



Revision D
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INSTRUCTION MANUAL

1251WP

User's Manual

AC Power Source

California Instruments

Models :

1251WP

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SAFETY SUMMARY

This power source contains high voltage and current circuits which are potentially lethal. Because of its size and weight, mechanical stability must be ensured. The following safety guidelines must be followed when operating or servicing this equipment. These guidelines are not a substitute for vigilance and common sense. California Instruments assumes no liability for the customer's failure to comply with these requirements.

APPLYING POWER AND GROUNDING

Verify the correct voltage is applied to the unit (100 to 240 VAC Nominal). **Verify that the input power cord is plugged into a properly grounded utility outlet.**

FUSES

Use only fuses of the specified current, voltage, and protection speed.

Do not short out the fuse holder or use a repaired fuse.

The 1001WP unit uses a North American ferrule type fuse rated at 15A and 250Volts. (Fast Acting)

The 1251WP unit uses a North American ferrule type fuse rated at 20A and 250Volts. (Fast Acting)

DO NOT OPERATE IN A VOLATILE ATMOSPHERE

Do not operate the power source in the presence of flammable gases or fumes.

DO NOT TOUCH ENERGIZED CIRCUITS

Disconnect the power cable before servicing this equipment. Even with the power cable disconnected, high voltage can still exist on some circuits. Discharge these voltages before servicing. Only qualified service personnel may remove covers, replace components or make adjustments.

DO NOT SERVICE ALONE

Do not remove covers, replace components, or make adjustments unless another person, who can administer first aid, is present.

DO NOT EXCEED INPUT RATINGS

Do not exceed the rated input voltage or frequency. Additional hazards may be introduced because of component failure or improper operation.

DO NOT MODIFY INSTRUMENT OR SUBSTITUTE PARTS

Do not modify this instrument or substitute parts. Additional hazards may be introduced because of component failure or improper operation.

MOVING THE POWER SOURCE

When moving the power source, observe the following:

1. Remove all AC power to unit.
2. Use two people to prevent injury.

SURFACE STABILITY

1. Operate the power source only on a level surface.

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1. Introduction

This manual contains information on the operation, calibration and maintenance of the Model 1251WP.

1.1. General description

The 1251WP unit is a light weight power source that will operate from any AC utility worldwide. Output is selectable for low range, 100V or 115V, operation, or high range, 220V, 230V or 240V, operation, at either 50 Hz or 60 Hz.

The universal nominal input can be from 100 to 240 volts at 50 or 60 Hz. Maximum operating range is 85 to 265 volts.

The maximum output power is 1250 VA - 11 amps at 115V or 5.5 amps at 230 volts. The voltage range is selected by the rear mounted selector switches. The output voltage and frequency can be incremented $\pm 10\%$ and ± 3 Hz respectively by the front panel push button switches.

An internal dip switch on the oscillator assembly allows the selection of 220V, 230V or 240V on the high range and 100V or 115V on the low range. One high range and one low range output voltage may be selected.

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2. Specifications

2.1. Electrical

2.1.1. Input

(115 VAC, 60 Hz, unless specified otherwise)

- Nominal Line Voltage Range: 100 - 240 VAC
- Max Line Voltage Range: 85 - 265 VAC
- Max. Line Current (85V): 20A, Current harmonics per IEC 555-2
- Line Frequency: 45 - 63 Hz
- Efficiency: $\geq 75\%$ (typical)
- Power Factor: 0.99
- Line Inrush Current: $\leq 30A$
- Hold-Up Time: 10 ms (typically 20 ms)
- Isolation Voltage (input-output): 1500 VAC
(input chassis): 1350 VAC

2.1.2. Output

- * Total Power: 1250 VA RMS
- Load Power Factor: 0 to unity
- Current: 11A (115V), 5.5 (230V)
- Repetitive Peak Current: 33A (115V), 16.5A (230V)
- * Voltage Range:
 - Low: 100V or 115V
 - High: 220 VAC or 230 VAC or 240 VAC
 - Limit Conditions: $\pm 10\%$
- * Total Harmonic Distortion:
 - Bandwidth 30 kHz, Linear Load: $\leq 2\%$ (1% typical)
 - Repetitive Peak Load: $\leq 4\%$

Output Noise (20 kHz to 1MHz) RMS: 150 mV (115V) 500mV (230V)

Voltage Accuracy:

Line Regulation (10% line change)

* Load Regulation (Full load change): $\leq 2\%$

* Frequency: 50 Hz, 60 Hz

Limit Conditions: ± 3 Hz (nominal)

Accuracy: $\leq 1\%$

DC Offset Voltage: ≤ 50 mV

Isolation Voltage (output-chassis): 1350 VAC

*Denotes warranted specifications. All other specifications are supplemental.

"WARNING: Failure to use the equipment in a manner specified by California Instruments may impair the protection by the equipment."

2.1.3. Protection

Output Overcurrent : ^{AA}	Constant current mode 15% above rated current.
Output Short Circuit:	Shutdown after approx. 5 secs. Cycle input power ON/OFF to reset.
Output Overvoltage:	Shutdown, recycle input power to reset.
Input Overcurrent:	Electronic Current Limit/Fuse
Input Undervoltage:	Protect, automatic recovery
Input Overvoltage/Transients:	Protect, automatic recovery
Overtemperature:	Shutdown, automatic recovery

^{AA}The Model 1251WP automatically reduces the output voltage until the full load current can be delivered without gross distortion.

The overload indicator is on during this condition. Automatic reset occurs when the load is reduced.

2.1.4. Control

Front Panel Controls

	<u>Control</u>	<u>Indicator</u>	<u>Resolution</u>	<u>Accuracy</u>
Output ON/OFF	√	√		
OVERLOAD		√		
100V		√		1%
115V		√		1%
220V		√		1%
230V		√		1%
240V		√		1%
50 Hz		√		1%
60 Hz		√		1%
Voltage +10%	√	√	10%	1%
Nominal	√	√		1%
-10%	√	√	10%	1%
Frequency +3 Hz	√	√	3 Hz	1%
Nominal	√	√		1%
-3%	√	√	3 Hz	1%
Outputs Live		√		

Rear Panel Controls:

Voltage: High Range, Low Range
 Frequency: 50 Hz, 60 Hz

2.1.5. Internal Controls

Low Range Setting: 110V or 115V
 High Range Setting: 220V, or 230V, or 240V

One low range value and one high range value only may be selected.

