

# TECHNICAL MANUAL

MW-1A AM TRANSMITTER

994 7966 001



HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1732 001

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Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.



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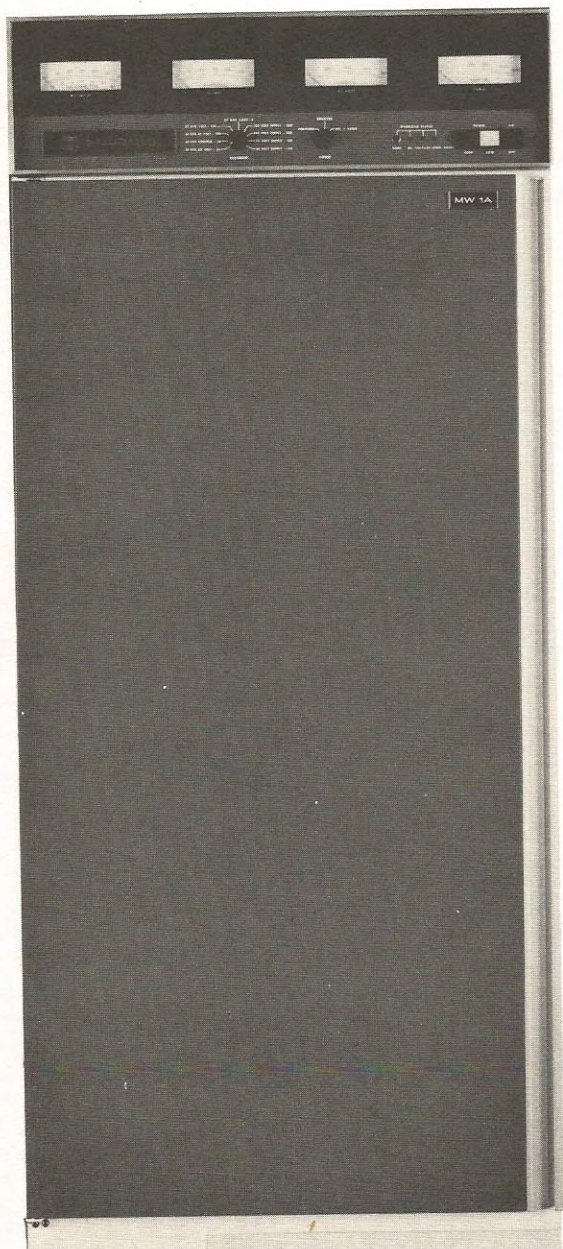
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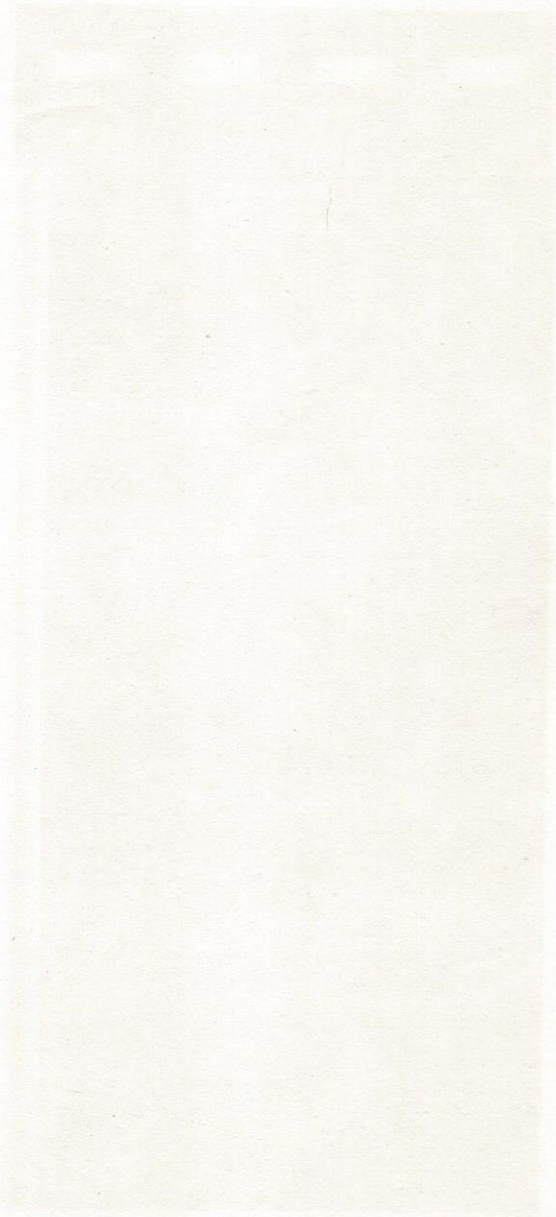
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Figure 1-1. MW-1A Transmitter

1-0

WARNING: Disconnect primary power prior to servicing.







## SECTION I

### GENERAL DESCRIPTION

#### 1-1. INTRODUCTION.

1-2. This technical manual contains all information necessary to install, operate, maintain, and service the Model MW-1A Solid State AM Broadcast Transmitter. Figure 1-1 depicts the external configuration of the transmitter. The various sections in this technical manual provide the following types of information.

a. SECTION I, GENERAL DESCRIPTION, provides a description of the equipment, identifies the major components, lists operating parameters and specifications, and describes other pertinent features of the equipment.

b. SECTION II, INSTALLATION, provides information relative to incoming inspection, power requirements, input/output connections, and component mounting instructions.

c. SECTION III, OPERATION, provides identification and functions of panel or component mounted controls and indicators, along with information necessary to setup and operate the transmitter.

d. SECTION IV, PRINCIPLES OF OPERATION, provides descriptions of functional circuits within the transmitter, beginning with a general, overall block diagram discussion and proceeding through detailed, printed circuit board discussion.

e. SECTION V, MAINTENANCE, provides information pertaining to preventive and corrective maintenance, along with applicable performance schedules.

f. SECTION VI, TROUBLESHOOTING, provides fault location guidance and troubleshooting procedures along with instructions for equipment servicing.

g. SECTION VII, PARTS LIST, provides information for ordering replacement electrical components and assemblies together with selected mechanical parts.

h. SECTION VIII, DIAGRAMS, provides block, logic, and schematic diagrams and other drawings necessary for maintaining the transmitter.

1-3. An Installation Checklist is shipped with the transmitter and is also provided as Appendix A of this manual. This checklist, which is designed to be used in conjunction with instructions contained in Section II, will ensure proper installation of the transmitter if followed carefully.



1-4. EQUIPMENT PURPOSE.

1-5. The MW-1A transmitter introduces two new state-of-the art features never before included in any FCC-type-accepted AM transmitter. These are a total solid-state design and a Progressive Series Modulator (PSM). Because of these features, the MW-1A transmitter provides low distortion, excellent transient response, wide frequency response, and high positive peak capability to produce the loudest, cleanest signal available in the one-kilowatt power range.

1-6. The basic difference between Models MW-1 and MW-1A is the addition of an ME-1 Modulation Enhancer to the Model MW-1A. The enhancer was added to permit maximum modulation.

1-7. The transmitter operates 12 transistorized power amplifier modules in parallel to provide an 1100 watts output at 125 percent program modulation. Failure of one of these modules will not affect the rated performance of the transmitter and the transmitter will stay on the air at a reduced power level even if several modules fail.

1-8. Each module operates at an efficiency of close to 90 percent and is capable of 100 watts carrier and 500 watts peak to provide full carrier power and modulation capability. Control of the transmitter power over a wide range is accomplished in the PSM by means of a front-panel vernier control. Transmitter output power may be reduced to 500 or 250 watts and may also be switched with the carrier and program on.

1-9. PHYSICAL DESCRIPTION.

1-10. The MW-1A transmitter has no external components and is completely self-contained in one equipment cabinet. Access to all transmitter components, except the transmitter control and meter panel, is achieved through the easily removed front and rear cabinet doors (figures 1-2 through 1-4). The swing-up transmitter control and meter panel is located at eye level on the front of the transmitter. Opening the front door exposes the oscillator and audio input/overload modules and the remote power control, which are mounted on a swing-down panel on the internal control panel. The internal control panel also accommodates the vernier control used to regulate output power, protective circuit-breaker controls, remote/local control switch, and status indicators. Fault indicating devices for the 12 power amplifier modules and the controls for the built-in dummy load are panel-mounted just above the internal control panel.

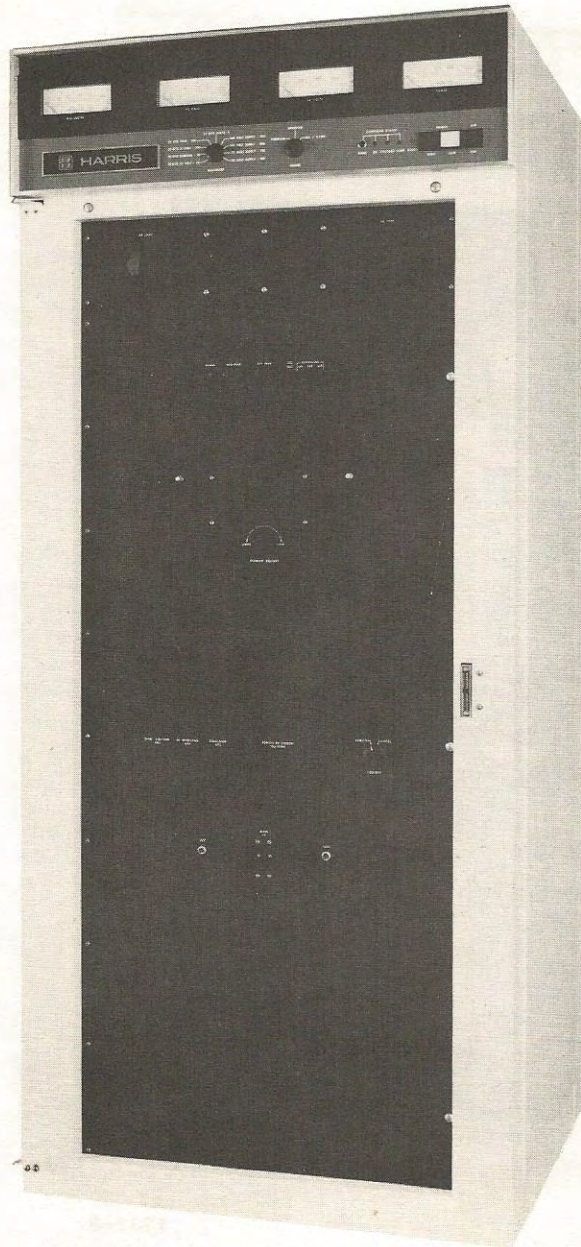
1-11. Transmitter ease of maintenance is also achieved through use of a spacious configuration layout, plug-in modules, and easily removed power supplies. The two low-voltage power supplies may be lifted out by removing four screws and a few wires. The plug-in modules include the following:

1-2

WARNING: Disconnect primary power prior to servicing.



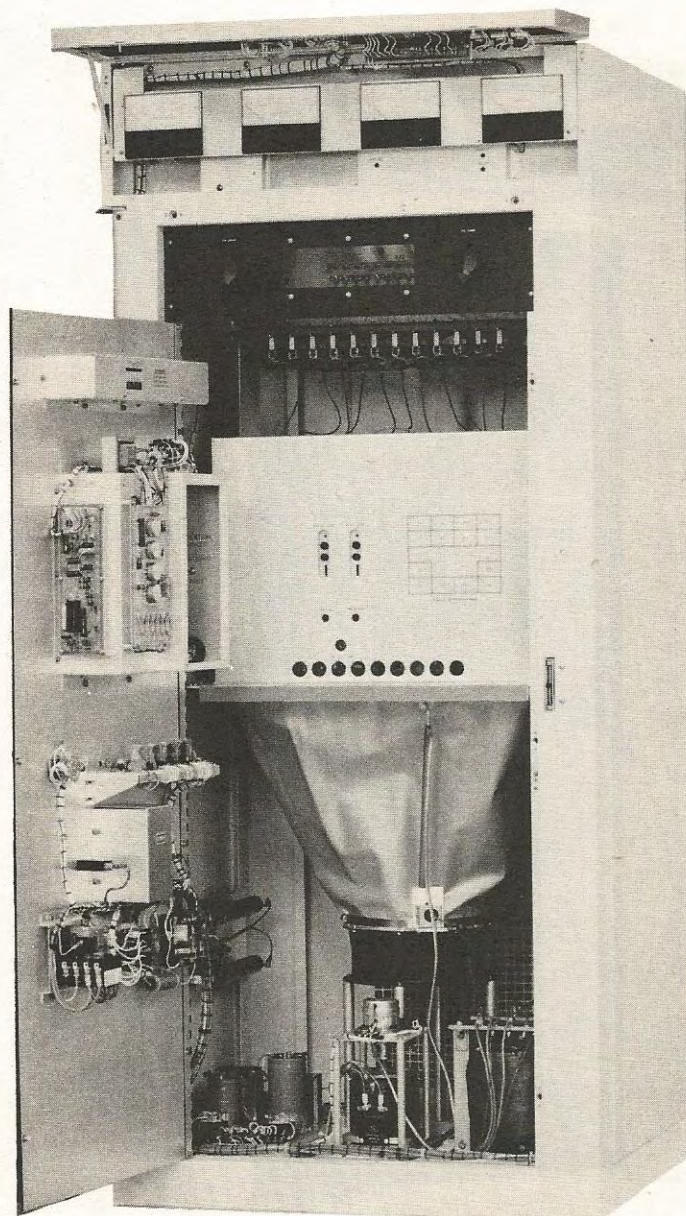
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Figure 1-2. MW-1A Transmitter, Front View





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Figure 1-3. Transmitter Front Access Door Open



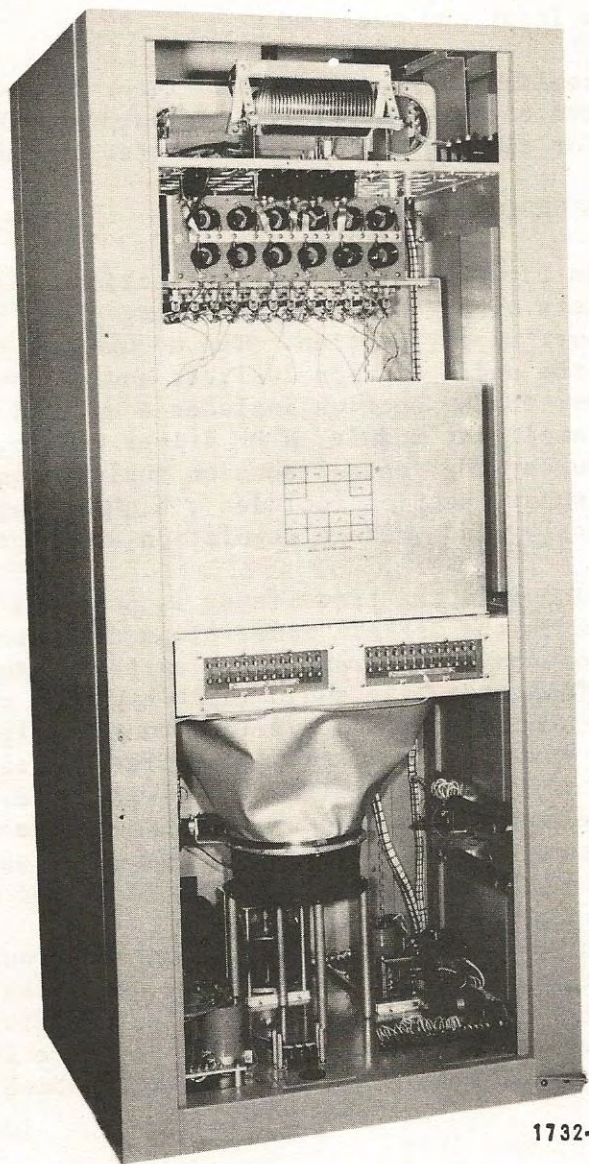


Figure 1-4. Transmitter, Rear View



- a. Power Amplifier (PA)/Modulator (12 modules)
- b. RF Driver (identical to PA/Modulator modules)
- c. Intermediate Power Amplifier (IPA)
- d. Oscillator
- e. Audio Driver
- f. Audio Input and Overload

1-12. Filtered cooling air for the transmitter is provided by a fan and filter located at the bottom rear of the equipment cabinet. The air filter may be removed for cleaning during transmitter operation.

1-13. FUNCTIONAL DESCRIPTION.

1-14. As shown in figure 1-5, the basic functional circuits in the MW-1A transmitter consists of a modulation enhancer, audio section, RF section, control section, and power supply section. The modulation enhancer includes an adjustable clipper, the audio section includes audio input and overload and audio driver modules; the RF section includes a crystal oscillator, and intermediate power amplifier module, a RF driver module, and 12 power amplifier/modulator modules; the control section includes gating and power control; and the power supply section includes a high voltage supply, 160-volt supply, 30-volt supply, and voltage regulation and protective circuits.

1-15. The audio input to the transmitter is provided through a pad to the enhancer which, when in the OPERATE mode, clips the input and then is applied to a balanced-to-unbalanced transformer on the audio input and overload board. (In the BYPASS mode, the audio input bypasses the enhancer and is applied directly to the audio input and overload board.) The audio input is applied directly to the current and voltage amplifier stages in the audio driver and, from there, to the final emitter-follower stage. The emitter-follower output from the audio driver is routed through the gating and power control circuit and contains the DC and audio voltages necessary to drive all 12 power amplifier/modulator modules and the RF driver module.

1-16. The oscillator in the RF section produces an output which is twice or four times that of the carrier frequency, depending upon which is more stable with respect to temperature. This output is divided by two or four to reach the carrier frequency and amplified to drive the intermediate power amplifier (IPA). The IPA is a Class A amplifier which drives the RF driver module.

1-17. The RF driver module is interchangeable with a power amplifier/modulator module and serves the same purpose. It acts as a push-pull, Class D amplifier whose output drives all 12 power amplifier/modulator modules in parallel. The transmitter output network provides 225 degrees of phase shift between each power amplifier/modulator module and the antenna. Because of



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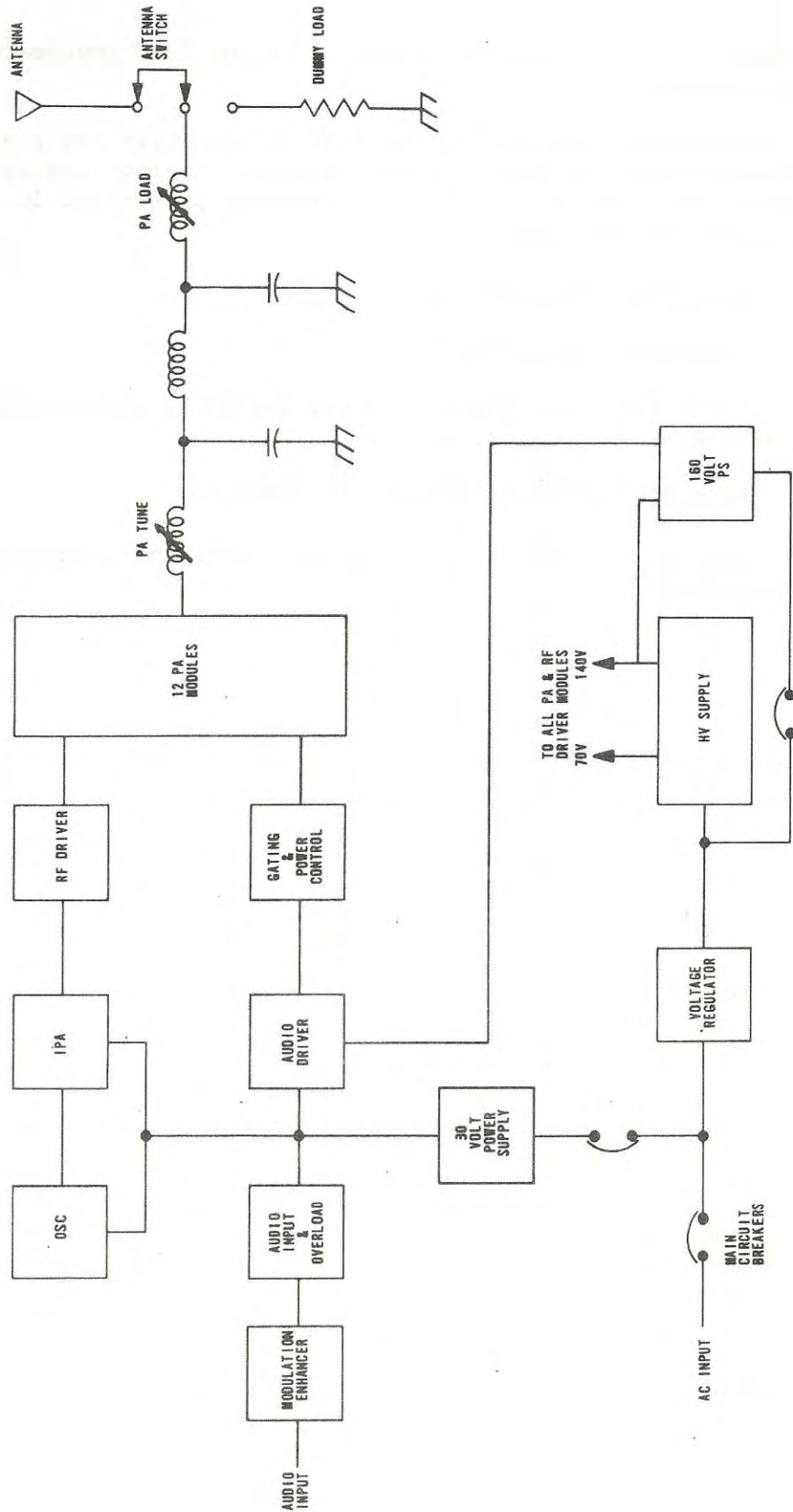


Figure 1-5. Transmitter Simplified Block Diagram

WARNING: Disconnect primary power prior to servicing.

this, the change in the resistive component of the load impedance will not detune the PA stages.

1-18. The power supplies in the MW-1A transmitter are protected by circuit breakers which are easily reset from the internal control panel. The audio input and overload module also provides protection in case the transmitter trips or recycles.

1-19. EQUIPMENT CHARACTERISTICS.

1-20. ELECTRICAL CHARACTERISTICS.

1-21. Table 1-1 lists the electrical operating characteristics and parameters of the MW-1A transmitter.

1-22. MECHANICAL/ENVIRONMENTAL CHARACTERISTICS.

1-23. Table 1-2 lists the physical/environmental characteristics of the MW-1A transmitter.



Table 1-1. Electrical Characteristics

FUNCTION	CHARACTERISTIC
Power Input	210/220/240/260 vac, 50 or 60 Hz balanced or unbalanced
Power Consumption	2.0 kW at 1000 watts carrier and no modulation. 3.0 kW at 1000 watts carrier and 100% modulation at 400 Hz.
Audio Input-Enhancer BYPASS mode -Enhancer OPERATE mode	10 dBm, <u>+2</u> dB, 600 ohms balanced 16 dBm, <u>+2</u> dB, 600 ohms balanced
Audio Frequency Response	<u>+1</u> dB from 20 to 10,000 Hz
Audio Frequency Distortion	1.5 percent or less at 1 kW, 20 to 10,000 Hz, 95 percent modulation. 2 percent or less at 500 and 250 watts, 20 to 10,000 Hz, 95 percent modulation.
Power Output	Rated-1000 watts. Capable-1100 watts. Power reduction to 500 watts or 250 watts.
Spurious Output	Meets or exceeds FCC and CCIR requirements.
RF Frequency Range	535 kHz to 1620 kHz. Supplied to one frequency as ordered.
RF Output Impedance	50 ohms, unbalanced.
RF Harmonics	Meets or exceeds FCC or CCIR specifications.
Carrier Shift	Less than 2 percent at 100 percent modulation with 400 Hz tone.
Noise (Unweighted)	60 dB or better below 100 percent modulation with 400 Hz tone.
Postive Peak Capability	125 percent positive peak program modulation capability at 1.0 kW and at 1.1 kW.

Table 1-1. Electrical Characteristics (Continued)

FUNCTION	CHARACTERISTIC
IM Distortion	2 percent or less 4/1 or 1/1, 60/2000 Hz or 60/7000 Hz at 95 percent modulation.
Monitor Provisions	10 volts RF (RMS) modulated output sample at 50 ohms and high/low balance control.
Remote Control	Self-contained interface for all standard systems.
Type of Modulation	Progressive Series Modulation (PSM) (Patent Pending).
Efficiency	Power amplifier typically 80-85 percent: Overall transmitter is 50% efficient at 1100 watts.

WARNING: Disconnect primary power prior to servicing.



Table 1-2. Mechanical/Environmental Characteristics

FUNCTION	CHARACTERISTIC
Mechanical:	
Height	72 inches (183 cm)
Width	31.5 inches (80 cm)
Depth	31.5 inches (80 cm)
Weight	
Unpacked	598 pounds (271.5 kg) - approximate
Domestic Packed	788 pounds (357.5 kg) - approximate
Export Packed	898 pounds (407.5 kg) - approximate
Cubic Area	68.7 cubic feet (2 cubic meters) - packed
Environmental:	
Temperature	-20° to +50° C
Humidity	0 to 95 percent
Altitude	0 to 10,000 feet (3048 cm)

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WARNING: Disconnect primary power prior to servicing.

Component	Function
Boiler	Heats water to produce steam
Cylinder	Where steam expands to do work
Piston	Converts steam pressure into mechanical work
Crankshaft	Converts the piston's linear motion into rotary motion
Connecting Rod	Links the piston to the crankshaft
Valves	Allow steam to enter and exit the cylinder at the right times
Exhaust	Removes spent steam from the cylinder
Condenser	Cools the exhaust steam back into water
Water Pump	Re-circulates water from the condenser back to the boiler
Flywheel	Stores energy to keep the engine running smoothly
Slide Valve	Controls the flow of steam into and out of the cylinder
Expansion Valve	Controls the amount of steam entering the cylinder
Pressure Gauge	Monitors the steam pressure in the boiler
Temperature Gauge	Monitors the temperature of the boiler water
Water Level Gauge	Monitors the amount of water in the boiler
Pressure Relief Valve	Safety device to release excess pressure
Steam Trap	Prevents condensate from returning to the boiler
Check Valve	Prevents backflow of steam
Isolation Valve	Allows for maintenance on individual components
Control Valve	Regulates the engine's speed
governor	Automatic speed control mechanism
Piston Rings	Seal the cylinder and scrape excess oil
Crankshaft Bearings	Support the crankshaft
Main Bearings	Support the engine's main shaft
Valve Gear	Mechanism for operating the valves
Eccentric	Converts rotary motion into the valve's oscillating motion
Eccentric Rod	Connects the eccentric to the valve gear
Eccentric Strap	Connects the eccentric rod to the valve gear
Eccentric Nut	Secures the eccentric rod to the eccentric
Eccentric Pin	Secures the eccentric rod to the eccentric
Eccentric Bolt	Secures the eccentric rod to the eccentric
Eccentric Washer	Secures the eccentric rod to the eccentric
Eccentric Nut Washer	Secures the eccentric rod to the eccentric
Eccentric Pin Washer	Secures the eccentric rod to the eccentric
Eccentric Bolt Washer	Secures the eccentric rod to the eccentric
Eccentric Washer Nut	Secures the eccentric rod to the eccentric
Eccentric Pin Nut	Secures the eccentric rod to the eccentric
Eccentric Bolt Nut	Secures the eccentric rod to the eccentric
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SECTION II  
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information for installing the MW-1A AM Transmitter and performing preoperational checks. Under normal conditions, the MW-1A is shipped completely assembled and ready for installation. However, if adverse shipping conditions are anticipated, certain components may be removed for transport in which case these components will be properly identified with appropriate instructions for making wiring connections.

**CAUTION**

A comprehensive installation checklist is provided in Appendix A of this manual. Be sure to use it to avoid damaging the equipment.

2-3. UNPACKING.

2-4. Carefully unpack the transmitter and perform a visual inspection to determine that no apparent damage was incurred during shipment. Retain the shipping materials until it has been determined that the unit is not damaged. The contents of the shipment should be as indicated on the packing list. If the contents are incomplete or if the unit is damaged electrically or mechanically, notify the carrier and Harris Corporation, Broadcast Products Division.

2-5. INSTALLATION.

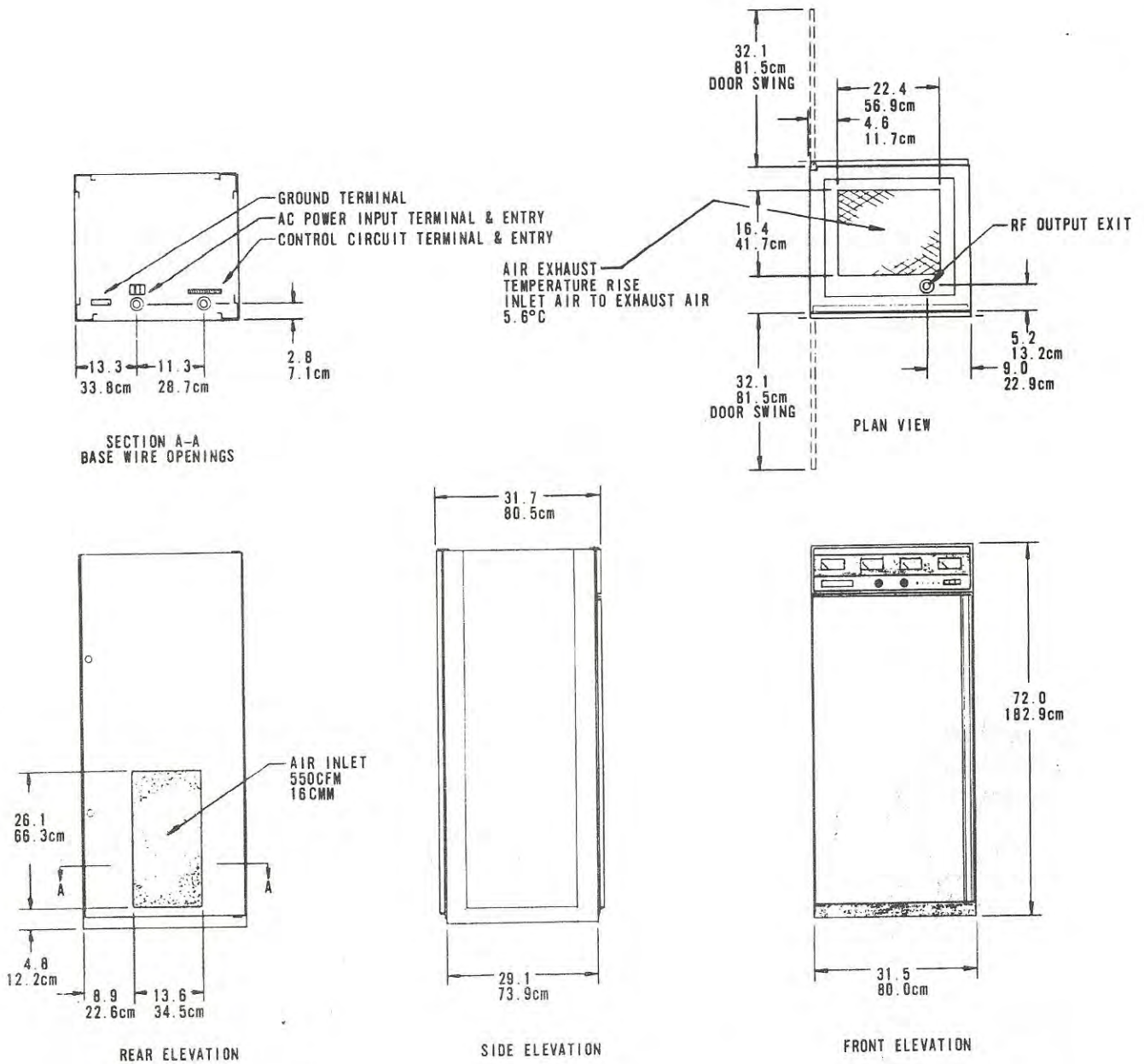
2-6. Installation of the MW-1A Transmitter is accomplished in three steps: 1) positioning the transmitter, 2) providing external connections, and 3) performing the preoperational checks. To assist in identifying parts and external connections, the following installation procedures include photographs and provide reference to diagrams contained in Section VIII of this document.

2-7. TRANSMITTER INSTALLATION.

2-8. No special instructions are necessary for installing the transmitter since fastening to the floor is not required. Position the transmitter in the desired location with regard to accessibility of interconnecting wiring and interfacing equipment. Refer to figure 2-1 for dimensions and interface information.

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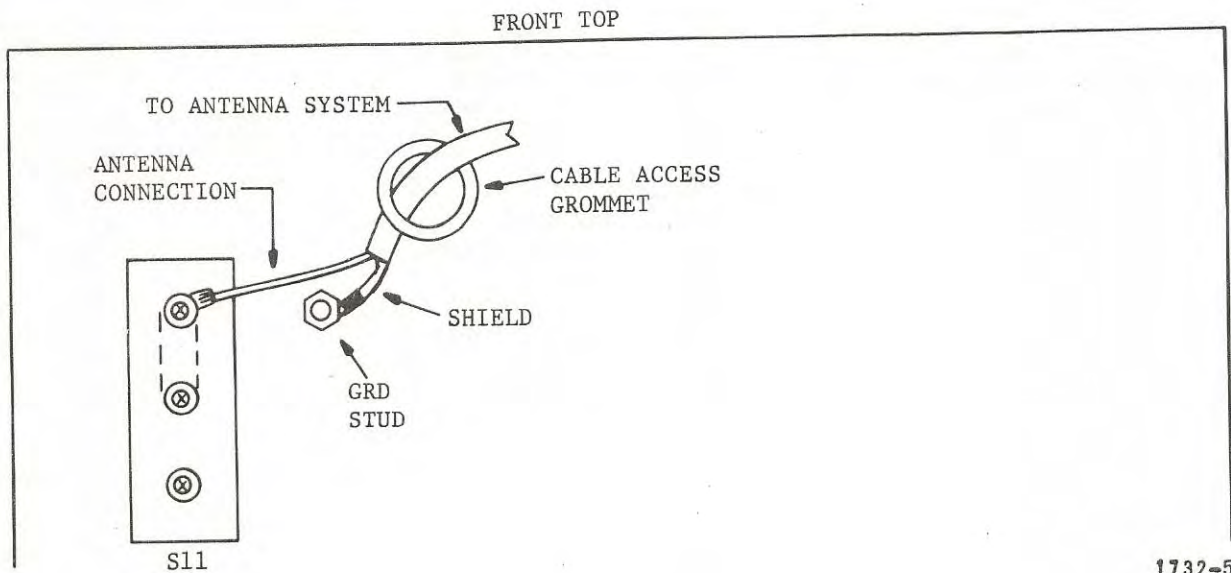
NOTES:  ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED

Figure 2-1. MW-1A Transmitter Outline

2-9. EXTERNAL CONNECTIONS.

2-10. External connections required for this installation are: 1) ground, 2) power, 3) antenna, 4) audio input, 5) modulation monitor, and 6) remote control (if applicable). The antenna connection is shown in figure 2-2; all other external connections are shown in figure 2-3.



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Figure 2-2. Antenna Connection.

2-11. STATION GROUND. The transmitter must be properly connected to the station ground. The connection is made to the main ground bus as shown in figure 2-1. Using 4-inch copper strap, connect the main ground bus located in the transmitter to the station ground at the base of the antenna.

2-12. POWER REQUIREMENTS. The MW-1A is designed to operate from a standard 210/220/240/260 vac, single-phase, 50 to 60 Hz source. Thirty ampere service is required. Power consumption is 2.0 kW at 0% modulation at 1000 watts carrier, and 3.0 kW at 100% modulation at 1000 watts carrier.

a. Verify that the proper power connections are made to the main power supply transfer, T1, based upon the power source available as follows:

WARNING: Disconnect primary power prior to servicing.



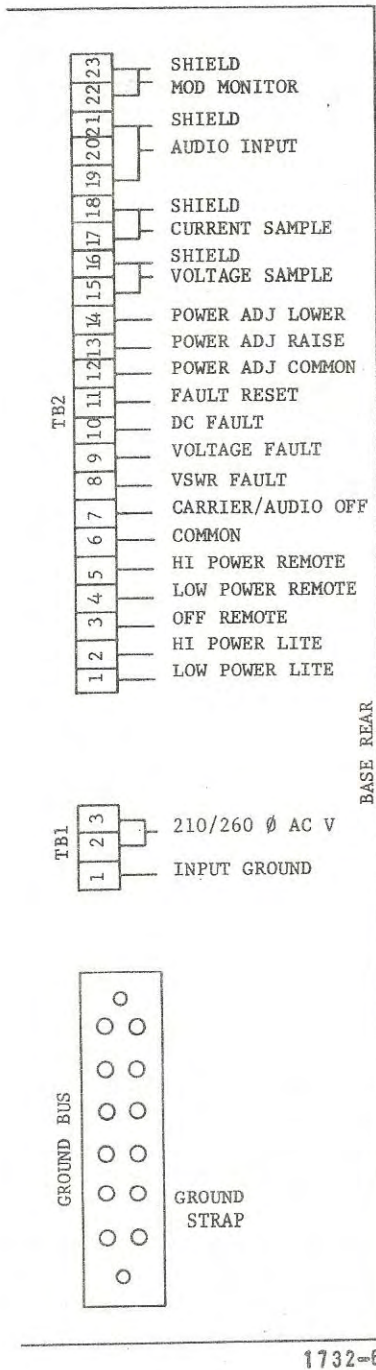


Figure 2-3. External Connections

1. For 190 to 215 vac, large gray wire No. 4 connected to the 210 transformer tap.
2. For 215 to 230 vac, large gray wire No. 4 connected to the 220 transformer tap.
3. For 230 to 250 vac, large gray wire No. 4 Connected to the 240 transformer tap.
4. For 250 to 270 vac, large gray wire No. 4 connected to the 260 transformer tap.

NOTE

For any of the above power sources, Wire No. 22 should always be connected to the 240 transformer tap.

This unit may turn on by itself when the main ac power is connected to the transmitter. To avoid this, set the main circuit breaker on the front access door to the OFF position.

b. Remove the cover from the 210/260 vac input terminal board, TB1. Using No. 6 wire, connect the 210/260 vac service to terminals 2 and 3 of TB1. Connect ground or neutral to terminal 1 of TB1. The neutral line should be No. 6 gauge or heavier wire. Replace cover on TB1.

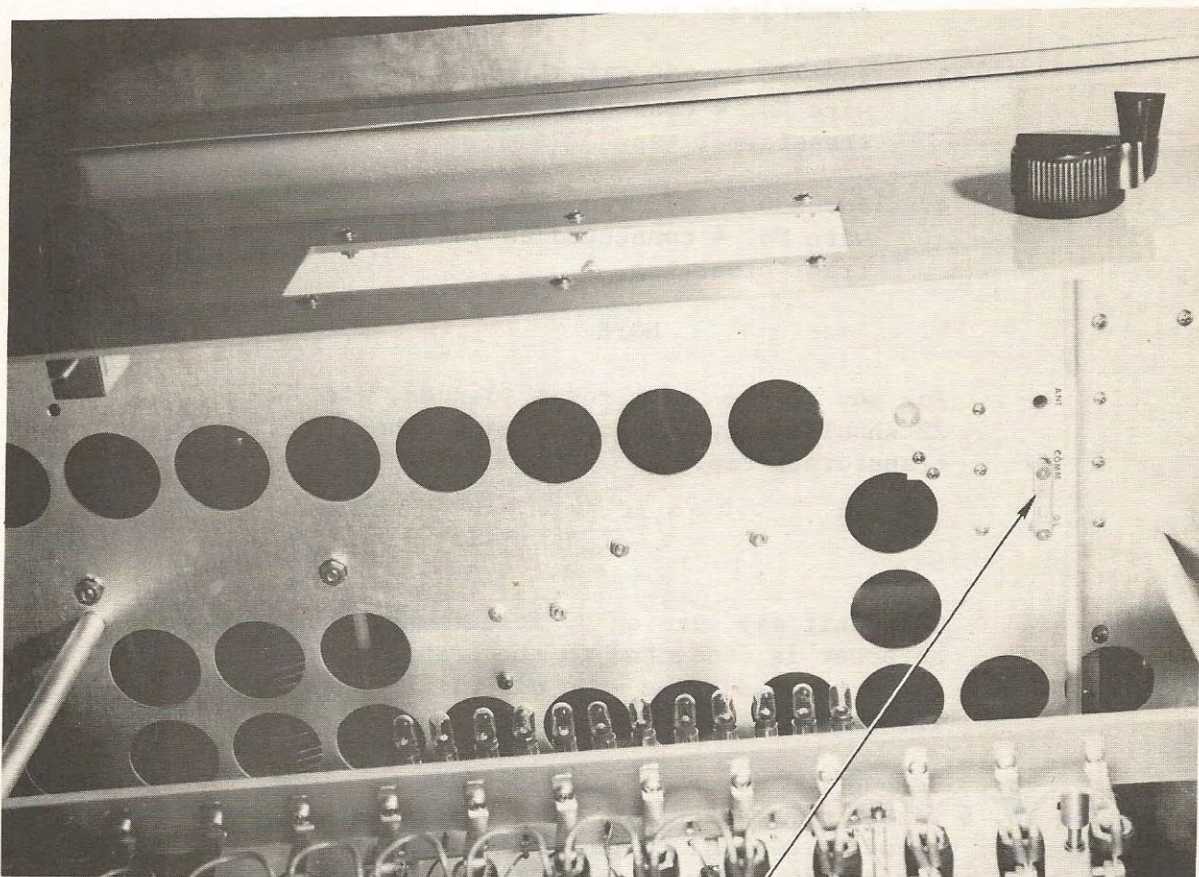
2-13. MODULATION MONITOR SAMPLE. Connect the center conductor of the coaxial cable from the modulation monitor sample to terminal 22 of TB2.

2-14. AUDIO INPUT. Connect the center conductors of the audio input cable (twisted, shielded pair) to terminals 19 and 20 to TB2. Connect the shield to terminal 21 of TB2.

2-15. ANTENNA. The coaxial cable from the antenna is connected to the changeover switch (shorting bar), S11, as shown in figure 2-2 and 2-4. Connect the center conductor to the front stud of S11. Connect the shield to the ground stud located near S11.

2-16. REMOTE CONTROL. If the remote control capability is utilized, provide the following connections to terminal board TB2.





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ANTENNA/DUMMY CHANGEOVER SWITCH - S11 (SHORTING BAR)

Figure 2-4. Antenna/Dummy Load Switch



a. On/High Power. A momentary contact closure is required. The controlling relay or switch must be rated for 100 milliamperes at 30 Vdc. Make connections to TB2-5 and TB2-6 (ground).

b. On/Low Power. A momentary contact closure is required. The controlling relay or switch must be rated for 100 milliamperes at 30 Vdc. Make connections to TB2-4 and TB2-6 (ground).

c. Off. A momentary contact closure is required. The controlling relay or switch must be rated for 100 milliamperes at 30 Vdc. Make connections to TB2-3 and TB2-6 (ground).

**CAUTION**

The Raise Power and Lower Power functions are not referenced to ground. A floating set of contacts at the controlling device is required to prevent a short circuit condition.

d. Raise Power. A momentary contact closure is required. The controlling relay or switch must be rated for 100 milliamperes at 24 volts ac. Make connections to TB2-12 and TB2-13. This connection is not referenced to ground.

e. Lower Power. A momentary contact closure is required. The controlling relay or switch must be rated for 100 milliamperes at 24 volts ac. Make connections to TB2-12 and TB2-14. This connection is not referenced to ground.

f. PA Voltage Sample. A positive 3-volt sample is provided at TB2-15 (+) and TB2-16 (shield).

g. PA Current Sample. A positive 6-volt sample is provided at TB2-17 and TB2-18 (shield).

2-17. REMOTE READOUT AND RESET OF FAULT INDICATIONS. Remote indications are provided for dc, overvoltage, and VSWR faults. Provisions for reset of remote indicators are also provided. A positive 20-volt signal through a 10k ohm resistor is provided when there is no fault. Approximately 2 volts through a 10k ohm resistor is provided when a fault is indicated.

a. DC Overload Fault Indication. Make connections to TB1-10 (positive) and TB2-6 (ground).

b. Overvoltage Fault Indication. Make connections to TB2-9 (positive) and TB2-6 (ground).

c. VSWR Fault Indication. Make connections to TB2-8 (positive) and TB2-6 (ground).

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d. Fault Indicator Reset. A momentary contact closure is required. The controlling relay or switch must be rated for 50 milliamperes at 30 volts dc. Make connections to TB2-11 (positive) and TB2-6 (ground).

NOTE

Terminal 6 of terminal board TB2 is the common ground for most functions. Use No. 14 AWG wire or larger for ground connections. Other remote connections may be made with No. 22 AWG wire.

2-18. INITIAL TURN ON.

2-19. Initial turn on of the transmitter should be performed with the transmitter connected to the internal dummy load. The final tuning of the transmitter has been performed at the factory with the transmitter operating into the dummy load so that a minimum of adjustment should be required for this initial test. After familiarizing yourself with the operation of the transmitter connected to the dummy load, the transmitter may be switched to the antenna for final checks.

**CAUTION**

The internal dummy load is approximately 55 ohms at the center of the band (slightly less at the low end and greater at the high end). Normally, some difference will be noted between operation of the transmitter into the dummy load and your antenna. To prevent damage and ensure proper operation, it is recommended that the impedance of the antenna be measured at the operating frequency with an accurate RF bridge before tuning the transmitter into the antenna system. The transmitter is designed to operate with an impedance of 40 to 60 ohms.

2-20. After checking all wiring and performing a general inspection of the transmitter, perform the following procedure to energize the transmitter.

a. Place the ANTENNA/DUMMY changeover switch (shorting bar), S11, in the dummy position, figure 2-4. Ensure that the spark gap setting of E2 is 0.020 inch.

b. Operate the OPERATIONAL/BYPASS switch, S14, to the BYPASS position.

