

# Roofit.solar

## Double Seam

### Safety and Installation

### Manual



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## » Acronyms

<b>AM1.5</b>	Air Mass 1.5
<b>BIPV</b>	Building Integrated Photovoltaics (i.e. metal integrated photovoltaics)
<b>DC</b>	Direct Current
$I_{max}$	Current at maximum power
$I_{sc}$	Short Circuit Current
<b>JB</b>	Junction box
<b>m.a.s.l.</b>	Meters above sea level
<b>PV</b>	Photovoltaic
$P_{max}$	Maximum power
<b>STC</b>	Standard Test Conditions (T= 25°C, Solar Irradiance = 1000 W/m <sup>2</sup> , AM = 1.5)
$V_{max}$	Voltage at maximum power
$V_{oc}$	Open Circuit Voltage
<b>R</b>	Radius
<b>d</b>	Diameter

## » Definitions

<b>Buyer</b>	A person or party that purchases the Product/s from the Roofit Solar Energy OÜ.
<b>Product/s</b>	Roofit Solar Energy OÜ BIPV (i.e. metal integrated photovoltaics)
<b>Warranty Period</b>	The period beginning on the date of purchase Product/s by the Buyer
<b>PV layer</b>	The Photovoltaic part of the <b>Roofit.solar</b> Product
<b>PV system</b>	System composed of several <b>Roofit.solar</b> Products combined with an inverter and other electrical and mechanical hardware

## » Introduction

This manual contains essential information for electrical and mechanical installation that must be followed before handling, installing and maintaining our Product. In addition, this manual also contains safety information one needs to be familiar with.

## » Disclaimer of Liability

All the information contained within this manual is the intellectual property of the 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, expressed or implied. Roofit Solar Energy OÜ does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected with installation, operation, use or maintenance of our Product. No responsibility is assumed by the Roofit Solar Energy OÜ for any infringement of patents or other rights of third parties that may result from use of our Product.

Roofit Solar Energy OÜ reserves the right to make changes to the Product, specifications or installation manual without prior notice. Failure to comply with the requirements listed in this manual will invalidate the warranty for our Product as provided by the Roofit Solar Energy OÜ. Additional recommendations are provided to enhance safety practices and performance results.

The mechanical and electrical installation of PV systems shall be performed in accordance with all applicable codes, including electrical codes, building codes and electric utility interconnect requirements. Such requirements may vary for different countries. Contact local authorities for governing regulations. The installation of the product must be done by a qualified person. Electrical connection must be done by a certified electrician. Planning of the Product's location on the roof should be done by a competent professional experienced in PV system planning.

# » Safety

## General Consideration

The Product is designed to meet the requirements of IEC 61215 and IEC 61730 standards. It is essential to perform a structural analysis of the roof before installing the **Roofit.solar** Products.

Take note of all relevant laws, regulations, guidelines and safety measures when handling solar photovoltaics.

**Roofit.solar** Products can be combined with other components to form a photovoltaic system. In this case you must also follow the installation and operation instructions issued for these additional components.

The distributor of our Products is required to provide a copy of this manual to the PV system owner for their reference, and inform them of all relevant aspects of safety, operation, and maintenance.

## Storage and Transportation Safety

Do not keep the Product open in the outdoor environment until they are ready to be installed. The package needs to be protected against exposure to damage. Secure boxes/pallets from falling over.

Make sure the Products are transported and stored in properly designed packaging. Store Products in a ventilated, rain-proof, and dry location.

Be cautious when laying Products down, especially note the corner of the Product, as inappropriate transport and installation may break the Product.

When storing uninstalled Products outdoors for any period of time, always cover them with a waterproof cover and ensure that the glass side faces downwards to prevent damage to JB's and connectors.

## Electrical Safety

To eliminate the risks of electrical shock, Products have been tested in accordance with EN IEC 61730-2:2018.

A PV system produces DC electricity when exposed to light and therefore can produce an electrical shock or burn when improperly handled. DC voltage of 42 Volts or higher is potentially lethal. This hazard increases when multiple Products are connected to provide higher system voltage or current levels. Dangerous voltages may also be present at night from connections to batteries and feedback from inverters or other system



components. PV systems produce voltage even when not connected to an electrical circuit or load.

The Products can be rendered inoperative only by removing them from sunlight, or by fully covering their front surface with cloth, cardboard, or other completely opaque material, or by working with Products face down on a smooth flat surface.

A PV system can produce higher output than the rated specifications. Industry standard ratings are made at STC. Reflection from snow or water can increase sunlight and therefore boost current and power. In addition, colder temperatures can substantially increase voltage and power. This must be taken into consideration during the system design done by a competent person experienced in PV system planning (for more information refer to the section Electrical Installation).

## Always adhere to the following installation precautions:

- DO NOT disconnect/connect electrical connections under load. Faulty connections can result in arcs and electrical shock.
- DO NOT take off a dust cap that protects the connector from the moisture and dust particles before electrical connection takes place.
- DO NOT open the junction box. There are no user serviceable parts inside. Opening the junction box may expose the individual to an electrical shock hazard and will void the warranty.
- DO NOT connect the cables if the terminals are wet.
- DO use electrically insulated tools and rubber gloves when working with the Product.
- DO NOT use mirrors or other magnifiers to concentrate sunlight onto the Product.
- DO NOT overbend or apply stress to the cables. Observe recommended cable bend radius.
- The maximum bending radius is defined as following:  
 $R \text{ (bend radius)} > 5 \times d \text{ (cable diameter)}$
- DO NOT group together positive, negative and grounding cables to avoid earth fault and short-circuit.
- DO insulate bare DC cables for the time between PV system and inverter installation
- DO ensure that all electrical connections are properly secured and protected from unwanted interference



# Installation Safety

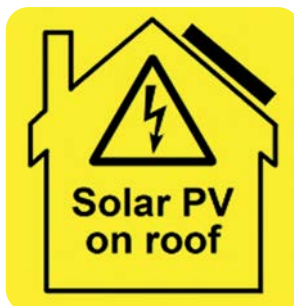
For your safety, do not attempt to work on a rooftop until the necessary safety precautions have been identified and taken, including without limitation: fall protection measures, ladders, lifts or stairways, and personal protective equipment. Sufficient protective equipment (e.g. harnesses etc.) is required throughout the installation process.

## Always adhere to the following installation precautions:

- DO NOT install or handle Product under adverse conditions (strong or gusty winds, wet or frosted roof surfaces, etc.).
- DO NOT lift the Product by grasping the junction box or electrical leads.
- DO NOT stress the Product with a heavy load.
- DO NOT drop the Product or drag it across any surface.
- DO NOT attempt to repair Product yourself.
- DO NOT apply paint or adhesive to the Product's surface.
- DO NOT leave a Product unsecured. If a Product falls, the glass layer could break. A Product with a broken glass layer cannot be repaired and must not be installed.
- DO NOT attempt to modify the Product or disassemble it.
- DO NOT remove any markings or labels applied or parts fitted to the Product by the manufacturer.
- DO NOT attempt to install or service any portion of the PV system unless you are qualified to do so.
- DO NOT drill holes in the PV layer of the Product. Doing so will void the warranty.
- DO NOT work with the Products if they are wet.
- ALWAYS mount the Product so that the junction box is unobstructed and does not carry any of the weight of the Product.