2.2. Mechanical

Dimensions: 8.5" (216 mm) H, 8.75" (222mm) W, 18" (457 mm) D

Weight: 30 lbs. (13.6 kg)

Air Intake/Exhaust: Sides/Rear

Connectors:

- Input: IEC 320 - C20
- Output: U.S. duplex (Nema 5-15P) European (Schuko CEE7/7, square face plate)

2.3. Environmental

Operating Temperature:	0°C to 40°C
Storage Temperature:	-40° to +85°C
Humidity:	Operating: ≤90% RH up to 40° C.
Storage:	≤90% RH up to 40° C, ≤75% RH up to 70° C.
Creepage and Clearance:	Rated for Pollution Degree 2.
Insulation:	Rated to Installation Category(Overvoltage Category) II
Operating Altitude:	7500 ft.
Vibration:	Transportation level
Shock:	Transportation level
Quality Level:	Commercial components

2.4. Regulatory

Electromagnetic Emissions:	CISPR 11
Acoustic Noise:	Less than 60 dBA, 3 ft., no load to 50% load, 65 dBA full load
Safety:	UL3111 Listed and CUL CAN/CSA C22.2 No 1010.1-92 listed (Both based on IEC 1010).

3. Unpacking and Installation

3.1. Unpacking

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. Do not destroy the packing container until the unit has been inspected for damage in shipment.

3.2. Power requirements

The unit has been designed to work from any single phase utility supply. The IEC 320 input connector will accept a standard IEC line cord with the appropriate mating connector for the utility output. The utility outlet must be properly grounded and be capable of supplying 1725 VA at 100 to 240 volts in order to deliver full output power.

3.3. Mechanical installation

The 1251WP unit is a completely self contained portable unit. The cooling of the unit is accomplished by an internal fan that draws air in at the rear of the unit and expels it at the sides.

Both sides and rear of the unit must be kept free of obstructions and a 1" clearance from other equipment or structures should be maintained.

3.4. Output Connections

When the low range is selected, only the duplex U.S. NEMA 5-15P output socket will be active.

If the high range is selected, only the European CEE7/7 socket will be active.

3.5. Functional Test

Ensure that the input power switch located on the rear panel is in the OFF position.

Select required output voltage and frequency by the position of the two slide switches on the back panel. NOTE: The input power should always be in the OFF position when the output range is changed.

Plug the unit into the AC power and turn the OFF/ON switch on the back of the unit to ON.

Enable the output by pressing the output ON/OFF switch on the front panel. The output "ON" light will be energized as well as one of the output voltage indicators and one of the frequency indicators. These indicators should correspond to the voltage and frequency selected. The neon lamp above the sockets will also be ON, showing power is present.

The push button switches on the front panel will select either $\pm 10\%$ output voltage and/or ± 3 Hz of the output frequency. The voltage and frequency deviation selected will be indicated by front panel LEDs.

4. Operation

4.1. General

The input power ON/OFF switch and the OUTPUT VOLTAGE range switch and FREQUENCY switch are mounted on the rear panel. All other controls including the output ON/OFF switch are mounted on the front panel except for the actual individual output voltage selection which is determined by DIP switch selection inside the unit.

4.2. Rear Panel Controls

The ON/OFF switch mounted at the back of the unit interrupts both input power lines and removes all power from the unit. **The voltage selector on the rear of the unit selects either the high range of voltages (220V, 230V, 240V) or the low range of voltages (110V, 115V). These individual voltages are preset by the internal switches. (See internal controls later in this section). The frequency control switch selects either 50 Hz or 60 Hz output.

4.3. Internal Controls

An internal DIP switch located on the oscillator board at the front left hand side of the unit controls the HI and LOW range output voltages. Slide open small door to access switches.

CAUTION

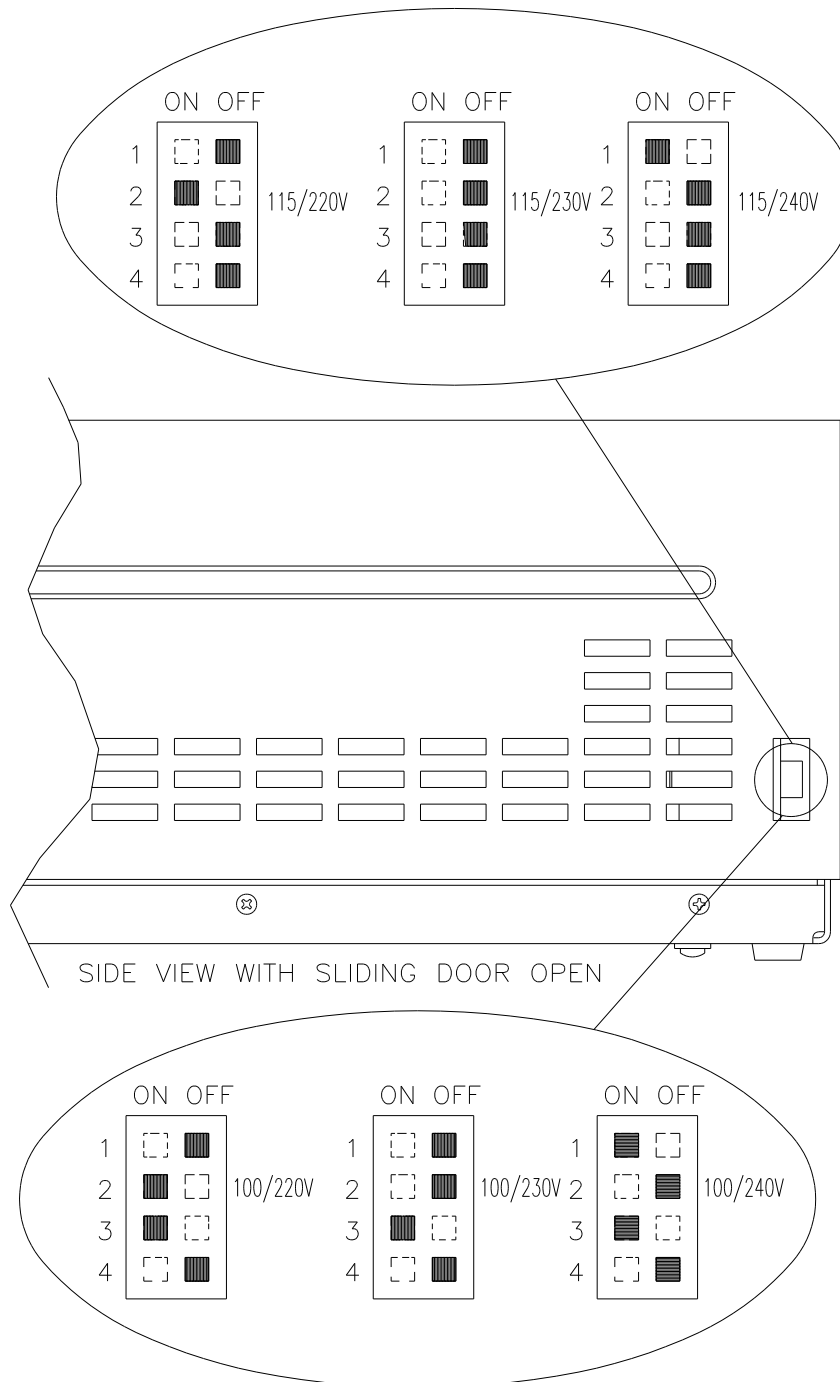
DISCONNECT THE INPUT LINE CORD AND ALWAYS WAIT 5 MINUTES BEFORE SLIDING THE DOOR OPEN TO ALLOW INTERNAL STORED VOLTAGES TO DECAY. SEE FIGURE 4-1.

