

Roofit.Solar

Click Safety and Installation Manual



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Acronyms

AM1.5	Air Mass 1.5
BIPV	Building Integrated Photovoltaics (i.e. metal integrated photovoltaics)
DC	Direct Current
VDC	Volts of direct current
PV	Photovoltaic
STC	Standard Test Conditions (T= 25°C, Solar Irradiance = 1000 W/m ² , AM = 1.5)
R	Radius

Definitions

Buyer	A person or party that purchases the Product/s from the Roofit Solar Energy OÜ.
Roofit.Solar	Roofit Solar Energy OÜ
PV module	Roofit Solar Energy OÜ roofing metal integrated photovoltaic module
Warranty Period	The period beginning on the date of purchase of Product/s by the Buyer
PV system	A system composed of two or more Roofit.Solar Products combined with an inverter and other electrical accessories

Introduction

This manual contains essential information about electrical and mechanical installation that must be followed before handling, installing, and maintaining Roofit.Solar PV modules. Failure to follow these safety instructions may result in personal injury or property damage.

Disclaimer of Liability

All the information contained in this manual is the intellectual property of Roofit Solar Energy OÜ and is based on the technologies and experience acquired and accumulated by the company. This manual does not constitute a warranty, either explicit or implicit.

Roofit Solar Energy OÜ does not assume responsibility and expressly disclaims liability for any loss, damage, or expenses arising from or in any way related to the installation, operation, use or maintenance of our PV module. Roofit Solar Energy OÜ assumes no responsibility for any infringements of patents or other rights of third parties that may result from the use of our PV module.

Roofit Solar Energy OÜ reserves the right to make changes to the PV module, the specifications, or the installation manual without prior notice. Failure to comply with the requirements listed in this manual will void the warranty provided by Roofit Solar Energy OÜ.

The mechanical and electrical installation of PV systems must be carried out with all applicable codes, including electrical codes, building codes and electric utility interconnection requirements. These requirements may vary from country to country. Contact local authorities for applicable regulations. The PV module must be installed by a qualified person. The electrical connection must be made by a certified electrician. Planning the location of the product on the roof should be carried out by a competent professional with experience in planning PV systems.



General Considerations

The distributor of our Products is required to provide this manual to the PV system owners.

Roofit.Solar is designed to meet the requirements of the IEC 61215 and IEC 61730 standards. Perform structural analysis of the roof before installing Roofit.Solar Products.

Observe all relevant laws, regulations, guidelines, and safety measures when handling solar modules. For your safety, do not attempt to work on a rooftop until the necessary safety precautions have been identified and taken. Sufficient protective equipment (e.g. harnesses, insulated rubber gloves and tools, etc.) must be used throughout the installation process.

Roofit.Solar PV modules can be combined with other components to form a photovoltaic system. In this case, installation and operating instructions provided for these additional components must also be followed.

NB! PV systems generate DC electricity when exposed to light, and if not handled properly, can cause an electrical shock or burn. PV modules operate at voltage levels higher than 30 VDC and currents exceeding 30 mA, so all contacts with bare wires without proper safety measures can be harmful to one's health. The risk increases when multiple PV modules are connected to provide higher system voltage or current levels. Dangerous voltages can also occur at night or even when the modules are not connected to an electrical circuit or load.

The PV modules can only be deactivated by removing them from sunlight, or by completely covering their front side with fabric, cardboard, or other opaque material, or by working with PV modules face down on a smooth, flat surface.

A PV system can produce an output higher than its rated specifications. Industry standard ratings are made at STC. Reflection from snow or water can increase sunlight, thus enhancing current performance and power. Furthermore, colder temperatures can significantly increase voltage and power. This must be taken into consideration during the system design which must be done by a competent person experienced in PV system planning (for more information, see the section Electrical Interconnection).

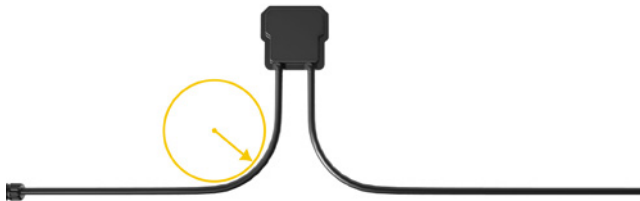
Main Precautions

Always follow the safety precautions listed below when dealing with Roofit.Solar Product:

- Keep the PV module packages indoors until they are ready to be installed. Transport and store the PV modules in appropriate packaging in a ventilated, rainproof, and dry location.
- Always use electrically insulated tools and gloves while working on the electrical connections of the PV module.
- Be careful with the sharp edges and corners of the PV module.
- NEVER disconnect/connect electrical connections under load. This can cause arcs and electrical shock. Keep the connectors dry and clean. Remove the dust caps only before making electrical connections.



- Ensure that all electrical connections are properly secured and protected from unwanted interference.
- DO NOT install the PV module in adverse conditions (rain, strong or gusty winds, wet or frosted roof surfaces, etc.).
- DO NOT use mirrors or other magnifiers to concentrate sunlight onto the PV module.
- DO NOT overbend or apply stress to the cables. Observe the recommended cable bending radius. Junction box cable maximum bending radius $R > 6 \times \text{cable diameter}$.

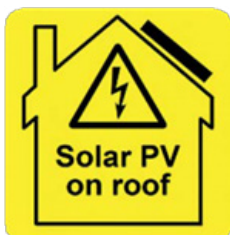


- Ensure that all electrical connections are properly secured and protected from unwanted interference.
- DO NOT lift the PV module by grasping junction boxes.
- DO NOT drop the PV module or drag it over any surface.
- DO NOT attempt to install or service the PV system unless you are qualified to do so.
- DO NOT attempt to open the junction box, repair, modify or disassemble the PV module.
- DO NOT leave the PV module unsecured. If it falls, the glass layer could break.
- DO NOT apply paint or adhesive to the PV module surface or attempt to remove any markings, labels or parts attached to the Product by the manufacturer.
- DO NOT drill holes in the glass part of the PV module.
- Always mount the PV module so that the junction box is unobstructed and does not carry any of the weight of the PV module.
- Avoid stepping or placing heavy loads on the modules during the installation. Doing so may cause microcracks or cracks that are not visible to the human eye.

Fire Safety

Consult your local authority for guidelines and requirements regarding building or structural fire safety. Roofit.Solar PV modules have been designed in accordance with the requirements of Fire Test in IEC 61730 Part 2 Class A, CEN/TS 1187 (Broof (t2)) in accordance with EN 13501-5:2016. The metal sheet has been tested according to the EN 14782:2006.

The roof construction and installation may affect the fire safety of buildings. Improper installation may lead to hazards in the event of a fire. Use appropriate components such as fuses and grounding connectors as required by local authorities.



Inform firefighters about the existence of a photo-voltaic system in the building.



In case of fire, stay away from all elements of the PV system, until the area is safe.

Roofit.Solar recommends using a combiner box for buildings with PV systems to protect the house and inverter(s) from unexpected overvoltage.

The combiner box is equipped with an emergency disconnect mechanism that shuts down the PV system and protects it from overvoltage caused by lightning strikes.

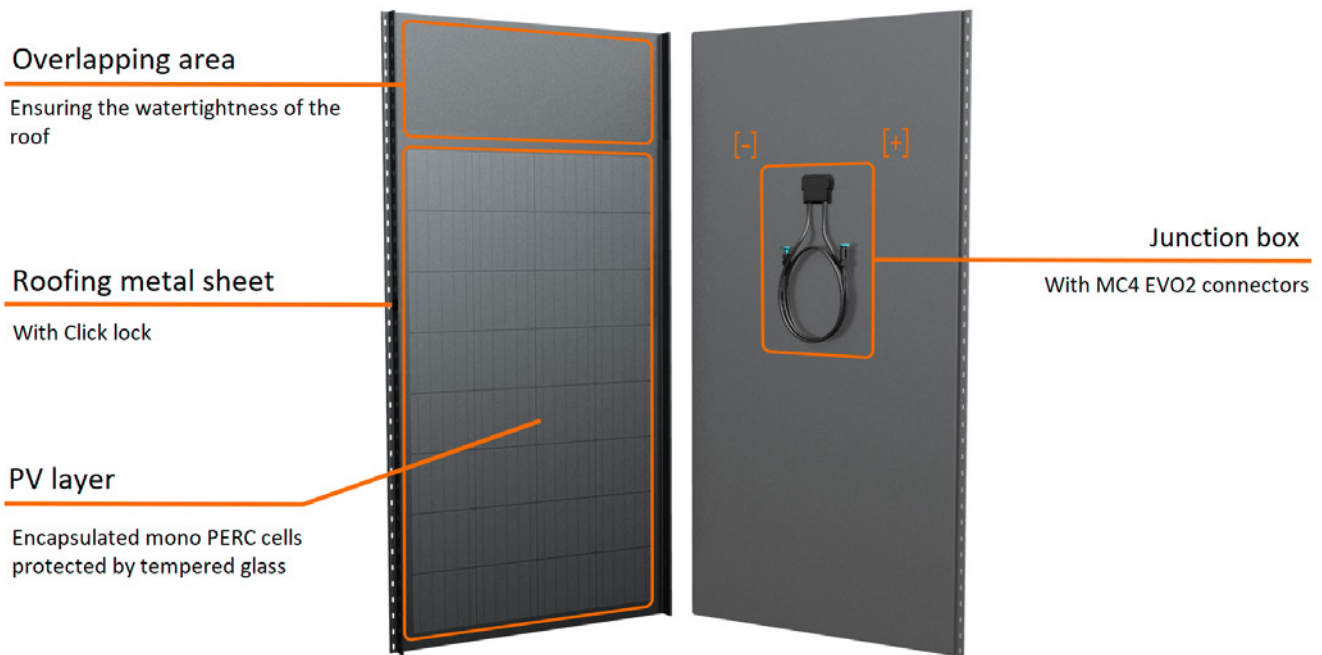
The combiner box includes a fireman's switch, which disconnects the DC power lines between the solar modules and the inverter(s). The device can be triggered locally, as it is installed outside of the building, providing easy access in case of a fire.

