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Photovoltaic concentrator cell documentation

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National foreword

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TECHNICAL SPECIFICATION

SPECIFICATION TECHNIQUE

colour inside

Photovoltaic concentrator cell documentation

Documentation relative aux cellules photovoltaïques à concentration

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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PHOTOVOLTAIC CONCENTRATOR CELL DOCUMENTATION

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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 TS 62789, which is a technical specification, has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

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

Enquiry draft	Report on voting
82/776/DTS	82/821/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 publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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PHOTOVOLTAIC CONCENTRATOR CELL DOCUMENTATION

1 Scope and object

This Technical Specification provides guidelines for the parameters to be specified for concentrator photovoltaic cells (both multijunction and single junction) and provides recommendations and references for measurement techniques. No attempt is made to determine pass/fail criteria for cells.

The purpose of this specification is to define the performance and physical characteristics of concentrator cells. This specification may also be used for describing cell assemblies and receivers, but is not written to specifically address cell packaging. It is not intended to standardize the properties of the concentrator cells, but to standardize how the properties are communicated.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *Photovoltaic devices – Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data*

IEC 62787, *Concentrator photovoltaic (CPV) solar cells and cell-on-carrier (COC) assemblies – Reliability qualification*[1]

3 Specifications for concentrator cells

All concentrator cell datasheets complying with this specification shall provide, as part of their product marking and documentation, the information specified in Table 1 below. See subsequent clauses and subclauses of this Technical Specification for further explanation of individual specifications. In addition to the information indicated by the examples, it is required to include a sketch of the cell and the indicated graphs.

Some of the specifications are optional; however, if a concentrator cell manufacturer chooses to include optional information, it should be reported and measured using the definitions provided in this Technical specification.

[1] To be published.

Table 1 – Specification template

Characteristic	Example	Notes/Section
Product identification		**4.2**
Manufacturer	The XYZ Company	4.2.2
Model number	XX1090	4.2.3
Type of cell	Three junction: GaInP (1,89 eV) / GaInAs (1,39 eV) / Ge (0,67 eV) on germanium substrate	4.2.4
Product description		**4.3**
Total area	(1,1 ± 0,003) cm × (1 ± 0,003) cm	4.3.2
Designated illumination area Simulator performance-defining area	(1 ± 0,003) cm × (1 ± 0,003) cm (see example Figure 1) 1,01 ± 0,006 cm^2	4.3.3
Nominal efficiency at design irradiance	39 % ± 2 % at 500 kW/m^2	4.3.4
Nominal current ratios	Current ratios under G173 direct spectrum (relative to top junction current): 1,89 eV cell = 1 1,39 eV cell = 1,0 ± 0,03 0,67 eV = 1,7 ± 0,03	4.3.5
Temperature coefficients (measured at the irradiance for which the product was designed)	α = dIsc/dT = + (0,11 % ± 0,03 %)/K when 1,89 eV-cell limited; +(0,07 % ± 0,03 %)/K when 1,39 eV-cell limited β = dVoc/dT = – (0,15 % ± 0,02 %)/K dPmax/dT = – (0,24 % ± 0,06 %)/K Measured at 1 000 kW/m^2; AM1,5 direct; temperature range of 25 °C to 70 °C. Other conditions may also be documented.	4.3.6
Front metallization	Silver	4.3.7
Front metallization thickness	1 µm	4.3.7
Back metallization	Gold	4.3.8
Anti-reflection coating design	Matched to index of 1.4	4.3.9
Thickness of substrate	150 µm	4.3.10
Cell processing and use conditions		**4.4**
Recommended operating (cell) temperature	–20 °C < T < 150 °C	4.4.1
Maximum photocurrent	1 A/cm^2	4.4.2
Recommended processing temperature	< 350 °C for 10 min	4.4.3
Chemical compatibilities/ incompatibilities	Incompatible with aqua regia	4.4.4
Storage conditions (shelf life, humidity, temperature, and atmosphere)	Storage 10 °C < T < 30 °C 20 % < RH < 70 % Shelf life < 4 months Atmosphere = air	4.4.5
Recommended bonding method	Front side: wire bonding Back side: solder	4.4.6
Electrostatic discharge threshold		As measured in future IEC 62787

