PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER

ELGAR CORPORATION

PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER

INSTRUCTION MANUAL

PRECISION POWER
PRECISION POWER

SERIES 200
POWER SOURCE

PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER
PRECISION POWER

SERIES 200
POWER SOURCE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION I

INTRODUCTION AND GENERAL DESCRIPTION

INTRODUCTION

The Elgar Model 200 Power Source provides AC power at precise frequencies for testing, motor operation, and frequency conversion. The basic power amplifier consists of two DC supplies and a 5-stage direct-coupled amplifier with an adjustable power output transformer. The output transformer permits output voltage ranges of 26, 115, and 230 VAC. Total available power is 200 volt-amperes at 115 volts RMS. Input power is 115 or 230 VAC at 50 or 60 Hz. Units operating with 400 Hz input power are available on special order.

Output power frequency is established by a plug-in oscillator. Output frequency range is 45 to 5000 Hz. The output is derated to half power at frequencies between 5 KHz and 10 KHz. A variety of plug-in oscillators are available, with frequency accuracy up to 0.001%.

The Elgar Power Source facilitates equipment tests over the Mil Spec frequency range of 47 to 63 Hz or 47 to 400 Hz The basic power amplifier output is single phase, but multi-phase power output is obtained by stacking two or three power amplifiers, all driven by the same plug-in oscillator.

SCOPE OF MANUAL

This manual describes the Series 200 Power Source manufactured by Elgar Corporation. The manual contains operating and maintenance instructions, circuit descriptions, circuit diagram, and parts list. Circuits normally understood by operating technicians and field engineers and details of mechanical construction are not described.

GENERAL DESCRIPTION

The Elgar Series 200 Power Source is contained in a rack-mount enclosure with a meter for power output monitoring, a POWER ON indicator, and an output voltage control located on the front panel. An input power circuit breaker is also located on the front panel. Cooling air is drawn through a front panel grill and exhausted at the rear of the enclosure.

The enclosure contains two similar power amplifiers mounted on separate heatsink chassis. Control circuitry is mounted on a plug-in circuit board with test points and adjustment controls available at the top of the board. Output power is available at a rear panel terminal strip and at front panel connectors. An input power cord and fuse are located on the rear panel.

SECTION II

SPECIFICATIONS

POWER AMPLIFIER	
OUTPUT POWER	0-200 VA
POWER FACTOR	Unity to ±0.7
OUTPUT VOLTAGE	Adjustable 0-26 VAC, 0-130 VAC, or 0-260 VAC
OUTPUT FREQUENCY RANGE	45 Hz to 5000 Hz at full power output 5000 Hz to 10,000 Hz at one-half power output
DISTORTION	Less than 1% — 45 Hz to 5000 Hz Less than 2% — 5000 Hz to 10,000 Hz
LOAD REGULATION	1% — 45 Hz to 5000 Hz 2% — 5000 Hz to 10,000 Hz
LINE REGULATION	1/2% — 115 VAC ±10 VAC 1/2% — 230 VAC ±20 VAC
SHORT CIRCUIT PROTECTION	Output may be shorted indefinitely and recovers immediately when short is removed
INPUT POWER	115 VAC ±10 VAC, or 230 VAC ±20 VAC, 45 Hz to 480 Hz 550 Watts maximum
TEMPERATURE RANGE	0 - 50°C
DIMENSIONS	5-1/4" x 19" relay rack panel by 14-1/2" deep overall
WEIGHT	Approximately 50 lbs

SECTION III

PRELIMINARY INSPECTION AND OPERATION

INSPECTION UPON RECEIPT

The Elgar Power Source has been aligned, calibrated, and tested prior to shipment. The instrument is therefore ready for immediate use upon receipt. The following checks should be made, however, to assure that the instrument has suffered no damage during shipment.

