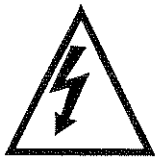
OPERATION & SERVICE MANUAL

A-500

Power Amplifier



HIGH RF VOLTAGES MAY BE PRESENT AT THE OUTPUT OF THIS UNIT. *All operating personnel should use extreme caution in handling these voltages and be thoroughly familiar with this manual.*

DO NOT USE ANY CFC (CHLOROFLUOROCARBON) SOLVENT IN THE MAINTENANCE OF THIS PRODUCT. In recognition of our responsibility to protect the environment, this product has been manufactured without the use of CFC's. The no-clean flux now used in all soldering operations may leave a small inert residue which will not affect the performance of the product. The use of CFC's for cleaning or maintenance may result in partial liquification of the no-clean flux residue, which will damage the unit and void the warranty.

This product is manufactured at ENI's Rochester NY plant, an ISO 9001 Quality System Certified Facility.

Notice

Revision Level: C1
Manual Order Number: A500-TM

Warranty

ENI warrants to the original purchaser for a period of one year from the date of delivery, each instrument to be free from defects in materials and workmanship. For a period of one year, ENI will, at its option, adjust, repair, or replace defective parts, without charge to the original purchaser, so that the instrument performs according to its specifications.

When warranty service is required, the instrument must be returned, transportation prepaid, to the factory or to one of ENI's designated service centers. If, in our opinion, the instrument has been damaged by accident, unreasonable use, buyer-supplied software or interfacing, improper site preparation or maintenance, or abnormal conditions of operation, repairs will be billed at standard rates. In this case, an estimate will be submitted before the work is started.

THIS LIMITED WARRANTY IS EXCLUSIVE AND ENI MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, AND ALL OTHER EXPRESS ORAL OR WRITTEN WARRANTIES AND ALL WARRANTIES IMPLIED BY LAW, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY ARE EXCLUDED AND DISCLAIMED. IN NO EVENT SHALL ENI BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM BREACH OF ANY WARRANTY, WHETHER EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR FROM ANY CAUSE WHATSOEVER, INCLUDING NEGLIGENCE. Buyer's sole and exclusive remedy under this warranty shall be repair or replacement as set forth above, or if ENI is unable to repair or replace the defective part within a reasonable time, a refund of the price of the part or goods which give rise to the warranty claim.

Service And Technical Assistance

For Service or Repair contact the closest Customer Service Department with the following information:

- Model and serial number
- Purchase order number
- Detailed description of malfunction
- Your company's "Bill To" and "Ship To" address

You will receive a RMA (Return Materials Authorization) number, the warranty status of the unit to be returned and estimated repair charge, if any. The RMA number is your authorization number. Please type this number on your purchase order and shipping label. After ENI receives the unit, a firm quote and estimated date of completion will be given.

For Technical Assistance for your particular application, contact the nearest ENI Sales and Service Center. The following information will help us provide you with prompt and efficient service:

- All of the information contained on the unit's name plate.
- Names and telephone numbers of important contacts.
- Detailed description (i.e. physical damage and/or performance anomalies, quantitative and/or qualitative deviation from specifications), including miscellaneous symptoms, dates and times.
- The environment and circumstances under which the issue developed
- Supporting test data and/or records that can be provided.
- Any previous, related conversations and/or correspondence with ENI.

Sales & Service Locations

ROCHESTER, NY	A Division of Astec America, Inc. 100 Highpower Road Rochester, NY 14623	Tel: (716) 292-7440 Fax: (716) 427-7839 Svc: (716) 292-7478
	Toll Free USA Sales Hotline: **Toll Free USA Service Hotline:**	**1-800-267-5362** **1-800-724-ENI1 (3641)**
FREMONT, CA	48834 Kato Road, Suite 110A Fremont, CA 94538	Tel: (510) 353-4ENI (4364) Fax: (510) 353-4360
AUSTIN, TX	4150 Freidrich Lane Suite J Austin, TX 78744	Tel: (512) 462-2191 Fax: (512) 462-9411
UNITED KINGDOM	Mundells Court, Welwyn Garden City Hertfordshire AL7 1EN England	Tel: (01707) 371 558 Fax: (01707) 339 286
GERMANY	Sielminger Str. 63 D-70771 Leinfelden-Echterdingen (Stetten) Stuttgart, Germany	Tel: (0711) 947 70 0 Fax: (0711) 947 70 25
JAPAN	541 Aoyogi Kunitachi Tokyo 186 Japan	Tel: (0425) 229 011 Fax: (0425) 222 636
TAIWAN	No. 15, Lane 24, Ming Hsiang 1 Street Hsinchu 300, Taiwan	Tel: (35) 787 762 Fax: (35) 787 760

Product and Applications information also available on the Internet at:

http://www.enipower.com

PRODUCT MANUAL REVISION CONTROL FORM

Title:	A-500 Operation & Service Manual	Part #:	A500-TM Rev #: C1	Final Assy #:	A500-1831 Eff. Date: 5/1/97

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CHAPTER 1

GENERAL INFORMATION

1.1 INTRODUCTION

The ENI Model A500 is an all solid state amplifier which has a flat frequency response from .3 mHz to 35 mHz. It provides 500 watts of linear power with low harmonic and intermodulation distortion. Gain is 60 dB nominal, with a variation of less than $\pm$1.0 dB over the entire frequency range. Input and output impedance are 50 ohms and the unit may be driven to full power output by most RF synthesizers, signal generators and swept signal sources.

The ENI Model A500 will deliver its rated power output into any load impedance, regardless of match. Built-in protection circuitry will absorb the power reflected from a mismatched load without causing failure or oscillation.

Output RF voltage is displayed on the front panel meter. Its integral power supply and cooling operate from a 230 VAC 50/60 Hz main supply.

The Model A500 will raise the power level of signal sources and generators without requiring tuning or bandswitching. The Class A linear circuitry will amplify signals of AM, FM, SSB, TV and complex modulations limited only by their peak input and bandwidth, with minimum distortion.

1.2 SPECIFICATIONS

Physical and electrical specifications are listed in Table 1-1.

1.3 INSTRUMENT IDENTIFICATION

Each amplifier is identified by a serial number tag on the back panel of the unit. Both the model number and the serial number should be given in any correspondence with the company.

Table 1-1 SPECIFICATIONS

FREQUENCY COVERAGE:	300 kHz to 35 MHz
GAIN:	60 dB
GAIN VARIATION:	± 1 dB
MAXIMUM LINEAR POWER OUTPUT:	500 Watts (into 50 ohms)
HARMONIC DISTORTION:	All harmonics greater than 22 dB below fundamental at 400 Watts. Lower at Reduced Power.
TYPICAL 3RD ORDER INTERMODULATION INTERCEPT POINT:	+66 dBM
INPUT/OUTPUT IMPEDANCE:	50 ohms
INPUT VSWR:	Less than 1.5: 1
OUTPUT VSWR:	Less than 3.5: 1
NOISE FIGURE:	10 dB Maximum
STABILITY:	Unconditionally stable; unit will not oscillate for any condition of load and source impedance.
PROTECTION:	Unit will withstand more than 16 dB of overdrive (input signal of 1V RMS) for all output load conditions.
OUTPUT METERING:	Average reading voltmeter calibrated in RMS volts for a sine wave with an accuracy of ±5% of full scale (0-255 volts) also calibrated in Watts into 50 ohms (0-900 Watts).