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WARNING: Disconnect primary power prior to servicing.

- c. Check to determine that audio is not going to the transmitter.
- d. Check to determine that the safety cover on the main ac terminal block, TB1, is in place.
- e. The front and rear access doors of the transmitter contain interlocks. The main circuit breaker cannot be turned on until these interlocks are closed. Check to determine that front and rear access doors are closed.
- f. Turn on the main ac power to the transmitter.
- g. Set the main circuit breaker, CB2, located at the lower middle of the front door, to the up position. If the circuit breaker trips, check the door interlocks. The green READY lamp, located near the on/off switch on the front of the transmitter, should light when the circuit breaker is on.
- h. Open the access door to the oscillator and power adjusting controls, figure 3-4. Adjust the HI PWR ADJ and LO PWR ADJ controls, located behind the hinged door, to their fully counterclockwise positions. Do not change the adjustments of the RF driver bias or voltage controls.
- i. Check to determine that the RF driver tune and load sliders, located to the left of the coarse high and low power controls, are in their factory-marked and locked-down positions.
- j. Depress the yellow ON/LOW switch. The main contactors on the transmitter should close and the yellow ON/LOW button should light. The PA voltage should be less than 10 volts and the PA current should be less than 2-1/2 amps as indicated on the meter panel.
- k. The green 30-volt and RF output LED's on the oscillator board should be on. Refer to figure 3-4.
- l. The green 30-volt and RF output LED's on the IPA should be on. Refer to figure 3-5.
- m. Using the MULTIMETER control and indicator, determine that the voltages and currents listed in table 2-1 are present.
- n. If all readings and indications are normal, depress the HIGH/ON switch located on the meter panel. Be certain that the POWER METER control is in the FORWARD position.
- o. Using the HI PWR ADJ control located at the rear of the oscillator/audio input chassis, slowly bring up the power until one of the following conditions occur:

WARNING: Disconnect primary power prior to servicing.



Table 2-1. Low Power Operation Control Indications

CONTROL/METER	INDICATION
MULTIMETER:	
AF DVR LO VOLT	21-25 volts 23.5
AF DVR CONTROL	21-25 volts 23.2 23
AF DVR HI VOLT	160-170 volts 179 184
RF DVR VOLT	20-30 volts 45 27
RF DVR AMPS	0.5-1.0 amps 1.055 95
160 VOLT SUPPLY	155-165 volts 173 179
140 VOLT SUPPLY	125-140 volts 142 145
70 VOLT SUPPLY	60-70 volts 70 74
30 VOLT SUPPLY	24-30 volts 32 32
PA AMPS	1-3 amps .97
PA VOLTS	2-7 volts 2.8
POWER:	
FORWARD	<100 watts
REFLECTED	< 5 watts
REF/VSWR	Zero
Hi and Lo power adjust controls must be CCW (lowest in LOW power mode).	

1. The PA voltage reaches 30 volts (each division equals 2 volts).
2. The PA current reaches 12 amperes (each division is 0.5 amperes).
3. The power output reaches 250 watts as indicated on the OUTPUT POWER meter with the selector switch in the FORWARD position.

NOTE

If the VSWR overload circuit trips disabling the transmitter, turn the HI PWR ADJ control in the fully CCW direction and perform the procedures in paragraph 2-21.

2-21. VSWR SENSOR ADJUSTMENT PROCEDURE.

**CAUTION**

Any adjustment of the PA LOAD control will affect the VSWR overload circuit.

2-22. This procedure is performed with the transmitter properly terminated into either the antenna or the dummy load. Refer to paragraph 6-20 for VSWR troubleshooting instructions.

- a. Open the meter panel.
- b. Adjust the HI PWR ADJ control fully counterclockwise.
- c. Operate the POWER meter control to the REL/VSWR position.
- d. Depress the HIGH/ON switch.
- e. Adjust the HI PWR ADJ control clockwise until one of the following conditions occur:
  1. The PA voltage reaches 30 volts
  2. The PA current reaches 12 amperes.
  3. A VSWR fault is indicated.
- f. The transmitter will turn off if a VSWR fault occurs in step e., reduce power slightly by adjusting the HI PWR ADJ control 1/8 turn counterclockwise.
- g. Turn on the transmitter.

2-11

WARNING: Disconnect primary power prior to servicing.

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h. Raise the hinged meter panel to gain access to the VSWR panel and adjust the two REL VSWR BAL controls on directional coupler A21 for a zero indication on the POWER meter.

i. If a zero reading cannot be obtained in step h., check the dummy load with a VOM for 50 to 55 ohms. If the transmitter is operating into the antenna during the performance of this procedure, check the antenna system with a RF bridge for an impedance of 50 to 55 ohms.

j. Switch the power meter control to REFLECTED and check the REFLECTED POWER for an indication of near zero.

k. Determine that the transmitter is properly loaded (ratio of PA volts to PA amps) in accordance with instructions provided in paragraph 2-23.

### CAUTION

The loading change described in step l., below, should not be corrected by an adjustment of the LOADING control.

l. Determine that no PA fault lamps are on. A faulted module will cause a change in loading.

m. Operate the POWER meter switch to the FORWARD position.

#### 2-23. TRANSMITTER LOADING.

a. Slowly increase transmitter power by adjusting the HI PWR ADJ control in a clockwise direction until one of the following conditions occur. Stop adjustment when any one of these conditions is achieved.

1. The PA voltage reaches 28 volts.
2. The PA current reaches 12 amperes.
3. The power output reaches 250 watts.

b. Observing the PA VOLTS meter, adjust the PA TUNE control for a dip in PA voltage.

c. Increase or decrease the HI PWR ADJ control until the PA VOLTS meter indicates 30 volts or the PA AMPS meter indicates 12 amperes, whichever occurs first.

d. The desired ratio of PA volts to PA amps is 28 to 12 (2.3:1). If the ratio of the actual values as observed on the PA VOLTS and PA AMPS

meters is within 10% of the desired ratio, increase the PA voltage by adjusting HI PWR ADJ control until the PA VOLTS meter indicates 50 volts or the PA AMPS meter indicates 22 amperes, whichever occurs first.

e. If the actual ratio of PA voltage to PA current is not within 10% of the desired ratio, perform the following operations:

1. If the PA voltage is high with respect to PA current, adjust the PA LOAD control one-half turn in the direction which decreases PA voltage. Adjusting the loading control will affect the zero balance of the VSWR circuit. If the VSWR overload trips, refer to the procedure in paragraph 2-21.
2. Adjust the PA TUNE control for a dip in PA voltage.
3. Adjust the HI PWR ADJ control for an indication of 28 volts on the PA VOLTS meter. Check for a ratio of 28 volts to 12 amperes.
4. Repeat steps 1. through 3. until a ratio of 28 to 12, PA volts-to-PA amperes, is obtained.

1/2 turns  
### ||  
← 2x  
Trips at 8  
turns  
Set at 7  
28V 12A  
Adj PA Load  
Set PA V  
at 28  
TUNE  
### |

f. Increase the PA voltage by adjusting the HI PWR ADJ control until 50 volts is observed on the PA VOLTS meter or 22 amperes is observed on the PA AMPS meter, whichever occurs first. The transmitter power should be approximately 800 watts.

g. Adjust the PA TUNE control for a dip in PA voltage as observed on the PA VOLTS meter. If the PA voltage is high with respect to PA current (that is, if PA voltage is 50 volts but the PA current is less than 22 amperes), perform the following operation:

1. Adjust the PA LOAD control 1/2 turn in the direction which causes the PA voltage to decrease.
2. Adjust the PA TUNE control for a dip in PA voltage.
3. Adjust the HI PWR ADJ control until 50 volts is observed on the PA VOLTS meter.
4. Check for a ratio of 50 volts-to-22 amperes. Repeat steps 1. through 3. if required to obtain the desired ratio.

h. If the PA current is high with respect to the PA voltage (that is, if the PA current is 22 amperes, but the PA voltage is less than 50 volts), perform the following operations:

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1/2 turn  
→  
1/1

1. Adjust the PA LOAD control 1/2 turn in the direction which increases the PA voltage.
2. Adjust the PA TUNE control for a dip in PA voltage.
3. Adjust the HI PWR ADJ control until 50 volts is observed on the PA VOLTS meter or 22 amperes is observed on the PA AMPS meter, whichever occurs first.
4. Repeat steps 1. through 3. until the ratio of 50 volts-to-22 amperes is obtained.

NOTE

If the VSWR overload circuit trips during the above procedure, refer to the adjustment procedure provided in paragraph 2-21.

- i. Set POWER ADJUST control (figure 3-2) to mid scale and increase the PA voltage to 52 volts by adjusting the HI PWR ADJ control.
- j. Adjust the PA TUNE control for a dip in PA voltage.
- k. Again set the PA voltage to 52 volts using the HI PWR ADJ control.
- l. If the PA current is greater than 22.5 amperes, adjust the PA LOAD control 1/2 turn in the direction which causes the PA voltage to increase.
- m. Again adjust the PA voltage using the HI PWR ADJ control until 52 volts is obtained.
- n. Repeat steps i. through l. as required to obtain a ratio of 52 volts-to-22.5 amperes, PA voltage to PA current. Transmitter power should be approximately 1000 watts.
- o. With the POWER meter switch in the REL/VSWR position, adjust the two TUNE BAL capacitors located behind the PA VOLTS meter for a reading of zero on the POWER METER.
- p. Check the transmitter meters listed in table 2-2 and compare actual readings with the values indicated.
- q. If the power output is less than 1000 watts, adjust the HI PWR ADJ control for 1000 watts, but AVOID exceeding 55 volts PA voltage or 25 amperes PA current.
- r. Depress the ON/LOW power switch located on the transmitter front panel.

Table 2-2. High Power Operation Control Settings

CONTROL/METER	INDICATION
MULTIMETER:	
AF DVR LO VOLT	21-25 volts
AF DVR CONTROL	21-28 volts
AF DVR HI VOLT	160-170 volts
RF DVR VOLT	45-50 volts
RF DVR AMPS	1.2-1.5 amps
160 VOLT SUPPLY	155-165 volts
140 VOLT SUPPLY	130-135 volts
70 VOLT SUPPLY	60-65 volts
30 VOLT SUPPLY	24-30 volts
PA AMPS	22.5 amps
PA VOLTS	52 volts
POWER:	
FORWARD	1000 watts
REFLECTED	<100 watts
REL/VSWR	Zero



s. Adjust the LO PWR ADJ control for the desired low power setting.

t. Check the transmitter meters and compare actual readings with the values indicated in table 2-3 (250 watts) or table 2-4 (500 watts).

u. Check the level going to the modulation monitor by carefully adjusting the carrier meter of the modulation monitor to 100 (or the value specified by the manufacturer).

v. Switch the transmitter to the high power mode by depressing the ON/HIGH switch.

w. With the modulation monitor adjusted as in step u. (low power), adjust the modulation monitor potentiometer, R7, on the transmitter (figure 3-3) for the value (100) established in step u.

#### 2-24. MODULATION CHECK.

a. Verify that the OPERATIONAL/BYPASS switch is at the BYPASS position.

b. Connect the test equipment as shown in figure 2-5. Refer to test equipment manuals for connection information.

c. With the transmitter in the high power mode of operation, apply a 1-kHz tone at 95% negative modulation and measure the distortion. The distortion should be 1.5% or less.

#### NOTE

In some instances, transmitter performance may exceed the measurement capability of available test equipment. If, when making measurements to improve distortion, the controls seem to have little effect, the most probable cause is the associated test equipment. However, most modulation monitors, tone generators, and distortion analyzers are capable of measuring 1% distortion.

d. Apply a 5-kHz tone at 95% negative modulation to the transmitter.

e. The distortion should be 1.5% or less if accurate test equipment is used.

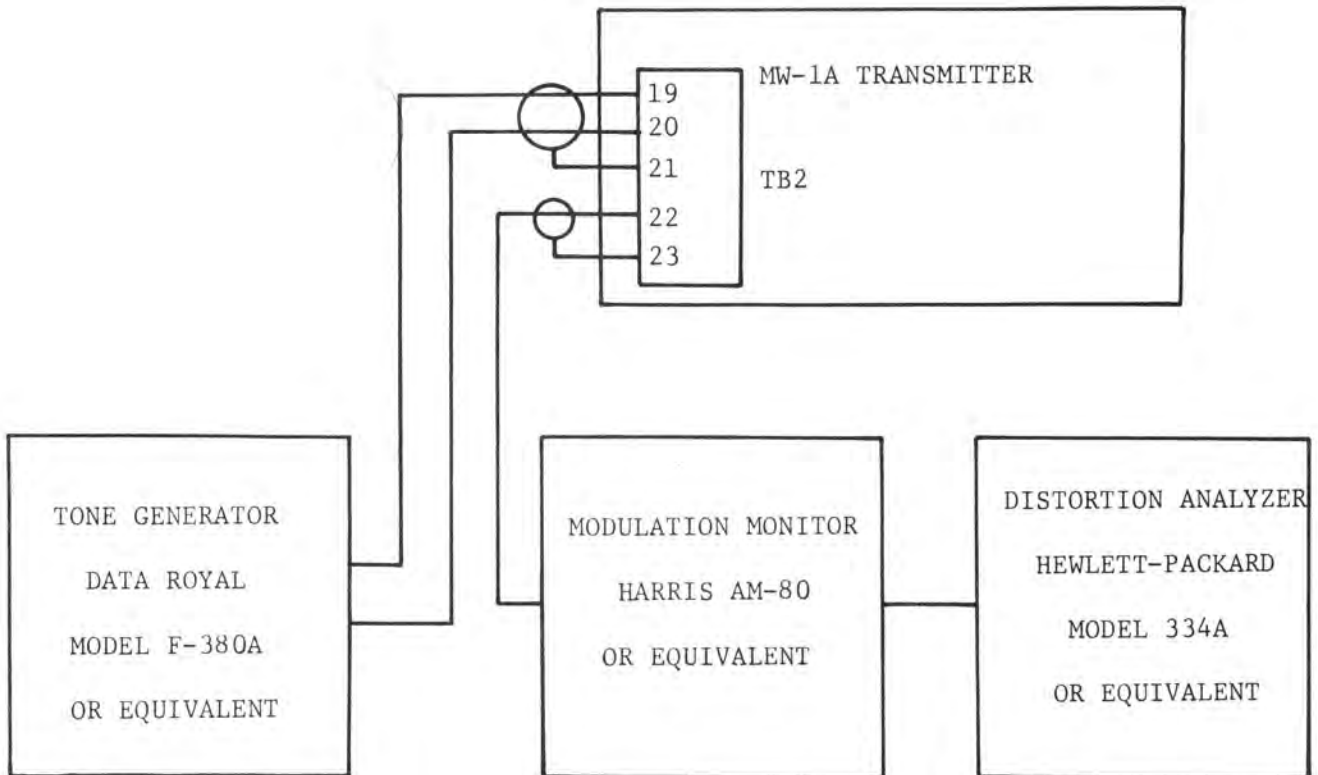
Table 2-3. Low Power Mode, Transmitter Adjusted for 250 Watts

CONTROL/METER	INDICATION
MULTIMETER:	
AF DVR LO VOLT	21-25 volts
AF DVR CONTROL	21-25 volts
AF DVR HI VOLT	160-170 volts
RF DVR VOLT	30-35 volts
RF DVR AMPS	0.7-1.0 amps
160 VOLT SUPPLY	155-165 volts
140 VOLT SUPPLY	130-140 volts
70 VOLT SUPPLY	60-70 volts
30 VOLT SUPPLY	24-30 volts
PA AMPS	11-12 amps
PA VOLTS	28-30 volts
POWER:	
FORWARD	250 watts
REFLECTED	<25 watts
REL/VSWR	Zero



Table 2-4. Low Power Mode, Transmitter Adjusted for 500 Watts

CONTROL/METER	INDICATION
MULTIMETER:	
AF DVR LO VOLT	21-25 volts
AF DVR CONTROL	21-25 volts
AF DVR HI VOLT	160-170 volts
RF DVR VOLT	35-40 volts
RF DVR AMPS	0.9-1.1 amps
160 VOLT SUPPLY	155-165 volts
140 VOLT SUPPLY	130-140 volts
70 VOLT SUPPLY	60-70 volts
30 VOLT SUPPLY	24-30 volts
PA AMPS	16 amps
PA VOLTS	38 volts
POWER:	
FORWARD	500 watts
REFLECTED	<50 watts
REL/VSWR	Zero



1732-8

Figure 2-5. Modulation Test Setup

**CAUTION**

The MW-1A Transmitter is not designed to operate with a highly-modulated audio tone above 5000 Hz for extended lengths of time. Tests at frequencies above 5 kHz limited to one to two minutes

f. Apply a 5K Hz tone at 95% negative modulation. The distortion should be 1% or less.

g. In the low power mode, check the distortion gain at 1 kHz and 50 Hz. The distortion should be less than 2% at each frequency.



NOTE

At frequencies above 5000 Hz, sideband clipping can occur at high modulation levels, due to high Q antenna systems. Measure distortion at 50%, then increase modulation percentage 10% at a time, checking distortion at these various levels. If the distortion should suddenly increase at a modulation level of less than 95%, the antenna should be carefully examined for a possible change in impedance at frequencies above and below the transmitter carrier frequency. If the dummy load is used, the transmitter itself can be checked for proper operation. In low power operation, especially at a level of 250 watts or lower, some feedthrough power will be noted in the transmitter, causing an inability to modulate 100% in the negative direction. The transmitter should always be capable of modulating to 95% in the negative direction. The positive peak performance is not affected.

h. Switch the transmitter to the antenna system by placing the ANTENNA/DUMMY changeover switch in the ANTENNA position. Adjust the HI PWR ADJ control fully CCW.

NOTE

When the interlocked access doors are opened, the main circuit breaker, CB2, will automatically trip. The doors must be closed and the circuit breaker reset before the transmitter will operate.

i. Depress the ON/HI power switch. Check the VSWR. Refer to paragraph 2-21.

j. Check the ratio of PA voltage-to-PA current. The voltage-current ratio should be the same as the final adjustment using the dummy load. If necessary, repeat paragraph 2-23 of this procedure.

k. With the POWER meter control in the REL/VSWR position, check the VSWR. Adjust the two REL VSWR BAL controls for a reading of zero on the POWER meter.

l. Adjust the HI PWR ADJ control for the rated current of the antenna system.

- m. Check the VSWR. Refer to paragraph 2-21.
- n. Modulate the transmitter and run a proof of performance test at both high and low power.

NOTE

When operating into an antenna, especially a directional array, the ability of the transmitter to modulate in the negative direction may be affected at frequencies above 5 kHz. This is caused by a changing impedance of the antenna system at the sideband frequencies. If transmitter distortion is within specification at 50% modulation by sudden increase at high modulation levels, the antenna system is the most probable cause. This condition also becomes more evident at higher frequencies.

o. During full power operation, the PA FAULT lamps should not be brighter than a very faint glow. The PA FAULT lamps should be entirely extinguished at the 250 watt output level. Only very slight changes in lamp brilliance should be noted when modulation is applied. Under heavily processed modulation the PA current will shift up to one ampere, and the PA voltage may shift upward two volts.

p. Set the audio input level to the transmitter under program conditions. Set the modulation level at full power, then switch to low power and adjust the LO PWR AUD ADJUST (R16) control located in the Audio Input and Overload Board, A18.

2-25. MODULATION ENHANCER CHECK.

2-26. Press the CAL OUT pushbutton. Turn on the transmitter and modulate with typical music. An AGC and limiter, preferably Harris units, should be used - both in the fastest position with the limiter set for 125% positive modulation. To further increase loudness, install a 750 K, 1/2W resistor in a phonograph plug and insert it into the jack in the back of the Harris limiter. This further increases the limiter release time. Do not use more than 5 dB limiting if this modification is done or distortion will not be tolerable and excess pumping will occur.

2-27. Operate the AGC at center scale with the limiter set for 5 dB of limiting. Adjust the limiter to modulate the transmitter in a usual fashion. Check that the positive peaks or highest peaks are going in the positive direction at the transmitter output. If not, reverse the input wires on terminal 19 and 20 of TB2 to cause the transmitter to modulate more in the positive direction than the negative direction.



2-28. Press the ENHANCING 1 dB pushbutton on the modulation enhancer. Adjust the negative control potentiometer R16 (NEG PEAK) on the enhancer while watching the modulation monitor and determine which peak (positive or negative) the negative control of the enhancer is adjusting.

2-29. Adjust the positive and negative controls on the modulation enhancer so the positive and negative peaks are as high as possible without overmodulating.

2-30. Only a listening test will determine how much enhancing is desired. The more enhancing (3 dB maximum), the louder the signal. Remember to adjust the transmitter for maximum legal modulation using the limiter output control with the enhancer in CAL OUT position, then switch in desired enhancing (1, 2, or 3 dB) and adjust positive and negative control of the enhancer for maximum modulation.

## SECTION III

### OPERATION

#### 3-1. INTRODUCTION.

3-2. This section contains information pertaining to the identification, location, and function of the controls and indicators on the MW-1A Transmitter. The procedures and test equipment required to set up and operate the transmitter are also presented.

#### 3-3. CONTROLS AND INDICATORS.

3-4. Tables 3-1 through 3-6 list all controls and indicators on the transmitter and figures 3-1 through 3-6 show their locations.

#### 3-5. OPERATING PROCEDURE.

### CAUTION

The OPERATIONAL/BYPASS switch, S14, should never be operated (in or out) while a program is operating over the air. This switch is used to put the modulation enhancer in or off line and causes a 6 dB change in modulation (overmodulation if switched to BYPASS, undermodulation if switched to OPERATIONAL). The operator must change the dB at the audio input terminals of the transmitter according to the direction of the switch. Add 6 dB when switching to the OPERATIONAL position. Remove 6 dB when switching to the BYPASS position.

3-6. This operating procedure is presented under the assumption that the transmitter has been thoroughly and properly aligned at the desired operating frequency and is free of any discrepancies. Perform the operating procedure as follows:

a. Visually inspect the transmitter to ensure that no foreign objects are inside the cabinet, all parts and components are properly installed, all connectors are seated, all grounding sticks are on their respective hooks, and all doors are closed.

b. Apply primary power (30-ampere service).

### NOTE

If a Remote Control is part of the transmitter system, set the CONTROL LOCAL/REMOTE switch to the REMOTE position and perform the remaining steps except for step c.



- c. Set the CONTROL LOCAL/REMOTE switch to the LOCAL position.
- d. Lower the access door to the oscillator and ensure that RECYCLE switch A18S1 is in the ON position. This allows for three over-voltage transmitter overloads within a 30-second period prior to shutdown.
- e. Starting with MAIN AC circuit breaker, set all circuit breakers to ON.
- f. Operate the OPERATIONAL/BYPASS switch to the desired position.
- g. Ensure that no overloads or malfunctions occur.
- h. Depress the proper switch/indicator for the desired power output operation (POWER HIGH or LOW). The transmitter is now ready for operation.

### 3-7. MODULATION ENHANCER.

3-8. If modulation enhancement is desired, set the OPERATIONAL/BYPASS switch to OPERATIONAL. Adjust the enhancer as follows:

- a. Depress the CAL OUT switch.
- b. Modulate the transmitter with typical music. Set the AGC and limiter for fastest operation. Set the limiter for 125% modulation.

#### NOTE

If using a Harris Corporation Limiter, additional volume can be achieved by installing a 750K ohm, 1/2 watt resistor in a phonograph plug and inserting it into the jack in the rear of the limiter to increase the limiter release time. If such a resistor is installed, do not use more than 5 dB of limiting.

- c. Operate the AGC at center scale and set the limiter for 5 dB of limiting. Adjust the limiter for maximum legal modulation of the transmitter.

#### NOTE

The desired amount of enhancing can only be determined by listening to the output. The more enhancing (3 dB maximum), the louder the signal.

- d. Depress the ENHANCING 1 dB, 2 dB, 3 dB switch and adjust the NEG PEAK (potentiometer R16) and POS PEAK (potentiometer R20) controls for maximum negative and positive peaks without overmodulating.

Table 3-1. Meter (Exterior) and Control Panel (Upper) Controls and Indicators

REF Fig. 3-1	CONTROL/INDICATOR	FUNCTION
1	MULTIMETER, M1	Displays the voltage or current selected by MULTIMETER switch S1.
2	PA AMPS meter, M2	Displays the current flowing through the I2 power amplifier modules.
3	MULTIMETER switch, S1	Selects the desired monitoring point for display on MULTIMETER M1.
4	POWER meter switch, S2	Selects either the forward or reflected power, or relative VSWR for display on POWER meter M4.
5	PA VOLTS meter, M3	Displays the voltage at the power amplifier.
6	RESET pushbutton, S6	When depressed, extinguishes any illuminated OVERLOAD STATUS indicator.
7	DC indicator, DS4	Illuminates when the power amplifier current exceeds the DC OVERLOAD level (27 amperes).
8	VOLTAGE indicator, DS3	Illuminates when the output from the 140V power supply exceeds the level established by the OVERVOLTAGE ADJUST control (155 vdc).
9	VSWR indicator, DS2	Illuminates when the transmitter has cycled because of a change in VSWR.



Table 3-1. Meter (Exterior) and Control Panel (Upper) Controls and Indicators (Continued)

REF Fig. 3-1	CONTROL/INDICATOR	FUNCTION
10	READY indicator, DS1	Illuminates when the transmitter power is turned on, the MAIN AC circuit breaker is closed, the door interlocks are closed, and the 30 vdc power supply is operating.
11	POWER meter, M4	Displays the forward or reflected power, or the relative VSWR selected by POWER switch S2.
12	OFF/AIR switch/indicator, S5/DS5	Deenergizes the transmitter when depressed. The indicator illuminates when the air system fails.
13	POWER/LOW switch/indicator, S4/DS4	When depressed, places the transmitter in the low power mode from an off condition or from operation in the high power mode. The indicator illuminates when the transmitter is operating in the low power mode.
14	POWER/HIGH switch/indicator, S3/DS3	When depressed, places the transmitter in the high power mode from an off condition or from operation in the low power mode. The indicator illuminates when the transmitter is operating in the high power mode.
15	PA TUNE control, L1 through L12	Rotation causes a change in the tuning of the power amplifier.
16	PA FAULT indicators, 1A19DS1 through 1A19DS12	When illuminated, each indicator signifies a failure in the associated power amplifier module.
17	PA LOAD control, L14	Rotation causes a change in the loading of the power amplifier.

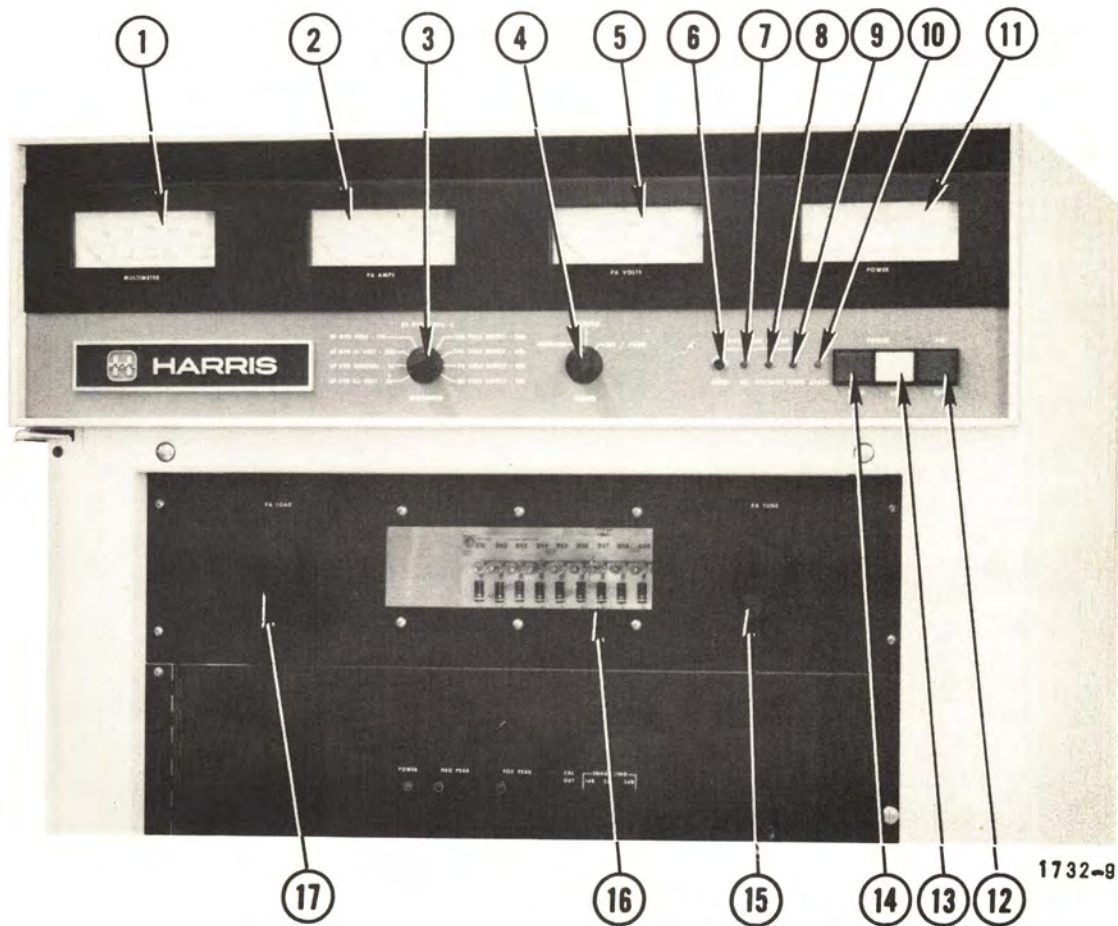


Figure 3-1. Meter (Exterior) and Control Panel (Upper) Controls and Indicators

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Table 3-2. Control Panel (Lower) Controls and Indicators.

REF	CONTROL/INDICATOR	FUNCTION
Fig. 3-2		
1	POWER ADJUST potentiometer, R8	Provides a +5% adjustment in the transmitter power output. The potentiometer is motor driven for remote control.
2	LOCAL/REMOTE switch, S9	In LOCAL, control of the transmitter is from the front panel controls. In REMOTE, control of the transmitter is from a remote position.
3	160V circuit breaker, CB3	In ON position, provides primary power to the 160V power supply. In series with MAIN AC circuit breaker CB2.
4	MAIN AC circuit breaker, CB2	In ON position, provides primary power to the transmitter.
5	30V circuit breaker, CB1	In ON position, provides primary power to the 30V power supply. In series with MAIN AC circuit breaker CB2.
6	REGULATOR ADJ potentiometer, A22R2	Adjusts the output voltage from the 140V power supply.
7	DC OVERLOAD ADJ potentiometer, A22R13	Adjusts the trip point for the DC overload.
8	OVER VOLTAGE ADJ potentiometer, A22R10	Adjusts the sensitivity of the overvoltage trip unit.

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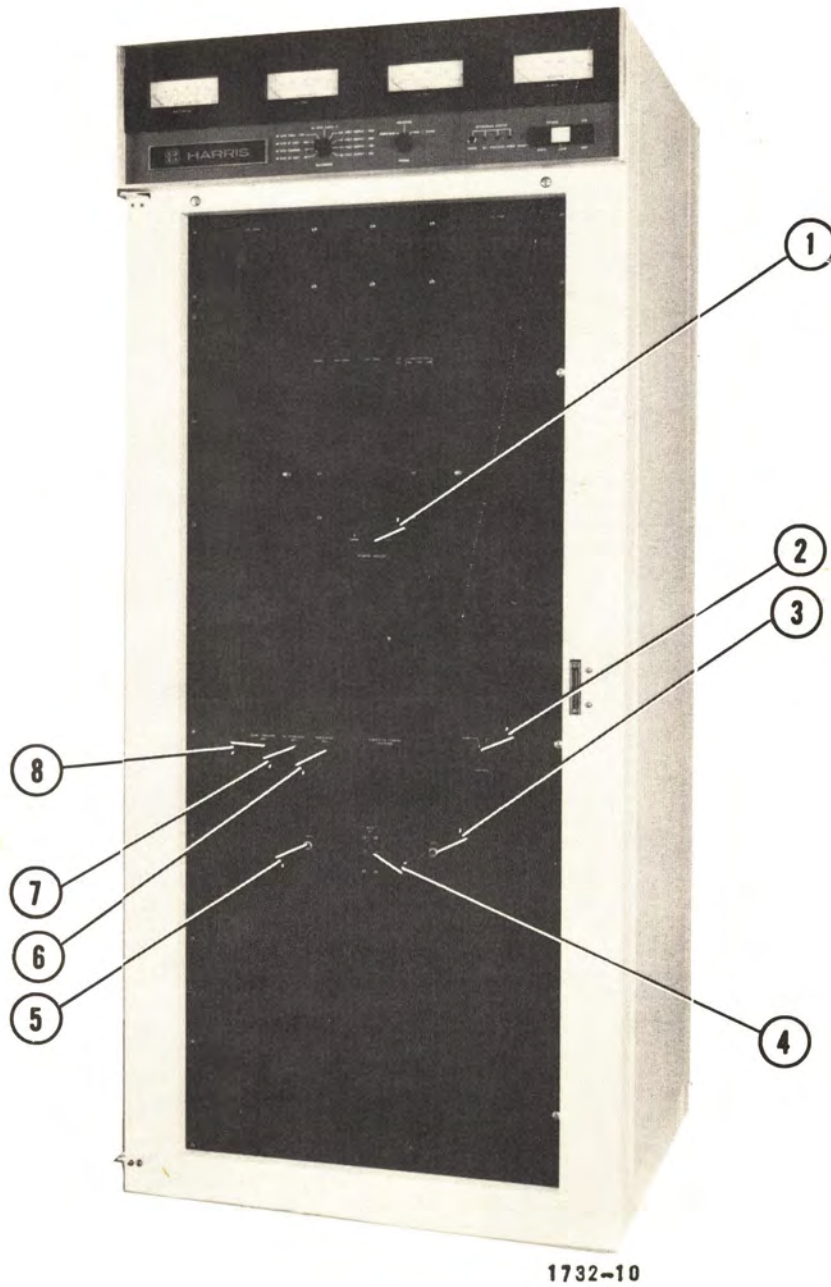


Figure 3-2. Control Panel (Lower) Controls and Indicators



Table 3-3. Meter Panel (Interior) Controls and Indicators

REF	CONTROL/INDICATOR	FUNCTION
Fig. 3-3		
1	FWD CAL potentiometer, A21R1	Calibrates POWER meter M4 on the meter panel to display forward power.
2	FWD BAL capacitor, A21C4	Balances the forward power port of the directional coupler.
3	REFL CAL potentiometer, A21R6	Calibrates POWER meter M4 on the meter panel to display reflected power.
4	REFL BAL capacitor, A21C10	Balances or zeroes the reflected power port of the directional coupler.
5	REL VSWR BAL capacitors, A21C20 and A21C23	Zeroes the pointer on POWER meter M4 for relative VSWR displays.
6	LO PWR MOD MONITOR potentiometer, R7	Balances the low/high modulation monitor sample.

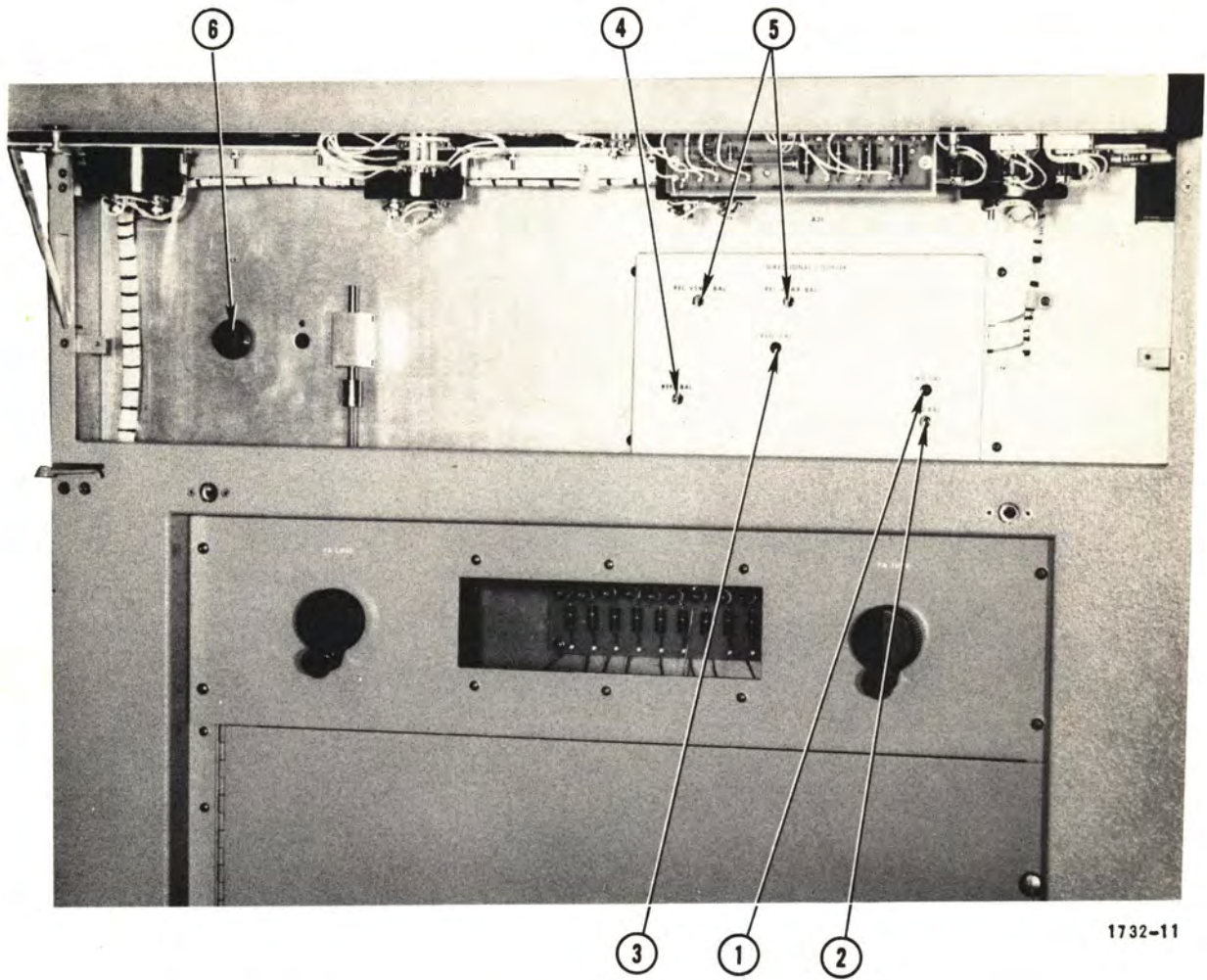


Figure 3-3. Meter Panel (Interior) Controls and Indicators

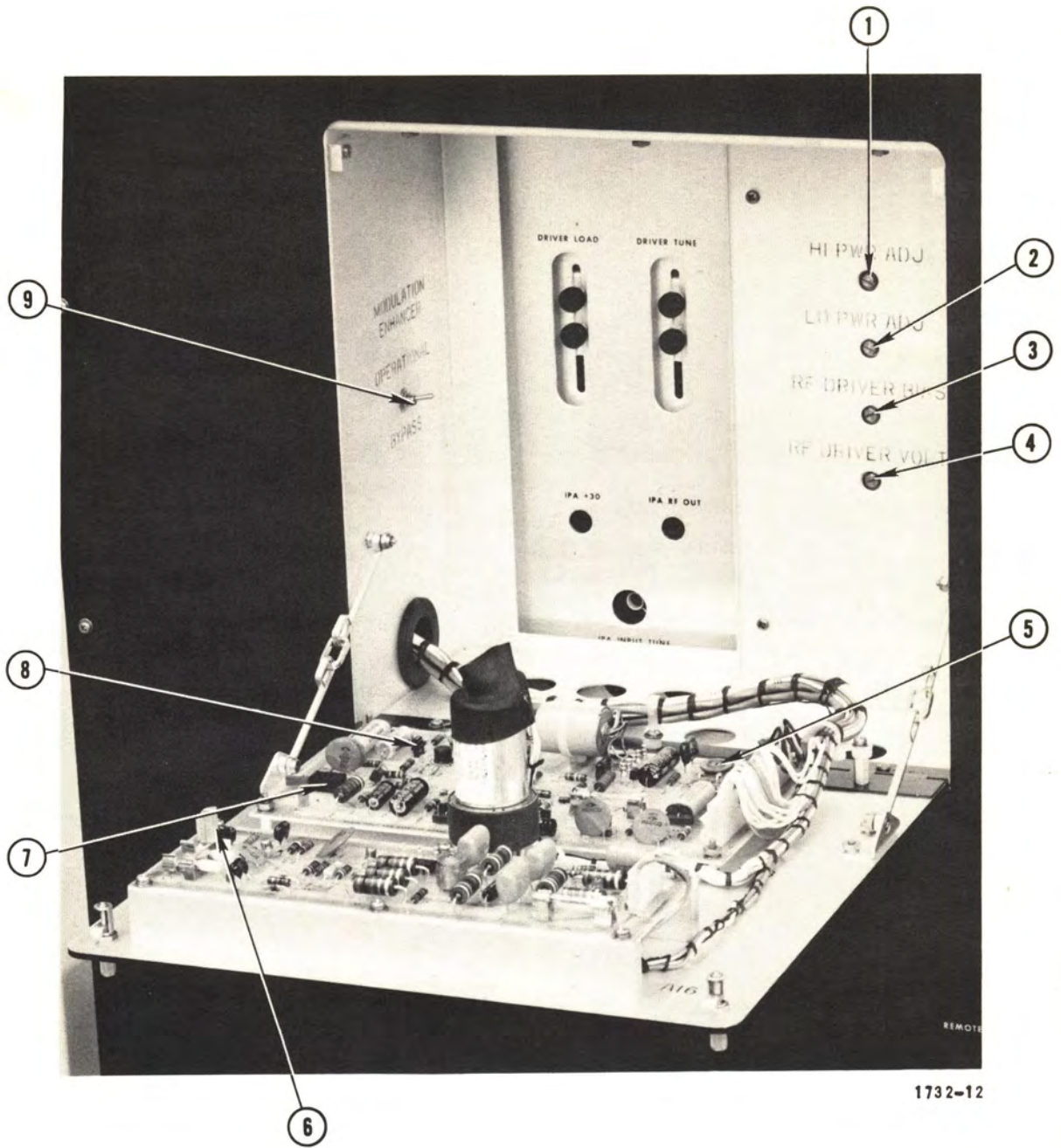
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WARNING: Disconnect primary power prior to servicing.



Table 3-4. Control Box (Internal) Controls and Indicators

REF	CONTROL/INDICATOR	FUNCTION
Fig. 3-4		
1	HI PWR ADJ potentiometer, A15R2	Adjusts output power level for transmitter operation in the high power mode.
2	LO PWR ADJ potentiometer, A15R1	Adjusts output power level for transmitter operation in the low power mode. Always adjust this potentiometer after HI PWR ADJ potentiometer, A15R2.
3	RF DRIVER BIAS potentiometer, A15R5	Provides a distortion adjustment by adjusting the modulation depth of the RF Driver.
4	RF DRIVER VOLTS potentiometer, A15R6	Adjusts the operation voltage level of the RF Driver.
5	LO PWR AUD ADJ potentiometer, A18R18	Adjusts the input required to balance the high and low power audio input during transmitter power mode operation.
6	OSC FREQ ADJ capacitor, A16C1	Adjusts the transmitter output frequency.
7	RECYCLE switch, A18S1	In one position, allows for three overvoltage transmitter overloads within a 30-second period prior to shutdown. The other position allows for only one overvoltage overload prior to shutdown.
8	VSWR sensitivity potentiometer, A18R8	Adjusts the sensitivity of the VSWR circuit on the input and overload printed-circuit board.
9	OPERATIONAL/BYPASS switch, S14 (MODULATION ENHANCER)	OPERATE position enables the audio input into the modulation enhancer. BYPASS position disconnects the enhancer from the signal path and enables the audio input into the audio input and overload module.



