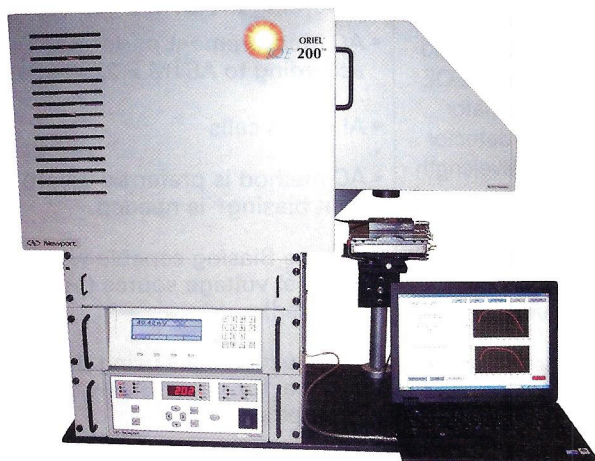




## IQE-200™



Newport® Corporation's Oriel® Instruments IQE-200™ QE measurement system

Oriel® Instruments IQE-200® takes 40 years of light source and monochromator expertise, as well as innovation in optical design to create a sophisticated measurement tool for Quantum Efficiency (EQE and IQE) with options that allow the user customize a solution that meets their needs for PV measurement.

Oriel Instrument's IQE-200 measurement systems allows researchers to measure External Quantum efficiency (EQE) also known as Incident Photon to Charge Carrier Efficiency (IPCE) as well as Internal Quantum Efficiency (IQE) for solar cells, detectors, or any other photon-to-charge converting device.

These systems utilize industry standard, durable Oriel components for the light management engines. Each model of the IQE-200 system provides a "turnkey" solution by providing the light source, monochromator, detectors, related electronics, software and PC in a preconfigured, assembled and calibrated format. A variety of accessory modules are available to provide positive sample positioning, temperature control, electrical probing capabilities and light bias. The IQE-200 incorporates a novel detector geometry which splits the beam allowing for simultaneous measurement of EQE and the reflective losses to quantify IQE. In addition, an accessory detector can be mounted which allows for measurement of Transmission through the cell for those samples on a transparent substrate. The unique design of the AC system meets the requirements outlined in ASTM Method E 1021-06, and ASTM Method E2236-05a

The IQE-200 accessories customize the system to perform QE measurements incorporating temperature control, light biasing, and even motorized mapping capabilities all controlled by our new QE Commander™ software system. Customized software can allow the user to "map" the entire device under test by wavelength or by a user definable pattern.

All Oriel components are from Newport Corporation, an industry leader in light sources, spectroscopy products, precision motion control, and continuous wave solar simulators.

Contact a Newport sales engineer to discuss custom configurations/capabilities.

### What are EQE and IQE?

External Quantum Efficiency (EQE) indicates the ratio of the number of photons incident on a solar cell to the number of generated charge carriers, while Internal Quantum Efficiency (IQE) considers the internal efficiency; that is, the losses associated with the photons reflected back from the surface of the cell are also measured to calculate a net efficiency.

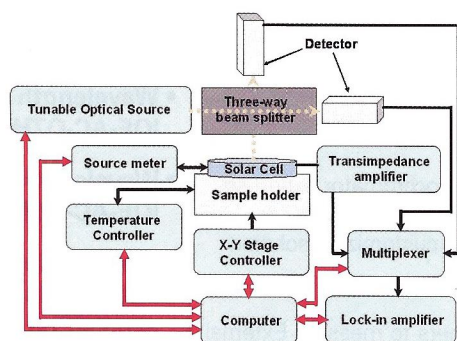
- Simultaneous EQE, IQE measurement
- Patent Pending (Quantum Efficiency Measurement System and Method of Use)
- Simultaneous 4 channel Data Acquisition, enables very rapid measurement
- Wavelength Range 350-1100 nm IQE-AC-QTH-SI
- Wavelength Range 300-1100 nm IQE-AC-XEN-SI
- Wavelength Range 360-1800 nm IQE-AC-QTH-EXT1
- Wavelength Range 300-1800 nm IQE-AC-XEN-EXT1
- Pre-installed dedicated software with single button data acquisition
- Designed for all types of solar cells including Tandem/ Multi-junction designs
- Transmission measurement optional
- Light Bias (white and monochromatic) are available options
- Temperature controlled vacuum chuck available for sample handling
- Manual positioning probe based electrical contacts available
- Motorized X-Y mapping options are available (special order)



## Product Detail

To accurately measure the EQE/IQE of a solar cell the system calculates the ratio of current produced by the monochromatic light at a given wavelength to the current generated by reference detectors at the same wavelength. The unique optical design of the IQE-200 allows for simultaneous measurement of the sample, reference detector and a second reference detector for reflected light to produce a precise measurement of EQE and IQE simultaneously without repositioning detectors or sample. The monochromator used is configured with the appropriate gratings for the wavelength range of the detector system. Order sorting filters have been chosen and preinstalled specific to the wavelength range of each model.