Table 1-1 SPECIFICATIONS (Cont'd)

POWER REQUIREMENTS:	208, 230, 245, VAC Tap Selected, ±5%, 50-60 Hz at approximately 25 amperes.
OPERATING TEMPERATURE:	0 to 40°C
SIZE:	26.5 x 17 x 22.5 in. 67.3 x 43.2 x 57.1 cm.
WEIGHT:	165 lbs. (74.8 kgs.)
CONNECTORS:	Type N

CHAPTER 2

PREPARATION

2.1 INITIAL INSPECTION

2.1.1 Mechanical Check

If damage to the shipping carton is evident, request the carrier's agent be present when the instrument is unpacked. Check the equipment for damage and inspect the cabinet and panel surfaces for dents and scratches.

2.1.2 Claim for Damage

If the Model A500 is mechanically damaged or fails to meet specifications upon receipt, notify ENI or our representative immediately. Retain the shipping carton and packing material for the carrier's inspection as well as for subsequent use in returning the unit if necessary.

2.1.3 Performance Check

The electrical performance of the Model A500 should be verified as soon as possible after receipt. The following is a performance check that is suitable for incoming inspection.

a. Set the amplifier front panel power switch to the ON position and check that the pilot light illuminates and the fan motors are operating normally.

b. Perform the RF Output Power Test, Section 5.1.4.

2.2 PREPARATION FOR USE

2.2.1 Power Requirements

The Model A500 requires a 50-60 Hz, single phase, power source with a fused capacity of 25 amperes. The unit must be adjusted to accommodate the available AC line voltage. This is accomplished by moving the AC line jumper to the correct terminal of terminal block TB1 in accordance with Table 2-1. The AC line jumper is easily identified by its red terminal lug.

Terminal strip TB1 is located on the Driver Power Supply Heatsink Assembly (A500-3839) and is accessible by removing twelve +6-32 screws from the top cover and lifting it off.

2.2.1 Power Requirements (Cont'd)

Disconnect the line cord from the power main when adjusting the operating voltage. Failure to connect the AC line jumper to the correct AC line voltage may result in severe damage to the instrument. The A500 is normally shipped from the factory with the jumper connected to the 230 volt line connection.

2.2.2 Power Cable Ground Protection

To protect operating personnel, the ENI Model A500 is equipped with a three conductor cable consisting of a black hot line, a white common line, and a green chassis ground. For U.S. delivery, the Model A500 is supplied with a three wire 30 ampere, 250 volt plug NEMA L6-30P. This plug must be inserted into a properly wired 30 ampere, three wire grounding receptacle NEMA L6-30R.

TABLE 2-1 LINE VOLTAGE CONNECTIONS

NOMINAL AC LINE VOLTAGE	TB1 TERMINAL CONNECTION (RED JUMPER)
208	3
230	2
245	1

2.2.3 Cooling

When the A500 is enclosed by an external cabinet, provisions must be made to insure an adequate flow of cooling air to the unit. Ambient temperature of the air must not exceed 40 degrees Celsius.

2.3 OPTIONAL RACK MOUNTING KIT (RA500)

The Model A500 may be mounted into any standard 19 inch rack cabinet that has a minimum depth of 25 inches with the aid of the optional RA500 rack mounting kit. The extra cost kit includes the slides, mounting brackets and hardware to enable the A500 to be mounted into the cabinet. Complete instructions for installing the RA500 components are included with the kit.

2.4 PACKAGING FOR RESHIPMENT

Whenever possible, the original shipping carton and packing material should be used for reshipment. If the original packing material is not available, wrap the instrument in heavy paper or plastic. Use a strong shipping container. If a cardboard carton is used, it should be at least 300 lbs. test material. Use shock absorbing material around all sides of the instrument to provide a firm cushion and to prevent movement inside the container. A minimum of two inches should be between the instrument and the container wall on each side. Protect the front panel and meter by means of cardboard spacers inserted between the front panel and the shipping carton. Make sure that the instrument cannot move in the container during shipment. Seal the carton with a good grade of shipping tape and mark the container: FRAGILE ELECTRONIC INSTRUMENT.

CHAPTER 3

OPERATION

3.1 FUNCTIONAL DESCRIPTION

The ENI Model A500 is a linear Class A amplifier capable of increasing the output of any signal generator, frequency synthesizer, sweep generator or laboratory signal source from .3 mHz to 35 mHz

Less than 300 millivolts of signal is required from the output of the signal source into the 50 ohm input of the amplifier to extract maximum power output. The output power of the A500 is directly proportional to the input signal and therefore, the attenuator of the signal generator will serve as attenuator for the overall output.

The Model A500 is completely protected against damage due to load mismatch provided that the input RF level does not exceed 1 volt RMS or 1.4 volts peak. If the attached signal source is capable of generating substantially more than this input voltage, please use caution in adjusting it. The Model A500 will saturate well before the maximum input voltage and there will be no increase in the output power at that point.

The A500 is unconditionally stable. Any combination of input and output impedances can be connected to the amplifier without causing damage or oscillation.

The A500 will deliver its rated power to any load impedance regardless of match. Load mismatch will cause RF power to reflect back to the amplifier. The unit is designed to withstand 100 percent reflected power (a pure reactance, open or short circuit load will cause 100 percent reflected power) continuously without damage.

An output meter is provided to indicate the average output voltage (calibrated in rms) as well as the power output when the unit is connected to a 50 ohm load. Since the meter responds only to average output, the modulation characteristics of the input signal must be taken into account when interpreting the meter readings. For example, the amplifier may be saturated during the ON portion of the pulse, yet the meter reading will be low due to the low duty cycle of the pulse input.

3.2 CONTROLS, INDICATORS AND CONNECTORS

Front and rear panel devices are described in Table 3-1.

3.3 OPERATING PROCEDURE

Refer to the following procedure as a guide to operating the Model A500.

a. The input and output are connected via the rear panel type N connectors to the signal source and load respectively.

b. The input signal should be increased gradually while observing the output voltage on the output RF voltmeter.

c. When the Model A500 is connected to a 50 ohm load, the CW power output of the unit may be read directly from the meter scale.

d. When the amplifier is connected to an arbitrary or unknown load impedance, the following procedure will insure a low distortion power output.

   1. Disconnect the output load cable from the output type N connector of the Model A500.

   2. If the CW output voltage is less than 225 volts RMS, the unit is operating at low distortion regardless of the load impedance.

   3. Reconnect the output of the amplifier to the load.

e. If the output of the amplifier is monitored by a high frequency oscilloscope or spectrum analyzer, the input signal may be increased until the point of maximum undistorted power output is observed.

3.4 PRECAUTIONS

a. The input and output of the Model A500 should not be connected together. This will cause oscillation and may damage the input preamplifier.

b. The Model A500 should not remain connected to an antenna when the unit is not in use. If thunderstorms are likely, it would be prudent to earth ground the unit's case.

c. When the input signal voltage of the signal source is unknown, insert an attenuator between it and the Model A500 input.

