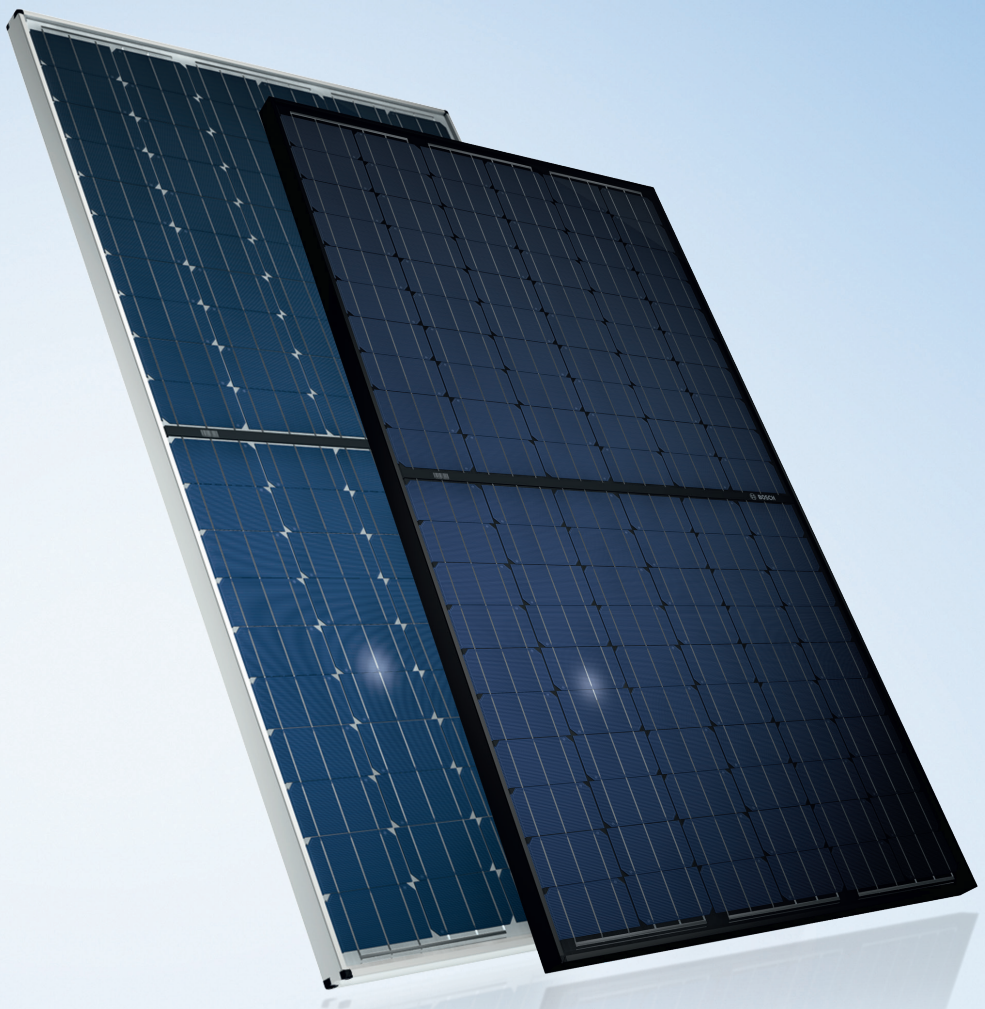


Installation and operation guide

Crystalline solar modules

For specialists

BOSCH

en User manual for Bosch Solar Module products c-Si M60+ S EU56117 and c-Si M60+ EU56117

Issue 11/2013

Contents

1 Introduction

Please read these installation and operating instructions completely and carefully before you transport, install and operate the solar modules. They contain important safety information which you must become familiar with. If these solar modules are used without observing all the instructions in this document, any warranty or guarantee claims against us are voided. We reserve the right to update any information contained in this document without prior notification if this is required from a technical point of view or if it represents an extension of application opportunities for the end customer.

A high degree of specialist knowledge and experience is required to assemble and install solar modules and put them into operation. For this reason, such work should only be carried out by specialists, such as electricians, who have demonstrated that they have suitable training.

These installation and operating instructions only apply to the following products with **Module Manufacturer Code 17:**

- Bosch Solar Module c-Si M 60+ S
- Bosch Solar Modules c-Si M 60+

Only the installation and user manual from 11/2013 is valid for Bosch solar modules of the above named series.

2 Safety instructions

Electrical installation work and initial operation may only be carried out by a qualified electrician in observance of the following instructions, since incorrect installation may lead to damage or injury. Suitable safety precautions, such as fall-arrest systems, must be in place when working on solar generators, particularly on rooftops. You must comply with employers' liability insurance association regulations on work safety. Please observe the following **safety instructions** for your own safety and to protect your solar module:

Important note!

