

# INTERNATIONAL STANDARD

# IEC 60904-2

Second edition  
2007-03

---

---

## Photovoltaic devices – Part 2: Requirements for reference solar devices

*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 60904-2:2007(E)

# INTERNATIONAL STANDARD

# IEC 60904-2

Second edition  
2007-03

---

---

## Photovoltaic devices – Part 2: Requirements for reference solar devices

Withdrawn

© IEC 2007 Copyright - all rights reserved

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission, 3, rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland  
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale  
International Electrotechnical Commission  
Международная Электротехническая Комиссия

PRICE CODE

**M**

*For price, see current catalogue*

## CONTENTS

FOREWORD.....	5
1 Scope and object.....	9
2 Normative references .....	9
3 Description .....	11
3.1 Calibration traceability.....	11
3.1.1 Primary reference device:.....	11
3.1.2 Secondary reference device: .....	11
3.1.3 Working reference device: .....	11
3.2 Construction of reference devices .....	11
3.2.1 Reference cell .....	11
3.2.2 Multi-cell reference devices .....	13
3.3 Built-in shunt resistors.....	13
4 Selection .....	15
4.1 Requirements, general .....	15
4.2 Additional requirements for reference modules.....	15
5 Temperature measurement.....	15
6 Electrical connections.....	15
7 Calibration.....	15
8 Data sheet.....	17
9 Marking .....	19
10 Packaging .....	19
10.1 Recommended packaging for use in natural sunlight .....	19
10.2 Recommended packaging for use under simulators .....	19
10.3 Single cell package .....	19
11 Care of reference devices.....	21
12 Calibration of secondary reference devices against a primary reference cell .....	21
12.1 Natural sunlight.....	21
12.2 Simulated sunlight.....	23
12.3 Test Procedure.....	23
13 Calibration of Working Solar Reference Device against a Secondary Solar Reference Device.....	25
Figure 1 – Reference cell in a multi-cell package .....	25
Figure 2 – Single-cell package.....	25

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### PHOTOVOLTAIC DEVICES –

#### Part 2: Requirements for reference solar devices

#### 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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

International Standard IEC 60904-2 has been prepared by IEC Technical Committee 82: Solar photovoltaic energy systems.

This second edition cancels and replaces IEC 60904-2 (1989), its Amendment 1 (1998) and IEC 60904-6 (1994) and its Amendment 1 (1998). It constitutes a technical revision.

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

- Added subclause on "Calibration traceability".
- Added subclause on "Construction" to differentiate the various types of reference devices.
- Added guidance on use of a built-in shunt resistor.

- Increased data sheet requirements. In particular added requirement for either a mismatch correction or an estimate of uncertainty due to the mismatch of the reference device.
- Added Clause on “Calibration of working solar reference devices”.

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

CDV	Report on voting
82/425/CDV	82/465/RVC

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.

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.

Withdrawn

## PHOTOVOLTAIC DEVICES –

### Part 2: Requirements for reference solar devices

#### 1 Scope and object

This part of IEC 60904 gives requirements for the classification, selection, packaging, marking, calibration and care of reference solar devices.

This standard covers solar reference devices used to determine the electrical performance of solar cells, modules and arrays under natural and simulated sunlight. It does not cover solar reference devices for use under concentrated sunlight.

#### 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 devices*

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

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 spectral mismatch error introduced in the testing of a photovoltaic device*

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

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

IEC 60904-10, *Photovoltaic devices – Part 10: Methods of linearity measurement*

IEC 61215, *Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval*

IEC 61646, *Thin-film terrestrial photovoltaic (PV) modules – Design qualification and type approval*