TABLE 3-1. FRONT AND REAR PANEL DEVICES

DEVICE	FUNCTION
POWER SWITCH	Throwing toggle to "on" position connects fans and power supply to main power source.
METER	Indicates output voltage and also power for a 50 ohm load. The meter circuit responds to the average RF voltage and is calibrated in rms volts for a sine wave. The voltage pick-off is mounted directly behind the rear panel at the output connector.
INPUT CONNECTOR	Type N for connection of the driving generator. Input impedance is 50 ohms. No more than 0.3 volts is required to obtain saturated output. Up to 1.4 volts peak can be supplied without causing damage; however, no additional power output can be expected.
OUTPUT CONNECTOR	Type N for connection of amplifier output to load.
FUSE	Holder required 3AG size, slow-blow type fuse: 25A for 208 to 245 VAC.
LINE CORD	Three prong type plug with safety ground pin connected to cabinet. For U.S. delivery the Model A500 is supplied with a 2 pole, 3 wire grounding, 30 ampere, 250 volt plug NEMA L6-30P. This plug must be inserted into a properly wired 30 ampere, 3 wire grounding receptacle NEMA L6-30R.

CHAPTER 4

PRINCIPLES OF OPERATION

4.1 GENERAL

The Model A500 achieves its high level of power output by combining the power outputs of a number of individual transistor amplifiers. The hybrid combining technique permits each amplifier to operate independently of all the others and to supply its power output contribution without regard to the other amplifier stages. This isolation is afforded by ferrite loaded transformer hybrids connected at the input and output of each transistor pair.

Each amplifier module is designed to have an input and output impedance of 50 ohms. Therefore, the individual modules can be disconnected and tested independently.

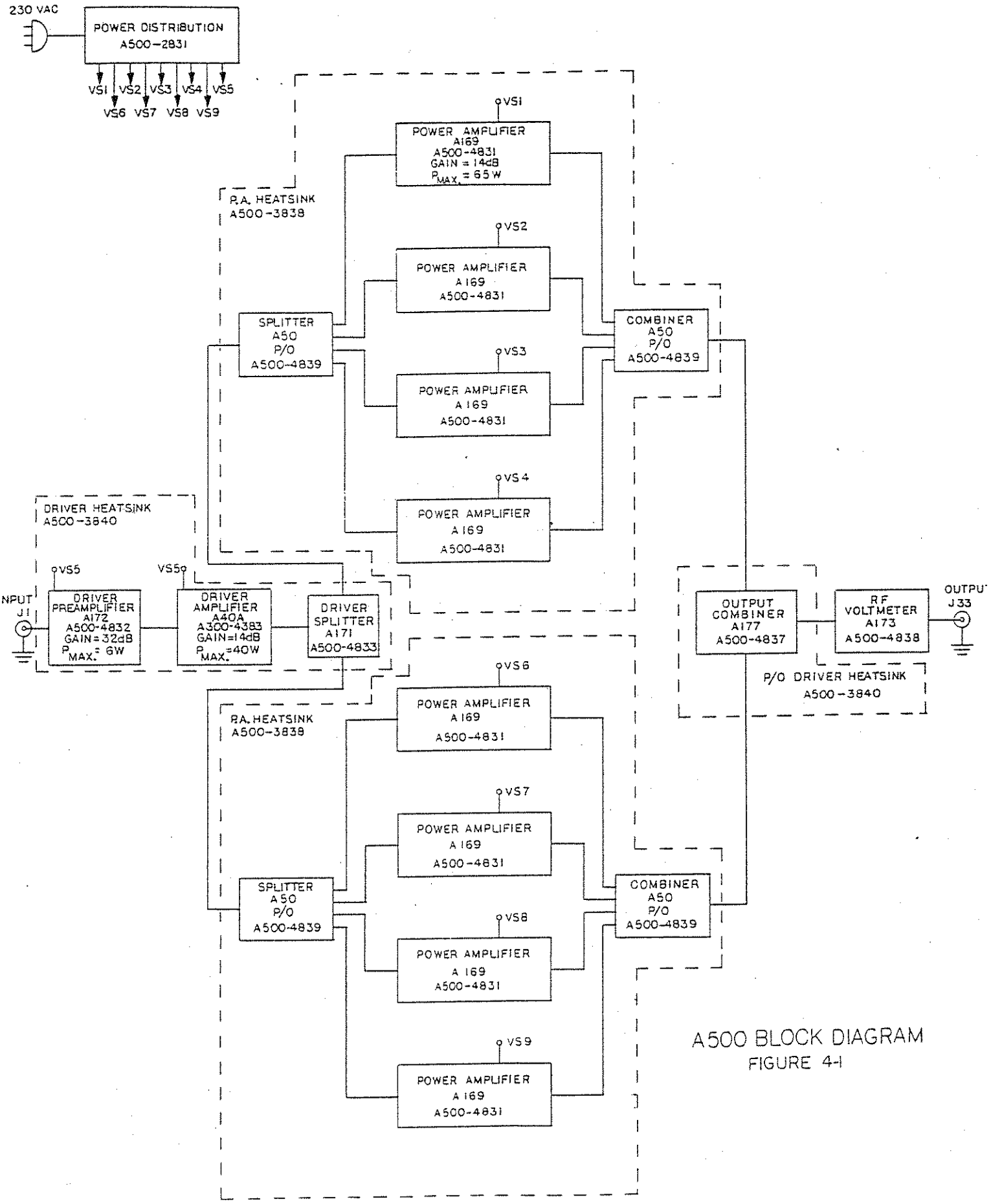
Highly linear Class A transistors are used throughout the amplifier. Their linearity is augmented by negative feedback networks connected to each stage. The high power output transistors have nichrome resistors deposited at their emitter terminals to increase linearity and reliability.

The amplifier is powered by a low noise DC regulator of dissipative design. Over-temperature protection is built into the power supply and cooling fans.

4.2 BLOCK DIAGRAM DESCRIPTION

A block diagram of the entire Model A500 is shown in Figure 4-1. The complete schematic diagrams are shown in Figures 7-1 and 7-2.

Input signal from the rear panel type N connector is fed to the driver preamplifier module (A500-4832). The preamplifier has a gain of 32 dB and a linear power output of up to 4 watts. The preamplifier output is fed via coaxial cable to the driver power amplifier module (A300-4381). Here, the signal assumes an additional 14 dB of gain, and the production of linear power can exceed 40 watts. This signal is then fed via coaxial cable, to the driver splitter module (A500-4833) which divides the signal into two equal amplitude and phase outputs. The driver splitter outputs are fed, again by coaxial cable, to two four-way splitter/combiner modules (A500-4839). The splitter section of each module has four equal amplitude and phase outputs which are fed to the power amplifier modules (A1000-4977). Each power amplifier has a gain of 14 dB and is capable of producing more than 65 watts of linear power at its output.



A500 BLOCK DIAGRAM
FIGURE 4-1

4.2 BLOCK DIAGRAM DESCRIPTION (Cont'd)

These outputs are summed and isolated from each other in the combiner sections of the splitter/combiner modules. The outputs of the combiner sections of these modules (A300-4383) are summed in the output combiner (A500-4837). RF output is fed to the rear panel type N output connector and to the RF voltmeter module (A500-4838). The RF voltmeter module provides a DC signal to the front panel meter, proportional to the output level. The power distribution (A500-2831) provides cooling and DC power to the entire unit. There are nine regulated power supplies, eight of which provide +35.4 VDC to the power amplifiers at a current of up to 8 amperes each. The driver power supply will deliver +25.5 VDC, again at a current of 8 amperes.

