BSI Standards Publication

Photovoltaic devices

Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices

bsi.

National foreword

This British Standard is the UK implementation of EN IEC 60904-7:2019. It is identical to IEC 60904-7:2019. It supersedes BS EN 60904-7:2009, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/82, Photovoltaic Energy Systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English Version

Photovoltaic devices - Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices (IEC 60904-7:2019)

Dispositifs photovoltaïques - Partie 7: Calcul de la correction de désadaptation des réponses spectrales dans les mesures de dispositifs photovoltaïques (IEC 60904-7:2019)

Photovoltaische Einrichtungen - Teil 7: Berechnung der spektralen Fehlanpassungskorrektur für Messungen an photovoltaischen Einrichtungen (IEC 60904-7:2019)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

The text of document 82/1590/FDIS, future edition 4 of IEC 60904-7, prepared by IEC/TC 82 "Solar photovoltaic energy systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60904-7:2019.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2020-06-24
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2022-09-24

This document supersedes EN 60904-7:2009 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 60904-7:2019 was approved by CENELEC as a European Standard without any modification.

(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60891	-	Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I-V characteristics	EN 60891	-
IEC 60904-1	-	Photovoltaic devices - Part 1: Measurement of photovoltaic current-voltage characteristics	EN 60904-1	-
IEC 60904-1-1	-	Photovoltaic devices - Part 1-1: Measurement of current-voltage characteristics of multi-junction photovoltaic (PV) devices	EN 60904-1-1	-
IEC 60904-2	-	Photovoltaic devices - Part 2: Requirements for photovoltaic reference devices	EN 60904-2	-
IEC 60904-3	-	Photovoltaic devices - Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data	EN IEC 60904-3	-
IEC 60904-8	-	Photovoltaic devices - Part 8: Measurement of spectral responsivity of a photovoltaic (PV) device	EN 60904-8	-
IEC 60904-8-1	-	Photovoltaic devices - Part 8-1: Measurement of spectral responsivity of multi-junction photovoltaic (PV) devices	EN 60904-8-1	-
IEC 60904-9	-	Photovoltaic devices - Part 9: Solar simulator performance requirements	EN 60904-9	-
IEC/TS 61836	-	Solar photovoltaic energy systems - Terms, definitions and symbols	-	-
ISO 9288	-	Welding consumables - Solid wire electrodes, solid wires and rods for fusion welding of magnesium and magnesium alloys - Classification	EN ISO 9288	1996

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 60904-7 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This fourth edition cancels and replaces the third edition published in 2008. It constitutes a technical revision.

The main technical changes with respect to the previous edition are as follows:

- For better compatibility and less redundancy, the clause "Determination of test spectrum" refers to IEC 60904-9.
- The spectral mismatch factor is called SMM instead of MM to enable differentiation to the angular mismatch factor AMM and spectral angular mismatch factor $SAMM$.
- Formulae for the derivation and application of the spectral mismatch factor SMM are added.
- Links to new standards are given, e.g. concerning multi-junction devices.

- Corrected wording (responsivity instead of response and irradiance instead of intensity).

The text of this International Standard is based on the following documents:

FDIS	Report on voting
82/1590/FDIS	82/1605/RVD

Full information on the voting for the approval of this International Standard 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 of 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.

PHOTOVOLTAIC DEVICES –

Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices

1 Scope

This part of IEC 60904 describes the procedure for correcting the spectral mismatch error introduced in the testing of a photovoltaic device, caused by the mismatch between the test spectrum and the reference spectrum (e.g. AM1.5 spectrum) and by the mismatch between the spectral responsivities (SR) of the reference device and of the device under test and therewith reduce the systematic uncertainty. This procedure is valid for single-junction devices but the principle may be extended to cover multi-junction devices.

The purpose of this document is to give guidelines for the correction of the spectral mismatch error, should there be a spectral mismatch between the test spectrum and the reference spectrum as well as between the reference device SR and the device under test SR. The calculated spectral mismatch correction is only valid for the specific combination of test and reference devices measured with a particular test spectrum.

Since a PV device has a wavelength-dependent spectral responsivity, its performance is significantly affected by the spectral distribution of the incident radiation, which in natural sunlight varies with several factors such as location, weather, time of year, time of day, orientation of the receiving surface, etc., and with a solar simulator varies with its type and conditions. If the irradiance is measured with a thermopile-type radiometer (that is not spectrally selective) or with a PV reference device (IEC 60904-2), the spectral irradiance distribution of the incoming light must be known to make the necessary corrections to obtain the performance of the PV device under the reference spectral irradiance distribution defined in IEC 60904-3.

If a reference PV device or a thermopile type detector is used to measure the irradiance, then, following the procedure given in this document, it is possible to calculate the spectral mismatch correction necessary to obtain the short-circuit current of the device under test under the reference spectral irradiance distribution in IEC 60904-3 or any other reference spectrum. If the reference PV device has the same relative spectral responsivity as the device under test then the reference device automatically takes into account deviations of the measured spectral irradiance distribution from the reference spectral irradiance distribution, and no further correction of spectral mismatch errors is necessary. In this case, location and weather conditions are not critical when the reference device method is used for performance measurements under natural sunlight. Also, for identical relative SRs, the spectral classification of the simulator is not critical for measurements with solar simulators.

If the performance of a PV device is measured using a known spectral irradiance distribution, its short-circuit current at any other spectral irradiance distribution can be computed using the spectral responsivity of the PV device under test.

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.