

# Model PVIV-10A

## PVIV 10Amp System



## User's Manual

**DRIEL**  
**INSTRUMENTS**  
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Please read these instructions completely before operating this equipment. The specification and operating instructions apply only to the model(s) covered by this manual. If there are any questions or problems regarding the use of this equipment, please contact Newport or the representative from whom this equipment was purchased.

## 1 INTRODUCTION

This manual covers the setup and operation of the Oriel® PVIV 10Amp System, which utilizes a high precision 10x current amplifier. This device is driven by the Sourcemeter® it is connected to, and is tailored to the purpose of IV curve measurement of photovoltaic cells.

The current amplifier is a four-quadrant, bipolar voltage and current supply, which allows for smooth and linear transition from sourcing to sinking, through positive and negative voltages. It extends the current measurement capability of the Oriel® PVIV family up to 10 Amps continuous sourcing, and 4 Amps sinking, within a  $\pm 2.5$  Volt compliance range.

This manual serves as a supplement to the MPVIV Manual, covering information specific to the Oriel® PVIV 10Amp System. The MPVIV Manual provides information on the operation of the 91540 PVIV software, as well as additional PVIV system information, and is provided in .pdf form on the USB drive included with the shipment.

### UNPACKING THE ORIEL® PVIV 10AMP SYSTEM

The Oriel® PVIV 10Amp System consists of the following components:

**PVIV-10A**      The Current Amplifier, SourceMeter®, software, and interconnection cables:

QTY	PART NUMBER	DESCRIPTION
1	PVIV-10A-I-AMP	PVIV 10A CURRENT AMP
1	2400	KEITHLEY 2400 SOURCEMETER
1	51-10-010	GPIB CONTROLLER FOR HS USB 2.0
1	91540	PVIV SOFTWARE rev 2.1
1	68700-1030	ASSY INTERLOCK PLUG
1	91530-1030	CABLE, SOURCEMETER TO SHUTTER
1	70016	2M STANDARD BNC CABLE
1	90009203	CABLE BNC MALE TO DBL BANANA PLUG
3	90026573	CABLE DBL BANANA PLUG BOTH ENDS 5FT
2	100783	CABLE DBL BANANA TO MINIGRABBER 3FT
2	90034536	BANJACK TO 2 PINJACK ADAPTOR
1	M-PVIV-10A	MANUAL FOR PVIV 10A SYSTEM

Some of the cabling may not be implemented depending on the fixture apparatus that is supplied or purchased by the user.

## SAFETY CONSIDERATIONS

### ELECTRICAL



The high current capability of the Oriel® PVIV 10Amp Current Amplifier may cause high temperatures in connections that have excessive resistance.

Recommendations:

Make sure connection surfaces are wiped clean and connections are tight.

Use caution when handling the test sample after testing.

Use connections at the OUTPUT CURRENT binding posts that prevent finger accessibility to bare metal.

Do not use a forward voltage scan limit that far exceeds the Voc for the solar cell under test. This may cause excessive heat dissipation within the solar cell.

When performing a Dark IV test, do not use a reverse voltage scan limit that may exceed the reverse breakdown voltage for the solar cell under test. This may cause irreversible damage in the form of micro-shunting, which are localized shorts that degrade performance.

## FRONT PANEL JACKS AND INDICATORS



There are 3 LEDs on the PVIV 10A I-AMP front panel. Whenever the power supply is turned on, at least one of the LEDs should be lit to indicate the power supply status.

**READY LED** -- This Green LED is ON when the internal voltage rails are normal.

**ACTIVE LED** -- This Green LED is ON when the SHUTTER IN is activated LOW and the INTERLOCK input is a closed circuit, either with the shorting plug or with a user supplied safety switch circuit. This coincides with the output relay closing, which provides current to the CURRENT OUTPUT terminals.

**FAULT LED** -- This Red LED is ON or FLASHING when the output is ACTIVE during a test and a circuit detects that the output current is not precisely 10 times the input current. This may indicate an out of range condition, improper wiring, or oscillation.

There are two sets of 5-way binding posts on the PVIV 10A I-AMP front panel, to which can be connected any of the following: 0.080" phone tip plug, 1/4" spade lug, standard banana plug, alligator clip, or wire.

