembly in Driver Transformer Assembly 1A1A4 or Final Transformer Assembly 1A1A2.</p> <p>b. Faulty or misadjusted TGC-PPC circuits.</p> <p>c. High VSWR at 1 KW PA or Tuner output.</p>
No RF output; 1 KW PA final plate current increases with increased RF input.	<p>a. Short to ground or an open circuit in Final Transformer Assembly 1A1A2.</p> <p>b. Short to ground in Tuner matching network or cabling.</p>

TABLE 4-3. TROUBLESHOOTING CHART (Cont)

SYMPTOM	POSSIBLE FAULT
Essentially no RF output; no increase in 1 KW PA final plate current with increase in RF input.	<ul style="list-style-type: none"> <li>a. Driver Tube Assembly 1A1A1 not properly seated, or fault in assembly.</li> <li>b. Driver Transformer Assembly 1A1A4 not properly seated, or fault in assembly.</li> <li>c. 1 KW PA key or bias circuit bad.</li> </ul>
Impossible to reach 1 KW output; driver current decreases with increased RF input.	<ul style="list-style-type: none"> <li>a. Defective or misadjusted TGC-PPC circuit in 1 KW PA or Exciter.</li> <li>b. Mistuned driver or final transformer assembly.</li> <li>c. Misadjusted or defective VSWR bridge.</li> </ul>
Excessive RF output.	<ul style="list-style-type: none"> <li>a. Defective TGC-PPC circuit (1 KW PA or Exciter) or misadjustment.</li> <li>b. Defective 1 KW PA and Tuner VSWR Bridges.</li> <li>c. TGC or PPC cable not connected to Exciter or cables faulty or reversed.</li> <li>d. Oscillating 1 KW PA driver or final amplifier stage.</li> </ul>
1 KW PA final amplifier plate currents equal at idle but spread at 1 KW out.	<ul style="list-style-type: none"> <li>a. Unmatched or defective 1 KW PA final amplifier tube.</li> <li>b. Defective or shorted cathode resistors.</li> </ul>
1 KW PA final amplifier plate currents not equal or near equal at idle.	<ul style="list-style-type: none"> <li>a. 1A1P6-P7 not plugged into proper sockets.</li> <li>b. Shorted tube element.</li> </ul>
1 KW PA final amplifier plate current excessive for rated 1 KW output.	<ul style="list-style-type: none"> <li>a. Incorrect tuning of Final Transformer Assembly 1A1A2.</li> <li>b. Final Transformer Assembly switch not connecting tuning capacitors correctly.</li> <li>c. Open final amplifier bypass capacitor.</li> </ul>
1 KW PA FREQUENCY MEGACYCLES dial does not index at correct position.	<ul style="list-style-type: none"> <li>a. If the switch in Final Transformer Assembly 1A1A2 also stops out of position, the coupling on Driver Transformer Assembly 1A1A4 has slipped.</li> <li>b. If the switch in Final Transformer Assembly 1A1A2 does stop in correct position, the set screws in FREQUENCY MEGACYCLES dial are loose.</li> <li>c. Open or mis-wired frequency code line between Exciter and I. Box or I. Box and 1 KW PA.</li> </ul>

TABLE 4-3. TROUBLESHOOTING CHART (Cont)

SYMPTOM	POSSIBLE FAULT
	d. Defective Decoder-Encoder Assembly 7A1A4 in I. Box.
Motor 1A1B2 does not energize.	a. Blown BANDSWITCH MOTOR fuse. b. Code lines not connected. c. Decoder-Encoder Assembly 7A1A4 not energized when required.
Motor 1A1B2 does not de-energize.	a. Shorted or miswired code line between case connector 1A2A1J7 and switch S1 in Driver Transformer Assembly 1A1A4. b. Coupling on Driver Transformer Assembly 1A1A4 does not pick up the mating coupling.
A tune condition can not be achieved (VSWR less than 1.5:1).	a. Defective or unbalanced Tuner Control or I. Box servo amplifier. b. Defective or mistuned Discriminator Assembly 9A1A1. c. No tune sensitivity drive. d. Adequate tune power not maintained throughout tune cycle.
Erratic Tuner Control logic signals during semi-automatic or automatic operation.	Defective -2 VDC Tuner Control power supply.
No RF power applied during automatic Tuner Control operation.	a. Defective home logic. b. Defective RF mute logic.
Tuner elements do not go to home when frequency is changed.	a. No ground pulse from I. Box. b. Defective home logic.
After homing, Tuner Control TUNING indicator does not illuminate.	a. Inadequate RF power for tuning. b. Faulty or mistuned Discriminator Assembly 9A1A1. c. Faulty or unbalanced servo amplifiers. d. Faulty motor drive transistors. e. Faulty I. Box keying, mute, and tune logic circuit. f. L1 position circuit defective. g. VSWR greater than 4:1.
Tuner Control TUNED indicator does not illuminate at completion of tuning.	Tuning element at end stop.

TABLE 4-3. TROUBLESHOOTING CHART (Cont)

SYMPTOM	POSSIBLE FAULT
Tuner elements cannot be repositioned.	<ul style="list-style-type: none"> <li>a. Defective Tuner Control or I. Box brake logic.</li> <li>b. Defective motor control transistors.</li> </ul>
1 KW Power Supply 115 VAC, 400 CPS line shorted to ground.	Blower 1A2B1 rotated in its mounting so that its terminal strip touches chassis.
1 KW PA driver and final amplifier screen voltages fall when keyed.	<ul style="list-style-type: none"> <li>a. Shorted screen in any of four tubes.</li> <li>b. Zener diodes 1A1CR3-CR11 open or shorted.</li> <li>c. Open phase in primary of 1 KW Power Supply 600 VDC supply.</li> <li>d. Open rectifier in 600 VDC supply.</li> </ul>
1 KW Power Supply 2400 VDC supply circuit falls to about 2000 volts when keyed.	Open phase of 1 KW Power Supply power transformer 2A2T1 or open rectifier.

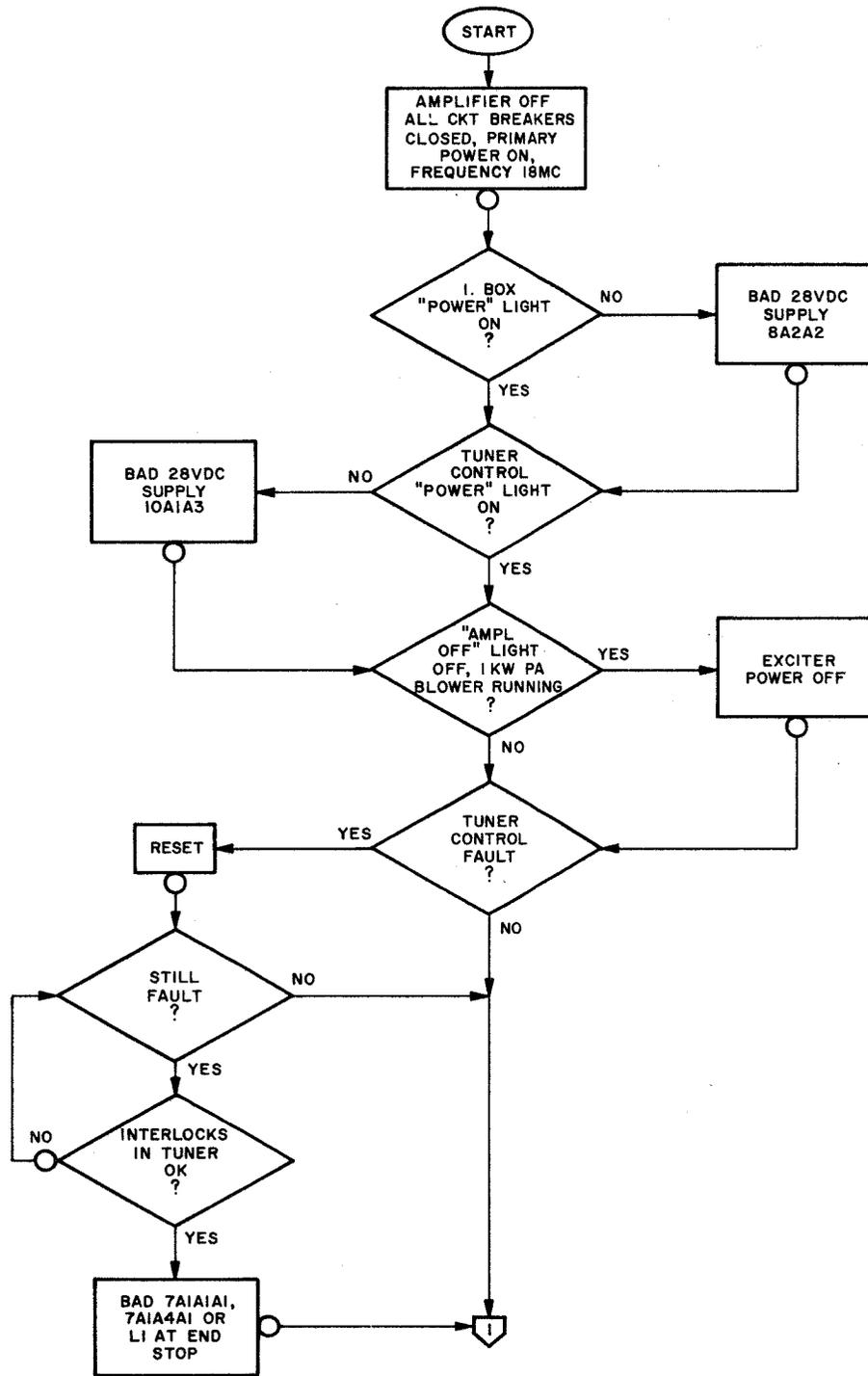


Figure 4-45. Troubleshooting Flow Chart (Sheet 1 of 10)

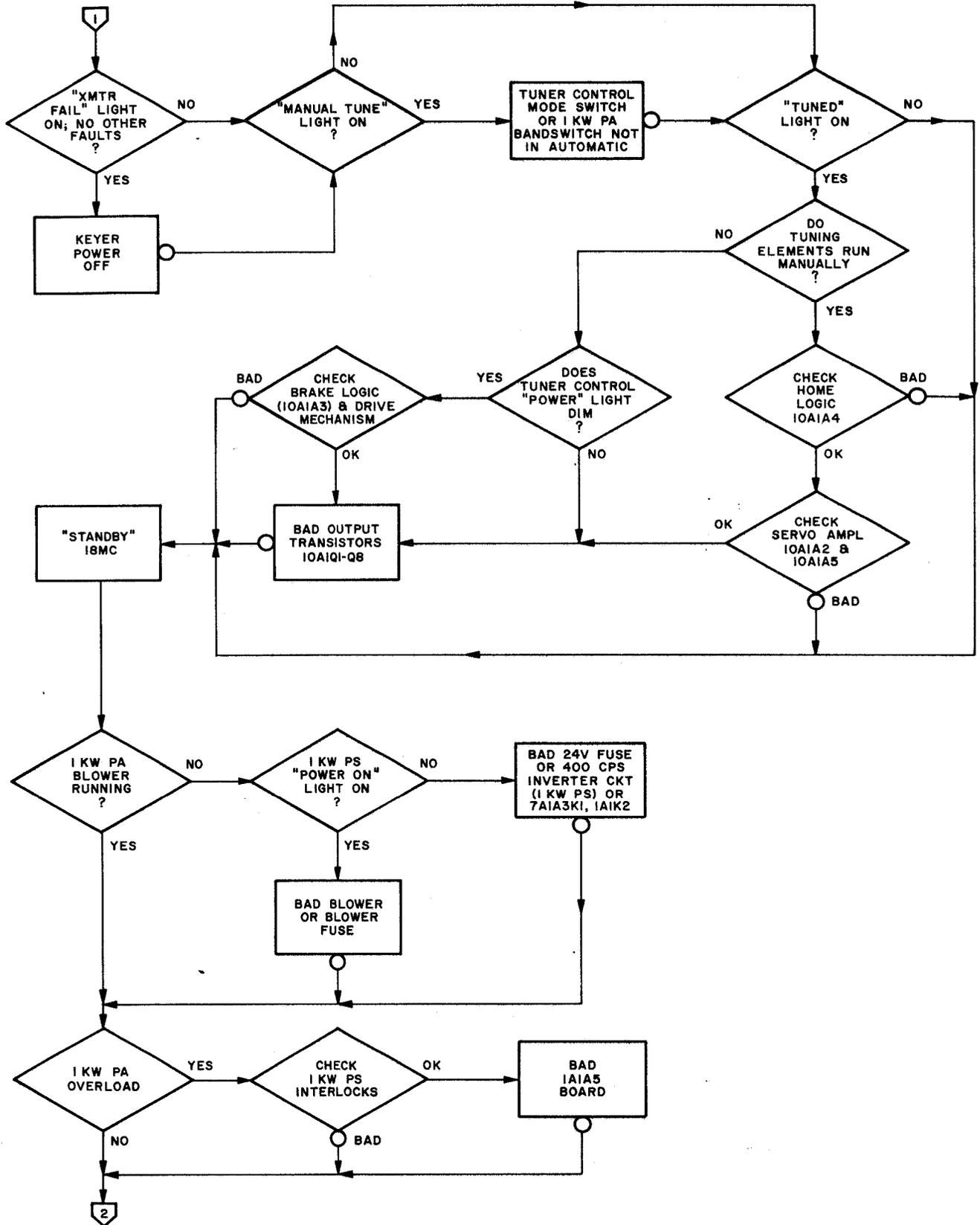


Figure 4-45. Troubleshooting Flow Chart (Sheet 2 of 10)

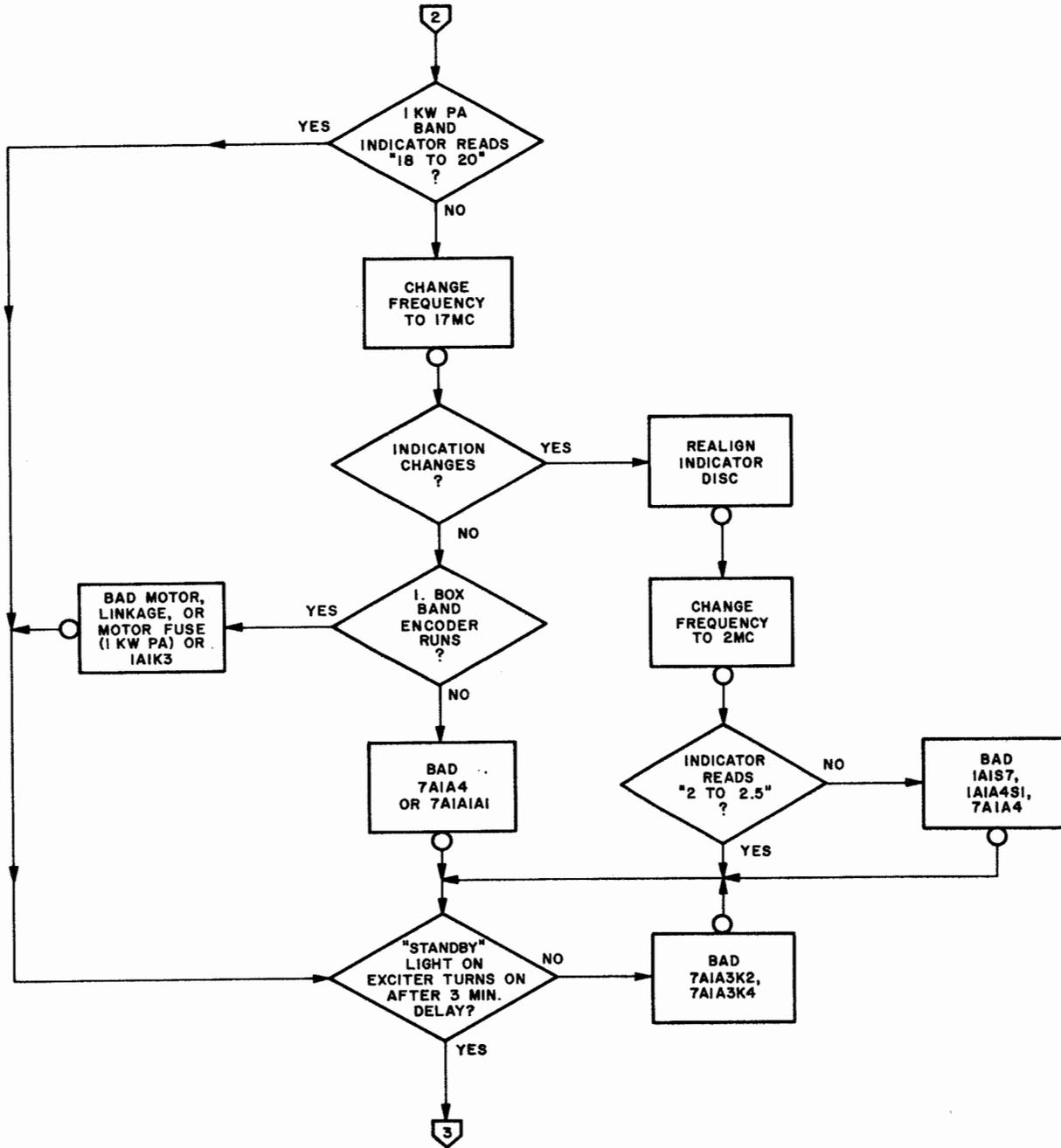


Figure 4-45. Troubleshooting Flow Chart (Sheet 3 of 10)

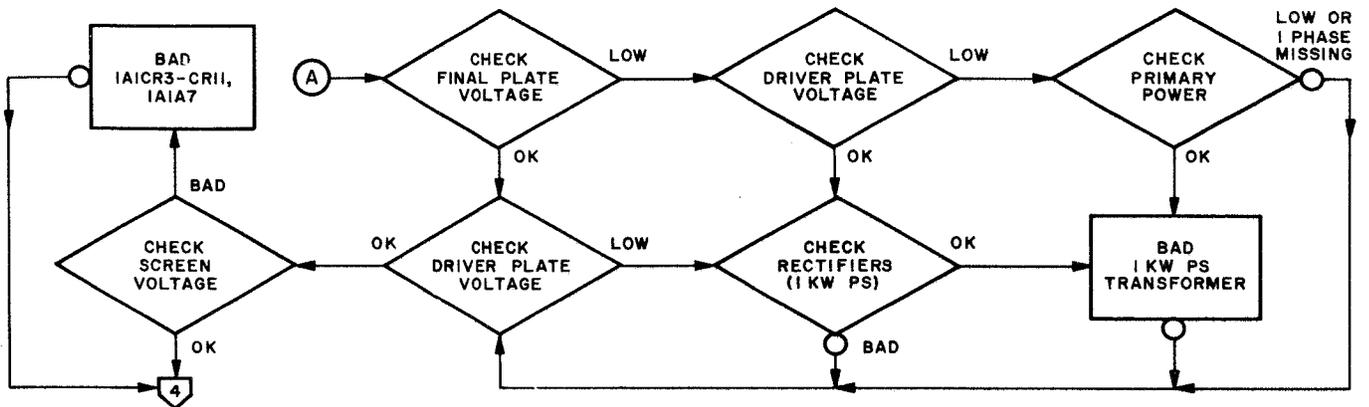
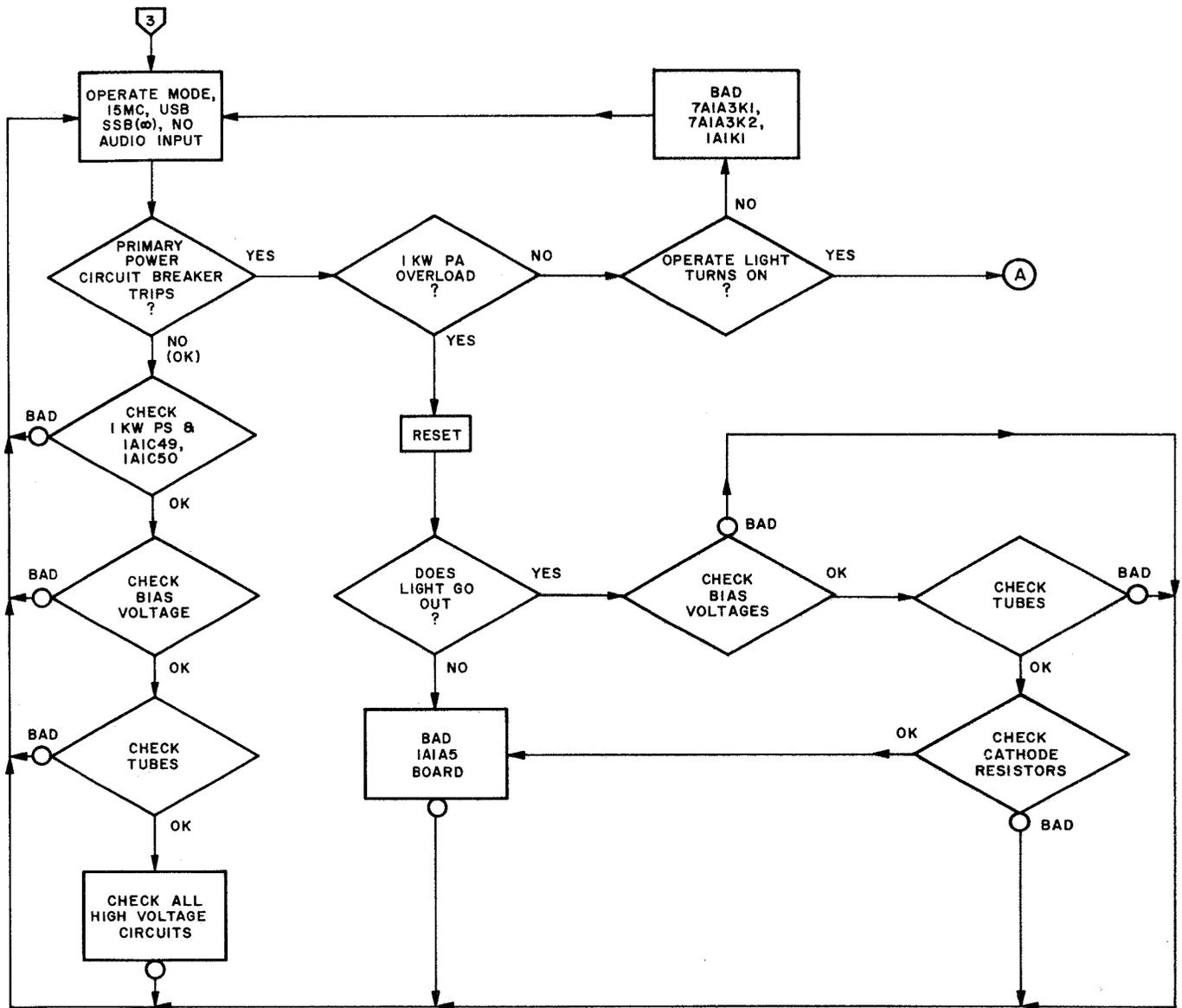


Figure 4-45. Troubleshooting Flow Chart (Sheet 4 of 10)

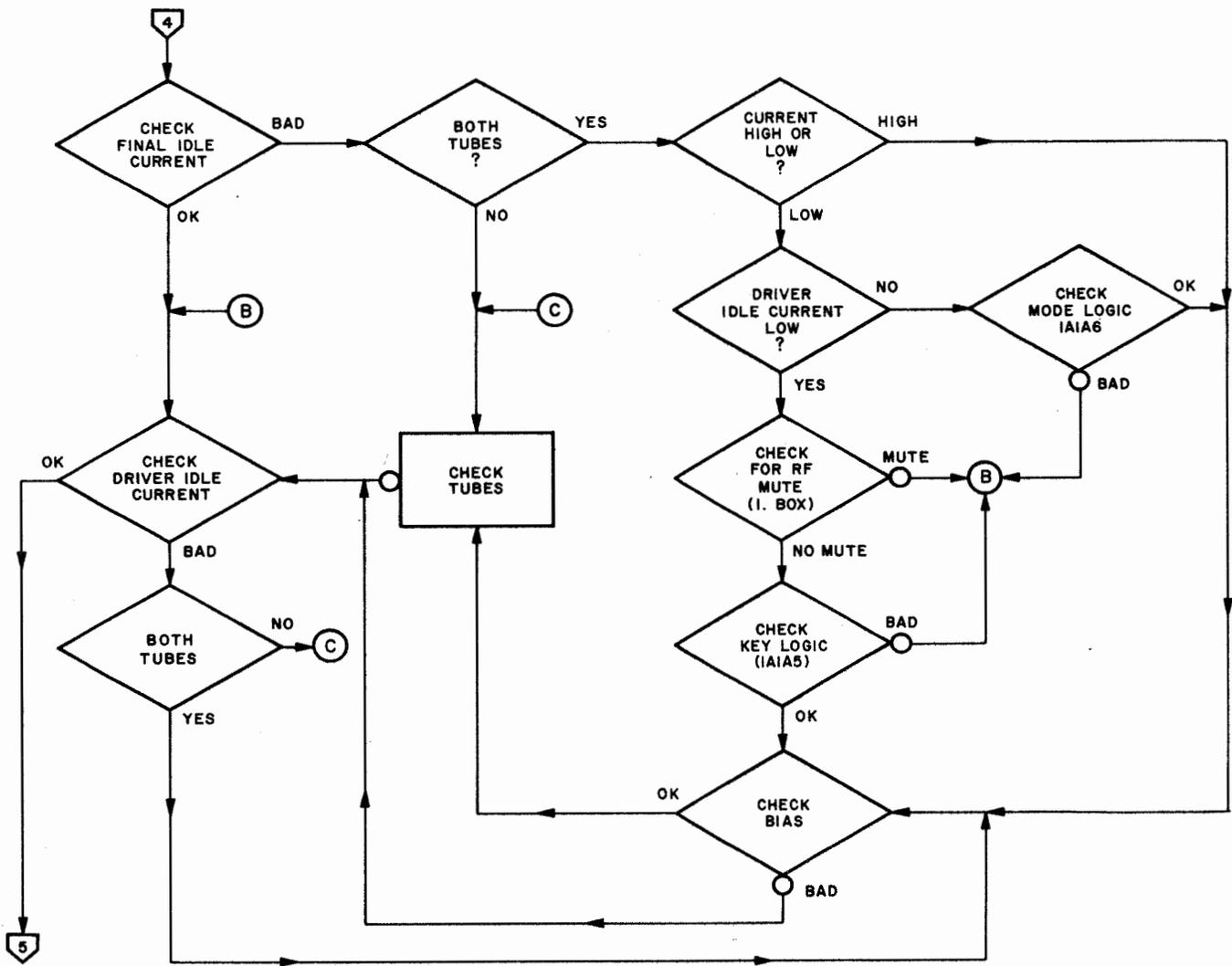


Figure 4-45. Troubleshooting Flow Chart (Sheet 5 of 10)

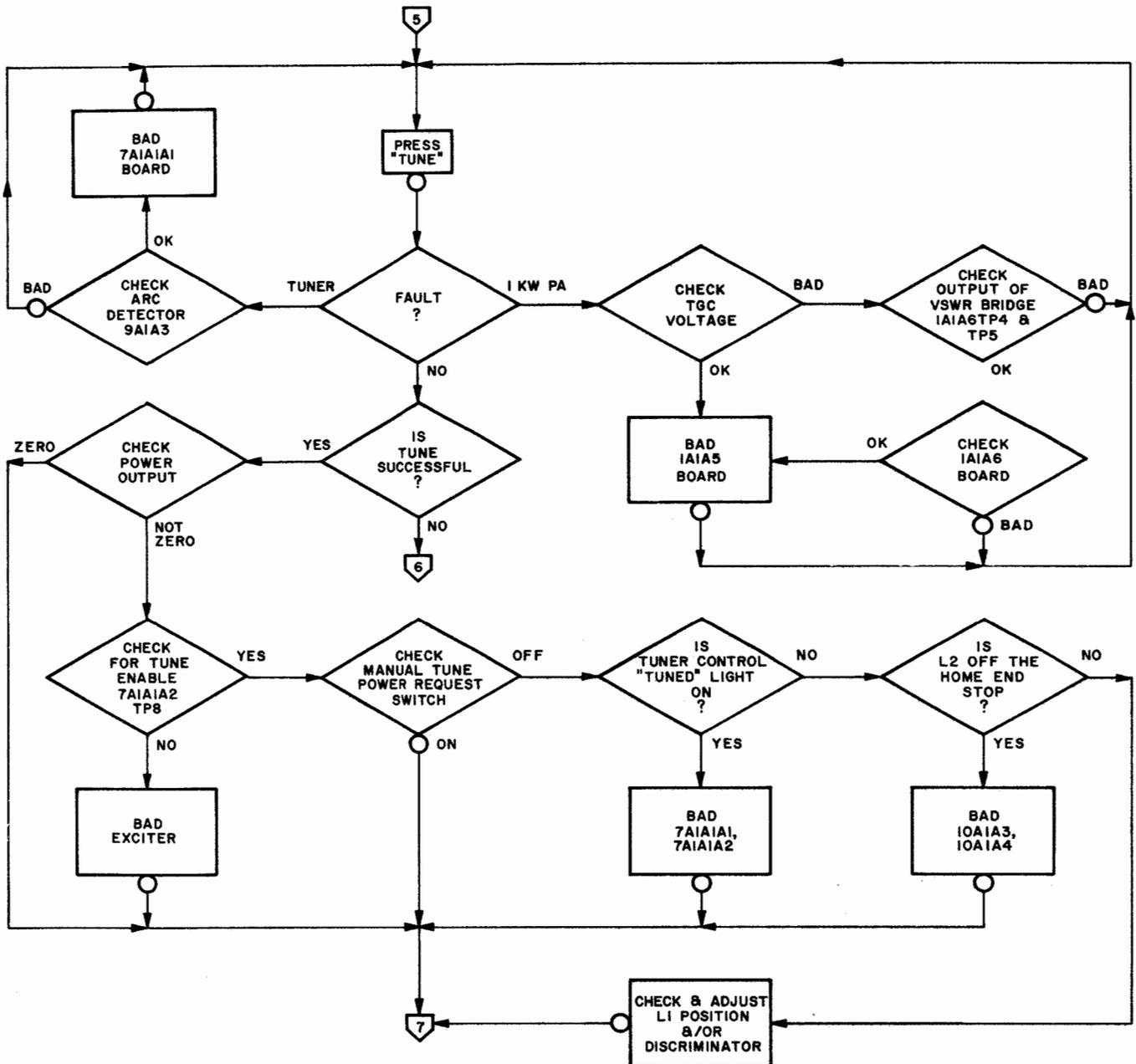


Figure 4-45. Troubleshooting Flow Chart (Sheet 6 of 10)

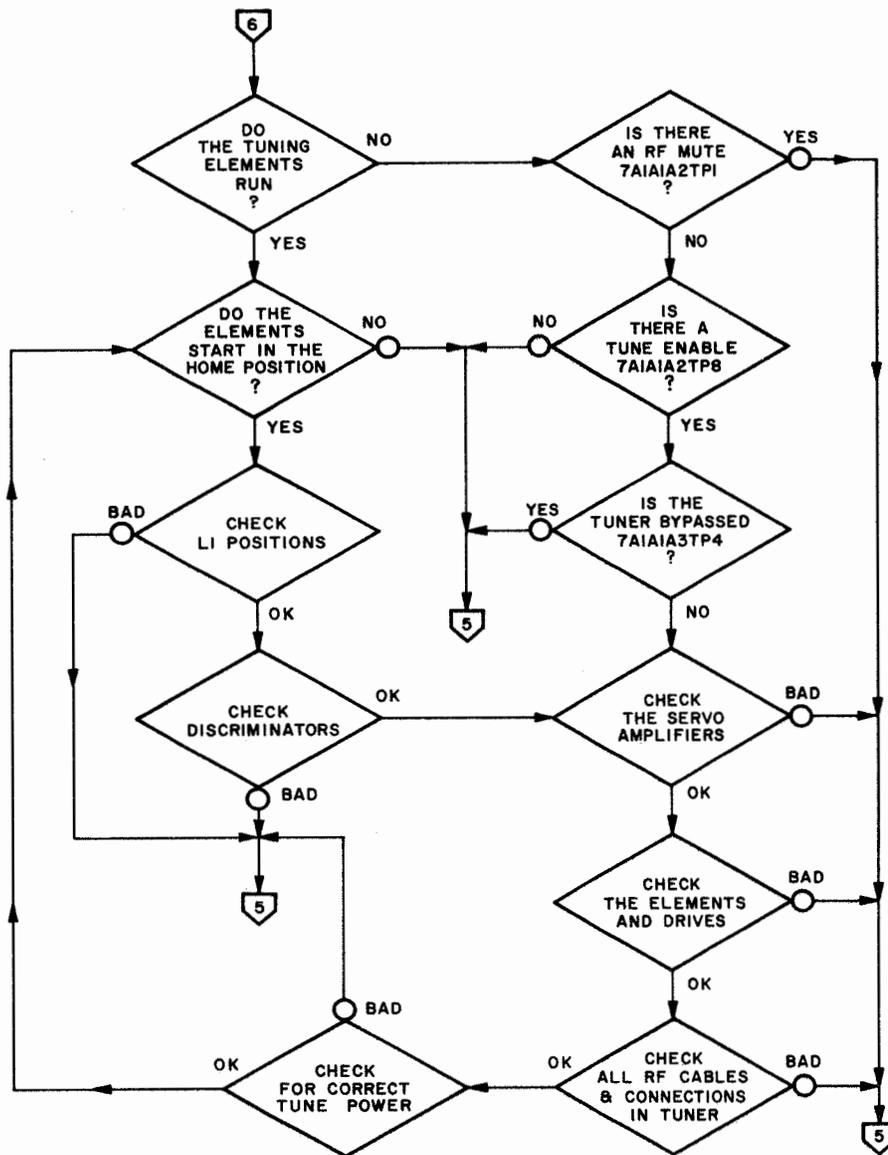


Figure 4-45. Troubleshooting Flow Chart (Sheet 7 of 10)

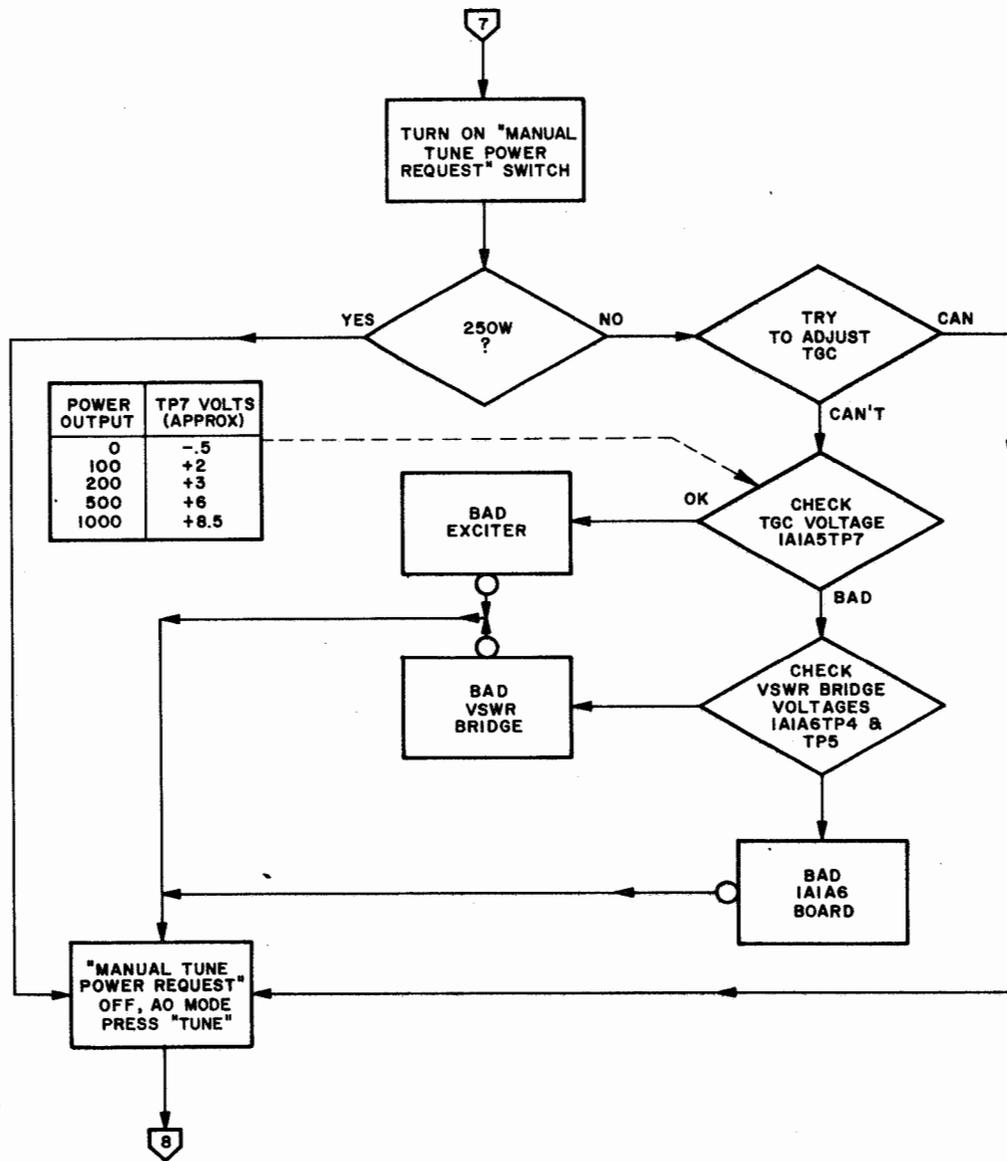


Figure 4-45. Troubleshooting Flow Chart (Sheet 8 of 10)

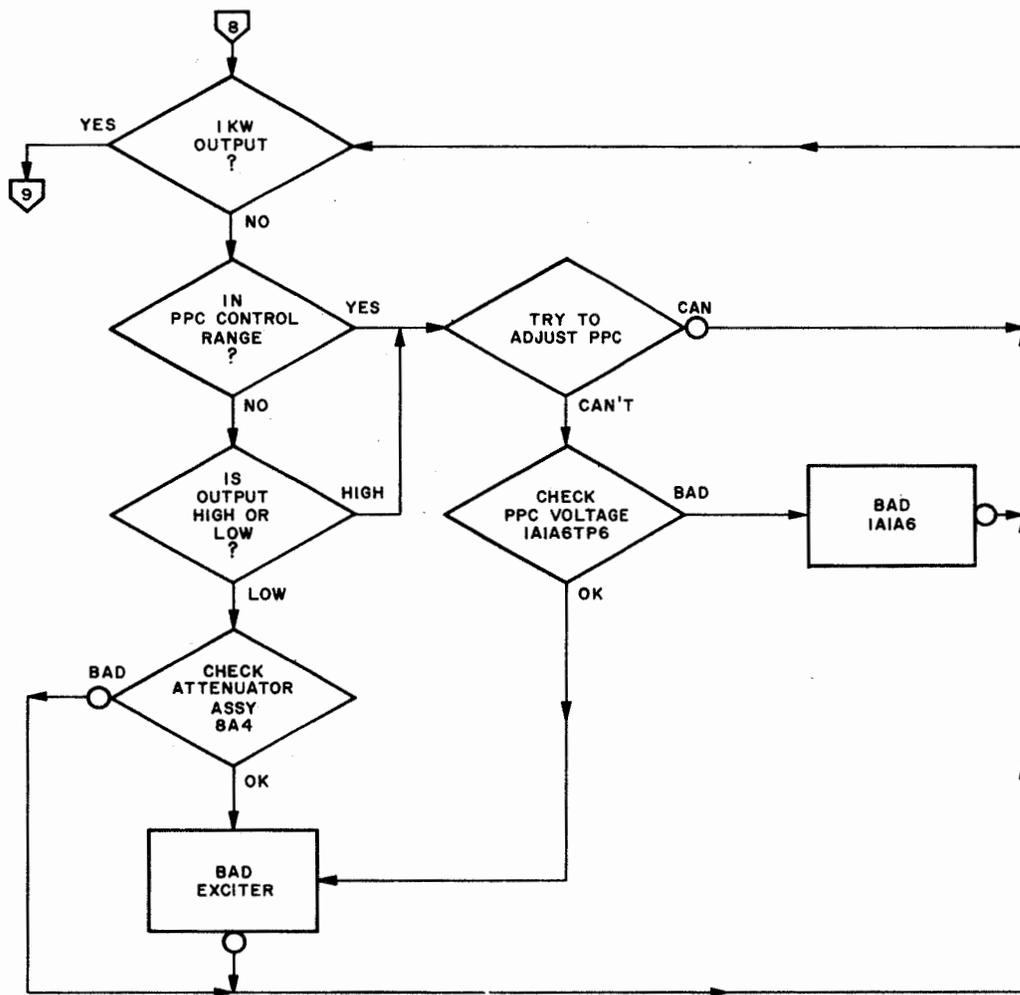


Figure 4-45. Troubleshooting Flow Chart (Sheet 9 of 10)

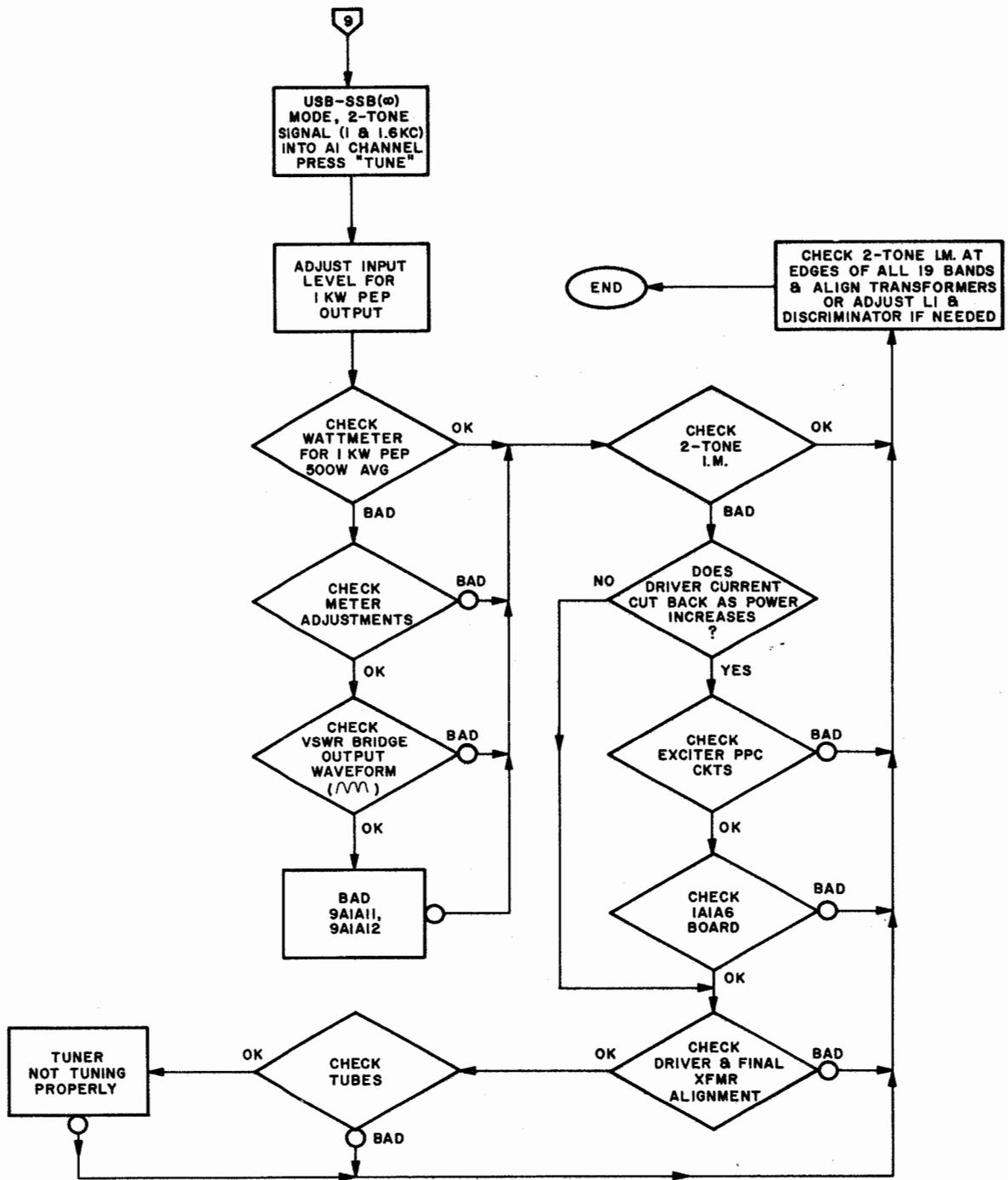


Figure 4-45. Troubleshooting Flow Chart (Sheet 10 of 10)

TABLE 4-4. TEST EQUIPMENT AND SPECIAL ADAPTERS

EQUIPMENT	TYPE	REQUIRED CHARACTERISTICS	USE
Multimeter	AN/USM-311	AC volts 2.5 to 1000V full scale (FS), DC volts 2.5 to 5000V FS, resistance 30 ohms to 30 MEGO.	General voltage and resistance measurements in troubleshooting.
Multimeter		full scale, 2 to 30 MCS.	
RF Cable Adapter	UG-1447/ USM-117	Type N coaxial feed-through with "Tee" tap for AC probe of USM-116	Connecting USM-116 AC probe in coaxial line at output of 1 KW PA or Tuner.
Oscilloscope	AN/USM-281(A)	Square wave voltage measurement to 300V P-P at 400 CPS.	Waveform measurements.
Dummy Load,	DA-242/U	50 ohms, 2 to 30 MCS, 1200W, VSWR 1.1:1 MAX.	Dummy load termination for testing without antenna.
Wattmeter	AN/URM-120		Power and VSWR measurements.
DC Power Supply	Power Design Model 4005	0-15V DC	Servo-amplifier adjustment.
Sweep Generator	Texscan Model VS-30	1-35 MHz, 0.5V output. 0-5 MHz sweepwidth 0.5, 1.0, and 5.0 MHz markers.	Circuit alignment signal source.
RF Signal Generator	SG-582/U	75 KHz-30 MHz, 3V RMS	Test and alignment signal source.
Alignment Tool	J.F.D. 5284	Non-inductive alignment tool	Circuit alignment.
PC Board and Module Extenders and Module Puller Handles	See table 1-2	Supplied with AN/FRT-83(V)	Testing assemblies extended from chassis.
AF Signal Generator	SG-376/U	2-tone generator, 20-20KHz, 2V RMS	PPC/APC control adjustment.

TABLE 4-5. 1 KW PA DRIVER AMPLIFIER ASSEMBLY 1A1A1  
VOLTAGE MEASUREMENTS

## Note

The voltage measurements for the driver amplifier are made at the terminals of terminal board 1A1A1TB1. If the Driver Amplifier Assembly was removed to gain access directly to the tube sockets, cooling air to both the driver and final amplifier tubes would be lost.

1A1A1TB1 TERMINAL No. CONDITIONS	1	2	6	7	8	9	10	11	12	13
OPERATE, UNKEYED	+630	+287	13.5 VAC	0	-83	0	0	+0.85	0	0
OPERATE, KEYED, NO SIGNAL	+630	+287	13.5 VAC	0	-2.7	+3.4*	+3.4*	0	0	0

\*Multipurpose meter switch must not be set in DRIVER 1 AMPERES or DRIVER 2 AMPERES position during this measurement.

TABLE 4-6. 1 KW PA DRIVER AMPLIFIER TUBES 1A1A1V1/V2  
RESISTANCE MEASUREMENTS

Note

Resistance measurements made directly at the tube sockets, with the assembly wired into the set. To remove the 1A1A1 assembly without disconnecting the leads to 1A1A1TB1, first detach the small cable clamps holding the main cable against the rear lip of the chassis near 1A1A4.

TUBE SOCKET PIN NO.	1	2	3	4	5	6	7	8	9	10	11
CONDITIONS											
METER POSITIVE POLARITY	10.0	220K	23K	10.0	0	0.2	220K	23K	10.0	220K	23K
METER NEGATIVE POLARITY	10.0	40K	22K	10.0	0	0.2	40K	22K	10.0	40K	22K

TABLE 4-7. 1 KW PA FINAL AMPLIFIER TUBES (1A1V1/V2)  
RESISTANCE MEASUREMENTS

Note

See paragraph 5-54 to obtain access to final amplifier tube sockets. These measurements are made with assemblies 1A1A1 and 1A1A4 disconnected and removed from the set. Figure 5-16 illustrates the final amplifier tube socket.

PIN COND	HEATERS	GRID	SCREEN	PLATE	CATHODE
METER POSITIVE POLARITY	5.4	5.5K	175K	800K	5
METER NEGATIVE POLARITY	5.4	16K	70K	125K	5

TABLE 4-8. 1 KW PA TRANSISTOR DC VOLTAGE MEASUREMENTS

TRANSISTOR STAGE	CONDITION (NOTE 2)	DC VOLTAGE TO GROUND		
		E	B	C
A5Q1	Standby	10.5	11.0	21.0
A5Q2	Standby	10.0	11.0	18.0
A5Q3	Normal Overload	3.8	0	21.0
		9.6	10.2	9.6
A5Q4	Normal Overload	19.0	19.0	0.15
		21.0	20.0	21.0
A5Q5	Normal-Keyed Normal-Unkeyed RF mute line grounded or bandswitch motor running	7.4	7.0	7.2
		5.8	9.7	0.1
		5.2	6.8	0.1
A5Q6	Normal Keyed	- 0.1	0	- 62.0
		0.3	0	0.35
A6Q1	(Note 3)	12.0	4.6	11.0
A6Q2	Standby Normal-Keyed (Note 3)	-125	-125	- 93.0
		- 47.0	- 46.0	- 34.0
		- 68.0	- 68.0	- 34.0
A6Q3	Standby Normal-Keyed (Note 4) (Note 3)	-175	-175	-175
		- 34.0	- 35.0	- 34.0
		- 34.0	- 30.0	-120
A6Q4	Normal-Unkeyed Normal-Keyed	1.5	9.4	- 87
		5.0	4.8	4.9
A6Q5	Normal-Unkeyed Normal-Keyed	- 86.0	- 87.0	- 61.0
		- 0.6	- .05	0.2
A6Q6	Normal-Unkeyed (Note 3)	4.4	0	11.0
		8.0	8.0	11.0
A6Q7	Normal	1.55	1.85	7.7
A6Q8	Normal-Unkeyed (Note 3)	1.0	0	20.0
		2.35	2.45	18.0

TABLE 4-8. 1 KW PA TRANSISTOR DC VOLTAGE MEASUREMENTS (Cont)

TRANSISTOR STAGE	CONDITION (NOTE 2)	DC VOLTAGE TO GROUND		
		E	B	C
A6Q9	Normal-Unkeyed (Note 3)	1.0	0	20.0
		2.35	2.5	18.0
A6Q10	Normal-Unkeyed (Note 3)	26.0	19.0	0
		17.0	16.0	3.5
A6Q11	Normal-Unkeyed (Note 3)	0.3	0	11.0
		4.1	3.0	11.0
A6Q12	Normal-Unkeyed (Note 3)	0	0	11.0
		13.0	3.0	11.0
A6Q13	Standby	10.5	11.0	0 to .05

NOTES:

1. Prefix reference designations with 1A1.
2. Measurements taken in OPERATE, USB-PTT mode, unkeyed no modulation, unless otherwise specified.
3. A0 mode, 1 KW AVG output.
4. Exact value depends on setting of PA BIAS control 1A1R10.

TABLE 4-9. 1 KW POWER SUPPLY TRANSISTOR  
DC VOLTAGE MEASUREMENTS

TRANSISTOR STAGE	CONDITION	DC VOLTAGE TO GROUND		
		E	B	C
2A1Q1	USB-PTT Unkeyed-Standby	22.0	22.0	0
2A1Q2	USB-PTT Unkeyed-Standby	22.0	22.0	0

TABLE 4-10. TUNER CONTROL TRANSISTOR DC VOLTAGE MEASUREMENTS

TRANSISTOR STAGE	CONDITION	DC VOLTAGE TO GROUND		
		E	B	C
Motor Drive Transistors	Motors Stopped: Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8	31.0 30.0	31.0 31.0	31.0 0
	Motors Running: (C1) (L2) Q1 or Q3 (Home +) Q2 or Q4 (Tune +) Q5 or Q7 (Tune -) Q6 or Q8 (Home -)	28.0 28.0 0.85 28.0	29.0 28.0 0 28.0	1.2 28.0 0 0
	Motors Running: (C1) (L2) Q1 or Q3 (Home +) Q2 or Q4 (Tune +) Q5 or Q7 (Tune -) Q6 or Q8 (Home -)	28.0 28.0 28.0 0.85	29.0 28.0 28.0 0	28.0 1.2 0 0
A2Q1 or A5Q1	(Note 5) (Note 6) (Note 7)	0 0 0.55	0 0 1.35	33.0 28.0 0.65
A2Q2 or A5Q2	(Note 5) (Note 6) (Note 7)	0 0 1.35	0 0 2.1	33.0 28.0 1.5
A2Q3 or A5Q3	(Note 5) (Note 6) (Note 7)	- 0.7 - 0.5 - 0.75	- 0.1 - 0.1 - 0.2	28.0 16.0 18.0
A2Q4 or A5Q4	(Note 5) (Note 6) (Note 7)	27.0 18.0 17.5	27.0 18.0 18.0	.05 0 3.7
A2Q5 or A5Q5	(Note 5) (Note 6) (Note 7)	- 0.7 - 0.75 - 0.5	- 0.1 - 0.2 0.1	27.0 18.0 16.0
A2Q6 or A5Q6	(Note 5) (Note 6) (Note 7)	27.0 17.5 18.0	27.0 18.0 18.0	.05 3.7 0
A2Q7 or A5Q7	(Note 5) (Note 6) (Note 7)	0 1.35 0	0 2.1 0	33.0 1.5 28.0

TABLE 4-10. TUNER CONTROL TRANSISTOR DC VOLTAGE MEASUREMENTS (Cont)

TRANSISTOR STAGE	CONDITION	DC VOLTAGE TO GROUND		
		E	B	C
A2Q8 or A5Q8	(Note 5) (Note 6) (Note 7)	.05 0.55 0	0 1.35 0	33.0 0.65 28.0
A2Q9 or A5Q9	(Note 5)	0	0	0
A2Q10 or Q5Q10	(Note 5)	0	0	0
A3Q2	L2 Motor Running L2 Motor Off	0 0	0.7 - 2.0	0.1 0.8
A3Q3	Motor(s) Stopped Motor(s) Running, Initial Tune Motor(s) Running, After Initial Tune or to Home	0 0 0	0.75 0 0	0.2 18.0 14.0
A3Q6	C1 Motor Running C1 Motor Off	0 0	0.7 - 2.0	0.1 0.8
A3Q7	L2 Motor Running L2 Motor Off	0 0	0.8 0.2	1.2 31.0
A3Q8	C1 Motor Running C1 Motor Off	0 0	0.8 0.2	1.2 31.0
A3Q9	Motors Stopped Motor(s) Running	0.7 0	1.3 0	0.8 28.0
A4Q1	Retune (Element(s) Running Home) Otherwise	0 0	0.7 0 to - 1.0	0.1 9.0 to 13.0
A4Q2	Retune (Element(s) Running Home) Otherwise	0 0	0.1 0.7	14.0 0.1
A4Q3	Either Tuning or Tuned Tuner Fault or Homing	0 0	- 0.7 0.7	11.0 0.1

TABLE 4-10. TUNER CONTROL TRANSISTOR DC VOLTAGE MEASUREMENTS (Cont)

TRANSISTOR STAGE	CONDITION	DC VOLTAGE TO GROUND		
		E	B	C
A4Q4	L2 at Home	0	- 0.8	0
	Tuning (Initial Tune)	0	0.7	0.1
	Otherwise	0	- 0.2 to - 0.9	4.0 to 6.2
A4Q5	Elements at Home or Initial Tune	0	- 0.1	28.0
	Otherwise	0	0.7	0.1
A4Q6	Tuned, With or Without RF	0	0.8	0.3
	Otherwise	0	- 0.1 to + 0.3	28.0

NOTES:

1. Prefix reference designations with 10A1.
2. Measurements taken with transmitter in operate, USB-PTT, unkeyed; other conditions as stated.
3. The voltage of the +28V supply varies considerably, from about +31 volts under quiescent condition to about +26 volts when the motors are running. Bear in mind that any voltage depending on the +28V supply for B+ will vary similarly with the motors stopped or running.
4. In the cross coupled amplifier stage of the two servo amplifier assemblies (10A1A2 and 10A1A5), the absolute value of the voltages may vary several volts depending on the amplitude of the discriminator error signal and the extent to which the motors load down the +28V supply. More important than the exact voltages themselves are the differences in polarity of base-to-emitter voltage between opposite sides of the amplifier; that is, which is being turned on and which is held cut off. (The voltages in the chart were measured in a unit with 300 MV error signals simulated from the discriminator.)
5. Automatic mode-elements homed.
6. 300 MV signal, with setup at right, TP3(+) and TP4(-)
7. 300 MV signal, with setup at right, TP3(-) and TP4(+)

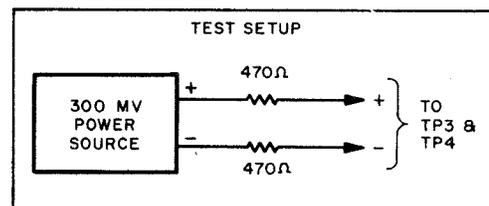


TABLE 4-11. TUNER TRANSISTOR AND INTEGRATED  
CIRCUIT VOLTAGE MEASUREMENTS

TRANSISTOR STAGE	CONDITION (Note 2)	DC VOLTAGE TO GROUND						
		E	B	C				
A11Q1		0.22	0	- 3.2				
A11Q2		- 3.8	- 3.2	0.22				
A11Q3		.02	- 0.22	- 8.2				
A11Q4		- 0.45	0.22	+ 14.5				
A11Q5		14.0	14.5	0.1				
A11Q6		14.0	14.0	0				
A11Q7		- 0.45	0.1	14.0				
A11Q8		- 2.0	- 1.33	0				
A11Q9		- .05	0.58	15.0				
A12Q1		15.0	15.5	+ 23				
A12Q2		- 15.0	- 15.4	- 23				
INTEGRATED CIRCUIT STAGE	DC VOLTAGE TO GROUND							
	1	2	3	4	5	6	7	8
A11IC1	10.0	0	0	-15.0	14.0	0	15.0	11.0

NOTES:

1. Prefix reference designations with 9A1.
2. Measurements taken with transmitter in standby.

TABLE 4-12. I. BOX TRANSISTOR DC VOLTAGE MEASUREMENTS

TRANSISTOR STAGE	CONDITION	DC VOLTAGE TO GROUND		
		E	B	C
A1Q1 (Notes 2 & 5)	Standby, S1 off	28.0	28.0	28.0
	S1 on, S2 pos., L1 motor running	26.0	26.0	2.5
	S1 on, S2 neg., L1 motor running	26.0	26.0	26.0
A1Q2 (Notes 2 & 5)	Standby, S1 off	27.5	28.0	0
	S1 on, S2 pos., L1 motor running	25.5	26.5	0
	S1 on, S2 neg., L1 motor running	1.5	1.0	0
A1Q3 (Notes 2 & 5)	Standby, S1 off	27.5	28.0	28.0
	S1 on, S2 pos., L1 motor running	26.0	26.0	26.0
	S1 on, S2 neg., L1 motor running	26.0	26.0	2.5
A1Q4 (Notes 2 & 5)	Standby, S1 off	27.5	28.0	0
	S1 on, S2 pos., L1 motor running	1.4	0.8	0
	S1 on, S2 neg., L1 motor running	26.0	26.0	0
A1A1Q1	Standby	0	0	33.0
	Ground A1C60, wait 15 seconds	0	0.75	0.25
A1A1Q2 (UJT) (Note 7)	Standby	(B <sub>2</sub> ) 10.2	(E) 0.03	(B <sub>1</sub> ) 0.15
	Ground A2C60, wait 15 seconds	10.5	3.0 to 7.0 (Note 6)	0.67
A1A1Q3	Standby	0	0.65	.05
	Ground A2C60, wait 15 seconds	0	0	3.0 to 7.0 (Note 6)
A1A1Q4 (SCR) (Note 7)	Standby	(K) 0	(G) 0.15	(A) 29.5
	Ground A2C60, wait 15 seconds	0	0.70	0.75
A1A3Q1	Standby	30.0	30.0	30.0
	Ground A2C50	0	0.65	.05
A1A3Q2	Standby	0	0	30.0
	Ground A2C50	0	0	0.65
A1A3Q3	Standby	- 0.6	0	9.8
A1A3Q4 (Notes 2 & 5)	Standby, S1 off	0	0.75	.05
	S1 on, S2 pos., L1 motor running	0	- 2.5	1.0

TABLE 4-12. I. BOX TRANSISTOR DC VOLTAGE MEASUREMENTS (Cont)

TRANSISTOR STAGE	CONDITION	DC VOLTAGE TO GROUND		
		E	B	C
A1A3Q5 (Notes 2 & 5)	Standby, S1 off	0	.05	30.7
	S1 on, S2 pos., L1 motor running	0	1.0	0
A1A3Q6	Standby	26.0	30.0	0
	Ground A2C50	17.0	16.0	10.5
A1A3Q7	Standby	29.2	29.9	30.7
	Ground A2C50	0	0	30.0
A1A3Q8	Standby	0	0.65	.06
	Ground A2C50	0	0	30.0
A1A3Q9	Standby	0	0	30.0
	Ground A2C50	0	0	30.0
	(Note 3)	0	0.75	0
A1A3Q10	Standby	24.0	27.5	0
	Ground A2C50	22.0	21.0	22.0
A1A2Q11	Standby	0	0	29.2
	Ground A2C50	0	0.75	.05
A1A3Q12	Standby	28.5	30.0	- 1.1
	Ground A2C50	26.2	25.8	26.2
A1A3Q13	Standby	0	- 1.45	30.0
	Ground A2C50	7.3	7.6	30.0
A1A3Q14	Standby	28.5	30.0	- 0.5
	Ground A2C50	28.5	30.3	.03
A1A3Q15	Standby	0	- 0.43	30.0
	Ground A2C50	0	0	30.0
A1A3Q16	Standby	0	0	30.5
	Ground A2C50	0	0.8	.05
A1A4Q1 (Notes 2 & 5)	Standby, S1 off	0	0	27.5
	S1 on, S2 pos., L1 motor running	0.6	1.5	0.8
	S1 on, S2 neg., L1 motor running	0	0	26.0

TABLE 4-12. I. BOX TRANSISTOR DC VOLTAGE MEASUREMENTS (Cont)

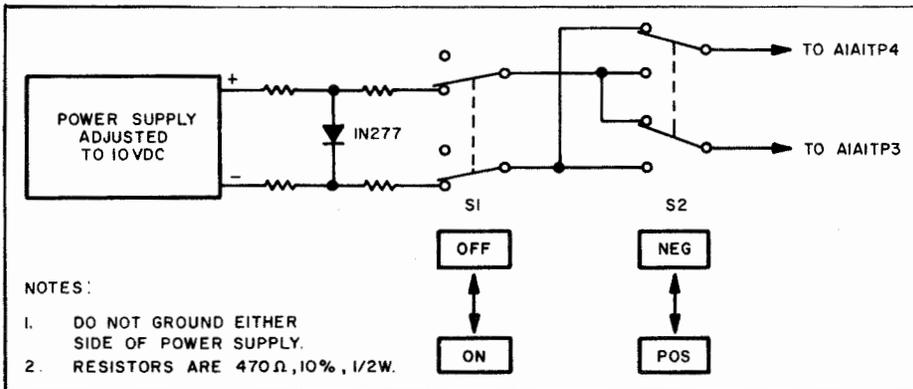
TRANSISTOR STAGE	CONDITION	DC VOLTAGE TO GROUND		
		E	B	C
A1A4Q2 (Notes 2 & 5)	Standby, S1 off	0	0.2	28.0
	S1 on, S2 pos., L1 motor running	1.5	2.1	2.5
	S1 on, S2 neg., L1 motor running	0	0	26.0
A1A4Q3 (Notes 2 & 5)	Standby, S1 off	10.5	11.0	24.5
	S1 on, S2 pos., L1 motor running	11.0	11.1	20.0
	S1 on, S2 neg., L1 motor running	10.3	10.8	20.0
A1A4Q4 (Notes 2 & 5)	Standby, S1 off	24.5	24.0	0
	S1 on, S2 pos., L1 motor running	20.0	20.0	2.7
	S1 on, S2 neg., L1 motor running	20.0	20.0	0
A1A4Q5 (Notes 2 and 5)	Standby, S1 off	10.3	11.0	24.0
	S1 on, S2 pos., L1 motor running	10.5	11.2	20.0
	S1 on, S2 neg., L1 motor running	10.0	10.8	21.0
A1A4Q6 (Notes 2 & 5)	Standby, S1 off	24.0	24.5	0
	S1 on, S2 pos., L1 motor running	20.0	20.0	0
	S1 on, S2 neg., L1 motor running	21.0	20.0	2.6
A1A4Q7 (Notes 2 & 5)	Standby, S1 off	0	0	28.0
	S1 on, S2 pos., L1 motor running	0	0	26.0
	S1 on, S2 neg., L1 motor running	1.5	2.1	4.0
A1A4Q8 (Notes 2 & 5)	Standby, S1 off	0	0	27.5
	S1 on, S2 pos., L1 motor running	0	0	26.0
	S1 on, S2 neg., L1 motor running	0.6	15.0	0.8
A1A4Q9 (Notes 2 & 5)	Standby, S1 off	0.2	0	0
	S1 on, S2 pos., L1 motor running	2.1	2.7	0
	S2 on, S2 neg., L1 motor running	0	0	0
A1A4Q10 (Notes 2 and 5)	Standby, S1 off	0	0	0
	S1 on, S2 pos., L1 motor running	0	0	0
	S2 on, S2 neg., L1 motor running	2.1	2.6	0
A4A1Q1 (Note 2)	Standby (Note 4)	23.0	23.3	28.0
		1.5	1.7	1.5

TABLE 4-12. I. BOX TRANSISTOR DC VOLTAGE MEASUREMENTS (Cont)

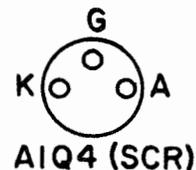
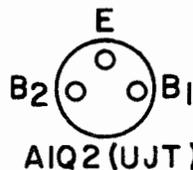
TRANSISTOR STAGE	CONDITION	DC VOLTAGE TO GROUND		
		E	B	C
A4A1Q2 (Note 2)	Standby (Note 4)	28.0	28.0	0
		1.5	1.5	0
A4A1Q3 (Note 2)	Standby (Note 4)	0	0	24.0
		0	0.6	6.0

NOTES:

- Prefix all reference designations for I. Box with 7A1.
- Measurement must be made with oscilloscope (AN/USM-117), using DC coupling and establishing a zero voltage reference line before measuring by grounding scope input.
- Disconnect the ground from A2C50. While relays on the A1A3 assembly are switching, the voltages shown should be observed on the oscilloscope.
- Cycle rotary solenoid by alternately changing Exciter frequency between 10.0000 and 20.0000 MCS. Pulses of peak value shown should be observed on oscilloscope. During the time between pulses, the voltages shown for standby condition should be observed.
- Fabricate test fixture and use with power supply as shown in schematic below. Conditions for pos. and neg. require that the L1 servo motor be running to observe results shown. Start with S1 off and S2 in desired position. Turn S1 on to actuate motor and observe results while it is running (about one second). This procedure may have to be repeated several times in alternate directions to be certain of obtaining an accurate reading on the oscilloscope before motor turns off.