4.2.1 Driver Preamplifier Module (A172) A1000-4977

Input RF signal is fed through J2 to the base of Q1, amplified, and fed to the base of Q2. From the collector of Q2 the amplified signal is fed through impedance matching transformer T1, to the base of Q3. Here the signal is again amplified, and sent from the collector, through impedance matching transformer T2 to the output connector J3.

4.2.2 Driver Power Amplifier Module (A40A) A300-4381 and Power Amplifier Module (A169) A1000-4977

The input signal is fed through J4 (A40A) or J11 (A169), matched split and phase reversed by transformer T1 and T2. Two equal amplitude, phase reversed signals are fed to the bases of Q1 and Q2 through matching transformers T3 and T4. The power outputs of Q1 and Q2 are matched through transformer T5 and T7 and combined in phase reversing transformer T8. Transformer T9 matches the output impedance to 50 ohms at connector J5 (A40A), or J19 (A169). Transformer T6 is an RF choke which isolates the collectors of Q1 and Q2 from the power supply.

4.2.3 Bias Regulator Module (A49) A300-4387 (A49) A500-4836

The bias regulator module A300-4387 and A500-4837 consist of an integrated circuit voltage regulator IC-1 feeding buffer transistor Q1. The voltage regulated output is adjusted by potentiometer R3 on both modules. The DC output is fed to the base of Q1 which is connected as an emitter follower. A49Q1 (A300-4387) supplies the base current for the RF power transistors A40AQ1 and A40AQ2, while A49Q1 (A500-4837) does the same for A169Q1 and A169Q2.

4.2.4 Four-Way Splitter/Combiner Module (A50) A500-4839

The splitter input signal is injected at connector J9. Transformer T1 impedance matches the signal to hybrid splitting transformers T2, T3, and T4 where it is divided into four equal amplitude and phase signals and fed to connectors P11, P12, P13, and P14.

RF power is injected into the combiner at connectors P19, P20, P21 and P22 and is summed by hybrid transformers T5, T6 and T7. Capacitor C2 compensates for the winding reactance of transformer T7. The RF power is matched to 50 ohms at the output connector J27 by transformer T8.

4.2.5 Two-Way Output Combiner Module (A177) A500-4837

RF signals injected by connectors J28 and J29 are summed by hybrid transformer T1. Transformer T2 matches the output impedance to 50 ohms at connector J31.

4.2.6 RF Voltmeter Module (A173) A500-4838

Resistors R1, R2, R3, R4 and R5 make up a high impedance voltage divider which is connected to the RF output voltage at the A500 output connector J33. A fast switching hot carrier diode D1 rectifies the RF voltage from the divider. A wire gimmick (capacitor C2) compensates for the high frequency roll off of diode D1. Resistors R6, R7 and capacitor C1 filter the rectified RF and convert it to DC which is fed to the front panel meter.

4.2.7 Power Distribution (A500-2831)

AC line voltage is carried through TB1 on the power supply baseplate (A500-3834), to contactor K1 and finally to the primary voltage taps of T1. These taps are located on TB1 of the driver power supply heatsink (A500-3839) and allow selection of line voltages suitable to the amplifiers operation. (See power requirements, section 2.2.1). The two rear panel fans (B1,B2) receive 115 VAC from the primary winding of T1 through TB1 (A500-3834). T1 has two secondary windings of different voltages. The high voltage winding supplies power to four full wave bridge rectifiers CR1, CR2, CR4 and CR5. The output of each of these rectifiers has a pair of filter capacitors (C1-C4, C6-C9). The low voltage secondary winding of T1 supplies power to full wave bridge rectifier CR3 only. The output of this rectifier has only a single filter capacitor C5.

4.2.7 Power Distribution (A500-2831) (Cont'd)

The outputs of CR1 and CR2 are fed to the collectors of Q1-Q16 located on the P.A. power supply heatsink assembly (A500-3836). The output of CR3 is fed to the collectors of Q1-Q4 on the driver power supply heatsink assembly (A500-3839).

The outputs of CR4 and CR5 are fed to the collectors of Q1-Q16 located on the P.A. power supply heatsink assembly (A500-3835).

These power supply assemblies form a total of nine (9) series pass regulators of the dissipative type and are connected to nine (9) separate integrated circuit voltage regulators IC1 through IC9, located on the power supply regulator board (A176) A500-4835. The voltage output of each supply is adjusted by potentiometers R31 through R39 located on the regulator board. Each of the nine power supplies has its own short circuit protection adjusted by potentiometers R11-R19, also on the power supply regulator board. These controls are factory set.

CHAPTER 5

PERFORMANCE TEST PROCEDURES

5.1 PERFORMANCE TESTS

5.1.1 General

There are three tests required to check the operation and performance of the Model A500. These tests are as follows: 1) the gain and gain variation test, 2) the RF output power test and the 3) RF output distortion test.

5.1.2 Test Equipment Required

The following test equipment is required for accomplishing the Model A500 performance tests. Equivalent substitutes for recommended models may be used.

a. Oscilloscope - Telequipment Model T921

b. RF Generator/Sweeper - HP-8601A

c. 50 ohm Detector - HP8471A or Wavetek D151

d. Attenuator, 30 dB, 2000 Watts-Bird 8329

e. Attenuator, 30 dB, 50 Watts-Bird 8321

f. Attenuator, 20 dB, 500 Watts - Electro-Impulse AX-500-20

g. Attenuator, 10 dB, 20 Watts-Narda 766-10

h. Calorimetric Power Meter - HP434A

i. Spectrum Analyzer - HP140T Display Unit, HP 8554L Spectrum Analyzer - RF section, HP 8552A Spectrum Analyzer - IF section.

5.1.3 Gain and Gain Variation Test

The purpose of this test is to verify the gain and gain flatness versus frequency of the Model A500.

5.1.3.1 Calibration of Set-Up

a. Set-up the test equipment as shown in Figure 5-1.

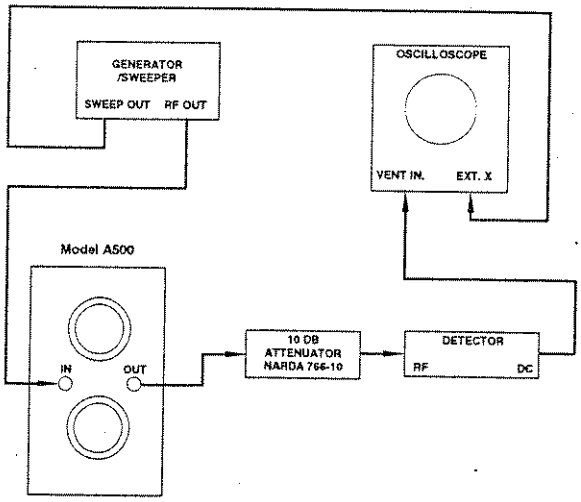


Figure 5-1. Gain and Gain Variation Test Set-Up

b. Set Oscilloscope to DC, Time/CM to Ext. X, and vertical gain to 10mV/CM.

c. Set the RF Generator/Sweeper to video sweep and frequency to 35 MHz.

d. Disconnect the Model A500 from the set-up and connect the Generator/Sweeper RF output directly to the 10 dB attenuator.

e. Adjust the output level of the Generator/Sweeper for full vertical deflection on the oscilloscope face.

f. Calibrate the scope face to show 2 dB in 1 dB steps by attenuating the Generator/Sweeper in 1 dB steps and marking the traces with a grease pencil.

g. Return Generator/Sweeper output level to full deflection. Rotate the step attenuator on the Generator/Sweeper (CCW) so that the output is reduced by 60 dB.

h. Reconnect Model A500 into the test set-up of Figure 5-1.

