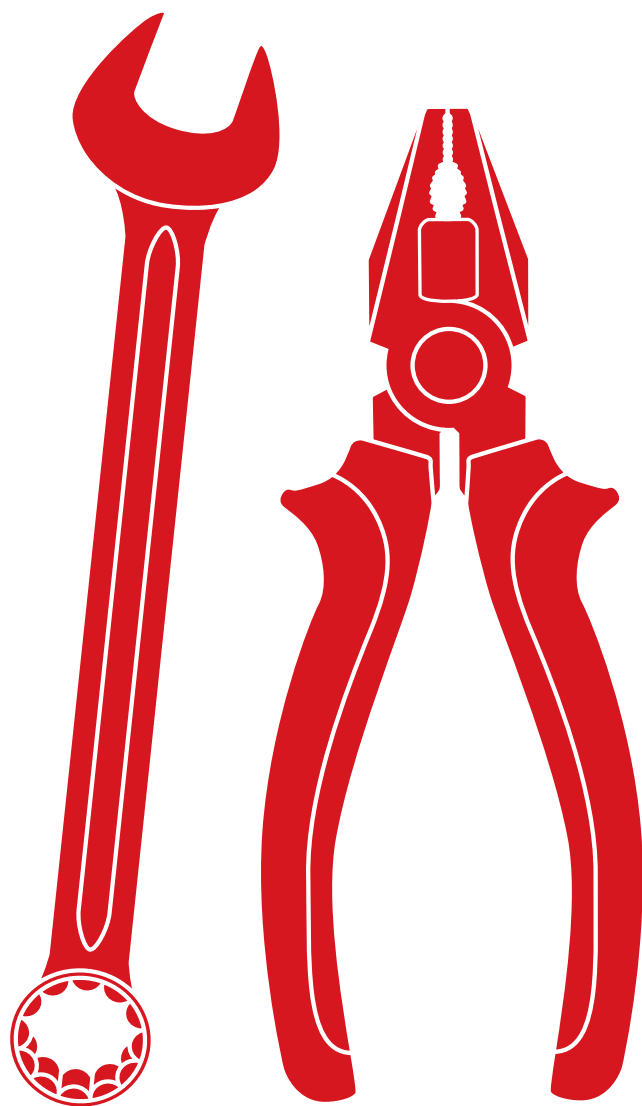


INSTALLATION AND OPERATION MANUAL

Solibro Solar Modules SL2 and SL2-F
from the Generation 1.5



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DOCUMENTREVISION 6

This document is valid from July 2014 for the following product ranges:
SL2 and SL2-F solar modules from the product generation G1.5.

Changes to the technical parameters and design reserved. The data sheets and customer information current at the point in time at which the relevant module was manufactured apply for the carrying out of installation, mounting or maintenance work on the solar modules.

1 INTRODUCTION

Solar modules from Solibro GmbH (referred to below as Solibro) allow you to directly transform the unlimited energy provided by the sun into environmentally friendly electrical energy. To ensure that you can use the full potential of the Solibro solar modules, read the following manual carefully and follow the instructions. Failure to follow the instructions in this manual will make the warranty null and void and can result in injuries and material damage. This installation manual outlines the process for installing CIGS solar modules safely.

- Read this installation manual carefully before carrying out the installation.
- Retain the installation manual for the usage life of the solar modules.
- Ensure that the operator has access to the installation manual at all times.
- Pass the installation manual on to each subsequent owner or user of the solar modules.
- Add any additions received from the manufacturer.
- Comply with any applicable documents.

INTENDED USE

These instructions provide information concerning safety in dealing with the CIGS quality solar module from Solibro GmbH, as well as instructions for installation, mounting, wiring and maintenance.

The manual is valid for SOLIBRO solar modules:

- SL2
- SL2-F

from the generation 1.5.

SYMBOLS AND LABELS

Symbols and labels are used in this installation manual to make the instructions quick and easy to understand.

SYMBOLS	DESCRIPTION
→	Action with one step or with multiple steps.
▪	List
✓	Ensure when carrying out an action, check the result of an action.
⊘	Action is not permitted.

SAFETY REGULATIONS

The operator of the solar module is responsible for ensuring that all relevant legal regulations and directives are complied with.

- Solar modules should only be commissioned, operated and maintained in accordance with the following regulations and standards:
 - Installation and assembly manual.
 - Applicable documents (country-specific regulations on pressure equipment, operational safety, hazardous material and environmental protection).
 - Plant-specific regulations and requirements.

- Valid country-specific laws, regulations and requirements for planning, installation and operation of solar power plants and working on the roof.
- Valid international, national and regional regulations, in particular regarding the installation of electrical equipment and systems, on working with direct current and regulations of the responsible energy supply company regarding parallel operation of solar power plants.
- Accident prevention regulations.
- Regulations of the Bau-Berufsgenossenschaft (employers' liability insurance association) (e.g. use of insulated and dry tools).
- Never use light concentrators (e.g. lenses) to increase the output of the module. The module may be damaged as a result.

PERSONNEL QUALIFICATIONS

The operator and installer are responsible for ensuring that the installation, maintenance, repair and dismantling work is only carried out by trained specialists.

VALIDITY

This manual only applies for solar modules from Solibro GmbH. Solibro assumes no liability for damage resulting from failure to observe these instructions.

- Note the wiring and dimensioning of the system.
- The observance of all necessary safety regulations when laying out and installing the system are the responsibility of the installer of the system.

This manual does not form a legal responsibility on the part of Solibro. Solibro only accepts liability within the realms of the contractual agreements or in the context of accepted guarantees. Solibro accepts no responsibility beyond the correct function and safety of the modules.

- The manuals for the other system components must also be complied with.
- If your questions are not answered in sufficient detail in this manual, please contact your system supplier or our Product Service in the first instance.

Further information is available on our website www.solibro-solar.com

APPLICABLE DOCUMENTS

This installation manual is only valid in conjunction with the following technical information.

DOCUMENT TYPE
Product data sheet
Approved clamps list
Warranty terms and conditions
Packaging and transport of CIGS modules

2 PLANNING

2.2 REQUIREMENTS

Installation location

Comply with the following notes on the installation location:

- The modules are tested in accordance with IEC 61646, 61730 and UL 1703 for safe use in a moderate climate.
- Modules are not explosion-proof devices.
- Do not operate the modules near highly flammable gases and vapours (e.g. gas containers, petrol stations).
- Do not subject the modules to severe chemical stresses.
- Do not position the modules in standing water.
- The junction box only has splash protection (IP 65).
- Do not install the modules in closed rooms.
- Do not install the modules in places where backwater can form.
- The modules are not suitable for mobile use.
- Roof-integrated installation (BIPV) is not permitted.

Limitations

The modules are designed for the following applications:

- Operating temperatures of $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $+185\text{ }^{\circ}\text{F}$).
- Wind and snow loads up to max. 2400 Pa (in accordance with test according to IEC 61646).

Requirements on the mounting frame

The mounting frame:

- fulfils the required static.
- fulfils the local snow and wind loads.
- enables correct fixing in the ground, on the roof or on the façade.
- transfers forces applied on the module to the substructure.
- ensures sufficient back ventilation of the module.
- in combination with a suitable clamp, enables stress-free, temperature-dependent expansion and contraction of the module and the substructure.
- has electrochemical properties, which prevent corrosion between different metals.
- The clamps and rail system must be compatible.
- Ensure that no mechanical stresses (e.g. due to vibrations, rotations or expansions) are generated on the module.

