

TECHNICAL MANUAL

GENERAL SUPPORT MAINTENANCE MANUAL

POWER AMPLIFIER AM-6545A/GRC-193A
(NSN 5820-01-186-3699)

HEADQUARTERS, DEPARTMENT OF THE ARMY

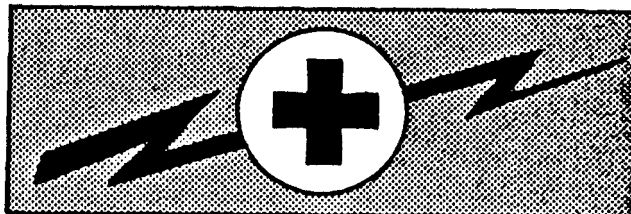
15 JANUARY 1986



SAFETY STEPS TO FOLLOW IF SOMEONE
IS THE VICTIM OF ELECTRICAL SHOCK

- 1** DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL
- 2** IF POSSIBLE , TURN OFF THE ELECTRICAL POWER
- 3** IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A WOODEN POLE OR A ROPE OR SOME OTHER INSULATING MATERIAL
- 4** SEND FOR HELP AS SOON AS POSSIBLE
- 5** AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION

WARNING



HIGH VOLTAGE

is used in the operation of this equipment

DEATH ON CONTACT

may result if personnel fail to observe safety precautions

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When the technician is aided by operators, he must warn them about dangerous areas.

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Take particular care to ground every capacitor likely to hold a dangerous potential. When working inside the equipment, after the power has been turned off, always ground every part before touching it.

Be careful not to contact high-voltage connections or 115 volt ac input connections when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through the body.

Warning: Do not be misled by the term "low voltage." Potentials as low as 50 volts may cause death under adverse conditions.

For Artificial Respiration, refer to FM 21-11;

SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must at all times observe all safety regulations. Unless specifically directed in this manual, do not replace components or make adjustments inside the equipment with any power supply turned on. Under certain conditions, dangerous potentials may exist in the power supplies when the power control is in the off position. To avoid casualties, always remove power and discharge and ground a circuit before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any person reach into or enter the enclosure for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid.

RESUSCITATION

FIRST AID

Each person engaged in electrical operations will be trained in first aid, particularly in the technique of mouth to mouth resuscitation and closed chest heart massage (FM 21-11).

The following warnings appear in this volume, and are repeated here for emphasis.

WARNING

A 3-wire (line, neutral, and safety ground) AC line power connections is required when operating the equipment. If a 3-wire safety grounded AC power receptacle is not available, a separate ground wire must be installed from the chassis ground to an earth ground. Without an adequate ground, the equipment chassis and frame will float to a dangerously high potential.

WARNING

Lethal voltage is used in the operational checkout of this unit. Death on contact may result if personnel fail to observe the following safety precautions. Remove watches and rings and exercise extreme caution when working inside the equipment throughout the remainder of this procedure.

WARNING

Prior to performing the following functions all electrical power is to be removed from the system. External power disconnected and a “MAINTENANCE IN PROGRESS” tag attached or power switches will be locked out to prevent inadvertent energizing of the system.

WARNING

Lifting heavy equipment incorrectly can cause serious injury. Do not try to lift more than 35 pounds by yourself. Get a helper. Bend legs while lifting. Don't support heavy weight with your back.

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame, the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician.

Compressed air shall not be used for cleaning purposes except where reduced to less than 29 psi and then only with effective chip guarding and personnel protective equipment. Do not use compressed air to dry parts when TRICHLOROTRIFLUOROETHANE has been used. Compressed air is dangerous and can cause serious bodily harm if protective means or methods are not observed to prevent chip or particle (of whatever size) from being blown into the eyes or unbroken skin of the operator or other personnel.

SAFETY SUMMARY

Safety precautions for protection of personnel and equipment are included throughout this manual wherever a procedure or condition is described that requires special care. These precautions are listed below.

WARNING

HIGH VOLTAGE is used in the operation of this equipment. DEATH ON CONTACT or severe electrical shock may result if personnel fail to observe safety precautions.

Learn the areas of high voltage in each piece of equipment. Be careful not to contact high-voltage connections when installing or operating this equipment. (General.)

WARNING

DANGER HIGH VOLTAGE

Dangerously high voltages (+1600 Vdc) are present on the plates of power tubes 1A14V1 and 1A14V2 (Y-621 B), Tank Circuit Module 1A8, Plate Assembly 1A9, and High Voltage Module 1A 13. Do not touch any part of these components when the equipment is energized. (Page 3-7, Para. 3-13.)

WARNING

Make sure the power is off before performing any cleaning or inspection procedures. (Page 3-7, Para. 3-13.)

WARNING

Power Amplifier Tubes 1A14V1 and 1A14V2 (Y-621 B) contain BERYLLIUM OXIDE (BeO) CERAMICS. The dust or fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC and breathing them can result in serious personal injury or DEATH.

Power tubes 1A14V1 and 1A14V2 (Y-621 B) contain Beryllium Oxide Ceramics which are used to conduct heat from the tubes (directly from the exposed anodes). Normal use of electron tubes having Beryllium Oxide Ceramics is safe. However, never alter, disassemble, grind, lap, fire, chemically clean, or perform any other operation on any ceramic parts of the power tubes which could possibly generate dust or fumes. Provisions for disposal of the Power Tubes will be provided separately. (Page 3-7, Para. 3-13.)

SAFETY SUMMARY (Continued)

CAUTION

Be sure that power amplifier air inlets (front of unit) and exhaust ports (rear of unit) are not obstructed before operating equipment. (Page 3-7, Para 3-13.)

CAUTION

Align all power amplifier cable connectors before mating and fastening. (Page 3-8, Para. 3-13.)

WARNING

Make sure power is off before performing any cleaning or inspection procedures. (Page 3-8, Para. 3-17.)

WARNING

Make sure power is off before performing these disassembly procedures, (Page 3-8, Para. 3-14.)

WARNING

Power amplifier tubes 1A14V1 and 1A14V2 (Y-621 B) contain BERYLLIUM OXIDE (BeO) CERAMICS. The dust or fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC and breathing them can result in serious personal injury or DEATH. (Page 3-7, Para, 3-13.) (Page 1-20, Para. 1-54.)

WARNING

Power amplifier tubes 1A14V1 and 1A14V2 (Y-621 B) contain BERYLLIUM OXIDE (BeO) CERAMICS. The dust of fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC and breathing them can result in serious personal injury or DEATH. Power amplifier tubes 1A14V1 and 1A14V2 should only be wiped with a dry lint free cloth, If the power amplifier case is muddy, wash it with detergent and water. Let unit air dry. (Page 3-18, Para. 3-49.)

SAFETY SUMMARY (Continued)

CAUTION

Do not use a high wattage soldering gun for printed wiring board repair. A high wattage gun voltages into the components and will reach a very high temperature in a few seconds, causing damage to the components and/or printed circuit/wiring boards. (Page 3-75, Para. 3-140.)

Technical Manual
 No. 11-5820-921-40-1

HEADQUARTERS
 DEPARTMENT OF THE ARMY
 Washington, DC, 15 January 1986

GENERAL SUPPORT MAINTENANCE MANUAL

**POWER AMPLIFIER AM-6545A/GRC-193A
 (NSN 5820-01-186-3699)**

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know, Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-ME-MP, Fort Monmouth, NJ 07703-5007. A reply will be furnished to you.

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SECTION 0

GENERAL

0-1. SCOPE. This manual covers Power Amplifier AM-6545A/GRC-193A. This manual provides instructions for general support maintenance. Throughout this manual AM-6545/GRC-193 should be AM-6545A/GRC-193A.

02. CONSOLIDATED INDEX OF ARMY PUBLICATIONS AND BLANK FORMS. Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes or additional publications pertaining to the equipment.

0-3. MAINTENANCE FORMS, RECORDS, AND REPORTS

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750 as contained in Maintenance Management Update.

b. Report of Packaging and Handling Deficiencies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.74A/AFR-400-54/MCO 4430.3F.

c. Discrepancy in Shipment Report (DISREP) (SF 362). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR55-38/NAVSUPINST 4610.33C/AFR 75-18/MCO P4610.19/DLAR 4500.15.

0-4. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR). If your Power Amplifier AM-6545A/GRC-193A needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us why you don't like the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-ME-MP, Fort Monmouth, New Jersey 07703-5007. We'll send you a reply.

0-5. ADMINISTRATIVE STORAGE. Administrative Storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the PMCS charts before storing. When removing the equipment from administrative storage the PMCS should be performed to assure operational readiness. Disassembly and repacking of equipment for shipment or limited storage are covered in TM 740-90-1.

0-6. DESTRUCTION OF ARMY ELECTRONICS MATERIEL. Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

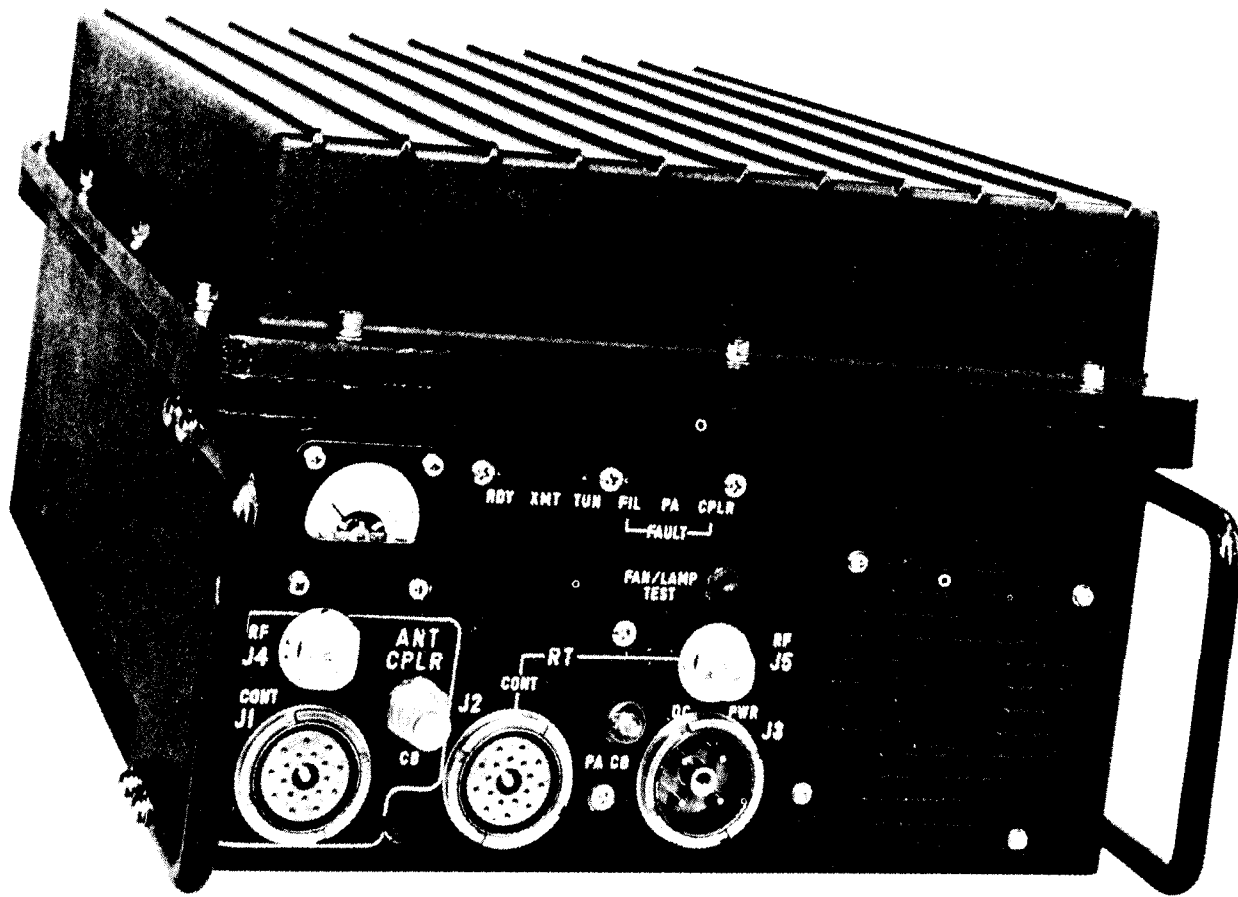


Figure 1-1. Power Amplifier AM-6545/GRC-193

CHAPTER 1 GENERAL INSTRUCTIONS

SECTION I

GENERAL DESCRIPTION AND SPECIFICATION DATA

1-1. INTRODUCTION

This manual provides intermediate maintenance instructions for Power Amplifier AM-6545/GRC- 193 hereinafter called the power amplifier), procured under Contract N00039-75-C-0022 (see figure 1-1). The power amplifier is part of Radio Set AN/GRC-193 and Radio Set AN/MRC-138. Its relationship to other components in the radio set is shown in figures 1-2 and 1-3. Organizational maintenance instructions for the power amplifier are provided in the system manual for the radio set, TM 11-5820-922-12.

1-3. FUNCTIONAL DESCRIPTION

14. The purpose of the power amplifier is to amplify a selected HF (high frequency) input signal, in the frequency range of 2.0000 to 29.9999 MHz. The input level to the amplifier from the receiver-transmitter is from 50 to 100 milliwatts. The output level is 400 watts average or PEP (peak envelope power). The power amplifier tunes automatically in response to bandswitching signals from the receiver-transmitter and to its own internally generated fine tuning (servo) signals. The power amplifier distributes +26.5 Vdc (nominal) primary power from the power source to the other radio set components, (the receiver-transmitter and the antenna coupler). The 400 watt output is coupled from the power amplifier to the antenna by the antenna coupler, which tunes automatically in response to bandswitching signals and RF excitation from the receiver-transmitter. The unit amplifies a 100 milliwatt RF input from the receiver transmitter to 400 watts \pm 1 dB average or PEP (peak envelope power) output power. Primary power at 26.5 Vdc (nominal) is supplied to the amplifier from a vehicular battery-generator system, or from another appropriate source, for distribution to the amplifier-converter, receiver-transmitter, and antenna coupler units of the system.

1-5. The power amplifier consists basically of three major functional areas:

- a. RF amplifiers and PA control circuits
- b. Power and cooling circuits
- c. Monitoring and test circuits

1-6. The RF amplifiers and PA control circuits include part of Meter Board PWB Assembly 1A1, RF Driver Module Assembly 1A11, Tune Detector Module Assembly 1A10, Tube Socket Assembly 1A14A2, Output Amplifiers 1A14V1 and 1A14V2, Plate Assembly 1A9, Tank Circuit Module Assembly 1A8, Harmonic Filter Assembly 1A15, ALC Module Assembly 1A7, System Control PWB Assembly 1A3, Tune Control PWB Assembly 1A4, Servo Amplifier PWB Assembly 1A5, and Band Control PWB Assembly 1A6. The 100 milliwatt input from the receiver-transmitter is first amplified by a two-stage transistorized wideband driver amplifier to an output level of about 15 watts. This output is used to drive the grounded-grid power amplifier stage. The power amplifier consists of two parallel-connected type Y621B triode vacuum tubes and a tunable π - network tank circuit that transforms the tube plate impedance from 1600 ohms to the 50-ohm output impedance. The 50-ohm output impedance matches the input impedances of the antenna coupler and provides selectivity to suppress harmonic signals. Tank Circuit tuning is automatic in less than five seconds, with the shunt elements selectable in eight bands by the motor operated 1A8A3B1 rotary switches 1A8S1-A through 1A8S1-C. The series coil is tuned to the proper inductance by the servo loop and the drive motor.

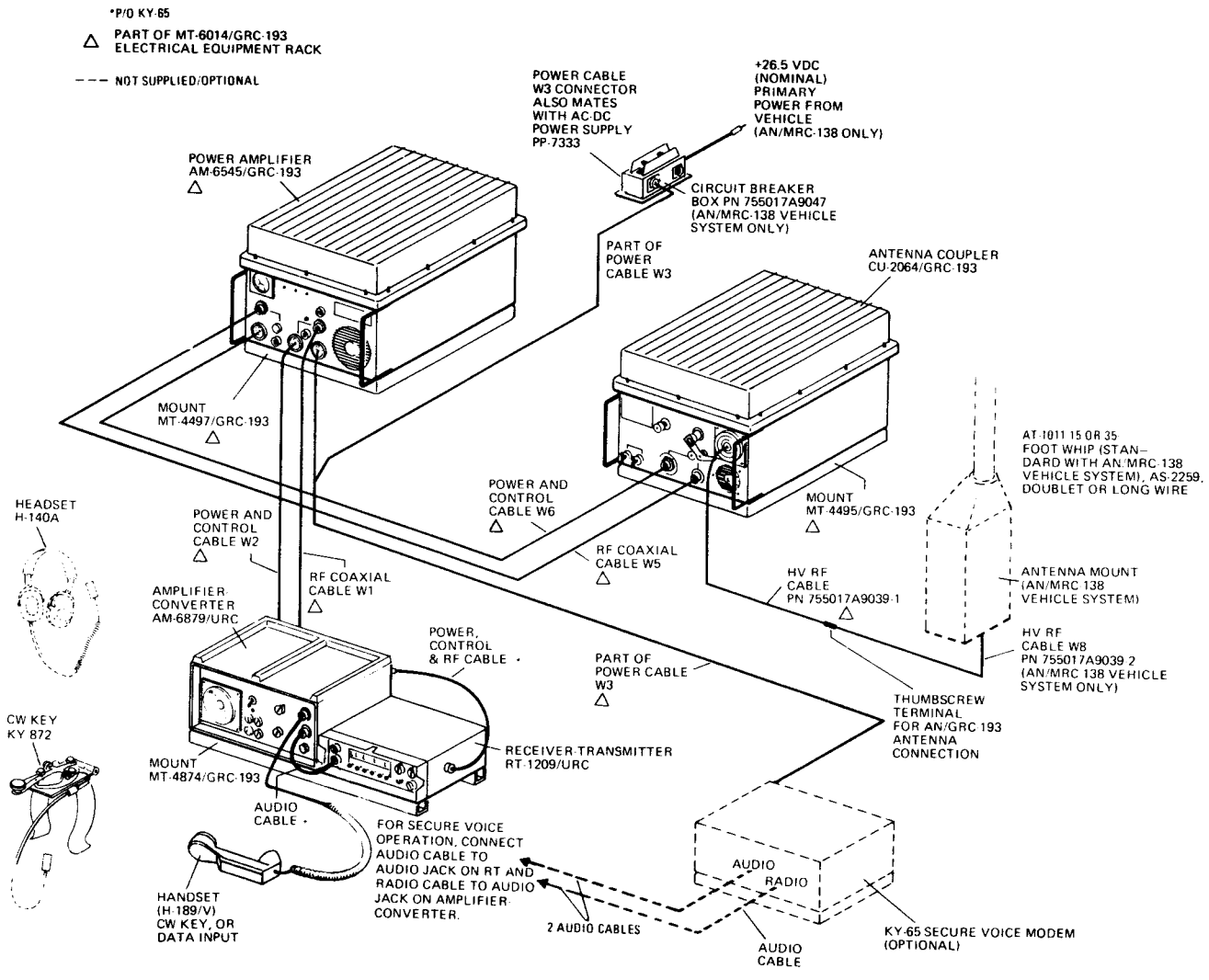


Figure 1-2. Radio Set AN/GRC-193 Components and System Relationships

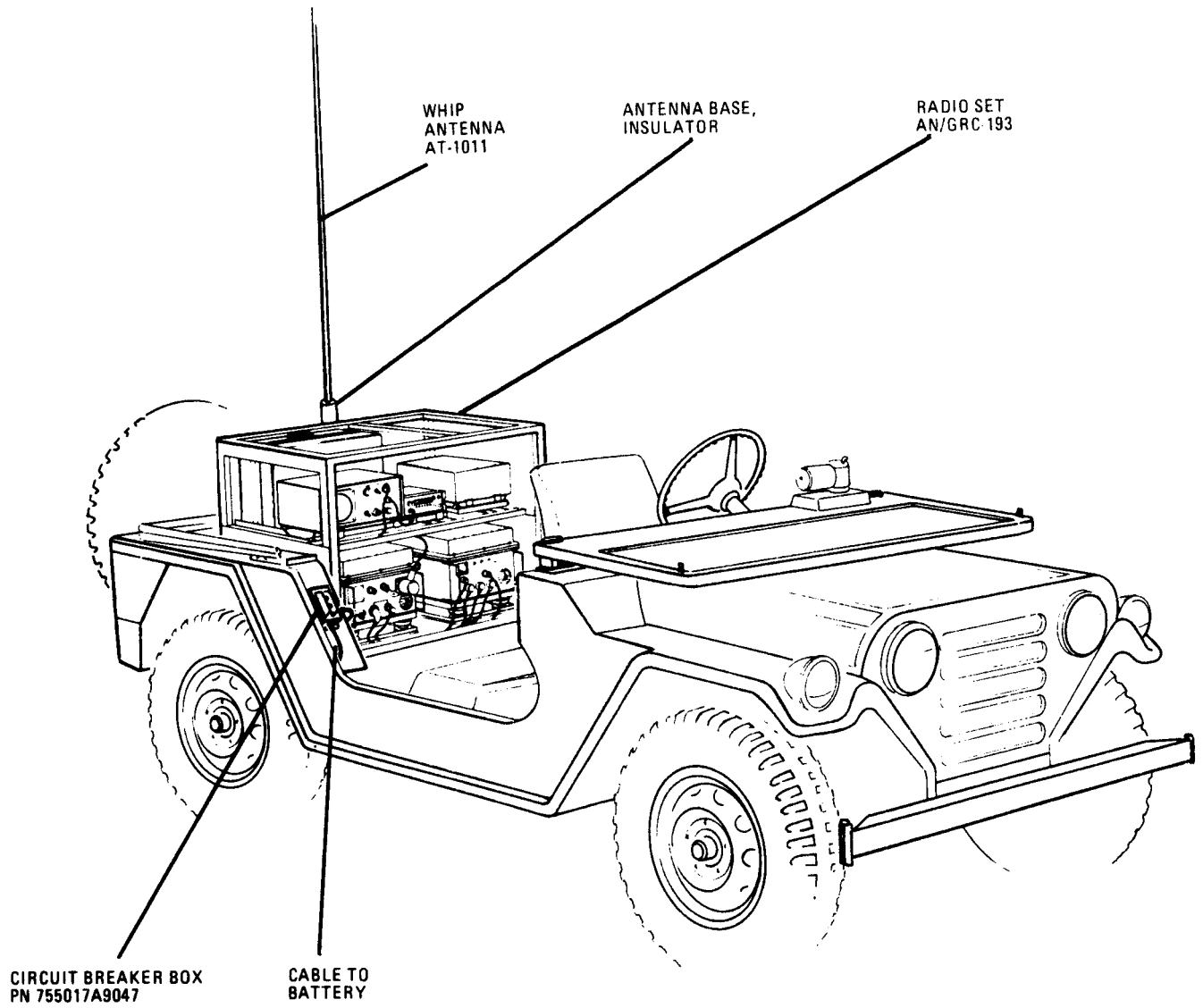


Figure 1-3. Radio Set AN/MRC-138, Components and System Relationships

1-7. The PA control circuits provide the following functions:

- a. ON-OFF switching of primary power to the dc-to-dc converter, voltage regulator, antenna coupler and other circuits within the power amplifier unit, on command from the RT.
- b. Rx-Tx (Receive-Transmit) switching of the RF signal as required for Receive mode and Transmit mode operation. In the Receive mode, both the 1A7A1K1 relay and the 1A1K1 relay are de-energized and the receive RF signal is bypassed around the power amplifier circuits to the input of the receiver-transmitter. In the transmit mode, both the 1A7A1K1 relay and the 1A1K1 relay are energized, connecting the tube tank circuit output to the antenna coupler and the transmitter output to the first driver stage.
- c. Inhibits transmit operation if: (1) the antenna coupler does not tune to a preset VSWR during a preset time, (2) the PA tank circuit does not tune correctly, (3) the system (PA and coupler) do not tune in less than 20 seconds, (4) the high voltage overload is tripped, or (5) the bandswitch motor is running.
- d. Samples the RF power output to provide a proportional positive-going ALC (automatic level control) signal to the RT (receiver-transmitter) for controlling the TX output of the receiver-transmitter. The ALC loop gain is preset to maintain a 400 watt output with variations in gain of the signal path.

1-8. The power circuits provide the necessary operating voltages for the circuits in the PA and are derived from the +26.5 Vdc (nominal) input from the power source. These voltages are +1600 Vdc from a transistorized dc-to-dc converter and high voltage module, -14 Vdc from Meter Board PWB Assembly 1A1, +19 Vdc from series type regulator 1A14Q3 and DC Control PWB Assembly 1A2, and filament voltages to the output amplifier tubes from filament regulators 1A14Q4 and 1A14Q5 and DC Control PWB Assembly 1A2. The voltage regulators are self-protected against shorts while the dc-to-dc converter is overload protected. In case of temperatures over 96°C the complete power supplies are disabled by thermostatic switch 1A14A3S2 until the PA has cooled down to a safe temperature. The primary power supply and system wiring are protected from short circuits in the PA by 50 ampere (normally closed) circuit breaker 1A14CB2.

1-9. The cooling circuit consists of a vane axial fan, 1A14B1, which is external to the sealed case-cover assembly, and Static Power Inverter Assembly 1A12, which is thermostatically controlled. The blower is automatically switched on by 1A14A351 when the heat sink temperature exceeds +55°C and switched off when the unit has cooled to about +54°C. When the system is operated in an intermittent Tx condition, the blower does not start. Under continuous Tx conditions and high ambient temperatures the blower runs continuously.

1-10. The PA contains circuits and indicators for monitoring operation. Meter 1A14M1, normally set to indicate forward power output in transmit, and six front panel indicator lamps provide the means for monitoring PA status without opening the unit. The indicators RDY and XMT are green, TUN and FIL fault are amber, and PA and CPLR fault are red.

1-11. For testing and troubleshooting the PA, meter (1A14M1) has eleven test positions selectable from TEST SWITCH 1A1S1. All dc voltages, the filament current of each tube, the ALC, the cathode level (RFK), tube plate current (Ip), reflected RF power (REF), and forward RF power (FWD) can be measured using TEST SWITCH 1A1S1 and meter 1A14M 1. Indicator lamps (GREEN) on Band Control PWB Assembly 1A6 show which band is being used. An overload lamp on DC Control PWB Assembly 1A2 shows that the PA fault is caused by excessive plate current when it is lighted (red) at the same time the front panel PA fault lamp is lighted (red). In addition all modules and pc boards have test points for monitoring and fault location.

1-12. Refer to chapter 2 for a detailed description and analysis of power amplifier operation.

1-13. PHYSICAL DESCRIPTION

1-14. The physical characteristics of the power amplifier are listed in table 1-1. The power amplifier major assemblies and panel nomenclature are shown in figure 1-4.

1-15. The power amplifier is a single unit designed for vehicular and fixed installation. It is housed in a rectangular, air-cooled, waterproof case, 7.875 in. (20.0 cm) high, 11.325 in. (28.77 cm) wide, and 16.5 in. (41.91 cm) long. The unit weighs 54.75 lbs (24.64 kg) and is supplied with a separate mount, equipped with quick release clamps for fastening the power amplifier unit. Assemblies 1A1 through 1A6 are plug-in printed wiring boards that are mounted in the card cage assembly and plugged into Interconnection PWB Assembly 1A14A 1. Interconnection PWB Assembly 1A14A1 is wired into the wiring harness of Case Assembly 1A1 4. Tube Socket Assembly 1A14A2, DC-DC Converter Assembly 1A14A3, Indicator Assembly 1A14A4, Junction Block PWB Assembly 1A14A5, Harmonic Filter Assembly 1A15, the regulator assembly, and the relay assembly are all wired directly into the wiring harness of Case Assembly 1A14. ALC Module Assembly 1A7, Tank Circuit Module Assembly 1A8, Tune Detector Module Assembly 1A10, RF Driver Module 1A11, Static Power Inverter Module 1A12, and High Voltage Module 1A13 are all plug-in assemblies that mount directly into Case Assembly 1A14 and plug into jacks that are connected to the - wiring harness of Case Assembly 1 A 14. Plate assembly 1A9 is a plug-in assembly that connects mechanically to the plates of 1A14V1 and 1A14V2. It has three jacks that the high voltage, the tank circuit 1A8, and the Ip sample are plugged into. It mounts directly into the case. Front panel connections facilitate RF input (1A14J5) and control (1A14J2) from the receiver-transmitter, RF output (1A14J4) and control (1A14J1) to the antenna coupler, and primary DC power (1A14J3) from the circuit breaker box. Figure 1-5 shows the interconnection of the power amplifier components.

1-16. The power amplifier can be used in a fixed site configuration such as Radio Set AN/GRC-193, shown in figure 1-2, or in a mobile application such as Radio Set AN/MRC-138, shown in figure 1-3. The power amplifier electronics compartment is water-tight and is submersible in fresh or salt water. The unit is equipped with a pressure relief valve and can be operated at altitudes up to 10,000 feet.

1-17. EQUIPMENT SUPPLIED

1-18. If Power Amplifier AM-6545/GRC-1 93 has been received as part of a radio set (AN/GRC-1 93 or AN/M RC- 138), the equipment supplied is as identified in figure 1-2. Otherwise, consult the applicable procurement document and/or shipping list for the items supplied.

1-19. SEMICONDUCTOR COMPLEMENT

1-20. Table 1-2 lists the semiconductors used in the various assemblies of the power amplifier.

TABLE 1-1. POWER AMPLIFIER AM-6545/GRC-193 CHARACTERISTICS

ITEM	CHARACTERISTIC
Dimensions	8.0 inches (20.3 cm)H x 16.4 inches (41.7 cm)L x 11.4 inches (28.9 cm)W
Weight	Approximately 54 lbs (24.5 kg)
Primary power requirements	+22 to +30 VdC, +26.5 Vdc (nominal), 45 amps maximum
Frequency range	2.0000 to 29.9999 MHz in 0.1 kHz increments
RF power input	100 milliwatts or less (2 watts PEP maximum)
RF input impedance	50 ohms with VSWR not greater than 1.3:1
RF output power	400 watts average or PEP
RF output impedance	50 ohms
Operational modes	USB, LSB, CW, SSB Secure Voice, SSB FSK
Distortion	
SSB	Third order intermodulation products suppressed more than 30 dB below either of two equal tones producing 400 watts PEP \pm 1 dB.
AM	Less than 20% at 85% modulation
Harmonic attenuation	35 dB or more below rated output
Spurious radiation	60 dB or more below rated output
Duty cycle	Continuous
Tuning	Automatic with information received from Receive-Transmitter in less than 5 seconds
Warm-up time	60 seconds \pm 10 seconds
Cooling	Convection and forced air (fan on case exterior)
Operating temperature	-40°C (-40°F) to +55°C (+131°F)
Operating altitude	10,000 feet
Immersion operation	3 feet in both fresh and salt water for 4 hours
Vibration	2.5 g's or 0.15 inch, double amplitude, 5.55 Hz

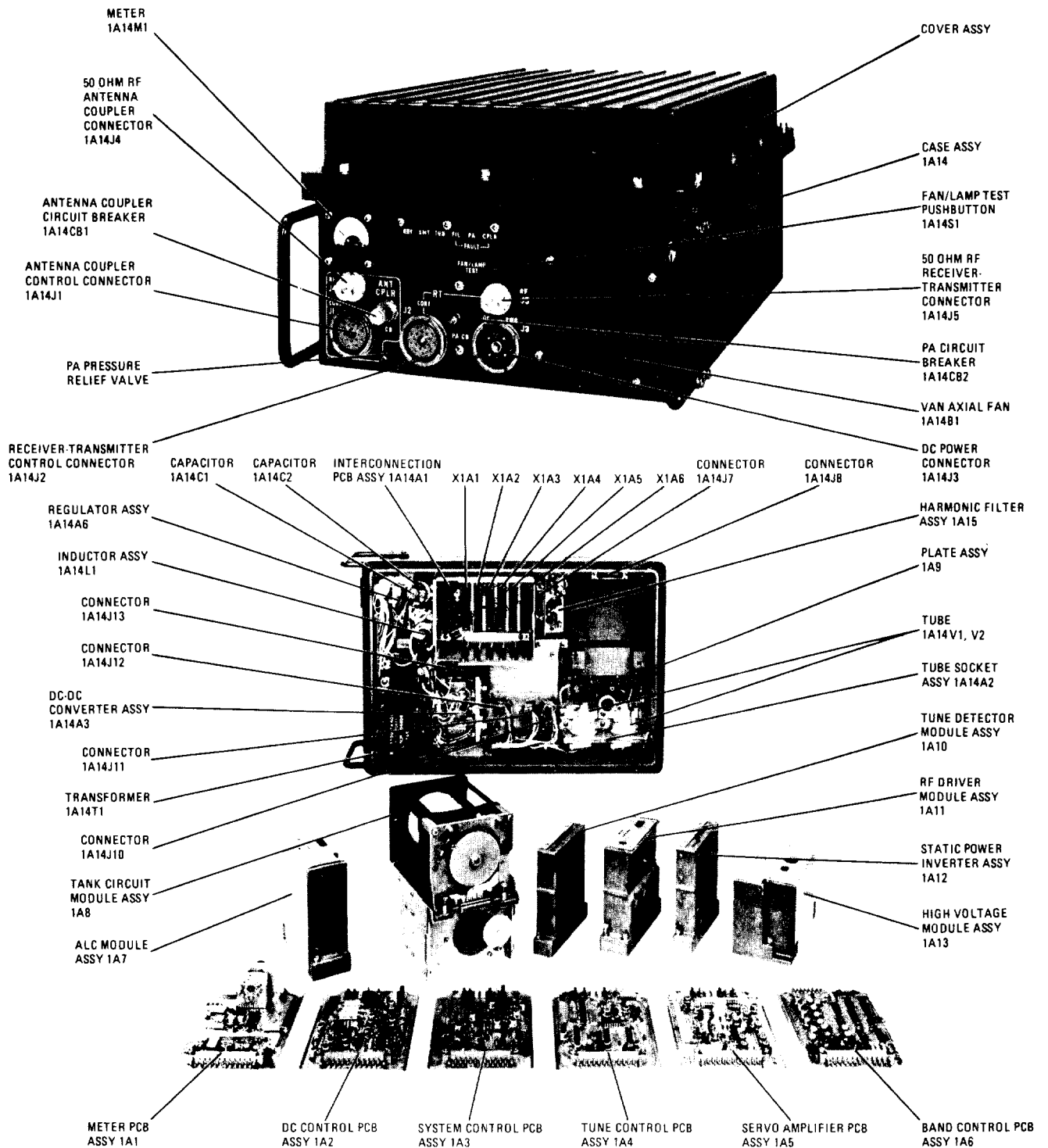


Figure 1-4. Power Amplifier AM-6545 /GRC-193 Major Assemblies and Components

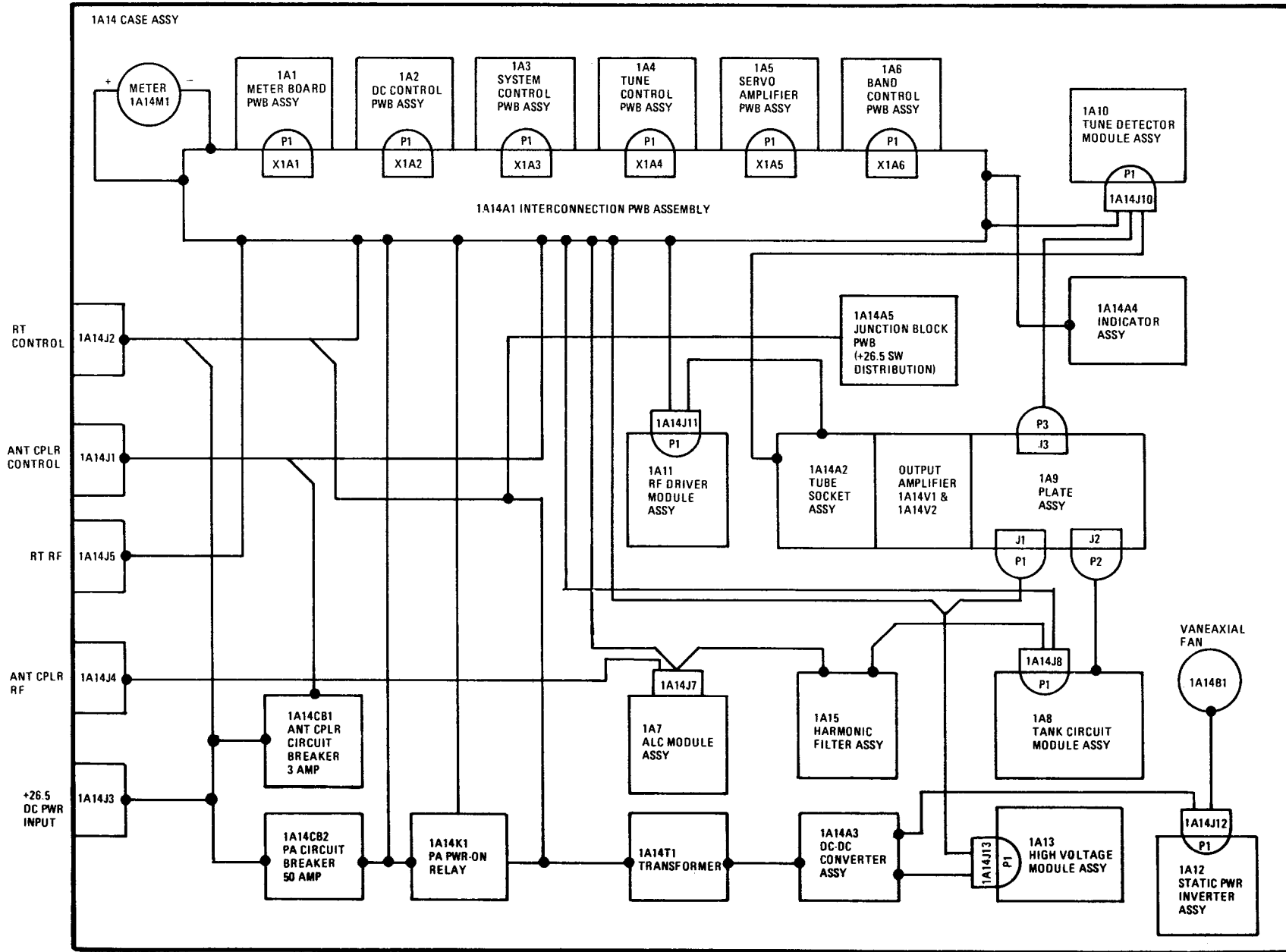


Figure 1-5. Power Amplifier AM-6545/GRC-193 Assemblies and Interconnection

TABLE 1-2. POWER AMPLIFIER AM-6545/GRC-193 SEMICONDUCTORS

DEVICE NAME	REFERENCE DESIGNATOR	TYPE
METER BOARD PWB ASSEMBLY 1A1		
Silicon Diode	1A1CR1,CR2,CR3,CR4,CR8,CR9,CR10	JAN1N645
NPN Transistor	1A1Q1 thru Q5	JAN2N2219A
Integrated Circuit (Linear Microcircuit Timer)	1A1U1	CA555F/4
DC CONTROL PWB ASSEMBLY 1A2		
Silicon Diode	1A2CR1 thru CR7	JAN1N645
Light Emitting Diode (Red)	1A2DS1	755017A3011-3 (5082-4684)
NPN Transistor	1A2Q1 thru Q3, Q5, Q7 thru Q11	JAN2N2219A
PNP Transistor	1A2Q4, Q6	JAN2N2905A
Integrated Circuit (Quad 2-Input NAND Gates)	1A2U1	CD4011AF-4
Diode (Voltage Regulator)	1A2VR1 to VR3	JAN1N758A
Diode (Voltage Regulator)	1A2VR5, VR6	JAN1N3030B
SYSTEM CONTROL PWB ASSEMBLY 1A3		
Silicon Diode	1A3CR1 thru CR5, CR7 thru CR11	JAN1N645
PNP Transistor	1A3Q1, Q6	JAN2N2905A
NPN Transistor	1A3Q2 thru Q5, Q8	JAN2N2219A
Diode (Voltage Regulator 5.1 V)	1A3VR1	JAN1N751A
Diode (Voltage Regulator 10V)	1A3VR2	JAN1N758A
TUNE CONTROL PWB ASSEMBLY 1A4		
Integrated Circuit (Dual Op-Amp)	1A4AR1	CA747TV1-4
Silicon Diode	1A4CR2 thru CR8	JAN1N645
NPN Transistor	1A4Q1 thru Q4, Q6	JAN2N2219A
Unijunction Transistor	1A4Q5	JAN2N4948
Integrated Circuit (Quad 2-Input NAND Gate)	1A4U1, U3, U5, U6	CD4011AF-4
Integrated Circuit (Triple 3-Input NAND Gate)	1A4U2, U4	CD4023AF-4
Diode (Voltage Regulator 10V)	1A4VR1	JAN1N758A

TABLE 1-2. POWER AMPLIFIER AM-6545/GRC-193 SEMICONDUCTORS (Continued)

DEVICE NAME	REFERENCE DESIGNATOR	TYPE
SERVO AMPLIFIER PWB ASSEMBLY 1A5		
Integrated Circuit (Dual Op-Amp)	1A5AR1 , AR2	CA747TB1-4
Silicon Diode	1A5CR1 thru CR10	JAN1N645
PNP Transistor	1A5Q1, Q2, Q8, Q12, Q16	JAN2N2905A
NPN Transistor	1A5Q3 thru Q7,Q11	JAN2N2219A
Power Transistor	1A5Q9, Q13	2N5784
Power Transistor	1A5Q10, Q14	2N5781
Unijunction Transistor	1A5Q15	JAN2N4948
BAND CONTROL PWB ASSEMBLY 1A6		
Silicon Diode	1A6CR1, CR3, thru CR12	JAN1N645
Silicon Diode	1A6CR2	JAN1N5550
Light Emitting Diode (Green)	1A6DS1 thru DS8	755017A3011-1 (5082-4984)
Integrated Circuit (Quad 2-Input NAND Gate)	1A6U1, U2	CD4011AF-4
Integrated Circuit (Quad 2-Input AND Gate)	1A6U3 thru U9	CD4081BF-4
NPN Transistor	1A6Q1 thru Q9, Q13, Q14	JAN2N2219A
Power Transistor	1A6Q10	2N5784
PNP Transistor	1A6Q11	JAN2N2905A
Power Transistor	1A6Q12	2N5781
TUNE LOAD PWB ASSEMBLY 1A7A1		
Silicon Diode	1A7A1CR1	755017A4613
ALC PWB ASSEMBLY 1A7A2		
Integrated Circuit (Dual Op-Amp)	1A7A2AR1	CA747TV1-4
Silicon Diode	1A7A2CR1 thru CR4	JAN1N645
NPN Transistor	1A7A2Q1	JAN2N2219A
Zener Diode 10V	1A7A2VR1	JAN1N758A
TANK CIRCUIT MODULE ASSEMBLY 1A8		
Silicon Diode	1A8CR1, CR2	JAN1N5550
Silicon Diode	1A8CR3	JAN1N645

TABLE 1-2. POWER AMPLIFIER AM-6545/GRC-1 93 SEMICONDUCTORS (Continued)

DEVICE NAME	REFERENCE DESIGNATOR	TYPE
TUNE DETECTOR PWB ASSEMBLY 1A10A 1		
Silicon Diode	1A10A1CR1 thru CR4	755017 A4613
DRIVER MODULE PWB ASSEMBLY 1 A1 1 A1		
Silicon Diode	1A11 A1CR1	JAN1N5550
NPN Transistor	1A11 A1Q1	2N5642
NPN Transistor	1A11A1Q2, Q3	2N5643
INVERTER MODULE PWB ASSEMBLY 1A12A1		
Silicon Diode	1A12A1CR1 thru CR4	JAN1N645
Unijunction Transistor	1A12A1Q1	JAN2N4948
NPN Transistor	1A12A1 Q2, Q5 thru Q7, Q10, Q11	JAN2N2219A
PNP Transistor	1A12A1Q3, Q4, Q8, Q9	JAN2N2905A
HIGH VOLTAGE MODULE ASSEMBLY 1A13		
Silicon Rectifier Sub-Assembly	1A13CR1, CR2	755017 A4315
HIGH VOLTAGE MODULE PWB ASSEMBLY 1A13A1		
Silicon Diode	1A13A1CR1	JAN1N645
Silicon Diode	1A13A1CR2	JAN1N5550
NPN Power Transistor	1A13A1Q1	JAN2N3055
TUBE SOCKET ASSEMBLY 1A14A2		
Diode (Voltage Regulator)	1A14A2CR1	JAN1N3995RA
DC-DC' CONVERTER ASSEMBLY 1A14A3		
Silicon Diode	1A14A3CR1, CR2	JAN1N5550
NPN, Silicon, High Power Transistor	1A14A3Q1, Q2	755017 A4108
Zener Diode	1A14A3VR1	JAN1N3337B

TABLE 1-2. POWER AMPLIFIER AM-6545/GRC-193 SEMICONDUCTORS (Continued)

DEVICE NAME	REFERENCE DESIGNATOR	TYPE
INDICATOR ASSEMBLY 1A14A4		
Light Emitting Diode (Green)	1A14A4DS1, DS2	755017A3011-1 (5082-4984)
Light Emitting Diode (Yellow)	1A14A4DS3, DS4	755017A3011-2 (5082-4584)
Light Emitting Diode (Red)	1A14A4DS5, DS6	755017A3011-3 (5082-4684)
INDICATOR PWB ASSEMBLY 1A14A4A 1		
Silicon Diode	1A14A4A1CR1 thru CR11	JAN1N645
Silicon Diode	1A14A4A1CR12	JAN1N5550
NPN Power Transistor	REGULATOR 1A14A6 1A14A6Q3 thru Q5	JAN2N3055

SECTION II

PREPARATION FOR USE

1-21. GENERAL

1-22. This section contains or references all procedures necessary to prepare the power amplifier for use.

1-23. PREPARATION FOR USE AS A COMPONENT RADIO SET AN/M RC-138

1-24. The procedures applicable to the power amplifier as a component of radio set AN/MRC-138 (GRC-193 components rack-mounted in an M151A2 vehicle) are given in the System Manual, TM 11-5820-924-12.

1-25. PREPARATION FOR USE AS A SEPARATE COMPONENT

1-26. Subsequent paragraphs 1-27 through 1-47 describe handling, unloading, unpacking and installation procedures for the power amplifier as a separate component.

1-27. HANDLING DURING UNLOADING

1-28. The unit is shipped in a single crate. The approximate shipping weight of the equipment and crate is 63 pounds. No special procedures are required for handling. However, since the equipment is made up of accurately calibrated precision components, rough handling should be avoided.

1-29. UNCRATING

1-30. Caution should be taken when uncrating the unit to prevent damage to the controls, indicators and connectors. It is advisable to save and store the power amplifier crating material for possible reshipment or relocation at a later time. Consequently, careful uncrating of the unit is suggested. Store crating material in a dry area. No other special uncrating procedures apply.

1-31. UNPACKING

1-32. Unpack the power amplifier as follows:

1. Remove the inner box containing the power amplifier from the crating insulation material and place it on a flat working surface.
2. If power amplifier Mount MT-4497/GRC-193 (RF Part No. 755017A90 15) and mating connectors (refer to table 1-3) were received, unpack them and place them on a flat work surface.
3. Carefully remove packing material from power amplifier. Do not remove plastic caps from J 1 ANT CPLR CONT, J2 RT CONT, J3 DC PWR; J4 ANT CPLR RF, and J5 RT RF connectors until the power amplifier is ready for installation.
4. If mating connectors were purchased, tag and identify the components (refer to table 1-3).

1-33. INSTALLATION AS A COMPONENT OF RADIO SET AN/MRC-138

1-34. Installation procedures applicable to Power Amplifier AM-6545/GRC-193 as a component of radio set AN/MRC-138 (AN/GRC-193 components rack-mounted in a M151A2 jeep vehicle) are given in System Manual, TM 11-5820-924-12.

1-35. INSTALLATION AS A SEPARATE COMPONENT

1-36. Subsequent paragraphs 1-37 through 1-42 describe the installation procedures for the power amplifier as a separate component.

1-37. INSTALLATION CONSIDERATIONS

1-38. The following considerations should be made when determining the proper location of the power amplifier:

- a. Best operating conditions.
- b. Ease of maintenance, adjustment of equipment and replacement and repair of defective parts or complete subassemblies.
- c. The possible interaction between the power amplifier and other electronic equipment in the vicinity.

- e. Availability of adequate power.
- f. Availability of adequate grounding.

1-39. POWER AMPLIFIER MOUNTING INSTRUCTIONS

1-40. The following instructions describe how, to mount the power amplifier using power amplifier Mount MT-4497/GRC- 193 (RF Part No. 755017A9015). Refer to figures 1-6 and 1-7 for dimensional details.

1. The exact method of mounting the power amplifier depends on the type of installation. Make sure that the surface selected allows adequate room for power amplifier ventilation intakes and outlets and proper clearance for cable interconnection.
2. Refer to figure 1-7 and mark off the four mounting hole centers on the mounting surface.
3. Secure the power amplifier mount to the mounting surface using appropriate hardware. The hardware selected should be of the appropriate type for the 0.375 inch (0.95 cm) mounting holes. Since the power amplifier weighs approximately 54 pounds (24.5 kg), the screws, washers and lock washers used should be of the appropriate type to secure the lower mounting tray to the mounting surface.

1-41. CABLE ASSEMBLIES

1-42. Variations among installations will determine the lengths of the cables connecting the power amplifier to the system antenna coupler, the input power source, and the receiver-transmitter. Refer to table 1-3 for the identification and types of cables and cable connectors required for use with the power amplifier. Table 1-4 identifies the pins on the power amplifier interface cables for cable fabrication reference.

1-43. PREOPERATIONAL SERVICING

1-44. No preoperational servicing procedures apply other than removal of the plastic connector caps prior to assembling cables to the power amplifier connectors. Retain plastic caps for future relocation and storage purposes.

TABLE 1-3. POWER AMPLIFIER AM-6545/GRC-193 MATING CONNECTOR AND CABLE IDENTIFICATION DATA

POWER AMPLIFIER CONNECTOR NAME	MATING CONNECTOR NAME	MATING CONNECTOR PART NO.	CABLE TYPE	CABLE PART NO. (RF PART NO.)
J1 ANT CPLR CONT	CONNECTOR, PLUG (P1)	MW10M(M)D17	Multiconductor Cable P/N 755017A9036	755017A9044
J1 RT CONT	CONNECTOR, PLUG (P2)	MW10M(M)D17	Multiconductor Cable P/N 755017A9036	755017A9043
J3 DC PWR	CONNECTOR, PLUG (P3)	UW1220FA17	Multiconductor Cable P/N 755017A9063 and Cable, Coax P/N RG-58A/U	755017A9045
J4 ANT CPLR RF	CONNECTOR, PLUG (P4)	755017A9050	RG-142B/U	755017A9040
J5 RT RF	CONNECTOR, PLUG (P5)	755017A9050	RG-142B/U	755017A9041
GROUND TERMINALS	Not Applicable	Not Applicable	See Note	See Note

NOTE: Grounding cable used (suggested) should be 0.040 inch (0.10 cm) thick copper, AWG 36, 0.75 inch (1.9 cm) nominal flat width per Federal Specification QQ-W-343. Use Alpha Industries Part No. 1234 cable or equivalent.

LEFT SIDE VIEW

TOP VIEW

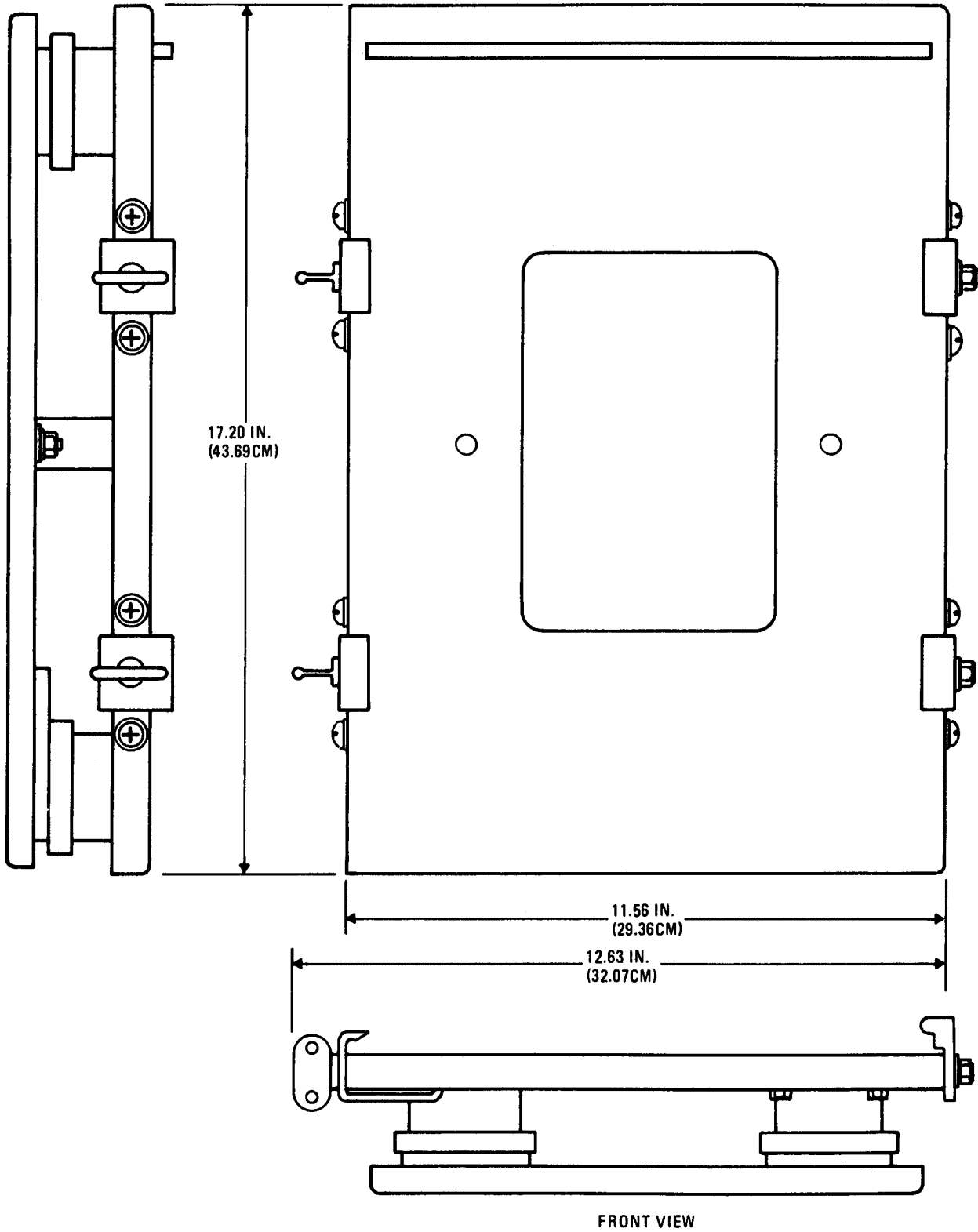


Figure 1-6. Power Amplifier Mount MT-4497/GRC-193

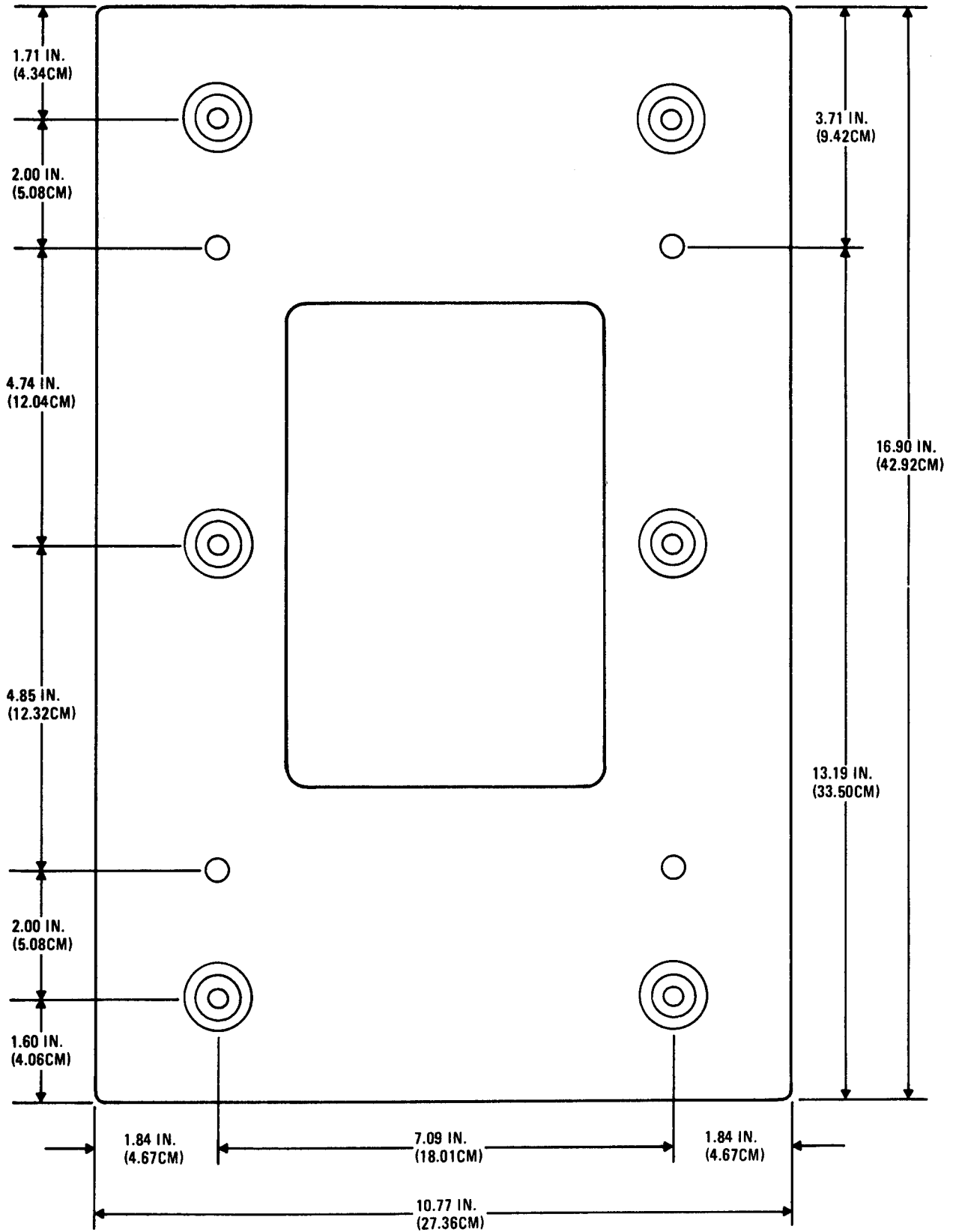


Figure 1-7. Power Amplifier Mount MT-4497/GRC-193 Lower Tray Assembly Dimensional Data

TABLE 1-4. POWER AMPLIFIER INTERFACE CABLE FABRICATION DETAILS

CABLE (W1) RF P/N 755017A9041, RT RF INPUT CABLE			
TO RCVR-XMTR	CABLE TYPE	TO PA J5	LINE FUNCTION
P3 Connector P/N 755017A9050	RG-142B/U	P5 Connector P/N 755017A9050	PA RF Input
CABLE (W2) RF P/N 755017A9043, RT CONTROL CABLE			
TO RCVR-XMTR	CABLE TYPE	TO PA J2	LINE FUNCTION
P1 Connector p/N 755017A9075	Multiconductor RF P/N 755017A9036	P2 Connector P/N MW10M(M)D17	
Pin No.	Wire Color	Pin No.	
L	Gray	A	1 MHZ ₈
M	Yellow	B	1 MHZ ₄
N	White-Gray	C	1 MHZ ₂
P	White-Violet	D	1 MHZ ₁
R	White-Blue	E	10 MHZ ₂
S	White-Green	F	10 MHZ ₁
E	White-Yellow	H	Sidetone
K	White-Orange	J	Tune in Progress
F	White-Red	K	Keyline
U	Orange	L	+26. 5 Vdc Direct
A	Violet	M	Ground
T	Black	N	PA On/Off
C	Green	P	Tune Start
J	Blue	R	ALC
H	Red	S	Fault
D	Brown	T	Antenna Coupler On
B	Shield	U	Ground
V	White-Brown	V	Spare

TABLE 1-4. POWER AMPLIFIER INTERFACE CABLE FABRICATION DETAILS (Continued)

CABLE (W3) RF P/N 755017A9045, DC PWR INPUT CABLE				
TO BREAKER BOX	TO KY-65	TO PA J3	CABLE TYPE	LINE FUNCTION
P1 Connector MS3108E-22-2P	P2 Connector MS3116F12-105	P3 Connector UW1220FA17	Multiconductor RF P/N 755017A9063	
Pin No.	Pin No.	Pin No.	Wire Color	
A	F	A&B*	Red	
A	NC	A&B*	Yellow	
A	NC	A&B*	Orange	
B	NC	C&D**	Brown	
B	NC	C&D**	Black	
C	G	C & D**	Shield	
CABLE (W5) RF P/N 755017A9040, ANT CPLR RF CABLE				
TO ANT CPLR J5	TO PA J4	CABLE TYPE	LINE FUNCTION	
P1 Connector P/N 755017A9050	P4 Connector P/N 755017A9050	RG-142B/U	PA RF Output to Antenna Coupler	
CABLE W6 RF P/N 755017A9044, ANT CPLR CONTROL CABLE				
TO ANT CPLR J2	TO PAJ1	CABLE TYPE	LINE FUNCTION	
P2 Connector P/N 755017A9049	P2 Connector P/N MW10M(M)D17	Multiconductor P/N 755017A9036		
Pin No.	Pin No.	Wire Color		
A	A	White-Orange		
B	B	Orange		
C	C	Red		
D	D	White-Gray		
E	P	Shield		
F	F	Gray		
H	H	White		
J	J	White-Brown		
K	K	White-Red		
L	L	Yellow		
M	M	Black		
N	N	Green		
P	E	Brown		
R	R	Violet		

*Wires Red, Yellow, and Orange are Jumpered Together Inside the P3 Connector

**Wires Brown, Black, and Shield are Jumpered Together Inside the P3 Connector

1-45. INITIAL CHECKOUT AND ADJUSTMENT

1-46. Specific initial checkout and adjustment procedures for the power amplifier depend on the system with which the power amplifier is used. If the power amplifier is used with radio set AN/MRC-138 (AN/GRC-1 93 components rack-mounted in an M151 A2, jeep vehicle), refer to the System Manual, TM-TM 11-5820-924-12. Otherwise, refer to the applicable system technical data for these procedures.

1-47. In general, the following inspections should be performed prior to operating the equipment:

1. Make sure that the power amplifier cooling intakes and outlets are free of any obstructions.
2. Make sure all electrical and ground cable connections are tight and secure and free of dirt and other obstructions.
3. Make sure the applicable operational technical data is close at hand.

1-48. RELOCATION PROCEDURES

1-49. If the power amplifier is to be relocated, turn off all power; then disconnect all cables. Place plastic caps over the power amplifier and cable connectors. Cover the power amplifier air intakes and outlets. Remove the power amplifier from the mounting surface and move it to the new location.

1-50. PREPARATION FOR LIMITED STORAGE AND RESHIPMENT

1-51. The procedure for preparation for limited storage and/or reshipment of the power amplifier is essentially the same as that described in paragraph 1-47 plus the following:

1. Repack the power amplifier in its original shipping crate (inner box, insulation, and outer crating).
2. Ensure that the origin and destination data, as required by local authorities and directives, are clearly marked as required.

SECTION III

DEMOLITION TO PREVENT ENEMY USE

1-52. GENERAL

1-53. When capture or abandonment of the power amplifier to an enemy is imminent, the responsible unit commander must make the decision to either destroy the equipment or to render it inoperative. Based on this decision, orders are issued which cover the desired extent of destruction.

1-54. DEMOLITION TO RENDER POWER AMPLIFIER INOPERATIVE

WARNING

Power Amplifier Tubes 1A14V1 and 1A14V2 (Y-621 B) contain BERYLLIUM OXIDE (BeO) CERAMICS. The dust or fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC; breathing them can result in serious injury or DEATH.

1-55. Demolition procedures such as breaking, hammering, or smashing this unit with a sledgehammer or some other heavy object may be dangerous to personnel unless power amplifier tubes 1A14V1 and V2 (Y-62 1-B) have been removed from the unit. If time permits perform the following procedure.

1. Disconnect all cables and destroy their connectors by hammering them with a heavy object, i.e., sledge hammer, pick axe, or any other available tool.
2. Remove the power amplifier cover and remove the two power amplifier tubes. Then destroy all printed circuit boards and subassemblies by hammering them with a heavy object.
3. Make sure that the coil assembly is broken or smashed. Take the two power amplifier tubes with you in a safe container when abandoning the power amplifier unit.
4. If time is of the essence and the above steps can not be accomplished, destroy the power amplifier by using a demolition charge or small arms fire from a safe distance. Remember, breathing the dust or fumes of beryllium oxide ceramics can kill.

CHAPTER 2 THEORY OF OPERATION

2-1. INTRODUCTION

2-2. This chapter describes overall, interrelated, and individual mechanical functioning and electrical theory of operation of the assemblies and circuits that comprises the power amplifier.

2-3. OVERALL FUNCTIONAL DESCRIPTION

2-4. The power amplifier consists of the following major and minor functional circuit groups as shown in figure 2-1:

RF Amplifiers and System Control Circuits

- a. RF Amplifier Circuits
- b. System Control Circuits
- c. Tuning Control Circuits

Power Supplies and Cooling Circuits

- a. Power Supply Circuits
- b. Cooling Circuit
- c. Monitoring and Test Circuits

2-5. RF AMPLIFIER CIRCUITS (See figure 2-1)

2-6. The \leq 100 milliwatt input signal (J5) from the receiver-transmitter is applied through input relay 1A1K 1 to the input of RF Driver Module 1A11, where the signal is amplified by the two-stage transistorized wide-band driver amplifier to an output level of about 15 watts. This output is the drive signal for the grounded-grid output power amplifier stage, consisting of two parallel-connected type Y621B triode vacuum tubes, plate circuit assembly 1A9, and a tunable pi-network tube tank circuit. The tunable tank circuit transforms the 1600 ohm tube plate impedance to the 50 ohm output impedance and provides selectivity to suppress harmonics. Tank circuit tuning is accomplished automatically in less than five seconds. The shunt elements are selected in eight bands by the motor (1A8A4B1) operated rotary switches (S 1-A, S 1-B, and S 1-C). The series coil L1 is fine-tuned to the proper inductance by the servo loop and servo motor (1A8A3B1).

2-7. SYSTEM CONTROL CIRCUITS (See figure 2-1)

2-8. The system control circuits perform the following functions: ON-OFF switching of primary power, Rx-Tx mode switching, fault switching, and Automatic Level Control (ALC) generation. The first two functions are initiated upon receipt of commands from the receiver-transmitter, while the last two functions are initiated within the power amplifier.

2-9. The ON-OFF switching of primary power is initiated by the PA ON/OFF signal from the receiver-transmitter and controls Power ON/OFF Relay 1A14K 1. This relay connects +26.5 Vdc to all circuits that require +26.5 Vdc.

2-10. The Rx-Tx switching function is controlled by the KEYLINE signal from the RT. In receive, both the input relay (1A1K1) and the output relay (1A7A1K 1) are de-energized, allowing the receive RF signal to bypass the power amplifier circuits. In transmit, both relays are energized connecting the exciter

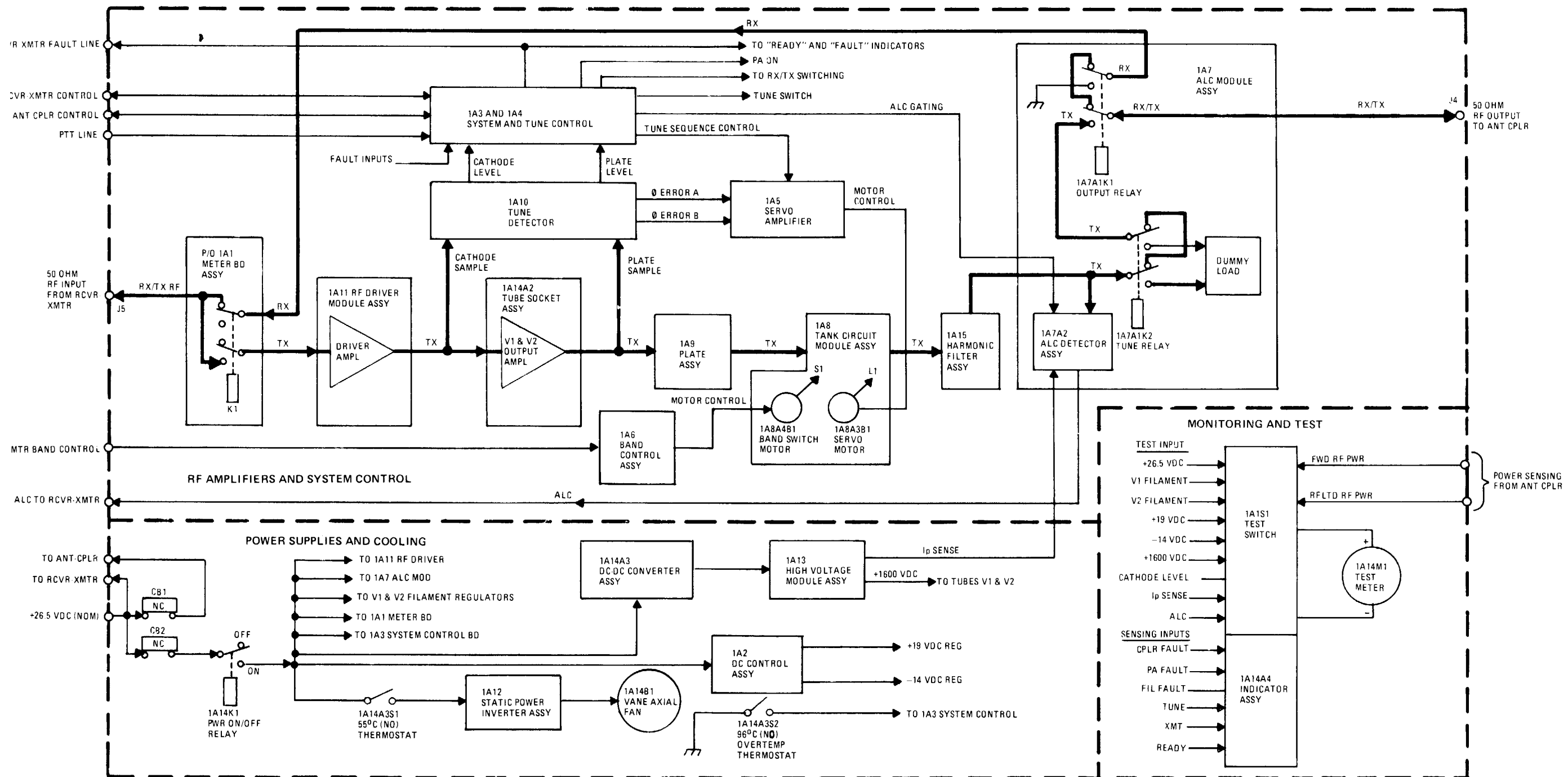


Figure 2-1. Power Amplifier AM-6545/GRC-193 Overall Functional Diagram

output from the receiver-transmitter to the input of the first driver stage in the power amplifier, and connecting the output of the tube tank circuit to the input of the antenna coupler.