5.1.3.2 Measurement Procedure

a. Turn on Model A500 power switch.

b. Observe the gain versus frequency sweep on the oscilloscope.

c. The average gain should be 60 dB (within 1 dB).

d. The gain variation should be within the 2 dB markings as shown on the oscilloscope face.

5.1.4 RF Output Power Test

The purpose of the RF power output test is to verify that the Model A500 will deliver more than 500 watts of RF power over the frequency range of 0.3 MHz to 35 MHz.

5.1.4.1 Measurement Procedure

a. Set-up the test equipment as shown in Figure 5-2.

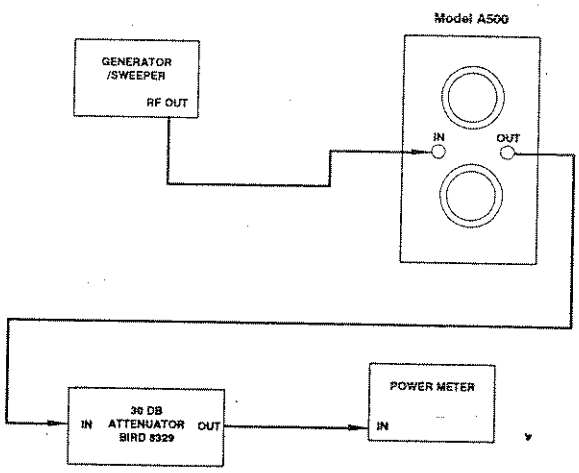


Figure 5-2. RF Output Power Test Set-Up

b. Set the calorimetric power meter to the 1.0 watt range. With the 30 dB series attenuator, this corresponds to a full scale deflection of 1000 watts.

c. Set the Generator/Sweeper to CW, output level to +10 dBm and frequency to 35 MHz.

d. Slowly decrease frequency while observing the power meter. Note that at every frequency down to 0.3 MHz, the power output is in excess of 500 watts.

5.1.5 RF Output Distortion Test

The purpose of this test is to verify that the harmonic distortion of the Model A500 and hence its linearity is within specified limits.

5.1.5.1 Measurement Procedure

a. Set-up the test equipment as shown in Figure 5-3.

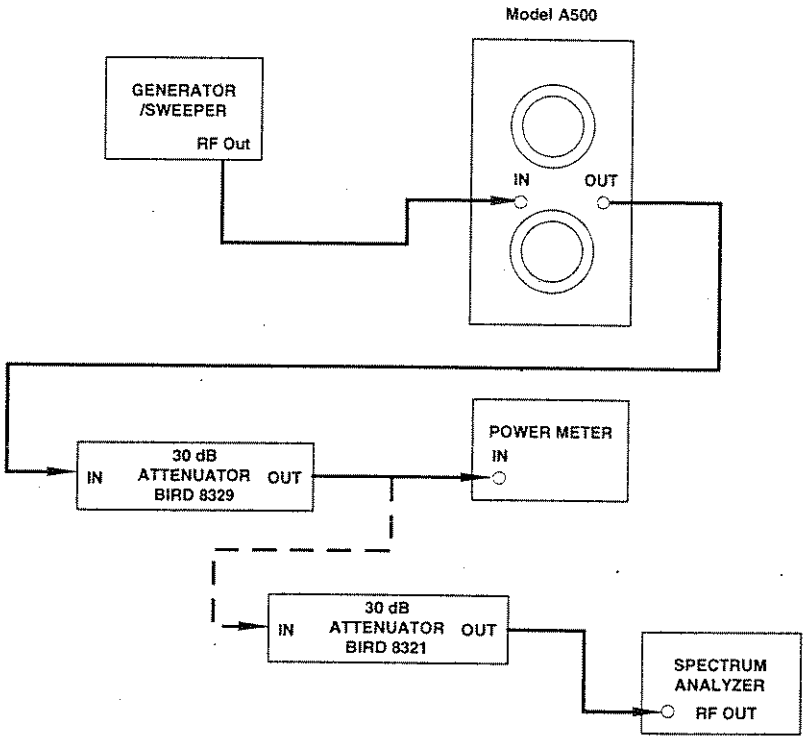


Figure 5-3. RF Output Distortion Test Set-Up

b. Set the calorimetric power meter to the 1.0 watt range. With the 30 dB services attenuator, this corresponds to a full scale deflection of 1000 watts.

c. Set the Generator/Sweeper to CW and frequency to 10 MHz.

d. Adjust the Generator/Sweeper output level so that the output power indicated on the calorimeteric power meter is 400 watts.

e. Disconnect the cable from the power meter and connect it to the Spectrum Analyzer through a 30 dB attenuator.

f. Observe that all the harmonics are at lease 22 dB below the fundamental signal.

g. Repeat steps a. through f. with the generator frequency set at 0.3 MHz, 1 MHz, 5 MHz, 20 MHz, and 35 MHz in sucession.

CHAPTER 6

TROUBLESHOOTING AND REPAIR

6.1 TROUBLESHOOTING

The first step in isolating a malfunction is to review the conditions under which the symptoms were observed and check that it was not caused by the external cabling or associated test equipment. Before proceeding to the detailed test procedure, a complete visual inspection of the A500 should be accomplished. Check for burnt or discolored components and broken wires and note any details which might localize the malfunction.

Commonly found symptoms together with their probable cause and troubleshooting recommendations are listed in the Troubleshooting Guide, Table 6-1.

TABLE 6-1. TROUBLESHOOTING GUIDE

SYMPTOM	PROBABLE CAUSE	RECOMMENDATIONS
Power lamp does not light	Burned out bulb	Check for 25.5 volts across bulb.
	Defective power supply	Perform test in section 6.3.2
	Thermal switch open	If TS1 or TS2 contacts do not close after unit has cooled, replace thermal switch.
	Defective Power Relay	Replace Relay K1.
	Defective Power Switch	Replace switch (S1).
	Blown Fuse	Replace fuse per table 3-1.

TABLE 6-1. TROUBLESHOOTING GUIDE (Cont'd)

SYMPTOM	PROBABLE CAUSE	RECOMMENDATIONS
Power Lamp dim	Power supply out of adjustment	Perform power supply adjustment section 6.3.2.
Blown fuse	Defective power supply	Perform test in section 6.3.2.
	Wrong fuse	Check per table 3-1.
	Defective line cord or AC wiring.	Visually inspect for signs of insulation breakdown.
No RF output or gain	Broken input or output type N connector.	Visually inspect connectors for broken pins.
	Defective input or output internal cables.	Visually inspect cables at input and output connectors.
Low RF Output or Gain	Defective input cables	Visually inspect cables.
	Faulty Power Supply Adjustment	Perform power supply adjustment section 6.3.2.
	Defective RF Amplifier Module	Perform procedure for locating faulty RF module, section 6.2.