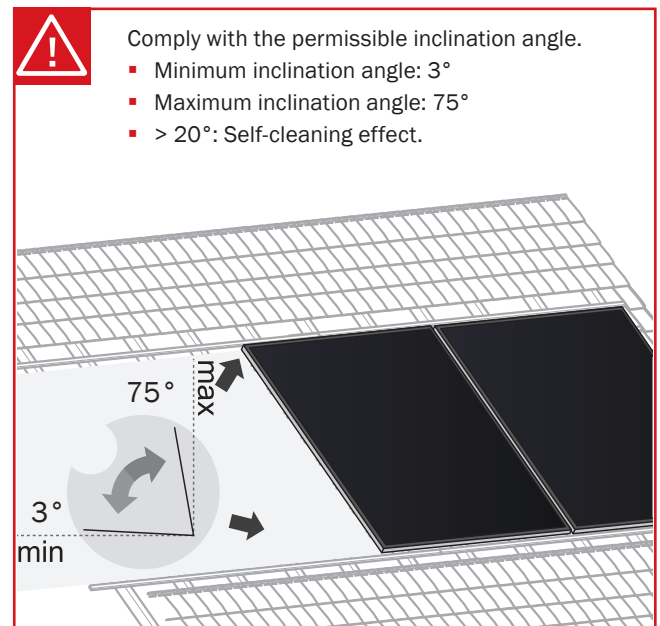
NOTE!

Ensure that the substructure is de-energized / is on ground potential ($R \leq 10\text{ Ohm}$).

- For further notes, see Chapter 3

Requirements on the module orientation

- Installation in landscape or portrait possible.
- Installation with the junction box in the top section of the module. The connection cables hang down.
- The optimal inclination angle of the module depends on the latitude.
- Do not seal up the drainage openings.
- Ensure that rainwater and snowmelt can run off freely. No backwater formation.



Fire Protection

Observe regulations and safety instructions for the fire protection classification for rooftop installations. The module is rated to fire protection class C. The fire rating of this module is valid only when mounted in the manner specified in the mechanical mounting instructions. To maintain this rating, the module assembly is to be mounted over a fire-resistant roof covering specified for the application.

2 PLANNING

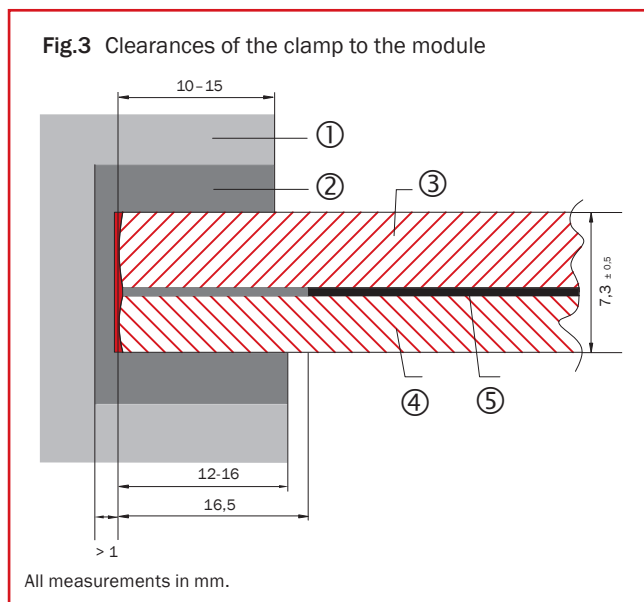
Requirements on the clamping system for unframed modules

Only clamp systems approved by Solibro may be installed. The list of all approved clamps is available at www.solibro-solar.com.

On request, Solibro will test clamp systems and approve them following successful testing.

- Clamps made from metal must not be connected directly with the glass.
- Use a suitable silicone oil free rubber mat between the module and substructure or clamp.
- Ensure that the rubber mat is in place completely and does not slip.
- Clamp width: ≥ 120 mm.
- Adapt the clamp height to the module thickness.
- Clamps must not throw a shadow on the active cells.
 - Distance from the glass edge to the first active cell amounts to 16.5 mm (Fig. 3).
- Comply with the glass inset (Fig. 3):
 - 10–15 mm on the top side of the module
 - 12–16 mm on the bottom side of the module
- Comply with the side clearance between the edge of the glass and the inner side of the clamps:
 - > 1 mm at 25 °C for thermal expansion of the module (Fig. 3)
 - Ensure that the screw connection does not apply any additional tension to the module. The modules must be positioned strainless, float-mounted.

- See applicable documents "Approved clamping systems"
- See Fig. 3 Clamping unframed module



- | | |
|---------------------------|------------------------------|
| ① Clamp (schematic) | ④ Glass (module bottom side) |
| ② Rubber | ⑤ Active surface |
| ③ Glass (module top side) | |

Requirements on the clamping system for framed modules

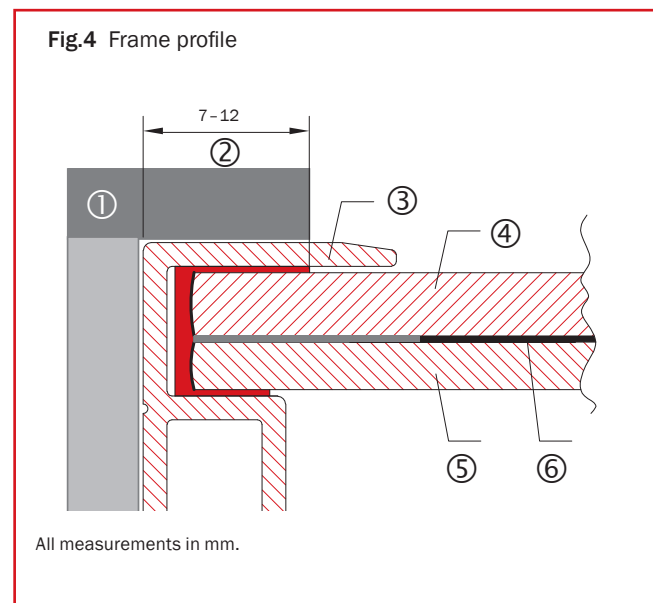
When using framed Solibro products, it is important to ensure that there is no potential difference between frame and ground. There are two options available for this:

Option 1: Usage of grounding clamps with grounding function specified in the approved Solibro clamps list.

Option 2: Potential equalization of the module must be done via one of the grounding holes on the module frame. Usage of market-based clamps is valid if they fulfil the following requirements:

- Clamp width: ≥ 100 mm.
- Clamp height corresponding to 30 mm frame height.
- Clamp depth: 7–12 mm.
- Clamps which fulfil the static requirements of the location.
- Clamps with long-term stability, which fix the module securely on the mounting frame.
- Clamps do not deform the frame.
- Minimum width middle clamp: ≥ 40 mm
- Minimum width end clamp: ≥ 35 mm

- See applicable documents "Approved clamping systems"
- See also information on potential equalization in Chap. 5.3



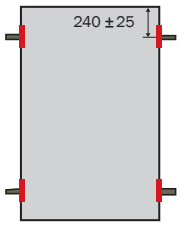
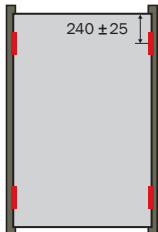


- | | |
|----------------|------------------------------|
| ① Clamp | ④ Glass (module top side) |
| ② Clamp depth | ⑤ Glass (module bottom side) |
| ③ Module frame | ⑥ Active surface |

2 PLANNING

2.3 MOUNTING OPTIONS

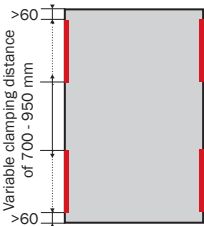
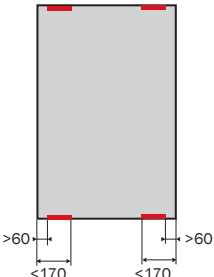

Approved clamp areas and mounting options for the solar modules (top view). Dimensions in mm. The specified dimensions refer to the clearance between the module edge and the middle of the clamp. The illustrated mounting variants apply for installation in portrait and landscape format.

