California INSTRUMENTS

Revision K
November 1986

INSTRUCTION MANUAL

MODEL 501TC

Invertron®

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SPECIFICATIONS

MODEL 501TC AC POWER SOURCE

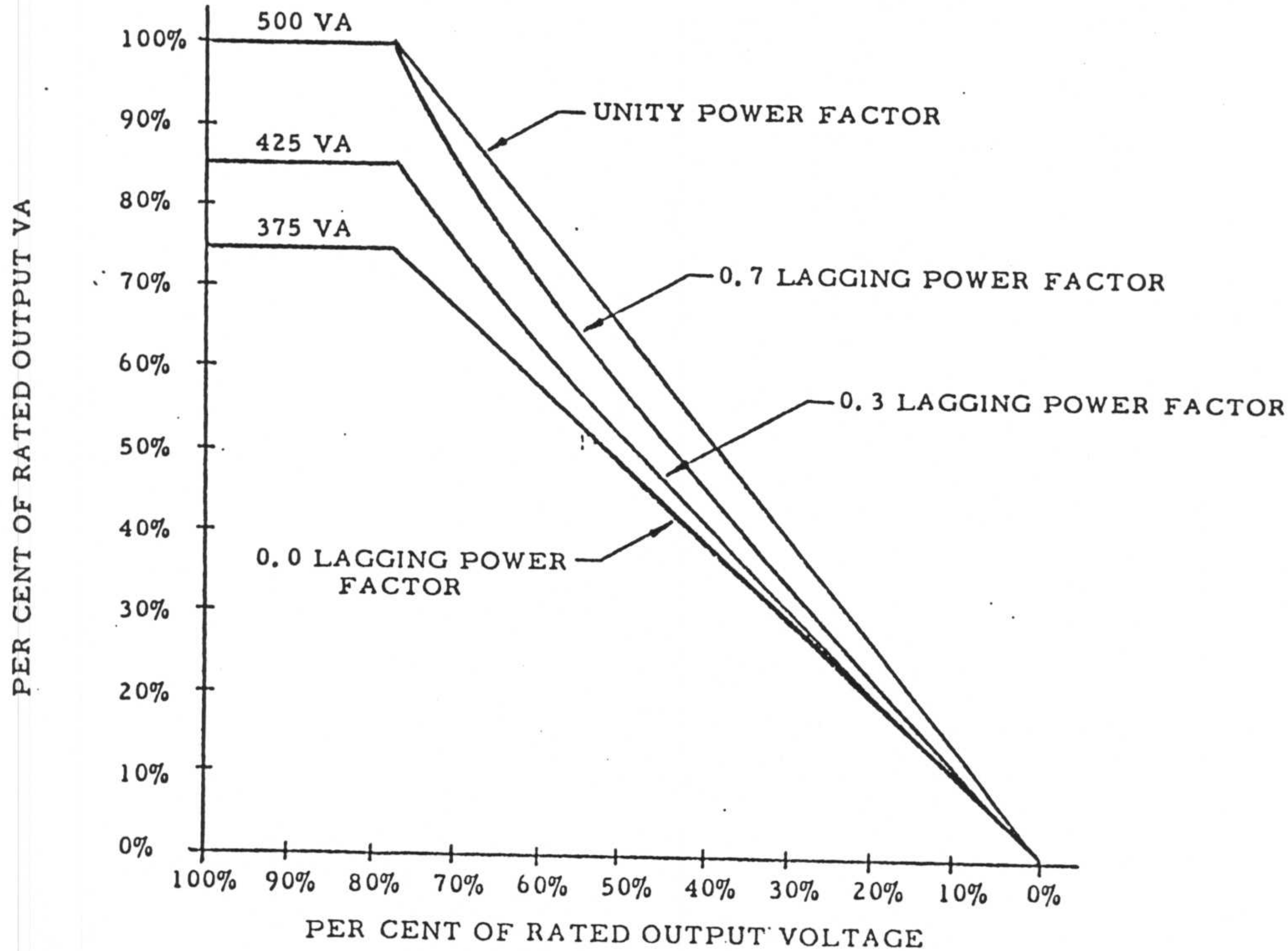
All specifications are tested in accordance with standard California Instruments test procedures and apply with a stable, low distortion input signal as generated by a T series plug-in oscillator.

POWER OUTPUT:	500 VA at 105 to 135 volts rms output from unity to ± 0.7 power factor. See derating chart for operation at other output voltages and/or power factor.
OUTPUT VOLTAGE RANGES:	0 to 135 volts rms and 0 to 270 volts rms as determined by rear panel straps.
TOTAL HARMONIC DISTORTION:	Less than 0.30% distortion from 200 Hz to 600 Hz; less than 0.5% distortion from 45 Hz to 5 KHz.
AMPLITUDE STABILITY: (after one hour warm-up)	± 0.25% for 24 hours at constant line, load and ambient temperature conditions.
LOAD REGULATION:	± 1% over the range from 45 Hz to 5 KHz when tested at unity power factor. In addition, a load regulation adjustment permits the regulation to be adjusted to zero at any given line voltage, signal frequency and load conditions. Control resolution is 0.1%.
LINE REGULATION:	± 0.25% of full output for a ± 10% line change.
* FULL POWER FREQUENCY RANGE:	45 Hz to 5 KHz.
FREQUENCY RESPONSE:	± 0.5 dB from 45 Hz to 5 KHz.
AC NOISE LEVEL:	80 dB below full output with input shorted; 60 dB below full output at full rated power output.
OVERLOAD AND SHORT CIRCUIT PROTECTION:	Complete protection from overloads and short circuits is provided. Automatic reset occurs when overload is removed.

* This power source may be used over the 20 Hz to 20 KHz frequency range provided the output voltage and the output VA are derated according to Table 2-2 in this instruction manual; otherwise permanent damage to the unit may occur.

AMPLIFIER DRIVE REQUIREMENTS: (normally obtained from plug-in)	5 volts rms (maximum) produces 135 volts rms.
AC INPUT LINE:	105 to 125 volts rms. Unit may be wired for the following single phase voltages on special order: 208 VAC, 220 VAC, 230 VAC, and 240 VAC.
AC INPUT FREQUENCY:	48 to 65 Hz. (400 Hz available on special order.)
AC INPUT POWER:	1900 watts maximum under worst case line and full rated load conditions.
OPERATING TEMPERATURE RANGE:	0 to 55°C.
FRONT PANEL METER:	0 to 150 volt and 0 to 300 volt AC voltmeter provides ± 1% of full scale accuracy at 400 Hz and ± 3% of full scale accuracy over the range from 45 Hz to 5 KHz.
DIMENSIONS:	7" high x 19" wide x 21" deep.
NET WEIGHT:	80 lbs.
SHIPPING WEIGHT:	90 lbs.
FRONT PANEL FINISH:	Grey, 26440 per Federal Standard 595 with black silk-screened lettering.

DERATING CHART FOR MODEL 501TC THREE PHASE POWER SOURCE (Applies over the range from 45 Hz to 5 KHz. Derate the curve for output VA by 2.0 to 1.0 factor at 10 KHz; 3.0 to 1.0 factor at 15 KHz; and 4.0 to 1.0 factor at 20 KHz)



GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction manual contains information of the installation, operation, calibration and maintenance of the California Instruments Model 501TC Power Source. Detailed schematics, parts location drawings, calibration procedures and theory of operation are also contained for the aid of maintenance personnel.

1.2 GENERAL DESCRIPTION

The California Instruments Model 501TC Power Amplifier is a solid state, high performance, low distortion power source that provides up to 500 VA output when used with the proper plug-in oscillator. The Model 501TC Power Source is illustrated in Figure 1-1. Full power output is available in two different voltage ranges and over the frequency range from 45 Hz to 5 KHz. These full power voltage ranges are:

1) 105 to 135 volts rms for normal single phase 115 volt applications and for three phase 208 to 234 volt line-to-line applications.

2) 210 to 270 volts rms for normal single phase 230 volt applications and for three phase 208 to 270 volt applications where open delta operation is acceptable.

For two phase and three phase operation, at least two power amplifiers must be combined together with the applicable multi-phase oscillator. Two power amplifiers will provide a total of 1000 VA two phase power (Model 1000TC/2-2), or 1000 VA of three phase power (Model 1000TC/2-3D) in the open delta configuration. Three power amplifiers will provide 1500 VA of three phase power in the wye configuration (Model 1500TC/3-3).

1.3 ACCESSORY EQUIPMENT

The following accessories are available for use with the California Instruments Model 501TC Power Source.

1.3.1 Zero Manufacturing Company Model CTN118 rack slides. These rack slides may be bolted directly to the sides of the unit, if required.

1.3.2 Series 800T Variable Frequency Oscillators. These general purpose Wien bridge oscillators provide one phase, two phase or three phase outputs over the range from 20 Hz to 20 KHz in three bands. Units with single phase output are designated as 800T-20/20K-1-1φ, two phase oscillators are designated as 800T-20/20K-1-2φ and three phase oscillators are designated as 800T-20/20K-1-3φ. Calibration accuracy is ± 1 percent at 25°C and amplitude stability is 0.25 per cent per 24 hours at 25°C. The total harmonic distortion is less than 0.25 per cent from 20 Hz to 20 KHz. Several versions of the 800T oscillator are also available which operate over a more restricted frequency range, but which provide improved frequency resolution.

1.3.3 Series 815T Fixed Frequency Oscillators. These low-cost fixed frequency oscillators provide one-phase, two-phase, or three-phase outputs over the range from 45 Hz to 10 KHz. Units with single-phase output are designated as 815T-Freq.-.1-1ϕ, two-phase oscillators are designated as 815T-Freq.-.1-2ϕ and three-phase oscillators are designated as 815T-Freq.-.1-3ϕ. Frequency accuracy is ±0.1 percent at 25°C. Amplitude stability is ±.25 percent per 24 hours at 25°C and varies less than 0.02 percent per degrees centigrade. Harmonic distortion is less than 0.2 percent from 45 Hz to 10 KHz.

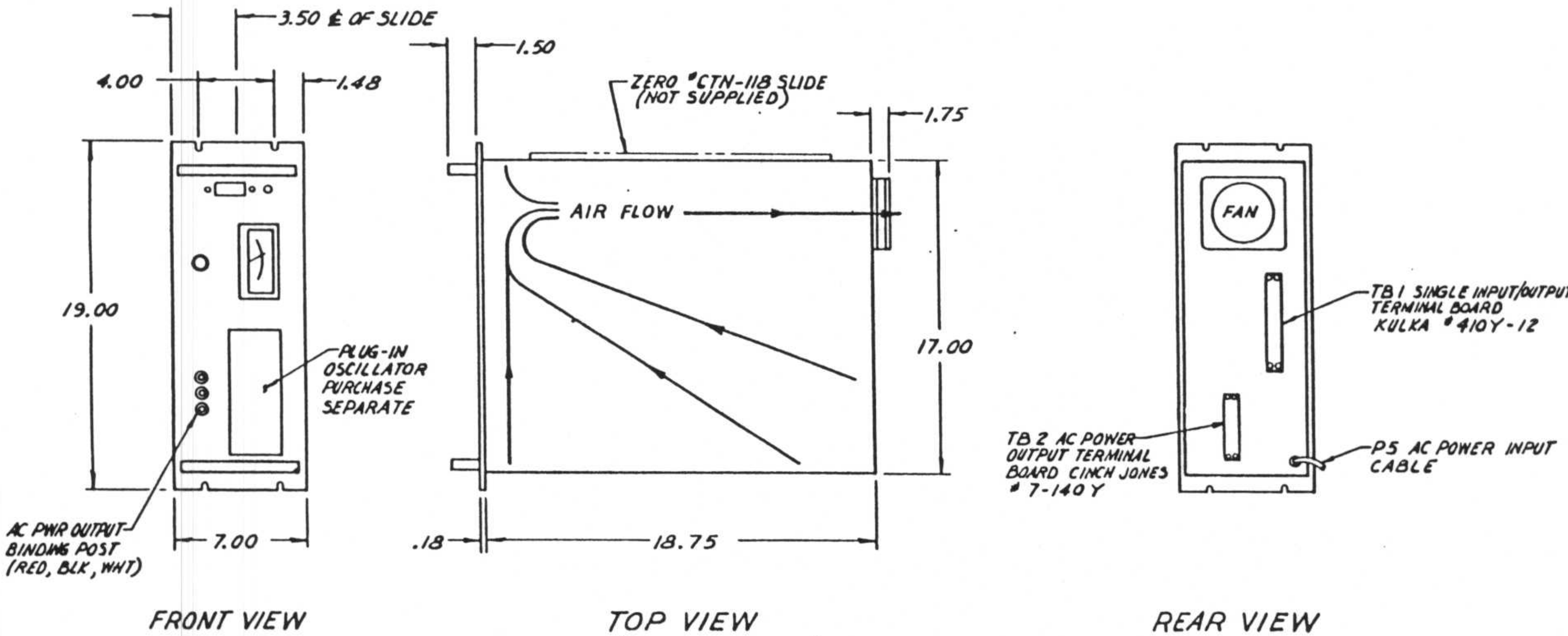
1.3.4 Series 835T Programmable Oscillators. These oscillators provide control of voltage amplitude, frequency, and phase angle in multiphase applications. Programming by either parallel BCD or IEEE-488 (1978) is available. These units are packaged in a separate 3.5 inch rack mountable chassis.

1.3.5 The Model 847T Programmable Oscillator is a digitally synthesized, crystal controlled oscillator featuring programmable amplitude and frequency via IEEE-488 BUS or BCD parallel. The 847T Oscillators are available in single-phase, two-phase 90°, three-phase 120° WYE, and three-phase 60° DELTA configurations.

1.3.6 Series 850T Oscillators. These oscillators are decade dialing, digitally synthesized, and crystal controlled. Basic accuracy is ±0.005% of set frequency. Amplitude stability is 0.02% per 24 hours 23°C, ±0.01% per C maximum average temperature coefficient from 0 to 55°C. The total harmonic distortion is less than 0.15 percent from 45 Hz to 999.9 Hz, less than 0.3 percent 45 Hz to 9999 Hz.

REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD
B		REMOVED AC PWR OUTLET				



C4050-903 B

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'

BREAK ALL SHARP CORNERS & EDGES ~~MACH SURFACES~~ ✓

DWG SIZE C

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TITLE: OUTLINE DRAWING 500 VA POWER SOURCE

MODEL: 501 TC

RELEASE / CHECKER / DESIGN / DRFTSMN — PURCHASING / PROJ ENGR / CHF ENGR

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO. — CODE IDENT 16067

DWG NO. C4050-903 REV B

SCALE 1/4 SHEET 1 OF 1

1. FRONT PANEL DIMENSIONS PER W.E./E.I.A. STANDARD

NOTES: (UNLESS OTHERWISE SPECIFIED)

WARNING

HIGH VOLTAGE (250 VAC)

Voltages up to 250 VAC are available in certain sections of this power source. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with pin C and pin D of the plug-in oscillator, the primary power circuits, and the output circuits of the power source.

INSTALLATION AND OPERATION

2.1 UNPACKING

The California Instruments Model 501TC Power Source is shipped in a cardboard container with protective inner packing. Do not destroy the packing container until the unit has been inspected for possible damage in shipment.

