ELGAR

2253M

Manual

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- Elgar is promptly notified of defects by the Buyer and that notification occurs within the warranty period;
- the Buyer receives a Return Material Authorization (RMA) number from Elgar's Repair Department prior to the return of the product to Elgar for repair, phone 800-73-ELGAR (800-733-5427), ext. 2295;
- the Buyer returns the defective product in the original, or equivalent, shipping container;
- if, upon examination of such product by Elgar it is disclosed that, in fact, a defect in materials and/or workmanship does exist, that the defect in the product was not caused by improper conditions, misuse, or negligence; and,
- that Elgar QA seal and nameplates have not been altered or removed and the equipment has not been repaired or modified by anyone other than Elgar authorized personnel.

This warranty is exclusive and in lieu of all other warranties, expressed or implied, including, but not limited to, implied warranties of merchantability and fitness of the product to a particular purpose. Elgar, its agents, or representatives shall in no circumstance be liable for any direct, indirect, special, penal, or consequential loss or damage of any nature resulting from the malfunction of the product. Remedies under this warranty are expressly limited to repair or replacement of the product.

CONDITIONS OF WARRANTY

- To return a defective product, contact an Elgar representative or the Elgar factory for an RMA number. Unauthorized returns will not be accepted and will be returned at the shipper's expense.
- For Elgar products found to be defective within thirty days of receipt by the original purchaser, Elgar will absorb all ground freight charges for the repair. Products found defective within the warranty period, but beyond the initial thirty-day period, should be returned prepaid to Elgar for repair. Elgar will repair the unit and return it by ground freight pre-paid.
- Normal warranty service is performed at Elgar during the weekday hours of 7:30 am to 4:30 pm Pacific time. Warranty repair work requested to be accomplished outside of normal working hours will be subject to Elgar non-warranty service rates.
- Warranty field service is available on an emergency basis. Travel expenses (travel time, per diem expense, and related air fare) are the responsibility of the Buyer. A Buyer purchase order is required by Elgar prior to scheduling.
- A returned product found, upon inspection by Elgar, to be in specification is subject to an inspection fee and applicable freight charges.
- Equipment purchased in the United States carries only a United States warranty for which repair must be accomplished at the Elgar factory.

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SECTION I
DESCRIPTION

1-1. INTRODUCTION

1-2. This instruction manual has been prepared for use with the Elgar Model 2253M AC Power Source. The instructions it contains are intended for use by operators and maintenance technicians with regard to the installation, operation, adjustment, troubleshooting, and repair of the AC Power Source. The theory of operation, description, parts list, and schematics are included to aid in maintaining the Model 2253M at optimum performance.

1-3. GENERAL DESCRIPTION

1-4. The Model 2253M has been designed to provide three-phase output AC power at adjustable amplitudes and precise frequencies for use in test purposes, motor operation, and frequency conversion applications. The output amplitude of the AC Power Source is adjustable from 0.0 to 130 VAC line-to-neutral at an output frequency range of 45 Hz to 5 kHz. The output frequency is controlled by an Elgar three-phase plug-in oscillator, Model 9010TMA.

1-5. This AC Power Source consists of two DC power supplies which provide the internal operating voltages and three power amplifiers whose separately phased inputs are amplified, and used to drive the three output transformers, thus providing nominal output up to 130 VAC line-to-neutral.

1-6. The input power to the Model 2253M is 208 VAC line-to-line, three phase, 47 to 63 Hz.

1-7. PHYSICAL DESCRIPTION

1-8. The Model 2253M is contained in a metal enclosure. The front panel has been designed to accomodate mounting the instrument in a standard 19 inch relay rack.

1-9. The Elgar plug-in oscillator module mounts directly into the front panel of the AC Power Source. Cooling air is drawn in through the grills located on both sides of the unit. The fans used for circulating the cooling air are located inside the unit behind the front panel. The cooling air is blown across the power heatsink assemblies and is exhausted at the rear of the unit. An input power connector, J13, and the output power connector, J14, are located on the rear of the unit. On the Model 2253M-001 there are 2 BNC type connectors, J15 and J16, on the rear. The Model 2253M-002 has 1 BNC type connected J15 on the rear. These connectors are used to synchronize a Model 2253M-002 to a master unit, Model 2253M-001.

1-10. The top and bottom covers of the power source are removable for access to the electronics housed by the enclosure. Test points, adjustment controls, and component locations are shown in Section V.

1-11. BLOCK DIAGRAM DESCRIPTION

1-12. A general block diagram of the Model 2253M is shown in Figure 1-1. The AC Power Source functionally consists of two DC power supplies, three power amplifiers with associated control circuitry, and four output power transformers. The DC supplies are obtained from a full wave bridge rectifier on the secondary of the input power transformer. These supplies are a nominal plus and minus 52V DC. They are used as the operating and bias voltages in the three amplifiers. The three power amplifiers are mounted on heatsink assemblies whose inputs are controlled by three plug-in amplifier circuit boards. The Elgar plug-in oscillator signals are AC coupled to the inputs of the circuit boards and determine the A, B, and C phase outputs. The amplitude of the three power amplifier signals is varied by the plug-in oscillator Model 9010TMA. The amplifier A, B, and C phase signal are applied to the three main output transformers, whose secondaries are connected to the rear panel output power connector through output power control contactors and, also drive the fourth transformer for special output power. The output power contactors are operated via the plug-in oscillator Model 9010TMA. The outputs available on the AC source Models 2253M-001 and 2253M-002 are listed in Table 2-1.

1-13. Each power amplifier is protected against an overload or short circuit on the output. Current limit transistors clamp the input drive signals when the power amplifier currents exceed their rated level. The power amplifier recovers immediately when the short or overload is removed. Regulation circuitry consisting of AC feedback and frequency compensation is employed to provide regulation of the output signals. In the event of unsafe operating temperatures, a thermostat located on the power amplifier will cause the microprocessor board on the Model 9010TMA to remove the drive signal to the amplifier and open the output power control contactors.

1-14. A test board in the unit is utilized for self testing of the AC source initiated through the plug-in oscillator Model 9010TMA.

1-15. PERFORMANCE SPECIFICATIONS

1-16. Specifications for the Model 2253M AC Power Source are provided in Table 1-1.

1-17. OUTPUT POWER DERATING

1-18. Power at less than full rated output voltage is derated as shown in Figure 1-2.