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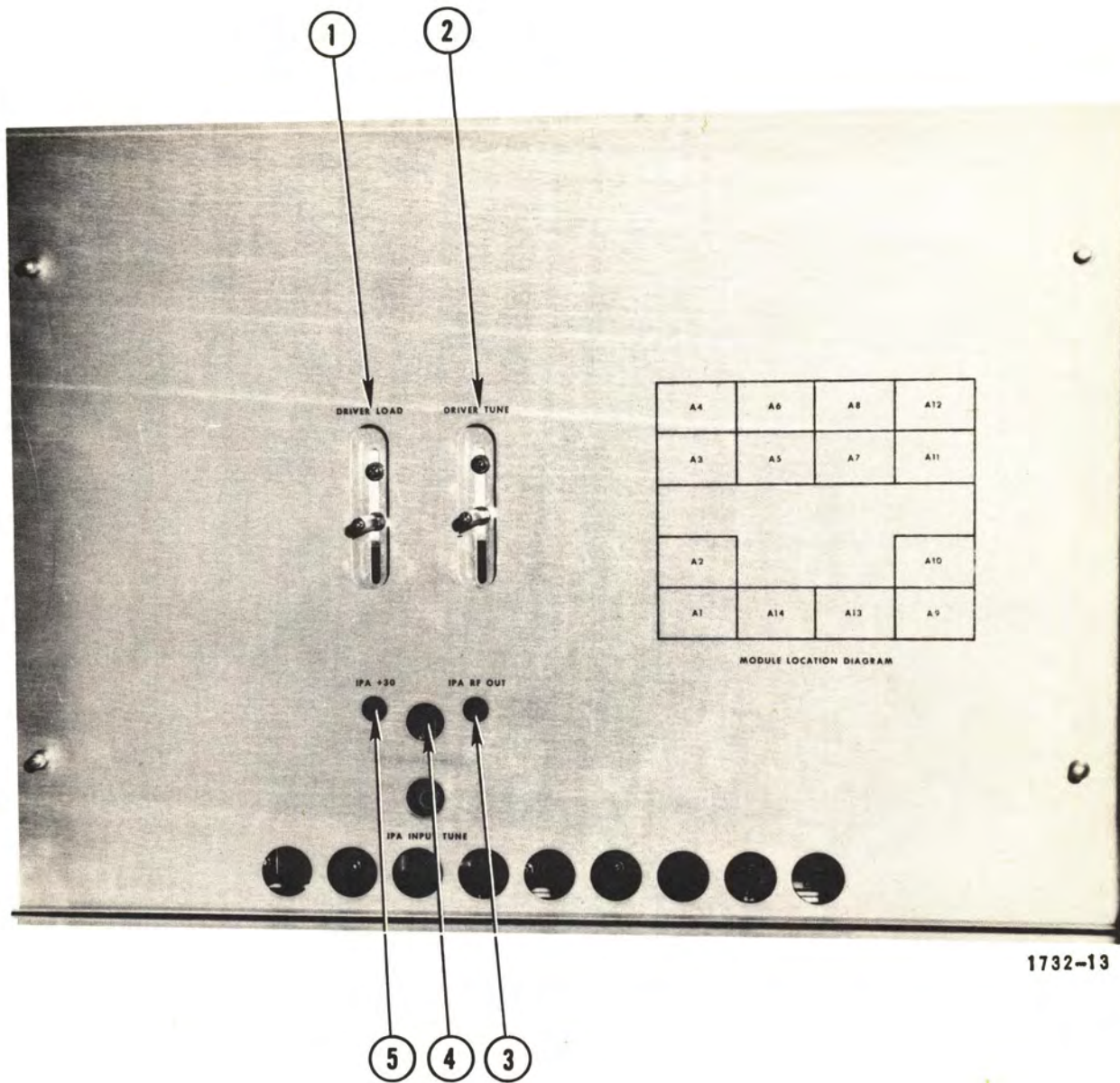
Figure 3-4. Control Box (Internal) Controls and Indicators

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Table 3-5. Module Compartment Controls and Indicators

REF	CONTROL/INDICATOR	FUNCTION
Fig. 3-5		
1	DRIVER LOAD control, L19	Adjusts loading of the output from the RF Driver.
2	DRIVER TUNE control, L18	Adjusts the tuning of the output from the RF Driver.
3	IPA RF OUT indicator, A14DS2	Illuminates when the output from the IPA is present and available.
4	IPA INPUT TUNE control, A14L2	Adjusts the input tuned circuit of the IPA to the fundamental frequency.



1732-13

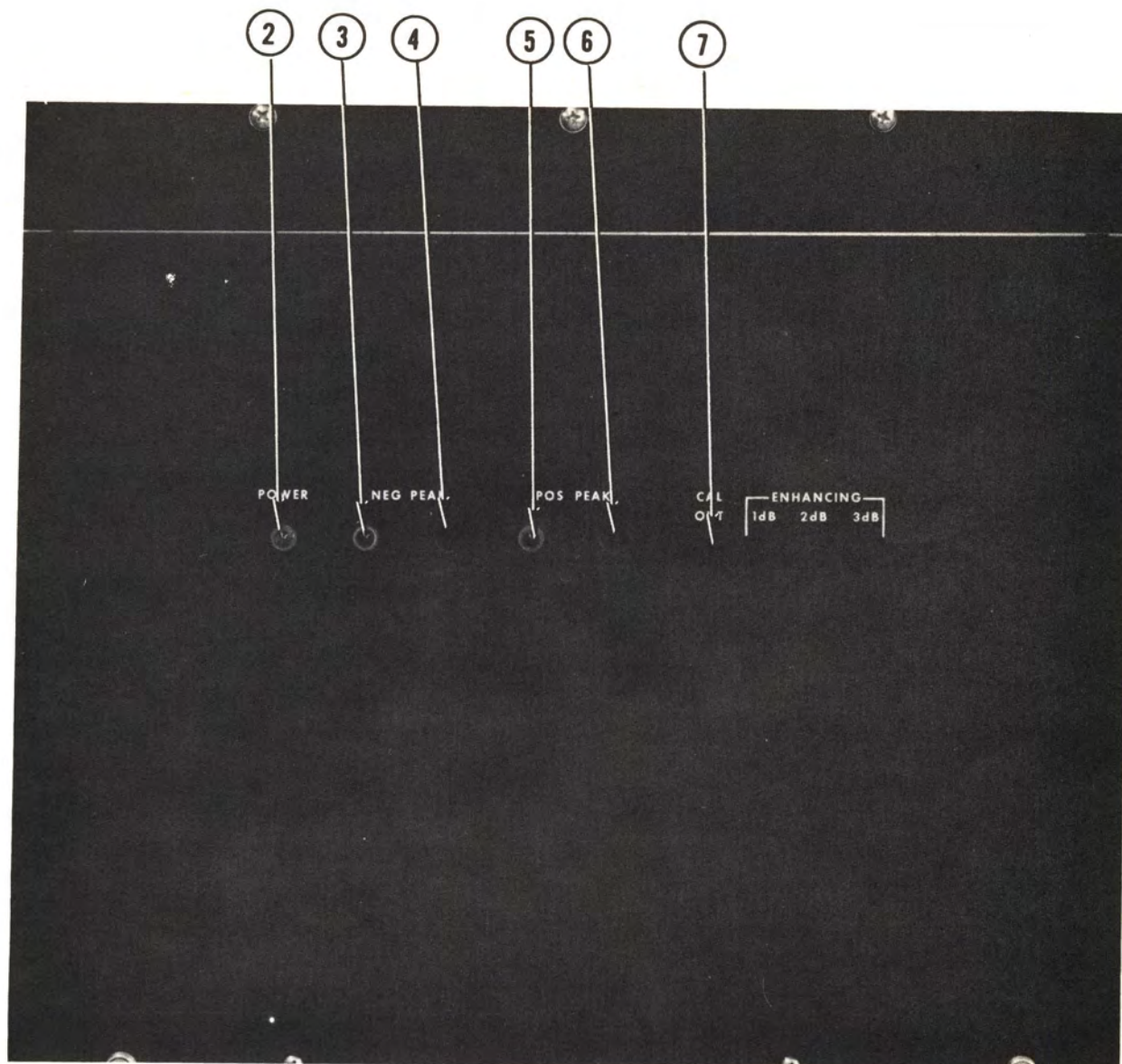
Figure 3-5. Module Compartment Controls and Indicators

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Table 3-6. Modulation Enhancer Controls and Indicators

REF	CONTROL/INDICATOR	FUNCTION
Fig. 3-6		
1	OPERATIONAL/BYPASS switch, S14 (Shown on figure 3-4.)	OPERATIONAL position: connects audio input to enhancer and enhances output to the Audio Input and Overload Module Circuit. BYPASS position: bypasses enhancer so that audio input is routed directly to the Audio Input and Overload Module Circuit.
2	POWER indicator, A27DS1	Illuminates to indicate that power supply circuit is operating.
3	NEG PEAK indicator, A27DS2	Illuminates when enhancer is clipping negative peaks.
4	NEG PEAK adjustment potentiometer, R16	Permits adjustment of the threshold for negative clipping
5	POS PEAK indicator, A27DS3	Illuminates when enhancer is clipping positive peaks.
6	POS PEAK adjustment potentiometer, R20	Permits adjustment of the threshold for positive clipping.
7	CAL OUT - ENHANCING 1dB/2dB/3dB switch, A27S1	CAL OUT position: permits initial setup without enhancement. ENHANCING 1dB, 2dB, or 3dB position: selects amount of enhancement from 1dB (minimum) to 3dB (maximum) in 1dB increments.
8	1/2 ampere fuse, A27F1 (Located internally on module.)	Provides circuit protection in primary power input.



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Figure 3-6. Modulation Enhancer Controls and Indicators



3-9.            SHUTDOWN PROCEDURE.

3-10.           Shutdown of the transmitter is accomplished by depressing the OFF/AIR switch/indicator. However, if maintenance or servicing is to be performed on the transmitter, set all circuit breakers to the OFF position and disconnect the primary power source.

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SECTION IV  
PRINCIPLES OF OPERATION

4-1.        INTRODUCTION.

4-2.        This section presents the principles of operation for the MW-1A transmitter at two levels. The first level explains the theory of the transmitter on a block diagram basis, and the second level provides a detailed description of circuits.

4-3.        OVERALL FUNCTIONAL DESCRIPTION.

4-4.        The MW-1A is a completely solid state AM Broadcast Transmitter that utilizes redundant circuitry of modular construction. The MW-1A consists of four basic subsystems; RF, Audio, Control, and Equipment/Personnel Protection. The following discussion references the block diagrams, figures 4-1 and 4-2.

4-5.        RF SUBSYSTEM.

4-6.        The RF Subsystem, figure 4-1, includes the Oscillator module, IPA (Intermediate Power Amplifier) module, RF Driver module, and the Power Amplifier which consists of twelve identical modules in a parallel configuration. The oscillator generates a stable RF signal from which the carrier frequency is derived. The purpose of the IPA is to isolate the oscillator for improved frequency stability and, in conjunction with the RF Driver, to amplify the RF signal in order to drive the Power Amplifier efficiently. The Power Amplifier (PA) increases the power of the RF signal to the rated output level to be radiated by antenna.

4-7.        The twelve power amplifier modules are class D, push-pull amplifiers. Each amplifier module is paralleled through one of twelve coils. These coils form 90° networks which provide isolation between each of the amplifier modules. The failure of one module, due to either an open or shorted condition, will not affect the operation of the remaining eleven modules.

4-8.        The output network is conventional and provides 225° of phase shift between each amplifier module and the antenna to prevent interaction of PA loading and tuning circuits.

4-9.        AUDIO SUBSYSTEM.

4-10.       The Audio Subsystem, figure 4-2, includes the Modulation Enhancer, Audio Input and Overload Circuit, Audio Driver, Gating and Power Control circuits, and the Modulator. The modulator circuits are physically located on the PA modules and are functionally associated with both the Audio and RF Subsystems.



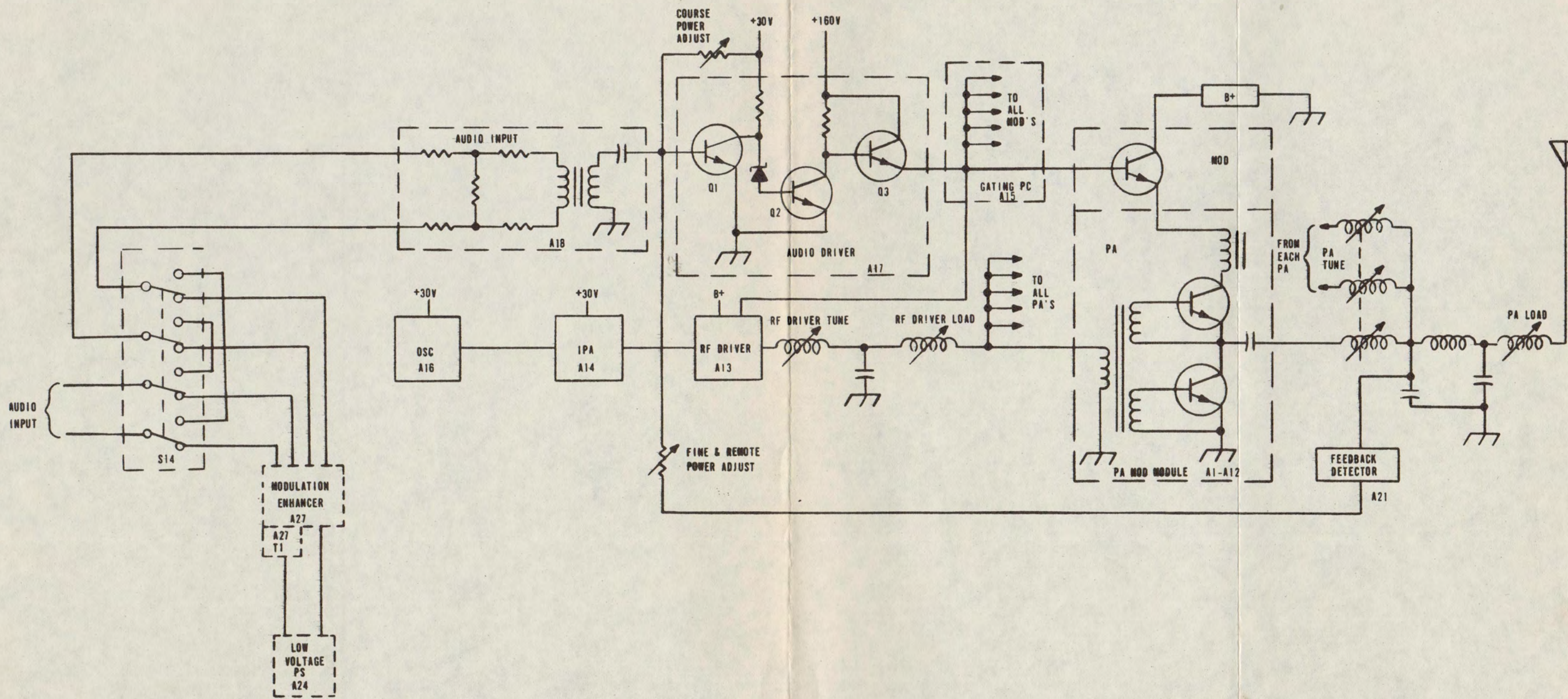


FIGURE 4-1. RF SUBSYSTEM,  
BLOCK DIAGRAM  
839 3143 001



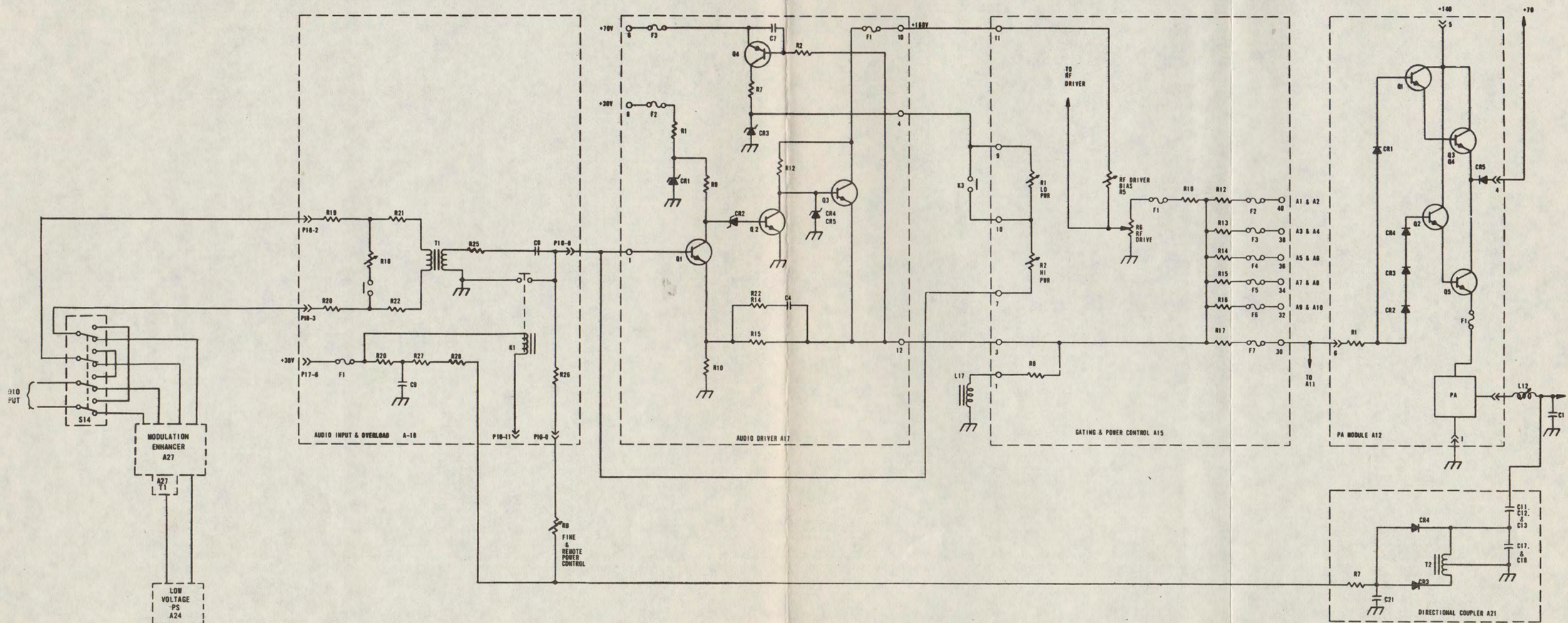


FIGURE 4-2. AUDIO AND POWER CONTROL, SUBSYSTEM BLOCK DIAGRAM 852 8317 001



4-11. MODULATION ENHANCER. The modulation enhancer functions as an adjustable clipper to shape the audio input to the modulator to permit maximum modulation. Controls are provided to select the amount of enhancement and to select the clipping threshold of both the positive and negative peaks. When properly adjusted, the enhancer removes the small peaks that have little power but hold the average level down and allows the larger and more powerful levels of the audio signal to modulate the transmitter at maximum limits. A bypass switch is included to switch the enhancer out of the audio circuit when its use is not desired.

4-12. AUDIO INPUT AND OVERLOAD. The Audio Input and Overload Board consists of an isolation pad, a balanced-to-unbalanced transformer, and a coupling capacitor. This board also includes an overload counter circuit and a VSWR sensing circuit. Audio directly from the program source or through the modulation enhancer is coupled through the passive elements of the audio input circuit directly to the base of transistor Q1 on the Audio Driver module.

4-13. AUDIO DRIVER. The audio driver consists of a current amplifier Q1, a voltage amplifier Q2, and emitter follower stage Q3. The audio signal from emitter follower Q3 is fed to the Gating and Power Control board.

4-14. GATING AND POWER CONTROL. The Gating and Power Control board contains a signal splitting network which provides audio drive signals to the modulation circuits of the twelve PA modules and the RF Driver Module. The high and low power adjustment controls are also contained on this board. The function of the bias control is to limit negative modulation of the RF Driver.

4-15. MODULATORS. The RF Driver and PA modules are identical and each contain a modulator. The modulator is a dc-coupled, progressive-series-modulator (PSM) type employing two modulator stages in series to achieve increased efficiency. In contrast to a conventional-series modulator, the PSM utilizes two power supply voltages, one slightly higher than that required to produce the proper PA voltage at carrier conditions and the second high enough to provide the positive peak required.

4-16. CONTROL SUBSYSTEM.

4-17. The Control Subsystem includes switches and relays which control the application of primary power to all internal power supplies except the 30 vdc power supply which provides operating voltages for the switching relays. The Control Subsystem consists of a Local/Remote switch, High, Low, and Off Power switches, Main Latching relay K1, Main Power Contactor K2 and High/Low Power Latching relay K3. The Main AC Circuit Breaker, CB2, is electronically controlled by the door interlock circuit. This circuit breaker removes all ac power from the transmitter when the door interlocks are open and cannot be manually reset until the doors are closed.

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4-18. PERSONNEL AND EQUIPMENT PROTECTION SUBSYSTEM.

4-19. This subsystem includes the following circuits and devices for the protection of personnel and transmitter equipment:

1. Safety Interlock circuit.
2. DC Overload circuit.
3. Overvoltage Overload circuit.
4. VSWR Overload circuit.
5. Overvoltage Counter and Turnoff circuit.
6. Air Interlock switch.

4-20. SAFETY INTERLOCK CIRCUIT. The front and rear transmitter access doors are equipped with interlock switches which disable the transmitter when either door is opened. By means of a magnetic trip circuit incorporated into the Main AC Circuit Breaker, CB2, the interlock switches cause CB2 to open the primary ac circuit, thereby removing all operating voltages from the transmitter. The Main AC Circuit Breaker cannot be manually re-set until the access doors are closed.

4-21. DC OVERLOAD CIRCUIT. The DC Overload circuit senses the voltage across a resistor in the negative output of the main power supply. When the current from the main power supply return exceeds a predetermined value (approximately 26 amperes), the DC Overload circuit will cause the transmitter to shut off.

4-22. OVERVOLTAGE OVERLOAD CIRCUIT. This circuit continuously monitors the main power supply voltage. When the voltage exceeds 155 volts, the Overvoltage circuit switches a SCR across the main power supply output, causing a near-short condition to drop the output voltage. An impulse is sent to the counter circuit on the Audio Input and Overload Board. If more than three overloads occur within a 30-second period, the transmitter will turn off. If the overloads occur more slowly (for example, one overload every 30-second period during an electrical storm), the transmitter will continue to recycle automatically.

4-23. VSWR OVERLOAD CIRCUIT. The transmitter includes a directional coupler that senses a VSWR change. If the impedance of the antenna system changes by more than 10%, the following action will take place causing the transmitter to recycle.

4-24. A short is placed at the base of transistor Q1 on the Audio Input and Overload board, causing Q1 to turn off. This causes the voltage at the collector of Q2 to drop to zero. Because all remaining audio stages are emitter followers, the voltage at the power amplifier will also drop



to zero, removing the voltage from the collectors of the power amplifier transistors. The short is held at the base of Q1 for approximately 50 ms, after which time the transmitter resumes normal operation. Recycling of the transmitter is continuous.

4-25. OVERLOAD COUNTER AND TURNOFF CIRCUIT. Located on the Audio Input and Overload board, this circuit consists of transistor Q8, relay K2, switch S1, and associated components. The function of this circuit is to count the impulses from the overvoltage overload circuit and cause the transmitter to turn off or recycle, depending upon the position of S1. When S1 is in the closed position, the transmitter will turn off at the first overload. With S1 in the open position, the transmitter will turn off if more than three overloads occur within a 30-second period; if the overloads occur at a rate less than three overloads per 30-second period, the transmitter will continue to recycle automatically.

4-26. AIR INTERLOCK SWITCH. The Air Interlock is a vane-actuated switch that senses the passage of air from the cooling fan. If the cooling fan does not operate within five seconds after initial turn on and cause the air interlock switch to close, the transmitter will be turned off automatically. If, during normal operation, turbulence in the air system causes the interlock switch to flutter, the transmitter will remain operational as long as the interlock switch is not continuously open for five seconds or longer.

4-27. DETAILED DESCRIPTION OF CIRCUITS.

4-28. RF SUBSYSTEM.

4-29. OSCILLATOR MODULE, A16 (figure 8-1). The Oscillator Module consists of a conventional crystal-controlled oscillator stage (Q1), buffer squaring amplifier (Q2), integrated circuit divider (U1), and power amplifier (Q3).

4-30. The first stage, Q1, is a Pierce Oscillator with a series resonant circuit which derives an operating voltage of 15 volts dc from zener regulator CR1. Crystal Y1 is selected to operate at either two times or four times the transmitter carrier frequency so that the crystal frequency is in the range of approximately 2 to 4 MHz, which is the most stable frequency range. This range eliminates the need for a temperature-controlled oven that requires warm-up time. The output of the oscillator is loosely coupled through capacitor C6 to the next stage.

4-31. The Buffer Squaring Amplifier, formed by transistor Q2 and associated components, is overdriven by the oscillator stage to generate a squared wave at the collector of Q2. Transistor Q2 operates at 5.1 volts dc derived from zener regulator diode CR2. Diode CR3 prevents the base of Q2 from going more than 0.6 volts negative. Conductor L1 provides a high impedance to the switching frequency so that the collector of Q2 will force a square wave. CR4 conducts when the Q2 collector voltage attempts to



swing higher than the supply voltage derived from CR2. The collector of Q2 provides a 5-volt peak-to-peak square wave to drive the following stage.

4-32. Integrated circuit U1 is a divider that operates at 5.1 volts dc derived from zener regulator diode CR2. This circuit is configured to divide by two or four, depending upon the crystal frequency, by the arrangement of jumpers on terminals 7, 8, 9, and 10. A jumper between terminals 7 and 10 will cause U1 to divide by two. Jumpers between terminals 7 and 9 and between terminals 8 and 10 will cause U1 to divide by four. In either case, the output at pin 10 is a 2- to 4-volt peak-to-peak square wave at the transmitter carrier frequency.

4-33. Power Amplifier Q3 is driven directly from divider U1 through potentiometer R14. The amplified output is fed to the IPA through pin 3 of P19. As the collector of Q3 swings above the 30-volt supply voltage, diode CR5 begins to rectify, causing LED, RF OUT indicator DS2 to indicate that Q3 and all preceding circuits are operating. Inductor L2 is the B+ choke. Fuse F1 provides circuit protection. DS1 provides an indication that 30 volts is available on the board.

4-34. INTERMEDIATE POWER AMPLIFIER, A14 (figure 8-2). The Intermediate Power Amplifier (IPA) is a single transistor class A amplifier. Inductor L2 and capacitor C4 form a tuned input circuit to produce a sine wave at the base of transistor Q1. The output of the IPA is fed to the RF Driver through pin 5 of J14. Inductor L1 is the B+ choke. When the collector voltage of Q1 begins to rise above the 30-volt power supply voltage due to energy stored in the choke, diode CR1 conducts causing LED indicator DS2 to light, indicating that the module is operating properly. LED indicator DS1 lights when 30 volts is available on the board. Fuse F1 provides circuit protection.

4-35. RF/PA MODULE, A1-A13 (figure 8-3). This module is used as the RF Driver and also in a twelve-module parallel configuration forming the Power Amplifier; therefore, the RF Driver is identical to, and interchangeable with, any of the twelve PA modules. This module consists of a class D push-pull amplifier formed by transistors Q6 and Q7 and a modulator stage consisting of transistors Q1, Q2, Q3, Q4, and Q5.

4-36. RF DRIVER, A13. To improve the modulation characteristics of the final output signal, modulation is also applied to the RF Driver. The audio signal to the RF Driver is set by potentiometer R6 on the Gating and Power Control board to provide a lower input voltage than is supplied to the PA circuits. Bias potentiometer R5, also located on the Gating and Power Control board, provides a bias voltage to the RF Driver to prevent overmodulation in the negative direction. This bias control is adjusted so that the RF Driver will modulate to approximately 80% negative while the PA circuits are modulated to 100% negative. The RF Driver will provide an RF drive signal to the PA circuits even when the PA circuits are totally cut off by their respective modulators.

*R6 = RF Drive*

*R5 = RF Bias*

4-10

WARNING: Disconnect primary power prior to servicing.



4-37. The RF signal from the IPA module is applied to the push-pull amplifier circuit formed by transistors Q6 and Q7 through transformer T1. The RF driver is tuned by adjusting coil L18 and loaded by adjusting coil L9. The output from L9 is applied to pin 2 of each PA module.

4-38. POWER AMPLIFIER, A1-A12 (figure 8-3). The Power Amplifier section consists of twelve RF/PA modules operating in parallel. The output of each PA module is coupled through blocking capacitor C6 to its associated output tuning coil (L1 through L12 for modules A1 through A12). Tuning coils L1 through L12 in conjunction with capacitor C1, form 90° networks at the output of each amplifier. This arrangement, in conjunction with isolation resistors R21 through R32, provides nearly complete isolation and prevents interaction between modules. Coils L1 through L12 are ganged and slug-tuned to provide the PA tuning function while coil L14 provides the PA loading function. The total output network, including coil L13 and capacitor C2, establishes the correct impedance characteristics, provides harmonic attenuation, and inserts 225° of phase shift between each power amplifier and the antenna. This phase relationship is selected so that tuning functions and load changes do not interact.

4-39. Coil L15 provides a modulated RF sample for an external modulation monitor and is also the static drain choke for the transmitter. In the event of a lightning strike, spark gap E1 operates in approximately one nanosecond when the voltage between L14 and C3 exceeds 1500 volts to place a direct short across the output network of the transmitter. This short (high VSWR) is sensed by the directional coupler which turns off the modulator and removes the PA voltage, protecting power amplifier transistors.

4-40. AUDIO SUBSYSTEM.

4-41. MODULATION ENHANCER. When the OPERATE/BYPASS switch is in the OPERATE position, the audio input is applied across switch-selectable pads controlled by the CAL OUT-ENHANCING/1dB/2dB/3dB switch. In the CAL OUT position, the audio signal is routed directly to the transmitter without clipping to permit adjustment of the modulation prior to enhancement. When the ENHANCING 1dB, 2dB, or 3dB position is selected, the audio line is applied to diodes CR6 and CR8 at the inputs to the positive and negative clipping circuits formed by transistors Q1 through Q4.

4-42. The clipping threshold for the positive and negative peaks of the audio input are independently adjusted by front panel controls R16 (NEG PEAK) and R20 (POS PEAK). These potentiometers are connected to the ±12 volt power supply formed by transformer T1, bridge rectifier CR1 through CR4, and zener diodes CR5 and CR7 and are adjusted to set the switching levels of Q1/CR6 and Q3/CR8. When the audio input goes sufficiently positive to overcome this switching level, diode CR6 and transistor Q1 conduct to prevent any further positive increase. With Q1 on, transistor Q2 turns on and LED indicator DS2 (NEG PEAK) illuminates. Diode CR8, transistors Q3 and Q4, and LED indicator DS3 (POS PEAK) function similarly to clip negative excursions at the threshold set by potentiometer R20. The enhancer is factory installed such that with



normal audio inputs, the NEG PEAK control adjusts clipping negative modulation peaks and the POS PEAK control adjusts clipping of positive modulation peaks.

4-43. POWER indicator DS1 is illuminated whenever primary power is applied and the internal  $\pm 12$  volt power supply is functioning properly.

4-44. AUDIO INPUT AND OVERLOAD, A18 (figure 8-4). The audio input to the transmitter is applied through resistors R19, R20, R21, and R22 which form a 10-dB isolation pad. Transformer T1 provides isolation from electrical transients and converts the balanced input to an unbalanced output at R26 and C8. The audio signal from capacitor C8 is applied directly to the base of Q1 on the Audio Driver module (A17).

4-45. AUDIO DRIVER MODULE, A17 (figure 8-5). The Audio Driver module consists of current amplifier Q1, voltage amplifier Q2, and emitter follower Q3. Transistor Q4 limits the average dc voltage output from the Audio Driver so that the power amplifier is not driven above the 70-volt power supply.

4-46. Positive current supplied to the base of Q1 causes current to flow through Q1 reducing the current available at the base of Q2. As the current to the base of Q2 decreases, the voltage at the collector of Q2 increases. Diodes CR4 and CR5 prevent this voltage from exceeding 140 volts which is the rating of the power amplifier transistors. Since Q3 is an emitter follower, the voltage at the emitter of Q3, which is the output of the audio driver, is the same as the collector voltage at Q2. The audio signal at the input of the audio driver varies the current at the base of Q1, which then causes the voltage at the collector of Q2 and the emitter of Q3 to vary from 0 to a maximum of 140 volts. A fixed bias is also applied to Q1 of the audio driver to establish the carrier voltage (power amplifier voltage) during carrier conditions.

4-47. Potentiometers R1 and R2, located on the Gating and Power Control board A15, are adjusted to provide the proper power amplifier voltage. The voltage to R1 (low power) and R2 (high power) are derived from Q4. If R1 or R2 are adjusted to exceed the 70-volt supply voltage, Q4 will turn off and cause the voltage to the high and low power controls to decrease, thereby preventing the power amplifier voltage from exceeding 70 volts. This protection is required to prevent accidental overpowering of the transmitter and to limit the PA voltage when one or more modules have failed. This voltage is limited so that the transmitter is always capable of 125% modulation regardless of the number of failed modules. The transmitter carrier power is allowed to drop as modules fail; however, the modulation depth remains the same. The output of the audio driver, which contains both audio and dc for the power amplifier, is fed to the Gating and Power Control board A15.

4-48. GATING AND POWER CONTROL BOARD, A15 (figure 8-6). Resistor R8 and inductor L17 (refer to overall schematic, figure 8-14) provide a constant current source for emitter follower Q3 of the audio driver. This circuit sets up a current of 30 to 50 mA to provide pull-down current for the



twelve power amplifier modules. The audio signal and dc are applied to the junction of isolation resistors R10 and R12 through R17. Resistors R12 through R17 provide distribution of the audio drive signal through the associated fuses, F2 through F7, to the PA modules. Each leg of the network supplies two modules which are driven in parallel (refer to figure 8-6). The audio voltage for the RF driver is supplied through isolation resistor R10 and fuse F1. The functions of potentiometer R6 (RF drive control) and potentiometer R5 (bias control) are discussed in paragraph 4-36.

4-49. PA MODULATOR CIRCUIT. Each PA module contains a modulator circuit consisting of transistors Q1 through Q5 and associated components. Refer to figure 8-3.

4-50. Audio and dc derived from the audio driver, A17, is applied to resistor R1 of each modulator circuit through the Gating and Control board as described previously. Resistor R1 provides isolation and diodes CR2, CR3, and CR4 provide a slight offset so that there is a smooth crossover when the modulator switches between the 70-volt and 140-volt supply voltages. Diode CR1 conducts when the driving voltage is less than 70 volts.

4-51. Transistors Q1 and Q2 are emitter followers that provide current gain to operate transistors Q3 and Q4. In a manner very similar to a class B modulator, Q3 and Q4 operate in parallel to provide positive modulation, while Q5 provides carrier voltage and negative modulation. During carrier conditions with negative modulation peaks, only Q2 and Q5 are in the circuit and obtain their voltage through CR5 from the 70-volt (half-voltage) power supply. At carrier conditions, Q5 is near saturation with respect to the 70-volt power supply and therefore loses little power. During the negative peak of the modulating signal, Q5 decreases conduction and reduces the voltage at the power amplifier, thereby modulating the carrier in the negative direction. When the modulating signal exceeds 70 volts, Q5 is saturated and Q3 and Q4 begin to conduct from the 140-volt supply. At this time, with Q5 saturated, the power amplifier voltage can go to 140 volts for 125% modulation. By operating the modulator in this fashion, the requirement for a modulation transformer is eliminated, efficiency is improved, and ac and dc feedback can be employed to promote extremely stable operation.

4-52. FEEDBACK. The Directional Coupler A21, includes an RF detector circuit that rectifies a sample of the modulated carrier obtained from the output side of coils L1 through L12. This circuit, which consists of transformer T1, diodes CR3 and CR4, and associated capacitors, provides approximately 10 dB of negative feedback at pin 2 of A21 which is routed to P17-5 of the Audio Input and Overload board, A18, through the front panel power control, R8. The feedback signal is a dc level proportional to the carrier power with an ac component proportional to the audio modulating signal. Power Control R8 provides a fine adjustment of output power by varying the level of negative feedback.

4-53. CONTROL SUBSYSTEM.

4-54. The MW-1A is designed to operate from 210/220/240/260 vac pri-



mary power. The Control Subsystem consists of switches and relays that control the application of primary power to the transmitter. Refer to figure 8-7.

4-55. PRIMARY POWER CONTROL. Primary ac power from terminal board TB1 is applied to the main ac circuit breaker CB2 which controls all power to the transmitter. CB2 is electrically interlocked with the front and rear access doors and is equipped with a magnetic trip circuit. CB2 opens whenever interlock switches S7 or S8 are opened. This circuit breaker cannot be manually reset until the interlocks are closed. When CB2 is closed, primary power is applied to the 30-volt power supply through circuit breaker CB1.

4-56. 30-VOLT POWER SUPPLY. Located on assembly A24 at the bottom of the transmitter, the 30-volt power supply consists of transformer T1, rectifier CR1, and filter capacitor C1 and provides 30 volts dc to the following circuits: control switching, oscillator, audio input and overload, IPA, relay and regulator, and audio driver.

4-57. TRANSMITTER POWER CONTROL. To activate the transmitter, either the HIGH POWER or LOW POWER front panel switches are depressed or ground is applied to TB2-4 or TB2-5 through remote control switches. This causes the main latching relay, K1, to latch in the on position through either diode CR5 or diode CR6. If the HIGH POWER switch is depressed (or ground is applied to TB2-5), the high coil of high/low power latching relay K3 is also energized causing the transmitter to operate in the high power mode. If the LOW POWER switch is depressed (or ground is applied to TB2-4), the low coil of K3 is energized causing the transmitter to operate in the low power mode. Depressing either the high or the low power switch causes K1 to latch in the on position. Diodes CR5 and CR6 function as an OR gate. Ground placed on either diode causes K1 to energize to the on position. Depressing the OFF switch, S5, or applying ground to TB2-3, causes the off coil of K1 to energize and latch K1 in the off mode.

4-58. Main Latching Relay K1. This relay has four sets of form C contacts. Refer to figure 8-14 and locate the top set of contacts.

a. One side of the AC line connects to terminal 10 of K1. In the up (off) position, one side of the line is applied directly to the reduced voltage windings of voltage regulator motor B1. This causes the voltage regulator to go to its lowest voltage position when the transmitter is turned off. When K1 is in the on position, one side of the ac line connects to the automatic voltage regulator control on the Relay and Regulator board, A22.

b. The second set of contacts on the A side of K1 applies 30 volts to the high voltage shorting relay, K4, when K1 is latched in the on position. When K4 is energized, its contacts open removing the short from the high voltage power supply.



c. The third set of contacts receives 110 volts from the Relay and Regulator board, A22, and in the on position applies 110 volts to the main contactor, K2. K2 places the main line voltage across the fan, the main high voltage supply, and the 160-volt booster supply.

d. The fourth set of contacts on relay K1 turns on the 30-volt bus to all circuits which require 30 volts.

4-59. Main Contactor K2. The main contactor, K2, energizes all power supplies through two of its contacts and allows the automatic voltage regulator to operate when the circuit is completed through a third set of contacts and closed contacts of K1. The fourth set of contacts allows the over-voltage SCR, CR12, to short the high voltage power supply to ground through resistor R10 until contactor K2 is deenergized.

4-60. High/Low Latching Relay K3. This relay has four sets of form C contacts.

a. The top set of contacts switch in variable resistor R18 of the Audio Input and Overload module, A18, so that the low power audio input may be matched to that required in the high power mode.

b. The second set of contacts short out the low power adjustment on the Gating and Power Control board, A15, when the transmitter is in the high power mode.

c. The third set of contacts on K3 switch in resistor R7, the high power modulated RF sample adjustment, so that the RF sample in the high power mode may be adjusted to equal the RF sample in the low power mode.

d. The fourth set of contacts cause the high and low power switches on the front of the transmitter to light, indicating the mode (high or low) of operation.

4-61. Relay and Regulator A22. The Relay and Regulator board provides four functions: voltage regulator control, overvoltage sensor, dc overload, and blower time delay. Refer to figure 8-8.

4-62. Voltage Regulator. The voltage regulator receives a sample of the 140-volt supply on terminal 6 of the board. Zener diodes CR1 and CR2 provide approximately 110 volts drop to increase sensitivity of the circuit. Thirty volts from terminal 9 supplies power to the transistors and relays. Zener diode CR5 regulates the voltage at the junction of Q1 and Q2 to approximately 14 volts. If the output of the 140-volt supply is low, the voltage on the wiper of R2 will be less than the voltage caused by CR5. This causes current to flow from the emitter to the base of Q2 turning on the transistor and causing K2 to energize. One side of the 110-volt bus is applied to terminal 11, then to pin 9 of relay K1 and out pin 8 of K1 to pin 12 of K2. When K2 is energized to increase the power supply voltage, 110 volts is fed from pin 13 of K2 to terminal 13 of the board which



contains the raise winding of the regulator motor control, B2. The 110 volts goes through the normally closed contacts of K1 before going to K2 to prevent the voltage from being applied to both the raise and lower motor windings of the regulator motor B2 if a failure occurs in either Q1 or Q2. Should the 140-volt supply go higher than desired, the voltage at the wiper of R1 goes above the voltage of CR5, causing current to flow from the base to the emitter of Q1, which energized relay K1. The 110 volts for motor control is routed from terminal 11 to pin 8 of deenergized K2, then out pin 9 to pin 12 of K1. When K1 is energized, the voltage from pin 13 of K1 is applied to terminal 12 of the board to the lower winding of the regulator motor control B2. Again, this voltage goes through both relays to provide interlocking should a failure occur in the circuit.

4-63. Overvoltage Control. When the main contactor K2 is energized, one set of contacts in series with R10 and terminal 15 of the regulator board closes. This allows the 140-volt sample to be applied to CR7 and CR8 through the jumper on terminals 17 and 18. Resistor R10 is adjusted to supply approximately 22 volts, which is the firing voltage of CR6, to the wiper of R10 when the output of the 140-volt power supply rises to 155 volts. When CR6 fires, a short circuit is created which dumps the charge on C2 to the gate of SCR CR12 through terminal 14 of the board. When CR12 fires, it creates a near short on the 140-volt supply through CR12. Terminal 6 of the board is still at 140 volts. This causes K3 to energize closing one set of its contacts and applying 30 volts to the Audio and Input Overload board, A18. The second normally-closed set of contacts opens, removing the voltage from K2, the main contactor. This action turns off the 140-volt supply and opens the contact in series with R10, allowing CR12 to reset. When the 140-volt supply drops to approximately zero volts, K3 on the regulator board deenergizes allowing the transmitter to return to the air. A jumper is provided at terminals 17 and 18. This jumper may be removed and an external 155 volts dc may be applied between terminal 18 and ground. Resistor R10 is adjusted for a trip. The jumper is then replaced between 17 and 18 for normal operation.

4-64. DC Overload. The DC Overload consists of Q3 on the regulator board and its associated circuitry. A voltage sample from resistor R18 is applied to pin 5 of the regulator board. As the current increases through the main power supply, the voltage increases at R18 (pin 5 of the regulator board) in the minus direction. As this voltage approaches about minus 1.5 volts, current will flow from the base to the emitter of Q3 causing Q3 to turn on and energize K4 on the regulator board. One set of normally-closed contacts on K4 opens, causing the main contactor K2 to deenergize and turn off the main power supply. A second set of contacts on K4 applies 30 volts to the Audio Input and Overload board (A18) to activate the DC OVERLOAD indicator circuit, Q8. Zener diode CR10 is in the circuit to prevent the voltage from base to emitter of Q3 from exceeding the maximum rating of Q3. This is necessary because a dead short placed on the high voltage supply could otherwise place 140 volts across R18 (or pin 5 of the regulator board) which could damage the circuit.



4-65. Blower Time Delay. When the fan is operating, the air switch, S10, is in the open position and the voltage at terminal 1 of the regulator board is 0. Should the fan fail, switch S10 energizes (closes) placing 30 volts on pin 1 of the regulator board. This 30 volts charges the time constant networks formed by R17 and C7 and R16 and C8. In approximately five seconds, the voltage at the base of Q4 reaches 0.6 volts turning on Q4. When Q4 turns on, the collector voltage is less than 0.5 volts. This places ground at the off switch indicator on the meter panel, indicating a loss of air. The discharge time of this circuit is also about five seconds, after which the transmitter is returned to normal operation without any resetting of controls.

4-66. AUDIO INPUT AND OVERLOAD BOARD, A18. The audio circuits on this board have been explained previously. The following paragraphs discuss the overload functions.

4-67. DC Overload. Thirty volts at terminal 8 of A22, caused by the closure of K4 on the regulator board, A22, is applied to P17-9 on the audio input and overload board, A18. This causes SCR Q1 to fire turning on the DC OVERLOAD LED on the meter panel.

4-68. Overvoltage. Positive 30 volts from the overvoltage overload circuitry on the regulator board, A22, is received at P17-8 on the Audio and Input Overload board and applied to the junction of R5 and CR2. This voltage causes SCR Q2 to fire turning on the overvoltage amplifier, located on the meter panel of the transmitter, and applies 30 volts through CR2 to R31 which causes K2 to energize.

4-69. VSWR Overload. The VSWR circuits on the Audio Input and Overload board consist of Q5, Q6, and Q7. Should the VSWR at the transmitter output change from its normal setting, a positive voltage will begin to develop at P17-2 on the Audio Input and Overload board. When this voltage at the wiper of R8 reaches a predetermined level, SCR Q4 fires. When Q4 fires, the following conditions exist.

a. The voltage at the junction of CR4 and CR6 and Q4 is about one volt or, for practical purposes, ground. A ground is then placed on the high and low power controls through CR4 to reduce the PA voltage.

b. A ground is placed on the power supply providing back bias to the feedback diodes through CR6. The voltage at the junction of Q4 and R10 is at 0.6 volts, which turns on Q5. The collector voltage at Q5 goes to near ground when it turns on, causing current to flow from the emitter to the base of Q6 which causes the collector to pull up to the 30-volt supply level. This 30 volts is then applied to the junction of R6 and CR3 causing SCR Q3 to fire which illuminates the VSWR overload indicator on the meter panel of the transmitter.

c. Current from the base of Q6 will also flow from the base to the emitter of Q7 causing its collector voltage to drop to less than 0.3



volts which shorts out all dc and audio currents going to the audio driver through P18, pin 8. This totally removes the PA voltage and current in a few microseconds.

d. When Q5 is energized, it also applies 30 volts across R13, K1, and C6. This combination has a time constant of about 50 milliseconds. Relay K1 energizes and places a short across SCR Q4 allowing it to turn off. When Q4 turns off, the voltage at the junction of Q4 and R10 goes to 0 turning off Q5, Q6, and Q7. Relay K1 deenergizes, opening its contacts, which allows the transmitter to return to the air. This entire sequence takes less than one-half second during which time no contactors or power supplies are turned off.

