IEC TS 61836

Edition 3.0 2016-12

TECHNICAL SPECIFICATION

Solar photovoltaic energy systems – Terms, definitions and symbols

IEC TS 61836:2016-12(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 27.160

ISBN 978-2-8322-3762-5

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SOLAR PHOTOVOLTAIC ENERGY SYSTEMS – TERMS, DEFINITIONS AND SYMBOLS

FOREWORD

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 61836, which is a technical specification, has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This third edition cancels and replaces the second edition published in 2007. This edition constitutes a technical revision.

The main technical change with regard to the previous edition consists of adding / revising terms and definitions which have been discussed and agreed on during recent TC 82 WG 1 meetings, more particularly at the WG 1 meeting in Pretoria in 2015-11.

The changes made in this new edition were kept limited deliberately, in order to avoid a long development process and get the newest terms and definitions published as promptly as possible, so that they can be used in the market place.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
82/1117/DTS	82/1176/RVC

Full information on the voting for the approval of this technical specification 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.

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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual edition of this document may be issued at a later date.

INTRODUCTION

Following the development of solar photovoltaic (PV) technology, specific Standards have been prepared by IEC Technical Committee 82 since 1987. The terms and symbols used in the PV industry necessitate a systematisation in order to have a consolidated glossary for experts' common understanding.

This Glossary lists the terms and symbols that the PV industry commonly uses. It is a living document that will change as new terms and symbols are added. These have been harmonized with IEC 60050 and other IEC documents as far as possible. All definitions not included in this Technical Specification may be found elsewhere in other IEC documents.

NOTE 1 The terms "PV", "photovoltaic" and "solar photovoltaic" can be read and used interchangeably and without the need for stating each term to show that each is applicable and commonly used by the solar photovoltaic industry.

NOTE 2 All terms beginning with "solar photovoltaic" and "PV" are listed under their respective "photovoltaic" names.

NOTE 3 The terms are listed alphabetically in ten categories. Under these categories, some of the terms have been grouped into families of related meaning in order for the reader to readily see the differences between the terms.

NOTE 4 This Glossary lists the precise usage of terms. Cross-references are provided to efficiently point the reader to the location of definitions. For example, a "solar photovoltaic array" may also be referred to as "photovoltaic array" or "array" when the reference to it is particularly clear. The definition for this term, for example, occurs under the family heading of "photovoltaic" in the "Solar photovoltaic systems" section.

NOTE 5 The colloquial use of "solar" as the sole adjective of a noun is discouraged. For example, though "solar array" may be commonly used in non-technical conversations, the precise terms are "solar photovoltaic array", "photovoltaic array", and "array".

NOTE 6 Unless specifically noted otherwise, the terms "device", "cell", "module", "array", "sub-array", "field", "component", "system", and "product" refer to items incorporating a photovoltaic device. As a result, each of these terms can be understood to read as "PV device", "PV cell", "PV module", etc., without having to re-state the term "PV" each time, though now and then it is useful to re-state "PV".

NOTE 7 The numeric quantities described by many of the terms can be expressed in any convenient unit of time that the user may wish, such as day, month or year.

NOTE 8 "W_p" is not a recommended unit for rated power. For example for a 50 W module, the correct terminology is "the rated power is 50 W", and not "the power is 50 W_p".

NOTE 9 The documents from which these terms originated are shown in square brackets [ ]. Some adaptations may have occurred.

NOTE 10 This Glossary document recognises the related IEC co-ordinating Technical Committees:

1	Terminology	77	Electromagnetic compatibility
21	Secondary cells and batteries	82	Solar photovoltaic energy systems
22	Power electronic systems and equipment	88	Wind energy generation systems
47	Semiconductor devices	105	Fuel cell technologies
64	Electrical installations and protection against electric shock	106	Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure

SOLAR PHOTOVOLTAIC ENERGY SYSTEMS – TERMS, DEFINITIONS AND SYMBOLS

1 Scope

This Technical Specification deals with the terms, definitions and symbols from national and international solar photovoltaic standards and relevant documents used within the field of solar photovoltaic (PV) energy systems. It includes the terms, definitions and symbols compiled from the published IEC technical committee 82 standards.

