

Photovoltaic devices - Part 1: Measurement of photovoltaic current- voltage characteristics

Photovoltaic devices - Part 1: Measurement of
photovoltaic current-voltage characteristics

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

<p>Käesolev Eesti standard EVS-EN 60904-1:2007 sisaldab Euroopa standardi EN 60904-1:2006 ingliskeelset teksti.</p> <p>Käesolev dokument on jõustatud 17.01.2007 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes.</p> <p>Standard on kättesaadav Eesti standardiorganisatsioonist.</p>	<p>This Estonian standard EVS-EN 60904-1:2007 consists of the English text of the European standard EN 60904-1:2006.</p> <p>This document is endorsed on 17.01.2007 with the notification being published in the official publication of the Estonian national standardisation organisation.</p> <p>The standard is available from Estonian standardisation organisation.</p>
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<p>Käsitlusala:</p> <p>This part of IEC 60904 describes procedures for the measurement of current-voltage characteristics of photovoltaic devices in natural or simulated sunlight. These procedures are applicable to a single photovoltaic solar cell, a sub-assembly of solar cells, or a PV module.</p>	<p>Scope:</p> <p>This part of IEC 60904 describes procedures for the measurement of current-voltage characteristics of photovoltaic devices in natural or simulated sunlight. These procedures are applicable to a single photovoltaic solar cell, a sub-assembly of solar cells, or a PV module.</p>
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ICS 27.160

Võtmesõnad: crystalline silicon, current-voltage characteristics, flat module, measurement, photovoltaic devices, solar cells, sub-assembly

English version

Photovoltaic devices
Part 1: Measurement of photovoltaic
current-voltage characteristics
(IEC 60904-1:2006)

Dispositifs photovoltaïques
Partie 1: Mesure des caractéristiques
courant-tension des dispositifs
photovoltaïques
(CEI 60904-1:2006)

Photovoltaische Einrichtungen
Teil 1: Messen der photovoltaischen
Strom-/Spannungskennlinien
(IEC 60904-1:2006)

This European Standard was approved by CENELEC on 2006-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 82/433/FDIS, future edition 2 of IEC 60904-1, prepared by IEC TC 82, Solar photovoltaic energy systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60904-1 on 2006-10-01.

This European Standard supersedes EN 60904-1:1993.

The main changes with respect to EN 60904-1:1993 are as follows:

- Added object.
- Added normative references.
- Updated original Clause 2 (General Measurement Requirements), removing Figure 1 as it is obsolete.
- Provided more detail and guidance on how to measure in sunlight or simulated sunlight.
- Expanded original Clause 6 (Test Report) with requirements based on ISO 17025.

The following dates were fixed:

- | | | |
|--|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2007-07-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2009-10-01 |

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60904-1:2006 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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 When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60891	- ¹⁾	Procedures for temperature and irradiance corrections to measured I-V characteristics of crystalline silicon photovoltaic devices	EN 60891	1994 ²⁾
IEC 60904-2	- ¹⁾	Photovoltaic devices Part 2: Requirements for reference solar cells	EN 60904-2	1993 ²⁾
IEC 60904-3	- ¹⁾	Photovoltaic devices Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data	EN 60904-3	1993 ²⁾
IEC 60904-5	- ¹⁾	Photovoltaic devices Part 5: Determination of the equivalent cell temperature (ECT) of photovoltaic (PV) devices by the open-circuit voltage method	EN 60904-5	1995 ²⁾
IEC 60904-6	- ¹⁾	Photovoltaic devices Part 6: Requirements for reference solar modules	EN 60904-6	1994 ²⁾
IEC 60904-7	- ¹⁾	Photovoltaic devices Part 7: Computation of spectral mismatch error introduced in the testing of a photovoltaic device	EN 60904-7	1998 ²⁾
IEC 60904-9	- ¹⁾	Photovoltaic devices Part 9: Solar simulator performance requirements	-	-
IEC 60904-10	- ¹⁾	Photovoltaic devices Part 10: Methods of linearity measurement	EN 60904-10	1998 ²⁾
ISO/IEC 17025	- ¹⁾	General requirements for the competence of testing and calibration laboratories	EN ISO/IEC 17025	2005 ²⁾

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

INTERNATIONAL STANDARD

IEC
60904-1

Second edition
2006-09

Photovoltaic devices –

Part 1:
Measurement of photovoltaic
current-voltage characteristics

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



Reference number
IEC 60904-1:2006(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

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- **IEC Web Site** (www.iec.ch)

- **Catalogue of IEC publications**

The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

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IEC
60904-1

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2006-09

Photovoltaic devices –

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PHOTOVOLTAIC DEVICES –

**Part 1: Measurement of photovoltaic
current-voltage characteristics**

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.
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International Standard IEC 60904-1 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This second edition cancels and replaces the first edition published in 1987. This edition constitutes a technical revision.

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

- Added object.
- Added normative references.
- Updated original Clause 2 (General Measurement Requirements), removing Figure 1 as it is obsolete.
- Provided more detail and guidance on how to measure in sunlight or simulated sunlight.
- Expanded original Clause 6 (Test Report) with requirements based on ISO 17025.

The text of this standard is based on the following documents:

FDIS	Report on voting
82/433/FDIS	82/450/RVD

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

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

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

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

PHOTOVOLTAIC DEVICES –

Part 1: Measurement of photovoltaic current-voltage characteristics

1 Scope and object

This part of IEC 60904 describes procedures for the measurement of current-voltage characteristics of photovoltaic devices in natural or simulated sunlight. These procedures are applicable to a single photovoltaic solar cell, a sub-assembly of photovoltaic solar cells, or a PV module.

NOTE 1 This standard may be applicable to multi-junction test specimens, if each sub-junction generates the same amount of current as it would under the reference AM1,5 spectrum in IEC 60904-3.

NOTE 2 This standard may be applicable to PV devices designed for use under concentrated irradiation if they are irradiated using direct normal irradiance and a mismatch correction with respect to a direct normal reference spectrum is performed.

The purpose of this standard is to lay down basic requirements for the measurement of current-voltage characteristics of photovoltaic devices, to define procedures for different measuring techniques in use and to show practices for minimising measurement uncertainty.

2 Normative references

The following referenced documents are indispensable for the application 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: *Procedures for temperature and irradiance corrections to measured I-V characteristics of crystalline silicon photovoltaic (PV) devices*

IEC 60904-2: *Photovoltaic devices – Part 2: Requirements for reference solar cells*

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

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

IEC 60904-6: *Photovoltaic devices – Part 6: Requirements for reference solar modules*

IEC 60904-7: *Photovoltaic devices – Part 7: Computation of spectral mismatch error introduced in the testing of a photovoltaic device*

IEC 60904-9: *Photovoltaic devices – Part 9: Solar simulator performance requirements*

IEC 60904-10: *Photovoltaic devices – Part 10: Methods for linearity measurements*

ISO/IEC 17025: *General requirements for competence of testing and calibration laboratories*