



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

NATIONAL RENEWABLE ENERGY LABORATORY (NREL)  
PV Cell and Module Group, Broadband Outdoor Radiometer Calibration (BORCAL) Group & Spectral  
Irradiance Group (SIG)  
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Golden, CO 80401  
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CALIBRATION

Valid To: November 30, 2022

Certificate Number: 1239.02

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1,6</sup>:

I. Optical Quantities

| Parameter/Equipment   | Range   | CMC <sup>2,3</sup> (±)                           | Comments   |
|---|---|--|--|
| Primary Photovoltaic Reference Cells –<br><br>DC Current                                    | (0.1 to 200) mA   | 0.40 %   | ASTM E1125 with:<br><br>Agilent 34401,<br>precision resistor   |
| Photovoltaic Reference Cells –<br><br>DC Voltage<br><br>DC Current<br><br>Power<br><br>Area | (0.1 to 40) V<br><br>1 mA to 15 A<br><br>1 mW to 600 W<br><br>(0.5 × 0.5) cm to<br>(20 × 20) cm | 0.26 %<br><br>0.57 %<br><br>0.61 %<br><br>0.06 % | ASTM E948, IEC<br>60904-1 (Sec. 4) with:<br><br>Agilent 34410<br><br>Agilent 34410<br>precision resistor<br><br>Agilent 34410<br><br>Nikon-NEXIV |

| Parameter/Equipment   | Range <sup>4</sup>  | CMC <sup>2, 3, 5</sup> ( $\pm$ )                             | Comments   |
|---|---|--|--|
| Photovoltaic Reference Modules –<br><br>DC Voltage<br><br>DC Current<br><br>Power<br><br>Area   | (2 to 290) V<br><br>(0.1 to 15) A<br><br>(1 to 800) W<br><br>(20 × 20) cm to<br>(140 × 210) cm  | 0.4 %<br><br>0.8 %<br><br>1.1 %<br><br>0.2 %                 | ASTM E1036, IEC 60904-1 (sec. 4) with:<br><br>Agilent 34401<br><br>Agilent 34401,<br>precision resistor<br><br>Agilent 34401<br><br>Tape measure                               |
| Broadband Outdoor Radiometer Calibration –<br><br>Pyranometers –<br><br>Irradiance Level:<br>Direct Beam $\geq 700$<br>$W/m^2 \pm 0.35 \%$<br><br>Diffuse: $10 W/m^2$ to $150 W/m^2 \pm (2.6 \% + 1 W/m^2)$<br><br>Pyrheliometers –<br><br>Irradiance Level:<br>Direct Beam $\geq 700$<br>$W/m^2 \pm 0.35 \%$ | Minimum Zenith Angle<br>Range:<br>Up to $30^\circ$<br>( $30$ to $60$ ) $^\circ$<br><br>Maximum Zenith Angle<br>Range: ( $16.5$ to $80$ ) $^\circ$<br><br>Minimum Zenith Angle<br>Range: ( $30$ to $60$ ) $^\circ$<br><br>Maximum Zenith Angle<br>Range: ( $16.5$ to $80$ ) $^\circ$ | 0.6 %<br>1.2 %<br><br><br><br><br><br><br><br><br><br>0.78 % | Traceability: SI,<br>through World Radiometric Reference (WRR)<br><br>Reference irradiance:<br>the outdoor direct beam irradiance from the sun disk and the diffuse irradiance |

| Parameter/Equipment  | Range  | CMC <sup>2,3</sup> (±)   | Comments   |
|--|--|--|--|
| Spectral Irradiance –<br><br>Spectroradiometer<br>(250 to 2400) nm | 250 nm<br>350 nm<br>450 nm<br>555 nm<br>655 nm<br>900 nm<br>1600 nm<br>2000 nm<br>2300 nm<br>2400 nm | 2.1 %<br>1.7 %<br>1.4 %<br>1.4 %<br>1.3 %<br>1.3 %<br>1.2 %<br>1.2 %<br>1.2 %<br>1.6 % | ASTM G138 with:<br><br>NIST spectral<br>irradiance standard<br>1000 W FEL lamp |

<sup>1</sup> This laboratory is conditionally available for commercial service.

<sup>2</sup> Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of  $k = 2$ . The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

<sup>3</sup> In the statement of CMC, percentages are percentage of reading, unless otherwise indicated.

<sup>4</sup> Zenith angle range of calibration of the NREL location will vary with the day of year and sky conditions during the calibration event, and are limited to the zenith angle ranges listed on the scope of accreditation. In addition, the maximum zenith angle range might change during the calibration event due to the irradiance level limitation.

<sup>5</sup> The uncertainty resulting from the UUT's performance outdoor will be added (RSS) to the uncertainty of the nominal values; therefore the combined uncertainty will vary based on the instrument model, serial number, and the reported environmental conditions during the calibration event.

<sup>6</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.



## *Accredited Laboratory*

A2LA has accredited

# **NATIONAL RENEWABLE ENERGY LABORATORY (NREL)**

*Golden, CO*

for technical competence in the field of

## **Calibration**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system *(refer to joint ISO-ILAC-IAF Communiqué dated April 2017)*.



Presented this 9<sup>th</sup> day of February 2021.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 1239.02  
Valid to November 30, 2022

*For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.*