



June 1988

Rev R

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P/N 4010-960

## INSTRUCTION MANUAL

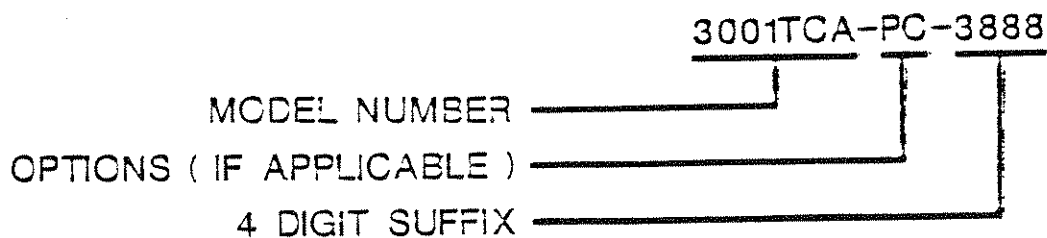
MODEL 101T

# Invertron<sup>®</sup>

### NOTE:

ASSEMBLIES, SCHEMATICS AND PARTS LISTS MAY DIFFER FROM THIS MANUAL IF MODEL NUMBER HAS A 3 OR 4 DIGIT SUFFIX. SEE SERIAL NUMBER TAG FOR PROPER IDENTIFICATION.

#### EXAMPLE



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None	C4010-900	OUTLINE DRAWING
None	E4010-400	FINAL ASSEMBLY
A1	D4010-700	AMPLIFIER AND HEATSINK ASSY
A2	D4010-701	HEATSINK ASSEMBLY
A1 and A2	E4010-070	SCHEMATIC

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# SPECIFICATIONS

## MODEL 101T AC POWER SOURCE

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

POWER OUTPUT:	100 VA at 105 to 135 volts rms output from unity to $\pm 0.7$ power factor. See derating chart for operation at other output voltages and/or power factor.
*OUTPUT VOLTAGE RANGE:	0 to 135 volts rms.
TOTAL HARMONIC DISTORTION:	Less than 0.30% distortion from 200 Hz to 1 KHz; less than 0.5% distortion from 45 Hz to 10 KHz.
AMPLITUDE STABILITY: (after one hour warm-up)	$\pm 0.25\%$ for 24 hours at constant line, load and ambient temperature conditions.
LOAD REGULATION:	$\pm 1\%$ over the range from 45 Hz to 5 KHz and $\pm 2\%$ over the range from 45 Hz to 10 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:	$\pm 0.25\%$ of full output for a $\pm 10\%$ line change.
**FULL POWER FREQUENCY RANGE:	45 Hz to 10 KHz.
FREQUENCY RESPONSE:	$\pm 0.5$ dB from 45 Hz to 10 KHz.
AC NOISE LEVEL:	80 dB below full output when tested with a shorted input; 70 dB below full output when tested 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.

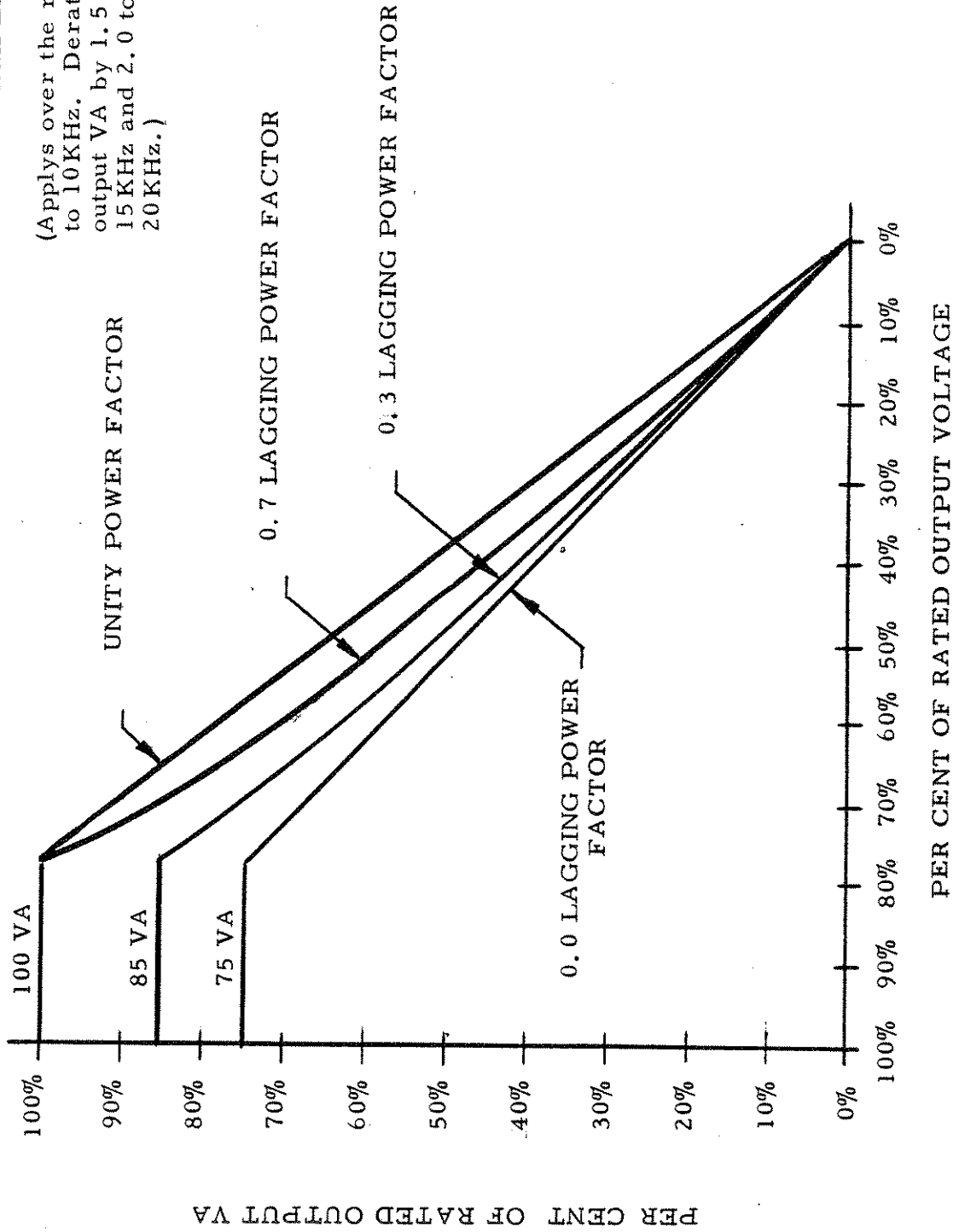
\*Other output voltage ranges available on special order, consult factory.

\*\*This power source may be used over the 20Hz to 20KHz 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:	400 watts maximum under worst case line and full rated load conditions.
OPERATING TEMPERATURE RANGE:	0 to 55°C.
FRONT PANEL METER:	0 to 160 volt AC voltmeter provides $\pm 1\%$ of full scale accuracy at 400Hz and $\pm 3\%$ of full scale accuracy over the range from 45Hz to 10KHz.
DIMENSIONS:	3 1/2" high x 19" wide x 17.5" deep.
NET WEIGHT:	40 lbs.
SHIPPING WEIGHT:	45 lbs.
FRONT PANEL FINISH:	Grey, 26440 per Federal Standard 595 with black silk-screened lettering.

DERATING CHART  
FOR 101T  
POWER AMPLIFIER

(Applies over the range from 45 Hz to 10 KHz. Derate the curve for output VA by 1.5 to 1.0 factor at 15 KHz and 2.0 to 1.0 factor at 20 KHz.)



## GENERAL DESCRIPTION

### 1.1 INTRODUCTION

This instruction manual contains information on the installation, operation, calibration and maintenance of the California Instruments Model 101T 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 101T Power Amplifier is a solid state, high performance, low distortion power source that provides up to 100 VA output when used with the proper California Instruments Oscillator. The Model 101T Power Source is illustrated in Figure 1-1. Full power output is available from 105 volts to 135 volts rms and from 45 Hz to 10 KHz.

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 200 VA two-phase power, or 200 VA of three-phase power in the open delta configuration. Three power amplifiers will provide 300 VA of three-phase power in the wye configuration.

### 1.3 ACCESSORY EQUIPMENT

The following accessories are available for use with the California Instruments Model 101T Power Source.

- 1.3.1 Zero Manufacturing Company Model C300S-18 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-1-1 $\phi$ , two-phase oscillators are designated as 800T-20/20K-1-2 $\phi$  and three-phase oscillators are designated as 800-20/20K-3 $\phi$ .
- 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.-.1-1 $\phi$ , two-phase oscillators are designated as 815T-Freq.-.1.2 $\phi$  and three-phase oscillators are designated as 815T-Freq.-.1-3 $\phi$ . Frequency accuracy is  $\pm 0.1$  percent at 25°C. Amplitude stability is 1.25 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.

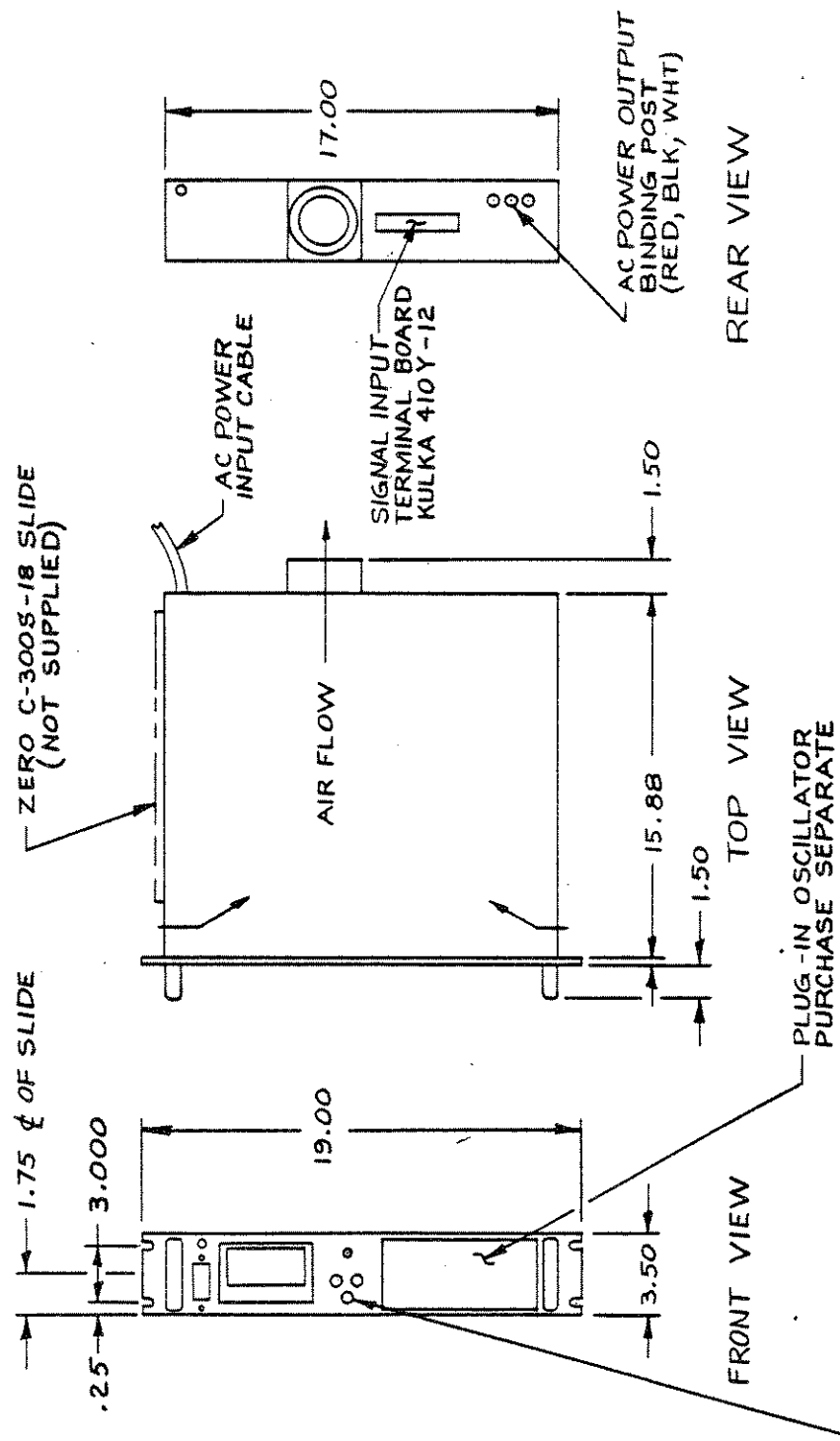


- 1.3.4 Series 835T Programmable Oscillators. These oscillators provide control of voltage amplitude, frequency, and phase angle in multiphase applications. Programming by either parallel BCD or IEEE-488 (1978) is available. These units are packaged in a separate 3.5 inch rack mountable chassis.
- 1.3.5 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  $\pm 0.005\%$  of set frequency. Amplitude stability is 0.02% per 24 hours 23°C,  $\pm 0.01\%$  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.

4 3 2

REVISIONS			
REV	AUTH	DESCRIPTION	ZONE

D C B A



C4010-900

ITEM NO.	PART NUMBER	PART NAME	MATERIAL - SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

**OUTLINE DRAWING  
100 VA AMPLIFIER**

MODEL	101-T
RELEASE	1/2/50
CHECKER	[Signature]
DESIGN	1/2/50
PROJ ENGR	[Signature]
PURCHASING	[Signature]
DATE	2/16/50

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

NOTES: (UNLESS OTHERWISE SPECIFIED)

CALIFORNIA INSTRUMENTS CORP.  
SAN DIEGO, CALIFORNIA  
CONTRACT NO. C4010-900  
DWG NO. 16067  
SCALE 1/4" = 1"

SHEET 1 OF 1

# **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 101T 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 101T Power Source has been designated 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.	5 ampere
208 volts rms	190-226 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 4.	3 ampere
220 volts rms	201-239 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 5.	3 ampere
230 volts rms	210-250 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 6.	3 ampere
240 volts rms	219-261 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 7.	3 ampere

- 2.2.2 The Model 101T has been designated 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 100 VA output, is between 250 and 400 watts depending on line and load conditions. During "turn-on" the peak transient will generally exceed 1000 watts.

### 2.3 CIRCUIT BREAKER REQUIREMENTS

The Model 101T Power Source uses a 5 ampere Heinemann AM12-5A curve 5 circuit breaker for operation from the 115 volt AC line. A Heinemann AM12-3A curve 5 circuit breaker is used for operation from the 208 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 AND METER RANGE

The Model 101T Power Source has a single output voltage range from 0 to 135 volts rms. The full scale front panel voltmeter range is 160 volts rms. The Model 101T is available with other output voltage ranges on special order.

### 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 2.2.1 of this instruction manual). Connect a 1 KW Variac and a 1.0 KW watt-meter in series with the AC line. The Model 101T Power Source should draw less than 60 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 10 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 12 pin 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 The output voltage range is given in Section 2.4 of this instruction manual. The following table lists the proper external load for full power output.

Output Voltage Range	Output Voltage	Full Power Load Resistance	50 Per Cent Power Load Resistance
0-135 volts rms	135 volts rms	182 ohms	364 ohms

- 2.5.4 Connect 182 ohm, 100 watt load resistor to the red and white binding posts on the rear of the power source. Connect a Tektronix Model 533A Oscilloscope or equivalent across this load resistor.
- 2.5.5 Using the GAIN control and the front panel METER, set the output voltage of the power source to 135 volts rms. The power line wattmeter should read between 200 and 300 watts at mid-line voltage. 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 the 364 ohm resistor in parallel with the external load resistor to provide a 50 per cent overload on the output of the power source. 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 long period of time.
- 2.5.9 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 101T 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 Manufacturing type C300S-18 or equivalent).

The cooling fan on the rear of the unit must be free of any obstructions which would interfere with the flow of air. A 1.5 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 of the power source must not be obstructed.

2.7 INPUT POWER WIRING

The Model 101T 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 10 amperes or greater. If 200 to 260 volt AC lines are used, their capacity should be 5 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 100 VA output at a distance of 20 feet from the power source to the load.

<u>Output Voltage</u>	<u>Maximum Line Drop</u>	<u>Load Current</u>	<u>Loop Length</u>	<u>Minimum Required Wire Size</u>
115 volts	1.15 volts	0.87 amperes	40 ft.	#25

The wire size should be reduced 3 sizes every time 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 101T Power Source, is used to switch the POWER to the unit "on." At this time the amber indicator lamp located above this circuit breaker 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 METER has a range of 0 to 160 volts AC and is used to read the value of the AC output voltage for normal applications of the power source.

CAUTION

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 10 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 Output Voltage on 0 to 135 Volt Range.	Maximum VA Output at Maximum Safe Output Voltage with $\pm 0.7$ Power Factor Load.
20 Hz	60 volts rms	52 VA
30 Hz	90 volts rms	85 VA
40 Hz	120 volts rms	100 VA
45 Hz to 10 KHz	135 volts rms	100 VA
15 KHz	90 volts rms	57 VA
20 KHz	67.5 volts rms	30 VA



## THEORY OF OPERATION

### 3.1 GENERAL

The California Instruments Model 101T Power Source is an all silicon solid state 100 VA amplifier and, with companion oscillator, is designed to provide reliable sine wave AC power over the frequency range from 45 Hz to 10 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 a floating secondary winding which allows 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 overall negative feedback is taken from the negative feedback winding on the output transformer back to one input of the pre-amplifier and provides a closed loop gain of 20 from the high side of A1R7 to the primary of T2.

The positive 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 divider network containing the regulation control A1R3. As this positive feedback is increased from zero with potentiometer A1R3, 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 101T Power Source is shown in drawing E4010-070. The large printed circuit board is designated as the A1 assembly and contains the circuitry for the preamplifier and power amplifier section of the power source. For information on the plug-in oscillator, consult the applicable oscillator manual. These drawings give typical voltage levels and waveforms for the various sections of the power source.