1. Make a visual inspection of the shipping container prior to accepting the package from the carrier. If extensive damage to the shipping container is evident, a description of the damage should be noted on the carriers receipt, and signed by the driver of carrier agent. If damage is not apparent until the instrument is unpacked, a claim for concealed damage should be placed with the carrier and all shipping containers and filler material saved for inspection. Forward a report of damage to the Elgar Service Department, which will provide instructions for repair or replacement of the instrument.

2. Make a visual inspection of the instrument when it is removed from the shipping container. Remove the cover and determine that the circuit boards are firmly seated in the proper position.

OPERATION

Operating an Elgar Power Source requires only the the following steps:

1. Install the power source so that the flow of cooling air into the front panel grill and out the rear panel grill is unobstructed.
2. Insert the plug-in oscillator.
3. Connect the power output load to the rear panel terminal connectors or the front panel output connectors.
4. Insert the power connector on the power cord into the AC power source.
5. Set the front panel POWER switch to ON. The indicator on the front panel is lighted when power is applied.
6. Adjust the front panel AMPLITUDE control for the desired output voltage.

NOTE
Some Elgar plug-in oscillators do not require the use of the AMPLITUDE control. Consult the oscillator instruction manual.

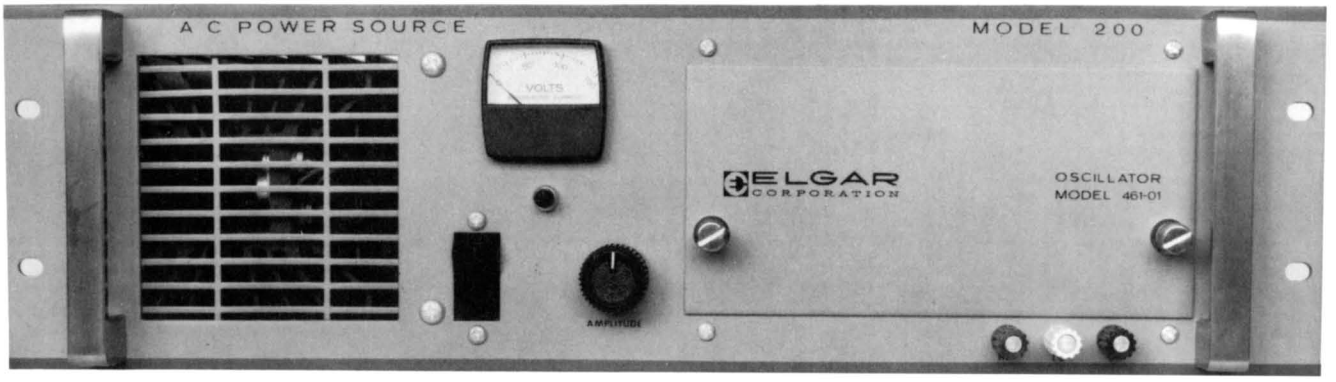


FIGURE 3-1 FRONT PANEL

Some major applications of the Elgar Power Source require an output of 26 volts. With the amplifier current limiting circuitry, full power cannot be obtained from the 115 volt output operating at 26 volts. Terminals 6 and 9 of the transformer are strapped together to provide 26 volts at full power between terminal 9 and terminal 5.

The 26-volt output is not available at the front panel. The front panel meter is wired to one of the 115 volt windings of the output transformer. When operating at 230 volts, full output voltage is indicated by a reading of 115 volts. When operating at 26 volts, full output voltage is indicated by a reading of 115 volts.