TABLE 6-1. TROUBLESHOOTING GUIDE (Cont'd)

SYMPTOM	PROBABLE CAUSE	RECOMMENDATIONS
Excessive Distortion	Defective Power Amplifier	Perform procedure for locating faulty RF module, section 6-2.
	AC line Jumper at wrong connection.	See Table 2-1.
Amplifier Overheating	Defective Fan	Check that fans are operating properly.
	AC line Jumper at wrong connection.	See Table 2-1.
	Ambient air is above specifications	Measure the ambient temperature.
	Defect in Power Supply	Perform test in section 6.3.2.
Incorrect Front Panel Meter Indication	Improper Calibration or defective RF voltmeter board (A173)	Perform RF voltmeter adjustment, section 6.2.3.
	Defective Meter	Replace meter
Meter reads up scale with input & output cables removed.	Sticking meter movement	Replace meter

TABLE 6-1. TROUBLESHOOTING GUIDE (Cont'd)

SYMPTOM	PROBABLE CAUSE	RECOMMENDATIONS
Meter reads up scale with input and output cables removed.	Unit oscillating because of loose or defective internal coax cable connections	Tighten all RF connectors
Excessive ripple on gain versus frequency sweep of amplifier.	Ripple on Power Supply	Perform DC power supply test, section 6.3.2.

6.2 LOCATING FAULTY RF MODULE

6.2.1 General

The input and output impedance of each of the RF modules in the Model A500 is 50 ohms. Therefore, they can be disconnected from each other at any point and tested independently.

The following sections provide a method of locating a faulty RF module.

6.2.2 Isolating Amplifier Problem

a. Set-up the test equipment as shown in Figure 5-2 for RF power output test.

b. Set the RF generator to CW, the frequency to 10 Mhz and output level to -3 dBm. If the Model A500 output power is less than 500 watts, as indicated on the calormetric power meter, a faulty RF module may exist.

6.2.2 Isolating Amplifier Problem (Cont'd)

c. With an output of 500 watts or less, disconnect the coaxial cable from J19 of the power amplifier module (A1000-4977) and observe the output power of the A500 as indicated on the calorimetric power meter. The power will drop 24% (±4%) for a properly functioning power amplifier. Reconnect the coax cable to J19 and remove the coax cable from J20. Observe the power drop. Repeat the identical procedure for J21 through J26. If the power output drops an equal amount (within 4%) as each cable is removed, the fault is in either the two-way output combiner (A500-4837) or the driver amplifier section (A500-3840). Perform tests in section 6.2.2.1 and 6.2.2.3.

   If the output power does not drop or drops less than normal, as each of the cables is removed, the fault is in the power amplifier associated with that cable. Perform tests in section 6.2.2.2.

6.2.2.1 Two-Way Output Combiner Test (A177) A500-4837

a. Set the Generator/Sweeper to CW, frequency to 10 MHz, output level to -10 dBm and connect it to the A500 input. This level should correspond to an RF output of approximately 100 watts from the A500. Connect a 50 ohm, 2000 watt load (Bird 8329) to the output of the A500. Connect the calorimetric power meter in series with a 20 dB, 500 watt attenuator. Set the power meter range to the .3 watt which corresponds to a full scale deflection of 300 watts. Successively, connect each RF heatsink assembly output (A50P22 and A50P23) to the attenuator and record its power output.

b. Using the set-up in Figure 5-2, measure and record the output power of the A500.

c. The sum of the powers from step (a.) should be within 5 percent of the total power recorded in step (b.). If they are not, the two-way output combiner A500-4837 is faulty.

6.2.2.2 Heatsink Assembly Test (A500-3838)

Two tests are required to test a heatsink assembly. They are a bias voltage check and RF power test. In order to perform these tests the following test equipment is required. Equivalent substitutes may be used for the recommended models.

6.2.2.2 Heatsink Assembly Test (A500-3838) (Cont'd)

1. DVM - Fluke 8000A or Fluke 8100A or Weston 1241
2. Generator/Sweeper HP8601A
3. Calorimetric Power Meter - HP435
4. Attenuator-20 dB, 500 watts - Electro Impulse AX-500-20
5. RF Power Amplifier - ENI 325LA
6. Power Supply, Lambda LK-361-FM
7. Cooling fan - Rotron Type 113

6.2.2.2.1 Bias Voltage Check

a. Adjust the power supply to +35.4 volts.

b. Connect the power supply minus (-) lead to the heatsink. Group the red wires from the power amplifier modules together and connect them to the positive (+) lead of the supply.

c. Position the cooling fan so that the cooling air is directed at the heatsink assembly.

d. Verify that the emitter voltage of each power amplifier transistor is +3.6 VDC $\pm$ .15 VDC.

e. If all voltages are within tolerance proceed to the RF power test.

6.2.2.3 RF Power Test

a. Set-up the test equipment shown in Figure 6-1 with the 325LA amplifier connected to the splitter input J9 or J10 (right or left hand RF heatsink assembly).

b. Set the Generator/Sweeper to CW, frequency to 10 MHz and the output level to - 15 dBm.

c. Set the power meter to the 1 watt scale. With the 20 dB attenuator, full scale deflection on the power meter is equivalent to 100 watts.

6.2.2.3 RF Power Test (Cont'd)

d. With 20 dB attenuator connected to either J20 or J30 slowly increase the output level while observing the power meter.

e. Set the input level so that the power meter indicates 100 watts of output.

f. Connect the outputs (J19-J22 or J23-J26) of each power amplifier module (A500-4831) to the power meter in succession and record the individual output powers. They should be within 5 percent of 25 watts.

g. If the output power of a module is less than 23 watts as determined in step f., then the module is faulty.

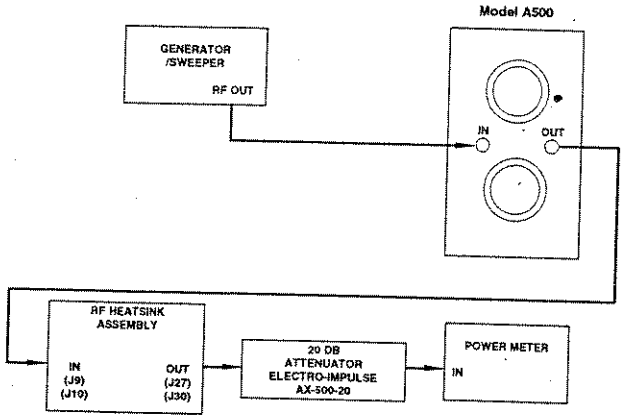


Figure 6-1. RF Heatsink Assembly Test Set-Up

6.2.2.4 Driver Amplifier Heatsink Assembly A500-3840

If the test in section 6.2.2.2 shows that the RF heatsink assemblies (A500-3838) are not faulty, and the two-way output combiner test in section 6.2.2.1 shows that the output combiner is not faulty, then the driver amplifier heatsink assembly (A500-3840) is suspect. A check of the power supply per section 6.3.2 should be performed to conclude positively that the driver amplifier module is faulty.

6.2.3 RF Voltmeter (A173) A500-4838

The Model A500 output meter should be accurate to within ±45 watts of the actual output power. If the meter is out of calibration, the following alignment procedure should be used:

6.2.3.1 Alignment Procedure

a. Set-up the test equipment as shown in Figure 5-2.

b. Set the Generator/Sweeper to CW, and the frequency to .3 MHz. Adjust the output level so that 300 watts is indicated on the calorimetric power meter.

c. Adjust potentiometer A173R7, located on the RF voltmeter module so that the front panel meter indicates 300 watts.

d. Set the Generator/Sweeper to 35 MHz and adjust the output level so that 300 watts is indicated on the calorimetric power meter. Adjust the wire gimmick (capacitor C2) around resistors A173R2, A173R3 and A173R4 until the front panel meter indicates 300 watts.