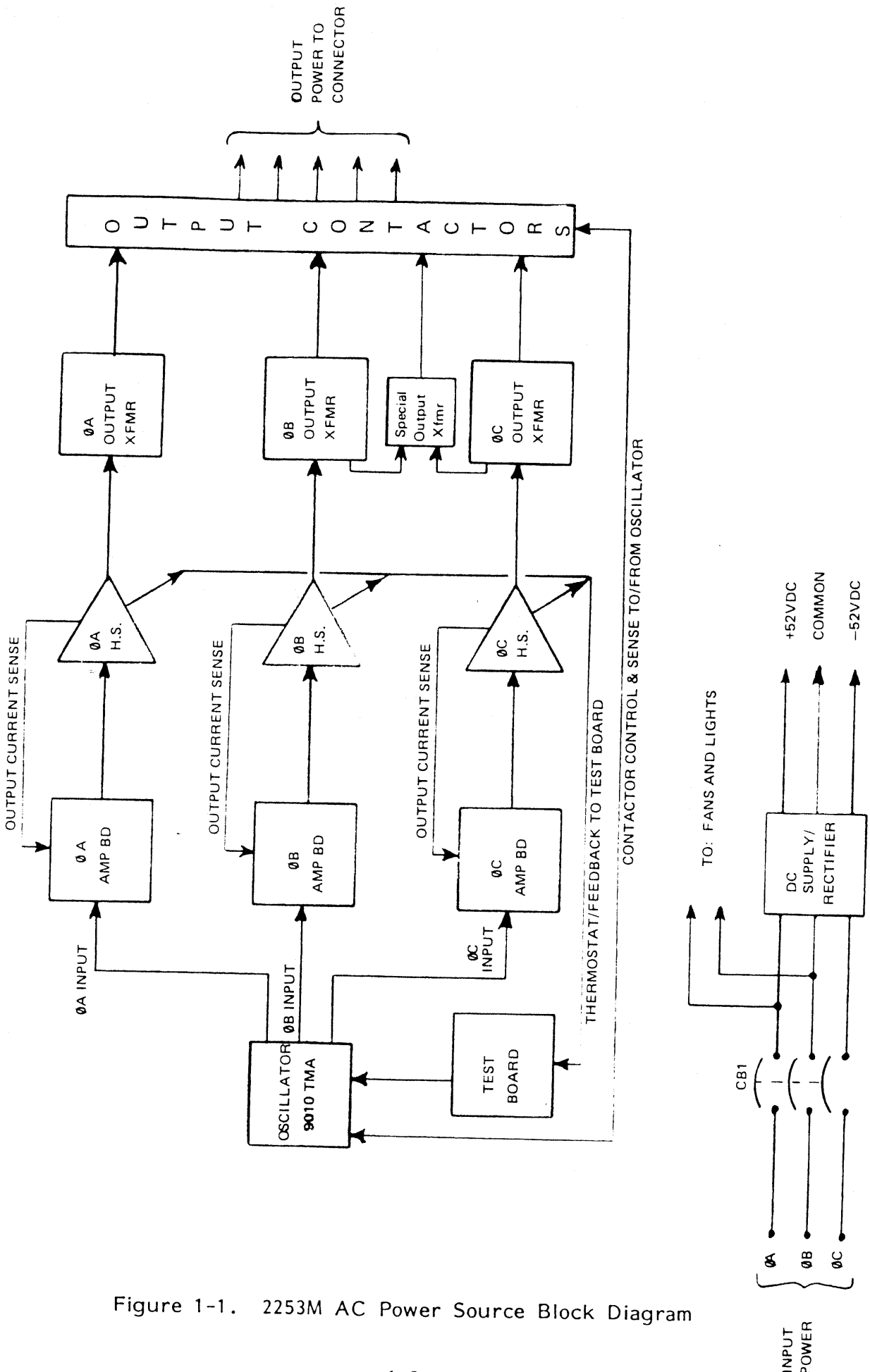

Figure 1-1. 2253M AC Power Source Block Diagram

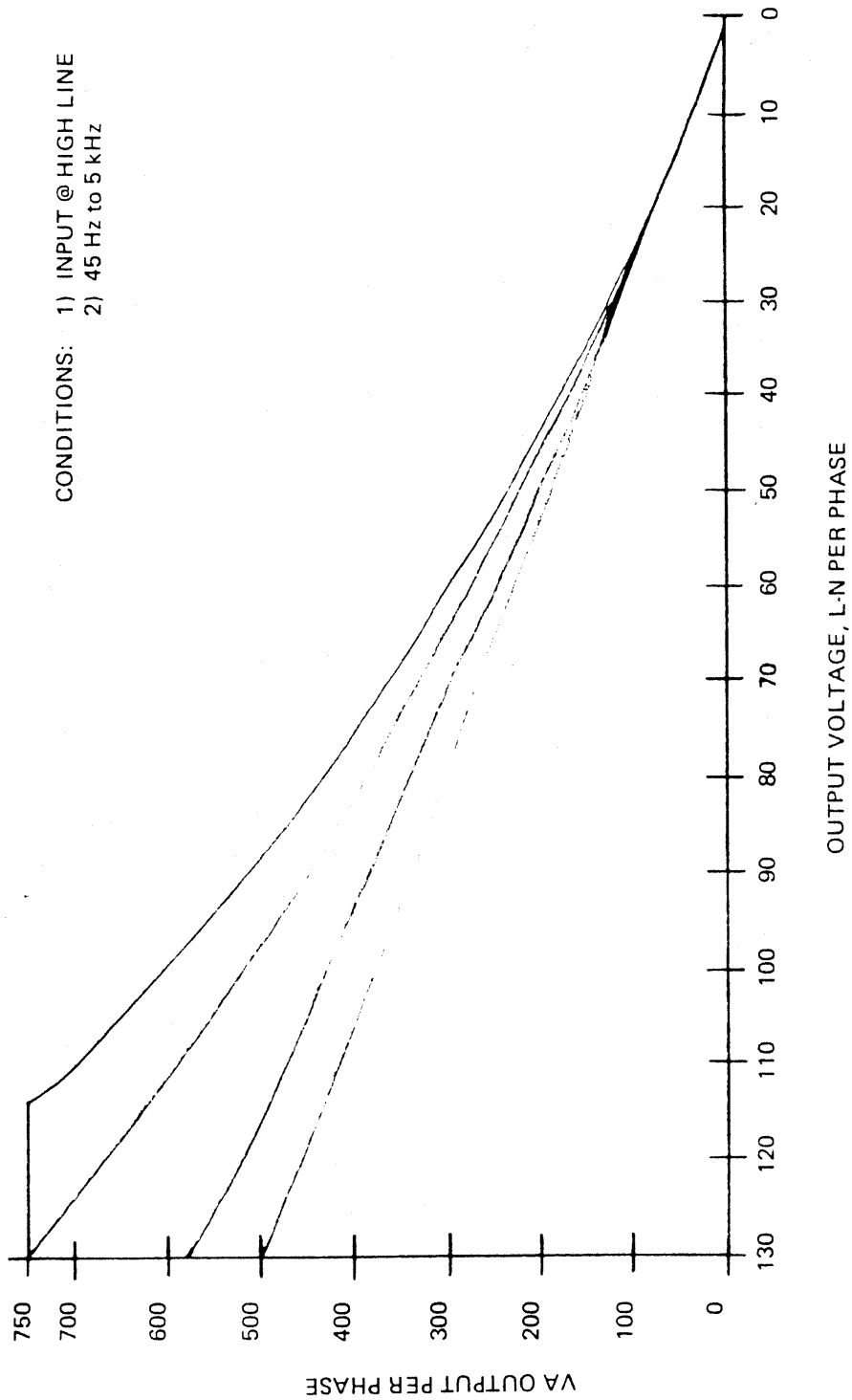

Figure 1-2. Output Power Derating

TABLE 1-1. PERFORMANCE SPECIFICATIONS

Output Power Per Phase	650VA
Load Power Factor	Unity to ±.7
Output Voltage	0-130V RMS L-N
Output Configuration	4 wire isolated from ground any one phase or neutral may be grounded
Output Frequency Range	45 Hz to 5 kHz
Output Distortion (full load)	Less than .9%
Load Regulation	Less than 1% L-N
Hum and Noise	Less than 70 dB full load
Input Power	3 phase, 208VAC L-L, 47-63 Hz 5.5 kVA maximum input power
Operating Temperature Range	0-50°C
Weight	300 Lbs approximately

TABLE 1-2. AVAILABLE OUTPUTS

OUTPUT	MODEL 2253M-001			MODEL 2253M-002		
Output #1	3Ø 650VA/Ø	130VRMS	45-5kHz	3Ø 650VA/Ø	130VRMS	45-5kHz
Output #2	1Ø 52VA	26VRMS	400 Hz	1Ø 30VA	5VRMS	400 Hz
Output #3	1Ø 13VA	26VRMS	400Hz	1Ø 52VA	26VRMS	400 Hz
Output #4	1Ø 13VA	26VRMS	400Hz			
Output #5	1Ø 130VA	130VRMS	400Hz			

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. The Elgar AC Power Source has been calibrated and quality tested prior to shipment. The unit is therefore ready for installation and operation upon receipt. Instructions in this section must be followed to ensure proper inspection of the unit and correct installation.

2-3. UNPACKING AND RECEIVING INSPECTION

2-4. The AC Power Source has been packed in accordance with industrial standards for safe shipment. Upon receipt of the unit, unpack and inspect the unit as described in the following steps.

1. Make a visual inspection of the shipping container before accepting the package from the carrier. If the shipping container is damaged, describe the damage on the carrier's receipt.

2. If there is no apparent damage to the shipping container, carefully unpack the instrument and save the container and filler materials until preliminary inspection is completed.

3. Visually inspect the instrument for evidence of external damage such as chassis dents, scratches, or distortion.

4. Check front panel control and switch-circuit breaker for ease of operation.

5. Check that the front panel meter is not damaged.

6. Remove both instrument covers and verify that the four circuit boards are securely seated in their respective receptacles. Ensure the individual components are not damaged.

7. Check that the heatsinks underneath are firmly secured in place.

8. Check harness and leads for broken insulation, cracks or broken wiring.

NOTE

If any physical damage is evident, file a claim for concealed damage with the carrier agent and save all shipping materials for inspection. Forward a report of damage to Elgar, 9250 Brown Deer Road, San Diego, CA 92121-2294. Elgar will provide instructions for repair or replacement of the instrument.

2-5. INSTALLATION REQUIREMENTS

2-6. The Elgar AC Power Source is designed for installation in a standard 19 inch instrument rack. See Figure 2-1 for mounting dimension requirements. The AC power source must be installed such that the flow of cooling air into the side panel grills and out the rear panel is not obstructed. For slide out capability the unit is equipped with threaded inserts located on each side for mounting Zero Mfg. Co. slides, CTHRN-124.

2-7. INPUT POWER REQUIREMENTS

2-8. The Model 2253M operates from 208VAC line to line three phase input power at 47-63 Hz power only. The input power connectors mating connector is an Amphenol P.N. MS3106A-24-10S. Refer to Figure 2-2 for the location of the input power connector. Refer to Figure 2-3 for input power connector pin numbers.

2-9. SYNC IN/OUT BNC TYPE CONNECTORS

2-10. The Model 2253M-001 is considered a master unit and is equipped with 2 "Sync Out" connectors located on the rear panel of the unit. These connectors are BNC types. They are used to synchronize the master unit with 1 or 2 slave units such as the Model 2253M-002. The Model 2253M-002 is considered a slave unit and is equipped with 1 "Sync In" connector located on the rear panel of the unit.

2-11. OUTPUT POWER CONNECTIONS

2-12. Output power available is listed in Table 1-2. The mating connector required for the Model 2253M-001 is an Amphenol P.N. MS3106A-40-1P and for the Model 2253M-002 is an Amphenol P.N. MS3106A-40-1SW. Refer to Figure 2-2 for the location of the output power connector. Refer to Figure 2-4 for the output power connector pin numbers.

2-13. INSTALLATION INSTRUCTIONS

2-14. To install the AC Power Source, proceed as follows:

1. Install the AC Power Source such that the flow of cooling air into and out of the unit is unobstructed. Allow 6 inches clearance at the rear!