**CURRENT INPUT** -- The direction for maximum output current capability occurs when current (up to 1.0A) is flowing into the BLACK terminal and out of the RED terminal. The polarity is marked this way so that the Keithley<sup>®</sup> INPUT/OUTPUT connections are RED to RED, and BLACK to BLACK when used in conjunction with the PVIV software. Current is internally PTC foldback limited to less than 1.5A.

**CURRENT OUTPUT** -- The direction for maximum output current occurs when current (up to 10A) is flowing into the RED terminal and out of the BLACK terminal. The polarity is marked this way so that the solar cell positive lead connects to RED, and the solar cell negative lead connects to BLACK. This makes it consistent with the Keithley<sup>®</sup> 4-WIRE SENSE RED and BLACK connections at the solar cell, when used in conjunction with the PVIV software. An internal output relay allows current to flow only when the **ACTIVE LED** is ON.

## REAR PANEL CONNECTIONS



There are 5 connection points on the rear panel:

**INTERLOCK** -- This cinch connector requires a TTL logic LOW or shorted input to activate the CURRENT OUTPUT and the **SHUTTER OUT**. It may be connected to a safety interlock circuit consisting of one or more switches activated by a safety shield at the solar cell test area. A shorted plug is otherwise provided, P/N 68700-1030.

**SHUTTER IN** -- This BNC input requires a TTL logic LOW input to activate the **SHUTTER OUT**. This is intended to be connected to the Keithley® **DIGITAL I/O** DB9 connector using the 91530-1030 cable when used in conjunction with the PVIV software.

**SHUTTER OUT** -- This BNC output provides a TTL logic LOW output to activate the shutter on an Oriel solar simulator or other light source. This is intended to be connected to the **SHUTTER** BNC using the 70016 cable when used in conjunction with the PVIV software. There are time delays incorporated into the electronics to ensure that the output relay closes before the shutter is activated open, then the shutter closes before the output relay deactivates output. This “dry switching” enhances relay contact reliability.

**POWER ENTRY MODULE** -- This module provides the mains switch, an IEC 320 mains receptacle for power cord attachment, mains voltage selection, and fuse holder.

**GROUND STUD** -- If the power cord does not provide an earth ground of the facility's power system, this 10-32 stud adjacent to the power connector is available to connect to, using a wire sized at least 16 AWG, and not more than 5 feet (1.5 meters) long.

## 2 SETTING UP THE ORIEL® PVIV 10AMP SYSTEM

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### SOFTWARE INSTALLATION

Refer to section 7 of the accompanying MPVIV Manual for software installation instructions.

### GENERAL

The PVIV-10A-I-AMP, Keithley® 24xx series SourceMeter®, the solar cell fixture, and the computer should be placed close to each other for the cables to reach. The PVIV-10A-I-AMP may be stacked on top of the Keithley® 24xx series SourceMeter®, but otherwise should be removed from major sources of heat.

Allow sufficient clearance around the fan in the rear, and the exhaust vent holes on the sides for proper cooling and airflow through the PVIV-10A-I-AMP.

Prior to plugging in the AC power cord, verify that the correct mains voltage is selected. The white number on the red background of the power entry module indicates the selection. For 100 - 130 VAC operation use the 115V position, and for 200 - 240 VAC use the 230V position.

### Re-configuring the Power Input Module:

This power entry module provides the mains switch an IEC 320 mains receptacle for power cord attachment, mains voltage selection, and fuse holder. To access the voltage selector/fuse module, remove the mains cord and the cover/fuse block assembly with a small bladed screwdriver or similar tool. Pull the module straight out to retrieve the fuses. The two 5 x 20mm fuses should be placed on the innermost terminals. According to the AC mains Voltage, use:

1.5A, T type (slow blow), 250V, 5 x 20 mm fuses for 115VAC nominal operation  
0.8A, T type (slow blow), 250V, 5 x 20 mm fuses for 230VAC nominal operation

Reinsert the module, rotate the module to change the mains voltage selection if necessary, close the cover, and check that the appropriate mains voltage is displayed in the window.

This unit has been set at the factory, based on destination, for either 115 VAC/North American fused operation or 230 VAC/European operation.

