SOLARONIX

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Sunirad A-1525-V-LC

Based on Solaronix' exclusive light engine, our solar simulation equipment delivers a perfect and continuous artificial sunlight 24/7, allowing for accurate stability and performance assessments of solar

INNOVATIVE SOLUTIONS FOR SOLAR PROFESSIONALS

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Sunirad A-1525-V-LC Specifications

The Sunirad A-1525-V-LC is a complete light soaking unit having a total sample area of 1.5x2.5m. It consists of three main components:

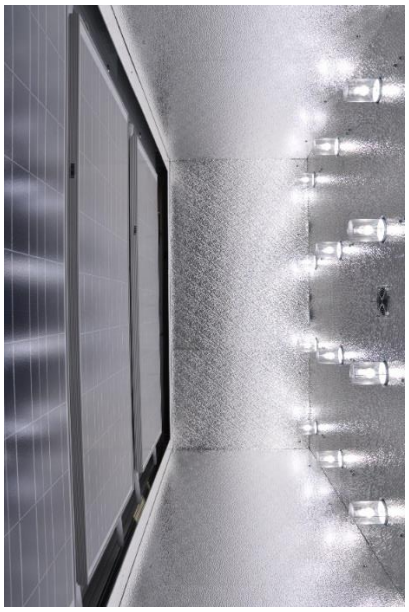
- A high efficiency Lumixo plasma light engines array (20 lamps) fitted with bulbs giving a Class A spectrum when operated between 800 and 1100 W/m2 of irradiance intensity.

At the heart of our simulators stand Solaronix' exclusive Lumixo light-engines ("Xenonless xenon lamp"), 1kW electrode-less discharge lamps with a lifetime up to 20'000 hours. All parts of the light engines can be refurbished or replaced.

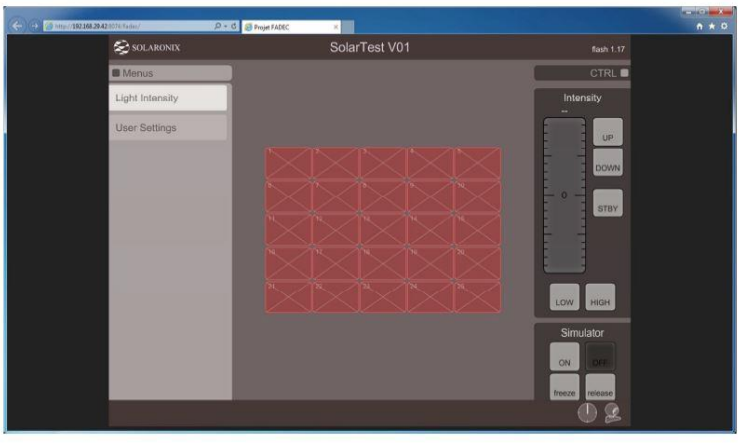
- A reflector box homogenizing the diffuse light from the light sources, in a way to ensure uniformity and proper spectrum on the sample area. The reflector box consists of a mechanical structure and its cabling elements dedicated to the light-engine array. The sample surface is placed 20-50 mm in front the reflector edge. The illuminator and the cooling system are installed on rails to ensure full access to the sample when the system is non-operating.

The light-engines array and its reflector with the associated mechanics forms the complete illuminating unit.

- The system has an air cooled sample holder to control the sample temperature during the illumination tests. The sample holder uses ambient air to maintain the PV module steady during illumination.



