INSTALLATION MANUAL AND SAFETY INSTRUCTIONS

Rev.1.0

SOLVIS PHOTOVOLTAIC MODULES G12R FAMILY

MB 2243733 OIB 80258164780

Table of Contents

Table of Contents 1
1. Introduction 1
1.1. Disclaimer of Liability 1
1.2. International Electrotechnical Commission (IEC) Listing Information 1
1.3. Limited Warranty 1
2. General Safety 2
2.1. Safety Precautions 2
2.2. Packing removal and temporary storage 2
3. Installation 3
3.1. General 3
3.2. Notes on Installation 3
3.3. Antireflective coating visuals 3
3.4. Module Mounting 3
3.4.1. Site Considerations 3
3.4.2. Mounting Configurations 4
3.4.3. Permissible loads on the module 6
3.5. Overcurrent protection device 9
3.6. Bypass diodes 9
3.7. General Wiring 9
3.7.1. Series Connection 10
3.7.2. Parallel Connection 10
3.7.3. Connectors 10
3.7.4. Grounding 10
3.7.5. Fire safety 11
4. Maintenance 11
5. Specifications 12
6. Contact information 12

1. Introduction

The photovoltaic (PV) modules by SOLVIS are devices that produce electrical energy by converting the sunlight's radiation reaching their surface, when appropriately exposed, into continuous/direct current (DC).

PV modules are intended to be used in photovoltaic module systems connected to the electrical grid. It is also possible to use them in battery powered photovoltaic module systems (stand alone).

The rated currents at Standard Test Conditions (STC) of the SOLVIS PV modules are variable depending on the model and the relative power rating, as indicated in the respective technical data sheets.

This manual provides information for SOLVIS photovoltaic (PV) modules.

Serial number: LYYMM00001 (~99999) (Ex. 1250100004)

- L – production site
  - site **1** - Ulica Vesne Parun 15, 42000 Varazdin, Croatia
  - site **2** – Ulica Ivane Brlić Mažuranić 25, 42000 Varaždin, Croatia
- YYMM : Production year and month
- 00001~99999 : Production number

This document is applicable to SOLVIS monocrystalline G12R photovoltaic modules.

Important!

- Read this instruction sheet in its entirety before installing, wiring, or using this product in any way. Failure to comply with these instructions will invalidate SOLVIS Limited Warranty for PV module.
- This documentation refers to the PV-modules themselves and is not meant to be a complete installation manual for personnel not specifically trained to PV-modules. It serves as a general but strictly mandatory to the Installer reference. Infringement or inaccurate observance of any clause of this documentation voids the warranty.
- The installer must understand and follow all applicable local, state, and federal regulations and standards for building construction, electrical design, fire, and safety, and must check with local authorities to determine applicable permitting requirements before attempting to install or maintain PV modules and should become familiar with the mechanical and electrical requirements for photovoltaic systems.

1.1. Disclaimer of Liability

The installation techniques, handling and use of this product are beyond company control. Therefore, SOLVIS does not assume responsibility for loss, damage or expense resulting from improper installation, handling or use.

1.2. International Electrotechnical Commission (IEC) Listing Information

This product meets all requirements listed by IEC 61215 terrestrial PV modules. The IEC standard covers flat-plate PV modules and panels intended for installation on buildings and those intended to be freestanding. This product is not intended for use where artificially concentrated sunlight is applied to the module.

1.3. Limited Warranty

Limited warranty on SOLVIS PV modules is defined in separate document "SOLVIS Limited Product Warranty for PV modules". Last version of this document can be downloaded from SOLVIS website http://www.solvis.hr/downloads/warranty-and-manuals/.

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.

2. General Safety

2.1. Safety Precautions

Danger!

PV modules are sources of voltage when exposed to light. Module interconnects pass direct current (DC) when the module is under load. Do not connect or disconnect modules when they are under load! Direct current can arc across gaps and may cause injury or death if improper connection or disconnection is made, or if contact is made with module leads that are frayed or torn.

Before installing PV modules, read all the safety instructions in this manual!

