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INSTRUCTION MANUAL

MODEL 251TCA

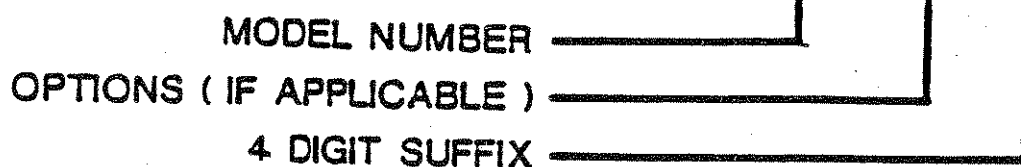
Invertron®

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

3001TCA-PC-3888



SPECIFICATIONS

MODEL 251TCA AC POWER SOURCE

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

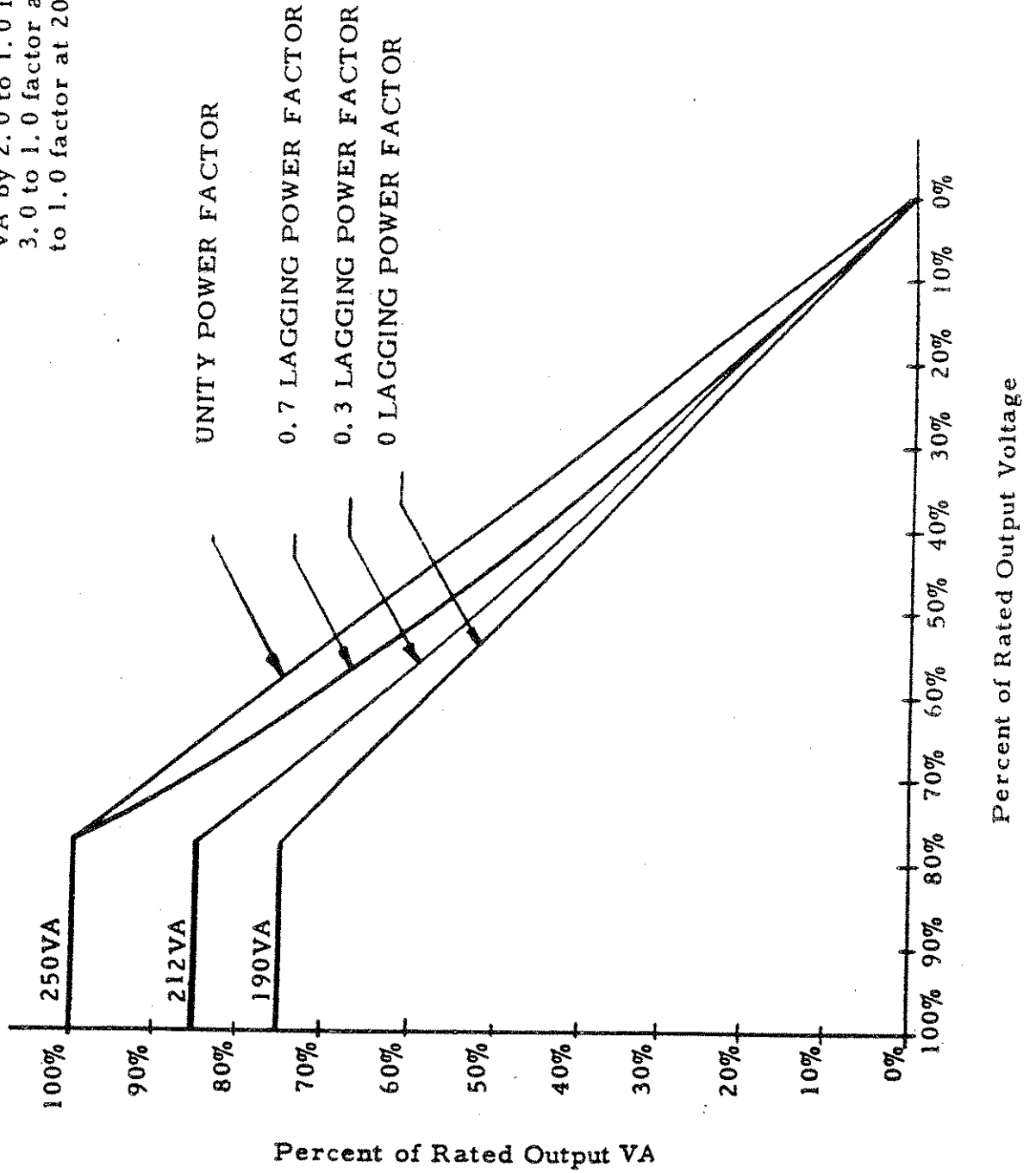
POWER OUTPUT:	250 VA at 105 to 135 volts rms output from unity to ± 0.7 power factor. See derating chart for operation at other output voltages and/or power factor.
OUTPUT VOLTAGE RANGES:	0 to 135 volts rms and 0 to 270 volts rms as determined by rear panel straps.
TOTAL HARMONIC DISTORTION:	Less than 0.30% distortion from 200 Hz to 600 Hz; less than 0.5% distortion from 45 Hz to 5 KHz.
AMPLITUDE STABILITY: (after one hour warm-up)	$\pm 0.25\%$ for 24 hours at constant line, load and ambient temperature conditions.
LOAD REGULATION:	$\pm 1\%$ over the range from 45 Hz to 5 KHz 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 5 KHz.
FREQUENCY RESPONSE:	± 0.5 dB from 45 Hz to 5 KHz.
AC NOISE LEVEL:	80 dB below full output with input shorted; 60 dB below full output at full rated power output.
OVERLOAD AND SHORT CIRCUIT PROTECTION:	Complete protection from overloads and short circuits is provided. Automatic reset occurs when overload is removed.