- This voltage occurs in a unijunction transistor timing circuit and varies slowly over a 15 second period.
- Special base configurations (bottom views) shown at right.



- NOTES:
1. Prefix incomplete reference designations with 1A1.
  2. Heavy lines indicate main signal paths.
  3. Letters outside transistor and tube blocks indicate element.
  4.  Indicates front panel markings.
  5. Equipment keyed, in AO mode, with 1 KW output.
  6. Measurements made with AN/USM-116.
  7. Refer to table 4-1 for 5-wire code.
  8. Part of cabinet cable harness.

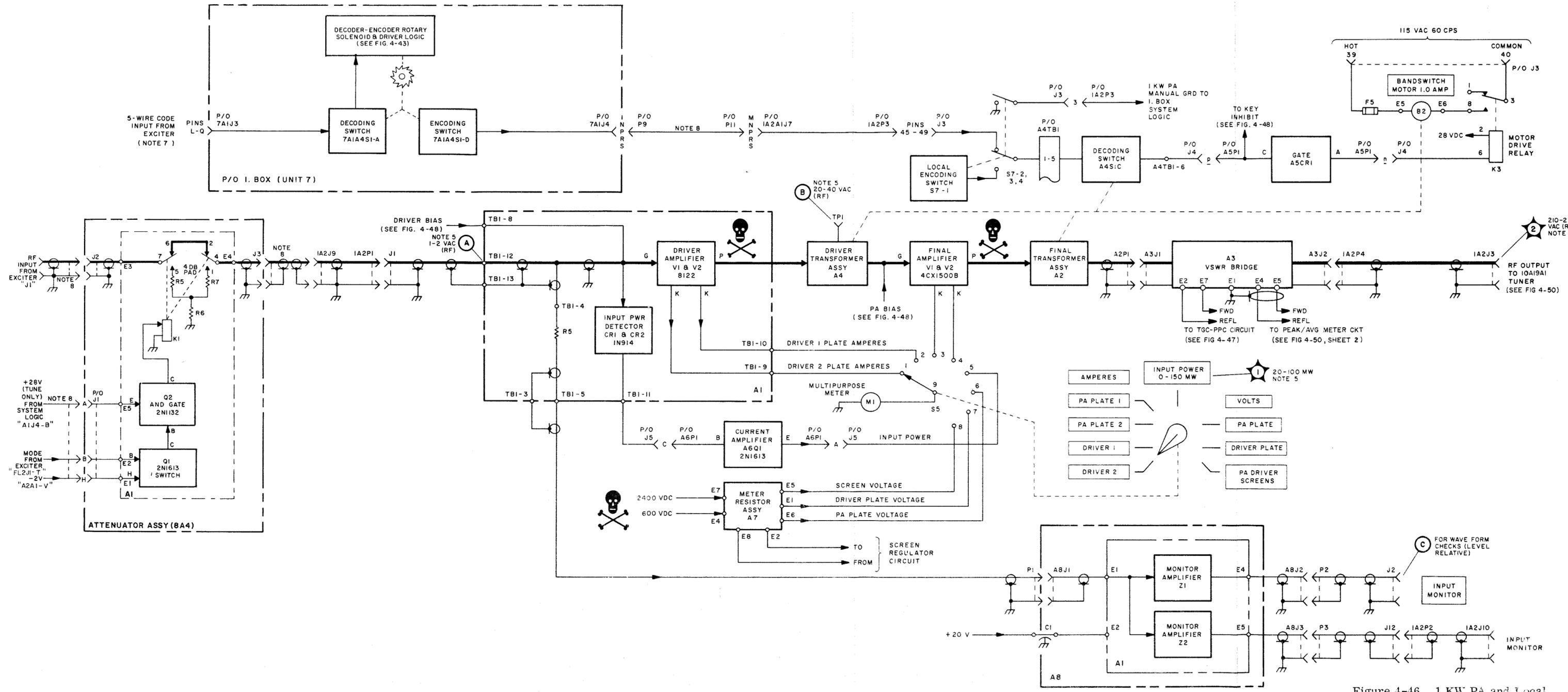


Figure 4-46. 1 KW PA and Local Equipment Cabinet, Main RF Signal Flow Servicing Diagram

NOTES:

1. Prefix incomplete reference designations with 1A1A6.
2. Heavy lines indicate main signal paths.
3. Letters outside transistor blocks indicate element.
4.  indicates screwdriver adjustment.
5.  indicates front panel markings.
6. Unkeyed condition is USB-PTT mode with open push-to-talk circuit.
7. All measurements taken with AN/PSM-4B.
8. Adjust 1A1R12 for 2 VDC at 1A1A6TP5, with equipment keyed in A0 mode, with 1 KW output.

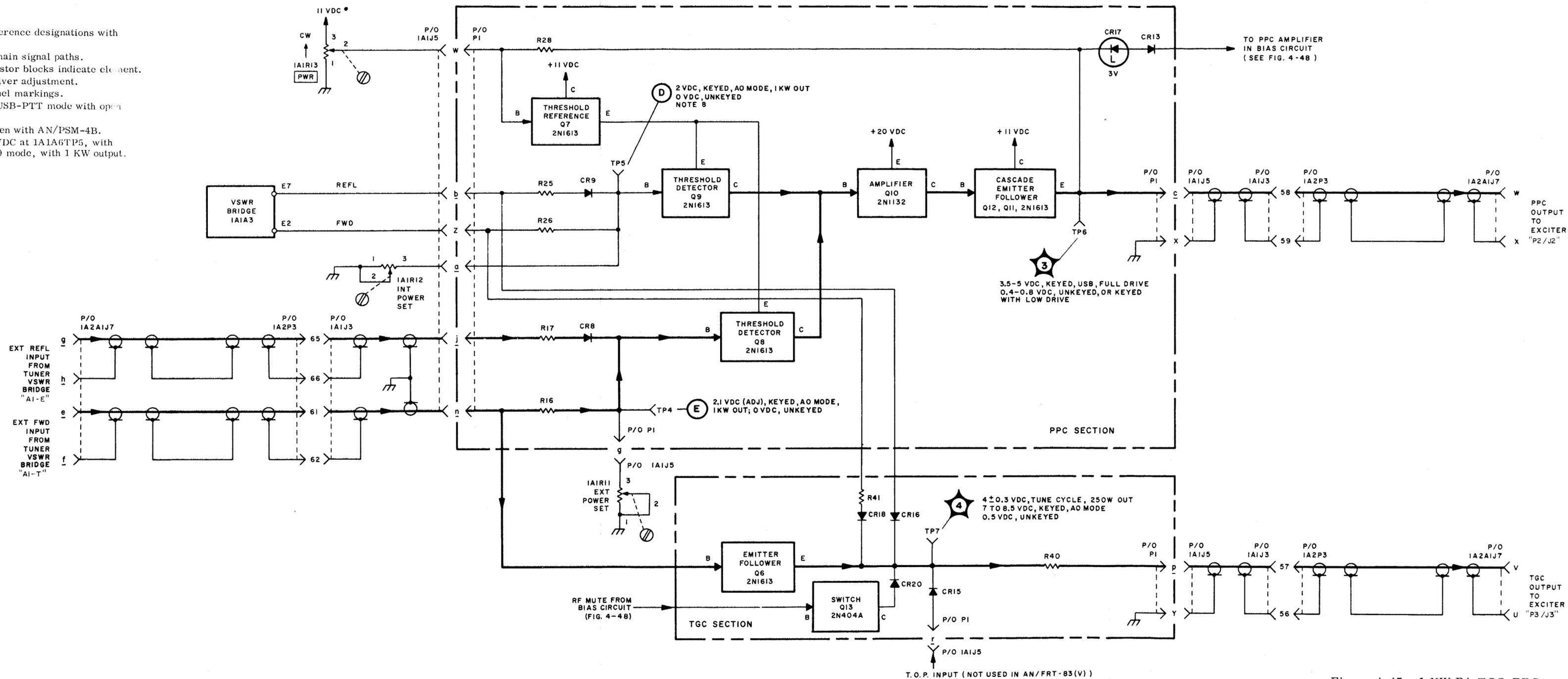


Figure 4-47. 1 KW PA TGC-PPC Circuit, Servicing Diagram

- NOTES:
1. Prefix incomplete reference designations with 1A1.
  2. Letters outside transistor blocks indicate element. Numbers on parts indicate terminal numbers.
  3.  indicates screwdriver adjustment.
  4.  indicates front panel markings.
  5. All measurements taken with AN/PSM-4B.
  6. Measurements taken in operate condition unless otherwise specified. Keyed conditions shown are in USB, SSB-( $\infty$ ) mode, no audio applied. Unkeyed conditions are in USB-PTT with push-to-talk circuit open.
  7. Unkeyed, OVDC; Keyed with no signal,  $1 \pm 0.5$  VDC; keyed with signal, 1 to 4 VDC; overload condition,  $10 \pm 1.0$  VDC.

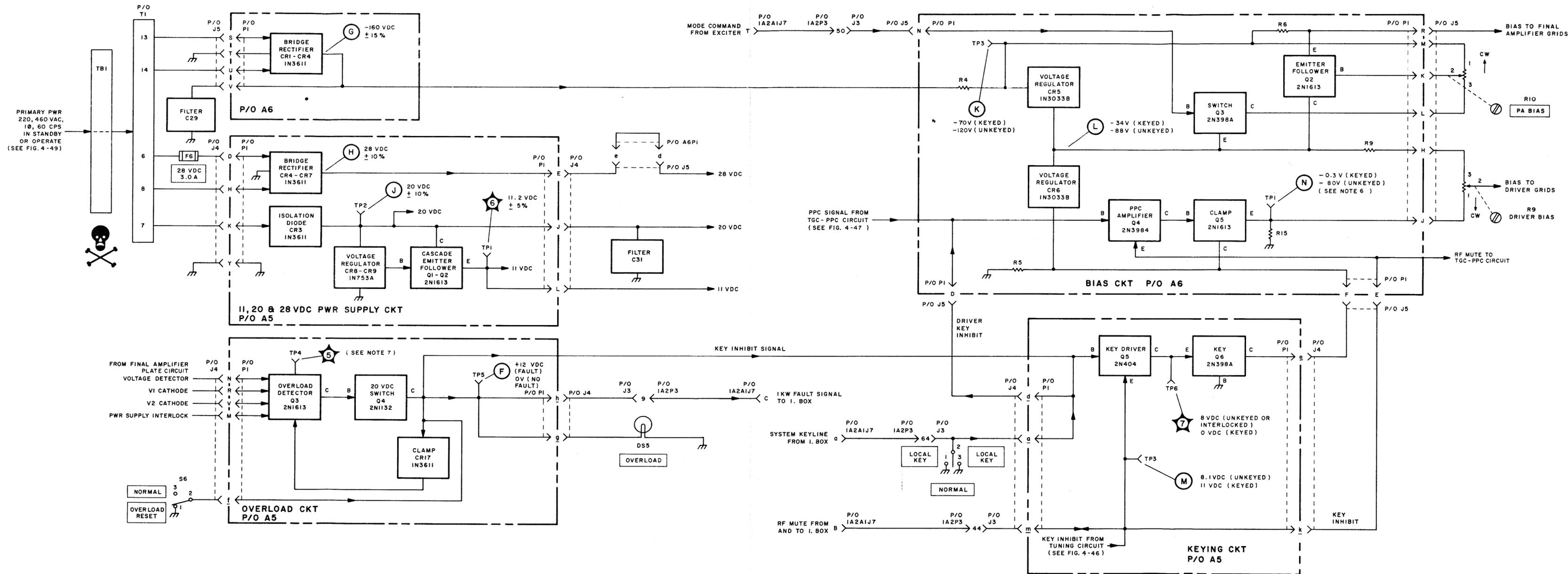
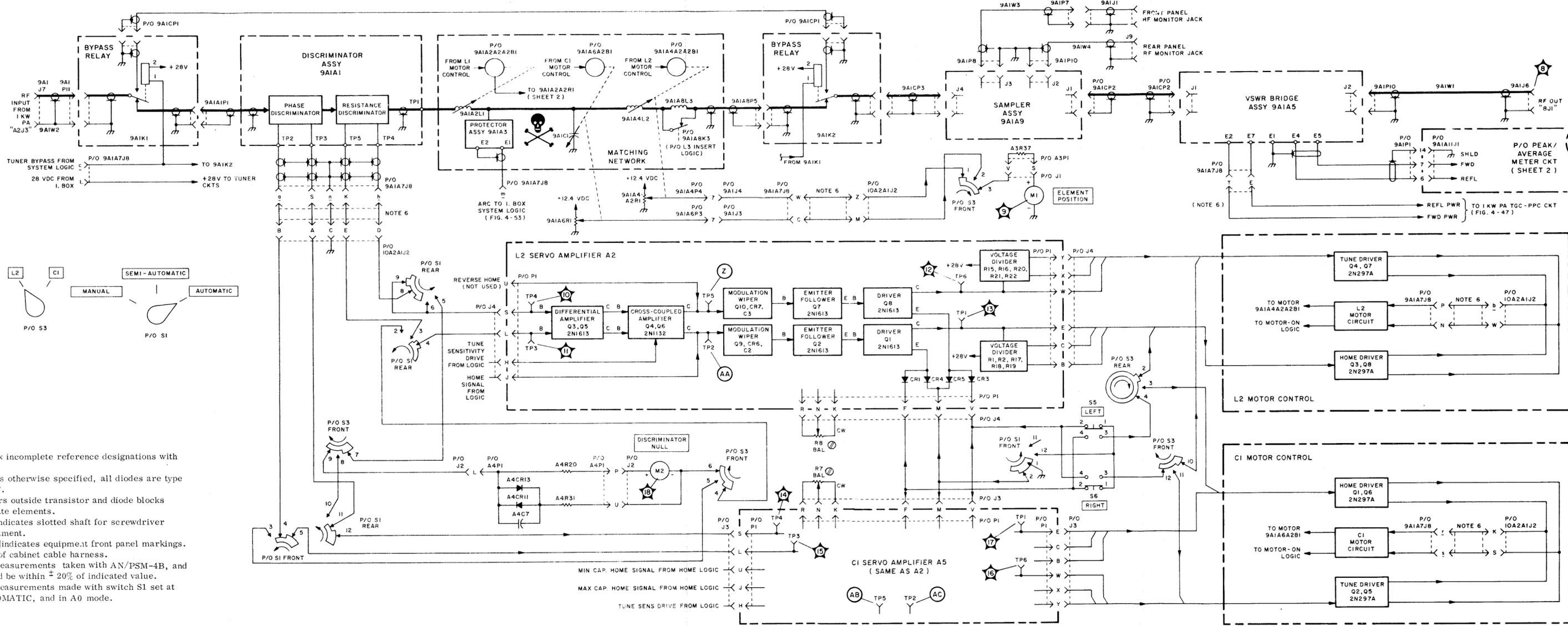


Figure 4-48. 1 KW PA Low Voltage DC Control Circuits, Servicing Diagram



TEST POINT INFORMATION

TEST POINT	CONDITION	DC VOLTAGE	TEST POINT	CONDITION	DC VOLTAGE
8	Keyed, A0 mode, 1 KW Output	210 - 238V	16	Decreasing C1 Otherwise	+0.7V +31V
9	On L2 On C1	0 - 10 0 - 5.5	17	Increasing C1 Otherwise	+0.7V +31V
10	Manual "Increase L2" Discriminator Signal "Decrease L2" Discriminator Signal Normal (no RF or tuned)	-1.7 -0.1 to -0.5V +0.1 to +0.5V less than +0.1V	18	Increasing C1 Otherwise	+2.5V +0.05V
11	All Conditions { Automatic Manual	less than -0.15V -1.7	19	Decreasing C1 Otherwise	+2.5V +0.05V
12	Increasing L2 Otherwise	+0.7V +31V	20	Should be close to null after automatic tuning	-
13	Decreasing L2 Otherwise	+0.7V +31V	21	All Conditions	+8 to +12.4V
Z	Increasing L2 Otherwise	+2.5V 0 to +0.05V	22	All Conditions	0 to +12.4V
AA	Decreasing L2 Otherwise	+2.5V 0 to +0.05	23	Increasing L1 Otherwise	+0.7V 30 ± 2VDC
14	Manual "Increase C1" Discriminator Signal "Decrease C1" Discriminator Signal Normal (no RF or tuned)	-4.7 -0.1 to -0.6 +0.1 to +0.6	AH	Increasing L1 Otherwise	+2.5V 0 to +0.75V
15	All Conditions { Automatic Manual	0 to -0.15 -4.7	AJ	Decreasing L1 Otherwise	+2.5V 0 to +0.75V



- NOTES:
1. Prefix incomplete reference designations with 10A1.
  2. Unless otherwise specified, all diodes are type 1N277.
  3. Letters outside transistor and diode blocks indicate elements.
  4. Ⓢ indicates slotted shaft for screwdriver adjustment.
  5. □ indicates equipment front panel markings.
  6. Part of cabinet cable harness.
  7. All measurements taken with AN/PSM-4B, and should be within ± 20% of indicated value.
  8. All measurements made with switch S1 set at AUTOMATIC, and in A0 mode.

Figure 4-50. Tuner, Tuner Control, and Related Parts of I. Box; Servo Loops and Matching Network; Servicing Diagram (Sheet 1 of 2)

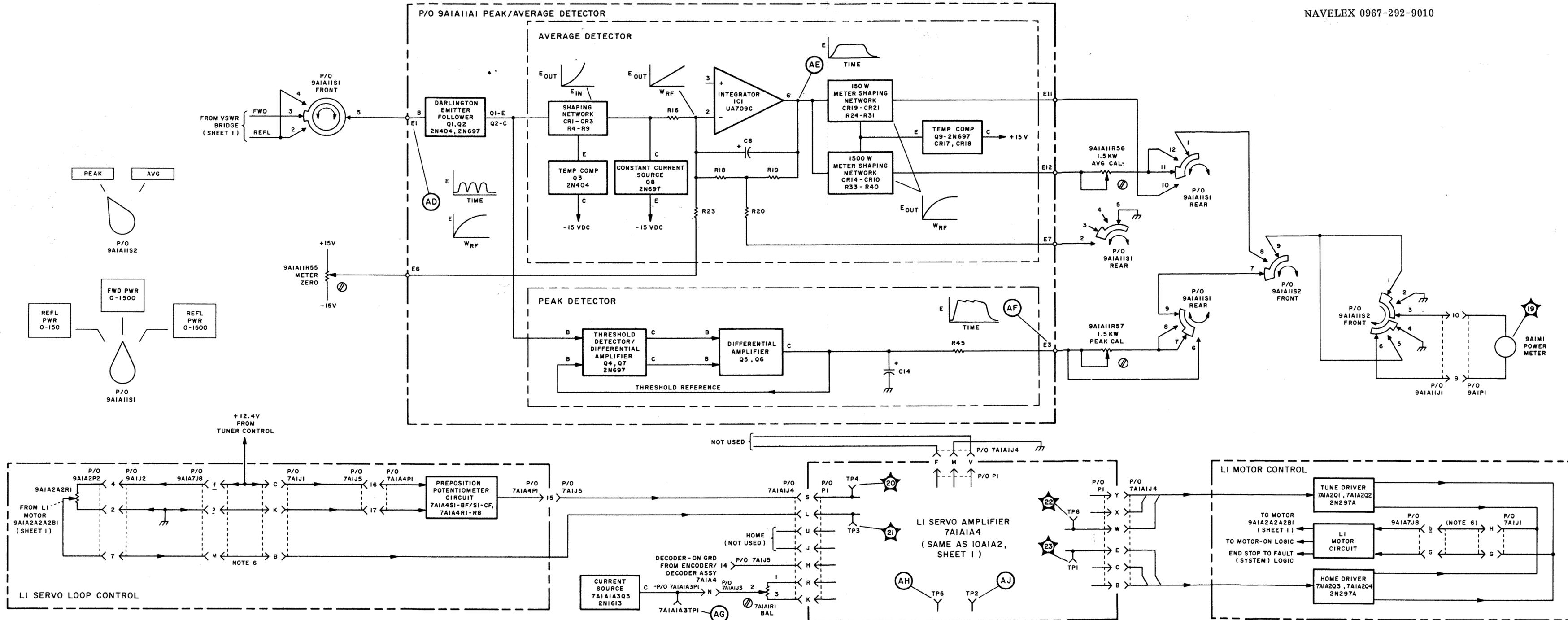


Figure 4-50. Tuner, Tuner Control, and Related Parts of I. Box; Servo Loops and Matching Network; Servicing Diagram (Sheet 2 of 2)

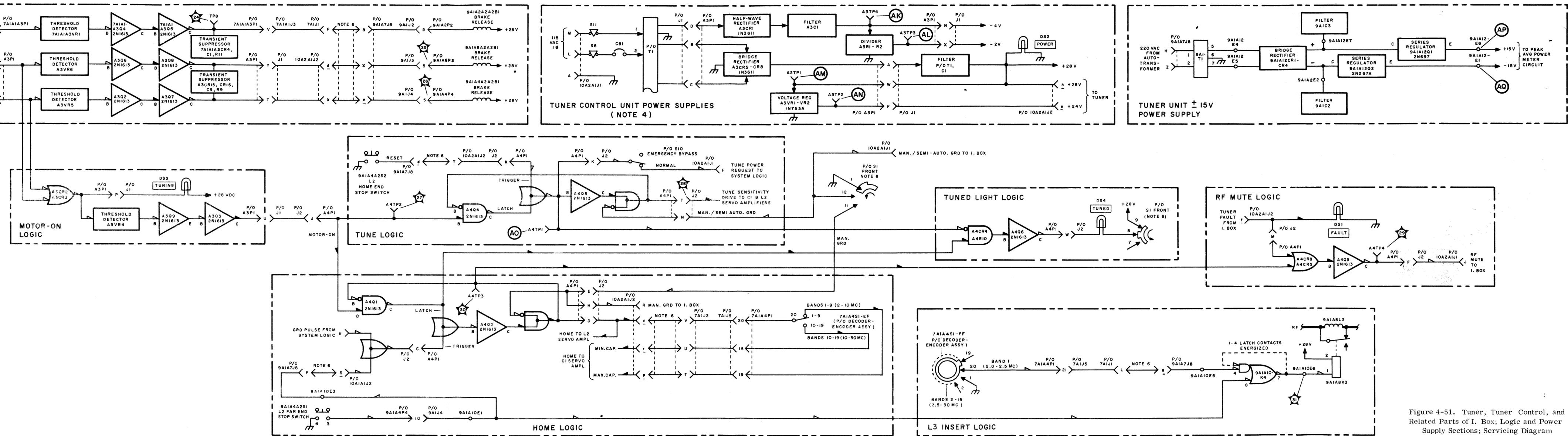
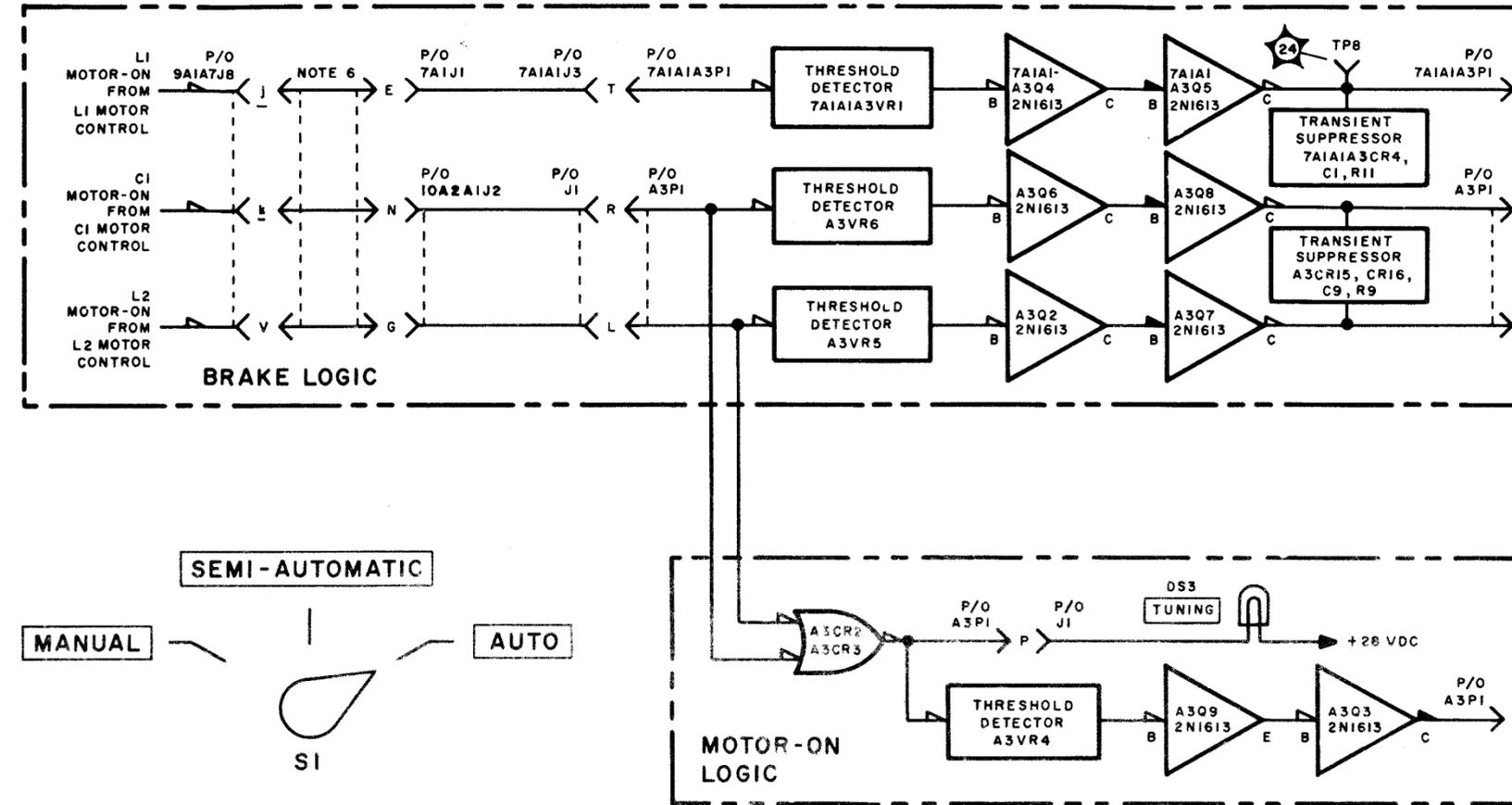


Figure 4-51. Tuner, Tuner Control, and Related Parts of I. Box; Logic and Power Supply Sections; Servicing Diagram

TEST POINT INFORMATION

TEST POINT	CONDITION	DC VOLTAGE	TEST POINT	CONDITION	DC VOLTAGE
24	L1 Motor On L1 Motor Off	+7V +31.0V	30	C1 and L2 Motors Running Home Otherwise	+15 +0.15
25	C1 Motor On C1 Motor Off	+7V +31.0V	31	L3 Inserted Otherwise	+0.1 +28V
26	L2 Motor On L2 Motor Off	+7V +31.0V	(AK)	Any	-5.0V
27	C1 and L2 Motors Stopped C1 and L2 Motors Running, Initial Tune C1 and L2 Motors Running, Home or Fine Tuning	+0.2V	(AL)	Any	-1.3
		+21V	(AM)	Any	+28.0V
		+19V	(AN)	Any	+12.0V
28	Automatic & Tuned or Running Home Otherwise	+0.1 +28V	(AO)	L2 at Home Initial Tune Cycle Otherwise	0V +0.1V +27V
29	Retune (Elements Running Home) Otherwise	+0.40V +28V	(AP)	Any	+15
			(AQ)	Any	+15



NOTES:

1. Prefix incomplete reference designations with 10A1.
2. Unless otherwise specified, all diodes are type 1N277.
3. Letters outside transistor and diode block indicate elements.
4.    indicates equipment front panel markings.
5. Signal levels are indicated by arrow types (all arrow symbols point in the direction of signal flow, check low level signals to +28 V reference; check high level signals to ground reference):  
 HI = = Positive level (close to positive supply voltage)  
 LO = = Ground level (less than +2 V).
6. Part of cabinet cable harness.
7. All measurements taken with AN/PSM-4B, and should be within ± 20%.
8. S1 shown in AUTOMATIC.

- NOTES:
1. Prefix incomplete reference designations with 7A1.
  2. Heavy lines indicate main signal paths.
  3. Numbers on parts indicate terminal numbers.
  4.   indicates front panel markings.
  5. All measurements taken with AN/PSM-4B.

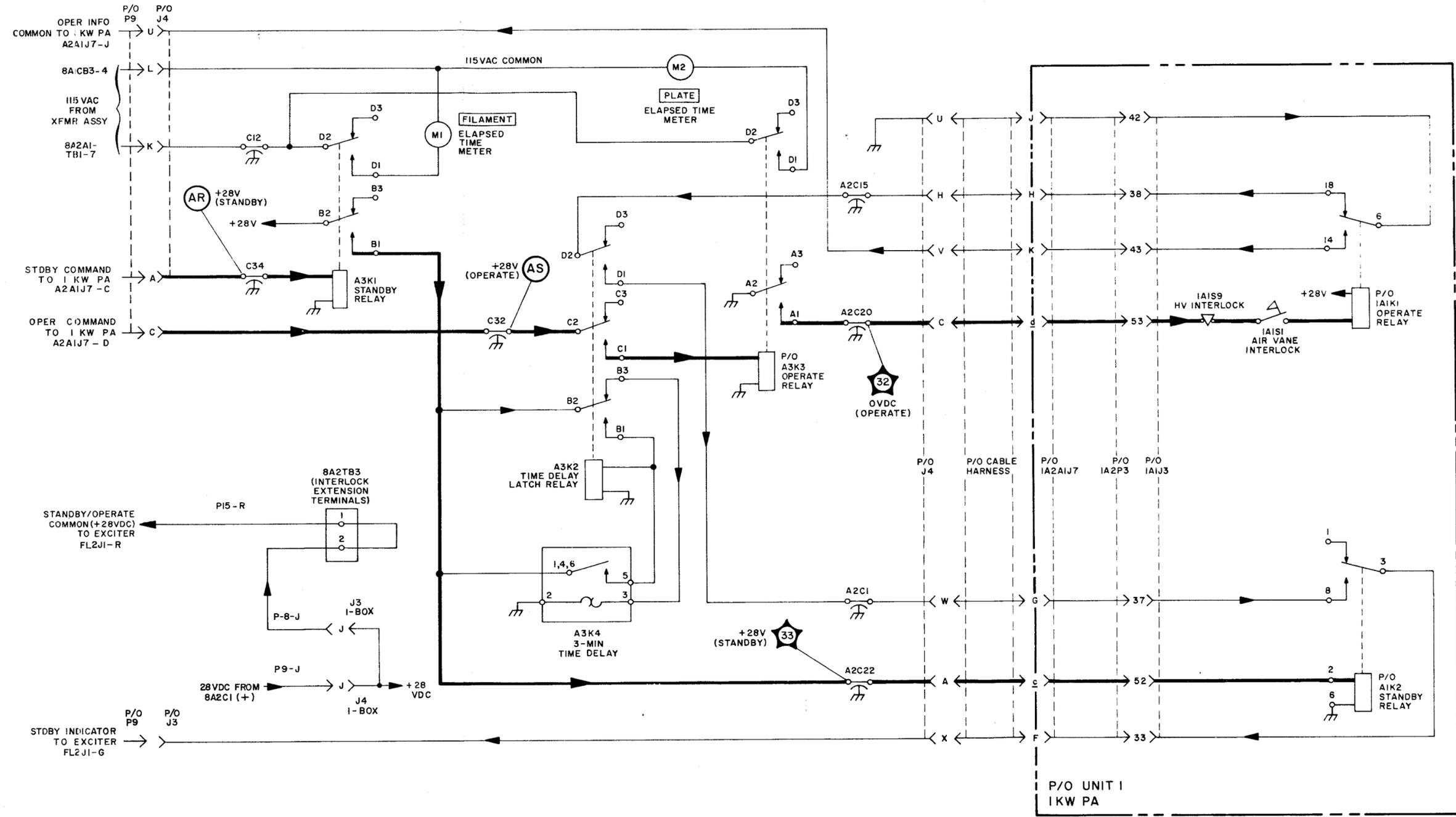


Figure 4-52. I. Box Standby and Operate Control Circuit, Servicing Diagram

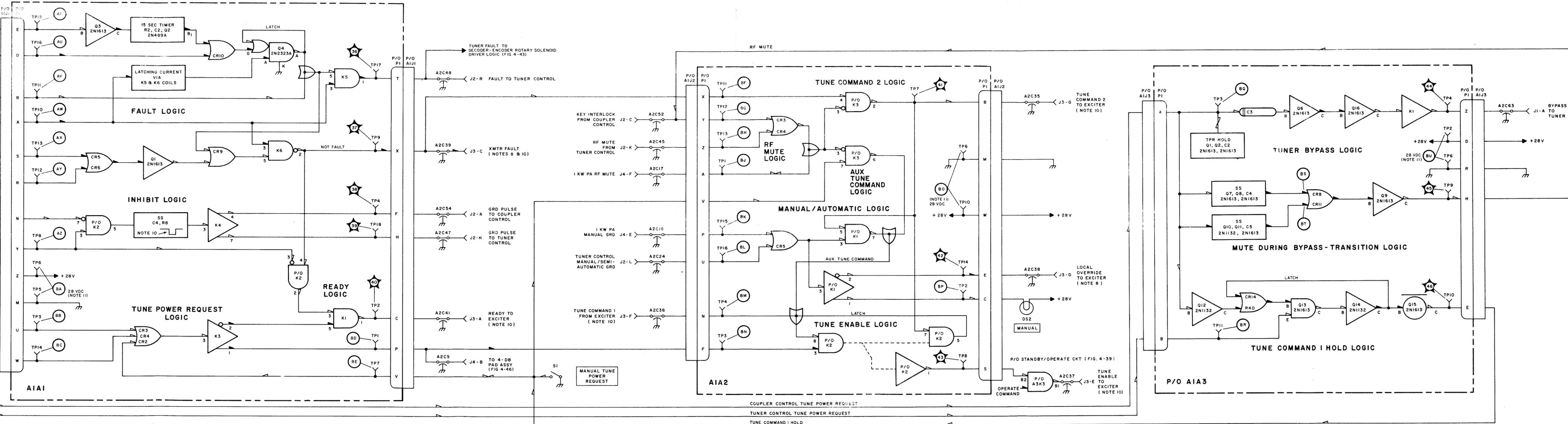
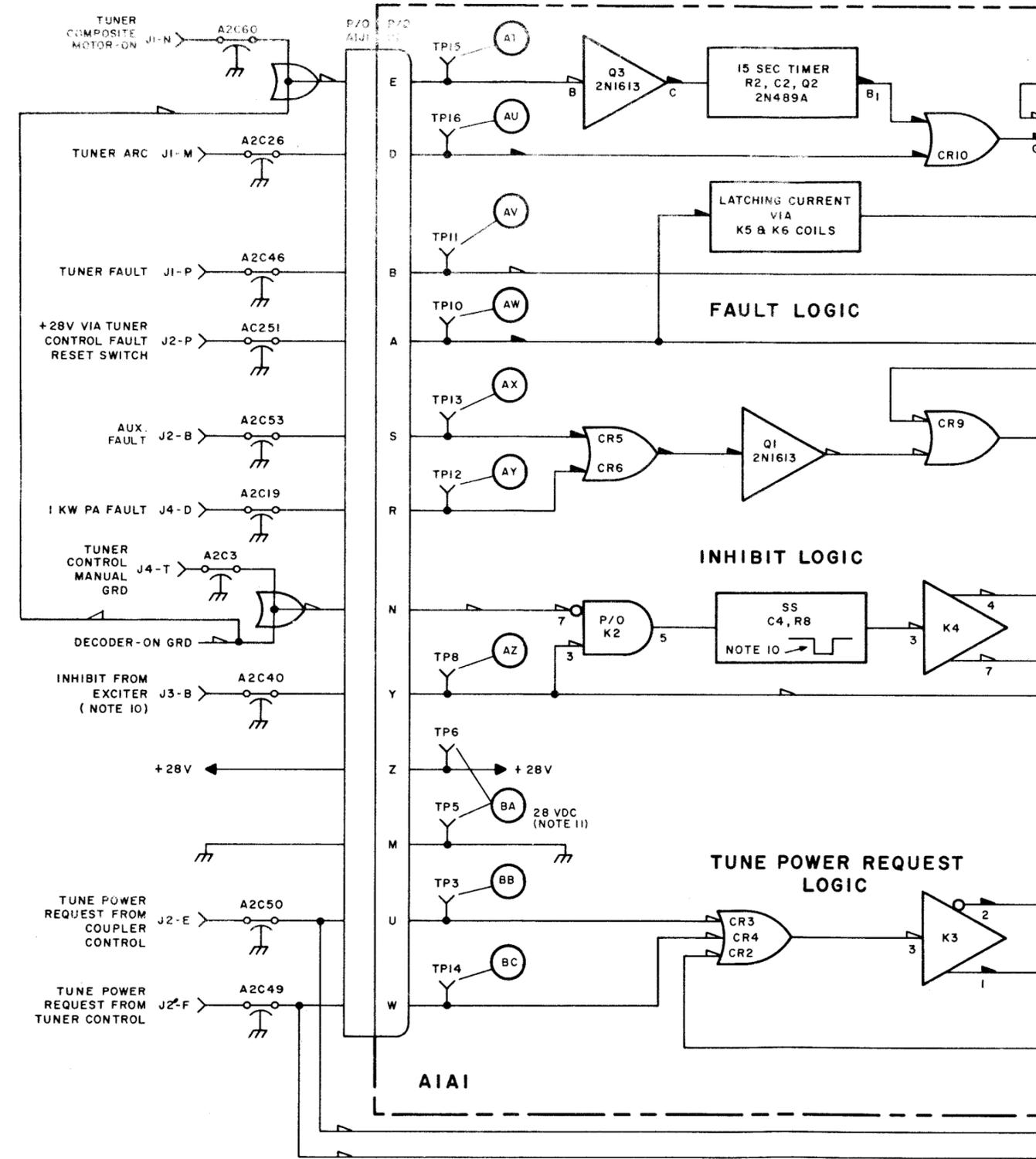


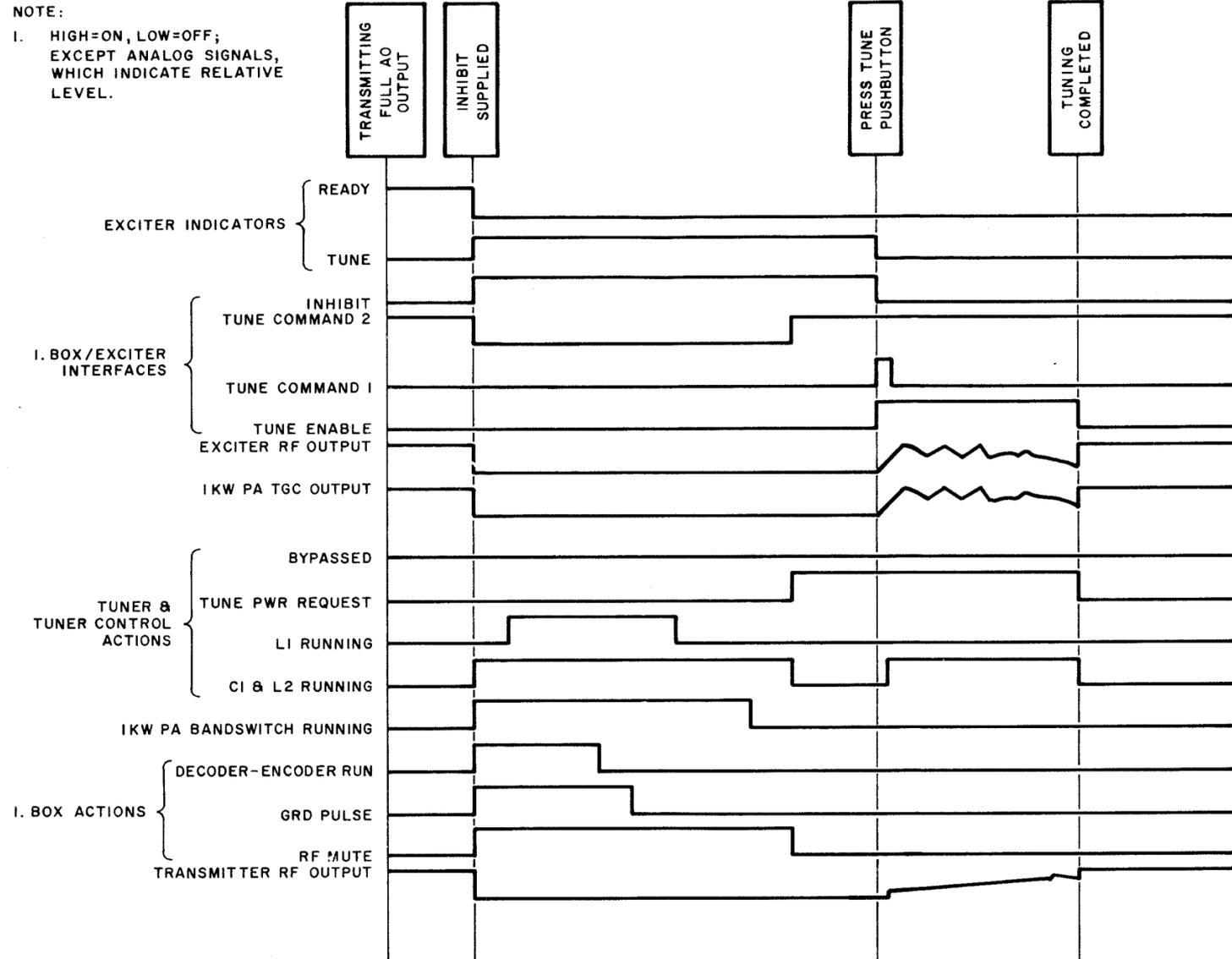
Figure 4-53. I. Box, System Logic, Servicing Diagram

TRUTH TABLE

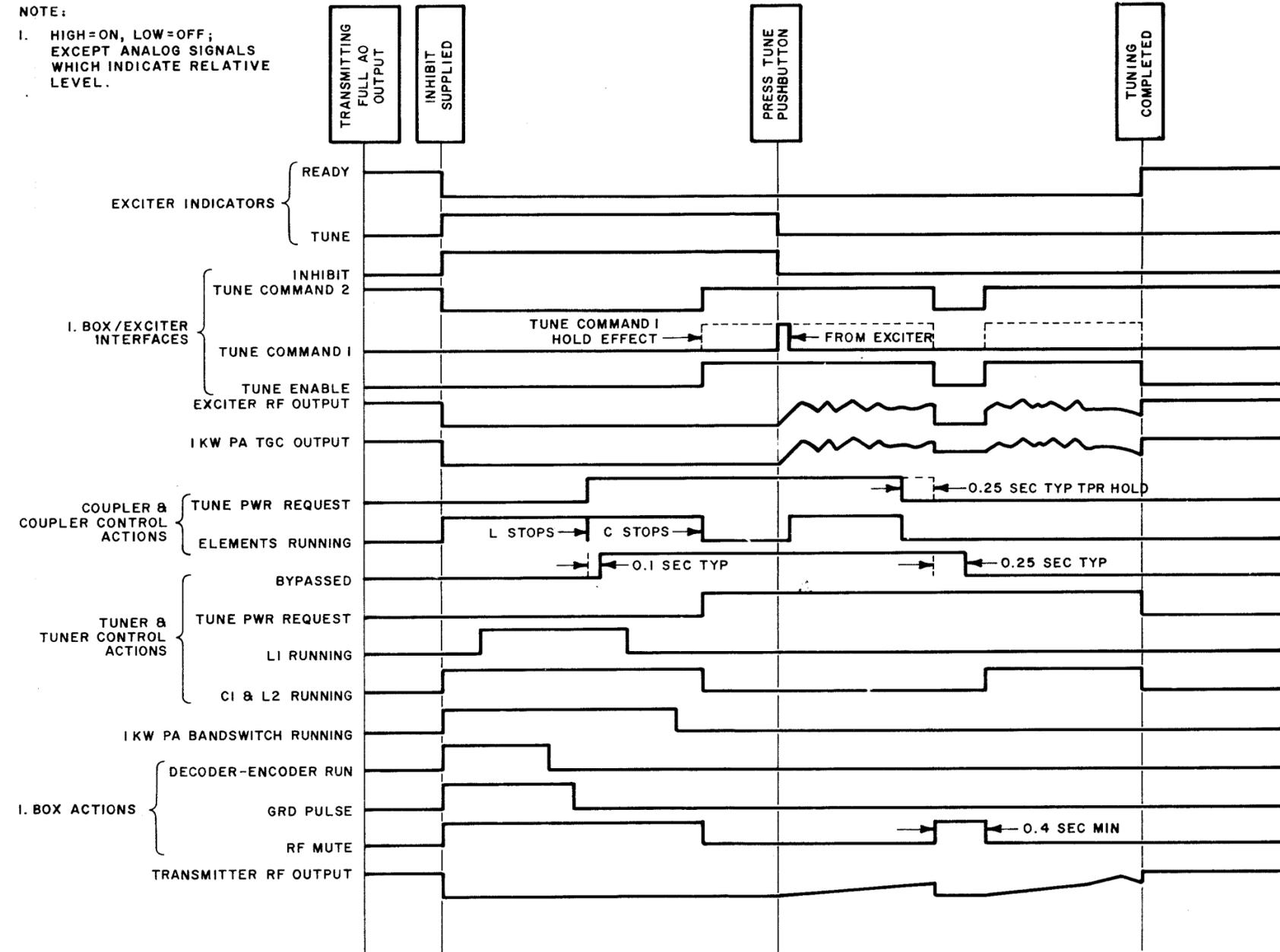
Input Signals/Conditions 1 = Present 0 = Not Present - = Either (No effect) 2 or 3 = At least one present of those identically marked. 4 = Pulsed output, one pulse at input turn on and one at turn off. 5 = Must be on initially to trigger, then may be removed.	Output (present according to signal flow arrows when exact conditions are present) (note 6)																
	(A) Tuner Comp. Motor-on (After 15 sec.)	(AU) Tuner Arc	(AV) Tuner Fault	(AX) Aux. Fault	(AY) Fault from 1 KW PA	(AW) +28V via Reset Switch	(AZ) Inhibit	(BB) Coupler Control Tune Power Request	(BC) Tuner Control Tune Power Request	(BE) Manual Tune Power Request	(BG) Coupler Control Key Intik	(BH) Tuner Control RF Mute	(BJ) 1 KW PA RF Mute	(BK) 1 KW PA Man. Grd	(BL) Tuner Control Manual/Semi-Auto Grd	(BM) Tune Command 1	Set in operate
36 Fault to Tuner Control	2	2	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
37 Fault to Exciter	2	2	2	2	2	1	-	-	-	-	-	-	-	-	-	-	-
38 Grd Pulse to Coupler Control	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
39 Grd Pulse to Tuner Control	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
40 Ready to Exciter	0	0	0	0	0	-	0	0	0	-	-	-	-	-	-	-	-
(BJ) RF Mute to 1 KW PA	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-
41 Tune Command 2 to Exciter (either of 2 conditions)	(1) 0 (2) -	0	0	0	0	0	-	-	-	1	0	0	0	0	2	2	-
43 Tune Enable to Exciter (Any of 3 conditions)	(1) 0 (2) - (3) 0	0	0	0	0	0	-	-	2	2	-	0	0	0	-	-	1
42 Local Override to Exciter	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-
44 Bypass to Tuner	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
45 RF Mute Pulse	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-
46 Tune Command 1 Hold	-	-	-	-	-	-	-	5	1	-	-	-	-	-	-	-	-

- NOTES:
- Prefix incomplete reference designations with 7A1.
  - Letters outside transistor blocks indicate elements; numbers at relays are terminal numbers.
  - indicates front panel markings.
  - I. Box inputs and outputs may be conveniently checked at the feed through capacitors in the chassis instead of the indicated test points.
  - Use truth table for troubleshooting in conjunction with test points. Conditions shown are requirements of I. Box logic. It may also be necessary for other logic functions to be fulfilled in order for other units to perform required steps. E.g., tune enable will not cause Exciter to produce tune power unless Exciter's internal logic conditions are met.
  - Signal levels are indicated by arrow types next to test points as follows (all arrow symbols point in direction of signal flow; check LO level signals to +28 V reference; check HI level signals to ground reference):  
 HI = = Positive level (close to positive supply voltage).  
 LO = = Ground level (less than +2V).
  - All measurements can be made with AN/PSM-4B.
  - These functions inverted (Grd is normal, open is significant signal).
  - Pulse triggered by beginning of inhibit or end of decoder-on ground and tuner control manual ground.
  - Refer to figure 4-36 for functional representation of Exciter interface logic.
  - Make measurements between indicated test points.





A. WITHOUT AN/URA-38 ANTENNA COUPLER GROUP



B. WITH AN/URA-38 ANTENNA COUPLER GROUP

Figure 4-54. Tune Cycle, Timing Diagram

SECTION V

MAINTENANCE

5-1 GENERAL.

5-2 FAILURE, AND PERFORMANCE AND OPERATIONAL REPORTS. The Navy no longer requires the submission of failure reports for all electronic equipment. Failure reports and performance and operational reports are to be accomplished for designated equipment (Refer to Electronic Installation and Maintenance Book 0967-000-000.) only to the extent required by existing directives. All 3-M reports shall be made on current OPNAV 4790 series forms in accordance with OPNAV manual 43P2.

5-3 MAINTENANCE SCOPE. This section covers the maintenance of the 1 KW PA, 1 KW Power Supply, Tuner, Tuner Control, I. Box, and adjustment of the AN/FRT-83(V) power control loops. The Exciter, Keyer, Decoder-Encoder, and Remote Control equipments are covered by publications listed in table 5-1.

5-4 Within the scope stated above, this section contains those maintenance, adjustment, and parts replacement procedures which use test equipment and tools generally available at shore installations. Special devices and test fixtures required are limited to those which are provided by the Maintenance Kit supplied as a part of the AN/FRT-83(V) (table 1-2) or those which can be readily constructed with moderate maintenance-shop facilities. Maintenance procedures which require special test equipment, or more elaborate devices and test fixtures, are included in the Overhaul and Repair Manual, NAVSHIPS 0967-292-9100. Following is a summary of items covered in the Overhaul and Repair Manual.

- a. 1 KW PA driver and final transformer assembly and transmission assembly repair and mechanical alignment.

TABLE 5-1. MAINTENANCE COVERAGE FOR UNITS NOT COVERED IN THIS MANUAL.

DESIGNATION & COMMON NAME	TECHNICAL MANUAL	MAINTENANCE STANDARDS BOOK	OVERHAUL AND REPAIR MANUAL
MD-777/FRT, Exciter	0967-292-9030	0967-293-3010	0967-293-3020
KY-655/FRT, Keyer	0967-292-9020	0967-293-4010	0967-293-4020
C-7709/FRT, Remote Control	0967-292-9040	0967-293-5020	0967-293-5030
KY-656/FRT, Decoder-Encoder	0967-292-9050	0967-293-6010	0967-293-6020

b. 1 KW PA driver and final transformer assembly switch and coil replacement. (See paragraph 5-21.)

c. 1 KW PA bandswitch motor replacement.

d. Transmitter measurements to determine intermodulation distortion, unwanted sideband suppression, carrier suppression, harmonic output, and no-signal noise.

e. A systematic method of checking transmitter performance is contained in the Maintenance Standards Book, NAVSHIPS 0967-292-9090. Scheduled preventive maintenance is established under the PMS subsystem of the Maintenance and Material Management (3-M) System.

#### 5-5 TUNING AND ADJUSTMENT.

5-6 No adjustment procedures are required for the 1 KW Power Supply. Adjustments for the 1 KW PA, Tuner, Tuner Control, and I. Box, plus AN/FRT-83(V) power control adjustments are described under the subheadings which follow. Electrical adjustments are given first, followed by mechanical adjustment procedures where applicable.

5-7 1 KW PA DRIVER TUBES BIAS. When the plate current of either driver tube, 1A1A1V1 or 1A1A1V2, is greater than 400 milliamperes or less than 260 milliamperes while the 1 KW PA is keyed, the driver tube bias should be adjusted as follows. (All control, indicator, and connector references apply to the 1 KW PA unless otherwise specified.)

a. Turn on external primary power to the equipment.

b. Depress Exciter AMPLIFIER OFF

pushbutton.

c. Loosen 1 KW PA front panel captive screws and slide out chassis.

d. Defeat two interlock switches on 1 KW PA by pulling plungers straight out.

e. Loosen lock nut on DRIVER BIAS ADJ 1A1R9 (figure 5-10) and set maximum counterclockwise.

f. Depress Exciter STANDBY pushbutton and allow for three minutes time delay; then depress Exciter OPERATE pushbutton.

g. Change Exciter frequency to lock transmitter into tune cycle condition, but do not depress TUNE pushbutton for the balance of this procedure. With the TUNE indicator illuminated and the READY indicator extinguished, there will be no driving signal at the 1 KW PA.

h. Set Multipurpose Meter switch at DRIVER PLATE VOLTS and observe indication of  $600 \pm 60$  VDC at nominal line voltage.

i. Set Multipurpose Meter switch at PA DRIVER SCRNS VOLTS and observe indication of  $287 \pm 15$  VDC.

j. Set Multipurpose Meter switch alternately at DRIVER 1 AMPERES and DRIVER 2 AMPERES and observe Multipurpose Meter while slowly rotating DRIVER BIAS ADJ clockwise.

k. Set DRIVER BIAS ADJ for an indication of 320 milliamperes for tube which indicates lowest plate current. Plate current of other tube should now indicate between 320 and 400 milliamperes; if it does not, one of the tubes is defective and should be replaced or there is a defect in the circuit. Tighten lock nut on DRIVER BIAS ADJ, and recheck indications.

1. Depress Exciter AMPLIFIER OFF pushbutton.

m. Slide 1 KW PA chassis into cabinet and secure.

5-8 FINAL AMPLIFIER TUBES SCREEN VOLTAGE. The difference in plate current between 1 KW PA final amplifier tubes 1A1V1 and 1A1V2 should not exceed 40 milliamperes. In case the difference does exceed 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. (In the adjustment procedure which follows, all control, indicator, and connector references apply to the 1 KW PA unless otherwise specified.)

WARNING

Lethal voltages exist within the 1 KW PA during operation. Screen voltage (300 VDC) is present at jacks J6 through J11. Refer to NAVSHIPS 0967-000-0000 Electronics Installation and Maintenance Book, High-voltage Adjustment Procedures before proceeding.

a. Depress Exciter STANDBY pushbutton, and allow for three-minute time delay; then depress OPERATE pushbutton.

b. Change Exciter frequency to lock transmitter in a tune cycle condition, but do not depress TUNE pushbutton for this procedure. The set will be keyed, but no drive will be applied to the 1 KW PA.

c. Set Multipurpose Meter switch at PA DRIVER SCRNS VOLTS. Multipurpose Meter should indicate  $287 \pm 15$  VDC.

d. Set Multipurpose Meter switch at

PA PLATE VOLTS. Multipurpose Meter should indicate  $2400 \pm 240$  VDC at nominal line voltage.

e. Rotate PA BIAS control fully counterclockwise.

CAUTION

Excessive plate current will damage final amplifier tubes 1A1V1 and 1A1V2.

f. Set Multipurpose Meter switch alternately at PA PLATE 1 AMPERES and PA PLATE 2 AMPERES and observe Multipurpose Meter while slowly rotating PA BIAS control clockwise.

g. Set PA BIAS control for an indication of 240 milliamperes for the tube which indicates the highest plate current. Take note of which tube is set for 240 milliamperes and also note the differences between this and the (lower) current of the other tube. If the lower-current tube is conducting at 220 to 240 milliamperes rate, no further adjustment is required; if conduction is below 220 milliamperes, continue with procedure below.

h. Depress Exciter STANDBY pushbutton.

i. Loosen 1 KW PA front panel captive screws and slide out chassis.

j. Defeat two interlock switches on 1 KW PA by pulling plungers straight out.

k. Locate screen voltage adjustment jacks J6 through J11 on left side of 1 KW PA chassis (figure 5-10).

l. 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 or P7) to a higher-number jack will increase the plate current of that tube.

m. Determine which plug should be moved to adjust conduction of lower-current tube toward desired rate of at least 220 milliamperes, but not more than 240 milliamperes. Change that plug to a new trial position.

n. Depress Exciter OPERATE pushbutton.

o. Recheck plate current indication for tube which was adjusted. If current is not yet within the stated range (approaching 240 milliamperes), depress Exciter STANDBY pushbutton and adjust appropriate plug as required to attain acceptable plate current. Depress Exciter OPERATE pushbutton, and check results. Repeat this step until acceptable results are obtained.

CAUTION

Damage to the tube may result if its screen plug is left disconnected during operation.

p. Depress Exciter AMPLIFIER OFF pushbutton.

q. Slide 1 KW PA chassis into cabinet and secure.

5-9 1 KW PA VSWR BRIDGE BALANCE. The 1 KW PA VSWR Bridge must be properly balanced to provide related forward and reflected power outputs for application to the TGC-PPC circuits to protect against overdrive and high VSWR conditions.

5-10 The following test equipment is required for this procedure:

- a. RF Dummy Load DA-242/U.
- b. Electronic Multimeter AN/USM-116.
- c. Multimeter, AN/PSM-4B.
- d. RF Signal Generator SG-582/U.
- e. RF Cable Adapter UG-1447/USM-117.
- f. Non-inductive alignment tool, JFD #5284.

5-11 The following procedures are required to properly balance the 1 KW PA Bridge:

NOTE

All control, indicator, and connector references apply to the 1 KW PA unless otherwise specified.

- a. Depress Exciter AMPLIFIER OFF pushbutton.
- b. Open rear door of local equipment cabinet.
- c. Disconnect RF Cable 8W5 from XMTR OUT connector 1A2J3 on the 1 KW PA.
- d. Disconnect RF cable 8W11 from RF input connector 1A2J9 on the 1 KW PA.
- e. Connect a 47 ohm, 2W resistor or similar type of dummy load to the free end of cable 8W11 to terminate the Exciter.
- f. Connect RF Signal Generator SG-582/U to 1 KW PA RF input connector 1A2J9 (figure 5-1). Set SG-582/U for minimum output at 21 MCS with no modulation (CW).

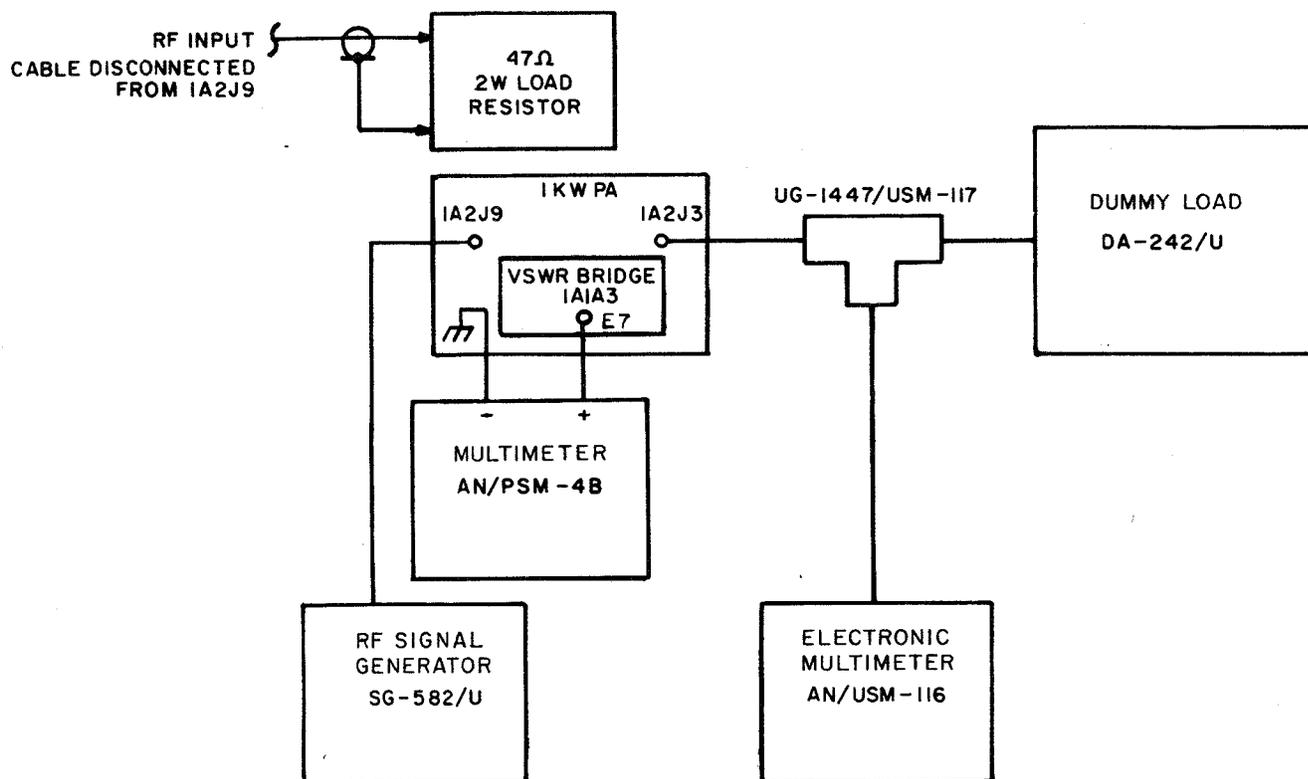


Figure 5-1. 1 KW PA VSWR Bridge Alignment Setup

g. Connect DA-242/U RF Dummy Load through RF Cable Adapter UG-1447/USM-117 to 1 KW PA XMTR OUT connector 1A2J3.

h. Connect Electronic Multimeter AN/USM-116, set to measure 225 VAC, to UG-1447/USM-117.

i. Loosen 1 KW PA front panel cap-tive screws, and slide out chassis.

**WARNING**

Lethal voltages are present in the 1 KW PA. Refer to high voltage adjustment procedures in Electronics Installation and Maintenance Book, NAVSHIPS 0967-000-0000 before proceeding.

j. Remove protective shield from over left side of 1 KW PA chassis.

k. Carefully connect AN/PSM-4B Multimeter positive lead to VSWR bridge terminal 1A1A3E7 (figure 5-17) and negative lead to chassis ground. Set to low DC voltage range.

**WARNING**

Voltages of up to 460 VAC will be present at terminals under protective shield during following procedure.

1. Defeat two interlock switches on 1KW PA by pulling plungers straight out.

m. Turn off Tuner Control and Coupler Control POWER circuit breakers.

n. Depress Exciter STANDBY pushbutton, and allow for three-minute time delay; then depress OPERATE pushbutton.

o. Set 1 KW PA FREQUENCY MEGACYCLES selector to the "20 to 22" MC band. Observe that FREQUENCY MEGACYCLES dial rotates to "20 to 22" MC band.

p. Change Exciter frequency to lock transmitter into tune cycle, but do not depress the Exciter TUNE pushbutton. This will key the set.

q. Increase the audio output levels of the SG-582 to obtain 225 VAC indication on the USM-116.

r. Insert JFD 5284 tuning tool through access hole in top of VSWR bridge assembly and carefully adjust 1A1A3C6 (figure 5-17) for minimum indication on multimeter. This indication must be less than 0.65V null.

s. Depress Exciter AMPLIFIER OFF pushbutton.

t. Dismantle test setup, and reassemble equipment and cables.

u. Return 1 KW PA FREQUENCY MEGACYCLES selector to AUTOMATIC.

v. Turn on Tuner Control power circuit breaker.

5-12 INTERNAL POWER CONTROL. The INTERNAL POWER SET adjustment within the 1 KW PA is an extra protection for the 1 KW PA. In the event of a fault in the external power control circuit, or when the 1 KW PA is removed from the AN/FRT-83(V), the internal power control circuit will provide protection against the 1 KW PA

being over-driven. The adjustment of INTERNAL POWER SET is accomplished in conjunction with the overall peak power control adjustment procedure found in paragraph 5-45.