2.2 POWER REQUIREMENTS

2.2.1 The Model 501TC Power Source has been designed to operate from any one of the following AC line voltages, 115 volts, 208 volts, 220 volts, 230 volts, or 240 volts rms. The power transformer is normally wired at the factory for operation from the 115 volt line. Table 2-1 below indicates how the primary connections to the power transformer are made for various AC input line voltages.

TABLE 2-1

NOTE

Prior to reconnection power transformer T1, remove all existing jumpers from the primary winding.

Nominal Input Voltage	Operating Line Voltage Range	Power Transformer Connections	Front Panel Circuit Breaker Value
115 volts rms	105-125 volts rms	jumper pins 1 and 3; jumper pins 2 and 6; connect load side of circuit breaker to pin 6.	20 ampere 125 volt circuit breaker
208 volts rms	190-226 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 4.	12 ampere 250 volt circuit breaker
220 volts rms	201-239 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 5.	12 ampere 250 volt circuit breaker
230 volts rms	210-250 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 6.	10 ampere 250 volt circuit breaker
240 volts rms	219-261 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 7.	10 ampere 250 volt circuit breaker

2.2.2 The Model 501TC has been designed to operate over the line frequency range from 48 to 65 Hz. On special order, units will be supplied to operate from the 400 Hz line.

2.2.3 The normal input power, at rated output, is between 1100 and 1900 watts depending on line and load conditions. During "turn-on" the peak transient will generally exceed 3000 watts.

2.3 CIRCUIT BREAKER REQUIREMENTS

The Model 501TC Power Source uses a 20 ampere Heinemann AM12-20A curve 5 circuit breaker for operation from the 115 volt AC line. A Heinemann AM12-12A curve 5 circuit breaker is used for operation from the 208 through 220 volt AC lines. A Heinemann AM12-10A curve 5 circuit breaker is used for operation from the 230 volt through 240 volt AC lines. Substitution of circuit breaker type or current rating may cause permanent damage to the unit.

2.4 OUTPUT VOLTAGE RANGE AND METER RANGE

The output voltage range is determined by the strapping of terminal strip TB2 located on the rear of the Model 501TC Power Source. The power source is on the 135 volt range when TB2 terminal 3 is connected to TB2 terminal 4 and TB2 terminal 5 is connected to TB2 terminal 6. The 0 to 150 volt meter range is selected by connecting TB2 terminal 2 to TB2 terminal 3. The 0 to 135 volt output may be taken across pin 3 and pin 6 to TB2, or at the rear panel flat blade power receptacle J5, or across J2 and J3 located on the front panel, as desired.

The power source is on the 270 volt range when TB2 terminal 4 is connected to TB2 terminal 5. The 0 to 300 volt meter range is selected by connecting TB2 terminal 1 to TB2 terminal 3. The 0 to 270 volt output may be taken across pin 3 and pin 6 of TB2, or at the rear panel flat blade power receptacle J5, or across J2 and J3 located on the front panel, as desired.

2.5 ACCEPTANCE TEST PROCEDURE

Inspect the unit for any possible shipping damage immediately upon receipt. If damage is evident, notify the carrier. DO NOT return an instrument to the factory without prior approval. If the unit appears in good condition, perform the following:

2.5.1 Connect the AC line cord to an AC power line of the proper voltage and frequency as determined by either the serial number tag on the unit or by inspection of the wiring to the primary of the power transformer (see Section 2.2 of this instruction manual). Connect a 5 KW Variac and a 5 KW wattmeter in series with the AC line. The Model 501TC Power Source should draw less than 200 watts under no load conditions at mid-line voltage.

2.5.2 Using either a California Instruments 800T Series Oscillator or a suitable external low distortion sine wave oscillator, set the oscillator to the desired frequency (between 45 Hz and 5 KHz) and adjust the output of the oscillator to 5 volts rms. The amplifier input is available at pin 2 (tie oscillator ground to pin 1) of the small terminal strip TB1 located on the rear of the unit, if the external oscillator is employed. Tie a jumper strap from pin 2 to pin 3 of TB1 if an 800T Series Plug-in Oscillator is being used as the signal source.

2.5.3 Select the proper output voltage range as determined in Section 2.4 of this instruction manual. The following table lists the proper external load for full power output on each of the voltage ranges.

Output Voltage Range	Output Voltage	Full Power Load Resistance	50 Per Cent Power Load Resistance
0-135 volts rms	135 volts rms	36.4 ohms	72.8 ohms
0-270 volts rms	270 volts rms	146 ohms	292 ohms

2.5.4 Connect the proper 500 watt load resistor to TB2-3 and TB2-6 on the rear of the power source. Connect a Tektronix Model 533A Oscilloscope across this load resistor.

2.5.5 Using the GAIN control and the front panel METER, set the output voltage to the rated voltage of the unit as determined in Section 2.5.3 of this manual. The power line wattmeter should read 1200 to 1400 watts at mid-line. Check on the oscilloscope for peak clipping or excessive distortion of the sine wave output.

2.5.6 With the output still adjusted as determined in 2.5.5, place a resistor in parallel with the external load resistor to provide a 50 per cent overload on the output of the power source. The value of this resistor is given in Section 2.5.3 of this manual. The signal on the oscilloscope should exhibit significant clipping on both the positive and negative peaks.

2.5.7 Remove the 50 per cent overload resistor and the output should automatically return to normal.

2.5.8 Place a short circuit in parallel with the external load resistor and then remove the short circuit after a few seconds. The signal on the oscilloscope should go to zero and then return to normal when the short circuit is removed. The front panel circuit breaker may be activated if the short circuit remains across the output for a period of time.

2.5.9 If it is desired to check the Model 501TC Power Source on the 270 volt range, select this range as described in Section 2.4 of this instruction manual and repeat steps 2.5.3 through 2.5.8 of this procedure.

2.5.10 The CALIBRATION PROCEDURE given in Section 4.0 of this manual should be followed if a more detailed evaluation of the unit is required at this time.

2.6 MECHANICAL INSTALLATION

The Model 501TC Power Source has been designed for rack mounting in a standard 19 inch rack. The unit should be supported from the bottom with a shelf-track or supported from the sides with a pair of rack slides (Zero Mfg. Co. part number CTN118).

The cooling fan on the rear of the unit must be free of any obstructions which would interfere with the flow of air. A 2.5 inch clearance should be maintained between the rear of the fans and the rear door of the mounting cabinet. Also, the air intake holes on the sides and rear of the power source must not be obstructed.

2.7 INPUT POWER WIRING

The Model 501TC Power Source will operate from single phase input voltages from 105 volts to 260 volts rms in five ranges as described in Section 2.2 of this manual. The power source should be used with 115 volt power lines with a capacity of 20 amperes or greater. If 200 to 260 volt AC lines are used, their capacity should be 10 amperes or greater.

2.8 OUTPUT POWER WIRING

The power output wires should be large enough to avoid excessive line voltage drops. The internal regulation control is capable of providing greater than 2 per cent over-regulation for all normal load conditions. If it is desired to provide a zero output impedance at the load side of the power wiring, it is necessary that these line drops be limited to approximately 1 to 2 per cent of the required output voltage. The following table lists the minimum acceptable wire size for a 1.0 per cent line drop assuming a 500 VA output at a distance of 20 feet from the power source to the load.

Output Voltage	Maximum Line Drop	Load Current	Loop Length	Minimum Required Wire Size
115 volts	1.15 volts	4.35 amperes	40 ft.	#18
230 volts	2.30 volts	2.18 amperes	40 ft.	#24

The wires size should be reduced 3 sizes everytime that the distance between the power source and load is doubled.

2.9 FRONT PANEL CONTROLS

2.9.1 The circuit breaker, located on the front panel of the Model 501TC Power Source, is used to switch the POWER to the unit "on". At this time the amber indicator lamp located above this switch should glow.

2.9.2 The GAIN control is used to adjust the output voltage level of the power source. In the case of a multi-phase power source, the gain control is turned nearly fully clockwise and then used as a fine gain trim control. The amplitude of the output of the multi-phase system is controlled by the amplitude control located on the multi-phase oscillator.

2.9.3 The front panel meter has a full scale of 0 to 150 volts and 0 to 300 volts and measures the output voltage of the power source to an accuracy of ± 1 per cent of full scale at 400 Hz and ± 3 per cent of full scale from a 45 Hz to 5 KHz. The 150 volt meter scale is used with the 135 volt range of the power source by connecting pin 2 of TB2 to pin 3 of TB2. The 300 volt meter scale is used with the 270 volt range of the power source by connecting pin 1 of TB2 to pin 3 of TB2.

2.10 OPERATION OVER EXTENDED FREQUENCY RANGE

2.10.1 This power source must not be driven at signal frequencies below 20 Hz or above 20 KHz, otherwise permanent damage to the unit may occur. For operation in the region between 20 Hz and 45 Hz and for operation in the region between 5 KHz and 20 KHz, derate the output voltage and output power according to Table 2-2 in order to provide reliable operation of the power source.

TABLE 2-2

Output Frequency	Maximum Safe Sine Wave Output Voltage (rms)		Maximum VA Output at Maximum Safe Output Voltage with ± 0.7 Power Factor Load.
	135 Volt Range	270 Volt Range	
20 Hz	60 V	120 V	250 VA
30 Hz	90 V	180 V	400 VA
40 Hz	120 V	240 V	500 VA
45 Hz to 5 KHz	135 V	270 V	500 VA
5 KHz to 10KHz	135 V	270 V	250 VA
15 KHz	90 V	180 V	125 VA
20 KHz	67.5 V	135 V	70 VA

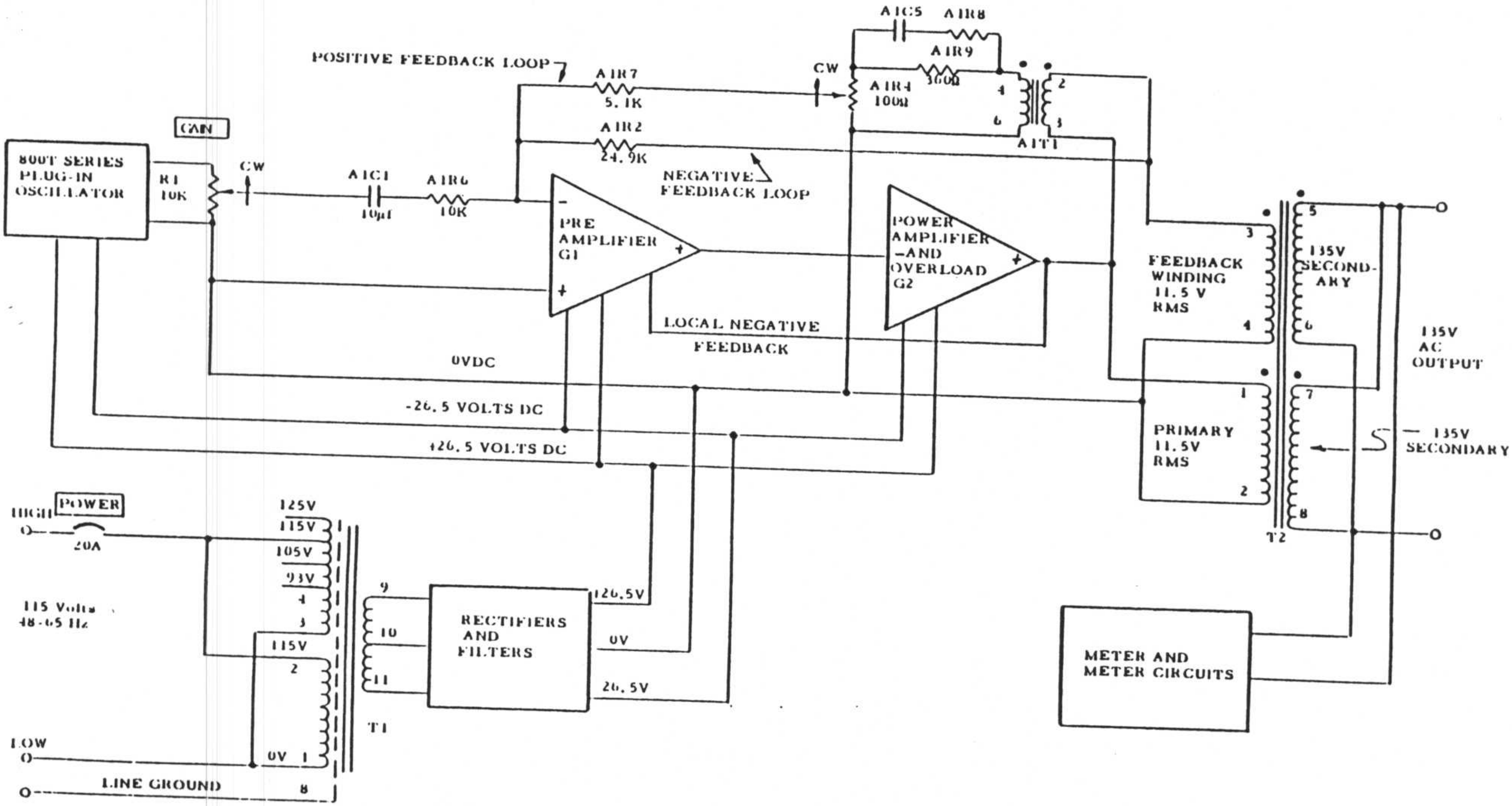


FIGURE3-1. BLOCK DIAGRAM FOR MODEL 501TC POWER SOURCE

THEORY OF OPERATION

3.1 GENERAL

The California Instruments Model 501TC Power Source is an all silicon solid state 500 VA amplifier and with companion oscillator is designed to provide reliable sine wave AC power over the frequency range from 45 Hz to 5 KHz.

A block diagram for the amplifier is shown in Figure 3-1. The pre-amplifier G1 is used to amplify the input signal to such a level so as to supply adequate drive to the power amplifier G2.

The power amplifier G2 provides the necessary sine wave signal to drive the output transformer T2. The output transformer has floating secondary windings which allow the load to float from the amplifier and oscillator circuitry.

The power amplifier G2 contains the overload and short circuit protection circuitry. A local negative feedback loop is taken from the output of the power amplifier back to the pre-amplifier, G1.

The over-all negative feedback is taken from the feedback winding of T2 back to the inverting input of the preamplifier and provides a closed loop gain of 2.5 from the arm of potentiometer R1 to the primary of T2.

The two 135 volt secondary windings of T2 are connected in parallel for the 0 to 135 volt output and are connected in series for the 0 to 270 volt output.

The positive current feedback signal is generated by sensing the IR drop across the primary of T2 and applying this signal to transformer A1T1. Transformer A1T1 converts this differential signal into a single-ended signal and applies it to the input of the pre-amplifier through a resistive divider network containing the regulation control, A1R4. As this positive feedback is increased from zero with potentiometer A1R4, the output impedance of the power source is reduced toward zero.

Power transformer T1, along with the associated rectifiers and filters, supply the operating voltages for the plug-in oscillator, the pre-amplifier G1 and the output amplifier G2.

3.2 DETAILED CIRCUIT DESCRIPTION

A schematic diagram for the Model 501TC Power Source is shown in drawing E4050-075. All components mounted on the large printed circuit board, 4050-707, are designated as a part of the A1 assembly. All components on the negative polarity output amplifier board, 4050-708, are designated as a part of the A2 assembly. All other components are a part of the top assembly. For information on the plug-in oscillator, consult the applicable oscillator manual. The drawings give typical voltage levels and waveforms for the various sections of the power source.