Illuminating chamber



Lamp array remote control

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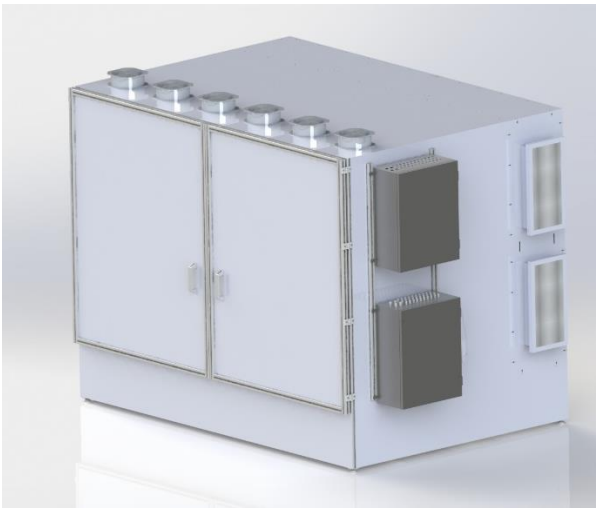
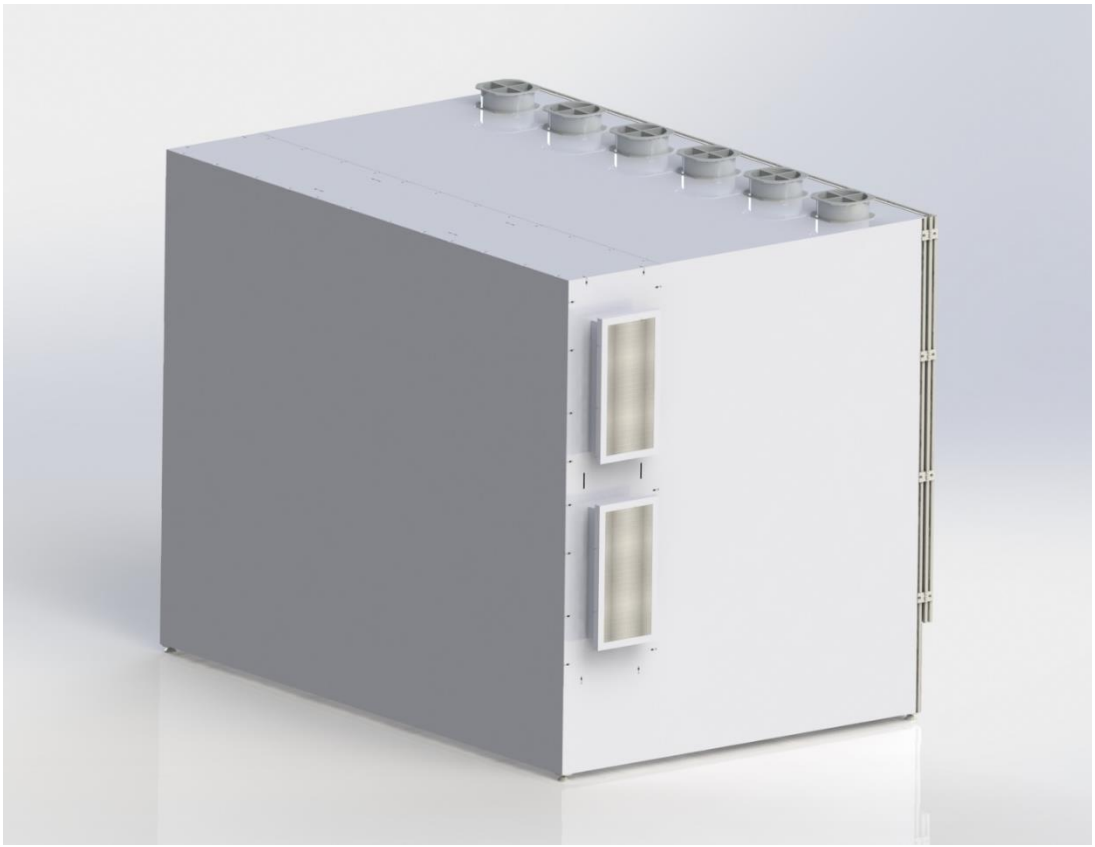


Sunirad & Hotspot Tester A-1525-V-LC (front view)



Sunirad & Hotspot Tester A-1525-V-LC (back view)

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Illuminating unit specifications

Total Class AAA area: 1.5 x 2.5 m

Irradiance level: The nominal central irradiance measured with a reference silicon solar cell is 1000W/m2 adjustable from 800W/m2 to 1100W/m2.

The lowest achievable irradiance (e.g. 700W/m2 or lower) acts as the standby mode, for example, used while the sample is cooling down.

No shutter is necessary, as the light engine array may be switch ON and OFF quickly.

Homogeneity over the sample area (within 800-1100 W/m2 operating range):

The class AAA adjustment and characterization is provided by Solaronix, the specification is a class A uniformity (2% as per IEC 60904-9:2007) on the complete sample area.