Unframed modules

Clamping at long side, perpendicular to profile	Clamping at long side, longitudinal to profile
	
 Clamping area  Substructure	

The module can bend by up to 15 mm under maximum load. The glass must not contact the subconstruction. The listed mounting options are valid for point module mounting only.

Framed modules

Clamping at long side	Clamping at transverse side
	
 Clamping area	

The listed mounting variants are valid for point module mounting and linear module mounting. For the usage of an expanded clamping area a special release is required.

2 PLANNING

2.4 ELECTRICAL LAYOUT

Requirements on the system

You can find the detailed electrical parameters in the product data sheet.

- Only connect modules of the same type and the same power class.
- The voltage limitation of the inverter must also be taken into account in the layout of the string length.

Safety factor

During normal operation, the module may provide a greater current and/or a higher voltage than that determined under standardized test conditions. A safety factor of 1.25 for I_{sc} and V_{oc} should therefore be applied when:

- determining the voltage rated values of the components used,
 - determining the current rated values of the cables, the size of the fuses and dimensioning the controls.
- The relevant applicable national regulations for the installation of electrical systems should be applied.

Series connection

Serial connection of the modules is only permitted up to the maximum system voltage specified in the current valid data sheet.

- Carry out the layout taking into account all working conditions and relevant technical specifications and standards. This will help you ensure that the maximum system voltage, including the necessary safety margins, is not exceeded.
- Please note that the voltage of our CIGS solar modules can increase slightly after extended periods of solar radiation due to the light-soaking effect. A safety factor of +2.5 % must therefore be taken into account in the system layout for V_{oc} and V_{MPP} .

Parallel connection

- Only connect modules of the same type and power class.
- Do not exceed the maximum permissible reverse current as given in the respective data sheet. In the event of reverse currents (caused by module defects, ground leakage or shading), modules can be placed under strain.

In order to safely account for reverse currents, we recommend the following fuse variants:

Layout with limit on the number of strings operated in parallel

Without further measures for current limitation, only a maximum of 3 strings of modules may be operated parallel on an inverter.

Layout with string diodes

When more than 3 strings are connected parallel, a maximum of 3 strings respectively must be protected against reverse currents from the remaining system with a shared string diode.

Layout with string fuses

In this case, each string of modules must be protected with 5 A on the plus and minus side.

NOTE!

When installing modules from different product revisions, observe the minimum permitted reverse current loading capability.

Inverter

Framed Solibro modules (SL2-F) can be operated with any inverter where the negative generator pole must be grounded or its potential curve is always positive.

NOTE!

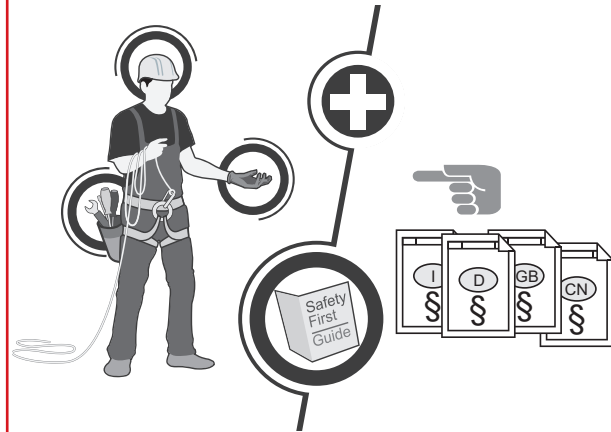
Further information is available in Chapter 5.1 Specifications for functional grounding.

3 INSTALLATION

3.1 SAFETY AND TRANSPORT

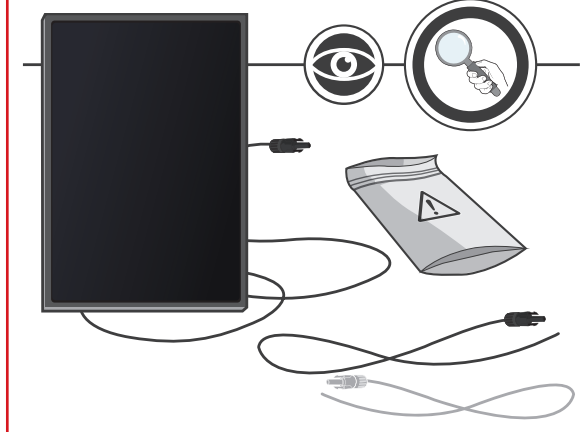


- Ensure that the personnel are familiar and comply with the accident prevention and safety regulations.

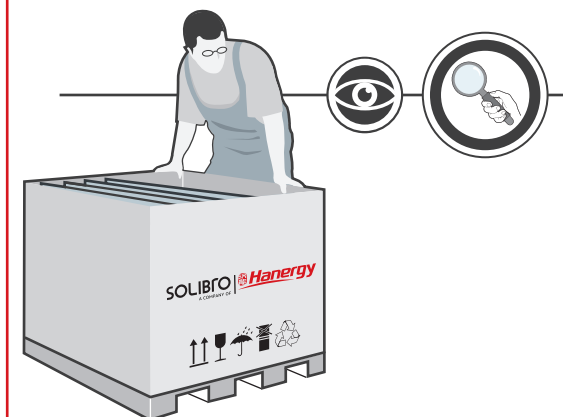


DANGER! Danger due to electric shock!

- Do not install damaged modules.
- Report any damage to your dealer immediately.

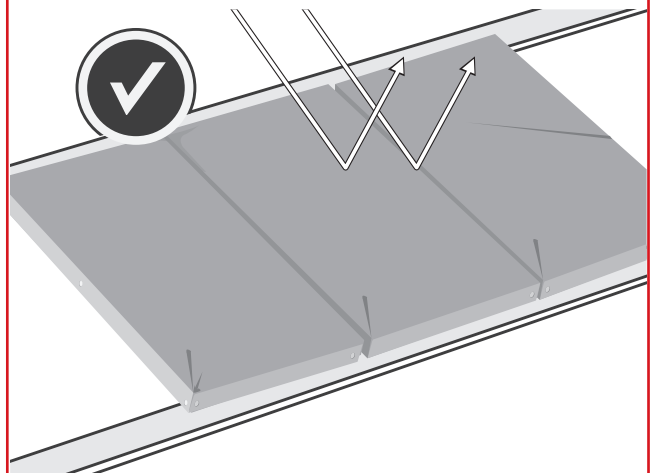


- Check the packaging for damage.
- If the packaging is damaged, contact the shipping company.
- Follow the packaging instructions.

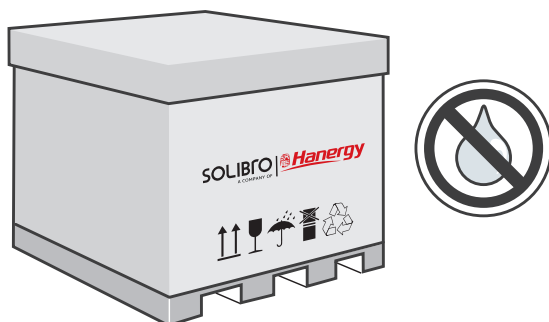


DANGER! Danger due to electric shock!

- Cover the modules with lightproof material for the duration of the installation.



- Leave the modules in the original packaging right up until installation.
- Store the modules securely in dry rooms. The packaging is not weatherproof!