3.2.1 PRE-AMPLIFIER

The pre-amplifier G1 is a part of the A1 assembly and consists of integrated circuit A1IC1, transistors A1Q1 and A1Q2 and associated components connected as a direct coupled differential amplifier. The open loop gain of this pre-amplifier is approximately 20 at 400 Hz and rolls off at 6 db per octave above 10 KHz. Integrated circuit A1IC1 is a transistor array which contains five active devices, two of which are not used in the pre-amplifier. Integrated circuits A1IC1A and A1IC1B are connected in the differential amplifier configuration and provide a voltage gain of approximately 10 at 400 Hz. Capacitor A1C7 and resistor A1R18 provide a high frequency step roll off from 10KHz to 300 KHz.

Potentiometer A1R14, in the emitter circuit of A1IC1A and A1IC1B, is used to adjust the DC bias at the primary of T2 to zero volts with no signal.

Integrated circuit A1IC1C is connected as a zener diode and provides a -6 volt reference voltage for the emitters of A1IC1A and A1IC1B.

Transistor A1Q1 and A1Q2 are used in the differential amplifier configuration and provide an open loop voltage gain of approximately 2 at 400 Hz.

3.2.2 POWER AMPLIFIER

The power amplifier G2 mechanically consists of the remainder of the A1 board and the A2 assembly. Electrically, the power amplifier consists of transistors A1Q3 through A1Q14, A2Q1 through A2Q9, and associated components.

Resistors A1R28 and A1R29 are connected so as to supply a constant current to bias the output stage. This is accomplished by bootstrapping the junction of A1R28 and A1R29 back to the primary of the output transformer T2 via capacitor, A1C12. Static DC bias for the output stage is developed across diodes A1CR5 through A1CR7 which allows the output stage to operate as a Class A amplifier for no load or low VA load conditions and to operate nearly as a Class B amplifier for large load conditions.

Transistor A1Q5 and associated components are connected in the grounded emitter configuration. Local negative feedback is provided by A1C9, A1C10, A1C11, A1R22, A1R25 and A1R31. The local feedback limits the gain of this stage to 18 at 400 Hz. The gain falls off at 6 dB per octave above 50 KHz.

The positive polarity output amplifier is contained on the A1 assembly and consists of A1Q6 through A1Q14 connected as emitter followers. These transistors supply a total of 86 amperes peak during the positive one-half cycle of the output waveform when the power source is loaded to 500 VA output at 78 per cent of rated output voltage (worst case condition within specification limits). These positive output amplifier transistors and their associated heatsink can dissipate over 600 watts with less than a 80°C case temperature rise with an air flow of 40 cfm per heatsink.

The negative polarity output amplifier is contained on the A2 assembly and consists of transistors A2Q1 through A2Q9 connected in the quasi complementary symmetry configuration. These transistors supply a total of 86 amperes peak during the negative one-half cycle of the output waveform when the power source is loaded to 500 VA output at 78 per cent of rated output voltage (worst case condition within specification limits). These negative output amplifier transistors and their associated heatsink can dissipate over 600 watts with less than a 80°C case temperature rise with an air flow of 40 cfm per heatsink.

When the power source is delivering its full rated output voltage, the primary of the output transformer has an 11.5 volt rms signal.

3.2.3 OVERLOAD PROTECTION

The overload protection circuitry is also shown in drawing E4050-075 and consists of A1Q3, A1Q4 and associated components.

Transistor A1Q3 and associated components are connected as a clamp circuit which is used to protect the positive polarity output amplifier during periods of overload or short circuit. This is accomplished by sensing the load current flowing through A1R46 and applying the resultant voltage drop to the emitter-base junction of A1Q3 through a suitable attenuator network. During periods of overload, the emitter-base junction of A1Q3 is forward biased sufficiently to allow the collector circuit of A1Q3 to conduct a significant portion of the base drive normally available to A1Q6. This limits the base drive to A1Q6 and hence limits the available current from the positive polarity output amplifier during periods of overload. Potentiometer A1R40 is used to set the current level where the overload protection circuit is activated.

Transistor A1Q4 and associated components are used in a similar fashion to protect the negative polarity output amplifier. The only differences are that the control voltage for A1Q4 is sensed across A2R2 and potentiometer A1R43 is used to set the overload current level.

The rated VA output of the power source is, to a large extent, determined by the power dissipation in the quasi-complementary symmetry output stage. This power dissipation is determined by the power factor of the load, the output VA level of the amplifier, and to the actual output voltage expressed as a percentage of the rated output voltage. The derating chart, given in the specifications, expresses this derating in a graphical form.

The design of the overload circuitry is such that the overload level is determined by the same three parameters that determine the power dissipation in the push-pull output stage. Resistors A1R33, A1R34, A1R38, A1R39, A1R41 and A1R42 have been selected so that the overload protection circuit and the power factor derating chart track one another quite closely in the region between 0 volts output and 78 per cent of rated output voltage. In the region between 78 per cent of rated output voltage and 100 per cent of rated output voltage, the rated VA output of the power source is limited by an arbitrary rating and as a result, the overload circuit allows a somewhat greater power output than that specified for the power source. The unit will be reliable in this mode of operation; however, output distortion and/or other specifications may be excessive.

3.2.4 OVERALL NEGATIVE FEEDBACK

The overall negative feedback loop is a single-ended operational feedback loop taken from the feedback winding of T2 back to the base of A1IC1B via resistors A1R2, A1R5 and capacitor A1C2. This feedback network limits the mid-band closed loop voltage gain of the amplifier to 2.5 from the arm of potentiometer R1 to the primary of T2.

This overall feedback loop provides approximately 30 dB of negative feedback over the range from 45 Hz to 5 KHz. The feedback rolls off at approximately 9 dB per octave for frequencies greater than 10KHz. The purpose of this feedback loop is to insure that the frequency response, distortion, gain and amplitude stability specifications are met and/or exceeded.

A low frequency negative feedback loop is taken from the power amplifier primary winding of T2 back to the base of A1IC1B through A1R10 and A1R11. This loop limits the closed loop voltage gain of the amplifier to approximately 2.5 at DC and thereby provides improved DC bias stability for the amplifier.

3.2.5 POSITIVE CURRENT FEEDBACK

The positive current feedback loop generates a positive current feedback proportional to the load current in the secondary of T2. This is accomplished in the following fashion:

The load current in the secondary of the output transformer T2 is reflected back into the power primary winding producing an IR drop across the power primary winding. The negative feedback winding is connected so as to buck out the $L \frac{di}{dt}$ drop in the power primary winding. The remaining differential signal is applied to the primary of transformer A1T1 and converted into a single-ended signal at the secondary of A1T1. This signal is then applied to the base of A1IC1B through a divider network consisting of A1R3, A1R4, A1R7, A1R8, A1R9 and capacitors A1C3 and A1C5. Potentiometer, A1R4, which is accessible from the bottom of the A1 printed circuit board, is used to adjust the amount of positive feedback and thereby adjust the output impedance of the power source.

3.2.6 POWER SUPPLY

A schematic diagram for the DC power supply is a part of drawing E4050-075. This power supply delivers ±26.5 volts ±5 per cent at 20 amperes DC with less than 3 volts peak-to-peak ripple from the 115 volt, 60Hz AC line. These unregulated supplies consist of rectifier diodes A1CR1 through A1CR4 and filter capacitors C1 and C2 connected in a conventional fashion.

3.2.7 FRONT PANEL METER

The front panel meter M1 has a full scale sensitivity of 0 to 1 milliampere DC and an internal resistance of approximately 100 ohms. The meter has a dual scale with a full scale range of 0 to 150 volts AC and 0 to 300 volts AC. The meter rectifiers and scaling circuitry are a part of the A1 assembly. The meter circuitry consists of rectifier diodes A1CR12 through A1CR15, potentiometer A1R54 and associated components. The four rectifier diodes are connected so as to form a full wave bridge rectifier. Potentiometer A1R54 is used to shunt a small portion of the meter current and provide a sensitivity adjustment on the 150 volt scale.

WARNING

HIGH VOLTAGE (250 VAC)

Voltages up to 250 VAC are available in certain sections of this power source. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. DO NOT touch electronic circuits when power is applied. Avoid contact with pin C and pin D of the plug-in oscillator, the primary power circuits, and the output circuits of the power source.

CALIBRATION PROCEDURE

4.1 GENERAL

The following calibration procedure, or any part of it, may be performed on a routine basis to insure that the Model 501TC Power Source remains within specified tolerances. This procedure should always be performed after any repairs have been made to the unit. This procedure also covers. test methods for the following power source adjustments and specifications:

a) Initial Adjustments.

b) AC Line Input Power and Overload Adjustment.

c) Voltage, Power Output, and Harmonic Distorion.

d) Line Regulation.

e) Load Regulation Adjustment.

f) Amplitude Stability.

g) Frequency Response.

h) AC Noise Level.

i) 0.7 Lagging Power Factor.

j) 0.7 Leading Power Factor.

This calibration procedure assumes that the power source will be operated from the 115 volt, 47 to 65 Hz AC line. For higher values of AC line voltage, a 240 volt variac and a 240 volt wattmeter must be substituted for those called out in this procedure. Consult Section 2.2.1 of this instruction manual for operation from other than the 115 volt AC line.

This calibration procedure further assumes that the power source is tested on the 0 to 135 volt range. Performance is very similar on the 0 to 270 volt range. The following table illustrates the change in measurement voltage and impedance level when evaluating the power source on both output voltage ranges.

TABLE 4-1.

Rated Output Voltage.	135V AC	270V AC
78% of Rated Output Voltage.	105V AC	210V AC
Resistive Load for 500 VA Output At Rated Output Voltage.	36.4Ω	146Ω
Resistive Load for 500 VA Output at 78% of Rated Output Voltage.	22.1Ω	88.2Ω

Section 2.4 of this instruction manual indicates the procedure required to change output voltage range and Section 2.8 indicates some potential problems associated with output wiring IR drop on both voltage ranges. When checking load regulation and amplitude stability, care should be taken to use a four-wire connection such that the external load and the measurement equipment have completely separate wiring from terminal strip TB2 at the rear of the power source.

4.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform the calibration procedure assuming that the input line voltage has a nominal value of 115 volts rms and that the power source is tested on the 0 to 135 volt AC range. Some equipment substitutions will be required if this is not the case.

a) Oscilloscope, Tektronix 533A with "W" plug-in.

b) 5.0 KVA Variac, General Radio W50M or equivalent.

c) 5.0 KVA Wattmeter, Simpson Electric or equivalent.

d) Distortion Analyser, H.P. 330B or equivalent.

e) Differential Voltmeter, Fluke 883A or equivalent.

f) Multi-range 500 watt load box, or individual 500 watt power resistors, as defined in Table 4-1. Dale type NHL resistors or equivalent.

g) Expanded Scale (about 115 VAC) strip chart recorder, Voltron Model 89.038 or equivalent.

h) Multimeter, Simpson 260 or equivalent.

4.3 INITIAL ADJUSTMENTS

4.3.1 Connect the Model 501TC Power Source as shown in Figure 4-1. Turn the GAIN control fully counter clockwise. Adjust the line voltage to its nominal value with the variac. Turn the POWER switch "on". The wattmeter should indicate 200 watts or less at nominal line voltage. If a problem is encountered, perform step 4.3.2 below.

4.3.2 Remove the top and bottom covers from the unit and connect the differential voltmeter between terminal 1 and terminal 2 of T2. Adjust potentiometer A1R14 so that the DC voltage across the primary of T2 is 0.00 volts ±5 millivolts. This balances and minimizes the collector current in both halves of the output stage. If the input power is still greater than 200 watts, resistor A1R30 may be reduced in value and test repeated.

4.3.3 Connect the differential voltmeter to the power output terminals at the rear of the unit and select the 0 to 135 volt range. Adjust the GAIN control for a 135 volt output with the oscillator set to 400Hz. Adjust the meter calibration control A1R54 so that the front panel meter and the differential voltmeter correlate within one per cent of each other. Vary the frequency from 45Hz to 5KHz and check that the front panel meter reads within ±3 per cent of the correct value.

4.3.4 Remove power from the unit and select the 0 to 270 volt range at TB2 according to the procedures given in Section 2.4 of this manual. Set the oscillator to 400 Hz and adjust the output to exactly 270 volts while reading the differential voltmeter. Select resistor A1R59 so that the front panel meter and the differential voltmeter correlate within one per cent. Vary the frequency from 45 Hz to 5 KHz and check that the front panel meter reads within ± 3 per cent of the correct value.

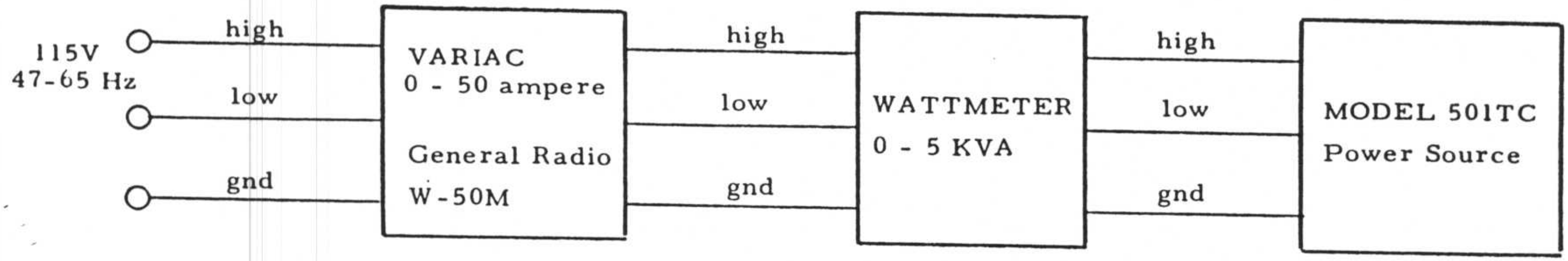
4.4 AC LINE INPUT POWER and OVERLOAD ADJUSTMENT

4.4.1 Connect the Model 501TC Power Source as shown in Figure 4-3. Select the 135 volt range with the straps on TB2 and adjust the output voltage of the power source to 105 volts rms (78 per cent of rated output voltage) at 400Hz. Close switch S2 22.1 ohm load) and readjust the output voltage slightly, if required, in order to maintain a 105 volt output. The power. source should deliver a clean sine wave output with less than 0.30 per cent distortion. Vary the frequency from 45Hz to 5KHz and check that the distortion does not exceed 0.50 per cent over the AC input line voltage range of 105 to 125 volts while maintaining the output voltage at 105 volts rms. Adjust potentiometer A1R40 so that no clipping or excessive distortion occurs on the positive peak of the output waveform under worst case conditions outlined above. Adjust potentiometer A1R43 so that no clipping or excessive distortion occurs on the negative peak of the output wave form under worst case conditions outlined above. These two adjustments may interact somewhat, so care should be taken not to move one adjustment excessively without checking the effect on the other adjustment.

4.4.2 With the AC input line voltage adjusted to its maximum value (normally 125 volts AC), close switch S2 and set the output voltage to 105 volts rms at 400Hz. The AC line wattmeter should indicate less than 1900 watts.

4.4.3 Repeat step 4.4.2 except close switch S1 instead of S2 and set the output voltage to 135 volts rms (100 per cent of rated output voltage). Maintain the input AC line voltage at 125 volts rms. The AC line wattmeter should indicate less than 1600 watts.