Please, follow the Combiner box instructions during the connection to the system, as in most cases the maximum distance between the Combiner Box and the PV modules must not exceed 10 meters of cable length. If this distance is exceeded, an additional combiner box needs to be installed.

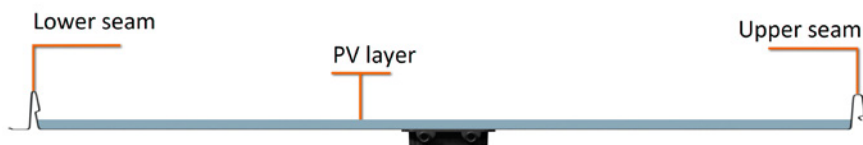
Roofit.Solar Product Information

The Roofit.Solar product is a building-integrated photovoltaic (BIPV) system that can be used as a construction material on roofs or building facades. General information about the components of Roofit.Solar PV module is depicted in the pictures below. Detailed information about their electrical, mechanical and thermal characteristics can be found in datasheets of the products.

Illustration of the Product



View from the Front View from the Back



View from the Bottom Edge

→ PV system planning

To ensure the safety and performance of the PV module, it is important to take special precautions when installing or operating in areas with heavy snow, extreme cold, strong wind, near coastal areas, or deserts where salt fog may occur. The product can be used in temperatures between -40°C and 85°C and in environments with up to 100% relative humidity and rain. The maximum altitude for installation is 2000 meters above sea level for a maximum system voltage of 1000V.

Make sure that the product is not exposed to wind or snow that exceeds the maximum permissible load. The maximum permissible designed snow load is 5300 Pa with a safety factor of 1.5, and the maximum permissible designed wind load is 1600 Pa with a safety factor of 1.5.

Roofit.Solar is not responsible for any damage caused by lightning, so it is recommended to install surge protection in areas with a high probability of lightning strikes. The product should not be installed in locations where corrosive agents or flammable gases may be present. For the purposes of waterproofing and maintenance, the roof slope must be greater than 10 degrees.

Roof Support Structure

Ensure that the installation method and supporting system of the roofing materials are strong and durable enough to install the Product and meet its load requirements.

The supporting system must be installed in accordance with local, national, or international standards.

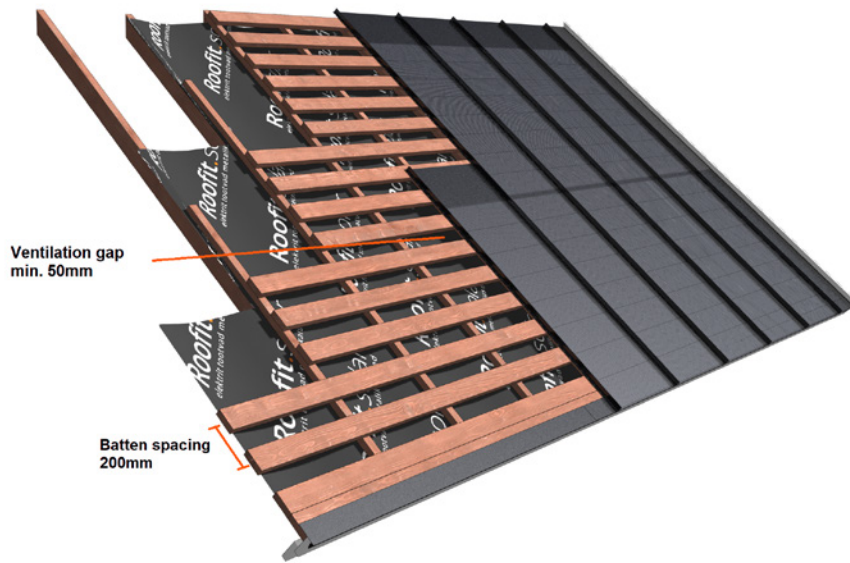
Any penetration (e.g. chimney, pipes etc.) to the roof must be properly sealed to prevent leaks.

The back of the product must be kept free of foreign objects that are not part of the support structure.

Battens support the Product and must thus be installed on the same level and form a flat surface to reduce the chance of glass layer damage, provide proper locking quality, and decrease passive metal oil canning.

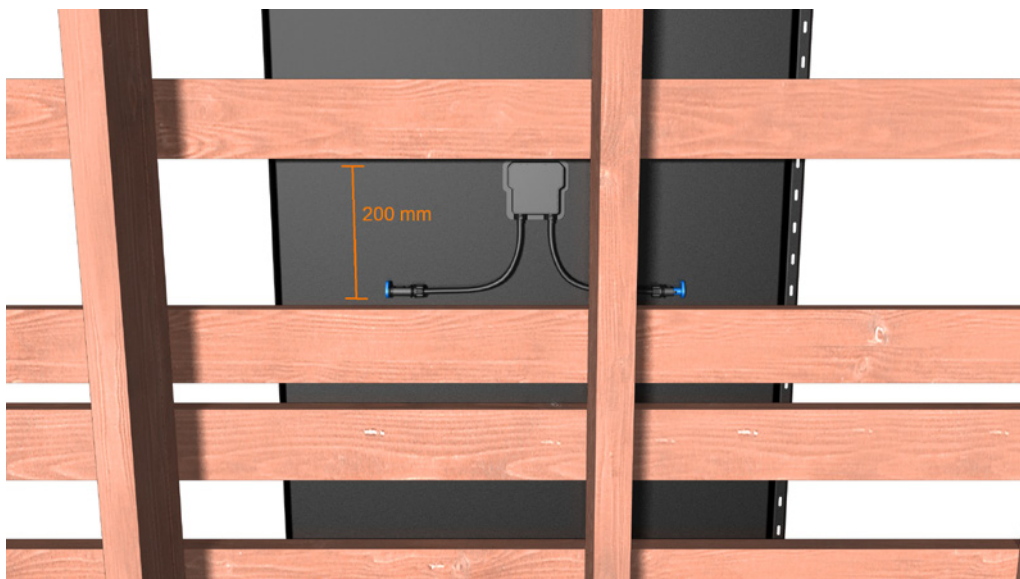
Tolerance of ± 2 mm is allowed for unevenness of the battening. Leveled rafters and calibrated wood is a best practice for achieving that.





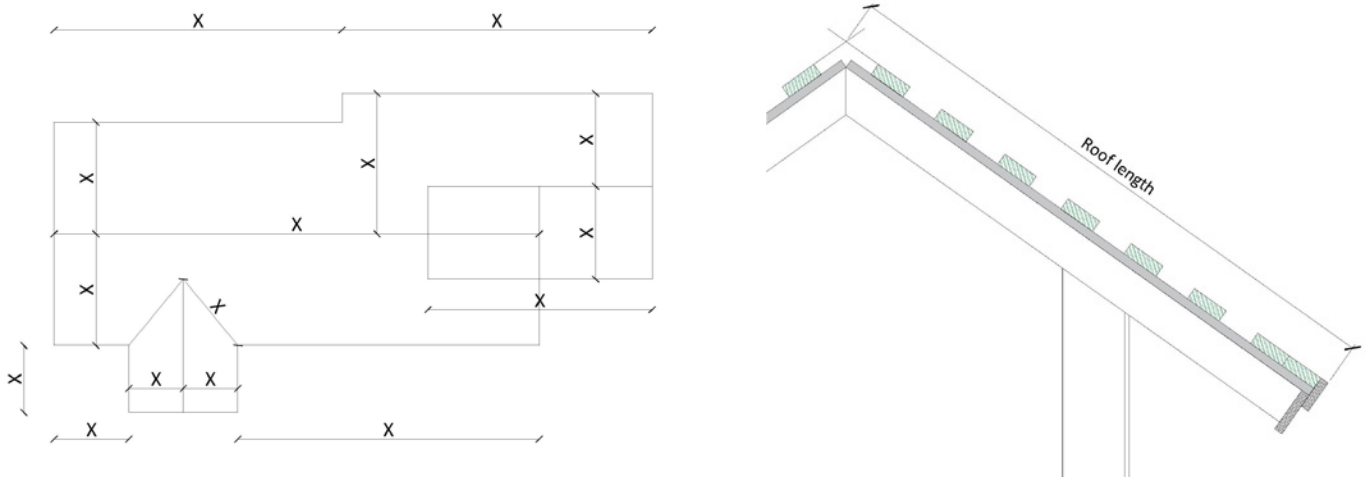
For the installation of the subframe, use wooden battens with dimensions of 32 x 100mm. The recommended center-to-center batten spacing is 200mm to ensure proper wind resistance. A ventilation gap of at least 50mm should be maintained between the Roofit.Solar Product and the moisture barrier, which can be achieved by using a ventilation board and batten of appropriate thicknesses. Additionally, a minimum of 200mm from the bottom of the roof should be fully decked.

