

### 3 COMPONENTS INCLUDED

- ✓ • IQE-200 System
- ✓ • MIQE-AC-X-EXT1 (Manual)
  - Laptop Computer 90030797
  - Low Reflectance Standard: 90048059
  - High Reflectance Standard : 90031272
- ✓ • Test sample, Si and Ge sandwich detector: 71619 (Test sample data file stored on laptop)
  - Adapter Calibrating 50 MM: 90029674
  - International Line cord adapter for PC (if shipped outside US)

Additional accessory components may have been purchased and some, like the IQE-TC-VAC temperature controlled vacuum chuck will be incorporated into the system.

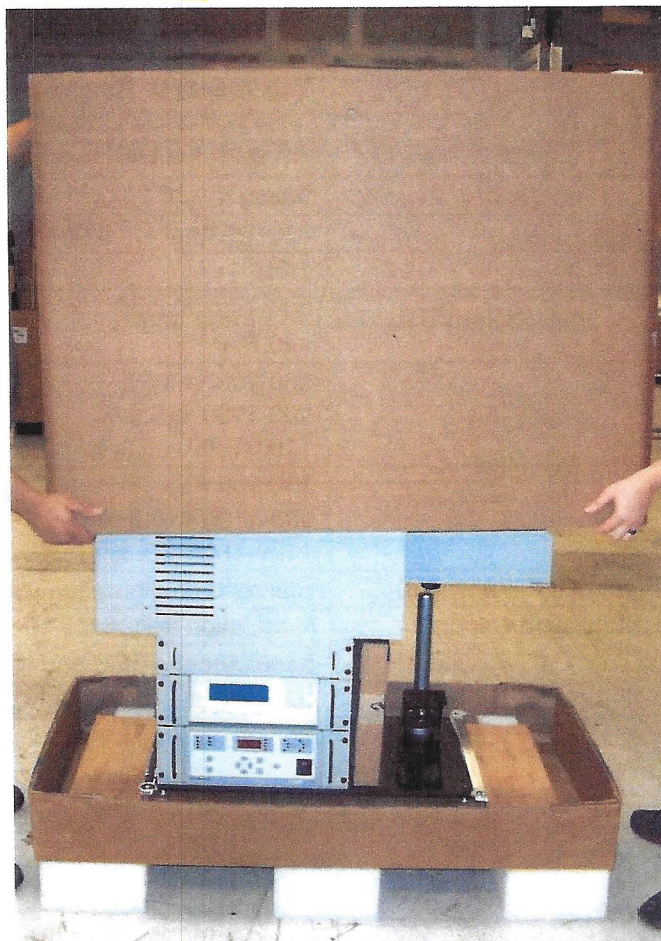


Figure 1 Unpacking

## 4 SPECIFICATIONS

### ELECTRICAL SPECIFICATIONS

Input Voltage	90-264 VAC
Input Frequency	47 - 63 Hz
Power Consumption	400 W
Operating Mode Power Supply (69931)	Constant current or constant power
Ambient Operating Temperature	0 - 40 °C
Weight	120 lb
Dimensions (W x D x H) [in. (mm)]	38.25 (971.54) x 18.00 (457.2) x 30.63 (777.9)

### PERFORMANCE SPECIFICATIONS

Light Source	250 W Quartz Tungsten Halogen Lamp or 200W Xe Arc Lamp
Spot Size	1mm x 2.5mm rectangular
Working Distance	50mm
Wavelength Range	350-1800nm for QTH or 320-1800nm for Xe
Pathlength	1/8M
Resolution	5nm (adjustable)
Repeatability	<±0.5%
Accuracy with QTH Lamp	360-900 <±3.5% 900-1100 <±6.5 % 1100-1800 < 5.3(%)
Accuracy with Xe Lamp	360-900 <±3.5% 900-1100 <±6.5 % 1100-1800 < 5.3(%)
Order Sorting Filters (Automated Filter wheel)	Standard configuration uses 3
Lock-in Amplifier Signal Acquisition Chopper	Modulation frequency 10-1100Hz
Measurement Type	Simultaneous EQE and IQE measurement
Optical Power Output	10.6 μW @ 600nm



## 6 PRODUCT DESCRIPTION

Oriel Instrument's IQE-200 system allows users 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. The system utilizes industry standard Oriel components for the tunable light source. 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. Accessory modules are available to provide sample positioning, temperature control, electrical probing capabilities and light/voltage bias. The IQE-200 incorporates a novel geometry which splits the beam allowing for simultaneous measurement of EQE and the reflective losses to quantify IQE. If equipped, a third accessory detector may be mounted to allow 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. The electronic band structure in a photovoltaic device introduces a wavelength dependent optical absorptivity. A photon with energy larger than the band gap is typically absorbed by the material, while the material is transparent for a photon with energy smaller than the band gap. The absorbed photon energy creates an electron-hole pair, which leads to creation of photocurrent. The spectral response for a photovoltaic device is dependent on this induced photocurrent and on the wavelength of incident light.