## Fire Safety

Consult your local authority for guidelines and requirements for building or structural fire safety. Roofit Solar Energy Products were tested according to CEN/TS 1187 and labelled as Broof (t2) in accordance with EN 13501-5:2016. In addition, the metal sheet was tested according to the EN 14782:2006 Self-supporting metal sheet for roofing, external cladding and internal lining. Roof constructions and installations may affect the fire safety of buildings. Improper installation may create hazards in the event of a fire. Use appropriate components such as fuses and grounding connectors as required by the local authority.



**Inform firefighters about the existence of a photovoltaic system in the building.**



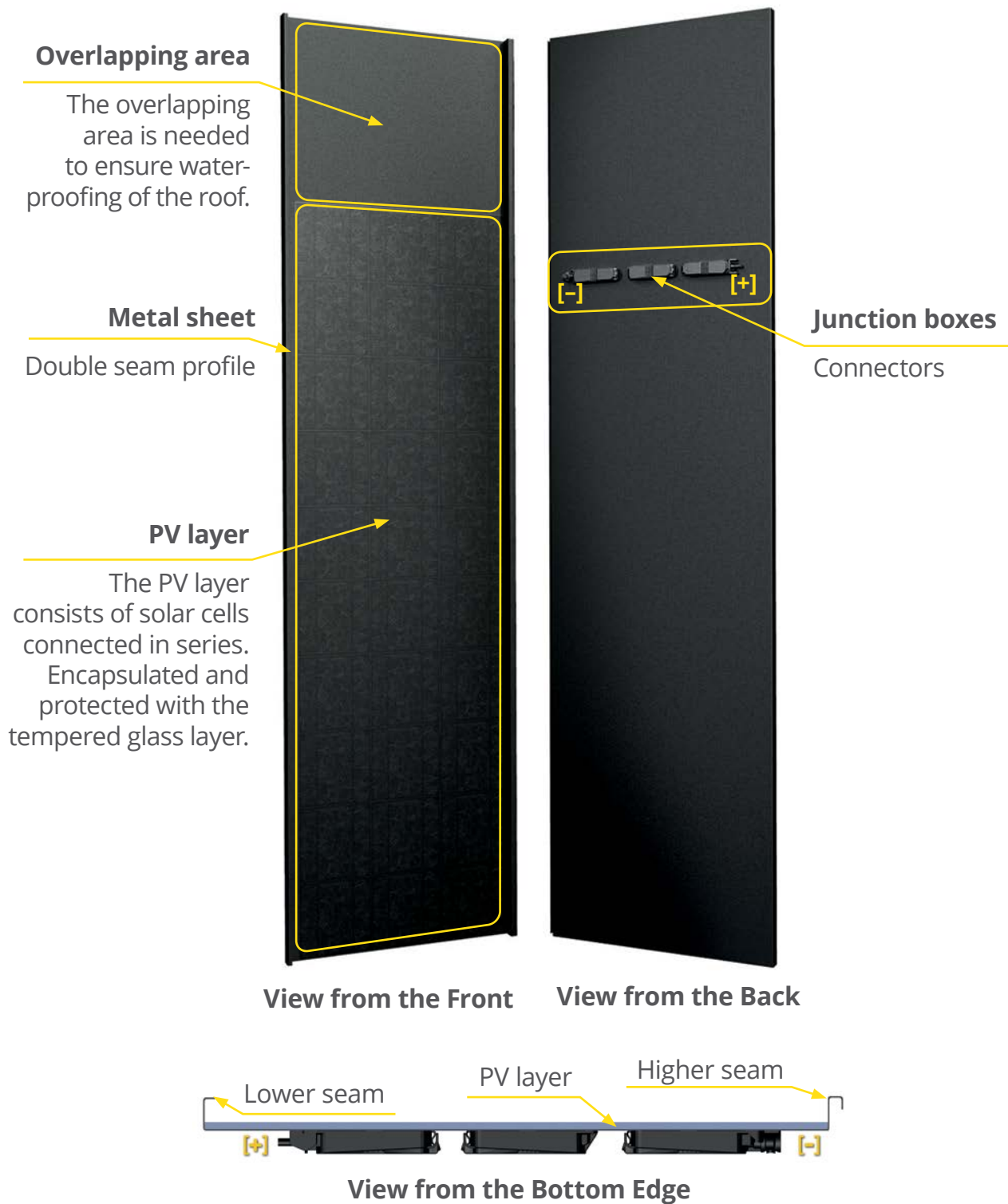
**In case of fire, stay away from all elements of the PV system, until the area is safe.**



## » Roofit.solar Product Information

The **Roofit.solar** Product is a building integrated photovoltaic (PV) product that is used as a construction material placed on a roof or the facade of a building.

### Illustration of the Product



## Connectors

The **Roofit.solar** Product has three JBs which include positive and negative MC4 terminals. The junction boxes have been designed to be electrically interconnected in series with IP67 protection grade.

Manufacturer	Type	Ambient temperature (°C)	Degree of protection	Rated voltage (V, DC)	Rated current (I, A)
TE Connectivity	PV4-S/S1 Connector	-40 to +85	IP67	1500 V	UL 20A DC TUV 40A DC

## Bypass diodes

The junction boxes contain a bypass diode wired in parallel with the PV cell strings. In the case of partial shading, the diodes bypass the current generated by the non-shaded cells, thereby limiting the Product's heating and performance losses. Bypass diodes are not overcurrent protection devices. In the event of a known or suspected diode failure, installers or maintenance providers should contact the supplier.

## Specification of the bypass diode

Type	Rated bypass current	Rated reverse current	Rated voltage	Operating temperature
TE 2213713-1	15 A	30 A	1500 VDC	-40 to 115 °C

## » Product environment

### Product location

The product must not be installed nor operated in areas where salt, hail, snow, sand, dust, air pollution, chemically active vapors, acid rain, soot, etc., are excessive. If necessary, appropriate measures must be adopted to ensure the performance and safety of the Product when installed or operated in areas with heavy snow, extreme cold, strong wind, or near coastal areas or deserts where salt fog may manifest. The operating temperature range of the product is between  $-40^{\circ}\text{C}$  and  $85^{\circ}\text{C}$ .

The recommended maximum altitude for the **Roofit.solar** Product installation is 2000 m.a.s.l.

Ensure the Product is not subject to wind or snow exceeding the maximum permissible load. The maximum permissible load has been defined as 2400 Pa. The Products should be installed in a location where there is none or minimal shading throughout the year. Ensure there are no obstacles to blocking light to the installed Product.

