

Product specification

PV module series

This specification sets out the requirements for assessing the technical, electrical and optical quality of our photovoltaic modules.

It acts as a basis for our tenders and forms part of the contract when an order is placed, unless otherwise agreed in writing.

1. Design of photovoltaic elements

Our modules are divided into two groups.

1.1 Glass-glass modules

1.1.1 Standard design

A 2 mm thick pane of heat-treated glass (TVG) (with bevelled edges) is used as the outer pane. The PV cells are embedded between two PVB sheets (polyvinyl butyral) and laminated together with a further 2 mm thick TVG pane.

1.1.2 Special design

Fully tempered (ESG) or heat-treated (TVG) white glass (low iron oxide content) with bordered edges is used for the outer panes. The thickness of both panes is determined by static requirements or by the customer. Thicknesses between 4 mm and 12 mm are available. As a general rule, fully tempered (ESG) glass is not subject to a heat-soak test (HS test). Spontaneous breakage as a result of a nickel sulphide inclusion cannot, therefore, be ruled out. This chargeable test can be carried out at the customer's request.

The number of cells and the cell spacing can be varied.

Glass can have special finishes:

- KG cut edges
- KGS bordered edges
- KGN bevelled edges
- KPO polished edges
- GK mitred edges

Coloured designs are possible as follows:

- Screen printing in the case of different screening options (dots, stripes, cell matrix special shapes)
- Enamelling in the case of full-surface printing
- Coloured PVB foil
- Coloured glass

1.2 Glass-insulating glass modules

1.2.1 Standard design

Fully tempered (ESG) or heat-treated (TVG) white glass (low iron oxide content) with bordered edges is used for the outer panes.

The PV cells are embedded between two PVB sheets (polyvinyl butyral) and laminated with a further ESG or TVG pane.

The panes are either 4 or 5 mm thick depending on the size of the module.

Aluminium or stainless steel profiles are used as spacers, creating a 16 mm gas-filled (argon) cavity between the panes.

A 4 or 5 mm thick ESG or TVG pane is used as the rear glass. The edge seal corresponds to standard insulating glass designs.

1.2.2 Special design

The thickness of both outer panes is determined by static requirements or by the customer.

Thicknesses between 2 mm and 12 mm are available.

The number of cells and the cell spacing can be varied, thus altering light transparency.

Aluminium or stainless steel profiles are used as spacers, creating a 6 to 22 mm gas-filled (argon, krypton) cavity between the panes. A multi-layer glass structure can be used for increased U values, in which case the cavity is filled with krypton.

An ESG pane is used as the rear pane, thick enough to comply with static requirements. This pane may be processed to form a VSG composite structure (with PVB sheet) and can thus be used overhead.

See Section 1.1.2 for further glass processing options.

2 Dimensions/sizes/tolerances

The maximum dimensions are as follows:

- Glass-glass modules
 - with 2 mm glass: 3200 x 1600 mm
 - with 4-10 mm glass: 5000 x 2200 mm
- Insulating glass modules
 - with 4-10 mm glass: 5000 x 2200 mm
 - Special sizes on request

Please consult EN 12153 for tolerances

Size tolerances for width W and length H in mm					
Fixed dimensions, cut and bordered			Edges matt - polished - mitred		
Dimensions in mm W or H	Nominal thickness	Each glass unit	< 24 mm	< 35 mm	> 35 mm
	≤ 8 mm	> 8 mm nominal thickness	Glass thickness	Glass thickness	Glass thickness
< 1000	± 1	± 2.5	+1 / - 2	+1 / - 3	+1 / - 4
< 1500	± 1.5	± 3	+1 / - 3	+1 / - 3	+1 - 4
< 2500	± 2.5	± 4	+1 / - 3	+1 / - 3	+1 / - 4
> 2500	± 3	± 4.5	+1 / - 3	+1 / - 3	+1 / - 4
Glass thickness tolerance	Element thickness mm	Tolerance mm			
	≤ 6	± 0.4			
	6.1-12	± 0.6			
	12.1-18	± 1			
	>18.1	± 2			
Offset	Nominal size in mm	Offset in mm			
	≤ 1000	2.0			
	1001-2000	3.0			
	2001-4000	4.0			
	> 4000	6.0			

Alternative tolerances are specified on the order confirmation.

The maximum ratio between width and length is 1:20.

3 Marking

All modules are provided with a type plate specifying the module type, serial number and manufacturer's information. This type plate is located at the back of the module. All production data and performance values can be traced using the serial number.