2. Set the Power switch-circuit breaker to OFF.

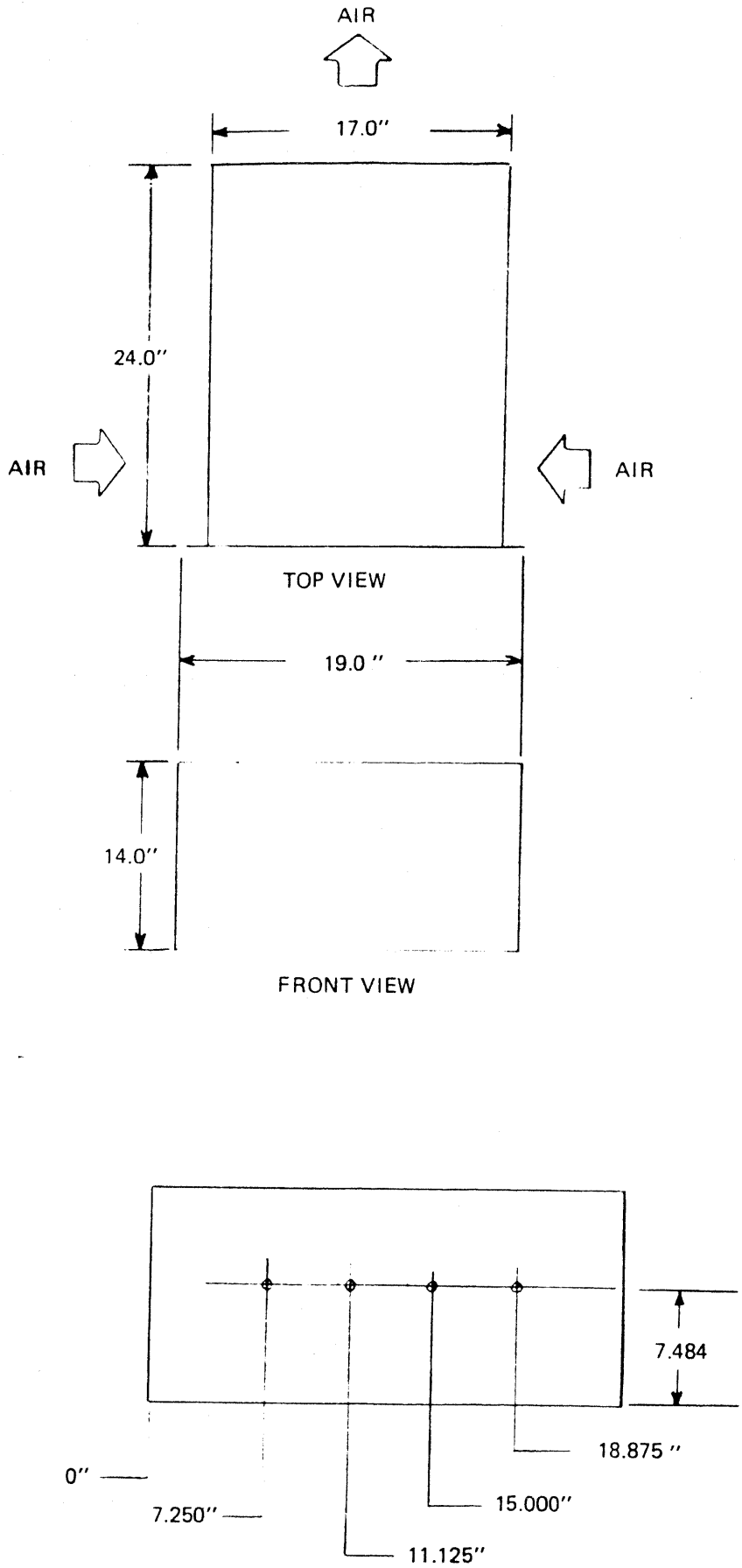

Figure 2-1. Mounting Dimensions

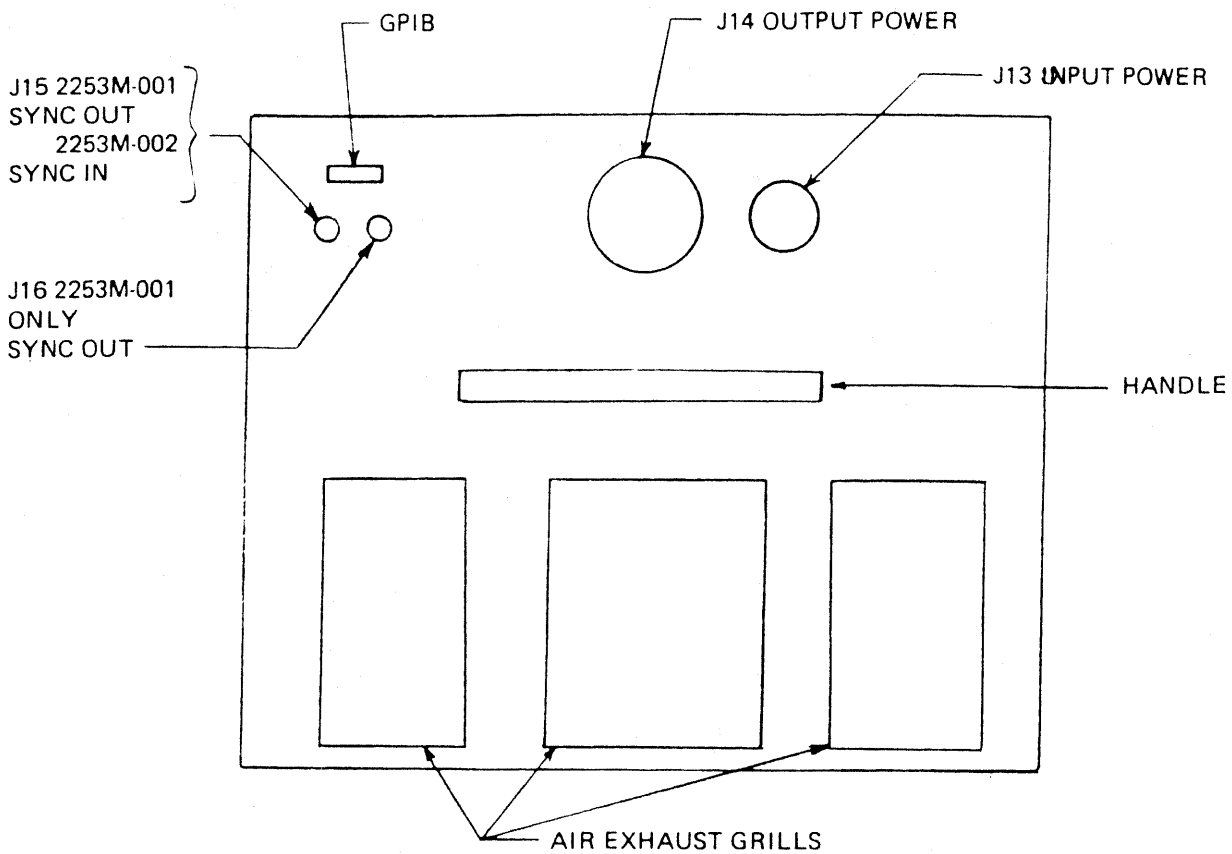

Figure 2-2. Rear Panel Power Connections

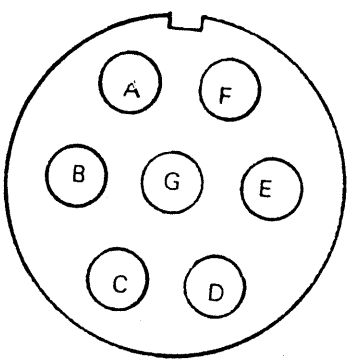

Figure 2-3. Input Connector Pin Numbers

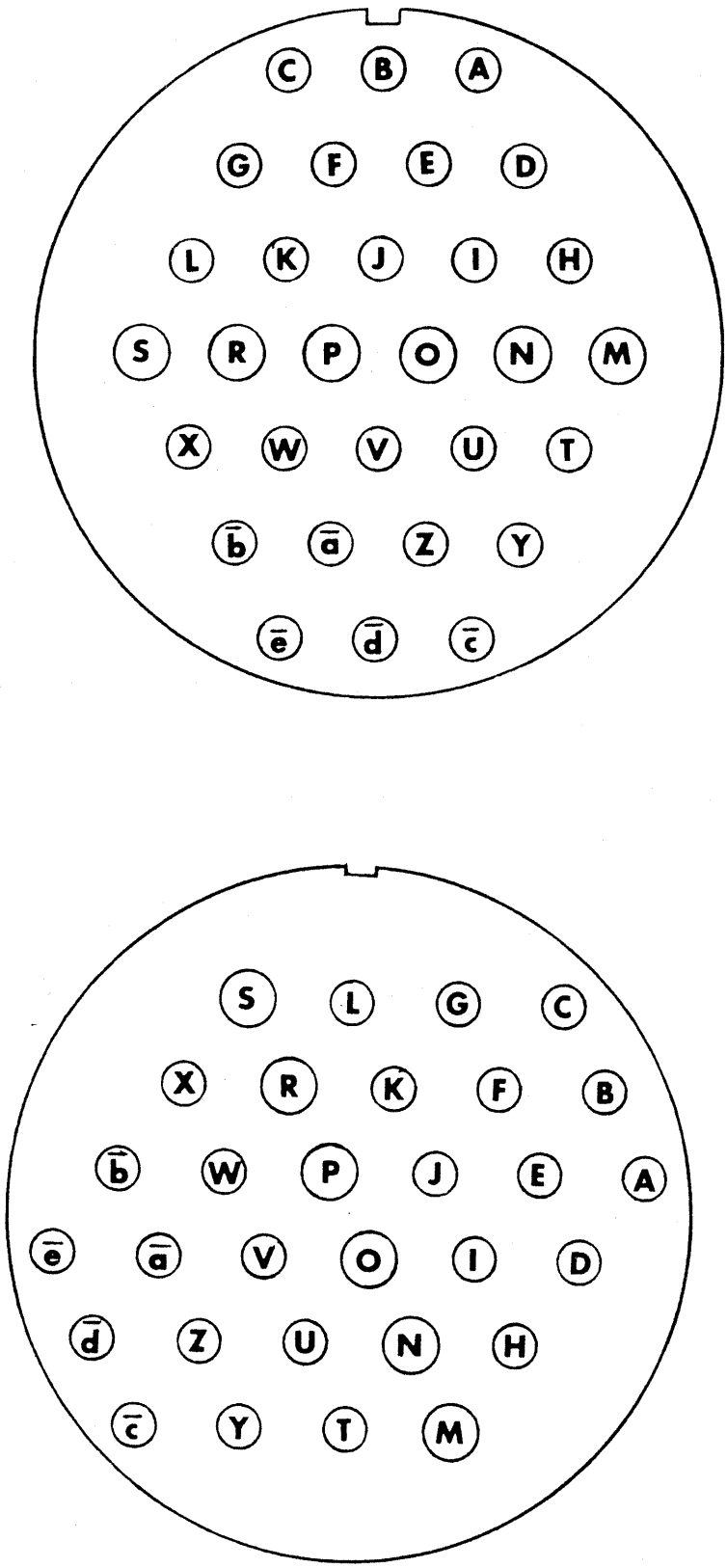

Figure 2-4. Output Connector Pin Numbers

3. Insert the Elgar plug-in oscillator Model 9010TMA, which provides control over output amplitudes and output frequencing, into the front panel.

4. Connect output load to the rear panel output connector. For initial installation, a dummy load should be used until the unit is completely checked out and verified as operational.

5. Connect the input power to the rear panel input power connector.

2-15. PRELIMINARY FUNCTIONAL CHECKOUT

2-16. To check out the AC Power Source after initial installation, proceed as instructed in the following steps:

1. Set Power switch-circuit breaker to ON. Observe that the power-on indicator lights and remains on.

2. Check that the fans are exhausting air through the rear panel grills.

3. Set the Elgar plug-in oscillator to desired amplitude and frequency. Refer to the oscillator's instruction manual for operating instructions.

4. Select position A at the OUTPUT VOLTAGE selector. Observe that the meter reads the same value set in the oscillator for phase A output voltage.

5. Select position B at OUTPUT VOLTAGE selector and observe that B phase output voltage is equal to phase A.

6. Select position C at OUTPUT VOLTAGE selector and observe that C phase output voltage is equal to phase A.

7. Set Power switch-circuit breaker to OFF. Observe that power on lamp extinguishes and fan turns off.

TABLE 2-1. J13 INPUT POWER CONNECTOR

PIN	AWG	ALL UNITS
A	8	AØ
B	8	BØ
C	8	CØ
D	8	----
E	8	Chassis
F	8	----
G	8	Neu

TABLE 2-2. J14 OUTPUT POWER CONNECTOR

PIN	AWG	2253M-002	2253M-002
A	16	AØ Sense	AØ Sense
B	16	BØ Sense	BØ Sense
C	16	CØ Sense	CØ Sense
D	16	Neu Sense	Neu Sense
E	16	Chassis	Chassis
F	16	#5 HI	-----
G	16	#5 LO	-----
H	16	-----	-----
I	16	-----	-----
J	16	-----	-----
K	16	-----	-----
L	16	-----	-----
M	12	#1 AØ	#1 AØ
N	12	#1 BØ	#1 BØ
O	12	#1 CØ	#1 CØ
P	12	#1 Neu	#1 Neu
R	12	-----	#2 LO
S	12	-----	#2 HI
T	16	-----	-----
U	16	-----	-----
V	16	-----	-----
W	16	-----	-----
X	16	-----	-----
Y	16	-----	-----
Z	16	-----	-----
A	16	#2 HI	#3 HI
B	16	#2 LO	#3 LO
C	16	#3 HI	-----
D	16	#3 & #4 LO	-----
E	16	#4 HI	-----

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section contains the operating instructions for the AC Power Source. A description of the controls and indicators precedes the operating instructions.

3-3. CONTROLS AND INDICATORS

3-4. The controls and indicators for the Model 2253M are shown in Figure 3-1. Function of these items are included in Table 3-1.

3-5. OPERATING INSTRUCTIONS

1. Power On. Set POWER switch-circuit breaker to ON. Observe that the Power Indicator lights and remains on and that the fans are operating.

2. Frequency Control. Enter the desired frequency into the plug-in oscillator Model 9010TMA. Refer to the oscillator manual for operating instructions.

3. Amplitude Control. Enter the desired amplitude into the plug-in oscillator Model 9101TMA. Refer to the oscillator manual for operating instructions.