INTERNAL DIP SWITCH SELECTOR				
Switch #	1	2	3	4
100	*	*	ON	*
115	*	*	OFF	*
220	OFF	ON	*	*
230	OFF	OFF	*	*
240	ON	OFF	*	*

CLOSE SLIDING DOOR AFTER CHANGING SWITCH POSITIONS BEFORE RECONNECTING LINE CORD.

* N/A

**SWITCH INPUT OFF BEFORE CHANGING VOLTAGE RANGE

Figure 4-1: Dip Switch Location Oscillator PC Assembly

4.4. Front panel controls

The OUTPUT ON/OFF switch, electronically inhibits the operation of the output. It does not mechanically disconnect or isolate the output wiring.

The VOLTAGE control push button switches select nominal or $\pm 10\%$ of the programmed output voltage. The FREQUENCY push button switches will select either nominal or ± 3 Hz of the 50 or 60 Hz frequency selected.

4.5. Front Panel Indicators

The OUTPUT ON/OFF indicator light when lit shows that the output is on. The red overload light will be lit if the output load is 5% or more than full rated load.

The appropriate VOLTAGE indicator light will be lit once the unit is energized, even if the output ON/OFF switch is off. The LEDs next to the VOLTAGE select switches will be lit to show whether +10%, nominal, or -10% has been selected.

In the FREQUENCY control panel section either the 50 Hz or 60 Hz indicator will be lit. The +3 Hz, nominal, or -3 Hz LED will be on depending on the selection mode.

Output voltage light above outlets will be lit whenever high voltage is present.

4.6. Rear Panel Connections

An IEC 320-C20 type input connector is provided for input power. The input cord must be sized correctly to carry the input current at the input operating voltage. This is 20A at low input voltages, (100-126V), or 10A at high input voltages (200V to 265V).

4.7. Front Panel Connections

The output is available from a duplex USA style connector and a single European style connector. If the low range is selected, the US style connector is live and the European connector is not active. If the high range is selected then only the European connector can deliver power. When the power is present on the output sockets, the neon lamp above them will be lit.

5. Calibration

5.1. General

Calibration is not normally required as all modules are factory preset and sealed in order for them to be field interchangeable. A digital multimeter may be connected to the output sockets and the different output voltages selected to verify that the output is within the accuracy specified in the "SPECIFICATIONS".

A frequency or Universal Counter with an accuracy of greater than 0.1% may be used to verify the output frequency accuracy. The frequency counter should be connected by means of a 10:1 probe to prevent damage to the input circuits.

6. Principle of operation

6.1. General

The unit is designed to be operated from any supply from 100 to 240 volts AC, 50 or 60 Hz and deliver any one of 5 preset voltages from 100 to 240 volts at either 50 or 60 Hz.

6.2. Overall description (see Figure 6-1)

The AC input is fed to a power factor-correcting, boost-type converter. This converter steps the voltage up to 385 VDC while drawing only sinusoidal unity power factor current from the input power line.

The DC to DC converter provides isolation and changes the voltage to 250 VDC or 400 VDC depending on whether the low output range or high output range is selected.

The A.C. converter develops an AC sine wave voltage at the output that is either 50 or 60 Hz depending what is selected.

The oscillator board provides the reference signal to the AC converter and has the front panel switches mounted on it to control the output frequency and voltage.

6.3. Power Factor Correction module (see Figure 6-2) (PFC)

The P.F.C. consists of an input EMI filter, input bridge and a boost converter. The boost converter is PWM controlled by a single chip that adjusts the pulse width during the cycle so that only a pure sine wave CURRENT is drawn from the supply. An auxiliary winding on the boost inductor provides "bootstrap" power to the logic circuits and is self sustaining.

6.4. DC - DC Converter module

The 385 VDC from the boost converter is fed to the DC-DC module. It first supplies 385 volts DC to the Auxiliary Power Supply (Aux. P.S.). When the Aux starts up and runs, it supplies 6 isolated logic level supplies to the A.C. module. It also supplies 15 volts to the D.C. converter on the same D.C. module. The DC-DC converter then can start running. The D.C. converter supplies either 250 volts DC or 400V DC to the DC-AC module.

The DC-DC converter is a full bridge converter and the auxiliary converter is a two FET forward converter.