2-11. The fault switching function inhibits the transmit operation whenever one of the following malfunctions occurs:

- a. The antenna coupler does not tune properly (to a preset VSWR within a preset time).
- b. The power amplifier tube tank circuit does not tune correctly.
- c. The system (power amplifier and antenna coupler) do not tune in less than 20 seconds.
- d. The high voltage overload is tripped.
- e. The bandswitch motor is running.

2-12. The Automatic Level Control (ALC) Detector (1A7A2) samples the RF power output level and provides a proportional positive-going signal to the receiver-transmitter for controlling the Tx output of the exciter. The ALC loop gain is preset to maintain a 400 watt \pm 1 dB output with variations of gain in the signal path.

2-13. TUNING CONTROL CIRCUITS (See figure 2-1)

2-14. The tuning control circuit provides the sensing, switching and sequencing of operation for proper tuning of Tube Tank Circuit 1A8. The tuning control circuits consists of Band Control Assembly 1A6, Bandswitch Motor 1A8A4B1, Tune Detector 1A10, Servo Amplifier 1AS, Servo Motor 1A8A3B1, and Tune Control 1A4.

2-15. The band control assembly changes the binary MHz frequency code (from the receiver-transmitter) to eight signals that are used to control the position of the bandswitch (S 1) wiper through a position Decoding Switch (S1-A) and Bandswitch Motor 1A8A4B 1. Bandswitching takes place automatically when the frequency is changed on the receiver-transmitter.

2-16. Servo tuning takes place in two steps. The first step occurs when the frequency is changed (except the 100 Hz digit) at the receiver-transmitter or when the system is switched "ON" and the power amplifier has to be retuned. During the first step, the system control circuit (1) latches the power amplifier into the TUNE mode, (2) energizes Tune Relay 1A7A1K2, which switches the dummy load in series with the power amplifier output and modifies the ALC voltage to prevent overdriving the amplifier during the second step of the TUNE cycle, and (3) enables the servo amplifier, allowing variable inductor 1A8A5L1 to drive to its starting position for the start of the servo-controlled fine tuning cycle. After the above operations are completed, the second step of the system fine-tune cycle is initiated by momentarily depressing the PTT (press-to-talk) switch on the system handset.

2-17. During the second step, the servo amplifier is forced to tune toward the proper variable coil setting by signals from Tune Control Assembly 1A4, until the RF signal at the plate (PLATE SAMPLE) is sufficiently high to permit servo tuning with phase difference signals (0 ERROR "A" and 0 ERROR "B") from the phase detector. The servo loop rotates the coil sliding contact until an in-phase signal condition of the CATHODE SAMPLE and PLATE SAMPLE signals indicates the correct setting of the coil. Servo motor 1A8A3B1 then stops. When the PA is nearly tuned, the antenna coupler tune cycle begins. When the antenna coupler is tuned, a COUPLER READY signal is sent to the power amplifier and AND-gated with the PA READY signal to switch the radio set (AN/GRC-193 or AN/MRC-138) into OPERATE-(ready for normal RX-TX operation) at the newly selected frequency.

Note

The TUNE cycle is interrupted if a fault occurs or the frequency is changed (except the 100 Hz digit). It may be repeated by going through the frequency change and the PTT (press-to-talk) keying sequence previously described.

2-18. POWER SUPPLY CIRCUITS (See figure 2-1)

2-19. The necessary operating voltages for circuits in the power amplifier and the system are derived from a +26.5 Vdc (nominal) primary power source (J3). The +26.5 Vdc is applied directly to the receiver-transmitter which controls the application of power to the system. The +26.5 Vdc is routed to Antenna Coupler CU-2064/GRC-193 through circuit breaker 1A14CB1. When the ON/VOLUME control on Receiver-Transmitter RT-1209/URC is turned ON, power is applied to all circuits in system.

2-20. In the power amplifier, the +26.5 Vdc is applied directly to RF Driver 1A1 1, ALC Module 1A7, Filament Regulators 1A14A6Q4 and Q5, Meter Board A11, DC Control PWB 1A2, and System Control Board 1A3. The +26.5 Vdc is also used to develop +1600 volts in Dc-to-Dc Converter 1A14A3 that is controlled by High Voltage Module 1A13. The +1600 volts is applied to the plates of RF Amplifier tubes 1A14V1 and V2, while an Ip SENSE signal is applied to ALC Detector 1A7A2, DC Control PWB 1A2, and Meter Board 1A1. The +26.5 Vdc is applied to Voltage Regulator 1A14A6Q3 to develop the +19 Vdc which is used to derive the -14 Vdc in Meter PCB 1A1.

2-21. COOLING CIRCUITS (See figure 2-1)

2-22. The +26.5 Vdc is applied through a normally open 55°C thermostat (1A14A3S1) to the input of Static Power Inverter 1A12. When the power amplifier temperature reaches 55°C, the +26.5 Vdc is turned ON, thus supplying a 400 Hz, 20 volt drive to axial-flow Fan 1A14B1. The power amplifier is forced-air cooled by the fan which is external to the sealed case-cover assembly. When the system is operated intermittently in the Tx mode, the blower never starts. However, under continuous Tx mode operating conditions and high ambient temperatures, the blower runs continuously. When the heat-sink temperature has cooled to about 54°C, the fan is turned OFF.

2-23. The power amplifier is also protected from overtemperature conditions by Overttemperature Thermostat 1A14A3S2 (normally open), which applies a GROUND to System Control Board 1A3, when the sink temperature reaches 96°C, thereby shutting down the entire power amplifier.

2-24. MONITORING CIRCUITS (See figure 2-1)

2-25. In the AN/MRC-1 38 vehicular configuration, external meter 1A14M1 and the six front panel indicators are the only monitoring devices available on the power amplifier without opening the case-cover assembly. The meter (1A14M1) normally shows the forward power output in the transmit (Tx) mode, The RDY indicator lights GREEN one minute after power-up if no faults are present. The XMT indicator lights GREEN in transmit (Tx) mode when the PTT (press-to-talk) or CW switch signal is keyed. The TUN indicator lights AMBER during the sixty second warmup period and whenever the power amplifier is in Tune Mode. The FIL FAULT indicator lights AMBER when a tube filament has failed. The PA FAULT indicator lights RED when there is a fault relating to the power amplifier, The CPLR FAULT indicator lights RED when there is a CPLR fault.

2-26. TEST CIRCUITS (See figure 2-1)

2-27. For test and troubleshooting the power amplifier, the same meter (1A14M1) is used in conjunction with TEST SWITCH 1A1S1 on Meter Board Assembly 1A1. This allows the operator to select and measure the following voltage and power levels in the power amplifier:

- | | |
|----------------|------------------|
| a. +26.5 Vdc | g. CATHODE LEVEL |
| b. V1 FILAMENT | h. Ip SENSE |
| c. V2 FILAMENT | i. ALC |
| d. +19 Vdc | j. FWD RF PWR |
| e. -14 Vdc | k. RFLTD RF PWR |
| f. +1600 Vdc | |

2-28. Indicator lamps (DS1 thru DS8) on Band Control PWB Assembly 1A6 show which band is presently being used, while an OVERLOAD indicator (DS1) on DC Control PWB Assembly 1A2 lights when the PA FAULT is caused by excessive plate current. This lamp will be lit at the same time as the PA FAULT lamp when an OVERLOAD FAULT occurs. In addition all modules and pc boards have test points that are easily accessible for monitoring and fault location.

2-29. RF AMPLIFIER DETAILED DESCRIPTION

2-30. Subsequent paragraphs 2-31 through 2-48 are a detailed description of the RF amplifier.

2-31. RECEIVE MODE RF SIGNAL PATH (See figure 2-2)

2-32. In the receive mode of operation, none of the power amplifier circuits are required for operation and are bypassed. The RCV RF signal from the antenna (through Antenna Coupler CU-2064/GRC-1 93) enters the power amplifier through "N" type 50-ohm coaxial Connector 1A14J4 and is routed through the normally closed contacts (pins 6 and 8) of relay 1A7AK1. The RCV RF signal is then routed through a coaxial cable (RG-188) from the A2 output of the ALC Module to pin 20 of Meter Board PWB Assembly 1A1. Here the RCV RF signal is routed through the normally closed contacts (pins 6 and 8) of relay 1A1K1 to pin 18 of Meter Board PWB Assembly 1A1. From pin 18 of Meter Board 1A1, the RCV RF signal is routed through a coaxial cable (RG-158) to the "N" type 50-ohm coaxial connector 1A14J5 and then to Receiver-Transmitter RF-1209/URC. Both relays (1A7AK1 and 1A1K1), which are de-energized during the receive mode, are controlled by the T/R LINE signal from System Control PWB Assembly 1A3.

2-33. Dc power is applied to all necessary power amplifier circuits during the receive portion of the Rx-Tx mode of operation so that the power amplifier is ready for immediate operation during the transmit portion of the Rx-Tx mode. When the radio set is in the Rx-Only mode, all power amplifier circuits are de-energized because a PA ON signal is not sent to the power amplifier from the receive-transmitter.

2-34. TRANSMIT MODE RF SIGNAL PATH NORMAL OPERATION (See figure 2-3)

2-35. In the transmit mode of operation, the XMT RF signal input (<1 100 milliwatts, nominal) from the receiver-transmitter is applied to the 1A14J11-A1-A1 input of RF Driver Module 1A11 through the RT RF input connector 1A14J5 and the closed contacts (pin 5 to pin 2) of energized relay 1A1K1. Relay 1A1K1 is energized by the +1600V SENSE signal which charges capacitor 1A1C9 across resistors 1A1R18 and 1A1R20. When the charge across capacitor 1A1C9 reaches a sufficient amplitude, transistor 1A1Q5 is biased on, applying a positive bias to the base of transistor 1A1Q4. This biases 1A1Q4 on, applying a ground through 1A1Q 1 to pin 7 of relay 1 A1 K 1 and energizing the relay.

2-36. DRIVER MODULE 1A11 (See figure 2-3)

2-37. The XMT RF signal from relay 1 A 1 K 1 is applied through a resistive attenuator, comprising 1A11R2, R3 and capacitor 1A11C1, to the base of first RF amplifier transistor 1 A1 1 Q 1. The attenuator reduces the nominal <1 00 milliwatt input signal by less than 1 dB and presents a constant 50-ohm termination impedance to the receiver-transmitter output stage. Transistor 1 A 11 Q 1 is operated as a common-emitter class A amplifier whose output is transformer coupled through 1A11T1, to the push-pull high level driver stage, formed by transistors 1A11Q2 and Q3. The DC collector voltage of transistor 1A11Q1 is fed through the primary of transformer 1 A1 1 T1 while the base bias is established by resistors 1A11R4 and R6. Both collector-base feedback (through selective network 1A1 1 R5, C2, and L2) and emitter degeneration (through resistor 1A11R7) are used to stabilize the first stage gain in the presence of supply voltage variations and transistor parameters over the 2 to 30 MHz frequency range.

2-38. As stated before, the output of the first rf amplifier stage is coupled to the bases of the class AB push-pull output stage, formed by transistors 1A11Q2 and Q3, through impedance matching transformer 1 A1 1 T1. +26.5 Vdc (nominal) is fed to the collectors of 1A1 1 Q2 and Q3 through transformer 1A11T2. The voltage drop across the resistor-diode combination of 1A1 1 R 1 and 1A1 1 CR1, which is caused by the current through transistor 1 A1 1 Q1, is used as the base bias for push-pull transistors 1A11Q2 and Q3.

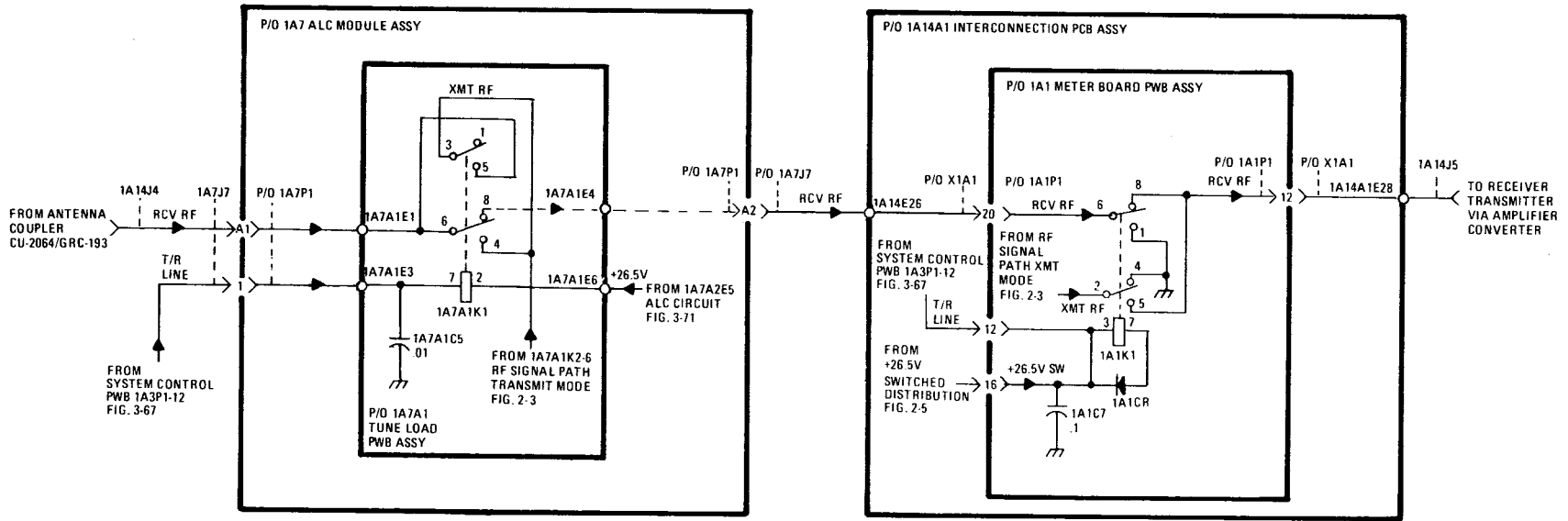


Figure 2-2. RF Signal Path Receive Mode

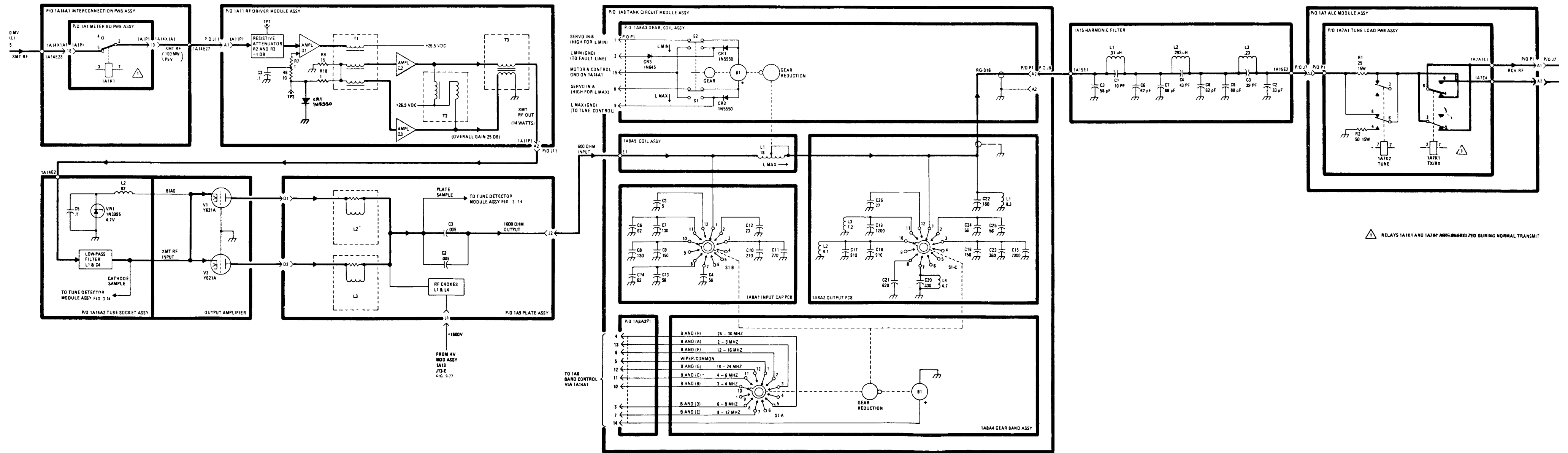


Figure 2-3. RF Signal Path Transmit Mode

This provides a low source impedance bias supply with only two components, which is necessary to maintain low inter-modulation distortion in the push-pull stage output.

2-39. Voltage feedback for transistor 1A11Q2 (through resistor 1A11R10, capacitor 1A11C5, and inductor 1A11L3) and for transistor 1A11Q3 (through resistor 1A11R14, capacitor 1A11C6, and inductor 1A11L4), and, current feedback for transistor 1A11Q2 (due to unbypassed emitter resistors 1A11R12 and R11), and for transistor 1A11Q3 (resistors 1A11R15 and R 16), provide negative feedback to stabilize the gain of the push-pull stage. The output of the push-pull stage is impedance transformed to 50 ohms by two wideband transmission line transformers, wound on toroidal cores, 1A11T2 and T3. The overall gain of the two-stage driver is 25 dB with a nominal output level of 14 watts. The driver is protected from damage due to excessive RF input levels up to two watts because the currents and voltages of the Q1 first stage are limited and the Q2, Q3 second stage can handle the saturated output of Q1.

2-40. OUTPUT AMPLIFIER (See figures 2-3 and 3-78)

2-41. The output of RF Driver 1A1 1 is amplified to the rated 400 watt \pm 1 dB power amplifier output level in the grounded-grid class AB tube amplifier stage which consists of Tube Socket Assembly 1A14A2, Tubes 1A14V1 and V2, and Plate Assembly 1A9. Tubes 1A14V1 and V2 are two ceramic triode vacuum tubes, type Y-621B, which are connected in parallel with their grids grounded directly to the chassis. The cathode bias for V 1 and V2 is developed across a 4.7 volt zener diode VR1 in Tube Socket Assembly 1A4A2. The RF input from the driver stage to the parallel connected cathodes of V1 and V2 is coupled through a low-pass filter network 1A14A2-L1 and C4. The plate voltage (+600 Vdc) is series-fed through RF chokes L1 and L4 of Plate Assembly 1A9 (See figure 3-73). A CATHODE SAMPLE signal is picked off at Tube Socket Assembly 1A14A2 by a capacitive divider network and applied to Tune Detector 1A10 as one of its inputs. A PLATE SAMPLE signal is picked off at Plate Assembly 1A9 by another capacitive divider network and applied to Tune Detector 1 A10 as its other sample input.

2-42. TANK CIRCUIT MODULE (See figures 2-3 and 3-78)

2-43. A pi-type impedance matching (1600 ohms to 50 ohms) Tank Circuit Module 1A8 is RF coupled to the plates of tubes 1A14V1 and V2 through capacitors C2 and C3 of Plate Assembly 1A9. The tank circuit, along with Harmonic Filter 1A15, attenuates the harmonic output of the RF signal to the antenna coupler. The Tank Circuit consists of a continuously variable coil series element (1A8A5L1) and bandswitched input shunt capacitors (1A8A1C3, C4, and C6 through C14 and output LC shunt networks 1A8A2L1 through L1 and 1A8A2C15 through C24). In normal operation (tune condition) the proper shunt elements have been selected and the 1A8A5L1 inductance has been adjusted automatically to match the tube impedance to 50 ohms at the desired operating frequency as described in Servo Controlled Adjustment of Coil 1A8A5L 1.

2-44. The output of Tank Circuit 1A8 is applied through Harmonic Filter 1A15 and the energized contacts (pins 4 to 6 and pins 3 to 5) of relay 1A7A1K1 to antenna coupler RF connector 1A14J4. Relay 1A7A1K 1 is energized by the Tx/Rx LINE Signal from System Control Assembly 1A3, during the Transmit mode of operation. The output of the power amplifier is kept constant by the ALC (Automatic Level Control) circuit 1A7, which is pre-adjusted to provide a 400-watt nominal output into a 50-ohm load. In the Transmit mode of operation, the receive RF bypass line is grounded by relay 1A1K1 to prevent unwanted signal feedback to the input of the power amplifier.

2-45. For system operation, the RF output of the power amplifier is normally connected to the antenna through Antenna Coupler CU-2064/GRC-193 (see figure 1-2). Direct connection to a 50 ohm, nominal. antenna system is also permissible, but a dummy antenna coupler plug is required at 1A14J1, wired to feed back to the power amplifier a COUPLER READY ground signal. Otherwise, the power amplifier will not tune.

2-46. TUNE MODE RF SIGNAL PATH (See figure 2-3)

2-47. When the power amplifier is in the Tune Mode, operation of the circuits in the XMT RF signal path is identical to that previously described, with the following exceptions:

1. Tune Relay 1A7A1K2 is also energized, switching the dummy load (series resistor 1A7A1R1 and shunt resistor 1A7A1R2) in series with the tank circuit output. This assures a constant loading for tuning the tank circuit regardless of the impedance presented by the antenna coupler. The power amplifier can tune load impedances exceeding the 25 to 75 ohm worst case range, including reactive loads.
2. The ALC (Automatic Level Control) system loop gain is automatically increased to reduce the XMT RF power output to about 40 watts. A current-derived ALC signal called Ip SENSE is provided to limit drive until sufficient RF voltage is generated to control the system.
3. The reactive elements in the tank circuit π network are not initially correct for matching the tube output impedance to the nominally 50 ohm load, but the proper elements are automatically selected in the Tune Mode by the bandswitching of the shunt elements and the fine servo tuning of inductor 1A8A5L1.

2-48. Control and sequencing of circuit operation in the Tune Mode are described in the following paragraphs. The explanation includes command and control signals to the receiver-transmitter and the antenna coupler.

2-49. SYSTEM CONTROL NORMAL OPERATION-DETAILED DESCRIPTION

2-50. Subsequent paragraphs 2-51 through 2-112 describe the operation of power amplifier circuits as they are used during the normal receive-transmit operation, i.e., system tuned at the desired frequency.

2-51. DC POWER SWITCHING (See figures 2-4 and 3-78)

2-52. The ON-OFF switching of the +26.5 Vdc nominal primary power line in the power amplifier is controlled remotely by the receiver-transmitter. As shown in figure 2-4, +26.5 Vdc (DIRECT) is distributed to receiver-transmitter RT-1209/URC via connector 1A14J2-L and Amplifier-Converter AM-6879-URC and to Antenna Coupler CU-2064/GRC-193 via circuit breaker 1A14CB1 and connector 1A14J1-M. Figure 2-5 shows the +26.5 Vdc FAN (SWITCHED) distribution to the antenna coupler via connector 1A14J1-L.

2-53. The dc power ON command from the receiver-transmitter (called PA ON/OFF) is a ground on pin N of connector 1A14J2. This ground is applied to the base of transistor 1A3Q1, turning the transistor "ON". This applies a positive voltage through resistor 1A3R6, transistor 1A3Q 1, and diode 1A3CR3 to the base of transistor 1A3Q3 driving the transistor into saturation and completing the current path from the +26.5 Vdc line thru the coil of relay 1A14K 1. When the PA ON/OFF relay is energized, the +26.5 Vdc is connected from DC PWR connector 1A4J3 through the normally closed contacts of circuit breaker 1A14CB2 to all user circuits within the power amplifier.

2-54. The dc power switching circuit also contains the following protective features:

- a. Reverse Polarity Protection - The correct power line connections at DC PWR connector 1A14J3 are:
 - (1) Pins A and B positive (+26.5 Vdc)
 - (2) Pins C and D negative (ground)

If the polarity of these connections is accidentally reversed, dc power to the power amplifier circuits cannot be switched on. Diode 1A3CR2 on the system control PWB assembly prevents a negative voltage from being applied to switching transistors 1A3Q1 and 1A3Q3, The transistors cannot be damaged nor can PA ON/OFF relay 1A14K 1 be energized.

- b. Over-voltage "Protection" - If the primary supply line dc voltage exceeds +33 Vdc, the power amplifier is automatically switched OFF to prevent damage to circuits and components. The tripping voltage is sensed via voltage regulator 1A3VR2 and resistors 1A3R3, R4, and R7. The trip point is adjusted

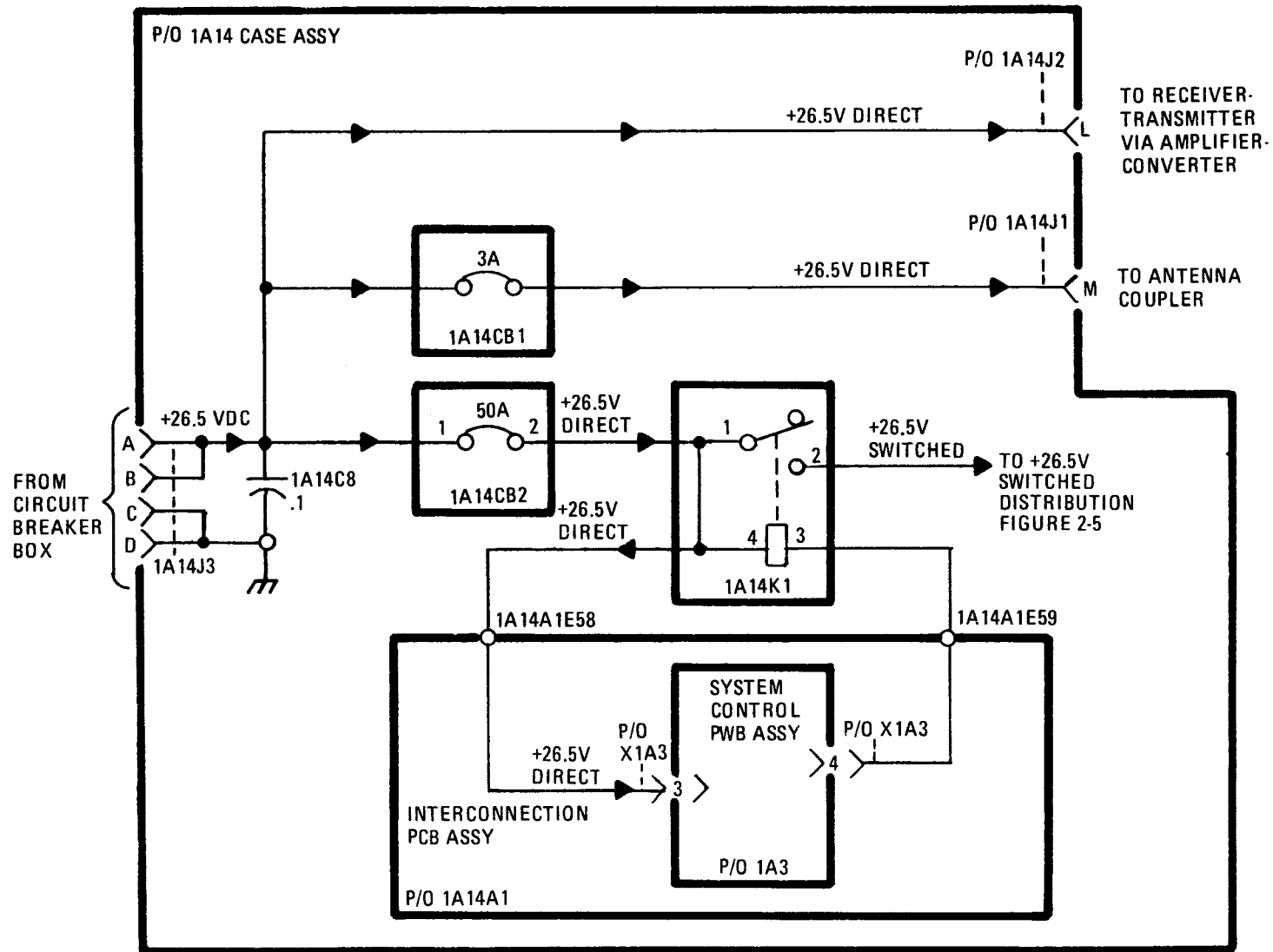


Figure 2-4. +26.5 Vdc Direct Distribution

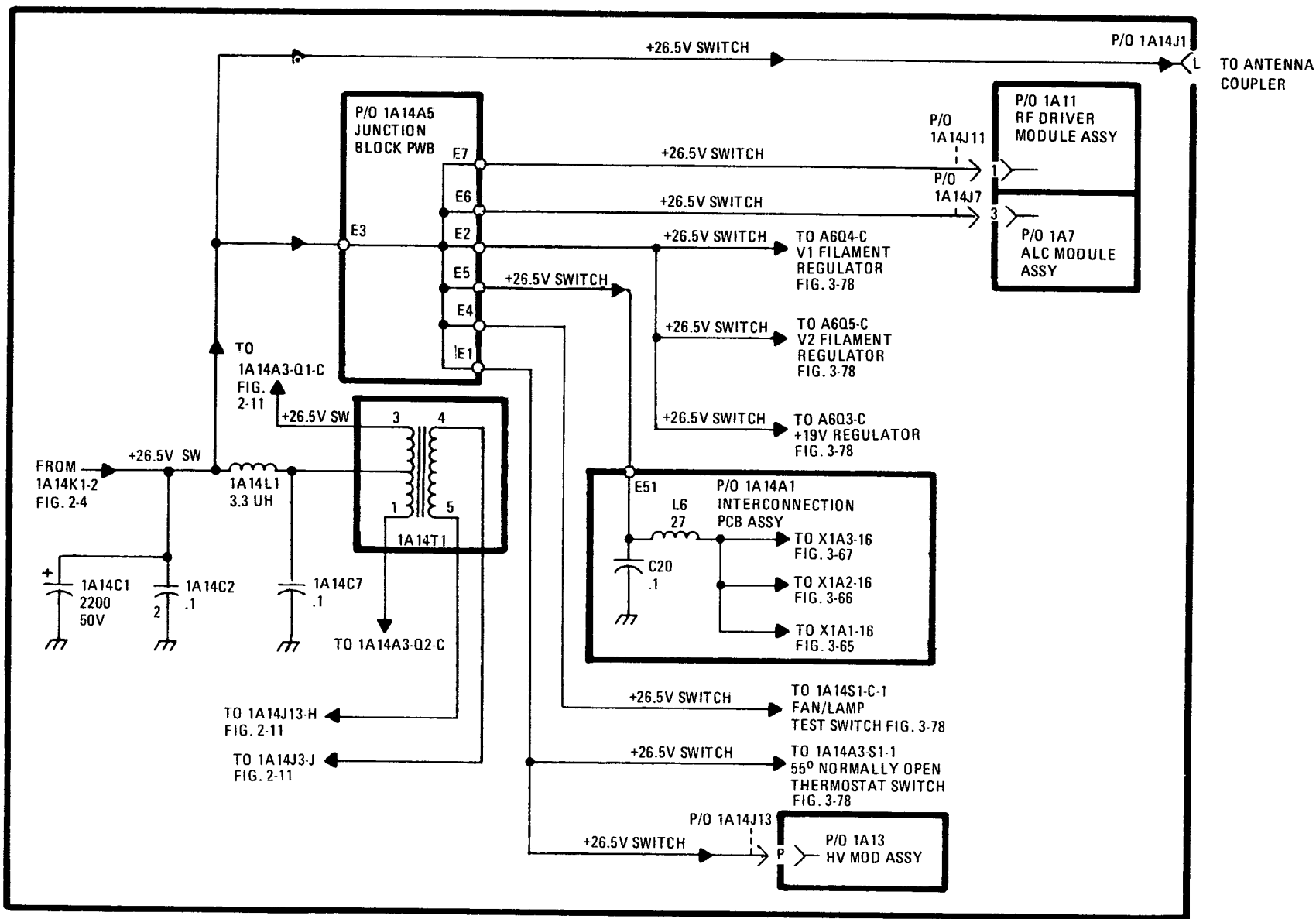


Figure 2-5. +26.5 Vdc Switched Distribution

to+33Vdc by variable resistor 1A3R3. When the supply voltage exceeds +33 Vdc, transistor 1A3Q2 is biased into saturation, shorting the collector of transistor 1A3Q1 to ground. If the system is turned "ON" 1A3Q3 switches off and de-energizes PA ON/OFF relay 1A14K1. If the system is turned OFF transistor 1A3Q3 is prevented from being switched ON by the PA ON/OFF command signal (ground) from the receiver-transmitter.

- c. Overtemperature Protection - Whenever the heat sink (case assembly) temperature exceeds +96°C, the normally open contacts of thermostat 1A14A3S2, (on Dc-to-Dc Converter 1A14A3) close, grounding the collector of transistor 1A3Q1. Transistor 1A3Q3 switches OFF, de-energizing PA ON/OFF relay 1A14K1. Dc power to the PA is interrupted and cannot be switched ON until the heat sink temperature has cooled to at least 80°C (the thermostat contact opening temperature).

2-55. RECEIVE-TRANSMIT (RX-TX) SWITCHING

2-56. In normal operation, system switching from receive to transmit is controlled by the depressing the PTT (push-to-talk) switch on the handset. This action switches the receiver-transmitter into the Transmit Mode and provides a ground on the KEYLINE signal input, connector 1A14J2-K, of the power amplifier. The KEYLINE signal (ground) is applied to the base of transistor 1A3Q6 through pin 18 on System Control PWB Assembly 1A3. Transistor 1A3Q6 is turned on, applying a positive voltage to the bases of transistors 1A3Q7 and 1A3Q8. When the base of transistor 1A3Q7 goes positive, the transistor turns ON, applying a ground to the T/R LINE at pin 12 of System Control PWB Assembly 1A3. This energizes the high voltage relay 1A13K1. The +1600V SENSE signal causes the RF input relay 1A1K1 to energize, connecting the receiver-transmitter to the RF driver input. It also: (1) energizes the RF output relay 1A7A1K1, connecting the output tank circuit to connector 1A14J4 (input to the Antenna Coupler), (2) energizes the HV ON circuit by turning on transistor 1A2Q8 on DC Control PWB Assembly 1A2, and (3) lights XMT indicator 1A14A4DS3 on Indicator Assembly 1A14A4.

2-57. When the base of transistor 1A3A8 goes positive, it turns on, applying a ground to the CPLR KEYLINE signal at pin 22 of System Control PWB Assembly 1A3. The CPLR KEYLINE signal is applied to the antenna coupler via connector 1A14J1-K, allowing the antenna coupler to tune.

2-58. Receive to transmit switching is automatically prevented whenever any faults occur or during the 60-second warm-up period immediately after dc power in the power amplifier is switched on. This is accomplished by grounding the collector of transistor 1A3Q6, preventing the transistor from turning ON. The CPLR FAULT signal is fed back from the antenna coupler through connector 1A14J1-B to pin 9 of System Control PWB Assembly 1A3. Any PA FAULT is applied to pin 11 of 1A3. The GND DURING WARMUP signal from DC Control PWB Assembly 1A2, pin 19, is applied to pin 20 of System Control PWB Assembly 1A3. With any of these signals at a ground level, transistor 1A3Q6 is prevented from turning on, which prevents RX-TX switching.

2-59. AUTOMATIC LEVEL CONTROL (ALC) (See figures 3-65,3-71, and 3-78)

2-60. The receiver-transmitter must provide 8 dB ± 2 dB attenuation of RF output per volt at ALC input level, starting at 0.6 Vdc maximum and ending at 6.0 Vdc minimum. This requirement establishes the following levels for the power amplifier:

MIN ALC	≡	+0.94 Vdc
P R E S E T A L C	≡	+2.6 Vdc
O P E R A T E A L C	≡	+2.0 Vdc
TUNE ALC	≡	OPERATE ALC plus (+) 0.4 Vdc (3 dB power attenuation)

2-61. Due to the slow attack time of the ALC and the need to protect the power amplifier against large bursts of rf, the MIN ALC and the PRESET ALC values were chosen to keep the ALC voltage level higher than any operate or tune ALC level. Thus, the decaying ALC voltage places the power amplifier in its

normal operating range as opposed to starting the power amplifier in an overload (overdriven state). The minimum ALC level was chosen to keep the attenuator inside its range during keyed intermittent voice, CW, or data transmission periods. The OPERATE ALC is variable and may operate anywhere in the range described above, thus allowing for any normal system variations due to environmental or electrical changes.

2-62. Prior to keying, the PRESET ALC voltage ($\cong +2.6$ Vdc) is developed on Meter Board PWB Assembly 1A1 by resistive divider 1A1R21 and R22. This PRESET ALC voltage is applied through connector X1 A1-23, on Interconnection PCB Assembly 1A1, and connector 1A14J2-R to the receiver;transmitter. When the PA is keyed, the T/R LINE is grounded. This inserts diode 1A1CR10 and resistor 1A1R23 into the PRESET ALC circuit, causing the $\cong +2.6$ Vdc PRESET ALC voltage to start decaying toward the MIN ALC voltage of $\cong 0.94$ Vdc. At the same time, the OPERATE ALC voltage ($\cong 2.0$ Vdc) is developed in ALC Module Assembly 1A7. This is accomplished when the RF output of the final tank circuit is sampled by capacitive divider network 1A7A1C1 and C2 and detected by diode 1A7A1CR1, a positive dc signal is applied to pin 4 of operational amplifier 1A7A2AR1-1 and compared to the RF ALC voltage applied to pin 3 of 1A7A2AR 1-1. This produces the OPERATE ALC voltage which is applied through diode 1A7A2CR4 and resistor 1A7A2R9 to connector 1A7P1 -6. The ALC voltage is then applied through connector 1A14J2-R to the receiver-transmitter to control the RF input to the power amplifier. Nominally, the ALC voltage is +2.0 Vdc, for a power amplifier output of 400 watts ± 1 dB.

2-63. When the PA is operated in the Tune Mode, the TUNE LINE is grounded to accomplish two functions. First, the grounded TUNE LINE energizes Tune Relay 1A7A1K2, connecting dummy load resistor 1A7A1R1 in series and resistor 1A7A1R2 in parallel with the power amplifier output, Second, it changes the threshold voltage developed by voltage divider network 1A7A2R3, R4, R1 (adjustable), R12, R13, and R18. The threshold voltage is compared to the Ip SENSE signal (i.e., plate current of final amplifier tubes 1A14V1 and V2), to produce the TUNE ALC voltage output (OPERATE ALC +0.4 Vdc) at pin 9 of operational amplifier 1A7A2AR1-2. The increased ALC voltage is sent to the receiver-transmitter via 1A14J2-R, to reduce the RF drive input of the power amplifier.

2-64. FAULT PROTECTION

2-65. The power amplifier contains circuits that prevent destructive secondary failures due to the following circuit malfunctions or abnormal operating conditions:

- a. REVERSE POLARITY PROTECTION - Described in paragraph 2-54a.
- b. OVERVOLTAGE PROTECTION - Described in paragraph 2-54.b.
- c. OVERTEMPERATURE PROTECTION - Described in paragraph 2-54.c.
- d RECEIVE TO TRANSMIT RX-TX SWITCHING INHIBIT - (See paragraph 2-55).

The power amplifier cannot be switched into the Transmit Mode if any of the following conditions exists:

- e. GND DURING WARM-UP -60 second initial power-on warm-up time has not elapsed. (See paragraph 2-5 1.)
- f. HF OVERLOAD FAULT - The+ 1600 Vdc is OFF due to tripping the De-to-De Converter overload protection. (See paragraph 2-1 37.)
- g. TUNE TIME FAULT - Tuning of the PA and the ANT CPLR was not completed in less than 20 seconds, (See paragraph 2-1 24.)
- h. BAND SWITCH FAULT - The bandswitch motor 1A8A4B1 is running (either during a normal frequency change or abnormally because of a malfunction in the control circuits). (See paragraph 2-77.)
- i. ¹MIN GND - The power amplifier tank circuit has not tuned correctly, i.e., the 1 A8A5 L 1 variable coil wiper has rotated all the way to the minimum inductance end of the coil and the ¹MIN micro-switch 1A8A3S2 has been actuated, grounding the ¹MIN line. (See paragraph 2-88.)
- j. ANT CPLR FAULT - The antenna coupler has not tuned properly (i.e., the tune cycle was not completed in 20 seconds or the VSWR is greater than 2:1). (See antenna coupler Technical Manual TM-87117B-34/1,)

2-66. When any of the receive-to-transmit switching inhibit conditions exists, fault switching transistor 1A3Q4 is deactivated. Under normal conditions, with no faults present at pins 9, 11, and 20 of System Control PWB Assembly 1A3, transistor 1A3Q4 is biased ON by the +26.5 Vdc line through resistor 1A3R18. This shorts pin 7 and (through diode 1A3CR9) pin 8 to ground, accomplishing two functions:

- a. Grounding pin 7 of 1A3 turns on the ready (RDY) lamp 1A14A4DS2 on the front panel.
- b. Grounding pin 8 of 1A3, the RT FAULT line, disables the receive-transmit inhibit circuitry in the receiver-transmitter. Under this condition, normal receive-transmit switching is possible using the PTT key on the handset or the CW key.

2-67. When a PA FAULT (1A3 pin 11) has occurred, the PA READY signal line is open circuited, turning OFF the RDY lamp on the PA front panel. At the same time the RT FAULT line is also open circuited, with +26.5 Vdc on pin 8 of 1A3 blocked by diode 1A3CR9. In the receiver-transmitter, this open circuit is sensed as a FAULT, inhibiting the transmit keying so that the system cannot be switched into the Transmit Mode until the malfunction has been cleared.

- a. VARIABLE COIL WIPER TRAVEL LIMITING - (see figure 3-72). Cam operated microswitches 1A8A3S1 and 1A8A3S2 stop the servo drive motor 1A8A3B 1 when the 1A8A5L1 coil wiper approaches the extreme low or high inductance ends of coil 1A8A5 L1, respectively. This prevents the wiper from running off the coil windings and damaging the assembly.
- b. WARM-UP DELAY - (See the Dc-to-Dc Converter Description paragraph 2-129.) The application of the +1600 Vdc (i.e., the start of the Dc-to-Dc Converter) to the plates of vacuum tubes 1A14V1 and 1A4V2 is delayed 60 seconds \pm 10 seconds after primary dc power (+26.5 Vdc) has been switched ON. This is necessary to allow the tube filaments and cathodes to heat up and reach their normal electron emission capability.

2-68. SYSTEM CONTROL TUNE CYCLE OPERATION DESCRIPTION

2-69. This section describes the operation of power amplifier circuits as they are used during tune cycle operation. The rf signal amplifier circuits used in the power amplifier, with the exception of Tank Circuit Module Assembly 1A8, are all of the wideband type and therefore require no tuning when operated over the 2 to 30 MHz frequency range. However, π network tube Tank Circuit Module Assembly 1A8 must be tuned at the desired operating frequency to match the tube plate resistance (RP), of about 1600 ohms, to the 50 ohm output impedance of the power amplifier (input impedance of the antenna coupler) and attenuate unwanted signals harmonically related to the carrier frequency. A Tune Cycle is initiated automatically when the dc power is initially switched on or when the receiver-transmitter frequency setting is changed, with the exception of the 100 Hz setting. The general sequence of operations during the Tune Cycle is shown in figure 2-6 for the power amplifier and the antenna coupler. The Tune Cycle is divided into the Preset and Wait Cycle and the Automatic Tune Cycle.

2-70. PRESET AND WAIT CYCLE

2-71. The Preset and Wait Cycle is automatically initiated by a >30 millisecond ground pulse (Tune Start) from the receiver-transmitter. After Tune Start initiation, the power amplifier and the antenna coupler tuning circuits are latched into the Tuning Mode of operation, thus inhibiting the normal Receiver-Transmit (Rx-Tx) mode of operation. As shown in figure 2-6, during the T_1 and T_6 time periods, power amplifier and antenna coupler circuits and relays are switched and variable tuning elements returned to their home (or starting) positions (e.g., variable coil 1A8A5L1 is driven to the maximum inductance setting) in preparation for initiation of the Automatic Tune Cycle.

2-72. AUTOMATIC TUNE CYCLE

2-73. The Automatic Tune Cycle is initiated by momentarily depressing the PTT key or CW key on the handset. This applies a ground to the KEYLINE signal line which goes to System Control PWB Assembly 1A3 in the PA, provided the warm-up time delay has timed out and all preprogrammed band switching has

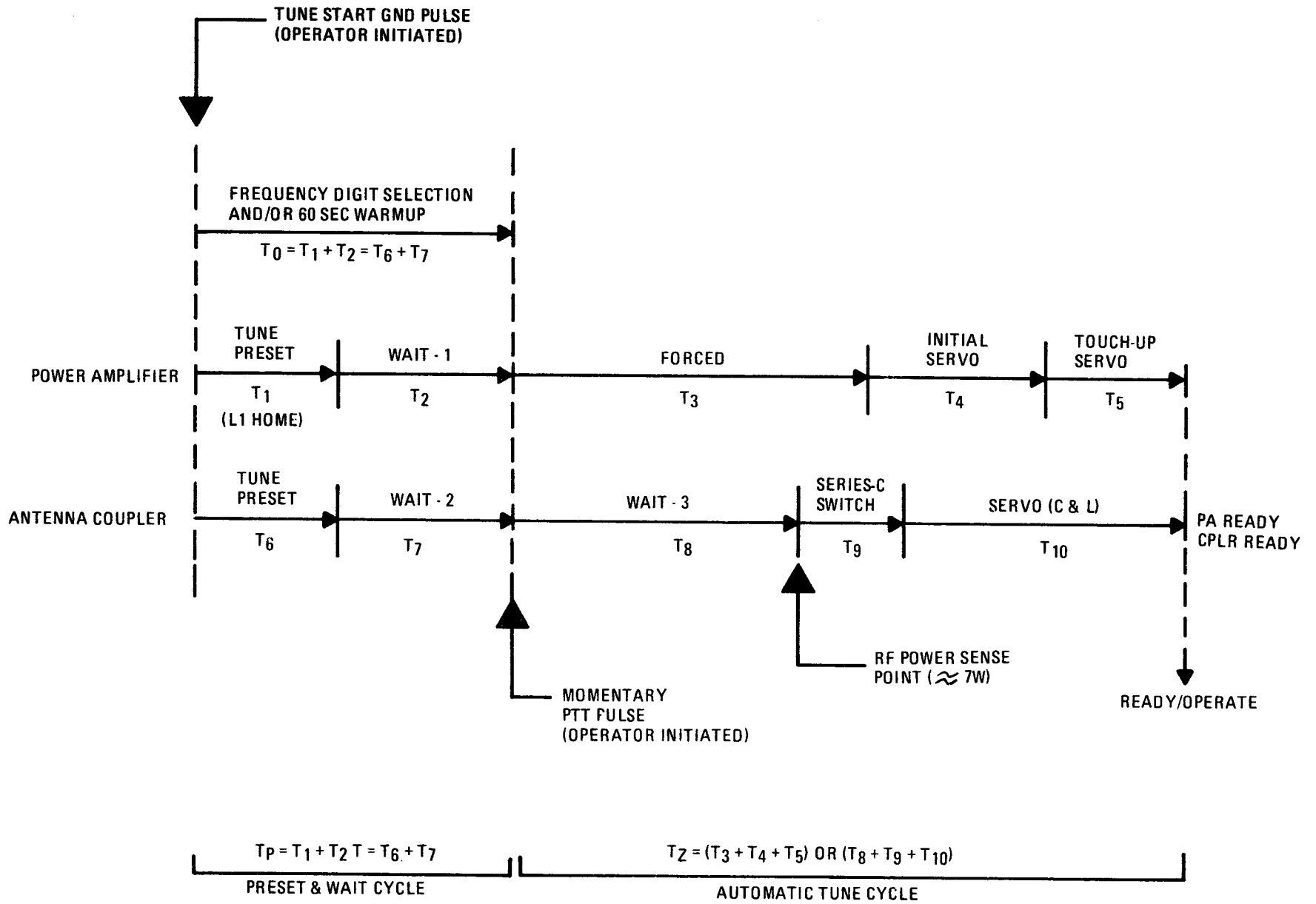


Figure 2-6. System Tune Cycle Detail

been completed without faults. Initiation of the Automatic Tune Cycle locks the receiver-transmitter into the Tune mode of operation and starts fine tuning the power amplifier. The antenna coupler cannot start its fine tune cycle yet, because it has no rf input. The power amplifier servo system is initially forced to rotate the variable coil 1A8A5L1 contact toward the correct tune setting, until sufficient output is sensed at the tube plates. When this occurs, the servo control is automatically transferred to the phase discriminator (e.g., Tune Detector Module Assembly 1A10) for final tuning adjustments of the variable coil.

2-74. When the power amplifier rf output (input to the antenna coupler) reaches about 10 to 20 watts, the antenna coupler starts to tune automatically. For a short period of time, the power amplifier and the antenna coupler tune simultaneously. When the antenna coupler has tuned properly (within a set time period and with a VSWR less than 2:1), an ANT CPLR READY signal (ground) is sent to the power amplifier. This signal is AND-gated with a PA READY signal (ground), when the power amplifier fine tuning cycle is completed, to unlatch the Tune Mode and return the system to the normal receive-transmit operating condition. The system is then ready to operate at the selected frequency, in either receive or transmit, as controlled by the operator.

2-75. TUNE CYCLE OPERATION-DETAILED DESCRIPTION

2-76. The tube output stage Tank Circuit Module Assembly 1A8 is tuned in two independent operations: (1) the preprogrammed bandswitching of the shunt elements and (2) the servo controlled adjustment of the series coil (1A8A5L1) inductance.

2-77. PREPROGRAMMED BANDSWITCHING-DETAILED DESCRIPTION

2-78. As shown in figure 3-72, the proper pi-network input and output shunt reactance for tuning the desired frequency are selected in eight bands by motor driven ganged rotary switches 1A8A1S1-B and 1A8A2S1-C. Switch wafer 1A8A4S1-A, ganged to 1A8A1S1-B and 1A8A2S1-C, is used to translate the eight BAND CODE signals, from Band Control PWB Assembly 1A6, to an angular position of the switch shaft. This is accomplished by using the "ground-seeking" method of position control, i.e., the motor (1A8A4B1) control circuit on Band Control PWB Assembly 1A6 is designed to stop the motor when the 1A8A4S1-A switch wiper hits the contact with a "grounded" BAND CODE signal. The "ground" BAND CODE signal is present on only one of the eight lines from Band Control PWB Assembly 1A6 and the grounded signal line corresponds to the selected operating frequency band. All of the other BAND CODE signal lines, tied to the 1A8A4S1 -A switch contacts, are open circuited. The SWITCH WIPER signal from 1A8A4S1-A is fed back to Band Control PWB Assembly 1A6 as described in the following paragraphs.

2-79. BAND MOTOR CONTROL-DETAILED DESCRIPTION

2-80. Bandswitch wafer 1A8A4S1-A, as shown in figure 3-72, is in the band B position (3-4 MHz). Therefore, the input BAND CODE signal on line 10 of connector 1A8P1 is "grounded" and all other BAND CODE signal input lines are open. The ground signal, SWITCH WIPER, is returned to the Band Control circuit through pin 6 of connector 1A8P1. As shown in figure 3-72, the grounded SWITCH WIPER input at pin 10, of connector 1A6P1, biases transistor 1A6Q11 ON and 1A6Q9 OFF. This in turn cuts OFF transistor 1A6Q10 and biases transistor 1A6Q12 into saturation. With transistor 1A6Q12 saturated, no operating dc voltage (BAND MOTOR +) is applied to bandswitch motor 1A8A4B1, stopping the drive. Since all switch wiper contacts, for 1A8A4S1-A, 1A8A1S1-B and 1A8A2S1-C are aligned, all three switches stop on position 10. This selects capacitor 1A8A1C8 and C9 for the input capacitance circuit and inductor 1A8A2L2 and capacitors 1A8A2C17 and C18 for the output reactance circuit, thus tuning the pi-network for the 3-4 MHz frequency range,

2-81. When the system operating frequency is changed, for example, to 15.5000 MHz, a new band is selected, in this case band F, the 12 to 16 MHz band. The BAND CODE signal line B (switch position 10) is open circuited and BAND CODE signal line F (switch position 2) is grounded. With the ground removed from the SWITCH WIPER signal input to Band Control PWB Assembly 1A6, transistor 1A6Q 11 is cut OFF while transistor 1A6Q9 is biased ON. This biases transistor 1A6Q10 ON and 1A6Q12 OFF, applying +19 Vdc (the BAND MOTOR (+) signal) through saturated transistor 1A6Q10 to Bandswitch Drive motor

1A8A4B1, causing it to rotate and turn switch wafers S1-A, S1-B, and S 1-C through a set of speed reduction gears. The motor (1A8A4B1) will continue to move the switch rotors until the 1A8A4S1 -A wiper touches the contact 2 switch position that now has the grounded BAND CODE signal applied to it. The instant this occurs, the SWITCH WIPER signal to the band control circuit is grounded, turning transistors 1A6Q11 ON, 1A6Q9 OFF, 1A6Q12 ON, and 1A6Q10 OFF. This disconnects the +19 Vdc from the BAND MOTOR + signal line through 1A6Q10 and grounds the BAND MOTOR (+) signal line and the MOTOR (-) GND signal line together through transistor 1A6Q12 for dynamic breaking, causing the motor to stop with all switch rotor contacts in position 2. This position selects capacitor 1A8A1C12 for the input to the pi - network and capacitors 1A8A2AC24 and C25 for the output of the pi-network, tuning the pi-network to the F frequency band (12 -16 MHz),

2-82, BAND CODE GENERATION-DETAILED DESCRIPTION (See figures 3-70 and 3-78)

2-83. The power amplifier receives six lines of binary coded decimal frequency input information (1 MHz (8), 1 MHz (4), 1 MHz (2), 1 MHz (1), 10 MHz (2), and 10 MHz (1)) from Receiver-Transmitter RT-1209/URC via Amplifier-Converter AM-6879/GRC-1 93. These signals are applied to Band Control PWB Assembly 1A6 thru RT CONTROL connector 1A14J2 and Interconnection PWB Assembly 1A14A1. Band code generation is the process of converting the six BCD (Binary Coded Decimal) input frequency codes into nine discrete BAND CODE signal lines (X, A, B, C, D, E, F, G, and H). BAND CODE X is an invalid band code which is used to generate the BANDSWITCH INHIBIT signal described in paragraph 2-84. The remaining BAND CODE signal lines (A thru H) are used to position the bandswitch drive motor 1A3A4B1 through the band motor control circuitry described in paragraph 2-77. Table 2-1 shows the direct relationship of the BCD input signal frequency codes, the BAND CODE signals, and their corresponding 28 usable frequency ranges. Using the letter designations A through F for the six binary inputs, with a dash above the letter to indicate the binary “ 1” state (high), the simplifications shown in table 2-12 can be written.

2-84. For each BAND CODE, only the last simplified set of input code bits that are underlined are significant and need be considered. The actual code conversion process is performed in three columns of gates, 1A6U1 through 1A6U9, by combining pairs of digits in each term of the expression. For example, when the selected frequency is 2.6750 MHz, the code conversion expression A = ABCDEF must be satisfied to get a logic “ 1” (high) signal at the BAND A output terminal. In the first column of AND gates, the inverted A output, at 1A6U1-3, is combined with the inverted B output at 1A6U1-4, to produce the logic “1” (high) AB output, at 1A6U6-3. The inverted E output, at 1A6U24, is combined with the inverted F output, at 1A6U1-11, to produce the logic “ 1” (high) EF output at 1A6U3-11. The inverted C output, at 1A6U1-10, is combined with the direct D code line, from 1A6P1-2, to produce the logic “ 1” (high) CD output, at 1A6U5-3.

BAND CODE	=	BCD BIT DESIGNATION
<u>X</u>	=	$\overline{ABCDEF} + \overline{ABCDEF} = \underline{\overline{ABDEF}}$
<u>A</u>	=	$\underline{\overline{ABCDEF}}$
<u>B</u>	=	$\underline{\overline{ABCDEF}}$
<u>C</u>	=	$\overline{ABCDEF} + \overline{ABCDEF} = \underline{\overline{ABDEF}}$
<u>D</u>	=	$\overline{ABCDEF} + \overline{ABCDEF} = \underline{\overline{ABDEF}}$
<u>E</u>	=	$\overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} = \underline{\overline{ABDEF}} + \underline{\overline{ABDEF}}$
<u>F</u>	=	$\overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} = \underline{\overline{ABDEF}} + \underline{\overline{ABDEF}}$
<u>G</u>	=	$\overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} = \underline{\overline{ABDEF}} + \underline{\overline{ABDEF}} + \underline{\overline{ABDEF}} + \underline{\overline{ABDEF}} + \underline{\overline{ABDEF}}$
<u>H</u>	=	$\overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} + \overline{ABCDEF} = \underline{\overline{ABEF}} + \underline{\overline{ABDEF}}$

TABLE 2-1. BAND CODE GENERATION

BAND CODES	FREQUENCY RANGES (MHZ)	RECEIVER-TRANSMITTER BCD CODE					
		10 MHZ		1 MHZ			
		1	2	1	2	4	8
x	0	0	0	0	0	0	0
	1	0	0	1	0	0	0
A	2	0	0	0	1	0	0
B	3	0	0	1	1	0	0
c	4	0	0	0	0	1	0
	5	0	0	1	0	1	0
D	6	0	0	0	1	1	0
	7	0	0	1	1	1	0
E	8	0	0	0	0	0	1
	9	0	0	1	0	0	1
F	10	1	0	0	0	0	0
	11	1	0	1	0	0	0
	12	1	0	0	1	0	0
	13	1	0	1	1	0	0
G	14	1	0	0	0	1	0
	15	1	0	1	0	1	0
	16	1	0	0	1	1	0
	17	1	0	1	1	1	0
	18	1	0	0	0	0	1
	19	1	0	1	0	0	1
	20	0	1	0	0	0	0
H	21	0	1	1	0	0	0
	22	0	1	0	1	0	0
	23	0	1	1	1	0	0
	24	0	1	0	0	1	0
	25	0	1	1	0	1	0
	26	0	1	0	1	1	0
	27	0	1	1	1	1	0
	28	0	1	0	0	0	1
	29	0	1	1	0	0	1
BIT DESIGNATION		A	B	C	D	E	F

LEGEND: 0=GND THROUGH DIODE
 1= OPEN CIRCUIT

2-85. In the second column of AND gates, the AB logic "1" input, at 1A6U3-8, is combined with the EF logic "1" input, at 1A6U3-9, to produce the logic "1" AB EF output, at 1A6U3-10. In the third column of AND gates, the CD logic "1" output from the first column is applied to 1A6U5-8 and combined with the AB EF logic "1" input, at 1A6U5-9, to produce the logic "1" ABCDEF output, at 1A6U5-10. This biases transistor 1A6Q7 ON, applying ground to diode 1C6CR 11, which lights indicator 1A6DS7 to show that BAND A is selected, and applies a ground on the BAND CODE A signal line, which corresponds to position 3 on band control selector switch wafer 1A8A4S 1-A. The preprogrammed bandswitching is completed in less than one second after a frequency code signal change is received from the receiver-transmitter. The eight band positions on band control selector switch 1A8S1 are not in an increasing frequency sequence. The positions have been arranged to allow the shunt components of higher frequency bands to be connected between the proper switch wafer contacts and ground with the shortest possible lead lengths (to minimize lead inductances). In the lower frequency bands, lead inductance is not critical, because of the relatively high inductance setting of coil 1A8A5L1 when the pi - network is tuned.

2-86. BAND SWITCH INHIBIT-DETAILED DESCRIPTION

2-87. The BAND SWITCH INHIBIT circuit portion of the preprogrammed band switching network is a built-in protection which prevents the system from switching to transmit when a frequency band below 2 MHz is selected or when band switch motor 1A8A4B1 is driving to a new band switch position. As described in paragraph 2-78, when transistor 1A6Q10 is biased ON, providing the +19 Vdc to the BAND MOTOR (+) signal line, the +19 Vdc is also applied to the base of transistor 1A6Q 14, biasing it ON. This applies a ground through 1A6Q 14 to the BAND SWITCH INHIBIT signal line, which is then applied to System Control PWB 1A3 as a PA FAULT. Another way of generating a PA FAULT on the BAND SWITCH INHIBIT signal line occurs when a frequency band below 2 MHz is selected on the receiver-transmitter. When this happens, the six binary coded frequency lines will be coded for one of the two BAND X frequency ranges as shown in table 2-1. Either one of these input signal combinations produces a logic "1" (high) level at the base of transistor 1A6Q 13. This biases 1A6Q13 ON, applying a ground through the transistor to the BAND SWITCH INHIBIT signal line.

2-88. SERVO CONTROLLED ADJUSTMENT OF COIL 1A8A5L1

2-89. The servo system consists of the following major elements:

- a. Torque motor 1A8A3B 1 and limit switches 1A8A3S1 and S2 (see figure 3-72).
- b. Servo Amplifier PWB Assembly 1A5 (see figure 3-69).
- c. Tune Detector Module Assembly 1A10 (see figure 3-74).
- d. Tune Control PWB Assembly 1A4 (see figure 3-68).

2-90. TORQUE MOTOR 1A8A3B1 AND LIMIT SWITCHES 1A8A3S1 AND 1A8A3S2 (see figure 3-72)

2-91. Torque motor 1A8A3B 1 is connected through reduction gears to the shaft of variable series coil 1A8A5L1 and is used to position the rotor, with the attached contact finger, along the length of the coil winding. As the shaft is rotated, the contact fingers are moved along the flat coil wire, providing an infinitely fine adjustment of the coil inductance. The wiper contacts short out that portion of the coil winding that is between the contact point and the output end of the coil (i.e., motor end). The direction and speed of rotation of the torque motor (and the coil shaft) are controlled by the SERVO IN A (1A14J8, pin 8) and SERVO IN B (1A14J8, pin 1) signals from Servo Amplifier 1A5 (see paragraphs 2-98 and 2-100). The direction of rotation, looking from the motor end of the 1A8A3 assembly, is clockwise to decrease the inductance of coil 1A8A5L1 and counterclockwise to increase the inductance of coil 1A8A5L1. The 1A8A3S1 and S2 limit switches are cam actuated, A gear is connected to the torque motor shaft in such a way that torque motor 1A8A3B1 is stopped, by opening and then grounding the positive motor line, just before the wiper contact reaches either end of the coil winding. Limit switch 1A8A3S1 stops the wiper at the high inductance end of the coil and 1A8A3S2 stops the wiper at the low inductance end of the coil (near the tubes).

2-92. Opening and then grounding the positive motor line, either SERVO IN A or SERVO IN B, makes it possible to start the motor in the reverse direction by changing the polarity on the other input signal line. It also provides a rotor position sense signal, ¹MAX GND from 1A8A3S1 and ¹MIN GND from 1A8A3S2, to the tune control and sequencing circuits, depending upon which limit switch is actuated. The ¹MAX GND signal goes to Tune Control PWB Assembly 1A4 (see paragraph 2-1 18). The ¹MIN GND signal goes to System Control PWB Assembly 1A5 as a PA FAULT (see paragraph 2-65).

2-93. SERVO AMPLIFIER 1A5 (See figure 3-69)

2-94. The servo amplifier has four distinct modes of operation and depends upon control signals from other circuits of the servo system.

2-95. SERVO DISABLED CONDITION

2-96. When the SERVO ENABLE (ground) signal is not present, pin 8 of 1A5 is at +19.0 Vdc. This causes the grounding of both servo amplifier output lines (pins 1 and 5 of 1A5) as shown in table 2-2.

TABLE 2-2. SERVO DISABLE CONDITION

CHANNEL	TRANSISTOR CONDITION					SIGNAL AND LOCATION CONDITION
A	1A5Q4 ON	1A5Q7 OFF	1A5Q8 ON	1A5Q9 OFF	1A5Q10 ON	SERVO IN A (Pi-1) GND THRU 1A5Q10
B	1A5Q6 ON	1A5Q11 OFF	1A5Q12 ON	1A5Q13 OFF	1A5Q14 ON	SERVO IN B (P 1 -5) GND THRU 1A5Q14

2-97. This condition is present when the power amplifier is TUNED and READY to operate. Grounding the servo amplifier outputs prevents activation of servo motor 1A8A3B1 by spurious signals. The SERVO ENABLE (ground) signal is provided automatically by Tune Control PWB Assembly 1A4, as the TUNE (ground) signal, when the power amplifier must be retuned.

2-98. SERVO ¹MAXFORCE CONDITION

2-99. At the beginning of the TUNE CYCLE, the polarity of the servo amplifier outputs are such that the SERVO IN B signal is grounded through transistor 1A5Q14 and the SERVO IN A signal is +19 Vdc through transistor 1A5Q9, This forces torque motor 1A8A3B1 to tune the coil wiper of 1A8A5L1 toward the ¹MAX position. To accomplish this, a positive (about + 10V) ¹MAX FORCE signal is applied to pin 6 of 1A5 from Tune Control PWB Assembly 1A4. Table 2-3 shows the effect of the positive ¹MAXFORCE signal in the servo amplifier.

2-100. SERVO ¹MIN FORCE CONDITION

2-101. At the start of the final tuning cycle (¹MAX FORCE cycle completed), the servo amplifier is forced to turn the rotor of coil 1A8A5L1 toward the minimum inductance (and the correct tune setting) position. This is necessary because the initial outputs from the phase discriminator are not high enough to control the servo amplifier. The ¹MIN FORCE signal (about +10V) from the tune control circuits has the following effects on the servo amplifier circuits shown in table 2-4.

TABLE 2-3. ⁴MAX FORCE CONDITION

CHANNEL	TRANSISTOR					SIGNAL AND LOCATION
	CONDITION					
A	1A5Q4	1A5Q7	1A5Q8	1A5Q9	1A5Q10	SERVO IN A(P1-1)
	OFF	ON	OFF	ON	OFF	+19 VDC THRU Q10
B	1A5Q6	1A5Q11	1A5Q12	1A5Q13	1A5Q14	SERVO IN B (P1-5)
	OFF	OFF	ON	OFF	ON	GND THRU Q14

TABLE 2-4. ⁴MIN FORCE CONDITION

CHANNEL	TRANSISTOR					SIGNAL AND LOCATION
	CONDITION					
A	1A5Q4	1A5Q7	1A5Q8	1A5Q9	1A5Q10	SERVO IN A(P1-1)
	OFF	OFF	ON	OFF	ON	GND THRU Q10
B	1A5Q6	1A5Q11	1A5Q12	1A5Q13	1A5Q14	SERVO IN B (P1-5)
	OFF	ON	OFF	ON	OFF	+19 VDC THRUQ14

2-102. PHASE ERROR-CONTROLLED SERVO OPERATION

2-103. In the final fine tune portion of the TUNE CYCLE, the direction and speed of rotation of torque motor 1A8A3B1, are controlled by the closed servo loop consisting of torque motor 1A8A3B1, variable coil 1A8A5LI, rotor contact, tune detector 1A10, and servo amplifier 1A5. In the closed loop mode of operation, the polarity and magnitude of the motor drive signals (and thus the direction and speed of rotation) at the outputs (SERVO IN A and SERVO IN B) of the servo amplifier depend on the polarity and magnitude of the TUNE SENSE input signals (PHASE ERROR A and PHASE ERROR B at pins 21 and 23 of 1A5P1, respectively). The two dc outputs from the phase detector are applied to the inputs of differential amplifier 1A5AR1-1 whose output is applied to differential amplifiers 1A5AR1-2 and 1A5AR2-1. The inverted output of differential amplifier 1A5AR2-1 is applied to the input of differential amplifier 1A5AR2-2. 1A5AR1 and AR2 control the separate servo channels, one for each motor lead, which ground or apply the +19 Vdc to the inputs of torque motor 1A8A3B1, as required for proper direction of motor rotation. The outputs of amplifiers 1A5AR1-2 and 1A5AR2-2 are square waves, whose duty cycle is controlled by oscillator 1A5Q15 and amplifier 1A5Q16. The output of differential amplifier 1A5AR1-2 is connected to the common base inputs of transistors 1A5Q7 and 1A5Q8. In a similar manner, the output of amplifier 1A5AR2-2 is connected to the common base inputs of transistors 1A5Q11 and 1A5Q12. When the error signal (PHASE ERROR A) from pulse detector 1A10 is large enough and of the proper polarity, amplifier 1A5AR1-2 applies a positive-going (+10V) square wave signal to transistors 1A5Q7 and 1A5Q8. On the positive cycle, transistor 1A5Q7 conducts, applying +19 Vdc to the base of transistor 1A5Q9. This causes 1A5Q9 to conduct, applying +19 Vdc to torque motor 1A8A3B1. On the negative cycle, transistor 1A5Q8 conducts, applying a ground to the base of transistor 1A5Q10. This causes 1A5Q10 to conduct, applying a ground to torque motor 1A8A3B 1. This action produces a series of pulses, the duration of which is directly proportional to the amplitude of the input error signal. This results in torque motor 1A8A3B1 being driven by a series of pulses, with longer pulses for faster tuning when the error is great and shorter pulses for slower motor positioning as the proper tune point is approached and the error signal is reduced, If the SERVO ENABLE signal

(a ground from Tune Control 1A4) is not present, transistors 1A5Q4 and 1A5Q6 conduct. This applies grounds to the common bases of transistors 1A5Q7 and Q8 and 1A5Q11 and Q12, respectively, and prevents any error signals from amplifiers 1A5AR1-2 and 1A5AR2-2 from passing those points. However if a SERVO ENABLE (ground) signal is present, transistors 1A5Q4 and 1A5Q6 are turned OFF, enabling both the A and B error channels. As the variable coil 1A8A5L1 is tuned toward the correct position, the error signals applied to the servo amplifier will decrease until there is insufficient amplitude to turn on differential amplifier 1A5AR1-2 or 1A5AR2-2. When this occurs, both servo outputs (SERVO IN A and SERVO IN B) are grounded through transistors 1A5Q10 and 1A5Q14, respectively, and torque motor 1A8A3B1 stops.