When installing the Product, make sure to pay attention to where the battens are placed in relation to the junction box. Each Product has a junction box that needs to be placed between the battens. To make sure everything fits and works correctly, you need to leave 200mm of space for the junction box, wires and any potential misplacements. If the battens are in the way of the junction box, move them up or down before installing the Product.



Measuring the roof

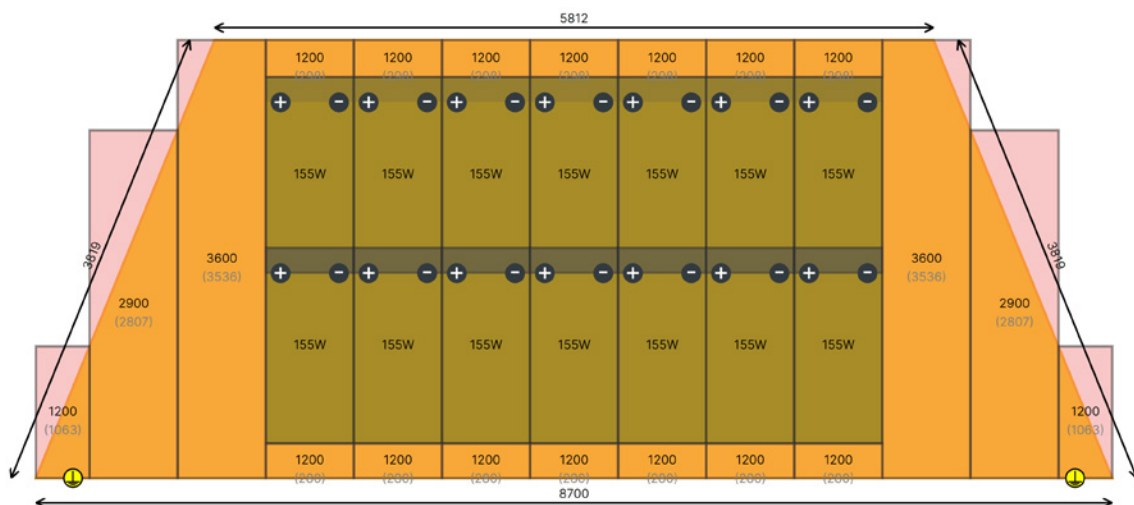
The customer needs to provide Roofit.Solar with a drawing or a simple sketch of their roof with important measurements for the PV system. Length of the roof is measured from the outer surface of the farthest facing board from the eaves to the middle of the ridge.



Planning the layout

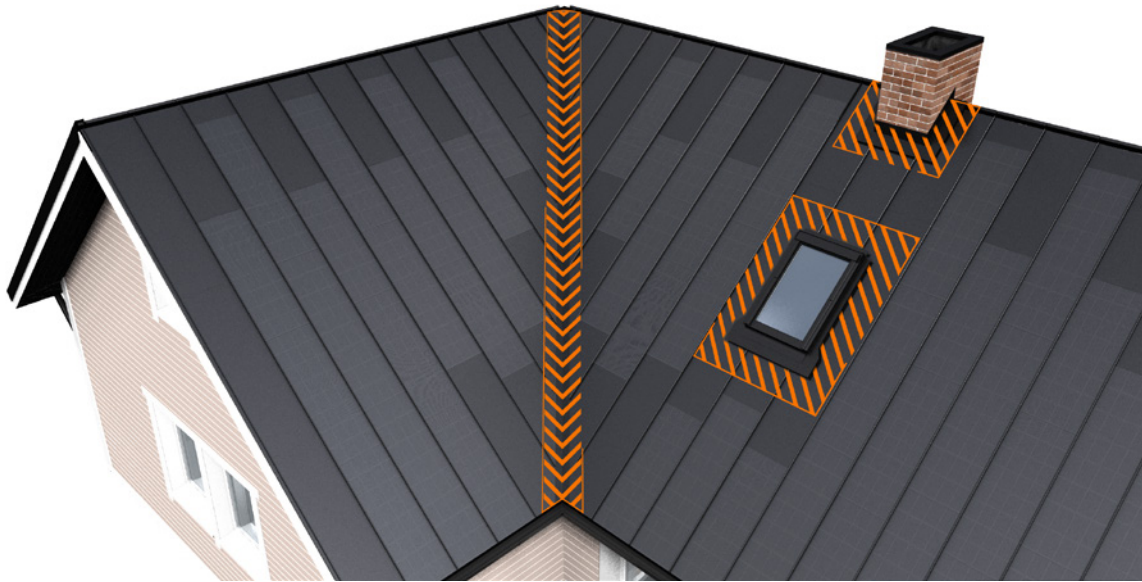
Roofit app software helps with roof planning by determining the most effective solar module placement based on the complexity of each roof. Shadow analysis determines the potential power loss from trees, chimneys, dormers, and other structures and determines the best location for solar modules.

Snow guards, passage ladders, skylights, and personal demands from the Buyer are also factors in PV module layout. Roofit.Solar needs as much information about the roof as possible, including the estimated height of the chimneys, vent pipes, and trees in close proximity, in order to offer the most accurate design.



Roofit.Solar products can either cover the entire roof or be used with regular metal roofing materials, depending on the design of the roof. However, all elements that penetrate the roof (like chimneys or skylights) and the valleys need to be surrounded with standard metal sheets that are 300mm wide.

This is because the PV layer of the Roofit.Solar product should not be cut, bent or otherwise damaged.



PV modules cannot be cut to size, so an extra piece of metal sheet is added on top or bottom to finish the column and complete the roof. The decision of whether to extend the ridge side or the eave side depends on the look you want and any technical needs like adding snow guards or avoiding shadows.

→ Electrical interconnection

Electrical connection accessories

Extension cable with QC4.10 male/female connectors



Extension cable (> 1 m)

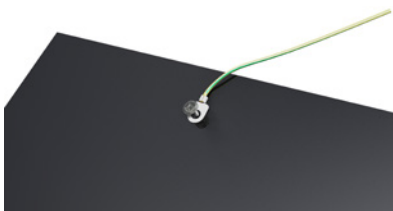
Customized length.
Extension cables are needed if the connection distance between the modules is more than 1 m.

DC cable with QC4.10 male/female connectors



DC cables are used to connect Roofit.solar DC Strings with the inverter.

Grounding cable



Unlocking tool



Unlocking tool is used for the disassembly of connectors

Crimping pliers



To attach MC4 EVO2 connectors to the inverter DC cable.

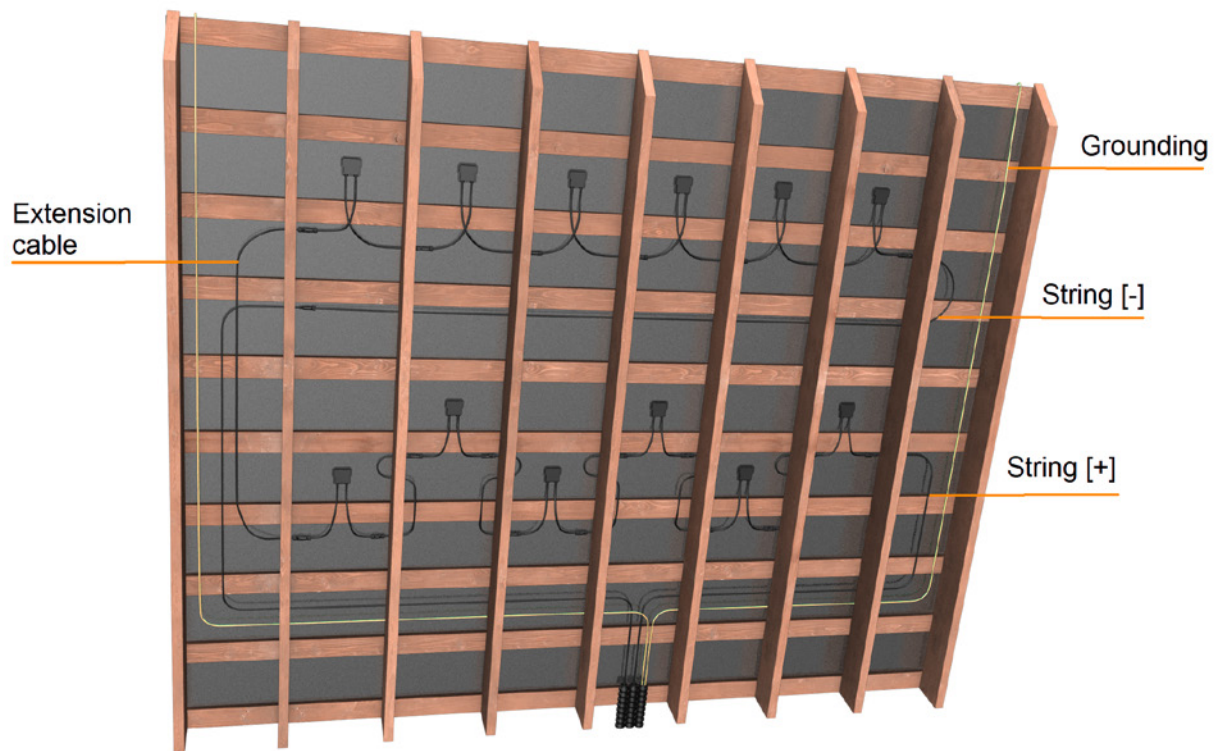
Electrical Characteristics of the PV module