- The pertinent regulations and safety information concerning the installation of electrical equipment and systems and the electricity provider's regulations on the operation of solar power systems in parallel mains operations must be taken into account when installing and servicing solar modules.
- Guidelines on fires in electrical systems apply (e.g. VDI 3819).
- The modules have been classified for Application Class A: Dangerous voltage (IEC 61730: 50 V, EN 61730: greater than 120 V).
- Even in poor light conditions, modules can be expected to carry a full open-circuit voltage. Consequently, this means extreme care must be taken to prevent electrical faults, such as short circuits, when installing modules.
- Solar modules should be handled in the same way as glass products and you must never place objects such as tool boxes on their surface or tread on them when they are in their shipping container or when they are installed.
- The solar modules must be checked to be in perfect mechanical integrity before their installation.

Warning!
Damaged solar modules, such as those with broken glass or damage to the rear side insulating foil, must not be installed. Damage to the rear side insulating foil can have severe consequences (delamination, health and life-threatening hazards).

- Mount the solar module in such a way that it is not effected by shade (even temporary of partial shade caused by dormers, trees or similar obstacles) since this may lead to damage in the solar module (e.g. such as formation of hot spots and resulting fire hazard), PV generator failure or losses in performance.
- Connecting modules in series (addition of module voltages) can generate voltages above the safety extra-low voltage of 120 V DC.
- Disconnecting lines carrying direct current may cause electric arcs. It is therefore essential to disconnect the inverter from the AC network before beginning any type of work on solar power systems, especially before disconnecting plug connections from the DC circuit.
- If systems are installed on roofs, the modules must be mounted above a fire resistant subsurface.
- Solar modules must not be installed near easily flammable substances, gases or vapors.

Warning!
The maximum permissible total system voltage of the inverter must never be exceeded.

- To do so, the open-circuit voltage of the overall system must also be calculated at the minimum permissible temperature due to the negative temperature coefficient of the solar modules (see data sheet and module label).
- The modules and module frames must never be drilled, nailed, stuck with adhesive or welded.

Warning!
Do not use connection cables or the junction box to hold or carry solar modules.

Warning!
The module must not be trodden on, under no circumstances.

- Solar modules must never be left in a free-standing or unsecured position.
- The safety instructions provided by the manufacturers of the other components in the solar power system must always be followed.
- Bosch Solar modules meet the building regulation list requirements for PV modules having a maximum glass surface of by 2 m² as established by the DIBt (Deutsches Institut für Bautechnik, [German Institute for Building Technology]).

Important note!
In Germany the installation of a solar module on a roof area having a slope angle > 75° requires a general technical approval.

3 Positioning guidelines

We recommend a module installation which fulfills the following requirements to ensure the highest annual energy yield possible:

- Mount the solar module in such a way that it is not effected by shade (even temporary of partial shade caused by dormers, trees or similar obstacles) since this may lead to damage in the solar module (e.g. such as formation of hot spots and resulting fire hazard), PV generator failure or losses in performance.
- Position the front of the solar module, so that it faces the Equator.
- Select the inclination angle according to local conditions and structure type (30° ± 15°). You can obtain detailed information on optimum module installation in relevant specialist publications. You can calculate the inclination angle using the following formula: inclination angle = latitude of installation location – 20°.

Important note!
All modules in a photovoltaic generator should be positioned at the same angle (both horizontally and vertically). Separate MPP trackers (inverters) are to be provided if modules are not positioned at the same angle.

- The inclination angle must be at least 10° to ensure self-cleaning is effective. A minimum inclination angle of 15° is recommended to optimize self-cleaning and air convection.
- Make sure that rear of the module is well ventilated.
- Modules must be mounted so that the rear of the module does not come into contact with objects behind it, even if a mechanical load is applied, e.g. cables and parts of the substructure.
- Minimum clearance from building edges according to e.g. DIN EN 1991-1-4 Eurocode 1 must be taken into account to prevent increased stress on modules due to wind load.
- When arranging modules in open field systems, suitable measures must be taken to ensure that readily ignited organic materials (e.g. dry grass, hay) are regularly removed from the vicinity of the system.

Important note!
Prerequisite to installation on a flat roof is a hard roofing seal per DIN 4102, Parts 4 and 7 – if there is uncertainty about the roofing surface, please ask your roofer.

Warning!
Due to heat accumulation under the modules there is an increased fire hazard associated with rooftop installations which do not meet the aforementioned requirements.

Warning!
It is forbidden to use mirrors or lenses to concentrate sunlight on modules.

Important note!
Ensure modules do not come into contact with saltwater.

- The crystalline solar modules by Bosch Solar Energy have been successfully tested for their contact with salty air according to the following standards:
  - IEC 61701: 1995
  - DIN EN 61701: 2000-08
  - IEC 60068-2-52.

Please note the test conditions given in the use of modules in salty air.

4 Installation guidelines

- Mount the solar module in such a way that it is not effected by shade (even temporary of partial shade caused by dormers, trees or similar obstacles) since this may lead to damage in the solar module (e.g. such as formation of hot spots and resulting fire hazard), PV generator failure or losses in performance.