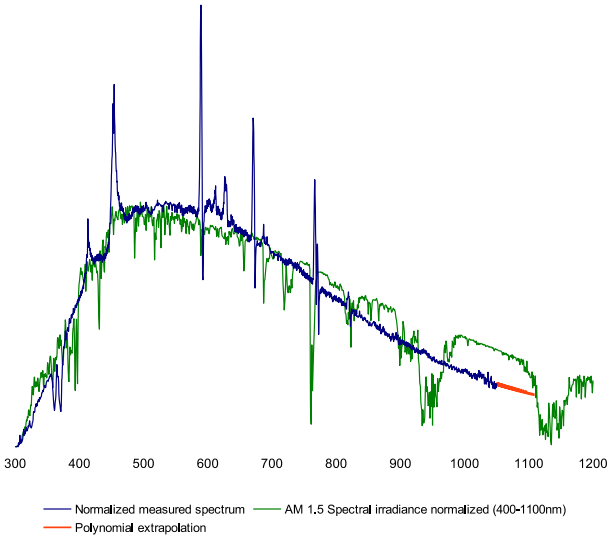
Temporal stability (within 800-1100 W/m2 operating range):

The irradiance stability (LTI and STI as per IEC 60904-9:2007) is defined as per IEC 60904-9:2007, 5.4.1.3.c. The system is built to ensure a temporal stability of < ± 0.5%.

Spectrum (within 800-1100 W/m2 operating range): class A (as per IEC 60904-9:2007)

Wavelentgh range	AM1.5 ratio	Spectrum ratio	Mismatch	Class
400-500 nm	18.4	17.9	0.97	A
500-600 nm	19.91	20.9	1.05	A
600-700 nm	18.36	19.6	1.07	A
700-800 nm	14.92	15.8	1.06	A
800-900 nm	12.46	11.5	0.92	A
900-1100 nm	15.94	14.4	0.90	A

Class A	Class B	Class C
0.75	0.60	0.40
1.25	1.40	2.00



Warm up time for stabilization of irradiance: ~150 s

Warm up time for stabilization of I-V measurements: ~150 s

Maximum angle subtended by the light source (including reflected light) in the test plane: 90°

Changes that may require verification of the classification:

Any lamp unit or power supply replacement may change the irradiance uniformity specification.

Any change of the system settings in the operating software may change the irradiance uniformity specification.

Temporal stability and spectrum should not be affected by such changes.

Operating conditions:

Ambient temperature +25°C ± 2°C

As no dust filter is provided on the air cooling system, the system has to operate in a clean environment, i.e. with no dust or fumes emitting process nearby.

Maximal power requirement: 30kW, nominal 20kW, 400VAC 50Hz; 3P/N/PE.

Required flow of cooling air:

System consumption (intake): max 12'000 m3/H at 25°C, taken from the ambient air.

System exhaust: max 12'000 m3/H at 45-50°C, rejected into ambient.

Light engine

The Sunirad and Hot-spot tester A-1525-V-LC uses 20 plasma lamp based light engines, which not require any bulb changes.

The advantages of this plasma lamp are:

- Sun spectrum class A without any filter, according IEC60904-9:2007
    - Reduced maintenance cost
- Life time up to 40'000 hours (warranty 20'000 hours)
    - Reduced maintenance cost
- No spectrum shift
    - Increased quality test
- No light flux reduction
    - Increased quality test

Sample holder specifications

The PV modules are installed on a vertical frame inside the equipment, accessible by hinged doors allowing easy access to the sample. The sample sits in a vertical air blade cooling the module from the bottom to the top. The air blade velocity is regulated to ensure that the PV module is kept at +50°C ±10°C requested by the light soaking test according the norm IEC61646:2008.

The sample holder uses ambient air of the room. The room must be kept at 25°C ±2°C to ensure the proper cooling of the PV modules.

The temperature measurement repeatability of regulation loop is better than ±1°C for the regulation loop to respect the norm IEC61215-2:2015 & IEC61646:2008. The temperature measurement accuracy of the regulation loop is better than ±1°C to respect the norm IEC61215-2:2015 & IEC61646:2008.

The equipment comes with 20 shadow tools, built to cover the 6'' wafer surface in 5% increments, according to the norm IEC61215-2:2015 & IEC61646:2008.