Characteristic	Example	Notes/Section
Graphs/Tables		**4.5**
Typical I-V curve (measured at the irradiance for which the product was designed, AM1,5 Direct spectrum, 25 °C). Isc, Imp, Vmp, Voc, FF, Efficiency specified	See example Figure 2 NOTE It is requested that irradiance be specified in units of kW/m^2, since these units also indicate the approximate concentration	4.5.1
Efficiency as function of irradiance at 25 °C	See example Figure 3 NOTE It is requested that irradiance be specified in units of kW/m^2, since these units also indicate the approximate concentration	4.5.2
Voltage at maximum power point as a function of irradiance at 25 °C	See example Figure 4 NOTE It is requested that irradiance be specified in units of kW/m^2, since these units also indicate the approximate concentration	4.5.3
Quantum efficiency (presented as either a graph or a table). One curve for each junction, measured at 25 °C	See example Figure 5	4.5.4
Angular responsivity, Isc as a function of incidence angle compared with cosine function	See example Figure 6	4.5.5
Cell testing		**4.6**
LIV and other characterization testing: Note conditions for testing and sampling rate	500 kW/m^2; AM1,5D; 25 °C; 100 % of samples	Example only; refer to description in 4.6
Stress testing: Describe stress testing that is applied and sampling rate, if applicable	Certification to future IEC 62787	Example only; refer to description in 4.6

4 Concentrator cell characterization

4.1 Overview

This clause describes parameters and guidelines for characterizing concentrator cells, with one subclause for each entry in Table 1. It is useful for datasheets to present similar types of information and the primary purpose of this Technical Specification is to facilitate consistency between datasheets. However, recognizing that the information that is presented represents a typical cell rather than a specific cell, small variations in testing methodology may be unimportant. The focus of this specification is to provide consistent definitions of test conditions rather than to specify precise methods for the measurements. In the future, it may be useful to define the measurement techniques in more detail, but there is not yet consensus on all of the details of the measurements. For example, characterizing/controlling the spectrum as a function of time and location during the flash of a simulator can be quite challenging and each lab has its own method for controlling the spectrum. Some of the measurements described in this specification may have uncertainties on the order of 5 % to 10 %. Defining careful measurement techniques that can reduce these uncertainties will be useful, but is outside of the scope of this specification.

4.2 Product identity

4.2.1 General

The datasheet shall unambiguously define the identity of the product. This may become especially confusing if a different model number is used for a concentrator cell and a mounted cell.

4.2.2 Manufacturer

In some cases, multiple manufacturers may be involved for the epitaxial growth, cell processing, and cell testing. The name of the manufacturer should identify the company that is responsible for the creation of the datasheet.

4.2.3 Model number

The model number should be unique to the described product.

4.2.4 Type of cell

The description of the cell should include at a minimum:

- The number of junctions
- The material(s) used for each junction
- The band gap associated with each junction if this is not clear from the material (e.g. silicon needs no clarification)
- The substrate

Optionally, the thicknesses of each of the layers may also be included.

4.3 Product description

4.3.1 General

A drawing is needed to define the sample geometry.

4.3.2 Total chip area

The total cell (chip) area is needed for designing cell assemblies and how cells will be implemented into CPV modules. The total area designation should include the dimensions (e.g. 1 cm × 1,1 cm) and a sketch. The sketch should include the total chip dimensions as well as the inactive areas that are both metallized and unmetallized. Figure 1 is an example, including an expanded view of the lower right corner; the cell manufacturer may use a different method to communicate the correct geometry.