The IQE-200 utilizes a modular design concept which allows for flexibility in light source (QTH or Xenon), a 1/8 m monochromator, order sorting filters in a motorized filter wheel, chopper motor with lock-in amplifier, and detector choices for desired wavelength ranges to create a flexible platform for AC type measurements of solar cells.



### Typical Light AC Engine configuration

- Light source – Can be ordered with a 250 W Quartz Tungsten Halogen (QTH) Source or a 150W Xenon Arc lamp. The light source is coupled to a monochromator to create the scanning monochromatic light.
- The 1/8m Monochromator provides excellent throughput and resolution and is controlled via USB connection through the QE Commander software.
- Gratings have been chosen to optimize performance for the entire wavelength range of interest
- An automated filter wheel with appropriate order sorting filters is incorporated to minimize second order artifacts and are specific to the wavelength range defined by the detectors in use.
- Merlin lock-in amplifier, optical chopper and calibrated detectors
- A single channel lock-in amplifier is along with a four channel multiplexer to measure up to four channels during a run. The lock-in amplifier comes with a built-in chopper controller. An optical chopper with one two-aperture blade is also included in the kit.

### QE Applications matrix for Solar Cells

- AC Measurement performed according to ASTM E 1021-06
- AC Measurement performed according to ASTM E 2236-05a
- All types cells
- AC method is preferred where light biasing\* is needed
- Voltage Biasing capable with external voltage source (not included)
- Multi junction cells using the optional IQE-Light Bias kit with appropriate filters
- Single Junction Cells
- Si based cells amorphous and mono / poly crystalline
- Thin Film cells
- CIGS (copper indium gallium diselenide)
- CdTe (cadmium telluride)
- DSSC cells at very slow chopper speed where white light bias is needed to excite the cell
- Tandem/Multi Junction Cells
- A-Si based cells alloyed with Ge, C, O, and N
- Light biasing option with filters needed to saturate junction not under test
- Light bias source with adjustable intensity level
- Color filter(s) needed to DC bias each layer not being tested

\*Colored filters are available for biasing a junction

Built by Newport Corporation's, Oriel Instruments, an industry leader in light sources and spectroscopy, so you can rely on our expertise to ensure the accuracy of the measurement



## Typical Detection Configuration

- Uses Calibrated detectors
- (1) reference detector
- (1) reference detector for measuring reflected light
- (1) optional detector for measuring transmitted light
- Output optics are downward looking and focus to a 1x2.5 mm spot size at the focal plane (Speak to your sales engineer for upward or side looking output)
- Light Bias Preamp designed to interface a current generating device to work with the Merlin Digital Lock-in Amplifier under light biasing or electrical biasing conditions.

## Optional Accessories Available:

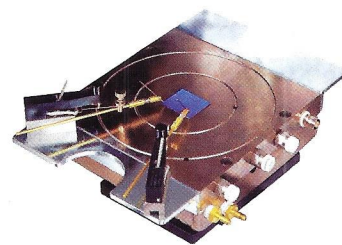
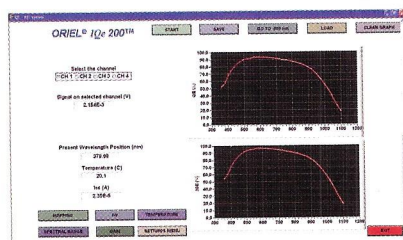
- Temperature Controlled Vacuum Chuck\* (IQE-TC-VAC)  
(Water Bath/Chiller and Vacuum pump ordered separately)
- Temperature controlled circulating water bath (PVIV-CHILLER)
- Electrical Contact probes (PVIV-PROBE-KIT)
- Vacuum pump (PVIV-VAC-PUMP)
- Light Biasing kit to deliver white or colored biasing illumination (IQE-LIGHT-BIAS)

## Software

The Oriel QE Commander software is written using LabView® and comes pre-installed on a laptop computer included as part of the system. The QE Commander software provides control of the hardware via a simple intuitive interface allowing for one button data acquisition for EQE and IQE. QE Commander can be customized to allow the user to create a map of QE performance over a user defined area or pattern of the device under test. Your Newport sales engineer can discuss the hardware requirements and customization of the QE Commander software to fit your application (additional costs may apply for application development).