The focus of this document is "what do the words mean" and not "under what conditions do the terms apply".

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 60904-3:2016, *Photovoltaic devices – Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data*

3 Terms, definitions and symbols for solar photovoltaic energy systems

3.1 Solar photovoltaic cells and modules

This subclause addresses vocabulary pertaining to photovoltaic materials, photovoltaic cells and photovoltaic modules. Other photovoltaic components are described in 3.2. Photovoltaic systems are described in 3.3.

3.1.1
amorphous photovoltaic material
solid-state material in a semi-stable condition with no long-range order in the structural arrangement of the atoms

3.1.2
amorphous silicon
SEE: "silicon/amorphous", 3.1.67.1

3.1.3
anti-reflective coating
layer formed on the surface of a PV cell to reduce reflective loss

3.1.4 Area

3.1.4.1
active cell area
part of the total cell area designed to receive solar radiation for creating the photovoltaic effect

Note 1 to entry: Active cell area equals the total cell area minus the area contribution of the metallisation lines if any.

3.1.4.2
active module area
sum of total cell areas of all the cells in the module

3.1.4.3
cell aperture area
area that is smaller than the total cell area and bounded by an opaque mask

3.1.4.4
module aperture area
area that is smaller than the total module area and bounded by an opaque mask or frame

3.1.5
back surface field effect
SEE: "effect/back surface field effect", 3.1.28.1

3.1.6
band gap energy
amount of energy required to bring an electron from the state of valence electron to the state of conduction electron

Note 1 to entry: Unit: eV.

3.1.7
barrier energy
energy given up by an electron in penetrating the PV cell barrier

Note 1 to entry: The barrier energy is a measure of the electrostatic potential of the barrier.

Note 2 to entry: Unit: eV.

3.1.8
building-attached photovoltaic module
photovoltaic module that is designed to be fastened onto building construction materials

Note 1 to entry: Building-attached photovoltaic modules do not form part of the construction materials.

3.1.9
building-integrated photovoltaic module
photovoltaic module that provides one or more required functions of the building envelope

Note 1 to entry: When a building-integrated photovoltaic module is removed, it leaves something out of the building envelope that must be repaired.

3.1.10
bus lines
SEE: "metallisation line/bus bar", 3.1.42.1

3.1.11
bypass diode <on a module level>
diode connected across one or more PV cells in the forward electric current direction to allow the PV module electric current to bypass cells to prevent hot spot or hot cell damage resulting from the reverse voltage biasing from the other cells in that module

3.1.12
cell
SEE: "photovoltaic/photovoltaic cell", 3.1.48.1

The following terms are used to describe the structure of PV cells and materials.

3.1.12.1
CIS photovoltaic cell
PV cell fabricated of copper indium diselenide ($CuInSe_2$, abbreviation CIS) material as a main constituent (thin film type)

3.1.12.2
compound semiconductor photovoltaic cell
PV cell made of compound semiconductor, which consists of different chemical elements, such as GaAs (III-V compounds), CdS/CdTe (II-VI compounds), CdS/$CuInSe_2$, etc.

3.1.12.3
concentrator photovoltaic cell
SEE: "concentrator photovoltaic cell", 3.8.5.1

3.1.12.4
dye-sensitized photovoltaic cell
photoelectrochemical device using dye molecules with two electrodes and an electrolyte

3.1.12.5
integrated type photovoltaic cell
multiple PV cells connected in series produced on a single substrate that appears like a single cell

Note 1 to entry: Integrated type PV cells may include stacked or side-by-side configurations.