2-104. PHASE AND LEVEL DETECTOR (See figure 3-74)

2-105. Tune Detector Module Assembly 1A10 contains the phase and level detector circuits which compare the phase of RF signals from the cathode and plate circuits of the tubes (1A14V1 and 1A14V2) in the final RF stage of the power amplifier and provide dc signals to the servo amplifier and tune control PCB'S for tuning. There are three separate passive networks in the phase and level detector circuitry. The following discussion breaks out each network separately for better understanding.

2-106. RF INPUT VOLTAGE SAMPLING NETWORK (See figure 2-7)

2-107. The function of the RF input voltage sampling network is to produce a dc output voltage proportional to the RF drive voltage at the cathode of power amplifier tubes 1A14V1 and 1A14V2. The RF drive is sampled through a capacitive divider network which consists of capacitors 1A14A2C3 and C4. The output of the divider is applied through pin 8 of Tune Detector Module Assembly 1A10 to the cathode of diode 1A10CR4. Here the signal is peak detected by diode 1A10CR4 and capacitor 1A10C11, then filtered by capacitor 1A10C12 and attenuated by resistor 1A10R18 to produce the CATHODE LEVEL signal. The CATHODE LEVEL signal is sent to Tune Control PWB Assembly 1A4 and to the monitoring circuit on Meter PWB Assembly 1A1.

2-108. RF OUTPUT VOLTAGE SAMPLING NETWORK (See figure 2-8)

2-109. The function of the rf output voltage sampling network is to produce a dc voltage proportional to the rf voltage at the plates of power amplifier tubes 1A14V1 and 1A14V2. The rf output voltage is picked off of Plate Assembly 1A9, just after the junction of inductors 1A9L2 and L3, by a capacitive divider network which consists of 1A9C4 and C5. The output of the divider is applied through pin 6 of Tune Detector Module Assembly 1A10 and capacitor 1A10C13 to the cathode of diode 1A10CR1. Here the signal is peak detected by diode 1A10CR1 and capacitor 1A10C1, then filtered by capacitor 1A10C2 and attenuated by resistors 1A10R3 and R5 to produce the PLATE LEVEL signal. The PLATE LEVEL signal is sent to Tune Control PWB Assembly 1A4.

2-110. PHASE DETECTOR (See figure 3-74)

2-111. The function of the phase detector network is to produce two dc outputs (SERVO IN A and SERVO IN B) each of which is directly proportional to one of the sampled rf inputs. These two signals are applied to the input of Servo Amplifier PWB Assembly 1A5, and are equal when variable inductor 1A8A5L1 in the final tank circuit is correctly positioned and the power amplifier is working into an essentially resistive load. Figure 3-74 shows the complete phase detector. Inductor 1A10L3 and resistor 1A10R2, in the CATHODE SAMPLE input, are used to compensate the input impedance of capacitor 1A10C10 and resistor 1A10R15 by completing an all-pass circuit. Similarly, capacitor 1A10C3 and resistor 1A10R1, in the PLATE SAMPLE input, form another all-pass circuit with inductor 1A10L1, transformer 1A10T1, and resistor 1A10R7. This is necessary so that the amplitude and phase differences between the CATHODE and PLATE voltage samples can be maintained accurately as they go through voltage dividers to the input of the detector.

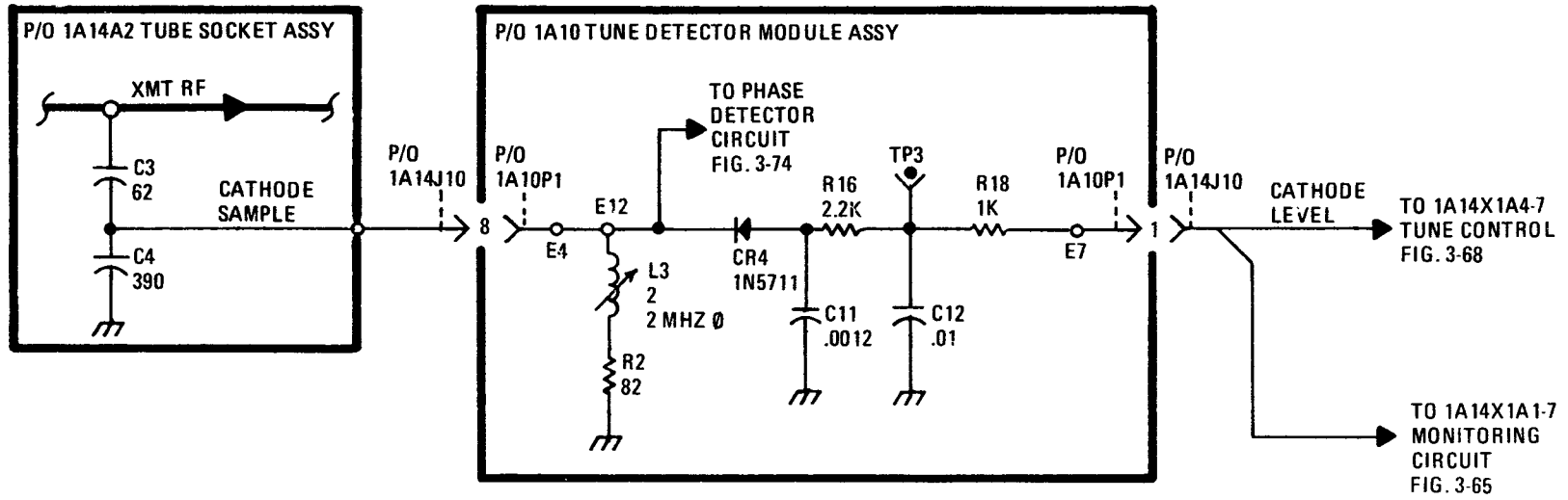


Figure 2-7. RF Input Voltage Sampling Network Simplified Schematic

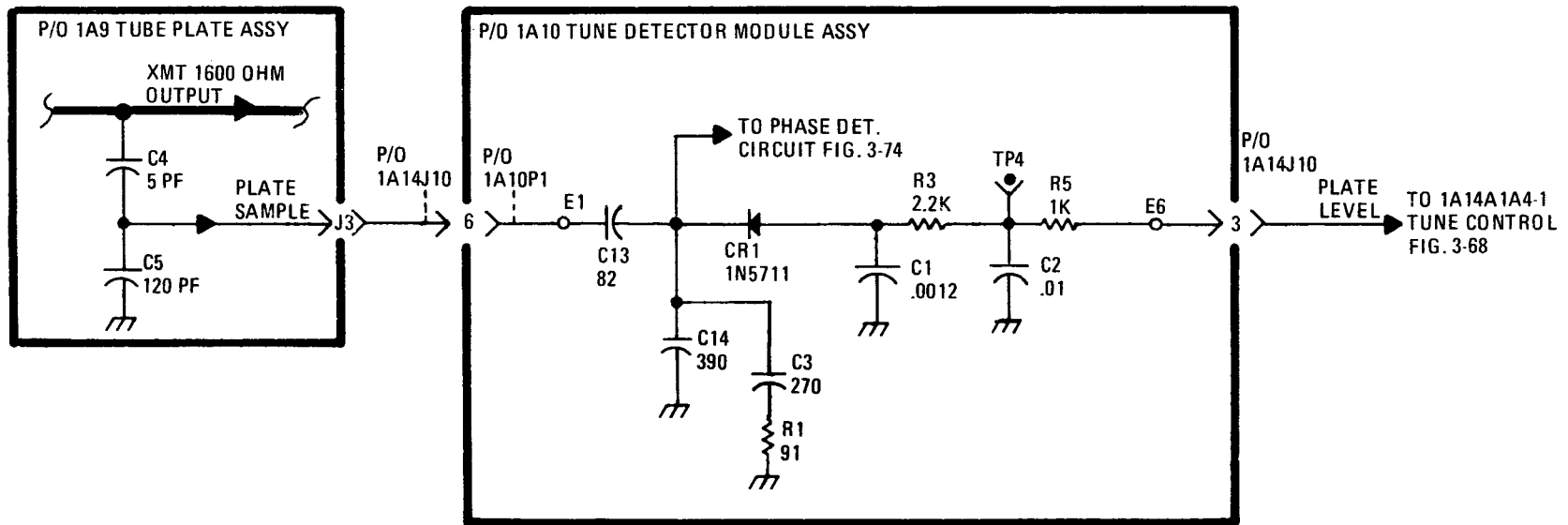


Figure 2-8. RF Output Voltage Sampling Network Simplified Schematic

2-112. Inductor 1A10L2 is used to compensate for the phase delay through transformer 1A10T1. In addition, inductor 1A10L2 is used as a high frequency adjustment to vary the phase of the voltage developed across resistor 1A10R15 for zero balancing. Inductor 1A10L1 is the mid-frequency balance control for the phase detector, while inductor 1A10L3 is the low frequency balance control for the input (CATHODE) voltage sampling network and has a slight affect on the phase at low frequencies. Inductor 1A10L1 has its greatest effect at 8 MHz due to the resonance of the all-pass network. Resistors 1A10R6 and R8 are used to compensate diode detectors 1A10CR2 and CR3, making the detectors less sensitive to diode characteristics or to RF waveform variations.

2-113. TUNE CYCLE CONTROL (See figure 3-68)

2-114. Subsequent paragraphs 2-115 through 2-124 describe the tune cycle control.

2-115. In the preceding paragraphs, the functioning of the individual elements of the servo system under various control and command signal conditions was described. The operation of these elements (e.g., ON-OFF switching, sequencing, interlocking) is controlled by the high level discrete component logic circuits on Tune Control PWB Assembly 1A4, which also provides and accepts system interface signaling to and from the receiver-transmitter and the antenna coupler. Table 2-5 will help in understanding how the tune cycle control functions.

2-116. POWER AMPLIFIER TUNE

2-117. The tune cycle is initiated by a 30 millisecond ground pulse (TUNE START) on pin 16, of Tune Control PWB Assembly 1A4, whenever the receiver-transmitter operating frequency is changed or the system dc power is switched ON. The ground pulse on pin 16 (TUNE START) momentarily switches ON the tune latch circuit (P/O 1A4U1 and 1A4U2) and the tune time latch circuit (P/O 1A4U6). The tune latch circuit and the tune time latch circuit are latched ON for the duration of the Tune Cycle. This prevents normal Receive-Transmit operation until the system has been correctly tuned. When pin 13 of 1A4U1 is grounded, a logic "1" level (high) is applied to the base of transistor 1A4Q3, turning the transistor ON and applying a ground to the TUNE line at pin 22 of 1A4. The TUNE (ground) signal is sent to Servo Amplifier 1A5 as the SERVO ENABLE (ground) signal to activate the servo amplifier. The TUNE (ground) signal is also sent to ALC Module Assembly 1A7 (pin 2) to energize Tune Relay 1A7A1K2, connecting dummy load resistor 1A7A1R1 in series and resistor 1A7A1R2 in parallel with the power amplifier rf output.

2-118. L_{MAX} FORCE CONDITION

2-119. When pin 13 of 1A4U1 is grounded, a logic "1" (high) is applied to pin 1 of 1A4U6 producing a +10V (high) L_{MAX} FORCE signal that is sent to Servo Amplifier 1A5 through pin 5 of connector 1A4P1. This forces torque motor 1A8A3B1 to drive coil 1A8A5L1 toward its maximum inductance value. When the coil has been tuned to maximum inductance, the limit switch 1A8A3S1 stops the motor and grounds the L_{MAX} LIMIT signal line. (Grounding the L_{MAX} LIMIT signal line (1A4P1-18) applies a low logic level to pins 1 and 2 of NAND gate 1A4U5. If the tune cycle was initiated by equipment turn-on, the tuning cycle will be interrupted at this point, until the time delay (60 seconds) in the power supply has timed out. Interrupting the tune cycle until the warm-up time delay is completed, insures that the tubes have had sufficient warm-up time to be ready to transmit, The TUNE START signal (ground) is also sent to the antenna coupler to initiate a similar TUNE PRESET sequence there.

2-120. AUTOMATIC TUNE CYCLE CONTROL

2-121. The final automatic tuning of the Power Amplifier is initiated (after frequency selection and/or the warm-up delay have been completed) by depressing momentarily the PTT key on the handset. This applies a momentary ground on the KEYLINE signal line, pin 12 of 1A4, and pins 8 and 9 of NAND gate 1A4U5. This in turn switches (and latches) U5, U4, U2, and U6 into saturation, shorting to ground the L_{MAX} FORCE command signal line. The KEYLINE ground also forward bias the gate of unijunction transistor 1A4Q5, latching it into conduction. In System Control PWB Assembly 1A3,

TABLE 2-5. TUNE CONTROL PWB GATE STATUS DURING TUNE OPERATION SEQUENCE

TUNE CONTROL PWB ASSEMBLY 1A4		PA TUNE INITIATION	TUNE IN PROGRESS	OPERATE STATUS UNKEYED	OPERATE STATUS KEYED	TUNE CONTROL PWB ASSEMBLY 1A4		PA TUNE INITIATION	TUNE IN PROGRESS	OPERATE STATUS UNKEYED	OPERATE STATUS KEYED	
GATE REF.DESIG.	PIN NO.					GATE REF. DESIG	PIN NO.					
U1	4	1	0*	1	1	U4	1	0	1	0	0	
	5,6	0	1*	0	0		2	0	1	0	1	
	8,9	0	1*	0	0		3	1	0**	0	0	
	10	1	0*	1	1		4	1	1	1	1	
	11	1	1	1	0		5	0	1	0	1	
	12	0	0	1	1		6	1	1**	1	1	
	13	1	1**	1	1		8	1	1*	1	0	
U2	1,2,6	1	1*	1	1	U5	9	1	0*	1	1	
	3	0	0*	1	1		1,2	0	1**	1	1	
	4	0	1*	0	0		3	1	0**	0	0	
	5	1	0*	1	1		4	1	1	1	1	
	8,12	1	1	0	0		5,6	0	0	0	0	
	9	0	0	1	1		8,9	1	0	1	0	
	10	1	0	1	1		10	0	1	0	1	
U3	11	1	1**	1	1	11	0	1	0	0		
	13	0	1	0	0	12	1	1**	0	0		
	U6	1,2	1	1*	1	0	U6	13	1	1**	1	1
		3	0	0*	0	1		1	1	1	0	0
		4	0	1*	1	0		2	1	0	1	1
		5,11	0	0*	0	1		3,5,6	0	1	1	1
		6	0	1	0	1		4	1	0	0	0
8,9		0	0*	0	1	8		1	1	1	1	
10		0	1*	1	1	9,11		1	1	1	1	
2,13	1	1*	1	0	10,12	0	0	0	0			
						13	1	1**	1	1		

LEGEND: 0 = Logic Level Zero
 1 = Logic Level One
 * = Level Shown Exist for Most of Tune In Progress Sequence. Depending on frequency Selected.
 ** = For a Short Interval at the Beginning of the Tune In Progress Sequence These Levels are Opposite of the Level Shown

(see figure 3-67), the KEYLINE (ground) signal momentarily switches ON transistors 1A3Q6, A3A7, and 1A3A8, producing the T/R LINE (ground) signal that energizes the rf relays. The power amplifier is switched into the Transmit Mode of operation. On Tune Control PWB Assembly 1A4, transistor 1A4Q2 is forwarded biased through the TUNE IN PROGRESS latch (P/O U2 and U5), grounding the TUNE IN PROGRESS signal line at pin 17; this signal is also sent to the receiver-transmitter. When the TUNE IN PROGRESS line is grounded, it switches and locks the receiver-transmitter into the TUNE MODE of operation (transmit with a tune tone output). Also, the RT-1209/URC KEYLINE is grounded for the remainder of the TUNE CYCLE. This locks the power amplifier into the Transmit Mode of operation.

2-122. A positive L_{\min} signal is applied to Servo Amplifier 1A5 through U4, U3, and pin 10, provided it is not inhibited by U4. The operation of U4 is controlled by the CATHODE LEVEL and PLATE LEVEL sense signals from Phase Detector Module 1A10 through differential amplifier 1A4AR1 and TUNE IN PROGRESS latch (P/O U2 and P/O U5). After completion of the steps above, the system is in the Transmit Mode and rf drive signal is present at the cathodes of output tubes 1A14V1 and V2. At the plates, however, the rf signal is still quite low because the tank circuit is not tuned. The PLATE SAMPLE signal is insufficient to be detected by the phase detector circuit for closed loop control of the servo amplifier. Therefore, initially, the servo amplifier has to be forced to drive the variable coil wiper of 1A8A5L1 toward the low inductance end of the coil and also toward the proper tuning position by the L_{\min} (positive) signal.

2-123. As long as the CATHODE LEVEL signal is more than the PLATE LEVEL signal, differential amplifier 1A4AR1-A is unbalanced producing a positive output to cut off U4, generating the L_{\min} FORCE signal. When the L_{\min} FORCE signal tunes the variable inductor 1A8A5L1 close to the proper tuning point, the rf level in the output stage increases, causing the PLATE LEVEL signal to increase. When this signal becomes strong enough it will unbalance differential amplifier 1A4AR 1-A in the opposite direction, producing a negative output. Since the differential amplifier on the CATHODE LEVEL signal side (1A4AR 1-B) is already unbalanced (producing a positive output), 1A4AR1-A will turn on U4 with its negative output, which turns on U3, grounding the L_{\min} FORCE signal and automatically transferring control of the servo amplifier to the phase detector output signals (SERVO IN A and SERVO IN B). Variable coil 1A8A5L1 is now fine tuned for the proper impedance matching by the closed loop servo system. When the power amplifier is near an initial tune condition, the antenna coupler goes through its own automatic tune cycle. During this period, the servo makes minor corrections to the tank circuit tuning. When the power amplifier is tuned, the stopped condition of the servo motor 1A8A3B1 is sensed as a PA READY (ground) signal on pin 3 of Tune Control PWB Assembly 1A4. As soon as the antenna coupler has completed its tune cycle, the CPLR READY signal at pin 20 of 1A4 is grounded. These two grounded signals are applied through individual NAND gates of 1A4U1 to turn OFF a third NAND gate, part of 1A4U2, producing a low logic level input to pins 1 and 2 of 1A4U2, part of the TUNE LATCH circuit. This circuit unlatches all circuits in the power amplifier, the receiver-transmitter, and the antenna coupler from the TUNE operating mode. The system is now ready for normal Receive-Transmit operation.

2-124. The AUTOMATIC TUNE CYCLE is normally completed in less than 20 seconds. If not, the TUNE TIME LATCH circuit (P/O 1A4U6 pin 10) is set to a logic "1" (high) when the timing circuit (1A4Q5 and 1A4Q6) times out. This biases transistor 1A4Q4 ON, applying a ground to the TUNE TIME FAULT signal line (pin 11 of 1A4) which is sent to System Control PWB Assembly 1A3 to inhibit transmit switching. The Transmit Mode cannot be started in the presence of any FAULT condition because the RT FAULT signal line (ground) from the system control circuit inhibits Rx-Tx switching.

2-125. DC POWER SUPPLIES. DETAILED DESCRIPTION

2-126. The following dc voltages are required for operation of the power amplifier: +26.5 Vdc (nominal), +19 Vdc, -14 Vdc, and +1600 Vdc. The circuits and components that derive these voltages are discussed in subsequent paragraphs 2-127 through 2-141.

2-127. +26 VDC (NOMINAL)

2-128. The +26.5 Vdc is applied to the power amplifier directly from the system primary power source (see figures 2-4 and 3-78) through DC PWR input connector 1A14J3. The power source should have a 50

to 60 ampere capacity (i.e., 45 amperes for the power amplifier plus the drain of the antenna coupler, the receiver-transmitter, and any auxiliary equipment). The +26.5 Vdc is applied directly to Receiver-Transmitter RT-1209/URC through connector 1A14J 2, pin L, and Amplifier-Converter AM-6879/GRC-1 93, and to Antenna Coupler CU-2064/GRC-1 93 through ANT CPLR circuit breaker 1A14CB 1 and connector 1A14J1, pin M. Dc power is applied to the system only after the receiver-transmitter ON/MAX VOLUME control is switched to the ON position, which sends ground signals (PA ON/OFF and ANT CPLR ON/OFF) to the power amplifier via the amplifier-converter. The PA ON/OFF signal ground is applied to System Control PWB Assembly 1A3 to enable the DC RELAY (ground) signal which energizes POWER ON relay 1A14K1. The +26.5 VDC DIRECT power is applied through the POWER ON relay as the +26.5 VDC SWITCHED power (see figure 2-5 and 3-78) for distribution within the power amplifier.

2-129. +26.5 VDC SWITCHED POWER (See figures 2-5 and 3-78)

2-130. The +26.5 VDC SWITCHED power is routed to Antenna Coupler CU-2064/GRC-1 93 through connector 1A14J1, pin L. The +26.5 VDC SWITCHED power is applied to Junction Block PWB Assembly 1A14A5-E3 where it is distributed to RF Driver Module Assembly 1A11 through 1A14A5-E7, to ALC Module Assembly 1A7 through 1A14A5-E6, to the V1 Filament Regulator 1A14Q4-C, the V2 Filament Regulator 1A14Q5-C, and the +19V Regulator 1A14Q3-C through 1A14A5-E2, to Interconnection PCB Assembly 1A14A1 through 1A14A5-E5, to FAN/LAMP test switch 1A14S 1-C-1 through 1A14A5-E4, and to the 550 NORMALLY OPEN THERMOSTAT switch 1A14A3-S 1-1 and the High Voltage Module Assembly 1A13 through 1A14A5-E1. The +26.5 Vdc is also applied across inductor 1A14L1 to the center tap (pin 2) of step-up transformer 1A14T 1. The primary winding of 1A14T 1 is connected to transistor 1A14A3Q1-C (from 1A14T 1-3) and to transistor 1A14A3Q2-C (from 1A14T1-1) in the Dc-to-Dc Converter Module. The secondary winding of 1A14T 1 is applied to High Voltage Module 1A13 through connector 1A14J13-H (from 1A14T1-5) and 1A14J13-J (from 1A14T1-4).

2-131. +19 VDC SERIES REGULATOR (See figures 2-9,3-66, and 3-78)

2-132. The +19 Vdc voltage regulator consists of series pass transistor 1A14Q3, driver 1A2Q4, sensing amplifier 1A2Q5, and voltage reference zener diodes 1A2VR2 and 1A2VR3. The base voltage of sensing amplifier 1A2Q5 is held constant by zener diode 1A2VR2 (at +10V). Output voltage variations are sensed across emitter resistor 1A2R18 through zener diode 1A2VR3 (- 10V drop). When the output voltage increases due to input voltage or load change, conduction through driver 1A2Q4 and series pass transistor 1A14Q3 decreases, reducing the voltage at the emitter of 1A14Q3. If the output voltage decreases, the circuit acts just the opposite, with increased conduction through 1A2Q4 and 1A14Q3, increasing the emitter voltage of 1A14Q3. Therefore, the output voltage is maintained constant.

2-133. If there is a short circuit on the +19 Vdc line, the base and emitter voltages of sensing amplifier 1A2Q5 simultaneously go to zero, cutting OFF both 1A2Q4 and 1A14Q3. Resistor 1A2R 6 bypasses the 1A14Q3 transistor in order to restart the regulator circuit after the short circuit condition disappears or has been corrected. Without resistor 1A2R16, all of the transistors would be cut off and could not restart because there would be no bias voltage present. With resistor 1A2R16 in the circuit, transistor 1A2Q5 is biased through resistor 1A2R17 to start to conduct as soon as the regulator output is no longer shorted (normal load). The value of 1A2R16 is large enough so as not to affect the normal operation of the regulator circuit. Capacitor 1A2C3 is used to filter the regulator output. Regulation is maintained within about 0.2 Vdc of the nominal 19.5 Vdc output with the actual absolute voltage value depending on the tolerances of the zener diodes. There is no voltage adjustment provision because the absolute output voltage is not critical.

2-134. -14 VDC SWITCHING SUPPLY (See figures 2-10,3-65, and 3-78)

2-135. The -14 Vdc switching supply consist of square wave generator 1A1U 1 (approximately 20 kHz), voltage amplifier 1A1Q1, and current amplifiers 1A1Q2 and 1A1Q3, coupling capacitor 1A1C4, rectifiers 1A1CR2 and CR3, and filter capacitor 1A1C5. The -14 Vdc output is not critical; therefore, it is not regulated.

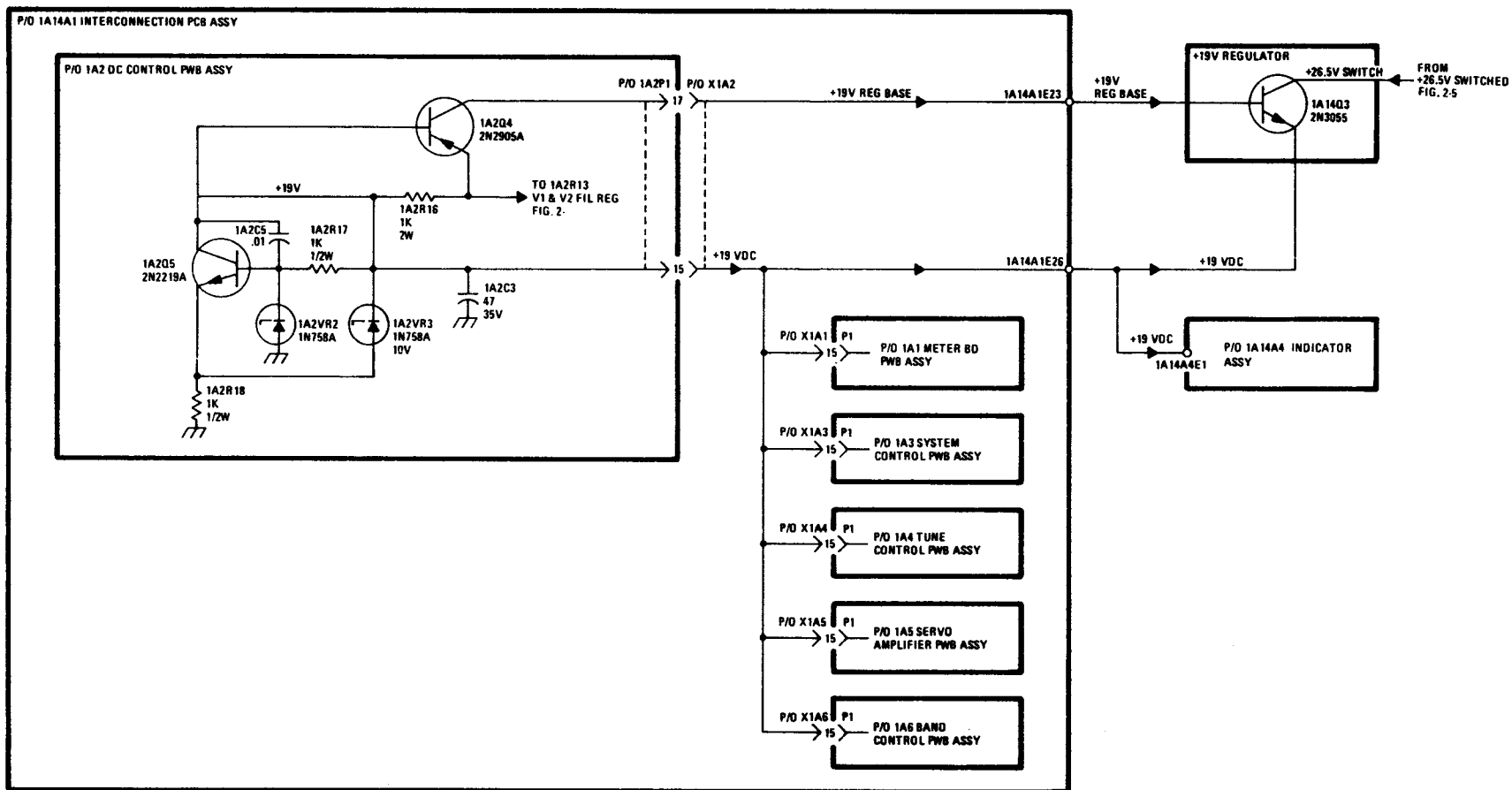


Figure 2-9. +19 Vdc Distribution

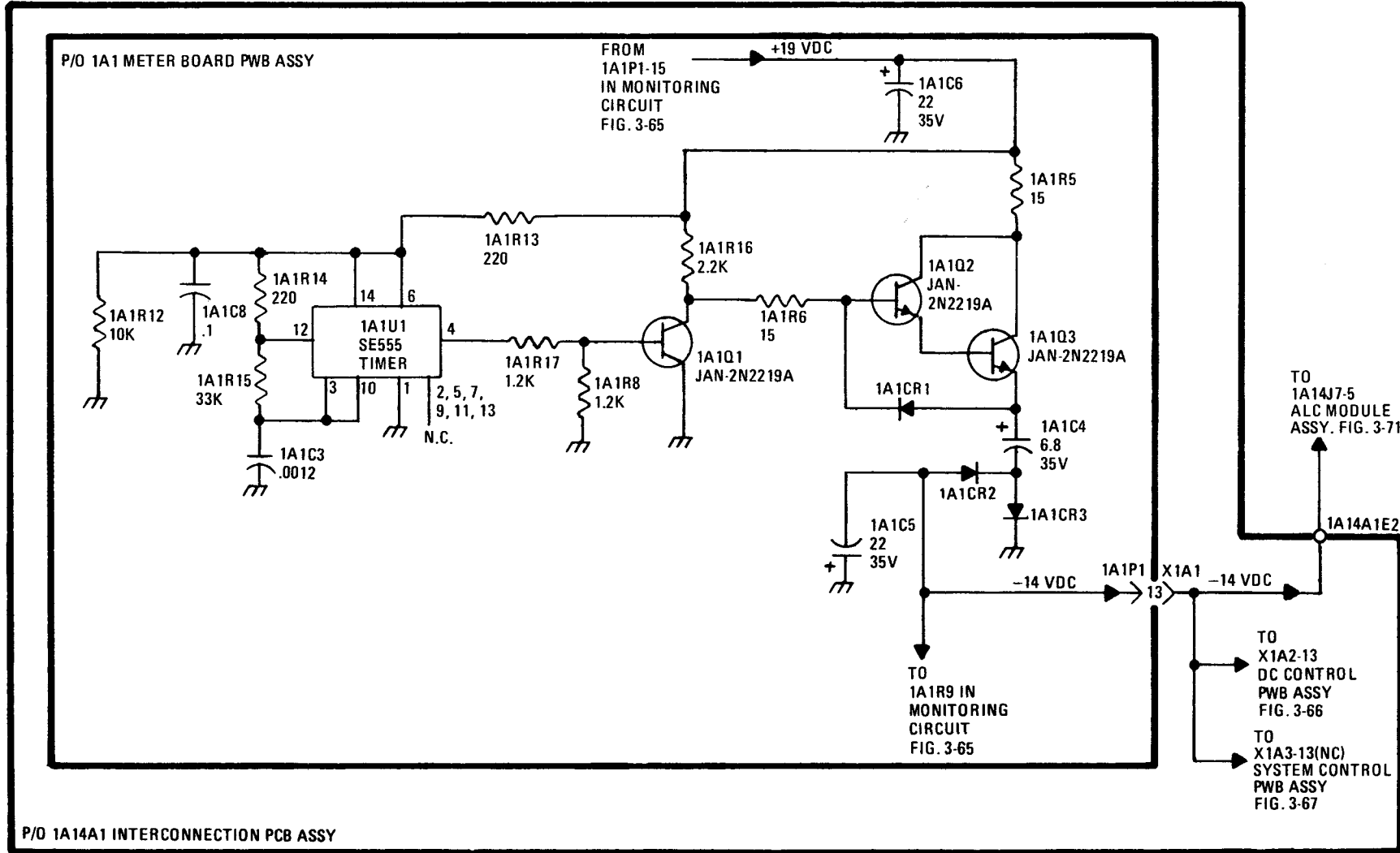


Figure 2-10. -14Vdc Distribution

2-136. When the +19Vdc is applied to the -14Vdc power supply circuit, square wave generator 1A1U1 generates a 20 kHz square wave (pin 4 of 1A1U1) which is voltage amplified by transistor 1A1Q1 and current amplified by transistors 1A1Q2 and Q3. This amplified square wave is coupled through capacitor 1A1C4 to rectifiers 1A1CR2 and CR3. During the positive half cycle, diode 1A1CR3 provides a short circuit to ground. During the negative half cycle, capacitor 1A1C5 is charged through diode 1A1CR2 to approximately -14 Vdc. Transistor 1A1Q1 and diode 1A1CR1 provide a discharge path for coupling capacitor 1A1C4.

2-137. +1600 VDC HIGH VOLTAGE POWER SUPPLY (See figures 2-11, 3-78, 3-66, and 3-77)

2-138. The +1600 Vdc High Voltage Power Supply consists of three main functional circuit groups:

- a. The De-to-De Converter 1A14A3 (see figures 2-11, 3-78 and 3-77) is a power oscillator which consists of transistors 1A14A3Q1 and Q2, two ferrite beads labeled 1A14A3T 1, and base feedback transformer 1A13T1 (part of HV Module Assembly 1A13). When the HV ON signal (ground) from DC Control PWB Assembly 1A2 energizes the HV START relay 1A13A1K1, transistors 1A14A3Q1 and Q2 oscillate at approximately 2 kHz. Transformers 1A14T1 and 1 A13A1T1 are phased to sustain oscillation, and resistors 1A14A3R1 and R2 are used to limit the base current of transistors 1A14A3Q1 and Q2.
- b. The high voltage circuit consists of the secondary winding of step-up transformer 1A14T1, diode bridges 1A13CR1 and CR2, filter capacitor 1A13C1, and bleeder resistors 1A13A1R1 through R7. The stepped-up voltage from 1A14T1 is rectified by diode bridges 1A13CR 1 and CR2 and filtered by capacitor 1A13C1. Bleeder resistors 1A13A1R1 through R7 across the high voltage output provide a quick discharge of the 2.0 u F1A13C1 capacitor when the PA is switched off and also derive the 1600V SENSE signal that is sent to the metering circuit and used to actuate indicator light 1A13A1DS1.
- c. Control Circuit - The active elements of the dc-to-dc converter control circuits operate in the two-state switching mode. They are either ON or OFF. Table 2-6 shows the operating states of the active elements under three operating conditions:
 - (1) When primary power is switched ON.
 - (2) During normal operation after the 60 second warm-up time delay and with the transmitter keyed.
 - (3) During a FAULT.

TABLE 2-6. HV CONTROL CIRCUITS

ACTIVE CONTROL ELEMENT	OPERATING CONDITION		
	A PRIMARY POWER SWITCHED ON	B NORMAL OPERATION	C PA FAULT
1A13A1K1	0	1	0
1A2Q7	0	0	1
1A2Q8	0	1	0
1A13A1Q1	0	1*	0
1A2U1-3	0	1	1

LEGEND: 1 = ON (Transistor saturated or relay energized)
 0 = OFF (Transistor cutoff or relay de-energized)
 * = Pulse output to start power oscillator transistor 1A13A1Q1, then open.

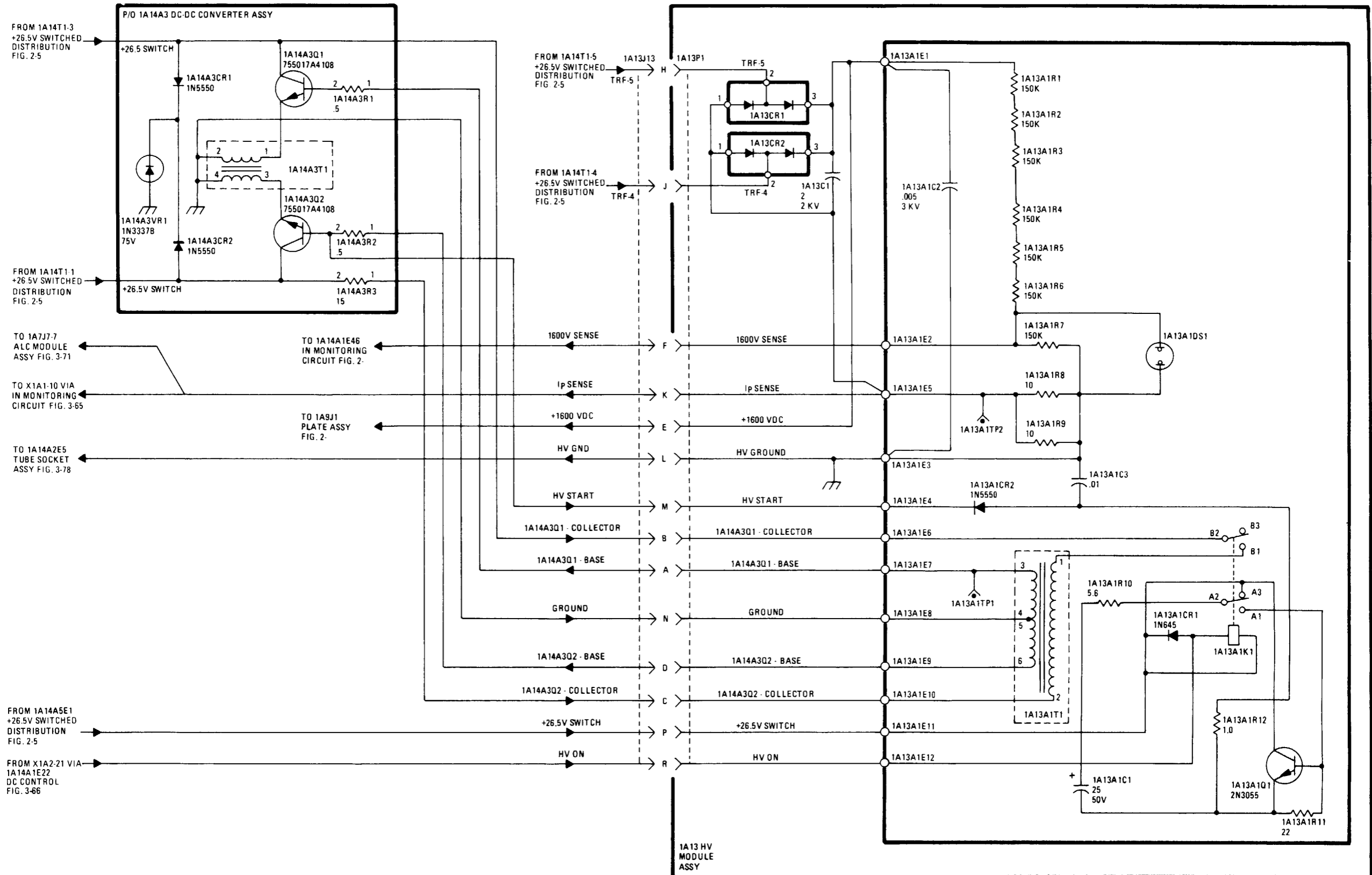


Figure 2-11. +1600V Generation and Distribution

- d. Starting from condition A, the sequence of events for starting the +1600 Vdc High Voltage Power Supply, (assuming there is no fault) areas follows:
- (1) Switching on the +26.5 Vdc power starts the time delay circuit cycle through its preset 60-second delay period and applies operating voltages (except the +1600 Vdc) to all circuits in the power amplifier.
 - (2) After 60 seconds, the timing circuit applies a high to pin 6 of NAND gate 1A2U1, enabling the gate in preparation for the initiation of the Automatic Tune Cycle.
 - (3) When the power amplifier is keyed, the T/R LINE signal input to NAND gate 1A2U1, pins 8 and 9, is grounded. This produces a high at pin 5 of NAND gate 1A2U1 which, when NANDed with the high from the time delay circuit, produces a low output which is inverted and applied to the base of transistor 1A2Q8, turning it ON. This applies the HV ON signal (ground) to HV ON relay 1A13A1K1, energizing it.
 - (4) The 1A14A3Q1 base-to-collector feedback path is completed through contacts B1 and B2 of relay 1A13A1K1.
 - (5) When capacitor 1A13A1C1 discharges through 1A13A1K1, contacts A1 and A2, and resistor 1A13A1R10, transistor 1A13A1Q1 momentarily turns ON, providing a HV START pulse (+26.5 Vdc) to the base of transistor 1A14A3Q1 through transistor 1A13A1Q1, resistor 1A13A1R12, and diode 1A13A1CR2.
 - (6) The dc-to-dc converter transistors (1A14A3Q1 and Q2) go into self-sustained oscillation at 2 kHz.
 - (7) The +1600 Vdc appears across bleeder resistors 1A13A1R1 through R7, developing the +1600V SENSE signal which turns HV ON indicator lamp 1A13A1DS1 (Amber).

Note

After completion of steps d.(1) through d.(7), the active elements of the control circuit are in condition B (see table 2-5). An overload condition is sensed by the magnitude of the voltage drop across the 10 ohm resistors (1A13A1R8 and 1A13A1R9) between the negative (cathode) side of rectifier bridge 1A13CR2 and ground. This voltage (Ip SENSE) is applied to amplifier and latch 1A2AR1, pin 3, in the DC Control PWB Assembly 1A2. Resistor 1A2R20 is adjusted to approximately 3.5V as a reference so that when the current drain from the +1600V power supply exceeds 700 mA, amplifier 1A2AR1 turns ON and latches. The sequence of events after an overload condition has been sensed is:

- (8) Transistor 1A2Q7 is turned ON by amplifier 1A2AR1, shorting the base of transistor 1A2Q8 to ground.
- (9) Transistor 1A2Q8 turns OFF, de-energizing HV ON Relay 1A13A1K1.
- (10) When relay 1A13A1K1 de-energizes, it opens the base-to-collector feedback path of transistor 1A14A3Q1 and stops operation of the dc-to-dc converter.
- (11) The +1600V across bleeder resistors 1A13A1R1 through R7 drains off, turning OFF the 1A13A1DS1 HV ON indicator light.
- (12) When transistor 1A2Q7 is turned ON, it also grounds the PA FAULT line which is sensed by the transmit-receive switching inhibit circuit in System Control PWB Assembly 1A3 and transmit operation is inhibited.

Note

After completion of steps d.(8) through d.(12), the active elements of the control circuit are in condition C (see table 2-5). The dc-to-dc converter can be restarted by changing any of the frequency select switches on the receiver-transmitter front panel (except the 100 Hz switch) or by turning off the power momentarily. This generates a TUNE START pulse (30 millisecond ground) which resets overload latch 1A2AR1 at pin 4. When the power amplifier is again keyed, the dc-to-dc converter will restart. If the overload is still present, the overload latch 1A2AR1 will latch again and converter oscillation will stop.

2-139. FILAMENT REGULATORS (See figures 3-78 and 3-66)

2-140. The filaments of output amplifier tubes 1A14V1 and 1A14V2 are supplied with a regulated filament voltage of about +25.5 Vdc. When the primary supply voltage (+26.5 Vdc nominal) drops below +25 Vdc, the filament voltage to tubes 1A14V1 and V2 also drops, with a 1 volt difference. The filament regulator for 1A14V1 consists of voltage regulator 1A2VR5, transistor 1A2Q2 and regulator transistor 1A14A6Q4. The filament regulator for 1A14V2 consists of voltage regulator 1A2VR6, transistor 1A2Q1, and regulator transistor 1A14A6Q5. The series transistors 1A14A6Q4 and Q5 are fastened to the heat sink (on chassis 1A14) for cooling.

2-141. FAN INVERTER (See figures 3-76 and 3-78)

2-142. Static Power Inverter Assembly 1A12 convert the +26.5 Vdc (Nominal) voltage to a 400 Hz square wave, about 20 volts in amplitude. The inverter assembly consists of three main circuit groups.

2. The next two circuit groups are identical amplifiers. One amplifier consists of transistors 1A2Q2, Q3, Q4, Q5, Q6, Q12, and Q13 and diodes 1A2CR1 and CR2. The other amplifier consists of transistors 1A2Q7, Q8, Q9, Q10, Q11, Q14, and Q15, and diodes 1A2CR3 and CR4. When the two amplifiers receive a pulse from the oscillator, one amplifier turns ON while the other one stays turned OFF. On the next pulse from the oscillator, both amplifiers change state (i.e., the amplifier that was ON now turns OFF while the amplifier that was OFF now turns ON). The output of either amplifier, as seen at 1A12TP2 or 1A12TP3, is a square wave whose amplitude is 5 volts less than the line voltage applied to the inverter.

2-143. AUXILIARY CIRCUITS (See figure 3-78)

2-144. The filtering and cooling circuits are described in subsequent paragraphs 2-144 through 2-147.

2-145. FILTERING

2-146. All DC lines entering the power amplifier enclosure are RFI-filtered.

2-147. COOLING

2-148. The majority of power amplifier components and assemblies are conduction and/or convection cooled. Heat is transferred by conduction from the main heat sources (i. e., tubes 1A14V1 and V2, Driver Module 1A11, and Dc-to-Dc Converter 1A14A2) to the heat sink. The heat sink is cooled by forced air blowing over the fins located outside of the sealed power amplifier enclosure. High speed air flow past the fins of the heat sink is provided by axial-flow 400 Hz blower 1A14B1. The blower is powered by a 400 Hz inverter (1A12). The inverter is powered by +26.5 Vdc that is switched ON by the normally open contacts of thermostat switch 1A14A3S2 when the power amplifier temperature reaches 55°C.

CHAPTER 3 MAINTENANCE INSTRUCTIONS

SECTION I INTRODUCTION

NOTE

Maintenance Kit OA-9163/GRC-193A is available as a Maintenance Test Bed.

3-1. INTRODUCTION

3-2. This chapter describes the intermediate maintenance effort applicable to the power amplifier. Included herein are maintenance scheduling, tools and equipment, safety precautions, disassembly and assembly, inspection, and various troubleshooting, alignment, and adjustment data for the power amplifier. Tabular data, illustrations, and references to the theoretical explanations of chapter 2 are included to aid the technician in a complete understanding of the procedures and equipment.

3-3. This chapter is arranged such that the troubleshooting and field maintenance sections are integrated with one another. The maintenance procedures contained in this chapter use input and output signals, switching and control, and power sources provided by various components of Radio Set AN/GRC-193, of which Power Amplifier AM-6545/GRC-193 is a component. If it is desired to test the power amplifier not using Radio Set AN/GRC-193 as a test standard, the inputs and outputs can be duplicated using laboratory equipment. Refer to figure 3-1 for specific details.

3-4. SCHEDULED MAINTENANCE ACTION INDEX

3-5. Table 3-1 lists procedures, applicable paragraph references, and the frequencies of performance for all maintenance instructions (inspection, repair, adjustments, etc.) contained in this chapter.

SECTION II

TOOLS AND EQUIPMENT

3-6. TOOLS, CLEANING SOLVENTS, LUBRICANTS, AND OTHER CONSUMABLE SUPPLIES

3-7. Tables 3-2 and 3-5 list the tools, cleaning solvents, lubricants, and other consumable supplies, respectively, needed for maintenance of the power amplifier.

3-8. MAINTENANCE RECORDS AND REPORT FORMS

3-9. See paragraph 0-3 for maintenance, records and reports.

3-10. SERVICE REQUIREMENTS PRIOR TO, DURING AND AFTER OPERATION

3-11. To ensure that the equipment is ready for operation at all times, it must be inspected systematically before operation, during operation, and after operation, so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance procedures will be performed before operation. Defects discovered during operation of the unit will be noted for future correction, to be made as soon as operation has ceased. Stop operation immediately if a deficiency is

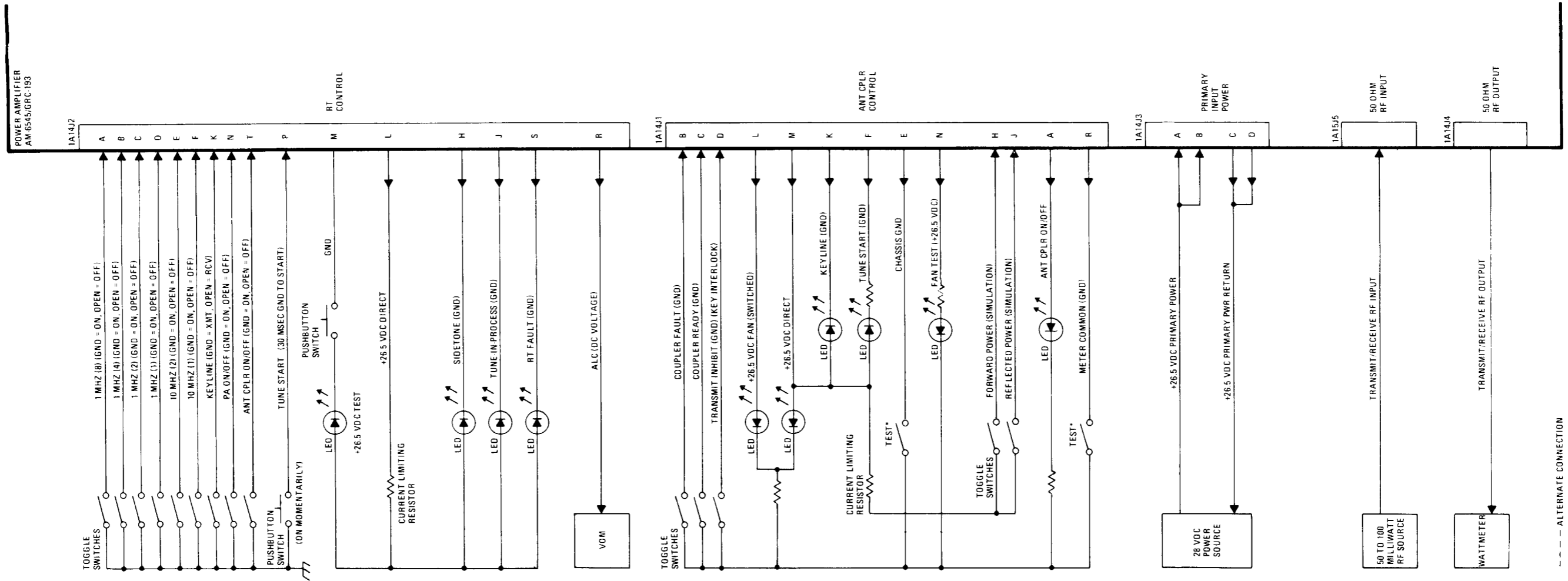


Figure 3-1. Special Setup For Testing Power Amplifier

TABLE 3-1. POWER AMPLIFIER AM-6545/GRC-193 MAINTENANCE INSTRUCTION INDEX

PERIODICITY	MAINTENANCE INSTRUCTION	REFERENCE
Daily, before operation	External inspection and cleaning	Para. 3-14 and 3-46
As required	Paint touchup	Para. 3-14
Only when unit is opened for troubleshooting	Internal inspection and cleaning	Para 3-46 through 3-84 and table 3-6
Only when unit requires internal troubleshooting or repair	Disassembly	Para. 3-15 through 3-45
Only when unit requires internal troubleshooting or repair	Refurbishment or repair of mechanical parts	Para. 3-52 through 3-84
Daily, before use	System test (operational)	Perform system test given in TM 11-5820-924-12, Para. 5-3.
Only when a malfunction is encountered	Trouble analysis	Para. 3-90 through 3-103
Following repair or when a malfunction indicates the need	Adjustment and alignment	Para. 3-108 through 3-121

TABLE 3-2. POWER AMPLIFIER AM-6545/GRC-193 MAINTENANCE TOOLS REQUIRED BUT NOT SUPPLIED

DESCRIPTION	USE
Extraction tool CET - C6B	Cable removal (Para. 3-32, 3-41)
25 watt soldering iron	General maintenance (Para. 3-138)
Flat blade screwdriver, 3/16 inch blade x 8 inches long; Vaco No. A316-8	Power amplifier disassembly and reassembly (Para. 3-24, 3-25, 3-26, 3-27, 3-28, 3-29, 3-30, 3-45)
Phillips head screwdriver, No. 1, 3-1/2 inches long; Xcelite No. X101	Power amplifier disassembly and reassembly (Para. 3-31, 3-32, 3-33, 3-35, 3-36, 3-37, 3-38, 3-30, 3-40, 3-41, 3-42, 3-43, 3-44, 3-45, 3-63, 3-77, 3-80, 3-130, 3-131, 3-133, 3-134, 3-141, 3-142, 3-144, 3-145)
Nut driver 11/32 inch	Power amplifier disassembly and reassembly (Para. 3-17)
Nut driver, 11/32 inch, deepwell	Power amplifier disassembly and reassembly (Para. 3-1321)
Nut driver, No. 6	Power amplifier disassembly and reassembly (Para. 3-31, 3-32)

TABLE 3-2. POWER AMPLIFIER AM6545/GRC-193
 MAINTENANCE TOOLS REQUIRED BUT NOT SUPPLIED (CONTINUED)

DESCRIPTION	USE
4 In. adjustable wrench	Power amplifier disassembly and reassembly (Para. 3-31, 3-33, 3-39, 3-79, 3-144)

TABLE 3-3. POWER AMPLIFIER AM-6545/GRC-193
 MAINTENANCE-CLEANING SOLVENTS REQUIRED BUT NOT SUPPLIED

DESCRIPTION AND SPECIFICATION	USE
Trichlorethylene, Fed. Spec. O-T-634 or Methylethylketone (MEK), Fed. Spec. TT-M-261 Technical Isopropyl Alcohol, Spec. MIL-I-10428	Cleaning metal parts (Para. 3-73) Cleaning metal parts (Para. 3-73) Cleaning case contours (Para. 3-14, 3-48, 3-52)

TABLE 3-4. POWER AMPLIFIER AM-6545/GRC-193
 MAINTENANCE-LUBRICANTS REQUIRED BUT NOT SUPPLIED

DESCRIPTION AND SPECIFICATION	USE
Lubriplate Grease; RF Spec. No. 755017A8241	Used to lubricate the gears of the RF Tuner Assembly gears (Para. 3-73)

TABLE 3-5. POWER AMPLIFIER AM-6545/GRC-193
 MAINTENANCE-OTHER CONSUMABLE SUPPLIES REQUIRED BUT NOT SUPPLIED

DESCRIPTION AND SPECIFICATION	USE
Solder, Type AG1-5: Fed. Spec. QQ-S-571	General repair usage
Heat sink compound: RF Spec. No. 755017A4412	During reassembly of tube secret assembly 1A14A2, DC-to-DC converter 1A14A3, Static Inverter Assy 1A12 (Para. 3-37, 3-133)

noted during operation which would damage the equipment if operating were continued. After-operation-services shall be performed by the operator after every operating period. After-operation-services will be performed at intervals based on the normal operations of the equipment. Reduce interval to compensate for abnormal conditions. Defects or unsatisfactory operating characteristics beyond the scope of the operator to correct must be reported at the earliest opportunity to organizational maintenance (see Maintenance Records and Report Forms, paragraph 3-8).

3-12. SAFETY PRECAUTIONS

3-13. Safety precautions for protection of personnel and equipment are included throughout this manual whenever a procedure or condition is described that requires special care. In most instances, the power amplifier has either been de-energized or removed from the system in which it has been operating before maintenance is performed. However, the following WARNINGS and CAUTIONS apply in the event that circumstances warrant them.

WARNING

DANGER HIGH VOLTAGE

Dangerously high voltages (+1600 Vdc) are present on the plates of power tubes 1A14V1 and 1A14V2 (Y-621B), Tank Circuit Module 1A8, Plate Assembly 1A9, and High Voltage Module 1A13. Do not touch any part of these components when the equipment is energized.

WARNING

Make sure the power is off before performing any cleaning or inspection procedures.

WARNING

Power Amplifier Tubes 1A14V1 and 1A14V2 (Y-621B) contain BERYLLIUM OXIDE (BeO) CERAMICS. The dust or fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC and breathing them can result in serious personal injury or DEATH.

Power tubes 1A14V1 and 1A14V2 (Y-621B) contain Beryllium Oxide Ceramics which are used to conduct heat from the tubes (directly from the exposed anodes). Normal use of electron tubes having Beryllium Oxide Ceramics is safe. However, never alter, disassemble, grind, lap, fire, chemically clean, or perform any other operation on any ceramic parts of the power tubes which could possibly generate dust or fumes. Provisions for disposal of the power tubes will be made separately.

CAUTION

Be sure that power amplifier air inlets (front of unit) and exhaust ports (rear of unit) are not obstructed before operating equipment.

CAUTION

Align all power amplifier cable connectors before mating and fastening.

3-14. POWER AMPLIFIER INSPECTION, CLEANING AND TOUCHUP - EXTERNAL

WARNING

Make sure power is off before performing any cleaning or inspection procedures.

1. Inspect the unit externally for cleanliness and for signs of damage to connectors, painted surfaces, indicator lamps, controls, cables, meter, and attaching hardware. Check that all connections are tight.
2. Use a lint-free cloth dampened with technical isopropyl alcohol (Federal Specification MIL-I-10428) to wipe and clean the power amplifier external surfaces. Use a small, non-metallic brush if required.
3. If scratches or extreme fading are noted on the power amplifier external surface, repaint affected areas as follows:
 - a. Clean and prime affected areas with Primer (in accordance with Federal Specification TT-E-485).
 - b. Touch up green areas with Marine Corps Green, Color No. 23 (in accordance with Federal Specification TT-E-485).
 - c. Touch up yellow-nomenclated areas with Semigloss Yellow, Color No. 23538 (in accordance with Federal Standard 595).

3-15. POWER AMPLIFIER ACCESS DISASSEMBLY INSTRUCTIONS

3-16. The following procedures describe the disassembly necessary to reach and service the power amplifier modules, printed circuit boards, and components. This procedure is arranged so that any assembly can be removed individually for maintenance, in a minimum amount of time. Refer to figure 3-2 for locations of parts referred to in the procedures.

WARNING

Make sure power is off before performing these disassembly procedures.

3-17. REMOVAL OF POWER AMPLIFIER COVER ASSEMBLY

1. Refer to Detail A of figure 3-2. Use a 1/4-inch nut driver to loosen the 14 captive cover retaining screws that secure the power amplifier cover to the case assembly.
2. Carefully lift the cover from the case assembly so as not to damage the sealing gasket attached to the cover.

3-18. REMOVAL OF METER BOARD PWB ASSEMBLY 1A1

1. Refer to Detail B of figure 3-2. Pull upward on the inboard portion of the PWB handle ejectors on each side of Meter Board PWB Assembly 1A1 to get the PWB loose from the socket on the card cage assembly.
2. Grasp the handle ejectors with both hands and lift straight up to remove the PWB.

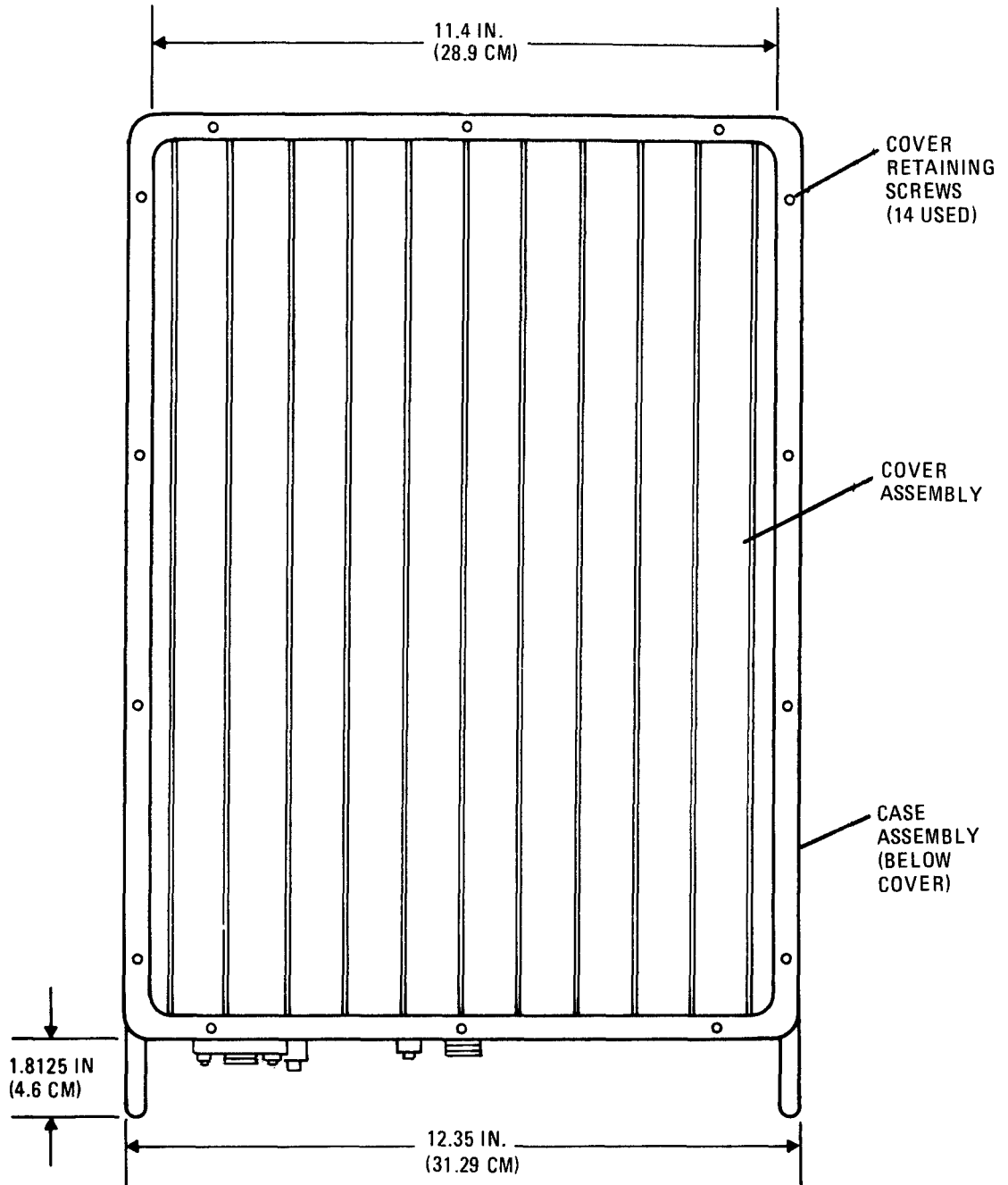
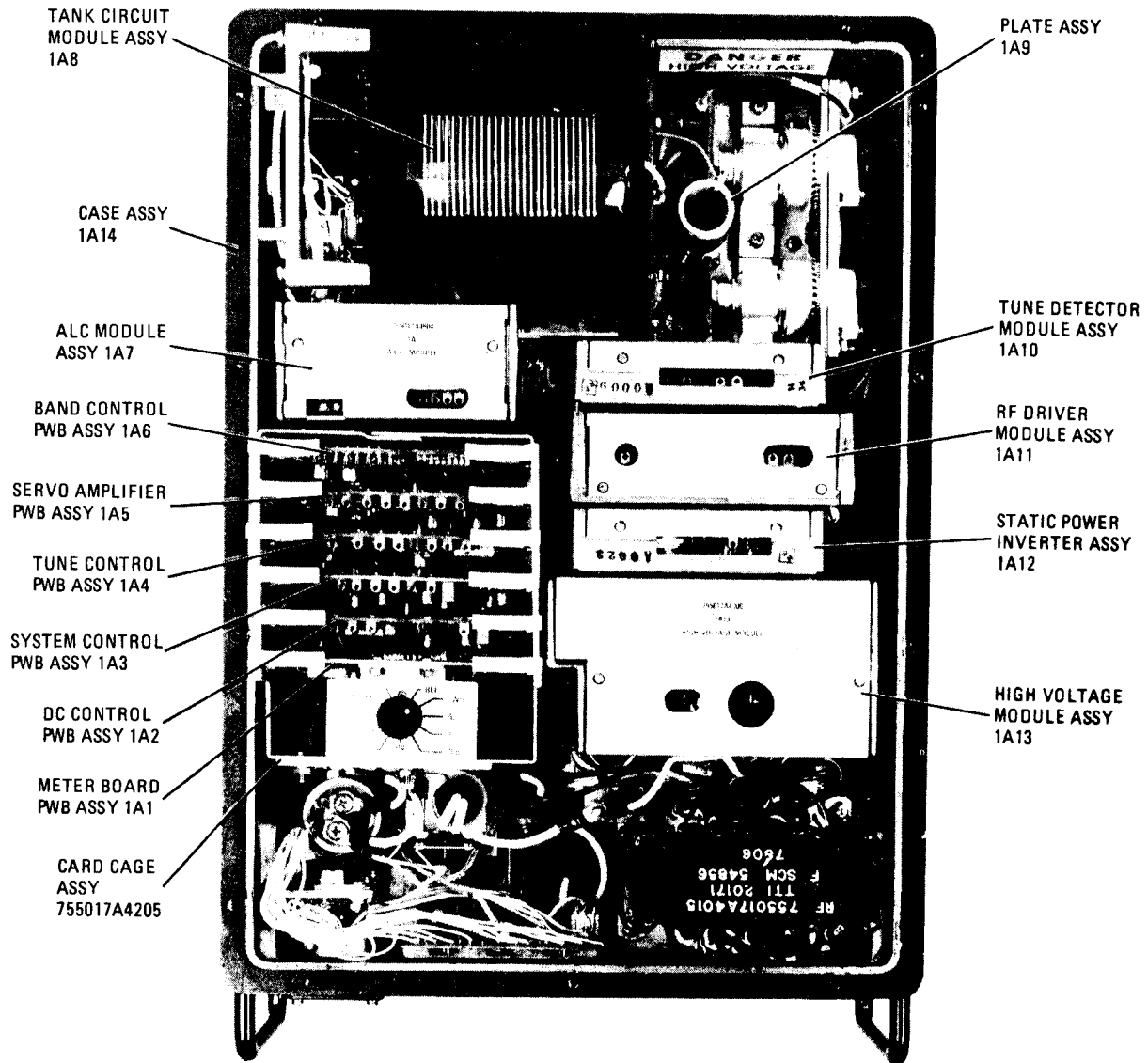
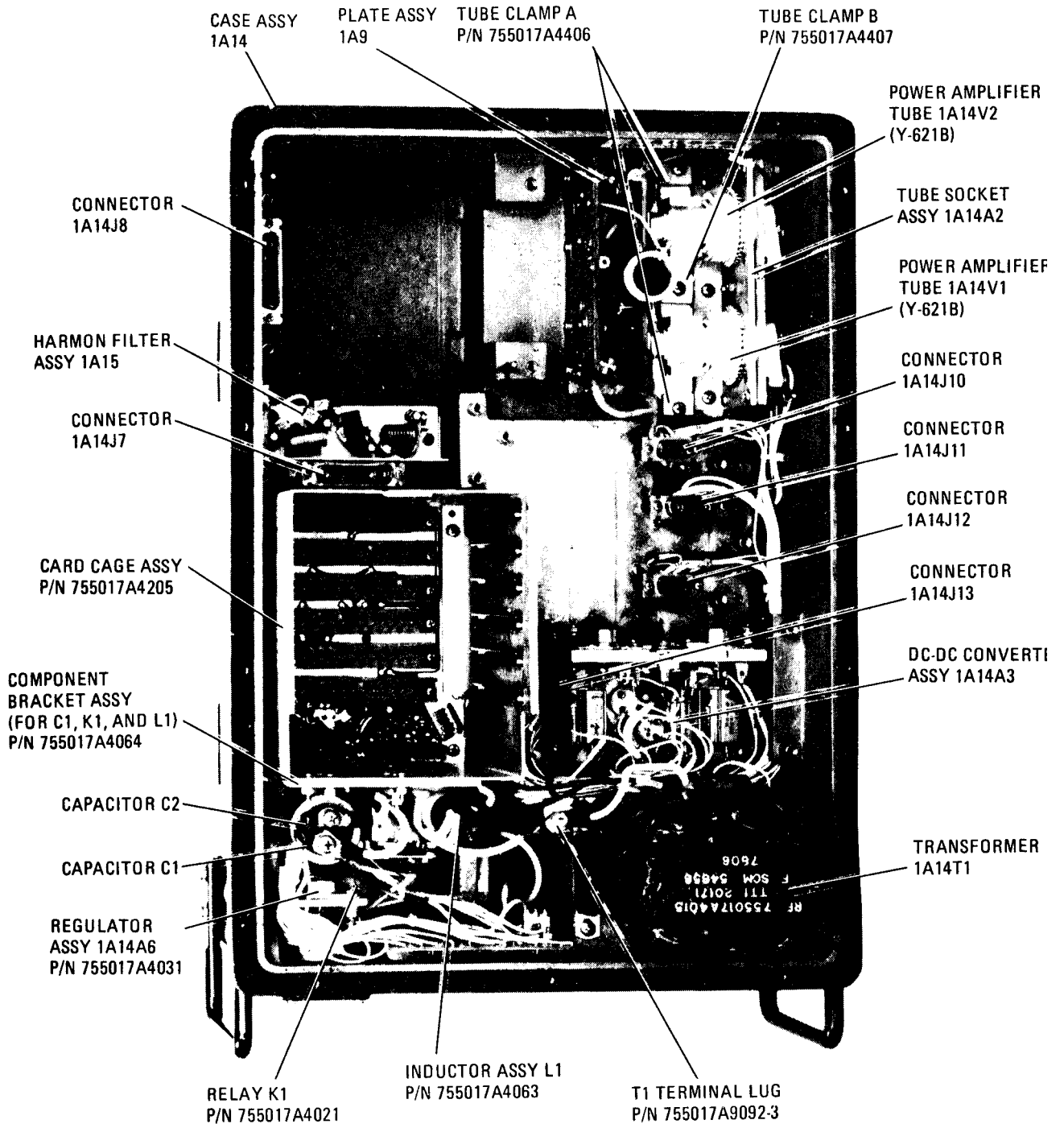


Figure 3-2. Power Amplifier AM-6545/GRC-193 Disassembly/Reassembly Diagram (Sheet 1 of 4)



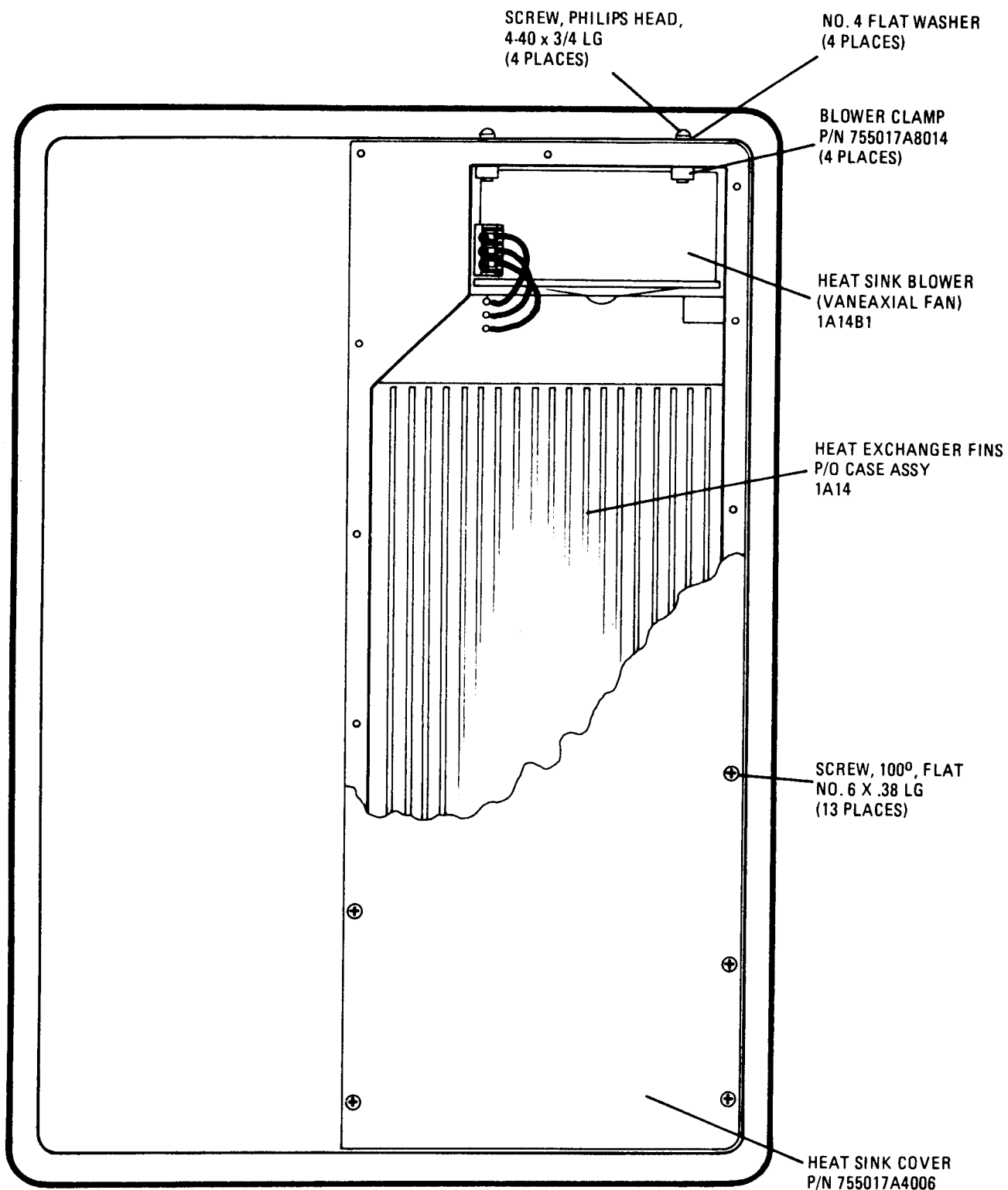
Detail B

Figure 3-2. Power Amplifier AM-6545/GRC-193 Disassembly/Reassembly Diagram (Sheet 2 of 4)



Detail C

Figure 3-2. Power Amplifier AM-6545/GRC-193 Disassembly/Reassembly Diagram (Sheet 3 of 4)



Detail D

Figure 3-2. Power Amplifier AM-6545/GRC-193 Disassembly/Reassembly Diagram (Sheet 4 of 4)

3-19. REMOVAL OF DC CONTROL PWB ASSEMBLY 1A2

1. Refer to Detail B of figure 3-2, Pull upward on the inboard portion of the PWB handle ejectors on each side of DC Control PWB Assembly 1A2 to get the PWB loose from the socket on the card cage assembly.
2. Grasp the handle ejectors with both hands and lift straight up to remove the PWB.