CAUTION

Do not continue operation of the AC power source if the Power switch-circuit breaker trips when power is turned on or the amplitude is increased. The AC power source is protected against shorts at the output terminals and recovers immediately when the short is removed. Tripping of the circuit breaker indicates that the unit requires adjustment or repair. Troubleshoot the unit as described in Section VI of the manual.

4. Output Voltage Monitor. See Figure 1-2 for output power derating when operating at less than full-rated output voltage. Select individual A, B, or C phase output voltage for readout at front panel meter by setting OUTPUT VOLTAGE selector to desired position.

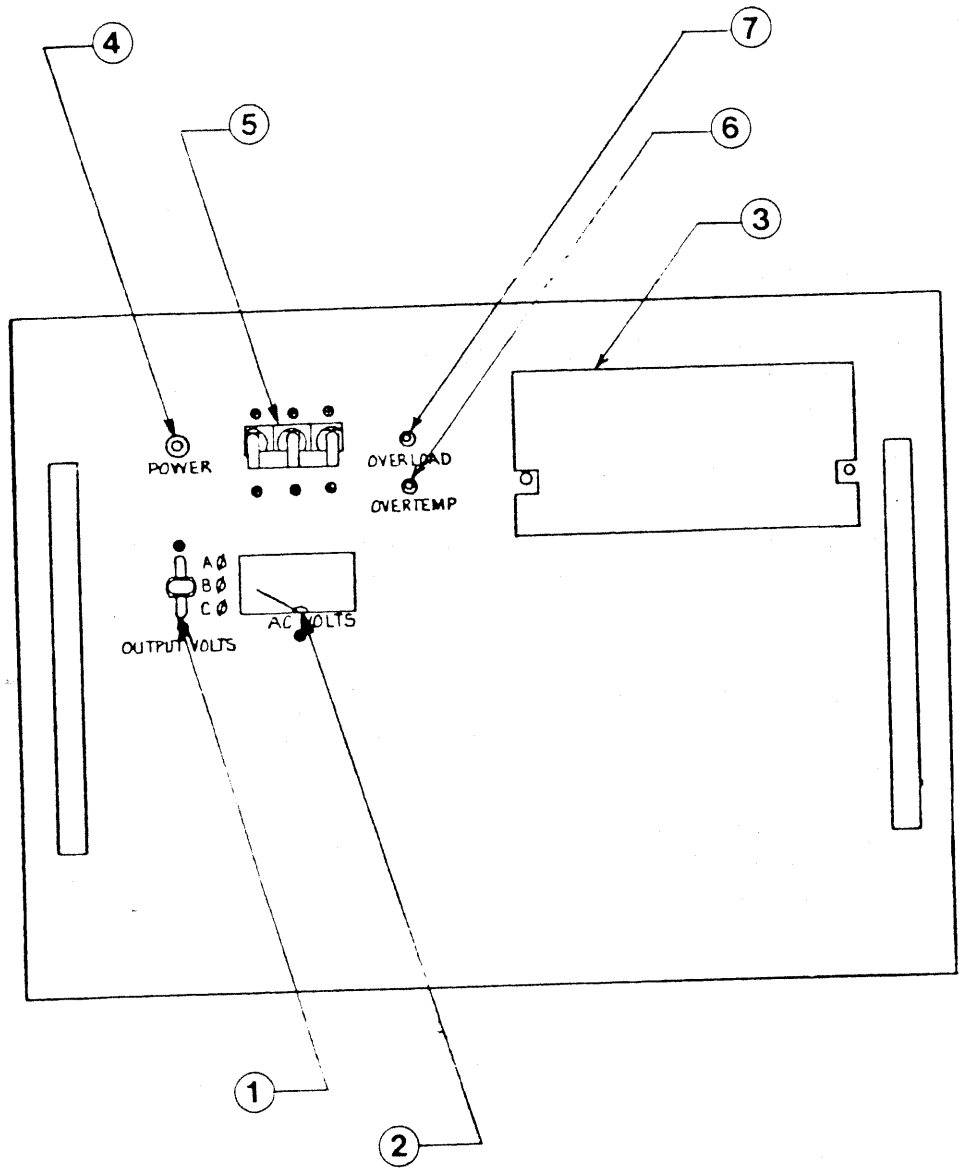

Figure 3-1. Front Panel Controls and Indicators

5. Power Off. To shutdown the AC Power Source, set POWER switch-circuit breaker to OFF.

TABLE 3-1. CONTROLS AND INDICATORS

INDEX NO.	NAME	FUNCTION
1	Output Voltage Meter	Indicates A, B, or C phase voltage when connected by OUTPUT VOLTAGE selector.
2	Output Voltage Selector	Connects A, B, or C phase voltage to OUTPUT VOLTAGE METER.
3	Oscillator Cavity	Insert Elgar plug-in oscillator Model 9010TMA. Refer to oscillator manual for operating instructions.
4	Power On Indicator	Indicates AC line input power is present in unit when POWER switch-circuit breaker is turned on. Extinguishes when AC line power is removed.
5	Power Switch-Circuit Breaker	Applies AC line input power to the unit. Safeguards unit by disconnecting AC line power when input current exceeds rated value of circuit breaker.
6	Overload Indicator	Indicates an overload condition exists on the output power line of the unit.
7	Overtemp Indicator	Indicates an overtemp condition exists in the power heatsink wind tunnel area. When this lamp lights, the drive signals are removed from the amplifier boards, the output contactors will open and the oscillator microprocessor will go to a reset condition. Unit will be operative when this lamp extinguishes.

SECTION IV
THEORY OF OPERATION

4-1. CIRCUIT DESCRIPTION

4-2. DC POWER SUPPLIES. When circuit breaker CB1 is energized, the Power On indicator DS1 lights, the fan turns on and the plus and minus 52V power supplies are energized. The DC power supplies consists of input power transformer T1, and full wave bridge rectifiers with filter capacitors and bleeder resistors. Stepped down AC line voltage at the secondary of T1 is rectified by the full wave bridge to produce plus (+) and minus (-) 52V DC across the filter capacitors. The high current DC supplies provide bias and operating voltage for the amplifiers.

4-3. POWER AMPLIFIERS. The Model 2253M AC Power Source contains three essentially identical power amplifiers for A, B, and C phases. Three input signals phase displaced 120° are supplied by a three phase plug-in oscillator. The amplitude of all three signals is varied by the plug-in oscillator Model 9101TMA. B and C phase output amplitudes are adjusted equal to A phase by amplitude balance potentiometers located on the plug-in oscillator.

4-4. The A phase input signal is AC coupled to the pre-amplifier comprised of transistors Q101, Q102, Q105, Q106 and Q107. A 12 volt zener diode, CR101 is used to supply constant current to differential amplifier Q101 and Q102. The output of the differential amplifier is applied to the base of Class A driver transistor Q105. Q105 in turn furnishes drive power to Q106 and Q107. Q106 operating as an emitter follower supplies drive signals to the upper half of the power amplifier. Phase inverted drive signals for the lower half of the power amplifier is supplied by Q107. A small amount of forward bias is established by diodes CR106-CR109 to reduce crossover distortion in the power amplifier. Bootstrap capacitor C107 supplies additional drive during the positive conduction of the amplifier.

4-5. The power amplifier consists of series connected output transistors for amplifying the positive and negative half cycles of the sine wave output. Base drive for the respective amplifier is furnished by an emitter follower located on the respective heatsinks. Each power transistor has a .22 ohm resistor in its emitter to ensure equal current sharing of the output transistors. The sine wave output of the power amplifier is connected to the primaries of the three output transformers. At full output voltage on the secondary of the output transformer the power amplifier stage is operating at approximately 25V RMS.

4-6. A thermostat, S1 located on one of the heatsink assemblies, provides thermal protection for the power amplifier. If the heatsink reaches an unsafe

operating temperature, due to obstructed air flow or excessive environmental temperature, thermostat S1 closes and removes drive signals from the power amplifier. The drive signals are restored when the heatsink temperature returns to normal.

4-7. Distortion in the power amplifier is reduced by negative feedback taken across resistor R112 to the differential amplifier. Positive current feedback is used in these amplifiers to accomplish load regulation in the output transformer. This signal is developed across current transformers C1,2, and 3 in the primary loop of the output transformers. These signals are dropped across R137 on the pre-amplifier. The regulation signal in all cases is applied across a regulation adjust potentiometer R110 (for A phase). This potentiometer is used to set the load regulation at frequencies up to approximately 1 kHz. Factory selected components C104 and R104 provide regulation boost at frequencies above 1 kHz.

4-8. The power amplifier is protected against overload or short circuits on the secondaries of the output transformer by current limit transistors Q103 and Q104. In the event an overload or a short circuit is incurred on the output, current signals sampled across resistors in the power amplifier drive Q103 and Q104 into conduction clamping the drive signals to the power amplilfier. The current limit threshholds are adjustable using R123 for the positive half cycle and R127 for the negative half cycle. These adjustments are factory set to initiate current limiting at slightly more than full power out.

4-9. The front panel meter is connected to read the output voltage of any phase of Output #1 by the output voltage switch S1.