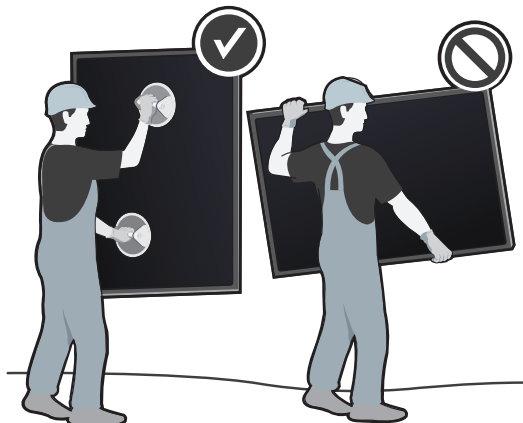


3 INSTALLATION



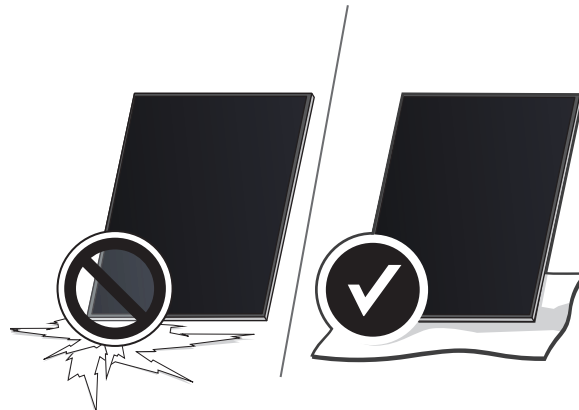
Note! Damage to the modules!

- Use glass suction cups to remove and transport modules.
- Carry the modules vertically.



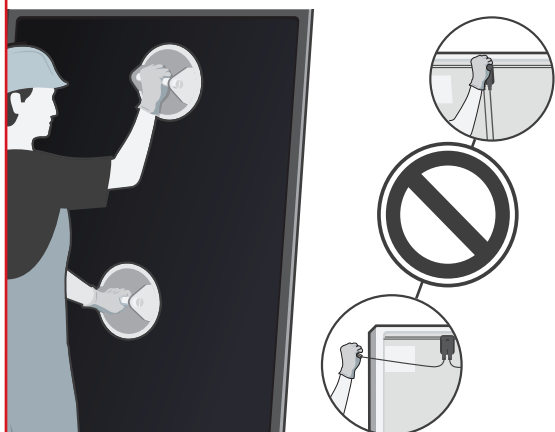
NOTE! Damage to the modules!

- Do not put unframed modules down on their edges without protection.



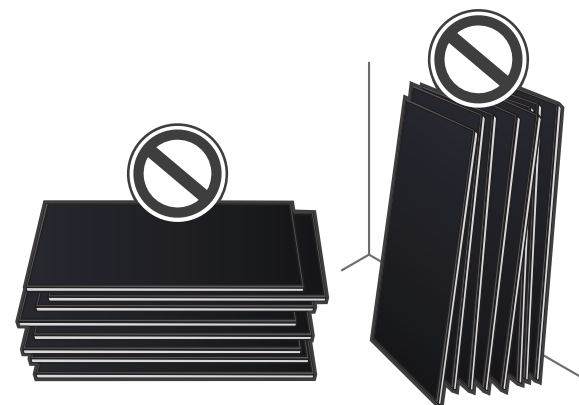
NOTE! Damage to the modules!

- Never lift or move the modules by the connection cables or the junction box.



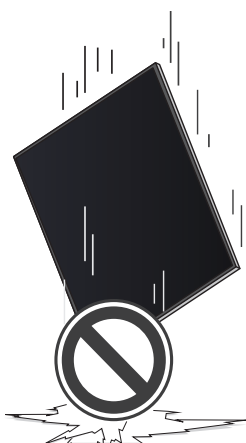
NOTE! Damage to the modules!

- Do not stack the modules.



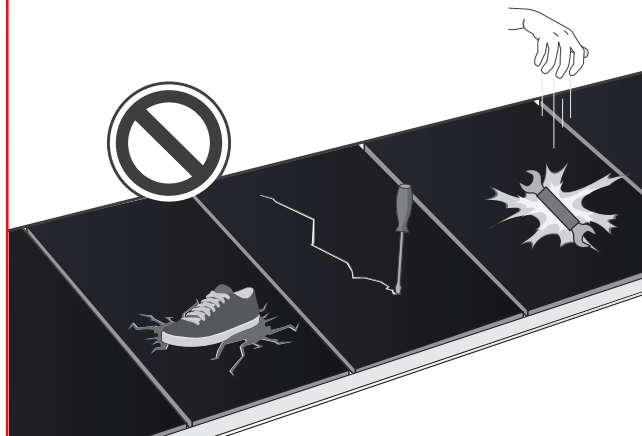
NOTE! Damage to the modules!

- Do not drop the modules.



NOTE! Damage to the modules!

- Never stand on the modules.
- Do not apply mechanical stress to the modules.
- Do not drop objects on the modules.



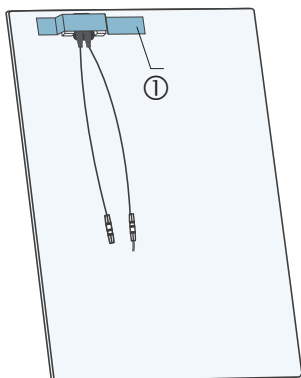
3 INSTALLATION

3.2 PREPARATION FOR INSTALLATION



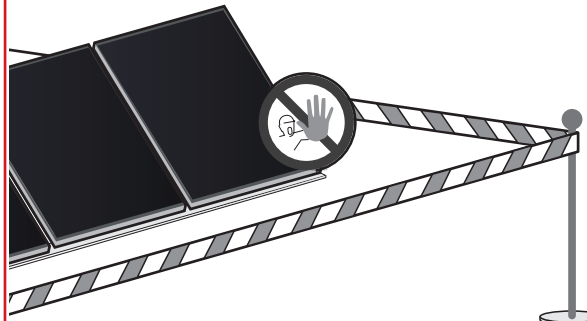
NOTE! Damage to the modules!

- The transport protection ① should not be removed until immediately before or after the installation (only applies for the unframed SL2 module)



DANGER! Danger due to electric shock!

- Cordon off the installation area.
- Keep children and unauthorised persons away from the solar system.

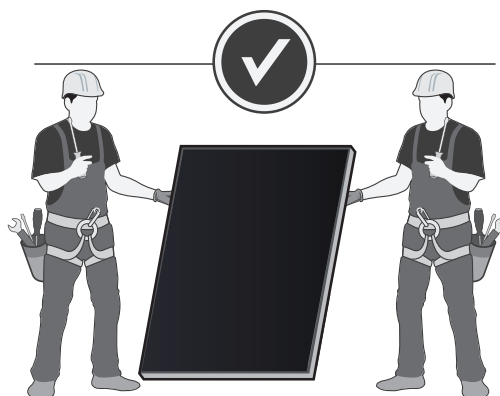


NOTE! Damage to the modules!

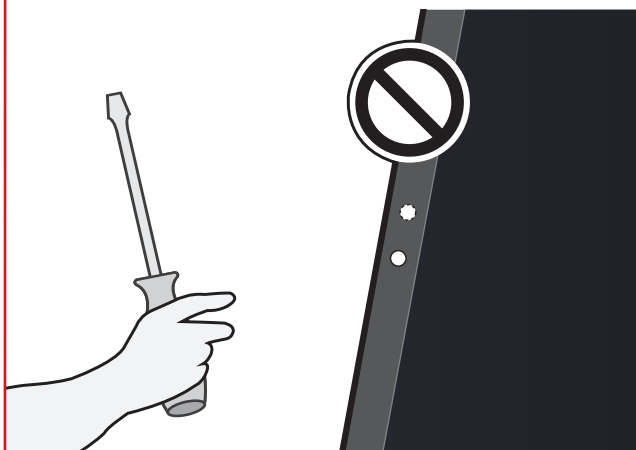
- Changes may only be made to the module, which have been approved by Solibro in writing.