- Cover all modules in the PV array with an opaque material before making or breaking electrical connections.
- All installations must be performed in compliance with all applicable regional and local codes.
- Do not attempt to repair any part of the module or disassemble the module.
- Do not use modules that are damaged (e.g.: front glass is broken, or back sheet is torn)
- Do not open the junction box on the back side of the module.
- Contact your module supplier if maintenance is necessary.
- Installation should be performed only by authorized personnel.
- Use only equipment, connectors, wiring and supporting constructions designed for use in photovoltaic systems.
- Remove all metallic jewelry prior to installing this product to reduce the chance of accidental exposure to live circuits.
- Use insulated installation tools to reduce risk of electrical shock.
- Do not stand on, drop, scratch or allow objects to fall on modules.
- To avoid damage to the backsheet, do not scratch or hit the backsheet.
- Do not drill holes in the frame, as this can compromise the frame strength and cause corrosion of the frame.
- Do not scratch the frame as this may remove the anodized coating of the frame and cause corrosion of the frame.
- Do not use junction box or connecting wires for transportation help or for holding the module.
- Do not treat the back side of modules with paint, glue or sharp objects.
- If the front glass is broken or the back sheet is torn, contact with any module surface or module frame can cause electric shock.
- Do not install or handle the modules when they are wet or during periods of high wind.
- Do not install or handle the modules under adverse conditions (e.g.: wet or frosted roof surfaces)
- Do not install modules close to flammable gas
- Take care not to allow water to ingress into connectors
- Junction box cover must be closer or always sealed
- SOLVIS modules have been qualified for safety Class II according to IEC61730:2016
- Save these instructions for later reference in an easily reachable place.

2.2. Packing removal and temporary storage

- Modules must be stored in dry and ventilated spaces.
- Leave modules unpacked in their original packing until you are ready to install them.
- Two people should handle modules when removing them from packing and installing.
- Carry the modules with both hands
- Do not put weight on the modules.
- Do not remove any identification labels from the modules.
- If storing uninstalled modules outdoors for any period, always cover the modules and ensure that the glass faces down to stop water from collecting inside the module and on top of the glass

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.

3. Installation

3.1. General

Before installing and operating, this manual must be well understood.
The installation must be done according to local electrical and building codes.

3.2. Notes on Installation

A gap between PV module frame and installation object is necessary for cooling air circulation. Do not seal this gap. The recommended standoff height is minimum 10 cm (~4 inch).

3.3. Antireflective coating visuals

Do not touch glass with bare hands or gloves that can cause the effect of fingerprints, stains and smudges on the AR coating of the glass. These kinds of visual differences are responsibility of installer.

3.4. Module Mounting

SOLVIS Limited Warranty for PV Modules is contingent upon modules being mounted in accordance with the requirements described in this section.

3.4.1. Site Considerations

SOLVIS modules should be mounted in locations that meet the following requirements:

Operating Temperature: All SOLVIS modules must be mounted in environments that ensure operation within the following maximum and minimum operating temperatures:

Maximum Operating Temperature: + 70˚C
Minimum Operating Temperature: - 40˚C

Care should be taken to provide adequate ventilation behind the modules, especially in hot environments.

Design Strength: When mounting modules in snow prone or high wind environments, special care should be taken to mount the modules in a manner that provides sufficient design strength while meeting local code requirements.

Shading: Avoid installation in locations that are hard shading the modules. Such installation can lead to accelerated ageing of materials and thermal stress on bypass diodes. Modules are not meant to be used in areas that provide long time hard shading on part of a module.

Excluded Operating Environments: Certain operating environments are not recommended for specific SOLVIS modules and are excluded from the SOLVIS Limited Warranty for these modules.

Maximum altitude: All SOLVIS PV modules should be installed at altitude less than or equal to 2000 m.

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.

3.4.2. Mounting Configurations

Modules may be mounted at any angle from horizontal to vertical with exclusions mentioned in this manual. Select the appropriate orientation to maximize sunlight exposure. Specific information on module dimensions and the location of mounting and grounding holes is provided below (Figure 2). All SOLVIS PV modules should be mounted at a minimum tilt angle of 6° with respect to the horizon. For tilts less than 6°, please contact the manufacturer.

In order to prevent water from entering the junction box, which could present a safety hazard, modules should not be mounted in the manner that the front/top glass faces downward (e.g. on a tracking structure that positions the module with the junction box facing skyward during sleep mode).

Clearance between the module frames and structure or ground is required to prevent wiring damage and allow air to circulate behind the module.

When installed on a roof, the module shall be mounted over a fire-resistant roof covering rated for the application. A safe working area also must be left between the edge of the roof and the external edge of the solar array.

