



The TecHno350 Quantum Efficiency / Spectral Response (SR)/ Incident Photon to Current Conversion Efficiency (IPCE) Measurement System is a turnkey photovoltaic device characterization system. TecHno350 is an all in one solution for External Quantum Efficiency (EQE), Internal Quantum Efficiency (IQE), and IV characterization of most solar cells.

Overview:

The TecHno350 uses a xenon arc lamp and Quartz Tungsten Halogen Lamp, monochromator, filters and reflective optics to provide stable monochromatic light to a photovoltaic test device. A broadband bias light also illuminates the test device to simulate end-use conditions. The system uses a detection circuit designed to maximize measurement speed and accuracy for solar cell development



Multi - Junction Quantum Efficiency Measurements

The QEX10 bias light illuminates a region on the sample approximately 1.5 cm in diameter with stable, broad-band bias light adjustable from 0 to 1.5 sun intensity. Bias your solar cell with up to 5 suns intensity over a 7 mm diameter region with the included focusing optics.

The included holder for 25 mm diameter optics enables the use of easily available optical filters to customize the bias light spectrum. PV Measurements also offers accessories to facilitate application of spectrally-selective bias light for multi-junction solar cell measurements, including multi-colored LED bias lights. The correct bias lighting along with the correct voltage bias can allows the discerning scientist to make accurate measurements of each of the individual junctions in a multi-junction measurements.

- ✓ System of choice by national laboratories
- ✓ Fast and easy installation
- ✓ Excellent repeatability
- ✓ Accurate measurements
- ✓ Light bias current capability up to 150 mA
- ✓ ASTM E 1021-06 and IEC 60904-8 compliant
- ✓ DC mode measurement capability (optional)
- ✓ Measures reflectance and IQE (optional)
- ✓ Glove box accessory (optional)

The system operates automatically under the control of a computer with a Microsoft Windows[™] Operating System and custom software written with National Instruments' LabVIEW[™]. The system software controls the equipment, gathers the instrument readings, and maintains the calibration information. It provides a graphical user interface, allowing the operator to easily and quickly specify tests to be performed, monitor test progress, and produce clear and informative test reports. The software saves the data in tab-delimited text format for simple import to graphing or other data analysis software.

Solar Cell Characterization Capabilities

	Types of devices												
Capabilities	c: Si	mc: Si	a: Si/ µ c- Si	CIGS	Organic	DSSC	CdTe	CZTS	GaAs	InGaAs	III-IV dual jn	Triple junction	4-junction
250/300 nm to	✓			~							V		
1400 nm													
250/300 nm to										\checkmark	Ø	V	
1800 nm													
1 Hz to 10 Hz						\checkmark							
chopping													
Bias Light			\checkmark			\checkmark				\checkmark	\checkmark	\checkmark	\checkmark
Reflectance &	\checkmark	✓	✓	$\mathbf{\nabla}$	$\mathbf{\nabla}$		$\mathbf{\nabla}$						
IQE													
measurement													
Voltage Bias			\checkmark	\checkmark			\checkmark				\checkmark	\checkmark	\checkmark

✓ : Recommended

☑ : Suggested

Light Source



DLS-350 is a dual light source equipped with two light sources in a single housing, with automated switchover of lamps using software. Its ellipsoidal optics geometry, and condenser lens deliver very high output intensity for optimized performance

Lamp Option	Wavelength Coverage	Power options
Хе	200 – 1100 nm	75 W, 150 W
QTH	200 – 3000 nm	100 W, 150 W, 250 W
IR-Nernst	1 – 25 µm	Nernst element

Optical Chopper:

Software controlled chopping frequency, variable from 1 to 10 Hz (low frequency chopping) and 5 Hz to 1.5 kHz. Different chopper blade options available, and frequency can be set using chopper controller.