QE Commander controls all the basic system components, including the monochromator, order sorting filter wheel, Merlin lock-in amplifier, chopper and light source power supply. It is also designed to control the Oriel accessory light biasing source, chiller for the temperature controlled vacuum chuck and motion controllers for mapping. QE Commander measures up to 4 channels in a single pass and generates real time EQE and IQE curves as a function of wavelength being measured. It can provide real time readout of temperature and ISc as well. EQE, IQE are all calculated in a single pass without the need to reposition detectors or sample, minimizing error in measurement accuracy.

The IQE-200 models and QE Commander software offer a versatile design which allows for customization of the system configuration and software to suit many applications. Please contact a Newport sales engineer to discuss your application for a quotation on a system that meets your applications specific needs.



Temperature Controlled Vacuum Chuck with Electrical Probes



Chiller



Vacuum Pump



Light Bias Kit with Optional Filters





## Specifications

### Base System Performance Spec

Model	IQE-AC-QTH-SI	IQE-AC-XEN-SI	IQE-AC-QTH-EXT1	IQE-AC-XEN-EXT1
Lamp Power	250W	150W	250W	150W
Lamp Type	Quartz Tungsten Halogen	Xenon	Quartz Tungsten Halogen	Xenon
Spot Size	1 mm x 2.5 mm rectangular at focus	1 mm x 2.5 mm rectangular at focus	1 mm x 2.5 mm rectangular at focus	1 mm x 2.5 mm rectangular at focus
Working Distance	50 mm	50 mm	50 mm	50 mm
Wavelength Range	350-1100 nm	300-1100 nm	360-1800 nm	300-1800 nm
Monochromator Path Lengths	1/8M	1/8M	1/8M	1/8M
Resolution	5 nm (adjustable)	5 nm (adjustable)	10 nm (adjustable to 5nm)	10 nm (adjustable to 5nm)
Repeatability	<±0.5	<±0.5	<±0.5	<±0.5
Accuracy	350-900 <±2% 900-1100 <±5(%)	300-900 <±2% 900-1100 <±5(%)	360-900 <±3.5% 900-1100 <±6.5 % 1100-1800 <5.3(%)	300-900 <±3.5% 900-1100 <±6.5 % 1100-1800 <5.3(%)
Order Sorting Filters (Automated Filter wheel)	5 filters max (standard configuration uses 2)	5 filters max (standard configuration uses 2)	5 filters max (standard configuration uses 3)	5 filters max (standard configuration uses 3)
Signal Acquisition	Chopper with Lock-in Amplifier. Modulation frequency 8-1100Hz	Chopper with Lock-in Amplifier. Modulation frequency 8-1100Hz	Chopper with Lock-in Amplifier. Modulation frequency 8-1100Hz	Chopper with Lock-in Amplifier. Modulation frequency 8-1100Hz
Measurement Type	Simultaneous EQE and IQE measurement	Simultaneous EQE and IQE measurement	Simultaneous EQE and IQE measurement	Simultaneous EQE and IQE measurement
QE Calibration test cell	Included	Included	Included	Included
Computer Included	Dell Latitude	Dell Latitude	Dell Latitude	Dell Latitude

Model	IQE-AC-QTH-SI	IQE-AC-XEN-SI	IQE-AC-QTH-EXT1	IQE-AC-XEN-EXT1
Input Voltage	90-264 VAC	90-264 VAC	90-264 VAC	90-264 VAC
Input Current	15 A	15 A	15 A	15 A
Input Frequency	47 - 63 Hz	47 - 63 Hz	47 - 63 Hz	47 - 63 Hz
Power Consumption	<400 W	<400 W	<400 W	<400 W
Operating Mode Power Supply (69931)	69907	69907	69931	69931
Ambient Operating Temperature	0 - 40 °C	0 - 40 °C	0 - 40 °C	0 - 40 °C
Weight	120 lb	120 lb	120 lb	120 lb
Dimensions (W x D x H) [in. (mm)]	38.25 (971.54) x 18.00 (457.2) x 30.63 (777.9)	38.25 (971.54) x 18.00 (457.2) x 30.63 (777.9)	38.25 (971.54) x 18.00 (457.2) x 30.63 (777.9)	38.25 (971.54) x 18.00 (457.2) x 30.63 (777.9)