The module is only IEC listed for use when its factory frame is fully intact. Do not remove or alter the module frame. Creating additional mounting holes may damage the module and reduce the strength of the frame.

Modules may be mounted using the following methods only:

1) **Frame Holes:** Secure the module to the structure using the factory mounting holes. Four M6 or M8 (depending on module) stainless steel bolts, with nuts washers, and lock washers are recommended per module (*Figure 1.*). Position of mounting holes are specified in the datasheet of each module type. Before mounting, please check the relevant datasheet.

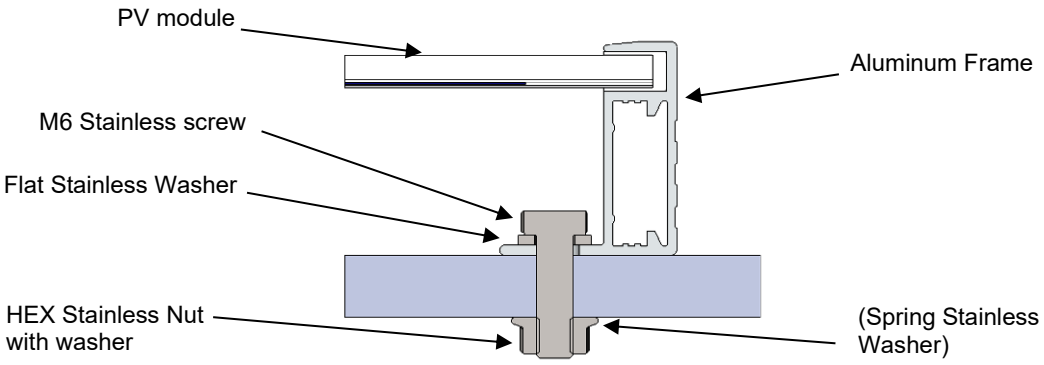


Figure 1. Screw fitting (for illustration only)

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.

2) **Pressure Clamps or Clips:** Mount the module with the clips on the side frame of the module. The side frames are attached to the longer or shorter sides of the module. Clamps should always hold the modules with their entire length, i.e. it is not allowed to mount the clamps at an angle or outside of module frame. Installers should ensure that the clamps are of sufficient strength to allow for the maximum design pressure of the module.
Clamp must overlap module frame minimum 6 mm (or as required to withstand designed loads depending on chosen profile), but not more than the frame width itself. Clamp should never come into contact with module glass or shade the glass. Clips and clamps are not provided by SOLVIS.

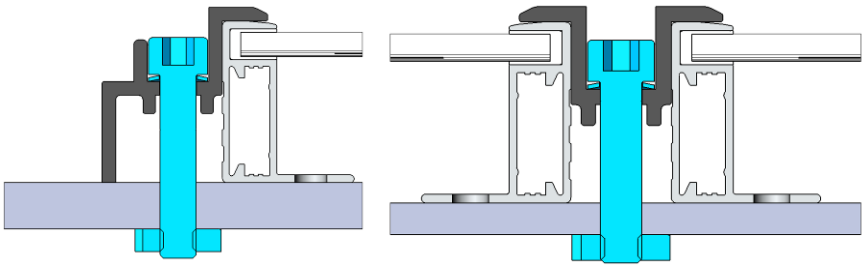


Figure 2. Clamp fitting (for illustration only)

3) **End Mount:** End mounting is the capture mounting of the length of the module's end frame to a supporting rail. The end frames can be on the shorter or on the longer sides of the module. Modules should not slide off the end mount and distance between modules must be secured.
Mounting profile must overlap module frame minimum 6 mm (or as required to withstand designed loads depending on chosen profile), but not more than the frame width itself. Mounting profile should never come into contact with module glass or shade the glass.

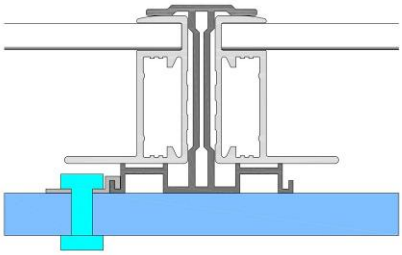


Figure 3. Mounting of the modules using end mounts (for illustration only)

For all three mounting methods the torque used for tightening should be used as specified by supplier of fastening system, but generally torque values would be around:

- M6 → ~ 5-9 Nm
- M8 → ~ 15-18 Nm

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.