**Roofit.solar** is not responsible or liable for Products damaged during lightning. Therefore, surge protection is recommended for Products to be installed in locations with high probability of lightning strikes.

The Product should not be installed in locations where any type of corrosive agent and/or flammable gasses may be generated or collected.

### Roof Support Structure



Ensure the installation method and supporting system of the roofing materials are strong and durable enough to install the Product and meet its load conditions. The supporting system must be tested according to the local, national or international standards.

Any penetration (e.g. chimney, pipes etc.)

to the **Roofit.solar** Product must be properly sealed to prevent leaks. Always keep the back of the Product free from foreign objects which are not part of the support structure, especially when the Product is under mechanical load (e.g. during installation).



## Roof Slope

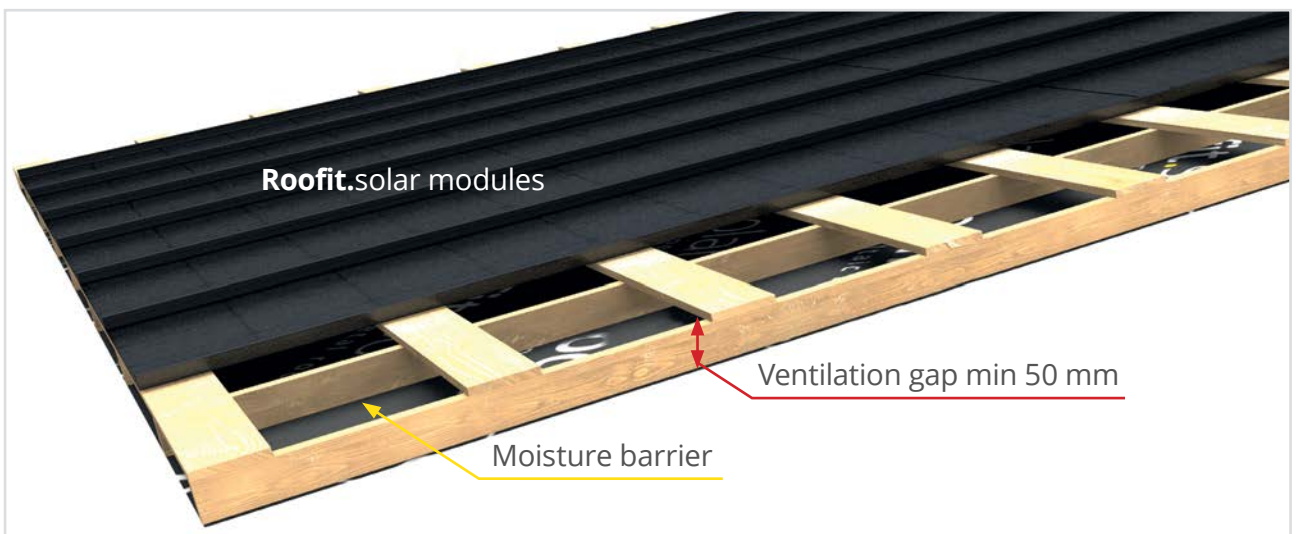
For the purposes of waterproofing as well as maintenance, it is strongly recommended the roof is at slope of more than 10 degrees.

## Location of battens

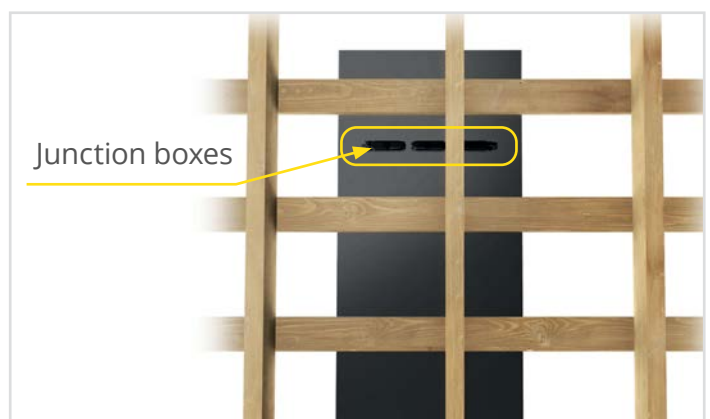
The battens provide support for the Product, and therefore, must be installed on one plane to eliminate the possibility of damage to the glass layer during installation.

Due to the stiff structure of the Product compared to the regular metal the batten spacing under the Product can be increased. However, observe the frequency of fixation of the Product to the battens according to the local roof installation requirements.

**Roofit.solar** recommends to have min 50 mm air gap between the Product and the insulation cover for air ventilation.



Special attention must be paid to the positioning of the battens in respect to the installation of the Product. Each Product has junction boxes that must be placed in between the battens to guarantee safe installation.

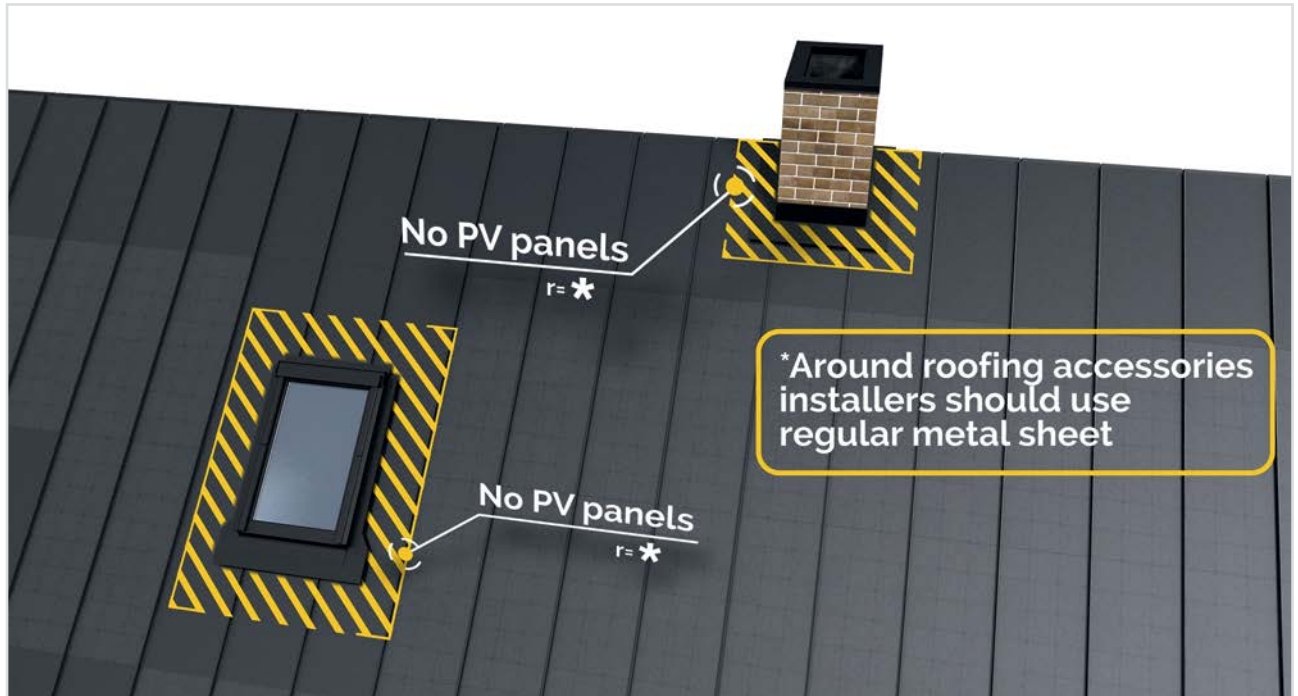




## Roofit.solar PV system planning

The PV layer of the **Roofit.solar** Product must not be cut or bent. All the penetrating roofing elements should be surrounded by standard metal sheets.