Sample area: 1.5 x 2.5m

Cooling capacity:

The temporal stability of the sample temperature is within ±5°C after thermal equilibrium of PV module, before the beginning of measurements according the norm IEC 61215-2:2015 requested by the Hot-spot endurance test (MQT 09).

Operating conditions:

Ambient temperature: +25°C ± 2°C

Measurements capabilities

The system is compliant to produce the following measurements:

- Hot-spot endurance test according IEC61215-2:2015 & IEC61646:2008
- I-V measurement and IR camera are not included in quotation QUO220116LC01
- Light soaking test according IEC61646:2008

Size of equipment

Simulator with doors closed: 3m (width) x 2m (depth) x 2.2m (height)

System overall footprint, including access areas: 5m (width) x 4.2m (depth) x 3.3m (height)

Weight: ~1300 kg (whole equipment)

I-V System professional

Our I-V System Pro is built around the well-known Kepco Bop bi-polar power supply and 3 Agilent DMMs to realize high quality data acquisition on current, voltage and reference cell. These proven instruments have all it takes to measure IV-curves (both dark and illuminated) on solar cells and modules.

The current range is ±4A, where the voltage range is ±100V. Other ranges are available on request.

When measuring solar cells, it is very important to use a thermostated sample holder, to avoid measurement due to thermal drift of the sample.

Another important parameter for solar cell metrology is the temperature. A high precision, class A Pt100 temperature sensor including computer interface (USB) is included with this professional I-V System.

Please note that the Tracer I-V Curve Software is required to operate the I-V System professional.

Key features

- Kepco Bop bi-polar power supply (electronic load)
- 3 x Agilent digital multi-meter (DMM)
- Instrument for measuring I-V curves (both dark and illuminated)
- Current ±1A (other ranges are available on request.)
- Voltage range ±100V (other ranges are available on request)
- Including GPIB interface
- Including class A Pt100 temperature sensor with USB computer interface

I-V System professional

I-V Measurement Software

A powerful software named Tracer, controlling the electronic load, allows a user-friendly operation, going from simple current-voltage (I-V) plot tracing to more advanced device characterization.

It seems logical for this measurement to use a standard power supply, because a power supply is normally used to provide a variable voltage and current. Unfortunately, this would not work for solar cells. A solar cell generates current, so you will need to have a power supply that sinks this generated current instead of provide it. This can be done with a so called bi-polar power supply (or electronic load). This is a power supply that can sink and source current at both positive and negative voltages. There are many instruments on the market that can be used a such a bi-polar power supply. Some of them are just bi-polar power supplies while others integrate measurement and control capabilities as well.

Tracer will let you define and setup a system based on different instruments to measure your I-V curves. You can add multiplexers to automatically measure multiple cells by using one single measurement system, implement contact checking and measure monitoring solar cells.

Some examples of the supported hardware:

- Keithley 2400 series
- Keithley 2600 series
- HACKL Electronic Loads
- Kepco BOB
- B&K Electronic Loads
- Toellner loads info
- EKO MP-180 Curve Tracer
- National Instruments Data Acquisition
- MODBUS / Ethernet controlled instruments

Of course Tracer natively supports the control of all Keithley 2400 and 2600 series SourceMeters. These instruments have proven their strength over time for the measurement of solar cells. They range from 0.1fA – 20 Amperes. Tracer is developed with the latest Microsoft.NET Technology, which resulted in a modern 'Microsoft Office' look and feel. A stable operation on the Microsoft Windows platform is guaranteed (Vista or higher). Other popular platforms like Linux and MacOS will be supported in the future.