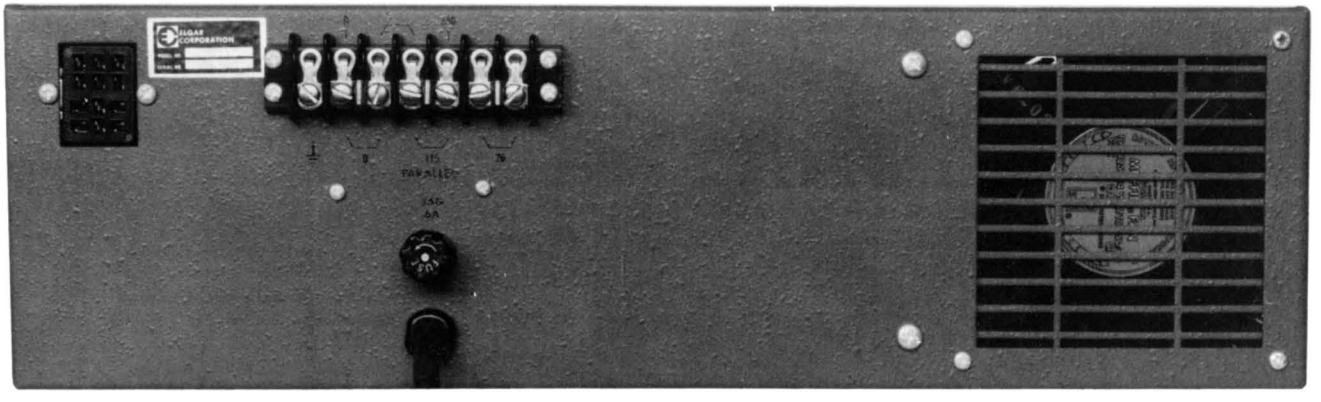


FIGURE 3-2 REAR PANEL

SECTION IV

THEORY OF OPERATION

CIRCUIT DESCRIPTION

The input signal, at a nominal two volts, is provided by the plug-in oscillator. The signal is applied to the first amplifier stage, differential pair transistor amplifiers Q1 and Q2. The differential pair provides high dc stability, inverts the signal and shifts the signal level to -40 volts. Potentiometer R8 provides dc balance adjustment for the differential pair. CR5 and CR10 are transistors used as Zener diodes to produce regulated 12.4 volts at the junction of resistors R11 and R10. (The collector-base junctions of CR5 and CR10 are forward-biased and the emitter-base junctions are operated at Zener breakdown.) The 12.4 volts, in conjunction with R10, provides constant current to the emitters of Q1 and Q2.

The output of the differential amplifier stage is coupled to the base of transistor Q5 through emitter follower Q4. Q5 is a class A driver which provides the signal to the complementary driver stage, transistors Q7 and Q10 The output section is a split circuit construction built on two heatsinks. Cooling air is drawn in through the front panel louvres, passed through the wind-tunnel formed by the two heatsinks, and out through the rear panel opening. The heatsinks carry the output transistors, protective diodes, and the complementary driver transistors. Q7, the upper driver transistor, is NPN and Q10, the lower driver transistor, is PNP. The PNP transistor inverts the phase of the signal to the lower output transistor.

Resistors R14 and R15 form the load for transistor Q5. To improve the dynamic range and allow Q7, Q8, and Q9 output circuitry the same gain as the Q10, Q11, and Q12 output circuitry, the junction of R14 and R15 is bootstrapped to the amplifier output through capacitor C10. The output current of transistors Q8 and Q11 is drawn across emitter resistors R28 and R31. A portion of the voltage developed across the resistors is picked off by potentiometers R18 and R22. The potentiometer outputs are applied to current-limiting transistors Q3 and Q6. If the current in the power transistors becomes excessive, the potentiometer output drives the limiting transistors into conduction, reducing the drive signal to the power transistors. The output current limit is established by the potentiometer setting. Since the dissipation of the power amplifier transistors is increased if the amplifier operates into a short circuit or very low impedance load, additional drive to transistors Q3 and Q6 is provided by resistors R16 and R20. As the voltage across the power transistors is increased, current limiting occurs more rapidly, reducing the output current. Current limiting normally occurs at 1-3/4 to 2 amperes RMS output when operating at 115 volts. When operating into a direct short circuit, however, the output current is limited at 1 ampere. No matter how heavily the amplifier is overloaded, transistor dissipation remains relatively constant. The amplifier output can be directly short-circuited without damage to the amplifier, which recovers immediately when the short circuit is removed.