3.4.3. Permissible loads on the module

PV modules can be mounted by fixing for the long or short side of the module. Allowed load on the module depends on the position of the fixing point. The declared mechanical loads on datasheets are valid in case the module is fixed at recommended positions and if the installation is representative compared to testing protocol within IEC 61215 and 61730 standards.

3.4.3.1 4 fixing points

The position of the fixing point is defined as a distance from the edge of the module. Point in the middle of the mounting clamp is considered as a fixing point. A chart with values of allowed loads depending on the position of fixing point can be seen in figure 4.

Solvis always recommends setting fixing point at **distance from L/5 to L/4 with respect to the long module side where L is length of the longer side of the module.**

	Module dimensions [mm]			Distance from edge of the module [mm]	Design load (maximum load) (downward / upward) [Pa]
PV module group	L	W	H	S=L/5 to L/4	
SV132 E HCG12R	2382	1134	35/30	476 - 595	Down 1600 (2400) Up 1600 (2400)
SV108 E HCG12R	1961	1134	35/30	392 - 490	Down 1600 (2400) Up 1600 (2400)
SV96 E HCG12R	1762	1134	30	352 - 440	Down 3600 (5400) Up 1600 (2400)

Table 1. Optimal fixing point distance from the edge

In this table the design load is stated. To calculate maximum short time test load safety factor or 1,5 is used (e.g. design load 1600 Pa is 1600 Pa * 1,5 = 2400 Pa maximum test load).

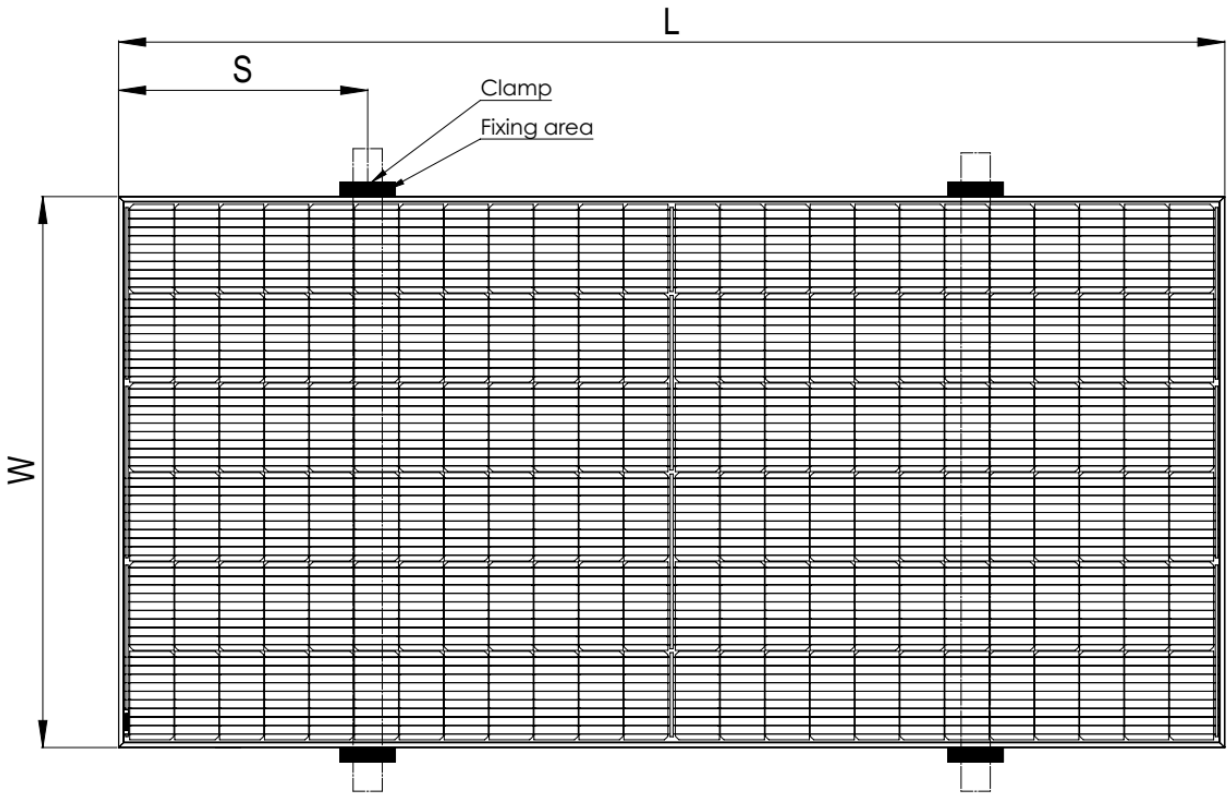


Figure 4. Example of optimal fixing area

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.