4-70. Overload Counter. Whenever an overvoltage occurs, plus 30 volts is placed on R31 in series with the coil of K2. Switch S1, in the open position, allows the transmitter to recycle. In the closed position, S1 causes the transmitter to turn off at the first overload. Capacitor C11 is charged up to 30 volts either through R32 or through switch S1. When K2 is energized because of an overload, the charge on C11 is dumped on capacitor C12. With switch S1 in the open or recycle position, the voltage at C12 will only be about 7 volts after the first dump. If the overload is cleared, K2 deenergizes, opening its contacts to allow C11 to again charge to plus 30 volts. Should another overload occur quickly, the 30-volt charge on C11 will again be dumped on C12 causing its voltage to rise to about 12 volts. On the third overload, the 30-volt charge on C11 is dumped on C12 which has now reached a voltage level high enough to cause current flow through zener diode CR8 turning on transistor Q8. When transistor Q8 turns on, its collector goes to near ground energizing the off coil of main latching relay, K1, which turns off the transmitter. Should switch S1 be in a closed position, the first overload will place 30 volts on C12 causing Q8 to conduct and turn off the transmitter. The ground caused at P17-12, 11, or 10 due to the firing of SCR Q1, Q2, or Q3 goes to the overload lapse on loading lamp board, A20. This causes DS8, DS7, or DS6 to illuminate. To reset or extinguish the overload indicators, the RESET switch, S6, places a short between terminals 1 and 2 of the overload lamp board causing the current to cease flowing through any of the three indicators (or SCRs) on the Audio Input and Overload board, A18. As soon as the current stops flowing through an SCR and no gate current exists, the SCR opens causing the SCR to reset (open).

4-71. DIRECTIONAL COUPLER BOARD, A21. The directional coupler board provides four functions in the transmitter: forward power indication, reflective power indication, relative VSWR indication, and feedback detection.

4-72. Forward and Reflective Power. The RF output current of the transmitter passes through current transformer T1, establishing a voltage at R3 and R4 which is proportional to the current flowing in the RF transmission line. A voltage sample is obtained across capacitor C5 from capacitor divider C1, C2 and C3. Another voltage sample across C9 is obtained



from capacitor divider C6, C7, and C8. The voltage developed across R3 is 180 degrees out of phase from the voltage developed across R4. When properly terminated and adjusted, the voltage across R4 equals the voltage across C9 and is in phase, causing 0 voltage across CR2 and 0 voltage at pin 6 of the Directional Coupler board A21, and a 0 indication on the reflected power meter. The voltage at C5 and the voltage at R3 will be equal but 180 degrees out of phase causing a voltage across CR1 and a voltage to the forward power meter through pin 7. As VSWR changes, the in-phase condition of R4 and C9 will cease, causing a voltage to exist on the reflected power meter through pin 6. As the voltage on C5 and R3 begin to change in phase, the voltage to the power meter through pin 7 will begin to decrease.

4-73. VSWR Overload Detector. The operation of the VSWR overload detector is identical to forward or reverse power operation except the sample is received at the 90° network common point. The impedance at the common point is approximately 30 ohms when the transmitter is properly adjusted. A current sample is applied at pin 9 on the board. A voltage sample is applied to pin 10. Capacitors C14, 15, and 16 form a capacitor divider to apply the voltage at C9. The current sample from pin 9 causes a voltage across R10, 11, 12 and 13 in parallel. When the transmitter is operating properly, C20 and C22 are adjusted so that the phase and gain across C19 and C23 are identical, causing a 0 reading on the VSWR meter which is the reference for VSWR trips. Should a change occur in the transmission line, the voltage will increase in the positive direction at pin 5. When approximately 2 volts is reached, a VSWR overload will occur.

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SECTION V  
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section provides system performance checks, preventive maintenance information, and corrective maintenance procedures.

5-3. PURPOSE.

5-4. The information contained in this section is intended to provide guidance for establishing a comprehensive maintenance program to promote operational readiness and eliminate downtime. Particular emphasis is placed on preventive maintenance and record-keeping functions.

5-5. STATION RECORDS.

5-6. The importance of keeping station performance records cannot be overemphasized. Separate logbooks should be maintained by operation and maintenance activities. These records can provide data for predicting potential problem areas and analyzing equipment malfunctions.

5-7. TRANSMITTER LOGBOOK.

5-8. As a minimum performance characteristic, the transmitter should be monitored (using front panel meters) and the results recorded in the Transmitter Logbook at each shift change or at least once per day.

5-9. MAINTENANCE LOGBOOK.

5-10. The maintenance logbook should contain a complete description of all maintenance activities required to keep the transmitter in operational status. A listing of maintenance information to be recorded and analyzed to provide a data base for a failure reporting system is as follows:

DISCREPANCY	Describe the nature of the malfunction including all observable symptoms and performance characteristics.
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CORRECTIVE ACTION	Describe the repair procedure used to correct the malfunction.
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DEFECTIVE PART(S) List all parts and components replaced or repaired and include the following details:

- a. TIME IN USE
- b. PART NUMBER
- c. SCHEMATIC NUMBER
- d. ASSEMBLY NUMBER
- e. REFERENCE DESIGNATOR

SYSTEM ELAPSED TIME Total time on transmitter.

NAME OF REPAIRMAN Person who actually made the repair.

STATION ENGINEER Indicates Chief Engineer noted and approved the repair to the transmitter.

5-11. SAFETY PRECAUTIONS.

5-12. Because of voltages and currents, it is very dangerous to attempt to make measurements or replace components with the power on. The design of the transmitter provides safety features such that when a door is open or a grounding stick is not in its proper place, the interlock switch opens and removes power from the transmitter. Do not short out or bypass these switches unless an instruction in this manual directs the maintenance person to do so.

5-13. Grounding sticks are provided as a safety feature. It consists of a metal rod with a phenolic plastic handle and the metal end connected to the transmitter ground. Before putting a hand into the transmitter, use the grounding stick and touch every part in the area or circuit on which maintenance is to be performed.

5-14. PREVENTIVE MAINTENANCE.

5-15. Preventive maintenance is a systematic series of operations performed periodically on equipment. Since these procedures cannot be applied indiscriminately, specific instructions are necessary. Preventive maintenance consists of seven operations: inspecting, feeling, tightening, cleaning, adjusting, lubrication, and painting.

a. Inspect. Inspection is the most important preventive maintenance operation because it determines the necessity for the others. Become thoroughly acquainted with normal operating conditions in order to recognize and identify abnormal conditions readily. Inspect for:

1. Overheating, which is indicated by discoloration, bulging of parts, and peculiar odors.
2. Leakage of grease and oil.



3. Oxidation.

4. Dirt, corrosion, rust, mildew, and fungus growth.

b. Feel. Use this operation to check parts for overheating, especially rotating parts such as blower motors. By this means, the need for lubrication, the lack of proper ventilation, or the existence of some defect can be detected and corrected before serious trouble occurs. Become familiar with operating temperatures in order to recognize deviations from the normal range.

c. Tighten. Tighten loose screws, bolts, and nuts. Do not tighten indiscriminately as fittings that are tightened beyond the pressure for which they are designed may be damaged or broken.

d. Clean. Clean parts only when inspection shows that cleaning is required. Use approved cleaning solvent.

e. Adjust. Make adjustments only when inspection shows that they are necessary to maintain normal operation.

f. Lubricate. Lubricate meshing mechanical surfaces at specified intervals, and with specified lubricants, to prevent mechanical wear and keep the equipment operating normally.

g. Paint. Paint steel surfaces with the original type of paint (use prime coat if necessary) when inspection shows rust, or worn or broken paint film.

#### 5-16. BLOWER FILTER CLEANING.

5-17. A blower assembly is provided in the transmitter. The blower filter is the replaceable cartridge type. Inspect the filter once a week with replacement done on an as-needed or every month basis, whichever occurs first. Dirt in the filter may not be noticed during visual inspection unless the filter is gently tapped against a white paper to observe the quantity of accumulated dirt. If the weekly inspection indicates excessive dirt accumulation in the filter or if the monthly periodic service period has expired, replace the filter.

#### 5-18. BLOWER MAINTENANCE.

5-19. Inspect pressure blower and flushing fan for dust accumulation on blower wheels and propellers monthly. Remove dust with a vacuum cleaner. Check blower for wear. All blower drives are lifetime lubricated. Bearings that are noisy or show wear must be replaced.

#### 5-20. MAINTENANCE OF COMPONENTS.

5-21. The following paragraphs provide information necessary for the maintenance of components.

5-22. TRANSISTORS. Preventive maintenance of transistors is accomplished by performing the following steps:

- a. Inspect the transistors and surrounding area for dirt as accumulations of dirt or dust could form leakage paths.
- b. Use compressed dry air to remove dust from the area.

**CAUTION**

Do not touch heat sinks and transistors mounted in heat sinks immediately after removing power. Burns may result from contact.

- c. Examine all transistors for loose connections or corrosion.

5-23. CAPACITORS. Preventive maintenance of capacitors is accomplished by performing the following steps:

- a. Examine all capacitor terminals for loose connections or corrosion.
- b. Ensure that component mountings are tight.
- c. Examine the body of each capacitor for swelling, discoloration, or other evidence of breakdown.
- d. Inspect oil-filled or electrolytic capacitors for leakage signs.
- e. Use standard practices to repair poor solder connections with a low-wattage soldering iron.
- f. Clean cases and bodies of all capacitors.

5-24. FIXED RESISTORS. Preventive maintenance of fixed resistors is accomplished by performing the following steps:

- a. When inspecting a chassis, printed-circuit board, or discrete component assembly, examine resistors for dirt or signs of overheating. Discolored, cracked, or chipped components indicate a possible overload.
- b. When replacing a resistor, ensure that the replacement value corresponds to the component designated by the schematic diagram.
- d. Clean dirty resistors with a small brush.

5-25. VARIABLE RESISTORS. Preventive maintenance of variable resistors is accomplished by performing the following steps:

5-4

WARNING: Disconnect primary power prior to servicing.



- a. Inspect the variable resistors and tighten all loose mountings, connections, and control knob setscrews (do not disturb knob alignment).
- b. If necessary, clean component with a dry brush or cloth.
- c. When dirt is difficult to remove, clean component with a cloth moistened with cleaning solvent.

5-26. TRANSFORMERS. Preventive maintenance of transformers is accomplished by performing the following steps: it must be remembered that transformers are enclosed in metal housings and impregnated with an insulating compound.

- a. Examine a transformer by feeling soon after power removal, for signs of overheating.
- b. Inspect each transformer for dirt, loose mounting brackets and rivets, loose terminal connections, and insecure connecting lugs. Dust, dirt, or moisture between terminals of a transformer may cause flashovers. Insulating compound or oil around the base of a transformer indicates overheating or leakage.
- c. Tighten loose mounting lugs, terminals, or rivets.
- d. Clean with a dry cloth or one moistened with cleaning solvent.
- e. Clean corroded contacts or connections with No. 0000 sandpaper.
- f. Replace defective transformers.

5-27. FUSES. Preventive maintenance of fuses is accomplished by performing the following steps:

- a. When a fuse blows, ascertain the cause before installing a replacement.
- b. Inspect fuse caps and mounts for charring and corrosion.
- c. Examine fuse clips for dirt, improper tension, and loose connections.
- d. If necessary, tighten fuse clips and connections to the clips. The tension of the fuse clips may be increased by pressing the clip sides closer together.
- e. Clean fuses and clips with a small brush.
- f. Remove corrosion with No. 0000 sandpaper.

5-28. METERS. Preventive maintenance of monitoring meters is accomplished by performing the following steps:

- a. Inspect meters for loose, dirty, or corroded mountings and connections.
- b. Examine leads for frayed insulation and broken strands.
- c. Check for cracked or broken plastic cases and cover glasses.
- d. Tighten loose mountings or connections. Since meter cases are made of plastic, exercise care to prevent breakage.
- e. Clean meter cases and glass covers with a dry cloth.
- f. Remove dirt from mountings and connections with a stiff brush moistened with cleaning solvent.
- g. Remove corrosion with No. 0000 sandpaper.

5-29. RELAYS. Replace hermetically sealed relays if they are defective. Nonhermetically sealed relays are considered normal if the following conditions exist:

- a. The relay is mounted securely.
- b. Connecting leads are not frayed, and the insulation is not damaged.
- c. Terminal connections are tight and clean.
- d. Moving parts travel freely.
- e. Spring tension is correct.
- f. Contacts are clean, adjusted properly, and make good contact.
- g. The coil shows no signs of overheating.
- h. The assembly parts are clean, and no corrosion is present.

5-30. SWITCHES. Preventive maintenance of switches is accomplished by performing the following steps:

- a. Inspect switch for defective mechanical action or looseness of mounting and connections.
- b. Examine cases for chips or cracks. Do not disassemble switches.



- c. Inspect accessible contact switches for dirt, corrosion, or looseness of mountings or connections.
- d. Check contacts for pitting, corrosion, or wear.
- e. Operate the switches to determine if they move freely and are positive in action. In gang and wafer switches, the movable blade should make good contact with the stationary member.
- f. Tighten all loose connections and mountings.
- g. Adjust contact tension.
- h. Clean any dirty or corroded terminal connections or switch section with No. 0000 sandpaper.
- i. Replace defective switches.

5-31. INDICATORS AND INDICATOR SWITCHES. Preventive maintenance of indicator lamps and indicator switches is accomplished by performing the following steps:

- a. Examine indicator sockets for corrosion, loose nuts, and condition of rubber grommets.
- b. Examine indicator switches by pulling the plastic cover (indicator assembly) from the case.
- c. Inspect indicator assemblies for broken or cracked covers, loose envelopes, loose mounting screws, and loose or dirty connections.
- d. Tighten loose mounting screws; solder loose connections. If connections are dirty or corroded, clean with No. 0000 sandpaper before soldering.
- e. Clean indicator covers, bases, and glass bulbs with a dry cloth.
- f. Clean corroded socket contacts and connections with No. 0000 sandpaper. Low operating voltages require clean contacts and connections.

5-32. PRINTED-CIRCUIT BOARDS. Preventive maintenance of printed-circuit boards is accomplished by performing the following steps:

- a. Inspect the printed-circuit boards for cracks or breaks.
- b. Inspect the wiring for open circuits or raised foil.
- c. Check components for breakage or discoloration due to overheating.

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d. Clean off dust and dirt with a clean, dry cloth.

e. Use standard practices to repair poor solder connections with a low-wattage soldering iron.

5-33. CORRECTIVE MAINTENANCE.

5-34. Corrective maintenance for the transmitter is limited by the objective of minimum down time. Since the transmitter was designed and built with highly reliable and proven elements having excellent performance characteristics, maintainability and care are considerable simplified for operating and maintenance personnel. If the need to remove and replace a defective component rises, refer to Section II, Installation. Reverse the sequence of installation to remove the component and reinstall as described.

5-35. ALIGNMENT AND CALIBRATION.

5-36. RF DRIVER ALIGNMENT.

5-37. The RF Driver should be aligned only if the RF drive current is less than 1 ampere or more than 1.5 amperes with the output at 1000 watts. Suspect a malfunctioning RF Driver Module if the RF DRIVER BIAS and VOLTAGE adjustments cause no change in the RF Drive current (paragraph 6-11). Align the RF Driver as follows:

NOTE

Because of control interaction, repeat steps a. and b. at least twice.

a. With the transmitter operating at 1000 watts, adjust the DRIVER TUNE slide for a peak in RF Driver current.

b. Adjust the DRIVER LOAD slide for a RF Driver current of 1.25 amperes.

c. Modulate the transmitter to 90 percent at 5000 Hz and measure the distortion.

d. Keeping the RF Driver current between 1 and 1.5 amperes, make a slight adjustment of the DRIVER TUNE and DRIVER LOAD controls for minimum distortion.

e. Adjust the DRIVER VOLTAGE and BIAS potentiometers for minimum distortion.

f. Keeping the RF Driver current between 1 and 1.5 amperes, adjust the DRIVER TUNE and DRIVER LOAD controls for minimum distortion.



NOTE

Adjustment of the DRIVER VOLTAGE and BIAS controls affects the amount of feedthrough power. For best results, maintain adjustments within the center range of the potentiometers.

g. Keeping the RF Driver current between 1 and 1.5 amperes, verify the above adjustments are optimum by checking the distortion at 1000 Hz. Make the same adjustments as necessary.

5-9/5-10

WARNING: Disconnect primary power prior to servicing.  
If You Didn't Get This From My Site,  
Then It Was Stolen From...

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SECTION VI  
TROUBLESHOOTING

6-1.            INTRODUCTION.

6-2.            This section contains troubleshooting procedures for the MW-1A AM Transmitter. Appendix B of this manual contains a simplified troubleshooting chart.

6-3.            TROUBLESHOOTING PROCEDURES.

6-4.            The transmitter troubleshooting procedures presented in this section provide the operation with a logical method of isolating a malfunction. This isolation procedure is accomplished primarily by observation of built-in system indicators and is intended to assist in restoring operation by reducing time wasted troubleshooting a stage or section not causing the problem. Table 6-1 lists some typical trouble symptoms, probable causes, and corrective actions pertaining to the overall transmitter. The corrective action given for a trouble symptom is not necessarily the only answer to the problem. It only tends to lead the repairman into the area that may be causing the problem. Tables 6-2 through 6-8 provide troubleshooting procedures for the most common malfunctions occurring in various modules.

6-5.            OSCILLATOR A16 - TROUBLESHOOTING.

6-6.            Table 6-2 lists the trouble symptoms, probable causes, and corrective action for those malfunctions which most commonly occur on Oscillator printed-circuit board A16. After a malfunction has been isolated to the oscillator, troubleshoot according to the table.

6-7.            IPA MODULE A14 - TROUBLESHOOTING.

6-8.            Table 6-3 lists the trouble symptoms, probable causes, and corrective action for those malfunctions which most commonly occur on IPA Module A14. After a malfunction has been isolated to the IPA, troubleshoot according to the table.

6-9.            AUDIO DRIVER BOARD A17 - TROUBLESHOOTING.

6-10.           Table 6-4 lists the trouble symptoms, probable causes, and corrective action for those malfunctions which most commonly occur on Audio Driver printed-circuit board A17. After a malfunction has been isolated to the audio driver, troubleshoot according to the table.

6-11.           RF/PA MODULE A1 THROUGH A13 - TROUBLESHOOTING.

6-12.           Troubleshooting of the RF/PA Module (PA and RF Driver) consists of performing VOM measurements of transistors and component inspection for

visual signs of malfunctions. Table 6-5 lists the trouble symptoms, probable causes, and corrective action for those malfunctions which most commonly occur in each RF/AF module. After a malfunction has been isolated to the RF/AF module, troubleshoot according to the table.

6-13. VOLTAGE REGULATOR - TROUBLESHOOTING.

6-14. If the voltage regulator fails, limit switches S12 and S13 prevent power from reaching motor B2 although Variac transformer T2 (figure 6-4) will be driven to the maximum clockwise or counterclockwise position. Contacts on ON/OFF relay K2 force the voltage regulator to the low output voltage condition when the transmitter is turned off.

6-15. Troubleshoot the voltage regulator as follows:

NOTE

Wire No. 22 (figure 6-4) leading to transformer T1 should always be secured to the 240V tap on the transformer.

a. Verify transmitter primary power input.

1. For 190 to 215 vac, wire No. 4 should be secured to the 210 transformer tap.
2. For 215 to 230 vac, wire No. 4 should be secured to the 220 transformer tap.
3. For 230 to 250 vac, wire No. 4 should be secured to the 240 transformer tap.
4. For 250 to 270 vac, wire No. 4 should be secured to the 260 transformer tap.

b. Depress OFF/AIR switch/indicator S5/DS5 to deenergize the transmitter. Observe that READY indicator DS1 remains illuminated. After 1 minute, open the front access door and verify that the brushes on Variac transformer T2 are in the maximum counterclockwise position. Close access door.

c. Measure the input voltage between terminals TB3-1 and TB3-3. Voltage measurement should be 120 vac.

d. Operate MULTIMETER switch S1 to the 140 VOLT SUPPLY position.



e. Reset MAIN AC circuit breaker CB2 and depress HIGH POWER switch/indicator S3/DS3. Observe that switch/indicator illuminates and that MULTIMETER M1 registers an indication of 120 vdc.

f. Measure the input voltage between terminals TB3-1 and TB3-2. Voltage measurement should be 120 vac until the 140V power supply reaches the proper operating voltage. The TB3-1-to-TB3-2 voltage should then go to zero.

g. Increase voltage indication on MULTIMETER M1 to approximately 130 to 135V dc by adjusting REGULATOR ADJ control A22R2 (figure 3-2) in a clockwise direction.

h. Adjust REGULATOR ADJ control A22R2 to the maximum counter-clockwise position. Observe that the voltage indication on MULTIMETER M1 decreases slowly.

i. If adjustment of A22R2 does not vary the voltage indication on MULTIMETER M1, determine the following:

1. With transmitter on, does voltage indication remain low (approximately 120 vdc) or slowly increase to a value over 135 vdc. If so, the following malfunctions may have occurred on relay and regulator module A22.

- (a) Transistor Q2 shorted.
- (b) Diode CR1 and/or CR2 open.
- (c) Resistor R1 open.
- (d) REGULATOR ADJ R2 faulty or open.

j. Measure the input voltage between terminals TB3-1 and TB3-3. Voltage measurement should be 0 vac.

k. If adjustment of A22R2 does not vary the voltage indication on MULTIMETER M1, determine the following:

1. With transmitter on, does voltage indication remain low. Verify that input voltage between terminals TB3-1 and TB3-3 is 0 vac. If these conditions exist and 120 vac is not available between terminals TB3-1 and TB3-2, the following malfunctions may have occurred on relay and regulator module A22.

- (a) Transistor Q1 open.
- (b) Transistor Q2 shorted.

- (c) Diodes CR1, CR2, or CR5 shorted.
- (d) Variac transformer T2 defective.
- (e) Motor B2 defective.
- (f) Relay K1 defective.

6-16. LINE REGULATOR (T2) OPERATION.

6-17. Line regulator operation can be checked as follows:

a. Check the 140 V supply reading. Its normal factory setting is 135 V.

b. Observe the position of the wiper contact of T2 during normal operation on high power. Preferably, it will be in the middle portion of its range.

c. If the wiper contact is positioned at or near either extreme, change the tap on T1. If the wiper contact on T2 is counterclockwise viewed from the top, move the tap on T1 to a higher voltage setting.

d. Check to see if the A22 regulator circuitry is working by turning the front panel regulator adjust control. Typically, the range of voltage adjustment is 10 volts.

e. On A22, K1 closes to lower the supply voltage. K2 closes to raise the supply voltage. During normal operation, these relays will operate every several seconds.

f. Typical failure modes of the A22 regulator circuit are:

1. Always raising - Q2 shorted
2. Always lowering - CR5 shorted (check voltage) Q1 shorted  
CR1, CR2 shorted (check voltage drop).

**CAUTION**

A22 pins 6 and 15 are not fused from the 140 V supply. Be very cautious when attaching meter leads to these terminals.

6-18. OVERVOLTAGE CIRCUIT - TROUBLESHOOTING.

6-19. Table 6-6 lists the trouble symptoms, probable causes, and corrective action for those malfunctions which most commonly occur in the over-voltage circuit on relay and regulator module A22. After a malfunction has been isolated to the overvoltage circuit, troubleshoot according to the table.



## 6-20. FEEDBACK CIRCUIT - TROUBLESHOOTING.

6-21. Feedback voltages from the MW-1A transmitter originate from transformer T2 and associated circuits on Directional Coupler module A21. Table 6-7 lists the trouble symptoms, probable causes, and corrective action for those malfunctions which most commonly occur in the feedback circuit. After a malfunction has been isolated to the feedback circuit, troubleshoot according to the table.

## 6-22. VSWR CIRCUIT - TROUBLESHOOTING.

6-23. Troubleshooting of the relative VSWR circuit on Directional Coupler module A21 is performed if the transmitter cannot be properly loaded and tuned for an output of 1000 watts. Table 6-8 lists the trouble symptoms, probable causes, and corrective action for VSWR circuit malfunctions.

## 6-24. FORWARD AND REFLECTED POWER CALIBRATION.

6-25. Forward and reflected power adjustments for Directional Coupler A21 must be made with the transmitter output into a known load with no reactance. The power output at the transmitter ANT connector must also be known because transmission line and phase losses into the antenna may be excessive. Adjust the directional coupler as follows:

## NOTE

External test equipment must be used.

- a. Set POWER meter switch S2 to the REFLECTED position.
- b. Depress HIGH POWER switch/indicator S3/DS3.
- c. Using HI PWR ADJ potentiometer A15R2, set the transmitter power output into a known near zero reactance load for a 100-watt indication on the external test equipment.
- d. Raise the meter panel.
- e. Adjust REFL BAL variable capacitor A21C10 (figures 3-3 and 6-6) on directional coupler A21 for a null (zero) indication on POWER meter M4.
- f. Depress OFF/AIR switch/indicator S5/DS5.

**WARNING**

Use extreme care when removing the cover of directional coupler A21. 200 watts of RF are on the board (if the transmitter is ON).

- g. Remove the two screws securing the hinged meter panel.
- h. Remove the four phillips-head screws securing the directional coupler cover to the chassis. Remove cover.
- i. Locate shorting jacks TJ1 and TJ2 (figure 6-6) in the approximate center of the module. Remove shorting jacks TJ1 and TJ2 from the vertical position and reinsert in the horizontal position.
- j. Depress HIGH POWER switch/indicator S3/DS3. If necessary, readjust HI PWR ADJ potentiometer A15R2 for exactly 1000 watts.
- k. Adjust REFL CAL potentiometer A21R6 (figures 3-3 and 6-6) for an indication of 1000 watts.
  - l. Set POWER meter switch S2 to the FORWARD position.
- m. Adjust FWD BAL variable capacitor A21C4 (figures 3-3 and 6-6) for a null (zero) indication on POWER meter M4.
- n. Depress OFF/AIR switch/indicator S5/DS5.
- o. Remove shorting jacks TJ1 and TJ2 from the horizontal position and reinsert in the original vertical position.
- p. Depress HIGH POWER switch/indicator S3/DS3. Operate transmitter at exactly 1000 watts.
- q. Adjust FWD CAL potentiometer A21R1 (figures 3-3 and 6-6) for an indication of 1000 watts.
- r. Depress OFF/AIR switch/indicator S5/DS5.
- s. Replace the directional coupler cover with the four phillips-head screws and lower the meter panel.

6-26. MODULATION ENHANCEMENT CALIBRATION.

6-27. Refer to paragraph 2-5 of this manual.

6-28. MODULATION ENHANCER A27 - TROUBLESHOOTING.

6-29. Table 6-9 list the trouble symptoms, probable causes, and corrective action for those malfunctions which most commonly occur on Modulation Enhancer, A27. After a malfunction has been isolated to the enhancer, troubleshoot according to the table.



Table 6-1. MW-1A Transmitter Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>With the HIGH POWER switch/indicator illuminated: the PA VOLTS meter displays 60 to 70 volts; the PA AMPS meter displays 0 amperes; and the MULTIMETER displays 0 amperes in the RF DVR AMPS position and less than 20 volts in the AF DVR CONTROL position. FAULT indicators and OVERLOAD indicators are not illuminated.</p>	<ol style="list-style-type: none"> <li>Oscillator defective.</li> <li>IPA defective.</li> </ol>	<ol style="list-style-type: none"> <li>Observe +30V indicator DS1 and RF OUT indicator DS2 on oscillator module A16. Replace fuse F1 if +30V indicator is not illuminated. Oscillator is defective if RF OUT indicator is not illuminated. Refer to paragraph 6-5 and table 6-2.</li> <li>Observe +30V indicator DS1 and RF OUT indicator DS2 on IPA module A14. Refer to paragraph 6-7 and table 6-3.</li> </ol>
<p>DC OVERLOAD indicator illuminated. Transmitter turns off at all power settings.</p>	<ol style="list-style-type: none"> <li>RF Driver defective.</li> <li>Audio Driver defective.</li> </ol>	<ol style="list-style-type: none"> <li>Refer to paragraph 6-11 and table 6-5.</li> <li>Refer to paragraph 6-9 and table 6-4.</li> </ol>
<p>Random illumination of DC OVERLOAD indicator. Transmitter may turn off.</p>	<ol style="list-style-type: none"> <li>DC overload circuit on relay and regulator module A22 defective.</li> <li>Improper tuning of transmitter.</li> </ol>	<ol style="list-style-type: none"> <li>Refer to paragraph 6-16 and table 6-6.</li> <li>Depress LOW POWER switch/indicator. Refer to table 2-3 and 2-4 and verify the listed</li> </ol>

Table 6-1. MW-1A Transmitter Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>VOLTAGE OVERLOAD indicator illuminated.</p>	<ol style="list-style-type: none"> <li>2. Overmodulation of the transmitter.</li> <li>3. Improper threshold adjustment of DC overload circuit on relay and regulator module A22.</li> <li>1. High output from 140 VDC power supply.</li> <li>2. Improperly adjusted or inoperative overvoltage sensitivity control on relay and regulator module A22.</li> <li>3. Line transients.</li> </ol>	<p>meter indications. If meter indications are incorrect, perform the instructions described in paragraphs 2-18 through 2-24 to properly tune the transmitter.</p> <ol style="list-style-type: none"> <li>2a. Adjust for proper modulation. Refer to paragraph 2-24.</li> <li>3a. Refer to paragraph 6-16 and table 6-6.</li> <li>1a. Check 140 VDC power supply.</li> <li>1b. Voltage regulator defective. Refer to paragraph 6-13.</li> <li>2a. Refer to paragraph 6-16 and table 6-6.</li> <li>3a. Normally results from malfunctions external to the transmitter.</li> </ol>



Table 6-1. MW-1A Transmitter Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>With high modulation, VSWR OVERLOAD indicator illuminates during transmitter HIGH POWER operation.</p>	<ol style="list-style-type: none"> <li>1. Improper adjustment of VSWR circuit.</li> <li>2. Antenna impedance drifts at transmitter terminal. Maximum rated impedance of the transmitter is 60 ohms.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Refer to paragraph 2-21.</li> <li>2a. Change transmitter operational mode by depressing the LOW POWER switch indicator.</li> </ol> <div style="text-align: center; border: 2px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p><b>CAUTION</b></p> </div> <p>Under static conditions, transmitter operation without spark gap E1 may produce malfunctions in PA modules A1 through A12.</p>
<p>With no modulation, VSWR OVERLOAD indicator illuminates at any power level.</p>	<ol style="list-style-type: none"> <li>3. Arcing at spark gap E1 or E17.</li> <li>4. Antenna static drain choke open.</li> </ol>	<ol style="list-style-type: none"> <li>3a. Replace E1 if arcing occurs at E1. Burnish and set spark gap at E17 to 0.20 inch.</li> <li>4a. Replace defective choke.</li> </ol>
	<ol style="list-style-type: none"> <li>1. Antenna shorted.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Switch the transmitter output to the dummy load (D.L.) at antenna/dummy load changeover switch S11 (figure 2-4).</li> <li>1b. Check antenna impedance. Repair and/or replace.</li> </ol>

Table 6-1. MW-1A Transmitter Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Transmitter will not modulate to 95 percent at a 1000 watt output with a 400-Hz tone.</p>	<p>2. Shorted or open component in output network.</p> <p>3. Directional Coupler defective.</p> <p>4. VSWR overload circuit on audio input and overload module A18 defective.</p> <p>1. PA module defective.</p>	<p>2a. Check capacitors C1, C2, and C3 along with spark gaps E1 and E17 in the output network. Replace defective component.</p> <p>3a. Repair and/or replace directional coupler module A21. Refer to paragraph 6-22.</p> <div data-bbox="662 436 727 634" style="text-align: center; border: 1px solid black; padding: 2px; width: fit-content; margin: 10px auto;"> <b>CAUTION</b> </div> <p>Operating the transmitter with a defective VSWR circuit will produce malfunctions in PA modules A1 through A12.</p> <p>4a. Refer to paragraph 6-20.</p> <p>1a. Observe FAULT indicators DS1 through DS12. A brightly lit indicator during HIGH POWER operation signifies a faulty PA module. (Refer to paragraph 6-11 and table 6-5.) A very dim indicator (hardly noticeable) signifies acceptable operation. Turn LOW</p>



Table 6-1. MW-1A Transmitter Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	<p>2. High adjustment of RF DRIVER BIAS potentiometer A15R5 or VOLTAGE potentiometer A15R6.</p> <p>3. Improper tuning of RF Driver Module.</p> <p>4. Audio Driver defective.</p> <p>5. VSWR overload circuit on audio input and overload module A18 defective.</p>	<p>PWR ADJ A15R1 to the maximum counterclockwise position. During low power operation, a dimly lit indicator signifies a faulty PA module (refer to paragraph 6-11 and table 6-5).</p> <p>2a. Refer to paragraph 2-24.</p> <p>3a. Refer to paragraph 5-36.</p> <p>4a. Refer to paragraph 6-9 and table 6-4.</p> <div style="text-align: center; border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <b>CAUTION</b> </div> <p>Operating the transmitter with a defective VSWR circuit will produce malfunctions in PA modules A1 through A12.</p> <p>5a. Refer to paragraph 6-20.</p>

Table 6-1. MW-1A Transmitter Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Transmitter will not modulate to 125 percent with the program although the negative peaks are overmodulated.</p>	<p>6. Defective fuse on fuse board A25</p>	<p>6a. Replace defective fuse.</p>
<p>PA VOLTS meter registers a sudden 2-to-4 volt increase and the PA AMPS meter registers a sudden 2-ampere drop.</p>	<p>1. Improper phasing of external AM Limiters.</p>	<p>1a. Refer to proper instruction manual for maintenance instructions.</p>
	<p>2. Defective fuse on 140 VDC bus.</p>	<p>2a. Replace defective fuse on fuse board A26.</p>
	<p>3. Improper tuning of RF Driver Module.</p>	<p>3a. Refer to paragraph 5-36.</p>
	<p>4. PA module defective.</p>	<p>4a. Observe the FAULT indicators to determine the defective module and refer to paragraph 6-11 and table 6-5.</p>
	<p>5. ME-1 improperly set up.</p>	<p>5a. Refer to paragraph 3-7 for proper set up.</p>
<p>Sudden increase in carrier shift (negative) with program modulation.</p>	<p>1. PA module defective.</p>	<p>1a. Observe the FAULT indicators to determine the defective module and refer to paragraph 6-11 and table 6-5.</p>
	<p>1. One or more PA modules defective.</p>	<p>1a. Observe the FAULT indicators to determine the defective module(s) and refer to paragraph 6-11 and table 6-5.</p>



Table 6-1. MW-1A. Transmitter Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION														
<p>Two PA modules defective. Repeated indications of defective fuses.</p>	<p>2. Improper loading of PA module (high indication on PA VOLTS meter).</p> <p>3. An attempt to operate the transmitter at an output greater than 1100 watts.</p> <p>1. Defective fuse on gating and power control module A15 associated with the two defective PA modules. Fuse/module association is as follows:</p> <table data-bbox="909 924 1136 1344"> <tr> <td><u>Modules</u></td> <td><u>Fuse</u></td> </tr> <tr> <td>A1, A2</td> <td>A15F2</td> </tr> <tr> <td>A3, A4</td> <td>A15F3</td> </tr> <tr> <td>A5, A6</td> <td>A15F4</td> </tr> <tr> <td>A7, A8</td> <td>A15F5</td> </tr> <tr> <td>A9, A10</td> <td>A15F6</td> </tr> <tr> <td>A11, A12</td> <td>A15F7</td> </tr> </table>	<u>Modules</u>	<u>Fuse</u>	A1, A2	A15F2	A3, A4	A15F3	A5, A6	A15F4	A7, A8	A15F5	A9, A10	A15F6	A11, A12	A15F7	<p>2a. Perform the instructions described in paragraphs 2-18 through 2-24 to properly load the transmitter.</p> <p>3a. Reduce transmitter power output.</p> <p>1a. Replace defective fuse on gating and power control module A15.</p> <p>1b. If fuse blows again, remove one of the two defective PA modules and check for another blown fuse.</p> <p>1c. If fuse blows again, remove the second defective PA module. If transmitter operation returns to normal conditions, repair the defective module(s) and check for a defective fuse on fuse board A26 associated with the 140V power supply. Refer to paragraph 6-11 and table 6-5 for defective PA module.</p>
<u>Modules</u>	<u>Fuse</u>															
A1, A2	A15F2															
A3, A4	A15F3															
A5, A6	A15F4															
A7, A8	A15F5															
A9, A10	A15F6															
A11, A12	A15F7															

WARNING: Disconnect primary power prior to servicing.

Table 6-1. MW-1A Transmitter Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>One FAULT indicator flickers brightly with program modulation.</p>	<p>1. Defective fuse on fuse board A26 associated with 140V power supply.</p> <p>2. PA module defective.</p>	<p>1a. Replace defective fuse on fuse board A26.</p> <p>2a. Refer to paragraph 6-11 and table 6-5.</p>
<p>Transmitter operates with excessive overmodulation and power output, along with carrier shift.</p>	<p>1. Defective feedback circuit on directional coupler module A21 and audio input and overload module A18.</p> <p>2. Defective VSWR circuit on audio input and overload module A18.</p>	<p>1a. Check terminals on POWER ADJUST potentiometer R8 for an indication of +12 to +15 vdc. If proper voltage is not observed, refer to paragraph 6-18 and table 6-7.</p> <p>2a. Remove diode CR6 on audio input and overload module A18. Depress HIGH POWER switch/indicator. If transmitter operates properly, VSWR circuit is defective. Refer to paragraph 6-20 and table 6-8.</p>
<p>Current for the RF Driver Module is either low or high. (MULTIMETER switch in the RF DVR AMPS position).</p>	<p>3. Defective wiring.</p> <p>1. Improper tuning of RF Driver.</p>	<p>3a. Locate and repair defective wiring.</p> <p>1a. Adjust DRIVER TUNE control L18 (figure 3-5) on the module compartment for a peak indication on MULTIMETER M1 (MULTI-</p>



Table 6-1. MW-1A Transmitter Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Voltage for the RF Driver Module is either low or high. (MULTIMETER switch in the RF DVR VOLT position.)</p> <p>Deviation in transmitter carrier frequency.</p>	<p>2. Improper loading of RF Driver.</p> <p>1. RF Driver module defective</p> <p>2. Defective RF Driver BIAS or VOLTAGE adjust circuits on gating and power control module A15.</p> <p>1. Frequency adjustment due to natural drift of crystal oscillator and other components.</p> <p>2. Defective oscillator.</p>	<p>METER switch in the RF DVR AMPS position).</p> <p>2a. Adjust DRIVER LOAD control L19 (figure 3-5) on the module compartment for a 1.25 ampere indication on MULTIMETER M1 (MULTIMETER switch in the RF DVR AMPS position).</p> <p>1a. Repair or replace defective RF Driver module (interchangeable with PA module). Refer to paragraph 6-11 and table 6-5.</p> <p>2a. Locate and replace defective component.</p> <p>1a. Adjust trimmer capacitor A16C1 (figure 3-4) on Oscillator module A16 for the correct carrier frequency.</p> <p>2a. Refer to paragraph 6-5 and 6-2.</p>



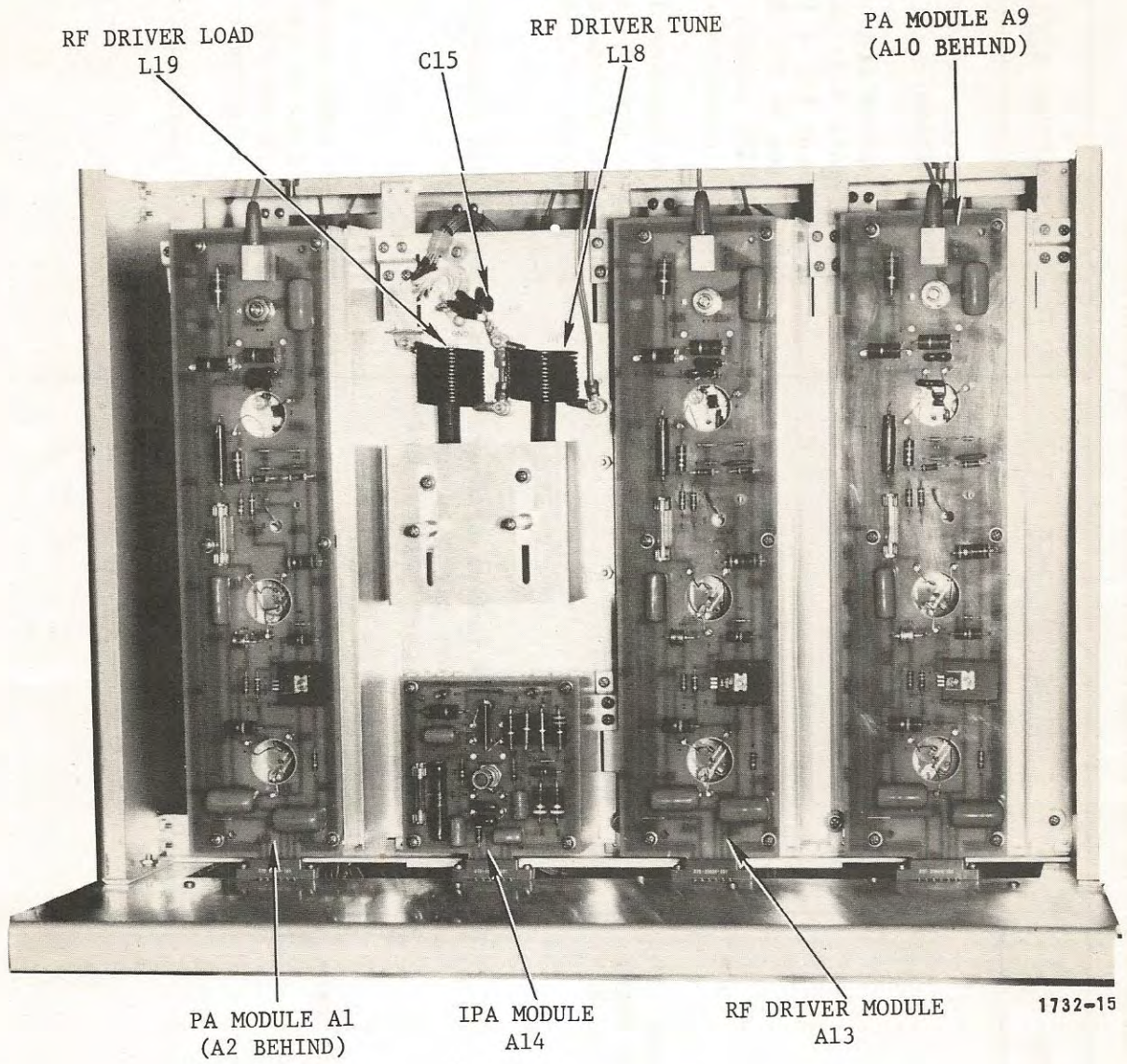


Figure 6-1. Module Compartment, Front View with Cover Removed



Table 6-2. Oscillator Module A16 Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>+30V indicator DS1 and RF OUT indicator DS2 are not illuminated.</p> <p>+30V indicator DS1 and RF OUT indicator DS2 are not illuminated and power is not available to the transmitter.</p>	<p>1. Fuse F1 defective.</p> <p>1. Relay K1 defective.</p>	<p>1a. Replace defective fuse.</p> <p>1a. Verify that READY indicator DS1 and either HIGH POWER switch/indicator DS3 or LOW POWER switch/indicator DS4 on the meter panel are illuminated. These conditions must exist before operation voltages are available to the oscillator module.</p>
<p>Oscillator fuse F1 continues to blow.</p>	<p>2. 30V power supply defective.</p> <p>3. Defective wiring.</p>	<p>2a. Check 30V power supply A24 (MULTIMETER switch in the 30 VOLT SUPPLY position).</p> <p>3a. Locate and repair defective wiring.</p>
	<p>1. Shorted transistor Q3, resistor R19, or a short in the +30 VDC wiring.</p>	<p>1a. Disconnect P19 from the module. Connect a VOM to the circuit side of fuse F1 and check for a resistance greater than 600 ohms.</p> <p>1b. Locate and repair/replace shorted component.</p>

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Oscillator Module A16 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Fuse F1 functions normally, +30V indicator DS1 is illuminated, and RF OUT indicator DS2 is extinguished. PA VOLTS meter M3 on meter panel displays 60 to 70 volts and PA AMPS meter M2 displays 0 amperes. +30V indicator DS1 on IPA module A14 is illuminated and RF OUT indicator DS2 is extinguished.</p>	<p>1. IPA module defective.</p>	<p>1a. Remove IPA module A14 to terminate the input drive to the RF driver and PA modules, and to remove the load from the oscillator. To gain access to IPA module A14, open the front interlock access door (figure 1-3) and remove the front cover of the module compartment. Remove IPA module A14 (figure 6-1) by loosening the top left and top right hold down screws and lifting the unit from the socket. 1c. Shut the front access door to apply power to the transmitter. 1d. Refer to paragraph 6-7 and table 6-3 for IPA troubleshooting instructions if +30V indicator DS1 on oscillator module A16 remains illuminated and RF OUT indicator DS2 comes on.</p>
	<p>2. Defective oscillator components.</p>	<p>2a. Proceed with the following steps if +30V indicator DS1 remains illuminated and RF OUT</p>

WARNING: Disconnect primary power prior to servicing.