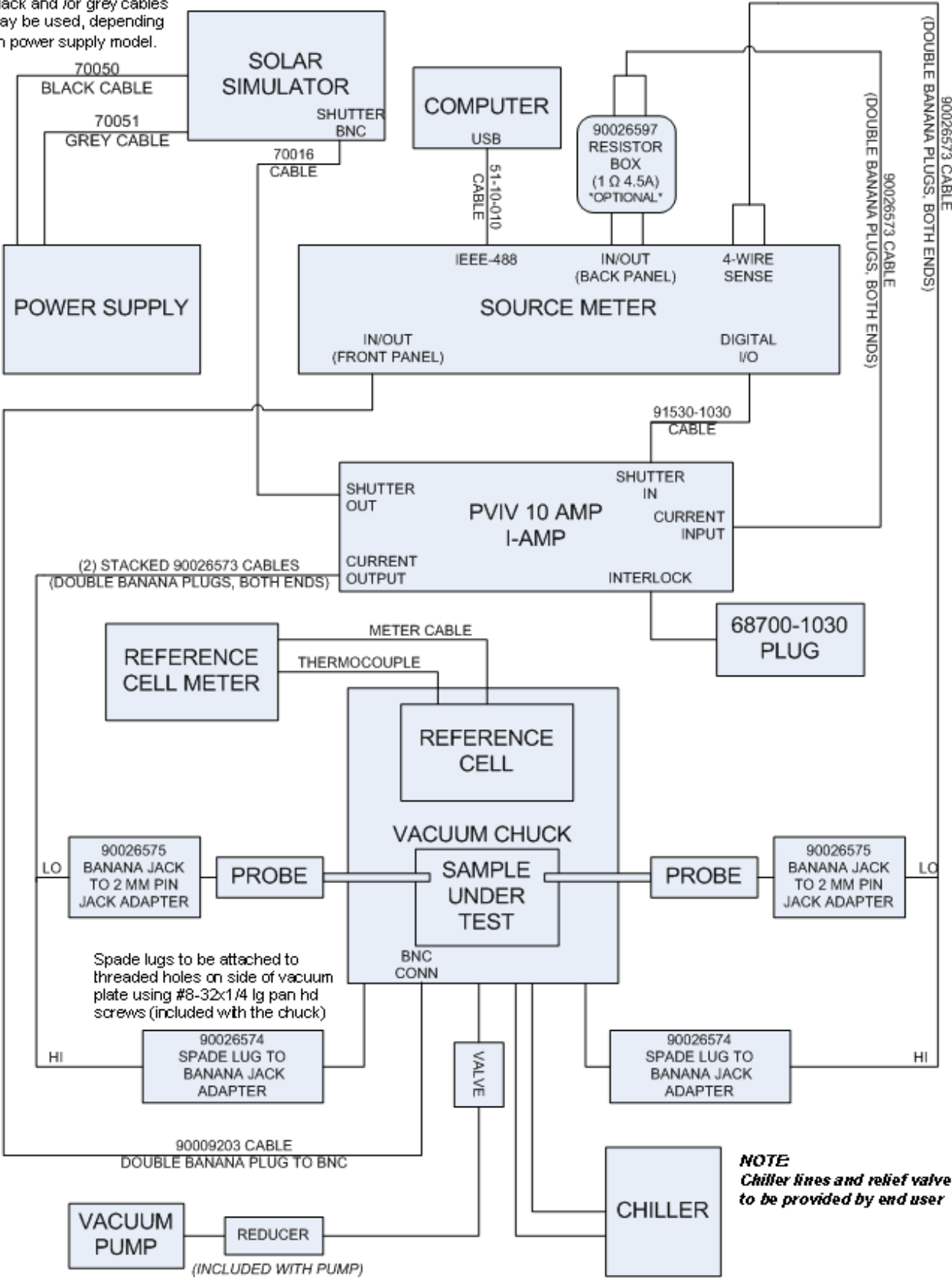
With the On/Off switch set to "0", insert the power cord. Verify that the plug end of the cord is connected to a grounded AC line. The ground stud adjacent to the power connector is otherwise available to connect to the earth ground of the facility's power system using a wire sized at least 16 AWG, and not more than 5 feet (1.5 meters) long.

Attach all cables and check that connections are correct and tight prior to turning on the power. Refer to the Hookup Diagram on the following page. Note that not all items may be supplied with your configuration.

To attach more than two probe kits (utilizing a pin plug) on the current sourcing connections, a BANJACK TO 2 PINJACK ADAPTOR (90034536) can be substituted. Two of these adaptors are supplied, which can be connected to the two stacked CABLE DBL BANANA PLUG BOTH ENDS 5FT (90026573) attaching to the CURRENT OUTPUT of the PVIV-10A-I-AMP.