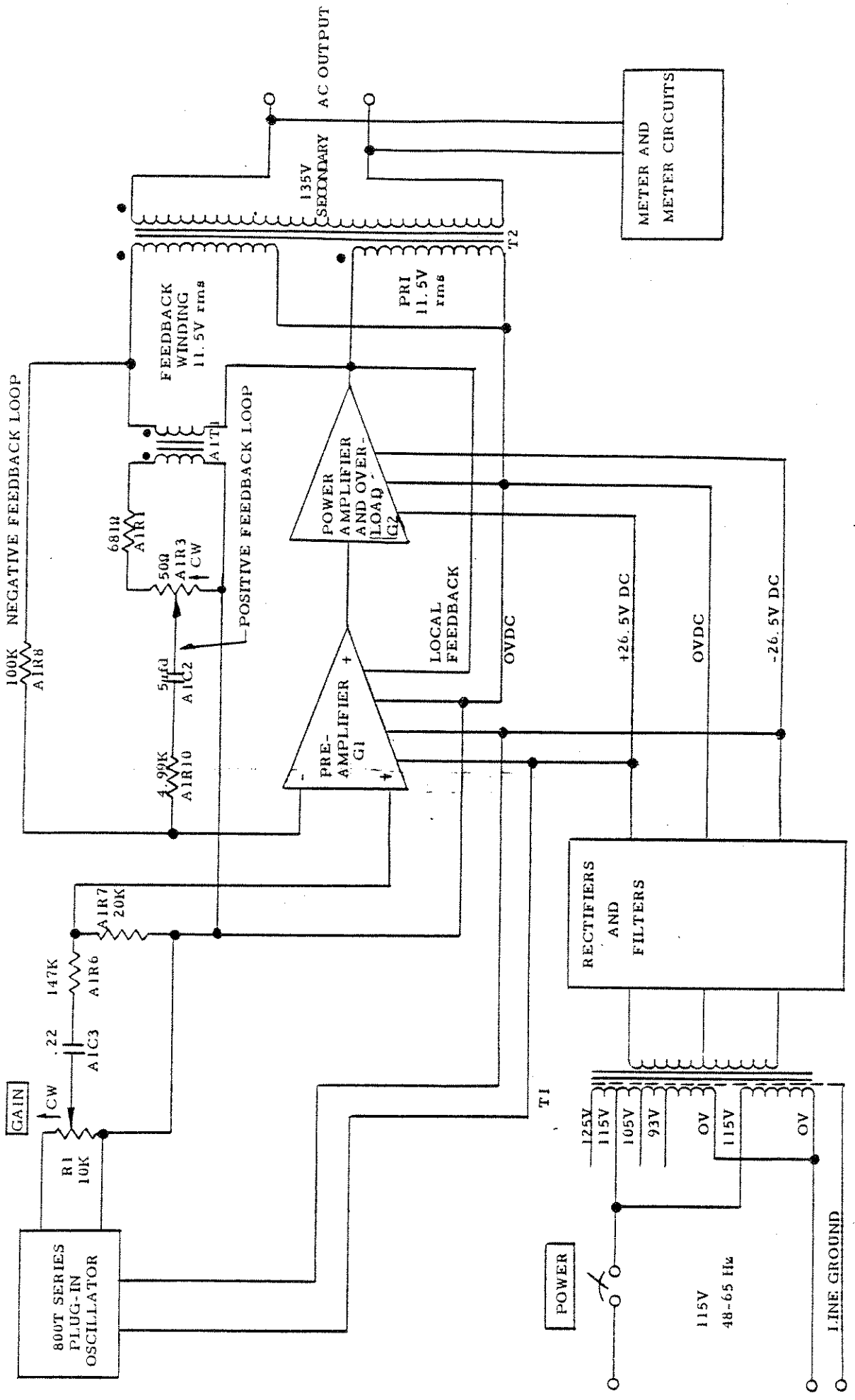


FIGURE 3-1. BLOCK DIAGRAM OF MODEL 101T POWER SOURCE

### 3.2.1 PRE-AMPLIFIER

The pre-amplifier G1 is a part of the A1 assembly and consists of transistors A1Q1 through A1Q6 and associated components connected as a direct coupled differential amplifier. The open loop gain of this pre-amplifier is approximately 30 at 400 Hz and rolls off at 6 dB per octave above 30 KHz.

Transistor A1Q1 is a dual field effect transistor used in the differential source follower configuration to provide a high input impedance and a gain of approximately 1.0. Potentiometer A1R14 is used to adjust the DC bias at the primary of T2 to zero volts with no signal.

Transistor A1Q2 is a dual transistor used in a differential configuration and provides a gain of approximately 15 at 400 Hz. Capacitor A1C7 and resistor A1R24 provide a high frequency step roll off from 30 KHz to 300 KHz.

Transistor A1Q3 and associated components are connected as a constant current source which provides the emitter current for A1Q2. This current source is designed to sink 2 milliamperes from the junction of A1R17 and A1R18 to the -15 volt supply.

Transistors A1Q4, A1Q5 are used in the differential amplifier configuration and provide an open loop gain of 2 at 400 Hz.

Transistor A1Q6 and associated components are connected as a constant current source which provides 6 milliamperes to the junction of A1R23 and A1R25.

### 3.2.2 POWER AMPLIFIER

The power amplifier G2 mechanically consist of the remainder of the A1 board and the A2 assembly. Electrically, the power amplifier consist of transistors A1Q7 through A1Q11A and A2Q1 through A2Q3A and associated components.

Transistor A1Q7 and associated components are connected as a constant current source which provides 22 milliamperes to bias the output stage by means of diodes A1CR6 and A1CR7. This 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 A1Q8 and associated components are connected in the ground emitter configuration. Local negative feedback is provided by A1C10, A1C11, A1R42 and A1R43. The local feedback limits the gain of this stage to 24 at 400 Hz. The gain falls off at 6 dB per octave above 30 KHz.

The positive polarity output amplifier is contained on the A2 assembly and consist of A2Q1 through A2Q3 connected as emitter followers. These transistors supply a total of 16 amperes peak during the positive one-half cycle of the output wave form when the power source is loaded to 100 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 100 watts with less than a 35°C case temperature rise with an air flow of 10 cfm per heatsink.

The negative polarity output amplifier is contained on the A1 assembly and consist of A1Q9 through A1Q11 connected in the quasi complementary symmetry configuration. These transistors supply a total of 16 amperes peak during the negative one-half cycle of the output wave form when the power source is loaded to 100 VA output at 78 per cent of rated output voltage (worst case condition within specification limits). These negative output amplifier transistors and their associated heatsinks can dissipate over 100 watts with less than a 35°C case temperature rise with an air flow of 10 cfm per heatsink.

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 percentage of the rated output voltage. The derating chart, given in the specifications, expresses this derating in a graphical form.

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 E4010-070 and consist of zener diode A1CR13, diode A1CR6, A1CR7 and emitter resistors A2R2, A2R3, A1R48 and A1R49.

Diode A1CR13 is used in the zener mode to limit the positive voltage drive to the positive polarity output amplifier (assembly A2) during periods of overload or short circuit. This in turn, limits the output current of the positive polarity output amplifier as determined by the value of emitter resistors A2R2 and A2R3.

Diodes A1CR13 and A1CR7 are used in the normal forward biased mode to limit the negative voltage drive to A1Q9 during

periods of overload or short circuit. This, in turn, limits the collector current available from A1Q9 as determined by the value of emitter resistors A1R48 and A1R49. Since the base drive to A1Q10 and A1Q11 is limited, the corresponding collector current from A1Q10 and A1Q11 will also be limited. Resistor A1R49 is selected to provide symmetrical limiting for both the positive and the negative polarity output amplifiers.

#### 3.2.4 OVERALL NEGATIVE FEEDBACK

The overall negative feedback loop is a single-ended potentiometric feedback loop taken from the negative feedback winding of T2 back to the gate of A1Q1B. The feedback network consists of A1R8, A1R9, A1R10, A1C2 and A1C4 and limits the mid-band closed loop voltage gain of the amplifier to 20 from the gate of A1Q1A to the primary of T2.

This overall feedback loop provides approximately 30 dB of negative feedback over the range from 45 Hz to 20 KHz. The feedback rolls off at approximately 9 dB per octave for frequencies greater than 20 KHz. 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 primary winding of T2 back to the gate of A1Q1B through A1R11 and A1R12. This loop limits the closed loop voltage gain of the amplifier to 1.6 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 feedback voltage 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 gate of A1Q1B through a divider network consisting of A1R1, A1R2, A1R3, A1R10, A1C1 and A1C2. Potentiometer A1R3, which is accessible from the top of 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 also a part of drawing E4010-070. This power supply delivers  $\pm 26.5$  volts  $\pm 5$  per cent at 4 amperes DC with less than 2 volts peak-to-peak ripple from the 115 volt 60Hz AC line. These unregulated supplies consist of quad rectifier diode CR1 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 millampere DC and an internal resistance of approximately 100 ohms. The meter has a single scale with a range of 0 to 160 volts AC. The meter rectifiers and scaling circuitry are a part of the A1 assembly. This meter circuitry consist of rectifier diodes A1CR8 through A1CR11, potentiometer A1R39, and resistors A1R38, A1R47 and A1R52. The four rectifier diodes are connected so as to form a full wave bridge rectifier. Potentiometer A1R39 is used to shunt a small portion of the meter current and thereby provide a full scale sensitivity adjustment.

## WARNING

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 101T Power Source remains within specified tolerance. 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 Distortion
- 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.

Table 4-1 below illustrates the measurement voltage and impedance level when evaluating the output of the power source.

Rated Output Voltage	135V AC
78% of Rated Output Voltage	105V AC
Resistive Load for 100 VA Output at Rated Output Voltage	182 $\Omega$
Resistive Load for 100 VA Output at 78% of Rated Output Voltage	110 $\Omega$

Section 2.8 indicates some potential problems associated with output wiring IR drop. 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 the large binding posts at the rear of the power source.

#### 4.2 TEST EQUIPMENT REQUIRED

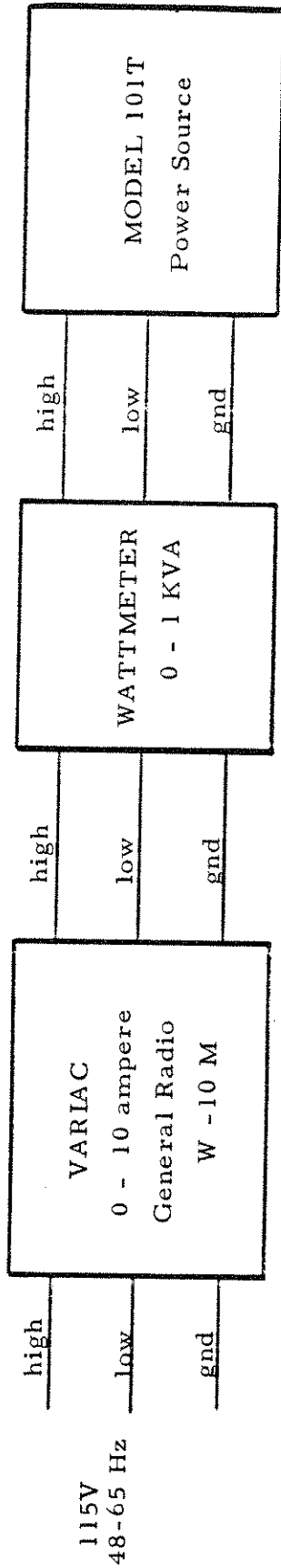
The following test equipment is required to perform the calibration procedure assuming that the input line voltage has a nominal value of 115 volts rms. Some equipment substitutions will be required if this is not the case.

- a) Oscilloscope, Tektronix 533A with "W" plug-in
- b) 1.0KVA Variac, General Radio W10M or equivalent
- c) 1.0 KVA Wattmeter, Simpson Electric or equivalent
- d) Distortion Analyser, H. P. 330B or equivalent
- e) Differential Voltmeter, Fluke 883A or equivalent
- f) Multi-range 100 watt load box, or individual 100 watt power resistors, as defined in Table 4-1. Dale type NHL or equivalent
- g) Expanded Scale (about 115 VAC) strip chart recorder, Voltron Model 89.038 or equivalent
- h) Multimeter, Simpson 260 equivalent

#### 4.3 INITIAL ADJUSTMENTS

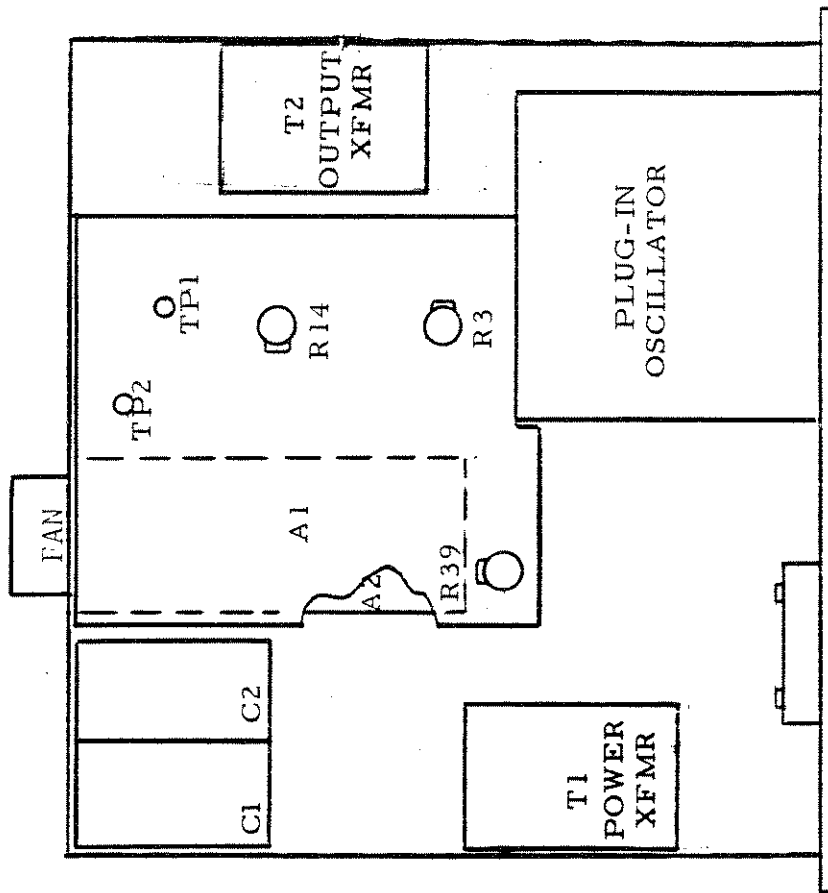
- 4.3.1 Connect the Model 101T Power Source as shown in Figure 4-1. Turn the GAIN control fully counter-clockwise. Adjust the line voltage to its nominal value with the variac. Turn the POWER switch "on." The wattmeter should indicate 60 watts or less at nominal line voltage. If a problem is encountered, perform step 4.3.2 below.
- 4.3.2 Remove the top cover 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  $\pm$ 5 millivolts.
- 4.3.3 Connect the differential voltmeter to the power output terminals at the rear of the unit. Adjust the GAIN control for a 135 volt output with the oscillator set to 400 Hz. Adjust the meter calibration control A1R39 so that the front panel meter and the differential voltmeter correlate within one per cent of each other. Vary the frequency from 45 Hz to 10 KHz and check that the front panel meter reads within  $\pm$ 3 per cent of the correct value.





See Table 2-1 for AC line input wiring to the Model 101T 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 101T Power Source.



TOP VIEW

FIGURE 4-2. INTERNAL ADJUSTMENTS FOR MODEL 101T POWER SOURCE

#### 4.4 AC LINE INPUT POWER and OVERLOAD ADJUSTMENT

- 4.4.1 Connect the Model 101T Power Source as shown in Figure 4-3. Adjust the output voltage of the power source to 105 volts rms (78 per cent of rated output voltage) at 400 Hz. Close switch S2 (110 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 45 Hz to 10 KHz 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. Select zener diode A1CR13 so that no clipping or excessive distortion occurs on the positive peak of the output wave form under worst case conditions outlined above. Select resistor A1R49 so that no clipping or excessive distortion occurs on the negative peak of the output wave form under worst case conditions outlined above.
- 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 400 Hz. The AC line wattmeter should indicate less than 400 watts.
- 4.4.3 Repeat step 4.4.2 except open switch S2 (no load on output of power source). The AC line wattmeter should indicate less than 100 watts with a line voltage of 125 volts rms.

#### 4.5 VOLTAGE, POWER OUTPUT and HARMONIC DISTORTION

- 4.5.1 Connect the Model 101T Power Source as shown in Figure 4-3. 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 400 Hz 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 182 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 45 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 0.50 per cent over the full line voltage range.
- 4.5.4 Set the oscillator output to 1 KHz 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 0.30 per cent over the full line voltage range.

- 4.5.5 Set the oscillator output to 10 KHz 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 0.50 per cent over the full line voltage range.
- 4.5.6 Repeat steps 4.5.1 through 4.5.5 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 0.30 per cent from 200 Hz to 1 KHz, and less than 0.50 per cent from 45 Hz to 10 KHz.

#### 4.6 LINE REGULATION

- 4.6.1 Connect the Model 101T Power Source as shown in Figure 4-3. Set the oscillator frequency to 400 Hz. Close switch S1 (182 ohm load) and adjust the output of the power amplifier to 135 volts rms (100 per cent of rated output voltage) at 400 Hz.
- 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 .68 volts rms.
- 4.6.3 Set the frequency of the oscillator to 45 Hz and repeat 4.6.1 and 4.6.2. The change in the output voltage should be less than .68 volts rms.
- 4.6.4 Set the frequency of the oscillator to 10 KHz and close switch S1. Repeat step 4.6.2. The change in output voltage should be less than .68 volts rms.

#### 4.7 LOAD REGULATION ADJUSTMENT

The load regulation adjustment is accessible after the top cover of the Model 101T Power Source has been removed. This adjustment is usually set for zero regulation at 400 Hz.