Important note!
Take into account additional loads produced by the PV system's weight and structural mount when carrying out the structural analysis for the overall structure.

- The system installer or operator must provide an analysis of the building structure's stability, deflection and loads.
- Mount the modules on an adequately dimensioned, permanently corrosion resistant, stable substructure.
- The installation profiles are to be positioned in parallel to one another.
- The fastening points are to be aligned symmetrically (see Figure 1).
- The solar module can be attached with clamps, lay-in systems or, alternatively, directly to the assembly holes. If clamp systems are used, the clamp contact surface must be at least 400 mm² for each fastening point. Furthermore, under all conditions, the surface area must be min. 400 mm² for each fastening point.

Important note!
Ensure you use the fastening sections as indicated in tables 2 to 5.

- Ensure that the mounting holes are correctly positioned as in Figures 2 and 4 when fitting the module using mounting holes. You are also to use four corrosion resistant screws and nuts as per Table 1 and washers with a minimum outside diameter of 12 mm and a maximum of 14 mm.

Module Manufacturer Code	Screw diameter
17	M6

Table 1: Permissible fastening screws for direct installation

- When using clamps or direct attachment at the assembly holes, the modules must be fastened flush to the substructure at at least four points under as little stress and tension as possible.
- The solar module must be installed under as little mechanical stress as possible and at a minimum distance of 5 mm from the next module to allow for any expansion in materials resulting from temperature fluctuations.
- The supporting structure or substructure must be adequately dimensioned based on a structural analysis and adapted to the environmental conditions locally to ensure that the maximum permissible deflection or deformation on the long side of the module under a load of max. 4 mm is not exceeded. For the short side, there is a max. value of 2 mm. You also

need to ensure that the module does not distort or warp more than 10 mm across its diagonal line. Only one of the named deformations is permissible in this.

Important note!
The substructure and solar module must have the same thermal expansion coefficient (e.g. aluminum).

- Ensure contact corrosion between the solar module and substructure is prevented when different materials are used.
- Fasten the solar modules in such a way that they are able to withstand all anticipated loads and any impacts caused by weather conditions.
- Use only corrosion resistant screws to install modules.

Important note!
Solar modules must always be installed in such a way that the cable inlets in the junction box face downwards or sideways.

- Ensure the support structure does not allow rainwater or condensation water to reach the cable screw connections in the junction box.

Warning!
The solar module must not stand in condensation or stagnant water.

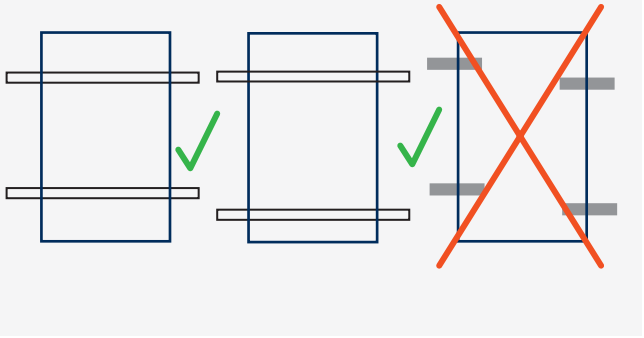


Figure 1: Permissible layout of the fastening points and installation profiles

Vertical fastening sections for Bosch Solar Module c-Si M60+ S EU56117 (with crossbar)

Consider that the module crossbar is not in the middle of the module. See Figure 2 for details.

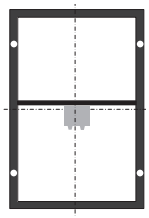
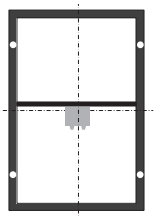
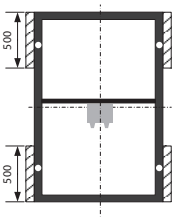
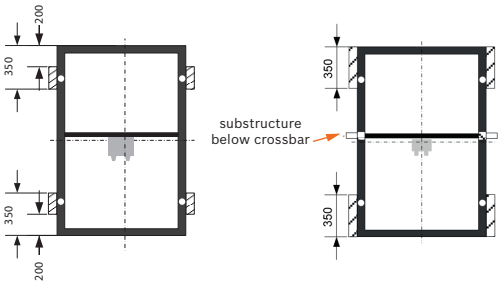
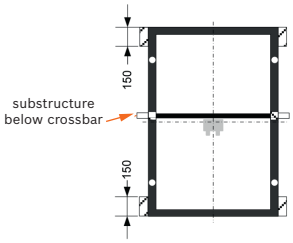
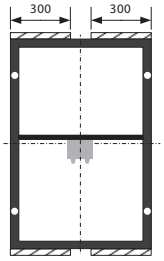
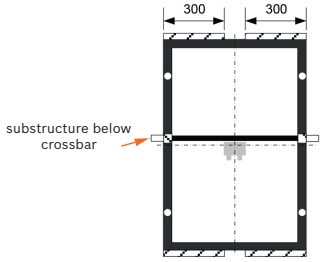
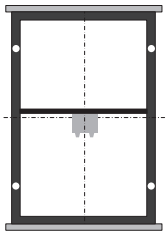
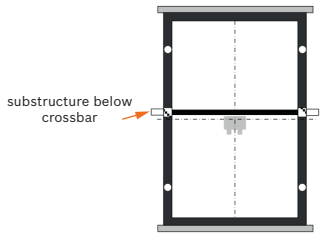
	Pressure load rating to 3900 N/m²	Pressure load rating from 3900 N/m² to 5400 N/m²	Pressure load rating up to 7200 N/m²
Screw fastening to assembly holes			
Fastener clamp system on long sides[1, 2]			
Fastener clamp system on short sides[2]			
Slide-in and lay-in system[3]			