In case of the complex geometry, shadow analysis is recommended in order to determine suitable area for Products installation.



## » Electrical interconnection

### Electrical connection accessories

#### Jumper/Extension cable



##### Jumper cable (1 m)

Jumper cable connects Products electrically between each other.

##### Extension cable (> 1 m)

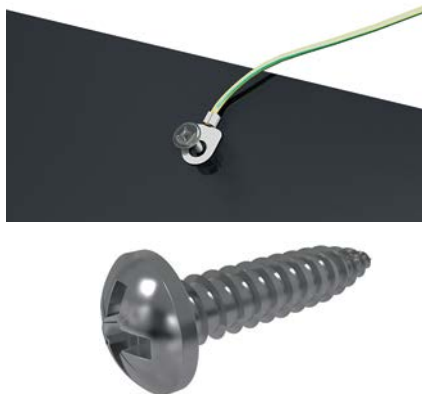
Customized length. Extension cables are needed if the connection distance between the modules is more than 1 m.

#### DC cable with MC4 male/female connector



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

#### Grounding cable



#### MC4 Spanner



MC4 spanner is a tool for MC4 male/female connectors disassembly.

## Wiring Considerations

Roofit Solar Energy OÜ recommends all wiring be double insulated with a minimum temperature rating of 110°C. All wiring should use flexible copper (Cu) conductors. The minimum sizes of wiring are determined by the applicable codes. Roofit Solar Energy OÜ recommends a size not less than 4 mm<sup>2</sup>. The insulation should be appropriate for the type of installation method used and must meet SKII (Safety Class II) and



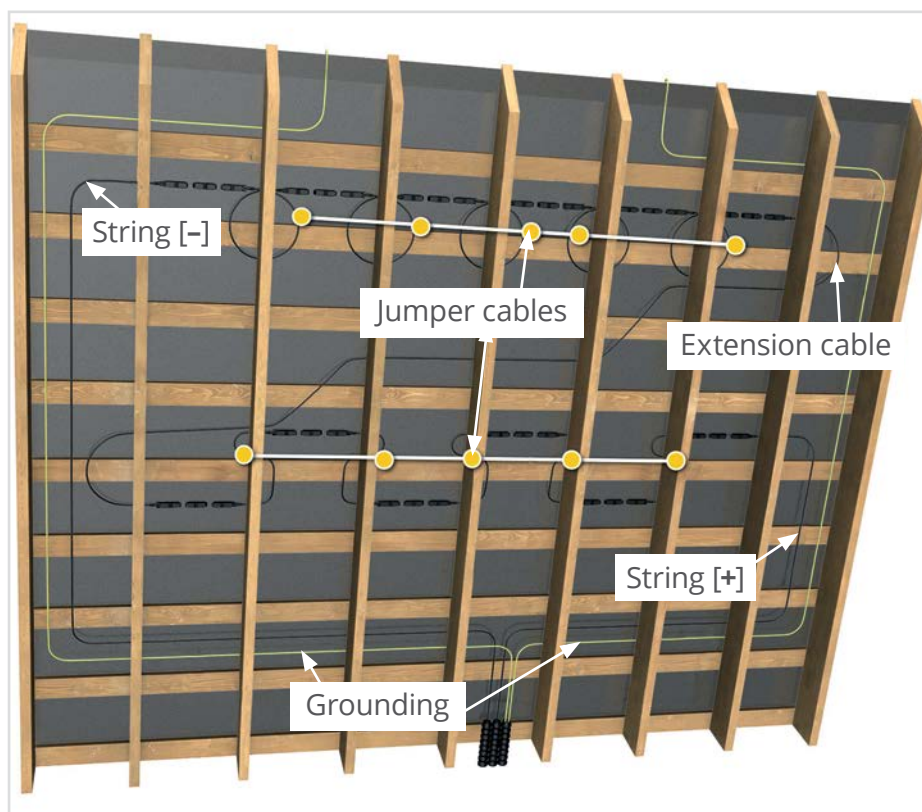
IEC 61730 requirements. The polarities of cables and terminals must be matched when making the connections, failure to do so may result in damage to the Product and your person. Ensure that all electrical connections are secure and tight.

## Series and Parallel Wiring

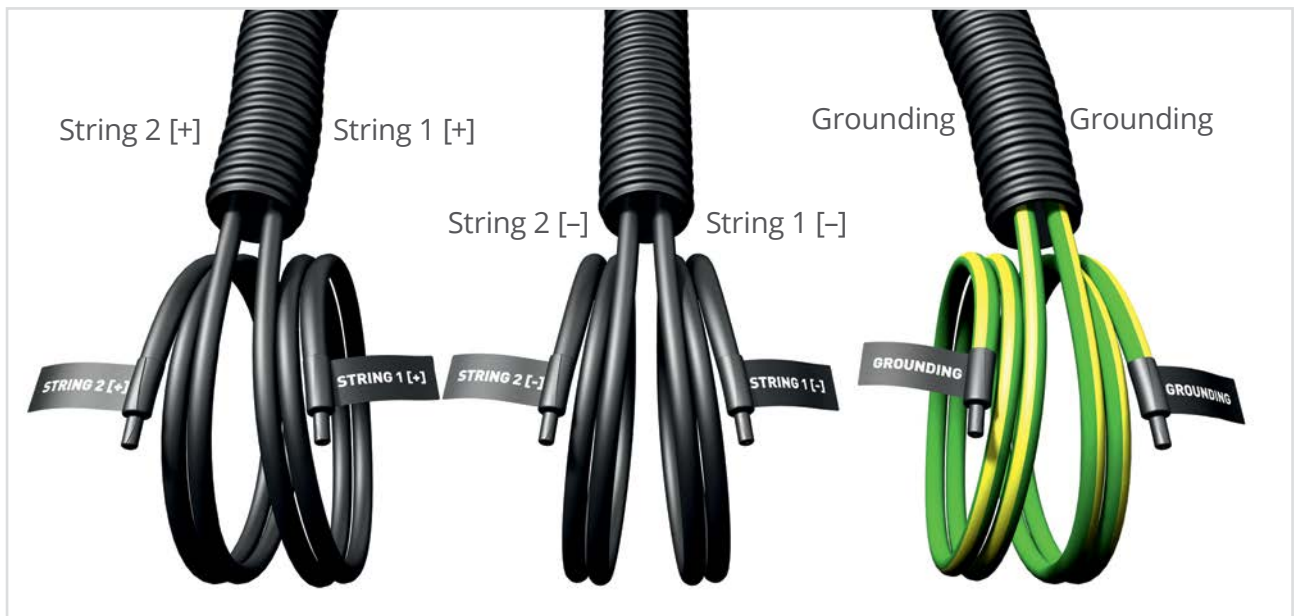
Voltages are additive when Products are connected directly in series, and currents are additive when Products are connected directly in parallel. PV circuits should be designed according to the best practice guidelines in the respective country. The maximum number of Products that can be connected in a series string must be calculated in accordance with applicable regulations in such a way that the specified maximum system voltage of the Products and all other electrical DC components will not be exceeded in open-circuit operation at the lowest temperature expected at the PV system location. In addition, 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 series string if more than two series strings are connected in parallel. The maximum system voltage of **Roofit.solar** Product is DC 1500V according to the safety appraisal of the IEC61730. The correction factor for the open-circuit voltage can be calculated based on the following formula:

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

$T_{min}$ , °C is the lowest expected ambient temperature at the system location.  $\beta$ , %/°C is the temperature coefficient of the selected Product  $V_{oc}$  (Refer to Annex 2). An appropriately rated overcurrent protection device must be used when the reverse current could exceed the value of the maximum fuse rating of the Product.



The inverter (String [-], String [+]), grounding and long extension cables connecting the **Roofit.solar** Products should be positioned in place (i.e. between battens) before the installation.



The positive, negative and grounding cables **must not be** grouped together to avoid ground fault and short circuit. Each type of cable must be routed to the inverter separately in isolation. The open end of the DC cable on the inverter side must be insulated for the period between the roof installation and the inverter installation.

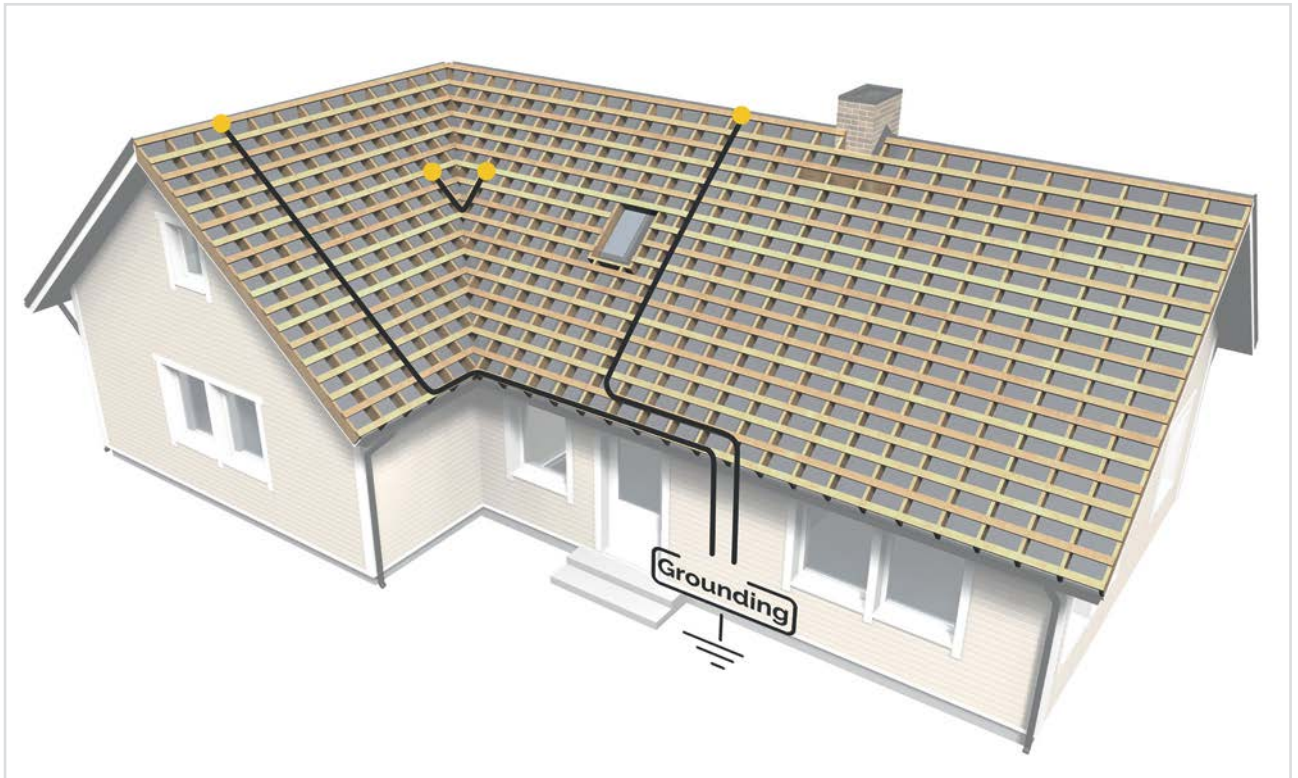
In order to avoid confusion, cables must be appropriately marked prior to installation.



Make sure all the MC4 connectors have blue dust-caps on prior to installation.

N.B. **Roofit.solar** PV system must be equipped with DC arc-fault circuit protection. DC arc-fault circuit protection provides supplementary protection against fires that may arise because of arcing faults in PV system components or wiring. Therefore, inverters with arc fault circuit interrupter shall be used for the **Roofit.solar** PV system installation.

# Grounding














Each solar roof surface must be connected to the grounding cable to ensure electrical safety. **Roofit.solar** recommends 2 grounding cables per roof, to establish the possibility to measure ground connection quality. Double grounding the PV system is recommended even when applicable regulations, code requirements and standards do not require any safety-related grounding.

In the case of the building having more than one type of active surface on the roof (i.e. **Roofit.solar** Products covering different sides of the roof), these can be connected in one grounding circuit to minimize the number of grounding cables.

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 grounding conductor on the uppermost metal sheet of the roof under the ridge cap. Grounding is finalized by connecting the grounding conductors to equipotential grounding.