4.4.4 Repeat step 4.4.2 except open switch S1 (no load on output of power source). The AC line wattmeter should indicate less than 250 watts with a line voltage of 125 volts rms.



See Table 2-1 for AC line input wiring to the Model 501TC Power Source. Unit is normally wired for 105 to 125 volt AC line operation.

FIGURE 4-1. Test set up for initial adjustments of Model 501TC Power Source.

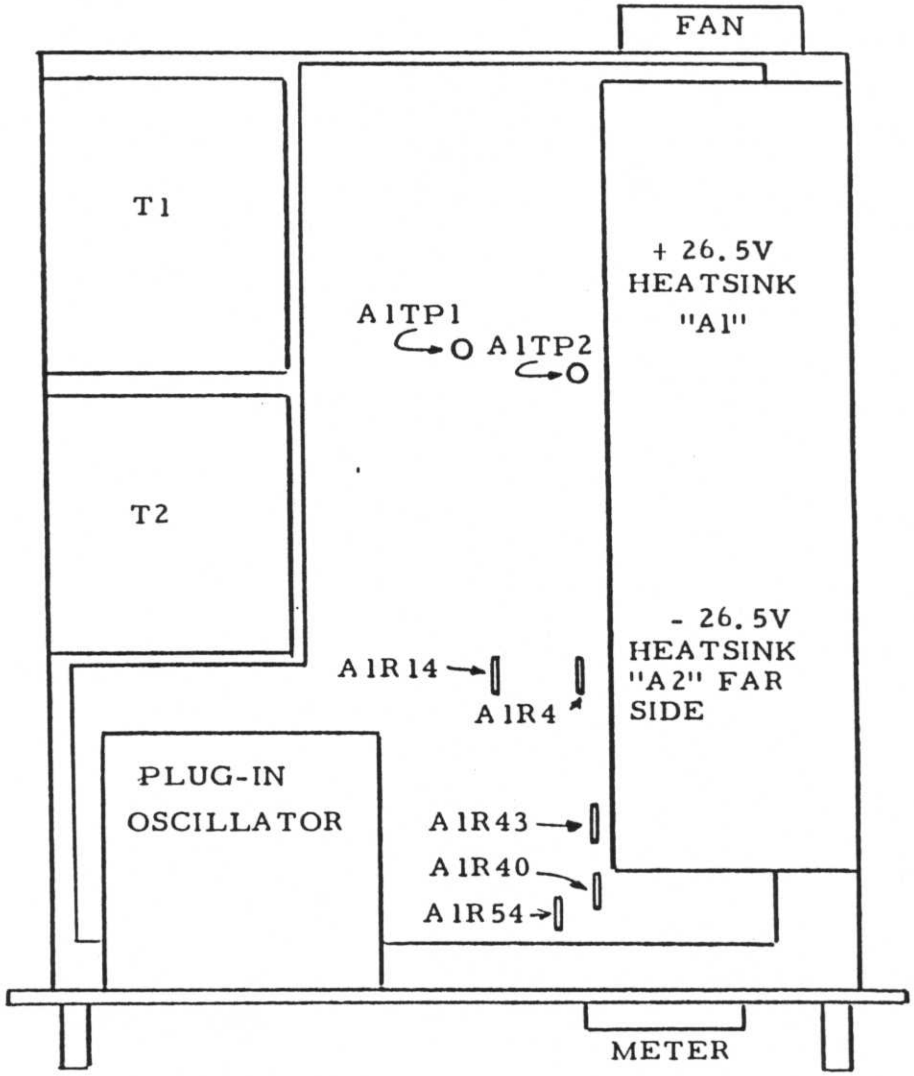


FIGURE 4-2. Internal Adjustments for Model 501TC Power Source. (Viewed from bottom).

4.4.5 This procedure may be performed for the 0 to 270 volt range if desired. In this case, the load impedance and output voltage levels should be taken from those given in Table 4-1.

4.5 VOLTAGE, POWER OUTPUT and HARMONIC DISTORTION

4.5.1 Connect the Model 501TC Power Source as shown in Figure 4-3. Select the 135 volt range with the straps on TB2. Adjust the variac to provide a 115 VAC line input and allow the power source to warm up for a few minutes. Set the oscillator output to 400Hz and adjust the output of the amplifier with the GAIN control to provide 135 volts rms (100% of rated output). Close switch S1 so that the 36.4 ohm load is across the output of the power source.

4.5.2 Vary the AC line voltage from 105 to 125 volts with the variac and check that no significant clipping is observed on the sine wave output with the oscilloscope. The harmonic distortion must be less than 0.3 per cent over the full line voltage range.

4.5.3 Set the oscillator output to 45Hz and adjust the output of the power source to 135 volts rms with the GAIN control. Repeat step 4.5.2. The harmonic distortion must be less than 0.5 per cent over the full line voltage range.

4.5.4 Set the oscillator output to 600 Hz and adjust the output of the power source to 135 volts rms with the GAIN control. Repeat step 4.5.2. The harmonic distortion must be less than 0.3 per cent over the full line voltage range.

4.5.5 Set the oscillator output to 5KHz and adjust the output of the power source to 135 volts rms with the GAIN control. Repeat step 4.5.2. The harmonic distortion must be less than 0.5 per cent over the full line voltage range.

4.5.6 Repeat steps 4.5.1 through 4.5.4 except set the output of the power source to 105 volts rms (78% of rated output) and close switch S2 instead of S1. The harmonic distortion must be less than 0.3 per cent from 200 Hz to 600 Hz, and less than 0.5 per cent from 45Hz to 5KHz.

4.5.7 This procedure may be performed for the 0 to 270 volt range, if desired. In this case, the load impedance and output voltage levels should be taken from those given in Table 4-1.

4.6 LINE REGULATION

4.6.1 Connect the Model 501TC Power Source as shown in Figure 4-3. Select the 135 volt range with the straps on TB2. Set the oscillator frequency to 400 Hz. Close switch S1 (36.4 ohm load) and adjust the output of the power amplifier to 135 volts rms (100 per cent of rated output voltage) at 400 Hz.

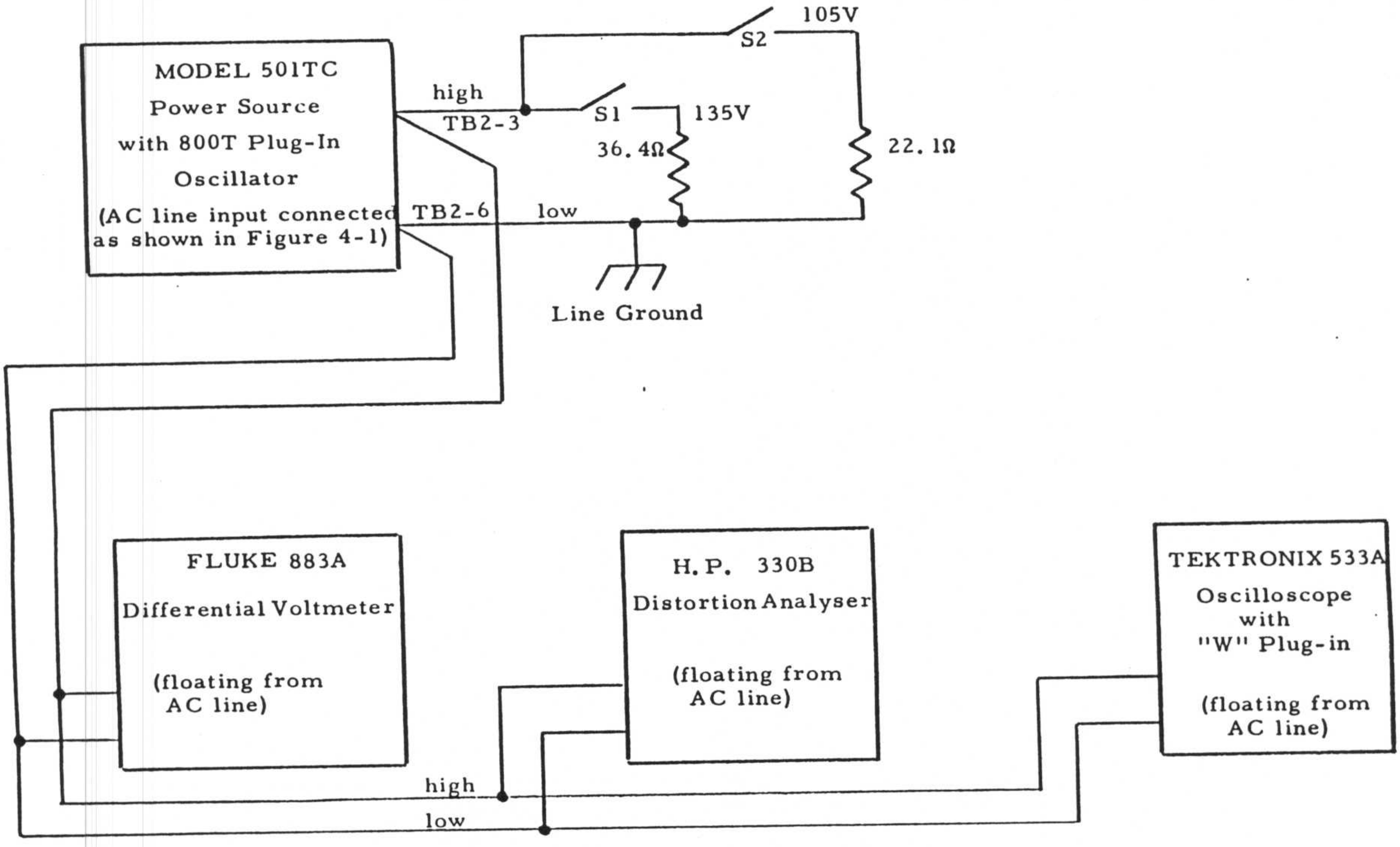


FIGURE 4-3. Test circuit for Model 501TC Power Source

4.6.2 Vary the line voltage from 105 volts to 125 volts AC and measure the change in output voltage of the power amplifier. This change should be less than 0.68 volts rms.

4.6.3 Set the frequency of the oscillator to 5 KHz and repeat 4.6.1 and 4.6.2. The change in the output voltage should be less than 0.68 volts rms.

4.6.4 Set the frequency of the oscillator to 45 Hz and repeat 4.6.1 and 4.6.2. The change in output voltage should be less than 0.68 volts rms.

NOTE

Care should be taken to insure that the output amplitude of the oscillator remains stable and independent of line conditions during this test.

4.6.5 This procedure may be performed for the 0 to 270 volt range, if desired. In this case, the load impedance and output voltage level should be taken from those given in Table 4-1.

4.7 LOAD REGULATION ADJUSTMENT

4.7.1 Connect the Model 501TC Power Source as shown in Figure 4-3. Check that the load is connected across TB2-3 and TB2-6 at the rear of the power source. The output voltage may be monitored either at the rear or the front of the power source. If it is monitored at the rear of the power source, care should be taken to use four-wire sensing. Adjust the output voltage of the Model 501TC Power Source to 105V rms output (78 per cent of rated output voltage)at 400 Hz.

4.7.2 Place the differential voltmeter on the 1000 volt AC range and connect it across the front panel output terminals of the power source. Adjust A1R4 so that the output voltage variation is less than 100 millivolts as the 22.1 ohm load is added and removed. Maintain the line voltage at 115 volts during this test.

4.7.3 Set the frequency of the oscillator to 5 KHz. Adjust the output amplitude of the power source to 105 volts rms with no load on the output of the power source. The output of the power source should change less than ± 1.05 volts when loaded with the 22.1 ohm resistor. Maintain the line voltage at 115 volts during this test.

4.7.4 Set the frequency of the oscillator to 45 Hz and repeat 4.7.3. The output of the power source should change less than ± 1.05 volts.

4.7.5 This procedure (steps 4.7.1 through 4.7.4) may be performed for the 0 to 270 volt range, if desired. In this case, the load impedance and output voltage levels should be taken from those given in Table 4-1. The load regulation must remain within a ± 1 per cent band from 45 Hz to 5 KHz.

4.8 AMPLITUDE STABILITY

4.8.1 Connect the Model 501TC Power Source as shown in Figure 4-3. Adjust the AC input line voltage to 115 volts rms. Adjust the output of the power source to provide 115 volts rms output (85.3 per cent of rated output voltage) at 400 Hz. Connect a 26.4 ohm (500 VA) load to the output terminals at the rear of the power source and check that the regulation control has been set to provide a zero output impedance.

4.8.2 Connect an AC expanded scale (about 115 volts rms) strip chart recorder across the output terminals of the power source and record the drift during a 24 hour period. This drift should be less than ± 0.29 volts rms. Disregard the drift during the first hour, as this represents initial warm-up drift. Care should be taken to insure that the ambient temperature is held constant within ± 3 degrees C for this test.

4.8.3 This procedure may be performed for the 0 to 270 volt range, if desired. In this case, the load impedance and output voltage level should be taken from those given in Table 4-1 consistent with the dynamic range of the specific expanded scale strip chart recorder employed for the test.

4.9 FREQUENCY RESPONSE

4.9.1 Connect the Model 501TC Power Source as shown in Figure 4-3. Adjust the input AC line voltage to 115 volts rms. Adjust the output of the power source to provide 135 volts output (100 per cent of rated output voltage) at 400 Hz.

4.9.2 Vary the output frequency of the oscillator from 45Hz to 5KHz and monitor the output voltage of the power source with a differential voltmeter under no-load conditions. The output of the power source should vary less than ±8.0 volts rms from 45Hz to 5KHz.

4.9.3 Close switch S1 and repeat 4.9.1 and 4.9.2. The output of the power source should vary less than ±8.0 volts rms from 45Hz to 5KHz.

4.9.4 This procedure may be performed for the 0 to 270 volt range, if desired. In this case, the load impedance and output voltage level should be taken from those given in Table 4-1. The output must vary less than ±0.5 dB from 45Hz to 5KHz.

4.10 A.C NOISE LEVEL

4.10.1 Connect the Model 501TC Power Source as shown in Figure 4-3. Adjust the line voltage to 115 volts rms. Adjust the output of the power source to provide 105 volts rms (78% of rated output voltage) at 400Hz.

4.10.2 Close switch S2 and monitor the output of the power source with the Tektronix 533A Oscilloscope with a "W" plug-in. Using the offset feature of the "W" plug-in, observe the positive peak of the output voltage at a vertical sensitivity of .2 volt per centimeter and a sweep rate of 5 milliseconds per centimeter. The peak-to-peak noise and ripple should not exceed .297 volts (60 dB below full output).

4.10.3 Remove the plug-in oscillator and short pins 1 and 2 together of the small 12 pin terminal strip TB1 located on the rear panel of the Model 501TC. The AC rms noise in the output should now be less than 10.5 millivolts rms (80 dB below full output) when read on the differential voltmeter. Remove the short from pins 1 and 2 of the TB1 and then insert the plug-in oscillator into the 501TC.

4.10.4 Steps 4.10.1 through 4.10.3 may be performed on the 270 volt range, if desired. The load impedance and output voltage level should be taken from those given in Table 4-1. The following chart gives the acceptable noise level output on each voltage range.