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

AMPLIFIER DRIVE REQUIREMENTS: (normally obtained from plug-in)	5 volts rms (maximum) produces 135 volts rms.
AC INPUT LINE:	105 to 125 volts rms. Unit may be wired for the following single phase voltages on special order: 208 VAC, 220 VAC, 230 VAC, and 240 VAC.
AC INPUT FREQUENCY:	48 to 65 Hz. (400 Hz available on special order.)
AC INPUT POWER:	950 watts maximum under worst case line and full rated load conditions.
OPERATING TEMPERATURE RANGE:	0 to 55°C.
FRONT PANEL METER:	0 to 320 volt AC voltmeter provides $\pm 1\%$ of full scale accuracy at 400 Hz and $\pm 3\%$ of full scale accuracy over the range from 45 Hz to 5 KHz.
DIMENSIONS:	5-1/4" high x 19" wide x 21" deep.
NET WEIGHT:	70 lbs.
SHIPPING WEIGHT:	75 lbs.
FRONT PANEL FINISH:	Grey, 26440 per Federal Standard 595 with black silk-screened lettering.

**POWER DERATING CHART
FOR MODEL 25ITCA POWER SOURCE**

(Applies over the range from 45 Hz to 5 KHz. Derate the curve for output VA by 2.0 to 1.0 factor at 10 KHz; 3.0 to 1.0 factor at 15 KHz; and 4.0 to 1.0 factor at 20 KHz).



GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction manual contains information of the installation, operation, calibration and maintenance of the California Instruments Model 251TCA 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 251TCA Power Amplifier is a solid state, high performance, low distortion power source that provides up to 250 VA output when used with the proper plug-in oscillator. The Model 251TCA Power Source is illustrated in Figure 1-1. Full power output is available in two different voltage ranges and over the frequency range from 45 Hz to 5 KHz. These full power voltage ranges are:

- 1) 105 to 135 volts rms for normal single phase 115 volt applications and for three phase 208 to 234 volts line-to-line applications.
- 2) 210 to 270 volts rms for normal single phase 230 volt applications and for three phase 364 to 467 volt line-to-line applications.

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 to 500 VA two phase power (Model 500TCA/2-2), or 500 VA of three phase power (Model 500TCA/2-3D) in the open delta configuration. Three power amplifiers will provide 750 VA of three phase power in the wye configuration (Model 750TCA/3-3).