**HOOKUP DIAGRAM**

Black and /or grey cables may be used, depending on power supply model.



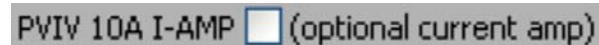
**NOTE**  
 Chiller lines and relief valve to be provided by end user



### 3 OPERATION

Refer to section 7 “Oriel I-V Test Station Software – Introduction Summary” and section 7 “I-V Test Station Software – Use Summary” of the accompanying MPVIV user manual for information on running the PVIV system. The use of the PVIV 10Amp System introduces some specific differences, which shall be covered here.

When using the PVIV 10Amp System, select the following box found in the “PVIV Recipe Editor” window:



of PVIV software versions 2.0 and later. For older versions of software, select the switch adjacent to the RUN button to the UP position, or select the box in the Testing Settings Menu. The software will then be properly set up to have the correct current limit scaling, properly scaled current axis on the graph, as well as Isc, Jsc, Imax, Pmax, Efficiency, R at Voc, and R at Isc.

For dark current measurements, the 10x current amplifier must be removed out of series with the cell, and the Keithley must be used to connect directly to the PV cell. With the removal of the 10x current amplifier, the recipe will need to be modified by deselecting the PVIV 10A I-AMP box.

If dark current measurements of greater than 1A are needed, please contact the Newport Oriel Instruments office for a technical note detailing a workaround with the PVIV-10A-I-AMP installed.

Set the current limit in the Recipe Editor to a value that is slightly above the expected maximum current. This will limit the amount of power dissipated in the solar cell in the event of cable mis-wiring, oscillation, or other malfunctions.

The number of sweep points that can be selected has been extended from 2 to 1000 points. It is recommended to start with a quick 20 point sweep to check for proper voltage range setting, as well as proper operation without oscillation. For easy comparison among several data sets, it may be useful to set the scan voltage limits and number of sweep points so that the voltage step size is a round increment of 0.1V or 0.05V. For example, with the scan voltage limits set from -0.10V to +0.60V, it will take 71 sweep points to cover the scan with 0.10V increments. Likewise, it will take 141 sweep points to cover the scan with 0.05V increments.

If the Red FAULT light comes on during a test, then the output current is not precisely 10 times the input current, and in some cases it may be oscillating. Some of the results may then be inaccurate. Oscillation will also cause the “Cmpl” icon to flash on the Keithley® display. If the I-V graph has a sudden drop in the curve, oscillation is the likely problem. An example of this phenomenon is shown on the bottom of the next page—Note the glitch apparent at 0.34V. Refer to the Troubleshooting section of this manual to resolve the problem.

Using two 90026573 cables (or suitable substitute) stacked in parallel at the Output Current terminals will benefit in two ways:

- 1) Reduce the load inductance to enhance stability, preventing oscillation
- 2) Reduce the load resistance to increase compliance voltage capability, if needed

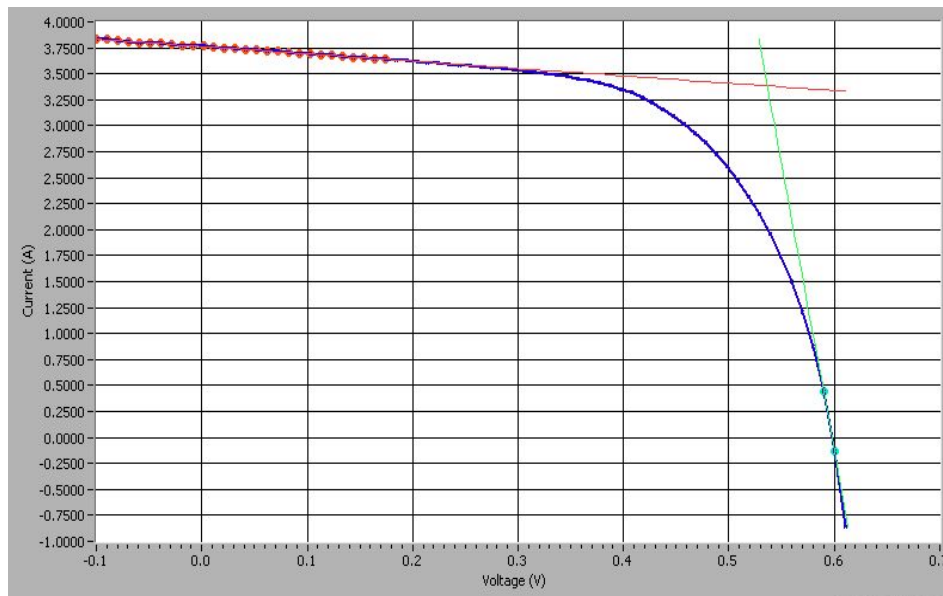
The 1 Ohm Resistor Box (90026597) is rated at 5 Amps. Although the PVIV-10A-I-AMP has sufficient resistance built in, if there is oscillation it can be used on the CURRENT INPUT side of the circuit, as shown in the hookup diagram. Do not use it on the CURRENT OUTPUT side of the PVIV 10Amp current amplifier.

