IEC 63387-1

Edition 1.0 2026-08

INTERNATIONAL STANDARD

Hybrid CPV/PV modules: General characteristics and measurement procedures - Part 1: Performance measurement and power rating - Irradiance and temperature

ICS 27.160

ISBN 978-2-8327-1405-8

IEC 63387-1:2026-08(en)

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

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

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FOREWORD

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IEC 63387-1 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is an International Standard.

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

Draft	Report on voting
82/2634/FDIS	82/2670/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 63387 series, published under the general title *Hybrid CPV/PV modules: General characteristics and measurement procedures*, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,
– withdrawn, or
– revised.

INTRODUCTION

The IEC 61853 [9] [1] and IEC 62670 series [10] establish requirements for evaluating, respectively, photovoltaic (PV) and concentrated photovoltaic (CPV) module performance, based on power, energy, and performance ratio (PR). They are applicable to most PV and CPV technologies; however they are not well suited to hybrid CPV/PV modules, whose performance can be a discontinuous function of the angle of incidence (AOI), whose geometry can include PV "dead" areas in addition to the module frame, and for which it is important to specify appropriate reference spectra for beam and diffuse components.

The reasons for preparing this document are therefore related to the need to define specific terms and procedures for the performance measurement of hybrid CPV/PV modules. As some hybrid CPV/PV modules incorporate integrated tracking actuators and internal moving parts, the development of specific qualification standards for such modules is also envisaged.

[1] Numbers in square brackets refer to the Bibliography.

1 Scope

This part of IEC 63387 specifies the methods for evaluating CPV/PV hybrid module performance in terms of power rating. Standard conditions for assessing the power produced by the module and the procedures to measure the power as a function of AOI, irradiance, and temperature are described. A methodology for determining a set of characterization parameter values for the hybrid CPV/PV module (FoV) is also included. In order to compare the performance of different hybrid CPV/PV modules whose output is discontinuous and time-dependent, the concept of effective nominal power is introduced.

This document is applicable to CPV/PV hybrid modules which include both solar cells designed to collect concentrated light (CPV cells array) and solar cells designed to collect diffuse or global light (PV cells array), the latter with bifacial or monofacial illumination. This document applies to hybrid CPV/PV modules with a geometrical concentration ratio > 3x for the CPV cells. For lower geometrical concentration ratio (≤ 3x), the IEC 60904-1 [11] and IEC 61853 series [9] 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 TS 60904-1-2, *Photovoltaic devices - Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices*

IEC TS 61836, *Solar photovoltaic energy systems - Terms, definitions and symbols*

IEC 62108, *Concentrator photovoltaic (CPV) modules and assemblies - Design qualification and type approval*

IEC 62670-1, *Photovoltaic concentrators (CPV) - Performance testing - Part 1: Standard conditions*

IEC 62670-3, *Photovoltaic concentrators (CPV) - Performance testing - Part 3: Performance measurements and power rating*

ISO 2859-1, *Sampling procedures for inspection by attributes - Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TS 60904-1-2, IEC TS 61836, IEC 62108 and the following apply.

ISO and IEC maintain terminological databases for use in standardization athe following addresses:

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp

NOTE 1 Hybrid CPV/PV module can present areas which are intentionally not utilized for PV conversion. These areas are found in the case the hybrid CPV/PV module which use 2D-3D integrated tracking. Refer to Figure 1 and Annex A.

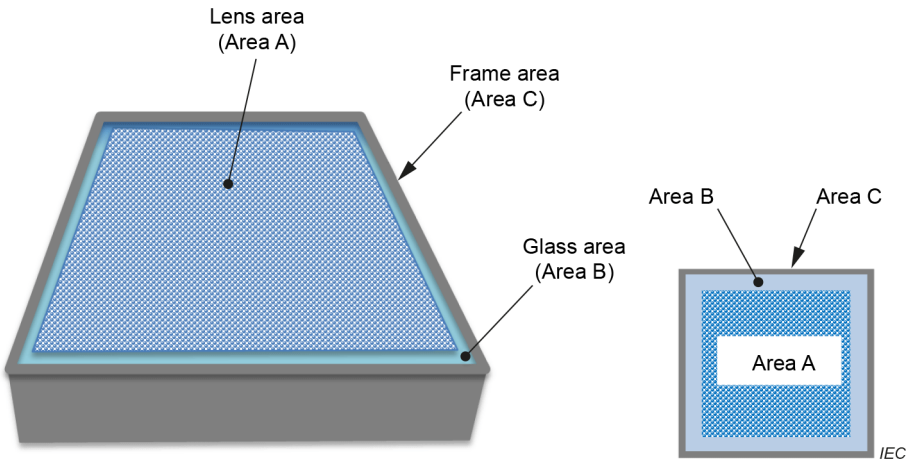

Figure 1 – Schematic of a hybrid CPV/PV module

NOTE 2 In some CPV/PV hybrid modules the glass area (Area B) is covered by silicon or thin film cells. In this case, the hybrid CPV/PV module is said to have an "external" PV array and the area covered by the PV array is part of the operational area.

NOTE 3 An example of a normalized angular response of a CPV/PV hybrid module is reported in Figure 2.

3.1
CPV/PV hybrid module
module with solar cells designed to collect concentrated light (CPV cells array) and solar cells designed to collect diffuse or global light (PV cells array), with bifacial or monofacial illumination

3.2
field of view
FoV
range of angles within which the normalized angular power value of the CPV cells remains within the 50 % of its maximum value

Note 1 to entry: See 3.3.

3.3
normalized angular response of a CPV/PV hybrid module
CPV module angular power normalized to the maximum power condition, computed according to Formula (33)

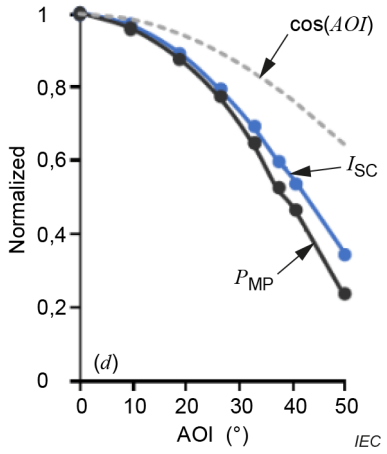

Figure 2 – Example of the hybrid CPV/PV module power variation as a function of AOI, compared with the cos(AOI) behaviour (after [1])