All the 8 LEDs on the DC-DC board should be lit under normal operation. The LED DS200 is lit when the DC output is up and within regulation. The amber LEDs DS5, DS4 and DS3 indicate that 15V power to the optocouplers on the AC Converter are within regulation. The red and green LEDs DS7 and DS6 indicate logic power OK to the AC converter. The LED DS8 shows logic power to the DC converter is within specifications at 15 volts. The LED DS2 shows 24 volt fan power is available.

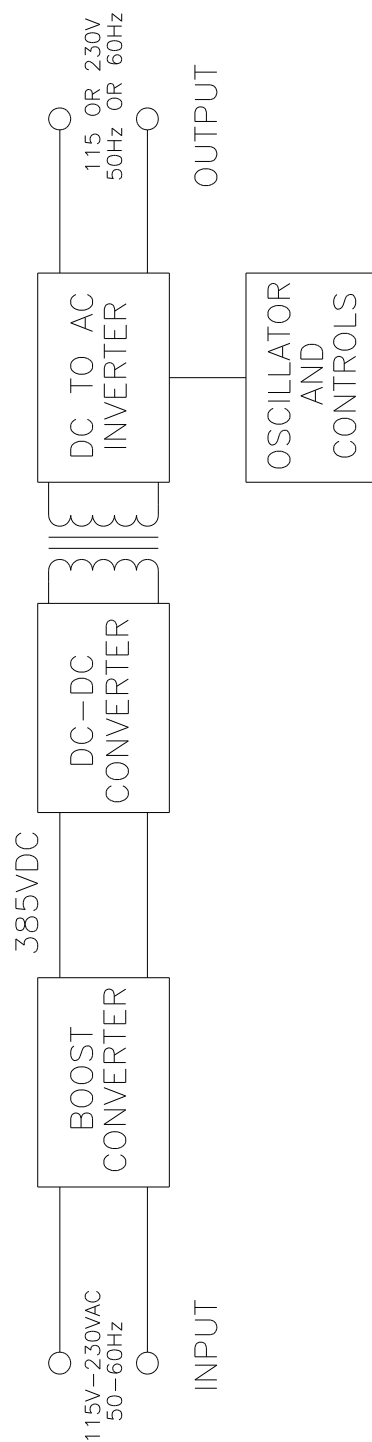
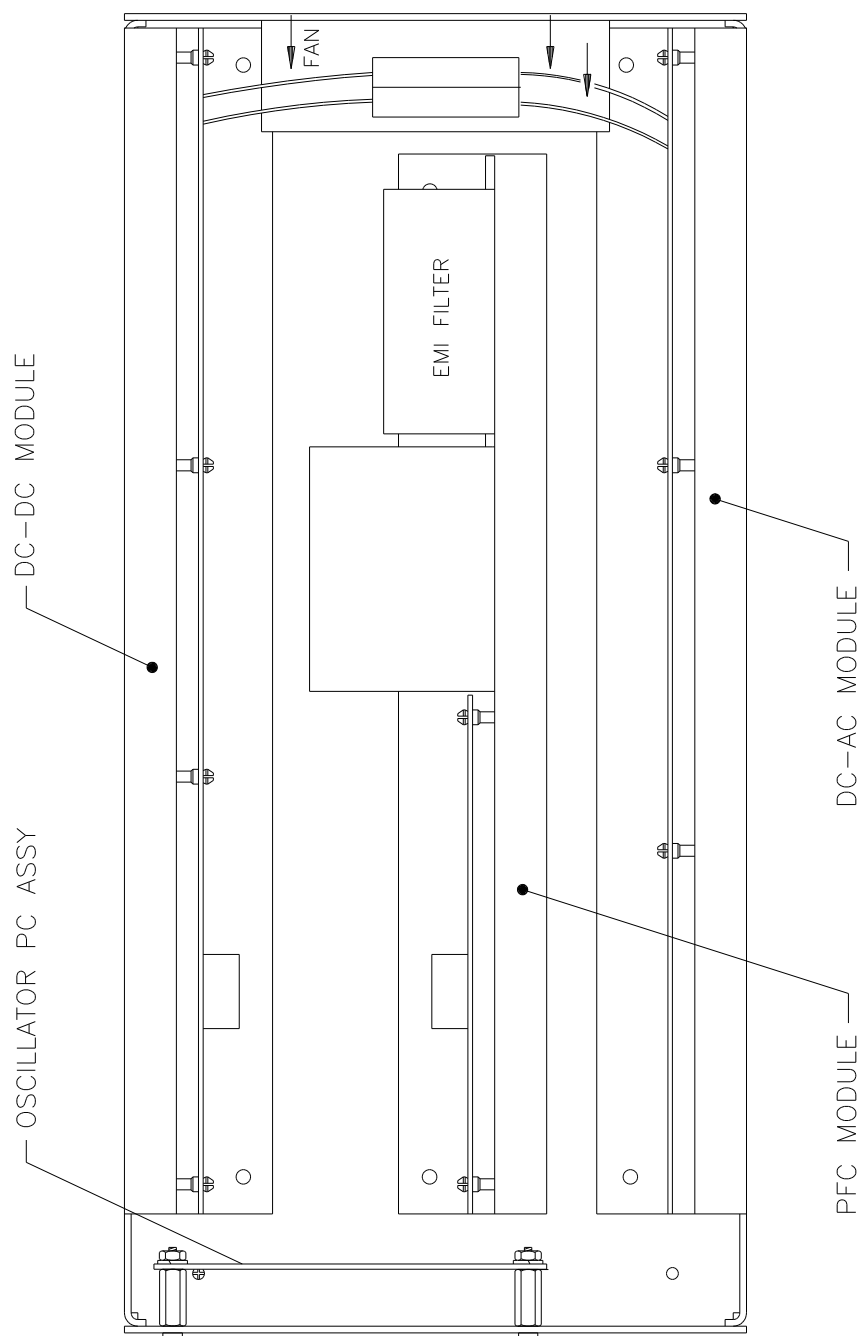
Figure 6-1: Block Diagram Portable Frequency Converter

Figure 6-2: 1251WP Top View (with cover removed)



6.5. Oscillator control board

The oscillator board receives power from the DC-AC module. This board uses programmable logic devices, PLDs, to control the frequency and amplitude of the reference signal used to control the AC converter output.