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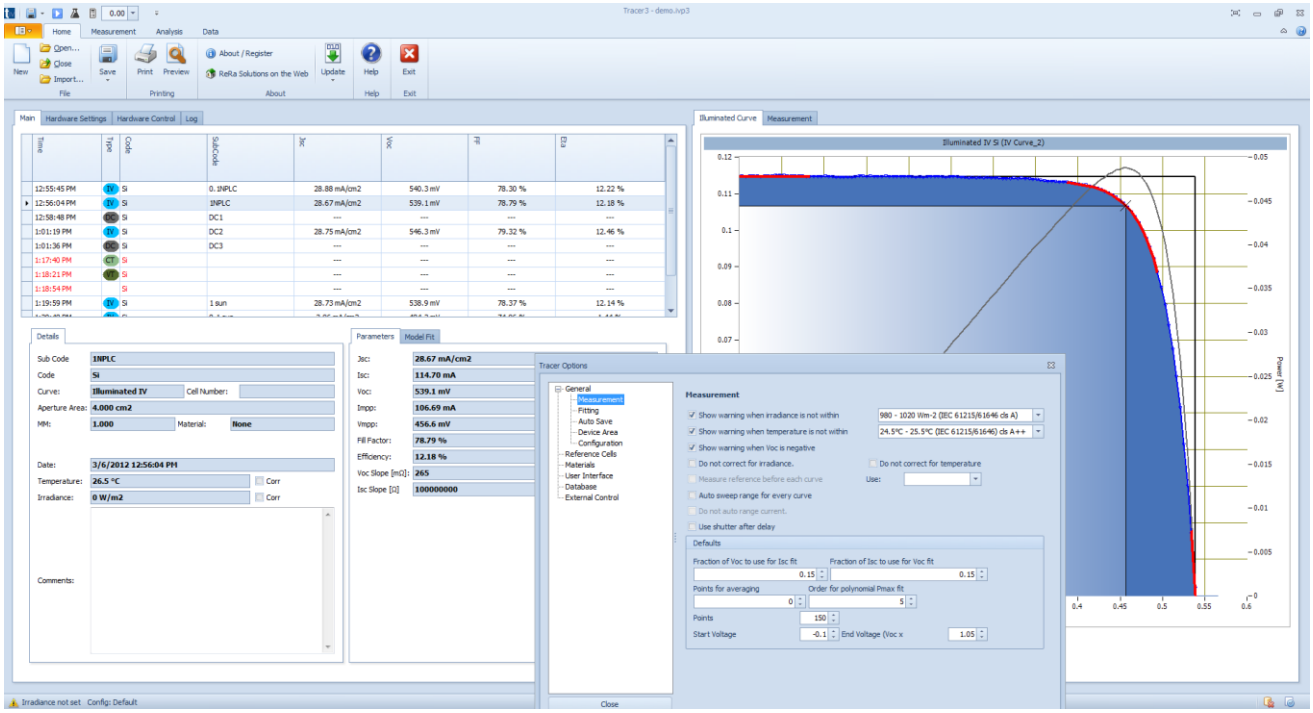
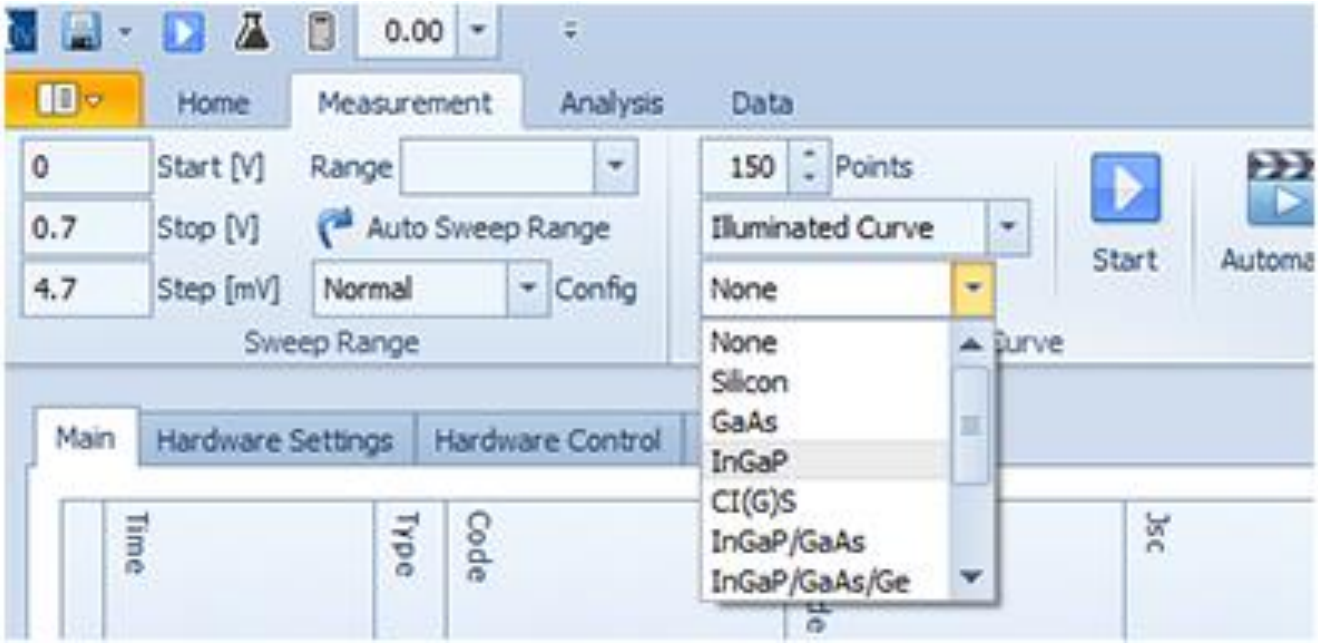
I-V Software main window