- Do not carry out the installation alone.



- Only install modules and components which are free from damage.
- Do not add any holes.

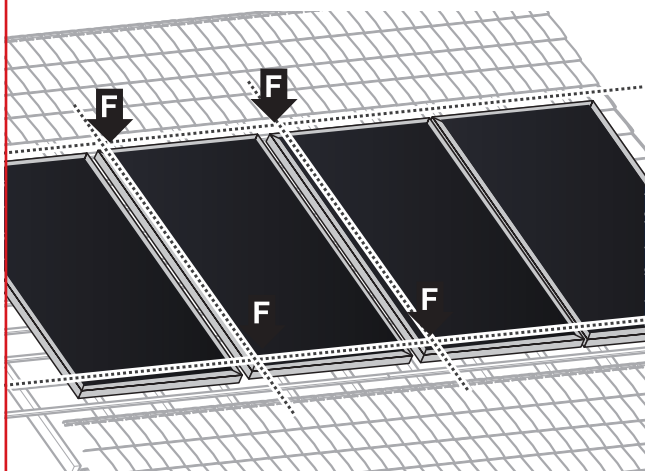


3 INSTALLATION

3.3 MODULE INSTALLATION

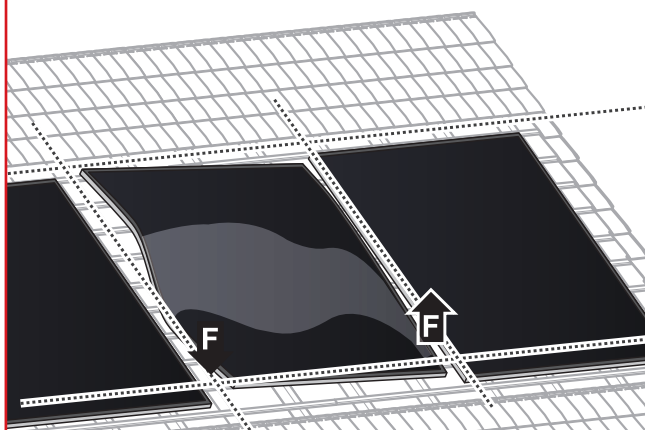


→ Position the modules plane.

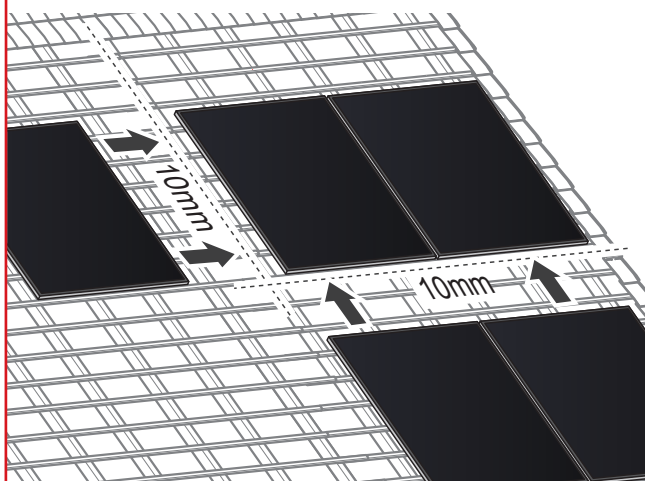


NOTE! Damage to the modules!

→ Do not apply any mechanical stress to the modules. Max. torsion 3 mm/m.



→ Keep a minimum distance of 10 mm between 2 modules.



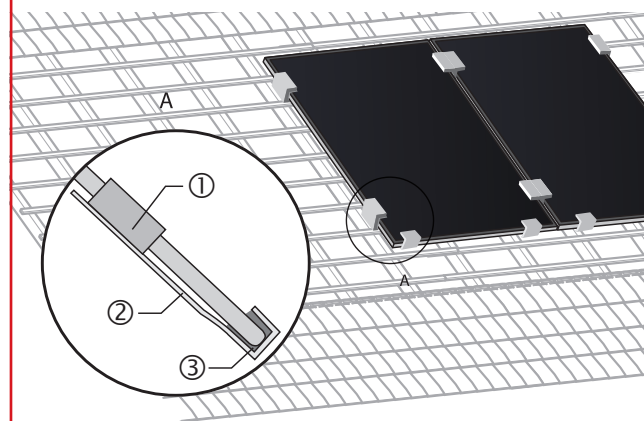
Installing unframed modules

- Please note the requirements on the clamping system outlined in Chapter 2.
- Use anti-slip protection or spacers on the modules. This is particularly important when installing the modules in portrait format.



→ Lay anti-slip protection between the module clamp and the substructure.

- ① Module clamp, ② anti-slip protection, ③ rubber



Installing framed modules

- Please note the requirements on the clamping system outlined in Chapter 2.
- Tighten the clamps with a torque of 18 Nm.

4 ELECTRICAL CONNECTION

4.1 SAFETY



DANGER!
Danger due to electric shock!

When disconnecting an electric circuit transporting direct current, electric arcs can occur that can result in life-threatening injuries.

- Do not disconnect the cable and plug while they are energised.
- Do not touch the poles at the same time.

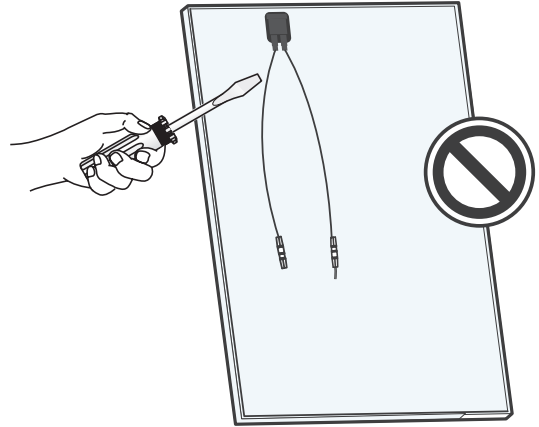
Even at a low illuminance level, a solar module generates electric current and voltage. Sparks and electric arcs can result from the separation of a closed circuit. This can result in fatal injury. The danger increases when several modules are connected in series.

- Note that, even with low levels of sunlight, the entire open circuit voltage can be applied.
- Comply with the valid regulations and safety instructions for the installation of electrical equipment and systems.
- Undertake the necessary protection and precautionary measures. In the case of module or phase voltages of more than 120 V, this is outside the extra-low voltage.
- Work on the inverter and on the cables may only be carried out by a qualified electrician.



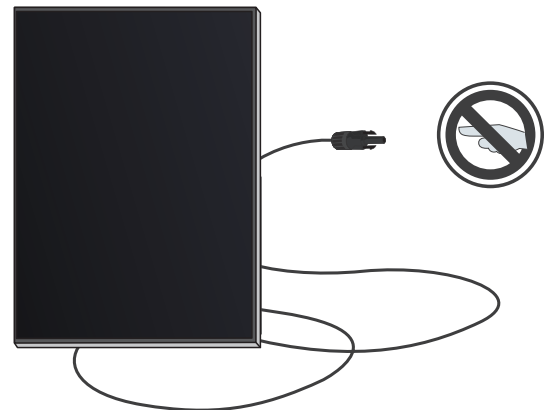
DANGER! Danger due to electric shock!

- Never open the junction box.
- Do not remove the bypass diodes.