3.1.12.6
multijunction photovoltaic cell
PV cell consisting of layers of different PV cells having different optical properties in which incident light is absorbed by each cell layer

3.1.12.7
organic photovoltaic cell
PV cell fabricated of organic materials being polymers and/or small molecules (thin film type)

3.1.12.8
PN junction photovoltaic cell
PV cell using a PN junction

Note 1 to entry: See also "PN junction", 3.1.39.6.

3.1.12.9
Schottky barrier photovoltaic cell
PV cell using a Schottky junction formed at the metal-semiconductor interface

3.1.12.10
silicon photovoltaic cell
PV cell fabricated of silicon material as a main constituent

3.1.12.11
stacked photovoltaic cell
SEE: "cell/multijunction photovoltaic cell", 3.1.12.6

3.1.12.12
tandem photovoltaic cell
common name for a stack of two or more PV cells behind each other

SEE: "cell/multijunction photovoltaic cell", 3.1.12.6

3.1.12.13
thin film photovoltaic cell
PV cell made of thin layers of semiconductor material

Note 1 to entry: See also "silicon/polycrystalline silicon", 3.1.67.5.

3.1.13
cell barrier
very thin electric-potential barrier along the interface between the P-type layer and the N-type layer of a PV cell

Note 1 to entry: A cell barrier is also known as the "depletion zone".

Note 2 to entry: An enlectric-potential barrier is a region of high electric field strength opposing the passage of an electrically charged particle in a direction depending on the sign of the electric charge.

3.1.14
cell junction
SEE: "junction/cell junction", 3.1.39.1

3.1.15
CIS photovoltaic cell
SEE: "cell/CIS photovoltaic cell", 3.1.12.1

3.1.16
compound semiconductor photovoltaic cell
SEE: "cell/compound semiconductor photovoltaic cell", 3.1.12.2

3.1.17
conversion efficiency
ratio of electric power generated by a PV device per unit area to its incident irradiance

Note 1 to entry: Typically measured under standard test conditions, STC. See also "conditions/standard test conditions", 3.4.16.5.

Note 2 to entry: Unit: dimensionless, usually expressed as a percentage, %.

3.1.18
crystalline silicon
SEE: "silicon/crystalline silicon", 3.1.67.2

3.1.19
current
for PV devices and related entries, see "photovoltaic/photovoltaic current", 3.1.48.2

Note 1 to entry: There are many uses for the electrical term "current".

3.1.20
Czochralski process
SEE: "ingot manufacturing process/Czochralski process", 3.1.37.1

3.1.21
dark current
electric current remaining in a PV device when its incident irradiance is zero

Note 1 to entry: Unit: A.

3.1.22
device
SEE: "photovoltaic/photovoltaic device", 3.1.48.3

3.1.23
diffusion layer
portion of P-layer or N-layer prepared by a diffusion of dopants to form a PN junction

3.1.24
directional solidification
SEE: "ingot manufacturing process/directional solidification", 3.1.37.2

3.1.25
donor <in photovoltaic cells>
dopant (such as phosphorus in the case of silicon material) that supplies an additional electron to an otherwise balanced material structure

3.1.26
dopant <in photovoltaic cells>
chemical added in small amounts to a semiconductor material to modify its electrical properties

Note 1 to entry: An N-dopant introduces more electrons than are required for the structure of the material (e.g., phosphorus for silicon material).

Note 2 to entry: A P-dopant creates electron vacancies in the material structure (e.g., boron for silicon material).

3.1.27
dye-sensitized photovoltaic cell
SEE: "cell/dye-sensitized photovoltaic cell", 3.1.12.4

3.1.28
effect
SEE: "photovoltaic/photovoltaic effect", 3.1.48.4

3.1.28.1
back-surface field effect
effect where the charge carriers generated near the back side of a PV cell are collected effectively by the inner electric field that is formed by a heavily doped zone near the rear electrode

3.1.28.2
light-confinement effect
effect where the short-circuit electric current is increased by trapping incident light inside a PV cell using textured surfaces and structures, etc.