### Computer System (Included)

Dell Latitude 5400 Laptop	
Processor	Intel Core 2 Duo T7250, 2.00GHz, 2M L2 Cache, 800MHz FSB
Memory	1.0GB, DDR2-800 SDRAM, 1 DIMM
Keyboard	Internal English Keyboard Dual Pointing
Video Card	Intel Integrated Graphics Media Accelerator 4500MHD
Hard Drive	80GB Hard Drive 9.5MM, 5400RPM
Display	14.1 inch Wide Screen WXGA LCDf
Operating System	Windows XP PRO SP3
CD-ROM or DVD-ROM Drive:	8X DVD
Wireless Ethernet	WLAN 1397 (802.11b/g)



## Sample Handling Temperature Controlled Vacuum Chuck

Sample Size	6x6 inch (156 x 156mm) sq. max
Temperature Controlled Range	Temperature Controlled Range
Temperature Holding	<0.5° C/minute with Newport chiller P/N: PVIV-Chiller
Sample Temperature Sensing Range	-40 to 125°C
Sample Temperature Sensing Tolerance	±0.1° C
Material	Nickel plated Aluminum
Vacuum Requirement	150 mm Hg min.
Cold Plate Size	6" x 6" (152 x 152mm)
Motion	
Weight	9.5 (lb)

## Vacuum Pump Module

Discharge	Oil free
Max Vacuum (hg)	650
Free Air (cfm)	20
Max psi	
dB Rating	50
Horsepower	1/8 HP
VAC @ 60 Hz	115 (1)
Amps	0.7
Size (inches)	11 x 6 x 4.5
Connection	Barbed for use 1/4 inch ID tubing, Conversion parts for 1/4 inch OD tubing included
Temperature Range	
Weight	4.1 (lb)

## Chiller Module

Operating Range	10-40°C
Cooling Capacity	150 W at 20°C (20°C ambient)
Modes	Cool, Heat, Cycle
Precision	<0.1°C with a constant load
Operating Voltage	12 VDC, 8 A maximum, universal AC adapter supplied
Power Consumption	< 100 (W)
Pump	0.5 lpm gear pump at 10 psi, with a magnetically-coupled brushless DC motor (10,000 hr MTBF)
Tank Volume	75 ml, additional coolant needed to fill hoses and cold plate
Size (inches)	7.5 x 5 x 7" (19 x 13 x 18 cm)
Weight	6.5 lbs (lb)
Communication	Dry contact alarm and RS232
Connection	1/8" CPC with shut-off valves
Noise	63 dBA at 3 feet
Certification	CE

## Probe Kit

Probe Quantity Per Kit	1
Probe Base Quantity Per Kit	1
Probe Positioning (coarse)	Magnetic
Probe Positioning (fine)	X-Y joystick
Probe Tip Material	BeCu standard, other materials available
Probe Tip Diameter	125 microns standard, other sizes available
Connector	Pin tip plug, 0.080" (2mm) pin diameter
Recommended Current Level	<3A per probe (standard probe tip)



## Light Biasing Module

Source	QTH
Light Delivery	Fiber
Number of Fibers	1 Bifurcated to dual output
Filter Holder (slide mount)	Up to 3 filters (1" diameter)
Control/Communication	RS232 via QE Commander
Intensity	Variable
Weight	11.0 (lb)