4 Electrical connections

The connections include bypass diodes which are sealed so they are waterproof and electrically insulated. A maximum of 24 cells form a string and are equipped with a diode. The connections are provided on the short side as standard. However, in special cases the connections can also be provided on one of the two longitudinal edges. Our project-specific datasheets and previously agreed customer-specific solutions apply in such cases. The following connection scenarios are possible:

4.1 Front of the glass panels: side connection

4.2 Rear of the panel: rear socket

5 Cells

Our modules use cells in the following variations:

- polycrystalline silicon cells, 6" + 156 x 156 mm
 - monocrystalline silicon cells, 6" + 156 x 156 mm
 - monocrystalline silicon cells, 5" 125 x 125 mm
 - ultra-efficient monocrystalline silicon cells, 5" 125 x 125 mm
- The above cells are certified to IEC 612515 and 61730.
- polycrystalline coloured cells, 6" + 156 x 156 mm
 - polycrystalline coloured cells, 5" + 125 x 125 mm
 - monocrystalline coloured cells, 6" + 156 x 156 mm
 - black cell connectors

The different colour shades on the cells are due to the production process and may vary within a module. These are not regarded as defects. Other cell formats or colours can also be processed at the customer's request.

6 Strings

Cell spacing: min. 3 mm; max. 150 mm

String dimensions can vary due to the dimensional tolerances of cells (+/- 1 mm) and the manufacturing process.

The following are fixed tolerances:

Distance from glass edges:	+/- 3 mm
Distance between cells:	+/- 2mm
Distance between strings:	+/- 3 mm
Length of all strings with respect to one another:	+/- 3 mm
Parallel with edge of panes:	+/- 4 mm/lm
Solder strips / cell connectors:	+/- 3 mm
Connecting plates:	+/- 3 mm
Plate return	+/-10 mm/lm

All tolerances relate to the default dimensions specified in writing.

7 Cell breakage

7.1 Opaque panels (foil or enamel coating)

If the electrical function is within the tolerance range, any kind of cell breakage is permitted.

7.2 Semi-transparent panels (glass-glass)

If the electrical function is within the tolerance range, any kind of cell breakage is permitted. However, if more than three cells or up to 5 % of the cells in each module are affected; these should be marked as "B-grade goods" and marketed separately.

8 Air inclusions

Small air bubbles may remain in the modules as a result of the production process. These should not affect the electrical properties or longevity of products and should not exceed the following limits:

- up to 10 bubbles measuring 1 - 3 mm
- up to 8 bubbles measuring 3 - 5 mm
- up to 5 bubbles measuring 5 - 10 mm
- up to 2 bubbles measuring > 10 mm

All details refer to one square meter of module surface.

9 Changes in colour

All materials used in PV production have individual colours due to the raw materials used. This individual colouring may appear differently when looking through and/or looking at the glass. Variations in colour are inevitable due to the type of glass, thickness of the glass and the structure of the panes. They are not regarded as defects and are no different from discolouration of the foil at the edges or in the solder strips.

10 Foreign bodies

Dirt inside the laminate, such as soldering splashes, small cell fragments, inclusions in the glass or fluff should not affect the overall optical image.

11 Linear defects

Scratches or grinding marks on the glass surface, and small fractures at the edge of the glass are also not regarded as defects provided that modules meet their inspection criteria.

12 Inspection criteria

The specifications described above are subject to the following inspection criteria.

13 Technical details

All technical details should be defined in writing before production commences and are confirmed by drawings and by the order confirmation.

12.2. Electrical data

The specified electrical values are documented in the form of "flash reports" (measurement reports). All values are subject to a tolerance of +/- 5 %. Modules are regarded as being electrically acceptable if the output measured under STC is within the tolerance limit for the specified rated output. The high efficiency back-contact cells produced by Sunpower are exceptions to this rule. An external supplier's flash report can be supplied subject to an additional charge.

12.3. Optical criteria

As inspection criteria from the glass technology sector do not apply due to the specific manufacturing process, the following inspection method is used:

The module in question is placed in a vertical position. The inspector stands 2 m away from the module and inspects it in daylight, but away from direct sunlight.

13 Certificates

The PV modules we manufacture are subject to stringent internal and external testing.

13.1. Glass-glass modules

Our standard glass-glass modules are certified to EN 61215 and EN 61730 and protection class II. A test report is available to confirm that a 10/10 VSG structure can be walked on. Entry DIBt Z-70.3-172.

13.2. Insulating glass modules

The terms of EN 673 apply to U values. Measurement results are available showing g-values for different transparency grades.

13.3. Chargeable certificates can be provided for special modules which are manufactured at the customer's request. This specifically includes different glass structures, cell types, diode boxes, enamel coatings and edge seals.

14. Output guarantee and warranty

Please refer to our T&C (3.2015 version).

The Product specification in the German language are legally binding. Further Product specifications in English, French, Italian or other languages are for information purposes. Where translations have been formulated in a way which is disputed, the German Product specifications in the German language shall take priority over those translated into other languages.