Each junction box contains two bypass diodes wired in parallel with the PV cell strings. In case of partial shading, the diodes bypass the current generated by the unshaded cells, thereby limiting the Product heating and performance losses. However, it is important to note that bypass diodes are not overcurrent protection devices. In the event of a known or suspected diode failure, it is recommended that installers or maintenance providers contact the supplier.

Wiring Considerations

All wiring installation should be carried out by qualified installers in accordance with local electrical construction codes, procedures, and regulations.

All cables used to connect the DC system must use copper wires with a cross-sectional area of at least 4 mm², with double insulation and a designation code H1Z2Z2-K (according to EN 50618). The polarities of cables and terminals must be matched when making connections. Failure to do so can result in damage to the Product and injury to individuals. Make sure all electrical connections are secure and tight – confirm that you hear “click” to indicate that the connection is successful.

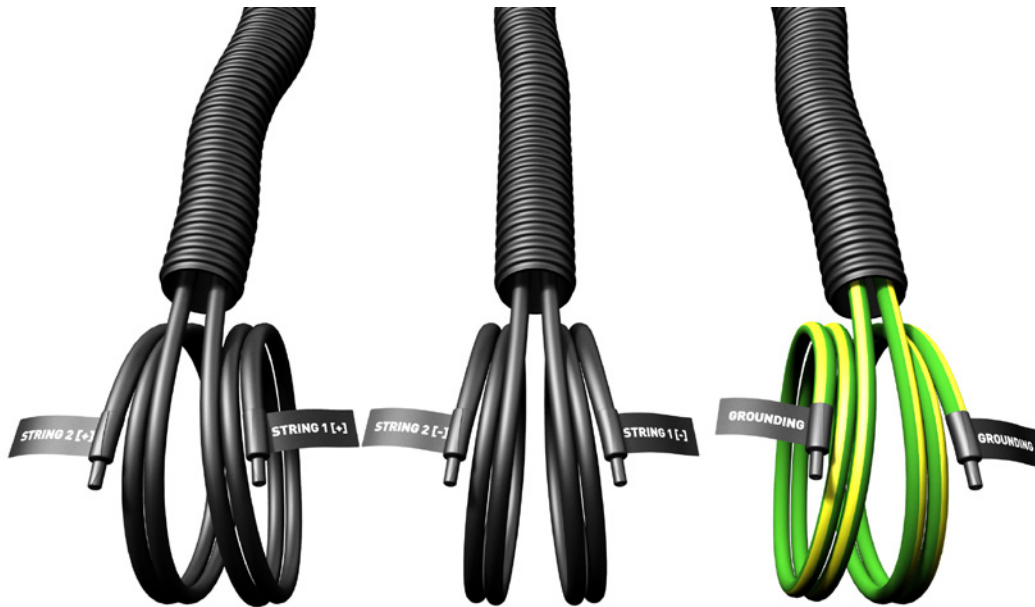


The inverter cables (String [-], String [+]), the grounding and extension cables connecting the Roofit.Solar Products should be positioned on site (i.e. between battens) before the installation. Loose cables should be fixed to the wooden structure with the help of cable holder clips.

In order for the PV system to maximize EMC (Electromagnetic compatibility) and minimize electromagnetic radiation, cabling should be positioned in a way to minimize the area of the wiring loop.

DO NOT group together positive, negative, and grounding cables to avoid ground fault and short circuit. Insulate bare DC cables and mark them accordingly for the time between PV system and inverter installation.

Each type of the cables should be separately routed to the protective tubes and taken to the technical room where they will later be connected to the inverter.



NB. Roofit.Solar PV systems must be equipped with DC arc fault circuit protection to provide protection against fires that may arise from the arcing faults in PV system components or wiring. Therefore, inverters with arc fault circuit interrupter (AFCI) must be used for the Roofit.Solar PV system installation.

Wiring Considerations

Voltages are additive when Products are connected directly in series, and currents are additive when the Products are connected directly in parallel. PV circuits should be designed according to the best practice guidelines of the relevant country.

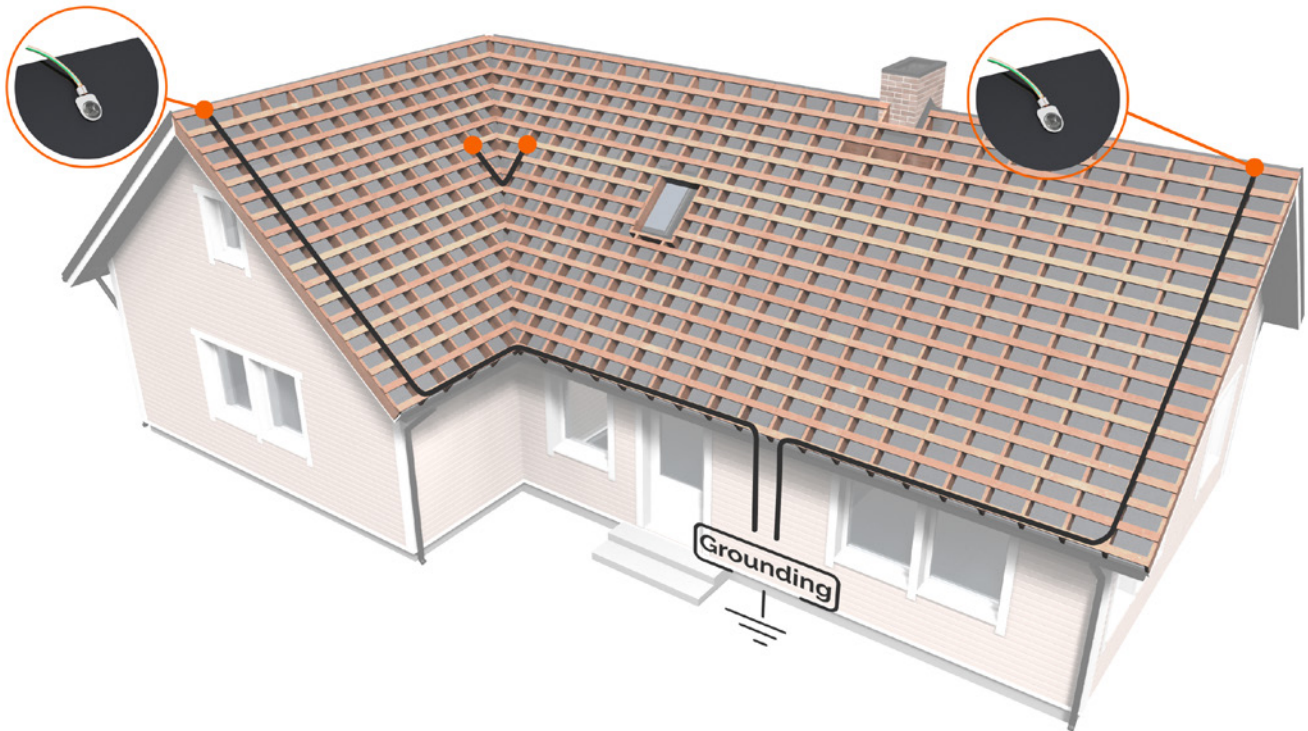
The maximum number of Products that can be connected in series string must be calculated according to the relevant regulations to ensure that the specified maximum system voltage of the Products and all other electrical DC components are not exceeded during open-circuit operation at the lowest expected temperature at the PV system location.