5-13 1 KW PA RF TUNED CIRCUITS ALIGNMENT. Complete alignment of the 1 KW PA consists of tuning the driver and final transformer assemblies. These procedures must be performed whenever sufficient power output cannot be obtained or excessive plate current (not due to aging tubes or component failure) is noted on one or more frequency bands or whenever a transformer assembly is replaced.

5-14 The critical parameters used to determine proper final amplifier tube and final transformer assembly operation are as follows. The maximum plate current for either final amplifier tube with 1 KW output is 710 MA. The maximum allowable difference between one band edge and the other is 30 MA. If the balance between band edges is greater than 30 MA after alignment to obtain proper scope pattern, a final adjustment should be made to provide this degree of balance.

5-15 The driver stage, operating as a class A amplifier, does not provide a simple indication of performance. However, after both driver and final transformer assembly alignment, no more than 100 MW (2.24 VAC) of drive should be required to obtain full 1 KW rated output at any frequency.

5-16 The following test equipment is required for this procedure:

a. Sweep generator, Texscan model VS-30 or equivalent, with remote flattening, 0-5 MC sweep bandwidth, 1 to 35 MC, 0.5V RF output, multiple markers at 0.5, 1.0, and 5.0 MC intervals.

b. Dual trace oscilloscope, AN/USM-281A or equivalent.

- c. Signal Generator SG-582/U.
- d. Electrical Dummy Load DA-242/U.
- e. Electronic Multimeter AN/USM-116 with UG-1447/USM-117 tee-probe adapter.
- f. Detector test fixture (fabricate per figure 5-2).
- g. Alignment Tool, 0.100 inch hex each end, non-conductive, one end with undercut shank.
- h. Nut driver, 1/4 inch.

5-17 DRIVER TRANSFORMER ALIGNMENT. The driver transformer assemblies for the nineteen frequency bands are arranged on sixteen coil forms. Figure 5-47 illustrates the schematic representation of the coils, while table 5-2 lists the frequencies covered by each band. To align the coils of any one band proceed as follows. (All control, indicator, and connector references apply to the 1 KW PA unless otherwise specified.)

5-18 Perform the following preliminary procedures:

WARNING

Lethal voltages exist within the 1 KW PA during operation. Refer to NAVSHIPS 0967-000-0000 Electronics Installation and Maintenance Book High-Voltage Adjustment Procedures before proceeding.

- a. Depress Exciter AMPLIFIER OFF pushbutton.
- b. Loosen 1 KW PA front panel captive screws and slide out chassis.
- c. Disconnect 1A2P1 (RF from Exciter)

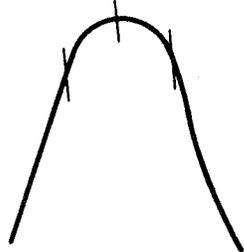
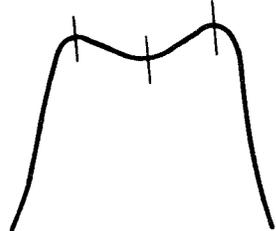
from 1A1J1 on rear of 1 KW PA chassis.

- d. Connect 47 ohm, 2W resistor (or other suitable dummy load) to 1A2P1 to terminate Exciter.
- e. Disconnect 1A2P4 (RF from VSWR bridge) from 1A1A3J2 on rear of 1 KW PA chassis.
- f. Turn off Tuner Control and Coupler Control POWER circuit breakers.

5-19 After completing the preliminary procedures proceed as follows:

- a. Tilt chassis to expose underside; lock.
- b. Connect test equipment with 1 KW PA to provide test setup illustrated by figure 5-2. Note that Detector Test Fixture is placed at driver transformer 1A1A4 so that very short (1/4") leads are utilized. Shielded RF cables connect between sweep generator and 1 KW PA and between sweep generator and Detector Test Fixture.
- c. Make sure set is in AMPLIFIER OFF condition. Then record positions of screen balance plugs P6 and P7 in jacks J6-J11 at left-rear of chassis, and unplug and ground plugs to disable final amplifier stage.
- d. Activate test equipment. Temporarily set the output level of the sweep generator to zero. Allow 15 minutes warmup.
- e. Defeat two interlock switches on 1 KW PA by pulling plungers straight out.
- f. Depress Exciter STANDBY pushbutton and allow 15 minutes for equipment warmup.

TABLE 5-2. DRIVER TRANSFORMER ALIGNMENT

BAND NO.	BAND LIMITS (MC)	TUNING SLUG(s)	
1	2 - 2.5	A1	 <p>Requirements</p> <ul style="list-style-type: none"> <li>● Good symmetry over top of curve</li> <li>● High and low markers same amplitude</li> </ul>
2	2.5 - 3	A2	
3	3 - 3.5	A3 bottom	
4	3.5 - 4	A3 top	
5	4 - 5	A4 top	
6	5 - 6	A4 bottom	
7	6 - 7	A5 top	
8	7 - 8	A5 bottom	
9	8 - 10	A6 top & bottom	 <p>Requirements</p> <ul style="list-style-type: none"> <li>● Top symmetry</li> <li>● High and low markers each near peak of hump</li> </ul>
10	10 - 12	A7 top & bottom	
11	12 - 14	A8 top & bottom	
12	14 - 16	A9 top & bottom	
13	16 - 18	A10 top & bottom	
14	18 - 20	A11 top & bottom	
15	20 - 22	A12 top & bottom	
16	22 - 24	A13 top & bottom	
17	24 - 26	A14 top & bottom	
18	26 - 28	A15 top & bottom	
19	28 - 30	A16 top & bottom	

NOTE: Detuning the top slug (primary of a double-tuned circuit will move the entire waveform with respect to the markers. Detuning the bottom slug (secondary) will skew the waveform so that one peak is more pronounced.

g. Depress Exciter OPERATE push-button. Change frequency at Exciter to place transmitter in a tune condition, but do not depress TUNE push-button.

h. Set Multipurpose Meter switch at DRIVER 1 AMPERES and then at DRIVER 2 AMPERES. If necessary,

adjust driver bias control 1A1R9 to obtain 320 MA for the lowest of the two DRIVER AMPERES positions. The higher DRIVER AMPERES current should then not exceed 400 MA.

i. Set 1 KW PA FREQUENCY MEGACYCLES selector at frequency range corresponding to frequency of band being aligned.

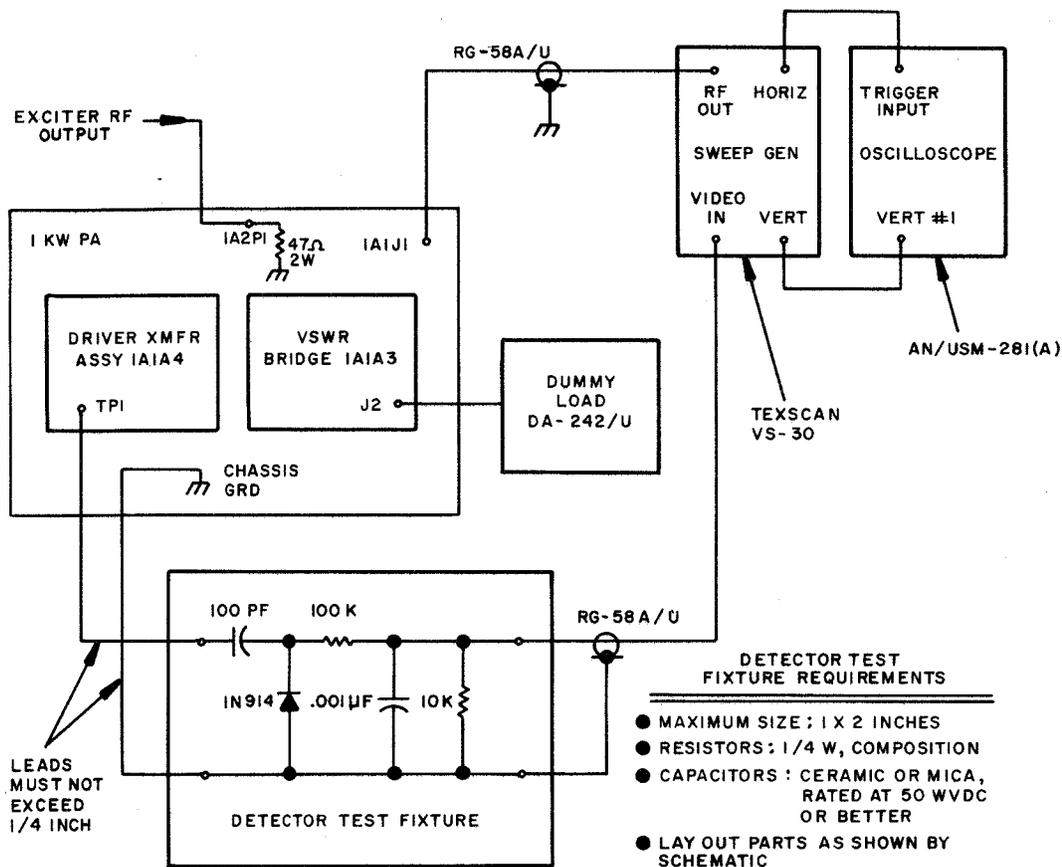


Figure 5-2. Driver Transformer Alignment Test Setup

j. Set generator to sweep band being aligned (approximately 0.5 volts RF output) and insert markers for center, upper, and lower limits of this band (table 5-2).

k. For bands 1 through 8, adjust the appropriate slug as stated in table 5-2, which shows a single tuned response curve typical of bands 1 through 8 when properly aligned. Repeat steps i. through k. for each successive band alignment.

l. For bands 9 through 19, alternately adjust two slugs per band (top slug first), as stated in table 5-2, until the double tuned response curve, which is typical of bands 9 through 19 when

properly aligned, is obtained. Repeat steps i., j., and l. for each successive band alignment.

m. Depress Exciter AMPLIFIER OFF pushbutton.

n. Disconnect Detector Test Fixture and all other test equipment.

o. Reconnect P6 and P7 disconnected in step d.

NOTE

Omit steps p. and q. if final transformer assembly must also be aligned.

p. Reconnect 1A2P1 and 1A2P4 by

reversing steps d. through b. of Preliminary Procedures, paragraph 5-18.

q. To return equipment to operation, slide 1 KW PA into cabinet and secure. Turn on Tuner Control and Coupler Control POWER circuit breakers. Reset 1 KW PA FREQUENCY MEGACYCLES selector to AUTOMATIC.

#### 5-20 FINAL TRANSFORMER ALIGNMENT.

The final transformer assemblies for the nineteen frequency bands are arranged on nineteen coil forms (figure 5-46). Frequency bands 1 and 2 both use coil forms 1 and 2 connected in series, and frequency bands 3 and 4 both use coil forms 3 and 4 connected in series. The coils for the remaining fifteen bands are arranged on fifteen separate forms, with two coils on each form providing a double-tuned circuit for each band. The slug-tuned coils are aligned from the top of the form. The adjustment slug for the coil on the top of each form (coil L1) is marked black while the slug for the bottom coil is unmarked. To align final transformer assemblies, proceed as follows. (All control, indicator, and connector references apply to the 1 KW PA unless otherwise specified.)

a. Perform preliminary procedures as directed by paragraph 5-18.

b. Connect test equipment with 1 KW PA to provide test setup illustrated by figure 5-3.

c. Activate test equipment, and set sweep generator output level to minimum.

d. Set PWR control (front panel) to maximum clockwise and set Internal Power Set control (figure 5-10) to maximum counterclockwise.

e. Defeat two interlock switches on 1 KW PA by pulling plungers straight out.

f. Depress Exciter STANDBY pushbutton and allow 15 minutes for equipment warmup.

g. Depress Exciter OPERATE pushbutton. Change Exciter frequency to lock transmitter in tune condition, but do not depress TUNE pushbutton. This will key the set.

h. Set 1 KW PA FREQUENCY MEGACYCLES selector at frequency range corresponding to frequency of band being aligned.

i. Set generator to sweep band being aligned (approximately 0.5 volts RF output) and insert markers for upper and lower limits of this band.

#### NOTE

The second trace on the oscilloscope will display the remote flattening (external monitor) input to the sweep generator. The flat portion of this display must always be wider than the edges of the band being aligned to ensure that the remote flattening is maintaining constant driver stage output.

j. Perform alignment as stated in table 5-3 to obtain a waveform with maximum amplitude and resembling the example shown as closely as possible.

#### NOTE

Each final transformer assembly is aligned individually, except for bands 2 and 4. Band 2 alignment must be followed by band 1 alignment and band 4 alignment must be followed by band 3 alignment. When aligning bands 1-2 or 3-4, it will be necessary to repeat alignment of the two interacting bands a few times to obtain the best compromise on amplitude and waveshape between the two bands.

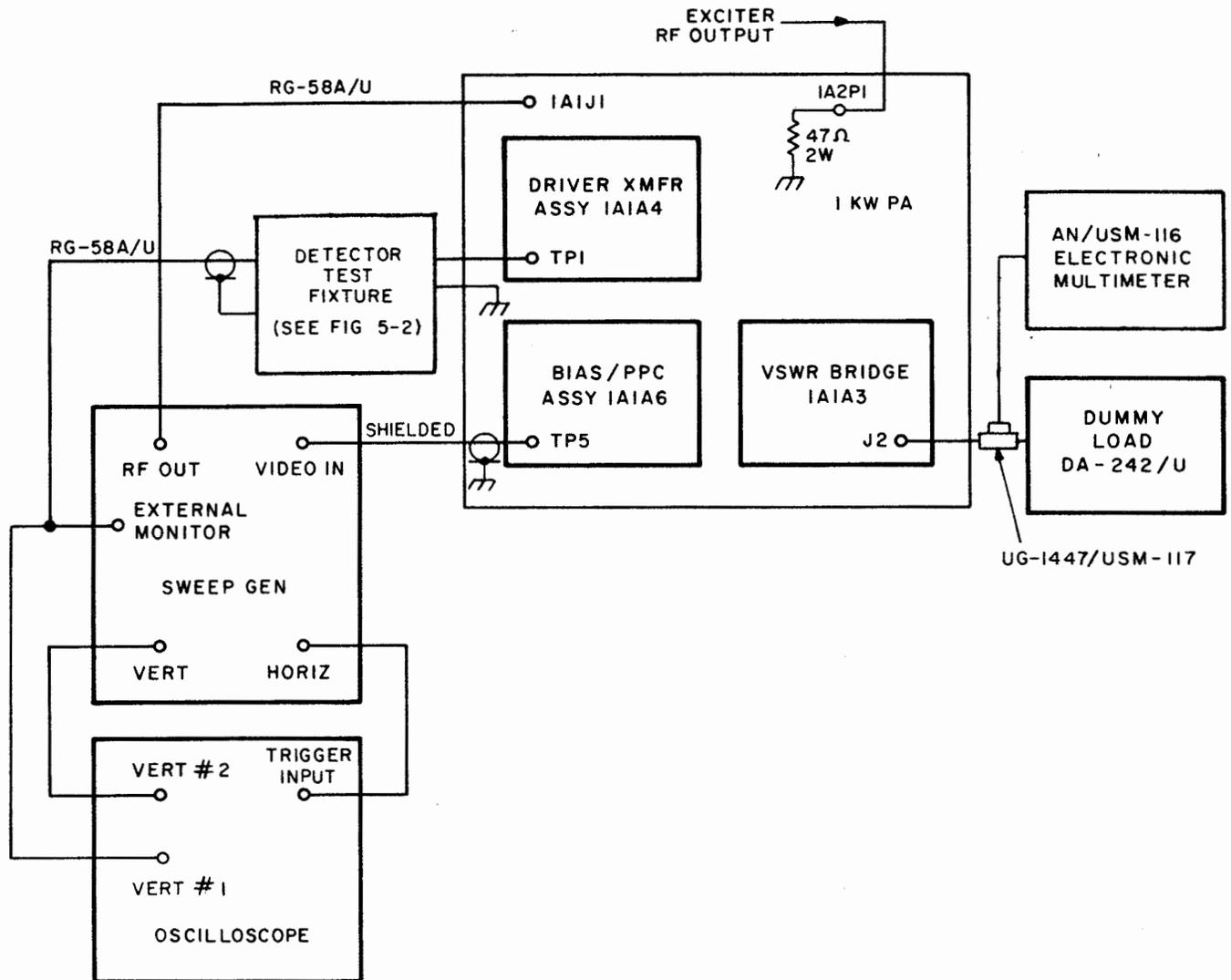


Figure 5-3. Final Transformer Alignment Test Setup

NOTE

Coils for bands 5-19 have primary tuning adjustments color-coded black, with no color marker on the secondary. Generally, once tuned close to the correct area, the primary adjustment can be expected to change the position of the entire waveform with respect to the frequency markers, and the secondary will affect the relative amplitudes of the two peaks and the shape of the response waveform.

NOTE

For bands 16-19, after alignment for desired waveform is completed, it may be necessary to readjust slightly for equal plate currents at band edges to obtain best I.M. characteristics, using the set-up in step 1. This can be done after all bands are aligned with the present setup. Other bands need only be checked as specified in step 1.; readjustment is necessary only if plate current spread is greater than specified.

TABLE 5-3. FINAL TRANSFORMER ALIGNMENT

BAND NO.	BAND LIMITS (MC)	TUNING SLUG(s)	NOTES	WAVEFORMS
1	2 - 2.5	A1 black		
2	2.5 - 3	A2 black A1 unmarked	Must realign band 1 after band 2 alignment	
3	3 - 3.5	A3 black		
4	3.5 - 4	A4 black A3 unmarked	Must realign band 3 after band 4 alignment	
5	4 - 5	A5 both		
6	5 - 6	A6 both		
7	6 - 7	A7 both		
8	7 - 8	A8 both		
9	8 - 10	A9 both		
10	10 - 12	A10 both		
11	12 - 14	A11 both		
12	14 - 16	A12 both		
13	16 - 18	A13 both		
14	18 - 20	A14 both		
15	20 - 22	A15 both		
16	22 - 24	A16 both		
17	24 - 26	A17 both		
18	26 - 28	A18 both		
19	28 - 30	A19 both		

k. To change bands, set 1 KW PA FREQUENCY MEGACYCLES selector and sweep generator to new band and repeat adjustments for the new band.

1. When alignment is completed, check alignment according to parameters listed in paragraph 5-13, using the following setup to generate a single-frequency signal; repeat alignment on any band which fails to meet the basic requirements listed:

1. Depress Exciter STANDBY push-button,
2. Disconnect sweep generator and oscilloscope from 1 KW PA,
3. Connect RF output from SG-582/U Signal Generator to 1 KW PA input connector 1A1J1,
4. Set Internal and External Power Set controls to maximum clockwise. Use CW output from signal generator to drive 1KW PA,
5. Set Exciter CLASS OF EMISSION selector to SSB ( $\infty$ ). Depress OPERATE pushbutton.

CAUTION

With Internal and External Power Set controls set to maximum clockwise, There is no overdrive protection for the 1 KW PA. Therefore, care must be exercised when setting signal generator output to prevent exceeding 1 KW (224 VAC on AN/USM-116).

m. After all alignment and tests are completed, depress STANDBY push-button, and allow one minute for cooling; then depress AMPLIFIER OFF pushbutton. Disconnect original cables and close up unit, performing the reverse of steps F. thru b. of paragraph 5-18. Reset 1 KW PA FREQUENCY MEGACYCLES selector to AUTOMATIC.

n. Perform Transmitter Peak Power Control Adjustment, paragraph 5-46

prior to releasing equipment to operating personnel.

5-21 REPLACEMENT OF THE 1 KW PA FTA/DTA UNITS. It is essential that whenever the FTA/DTA units are replaced that the positioning of the switch wipers be checked, and adjusted as necessary.

WARNING

Failure to properly adjust switching contacts will cause arching and burned contacts or switches in the FTA.

CAUTION

DO NOT key system at any time during this alignment check.

NOTE

The switches in both the FTA and DTA are mechanically indexed to the bandswitch motor. However, there are no mechanical adjustments within the drive train for the switches. Adjustments for the switching contacts result from movement of the code plate on S1 of the DTA.

5-22 After replacement of the FTA and/or DTA install the 1 KW PA in the system and secure in the ready-to-operate condition, and proceed as follows:

a. Turn the transmitter system power ON and place the MD-777/FRT (Exciter) in STANDBY.

b. To assure that the switches are properly indexed to the bandswitch motor drive, place the Exciter FREQUENCY KC switch in the 3.0 MCS position, then place the switch in the 2.0 to 2.5 MCS BAND.

c. Turn power OFF.

d. Remove the FTA and DTA assemblies and check that the switch wipers are properly centered at position 1. The FTA wiper must be properly centered on the contact button. The DTA wiper may be slightly off center, but must be fully engaged with the contacts.

e. If the FTA wiper contacts are not properly centered, remove the plug buttons on the top plate of the DTA and loosen the exposed nuts sufficiently to permit rotation of the code plate. Rotate the code plate CW to retard the wipers or CCW to advance the wipers. (FTA wipers turn clockwise as viewed from the top.) Normally the code plate requires a very small movement to adjust the wipers.

f. Tighten the code plate securing nuts, replace the plug buttons, and re-install the FTA and DTA in the Power Amplifier.

g. Repeat steps a. through e. until inspection determines that the wipers are making proper contact.

5-23 DRIVE CHAIN ADJUSTMENT. To tighten the 1 KW PA drive chain, proceed as follows:

a. Loosen 1 KW PA front panel captive screws and slide out chassis.

b. Tilt chassis to expose underside; lock.

c. Locate two phillips-head screws which secure drive chain bracket assembly to main chassis, directly behind front panel (figure 5-12).

d. Loosen two screws.

e. Push bracket toward front panel to increase tension on chain.

### CAUTION

The chain should be tight enough to eliminate all backlash. However, too much tension on the drive chain will cause excessive wear to the drive mechanism.

f. While maintaining light tension on drive chain bracket assembly, tighten two screws securing assembly to main chassis.

g. Return chassis to horizontal position, slide into cabinet, and secure.

### 5-24 TUNER, TUNER CONTROL, AND I. BOX ADJUSTMENTS.

#### WARNING

The Tuner is extremely hazardous when operated with its chassis exposed because of extremely high RF voltages. The following precautions should be observed when the Tuner is extended from the cabinet on its slides, exposing its chassis.

Never touch the unit before checking that the AN/FRT-83(V) is unkeyed.

Never let bystanders approach within arms length of the unit while it is being operated.

Never leave the unit unattended while the AN/FRT-83(V) is keyed.

Always clear the area within arms length of the unit before keying the AN/FRT-83(V).

Before starting to work on the Tuner, always disconnect the Tuner's RF input and RF output cables, unless otherwise directed by the specific instructions of the procedure being followed. **ALWAYS REMOVE THE RF INPUT CABLE BEFORE DISCONNECTING THE RF OUTPUT CABLE.**

NOTE

The Tuner may not tune correctly if attempt is made to operate with its top cover removed.

5-25 DISCRIMINATOR. The discriminator adjustment procedures are critical since the Discriminator controls the tuning accuracy of the Tuner matching network. Maladjustment could damage the equipment, depending on the degree of mismatch between the transmitter and the antenna. Therefore, the procedures should be followed only when the assembly has been repaired or if VSWR checks at the 1 KW PA indicate that the Tuner is consistently improperly tuned. The servo amplifier balance should be checked before assuming the Discriminator is misadjusted.

5-26 The following test equipment required for these procedures:

- a. Non-inductive alignment tool, JFD #5284.
- b. RF Dummy Load DA-242/U.
- c. Wattmeter AN/URM-120.
- d. RF Signal Generator SG-582/U.

5-27 Perform the following procedures:

- a. Depress Exciter AMPLIFIER OFF pushbutton.
- b. Shut off primary power circuit breakers on Tuner Control and Coupler Control units.
- c. Open rear cabinet door, and disconnect 1 KW PA to Tuner RF Cable 8W5 at both ends (1A2J3 and 9A1J7).

d. Disconnect RF cable 8W11 at 1 KW PA RF input connector 1A2J9. Connect SG-582/U RF output to 1A2J9. Set SG-582/U for minimum output CW signal at 30 MCS.

e. Disconnect RF cable 8W9 at Exciter RF OUT connector 3J1 (figure 5-4), and connect 47 ohm, 2W resistor or other suitable dummy load to 3J1.

f. Remove Tuner front panel rack screws, and slide Tuner chassis out.

g. Tilt Tuner chassis bottom up 90 degrees to expose underside.

h. Remove bottom cover (19 screws), and defeat interlock switch.

i. Prepare RG-58A/U cable approximately four feet long with UG-536B connector at one end. Strip back shield and center conductor insulation a maximum of one inch at other end. Tin shield and center conductor, and solder a #4 solder lug to shield.

CAUTION

Use care in making connections to Discriminator, since close proximity of  $\pm 15$  VDC power supply to Discriminator and terminal proximity to chassis make short circuits possible.

j. Unsolder strap from TP1 on Discriminator Assembly 9A1A1 item 3, (figure 5-31) and solder center conductor of test cable (prepared in step h.) to TP1 (figure 5-3). Secure test cable shield lug under nearest ground screw.

k. Connect UG-536B end of test cable to DA-242/U as shown in figure 5-4.

1. Connect RF cables from 1A2J3 on the 1 KW PA through the AN/URM-120 to 9A1J7 on the Tuner as shown in figure 5-4.

m. Depress Exciter STANDBY push-button, and allow for three minute time delay; then depress OPERATE push-button. Change Exciter frequency to lock into a tune cycle condition, but do not depress TUNE pushbutton. This will key the transmitter.

n. Set 1 KW PA FREQUENCY MEGACYCLES selector to "28 to 30" MC band.

o. Set AN/URM-120 for forward power measurement at 250 watt level.

p. Turn SG-582/U output up to obtain 250 watt indication on AN/URM-120.

q. Set Tuner Control L2-C1 to C1 and mode selector to MANUAL.

r. Adjust potentiometer R6 on Discriminator Assembly 9A1A1 for null indication on Tuner Control DISCRIMINATOR NULL meter.

s. Set Tuner Control L2-C1 selector to L2.

t. Adjust trimmer capacitor C6 on Discriminator Assembly 9A1A1 for zero (null) indication on Tuner Control DISCRIMINATOR NULL meter.

u. Depress Exciter AMPLIFIER OFF pushbutton, and reset 1 KW PA FREQUENCY MEGACYCLES selector and set Tuner Control mode selector to AUTOMATIC.

v. Disconnect cable from 9A1A1TP1 (connected in step j.).

w. Resolder strap to 9A1A1TP1 (which was disconnected in step j.).

x. Replace bottom cover on Tuner. Tilt chassis down to level position, slide back into rack, and secure with panel screws.

y. Disconnect all test connections except AN/URM-120, and reconnect cables at 3J1 and 1A2J9 (figure 5-4) and connect transmitter RF output to antenna system (or DA-242/U if broadband 2-30 MC antenna is not in use).

z. Turn on Tuner Control and Coupler Control POWER circuit breakers.

aa. Depress Exciter STANDBY push-button and allow for three minute time delay; then depress OPERATE pushbutton. Set Exciter CLASS OF EMISSION selector to A0.

ab. Check discriminator for tuning accuracy functionally by setting Exciter up, tuning, and operating at various frequencies between 2 and 30 MCS. Use PWR control on front of 1 KW PA to prevent exceeding 1 KW output. At about 1 KW output, the AN/URM-120 should indicate less than 40 watts reflected power if the discriminator is operating properly. If not, also check servo balance and any other items which might affect proper tuning.

ac. Depress Exciter STANDBY push-button, allow one minute for cooling, and then depress AMPLIFIER OFF pushbutton.

ad. Remove AN/URM-120 and reconnect cables to 1A2J3 and 9A1J7 (figure 5-4).

5-28 SERVO AMPLIFIERS. The three servo amplifiers each have a balance adjustment. Readjustment should be done to the appropriate one whenever the servo amp-

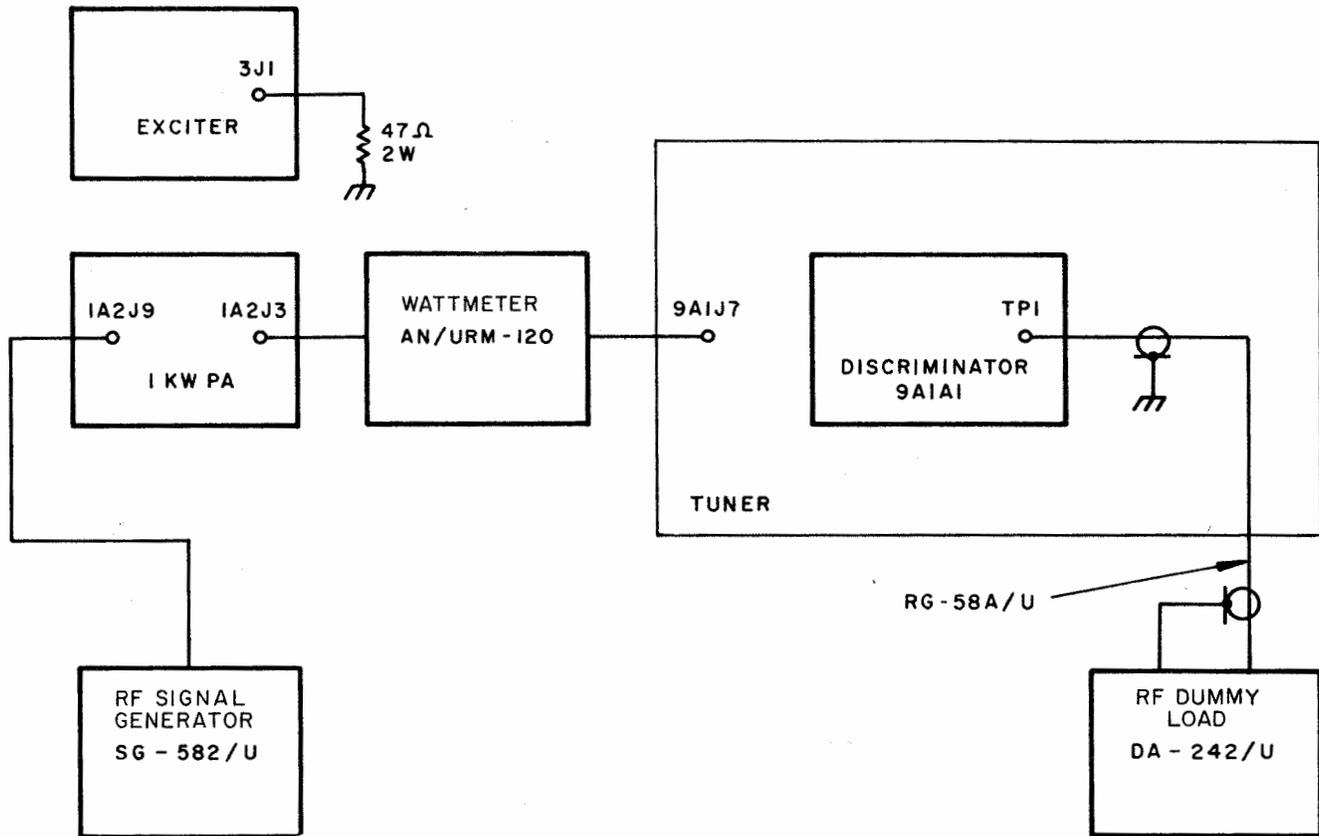


Figure 5-4. Tuner Discriminator Alignment Setup

lifier circuit has been repaired or if VSWR checks at the output of the 1 KW PA indicate that the Tuner is not tuning correctly and the Discriminator adjustment has already been checked (paragraph 5-25) and has been found not to be at fault.

5-29 The following test equipment is required for these procedures:

- a. DC Power Supply, variable 0 to 30 volts. Power Design Model 4005.
- b. Multimeter AN/USM-311 two required.
- c. Servo Amplifier Test Fixture (fabricate per figure 5-5).

5-30 To balance the servo amplifiers perform the following procedures:

- a. Depress Exciter AMPLIFIER OFF pushbutton.
- b. Open rear cabinet door. Disconnect control cable from Tuner Connector 9A1A7J8. If L1 servo is to be adjusted, also open I. Box, remove cover, and disconnect 7A1A4P1 (figure 5-24).
- c. Set Tuner Control Mode selector to AUTOMATIC.
- d. For access to 10A1A2 or 10A1A5 (L2 or C1) servo amplifier boards, loosen Tuner Control front panel cap-

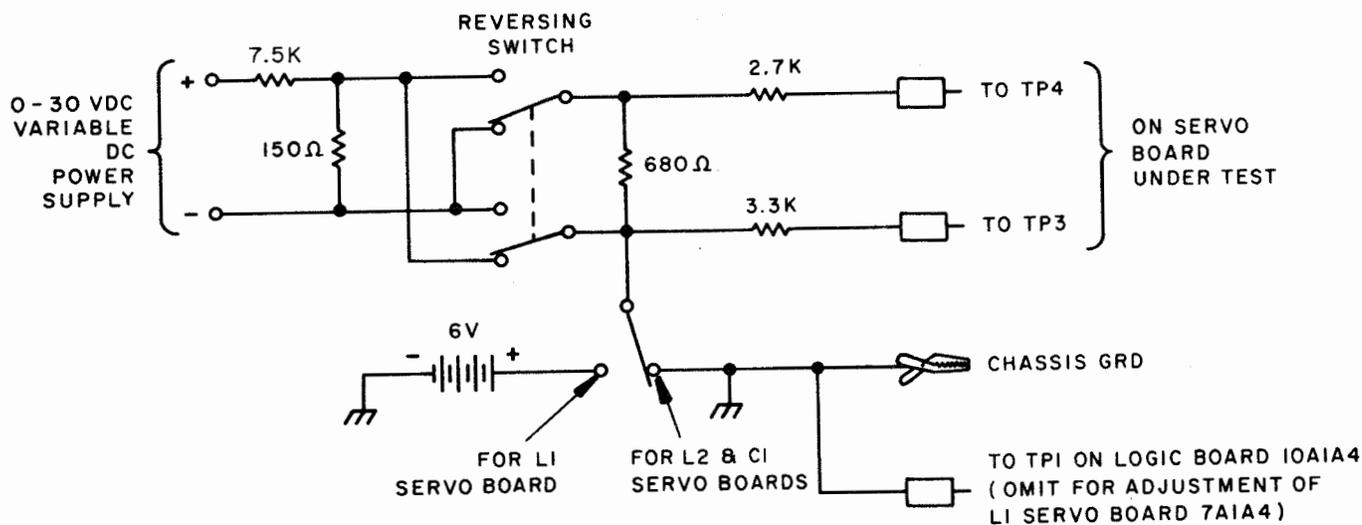


Figure 5-5. Servo Amplifier Test Fixture

tive screws and swing out chassis. Defeat interlock switches on chassis by pulling plungers straight out.

e. At left side of chasis adjust applicable potentiometer to approximate mid-range: 10A1R7 for C1 servo, 10A1R8 for L2 servo, 7A1R8 for L1 servo.

f. Connect one multimeter between TP6 on the servo amplifier board and ground. Connect the other from TP1 to ground. (Figure 5-40)

g. Connect DC power supply and Servo Amplifier Test Fixture as shown in figure 5-5. Set Test Fixture L1/L2 & C1 switch as applicable.

h. Ensure that operating power is applied to Tuner Control and I. Box.

i. Turn on DC power supply and adjust for minimum output.

j. Slowly increase DC supply voltage until indication of one multimeter drops toward zero. Decrease DC supply voltage and determine the DC input level which just results in 12 VDC indication on this meter.

## NOTE

The remainder of this procedure will refer to this meter as Meter No. 1.

k. Change the position of the reversing switch. Meter No. 1 should go to a high reading and meter No. 2 should go toward zero.

l. Alternately change positions of the reversing switch and adjust applicable potentiometer (10A1R7, 10A1R8, 7A1R8) so one meter reads zero and the other reads maximum.

m. Turn off primary power to the test equipment, the I. Box, and the Tuner Control.

- n. Remove all test equipment.
- o. Open rear cabinet door, and re-connect control cable(s) disconnected in step b.
- p. Replace applicable chassis in cabinet and secure.

5-31 TUNER VSWR BRIDGE OUTPUT. The Tuner VSWR Bridge must be properly balanced to provide related forward and reflected power output for application to the TGC-PPC circuits to protect against overdrive and high VSWR conditions.

5-32 The following test equipment is required for these procedures:

- a. RF Dummy Load DA-242/U.
- b. Electronic Multimeter AN/USM-116, two required.
- c. Multimeter AN/USM-31.
- d. RF Signal Generator SG-582/U.
- e. RF Cable Adapter UG-1447/USM-117.
- f. Non-Inductive alignment tool, JFD #5284.

5-33 All references apply to the Tuner unless otherwise specified. To properly balance the VSWR Bridge perform the following procedures:

NOTE

Lethal RF voltages are present inside the Tuner when the transmitter is in operate. Refer to high voltage adjustment procedure in Electronics Installation and Maintenance Book, NAVSHIPA 0967-000-0000, before proceeding.

- a. Depress Exciter AMPLIFIER OFF pushbutton.
- b. Open rear door of local equipment cabinet, and disconnect RF cable 8W9 from Exciter RF OUT connector 3J1.
- c. Connect a 47 ohm, 2W resistor or other suitable dummy load to Exciter RF OUT connector 3J1 (figure 5-6).
- d. Disconnect RF cable 8W10 from RF input connector 1A2J9 on the 1 KW PA.
- e. Connect RF Signal Generator SG-582/U to 1 KW PA RF input connector 1A2J9. Set SG-582/U for minimum output at 21 MCS with no modulation (CW).
- f. Disconnect RF cable from Tuner RF output connector 9A1J6.
- g. Connect DA-242/U RF Dummy Load through RF Cable Adapter UG-1447/USM-117 to 9A1J6.
- h. Connect Electronic Multimeter AN/USM-116, set to measure 225 VAC, to UG-1447/USM-117.
- i. Remove Tuner front panel rack screws. Slide chassis out, and tilt up 90 degrees to expose bottom.
- j. Remove bottom cover (19 screws). Defeat bottom interlock switch by pulling plunger out.
- k. Connect positive lead of AN/USM-311 to E4 on the VSWR Bridge. Connect the negative lead to ground. Set the AN/PSM-4B to 2.5 VDC range.
- l. Loosen captive screws on front panel of Tuner Control, and swing out chassis.

m. Set EMERGENCY BYPASS switch inside upper right hand side of unit to the ON position.

n. Close unit and temporarily secure with one screw.

o. Depress Exciter STANDBY push-button and allow for three-minute time delay; then depress OPERATE push-button. Change Exciter frequency to lock into a tune cycle condition, but do not depress TUNE pushbutton. This will key the set.

p. Set 1 KW PA FREQUENCY MEGA-CYCLES selector to the "20 to 22" MC band. Observe that FREQUENCY MEGA-CYCLES dial rotates to "20 to 22" MC band.

q. Turn the output level of the SG-582/U up to obtain a  $223.6 \pm 1$  VAC indication on the AN/USM-116.

r. Insert JFD #5284 tuning tool through access hole in VSWR bridge assembly (figure 5-34) and carefully adjust 9A1A5C6 (BAL TRIMMER) for minimum indication on the AN/USM-311. For proper operation, the null should occur at less than 0.65 volts.

s. Depress Exciter STANDBY push-button and allow one minute for cooling; then depress AMPLIFIER OFF pushbutton.

t. Open Tuner Control and return EMERGENCY BYPASS switch (step m.) to its normal off position.

u. Return 1 KW PA FREQUENCY MEGA-CYCLES selector to AUTOMATIC.

v. Break down test setup and reassemble equipment and cables, following reverse order of steps k. through v.

5-34 PEAK/AVERAGE DETECTOR ASSEMBLY ADJUSTMENTS. The peak/average detector assembly in the Tuner has three adjustments which are accessible from underneath the Tuner chassis. Adjustments should be made only if repairs to associated circuits have been made or if calibration is found to be in error when compared to a known standard. The three adjustment controls in the assembly are:

- a. 9A1A11R55 Meter Zero
- b. 9A1A11R56 1.5 KW Average Calibrate
- c. 9A1A11R57 1.5 KW Peak Calibrate

5-35 The Meter Zero control affects only average power readings. When adjustments are made, it is good practice to perform all adjustments; thus, a single procedure is provided.

5-36 The following test equipment is required for these procedures:

- a. AF Signal Generator SG-376/U or single-tone equivalent.
- b. 50 ohm, 1 KW RF Dummy Load and Calorimeter (either separate or integral unit) or 50 ohm, 1 KW RF Dummy Load and Wattmeter AN/URM-120.

NOTE

Calibration and accuracy of test equipment used for power measurement has a direct effect upon peak/average detector accuracy. A calorimeter is preferred to AN/URM-120.

5-37 To properly adjust the peak/average detector, perform the following procedures:

- a. Depress Exciter AMPLIFIER OFF push-button, and turn off PRIMARY POWER circuit breaker on bottom panel of cabinet.

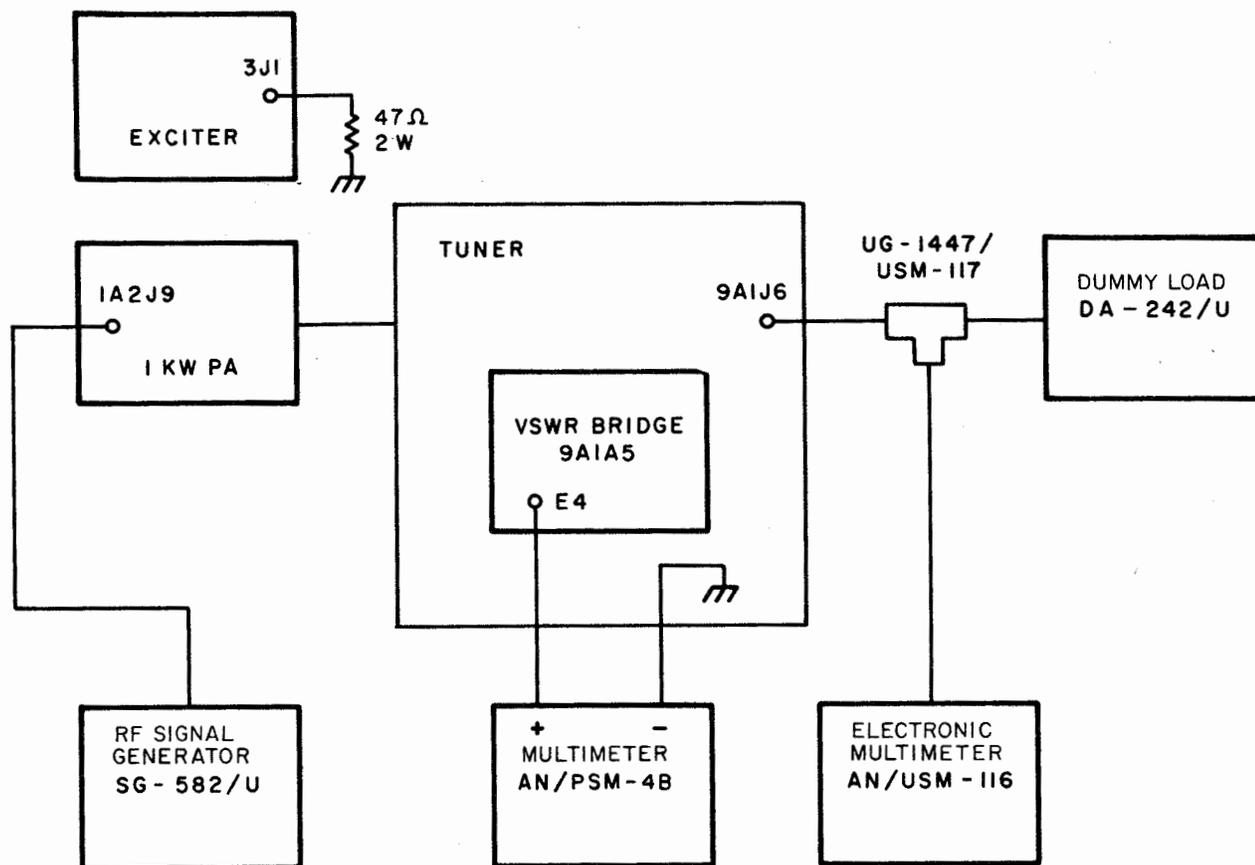


Figure 5-6. Tuner VSWR Bridge Alignment Setup

b. Check zero indication of Tuner power meter and adjust mechanical zero screw on meter if necessary.

c. Open rear door of cabinet and disconnect RF cable from Tuner RF output connector 9A1J6.

d. Connect calorimeter or substitute wattmeter and 50 ohm RF dummy load to Tuner RF output connector 9A1J6.

e. Connect SG-376/U AF Signal Generator to Exciter audio channel A1. Set SG-376/U frequency to about 1000 CPS. Turn output down to 0.

f. Set Tuner PEAK/AVG selector to AVG.

g. Remove Tuner front panel rack screws. Slide chassis out, and tilt up 90 degrees to expose bottom.

h. Remove bottom cover (19 screws). Defeat bottom interlock switch by pulling plunger out.

i. Turn on PRIMARY POWER circuit breaker (bottom panel).

j. Hold power meter range selector in REFL PWR 0-150 position. Adjust Meter Zero control 9A1A11R55 (figure 5-31)

for zero indication on front panel power meter.

k. Set Exciter FREQUENCY KC selectors to 09000.0 KC. Set CLASS OF EMISSION selector to A1, F1, F4 and set SIDEBAND SELECTOR to USB.

1. Press Exciter OPERATE and TUNE pushbuttons; and after READY indicator illuminates, adjust the output of one channel of the SG-376/U for exactly 1.0 KW indication of calorimeter or substitute.

NOTE

If unable to reach 1 KW level because of PPC action, check PPC adjustments (paragraph 5-45). Calorimeter response is slow, so allow reading to stabilize as power is advanced. Approach 1 KW slowly to avoid overdriving the transmitter.

m. With Tuner power meter range selector in the FWD PWR 0-1500 position, adjust 1.5 KW AVG CAL control 9A1A11R56 for 1.0 KW indication on Tuner meter.

n. Reset PEAK/AVG selector to PEAK, and adjust 1.5 KW PWA CAL control 9A1A11R56 for 1.0 KW indication on Tuner power meter.

NOTE

If it is desired to check calibration, bridge 1000 CPS tone Exciter audio channels A1 and B1. Set the Exciter for (2) ISB, SSB $\infty$  operation, and use CHANNEL GAIN RATIO controls and SG-376/U output control to adjust levels for exactly 250W on calorimeter (AN/URM-120 cannot be used for

this purpose) and a proper two-tone envelope pattern on an oscilloscope connected to Tuner OUTPUT MONITOR connector. The power meter on the Tuner should indicate 250W $\pm$  25W on AVG and 500W $\pm$  50W on PEAK.

o. Depress Exciter STANDBY pushbutton, and allow one minute for cooling; then depress AMPLIFIER OFF pushbutton.

p. Break down test setup, and reconnect normal Rf cable to Tuner Rf output connector 9A1J6.

q. Reinstall Tuner bottom cover and secure Tuner chassis in cabinet.

NOTE

If PPC adjustments were tampered with to allow this procedure to be performed, recheck according to PPC adjustment procedure (paragraph 5-46).

5-38 TUNER L1 COIL POSITIONING ADJUSTMENT. The 2 to 30 MC tuning range of the Tuner is divided into eight bands (table 5-4). Variable inductor L1 is electrically positioned according to the selected frequency and the corresponding Tuner band at the start of each automatic tuning cycle. The procedure given herein is for individual adjustment of the positioning point of variable inductor L1 for each Tuner band.

5-39 All L1 position settings must be checked and readjusted as necessary whenever L1 Servo Amplifier Assembly 7A1A1A4 is replaced or repaired or whenever L1 Coil and Drive Assembly 9A1A2 is disassembled beyond the point of removing the complete assembly from the Tuner chassis. The position setting for an individual Tuner band must be re-established whenever a position potentiometer is replaced or its setting changed for mainten-

5-40 There is no test equipment required for these procedures.

5-41 All control, indicator, and connector references apply to the Tuner unless otherwise specified. To properly position the Tuner L1 coil, perform the following procedures:

- a. Depress Exciter AMPLIFIER OFF pushbutton.
- b. Loosen Tuner front panel captive screws, and slide out chassis.
- c. Remove top cover (15 screws).
- d. Loosen I. Box front panel captive screws, and slide out chassis.
- e. Remove top cover.
- f. Defeat interlock switch on top of Tuner chassis by pulling out plunger.
- g. Set Exciter CLASS OF EMISSION selector to SSB ( $\infty$ ), and turn all CHANNEL GAIN RATIO controls to zero.
- h. Depress Exciter STANDBY pushbutton. Using Exciter FREQUENCY KILO-CYCLES controls, select a frequency which is within band to be adjusted. (Refer to table 5-4 for band information.)

WARNING

Do not depress TUNE or OPERATE pushbutton. RF power might be activated, causing a shock hazard at the Tuner.

- i. Refer to table 5-4 and identify I. Box potentiometer corresponding to the frequency band to be adjusted. Loosen the locknut and set that potentiometer (figure 5-24) fully counterclock-

wise. Inductor L1 rotor will move to the end of the coil nearest front panel.

j. Refer to table 5-4 and adjust the appropriate potentiometer to set the L1 rotor contact point to the proper number of turns from the electrical end of the inductor (point at which strap from C1 is joined to inductor L1 with a screw). The position must be set within 1/4 turn at the lower frequencies, and within 1/8 turn in the 14-30 MCS range. After adjustment, tighten the locknut.

k. After the adjustment is made, the resetability must be checked. Momentarily change the Exciter 10,000 KC FREQUENCY KC selector to cycle the decoder-encoder assembly rotary solenoid, allowing sufficient time for it to move to another Tuner band and then reset back to the desired band. Check rotor position according to data in table 5-4; and if necessary, loosen locknut, reset potentiometer slightly, and tighten locknut. Repeat check, and reset again if necessary until proper resetability is established.

l. Repeat steps h. through k. for other bands to be adjusted.

m. Depress Exciter AMPLIFIER OFF pushbutton.

n. Reinstall covers and close up units.

5-42 TRANSMITTER GAIN CONTROL ADJUSTMENT. The TGC adjustment provides a method of setting the Exciter TGC circuit to provide proper operation with the TGC section of the TGC-PPC circuit in the particular 1 KW PA with which the Exciter is used. Circumstances which might require readjustment include using a different Exciter with a particular 1 KW PA, repair of the TGC circuit in the Exciter

TABLE 5-4. INDUCTOR L1 POSITION DATA

TUNER FREQUENCY BAND (MC)	I. BOX POTENTIO- METER DESIG. 7A1A4:	TYPICAL NO. TURNS OF L1 FROM FRONT PANEL END (WHERE SCREW JOINS C1 & L1)
2 - 2.5	R1	24* (28)
2.5 - 3.5	R2	17
3.5 - 5	R3	12
5 - 7	R4	8
7 - 10	R5	6
10 - 14	R6	4.5
14 - 20	R7	2.3
20 - 30	R8	1.3
		* Use 28 turns if unable to tune successfully with 24 turns.

or the TGC-PPC circuit in the 1 KW PA, repair or replacement of the Tuner VSWR bridge, or any other repairs which would affect the drive level applied to the 1 KW PA by the Exciter.

5-43 In addition to affecting the power level during tune-up, the TGC adjustment also affects the level of the final transmitter signal relative to the desired level at which PPC should take effect. Thus, if set too low, the peak envelope power of the transmitted signal after tune up will always be lower than the PPC level (1 KW). If set too high, PPC will be constantly working to reduce the signal - not just on peaks - and even lower than full audio input signals will drive the transmitter to the PPC level. The desired setting results in a safe tune power level (250 watts) and desired PPC action during transmission.

5-44 The following test equipment is required for these procedures:

- a. RF Dummy Load DA-242/U.

- b. Electronic Multimeter AN/USM-116.
- c. RF Cable Adapter UG-1447/USM-117.
- d. Non-inductive Alignment Tool, JFD #5284.

5-45 Perform the following procedures:

- a. Depress Exciter AMPLIFIER OFF push-button.
- b. Open rear cabinet door, and disconnect RF output cable from Tuner RF output connector 9A1J6.
- c. Connect RF Dummy Load DA-242/U through UG-1447/USM-117 to 9A1J6.
- d. Connect AN/USM-116, set to 300 VAC range, to UG-1447/USM-117.
- e. Loosen Exciter front panel captive screws and pull Exciter chassis out on slides.
- f. Turn Exciter internal power control to full counterclockwise.

g. Disconnect cables from RF out (J1) on rear of Exciter.

h. Connect a cable from Exciter output connector (J1) through a Tee connector to a 50 ohm load. Connect the Electronic Multimeter to the Tee connector to measure the Exciter output.

NOTE

If external RF field prevents the use of a voltmeter, a power meter may be used rather than a voltmeter. (HP431C with a 30 db pad).

i. Turn on power, depress STANDBY pushbutton when standby light comes on (3 minutes).

j. Depress OPERATE pushbutton.

k. Set Exciter for 29.9999 MC and depress the TUNE pushbutton.

l. Advance the power control in the Exciter to obtain 70 MW (1.86 VRMS) at the load.

m. Disconnect test equipment from the Exciter and reconnect the RF output cable to the Exciter (J1).

n. Check the 1 KW PA from panel PWR control to ensure it is at maximum clockwise.

o. Depress Exciter STANDBY pushbutton and allow for three-minute time delay; then depress operate pushbutton.

p. Set Exciter FREQUENCY KC selectors for 15,000.0 KC operation.

q. Set I. Box MANUAL TUNE POWER REQUEST switch to ON.

r. Depress Exciter TUNE pushbutton.

After tuning, tilt Exciter chassis up 90 degrees to expose underside.

s. Locate the TGC module in the right hand corner of the underside of the Exciter. Remove its cover and locate the A14A1R18 potentiometer (lower right hand corner of the module). Adjust the potentiometer for 112 volt indication on the AN/USM-116.

NOTE

If external RF prevents a reading on the USM-116, the power panel meter on the tuner may be monitored and set for an indication of 250W.

t. Depress Exciter AMPLIFIER OFF pushbutton.

u. Set I. Box MANUAL TUNE POWER REQUEST switch to OFF.

v. Replace TGC Module cover.

w. Tilt Exciter chassis back to horizontal, slide it into case, and secure.

x. Unless PPC must also be adjusted (paragraph 5-46), disconnect test equipment and reconnect RF cable to Tuner RF output connector 9A1J6.

5-46 PEAK POWER CONTROL ADJUSTMENT. The peak power control adjustment provides proper limiting levels for the peak power control function of the transmitter so the RF output is maintained at 1 KW and the equipment is protected from being overdriven.

5-47 The following test equipment is required for these procedures:

a. RF Dummy Load DA-242/U.

b. Electronic Multimeter AN/USM-116.

c. RF Cable Adapter UG-1447/USM-117.

d. AF Signal Generator SG-376/U.

5-48 Perform the following procedures:

**NOTE**

If external RF prevents indication on the USM-116, adjustments may be made by monitoring the power meter on the panel of the tuner.

a. Depress Exciter AMPLIFIER OFF pushbutton.

b. Open rear cabinet door, and disconnect RF output cable from Tuner RF output connector 9A1J6.

c. Connect RF Dummy Load DA-242/U through UG-1447/USM-117 to 9A1J6.

d. Connect AN/USM-116, set to 300 VAC range, to UG-1447/USM-117.

e. Connect SG-376/U to channel A1 input of Exciter. Set SG-376/U for minimum output at frequencies of 1000 and 1625 CPS.

**WARNING**

Lethal voltages as high as 1200 VRF, 2400 VDC, and 460 VAC are present within the 1 KW PA when the system is operating. Refer to NAVSHIPS 0967-000-0100 Electronics Installation and Maintenance Book High-Voltage Adjustment Procedures before proceeding.

f. Loosen 1 KW PA front panel captive screws, and slide out chassis. Check 1 KW PA front panel PWR control to ensure that it is at maximum clockwise.

g. Depress Exciter STANDBY pushbutton and allow for three-minute time delay; then depress OPERATE pushbutton.

h. Set Exciter SIDEBAND SELECTOR and CLASS OF EMISSION selector for USB, SSB  $\infty$ . Set FREQUENCY KC selectors for 15,000.0 KC operation.

i. Depress Exciter TUNE pushbutton and set I. Box MANUAL TUNE POWER REQUEST switch to ON. Note tune power level indication on AN/USM-116. It should be approximately 112 volts. If not, check TGC adjustment (paragraph 5-42). Return MANUAL TUNE POWER REQUEST switch to the OFF position.

j. Set Exciter CHANNEL GAIN RATIO control A1 to 100.

k. Loosen locknuts and set 1 KW PA Internal and External Power Set controls 1A1R12 and 1A1R11 (figure 5-10) to full clockwise.

l. Increase output levels of the two tones at the SG-376/U in equal amounts until the AN/USM-116 indicates a transmitter output of 250 VAC. (1250 watts.)

m. Slowly turn 1 KW PA Internal Power Set control 1A1R12 counterclockwise until the indication on the AN/USM-116 drops to 245 VAC (1200 watts output). Tighten locknut and recheck level.

n. Slowly turn 1 KW PA External Power Set control 1A1R11 clockwise until the indication drops to 225 VAC (1000 watts output). Tighten locknut and recheck level.

o. Change Exciter frequency and retune to 2.0000 MCS. After tuning, check PPC action for limiting at about 225 VAC (1000 watts) as signal generator audio levels are increased in equal amounts from below previous setting to the level resulting in

PPC limiting.

p. Repeat step o. at 29.9999 MCS and check for proper PPC action at that frequency.

NOTE

If PPC limiting does not occur at approximately the same power level at various frequencies, the Tuner (or 1 KW PA) VSWR Bridge should be checked for proper operation and alignment.

q. Depress Exciter STANDBY push-button, and allow one minute for cooling; then depress AMPLIFIER OFF pushbutton.

r. Slide 1 KW PA chassis into case, and secure.

s. Disconnect test equipment.

t. Reconnect RF cable to Tuner RF output connector 9A1J6 and close cabinet door.

5-49 REPAIRS.

5-50 The following paragraphs give the removal and replacement instructions necessary for maintenance of the 1 KW PA, 1 KW Power Supply, Tuner, Tuner Control, and I. Box. Note that any procedures which require test equipment usually available only at a depot or depot level maintenance personnel are given in Overhaul and Repair Manual NAVSHIPS 0967-292-9100.

5-51 PARTS REPLACEMENT.

5-52 POWER TRANSFORMERS 2A2T1, 2A2T2. If either 1 KW Power Supply Transformer 2A2T1 or 2A2T2 requires replacement, the complete transformer/case assembly must be replaced. Remove components from the old transformer/case assembly and install them on the new assembly.

5-53 1 KW PA PANEL-MOUNTED PARTS. Electrolytic capacitors 1A1C29, 1A1C30, and 1A1C31, along with drive chain and 1 KW PA front panel parts, are more easily accessible if the front panel is loosened. This panel is secured by three screws on each side and one center screw. To allow some movement of the panel, remove the top two screws on each side plus the center screw. Loosen, but do not remove bottom screw on each side; panel can now be tipped forward slightly to improve access to parts.

CAUTION

If all six panel screws are removed, panel will hang by interconnecting wires and chain; damage to these items may result.

5-54 1 KW PA FINAL TUBE SOCKET ACCESS. The brief procedure outlined here will aid in gaining access to tube socket assemblies of final amplifier tubes 1A1V1 and 1A1V2.

a. For repairs affecting tube sockets, remove tube 1A1V1/1A1V2 ( paragraph 5-60).

b. Remove driver tube assembly 1A1A1 (steps a. through f. of paragraph 5-61).

c. Remove driver transformer assembly 1A1A4 (paragraph 5-63).

d. Remove chassis bottom plate (9 screws).

e. Swing bottom plate out of way (wires need not be unsoldered).

f. Capacitors 1A1C59 and 1A1C60 may be removed if required to gain desired parts access.

5-55 PRINTED CIRCUIT BOARD HANDLING.

5-56 CIRCUIT BOARD EXTRACTORS. There are three printed circuit boards enclosed within assembly 7A1A1 of the I. Box. To extract any of these circuit boards, loosen two captive screws on left and right hand flanges, and swing assembly 7A1A1 up on its hinge to gain access to internal circuit boards. Use extractor levers provided on each circuit board to remove the board from its mounting. One additional printed circuit board attached to the top of the assembly is removable by removing two screws from and removing a holding block and then pulling the board out of its edge connector.

5-57 When using extractor levers to remove I. Box circuit boards (or TGC-PPC and DC Power Control circuit boards in 1 KW PA) use levers simultaneously and apply equal extracting force on both levers to prevent binding of circuit boards due to tilting. Binding may damage board or socket connections.

5-58 CIRCUIT BOARD PARTS REPLACEMENT. When working with printed circuit boards, special handling and repair procedures described in Electronic Installation and Maintenance Handbook, NAVSHIPS 0967-000-0160, should be used to avoid damage and facilitate parts replacement.

CAUTION

When working on the I. Box for the -83 and -84 Transmitters, several modules have the same name and designator and ARE NOTE interchangeable. Check all replacement assemblies by part number as well as name and reference designator. (Such as the 7A1A1A2 and 7A1A1A1 PCBs).

5-59 1 KW PA REPAIRS.

5-60 FINAL AMPLIFIER TUBES 1A1V1/1A1V2 REPLACEMENT. To replace either final amplifier tube in the 1 KW PA, proceed as follows:

- a. Turn off PRIMARY POWER circuit breaker on bottom panel.
- b. Loosen front panel captive screws and slide out chassis.
- c. Remove protective cover from over top of tubes at rear of chassis (10 screws, figure 5-11).

WARNING

Lethal RF and DC voltages exist at the various tube terminations and connection points. Before proceeding, check to ensure that the equipment is completely de-energized and secure at the source; then short all accessible terminals to chassis ground with the shorting stick at the top of the front panel. Refer to NAVSHIPS 0967-000-0000 Electronics Installation and Maintenance Book, High-Voltage Adjustment Procedures before continuing.

- d. Use shorting stick to short top terminal of tubes to ground.
- e. Carefully release tube clamp and lift clamp off tube.
- f. Without lifting, carefully rotate tube counterclockwise for approximately sixty degrees, until tube is free in socket. (Further tube 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 the tube and the socket contacts.

g. Lift tube straight up from socket and set it aside.

NOTE

Before replacing tube 1A1V1 or 1A1V2, 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.

h. To start tube installation, observe guide pin in hole in base of tube and orient tube so that guide pin mates with one of slots in center guide post in tube socket.

i. Gently lower tube over guide post and into socket until tube touches bottom.

j. Carefully rotate tube clockwise. Tube should rotate approximately sixty degrees, with moderate mechanical resistance as contacts mesh, until a hidden pin prevents further rotation.

k. Place tube clamp over tube end and lock. Check connecting braid at both ends for tightness.

l. Replace protective cover over tubes 1A1V1 and 1A1V2, and secure.

m. Move plugs 1A1P6 and 1A1P7 (screen voltage connectors for tubes 1A1V1 and 1A1V2), to jacks 1A1J8 and 1A1J9 (figure 5-10).

n. If tubes are being replaced after 1000 hours of operation, as indicated by PLATE elapsed time meter on I. Box, note time to determine when next replacement is due.

o. Refer to paragraph 5-8 and perform the complete screen voltage and control grid bias adjustment for tubes 1A1V1 and 1A1V2.

5-61 DRIVE AMPLIFIER TUBE 1A1A1V1/1A1A1V2 REPLACEMENT. To replace either driver amplifier tube of the 1 KW PA, proceed as follows:

a. Turn off PRIMARY POWER circuit breaker on bottom panel.

b. Loosen front panel captive screws and slide out chassis.

c. Tilt chassis to expose underside; lock.

WARNING

Lethal RF and DC voltages exist at the various tube terminations and connection points. Before proceeding, check to ensure that the equipment is completely de-energized and secured at the source; then short all accessible terminals to chassis ground with the shorting stick. Refer to NAVSHIPS 0967-000-0000 Electronics Installation and Maintenance Book, High-Voltage Adjustment procedures before continuing.

d. Remove shield from over terminal board 1A1A1TB1 on bottom of driver tube assembly (figure 5-12).

e. Remove wires from terminal board 1A1A1TB1.

CAUTION

When removing the driver tube assembly, avoid using excessive force to prevent damage to the spring contacts located between driver tube assembly 1A1A1 and driver transformer assembly 1A1A4.

f. Loosen two captive screws and carefully lift driver tube assembly out from chassis.

CAUTION

Be careful to avoid damage to nearby capacitors.

g. Release tube clamp on tube to be removed.

h. Place a blunt tool against base of tube through underside of socket and push tube out. Prepare to catch tube when it suddenly pops out, as these tubes fit very tightly in their sockets.

i. To start tube installation, orient tube to properly align pins, and plug into socket.

j. Engage tube clamp and lock.

CAUTION

While installing the driver tube assembly, observe that the spring contacts located between driver tube assembly 1A1A1 and driver transformer assembly 1A1A4 mate properly to avoid damage.

k. Carefully guide driver tube assembly into position on bottom of main chassis and secure. Ensure that edges of driver tube assembly mate properly with their slots in

main chassis.

l. Reconnect wires to terminal board 1A1A1TB1 and replace its shield.

m. Perform driver tube bias adjustment, paragraph 5-7.

5-62 FINAL TRANSFORMER ASSEMBLY REMOVAL AND REPLACEMENT. The following procedure allows removal and replacement of Final Transformer Assembly 1A1A2 for inspection, minor repairs, or replacement. Major repairs, such as switch or coil repair or replacement or switch coupling alignment, require special procedures which are done at depot level maintenance facilities, using Overhaul and Repair Manual, NAVSHIPS 0967-292-9100. After repair or when installing a replacement assembly, realignment must be performed with the assembly in the unit (paragraph 5-18).

a. Turn off PRIMARY POWER circuit breaker on bottom panel.

b. Loosen front panel screws and slide out chassis.