Rated Output Voltage	135V AC	270V AC
Peak-to-Peak Noise Level with 500 VA Load (see 4.10.2).	0.297 volts p-p	0.594 volts p-p
Rms Noise Level at No Load (See 4.10.3).	10.5mv rms	21.0mv rms

4.11 0.7 LAGGING POWER FACTOR

4.11.1 Connect the Model 501TC Power Source as shown in Figure 4-3. Select the load circuit to correspond with the required output voltage range. Figure 4-4 illustrates the load circuit and gives load parameter values for 500 VA 0.7 power factor at 400Hz with 78 per cent of rated output voltage from the power source. This represent the worst case inductive load for maximum power dissipation inside the power source.

4.11.2 Set the oscillator frequency to 400Hz and adjust the GAIN control for 78 per cent of rated output voltage. Check that the power source produces a stable output with no high-frequency oscillation or excessive distortion. Refer to Section 4.5 of this instruction manual for the procedure to measure harmonic distortion. This distortion must be less than 0.3 per cent at 400Hz.

4.11.3 The regulation control usually does not require significant readjustment in order to provide a zero regulation with a 0.7 power factor load at 400Hz. If the unit is to be operated at a 0.7 power factor in the high frequency region, i.e. 2KHz to 5KHz, then it may be necessary to readjust the regulation control. In this case, rotate the internal regulation control until zero regulation is obtained at the specific frequency and load condition.

4.11.4 The AC line input power is 1900 watts maximum with a 0.7 power factor load at 78 per cent of rated output voltage and an input line voltage of 125 volts rms.

4.11.5 The above tests may be repeated at frequencies other than 400Hz provided that the inductance of the series inductor is changed inversely proportional to the absolute value of the test frequency. For example, at 1 KHz the inductance value must be divided by 2.5. The series resistance value remains unchanged.

4.12 0.7 LEADING POWER FACTOR

4.12.1 Connect the Model 501TC Power Source as shown in Figure 4-3. Select the load circuit to correspond with the required output voltage range. Figure 4-5 illustrates the load circuit and gives load parameter values for 500 VA 0.7 power factor operation at 400Hz with 78 per cent of rated output voltage from the power source. This represents the worst case capacitive load for maximum power dissipation inside the power source.

4.12.2 Set the oscillator frequency to 400 Hz and adjust the GAIN control for 78 per cent of the rated output voltage. Check that the power source produces a stable output with no high frequency oscillation or excessive distortion. Refer to Section 4.5 for the procedure to measure harmonic distortion. This distortion must be less than 0.3 per cent at 400 Hz.

4.12.3 The regulation control usually does not require significant readjustment in order to provide a zero regulation with a 0.7 power factor load at 400 Hz. If the unit is to be operated at a 0.7 power factor in the high frequency region, i.e. 2 KHz to 5 KHz, then it may be necessary to readjust the regulation control. In this case, rotate the internal regulation control until zero regulation is obtained at the specific frequency and load condition.

4.12.4 The AC line input power is 1900 watts maximum with an 0.7 power factor load at 78 per cent of rated output voltage and an input line voltage of 125 volts rms.

4.12.5 The above tests may be repeated at frequencies other than 400 Hz provided that the capacitance of the series capacitor is changed inversely proportional to the absolute value of the test frequency. For example, at 1 KHz the capacitance value must be divided by 2.5. The series resistance value remains unchanged.

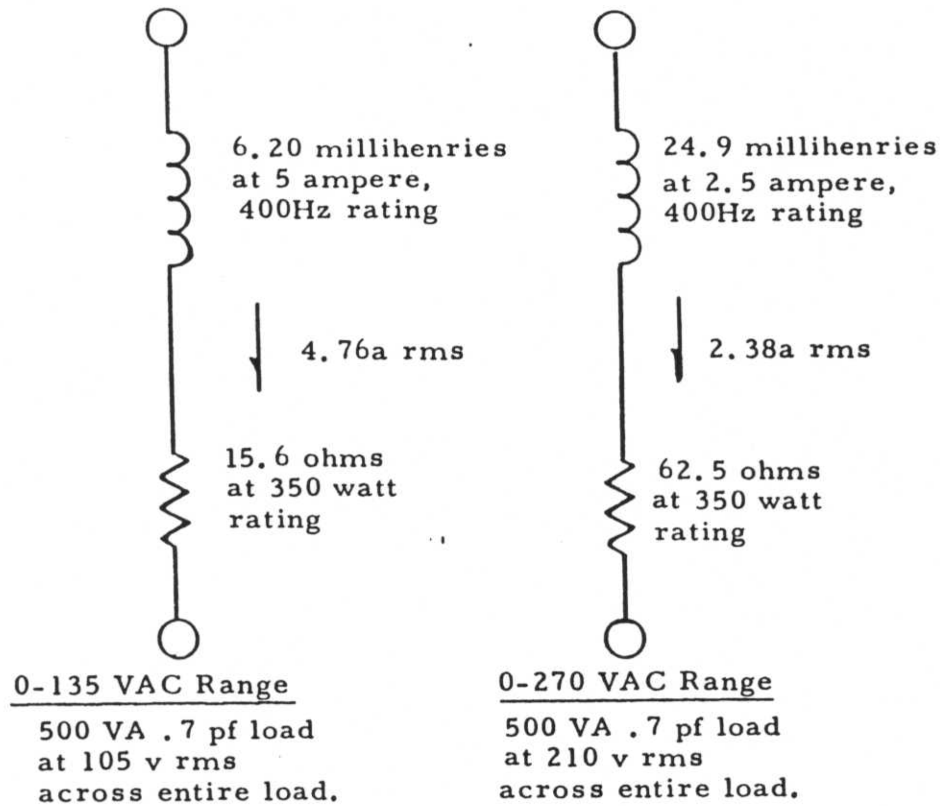


FIGURE 4-4. Circuit for 500VA 0.7 Lagging Power Factor Load at 400Hz.

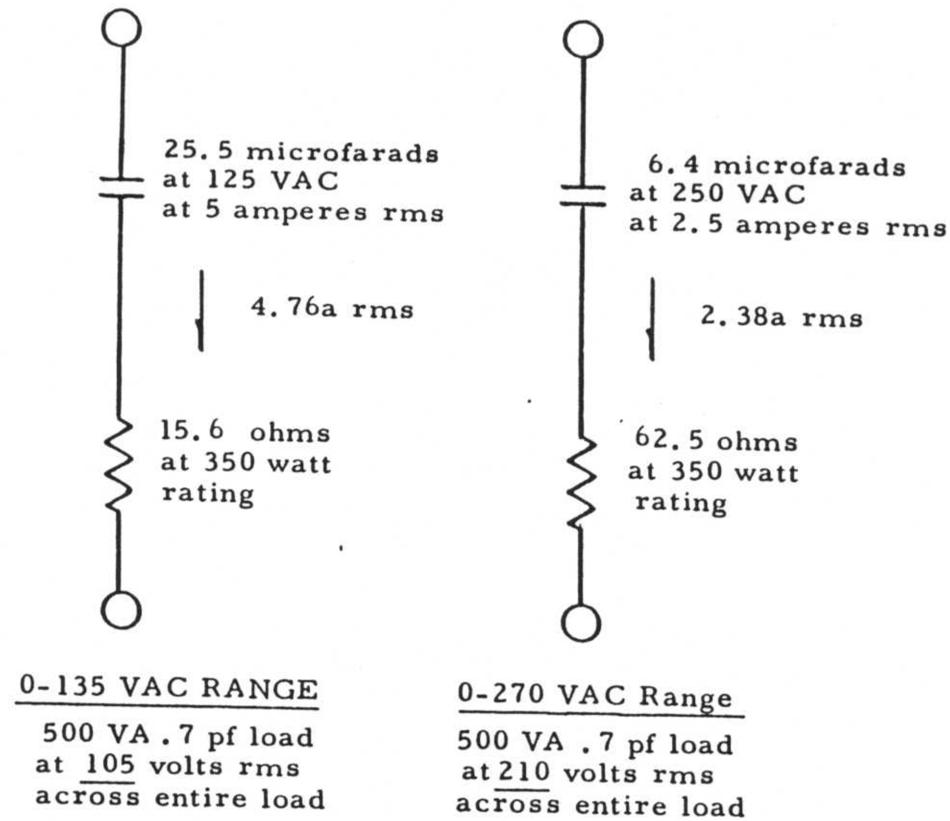


FIGURE 4-5. Circuit for 500 VA. 0.7 Leading Power Factor Load at 400Hz.

5.1 GENERAL

The California Instruments Model 501TC Power Source is a solid state unit and should require a minimum of maintenance. However, it is forced air cooled and will accumulate some dust with time. The power transistor heatsinks should receive a forced air bath at intervals not to exceed 6 months.

CAUTION

Failure to keep the heatsinks clean will reduce their thermal transfer efficiency somewhat and could eventually cause failure of the power source.

5.2 TROUBLESHOOTING

5.2.1 If a problem appears in the power source, it must be isolated to a specific section of the unit. Before servicing the amplifier, check that the AC power input to the unit is of the proper amplitude and frequency. Check that the signal input to the power amplifier is also of the proper amplitude (approximately 5 volts rms) and frequency (45 Hz to 5 KHz). Check that the output load on the power amplifier is not excessive or that the load starting transients are not excessive. Check that the output of the oscillator is coupled to the input of the power amplifier through the 12 pin connector TB1 on the rear of the power source.

5.2.2 If the problem has been resolved to be in the power amplifier, first check all DC power supply voltages. Information concerning power supply ripple and voltage tolerance is given in section 3.2.6 of this instruction manual.

5.2.3 Check that the quasi complementary symmetry output amplifier is operating properly and is not drawing excessive current under no load conditions. Section 3.2.2 of this instruction manual describes the operation of this output amplifier.

5.2.4 Check that the overload circuitry is operating properly. The overload circuit may be disabled by removing diodes A1CR8 and A1CR9.

5.2.5 If the problem has been resolved to be in the oscillator, consult the applicable oscillator instruction manual.

CIRCUIT DIAGRAMS

6.1 GENERAL

This section contains schematics and mechanical diagrams necessary for operation and maintenance of the Model 501TC AC Power Source. The schematic diagrams illustrate the circuit while the mechanical assemblies indicate the part placement.

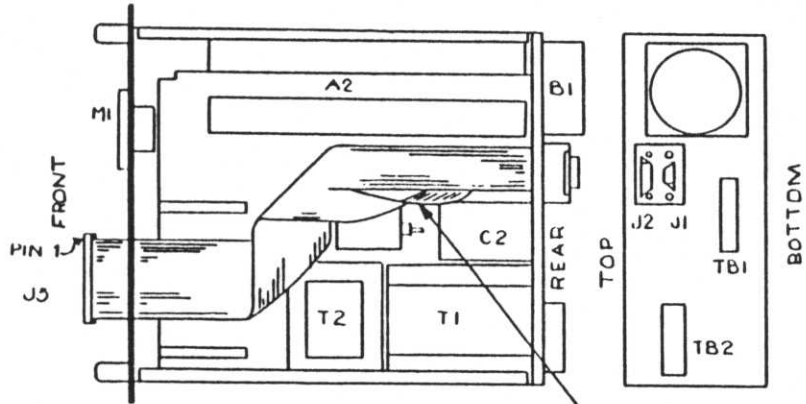
6.2 REFERENCE DESIGNATIONS

Partial reference designators are shown on schematic and mechanical drawings. Prefix these reference designators with assembly and/or sub-assembly designation for the complete reference designator. For example:

Assembly/Sub-Assembly	Component	Component Designation
A1	C8	A1C8
None	T1	T1

REV	DESCRIPTION	DATE	APPROVED
	SEE SHT ONE		

REVISIONS

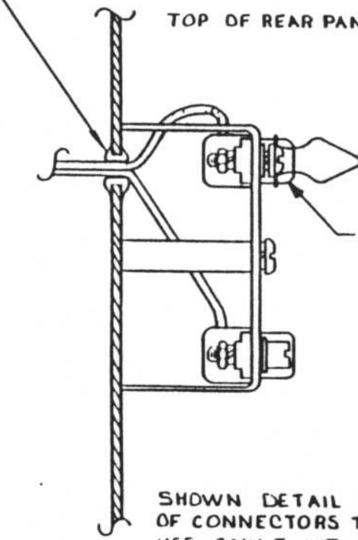


USE GROMMET STRIP ON REAR PANEL AS REQ'D

TWIST CABLE 180°

OPTION GPIB CABLE ASSY SHOWN IS FOR MODEL 501TC

TOP REMOVED FOR CLARITY



TOP OF REAR PANEL

36 PIN PARALLEL CONNECTOR SHOWN FOR "-GP" OPTION ONLY

SHOWN DETAIL ASSEMBLY OF CONNECTORS TO REAR PANEL USE CABLE KIT ASSY 4845-406-1, OR 4845-406-2

4050-405 H

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

LIST OF MATERIAL

NOTES (UNLESS OTHERWISE SPECIFIED)

QTY REQD	USED ON	NEXT ASSY
	501TC	

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X° ± 30'

BREAK ALL SHARP CORNERS & EDGES

MACH SURFACES √

DWG SIZE C

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FINISH

TITLE: TOP ASSEMBLY 500 VA POWER SOURCE

RELEASE		6/7/83
PROJ ENG		6/3/83
CHECK		6/3/83
DESIGN		6/6/83
DRAFT	S. Jachetto	5-11-83

ADDITIONAL APPROVALS

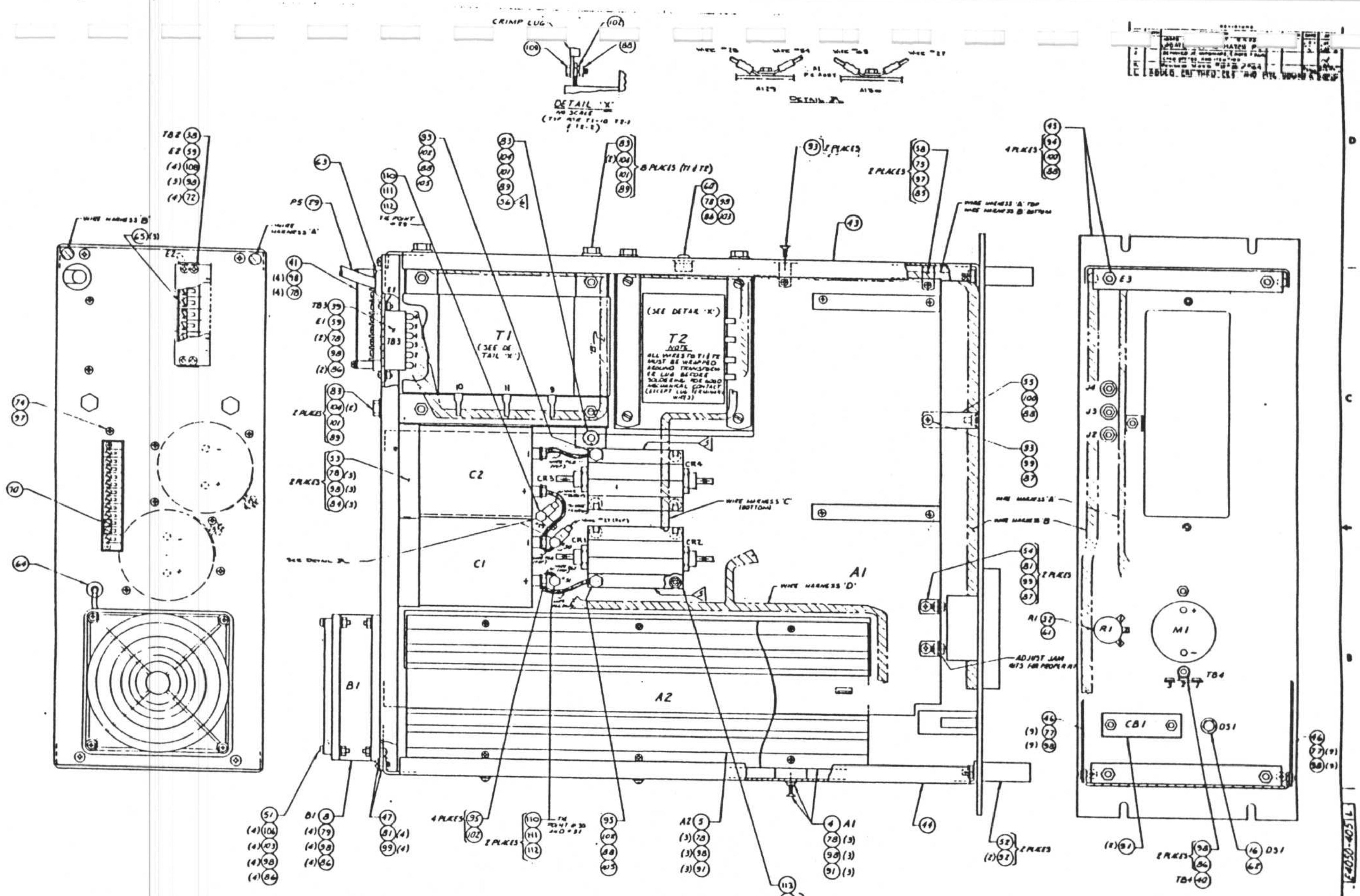
California Instruments
A DIVISION OF AMSTAR TECHNICAL PRODUCTS CO. INC
SAN DIEGO CALIFORNIA