## » Mechanical Installation

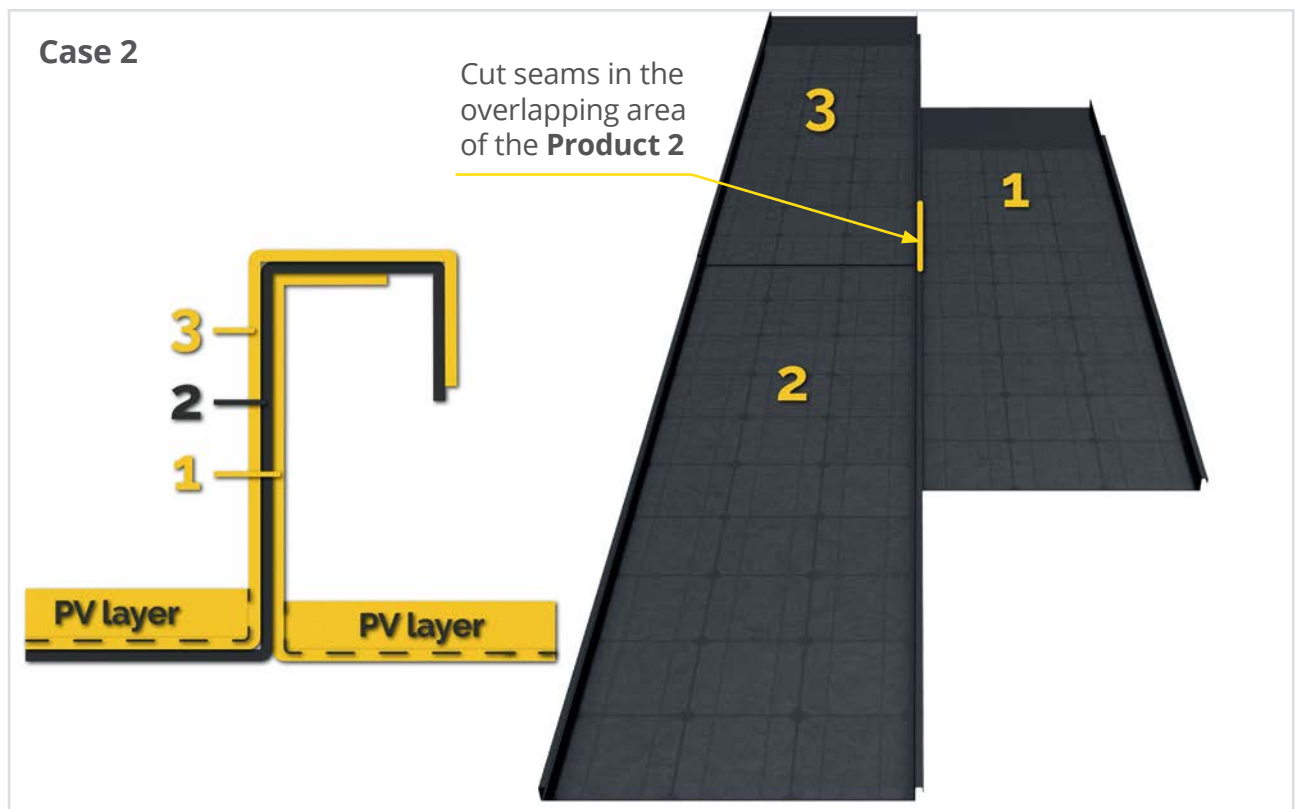
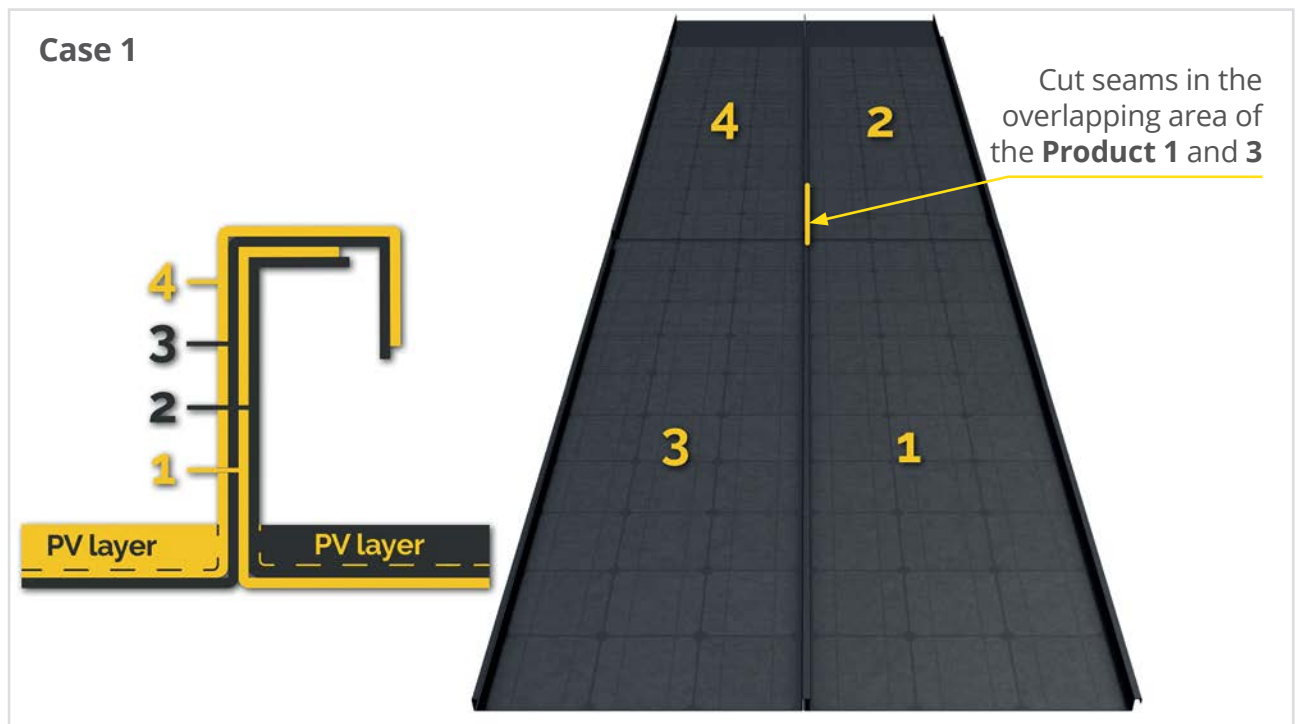
### Accessories for installation

<h3>Flat-head Screw</h3>  <p>Flat-head screws are used to fix fastening clips</p>	<h3>Sealant tape</h3>  <p>Sealant tape supports waterproofing of seams in the overlapping area for horizontal joint</p>	<h3>Double-sided Tape</h3>  <p>Double-sided tape is used to fix the overlapping fastening element</p>	
<h3>Overlapping Fastening Element</h3>  <p>The overlapping fastening element is used in the case of horizontal joints</p>	<h3>Seaming tools</h3> <h4>First seam folder</h4>   <h4>Second seam folder</h4>   <p>Seaming tools are needed to ensure the lock</p> <p>*Electric roof seamer can be used as long as no pressure is applied to the PV layer</p>		
<h3>Fastening Clip</h3>  <p>Fastening clips are used for fixing the Products to the battens</p>	<h3>Metal cutter</h3> 		<h3>Screwdriver</h3> 