Complementary driver transistors Q7 and Q10 are operated class AB, biased at about 1 milliampere by diodes CR6 and CR7. The voltage drop across the forward biased diodes overcomes the base-emitter voltage

drop of Q7 and Q10, and holds the transistors to a small reference-current level which is sufficiently small that the output transistors, in a quiescent state, are essentially off. Resistors R27 and R30 in the output transistor circuits permits the small reference current to flow in the output transformer, so that while the output stage is truly class B, cut off in the quiescent state, there is no threshold effect. The output transistors Q8, Q9, Q11, and Q12 are NPN transistors operated class B, in series across the positive and negative outputs of the power supply.

The amplifier has negative dc feedback through resistors R10 and R11 and decoupling capacitor C7. Capacitor C6 provides high frequency stabilization. However, due to the low dc resistance of the output transformer winding 1 and 2, there is very little dc feedback developed. Major feedback is provided by an additional winding of the transformer, between terminals 3 and 4 The winding is wound bifilar with winding 1 and 2 for very close coupling. The negative feedback from terminal 4 is applied through resistor R26 to the current summing junction at the base of transistor Q1. Transformer T3 provides load current compensation which permits ± 1% output regulation. T3 senses the difference in voltage between transformer terminals 2 and 4 of the output transformer. The voltage difference is caused by the load current flowing in the 1 and 2 winding, producing a voltage drop in the copper resistance of the winding. By sensing the voltage drop across the transformer copper resistance as a basis for current compensation, the resultant compensation is independent of the temperature variation in the transformer. Transformer T3 is loaded by potentiometer R23, which is the regulation adjustment. The signal from R23 is applied to the summing junction at the base of Q1 as a positive current feedback. The positive current feedback is applied to the summing junction through resistors R24 and R25, and capacitor C11. Potentiometer R23 is adjusted so that the no-load and full-load output voltages of the amplifier are the same. Capacitor C11 allows greater feedback at higher frequencies, to allow full control throughout the amplifier frequency range.

OUTPUT TRANSFORMER

Output transformer T2 has split output windings. Normal output is 115 volts with the windings in parallel. Terminals 5, 6, 7, 8, 9, and 10 are connected to a barrier strip on the outside of the rear panel. Terminals 5 and 8 are jumpered together, and terminals 7 and 10 are jumpered together. Taken between terminals 5 and 10, the output is 115 volts RMS. A red terminal on the front panel is connected directly to terminal 10 on the rear panel. A white terminal on the front panel is connected directly to terminal 5 on the rear panel, permitting 115 volts RMS from the front panel. By removing jumpers between terminals 5 and 8 and terminals 7 and 10, and installing a jumper between terminals 7 and 8, the split windings of the output transformer are placed in series. The output between terminals 5 and 10 is 230 volts RMS. The 230-volt output is also applicable for 208 volt, 3-phase operation, with 115 volt line-to-neutral and 208 volt line-to-line output. A 208 volt, 3-phase operation is also possible using two amplifiers in open delta configuration.

INPUT POWER

Input power can be 115 volts or 230 volts at 50 or 60 Hz, or by special order, 400 Hz Power transformer T1 has a split primary, connected to a 4-terminal barrier strip on the inside of the rear panel. Two jumpers normally parallel the windings of the transformer primary for operation at 115 volts. By removing the jumpers and connecting the windings in series the amplifier may be used with 230 volts input. The cooling fan and front panel pilot light are connected across one winding of the transformer primary, allowing these elements to operate at 115 volts regardless of the input power voltage. Diodes CR1, CR2, CR3, and CR4 provide full wave rectification for the +40 VDC and -40 VDC power supply outputs.

SECTION V

MAINTENANCE

SERVICE INFORMATION

Questions concerned with the operation, repair, or servicing of this instrument should be directed to the nearest Elgar representative or to the Service Department, Elgar Corporation, 8046 Engineer Road, San Diego, California, . INCLUDE THE MODEL NUMBER AND SERIAL NUMBER in any correspondence concerning this instrument.