CONTRACT NO

CODE IDENT 16067

DWG NO 4050-405 REV H

SCALE NONE SHEET 2 OF 2



- 1 ASSEMBLY

2 PLACES

6. ITEM 56 IS BETWEEN PC BOARD AND TRANSFORMER BRACKET
5. THIS FLANGE IS FREE OF ANODIZE
4. ASSEMBLE ON REAR PANEL THE FAN, CAPACITORS C1/C2 AND MISC PARTS BEFORE BOLTING TO SIDE RAILS
3. INSTALL T1 & T2 TRANSFORMERS PRIOR TO A1 PC BOARD ASSY
2. FOR WIRE TAB TABLE SEE A4050-051
1. FOR SCHEMATIC DIAGRAM SEE DWG. # E4050-075

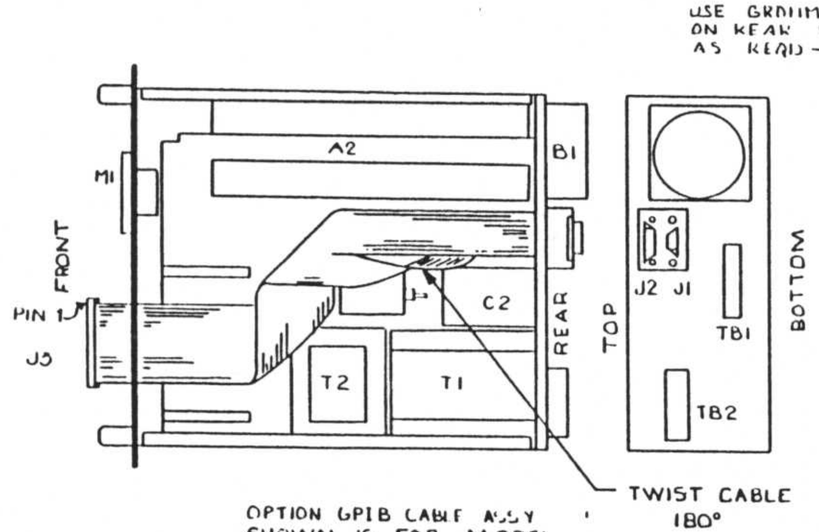
FOR PARTS LIST SEE PL 4050-405-1

TOP ASSEMBLY
500VA POWER SOURCE

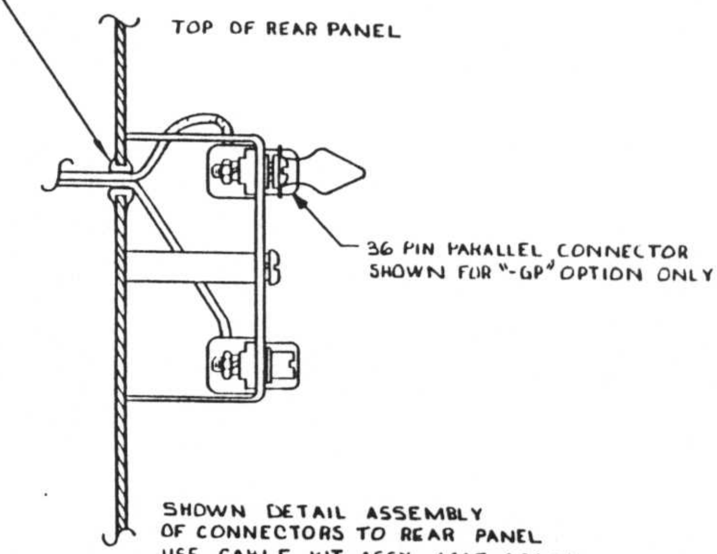
E4050-405

32

REV	DESCRIPTION	DATE	APPROVED
	SEE SHT ONE		



OPTION GPIB CABLE ASSY
SHOWN IS FOR MODEL
501TC
TOP REMOVED FOR CLARITY



SHOWN DETAIL ASSEMBLY
OF CONNECTORS TO REAR PANEL
USE CABLE KIT ASSY 4845-406-1,
OR 4845-406-2

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

LIST OF MATERIAL

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X° ± 30'

BREAK ALL SHARP CORNERS & EDGES

MACH SURFACES √

DWG SIZE C

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FINISH

TITLE: TOP ASSEMBLY 500 VA POWER SOURCE

RELEASE 4/9/83 · CHECK 6/3/83 · DESIGN · DRAFT S. [illegible] 5-11-83

ADDITIONAL APPROVALS

California Instruments
A DIVISION OF AMSTAR TECHNICAL PRODUCTS CO. INC
SAN DIEGO CALIFORNIA

CONTRACT NO · CODE IDENT 16067

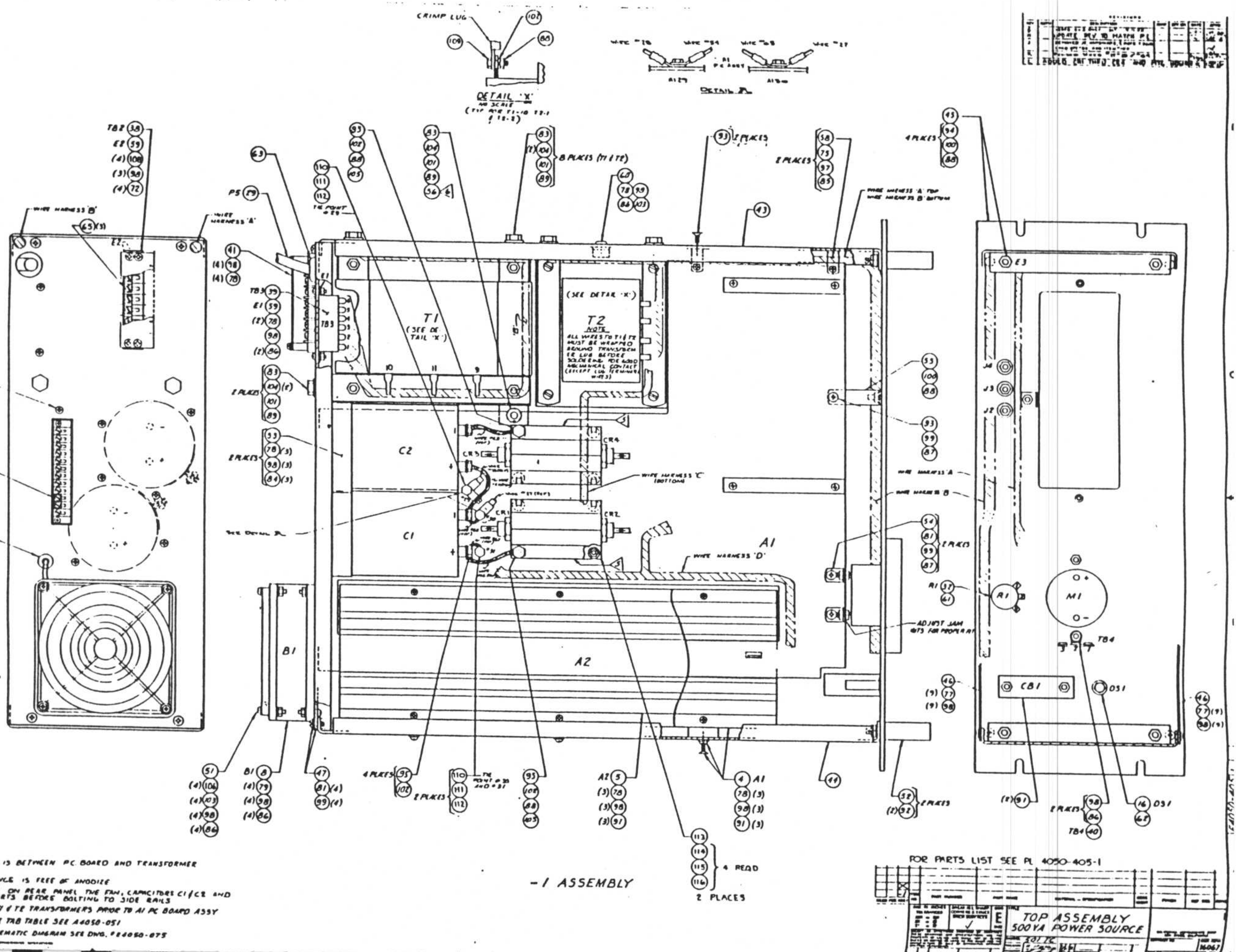
DWG NO 4050-405 · REV H

SCALE NONE · SHEET 2 OF 2

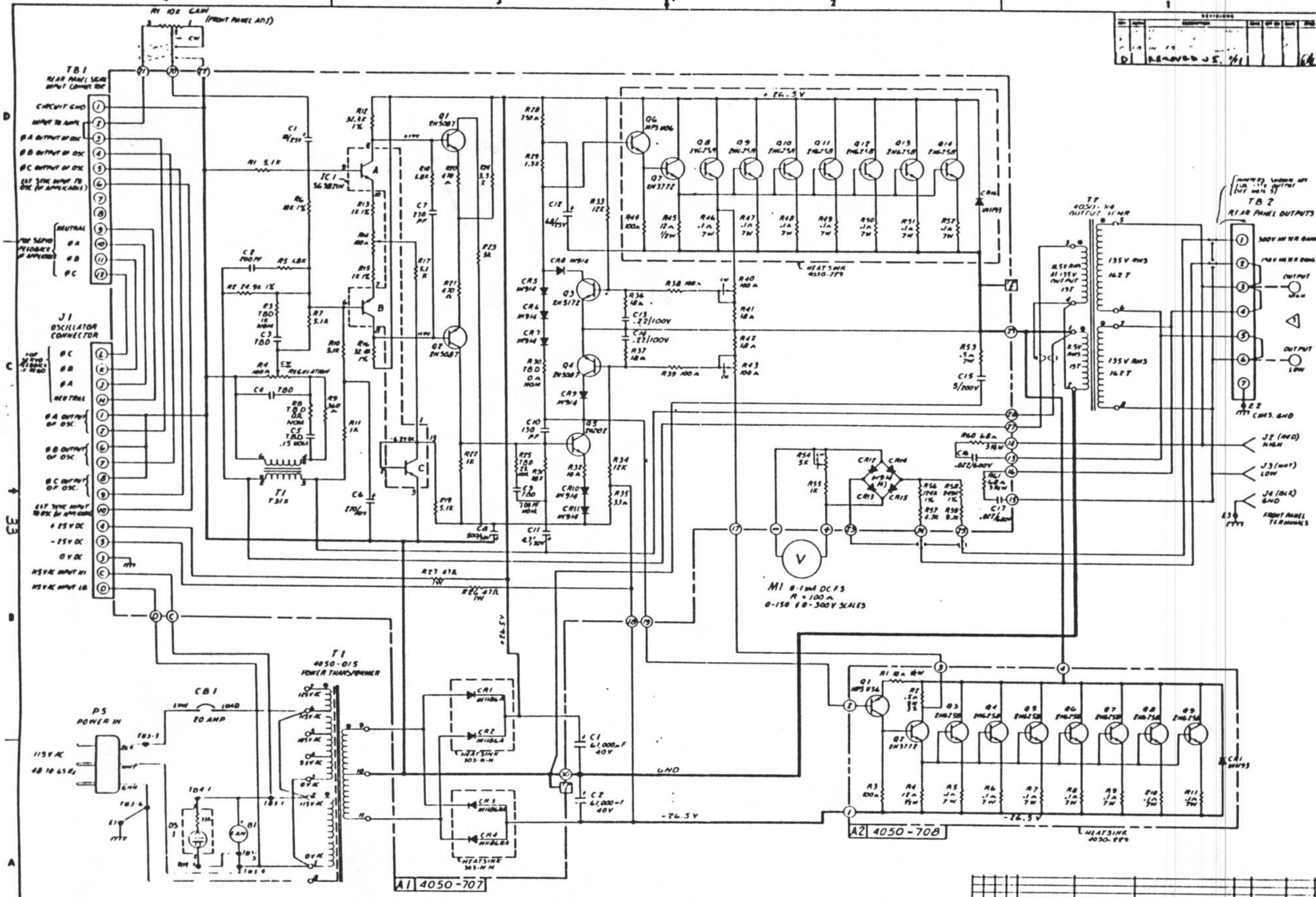
QTY REQD	USED ON	NEXT ASSY
	501TC	

NOTES (UNLESS OTHERWISE SPECIFIED)

4050-405 H



6. ITEM 56 IS BETWEEN PC BOARD AND TRANSFORMER BRACKET
5. THIS FLANGE IS FREE OF ANODIZE
4. ASSEMBLE ON REAR PANEL THE FAN, CAPACITORS C1/C2 AND MISC PARTS BEFORE BOLTING TO SIDE RAILS
3. INSTALL T1 & T2 TRANSFORMERS PRIOR TO A1 PC BOARD ASSY
2. FOR WIRE TAB TABLE SEE A4050-051
1. FOR SCHEMATIC DIAGRAM SEE DWG. F84050-075

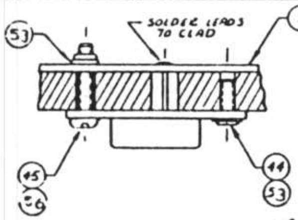


4. FOR WIRE TAB TABLE SEE A4050-051
3. FOR TOP ASSEMBLY DRAWING SEE E4050-405
2. ALL RESISTORS ARE 1/4W, 5%
1. ALL CAPACITANCE IS IN MICROFARADS.
NOTES UNLESS OTHERWISE SPECIFIED

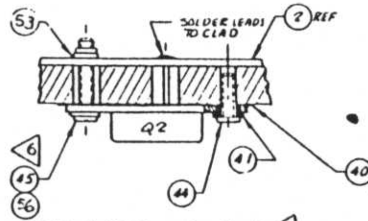
FOR 2KV OUTPUT, REMOVE ALL EXISTING JUMPERS FROM TB2 AND ADD JUMPERS FROM TB2-4 TO TB2-5 & TB2-1 TO TB2-5. CONNECT EXTERNAL LOAD FROM TB2-3 TO TB2-6.