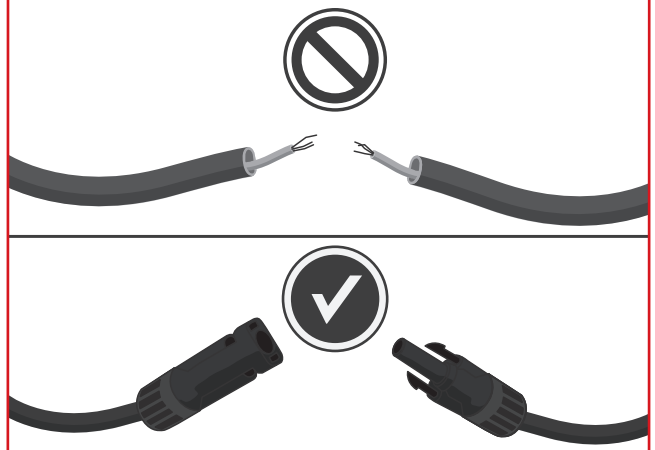
DANGER! Danger due to electric shock!

- Never touch live contacts with bare hands.
- Do not touch both poles at the same time.



DANGER! Danger due to electric shock!

- Insulate exposed cable ends.
- Only connect cables with plugs.



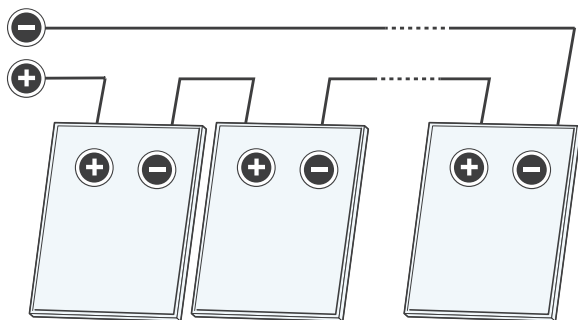
4 ELECTRICAL CONNECTION

4.2 SAFETY DURING ELECTRICAL INSTALLATION WORK



DANGER! Danger due to electric shock!

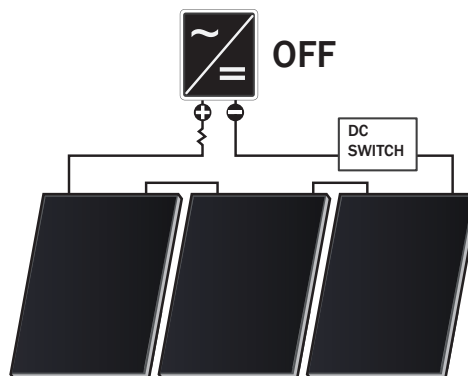
→ Ensure correct polarity.



DANGER! Danger due to electric shock!

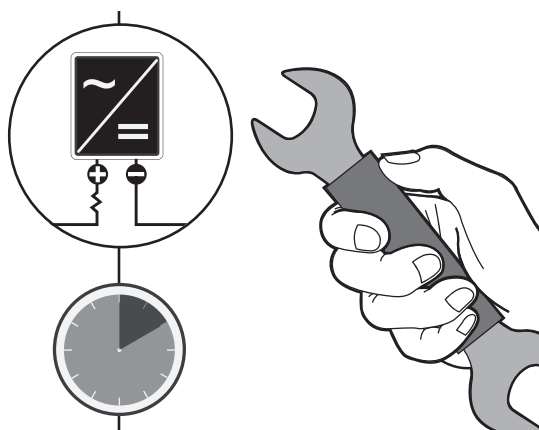
→ Never disconnect the plugs in energised state.

1. Switch off the inverter.
2. Keep the DC side free with isolators

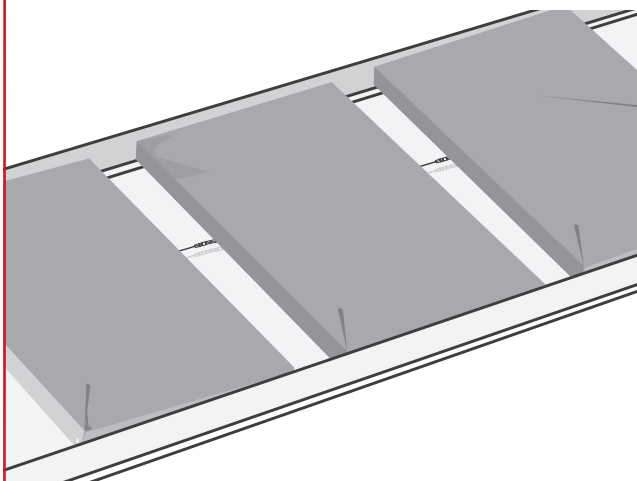


DANGER! Danger due to electric shock!

→ Always comply with the specified time intervals from switching off the inverter to starting further work.



3. Cover modules that need to be separated.

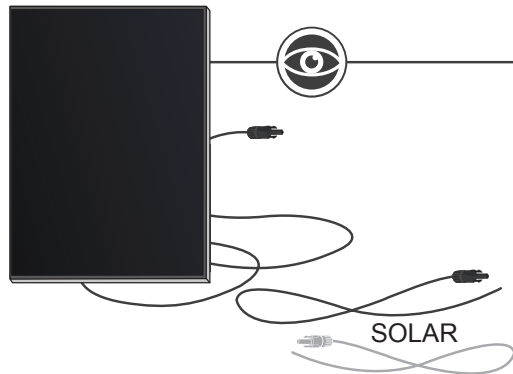


4 ELECTRICAL CONNECTION

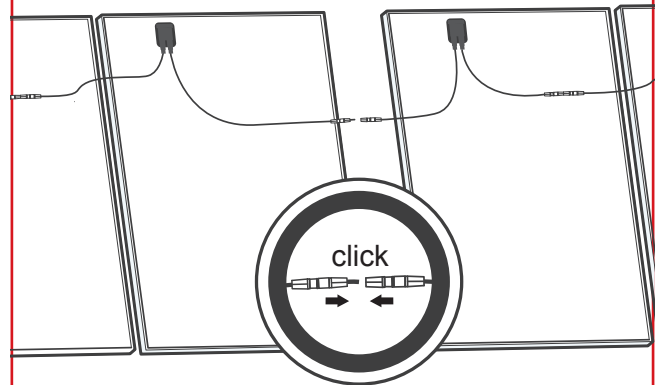
4.3 MODULE CONNECTION



- Use solar cables for the connection on the junction box outlet.
- Use matching plug systems, which are compatible with the inverter.

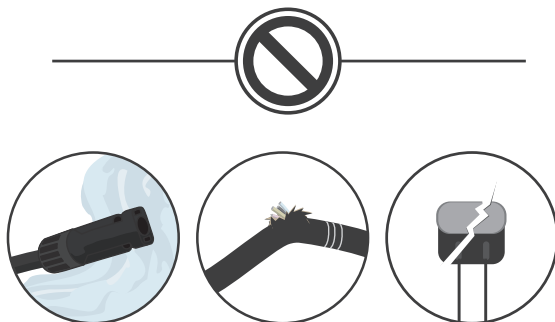


- Ensure that a secure connection is in place between the plugs. Plugs engage audibly.
- Do not apply mechanical stress to the cables. Comply with bending radius (min. 60 mm for cables on the junction box outlet).

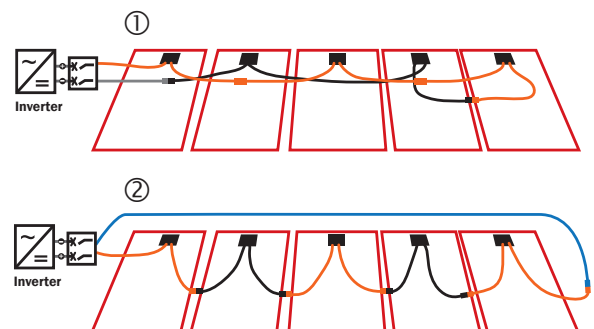


DANGER! Danger due to electric shock!