Monochromator

Shamrock 500 monochromator offers high throughput, and resolution and delivers very high performance in wavelength accuracy and repeatability. With its Czerny-Turner design and an optimized design for minimal stray light levels. Shamrock the series of monochromators are ideal for used in photovoltaic characterization. TecHno 350 offers monochromators from a range of 200 mm, 300 mm and 500 mm focal length of monochromator, and grating options, depending upon the performance required. Ideally 600 lines per mm, 1200 lines per mm,



and 1800 lines per mm gratings are used with the TecHno 350.

Spectrograph	200 mm	300 mm	500 mm		
Aperture	3.6	4.0	6.5		
Gratings	Resolution*				
600 lines/mm	0.3 nm	0.2 nm	0.12 nm		
1200 lines/mm	0.15 nm	0.1 nm	0.06 nm		
1800 lines/mm	0.09 nm	0.07 nm	0.045 nm		

*at the center of the slit

Various other gratings and blaze options are available for customized solutions. Contact us for more details.

- Salient Features:
- □ Gratings Interchangeable indexed triple turret
- \square Slit widths range, motorized 10 μm to 2.5 mm
- □ Communication USB
- □ Wavelength accuracy 0.04 nm
- □ Wavelength repeatability 10 pm
- □ Order sorting filter and scattered light filter, & shutter on a motorized filter wheel

QE Chamber

TecHno 350 is equipped with a light tight QE chamber that facilitates solar cell characterization in lab environment without the requirement of a dark room. The QE chamber permits up to four bias light housings to be fitted for light biasing. Solar cell mounts of area > 200 mm x 200 mm can be used inside the chamber. Temperature controlled vacuum chucks ($10^{\circ}C$ to $65^{\circ}C$, $\pm 0.5^{\circ}C$ stability) are available for prevention of generation of thermal carriers, and bending of solar cells. Contact probes are available for front contact solar cells and back contact solar cells (magnetic probes). Optionally a camera/telescope may be provided for easy of viewing of contact on solar cell.



Figure: Solar cell chuck and Kelvin contact probes

The QE chamber is also fitted with an integrating sphere (102 mm dia and 150 mm dia options) mounted on a rail that facilitates easy switch from EQE to IQE



Electronics

Lock-in amplifier: SRS 530



The Stanford Research SR530 is an analog lock-in amplifier which can measure AC signals as small as nanovolts in the presence of much larger noise levels. The Dual Phase SR530 has low-noise voltage and current inputs, high dynamic reserve, two stages of time constants, and an internal oscillator. In addition, THE SR530 comes equipped with a variety of features designed to make it simple to use.

Features:

Frequency Range: 0.5 Hz to 100 kHz Dual Phase, Duel Channel Current and Voltage Inputs Up to 80 dB Dynamic Reserve Internal Reference Oscillator Tracking Band-Pass and Line Filters Four ADC Inputs, Two DAC Outputs RS-232 Interface

Pre-amplifier: SRS 570

The SR570 is a low-noise current preamplifier capable of current gains as large as 1 pA/V. High gain and bandwidth, low noise, and many convenient features make the SR570 ideal for a variety of photonic, low temperature and other measurements.



Bias Voltage: Keithley



Model 2401 provides precision voltage and current sourcing and measurement capabilities (1 μ V-20V and 10pA-1A). It is both a highly stable DC power source and a true instrument-grade 6½-digit multimeter. The power source characteristics include low noise, precision, and readback. The multimeter capabilities include high repeatability and low noise. The result is a compact, single-channel, DC parametric tester.

Bias Light

150 W/ 250 W Quartz Tungsten Halogen lamp is used as a bias light source. Multiple bias light sources may be used for multi-junction solar cells. Bias light intensity can be varied between 0.1 to 2.0 Suns using automatic control. Bias light is delivered using optical fiber bundles for maximum intensity, or reflectors for larger area monitoring. Motorized iris is available as an option for control of bias light beam size. Filter sets are available for multi-junction solar cells.





System Requirements:

115 VAC, 10 A or 230 VAC, 5 A, 50 Hz to 60 Hz Sturdy table at least 2.0 m wide and 0.5 m deep Temperature between 20 °C and 27 °C Relative humidity < 60 % No dust, organic vapors or corrosive fumes