1.3 ACCESSORY EQUIPMENT

The following accessories are available for use with the California Instruments Model 251TCA Power Source.

- 1.3.1 Zero Manufacturing Company Model C300S 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 ϕ , two phase oscillators are designated as 800T-20/20K-1-2 ϕ and three phase oscillators are designated as 800T-20/20K-1-3 ϕ . Calibration accuracy is ± 1 percent at 25°C and amplitude stability is 0.25 percent per 24 hours at 25°C. The total harmonic distortion is less than 0.25 per cent from 20 Hz to 20 KHz. Several versions of the 830T are also available which operate over a more restricted frequency range, but which provide improved frequency resolution.

- 1.3.3 Series 815T Fixed Frequency Oscillators. These low cost fixed frequency oscillators provide one-phase, two-phase or three-phase outputs over the range from 45 Hz to 10 KHz. Units with single-phase output are designated as 815T-Freq.-.1-1 ϕ ; two-phase oscillators are designated as 815T-Freq.-.1-2 ϕ ; and three-phase oscillators are designated as 815T-Freq.-1-3 ϕ . Frequency accuracy is ± 0.1 percent at 25°C. Amplitude stability is ± 0.25 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 0.25 percent from 45 Hz to 999.9 Hz, less than 0.3 percent 45 Hz to 9999 Hz.

WARNING

HIGH VOLTAGE (270 VAC)

Voltages up to 270 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 251TCA 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 251TCA Power Source has been designed to operate from any one of the following AC line voltages, 115 volts, 208 volts, 220 volts, 230 volts, or 240 volts rms. The power transformer is normally wired at the factory for operation from the 115 volts 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
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.	10 ampere 125 volt
208 volts rms	190-226 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 4.	6 ampere 250 volt
220 volts rms	201-239 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 5.	6 ampere 250 volt
230 volts rms	210-250 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 6.	5 ampere 250 volt
240 volts rms	219-261 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 7.	5 ampere 250 volt

- 2.2.2 The Model 251TCA has been designed to operate over the line frequency range from 48 to 65 Hz. On special order, units will be supplied to operate from the 400 Hz line.
- 2.2.3 The normal input power, at rated output, is between 575 and 950 watts depending on line and load conditions. During "turn-on" the peak transient will generally exceed 1500 watts.

2.3 CIRCUIT BREAKER REQUIREMENTS

The Model 251TCA Power Source uses a 10 ampere, Heinemann AM12-10A curve 5 circuit breaker for operation from the 115 volt AC line. A Heinemann AM12-6A curve 5 circuit breaker is used for operation from the 208 volt and 220 volt AC lines. A Heinemann AM12-5A curves circuit breaker is used for operation from the 230 volt and 240 volt AC lines. Substitution of circuit breaker type or current rating may cause permanent damage to the unit.

2.4 OUTPUT VOLTAGE RANGE

The output voltage range is determined by the strapping of terminal strip TB2 located on the rear of the Model 251TCA Power Source. The power source is on the 270 volt range when TB2 terminal 2 is connected to TB2 terminal 3. The 0 to 270 volt output may be taken across pin 1 and pin 4 of TB2 or across J2 and J3, located on the front panel, as desired.

The power source is on the 135 volt range when TB2 terminal 1 is connected to TB2 terminal 2 and TB2 terminal 3 is connected to TB2 terminal 4. The 0 to 135 volt output may be taken across pin 1 and pin 4 of TB2, or across J2 and J3, located on the front panel, as desired.

2.5 ACCEPTANCE TEST PROCEDURE

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

- 2.5.1 Connect the AC line cord to an AC power line of the proper voltage and frequency as determined by either the serial number tag on the unit or by inspection of the wiring to the primary of the power transformer (see Section 2.2 of this instruction manual). Connect a 3 KW Variac and a 3 KW wattmeter in series with the AC line. The Model 251TCA Power Source should draw less than 100 watts under no load conditions at mid-line voltage.
- 2.5.2 Using either a California Instruments 800T Series Oscillator or a suitable external low distortion sine wave oscillator, set the oscillator to the desired frequency (between 45 Hz and 5 KHz) and adjust the output of the oscillator to 5 volts rms. The amplifier input is available at pin 2 (tie oscillator ground to pin 1) of the small terminal strip TB1 located on the rear of the unit, if the external oscillator is employed. Tie a jumper strap from pin 2 to pin 3 of TB1 if an 800T Series Plug-in Oscillator is being used as the signal source.