WARNING

Lethal DC voltages may remain due to charged filter capacitors. Before proceeding, check to be sure that equipment is completely de-energized. With final tube cover removed, short all accessible terminals to ground with the shorting stick. Refer to NAVSHIPS 0967-000-0000 Electronics Installation and Maintenance Book, High Voltage Adjustment Procedures, before continuing.

c. Remove protective cover from over top of final tubes at rear of chassis (10 screws, figure 5-11).

d. Use shorting stick to ground top terminal of tubes.

e. Disconnect 1A1A2P1 at VSWR bridge (figure 5-10), and unscrew and free cable clamp at bottom of left side plate adjacent to VSWR bridge.

f. Disconnect lead from final tube compartment at terminal on contact block at the front of the compartment. (E21).

g. Insert long screwdriver through each of four clearance holes; and after carefully engaging screwdriver in slot of captive screw (not caught on adjacent components), loosen each screw.

h. Loosen pan head screws (2) holding left and right hand "L" brackets.

i. Bend stiff wire to fabricate a pulling tool with hooks to insert into two opposite screwdriver clearance holes. Lift assembly straight out while freeing coaxial cable grommet on left side partition.

j. To reinstall assembly, orient as shown in figure 5-11, carefully lower into compartment, and engage locating pins.

k. Reverse steps i. through c. to secure and reconnect assembly. The two "L" brackets on each side (step h.) should be positioned with one inside and one outside the side partitions as shown in figure 5-11. Tighten screws with brackets snug against partition.

l. Refer to paragraph 5-18 if realignment is necessary. Otherwise slide chassis into case and secure.

m. Activate the set to standby, and rotate 1 KW PA FREQUENCY MEGA-CYCLES selector several times. Then set selector back to AUTOMATIC.

#### NOTE

Coupling pin on Transformer Assembly will engage coupling on Transmission Assembly during first full rotation of band-switch motor.

5-63 DRIVER TRANSFORMER ASSEMBLY REMOVAL AND REPLACEMENT. The following procedure allows removal and replacement of Driver Transformer Assembly 1A1A4 for inspection, minor repairs, or replacement. Major repairs, such as switch or coil replacement or switch coupling alignment, require special procedures which are done at depot level maintenance facilities, using Overhaul and Repair Manual NAVSHIPS 0967-292-9100. After repair or when installing a replacement assembly, re-alignment must be performed with the assembly in the unit (paragraph 5-18).

a. Turn off PRIMARY POWER circuit breaker on bottom panel.

b. Loosen front panel screws and slide out chassis. Tilt chassis up 90 degrees to expose underside.

#### WARNING

Lethal DC voltages may remain due to charged filter capacitors. Before proceeding, check to be sure that equipment is completely de-energized. Refer to NAVSHIPS 0967-000-0000 Electronics Installation and Maintenance Book, Voltage Adjustment Procedures before proceeding.

c. Disconnect six wires from terminal board 1A1A4TB1 on the bottom of the assembly.

d. Loosen two captive screws and carefully remove assembly.

CAUTION

Avoid using excessive force to prevent damaging contact fingers on the side of the assembly.

e. To reinstall assembly, orient it with the terminal board toward the rear of the chassis, and carefully set it in the chassis. As it slides into position, engage two locating pins on the transmission assembly. Avoid excessive force to protect contact fingers.

f. Secure assembly with the two captive screws.

g. Reconnect wires to terminal board 1A1A4TB1 according to tags previously attached.

h. Refer to paragraph 5-18 if realignment is necessary. Otherwise tilt chassis back to horizontal, slide in case, and secure.

i. Activate the set to standby, and rotate 1 KW PA FREQUENCY MEGACYCLES selector several times. Then set the selector back to AUTOMATIC.

## NOTE

Coupling pin on Transformer Assembly will engage coupling on Transmission Assembly during first full rotation of band-switch motor.

5-64 DRIVE CHAIN REPLACEMENT. To replace the drive chain of the 1 KW PA frequency-select mechanism, proceed as follows. (All control, indicator, and connector references apply to 1 KW PA unless otherwise specified.)

a. Turn off PRIMARY POWER circuit breaker on bottom panel.

WARNING

Lethal RF and DC voltages exist at the various tube terminations and connection points. Before proceeding, check to ensure that the equipment is completely de-energized and secured at the source; then short all accessible terminals to chassis ground. Refer to NAVSHIPS 0967-000-0000 Electronics Installation and Maintenance Book, High-Voltage Adjustment Procedures before proceeding.

b. Loosen front panel captive screws and slide out chassis.

c. Tilt chassis to expose underside; lock.

d. Loosen (but do not remove) two phillips-head screws which secure drive chain bracket to chassis (figure 5-12).

e. Return chassis to horizontal position; lock.

f. Loosen front panel assembly by removing center screw and two screws on each side at top. Bottom screws on each side should be loosened but not removed. Front panel can now be tipped forward slightly to aid in chain removal/replacement.

g. Remove damaged chain.

h. Loosen two allen-head set screws on FREQUENCY MEGACYCLES dial sprocket directly behind front panel (figure 5-11) so that sprocket rotates freely on shaft.

CAUTION

When tilting chassis up or down during chain installation, move the chassis slowly and with care to avoid damaging the loosely secured front panel.

i. Thread new chain around motor drive sprocket on motor 1A1B2, over sprockets on drive chain bracket, and around chain sprocket on FREQUENCY MEGACYCLES dial. Arrange chain so that ends meet for connection just behind drive chain bracket, underneath chassis (tilt and lock chassis as necessary).

CAUTION

Excessive pressure when connecting the chain ends will crush the chain.

j. Connect two ends of chain by inserting connecting link into split sphere and gently closing sphere around line with a small pair of pliers.

k. Tip front panel back into position and secure with screws loosened and removed in step f.

l. Ensure that drive chain is properly engaged in all sprockets, then use a screwdriver to push drive chain bracket toward front panel to take up slack in chain. Apply light tension to hold bracket in place while tightening two phillips-head screws which secure bracket.

m. Check chain tension. Chain should have just enough tension to eliminate slack.

CAUTION

Excessive tension on the drive chain will cause excessive wear.

n. Lock chassis in horizontal position.

o. Manually rotate dial behind FREQUENCY MEGACYCLES window until one set screw is accessible.

p. Defeat two interlock switches on 1 KW PA by pulling plungers straight out.

q. Turn on PRIMARY POWER circuit breaker on bottom panel.

r. Depress Exciter STANDBY pushbutton.

s. Set 1 KW PA FREQUENCY MEGACYCLES selector to frequency band indicated in center of FREQUENCY MEGACYCLES window. The 1 KW PA will automatically tune.

t. Depress Exciter AMPLIFIER OFF pushbutton.

u. Carefully rotate dial behind FREQUENCY MEGACYCLES window, until numbers corresponding to setting of FREQUENCY MEGACYCLES selector are located in center of window.

v. Tighten allen-head set screw which is accessible on dial behind FREQUENCY MEGACYCLES window.

w. Depress Exciter STANDBY pushbutton.

x. Set FREQUENCY MEGACYCLES selector in each position except AUTOMATIC. For each position, observe that numbers corresponding to selector setting are centered in window. Note amount of adjustment in dial setting required to center them perfectly.

y. Reset FREQUENCY MEGACYCLES selector to position which makes the

dial set screw accessible.

z. Depress Exciter AMPLIFIER OFF pushbutton.

aa. Loosen dial set screw, make necessary compensating adjustment in dial position, and retighten set screw.

ab. Repeat steps w. through aa. until dial position is satisfactory.

ac. Depress Exciter STANDBY pushbutton.

ad. Observe set screws on rear of dial and set FREQUENCY MEGACYCLES selector to different positions until second set screw is accessible.

ae. Depress Exciter AMPLIFIER OFF pushbutton.

af. Tighten remaining set screw on dial behind FREQUENCY MEGACYCLES window.

ag. Set FREQUENCY MEGACYCLES selector to AUTOMATIC.

ah. Slide 1 KW PA chassis into cabinet and secure.

#### 5-65 TUNER REPAIRS.

5-66 REMOVAL OF L2 COIL AND DRIVE ASSEMBLY 9A1A4. All control, indicator, and connector references apply to Tuner unless otherwise specified. To remove the L2 coil and drive assembly, proceed as follows:

a. Turn off PRIMARY POWER circuit breaker on bottom panel.

b. Remove Tuner front panel screws and slide out chassis.

c. Remove top cover (15 screws).

d. Tilt chassis to expose underside; lock.

e. Remove bottom cover (19 screws).

f. Remove two mounting screws each from coax relays 9A1K1 and 9A1K2, and remove rigid coupling 9A1CP3 to free relays. Swing relays aside to allow removal of peak/average detector assembly.

g. Remove front panel knobs, control nuts, and lockwashers from PEAK/AVG selector and meter range selector and unplug 9A1P1 (figure 5-31) to allow removal of peak/average detector assembly.

h. Tilt chassis back to horizontal.

i. Unplug 9A1A4P4 (figure 5-30).

j. Remove screw and nut (item 1, figure 5-30) which attaches output strap to left bottom support on inductor L2, and free the strap.

k. Remove screw (item 2, figure 5-30) from right side of C1, and free strap to L2.

l. With chassis level, remove 5 screws (item 1, figure 5-31); and lift L2 coil and drive assembly 9A1A4 out of the chassis.

5-67 REMOVAL OF L1 COIL AND DRIVE ASSEMBLY 9A1A2. All control, indicator, and connector references apply to Tuner unless otherwise specified. To remove L1 coil and drive assembly, proceed as follows:

a. Turn off PRIMARY POWER circuit breaker on bottom panel.

b. Remove Tuner front panel screws and slide out chassis.

c. Remove top cover (15 screws).

- d. Tilt chassis to expose underside; lock.
- e. Remove bottom cover (19 screws).
- f. Unsolder L1 coil strap (item 3, figure 5-31) from Discriminator terminal 9A1A1TP1, and straighten strap to allow removal through chassis hole.
- g. Remove two mounting screws each from coax relays 9A1K1 and 9A1K2, and remove rigid coupling 9A1CP3 to free relays. Swing relays aside to allow removal of peak/average detector assembly.
- h. Remove front panel knobs, control nuts, and lockwashers from PEAK/AVG selector and meter range selector; and unplug 9A1P1 (figure 5-31) to allow removal of peak/average detector assembly.
- i. Tilt chassis back to horizontal.
- j. Unplug 9A1A2P4 (figure 5-30).
- k. Remove screw (item 3, figure 5-30) which attaches L1 coil strap at left side of C1, and free strap.
- l. With chassis level, remove 5 screws (item 2, figure 5-31); lift L1 coil and drive assembly 9A1A2 out of the chassis.
- b. Set Exciter frequency to 29.0000 MCS.
- c. Turn off PRIMARY POWER circuit breaker on bottom panel.
- d. Remove L1, L2, or C1 drive assembly per appropriate instruction paragraph 5-66, 5-67 or 5-68. (Do not disengage coil from L1 or L2 drive assembly).
- e. Tag and unsolder wires connected to each terminal of position potentiometer (figure 5-30).

NOTE

Before proceeding, note orientation of bracket, potentiometer indexing tab, and potentiometer to prevent installation in position which is 180 degrees rotated from original position. It is not necessary to remove pin from end stop switch lever arm.

- f. Remove screws securing potentiometer mounting bracket. Pull bracket straight away from gear drive housing to disengage potentiometer shaft.
- g. Remove potentiometer from bracket.

CAUTION

Damage to gear drive assembly will result if potentiometer shaft is incorrectly oriented.

5-68 ELEMENT POSITION POTENTIOMETER REPLACEMENT. Element position potentiometer R1, on L1 and L2 coil drive assemblies and on C1 capacitor drive assembly, is replaced as follows. (All control, indicator, and connector references apply to Tuner unless otherwise specified.)

- a. With Tuner Control mode selector at AUTOMATIC, turn Tuner Control POWER circuit breaker off and on and allow C1 and L2 elements time to home.
- h. Mount and secure new potentiometer on bracket. Check that indexing tab is in correct hole in bracket.

i. Rotate potentiometer shaft to its maximum position as viewed from shaft end; fully clockwise for potentiometer on either coil gear drive assembly or fully counterclockwise for potentiometer on capacitor gear drive assembly.

j. Place potentiometer mounting bracket on gear drive housing, rotating potentiometer shaft slightly as necessary to align slot in shaft with pin in end-stop switch lever arm.

k. Secure potentiometer mounting bracket with mounting screws.

NOTE

Do not perform steps l. through p. for C1 drive assembly.

l. Resolder wires removed in step e.

m. Loosen screws securing servo motor retaining bracket.

n. Slide servo motor away from gear drive assembly to disengage gears.

o. Rotate gear drive assembly by hand from one end of its range to the other to verify smooth operation.

p. Replace servo motor and secure mounting bracket.

q. Replace drive assembly by performing steps in appropriate paragraphs 5-66, 5-67 or 5-70 in reverse order. For C1 drive assembly, perform alignment in paragraph 5-72, steps b. through i.

r. For L1 drive assembly, perform alignment in paragraph 5-38.

5-69 SERVO MOTOR REPLACEMENT.  
To replace servo motors on L1, L2, or C1 drive assemblies, first remove the

drive assembly according to appropriate instruction paragraph, 5-66, 5-67 or 5-70. With the drive assembly removed, motor replacement is accomplished as follows.

a. Tag and unsolder servo motor leads (red and black) and brake leads (yellow).

b. Loosen four screws on servo motor clamp and remove motor.

NOTE

For C1 drive assembly, be careful not to move gears to avoid having to reset end stop (paragraph 5-72).

c. Slide motor out to the rear.

d. Position new servo motor on drive assembly with gears properly meshed.

e. Tighten servo motor clamp.

f. Solder servo motor leads to terminals, using tags on removed motor as guide.

g. Replace drive assembly by reversing procedure in appropriate paragraphs, 5-66, 5-67 or 5-70.

5-70 VARIABLE CAPACITOR AND DRIVE REPLACEMENT.

5-71 REMOVAL OF C1 DRIVE ASSEMBLY 9A1A6. All control, indicator and connector references apply to Tuner unless otherwise specified. To remove the C1 drive assembly, proceed as follows:

a. With Tuner Control mode selector at AUTOMATIC and frequency set above 10 MCS, turn Tuner Control POWER circuit breaker off and on and allow time for homing of C1.

b. Turn off PRIMARY POWER circuit breaker on bottom panel.

c. Remove Tuner front panel screws and slide out chassis.

d. Remove top cover (15 screws).

e. Loosen one pair of set screws on drive shaft coupling.

f. Disengage connector plug 9A1A6P3 (figure 5-30).

g. Remove three drive assembly mounting screws (item 4, figure 5-30).

h. Drive assembly can now be disengaged from C1 drive coupling and carefully lifted away from Tuner chassis.

NOTE

Be careful not to disturb drive assembly gears to that preset position is maintained.

5-72 C1 CAPACITOR REPLACEMENT.

The removal of capacitor C1 is an obvious procedure, but correct installation of a new C1 depends on presetting the capacitor elements to their home condition as follows.

a. Perform steps a. through d. of paragraph 5-71.

b. Turn shaft on new capacitor C1 clockwise until lead screw begins to get tight.

c. Turn lead screw counterclockwise one-half turn.

d. Position front and rear mounting flanges on capacitor, and engage lead screw in coupling carefully so that capacitor lead screw setting obtained in step c. and drive assembly position from step a. are not disturbed.

e. Continue with installation, making

sure that capacitor lead screw is properly installed in the coupling before tightening coupling screws.

f. Tighten coupling screws, and check connection hardware (items 2 and 3, figure 5-30) for tightness. Also check for tightness on inductor end of connection straps.

g. Loosen screws securing servo motor retaining bracket.

h. Slide servo motor away from gear drive assembly to disengage gears.

i. Rotate gear drive assembly by hand from one end of its range to the other to ensure smooth operation and proper end-stop protection.

j. Replace servo motor and secure mounting bracket.

5-73 VARIABLE COIL AND VARIABLE COIL ROTOR REPLACEMENT.

5-74 VARIABLE COIL REPLACEMENTS.

The following procedure applies to the replacement of variable coil assemblies 9A1A2L1 and 9A1A4L2.

a. Set Exciter frequency to 29 MCS.

b. With Tuner Control mode selector at AUTOMATIC, turn Tuner Control POWER circuit breaker off and on and allow elements time to home.

c. Turn off PRIMARY POWER circuit breaker on bottom panel.

d. Remove coil and drive assembly per appropriate instruction paragraph 5-65 or 5-66.

e. Tag and unsolder any leads connecting to coil from drive assembly.

f. Loosen pair of set screws on (upper) drive shaft coupling and pair of set screws on (lower) shorting shaft coupling. Be careful not to disturb position of drive assembly, as it is indexed as required for realignment of the coil.

g. Loosen the six countersunk screws in the base (underneath) that secure the coil frame to the base. Keep the coil assembly in its installed position while these screws are removed, so that no strain is placed on the drive couplings.

h. Slide the coil assembly directly away from the drive assembly to disengage drive couplings.

i. Lift coil assembly away from base.

j. When reinstalling coil assembly, preset as follows to ensure proper alignment with the drive assembly before tightening couplings.

NOTE

For 9A1A4L2, preset rotor to electrical home position, with rotor contacting directly at the location of the output connection strap (located about one turn from non-driven end, i.e., end away from drive assembly). For 9A1A2L1, preset 1.5 turns toward the center from the electrical home position described for 9A1A4L2.

k. Complete the reinstallation by reversing steps h. through d. above.

l. Loosen screws securing servo motor mounting bracket.

m. Slide servo motor away from gear drive assembly to disengage gears.

n. Rotate the drive assembly manually from one end stop to the other to ensure smooth operation and proper end stop protection.

o. Replace servo motor and secure mounting bracket.

p. In the case of the 9A1A2L1 coil, re-alignment (per paragraph 5-40) is necessary.

5-74 VARIABLE COIL ROTOR REPLACEMENT. To replace the variable coil rotor, proceed as follows:

a. With Tuner Control mode selector at AUTOMATIC, turn Tuner Control POWER circuit breaker off and on and allow elements time to home.

b. Turn off PRIMARY POWER circuit breaker on bottom panel.

c. Remove coil assembly per appropriate instruction paragraph, 5-65 or 5-66.

d. Before proceeding with disassembly, mark position of rotor within coil and also on drive shaft to established exact replacement location.

e. Remove four assembly bolts attaching coil bar-supports to end support on non-drive end of coil assembly.

f. Carefully remove two countersunk screws in base (underneath) which secure end support that is being removed. Remove end support, carefully noting sequence of washers on shaft when removing them.

g. Note rotor orientation within coil and mark the number "1" on the rotor arm that has the coil-riding contacts. Also mark a "1" on the drive shaft flat which corresponds to this arm location. Mark the next rotor arm (proceeding clockwise, looking

into open end of coil) with a number "2" and remaining clockwise rotor arm with a number "3". Remove rotor from coil assembly.

h. On the new rotor, duplicate the 1, 2, 3 number markings on the similar rotor arms (viewed from same slide as old rotor).

i. Place new rotor on shaft with arm numbered "1" corresponding to drive shaft flat marked "1".

j. Start threading new rotor into open end of coil with arm numbered "3" entering coil first and arm "1", which is arm with coil-riding contacts, last.

k. Thread rotor into coil to the marked (step d.) location from which old rotor was removed.

l. Place washers on end of drive shaft. Set end support in place and replace countersunk base screws but do not fully tighten.

m. Replace four assembly bolts to attach coil bar-supports to end support. Use flat washers next to plastic materials and lock washers between flat washer and bolt head or nut. Tighten bolts and base screws.

n. Replace drive assembly by performing steps in appropriate paragraph, 5-65 or 5-66 in reverse order.

o. Remove screws securing servo motor retaining bracket.

p. Slide servo motor away from gear drive assembly to disengage gears.

q. Rotate gear drive assembly by hand from one end stop to the other to ensure smooth operation and proper end stop protection.

r. Replace servo motor and secure mounting bracket.

s. In the case of the 9A1A2L1 coil, realignment (per paragraph 5-40) is necessary.

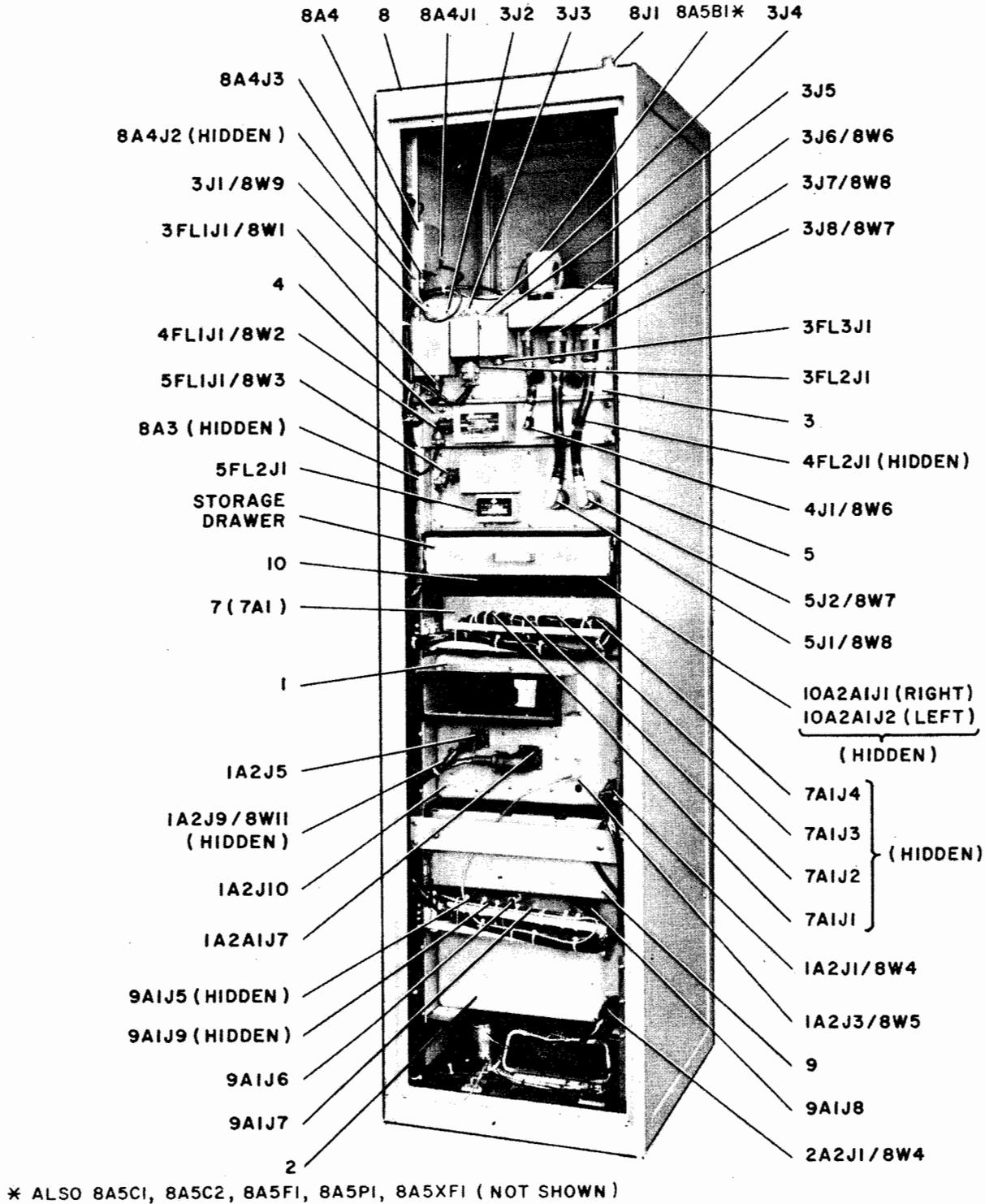


Figure 5-7. Local Equipment Cabinet, Component Locations

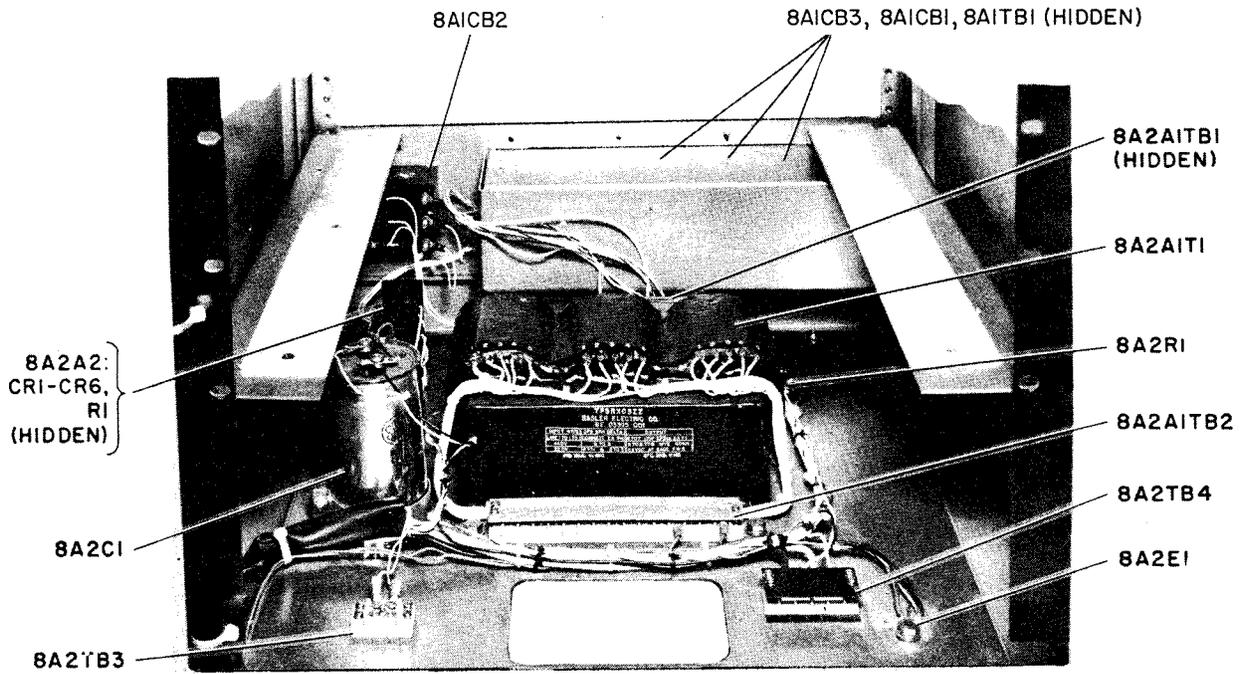


Figure 5-8. Bottom Plate Assembly 8A2 and Circuit Breaker Panel Assembly 8A1, Component Locations.

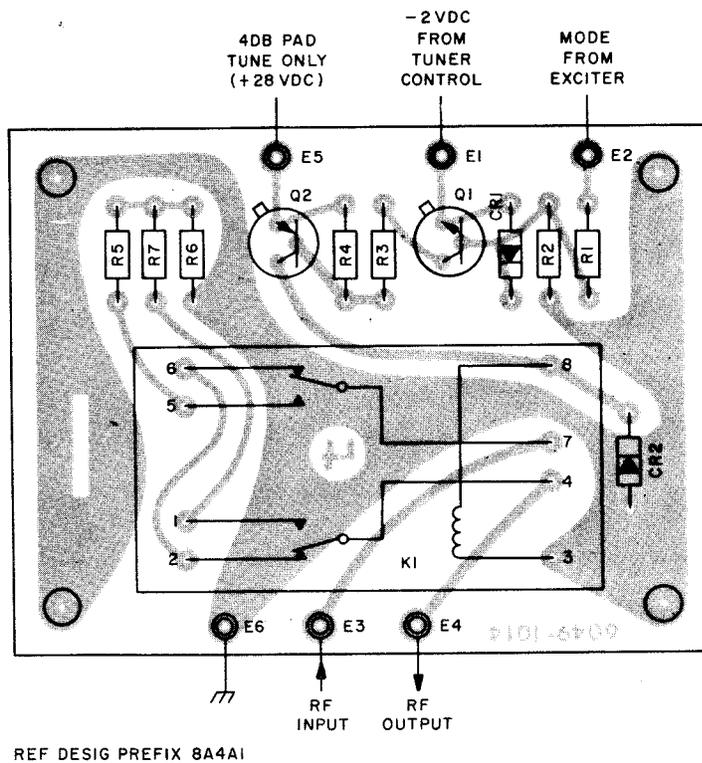
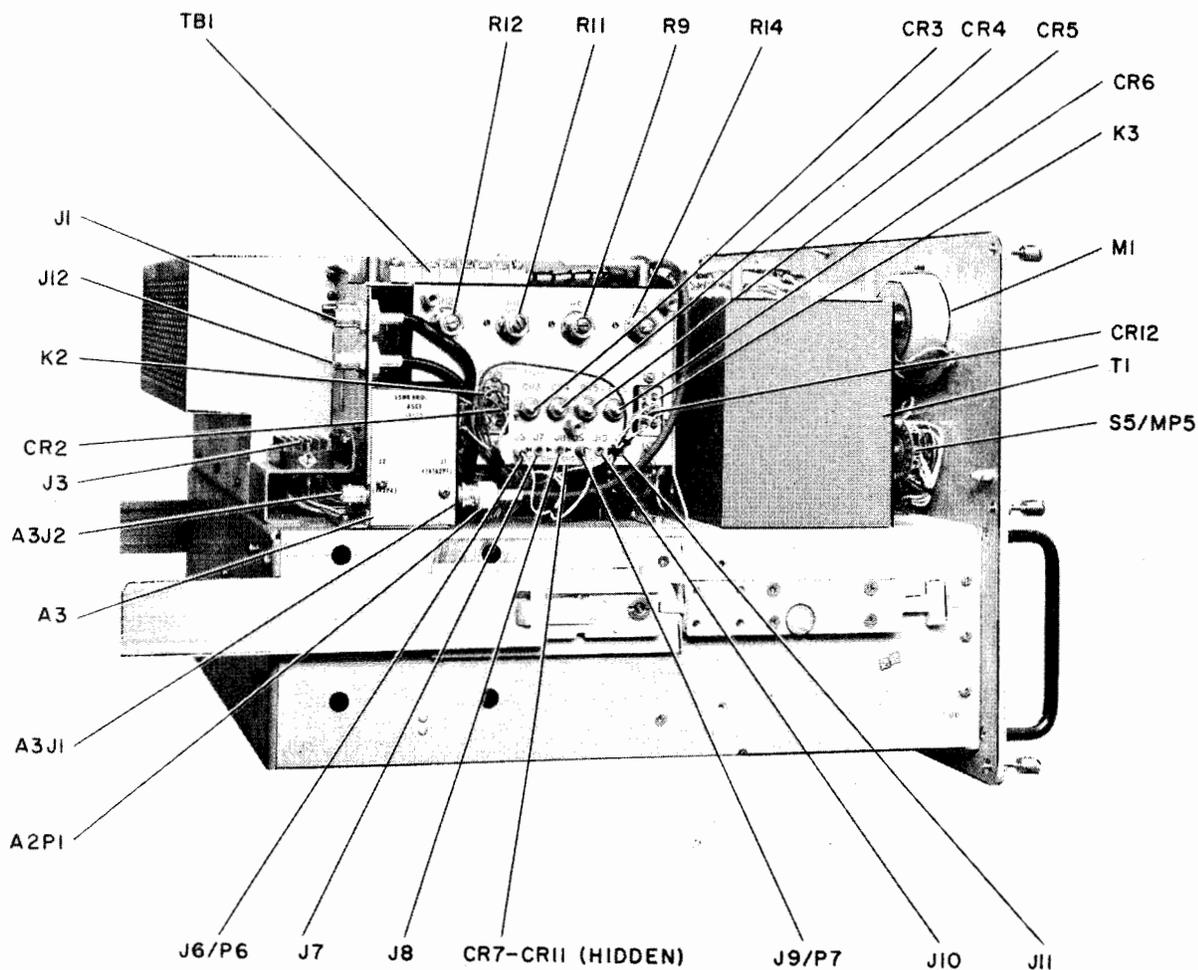
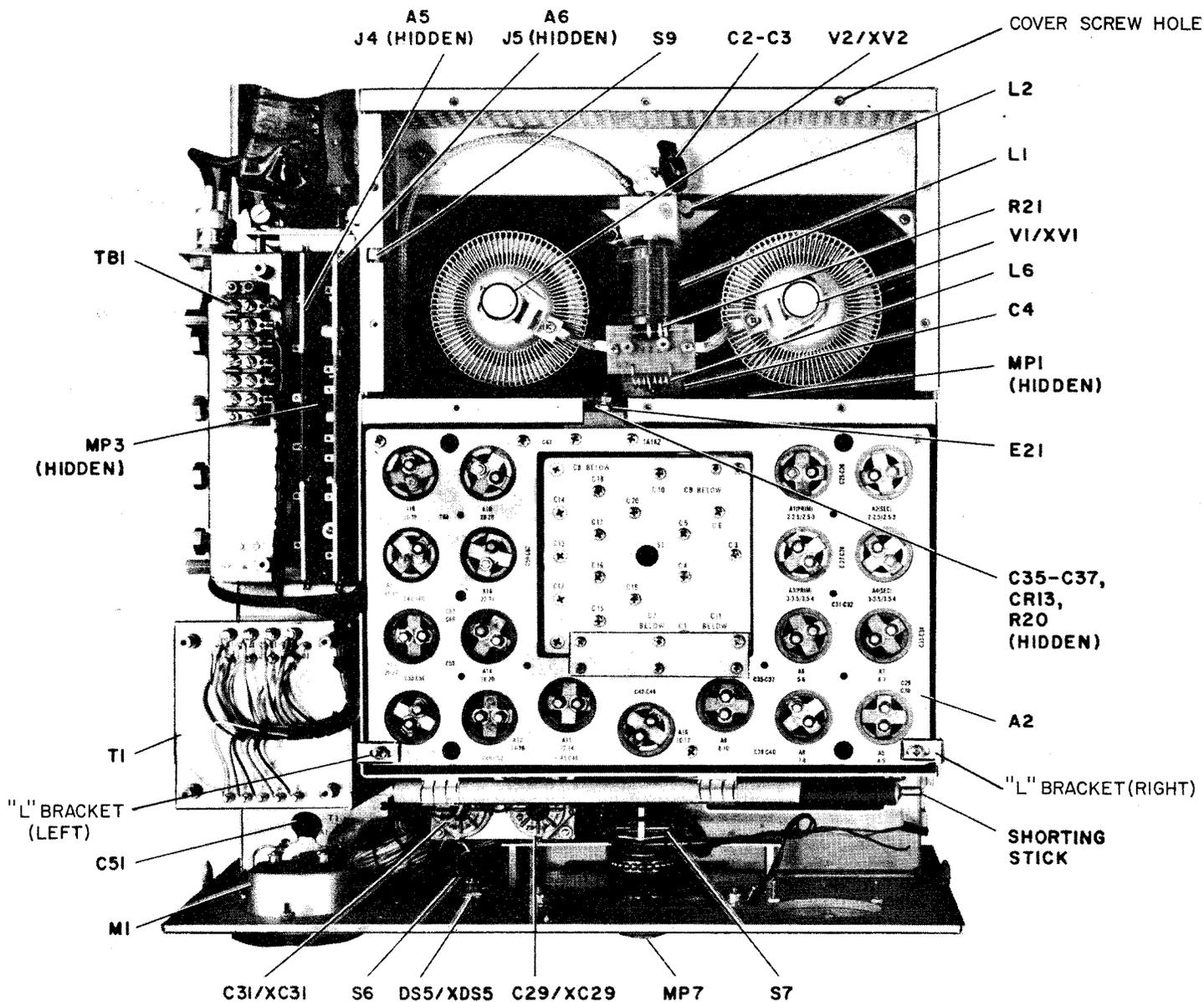


Figure 5-9. Attenuator PCB Assembly 8A4A1, Component Location From Foil Side.



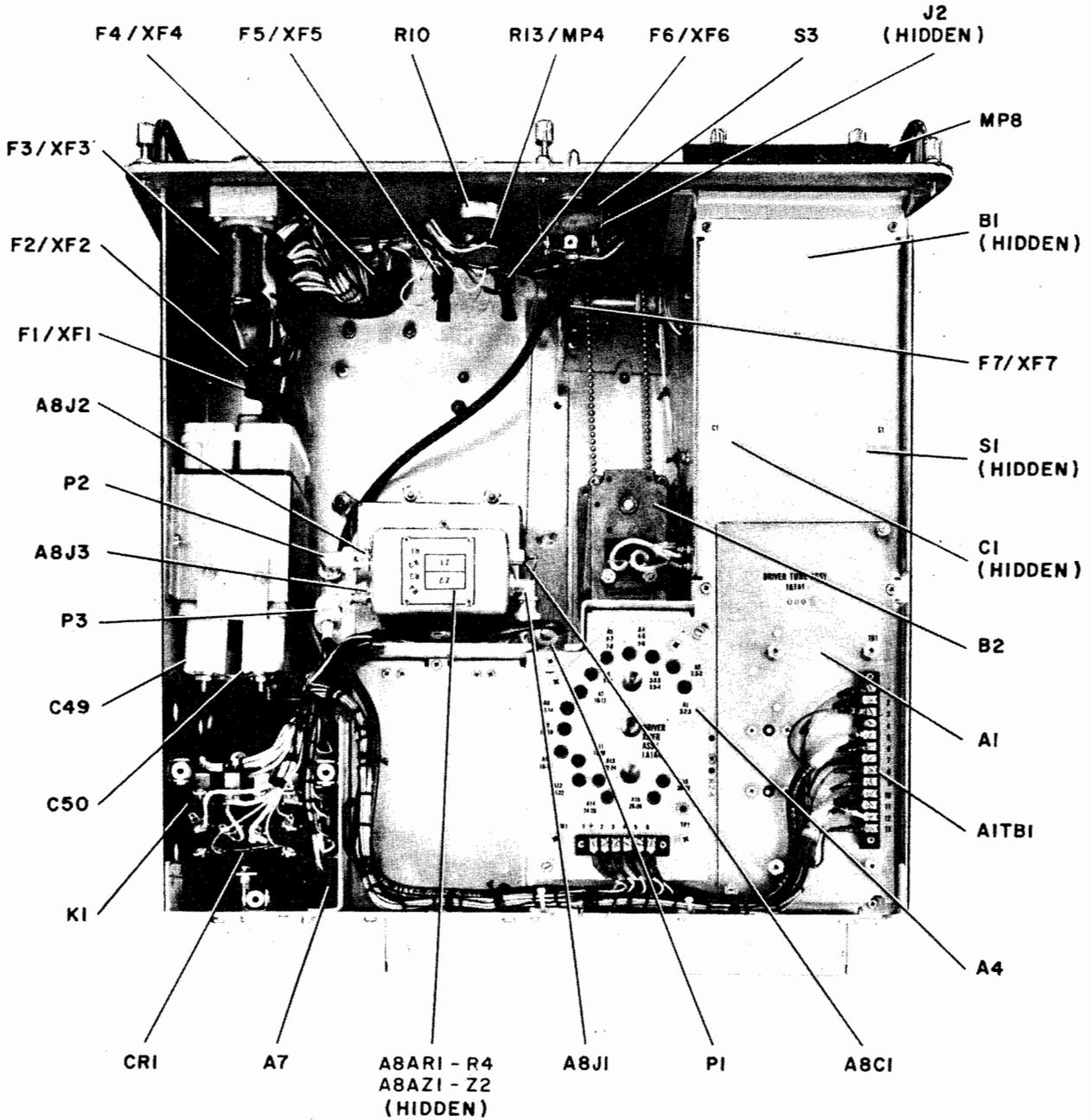
REF DESIG PREFIX 1A1

Figure 5-10. 1 KW PA 1A1, Left Side, Component Locations.



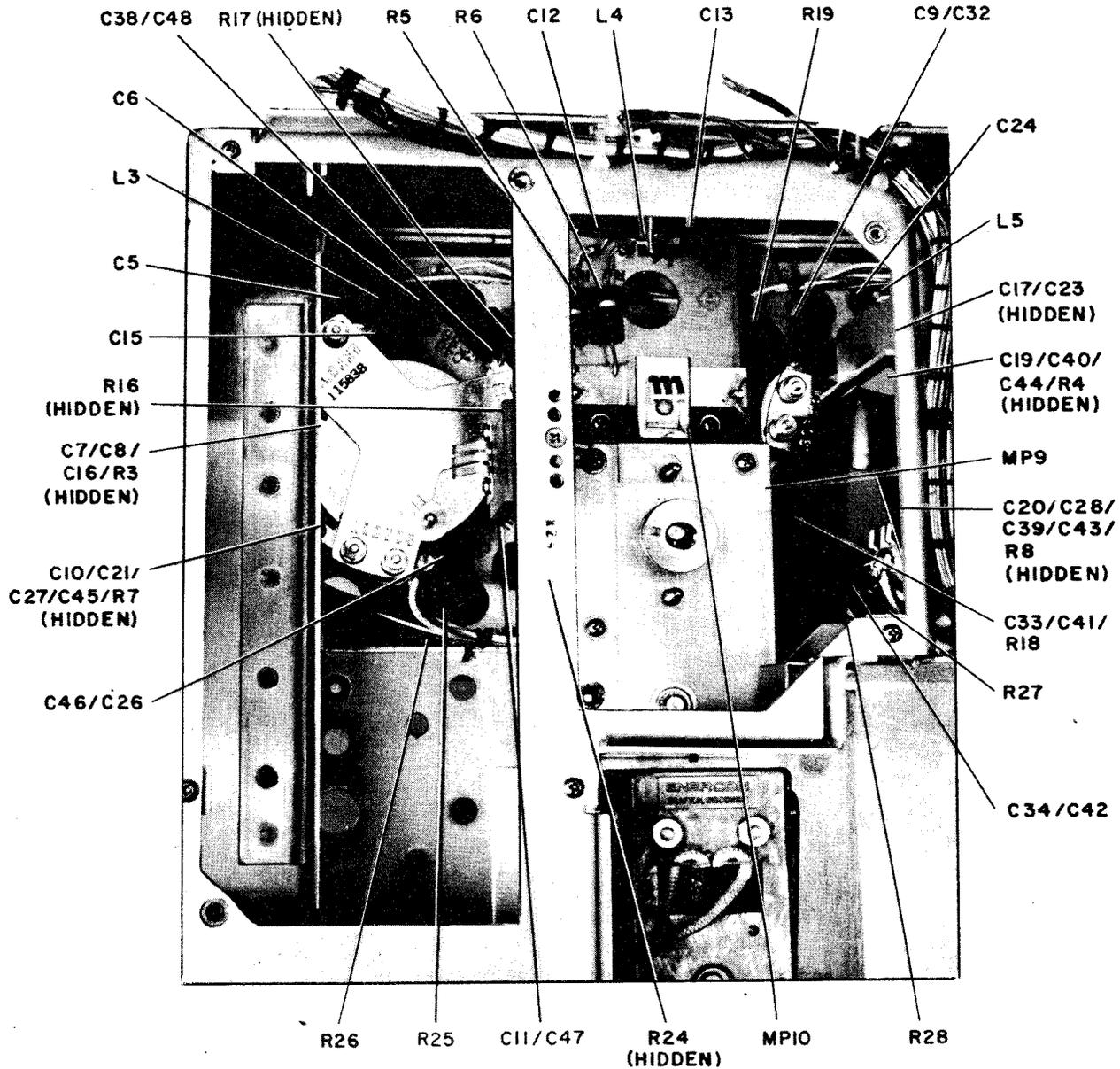
REF DESIG PREFIX 1A1 (PROTECTIVE COVERS REMOVED)

Figure 5-11. 1 KW PA 1A1, Top View, Component Locations.



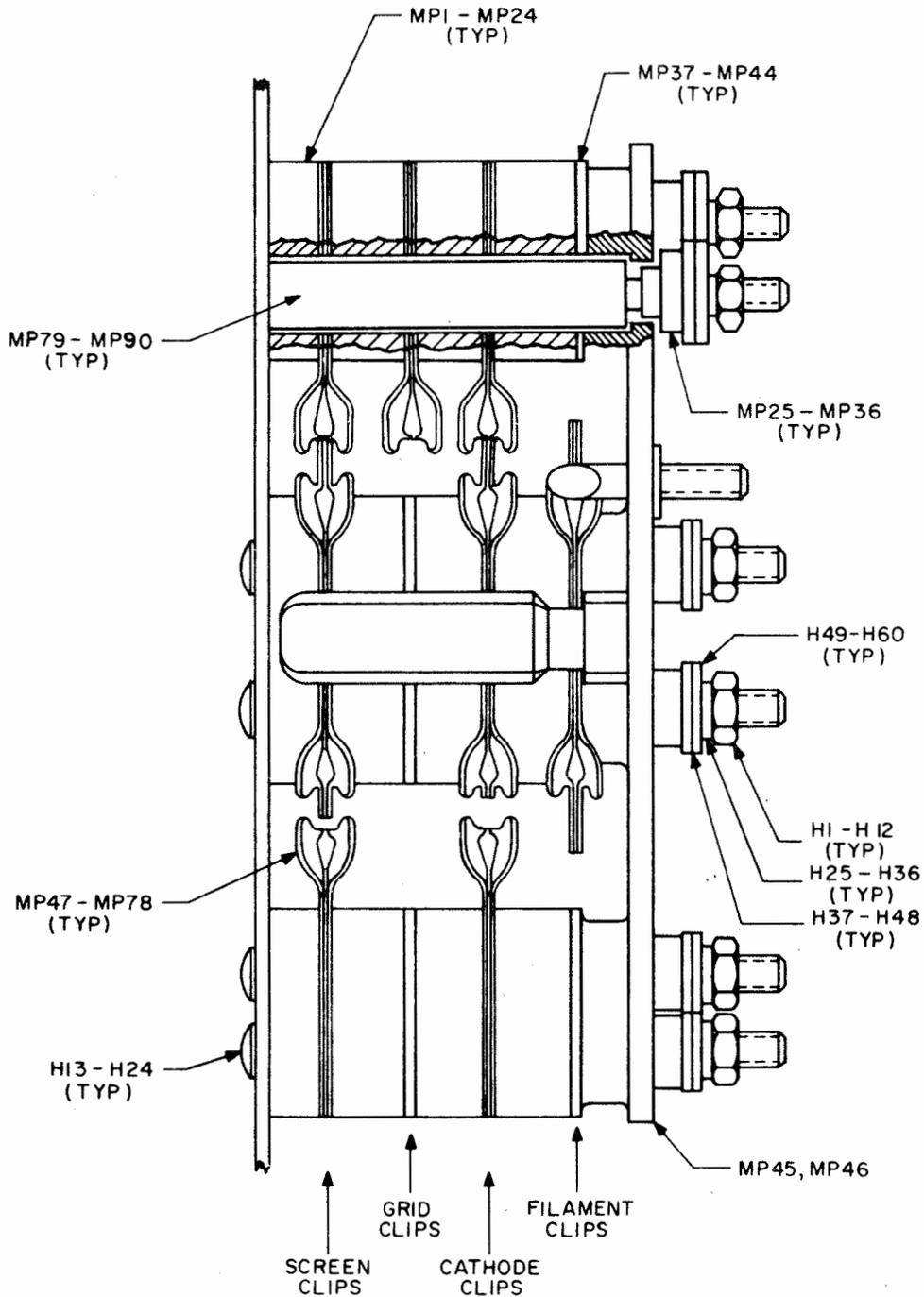
REF DESIG PREFIX 1A1

Figure 5-12. 1 KW PA 1A1, Bottom View, Component Locations.



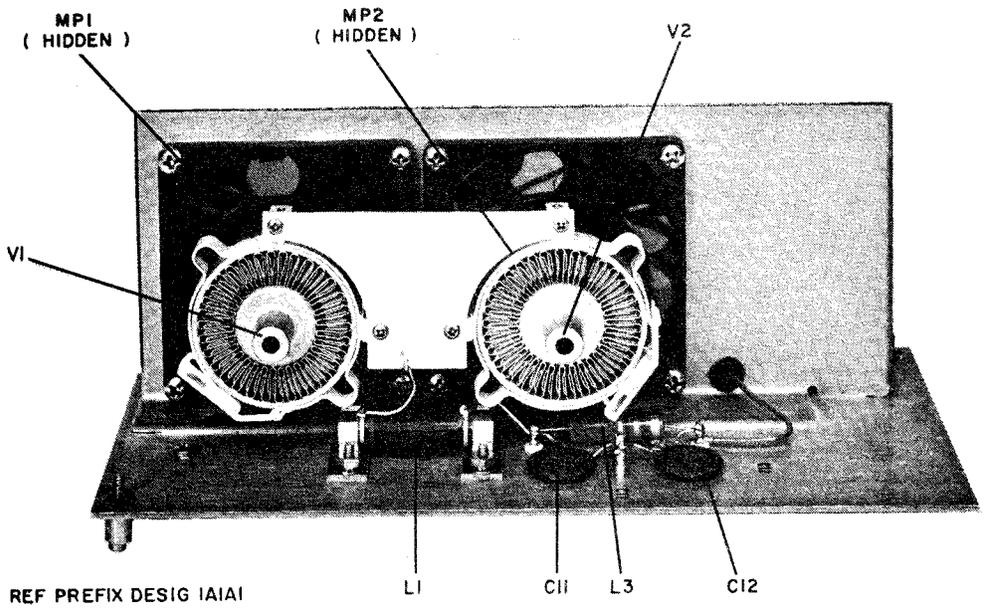
REF DESIG PREFIX 1A1

Figure 5-13. 1 KW PA, Bottom View with 1A1A1 Driver Tube Assy and 1A1A4 Driver Transformer Assembly Removed, Component Locations



NOTE:  
 AS SHOWN ABOVE, THE VIEW IS FROM THE REAR, AS IF LOOKING THRU THE REAR WALL OF THE CHASSIS.  
 XVI IS SHOWN, XV2 IS IDENTICAL, EXCEPT IT IS A MIRROR IMAGE

Figure 5-14. 1 KW PA, Final Amplifier Tube Socket Assembly, Component Locations



REF PREFIX DESIG 1A1A1

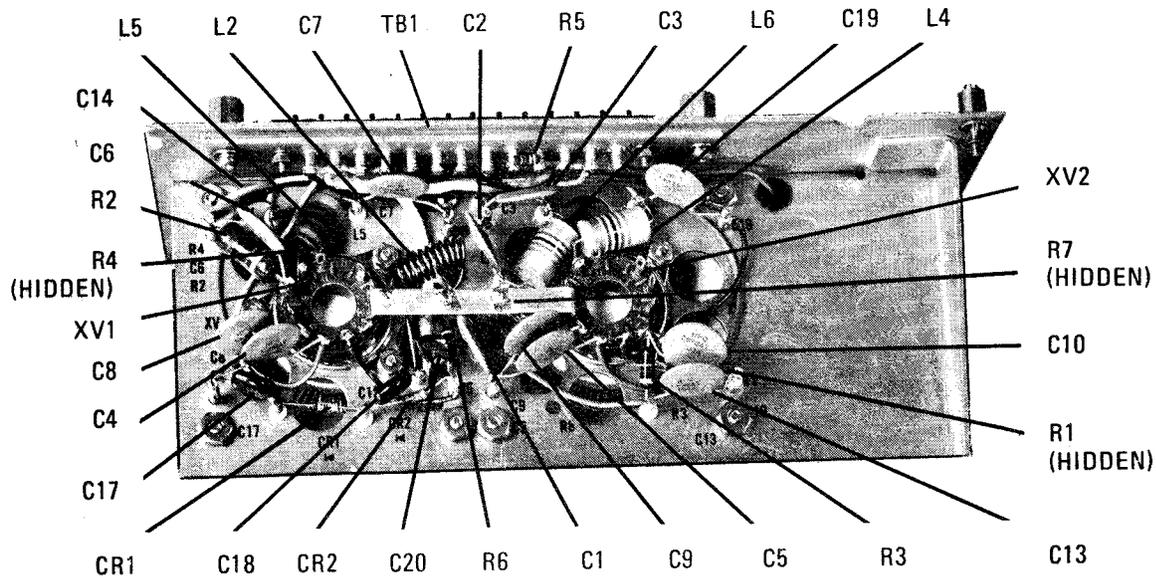
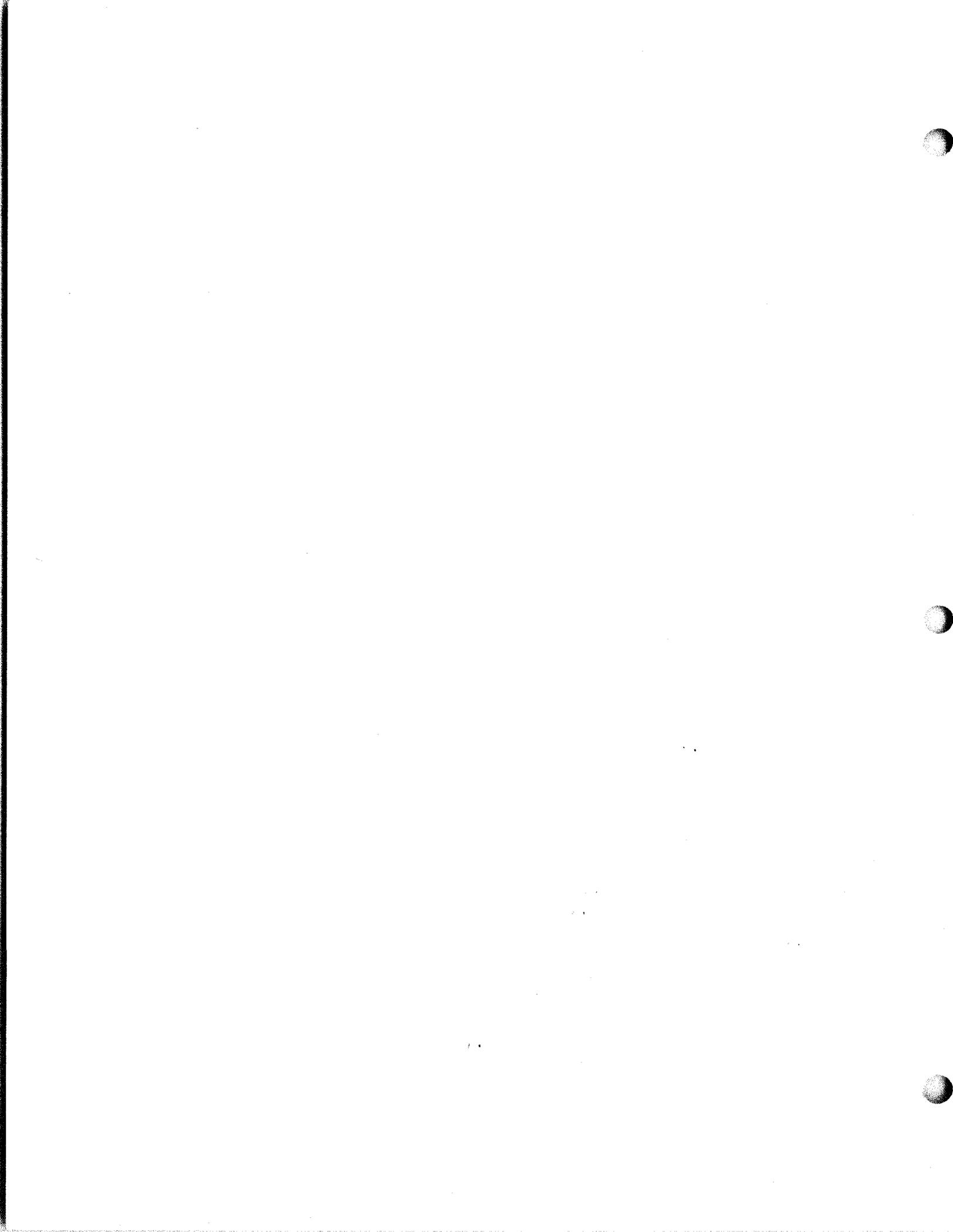
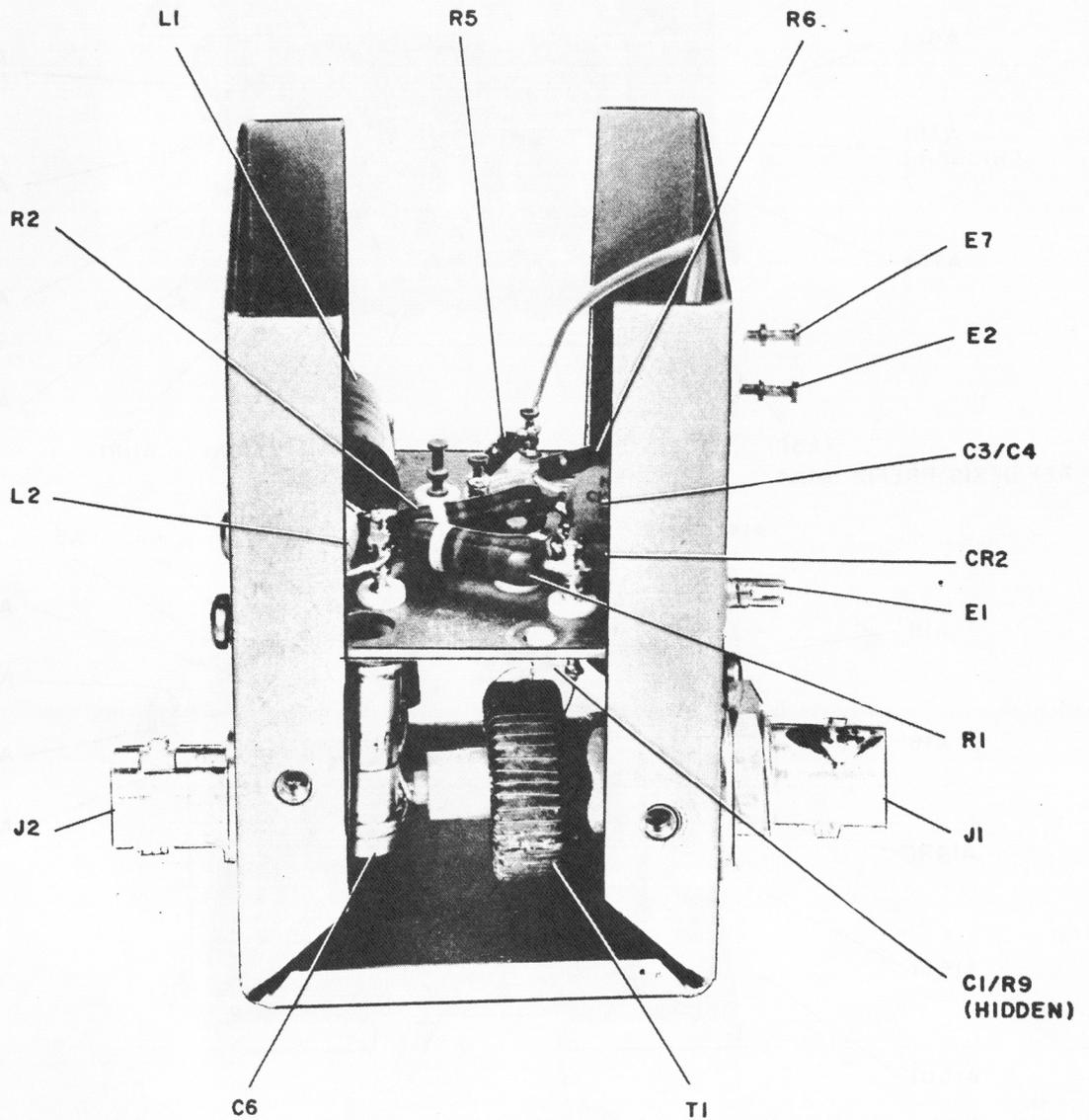


Figure 5-15. 1 KW PA, Driver Tube Assembly 1A1A1, Component Locations.

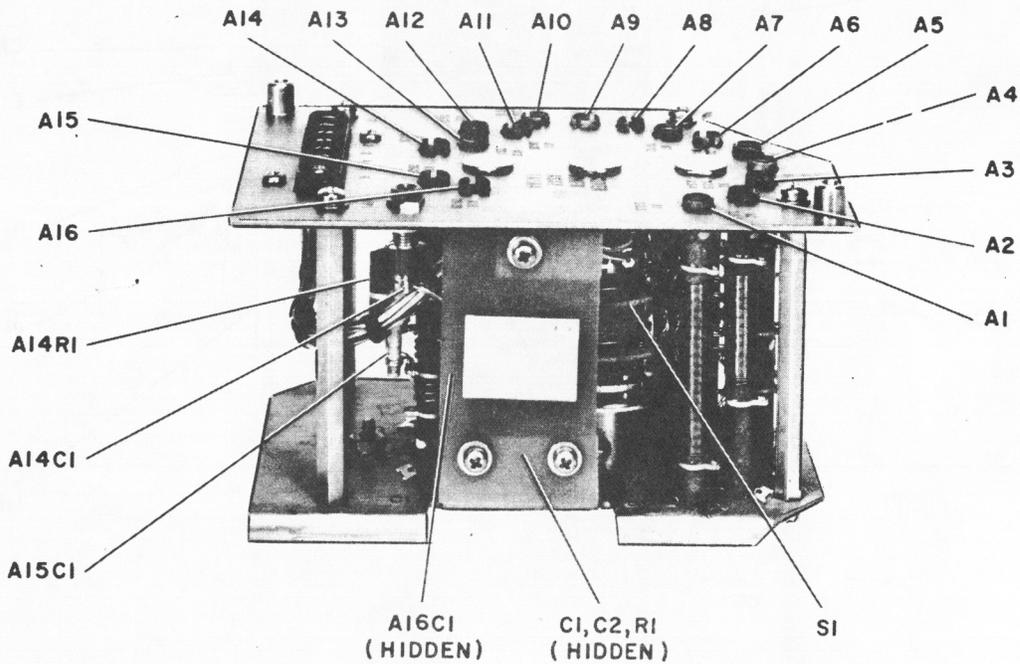
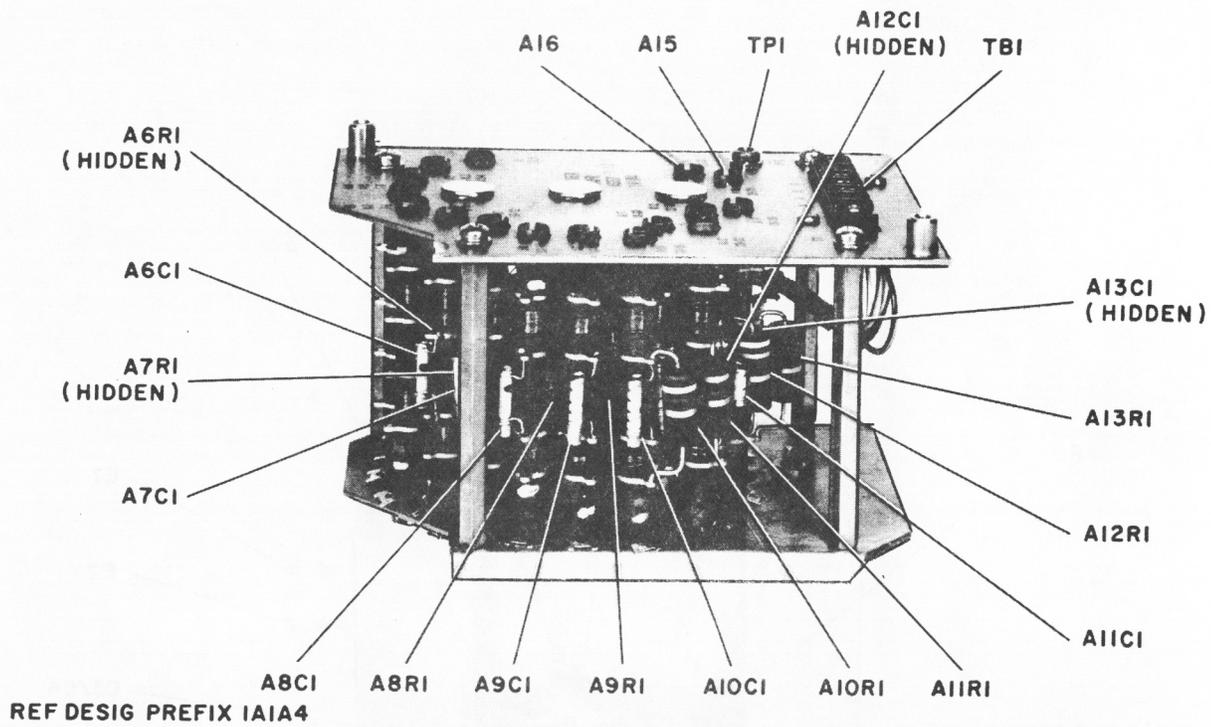






REF DESIG PREFIX 1A1A3

Figure 5-17. 1 KW PA, VSWR Bridge Assembly 1A1A3, Component Locations.



REF DESIG PREFIX IA1A4

Figure 5-18. 1 KW PA, Driver Transformer Assembly 1A1A4, Component Locations.