FACTORY REPAIR

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.

ELGAR CORPORATION
8046 Engineer Road
San Diego, California

SHIPPING DAMAGE

It is possible for equipment to be damaged in shipment. Therefore, it is imperative that the instrument be tested and inspected as soon as it is received. If the instrument shows signs of damage, notify the carrier immediately. The carrier's claim agent will prepare a report of damage to be forwarded to the Elgar Service Department. You will be advised as to the action necessary to have the instrument repaired or replaced.

TEST POINTS

Test points and adjustment controls are conveniently provided at the top of the plug-in circuit board, as shown in figure 6-1. Adjustment procedure is given in the following paragraph.

ADJUSTMENT

The following adjustments should be checked at regular intervals and whenever the character of the load on the instrument (resistive, capacitive, or inductive) is changed. These adjustments can be performed with the aid of a Simpson 260A multimeter, Tektronix 545A oscilloscope, and a Fluke differential voltmeter, or equivalent instruments. Test points and adjustments are shown in figure 6-1.

D.C. Balance

The DC balance adjustment prevents DC offset voltages which can cause large DC currents in the output transformer primary winding. Adjustment is accomplished with the front panel AMPLITUDE control set fully

counterclockwise to zero, or with the plug-in oscillator removed, to eliminate any signal input.

a. Measure the DC output voltage between TP2 and TP1 (common) using the 2.5 volt scale of the multimeter.

b. Adjust R7 to obtain a null (zero DC indication).

c. Set multimeter to the most sensitive current scale, such as 1 milliampere or 50 microamperes.

d. Adjust R7 to obtain a null (zero current indication).

Current Limiting Adjustment

Proper adjustment of the current limiting circuits prevents output distortion.

a. Connect an adjustable resistive load to the power source output. Adjust the load for 200 volt/ampere output at 110 volts (1.82 amperes).

b. Connect an oscilloscope to TP2 (amplifier output).

c. Advance the positive current limiting control R18 in a clockwise direction until clipping of the positive peaks of the waveform is observed on the oscilloscope.

d. Turn R18 counterclockwise until clipping is no longer observed.

e. Advance the negative current limiting control R22 in a clockwise direction until clipping of the negative peaks of the waveform is observed on the oscilloscope.

f. Turn R22 counterclockwise until clipping is no longer observed.

Regulated Output Adjustment

The output will remain within the specified ± 1% after it has been adjusted for frequency and load conditions.

a. With the load disconnected from the power source, read the output voltage. Use a differential voltmeter (Fluke or equivalent) to obtain precise reading. The output voltage can be read at the front panel output terminals.

b. Connect the power source to the normal operating load.

c. Read the output voltage and adjust R23 until the output voltage is the same as that obtained under no load conditions.

d. Repeat steps (a) through (c) for accuracy.

TROUBLESHOOTING

Blown Fuse

A blown fuse indicates failure of a power amplifier transistor or a power rectifier. Pull out both heatsink connector plugs. Insert a new fuse and apply power to the instrument. If the fuse fails again, the trouble is in the power rectifier. If the fuse does not fail, check transistors Q8, Q9, Q11, and Q12 on the power amplifier heatsink circuits. If all the transistors are good, check transistors Q7 and Q10.

Output Distortion

Output distortion is caused by improper setting of the current limiting circuits. Consult the adjustment procedure given in this section of the manual.

