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MODEL 3001

AC Power Source

Instruction Manual

REFERENCE ONLY DO NOT COPY

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March 1982

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- 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.
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- A returned product found, upon inspection by Elgar, to be in specification is subject to an inspection fee and applicable freight charges.
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SECTION I
GENERAL DESCRIPTION

1-1. INTRODUCTION

1-2. This manual describes the Model 3001 AC Power Source manufactured by Elgar. It provides operating, maintenance, and adjustment instructions, a circuit description, a schematic diagram, and a parts list.

1-3. The Model 3001 AC 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 direct-coupled amplifier with a tapped output transformer. The output transformer provides nominal output voltage of 115 and 230VAC that are adjustable between 0-130 and 0-260VAC. Total available power is 3000 volt-amperes at full rated output voltage. Power at less than full-rated output voltage is derated as illustrated in Figure 1-1. Shown in Figure 1-2 is a curve of typical harmonic distortion. Input power is three-phase 120/208V at 50-60 Hz. The power transformer may be wired for three-phase 230V delta or 230/400V wye at 50-60 Hz. Units operating on three-phase 480V are available on special order.

1-4. Output power frequency is usually established by a plug-in oscillator. Output frequency range is 45 to 5000 Hz. A variety of plug-in oscillators is available with frequency accuracies up to .0001%.

1-5. The Elgar AC Power Source facilitates equipment tests to meet military-specification operating requirements over the frequency range of 47-63 Hz or 47 to 425 Hz. The basic power source output is single-phase. Multiphase power can be obtained however, by stacking two or three power sources, all driven by the same multi-phase plug-in oscillator.

1-6. GENERAL DESCRIPTION

1-7. The Elgar Model 3001 AC Power Source is contained in a rack-mountable enclosure. A meter for output voltage monitoring, a power on indicator lamp, a voltage amplitude control and a power circuit breaker that applies line power to the unit are located on the front panel. Cooling air is drawn through front-panel grills and exhausted at the rear of the enclosure.

1-8. The enclosure contains 8 heatsink assemblies, which comprise a 4-section power amplifier. Control circuitry is mounted on plug-in circuit boards with test points and adjustment controls available at the top of the board. Output power is available at a rear panel terminal strip. Front panel test points are provided for external measurement of output voltage or frequency.

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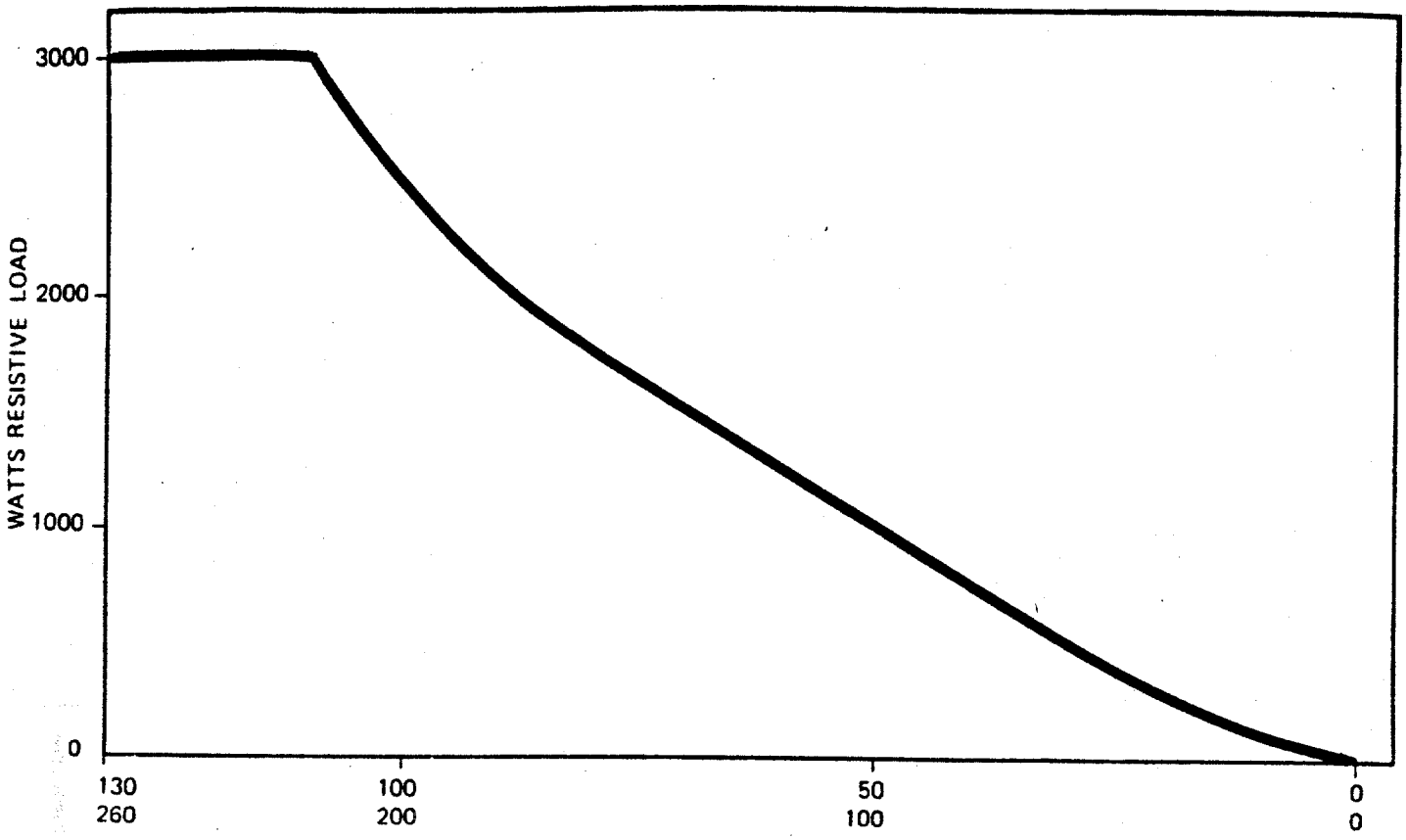