The IQE-AC-QTH-SI model uses a 250W QTH lamp (or Xe Arc Lamp) as the light source for the monochromatic light for the system. The monochromatic (1nm spectral resolution) modulated beam is obtained using the system consisting of the filter wheel, the chopper, and the 1/8<sup>th</sup> meter monochromator (Figure 1). The three - way beam splitter delivers the light simultaneously to the sample and to the reference detector. The PC controls (Figure 1) the monochromator, the lock-in amplifier as well as the multiplexer used for simultaneous data acquisition from the three detectors. The QE software provided pre-loaded on the PC performs the needed computations and calibrations. According to ASTM 1021-08, the power spectral responsivity,  $R_{ps}(\lambda)$ , for collected electrons per incident photons may be converted to external quantum efficiency,  $QE(\lambda)$  and then to internal quantum efficiency,  $IQE(\lambda)$ , using the equations below:

$$QE(\lambda) = \frac{hc}{q} \frac{R_{ps}(\lambda)}{\lambda} \quad (1)$$

and

$$IQE(\lambda) = \frac{QE(\lambda)}{1 - R_{sample}(\lambda)} \quad (2)$$

where  $R_{sample}(\lambda)$  is effective sample reflectance.

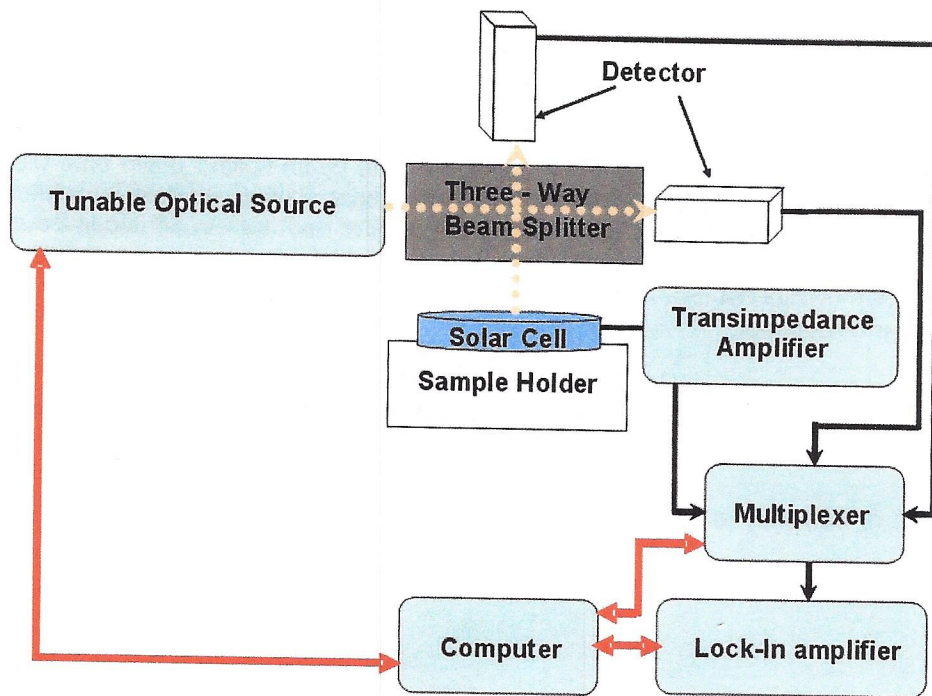


Figure 2 Block diagram of the system

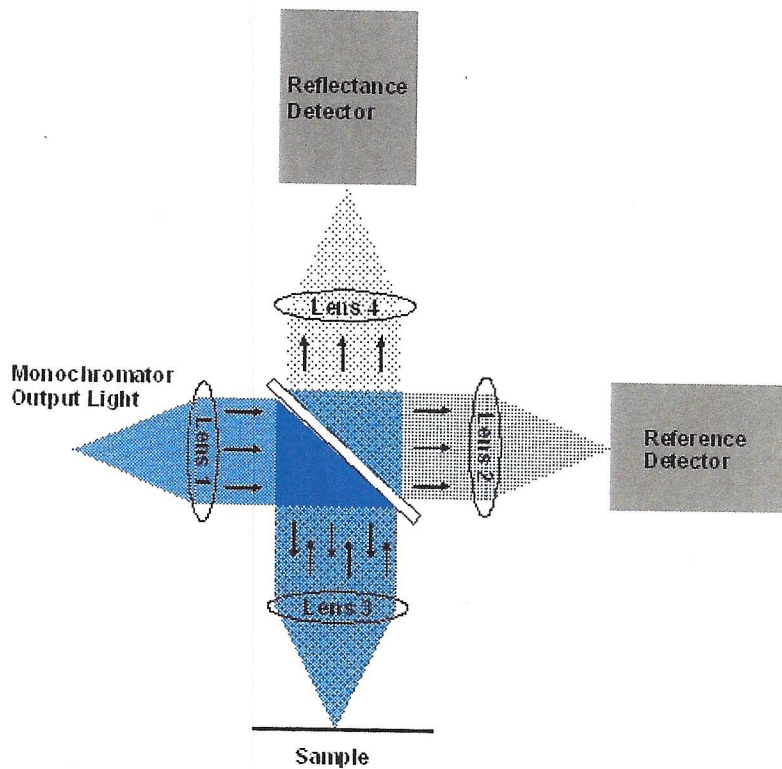


Figure 3 Optical path in the three-way beam splitter

## 9 SPECIFICATIONS

### 9.1 VACUUM CHUCK SPECIFICATIONS

Sample Size	6 inch square maximum
Sample Temp Sensing Range	-40°C to 125°C, $\pm 1^\circ\text{C}$
Vacuum Plate Material	Nickel plated aluminum
Vacuum Requirement	150 mm Hg minimum
Motion, Micrometer	25 mm X-Y travel
Micrometer Sensitivity	1 $\mu\text{m}$
Weight	4.3 kg (does not include packaging)
Cable	BNC male to dual pin tip plugs, 5 feet long Operating Voltage: 30 VAC / 60 VDC maximum Operating Temperature: +50°C maximum
Tubing, Vacuum	1/8 OD clear PVC, 10 feet long
Valve, Vacuum Shutoff	90023529
Terminals	.080" pin tip jack, quantity (6) Operating Temperature: +115°C maximum Current: 5 amps maximum Operating Voltage: 33 Vrms / 70 Vdc
Connector, Thermistor	BNC female conn
Connectors, Vacuum	KGH conn accepts 1/4" OD tubing, quantity (3)
Connectors, Chiller	Hose barb accepts 1/8" ID tubing, quantity (2)



## 9.2 PROBE SPECIFICATIONS

Specifications for the probe assembly are included for reference only. Refer to the instruction manual that come with this item for more details. In the event of discrepancies between this manual and the probe assembly manual, the probe assembly manual takes precedence.

### Model PVIV-PROBE-KIT

Positioning (coarse)	Magnetic
Positioning (fine)	X-Y joystick, Z adjustment knob
