



TECHNICAL SPECIFICATION



**Photovoltaic cells –
Part 3: Measurement of current-voltage characteristics of bifacial photovoltaic
cells**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 27.160

ISBN 978-2-8322-6415-7

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	3
1 Scope.....	5
2 Normative references	5
3 Terms and definitions	6
4 Methods	7
4.1 General.....	7
4.2 Double-side simultaneous irradiation	8
4.3 Equivalent irradiation	8
4.4 Sequential irradiation	10
5 Apparatus.....	11
5.1 General.....	11
5.2 Double-side simultaneous irradiation	11
5.3 Equivalent irradiation	11
5.4 Sequential irradiation	12
6 Procedures.....	12
6.1 General.....	12
6.2 Double-side simultaneous irradiation	12
6.2.1 Requirements for calibration	12
6.2.2 Procedures	13
6.3 Equivalent irradiation	13
6.3.1 Requirements for calibration	13
6.3.2 Procedures	13
6.4 Sequential irradiation	14
6.4.1 Requirements for calibration	14
6.4.2 Procedures	14
7 Report	15
Annex A (normative) Determination of bifacial I-V characteristics.....	16
A.1 General.....	16
A.2 Shift approximation	16
A.3 Linear interpolation	17
Figure 1 – Schematic procedure of double-side simultaneous irradiation method with integrated flash conditions	8
Figure 2 – Schematic procedure of equivalent irradiation method with sequential flash conditions	9
Figure 3 – Schematic procedure of equivalent irradiation method with integrated flash conditions	10
Figure 4 – Schematic procedure of sequential irradiation method with integrated flash conditions	10
Figure 5 – Separate solar simulator on both front and rear side for double-side simultaneous irradiation	11
Figure 6 – Setup for equivalent irradiation with adjustable intensity	12
Figure 7 – Schematic configuration with two consecutive solar simulators	12

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PHOTOVOLTAIC CELLS –

Part 3: Measurement of current-voltage characteristics of bifacial photovoltaic cells

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC TS 63202-3 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
82/2070/DTS	82/2094/RVDTS
	82/2094A/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at https://www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at <https://www.iec.ch/standardsdev/publications>.

A list of all parts in the IEC 63202 series, published under the general title *Photovoltaic cells*, 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 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.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

PHOTOVOLTAIC CELLS –

Part 3: Measurement of current-voltage characteristics of bifacial photovoltaic cells

1 Scope

This part of IEC 63202 describes procedures for the measurement of current-voltage (I-V) characteristics of crystalline silicon bifacial photovoltaic (PV) cells for both laboratory and mass production applications.

This document is intended to be used for measurement of individual unencapsulated bifacial PV cells, in addition to the requirements described in IEC 60904-1 and differentiating from IEC TS 60904-1-2 which is more applicable to encapsulated PV device. Specific requirements on bifacial reference cells and calibration of solar simulators are also defined to provide useful guidance for the proposed methods.

The bifacial I-V characteristics contain front standard test condition (STC), rear STC and bifacial STC results for the bifacial PV cells under test. Thus, bifaciality as well as the power generation capability under single-side or bifacial irradiation are evaluated.

NOTE This document does not apply to tandem or multi-junction bifacial PV cells.

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 TS 60904-1-2, *Photovoltaic devices – Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices*

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

IEC 60904-4, *Photovoltaic devices – Part 4: Photovoltaic reference devices – Procedures for establishing calibration traceability*

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

IEC 60904-9, *Photovoltaic devices – Part 9: Classification of solar simulator characteristics*

IEC 61215-1:2021, *Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1: Test requirements*

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