The maximum recommended current capability of the PVIV-PROBE-KIT probes are 3A each. Two can be connected to a banana jack, including that at the end of a 90026573 cable, by using a 90034536

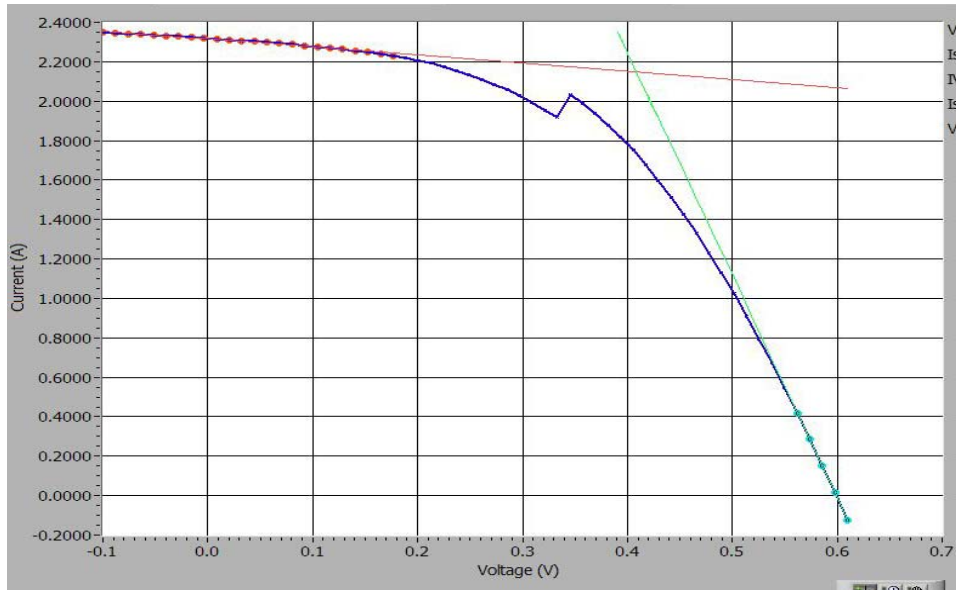
**BANJACK TO 2 PINJACK ADAPTOR.** By using two 90026573 cables and two 90034536 Adaptors, up to four PVIV-PROBE-KIT probes can be connected for current sourcing. At least one probe is needed for the voltage sense connection.

The interlock jack is available for a safety interlock circuit if the user desires. Otherwise insert the supplied shorted interlock plug, P/N 68700-1030, which utilizes a TRW/Cinch P/N P-302-CCT plug connector, into the rear panel of the PVIV-10A-I-AMP. The PVIV 10Amp current amplifier will not operate without a connection made between these two pins.

The cell temperature is sensed by the spring-loaded thermistor built into the vacuum chuck cell holder. It is in close thermal contact with the bottom of the PV Cell. If the user has not purchased an Oriel fixture, the thermistor function may be incorporated into the user supplied apparatus. The thermistor is Vishay (BC Components) P/N 2381-640-55103, Digikey P/N BC2299-ND. It has a NTC resistance (10KΩ @ 25°C, -4390ppm / °C, Vishay Curve 01) read by the Keithley® every second in standby mode, which is converted by the software to a temperature in degrees C.