TABLE 6-2. REGULATOR CONNECTIONS

CONTROL	VOLTAGE TEST POINTS	VOLTAGE	DESTINATION
A176R31	TB1 Pin 1	35.4	PA1
A176R32	TB1 Pin 2	35.4	PA2
A176R33	TB1 Pin 3	35.4	PA3
A176R34	TB1 Pin 4	35.4	PA4
A176R35	A53A TB1 all pins, TB1 (A500-3834) Pins 5 & 6	25.5	Driver, RF Voltmeter, DS1
A176R36	TB2 Pin 1	35.4	PA1
A176R37	TB2 Pin 2	35.4	PA2
A176R38	TB2 Pin 3	8 35.4	PA3
A176R39	TB2 Pin 4	35.4	PA4

6.3 DC POWER SUPPLY

6.3.1 General

The following test and adjustment procedure should be performed after the replacement of the power supply assembly consisting of regulator board (A500-4835) and power amplifier power supply (A500-3835) or (3836) or driver power supply (A500-3839), or if the power supply voltage is out of adjustment.

6.3.1 General (Cont'd)

The power supply regulator board (A176) is divided into nine separate voltage regulators. The individual controls, test points, voltages and destinations are shown in Table 6-2. Note that the driver, RF voltmeter, and front panel indicator lamp (DS1) operate at +25.5 VDC, while the eight power amplifiers operate at +35.4 VDC.

6.3.2 Test Procedure

a. To test the power supply, the following equipment is required. Equivalent substitutes may be used for the recommended models.

   1. Digital Voltmeter - Fluke 8000A or Fluke 8100A or Weston 1241

   2. Oscilloscope - Telequipment T921

b. Disconnect all external cables from the Model A500.

c. Connect the minus (-) DVM lead to the chassis and the positive (+) lead to the terminal block (A176TB2) on the power supply regulator. The DVM should indicate +25.5 volts DC. Adjust A176R35 until voltage is within this range.

d. Connect the oscilloscope to the terminal block. The ripple on the supply should be less than 25 millivolts peak to peak.

e. Repeat procedure for TB2 (A500-3834) and TB3 (A500-3834) all pins and adjust supplies per Table 6-2.

6.4 DISASSEMBLY PROCEDURES

6.4.1 General

The following disassembly procedures describe the recommended method of removing assemblies and printed circuit modules for the purpose of test, repair and/or replacement. Careful handling should be used to avoid damaging the boards.

6.4.2 Tools Required

The Model A500 is assembled with standard hardware. Screw sizes range from #2-56 to #10-32 and are of the phillips or slotted types. Standard tools are required for their removal.

6.4.3 Removal of Covers

Remove the handles from each side of the unit by releasing 12 #8-32 screws. Remove all screws on both side covers (20 #8-32 and 12 #6-32 screws) from the top cover. Carefully lift the covers away from the unit. If either the power supply assembly or the power amplifier assembly are to be removed, take off the lower front panel by removing 8 #6-32 flat head phillips screws. To replace covers, simply reverse procedure.

6.4.4 Upper Front Panel Assembly (A500-3833)

a. Remove 8 #6-32 flat head phillips screws holding the upper front panel.

b. Separate the molex connector between the upper front panel (A500-3833) and the power supply baseplate assembly (A500-3834).

6.4.5 Rear Panel Assembly (A500-3832)

a. Remove 10 #6-32 screws holding the rear panel assembly (A500-3832) and pull it away from the unit.

b. Disconnect the internal input (P1) and output (P32) cables.

c. Separate fan and RF voltmeter board (A500-4838) connectors.

d. Remove black linecord wire from TB1-1 and remove white linecord wire from TB1-2.

e. Remove green linecord wire from chassis ground.

6.4.6 Power Supply Baseplate Assembly (A500-3834) Upper Shelf

a. To remove the power supply baseplate assembly (A500-3834) the upper front panel assembly (A500-3833) and the rear panel assembly (A500-3832) should be removed per sections 6.4.4 and 6.4.5.

b. Remove top front panel bracket by removing one #6-32 flat head phillips screw.

6.4.6 Power Supply Baseplate Assembly (A500-3834) Upper Shelf (Cont'd)

c. Remove side front panel brackets by removing 4 #6-32 flat head phillips screws and associated hardware.

d. Separate the power supply baseplate to power amplifier baseplate molex connectors (red wires) located near the power amplifier baseplate assembly (A500-3837) and place the connector ends into the power supply so they will not become caught as the assembly is removed.

e. Remove the internal ground cable (white #6 AWG) by removing the 1/4-20 brass nut, lockwasher and flatwasher.

f. Release six spring loaded #10-32 panel fasteners located on the sides of the power supply baseplate assembly (A500-3834) and pull the entire assembly out from the front of the unit. Be careful when removing the assembly as it is quite heavy.

6.4.7 Power Amplifier Baseplate Assembly (A500-3837) Lower Shelf

a. To remove the power amplifier baseplate assembly, (A500-3837) it is necessary to remove the lower front panel per section 6.4.3.

b. Remove the lower front panel bracket by removing one #6-32 flat head phillips screw.

c. Separate the power supply baseplate to power amplifier baseplate molex wiring connectors (red wires) located near the rear of the power amplifier baseplate assembly (A500-3837).

d. Release six spring loaded #10-32 panel fasteners located on the sides of the power amplifier baseplate assembly (A500-3837) and slide the assembly partially out from the front of the unit.

e. Remove the internal ground cable (white #6 AWG) by removing the 1/4-20 brass nut, lockwasher and flatwasher.

f. Disconnect driver input cable (J2) and combiner output cable (J31) from power amplifier baseplate assembly, and remove assembly from unit.

6.4.8 Power Supply Regulator Board (A500-4835)

The power supply regulator board (A500-4835) is located on top of the power supply baseplate assembly (A500-3834).

a. Remove four #4-40 screws holding the board to the power supply heatsinks.

b. Remove the red wire from A176TB1.

c. Disconnect the four wiring connectors on each power supply heatsink assembly (A500-3835,3836).

d. Remove the molex connector plate on each heatsink by removing four #4-40 screws.

e. Separate the two molex connectors on the underside of the power supply regulator board and remove the board, wiring harness and connector panels as a unit.

6.4.9 Driver Power Supply Heatsink Assembly (A500-3839)

a. Separate the four wire molex connector on the underside of the power supply regulator board (A500-4835).

b. Remove all wires from TB2 and feed them through the plastic grommets.

c. Remove ten #4-40 screws and lift the driver power supply heatsink (A500-3839) away from the power amplifier power supply heatsink assemblies (A500-3835,3836).

6.4.10 Power Amplifier Power Supply Heatsink Assembly (A500-3835,3836)

a. Remove the power supply baseplate assembly as described in section 6.4.6.

b. Remove power supply regulator board (A500-4835) and the driver power supply heatsink assembly (A500-3839) as described in sections 6.4.8 and 6.4.9 respectively.

c. Unsolder the red and blue power supply wires coming up from the baseplate to each power supply series regulator board (A500-4834). The right power supply heatsink assembly (A500-3836) requires the separation of the thermal switch wiring connector.

d. Remove five #8-32 screws each side and pull the heatsink assemblies away from the baseplate.