3-20. REMOVAL OF SYSTEM CONTROL PWB ASSEMBLY 1A3

1. Refer to Detail B of figure 3-2. Pull upward on the inboard portion of the handle ejectors on each side of System Control PWB Assembly 1A3 to get the PWB loose from the socket on the card cage assembly.
2. Grasp the handle ejectors with both hands and lift straight up to remove the PWB.

3-21. REMOVAL OF TUNE CONTROL PWB ASSEMBLY 1A4

1. Refer to Detail B of figure 3-2. Pull upward on the inboard portion of the handle ejectors on each side of Tune Control PWB Assembly 1A4 to get the PWB loose from the socket on the card cage assembly.
2. Grasp the handle ejectors with both hands and lift straight up to remove the PWB.

3-22. REMOVAL OF SERVO AMPLIFIER PWB ASSEMBLY 1A5

1. Refer to Detail B of figure 3-2. Pull upward on the inboard portion of the handle ejectors on each side of Servo Amplifier PWB Assembly 1A5 to get the PWB loose from the socket on the card cage assembly.
Grasp the handle ejectors with both hands and lift straight up to remove the PWB.

3-23. REMOVAL OF BAND CONTROL PWB ASSEMBLY 1A6

1. Refer to Detail B of figure 3-2. Pull upward on the inboard portion of the handle ejectors on each side of Band Control PWB Assembly 1A6 to get the PWB loose from the socket on the card cage assembly.
2. Grasp the handle ejectors with both hands and lift straight up to remove the PWB.

3-24. REMOVAL OF ALC MODULE ASSEMBLY 1A7

1. Refer to Detail B of figure 3-2. Use an 8-inch flat blade screwdriver to loosen the four captive screws that secure ALC Module Assembly 1A7 to Case Assembly 1A14.
2. Remove the ALC module by rocking it gently back and forth, to loosen it from jack 1A14J7 mounted on the Case Assembly, while pulling it straight up.

3-25. REMOVAL OF TANK CIRCUIT MODULE ASSEMBLY 1A8

1. Refer to Detail B of figure 3-2. Disconnect bayonet connector 1A8P2 on the tank circuit assembly from jack 1A9J2 on Plate Assembly 1A9.
2. Use an 8-inch flat blade screwdriver to loosen the four captive screws that secure the tank circuit module to the case assembly.
3. Grasp the tank circuit module assembly by the frame surrounding the tuning coil and remove it by gently rocking the assembly back and forth while lifting straight up.

3-26. REMOVAL OF PLATE ASSEMBLY 1A9

1. Refer to Detail B of figure 3-2.

WARNING

Power amplifier tubes 1A14V1 and 1A14V2 (Y-621B) contain BERYLLIUM OXIDE (BeO) CERAMICS. The dust or fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC and breathing them can result in serious personal injury or DEATH.

2. Disconnect bayonet connector 1A8P2, on Tank Circuit Module Assembly 1A8, from jack 1A9J2 on Plate Assembly 1A9 if it has not already been disconnected. Disconnect bayonet connector 1A13P1 on High Voltage Module Assembly 1A13 from jack 1A9J1 on Plate Assembly 1A9. Disconnect bayonet connector 1A10P3 on Tune Detector Module Assembly 1A10 from jack 1A9J3 on Plate Assembly 1A9.
3. Use an 8-inch flat blade screwdriver to loosen the two captive screws that secure the plate assembly to the case assembly. Care should be taken so as not to damage any components mounted on the plate assembly while loosening the retaining captive screws.
4. When the captive screws are loosened, the spring contacts that apply pressure to exposed anodes of power amplifier tubes 1A14V1 and V2 will cause the plate assembly to move away from the tubes. Pick up the plate assembly and remove it from the case assembly.

3-27. REMOVAL OF TUNE DETECTOR MODULE ASSEMBLY 1A10

1. Refer to Detail B of figure 3-2. Use an 8-inch flat blade screwdriver to loosen the two captive retaining screws that secure the tune detector module to the case assembly.
2. Grasp the tune detector module firmly and remove it from the case assembly by rocking it gently back and forth while lifting straight up.

3-28. REMOVAL OF RF DRIVER MODULE ASSEMBLY 1A11

1. Refer to Detail B of figure 3-2. Use an 8-inch flat blade screwdriver to loosen the three captive retaining screws that secure the rf driver module to the case assembly.
2. Grasp the rf driver module firmly and remove it from the case assembly by rocking it gently back and forth while lifting straight up.

3-29. REMOVAL OF STATIC POWER INVERTER ASSEMBLY 1A12

1. Refer to Detail B of figure 3-2. Use an 8-inch flat blade screwdriver to loosen the two captive retaining screws that secure the static power inverter assembly to the case assembly.
2. Grasp the static power inverter assembly firmly and remove it from the case assembly by rocking it gently back and forth while lifting straight up.

3-30. REMOVAL OF HIGH VOLTAGE MODULE ASSEMBLY 1A13

1. Refer to Detail B of figure 3-2. Use an 8-inch flat blade screwdriver to loosen the three captive retaining screws that secure the high voltage module assembly to the case assembly.
2. Grasp the high voltage module assembly firmly and remove it from the case assembly by rocking it gently back and forth while lifting straight up.

3-31. REMOVAL OF CARD CAGE ASSEMBLY P/N 755017A4205

1. Refer to Detail C of figure 3-2. Use a No. 1 Phillips head screwdriver and a 4-inch adjustable wrench or a No. 6 nut driver to loosen the No. 6-32 x .5 screw, No. 6 split ring lock washer, and No. 6 nut in two places that holds the component bracket assembly (for L1, K1, and C1) P/N 775017A4064 to the card cage assembly. Use a No. 1 Phillips head screwdriver to loosen the four No. 6 screws that secure the component bracket (P/N 775017A4064) to Case Assembly 1A14. Do not remove these four screws, just loosen them enough to allow removal of the card cage assembly.
2. Use a No. 1 Phillips screwdriver to loosen and remove the four No. 6 screws and No. 6 split ring lockwashers that secure the card cage assembly to the case assembly. Gently pull the component bracket (for L1, K1, and C1) toward the front (i.e., the side with the meter and connectors) of the case assembly and lift the card cage assembly straight up out of the case assembly.

3-32. ACCESS AND/OR REMOVAL OF HARMONIC FILTER ASSEMBLY 1A15

1. Refer to Detail C of figure 3-2. Use a No. 1 Phillips head screwdriver to loosen the two 2-56 x .75 LG screws that secure connector 1A14J8 to plate nut assembly P/N 755017A4034. Remove plate nut assembly and screws, then gently pull connector 1A14J8 and its cable harness away from the side of Case Assembly 1A14. Use a pair of diagonal cutters to cut the tie wrap holding the cable harness to cable clamp (P/N TC-105A) on the inner wall of the case assembly, taking care not to damage any wires in the cable harness.
2. Use Extraction Tool CET-C6B to punch out the coaxial cable part of connector 1A14J8 (labeled A2).
3. Use a No. 1 Phillips head screwdriver to loosen and remove the two 2-56 x 5/16 LG screws that secure connector 1A14J7 to the standoffs P/N 775017A4017 attached to Case Assembly 1A14.
4. Use a No. Phillips head screwdriver to loosen and remove the three 4-40x .25 LG Phillips head screws, three No. 4 split ring washers, and three No. 4 flat washers that secure the harmonic filter assembly to the case assembly.
5. Gently lift the harmonic filter assembly and its cable harness up and away from the case assembly. Use Extraction Tool CET-C6B to punch out the coaxial connector labeled A3 on connector 1A14J7.

3-33. ACCESS AND/OR REMOVAL OF COMPONENT BRACKET P/N 755017A4064 (FOR L1, K1, AND C1)

1. Refer to Detail C of figure 3-2. Use a No. 1 Phillips head screwdriver and a 4-inch adjustable wrench to loosen and remove the 8-32 x 7/16 LG Phillips head screw, No. 8 split ring washer, and No. 8-32 Hex Nut that secure the minus (-) lead of capacitor C1 to the component bracket.
2. Use a No. 1 Phillips head screwdriver to loosen and remove the No. 8-32 x 5/16 and No. 8 split-ring lock washer that secure the plug (+) lead from capacitor C1 to pin 1 of relay K1. Then use No. 1 Phillips head screwdriver to loosen and remove the two No. 6-32 x 5/16 LG Phillips head

screws, the two No. 6 split-ring lock washers, and the two No. 6 flatwashers that secure the capacitor clamp P/N 755017A4075 and capacitor C1 to component bracket P/N 755017A4064 and the case assembly.

3. Using a No. 1 Phillips head screwdriver and a 4-inch adjustable wrench, disconnect and tag the two leads of inductor L1. Inductor L1 may now be removed from the component bracket by loosening and removing the 6-32 x .50 LG Phillips head screw, the No. 6-32 hex nut, the No. 6 split-ring washer, and the No. 6 flatwasher that secure inductor L1 to the component bracket.
4. Using a No. 1 Phillips head screwdriver and a 4-inch adjustable wrench, disconnect and tag all harness leads to relay K1. Loosen and remove the two remaining sets of 6-32 x .25 LG Phillips head screws, No. 6 split-ring washers, and No. 6 flatwashers use to secure component bracket P/N 755017A4064 to Case Assembly 1A14.

3-34. ACCESS TO INTERCONNECTION PCB ASSEMBLY 1A14A1

1. Refer to Detail C of figure 3-2. Once the card cage assembly and the component bracket have been removed from the case assembly, Interconnection PCB Assembly 1A14A1 may be lifted up with the cable harness for maintenance access.
2. If for any reason Interconnection PCB Assembly 1A14A1 must be replaced, it is recommended that replacement of the entire 1A14 wiring harness P/N 755017A4090, of which 1A14A1 is a part, would be more efficient.

3-35. REMOVAL OF POWER AMPLIFIER TUBES 1A14V1 and 1A14V2 Y-621B)

(See paragraph 3-26 before performing this procedure.)



Power amplifier tubes 1A14V1 and 1A14V2 (Y-621B) contain BERYLLIUM OXIDE (BeO) CERAMICS. The dust or fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC and breathing them can result in serious personal injury or DEATH.

1. Refer to Detail C of figure 3-2. Use a No. 1 Phillips head screwdriver to loosen and remove the three 6-32 x .75 LG Phillips head screws, three No. 6 flatwashers, and three No. 6 lockwashers that secure the two tube clamp A(P/N 755017A4406) and the one tube clamp B and thus tubes 1A14V1 and 1A14V2 to Case Assembly 1A14.
2. Carefully pull the tubes (1A1 4V1 and 1A14V2) from the fingers on Tube Socket Assembly 1A14A2.

3-36. ACCESS AND/OR REMOVAL OF TUBE SOCKET ASSEMBLY 1A14A2

1. Refer to Detail C of figure 3-2. After power amplifier tubes 1A14V1 and 1A14V2 have been removed (see paragraph 3-38), use a No. 1 Phillips head screwdriver to loosen and remove the three 6-32 x .38 LG Phillips head screws and three No. 6 lockwashers that secure Tube Socket Assembly 1A14A2 to Case Assembly 1A14.
2. Lift the tube socket assembly and its wiring harness up away from the case assembly for maintenance access. If removal is required, unsolder and tag all leads. Prior to reassembly, apply heat sink compound (P/N 755017A4412) to the bottom surface of the tube block that touches the casting of Case Assembly 1A14.

3-37. ACCESS AND/OR REMOVAL OF DC-TO-DC CONVERTER ASSEMBLY 1A14A3

1. Refer to Detail C of figure 3-2. Use a No. 1 Phillips head screwdriver to loosen and remove the four 6-32 x .75 LG Phillips head screws and four No. 6 lockwashers that secure the dc-to-dc converter assembly to the case assembly.
2. Lift the dc-to-dc Converter Assembly and its wiring harness up away from the case assembly for maintenance access. If removal is required, unsolder and tag all leads.
3. Prior to reassembly, apply heat sink compound (P/N 755017A4412) to the underside of the dc-to-dc converter assembly that touches the case assembly.

3-38. ACCESS AND/OR REMOVAL OF REGULATOR ASSEMBLY P/N 755017A4031

1. Refer to Detail C of figure 3-2. After component bracket (P/N 755017A4064) has been removed (refer to paragraph 3-36), use a No. 1 Phillips head screwdriver to loosen and remove the 8-32 x .5 LG Phillips head screw, the No. 8 lockwasher, and the No. 8 flatwasher that secure regulator assembly (P/N 755017A4031) to Case Assembly 1A14. If removal is required, unsolder and tag all leads. Prior to reassembly, apply heat sink compound (P/N 755017A4412) to the underside of the regulator assembly that touches the case assembly.

3-39. ACCESS AND/OR REMOVAL OF TRANSFORMER 1A14T1

1. Refer to Detail C of figure 3-2. Use a 4-inch adjustable wrench to disconnect the (T1) transformer lead from the (T1) terminal lug (P/N 755017A9092-3).
2. Use a No. 1 Phillips head screwdriver to loosen and remove the four 8-32 x 7/16 LG Phillips head screws, the four No. 8 lockwashers, and the four No. 8 flatwashers that secure transformer T1 to Case Assembly 1A14.
3. If removal is required, unsolder and tag all leads for replacement.

3-40. ACCESS AND/OR REMOVAL OF CONNECTOR 1A14J10

1. Refer to Detail C of figure 3-2. Use a No. 1 Phillips head screwdriver to loosen and remove the two 2-56 x 5/16 LG Phillips head screws that secure connector 1A14J10 to two standoffs (P/N 755017A4017) mounted on Case Assembly 1A14.
2. If removal is required, unsolder and tag all leads for reassembly.

3-41. ACCESS AND/OR REMOVAL OF CONNECTOR 1A14J11

1. Refer to Detail C of figure 3-2. Use a Phillips head screwdriver to loosen and remove the two 2-56 x 5/16 LG Phillips head screws that secure connector 1A14J11 to two standoffs (P/N 755017A4017) mounted on Case Assembly 1A14.
2. If removal is required, use Extraction Tool CET-C6B to punch out the two coaxial connectors at A1 and A2 of connector 1A14J11, tagging the coaxial connectors for identification. Unsolder and tag all the remaining leads attached to connector 1A14J11 for reassembly identification.

3-42. ACCESS AND/OR REMOVAL OF CONNECTOR 1A14J12

1. Refer to Detail C of figure 3-2. Use a No. 1 Phillips head screwdriver to loosen and remove the two 2-56 x 5/16 LG Phillips head screws that secure connector 1A14J12 to two standoffs P/N 755017A4017 mounted on Case Assembly 1A14.
2. If removal is required, unsolder and tag all leads for reassembly identification.

3-43. ACCESS AND/OR REMOVAL OF CONNECTOR 1A14J13

1. Refer to Detail C of figure 3-2. Use a No. 1 Phillips head screwdriver to loosen and remove the two 4-40 x .5 LG Phillips head screws that secure connector 1A14J13 to two standoffs (P/N 755017A4019) mounted on Case Assembly 1A14.
2. If removal is required, unsolder and tag all leads for reassembly identification.

3-44. REMOVAL OF HEAT SINK COVER P/N 755017A4006

1. Refer to Detail D of figure 3-2. Use a No. 1 Phillips head screwdriver to loosen and remove the 13 No. 6 x .36 LG, 100° flat head screws that secure the heat sink cover to the case assembly; then remove the heat sink cover.

3-45. REMOVAL OF HEAT SINK BLOWER 1A14B1

1. Use a No. 1 Phillips head screwdriver to loosen the four No. 4-40 x 3/4 LG Phillips head screws that secure the heat sink blower to the case assembly with blower clamps P/N 755017A8014.
2. Refer to Detail D of figure 3-2. Use a 3/16-inch x 8-inch flat-blade screwdriver to loosen the three No. 2 screws that secure the three leads to the heat sink blower terminal board and tag each lead for reassembly identification.

3-46. ASSEMBLY AND/OR COMPONENT INSPECTION PROCEDURES

3-47. The power amplifier is a fully automatic unit, with solid state logic and control circuits. The unit can be expected to function for extended periods with minimum attention. However, a normal periodic preventive maintenance schedule of cleaning and inspection should be maintained. Table 3-6 list the inspection procedures applicable to the power amplifier assemblies and components. Figures 3-29 through 3-65 (component location diagrams) can be used, if necessary, for specific component location while performing the inspection procedures.

3-48. DIRT AND/OR RESIDUE ON UNIT CONTOURS AND/OR COMPONENTS

3-49. Wipe surfaces with a lint free cloth dampened with technical isopropyl alcohol (Specification MIL-I-10428) to remove film and/or residue with the exception of power amplifier tubes 1A14V1 and 1A14V2.

WARNING

Power amplifier tubes 1A14V1 and 1A14V2 (Y-621B) contain BERYLLIUM OXIDE (BeO) CERAMICS. The dust or fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC and breathing them can result in serious personal injury or DEATH. Power amplifier tubes 1A14V1 and 1A14V2 should only be wiped with a dry lint free cloth. If the power amplifier case is muddy, wash it with detergent and water. Let unit air dry.

TABLE 3-6. POWER AMPLIFIER AM-6545/GRC-193 ASSEMBLY AND/OR COMPONENT INSPECTION PROCEDURES

MODULE, PCB/PWB, OR COMPONENT	INSPECT FOR
<p>Power amplifier unit (external) including J1 ANT CPLR CONT connector, J2 RT-CONT connector, J3 DC PWR connector, J4 ANT CPLR RF connector, and J5 RT RF connector.</p>	<p>Dirt and/or residue on unit contours; clogged heat exchanger intakes and outlets; clogged fan and/or relief valve outlet; damaged connectors and/or connector threads; bent, loose, or missing pins in the J1 and J2 CONTROL connectors; blurred or missing case markings; scratched or gouged painted surfaces; loose or missing handle hardware; structural cracks (casting); damaged meter (1A14M1); rotten or deteriorated circuit breaker boots and push-button seal nut.</p>
<p>Power amplifier unit (internal). All components assembled - cover removed)</p>	<p>Loose, frayed, abraded, or broken wires; disconnected wires and/or cold solder joints; cracked or missing insulation; evidence of overheating; bent or broken parts or components; loose or missing hardware; foreign objects and/or disconnected parts; structural cracks (casting).</p>
<p>Heat sink blower 1A14B1 (vaneaxial fan), heat exchanger fins, blower capacitor 1A14C3, and feedthroughs 1A14C4, C5, and C6</p>	<p>Loose, missing, or damaged cover hardware; loose, frayed, abraded, or burned wires. Loose, missing, or damaged hardware; cold soldered joints; broken or missing terminal lugs; dirt and/or corrosion on tins; seized fan rotor; cracked or damaged fan structural case; overheated, cracked, or missing components.</p>
<p>Meter Board PWB Assembly 1A1</p>	<p>Loose, damaged, or missing hardware; overheated, cracked, or missing pc board components; bent or damaged switch mounting bracket; bent pins or damaged edge connector; cracked, lifted, or cut pc board runs; cold soldered joints; damaged or missing card extrator handles.</p>
<p>DC Control PWB Assembly 1A2, System Control PWB Assembly 1A3, Tune Control PWB Assembly 1A4, Servo Amplifier PWB Assembly 1A5, and Band Control PWB Assembly 1A6 including the card cage assembly</p>	<p>Loose, damaged, or missing hardware; overheated, cracked, or missing pc board components; bent pins or damaged edge connector; cracked, lifted, or cut pc board runs; cold soldered joints; damaged or missing card extractor handles; bent or broken pc board locator slides on card cage assembly.</p>
<p>ALC Module Assembly 1A7, Tune Detector Module Assembly 1A10, RF Driver Module Assembly 1A11, Static Power Inverter Assembly 1A12, and High Voltage Module Assembly 1A13</p>	<p>Bent, damaged, or missing outer case or case hardware; broken, bent, or missing captive mounting hardware; dirt and/or corrosion in or on the rf input and output connectors; bent or missing connector/receptacle pins; overheated, cracked, or missing pcb components; loose, frayed, abraded, broken, or missing wires; cracked, lifted, or cut pcb runs; cold soldered joints.</p>

TABLE 3-6. POWER AMPLIFIER AM-6545/GRC-193 ASSEMBLY AND/OR COMPONENT INSPECTION PROCEDURES (Continued)

MODULE, PCB/PWB, OR COMPONENT	INSPECT FOR
Plate Assembly 1A9	Bent, broken, or missing captive mounting hardware; cracked, broken, overheated, or missing pc board components, dirty or corroded bayonet connectors; compressed, bent, or missing contact springs; cold soldered joints; and chipped, cracked, broken, or shorted coil form.
Tank Circuit Module Assembly 1A8	Bent, broken, or missing captive mounting hardware including assembly locator pins; loose, bent, or missing connector/receptacle pins; dirt or corrosion in or on rf input and output connectors; damaged or missing assembly hardware; dirty or excessively worn gears, cracked, broken, or damaged inductor housing; bent, broken, or shorted inductor (L1); loose, frayed, abraded, broken, or missing wires; overheated, cracked, or missing components. Loose, twisted, or worn rotor shaft and rotor switch contacts; overheated, cracked, or seized drive motors; and cold solder joints.
Interconnection PCB Assembly 1A14A1	Overheated, cracked, broken or missing pcb components, cold solder joints, loose, disconnected, broken, frayed, or abraded wires; damaged or missing connector mounting hardware; cracked, broken or missing pins or pcb keys on pcb connectors.
Tube Socket Assembly 1A14A2 Power Amplifier Tubes 1A14V1 and 1A14V2	<div data-bbox="1053 1187 1252 1261" style="border: 2px solid black; padding: 5px; text-align: center; margin: 10px auto; width: fit-content;"> WARNING </div> <p>Power amplifier tubes 1A14V1 and 1A14V2 (Y-621B) contain BERYLLIUM OXIDE (BeO) CERAMICS. The dust or fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC and breathing them can result in serious personal injury or DEATH.</p> <p>Chipped, cracked, or broken power amplifier tubes (1A14V1 and V2); broken, chipped, cracked, or bent tube sockets and tube socket fingers; overheated, cracked, broken, loose, frayed, abraded, or missing wires.</p>
Dc-to-Dc Converter Assembly 1A14A3	Bent, broken or missing assembly mounting hardware; overheated, broken, or missing components; corrosion or direct, lack of heat sink compound; loose, frayed, cracked, broken, abraded, or missing wires.

TABLE 3-6. POWER AMPLIFIER AM-6545GRC-193 ASSEMBLY AND/OR COMPONENT INSPECTION PROCEDURES (Continued)

MODULE, PCB/PWB, OR COMPONENT	INSPECT FOR
Indicator Assembly 1A14A4	Loose, damaged, or missing assembly mounting hardware; overheated, cracked, or missing pc board components; cracked, lifted, or cut pc board runs; cold solder joints; loose, frayed, cracked, broken, abraded, or missing wires.
Junction Block PWB Assembly 1A14A5	Loose, damaged, or missing assembly mounting hardware; cracked, lifted, or cut pcb runs; loose, frayed, cracked, broken, abraded, or missing wires; cold soldered joints.
Regulator Assembly 1A14A6 P/N 755017A4031	Loose, damaged, or missing assembly mounting hardware; bent, twisted, or warped bracket; loose, frayed, cracked, broken, abraded, or missing wires; cold soldered joints.
Harmonic Filter Assembly 1A15	Loose, damaged, or missing assembly mounting hardware; overheated, cracked, broken, or missing components; twisted, broken, or shorted inductors; loose, frayed, cracked, broken abraded, or missing wires; cold soldered joints; bent, twisted, broken, or missing coaxial cables and connectors.
Component Bracket Assembly (for L1, K1, and C1) P/N 755017A4064	Loose, damaged, or missing assembly mounting hardware; cracked, broken, or overheated capacitors (C1 and C2); cracked, broken, or overheated inductor assembly (L1); broken or damaged K1 relay assembly; burned relay contacts; loose, frayed, broken, abraded, or missing wires; cold soldered joints.

3-50. CLOGGED HEATER EXCHANGE INTAKES OR OUTLETS; CLOGGED FAN AND/OR RELIEF VALVE OUTLET

3-51. Use anon-metallic brush or tool to remove foreign matter. If it is suspected that the heat exchange vanes are plugged, remove power amplifier heat sink cover, as described in paragraph 3-44. Brush heat exchanger vanes and, if necessary, flush them with water. Let the unit air dry.

3-52. DAMAGED CONNECTOR THREADS; BENT, LOOSE, OR MISSING PINS; OR CORRODED CONTACTS

3-53. If the connector threads are severely galled or the connector has bent or missing pins, the connector must be replaced. Note any damaged case assembly connectors (1A14J1, 1A14J2, 1A14J3, 1A14J4, or 1A14J5) and notify nearest Maintenance Facility of the need for connector replacement. Other connectors that do not break the water seal of Case Assembly 1A14 can be replaced as described in paragraphs 3-32, 3-40, 3-41, 3-42, and 3-43 and below:

1. Remove connector from applicable mounting.
2. Unsolder and tag each connector wire and discard defective connector.
3. Resolder wires and insert coaxial connectors, if necessary, to new connector.
4. Reassemble new connector to applicable mount. Remove light corrosion using a lint-free cloth dampened with technical isopropyl alcohol (Specification MIL-I-10428). Excessively corroded connectors must be replaced, as previously described.

3-54. BLURRED OR MISSING CASE MARKINGS AND SCRATCHED OR CHIPPED PAINTED SURFACES

3-55. If blurred or missing case markings or any scratched or chipped painted surfaces are noted during inspection, record evidence and notify nearest Maintenance Facility of the need for retouching and/or repainting affected areas.

3-56. MISSING AND/OR DAMAGED HARDWARE

3-57. Replace any missing and/or damaged hardware. See figures 3-2 and 3-29 through 3-64 for hardware identification.

3-58. STRUCTURAL DAMAGE

3-59. If any structural cracks or damage are noted during inspection, record evidence and notify nearest Maintenance Facility (Fifth Echelon) for analysis and disposition of affected area.

3-60. CABLE HARNESS DAMAGE

3-61. Tighten and/or strap any loose cables or wires. Replace any frayed, cracked, broken, abraded, or missing wires and any wires that show signs of excessive overheating. Restrip and reconnect any broken wires, if possible; otherwise replace them.

3-62. SEIZED HEATSINK BLOWER (VANEAXIAL FAN) 1A14B1

3-63. If rotor does not turn freely, replace fan, Refer to paragraphs 3-44 and 3-45 for removal and reassembly procedures.

3-64. LOOSE CASE ASSEMBLY (1A14) COMPONENTS, ASSEMBLIES, AND CONNECTORS

3-65. Use a No. 1 or No. 2 Phillips screwdriver, as applicable, to tighten any loose mounting hardware.

3-66. OVERHEATED, CRACKED, BROKEN, OR MISSING PCB/PWB COMPONENTS

3-67. Overheated, cracked, broken, or missing PCB/PWB components can be repaired using standard repair techniques, if it is deemed practical.

3-68. COLD SOLDERED JOINTS

3-69. Reheat and/or resolder any cold soldered joints found during the inspection procedures.

3-70. BENT OR MISSING ASSEMBLY/MODULE LOCATOR PINS

3-71. If either of these conditions are noted, notify nearest Maintenance Facility of rework/replacement requirements.

3-72. EXCESSIVELY WORN GEARS

3-73. If excessively worn gears in Coil Gear Assembly 1A8A3 and Bandswitch Gear Assembly 1A8A4 are noted during the inspection procedures, record evidence and notify nearest Maintenance Facility of replacement requirements.

3-74. GEAR CLEANING

3-75. If metallic gears are dirty proceed as follows:

1. Use a non-metallic brush dampened with either Methylcelhlyketone (MEK) (Federal Specification TT-M-261) or Trichlorethylene (Federal Specification 0-T-634) to clean dirt from gears. Allow gear to dry thoroughly.

2. Lubricate gears at the points indicated in figure 3-3 with Lubriplate Grease (RF Specification No. 755017A8241).

3-76. CRACKED OR BROKEN INDUCTOR HOUSING (1A8A5L1)

3-77. If during the inspection procedures a cracked or broken inductor housing is noted, notify the nearest Maintenance Facility of replacement requirement.

3-78. BROKEN OR DAMAGED (OVERHEATED) CAPACITORS 1A14C1 AND 1A14C2

3-79. If capacitor 1A14C1 and/or C2 are broken, damaged, or overheated proceed as follows:

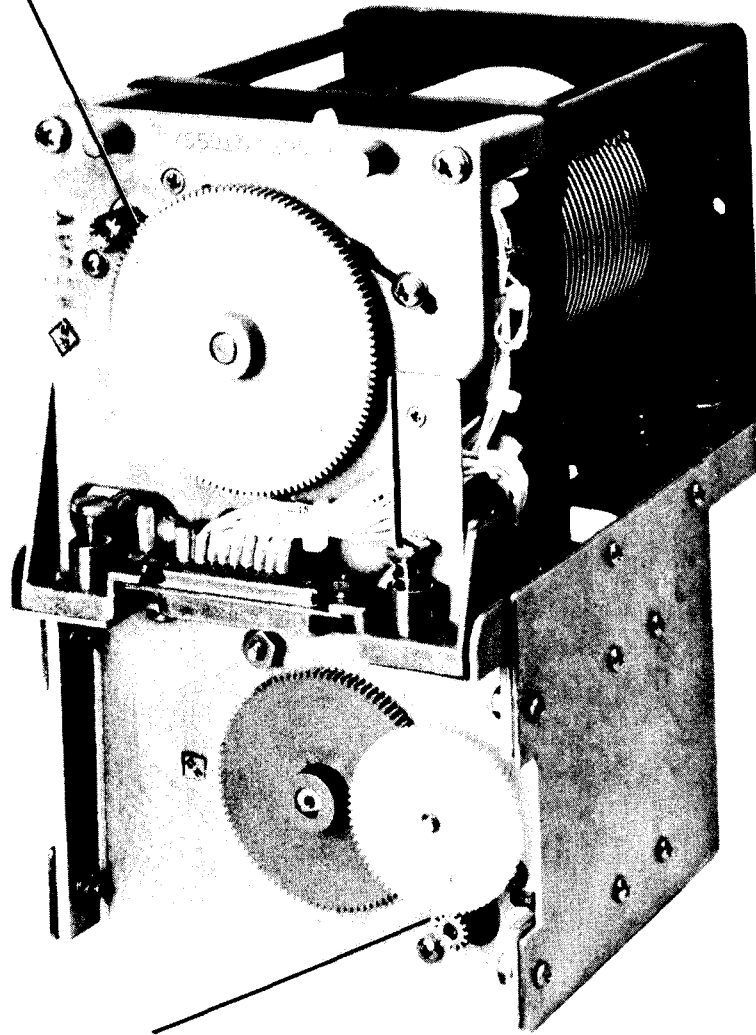
Note

Prior to performing the subsequent operations, note and sketch orientation of all associated terminals, wires, and components.

1. Refer to paragraphs 3-31 and 3-33 for removal of card cage assembly (P/N 775017A4205) and removal of component bracket (P/N 755017A4064).

Once component bracket (P/N 755017A4064) is accessible, use a No. 1 Phillips head screwdriver to loosen and remove the hardware connecting the wires to capacitor 1A14C1. Then loosen the Philips head screw that secures the capacitor in the capacitor mounting bracket. Lift capacitor 1A14C1 and 1A14C2 out of the mounting bracket.

LUBRIPLATE GREASE
RF SPEC No. 755017A8241



LUBRIPLATE GREASE
RF SPEC No. 755017A8241

Figure 3-3. Tank Circuit Module Assembly 1A8 Lubrication Points

3. Capacitor 1A14C2 is soldered between the plus (+) and minus (-) terminals of capacitor 1A14C1 and can be removed by unsoldering without removing capacitor 1A14C1 from the component bracket. If capacitor 1A14C1 is replaced, capacitor 1A14C2 should also be replaced.

4. Reinstall the new capacitors.

3-80. BROKEN OR DAMAGED (OVERHEATED) INDUCTOR 1A14L1

3-81. If inductor assembly 1A14L1 is broken, damaged, or burned, proceed as follows:

1. Refer to paragraphs 3-31 and 3-33 for removal of card cage assembly (P/N 755017A4205) and removal of component bracket (P/N 755017A4064).

2. Once component bracket (P/N 755017A4064) is accessible, use a No. 1 Phillips head screwdriver and an adjustable 4-inch wrench to loosen and remove Inductor Assembly 1A14L1 from component bracket (P/N 755017A4064).

3. Reconnect the new inductor assembly to the component bracket, making sure that all leads are reconnected in the same orientation as before disassembly.

3-82. BROKEN OR DAMAGED (OVERHEATED) RELAY ASSEMBLY 1A14K1

3-83. If Relay Assembly 1A14K1 is broken, damaged, or burned proceed as follows:

1. Refer to paragraphs 3-31 and 3-33 for removal of card cage assembly (P/N 755017A4205) and removal of component bracket (P/N 755017A4064).

2. Once component bracket (P/N 755017A4064) is accessible, use a No. 1 Phillips head screwdriver to loosen the hardware securing all wires to relay 1A14K1. Tag each wire for reassembly identification.

3. Use a No. 1 Phillips head screwdriver to loosen and remove the mounting hardware that secures relay 1A14K1 to component bracket (P/N 755017A4064).

4. Reconnect the new relay to component bracket (P/N 755017A4064) in the reverse order of disassembly, making sure the original wires are attached in the same orientation as before disassembly.

3-84. WORN ROTOR CONTACTS ON INDUCTOR 1A8A5L1

3-85. If worn inductor rotor contacts are noted during the inspection procedure, record evidence and notify nearest Maintenance Facility of replacement requirement.

3-86. SEIZED HEATSINK BLOWER (VANEAXIAL FAN) 1A14B1

3-87. If heat sink blower 1A14B1 is seized and its rotor does not turn freely, proceed as follows:

1. Refer to paragraphs 3-44 and 3-45 for removal of heat sink cover and heat sink blower 1A14B1.

2. Reconnect the new Heat Sink blower in the reverse order of disassembly.

SECTION IV

TROUBLESHOOTING - DIRECT SUPPORT INTERMEDIATE MAINTENANCE
AND GENERAL SUPPORT INTERMEDIATE MAINTENANCE

NOTE

Maintenance Kit OA-9163/GRC-193A is available as a Maintenance Test Bed.

3-88. INTRODUCTION

3-89. This section describes a logical approach to determining and resolving most power amplifier faults and malfunctions in the briefest time. Various tables list power amplifier faults and malfunctions, the

relative indications observed, possible causes, suggested checks and /or tests to verify the causes, and suggested corrective action or repair procedures.

3-90. This section contains troubleshooting instructions applicable to all intermediate maintenance activities. Where procedures are applicable to both echelons, no notation is included.

3-91. Troubleshooting, as it applies to intermediate Maintenance activities, consists of the procedures described in paragraphs 3-11 through 3-71 plus detail testing and replacement of modules, assemblies, pcb/pwb circuits and components.

3-92. LOGICAL APPROACHES TO POWER AMPLIFIER TROUBLESHOOTING

3-93. The following six logical steps should be followed when troubleshooting the power amplifier:

1. Symptom Recognition. Symptom recognition is based on knowledge and understanding of equipment operating characteristics. Not all equipment troubles are a direct result of component failure; therefore a malfunction in the equipment is not always easy to recognize, since conditions of less than peak performance are not always apparent.

2. Symptom Elaboration. After an equipment trouble has been recognized, use of system front panel controls (refer to chapter 3 of TM 11-5820-924-12) and other built-in testing aids (such as test meters, test points and LED indicators) are recommended to assist in the verification of the original symptom (and also to eliminate possible malfunctions in other equipment as the cause).

3. Listing Probable Faults or Malfunctions. The next step in logical troubleshooting is to list the logical causes and their likely locations (module, pcb/pwb, or functional section). The causes should be based on knowledge of equipment operation, identification of trouble symptoms, and information contained in this manual.

4. Localizing the Sources of Faults or Malfunctions. For best efficiency in localizing the trouble, the logical causes should be checked in the order that will require the least time; therefore, a selection is required to determine which section to test first. The selection should be based on the validity of the logical choice, and the difficulties involved in making the necessary tests (some of which may be outside the scope of intermediate maintenance). If the tests do not prove that a functional section is at fault, the next selection should be tested, and so on, until the faulty functional section is located.

5. Localizing Faults or Malfunctions to a Particular Circuit. After the faulty functional module, pcb/pwb, or major assembly has been isolated, it is often necessary to make additional logical choices as to which circuit(s) within the functional section is at fault. Again, familiarity with the equipment and an understanding of the functional operation as explained in chapter 2 of this manual, is important.

6. Fault/Malfunction Analysis. After the trouble (faulty component, misalignment, etc.) has been located, but prior to corrective action, the procedures followed up to this point should be reviewed to determine why the fault affected the equipment as it did. This review is necessary to make sure that the fault discovered is actually the cause of the malfunction and not a result of it.

3-94. TROUBLESHOOTING INDEX

3-95. Table 3-7 is the power amplifier troubleshooting index. The table lists the major functional areas where troubles may occur, and references troubleshooting procedures, diagrams, and functional descriptions.

3-96. RELAY, INDICATOR LAMP, AND CIRCUIT BREAKER INDEXES

3-97. Tables 3-8, 3-9 and 3-10 list trouble analysis references for relays, indicators, lamps, and circuit breakers in the power amplifier.

TABLE 3-7. POWER AMPLIFIER AM-6545/GRC-193 TROUBLESHOOTING INDEX

FUNCTIONAL AREA	TROUBLESHOOTING DIAGRAM (FIGURE NO.)	FUNCTIONAL DESCRIPTION PARAGRAPH
DC Power	3-4	2-51 and 2-125
DC to DC Converter	3-5 and 3-6	2-137
+19 Vdc	3-7	2-131
-14 Vdc	3-8	2-134
Bandswitching	3-9, 3-10, and 3-11	2-77 thru 2-87
Servo Tuning	3-12, 3-13, and 3-14	2-88 thru 2-112
Heatsink Blower	3-15	2-141 and 2-146
Power Amplifier Tube (1A14V1 and V2)	3-16	2-41
T/R Line	3-17	2-35
RF Drive	3-18	2-29 thru 2-45
+1600 Vdc	3-19	2-137
PA Faults (Front Panel)	3-20	2-58 thru 2-67
Meter Circuit	3-21	2-26
Antenna Coupler Fault (Front Panel)	3-22	See Antenna Coupler Manual

TABLE 3-8. POWER AMPLIFIER AM-6545/GRC-193 RELAY INDEX

REFERENCE DESIGNATOR	FUNCTIONAL NAME	ENERGIZING VOLTAGE	TROUBLESHOOTING DIAGRAM (FIGURE NO.)
1A1K1	Rx-Tx Input Switching (DPDT Electrical Relay)	+26.5 Vdc	3-65
1A7A1K1	Rx-Tx Output Switching (DPDT Electrical Relay)	+26.5 Vdc	3-71
1A7A1K2	Tune Load Switching (DPDT Electrical Relay)	+26.5 Vdc	3-71
1A13A1K1	HV ON (DPDT Electrical Relay)	+26.5 Vdc	3-77
1A14K1	POWER ON (SPST 50A Relay)	+26.5 Vdc	3-78

TABLE 3-9. POWER AMPLIFIER AM-6545/GRC-193 INDICATOR LAMP INDEX

REFERENCE DESIGNATOR	FUNCTIONAL NAME	ENERGIZING VOLTAGE	TROUBLESHOOTING DIAGRAM (FIGURE NO.)
(Red) 1A2DS1	OVERLOAD FAULT	+10 Vdc	3-66
(Grn) 1A6DS1	Band "G"	+19 Vdc	3-70
(Grn) 1A6DS2	Band "F"	+19 Vdc	3-70
(Grn) 1A6DS3	Band "H"	+19 Vdc	3-70
(Grn) 1A6DS4	Band "C"	+19 Vdc	3-70
(Grn) 1A6DS5	Band "D"	+19 Vdc	3-70
(Grn) 1A6DS6	Band "E"	+19 Vdc	3-70
(Grn) 1A6DS7	Band "A"	+19 Vdc	3-70
(Grn) 1A6DS8	Band "B"	+19 Vdc	3-70
(Wht) 1A13A1DS1	HV ON	+135 Vdc	3-77
(Grn) 1A14A4DS1	RDY	+19 Vdc	3-78
(Grn) 1A14A4DS2	XMT	+19 Vdc	3-78
(Amb) 1A14A4DS3	TUNE	+19 Vdc	3-78
(Amb) 1A14A4DS4	FIL FAULT	+19 Vdc	3-78
(Red) 1A14A4DS5	PA FAULT	+19Vdc	3-78
(Red) 1A14A4DS6	CPLR FAULT	+19 Vdc	3-78

TABLE 3-10. POWER AMPLIFIER AM-6545/GRC-193 CIRCUIT BREAKER INDEX

REFERENCE DESIGNATOR	FRONT PANEL MARKING	RATING		CIRCUIT PROTECTED	TROUBLESHOOTING DIAGRAM (FIGURE NO.)
		VOLTS	AMPS		
1A14CB1	ANT CPLR CB		3	Antenna Coupler CU-2064/GRC-193	3-78
1A14CB2	PA CB		50	Power Amplifier AM-6545/GRC-193	3-78

3-98. MAINTENANCE TURN-ON PROCEDURE

3-99. Refer to chapter 30 of System Manual TM 11-5820-924-12 for applicable turn-on procedure.

3-100. TROUBLESHOOTING DATA

3-101. The data contained in figure 3-4 and table 3-11 can be used both as a check of normal operation and in the location of trouble in the equipment.

3-102. Figure 3-4 (Details A, B, and C) lists all test points and indicators in the power amplifier.

3-103. Table 3-11 lists normal test point voltage indications for the various operating conditions of the equipment.

3-104. FAULT LOGIC DIAGRAMS

3-105. Figures 3-5 through 3-23 comprise the fault logic diagrams that apply to various power amplifier faults. These diagrams indicate logical approaches to trouble resolution, and, along with tables 3-8 through 3-11 and figures 3-4 through 3-23, should be referred to during fault logic analysis as aids to understanding the exact nature of the faults and their possible solutions.

SECTION V
FIELD MAINTENANCE - DIRECT SUPPORT INTERMEDIATE MAINTENANCE
AND GENERAL SUPPORT INTERMEDIATE MAINTENANCE

NOTE

Maintenance Kit OA-9163/GRC-193A is available as a Maintenance Test Bed.

3-106. INTRODUCTION

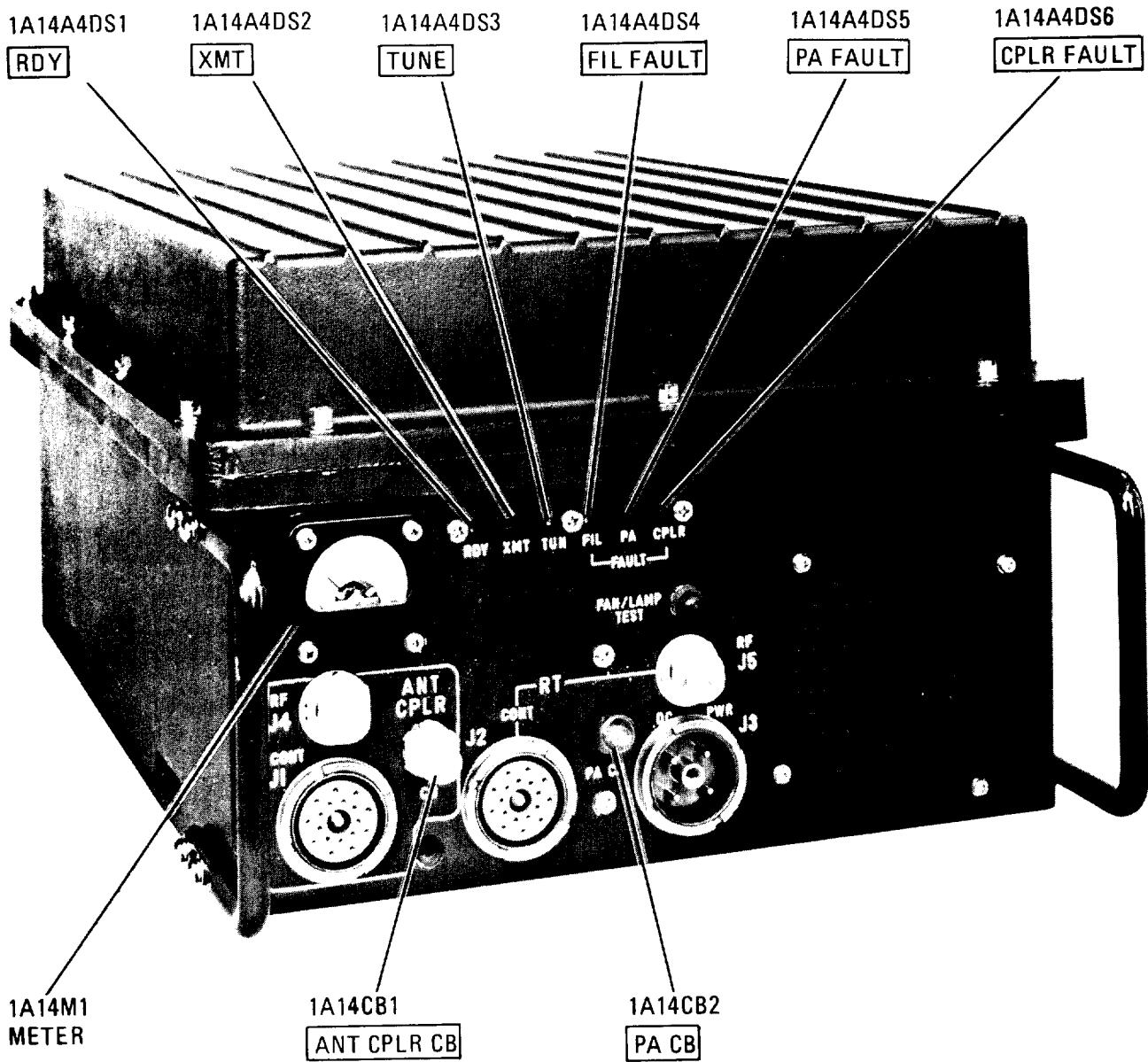
3-107. This section describes field maintenance procedures applicable to the power amplifier. Included herein are adjustment, repair, disassembly, and check/test procedures.

3-108. Maintenance performed in direct support of, or, in some specifically authorized cases, by the using unit, is limited primarily by the tools, test equipment, and repair parts authorized.

3-109. Maintenance requiring more elaborate facilities, tools, and test equipment, is normally performed in a centralized location and is limited only by the tools, test equipment, and repair parts authorized.

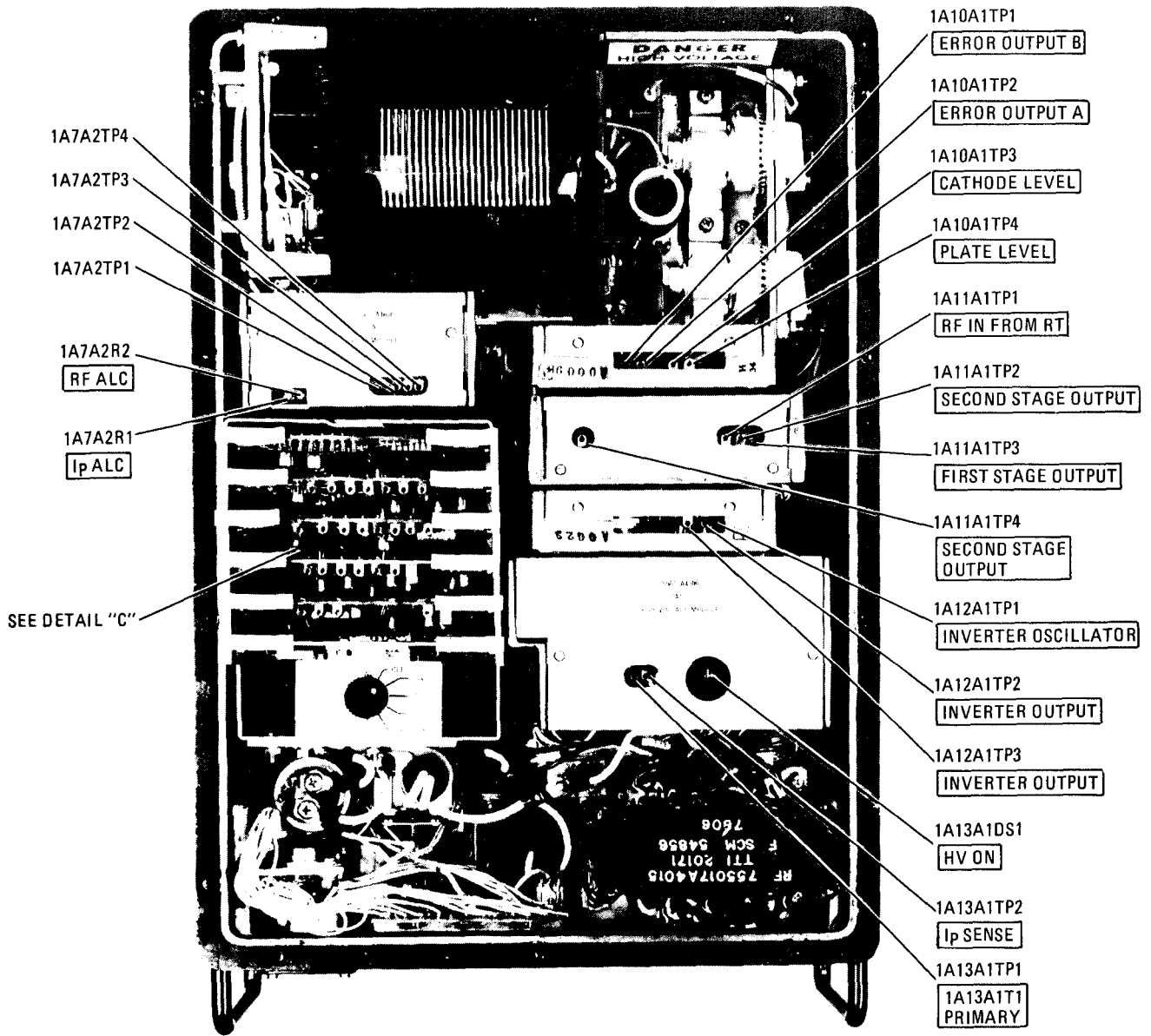
3-110. ADJUSTMENTS AND ALIGNMENTS

3-111. The only adjustments and alignments applicable to field maintenance activities are the HV OVER-LOAD THRESHOLD adjustment (1A2R20), the OVER VOLTAGE (+26.5 VDC) adjustment (1A3R3), the Ip ALC adjustment (1A7A2R1), the RF ALC adjustment (1A7A2R2), and 400 Hz ZERO BEAT adjustment (1A12A1R14). The mechanical and/or electrical alignment of Tank Circuit Module Assembly 1A8 and the electrical alignment of Tune Detector PWB Assembly 1A10A1 inductors (L1, L2, and L3) are applicable to maintenance activities having the facilities described in Rebuild Standard for Power Amplifier AM-6545/GRC-193, RS-87107B-50/3.



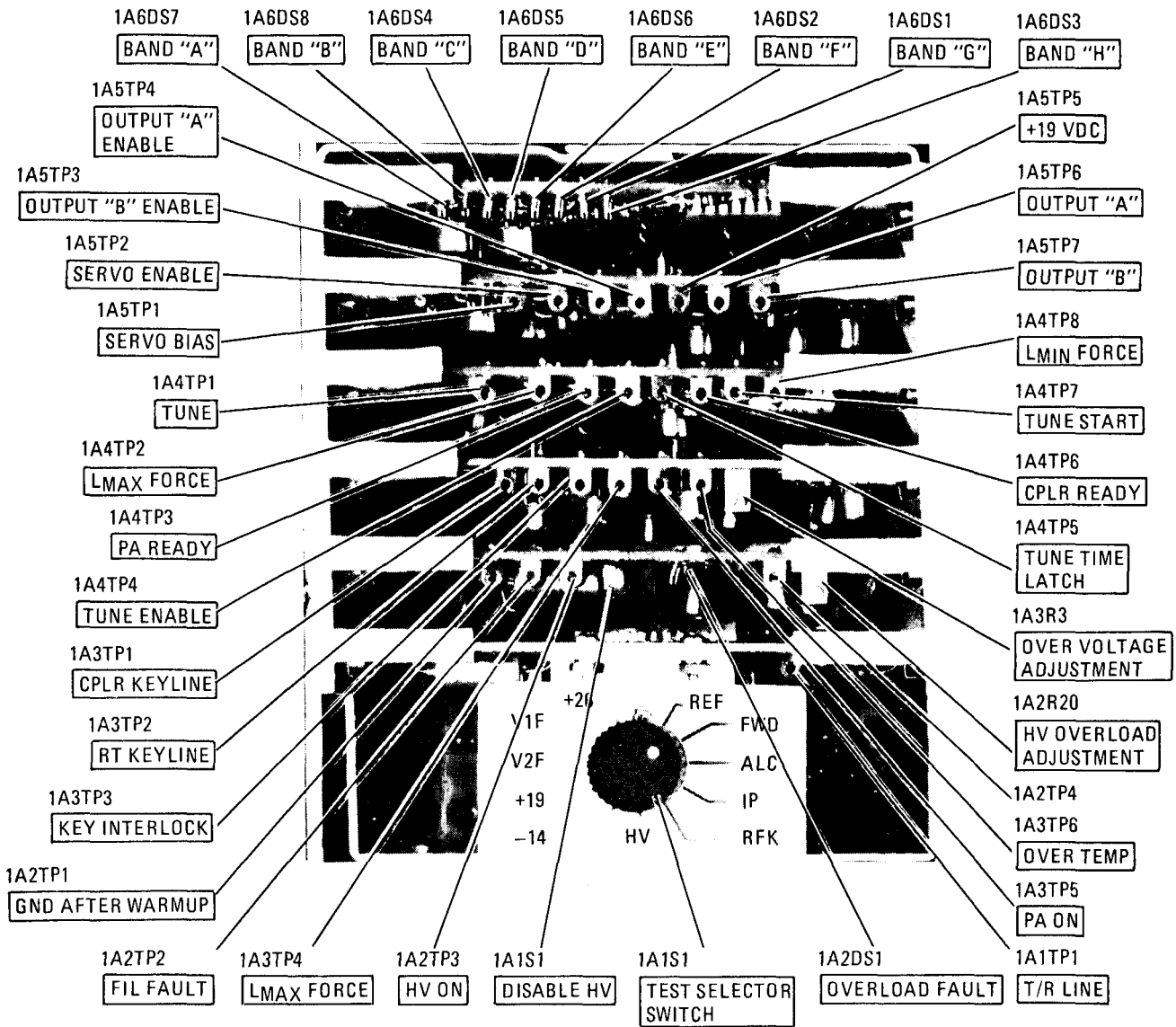
Detail A

Figure 3-4. PA Test Points and Indicators (Sheet 1 of 3)



Detail B

Figure 3-4. PA Test Points and Indicators (Sheet 2 of 3)



Detail C

Figure 3-4. PA Test Points and Indicators (Sheet 3 of 3)

TABLE 3-11. POWER AMPLIFIER AM-6545/GRC-193 TEST POINT/INDICATOR/OPERATION CORRELATION

ASSEMBLY NAME	TEST POINT OR INDICATOR REF. DESIG.	TEST POINT OR INDICATOR NAME	RECEIVE MODE INDICATION	TRANSMIT MODE INDICATION	TUNE MODE INDICATION		NOTES
					LMAX	LMIN	
Meter Board PWB Assy	1A1TP1	T/R Line	+26.5 Vdc	+0.1 Vdc	+26.5 Vdc	+0.1 Vdc	
DC Control PWB Assy	1A2TP1	Gnd After Warmup	+0.1 Vdc	+0.1 Vdc	+0.1 Vdc	+0.1 Vdc	+10V all modes during warmup
	1A2TP2	Fil Fault	-12 Vdc	-12.5 Vdc	-11 Vdc	-12 Vdc	+10V if Filament Fault
	1A2TP3	HF ON	0	+1.4 Vdc	0	+1.4 Vdc	
	1A2TP4	Fil Sense Threshold	+0.56 Vdc	+0.56 Vdc	+0.56 Vdc	+0.56 Vdc	
System Control PWB Assy	1A3R3	Over Voltage Adjustment					
	1A3TP1	Cplr Keyline	+0.02 Vdc	+0.02 Vdc	+0.02 Vdc	+0.02 Vdc	+4.7 Vdc ±0.5 Vdc if connected to Coupler
	1A3TP2	RT Keyline	+26 Vdc	+1.4 Vdc	+26 Vdc	+1.4 Vdc	
	1A3TP3	Key Interlock	0	+3.8 Vdc	0	+3.8 Vdc	
	1A3TP4	LMAX Force	0	0	+9.8 Vdc	0	
	1A3TP5	PA ON	+5 Vdc	+5 Vdc	+5 Vdc	+5 Vdc	
Tune Control PWB Assy	1A3TP6	Over Temp	+1.45 Vdc	+1.45 Vdc	+1.45 Vdc	+1.45 Vdc	
	1A4TP1	Tune	+26.5 Vdc	+25.5 Vdc	+0.18 Vdc	+0.18 Vdc	
	1A4TP2	LMAX Force	0	0	+9.2 Vdc	0	
	1A4TP3	PA Ready	+0.15 Vdc	+0.15 Vdc	+5.8 Vdc	+5.2 Vdc	
	1A4TP4	Tune Enable	0	0	+9 Vdc	+9 Vdc	
	1A4TP5	Tune Time Latch	0	0	0	+9 Vdc	
	1A4TP6	Cplr Ready	0	0	0	0	
	1A4TP7	Tune Start	+10 Vdc	+10 Vdc	+9.5 Vdc	+9 Vdc	+0.6 V when tune button pressed
Servo Amplifier PWB Assy	1A4TP8	LMIN Force	0	0	0	+9 to 0	AR1 & AR2 pin 7
	1A5TP1	Servo Bias	+12 Vdc	+12 Vdc	+12 Vdc	+12 Vdc	Sawtooth 6 msec long
	1A5TP2	Servo Enable	+6.1 Vdc	+6.3 Vdc	+0.81 Vdc	+0.81 Vdc	
	1A5TP3	Output "B" Enable	-1.14 Vdc	-1.20 Vdc	-1.14 Vdc	+18 Vdc	Input to 1A5Q11 & Q12 bases (LMIN)
	1A5TP4	Output "A" Enable	-1.1 Vdc	-0.1 Vdc	+18.5 Vdc	-1.2 Vdc	Input to 1A5Q7 & Q8 bases (LMAX)

TABLE 3-11. POWER AMPLIFIER AM-6545/GRC-193 TEST POINT/INDICATOR/OPERATION CORRELATION (Continued)

ASSEMBLY NAME	TEST POINT OR INDICATOR REF. DESIG.	TEST POINT OR INDICATOR NAME	RECEIVE MODE INDICATION	TRANSMIT MODE INDICATION	TUNE MODE INDICATION		NOTES
					LMAX	LMIN	
ALC Module Assy	1A5TP5	+19 Vdc	+19.5 Vdc	+19.5 Vdc	+19.5 Vdc	+19.5 Vdc	1A5P1-15
	1A5TP6	Output "A"	0	0	+26 Vdc	+0.3 Vdc	LMAX Drive
	1A5TP7	Output "B"	0	0	+0.2 Vdc	+18 Vdc	LMIN Drive
	1A7A2TP1	Regulated 9.3V	+8.7 Vdc	+8.7 Vdc	+8.7 Vdc	+8.7 Vdc	
	1A7A2TP2	1A7A2AR1 Pin 1	-11.5 Vdc	+1.6 Vdc	-11 Vdc	-11.5 Vdc	RF ALC
Tune Detector Module Assy	1A7A2TP3	1A7A2AR1 Pin 9	-11.5 Vdc	+1.5 Vdc	-11 Vdc	+2.0 Vdc	I _p ALC
	1A7A2TP4	Det. RF Level	0	+6.7 Vdc	0	0 to +5 Vdc	
	1A10A1TP1	Error Output B	0	-2.6 Vdc	0	-1.4 Vdc	
	1A10A1TP2	Error Output A	0	-2.4 Vdc	0	-1.4 Vdc	
	1A10A1TP3	Cathode Level	0	-3.5 Vdc	0	-2.2 Vdc	
RF Driver Module Assy	1A10A1TP4	Plate Level	0	-5 Vdc	0	-3.5 Vdc	
	1A11A1TP1	RF IN from RT	0 Vac	2.5 Vac PP	0 Vac	1.5 Vac PP	0 Vdc
	1A11A1TP2	Second Stage Output	+0.1 Vdc	+0.5 Vdc	+0.1 Vdc	-0.33 Vdc	
	1A11A1TP3	First Stage Output	+0.75 Vdc	+0.75 Vdc	+0.75 Vdc	+0.75 Vdc	
Static Power Inverter Assy	1A11A1TP4	Second Stage Output	+0.1 Vdc	+0.42 Vdc	+0.1 Vdc	+0.27 Vdc	
	1A12A1TP1	Inverter Oscillator	0.02 Vac	0.02 Vac	0.02 Vac	0.02 Vac	0 Vdc 0 to 1.5 Vac
	1A12A1TP2	Inverter Output	15 Vac	15 Vac	15 Vac	15 Vac	
High Voltage Module Assy	1A12A1TP3	Inverter Output	15 Vac	15 Vac	15 Vac	15 Vac	
	1A13A1TP1	1A13A1T1 Primary	0 Vac	4 Vac	0 Vac	3.4 Vac	
	1A13A1TP2	I _p SENSE	0	-2.9 Vdc	0	-2 Vdc	

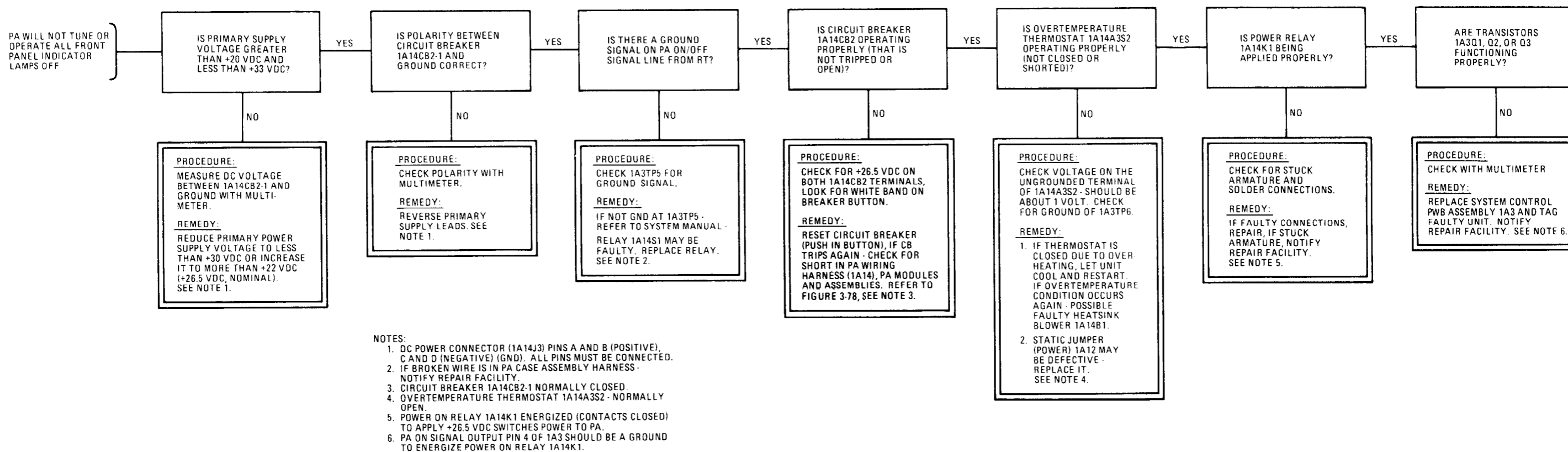
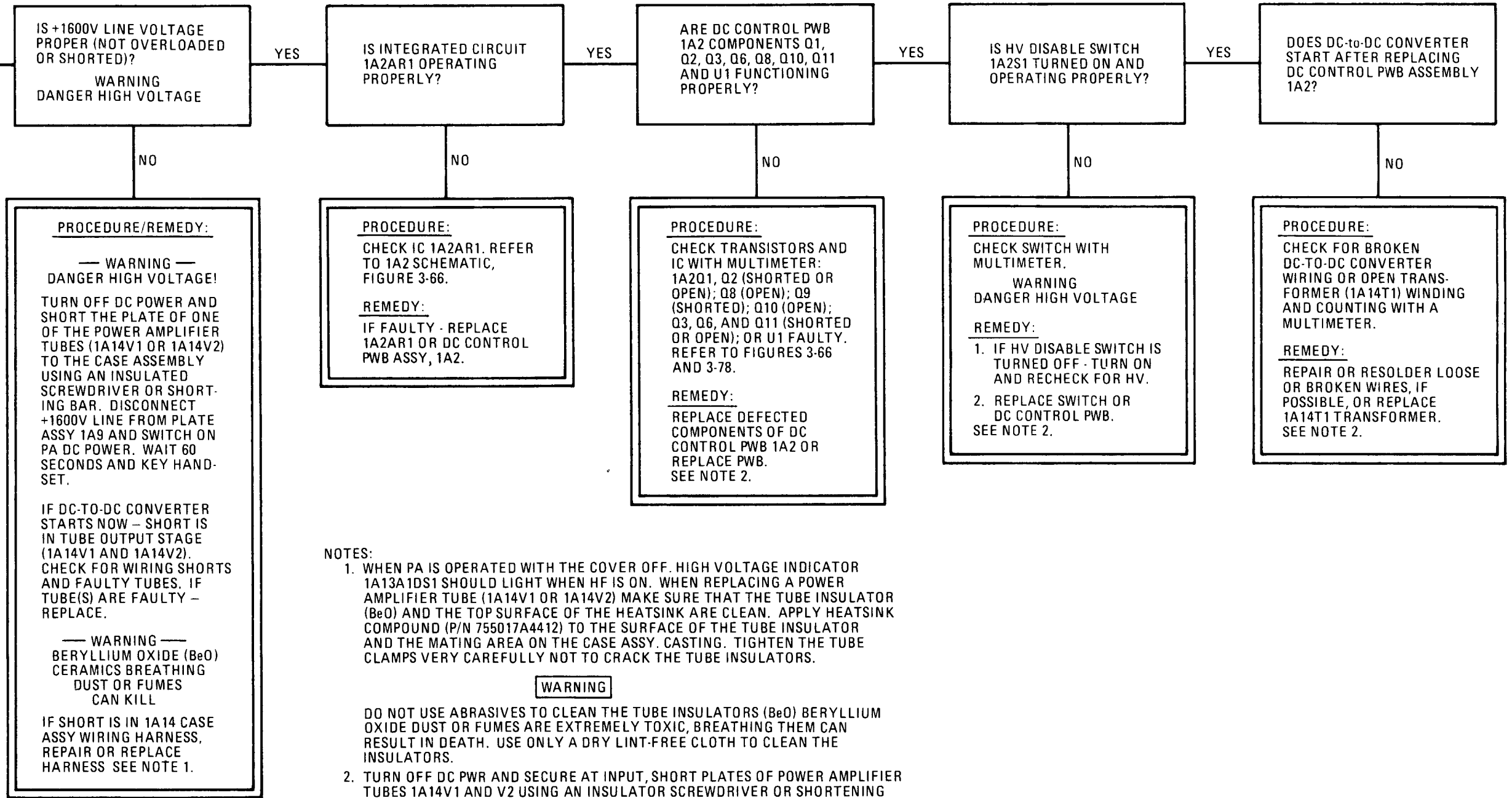


Figure 3-5. DC Power Fault Logic Diagram

NO HV INDICATION ON METER 1A14M1, HV INDICATOR LAMP 1A13A1DS1 OFF, NO AUDIBLE 2 KHZ HUM (60 SEC AFTER PRIMARY POWER IS APPLIED WHEN HANDSET IS KEYED)



NOTES:

1. WHEN PA IS OPERATED WITH THE COVER OFF. HIGH VOLTAGE INDICATOR 1A13A1DS1 SHOULD LIGHT WHEN HF IS ON. WHEN REPLACING A POWER AMPLIFIER TUBE (1A14V1 OR 1A14V2) MAKE SURE THAT THE TUBE INSULATOR (BeO) AND THE TOP SURFACE OF THE HEATSINK ARE CLEAN. APPLY HEATSINK COMPOUND (P/N 755017A4412) TO THE SURFACE OF THE TUBE INSULATOR AND THE MATING AREA ON THE CASE ASSY. CASTING. TIGHTEN THE TUBE CLAMPS VERY CAREFULLY NOT TO CRACK THE TUBE INSULATORS.