A typical Si Solar Cell IV curve



Example of a bad curve with oscillation occurring

#### 4 TROUBLESHOOTING

The following table may be used to help resolve operational problems:

PROBLEM	POSSIBLE CAUSE	ACTION
“READY” LED is not on	Line Power is not getting to unit	Check the power cord connections and that the power switch is on
		Check the power entry module for proper voltage setting or a blown fuses, replacing fuses if necessary
	PVIV 10A I-AMP is blown	Contact Newport for repair
“ACTIVE” LED does not go on when test is run	Shutter also does not operate during test	See Shutter troubleshooting section below
	USB – GPIB cable communication link not working, or is installed improperly	Try to restart PVIV software; reboot computer; Check for proper driver installation, GPIB address = 24 for both computer and Keithley®
“FAULT” LED turns on during test and/or “Cmpl” is flashing on the Keithley® and/or glitch is occurring in the IV curve	Oscillation is occurring in the current sourcing loop due to too much phase shift	Reduce INPUT and OUTPUT inductance by reducing cable lengths, twisting wire pairs, or paralleling cables
		Increase INPUT resistance by inserting 1 Ohm resistance Box (90026597) or other suitable resistance in series between Keithley® “INPUT/OUTPUT” and “CURRENT INPUT” of Current Amp
	Incorrect or missing connections	Inspect for proper wiring according to diagram in Figure 2, or excessive contact resistance at Solar Cell
Shutter does not operate during test	Shutter circuit open	Check the cable connections from Keithley® “INTERLOCK DIGITAL I/O” to “SHUTTER IN”
		Check the cable connections from “SHUTTER OUT” to Solarsim “SHUTTER REMOTE”
	INTERLOCK circuit open	Check that the INTERLOCK circuit is not open or that the plug is not inserted into “INTERLOCK”

## 5 SPECIFICATIONS

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The following applies to the **PVIV 10A I-AMP** Current Amplifier:

### ELECTRICAL

- Line Voltage rating: 100-240 VAC, 50-60Hz, 100W max
- Fuses (2 Required): 1.5A, T type (slow blow), 250V, 5 x 20 mm for 110VAC nominal operation  
0.8A, T type (slow blow), 250V, 5 x 20 mm for 220VAC nominal operation  
(1 required): 3.15A, T type (slow blow), 250V, 5 x 20 mm, internally mounted
- Input Current range: -0.4A - +1.0A
- Output Current range: -4A - +10A
- Output Voltage range:  $\pm 2.5V$
- Accuracy of 10x Current multiplication factor:  $\pm 0.03\%$  @ 23 °C Ambient
- Output offset Current:  $\pm 0.2mA$
- Temperature Coefficient of 10x Gain:  $\pm 50$  ppm / °C
- 3-dB Bandwidth: 2.3kHz into  $0.2\Omega$
- Slew Rate: 0.5A /  $\mu S$  into  $0.2\Omega$  for 1A input step
- Settling Time: 0.8mS to 90% of final value
- Input Impedance: 2.4ohm

### INPUT / OUTPUT

- CURRENT INPUT / OUTPUT : 5-way binding posts (0.080" phone tip plug, 1/4" spade lug, standard banana plug, alligator clip or wire)
- SHUTTER IN BNC: Active Low
- INTERLOCK: Active Low
- SHUTTER OUT BNC: Active Low when SHUTTER IN and INTERLOCK are Active Low
- LEDS: READY (green), ACTIVE (green), FAULT (red)