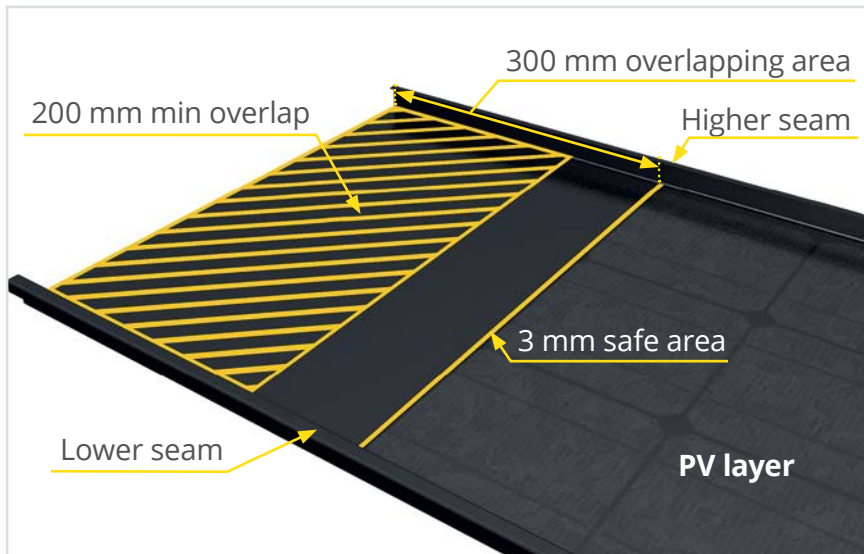
## Preparation of the Products

Cutting the seam is only necessary if more than 2 seams are overlapped. The seam cut should be done only in the overlapping area.

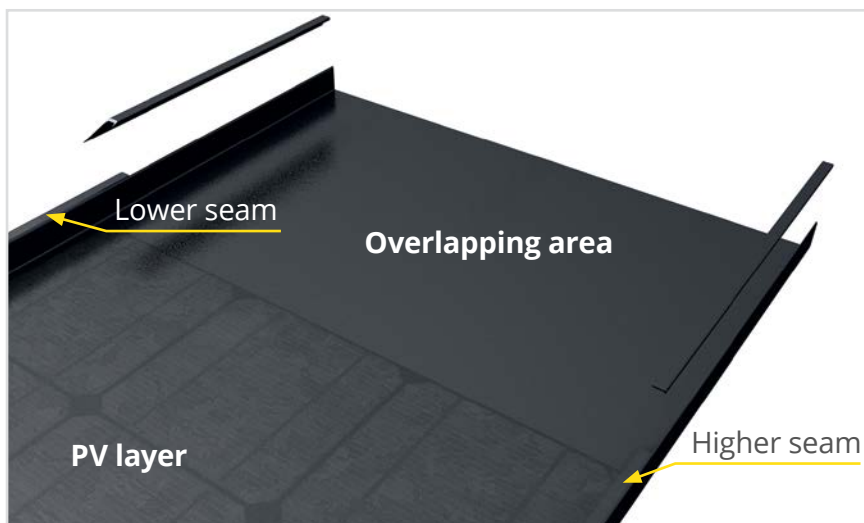
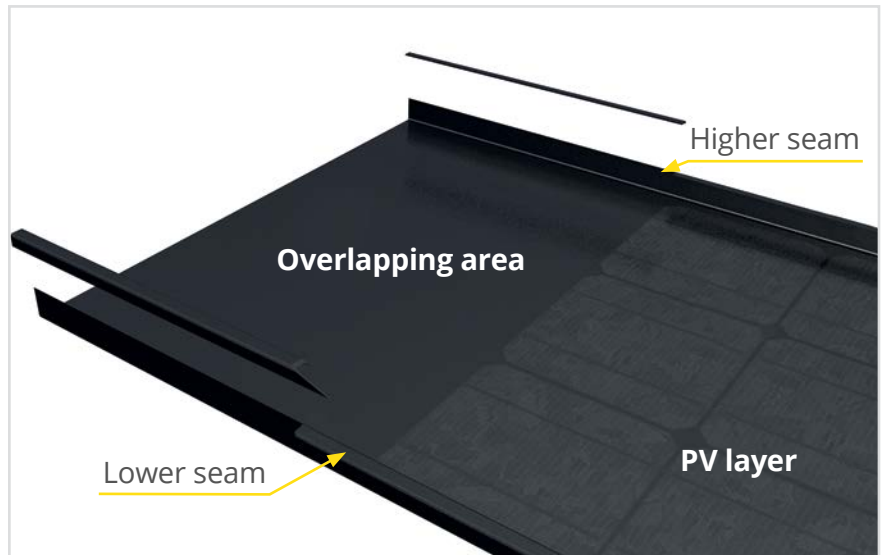


Conversely, if the top of the row is finalized with **Roofit.solar** Product, no cut is required.

## How to cut seams in the overlapping area for horizontal joint



The seam needs to be cut depending on overlapping coverage area – the gap between the PV layers can be changeable in a way that the overlapping area of minimum 200 mm and minimum distance of 3 mm between the PV layers (i.e. from glass to glass a minimum of 3 mm) must be assured.