WARNING

DO NOT USE ABRASIVES TO CLEAN THE TUBE INSULATORS (BeO) BERYLLIUM OXIDE DUST OR FUMES ARE EXTREMELY TOXIC, BREATHING THEM CAN RESULT IN DEATH. USE ONLY A DRY LINT-FREE CLOTH TO CLEAN THE INSULATORS.

2. TURN OFF DC PWR AND SECURE AT INPUT, SHORT PLATES OF POWER AMPLIFIER TUBES 1A14V1 AND V2 USING AN INSULATOR SCREWDRIVER OR SHORTENING BAR BEFORE PLACING HANDS IN UNIT.

Figure 3-6. HV Fault (DC-to-DC Converter 1A13 Won't Start) Logic Diagram

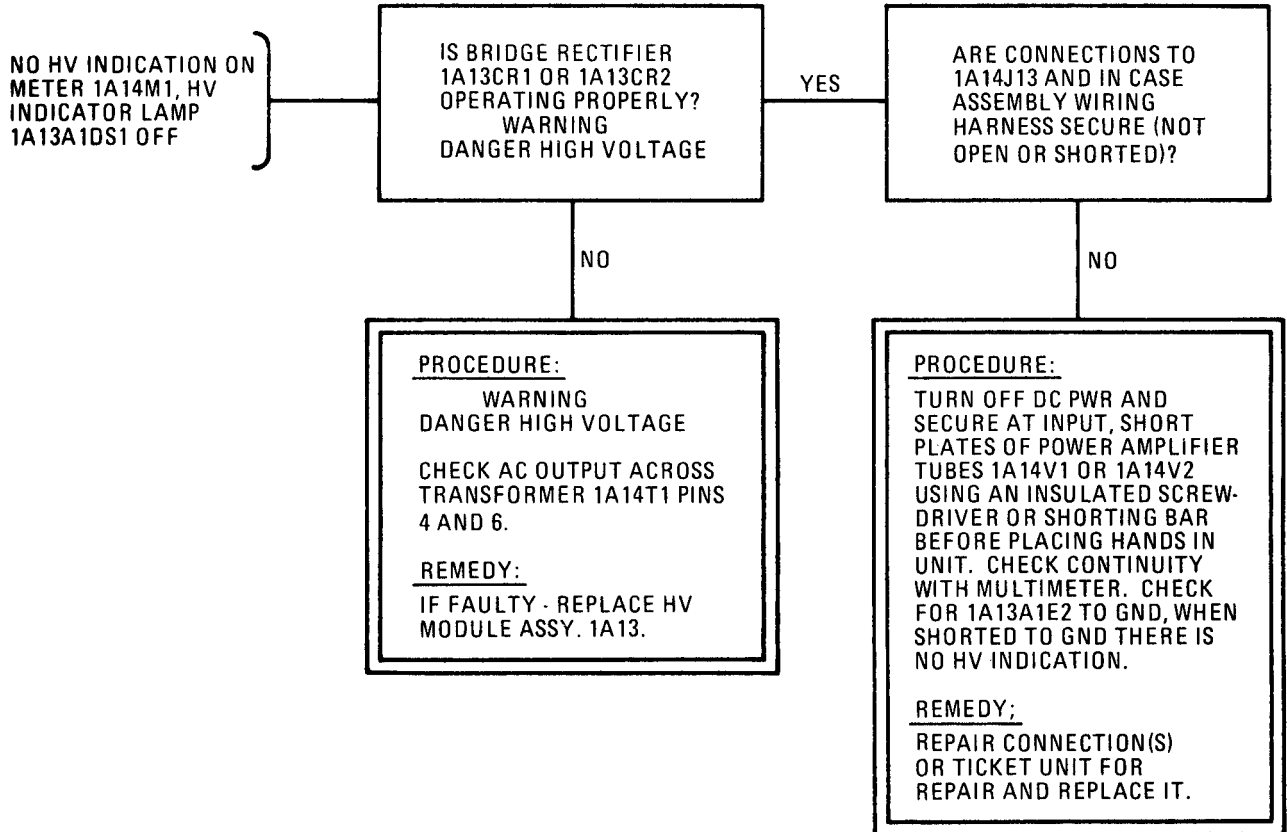


Figure 3-7. HV Fault (DC to DC Converter Starts but No. +1600V) Logic Diagram

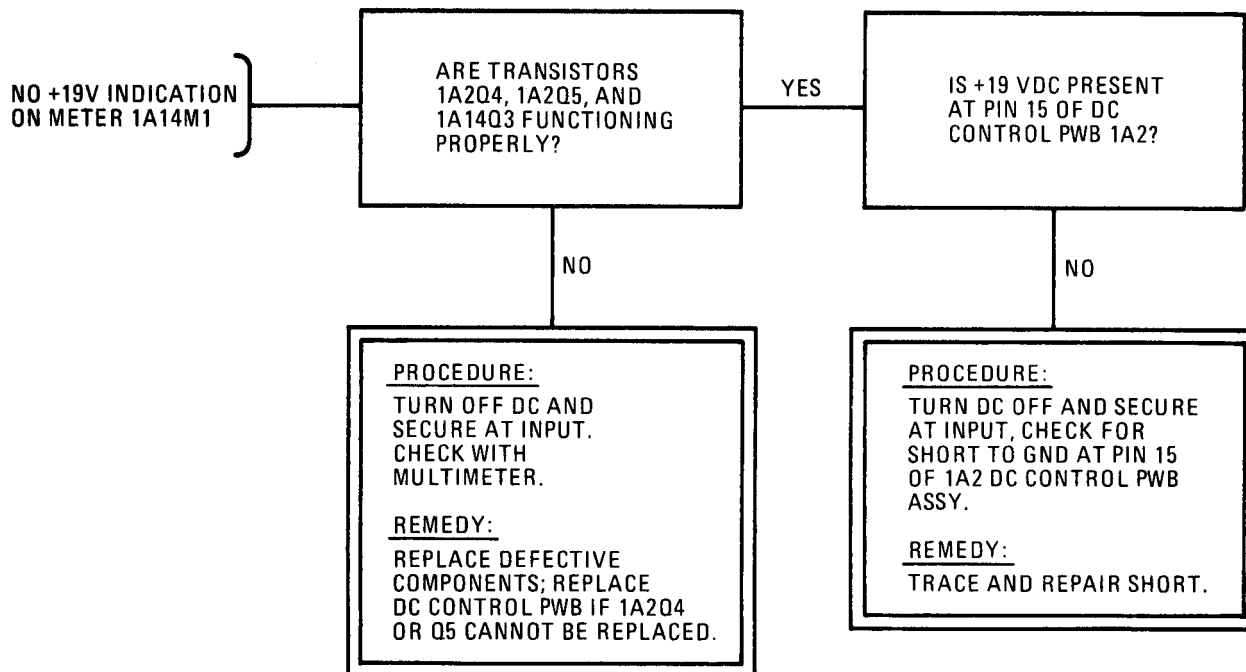


Figure 3-8. +19 Vdc Fault Logic Diagram

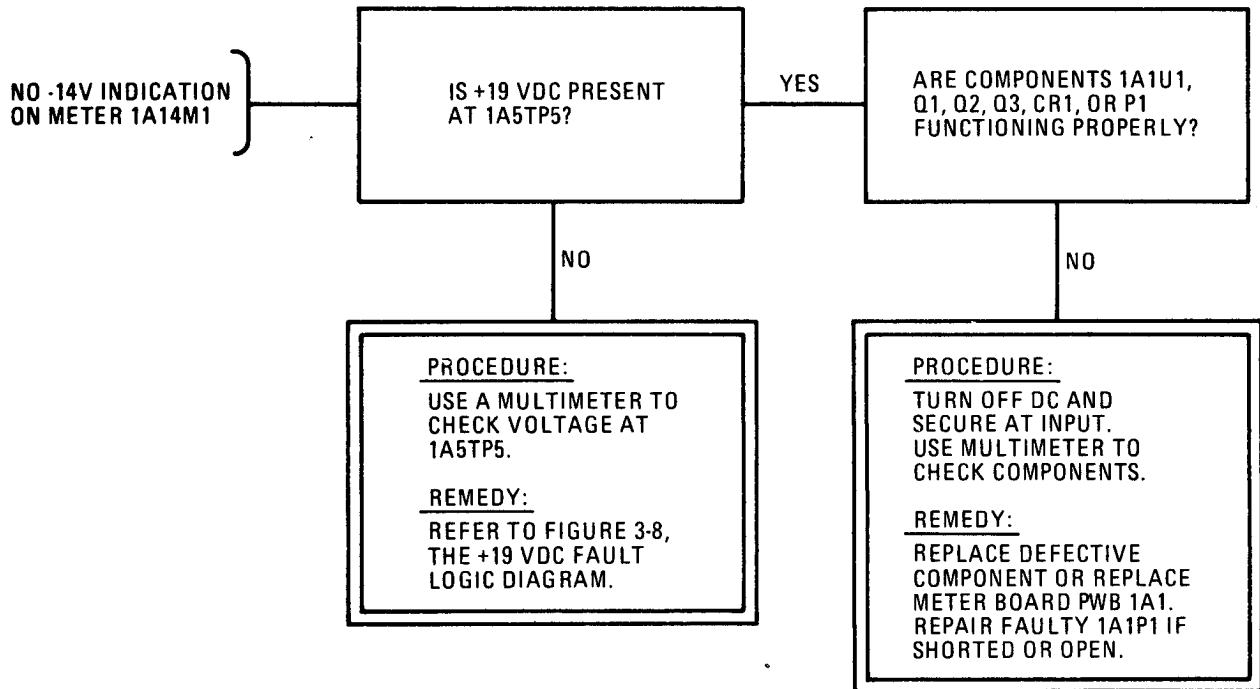


Figure 3-9. -14 Vdc Fault Logic Diagram

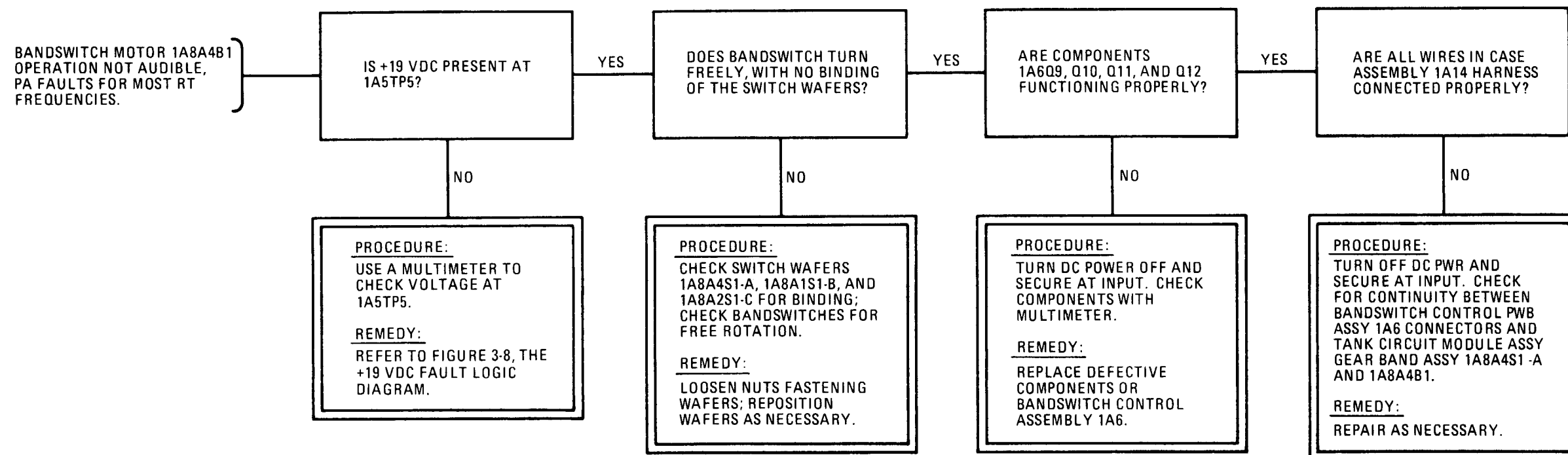


Figure 3-10. Bandswitching (Any Frequency)
Fault Logic Diagram

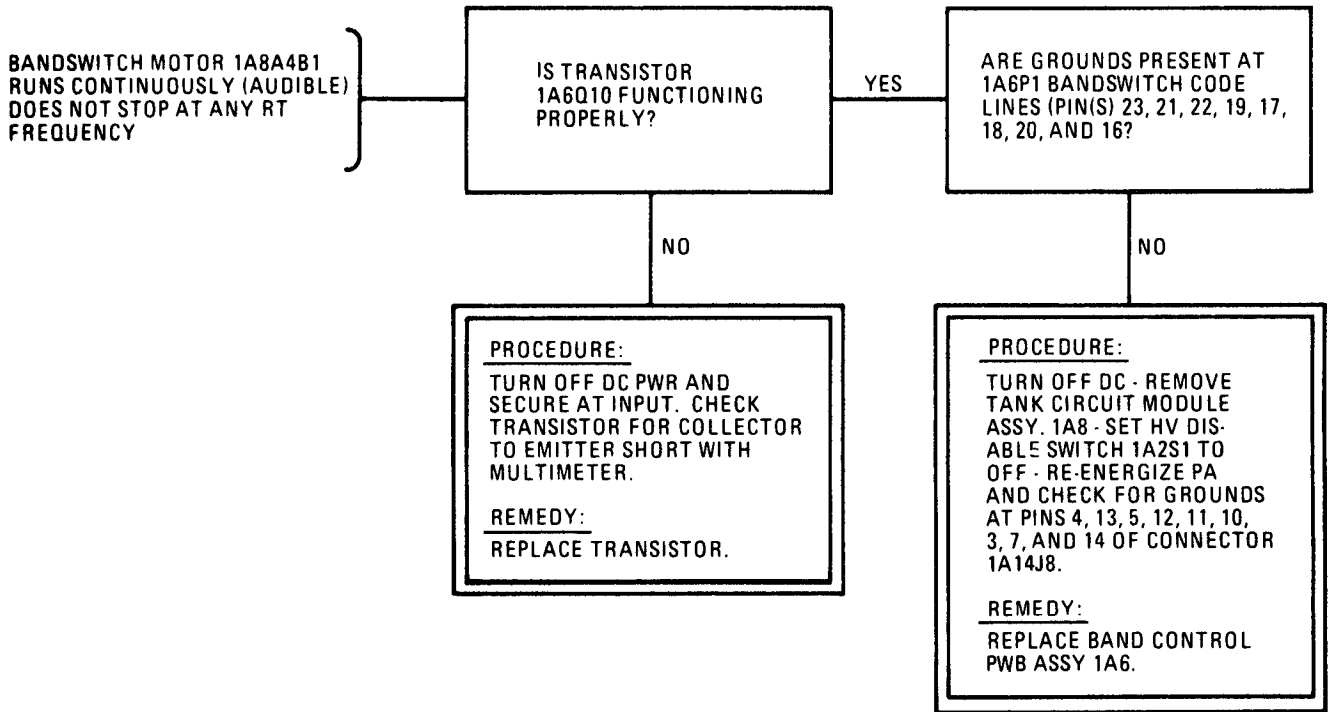


Figure 3-11. Bandswitching (Running Motor) Fault Logic Diagram

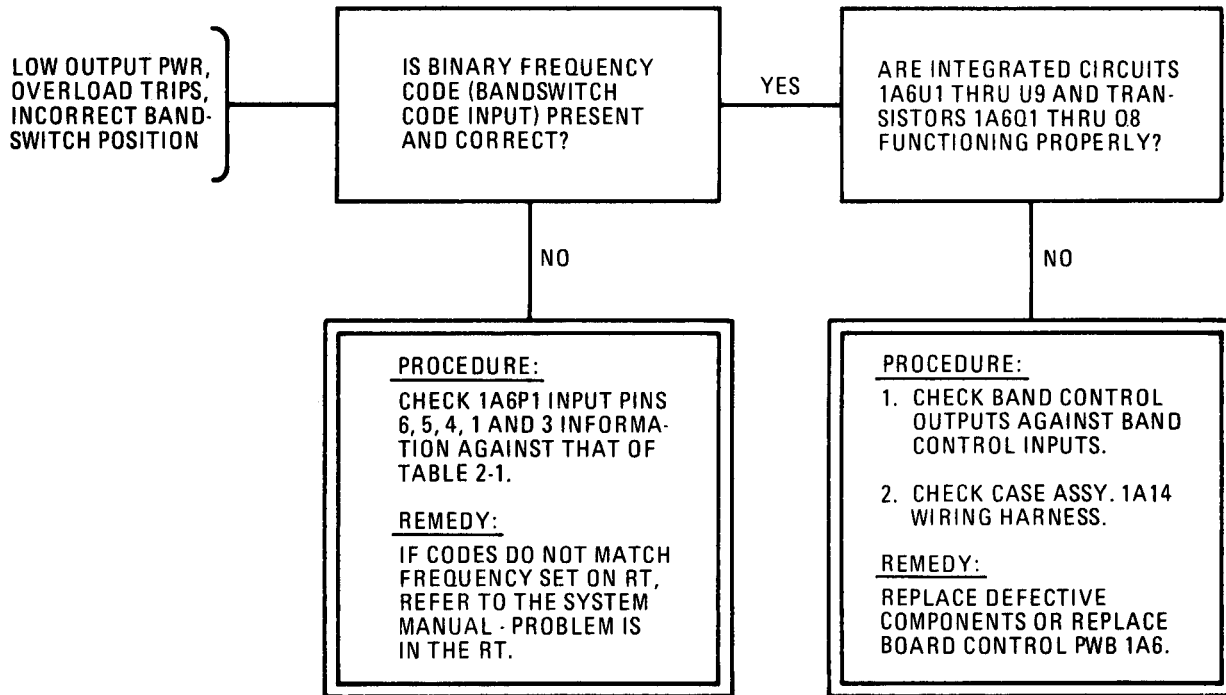
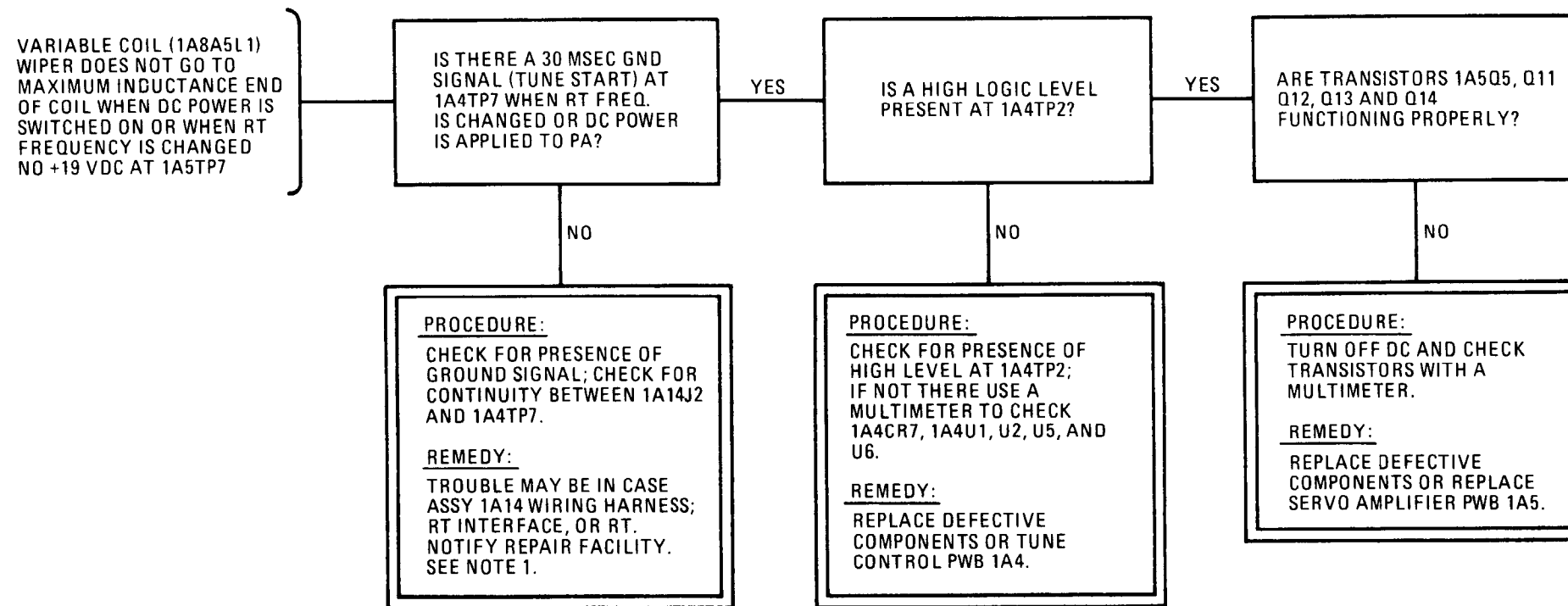


Figure 3-12. Bandswitching (Incorrect) Fault Logic Diagram



NOTES:

1. CHECK ALL PA SUPPLY VOLTAGES ON SYSTEM CONTROL PWB ASSY. 1A3, TUNE CONTROL PWB ASSY. 1A4, AND SERVO AMPLIFIER PWB ASSY. 1A5.

Figure 3-13. L MAX Force Fault Logic Diagram

VARIABLE COIL (1A8A5L1) WIPER DOES NOT START MOVING TOWARD MINIMUM INDUCTANCE END OF COIL WHEN PTT SWITCH ON HAND-SET IS KEYED - NO +19 VDC AT 1A5TP6

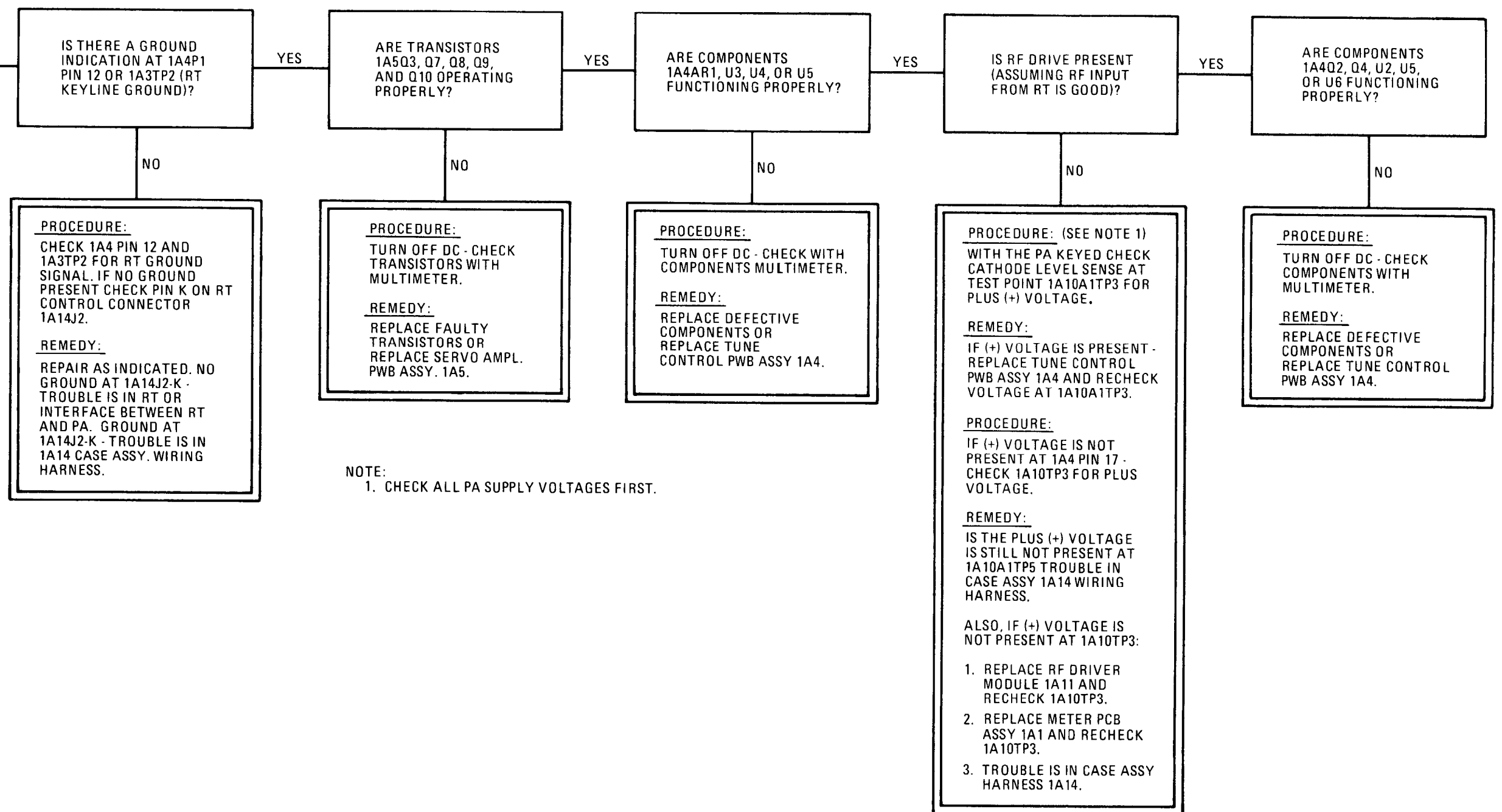
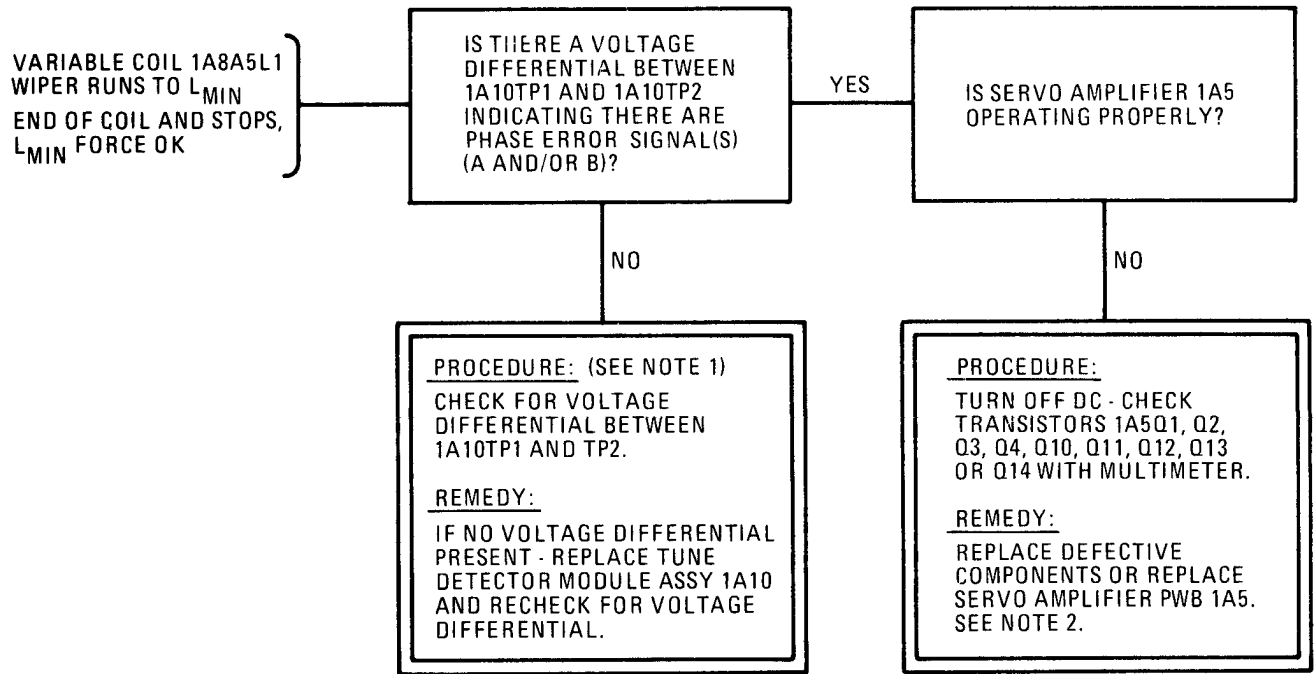


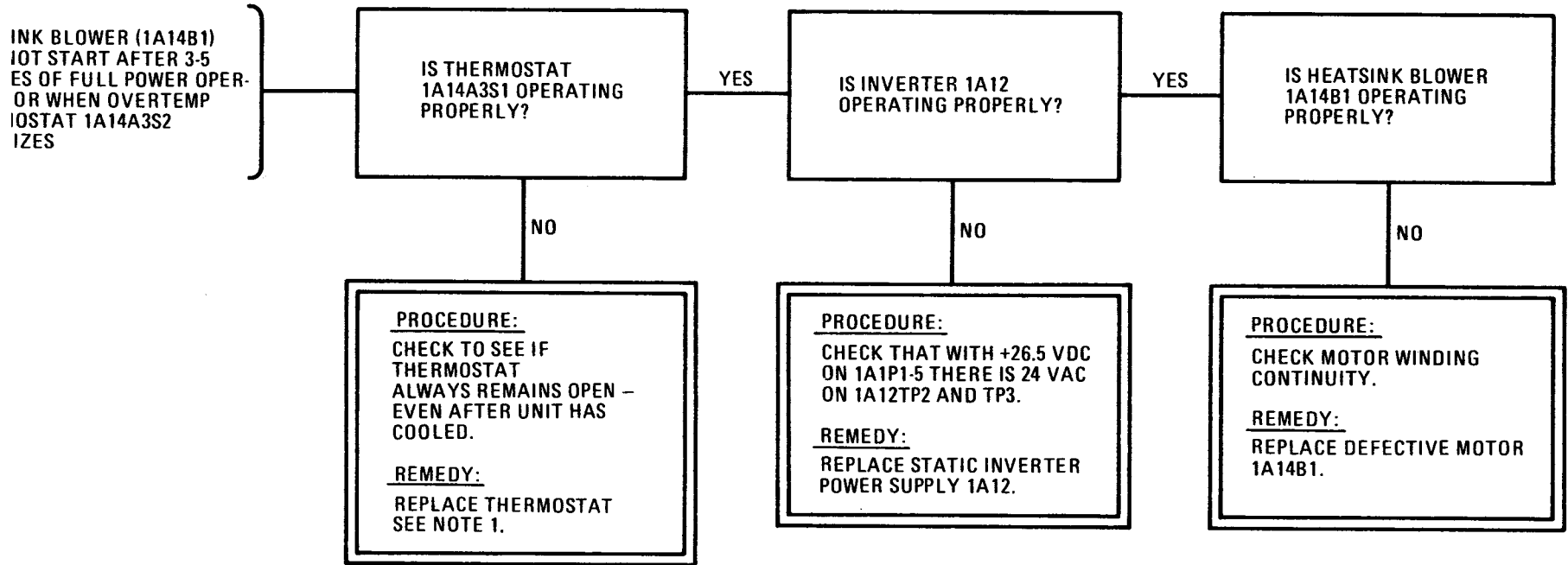
Figure 3-14. LMIN Force Fault Logic Diagram



NOTES:

1. CHECK ALL PA SUPPLY VOLTAGES TO TUNE CONTROL PWB ASSY 1A4 AND SERVO AMPLIFIER PWB ASSY 1A5, FIRST.
2. Q10, Q11, AND Q12 OK WHEN THERE IS A SAWTOOTH WAVE ON THE Q12 EMITTER WITH PA ON.

Figure 3-15. Servo Tune Fault Logic Diagram



NOTE:
 1. ALSO CHECK CASE ASSY 1A14 WIRING HARNESS WIRES
 RELATED TO BLOWER.

Figure 3-16. Heat Sink Blower Fault Logic Diagram

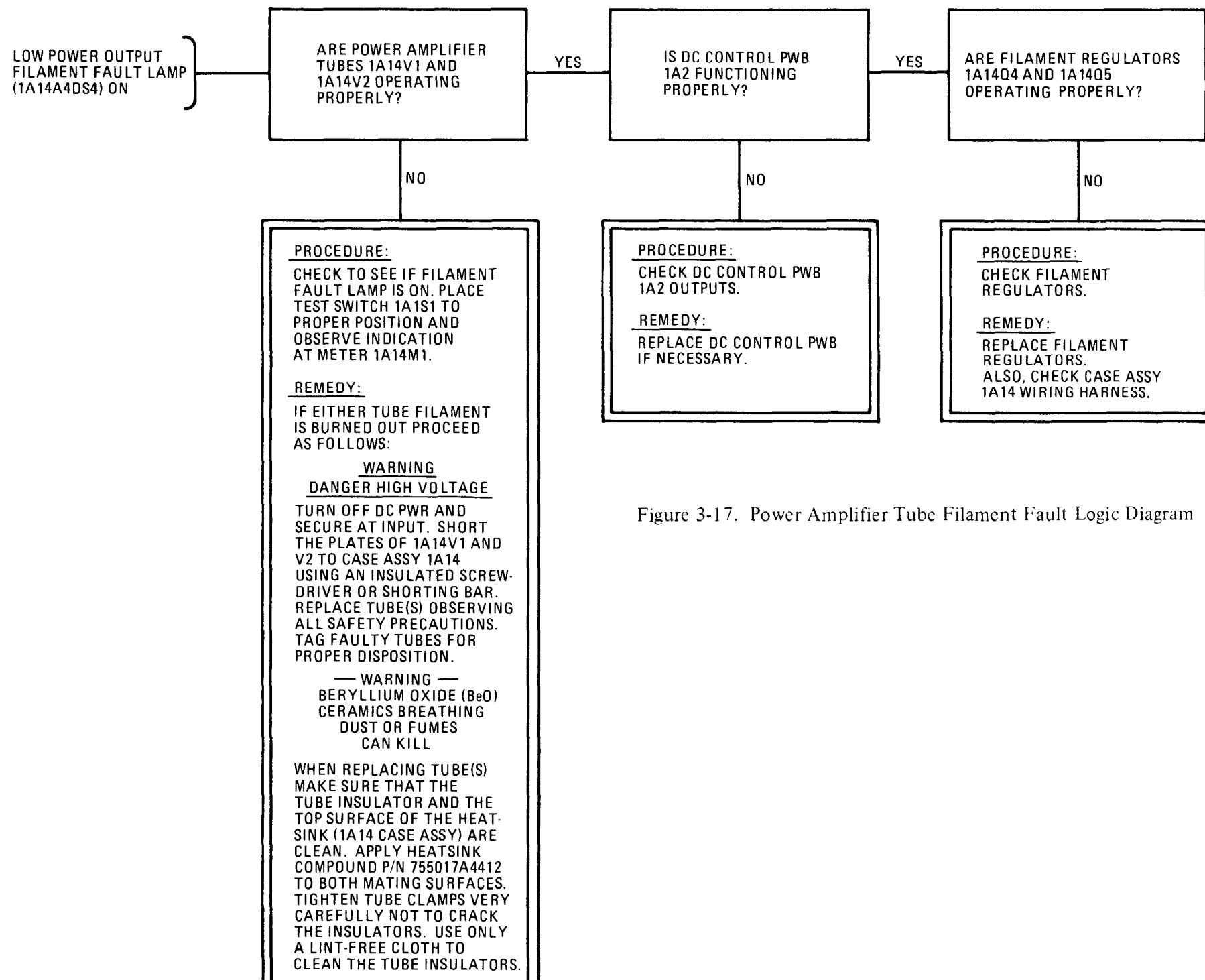


Figure 3-17. Power Amplifier Tube Filament Fault Logic Diagram

Figure 3-17. Power Amplifier Tube Filament Fault Logic Diagram

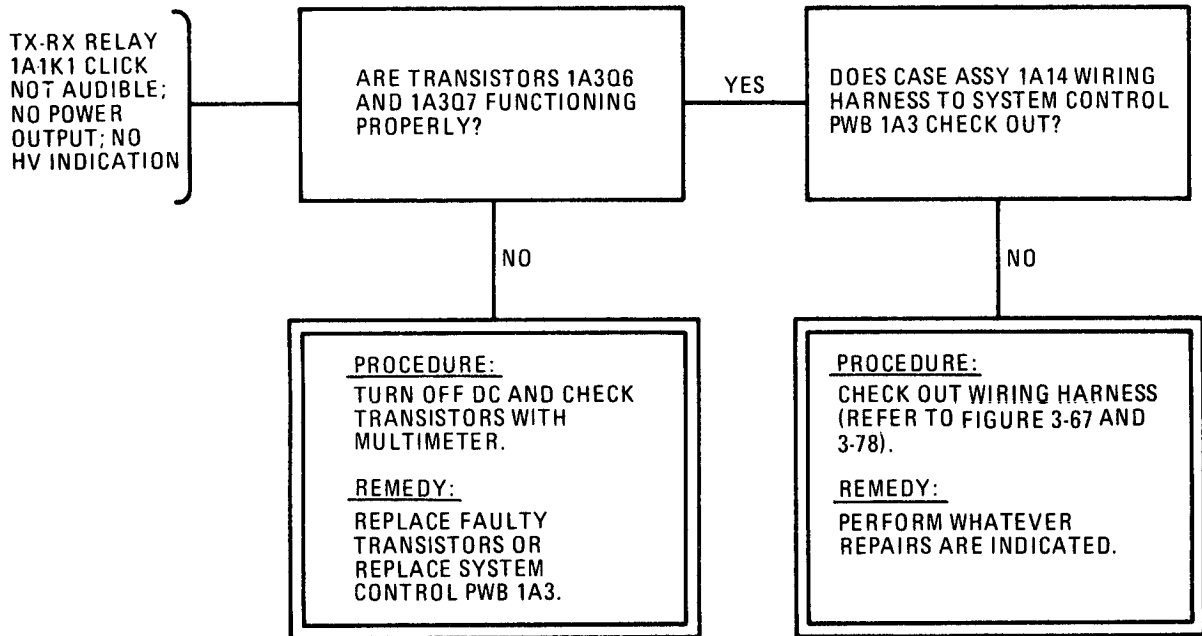


Figure 3-18. T/R Line Fault Logic Diagram

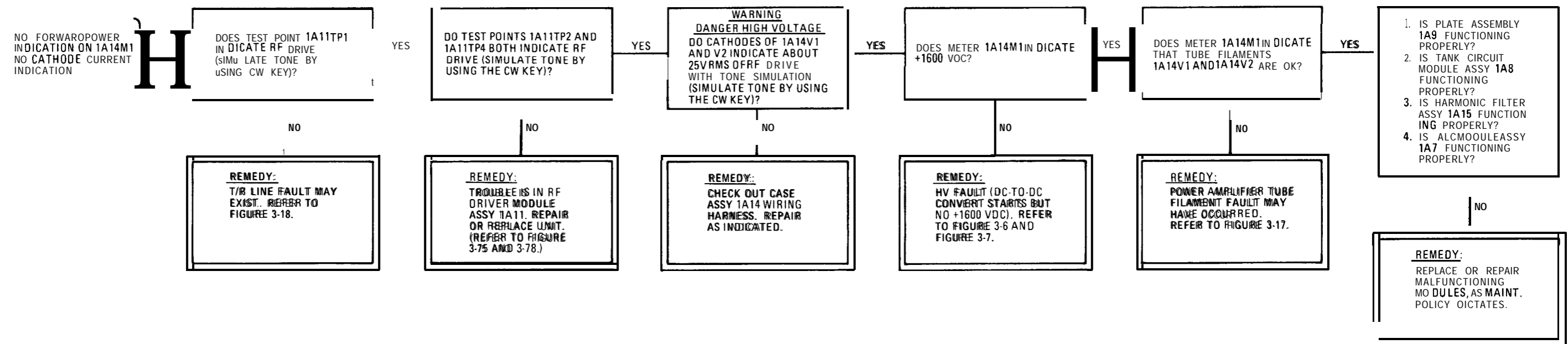


Figure 3-19. Transmit RF Fault Logic Diagram

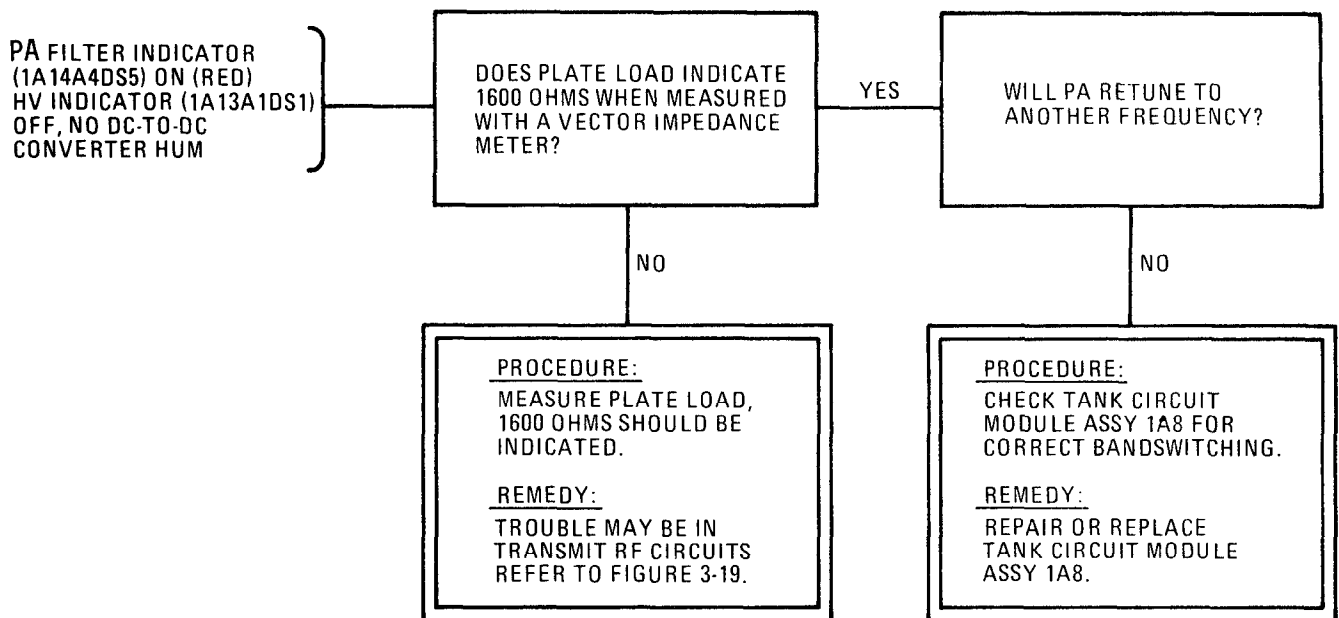


Figure 3-20. +1600 Vdc Overload Fault Logic Diagram

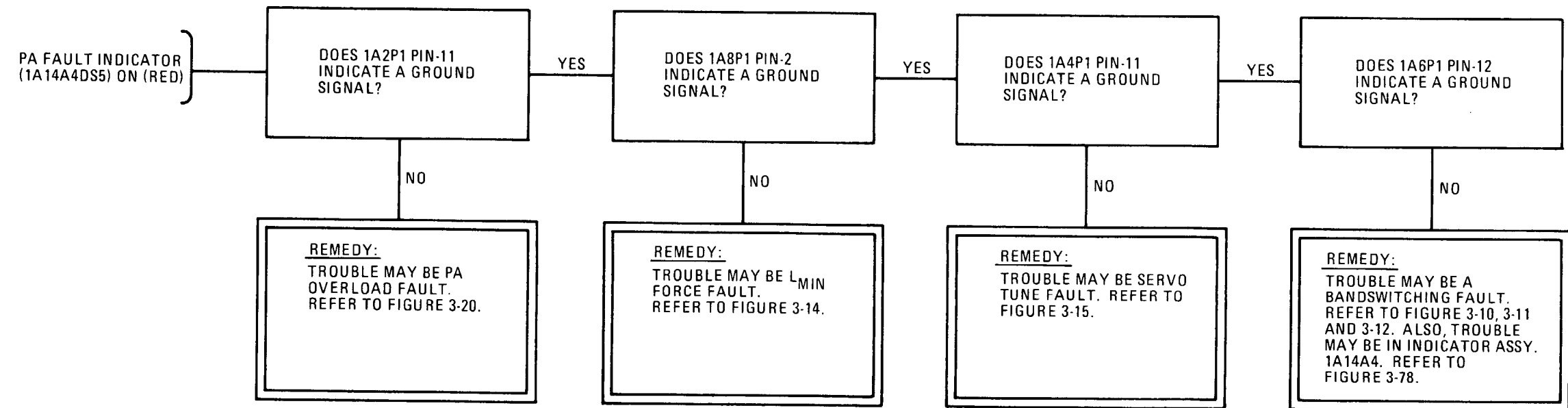


Figure 3-21. PA Fault Logic Diagram

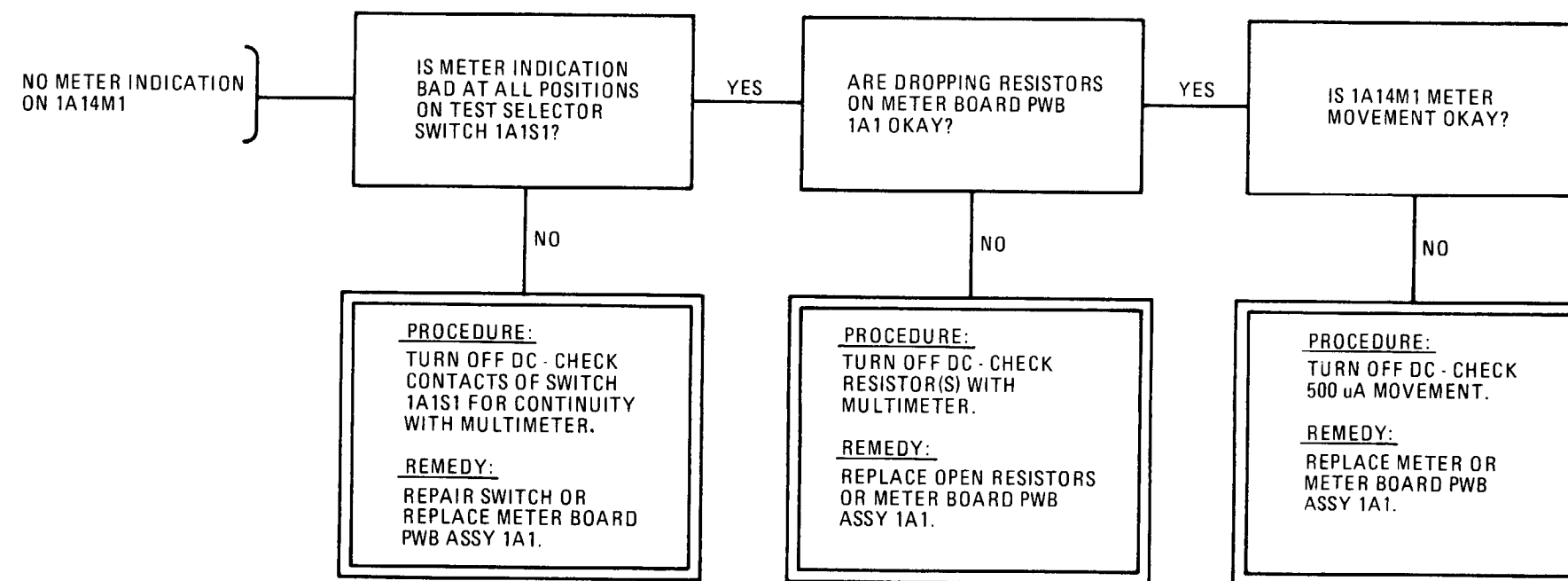


Figure 3-22. Meter 1A14M1 Fault Logic Diagram

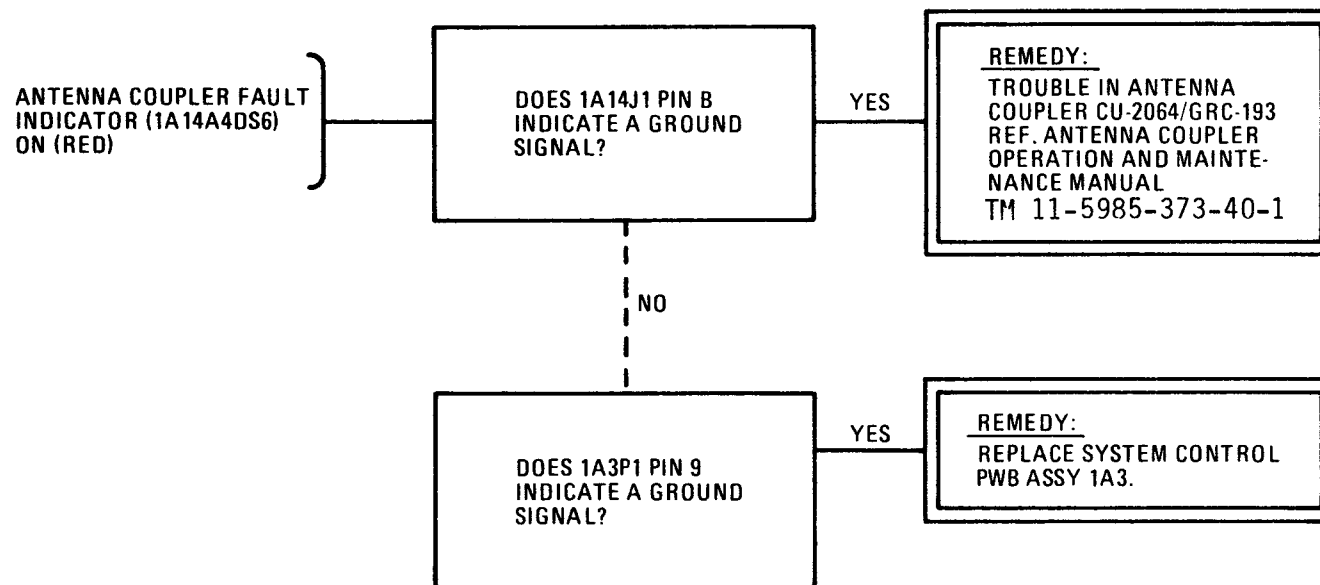


Figure 3-23. Antenna Coupler Fault Logic Diagram

3-112. HV OVERLOAD THRESHOLD ADJUSTMENT

3-113. If components of the HV overload circuit, on DC Control PWB Assembly 1A2, are replaced, the following HV OVERLOAD THRESHOLD ADJUSTMENT should be performed* (refer to figures 3-66 and 3-78).

1. Establish the adjustment setup shown in figure 3-24.
2. Adjust HV OVERLOAD THRESHOLD potentiometer 1A2R20 fully clockwise.
3. Close T/R LINE toggle switch applying a ground to 1A2P1-12.
4. HV ON indicator connected to 1A2P1-21 should illuminate (GRN).
5. Adjust potentiometer 1A2R20 counterclockwise (CCW) until OVERLOAD FAULT indicator 1A2DS1, on PWB, and OVERLOAD FAULT indicator connected to 1A2P1-11 illuminate (RED).
6. HV ON indicator connected to 1A2P1-21 should extinguish.
7. Close the TUNE START toggle switch applying a ground to 1A2P1-6.
8. Both OVERLOAD FAULT indicators should extinguish and the HV ON indicator should illuminate.
9. Open the TUNE START toggle switch, removing the ground from 1A2P1-6.
10. Both OVERLOAD FAULT indicators should re-illuminate and the HV ON indicator should extinguish.

3-114. OVER VOLTAGE (+26.5 VDC) ADJUSTMENT

3-115. If components of the +26.5 Vdc overvoltage circuit, on System Control PWB Assembly 1A3, are replaced, the following procedure should be performed (refer to figures 3-67 and 3-78).

1. Establish the adjustment setup shown in figure 3-25.
2. Close the PA ON toggle switch, applying a ground to 1A3P1-2.
3. Adjust OVER VOLTAGE potentiometer 1A3R3 fully counterclockwise.
4. Adjust variable power supply input at 1A3P1-3 to +33 Vdc \pm 1 Vdc.
5. Adjust OVER VOLTAGE potentiometer 1A3R3 clockwise until the PA ON indicator connected to 1A3P1-4 illuminates.
6. Adjust the variable power supply input at 1A3P1-3 to +26.5 Vdc; then continue adjusting toward +33 Vdc. The PA ON indicator connected to 1A3P1-4 should extinguish at +32 Vdc \pm 1 Vdc.

3-116. Ip ALC ALIGNMENT

3-117. If components are replaced on ALC PWB Assembly 1A7A2 or if resistor 1A13A1R8 and/or 1A13A1R9 are replaced, the following procedure should be performed, (refer to figures 3-71 and 3-77).

1. Establish the adjustment setup shown in figure 3-26.
2. Set the power supply for +26.5 Vdc (nominal).
3. Turn on the receiver-transmitter volume control and select 7.000 MHz, CW Mode. Observe that the power amplifier RDY (ready) lamp 1A14A4DS1 illuminates after approximately one minute.
4. Apply a CW key signal. Observe that the power amplifier tunes then stops (see TUN lamp 1A14A4DS3 on front panel).
5. Ground test point 1A7A2TP2 on the ALC Module Assembly 1A7.
6. Apply a CW key signal, Adjust Ip ALC potentiometer 1A7A2R1 for a reading of 45 amperes on the Simpson meter.
7. Remove the ground from test point 1A7A2TP2.

*For optimum performance, DC Control PWB Assembly 1A2 should be aligned in the PA in which it is intended to operate. However this procedure will align the PWB close enough for acceptable operation.

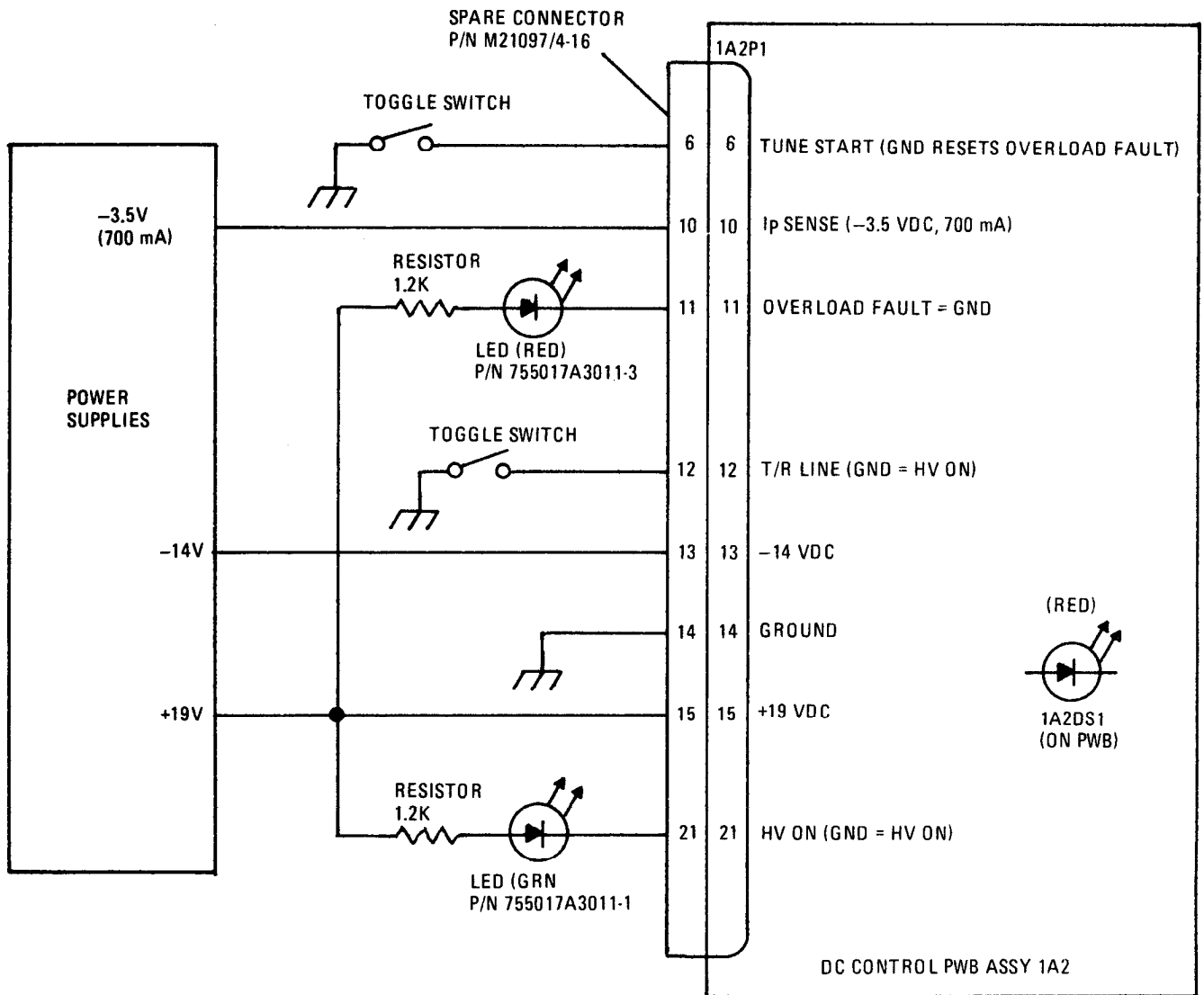


Figure 3-24. HV Overload Threshold Adjustment Setup - DC Control PWB Assy 1A2

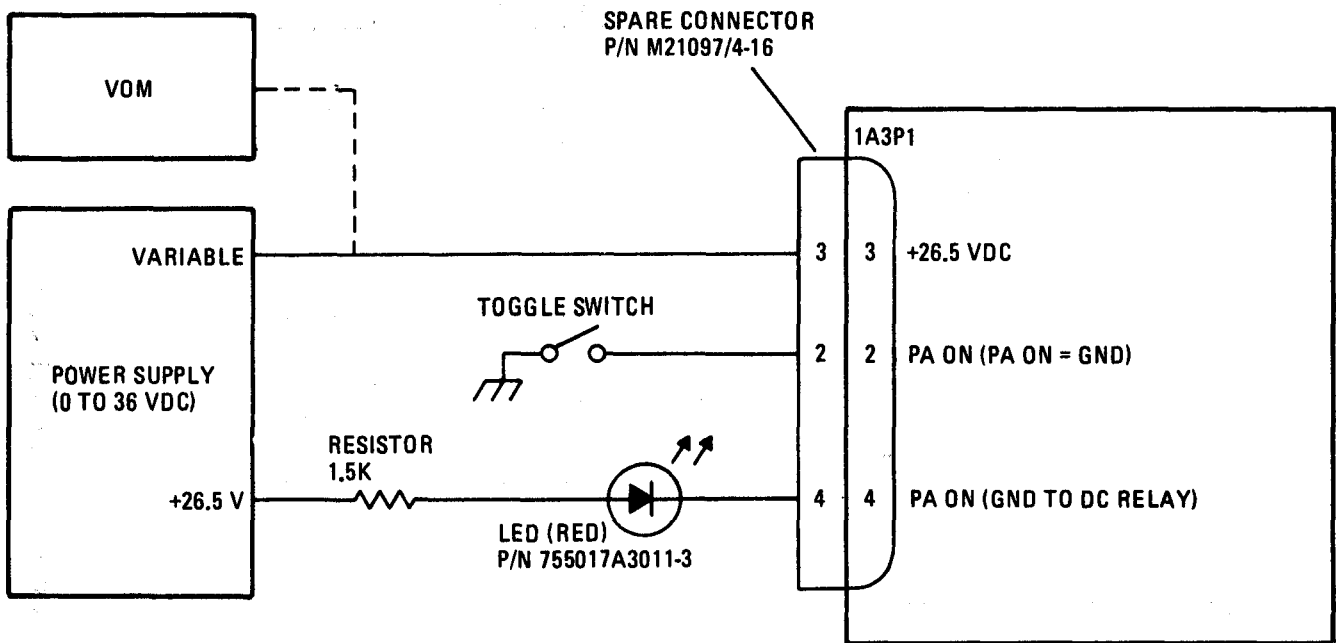


Figure 3-25. Over Voltage (+26.5 Vdc) Adjustment Setup - System Control PWB Assy 1A3

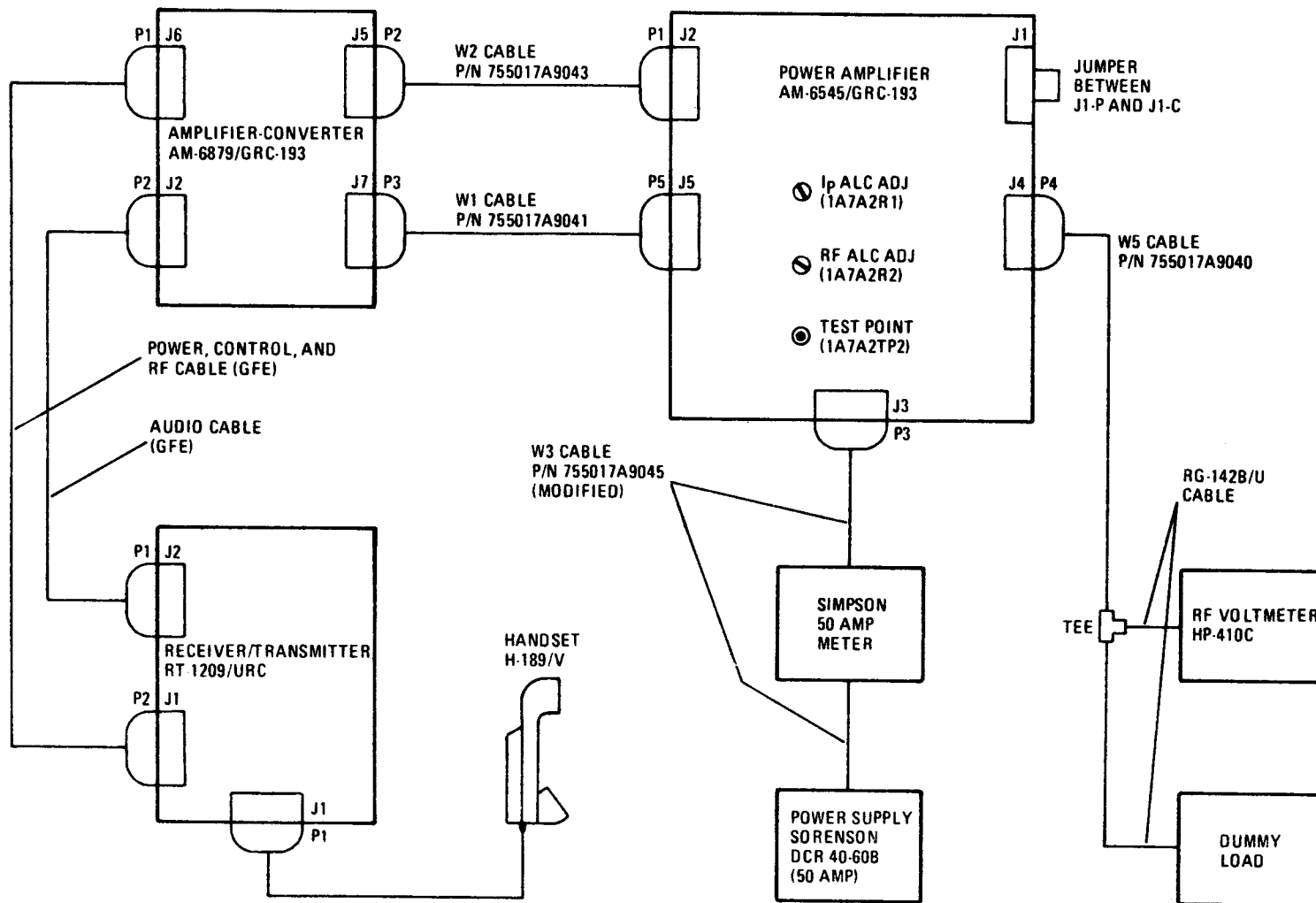


Figure 3-26. Ip ALC and RF ALC Adjustment Setup

3-118. RF ALC ALIGNMENT

3-119. If components are replaced on ALC PWB Assembly 1A7A2, the following procedures should be performed after completing the Ip ALC alignment procedure (paragraph 3-117).

1. After completing step 7 of the Ip ALC ALIGNMENT procedure, apply a CW key signal again.
2. Adjust RF ALC potentiometer 1A7A2R22 for a level of 136 volts on the HP-410C RF Voltmeter.
3. Tune the receiver-transmitter to 2.150 MHz and to 29.995 MHz. Observe that the power amplifier tunes properly with a resultant output level on the rf voltmeter of 125 to 159 volts.
4. Remove the CW key signal and de-energize the power amplifier.

3-120. 400 HZ ZERO BEAT ADJUSTMENT - STATIC POWER INVERTER ASSEMBLY 1A12

3-121. If unijunction transistor 1A12A1Q1 or potentiometer 1A12A1R14 of Static Power Inverter Assembly 1A-12 have been replaced, the following procedure must be performed (refer to figure 3-27).

1. Remove the cover (P/N 755017A4804) from Static Power Inverter Assembly 1A12 and reinsert the assembly into the Power Amplifier Case Assembly 1A14.
2. Establish the adjustment setup shown in figure 3-27.
3. Operate power amplifier in the continuous transmit mode until the 55°C thermostat 1A14A3S1 is energized.
4. Carefully adjust potentiometer 1A12A1R14 on Static Power Inverter Assembly 1A12 to obtain a 2.5 millisecond interval between the 400 Hz spikes observed on the oscilloscope.
5. De-energize the equipment and disconnect the adjustment setup.

3-122. TANK CIRCUIT MODULE ASSEMBLY 1A8 ADJUSTMENTS

3-123. Tank Circuit Module Assembly 1A8, with its associated servo motor (1A8A3B1) and end stop switches (1A8A3S1 and S2) will not require adjustment unless the assembly has been disassembled to repair or replace a damaged part. As shown in figure 3-28, the function of the L_{MAX} FORCE end stop switch 1A8A3S1 and the L_{MIN} FORCE end stop switch 1A8A3S2 is to limit the number of mechanical turns of the Variable Inductor 1A8A5L1 center shaft, thus preventing the contact attached to the shaft from running off the ends of the inductor coil assembly, damaging the rotor. The amount of travel between the end stop switches is the tuning range of inductor 1A8A5L1. The end stop switches are not adjusted to actuate at any significant value of inductance.

3-124. The following definitions and parameters apply to Tank Circuit Module Assembly 1A8:

1. The home end of the 1A8A5L1 inductor corresponds to the point of maximum inductance. This point is reached when the coil contact on the rotor assembly is rotated in a maximum counterclockwise direction looking from the 1A8A3B1 servo motor end of the assembly.
2. L_{MAX} GND is the ground signal generated when the coil (1A8A5L1) is in its home position.
3. When the automatic tune cycle is initiated, an L_{MIN} FORCE signal causes the servo system to drive the rotor of coil 1A8A5L1 clockwise until it reaches a tune position or the L_{MIN} end stop switch 1A8A3S2.
4. L_{MIN} GND is the ground signal generated when the coil (1A8A5L1) is at its minimum inductance.
5. The effective tuning range of coil 1A8A5L1 (the operating range between the end stop switches) is twenty-three revolutions of the coil contact.

