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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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– withdrawn, or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*

Bibliography

[1] S. Askins et al., "*Performance of Hybrid Micro-Concentrator Module with Integrated Planar Tracking and Diffuse Light Collection*," Conf. Rec. IEEE Photovolt. Spec. Conf., no. June, pp. 2507–2512, 2019

[2] J. F. Martínez, M. Steiner, M. Wiesenfarth, G. Siefer, S. W. Glunz, and F. Dimroth, "*Power rating procedure of hybrid concentrator/flat-plate photovoltaic bifacial modules*," Prog. Photovoltaics Res. Appl., vol. 29, no. 6, pp. 614–629, 2021

[3] Jared S. Price, Xing Sheng, Bram M. Meulblok, John A. Rogers & Noel C. Giebink, "*Wide-angle planar microtracking for quasi-static microcell concentrating photovoltaics*" Nat Commun 6, 6223 (2015). https://doi.org/10.1038/ncomms7223

[4] H. J. D. Johnsen, A. Aksnes, and J. Torgersen, "*High-performance stationary solar tracking through multi-objective optimization of beam-steering lens arrays*," Opt. Express, vol. 28, no. 14, p. 20503, 2020

[5] Edoardo Celi, Gianluca Timò, Alessandro Minuto and Franco Trespidi, "*New CPV/PV Hybrid module with a self-powered, integrated, 3D meso solar tracker based on Shape Memory Alloys*," CPV-17, 17th Int. Conf. Conc. Photovolt. Syst., pp. 2–7, 2021

[6] Steve Askins, César Dominguez, Gaël Nardin, "*HIPERION: Scale-up of hybrid planar micro- tracking solar panels for rooftop compatible*," AIP Conference Proceedings, 2550, 030001, 2022

[7] M. Iqbal, *An Introduction to solar Radiation*. 1983

[8] Matthew J.reno a al., "*Global horizontal irradiance clear sky models: implementation and analysis*", SANDIA REPORT, SAND2012-2389, Printed March 2012

[9] IEC 61853 (all parts), *Photovoltaic (PV) module performance testing and energy rating*

[10] IEC 62670 (all parts), *Photovoltaic concentrators (CPV) - Performance testing*

[11] IEC 60904-1 (all parts), *Photovoltaic devices - Part 1: Measurement of photovoltaic current-voltage characteristics*

[12] IEC 60904-2, *Photovoltaic devices - Part 2: Requirements for photovoltaic reference devices*

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

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

[15] IEC 61853-2:2016, *Photovoltaic (PV) module performance testing and energy rating - Part 2: Spectral responsivity, incidence angle and module operating temperature measurements*

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