## Ordering Information

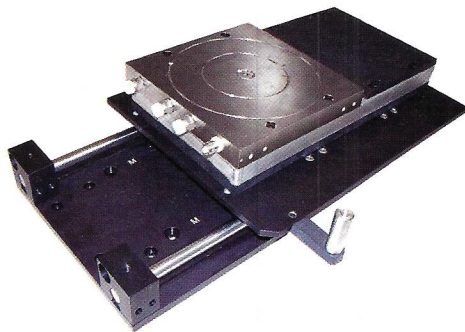
Model	Description	Price
IQE-AC-QTH-SI	EQE/IQE Measurement system, AC type, QTH source, 350-1100 nm Range	\$49,900
IQE-AC-QTH-EXT1	EQE/IQE Measurement system, AC type, QTH source, Extended Range 360-1800 nm	\$57,500
IQE-AC-XEN-SI	EQE/IQE Measurement system, AC type, Xenon Arc Lamp source, 300-100 nm Range	\$51,075
IQE-AC-XEN-EXT1	EQE/IQE Measurement system, AC type, Xenon Arc source, Extended Range 300-1800 nm	\$58,675
IQE-TC-VAC	Temperature controlled vacuum chuck assembly for IQE-200	\$6,495
PVIV-PROBE-KIT	Magnetic Electrical Probe Kit with X-Y micro control	\$990
PVIV-CHILLER	Circulating Water Bath Chiller	\$2,525
PVIV-VAC-PUMP	Vacuum Pump 110V	\$1,100
PVIV-VAC-PUMP-220	Vacuum Pump 220V	\$1,100
IQE-LIGHT-BIAS	Light Biasing Kit (Includes External QTH Source, mounting flange and bifurcated fiber optic cable)	\$3,890

## Replacement Parts

Model	Description
6334NS	250 Watt Quartz Tungsten Halogen
6253	150 Watt Xenon Arc Lamp



# PVIV Temperature Controlled Vacuum Chuck Kit



PVIV Temperature Controlled Vacuum Chuck Kit

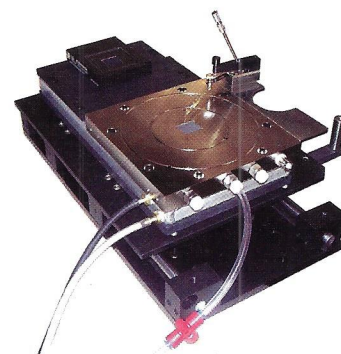
Oriel® Instrument's Temperature Controlled Vacuum Chuck Kit is an accessory kit that provides temperature control and vacuum positioning with a PV Cell in conjunction with the Oriel I-V Test Station. It incorporates a rail system on which the vacuum chuck plate and calibrated reference cell (91150V) can be mounted allowing easy exchange of position for the device under test (DUT) and reference cell under the simulator output beam. The chuck can accommodate up to a 156 x 156 mm cell, and can be used with smaller cells. It has been designed specifically to work with the Oriel Sol1A, Sol2A and Sol3A family of Solar Simulators, but can be used with proper mounting at the appropriate work plane with almost any Solar Simulator.

The Temperature Controlled Vacuum Chuck Kit provides temperature control of the sample under test by circulating water through the vacuum plate allowing it to be held at constant temperature (usually 25°C), while running I-V measurements.

An optional Peltier cooled water bath chiller (p/n PVIV-CHILLER) is available and sold separately. The vacuum pump (p/n PVIV-VAC-PUMP or PVIV-VAC-PUMP-220) is also sold separately. The Temperature Controlled Vacuum Chuck Kit can be configured to meet your lab requirements.

The Temperature Controlled Vacuum Chuck Kit is also compatible with the Oriel electrical probing kits (p/n PVIV-PROBE-KIT).

These electrical probing kits use magnetic bases that can be positioned to allow needle contact probes to make electrical contact anywhere on the cell of the conductors. The electrical probes have micro-positioning via an "x-y joystick". The number of probes needed is based on factors including but not limited to probing method, current capacity, electrical biasing requirements, etc.



Temperature Controlled Vacuum chuck showing optional Circulating bath and vacuum pump.



## PVIV-TC-VAC Detail

Testing of the IV performance of a photovoltaic device is by far the most common test done on all PV cells regardless of composition. The Oriel Temperature Controlled Vacuum Chuck, used in conjunction with Oriel Solar Simulators, provides researchers with all the tools necessary to measure an IV response curve in accordance with standard methodology such as ASTM E948-09 for all types of solar cells.

The Oriel Temperature Controlled Vacuum Chuck Kit facilitates IV measurements at constant temperature in accordance with standard reference conditions (SRC) as defined in ASTM method E948-09 for testing of solar cells as detailed in the methods for calculating critical parameters such as short circuit current ( $I_{sc}$ ), current density ( $J_{sc}$ ), open circuit voltage ( $V_{oc}$ ), fill factor ( $ff$ ), maximum output power ( $P_{max}$ ), cell efficiency ( $\eta$ ), and other standard photovoltaic cell parameters. Oriel IV Test stations can be configured to include a source/meter, calibrated solar reference cell, electrical probing kit, chiller, and vacuum pump depending upon the requirements of your application. These components along with the Oriel PVIV measurement software can provide a complete solution for your IV measurement needs.