Additionally, the maximum number of strings that can be connected in parallel cannot exceed 2 without proper protection. An overcurrent protection device is required for each inverter. The maximum system voltage of the Roofit.Solar Product is 1000 VDC according to the safety assessments outlined in the IEC61730. The correction factor for the open-circuit voltage can be calculated using the following formula:

$$C_{voc} = 1 - \beta * (25^{\circ}\text{C} - T_{min})$$

T_{min} , °C is the lowest expected ambient temperature at the system site. β , %/°C is the temperature coefficient of the selected Product V_{oc} (Refer to datasheet). A properly rated overcurrent protection device must be used when the reverse current could exceed the maximum fuse rating of the Product.

Grounding



Each PV system must be connected to the grounding cable to ensure electrical safety. All Roofit.Solar products that are seamed with each other are galvanically connected. Roofit.Solar recommends 2 grounding cables per roof, to provide the possibility to measure ground connection quality.

If the building has more than one type of active surface on the roof (i.e., Roofit.Solar Products covering different sides of the roof), they can be connected in one grounding circuit to minimize the number of grounding cables as shown in the picture. Double grounding of the PV system is recommended even when applicable regulations, code requirements and standards do not require any safety-related grounding.

The grounding should be initialized by screwing a self-tapping A2 or A4 stainless steel screw, ST 4.8 according to DIN 7981C with a length between 10 mm and 16 mm. The screw is connected to the grounding conductor on the uppermost metal sheet of the roof under the ridge cap. The grounding is finalized by connecting the grounding conductors to the equipotential grounding.

→ PV system installation

Accessories for installation

Flat-head Screw



4,2 x 25mm
Used for fixing fastening clips

Cable fastening clip



Used for fixing loose cables to the battens

Bumping Mallet



Metalcutter



Screwdriver



M82 butyl sealant



Seaming pliers



Overlapping element



Electric seamer



Installation instructions

Below, three different installation scenarios are presented, highlighting only the most important aspects to follow during the installation.

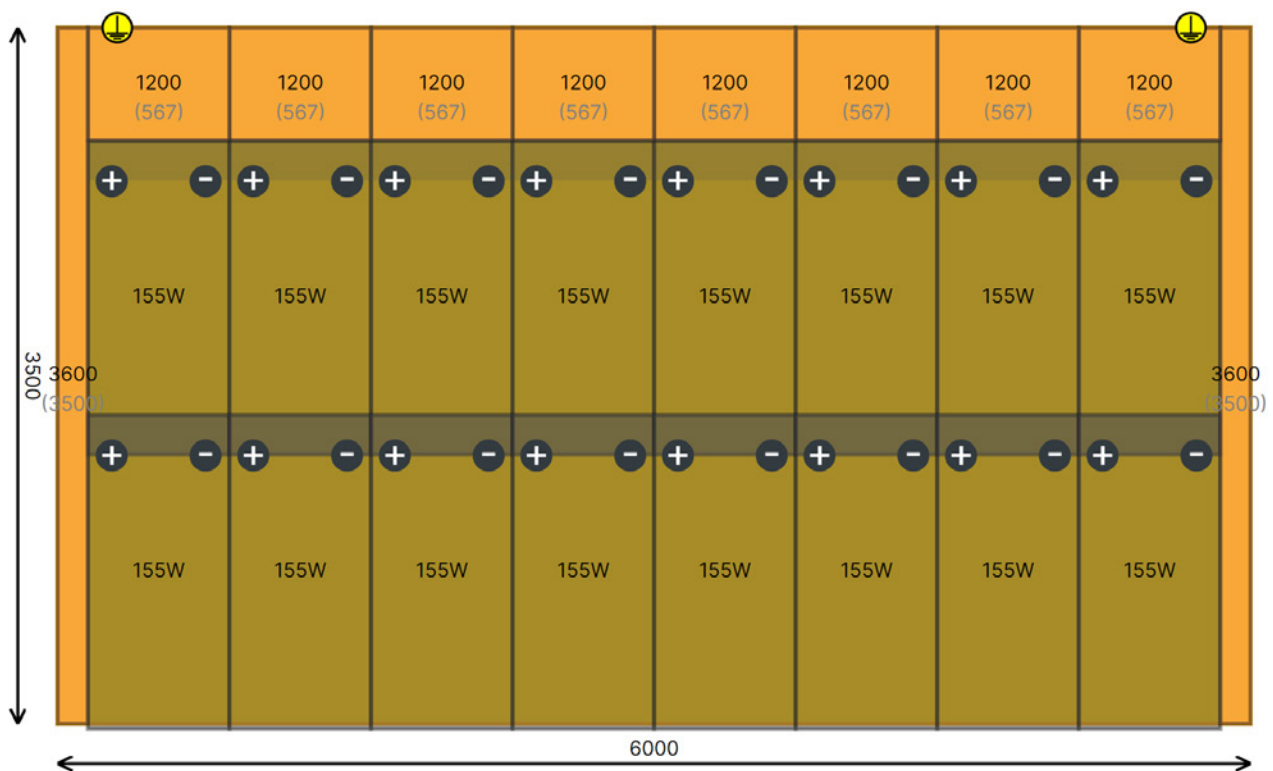
Case 1 represents the most straightforward scenario, where the entire roof is covered with solar modules.

Case 2 describes an installation, where the lower part of the roof uses regular metal.

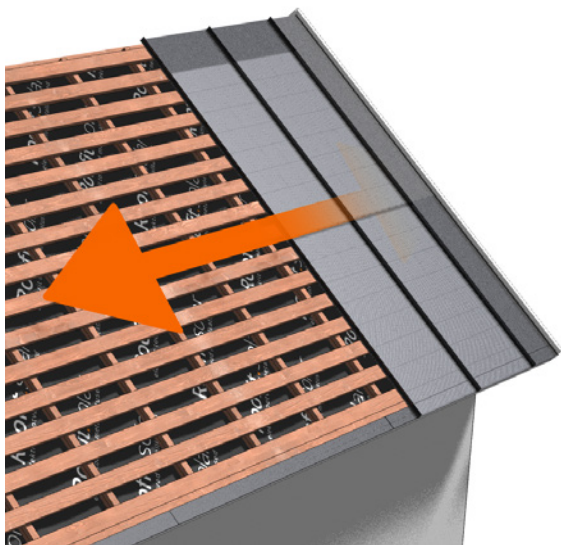
Case 3 describes an installation where the upper part of the roof uses regular metal.

Some of the steps in Case 1 are universal and won't be repeated in the other cases. Therefore, in any case, go through Case 1 and consult with our Technical Support for any questions.

Case 1: Roof fully covered with Roofit.Solar modules.

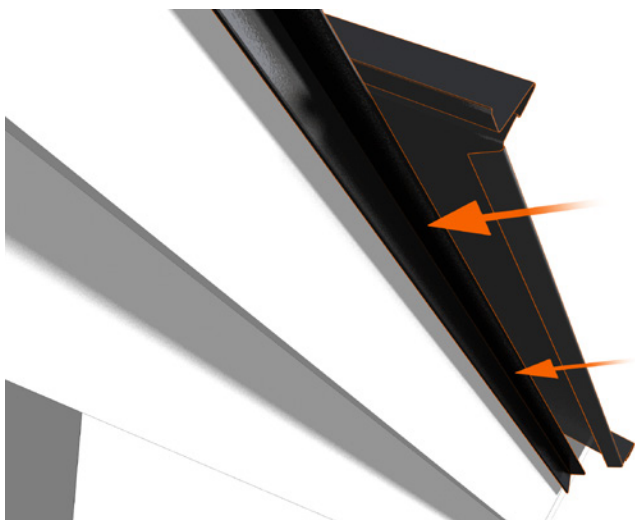


Step 1.



When installing solar modules on a roof, begin with the rightmost column and use a regular metal sheet for the first column. Depending on the size of the roof, some of the metal sheets may need to be cut to fit properly. Before starting, make sure to install the eave flashing in a continuous line, rather than overlapping it. It's also a good idea to use insulation under the regular metal to prevent issues like oil canning and noise.

Step 2.



When installing the first sheet, make sure the bottom backband is tucked under the lip of the eaves flashing. Then, pull the sheet towards the ridge until the lip of the eaves flashing is at the bottom of the sheet's backband.

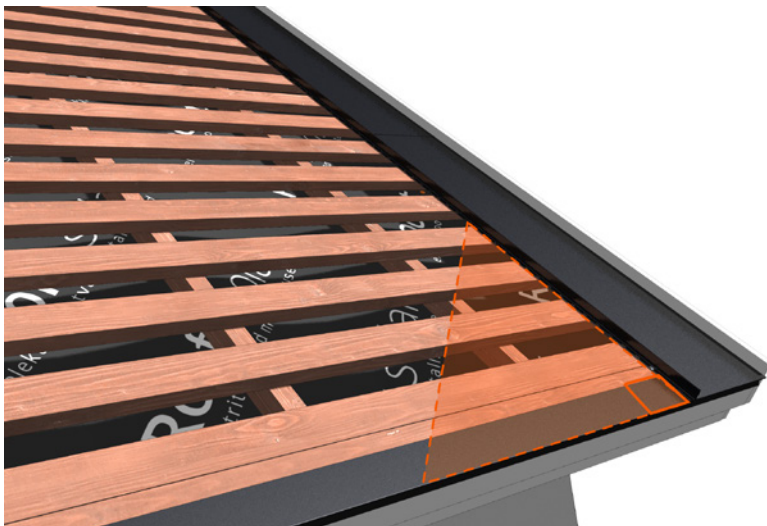
Step 3.