- 4.7.1 Connect the Model 101T Power Source as shown in Figure 4-3. Check that the load is connected to the large red and white binding posts 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 101T Power Source to 105 V rms output (or 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 A1R3 so that the output voltage variation is less than 100 millivolts as the 110 ohm load is added and removed. Maintain the line voltage at 115 volts during this test.

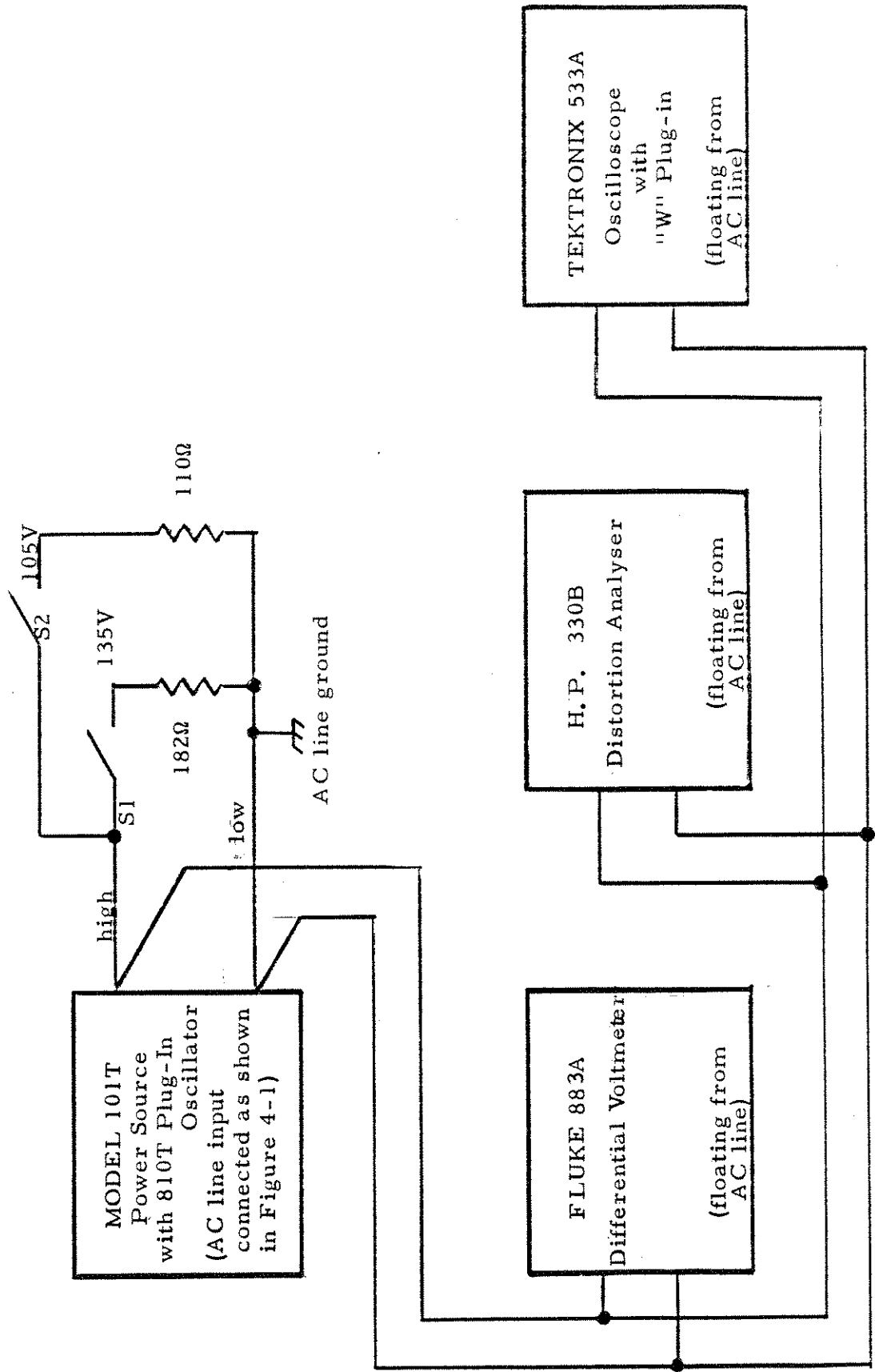


FIGURE 4-3. Test circuit for Model 101T Power Source

- 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  $\pm 1.05$  volts when loaded with the 110 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  $\pm 1.05$  volts.
- 4.7.5 Set the frequency of the oscillator to 10 KHz and repeat 4.7.3. The output of the power source should change less than  $\pm 2.10$  volts. Capacitor A1C1, in the secondary circuit of A1T1, has been set at the factory for optimum load regulation at 10 KHz and may be changed if required. Care should be taken to use non-inductive load resistors since load impedances are fairly low and a few micro henrys of inductance will significantly influence the power factor at 10 KHz.

#### NOTE

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

#### 4.8 AMPLITUDE STABILITY

- 4.8.1 Connect the Model 101T 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 132 ohm (100 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  $\pm .29$  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 at  $\pm 3$  degrees C for this test.

#### 4.9 FREQUENCY RESPONSE

- 4.9.1 Connect the Model 101T 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 45 Hz to 10 KHz 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  $\pm 8.0$  volts rms from 45 Hz to 10 KHz.

- 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  $\pm 8.0$  volts rms for 45 Hz to 10 KHz.
- 4.10 AC NOISE LEVEL
  - 4.10.1 Connect the Model 101T 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 400 Hz.
  - 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 0.093 volts (70 dB below full output). The noise and ripple output may be slightly greater if the power source is tested at an output frequency of less than 200Hz.
  - 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 101T. 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 101T.
- 4.11 0.7 LAGGING POWER FACTOR
  - 4.11.1 Connect the Model 101T Power Source as shown in Figure 4-3. Figure 4-4 illustrates the load circuit and gives load parameter values for 100 VA 0.7 power factor at 400 Hz with 78 per cent of rated output voltage from the power source. This represents the worst case inductive load for maximum power dissipation inside the power source.
  - 4.11.2 Set the oscillator frequency to 400 Hz 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 400 Hz.
  - 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 400 Hz. If the unit is to be operated at a 0.7 power factor in the high frequency region, i. e., 2KHz to 10KHz, then it may be necessary to readjust the regulation control. In this case, rotate the regulation control until zero regulation is obtained at the specific frequency and load condition.

- 4. 11. 4 The AC line input power is 400 watts maximum with an 0. 7 power factor load at 78 percent 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 to the test frequency. For example, at 1KHz, 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 101T Power Source as shown in Figure 4-3. Figure 4-5 illustrates the load circuit and gives load parameter values for 100 VA, 0. 7 power factor operation at 400Hz with 78 percent 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 400Hz and adjust the GAIN control for 78 percent 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 percent at 400Hz.
- 4. 12. 3 The regulation control usually does not require significant readjustment in order to provide zero regulation with a 0. 7 power factor load at 400Hz. If the unit is to be operated at 0. 7 power factor in the high frequency region, i. e. , 2KHz to 10KHz, then it may be necessary to readjust the regulation control until zero regulation is obtained at the specific frequency and load condition.
- 4. 12. 4 The AC line input power is 400 watts maximum with an 0. 7 power factor load at 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 400Hz, provided that the capacitance of the series capacitor is changed inversely proportional to the absolute value of the test frequency. For example, at 1KHz, the capacitance value must be divided by 2. 5. The series resistance value remains unchanged.



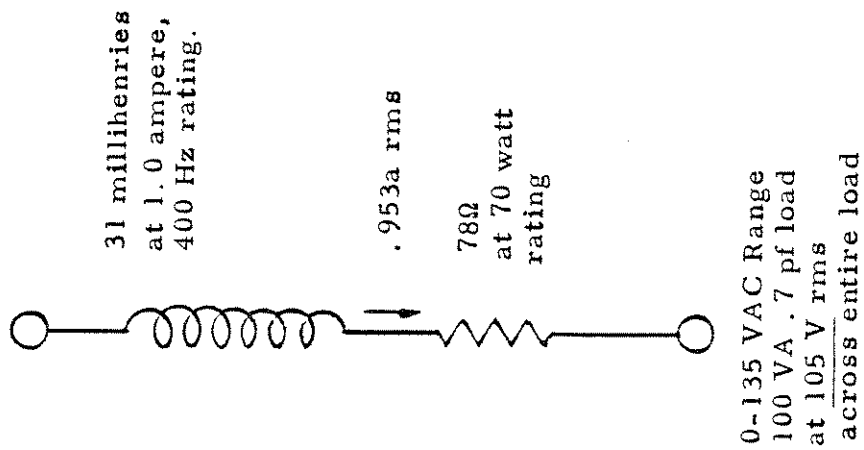


FIGURE 4-4. Circuit for 100VA, 0.7  
Lagging Power Factor Load  
at 400 Hz.

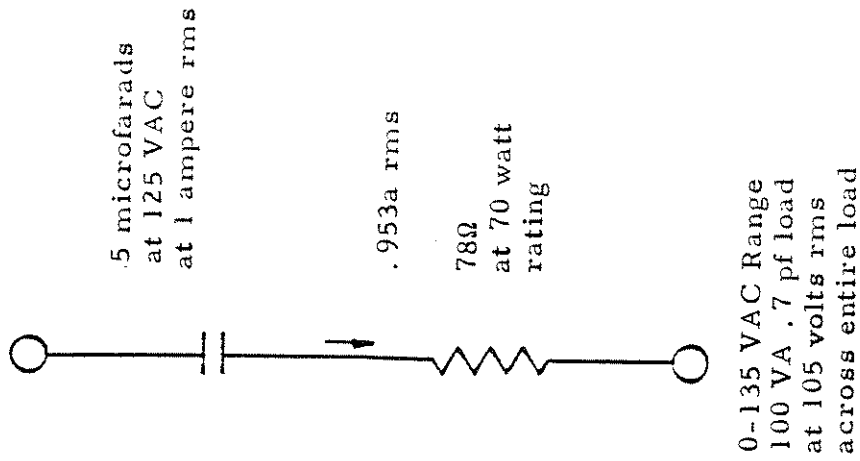


FIGURE 4-5. Circuit for 100VA, 0.7  
Leading Power Factor Load  
at 400 Hz.

## MAINTENANCE AND TROUBLESHOOTING

### 5.1 GENERAL

The California Instruments Model 101T 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 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 10 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 on the rear of the power amplifier.
- 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 A1CR13.
- 5.2.5 If the problem has been resolved to be in the oscillator, consult the applicable oscillator instruction manual.

## CIRCUIT DIAGRAM

### 6.1 GENERAL

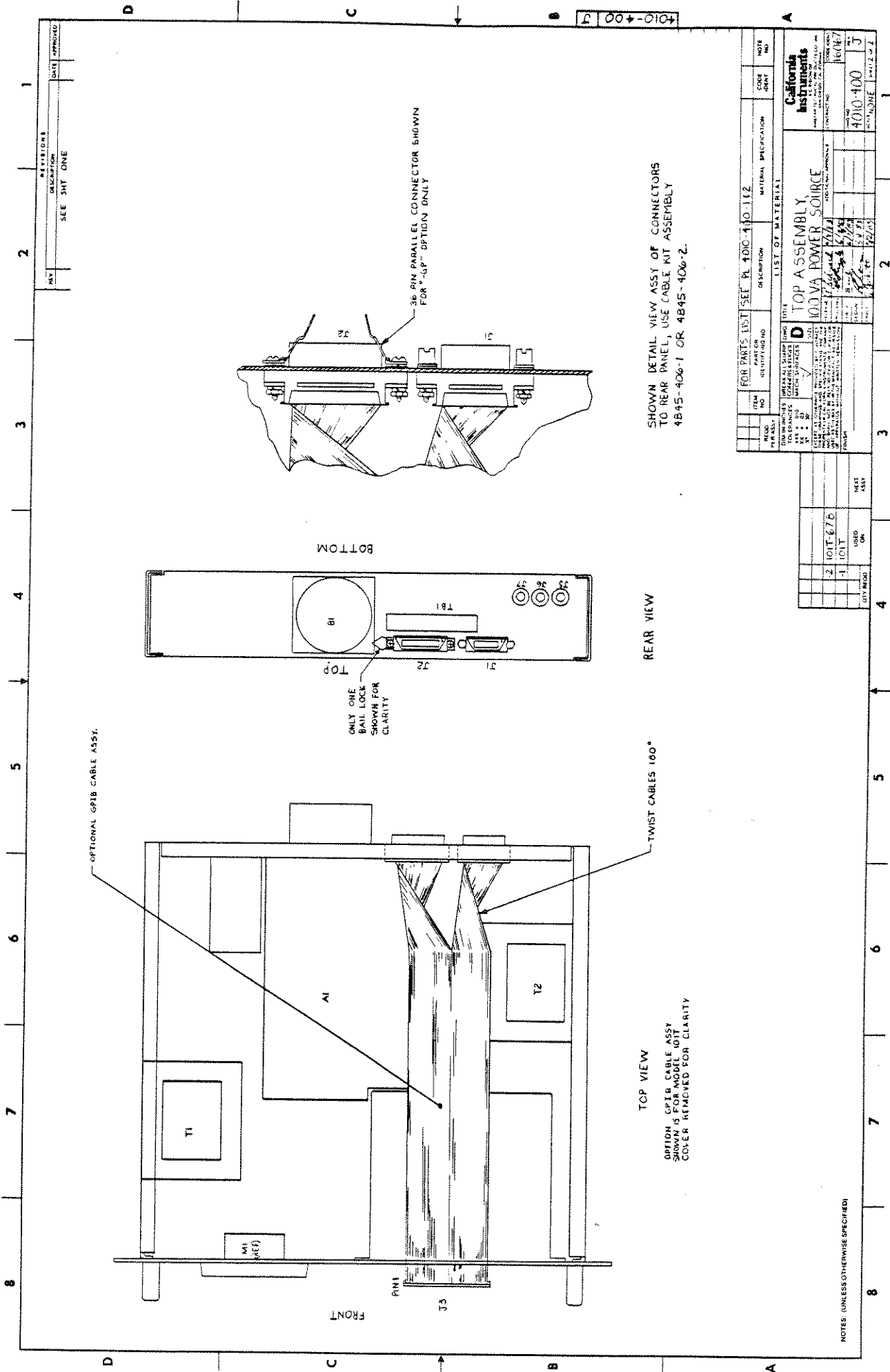
This section contains schematics and mechanical diagrams necessary for operation and maintenance of the Model 101T AC Power Source. The schematic diagrams illustrate the circuit while the mechanical assemblies indicate the part placement.

### 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	C14	A1C14
None	T1	T1
A2	R1	A2R1





SHOWN DETAIL VIEW ASSY OF CONNECTORS TO REAR PANEL, USE CABLE KIT ASSEMBLY 4B45-406-1 OR 4B45-406-2.

ITEM NO	DESCRIPTION	MATERIAL SPECIFICATION	CODE IDENT	NOTE NO
1	FOR PARTS LIST SEE PL 4010-400-112			
2	TOP A ASSEMBLY 100 VA POWER SOURCE			

REV	DESCRIPTION	DATE	APPROVED
1	SEE SHY ONE		

REV	DESCRIPTION	DATE	APPROVED
1	SEE SHY ONE		

REV	DESCRIPTION	DATE	APPROVED
1	SEE SHY ONE		

NOTES: (UNLESS OTHERWISE SPECIFIED)

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1	SEE SHY ONE		

REV	DESCRIPTION	DATE	APPROVED
1	SEE SHY ONE		

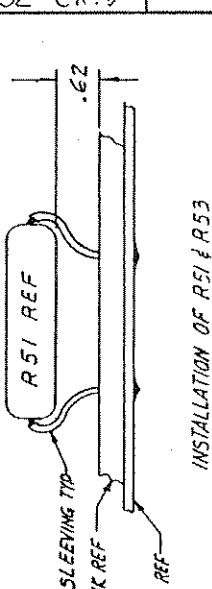
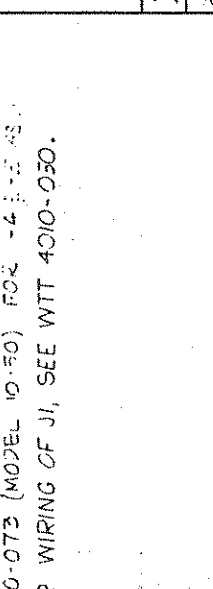
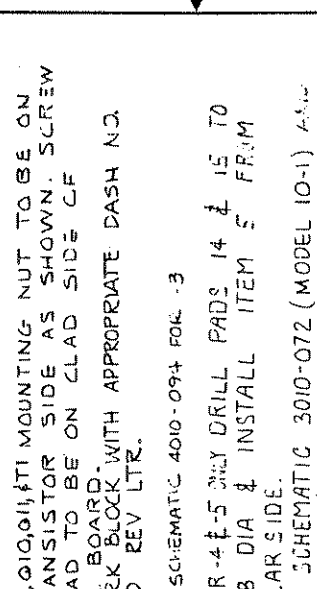
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REV	DATE	DESCRIPTION	ZONE	EFFON	DATE	APPRO
N	10/88	1088-02-0254				
P		ADDED - 4 ASSY				
R		ADDED - 5 ELO 11/16 11/87 AB				
S		ADD - 6 - 7 ASSY				
T		ADD - 8 ASSY				
U		ADD ITEM 154 DRAWING 10-700-1-2-5-6-7-8				
V		REVISED E.L.G. VALUES				
W		ADD J1				

NOTE:

- FOR SCHEMATIC DIAGRAM SEE DWG. NO. E4010-070 FOR -1 & E4016-070 FOR -2. APPLY ITEM 133 BETWEEN Q9, Q10, Q11, CR15 AND HEATSINK. USE MILA INSULATOR (ITEM 156 REF) ONLY UNDER Q9. MOUNT R48, R49, R50, R51, R53 ON HEATSINK SURFACE.
- MOUNT R27, R32, R54 1/8" OFF OF PC BOARD.
- Q9, Q10, Q11 MOUNTING NUT TO BE ON TRANSISTOR SIDE AS SHOWN. SCREW HEAD TO BE ON CLAD SIDE OF PC BOARD.
- MARK BLOCK WITH APPROPRIATE DASH NO. AND REV LTR.