6.4.11 Driver Amplifier Heatsink Assembly (A500-3840)

a. Remove the power amplifier baseplate assembly per section 6.4.7.

b. Disconnect the two coaxial cables at the input of the output combiner board (A500-4837) on the underside of the driver amplifier heatsink assembly (A500-3840).

c. Disconnect two coaxial cables from the output of the driver splitter board (A171).

d. Disconnect one red wire coming from the side of the power amplifier heatsink at TB1.

e. Remove twelve #6-32 screws holding the driver heatsink to the power amplifier heatsink assemblies (A500-3838).

6.4.12 Power Amplifier Heatsink Assembly (A500-3838)

a. Remove power amplifier baseplate assembly (A500-3837) per section 6.4.7.

b. Remove driver amplifier heatsink assembly (A500-3840) per section 6.4.11.

c. Remove thermal switch (TS2) from right side heatsink by removing two #4-40 screws and hardware.

d. Remove the red leads from the terminal blocks located on the baseplate adjacent to the heatsinks.

e. Remove the coaxial cables from J27 and J30 on the splitter/combiner boards (A50).

f. Remove six #8-32 screws from the bottom of the baseplate to release each heatsink assembly.

6.4.13 Power Amplifier Series Regulator Board (A170)

The upper two series regulator boards may be removed with the power supply heatsink assembly remaining in the unit. The lower two will require removal of the power amplifier power supply heatsink assembly (A500-3835,3836). See section 6.4.10.

a. Unsolder two wires (1 Blue, 1 Red) coming up from the baseplate.

b. Separate the 4 pin molex connector.

6.4.13 Power Amplifier Series Regulator Board (A170) (Cont'd)

c. Remove six #4-40 screws and pull the board straight away from the heatsink.

d. Unsolder two wires (yellow and white) at the transistor terminals.

6.4.14 Driver Amplifier Series Regulator Board (A170)

The removal of the driver series regulator board is similar to the power amplifier series regulator board procedure (6.4.13) except for the elimination of step (a.).

6.4.15 Four-Way Splitter/Combiner Module (A50) (A500-4839)

a. Disconnect all the input and output coaxial cables from the assembly and associated power amplifier modules.

b. Remove two #4-40 screws that hold the board to the heatsink.

6.4.16 Power Amplifier Module (A169) (A1000-4977)

a. Remove the heatsink assembly (A500-3838) per section 6.4.12.

b. Remove the four-way splitter/combiner (A500-4839) per section 6.4.15.

c. Remove four #4-40 acorn nuts which hold the module to the heatsink.

d. Remove four #4-40 screws which hold the transistors to the heatsink.

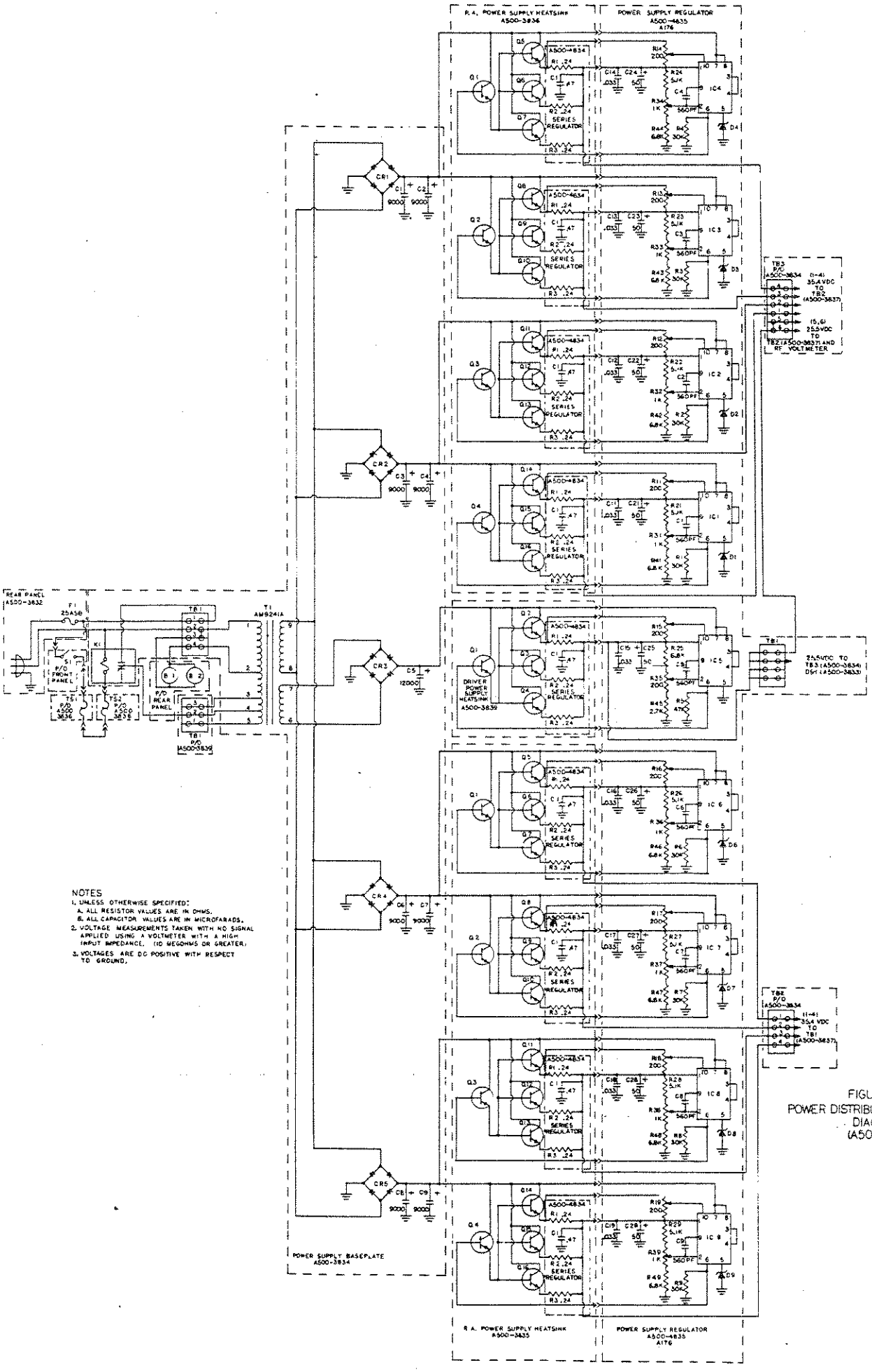
e. Carefully lift the board from the heatsink.

f. During assembly, care must be taken to insure proper alignment of the transistors and that all wires are properly dressed.

6.4.17 Two-Way Output Combiner (A177) (A500-4837)

a. Remove driver amplifier heatsink assembly (A500-3840) per section 6.4.11.

b. Remove three #4-40 screws which hold the board to the heatsink assembly.



NOTES

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTOR VALUES ARE IN OHMS.
   B. ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. VOLTAGE MEASUREMENTS TAKEN WITH NO SIGNAL APPLIED USING A VOLTMETER WITH A HIGH INPUT IMPEDANCE. (10 MEGOHMS OR GREATER)
3. VOLTAGES ARE DC POSITIVE WITH RESPECT TO GROUND.

FIGURE 7-2
POWER DISTRIBUTION SCHEMATIC DIAGRAM
(A500-2831)