Table 2: Vertical fastening sections for Bosch Solar Module c-Si M60+ S EU56117 (with crossbar)

Consider the position of the crossbar when using a center support. Position the support, so that it holds up the module crossbar.

---------- centre line clamping range junction box

[1] The clamp contact surface must be at least 400 mm² for each fastening point. Furthermore, under all conditions, the surface area must be min. 400 mm² for each fastening point.

[2] The clamping sections are also valid for the use of concealed clamping on the surrounding assembly groove (see p. 12).

[3] Please additionally note the information on installation of the module with lay-in and slide-in systems on p. 11.

Horizontal fastening sections for Bosch Solar Module c-Si M60+ S EU56117 (with crossbar)

Consider that the module crossbar is not in the middle of the module. See Figure 2 for details.

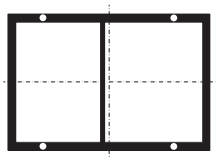
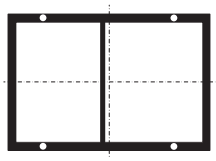
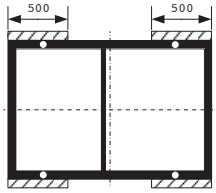
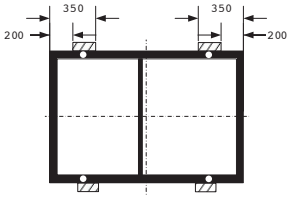
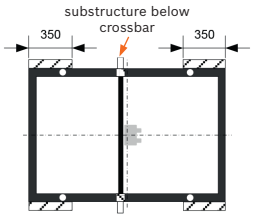
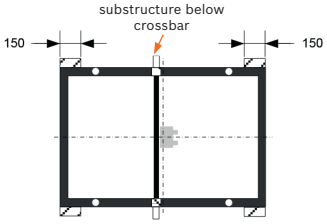
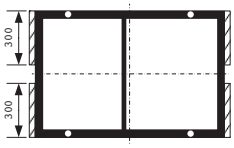
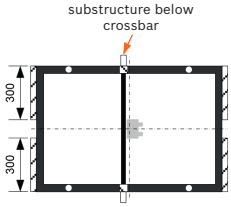
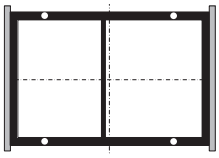
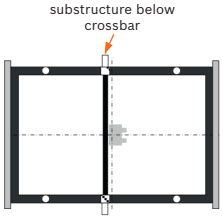
	Pressure load rating to 3900 N/m²	Pressure load rating from 3900 N/m² to 5400 N/m²	Pressure load rating up to 7200 N/m²
Screw fastening to assembly holes			
Fastener clamp system on long sides[4, 5]		 	
Fastener clamp system on short sides[5]			
Slide-in and lay-in system[6]			

Table 3: Horizontal fastening sections for Bosch Solar Module c-Si M60+ S EU56117 (with crossbar)

Consider the position of the crossbar when using a center support. Position the support, so that it holds up the module crossbar.

---------- centre line clamping range

[4] The clamp contact surface must be at least 400 mm² for each fastening point. Furthermore, under all conditions, the surface area must be min. 400 mm² for each fastening point.

[5] The clamping sections are also valid for the use of concealed clamping on the surrounding assembly groove (see p. 12).

[6] Please additionally note the information on installation of the module with lay-in and slide-in systems on p. 11.