Table 6-2. Oscillator Module A16 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>+30V indicator DS1 remains illuminated and RF OUT indicator DS2 extinguished with IPA module removed.</p>	<p>1. Defective oscillator components.</p>	<p>indicator DS2 extinguished.</p> <p>1a. Perform voltage checks of diodes CR1 and CR2. Voltage measurements should be +14 to +16 vdc for CR1 and +4.5 to +5 vdc for CR2. Replace defective component.</p> <p>1b. Perform a voltage check (2.75 or 3.0 vdc scale) at the junction of resistor R6 and diode CR3. Connect the positive VOM lead to the junction of R6 and CR3 and the negative lead to chassis ground. Voltage measurement should be -0.15 to -0.3 vdc if oscillator Y1 is operating correctly. Voltage should drop to 0 vdc when oscillator Y1 is removed.</p>
	<p>2. Crystal Y1 defective.</p>	<p>2a. Replace defective crystal.</p>
	<p>3. Defective stages of transistors Q1 and Q2.</p>	<p>3a. Locate and replace defective component.</p>

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Oscillator Module A16 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
With oscillator Y1 operating, voltage at the junction of coil L1, resistor R11, diode CR4, and the collector of transistor Q2 is something other than approximately 4-6 vdc. Voltage measurements should be approximately +4 to +5 vdc when oscillator Y1 is removed.	1. Integrated circuit U1 defective.	1a. Connect the positive VOM lead to the junction of C1, R11, CR4, and Q2 and the negative lead to chassis ground. Voltage measurement should be approximately 4 vdc to 6 vdc with oscillator Y1 removed. If voltage is incorrect, remove divider U1 and repeat measurement. Replace divider U1 if voltage is correct.
	2. CR2 defective.	2a. Replace CR2.
With oscillator Y1 operating, voltage at terminal E10 on the module is something other than approximately +1.25 to +1.75 vdc. Voltage measurement should be either approximately -0.2 vdc or +2.5 to +3.5 vdc when oscillator Y1 is removed.	1. Integrated circuit U1 defective.	1a. Connect the positive VOM lead to terminal E10 and the negative lead to chassis ground. Voltage measurement should be approximately +1.5 vdc or 0.2 vdc or +3 to +4 vdc with oscillator Y1 removed. If voltage is incorrect, replace divider U1.
	2. Defective output stage component.	2a. Locate and replace defective output stage components.
Emitter bias voltage incorrect.	1. Defective transistor Q3 or associated circuit.	1a. Perform check of emitter bias voltage of transistor Q3. Voltage measurement should be approximately +6 to +10 volts.



Table 6-2. Oscillator Module A16 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
		<p>1b. After RF OUT indicator DS2 illuminates, replace IPA module and check transmitter for proper operation in the LOW POWER mode. Resume normal operation.</p>

Table 6-3. IPA Module A14 Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>+30V indicator DS1 and RF OUT indicator DS2 on oscillator module A16 (figure 3-4) illuminated; one or both of IPA +30V indicator DS1 and IPA RF OUT indicator DS2 (figure 3-5) on IPA module A15 extinguishes; fuse F1 on IPA module A15 blown and continues to blow when replaced.</p>	<p>1. Transistor Q1 defective.</p>	<p>1a. Replace defective transistor.</p>
<p>IPA +30V indicator DS1 illuminated; IPA RF OUT indicator DS2 extinguished; low transmitter output power.</p>	<p>1. Transistor Q1 defective.</p>	<p>1a. Open front access door.                      1b. Remove the module compartment cover.                      1c. Close front access door to restore power to transmitter.                      1d. Perform voltage check at junction of resistors R9 and R10. Voltage measurement should be +2 to +3 vdc.                      1e. If voltage at the junction of R9 and R10 is 0 vdc, perform voltage check at the collector of Q1. Voltage measurement should be +24 to +30 vdc.</p>

WARNING: Disconnect primary power prior to servicing.



Table 6-3. IPA Module A14 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Voltage at junction of resistors R2 and R8 is +2.5 to +3.5 vdc; emitter bias voltage missing.</p> <p>Voltage at junction of resistors R2 and R8 is less than 1 vdc.</p>	<p>1. Transistor Q1 defective.</p> <p>1. Capacitor C3 shorted.</p> <p>2. Resistor R8 shorted.</p> <p>3. Resistor R2 open.</p>	<p>1a. Replace defective transistor.</p> <p>1a. Replace defective capacitor.</p> <p>2a. Replace defective resistor.</p> <p>3a. Replace defective resistor.</p>

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WARNING: Disconnect primary power prior to servicing.

Table 6-4. Audio Driver Module A17 Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>PA VOLTS meter M3 on meter panel indicates 0 vdc.</p> <p>PA VOLTS meter M3 continues to indicate 0 vdc.</p>	<p style="text-align: center;">NOTE</p> <p>Prior to troubleshooting, disconnect the load from the audio driver, by removing fuses F2 through F7 on gating and power control module A15. Proper operation of audio driver module A17 in the HIGH POWER mode is indicated by a 60 to 70 volt display on PA VOLTS meter M3, a 0 ampere display on PA AMPS meter M2, and MULTIMETER displays of AF DVR LO VOLT (21-25 vdc), AF DVR CONTROL (&lt;20), and AF DVR HI VOLT (160-170 vdc).</p> <ol style="list-style-type: none"> <li>1. Fuse F1 defective.</li> <li>1. Transistor Q1 open.</li> <li>2. Transistor Q2 shorted.</li> <li>3. Diodes CR2, CR4 and CR5 shorted.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Replace defective fuse.</li> <li>1a. Replace defective transistor.</li> <li>2a. Replace defective transistor.</li> <li>3a. Replace defective diode.</li> </ol>



Table 6-4. Audio Driver Module A17 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>PA VOLTS meter M3 on meter panel registers 0 or less than 20 vdc; adjustment of LO PWR control R1 and HI PWR control R2 on gating and power control module A15 has no operational effect; MULTIMETER indication with MULTIMETER switch S1 in the AF DVR CONTROL VOLT position is 0 vdc.</p>	<ol style="list-style-type: none"> <li>1. Defective fuse F3 on audio driver module A17 (figure 6-2).</li> <li>2. Zener diode CR3 shorted.</li> <li>3. Transistor Q4 open.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Replace defective F1.</li> <li>2a. Replace defective zener diode CR3.</li> <li>3a. Replace defective transistor Q4.</li> </ol>
<p>Indications on MULTIMETER M1 for AF DVR HI VOLT, AF DVR CONTROL, and AF DVR LO VOLT positions of panel meter MULTIPLIER switch S1 register normally; no transmitter power output; rotation of POWER ADJUST control R8 does not vary indication on PA VOLTS meter M3.</p>	<ol style="list-style-type: none"> <li>1. Relay K3 on audio input and overload module A18 energized or defective with shorted contacts.</li> <li>2. Transistor Q7 on audio input and overload module A18 shorted.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Perform voltage check at the junction of C8 and R26 on audio input and overload module A18. Voltage measurement should be +0.7 to +1.0 vdc. If indication is 0 vdc, replace relay K3.</li> <li>2a. Replace transistor Q7.</li> </ol>
<p>PA VOLTS meter M3 on meter panel registers and indication greater than 80 vdc (pegged).</p>	<ol style="list-style-type: none"> <li>1. Defective audio driver components.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Deenergize transmitter.</li> <li>1b. On gating and power control module A15, turn LO PWR control R1 and HI PWR control R2 to the maximum counterclockwise position.</li> </ol>



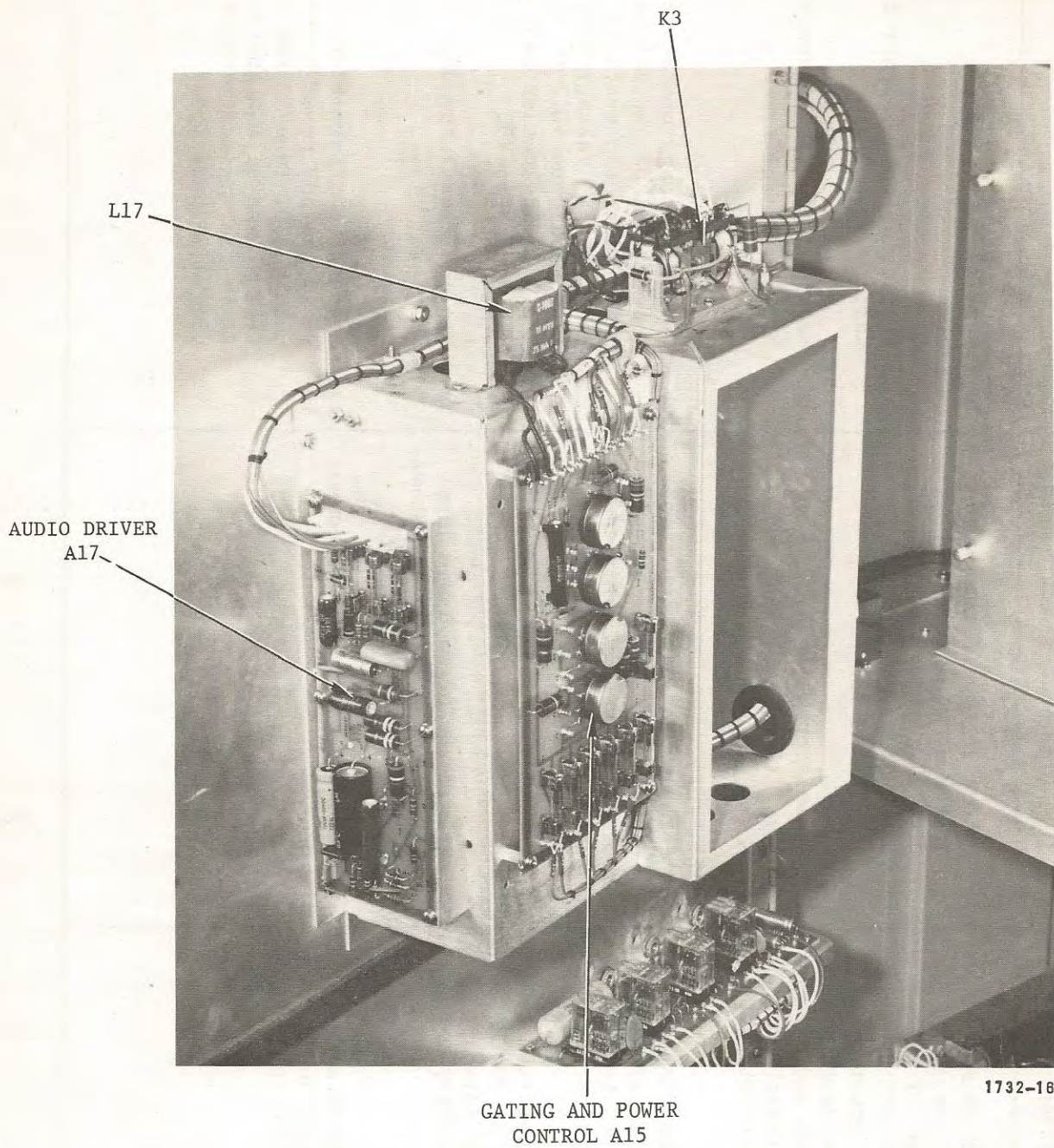


Figure 6-2. Front Access Door, Upper Interior View



Table 6-4. Audio Driver Module A17 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Transistor Q1 voltage measurements incorrect. MULTIMETER M1 on meter panel registers 21-to-25 vdc in the AF DVR 10 VOLT position.</p>	<p>1. Transistor Q1 shorted.</p>	<p>1c. Energize transmitter in the LOW POWER mode. Observe PA VOLTS meter M3. If meter indication is greater than 80 vdc, deenergize transmitter and remove fuse F1 on audio driver module A17. Perform the following checks if 80 vdc or greater is observed.</p> <p>1a. Disconnect P18 on audio input and overload module A18. If meter indication remains pegged, reconnect P18 and perform the following checks.</p> <p>1b. Perform Q1 voltage measurements. Base voltage should be +0.7 to +1.2 vdc. Collector voltage should be +5 to +7 vdc. Emitter voltage should be +0.3 to +0.7 vdc.</p> <p>1c. Short the base of Q1 to ground while observing the collector voltage. The collector voltage should increase to +5 to +7 vdc. If collector voltage is 0 vdc and MULTIMETER M1 registers 21 to 25 vdc, replace transistor Q1.</p>

WARNING: Disconnect primary power prior to servicing.

Table 6-4. Audio Driver Module A17 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>PA VOLTS meter M3 on meter panel continues to register greater than 80 vdc.</p>	<ol style="list-style-type: none"> <li>2. Zener diode CR2 shorted.</li> <li>3. Capacitor, C3 shorted.</li> <li>4. Resistor, R9 open.</li> <li>5. Fuse F1 defective.</li> <li>1. Transistor Q3 shorted.</li> </ol> <p style="text-align: center;"><u>NOTE</u></p> <p>Malfunctions associated with the defective transistors identified in the preceding steps could cause more than one fuse on gating and power control module A15 to open. After repairing audio driver A17, check each fuse removed from gating and power control module A15 with a VOM (RX100 or larger scale). Replace all fuses on gating and power control module A15 if more than one fuse was defective. If only one fuse is defective, replace all except the defective position.</p>	<ol style="list-style-type: none"> <li>2a. Replace zener diode CR2.</li> <li>3a. Replace capacitor C3.</li> <li>4a. Replace resistor R9.</li> <li>5a. Replace fuse F1 on audio driver module A17.</li> <li>1a. Perform Q3 voltage measurements. Replace if defective.</li> </ol>



Table 6-4. Audio Driver Module A17 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>One defective fuse on gating and power control module A15. Transmitter operating with a 60 to 70 vdc indication on PA VOLTS meter M3 and a limited Power output of 800 watts.</p>	<p>1. PA module(s) defective.</p>	<p>1a. Inspect the PA modules associated with the blown fuse for malfunctions and perform voltage measurement as listed in table 6-5. 1b. After repair, or if PA modules are not defective, install missing fuse and energize the transmitter.</p>
<p>More than one fuse on gating and power control module A15 blown.</p>	<p>1. Transistor Q3 on audio driver module A17 shorted.</p>	<p>1a. Replace all fuses on gating and power control module A15. 1b. Refer to previous steps for troubleshooting of transistor Q3.</p>

Table 6-4. Audio Driver Module A17 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Lack of positive peak capability and distortion, capability at high modulation levels.	<p data-bbox="370 1024 402 1094">NOTE</p> <p data-bbox="435 825 500 1339">Operate the transmitter with A15 F2-F7 removed.</p> <ol data-bbox="662 804 1203 1329" style="list-style-type: none"> <li data-bbox="662 804 727 1329">1. Abnormally low AF DVR HI voltage. (Check multimeter).</li> <li data-bbox="1052 804 1084 1329">2. A17, CR4 and/or CR5 shorted.</li> <li data-bbox="1117 804 1149 1329">3. A17, CR2 shorted.</li> <li data-bbox="1182 804 1203 1329">4. A17, Q2 partially shorted.</li> </ol>	<ol data-bbox="654 205 1198 751" style="list-style-type: none"> <li data-bbox="654 205 938 751">1a. Measure the audio driver output with a scope at P16-12 or A15 terminal 3. Audio must be applied to the transmitter. The output voltage swing should be about 130 volts and very much clipped. "PA VOLTS" should be around 60. <ol data-bbox="979 289 1198 751" style="list-style-type: none"> <li data-bbox="979 289 1011 751">1b. Locate cause and repair.</li> <li data-bbox="1044 289 1076 751">2a. Replace shorted diode.</li> <li data-bbox="1109 289 1141 751">3a. Replace shorted diode.</li> <li data-bbox="1174 289 1198 751">4a. Replace Q2.</li> </ol> </li> </ol>



Table 6-4. Audio Driver Module A17 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Distortion, a lack of positive peak capability, or a faint fault indication.	<p data-bbox="365 1024 397 1094"><u>NOTE</u></p> <p data-bbox="430 787 527 1333">Make the following tests with A15 F2-F7 in place and the transmitter operating at 1 kW.</p> <ol data-bbox="747 798 812 1333" style="list-style-type: none"> <li data-bbox="747 798 812 1333">1. Open fuse on the gating board (A15 F2-F7).</li> </ol>	<p data-bbox="365 447 397 516"><u>NOTE</u></p> <p data-bbox="430 220 495 756">Meter is floating at high voltage during this test.</p> <div data-bbox="511 346 592 598" style="border: 2px solid black; padding: 5px; text-align: center; width: fit-content; margin: 10px auto;"> <p data-bbox="527 409 560 535"><b>WARNING</b></p> </div> <p data-bbox="625 210 722 756">Turn the MW-1A off before connecting or disconnecting the meter leads in the following steps.</p> <ol data-bbox="747 210 1388 756" style="list-style-type: none"> <li data-bbox="747 210 1226 756">1a. Connect the positive lead of a VOM to terminal 3 of the gating and power control board A15. Connect the negative lead to the bottom side of F2 on A15. Normally the voltage measured will be 0.1 to 0.4 vdc (measured on a Simpson 260) with the transmitter operating around 1 kW. Make the same measurement at the bottom of F3-F7. Some variance in these readings is expected due to component tolerance.</li> <li data-bbox="1258 210 1388 756">1b. If a high reading is indicated in step 1a check probable cause 1 thru 5 if low check probable cause number 6.</li> </ol>

Table 6-4. Audio Driver Module A17 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	<ol style="list-style-type: none"> <li>2. Open fuse in the +70 volt line (A25).</li> <li>3. Open fuse in the +140 volt line (A26).</li> <li>4. A shorted modulator transistor Q1-A5 on one of the two PA modules associated with the fuse with the high reading.</li> <li>5. A damaged socket for one of the PA modules associated with the fuse having the high reading.</li> <li>6. No electrical connection between the fuse and the associated PA modules.</li> </ol>	<ol style="list-style-type: none"> <li>1c. Locate and replace fuse.</li> <li>2a. Replace fuse.</li> <li>3a. Locate and replace the shorted transistor.</li> <li>4a. Locate and replace the shorted transistor.</li> <li>5a. Repair and replace damaged socket.</li> <li>6a. Troubleshoot and correct open condition.</li> </ol>



Table 6-4. Audio Driver Module A17 Troubleshooting (Continued)

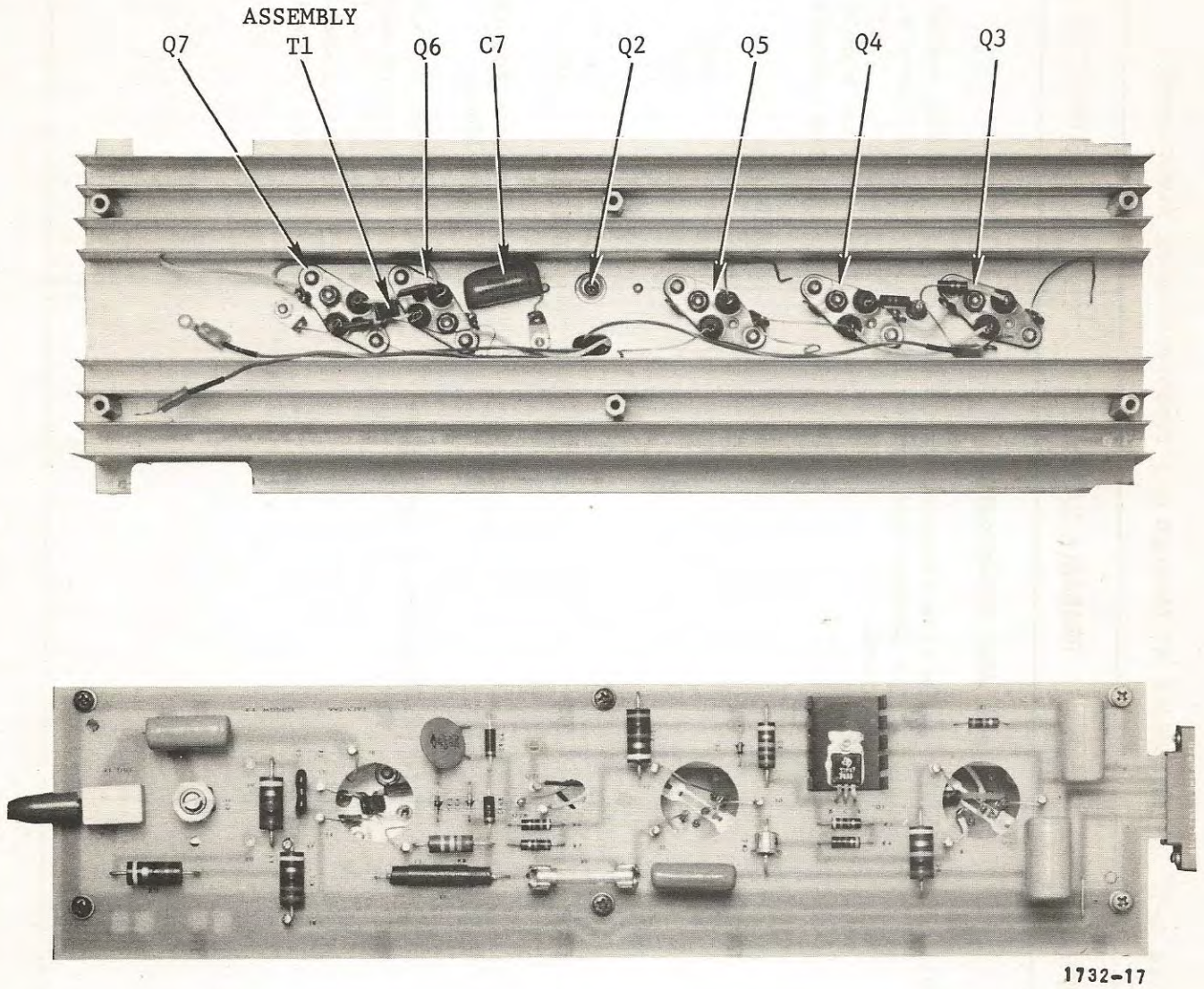
TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
"BUMPER" circuit operation not as described in text.	<ol style="list-style-type: none"> <li>1. Q4 shorted.</li> <li>2. A17, CR3 shorted.</li> <li>3. A17, Q3 shorted.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Operation of the circuit can be checked at turn on with A15 F2-F7 removed. "AF DVR CONTROL" will be about 24 volts initially but will decrease to less than 15 volts when "PA VOLTS" reaches 60.</li> <li>1b. If "AF DVR CONTROL" remains at 24 volts while "PA VOLTS" reaches 60 or higher. Replace Q4.</li> <li>2a. If no "AF DRV CONTROL" and no "PA VOLTS". Replace CR3.</li> <li>3a. If "PA VOLTS" pinned and "AF DVR CONTROL" is zero.</li> <li>3b. Replace Q3.</li> </ol>

*Property of KKK*

Table 6-5. RF/PA Module A1 through A13 Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Module fuse F1 blows. Replace defective components as necessary for quick repair of defective module without performing VOM measurements. (Refer to figure 6-3.)</p>	<ol style="list-style-type: none"> <li>1. Defective fuse F1.</li> <li>2. Defective transformer assembly T1.</li> <li>3. Defective transistor Q5.</li> <li>4. Defective transistors Q6 and Q7.</li> <li>5. Defective transistors Q3 and Q4.</li> <li>6. Defective transistors Q1 and Q2.</li> <li>7. Poor solder connections at capacitors C1, C4 and C6.</li> </ol> <div style="text-align: center; border: 1px solid black; padding: 2px; width: fit-content; margin: 10px auto;"> <b>CAUTION</b> </div> <p>Transistors Q6 and Q7 form a class D push-pull amplifier and usually become defective at the same time. Use extreme care when replacing these transistors in an otherwise operation circuit. The leads from transformer assembly T1 must be resoldered to the same transistor leads. Wire reversal will cause the PA fault indicator associated with that module to be extremely</p>	<ol style="list-style-type: none"> <li>1a. Replace fuse F1.</li> <li>2a. Replace transformer assembly T1.</li> <li>3a. Replace transistor Q5.</li> <li>4a. Replace transistors Q6 and Q7.</li> <li>5a. Replace transistors Q3 and Q4.</li> <li>6a. Replace transistors Q1 and Q2.</li> <li>7a. Clean connections and resolder.</li> </ol>





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Figure 6-3. RF/PA Module Component Location

WARNING: Disconnect primary power prior to servicing.



Table 6-5. RF/PA Module A1 through A13 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION																					
<p>Defective RF/PA Module.</p>	<p>bright when illuminated</p> <ol style="list-style-type: none"> <li>1. Defective transistors Q6 and Q7 or diodes CR6A and/or CR6B shorted.</li> <li>2. Transistor Q2 defective.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Perform resistance checks of transistors with a VOM (RX1 scale). The following indications should be observed if the circuit is operational. <table border="0" style="margin-left: 20px;"> <thead> <tr> <th style="text-align: left;"><u>+LEAD</u></th> <th style="text-align: left;"><u>-LEAD</u></th> <th style="text-align: left;"><u>READING</u></th> </tr> </thead> <tbody> <tr> <td>16</td> <td>GND</td> <td>Infinite</td> </tr> <tr> <td>13</td> <td>GND</td> <td>Infinite</td> </tr> <tr> <td>13</td> <td>16</td> <td>Infinite</td> </tr> <tr> <td>16</td> <td>13</td> <td>≈ 40 Ohms</td> </tr> <tr> <td>GND</td> <td>16</td> <td>≈ 35 Ohms</td> </tr> <tr> <td>GND</td> <td>13</td> <td>≈ 80 Ohms</td> </tr> </tbody> </table> </li> <li>1b. Replace defective transistor or diode.</li> <li>2a. Perform resistance check of transistor with a VOM (RX1 scale). The following indications should be observed if the circuit is operational.</li> </ol>	<u>+LEAD</u>	<u>-LEAD</u>	<u>READING</u>	16	GND	Infinite	13	GND	Infinite	13	16	Infinite	16	13	≈ 40 Ohms	GND	16	≈ 35 Ohms	GND	13	≈ 80 Ohms
<u>+LEAD</u>	<u>-LEAD</u>	<u>READING</u>																					
16	GND	Infinite																					
13	GND	Infinite																					
13	16	Infinite																					
16	13	≈ 40 Ohms																					
GND	16	≈ 35 Ohms																					
GND	13	≈ 80 Ohms																					



Table 6-5. RF/PA Module A1 through A13 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION																					
		<table border="1"> <thead> <tr> <th data-bbox="375 1115 407 1220"><u>+LEAD</u></th> <th data-bbox="375 1220 407 1325"><u>-LEAD</u></th> <th data-bbox="375 1325 407 1430"><u>READING</u></th> </tr> </thead> <tbody> <tr> <td data-bbox="407 1115 440 1220">Emitter</td> <td data-bbox="407 1220 440 1325">Base</td> <td data-bbox="407 1325 440 1430">Infinite</td> </tr> <tr> <td data-bbox="440 1115 472 1220">Emitter</td> <td data-bbox="440 1220 472 1325">Collector</td> <td data-bbox="440 1325 472 1430">200 Ohms</td> </tr> <tr> <td data-bbox="472 1115 505 1220">Base</td> <td data-bbox="472 1220 505 1325">Collector</td> <td data-bbox="472 1325 505 1430">11 Ohms</td> </tr> <tr> <td data-bbox="505 1115 537 1220">Base</td> <td data-bbox="505 1220 537 1325">Emitter</td> <td data-bbox="505 1325 537 1430">11 Ohms</td> </tr> </tbody> </table>	<u>+LEAD</u>	<u>-LEAD</u>	<u>READING</u>	Emitter	Base	Infinite	Emitter	Collector	200 Ohms	Base	Collector	11 Ohms	Base	Emitter	11 Ohms						
<u>+LEAD</u>	<u>-LEAD</u>	<u>READING</u>																					
Emitter	Base	Infinite																					
Emitter	Collector	200 Ohms																					
Base	Collector	11 Ohms																					
Base	Emitter	11 Ohms																					
	<p>2b. Replace defective transistor.</p> <p>3. Transistor Q5 defective.</p>	<p>3a. Perform resistance check of transistor with a VOM (RX1 scale). The following indications should be observed if the circuit is operational.</p> <table border="1"> <thead> <tr> <th data-bbox="618 1115 651 1220"><u>+LEAD</u></th> <th data-bbox="618 1220 651 1325"><u>-LEAD</u></th> <th data-bbox="618 1325 651 1430"><u>READING</u></th> </tr> </thead> <tbody> <tr> <td data-bbox="651 1115 683 1220">12</td> <td data-bbox="651 1220 683 1325">10</td> <td data-bbox="651 1325 683 1430">≈10 Ohms</td> </tr> <tr> <td data-bbox="683 1115 716 1220">12</td> <td data-bbox="683 1220 716 1325">11</td> <td data-bbox="683 1325 716 1430">≈10 Ohms</td> </tr> <tr> <td data-bbox="716 1115 748 1220">11</td> <td data-bbox="716 1220 748 1325">10</td> <td data-bbox="716 1325 748 1430">≈20 Ohms</td> </tr> <tr> <td data-bbox="748 1115 781 1220">11</td> <td data-bbox="748 1220 781 1325">12</td> <td data-bbox="748 1325 781 1430">≈90 Ohms</td> </tr> <tr> <td data-bbox="781 1115 813 1220">10</td> <td data-bbox="781 1220 813 1325">11</td> <td data-bbox="781 1325 813 1430">Infinite</td> </tr> <tr> <td data-bbox="813 1115 846 1220">10</td> <td data-bbox="813 1220 846 1325">12</td> <td data-bbox="813 1325 846 1430">Infinite</td> </tr> </tbody> </table>	<u>+LEAD</u>	<u>-LEAD</u>	<u>READING</u>	12	10	≈10 Ohms	12	11	≈10 Ohms	11	10	≈20 Ohms	11	12	≈90 Ohms	10	11	Infinite	10	12	Infinite
<u>+LEAD</u>	<u>-LEAD</u>	<u>READING</u>																					
12	10	≈10 Ohms																					
12	11	≈10 Ohms																					
11	10	≈20 Ohms																					
11	12	≈90 Ohms																					
10	11	Infinite																					
10	12	Infinite																					
	<p>4. Transistors Q3 and Q4 defective.</p>	<p>3b. Replace defective transistor.</p> <p>4a. Perform resistance check of transistors with a VOM (RX1 scale). The following indi-</p>																					

WARNING: Disconnect primary power prior to servicing.

Table 6-5. RF/PA Module A1 through A13 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION																					
<p>Transistors Q6 and/or Q7 shorted.</p>	<p>5. Poor solder connections at capacitors C1, C2, and C6.</p> <p>1. Resistors R1 and/or R2 open.</p> <p>2. Capacitors C1 and/or C2 open.</p> <p>3. Diodes CR1 and/or CR2 open.</p>	<p>cations should be observed if the circuit is operational.</p> <table border="0" data-bbox="483 302 737 793"> <thead> <tr> <th><u>+LEAD</u></th> <th><u>-LEAD</u></th> <th><u>READING</u></th> </tr> </thead> <tbody> <tr> <td>7</td> <td>8</td> <td>Infinite</td> </tr> <tr> <td>7</td> <td>9</td> <td>Infinite</td> </tr> <tr> <td>8</td> <td>7</td> <td>≈110 Ohms</td> </tr> <tr> <td>8</td> <td>9</td> <td>≈500 Ohms</td> </tr> <tr> <td>9</td> <td>7</td> <td>≈10 Ohms</td> </tr> <tr> <td>9</td> <td>8</td> <td>≈10 Ohms</td> </tr> </tbody> </table>	<u>+LEAD</u>	<u>-LEAD</u>	<u>READING</u>	7	8	Infinite	7	9	Infinite	8	7	≈110 Ohms	8	9	≈500 Ohms	9	7	≈10 Ohms	9	8	≈10 Ohms
		<u>+LEAD</u>	<u>-LEAD</u>	<u>READING</u>																			
		7	8	Infinite																			
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		8	7	≈110 Ohms																			
		8	9	≈500 Ohms																			
		9	7	≈10 Ohms																			
		9	8	≈10 Ohms																			
		4b. Replace defective transistor.																					
		5a. Clean connections and resolder.																					
1a. Locate and replace defective resistor.																							
2a. Locate and replace defective capacitor.																							
3a. Locate and replace defective diode.																							



Table 6-5. RF/PA Module A1 through A13 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Faint Fault Indication</p>	<p>1. Modulator section of module.</p>	<p>1a. Connect an oscilloscope with 15 MHz bandwidth or better to check the RF duty cycle at the output of each module.</p> <p>1b. Connect the oscilloscope to the output of each PA module with X10 probe.</p> <p>1c. The following should be observed: a square wave whose peak to peak amplitude is the "PA VOLTS" value and whose duty cycle is <math>50\% \pm 5\%</math>. Some ringing on the square wave should also be observed.</p> <p>1d. An error in amplitude is a problem associated with the modulator section of the module. Measure the voltage at the fuse on the PA module in question. It should be equal to the "PA VOLTS" reading within 0.3 volts.</p> <p>1e. Troubleshoot and locate defective components in modulation section of module.</p>
	<p>2. Q6 and Q7 gain mismatch.</p>	<p>2a. An error in duty cycle is caused by 2 or 3.</p> <p>2b. Interchange Q6 and Q7.</p>
	<p>3. Faulty transformer assembly T1.</p>	<p>3a. Replace transformer assembly T1.</p>

Table 6-5. RF/PA Module A1 through A13 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Carrier shift, distortion, poor modulation capability, or an abnormal "RF DVR AMPS" reading.</p>	<p>1. A15 F1 open.</p>	<p>1a. Modulate the transmitter to 100% with a tone.                      1b. Connect a X10 scope probe to the junction of L18 and L19 above the IPA module.                      1c. Observe the modulation envelope at this point.                      1d. The envelope should be about 50%-70% modulated. Normally it will be somewhat distorted but not clipped.                      1e. A cause for no modulation at the RF DRIVER would be A15 F1 being open.                      1f. Replace A15 F1.</p>
	<p>2. A25 F13 open or A26 F13</p>	<p>2a. Causes for clipping on the positive excursion would be in #2.                      2b. Locate the open fuse and replace it.</p>
	<p>3. Q2, Q5 shorted on the RF DRIVER MODULE.</p>	<p>3a. Cause for clipping on the negative excursion would be #3.                      3b. Locate and replace the defective transistor.</p>



Table 6-5. RF/PA Module A1 through A13 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>PA MODULE LOADING SHARING. There will not likely be any symptom of a problem in this area. The purpose of the test described is to obtain equal stress among the PA modules.</p>	<p>1. Using a VOM that has the capability of measuring several DC Amperes, you can check the amount of current each module is drawing.</p>	<p>1a. Turn the transmitter off. 1b. Remove one of the FI-F12 fuses from A25 and substitute the dc ammeter, with the <math>\pm</math> lead on the +70 volt bar.</p> <div style="text-align: center; border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <b>CAUTION</b> </div> <p>Be sure that the ammeter leads will not short to ground. The power supply is capable of extremely high short circuit current.</p> <p>1c. Disconnect any audio from the audio input. 1d. Turn the transmitter back on and allow time for the regulator to adjust. 1e. Read the current on the meter. It should be 1/12 of the "PA AMPS" reading. "PA AMPS" should never exceed 24. 1f. Using the same procedure, check the current drain of the other PA modules.</p>

Table 6-5. RF/PA Module A1 through A13 Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
		<p>lg. If necessary, make adjustments to L1-L12 to achieve uniform current drain. Compressing a coil results in a decrease in PA current for the module associated with the coil. Expanding a coil causes an increase in current. Be sure to dip "PA volts" after making an adjustment.</p> <p>A severe imbalance in current may be a fault of the module. Try interchanging modules to see if the current imbalance follows the module. Typically L11 and L12 will have to be slightly compressed in relation to L1-L10 in order to achieve a balance.</p>



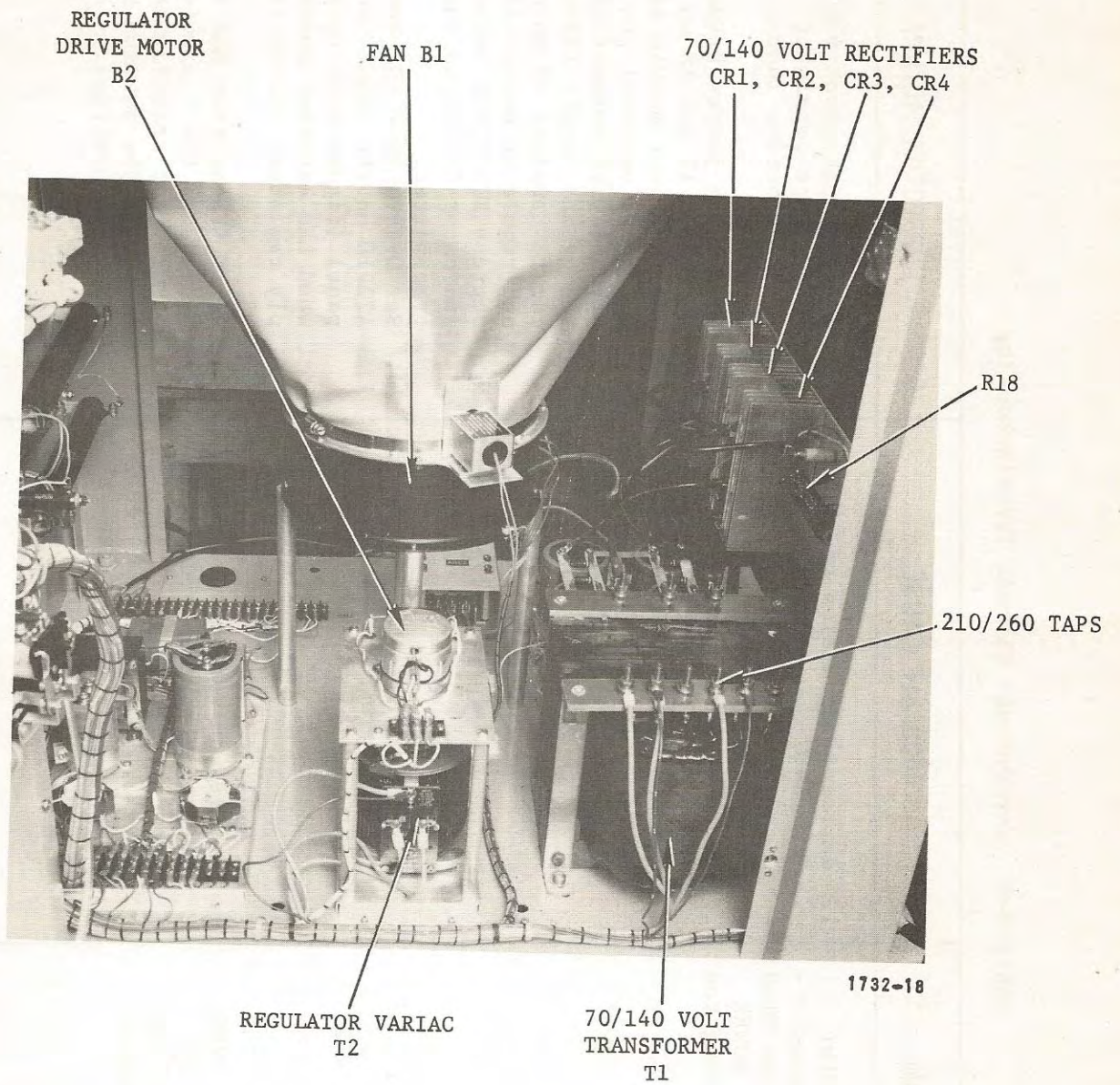


Figure 6-4. Lower Front Cabinet Compartment Location



Table 6-6. Overvoltage Circuit Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>OVERLOAD-VOLTAGE indicator DS3 illuminates when transferring the transmitter from HIGH POWER operation to LOW POWER operation, or when turning the transmitter off.</p> <p>Continuous tripping of OVERLOAD-VOLTAGE indicator DS4 (cycles transmitter off) immediately after transmitter turn on.</p>	<p>1. Improper regulation of output from 140V power supply.</p> <p>2. Improper threshold adjustment of DC overload circuit on relay and overload module A22.</p> <p>1. Brushes on Variac transformer T2 not in maximum counterclockwise position.</p>	<p>1a. Refer to paragraph 6-13 for voltage regulator troubleshooting instructions.</p> <p>2a. Remove the jumper between terminals 17 and 18 on relay and regulator module A22.</p> <p>2b. Using and external power supply and with respect to chassis ground, apply 155-to-160 vdc to terminal 18 on relay and regulator module A22.</p> <p>2c. Depress LOW POWER switch/indicator S4/DS4 to turn on transmitter.</p> <p>2d. Set OVERVOLTAGE ADJ control A22R10 on the lower control panel (figure 3-2) to trip when the external power supply registers 155-to-160 vdc.</p> <p>1a. After transmitter has been cycled off for 1 minute, ensure that transformer brushes are in the maximum counterclockwise position.</p>



Table 6-6. Overvoltage Circuit Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	<p>2. Diode CR6, CR7, or CR8 shorted on relay and regulator module A22.</p> <p>3. Diode CR12 shorted on main chassis.</p> <p>4. Defective relay K3 on relay and regulator module A22.</p>	<p>2a. Locate and replace defective diode.</p> <p>3a. Locate and replace defective diode.</p> <p>4a. Replace defective relay K3.</p>

WARNING: Disconnect primary power prior to servicing.

Table 6-6. Overvoltage Circuit Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>DC overload occurs at transmitter turn on, immediately shutting the transmitter off.</p>	<p>1. Q1, Q3 or CR1 shorted, or F2 blown.</p>	<p>1a. Remove A15 F2-F7. Turn the transmitter on. The PA modules should not draw any current, regardless of the audio driver output. Observe the PA VOLTS meter. If it pins, the problem is on the audio driver such as Q3 shorted, Q1 shorted, F2 blown, CR1 shorted.</p>
		<p>1b. Replace defective component or blown fuse.</p>
	<p>2. Fault in protection circuitry.</p>	<p>2a. If the transmitter still DC overloads at turn on with A15 F2-F7 removed, observe whether K2 pulls in momentarily. If K2 does not, the power supply is not being energized, therefore, a real DC overload is not possible. Look for a fault in the protection circuitry such as A22 Q3 shorted (A22 K4 would always be closed) A18 Q1 (can be removed for test purposes. It only lights the DC LED)</p>
		<p>2b. Replace defective components.</p>



Table 6-6. Overvoltage Circuit Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
DC overloads occur during normal programming.	<p>1. A22 C3 open.</p> <p>2. Audio going into transmitter contains subaudio signals whose amplitude is sufficient to trip DC overloads.</p>	<p>1a. The normal DC overload setting is made at 1100 watts output with 100% modulation at 20 Hz.</p> <p>1b. If correct adjustment is not achievable, A22 C3 may be open. Its purpose is to slow the overload circuit down. You might find that the transmitter will not overload when modulated with 1 kHz.</p> <p>1c. Replace A22 C3.</p> <p>2a. It is not normal to experience DC overloads during ordinary programming. If the sensitivity is set correctly and overloads persist, then it is evident that the audio going into the transmitter contains sub-audible signals whose amplitude is sufficient to trip the DC overload.</p> <p>2b. Correct problem in audio input signal.</p>

Table 6-7. Feedback Circuit Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>No feedback voltage at pin 2 on directional coupler module A21. Transmitter is operating with a 1000-watt power output.</p>	<ol style="list-style-type: none"> <li>1. Diode CR3 or CR4 shorted.</li> <li>2. Transformer T2 shorted.</li> <li>3. Capacitor C17, C18, or C21 shorted.</li> <li>4. Capacitor C11, C12, or C13 open.</li> <li>5. Terminal 2 on directional coupler module A21 shorted.</li> <li>6. Short circuit in audio input module A18.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Locate and replace defective diode.</li> <li>2a. Replace transformer.</li> <li>3a. Locate and replace defective capacitor.</li> <li>4a. Locate and replace defective capacitor.</li> <li>5a. Repair short circuit.</li> <li>6a. Locate and repair short circuit.</li> </ol>

WARNING: Disconnect primary power prior to servicing.

If You Didn't Get This From My Site,  
Then It Was Stolen From...