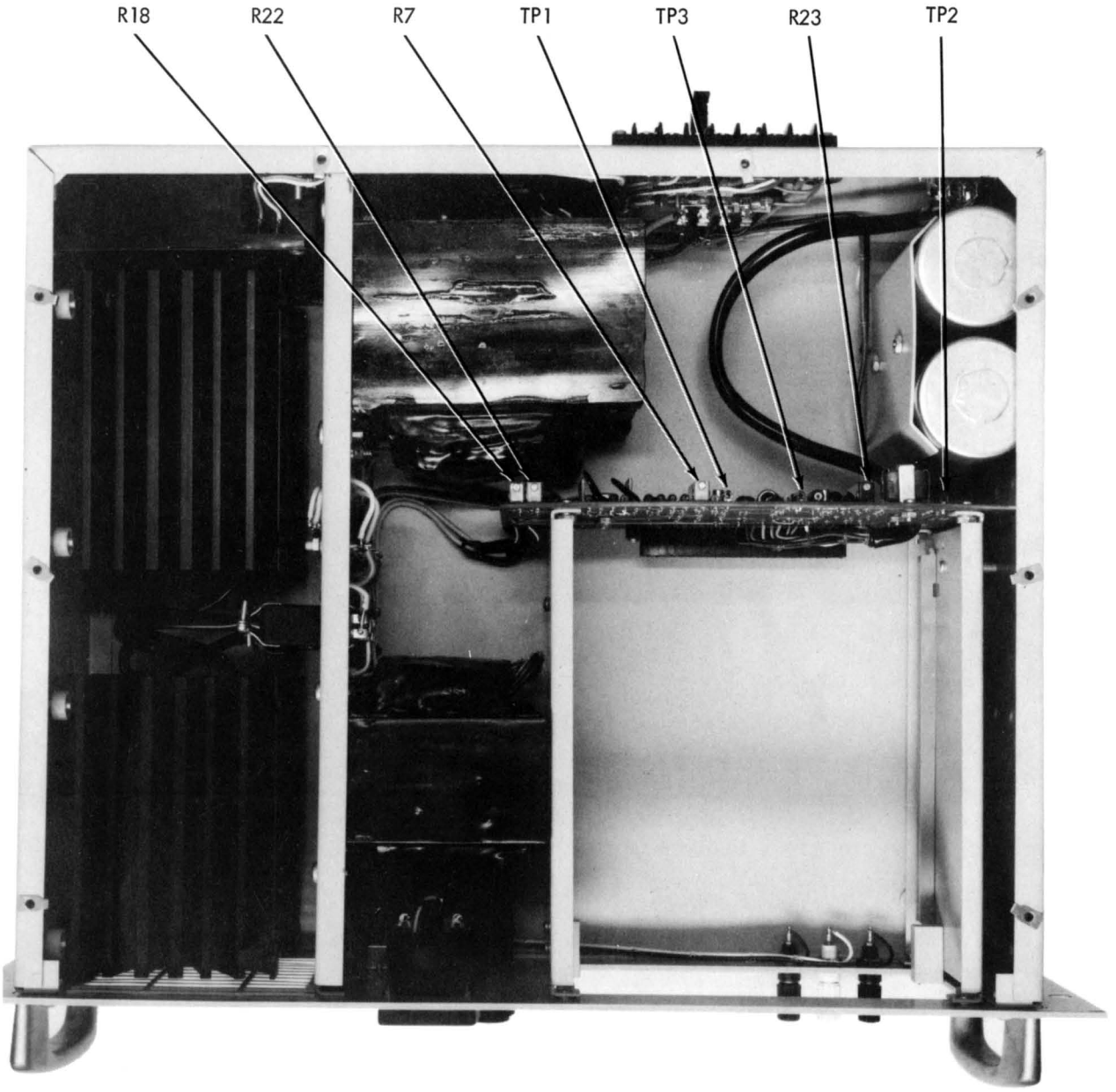
