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INTERNATIONAL STANDARD



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PHOTOVOLTAIC DEVICES –

**Part 3: Measurement principles for terrestrial photovoltaic (PV)
solar devices with reference spectral irradiance data**

FOREWORD

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International Standard IEC 60904-3 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This fourth edition cancels and replaces the third edition published in 2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) all spectral data were recalculated due to some minor calculation and rounding errors in the third edition; the global spectral irradiance returned to exactly the data of the second edition;
- b) the angular distribution of the irradiance was clarified.

This publication contains an attached file in the form of an Excel spreadsheet. This file is intended to be used as a complement and does not form an integral part of the publication.

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

CDV	Report on voting
82/1342/CDV	82/1425/RVC

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 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

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PHOTOVOLTAIC DEVICES – Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data

1 ~~Scope and object~~

This part of IEC 60904 applies to the following photovoltaic devices for terrestrial applications:

- solar cells with or without a protective cover;
- sub-assemblies of solar cells;
- modules; and
- systems.

NOTE The term “test specimen” is used to denote any of these devices.

The principles contained in this document cover testing in both natural and simulated sunlight.

Photovoltaic conversion is spectrally selective due to the nature of the semiconductor materials used in PV solar cells and modules. To compare the relative performance of different PV devices and materials a reference standard solar spectral distribution is necessary. This document includes such a reference solar spectral irradiance distribution.

This document also describes basic measurement principles for determining the electrical output of PV devices. The principles given in this document are designed to relate the performance rating of PV devices to a common reference terrestrial solar spectral irradiance distribution.

The reference terrestrial solar spectral irradiance distribution is given in this document in order to classify solar simulators according to the spectral performance requirements contained in IEC 60904-9.

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: Measurements of photovoltaic current-voltage characteristics*

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

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 61853-4, *Photovoltaic (PV) module performance testing and energy rating - Part 4: Standard reference climatic profiles*

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

**Dispositifs photovoltaïques –
Partie 3: Principes de mesure des dispositifs solaires photovoltaïques (PV) à
usage terrestre incluant les données de l'éclairement énergétique spectral de
référence**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PHOTOVOLTAIC DEVICES –

**Part 3: Measurement principles for terrestrial photovoltaic (PV)
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Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data

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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 61853-4, *Photovoltaic (PV) module performance testing and energy rating - Part 4: Standard reference climatic profiles*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

DISPOSITIFS PHOTOVOLTAÏQUES –

Partie 3: Principes de mesure des dispositifs solaires photovoltaïques (PV) à usage terrestre incluant les données de l'éclairage énergétique spectral de référence

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La Norme internationale IEC 60904-3 a été établie par le comité d'études 82 de l'IEC: Systèmes de conversion photovoltaïque de l'énergie solaire.

Cette quatrième édition annule et remplace la troisième édition parue en 2016. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) nouveau calcul de toutes les données spectrales en raison de la présence d'un certain nombre d'erreurs de calcul et d'arrondi dans la troisième édition; remplacement de l'éclairage spectral global par les données exactes de la deuxième édition;

b) clarification de la distribution angulaire de l'éclairage.

La présente publication contient un fichier joint de type feuille de calcul Excel. Ce fichier est destiné à être utilisé comme complément et ne fait pas partie intégrante de la publication.

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CDV	Rapport de vote
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Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60904, publiées sous le titre général *Dispositifs photovoltaïques*, peut être consultée sur le site web de l'IEC.

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DISPOSITIFS PHOTOVOLTAÏQUES –

Partie 3: Principes de mesure des dispositifs solaires photovoltaïques (PV) à usage terrestre incluant les données de l'éclairement énergétique spectral de référence

1 Domaine d'application

La présente partie de l'IEC 60904 s'applique aux dispositifs photovoltaïques suivants pour les applications terrestres:

- cellules solaires avec ou sans protecteur;
- assemblages de cellules solaires;
- modules; et
- systèmes.

NOTE Le terme "éprouvette d'essai" est utilisé pour désigner chacun de ces dispositifs.

Les principes contenus dans le présent document comprennent les essais réalisés sous un éclairement solaire naturel ainsi que sous un éclairement solaire simulé.

La conversion photovoltaïque est spectralement sélective en raison de la nature des matériaux à semiconducteurs utilisés dans les cellules et modules solaires PV. Pour comparer la performance relative de différents dispositifs et matériaux PV, une distribution spectrale de l'éclairement solaire normalisée de référence est nécessaire. Le présent document inclut une telle distribution spectrale de l'éclairement solaire de référence.

Le présent document décrit également des principes de mesure de base pour la détermination de la sortie électrique des dispositifs PV. Les principes indiqués dans le présent document sont prévus pour relier les caractéristiques assignées de performance des dispositifs PV à une distribution spectrale de l'éclairement solaire terrestre de référence commune.

La distribution spectrale de l'éclairement solaire terrestre de référence est indiquée dans le présent document pour classer les simulateurs solaires selon les exigences pour le fonctionnement spectral contenues dans l'IEC 60904-9.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60891, *Dispositifs photovoltaïques – Procédures pour les corrections en fonction de la température et de l'éclairement à appliquer aux caractéristiques I-V mesurées*

IEC 60904-1, *Dispositifs photovoltaïques – Partie 1: Mesure des caractéristiques courant-tension des dispositifs photovoltaïques*

IEC 60904-2, *Dispositifs photovoltaïques – Partie 2: Exigences applicables aux dispositifs photovoltaïques de référence*

IEC 60904-5, *Dispositifs photovoltaïques – Partie 5: Détermination de la température de cellule équivalente (ECT) des dispositifs photovoltaïques (PV) par la méthode de la tension en circuit ouvert*

IEC 60904-7, *Dispositifs photovoltaïques – Partie 7: Calcul de la correction de désadaptation des réponses spectrales dans les mesures de dispositifs photovoltaïques*

IEC 60904-8, *Dispositifs photovoltaïques – Partie 8: Mesure de la sensibilité spectrale d'un dispositif photovoltaïque (PV)*

IEC 60904-9, *Dispositifs photovoltaïques – Partie 9: Exigences pour le fonctionnement des simulateurs solaires*

IEC 61853-4, *Essais de performance et caractéristiques assignées d'énergie des modules photovoltaïques (PV) – Partie 4: Profils climatiques de référence normalisés*