6.6. DC to AC Power Module

The DC to AC Power Module takes a 250V DC input and generates the 100V or 115 volt directly coupled low range A.C. outputs. When supplied with 400 volts DC the AC module develops a 220V, 230V or 240V directly coupled AC output. The output converter is a P.W.M full bridge with L.C. filtering on the output. The switching frequency is 31.25 kHz.

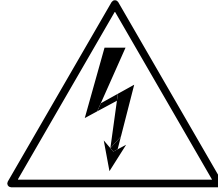
The module has pulse by pulse peak current limit and sinusoidal average current limiting to protect the power transistors and the load.

A slight overload of 20% will cause the output voltage to sinusoidally decrease in a constant current mode (e.g. output voltage would reduce to 100V at 13 Amps on the 115V output range) after approximately 1 second.

A heavy overload slowly applied will cause the output voltage to sinusoidally reduce down to 15 to 20 volts and the current to be constant at 13 Amps approximately.

Reducing the load to zero ohms (short circuit) will cause the peak current limit to come into effect limiting the current peaks to 35 Amps. This will continue for 3 to 5 seconds and then the unit will latch off until AC input power is recycled.

Applying a sudden overload (e.g. 3 ohms to a 115V output) will cause the converters supplying the AC converter to go into current limit and reduce the DC bus available to the AC converter. The AC converter will be forced to peak clip, flat topping the output waveform. After one second, the output will reduce sinusoidally into the constant current mode of 1 and 2 above.



CAUTION

**VOLTAGES UP TO 270 VAC AND 410 VDC ARE PRESENT
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.**

7. Maintenance and Troubleshooting

7.1. General

This section describes the suggested maintenance and troubleshooting procedures. Table 7-1 lists the symptoms and paragraph numbers for the troubleshooting section. If the frequency converter does not appear to function normally use this section to isolate the problem. The troubleshooting is broken down into two sections; first level and advanced. Only qualified electronic technicians should attempt the advanced troubleshooting section.

If the problem cannot be found using these steps, consult the factory.

Table 7-1: Troubleshooting

PARAGRAPH		PAGE NO.
7.2	POOR OUTPUT VOLTAGE REGULATION	17
7.3	OVERLOAD LIGHT ON	17
7.4	DISTORTED OUTPUT	18
7.5	UNIT SHUTS DOWN AFTER 3-5 SECONDS	18
7.6	NO OUTPUT	18

7.2. Poor output voltage regulation

a) Unit is overloaded	Remove overload
b) Unit is switched to wrong voltage range, causing overload	Turn off unit and select correct output voltage range.
c) Input line has fallen below 85 volts	Check supply voltage.

7.3. Overload light is on

a) Unit is overloaded	Remove overload
b) Unit is switched to too high voltage range	Turn off unit and select correct output voltage range

7.4. Distorted output

The AC power system output may have a distorted sine wave from the following causes:

a) Power source is grossly overloaded	Reduce overload
b) The crest factor of the load exceeds 3:1	Reduce load current peaks

7.5. Unit shuts down after 3-5 seconds

If the unit appears to run but shuts down after 3-5 seconds, it is probably due to one of the following causes:

a) Output shorted	Remove output short
b) Output grossly overloaded	Remove overload
c) Operating load with too high inrush or start up currents that last more than 3 seconds	Consult factory for application advice

7.6. No output

a) No output and no lights on front panel	Is the rear panel power switch in the "ON" position? Is unit plugged in to a "live" supply? Are power cords in good condition? Is fuse blown? Check fuse and replace with same type and rating.
b) No output but LEDs on front panel are lit.	Is "output on" switch depressed? Is power cord plugged into the correct socket output? Only the USA socket is energized when low range is selected, etc. Is the appliance being operated switched on?

7.7. Advanced troubleshooting. Only personnel with electrical/electronic knowledge should proceed beyond this point.

Switch off unit. Remove line cord and wait 5 minutes for all internal capacitors to discharge.

Remove cover screws and remove cover.

Step 1: Ensure all connectors are properly mated and there are no broken wires.

Step 2: Plug unit in and observe the LEDs.

a) No output, no front panel LEDs	Is LED on P.F.C. unit lit? OK if flickering with no load on output. If not lit, check input fuse and wiring on P.F.C. module. P.F.C. module is the one in the center. If lamp is not lit and power is available at the EMI filter, replace P.F.C. module. If LED is lit, proceed to DC-DC converter. The DC-DC converter is on the left hand side when looking at the front. Are LEDs lit on the DC to DC board?
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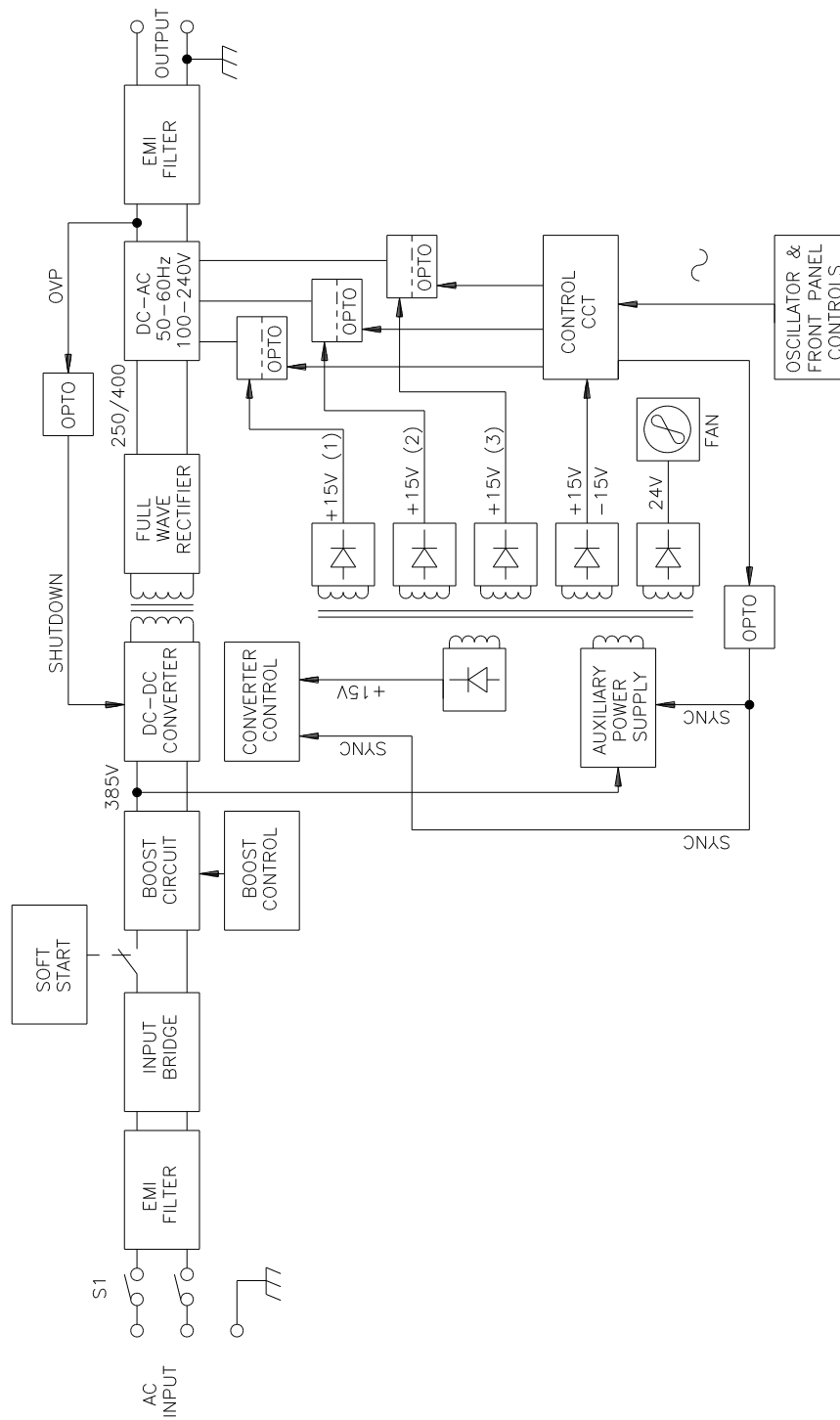
Figure 7-1: Block Diagram Portable Frequency Converter