3.1.29
electromagnetic casting
SEE: "ingot manufacturing process/electromagnetic casting", 3.1.37.3

3.1.30
encapsulant
material used between the substrate and superstrate to provide environmental protection for photovoltaic cells in a photovoltaic module

3.1.31
energy gap
smallest energy difference between two neighbouring allowed bands separated by a forbidden band

Note 1 to entry: See also "band gap energy", 3.1.6.

Note 2 to entry: Unit: eV.

3.1.32
flexible photovoltaic module
photovoltaic module that is designed to be intentionally and repetitively twisted, curved or otherwise bent without physical, electrical or visual damage

3.1.33
float zone melting
SEE: "ingot manufacturing process/float zone melting", 3.1.37.4

3.1.34
grid lines
SEE: "metallisation line/grid line", 3.1.42.2

3.1.35
heterojunction
SEE: "junction/heterojunction", 3.1.39.2

3.1.36
hot spot
intense localised heating occurring in a PV module when its operating electric current exceeds the reduced short-circuit current of a shadowed or faulty PV cell or group of cells within it

Note 1 to entry: When a hot spot occurs, the affected cell or group of cells is forced into reverse bias and must dissipate power, which can cause overheating. The voltage bias or damage creates a small, localized shunt path where a large portion of the PV module current appears.

3.1.37
ingot manufacturing process
process by which an ingot is manufactured

3.1.37.1
Czochralski process

method of growing a perfect large-size single crystal by slowly lifting, under careful cooling conditions, a rotating seed crystal from a counter-rotating molten silicon bath

Note 1 to entry: The Czochralski process produces a cylindrical-section silicon ingot, which can be cut into wafers that are usually round or pseudo-square.

3.1.37.2
directional solidification
method of making large-grain multicrystalline silicon ingots by controlling the cooling rate of molten silicon that has been placed in a square-section crucible

Note 1 to entry: Directional solidification produces a square-section silicon ingot that can be cut into wafers that are square or rectangular.

3.1.37.3
electromagnetic casting
method of making multicrystalline silicon ingots by which a continuously fed square-sectional open-bottom cold crucible of molten silicon is continuously pulled downward through an electromagnetic field

Note 1 to entry: Electromagnetic casting produces a square-section silicon ingot that can be cut into wafers that are square or rectangular.

3.1.37.4
float zone melting
method of growing and purifying high quality single crystal ingots

3.1.38
integrated type photovoltaic cell
SEE: "cell/integrated type cell", 3.1.12.5

3.1.39
junction <of semiconductors>
transition layer between semiconducting regions of different electrical properties, or between a semiconductor and a layer of a different type, being characterized by a potential barrier impeding the movement of charge carriers from one region to the other

[SOURCE: IEC 60050-521:2002, 521-02-72]

3.1.39.1
cell junction
junction between the P-type semiconductor and N-type semiconductor of a PV cell

Note 1 to entry: The PV cell junction lies within the cell barrier or depletion zone.

3.1.39.2
heterojunction
PN junction in which the two regions differ in their doping conductivities, and also in their atomic compositions

3.1.39.3
homojunction
PN junction in which the two regions differ in their doping conductivities, but not in their atomic compositions

3.1.39.4
Schottky barrier
junction between a metal and a semiconductor in which a transition region, formed at the surface of the semiconductor, acts as a rectifying barrier

[SOURCE: IEC 60050-521:2002, 521-02-71]

3.1.39.5
PIN junction
junction consisting of an intrinsic semiconductor between a P-type semiconductor and an N-type semiconductor, intended to reduce the recombination of minority carriers

Note 1 to entry: A PIN junction is widely used in thin film amorphous silicon PV cells.

3.1.39.6
PN junction
junction between a P-type semiconductor and an N-type semiconductor

3.1.40
light confinement effect
SEE: "effect/light-confinement effect", 3.1.28.2

3.1.41
material
SEE: "photovoltaic/photovoltaic material", 3.1.48.5

3.1.42
metallisation line
metallic conductor on the front or back of a PV cell intended to conduct the electric current generated by the PV cell