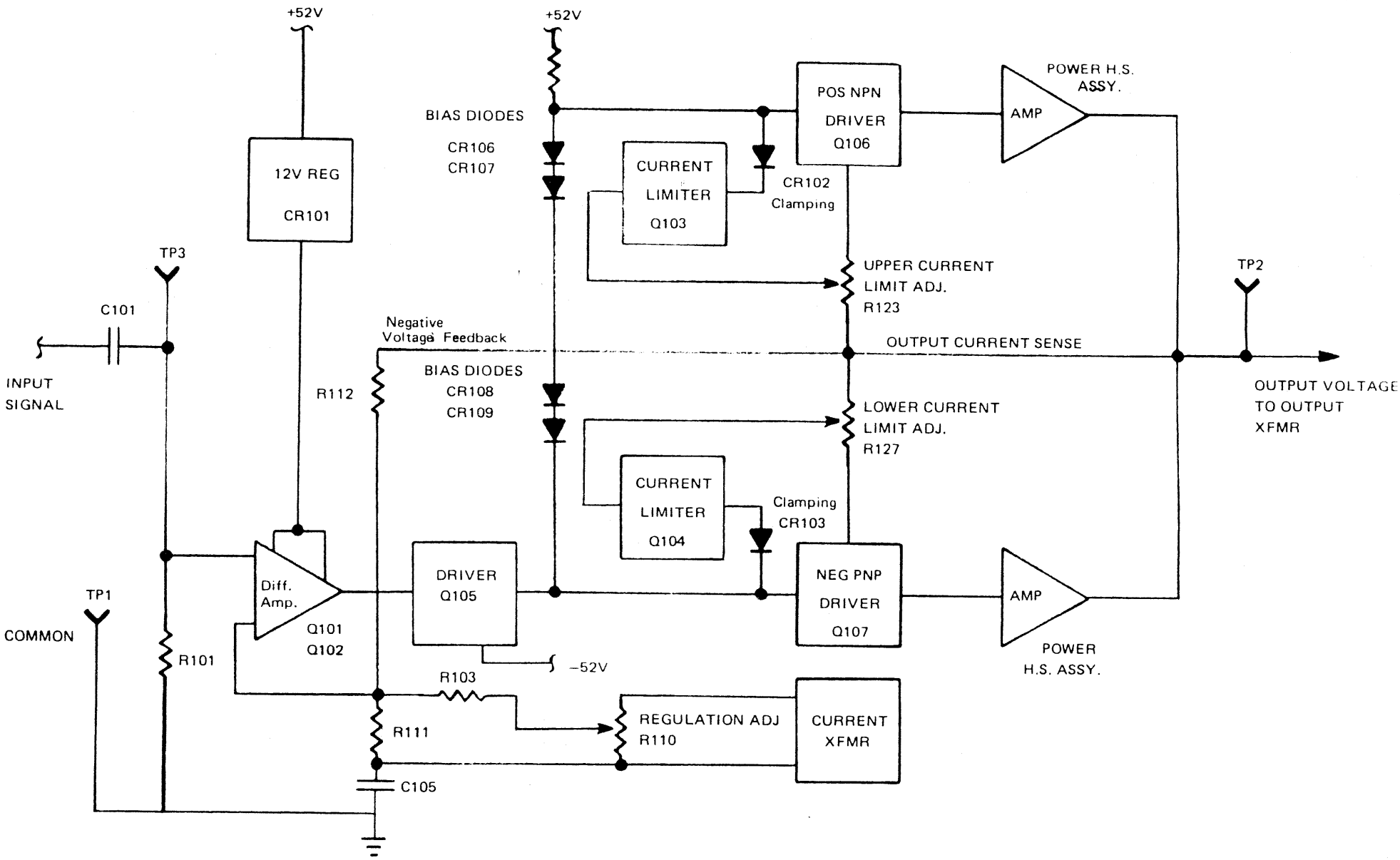

Figure 4-1. Simplified Block Diagram

SECTION V
MAINTENANCE

5-1. INTRODUCTION

5-2. This section contains procedures for preventive and corrective maintenance. Preventive maintenance consists of procedures for cleaning and inspecting the unit. Corrective maintenance includes checkout, troubleshooting, disassembly for repair, and adjustments. A list of special tools and test equipment required for maintenance and adjustment is also included in this section.

NOTE

Elgar is not responsible for instruments returned for repair without proper Elgar authorization. Please contact Elgar to make return shipment of the instrument. The unit should be returned to Elgar Repair Department, 9250 Brown Deer Road, San Diego, CA 92121-2294.

5-3. TEST EQUIPMENT REQUIRED

5-4. The test equipment required for maintenance and adjustment are listed in Table 5-1. Equivalent test equipment may be used.

WARNING

Remove power whenever performing maintenance on the unit. Failure to comply can result in serious electrical shock to persons coming in contact with live voltages at exposed terminals when unit is energized.

5-5. PREVENTIVE MAINTENANCE

5-6. Preventive maintenance is comprised of cleaning and inspection of the unit. The AC Power Source should be cleaned and inspected at regular periodic intervals (every six months, depending on operating conditions). The top and bottom panels of the unit are removable for access to components. To clean and inspect the unit, proceed as follows:

1. Inspect circuit board parts for evidence of overheating, such as burned or distorted resistors, capacitors, and charred insulation. Replace parts suspected of damage.

2. Inspect circuit board parts for evidence of physical damage, such as broken or cracked capacitors and resistors, broken solder joints and discontinuities in circuit foil paths.

3. Inspect circuit board connectors for corrosion and obvious physical damage. Remove corrosion with clean, lint-free cloth dampened in trychlorethylene; replace circuit board assembly if damaged.

4. Inspect chassis and front panel-mounted components for broken connections, burned insulation or damaged parts.

5. Inspect transformers for evidence of overheating such as discolored insulation.

6. Inspect rear panel connector and terminal blocks for damage, such as broken wire leads, cracked insulation.

5-7. CORRECTIVE MAINTENANCE

5-8. Corrective maintenance consists of checkout, troubleshooting, adjustments, and repair.

5-9. CHECKOUT. The unit should be checked after initial installation and at periodic intervals to ensure that it is operating at optimum performance. Checkout consists of the DC power circuit, regulation and distortion checks which should indicate whether the AC Power Source is operating within specifications or requires adjustment. Troubleshooting procedures are presented in paragraph 5-15, to aid in isolating suspected malfunctions in the unit.

WARNING

High voltages dangerous to life exist in the unit when energized. AC voltages are also present at the INPUT POWER terminals at any time the power cable is connected to the line voltage. Exercise extreme caution when performing maintenance checks in the unit. Always remove power when disconnecting circuit boards, performing continuity checks or disassembling the unit.

5-10. PRELIMINARY PROCEDURES. Before applying power, perform the following preliminary procedures.

1. Set POWER switch of unit to OFF.

2. Remove top panel of unit and remove the A, B, and C phase amplifier circuit boards.

3. Remove bottom panel of unit and disconnect the heatsink plugs. Tag the connectors to ensure proper reassembly in the unit (see Figure 5-1).

5-11. DC POWER CIRCUIT CHECK. To check the output of the DC supplies, proceed as follows:

1. Using the multimeter, check that the capacitors C1 and C2 are not shorted.

2. Apply line voltage to unit and set POWER switch on the front panel to ON.

3. Using multimeter, measure +52VDC and -52VDC outputs of the DC power circuit. The test point for the +52VDC is the positive (+) post of C2. The test point for the -52VDC is the negative (-) post of C2. The common point can be either the negative (-) post of C1 or the positive (+) post of C2. (See Figure 5-1.) Observe that the plus (+) and minus (-) 52VDC busses are even readings of 52VDC nominal (no load) and are within 5% (2 to 3 volts) of each other. If not, discontinue the checkout and troubleshoot the unit to correct the problem.

4. Set POWER switch of unit to OFF.

5-12. OUTPUT AMPLITUDE BALANCE CHECK. The output voltage is controlled by the plug-in oscillator Model 9101TMA. The B phase and C phase balance potentiometers, located on the plug-in oscillator also, are set to give B phase and C phase voltages equal to the A phase voltage. No adjustment should be required. To check the output amplitude balance, proceed as follows:

1. Connect the heatsink plugs into their respective connectors.

2. Install the A, B, and C phase amplifier boards in their respective receptacles.

3. Connect the RMS voltmeter to A phase output terminals of the unit. Set RMS voltmeter for 1000 volt range, 3%, 120 volts.

4. Set POWER switch of unit to ON.

5. Select position A on OUTPUT VOLTAGE selector and program 120V into the plug-in oscillator. (See oscillator operating manual.) The voltage can be read as 120 volts on the output voltage meter or null volts on the RMS voltmeter.

6. Select position B on OUTPUT VOLTAGE selector and observe that the output voltage meter reads 120 volts. Using the RMS voltmeter, measure B phase output voltage at output terminals of the unit. Observe that the reading is null volts. If not, refer to oscillator manual for adjustment of balance.

7. Select position C on OUTPUT VOLTAGE selector and observe that the output voltage meter reads 120 volts. Using the RMS voltmeter, measure C phase output voltage at output terminals of the

unit. Observe that the reading is null volts. If not, refer to oscillator manual for adjustment of the balance.

5-13. REGULATION CHECK AND ADJUSTMENT. Upon completion of output amplitude balance adjustment, perform a regulation check and adjustment as follows:

1. Set POWER switch of unit to OFF.

2. Connect three resistive loads each capable of dissipating 5.42 amperes. (See Figure 5-3.)

3. Set POWER switch of unit to ON.

4. Using RMS voltmeter (set at 1000 volt range, 3%, 120 volts), measure A phase output voltage at output terminal. Observe that output is null volts on meter. If not, adjust regulation potentiometer R110 on A phase amplifier circuit board for 120 volt output as needed.

5. Repeat step 4 to check and adjust regulation of B and C phase outputs. Use respective output terminals and regulation adjust potentiometers on the B and C phase circuit boards.

6. Set POWER switch to OFF and remove the three resistive loads.

7. Repeat the output amplitude balance checkout and adjustment in paragraph 5-12. Due to interaction between the phase regulation adjustments and the amplitude balance adjustments, it may be necessary to readjust the amplitude balance of the outputs. Repeat phase regulation and amplitude balance adjustments until no discernible difference is read on the RMS voltmeter as the loads are connected.

5-14. 400 Hz DISTORTION CHECK. The distortion check may be performed at 60 Hz, 400 Hz, or 5 kHz. The checks are performed identically except for changes in frequency and the specified distortion. Only one distortion check will be described as follows:

1. Set POWER switch of unit to OFF.

2. Connect resistive load to A phase output terminals.

3. Connect distortion analyzer to A phase output terminals (see Figure 5-3).

4. Adjust input signal of plug-in oscillator to 400 Hz.

5. Set POWER switch to ON and program oscillator for 120 volts output. Observe that distortion is less than 0.5% at 400 Hz.

6. Repeat steps 1 through 5 to check distortion at B and C phase output voltages in same manner.

5-15. TROUBLESHOOTING. Troubleshooting should be accomplished only after checkout procedures indicate a malfunction. The troubleshooting procedures

are presented in Table 5-2. General troubleshooting techniques are as described in the following paragraphs.

5-16. TRANSISTOR CHECK. Transistors may be checked for failure while installed on circuit board as follows:

1. Verify power is removed from circuit.

2. Set multimeter to measure resistance with X10 Ohms scale. (Note that current supplied by various multimeters and ohmmeters varies and use ohm scale appropriate for testing transistors in the following steps.)

   a. With negative lead on emitter, positive lead on base, verify resistance is 100 to 300 ohms. Reverse leads and verify resistance is infinite (as read on X10 scale).

   b. With positive lead on collector, negative lead on base, verify resistance is infinite. Reverse leads and verify resistance is 100 to 300 ohms.

   c. With base open, verify forward and reverse resistance of emitter-collector path in infinite.

NOTE

PNP transistors are checked in the same manner, except that positive and negative leads are used in the reverse as described in the previous steps.

5-17. HEATSINK TRANSISTORS CHECK. If the heatsink assembly(s) are suspected of being defective, check the heatsink transistors for shorts as follows:

1. Remove power and disconnect the heatsink plugs from the unit.

2. Set multimeter to measure resistance by X10 range. (Note that current supplied by various multimeters vary; therefore use ohm scale appropriate for testing emitter-collector paths of transistors.)

3. Check NPN transistors in heatsink assemblies No. 1 and 2 (six heatsink assemblies total) for shorted transistors. At each heatsink plug (see Figure 5-4), connect negative lead on pin 1 and positive lead on pin 7 and verify resistance 100 - 300 ohms. If the multimeter reads a direct short, the transistor(s) in the heatsink is shorted and must be replaced.

4. Upon completion of repair, perform the output check of the respective phase amplifier circuit board (paragraph 5-18) to determine if the circuit board could be the cause of the shorted transistor(s). Perform the current splitting checks (paragraph 5-19) on the repaired heatsink assemblies.