Vertical fastening section for Bosch Solar Module c-Si M60+ EU56117

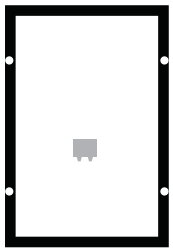
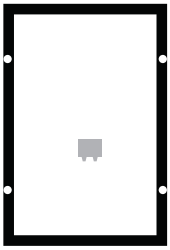
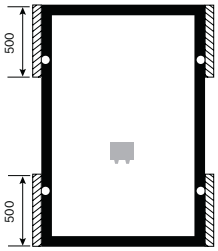
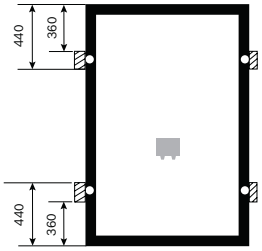
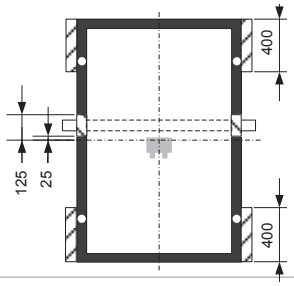
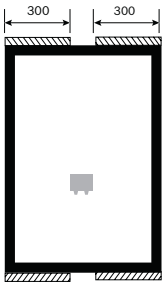
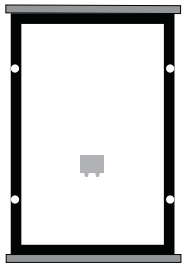
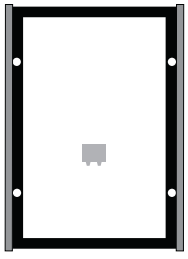
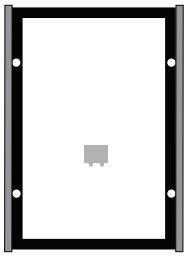
	Pressure load rating ≤ 2400 Pa	Pressure load rating ≤ 5400 Pa Without center support	Pressure load rating ≤ 5400 Pa With center support
Screw fastening to assembly holes			
Fastener clamp system on long sides			
Fastener clamp system on short sides			
Slide-in or lay-in system			
Slide-in or lay-in system			

Table 4: Vertical attachment section for Bosch Solar Module c-Si M60+ EU56117

When positioning the center support, ensure that it lies above the junction box.

center support clamping range junction box

Please additionally note the information on installation of the module with lay-in and slide-in systems on p. 11.
The clamping sections are also valid for the use of concealed clamping on the surrounding assembly groove (see p. 12).

Horizontal fastening section for Bosch Solar Module c-Si M60+ EU56117

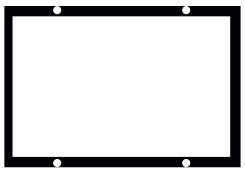
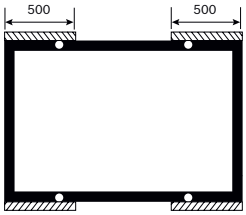
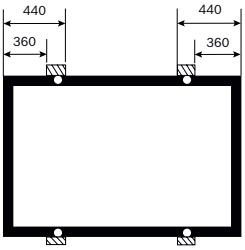
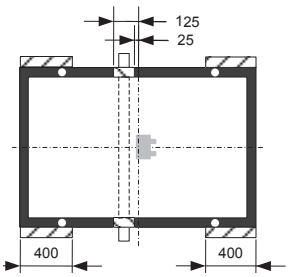
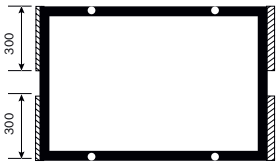
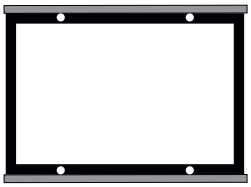
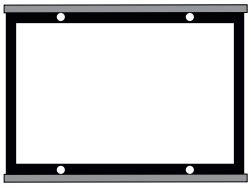
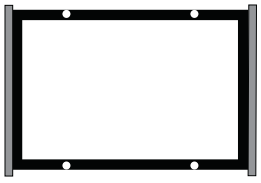
	Pressure load rating ≤ 2400 Pa	Pressure load rating ≤ 5400 Pa Without center support	Pressure load rating ≤ 5400 Pa With center support
Screw fastening to assembly holes			
Fastener clamp system on long sides			
Fastener clamp system on short sides			
Slide-in or lay-in system			
Slide-in or lay-in system			

Table 5: Horizontal attachment section for Bosch Solar Module c-Si M60+ EU56117

When positioning the center support, ensure that it lies above the junction box.

center support clamping range

Please additionally note the information on installation of the module with lay-in and slide-in systems on p. 11.
The clamping sections are also valid for the use of concealed clamping on the surrounding assembly groove (see p. 12).