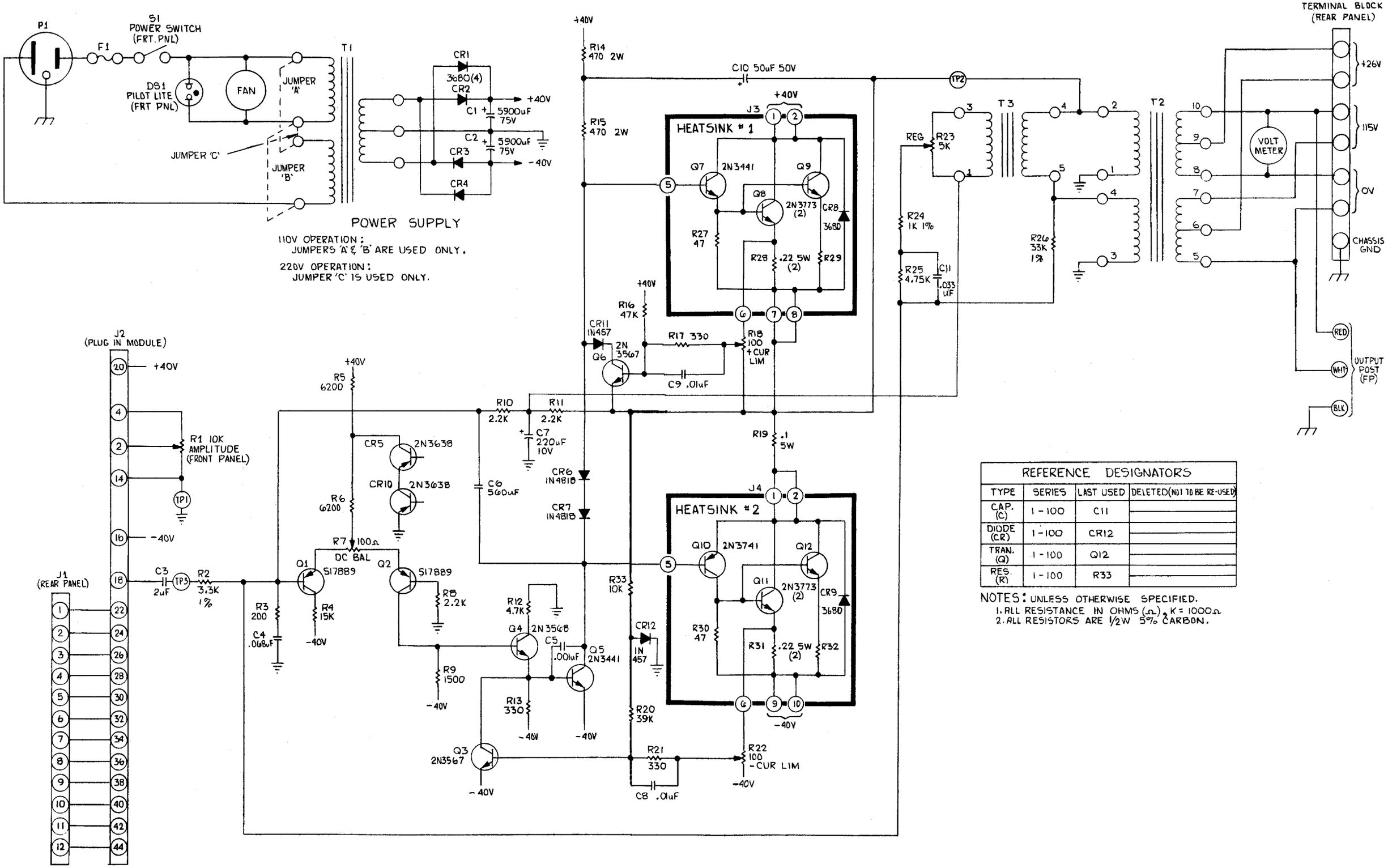