TABLE 5-1. TEST EQUIPMENT REQUIRED

NAME	MANUFACTURER AND MODEL NUMBER	CHARACTERISTICS
Multimeter	Simpson Electric Co. Model 260	20,000 ohms/volt, AC/DC/ OHMS ranges
Plug-In Oscillator	Elgar Corporation Model 9010TMA	Adjustable 45 Hz to 5 kHz 3-phase outputs
Differential Voltmeter	John Fluke Mfg. Co. Model 931	RMS Volts Range to 1000 VAC
Oscilloscope	Tektronix, Inc. Model 561 w/2B67 and 3A6 plug-ins	
Probe	Tektronix, Inc. Model P6028	X1 Probe
Distortion Analyzer	Hewlett-Packard Model HP333A	
Resistance Load (3)	Commercial	Capable of dissipating 5.42 ampere load at 120 VAC for Output #1

NOTE: This test set-up is used for verifying operation and for adjustment, therefore only the main Output #1 will be discussed. Additional loads may be required for additional outputs. See Table 1-2 for additional outputs available and their power level.

5-18. PHASE AMPLIFIER OUTPUT CHECK. This check is for an indication of amplifier output only. To perform the phase amplifier output check, proceed as follows:

1. Plug in the electrical connectors of the two heatsink assemblies No. 1 and 2 for operation with the respective phase amplifier circuit board but do not install the heatsinks into the unit.

CAUTION

Ensure heatsink assemblies do not touch chassis of unit or each other while power is on. If metal work bench is used, ensure that insulation is placed between heatsinks and bench to prevent grounding. Failure to comply can result in damage to heatsink transistors due to electrical shorting.

TABLE 5-2. TROUBLESHOOTING CHART

Trouble	Probable Cause	Remedy
a. Power lamp fails to light when POWER switch is turned on. Fan fails to operate.	1. Power not connected to unit.	1. Connect power as instructed in Section II.
	2. Power cord not plugged into main line voltage.	2. Plug cable in AC source.
	3. Lamp burned out.	3. Replace defective lamp.
	4. Fan defective.	4. Replace fan.
	5. Defective switch-circuit breaker.	5. Replace switch-circuit breaker CB1.
b. POWER switch-circuit breaker trips when turned on or when amplitude of output voltage is increased.	Continual tripping of POWER switch-circuit breaker indicates failure of the DC supply or a power amplifier transistors in the heatsink assemblies.	Disconnect the heatsink plugs from the unit. Set the POWER switch to ON. If it trips again, test the +45VDC supply and filter capacitors C1 & C2 for defective components. Reference para. 5-11. If it does not trip, check the power transistors on the heatsink assemblies for shorts. Collector to emitter or collector to base. Reference para. 5-17. If heat-sink transistor is shorted, check respective phase amplifier circuit board to determine if the board is the cause. Reference para. 5-18. Replace defective components as needed.
c. Front panel meter fails to indicate phase voltage selected at OUTPUT VOLTAGE switch.	The following causes could lead to a lack of output voltage indication.	Using multimeter, measure phase A, B,C voltages at output terminals. If normal, front panel OUTPUT VOLTAGE switch or meter is defective. If absent, measure signal output at TP2 of A, B, and C phase amplifiers. Using oscilloscope, observe the sine wave outputs. If normal, output transformer(s) are defective. If If below normal, measure signal at TP3 of A,B,C phase amplifiers and determine if plug-in oscillator is supplying correct phase and amplitude input signals. Reference para. 5-12. If input signal normal but still no output, check PCB's for thermostat
	1. Plug-in oscillator not properly seated or malfunctioned.	
	3. Front panel OUTPUT VOLTAGE meter or selector defective.	
	4. Output power transformers defective.	

TABLE 5-2. TROUBLESHOOTING CHART (Continued)

Trouble	Probable Cause	Remedy
	5. Heatsinks overheated, resulting in thermostat closure.	switch closure caused by overheating of the heatsink assemlies. If no signal present at the inputs, then check that plug-in oscillator is properly seated. If all right, troubleshoot Elgar plug-in oscillator as instructed in the oscillator instruction manual. Replace defective switch. Replace defective meter.
d. Phase A,B, or C output change significantly when output load connected.	Overload causing current limiting.	Remove overload condition
	Output regulation not set properly.	Adjust output amplitude balance and regulation as instructed in para. 5-12 and 5-13.
e. One or more phase output voltage differs from the other. For example, phase B output is low, whereas, phase A and C are normal.	Overload causing current limiting.	Remove overload condition.
	Respective phase amplifier circuit board(s) not properly adjusted.	Using oscilloscope, observe output signal at TP2 of suspected phase amplifier circuit board. If clipping is observed, perform current limit checks and adjustments as instructed in para. 5-22. If oscillating, the PCB must be returned to the factory for replacement of trim components. If amplitude too low or high, perform amplitude balance adjustment per para. 5-12.
f. One or all A,B, C output fail to meet specified output.	DC balance or current limit adjustment are improperly adjusted.	Check DC balance and current limiters as needed. Reference para. 5-21 and 5-22.

5-18. (Continued)

2. Install Elgar plug-in oscillator module into the unit.

3. Set POWER switch on unit to ON.

4. Set oscilloscope sensitivity for 2 volts/cm, DC coupling with X10 probe. Connect oscilloscope probes to output at TP2 and common at TP1 on phase amplifier circuit board under test.

5. Set plug-in oscillator for 115VAC output at 400 Hz. Observe that output sine wave is present at TP2. If not, check oscillator input signal at TP3 of amplifier circuit board and correct problem if signal is absent. Troubleshoot circuit board if output signal is absent and causes heatsink transistors to burn out again. If all right, perform current splitting check in paragraph 5-19.

5-19. CURRENT SPLITTING CHECKS. The current splitting checks are accomplished only if the heatsink assemblies have been repaired. Perform phase amplifier output check before doing the following current splitting checks.

1. Double the load resistance at the output power terminals to reduce the current load by one half at full output voltage.

2. Set the multimeter to DC volts and 2.5 volts -range. Connect the negative (-) lead of the multimeter to the emitter bus of heatsink assembly No. 1

3. Measure the individual voltage drops across each .22 ohm current splitting resistor by placing the positive (+) lead of the multimeter between the emitter of the NPN transistor and its respective emitter resistor. Observe that the multimeter reading is approximately 0.5 VDC each time. The emitter voltages should all be nearly equal. Note that the emitter follower transistor in each heatsink assembly will read slightly higher.

4. If the emitter voltage for any transistor is absent, replace the respective transistor as it is open.

5-20. ADJUSTMENTS. The AC Power Source is delivered fully adjusted and calibrated; therefore, adjustment is not normally required unless a malfunction occurs or parts are replaced. Adjustments should not be attempted unless indicated by troubleshooting. The A, B, and C phase amplifiers are identical, therefore, current limit adjustments are performed in the same manner. See Figure 5-2.

NOTE

Only one circuit board and its respective heatsink assemblies should be installed at a time when accomplishing these adjustments. Before performing the following adjustments, remove the other two circuit boards and disconnect their respective heatsink assemblies.

5-21. CURRENT LIMITS ADJUSTMENT. To perform current limit check and adjustment, proceed as follows:

1. Set POWER switch of unit to OFF.

2. Connect resistive load capable of dissipating 650 VA across respective output terminals of phase output being adjusted (for example, connect load across terminals A and N for A phase amplifier adjustment).

3. Connect oscilloscope to output TP2 and common TP2 of phase amplifier circuit board to monitor output sine wave.

4. Set OUTPUT VOLTAGE selector to monitor respective phase voltage on front panel meter.

5. Set POWER switch of unit to ON.

6. Set for 120 VAC output on front panel meter. Observe that sine wave output at TP2 is not clipping or oscillating. If clipping is observed, current limit adjustments must be made as described in next procedural steps.

NOTE

If oscillating is observed, the amplifier circuit board must be replaced and returned to the factory for adjustment. Replacement of certain factory-selected parts (such as trim capacitors and resistors) for eliminating oscillations is considered beyond the scope of customer maintenance. Notify Elgar Corporation for authority and shipping instructions.

7. To remove clipping from upper peak of sine wave, adjust the upper current limit potentiometer R123 (see Figure 5-2) CCW only as much as necessary to remove clipping. Further adjustment CCW will permit the output transistors to deliver an unsafe amount of current.

NOTE

The upper and lower current limit potentiometers R123 and R127 are each adjusted such that the potentiometers are backed off slightly to a point that just eliminate clipping.

8. To remove clipping from lower peak of sine wave, adjust the lower current limit potentiometer R127 as needed.

9. Upon completion of current limit adjustment of the A, B, and C phase amplifier circuit boards, perform the output amplitude balance checkout and adjustment as instructed in paragraph 5-12.

5-22. REPAIR AND REPLACEMENT. Generally, if any parts are suspected of damage, they should be checked with multimeter for proper electrical values before replacement. The schematic and parts list are presented in Sections VI and VII as an aid in repairing the unit.

5-23. CIRCUIT BOARD ASSEMBLIES. The circuit board assemblies can either be repaired or replaced if parts or circuit board is damaged. De-energize the unit before removing any circuit board assembly. To remove circuit board, pull straight up on the circuit board, taking care not to damage circuit components. When re-installing circuit board, carefully fit edge of circuit board in guide