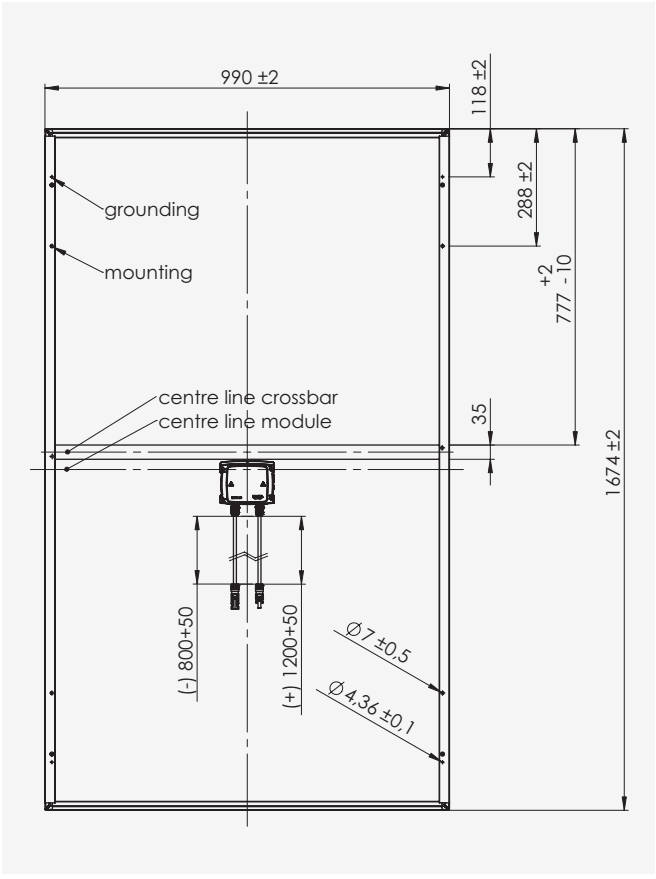


Figure 2: Rear Bosch Solar Module c-Si M60+ S EU56117

When fastening modules with slide-in or lay-in systems, the following should be observed (see Figure 3):

- Bearing area on frame: The frame must be covered on the upper side by at least 5 mm and no more than 12 mm (a).
- The slide-in or lay-in system must overlap the underside by at least 3 mm and have a surface area of at least 2 mm width (b).

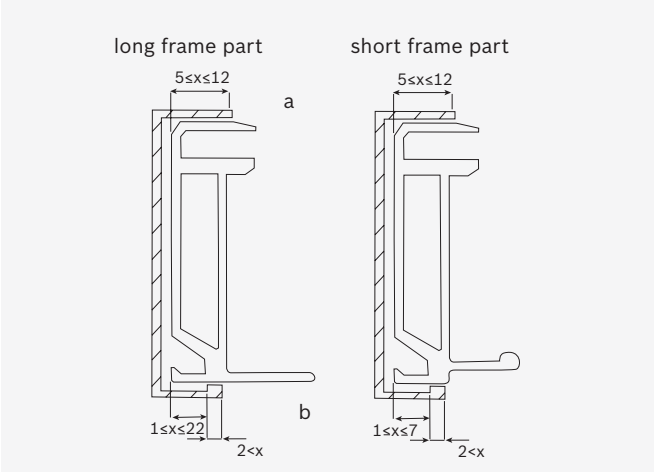


Figure 3: Permitted contact areas in slide-in and lay-in systems

Important note!
The draining function of the module corners for the frame profile must always be ensured. If necessary, additional draining opportunities should be put in place in the mounting system.

When using a lay-in system or the corner clamps for mounting the module, the draining function of the drainage corners (and therefore the cleaning function) can be limited.

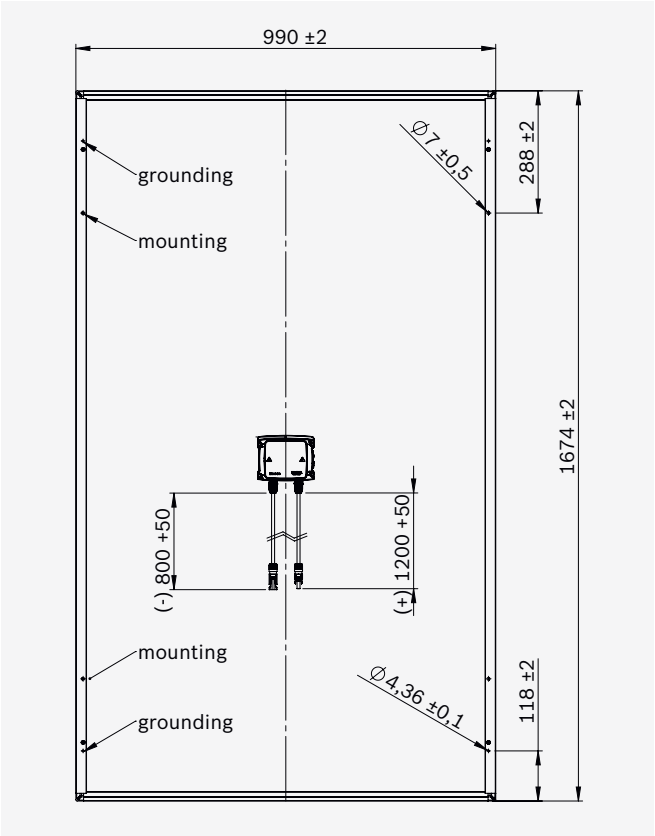


Figure 4: Rear Bosch Solar Module c-Si M60+ EU56117

When fastening modules in the area of the module or drainage corners, the following should be observed (see Figure 5):

- If corner clamps are used, a minimum cover area of 28 mm of the clamp must be ensured (length of the assembly clamp).
- The assembly clamp must overlie by min. 8 mm and max. 12 mm on the frame (depth of assembly clamp).