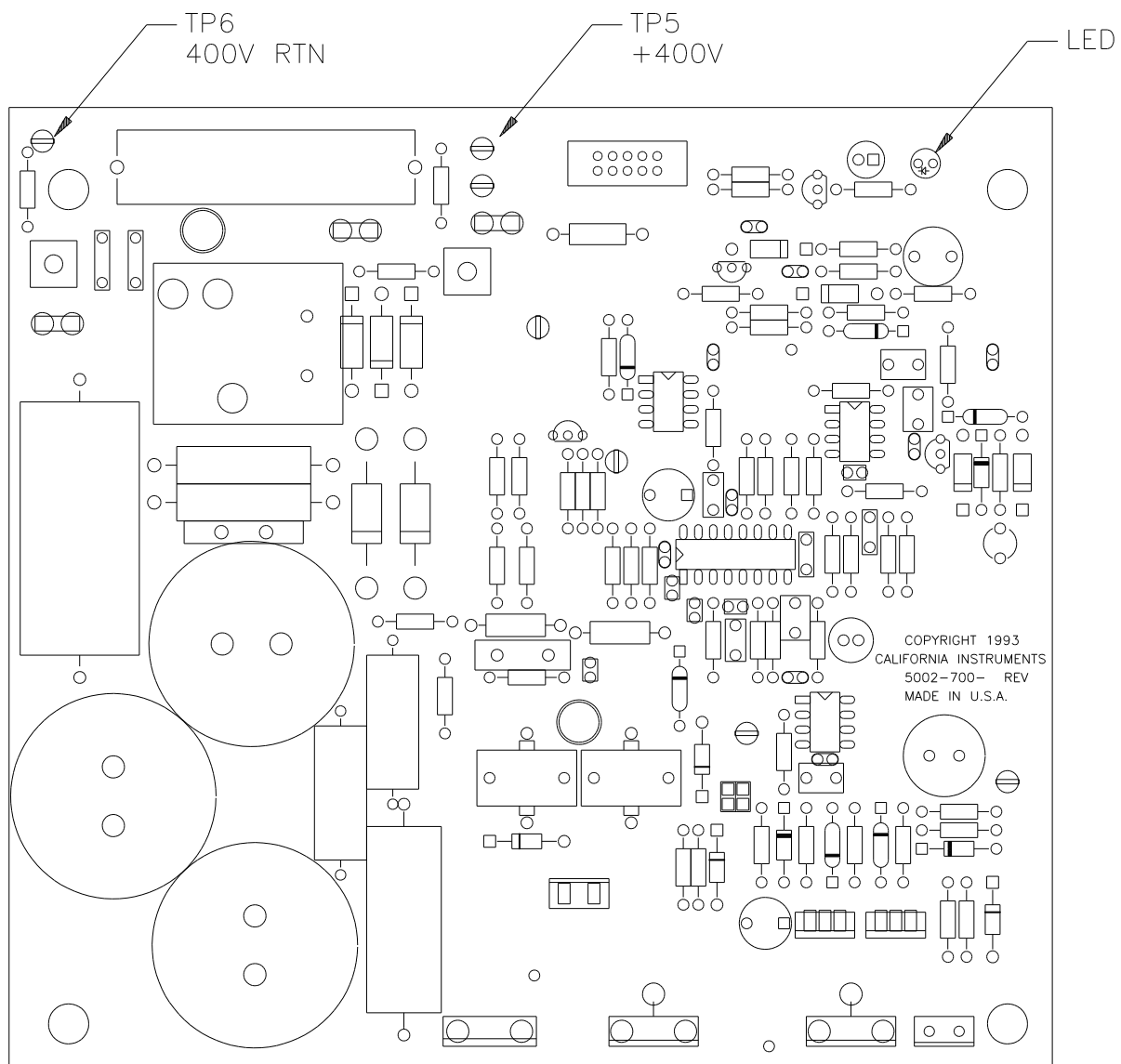
Figure 7-2: Test Point Locations (PFC Module)

Figure 7-3: Fuse and Led Locations (DC - DC Module)