First, fix the roofing sheet with just one flat-head screw at the bottom corner of the sheet.

Use extra caution when installing the first roofing sheet. Ensuring that the first roofing sheet is at a right angle to the eaves flashing will make the installation of the rest of the roof easier.

The right angle (90°) can be determined with a right-angled triangle equation $A^2 + B^2 = \sqrt{C}$, for example with dimensions of A=3m; B=4m; C=5m. Mark measurement A on the roofing sheet and B on the eaves flashing. Adjust the roofing sheet around the fixing point to achieve a value of exactly 5m for the line C.



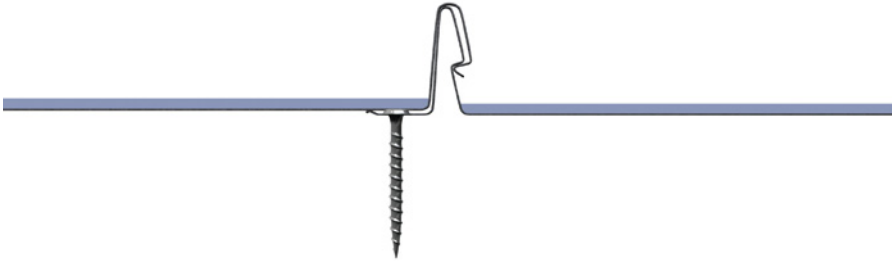
After the angle has been adjusted, fix the metal with more screws.

Fixing of the roof material depends on the width of the metal.

General rule requires min. 7 screws/m² for the roof. Areas with high wind speed require 10 screws/m².

If you follow the recommended batten spacing of 200mm, both the 712mm wide PV module and passive metal should be securely attached to each batten. A minimum of 200mm from the bottom edge of the roof should have full decking, and additional screws have to be used to ensure the proper fixation of the metal. For narrow (475mm) metal sheet installation, refer to the Ruukki manual.

Step 4.



Make sure to be mindful of how tight the screws are when fixing the sheets and the direction in which they are screwed. If the screws are too tight, it can prevent the sheets from expanding and contracting properly due to temperature changes.

Step 5

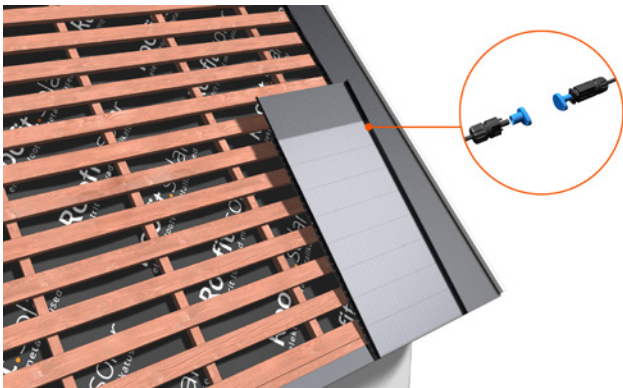


All PV modules come with a precut lock in the upper left and right corner.



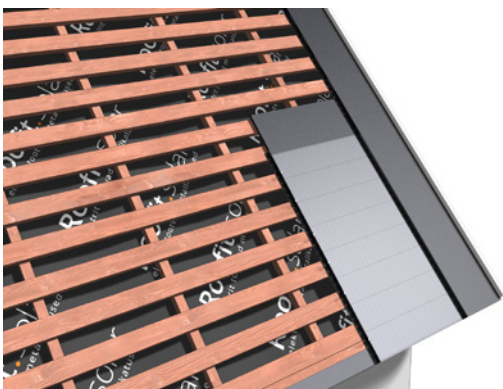
All PV modules, except those finishing the ridge of the roof, need to have an additional cut made in the right corner.

Step 6.



Before fixing the PV module, make sure to connect the cable with the previous module. Remove the dust caps and push the connectors together until you hear a *click*. Bring the second cable of the PV-module out from the left side to ease the connection of the next module afterwards.

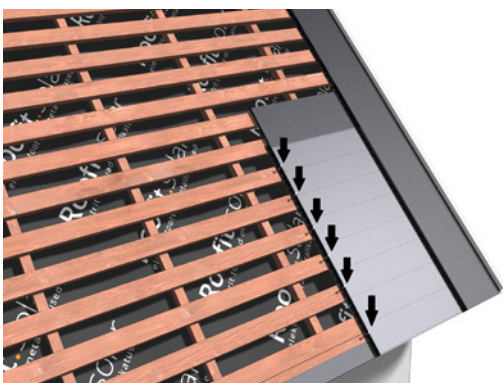
Step 7.



When installing the Roofit.Solar modules, make sure to align the edge of the new module with the edge of the one that is already fixed to the roof.

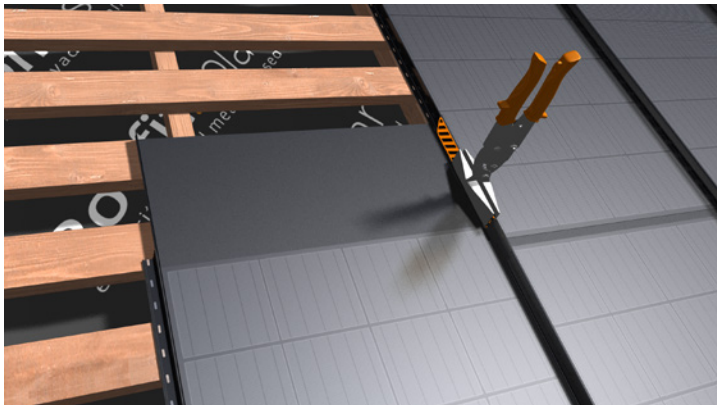
Once it is aligned, use your hand to secure it in place while moving from the eaves to the ridge. Make sure the bottom ends of the modules are in line.

Step 8.



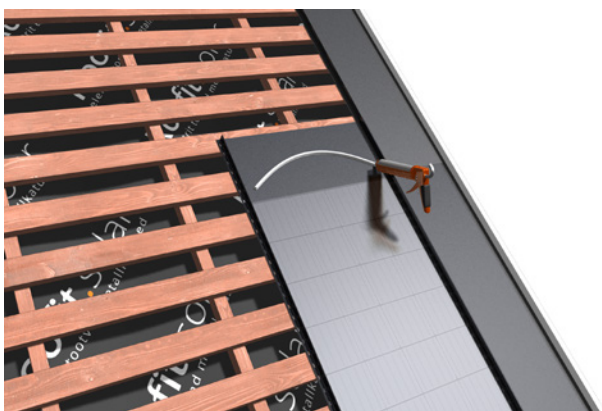
After locking the seam, use flat-head screws to attach the Roofit.Solar module in place.

Step 9.



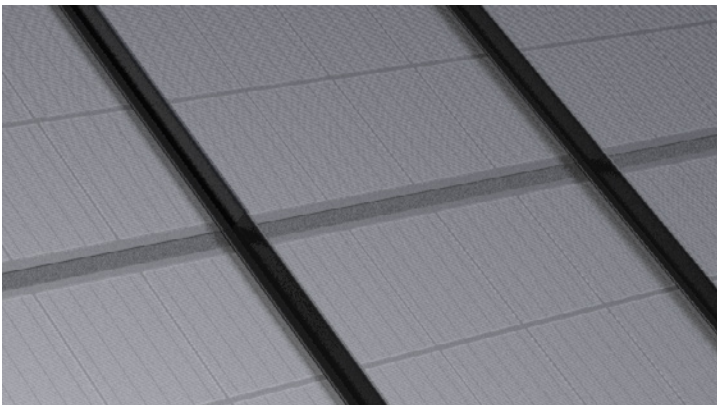
After fixing the module, use pliers to tighten the upper right side lock before next module is installed.

Step 10



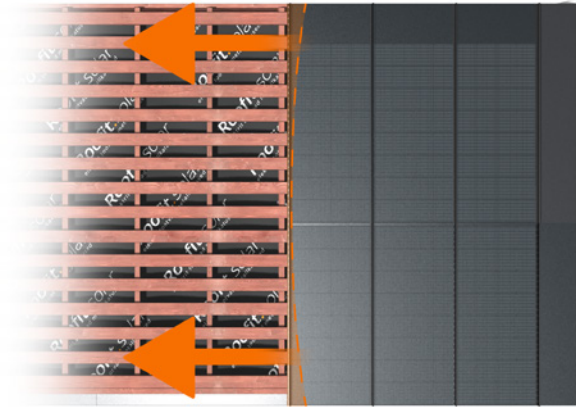
Butyl sealant M 82 is applied in a curved line in the middle of the overlap section, leaving a few centimeters gap at the end for condensation water drainage.