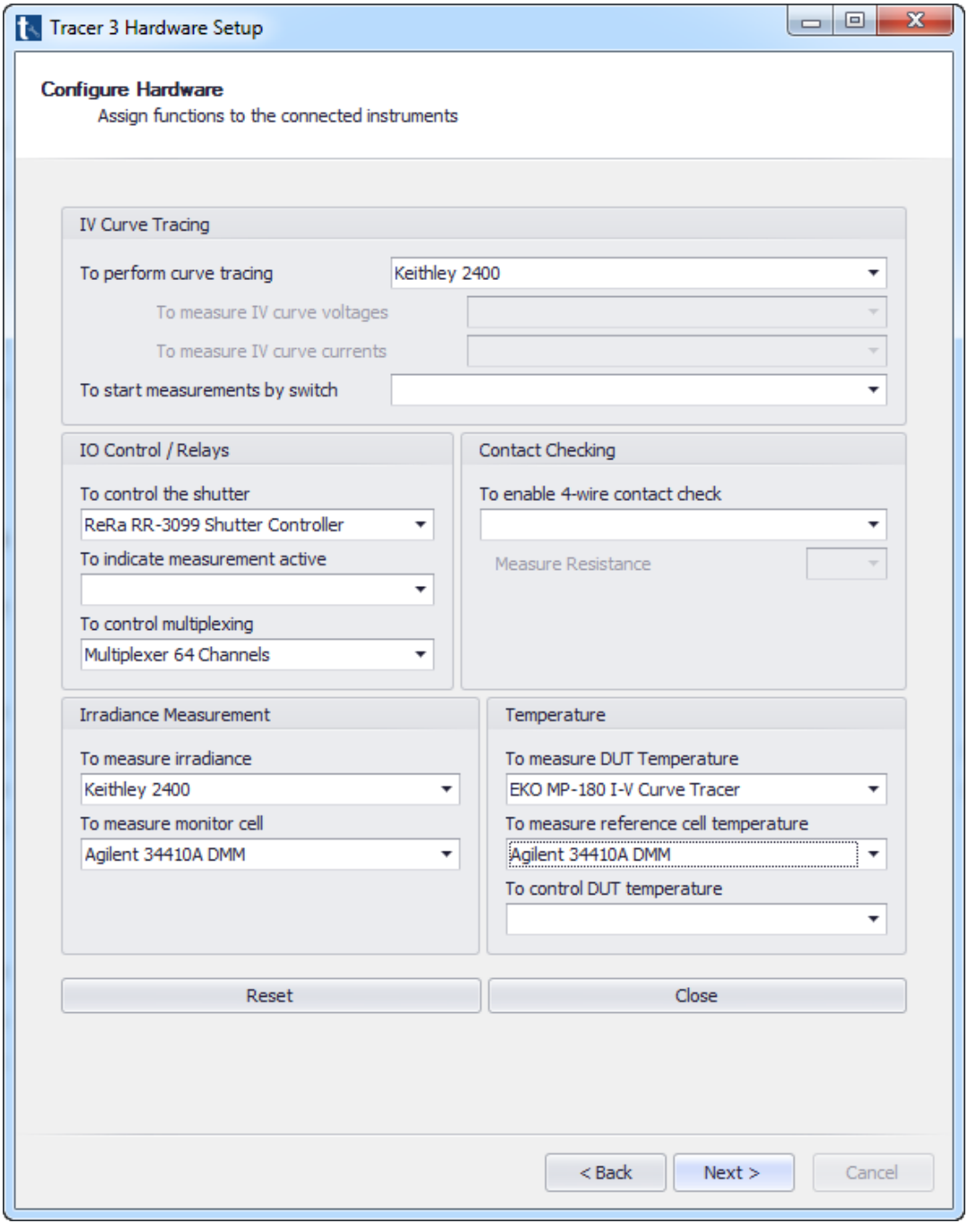


Definition of material tested



Tracer Configurator

Before you start working with Tracer, you will have to configure your system. This is done by the Tracer Configurator. A tool that completely defines the setup you want to use. Tracer intends to support most instruments available on the market to use as an IV-curve measurement system. You can use for example a Kepco BOP bipolar power supply, add 2 Agilent 34410A DMMs to measure voltage and current, use a National Instruments DAQ card to control the Kepco BOP and get that unused Keithley 2000 DMM to measure a Pt100 sensor for the solar cell temperature. This is all defined in the configurator.



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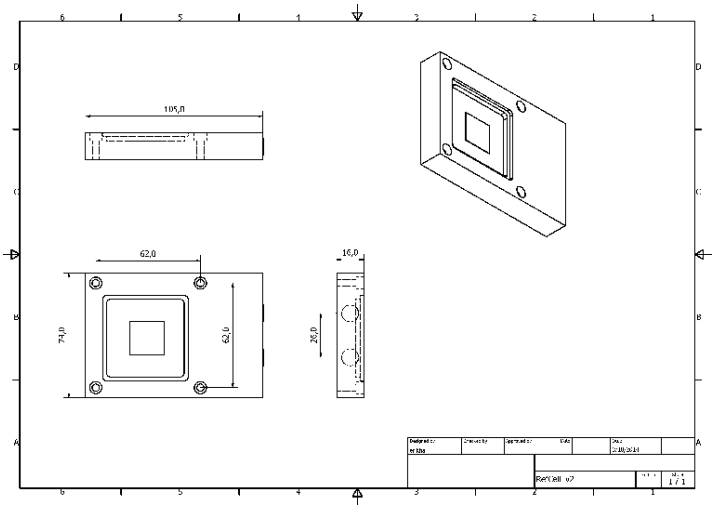
Reference Si solar cell

The reference Si cell has active area of 2 x 2 cm



The reference has a dimension of 74 x 105 x 16 mm

Product Description

The standard crystalline silicon reference cell manufactured by ReRa is a high-quality precision sensor for the determination of solar simulator irradiance levels. ReRa uses the Radboud University Nijmegen PV Measurement Facility to calibrate the