Other permissible design and maximum test loads depending on mounting system design are given in table below.

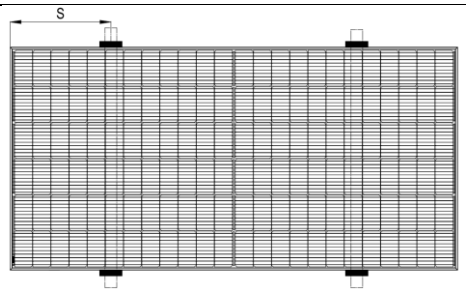
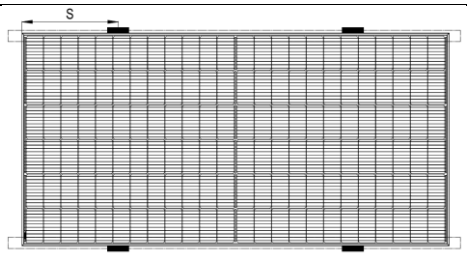
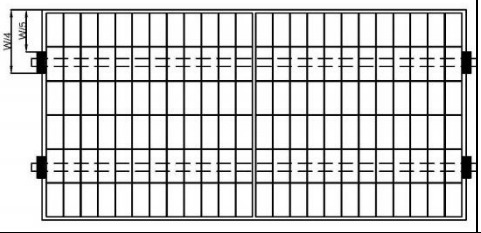
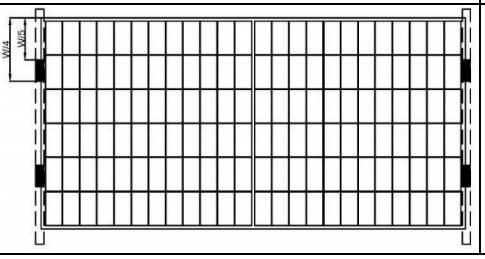
	Installation type	Distance	Product group	SV132 HCG12R	SV108 HCG12R	SV96 HCG12R
			Load type	Design load (max. test load) [Pa]		
Long side - 4 fixing points (at recommended positions or using mounting		210 < S < 391 & 491< S < 570	*Down-ward*	-	1600 (2400)	-
			Upward	-	1067 (1600)	-
		190 < S < 351 & 441 < S < 540	*Down-ward*	-	-	1734 (2600)
			Upward	-	-	1200 (1800)
		(1/5L-50) < S < (1/5L+50)	*Down-ward*	2400 (3600)	2400 (3600)	2400 (3600)
			Upward	1600 (2400)	1600 (2400)	1600 (2400)
Short side - 4 fixing points		(1/4W-50) < H < (1/4W+50)	*Down-ward*	Not allowed	700 (1050)	1067 (1600)
			Upward	Not allowed	700 (1050)	1067 (1600)
		(1/4W-50) < H < (1/4W+50)	*Down-ward*	Not allowed	700 (1050)	1067 (1600)
			Upward	Not allowed	700 (1050)	1067 (1600)

Table 2. Permissible loads – design and maximum tested load

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.

3.4.3.2 6 fixing points[1]

The position of the fixing point is defined as a distance from the edge of the module. Point in the middle of the mounting clamp is considered as a fixing point. A chart with values of allowed loads depending on the position of fixing point can be seen in figure 5.

Solvis always recommends setting fixing point at **distance from L/6 and L/2 with respect to the long module side where L is length of the longer side of the module.**

	Module dimensions [mm]			Distance from edge of the module [mm]		Design load (maximum load) (downward / upward) [Pa]
PV module group	L	W	H	L/6 ± 50	L/2 ±50	
SV132 E HCG12R	2382	1134	35/30	347 - 447	1141 - 1241	Down 3600 (5400) Up 1600 (2400)
SV108 E HCG12R	1961	1134	35/30	276 - 376	930 - 1030	Down 3600 (5400) Up 1600 (2400)
SV96 E HCG12R	1762	1134	30	243 - 343	831 - 931	Down 3600 (5400) Up 1600 (2400)

Table 3. Optimal fixing point distance from the edge

In this table the design load is stated. To calculate maximum short time test load safety factor or 1,5 is used (e.g. design load 1600 Pa is 1600 Pa * 1,5 = 2400 Pa maximum test load).

