



1 WPVS reference cell used in laboratory.

2 Monocrystalline silicon solar cell made by Fraunhofer ISE for reference cells.

REFERENCE CELLS

Reference cells produced by Fraunhofer ISE are cutting-edge equipment for manufacturers of PV modules, laboratories and EPC contractors (Engineering, Procurement and Construction) worldwide.

For different photovoltaic cell technologies and other applications we are providing tailored solutions for our customers. High efficiency monocrystalline silicon solar cells made by Fraunhofer ISE guarantee the most precise and long-term stable reference cells available worldwide.

WPVS (Indoor) Reference Cells

Our indoor reference cells comply with the World PV Scale (WPVS) standards. They are used by renowned laboratories and module manufacturers to perform most precise measurements for PV modules.

Technical Specifications

- housing of black anodized, mechanically stable aluminium
- dimensions 70 x 79 x 17 mm³

- monocrystalline silicon solar cell made by Fraunhofer ISE, 20 x 20 mm²
- potential-free mounting in the housing
- Pt100 temperature sensor (4-wire) integrated
- connection via LEMO connectors
- glass cover or filter e.g. for measuring thin-film cells
- Fraunhofer ISE DAkKS-calibration or Fraunhofer ISE proprietary calibration; PTB calibration on request

Outdoor Reference Cells

In order to check the performance of PV power plants very precisely, we developed outdoor reference cells. Outdoor reference cells include a precision shunt resistor providing a voltage signal equivalent to the irradiance. They can be used with most monitoring systems.

Technical Specifications

- housing of naturally anodized, mechanically stable aluminium IP65
- dimensions 70 x 79 x 17 mm³

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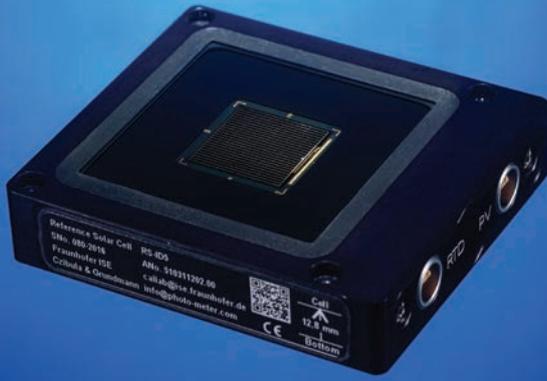
Reference Cells

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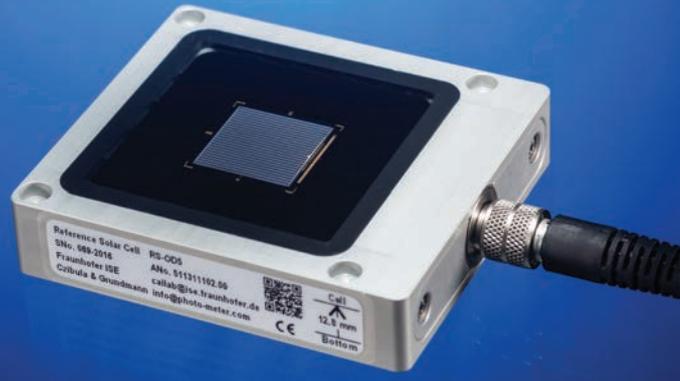
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- monocrystalline silicon solar cell made by Fraunhofer ISE, 20 x 20 mm²
- potential-free mounting in the housing
- Pt100 temperature sensor (4-wire) integrated
- connection via 8-pin binder connector
- glass cover or filter e.g. for measuring thin-film cells
- integrated precision resistor
- calibration of the short circuit current as shunt resistor voltage [mV]

Optional Accessories

To connect a reference cell to an existing data acquisition system in some cases the signal has to be converted. Therefore, we developed converters for WPVS and outdoor reference cells.

Current to Voltage Converter for WPVS Reference Cells

The current to voltage converter is made for signal conditioning of Fraunhofer ISE WPVS reference cells in continuous light measurements. With this device it is possible to operate a WPVS reference cell at I_{sc} and measure a DC voltage that is equivalent to the short-circuit current:

- input current: 0 - 200 mA DC limited at 220 mA
- output voltage: 0 - 2000 mV DC
- fixed converting factor: 10 mV / mA (individual values are given in the measurement report)
- calibration: Fraunhofer ISE measurement report included, DAkkS calibration available

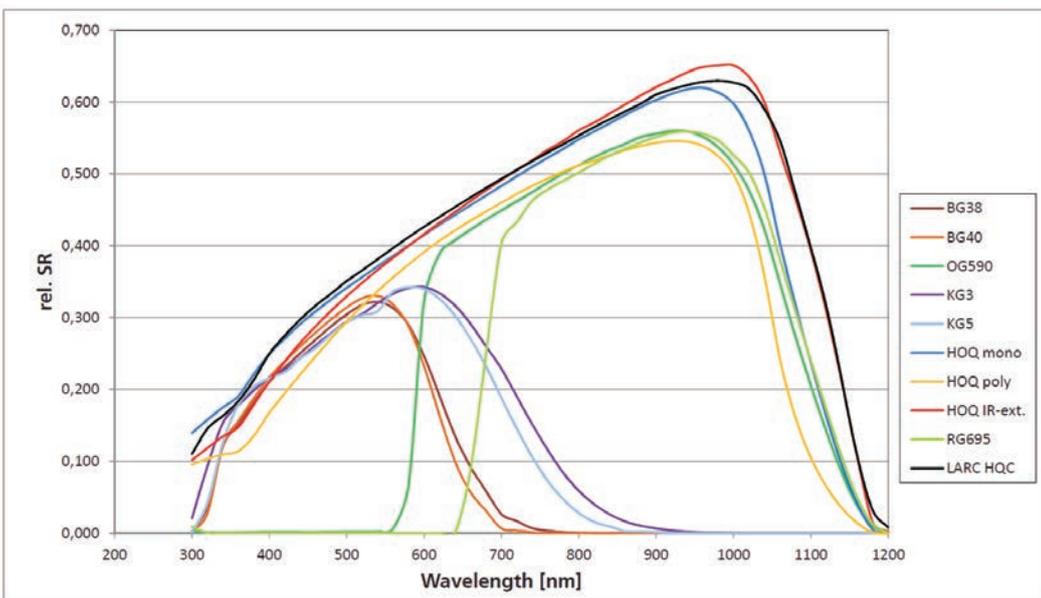
3 WPVS reference cell.

4 Outdoor reference cell.

Voltage Signal Amplifier for Outdoor Reference Cells

This voltage signal amplifier is made for signal conditioning of Fraunhofer ISE outdoor reference cells with integrated shunt resistor:

- amplification: 1, 10 or 100 selectable with jumper
- input voltage: 0 - 100 mV
- output voltage: 0 - 1000 mV
- Fraunhofer ISE measurement report included, DAkkS calibration available



5 Spectral response of different reference cells.