- Ensure that all electrical components are in a correct, dry and safe state.



- Modules with a cable length of 1210 mm can be cabled as a "2nd next neighbour".
 - ① "2nd next neighbour" cabling without return cable
 - ② Standard cabling with return cable



4 ELECTRICAL CONNECTION

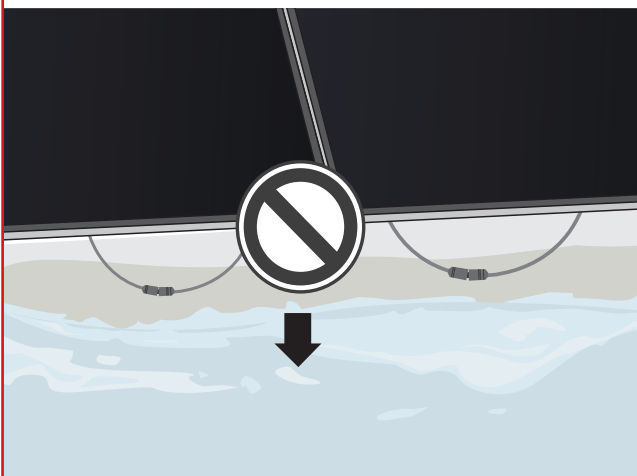
4.4 AFTER THE INSTALLATION



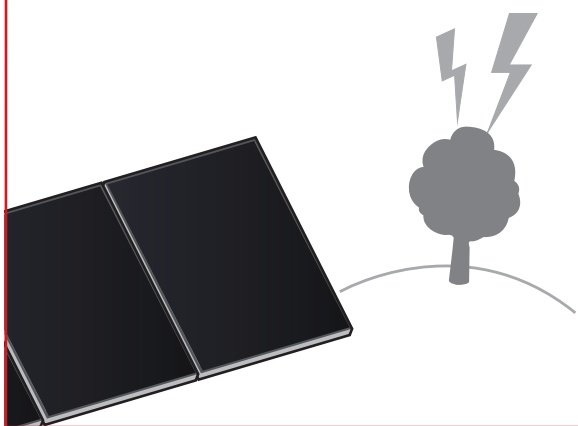
- Carry out all necessary safety and functional tests according to the current state of technology.



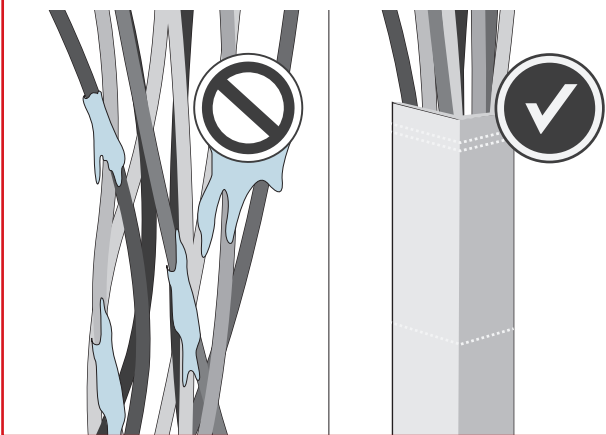
- Avoid having the connections on a level carrying water.



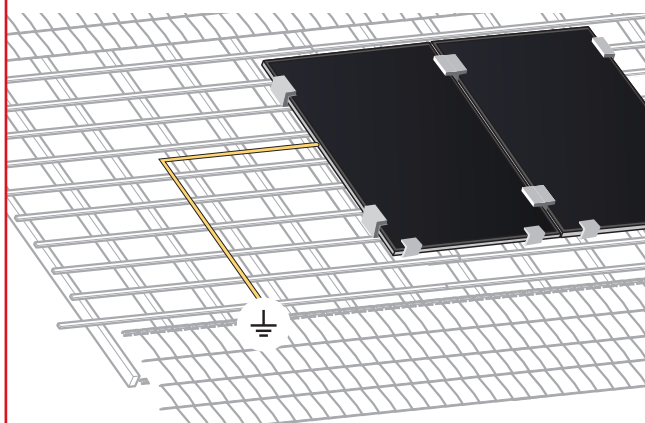
- Integrate the system in the existing lightning protection system according to the local regulations.



- Protect the cabling from dirt and wet.



- Ensure that the substructure is on ground potential ($R \leq 10 \text{ Ohm}$).



5 GROUNDING

5.1 SPECIFICATIONS FOR FUNCTIONAL GROUNDING

Solibro solar modules must always be protected against negative voltages on the generator poles!

- Always connect modules to systems with negative ground.
- Follow the usage instructions for negative generator pole grounding provided by the inverter manufacturer.
- Systems with centre grounding are not permitted.

Framed Solibro modules (SL2-F) can be operated with any inverter where the negative generator pole must be grounded or its potential curve is always positive.

When using an inverter with a transformer, always comply with the following specifications:

For fire protection reasons, the maximum permissible residual current in the event of a ground fault must not exceed 300 mA for roof-mounted systems. This does not affect the valid regulations for personal protection. The product-specific instructions in the following table must therefore be complied with. Also comply with the specifications of the relevant inverter manufacturer.

Modultyp	SL2 (unframed)		SL2-F (framed)	
General requirements	Negative generator pole grounding			
Type of grounding	Fuse	Resistor	Fuse	Resistor
Free field / utility	max. 2 A	–	max. 2 A	–
Roof-mounted / Residential and C&I	max. 300mA	≥ 35 kOhm ≤ 130 kOhm	max. 1 A	–
Maximum number of connected strings per inverter	∞	7*	∞	∞

* more strings on request, depending on type of installation

Please contact our Product Service to find an inverter suitable for your application.

5.2 FUNCTIONAL GROUNDING



WARNING!
Risk of fire due to incorrect grounding!

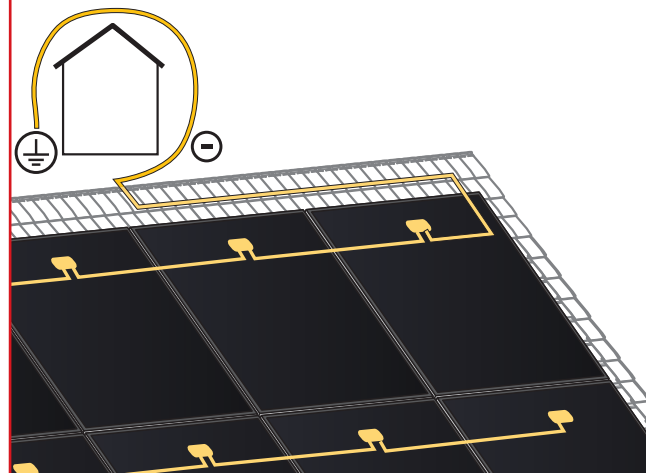
- Ensure that nobody is exposed to danger by the direct grounding.
- Comply with safety and fire protection regulations.

For safe functional grounding:

- Use an inverter, which is suitable for the functional grounding.
- Negative generator poles should be grounded with a grounding kit recommended by the inverter manufacturer.
- Follow the specifications of the inverter manufacturer.



→ Only ground the negative pole of the system.



5.3 POTENTIAL EQUALIZATION

When using framed Solibro products, it is important to ensure that there is no potential difference between frame and ground. There are two options available for this:

Option 1: Usage of grounding clamps with grounding function specified in the approved Solibro clamps list.