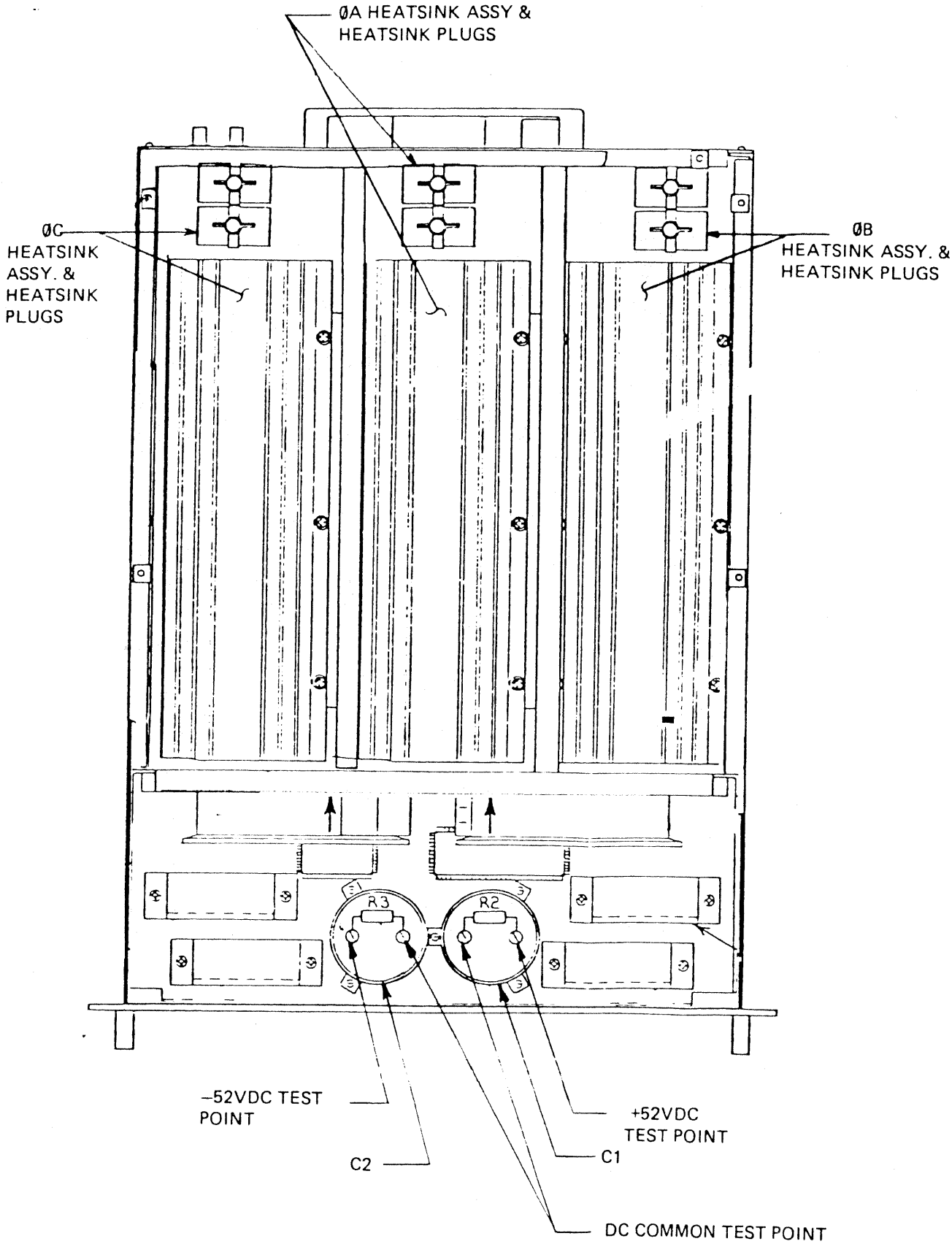

Figure 5-1. Bottom View

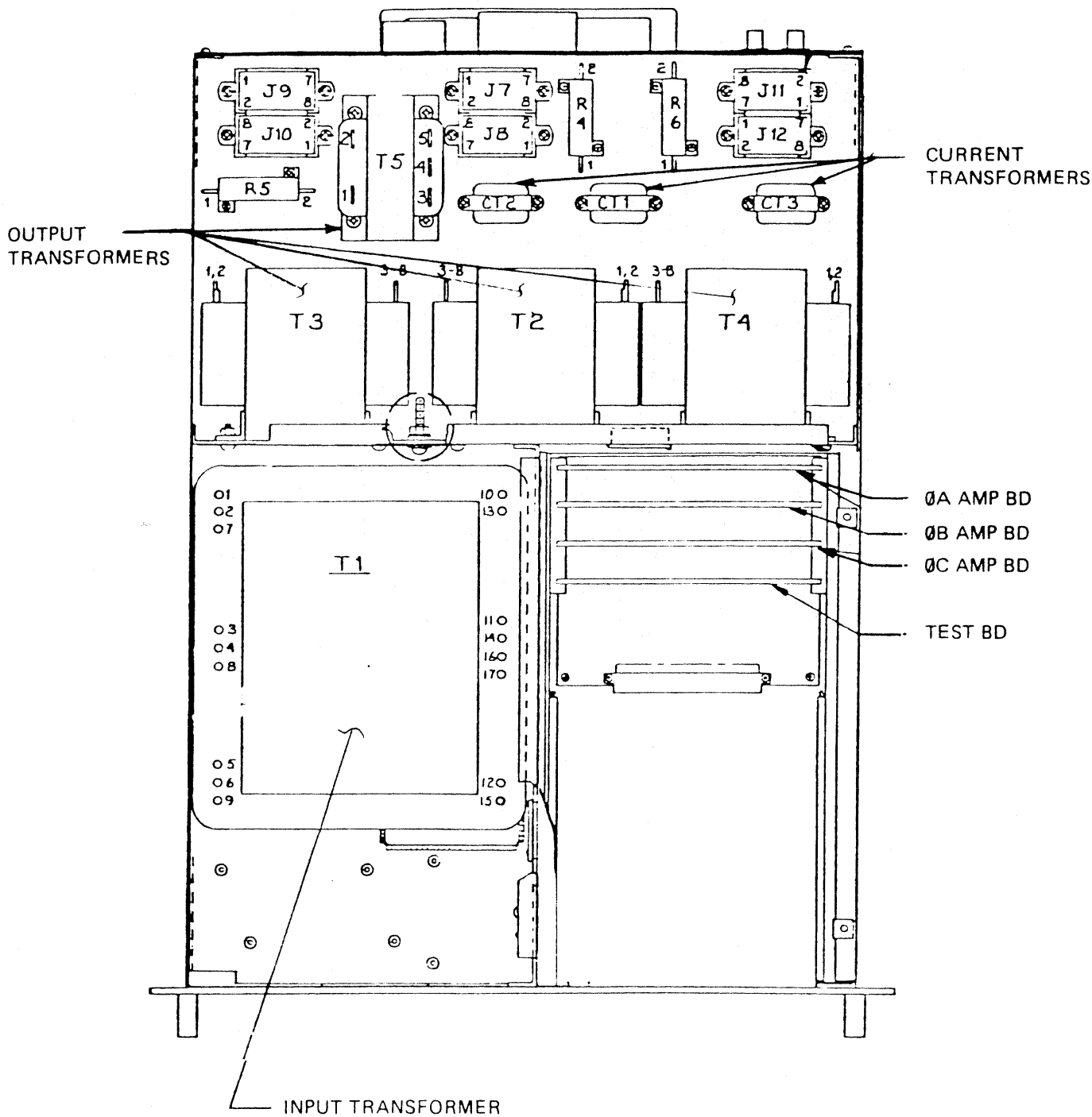

Figure 5-2. Top View

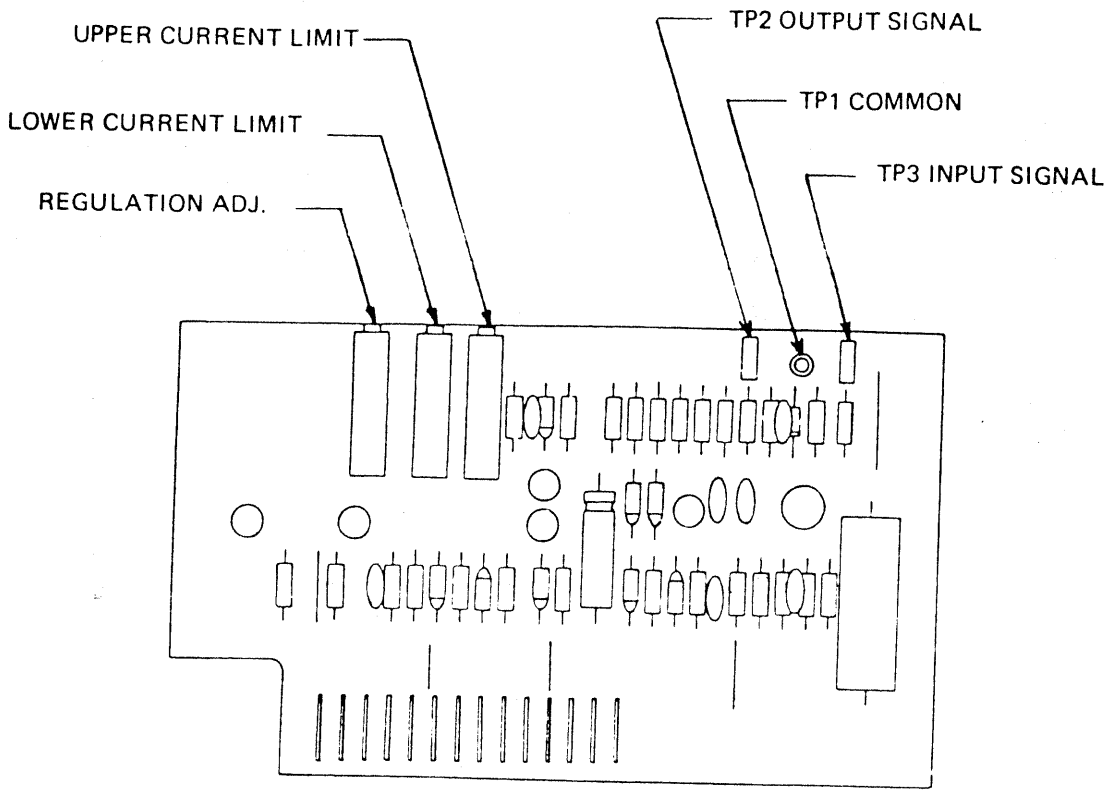

Figure 5-2a. Amplifier Board Detail

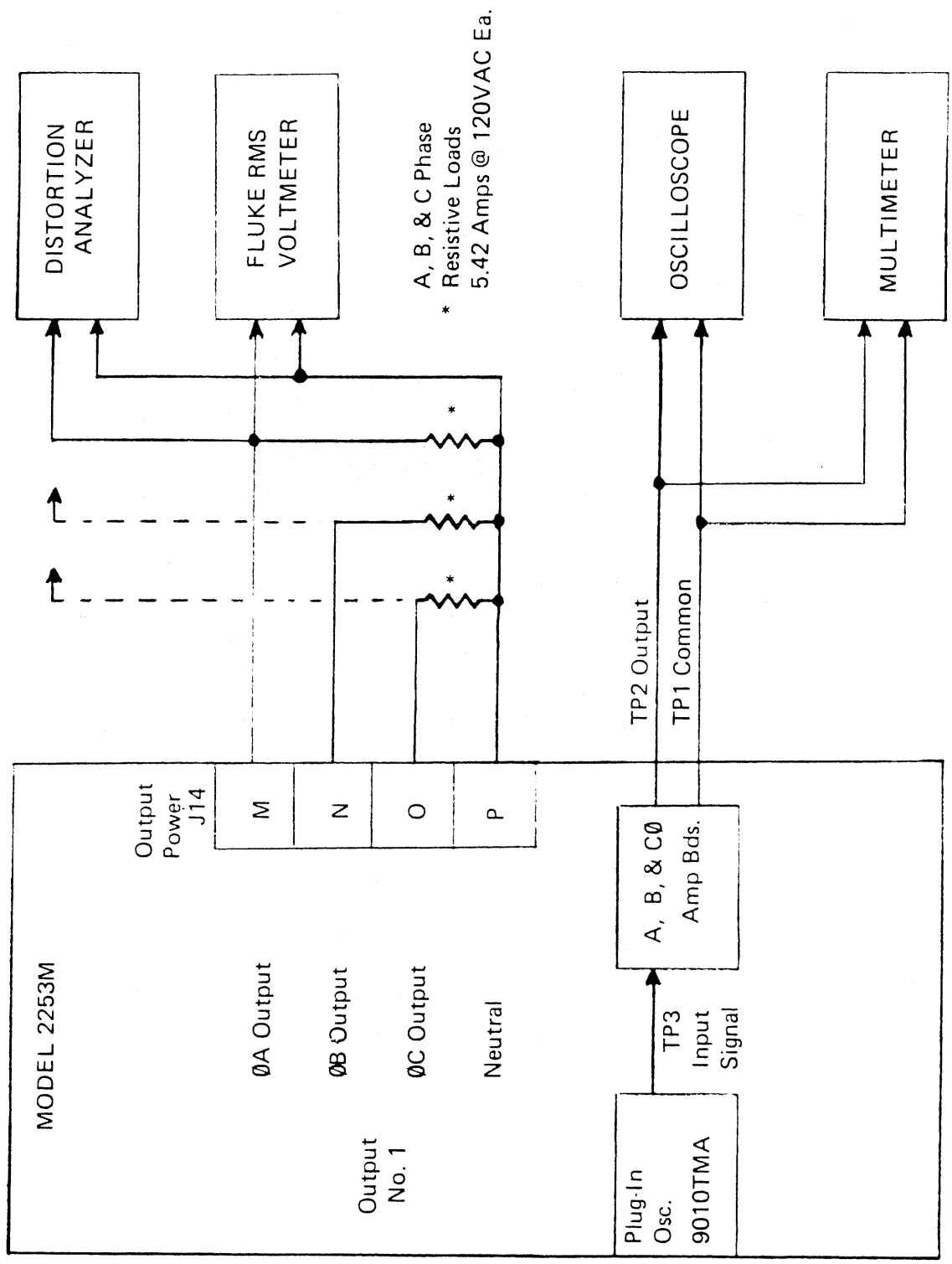

Figure 5-3. Test Set-Up

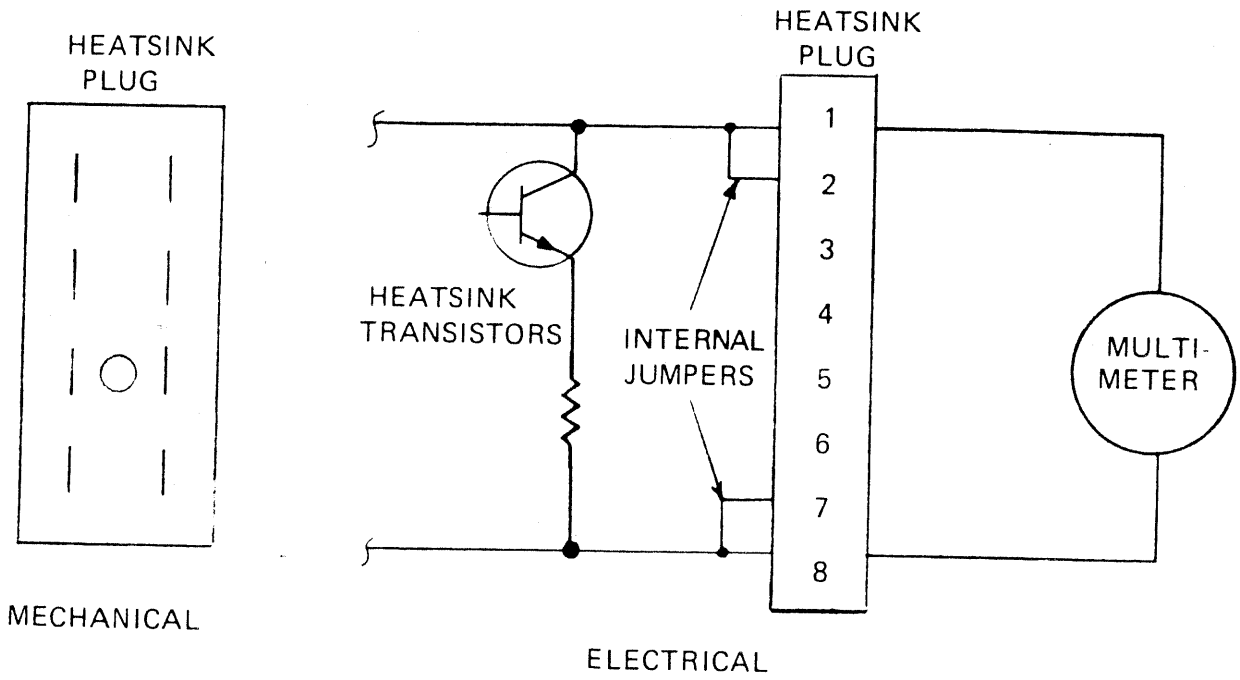

Figure 5-4. Heatsink Plug Diagram

and press circuit board firmly in connector. Standard circuit board repair procedures are applicable.

5-24. FACTORY REPAIR. Do not replace factory-selected parts. Should it be necessary to return an instrument to the factory for repair, please contact the Elgar Corporation Service Department for authorization to make shipment. DO NOT RETURN THE UNIT FOR REPAIR WITHOUT AUTHORIZATION.

SECTION VI
PARTS LIST

6-1. GENERAL

6-2. This section contains a listing of all parts necessary for factory-authorized repair of the unit. Parts are located on the diagrams in Section VII and correlated on the parts list by using their reference designators. Note that trimming capacitors are factory-selected parts and their replacement is considered beyond the scope of customer maintenance.

6-3. SPARE PARTS ORDERING

6-4. When ordering spare parts, specify part name, part number, manufacturer, component value and rating. If complete assemblies are desired, contact Elgar, 9250 Brown Deer Road, San Diego, CA 92121-2294. Specify assembly number, instrument series number and instrument name when ordering.

5080001-01 AMPLIFIER BOARD MODEL 2253M

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
R101,112	5.11K	Metal Film	1/8W, 1%	Dale	RN60C5111F	813-511-1F
R102	FSV	Carbon	½W, 5%	Comm.		
R103	2.61K	Metal Film	1/8W, 1%	Dale	RN60C2611F	813-261-1F
R104	FSV					
R120	200 ohm	Carbon	½W, 5%	Comm.	RC20GF201J	802-201-05
R105	3.9K	Carbon	½W, 5%	Comm.	RC20GF392J	802-392-05
R106,109,121, 122	4.7K	Carbon	½W, 5%	Comm.	RC20GF472J	802-472-05
R108	1.5K	Carbon	½W, 5%	Comm.	RC20GF152J	802-152-05
R110	1K	Potentiometer		Bourns	3059Y	819-102-05
R111	475	Metal Film	1/8W, 1%	Dale	RN60C4750F	813-475-0F
R113	FSV	Carbon	½W, 5%			
R114,118	68 ohm		½W, 5%		RC20GF680J	802-680-05
R124,128	15 ohm	Carbon	½W, 5%	Comm.	RC20GF150J	802-150-05
R115	6.2K	Carbon	½W, 5%	Comm.	RC20GF622J	802-622-05
R116,119,125, 126	100	Carbon	½W, 5%	Comm.	RC20GF101J	802-101-05
R123,127	10 ohm	Potentiometer		Bourns	3059Y	819-100-30
R117	5.6K		½W, 5%		RC20GF562J	802-562-05
C101	2 uF	Met.Mylar	100V,5%	IMB	ZA2Z205J	822-205-53
C102	.022 uF	Paper	200V,10%	GE	192P22392	822-223-05
C103	120 pF	Dip Mica	500V	Arco	DM15121J	820-121-05
C104	FSV	Paper	200V,5%	Sprague		
C105	220 uF	Tantalum	10V	Sprague	196D227X0010MA3	823-227-61
C106	.0015 uF	Cer.Disc	50V,10%	Centralab	CE152	821-152-00
C107	50 uF	Alum.Elec.	50V	Sprague	500D506G050DD7	824-506-71