Figure 1-1. Power Output Derating

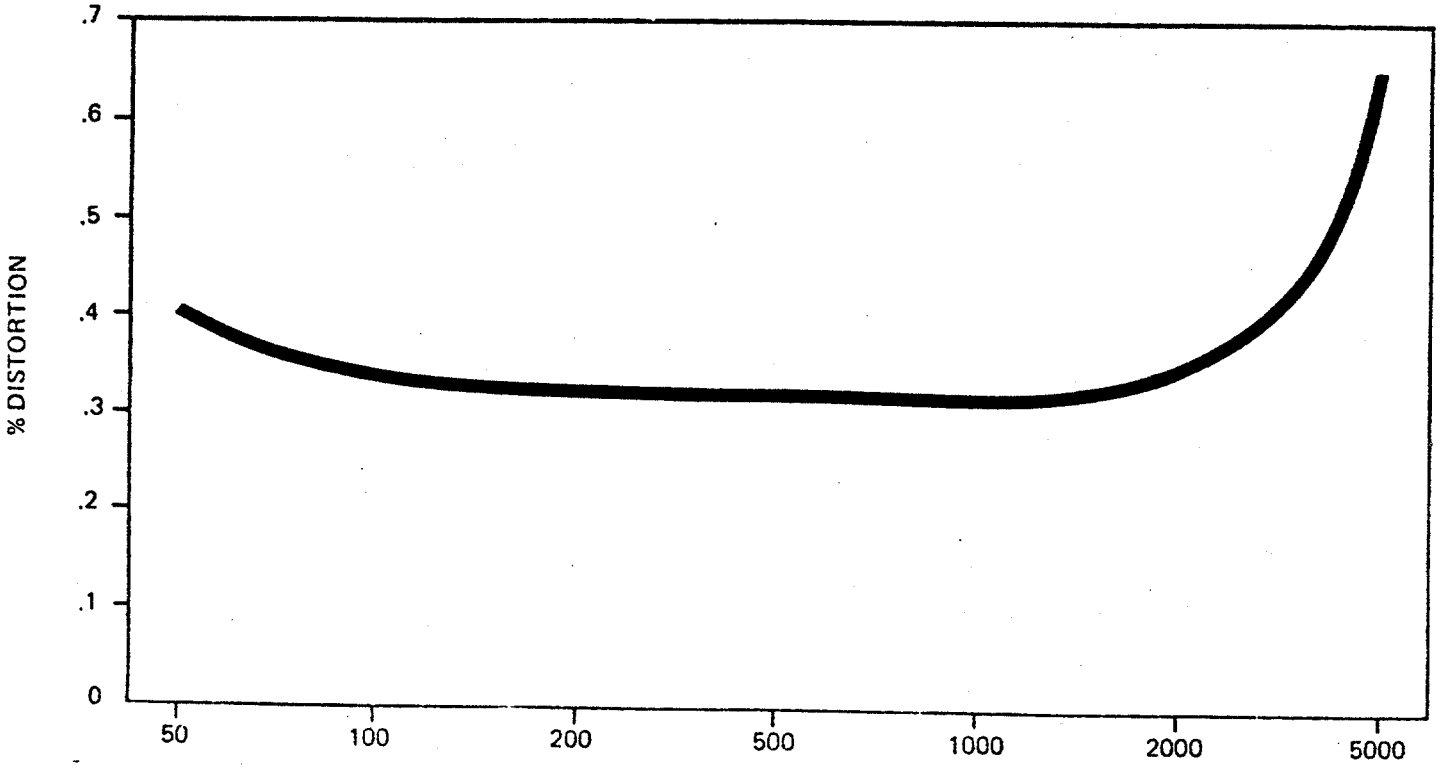


Figure 1-2. Typical Harmonic Distortion

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SECTION II
SPECIFICATIONS

Output Power	0-3000VA
Power Factor	Unity to ±.7
Output Voltage	Adjustable 0-65VAC, 0-130VAC or 0-260VAC
Output Frequency Range	45-3000 Hz
Distortion	Less than 0.9% Less than ½% 100-1000 Hz
Load Regulation	±1%, adjustable to zero for specific load and frequency
Line Regulation	±0.25% 117VAC ±10% ±0.25% 234VAC ±10%
Short Circuit Protection	Output may be shorted indefinitely and recovers immediately when short is removed.
Input Power	Three-phase 120/208VAC, 45-66 Hz or 3-phase 230VAC delta or wye, 9000 volt-amperes max. Three-phase 480VAC available on special order
Temperature Range	0-50°C
Dimensions	17½" x 19" relay rack panel by 23" deep overall
Weight	Approximately 310 pounds.
Slides	Accuride C501 Elgar P/N 105-501-21

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SECTION III
PRELIMINARY INSPECTION, INSTALLATION AND OPERATION

3-1. INSPECTION UPON RECEIPT

3-2. The Elgar AC Power Source has been aligned 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. Inspect the shipping container before accepting it from the carrier. If damage to the container is evident, remove the instrument from the container and visually inspect for damage to the instrument parts.

2. If any damage to the instrument or container is evident, a description of the damage should be noted on the carrier's receipt, and signed by the driver or carrier's agent. Save all shipping containers and filler material for inspection.

3. Forward a report of any damage to the Elgar Repair Department 9250 Brown Deer Road, San Diego CA 92121-2294. ELGAR will provide instructions for repair or replacement of the instrument.

3-3. INSTALLATION AND OPERATION

1. The Elgar AC Power Source is designed for installation in a standard electrical equipment rack. 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 load to the appropriate terminal of the rear panel power output terminal block (see Figure 3-1).

4. Connect the input power terminal block on the rear panel to an appropriate source of three-phase power. Phase sequence is immaterial.

WARNING

Do not connect input power to the output terminal block. Serious damage to the power source may result.

5. Turn front panel POWER switch ON. The pilot lamp illuminates when power is applied.

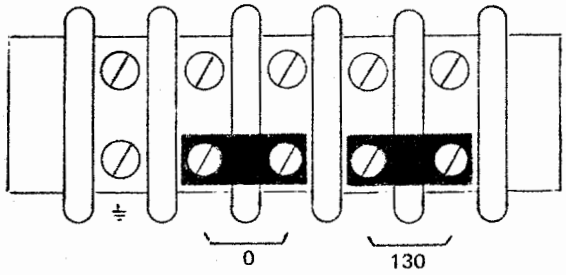
6. Adjust front panel AMPLITUDE control for the desired output voltage as indicated on the front panel voltmeter.

NOTE

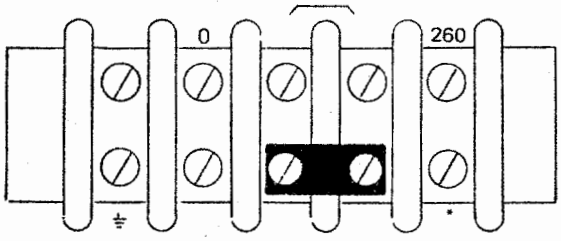
Certain Elgar plug-in oscillators do not require the use of the front panel AMPLITUDE control. Others are remotely programmed. Consult the oscillator instruction manual.

3-4. The front panel voltmeter is connected across a 0-130VAC winding of the output transformer. For the 0-260VAC connection, the meter indicates one half of the output voltage. The 0-65VAC requires changes on internal terminal board TB4,see Pg. 7-3.