Table 6-8. Relative VSWR Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Transmitter cannot be properly loaded or tuned for a 1000-watt output according to instructions in paragraphs 2-22 and 2-23.</p>	<ol style="list-style-type: none"> <li>1. Diode CR5 defective on A21 directional coupler.</li> <li>2. Capacitor C14, C15, C16, C19, C20, C22, or C23 opened etc, shorted on A21 directional coupler.</li> <li>3. Resistor R8, R10, R11, R12, R13, or R14 opened or shorted.</li> <li>4. Defective transformer T3 in the output network (figure 6-5).</li> <li>5. Broken or frayed wire between terminal 10 on directional coupler module A21 and components C1/L13 in the output network.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Replace diode.</li> <li>2a. Locate and replace defective capacitor.</li> <li>3a. Locate and replace defective resistor.</li> <li>4a. Check and replace transformer T3 if necessary.</li> <li>5a. Locate and repair/replace defective wiring.</li> </ol>

Table 6-8. Relative VSWR Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>VSWR is of a continuous nature (i.e., no power output because of it).</p>	<p>1. VSWR trip circuit (A18-Q3, Q4, or Q6).</p>	<p>1a. Remove A15 F2-F7. The transmitter will then operate with PA VOLTS at approximately 60 and PA AMPS at zero. It will not attempt to produce RF output, a real VSWR overload is not possible.</p> <p>1c. If the overloads continue, troubleshoot the VSWR trip circuit and replace the defective component(s).</p> <p>1d. If the overloads cease under conditions set forth in step 1a. only, the VSWR is real and of a fairly extreme nature such as an open or short in the antenna system. Be sure to test the transmitter on the dummy load.</p>
<p>VSWR overloads occur when a normal (zero) REL/VSWR reading is indicated while modulation is being applied. If overload at any frequency see cause #1 or overload is particularly sensitive to high frequency modulation see cause #2.</p>	<p>1. Voltage breakdown on one of the capacitors in the ATU or phasor.</p> <p>2. Narrow antenna bandwidth.</p>	<p>1a. Replace the defective capacitor.</p> <p>2a. If the overload seems particularly sensitive to high frequency modulation, then narrow antenna bandwidth is indicated. Note the action of the REL/VSWR meter. An upward deflection with modulation is a symptom of the effects the</p>



Table 6-8. Relative VSWR Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
VSWR overload trips.	<p style="text-align: center;"><u>NOTE</u></p> <p>VSWR overloads can be caused by improper transmitter loading adjustment or improper REL/VSWR circuit adjustment. The loading control should be adjusted such that PA AMPS reads 22 when PA volts reads 50. With the correct loading ration having been established, the REL/VSWR circuit should be adjusted for a zero reading on the power meter in the REL/VSWR position. With the REL/VSWR reading nulled to zero, rotate the PA loading control in the direction which lowers PA AMPS. Make sure the transmitter is not being modulated. The REL/VSWR reading will increase as you rotate the loading control. The VSWR trip circuit threshold should be 500-700 on the meter. After making or checking the correct VSWR trip adjustment, return the loading control to its proper setting.</p> <p>1. Improper impedance external to the transmitter</p>	<p>antenna bandwidth limits. The greater the meter reading, the more limited the bandwidth. It also depends on the amount of high frequency audio.</p> <p style="text-align: center;"><u>NOTE</u></p> <p>The REL/VSWR trip circuit appears to be more sensitive with modulation. The REL/VSWR reading does not have to reach 500-700 in order to trip with modulation.</p> <p>2b. If the transmitter indicates that the antenna bandwidth is sharply limited, an antenna impedance sweep should be made and an antenna broad-banding scheme should be considered.</p> <p>1a. See if a problem exists when operating on the internal dummy load. The dummy load is typically 52 ohm +j5.</p>

Table 6-8. Relative VSWR Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>VSWR trips are caused by something internal to the transmitter and occur only with high positive modulation.</p>	<ol style="list-style-type: none"> <li>1. Faulty E1, the glass spark gap.</li> <li>2. Loose connections in the output network, including the contact roller in L14, the loading coil.</li> </ol>	<p>1b. Assuming the transmitter has worked previously on the antenna, a failed capacitor in the ATU or phasor is the most probable cause of the VSWR.</p>
<p>Tower static is characterized by a gradual buildup on the REL/VSWR meter, usually during poor weather conditions. This static buildup continues until the tower base ball gaps arc over. The REL/VSWR reading then falls to zero indicating the charge has cleared.</p>	<ol style="list-style-type: none"> <li>1. Tower Static.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Disconnect E1.</li> <li>2a. Tighten the loose connection.</li> <li>1a. A static drain choke at the tower base to ground should prevent tower static buildup.</li> </ol>



Table 6-8. Relative VSWR Troubleshooting (Continued)

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Guy wire static is similar to a nearby lightning strike in that no charge is registered on the REL/VSWR meter. Instead, the static charge builds up on the guy wires and ultimately arcs across the insulators to the tower. The charge is then removed by the static drain choke and/or the ball gaps at the base of the tower.</p>	<p>1. Guy wire static.</p>	<p>1a. The guy wire static buildup may be prevented with RF chokes across the insulators or by using non-metallic guy wires. Arcing across the insulators may be reduced or eliminated by cleaning them.</p>

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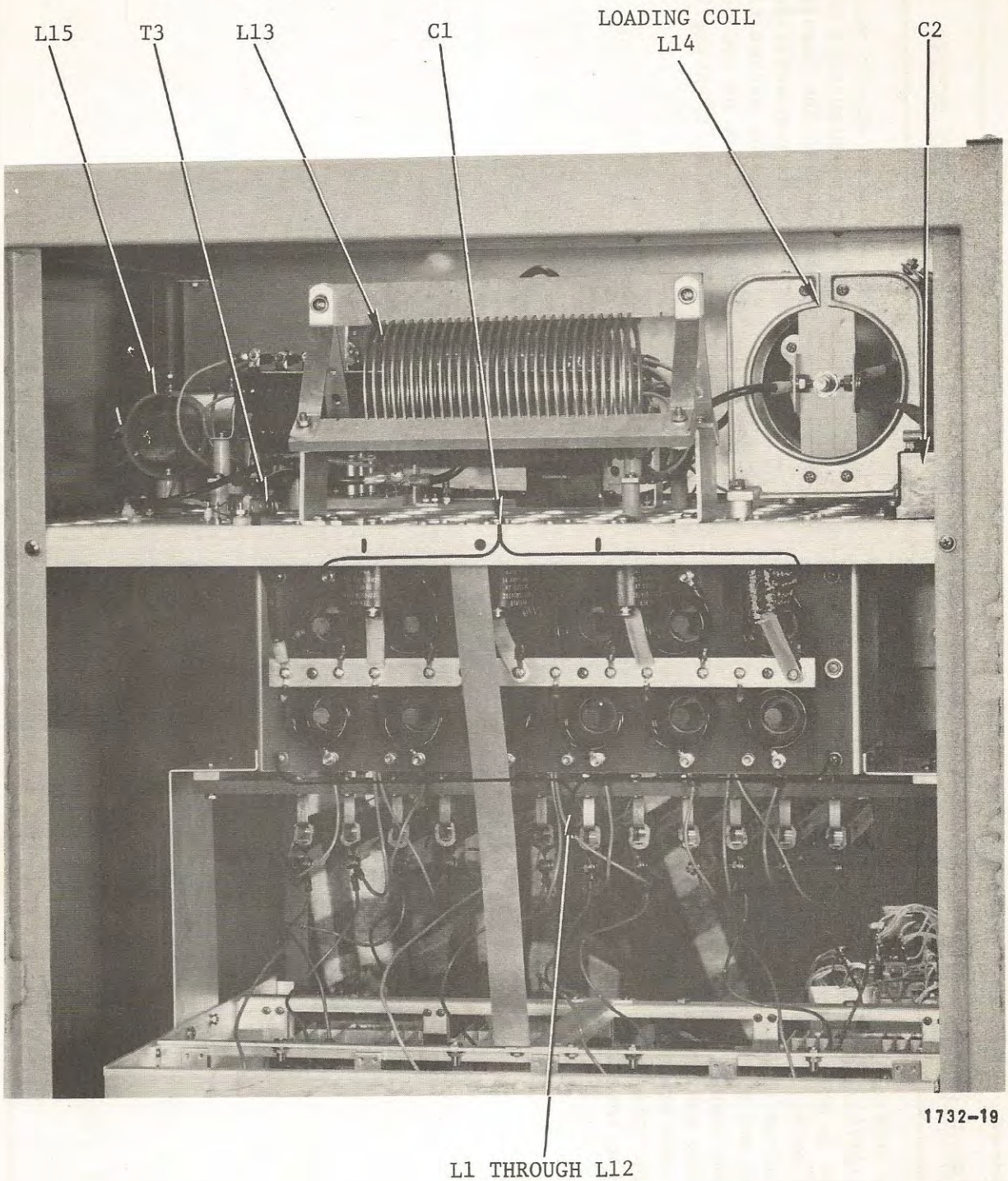


Figure 6-5. Output Network Component Location



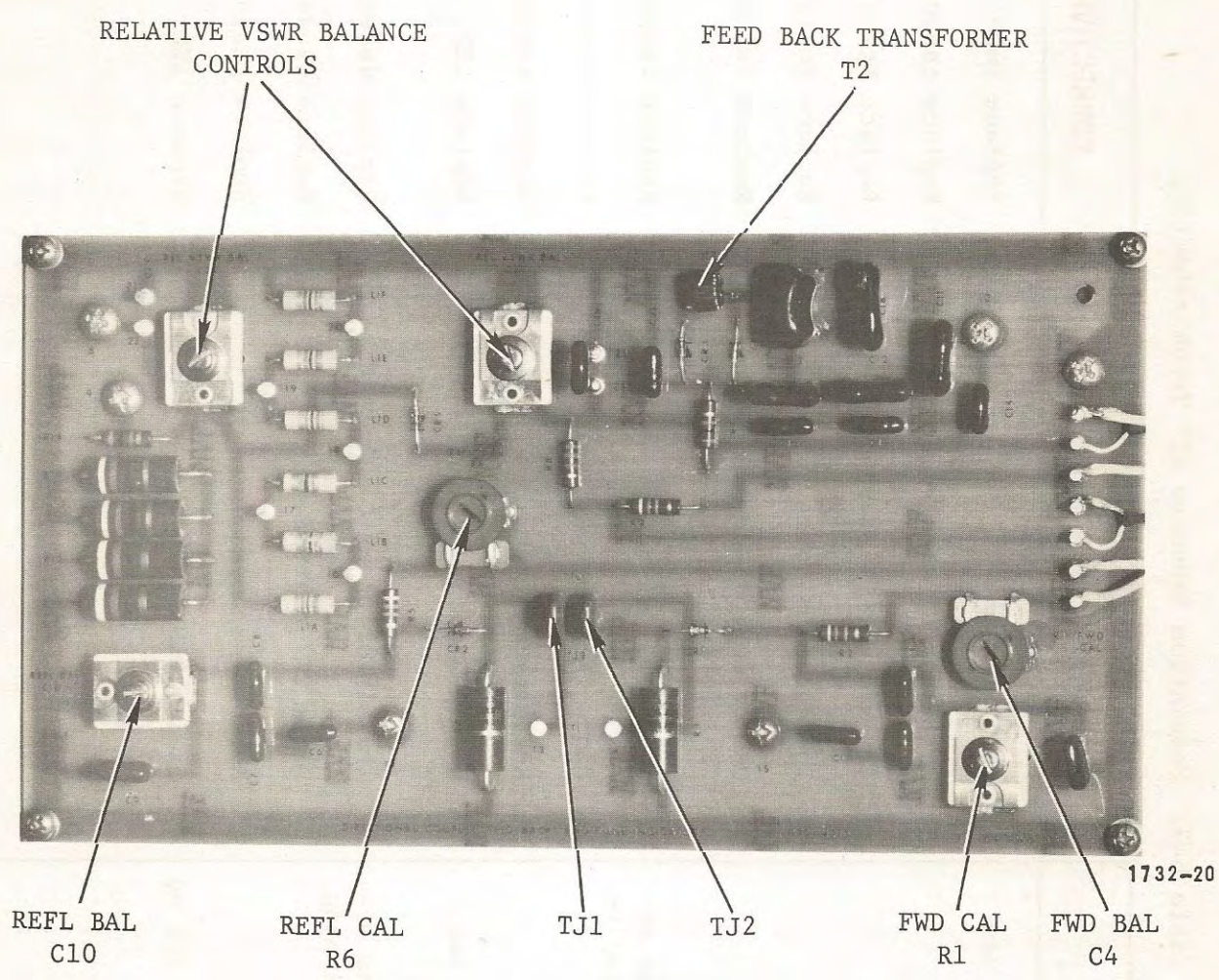


Figure 6-6. Directional Coupler A21, Cover Removed

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WARNING: Disconnect primary power prior to servicing.



Table 6-9. Modulation Enhancer A27 Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
POWER indicator DS1 does not light.	<ol style="list-style-type: none"> <li>1. Fuse F1 open.</li> <li>2. Capacitor C1 shorted.</li> <li>3. Transformer T1 shorted.</li> <li>4. Indicator DS1 open.</li> <li>5. One or more diodes CR1 thru CR4 shorted.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Replace fuse.</li> <li>2a. Replace capacitor.</li> <li>3a. Replace transformer.</li> <li>4a. Replace indicator.</li> <li>5a. Replace defective diode(s).</li> </ol>
NEG PEAK adjustment has no effect on negative peak clipping.	<ol style="list-style-type: none"> <li>1. Transistor Q1 and Q2 shorted.</li> <li>2. Diode CR5 shorted.</li> <li>3. Resistor R16 open.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Replace defective transistor.</li> <li>2a. Replace diode.</li> <li>3a. Replace resistor.</li> </ol>
Negative clipping occurs but no indication on LED (DS2).	<ol style="list-style-type: none"> <li>1. Faulty LED.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Replace LED.</li> </ol>
POS PEAK adjustment has no effect on positive peak clipping.	<ol style="list-style-type: none"> <li>1. Transistor Q3 or Q4 shorted.</li> <li>2. Diode CR7 shorted.</li> <li>3. Resistor R2 open.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Replace defective transistor.</li> <li>2a. Replace diode.</li> <li>3a. Replace resistor.</li> </ol>
Positive clipping occurs but no indication on LED (DS3).	<ol style="list-style-type: none"> <li>1. Faulty LED.</li> </ol>	<ol style="list-style-type: none"> <li>1a. Replace LED.</li> </ol>



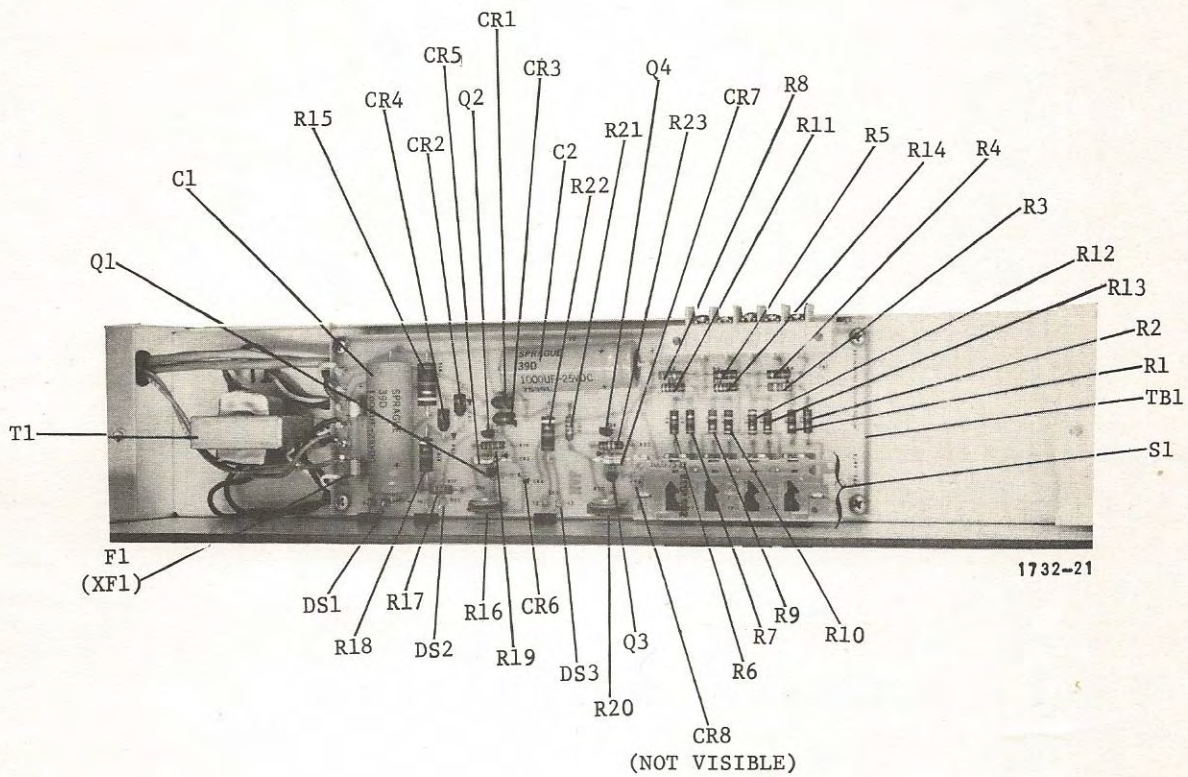


Figure 6-7. Modulation Enhancer A27, Component Location

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## SECTION VII

## PARTS LIST

7-1. INTRODUCTION.

7-2 This section provides a description, reference designator, and order number for replaceable electrical parts and assemblies, and selected mechanical parts necessary for proper maintenance of the MW-1A AM Transmitter. Table 7-1 lists the assemblies having replaceable parts, the number of the table listing the parts, and the page number on which the tables is located. Indenture of the assembly nomenclature in Table 7-1 signifies the equipment level within the overall equipment configuration.

## NOTE

Actual component values may vary slightly from component values listed on schematics and parts lists. Due to industry-wide shortages, it is sometimes necessary to use parts other than those specified. In every case, however, a substitute part is selected for conformance to overall design specifications so that equipment performance is not affected. Components that are frequency determined or peculiar to the individual transmitter are identified by a Harris part number and MW-1A component number on the final test and addendum sheets shipped with the transmitter.

7-3. REPLACEABLE PARTS SERVICE.

7-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Service Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois 62301, USA. The Harris factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

7-5. TECHNICAL ASSISTANCE.

7-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Department during normal working hours. Emergency technical service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

Table 7-1. Replaceable Parts List Index

TABLE NO.	UNIT NOMENCLATURE	PART NO.	PAGE
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7-3	Basic MW-1A Solid State 1 kW Transmitter	994 7966 002	7-5
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Table 7-1. Replaceable Parts List Index (Continued)

TABLE NO.	UNIT NOMENCLATURE	PART NO.	PAGE
7-19	Metering Printed Circuit Board A23	992 4217 001	7-34
7-20	Low Voltage Power Supply Assembly A24	992 4216 001	7-35
7-21	Fuse Board A25 and A26	992 4211 001	7-36
7-22	MW-1A AM Modulation Enhancer	992 4474 001	7-37

Table 7-2. MW-1A Solid State 1 kW Transmitter - 994 7966 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
A1C8 thru A13C8	See Test Sheet	Capacitor, (Frequency Determined)	13
A14C4A,A14C4B	See Test Sheet	Capacitor, IPA (Frequency Determined)	*AR
A16Y1	444 ---- 000	Crystal, (Per Spec #816 3493 001)	1
C1A thru C1F	See Test Sheet	Capacitor, Type 291 (Frequency Determined)	*AR
C2A thru C2C	See Test Sheet	Capacitor, Type F2 (Frequency Determined)	*AR
C15A thru C15C	See Test Sheet	Capacitor, RF Driver (Frequency Determined)	*AR
L1 thru L12	See Test Sheet	Coil, RF Driver (Frequency Determined)	12
L18	See Test Sheet	Coil, RF Driver (Frequency Determined)	1
L19	See Test Sheet	Coil, RF Driver (Frequency Determined)	1
	994 7966 002	Basic MW-1A Solid State 1 kW Transmitter	1
		( * AS REQUIRED)	



Table 7-3. Basic MW-1A Solid State 1 kW Transmitter - 994 7966 002

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
A1,A2,A3,A4,A5, A6,A7,A8,A9,A10, A11,A12,A13	992 4201 001	Heat Sink Assembly	13
A14	992 4202 001	IPA Module	1
A15	992 4208 001	Gating Power Control Assembly	1
A16	992 4207 001	Oscillator Assembly	1
A17	992 4206 001	Audio Driver Assembly	1
A18	992 4205 001	Audio Input and Overload Assembly	1
A19	992 4200 001	PA Fault Indicator, Printed Circuit Board	1
A20	992 4203 001	Overload Indicator, Printed Circuit Board	1
A21	992 4210 001	Directional Coupler Printed Circuit Board	1
A22	992 4213 002	Relay and Regulator, Printed Circuit Board	1
A23	992 4217 001	Metering Printed Circuit Board	1
A24	992 4216 001	Low Voltage Power Supply Assembly	1
A25,A26	992 4211 001	Fuse Board	2
A27	992 4474 001	Modulation Enhancer	1
A27DS1	384 0610 000	L.E.D., Green with Clear Mounting Clips	1
A27DS2,A27DS3	384 0611 000	L.E.D., Red with Clear Mounting Clips	2
A27T1	472 0730 000	Transformer, CTL P8395	1

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Table 7-3. Basic MW-1A Solid State 1 kW Transmitter - 994 7966 002  
(Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
B1	430 0031 000	Fan, Caravel CL3T2, 220/230V 1 PH 50/60 Hz, 1400/1650 RPM, 500/590 CFM	1
B2	436 0061 000	Motor, Synchronous, 1 RPM, 115V, 60 Hz, 5W Reversible	1
C1	See Test Sheet	Capacitor, Type 291 (Frequency Determined)	X
C2	See Test Sheet	Capacitor, Type F2 (Frequency Determined)	X
C3	504 0051 000	Capacitor, .05 uF, 1500V	1
C4	510 0690 000	Capacitor, 15 uF, 370V	1
C5	--- ---- ---	Capacitor, (Part of B2)	X
C6,C7,C8,C9,C10, C11	524 0322 000	Capacitor, 15,000 uF, 100V	6
C12,C13,C14	516 0082 000	Capacitor, .01 uF, 1 kV	3
C15	See Test Sheet	Capacitor, RF Driver (Frequency Determined)	X
C16	508 0515 000	Capacitor, .68 uF, 200V	1
C17	522 0421 000	Capacitor, 2300 uF, 50V	1
CB1	606 0479 000	Circuit Breaker, .5 Ampere	1
CB2	606 0525 000	Circuit Breaker, 30 Amperes	1
CB3	606 0466 000	Circuit Breaker, .1 Ampere	1
CR1,CR2,CR3,CR4	384 0614 000	Rectifier, 70H40A	4
CR5,CR6,CR7,CR8, CR9,CR10,CR11	384 0020 000	Rectifier, 1N4005	7
CR12	384 0615 000	Rectifier, Screen, 35 Amperes, 200V	1



Table 7-3. Basic MW-1A Solid State 1 kW Transmitter - 994 7966 002  
(Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
CR13	384 0020 000	Rectifier, 1N4005	1
CR14	386 0395 000	Diode, Zener, 1N2978A	1
DS3,DS4,DS5	396 0060 000	Lamp, #327, .04 Ampere, 28V	3
DS6,DS7,DS8	384 0611 000	L.E.D., Red with Clear Mounting Clips	3
DS9	384 0610 000	L.E.D., Green with Clear Mounting Clips	1
E1	560 0044 000	Spark Gap, 1500V	1
E2,E3,E4,E5,E6, E7,E8	614 0438 000	Terminal, Standoff, Ceramic	7
E9,E10,E11,E12	--- ---- ---	Mechanical Assembly	X
E13	815 0644 001	Ground Terminal	2
E14,E15,E16	614 0438 000	Terminal, Standoff, Ceramic	3
E17	--- ---- ---	Mechanical Assembly	X
K1	574 0370 000	Relay, Latching, 25V, 4 PDT	1
K2	570 0120 000	Contactor, 40 Amperes, 110V, 4 Pole, 50/60 Hz	1
K3	574 0370 000	Relay, Latching, 24V dc, 4 PDT	1
K4	574 0384 000	Relay, 24V dc, DPDT	1
L1 thru L12	See Test Sheet	Coil, Tuning (Frequency Determined)	AR
L13	931 6138 055	Coil Assembly	1
L14	931 6583 018	Coil, Output Loading	1
L15	938 0503 002	Coil, Monitor Pickup	1
L16	494 0396 000	Choke, 68 uH, 5 Ampere	1

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Table 7-3. Basic MW-1A Solid State 1 kW Transmitter - 994 7966 002  
(Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
L17	476 0308 000	Choke, Filter, 15 Hy, 74 mA	1
L18	See Test Sheet	Coil, Tuning, (Frequency Determined)	X
L19	See Test Sheet	Coil, Tuning, (Frequency Determined)	X
M1	632 0777 000	Meter, 0-12/0-30, SCL 0-1 MADC Movement (817 2824 001)	1
M2	632 0915 000	Meter, 0-30 Ampere, SCL, 0-1 MADC Movement (828 8035 001)	1
M3	632 0914 000	Voltmeter, 0-80V, SCL 0-1 MADC Movement (828 8034 001)	1
M4	632 0916 000	Meter, 0-1500W, SCL 0-100 UADC Movement (828 8036 001)	1
R1,R2,R3,R4,R5, R6	546 0216 000	Resistor, 312 ohms, 200W, 10%	6
R7	552 0335 000	Rheostat, 50 ohms, 50W, 10%	1
R8	550 0876 000	Potentiometer, Motorized, 1.5k ohms, 24V ac	1
R9	540 0591 000	Resistor, 150 ohms, 2W, 5%	1
R10	542 0351 000	Resistor, 5 ohms, 200W, 5%	1
R11	542 0356 000	Resistor, 100 ohms, 200W, 5%	1
R12,R13,R14,R15, R16,R17	540 0630 000	Resistor, 6.2k ohms, 2W, 5%	6
R18	542 1560 000	Resistor, .05 ohms, 105W	1
R19	540 0567 000	Resistor, 15 ohms, 2W, 5%	1
R20	540 0563 000	Resistor, 10 ohms, 2W, 5%	1



Table 7-3. Basic MW-1A Solid State 1 kW Transmitter - 994 7966 002  
(Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R21,R22,R23,R24, R25,R26,R27,R28, R29,R30,R31,R32	546 0289 000	Resistor, 7.5 ohms, 100W	12
S1	914 9494 006	Switch, Multimeter	1
S2	914 9494 007	Switch, FWD/REFL/VSWR	1
S3,S4,S5	604 0445 000	Switch, Pushbutton, Less Lens Cap	3
S6	604 0405 000	Switch, Pushbutton, Black	1
S7,S8	604 0196 000	Switch, Interlock	2
S9	915 2583 006	Switch, Local/Remote	1
S10	604 0458 000	Switch, Airflow	1
S12,S13	604 0624 000	Switch, Micro, SPDT	2
S14	604 0471 000	Switch, Toggle, 4 PDT	1
T1	472 1111 000	Transformer, Power	1
T2	474 0090 000	Transformer, Variable, VT8LN	1
T3	916 6619 001	Transformer, Assembly	1
TB1	614 0274 000	Terminal Board, 3 Terminals	1
TB2	614 0067 000	Terminal Board, 23 Terminals	1
TB3	614 0003 000	Terminal Board, 4 Terminals	1
	610 0305 000	Plug, Banana (Part of S11)	2
	612 0301 000	Jack, Banana, Brass, (Part of S11)	11
	650 0021 000	Knob for S9	1
	650 0028 000	Knob for S1,S2,R7,R8	4
	650 0104 000	Knob	1

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Table 7-3. Basic MW-1A Solid State 1 kW Transmitter - 994 7966 002  
(Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	816 8880 001	Insulator, (Driver Coils)	4
	829 1320 001	Ground Strap	1
	928 1833 001	Main MW-1A Cable Assembly	1
	928 8808 001	RF Deck Cable Assembly	1

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Table 7-4. Heat Sink Assembly A1 through A13 - 992 4201 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C7	508 0517 000	Capacitor, .15 uF, 200V	1
CR7,CR8	384 0678 000	Diode, Fast Recovery	2
E1	614 0438 000	Terminal Stand-off (6/32 Tap)	1
Q2	380 0518 000	Transistor, TIP47	1
Q3,Q4,Q5	380 0519 000	Transistor, 2N6254	3
Q6,Q7	380 0513 000	Transistor, 2N6340 (829 1427 001)	2
R13,R14	540 1101 000	Resistor, 1 ohm, 1/2W, 5%	2
XQ3,XQ4,XQ5,XQ6, XQ7	404 0661 000	Socket, Transistor, T0-3 Case	5
	410 0344 000	Insulator	1
	839 0226 001	Heat Sink	1
	992 4393 001	RF/PA Module, A1 through A13	1
	992 5217 001	R.F. Input Board	1

Table 7-5. RF/PA Module A1 through A13 - 992 4393 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1,C2	508 0515 000	Capacitor, .68 uF, 200V	2
C3	516 0082 000	Capacitor, .01 uF, 1 kV	1
C4	508 0514 000	Capacitor, .33 uF, 200V	1
C5	500 0852 000	Capacitor, 1000 pF, 500V	1
C6	508 0513 000	Capacitor, .15 uF, 400V	1
C8	See Test Sheet	Capacitor, (Frequency Determined)	1
CR1	384 0612 000	Diode, 1N3070	1
CR2,CR3,CR4	384 0134 000	Diode, 1N914	3
CR5	384 0613 000	Diode, MR841	1
CR6	386 0373 000	Diode, Zener, Matched Pair, 134V	1
F1	398 0020 000	Fuse, Fast Blow, 3AG, 3 Ampere, 250V	1
L1	494 0395 000	Choke, 40 uH, 2 Ampere	1
Q1	380 0518 000	Transistor, TIP47	1
R1	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	1
R2	540 0364 000	Resistor, 22k ohms, 1W, 5%	1
R3	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	1
R4	540 0043 000	Resistor, 560 ohms, 1/2W, 5%	1
R5	540 0635 000	Resistor, 10k ohms, 2W, 5%	1
R6	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	1
R7	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	1
R8	540 0270 000	Resistor, 2.7 ohms, 1W, 5%	1



Table 7-5. RF/PA Module A1 through A13 - 992 4393 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R9	540 0573 000	Resistor, 27 ohms, 2W, 5%	1
R12	540 0571 000	Resistor, 22 ohms, 2W, 5%	1
R15	540 0632 000	Resistor, 7.5k ohms, 2W, 5%	1
XF1,XF1A	402 0129 000	Fuse Clip, 102068	2
	816 6058 001	Jack, RF Output	1
	916 5964 001	Heat Sink for Q1	1
	939 0795 001	Printed Circuit Board	1

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Table 7-6. R.F. Input Board - 992 5217 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1,C2	516 0527 000	Capacitor, .47 uF, 50V	2
CR1,CR2	384 0284 000	Diode, 10D4/1N2070	2
R1,R2	540 0880 000	Resistor, 47 ohms, 1/4W, 5%	2
T1	916 6621 001	Toroid Assembly	1
	829 3240 001	Printed Circuit Board	1



Table 7-7. IPA Module A14 - 992 4202 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
Q1	380 0513 000	Transistor, 2N6340 (829 1427 001)	1
XQ1	404 0661 000	Socket, Transistor, for TO-3 Case	1
	410 0232 000	Insulator, Mica	1
	828 7879 001	Heat Sink	1
	992 4395 001	IPA Printed Circuit Board Assembly	1

Table 7-8. IPA Printed Circuit Board A14 - 992 4395 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1,C3	508 0378 000	Capacitor, .22 uF, 100V	2
C4	500 ---- 000	Capacitor, (Frequency Determined)	X
C5,C6	508 0378 000	Capacitor, .22 uF, 100V	2
CR1	384 0134 000	Diode, 1N914	1
DS1,DS2	384 0610 000	L.E.D., Green with Clear Mounting Clips	2
F1	398 0017 000	Fuse, Fast, 3AG, 1 Ampere, 250V	1
L1	494 0361 000	Choke, 55 uH, 500 mA	1
L2	492 0613 000	Coil, Adjustable, 1.6-3.1 uH	1
R1	540 0615 000	Resistor, 1.5k ohms, 2W, 5%	1
R2	540 0613 000	Resistor, 1.2k ohms, 2W, 5%	1
R3,R4	540 0611 000	Resistor, 1k ohms, 2W, 5%	2
R5	540 0603 000	Resistor, 470 ohms, 2W, 5%	1
R6	540 0579 000	Resistor, 47 ohms, 2W, 5%	1
R7	540 0019 000	Resistor, 56 ohms, 1/2W, 5%	1
R8	540 0316 000	Resistor, 220 ohms, 1W, 5%	1
R9	540 1101 000	Resistor, 1 ohm, 1/2W, 5%	1
R10	542 0052 000	Resistor, 5 ohms, 10W, 5%	1
R11,R12	540 0563 000	Resistor, 10 ohms, 2W, 5%	2
XF1,XF1A	402 0129 000	Fuse Clips, 102068	2
	928 8528 001	Printed Circuit Board	1



Table 7-9. Gating and Power Control Assembly A15 - 992 4208 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
CR1,CR2,CR3,CR4, CR5	384 0134 000	Diode, 1N914	5
F1,F2,F3,F4,F5, F6,F7	398 0006 000	Fuse, 1/8 Ampere, 250V, Fast Blow	7
L1	494 0196 000	Choke, RF, 100 uH	1
R1,R2	550 0073 000	Potentiometer, 100k ohms, 2W, 10%	2
R3	540 0642 000	Resistor, 20k ohms, 2W, 5%	1
R4	540 0639 000	Resistor, 15k ohms, 2W, 5%	1
R5	550 0071 000	Potentiometer, 50k ohms, 2W, 10%	1
R6	550 0065 000	Potentiometer, 5k ohms, 2W, 10%	1
R7	540 0635 000	Resistor, 10k ohms, 2W, 5%	1
R8	542 0075 000	Resistor, 1k ohms, 10W, 5%	1
R9	540 0621 000	Resistor, 2.7k ohms, 2W, 5%	1
R10	540 0300 000	Resistor, 47 ohms, 1W, 5%	1
R11	540 0581 000	Resistor, 56 ohms, 2W, 5%	1
R12,R13,R14,R15, R16,R17	540 0300 000	Resistor, 47 ohms, 1W, 5%	6
R18	548 0978 000	Resistor, 80.6k ohms, 1/2W, 1%	1
R19	540 0099 000	Resistor, 120k ohms, 1/2W, 5%	1
R20	540 0089 000	Resistor, 47k ohms, 1/2W, 5%	1
R21	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	1
XF1/XF1A thru XF7/XF7A	402 0129 000	Fuse Clips, 102068	14
	939 0806 001	Printed Circuit Board	1

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Table 7-10. Oscillator Assembly A16 - 992 4207 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
Q3	380 0204 000	Transistor, D44C9	1
	410 0334 000	Insulator, Film	1
	410 0335 000	Insulator	1
	992 4394 001	Oscillator Printed Circuit Board Assembly (A16)	1



Table 7-11. Oscillator Printed Circuit Board A16 - 992 4394 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	520 0439 000	Capacitor, Variable, 2.4-24.5 pF	1
C2	500 0805 000	Capacitor, 12 pF, 500V	1
C3	500 0837 000	Capacitor, 510 pF, 500V	1
C4	516 0387 000	Capacitor, .47 uF, 10V	1
C5	500 0761 000	Capacitor, 150 pF, 500V	1
C6	516 0080 000	Capacitor, .01 uF, 600V	1
C7,C8,C9,C10	508 0378 000	Capacitor, .22 uF, 100V	4
CR1	386 0082 000	Diode, Zener, 1N4744A	1
CR2	386 0135 000	Diode, Zener, 1N4733A	1
CR3,CR4,CR5	384 0134 000	Diode, 1N914	3
DS1,DS2	384 0610 000	L.E.D. Green	2
F1	398 0017 000	Fuse, 1 Ampere, 250V, Fast	1
L1	494 0196 000	Choke, RF, 100 uH	1
L2	494 0361 000	Choke, 55 uH, 500 mA	1
P19	610 0703 000	Connector, 6 Pin	1
Q1,Q2	380 0083 000	Transistor, 2N2369	2
R1	540 0087 000	Resistor, 39k ohms, 1/2W, 5%	1
R2	540 0079 000	Resistor, 18k ohms, 1/2W, 5%	1
R3	540 0015 000	Resistor, 39 ohms, 1/2W, 5%	1
R4	540 0035 000	Resistor, 270 ohms, 1/2W, 5%	1
R5	540 0049 000	Resistor, 1k ohms, 1/2W, 5%	1
R6	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	1

Table 7-11. Oscillator Printed Circuit Board A16 - 992 4394 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R7,R8,R9	540 0611 000	Resistor, 1k ohms, 2W, 5%	3
R10	540 0046 000	Resistor, 750 ohms, 1/2W, 5%	1
R11	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	1
R12	540 0615 000	Resistor, 1.5k ohms, 2W, 5%	1
R13	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	1
R14	550 0252 000	Potentiometer, 500 ohms, 1/4W, 20%	1
R15	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	1
R16	540 0041 000	Resistor, 470 ohms, 1/2W, 5%	1
R17,R18	540 0579 000	Resistor, 47 ohms, 2W, 5%	2
R19	540 0051 000	Resistor, 1.2k ohms, 1/2W, 5%	1
R20	540 0595 000	Resistor, 220 ohms, 2W, 5%	1
R21	540 0603 000	Resistor, 470 ohms, 2W, 5%	1
U1	382 0074 000	Integrated Circuit, MC7476P	1
XF1	402 0129 000	Fuse Clip (102068)	2
XY1	404 0267 000	Crystal Holder, Socket	1
Y1	See Test Sheet	Crystal (Frequency Determined)	X
	939 0797 001	Printed Circuit Board	1



Table 7-12. Audio Driver Assembly A17 - 992 4206 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
CR1	386 0139 000	Diode, Zener, 1N2986B	1
Q2	380 0518 000	Transistor, TIP47	1
Q3	380 0198 000	Transistor, 2N5240	1
Q4	380 0517 000	Transistor, D45H11	1
XQ3	404 0661 000	Socket, Transistor for TO-3 Case	1
	410 0344 000	Insulator, Transistor Mounting (For Q1,Q2,Q4)	3
	410 0232 000	Insulator, Mica	1
	839 3702 001	Heat Sink	1
	839 3728 001	Heat Sink	1
	992 4396 001	Audio Driver Printed Circuit Board (A17)	1

Table 7-13. Audio Driver Printed Circuit Board A17 - 992 4396 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	522 0394 000	Capacitor, 100 uF, 50V	1
C2	500 0845 000	Capacitor, 2000 pF, 500V	1
C3	516 0082 000	Capacitor, .01 uF, 1 kV	1
C4	522 0521 000	Capacitor, 100 uF, 150V	1
C5	508 0514 000	Capacitor, .33 uF, 200V	1
C6	516 0074 000	Capacitor, .005 uF, 1 kV	1
C7	522 0188 000	Capacitor, 250 uF, 6V	1
CR2	386 0133 000	Diode, Zener, 1N4734	1
CR3	386 0366 000	Diode, Zener, 1N5359A	1
CR4,CR5	386 0363 000	Diode, Zener, Matched Pair, 140V, 1%, 1W, 1R89-1122	2
F1	398 0015 000	Fuse, 1/2 Ampere, 250V, Fast	1
F2,F3	398 0017 000	Fuse, 1 Ampere, 250V, Fast	2
P1	610 0704 000	Connector, Plug, 12 Pin	1
Q1	380 0201 000	Transistor, D40D8	1
R1	542 0013 000	Resistor, 50 ohms, 5W, 5%	1
R2	540 0635 000	Resistor, 10k ohms, 2W, 5%	1
R3	540 0284 000	Resistor, 10 ohms, 1W, 5%	1
R4	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	1
R5	540 0049 000	Resistor, 1k ohms, 1/2W, 5%	1
R6	540 0059 000	Resistor, 2.7k ohms, 1/2W, 5%	1
R7	542 0036 000	Resistor, 2k ohms, 5W, 5%	1



Table 7-13. Audio Driver Printed Circuit Board A17 - 992 4396 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R8	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	1
R9	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	1
R10	540 0017 000	Resistor, 47 ohms, 1/2W, 5%	1
R11	540 0057 000	Resistor, 2.2k ohms, 1/2W, 5%	1
R12	542 0088 000	Resistor, 5k ohms, 10W, 5%	1
R13	540 1101 000	Resistor, 1 ohm, 1/2W, 5%	1
R14	540 0625 000	Resistor, 3.9k ohms, 2W, 5%	1
R15	540 0635 000	Resistor, 10k ohms, 2W, 5%	1
R16	540 0049 000	Resistor, 1k ohms, 1/2W, 5%	1
R17	540 0596 000	Resistor, 240 ohms, 2W, 5%	1
R18	540 0108 000	Resistor, 300k ohms, 1/2W, 5%	1
R19,R20	540 0084 000	Resistor, 30k ohms, 1/2W, 5%	2
R21	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	1
R22	540 0625 000	Resistor, 3.9k ohms, 2W, 5%	1
XF1, XF2, XF3, XF1A, XF2A, XF3A	402 0129 000	Fuse Clips, 102068	6
	939 0807 001	Printed Circuit Board	1

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Table 7-14. Audio Input and Overload Assembly A18 - 992 4205 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1,C2	516 0084 000	Capacitor, .02 uF, 1 kV	2
C3	522 0159 000	Capacitor, <sup>0582 000</sup> <del>10</del> <sup>Went to 25V</sup> 15 uF, 3V	1
C4	500 0842 000	Capacitor, 820 pF, 300V	1
C5	526 0053 000	Capacitor, 2.7 uF, 35V	1
C6	522 0256 000	Capacitor, 20 uF, 50V	1
C7	500 0781 000	Capacitor, 2200 pF, 500V	1
C8	522 0258 000	Capacitor, 50 uF, 50V	1
C9	522 0254 000	Capacitor, 10 uF, 50V	1
C10	522 0236 000	Capacitor, 5 uF, 25V	1
C11	522 0254 000	Capacitor, 10 uF, 50V	1
C12	522 0257 000	Capacitor, 35 uF, 50V	1
C13,C14	516 0082 000	Capacitor, .01 uF, 1 kV	2
C15	500 0852 000	Capacitor, 1000 pF, 500V	1
CR1,CR2,CR4,CR5, CR6,CR7	384 0020 000	Rectifier, 1N4005	6
CR8	386 0082 000	Diode, Zener, 1N4744A	1
CR9	386 0123 000	Diode, Zener, 1N4732A	1
DS1	384 0610 000	L.E.D., Green	1
F1	398 0017 000	Fuse, 1 Ampere, 250V, Fast	1
K1,K2,K3	574 0352 000	Relay, Correed, CC-12	3
L1	494 0190 000	Choke, RF, 330 uH, 80 mA	1
P17,P18	610 0704 000	Connector Plug, 12 Pin	2
Q1,Q2,Q3	384 0261 000	Transistor, 2N5061	3



Table 7-14. Audio Input and Overload Assembly A18 - 992 4205 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
Q4	384 0232 000	Transistor, 2N2324A	1
Q5	380 0204 000	Transistor, D44C8	1
Q6	380 0126 000	Transistor, 2N4403	1
Q7	380 0125 000	Transistor, 2N4401	1
Q8	380 0179 000	Transistor, MPS-U45	1
R1,R2,R3	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	3
R4,R5,R6	540 0089 000	Resistor, 47k ohms, 1/2W, 5%	3
R7	540 0097 000	Resistor, 100k ohms, 1/2W, 5%	1
R8	550 0410 000	Potentiometer, 25k ohms, 1/4W	1
R9	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	1
R10	540 0049 000	Resistor, 1k ohms, 1/2W, 5%	1
R11	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	1
R12	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	1
R13	540 0053 000	Resistor, 1.5k ohms, 1/2W, 5%	1
R14	540 0059 000	Resistor, 2.7k ohms, 1/2W, 5%	1
R15	540 0049 000	Resistor, 1k ohms, 1/2W, 5%	1
R16	540 0059 000	Resistor, 2.7k ohms, 1/2W, 5%	1
R17	540 0097 000	Resistor, 100k ohms, 1/2W, 5%	1
R18	550 0408 000	Potentiometer, 1k ohms, 1/4W	1
R19,R20,R21,R22	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	4
R23	540 0055 000	Resistor, 1.8k ohms, 1/2W, 5%	1
R24,R25	540 0049 000	Resistor, 1k ohms, 1/2W, 5%	2

Table 7-14. Audio Input and Overload Assembly A18 - 992 4205 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R26	540 0080 000	Resistor, 20k ohms, 1/2W, 5%	1
R27,R28	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	2
R29	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	1
R30	540 0615 000	Resistor, 1.5k ohms, 2W, 5%	1
R31	540 0336 000	Resistor, 1.5k ohms, 1W, 5%	1
R32	540 0089 000	Resistor, 47k ohms, 1/2W, 5%	1
R33	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	1
R34	540 0104 000	Resistor, 200k ohms, 1/2W, 5%	1
R35	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	1
R36	540 0121 000	Resistor, 1 Megohm, 1/2W, 5%	1
R37	540 0017 000	Resistor, 47 ohms, 1/2W, 5%	1
R38	540 0336 000	Resistor, 1.5k ohms, 1W, 5%	1
R39	540 0056 000	Resistor, 2k ohms, 1/2W, 5%	1
R40	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	1
S1	604 0748 000	Switch, Toggle, 2 Position	1
T1	478 0118 000	Transformer, Output	1
XF1,XF1A	402 0129 000	Fuse Clips, 102068	2
	939 0836 001	Printed Circuit Board	1



Table 7-15. PA Fault Indicator Printed Circuit Board A19 - 992 4200 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
DS1 thru DS12	396 0217 000	Lamp, 28V, .08 Ampere, #757	12
R1 thru R12	540 0591 000	Resistor, 150 ohms, 2W, 5%	12
XDS1 thru XDS12	406 0475 000	Lamp Socket, Lee Craft Model 7-35	12
	928 8505 001	Printed Circuit Board	1

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Table 7-16. Overload Indicator Printed Circuit Board A20 - 992 4203 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	516 0087 000	Capacitor, .05 uF, 600V	1
CR1,CR2,CR3	384 0134 000	Diode, 1N914	3
F1	398 0017 000	Fuse, Fast, 1 Ampere, 250V	1
R1,R2,R3,R4	540 0615 000	Resistor, 1.5k ohms, 2W, 5%	4
R5,R6,R7	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	3
XF1,XF1A	402 0129 000	Fuse Clips, 102068	2
	928 8530 001	Printed Circuit Board	1



Table 7-17. Directional Coupler Printed Circuit Board A21 - 992 4210 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1,C2,C3	500 0811 000	Capacitor, 27 pF, 500V	3
C4	500 0848 000	Capacitor, Variable, 9-180 pF	1
C5	500 0833 000	Capacitor, 390 pF, 500V	1
C6,C7,C8	500 0811 000	Capacitor, 27 pF, 500V	3
C9	500 0833 000	Capacitor, 390 pF, 500V	1
C10	500 0848 000	Capacitor, Variable, 9-180 pF	1
C11,C12,C13	500 0878 000	Capacitor, 1500 pF, 500V	3
C14,C15,C16	500 0753 000	Capacitor, 56 pF, 500V	3
C17A	500 0883 000	Capacitor, 4700 pF, 500V	1
C17B,C18A	500 0882 000	Capacitor, 3600 pF, 500V	2
C18B	500 0847 000	Capacitor, 3900 pF, 500V	1
C18C	500 0883 000	Capacitor, 4700 pF, 500V	1
C19	--- ---- ---	Capacitor (Frequency Determined)	1
C20	500 0848 000	Capacitor, Variable, 9-180 pF	1
C21	500 0837 000	Capacitor, 510 pF, 500V	1
C22	500 0848 000	Capacitor, Variable, 9-180 pF	1
C23	--- ---- ---	Capacitor, (Frequency Determined)	1
CR1,CR2,CR3,CR4, CR5	384 0134 000	Diode, 1N914	5
L1A,L1B,L1C,L1D, L1E,L1F	494 0196 000	Choke, RF, 100 uH	6
R1	550 0378 000	Potentiometer, 100k ohms, 1/4W, 20%	1
R2	540 0095 000	Resistor, 82k ohms, 1/2W, 5%	1