C108,109	.02 uF	Cer.Disc	50V,10%	Centralab	DDM203	821-203-00
C110	220 pF	Dip Mica	500V,5%	Arco	DM15-221J	820-221-05
C111	.0033 uF	Cer.Disc	1kV,10%	Erie	Z5V332J	821-332-00
C112	200 pF		500V,5%	Arco	DM15-201J	820-201-05
Q101,102		Transistor		National	2N3810	849-381-0X
Q103		Transistor		Fairchild	2N3567	835-356-7X
Q104		Transistor		Fairchild	2N3638	834-363-8X
Q105,106		Transistor		RCA	2N3440	837-344-0X
Q107		Transistor		Motorola	2N5416	836-541-6X
CR101		Zener	12V	Motorola	1N5242	843-524-2X
CR102-109		Diode		Motorola	1N4004	845-400-4X
L101	150 uH			Nytronics	SWD-150	851-105-01

5081004 CHASSIS ASSEMBLY MODEL 2253M

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
B1,2		Fan		Rotron	MR2B3	853-MA2-B4
C1,2	20,000uF	Capacitor	75VDC	GE Mepco	3188FH203U075AM	826-203-75
C3-5	0.1 uF	Capacitor	600VAC	Sprague	6PS-P10	822-104-06
CB1		Cir.Brkr	20A	Heineman	JA3-A3-20-3	852-203-53
CR1-3,7-9		Diode	35A,200V	I.R.	1N1186A	845-118-6A
CR4-6,10-12		Diode	35A,200V	I.R.	1N1186RA	845-118-6R
CT1-3		Cur.Xfmr		Elgar		990-191-91
DS1		Indicator		Eldema	BG02-RCS-A1C-68K	854-68K-22
DS2,3		Indicator		DDP		848-100-01
M1		Voltmeter		Jewell	82T 0-150VAC	857-150-82
R1	4.7 ohm	Resistor	½W, 5%			802-4R7-05
R2,3	10K ohm	Resistor	2W, 5%			804-103-05
R4-6	.05 ohm	Resistor	50W, 5%	Dale	RH50-.05	810-R05-05
S1		Switch		Centralab	1454	860-145-4X
T1		Input Xfmr		Elgar		991-284-90
T2-4		Output Xfmr		Elgar		991-285-90
T5 (2253M-001)		Output Xfmr		Elgar		991-286-90
T5 (2253M-002)		Output Xfmr		Elgar		991-287-90

5081016-01 HEATSINK ASSEMBLY MODEL 2253M

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
C1,2	.022 uF	Capacitor	200V	Sprague	192P22392	822-224-05
CR1,2		Diode		Motorola	MR2002S	845-368-DX
Q1-22		Transistor		RCA	2N6259	841-RCA-62
R1,13	22 ohm	Resistor	½W, 5%			802-220-05
R2,14	5.6 ohm	Resistor	5W, 5%	Dale	CW5-5.6	807-5R6-05
R3-13,15-24	.22 ohm	Resistor	5W, 5%	Dale	CW5-.22	807-R22-05

SECTION VII
DIAGRAMS

7-1. GENERAL

7-2. This section contains the schematic diagrams and parts layout for the AC Power Source. The schematic diagram should be used to understand the theory of operation as an aid in troubleshooting the unit. Reference designators shown on schematics, correspond to reference designators shown in parts lists, where exact component values are given. Components identified as "trim" are factory-selected parts whose values are derermined at time of final checkout.

7-3. DIAGRAMS

7-4. Diagrams included in this section are as follows:

Amplifier Board Schematic	6080001
Test Board Schematic	6809106
Mother Board Schematic	6809107
Heatsink Assy. Schematic	6081016
Interconnect Diagram (-001)	6081003-01
Interconnect Diagram (-002)	6081003-02
Amplifier Board Assembly	5080001
Test Board Assembly	5809106
Mother Board Assembly	5809107