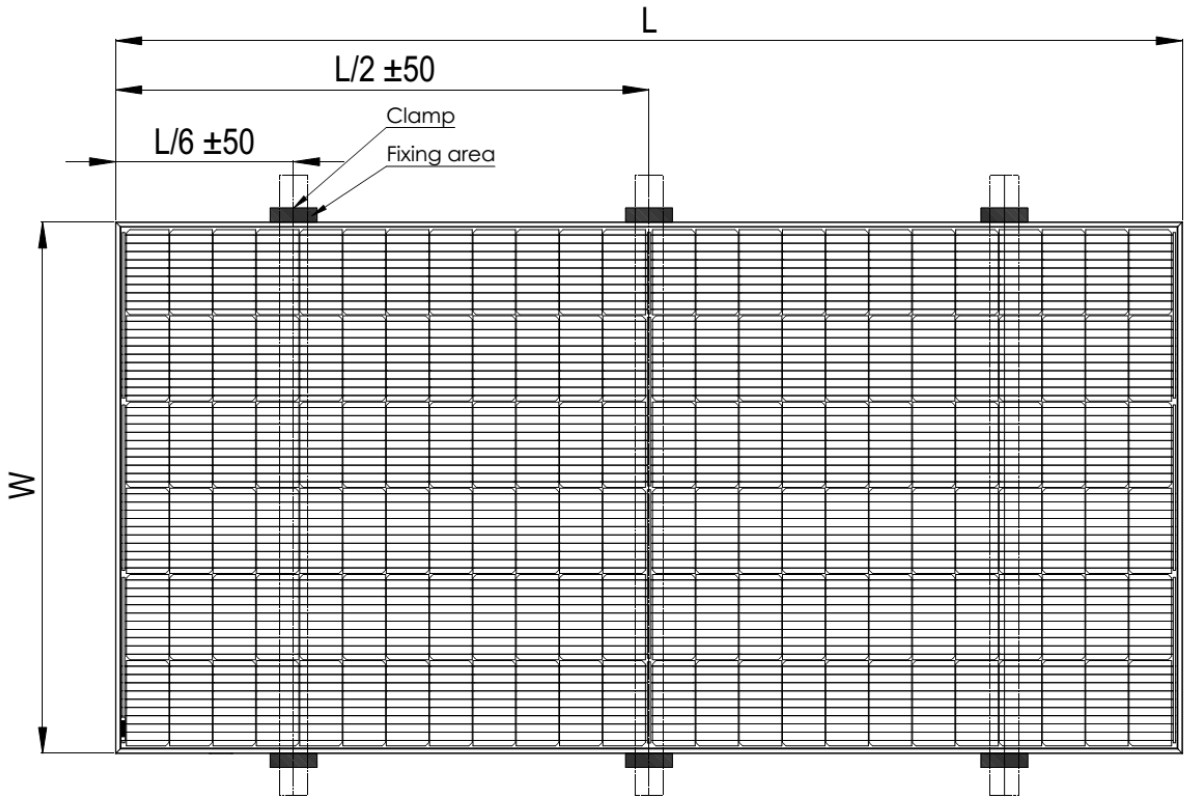


Figure 5. Example of optimal fixing area

**In case of special mounting conditions and loads for certain locations, please consult the manufacturer*
**Manufacturers hold the right to change module dimensions without prior announcement, please use the most recent version of this document from manufacturer website*

[1] *Manufacturer approved*

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.

3.5. Overcurrent protection device

When the potential reverse current of a PV string exceeds the rated SOLVIS PV module series fuse rating (values indicated at the module datasheet) an overcurrent protection device must be used (IEC 61730-1 clause 12.3). An overcurrent protection device is required for each series string if more than two series are connected in parallel. In this case, it is needed to use one fuse per string rated at 1.56 x Isc or higher (Isc is the PV module's short circuit current at STC). A PV fuse on each PV string will protect the PV modules and conductors from overcurrent faults and help minimize any safety hazards. The PV fuse will also isolate the faulted PV string so the balance of the PV system can continue to generate electricity.

Select the next higher standard rating at the catalogue of available PV Fuses. Using PV fuses in both positive and negative conductors is recommended.