PARTS LOCATIONS

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	6F	CR17	5D	R12	6D
C2	6F	CR18	3F	R13	5E
C3	6E	CR19	4E	R14	6C
C4	5E	Q1	8D	R15	5C
CR1	2D	Q2	8C	R16	5B
CR2	2C	Q3	6D	R17	4B
CR3	7E	Q4	6C	R18	4C
CR4	8E	Q5	3C	R19	5C
CR5	9E	Q6	3D	R20	4B
CR6	8E	R1	9B	R21	3C
CR7	8E	R2	9D	R22	3D
CR8	9C	R3	8B	R23	4D
CR9	9C	R4	8B	R24	4E
CR10	6E	R5	8B	TP1	9B
CR11	7E	R6	7F	TP2	7B
CR12	7D	R7	6F	TP3	2B
CR13	3B	R8	7C	TP4	6B
CR14	4F	R9	6C	TP5	5B
CR15	3F	R10	7E	TP6	3B
CR16	4C	R11	5D		

PIN FUNCTIONS

A - (not used)	W - (not used)
B - (not used)	X - (not used)
C - (not used)	Y - Ground
D - 16 VAC input	Z - (not used)
E - +28 VDC output	a - Keyline
F - (not used)	b - (not used)
H - 16 VAC input	c - (not used)
J - +20 VDC output	d - Driver Key Inhibit
K - +20 VDC input	e - Key to Bias Ckt
L - +11 VDC reg. output	f - Overload Reset
M - Power Supply Overload Input	g - Overload Light
N - Plate RF Overload Input	h - 1 KW PA Fault to I. Box
P - (not used)	j - (not used)
R - 1A1V1 Cathode Overload Input	k - Key Inhibit to Bias Ckt
S - (not used)	m - RF Mute Input
T - (Keyway)	n - To Motor Relay Coil
U - (not used)	p - From Decoding Switch
V - 1A1V2 Cathode Overload Input	r - (not used)

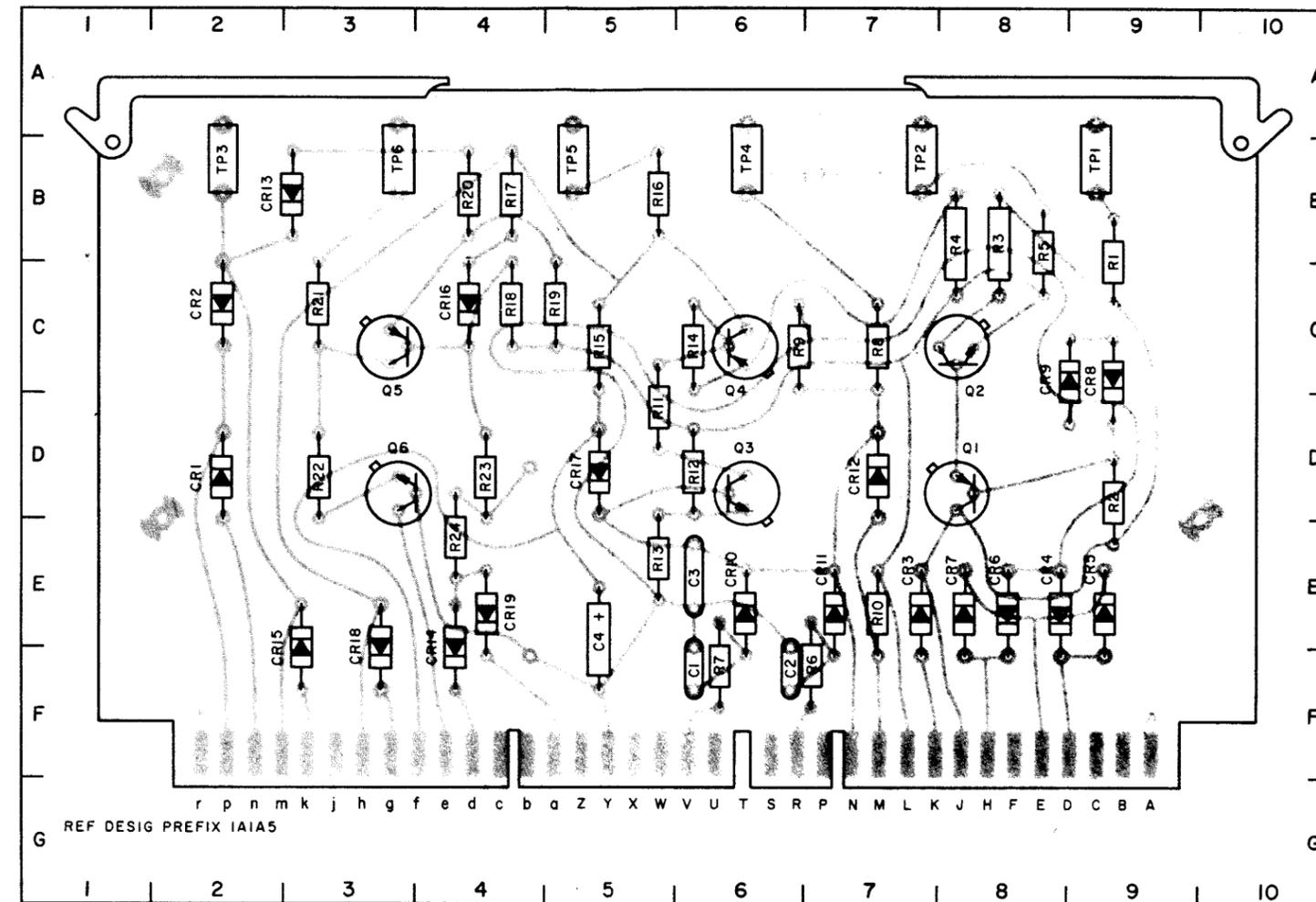


Figure 5-19. 1 KW PA, DC Power Control PCB Assembly, 1A1A5, Component Locations From Foil Side.

PARTS LOCATIONS

REF DESIG	LOC						
C1	2D	CR20	5D	R10	7C	R32	6C
C2	2C	Q1	9C	R11	8B	R33	7C
C3	5D	Q2	7C	R12	8C	R34	8D
C4	2B	Q3	7D	R13	8C	R35	3B
C5	4E	Q4	8B	R14	7D	R36	5B
C6	3D	Q5	9E	R15	8D	R37	4C
C7	2D	Q6	2E	R16	2F	R38	2C
CR1	6E	Q7	4B	R17	3E	R39	4E
CR2	6D	Q8	3C	R18	2E	R40	2E
CR3	6E	Q9	5C	R19	5E	R41	5E
CR4	6D	Q10	4D	R20	2D	R42	6B
CR5	7E	Q11	3E	R21	3C	R43	6B
CR6	8E	Q12	4D	R22	4B	R44	6B
CR7	8D	Q13	6C	R23	5C	R45	5C
CR8	3E	R1	9D	R24	5B	R46	6C
CR9	4E	R2	9C	R25	4E	TP1	9B
CR13	7B	R3	9D	R26	5E	TP2	7B
CR14	5D	R4	6F	R27	3D	TP3	6B
CR15	2E	R5	9D	R28	4C	TP4	3B
CR16	4E	R6	7C	R29	3D	TP5	5B
CR17	2C	R7	6E	R30	5D	TP6	4B
CR18	5D	R8	7E	R31	4F	TP7	2B
CR19	6B	R9	8E				

PIN FUNCTIONS

- |                                |                                     |
|--------------------------------|-------------------------------------|
| A - To Meter Switch            | W - PWR Pot. Wiper                  |
| B - Ground                     | X - Shield Ground                   |
| C - From RF Input Detector     | Y - Shield Ground                   |
| D - Driver Key Inhibit         | Z - Int. Forward from VSWR Bridge   |
| E - Key Inhibit                | a - Top of Int. Pwr. Set Pot.       |
| F - Key                        | b - Int. Reflected from VSWR Bridge |
| H - Top of Driver Bias Pot.    | c - PPC Output                      |
| J - Bottom of Driver Bias Pot. | d - +28 VDC Interlock Output        |
| K - Wiper of PA Bias Pot.      | e - +28 VDC Interlock Input         |
| L - Bottom PA Bias Pot.        | f - +20 VDC Input                   |
| M - Top of PA Bias Pot.        | g - Top of Ext. Pwr. Set Pot.       |
| N - Mode from Exciter          | h - (Keyway)                        |
| P - (not used)                 | j - Ext. Reflected Input            |
| R - PA Bias Output             | k - Shield Ground                   |
| S - 115 VAC Input              | m - Reg. +110 VDC Input             |
| T - Ground                     | n - Ext. Forward Input              |
| U - 115 VAC Input              | p - TGC Output                      |
| V - 1A1C29                     | r - 10 KW PA T.O.P. Input           |

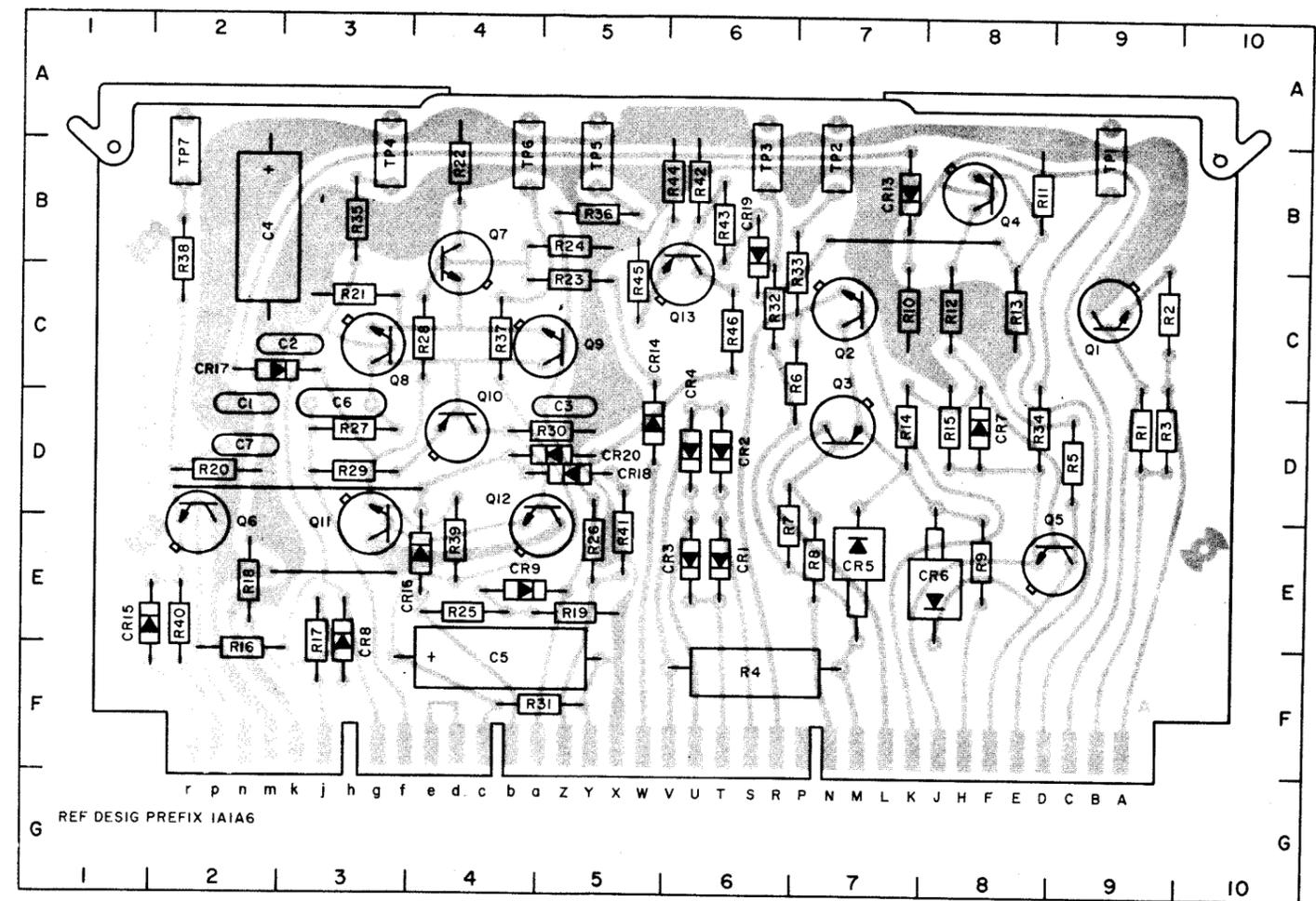
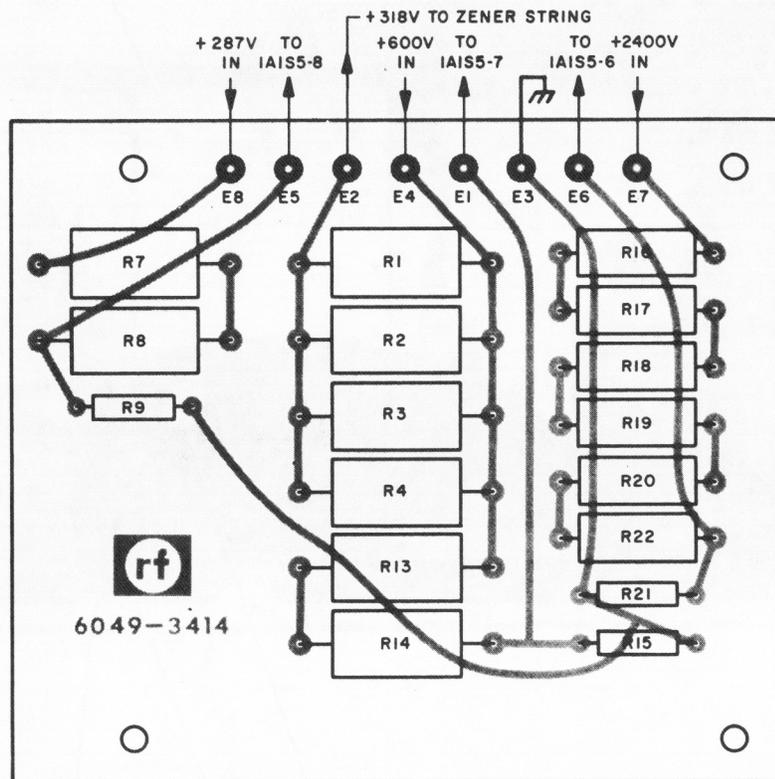


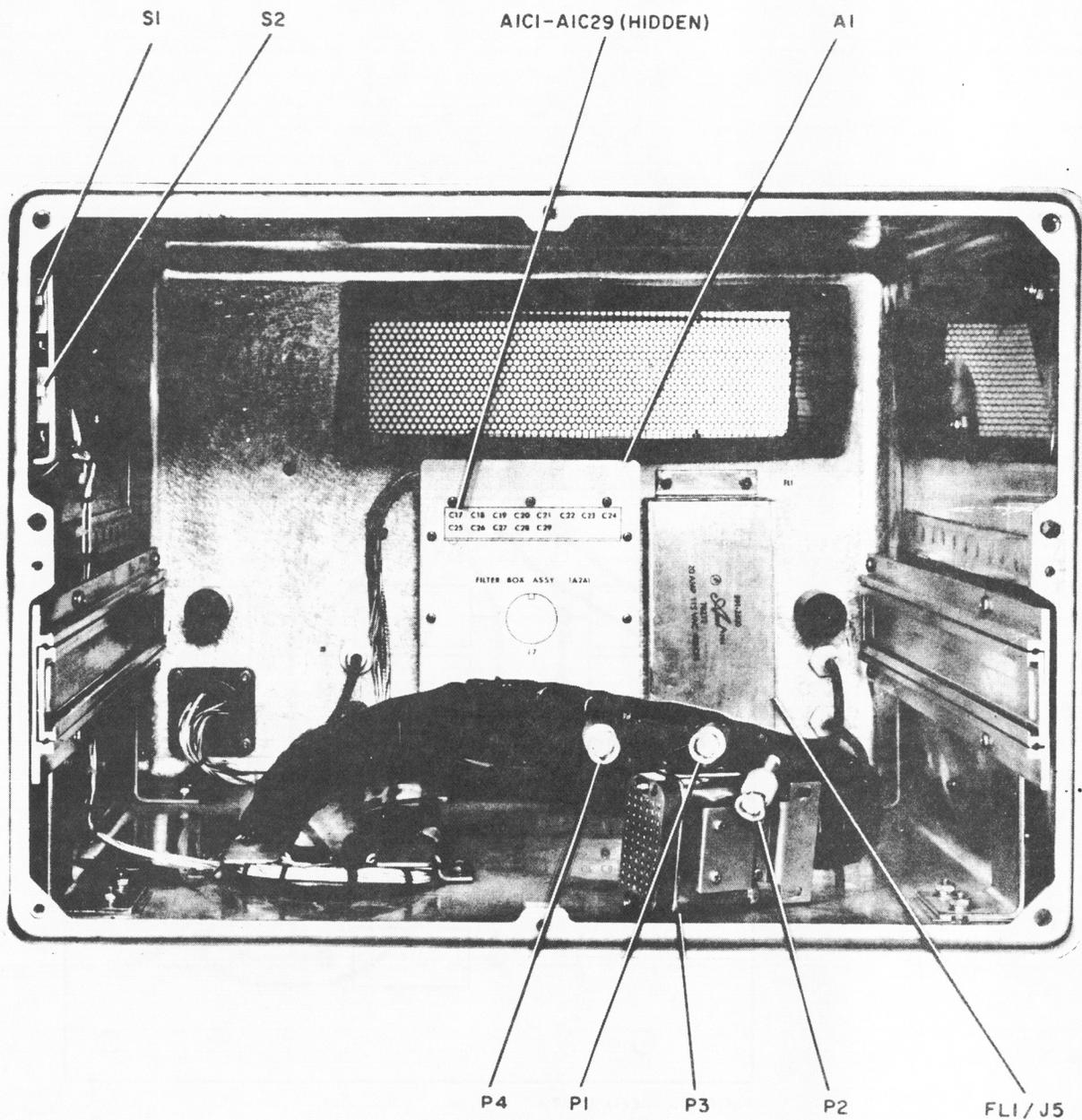
Figure 5-20. 1 KW PA, TGC-PPC PCB Assembly 1A1A6, Component Locations From Foil Side.

ORIGINAL



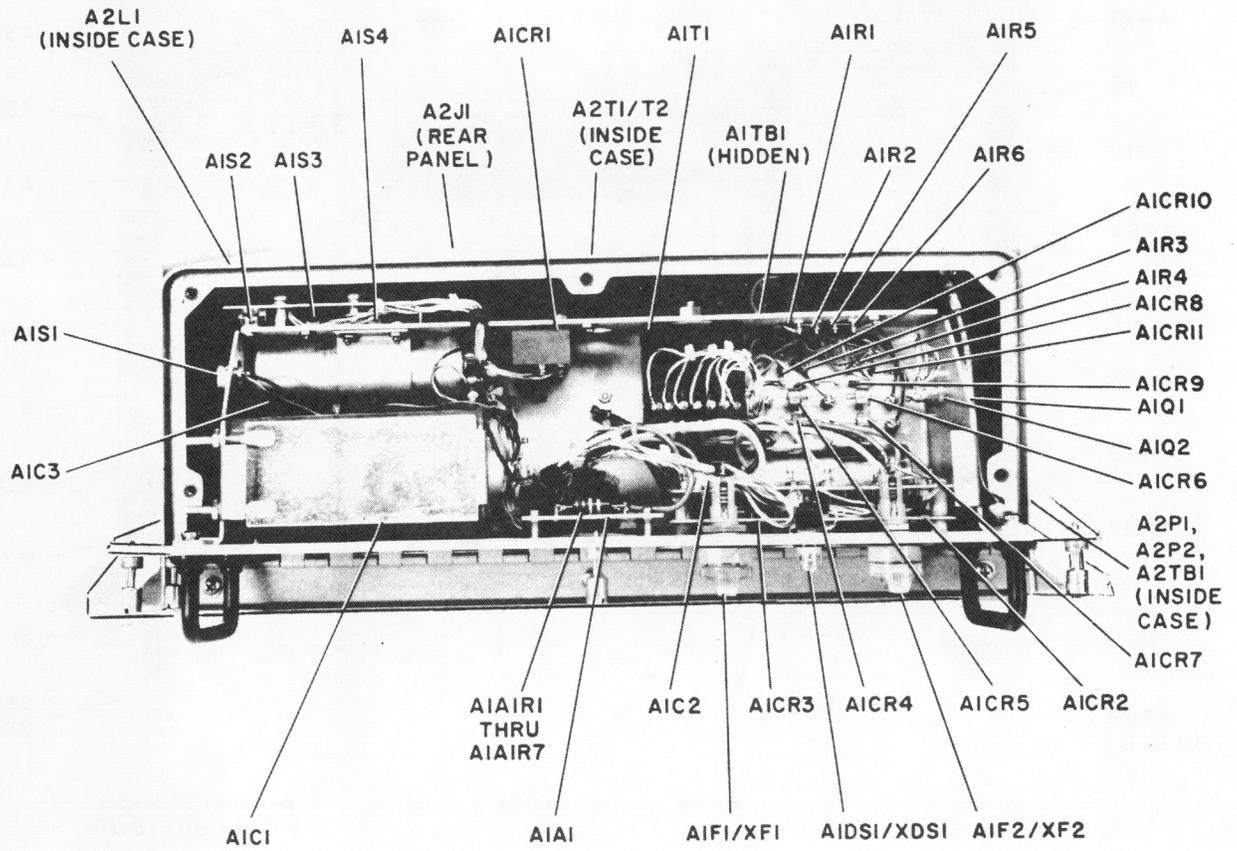
REF DESIG PREFIX IA1A7

Figure 5-21. 1 KW PA, Meter Resistor Assembly, 1A1A7, Component Locations from Foil Side



REF DESIG PREFIX 1A2

Figure 5-22. 1 KW PA, Case 1A2, Component Locations.



REF DESIG PREFIX 2

Figure 5-23. 1 KW Power Supply 2A1, Component Locations.



PARTS LOCATIONS

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	6B	K2	6D	TP1	5B
C2	4F	K3	7F	TP2	2C
C3	3G	K4	4E	TP3	7G
CR1	8E	K5	7I	TP4	4B
CR2	8F	K6	6G	TP5	5B
CR3	8G	Q1	5G	TP6	7H
CR4	8F	Q2	4G	TP7	7F
CR5	6G	Q3	4G	TP8	7B
CR6	6F	Q4	5I	TP9	8E
CR8	4H	R1	3I	TP10	2H
CR9	5H	R2	3H	TP11	2G
CR10	3C	R3	4G	TP12	6F
CR11	5I	R4	3G	TP13	6C
CR12	5H	R5	4H	TP14	7F
CR13	8C	R6	5G	TP15	4C
CR14	5E	R7	3H	TP16	3C
CR15	5D	R8	5C	TP17	8H
CR16	8H	R9	5G	TP18	4B
K1	3D				

PIN FUNCTIONS

- |                                    |                                    |
|------------------------------------|------------------------------------|
| A - Fault Reset from Tuner Control | N - Tuner Control Manual Grd.      |
| B - Fault to Tuner Control         | P - Tune Power Request Output      |
| C - Ready to Exciter               | R - 1 KW PA Fault Input            |
| D - From Tuner Arc Detector        | S - Auxiliary Fault Input          |
| E - Comp. Motor-on From Tuner      | T - Tuner Fault to Tuner Control   |
| F - Grd. Pulse to Coupler Control  | U - Coupler Control Tune Pwr. Req. |
| H - Grd. Pulse to Tuner Control    | V - Manual Tune Pwr Req.           |
| J - (not used)                     | W - Tuner Control Tune Pwr. Req.   |
| K - (Keyway)                       | X - Transmitter Fault to Exciter   |
| L - (not used)                     | Y - Inhibit from Exciter           |
| M - Ground                         | Z - +28 VDC                        |

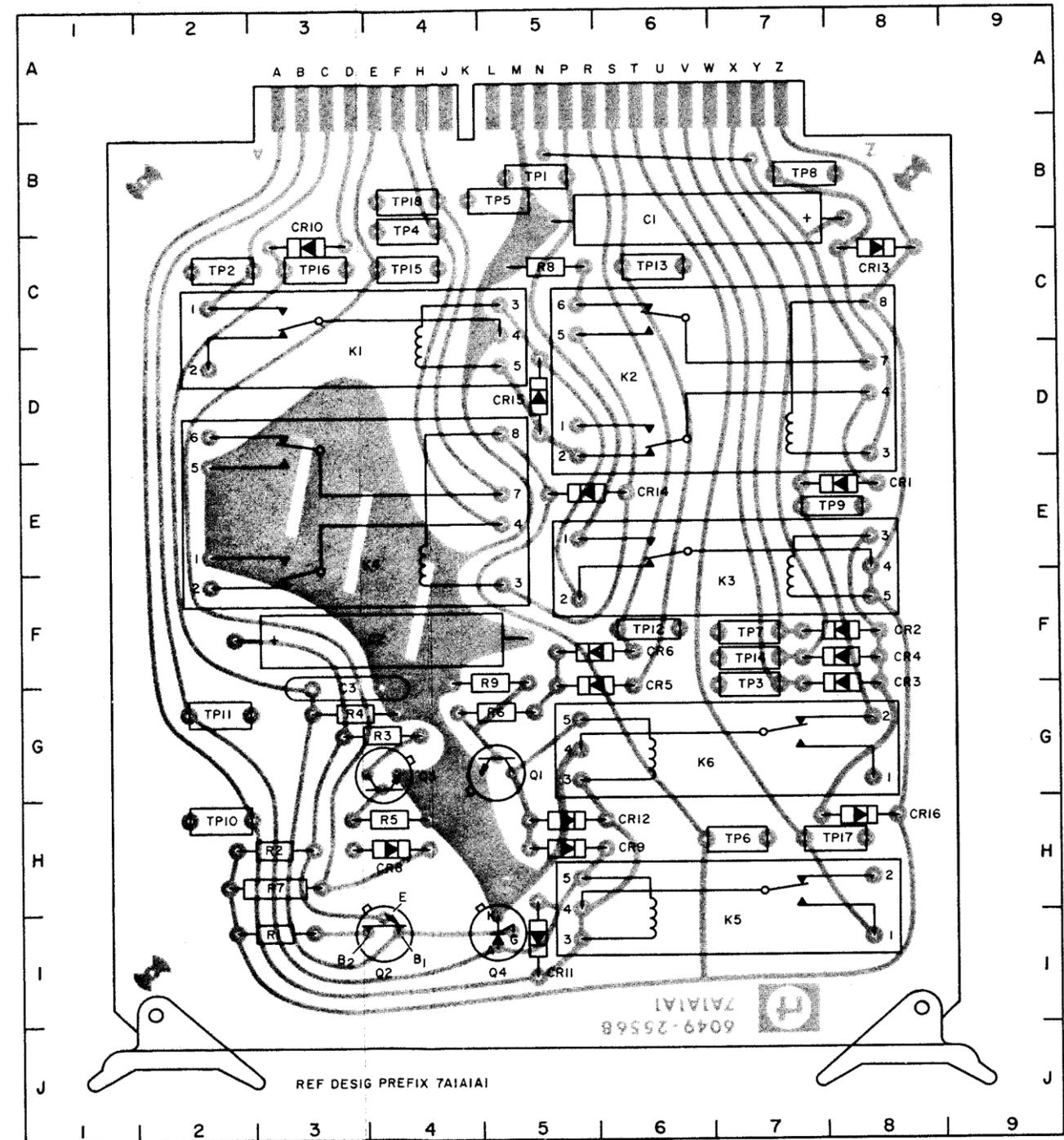


Figure 5-25. I. Box, Fault Logic PCB Assembly 7A1A1A1, Component Locations From Foil Side.

PIN FUNCTIONS

- |                               |                                 |
|-------------------------------|---------------------------------|
| A - 1 KW PA RF Mute           | N - Tune Command 1 from Exciter |
| B - Tune Command 2 Output     | P - 1 KW PA Manual Ground       |
| C - To MANUAL Indicator       | R - (not used)                  |
| D - (not used)                | S - Tune Enable Output          |
| E - Local Override to Exciter | T - (not used)                  |
| F - Tune Pwr. Req. Input      | U - T. C. Man./Semi-Auto Grd.   |
| H - (not used)                | V - Tune Command 1 Hold         |
| J - (Keyway)                  | W - +28 VDC                     |
| K - (not used)                | X - No Fault Input              |
| L - (not used)                | Y - Coupler Control RF Mute     |
| M - Ground                    | Z - Tuner Control RF Mute       |

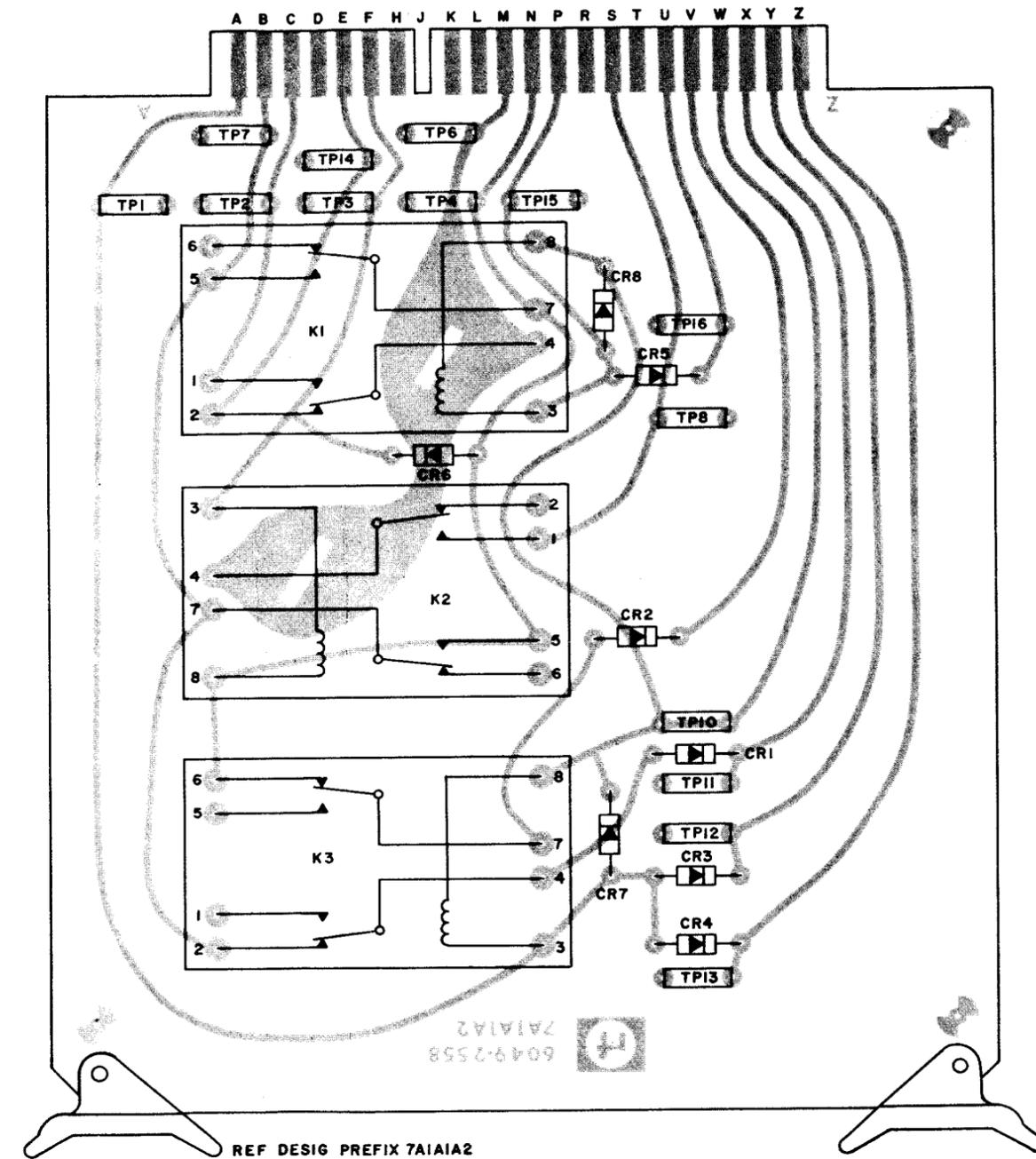


Figure 5-26. I. Box, Tune Logic PCB  
 Assembly 7A1A1A2, Component  
 Locations From Foil Side.

PARTS LOCATIONS

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	7E	Q12	2D	R29	2E
C2	3H	Q13	2C	R30	3E
C3	4H	Q14	4C	R31	2D
C4	3F	Q15	4D	R32	2D
C5	3E	Q16	5H	R33	3E
CR1	2I	R1	2I	R34	4E
CR2	2H	R2	2H	R36	2D
CR3	3H	R3	2I	R37	2C
CR4	4H	R4	3H	R38	3D
CR5	2F	R5	4I	R39	3D
CR6	2F	R6	6C	R40	3C
CR7	4G	R7	7B	R41	3C
CR8	4F	R8	7C	R42	3C
CR9	2D	R9	7D	R43	3C
CR10	4D	R10	7E	R44	4C
CR11	4E	R11	7E	R45	4C
CR12	2D	R12	7F	R46	4C
CR13	3B	R13	4H	R47	5C
CR14	4C	R14	4I	R48	5C
CR15	7F	R15	5I	R49	5D
CR16	8B	R16	7H	R50	5C
CR17	4C	R17	5H	TP1	6D
K1	6H	R18	5H	TP2	6E
Q1	2H	R19	7H	TP3	2B
Q2	3I	R20	7H	TP4	7I
Q3	6C	R21	2G	TP5	6B
Q4	8C	R22	2F	TP6	6B
Q5	6F	R23	2F	TP7	6C
Q6	5I	R24	3G	TP8	8B
Q7	2G	R25	4F	TP9	5F
Q8	3F	R26	5F	TP10	5E
Q9	4F	R27	2E	TP11	3B
Q10	2E	R28	2D	VR1	8C
Q11	3D				

PIN FUNCTIONS

- A - Coupler Control Tune Pwr. Req.
- B - Tuner Control Tune Pwr. Req.
- C - (not used)
- D - +28 VDC
- E - Tune Command 1 Hold
- F - (not used)
- H - RF Mute for Bypass Transition
- J - (not used)
- K - (not used)
- L - (Keyway)
- M - (not used)
- N - L1 Servo Ampl Current Source
- P - -2 VDC
- R - Ground
- S - (not used)
- T - L1 Motor-on Input
- U - (not used)
- V - L1 Motor Brake Release
- W - (not used)
- X - (not used)
- Y - (not used)
- Z - Bypass to Tuner

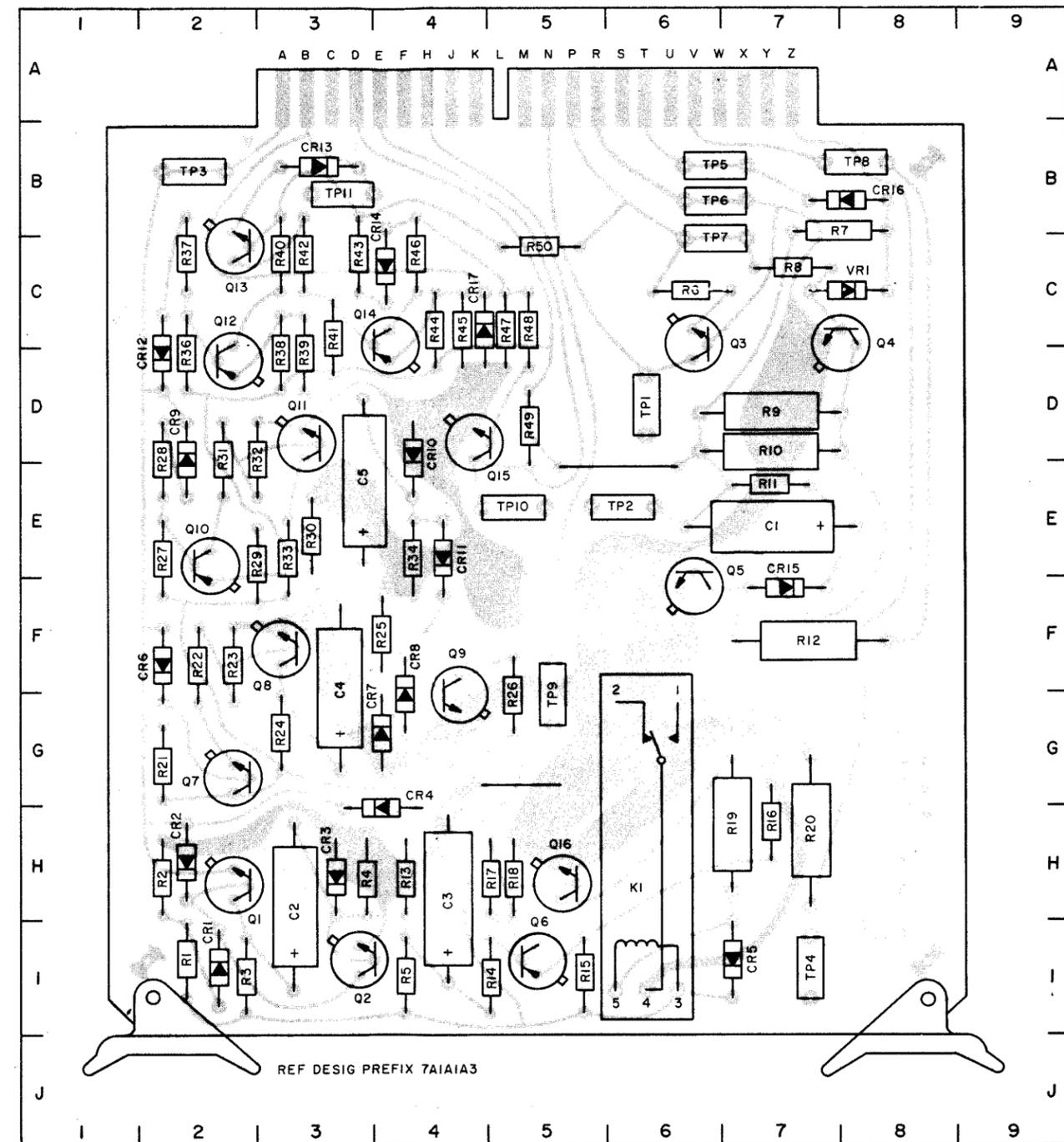
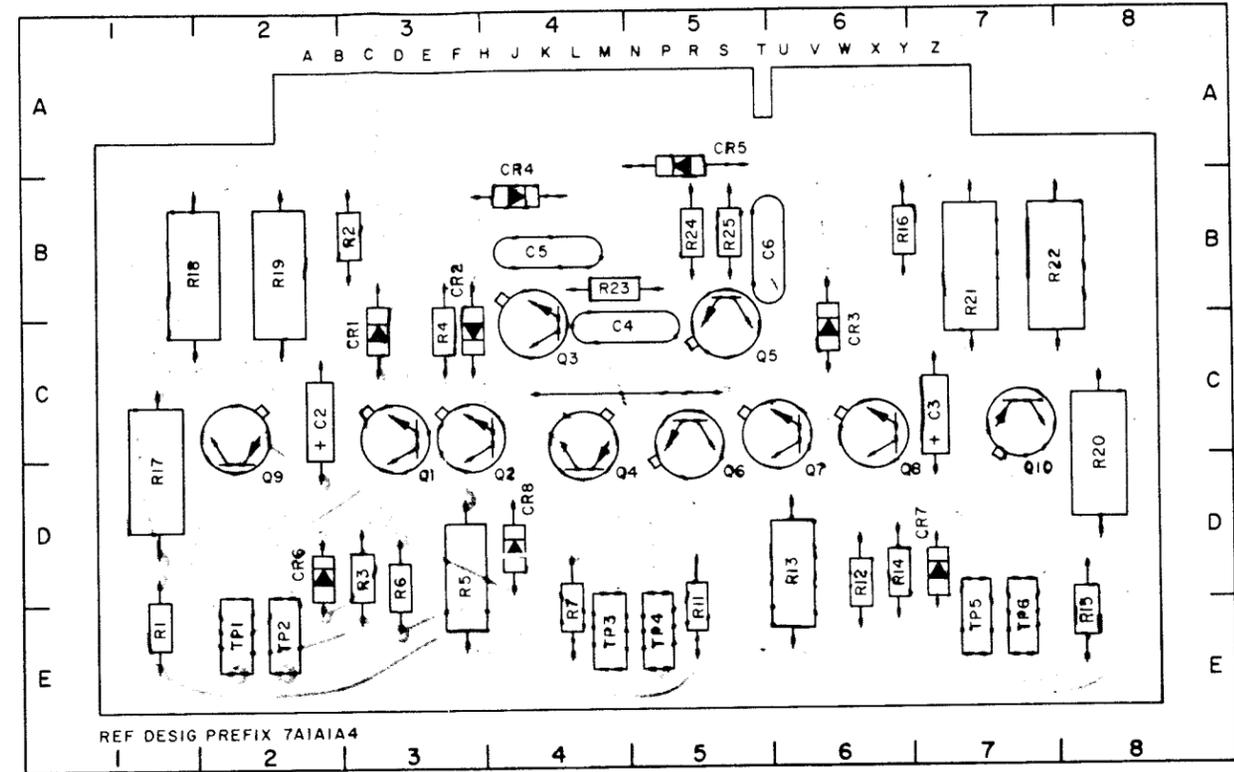


Figure 5-27. I. Box, Brake Logic PCB Assembly 7A1A1A3, - Component Locations From Foil Side.

PARTS LOCATIONS

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1		Q5	5C	R15	8E
C2	2C	Q6	5C	R16	6B
C3	7C	Q7	6C	R17	1D
C4	4C	Q8	6C	R18	2B
C5	4B	Q9	2C	R19	2B
C6	6B	Q10	7C	R20	8D
CR1	3C	R1	1E	R21	7B
CR2	3C	R2	3B	R22	7B
CR3	6C	R3	3D	R23	4B
CR4	4B	R4	3C	R24	5B
CR5	5A	R5	3D	R25	5B
CR6	2D	R6	3D	TP1	2E
CR7	7D	R7	4E	TP2	2E
CR8	4D	R11	5E	TP3	4E
Q1	3C	R12	6D	TP4	5E
Q2	3C	R13	6D	TP5	7E
Q3	4C	R14	6D	TP6	7E
Q4	4C				



PIN FUNCTIONS

- |                           |                            |
|---------------------------|----------------------------|
| A - +28 VDC               | N - (not connected)        |
| B - To 7A1A1Q3-B          | P - (not connected)        |
| C - To 7A1A1Q1-C          | R - Bottom of Balance Pot. |
| D - Ground                | S - L1 Position Input      |
| E - To 7A1A1Q4-B          | T - (Keyway)               |
| F - (not connected)       | U - (not used)             |
| H - Decoder-on Inhibit    | V - (not connected)        |
| J - (not connected)       | W - To 7A1A1Q2-B           |
| K - Top of Balance Pot.   | X - To 7A1A1Q3-C           |
| L - L1 Position Reference | Y - To 7A1A1Q1-B           |
| M - Ground                | Z - -28 VDC                |

Figure 5-28. I. Box, L1 Servo Amplifier  
PCB Assembly 7A1A1A4,  
Component Locations From  
Foil Side.

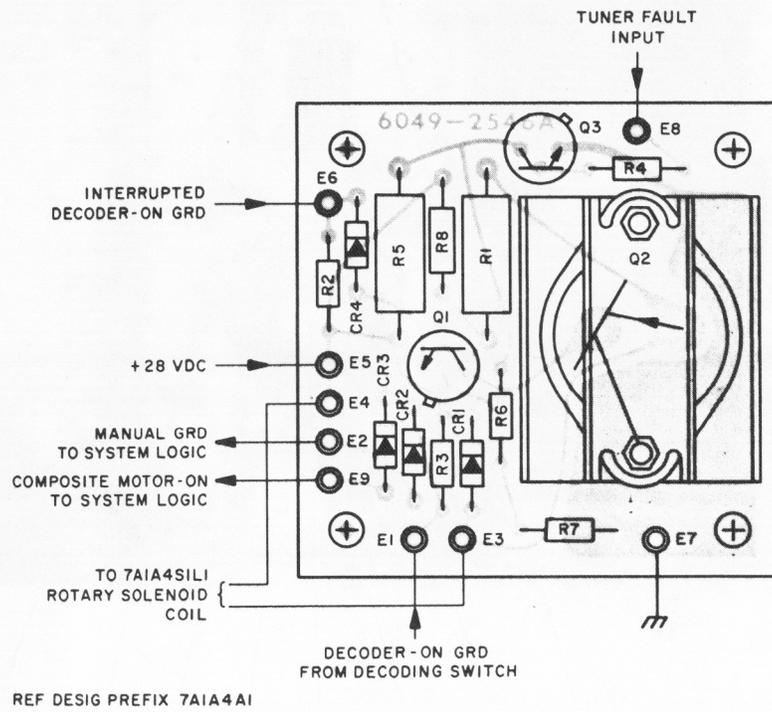


Figure 5-29. I. Box, Decoder-Encoder PCB Assembly 7A1A4A1, Component Locations From Foil Side.

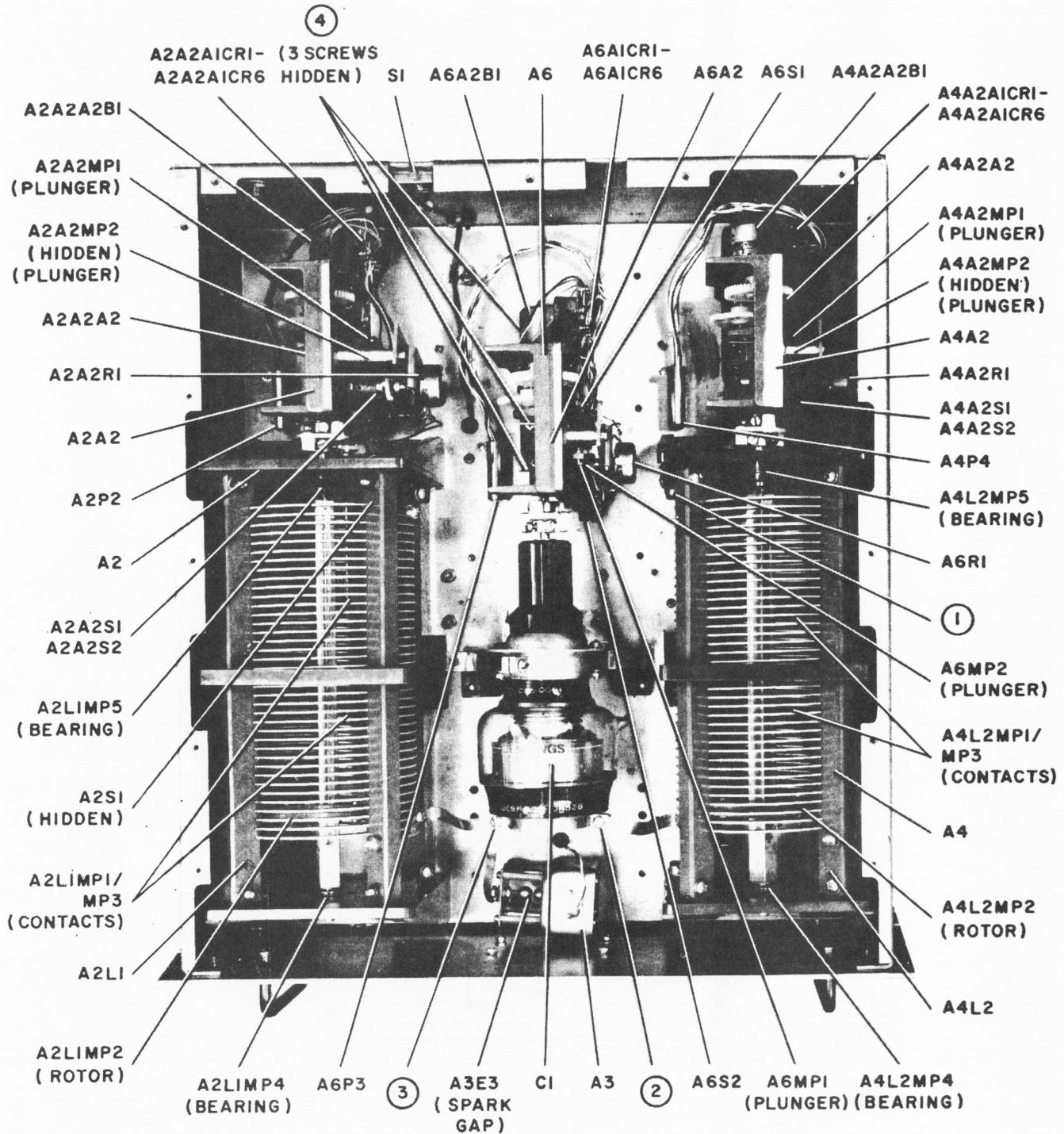


Figure 5-30. Tuner 9A1, Top View, Component Locations.

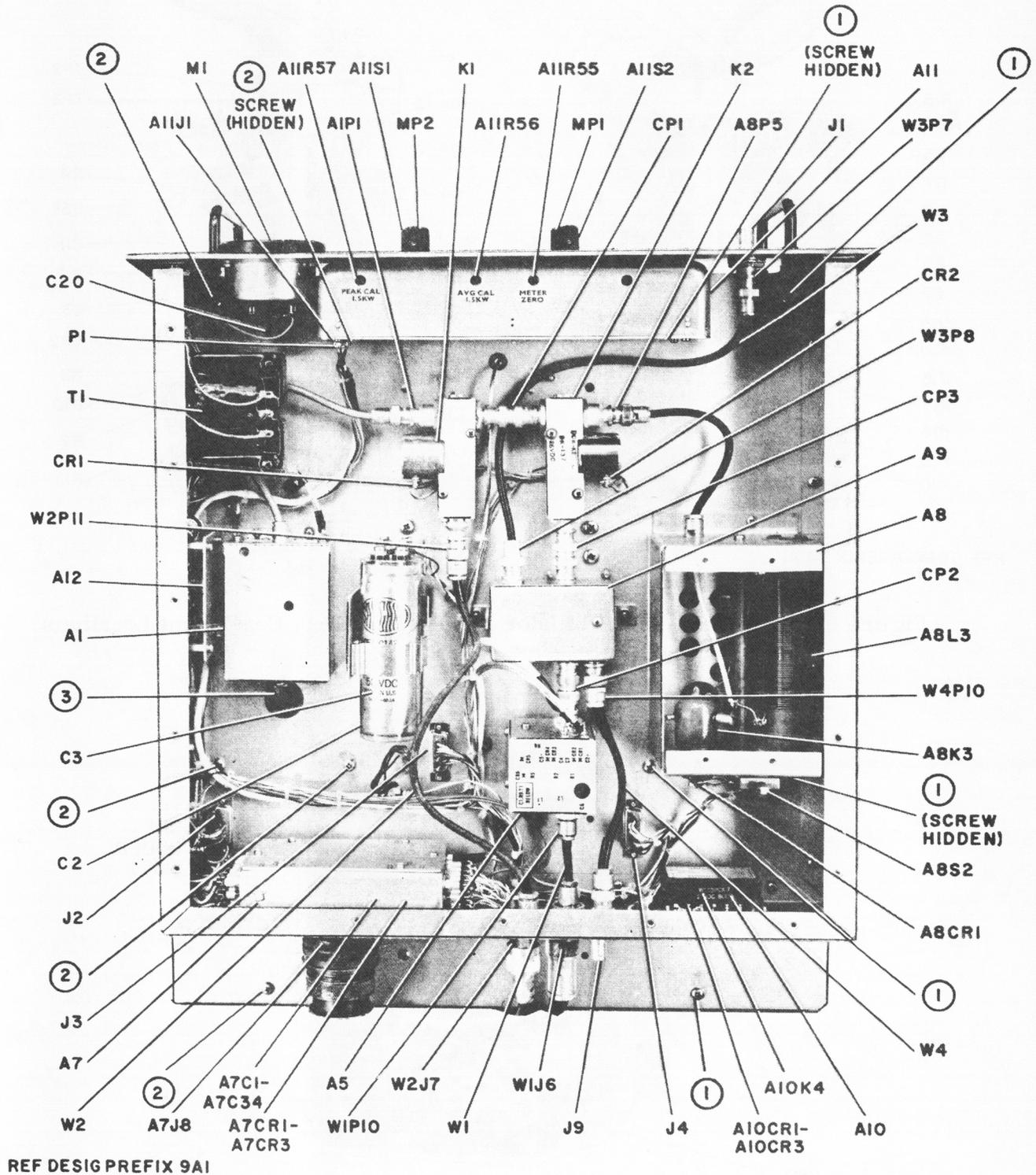
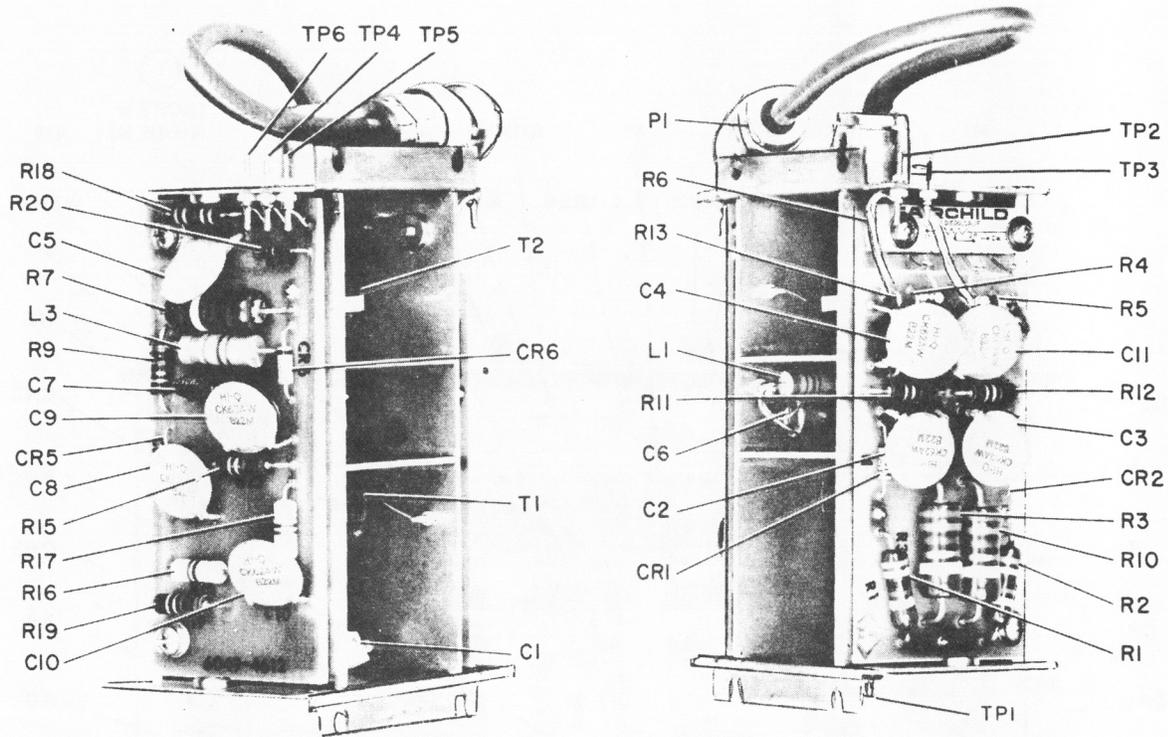
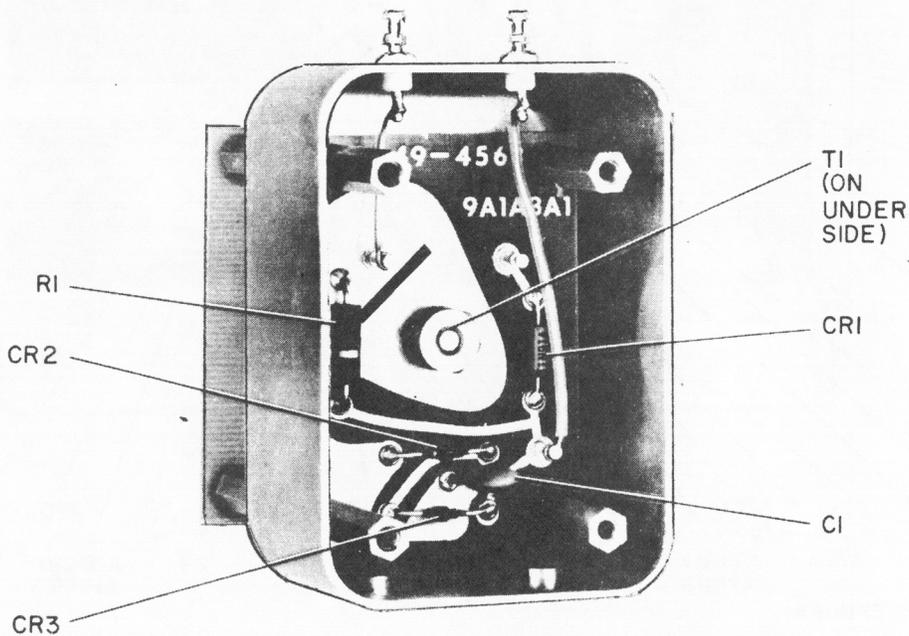


Figure 5-31. Tune 9A1, Bottom View, Component Locations.



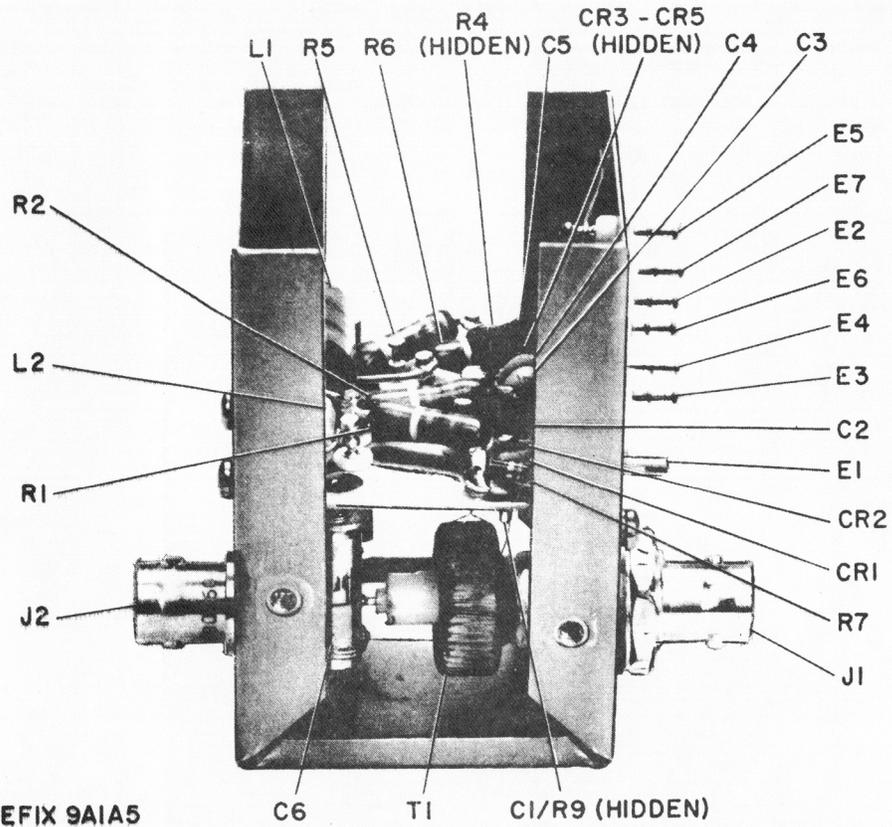
REF DESIG PREFIX 9A1A1

Figure 5-32. Tuner, Discriminator Assembly 9A1A1, Component Locations.



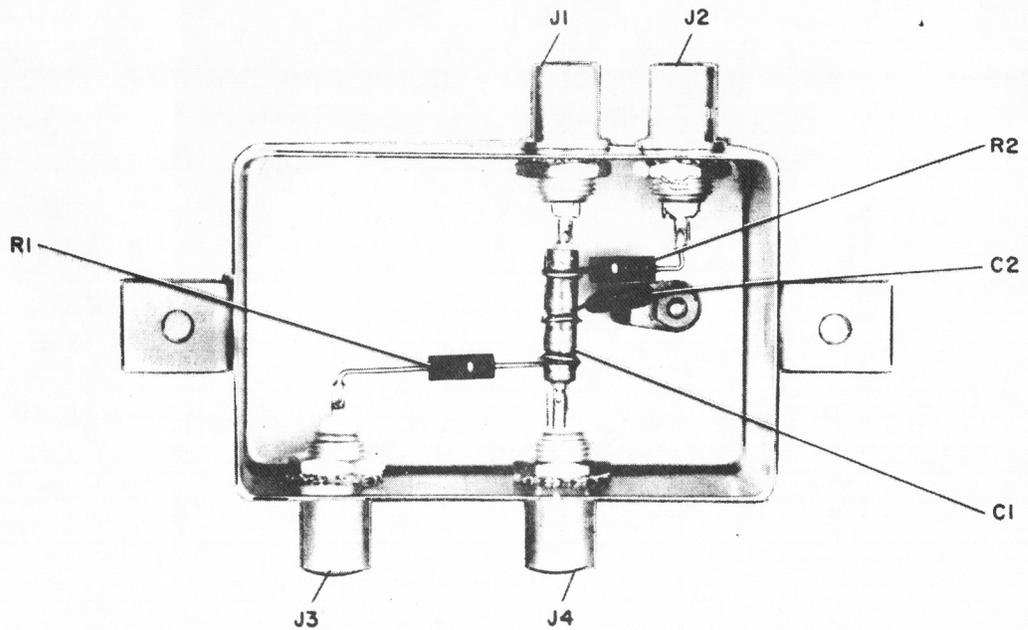
REF DESIG PREFIX 9A1A3

Figure 5-33. Tuner, Protector Assembly 9A1A3, Component Locations.



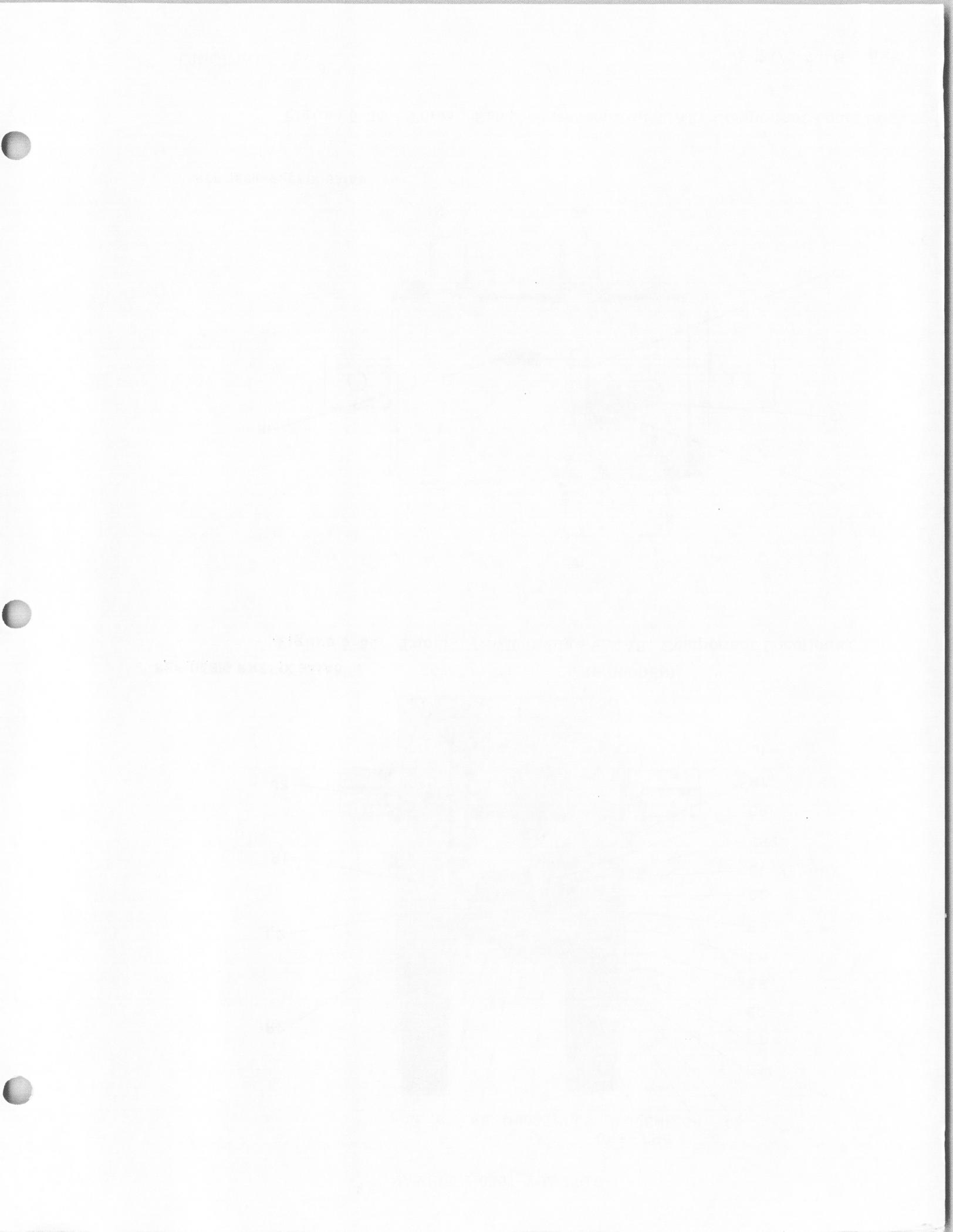
REF DESIG PREFIX 9A1A5

Figure 5-34. Tuner, VSWR Bridge 9A1A5, Component Locations.



REF DESIG PREFIX 9A1A9

Figure 5-35. Tuner, Sampler Assembly 9A1A9, Component Locations.