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PARALLEL JUMPER CONNECTIONS FOR 115VAC OPERATION



SERIES JUMPER CONNECTIONS FOR 230VAC OPERATION

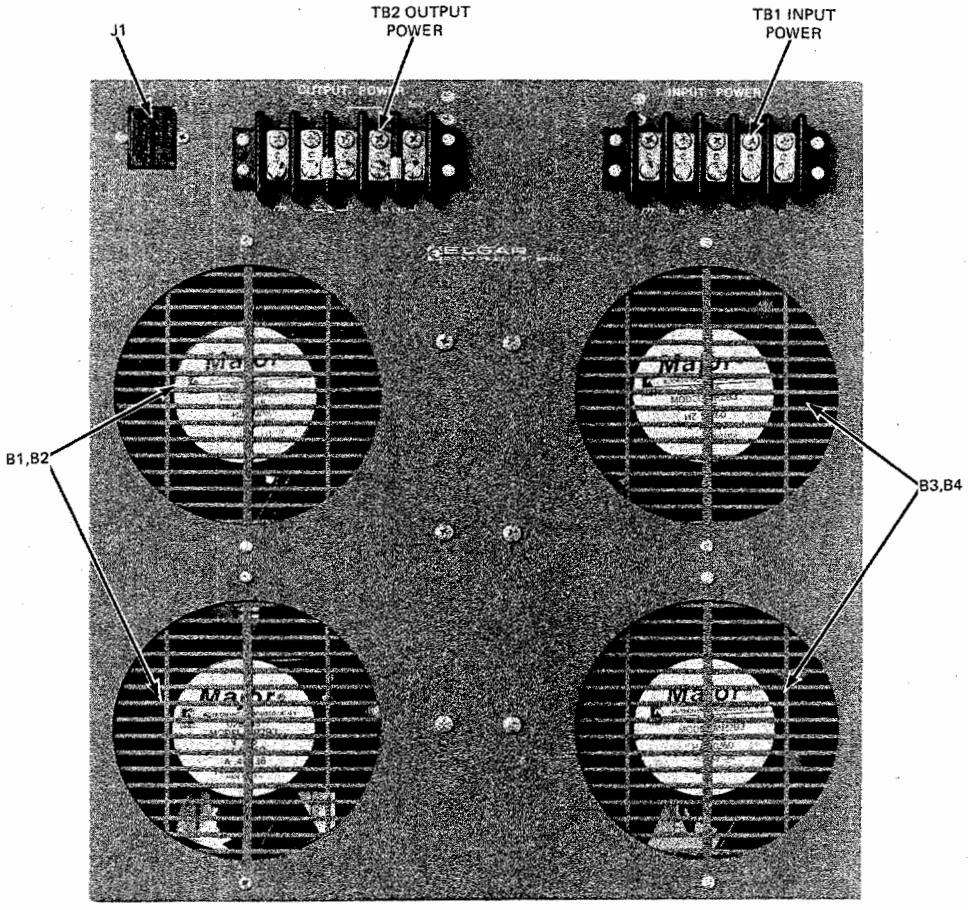


Figure 3-1. Rear Panel Terminal Strip Connections

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SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION

4-2. The Model 3001 contains two identical power amplifiers connected in a bridge configuration. An output transformer, connected between the outputs of the two amplifiers, transforms the output voltage to the desired value and isolates the load from the amplifier circuit common.

4-3. Each amplifier consists of an amplifier circuit board and four heatsink assemblies containing 44 power transistors.

4-4. The input signal, approximately 2V RMS, is provided by the plug-in oscillator. For most oscillators the input signal amplitude is controlled by front panel AMPLITUDE control, R6. The signal from R6 is applied to the first amplifier board, through C101 and R129 to the base of first amplifier transistor Q101. The signal is also applied through R102 to inverting operational amplifier Z101. Z101 inverts the input signal to provide an equal signal phase shifted 180^{o} for the second amplifier board. Q101 and Q102 are connected as a differential amplifier to provide high DC stability. This prevents circulation of large DC currents in the primary of output transformer T2. The output of Q102 is applied to the base of Q103 which provides drive signals to the complementary drive stage Q105 and Q107. Q105 operates as an emitter follower to drive emitter follower Q501 which provides base drive signals to the upper half of the push-pull class B power amplifier. Q107 is operated as a common-emitter stage to provide phase inversion of the drive signals to the lower half of the power amplifiers. The output of Q107 is applied to emitter follower Q701 which provides base drive signals to the lower half of the power amplifier.

4-5. Emitter followers Q501 and Q701 are mounted on power amplifier heatsink assemblies. Each emitter follower drives 10 identical power transistors mounted on the same heatsink assembly and 11 more power transistors mounted on an adjacent heatsink assembly. These 21 power transistors in each half of the amplifier are paralleled, with .22 ohm emitter resistors to ensure equal current division between the transistors. The upper half of the power amplifier operates from a +42VDC power supply and the lower half from a –42VDC power supply.

4-6. The power amplifier transistors are protected from overload by current limit transistors Q104 and Q106. The current in the upper half of the power amplifiers is sampled by R502. The voltage from R502 is applied through R123 to the base of upper current limit transistor Q104. When the voltage reaches the conduction threshold (approximately .6V) of Q104, Q104 conducts and diverts drive current from the base of Q105, thus preventing any further increase in output current. Simultaneously, the current in the lower half of the power amplifier is sampled by R7. The voltage from R7 is applied through R124 to the base of lower limit transistor Q106. Q106 conducts when the current in the lower half of the power amplifier reaches limit threshold and prevents further increase in the output current. The resistor-diode network in the base circuits of Q104 and Q106 senses the amplifier output voltage and modifies the bias voltages of Q104 and Q106 to further reduce the output current under short circuit or severe overload conditions, thus preventing excess dissipation in the power amplifier transistors.

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4-7. Negative voltage feedback is taken from the amplifier output to the base of Q101 through R130 and C112. Voltage regulation of the output transformer is compensated by adjustable positive current feedback. The power amplifier current is sampled by current transformer T3. The signal from T3 is attenuated by REGULATION potentiometer R127 and applied through R103, R104 and C103 to the base of Q101. The signal from R127 is also applied through R103, R106 and C104 to operational amplifier Z101 to compensate the signal to the second power amplifier.

4-8. Thermostats on the heatsink assemblies are connected to the collector circuit of Q103 to protect the power amplifier from overheating. If any of the thermostats close, the drive signals to the power amplifier are removed.

4-9. The second power amplifier is identical to the first. R127 and Z101 on the second amplifier circuit board have no function. They are installed so that identical circuit boards may be used.

4-10. POWER SUPPLIES

4-11. Plus and minus 42VDC for the first power amplifier are developed by bridge rectifiers BR1, BR2 and BR3 from the secondary voltages of three-phase power transformer T1. C1A and B and C2A and B are filter capacitors for these supplies and R1A and B and R2A and B are bleeder resistors.

4-12. Similary, plus and minus 42VDC for the second power amplifiers are developed by bridge rectifiers BR4, BR5 and BR6. C3A and B and C4A and B are filter capacitors for these supplies and R3A and B and R4A and B are bleeder resistors.

4-13. Input Power

4-14. The Model 3001 requires three-phase 45 to 66 Hz power. Each leg of the three-phase power transformer has two 115V windings which may be interconnected in series or parallel for 115V or 230V wye or delta operation. On special order, a transformer can be supplied with two 230V windings on each leg for 230 or 460V power. All the transformer primary connections are brought to an input power terminal block inside the chassis where the required interconnections are made. Phase sequence of the input power is immaterial.