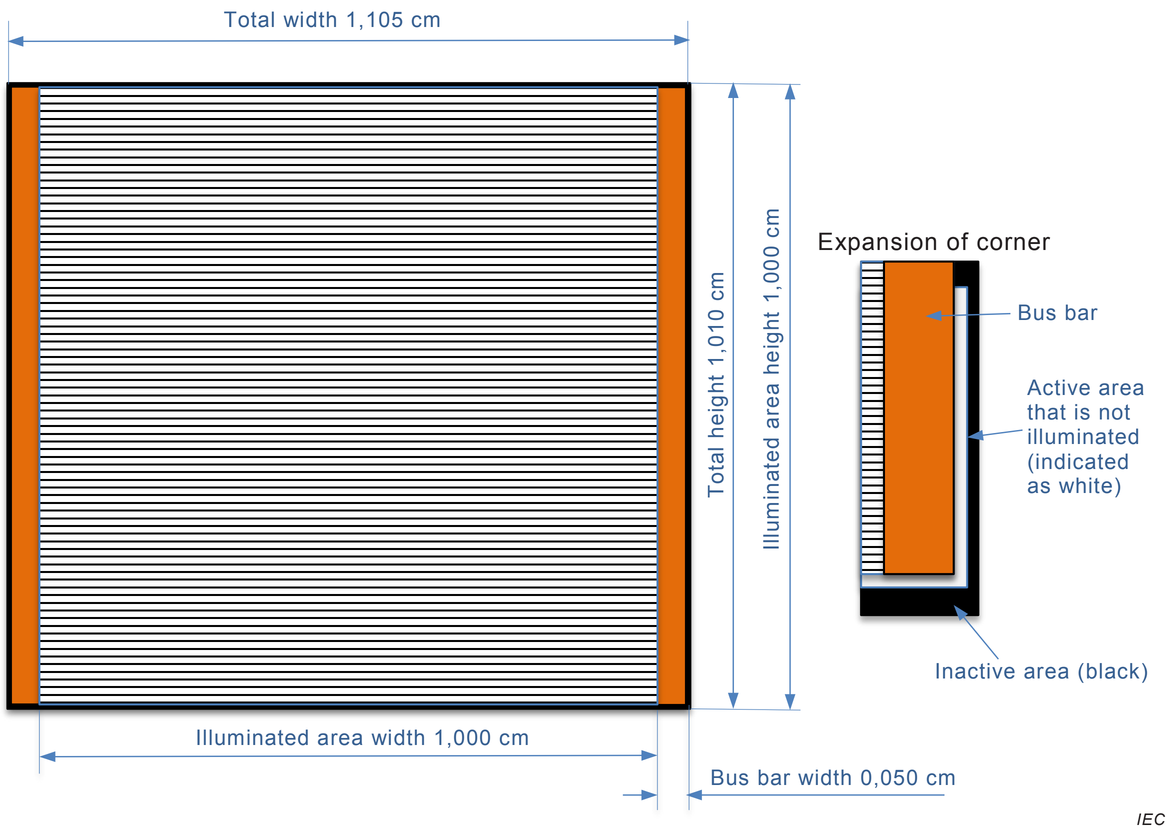

Figure 1 – Total cell area and designated illumination area

4.3.3 Designated illumination area

In contrast to flat-plate cells that are usually 100 % illuminated, the design of many concentrator systems allows for the cells' contacts to be made outside of the illuminated area. On the datasheet, the sketch should include indication of the location and dimensions of the designated illumination area, referring to the area that is designed to be illuminated, including the area of grid lines and busbars that are intended to be illuminated. The dimensions of the busbar that will be used for electrical contact should be well defined. This can be confusing because some concentrator cells include an area that responds to illumination but that is not intended to be illuminated. Specifically, to prevent shorting, busbars are often designed to leave a lip that is light active but will lie outside of the optical path. Thus, light-active areas that are not intended to be illuminated should be masked during the measurement process, or, a mathematical correction may be applied using the area on the simulator performance-definition area.

Simulator performance-definition area (area that is illuminated during test) = [area inside mesa isolation or cell edge (if no mesa)] – [busbars or bond pads].

Designated illumination area = the area designed to be illuminated between busbars and mesas or cell edge.

4.3.4 Nominal efficiency and design irradiance

The nominal efficiency should be reported for a typical cell measured under the following conditions:

- Design irradiance kW/m^2
- AM1,5 Direct (as specified in IEC 60904-3), and
- 25 °C cell temperature.