Option 2: Potential equalization of the module must be done via one of the grounding holes on the module frame.

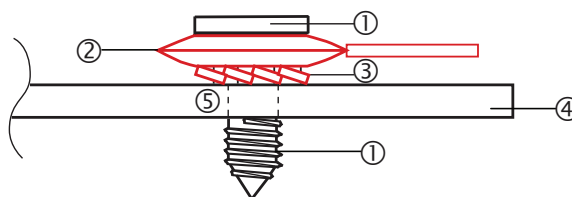
Establish the potential equalization of the framed module via a self-tapping screw (in accordance with DIN 7981, material: A2, size: 4.2 mm x 16 mm) on one of the four grounding holes marked in Fig. 1 (marked with a $\frac{1}{4}$). Attach the screw as shown in the figure below.

→ See Figure 1 for grounding holes



→ Achieve potential equalization with a self-tapping screw on the grounding points.

- ① Stainless self-tapping screw
- ② Stainless washer (cable lug)
- ③ Stainless serrated lock washer
- ④ Module frame
- ⑤ Grounding point



6 CLEANING AND MAINTENANCE

Solibro solar modules stand for a long useful life and minimal maintenance effort and expense. Light soiling is usually washed away by rain. Cleaning is necessary when the module is shaded by heavier soiling (e.g. plants, bird droppings). This can reduce the output of the module.

Maintenance

- An annual maintenance by a specialist firm is recommended
 - Secure fixing and corrosion resistance of all system components.
 - Secure connection, cleanliness and integrity of all electrical components.

Cleaning

Clean the modules as follows:

- Remove snow and ice without exerting force (e.g. with a broom).
- Do not scratch off the dirt.
- Rinse dirt (dust, leaves, bird nests etc.) off with lukewarm water.
- Dampen stubborn dirt with a soft cloth or sponge and remove carefully.
- Do not use abrasive cleaning agent, tenside, scrapers or devices with high water pressure.

If necessary, it is possible to use isopropyl selectively for stubborn dirt:

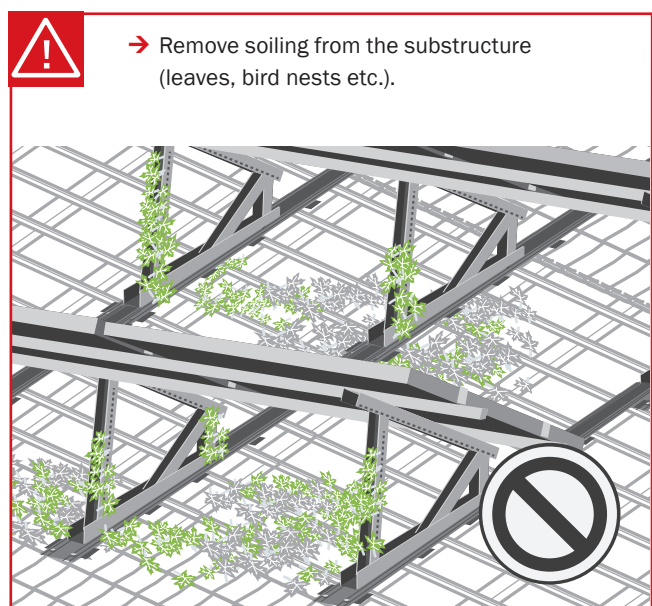
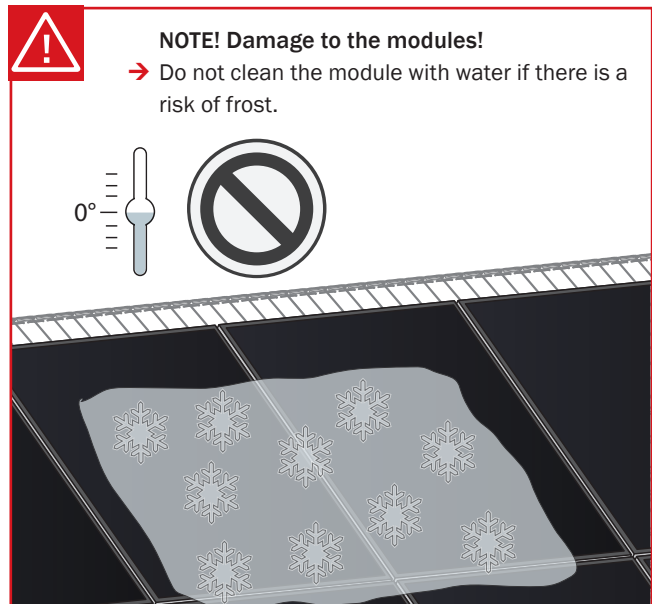
- Follow the safety instructions on the isopropyl packaging.
- Do not let isopropyl run into the space between the module and the frame or into the module edges.

NOTE! Damage to the modules!

Do not clean the module with water if there is a risk of frost.

WARNING! Danger of injury from heated and live modules!

Only clean the modules when the module temperature lies between 10 °C and 30 °C, e.g. in the early morning or late evening. Do not wear electrically conductive parts. Don't clean damaged modules. This can cause an electric shock.



7 FAULTS



DANGER!
Danger due to electric shock!

- In case of problems or damaged modules (e.g. glass breakage, damaged cables) please contact your installer immediately. The installer must ensure that the module is removed from the system as soon as possible.
- Do not operate the modules in short-circuit.
- The modules should not be operated in open clamp voltage for longer than 90 days.





8 RECYCLING

Do not decommission the module on your own. Commission (instruct/engage) a specialised company for this purpose. Dispose of old modules only in accordance with your national and regional waste regulation. Ask your local waste authority for options of disposal.

According to the recast of the European Directive on Waste Electrical and Electronic Equipment, the product should not be disposed of with the general household waste.




Voltage at maximum power*	V _{mpp}	[V]	76.9
Maximum system voltage	V _{sys}	[V]	1000 (600 (C
Weight	M	[kg]	16.5

*STC: 1000 W/m², 25 °C, AM 1.5 Spectrum. Data given are rated (nominal)



C UL1703 US
No 244748

APPROVED PR
MCS
PV-Module MCS F



49213 G1.5 21312

ENGINEERED, DESIGNED, MANUFACTURED AND QUALITY TESTED BY
Solibro GmbH, OT Thalheim, Sonnenallee 32-36, 06766 Bitterfeld-Wolfen, G

9 ADDITIONAL INFORMATION

Required information in accordance with IEC-61730:

- The Solibro modules from the series SL2 and SL2-F are qualified for application class A.
- Modules certified for application class A can be used in systems, which are operated with more than 120 V DC voltage in generally accessible environments. The specified maximum voltage of 1,000 V must be complied with, however.
- Modules in application class A, which conform to the standard IEC 61730, also meet the requirements of protection category II.
- Conductor recommendations: single core cable, type USE-2 (no cable duct).

Information from the Underwriters Laboratories and the Canadian Institute for Standardization Canadian Standard ULC / ORD - C1701-01:

- Under normal operating conditions, a photovoltaic module produces more current and / or voltage in reality than under standardized test conditions. The values marked on the module must therefore be multiplied by 1.25 when determining the operating voltage and conductivity, as well as when selecting a suitable circuit breaker and operating element to be connected with the PV output.
- In Section 690-8 of the National Electric Code (NEC), further factors are listed, which can be used with values of 125 % (80 % with a restriction).
- Recommendation for the selection of the conductor: single core cable, type USE-2 (not insulated), 14 AWG (min. 2.5 mm²).
- In order to fulfil the requirements in accordance with the Canadian Standard ULC/ORD-C1703-1, the installation must be carried out in accordance with CSA-C22.1, Safety standard for electrical installations, Canadian Electrical Code, Part 1.

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