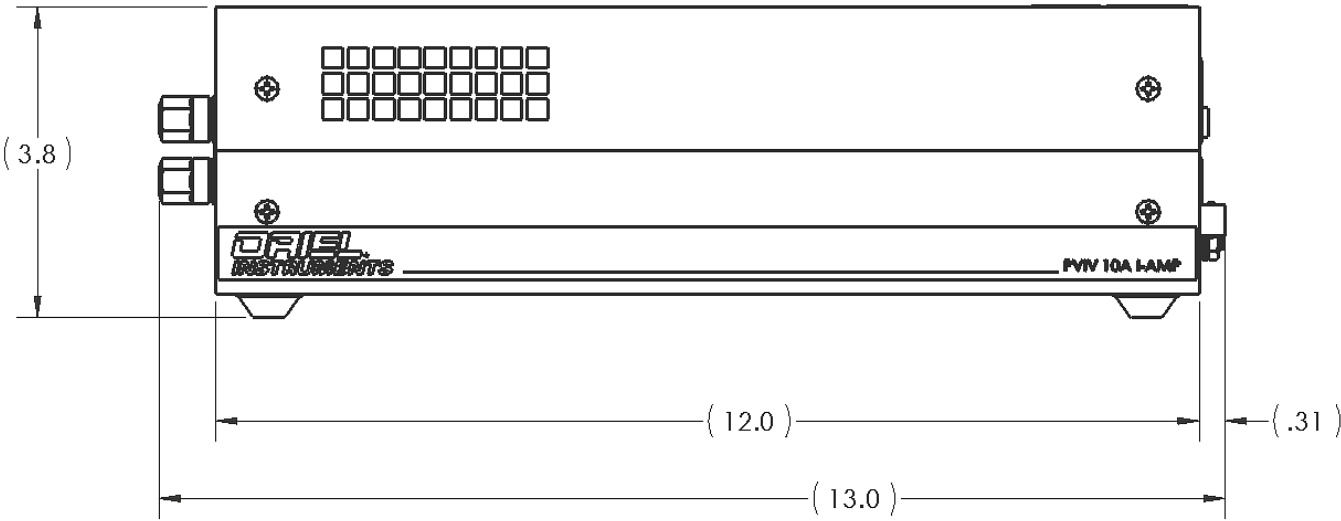
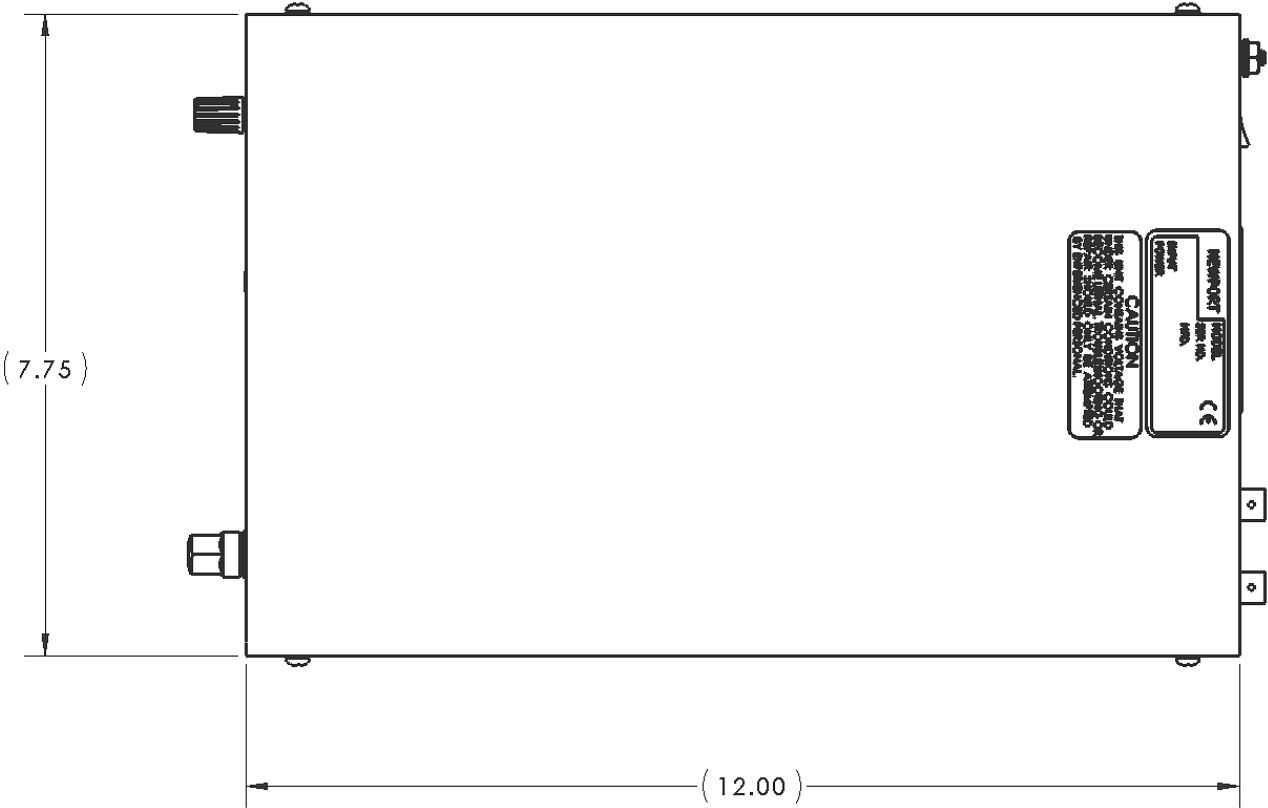
### MECHANICAL