The design irradiance is also specified. Methods for measuring I-V curves can be found in references listed above. The uncertainty of the measurement should be estimated and included.

4.3.5 Nominal current ratios

The photocurrents for each junction within a multijunction cell can be measured by adjusting the spectrum or by integrating the quantum efficiency curve convoluted with the spectrum of interest. The expected current ratios should be specified for the IEC 60904-3 direct reference spectrum measured at 25 °C in air (for the described package). If the product is a bare cell that will be encapsulated it could be useful to quote the values for measurement with the encapsulation, but this could become confusing since applying encapsulation, protective glass and/or secondary optics could change the optics. If such information is supplied, it should be clearly labelled as to how it was measured. By convention, the top cell will be considered to have a relative current of unity and the ratios of the currents for each of the other subcells are noted relative to the top-cell current. The ratios will apply to the same measurement conditions used to determine the nominal efficiency. The variability of these ratios should be reflected in the indication of the uncertainty. The junction identification should match the description of the cell in an unambiguous way by specifying the band gap, composition, junction number or other unique identifier.

4.3.6 Temperature coefficients

The temperature coefficients for the Voc (open-circuit voltage) and Pmax (maximum power) can be obtained by measuring the I-V curves for the cell under the irradiance for which the cell was designed and AM1,5 Direct illumination for a set of temperatures spanning a range of at least 70 °C and/or within the full operating temperature range, as specified by the manufacturer (see 4.4.1). The temperature coefficient of the Isc (short-circuit current) is especially difficult to measure and may best be reported from literature values or from integration of the quantum efficiency measured at variable temperatures considering bandgap lowering with increased temperature. All temperature coefficients should be expressed in relative units (%/K) and uncertainties included. Temperature coefficients for multiple irradiance levels may be included at the discretion of the manufacturer.

4.3.7 Front metallization

The chemical composition and thickness of the front metallization should be described with enough detail to facilitate contact formation.

4.3.8 Back metallization

The chemical composition of the back metallization should be described with enough detail to facilitate contact formation.

4.3.9 Antireflection coating design

Specify the index of refraction that the antireflection coating was designed to match to (for example, to air (n = 1)).

4.3.10 Thickness of substrate

The thickness of the substrate should be specified.

4.4 Cell processing and use conditions

4.4.1 Recommended cell operating temperature

If the cell operating temperature is increased, it may cause premature failure of the cells. Operation at very low temperatures may become problematic if the tunnel junction function becomes limited. The manufacturer should identify a recommended operating range.

4.4.2 Maximum cell photocurrent

The performance of a multijunction cell may decrease dramatically if the local photocurrent exceeds the capacity of the tunnel junctions. Silicon cells may show reduced output if carrier concentrations reach levels causing Auger recombination. The maximum recommended cell photocurrent should be specified with units of A/cm^2.

4.4.3 Recommended cell processing temperature

A processing temperature and time should be specified after which the cells will still retain the properties as described in the datasheet.

4.4.4 Chemical compatibilities/incompatibilities

List common chemicals or processes that would lead to degradation of the cell performance, or that are recommended.

4.4.5 Storage conditions

Describe recommended storage conditions of the cell at least including storage temperature, humidity, atmosphere (ex. dry box, nitrogen-purged plastic bag) and shelf life. Storage conditions are important both for protection of bare cells and for preserving the surface condition of the bonding pads.

4.4.6 Recommended bonding method

The metallization configuration is typically designed to be suitable for a specific bonding method such as wire bonding, soldering, welding or gluing. This bonding method may vary between the front and back sides and, therefore, needs to be specified for both the front and the back.

4.5 Graphs and tables

4.5.1 Typical I-V curve

The I-V curve measured in 4.3.3 to determine the nominal efficiency should be shown along with the measured values for Isc, Imp, Vmp, Voc, FF, and efficiency, as shown in Figure 2. Optionally, a power-voltage curve may be included.