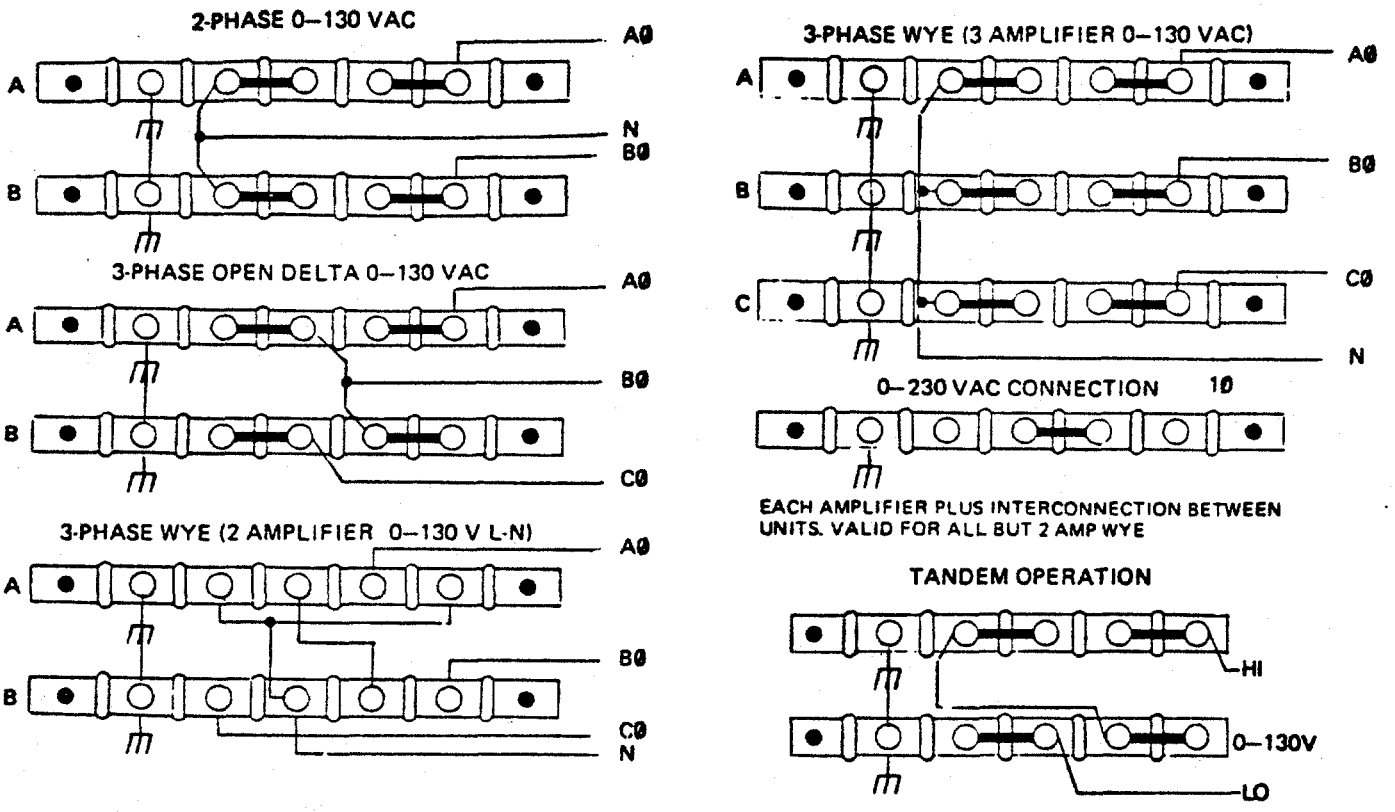
4-15. Interconnections for Multiphase Operation

4-16. Two or three Model 3001 power sources may be used to generate two-phase or three-phase AC power. Two-phase or three-phase signals are generated in a two-phase or three-phase oscillator installed in the master power amplifier. Signals from the oscillator are carried to one or two slave power amplifiers, each of which has a dummy oscillator plug-in which makes the required signal interconnections installed in it. The front panel AMPLITUDE control on the master amplifier controls the amplitude of all the amplifiers outputs simultaneously. The front panel AMPLITUDE controls of the slave amplifier(s) however, must initially be set so that their output voltages equal the master amplifier output voltage.

4-17. Two-phase operation requires two power sources. Three-phase operation may be accomplished with the three power sources in "wye" connection, or with two power sources in either "wye" or open-delta connection. The use of three Model 3001's for three-phase operation provides 9000VA total output while the use of two power sources provides 5200VA total power output. A more detailed circuit description of two-phase and three-phase power sources is provided in the oscillator instruction manuals.

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OUTPUT CONFIGURATIONS FOR MODEL 3001



NOTE: For tandem operation at 130V total, internal jumpers for output transformer must be changed. For tandem operation, 260V output use standard internal connections and 0-130V output.

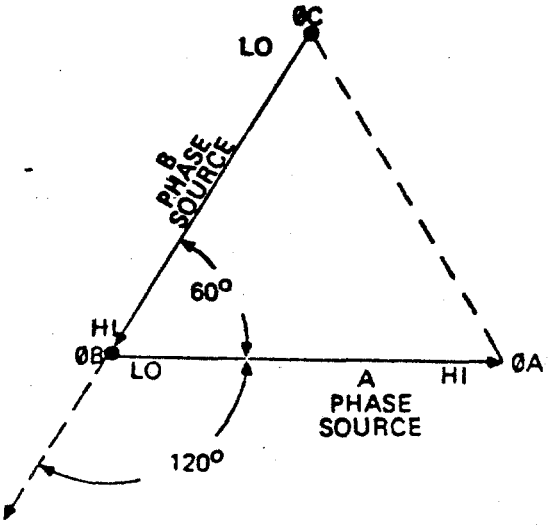


Figure 4-1. Interconnections for Multiphase Operation and Delta Hook-Up

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SECTION V
MAINTENANCE AND ADJUSTMENT

5-1. GENERAL INFORMATION

5.2. Questions concerning the operation, repair or servicing of this instrument should be directed to the Elgar Repair Department, 9250 Brown Deer Road, San Diego CA 92121-2294. Include the model number and serial number in any correspondence concerning this instrument.

5-3. Factory Repair

5-4. Should it be necessary to return an instrument to the factory for repair, please contact Elgar Corporation Service Department for authorization to make shipment. DO NOT RETURN THE UNIT WITHOUT AUTHORIZATION.

5-5. Test Points

5-6. Test points and adjustment controls are conveniently provided at the top of the amplifier circuit board, accessible by removing the top cover of the instrument. The test points are as follows:

TP1 – Circuit common - turret terminal
TP2 – Amplifier output - Red
TP3 – Oscillator signal - Orange

In addition, the output transformer secondary connections are available at the front panel binding posts.

5-7. Output Regulation Adjustment

5-8. The regulation adjustment, R127, is set at the factory to give ±1% load regulation over the frequency range of the power source. The regulation may require re-adjustment if the load is highly reactive or if zero regulation is desired for a specific load and frequency. To make this adjustment, disconnect the load and read the output voltage. Connect the load and adjust R127 until the same reading is obtained.

NOTE

If the load is heavy enough to cause current limit transistors Q104 and Q105 to conduct, the output voltage will be reduced, giving an indication of poor load regulation. Load voltage fall-off due to current limiting action should not be compensated by the regulation adjustment.

5-9. Periodic Maintenance

5-10. The only periodic maintenance required by the Model 3001 power source is occasional cleaning of the heatsinks. The heatsinks may be inspected through the front panel air grill. If enough dust and dirt have accumulated to restrict the air flow, an air jet should be directed through the front panel grill while the instrument is operating. If this does not dislodge the dirt, the heatsink must be removed to be cleaned.

5-11. TROUBLESHOOTING

5-12. Circuit Breaker Trips

5-13. If the circuit breaker trips at no load, a fault in either the power transistors or power recti-

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fiers is indicated. Unplug all the heatsinks and try the circuit breaker. If it does not trip, look for a shorted power transistor, (power transistors can be tested with an ohmmeter). If the circuit breaker still trips, look for a shorted rectifier diode. If all diodes and filter capacitors are good, a fault in the power transformer or wiring harness is indicated.

5-14. Output Distortion

5-15. Output distortion may be caused by overloading or improper setting of the circuit limit adjustments. Check the load current waveform with an oscilloscope since some high crest factor loads may draw considerably more peak current than is indicated by a load ammeter.