- Dimensions: 7.75"W x 12.90"L x 3.80"H (197mm x 328mm x 97mm)
- Weight: 6.00 Lbs. (2.73kg)

### ENVIRONMENTAL

- Operating Temperature: 0 °C - 45 °C
- Installation Category II; Pollution degree 2
- Operating Humidity: 10 – 90%RH Non-Condensing
- Storage Temperature: -40 °C - 70 °C Ambient

6 MECHANICAL DIMENSIONS



## 7 WARRANTY & SERVICE

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Newport warrants that all goods described in this manual (except consumables such as lamps, bulbs, filters, ellipses, etc.) shall be free from defects in material and workmanship. Such defects become apparent within the following period:

1. All products described here, except spare parts: one (1) year or 3000 hours of operation, whichever comes first, after delivery of the goods to the buyer.
2. Spare parts: ninety (90) days after delivery of goods to the buyer.

Newport's liability under this warranty is limited to the adjustment, repair and/or replacement of the defective part(s). During the above listed warranty period, Newport shall provide all materials to accomplish the repaired adjustment, repair or replacement. Newport shall provide the labor required during the above listed warranty period to adjust, repair and/or replace the defective goods at no cost to the buyer ONLY IF the defective goods are returned, freight prepaid, to a Newport designated facility. If goods are not returned to Newport, and the user chooses to have repairs made at their premises, Newport shall provide labor for field adjustment, repair and/or replacement at prevailing rates for field service, on a portal-to-portal basis.

Newport shall be relieved of all obligations and liability under this warranty of:

1. The user operates the device with any accessory, equipment or part not specifically approved or manufactured or specified by Newport unless buyer furnishes reasonable evidence that such installations were not the cause of the defect. This provision shall not apply to any accessory, equipment or part, which does not affect the safe operation of the device.
2. The goods are not operated or maintained in accordance with Newport's instructions and specifications.
3. The goods have been repaired, altered or modified by other than authorized Newport personnel.
4. Buyer does not return the defective goods, freight prepaid, to a Newport facility within the applicable warranty period.

IT IS EXPRESSLY AGREED THAT THIS WARRANTY SHALL REPLACE ALL WARRANTIES OF FITNESS AND MERCHANTABILITY. BUYER HEREBY WAIVES ALL OTHER WARRANTIES, GUARANTEES, CONDITIONS OR LIABILITIES, EXPRESSED OR IMPLIED, ARISING BY LAW OR OTHERWISE, WHETHER OR NOT OCCASIONED BY NEWPORT'S NEGLIGENCE.

This warranty shall not be extended, altered or varied except by a written document signed by both parties. If any portion of this agreement is invalidated, the remainder of the agreement shall remain in full force and effect.

### CONSEQUENTIAL DAMAGES

Newport shall not be responsible for consequential damages resulting from misfunctions or malfunctions of the goods described in this manual. Newport's total responsibility is limited to repairing or replacing the malfunctioning or malfunctioning goods under the terms and conditions of the above described warranty.

### INSURANCE

Persons receiving goods for demonstrations, demo loan, temporary use or in any manner in which title is not transferred from Newport, shall assume full responsibility for any and all damage while in their care, custody and control. If damage occurs, unrelated to the proper and warranted use and performance of the goods, recipient of the goods accepts full responsibility for restoring the goods to their condition upon original delivery, and for assuming all costs and charges.

### RETURNS

Before returning equipment to Newport for repair, please call the Customer Service Department at (203) 377-8282. Have your purchase order number available before calling Newport. The Customer Service Representative will give you a Return Material Authorization number (RMA). Having an RMA will shorten the time required for repair, because it ensures that your equipment will be properly processed. Write the RMA on the returned equipment's box. Equipment returned without a RMA may be rejected by the Newport Receiving Department. Equipment returned under warranty will be returned with no charge for the repair or shipping. Newport will notify you of any repairs not covered by the warranty, with the cost of the repair, before starting the work.

Please return equipment in the original (or equivalent) packaging. You will be responsible for damage incurred from inadequate packaging, if the original packaging is not used.

Include the cables, connector caps and antistatic materials sent and/or used with the equipment, so that Newport can verify correct operation of these accessories.

**8 CONTACT US**

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