- SEE SCHEMATIC 4010-094 FOR -3.
- FOR -4 & -5 ONLY DRILL PADS 14 & 15 TO .118 DIA & INSTALL ITEM 5 FROM NLR SIDE.
- SEE SCHEMATIC 3010-072 (MODEL 10-1) & 3010-073 (MODEL 10-50) FOR -4 & -5 ASSEMBLY.
- FOR WIRING OF J1, SEE WTT 4010-030.



INSTALLATION OF R51 & R53 FOR -2 & -5 ASSY ONLY FOR PL 4010-700-1, 2, 3, 4, 5, 6, 7, 8

ITEM NO.	PART NUMBER	PART NAME	MATERIAL - SPECIFICATION	CODE IDENT	FINISH	REF DES. ZONE

DWG NO.	REV	SCALE	SHEET	OF
4010-700	1	2:1	1	1

CONTRACT NO.	DATE

DATE	BY	CHKD	APP'D

DATE	BY	CHKD	APP'D

DATE	BY	CHKD	APP'D

DATE	BY	CHKD	APP'D

DATE	BY	CHKD	APP'D

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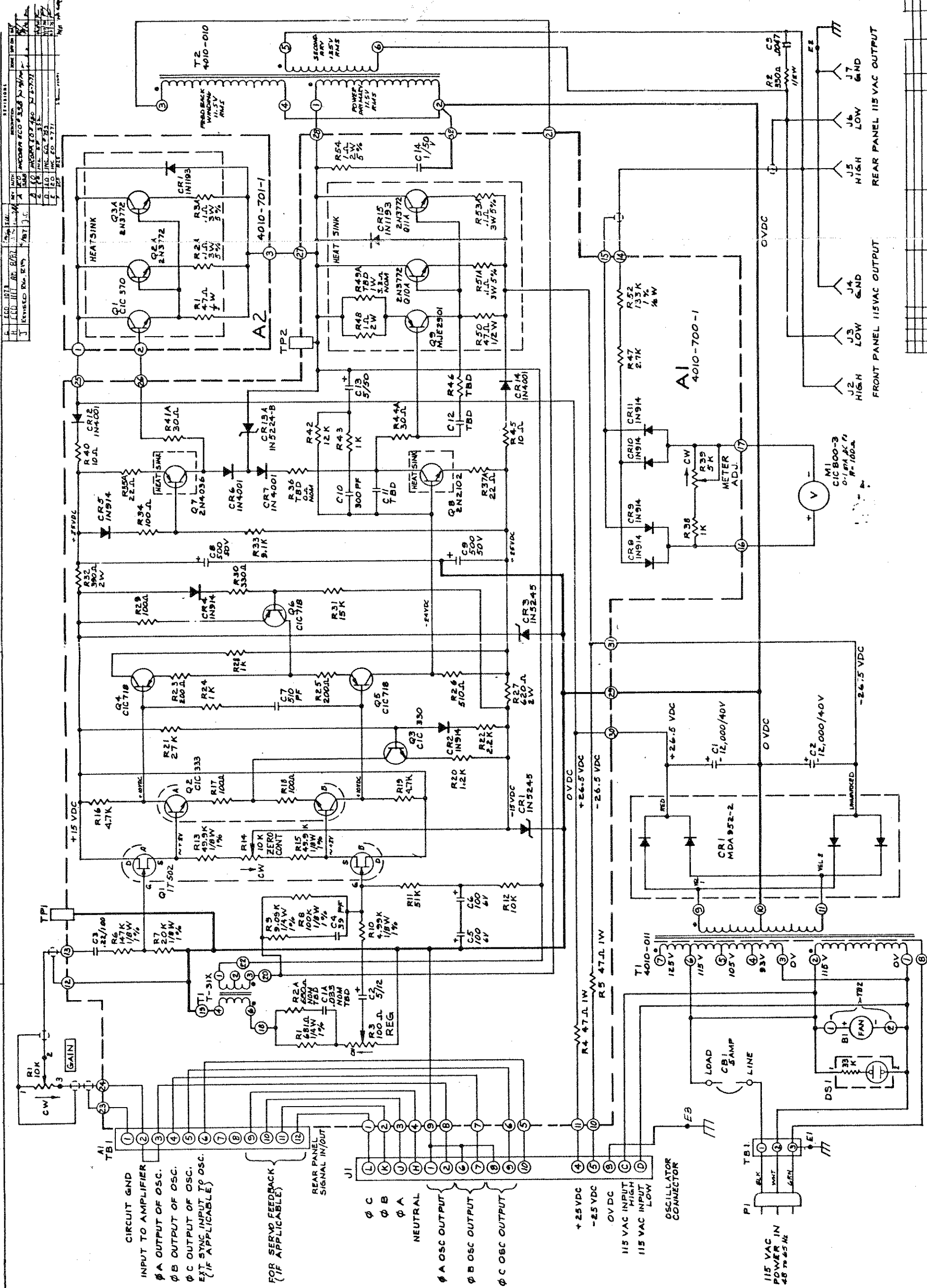
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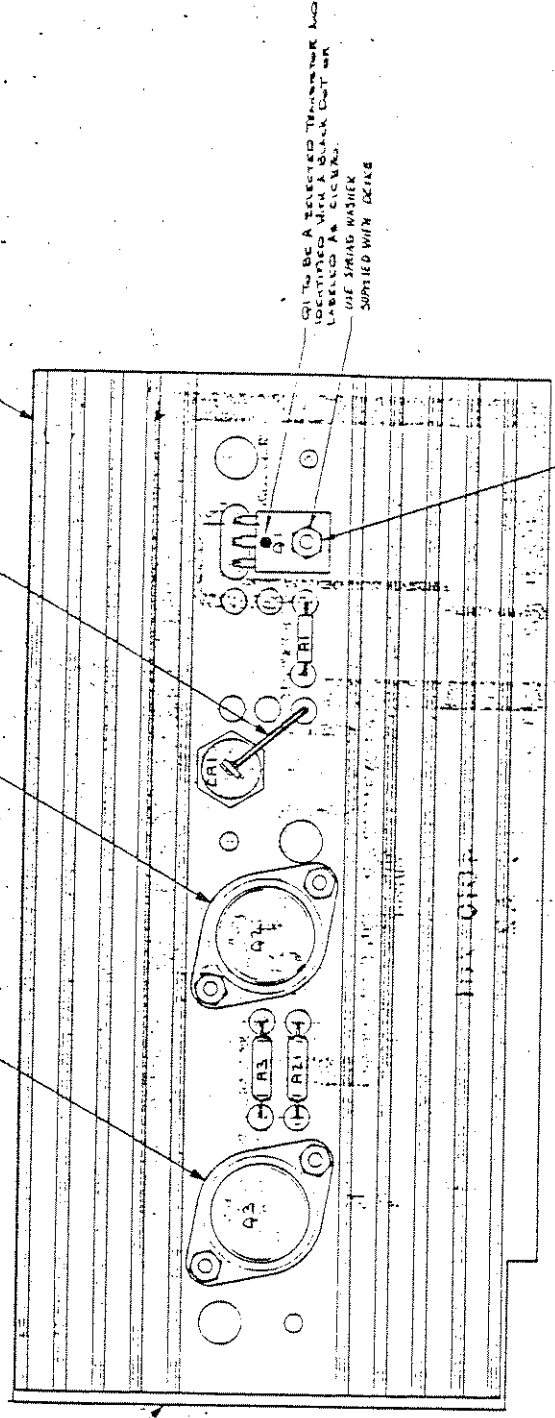
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3	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51
4	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51
5	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51
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7	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51
8	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51
9	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51
10	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51

REV.	DATE	BY	CHKD.	DESCRIPTION
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5	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51
6	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51
7	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51
8	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51
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10	10/10/51	W. J. B.		REVISED FOR REV. 10/10/51

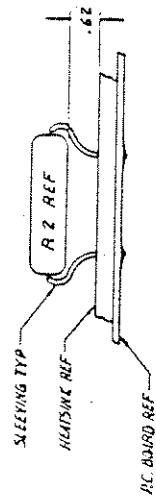
SCHEMATIC DIAGRAM  
100 VA PWR AMPL  
CALICO  
16067  
4010-070 J

- ALL TITLES SHOWN ARE LOCATED ON FRONT PANEL.
- ALL RESISTOR VALUES ARE IN OHMS, UNLESS OTHERWISE SPECIFIED.
- ALL CAPACITANCE IS IN MICROFARADS.
- FOR ASSY SEE E 4010-400.
- USE A 3 AMP CIRCUIT BREAKER WHEN PRIMARY OF T1 IS WIRED FOR OPERATION ON 208, 220, 230 OR 240 VOLTS INPUT.

REV	DESCRIPTION	DATE
1	E40 171	11-11-54
2	Added Mount for R2	1-1-55
3	Added Mount for R3	1-1-55
4	Added Mount for R4	1-1-55
5	Added Mount for R5	1-1-55



-1 PC BOARD ASSY (FOR MODEL 101T)  
 VIEW COMPONENT SIDE  
 -2 PC BOARD ASSY (FOR MODEL 1G1T)



INSTALLATION OF R2 FOR R3 FOR -2 ASSY ONLY

- 3 MOUNT R1, R2 & R3 FLUSH WITH HEATSINK.
2. APPLY ITEM 23 BETWEEN Q1, Q2, Q3, CR1 AND HEATSINK. DO NOT USE MICA WASHER.
1. FOR SCHEMATIC DIAGRAM SEE DWG NO. E4010-070 FOR -1 & E4016-070 FOR -2

NOTE:

FOR PARTS LIST SEE PL 4010-701-1 & 2

ITEM NO	QUANTITY	DESCRIPTION	UNIT	PRICE	TOTAL
1	1	AMPLIFIER PC BOARD (ASSEMBLY) A2			
2	1	STRAG WASHER			
3	1	HEATSINK			
4	1	RESISTOR			
5	1	RESISTOR			
6	1	RESISTOR			
7	1	RESISTOR			
8	1	RESISTOR			
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94	1	RESISTOR			
95	1	RESISTOR			
96	1	RESISTOR			
97	1	RESISTOR			
98	1	RESISTOR			
99	1	RESISTOR			
100	1	RESISTOR			



## SECTION 7

### REPLACEABLE PARTS

#### 7.1 GENERAL

This section contains ordering information and a complete list of replaceable parts. The parts are listed by their major assembly in alpha-numeric order by their reference designators. The list includes the parts description, manufacturers' identification (see Appendix A for list of manufacturers), and California Instruments' part numbers.

#### 7.2 ORDERING INFORMATION

In order to ensure prompt, accurate service, please provide the following information, when applicable, for each replacement part ordered.

- a. Model number and serial number of the instrument.
- b. California Instruments part number for the sub-assembly where component is located (PARENT ITEM NO.).
- c. Component reference designator (SEQ NO.).
- d. Component description (DESCRIPTION TRUNCATED).
- e. Component manufacturer's FSCM number (VENDOR).
- f. California Instruments part number (COMPONENT ITEM NO.).

A further explanation of these terms can be found in Section 7.3.

All replacement part orders should be addressed to:

California Instruments  
Attention: Parts Department  
9025 Balboa Avenue  
San Diego, California 92123-1509

### 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 alpha-numerical 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
	4010-050-0	HARNES ASSY,JUMPER	4010-050 REV G	16067	1.0	EA
	4010-050-1	HARNES ASSY	4010-050 REV G	16067	1.0	EA
	4010-453-1	FRONT PANEL ASSY	4010-453 REV 0	16067	1.0	EA
CBI	270016	CIRCUIT BREAKER,5A,250V	AM12-5-250-5-*	74193	1.0	EA
DS1	241021	LAMP,GAS,AMBER,120V	BG03ACSN2H/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	CIC300	METER,DC,ANLG,MA,0-1	CIC300-0	16067	1.0	EA
M1	CIC300-3	MTR FACE,MTL,W/4010-013	CIC300/4995-285	16067	1.0	EA
R1	570128	POT,PNL,10K,1/2W,PREC	B4010-012-1	16067	1.0	EA
53	110176-1	PANEL,FRONT W/4010-200	4010-200-1	16067	1.0	EA
58	110181	BRACKET,PLUG-IN,OSC	4010-205-1	16067	1.0	EA
64	240225	HANDLE,FLT,S/S,3"	11515-S-0832-4	06540	2.0	EA
66	240233	KNOB,BLK	PS-70-2-BLK	21604	1.0	EA
71	241124	GUIDE,PWB,4.15"	33-9016-12-01-*	91562	2.0	EA
	4010-454-1	REAR PANEL ASSY	4010-454 REV 0	16067	1.0	EA
B1	241059	FAN,3",115VAC,50/60HZ	SU2A1	82877	1.0	EA
C1	610716	CAP,AL,12000UF,40V	36D123G040BC2A	56289	1.0	EA
C2	610716	CAP,AL,12000UF,40V	36D123G040BC2A	56289	1.0	EA
C3	610547	CAP,MYLAR,.0047UF,600V	6DP-1-472	72136	1.0	EA
J5	240041	BINDING POST,RED	DF-31RC	58474	1.0	EA
J6	240090	BINDING POST,WHT	DF-31WTC	58474	1.0	EA
J7	240040	BINDING POST,BLK	DF-31BC	58474	1.0	EA
P1	241065	PWR CORD,115V,18-3,6'	17405	70903	1.0	EA
R2	520026	RES,CARB,1/2W,330 OHM	RC20GF331J	81349	1.0	EA
TB2	250111	TERMINAL STRP, 2TERM,2MT	3002	83330	1.0	EA
55	110779-1	PANEL,REAR W/4010-236	4010-236-1	16067	1.0	EA
63	240287	FAN GUARD	55081	23936	1.0	EA
65	240205	STRAIN RELIEF	SR6P3-4	28520	1.0	EA
67	610717	CAP CLAMP,2"	4586-48	56289	2.0	EA
68	FS3038	GROMMET,RUBBER,5/16"DIA	2172	83330	1.0	EA
	4010-455-1	SIDE RAIL ASSY,LEFT	4010-455 REV 0	16067	1.0	EA
CR1	310188	BRDG,RECT,FW,35A,400V	4KC3540	94232	1.0	EA
TB1	250050	TERMINAL STRP, 3TERM,2MT	3003	83330	1.0	EA
T1	710194	TRANSFORMER,INPUT	4010-011	16067	1.0	EA
54	110177	SIDE RAIL,LEFT	4010-201-7	16067	1.0	EA
73	FS2053	LUG,RING,SOLDER #6	1416-6	83330	2.0	EA
	4010-456-1	SIDE RAIL ASSY,RIGHT	4010-456 REV 0	16067	1.0	EA
T2	710193	TRANSFORMER,OUTPUT	4010-010	16067	1.0	EA
56	110179	SIDE RAIL,RIGHT	4010-203-7	16067	1.0	EA
	4010-960	MANUAL,101T	MANUAL REV R	16067	1.0	EA
A1	4010-700-1	PC ASSY,AMPLIFIER	4010-700 REV W	16067	1.0	EA
A2	4010-701-1	HEATSINK ASSY,OUT DRIVER	4010-701 REV G	16067	1.0	EA
E3	FS2054	LUG,RING,SOLDER #8	1416-8	83330	1.0	EA
57	110180	COVER,TOP	4010-204-7	16067	1.0	EA
59	110180	COVER,TOP	4010-204-7	16067	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
60	110191	GUSSET	4010-209-1	16067	4.0	EA
69	FS1141	NUT,SPEED,6-32	C3020-632	78553	16.0	EA
74	FS4004	ADHESIVE,SPRAY	77	04963	.2	OZ
75	FS4005	NOMEX,.010 THK,NATURAL	NOMEX,.010 THK	81349	442.0	SI
77	FS1018	SCREW,PNH,S/S,4-40X1/2	MS51957-17	96906	2.0	EA
78	FS1023	SCREW,FLH,S/S,4-40X1	MS24693-C10	81349	2.0	EA
79	FS1014	SCREW,FLH,S/S,4-40X1/4	MS24693-C2	96906	2.0	EA
80	FS1056	SCREW,PNH,S/S,10-32X3/8	MS51958-61	81349	4.0	EA
81	FS1024	SCREW,PNH,S/S,6-32X3/16	MS51957-25	96906	4.0	EA
82	FS1028	SCREW,PNH,S/S,6-32X5/16	MS51957-27	81349	14.0	EA
83	FS1001	SCREW,FLH,S/S,6-32X5/16	MS24693-C25	81349	20.0	EA
84	FS1029	SCREW,FLH,S/S,6-32X3/8	MS24693-C26	96906	4.0	EA
85	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	9.0	EA
86	FS1031	SCREW,PNH,S/S,6-32X7/16	MS51957-29	81349	7.0	EA
89	FS1049	SCREW,PNH,S/S,8-32X7/16	MS51957-44	81349	8.0	EA
90	FS1044	SCREW,FLH,S/S,8-32X1/2	MS24693-C50	81349	4.0	EA
91	FS1051	SCREW,PNH,S/S,8-32X5/8	MS51957-46	96906	2.0	EA
92	FS1075	WASHER,SPLT,S/S,#10	MS35338-138	96906	4.0	EA
93	FS1079	WASHER,FLAT,S/S,#4	MS15795-804	96906	2.0	EA
94	FS1068	WASHER,INTER,S/S,#4	MS35333-70	81349	4.0	EA
95	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	10.0	EA
96	FS1069	WASHER,INTER,S/S,#6	MS35333-71	96906	38.0	EA
97	FS1081	WASHER,FLAT,S/S,#8	MS15795-841	96906	8.0	EA
98	FS1070	WASHER,INTER,S/S,#8	MS35333-72	81349	14.0	EA
101	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	4.0	EA
102	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	12.0	EA
103	FS1065	NUT,HEX,S/S,8-32	MS35649-284	96906	14.0	EA
108	FS6003	TUBING,SHRINK,1/4	CP221-1/4-BLK	24011	1.0	IN

