Photovoltaic devices –
Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PHOTOVOLTAIC DEVICES –

Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices

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Technical Specification are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 60904-1-2, which is a Technical Specification, has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.
The text of this Technical Specification is based on the following documents:

<table>
<thead>
<tr>
<th>Draft TS</th>
<th>Report on voting</th>
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<tbody>
<tr>
<td>82/1403/DTS</td>
<td>82/1508/RVDTS</td>
</tr>
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</table>

Full information on the voting for the approval of this Technical Specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60904 series, published under the general title Photovoltaic devices, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under “http://webstore.iec.ch” in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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PHOTOVOLTAIC DEVICES –

Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices

1 Scope

This part of IEC 60904 describes procedures for the measurement of the current-voltage ($I-V$) characteristics of bifacial photovoltaic devices in natural or simulated sunlight. It is applicable to single PV cells, sub-assemblies of such cells or entire PV modules.

The requirements for measurement of $I-V$ characteristics of standard (monofacial) PV devices are covered by IEC 60904-1, whereas this document describes the additional requirements for the measurement of $I-V$ characteristics of bifacial PV devices.

This document may be applicable to PV devices designed for use under concentrated irradiation if they are measured without the optics for concentration, and irradiated using direct normal irradiance and a mismatch correction with respect to a direct normal reference spectrum is performed.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60891, Photovoltaic devices – Procedures for temperature and irradiance corrections to measured $I-V$ characteristics

IEC 60904-1, Photovoltaic devices – Part 1: Measurement of photovoltaic current-voltage characteristics

IEC 60904-2, Photovoltaic devices – Part 2: Requirements for reference devices

IEC 60904-3, Photovoltaic devices – Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data

IEC 60904-4, Photovoltaic devices – Part 4: Reference solar devices – Procedures for establishing calibration traceability

IEC 60904-5, Photovoltaic devices – Part 5: Determination of the equivalent cell temperature (ECT) of photovoltaic (PV) devices by the open-circuit voltage method

IEC 60904-7, Photovoltaic devices – Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices

IEC 60904-8, Photovoltaic devices – Part 8: Measurement of spectral responsivity of a photovoltaic (PV) device

IEC 60904-9, Photovoltaic devices – Part 9: Solar simulator performance requirements
IEC TS 60904-1-2:2019 © IEC 2019 – 7 –

IEC TS 61836, Solar photovoltaic energy systems – Terms, definitions and symbols

IEC TS 62446-3, Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 3: Photovoltaic modules and plants - Outdoor infrared thermography


3 Terms and definitions
For the purposes of this document, the terms and definitions given in IEC TS 61836 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

• IEC Electropedia: available at http://www.electropedia.org/
• ISO Online browsing platform: available at http://www.iso.org/obp

3.1 bifacial PV device
PV device, both surfaces (front and rear sides) are used for power generation

3.2 bifaciality
property expressing the ratio between the main characteristics of the rear side and the front side of a bifacial PV device quantified by specific bifaciality coefficients

Note 1 to entry: Unless otherwise specified, the bifacialities are typically referred to Standard Test Conditions STC. The main bifacialities are:
– Short-circuit current bifaciality: \( \phi_{ISC} \)
– Open-circuit voltage bifaciality: \( \phi_{VOC} \)
– Maximum power bifaciality: \( \phi_{P_{max}} \)

3.3 rear irradiance driven power gain yield
BiFi quantity which indicates the power gain, in addition to that obtained at STC conditions, per unit of rear irradiance

Note 1 to entry: It is expressed in W/(Wm\(^{-2}\)).

4 General considerations
The final performance of bifacial PV devices in a power plant depend not only on the spatial distribution of the irradiance incident onto the front surface, but additionally on that incident onto the rear surface of the device, which is strongly affected by site-specific conditions, such as albedo, reflective surface size, the racking system, the device’s elevation and its tilt angle.

Due to these dependencies and in order to obtain comparable measurement results, I-V characterisation is extended to quantify the bifaciality of the device and the rear irradiance driven power gain yield it can yield. Bifaciality is an intrinsic property of the device, unlike the site-specific conditions such as albedo. The measurement conditions for bifacial devices should strive to generate extra photocurrent proportional to their bifaciality. In general, this can be achieved with a test spectrum close to the reference spectrum such as provided by natural sunlight under suitable conditions or with a solar simulator whose irradiance level...