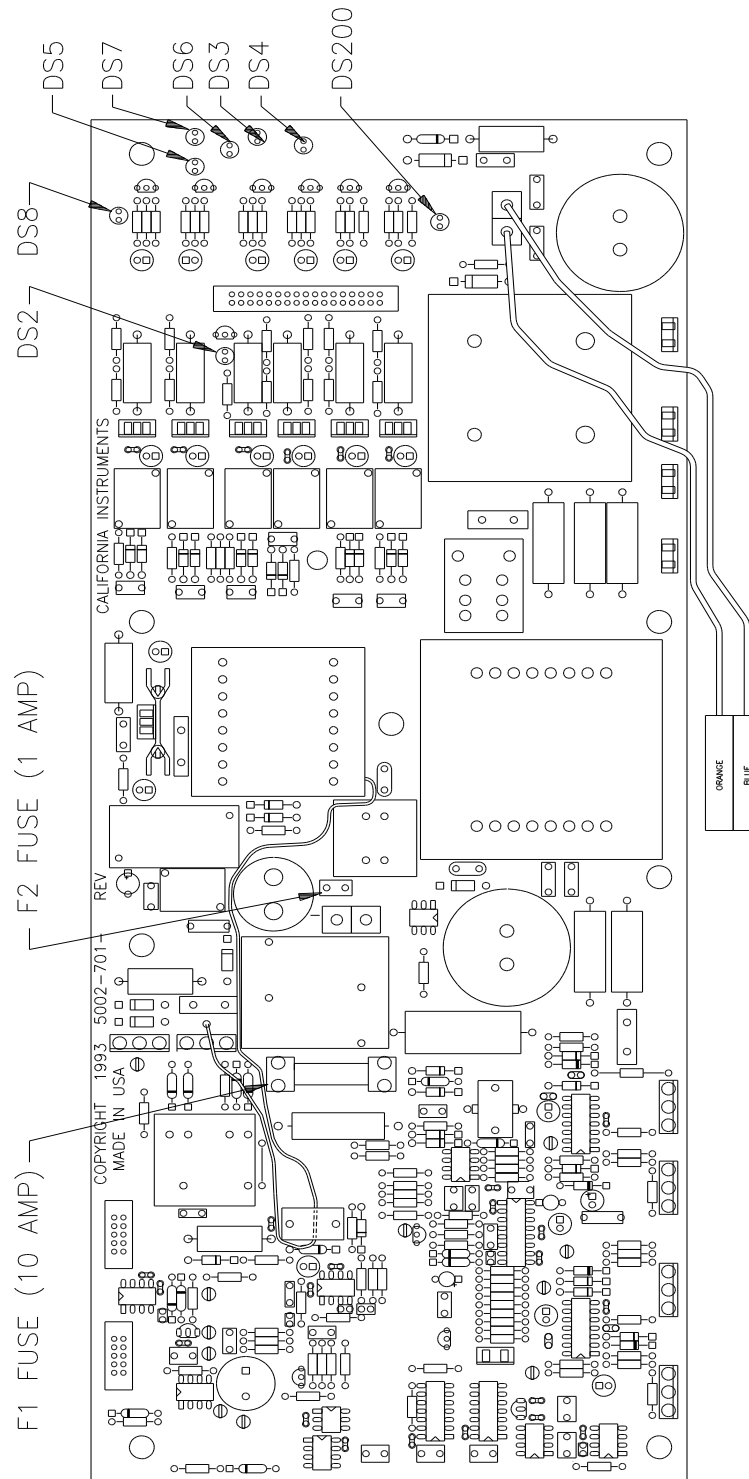
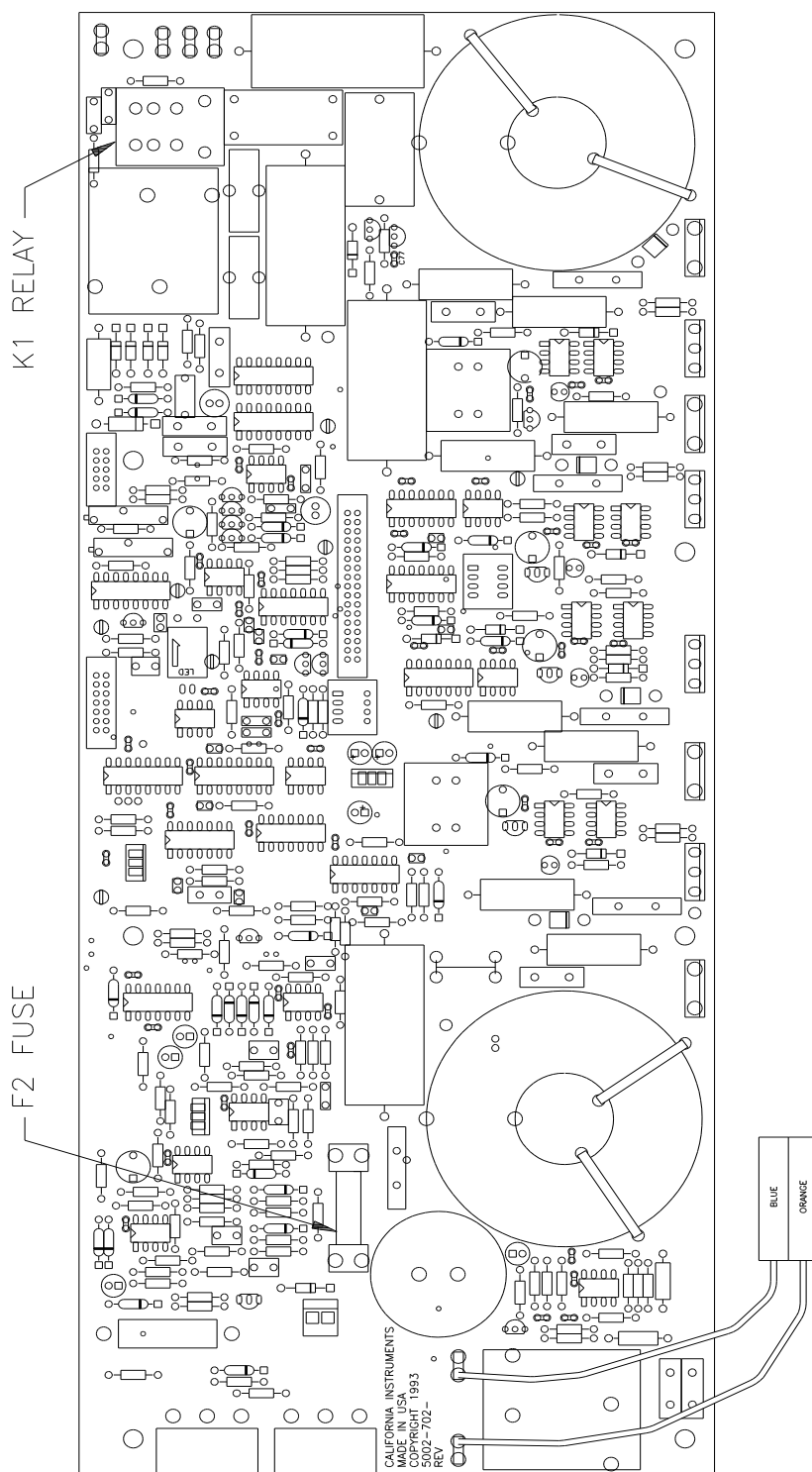