The PVIV-TC-VAC is designed to work with any of Oriel Instrument's "Sol" series of solar simulators. Choice of source meter and simulator are defined by the cell size and current produced. A Newport sales engineer will assist in choosing the optimal configuration for your needs.

## Technical Specifications for PVIV Temperature Controlled Vacuum Chuck Kit

### Temperature Controlled Vacuum Chuck Kit

Sample Size	6x6 inch (156 x 156mm) sq. maximum
Temperature Controlled Range	15-35 °C (Typically at 25 °C ambient)
Temperature Holding	<0.5 °C/minute with exposure to 1 sun condition (at 25 °C ambient, with Newport chiller)
Sample Temperature Sensing Range	-40 to 125 °C
Sample Temperature Sensing Tolerance	±0.25 °C
Material	Nickel plated Aluminum
Vacuum Requirement	150 mm Hg min.
Cold Plate Size	6" x 12"

### Probe Kit

Probe Quantity Per Kit	1
Probe Base Quantity Per Kit	1
Probe Positioning (coarse)	Magnetic
Probe Positioning (fine)	X-Y joystick
Probe Tip Material	BeCu standard, other materials available
Probe Tip Diameter	125 microns standard, other sizes available
Connector	Pin tip plug, 0.080" (2mm) pin diameter
Recommended Current Level	< 3A per probe (standard probe tip)





## Chiller

Operating Range	10-40 °C
Cooling Capacity	150 W at 20 °C (20 °C ambient)
Modes	Cool, Heat, Cycle
Precision	< 0.1 °C with a constant load
Coolant	25% propylene glycol/water preferred, ethylene glycol/water or water acceptable
Operating Voltage	12 VDC, 8 A maximum, universal AC adapter supplied
Power Consumption	< 100W
Pump	0.5 lpm gear pump at 10 psi, with a magnetically-coupled brushless DC motor (10,000 hr MTBF) see pump curves
Tank Volume	75 ml, additional coolant needed to fill hoses and cold plate.
Communication	Dry contact alarm and RS232
Connection	1/8" CPC with shut-off valves
Noise	63 dBA at 3 feet
Size	7.5 x 5 x 7" (19 x 13 x 18 cm)
Weight	6.5 lbs
Standards	CE

## Vacuum Pump

	PVIV-VAC-PUMP	PVIV-VAC-PUMP-220
Discharge	Oil free	Oil free
Max Vacuum (mm Hg)	650	650
Free Air (l/min)	20	17
dB Rating	50	50
Horsepower	1/8 HP	1/8 HP
Input	100-110V/60Hz	220-240V/50Hz
Amps	0.7	0.3
Size (inches)	11 x 6 x 4.5	11 x 6 x 4.5
Connection	Barbed for use 1/4 inch ID tubing, Conversion parts for 1/4 inch OD tubing included	Barbed for use 1/4 inch ID tubing, Conversion parts for 1/4 inch OD tubing included
Weight (kg)	4.1	4.1

## Ordering Information

Model	Description	Price
PVIV-TC-VAC	Cell Holder with Temperature control and vacuum positioning for 2x2 thru 6x6	\$8,990
PVIV-PROBE-KIT	Magnetic Electrical Probe Kit with X-Y micro control	\$990
PVIV-CHILLER	Circulating Water Bath Chiller	\$2,525
PVIV-VAC-PUMP	Vacuum Pump 110V	\$1,100
PVIV-VAC-PUMP-220	Vacuum Pump 220V	\$1,100
91150V	Reference Solar Cell and Meter, 2 x 2 cm Calibrated with fused silica window	\$3,193
PV3660B (M-PV3660B)	Photovoltaic Workstation, 36 x 60 x 2 in. SG Breadboard, 1/4-20 holes, Enclosed Frame	\$9,350
M-PV3660B	Photovoltaic Workstation, 900 mm x 1500 mm SG Breadboard, M6 holes, Enclosed Frame	\$9,350

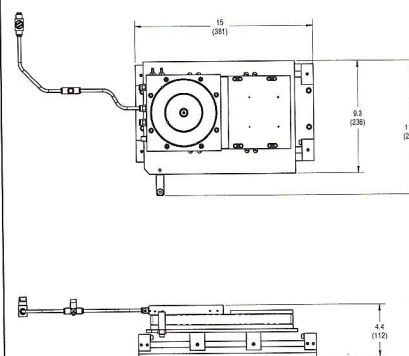


Fig. 1 Dimensional diagram of PVIV Temperature Controlled Vacuum Chuck Kit.