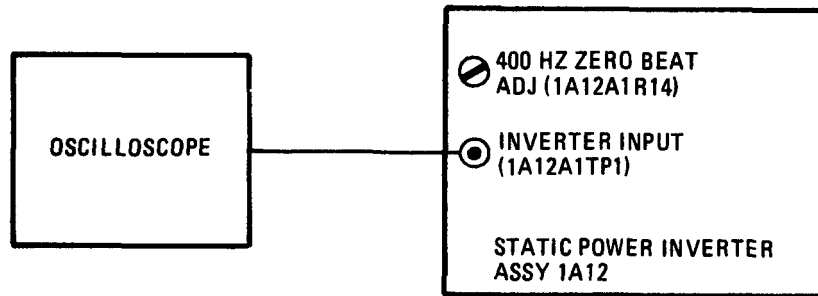
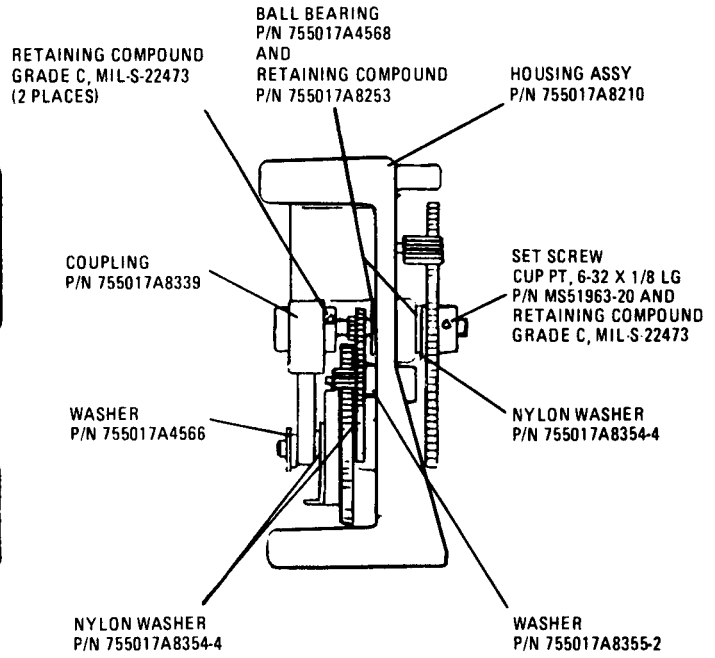
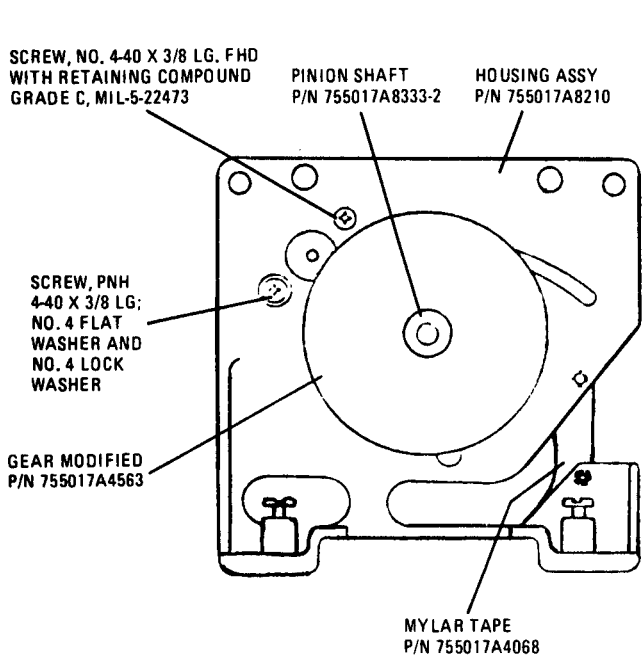


Figure 3-27. 400 Hz Zero Beat Adjustment Setup

**DETAIL A
FRONT VIEW OF COIL GEAR ASSY 1A8A3**

**DETAIL B
SIDE VIEW OF COIL GEAR ASSY 1A8A3**



**DETAIL C
COIL GEAR ASSY 1A8A3 ROTATED 180°**

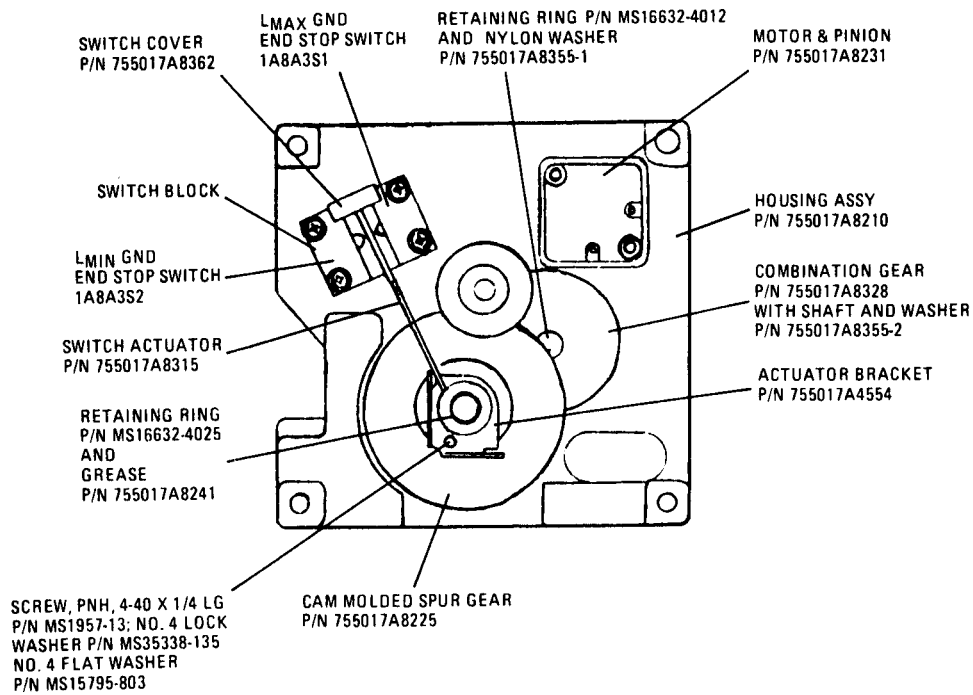


Figure 3-28. Tank Circuit Module Assy 1A8 Adjustment Detail Views

3-125. If any part of Coil Gear Assembly 1A8A3 or Coil Assembly 1A8A5 has been replaced, reset end stop switches 1A8A3S1 and S2 as follows:

1. Refer to DETAIL B of figure 3-28. With coupling (P/N 755017A8339) secured only to the coil shaft and not to the pinion shaft (P/N 755017A8333-2) shown in DETAIL A of figure 3-28, rotate the coil until the coil contact is against the mechanical stop located at the gear-train end of the coil.
2. Turn the coil rotor back 1/4 turn to locate the coil contact away from the mechanical stop and in line with the top left coil bar. Do not allow coil to turn.
3. Rotate modified gear (P/N 755017A4563), shown in DETAIL A of figure 3-28, counterclockwise (CCW) until the L_{MAX} GND end stop switch 1A8A3S1, shown in DETAIL C of figure 3-28, just clicks, and snug one of the set screws that secures coupling (P/N 755017A8339) to pinion shaft (P/N 755017A8333-2).
4. Turn the modified gear (P/N 755017A4553) clockwise to reach the other set screw. Remove the set screw and apply Loctite Grade E to the set screw hole, then reinstall the set screw securely.
5. Repeat step 4 for the other set screw.

3-126. POWER AMPLIFIER REPAIR

3-127. Repair of the power amplifier in the field can in many cases be accomplished by replacement of a faulty assembly. The replacement, described in the following paragraphs can be carried out by field maintenance activities having the proper tools and repair parts. Detailed repair of printed wiring boards should only be done by technicians trained and authorized to make such repairs, as described in paragraphs 3-119 through 3-132.

3-128. GENERAL REPAIR INFORMATION

3-129. Most power amplifier major assemblies and subassemblies are readily accessible for replacement. The removal and access instructions of paragraphs 3-15 through 3-45 apply to all major assemblies and subassemblies authorized for removal by field maintenance activities. The following standard maintenance practices should be followed:

1. Use the tools specified to prevent damage to hardware and components, and to ensure that hardware is properly tightened during reassembly.
2. When removing cables, tag each lead for easy identification at reassembly.
3. When replacing components with several connections, sketch the component connections before starting replacement.

3-130. MAJOR ASSEMBLIES DISASSEMBLY INSTRUCTIONS

3-131. The following disassembly instructions apply to ALC Module Assembly 1A7, Tune Detector Module Assembly 1A10, RF Driver Module Assembly 1A11, Static Power Inverter Assembly 1A12, and HF Module Assembly 1A13 after their removal from Case Assembly 1A14. Disassembly of Tank Circuit Module Assembly 1A8 is not authorized for Fourth Echelon Maintenance Activities.

3-132. DISASSEMBLY OF ALC MODULE ASSEMBLY 1A7

1. Refer to figure 3-36. Use a No. 1 Phillips screwdriver to loosen and remove the four cover retaining screws. Remove the cover from the frame assembly.
2. To remove Tune Load PWB Assembly 1A7A1, use a No. 1 Phillips screwdriver to loosen and remove the four retaining screws, lockwashers, and flatwashers that secure Tune Load PWB Assembly 1A7A1 to the frame assembly. Pull the pwb away from the frame assembly carefully. Access for component replacement is now available.

3. If complete removal of Tune Load PWB Assembly 1A2A1 is required, tag all leads on the board before unsoldering from pwb. Take care not to damage the coaxial leads as they are unsoldered from the pwb.
4. To remove ALC PWB Assembly 1A7A2, use a No. 1 Phillips screwdriver to loosen and remove the four retaining screws, lockwashers, and flatwashers that secure ALC PWB Assembly 1A7A2 to the frame assembly. Pull pwb away from frame assembly, tag all leads before unsoldering them from pwb.

3-133. DISASSEMBLY OF TUNE DETECTOR MODULE ASSEMBLY 1A10

1. Refer to figure 3-49. Use a No. 1 Phillips screwdriver to loosen and remove the two retaining screws that secure the cover to the frame assembly.
2. Lift cover up and off the two location tabs on top of the frame assembly.
3. Use a No. 1 Phillips screwdriver to loosen and remove the four retaining screws, lockwashers, and flatwashers that secure Tune Detector PWB Assembly 1A10A1 to the frame assembly. Carefully pull the pwb away from the frame assembly. Access for component replacement is now available.
4. If complete removal of Tune Detector PWB Assembly 1A10A1 is required, tag all leads before unsoldering from pwb.

3-134. DISASSEMBLY OR RF DRIVER MODULE ASSEMBLY 1A11

1. Refer to figure 3-51. Use a No. 1 Phillips screwdriver to loosen and remove the two retaining screws that secure the cover to the frame assembly. Lift the cover up and off the two location tabs on top of the frame assembly.
2. Use an 11/32 nutdriver (deepwell) to loosen and remove the three retaining nuts (8-32UNC-2B, plain-hexagon) and lock-spring washers that secure transistors 1A11A1Q1 through Q3 to the frame assembly.
3. Use a No. 1 Phillips screwdriver to loosen and remove the five retaining screws, lockwashers, and flatwashers that secure Driver Module PWB Assembly 1A11A1 to the frame assembly. Carefully pull the pwb away from the frame assembly. Access for component replacement is now available.
4. If complete removal of Driver Module PWB Assembly 1A11A1 is required, tag all leads before unsoldering them from pwb.

3-135. DISASSEMBLY OF STATIC POWER INVERTER ASSEMBLY 1A12

1. Refer to figure 3-53. Use a No. 1 Phillips screwdriver to loosen and remove the two cover retaining screws. Remove the cover.
2. Use a No. 1 Phillips screwdriver to loosen and remove the two board retaining screws, lockwashers, and flatwashers. Also loosen and remove the four board plate retaining screws, lockwashers, flatwashers and hex nuts on the side of the frame assembly.
3. Carefully pry Inverter Module PWB Assembly 1A12A1 and Transistor Mounting Bracket away from frame assembly. Access for component replacement is now available.

Note

Remove any traces of heat sink compound from transistor mounting bracket and frame assembly. The heat sink compound (P/N 755017A4412) will be replaced at reassembly.

4. If complete removal of Inverter Module PWB Assembly 1A12A1 is required, tag all leads before unsoldering from pwb.

3-136. DISASSEMBLY OF HIGH VOLTAGE MODULE ASSEMBLY 1A13

1. Refer to figure 3-55. Use a No. 1 Phillips screwdriver to loosen and remove the four cover retaining screws that secure the cover to the frame assembly. Remove cover.
2. Use a No. 1 Phillips screwdriver to loosen and remove the four PWB retaining screws, lockwashers, and flatwashers that secure High Voltage Module PWB Assembly 1A13A1 to the frame assembly. The pwb can now be lifted away from the frame assembly for component replacement. If complete removal of the pwb is required, tag all leads before unsoldering from pwb.
3. Use a No. 1 Phillips screwdriver and a four-inch adjustable wrench to loosen and remove the two rectifier retaining screws, four flatwashers, two lockwashers, and two hex nuts that secure rectifier sub-assemblies 1A13CR1 and CR2 to the frame assembly. If complete removal of the rectifier sub-assemblies is required, tag all leads before unsoldering.
4. Use a No. 1 Phillips screwdriver to loosen the captive screw that secures the capacitor clamp to the frame assembly. Remove the capacitor clamp and its captive screw. Fixed capacitor 1A13C1 is now free from the frame assembly. For complete removal of capacitor 1A13C1, tag the leads, and use a four-inch adjustable wrench to loosen and remove the two hex nuts and flatwashers that secure the wiring harness terminal lugs to the capacitor posts. Slip the terminal lug off the capacitor posts.

3-137. COMPONENT LOCATION DRAWINGS

3-138. Figures 3-29 through 3-64 comprise the component location drawings applicable to all power amplifier assemblies and sub-assemblies. Refer to these drawings as necessary for component location and orientation information. Table 3-12 presents a cross-reference of power amplifier subassembly component/schematic illustrations and their applicable reference designations and part numbers.

3-139. PARTS REPAIR AND REPLACEMENT PROCEDURES

3-140. The following information and procedures should be followed when replacing components or repairing pcb/pwb assemblies.

1. Use a pencil-type soldering iron with a 25-watt maximum capacity. If only ac-operated soldering irons are available, use an isolation transformer.

CAUTION

Do not use a high wattage soldering gun for printed wiring board repair. A high wattage gun can induce damaging voltages into the components and will reach a very high temperature in a few seconds, causing damage to the components and/or printed circuit/wiring boards.

2. When soldering solid-state devices, solder them quickly. Where space permits, use a heat sink (such as an alligator clip or needle-nose pliers) between the joint to be soldered and the component lead to conduct heat away from the component.
3. Excessive heat or pressure can cause the pcb/pwb copper runs to lift from the board. If this should occur, re-cement the strip in place using a quick-drying acetate base cement or an epoxy resin having good electrical insulating properties.
4. A break in the copper or copper strip of a pcb/pwb can be repaired by soldering a short length of tinned copper wire across the break.
5. Use only high quality resin core solder when repairing printed circuit/wiring boards. Never use acid core solder or paste flux.

TABLE 3-12. COMPONENT LOCATION/SCHEMATIC DIAGRAM ILLUSTRATION CROSS-REFERENCE

NAME	PART NO. 755017A	REF. DESIG.	COMP LOC. DWG. NO.	SCH. DWG. NO.	OTHER INFO. FIG. NO.
Power Amplifier AM-6545/GRC-193	3000	1	3-29	---	1-1, 1-4
Meter Board PWB Assembly	4210	1A1	3-30	3-65	2-2, 2-3, 2-9
DC Control PWB Assembly	4220	1A2	3-31	3-66	2-9
System Control PWB Assembly	4230	1A3	3-32	3-67	2-4, 2-9
Tune Control PWB Assembly	4240	1A4	3-33	3-68	2-9
Servo Amplifier PWB Assembly	4250	1A5	3-34	3-69	2-9
Band Control PWB Assembly	4260	1A6	3-35	3-70	2-9
ALC Module Assembly	4600	1A7	3-36	3-71	2-2, 2-3, 2-5
Tune Load PWB Assembly	4620	1A7A1	3-37	3-71	2-2, 2-3
ALC PWB Assembly	4610	1A7A1	3-38	3-71	
Tank Circuit Module Assembly	4500	1A8	3-39	3-72	2-3, 3-3
Input CAP PWB Assembly	4510	1A8A1	3-40	3-72	2-3
Output CAP PWB Assembly	4520	1A8A2	3-41	3-72	2-3
Coil Gear Assembly	4550	1A8A3	3-42	3-72	2-3
Bandswitch Gear Assembly	4540	1A8A4	3-43	3-72	2-3
Coil Assembly	4530	1A8A5	3-44	3-72	2-3
Plate Assembly	3900	1A9	3-45	3-73	2-3, 2-8
Plate Choke "A" PCB Assembly	3910	1A9A1	3-46	3-73	---
Plate Choke "B" PWB Assembly		1A9A2	3-47	3-73	---
Plate Choke "C" PWB Assembly		1A9A3	3-48	3-73	---
Tune Detector Module Assembly	4800	1A10	3-49	3-74	2-7, 2-8
Tune Detector PWB Assembly	4810	1A10A1	3-50	3-74	---
RF Driver Module Assembly	4700	1A11	3-51	3-75	2-3, 2-5
Driver Module PWB Assembly	4710	1A11A1	3-52	3-75	---
Static Power Inverter Assembly	4900	1A12	3-53	3-76	---
Inverter Module PWB Assembly	4910	1A12A1	3-54	3-76	---
High Voltage Module Assembly	4300	1A13	3-55	3-77	2-5, 2-11
High Voltage Module PWB Assembly	4310	1A13A1	3-56	3-77	2-11
Case Assembly	4000	1A14	3-29	3-78	2-4
Interconnection PWB Assembly	4270	1A14A1	3-57	3-78	2-2, 2-3, 2-5, 2-9
Tube Socket Assembly	4400	1A14A1	3-58	3-78	2-3, 2-7
DC-DC Converter Assembly	4100	1A14A3	3-59	3-78	2-5, 2-11
Indicator Assembly	3800	1A14A4	3-60	3-78	---
Indicator PCB Assembly	3810	1A14A4A1	3-60	3-78	---
Junction Block PWB	4041	1A14A5	3-61	3-78	2-5
Regulator Assembly	4031	1A14A6	3-62	3-78	2-9
Component Bracket Assembly	4064	---	3-63	3-78	---
Harmonic Filter Assembly	4070	1A15	3-64	3-79	2-3

6. When removing components from a pcb/pwb, apply heat sparingly to the lead of the part to be replaced. Remove the part from the board as the soldering heats the lead. Use an awl to clean the component mounting holes prior to replacing component.
7. Tin the leads of the replacement part. Align the leads with the pcb/pwb holes and carefully insert the component. Bend the leads close to the pcb/pwb foil and cut them that approximately one-sixteenth of an inch of lead protrudes below the board surface to be soldered. Hold the component against the board and quickly solder the leads.

3-141. REPLACEMENT OF CONNECTORS

3-142. Any damaged Case Assembly 1A14 Connectors (J1, J2, J3, J4, or J5) should be repaired at the nearest Depot Maintenance Facility. Other connectors can be replaced at a field maintenance facility. Proceed as follows:

1. Remove connector from applicable mounting.
2. Unsolder and tag each connector wire and discard defective connector.
3. Resolder wires to new connector.
4. Reassemble new connector to applicable mount.

3-143. REPLACEMENT OF POWER-ON RELAY 1A14K1

3-144. Prior to performing the subsequent operations, note and sketch orientation of relay terminals and connecting wires.

1. Refer to Detail B of figure 3-29 and figure 3-63. Use a short No. 1 Phillips screwdriver and a four-inch adjustable wrench to loosen and remove the two component bracket retaining screws, lockwashers, and hex nuts that secure the component bracket to the card cage assembly, after the pwb's have been removed from the card cage assembly.
2. Remove the card cage assembly as described in paragraph 3-31.
3. Carefully lift the component bracket and wiring harness up high enough for accessibility.
4. Use a No. 1 Phillips screwdriver to loosen and remove the relay terminal retaining screw and lockwashers that secure all leads to the relay. Disconnect all leads from the relay.
5. Use a No. 1 Phillips screwdriver to loosen the relay retaining screw (on the back of the component bracket) that secures the relay to the component bracket. Remove the relay retaining screw and the relay.
6. Reassemble the new relay to the component bracket in the reverse order of disassembly.

3-145. REPLACEMENT OF INDUCTOR ASSEMBLY 1A14L1

3-146. Prior to performing the subsequent operations, note and sketch orientation of inductor connections.

1. Refer to figure 3-63. Use a short No. 1 Phillips screwdriver and a four-inch adjustable wrench to loosen and remove the two component bracket retaining screws, lockwashers, and hex nuts that secure the component bracket to the card cage assembly, after the pwb's have been removed.
2. Remove the card cage assembly as described in paragraph 3-34.
3. Carefully lift the component bracket and wiring harness up high enough for accessibility.
4. Use a No. 1 Phillips screwdriver and a four-inch adjustable wrench to loosen and remove the hardware connecting the inductor leads to relay 1A14K1 and the small transformer pcb.
5. Use a No. 1 Phillips screwdriver and a four-inch adjustable wrench to loosen and remove the inductor retaining hardware that secures the inductor assembly to the component bracket. Remove the inductor assembly.
6. Reassemble the new inductor assembly in the reverse order of disassembly.

3-147. REPLACEMENT OF CAPACITOR 1A14C1 AND 1A14C2

3-148. Prior to performing the following operations, note and sketch orientation of capacitor connections.

1. Refer to figure 3-63. Use a short No. 1 Phillips screwdriver and a four-inch adjustable wrench to loosen and remove the two component bracket retaining screws, lockwashers, and hex nuts that secure the component bracket to the card cage assembly, after the pwb's have been removed.
2. Remove card cage assembly as described in paragraph 3-31.
3. Carefully, lift the component bracket and wiring harness up high enough for accessibility.
4. Use a No. 1 Phillips screwdriver to loosen and remove the two No. 10-32 x 7/16 screws and No. 10 lockwashers that secure the two dc power cable assemblies to the 1A14C1 and C2 capacitors. Remove the dc power cable assemblies from the capacitors.
5. Unsolder capacitor 1A14C2 from the two No. 10 terminal lugs and resolder the new 1A14C2 capacitor to the terminal lugs.
6. Use a No. 1 Phillips head screwdriver to loosen the capacitor retaining screw on the capacitor clamp. Remove the 1A14C1 capacitor.
7. Reassemble the new 1A14C1 and C2 capacitors in the reverse order of disassembly.

3-149. CLEANING REPLACEMENT COMPONENTS

3-150. No special cleaning procedures apply to replacement components; however make sure that adjoining areas on pcb/pwb assembly tracks, connectors and cable wiring are not shorted by excess solder or solder globules.

3-151. REASSEMBLY AND/OR REINSTALLATION INSTRUCTIONS

3-152. Replacement and reassembly of detailed parts or subassemblies are described in paragraphs 3-139 through 3-150. Tighten the cover assembly captive retaining screws with a 3-inch flat-bladed screwdriver. Reconnect the connectors removed, as applicable. For specific reassembly and reinstallation instructions that cover non-obvious steps refer to the following.

1. General - Do not overtorque assembly hardware, as damage to threads and bushings may result.



Power tubes 1A14V1 and V2 contain Beryllium Oxide Ceramics. Never alter, disassemble, grind, lap, fire, chemically clean, or perform any other operation on any ceramic parts of the power tubes which could possibly generate dust or fumes. BREATHING THE DUST OR FUMES CAN KILL.

2. If a power tube is found bad and replaced, refer to separate instructions for disposal.

3-153. OPERATIONAL CHECKOUT

3-154. Refer to chapter 3 of the Systems Manual TM 11-5820-924-12 for applicable operational checkout.

3-155. SCHEMATIC DIAGRAMS

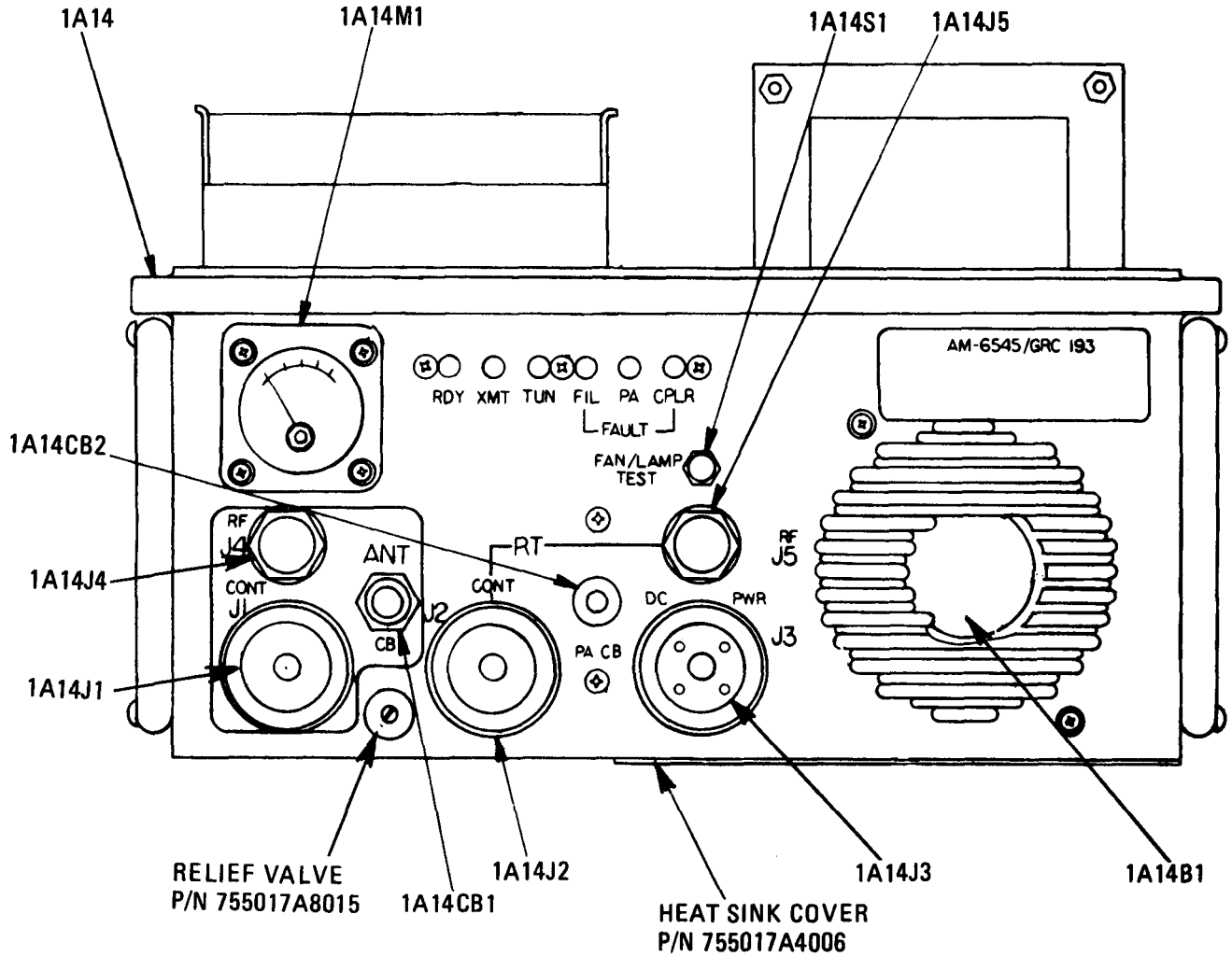
3-156. Figures 3-65 through 3-79 comprise schematic diagrams for the power amplifier. Table 3-12 is a cross-reference of power amplifier subassembly component/schematic illustrations and their applicable designations and part numbers.

SECTION VI

CARE AND PREPARATION FOR STORAGE

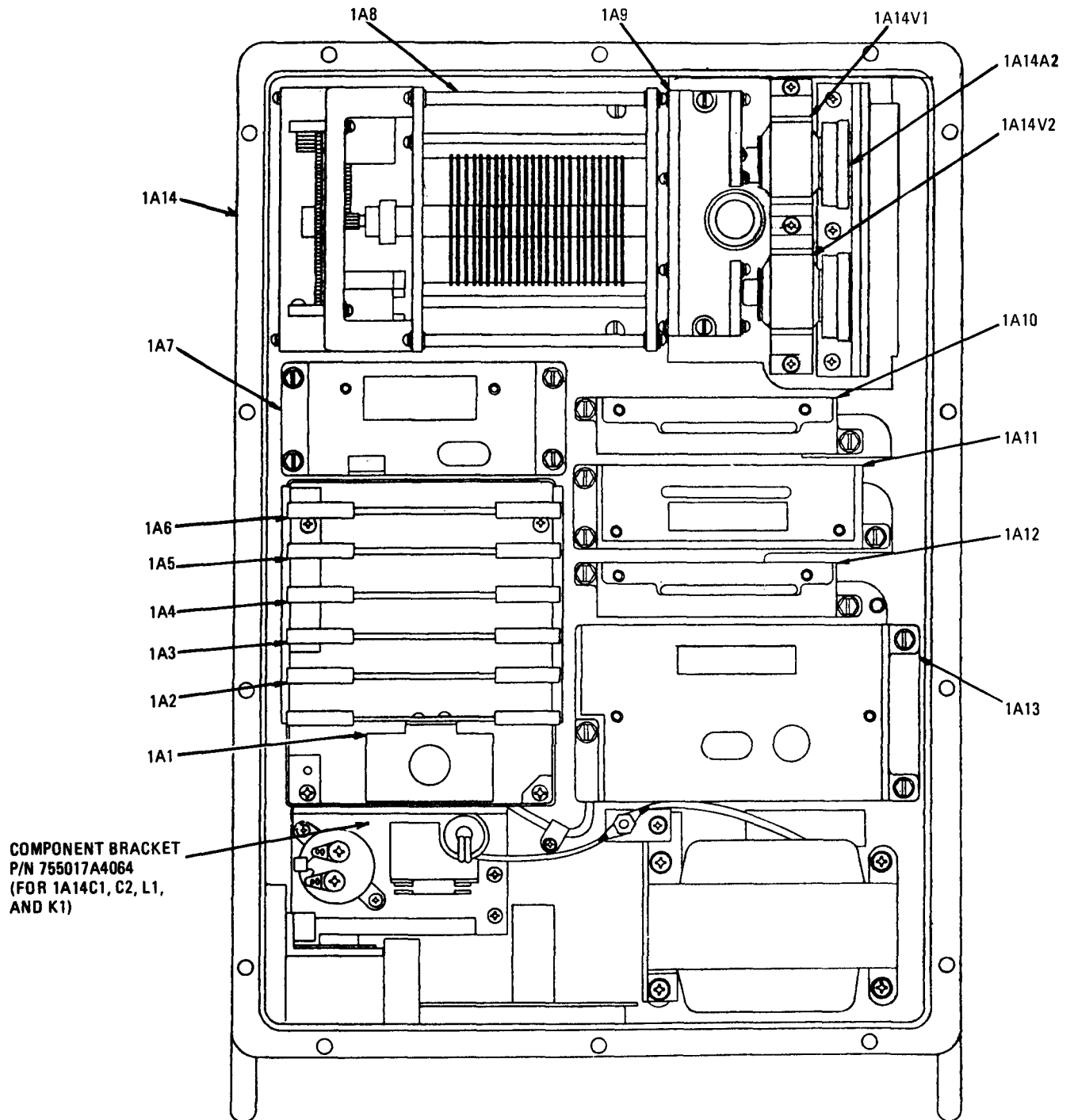
3-157. INTRODUCTION

3-158. Refer to chapter 1, paragraph 1-52, for applicable care and preparation for storage data.



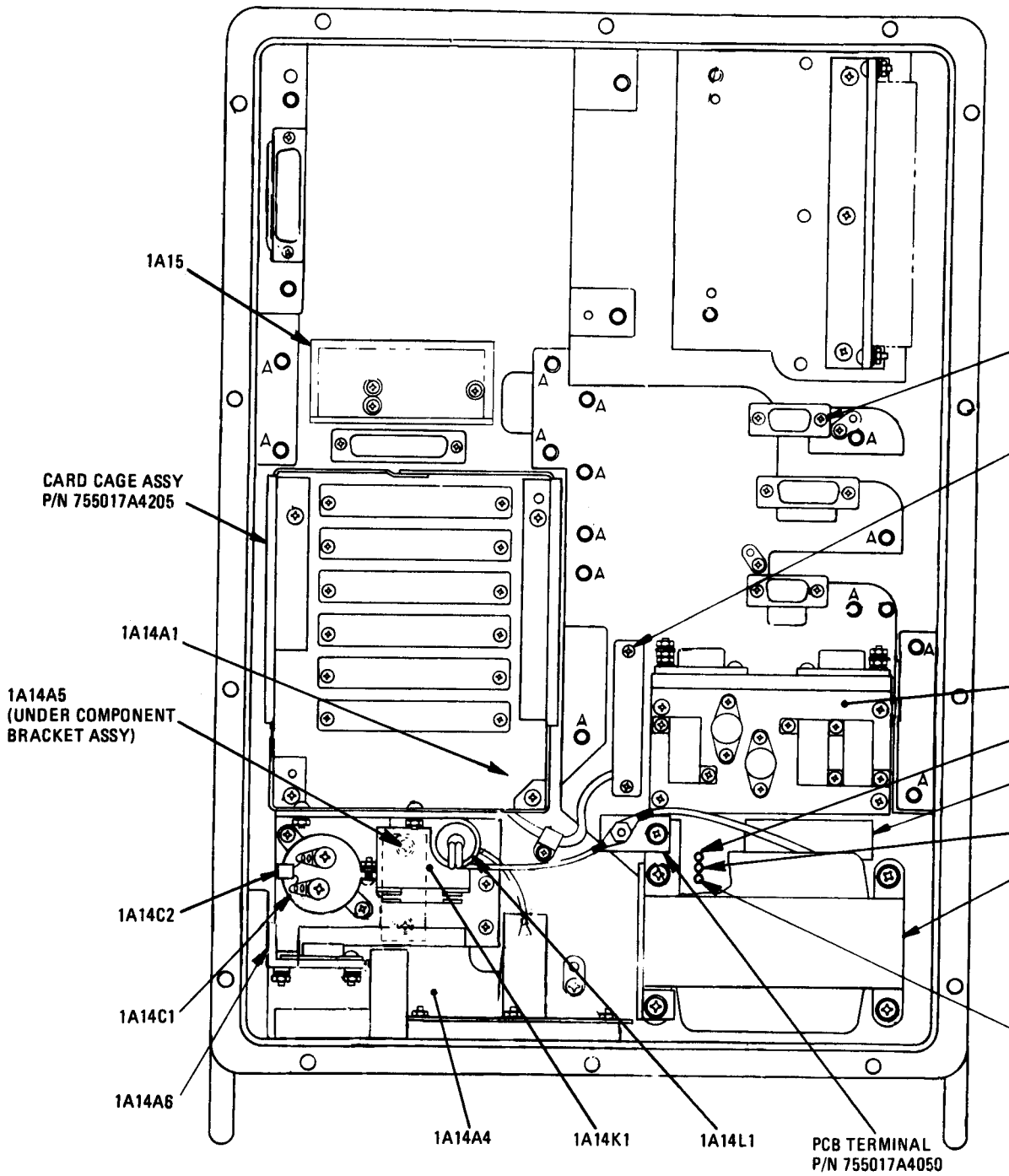
Detail A

Figure 3-29. Power Amplifier AM-6545/GRC-193 Component Location Diagram (Sheet 1 of 3)



Detail B

Figure 3-29. Power Amplifier AM-6545/GRC-193 Component Location Diagram (Sheet 2 of 3)



Detail C

Figure 3-29. Power Amplifier AM-6545/GRC-193 Component Location Diagram (Sheet 3 of 3)

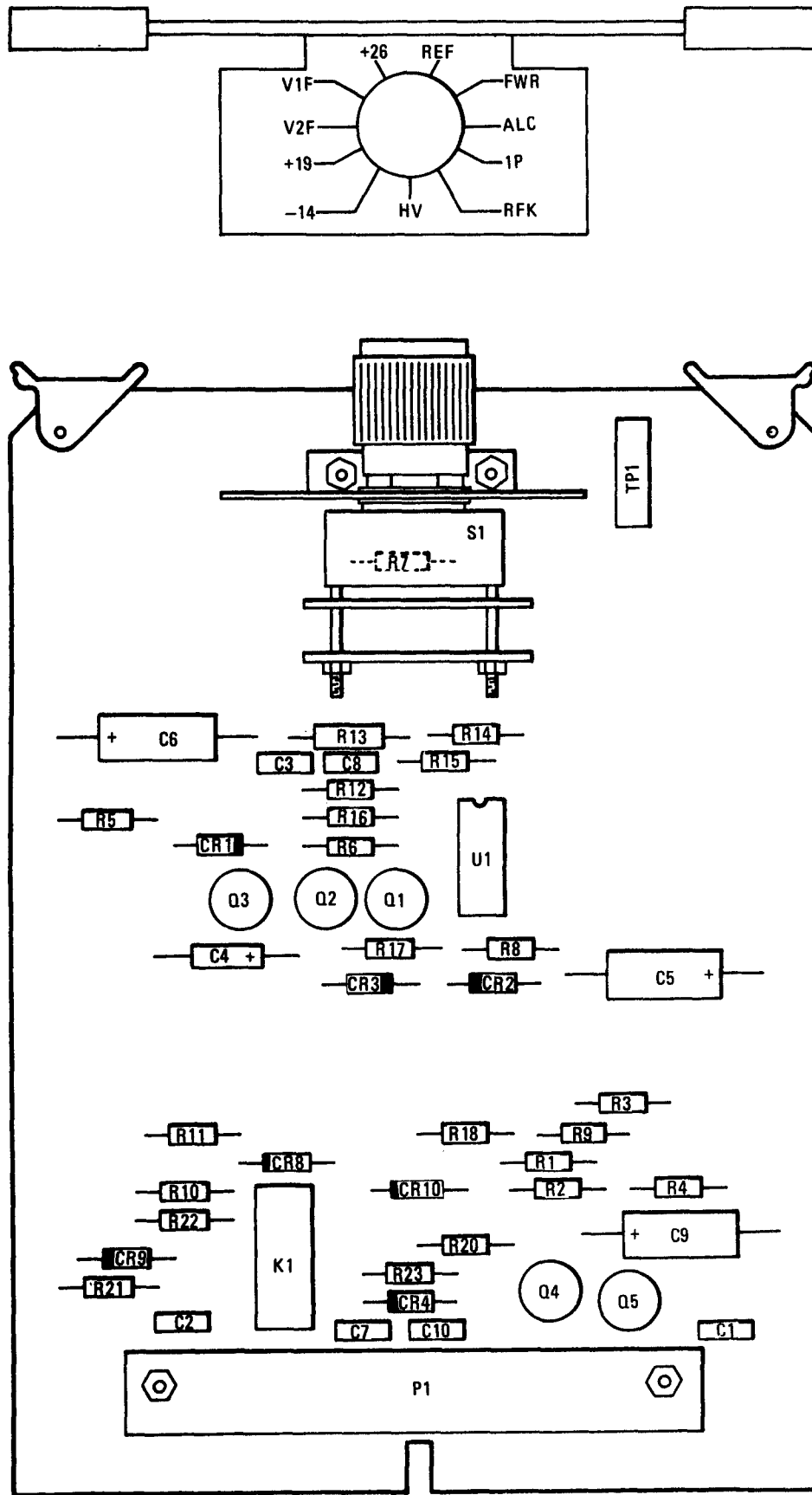


Figure 3-30. Meter Board PWB Assembly 1A1, P/N 755017A4210, Component Location Diagram

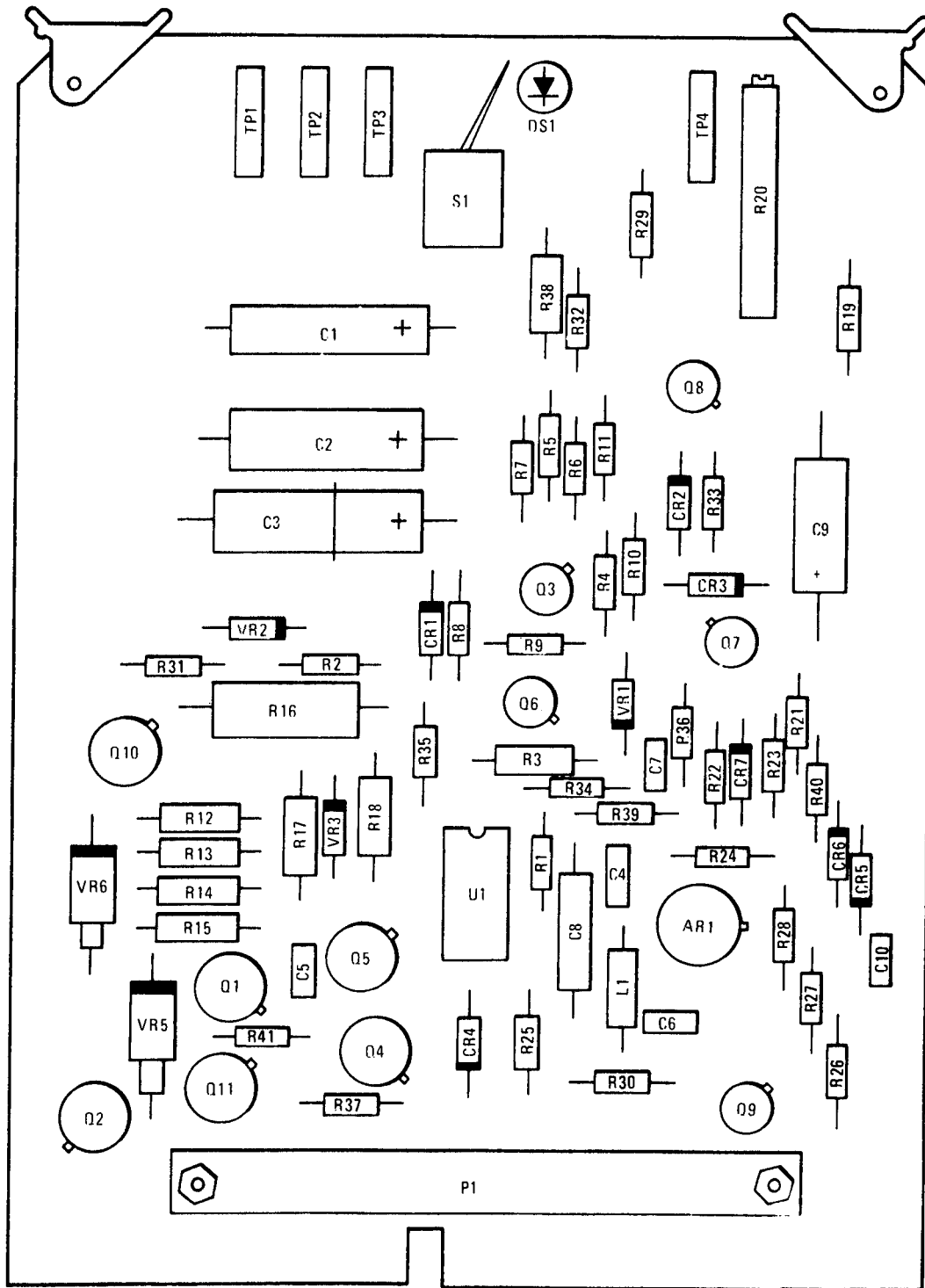


Figure 3-31. DC Control PWB Assembly 1A2, P/N 755017A4220, Component Location Diagram

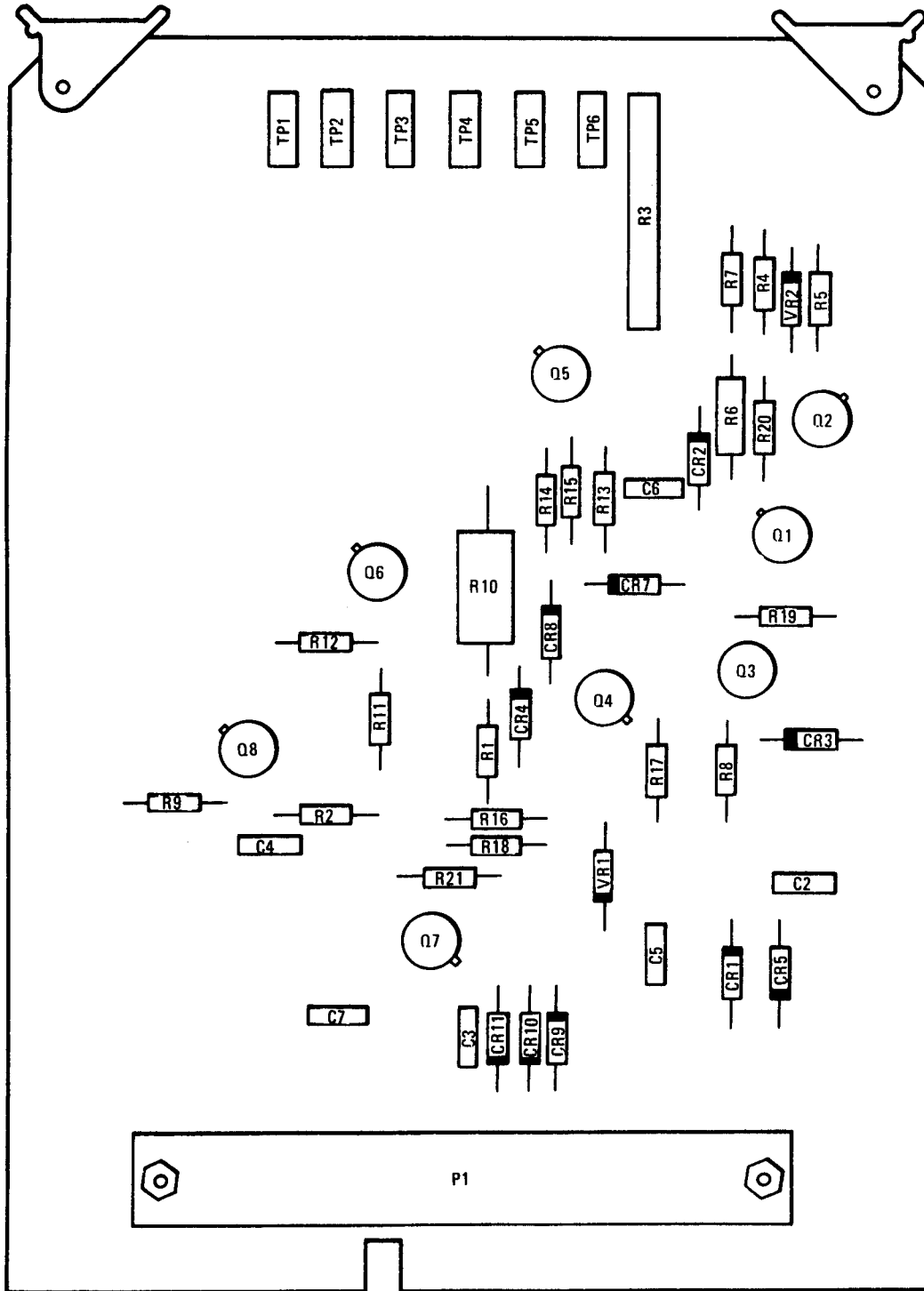


Figure 3-32. System Control PWB Assembly 1A3, P/N 755017A4230, Component Location Diagram

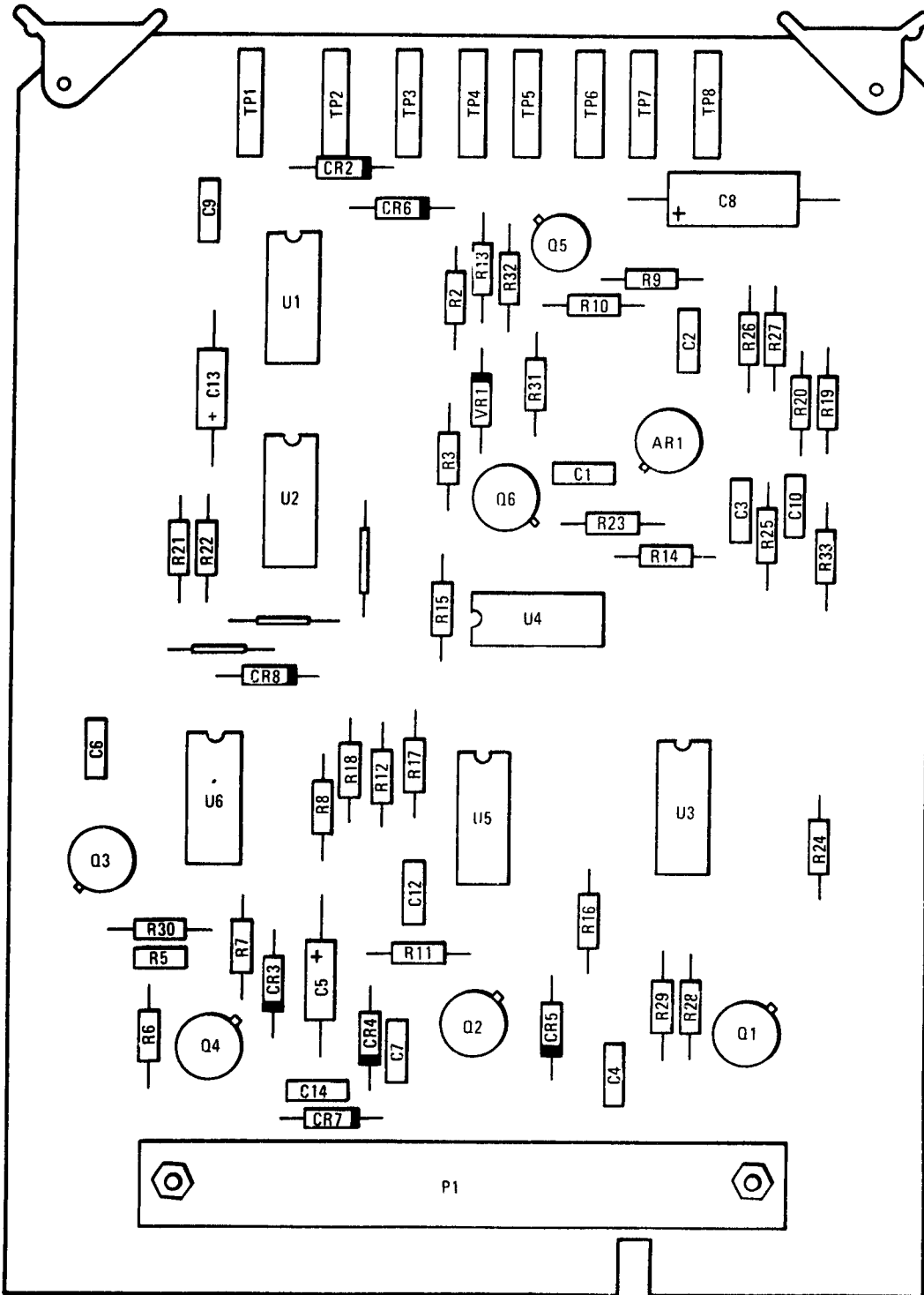


Figure 3-33. Tune Control PWB Assembly 1A4, P/N 75507A4240, Component Location Diagram

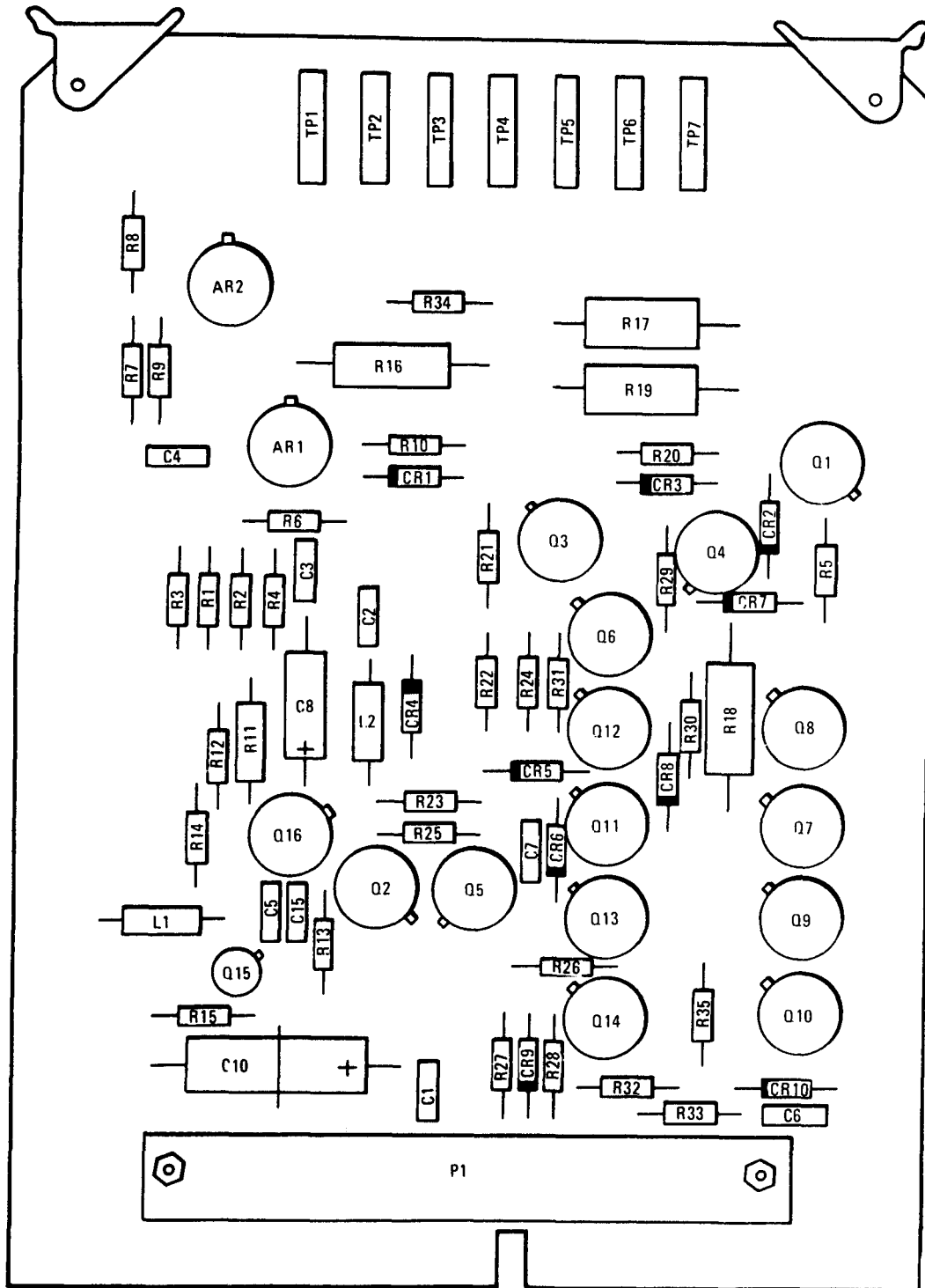


Figure 3-34. Servo Amplifier PWB Assembly 1A5, P/N 755017A4250, Component Location Diagram

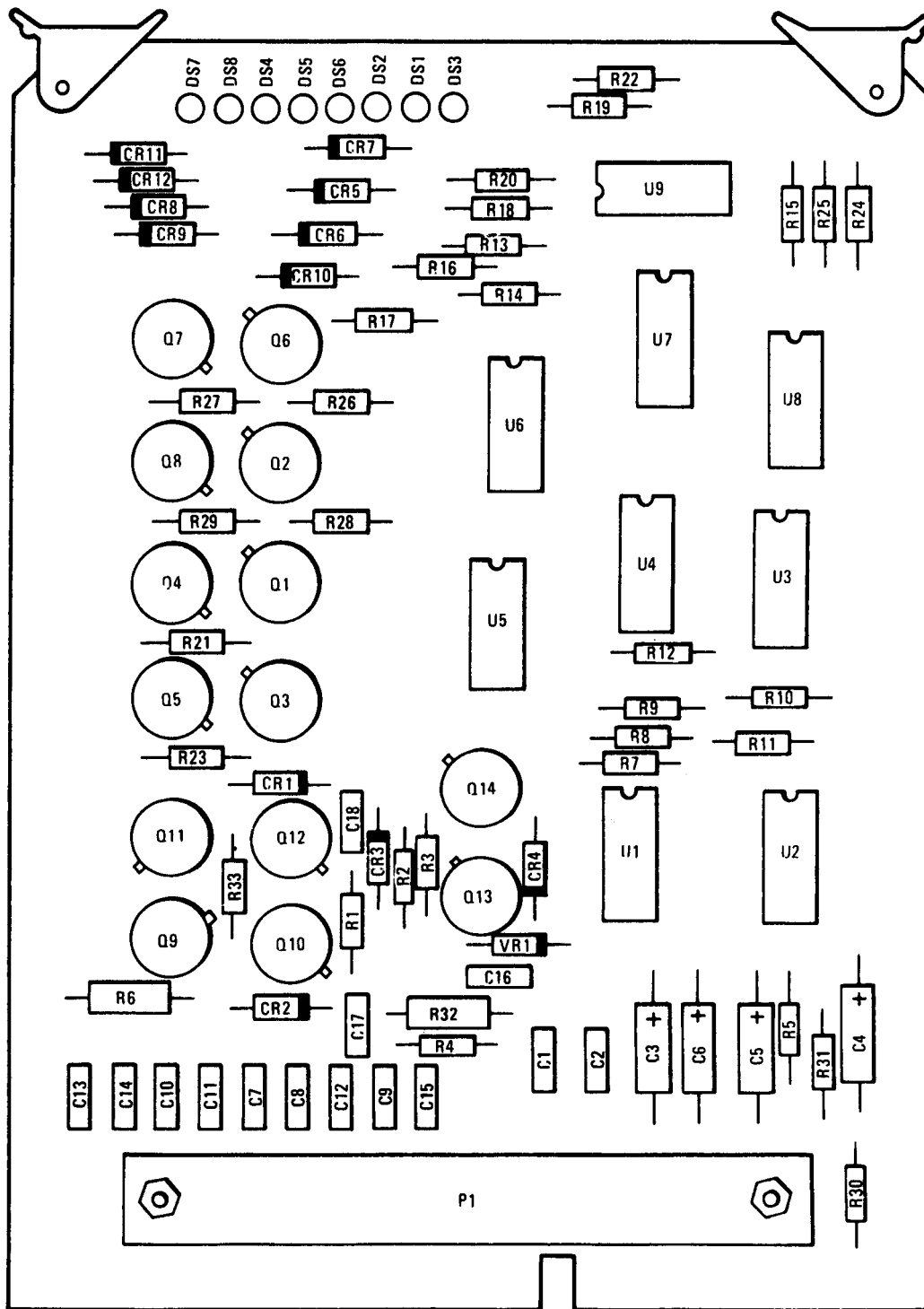


Figure 3-35. Band Control PWB Assembly 1A6, P/N 755017A4260, Component Location Diagram

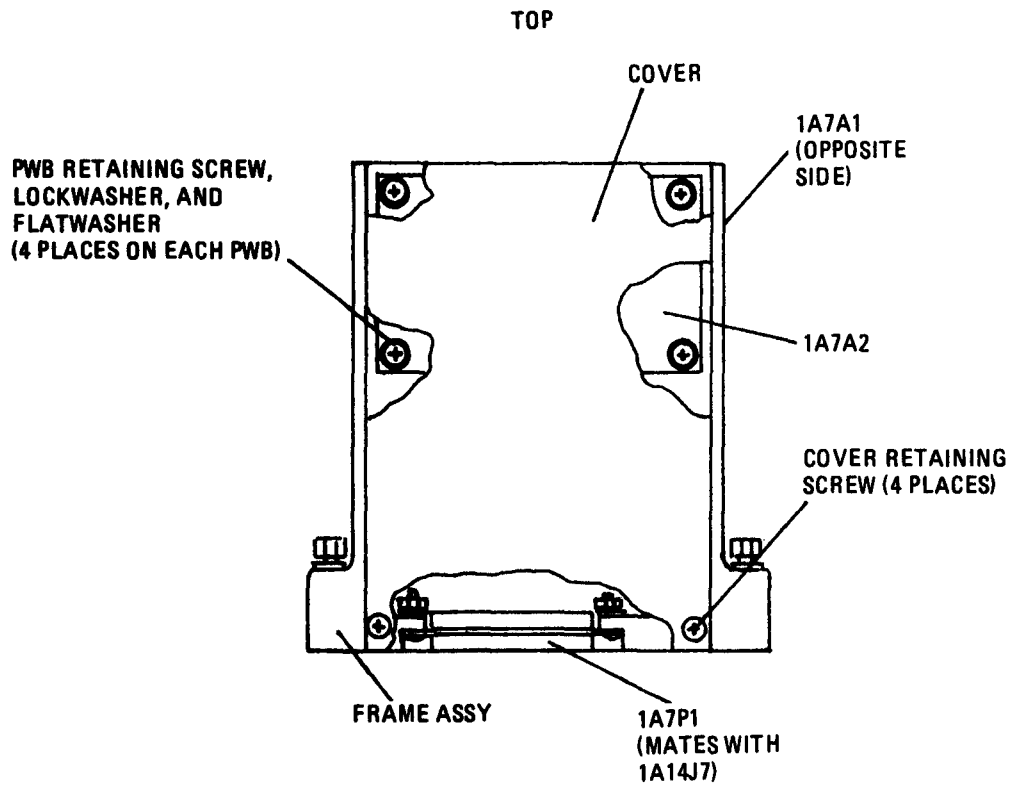


Figure 3-36. ALC Module Assembly 1A7, P/N 755017A4600, Component Location Diagram

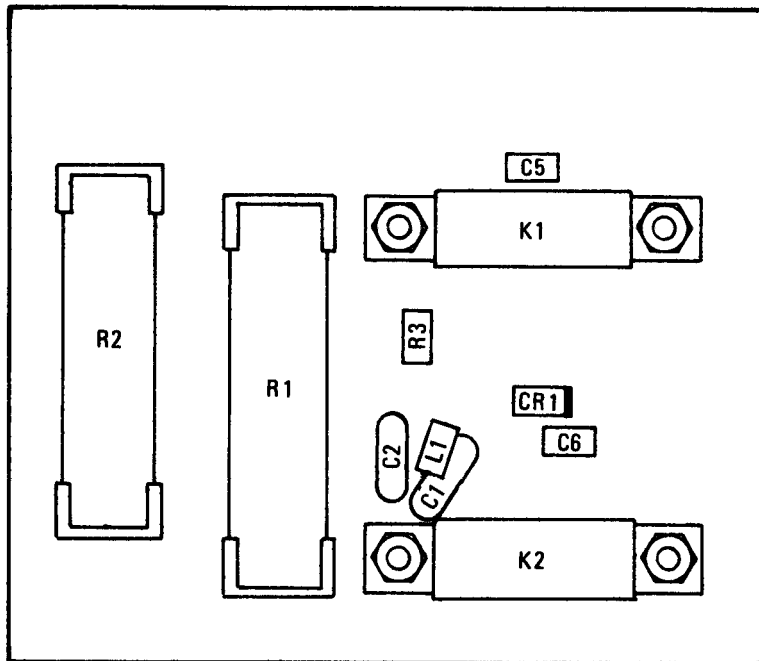


Figure 3-37. Tune Load PWB Assembly 1A7A1, P/N 755017A4620, Component Location Diagram

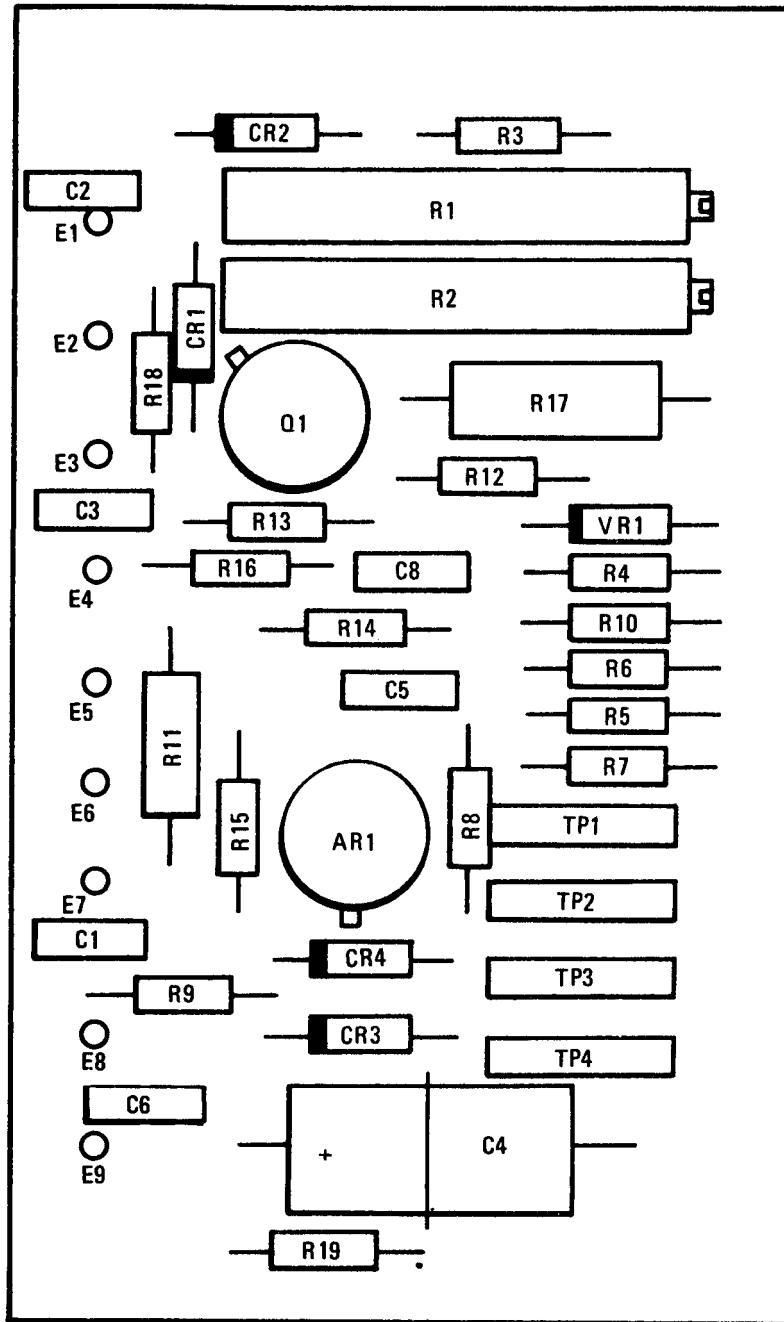


Figure 3-38. ALC PWB Assembly 1A7A2, P/N 755017A4610, Component Location Diagram

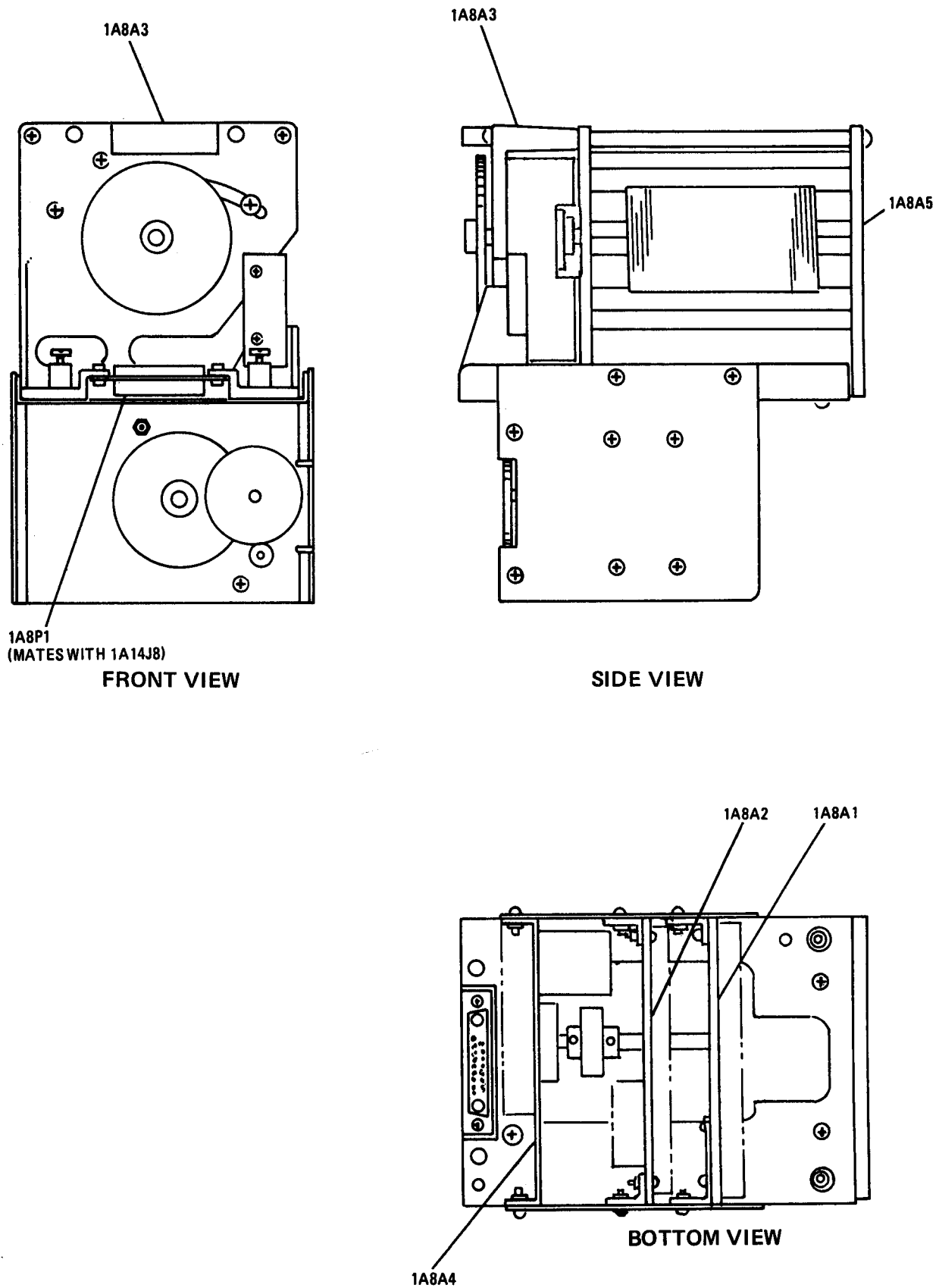


Figure 3-39. Tank Circuit Module Assembly 1A8, P/N 755017A4500, Component Location Diagram