FIGURE 5-1 TEST POINT AND ADJUSTMENT LOCATION



REFERENCE DESIGNATORS			
TYPE	SERIES	LAST USED	DELETED (NOT TO BE RE-USED)
CAP. (C)	1-100	C11	
DIODE (CR)	1-100	CR12	
TRAN. (Q)	1-100	Q12	
RES. (R)	1-100	R33	

NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTANCE IN OHMS (Ω), K = 1000Ω
2. ALL RESISTORS ARE 1/2W 5% CARBON.

FIGURE 5-2 SCHEMATIC DIAGRAM OF ELGAR SERIES 200 POWER SOURCE

SECTION VI

PARTS LIST

PARTS LIST

ASSEMBLY: Power Source, Model 200

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION TYPE	RATING	MANUFACTURER NAME	PART NUMBER
CAPACITORS					
C1, C2	5900 ufd		75V	Sprague	36D 592F075B62A
C3	2 ufd		200V 1%	Elpac	ZD2A205F
C4	.068 ufd		200V 10%	Sprague	192P 68392
C5	.001 ufd			Centralab	DD102
C6	560 ufd		500V 5%	ARCO	DM 15-561J
C7	220 ufd	TANTALUM	10V	Kemet	K220C10K
C8, C9	.02 ufd		150V	Centralab	DD203
C10	50 ufd		50V	Sprague	TE 1307
C11	.033 ufd			Sprague	192P 33392
RESISTORS					
R1	10K	POTENTIOMETER		Helipot	7246R10K
R2	3.3K		1%	Corning	RN60D 3301F
R3	200Ω		1/2W 5%	Ohmite	
R4	15K		1/2W 5%	Ohmite	
R5, R6	6200Ω		1/2W 5%	Ohmite	
R7, R18, R22	100Ω	POTENTIOMETER		Bourns	275-1-101
R9	1500Ω		1/2W 5%	Ohmite	
R10, R11	2.2K		1/2W 5%	Ohmite	
R12	4.7K		1/2W 5%	Ohmite	
R13, R17, R21	330Ω		1/2W 5%	Ohmite	
R14, R15	470Ω		2W 5%	Ohmite	
R16	47K		1/2W 5%	Ohmite	
R19	.1Ω		5W 5%	Dale	
R20	39K		1/2W 5%	Ohmite	
R23	5K	POTENTIOMETER		Bourns	275-1-502
R24	1K		1%	Corning	RN60D 1001F
R25	4.75K			Corning	RN60D 4751F
R26	33K		1%	Corning	RN60D 3302F
R27, R30	47Ω		1/2W 5%	Ohmite	
R28, R29, R31, R32	.22Ω		5W	Dale	RS-5
R33	10K		1/2W 5%	Ohmite	
SEMI CONDUCTORS					
CR1, CR2, CR3, CR4, CR8, CR9		DIODE, 368D		Westinghouse	368D
CR5, CR10		ZENER, 2N3638		Fairchild	2N3638
CR6, CR7		DIODE, 1N4818		Westinghouse	1N4818
CR11, CR12		DIODE, 1N457		Sylvania	1N457
TRANSISTORS					
Q1, Q2		S1788A		Fairchild	S1788A
Q3, Q6		2N3567		Fairchild	2N3567
Q4		2N3568		Fairchild	2N3568
Q5, Q7		2N3441		RCA	2N3441
Q10		2N3741		Motorola	2N3741
Q8, Q8, Q11, Q12		2N3773		RCA	2N3773

PARTS LIST

ASSEMBLY: Power Source, Model 200

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION TYPE	RATING	MANUFACTURER NAME	PART NUMBER
TRANSFORMERS					
T1		POWER		Aztec	3966
T2		OUTPUT		Aztec	6298
T3				Triad	T31X
Fuse				Littlefuse	314-006

WARRANTY

Elgar Corporation warrants each instrument it manufactures to be free from defects in material and workmanship. The corporation's obligation under this warranty is limited to servicing the instrument and replacing defective parts, when the instrument is returned to the factory and transportation charges pre-paid. This warranty is effective for one year after delivery of the instrument to the original purchaser. Defects caused by improper operating conditions, misuse, negligence, or the alteration or removal of the nameplate, will void the warranty. Elgar Corporation shall in no circumstance be liable for any direct or consequential loss or damage of any nature resulting from the malfunction of the instrument. This warranty is effective in lieu of any or all other obligations or liabilities on the part of Elgar Corporation, its agents, or representatives.