

The ISFH Calibration and Test Center (ISFH-CalTeC) operates an ISO/IEC 17025 certified **solar cell calibration laboratory**.

In accordance to the IEC60904 standards, the laboratory provides calibrated measurements of the characteristic solar cell parameters:

- short-circuit current -  $I_{SC}$
- open-circuit voltage -  $V_{OC}$
- fill factor -  $FF$
- maximum power -  $P_{MPP}$
- energy conversion efficiency -  $\eta$

The service is focused on the measurement of wafer-based silicon solar cells from laboratory up to industrial formats of 6".

A modular contacting scheme allows calibration of mono- and bifacial H-pattern cells with up to six busbars as well as back contact cells up to 5" and reference solar cells in WPVS design.

The certified procedure consists of three measurements:

1. solar cell area
2. spectral responsivity
3. current-voltage curve

In order to ensure traceability to SI units, all reference devices are calibrated at the national metrology institute of Germany, the PTB (Physikalisch-Technische Bundesanstalt).



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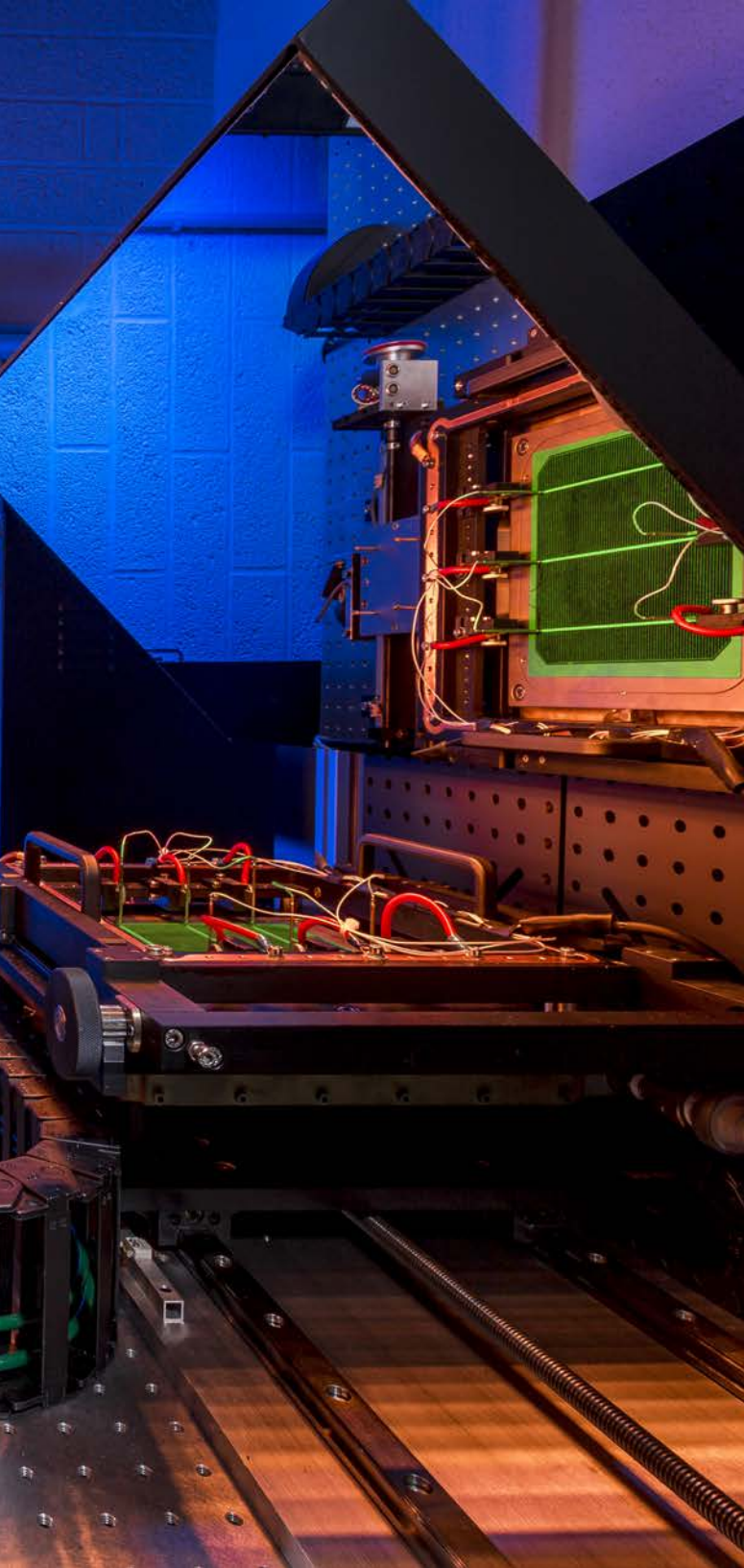
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## Solar cell calibration