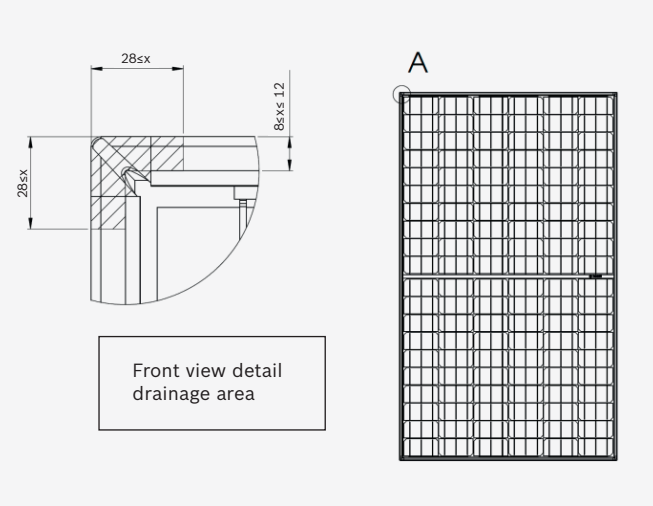


Figure 5: Fastening of the modules in the area of module or drainage corners

Alternatively, the module can also be attached to the surrounding assembly groove by using the covered clamping with the innovative Bosch mini-clamp. The clamp areas and assumed loads are valid the same as for mounting of the module with clamp system (see Tables 2 to 5).

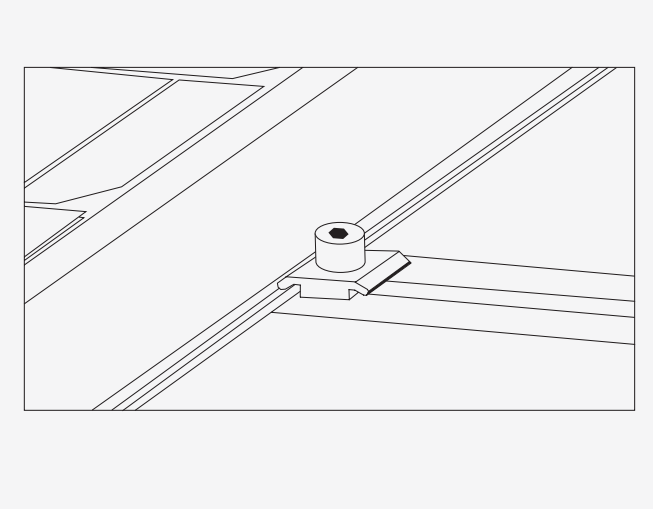


Figure 6: Additional mounting possibility of covered clamping on surrounding assembly groove

5 Circuitry guidelines

You may only interconnect identical solar modules of the same type and the same power class. Ensure that the maximum permissible system voltage is not exceeded when you connect the modules in series. In doing so, take into account the effect of variations in temperature on the voltage in solar modules, particularly since module voltage increases at low temperatures.

When connecting modules in parallel, make sure that each line connected in parallel contains the same number of modules and that suitable measures are in place to protect against power surges (e.g. line fuse). Make certain that the indicated load capacity regarding the reverse current I_R, as stated in the datasheet, is not exceeded.

A PV module may supply a higher current and/or a higher voltage under normal conditions than under standardized test conditions. As a result the Isc and Uoc values on the module should be multiplied by a safety factor of 1.25 to determine the rated voltages of components, the rated current in cables, the sizes of fuses and sizing of controls which are connected to the output of the PV modules. Ensure that you comply with local applicable standards and regulations.

6 Electrical connection

The solar modules are designed for use in grid-connected solar generators. If they are used for any other purposes, differing technical features should be taken into account. Solar modules may only be installed by qualified specialists. In the process, they must comply with the relevant industrial standards and regulations for PV systems, such as the German Association for Electrical, Electronic & Information Technologies regulations, DIN standards, German Association of Energy and Water Industries guidelines, the network operator's technical connection conditions and employers' liability insurance associations' accident prevention rules. We draw your attention again to the following points in particular:

Important note!

- Only install non-damaged modules with clean, dry cabling, plug connectors and junction boxes.
- The solar modules, particularly the plug connectors and tools, must remain dry during installation.
- Disconnection devices must be fitted between the module and inverter. The disconnect component must be readily accessible in order to disconnect the direct current side if danger should arise.
- Make sure that all electrical connections are properly secured.
- Only use cabling which is suitable for outdoor installation to interconnect module strings (UV and ozone-resistant, temperature resistance at least between -40° C and 110° C).
- Cables must feature a minimum cross-section of 4 mm² and isolation must be approved for the maximum system open-circuit voltage.
- Protect cabling against damage by such means as suitable fastening with cable clips.

Important note!
Connecting cables which are able to move can lead to chafed points, thus causing insulation damage to the connecting cable.