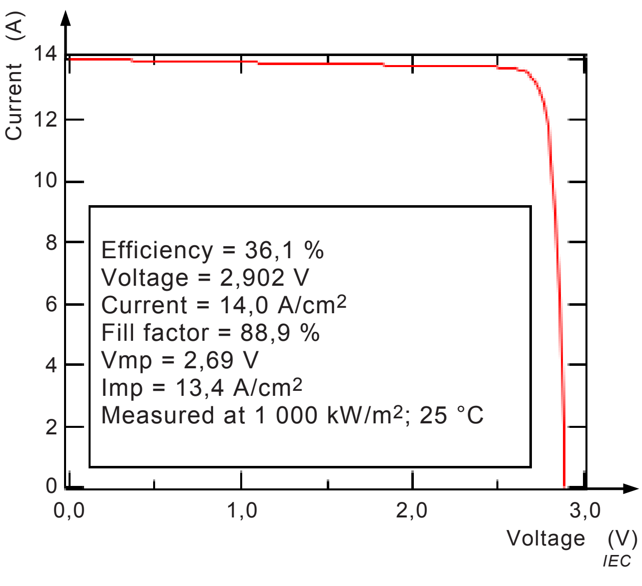

Figure 2 – Example current-voltage graph

4.5.2 Efficiency versus irradiance

The efficiency measured as a function of irradiance for the AM1,5 Direct spectrum and 25 °C cell temperature, as shown in Figure 3.

It is requested that irradiance be specified in units of kW/m^2, since these units also indicate the approximate concentration.

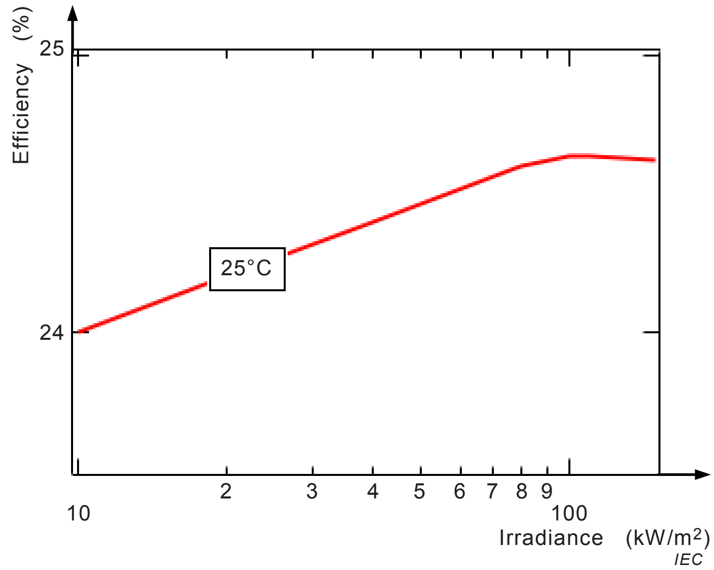

Figure 3 – Example graph of efficiency as a function of irradiance

4.5.3 Vmp versus irradiance

The Vmp measured as a function of irradiance for the AM1,5 direct spectrum and 25 °C cell temperature, as shown in Figure 4.