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

Output Voltage Range	Output Voltage	Full Power Load Resistance	50 Per Cent Power Load Resistance
0-135 volts rms	135 volts rms	73.0 ohms	146 ohms
0-270 volts rms	270 volts rms	291.6 ohms	583.2 ohms

- 2.5.4 Connect the proper 250 watt load resistor to TB2-1 and TB2-4 on the rear of the power source. Connect a Tektronix Model 533A Oscilloscope and a Fluke Model 883A differential voltmeter across this load resistor.
- 2.5.5 Using the GAIN control and the differential voltmeter, set the output voltage to the rated voltage of the unit as determined in Section 2.5.3 of this manual. The power line wattmeter should read 600 to 700 watts at mid-line. Check on the oscilloscope for peak clipping or excessive distortion of the sine wave output.
- 2.5.6 With the output still adjusted as determined in 2.5.5, place a resistor in parallel with the external load resistor to provide a 50 per cent overload on the output of the power source. The value of this resistor is given in Section 2.5.3 of this manual. The signal on the oscilloscope should exhibit significant clipping on both the positive and negative peaks.
- 2.5.7 Remove the 50 per cent overload resistor and the output should automatically return to normal.
- 2.5.8 Place a short circuit in parallel with the external load resistor and then remove the short circuit after a few seconds. The signal on the oscilloscope should go to zero and then return to normal when the short circuit is removed. The front panel circuit breaker may be activated if the short circuit remains across the output for a period of time. Reset the circuit breaker if required.
- 2.5.9 If it is desired to check the Model 251TCA Power Source on the 270 volt range, select this range as described in Section 2.4 of this instruction manual and repeat steps 2.5.3 through 2.5.8 of this procedure.
- 2.5.10 The CALIBRATION PROCEDURE given in Section 4.0 of this manual should be followed if a more detailed evaluation of the unit is required at this time.

2.6 MECHANICAL INSTALLATION

The Model 251TCA Power Source has been designed for rack mounting in a standard 19 inch rack. The unit should be supported from the bottom with a shelf-track or supported from the sides with a pair of rack slides (Zero Mfg. Co. part C300S).

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

2.7 INPUT POWER WIRING

The Model 251TCA 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 6 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 250 VA output at a distance of 20 feet from the power source to the load.

Output Voltage	Maximum Line Drop	Load Current	Loop Length	Minimum Required Wire Size
115 volts	1.15 volts	2.18 amperes	40 ft.	#21
230 volts	2.30 volts	1.087 amperes	40 ft.	#27

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

2.9 FRONT PANEL CONTROLS

2.9.1 The circuit breaker, located on the front panel of the Model 251TCA 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 front panel METER has a full scale range of 320 volts and measures the output voltage of the power source to an accuracy of ± 1 per cent of full scale at 400 Hz and ± 3 per cent of full scale from a 45 Hz to 5 KHz.

2.10 OPERATION OVER EXTENDED FREQUENCY RANGE

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

TABLE 2-2			
Output Frequency	Maximum Safe Sine Wave Output Voltage (rms)		Maximum VA Output at Maximum Safe Output Voltage with ± 0.7 Power Factor Load.
	135 Volt Range	270 Volt Range	
20 Hz	60 V	120 V	125 VA
30 Hz	90 V	180 V	200 VA
40 Hz	120 V	240 V	250 VA
45 Hz to 5 KHz	135 V	270 V	250 VA
5 KHz to 10 KHz	135 V	270 V	125 VA
15 KHz	90 V	180 V	67 VA
20 KHz	67.5 V	135 V	36 VA