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310067	DIODE,ZNR,15V,.5W,5%	1N5245B	04713	1.0	EA
CR2	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR3	310067	DIODE,ZNR,15V,.5W,5%	1N5245B	04713	1.0	EA
CR4	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR5	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR6	310062	DIODE,RECT,1A,400V,DO41	1N4004	81349	1.0	EA
CR7	310062	DIODE,RECT,1A,400V,DO41	1N4004	81349	1.0	EA
CR8	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR9	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR10	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR11	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR12	310062	DIODE,RECT,1A,400V,DO41	1N4004	81349	1.0	EA
CR13	310194	DIODE,ZNR,2.8V,.5W,5%	1N5224B	04713	1.0	EA
CR14	310062	DIODE,RECT,1A,400V,DO41	1N4004	81349	1.0	EA
CR15	310221	DIODE,RECT,40A,400V,DO5	1N1188A	07716	1.0	EA
	C1 610732	CAP,MYLAR,.033UF,100V	225P33391	56289	1.0	EA
	C2 610708	CAP,AL,5UF,12V	TE1127	56289	1.0	EA
	C3 610566	CAP,MYLAR,.22UF,100V	IDP-3-224	72136	1.0	EA
	C4 610013	CAP,MICA,39PF,500V	CM05E390J03	81349	1.0	EA
	C5 610375	CAP,AL,100UF,6V	TE1102	56289	1.0	EA
	C6 610375	CAP,AL,100UF,6V	TE1102	56289	1.0	EA
	C7 610046	CAP,MICA,510PF,500V	CM06F511J03	81349	1.0	EA
	C8 610187	CAP,AL,500UF,50V	TC50050C	90201	1.0	EA
	C9 610187	CAP,AL,500UF,50V	TC50050C	90201	1.0	EA
	C10 610041	CAP,MICA,300PF,500V	CM05F301J03	81349	1.0	EA
	C11 FS7002	CAP,TBD	TBD	81349	.0	EA
	C12 FS7002	CAP,TBD	TBD	81349	.0	EA
	C13 610331	CAP,AL,5UF,50V	TE1303	56289	1.0	EA
	C14 610721	CAP,MYLAR,1UF,100V	112A1B105M	14752	1.0	EA
	J1 410032	CONN,PC EDGE,10 PIN	8BD10S-0	81312	1.0	EA
	Q1 330293	TRANSISTOR,FET,N,DUAL	IT502	32293	1.0	EA
	Q2 330012	TRANSISTOR,SS,NPN,DUAL	CIC333	16067	1.0	EA
	Q3 330008	TRANSISTOR,SS,NPN,TO18	CIC330	16067	1.0	EA
	Q4 330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
	Q5 330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
	Q6 330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
	Q7 330106	TRANSISTOR,SS,PNP,TO39	2N4036	04713	1.0	EA
	Q8 330075	TRANSISTOR,SS,NPN,TO39	2N2102	81349	1.0	EA
	Q9 330193	TRANSISTOR,PWR,PNP,TO220*	MJE2901	04713	1.0	EA
	Q10 330173	TRANSISTOR,PWR,NPN,TO3	61491 (2N3772)	86684	1.0	EA
	Q11 330173	TRANSISTOR,PWR,NPN,TO3	61491 (2N3772)	86684	1.0	EA
	R1 560017	RES,FILM,1/4W,681 OHM,1%	RN60D6810F	81349	1.0	EA
	R2 510049	RES,CARB,1/4W,680 OHM	RC07GF681J	81349	1.0	EA
	R3 570107	POT,1T,PC,100 OHM,1/4W	U-201R101B	71450	1.0	EA
	R4 530068	RES,CARB,1W,47 OHM	RC32GF470J	81349	1.0	EA
	R5 530068	RES,CARB,1W,47 OHM	RC32GF470J	81349	1.0	EA
	R6 560340	RES,FILM,1/4W,147K,1%	RN60C1473F	81349	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
R7	560239	RES,FILM,1/4W,20K,1%	RN60C2002F	81349	1.0	EA
R8	560131	RES,FILM,1/4W,100K,1%	RN60C1003F	81349	1.0	EA
R9	560196	RES,FILM,1/4W,9.09K,1%	RN60D9091F	81349	1.0	EA
R10	560238	RES,FILM,1/4W,4.99K,1%	RN60C4991F	81349	1.0	EA
R11	510093	RES,CARB,1/4W,51K OHM	RC07GF513J	81349	1.0	EA
R12	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	EA
R13	560114	RES,FILM,1/4W,49.9K,1%	RN60C4992F	81349	1.0	EA
R14	570035	POT,1T,PC,10K,1/4W	U201R103B	71450	1.0	EA
R15	560114	RES,FILM,1/4W,49.9K,1%	RN60C4992F	81349	1.0	EA
R16	510068	RES,CARB,1/4W,4.7K OHM	RC07GF472J	81349	1.0	EA
R17	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R18	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R19	510068	RES,CARB,1/4W,4.7K OHM	RC07GF472J	81349	1.0	EA
R20	510055	RES,CARB,1/4W,1.2K OHM	RC07GF122J	81349	1.0	EA
R21	510086	RES,CARB,1/4W,27K OHM	RC07GF273J	81349	1.0	EA
R22	510060	RES,CARB,1/4W,2.2K OHM	RC07GF222J	81349	1.0	EA
R23	510036	RES,CARB,1/4W,200 OHM	RC07GF201J	81349	1.0	EA
R24	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R25	510036	RES,CARB,1/4W,200 OHM	RC07GF201J	81349	1.0	EA
R26	510046	RES,CARB,1/4W,510 OHM	RC07GF511J	81349	1.0	EA
R27	540003	RES,CARB,2W,620 OHM	RC42GF621J	81349	1.0	EA
R28	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R29	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R30	510041	RES,CARB,1/4W,330 OHM	RC07GF331J	81349	1.0	EA
R31	510080	RES,CARB,1/4W,15K OHM	RC07GF153J	81349	1.0	EA
R32	540028	RES,CARB,2W,390 OHM	RC42GF391J	81349	1.0	EA
R33	510075	RES,CARB,1/4W,9.1K OHM	RC07GF912J	81349	1.0	EA
R34	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R35	510013	RES,CARB,1/4W,22 OHM	RC07GF220J	81349	1.0	EA
R36	FS5118	WIRE,BUS,AWG 24,QQ-W-343E	QQW343S24S2B	81348	1.0	IN
R37	510013	RES,CARB,1/4W,22 OHM	RC07GF220J	81349	1.0	EA
R38	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R39	575036	POT,1T,PC,5K,1/4W	U201R502B	71450	1.0	EA
R40	510005	RES,CARB,1/4W,10 OHM	RC07GF100J	81349	1.0	EA
R41	510016	RES,CARB,1/4W,30 OHM	RC07GF300J	81349	1.0	EA
R42	510078	RES,CARB,1/4W,12K OHM	RC07GF123J	81349	1.0	EA
R43	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R44	510016	RES,CARB,1/4W,30 OHM	RC07GF300J	81349	1.0	EA
R45	510005	RES,CARB,1/4W,10 OHM	RC07GF100J	81349	1.0	EA
R46	FS7000	RES,CARB,1/4W,TBD	RC07GF...	81349	1.0	EA
R47	510062	RES,CARB,1/4W,2.7K OHM	RC07GF272J	81349	1.0	EA
R48	540001	RES,CARB,2W,1 OHM	BWH 1 OHM	07716	1.0	EA
R49	FS7001	RES,CARB,2W,TBD	RC42GF...	81349	1.0	EA
R50	520013	RES,CARB,1/2W,47 OHM	RC20GF470J	81349	1.0	EA
R51	550188	RES,PWR,3W,.1 OHM,5%	RW69VR10WL	81349	1.0	EA
R52	560329	RES,FILM,1/4W,133K,1%	RN60C1333F	81349	1.0	EA
R53	550188	RES,PWR,3W,.1 OHM,5%	RW69VR10WL	81349	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
R54	540001	RES,CARB,2W,1 OHM	BWH 1 OHM	07716	1.0	EA
TB1	241123	TERMINAL BLK,12TERM, 5A	410-Y-12	75382	1.0	EA
TP1	410155	TEST JACK,PC,VERT,BRN	105-0858-001	74970	1.0	EA
TP2	410156	TEST JACK,PC,VERT,RED	105-0852-001	74970	1.0	EA
T1	710130	TRANSFORMER	T31X	81095	1.0	EA
2	160101	PWB,AMPLIFIER	4010-750-1	16067	1.0	EA
6	FS3044	STANDOFF,SWGE,6-32 X 1/4	150B-1/4	88245	3.0	EA
132	240120	HEATSINK	TXBF-032-025B	98978	2.0	EA
133	FS3032	SOCKET,XSTR,TO-5	RCT05075-7A	19080	2.0	EA
134	FS3033	SOCKET,XSTR,TO-18	RCT018110-1A	19080	4.0	EA
135	110167	BRACKET,ANGLE	129515	73734	2.0	EA
136	FS1183	FSTNR,RVT,BRS,1/8 X .156	1236	73734	2.0	EA
137	110183	HEATSINK	4010-206-7	16067	1.0	EA
138	FS5121	WIRE,BUS,AWG 18,QQ-W-343E	QQW343S18S2B	81348	1.0	IN
139	FS4001	THERMAL COMPOUND	351	I3103	.1	OZ
140	FS6011	TUBING,TEFLON,AWG 18	TFT-200-18-NAT.	92194	1.0	IN
141	FS5120	WIRE,BUS,AWG 20,QQ-W-343E	QQW343S20S2B	81348	1.0	IN
142	FS1006	SCREW,PNH,S/S,4-40X5/16	MS51957-14	96906	1.0	EA
143	FS2051	JUMPER,TERMINAL BLK	410J	75382	1.0	EA
146	FS1032	SCREW,PNH,S/S,6-32X1/2	MS51957-30	96906	5.0	EA
150	FS1068	WASHER,INTER,S/S,#4	MS35333-70	81349	4.0	EA
151	FS1069	WASHER,INTER,S/S,#6	MS35333-71	96906	5.0	EA
154	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	2.0	EA
155	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	4.0	EA
156	FS3019	INSULATOR,RECT,MICA	4673	91833	1.0	EA

PARENT ITEM NO.  
4010-701-1

HEATSINK ASSY,OUT DRIVER  
ENGR DRAW NO. 4010-701 REV G

PAGE 1  
9/30/87

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	330220	TRANSISTOR,PWR,NPN,TO220*	CIC370	16067	1.0	EA
Q2	330173	TRANSISTOR,PWR,NPN,TO3	61491 (2N3772)	86684	1.0	EA
Q3	330173	TRANSISTOR,PWR,NPN,TO3	61491 (2N3772)	86684	1.0	EA
R1	520013	RES,CARB,1/2W,47 OHM	RC20GF470J	81349	1.0	EA
R2	550188	RES,PWR,3W,.1 OHM,5%	RW69VR10WL	81349	1.0	EA
R3	550188	RES,PWR,3W,.1 OHM,5%	RW69VR10WL	81349	1.0	EA
	2 160102	PWB,HEATSINK,OUT DRIVER	4010-701-7	16067	1.0	EA
	22 110183	HEATSINK	4010-206-7	16067	1.0	EA
	23 FS4001	THERMAL COMPOUND	351	13103	.1	OZ
	24 FS5121	WIRE,BUS,AWG 18,QQ-W-343E	QQW343S18S2B	81348	1.0	IN
	25 FS6011	TUBING,TEFLON,AWG 18	TFT-200-18-NAT.	92194	1.0	IN
	28 FS1032	SCREW,PNH,S/S,6-32X1/2	MS51957-30	96906	5.0	EA
	31 FS1069	WASHER,INTER,S/S,#6	MS35333-71	96906	4.0	EA
	33 FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	5.0	EA



## MANUAL ADDENDUM

### Model 101T-638

#### 1.0 GENERAL:

The Model 101T-638 AC Power Source is identical to the standard Model 101T AC Power Source except the Model 101T-638 has an output of 0-35 volts rms.

#### 2.0 SPECIFICATIONS:

All specifications are identical to the standard Model 101T except full power is available from 35 volts rms to 27.3 volts (78% of rated output voltage) and a 0 to 40 voltmeter is used in place of the 0 to 160 voltmeter.

#### 3.0 THEORY OF OPERATION:

The theory of operation section given in section 3.0 of the standard 101T manual is applicable except that the output transformer T2 is replaced with an output transformer whose secondary voltage is 35 volts rms rather than 135 volts rms.

4.0 The calibration procedure given in section 4.0 of the standard 101T manual is applicable except that the full load resistance at 35 volts output is 12.25 ohms rather than 182 ohms and that the full load resistance at 78% of rated output voltage is 7.46 ohms rather than 110 ohms. Line regulation, load regulation, amplitude stability, frequency response and AC noise level tests given in section 4.6 through 4.10 of the standard manual are correct except that the load resistance values are changed to 12.25 $\Omega$  when S1 is closed and 7.46 ohms when S2 is closed. Test data tolerances are further restricted by the ratio of 135V to 35V or 3.85 to 1.

#### 5.0 PARTS LIST:

Parts list 4995-410 defines part substitutions required to the standard Model 101T.

**CALICO**CALIFORNIA INSTRUMENTS CO.  
SAN DIEGO, CALIFORNIACODE IDENT  
**16067****PARTS LIST**

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	Std. 101T AC Power Source from Finished Goods				
					1
	Remove from Std. 101T				2
M1	C1C800-3	Meter	16067	2-50105	4
					5
T2	4010-010	Output Transformer	16067	7-10193	6
					7
A1R47	RC07GF272J	Resistor 2.7K 1/4W 5%	81349	5-10062	8
A1R52	RN60C1333F	Resistor 133K 1/8W 1%	81349	5-60329	9
					10
R2	RC20GF331J	Resistor 330Ω 5% 1/2W	81349	5-20026	11
C3	6DP-1-472	Capacitor .0047 μF	04062	6-10547	12
					13
					14
	Add to Std. 101T				15
					16
M1	C1C 800-7	Meter 40V	16067	2-50158	17
					18
T2	4010-015	Output Transformer	16067	710331	19
					20
A1R47	24 Ga Buss	Jumper	-	-	21
A1R52	RN60C2492F	Resistor 33.2K 1/8W 1%	81349	5-60249	22
					23
R2	RC20GF220J	Resistor 22Ω 1/2W 5%	81349	5-20008	24
C3	4DP-3-683	Capacitor .068 μF	04062	6-10792	25
					26
					27
					28
					29
					30
					31
					32
					33
					34
					35
MODEL 101T-638		CALICO P/N 4995-410			ASSY R.D.
TITLE 100VA AC Power Source 35V Output			SHT 2 OF 2		

## MANUAL ADDENDUM

### Model 101T-672

#### 1.0 GENERAL:

The Model 101T-672 AC Power Source is identical to the standard Model 101T AC Power Source except the Model 101T-672 AC Power Source has an output of 0-30 volts rms and is tested from 45 Hz to 5 KHz.

#### 2.0 SPECIFICATIONS:

All specifications are identical to the standard Model 101T except full power is available from 30 volts rms to 23.4 volts (78% of rated output voltage) and a 0 to 30 voltmeter is used in place of the 0 to 160 voltmeter. Load regulation and distortion specifications apply for operation at 45 Hz to 5 KHz.

#### 3.0 THEORY OF OPERATION:

The theory of operation section given in section 3.0 of the standard 101T manual is applicable except that the output transformer T2 is replaced with an output transformer whose secondary voltage is 30 volts rms rather than 135 volts rms.

#### 4.0 CALIBRATION PROCEDURE:

The calibration procedure given in section 4.0 of the standard 101T manual is applicable except that the full load resistance at 30 volts output is 9.0 ohms rather than 182 ohms and that the full load resistance at 78% of rated output voltage is 5.46 ohms rather than 110 ohms. Line regulation, load regulation, amplitude stability, frequency response and AC noise level tests given in section 4.6 through 4.10 of the standard manual are correct except that the load resistance values are changed to 9.0 ohms when S1 is closed and 5.46 ohms when S2 is closed. Test data tolerances are further restricted by the ratio of 135V to 30V or 4.50 to 1.

#### 5.0 PARTS LIST:

Parts list 4995-408 defines part substitutions required to the standard Model 101T.

**GALICO**CALIFORNIA INSTRUMENTS CO.  
SAN DIEGO, CALIFORNIA

CODE IDENT

**16067****PARTS LIST**

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
		Std. 101T AC Power Source From Finished Goods			1
Remove from Std. 101T					2
					3
M1	C1C800-3	Meter	16067	2-50105	4
					5
T2	4010-010	Output Transformer	16067	7-10193	6
					7
A1R47	RC07GF272J	Resistor 2.7K 1/4W 5%	81349	5-10062	8
A1R52	RN60C1333F	Resistor 133K 1/8W 1%	81349	5-60329	9
					10
R2	RC20GF331J	Resistor 330Ω 5% 1/2W	81349	5-20026	11
C3	6DP-1-472	Capacitor .0047 μF	04062	6-10547	12
					13
Add to Std. 101T					14
					15
					16
M1	C1C800-6	Meter 30V	16067	2-50150	17
					18
T2	4010-014	Output Transformer	16067	7-10209	19
					20
A1R47	24 Ga. Buss	Jumper	-	-	21
A1R52	RN60C2492F	Resistor 24.9K 1/8W 1%	81349	5-60256	22
					23
R2	RC20GF150J	Resistor 15Ω 1/2W 5%	81349	5-20122	24
C3	6DP-1-104	Capacitor .1 μf 600V	04062	6-10135	25
					26
					27
					28
					29
					30
					31
					32
					33
					34
					35
MODEL	101T-672	CALICO P/N	4995-408	ASSY R.D.	
TITLE	100 VA AC Power Source 30 V Output			SHT	2 OF 2

MODEL 101T-771  
MANUAL ADDENDUM

1.0 GENERAL

The Model 101T-771 AC Power Source is identical to the standard Model 101T AC Power Source except the Model 101T-771 has an output of 0 to 270 volts rms.