SCHEMATIC DIAGRAM
500 VA AC POWER SOURCE

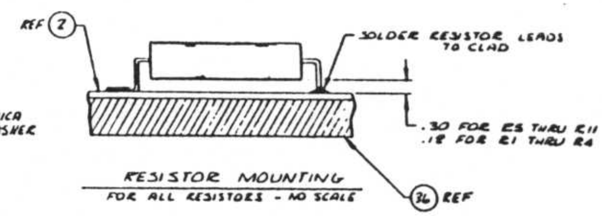
E4050-075



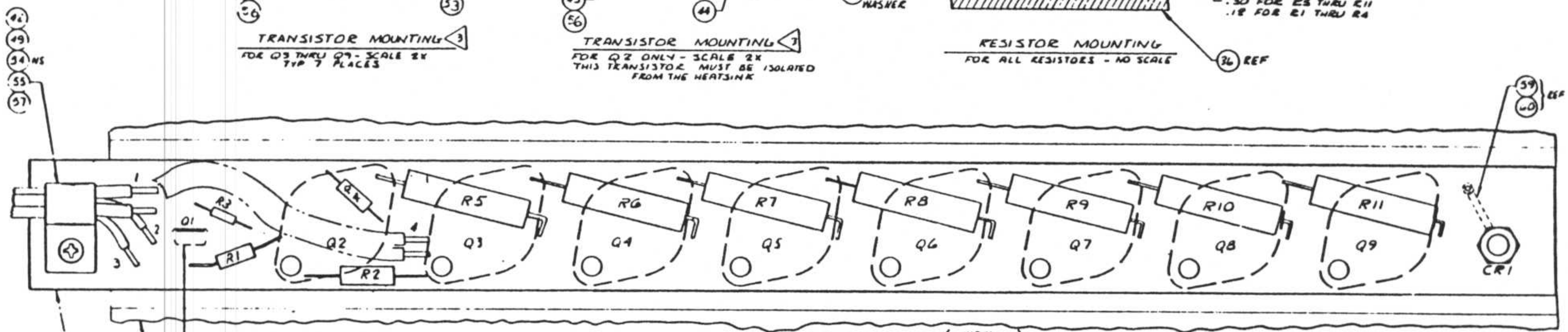
TRANSISTOR MOUNTING 3
FOR Q3 THRU Q9 - SCALE 2X
TYP 7 PLACES



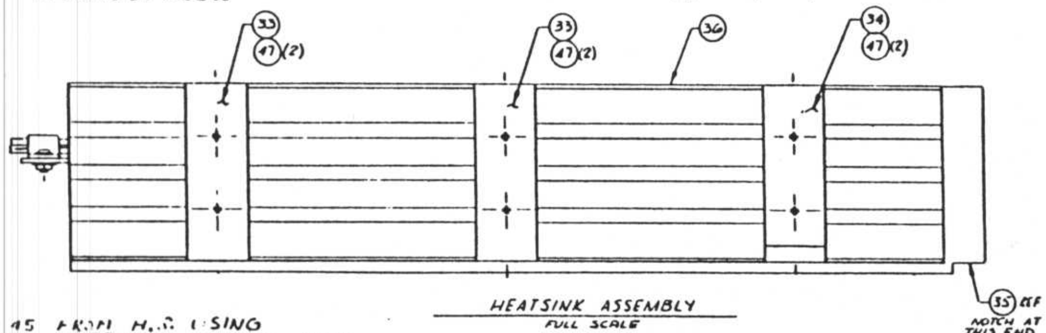
TRANSISTOR MOUNTING 3
FOR Q2 ONLY - SCALE 2X
THIS TRANSISTOR MUST BE ISOLATED FROM THE HEATSINK



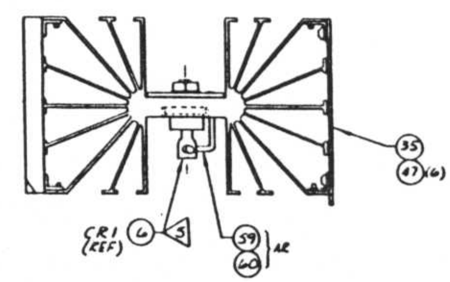
RESISTOR MOUNTING
FOR ALL RESISTORS - NO SCALE



P.C. BOARD ASSEMBLY (VIEW-CLAD SIDE)
SCALE 2X



HEATSINK ASSEMBLY
FULL SCALE



6 INSULATE ITEM 45 FROM H.S. USING A.W.G. 10 TEFLON SLEEVING ON Q2 ONLY.

5 WIRE CR1 ANODE TO -26.5V CLAD AS SHOWN

3 APPLY ITEM 39 THERMATE SILICONE COMPOUND BETWEEN TRANSISTORS AND HEATSINK.

2 FOR SCHEMATIC SEE DWG E4050-075.

1 COORDINATE WITH WIRE TAB TABLE A4050-051.

NOTES. (UNLESS OTHERWISE SPECIFIED)

WIRING TABLE 1

WIRE NO	FROM	TO (REF)	AWG	COLOR	LENGTH	REMARKS
51	A2-1	C2-(-)	2X12AWG	BLK		TERMINATE WITH ITEM 63.
52	A2-2	A1-19	18	ORN		
53	A2-3	A1-17	18	RED		
54	A2-4	A1-25	2X12AWG	WHT		TERMINATE WITH ITEM 63

REQD PER ASSY	ITEM NO	PART NUMBER	PART NAME	MATERIAL - SPECIFICATION	CODE IDENT	FINISH	REF DES	ZONE
		-1	P.C. BOARD ASSY	FOR PARTS LIST, SEE SHEET 3,4,&5.				

DIM IN INCHES TOLERANCES
BREAK ALL SHARP CORNERS & EDGES
DWG SIZE D
TITLE P.C BOARD ASSY, -26.5V SUPPLY A2
[redacted]
CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA
MODEL 501TC
CODE IDENT 16067
NEXT ASSEMBLY 4030-405
DRAFTSMAN MARTIN M
DWG NO D4050-708 REV C
SCALE NOTED SHEET 2 of 5

D4050-708 C

REPLACEABLE PARTS

7.1 GENERAL

This section contains ordering information and complete list of replaceable parts. Parts are listed by major assembly in alphanumerical order of their reference designators. Description, manufacturers' part number, manufacturers' code ident number (see Appendix A for list of manufacturers), and California Instruments' stock number are indicated.

7.2 ORDERING INFORMATION

In order to provide our customers with prompt service on replacement parts, please provide the following information, when applicable, for each part ordered:

a) Model number and serial number of the instrument.

b) California Instruments part number of the sub-assembly where component is located.

c) Component reference designator.

d) Component description.

e) Component manufacturer's number and code ident.

f) California Instruments stock number.

All replacement parts orders should be placed with California Instruments, Division of Amstar Technical Products Co., Inc., San Diego, California, 92111-1266.

7.3 COMPUTER GENERATED PARTS LISTS

The following information is included as an explanation of the computer formatted parts list column.

7.3.1 "Seq. No." - Sequence number; the reference designator or the component, or (if there is no reference designator) the balloon number (bubble or "find" number) on the face of the assembly drawing or the top assembly drawing. They are listed in alphanumerical order.

7.3.2 "Component Item No." - This is California Instruments part number. Please use this number when ordering spares.

7.3.3 "Description, Truncated" - A brief description of the item. Abbreviations are per MIL-STD-12 or industry accepted standards.

7.3.4 "Engineering Drawing No." - This is used for one of the following:

a) The document/specification number generated by California Instruments to control the part.

b) The generic part number (military specification or industry accepted standard).

c) The primary vendor's catalog part number. An asterisk at the end of the number indicates number is longer than that shown (contact California Instruments if the full number is required).

7.3.5 "Vendor" - This is the FSCM code identification (see Appendix A).

7.3.6 "Quan" and "U/M" - The requirements per unit of measure such as: "2 each"; "1 lb."; "4 oz."; or "6 SI" (square inches).

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
	4050-051-0	HARNESS ASSY,JUMPER	4050-051 REV J	16067	1.0	EA
	4050-051-1	HARNESS ASSY	4050-051 REV J	16067	1.0	EA
	4050-051-2	HARNESS ASSY	4050-051 REV J	16067	1.0	EA
	4050-418-1	FRONT PANEL ASSY	4050-418 REV 0	16067	1.0	EA
CB1	270039	CIRCUIT BREAKER,20A,250V	AM1-A3-A-20-3	74193	1.0	EA
)S1	241021	LAMP,GAS,AMBER,120V	BG03ACSNE2H/33K	03797	1.0	EA
J2	240041	BINDING POST,RED	DF-31RC	58474	1.0	EA
J3	240090	BINDING POST,WHT	DF-31WTC	58474	1.0	EA
J4	240040	BINDING POST,BLK	DF-31BC	58474	1.0	EA
M1	CIC800	METER,DC,ANLG,MA,0-1	CIC800-0	16067	1.0	EA
M1	CIC800-18	MTR FACE,MTL,W/4050-100	CIC800/4995-285	16067	1.0	EA
R1	570128	POT,PNL,10K,1/2W,PREC	B4010-012-1	16067	1.0	EA
TB4	250093	TERMINAL STRP, 3TERM,1MT	864	83330	1.0	EA
45	110367-1	PANEL,FRONT W/4050-224	4050-224-1	16067	1.0	EA
52	240224	HANDLE,FLT,STEEL,6"	11520-S-0832-4	06540	2.0	EA
55	110358	BRACKET,ANGLE	MS9596-023	18076	1.0	EA
61	240233	KNOB,BLK	PS-70-2-BLK	21604	1.0	EA
	4050-419-1	REAR PANEL ASSY	4050-419 REV H	16067	1.0	EA
B1	241063	FAN,4",115VAC,50/60HZ	WS2107F-110	99743	1.0	EA
C1	610845	CAP,AL,61000UF,40V	DCM613U040DD2B	00853	1.0	EA
C2	610845	CAP,AL,61000UF,40V	DCM613U040DD2B	00853	1.0	EA
E1	250047	LUG,RING,SOLDER,#6	1416-6	83330	1.0	EA
E2	250047	LUG,RING,SOLDER,#6	1416-6	83330	1.0	EA
P5	241078	PWR CORD,115V,14-3,6' W/	14-3-SJT	0000A	1.0	EA
TB2	240405	TERMINAL BLK, 7TERM,15A	7-140Y	71785	1.0	EA
TB3	240110	TERMINAL STRP, 6TERM,2MT	3006	83330	1.0	EA
47	110369-1	PANEL,REAR W/4050-231	4050-231-1	16067	1.0	EA
51	241064	FAN GUARD	550481	82877	1.0	EA
53	241052	CAP CLAMP,3"	4586-2	56289	2.0	EA
63	210361	STRAIN RELIEF	SR-7P-2	28520	1.0	EA
64	210105	GROMMET,RUBBER,5/16"DIA	2172	83330	1.0	EA
65	250187	JUMPER,TERMINAL BLOCK	140J-1	71785	3.0	EA
72	210063	STANDOFF,6-32 X 1/2"	2322	83330	4.0	EA
	4050-420-1	SIDE RAIL ASSY,RIGHT	4050-420 REV 0	16067	1.0	EA
T1	710242	TRANSFORMER,INPUT	4050-015-1	16067	1.0	EA
T2	710241	TRANSFORMER,OUTPUT	4050-014-1	16067	1.0	EA
43	110365	SIDE RAIL,RIGHT	4050-222-7	16067	1.0	EA
58	110264	BRACKET,ANGLE	631	91833	2.0	EA
83	210220	BOLT,HEX,S/S,1/4-20X3/4	MS35307-306	96906	8.0	EA
89	210298	NUT,HEX,S/S,1/4-20	MS35649-2254	96906	8.0	EA
101	210459	WASHER,SPLT,1/4	MS35338-139	96906	8.0	EA
104	210097	WASHER,FLAT,1/4	MS15795-810	96906	16.0	EA
A1	4050-707-1	PC ASSY,AMPLIFIER	4050-707 REV L	16067	1.0	EA
A2	4050-708-1	HEATSINK ASSY,OUT DRIVER	4050-708 REV C1	16067	1.0	EA
CR1	310221	DIODE,RECT,40A,400V,DO5	1N1188A	07716	1.0	EA
CR2	310221	DIODE,RECT,40A,400V,DO5	1N1188A	07716	1.0	EA
CR3	310257	DIODE,RECT,40A,400V,DO5	1N1188RA	07716	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR4	310257	DIODE,RECT,40A,400V,DO5	1N1188RA	07716	1.0	EA
41	250188	MARKER STRP, 7TERM,140Y	MS-7-140Y	71785	1.0	EA
44	110366	SIDE RAIL,LEFT	4050-223-7	16067	1.0	EA
46	110368	COVER,TOP & BOTTOM	4050-225-7	16067	2.0	EA
54	110280	BRACKET,ANGLE	MS9596-017	18076	2.0	EA
56	210469	SPACER,1/4 X 3/16"	9254A257	06540	1.0	EA
60	FS3004	CABLE CLAMP,1/4"ID	CLE-1/4	51705	1.0	EA
70	250090	JUMPER,TERMINAL BLOCK	410J	75382	1.0	EA
74	FS1011	SCREW,PNH,S/S,4-40X1/4	MS51957-13	96906	1.0	EA
75	FS1006	SCREW,PNH,S/S,4-40X5/16	MS51957-14	96906	2.0	EA
77	FS1026	SCREW,PNH,S/S,6-32X1/4	MS51957-26	96906	18.0	EA
78	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	19.0	EA
80	FS1036	SCREW,PNH,S/S,6-32X3/4	MS51957-32	81349	4.0	EA
81	FS1042	SCREW,PNH,S/S,8-32X3/8	MS51957-43	96906	6.0	EA
83	210220	BOLT,HEX,S/S,1/4-20X3/4	MS35307-306	96906	3.0	EA
84	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	6.0	EA
85	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	2.0	EA
86	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	13.0	EA
87	FS1065	NUT,HEX,S/S,8-32	MS35649-284	96906	6.0	EA
88	FS1067	NUT,HEX,S/S,10-32	MS35650-304	96906	7.0	EA
89	210298	NUT,HEX,S/S,1/4-20	MS35649-2254	96906	3.0	EA
91	FS1001	SCREW,FLH,S/S,6-32X5/16	MS24693-C25	81349	8.0	EA
92	FS1044	SCREW,FLH,S/S,8-32X1/2	MS24693-C50	81349	4.0	EA
93	FS1043	SCREW,FLH,S/S,8-32X3/8	MS24693-C48	81349	3.0	EA
94	FS1061	SCREW,FLH,S/S,10-32X1/2	MS24693-C272	96906	4.0	EA
95	210233	BOLT,HEX,S/S,10-32X1/2	MS9489-06	96906	13.0	EA
97	FS1068	WASHER,INTER,S/S,#4	MS35333-70	81349	3.0	EA
98	FS1069	WASHER,INTER,S/S,#6	MS35333-71	96906	49.0	EA
99	FS1074	WASHER,SPLT,S/S,#8	MS35338-137	96906	10.0	EA
100	FS1071	WASHER,INTER,S/S,#10	MS35333-73	96906	5.0	EA
101	210459	WASHER,SPLT,1/4	MS35338-139	96906	3.0	EA
102	FS1075	WASHER,SPLT,S/S,#10	MS35338-138	96906	7.0	EA
103	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	6.0	EA
104	210097	WASHER,FLAT,1/4	MS15795-810	96906	5.0	EA
105	FS1082	WASHER,FLAT,S/S,#10	MS15795-842	96906	2.0	EA
106	FS1037	SCREW,PNH,S/S,6-32X7/8	MS51957-33	96906	4.0	EA
108	FS1033	SCREW,PNH,S/S,6-32X9/16	MS51957-123	81349	4.0	EA
109	210354	BOLT,HEX,S/S,10-32X3/8	10-32X3/8	81349	4.0	EA
110	FS1104	BOLT,HEX,BRS,10-32X1/2	10-32X1/2	81349	3.0	EA
111	FS1098	WASHER,SPLT,BRONZE,#10	4221B116	33855	3.0	EA
112	FS1097	NUT,HEX,BRASS,10-32	4139B122	33855	3.0	EA
113	210456	HEATSINK,DO10	303S-N-N	05820	2.0	EA
114	210457	INSULATOR,HEATSINK,TFE	TYPE 104	05820	8.0	EA
115	FS1047	SCREW,PNH,S/S,8-32X9/16	MS51957-126	81349	8.0	EA
116	FS1070	WASHER,INTER,S/S,#8	MS35333-72	81349	8.0	EA