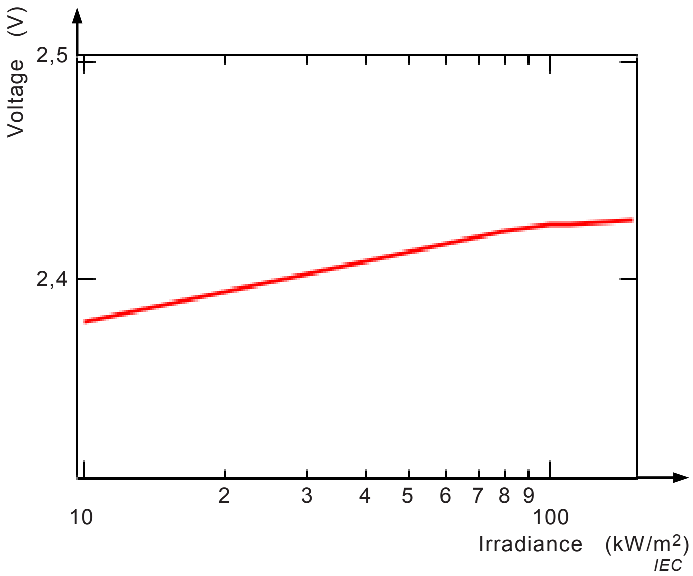

Figure 4 – Example graph showing voltage as a function of irradiance

4.5.4 Quantum efficiency

Plot or tabulate the typical external quantum efficiency as a function of wavelength for each junction as measured on a cell taken from the bin with the greatest population, as shown in Figure 5 and Table 2. It is understood that this data will vary slightly from sample to sample.

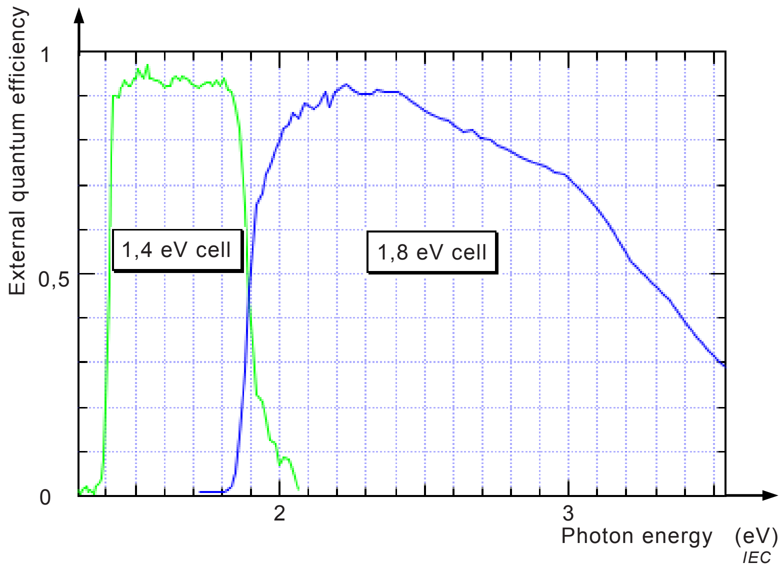

Figure 5 – Example graph of external quantum efficiency

Table 2 – Example tabulation of quantum efficiency data

Wavelength nm	**Top cell response** unitless	**Bottom cell response** unitless
350	0,288	
355	0,323	
360	0,357	
365	0,395	
370	0,438	
375	0,469	
380	0,495	
385	0,526	
390	0,570	
395	0,611	
400	0,644	
405	0,675	
410	0,700	
415	0,724	
420	0,730	
425	0,742	
430	0,750	
435	0,760	
440	0,767	
445	0,782	
450	0,789	
455	0,800	
460	0,806	
465	0,821	

Wavelength nm	**Top cell response** unitless	**Bottom cell response** unitless
470	0,819	
475	0,833	
480	0,844	
485	0,850	
490	0,857	
495	0,867	
500	0,878	
505	0,888	
510	0,900	
515	0,908	
520	0,907	
525	0,911	
530	0,908	
535	0,904	
540	0,903	
545	0,905	
550	0,915	
555	0,926	
560	0,916	
565	0,908	
570	0,875	
575	0,907	
580	0,883	
585	0,872	
590	0,879	
595	0,882	
600	0,850	
605	0,861	
610	0,834	
615	0,829	
620	0,797	
625	0,780	0,103
630	0,742	0,102
635	0,724	0,109
640	0,682	0,105
645	0,653	0,121
650	0,558	0,144
655	0,46	0,167
660	0,278	0,208
665	0,132	0,257
670	0,050	0,272
675	0,019	0,286
680	0,010	0,287
685	0,0096	0,285
690	0,009	0,274
695	0,008	0,275
700	0,004	0,269
705	0,00	0,28
710		0,286
715		0,295