2.0 SPECIFICATIONS

All specifications are identical to the standard Model 101T except full power is available from 270 volts rms to 210 volts (78% of rated output voltage) and a 0 to 320 voltmeter is used in place of the 0 to 160 voltmeter.

3.0 THEORY OF OPERATION

The theory of operation section given in section 3.0 of the standard 101T manual is applicable except that the output transformer T2 is replaced with an output transformer whose secondary voltage is 270 volts rms rather than 135 volts rms.

4.0 CALIBRATION

The calibration procedure given in section 4.0 of the standard 101T manual is applicable except that the full load resistance at 270 volts output is 729 ohms rather than 182 ohms and that the full load resistance at 78% of rated output voltage is 441 ohms rather than 110 ohms. Line regulation, amplitude stability, frequency response and AC noise level tests given in section 4.6 through 4.10 of the standard manual are correct except that the load resistance values are changed to 729 $\Omega$  when S1 is closed and 441 ohms when S2 is closed. Load regulation is optimized for 400 Hz and is slightly degraded at higher frequencies. Test data tolerances are further relaxed by the ratio of 135V to 270V or 1 to 2.00.

5.0 PARTS LIST

Parts list 4010-406 defines part substitutions required to the standard Model 101T.

# California Instruments

CODE IDENT  
16067

# PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	4010-406-1	220V IN - 270V OUT	16067		1
	4010-406-2	115V IN - 270V OUT	16067		2
	4010-400-1	STD MODEL 101T	16067	F.G.	3
ADD TO STD UNIT:					4
C3	6DP-1-122	CAP .0012 $\mu$ F 600V	72136	6-10065	5
					6
CB1	AM12-3-250-5-60	CIRCUIT BREAKER, 3A	74193	2-70017	7
					8
M1	CIC 800-10	METER, 0-320V	16067	2-50164	9
					10
R2	RC20GF122J	RESISTOR, 1.2K 1/2W 5%	81349	5-20036	11
AIR47	RC07GF682J	RESISTOR, 6.8K 1/4W 5%	81349	5-10072	12
AIR52	RN70C2673F	RESISTOR, 267K 1/2W 1%	81349	5-60330	13
					14
T2	4010-019-1	TRANSFORMER, OUTPUT	16067	SPL PART	15
					16
					17
DELETE FROM STD UNIT:					18
					19
C3	6DP-1-472	CAP .0047 $\mu$ F	72136	6-10547	20
					21
CB1	AM12-6-250-5-60	CIRCUIT BREAKER, 6 AMP	74193	2-70000	22
					23
M1	CIC 800-3	METER	16067	2-50105	24
					25
R2	RC20GF331J	RESISTOR 330 $\Omega$ 1/2W 5%	81349	5-20026	26
AIR47	RC07GF272J	RESISTOR 2.7K 1/4W 5%	81349	5-10062	27
AIR52	RN60C1333F	RESISTOR 133K 1/8W 5%	81349	5-60329	28
					29
T2	4010-010-1	TRANSFORMER OUTPUT	16067	7-10193	30
					31
					32
					33
					34
					35
					36
MODEL 101T-722/101T-771		CALICO P/N 4010-406			ASSY R.D.
TITLE AC POWER SOURCE			SHT 2 OF 2		

MANUAL ADDENDUM  
MODEL 101T-3336 AC POWER AMPLIFIER

1.0 GENERAL

The Model 101T-3336 AC Power Source is identical to the standard Model 101T AC Power Source except that a Current Sense Transformer and a Programmable Current Limit PC Board have been added to provide programmable current limit via the IEEE-488 GPIB or the front panel of the 849TA-series Programmable Control Module with the Current Limit option installed.

2.0 SPECIFICATIONS

All specifications for the Model 101T-3336 remain the same as the standard Model 101T AC Power Source except for the following:

SPECIAL FEATURE:

\* PROGRAMMABLE OUTPUT  
CURRENT LIMIT:

Front panel and IEEE-488 Bus programmable output current limit from 10% to 100% of full load output current. Current limit accuracy of 2% of full load current (0.9523 Amps) from 45 Hz to 5.0 KHz.

For Current Limit Programming instructions see Model 849TA Instruction Manual, section 3.5.2.8.

FULL POWER: 45 Hz to 10.0 KHz

DISTORTION: Less than 1% from 45 Hz to 5.0 KHz.

\* Must be used with the 849TA Programmable Controller Module with the Current Limit option installed.

3.0 THEORY OF OPERATION:

The theory of operation remains unchanged from the standard Model 101T. The added Current Sense Transformer and Current Limit PC Board allow the 849TA Programmable Control Module to program the output current limit level. The current limit is programmed in percent of full scale current for the proper output voltage range (0.9523 Amps).

The output power wire is routed through the Current Sense Transformer T101. Full load current (0.9523 Amps) is scaled to 1.00 VAC by burden resistors R101 and R102.

The secondary of A101T1 is connected to the A101 Current Limit PC Board, rectified and compared to the DC programming input voltage (full scale equals 9.766 VDC) from the 849T. The 849TA oscillator output is routed to the A101 board, buffered and routed to the power source Gain Pot. If the output current exceeds the programmed input, the A101 board attenuates the oscillator input from the 849TA until the output current is equal to the programmed value. The A101 is powered from the 115 VAC winding on the primary of the power source Input Transformer T1.

#### NOTES

- 1) This Current Limit Option is intended to protect sensitive loads and DOES NOT PROTECT THE POWER SOURCE FROM DAMAGE IF OPERATED OUTSIDE THE POWER DERATING CURVES found on page iii of the Model 101T Instruction Manual.
- 2) If an 849TA Programmable Control Module is not available to control the Model 101T-3336 the A101 Assembly can be bypassed by switching A101S1-1 to the "ON" position. The power source can be returned to normal operation by moving A101S1-1 to the "OFF" position.

#### 4.0 CALIBRATION

The calibration procedure for the Model 101T-3336 remains the same as the standard Model 101T except for the verification of the current limit accuracy. The following steps may be used to test the accuracy of the programmable current limit function that is provided by the 101T-3336 and the A101 assembly.

##### 4.1 Set Up For Current Limit Tests

- 1) Turn the power source "OFF"
- 2) If not already accomplished, connect the power source and test circuits as shown in Figure 4-1.
- 3) Turn the power source "ON".
- 4) Set the frequency of the 800T to 400 Hz.



#### 4.2 Test Current Limit

- 1) Set the amplitude of the 800T and 101T-3336 to 105 VAC.
- 2) Set the precision DC Voltage Source to 9.766 VDC.
- 3) Close "S2" on the 100 VA Load Assembly (100% load at 78% output voltage).
- 4) Verify that the power source output current is 0.9523 amps  $\pm 0.02$  amps.
- 5) Open "S2"
- 6) Repeat steps 3-5 with the precision DC Voltage Source set at 4.883 VDC and 0.977 VDC.

#### 4.3 Test Output Voltage Ranges and Frequencies

The above procedures must also be performed for 45 Hz, 2 KHz and 5 KHz. The load impedance, output voltage levels, output current levels and tolerances should be taken from Table 4-2.

TABLE 4-2

VOLTAGE RANGE	LOAD IMPEDANCE	OUTPUT VOLTAGE	OUTPUT CURRENT	OUTPUT CURRENT TOLERANCE
0-135 VAC	110.25	105 VAC	0.9523	$\pm 0.02$

#### 5.0 MULTIPHASE OPERATION

The 101T-3336 is designed for multiphase operation, however, special interconnect hardware must be utilized. See system Manual Addendum SER 3614 suffix for multiphase operation.

#### 6.0 DOCUMENTATION

Refer to the standard Model 101T Instruction Manual and to modification drawing 4010-463 and 4995-732, parts lists 4010-463-1 and 4995-732-1 and schematic 4995-616 and 4010-096.

7.0 PROGRAMMING

Refer to Model 849TA Programmable Control Module Instruction Manual, section 3.2.5.8.

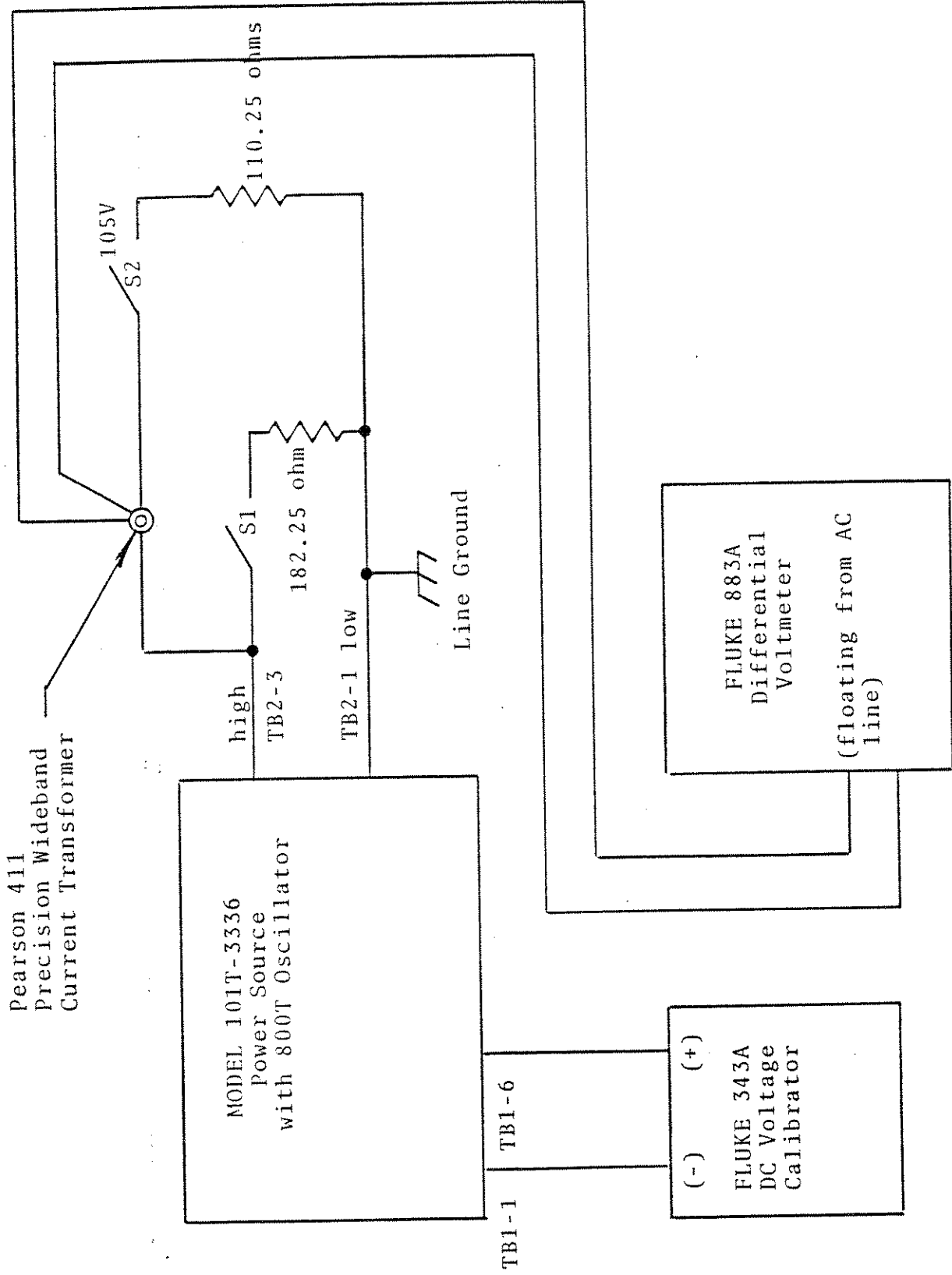


FIGURE 4-1  
TEST CIRCUIT FOR MODEL 101T-3336 PROGRAMMABLE CURRENT LIMIT

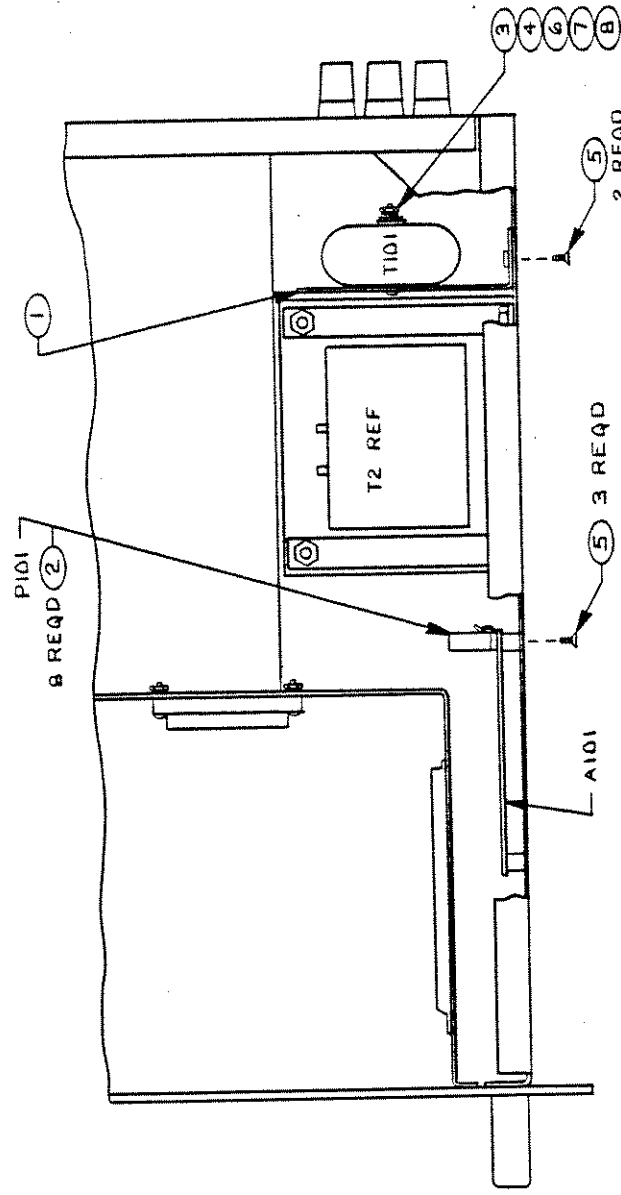
WIRING MODIFICATIONS

\*DELETE\* WIRE LIST (REF WTT 4010-050)

NO.	FROM	TO	AWG	REMARKS
34	J1-1	J1-6	22	BUS W/SLEEVING
36	J1-6	J1-8	22	BUS W/SLEEVING
40	R1-3	A1-24	RG174	SHIELD
50	T2-6	J6	14	WHITE

\*ADD\* WIRE LIST

NO.	FROM	TO	AWG	REMARKS
101	A10-U3-3	A10-U3-14	24	BUS W/SLEEVING
102	PI01-1	T1-2	20	WHITE
103	PI01-2	T1-1	20	WHITE
104	PI01-4	T101-7	20	WHITE
105	PI01-6	A1-J1-A	20	WHITE
106	PI01-7	R1-3	RG174	SHIELD
	PI01-5	R1-1	SHIELD	
107	PI01-8	A1-24	RG174	SHIELD
	PI01-5	A1-23	SHIELD	
108	PI01-10	T101-6	20	WHITE
109	A1-J1-A	TBI-7	20	WHITE
110	A1-J1-B	TBI-8	20	WHITE
111	T2-6	T101-1	18	WHITE
112	J6	T101-5	18	WHITE



REVISIONS

REV	DESCRIPTION	DATE	APPROVED

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

LIST OF MATERIAL

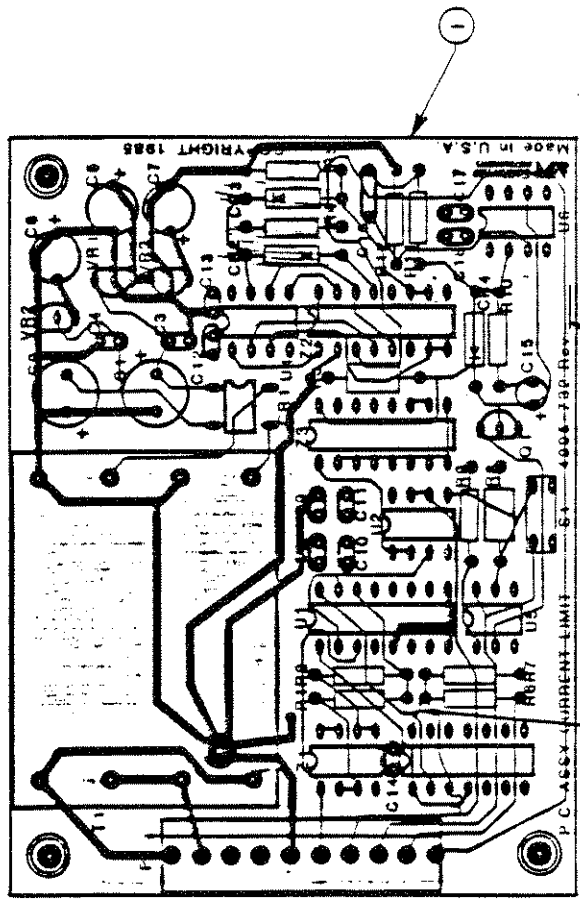
TITLE	CONTRACT NO	CODE IDENT
MODIFICATION DRAWING, 101T-3336/101T-PC-3336		16067

RELEASE	PROJ ENG	CHECK	DESIGN	DRAFT	SCALE	SHEET 1 OF 1

**California INSTRUMENTS**  
A DIVISION OF CALIFORNIA INSTRUMENTS CO. INC.  
4100 LA JOLLA VILLAGE ROAD  
SAN DIEGO, CALIFORNIA 92161

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS		DATE	APPROVED
REV	DESCRIPTION		
A	W-001013R35 C15 ON PL'S -1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100	10/1/65	DUS
B	CHGO VALUES ON R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100	10/1/65	WLB
C	ADD -5 ASSY	11-11-65	WLB



ADD 24 BUS SLEEVED JUMPER FROM U3-14 TO R6 PAD ON -5 ASSY ONLY (FARSIDE)

