

- 1 *Advanced two-mirror setup for determination of I-V parameters.*
- 2 *Top view of the advanced two-mirror setup.*
- 3 *Reflective and non-reflective background contacts for standard I-V measurement.*

CALIBRATION SERVICES FOR BIFACIAL SOLAR CELLS

Fraunhofer ISE CalLab PV Cells, one of the world's leading calibration laboratories, provides industry and research facilities with comprehensive measurement services for a wide range of solar cells.

CalLab PV Cells is accredited according to ISO/IEC 17025 from DAkkS (Deutsche Akkreditierungsstelle; D-K-11140-01-00). Our calibrations are traceable to the international System of Units (SI).

With more than 30 years of experience in the measurement of solar cells, CalLab PV Cells enforces strict quality management procedures and complies with the measurement requirements stated in international standards (IEC) in order to guarantee the highest level of reproducibility, reliability and measurement accuracy.

Measurement of Bifacial Solar Cells

Detailed knowledge of bifaciality is essential for solar cell production and energy yield assessment of power plants. Since bifacial solar cells are able to convert light from both the front and rear surfaces of the cell, they can gather more energy in field operation than monofacial devices.

Several options are available to quantify bifaciality. First, the electrical characteristics can be measured individually for both front and rear sides. As advanced option, these characteristics can also be determined by using simultaneous front and rear illumination, or by using front illumination with increased irradiance. We offer all these options for a wide range of bifacial solar cells.

At CalLab PV Cells we are able to measure most types of bifacial solar cells: laboratory and industrial cells, small and large cells. We provide measurements for bifacial solar cells with a wide range of busbar configurations as well as for shingled cells.

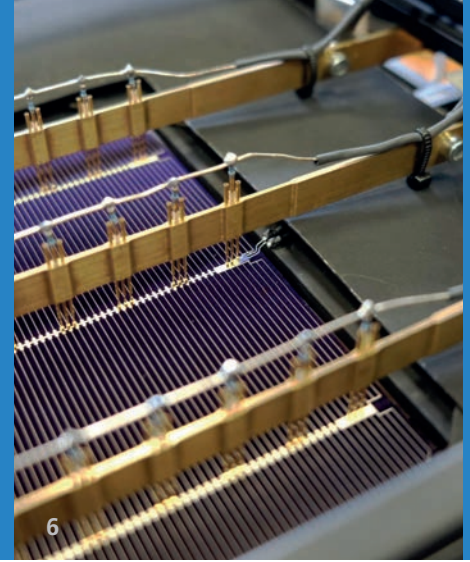
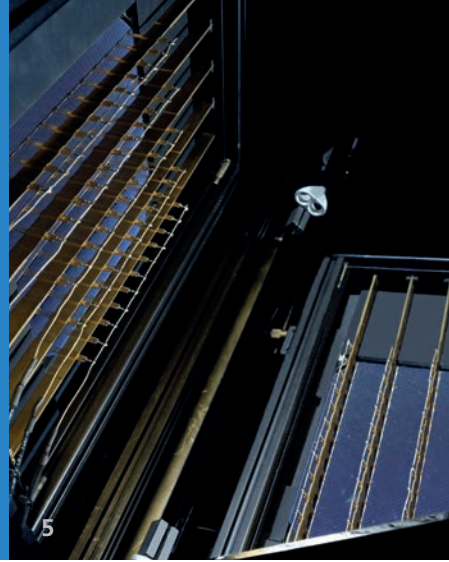
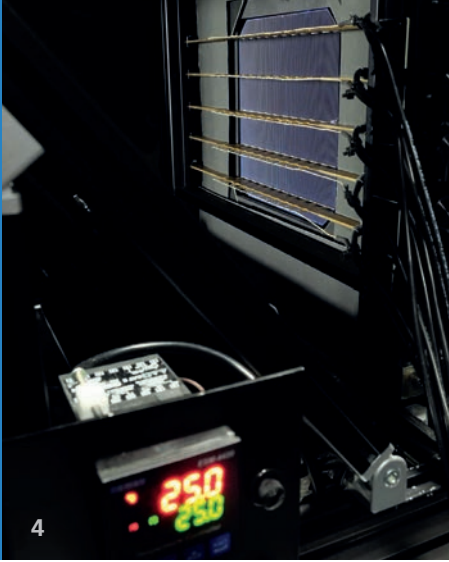
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Individual Front and Rear Measurements

The comprehensive services available at CallLab PV Cells offer different calibration options (SR/I-V) for front and rear sides of bifacial solar cells using

- reflective and conductive (“golden chuck”) or
- non-reflective and non-conductive (“black chucks”) background contacts upon request.

Spectral Responsivity/ EQE Measurement

We measure spectral responsivity for front and rear sides in the wavelength range of 300 to 1200 nm, under monochromatic and additional bias illumination.

Individual I-V Measurement

I-V characteristics of the front and rear sides of a bifacial solar cell are measured individually under steady-state illumination at Standard Testing Conditions (AM1.5g, 1000 W/m², 25°C). I_{sc} , V_{oc} , P_{max} , fill factor and conversion efficiency of each side as well as respective measurement uncertainties can be provided.

Advanced I-V Measurement

We characterize I-V curves under pulsed illumination with the standard spectrum of AM1.5g and cell temperature of 25°C using

- simultaneous front and rear side illumination or
- equivalent front side illumination (G_E method)

according to IEC 60904-1-2-TS. Supplementary configurations beyond this standard are also available.

Traceable data for I_{sc} , V_{oc} , P_{max} , fill factor, conversion efficiency, gain efficiency product and measurement uncertainties can be provided for double- and single-sided illumination methods. In addition, the quantitative comparison between the two methods can be provided as well.

Reliable and Individual Customer Services

CallLab PV Cells also offers individual services according to customer specific requirements (e.g. temperature coefficient, irradiance dependence, various illumination conditions).

- 4 Temperature regulation unit for stabilizing cell temperature to 25°C.
- 5 Rear side of bifacial cell reflected by mirror.
- 6 Temperature sensor mounted on probe pins for instantaneous cell temperature tracking.