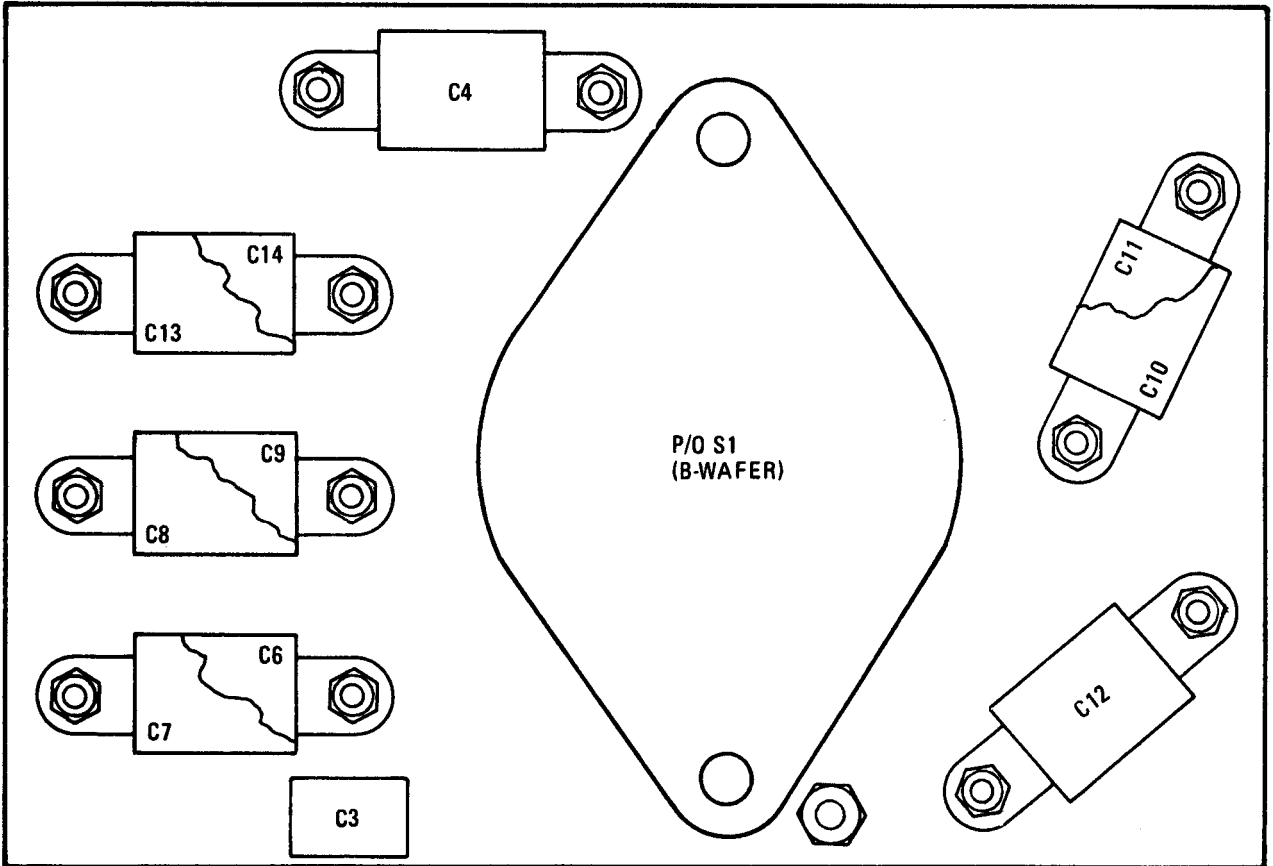


Figure 3-40. Input CAP PWB Assembly P/N 755017A4510, Component Location Diagram

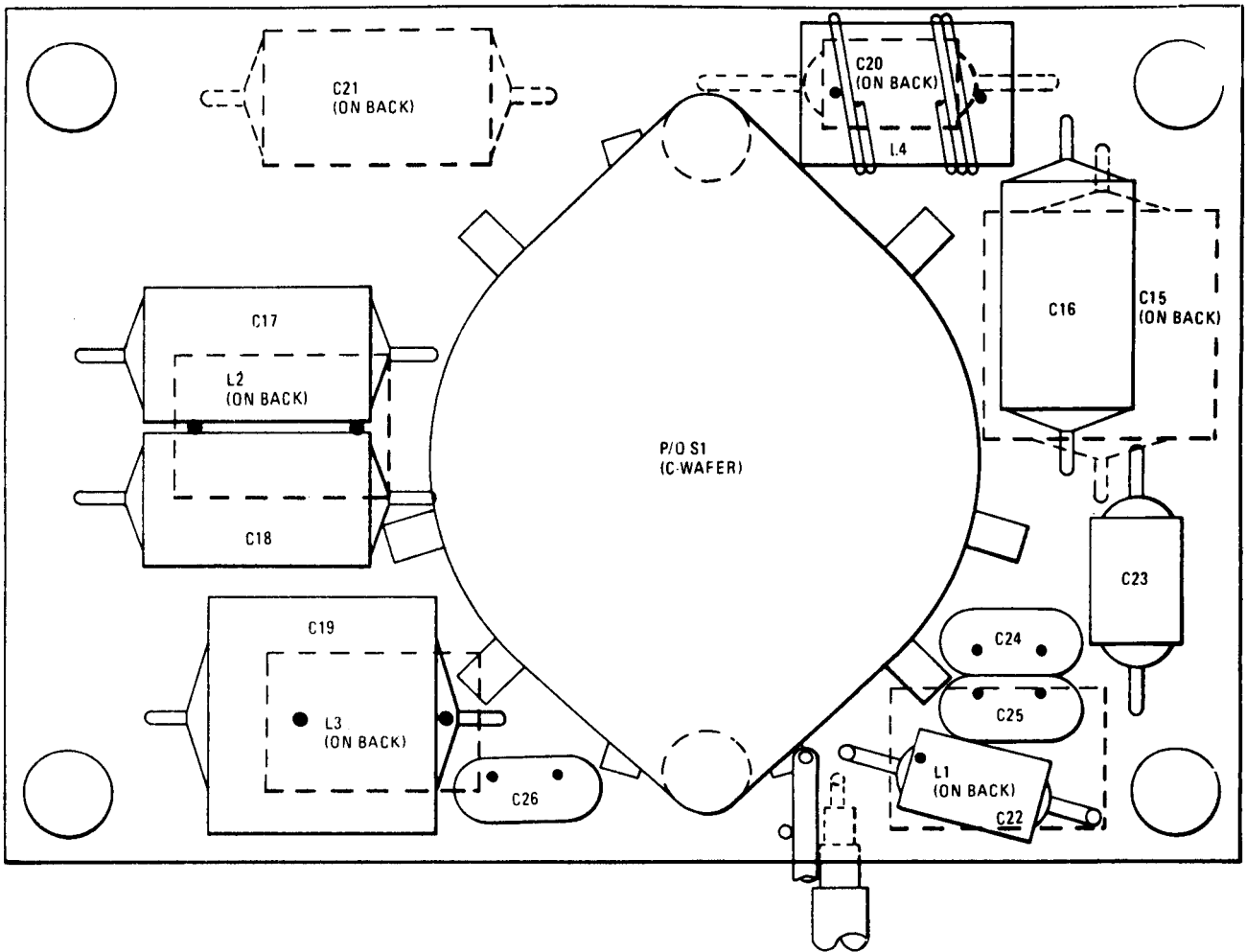
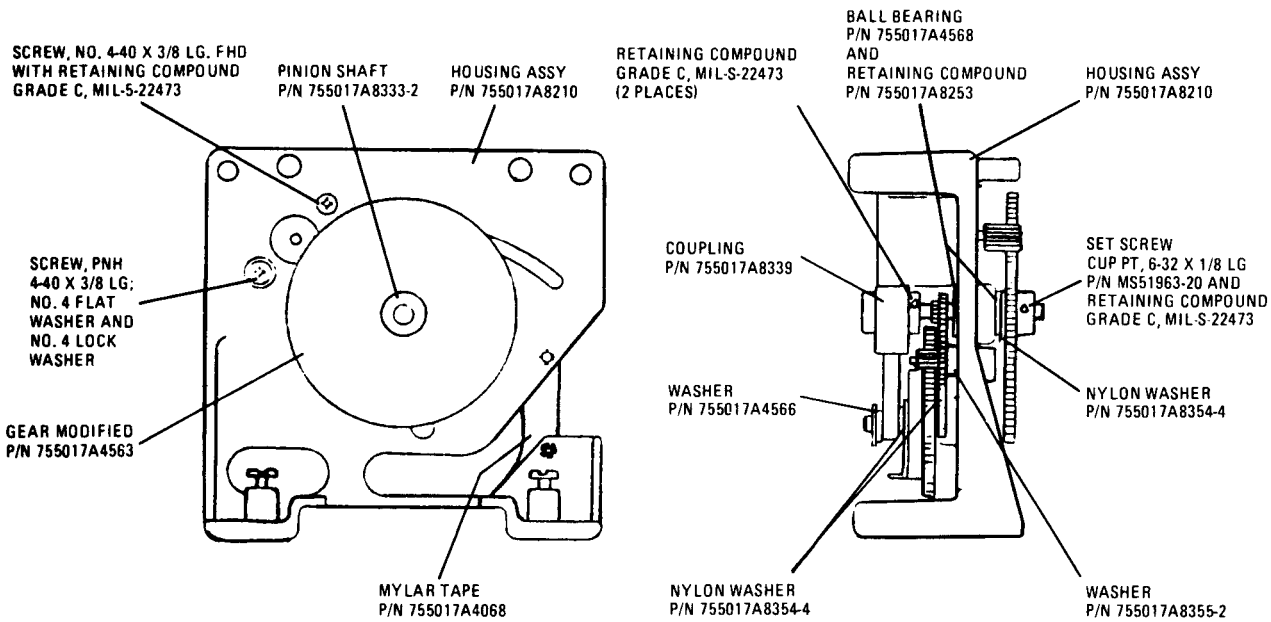


Figure 3-41. Output CAP PWB Assembly 1A8A2, P/N 755017A4520, Component Location Diagram



DETAIL C
COIL GEAR ASSY 1A8A3 ROTATED 180°

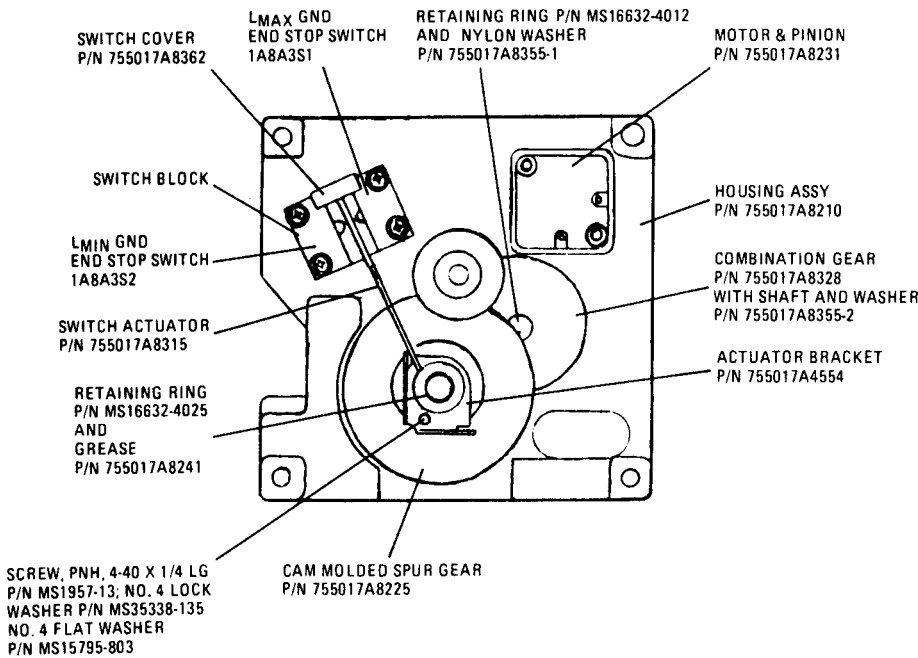


Figure 3-42. Coil Gear Assembly 1A8A3, P/N 75507A4550, Component Location Diagram

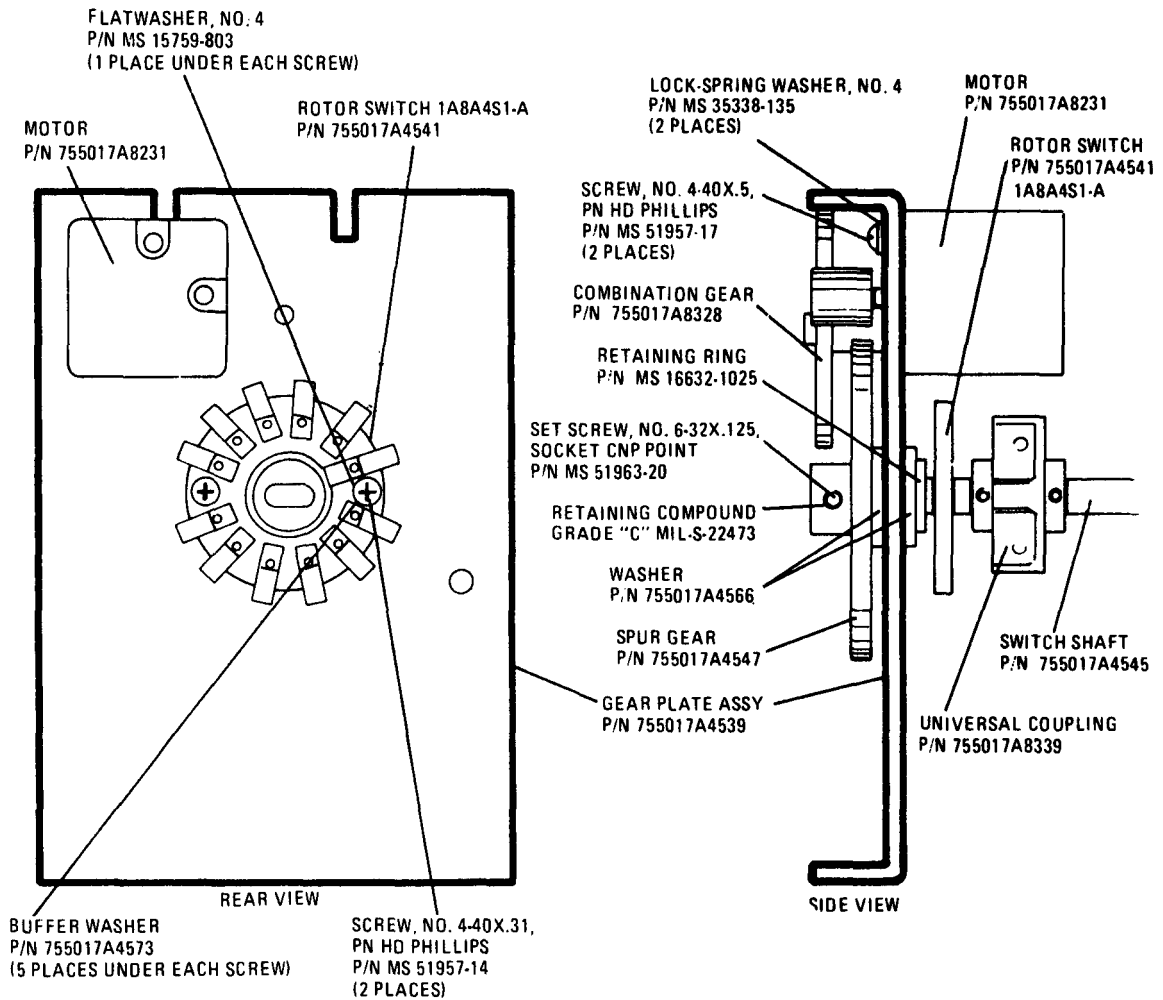


Figure 3-43. Bandswitch Gear Assembly 1A8A4, P/N 755017A4540, Component Location Diagram

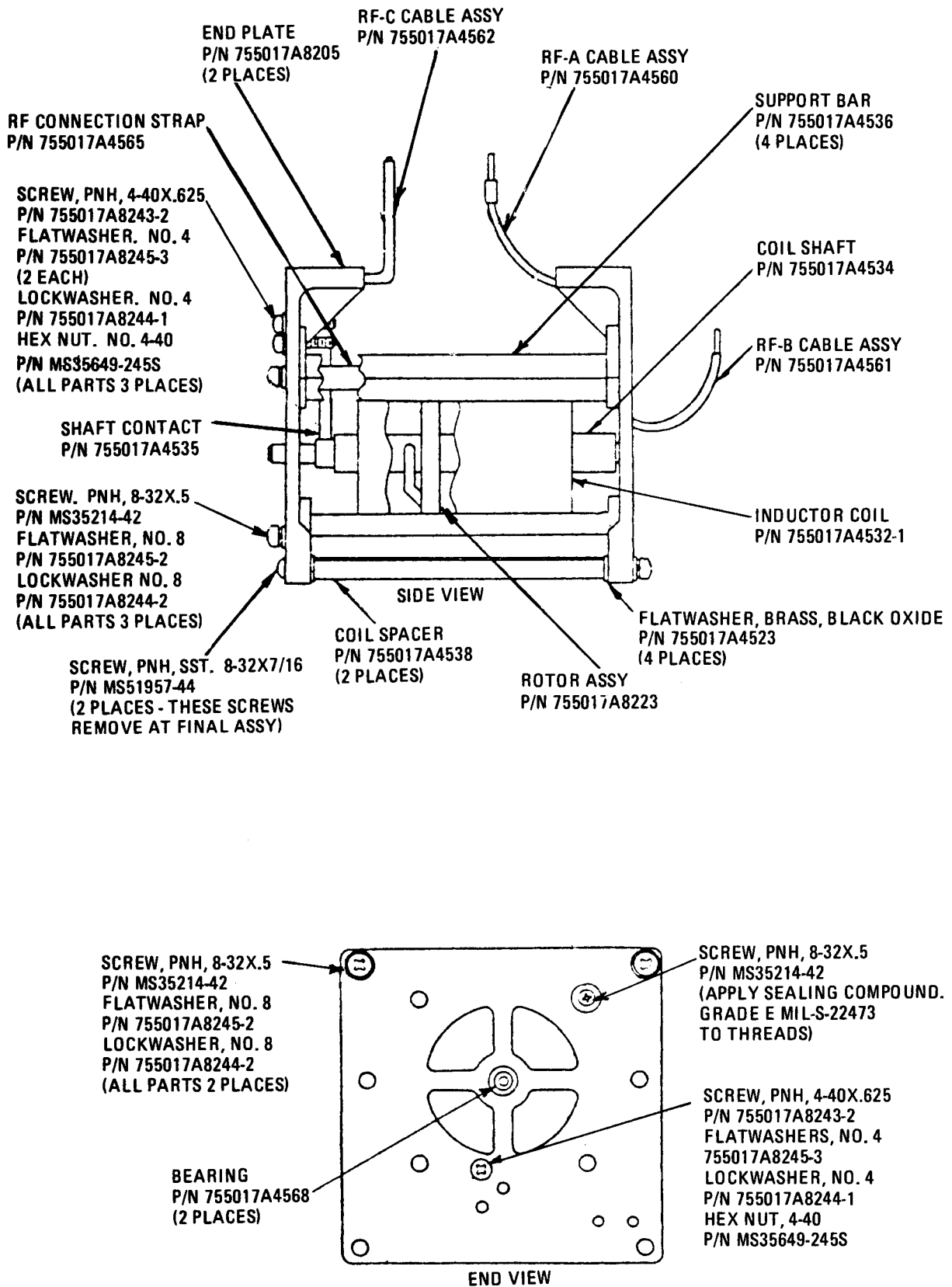


Figure 3-44. Coil Assembly 1A8A5, P/N 755017A4530, Component Location Diagram

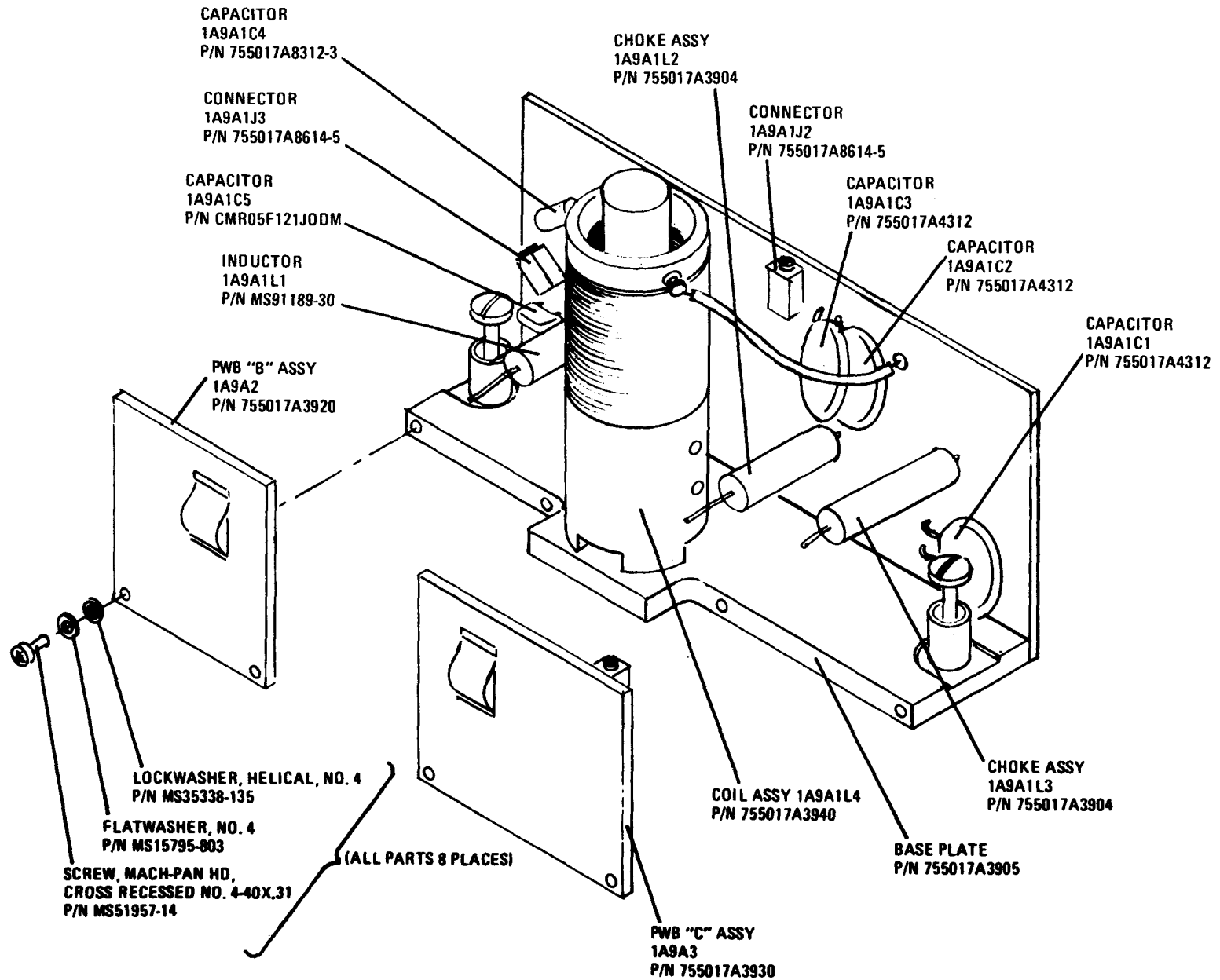


Figure 3-45. Plate Assembly 1A9, P/N 755017A3900, Component Location Diagram

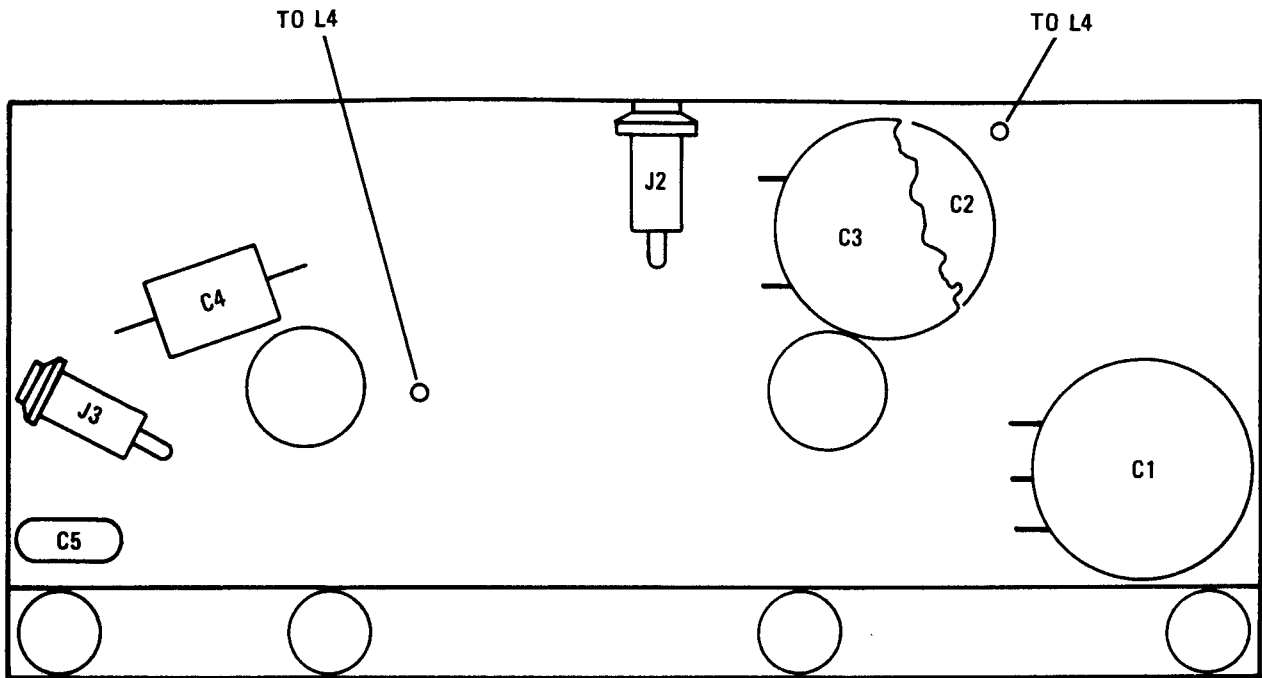


Figure 3-46. Plate Choke "A" PCB Assembly 1A9A1, P/N 755017A3910, Component Location Diagram

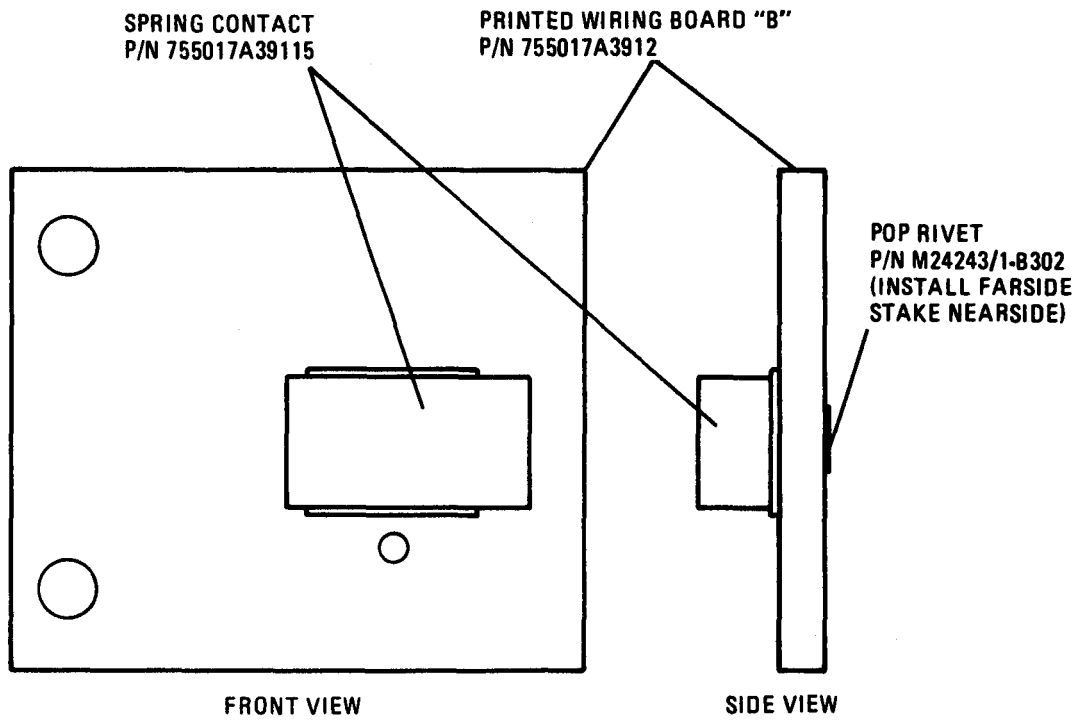


Figure 3-47. PWB "B" Assembly 1A9A2, P/N 755017A3920, Component Location Diagram

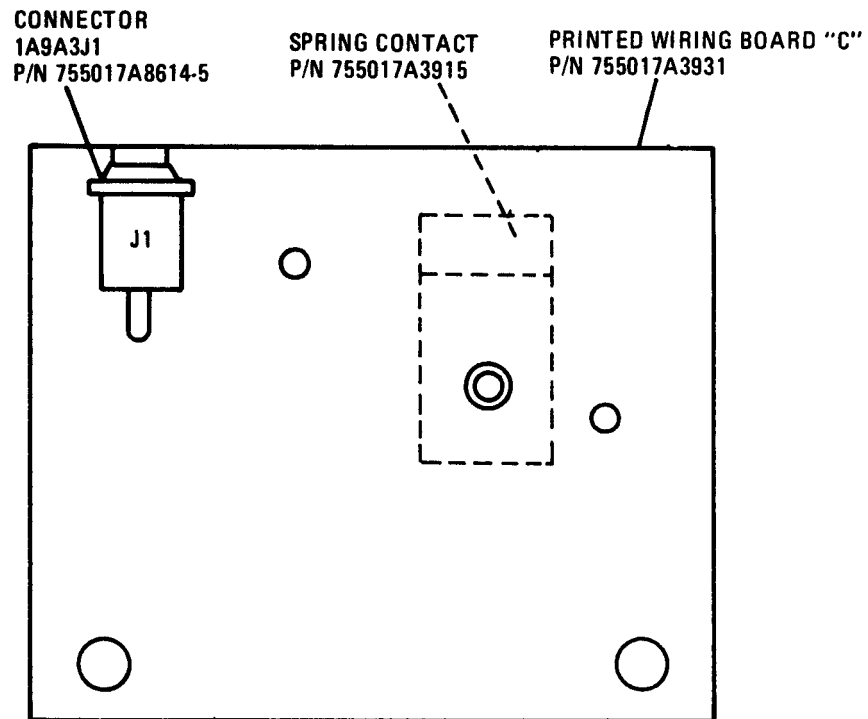


Figure 3-48. PWB "C" Assembly 1A9A3, P/N 755017A3930, Component Location Diagram

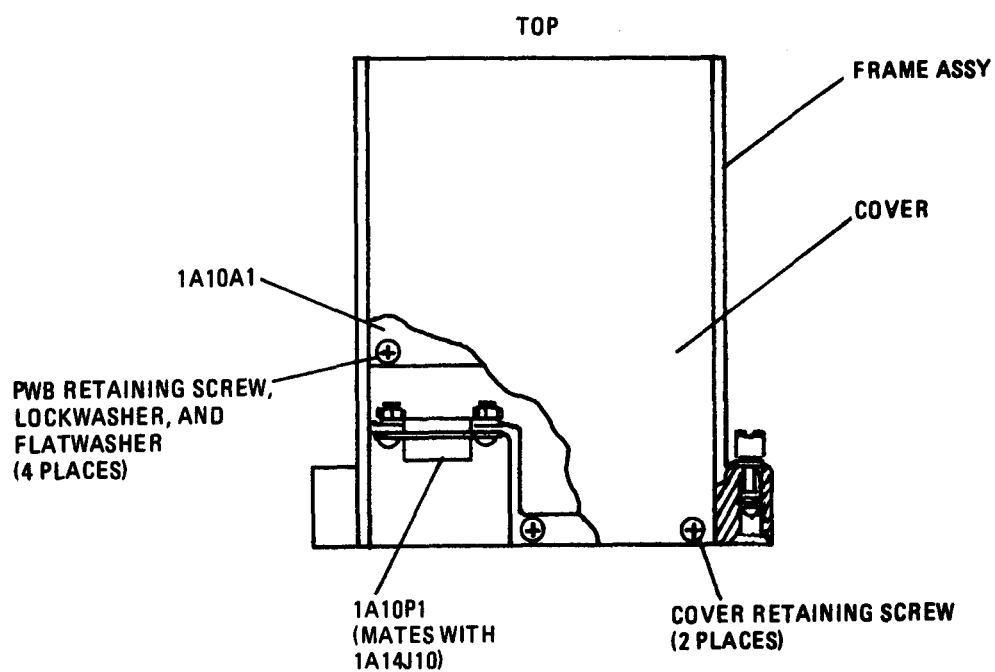
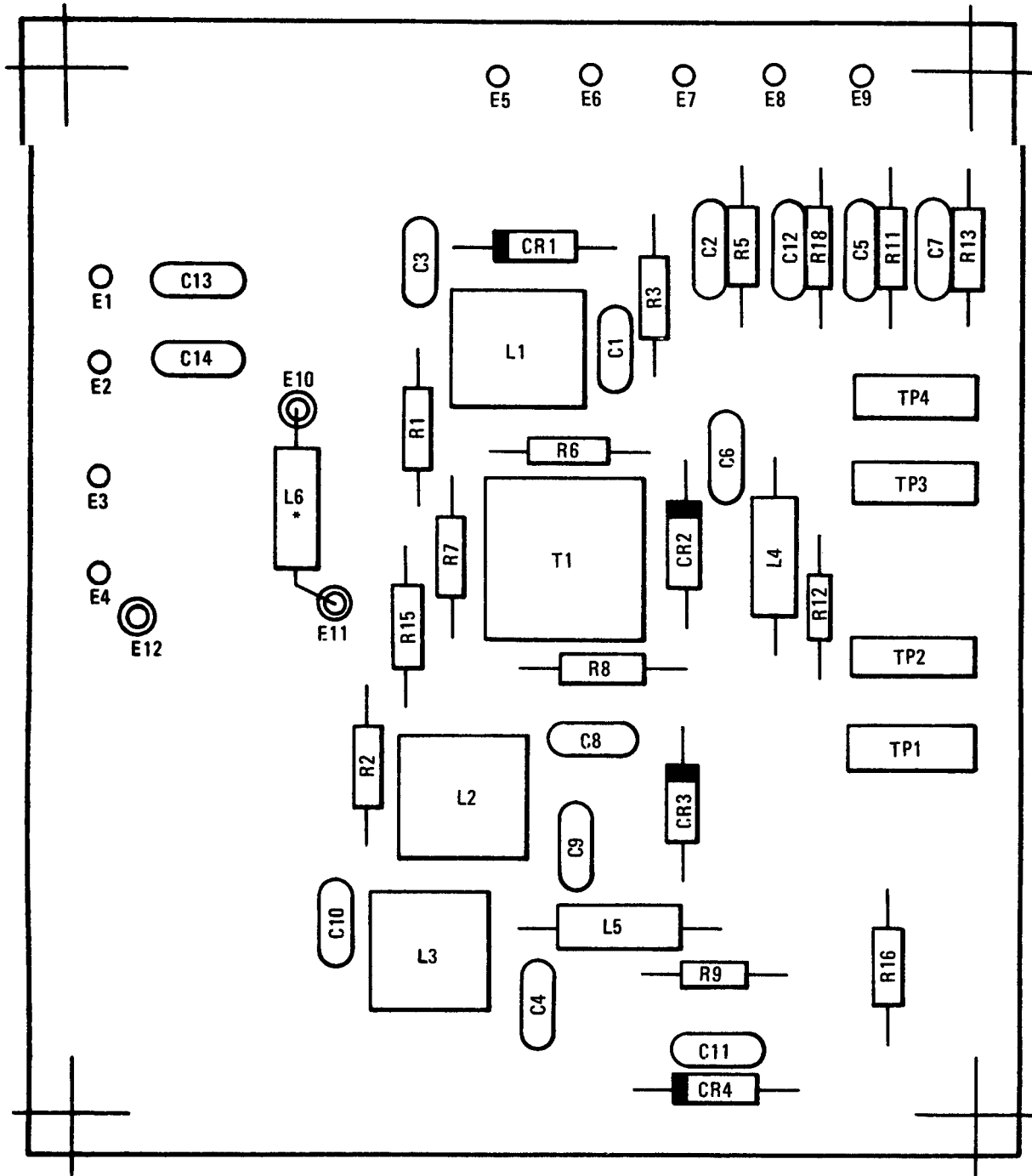


Figure 3-49. Tune Detector Module Assembly 1A10, P/N 755017A4800, Component Location Diagram



***INDUCTOR 1A10A1L6 IS FACTORY INSTALLED WHEN THE PWB IS TESTED, IF NECESSARY, AND MAY NOT EXIST ON SOME PWB'S, ALSO L6 MAY BE INSTALLED BETWEEN E11 AND E12.**

Figure 3-50. Tune Detector PWB Assembly 1A10A1, P/N 755017A4810, Component Location Diagram

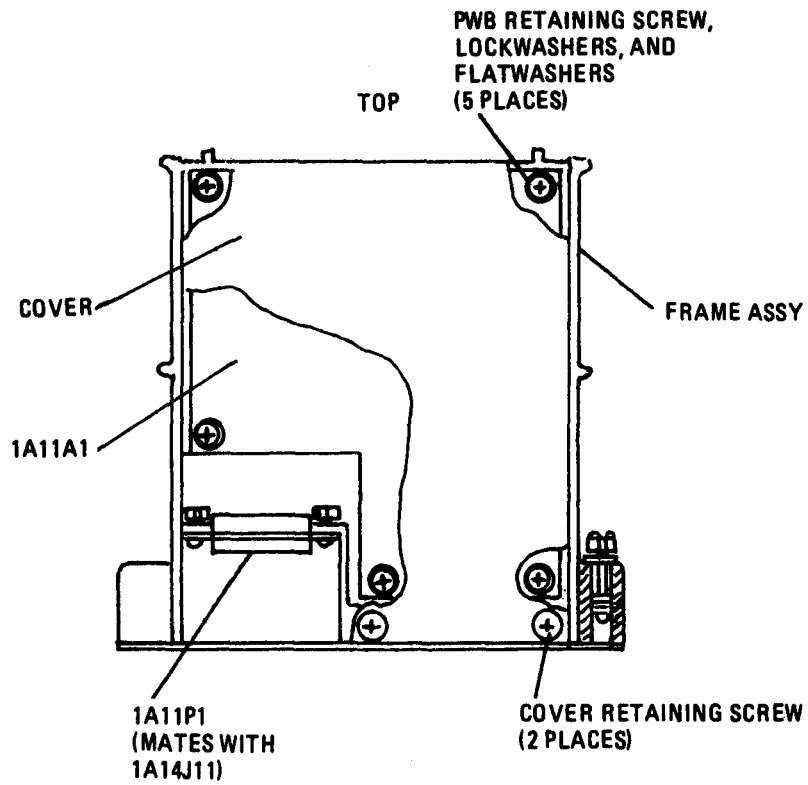


Figure 3-51. RF Driver Module Assembly 1A11, P/N 755017A4700, Component Location Diagram

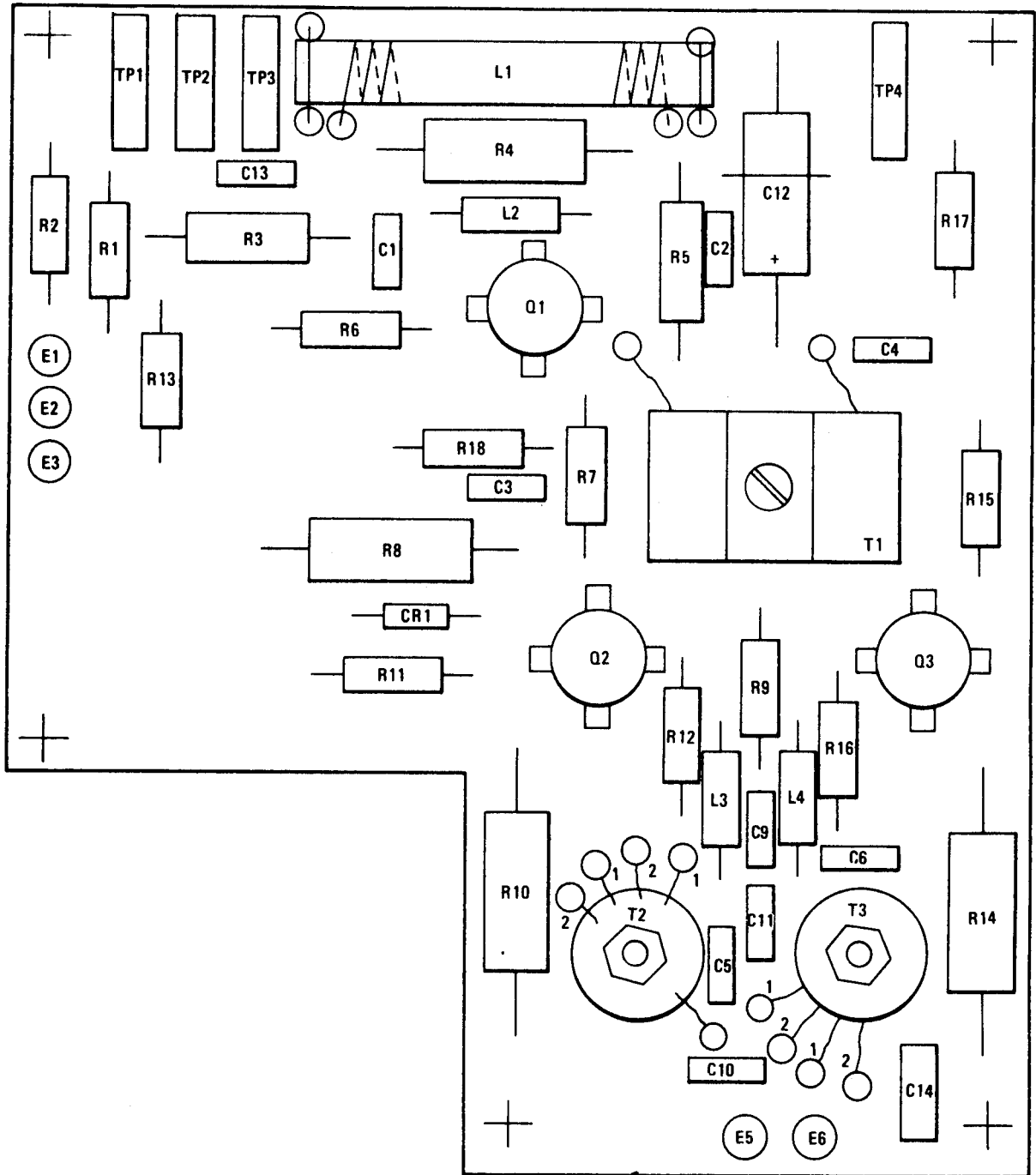


Figure 3-52. Driver Module PWB Assembly 1A11A1, P/N 755017A4710, Component Location Diagram

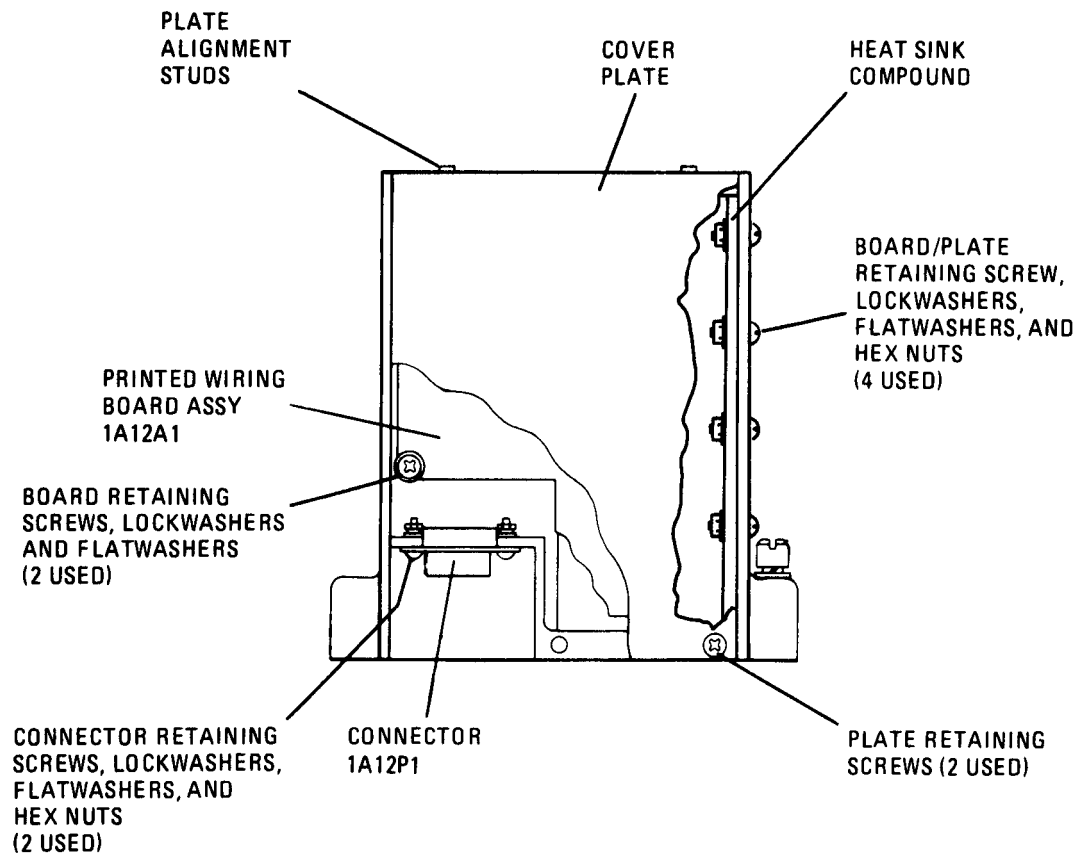


Figure 3-53. Static Power Inverter Assembly 1A12, P/N 755017A4900, Component Location Diagram

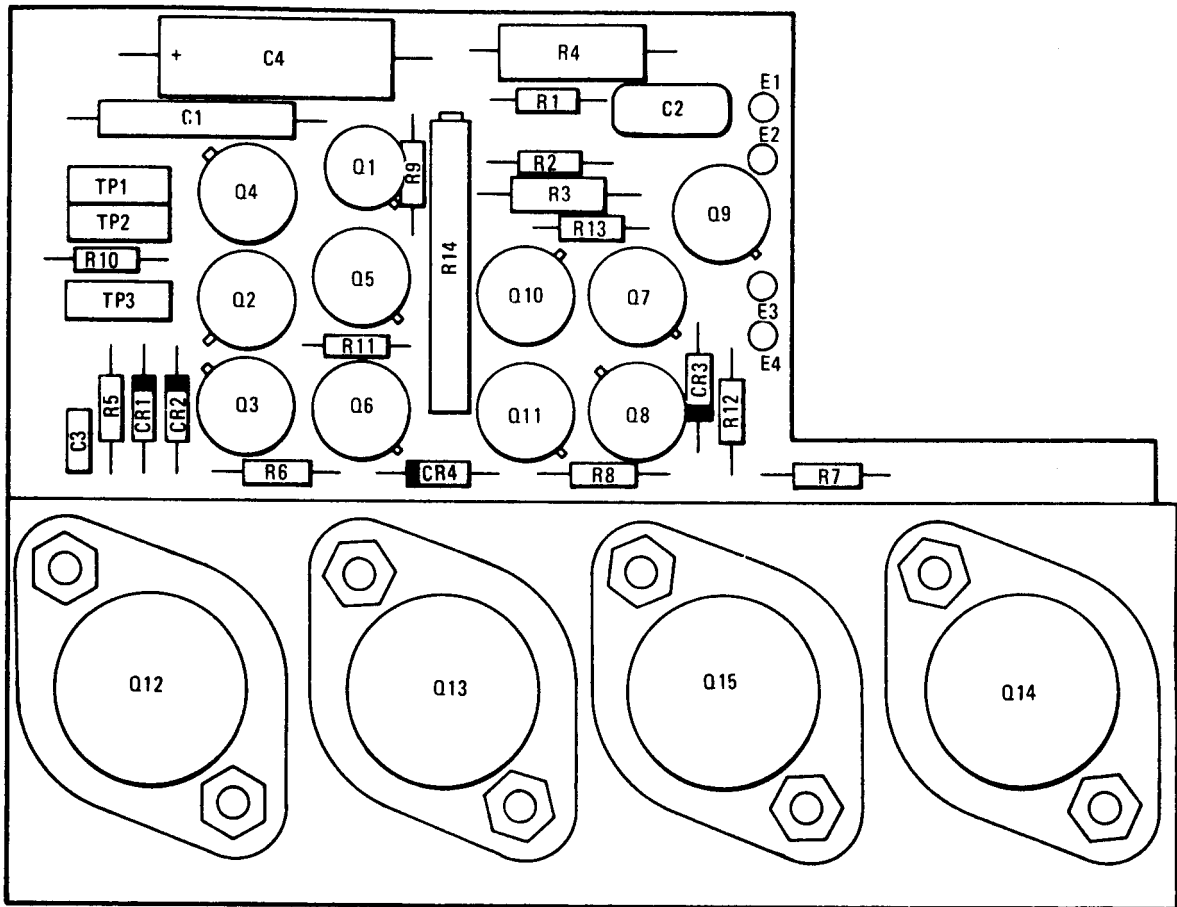
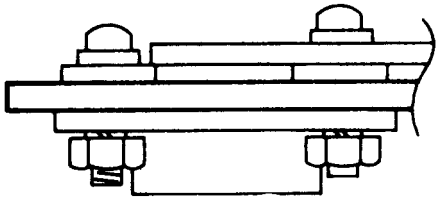


Figure 3-54. Inverter Module PWB Assembly 1A12A1, P/N 755017A4910, Component Location Diagram

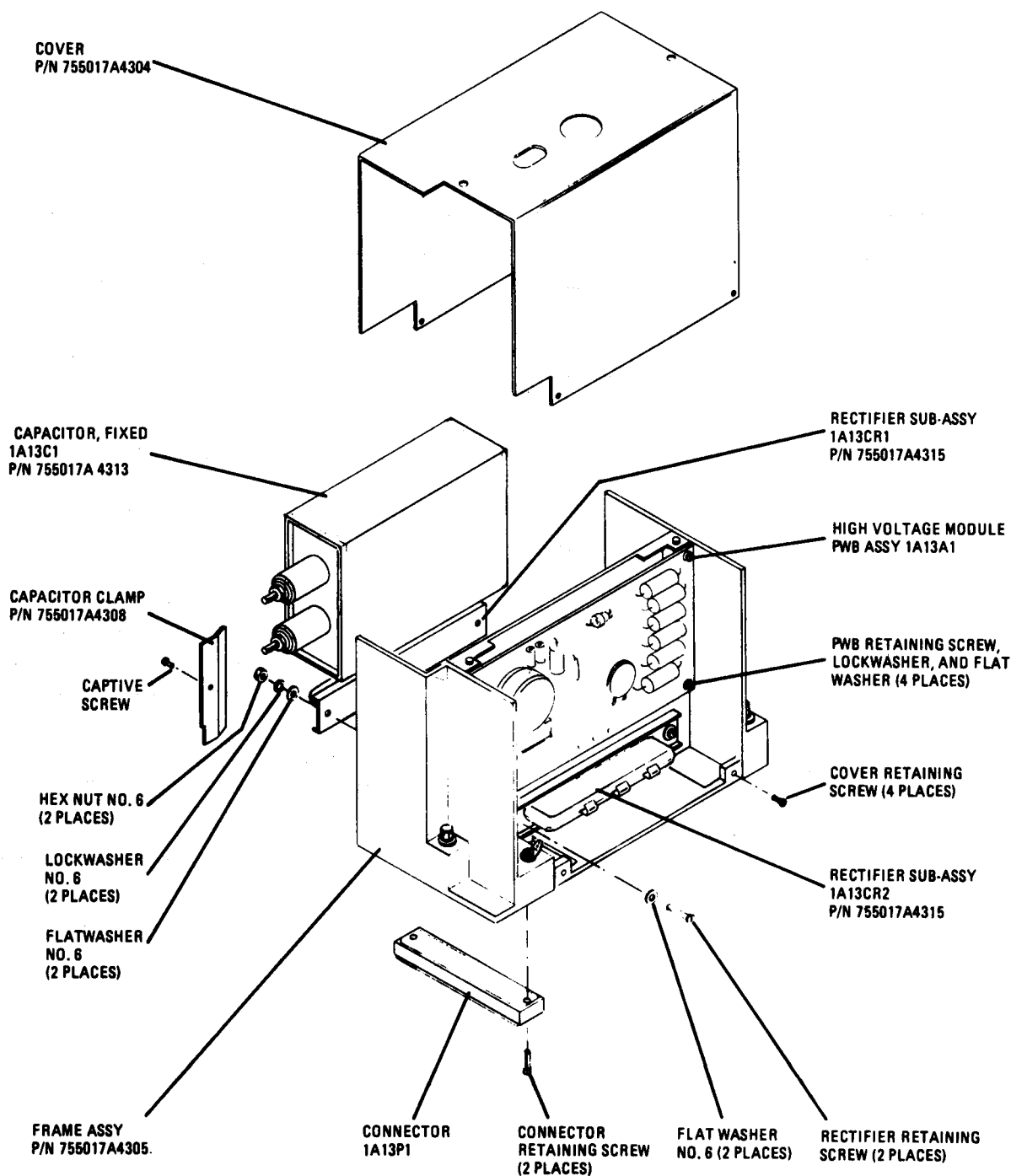


Figure 3-55. High Voltage Module Assembly 1A13, P/N 755017A4300, Component Location Diagram

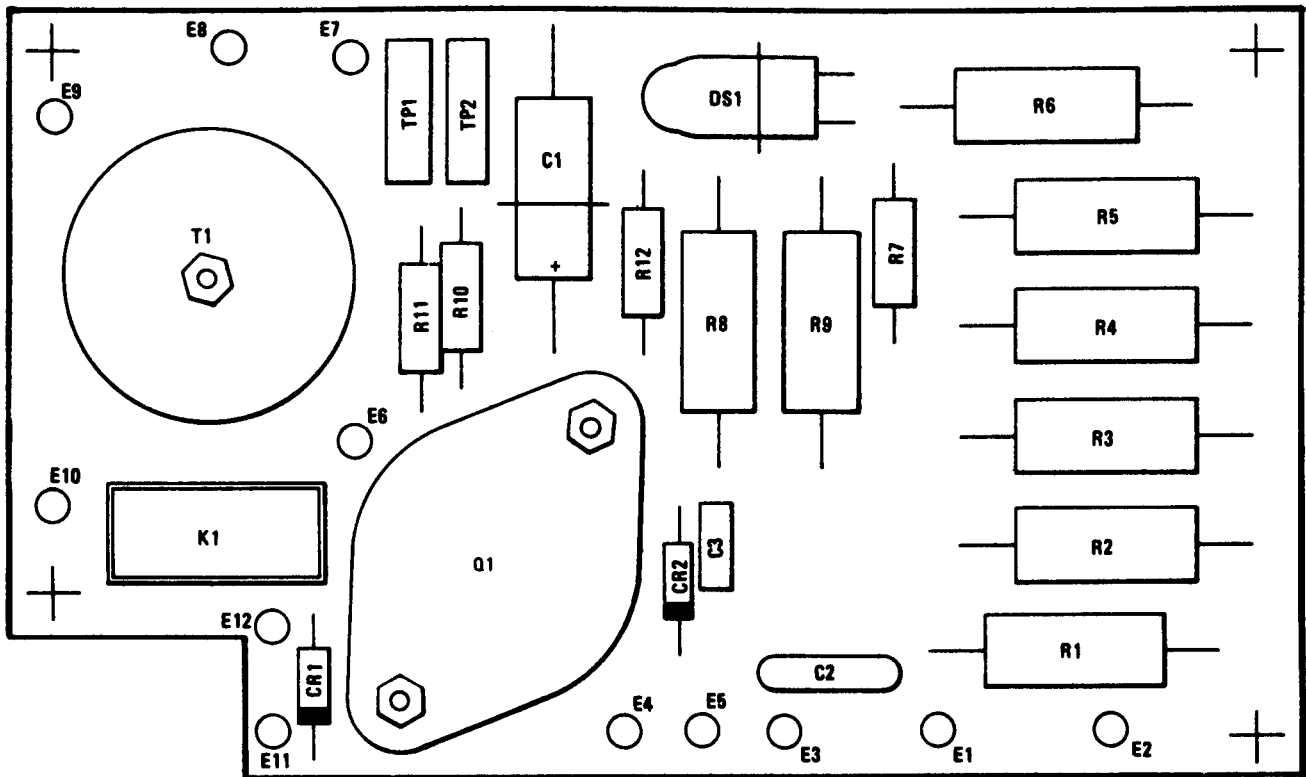


Figure 3-56. High Voltage Module PWB Assembly 1A13A1, P/N 755017A4310, Component Location Diagram

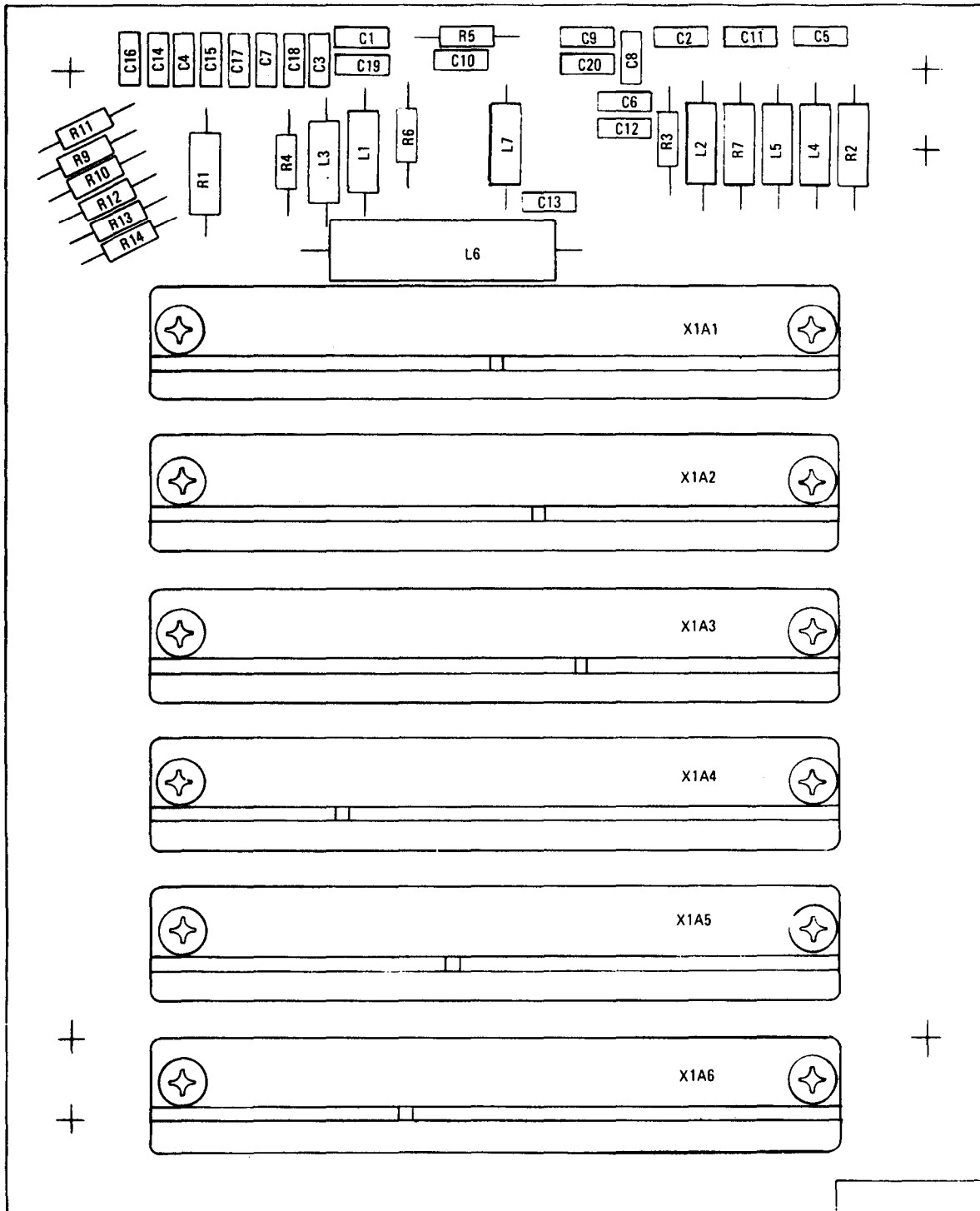


Figure 3-57. Interconnection PCB Assembly 1A14A1, P/N 755017A4270, Component Location Diagram

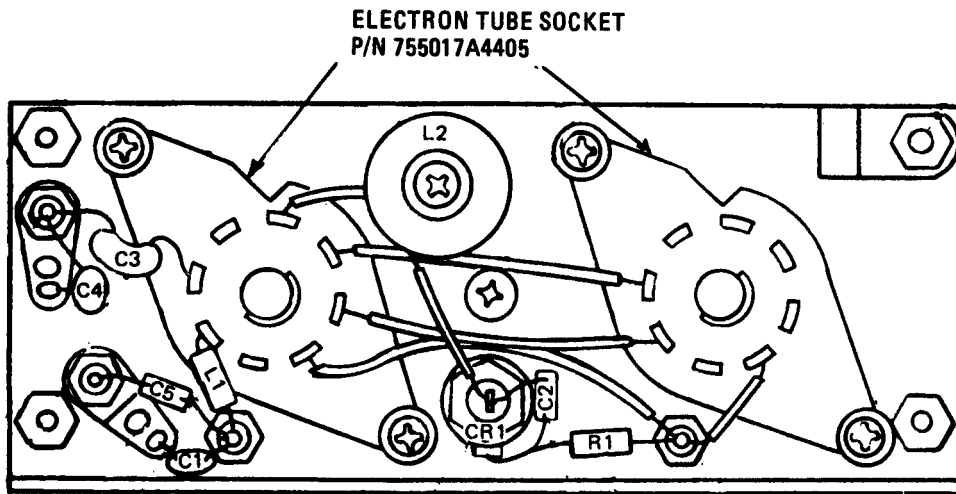


Figure 3-58. Tube Socket Assembly 1A14A2, P/N 755017A4400, Component Location Diagram

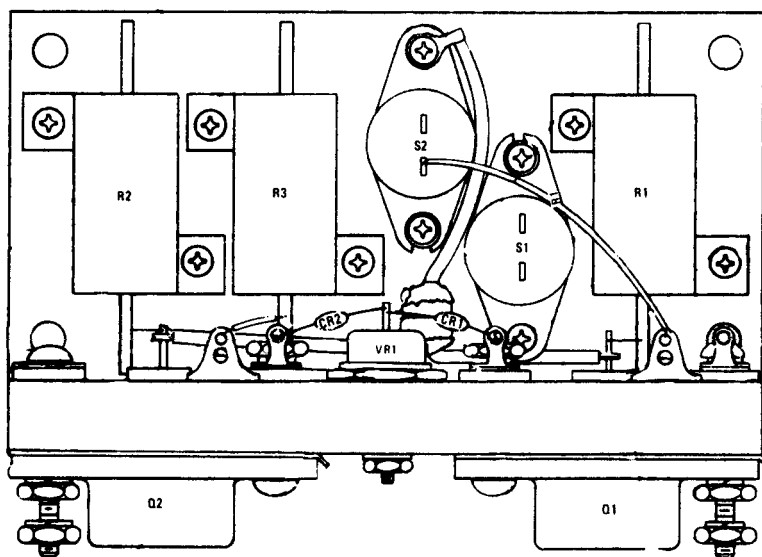


Figure 3-59. DC to DC Converter Assembly 1A14A3, P/N 755017A4100, Component Location Diagram

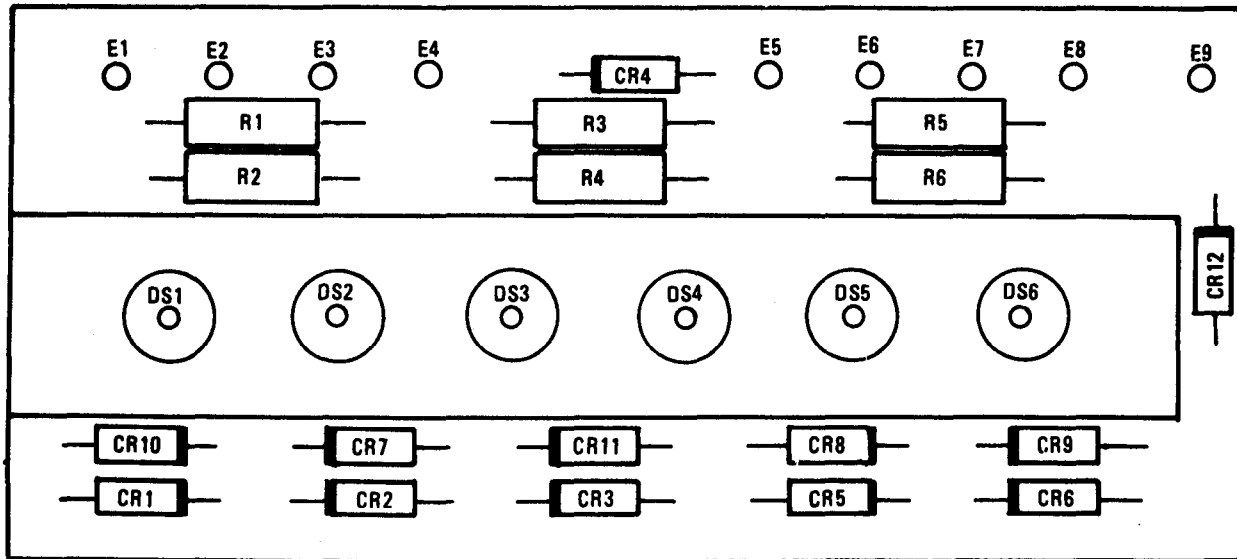


Figure 3-60. Indicator Assembly 1A14A4, P/N 755017A3800, Component Location Diagram

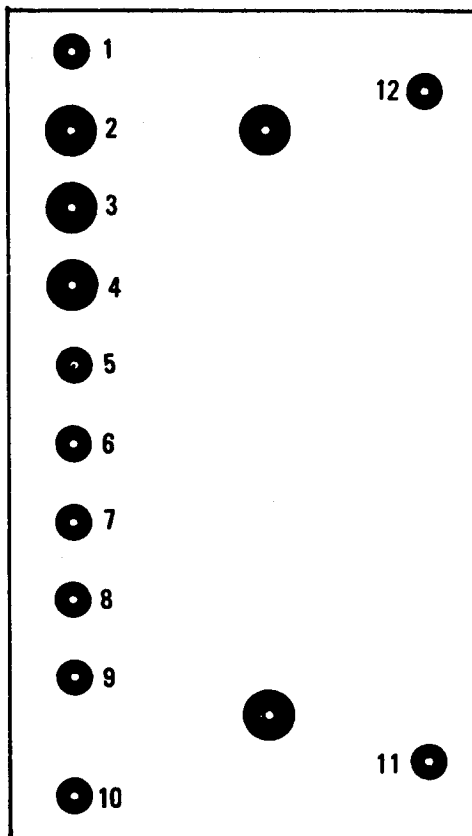


Figure 3-61. Junction Block PWB 1A14A5, P/N 755017A4041, Component Location Diagram

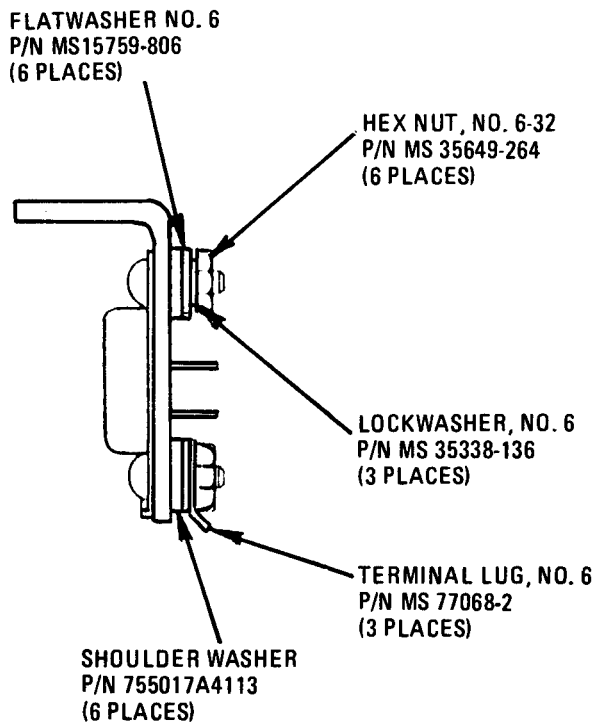
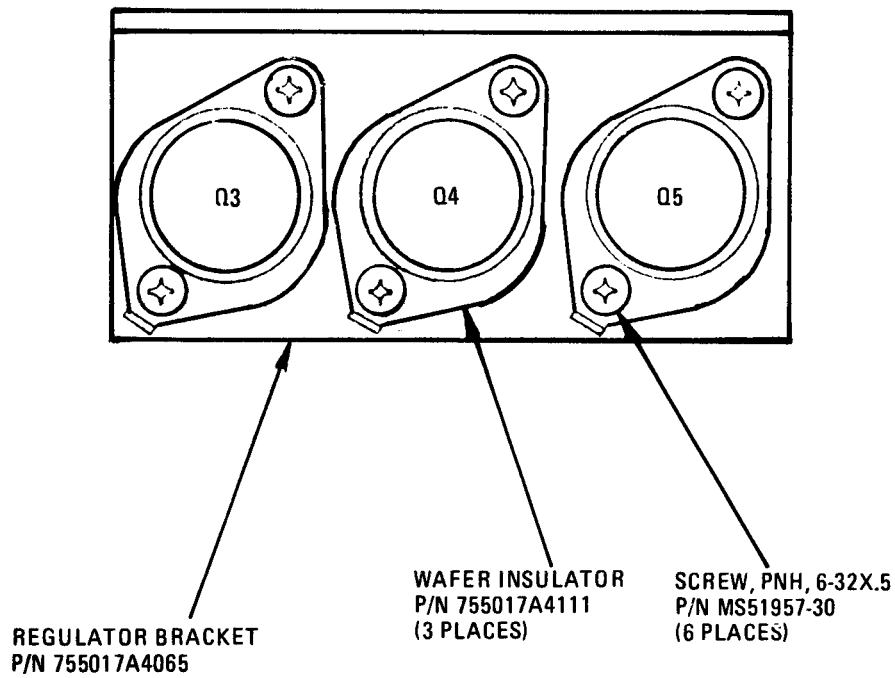