3 PLCS

FOR PARTS LIST SEE PL 4995-732-1, -2, -3, -4, -5

ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL SPECIFICATION	CODE IDENT.	NOTE NO.
LIST OF MATERIAL					
PC ASSY, CURRENT LIMIT					
California Instruments A DIVISION OF AMSTAR ELECTRICAL PRODUCTS CO. INC. 340 BEECH CANYON DRIVE, BAKERSFIELD, CALIF. 93311					
CONTRACT NO.		DPO NO.		REV.	
4995-732		4995-732		C	
SCALE		SHEET		OF	
1/4" = 1"		2		1	

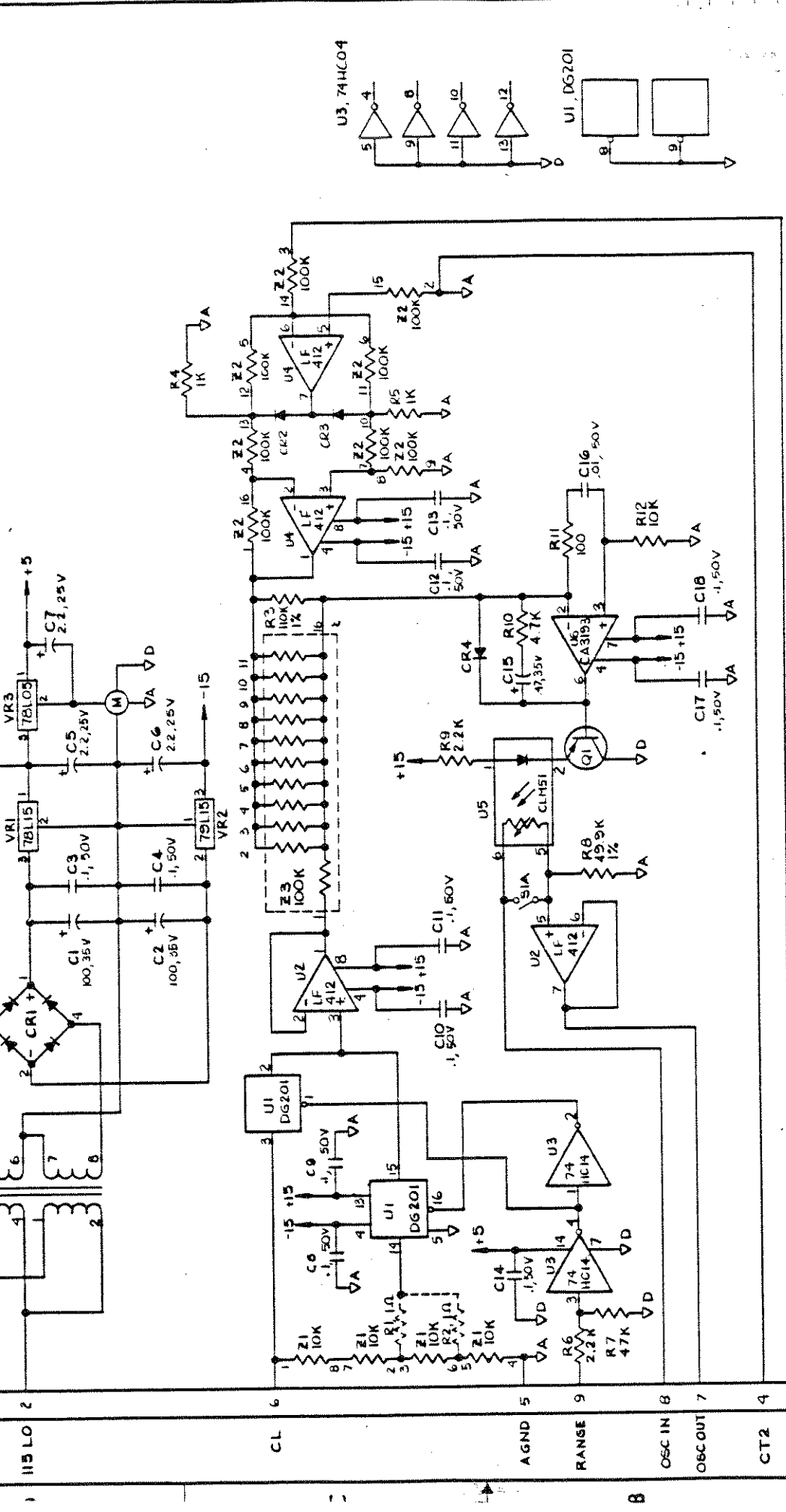
RECD PER ASSY	FINISH	QTY RECD	USED ON	NEXT ASSY
	761TC-333-G	-1	ON	
	4-575-435-1			

MARK WITH APPROPRIATE REV. LTR.  
1. FOR SCHEMATIC DIAGRAM SEE 4995-616.  
NOTES: (UNLESS OTHERWISE SPECIFIED)

TR

1 2 3 4

REV	DESCRIPTION	DATE	APPROVED
A	CHG (U3, WAS: 39; R11 WAS: 100K	1/14/67	AK
B	CHG R6, WAS 10K; R7 WAS 220K; U3 WAS MC104	1/14/67	AK



REV	DESCRIPTION	DATE	APPROVED
A	CHG (U3, WAS: 39; R11 WAS: 100K	1/14/67	AK
B	CHG R6, WAS 10K; R7 WAS 220K; U3 WAS MC104	1/14/67	AK

ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL SPECIFICATION	CODE IDENT	NOTE NO.
LIST OF MATERIAL					
SCHEMATIC CURRENT LIMIT					
California Instruments					
11450 SHELTON BLVD., LOS ANGELES, CALIFORNIA 90025					
CONTRACT NO. 4995-616					
DWG. NO. 16067					
REV. B					

REV	DESCRIPTION	DATE	APPROVED
A	CHG (U3, WAS: 39; R11 WAS: 100K	1/14/67	AK
B	CHG R6, WAS 10K; R7 WAS 220K; U3 WAS MC104	1/14/67	AK

1. ALL DIODES IN4148.  
 NOTES: (UNLESS OTHERWISE SPECIFIED)



SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310254	BRDG, RECT, FW, 1A, 200V, DIP	VM29	27583	1.0	EA
CR2	310227	DIODE, SWNG, 75V, .5W, DO35	1N4148	81349	1.0	EA
CR3	310227	DIODE, SWNG, 75V, .5W, DO35	1N4148	81349	1.0	EA
CR4	310227	DIODE, SWNG, 75V, .5W, DO35	1N4148	81349	1.0	EA
C1	611139	CAP, AL, 100UF, 35V	ECEA1VV101S	0008G	1.0	EA
C2	611139	CAP, AL, 100UF, 35V	ECEA1VV101S	0008G	1.0	EA
C3	611103	CAP, CER, .1UF, 50V, Z5U	CZ20C104M	71590	1.0	EA
C4	611103	CAP, CER, .1UF, 50V, Z5U	CZ20C104M	71590	1.0	EA
C5	610798	CAP, TANT, 2.2UF, 25V	T362B225M025AS	05397	1.0	EA
C6	610798	CAP, TANT, 2.2UF, 25V	T362B225M025AS	05397	1.0	EA
C7	610798	CAP, TANT, 2.2UF, 25V	T362B225M025AS	05397	1.0	EA
C8	611103	CAP, CER, .1UF, 50V, Z5U	CZ20C104M	71590	1.0	EA
C9	611103	CAP, CER, .1UF, 50V, Z5U	CZ20C104M	71590	1.0	EA
C10	611103	CAP, CER, .1UF, 50V, Z5U	CZ20C104M	71590	1.0	EA
C11	611103	CAP, CER, .1UF, 50V, Z5U	CZ20C104M	71590	1.0	EA
C12	611103	CAP, CER, .1UF, 50V, Z5U	CZ20C104M	71590	1.0	EA
C13	611103	CAP, CER, .1UF, 50V, Z5U	CZ20C104M	71590	1.0	EA
C14	611103	CAP, CER, .1UF, 50V, Z5U	CZ20C104M	71590	1.0	EA
C15	610839	CAP, TANT, .47UF, 35V	1960474X9035A1	56289	1.0	EA
C16	610094	CAP, CER, .01UF, 50V	CK103	71590	1.0	EA
C17	611103	CAP, CER, .1UF, 50V, Z5U	CZ20C104M	71590	1.0	EA
C18	611103	CAP, CER, .1UF, 50V, Z5U	CZ20C104M	71590	1.0	EA
P1	410294	CONN, PC HDR, 10 PIN	26-48-1105	27264	1.0	EA
Q1	330311	TRANSISTOR, SS, PNP, TO92	2N5401	81349	1.0	EA
R1	510165	RES, CARB, 1/4W, 1 OHM	RC07GF1R0J	81349	1.0	EA
R3	560840	RES, FILM, 1/8W, 110K, 1%	RN55C1103F	81349	1.0	EA
R4	510053	RES, CARB, 1/4W, 1K OHM	RC07GF102J	81349	1.0	EA
R5	510053	RES, CARB, 1/4W, 1K OHM	RC07GF102J	81349	1.0	EA
R6	510060	RES, CARB, 1/4W, 2.2K OHM	RC07GF222J	81349	1.0	EA
R7	510092	RES, CARB, 1/4W, 47K OHM	RC07GF473J	81349	1.0	EA
R8	560796	RES, FILM, 1/8W, 49.9K, 1%	RN55D4992F	81349	1.0	EA
R9	510060	RES, CARB, 1/4W, 2.2K OHM	RC07GF222J	81349	1.0	EA
R10	510068	RES, CARB, 1/4W, 4.7K OHM	RC07GF472J	81349	1.0	EA
R11	510029	RES, CARB, 1/4W, 100 OHM	RC07GF101J	81349	1.0	EA
R12	510076	RES, CARB, 1/4W, 10K OHM	RC07GF103J	81349	1.0	EA
S1	240494	SWITCH, DIP, 2 SECT	CTS 206-2	71450	1.0	EA
T1	710360	TRANSFORMER	LP34-75	08779	1.0	EA
U1	360405	IC, ANA, SWITCH, QUAD	DG201BK	81349	1.0	EA
U2	360530	IC, OP-AMP, FET, DUAL	UPC812	33297	1.0	EA
U3	360355	IC, MOS, INVERT, HEX, HS	74HC14N	27014	1.0	EA
U4	360530	IC, OP-AMP, FET, DUAL	UPC812	33297	1.0	EA
U5	360256	IC, OPTO, MODULATOR	CLM51	03911	1.0	EA
U6	360237	IC, OP-AMP, PREC	CA3193E	18722	1.0	EA
VR1	360268	IC, VOLTAGE REG, +15, .1A	MC78L15ACP	04713	1.0	EA
VR2	360269	IC, VOLTAGE REG, -15, .1A	MC79L15ACP	04713	1.0	EA
VR3	360164	IC, VOLTAGE REG, +5, .1A	UA78L05AWC	02335	1.0	EA
Z1	360420	RES, ARRAY, TFLM, DIP, 10K	694-3-R10K-D	73138	1.0	EA



PARENT ITEM NO.  
4995-732-1

PC ASSY,CURRENT LIMIT  
ENGR DRAW NO. 4995-732 REV C

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SEQ COMPONENT NO. ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY UM
Z2 360384	RES,ARRAY,TFLM,DIP,100K	698-3-R100K-F	73138	1.0 EA
Z3 360204	RES,ARRAY,TFLM,DIP,100K	698-1-R100K	73138	1.0 EA
1 4995-782-1	PWB,CURRENT LIMIT	4995-782-1	16067	1.0 EA
2 FS3044	STANDOFF,SWGE,5-32 X 1/4	1508-1/4	88245	3.0 EA



## MANUAL ADDENDUM

### Model 200T/2-3D

#### 1.0 GENERAL:

The Model 200T/2-3D AC Power Ssystem consists of two Model 101T AC Power Sources connected as shown in Drawing D4995-806, and provides 200 VA. Under normal operating conditions, both Model 101T's are adjusted to provide the same output voltage with their front panel GAIN controls. The two outputs of the Model 101T's provide the phase A and phase C of the delta, the third leg of the delta is then generated between the two high outputs of the Model 101T's. This third leg is equal in the amplitude to the high to neutral outputs of the Model 101T's. The Model 101T that supplies the phase A output houses the plug-in oscillator.





## MANUAL ADDENDUM

### Model 101T-3016

#### 1.0 GENERAL:

The Model 101T-3016 AC Power Source is similar to the standard Model 101T AC Power Source except that the 101T-3016 has a frequency response from 15 Hz to 999 Hz. The unit will deliver from 0 to 120 volts rms output while working into a 2880 ohm load (5VA).

#### 2.0 SPECIFICATIONS:

The specifications for the Model 101T-3016 AC Power Source are listed below and apply when the power source is used with a Model 845T-1-3016 Oscillator or a Model 847T-1-3016 Oscillator.

POWER OUTPUT:	5 VA at 120 volts rms from unity to $\pm 0.7$ power factor.
OUTPUT VOLTAGE RANGE:	0 to 120 volts rms.
NUMBER OF PHASES:	Single phase output.
OUTPUT FREQUENCY:	15 Hz to 999 Hz.
TOTAL HARMONIC DISTORTION:	1.0% percent maximum from 15 Hz to 999 Hz.
AMPLITUDE STABILITY: (after one hour warm-up)	$\pm 0.25\%$ for 24 hours at constant line, load and ambient temperature conditions.
LOAD RANGE:	$\pm 1\%$ over the range from 15 Hz to 999 Hz when tested at unity power factor. In addition, a load regulation to be adjusted to zero at any given line voltage, signal frequency and load conditions. Control resolution is 0.1%.
LINE REGULATION:	$\pm 0.10\%$ of full output for a $\pm 10\%$ line change.
FULL POWER FREQUENCY RANGE:	15 Hz to 999 Hz (power source only).

FREQUENCY RESPONSE:	±0.5 dB from 15 Hz to 999 Hz.
AC NOISE LEVEL:	80 dB below full output when tested with a shorted input; 70 dB below full input power tested at full power output.
OVERLOAD AND SHORT CIRCUIT PROTECTION:	Complete protection from overloads and short circuit is provided. Automatic reset occurs when overload is removed.
AMPLIFIER DRIVE REQUIREMENTS: (Normally obtained from plug-in)	5 volts rms (maximum) produces 120 volts rms.
AC INPUT LINE:	105 to 125 volts rms, single phase.
AC INPUT FREQUENCY:	48 to 65 Hz.
AC INPUT POWER:	200 watts maximum under worst case line and full rated load conditions.
OPERATING TEMPERATURE RANGE:	0 to 55°C.
FRONT PANEL METER:	0 to 160 volt AC voltmeter provides ±3% of full scale accuracy over the range from 15 Hz to 999 Hz.
DIMENSIONS:	3 - 1/2" high X 19" wide X 17.5" deep.
NET WEIGHT:	35 pounds.
SHIPPING WEIGHT:	40 pounds.
FRONT PANEL FINISH:	Gray, 26440 per Federal Standard 595 with black silk-screened lettering.

### 3.0 THEORY OF OPERATION:

The theory of operation section given in Section 3.0 of the standard 101T Instruction Manual is correct except as noted below:

- a) The output transformer T2 has been replaced with an output transformer whose bandwidth extends from 15 Hz to 1.0 KHz and whose secondary voltage is 120 volts rms rather than 135 volts rms.

- b) The values of capacitors A1C2, A1C3, A1C5, A1C6 and A1C15 have been increased in value to provide improved low-frequency response. The values of capacitors A1C4, A1C7, A1C10, and A1C11 have been increased in value to provide a greater stability margin at high frequencies. Transistors A1Q11 and A2Q3 and associated components have been removed to provide proper operation of the overload circuit at reduced power output.

A complete schematic for the Model 101T-3016 AC Power Source is given in Drawing 4010-084.

#### 4.0 CALIBRATION:

The calibration procedure given in the standard 101T manual is not applicable. The following procedure should be used:

- 1) Apply power to the unit with the Model 845T-1-3016 Plug-in installed in the 101T-3016 Power Source. Set the oscillator frequency to 45 Hz.
- 2) Turn the front panel GAIN control fully counterclockwise and check that the input power is less than 60 watts. If this is not the case, perform Step 4.3.2 in the standard 101T Instruction Manual.
- 3) Set the output of the unit to 120 volts rms with a differential voltmeter connected to the output of the 101T Power Source and check that the front panel METER is within  $\pm 3.0$  percent of the actual output voltage. Adjust A1R39, if required. Check that the front panel voltmeter reads within  $\pm 3$  percent of the actual output voltage when tested from 15 Hz to 999 Hz.
- 4) Set the internal load regulation control A1R3 so that the output voltage variation is less than 120 millivolts rms as the 5VA load is applied to the output of the 101T-3016 Power Source.

Vary the output frequency from 15 Hz to 999 Hz and check that the load regulation remains within  $\pm 1.2$  volts rms.

- 5) Check that the output distortion does not exceed 1.0 percent at 45 Hz with a 5 VA resistive load (2880 ohms).

Repeat this test at 15 Hz and at 999 Hz. The distortion must remain below 1.0% at 15 Hz and 999 Hz.



- 6) Vary the line voltage from 103.5 to 126.5 volts rms and check that the output voltage varies less than 240 millivolts rms for operation at either 15 Hz to 999 Hz.

#### 5.0 PARTS LIST:

A parts list which indicates how to build a Model 101T-3016 AC Power Source from a standard Model 101T is given in Drawing 4010-435.