Step 11



When installing the next module on top, make sure to align it with the seam cuts of the lower module, leaving a 5mm gap between the two glass surfaces.

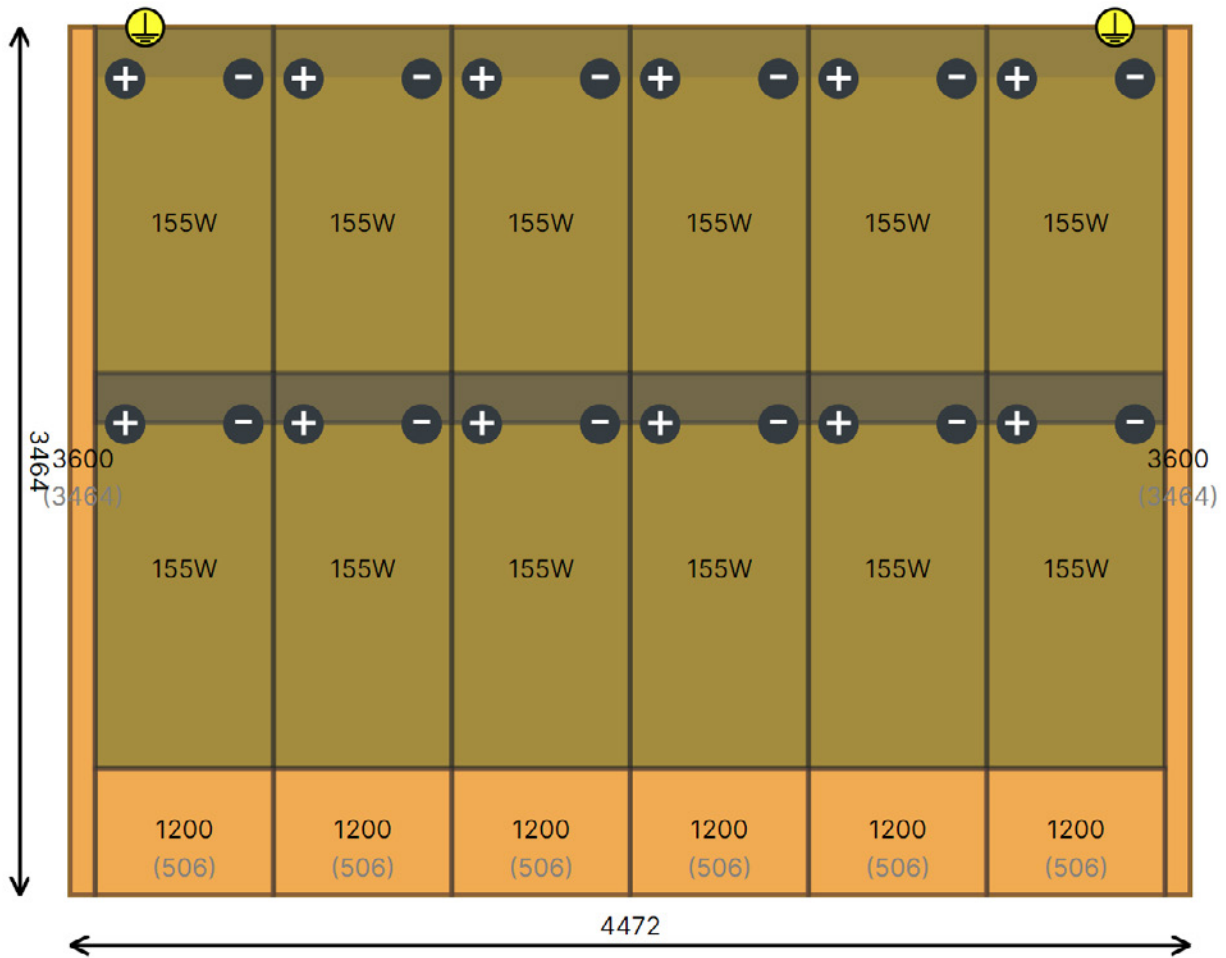
Step 12.



During the installation, be aware that multiple metal layers come together in the overlap area, which can cause misalignment. Make sure to check the width of the roof and if needed, adjust the line by slightly pulling the left side lock before attaching the screw to ensure everything is lined up correctly.

Case 2: Column starts with “bottom extension”

The majority of the installation steps are similar to Case 1, except for the lower part with non-PV regular meta.

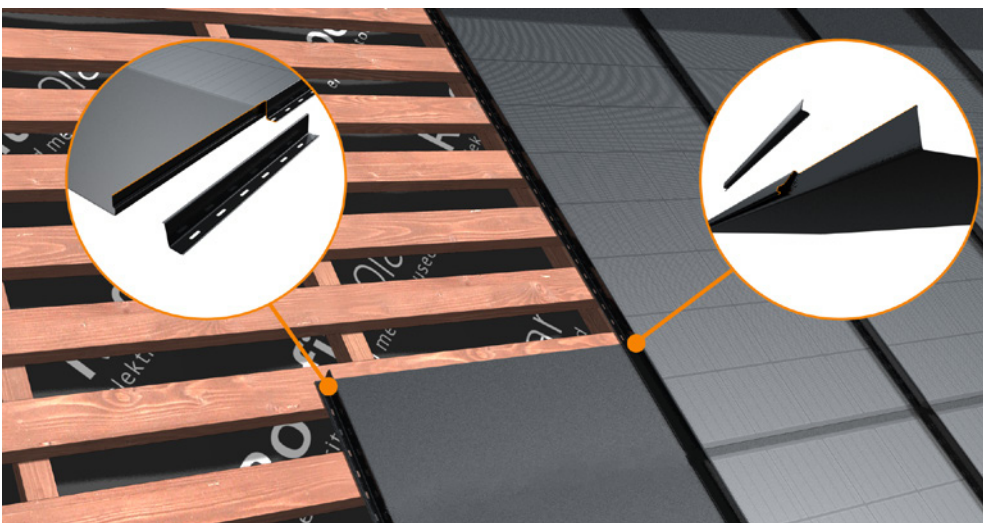


Step 1.



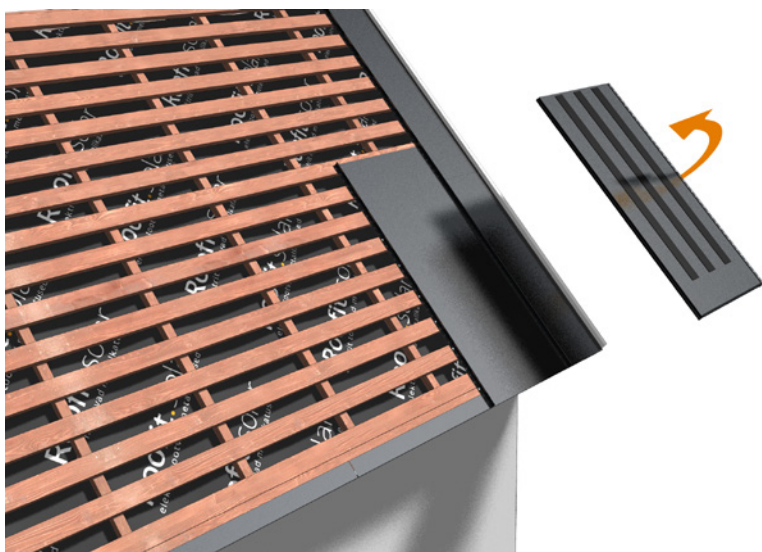
Bottom extensions are provided with a backbend in a minimum length of 1200mm. In case a shorter piece is needed, use metal scissors, low speed circular saw, nibbling machine, jigsaw or any other device that does not produce heat. While measuring, consider 200mm overlap that goes under the top piece.

Step 2.



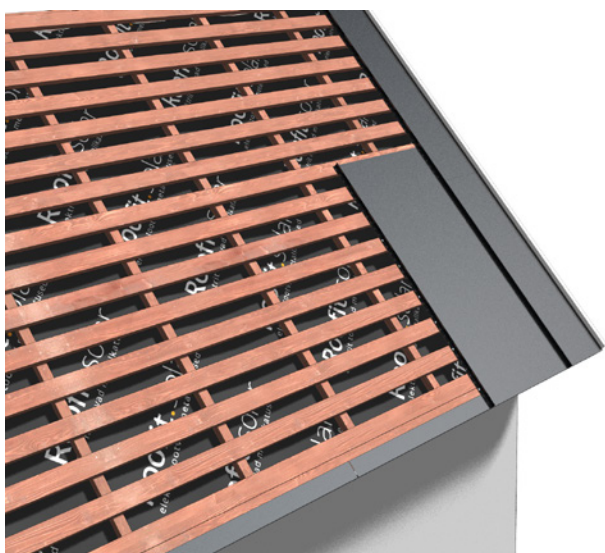
The top part of the left and right seams needs to be cut in the length of 205mm before installing a PV module on top.

Step 3.