5-16. Overheating

5-17. If overheating causes one of the thermostats to close, the output voltage will fall to zero. Overheating may be caused by restricted air flow or excessive environmental temperature (greater than 50°C).

5-18. No Output at Front Panel Terminals

5-19. If the front panel voltmeter indicates normal output, but output voltage does not appear on the front panel terminals, check that the proper series or parallel jumper connections have been made on the rear panel output terminal strip.

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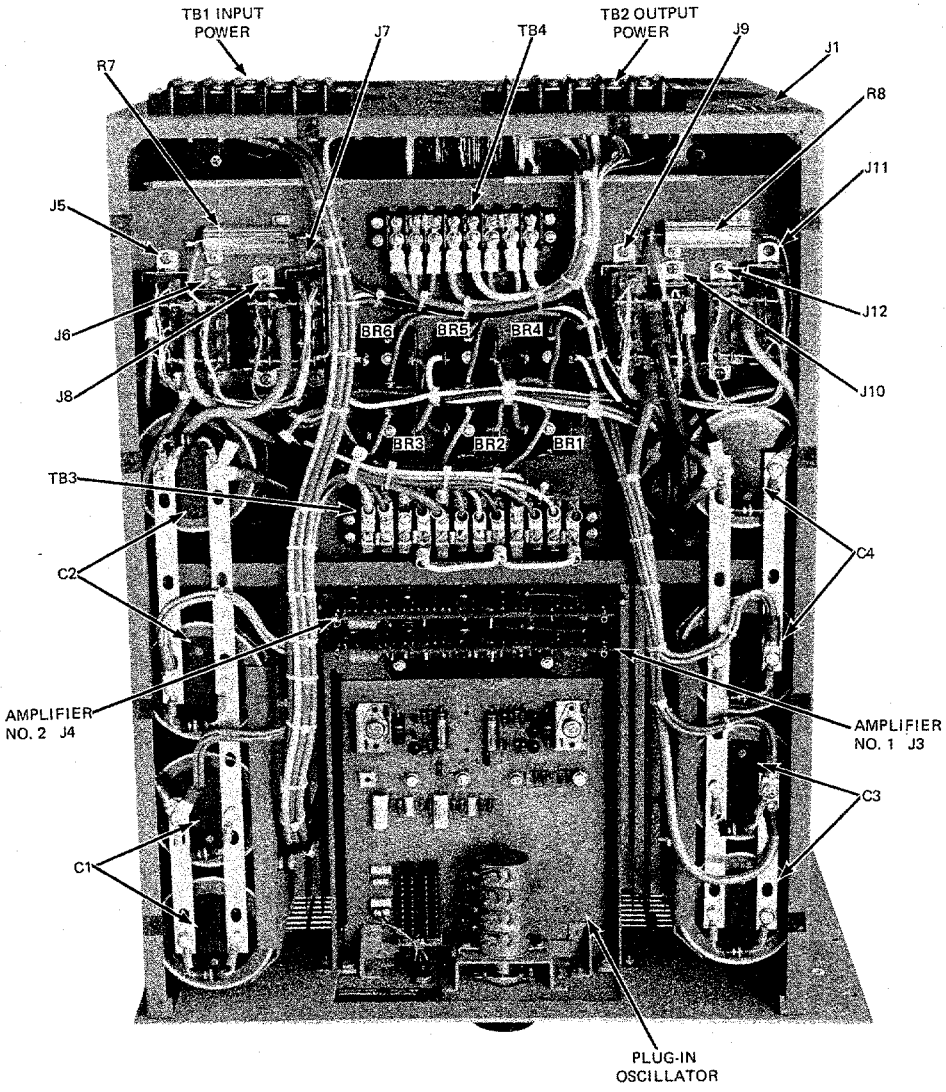


Figure 5-1. Top View, Model 3001

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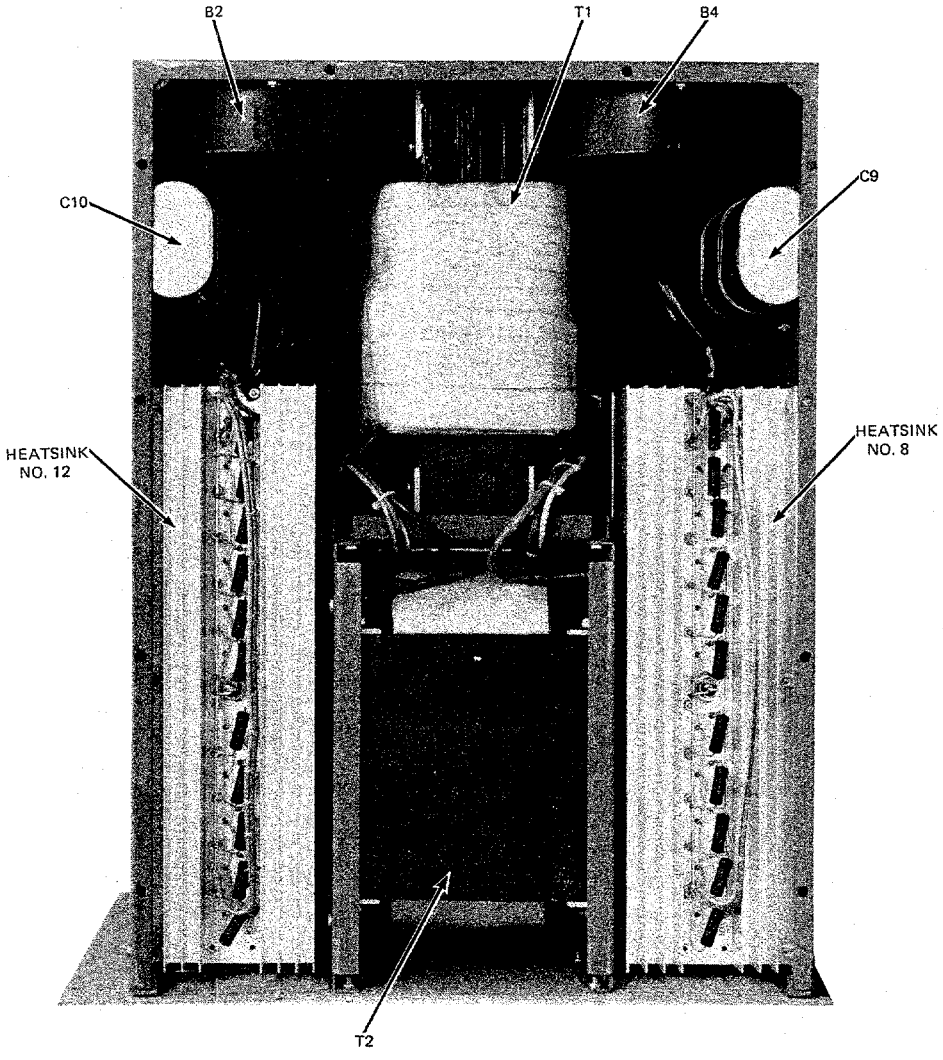


Figure 5-2. Bottom View, Model 3001

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SECTION VI
PARTS LISTS

6-1. GENERAL

6-2. This section contains a listing of all parts necessary for factory-authorized repair of the Model 3001 AC Power Source. Location of parts and assemblies is given on an illustration accompanying each parts list. Parts are located on the illustrations and correlated on the parts list by reference designators. Note that trimming capacitors are factory-selected parts and replacement of these parts is beyond the scope of customer maintenance. They are, therefore, not included in the following lists.