# Appendix A

Number	Vendor Name	City	State	Number	Vendor Name	City	State
0000A	Electricoid	Westfield	PA	27556	IMS Electronic Products	Santa Fe Springs	CA
0000C	Jackson Bros.	Weldon, Surrey	GB	27443	Vase, Carl and	Bridgeport	CT
0000S (178544)	Perfac Elec. Corp.	Waco	TX	27333	F-Dyne Electronics	Newport Beach	CA
0000W	Milton Ross Co.	Waco	TX	28480	Hueber Aircraft	Palo Alto	CA
0000I (52745)	Time	Wachsmann	PA	28571	Hewlett-Packard Co.	Redwood City	CA
0000K	Itac	Los Angeles	CA	28406	Raychem Company (Honey)	Redwood Ont.	Canada
0000Q (55112)	Leavelle (Westlake Cap. Inc.)	Santa Clara	CA	29372	Reanord Inc. Feidat Ind.	Torrance	CA
000AG	Lafrence	Philadelphia	PA	29198	Reed, Inc.	El Segundo	CA
000AH (54363)	Jan Ciyetal	Pt. Hays	CA	30019	International Components Corp.	Aubury Park	NJ
000AL (53495)	Data Components, Inc.	Gardena	CA	30161	Avaid Engineering, Inc.	Lyndhurst	NJ
000AM	Kraus & Kaiser	Santa Monica	CA	30889	Durham Company	Sylvania	CA
000AN	Rte Instrument Transformer	San Diego Beach	CA	30983	Electro-Midland (Mapco)	San Diego	CA
000AS	Switches Incorporated	N. View	CA	31827	Budwig Mfg. Co.	Pomona	CA
000AT (42643)	Wilson Chemicon	Los Alamitos	CA	31951	Trickford Inc.	Trickford	PA
000AU	JNJ Technical Prod. Inc.	Kendall Park	NJ	32293	Intekil	Cupertino	CA
000AV (61823)	Sens Processes, Inc.	San Jose	CA	32559	Bivar, Inc.	Santa Ana	CA
000AW	Chatsworth	Chatsworth	CA	33993	Burns Inc. (Tripart Div)	Riverside	CA
000AX (63878)	Apogee	Menlo Park	CA	33005	Jewell Electrical Indst. Inc.	San Francisco	CA
000AY	Silicon Power Cube Corp.	Long Beach	CA	33333	Logic Dynamics, Inc.	Gardena	CA
000AZ (61271)	Fujitsu	Santa Clara	CA	33716	Kingebachner Murray Co.	Los Angeles	CA
000BA (61846)	Depron Electronics, Inc.	Schmading	CA	33855	Ducommun, Inc.	Los Angeles	CA
000BB	Hillmark Metals, Inc.	Clendora	CA	33901	Colber Corp.	Livingston	NJ
000BC	Tomajoe America, Inc.	Tustin	CA	34238	Mills Resistor Co.	Los Alamitos	CA
000BD (55982)	Electronic Essentials	Woodside	NY	34332	Silicon General	Westminster	CA
000BE (57855)	Set-Am	Elizabet	NY	34449	Intel Corporation	Santa Clara	CA
000BF (53285)	Bequist	Ninneapolis	MN	35001	Aerovec Canada Ltd.	Aberst MS	Canada
000BG	Panasonic	Secaucus	NJ	37364	Linear Technology, Inc.	Wilmington, Ont	CAN
000BH	Data Components	San Jose	CA	44518	Manufacturing Co.	Shelton	CT
000BI (54186)	Micro Power Systems	Santa Clara	CA	45722	Parmer-Kalou	Clifton	NJ
000BJ (06776)	Robinson Mudget	New Albany	IN	46384	Penn. Eng. and Mfg. Corp.	Dorweston	PA
000BK (11350)	Seew Products (Veritron)	Laconia	NH	30137	Ridwest Components, Inc.	Muskegon	MI
000BL (51723)	Sealed Plier (Gardard Ad & Co.)	San Jose	CA	50322	Rockwell, Electronic Special Products	Cupertino	CA
000BU	Mitsubishi Electronics Amer.	Sunnyvale	CA	30558	Electronic Concepts, Inc.	Easton	NJ
000BV	Silicon Power Cube	Long Beach	CA	50811	Heuser Corp.	Santa Ana	CA
000BW	Panel Components Corp.	Bonpoint	France	51185	Aries Electronics, Inc.	Franktown	CO
000CX	Metal-Cal Div., Avery Prod.	Ingleside	CA	51506	Accurate Screw Machine Co.	Hutley	NJ
000CY	AMP Inc.	Harrisburg	PA	51705	ICG/Rally	Palo Alto	CA
000D1	Samson Electronic Co.	Frickens	SC	52186	Circuit Assembly Corp.	Clarks Mass	CA
000D2	Goa Eng. Co., Inc.	City of Industry	CA	52745	Timco	Los Angeles	CA
01002	G.P. Co., Ind. & Pwr. Cap. Dept.	John St. Hudson	NY	53076	Rinter, Inc.	Buffalo	NY
01121	A.L. Bradley Co.	Falls	WI	53195	Data Components, Inc.	Gardena	CA
01119	G.C. Co., Silicons Prod.	Waterford	NY	54161	Frederick Metal Works	Fredericktown	OH
01295	Texas Instruments	Dallas	TX	54407	Power-One Co.	Camacillo	CA
01391	Police Engineering, Inc.	San Diego	CA	55322	Saaten, Inc.	New Albany	IN
02111	Spectrol Electronics	City of Industry	CA	55546	PAC Electronic Hardware, Inc.	Wilmington	CA
02113	Colcraft, Inc.	Cary	IL	56289	Spears Electric Company	North Adams	MA
02335	Fairchild Controls Corp.	Nickville, IL	IL	56337	RCD Components, Inc.	Manchester	NH
02375	American Insulating Mach. Co.	Philadelphia	PA	57440	United Chem-Com Corp.	Philadelphia	PA
02378	Electronic Co.	Dallas	TX	51256	Kal-Am, Inc.	Elizabet	NJ
02460	Amphenol Corporation	Broadview	IL	58474	Supertec Electric Company	Bristol	CT
02768	Illinois Tool Works, Inc.	Des Plaines	IL	59730	Thomas and Betts Company	Elizabeth	NJ
02759	Use Code #7236	St. Louis	MO	59993	International Rectifier	El Segundo	CA
03507	General Electric Company	Syracuse	NY	60395	Semiconductors Div.	Midland	CA
03508	General Electric Company	Syracuse	NY	61394	Vico, Inc.	San Jose	CA
03797	Eldem Corporation	Compton	CA	61441	Seeq Technology, Inc.	San Jose	CA
03868	Pyrotec Resistor Co., Inc.	Cedar Knolls	OH	61807	Aerostat Corp.	Palo Alto	CA
03911	Clairt Corporation	Hartford	CT	61735	Pulse Engineering, Inc.	Houma	LA
04009	Artow-Hart and Hegeem Elec.	Hartford	CT	62483	Densitron Corp. of America	Torrance	CA
04099	Capech, Inc.	Grand Junction	CO	62843	United Chemicon, Inc.	Rosemont	IL
04712	Phonix Semiconductor Prod.	Phoenix	AZ	62843	Phonix Equipment Co.	San Jose	CA
04729	Universal Components Corp.	Green Brook	NJ	63743	Ward Leonard Electric Co.	West Vernon	NY
04963	J-W	St. Paul	IL	63791	Star Microtronics, Inc.	New York	NY
05245	Corcon Inc.	Chicago	IL	70291	Allmetal Screw Prod. Co.	Garden City	NY
05276	Phoenix Electronics, Inc.	Pomona	CA	70903	Beider Manufacturing Co.	Chicago	IL
05397	Kemet, Union Carbide Corp.	Cleveland	OH	71218	Bud Industries, Inc.	Willoughby	OH
05791	Lyn-Tron, Inc.	Burbank	CA	71279	Cambridge Thermionic Corp.	Cambridge	MA
05820	Wahfield Engineering, Inc.	Wahfield	MA	71400	Burman Mfg. Div. McGraw-Edison Co.	St. Louis	MO
05972	Loctite Corp.	Havington	CT	71450	CTS Corporation	Elkhart	IN
06383	Panduit Corp.	Tinley Park	IL	71468	ITT Cannon Electric, Inc.	Los Angeles	CA
06518	Stantech, Spec Metal Prod.	N. Hollywood	CA	71490	ITT Cannon Electric, Inc.	Los Angeles	CA
06540	Amcon Elect. Hardware	New Rochelle	NY	71707	Wilson Div. Globe-Union	Providence	RI
06665	Precision Nonolithics Inc.	Santa Clara	CA	71744	Cole-Coil	Chicago	IL
06776	Robinson Mudget, Inc.	New Albany	IN	71744	Chicago Miniature Lampworks	Chicago	IL
06915	Chicago Electronics Co.	Chicago	IL	71824	Cinch Manufacturing Company	Chicago	IL
07088	Kevin Electric Company	Van Buren	IL	71884	Owe Corning Corp.	Midland	NE
07263	Fairchild Camera & Instr.	N. View	CA	72136	Sinenco (Electro Motive)	Williamsville	NY
07387	Birchec Corporation	Los Angeles	CA	72149	Delight Corporation	Brooklyn	CT
07556	Upper Glarco Plastics	Upper Mersey	NY	72459	General Instruments	Herk	NY
07613	Epoxy Prod. Co., Allied Prod. Corp.	New Haven	CT	72982	Eric Technological Prod. Inc.	Eric	PA
07767	USM Corp. (USM Fastener Div)	Shelton	CT	73138	Beckman Instruments, Inc.	Fullerton	CA
07716	IRC Incorporated	Buckington	IA	73612	Consolidated Electronic Wire and Cable Corp.	Chicago	IL
07910	Use Code #15818	Chicago	IL	73734	Federal Screw Products, Inc.	Chicago	IL
08028	Loctite (Auto & Consumer Grp)	Mtn View	CA	74133	Wellemann Electric Company	Trenton	NJ
08057	Amtek Ind. (Magnetics Div)	Sandy Lake	CA	74133	Wellemann Electric Company	Bridgeport	CT
08055	Accurate Rubber and Plastics	San Diego	CA	74240	Illinois Condenser Co.	Massac	PA
08251	Spectra Strip (Amphenol)	Garden Grove	CA	74970	E.F. Johnson Company	Philadelphia	PA
08289	Blinn Delbert Co.	Pomona	CA	75942	YHM Electronic Components	Philadelphia	PA
08351	Telecon Co. of Canada	Toronto, Ont	Canada	75942	Fulcrum Corporation	Little Neck	NY
08730	Ostby & Barton (Vernaline Prod. Div.)	Narvik	RI	75982	Leviton Mfg. Co.	Des Plaines	IL
08779	Signal Transformer	Brooklyn	NY	75915	Littlefuse, Inc.	New Rochelle	NY
09211	IC Semiconductor Prod. Div	Newton	MA	76285	Minor Rubber Co., Inc.	Bloomfield	NY
09353	C & K Components	Newton	MA	77132	Parabellum, Inc.	Elizabet	NJ
09822	Burndy Corp.	Norwalk	CT	77342	United-Carr Inc., Patwin Div	Waterbury	CT
10388	Chicago Switch	Chicago	IL	77342	Potter and Blumfield Div. AMF E. Princeton	IN	
11815	Cherty/Tacton (Fastener Div)	San Jose	CA	78189	Shakproof Div. IL Tool Works	Chicago	IL
12406	Zipac Electronics	Santa Ana	CA	78253	Time-Land Products, Inc.	Cleveland	OH
12697	Claroast Mfg.	Dover	NY	79130	Johns-Manville Products Corp	Chicago	IL
13103	Thermalloy Company	Dallas	TX	79136	Walden Rohinor Inc.	Long Island City	NY
13150	Wilson Corp. (Seaw Prod.)	Laconia	NH	79563	Rivick Mfg. Corp.	New Rochelle	NY
13604	Spery Corp. Elec. Systems	Greek Neck	NY	80031	Ward Leonard Electric Co.	Herk	NY
13919	Burr-Brown	Tucson	AZ	80294	Bourne, Inc.	Riverside	CA
14099	Swatch Corporation	Newbury Park	CA	80495	High Voltage Engineering Corp	Brighton	MA
14504	Elwood Samsen, Inc.	Clanton	MI	81205	(Ande) Spec. Prod. Div)	San Jose	CA
14655	Cornell-Dubilier Elect. Corp.	Hewark	NJ	81212	Triad Transformer Corp.	Venice	CA
14726	Rollingsworth Co.	Phonitsville	PA	81248	Winchester Electronics	Dakville	CT
14752	Electro Cube, Inc.	San Gabriel	CA	81349	(Fed. Spec) Promulgated by General Services Administration Washington DC	Washington	DC
14908	Electronic Instrument and Specialty Corp.	Stoneman	MA	81349	Military Specification or Commercial Generic Number		
15239	ITT Semiconductors	Lawrence	MA	81341	Alphas Corp.	Cambridge	MA
15454	Amtek Enk (Rodan Div)	Amshelm	CA	81402	Race Products Co.	Chicago	IL
15636	Electrol	Horsfield	MA	81851	Bentley-Harris Mfg Co.	Lionville	PA
15601	Fanwall Electronics	Framingham	MA	82104	Standard Gleggby	Aucora	CA
15818	Ameco Teledyne, Inc.	N. View	CA	82189	Chicon	Chicago	IL
15912	Ranley	Los Angeles	CA	82877	Electron Mfg. Co., Inc.	Woodstock	NY
16067	California Instruments Co.	San Diego	CA	82897	Vector Electronics, Inc.	Syner	CA
16750	Delco Radio Div., Gen. Mtrs.	Kokomo	IN	83330	Vermon H. Smith, Inc.	Brooklyn	NY
16879	Denham	Framingham	MA	83486	Sico Tool & Screw Corp.	Rosford	IL
17054	Siliconix, Inc.	City of Industry	CA	85480	Strady W.H. Co.	Milwaukee	WI
18078	Umpeo	Norwalk	CT	86484	RCA	Harrison	NJ
18178	Vactec, Inc.	Norwalk	CT	86928	Santrom Mfg. Co., Inc.	Alhambra	CA
18310	Concord Electronics Corp.	Sunnyvale	CA	87034	Marco-Oak Industries	Anaheim	CA
18324	Synetics	Sunnyvale	CA	88245	Useco Div., Litton Ind.	Van Nuys	CA
18612	Vishay Instruments, Inc.	Monterey Park	CA	90201	Melloy Capacitor Co.	Indianapolis	IN
18679	Scanoe Mfg. Co. (Isero Corp.)	Mountain Top	PA	91508	Auset, Inc.	Alhambra	CA
18720	RCA	Reno	CA	91637	Ode Electronics, Inc.	Columbus	NE
18736	Voltronics Corp.	Reno	CA	91662	Sico Corporation	Willow Grove	PA
19080	Robison Company	Hawthorne	CA	91802	Industrial Devices, Inc.	Edgewater	NJ
21034	Stamping Company	Colton	OH	91813	Industrial Electronics Corp.	New Rochelle	NY
21845	Solution Devices (Semi-conductor Group)	Riviera Beach	FL	91967	National Tel-Tronics	New Rochelle	NY
22599	Elastic Stop Nut Corp.	Van Nuys	CA	92134	Alpha Wire Corp.	Elizabeth	NJ
23050	Perkins Components Corp.	Perkins-on-Hudson	NY	92323	Perkins Products Co.	Washington	DC
23734	Paxator, Inc.	San Francisco	CA	94222	Sauco, Inc.	Lafayette	PA
24011	ECC	Burlington	MA	94696	Negecraft Electric Co.	Chicago	IL
24355	Analog Devices, Inc.	Norwood	MA	95148	Aice Electronic Prod., Inc.	Ms. Andover	MA
24444	AT Semiconductor Inc.	Tampa	FL	95105	CKA	Cincinnati	OH
24794	Facelco, Inc.	Paramount	IN	95354	Method Manufacturing Corp.	Rolling Meadows	IL
24931	Specialty Connector Co., Inc.	Greenwood	IN	95566	Arnold Engineering Co.	Marengo	IL
24972	AGC-Teletsunen Corp.	Sunnysville	NJ	95987	Wecesser Company, Inc.	Chicago	IL
25401	Amelco Electronic Corp.	Elizabet	NY	96908	Electronic Engineering Co.	Santa Ana	CA
25497	Water Master	Los Angeles	CA	97525	Rubber Tech, Inc.	Gardena	CA
26405	Marathon Electric Mfg. Corp.	Bowling Green	OH	98159	Selelecto Corp.	Hawthorne	CA
26806	American Textile, Inc.	Costa Mesa	CA	98271	Burham Co. (West)	Burbank	CA
27014	National Semi-Conductor Corp.	Santa Clara	CA	98776	LERC	Buffalo	NY
27191	Cutler-Hammer, Inc.	Milwaukee	WI	99017	Protectivelosures Co., Inc. (Carpas Div)	Buffalo	NY
27284	Nolex	Downers Grove	IL	99217	Bell Industries, Inc.	Delevan	NY
27335	B & B Motor & Control Corp.	New York	NY	99742	Pernacell	New Brunswick	NJ
				99743	INC	Haywood	CA
				99800	Delevan Electronics Corp.	Aucora	NY

## ONE YEAR WARRANTY

CALIFORNIA INSTRUMENTS CORPORATION warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned freight prepaid, and when examination reveals that the fault has not occurred because of misuse, abnormal conditions of operation, user modification, or attempted user repair. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALIFORNIA INSTRUMENTS will submit an estimate for such charges before commencing repair, if so requested.

## PROCEDURE FOR SERVICE

If a fault develops, notify CALIFORNIA INSTRUMENTS or its local representative, giving full details of the difficulty, including the model number and serial number. On receipt of this information, service information or a Return Material Authorization (RMA) number will be given. Add RMA No. to shipping label. Pack instrument carefully to prevent transportation damage, affix label to shipping container, and ship freight prepaid to the factory. CALIFORNIA INSTRUMENTS shall not be responsible for repair of damage due to improper handling or packing. Instruments returned without RMA No., or freight collect will be refused. Instruments repaired under Warranty will be returned by prepaid surface freight. Instruments repaired outside the Warranty period will be returned freight collect, F.O.B. CALIFORNIA INSTRUMENTS, San Diego, CA. If requested, an estimate of repair charges will be made before work begins on repairs not covered by the Warranty.

## DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed immediately with the carrier. A full report of the damage should be obtained by the claim agent, and a copy of this report should be forwarded to us. CALIFORNIA INSTRUMENTS will prepare an estimate of repair cost and repair the instrument when authorized by the claim agent. Please include model number and serial number when referring to the instrument.