PARTS LOCATIONS

REF DESIG	LOC						
C1	3A	CR8	4B	R2	4B	R25	3I
C2	4A	CR9	4B	R3	4C	R26	4I
C3	4H	CR14	5J	R4	5D	R27	5I
C4	4H	CR15	5K	R5	4D	R28	4I
C5	4H	CR16	5J	R6	5D	R29	5I
C6	5E	CR17	5F	R7	4D	R30	4I
C8	3B	CR18	5F	R8	5D	R31	5I
C10	5G	CR19	4I	R9	4D	R32	6F
C11	3F	CR20	4I	R10	3D	R33	5H
C12	3F	CR21	4J	R11	3D	R34	5H
C14	6B	CR22	5C	R12	4D	R35	4J
C16	3H	CR23	4F	R13	4F	R36	5J
C17	5G	IC1	4G	R14	3E	R37	4J
C18	3I	Q1	5A	R15	3E	R38	5J
C19	4C	Q2	4A	R16	4F	R39	4J
CR1	4D	Q3	3E	R17	4F	R40	5J
CR2	4D	Q4	5B	R18	5E	R41	5A
CR3	4E	Q5	5B	R19	5F	R42	5B
CR4	4E	Q6	5C	R20	3G	R43	5C
CR5	4G	Q7	4C	R21	4H	R44	4B
CR6	4G	Q8	4E	R22	4H	R45	4C
CR7	5G	Q9	5G	R23	3F	R54	4A
		R1	4B	R24	4H		

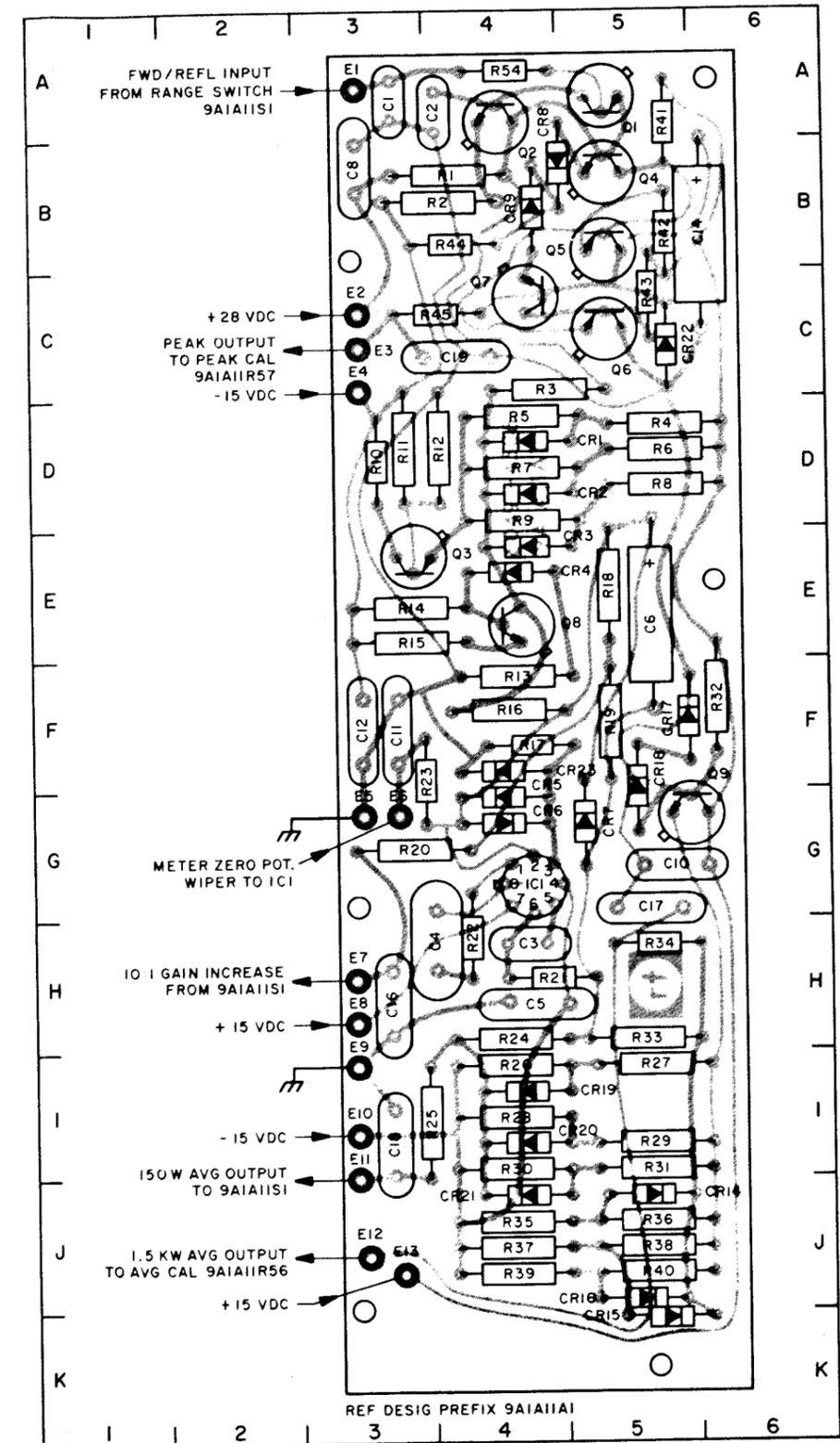


Figure 5-36. Tuner, Peak/Average Detector PCB Assembly 9A1A11A1, Component Locations.

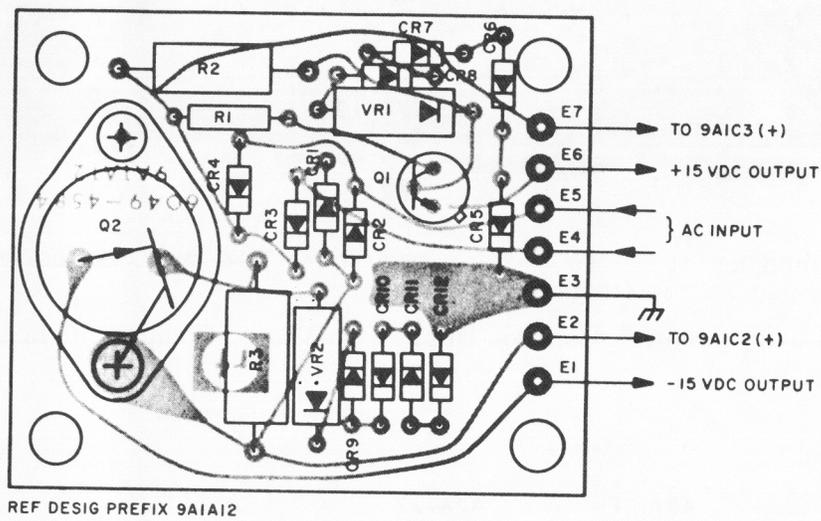


Figure 5-37. Tuner, Power Supply PCB Assembly 9A1A12, Component Locations.

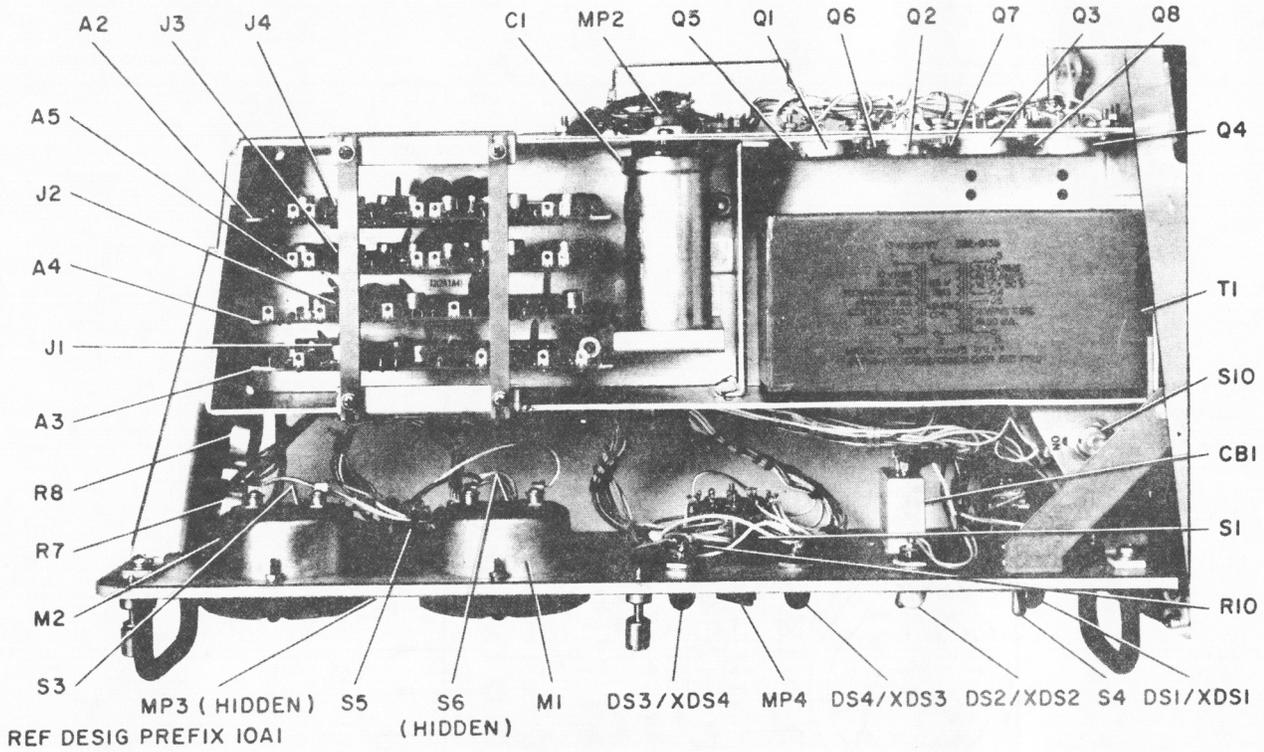


Figure 5-38. Tuner Control 10A1, Top View, Component Locations.

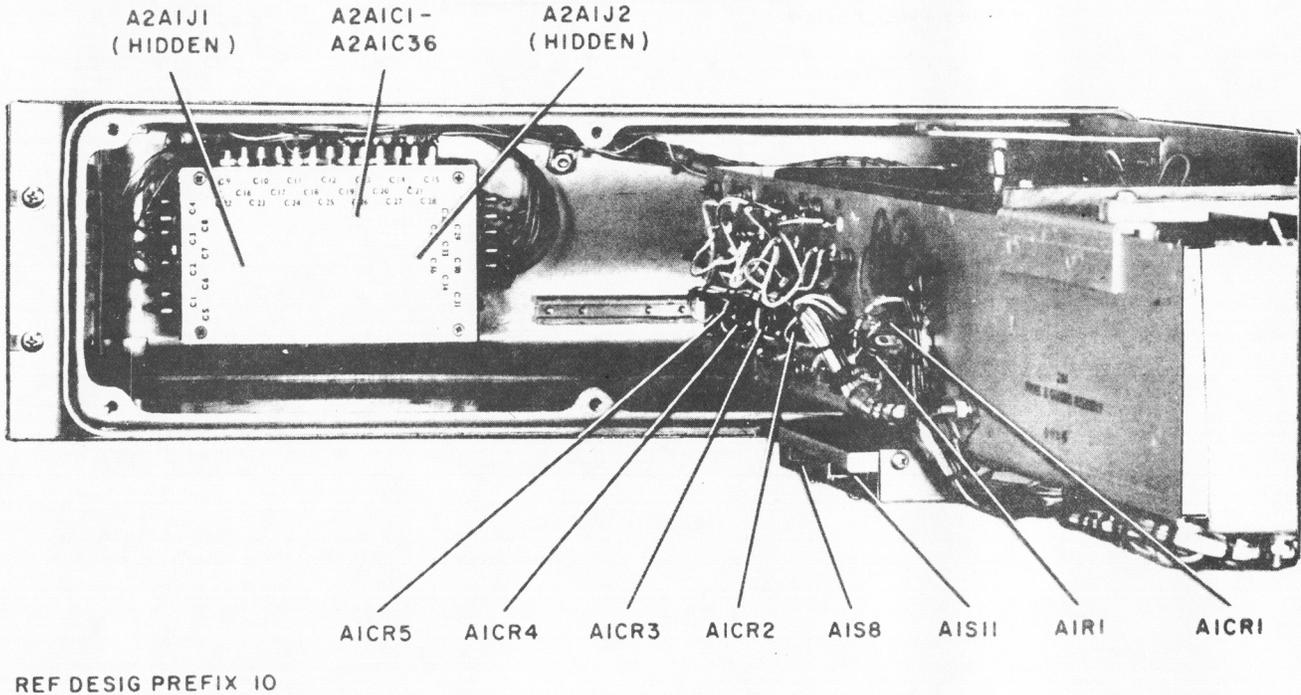
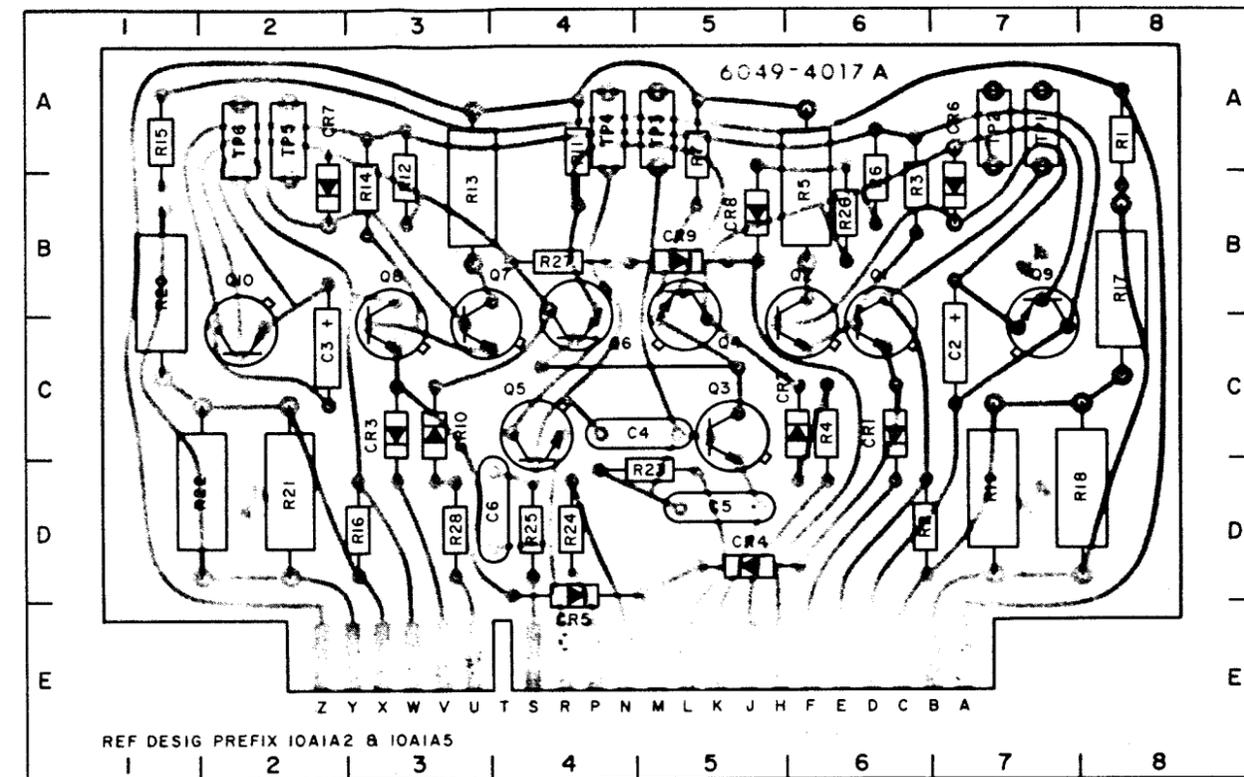


Figure 5-39. Tuner Control 10A1 and 10A2, Rear View, Component Locations.

PARTS LOCATIONS

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C2	7C	Q5	4C	R17	8B
C3	2C	Q6	4C	R18	7D
C4	5C	Q7	3B	R19	7D
C5	5D	Q8	3B	R20	1B
C6	4D	Q9	7B	R21	2D
CR1	6C	Q10	2B	R22	2D
CR2	6C	R1	8A	R23	5D
CR3	3C	R2	6D	R24	4D
CR4	5D	R3	6B	R25	4D
CR5	4D	R4	6C	R26	6B
CR6	7B	R5	6B	R27	4B
CR7	2B	R6	6B	R28	3D
CR8	5B	R7	5A	TP1	7A
CR9	5B	R11	4A	TP2	7A
CR10	3C	R12	3B	TP3	5A
Q1	6B	R13	3B	TP4	4A
Q2	6B	R14	3B	TP5	2A
Q3	5C	R15	1A	TP6	2A
Q4	5C	R16	3D		



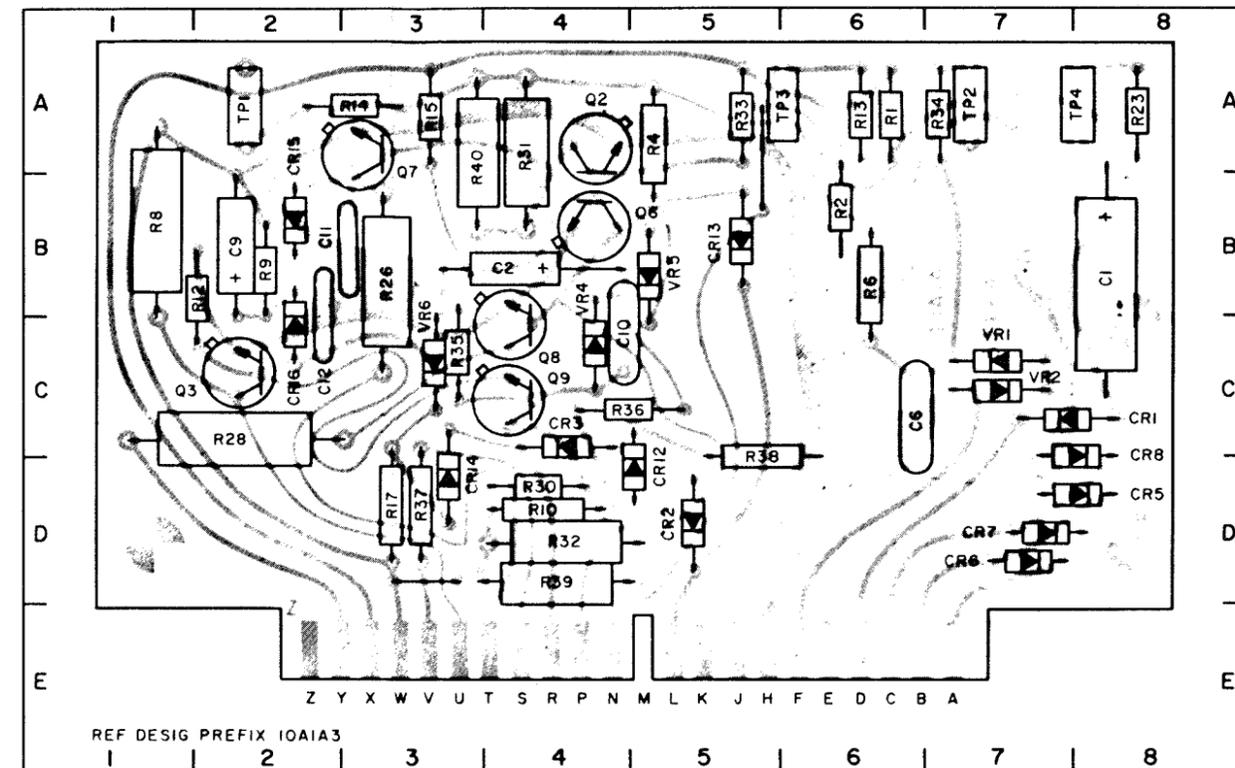
PIN FUNCTIONS

- |                            |                                  |
|----------------------------|----------------------------------|
| A - +28 VDC                | N - Wiper of Balance Pot.        |
| B - To 10A1Q1-B or Q3-B    | P - -4 VDC                       |
| C - To 10A1Q2-C            | R - Bottom of Balance Pot.       |
| D - Ground                 | S - Signal Input                 |
| E - To 10A1Q6-B or Q8-B    | T - (Keyway)                     |
| F - Switched Home Ground   | U - Reverse Home (C1 at Min.)    |
| H - Tune Sensitivity Drive | V - Switched Tune Ground         |
| J - Home                   | W - To 10A1Q5-B or Q7-B          |
| K - Top of Balance Pot.    | X - To 10A1Q1-C or Q3-C          |
| L - Reference Input        | Y - To 10A1Q2-B or Q4-B          |
| M - Switched Ground        | Z - +28 VDC (Auto and Semi-auto) |

Figure 5-40. Tuner Control, L2 & C1 Servo Amplifier PCB Assemblies 10A1A2 and 10A1A5, Component Locations From Foil Side.

PARTS LOCATIONS

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	8B	Q3	2C	R30	4D
C2	4B	Q6	4B	R31	4A
C6	6C	Q7	3A	R32	4D
C9	2B	Q8	4C	R33	5A
C10	4C	Q9	4C	R34	7A
C11	3B	R1	6A	R35	3C
C12	2C	R2	6B	R36	4C
CR1	7C	R4	5A	R37	5D
CR2	5D	R6	6B	R38	5D
CR3	4C	R8	1B	R39	4D
CR5	7D	R9	2B	R40	3A
CR6	7D	R10	4D	TP1	2A
CR7	7D	R12	2B	TP2	7A
CR8	7C	R13	6A	TP3	6A
CR12	5D	R14	3A	TP4	8A
CR13	5B	R15	3A	VR1	7C
CR14	3D	R17	3D	VR2	7C
CR15	2B	R23	8A	VR4	4C
CR16	2C	R26	3B	VR5	5B
Q2	4A	R28	2C	VR6	3C



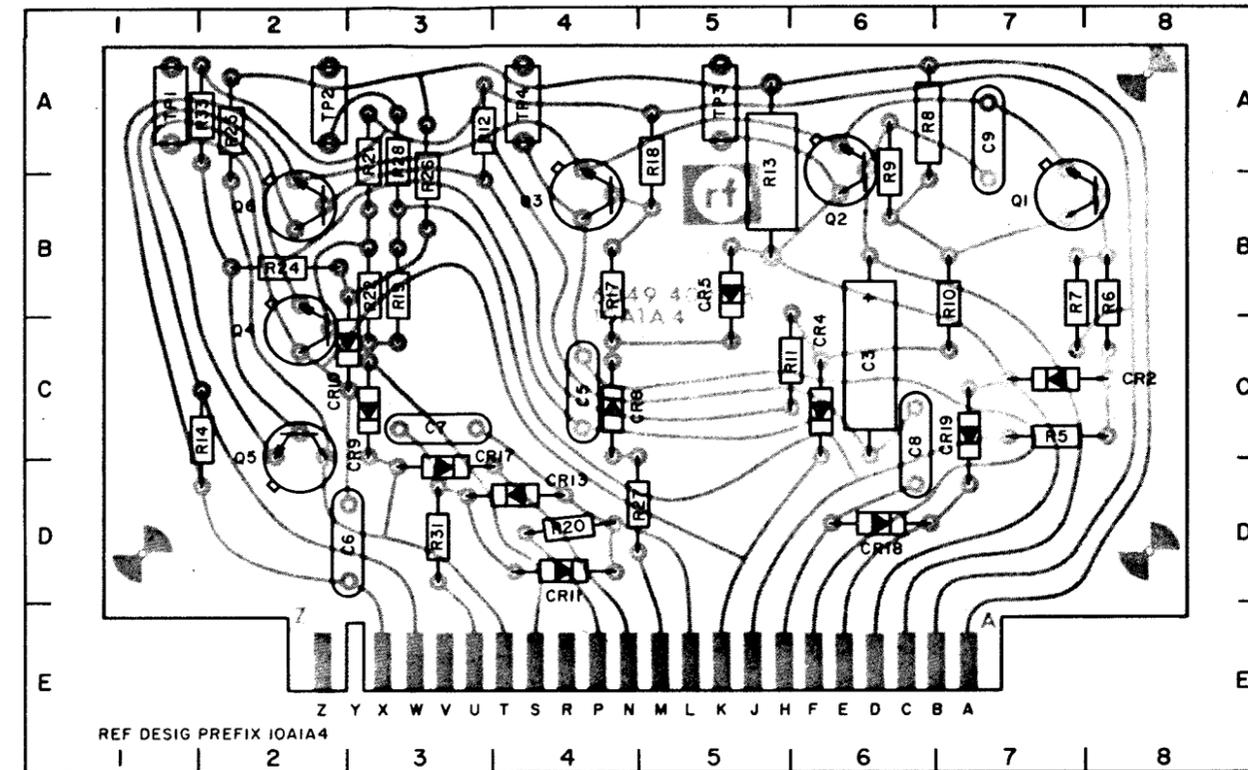
PIN FUNCTIONS

- |                      |                               |
|----------------------|-------------------------------|
| A - +28 VDC output   | N - -4 VDC output             |
| B - 32 VAC input     | P - To TUNING indicator       |
| C - 32 VAC input     | R - C1 Motor On               |
| D - 4 VAC input      | S - To Element Position Meter |
| E - (not used)       | T - L2 Motor Brake Release    |
| F - +12.4 VDC output | U - Motor-on Output           |
| H - Ground           | V - Element Position Input    |
| J - (not used)       | W - +28 VDC                   |
| K - (not used)       | X - -2 VDC Output             |
| L - L2 Motor On      | Y - C1 Motor Brake Release    |
| M - (Keyway)         | Z - (not used)                |

Figure 5-41. Tuner Control, Power Supply PCB Assembly 10A1A3, Component Locations From Foil Side.

PARTS LOCATIONS

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C3	6C	Q1	7B	R18	5A
C5	4C	Q2	6B	R19	3B
C6	3D	Q3	4B	R20	4D
C7	3C	Q4	2C	R21	3A
C8	6C	Q5	2C	R22	3B
C9	7A	Q6	2B	R24	2B
CR2	7C	R5	7C	R25	2A
CR4	6C	R6	8B	R26	3A
CR5	5B	R7	7B	R27	5D
CR8	4C	R8	6A	R28	3A
CR9	3C	R9	6A	R31	3D
CR10	2C	R10	7B	R33	2A
CR11	4D	R11	6C	TP1	1A
CR13	4D	R12	3A	TP2	2A
CR17	3C	R13	5A	TP3	5A
CR18	6D	R14	2C	TP4	4A
CR19	7C	R17	4B		



PIN FUNCTIONS

- |                             |                               |
|-----------------------------|-------------------------------|
| A - +28 VDC                 | N - Manual/Semi-automatic Grd |
| B - -2 VDC                  | P - Discriminator Meter (+)   |
| C - Ground Pulse Input      | R - (not used)                |
| D - Home Output             | S - (not used)                |
| E - Manual Ground Input     | T - Tune Sensitivity Drive    |
| F - RF Mute to I. Box       | U - Discriminator Meter (-)   |
| H - Manual Grd. To I. Box   | V - (not used)                |
| J - Motor-on Input          | W - +28 VDC (automatic)       |
| K - Reset & Tune Power Req. | X - Ground                    |
| L - Discriminator Signal    | Y - (Keyway)                  |
| M - Fault Input             | Z - (not used)                |

Figure 5-42. Tuner Control, Logic PCB Assembly 10A1A4, Component Locations From Foil Side.

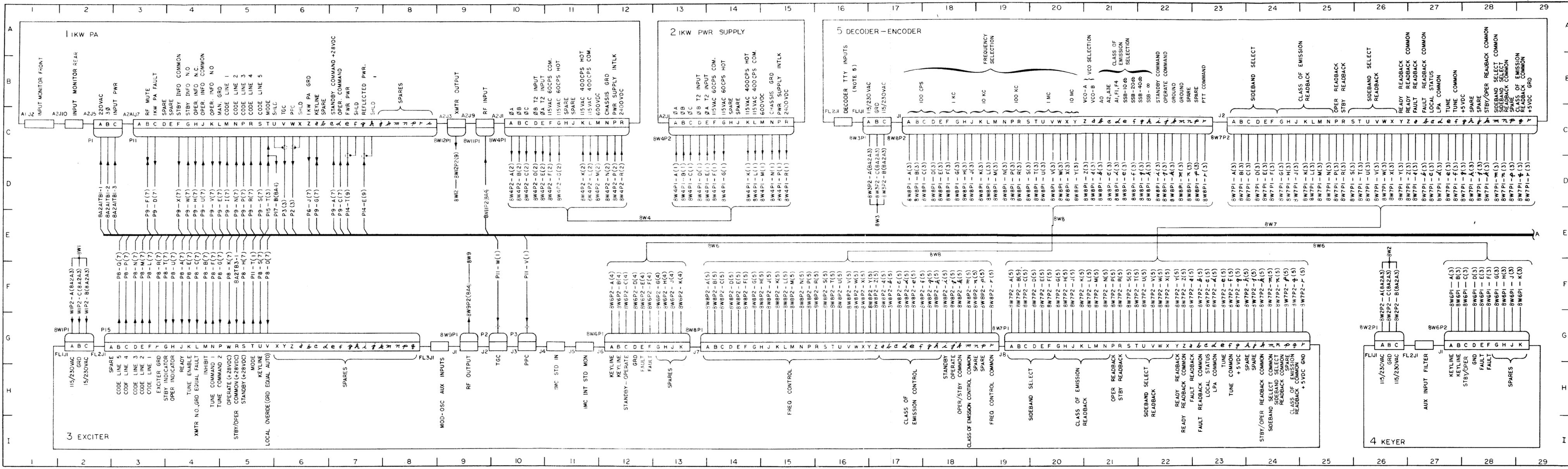
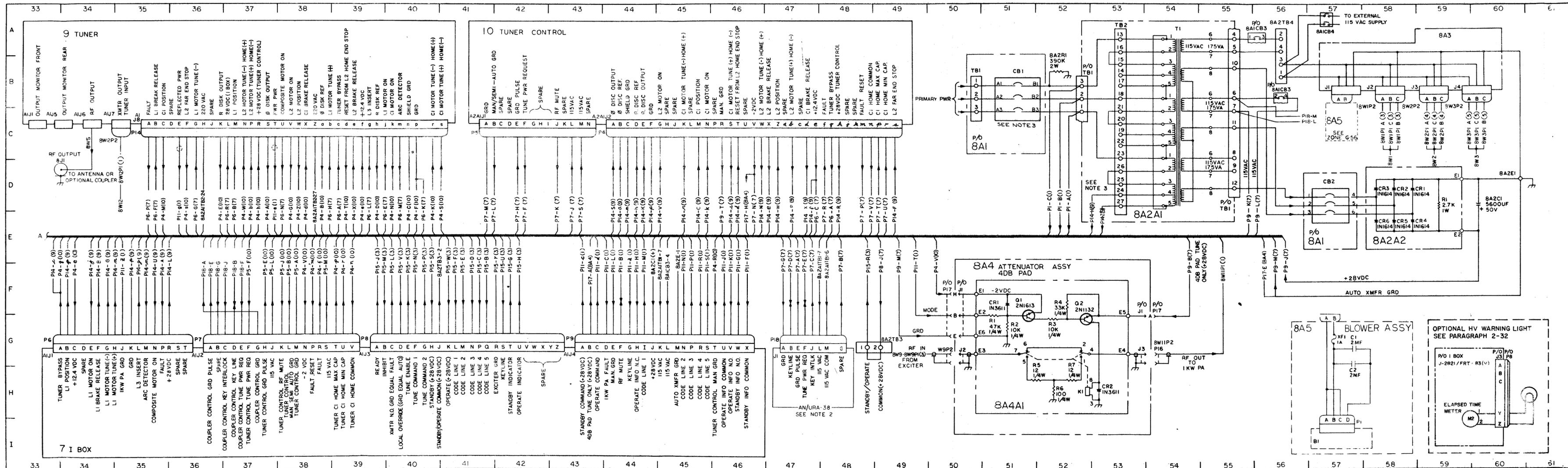


Figure 5-43. AN/FRT-83(V) Local Equipment Cabinet and Unit Interconnection Wiring, Schematic Diagram (Sheet 1 of 2)



- NOTES:
- INDICATES DIRECTION OF SIGNAL FLOW ONLY. CURRENT MAY FLOW EITHERWAY.
  - THESE WIRES SHALL BE CONNECTED ONLY IF URA-38 IS USED WITH THE SYSTEM.
  - 8A2AITB2 AND 8A1CB1 ARE SHOWN WIRED FOR 460VAC PRIMARY POWER FOR 220VAC PRIMARY POWER WIRE 8A2AITB2 AND 8A1CB1 AS SHOWN BELOW.
  - PREFIX ALL INCOMPLETED REFERENCE DESIGNATORS WITH 8WIO.
  - FOR DETAIL CONNECTIONS AND USE FOR REMOTE CONTROL UNIT SEE FIGURE 2-1, C-7709/FRT NAVSHIPS 0967-292-9040, AND FIGURE 5-25, KY 656/FRT NAVSHIPS 0967-292-9051.
  - A NUMERAL WITHIN PARENTHESIS ( ) AFTER A WIRE IDENTIFICATION NUMBER DENOTES THE UNIT IN WHICH THE WIRE COMES FROM OR GOES TO.

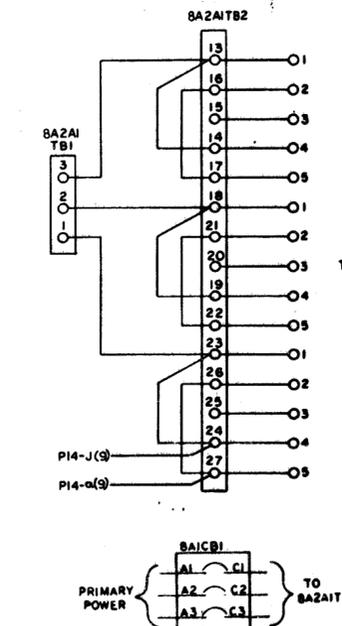


Figure 5-43. AN/FRT-83(V) Local Equipment Cabinet and Unit Interconnection Wiring, Schematic Diagram (Sheet 2 of 2)

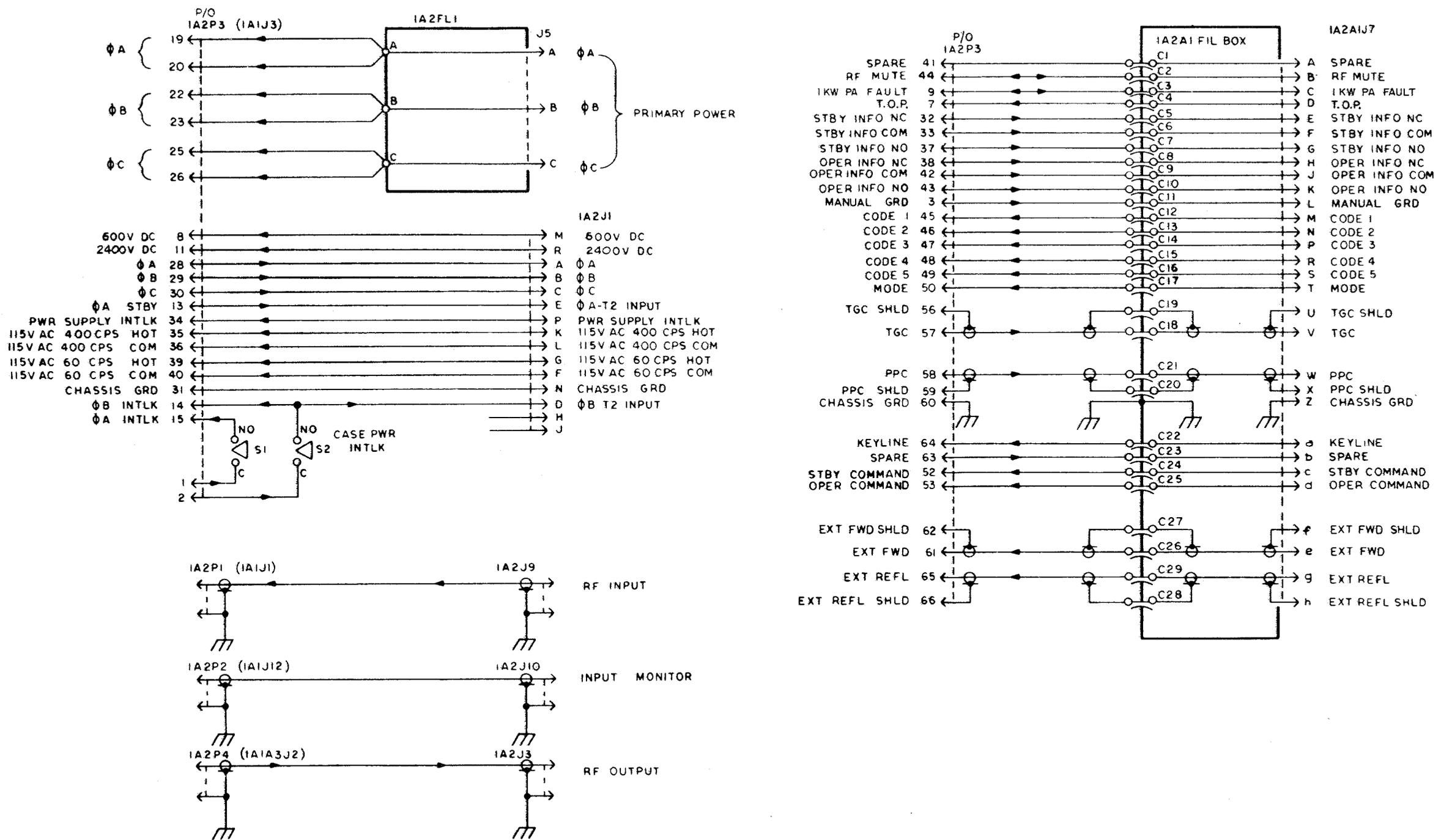


Figure 5-44. 1 KW PA, Case 1A2A1 and 1A2FL1, Schematic Diagram.

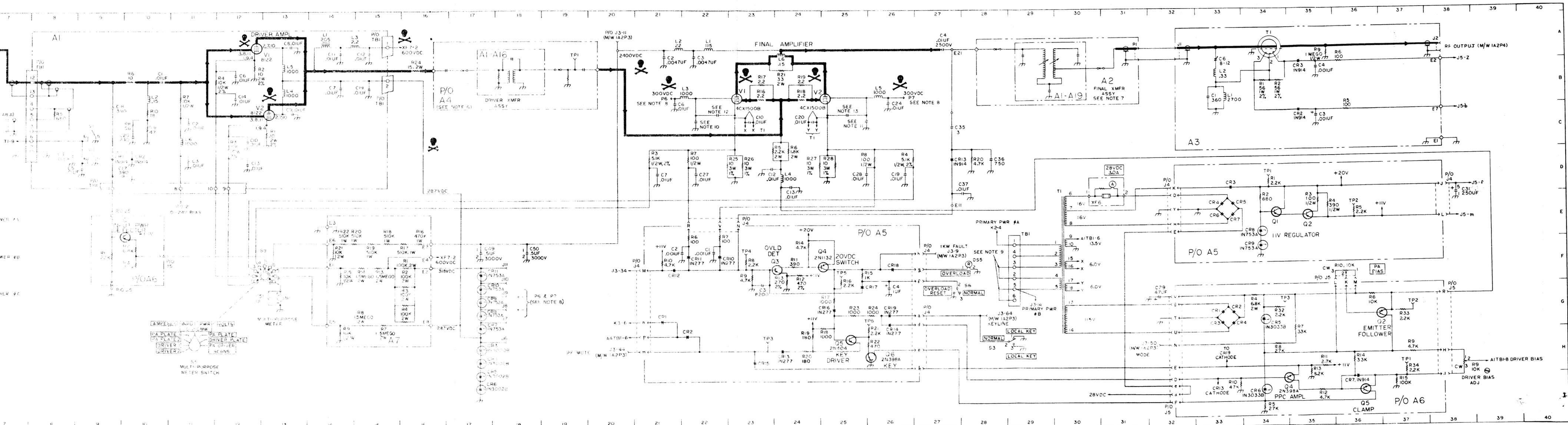
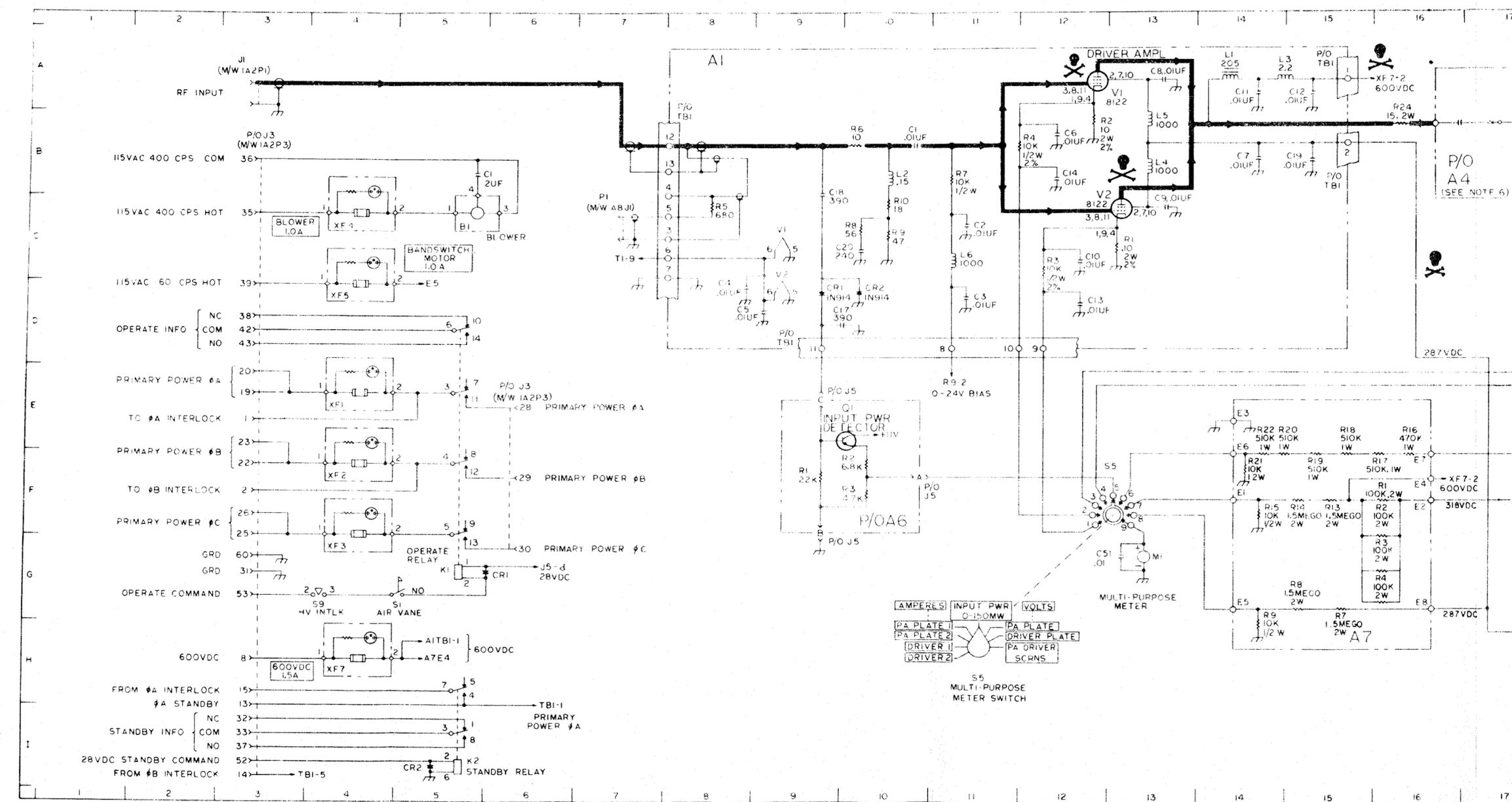
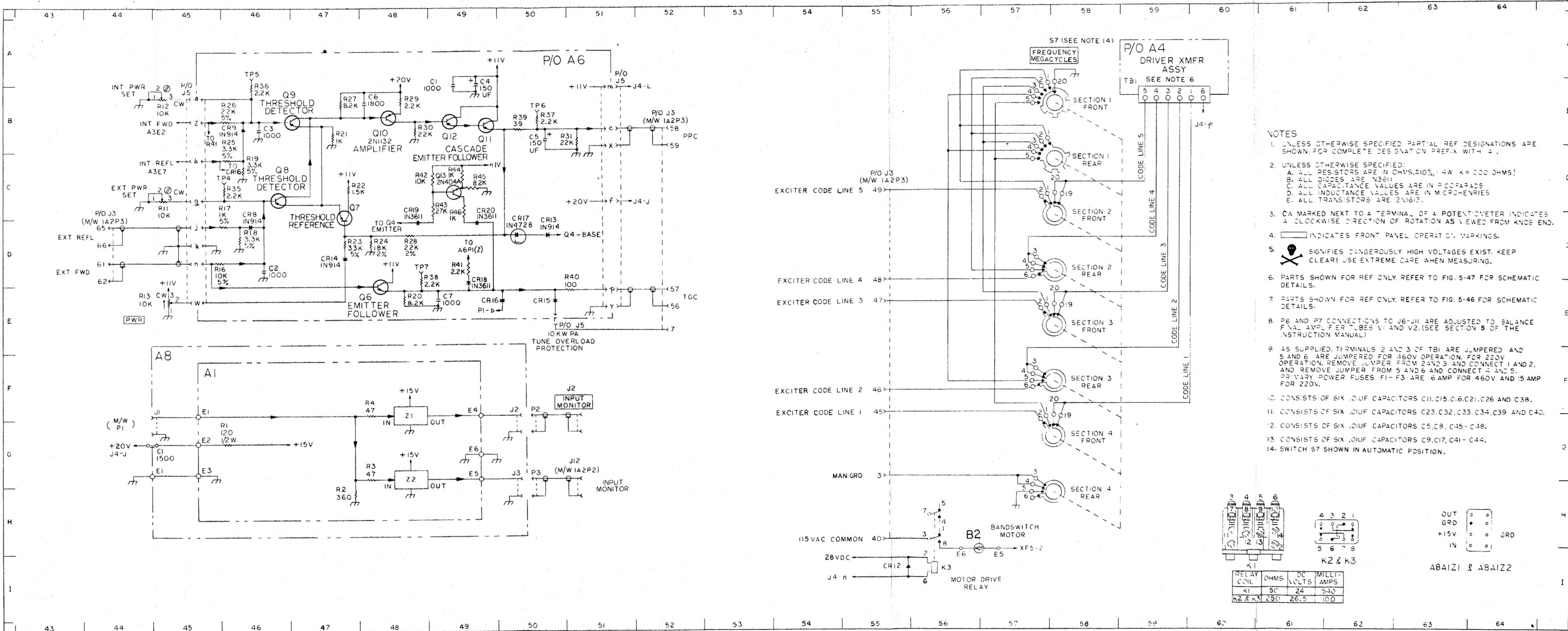


Figure 5-45. 1 KW PA, Chassis, 1A1, Schematic Diagram (Sheet 1 of 2)

ORIGINAL

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
R1	5C	D85	28F	R21	24B	A3C6	33A	A5R11	24F	A6R2	10F	A7R16	16E
R2	571	F1	4E	R24	16F	A3CR1	Not used	A5R12	24F	A6R3	10F	A7R17	16F
C1	5C	F2	4F	R25	23D	A3CR2	35C	A5R13	24F	A6R4	34G	A7R18	15E
C2	21A	F3	4F	R26	23D	A3CR3	35B	A5R14	24F	A6R5	34I	A7R19	15F
C3	22A	F4	4C	R27	24D	A3CR4	Not used	A5R15	25F	A6R6	36G	A7R20	15E
C4	27A	F5	4C	R28	25D	A3J1	32A	A5R16	25F	A6R7	35G	A7R21	14E
C5	22B	F6	31D	S1	5G	A3J2	35A	A5R17	25G	A6R8	34H	A7R22	14F
C6	22B	F7	4H	S3	28H	A3L1	33B	A5R18	25H	A6R9	37H	A8C1	45G
C7	21D	J1	3A	S5	13F	A3L2	33B	A5R19	24H	A6R10	33I	A8J1	45F
C8	22B	J2	51F	S6	28G	A3R1	34B	A5R20	24H	A6R11	35H	A8J2	50F
C9	25B	J3	3B, 6E,	S7	58A	A3R2	34B	A5R21	26G	A6R12	35I	A8J3	50G
C10	23C		20A, 27F,	S8	Not used	A3R3	Not used	A5R22	26G	A6R13	35H	A9A1R1	46G
C11	22C		28G, 20H,	S9	9G	A3R4	Not used	A5R23	25G	A6R14	36H	A8A1R2	47H
C12	23D		32H, 44D,	T1	30D	A3R5	36B	A5R24	26G	A6R15	37I	A8A1R3	48G
C13	24D		52B, 55C,	TB1	29E	A3R6	36A	A5TP1	34D	A6R16	46D	A8A1R4	48F
C14	22C	J4	21F, 27F,	V1	23B	A3R7	Not used	A5TP2	36E	A6R17	46D	A8A1Z1	48F
C15	22C		27G, 23E,	V2	25B	A3R8	Not used	A5TP3	23H	A6R18	46D	A8A1Z2	48H
C16	22C		38D, 32D,	A1C1	10B	A3R9	35B	A5TP4	23F	A6R19	46C		
C17	25B	J5	9E, 9G,	A1C2	11C	A3T1	34A	A5TP5	25F	A6R20	48E		
C18	24C		10F, 35F,	A1C3	11D	A4	17B, 69A	A5TP6	25H	A6R21	47B		
C19	26D		38G, 45B,	A1C4	8D	A5C1	22F	A6C1	49A	A6R22	47C		
C20	21C		51A, 50E	A1C5	8D	A5C2	21F	A6C2	46D	A6R23	47D		
C21	22C			A1C6	12B	A5C3	23G	A6C3	46B	A6R24	48D		
C22	25C	J6		A1C7	14B	A5C4	26G	A6C4	49A	A6R25	46B		
C23	25C			A1C8	13A	A5CR1	21G	A6C5	50B	A6R26	46B		
C24	26B	J7		A1C9	13C	A5CR2	22H	A6C6	48B	A6R27	47B		
C25	Not used	J8		A1C10	12C	A5CR3	33D	A6C7	49E	A6R28	48D		
C26	22C	J9		A1C11	11A	A5CR4	33E	A6CR1	33G	A6R29	48B		
C27	22D	J10		A1C12	15A	A5CR5	33E	A6CR2	33G	A6R30	48B		
C28	25D	J11		A1C13	12D	A5CR6	33E	A6CR3	33G	A6R31	51B		
C29	32G	J12		A1C14	12B	A5CR7	33E	A6CR4	33G	A6R32	34G		
C30	25C	K1		A1C15	10D	A5CR8	34E	A6CR5	34G	A6R33	37G		
C31	38D	K2		A1C16	10D	A5CR9	34F	A6CR6	34I	A6R34	37H		
C32	25C	K3		A1C17	10D	A5CR10	23F	A6CR7	36I	A6R35	46C		
C33	25C	K4		A1C18	9B	A5CR11	22F	A6CR8	46C	A6R36	46A		
C34	25C	L1		A1C19	15B	A5CR12	21F	A6CR9	46B	A6R37	50B		
C35	27C	L2		A1C20	10C	A5CR13	24H	A6CR10	50E	A6R38	48D		
C36	28D	L3		A1C21	10C	A5CR14	26G	A6CR11	50E	A6R39	50B		
C37	27D	L4		A1C22	10A	A5CR15	23H	A6CR12	50E	A6R40	51D		
C38	22C	L5		A1C23	15A	A5CR16	25G	A6CR13	50D	A6R41	49D		
C39	25C	L6		A1C24	12B	A5CR17	25G	A6CR14	47D	A6R42	49C		
C40	28C	L7		A1C25	10D	A5CR18	26F	A6CR15	50E	A6R43	49C		
C41	25B	M1		A1C26	10A	A5CR19	26G	A6CR16	50E	A6R44	49C		
C42	25B	M2		A1C27	13B	A5P1	21H, 23F,	A6CR17	50D	A6R45	49C		
C43	25B	P1		A1C28	13B		26F, 32F,	A6CR18	49D	A6R46	49C		
C44	25B	P2		A1C29	13B	A5Q1	31E	A6CR19	98C	A6R47	49C		
C45	22B	P3		A1C30	11C	A5Q2	35E	A6CR20	49C	A6R48	49C		
C46	22B	P4		A1C31	11C	A5Q3	23F	A6P1	9E, 9F,	A6TP1	37H		
C47	22B	P5		A1C32	10B	A5Q4	25F		10F, 32G,	A6TP2	37G		
C48	22B	P6		A1C33	10A	A5Q5	25H		35F, 38G,	A6TP3	39G		
C49	17F	R1		A1C34	13C	A5Q6	26H		45A, 51B	A6TP4	46C		
C50	18F	R2		A1C35	13B	A5Q7	26H	A6Q1	10E	A6TP5	46A		
C51	12G	R3		A1C36	11C	A5Q8	26H	A6Q2	37G	A6TP6	50B		
CR1	6G	R4		A1C37	11B	A5Q9	25F			A6TP7	98B		
CR2	5I	R5		A1C38	10C	A5Q10	25H			A7R1	16F		
CR3	17H	R6		A1C39	10C	A5Q11	26H			A7R2	16F		
CR4	17H	R7		A1C40	10C	A5Q12	26H			A7R3	16G		
CR5	17H	R8		A1C41	10C	A5Q13	26H			A7R4	16G		
CR6	17I	R9		A1C42	10C	A5Q14	26H			A7R5	15G		
CR7	17G	R10		A1C43	10C	A5Q15	26H			A7R6	15G		
CR8	17G	R11		A1C44	10C	A5Q16	26H			A7R7	14G		
CR9	17G	R12		A1C45	10C	A5Q17	26H			A7R8	15F		
CR10	17G	R13		A1C46	10C	A5Q18	26H			A7R9	14G		
CR11	17E	R14		A1C47	10C	A5Q19	26H			A7R10	15F		
CR12	55I	R15		A1C48	10C	A5Q20	26H			A7R11	15F		
CR13	27D	R16		A1C49	10C	A5Q21	26H			A7R12	15F		
		R17		A1C50	10C	A5Q22	26H			A7R13	15F		
		R18		A1C51	10C	A5Q23	26H			A7R14	15F		
		R19		A1C52	10C	A5Q24	26H			A7R15	14F		
		R20		A1C53	10C	A5Q25	26H						





- NOTES
- UNLESS OTHERWISE SPECIFIED PARTIAL REF DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH A.
  - UNLESS OTHERWISE SPECIFIED:
    - A. ALL RESISTORS ARE IN OHMS, ±10%, 1/4 W, K = 1000 OHMS
    - B. ALL DIODES ARE IN3611
    - C. ALL CAPACITANCE VALUES ARE IN PICO-FARADS
    - D. ALL INDUCTANCE VALUES ARE IN MICRO-HENRIES
    - E. ALL TRANSISTORS ARE 2N1613.
  - CW MARKED NEXT TO A TERMINAL OF A POTENTIOMETER INDICATES A CLOCKWISE DIRECTION OF ROTATION AS VIEWED FROM KNOB END.
  - INDICATES FRONT PANEL OPERATION MARKINGS.
  - SIGNIFIES DANGEROUSLY HIGH VOLTAGES EXIST. KEEP CLEAR! USE EXTREME CARE WHEN MEASURING.
  - PARTS SHOWN FOR REF ONLY. REFER TO FIG. 5-47 FOR SCHEMATIC DETAILS.
  - PARTS SHOWN FOR REF ONLY. REFER TO FIG. 5-46 FOR SCHEMATIC DETAILS.
  - P6 AND P7 CONNECTIONS TO J6-J11 ARE ADJUSTED TO BALANCE FINAL AMPLIFIER TUBES V1 AND V2. (SEE SECTION 5 OF THE INSTRUCTION MANUAL)
  - AS SUPPLIED, TERMINALS 2 AND 3 OF TBI ARE JUMPED AND 5 AND 6 ARE JUMPED FOR 460V OPERATION. FOR 220V OPERATION, REMOVE JUMPER FROM 2 AND 3 AND CONNECT 1 AND 2, AND REMOVE JUMPER FROM 5 AND 6 AND CONNECT 4 AND 5. PRIMARY POWER FUSES F1-F3 ARE 6 AMP FOR 460V AND 15 AMP FOR 220V.
  - CONSISTS OF SIX .01UF CAPACITORS C11, C15, C16, C21, C26 AND C38.
  - CONSISTS OF SIX .01UF CAPACITORS C23, C32, C33, C34, C39 AND C40.
  - CONSISTS OF SIX .01UF CAPACITORS C5, C8, C45-C48.
  - CONSISTS OF SIX .01UF CAPACITORS C9, C17, C41-C44.
  - SWITCH S7 SHOWN IN AUTOMATIC POSITION.

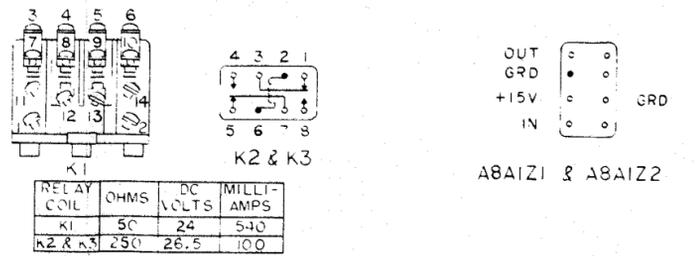


Figure 5-45. 1 KW PA Chassis, 1A1, Schematic Diagram (Sheet 2 of 2)

- NOTES:  
 1 UNLESS OTHERWISE INDICATED ALL CAPACITORS ARE IN PICO FARADS AND RESISTORS ARE IN OHMS  
 2 SWITCH IS SHOWN IN 2.0-2.5 MC POSITION  
 3 † INDICATES BLUE COLOR CODED TUNING SCREW  
 ‡ INDICATES UNCODED SCREW  
 ↳ ARROWS INDICATE DIRECTION OF SLUG TRAVEL WITH CLOCKWISE ROTATION OF SCREW  
 4 PREFIX PARTIAL REFERENCE DESIGNATIONS WITH 1A1A2  
 5 \* CONSISTS OF R1 THROUGH R4 IN PARALLEL, EACH 27K, 2W  
 \*\* CONSISTS OF R5 THROUGH R8 IN PARALLEL, EACH 27K, 2W

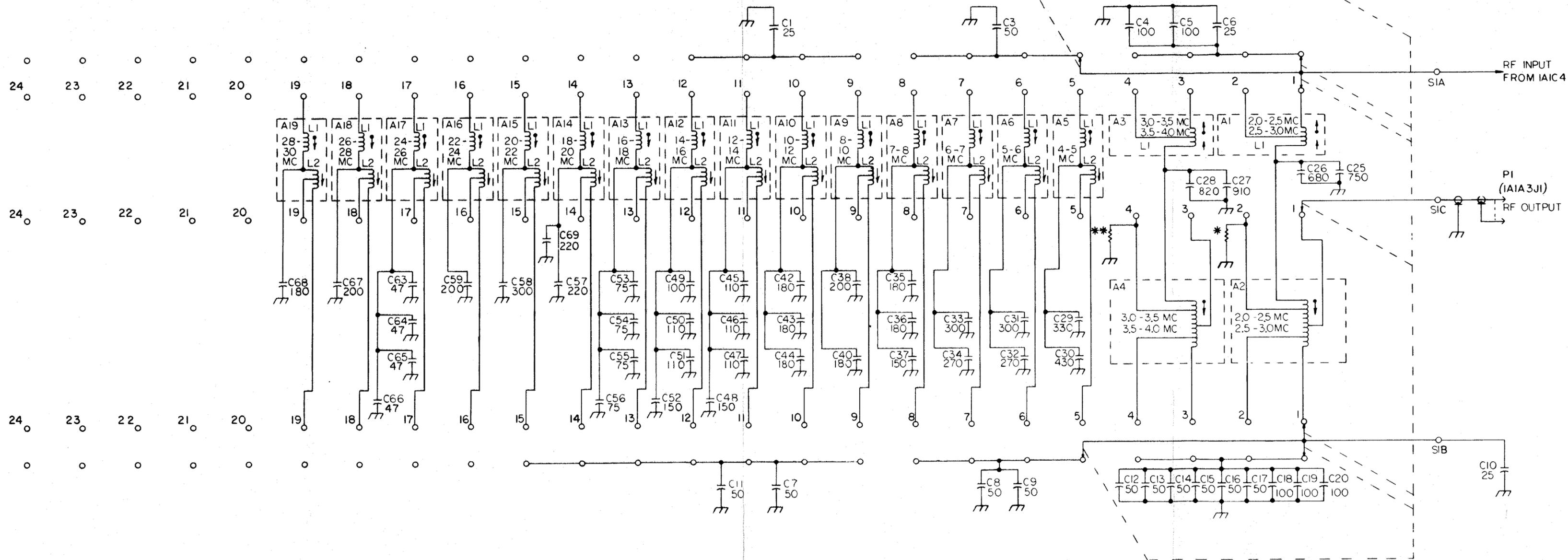
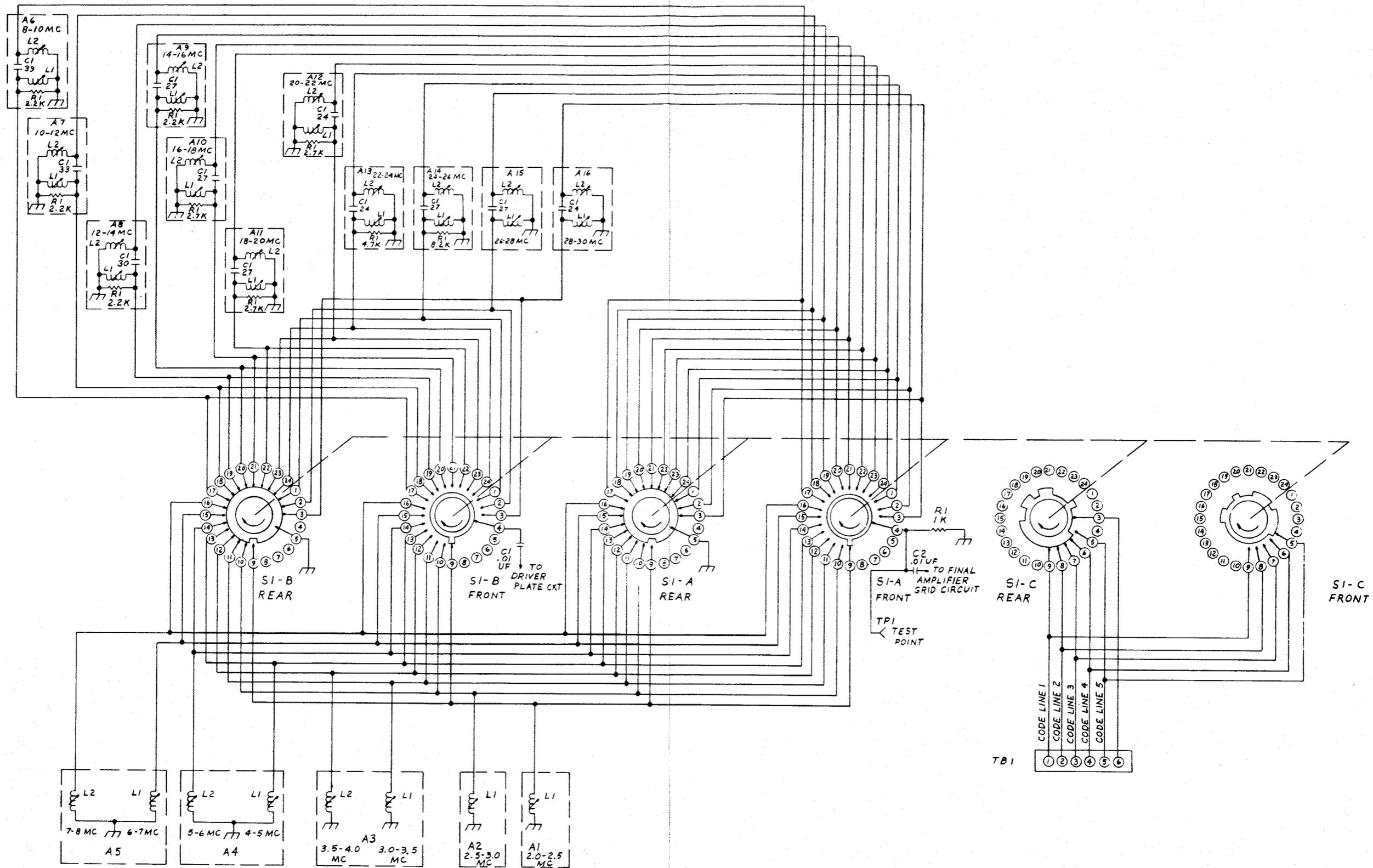


Figure 5-46. 1 KW PA, Final Transformer Assembly 1A1A2, Schematic Diagram



NOTES:

1. UNLESS OTHERWISE INDICATED
- A. ALL CAPACITORS ARE IN PICOFARADS
- B. ALL RESISTORS ARE IN OHMS, 2W, 10% CARBON

Figure 5-47. 1 KW PA, Driver Transformer Assembly 1A1A4, Schematic Diagram

NOTES:

1. UNLESS OTHERWISE INDICATED:  
A ALL RESISTORS ARE IN OHMS, 1/2 W, 10%.
2. PREFIX ALL INCOMPLETE REFERENCE DESIGNATIONS WITH 2A1.
3.   INDICATES FRONT PANEL MARKING.