cells indoor. The calibration is done against an established set of reference cells calibrated at NREL and Fraunhofer ISE. These references are measured each year at the spectroradiometer and broadband intercomparison to ensure traceability.

Key features

- Lower cost reference cell
- Calibrated against traceable reference set
- Irradiance and temperature readout
- Protective Quartz (standard) or Schott KG glass window
- Compatible with the Tracer I-V software
- Open and shunted version available
- Several filter options (KG# window) to match spectral response, KG number to be specified at order.
- Including full calibration report (I-V curve plot, Isc, Voc, Impp, Vmpp, Fill Factor and Efficiency)
- Including cables to connect reference cell in a 4 wires configuration
- Including protective suitcase

Models

- Shunted Silicon Reference Cell
- Open Silicon Reference Cell

Options

All reference cells can be ordered with a KG3 or KG5 window for measurements of specific cell materials.

- KG3 window (+ € 125)
- KG5 window (+ € 125)

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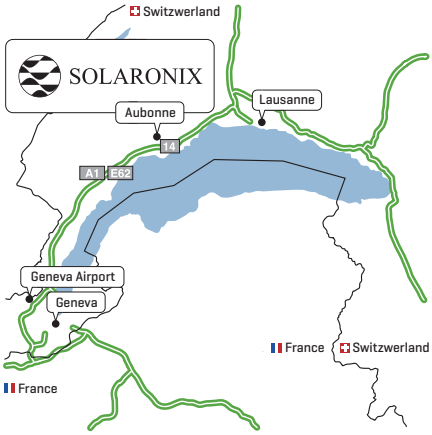

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