6-3. SPARE PARTS

6-4. When ordering spare parts, specify part name, part number, manufacturer, component value and rating. Where no specific manufacturer or part number is given, the replacement part should conform to value, rating and tolerance as listed. If complete assemblies are desired, order assemblies from ELGAR 9250 Brown Deer Road, San Diego CA 92121-2294. Specify assembly number, instrument series number and instrument name.

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MODEL 3001 Chassis Assembly

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
B1-B4		Fan		Rotron	MA2B4/MR2B3	853-MA2-B4
BR1-6		Diode Bridge		Motorola	MDA990-3	847-990-3X
C1-C4 (A-B)	23,200 uF	Capacitor	50V	G.E.	86F170M1	826-239-12
C9,10	20 uF	Capacitor	370V	G.E.	45F513	825-206-34
CB1		Circuit Breaker		Airpax	UPL-111-1-6-1-253	852-253-58
DS1		Lamp		Eldema	BG02-RCS A1C-68K	854-68K-22
J1		Connector				
J2		Connector				
M1		Meter	0-150VAC	Jewell	MS1T	857-150-1T
R1-R4 (A B)	10K	Resistor	2W, 5%	Speer	RC42GF103J	804-103-05
R5	4.7 ohm	Resistor	½W, 5%	Speer	RC20GF4R7J	802-4R7-05
R6	10K	Hi Torque Pot		Spectrol	534-9561-10	819-103-53
R7,R8	.01 ohm	Resistor	50W, 5%	Dale	RH50 .01	810-R01-05
T1		Input Transformer		Elgar		990-809-9X
T2		Output Xfmr		Elgar		990-810-9X
T3		Current Xfmr		Elgar		990-137-9X

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AMPLIFIER BOARD 612-100-4X

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
C101,105	4.7	Capacitor	35V	Sprague	196D475X0035JA1	823-475-61
C102,114	10 uF	Capacitor	50V, 20%		DA2A106	822-106-20
C103	.01	Capacitor		Centralab	DDM103	821-103-00
C104,106	300 pF	Capacitor	500V, 5%	Sangamo	DM15-301J	820-301-05
C107,109,115	.1 uF	Capacitor	200V, 10%	Sprague	192P10492	822-104-05
C108 (T)						
C110	220 uF	Capacitor	10V	Sprague	196D227X0010MA3	823-227-61
C111	.022	Capacitor	200V, 10%	Sprague	192P22392	822-223-05
C112	200 pF	Capacitor	500V, 5%	Sangamo	DM15-201J	820-201-05
C113	50	Capacitor	50V	Sprague	500D506G050DD7	824-506-71
CR101,102		Zener Diode		Motorola	1N5242	843-524-2X
CR103-109		Diode		T.I.	1N4004	845-400-4X
L101	150 uH	Choke		Nytronics	SWD150	851-150-01
Q101,102		Diff. Amp.		National	2N3810	849-381-0X
Q103,105		Transistor		RCA	2N3583	839-358-3X
Q104		Transistor		National	2N3567	835-356-7X
Q106		Transistor		National	2N3638	834-363-8X
Q107		Transistor		RCA	2N6211	842-621-1X
R101,102	100K	Resistor	1/8W, 1%	Dale	RN60C1003F	813-100-3F
R103	5.11K	Resistor	1/8W, 1%	Dale	RN60C5111F	813-511-1F
R104	6.8K	Resistor	½W, 5%	Speer	RC20GF682J	802-682-05
R105	180K	Resistor	½W, 5%	Speer	RC20GF184J	802-184-05
R106	150K	Resistor	1/8W, 1%	Dale	RN60C1503F	813-150-3F
R107,115-117	2.2K	Resistor	1W, 5%	Speer	RC32GF222J	803-222-05
R108	6.2K	Resistor	½W, 5%	Speer	RC20GF622J	802-622-05
R109,120,126	4.7K	Resistor	½W, 5%	Speer	RC20GF472J	802-472-05
R110	8.2K	Resistor	½W, 5%	Speer	RC20GF822J	802-222-05
R111,114,118	33 ohm	Resistor	½W, 5%	Speer	RC20GF330J	802-330-05
R112	1.2K	Resistor	½W, 5%	Speer	RC20GF122J	802-122-05
R113 (T)						
R119,121	3.0K	Resistor	½W, 5%	Speer	RC20GF302J	802-302-05
R122-125	100 ohm	Resistor	½W, 5%	Speer	RC20GF101J	802-101-05
R127	1K	Potentiometer		Bourns	3095Y	819-102-30
R128	15 ohm	Resistor	½W, 5%	Speer	RC20GF150J	802-150-05
R129	3.32K	Resistor	1/8W, 1%	Dale	RN60C3321F	813-332-1F

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AMPLIFIER BOARD (Continued)

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
R130	33.2K	Resistor	1/8W, 1%	Dale	RN60C3322F	813-332-2F
R131	5.1 ohm	Resistor	1W, 5%	Speer	RC32GF5R1J	803-5R1-05
Z101		I.C.		National	LF356H	849-LF3-56
HEATSINK ASSEMBLY W/TK						
CR501		Diode		I.R.	1N1186A	845-118-6A
Q501-511		Transistor		RCA	2N6259	841-625-9X
R501	5.6 ohm	Resistor	5W, 5%	Dale	CW5 5.6	807-5R6-05
R502-511	.22 ohm	Resistor	5W, 5%	Dale	CW5 .22	807-R22-05
TK501		Thermostat			3400	861-340-0X
HEATSINK ASSEMBLY W/O TK						
CR601		Diode		I.R.	1N1186A	845-118-6A
Q501-611		Transistor		RCA	2N6259	841-625-9X
R601	5.6 ohm	Resistor	5W, 5%	Dale	CW5 5.6	807-5R6-05
R602-611	.22 ohm	Resistor	5W, 5%	Dale	CW5 .22	807-R22-05

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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 and 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 determined at time of final checkout.

7-3. DIAGRAMS

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

a. AC Power Source, Schematic Diagram
b. Amplifier Board Schematic
c. Amplifier Board Parts Layout
d. Typical Plug-In Oscillator Power Amplifier Interconnection