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Table 7-17. Directional Coupler Printed Circuit Board A21 - 992 4210 001  
(Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R3,R4	540 0570 000	Resistor, 20 ohms, 2W, 5%	2
R5	540 0095 000	Resistor, 82k ohms, 1/2W, 5%	1
R6	550 0378 000	Potentiometer, 100k ohms, 1/4W, 20%	1
R7	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	1
R8	540 0057 000	Resistor, 2.2k ohms, 1/2W, 5%	1
R9	540 0089 000	Resistor, 47k ohms, 1/2W, 5%	1
R10,R11,R12,R13	540 0586 000	Resistor, 91 ohms, 2W, 5%	4
R14	540 0049 000	Resistor, 1k ohms, 1/2W, 5%	1
T1	916 5923 001	Transformer	1
T2	916 6620 001	Transformer	1
TJ1,TJ2	610 0679 000	Shorting Plug, .040 Pins, Insulated	2
	939 0837 001	Printed Circuit Board	1

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Table 7-18. Relay and Regulator Printed Circuit Board A22 - 992 4213 002

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	522 0417 000	Capacitor, 1000 uF, 25V	1
C2	508 0424 000	Capacitor, .15 uF, 50V	1
C3	522 0188 000	Capacitor, 250 uF, 6V	1
C4,C5,C6	516 0087 000	Capacitor, .05 uF, 600V	3
C7	522 0394 000	Capacitor, 100 uF, 50V	1
C8	522 0208 000	Capacitor, 50 uF, 12V	1
C9	516 0393 000	Capacitor, .025 uF, 500V	1
C10,C11	516 0087 000	Capacitor, .05 uF, 600V	2
C12	526 0097 000	Capacitor, 47 uF, 35V	1
CR1,CR2	386 0364 000	Diode, Zener, 1N5370A	2
CR3,CR4	384 0020 000	Rectifier, 1N4005	2
CR5 CR6	384 0609 000	Diode, 1N5758A	1
CR7,CR8	386 0364 000	Diode, Zener, 1N5370A	2
CR9	384 0020 000	Rectifier, 1N4005	1
CR10	386 0297 000	Diode, Zener, 1N5338A	1
CR11,CR12	384 0020 000	Rectifier, 1N4005	2
CR13	386 0082 000	Diode, Zener, 1N4744A	1
CR14,CR15	384 0134 000	Diode, 1N914	2
CR16	386 0366 000	Diode, 1N5359A	1
K1,K2	574 0219 000	Relay, 12V, 4 PDT	2
K3,K4	572 0127 000	Relay, 24V, 4 PDT	2
Q1	380 0201 000	Transistor, D40D8	1

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Table 7-18. Relay and Regulator Printed Circuit Board A22 - 992 4213 002  
(Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
Q2	380 0516 000	Transistor, D45C8	1
Q3	380 0201 000	Transistor, D40D8	1
Q4	380 0179 000	Transistor, MPS-U45	1
Q5,Q6	380 0125 000	Transistor, 2N4401	2
R1	540 1178 000	Resistor, 750 ohms, 1/2W, 5%	1
R2	550 0868 000	Potentiometer, 1k ohms, 1/4W	1
R3	540 1178 000	Resistor, 750 ohms, 1/2W, 5%	1
R4,R5,R6	540 0605 000	Resistor, 620 ohms, 2W, 5%	3
R7,R8	540 0051 000	Resistor, 1.2k ohms, 1/2W, 5%	2
R9	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	1
R10	550 0869 000	Potentiometer, 10k ohms, 1/4W	1
R11	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	1
R12	540 0042 000	Resistor, 510 ohms, 1/2W, 5%	1
R13	550 0868 000	Potentiometer, 1k ohms, 1/4W	1
R14	542 0054 000	Resistor, 10 ohms, 10W, 5%	1
R15	540 0587 000	Resistor, 100 ohms, 2W, 5%	1
R16	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	1
R17	540 0089 000	Resistor, 47k ohms, 1/2W, 5%	1
R18	540 0121 000	Resistor, 1 Megohm, 1/2W, 5%	1
R19	540 0049 000	Resistor, 1k ohms, 1/2W, 5%	1
R20	540 0595 000	Resistor, 220 ohms, 2W, 5%	1
R21	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	1



Table 7-18. Relay and Regulator Printed Circuit Board A22 - 992 4213 002  
(Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R22	540 0089 000	Resistor, 47k ohms, 1/2W, 5%	1
R23	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	1
R24	540 0059 000	Resistor, 2.7k ohms, 1/2W, 5%	1
R25	540 0065 000	Resistor, 4.7k ohms, 1/2W, 5%	1
R26	540 0089 000	Resistor, 47k ohms, 1/2W, 5%	1
R27	550 0347 000	Potentiometer, 50k ohms, 1/4W	1
R28	540 0089 000	Resistor, 47k ohms, 1/2W, 5%	1
XK1, XK2, XK3, XK4	404 0214 000	Relay Socket	4
	939 0829 002	Printed Circuit Board	1

Table 7-19. Metering Printed Circuit Board A23 - 992 4217 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R1	548 0176 000	Resistor, 120k ohms, 1/2W, 1%	1
R2	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	1
R3	548 0386 000	Resistor, 301k ohms, 1/2W, 1%	1
R4	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	1
R5	540 0049 000	Resistor, 1k ohms, 1/2W, 5%	1
R6	550 0061 000	Potentiometer, 1k ohms, 2W, 10%	1
R7	540 0049 000	Resistor, 1k ohms, 1/2W, 5%	1
R8	540 0060 000	Resistor, 3k ohms, 1/2W, 5%	1
R9	542 0438 000	Resistor, 2 ohms, 25W, 5%	1
R10	540 0060 000	Resistor, 3k ohms, 1/2W, 5%	1
	928 8488 001	Printed Circuit Board	1



Table 7-20. Low Voltage Power Supply Assembly A24 - 992 4216 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	524 0313 000	Capacitor, 25,000 uF, 40V	1
C2	524 0321 000	Capacitor, 8400 uF, 40V	1
CR1,CR2	384 0595 000	Bridge Rectifier, MDA 1201, 100V, 10 Ampere	2
R1	540 0611 000	Resistor, 1k ohms, 2W, 5%	1
R2	540 0099 000	Resistor, 120k ohms, 1/2W, 5%	1
R3	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	1
R4	540 0611 000	Resistor, 1k ohms, 2W, 5%	1
R5	540 0108 000	Resistor, 300k ohms, 1/2W, 5%	1
R6	540 0073 000	Resistor, 10k ohms, 1/2W, 5%	1
T1	472 1077 000	Transformer, 24V, 4 Ampere	1
T2	472 0622 000	Transformer, 24V, 2 Ampere	1
TB1	614 0059 000	Terminal Board, 15 Terminals	1
TS1,TS2	614 0438 000	Terminal Standoff, Ceramic	2
	839 0732 001	Chassis, Low Voltage	1
	928 8790 001	Cable, Low Voltage	1

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Table 7-21. Fuse Board A25 and A26 - 992 4211 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
* F1 thru F13	398 0333 000	Fuse, 3 Ampere, Type GBA	13
XF1/XF1A thru XF13, XF13A	402 0129 000	Clips, Fuse, 102070, .0001 Tinned Spring Brass with Ear for 1/4 Dia. Fuse	13
	402 0168 000	Clips, Fuse, 1/4 Dia. Without End Stops (XF1 - XF13)	13
	816 6459 001	Bar, Fuse Board	1
	939 0812 001	Printed Circuit Board	1



Table 7-22. Modulation Enhancer Assembly A27 - 992 4474 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1,C2	522 0417 000	Capacitor, 1000 uF 25V	2
CR1,CR2,CR3,CR4	384 0020 000	Rectifier, 1N4005	4
CR5	386 0145 000	Diode, Zener, 1N3022A	1
CR6	384 0134 000	Diode, 1N914	1
CR7	386 0145 000	Diode, Zener, 1N3022A	1
CR8	384 0134 000	Diode, 1N914	1
F1	398 0011 000	Fuse, Fast, 1/4 Ampere, 250V	1
Q1	380 0126 000	Transistor, 2N4403	1
Q2,Q3	380 0125 000	Transistor, 2N4401	2
Q4	380 0126 000	Transistor, 2N4403	1
R1,R2	540 0018 000	Resistor, 51 ohms, 1/2W, 5%	2
R3	540 0055 000	Resistor, 1.8k ohms, 1/2W, 5%	1
R4,R5	540 0018 000	Resistor, 51 ohms, 1/2W, 5%	2
R6,R7	540 0025 000	Resistor, 100 ohms, 1/2W, 5%	2
R8	540 0055 000	Resistor, 1.8k ohms, 1/2W, 5%	1
R9,R10	540 0021 000	Resistor, 68 ohms, 1/2W, 5%	2
R11	540 0059 000	Resistor, 2.7k ohms, 1/2W, 5%	1
R12,R13	540 0014 000	Resistor, 36 ohms, 1/2W, 5%	2
R14	540 0066 000	Resistor, 5.1k ohms, 1/2W, 5%	1
R15	540 0615 000	Resistor, 1.5k ohms, 2W, 5%	1
R16	550 0966 000	Potentiometer, 2k ohms, 1/2W/.3W, 10%	1
R17	540 0035 000	Resistor, 270 ohms, 1/2W, 5%	1

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Table 7-22. Modulation Enhancer Assembly A27 - 992 4474 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R18	540 0332 000	Resistor, 1k ohms, 1W, 5%	1
R19	540 0083 000	Resistor, 27k ohms, 1/2W, 5%	1
R20	550 0966 000	Potentiometer, 2k ohms, 1/2W/.3W, 10%	1
R21	540 0035 000	Resistor, 270 ohms, 1/2W, 5%	1
R22	540 0332 000	Resistor, 1k ohms, 1W, 5%	1
R23	540 0083 000	Resistor, 27k ohms, 1/2W, 5%	1
S1	604 0813 000	Switch, Pushbutton, 4 Station	1
TB1	614 0696 000	Terminal Board, 5 Terminals	1
XF1, XF1A	402 0129 000	Clip, Fuse, 102068	2
	939 1062 001	Printed Circuit Board	1



## SECTION VIII

### DIAGRAMS

8-1.        INTRODUCTION.

8-2.        This section provides schematic diagrams necessary for maintaining the MW-1A AM Transmitter. The following diagrams are contained in this section.

<u>Figure</u>	<u>Title</u>	<u>Number</u>
8-1.	RF Oscillator, A16, Schematic	828 8515 001
8-2.	Intermediate Power Amplifier, A14, Schematic	828 8513 001
8-3.	RF/PA Module, A1-A13, Schematic	828 8512 001
8-4.	Audio Input and Overload, A18, Schematic	839 1157 001
8-5.	Audio Driver, A17, Schematic	828 8516 001
8-6.	Gating and Power Control, A15, Schematic	828 8514 001
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8-9.	Directional Coupler, A21, Schematic	828 8519 001
8-10.	Low Voltage Power Supply, A24, Schematic	816 6409 001
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8-14.	MW-1A Overall Schematic	852 7772 002
8-15.	ME-1 AM Modulation Enhancer, A27, Schematic	839 1066 001

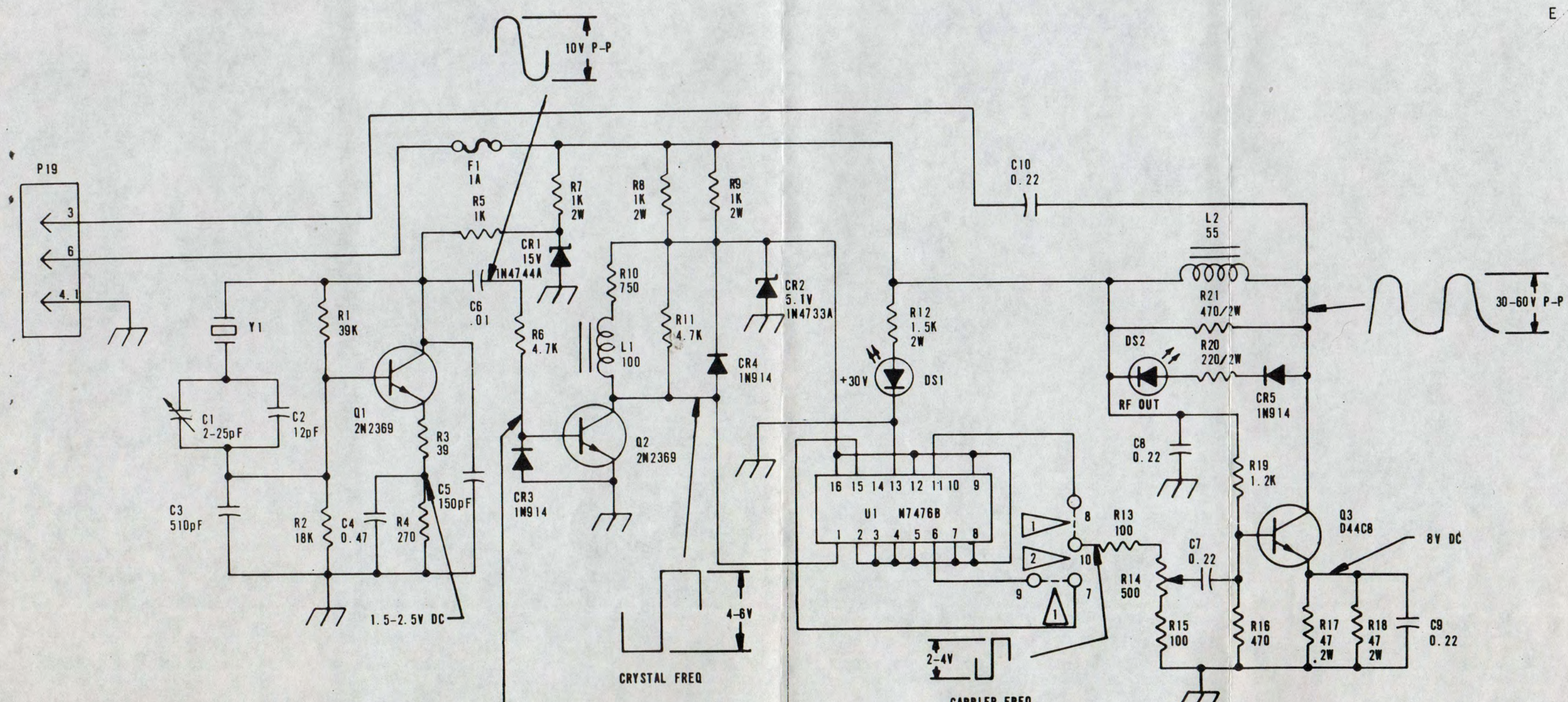
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1-44	1-44	1-44
1-45	1-45	1-45
1-46	1-46	1-46
1-47	1-47	1-47
1-48	1-48	1-48
1-49	1-49	1-49
1-50	1-50	1-50
1-51	1-51	1-51
1-52	1-52	1-52
1-53	1-53	1-53
1-54	1-54	1-54
1-55	1-55	1-55
1-56	1-56	1-56
1-57	1-57	1-57
1-58	1-58	1-58
1-59	1-59	1-59
1-60	1-60	1-60
1-61	1-61	1-61
1-62	1-62	1-62
1-63	1-63	1-63
1-64	1-64	1-64
1-65	1-65	1-65
1-66	1-66	1-66
1-67	1-67	1-67
1-68	1-68	1-68
1-69	1-69	1-69
1-70	1-70	1-70
1-71	1-71	1-71
1-72	1-72	1-72
1-73	1-73	1-73
1-74	1-74	1-74
1-75	1-75	1-75
1-76	1-76	1-76
1-77	1-77	1-77
1-78	1-78	1-78
1-79	1-79	1-79
1-80	1-80	1-80
1-81	1-81	1-81
1-82	1-82	1-82
1-83	1-83	1-83
1-84	1-84	1-84
1-85	1-85	1-85
1-86	1-86	1-86
1-87	1-87	1-87
1-88	1-88	1-88
1-89	1-89	1-89
1-90	1-90	1-90
1-91	1-91	1-91
1-92	1-92	1-92
1-93	1-93	1-93
1-94	1-94	1-94
1-95	1-95	1-95
1-96	1-96	1-96
1-97	1-97	1-97
1-98	1-98	1-98
1-99	1-99	1-99
1-100	1-100	1-100





- 6. RESISTORS ARE 1/2WATT 5%, UNLESS OTHERWISE SPECIFIED.
- 5. RESISTANCE IN OHMS
- 4. CAPACITANCE IN  $\mu$ F
- 3. INDUCTANCE IN  $\mu$ H
- 2 JUMPER 7 TO 10 DIVIDE BY 2
- 1 JUMPER 7 & 9, 8 & 10 DIVIDE BY 4

NOTES:

FIGURE 8-1. RF OSCILLATOR, A16, SCHEMATIC 828 8515 001

8-3/8-4



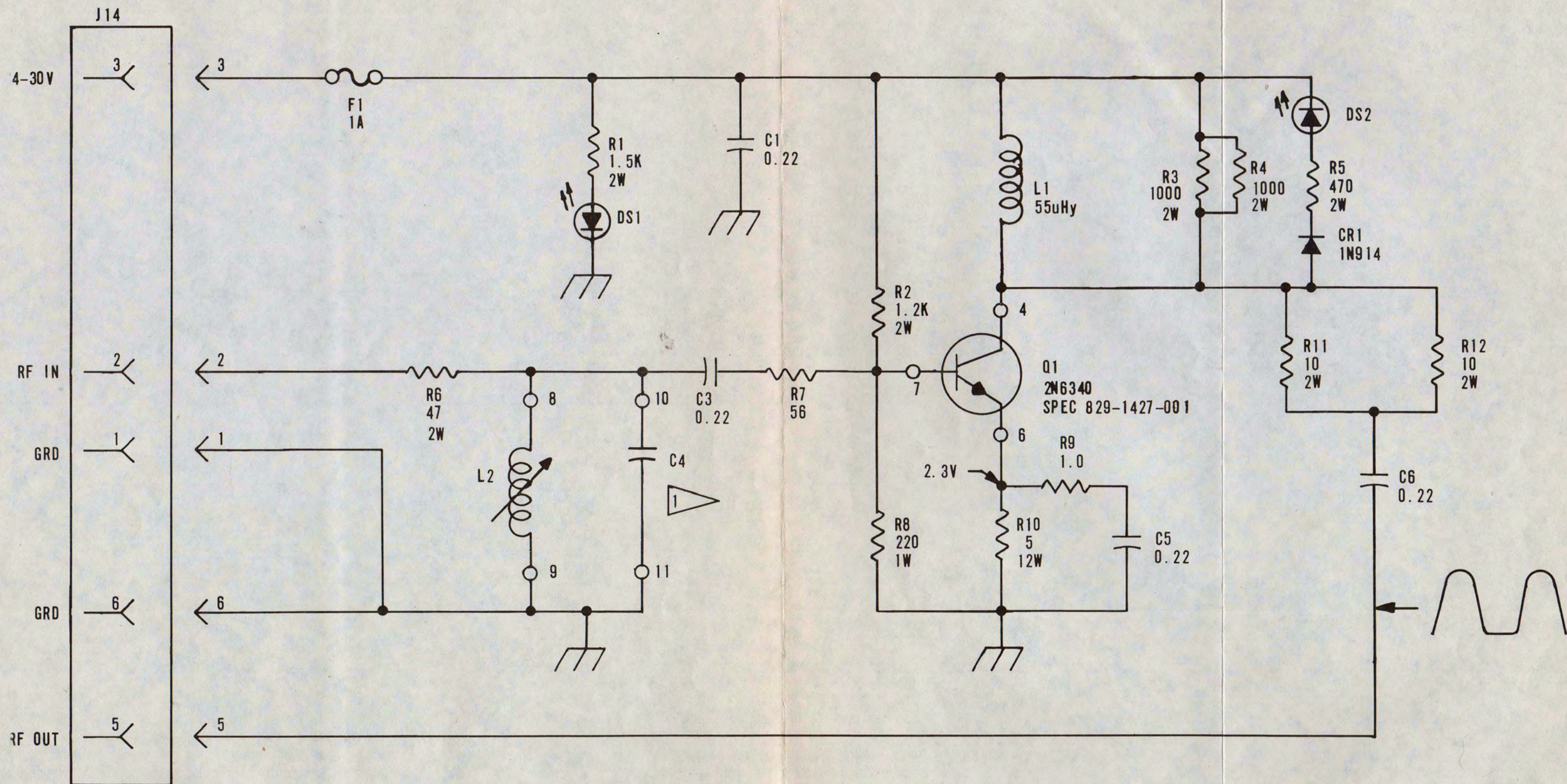
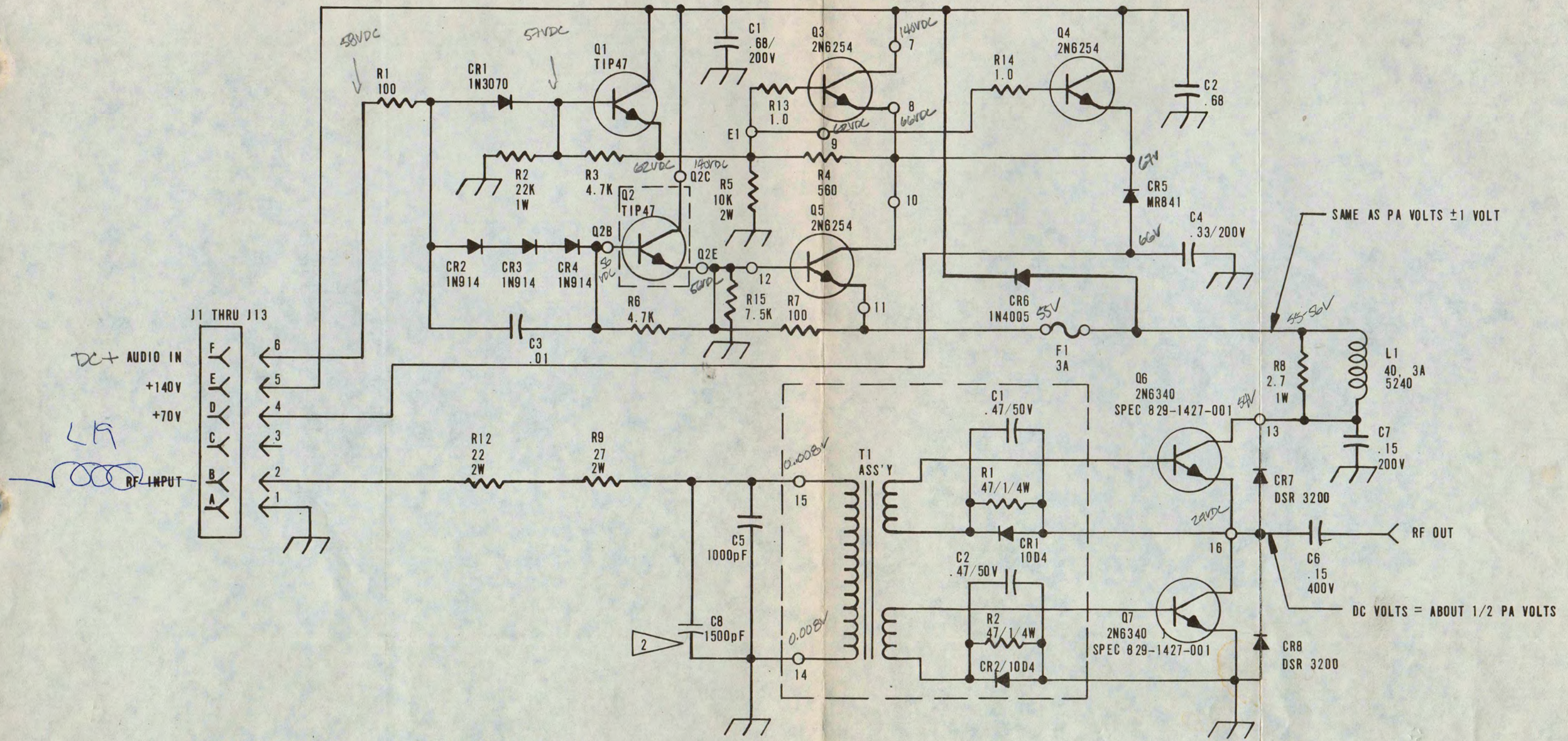


FIGURE 8-2. INTERMEDIATE POWER AMPLIFIER, A14, SCHEMATIC 828 8513 001





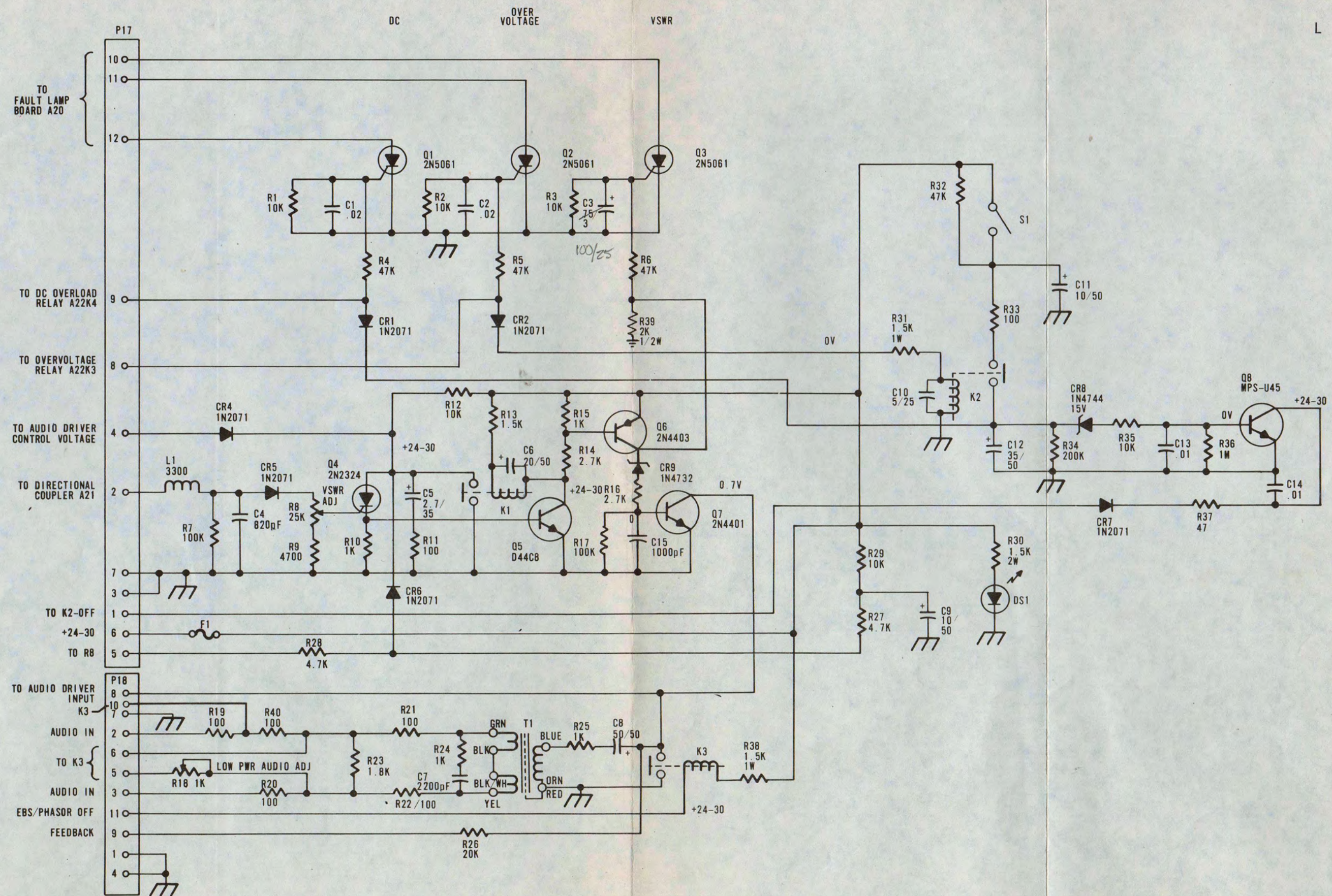
- 6. RESISTORS ARE 1/2WATT, 5% UNLESS OTHERWISE SPECIFIED.
- 5. RESISTANCE IN OHMS
- 4. CAPACITANCE IN  $\mu$ F
- 3. INDUCTANCE IN  $\mu$ H

NOTE:  
 2  $\nabla$  C8 TO BE USED BELOW 1MHZ.  
 1  $\nabla$

*Handwritten notes:*  
 Q3 collector case to ground  $\times 10K$ : capacitive etc.  
 Q4  
 Q5 collector  $\times 100$ : 75-80 $\Omega$   
 Q6 collector  $\times 100$ : 40-50 $\Omega$   
 Q7 collector  $\times 100$ : 70-80 $\Omega$

FIGURE 8-3. RF/PA MODULE, A1-A13, SCHEMATIC 828 8512 001



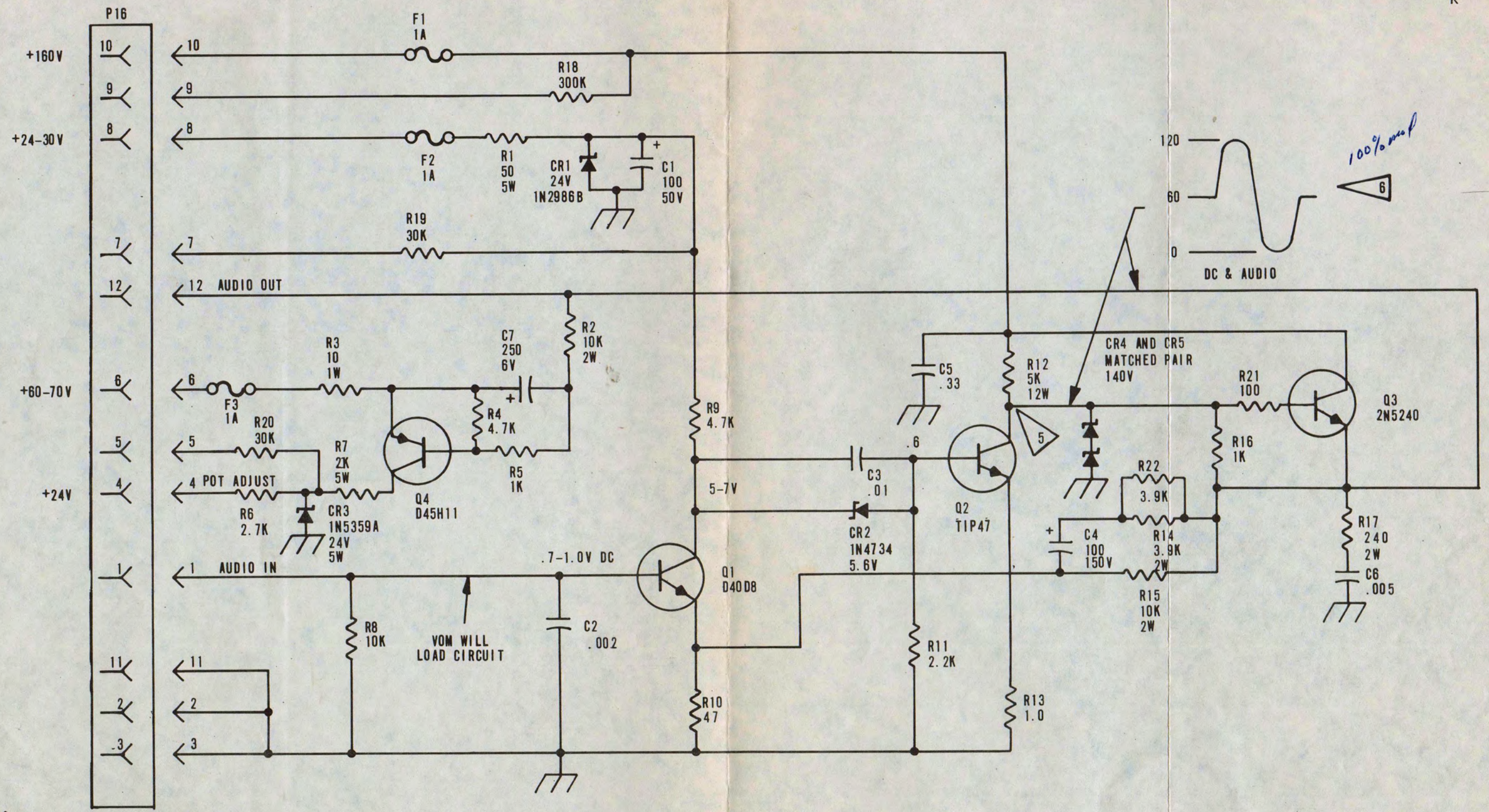


4 INDUCTANCE IN  $\mu$ H  
 3 CAPACITANCE IN  $\mu$ F  
 2 RESISTANCE IN OHMS  
 1 RESISTORS ARE 1/2 WATT, 5%  
 NOTES: UNLESS OTHERWISE NOTED.

FIGURE 8-4. AUDIO INPUT AND OVERLOAD A18, SCHEMATIC 839 1157 001

8-9/8-10





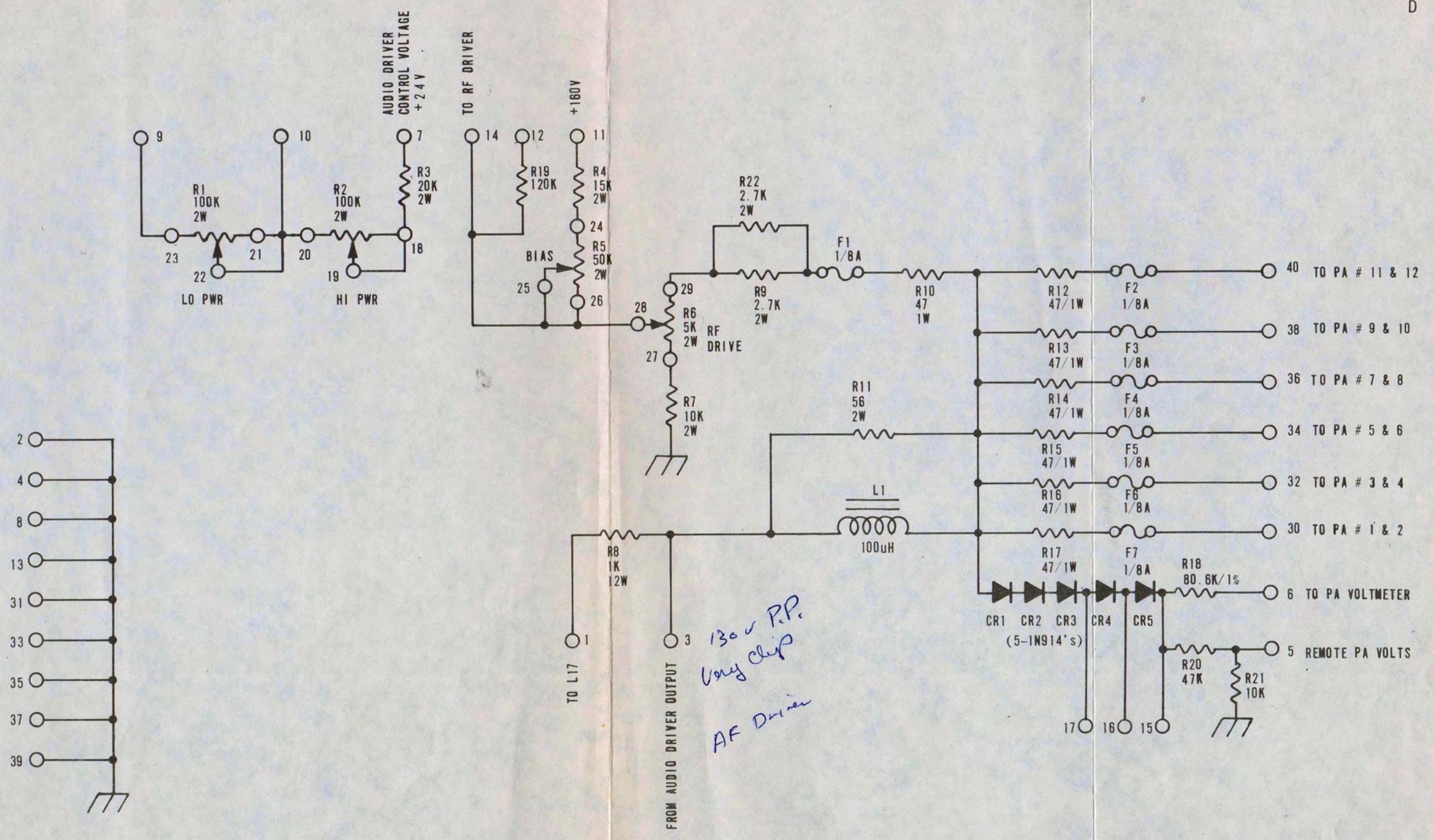
- 6 100% MOD AT 1Kw
- 5. 5 VOLTS HIGHER THAN PA VOLTS
- 4. RESISTORS ARE 1/2WATT, 5%
- 3. RESISTANCE IN OHMS
- 2. CAPACITANCE IN  $\mu$ F
- 1. INDUCTANCE IN  $\mu$ H

UNLESS OTHERWISE SPECIFIED:

FIGURE 8-5. AUDIO DRIVER A17, SCHEMATIC 828 8516 001

8-11/8-12





4. RESISTORS ARE 1/2WATT, 5%  
 3. RESISTANCE IN OHMS  
 2. CAPACITANCE IN uF  
 1. INDUCTANCE IN uH  
 UNLESS OTHERWISE SPECIFIED

FIGURE 8-6. GATING AND POWER CONTROL, A15, SCHEMATIC 828 8514 001



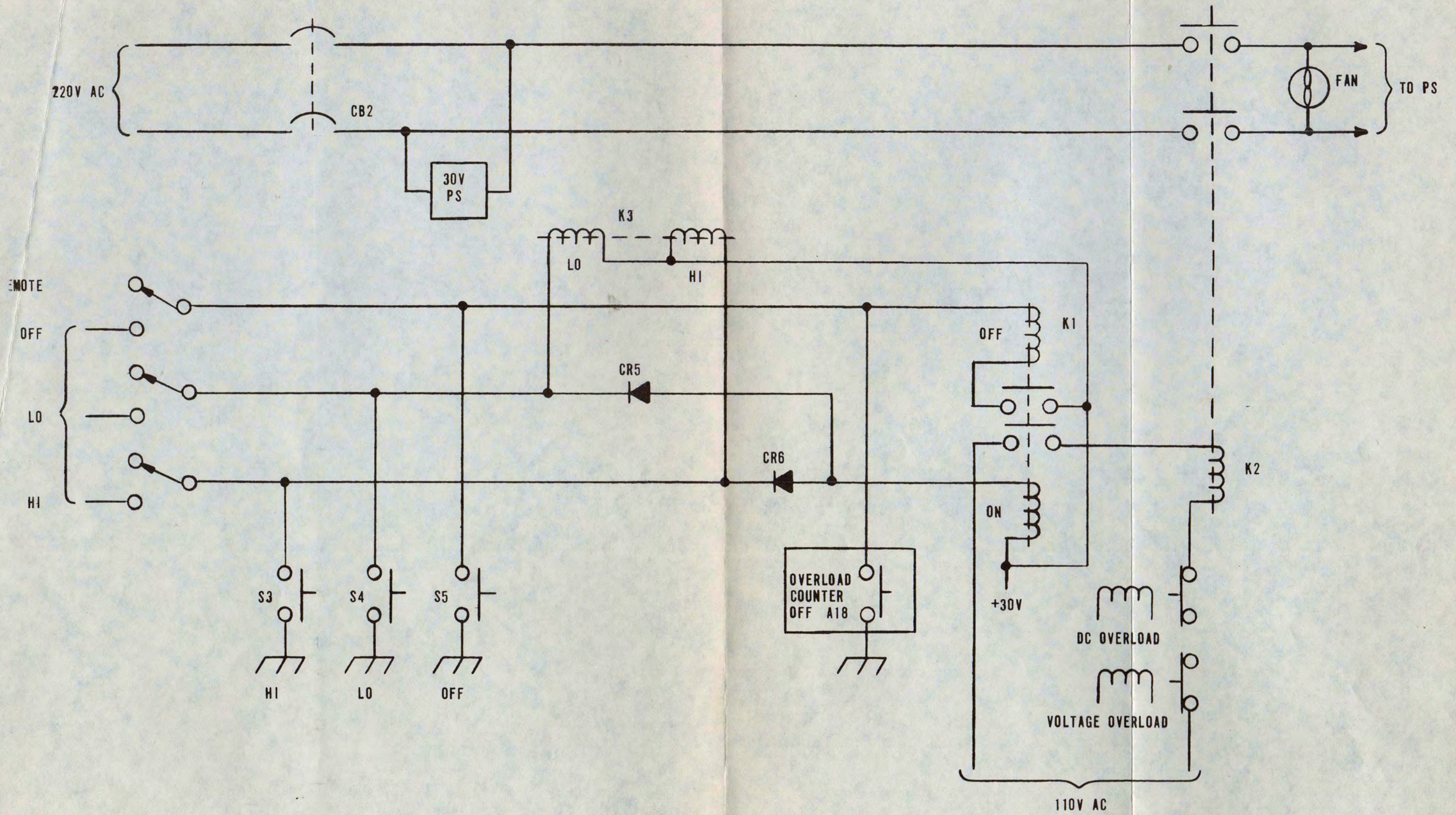
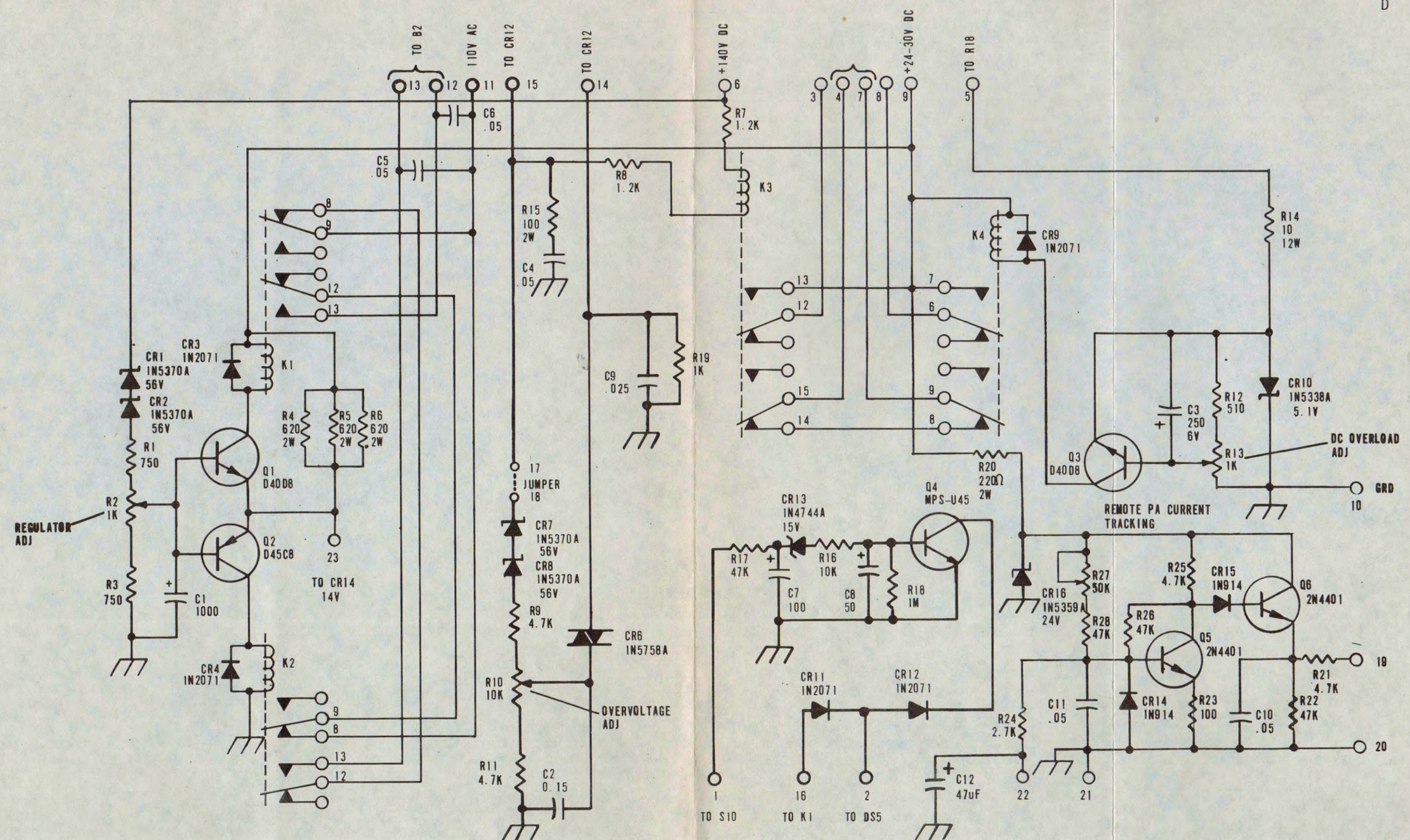


