

SpeQuest

Spectral Response Measurement System

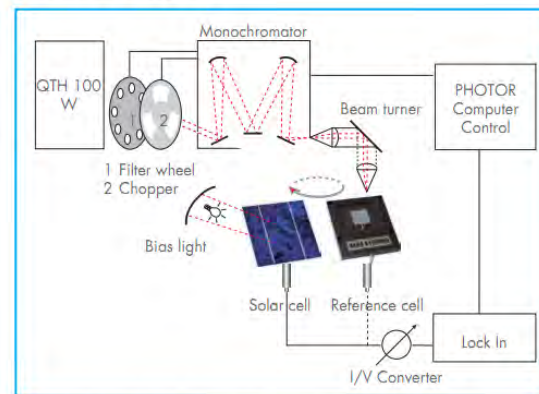


- Complete turnkey solution for spectral characterization
- Modular setup for maximum flexibility
- All type of solar cells: poly silicon, c-Si, mc-Si, nc-Si, III/V compound cells, thin film: CdTe, CIS, CIGS, Si, 3rd generation: organic polymer, dye
- Single and multi-junction devices
- Spectral range 200 – 2200 nm
- Variable bias light (white light or multi-color)

In today's rapidly evolving markets for solar cells, the characterization of the spectral response (quantum efficiency) is one of the most important parameters for research and development of new materials and devices but also for production and quality control. Today still 90% of the solar cells manufactured around the world are single junction silicon devices; therefore the layout of a spectral response measurement system is relatively simple and straightforward. However, the most promising research areas focus on different devices and

materials, e.g. thin film and 3rd generation devices, which require a different layout of a spectral response characterization system. SPEQUEST takes into account the latest developments in solar cell research, the modular and very flexible setup enables quick and simple adaptation to research and production requirements. PHOTOR software allows complete control of the measurement and data evaluation, all calculations are IEC compliant.

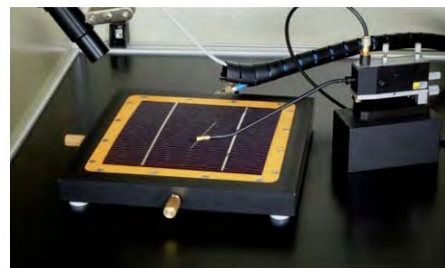
SPEQUEST layout



Schematic system layout for spectral response characterisation system

Vacuum stage

The standard vacuum stage allows easy sample mounting of solar cells and devices, electrical probing is done via proven PH100 Cascade Microtech-Probes. For maximum accuracy the stage can be equipped with a temperature controller, which allows computer controlled set up from about 5 °C (dew point) to 70 °C.

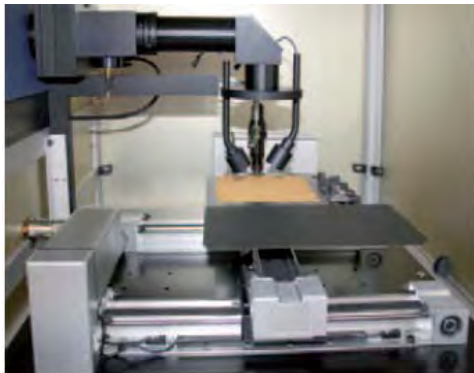


Bias light source

Accurate quantum efficiency measurements of solar cells require a DC light source for biased characterization measurements. The standard SPEQUEST system comes with a variable white light bias source. The output is 500 W/m^2 . Optional a 1000 W/m^2 (1 sun) bias light is available.

Motorized XY table

This fully computer controlled table allows 5 point current mapping over a selectable wave range and multiple mapping at one wavelength. The implemented CurrentMapper software provides 3D view of the results. This table can be combined with each of our stages. Depending on dimensions third party contact stages can be hold up to 10kg.



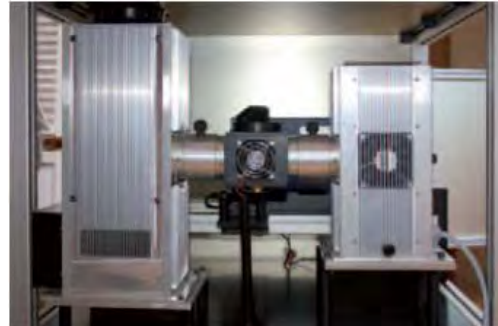
IQE

Measuring the internal quantum efficiency (IQE) is very interesting for some applications. Therefore the system can be equipped with an additional sphere of 59 mm diameter. Both diffuse and specular reflection can be obtained. An algorithm eliminates the effect of gridline reflection.