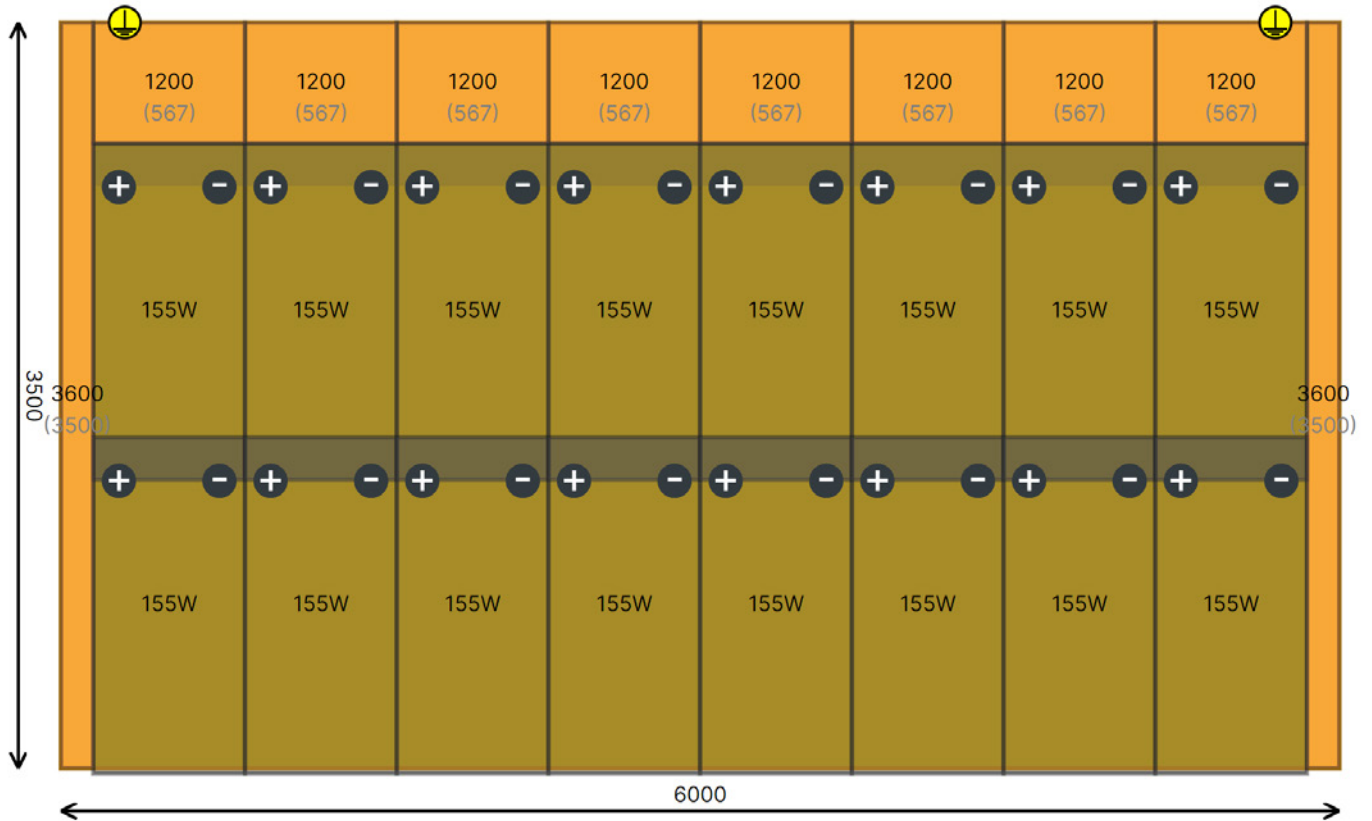
To reduce wind noise and oil canning, use a sound insulation band under the regular metal sheet. Be careful when handling the metal sheet and place it on a soft surface to prevent scratches on the paint or zinc coating. When gluing the insulation band, apply 3 stripes under the wide (712mm) regular metal sheet, leaving 250mm clear from the bottom.

Step 4.



Install the next PV module on top with a 200mm overlap.

Case 3: Overlap between module and “upper extension metal”



Step 1.



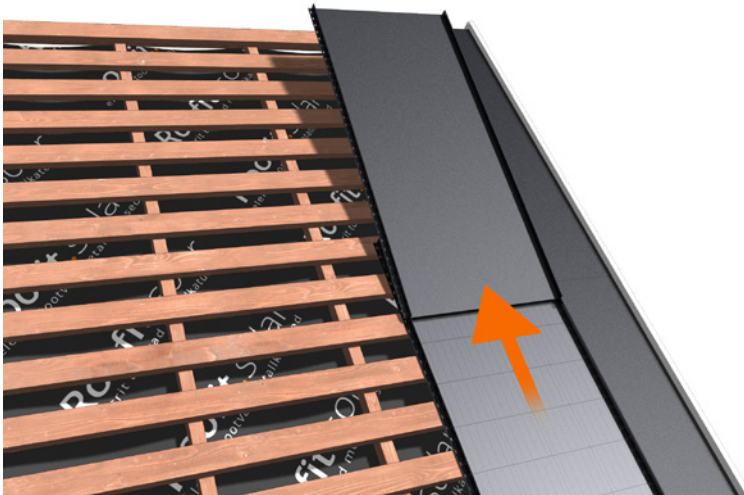
Upper extensions are provided with a backbend in a minimum length of 1200mm. In case a shorter piece is needed, one must use metal scissors, low speed circular saw, nibbling machine, jigsaw or any other device that does not produce heat.

Step 2.



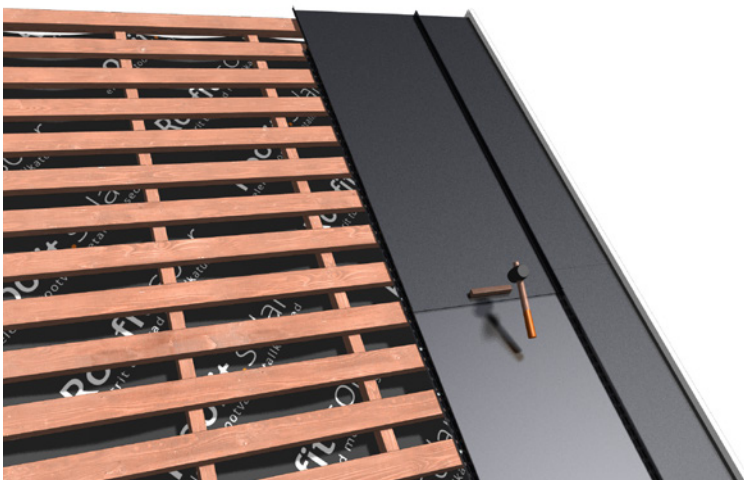
To install a regular metal sheet on top of the PV module, a 200mm overlap element is placed on the lower PV module. Overlap element is attached with 3 flat-head screws. If there is no batten underneath, install one. Bending the lower side of the overlap element upwards will make the next steps easier.

Step 3.



The backend of the upper roofing metal must be hooked behind the overlap element on the lower PV module. Then, firmly pull the upper sheet towards the ridge to ensure it is securely in place.

Step 4.



Lock both roofing sheet seams by tapping along the inner edges of the seam with a rubber mallet and a wooden block. Pay attention not to hit the glass of the lower PV module.

Maintenance

Regular inspection and maintenance of the Products is necessary, especially within the Warranty Period. It is the user's responsibility to report any damages to the supplier within 4 weeks after the Product delivery.

Cleaning

Dust accumulation on the glass may reduce power output and even cause regional hot-spot effects. Industrial emissions or bird droppings may also affect, and the degree of severity depends on the transparency of the foreign objects. Usually, the accumulated dust does not reduce the transparency much, as light intensity is still homogeneous and the reduction in power output is typically not visible.

Negative environmental effects, such as foreign objects casting shadows or laying directly on the roof, may adversely affect the power output of the Product. Roofit.Solar advises that the PV part of the system should not be obstructed at any time. The Product cleaning frequency depends on the environmental factors. In many cases the glass is sufficiently cleaned by naturally occurring rain and the necessity to explicitly clean it is reduced.

When cleaning the Product, it is recommended to wipe the glass surface with a damp sponge or soft cloth – without touching any electrical connections. Do not clean the glass with an acidic or alkaline cleaning agent.

Visual inspection

Inspect the Products visually to detect any possible defects such as glass breakage. It is recommended to implement the following preventive maintenance every 12 months (if accessible):
Check if the connectors are intact and encapsulated (i.e., the cables are not exposed).
Check the sealing gel of the junction box to locate any possible cracks or crevices.

Decommissioning and Disposal

Roofit.Solar is strongly committed to protecting the environment. The Products are durable for decades and built of non-hazardous materials. When the Products have reached the end of their life cycle, they should be disposed in accordance with local recycling regulations.

Customer Support

Technical support shall be provided to the owner of the Roofit.Solar system by the Buyer For more information, please visit Roofit.Solar website www.roofitsolar.com