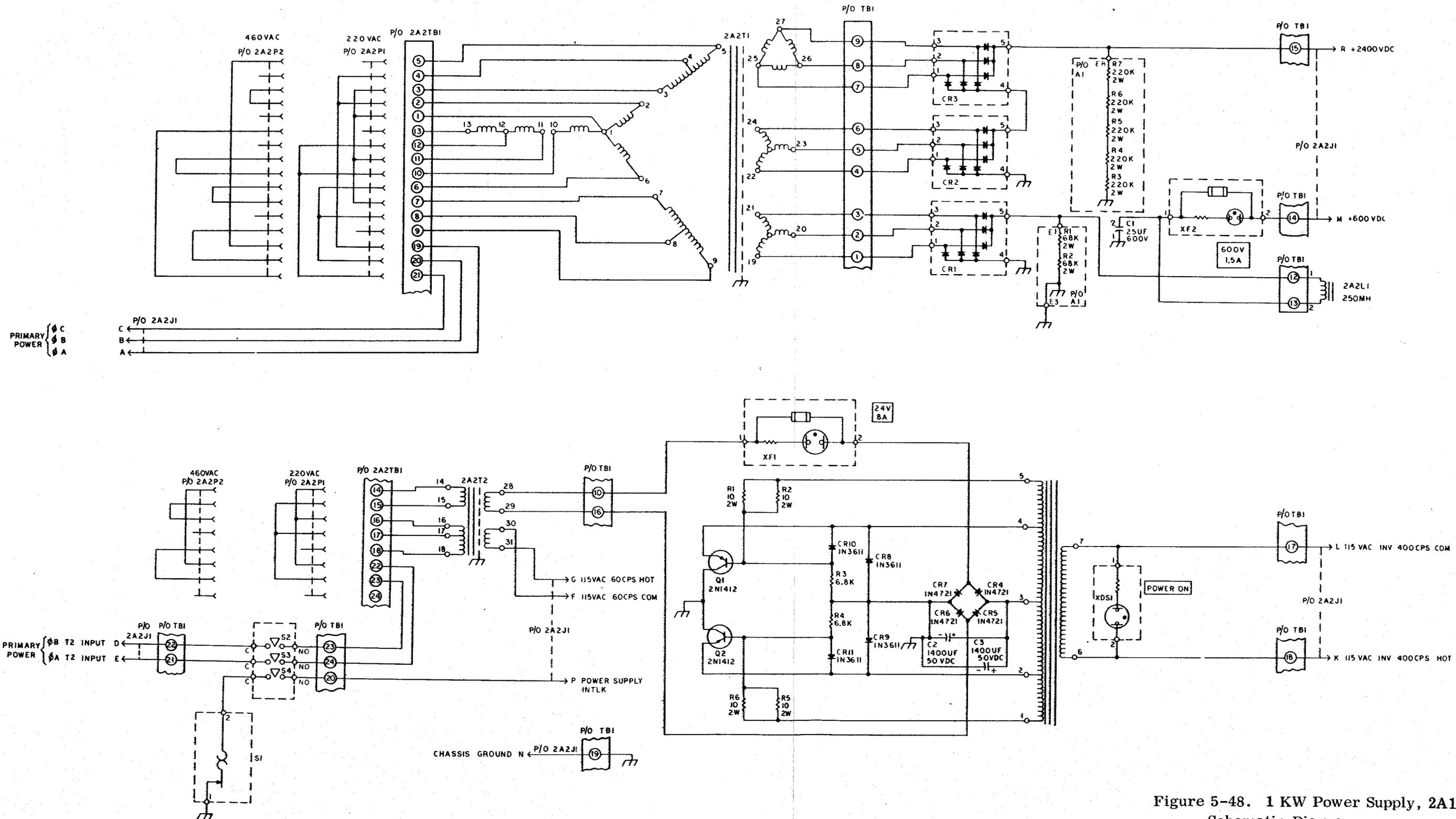


Figure 5-48. 1 KW Power Supply, 2A1, Schematic Diagram

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
A1R3	42D	A2C33	6D	A4A1CR3	49H
A1R1	39E	A2C34	5D	A4A1CR4	50G
A1R5	42D	A2C35	5D		
A1R6	40E	A2C36	6D	A4A1Q1	50F
A1R7	40D	A2C37	5D	A4A1Q2	51F
A1R11	40B	A2C38	6D	A4A1Q3	49F
A1R12	41C	A2C39	5D	A4A1R1	51G
A1R13	42B	A2C40	6C	A4A1R2	49G
A1R14	42C	A2C41	5C	A4A1R3	49H
A1R15	41B	A2C42	5B	A4A1R4	49F
A1R16	41C	A2C44	35B	A4A1R5	50F
A1R17	44D	A2C45	6C	A4A1R6	50G
A1R18	44D	A2C46	5I	A4A1R7	50G
A1R19	45D	A2C47	5B	A4A1R8	51F
A1R20	41B	A2C48	6B		
A1R21	44B	A2C49	6B		
A1R22	45B	A2C50	6A		
A1R23	38D	A2C51	5B		
A1R24	38C	A2C52	6A		
A1R25	38B	A2C53	5A		
A4TP1	44D	A2C54	5A		
A4TP2	42D	A2C56	35C		
A4TP3	39B	A2C57	35C		
A4TP4	39B	A2C58	6I		
A4TP5	41B	A2C59	6H		
A4TP6	44C	A2C60	5H		
C1	5F	A2C61	35B		
C2	6C	A2C62	35B		
C3	6C	A2C63	6H		
C4	35D	A2CR1	46C		
C5	6F	A2CR2	46E		
C6	35I	A2L1	5H		
C7	35H	A2Q1	46B		
C8	35H	A2Q2	46C		
C9	35H	A2Q3	46D		
C10	35E	A2Q4	46E		
C11	5H	A2R1	6C		
C12	5G	A3K1	22H		
C13	5G	A3K2	25H		
C14	35H	A3K3	27H		
C15	6F	A3K4	23G		
C16	6E				
C17	5G				
C18	5G	A4P1	38F, 41F, 48A		
C19	5G				
C20	5F				
C21	35D	A4R1	52C		
C22	5F	A4R2	52C		
C23	35C	A4R3	52C		
C24	5C	A4R4	51D		
C25	4H	A4R5	51D		
C26	5H	A4R6	51D		
C27	35G	A4R7	50E		
C28	35F	A4R8	50E		
C29	35F	A4R9	53E		
C30	35F	A4S1	38H, 41H, 42H, 43H, 45H, 49B, 54B, 53G, 55G		
C31	35F	A4A1CR1	50G		
C32	5D	A4A1CR2	49H		

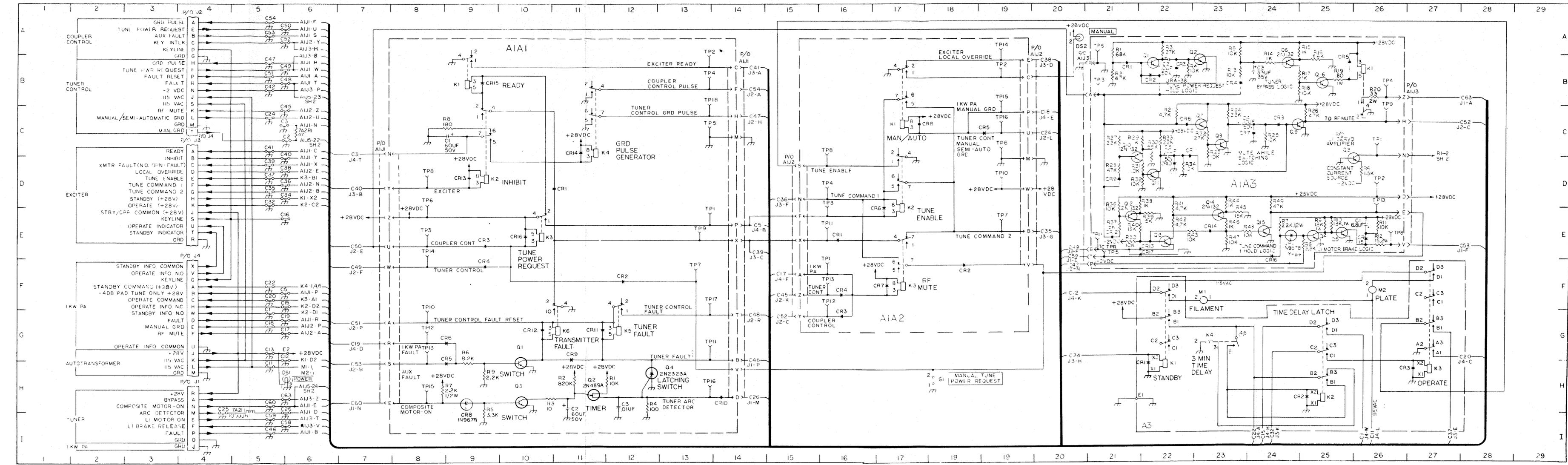
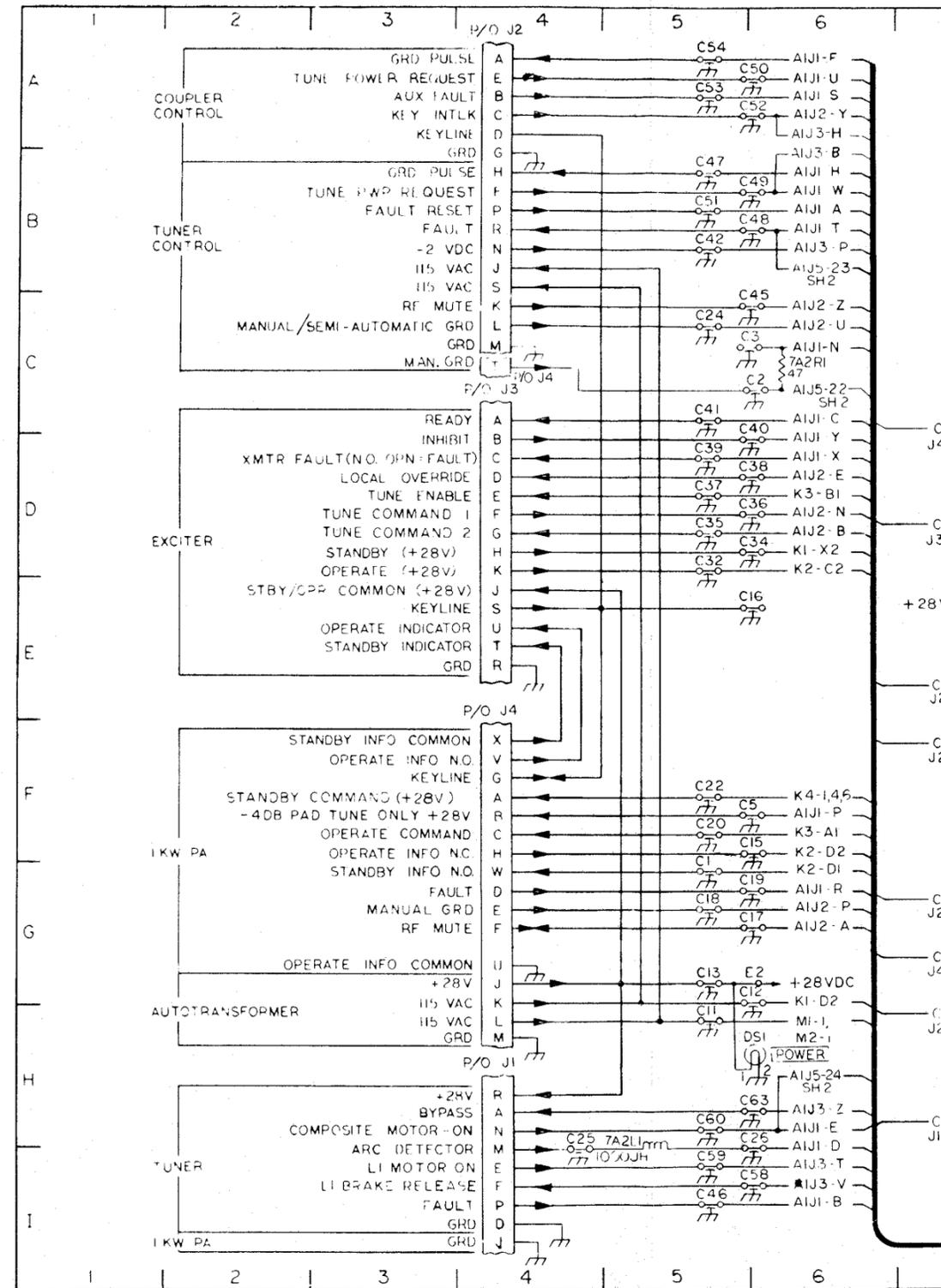
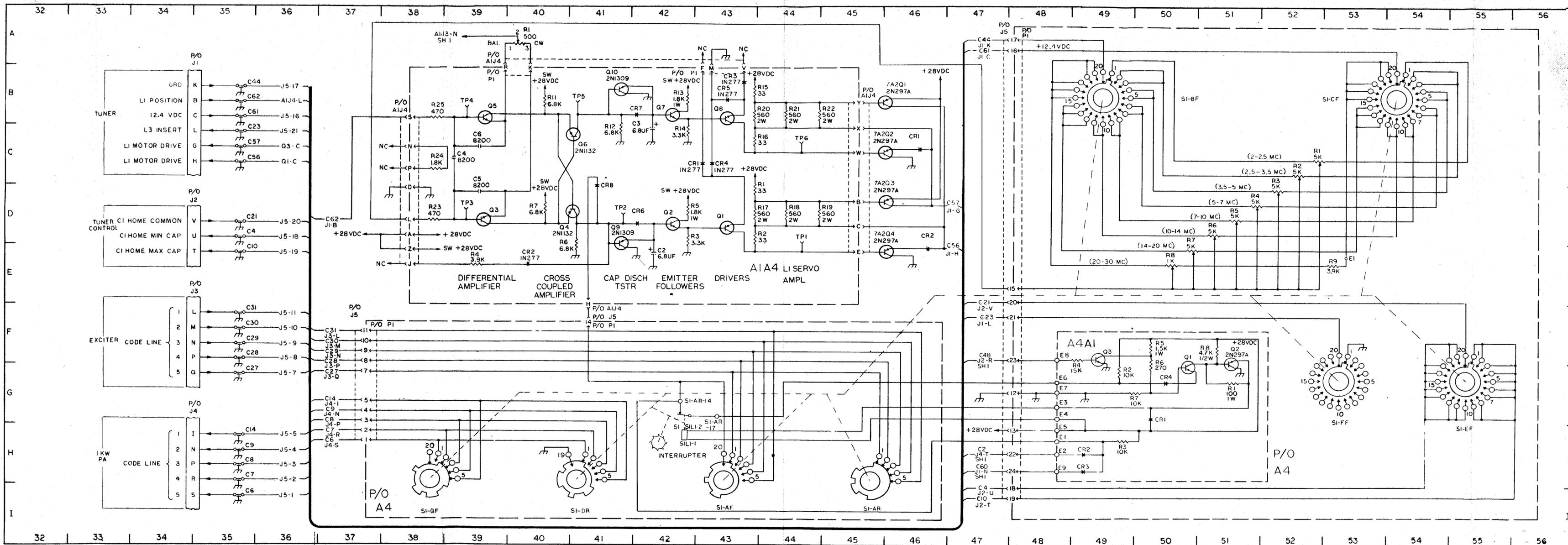


Figure 5-49. I. Box, 7A1, Schematic Diagram (Sheet 1 of 2)

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
DS1	6H	A1A1TP1	13E	A1A3CR9	21D	A1A3R33	22C	A1A1R3	12D	A2C33	6D	A1A1CR3	49H		
DS2	20A	A1A1TP2	13A	A1A3CR10	22D	A1A3R34	22D	A1A1R1	39E	A2C34	5D	A1A1CR4	50G		
J1	34A,4H	A1A1TP3	8E	A1A3CR11	23C	A1A3R36	21D	A1A1R5	42D	A2C35	5D	A1A1Q1	50F		
J2	34D,4A	A1A1TP4	13B	A1A3CR12	21E	A1A3R37	21E	A1A1R6	10E	A2C36	6D	A1A1Q2	51F		
J3	34F,4C	A1A1TP5	14C	A1A3CR13	22E	A1A3R38	22D	A1A1R7	10D	A2C37	5D	A1A1Q3	49F		
J4	34G,4F,4C	A1A1TP6	8D	A1A3CR14	23E	A1A3R39	22E	A1A4R11	40B	A2C38	6D				
J5	37F,41F,47A	A1A1TP7	13F	A1A3CR15	26E	A1A3R40	21E	A1A4R12	41C	A2C39	5D	A1A1R1	51G		
M1	23F	A1A1TP8	8D	A1A3CR16	24F	A1A3R41	22D	A1A4R13	42B	A2C40	6C	A1A1R2	49G		
M2	26F	A1A1TP9	13E	A1A3CR17	22E	A1A3R42	22E	A1A4R14	42C	A2C41	5C	A1A1R3	49H		
S1	18H	A1A1TP10	8F	A2A3K1	26B	A1A3R43	22E	A1A4R15	44B	A2C42	5B	A1A1R4	49F		
R1	40A	A1A1TP11	13G	A1A3Q1	22B	A1A3R44	23D	A1A4R16	44C	A2C44	35B	A1A1R5	50F		
A1J1	7C,14B	A1A1TP12	8G	A1A3Q2	23A	A1A3R45	23E	A1A4R17	44D	A2C45	6C	A1A1R6	50G		
A1J2	15D,20A	A1A1TP13	8G	A1A3Q3	25C	A1A3R46	23E	A1A4R18	44D	A2C46	5I	A1A1R7	50G		
A1J3	20B,27B	A1A1TP14	8E	A1A3Q4	25E	A1A3R47	23E	A1A4R19	45D	A2C47	5B	A1A1R8	51F		
A1J4	38B,41F,45B,38A	A1A1TP15	8H	A1A3Q5	25E	A1A3R48	24E	A1A4R20	44B	A2C48	6B				
		A1A1TP16	14H	A1A3Q6	24B	A1A3R49	24E	A1A4R21	44B	A2C49	6B				
		A1A1TP17	14H	A1A3Q7	23C	A1A3R50	21E	A1A4R22	45B	A2C50	6A				
		A1A1TP18	14B	A1A3Q8	23C	A1A3TP1	26C	A1A4R23	38D	A2C51	5B				
A1A1C1	9C	A1A2CR1	16E	A1A3Q9	24C	A1A3TP2	26D	A1A4R24	38C	A2C52	6A				
A1A1C2	11H	A1A2CR2	18F	A1A3Q10	21C	A1A3TP3	21B	A1A4R25	38B	A2C53	5A				
A1A1C3	12H	A1A2CR3	16G	A1A3Q11	22D	A1A3TP4	26B	A1A4TP1	44D	A2C54	5A				
A1A1CR1	11D	A1A2CR4	16F	A1A3Q12	21E	A1A3TP5	21E	A1A4TP2	42D	A2C56	35C				
A1A1CR2	12H	A1A2CR5	19C	A1A3Q13	22E	A1A3TP6	21B	A1A4TP3	39B	A2C57	35C				
A1A1CR3	9F	A1A2CR6	17D	A1A3Q14	23E	A1A3TP7	24F	A1A4TP4	39B	A2C58	6I				
A1A1CR4	9F	A1A2CR7	17F	A1A3Q15	24E	A1A3TP8	26E	A1A4TP5	41B	A2C59	6H				
A1A1CR5	9G	A1A2CR8	17C	A1A3Q16	25B	A1A3TP9	26B	A1A4TP6	44C	A2C60	5H				
A1A1CR6	9G	A1A2K1	17C	A1A3R1	21A	A1A3TP10	26D	A2C1	5F	A2C61	35B				
A1A1CR7	9H	A1A2K2	17D	A1A3R2	21B	A1A3TP11	21E	A2C2	6C	A2C62	35B				
A1A1CR9	11G	A1A2K3	17F	A1A3R3	22A	A1A3VR1	24E	A2C3	6C	A2C63	6H				
A1A1CR10	14H	A1A2P1	19A,15C	A1A3R4	23B	A1A4C2	32E	A2C4	35D	A2CR1	46C				
A1A1CR11	11G	A1A2TP1	16E	A1A3R5	23A	A1A4C3	42C	A2C5	6F	A2CR2	46E				
A1A1CR12	10G	A1A2TP2	19B	A1A3R6	26D	A1A4C4	39C	A2C6	35I	A2L1	5H				
A1A1CR13	9D	A1A2TP3	16D	A1A3R7	24E	A1A4C5	39D	A2C7	35H	A2Q1	46B				
A1A1CR14	11C	A1A2TP4	16D	A1A3R8	25E	A1A4C6	39C	A2C8	35H	A2Q2	46C				
A1A1CR15	9B	A1A2TP6	19C	A1A3R9	25E	A1A4CR1	43C	A2C9	35H	A2Q3	46D				
A1A1CR16	10E	A1A2TP7	19E	A1A3R10	25E	A1A4CR2	40E	A2C10	35E	A2Q4	46E				
A1A1K1	9B	A1A2TP10	19D	A1A3R11	26E	A1A4CR3	43B	A2C11	5H	A2R1	6C				
A1A1K2	9D	A1A2TP11	16E	A1A3R12	26E	A1A4CR4	43C	A2C12	5G	A3K1	22H				
A1A1K3	10E	A1A2TP12	16F	A1A3R13	23B	A1A4CR5	43B	A2C13	5G	A3K2	25H				
A1A1K4	11C	A1A2TP13	16F	A1A3R14	24B	A1A4CR6	42D	A2C14	35H	A3K3	27H				
A1A1K5	12G	A1A2TP14	19A	A1A3R15	25A	A1A4CR7	42B	A2C15	6F	A3K4	23G				
A1A1K6	11G	A1A2TP15	19B	A1A3R16	25A	A1A4CR8	41D	A2C16	6E	A4P1	38F,41F,48A				
A1A1P1	8C,14B	A1A2TP16	19C	A1A3R17	25B	A1A4P1	38B,39B,42B,41E,45B	A2C17	5G	A4R1	52C				
A1A1Q1	10G	A1A3C1	26E	A1A3R18	25B	A1A4Q1	43D	A2C18	5G	A4R2	52C				
A1A1Q2	11H	A1A3C2	22B	A1A3R19	25B	A1A4Q2	42D	A2C19	5G	A4R3	52C				
A1A1Q3	10H	A1A3C3	24B	A1A3R20	26B	A1A4Q3	39D	A2C20	5F	A4R4	51D				
A1A1Q4	12H	A1A3C4	23C	A1A3R21	22C	A1A4Q4	40D	A2C21	35D	A4R5	51D				
A1A1R1	12H	A1A3C5	22C	A1A3R22	23C	A1A4Q5	39B	A2C22	5F	A4R6	51D				
A1A1R2	11H	A1A3CR1	21B	A1A3R23	23D	A1A4Q6	41C	A2C23	35C	A4R7	50E				
A1A1R3	10H	A1A3CR2	22B	A1A3R24	23C	A1A4Q7	42B	A2C24	5C	A4R8	50E				
A1A1R4	12H	A1A3CR3	22B	A1A3R25	24C	A1A4Q8	43B	A2C25	4H	A4R9	53E				
A1A1R5	9I	A1A3CR4	23B	A1A3R26	25C	A1A4Q9	41D	A2C26	5H	A4S1	38H,41H,42H,43H,45H,49B,54B,53G,55G				
A1A1R6	9G	A1A3CR5	25A	A1A3R27	21C	A1A4Q10	41D	A2C27	35G	A4A1CR1	50G				
A1A1R7	8H	A1A3CR6	22C	A1A3R28	21D	A1A4R1	44D	A2C28	35F	A4A1CR2	49H				
A1A1R8	9C	A1A3CR7	24C	A1A3R29	21C	A1A4R2	44D	A2C29	35F						
A1A1R9	9H	A1A3CR8	24C	A1A3R30	22C			A2C30	35F						
				A1A3R31	21D			A2C31	35F						
				A1A3R32	21D			A2C32	5D						





- NOTES
1. PREFIX INCOMPLETE DESIGNATIONS WITH 7A1.
  2. UNLESS OTHERWISE SPECIFIED:
    - a ALL RESISTORS ARE IN OHMS, 1/4W, 5%
    - b ALL CAPACITORS ARE IN PF
    - c ALL DIODES ARE IN3611
    - d ALL TRANSISTORS ARE 2N1613.
  3. INDICATES FRONT PANEL MARKINGS.
  4. FEEDTHRU CAPACITORS, C1-C63, ARE P/O A2. PREFIX DESIGNATIONS WITH 7A1A2.

Figure 5-49. I. Box, 7A1, Schematic Diagram (Sheet 2 of 2)

ORIGINAL

5-103/5-104 (blank)

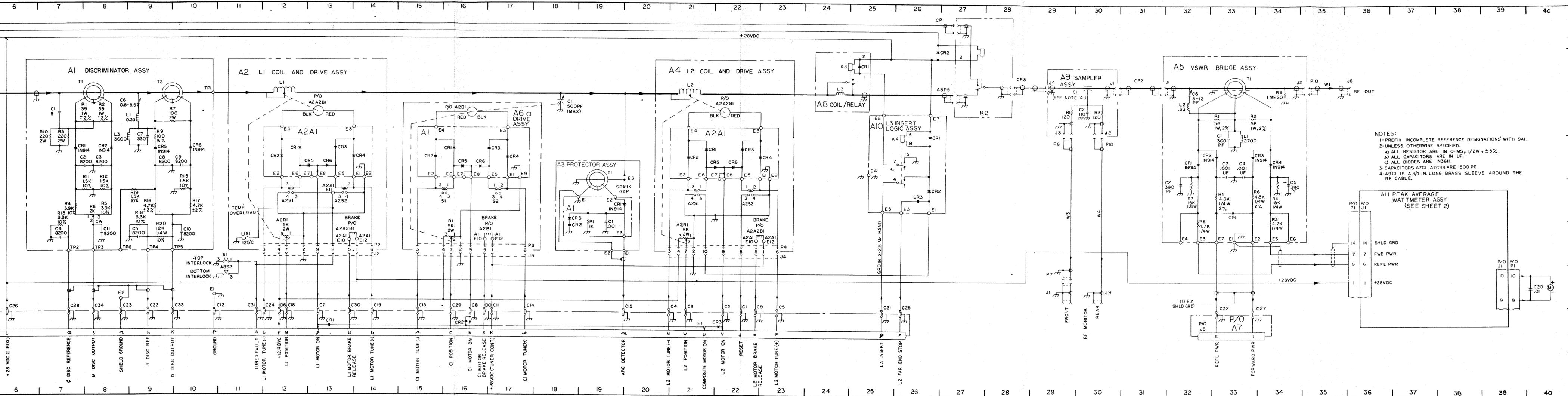
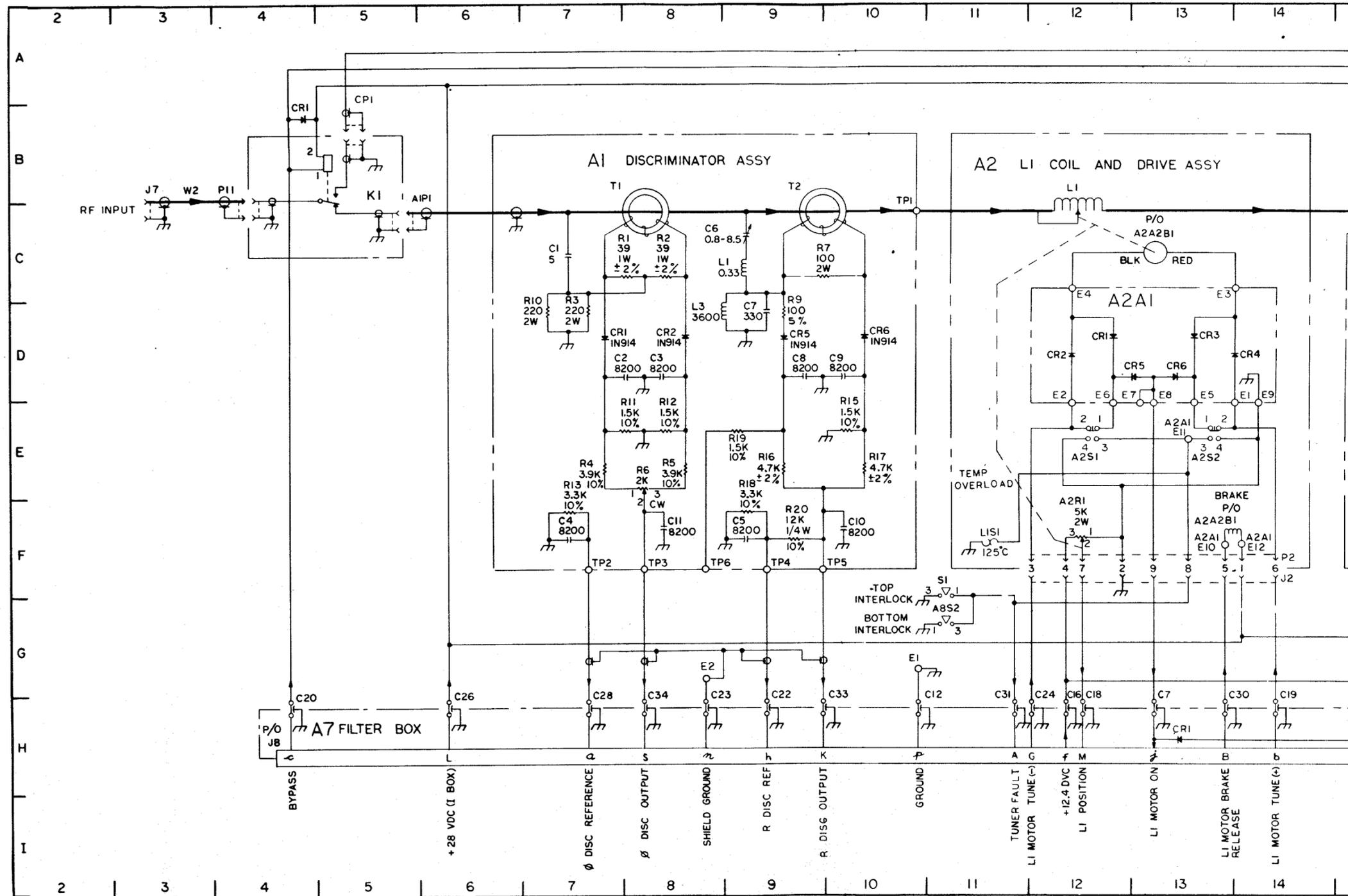
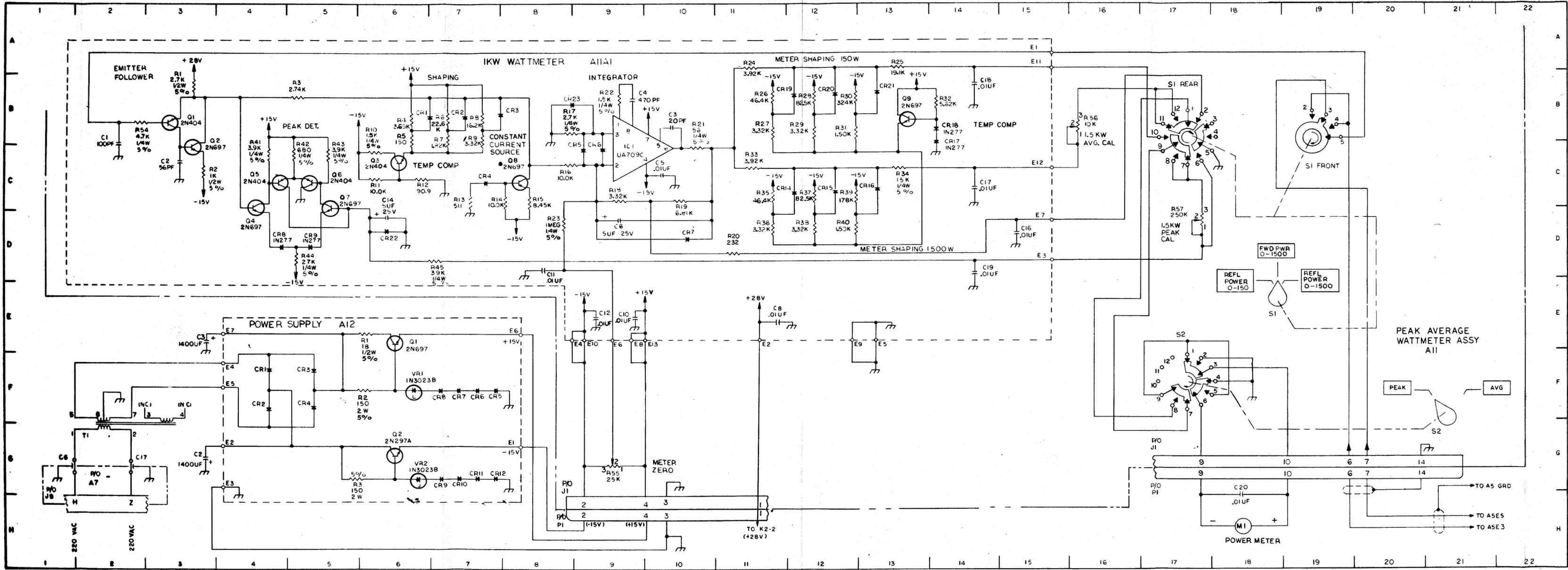


Figure 5-50. Tuner, 9A1, Schematic Diagram (Sheet 1 of 2)

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	18C	A1R3	7D	A6	17C	A11A1Q7	46D
C2	44G	A1R4	7E	A7	5H,33H	A11A1Q8	49C
C3	44E	A1R5	8E		43H	A11A1Q9	54B
C20	59E	A1R6	8E	A8	24B		
CP1	5B	A1R7	9C	A9	28C	A11A1R1	44B
CP2	27A	A1R9	9D	A10	26D	A11A1R2	44C
CP3	28B	A1R10	7D	A11J1	36E,39F	A11A1R3	46B
CR1	4B	A1R11	8E		58E,49G	A11A1R4	47B
CR2	26B	A1R12	8E	A11R55	50G	A11A1R5	47B
J1	29F	A1R13	7F	A11R56	57B	A11A1R6	48B
J2	14F	A1R15	10E	A11R57	58D	A11A1R7	48B
J3	18F	A1R16	9E	A11S1	58B,60B	A11A1R8	48B
J4	23F	A1R17	10E	A11S2	58F	A11A1R9	48B
J7	3B	A1R18	9E	A11A1C1	43B	A11A1R10	47B
J8	43H	A1R19	9E	A11A1C2	44C	A11A1R11	47C
J9	30F	A1R20	9F	A11A1C3	51B	A11A1R12	47C
K1	5B	A1T1	7B	A11A1C4	50B	A11A1R13	48C
K2	28C	A1T2	9B	A11A1C5	51C	A11A1R14	48C
M1	40G	A1TP1	10B	A11A1C6	50D	A11A1R15	49C
P1	36E,17H, 8H,39G	A1TP2	7F	A11A1C8	52E	A11A1R16	49C
P7	29F	A1TP3	8F	A11A1C10	50E	A11A1R17	49B
P8	29D	A1TP4	9F	A11A1C11	49D	A11A1R18	50C
P10	30D	A1TP5	10F	A11A1C12	50E	A11A1R19	51C
P11	4B	A1TP6	8F	A11A1C14	47C	A11A1R20	52D
S1	11F	A2	11B	A11A1C16	56D	A11A1R21	51B
T1	43F	A3	18D	A11A1C17	55C	A11A1R22	50B
W2	3B	A4	21B	A11A1C18	55B	A11A1R23	49D
W3	29E	A5C1	33D	A11A1C19	55D	A11A1R24	52A
W4	30E	A5C2	32E	A11A1CR1	47B	A11A1R25	54A
A1C1	7C	A5C3	33D	A11A1CR2	48B	A11A1R26	52B
A1C2	8D	A5C4	33D	A11A1CR3	48B	A11A1R27	52B
A1C3	8D	A5C5	34E	A11A1CR4	48C	A11A1R28	53B
A1C4	7F	A5C6	32C	A11A1CR5	50C	A11A1R29	53B
A1C5	9F	A5CR1	32D	A11A1CR6	50C	A11A1R30	53B
A1C6	8C	A5CR2	33D	A11A1CR7	51D	A11A1R31	53B
A1C7	9F	A5CR3	33D	A11A1CR8	45D	A11A1R32	55B
A1C8	9D	A5CR4	34D	A11A1CR9	46D	A11A1R33	52C
A1C9	10D	A5CR5	35E	A11A1CR14	52C	A11A1R34	54C
A1C10	10F	A5J1	32B	A11A1CR15	53C	A11A1R35	52C
A1C11	8F	A5J2	34B	A11A1CR16	54C	A11A1R36	52D
A1CR1	7D	A5L1	33D	A11A1CR17	55C	A11A1R37	53C
A1CR2	8D	A5L2	32C	A11A1CR18	55B	A11A1R38	53D
A1CR5	9D	A5R1	33C	A11A1CR19	53B	A11A1R39	53C
A1CR6	10D	A5R2	33C	A11A1CR20	53B	A11A1R40	53C
A1L1	9C	A5R3	34E	A11A1CR21	54B	A11A1R41	45C
A1L3	9D	A5R4	34E	A11A1CR22	47D	A11A1R42	46C
A1P1	6B	A5R5	33E	A11A1CR23	49B	A11A1R43	46C
A1R1	7C	A5R6	33E	A11A1Q1	44B	A11A1R44	46D
A1R2	8C	A5R7	32E	A11A1Q2	44B	A11A1R45	48D
		A5R8	32E	A11A1Q3	47C	A11A1R54	43B
		A5R9	34B	A11A1Q4	45D	A12	46E
		A5T1	33B	A11A1Q5	45C		
				A11A1Q6	47C		



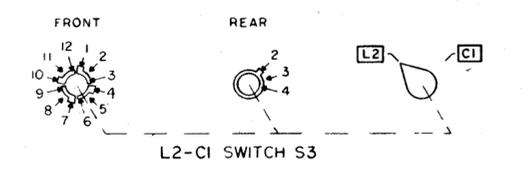
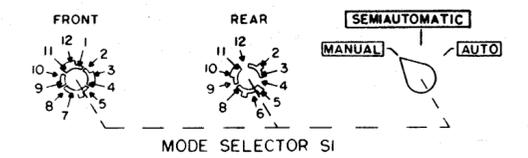
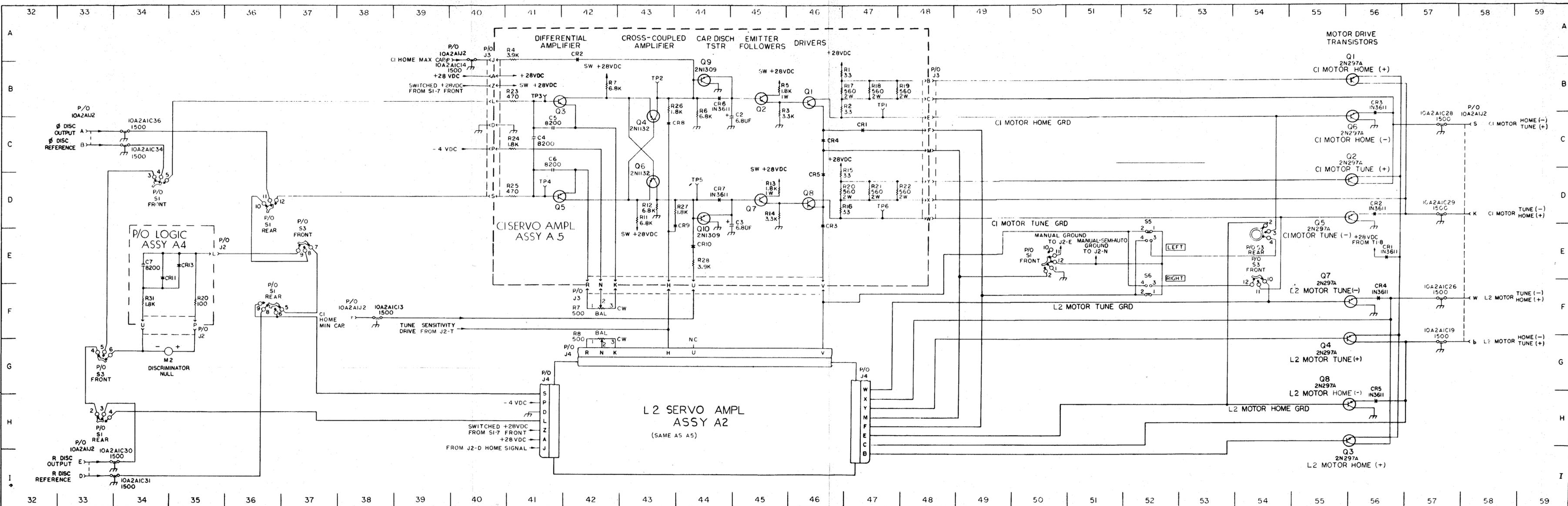


NOTES:  
 2.1-PREFIX INCOMPLETE REFERENCE DESIGNATIONS WITH 9A1.  
 2.2-UNLESS OTHERWISE SPECIFIED:  
 a) ALL RESISTOR ARE IN OHMS, 1/4W, ±1%.  
 b) ALL CAPACITORS ARE IN UF.  
 c) ALL DIODES ARE IN914, EXCEPT ON A12, CR1-CR12 ARE IN3611.

Figure 5-50. Tuner, 9A1, Schematic Diagram (Sheet 2 of 2)







- NOTES:
1. PREFIX INCOMPLETE REFERENCE DESIGNATIONS WITH IOA1.
  2. UNLESS OTHERWISE SPECIFIED:
    - A. ALL RESISTORS ARE 1/4 WATT, ±10% TOLERANCE.
    - B. ALL RESISTANCE VALUES ARE IN OHMS; K INDICATES THOUSANDS OF OHMS.
    - C. ALL DIODES ARE INZ77.
    - D. ALL TRANSISTORS ARE 2N1613.
    - E. ALL CAPACITANCE VALUE ARE IN PICOFARADS.
  3. THE LETTERS CW DIRECTION ADJACENT TO TERMINAL 3 OF A POTENTIOMETER INDICATES THE DIRECTION OF CLOCKWISE ROTATION WHEN VIEWED FROM THE SHAFT END. TERMINALS ARE NUMBERED IN A CCW DIRECTION AS VIEWED FROM THE KNOB ON ACTUATOR END OF CONTROL.
  4. □ INDICATES EQUIPMENT OPERATION MARKINGS (FRONT PANEL CONTROL).
  5. WAFER SWITCHES S1 AND S3 ARE SHOWN IN THE EXTREME CCW POSITION AS VIEWED FROM THE KNOB END OF THE SWITCH.
  6. ALL LEADS EXITING TUNER CONTROL, EXCEPT GRD, ARE BY PASSED IN THE FILTER BOX.

Figure 5-51. Tuner Control, Schematic Diagram (Sheet 2 of 2)



illustrations following the notation "REF DESIGN PREFIX".

### 6-3 LIST OF UNITS.

Table 6-1 is a listing of the units comprising the equipment. As indicated, parts lists for units not covered in detail in this manual are given in technical manuals for the individual units. The units are listed by unit number in numerical order. Thus when the complete reference designation of a part is known, this table will furnish the identification of the unit in which the part is located, since the first number of a complete reference designation identifies the unit. Table 6-1 also provides the following information for each unit listed: (1) quantity per equipment, (2) official name, (3) designation, (4) colloquial name, and (5) location of the first page of its parts listing in Table 6-2.

### 6-4 MAINTENANCE PARTS LIST.

Table 6-2 lists units covered in detail in this manual and their maintenance parts. The units are listed in numerical sequence. Maintenance parts for each unit are listed alphabetically-numerically by class or part following the unit designation. Thus the parts for each unit are grounded together. Table 6-2 provides the following information: (1) the complete reference designation

of each unit, assembly or subassembly, (2) reference to explanatory notes in paragraph 6.6, (3) noun name and brief description, and (4) identification of the illustration which locates the part.

### 6-5 LIST OF MANUFACTURERS.

Table 6-3 lists the manufacturers of parts used in the equipment. The Table includes the manufacturers' code used in Table 6-2 to identify the manufacturers.

### 6-6 NOTES.

The following notes provide information as referenced on Table 6-2.

NOTE 1: The AN/FRT-83(V) is normally supplied with three 6 amp fuses (for 460 VAC). When operating from 220 VAC primary power, 15 amp fuses are supplied as a part of Accessory Kit 6049-0033.

NOTE 2: The AN/FRT-83(V) is normally supplied for 460 VAC operation. For 220 VAC operation, 2A2P2 is replaced by 2A2P1, which is supplied as a part of Accessory Kit 6049-0033.

NOTE 3: Extender boards listed in Table 1-2 are included as a part of Accessory Kit 6049-0033.

TABLE 6-1. LIST OF UNITS

UNIT NO.	QTY	NOTE	NAME OF UNIT	DESIGNATION	COLLOQUIAL NAME	PAGE
1	1		Radio Frequency Amplifier	AM-6046/FRT	1 KW PA	6-4
2	1		Power Supply	PP-6067/FRT	1 KW Power Supply	6-12
3	1		Modulator-Synthesizer	MD-777/FRT	Exciter	*
4	1		Frequency Shift Keyer	KY-655/FRT	Keyer	*
5	1		Decoder-Encoder	KY-656/FRT	Decoder-Encoder	*
6	1		Transmitter Control-Indicator	C-7709/FRT	Remote Control	*
7	1		Interconnecting Box	J-2821/FRT-83 (V)	I. Box	6-12
8	1				Local Equipment Cabinet	6-16
9	1		Radio Frequency Tuner	TN-509/FRT-83(V)	Tuner	6-17
10	1		Control, Tuner	C-7704/FRT-83(V)	Tuner Control	

\* Parts lists for these units provided in individual technical manuals. See Table 5-1.

TABLE 6-2. MAINTENANCE PARTS LIST

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.	REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>1</u>		<u>AMPLIFIER, RADIO FRE-</u>	5-7	CR1, CR2		DIODE: Mil type 1N3611	5-10/ 5-12
<u>1A1</u>		<u>QUENCY AM-6046/FRT:</u>		CR3		DIODE: Mil type 1N3000B	5-10
		MFR14304, PN 6049-3000	5-7	CR4 to		DIODE: Mil type 1N3002B	5-10
		AMPLIFIER ASSEMBLY,		CR6			
		RADIO FREQUENCY:		CR7 to		DIODE: Mil type 1N753A	5-10
B1		MFR14304, PN 6049-3100	5-12	CR11		Same as 1A1CR1	5-10
		FAN: 115V, 400CPS, 1Ø		CR12		DIODE: Mil type 1N914	5-11
B2		MFR14304, PN B22-	5-12	CR13		Not Used	
		0001-000		DS1 to			
		MOTOR, SYNCHRONOUS:		DS4			
		115V, 60CPS, 1Ø, 6RPM,		DS5		LAMP, INCANDESCENT:	5-11
		MFR14304, PN B11-				Mil type MS25237-327	
		0004-000		F1 to F3		FUSE, CARTRIDGE: Mil	5-12
C1		CAPACITOR, FIXED	5-12			type: F60-6A or F60-15A	
		PAPER: Mil type		F4, F5		FUSE, CARTRIDGE: Mil	5-12
		CP53BIEF205K1				type F02A250V1A	
C2, C3		CAPACITOR, FIXED	5-11	F6		FUSE, CARTRIDGE: Mil	5-12
		CERAMIC: Mil type				type F02A250V3A	
		CK65AW472M		F7		FUSE, CARTRIDGE: Mil	5-12
C4		CAPACITOR, FIXED	5-11			type F02A250V1.5A	
		MICA: Mil type		J1		CONNECTOR, RECEP-	5-10
		CM60B103K03				TACLE: Mil type	
C5 to		CAPACITOR, FIXED	5-13	J2		UG-909A/U	
C13		CERAMIC: Mil type				CONNECTOR, RECEP-	5-12
		CK63AY103X		J3		TACLE: Mil type	
C14		Not Used				UG-909B/U	
C15 to		Same as 1A1C5	5-13	J4, J5		CONNECTOR, RECEP-	5-10
C17						TACLE: 36 pin,	
C18		Not Used				MFR14304, PN J10-	
C19 to		Same as 1A1C5	5-13			0001-000	
C21				J6 to		CONNECTOR, RECEP-	5-10
C22		Not Used		J11		TACLE: 1 pin,	
C23,C24		Same as 1A1C5	5-13			MFR14304, PN J60-	
C25		Not Used		J12		0002-213	
C26 to		Same as 1A1C5	5-13	K1		Same as 1A1J1	5-10
C28						RELAY, SOLENOID:	5-12
C29		CAPACITOR, FIXED	5-11	K2		24VDC, 4PDT,	
		ELECTROLYTIC: Mil				MFR14304, PN K30-	
		type CE51C470K		K3		0001-003	
C30		Not Used				RELAY, SOLENOID:	5-10
C31		CAPACITOR, FIXED	5-11	L1		MFR14304, PN K32-	
		ELECTROLYTIC: Mil				0002-001	
		type CE51C251F		L2		RELAY, SOLENOID:	5-10
C32 to		Same as 1A1C5	5-13			Mil type M5757-23-001	
C34				L3		COIL, FIXED RF:	5-11
C35		CAPACITOR, FIXED	5-11			MFR14304, PN 8948-	
		CERAMIC: 3PF NPO±5%,				3307	
		5000 WVDC, MFR14304,				CHOKe, RF: Mil type	5-11
		PN C15-0002-001				MS16221-15	
C36		CAPACITOR, FIXED	5-11			CHOKe, RF: Mil type	5-13
		MICA: Mil type				LT4K068	
		CM06D751J03					
C37 to		Same as 1A1C5	5-11/ 5-13				
C48			5-12				
C49,C50		CAPACITOR, FIXED	5-12				
		PAPER: Mil type					
		CP70E1FL504K1					
C51		Same as 1A1C5	5-11				

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
1A1 (Cont)			
L4, L5		Same as 1A1L3	5-13
L6		COIL, FIXED RF: MFR14304, PN 391-3311	5-11
M1		METER, PANEL: MFR14304, PN 391-3677	5-11
MP1		PLUG, BUTTON: MFR14304, PN Z24-0001-001	5-11
MP2		Not Used	
MP3		POLORIZING KEY: MFR14304, PN J10-0007-501	5-11
MP4		KNOB: Mil type MS91528-1D2B	5-12
MP5		KNOB: Mil type MS91528-1P2B	5-10
MP6		Not Used	
MP7		KNOB: Mil type MS91528-3F2B	5-11
MP8		FILTER, AIR: MFR14304, PN Z16-0001-000	5-12
MP9		TRANSMISSION ASSEMBLY: MFR14304, PN 391-3250	5-13
MP10		CONTACT ASSEMBLY: MFR14304, PN 391-3605	5-13
P1 to P3		CONNECTOR, PLUG: Mil type UG-88E/U	5-12
P4, P5		Not Used	
P6		CONNECTOR, PLUG: MFR14304, PN J20-0002-101	5-10
P7		CONNECTOR, PLUG: MFR14304, PN J20-0002-201	5-10
R1, R2		Not Used	
R3, R4		RESISTOR, FIRED FILM: Mil type RL20S512G	5-13
R5		RESISTOR, FIXED COMPOSITION: Mil type RC42GF222K	5-13
R6		RESISTOR, FIXED COMPOSITION: Mil type RC42GF182K	5-13
R7, R8		RESISTOR, FIXED COMPOSITION: Mil type RC20GF101J	5-13
R9		RESISTOR, VARIABLE: Mil type RA20LASB103A	5-10
R10		RESISTOR, VARIABLE: Mil type RA20NASD103A	5-12
R11, R12		Same as 1A1R9	5-10

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
R13		Same as 1A1R10	5-12
R14, R15		Not Used	
R16 to R19		RESISTOR, FIXED COMPOSITION: 2.2 ohms, ±5%, 1/2 watt, MFR14304 PN R11-0001-001	5-13
R20		RESISTOR, FIXED COMPOSITION: Mil type RC20GF472J	5-11
R21		RESISTOR, FIXED COMPOSITION: Mil type RC42GF330K	5-11
R22, R23		Not Used	
R24		RESISTOR, FIXED COMPOSITION: Mil type RC42GF150K	5-13
R25 to R28		RESISTOR, FIXED WIREWOUND: Mil type RWP20F10R0F	5-13
S1		SWITCH, SENSITIVE: MFR14304, S95-0001-000	5-12
S2		Not Used	
S3		SWITCH, TOGGLE: Mil type MS35059-31	5-12
S4		Not Used	
S5		SWITCH, ROTARY: MFR14304, PN 391-3673	5-10
S6		Same as 1A1S3	5-11
S7		SWITCH, ROTARY: MFR14304, PN 391-3660	5-11
S8		Not Used	
S9		SWITCH, INTER LOCK: Mil type MS16106-4	5-11
T1		TRANSFORMER: MFR14304, PN 6049-3010	5-11
TB1		TERMINAL BOARD: Mil type 37TB6	5-11
V1, V2		ELECTION TUBE: MFR14304, PN V12-0002-000	5-11
XC1 to XC28		Not Used	
XC29		SOCKET, OCTAL: Mil type TS101P02	5-11
XC30		Not Used	
XC31		Same as 1A1XC29	5-11
XDS1 to XDS4		Not Used	
XDS5		LAMPHOLDER: Mil type LH73LC12RT	5-11
XF1 to XF3		FUSEHOLDER: Mil type FHL12U	5-12
XF4		FUSEHOLDER: Mil type FHL17G	5-12

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>1A1 (Cont)</u>			
XF5		Same as 1A1XF1	5-12
XF6		FUSEHOLDER: Mil type FHL18G2	5-12
XF7		Same as 1A1XF1	5-12
<u>1A1A1</u>		DRIVER TUBE ASSEMBLY: MFR14304, PN 6049-3180	5-12/ 5-15
C1 to C14		Same as 1A1C5	5-15
C15, C16		Not Used	
C17, C18		CAPACITOR, FIXED MICA: Mil type CM05D391J03	5-15
C19		Same as 1A1C5	5-15
C20		CAPACITOR, FIXED MICA: Mil type CM05D241J	5-15
CR1, CR2		Same as 1A1CR13	5-15
L1		COIL, FIXED RF: MFR14304, PN 391-3860	5-15
L2		COIL, FIXED RF: Mil type LT4K027	5-15
L3		COIL, FIXED RF: Mil type LT4K005	5-15
L4 to L6		Same as 1A1L3	5-15
MP1, MP2		TUBE CHIMNEY: MFR14304, PN 391-3869	5-15
R1, R2		RESISTOR, FIXED FILM: Mil type RL42S100G	5-15
R3, R4		RESISTOR, FIXED FILM: Mil type RL20S103G	5-15
R5		RESISTOR, FIXED COMPOSITION: Mil type RC07GF681K	5-15
R6		RESISTOR, FIXED COMPOSITION: Mil type RC07GF100K	5-15
R7		RESISTOR, FIXED COMPOSITION: Mil type RC20GF103K	5-15
R8		RESISTOR, FIXED COMPOSITION: Mil type RC07GF560K	5-15
R9		RESISTOR, FIXED COMPOSITION: Mil type RC07GF470K	5-15
R10		RESISTOR, FIXED COMPOSITION: Mil type RC07GF180K	5-15
TB1		TERMINAL BOARD: 13 terminal, MFR14304, PN E31-0004-013	5-15
V1, V2		ELECTRON TUBE: MFR14304, PN V12-0001-000	5-15

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
XV1, XV2		SOCKET, ELECTRON TUBE: MFR14304, PN J30-0001-000	5-15
<u>1A1A2</u>		FINAL TRANSFORMER ASSEMBLY: MFR14304, PN 391-3700	5-11/ 5-16
C1		CAPACITOR, FIXED CERAMIC: 25PF ±10% 7500 WVDC, MFR14304, PN C15-0001-001	5-16
C2		Not Used	
C3		CAPACITOR, FIXED CERAMIC: 50PF ±10%, 7500 WVDC, MFR14304, PN C15-0001-002	5-16
C4, C5		CAPACITOR, FIXED CERAMIC: 100PF ±10%, 5000 WVDC, MFR14304, PN C15-0001-003	5-16
C6		Same as 1A1A2C1	5-16
C7 to C9		Same as 1A1A2C3	5-16
C10		Same as 1A1A2C1	5-16
C11 to C17		Same as 1A1A2C3	5-16
C18 to C20		Same as 1A1A2C4	5-16
C21 to C24		Not Used	
C25		CAPACITOR, FIXED PORCELAIN: 750PF ±5%, 500 WVDC, MFR14304, PN C50-0001-046	5-16
C26		CAPACITOR, FIXED PORCELAIN: 680PF ±5%, 500 WVDC, MFR14304, PN C50-0001-045	5-16
C27		CAPACITOR, FIXED PORCELAIN: 910PF ±5%, 500 WVDC, MFR14304, PN C50-0001-048	5-16
C28		CAPACITOR, FIXED PORCELAIN: 820PF ±5%, 500 WVDC, MFR14304, PN C50-0001-047	5-16
C29		CAPACITOR, FIXED PORCELAIN: 330PF ±5%, 500 WVDC, MFR14304, PN C50-0001-037	5-16
C30		CAPACITOR, FIXED PORCELAIN: 430PF ±5%, 500 WVDC, MFR14304, PN C50-0001-040	5-16
C31		CAPACITOR, FIXED PORCELAIN: 300PF ±5%, 500 WVDC, MFR14304, PN C50-0001-036	5-16

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>1A1A2</u> (Cont) C32		CAPACITOR, FIXED PORCELAIN: 270PF ±5%, 500 WVDC, MFR14304, PN C50-0001-035	5-16
C33		Same as 1A1A2C31	5-16
C34		Same as 1A1A2C32	5-16
C35, C36		CAPACITOR, FIXED PORCELAIN: 180PF ±5%, 500 WVDC, MFR14304, PN C50-0001-031	5-16
C37		CAPACITOR, FIXED PORCELAIN: 150PF ±5%, 500 WVDC, MFR14304, PN C50-0001-029	5-16
C38		CAPACITOR, FIXED CERAMIC: 200PF ±5%, 2500 WVDC, MFR14304, PN C11-0004-028	5-16
C39		Not Used	
C40		CAPACITOR, FIXED CERAMIC: 180PF ±5%, 2500 WVDC, MFR14304, PN C11-0004-029	5-16
C41		Not Used	
C42 to C44		Same as 1A1A2C35	5-16
C45 to C47		CAPACITOR, FIXED PORCELAIN: 110PF ±5%, 500 WVDC, MFR14304, PN C50-001-026	5-16
C48		Same as 1A1A2C37	5-16
C49		CAPACITOR, FIXED PORCELAIN: 100PF ±5%, 500 WVDC, MFR14304, PN C50-0001-025	5-16
C50, C51		Same as 1A1A2C45	5-16
C52		Same as 1A1A2C37	5-16
C53 to C56		CAPACITOR, FIXED PORCELAIN: 75PF ±5%, 500 WVDC, MFR14304, PN C50-0001-022	5-16
C57		CAPACITOR, FIXED CERAMIC: 220PF ±5%, 2500 WVDC, MFR14304, PN C11-0004-009	5-16
C58		CAPACITOR, FIXED CERAMIC: 300PF ±5%, 2500 WVDC, MFR14304, PN C11-0004-018	5-16
C59		Same as 1A1A2C38	5-16
C60 to C62		Not Used	
C63 to C66		CAPACITOR, FIXED PORCELAIN: 47PF ±5%, 500 WVDC, MFR14304, PN C50-0001-017	5-16

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
C67		Same as 1A1A2C38	5-16
C68		Same as 1A1A2C40	5-16
C69		Same as 1A1A2C57	5-16
P1		Same as 1A1P1	5-16
R1 to R8		RESISTOR, FIXED COMPOSITION: Mil type RC42GF273K	5-16
S1		SWITCH ASSEMBLY: MFR14304, PN 391-3732	5-16
<u>1A1A2A1</u>		2-3MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3711	5-16
<u>1A1A2A2</u>		2-3MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3712	5-16
<u>1A1A2A3</u>		3-4MC TRANSFORMER ASSEMBLY, MFR14304, PN 391-3713	5-16
<u>1A1A2A4</u>		3-4MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3714	5-16
<u>1A1A2A5</u>		4-5MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3715	5-16
<u>1A1A2A6</u>		5-6MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3716	5-16
<u>1A1A2A7</u>		6-7MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3717	5-16
<u>1A1A2A8</u>		7-8MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3718	5-16
<u>1A1A2A9</u>		8-10MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3719	5-16
<u>1A1A2A10</u>		10-12MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3720	5-16
<u>1A1A2A11</u>		12-14MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3721	5-16
<u>1A1A2A12</u>		14-16MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3722	5-16
<u>1A1A2A13</u>		16-18MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3723	5-16
<u>1A1A2A14</u>		18-20MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3724	5-16
<u>1A1A2A15</u>		20-22MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3725	5-16
<u>1A1A2A16</u>		22-24MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3726	5-16

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>1A1A2A17</u>		24-26MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3727	5-16
<u>1A1A2A18</u>		26-28MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3728	5-16
<u>1A1A2A19</u>		28-30MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3729	5-16
<u>1A1A3</u>		VSWR BRIDGE ASSEMBLY: MFR14304, PN 6049-3150	5-10/ 5-17
C1		CAPACITOR, FIXED MICA: Mil type CM05F361J03	5-17
C2		Not Used	
C3, C4		CAPACITOR, FIXED CERAMIC: Mil type CK60AW102M	5-17
C5		Not Used	
C6		CAPACITOR, VARIABLE GLASS: Mil type PC51H160	5-17
CR1		Not Used	
CR2, CR3		Same as 1A1CR13	5-17
J1		Same as 1A1J1	5-17
J2		CONNECTOR, RECEPTACLE: Mil type UG-625B/U	5-17
L1		COIL, FIXED RF: Mil type LT4K071	5-17
L2		COIL, FIXED RF: Mil type LT4K029	5-17
R1, R2		RESISTOR, FIXED FILM: Mil type RL32S560G	5-17
R3, R4		Not Used	
R5, R6		RESISTOR, FIXED COMPOSITION: Mil type RC07GF101J	5-17
R7, R8		Not Used	
R9		RESISTOR, FIXED COMPOSITION: Mil type RC20GF105J	5-17
T1		TRANSFORMER, TOROID: MFR14304, PN 391-3426	5-17
<u>1A1A4</u>		DRIVER TRANSFORMER ASSEMBLY: MFR14304, PN 391-3800	5-12/ 5-18
C1, C2		Same as 1A1C5	5-18
R1		RESISTOR, FIXED COMPOSITION: Mil type RC42GF102K	5-18
S1		SWITCH ASSEMBLY: MFR14304, PN 391-3830	5-18
TB1		TERMINAL BOARD: 6 terminal, MFR14304, PN E31-0004-006	5-18

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
TP1		JACK, TEST; Mil type MS160108-2A	5-18
<u>1A1A4A1</u>		2-2.5MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3807	5-18
<u>1A1A4A2</u>		2.5-3MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3808	5-18
<u>1A1A4A3</u>		3-4MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3809	5-18
<u>1A1A4A4</u>		4-6MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3810	5-18
<u>1A1A4A5</u>		6-8MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3811	5-18
<u>1A1A4A6</u>		8-10MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3812	5-18
<u>1A1A4A7</u>		10-12MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3813	5-18
<u>1A1A4A8</u>		12-14MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3814	5-18
<u>1A1A4A9</u>		14-16MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3815	5-18
<u>1A1A4A10</u>		16-18MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3816	5-18
<u>1A1A4A11</u>		18-20MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3817	5-18
<u>1A1A4A12</u>		20-22MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3818	5-18
<u>1A1A4A13</u>		22-24MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3819	5-18
<u>1A1A4A14</u>		24-26MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3820	5-18
<u>1A1A4A15</u>		26-28MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3821	5-18
<u>1A1A4A16</u>		28-30MC TRANSFORMER ASSEMBLY: MFR14304, PN 391-3822	5-18
<u>1A1A5</u>		KEYER OVERLOAD PCB ASSEMBLY: MFR14304, PN 6049-3140	5-11/ 5-19
C1, C2		Same as 1A1A3C3	5-19
C3		CAPACITOR, FIXED CERAMIC: Mil type CK62AW822M	5-19

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>1A1A5</u> (Cont)			
C4		CAPACITOR, FIXED TANTALUM: Mil type CS13BF105M	5-19
CR1 to CR7		Same as 1A1CR1	5-19
CR8, CR9		Same as 1A1CR7	5-19
CR10,		DIODE: Mil type 1N277	5-19
CR11			
CR12		Same as 1A1CR1	5-19
CR13 to CR16		Same as 1A1A5CR10	5-19
CR17,			
CR18		Same as 1A1CR1	5-19
CR19		Same as 1A1A5CR10	5-19
MP1		PC BOARD: MFR14304, PN 6049-3141	5-19
MP2,		EXTRACTOR, PC BOARD:	5-19
MP3		MFR14304, PN Z13- 0002-001	5-19
Q1 to Q3		TRANSISTOR: Mil type 2N1613	5-19
Q4		TRANSISTOR: Mil type 2N1132	5-19
Q5		TRANSISTOR: Mil type 2N404	5-19
Q6		TRANSISTOR: Mil type 2N398A	5-19
R1		RESISTOR, FIXED COMPOSITION: Mil type RC07GF222K	5-19
R2		Same as 1A1A1R5	5-19
R3		RESISTOR, FIXED COMPOSITION: Mil type RC20GF101K	5-19
R4		RESISTOR, FIXED COMPOSITION: Mil type RC20GF391K	5-19
R5		Same as 1A1A5R1	5-19
R6, R7		RESISTOR, FIXED COMPOSITION: Mil type RC07GF101K	5-19
R8		Same as 1A1A5R1	5-19
R9, R10		RESISTOR, FIXED COMPOSITION: Mil type RC07GF472K	5-19
R11		RESISTOR, FIXED COMPOSITION: Mil type RC07GF391K	5-19
R12		RESISTOR, FIXED FILM: Mil type RL07S471J	5-19
R13		RESISTOR, FIXED FILM: Mil type RL07S271J	5-19
R14		Same as 1A1A5R9	5-19
R15		RESISTOR, FIXED COMPOSITION: Mil type RC07GF102K	5-19