Deutsche  
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D-K-18657-01-00



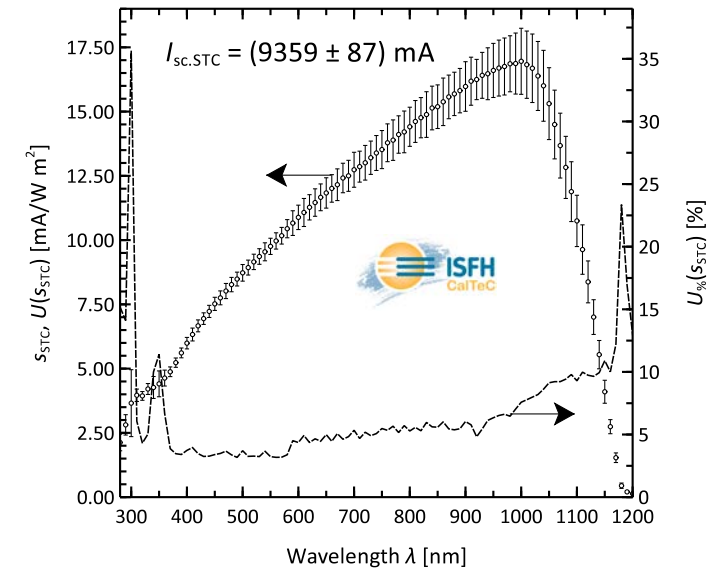


## Spectral responsivity

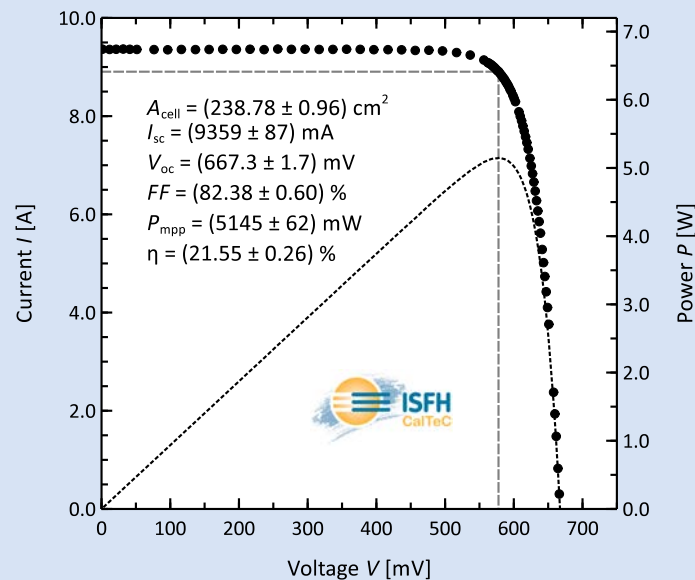
Full area measurement of the differential spectral responsivity  $\tilde{s}(\lambda, E)$  for at least six different bias irradiances  $E$  in accordance to the IEC 60904-8 Ed. 3.0 standard.

Determination of the short-circuit current  $I_{sc,STC,IV}$  at standard test conditions (STC) with an AAA solar simulator in accordance to the IEC 60904-1 Ed. 2.0 for scaling of the spectral responsivity curves.

Report of the absolute spectral responsivity  $s_{STC}(\lambda)$  at standard test conditions including the accompanied uncertainties.



Results of a calibrated measurement of the spectral responsivity of an industrial crystalline silicon solar cell



Results of a calibrated measurement of the current-voltage curve of an industrial crystalline silicon solar cell

## Current-voltage curve

Adjustment of the irradiance of the two-lamp AAA solar simulator using a calibrated WPVS reference cell.

Measurement of the solar simulator spectrum using an integrated spectroradiometer.

Correction for spectral mismatch and shading of contacting bars.

Determination of the 25°C equivalent open-circuit voltage using the  $V_{OC}-t$  approach.

Measurement of the current-voltage curve in both directions to exclude hysteresis effects.