- The cables must be laid in such a way that the cables are not squashed or put under pressure in any other way.
- You must not open the junction box with pre-assembled, connected cables.
- The junction box, cabling and connection plug must not be cleaned or dampened with substances containing grease or alcohol.
- Solar plugs pre-fitted in the factory must not be removed.
- Ensure that the module connection cable is relieved of strain when installed.
- The connection cables should be installed in such a way that the minimum bend radius of 60 mm is complied with.
- The connection cables are equipped with a high-quality plug system (original MC4) for photovoltaics which latch on if correctly connected. The plugs are marked with their respective polarity symbols (see datasheet).
- Ensure the polarity symbols are in the right position when connecting plug connectors and modules and when connecting solar modules to the inverter. Incorrect polarity can permanently damage all technological components in the system.
- All solar module frames and the support structure must feature highly conductive connections to a protective grounding system to eliminate the risk of electric shocks. We recommend installing the grounding system outside the building. Observe local statutory regulations and recommendations given by the inverter manufacturer and your insurance company.

Important note!
Never remove or insert plug-in contacts when the system is under load!

7 Grounding and lightning protection

It is recommended to provide adequate lightning protection, especially in exposed locations. You must comply with local applicable standards and regulations when integrating modules into existing lightning protection systems.

Important note!

- Please observe the country-specific standards and regulations when grounding.

Please implement the following measures for the grounding system (you will find the respective mounting holes for the grounding system on the rear of the module frame):

- For the installation of a fitting ring terminal, use a thread grooving screw (DIN7500-1, minimum diameter 5 mm), a self-cutting lock washer, a snap ring and the right nut.
- Damaging contact corrosion can be avoided by using corrosion-resistant materials.
- Position of the mounting holes for grounding according to Figures 2 and 4.
- There is an additional grounding opportunity in the module corners. Use the grounding of a thread grooving screw M5 according to DIN7500-1 and attach it from the rear side of the module behind the plastic corner. See Figure 7.

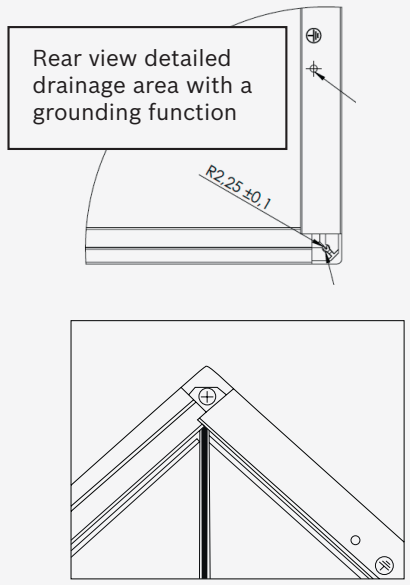


Figure 7: Grounding possibilities on the module with detailed illustration of module corner

Functional grounding

Isolated operation of the modules is recommended, this means neither plus nor minus terminal of the module have an electrically charged connection to the ground.

Important note!
If a functional grounding is required, then this can only be undertaken on the minus terminal in the PV system.

8 Maintenance and care

Little maintenance and care is required to deliver optimum solar module performance. We recommend the following items are checked or the following action taken on a half-yearly basis to ensure optimum system performance:

- If modules are heavily soiled or dirty in places, from bird droppings, for instance, it is recommended to clean module glass surfaces with a soft brush and lime-free water at module temperature. Do not use aggressive cleaning agents, acids or alkaline solutions.
- Under no circumstances should there be increased pressure during cleaning e.g. by pressing a brush so strongly during cleaning, that this can lead to damage to the antireflective coating of the glass for example. In the case of intensive soiling, repeated cleaning or soaking is recommended.
- Any finger prints on the anti-reflection solar glass can be removed with a microfiber cloth and distilled water or isopropanol.
- Check electrical and mechanical connections to ensure they are clean, tightly fastened and intact. Any anomalies must be remedied immediately.
- The operator is recommended to check the system's output on a regular basis.
- The grass and weeds in and around open ground area systems must be mowed regularly. This is necessary to minimize the potential hazard of organic material (e.g. dry grass, hay) combustion in the vicinity of the system.

9 Disposal

Important note!
Defective or old solar modules should be disposed of in the correct manner. They must not be thrown away with household waste.

10 Transport and storage

Modules must be handled with great care. Care is required when unpacking, transporting or storing modules temporarily:

Important note!

- Set modules down gently without knocking them when placing them on hard ground or on their corners.
- Avoid bending modules when transporting or unpacking them.
- Do not drop modules.
- Do not place any objects on top of modules.
- Do not use sharp objects to work on modules.
- Ensure that each module is adequately supported during storage or transportation.
- Stacking packaging units may lead to damage and must be avoided.
- Secure solar modules, so that they don't tip over.
- Padding should be used between individual solar modules.

We recommend storing all solar modules in their original packaging in a dry interior space until they are finally installed.

Modules being transported must be packaged securely in accordance with local and European requirements. The original packaging should be used wherever possible.

Avoid damaging modules in any way when putting them down or carrying them to their installation location (e.g. roof).

Use more than one single part of the frame to hold modules when transporting them.

If you have any questions on the instruction and operating guidelines, please contact our technical support at support.se@bosch.com.

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