3.6. Bypass diodes

The PV module's junction box contains 3 bypass diodes (one in each part of split junction box; Schottky type) connected in parallel with the PV cell strings. In the case of partial shading (hot-spot effect), the diodes bypass the current generated by the non-shaded cells, thereby limiting module heating and performance losses.

Bypass diodes are not overcurrent protection devices. Bypass diodes divert current from the cell strings in the event of partial shading.

The characteristics of diodes located in split junction box:

- Voltage rating – 45 V
- Current rating – 50 A

3.7. General Wiring

SOLVIS recommends that all wirings be double insulated with a minimum rating of 1.8 kV and 90 ˚C. All wiring should use flexible copper (Cu) conductors. Minimum size should be determined by the applicable codes. Size less than 4 mm^2 is not recommended. The insulation type should be appropriate for the type of installation method used and must meet IEC 61730-1 and Safety Class II requirements.

Solvis recommends installers use only sunlight resistant cables qualified for direct current (DC) wiring in PV systems. Cables should be fixed to the mounting structure in such a way that mechanical damage of the cable and/or the module is avoided. Do not apply stress to cables. For fixing, use appropriate means, such as sunlight resistant cable ties and/or wire management clips. While the cables are sunlight resistant and waterproof, where possible, avoid direct sunlight exposure and water immersion of the cables.

To achieve the desired electrical output PV modules can be connected in series and/or parallel as long as certain conditions are met.

When wiring, take care that the minimum bending radius of cables should be at least 5 x cable diameter.

Wiring of PV modules must satisfy the following rules:

- Use only the same type of modules in combined source circuit.
- Maximum system voltage (datasheet) must not be exceeded.

Complete wiring must be done by qualified personnel according to safety measures given in chapter 2.1..

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.

3.7.1. Series Connection

Modules may be wired in series to produce the desired voltage output. The maximum number of modules connected in series is calculated by following expression:

$$U_{\max(DC)} = n_{PVmodule} \cdot U_{OC} \cdot (1 + \Delta_T \cdot K); \quad \Delta_T = T_{low} - T_{STC}$$

$U_{max(DC)}$ - maximum system voltage (dataseheet)
$n_{PVmodule}$ - number of modules which are connected in series
U_{OC} - open circuit voltage (datasheet)
T_{low} - lowest temperature expected at site location [K]
T_{STC} - temperature at STC (Standard Test Conditions) 25 °C (298,15 K)
K - temperature coefficient of V_{OC} [%/K] (datasheet)

Overcurrent protection rating is calculated by module Isc*1,56 (I_{SC} - short circuit current, datasheet).

3.7.2. Parallel Connection

Modules may be combined in parallel to produce the desired current output. The maximum number of modules in parallel connection depends on the inverter's capacity and can be calculated by formula Fuse rating[A]/Isc[A]. Every series of string or module must be fused prior to combining with other strings. Bypass diodes are factory installed in the modules. Please refer to the applicable regional and local codes and inverter producers for additional fusing requirements and limitations on the maximum number of modules in parallel.

3.7.3. Connectors

Modules from SOLVIS PV family are delivered to the market with MC4 compatible connectors. Connector types are specified in the datasheet of each module type. Keep PV connectors dry and clean and ensure that connector caps are hand tight before connecting the modules. Do not attempt making an electrical connection with wet, soiled, or otherwise faulty connectors. Avoid sunlight exposure and water immersion of the connectors. Avoid connectors resting on the ground or roof surface. Do not disconnect under load. Faulty connections can result in arcs and electrical shock. Check that all electrical connections are securely fastened. Make sure that all locking connectors are fully engaged and locked.

Do not connect different brand connectors for the same installation. In case of compatibility concerns, check with your supplier.

3.7.4. Grounding

All module frames and mounting racks must be properly grounded in accordance with appropriate respective national electrical code. If required, proper grounding is achieved by bonding the module frames and all metallic structural members together continuously using a suitable grounding conductor. Grounding conductor or strap may be copper, copper alloy, or other material acceptable for use as an electrical conductor per respective National Electrical Codes. The grounding conductor must then make a connection to earth using a suitable earth ground electrode.