FIGURE 8-7. CONTROL CIRCUIT,  
SIMPLIFIED DIAGRAM  
828 9617 001



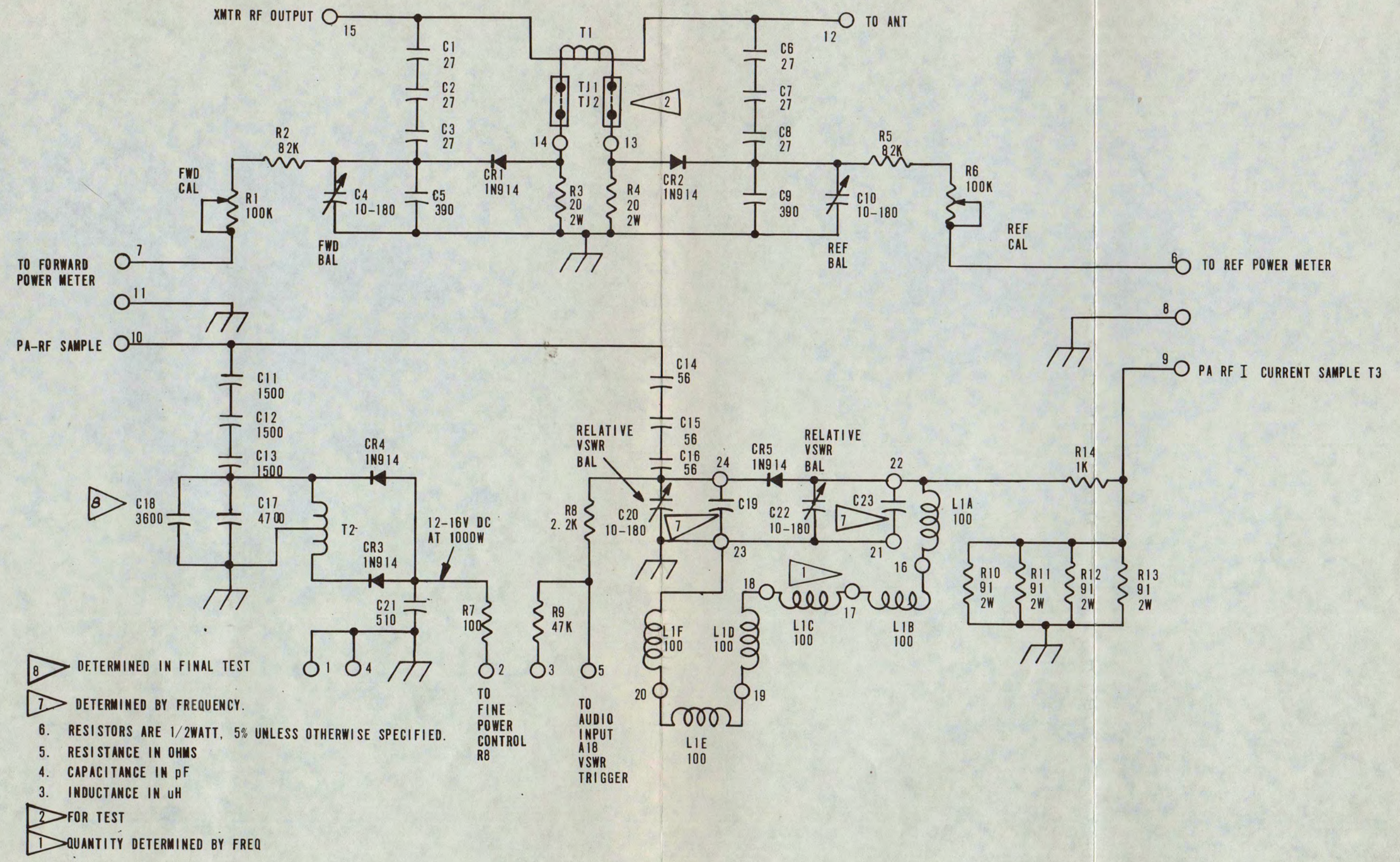


4. INDUCTANCE IN  $\mu$ H  
 3. CAPACITANCE IN pF  
 2. RESISTANCE IN OHMS  
 1. RESISTORS ARE 1/2WATT, 5%  
 UNLESS OTHERWISE SPECIFIED:

FIGURE 8-8. RELAY AND REGULATOR  
 A22, SCHEMATIC  
 828 8520 002

8-17/8-18





- 8 DETERMINED IN FINAL TEST
- 7 DETERMINED BY FREQUENCY.
- 6. RESISTORS ARE 1/2WATT, 5% UNLESS OTHERWISE SPECIFIED.
- 5. RESISTANCE IN OHMS
- 4. CAPACITANCE IN pF
- 3. INDUCTANCE IN uH
- 2 FOR TEST
- 1 QUANTITY DETERMINED BY FREQ

NOTES:

FIGURE 8-9. DIRECTIONAL COUPLER, A21, SCHEMATIC 828 8519 001

8-19/8-20



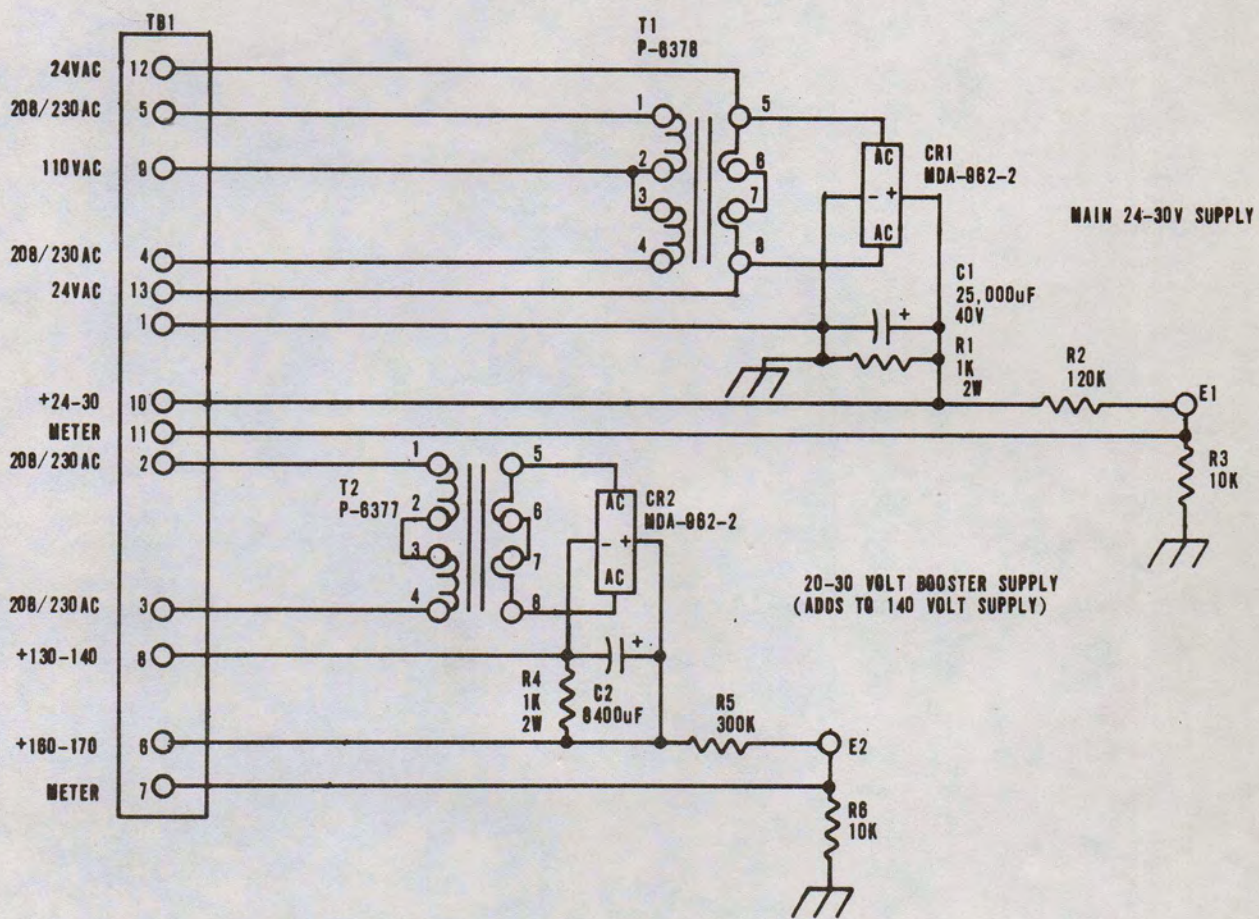


FIGURE 8-10. LOW VOLTAGE POWER SUPPLY, A24, SCHEMATIC 816 6409 001

8-21/8-22

WARNING: Disconnect primary power prior to servicing.



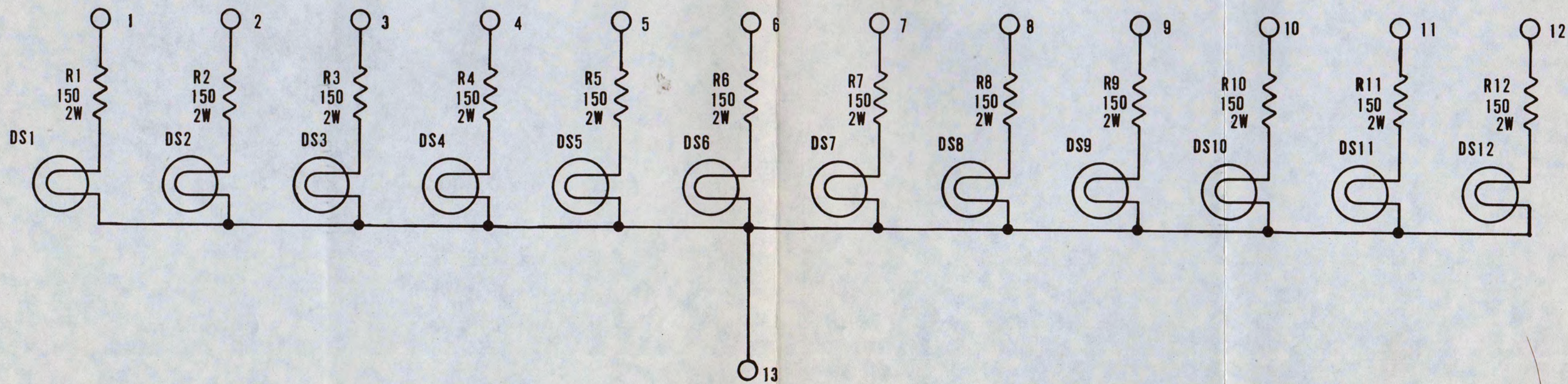


FIGURE 8-11. PA FAULT INDICATOR, A19, SCHEMATIC 828 8518 001

8-23/8-24



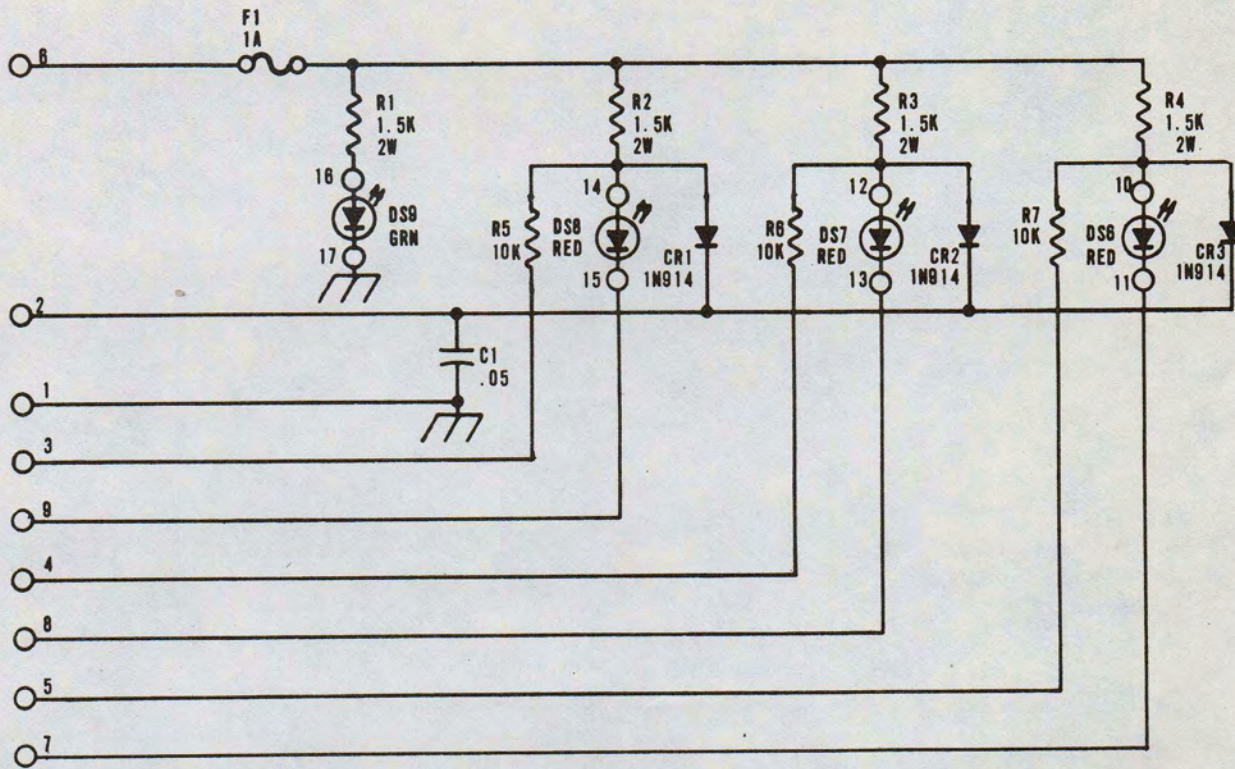


FIGURE 8-12. OVERLOAD LAMPS METER PANEL,  
A20, SCHEMATIC  
816 6408 001

8-25/8-26

WARNING: Disconnect primary power prior to servicing.



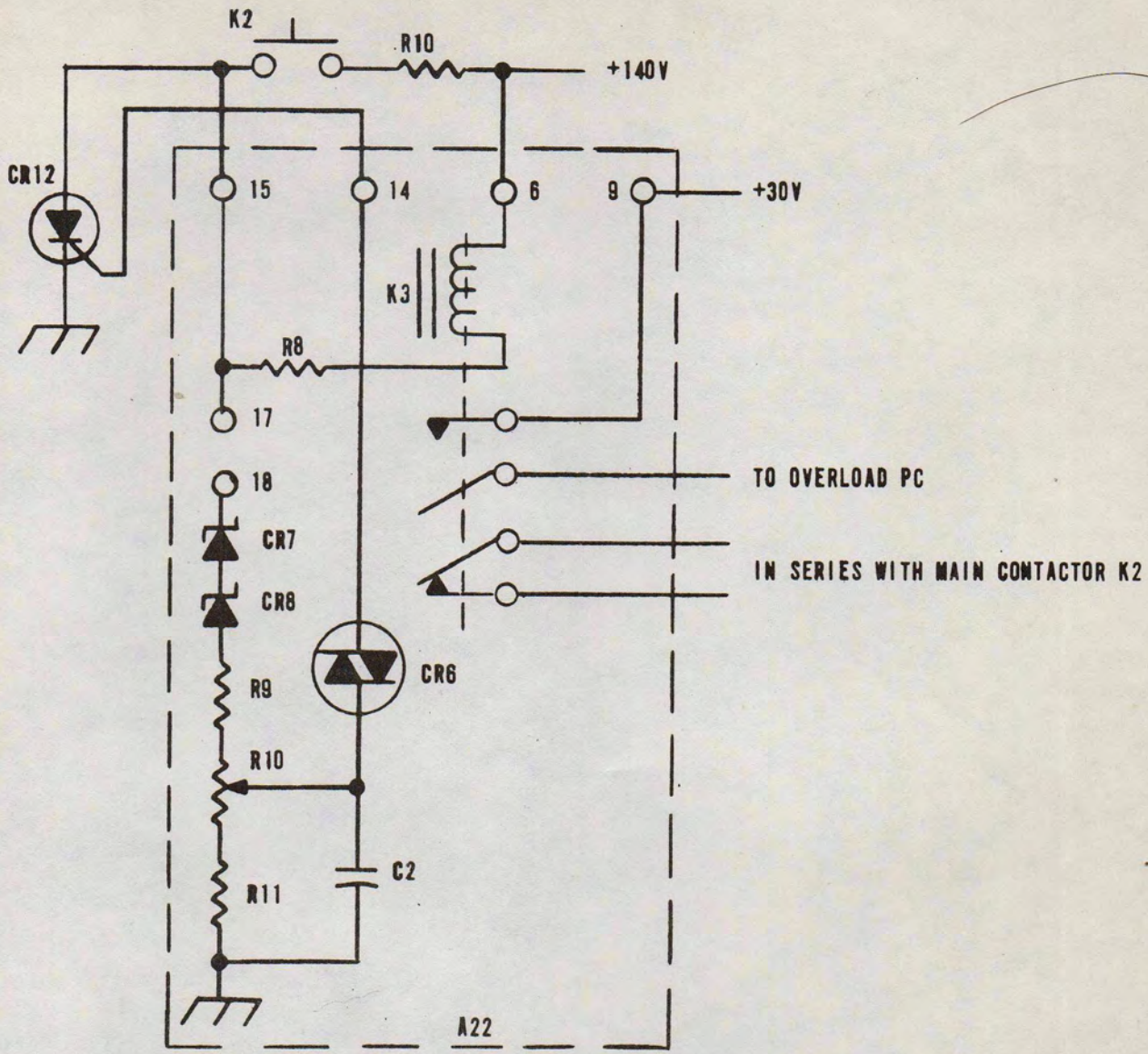


FIGURE 8-13. OVERVOLTAGE SENSOR SCHEMATIC,  
816 7534 001

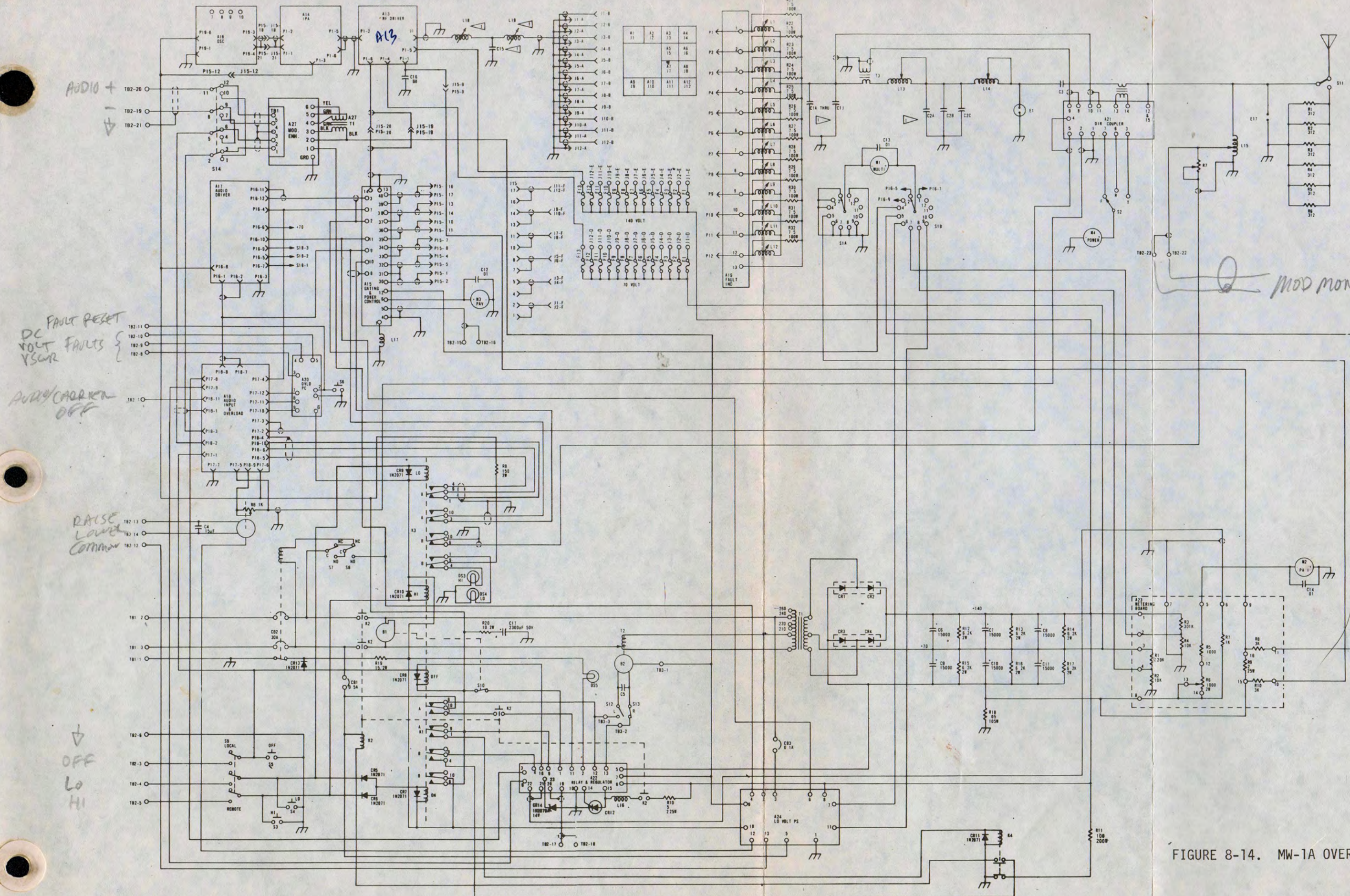
8-27/8-28

WARNING: Disconnect primary power prior to servicing.



50-80% modulation @ TX 100%

202



DC VOLT FAULTS YSWR

RAISE LOWER Common

OFF Lo HI

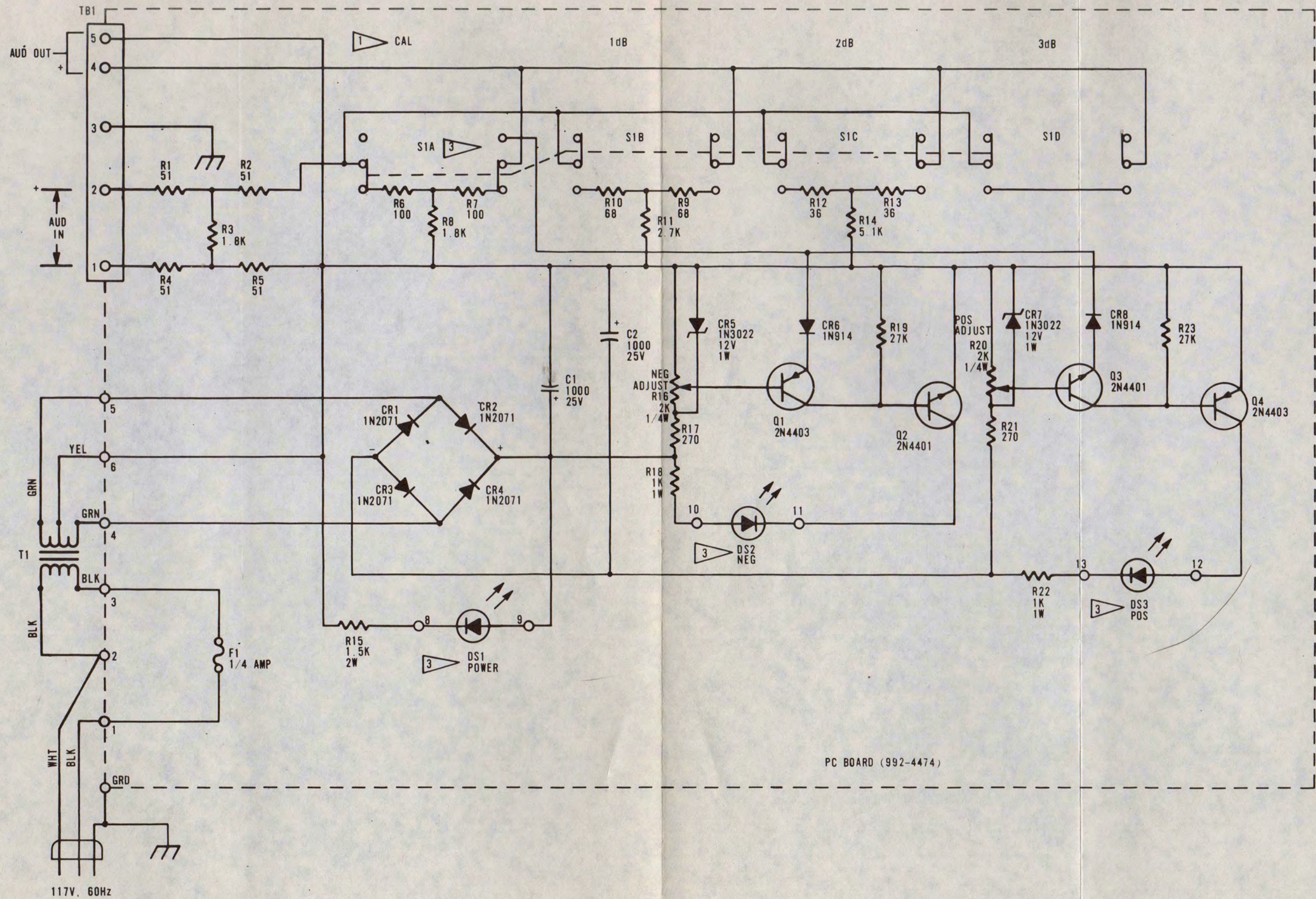
MOD MON

FIGURE 8-14. MW-1A OVERALL SCHEMATIC  
852 772 002

8-29/8-30

VALUES DETERMINED BY FREQUENCY  
NOTES:





2 TERM 2 IS + INPUT FROM LIMITER  
 TERM 4 IS + INPUT TO THE TRANSMITTER  
 1 SWITCH IS SHOWN IN CAL POSITION

5 ALL CAPACITORS 1 WATT MICROFARADS UNLESS NOTED  
 4 ALL RESISTORS 1/2 WATT UNLESS NOTES  
 3 COMPONENT MOUNTED ON FRONT PANEL

FIGURE 8-15. ME-1 MODULATION ENHANCER,  
 A27, SCHEMATIC  
 839 1066 001



APPENDIX A

MW-1 AM TRANSMITTER  
INSTALLATION CHECKLIST

① INTRODUCTION

The installation of the MW-1 Transmitter must be performed in strict accordance with instructions contained in Section II of the MW-1 Technical Manual. The purpose of the following checklist, which is referenced to Section II of the Technical Manual, is to provide a convenient method for verifying each step of the installation sequence. Carefully read the instructions before starting the installation. Use this checklist in conjunction with the Technical Manual while performing the transmitter installation. Verify that each procedural step is complete by providing a checkmark (✓) in the appropriate space. See Appendix B for a simplified troubleshooting chart for use during installation.

<u>PARAGRAPH REFERENCE</u>	<u>INSTRUCTIONS</u>	<u>PERFORMANCE VERIFICATION (✓)</u>
② <u>UNPACKING</u>		
2-3 thru 2-4	Compare packing list with items shipped. Perform visual inspection.	_____ _____
③ <u>PHYSICAL INSTALLATION</u>		
2-5 thru 2-8	Consult figure 2-1. Locate transmitter in place.	_____ _____
④ <u>EXTERNAL CONNECTIONS</u>		
2-9 thru 2-11	Consult figures 2-1 thru 2-3. Provide connections per instructions.	_____ _____
⑤ <u>POWER REQUIREMENTS</u>		
2-12	Perform step a. Perform step b.	_____ _____
⑥ <u>MODULATION MONITOR SAMPLE</u>		
2-13	Consult figure 2-3. Provide connection per instructions.	_____ _____
⑦ <u>AUDIO INPUT</u>		
2-14	Consult figure 2-3 Provide connection per instructions.	_____ _____



PARAGRAPH  
REFERENCE

INSTRUCTIONS

PERFORMANCE  
VERIFICATION (✓)

<u>PARAGRAPH REFERENCE</u>	<u>INSTRUCTIONS</u>	<u>PERFORMANCE VERIFICATION (✓)</u>
	<b>8</b> ANTENNA	
2-15	Consult figures 2-2 and 2-4. Provide connection per instructions.	_____ _____
	<b>9</b> REMOTE CONTROL (Optional)	
2-16	Consult figure 2-3. Perform steps a. through g.	_____ _____
	<b>10</b> REMOTE FAULT INDICATIONS (Optional)	
2-17	Consult figure 2-3. Perform steps a. through d.	_____ _____
	<b>11</b> INITIAL TURN ON (Preliminary)	
2-18 and 2-19	Observe cautionary notice following para. 2-19. Perform thorough visual inspection. Perform the following checks before proceeding with the Turn On Procedure: (1) Check internal wiring and connections. (2) Determine that PA and IPA modules are secure in their sockets. (3) Using an ohmmeter (RX1 scale). check Audio Driver, A17, fuses F1, F2, and F3. (4) Using an ohmmeter (RX1 scale), check 70-volt and 140-volt fuses, F1 through F13 located at rear of transmitter.	_____ _____ _____ _____ _____ _____

CAUTION

Fuses F1 thru F13 must be functioning properly and secure in their sockets. An open fuse will cause damage to the PA modules.

- (5) Remove fuses F1 thru F6 located on the Gating and Power Control board, A15. \_\_\_\_\_
- (6) Close front access door to engage interlock. \_\_\_\_\_

PARAGRAPH  
REFERENCE

INSTRUCTIONS

PERFORMANCE  
VERIFICATION (✓)

⑫ TURN ON PROCEDURE

2-20

Perform steps a. through g.

⑬ SUPPLEMENTARY INSTRUCTIONS

Before proceeding to step h., perform the following operations:

- (1) Depress the ON/HIGH switch.  
An indication of 55 to 65 volts should be observed on the PA VOLTS meter.

CAUTION

A voltage greater than 65 volts indicates a possible malfunction in the Transmitter. Do not proceed with the turn on procedure. Refer to Section VI, Troubleshooting, of the MW-1 Technical Manual.

- (2) Depress the Transmitter OFF switch.
- (3) If a correct reading of 55 to 65 PA volts has been obtained, replace Gating and Power fuses F1 thru F6 and close the front access door.
- (4) Apply power to the transmitter and proceed with the Turn On procedure.

2-20

⑭ Perform steps h. thru k.

⑮ Referring to Table 2-1, perform step 1. and record the actual readings observed:

AF DVR LO VOLT  
AF DVR CONTROL  
AF DVR HI VOLT  
RF DVR VOLT  
RF DVR AMPS  
160 VOLT SUPPLY  
140 VOLT SUPPLY  
70 VOLT SUPPLY  
30 VOLT SUPPLY  
PA AMPS



PARAGRAPH  
REFERENCE

INSTRUCTIONS

PERFORMANCE  
VERIFICATION (✓)

PA VOLTS  
FORWARD POWER  
REFLECTED POWER  
REF/VSWR

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①⑥ Perform steps m. thru n.

CAUTION

The Load and Tuning controls may become misadjusted during shipment. Carefully follow the instructions contained in step n.

①⑦ VSWR ADJUSTMENT PROCEDURE

2-21 and 2-22 Perform steps a. thru m.

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①⑧ TRANSMITTER LOADING

2-23 ①⑨ Perform steps a. thru o.

---

Referring to Table 2-2, perform step p. and record the actual readings observed:

AF DVR LO VOLT  
AF DVR CONTROL  
AF DVR HI VOLT  
RF DVR VOLT  
RF DVR AMPS  
160 VOLT SUPPLY  
140 VOLT SUPPLY  
70 VOLT SUPPLY  
30 VOLT SUPPLY  
PA AMPS  
PA VOLTS  
FORWARD POWER  
REFLECTED POWER  
REF/VSWR

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2-23 ②⑦ Perform step q.

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2-23 ②⑧ Perform steps r. and s.

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PARAGRAPH  
REFERENCE

INSTRUCTIONS

PERFORMANCE  
VERIFICATION (✓)

- 22 Referring to Table 2-3 and 2-4, perform steps s. and record the actual readings observed:

	<u>250 WATTS</u>	<u>500 WATTS</u>
AF DVR LO VOLT	_____	_____
AF DVR CONTROL	_____	_____
AF DVR HI VOLT	_____	_____
RF DVR VOLT	_____	_____
RF DVR AMPS	_____	_____
160 VOLT SUPPLY	_____	_____
140 VOLT SUPPLY	_____	_____
70 VOLT SUPPLY	_____	_____
30 VOLT SUPPLY	_____	_____
PA AMPS	_____	_____
PA VOLTS	_____	_____
FORWARD POWER	_____	_____
REFLECTED POWER	_____	_____
REL/VSWR	_____	_____

- 23 Perform steps u. thru w.

- 24 MODULATION CHECK

2-24

Perform steps a. thru o.



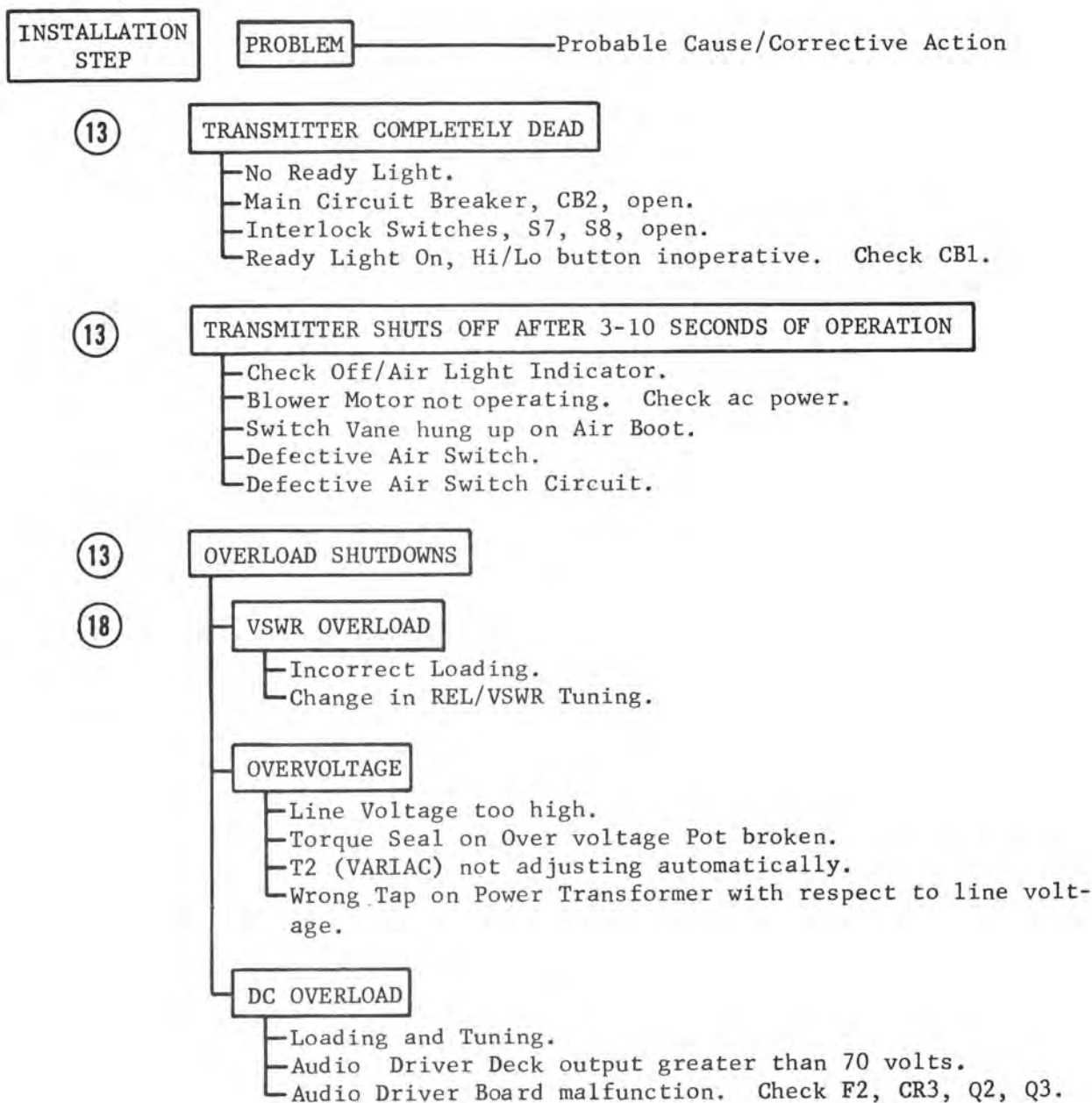
APPENDIX B

MW-1 AM TRANSMITTER TROUBLESHOOTING CHART

INTRODUCTION.

This simplified troubleshooting chart is provided for use during installation in the event a planned event or response does not occur or a negative response does occur. This chart should be used in conjunction with Appendix A--Installation Checklist.

SIMPLIFIED TROUBLE CHART

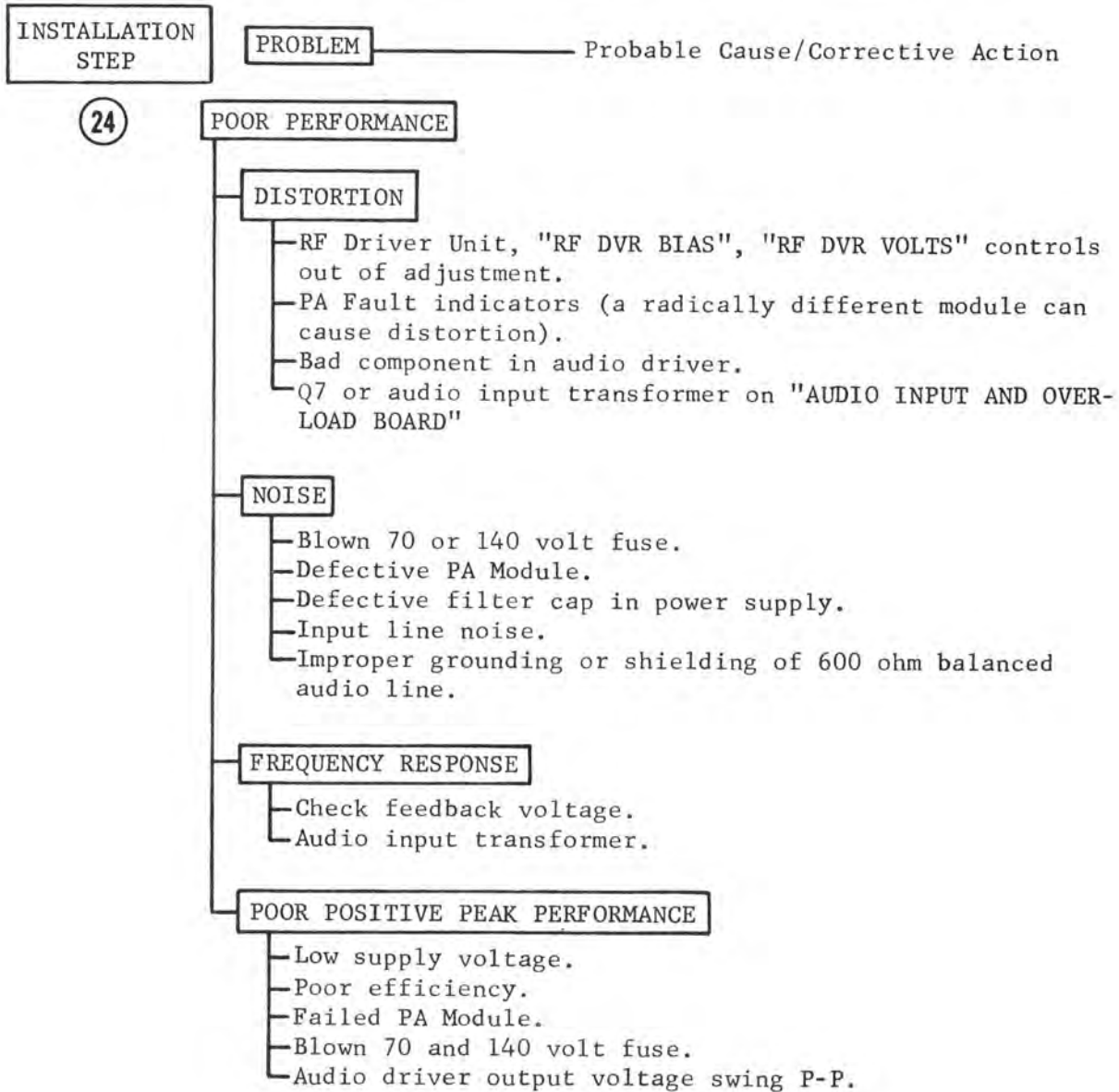


TROUBLESHOOTING CHART (Cont'd)

INSTALLATION STEP	PROBLEM	Probable Cause/Corrective Action
18	TRANSMITTER IS INCAPABLE OF 1000 WATTS	
19	SHUTS OFF BEFORE 1000 WATTS IS REACHED	<ul style="list-style-type: none"> <li>- Observe REL/VSWR reading.</li> <li>- Check Loading.</li> <li>- DC Overload Indicator. Check DC Overload Pot for torque seal.</li> </ul>
	POWER OUTPUT LIMITED, NOT BE OVERLOAD	<ul style="list-style-type: none"> <li>- Compare "PA VOLTS" to "PA AMPS" for correct ratio.</li> <li>- Compare "RF DVR AMPS" with value recorded on Test Data Sheet.</li> <li>- Observe "PA VOLTS". Limitation should be at 60 volts.</li> <li>- Monitor supply voltages (30, 70, 140, and 160 volts).</li> <li>- Check RF DVR TUNING for torque seal.</li> <li>- Check LED indicators on OSC. Board and IPA Board with scope. Observe output amplitude and waveshapes.</li> </ul>
13	"PA VOLTS" LIMITS BEFORE 60 VOLTS	<ul style="list-style-type: none"> <li>- Check supply voltage.</li> <li>- Check "AF DRIVER CONTROL".</li> <li>- Check Q4, Zener, and associated parts in PA Volt Limiter.</li> </ul>
18	NO RF OUTPUT AT ALL	
	NO RF DRIVE	<ul style="list-style-type: none"> <li>- Check for LED indicators on OSC. Board and IPA Board (2 on each).</li> <li>- Observe "RF DVR AMPS", 140 and 70 volt metering.</li> <li>- Fuse on A13 blown.</li> <li>- Observe "RF DVR VOLTS" metering and fuse F1 on A15 Board.</li> <li>- Is output of A13 module connected?</li> <li>- Are tuning slugs for L18 and L19 in torque seal position (driver tune).</li> </ul>
24	NO MODULATION OR DC BIAS TO PA MODULES	<ul style="list-style-type: none"> <li>- Observe "AF DVR HI VOLTS", "AF DVR LO VOLTS".</li> <li>- AF driver control.</li> <li>- Fuses F1, F3 on audio driver.</li> <li>- Fuses F1-F7 on Gating and Power Control Board, A15.</li> <li>- High and Low Power controls and their connections for continuity.</li> </ul>



TROUBLESHOOTING CHART (Cont'd)



994-7966-001

Frequency 1400 Output % 50 Pwr Hi 1000 Lo 250

Customer KUKI UKIAH CA. Serial No. 80-5398-003

All high power performance data taken at 1100 watts.

AC Supply 208 volts. Audio input level 10.4 dBm for MAX. Modulation at 1KHz.

Distortion Measured at 95% modulation: 1.5% Max High Pwr. 2% Max Low Pwr.

20 Hz	<u>1.01</u>	% Hi Pwr	<u>.73</u>	%	<u>250W</u>	_____	%	_____	W
1000 Hz	<u>.68</u>	%	<u>.69</u>	%	_____	_____	%	_____	W
10KHz	<u>1.35</u>	%	<u>.81</u>	%	_____	_____	%	_____	W

Audio Response measured at 95% modulation, reference to 1KHz.

+1 dB 20 to 10 KHz		Noise -60 dB or less	Lo Pwr Option
20 Hz	<u>-0.2</u> dB Hi Pwr	<u>-0.2</u> dB	<u>250W</u> _____ dB _____ W
1000 Hz	<u>-0-</u> dB	<u>-0-</u> dB	_____ dB
10KHz	<u>-0.2</u> dB	<u>-0.8</u> dB	_____ dB
Noise	<u>-61</u> dB	<u>-69</u> dB	_____ dB

Carrier Shift 1.0 %: Less than 2% at MAX modulation

Multi Meter

	1KHz Carrier	1KHz MAX Mod.	Reduced Pwr. MAX. Mod.
AF Dvr Lo Volt -30	<u>23.1</u>	<u>23.2</u>	<u>23.2</u>
AF Dvr Control -30	<u>23.0</u>	<u>23.0</u>	<u>23.0</u>
AF Dvr Hi Volt -300	<u>164</u>	<u>164</u>	<u>165</u>
RF Dvr Volt -120	<u>51</u>	<u>50</u>	<u>37</u>
RF Dvr Amps -3	<u>1.39</u>	<u>1.39</u>	<u>1.0</u>
160 Volt Supply -300 <u>160/170</u>	<u>161</u>	<u>159</u>	<u>161</u>
140 Volt Supply -300 <u>135/145</u>	<u>139</u>	<u>132</u>	<u>134</u>
70 Volt Supply <u>65/75</u>	<u>65</u>	<u>65</u>	<u>66</u>
30 Volt Supply <u>30-32</u>	<u>28</u>	<u>28</u>	<u>28</u>



P.A. Current (Internal Dummy)

22.5      24      12.1

P.A. Voltage (Internal Dummy)

51      53.8      28.2

Carrier Conditions Below Reflect Readings  
Into Flat 50 Ohm Load.

Power Output 1000 W

Reflected Power 2 W

P.A. Eff. % 86.3

P.A. Current 22.7

P.A. Voltage 51

Frequency Determining Components

Symbol	Value	Part No.
A14C4	(1) 5100 PF	500-0783-000
A13L18	(1) 8 TURN	928-8722-001
A13L19	(1) 12 TURN	928-8722-002
A13C15	(1) 5100 PF	500-0783-000
A21C17	(1) 3300 PF	500-0902-000
A21C18	(1) 3900 PF	500-0888-000
PA L1-L12	(12) 10 TURNS	928-7951-001
PA C1	(2) 5,000 PF	504-0244-000
	(2) 10,000 PF	504-0236-000
PA C2	(2) 1,000 PF	504-0037-000
	(1) 500 PF	504-0033-000

COMMENTS: T1 tapped at 230 Volts after testing.      IMD 2.7

L13 10 turns in use.

L14 9 turns in use.

ML

Tested by Bob HAVERMALE

Date 3-25-80

Released for Shipment \_\_\_\_\_

Release for Shipment R. J. Kellman Engineering