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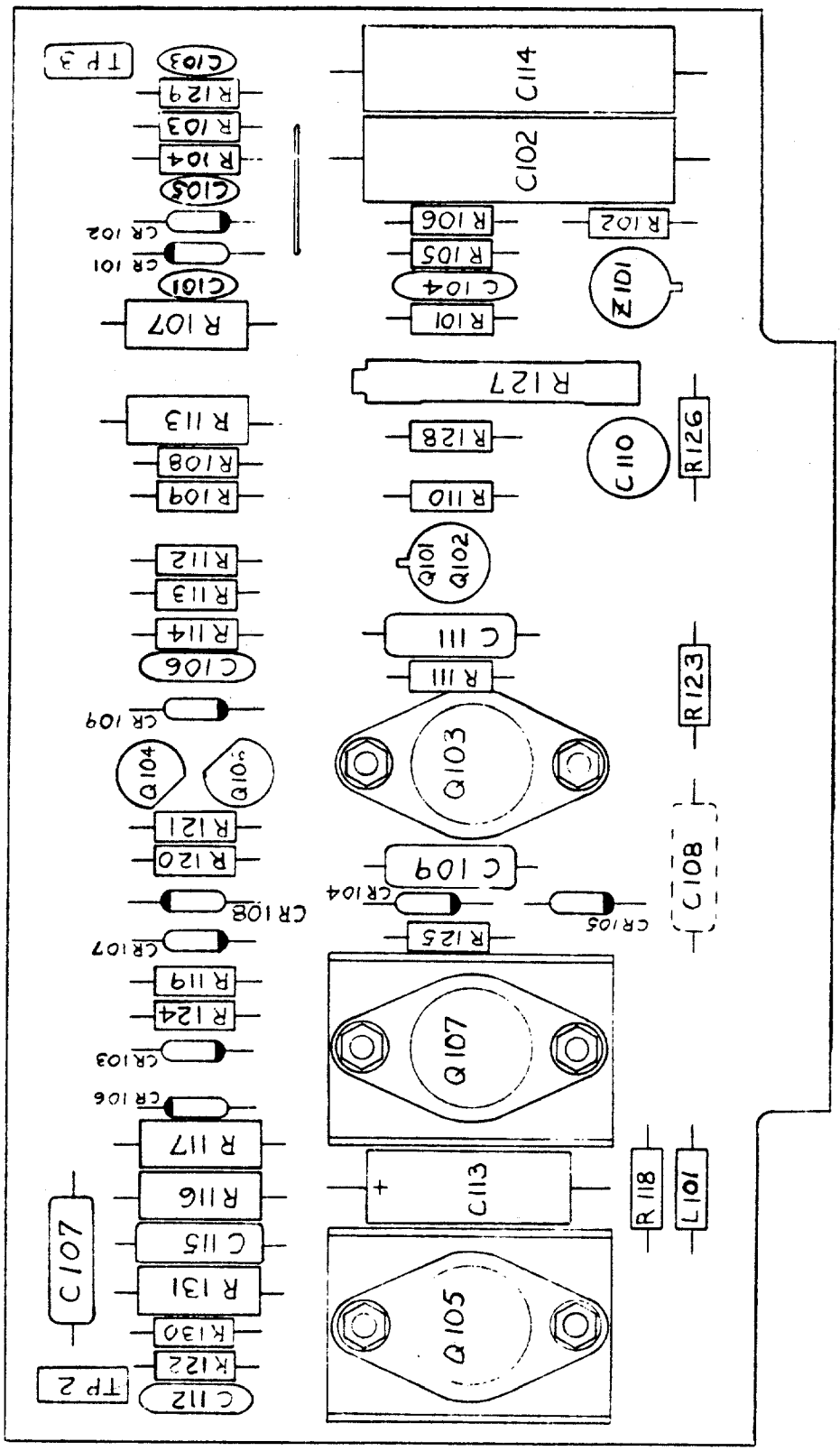


Figure 7-3. Amplifier Board Parts Layout

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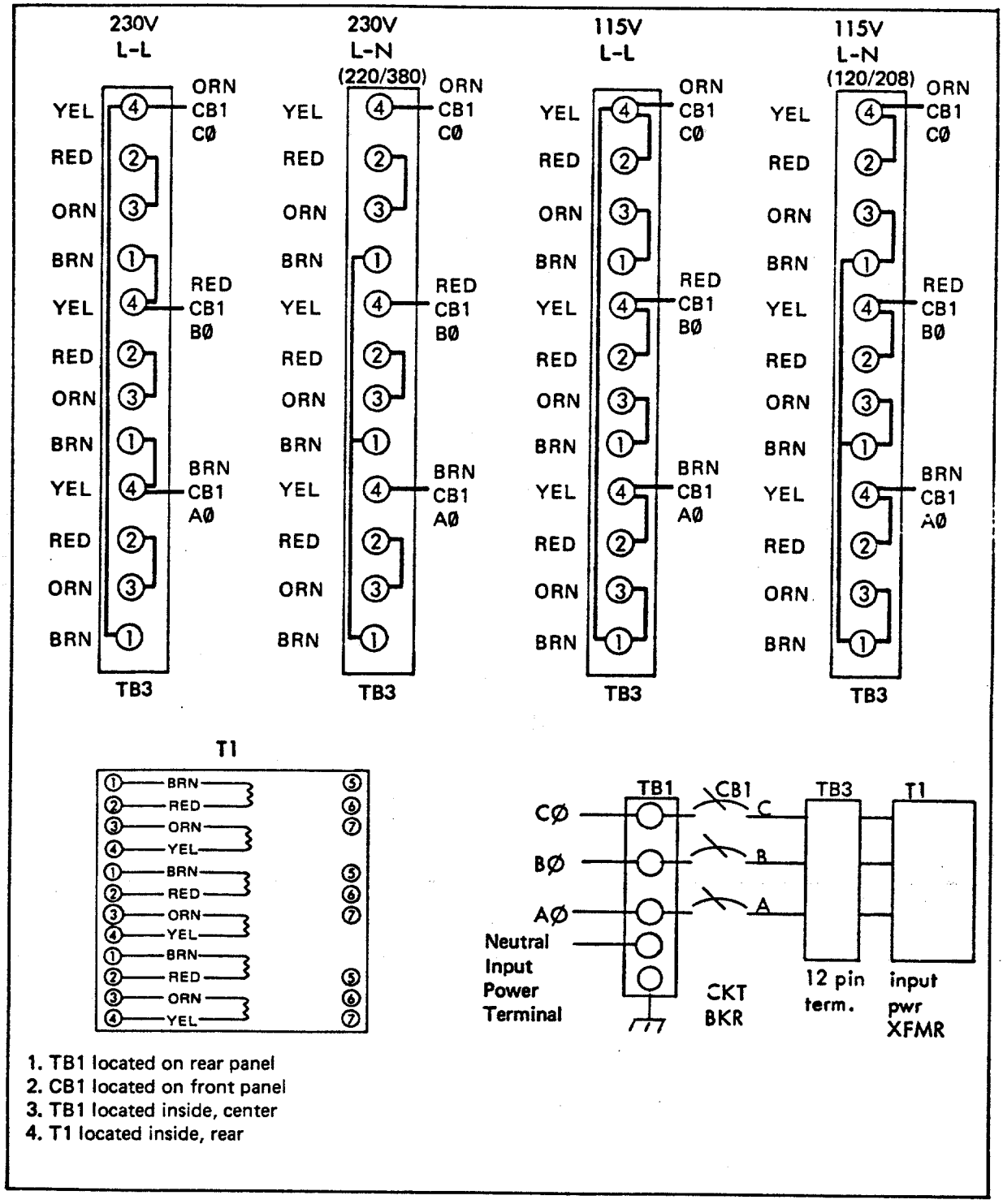