Figure 3-62. Regulator Assembly 1A14A6, P/N 755017A4031, Component Location Diagram

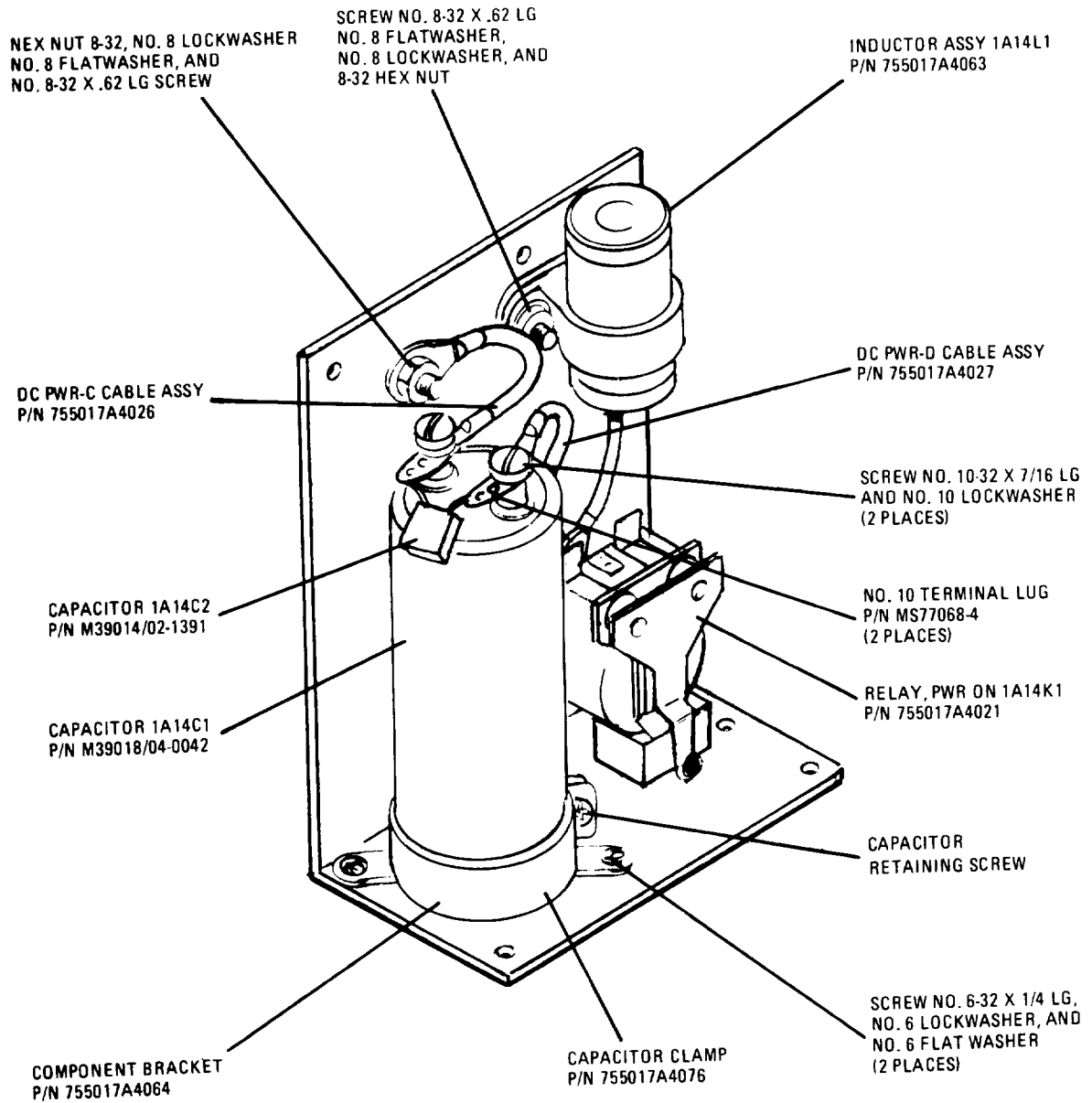


Figure 3-63. Component Bracket Assembly P/N 755017A4064, Component Location Diagram

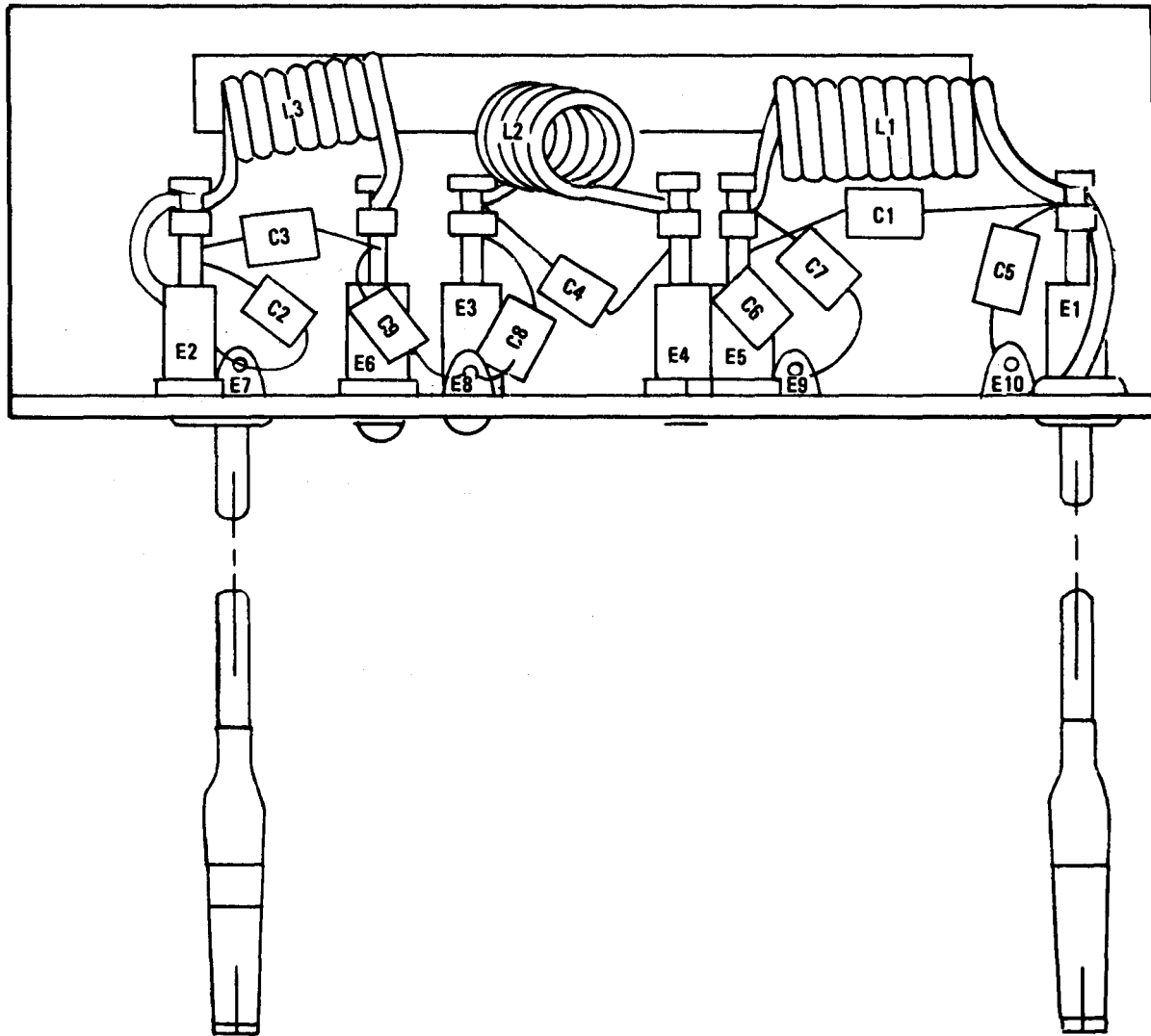


Figure 3-64. Harmonic Filter Assembly 1A15, P/N 755017A4070, Component Location Diagram

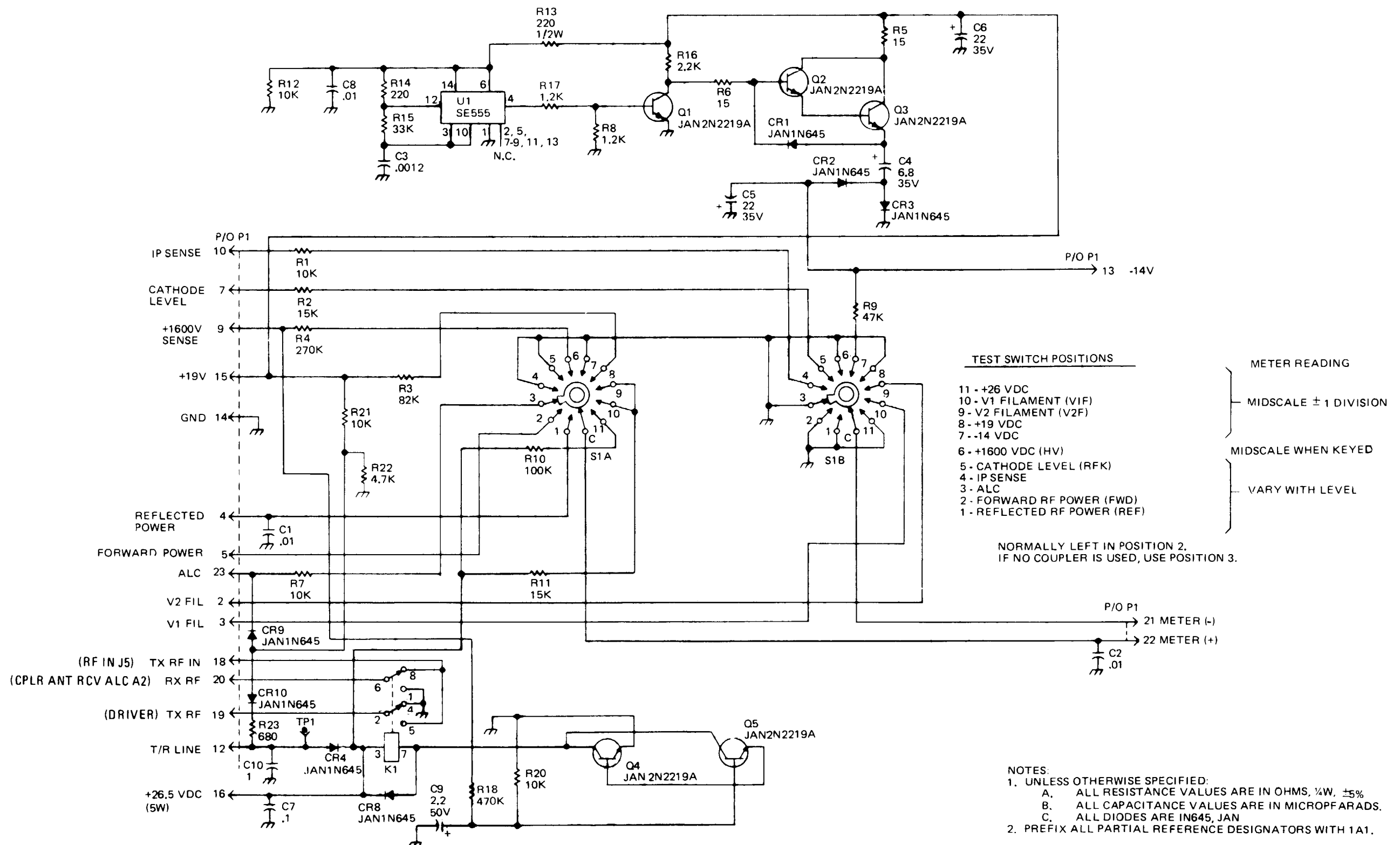


Figure 3-65. Meter Board PWB Assembly 1A1, P/N 755017A4210, Schematic Diagram

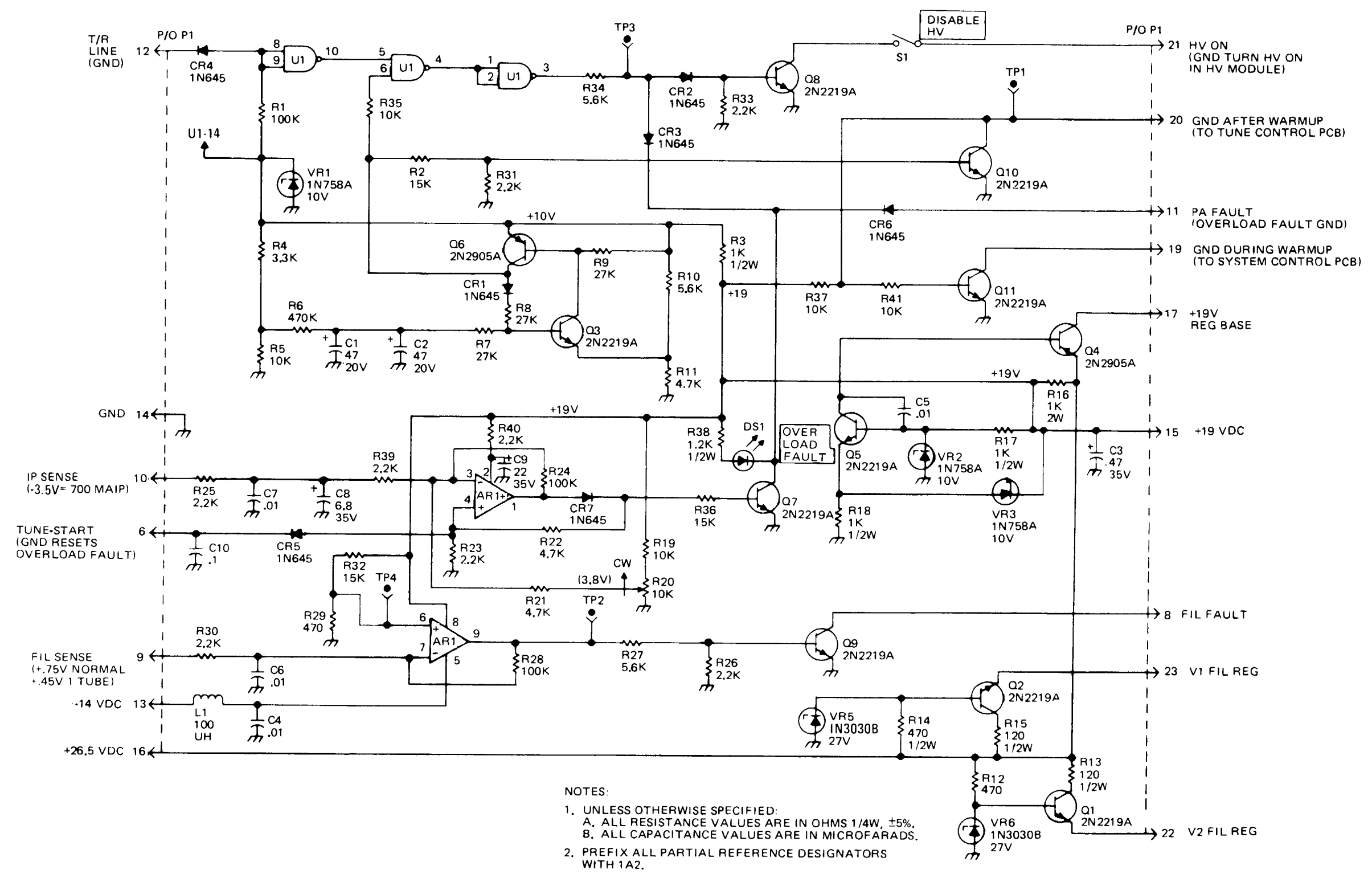
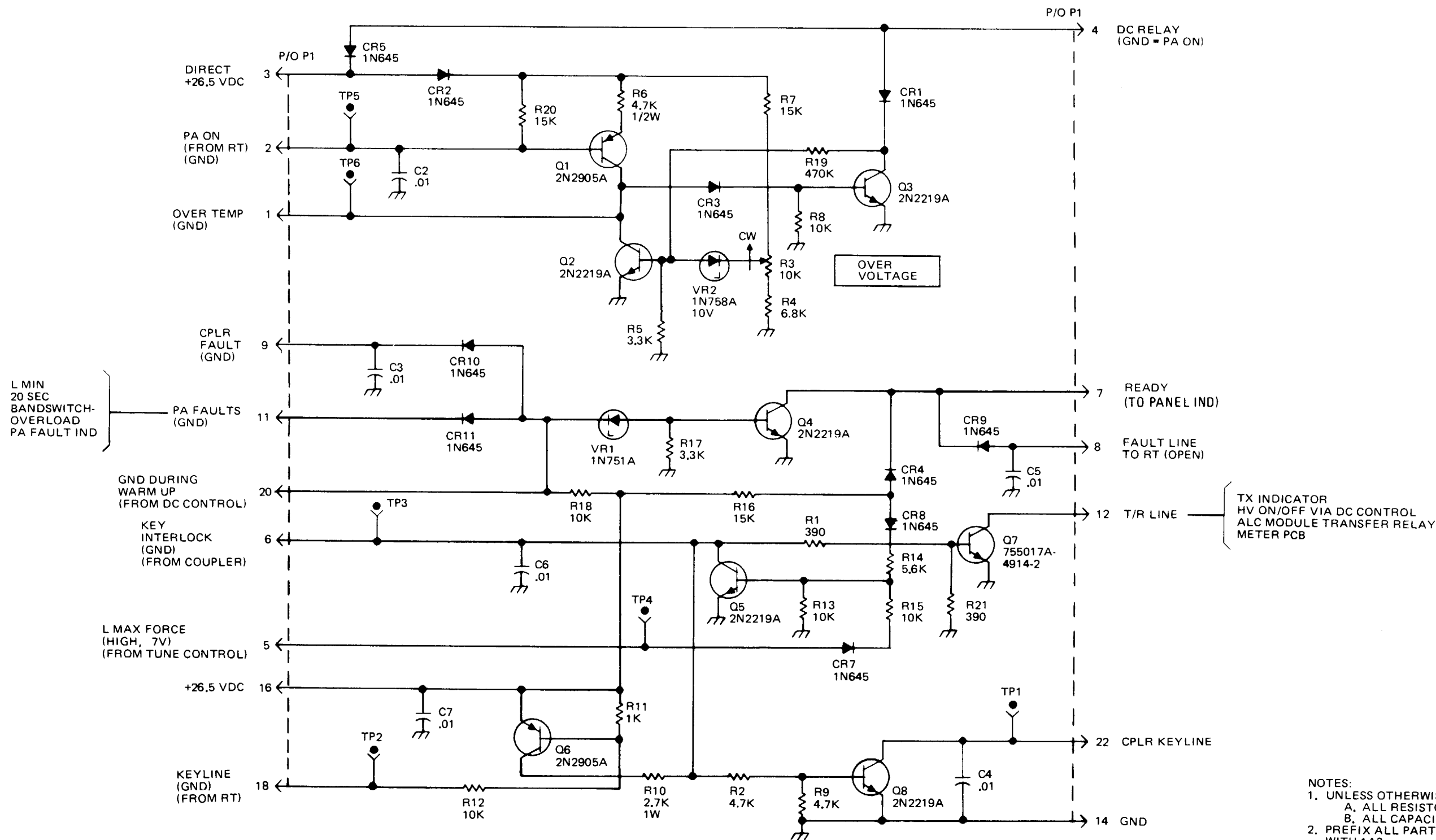
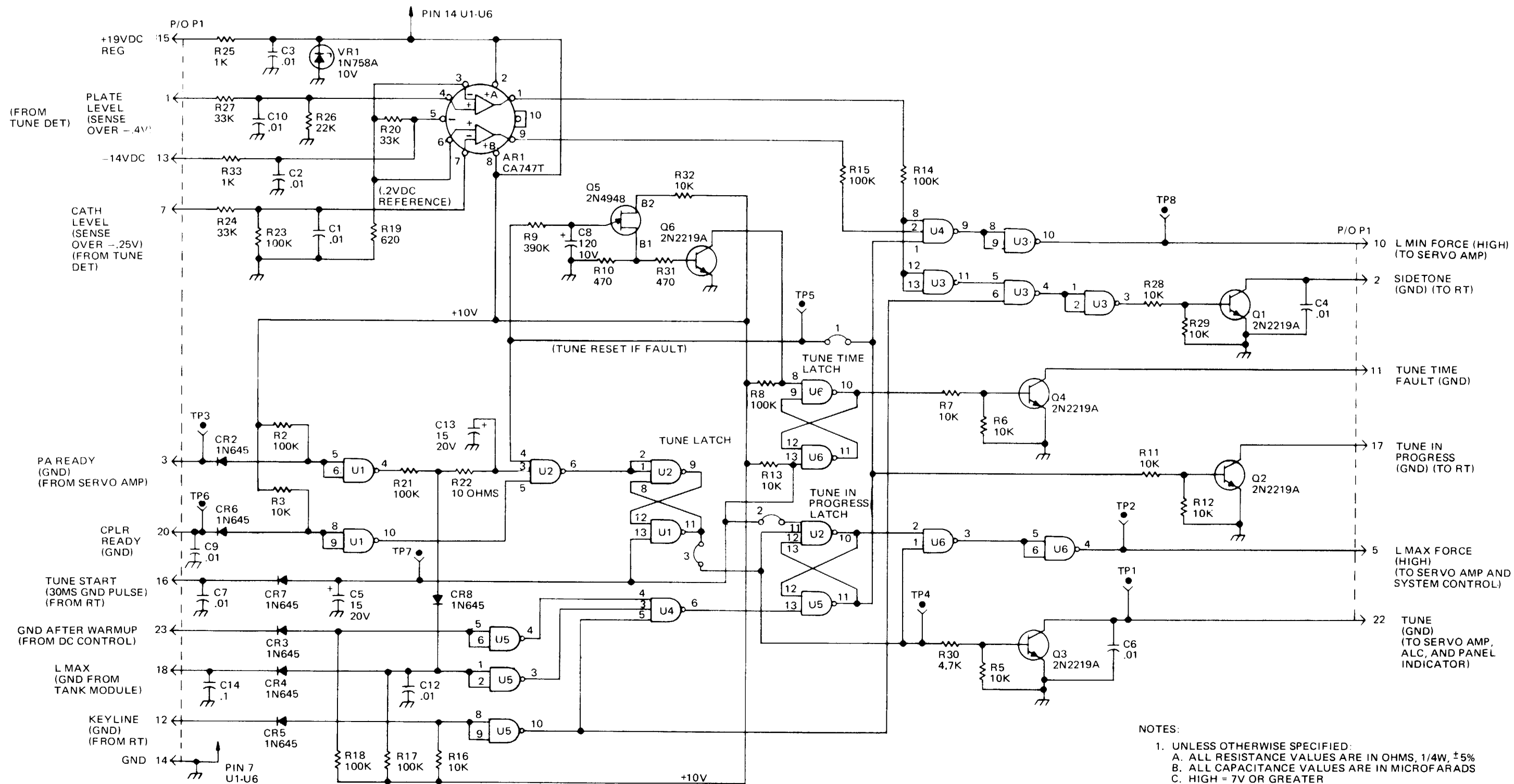


Figure 3-66. DC Control PWB Assembly 1A2, P/N 755017A4220, Schematic Diagram



- NOTES:
 1. UNLESS OTHERWISE SPECIFIED:
 A. ALL RESISTOR ARE IN OHMS, 1/4, ±5%
 B. ALL CAPACITORS ARE IN MICROFARADS
 2. PREFIX ALL PARTIAL REFERENCE DESIGNATORS WITH 1A3.

Figure 3-67. System Control PWB Assembly 1A3, P/N 755017A4230 Schematic Diagram



- NOTES:
1. UNLESS OTHERWISE SPECIFIED:
 - A. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W, ±5%
 - B. ALL CAPACITANCE VALUES ARE IN MICROFARADS
 - C. HIGH = 7V OR GREATER
 - D. GND = 3V OR LOWER
 - E. = TEST JUMPER
 - F. ALL 2 INPUT NAND GATES ARE CD4011
 - G. ALL 3 INPUT NAND GATES ARE CD4023
 2. PREFIX ALL PARTIAL REFERENCE DESIGNATORS WITH 1A4.

Figure 3-68. Tune Control PWB Assembly 1A4, P/N 755017A4240, Schematic Diagram

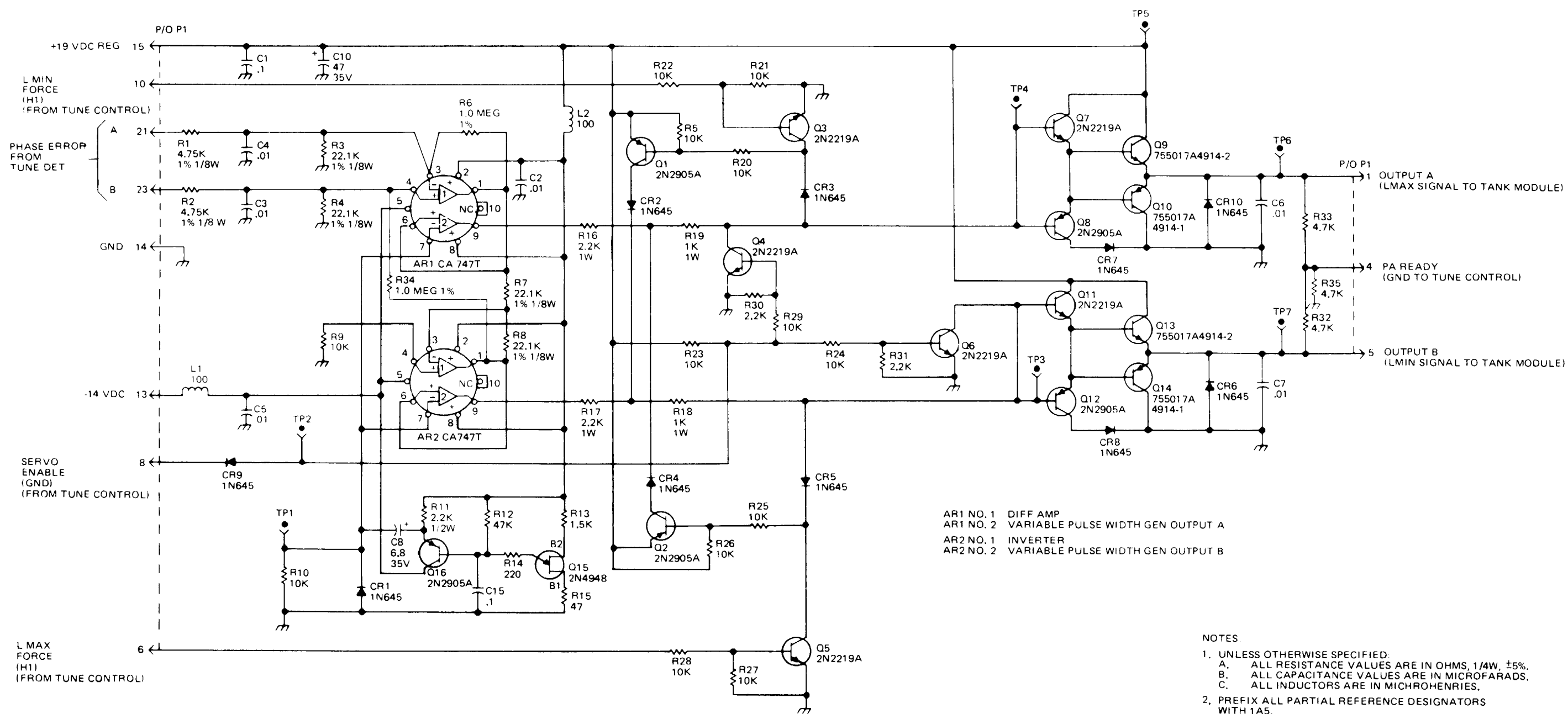


Figure 3-69. Servo Amplifier PWB Assembly 1A5, P/N 755017A4250, Schematic Diagram

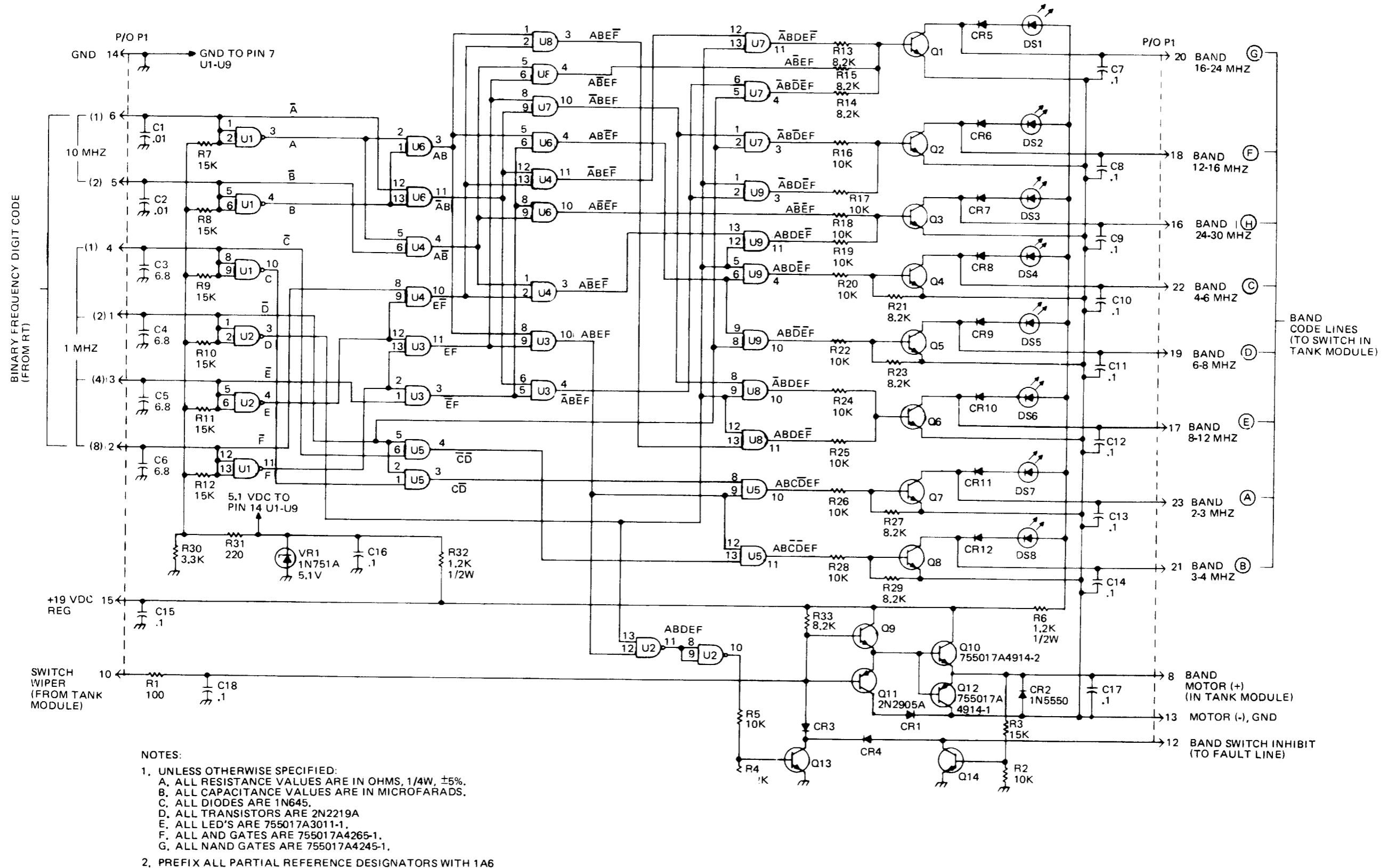
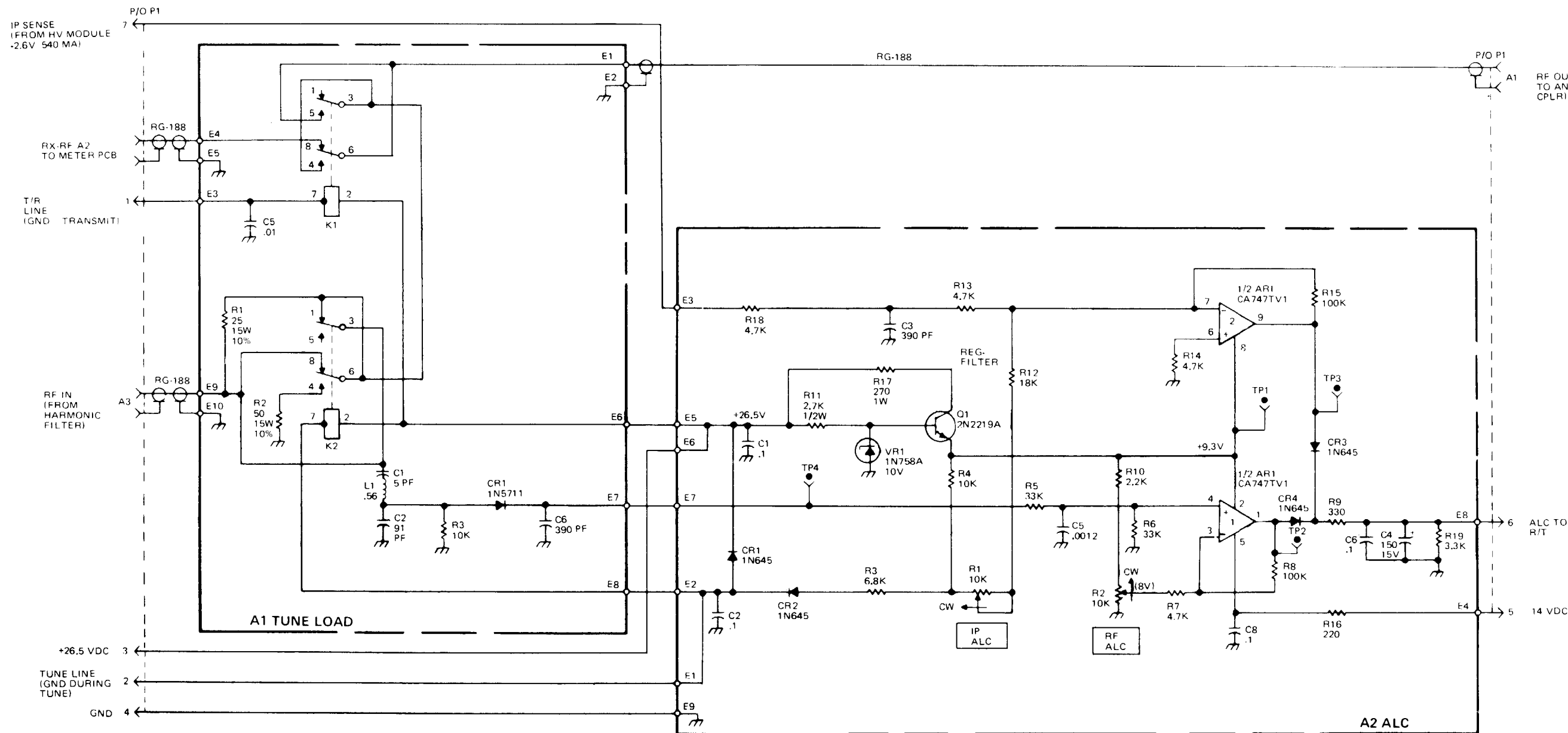


Figure 3-70. Band Control PWB Assembly 1A6, P/N 755017A4260, Schematic Diagram



- NOTES:
1. UNLESS OTHERWISE SPECIFIED.
 - A. ALL RESISTORS ARE IN OHMS, 1/4W, ±5%.
 - B. ALL CAPACITORS ARE IN MICROFARADS.
 - C. ALL INDUCTORS ARE IN MICROHENRIES.
 2. R3 SETS TUNE POWER LEVEL.
 3. PREFIX ALL PARTIAL REFERENCE DESIGNATORS WITH 1A7.

Figure 3-71. ALC Module Assembly 1A7, P/N 755017A4600, Schematic Diagram

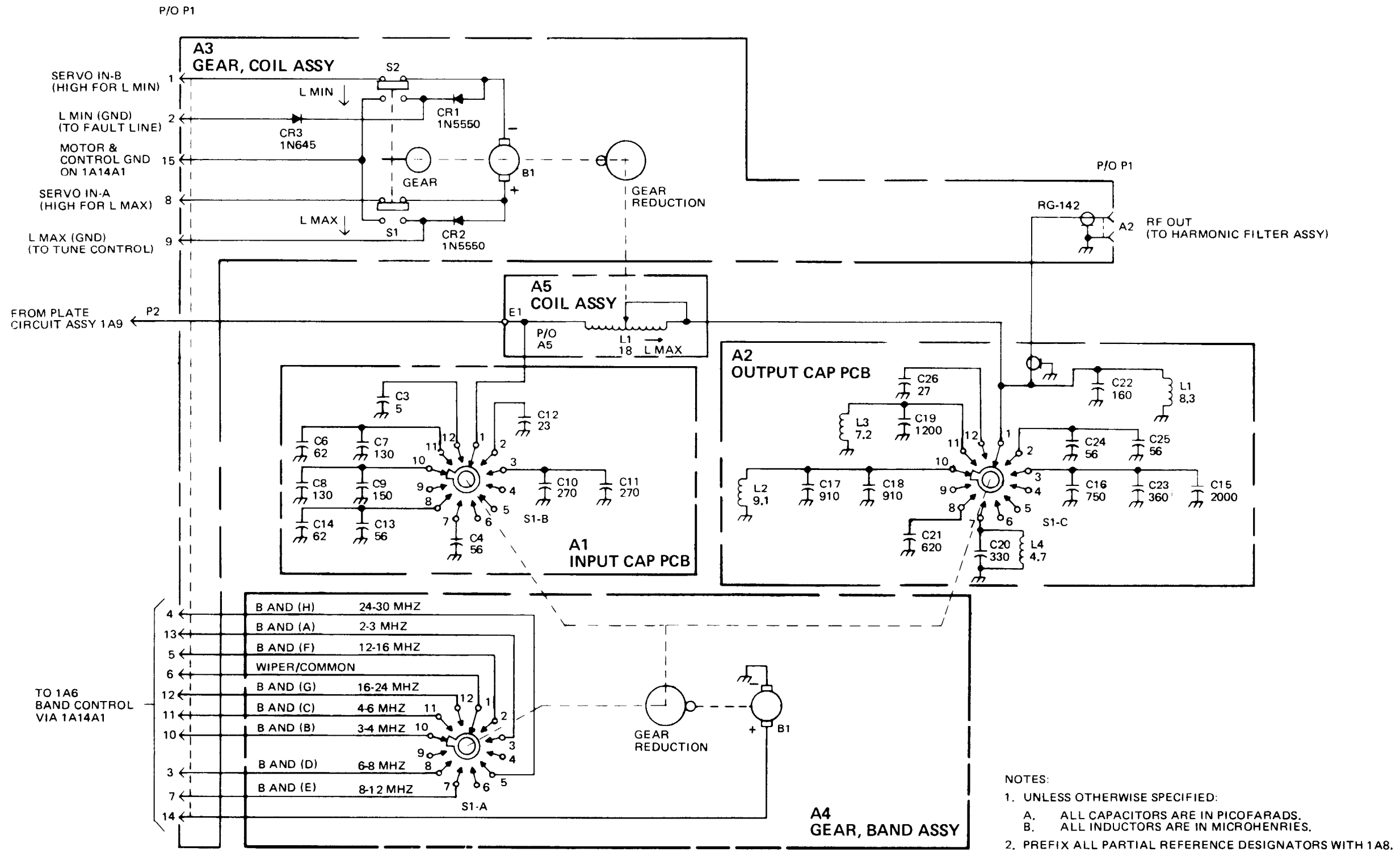


Figure 3-72. Tank Circuit Module Assembly 1A8, P/N 755017A4500, Schematic Diagram

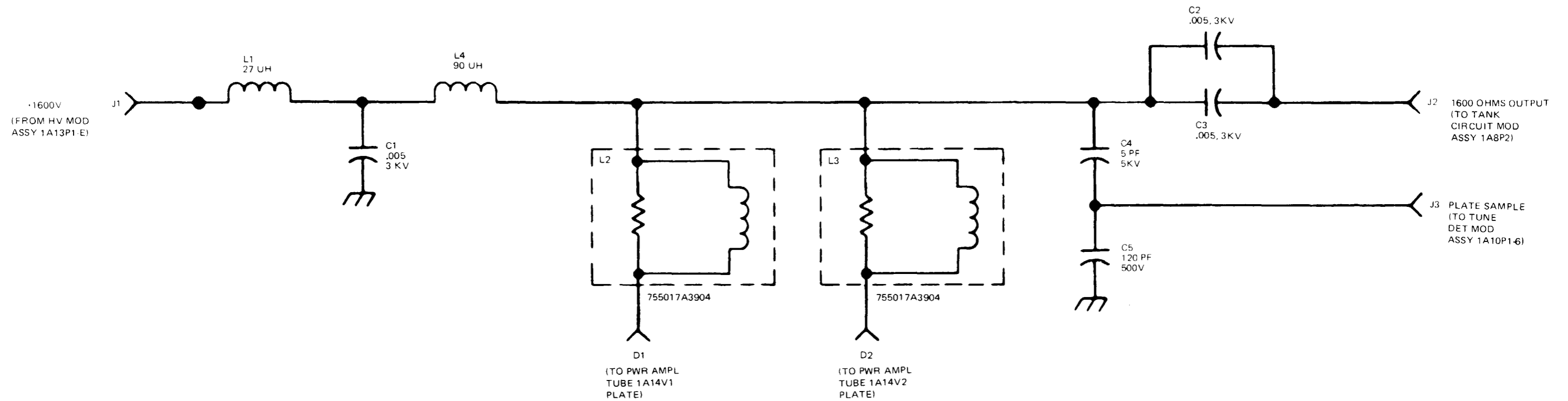


Figure 3-73. Plate Assembly 1A9,
P/N 755017A3900, Schematic Diagram

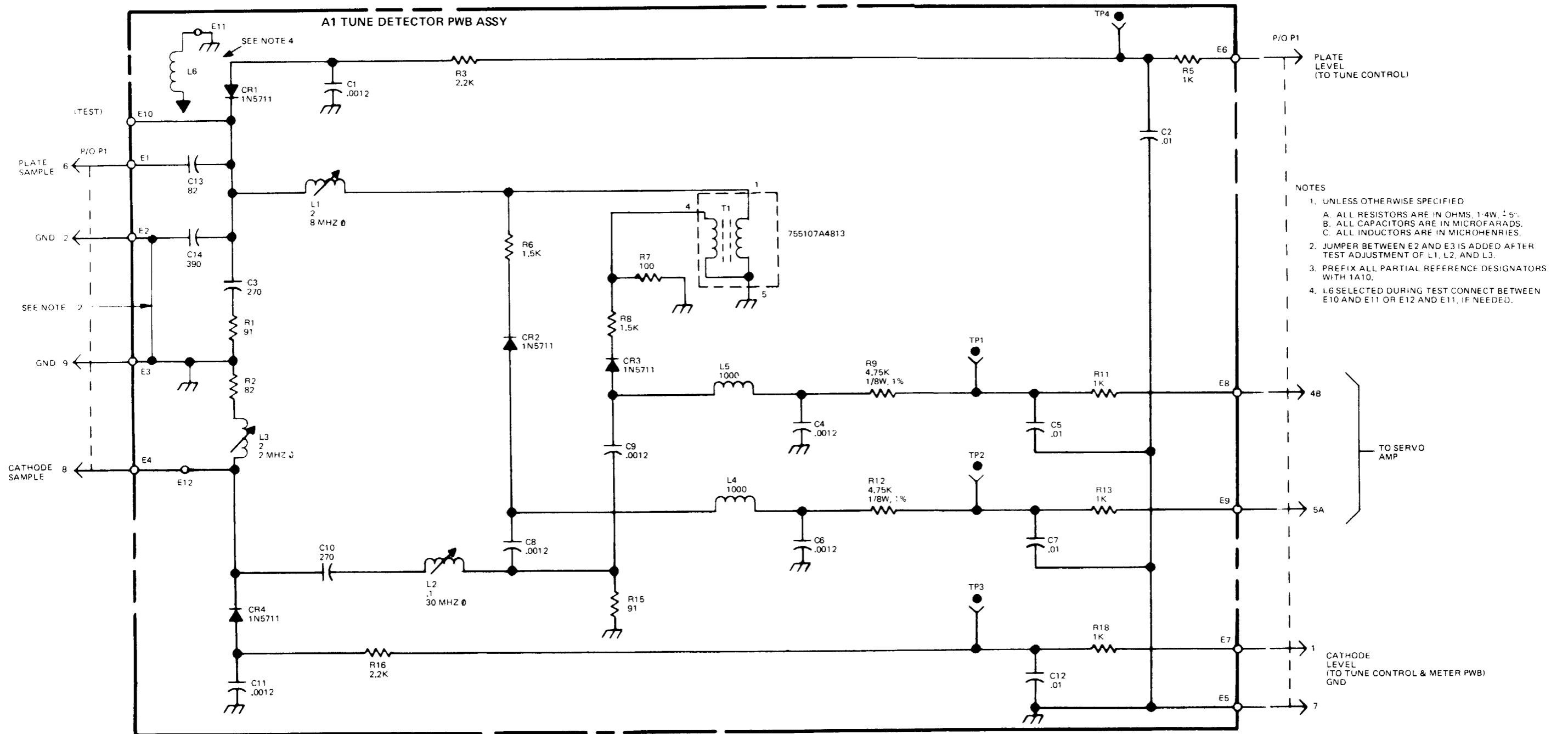
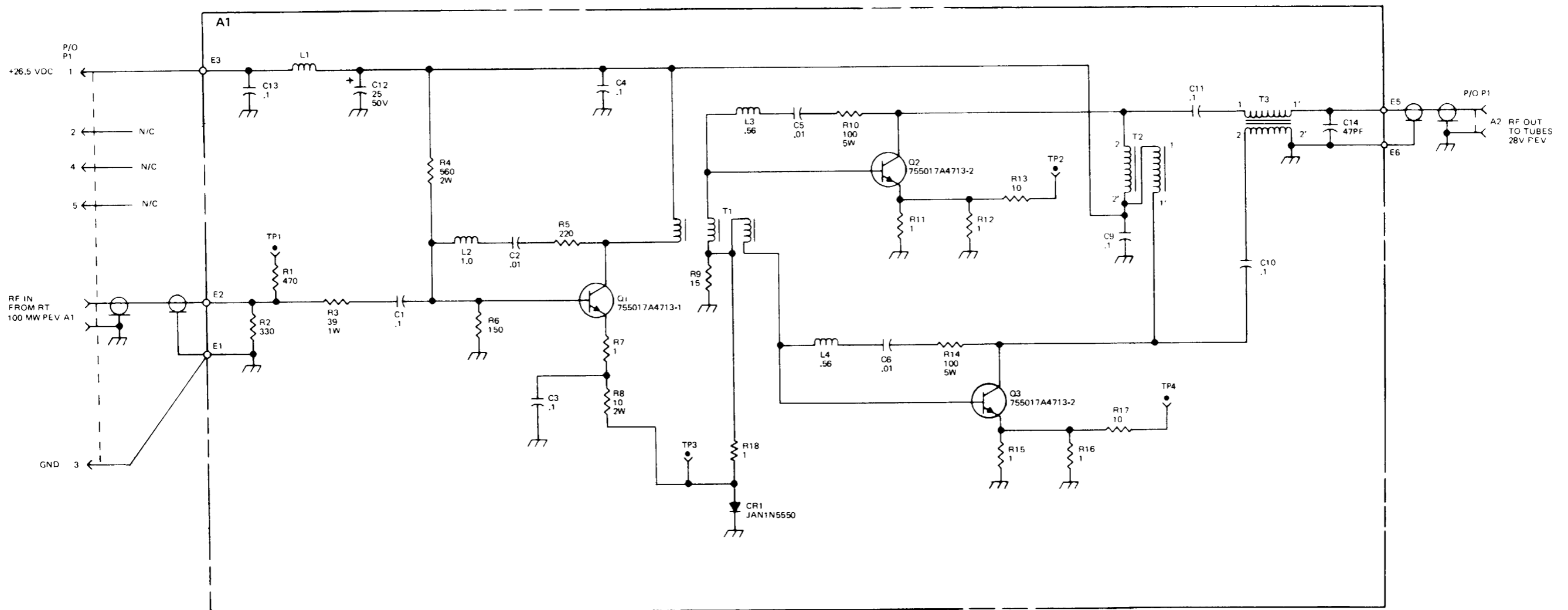
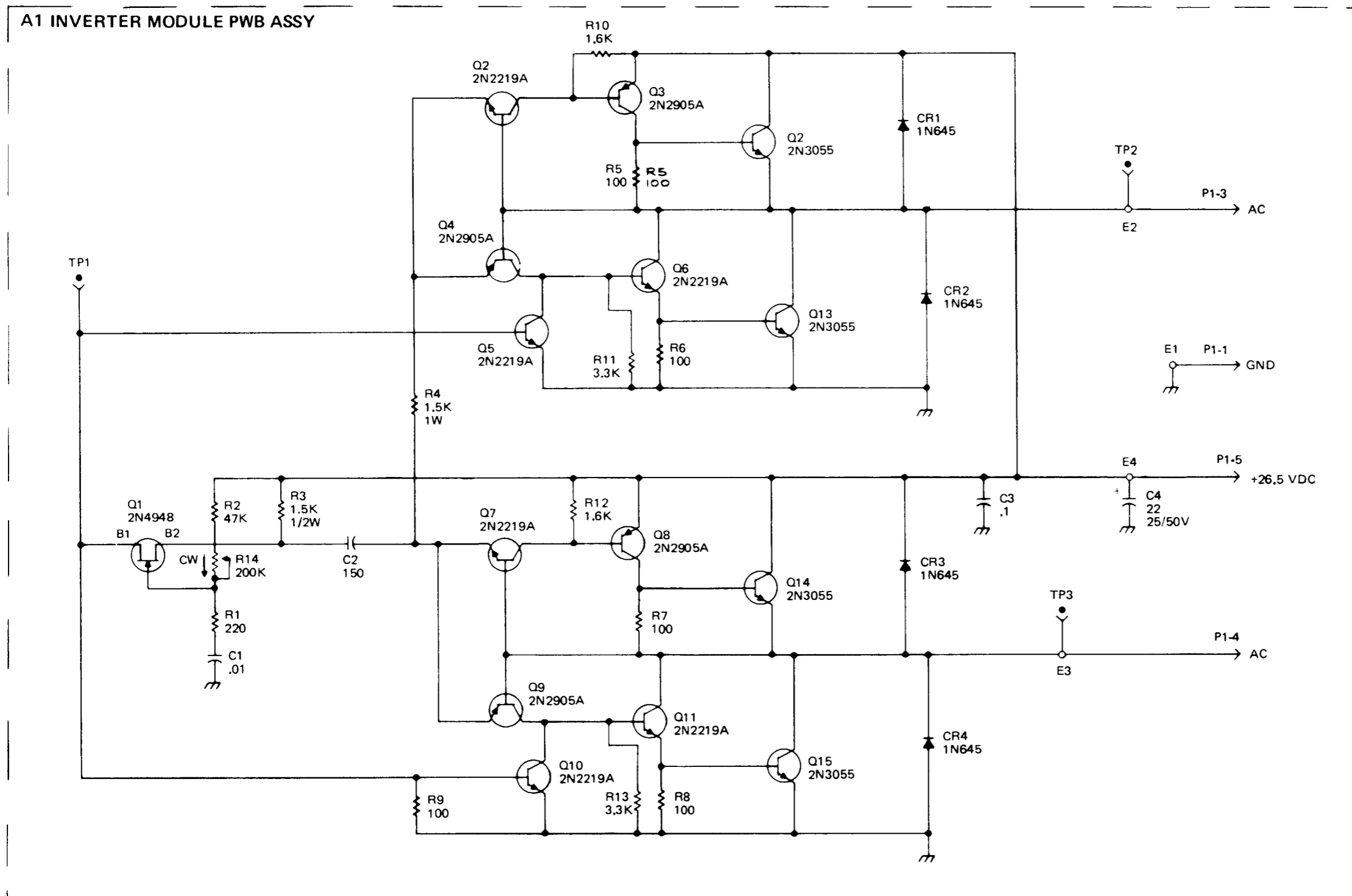


Figure 3-74. Tune Detector Module Assembly 1A10, P/N 755017A4800, Schematic Diagram



NOTES
 1. UNLESS OTHERWISE SPECIFIED
 A. ALL CAPACITANCE VALUES ARE IN MICROFARADS.
 B. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
 C. ALL RESISTANCE VALUES ARE IN OHMS, 1/2W, 5%.
 2. PREFIX ALL PARTIAL REFERENCE DESIGNATORS WITH 1A11.

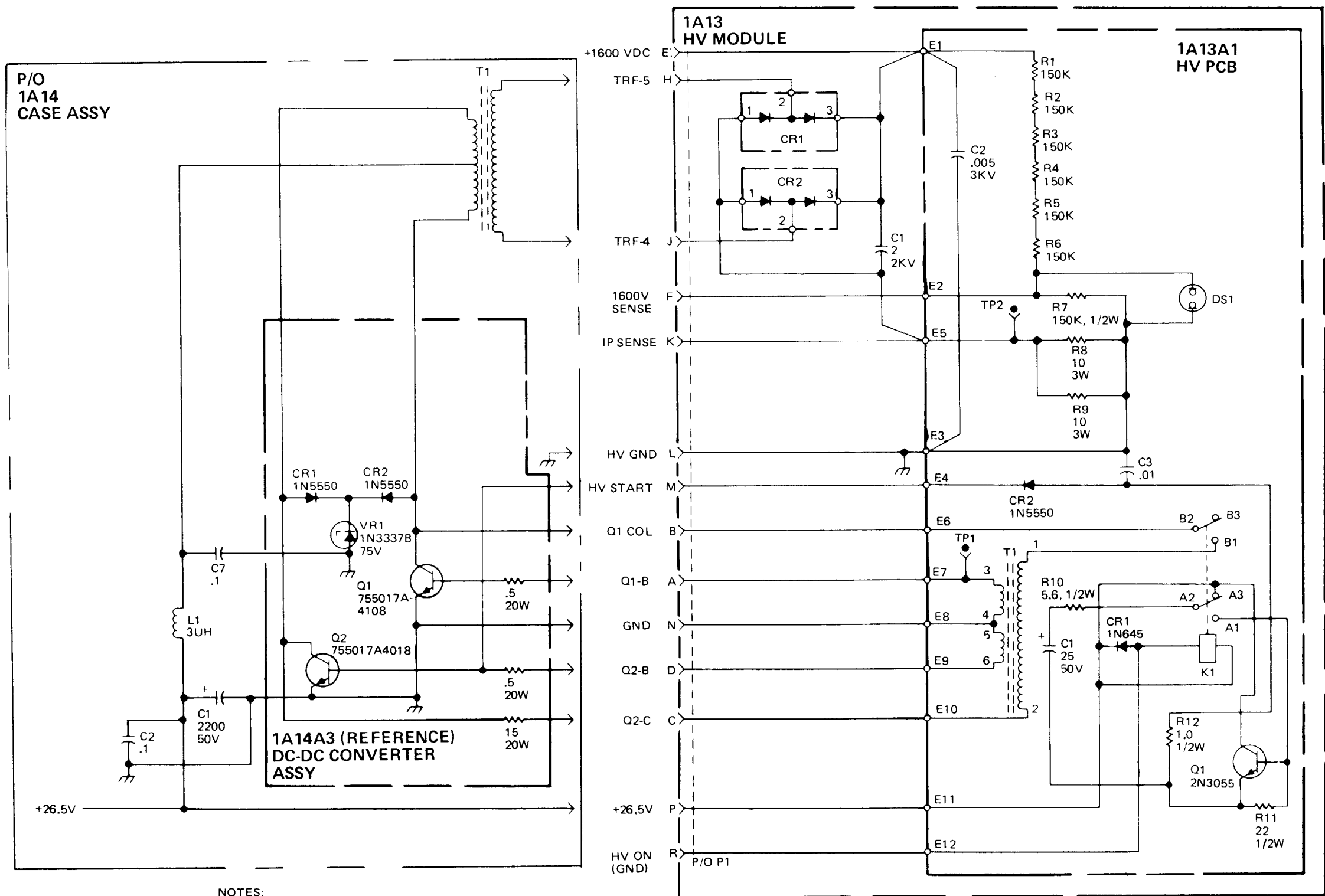
Figure 3-75. RF Driver Module Assembly 1A11, P/N 755017A4700, Schematic Diagram



NOTES:

- UNLESS OTHERWISE SPECIFIED:
1. ALL CAPACITANCE VALUES ARE IN MICROFARADS.
 2. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W, 5%.
 3. PREFIX ALL PARTIAL REFERENCE DESIGNATORS WITH 1A12

Figure 3-76. Static Power Inverter Assembly 1A12, P/N 755017A4900, Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
 - A. ALL RESISTORS ARE IN OHMS, 2W, 5%.
 - B. ALL CAPACITORS ARE IN MICROFARADS.
2. PREFIX ALL PARTIAL REFERENCE DESIGNATORS WITH MAJOR

Figure 3-77. High Voltage Module Assembly 1A13, P/N 755017A4300, Schematic Diagram

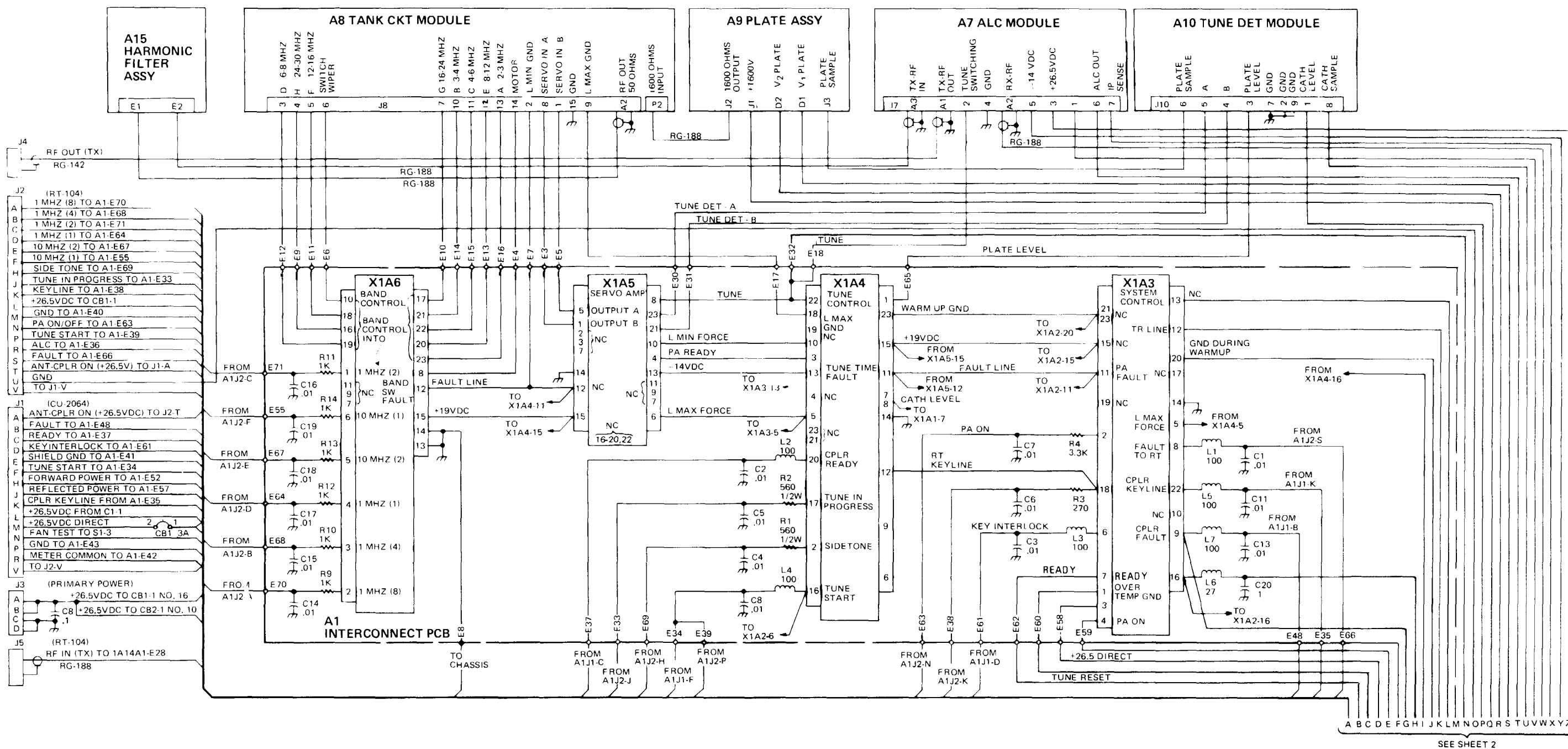


Figure 3-78. Case Assembly 1A14, P/N 755017A400 Schematic Diagram (Sheet 1 of 2)

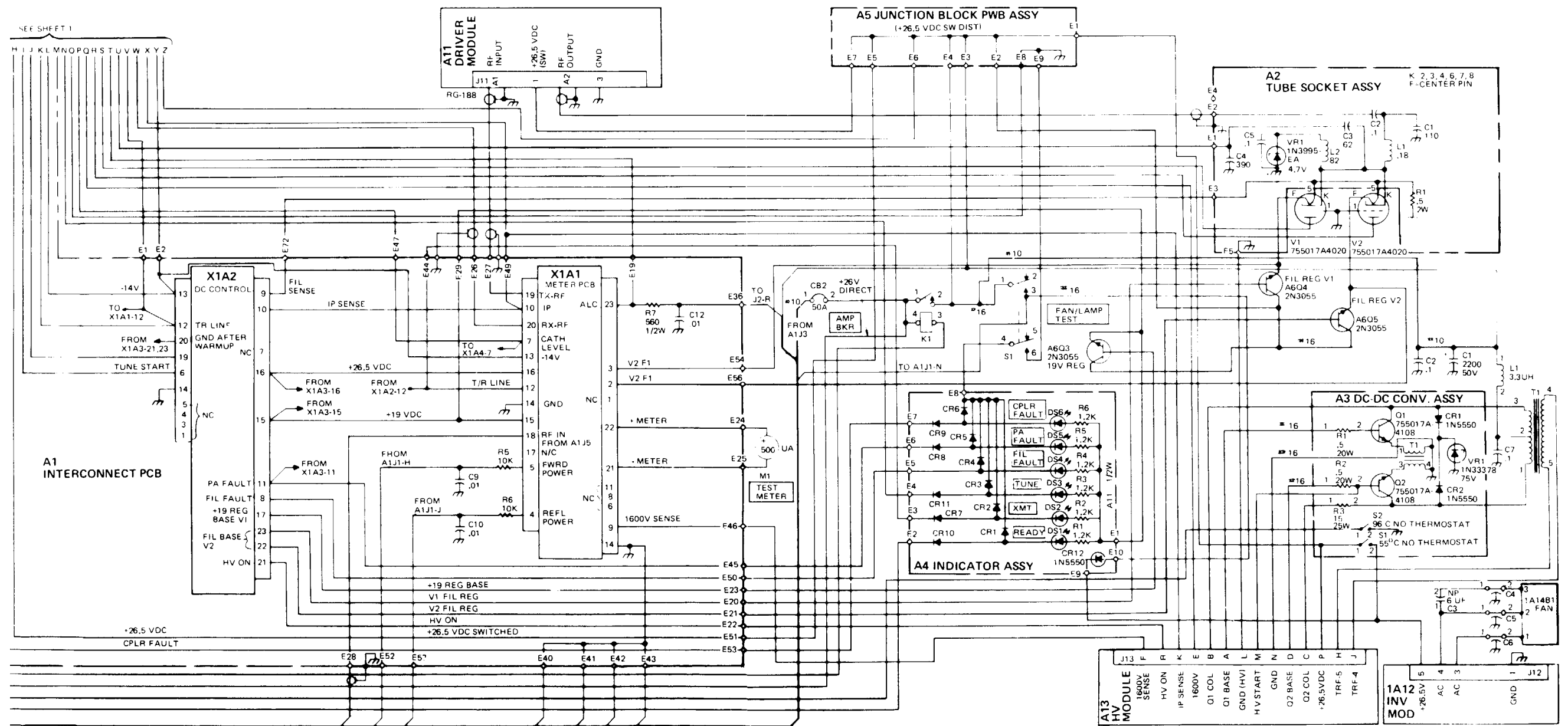
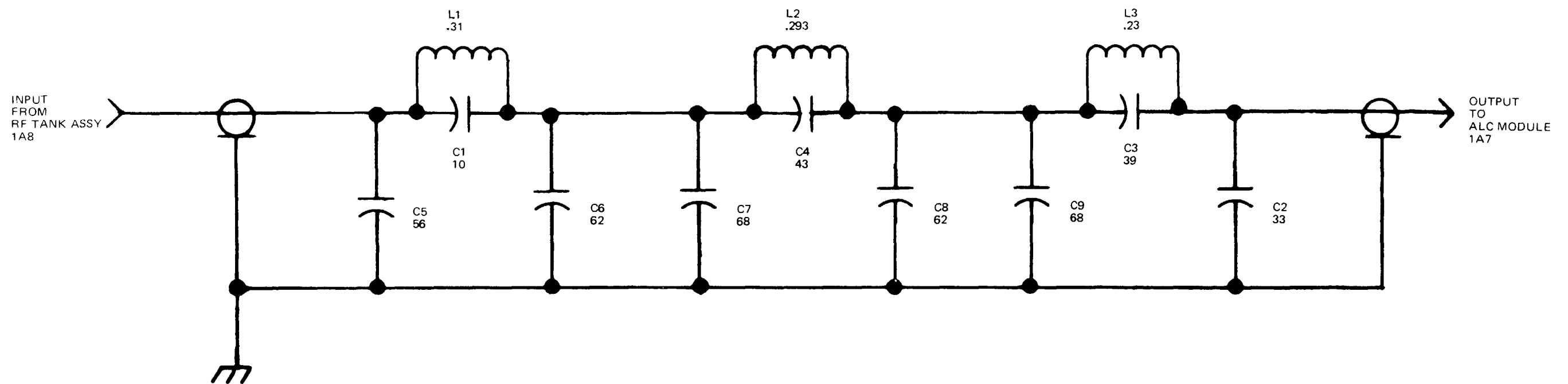


Figure 3-78. Case Assembly 1A14,
P/N 755017A400 Schematic Diagram
(Sheet 2 of 2)



NOTES:
 1. ALL CAPACITORS ARE IN PICO FARADS.
 2. ALL INDUCTORS ARE IN MICROHENRIES.
 3. PREFIX ALL PARTIAL REFERENCE DESIGNATORS WITH 1A15.

Figure 3-79. Harmonic Filter Assembly 1A15,
 P/N 755017A4070, Schematic Diagram

APPENDIX A**REFERENCES**

AR 55-38	Reporting of Transportation Discrepancies in Shipments
AR 735-11-2	Reporting of Item and Packaging Discrepancies
DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms
DA Pam 738-750	The Army Maintenance Management System (TAMMS)
TM 11-5820-921-40-2	General Support Maintenance Manual Power Amplifier AM-6545A/GRC-193A
TM 11-5820-922-12	Operator's and Organizational Maintenance Manual Amplifier-Converter AM-6879/URC
TM 11-5820-924-12	Operator's and Organizational Maintenance Manual Radio Sets AN/GRC-193A
TM 11-5985-373-40-1	General Support Maintenance Manual Coupler, Antenna CU-2064/GRC-193A
TM 740-90-1	Administrative Storage of Equipment
TM 750-244-2	Procedures for Destruction of Electronic Materiel to Prevent Enemy Use (Electronics Command)

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 Stateside, N.J. 07703-5007

DATE SENT 10 July 1975

PUBLICATION NUMBER TM 11-5840-340-12	PUBLICATION DATE 23 Jan 74	PUBLICATION TITLE Radar Set AN/PRC-76
---	-------------------------------	--

BE EXACT... PIN-POINT WHERE IT IS				IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO	
2-25	2-28			<p>Recommend that the installation antenna alignment procedure be changed throughout to specify a 2° IFF antenna lag rather than 1°.</p> <p>REASON: Experience has shown that with only a 1° lag, the antenna servo system is too sensitive to wind gusting in excess of 25 knots, and has a tendency to rapidly accelerate and decelerate as it hunts, causing strain to the drive train. Hunting is minimized by adjusting the lag to 2° without degradation of operation.</p>
3-10	3-3		3-1	<p>Item 5, Function column. Change "2 db" to "3db."</p> <p>REASON: The adjustment procedure for the TRANS POWER FAULT indicator calls for a 3 db (500 watts) adjustment to light the TRANS POWER FAULT indicator.</p>
5-6	5-8			<p>Add new step f.1 to read, "Replace cover plate removed in step e.1, above."</p> <p>REASON: To replace the cover plate.</p>
		F03		<p>Zone C 3. On J1-2, change "+24 VDC to "+5 VDC."</p> <p>REASON: This is the output line of the 5 VDC power supply. +24 VDC is the input voltage.</p>

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TM 11-5820-921-40-1

PUBLICATION DATE
15 January 86

PUBLICATION TITLE Power Amplifier
AM-6545A/GRC-193A

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