Positioner material	Delrin
Arm material	Brass
Probe tip material	Beryllium copper [other materials available as a special order]
Bracket material	Zinc plated steel
Arm length	4.75" long x .087 diameter
Tip dimensions	.025" shank diameter, .75" long, 12 µm diameter tip
Magnetic mount dimensions	1.75" long x .44" wide
Overall Dimensions	3.75" high x .44" wide x 5" long at maximum arm extension
Wire length	18"
Connector	Pin tip plug, .080 inch (2 mm) diameter
Maximum current	3 amps per probe, when using the standard probe tip
Weight	2 lbs (does not include packaging)

## 9.3 THERMOELECTRIC CHILLER SPECIFICATIONS

Specifications for the chiller are included for reference only. Refer to the instruction manual that come with this item for more details. In the event of discrepancies between this manual and the vacuum pump manual, the chiller manual takes precedence.

### Model PVIV-CHILLER

Set Point Range	50°F to 113°F (10°C to 45°C)
Control Accuracy	±2°C
Power Supply	100 watt, 12 VDC; 85-265 VAC input
Current	8 Amps max
Maximum Coolant Outlet Pressure:	25 psig (1.72 bar)
System Proof Pressure:	50 psig (3.36 bar)
Coolant Fluid Connections:	Quick disconnect fittings for 1/4 OD tubing
Tank Volume:	75 ml
Noise:	< 56 dB with 25% propylene glycol/water
Dimensions:	7.5" x 5" x 7" (L x W x H, plus fittings)
Weight:	3 kg (does not include packaging)
Operating Environment	Less than 40°C
Storage Environment	Less than 100°C
Alarm	250 VAC 1 Amp dry contact relay
Communication	Top Panel or RS-232
AC Input	85 to 265 VAC

## 9.4 VACUUM PUMP SPECIFICATIONS

Specifications for the vacuum pumps are included for reference only. Refer to the instruction manual that come with this item for more details. In the event of discrepancies between this manual and the vacuum pump manual, the vacuum pump manual takes precedence.

### Model PVIV-VAC-PUMP

Motor	110 VAC, 60 Hz, 1/8 HP
Vacuum	650 mm Hg max
Power Consumption	65 Watts
Current	0.7 Amps max
Sound Level	50 dB approx
Flow Rate	20 lpm (at 0 mm Hg) to 2 lpm (at 600 mm Hg)
Port Thread	5/16"
Coupler	Hose barb reducer from 5/16 ID to 1/8 ID tubing
Tubing	5/16" ID PVC, 1 foot long
Dimensions	11 x 6.5 x 6"
Weight	11.2 lbs (does not include packaging)

### Model PVIV-VAC-PUMP-220

Motor	220 VAC, 50 Hz, 1/8 HP
Vacuum	650 mm Hg max
Power Consumption	60 Watts
Current	0.3 Amps max
Sound Level	50 dB approx
Flow Rate	17 lpm (at 0 mm Hg) to 1.5 lpm (at 600 mm Hg)
Port Thread	5/16"
Coupler	Hose barb reducer from 5/16 ID to 1/8 ID tubing
Tubing	5/16" ID PVC, 1 foot long
Dimensions	11 x 6.5 x 6"
Weight	11.2 lbs (does not include packaging)