Figure 7-4. Input Power Configurations

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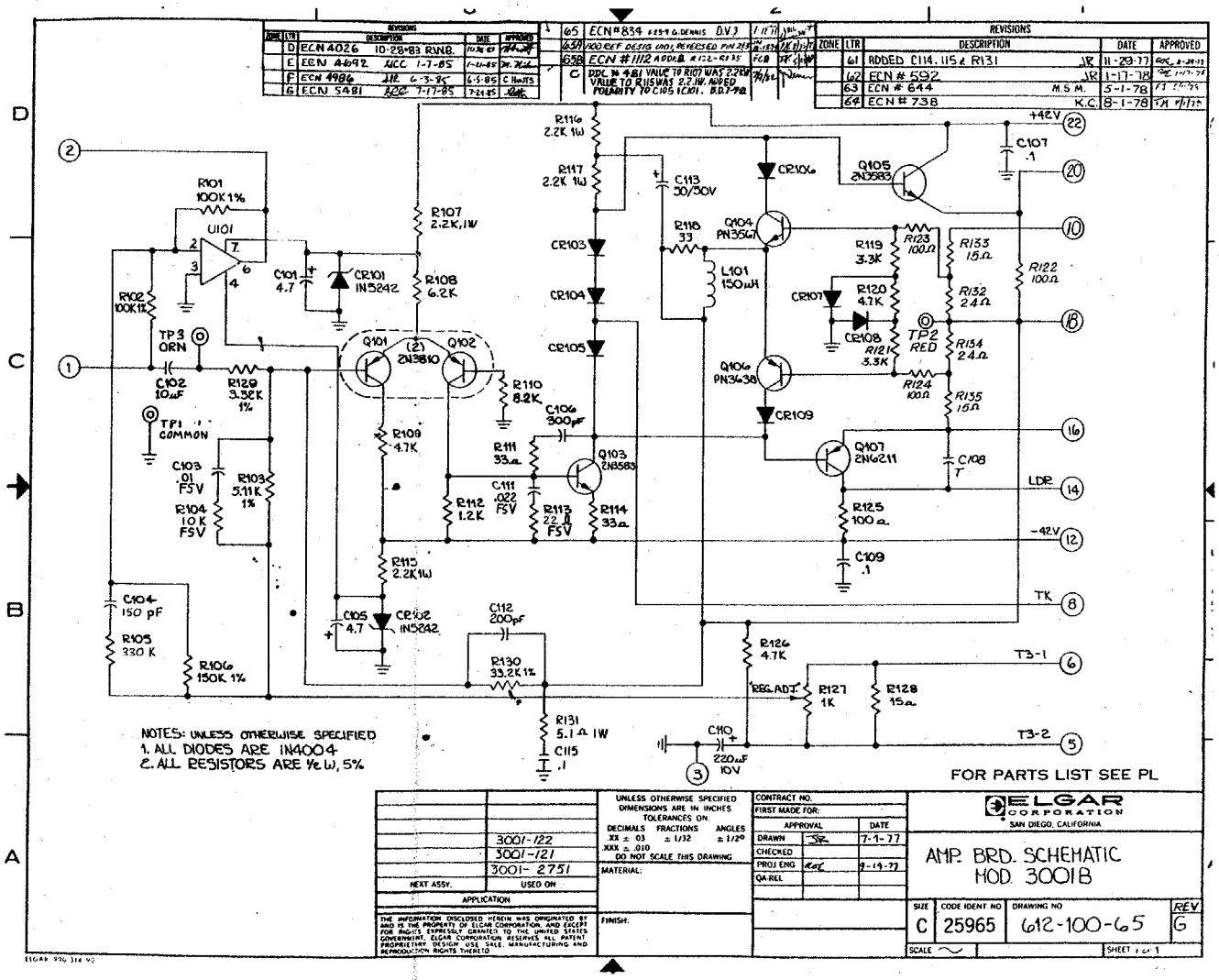


Figure 7-2. Amplifier Board Schematic, No. 612-100-6X

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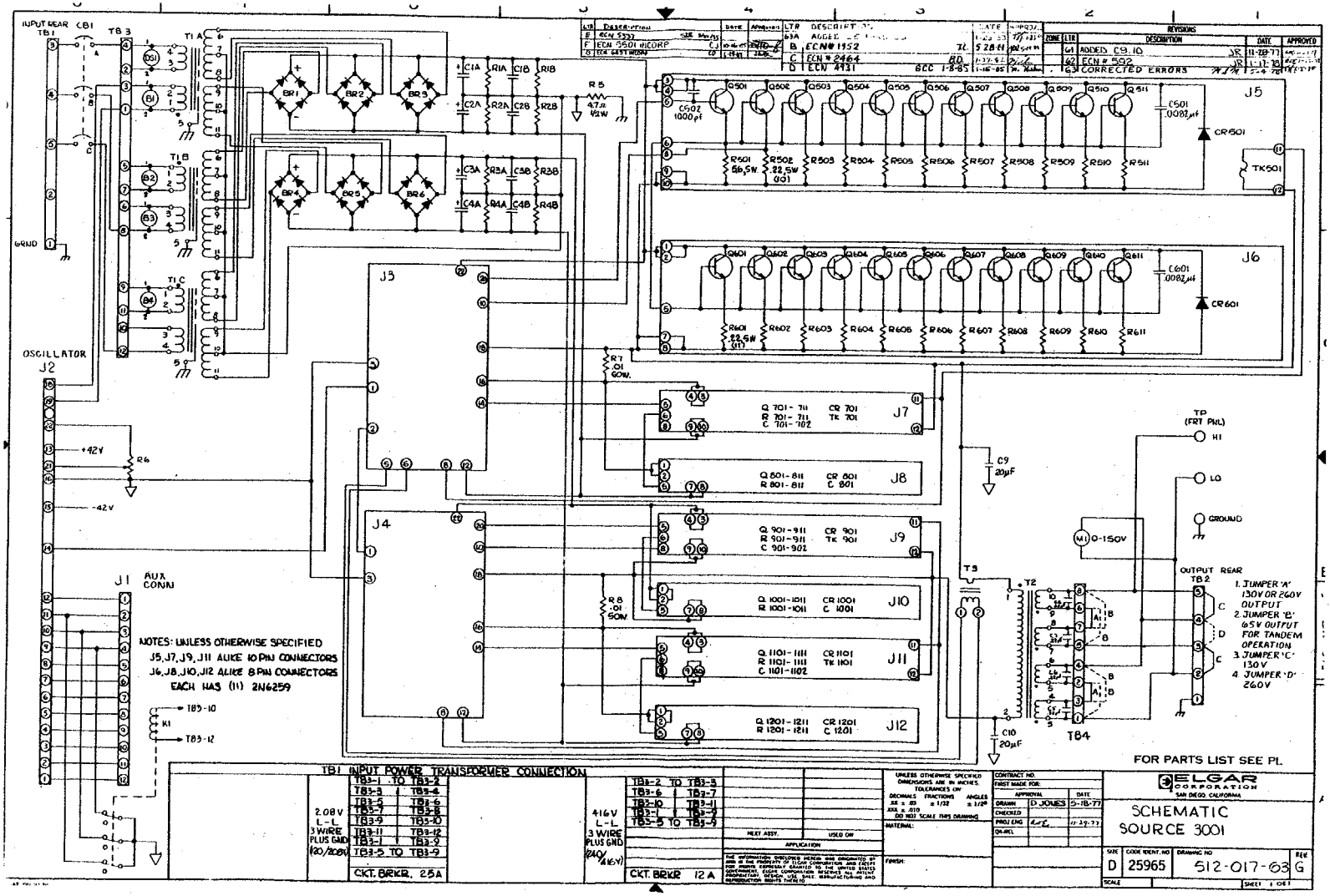


Figure 7-1. Model 3001 Overall Schematic, No. 512-017-6X

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