# PVIV Vacuum Pump



## Vacuum Pump

	PVIV-VAC-PUMP	PVIV-VAC-PUMP-220
Discharge	Oil free	Oil free
Max Vacuum (mm Hg)	650	650
Free Air (l/min)	20	17
dB Rating	50	50
Horsepower	1/8 HP	1/8 HP
Input	100-110V/60Hz	220-240V/50Hz
Amps	0.7	0.3
Size (inches)	11 x 6 x 4.5	11 x 6 x 4.5
Connection	Barbed for use 1/4 inch ID tubing, Conversion parts for 1/4 inch OD tubing included	Barbed for use 1/4 inch ID tubing, Conversion parts for 1/4 inch OD tubing included
Weight (kg)	4.1	4.1

## Ordering Information

Model	Description	Price
PVIV-VAC-PUMP	Vacuum Pump 110V	\$1,100
PVIV-VAC-PUMP-220	Vacuum Pump 220V	\$1,100

# PVIV Chiller



## Chiller

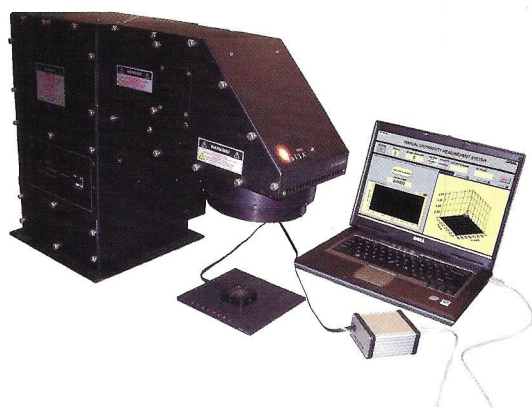
Operating Range	10-40 °C
Cooling Capacity	150 W at 20 °C (20 °C ambient)
Modes	Cool, Heat, Cycle
Precision	< 0.1 °C with a constant load
Coolant	25% propylene glycol/water preferred, ethylene glycol/water or water acceptable
Operating Voltage	12 VDC, 8 A maximum, universal AC adapter supplied
Power Consumption	< 100W
Pump	0.5 lpm gear pump at 10 psi, with a magnetically-coupled brushless DC motor (10,000 hr MTBF) see pump curves
Tank Volume	75 ml, additional coolant needed to fill hoses and cold plate
Communication	Dry contact alarm and RS232
Connection	1/8" CPC with shut-off valves
Noise	63 dBA at 3 feet
Size	7.5 x 5 x 7" (19 x 13 x 18 cm)
Weight	6.5 lbs
Standards	CE

## Ordering Information

Model	Description	Price
PVIV-CHILLER	Circulating Water Bath Chiller	\$2,525



# Uniformity Measurement Tool



- Validate the uniformity of irradiance of a solar simulator after each lamp installation
- The Uniformity Measurement Tools software provides:
- 5 and 9 point survey tests for quick alignment
- 17, and 64 in compliance to IEC, ASTM or JIS standard's methodology
- Measurement positioning guidance using blinking red colored prompts for each point measurement

The Oriel Uniformity Management Tool has been designed to allow the user to accurately measure the uniformity of the irradiance at the test plane of a Solar Simulator. The system incorporates a test platen designed to positively position an appropriate test head in 64 equally spaced positions as defined by IEC method 60904-9, or in 17 predetermined positions as defined by JIS standard C8912. A detector head is provided that is appropriately masked to the area defined by either the IEC method or JIS method, depending on the model purchased. A data acquisition box interfaces with a PC via a USB connection which powers the system without need for any external power supply. Data is acquired using the MUMS software package which prompts the user to position the detector in the appropriate position and provides real-time readout of the Class Uniformity obtained as each datapoint is measured. The software also provides a survey mode which averages fewer points and can be used to assist in lamp alignment. Models are available for 2x2, 4x4, 6x6, and 8x8 simulators. The software/data interface box kit and head/platen kit are sold separately. The software/data interface kit can be used for any size simulator. The detector/platen kits are specific to the size simulator illumination area being measured.