Wavelength nm	**Top cell response** unitless	**Bottom cell response** unitless
720		0,296
725		0,3
730		0,291
735		0,281
740		0,278
745		0,267
750		0,269
755		0,269
760		0,28
765		0,289
770		0,299
775		0,307
780		0,308
785		0,306
790		0,295
795		0,287
800		0,274
805		0,273
810		0,263
815		0,266
820		0,268
825		0,273
830		0,282
835		0,292
840		0,298
845		0,303
850		0,308
855		0,3
860		0,286
865		0,273
870		0,265
875		0,225
880		0,131
885		0,051
890		0,0218
895		0,0126
900		0,00657
905		0,00621
910		0,00635

4.5.5 Angular responsivity

Plot or tabulate the angular dependence of the Isc as measured in air for the described package, as shown in Figure 6. If the measurement applies to a bare cell that has been packaged in a way that is not part of the product, such data shall be clearly labelled. Preferably, the cosine function will be superimposed on the measured data for comparison. If preferred, the response may be presented relative to the cosine response. In this case, the deviation from cosine is more apparent, but as glancing angles are approached, the uncertainty of the relative response may be very large, resulting in a misleading graph. The angular response should be documented for rotation parallel to grids and perpendicular to grids unless these are not easily distinguished.

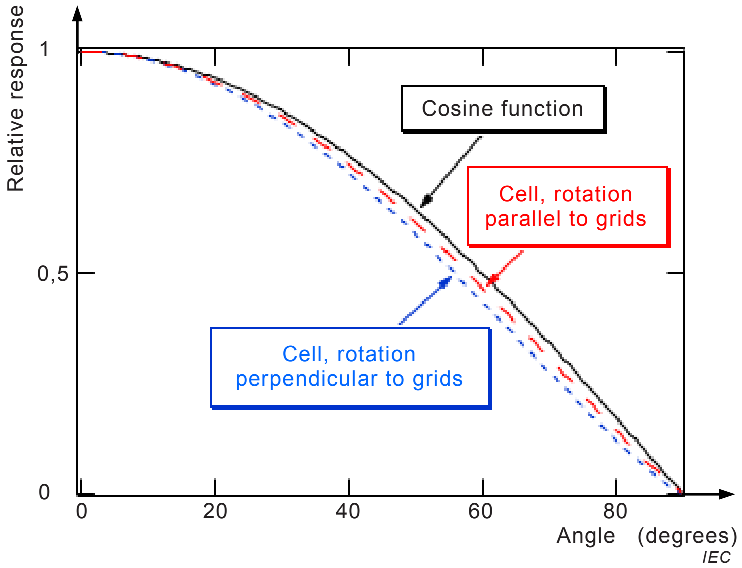

Figure 6 – Example graph showing response as a function of the angle of incidence

4.6 Cell testing

Describe types of tests, fraction of cells that are tested, and pass conditions that are applied both for performance and qualification. Understanding the test procedures helps the customer assess the consistency of the product that can be expected and/or requested.

Bibliography

IEC 61836:2007, *Solar photovoltaic energy systems – Terms, definitions and symbols*

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

Emery K, Meusel M, Beckert R, Dimroth F, Bett A, Warta W, *Procedures for Evaluating Multijunction Concentrators*, 28th IEEE Photovoltaic Specialists Conference, Anchorage, Alaska, 2000 (IEEE, New York), p. 1126

Emery KA, Osterwald CR, *Current topics in photovoltaics*, Vol. 3 (Academic Press, 1988), pp. 301-350

Emery KA, *Handbook of Photovoltaic Science and Engineering*, edited by A. Luque and S. Hegedus (John Wiley and Sons, West Sussex, England, 2003), pp. 701-747

Kinsey GS, Hebert P, Barbour KE, Krut DD, Cotal HL, Sherif RA, *Concentrator Multijunction Solar Cell Characteristics Under Variable Intensity and Temperature*, Prog. Photovolt. 2008, 16(503-508)

Virshup GF, Chung B-C, Ladle Ristow M, Kuryla MS, Brinker D, *Temperature coefficients of multijunction solar cells*, 21st IEEE PVSC, 1990 (IEEE), pp. 336-338

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