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
R16		Same as 1A1A5R1	5-19
R17, R18		Same as 1A1A5R15	5-19
R19, R20		RESISTOR, FIXED COMPOSITION: Mil type RC07GF181K	5-19
R21		Same as 1A1A5R1	5-19
R22		RESISTOR, FIXED COMPOSITION: Mil type RC07GF471K	5-19
R23, R24		Same as 1A1A5R15	5-19
TP1		JACK, TEST: MFR14304, PN J60-0001-008	5-19
TP2		JACK, TEST: MFR14304, PN J60-0001-002	5-19
TP3		JACK, TEST: MFR14304, PN J60-0001-006	5-19
TP4		JACK, TEST: MFR14304, PN J60-0001-007	5-19
TP5		JACK, TEST: MFR14304, PN J60-0001-004	5-19
TP6		JACK, TEST: MFR14304, PN J60-0001-010	5-19
<u>1A1A6</u>		PCC-TGC-BIAS PCB ASSEMBLY: MFR14304, PN 6049-3130	5-11/ 5-20
C1 to C3		Same as 1A1A3C3	5-20
C4, C5		CAPACITOR, FIXED TANTALUM: Mil type CS13BD157K	5-20
C6		CAPACITOR, FIXED MICA: Mil type CM06DC182J	5-20
C7		Same as 1A1A3C3	5-20
CR1 to CR4		Same as 1A1CR1	5-20
CR5, CR6		DIODE: Mil type 1N3033B	5-20
CR7 to CR9		Same as 1A1CR13	5-20
CR10 to CR12		Not Used	
CR13,			
CR14		Same as 1A1CR13	5-20
CR15,			
CR16		Same as 1A1CR1	5-20
CR17		DIODE: Mil type 1N4728	5-20
CR18 to CR20		Same as 1A1CR1	5-20
MP1		PC BOARD: MFR14304, PN 6049-3131	5-20
MP2,		Same as 1A1A5MP2	5-20
MP3			
Q1, Q2		Same as 1A1A5Q1	5-20
Q3, Q4		Same as 1A1A5Q6	5-20
Q5 to Q9		Same as 1A1A5Q1	5-20
Q10		Same as 1A1A5Q4	5-20
Q11, Q12		Same as 1A1A5Q1	5-20
Q13		TRANSISTOR: Mil type 2N404A	5-20

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>1A1A6</u> (Cont)			
R1		RESISTOR, FIXED COMPOSITION: Mil type RC07GF223K	5-20
R2		RESISTOR, FIXED COMPOSITION: Mil type RC07GF682K	5-20
R3		RESISTOR, FIXED COMPOSITION: Mil type RC07GF473K	5-20
R4		RESISTOR, FIXED COMPOSITION: Mil type RC42GF682K	5-20
R5		RESISTOR, FIXED COMPOSITION: Mil type RC07GF273K	5-20
R6		RESISTOR, FIXED COMPOSITION: Mil type RC07GF103K	5-20
R7		RESISTOR, FIXED COMPOSITION: Mil type RC07GF333K	5-20
R8		Same as 1A1A6R5	5-20
R9		Same as 1A1A5R9	5-20
R10		Same as 1A1A6R3	5-20
R11		RESISTOR, FIXED COMPOSITION: Mil type RC07GF272K	5-20
R12		Same as 1A1A5R9	5-20
R13		RESISTOR, FIXED COMPOSITION: Mil type RC07GF822K	5-20
R14		Same as 1A1A6R7	5-20
R15		RESISTOR, FIXED COMPOSITION: Mil type RC07GF104K	5-20
R16		RESISTOR, FIXED FILM: Mil type RL07S103J	5-20
R17		RESISTOR, FIXED FILM: Mil type RL07S102J	5-20
R18, R19		RESISTOR, FIXED FILM: Mil type RL07S332J	5-20
R20		Same as 1A1A6R13	5-20
R21		Same as 1A1A5R15	5-20
R22		RESISTOR, FIXED COMPOSITION: Mil type RC07GF152K	5-20
R23		RESISTOR, FIXED FILM: Mil type RL07S333J	5-20
R24		RESISTOR, FIXED FILM: Mil type RL07S183G	5-20
R25		Same as 1A1A6R18	5-20
R26		RESISTOR, FIXED FILM: Mil type RL07S223J	5-20
R27		Same as 1A1A6R13	5-20
R28		RESISTOR, FIXED FILM: Mil type RL07S223G	5-20

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
R29		Same as 1A1A5R1	5-20
R30, R31		Same as 1A1A6R1	5-20
R32 to R38		Same as 1A1A5R1	5-20
R39		RESISTOR, FIXED COMPOSITION: Mil type RC07GF390K	5-20
R40		Same as 1A1A5R6	5-20
R41		Same as 1A1A5R1	5-20
R42		Same as 1A1A6R6	5-20
R43		Same as 1A1A6R5	5-20
R44		Same as 1A1A5R15	5-20
R45		RESISTOR, FIXED COMPOSITION: Mil type RC07GF822K	5-20
R46		Same as 1A1A5R15	5-20
TP1		Same as 1A1A5TP1	5-20
TP2		Same as 1A1A5TP2	5-20
TP3		Same as 1A1A5TP3	5-20
TP4		Same as 1A1A5TP4	5-20
TP5		Same as 1A1A5TP5	5-20
TP6		Same as 1A1A5TP6	5-20
TP7		JACK, TEST: MFR14304, PN J60-0001-012	5-20
<u>1A1A7</u>		METER RESISTOR PCB ASSEMBLY: MFR14304, PN 6049-3414	5-12/ 5-21
MP1		PC BOARD: MFR14304, PN 6049-3415	5-21
R1 to R4		RESISTOR, FIXED COMPOSITION: Mil type RC42GF104K	5-21
R5, R6		Not Used	
R7, R8		RESISTOR, FIXED FILM: Mil type RL42S155G	5-21
R9		Same as 1A1A1R7	5-21
R10 to R12		Not Used	
R13, R14		Same as 1A1A7R7	5-21
R15		Same as 1A1A1R7	5-21
R16		RESISTOR, FIXED FILM: Mil type RL32S474G	5-21
R17 to R20		RESISTOR, FIXED FILM: Mil type RL32S514G	5-21
R21		Same as 1A1A1R7	5-21
R22		Same as 1A1A7R17	5-21
<u>1A1A8</u>		DUAL AMPLIFIER ASSEMBLY: MFR14304 PN 6049-3190	5-12
C1		CAPACITOR, FIXED CERAMIC: Mil type CK70AW152M	5-12
J1		CONNECTOR, RECEPTACLE: Mil type UG-1098/U	5-12
J2, J3		Same as 1A1A3J2	5-12

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>1A1A8A1</u>		DUAL AMPLIFIER PCB ASSEMBLY: MFR14304, PN 6049-3196	5-12
MP1		PC BOARD: MFR14304, PN 6049-3197	5-12
R1		RESISTOR, FIXED COMPOSITION: Mil type RC20GF121K	5-12
R2		RESISTOR, FIXED COMPOSITION: Mil type RC07GF361J	5-12
R3,R4		RESISTOR, FIXED COMPOSITION: Mil type RC07GF470J	5-12
Z1, Z2		WIDE BAND AMPLIFIER: MFR14304, PN 6049-3189	5-12
<u>1A1XV1/</u> <u>XV2</u>		TUBE SOCKET ASSEMBLY: PN None	5-14
H1 to H12		NUT, HEX, LARGE PATTERN: No. 4-40UNC-2B, MFR14304, PN J30-0002-003	5-14
H13 to H24		SCREW, MACHINE, BINDING HEAD, CROSS RECESSED: No. 4-40UNC-2A, 1.75 IN. Long, MFR14304, PN J30-0002-006	5-14
H25 to H36		LOCKWASHER, SPLIT, LIGHT SERIES: No. 4, MFR14304, PN J30-0002-007	5-14
H37 to H48		WASHER, FLAT, FIBER: .03 Thick x .31 OD x .12 ID, MFR14304, PN J30-0002-009	5-14
H49 to H60		WASHER, PLAIN, NICKEL PLATED BRASS: .03 Thick x .31OD x .12 ID, MFR14304, PN J30-0002-010	5-14
MP1 to MP24		SPACER, CERAMIC: MFR14304, PN J30-0002-001	5-14
MP25 to MP36		BUSHING, CERAMIC: MFR14304, PN J30-0002-002	5-14
MP37 to MP44		SPACER, SILVER PLATE: MFR14304, PN J30-0002-004	5-14
MP45, MP46		BASE: MFR14304, PN J30-0002-005	5-14
MP47 to MP78		CONTACT FINGER: MFR14304, PN J30-0002-008	5-14
MP79 to MP90		SPACER: MFR14304, PN 391-3488	5-14

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>1A2</u>		CASE ASSEMBLY: MFR14304, PN 6049-3400	5-22
FL1/J5		FILTER, INPUT: MFR14304, PN 391-2300	5-7/ 5-22
J1		CONNECTOR, RECEPTACLE: Mil type MS3102R28-17S	5-7
J2		Not Used	
J3		CONNECTOR, RECEPTACLE: Mil type UG-566B/U	5-7
J4 to J8		Not Used	
J9, J10		Same as 1A1J1	5-7
P1, P2		Same as 1A1P1	5-22
P3		CONNECTOR, PLUG: MFR14304, PN 391-2405	5-22
P4		Same as 1A1P1	5-22
S1, S2		Same as 1A1S9	5-22
<u>1A2A1</u>		FILTER BOX ASSEMBLY: MFR14304, PN 6049-3420	5-22
C1 to C29		Same as 1A1A8C1	5-22
J1 to J6		Not Used	
J7		CONNECTOR, RECEPTACLE: Mil type MS3102R28-21S	5-7
<u>2</u>		<u>POWER SUPPLY</u> <u>PP-6067/FRT:</u> MFR14304, PN 6049-3500	5-7/ 5-23
<u>2A1</u>		CHASSIS-PANEL ASSEMBLY: MFR14304, PN 6049-3700	5-23
C1		CAPACITOR, FIXED PAPER: 25UF ±10%, 600 WVDC, MFR14304, PN C30-0001-000	5-23
C2, C3		CAPACITOR, FIXED ELECTROLYTIC: Mil type CE71C142G	5-23
CR1		RECTIFIER BRIDGE: MFR14304, PN D22-5001-000	5-23
CR2, CR3		RECTIFIER BRIDGE: MFR14304, PN 8948-4015	5-23
CR4 to CR7		DIODE: MFR14304, PN D22-0004-001	5-23
CR8 to CR11		DIODE: Mil type 1N3611	5-23
DS1		LAMP, NEON: Mil type MS25252NE2D	5-23
F1		FUSE, CARTRIDGE: Mil type F03A250V8AS	5-23
F2		FUSE, CARTRIDGE: Mil type F02A250V1.5A	5-23

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>2A1 (Cont)</u>			
Q1, Q2		TRANSISTOR: Mil type 2N1412	5-23
R1, R2		RESISTOR, FIXED COMPOSITION: Mil type RC42GF100K	5-23
R3, R4		RESISTOR, FIXED COMPOSITION: Mil type RC20GF682K	5-23
R5, R6		Same as 2A1R1	5-23
S1		SWITCH, THERMAL: MFR14304, PN S70-0002-000	5-23
S2 to S4		SWITCH, INTERLOCK: Mil type MS16106-4	5-23
T1		TRANSFORMER, TOROID: MFR14304, PN 391-8405	5-23
TB1		TERMINAL BOARD: Mil type 37TB24	5-23
XDS1		LAMPHOLDER: Mil type LH74LC13CN	5-23
XF1		FUSEHOLDER: MFR14304, PN J50-0004-002	5-23
XF2		FUSEHOLDER: MFR14304, PN J50-0004-001	5-23
<u>2A1A1</u>		BLEEDER RESISTOR ASSEMBLY: MFR14304, PN 391-8111	5-23
MP1		TERMINAL BOARD: MFR14304, PN 391-8110	5-23
R1, R2		RESISTOR, FIXED COMPOSITION: Mil type RC42GF683K	5-23
R3 to R7		RESISTOR, FIXED COMPOSITION: Mil type RC42GF224K	5-23
<u>2A2</u>		CASE ASSEMBLY: MFR14304, PN 6049-3600	5-23
J1		CONNECTOR, RECEPTACLE: Mil type MS3102R28-17P	5-23
L1		CHOKE-FILTER: MFR14304, PN 6049-3105	5-23
P1	2	PLUG: 220V JUMPER: MFR14304, PN 6049-3610	5-23
P2	2	PLUG, 460V JUMPER: MFR14304, PN 391-8300	5-23
T1/T2		CASE AND TRANSFORMER ASSEMBLY: MFR14304, PN 6049-3507	5-23
TB1		Same as 2A1TB1	5-23

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>7</u>		BOX, INTERCONNECTING J-2821/FRT-83(V): MFR14304, PN 6049-2500	5-7
<u>7A1</u>		CHASSIS ASSEMBLY: MFR14304, PN 6049-2510	5-7/
DS1, DS2		LAMP, INCANDESCENT: Mil type MS25237-327	5-24
J1		CONNECTOR, RECEPTACLE: Mil type MS3102R20-29S	5-24
J2		CONNECTOR, RECEPTACLE: Mil type MS3102R22-14S	5-24
J3		CONNECTOR, RECEPTACLE: Mil type MS3102R24-28S	5-24
J4		CONNECTOR, RECEPTACLE: Mil type MS3102R28-11S	5-24
J5		CONNECTOR, RECEPTACLE: Mil type MFR14304, PN 6049-4528-3	5-24
M1, M2		METER: MFR14304, PN 6049-2530	5-24
S1		SWITCH, TOGGLE: Mil type MS35058-22	5-24
XDS1		LAMPHOLDER: Mil type LH73LC12WT	5-24
XDS2		LAMPHOLDER: Mil type LH73LC12RT	5-24
<u>7A1A1</u>		CIRCUIT BOARD/RETAINER ASSEMBLY: MFR14304, PN 6049-2550	5-24
J1 to J4		CONNECTOR, RECEPTACLE: Mil type M21097/6-48	5-24
R1		RESISTOR, VARIABLE: Mil type RV4LAYS501A	5-24/
<u>7A1A1A1</u>		FAULT LOGIC PC BOARD ASSEMBLY: MFR14304, PN 6049-2556	5-25
C1, C2		CAPACITOR, FIXED CERAMIC: Mil type CL25BJ600TP3	5-25
C3		CAPACITOR, FIXED CERAMIC: Mil type CK63AY103X	5-25
CR1 to CR6		DIODE: Mil type 1N3611	5-25
CR7		Not Used	
CR8		DIODE: Mil type 1N967B	5-25
CR9 to CR16		Same as 7A1A1A1CR1	5-25
K1		RELAY, REED: MFR14304, PN 6049-6210-1	5-25

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>7A1A1A1</u> (Cont)			
K2		RELAY, REED: MFR14304, PN 6049-6210-2	5-25
K3		Same as 7A1A1A1K1	5-25
K4		Same as 7A1A1A1K2	5-25
K5, K6		Same as 7A1A1A1K1	5-25
MP1		PC BOARD: MFR14304, PN 6049-2557	5-25
MP2, MP3		EXTRACTOR, PC BOARD: MFR14304, PN Z03-0003-001	5-25
Q1		TRANSISTOR: Mil type 2N1613	5-25
Q2		TRANSISTOR: Mil type 2N489A	5-25
Q3		Same as 7A1A1A1Q1	5-25
Q4		TRANSISTOR: Mil type 2N2323A	5-25
R1		RESISTOR, FIXED COMPOSITION: Mil type RC07GF103J	5-25
R2		RESISTOR, FIXED COMPOSITION: Mil type RC07GF824J	5-25
R3		RESISTOR, FIXED COMPOSITION: Mil type RC07GF100J	5-25
R4		RESISTOR, FIXED COMPOSITION: Mil type RC07GF101J	5-25
R5		RESISTOR, FIXED COMPOSITION: Mil type RC07GF332J	5-25
R6		RESISTOR, FIXED COMPOSITION: Mil type RC07GF822J	5-25
R7		RESISTOR, FIXED COMPOSITION: Mil type RC20GF272J	5-25
R8		RESISTOR, FIXED COMPOSITION: Mil type RC07GF181J	5-25
R9		RESISTOR, FIXED COMPOSITION: Mil type RC07GF222J	5-25
TP1		JACK, TEST: MFR14304, PN J60-0001-001	5-25
TP2		JACK, TEST: MFR14304, PN J60-0001-008	5-25
TP3		JACK, TEST: MFR14304, PN J60-0001-006	5-25
TP4		JACK, TEST: MFR14304, PN J60-0001-007	5-25

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
TP5		JACK, TEST: MFR14304, PN J60-0001-003	5-25
TP6		JACK, TEST: MFR14304, PN J60-0001-002	5-25
TP7		JACK, TEST: MFR14304, PN J60-0001-004	5-25
TP8		JACK, TEST: MFR14304, PN J60-0001-013	5-25
TP9		Same as 7A1A1A1TP1	5-25
TP10		Same as 7A1A1A1TP8	5-25
TP11		Same as 7A1A1A1TP2	5-25
TP12		JACK, TEST: MFR14304, PN J60-0001-010	5-25
TP13		JACK, TEST: MFR14304, PN J60-0001-012	5-25
TP14		Same as 7A1A1A1TP4	5-25
TP15		Same as 7A1A1A1TP3	5-25
TP16		JACK, TEST: MFR14304, PN J60-0001-005	5-25
TP17		Same as 7A1A1A1TP13	5-25
TP18		JACK, TEST: MFR14304, PN J60-0001-009	5-25
<u>7A1A1A2</u>		TUNE LOGIC PC BOARD ASSEMBLY: MFR14304, PN 6049-2558	5-24/ 5-26
CR1 to CR8		Same as 7A1A1A1CR1	5-26
K1 to K3		Same as 7A1A1A1K2	5-26
MP1		PC BOARD: MFR14304, PN 6049-2559	5-26
MP2, MP3		Same as 7A1A1A1MP2	5-26
TP1		Same as 7A1A1A1TP2	5-26
TP2		Same as 7A1A1A1TP3	5-26
TP3		Same as 7A1A1A1TP4	5-26
TP4		Same as 7A1A1A1TP13	5-26
TP5		Not Used	
TP6		Same as 7A1A1A1TP5	5-26
TP7		Same as 7A1A1A1TP16	5-26
TP8		Same as 7A1A1A1TP8	5-26
TP9		Not Used	
TP10		Same as 7A1A1A1TP6	5-26
TP11		Same as 7A1A1A1TP18	5-26
TP12		Same as 7A1A1A1TP4	5-26
TP13		Same as 7A1A1A1TP3	5-26
TP14		Same as 7A1A1A1TP7	5-26
TP15		Same as 7A1A1A1TP1	5-26
TP16		Same as 7A1A1A1TP13	5-26
<u>7A1A1A3</u>		BRAKE LOGIC PC BOARD ASSEMBLY: MFR14304, PN 6049-2560	5-24/ 5-27
C1		CAPACITOR, FIXED TANTALUM: Mil type CS13BG685K	5-27

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>7A1A1A3</u> (Cont)			
C2		CAPACITOR, FIXED ELECTROLYTIC: Mil type CE11C100G	5-27
C3		CAPACITOR, FIXED TANTALUM: Mil type CS13BG336K	5-27
C4, C5		Same as 7A1A1A3C2	5-27
CR1 to CR17		Same as 7A1A1A1CR1	5-27
K1		Same as 7A1A1A1K1	5-27
MP1		PC BOARD: MFR14304, PN 6049-2561	5-27
MP2, MP3		Same as 7A1A1A1MP2	5-27
Q1 to Q5		Same as 7A1A1A1Q1	5-27
Q6		TRANSISTOR: Mil type 2N1132	5-27
Q7 to Q9		Same as 7A1A1A1Q1	5-27
Q10		Same as 7A1A1A3Q6	5-27
Q11		Same as 7A1A1A1Q1	5-27
Q12		Same as 7A1A1A3Q6	5-27
Q13		Same as 7A1A1A1Q1	5-27
Q14		Same as 7A1A1A3Q6	5-27
Q15, Q16		Same as 7A1A1A1Q1	5-27
R1		RESISTOR, FIXED COMPOSITION: Mil type RC07GF683K	5-27
R2		RESISTOR, FIXED COMPOSITION: Mil type RC07GF472K	5-27
R3		RESISTOR, FIXED COMPOSITION: Mil type RC07GF273K	5-27
R4, R5		RESISTOR, FIXED COMPOSITION: Mil type RC07GF103K	5-27
R6		RESISTOR, FIXED COMPOSITION: Mil type RC07GF152K	5-27
R7		RESISTOR, FIXED COMPOSITION: Mil type RC20GF222J	5-27
R8		Same as 7A1A1A1R5	5-27
R9, R10		RESISTOR, FIXED COMPOSITION: Mil type RC32GF182J	5-27
R11		Same as 7A1A1A1R1	5-27
R12		RESISTOR, FIXED COMPOSITION: Mil type RC42GF150J	5-27
R13		Same as 7A1A1A3R4	5-27
R14, R15		RESISTOR, FIXED COMPOSITION: Mil type RC07GF102K	5-27

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
R16		RESISTOR, FIXED COMPOSITION: Mil type RC07GF562K	5-27
R17		Same as 7A1A1A3R14	5-27
R18		Same as 7A1A1A3R4	5-27
R19		RESISTOR, FIXED COMPOSITION: Mil type RC32GF181K	5-27
R20		RESISTOR, FIXED COMPOSITION: Mil type RC42GF330K	5-27
R21		Same as 7A1A1A3R2	5-27
R22		Same as 7A1A1A3R3	5-27
R23		Same as 7A1A1A3R4	5-27
R24		RESISTOR, FIXED COMPOSITION: Mil type RC07GF223K	5-27
R25		Same as 7A1A1A3R4	5-27
R26		RESISTOR, FIXED COMPOSITION: Mil type RC07GF473K	5-27
R27		Same as 7A1A1A3R24	5-27
R28		Same as 7A1A1A3R26	5-27
R29		Same as 7A1A1A3R14	5-27
R30		Same as 7A1A1A3R16	5-27
R31, R32		Same as 7A1A1A3R4	5-27
R33		Same as 7A1A1A3R24	5-27
R34		Same as 7A1A1A3R4	5-27
R35		Not Used	
R36		Same as 7A1A1A3R4	5-27
R37		RESISTOR, FIXED COMPOSITION: Mil type RC07GF153K	5-27
R38		Same as 7A1A1A3R14	5-27
R39		Same as 7A1A1A3R37	5-27
R40		RESISTOR, FIXED COMPOSITION: Mil type RC07GF183K	5-27
R41, R42		Same as 7A1A1A3R2	5-27
R43		Same as 7A1A1A3R4	5-27
R44		Same as 7A1A1A3R14	5-27
R45		Same as 7A1A1A3R37	5-27
R46		Same as 7A1A1A3R14	5-27
R47, R48		Same as 7A1A1A3R4	5-27
R49		Same as 7A1A1A3R26	5-27
R50		Same as 7A1A1A3R4	5-27
TP1		Same as 7A1A1A1TP1	5-27
TP2		Same as 7A1A1A1TP6	5-27
TP3		Same as 7A1A1A1TP3	5-27
TP4		Same as 7A1A1A1TP4	5-27
TP5		Same as 7A1A1A1TP7	5-27
TP6		Same as 7A1A1A1TP5	5-27
TP7		Same as 7A1A1A1TP12	5-27
TP8		Same as 7A1A1A1TP8	5-27
TP9		Same as 7A1A1A1TP2	5-27
TP10		Same as 7A1A1A1TP18	5-27

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.	REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>7A1A1A3</u> (Cont)				TP1 to TP6		Same as 7A1A1A1TP4	5-28
TP11		Same as 7A1A1A1TP4	5-27	<u>7A1A2</u>		BRACKET ASSEMBLY, FILTER CAPACITOR: MFR14304, PN 6049-2514	5-24
VR1		Same as 7A1A1A1CR8	5-27	C1 to C63		CAPACITOR, FIXED CERAMIC: Mil type CK70AW152M	5-24
<u>7A1A1A4</u>		L1 SERVO AMPLIFIER	5-24	CR1, CR2		Same as 7A1A1A1CR1	5-24
		PC BOARD ASSEMBLY: MFR14304, PN 6049-2562	5-28	L1		Same as 7A1A1A1CR1	5-24
C1		Not Used		Q1 to Q4		TRANSISTOR: Mil type 2N297A	5-24
C2, C3		CAPACITOR, FIXED TANTALUM: Mil type CS13BB685K	5-28	R1		RESISTOR, FIXED COMPOSITION: Mil type RC07GF470K	5-24
C4 to C6		CAPACITOR, FIXED CERAMIC: Mil type CK62AW822M	5-28	<u>7A1A3</u>		RELAY BRACKET ASSEMBLY: MFR14304, PN 6049-2520	5-24
CR1 to CR5		DIODE: Mil type 1N277	5-28	K1 to K3		RELAY, SOLENOID: Mil type M5757-15-001	5-24
CR6, CR7		Same as 7A1A1A1CR1	5-28	K4		RELAY, THERMAL: Mil type M19648-1-021	5-24
CR8		Same as 7A1A1A4CR1	5-28	<u>7A1A4</u>		CHASSIS ASSEMBLY, DECODER/ENCODER: MFR14304, PN 6049-2540	5-24
MPI		PC BOARD: MFR14304, PN 6049-2563	5-28	P1		CONNECTOR, PLUG: MFR14304, PN 6049-4528-4	5-24
Q1 to Q3		Same as 7A1A1A1Q1	5-28	R1 to R7		RESISTOR, VARIABLE: Mil type RV4LAYS502A	5-24
Q4		Same as 7A1A1A3Q6	5-28	R8		RESISTOR, VARIABLE: Mil type RV4LAYS5102A	5-24
Q5		Same as 7A1A1A1Q1	5-28	R9		RESISTOR, FIXED COMPOSITION: Mil type RC07GF392J	5-24
Q6		Same as 7A1A1A3Q6	5-28	S1		SWITCH ASSEMBLY: MFR14304, PN 6049-2518	5-24
Q7, Q8		Same as 7A1A1A1Q1	5-28	<u>7A1A4A1</u>		DECODER/ENCODER PC BOARD ASSEMBLY: MFR14304, PN 6049-2546	5-24, 5-29
Q9, Q10		Same as 7A1A1A3Q1	5-28	CR1 to CR4		Same as 7A1A1A1CR1	5-29
R1, R2		RESISTOR, FIXED COMPOSITION: Mil type RC07GF330K	5-28	MPI		PC BOARD: MFR14304, PN 6049-2547	5-29
R3		RESISTOR, FIXED COMPOSITION: Mil type RC07GF332K	5-28	Q1		Same as 7A1A1A1Q1	5-29
R4		RESISTOR, FIXED COMPOSITION: Mil type RC07GF392K	5-28	Q2		Same as 7A1A2Q1	5-29
R5		RESISTOR, FIXED COMPOSITION: Mil type RC32GF182K	5-28	Q3		Same as 7A1A1A1Q1	5-29
R6, R7		RESISTOR, FIXED COMPOSITION: Mil type RC07GF682K	5-28	R1		RESISTOR, FIXED COMPOSITION: Mil type RC32GF101J	5-29
R8 to R10		Not Used		R2, R3		Same as 7A1A1A1R1	5-29
R11, R12		Same as 7A1A1A4R6	5-28	R4		RESISTOR, FIXED COMPOSITION: Mil type RC07GF153J	5-29
R13		Same as 7A1A1A4R5	5-28				
R14		Same as 7A1A1A4R3	5-28				
R15, R16		Same as 7A1A1A4R1	5-28				
R17 to R22		RESISTOR, FIXED COMPOSITION: Mil type RC42GF561K	5-28				
R23		RESISTOR, FIXED COMPOSITION: Mil type RC07GF471K	5-28				
R24		RESISTOR, FIXED COMPOSITION: Mil type RC07GF182K	5-28				
R25		Same as 7A1A1A4R23	5-28				

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>7A1A4A1</u> (Cont) R5		RESISTOR, FIXED COMPOSITION: Mil type RC32GF152J	5-29
R6		RESISTOR, FIXED COMPOSITION: Mil type RC07GF271J	5-29
R7		Same as 7A1A1A1R1	5-29
R8		RESISTOR, FIXED COMPOSITION: Mil type RC20GF472J	5-29
<u>8</u>		<u>ENCLOSURE ASSEMBLY:</u> MFR14304, PN 6049-2000	5-7
<u>8A1</u>		CIRCUIT BREAKER PANEL ASSEMBLY: MFR14304, PN 6049-1040	5-8
CB1		CIRCUIT BREAKER: MFR14304, PN 6049-1043	5-8
CB2		CIRCUIT BREAKER: MFR14304, PN 6049-1044	5-8
CB3		CIRCUIT BREAKER: MFR14304, PN 6049-1046	5-8
TB1A to TB1C		TERMINAL BOARD: MFR14304, PN E31- 0008-001	5-8
<u>8A2</u>		BOTTOM PLATE ASSEMBLY: MFR14304, PN 6049-1020	5-8
C1		CAPACITOR, FIXED ELECTROLYTIC: Mil type CE71C562G	5-8
R1		RESISTOR, FIXED COMPOSITION: Mil type RC42GF394J	5-8
TB1, TB2 TB3		TERMINAL BOARD: Mil type 37TB2	5-8
TB4		TERMINAL BOARD: Mil type 37TB4	5-8
<u>8A2A1</u>		AUTO TRANSFORMER ASSEMBLY: MFR14304, PN 6049-1121	5-8
T1		AUTO TRANSFORMER: MFR14304, PN 6049-1120	5-8
TB1		TERMINAL BOARD: Mil type 37TB12	5-8
TB2		TERMINAL BOARD: Mil type 37TB15	5-8
<u>8A2A2</u>		POWER SUPPLY ASSEMBLY: MFR14304, PN 6049-1025	5-8
CR1 to CR6 MP1		DIODE: Mil type 1N1614	5-8
		HEATSINK: MFR14304, PN 6049-1026	5-8

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
R1		RESISTOR, FIXED COMPOSITION: Mil type RC32GF272J	5-8
<u>8A3</u>		OUTLET STRIP: MFR14304, PN 6049-2031	5-7
<u>8A4</u>		ATTENUATOR ASSEM- BLY: MFR14304, PN 6049-1010	5-7
J1		CONNECTOR, RECEPTACLE: Mil type MS3112E12-10P	5-7
J2, J3		CONNECTOR, RECEPTACLE: Mil type UG-625 B/U	5-7
<u>8A4A1</u>		ATTENUATOR PC BOARD ASSEMBLY: MFR14304, PN 6049-1014	5-9
CR1, CR2 K1		DIODE: Mil type 1N3611	5-9
		RELAY, REED: MFR14304, PN 6049- 6210-2	5-9
Q1		TRANSISTOR: Mil type 2N1613	5-9
Q2		TRANSISTOR: Mil type 2N1132	5-9
R1		RESISTOR, FIXED COMPOSITION: Mil type RC07GF473K	5-9
R2, R3		RESISTOR, FIXED COMPOSITION: Mil type RC07GF103K	5-9
R4		RESISTOR, FIXED COMPOSITION: Mil type RC07GF333K	5-9
R5		RESISTOR, FIXED COMPOSITION: Mil type RC07GF120K	5-9
R6		RESISTOR, FIXED COMPOSITION: Mil type RC07GF101K	5-9
R7		Same as 8A4A1R5	5-9
<u>8A5</u>		BLOWER ASSEMBLY: MFR14304, PN 6049-1054	5-7
B1		BLOWER: Mil type FC1S6CA10-0A	5-7
C1, C2		CAPACITOR, FIXED PAPER: Mil type CP53B1EF205K1	5-7
F1		FUSE, CARTRIDGE: Mil type M23419/1-015	5-7
P1		CONNECTOR, PLUG: Mil type MS3116F8-4S	5-7
XF1		FUSEHOLDER: Mil type M19207/26-0001	5-7
<u>8W1</u>		CABLE ASSEMBLY: MFR14304, PN6049-1019	5-7

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.	REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>8W1 (Cont)</u>				P15		CONNECTOR, PLUG: Mil type MS3116E20-39SX	5-7
P1		CONNECTOR, PLUG: MFR14304, PN W80-0001-000	5-7	P16		Not Used	
P2		CONNECTOR, PLUG: MFR14304, PN MS3108B14S7S	5-7	P17		CONNECTOR, PLUG: Mil type MS3116E12-10S	5-7
<u>8W2, 8W3</u>		Same as 8W1	5-7	<u>8W11</u>		CABLE ASSEMBLY: MFR14304, PN 6049-1061	5-7
<u>8W4</u>		CABLE ASSEMBLY: MFR14304, PN 6049-1017	5-7	P1, P2		Same as 8W9P2	5-7
P1		CONNECTOR, PLUG: Mil type MS3106E28-17P	5-7	<u>8W12</u>		CABLE ASSEMBLY: MFR14304, PN 6049-1062	5-7
P2		CONNECTOR, PLUG: Mil type MS3106E28-17S	5-7	P1, P2		Same as 8W9P1	5-7
<u>8W5</u>		CABLE ASSEMBLY: MFR14304, PN 6049-1018	5-7	<u>9</u>		TUNER, RADIO FRE- QUENCY TN-509/FRT- 83(V); MFR14304, PN 6049-4500	5-7
J1		CONNECTOR, RECEPTACLE: Mil type UG-160D/U	5-7	<u>9A1</u>		CHASSIS AND PANEL ASSEMBLY: MFR14304, PN 6049-4504	5-30/ 5-31
P1		CONNECTOR, PLUG: Mil type UG/21B/U	5-7	C1		CAPACITOR, VACUUM VARIABLE: 10 to 500PF, MFR14304, PN C95- 0001-000	5-30
<u>8W6</u>		CABLE ASSEMBLY: MFR42498, PND45336G1	5-7	C2		CAPACITOR, FIXED ELECTROLYTIC: Mil type CE71C142G	5-31
<u>8W7</u>		CABLE ASSEMBLY: MFR42498, PND45336G3	5-7	C3		Same as 9A1C1	5-31
<u>8W8</u>		CABLE ASSEMBLY: MFR42498, PND45336G2	5-7	C4 to C19 C20		Not Used	
<u>8W9</u>		CABLE ASSEMBLY: MFR14304, PN 6049-1060	5-7			CAPACITOR, FIXED CERAMIC: Mil type CK63AW103M	5-31
P1		CONNECTOR, PLUG: Mil type UG-536B/U	5-7	CP1 to CP3		CONNECTOR: Mil type UG-491B/U	5-31
P2		CONNECTOR, PLUG: Mil type M23329/3-01	5-7	J1		CONNECTOR, RECEPTACLE: Mil type UG-492D/U	5-31
<u>8W10</u>		CABLE ASSEMBLY: MFR14304, PN 6049-1003	5-7	J2 to J4		CONNECTOR RECEPTACLE: MFR14304, PN 6049-4528-2	5-31
P1		CONNECTOR, PLUG: Mil type MS3108B20-19S	5-7	K1, K2		RELAY, COAXIAL: SPDT, MFR14304, PN 6049-4529	5-31
P2, P3 P4		Not Used		M1		METER, PANEL: MFR14304, PN 391-3676	5-31
P5		CONNECTOR, PLUG: Mil type MS3108B28-21P	5-7	MP1, MP2		KNOB: Mil type MS91528/1P2B	5-31
P6		CONNECTOR, PLUG: Mil type MS3106A20-27S	5-7	P1		CONNECTOR, PLUG: MFR14304, PN 6049- 4528-1	5-31
P7		CONNECTOR, PLUG: Mil type MS3106A20-20P	5-7	S1		SWITCH, INTERLOCK: Mil type MS16106-4	5-30
P8		CONNECTOR, PLUG: Mil type MS3106A22-14P	5-7	T1		TRANSFORMER: MFR14304, PN 6049-5105	5-31
P9		CONNECTOR, PLUG: Mil type MS3106A29-28P	5-7	<u>9A1A1</u>		DISCRIMINATOR ASSEMBLY: MFR14304, PN 6049-4614	5-31/ 5-32
P10		Not Used					
P11		CONNECTOR, PLUG: Mil type MS3106A28-21P	5-7				
P12, P13 P14		Not Used Same as 8W10P11	5-7				

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>9A1A1</u> (Cont)			
C1		CAPACITOR, FIXED GLASS: Mil type CY13C5R1C	5-32
C2 to C5		CAPACITOR, FIXED CERAMIC: Mil type CK62AW822M	5-32
C6		CAPACITOR, VARIABLE: Mil type PC41J8R5	5-32
C7		CAPACITOR, FIXED MICA: Mil type CM05DD331JP3	5-32
C8 to C11		Same as 9A1A1C2	5-32
CR1, CR2 CR3, CR4 CR5, CR6		DIODE: Mil type 1N914 Not Used	5-32
L1		Same as 9A1A1CR1 CHOKE, RF: Mil type LT4K029	5-32
L2		Not Used	
L3		CHOKE, RF: 3600UH, ±5%, MFR14304, PN L10- 0002-054	5-32
P1		CONNECTOR, PLUG: Mil type UG-88E/U	5-31/ 5-32
R1, R2		RESISTOR, FIXED FILM: Mil type RL32S390G	5-32
R3		RESISTOR, FIXED FILM: Mil type RL42S221J	5-32
R4, R5		RESISTOR, FIXED COMPOSITION: Mil type RC20GF392K	5-32
R6		RESISTOR, VARIABLE: Mil type RT11C2P202	5-32
R7		RESISTOR, FIXED FILM: Mil type RL42S101J	5-32
R8		Not Used	
R9		RESISTOR, FIXED COMPOSITION: Mil type RC20GF101K	5-32
R10		Same as 9A1A1R3	5-32
R11, R12		RESISTOR, FIXED COMPOSITION: Mil type RC20GF152K	5-32
R13		RESISTOR, FIXED COMPOSITION: Mil type RC20GF332K	5-32
R14		Not Used	
R15		Same as 9A1A1R11	5-32
R16, R17		RESISTOR, FIXED FILM: Mil type RL20S472G	5-32
R18		Same as 9A1A1R13	5-32
R19		Same as 9A1A1R11	5-32
R20		RESISTOR, FIXED COMPOSITION: Mil type RC07GF123K	5-32

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
T1		TRANSFORMER, RF: MFR14304, PN T10- 0002-000	5-32
T2		TRANSFORMER, RF: MFR14304, PN T10- 0001-000	5-32
<u>9A1A2</u>		L1 COIL AND DRIVE ASSEMBLY: MFR14304, PN 6049-4640	5-30
P1		Not Used	
P2		Same as 9A1P1	5-30
S1		SWITCH, THERMAL: MFR14304, PN S70- 0001-000	5-30
<u>9A1A2A1</u> <u>9A1A2A2</u>		Not Used GEAR DRIVE ASSEMBLY, L1 AND L2 COILS: MFR14304, PN 6049-4610	5-30
MP1, MP2 R1		PLUNGER: MFR14304, PN Z20-9001-001 POTENTIOMETER: 5000 OHMS, MFR14304, PN 392-1607	5-30
S1, S2		SWITCH, LIMIT: Mil type MS25343-1	5-30
<u>9A1A2A2A1</u>		DIODE BOARD ASSEM- BLY: MFR14304, PN 6049-4605	5-30
CR1 to CR6 MP1		DIODE: Mil type 1N3611  PC BOARD: MFR14304, PN 6049-4606	5-30
<u>9A1A2A2A2</u>		GEAR DRIVE ASSEMBLY: MFR14304, PN 6049- 4650-3	5-30
B1		MOTOR, DC: MFR14304, PN 6049-4652	5-30
<u>9A1A2L1</u>		COIL ASSEMBLY: MFR14304, PN 6049-4570	5-30
MP1		CONTACT, SHORTING: MFR14304, PN 6049-4576	5-30
MP2		ROTOR ASSEMBLY: MFR14304, PN 392-1935	5-30
MP3 MP4, MP5		Same as 9A1A2L1MP1 BEARING, BALL: MFR14304, PN Z05- 0010-001	5-30
<u>9A1A3</u>		PROTECTOR ASSEMBLY: MFR14304, PN 6049-4560	5-30/ 5-33
<u>9A1A3A1</u>		PROTECTOR PC BOARD ASSEMBLY: MFR14304, PN 6049-4563	5-33
C1		CAPACITOR, FIXED CERAMIC: Mil type CK60AW102M	5-33
CR1		Same as 9A1A1CR1	5-33

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>9A1A3A1</u> (Cont)			
CR2, CR3 MP1		Same as 9A1A2A2A1CR1	5-33
R1		PC BOARD: MFR14304, PN 6049-4564	5-33
T1		RESISTOR, FIXED COMPOSITION: Mil type RC20GF102K	5-33
<u>9A1A4</u>		TRANSFORMER: MFR14304, PN 6049-4569	5-33
P4		L2 COIL AND DRIVE ASSEMBLY: MFR14304, PN 6049-4630	5-30
<u>9A1A4A1</u>		Same as 9A1P1	5-30
<u>9A1A4A2</u>		Not Used	
<u>9A1A4A2A1</u>		Same as 9A1A2A2	5-30
<u>9A1A4A2A2</u>		Same as 9A1A2A2A1	5-30
<u>9A1A4L2</u>		Same as 9A1A2A2A2	5-30
<u>9A1A5</u>		Same as 9A1A2L1	5-30
C1		VSWR BRIDGE ASSEM- BLY: MFR14304, PN 6049-4508	5-31/ 5-34
C2		CAPACITOR, FIXED MICA: Mil type CM05F361J03	5-34
C3, C4		CAPACITOR, FIXED MICA: Mil type CM05F391J03	5-34
C5		Same as 9A1A3A1C1	5-34
C6		Same as 9A1A5C2	5-34
CR1 to CR4 CR5 J1		CAPACITOR, VARIABLE: 8 to 12PF, MFR14304, PN 6049-4625	5-34
J2		Same as 9A1A1CR1	5-34
L1		Same as 9A1A2A2A1CR1	5-34
L2		CONNECTOR, RECEPTACLE: Mil type UG-909A/U	5-34
R1, R2		CONNECTOR, RECEPTACLE: Mil type UG-625B/U	5-34
R3		CHOKE, RF: Mil type LT4K071	5-34
R4		Same as 9A1A1L1	5-34
R5, R6		RESISTOR, FIXED FILM: Mil type RL32S560G	5-34
		RESISTOR, FIXED COMPOSITION: Mil type RC07GF472J	5-34
		RESISTOR, FIXED COMPOSITION: Mil type RC07GF152J	5-34
		RESISTOR, FIXED FILM: Mil type RL07S432G	5-34

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
R7		Same as 9A1A5R4	5-34
R8		Same as 9A1A5R3	5-34
R9		RESISTOR, FIXED COMPOSITION: Mil type RC20GF105J	5-34
T1		TRANSFORMER, TOROID: MFR14304, PN 391-3426	5-34
<u>9A1A6</u>		CAPACITOR DRIVE ASSEMBLY: MFR14304, PN 6049-4600	5-30
MP1, MP2 P1, P2 P3		Same as 9A1A2A2MP1	5-30
R1		Not Used	
S1, S2		Same as 9A1A2P2	5-30
<u>9A1A6A1</u>		Same as 9A1A2A2R1	5-30
<u>9A1A6A2</u>		Same as 9A1A2A2S1	5-30
B1		Same as 9A1A2A2A1	5-30
<u>9A1A7</u>		GEAR DRIVE ASSEMBLY: MFR14304, PN 6049-4650-1	5-30
C1 to C34		Same as 9A1A2A2A2B1	5-30
CR1 to CR3 J1 to J7 J8		FILTER BOX ASSEMBLY: MFR14304, PN 6049-4506	5-31
<u>9A1A8</u>		CAPACITOR, FIXED CERAMIC: Mil type CK70AW152M	5-31
CR1 K1, K2 K3		Same as 9A1A2A2A1CR1	5-31
L1, L2 L3		Not Used	
P1 to P4 P5		CONNECTOR, RECEPTACLE: Mil type MS3102R28-21S	5-31
S1 S2		COIL RELAY ASSEMBLY: MFR14304, PN 6049-4507	5-31
<u>9A1A9</u>		Same as 9A1A2A2A1CR1	5-31
C1		Not Used	
C2		RELAY, DPDT: MFR14304, PN 6049-4539	5-31
J1 to J4		Not Used	
		COIL ASSEMBLY: MFR14304, PN 6049-4530	5-31
		Not Used	
		Same as 9A1A1P1	5-31
		Not Used	
		Same as 9A1S1	5-31
		SAMPLER ASSEMBLY: MFR14304, PN 6049-4540	5-31/ 5-35
		CAPACITOR: MFR14304, PN 6049-4546	5-35
		CAPACITOR, FIXED MICA: Mil type CM05CD111J P3	5-35
		Same as 9A1A5J2	5-35

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>9A1A9</u> (Cont) R1, R2		RESISTOR, FIXED COMPOSITION: Mil type RC07GF121J	5-35
<u>9A1A10</u>		L3 INSERT PC BOARD ASSEMBLY: MFR14304, PN 6049-4538	5-31
CR1 to CR3 K1 to K3 K4		Same as 9A1A2A2A1CR1	5-31
MP1		Not Used	
<u>9A1A11</u>		RELAY, REED: MFR14304, PN 6049- 6210-2	5-31
J1 R1 to R54 R55		PC BOARD: MFR14304, PN 6049-4537	5-31
R56		PEAK AVERAGE WATT- METER ASSEMBLY: MFR14304, PN 6049-4594	5-31
R57		Same as 9A1J2	5-31
S1		Not Used	
S2		RESISTOR, VARIABLE: Mil type RV5LAYSB253A	5-31
<u>9A1A11A1</u>		RESISTOR, VARIABLE: Mil type RV5LAYSB103A	5-31
C1		RESISTOR, VARIABLE: Mil type RV5LAYSB254A	5-31
C2		SWITCH, ROTARY: MFR14304, PN 6049-4544	5-31
C3		SWITCH, ROTARY: MFR14304, PN 392-6118	5-31
C4		WATTMETER PC BOARD ASSEMBLY: MFR14304, PN 6049-4586	5-36
C5		CAPACITOR, FIXED MICA: Mil type CM05DC101JP3	5-36
C6		CAPACITOR, FIXED MICA: Mil type CM05DC560JP3	5-36
C7		CAPACITOR, FIXED MICA: Mil type CM05DC200JP3	5-36
C8		CAPACITOR, FIXED MICA: Mil type CM06DC471JP3	5-36
C9		CAPACITOR, FIXED CERAMIC: Mil type CK63AY103X	5-36
		CAPACITOR, FIXED ELECTROLYTIC: Mil type CE11C050E	5-36
		Not Used	
		Same as 9A1A11A1C5	5-36
		Not Used	

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
C10 to C12		Same as 9A1A11A1C5	5-36
C13		Not Used	
C14		Same as 9A1A11A1C6	5-36
C15		Not Used	
C16 to C19		Same as 9A1A11A1C5	5-36
CR1 to CR7		Same as 9A1A1CR1	5-36
CR8		DIODE: Mil type 1N277	5-36
CR9		Same as 9A1A11A1CR8	5-36
CR10 to CR13		Not Used	
CR14 to CR16		Same as 9A1A1CR1	5-36
CR17, CR18		Same as 9A1A11A1CR8	5-36
CR19 to CR23		Same as 9A1A1CR1	5-36
IC1		INTEGRATED CIRCUIT: MFR14304, PN 6049-6205	5-36
MP1		PC BOARD: MFR14304, PN 6049-4587	5-36
Q1		TRANSISTOR: Mil type 2N404	5-36
Q2		TRANSISTOR: Mil type 2N697	5-36
Q3		Same as 9A1A11A1Q1	5-36
Q4		Same as 9A1A11A1Q2	5-36
Q5, Q6		Same as 9A1A11A1Q1	5-36
Q7 to Q9		Same as 9A1A11A1Q2	5-36
R1		RESISTOR, FIXED COMPOSITION: Mil type RC20GF272J	5-36
R2		RESISTOR, FIXED COMPOSITION: Mil type RC20GF102J	5-36
R3		RESISTOR, FIXED FILM: Mil type RN60D2741F	5-36
R4		RESISTOR, FIXED FILM: Mil type RN60D3651F	5-36
R5		RESISTOR, FIXED FILM: Mil type RN60D1500F	5-36
R6		RESISTOR, FIXED FILM: Mil type RN60D2262F	5-36
R7		RESISTOR, FIXED FILM: Mil type RN60D1821F	5-36
R8		RESISTOR, FIXED FILM: Mil type RN60D1622F	5-36
R9		RESISTOR, FIXED FILM: Mil type RN60D3321F	5-36
R10		Same as 9A1A5R4	5-36
R11		RESISTOR, FIXED FILM: Mil type RN60D1002F	5-36
R12		RESISTOR, FIXED FILM: Mil type RN60D90R9F	5-36

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.	REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>9A1A11A1</u> (Cont)				R44		RESISTOR, FIXED COMPOSITION: Mil type RC07GF273J	5-36
R13		RESISTOR, FIXED FILM: Mil type RN60D5110F	5-36	R45		RESISTOR, FIXED COMPOSITION: Mil type RC07GF393J	5-36
R14		Same as 9A1A11A1R11	5-36	R46 to R53		Not Used	
R15		RESISTOR, FIXED FILM: Mil type RN60D8451F	5-36	R54		Same as 9A1A5R3	5-36
R16		Same as 9A1A11A1R11	5-36	<u>9A1A12</u>		WATTMETER POWER SUPPLY PC BOARD ASSEMBLY: MFR14304, PN 6049-4584	5-31/ 5-37
R17		RESISTOR, FIXED COMPOSITION: Mil type RC07GF272J	5-36	CR1 to CR12		Same as 9A1A2A2A1CR1	5-37
R18		Same as 9A1A11A1R9	5-36	MP1		PC BOARD: MRF14304, PN 6049-4585	5-37
R19		RESISTOR, FIXED FILM: Mil type RN60D6811F	5-36	Q1		Same as 9A1A11A1Q2	5-37
R20		RESISTOR, FIXED FILM: Mil type RN60D2320F	5-36	Q2		TRANSISTOR: Mil type 2N297A	5-37
R21		RESISTOR, FIXED COMPOSITION: Mil type RC07GF560J	5-36	R1		RESISTOR, FIXED COMPOSITION: Mil type RC20GF180J	5-37
R22		Same as 9A1A5R4	5-36	R2, R3		RESISTOR, FIXED COMPOSITION: Mil type RC42GF151J	5-37
R23		RESISTOR, FIXED COMPOSITION: Mil type RC07GF105J	5-36	VR1,VR2		DIODE: Mil type 1N3023B	5-37
R24		RESISTOR, FIXED FILM: Mil type RN60D3921F	5-36	<u>9A1W1</u>		CABLE ASSEMBLY: MFR14304, PN 6049-4534	5-31
R25		RESISTOR, FIXED FILM: Mil type RN60D1912F	5-36	J1 to J5		Not Used	
R26		RESISTOR, FIXED FILM: Mil type RN60D4642F	5-36	J6		CONNECTOR, RECEPTACLE: Mil type UG-556B/U	5-31
R27		Same as 9A1A11A1R9	5-36	P1 to P9		Not Used	
R28		RESISTOR, FIXED FILM: Mil type RN60D8252F	5-36	P10		Same as 9A1A1P1	5-31
R29		Same as 9A1A11A1R9	5-36	<u>9A1W2</u>		CABLE ASSEMBLY: MFR14304, PN 6049-4532	5-31
R30		RESISTOR, FIXED FILM: Mil type RN60D3243F	5-36	J1 to J6		Not Used	
R31		RESISTOR, FIXED FILM: Mil type RN60D1501F	5-36	J7		Same as 9A1W1J6	5-31
R32		RESISTOR, FIXED FILM: Mil type RN60D5621F	5-36	P1 to P10		Not Used	
R33		Same as 9A1A11A1R24	5-36	P11		Same as 9A1A1P1	5-31
R34		RESISTOR, FIXED COMPOSITION: Mil type RC07GF153J	5-36	<u>9A1W3</u>		CABLE ASSEMBLY: MFR14304, PN 6049-4531	5-31
R35		Same as 9A1A11A1R26	5-36	P1 to P6		Not Used	
R36		Same as 9A1A11A1R9	5-36	P7, P8		Same as 9A1A1P1	5-31
R37		Same as 9A1A11A1R28	5-36	<u>9A1W4</u>		CABLE ASSEMBLY: MFR14304, PN 6049-4533	5-31
R38		Same as 9A1A11A1R9	5-36	J1 to J8		Not Used	
R39		RESISTOR, FIXED FILM: Mil type RN60D1783F	5-36	J9		Same as 9A1A5J1	5-31
R40		Same as 9A1A11A1R31	5-36	P1 to P9		Not Used	
R41		RESISTOR, FIXED COMPOSITION: Mil type RC07GF392J	5-36	P10		Same as 9A1A1P1	5-31
R42		RESISTOR, FIXED COMPOSITION: Mil type RC07GF681J	5-36	<u>10</u>		TUNER CONTROL C-7704/FRT-83(V): MFR14304, PN 6049-4000	5-7
R43		Same as 9A1A11A1R41	5-36	<u>10A1</u>		CHASSIS-PANEL ASSEMBLY: MFR14304, PN 6049-4010	5-38

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>10A1 (Cont)</u>			
C1		CAPACITOR, FIXED ELECTROLYTIC: Mil type CE51C501G	5-38
CB1		CIRCUIT BREAKER: Mil type 1411-2-11	5-38
CR1 to CR4		DIODE: Mil type 1N3611	5-39
DS1 to DS4		LAMP, INCANDESCENT: Mil type MS25237-327	5-38
J1 to J4		CONNECTOR, RECEP-TACLE: Mil type M21097/6-47	5-38
M1		METER: MFR14304, PN 392-6106	5-38
M2		METER: MFR14304, PN 392-6107	5-38
MP1		Not Used	
MP2		SOCKET: Mil type TS101P01	5-38
MP3, MP4		KNOB: Mil type MS91528-1P2B	5-38
Q1 to Q8		TRANSISTOR: Mil type 2N297A	5-38
R1		RESISTOR, FIXED COMPOSITION: Mil type RC20GF103K	5-39
R2 to R6		Not Used	
R7, R8		RESISTOR, VARIABLE: Mil type RV4LAYS501A	5-38
R9		Not Used	
R10		RESISTOR, FIXED COMPOSITION: Mil type RC20GF682K	5-38
S1		SWITCH, ROTARY: MFR14304, PN 392-6117	5-38
S2		Not Used	
S3		SWITCH, ROTARY: MFR14304, PN 392-6118	5-38
S4		SWITCH, TOGGLE: Mil type MS35058-29	5-38
S5, S6		SWITCH, PUSH: Mil type MS25089-3C	5-38
S7		Not Used	
S8		SWITCH, INTERLOCK: Mil type MS16106-4	5-39
S9		Not Used	
S10		SWITCH, TOGGLE: Mil type MS35059-23	5-38
S11		Same as 10A1S8	5-39
T1		TRANSFORMER ASSEMBLY: MFR14304, PN 392-6135	5-38
XDS1		LAMPHOLDER: Mil type LH73LC12RT	5-38
XDS2		LAMPHOLDER: Mil type LH73LC12WT	5-38

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
XDS3		LAMPHOLDER: Mil type LH73LC12YT	5-38
XDS4		LAMPHOLDER: Mil type LH73LC12GT	5-38
<u>10A1A1</u> <u>10A1A2</u>		Not Used	
		SERVO AMPLIFIER PC BOARD ASSEMBLY: MFR14304, PN 6049-4017	5-38/ 5-40
C1		Not Used	
C2		CAPACITOR, FIXED TANTALUM: Mil type CS13BB685K	5-40
C3		Same as 10A1A2C1	5-40
C4 to C6		CAPACITOR, FIXED CERAMIC: Mil type CK62AW822M	5-40
CR1 to CR5		DIODE: Mil type 1N277	5-40
CR6, CR7		Same as 10A1CR1	5-40
CR8 to CR10		Same as 10A1A2CR1	5-40
MP1		PC BOARD: MFR14304, PN 6049-4018	5-40
Q1 to Q3		TRANSISTOR: Mil type 2N1613	5-40
Q4		TRANSISTOR: Mil type 2N1132	5-40
Q5		Same as 10A1A2Q1	5-40
Q6		Same as 10A1A2Q4	5-40
Q7, Q8		Same as 10A1A2Q1	5-40
Q9, Q10		TRANSISTOR: Mil type 2N1309	5-40
R1, R2		RESISTOR, FIXED COMPOSITION: Mil type RC07GF330K	5-40
R3		RESISTOR, FIXED COMPOSITION: Mil type RC07GF332K	5-40
R4		RESISTOR, FIXED COMPOSITION: Mil type RC07GF392K	5-40
R5		RESISTOR, FIXED COMPOSITION: Mil type RC32GF182K	5-40
R6, R7		RESISTOR, FIXED COMPOSITION: Mil type RC07GF682K	5-40
R8 to R10		Not Used	
R11, R12		Same as 10A1A2R6	5-40
R13		Same as 10A1A2R5	5-40
R14		Same as 10A1A2R3	5-40
R15, R16		Same as 10A1A2R1	5-40
R17 to R22		RESISTOR, FIXED COMPOSITION: Mil type RC42GF561K	5-40

TABLE 6-2. MAINTENANCE PARTS LIST (CONT)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
<u>10A1A2</u> (Cont)			
R23		RESISTOR, FIXED COMPOSITION: Mil type RC07GF471K	5-40
R24		RESISTOR, FIXED COMPOSITION: Mil type RC07GF182K	5-40
R25		Same as 10A1A2R23	5-40
R26, R27		Same as 10A1A2R24	5-40
R28		Same as 10A1A2R4	5-40
TP1 to TP6		JACK, TEST: MFR14304, PN J60-0001-007	5-40
<u>10A1A3</u>		POWER SUPPLY PC BOARD ASSEMBLY: MFR14304, PN 6049-4030	5-38/ 5-41
C1		CAPACITOR, FIXED TANTALUM: Mil type CS13BB337K	5-41
C2		CAPACITOR, FIXED TANTALUM: Mil type CS13BC396K	5-41
C3 to C5		Not Used	
C6		Same as 10A1A2C4	5-41
C7, C8		Not Used	
C9		CAPACITOR, FIXED TANTALUM: Mil type CS13BF685K	5-41
C10 to C12		Same as 10A1A2C4	5-41
CR1		Same as 10A1CR1	5-41
CR2, CR3		Same as 10A1A2CR1	5-41
CR4		Not Used	
CR5 to CR8		Same as 10A1CR1	5-41
CR9 to CR11		Not Used	
CR12		Same as 10A1CR1	5-41
CR13, CR14		Same as 10A1A2CR1	5-41
CR15, CR16		Same as 10A1CR1	5-41
MP1		PC BOARD: MFR14304, PN 6049-4029	5-41
Q1		Not Used	
Q2, Q3		Same as 10A1A2Q1	5-41
Q4, Q5		Not Used	
Q6 to Q9		Same as 10A1A2Q1	5-41
R1		RESISTOR, FIXED COMPOSITION: Mil type RC07GF391K	5-41
R2		RESISTOR, FIXED COMPOSITION: Mil type RC07GF821K	5-41
R3		Not Used	
R4		RESISTOR, FIXED COMPOSITION: Mil type RC20GF222K	5-41

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
R5		Not Used	
R6		RESISTOR, FIXED COMPOSITION: Mil type RC20GF152K	5-41
R7		Not Used	
R8		RESISTOR, FIXED COMPOSITION: Mil type RC42GF821K	5-41
R9		RESISTOR, FIXED COMPOSITION: Mil type RC07GF103K	5-41
R10		RESISTOR, FIXED COMPOSITION: Mil type RC20GF683K	5-41
R11		Not Used	
R12		RESISTOR, FIXED COMPOSITION: Mil type RC07GF472K	5-41
R13		RESISTOR, FIXED COMPOSITION: Mil type RC07GF102K	5-41
R14		Same as 10A1A2R6	5-41
R15		Same as 10A1A2R3	5-41
R16		Not Used	
R17		Same as 10A1A3R4	5-41
R18 to R22		Not Used	
R23		Same as 10A1A3R13	5-41
R24, R25		Not Used	
R26		RESISTOR, FIXED COMPOSITION: Mil type RC42GF150K	5-41
R27		Not Used	
R28		Same as 10A1A3R26	5-41
R29		Not Used	
R30		Same as 10A1A2R6	5-41
R31, R32		Same as 10A1A2R5	5-41
R33		Same as 10A1A2R3	5-41
R34		Same as 10A1A3R13	5-41
R35		Same as 10A1A3R12	5-41
R36		RESISTOR, FIXED COMPOSITION: Mil type RC07GF100K	5-41
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R38		RESISTOR, FIXED COMPOSITION: Mil type RC20GF332K	5-41
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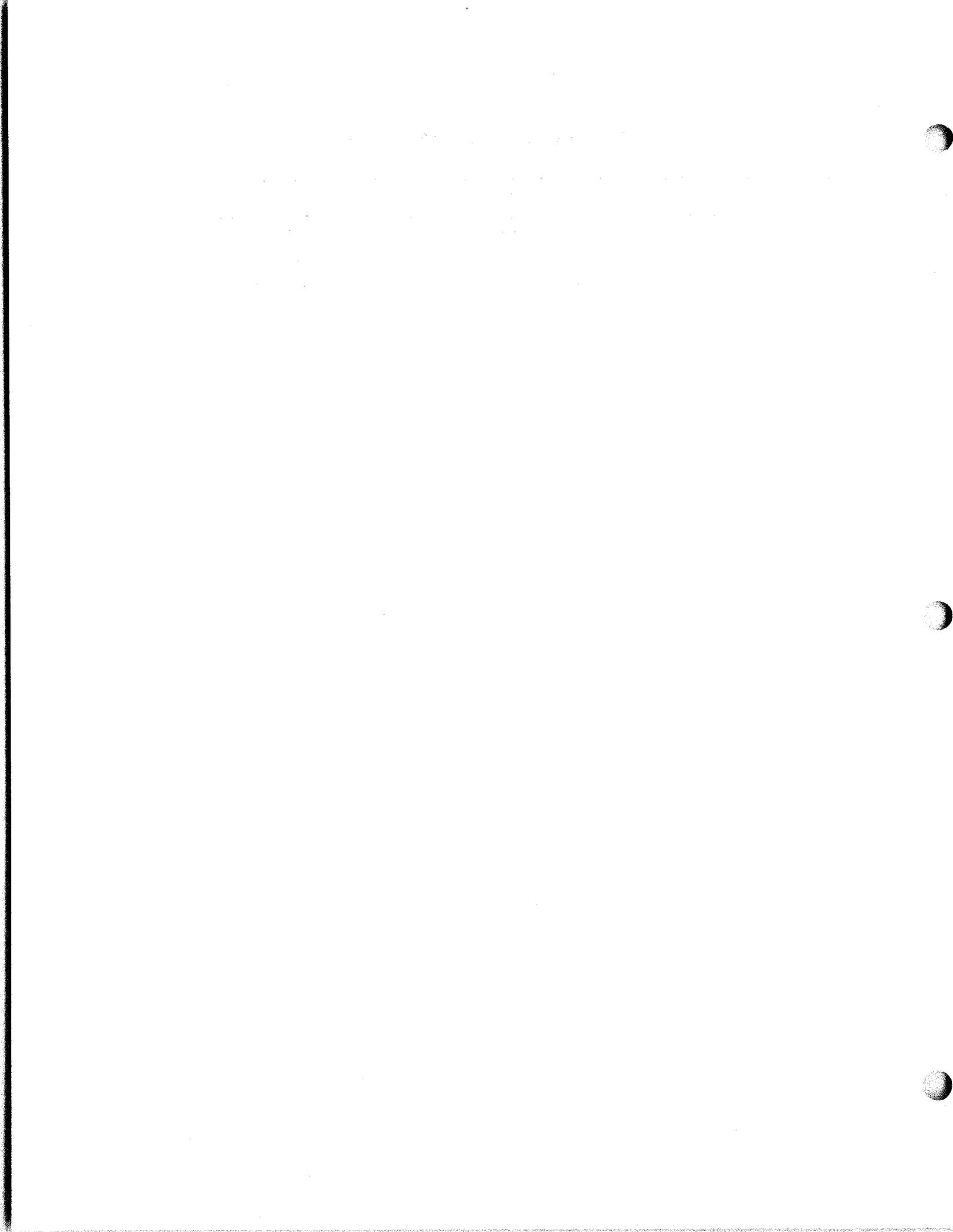
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REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
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C1, C2		Not Used	
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C4		Not Used	
C5 to C9		Same as 10A1A2C4	5-42
CR1		Not Used	
CR2		Same as 10A1A2CR1	5-42
CR3		Not Used	
CR4, CR5		Same as 10A1A2CR1	5-42
CR6, CR7		Not Used	
CR8 to CR11		Same as 10A1A2CR1	5-42
CR12		Not Used	
CR13		Same as 10A1A2CR1	5-42
CR14 to CR16		Not Used	
CR17		Same as 10A1A2CR1	5-42
CR18, CR19		Same as 10A1CR1	5-42
MP1		PC BOARD: MFR14304, PN 6049-4027	5-42
Q1 to Q6		Same as 10A1A2Q1	5-42
R1 to R4		Not Used	
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R7		Same as 10A1A3R12	5-42
R8		Same as 10A1A3R4	5-42
R9		Same as 10A1A3R12	5-42
R10		RESISTOR, FIXED COMPOSITION: Mil type RC07GF122K	5-42
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R13		Same as 10A1A2R5	5-42
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R15, R16		Not Used	
R17		Same as 10A1A2R3	5-42
R18		Same as 10A1A3R12	5-42

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
R19		Same as 10A1A3R13	5-42
R20		RESISTOR, FIXED COMPOSITION: Mil type RC07GF101K	5-42
R21		Same as 10A1A3R12	5-42
R22		Same as 10A1A2R24	5-42
R23		Not Used	
R24		Same as 10A1A3R13	5-42
R25		RESISTOR, FIXED COMPOSITION: Mil type RC07GF153K	5-42
R26		Same as 10A1A2R6	5-42
R27		RESISTOR, FIXED COMPOSITION: Mil type RC07GF152K	5-42
R28		Same as 10A1A2R6	5-42
R29, R30		Not Used	
R31		Same as 10A1A2R24	5-42
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J1		CONNECTOR, RECEPTACLE: Mil type MS3102R20-27P	5-39
J2		CONNECTOR, RECEPTACLE: Mil type MS3102R28-21S	5-39

TABLE 6-3. LIST OF MANUFACTURERS

MFR CODE	NAME	ADDRESS
14304	RF COMMUNICATIONS, INC.	ROCHESTER, N. Y.
42498	NATIONAL RADIO CO., INC.	MELROSE, MASS.



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