## Specifications

### Measurement Specifications

Range	0.02 - 2 Volts Preamplified Detector (0 - 1.5 Sun, typical)
Resolution	16 bits effective (22 $\mu$ V)
Accuracy	< 0.2 % Uniformity
Repeatability	0.02 % uniformity
Spectral Response	300 nm - 1100 nm (Si Monocrystalline Solar Cell with Polycarbonate Window)
Temperature Coefficient of Detector Cell, Software Corrected	$\pm$ 500 ppm / °C
Detector Temperature Stabilization Time	within 2 minutes for Variance error <0.4%
Monitoring Mode	1ms per sample, 500 sample average, 0.5 second update time
Acquisition Time	2 seconds to acquire 2000 samples, averaged into 1 grid square
64 Point IEC Test Time	4 minutes, typical
17 Point JIS Test Time	1 minute, typical
5 Point Lamp Alignment Quick Check	20 seconds, typical
Input Connector	USB Type B Jack to connect to PC having USB Type A Jack (USB 1.0 and 2.0 compatible)



## Mechanical Specifications Detectors and Platens

Detector Material	Anodized Aluminum, with AR coated Polycarbonate window
Detector Dimensions	2.00"W x 2.00"L x 0.95"H (50.8 mm x 50.8 mm x 24.1 mm)
Detector Weight	0.15 Lbs. (0.07kg)
Platen Material	Clear Black Anodized Aluminum
Platen Dimensions (IEC or JIS) PV-MUMS 2, PV-MUMS-2J	5"W x 5"L x 0.31"H (127 mm x 127 mm x 7.9 mm) for 2x2
Platen Dimensions (IEC or JIS) PV-MUMS 4, PV-MUMS-4J	7"W x 7"L x 0.31"H (178 mm x 178 mm x 7.9 mm) for 4 x 4
Platen Dimensions (IEC or JIS) PV-MUMS 6, PV-MUMS-6J	9"W x 9"L x 0.31"H (229 mm x 229 mm x 7.9 mm) for 6 x 6
Platen Dimensions (IEC or JIS) PV-MUMS 8, PV-MUMS-8J	11"W x 11"L x 0.5"H (279 mm x 279 mm x 12.7 mm) for 8 x 8
Platen Weight PV-MUMS-2, PV-MUMS-2J	1.0 Lbs. (0.5 kg) for 2 x 2
Platen Weight PV-MUMS-4, PV-MUMS-4J	2.0 Lbs. (0.9 kg) for 4 x 4
Platen Weight PV-MUMS-6, PV-MUMS-6J	3.2 Lbs. (1.5 kg) for 6 x 6
Platen Weight PV-MUMS-8, PV-MUMS-8J	5.8 Lbs. (2.6 kg) for 8 x 8
Interface Box Material	Clear Anodized Aluminum
Interface Box Dimensions	3.2"W x 3.7"L x 1.9"H (81 mm x 94 mm x 48 mm)
Interface Box Weight	1 Lbs.

## Environmental

Operating Temperature	0°C - 70°C Detector and Platen
Installation Category II	Pollution degree 2
Operating Humidity	10 - 90%RH Non-Condensing
Storage Temperature	-40°C - 70°C Ambient

## Ordering Information

### Software Kit with Data Acquisition Module

NOTE: Requires a choice of a Detector Head Kit to operate

Model	Description	Price
PV-MUMS-S	Data Acquisition Module, Cabling and Manual Uniformity Measurement Software	\$995

### Detector Head kit with Positioning Plate

NOTE: Requires a Software Kit PVIV-MUMS-S to operate

Model	Platen Dimensions (IEC or JIS)	Detector Active Area	Price
PV-MUMS-2	2 x 2 inch, IEC and JIS	1/4 inch square, IEC/ASTM	\$995
PV-MUMS-4	4 x 4 inch, IEC and JIS	1/2 inch square, IEC/ASTM	\$1,190
PV-MUMS-6	6 x 6 inch, IEC and JIS	3/4 inch square, IEC/ASTM	\$1,290
PV-MUMS-8	8 x 8 inch, IEC and JIS	1 inch square, IEC/ASTM	\$1,390
PV-MUMS-2J	2 x 2 inch, IEC and JIS	1 cm square, JIS	\$995
PV-MUMS-4J	4 x 4 inch, IEC and JIS	2 cm square, JIS	\$1,190
PV-MUMS-6J	6 x 6 inch, IEC and JIS	2 cm square, JIS	\$1,290
PV-MUMS-8J	8 x 8 inch, IEC and JIS	2 cm square, JIS	\$1,390

Each Kit requires a PVIV-MUMS-S for proper operation.  
The PVIV-MUMS-S can be used with any Detector head Kit