PARENT ITEM NO.
4050-707-1

PC ASSY,AMPLIFIER
ENGR DRAW NO. 4050-707 REV L

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR5	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR6	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR7	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR8	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR9	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR10	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR11	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR12	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR13	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR14	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR15	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR16	310221	DIODE,RECT,40A,400V,DO5	1N1188A	07716	1.0	EA
C1	610738	CAP,TANT,10UF,25V	T362A106M025AS	05397	1.0	EA
C2	610282	CAP,MICA,200PF,500V	CM05F201J03	81349	1.0	EA
C3	FS7002	CAP,TBD	TBD	81349	1.0	EA
C4	FS7002	CAP,TBD	TBD	81349	1.0	EA
C5	610478	CAP,MYLAR,.15UF,100V	1DP-3-154K	72136	1.0	EA
C6	610766	CAP,TANT,220UF,10V	T362D227M010AS	05397	1.0	EA
C7	610040	CAP,MICA,270PF,500V	CM05F271J03	81349	1.0	EA
C8	610187	CAP,AL,500UF,50V	TC50050C	90201	1.0	EA
C9	610282	CAP,MICA,200PF,500V	CM05F201J03	81349	1.0	EA
C10	610278	CAP,MICA,130PF,500V	CM05F131J03	81349	1.0	EA
C11	610803	CAP,TANT,4.7UF,50V	T362B475M050AS	05397	1.0	EA
C12	610764	CAP,TANT,68UF,25V	T362D686M025AS	05397	1.0	EA
C13	610566	CAP,MYLAR,.22UF,100V	1DP-3-224	72136	1.0	EA
C14	610566	CAP,MYLAR,.22UF,100V	1DP-3-224	72136	1.0	EA
C15	610632	CAP,MYLAR,5UF,200V	210B1C505	14752	1.0	EA
C16	610104	CAP,MYLAR,.022UF,600V	6DP-2-223	72136	1.0	EA
C17	610104	CAP,MYLAR,.022UF,600V	6DP-2-223	72136	1.0	EA
IC1	330203	TRANSISTOR,ARRAY,NPN,DIP	SG3821N	34333	1.0	EA
J1	410146	CONN,PC EDGE,10 PIN,90D	8BDJ10M-0	81312	1.0	EA
Q1	330204	TRANSISTOR,SS,PNP,TO92	2N5087	04713	1.0	EA
Q2	330204	TRANSISTOR,SS,PNP,TO92	2N5087	04713	1.0	EA
Q3	330219	TRANSISTOR,SS,NPN,TO92	2N5172	81349	1.0	EA
Q4	330204	TRANSISTOR,SS,PNP,TO92	2N5087	04713	1.0	EA
Q5	330075	TRANSISTOR,SS,NPN,TO39	2N2102	81349	1.0	EA
Q6	330232	TRANSISTOR,PWR,NPN,TO202	MPSU06	04713	1.0	EA
Q7	330173	TRANSISTOR,PWR,NPN,TO3	61491 (2N3772)	86684	1.0	EA
Q8	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q9	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q10	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q11	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q12	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q13	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q14	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
R1	510069	RES,CARB,1/4W,5.1K OHM	RC07GF512J	81349	1.0	EA
R2	560256	RES,FILM,1/4W,24.9K,1%	RN60C2492F	81349	1.0	EA

PARENT ITEM NO. 4050-707-1

619-278-8620

PC ASSY,AMPLIFIER

ENGR DRAW NO. 4050-707 REV L

11/03/86

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
R3	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R4	570153	POT,1T,PC,100 OHM,1/4W	X201R101B	71450	1.0	EA
R5	510058	RES,CARB,1/4W,1.8K OHM	RC07GF182J	81349	1.0	EA
R6	560081	RES,FILM,1/4W,10K,1%	RN60C1002F	81349	1.0	EA
R7	510069	RES,CARB,1/4W,5.1K OHM	RC07GF512J	81349	1.0	EA
R8	FS5118	WIRE,BUS,AWG 24,QQ-W-343E	QQW343S24S2B	81348	1.0	IN
R9	510042	RES,CARB,1/4W,360 OHM	RC07GF361J	81349	1.0	EA
R10	510069	RES,CARB,1/4W,5.1K OHM	RC07GF512J	81349	1.0	EA
R11	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R12	560567	RES,FILM,1/4W,32.4K,1%	RN60D3242F	81349	1.0	EA
R13	560020	RES,FILM,1/4W,1K,1%	RN60D1001F	81349	1.0	EA
R14	570153	POT,1T,PC,100 OHM,1/4W	X201R101B	71450	1.0	EA
R15	560020	RES,FILM,1/4W,1K,1%	RN60D1001F	81349	1.0	EA
R16	560567	RES,FILM,1/4W,32.4K,1%	RN60D3242F	81349	1.0	EA
R17	510069	RES,CARB,1/4W,5.1K OHM	RC07GF512J	81349	1.0	EA
R18	510058	RES,CARB,1/4W,1.8K OHM	RC07GF182J	81349	1.0	EA
R19	510069	RES,CARB,1/4W,5.1K OHM	RC07GF512J	81349	1.0	EA
R20	510045	RES,CARB,1/4W,470 OHM	RC07GF471J	81349	1.0	EA
R21	510045	RES,CARB,1/4W,470 OHM	RC07GF471J	81349	1.0	EA
R22	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R23	510063	RES,CARB,1/4W,3.0K OHM	RC07GF302J	81349	1.0	EA
R24	510064	RES,CARB,1/4W,3.3K OHM	RC07GF332J	81349	1.0	EA
R25	510059	RES,CARB,1/4W,2.0K OHM	RC07GF202J	81349	1.0	EA
R26	530068	RES,CARB,1W,47 OHM	RC32GF470J	81349	1.0	EA
R27	530068	RES,CARB,1W,47 OHM	RC32GF470J	81349	1.0	EA
R28	510050	RES,CARB,1/4W,750 OHM	RC07GF751J	81349	1.0	EA
R29	510057	RES,CARB,1/4W,1.5K OHM	RC07GF152J	81349	1.0	EA
R30	FS5118	WIRE,BUS,AWG 24,QQ-W-343E	QQW343S24S2B	81348	1.0	IN
R31	510082	RES,CARB,1/4W,18K OHM	RC07GF183J	81349	1.0	EA
R32	510005	RES,CARB,1/4W,10 OHM	RC07GF100J	81349	1.0	EA
R33	510078	RES,CARB,1/4W,12K OHM	RC07GF123J	81349	1.0	EA
R34	510078	RES,CARB,1/4W,12K OHM	RC07GF123J	81349	1.0	EA
R35	510017	RES,CARB,1/4W,33 OHM	RC07GF330J	81349	1.0	EA
R36	510011	RES,CARB,1/4W,18 OHM	RC07GF180J	81349	1.0	EA
R37	510011	RES,CARB,1/4W,18 OHM	RC07GF180J	81349	1.0	EA
R38	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R39	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R40	570153	POT,1T,PC,100 OHM,1/4W	X201R101B	71450	1.0	EA
R41	510011	RES,CARB,1/4W,18 OHM	RC07GF180J	81349	1.0	EA
R42	510011	RES,CARB,1/4W,18 OHM	RC07GF180J	81349	1.0	EA
R43	570153	POT,1T,PC,100 OHM,1/4W	X201R101B	71450	1.0	EA
R44	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R45	520117	RES,CARB,1/2W,12 OHM	RC20GF120J	81349	1.0	EA
R46	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R47	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R48	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R49	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA

PARENT ITEM NO.
)50-707-1

PC ASSY,AMPLIFIER
ENGR DRAW NO. 4050-707 REV L

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
R50	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R51	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R52	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R53	550143	RES,PWR,7W,.5 OHM,3%	RS-7-.5 OHM	91637	1.0	EA
R54	570156	POT,1T,PC,5K,1/4W	X201R502B	71450	1.0	EA
R55	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R56	560435	RES,FILM,1/4W,124K,1%	RN60C1243F	81349	1.0	EA
R57	510068	RES,CARB,1/4W,4.7K OHM	RC07GF472J	81349	1.0	EA
R58	560539	RES,FILM,1/4W,249K,1%	RN60C2493F	81349	1.0	EA
R59	510075	RES,CARB,1/4W,9.1K OHM	RC07GF912J	81349	1.0	EA
R60	550023	RES,PWR,3-1/4W,68 OHM,5%	4385	44655	1.0	EA
R61	550023	RES,PWR,3-1/4W,68 OHM,5%	4385	44655	1.0	EA
TB1	241123	TERMINAL BLK,12TERM, 5A	410-Y-12	75382	1.0	EA
T1	710130	TRANSFORMER	T31X	81095	1.0	EA
2	160179	PWB,AMPLIFIER	4050-757-1	16067	1.0	EA
5	250146	TERMINAL,TURRET,SOLID	1299B-1	88245	2.0	EA
147	210451	INSULATOR,MOUNT,HEATSINK	4050-226-1	16067	3.0	EA
148	210453	WIND TUNNEL,HEATSINK	4050-228-7	16067	1.0	EA
149	210454	HEATSINK	4050-229-7	16067	1.0	EA
150	210455	GUIDE,PWB	4050-230-7	16067	2.0	EA
158	110167	BRACKET,ANGLE	129515	73734	3.0	EA
160	FS4001	THERMAL COMPOUND	351	13103	.1	OZ
163	FS1011	SCREW,PNH,S/S,4-40X1/4	MS51957-13	96906	13.0	EA
164	FS1018	SCREW,PNH,S/S,4-40X1/2	MS51957-17	96906	2.0	EA
165	FS1020	SCREW,PNH,S/S,4-40X5/8	MS51957-18	96906	10.0	EA
166	FS1014	SCREW,FLH,S/S,4-40X1/4	MS24693-C2	96906	12.0	EA
168	FS1034	SCREW,PNH,S/S,6-32X5/8	MS51957-31	96906	4.0	EA
171	FS1076	WASHER,EXTER,S/S,#4	MS35335-57	81349	2.0	EA
172	FS1068	WASHER,INTER,S/S,#4	MS35333-70	81349	25.0	EA
173	FS1069	WASHER,INTER,S/S,#6	MS35333-71	96906	4.0	EA
175	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	4.0	EA
176	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	7.0	EA
177	FS5124	WIRE,BUS,AWG 12,QQ-W-343E	QQW343S12S2B	81348	8.0	IN
178	FS6014	TUBING,TEFLON,AWG 12	TFT-200-12-NAT.	92194	8.0	IN
179	FS5120	WIRE,BUS,AWG 20,QQ-W-343E	QQW343S20S2B	81348	2.0	IN
180	FS6010	TUBING,TEFLON,AWG 20	TFT-200-20-NAT.	92194	2.0	IN

PARENT ITEM NO.
4050-708-1

HEATSINK ASSY,OUT DRIVER
ENGR DRAW NO. 4050-708 REV C1

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310221	DIODE,RECT,40A,400V,DO5	1N1188A	07716	1.0	EA
Q1	330222	TRANSISTOR,PWR,PNP,TO202	MPS-U56	04713	1.0	EA
Q2	330173	TRANSISTOR,PWR,NPN,TO3	61491 (2N3772)	86684	1.0	EA
Q3	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q4	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q5	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q6	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q7	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q8	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
Q9	330226	TRANSISTOR,PWR,NPN,TO3	62287 (2N6258)	86684	1.0	EA
R1	520006	RES,CARB,1/2W,10.0 OHM	RC20GF100J	81349	1.0	EA
R2	550010	RES,PWR,3W,.5 OHM,3%	RS-2B-.5 OHM	91637	1.0	EA
R3	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R4	520117	RES,CARB,1/2W,12 OHM	RC20GF120J	81349	1.0	EA
R5	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R6	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R7	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R8	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R9	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R10	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
R11	550104	RES,PWR,7W,.1 OHM,5%	RS-7-.1 OHM	91637	1.0	EA
2	160180	PWB,HEATSINK,OUT DRIVER	4050-708-7	16067	1.0	EA
33	210451	INSULATOR,MOUNT,HEATSINK	4050-226-1	16067	2.0	EA
34	210458	INSULATOR,MOUNT,HEATSINK	4050-226-2	16067	1.0	EA
35	210452	WIND TUNNEL,HEATSINK	4050-227-1	16067	1.0	EA
36	210454	HEATSINK	4050-229-7	16067	1.0	EA
39	FS4001	THERMAL COMPOUND	351	13103	.1	OZ
40	330192	INSULATOR,MICA,TO3	DM123	08289	1.0	EA
41	210076	INSULATOR,SHLDR,NYL,#4	NY04-040	08289	1.0	EA
42	FS3005	CABLE CLAMP,5/16"ID	CLE-5/16	51705	1.0	EA
44	FS1006	SCREW,PNH,S/S,4-40X5/16	MS51957-14	96906	8.0	EA
45	FS1020	SCREW,PNH,S/S,4-40X5/8	MS51957-18	96906	8.0	EA
47	FS1014	SCREW,FLH,S/S,4-40X1/4	MS24693-C2	96906	12.0	EA
49	FS1028	SCREW,PNH,S/S,6-32X5/16	MS51957-27	81349	1.0	EA
52	FS1068	WASHER,INTER,S/S,#4	MS35333-70	81349	15.0	EA
53	FS1076	WASHER,EXTER,S/S,#4	MS35335-57	81349	2.0	EA
54	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	1.0	EA
55	FS1069	WASHER,INTER,S/S,#6	MS35333-71	96906	1.0	EA
56	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	2.0	EA
57	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	1.0	EA
59	FS5124	WIRE,BUS,AWG 12,QQ-W-343E	QQW343S12S2B	81348	2.0	IN
60	FS6014	TUBING,TEFLON,AWG 12	TFT-200-12-NAT.	92194	2.0	IN
63	FS2003	LUG,RING,CRIMP,8-10	R3031BF	14726	2.0	EA