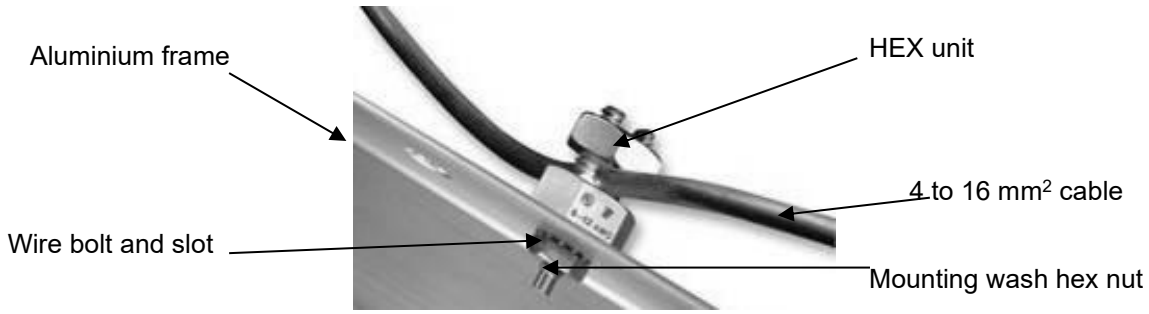


Figure 6. Module frame grounding

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.

To ensure optimal performance of SOLVIS modules in combination with galvanically isolated inverters, it is recommended to ground negative (-) polarity of the PV array. While using modules in combination with transformerless inverter, both poles of the PV array (positive (+) and negative (-)) must remain ungrounded, unless specifically allowed by inverter manufacturer.

3.7.5. Fire safety

The modules passed UL 790 class C fire tests, the slope of tested module is 5 inches (127 mm) to the horizontal foot (0.3m), which is the most severe condition. For roof-top installations, the roof must be covered with at least one layer of fireproof material suitable for the fireproof class of the PV modules. To facilitate ventilation and heat dissipation of the module, the minimum distance between modules and roof must be ≥ 10 cm. Please use appropriate module components to comply with local laws and regulations, as well as the building fire safety requirements before installation, such as fuses, circuit breakers and grounding connectors, etc.

4. Maintenance

Inspect all modules annually for safe electrical connections, sound mechanical connection and freedom from corrosion. Glasses of PV modules can be washed with plenty of clean water and soft paper towels, soft brushes, soft cloths or tissues. Once cleaned, the glass should be rinsed with clean water and carefully wiped with a soft cloth.

Before washing the glass with AR coating make sure to remove all residues and particles that could scratch the surface of the glass (grains of sand, glass splinters, iron oxides, etc…)

Make sure that cloths, brushes and other tools are clean and in good conditions at all times during cleaning. Abrasive powders, razor blades, scrub sponges and pads must not be used on solar glasses.

Use of such materials will invalidate the product warranty. Modules that are mounted flat (0° tilt angle) should be cleaned more often, as they will not self-clean as effectively as modules mounted at a 15° tilt or greater. We recommend that PV modules are mounted at a minimum tilt angle of 6° with respect to the horizon, in order to facilitate the self-cleaning of their front glass from dirt during ordinary rain.

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.

5. Specifications

Module electrical ratings are measured under Standard Test Conditions (STC) of 1000 W/m^2 irradiance with AM 1.5 spectrum and cell temperature of 25 ˚C. Electrical characteristics for specific SOLVIS PV modules are located on the product label and product datasheet.

Temperature coefficients for voltage at open-circuit, maximum power and short-circuit current are same for all SOLVIS PV modules and they are given in datasheet of each module type. All other PV module electrical and technical data, users may find in latest datasheet.

Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Sunny and cool weather and reflection from snow or water can increase current and power output. Accordingly, the values of voltage should be multiplied by factor 1,25 and values of current by factor 1,56 when determining component voltage ratings, conductor current ratings, fuse sizes, and size of controls connected to the PV output.

List of applicable series of solar modules:

SV132-XXX E	(YYY)	HCG12R
SV108-XXX E	(YYY)	HCG12R
SV96-XXX E	(YYY)	HCG12R

*YYY – optional suffix
The YYY suffix can be:

- F – black frame and white backsheet
- BC – black frame and black backsheet

Without YYY suffix – silver frame and white backsheet

6. Contact information

SOLVIS d.o.o.

Address: Ulica Vesne Parun 15, 42 000 Varaždin, Croatia
Telephone: +385 42 262 250
Fax: +385 42 241 100
E-mail: info@solvis.hr

SOLVIS is a trademark of SOLVIS d.o.o. Varaždin, Croatia.
The content of this manual may be changed without prior notice.