Dual light source setup

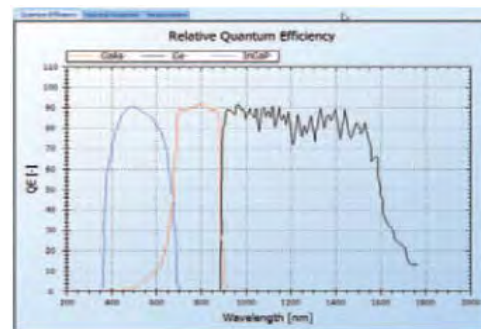
Select this option if your measurements require maximum UV output and excellent stability beyond 350nm. SpeQuest can than hold both,

a xenon and a halogen light source in one system. Switching is completely done by the Photor software. This option is only available together with a 300 mm monochromator.



Multi-color bias light

Uses a combination of the (standard) halogen bias lamp with a blue power LED at 455 nm and an IR LED with short pass filter for 810 nm. For every sub cell in the multi-junction stack a specific setting of the 3 different light sources can be selected and stored. For perfect matching all three light sources are independently controllable. The Photor software completely controls all lamps and each preset can be stored in the software. A computer controlled power supply in the range $\pm 10 \text{ V}$ for voltage biasing is included.



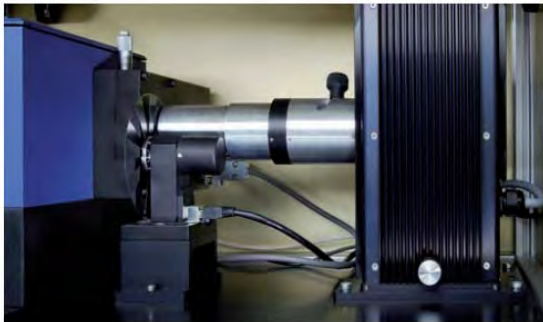
Example of multi-junction measurement

Monochromatic light source

Key component of every spectral response measurement system is the monochromatic light source. SPEQUEST operates a QTH light source with a 150mm dual-grating Czerny Turner spectrograph to provide monochromatic light between 350 and 1700 nm. For UV measurements below 350 nm SPEQUEST can be equipped with a xenon arc lamp to provide output down to 250 nm. For this application the Monochromator requires a grating blazed at 300 nm.

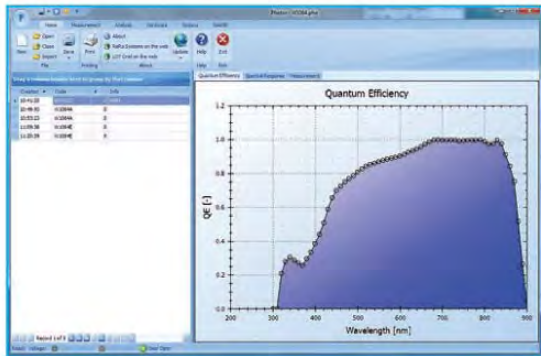
Detection electronics

The electrical signal is fed into a Lock-In amplifier via a high speed large range IV converter. Careful selection of the detection electronics and adaptation to the optical system ensures maximum measurement accuracy. The superior stability of the QTH monochromatic light source allows a single Lock-In amplifier setup.

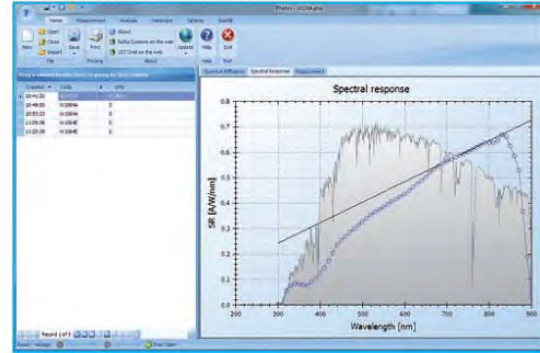


PHOTOR software

PHOTOR is your powerful interface to operate SPEQUEST and analyze your data. It is specifically developed for the measurement and characterization of the spectral response of solar cells and devices. PHOTOR is developed using the latest Microsoft.NET technology resulting in a modern “Microsoft Office 2010” look and feel. It operates under Windows operating system, support of platforms like Linux and MacOS is currently under development. The algorithms used in PHOTOR meet all IEC standards for spectral response measurements. Relative measurements can be easily scaled to calibrated currents for different spectral irradiances. All calculations are done by using the ASTM G173 Reference Solar Spectral Tables.



Quantum Efficiency Measurement



Spectral Response Measurement

ReRa Solutions has a license agreement with the ASTM organization to use these tables. Measurements are stored in project files which can be processed off-line as well; PHOTOR provides the connector protocols to the most popular databases:

- SQL server
- Oracle
- MySQL

Standard functions included with PHOTOR are:

- Quantum Efficiency (EQE and IQE)
- Spectral Response
- Mismatch factor
- Short circuit current for different ASTM standard spectra

A free viewer to analyze the projects generated by PHOTOR is available for download.