Figure 7-4: Fuse and Relay Locations (DC - AC Module)

YES	NO
If LEDs on the DC-DC board are lit and front panel LEDs are not lit, the problem is probably in the large ribbon cable that runs between the DC-DC and the AC converter.	Check fuses on the DC-DC converter board. There is a 3 AMP (F2) fuse and a 10 Amp (F1) fuse both located in the center of the PC board. You will have to remove the two screws at the bottom of the unit to remove the module in order to replace the fuses. TURN OFF THE UNIT AND WAIT 5 MINUTES BEFORE REMOVING MODULE. If fuses are blown and there are signs of burn marks on the components, do not replace fuses and power up. Replace DC-DC module.
b) No output. LEDs on front are lit.	Plug unit in and switch on. Are all the LEDs lit on the DC-DC board? 3 amber LEDs (DS3, DS4, DS5) - if one or more of these LEDs is not lit the trouble is on the DC-AC board. Unplug the cable to the DC-AC module (after safely removing power). If all the LEDs are lit after power up, replace the DC-AC module as it has a shorted gate drive and probably blown power transistors. Red and green LEDs, DS6 and DS7, on the back of the board provide power to DC-AC and the oscillator board. If either of these are not lit, switch off power, remove large ribbon cable from DC-DC converter and power up again. If LEDs are lit, the problem is on the DC-AC or the oscillator board. If the LEDs remain off, replace the DC-DC board. If LED, DS8, is not lit, no power will be available to run the DC converter drive logic. Replace DC-DC module. LED, DS2 (red), indicates 24V fan power available. LED, DS200, will be lit if the DC converter is running. If DS200 is not lit check fuse F1 on the DC-DC board as in paragraph 7.7(a) above. If all LEDs are lit and neon output voltage indicator is ON but no output, then suspect relay on DC-AC board.

If all 8 LEDs are lit on the DC-DC converter then the problem is on the DC-AC module. Switch off, then check wiring from the DC-AC board output to the output sockets on the front panel. If this is OK check the fuse, F2, on the DC-AC module. Switch off. Remove two screws from the underside of the enclosure to gain access to the module and F2. If the fuse is blown and a check shows signs of damage or burning on the board, **DO NOT REPLACE FUSE**. Replace DC-AC module. If there are no signs of burning or damage on the DC-AC board or components, then it could be assumed that it is a random fuse failure and it would be OK to replace the fuse and try again.

WARNING: In most cases when a fuse blows it is caused by a failed power semiconductor and repeatedly replacing a fuse will only cause severe damage to that or other assemblies.

8. Top Assembly Replaceable Parts

8.1. General

This section contains ordering information and a list of replaceable parts. The list includes the parts description and California Instruments part numbers.

8.2. 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 subassembly where the component is located. (PARENT ITEM NO.)
- c. Component reference designator. (SEQ NO.)
- d. Component description.
- e. Component manufacturers' FSCM number. (VENDOR)
- f. California Instruments' part number. (COMPONENT ITEM NO.)

All replaceable part orders should be addressed to:

California Instruments
Attention: Customer Service
9689 Towne Centre Drive
San Diego, California 92121

TOP ASSEMBLY 1251WP 5002-406-1

Table 8-1: Replaceable Parts

SEQ#	C.I.PART #	DESCRIPTION	VENDOR	QTY.
A1	5002-401-1	HEATSINK ASSEMBLY, PFC	16067	1
A2	5002-402-1	HEATSINK ASSEMBLY, DC-DC	16067	1
A3	5002-403-1	HEATSINK ASSEMBLY, DC-AC	16067	1
A4	5002-703-3	PC ASSEMBLY, OSCILLATOR	16067	1
B1	241184	FAN, 4 INCH, M24CDX	0D1M6	1
*F1	270176	FUSE, 20A,250V	71400	1
J1	410640	CONNECTOR,RCPT,3 PIN,PWR INPUT	61935	1
J2	410621	CONNECTOR,AC,RCPT,3W,DUP.125V	72041	1
J3	410589 (PC FURN)	CONNECTOR,RCPT,3 SOC,EUROPEAN	5F520	1
S1	240547	SWITCH,ROCKER,SPDT	82389	1
XF1	250587	FUSE HOLDER, CHASSIS	61935	1
	250596	FUSE CARRIER,1-1/4"X 1/4	61935	1
		FUSE CARRIER,5 X 20mm	61935	1
CR1	310324	BRIDGE RECT,FW,35A,800V	04713	1
F1	270182	FUSE,10A, 250V, (PFC BOARD)	61935	1
F1	270151	FUSE,10A, (DC-DC BOARD)	71400	1
F2	270183	FUSE,3A, -PCC3 (DC-DC)	71400	1
F2	270167	FUSE,15A, (DC-AC BOARD)	71400	1
USER REPLACEABLE REAR PANEL INPUT FUSE				
INPUT FUSE		BUSSMAN PART NO.		
*FUSE 20A, 250V		ABC-20		

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 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 number 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 9025 Balboa Avenue San Diego, CA 92123-1509. 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 when 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.