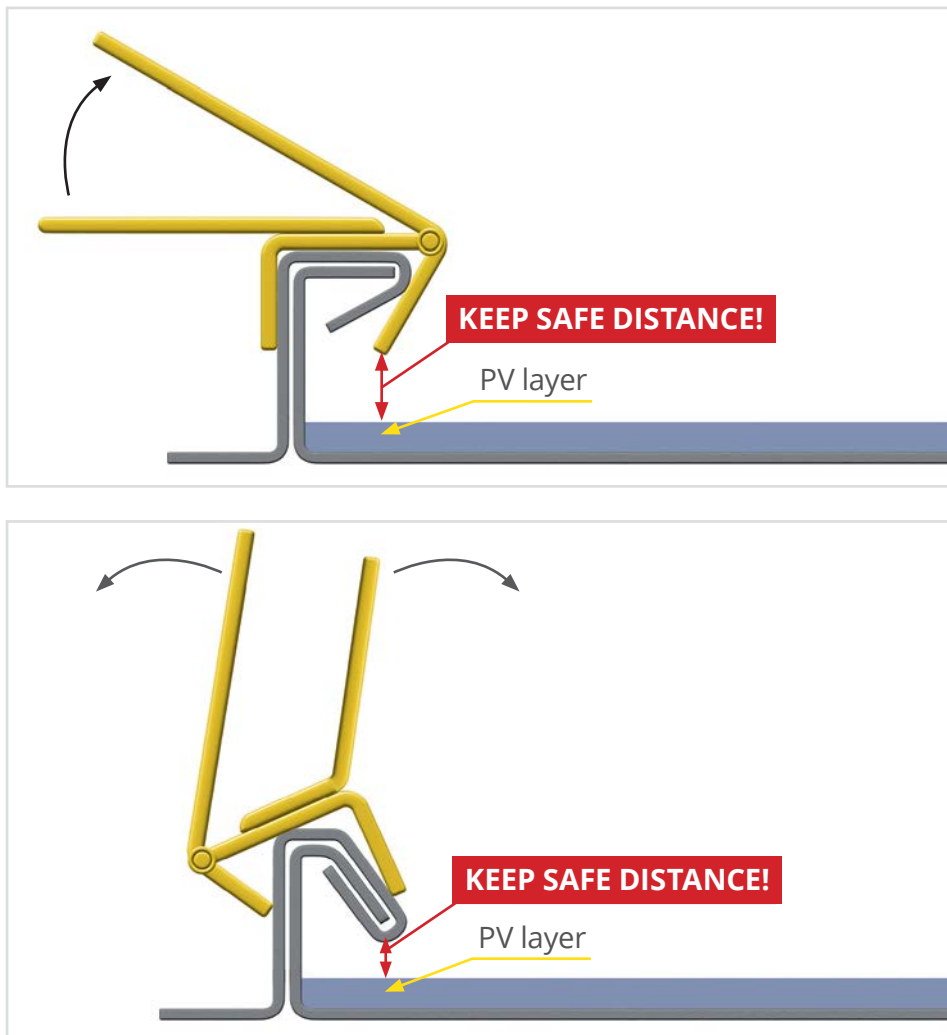


# Seaming of the Roofit.solar Products

The Product must be fastened with clips according to the double seam metal installation instructions.

Fastening screws must be fully tightened.

Special attention must be paid if pressing towards the glass where pressure must be always evenly distributed. Special care should be taken during seaming the Products, since tools must not touch the glass area.



## First column installation

The installation starts from the right side.

According to the roof planning the column can consist of:

**Case 1: Roofit.solar** modules. No additional metal needed.

**Case 2:** Start from the metal. And continue with **Roofit.solar** modules.

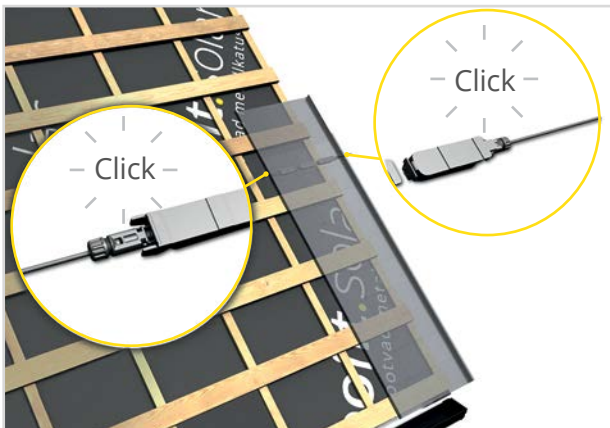
**Case 3:** Start with the **Roofit.solar** module and finish with the additional metal on top.

## Case 1: The column starts and finished with Roofit.solar module

Follow the instructions “How to cut seams for horizontal joint”.



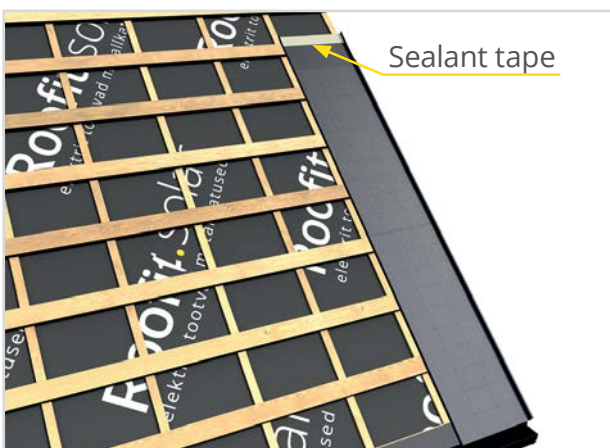
A seam cut of the lower **Roofit.solar** Product should be performed if any additional **Roofit.solar** Product or metal will be installed on the top.



The PV cables with female and male connectors should be in accessible positions prior to fastening of the panels to the battens.



**Roofit.solar** Products should be placed along the base of the eave and fixed with the fastening clips.



New module should be placed min 3 mm from the lower PV layer.

## Case 2: The column starts from the non-solar metal sheet

Follow the instructions “How to cut seams for horizontal joint”.



Bottom sheet shall be installed as required in the Installation manual of the double seam metal with metal folding under the eave.



Attach sealant tape on the upper edge of the metal. Install **Roofit.solar** Product with a minimum overlap of 200 mm of the non-PV metal sheet.

### Case 3: The top of the column completed with the metal sheet



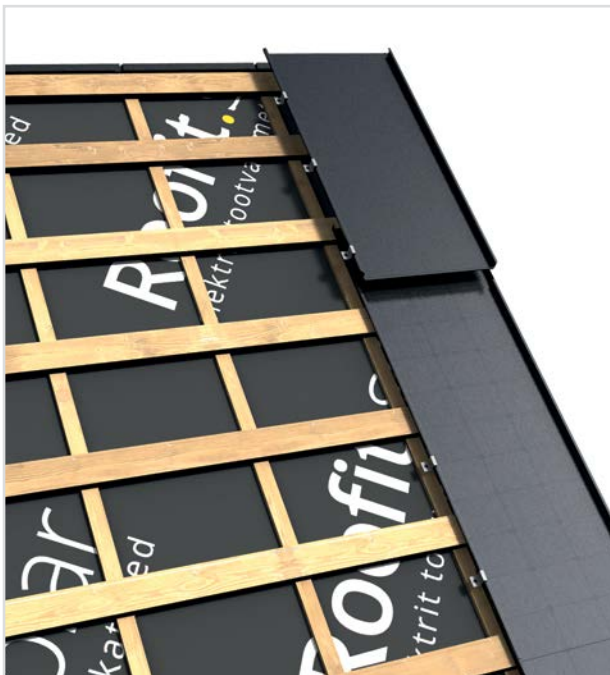
Prepare the top metal part (cut seams and roll back the bottom part)



The seams of the **Roofit.solar** Products overlapping area should be cut.

A strip of double-sided tape is attached in the overlapping area.

The fastening element is attached to the double-sided tape and screwed through the overlapping area.



The top metal sheet must be aligned with the adjoining edge of the previous panel. The folded end of the metal sheet must be inserted under the overlapping element already attached.

## » 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.

### Cleaning

Dust accumulation on the glass may reduce the power output and even cause regional hot-spot effects. Industrial emissions or bird droppings may also have an effect, and the extent of the severity depends on the transparency of the foreign objects. It is usually not dangerous for the accumulated dust to reduce the sunshine, as light intensity is still homogeneous and the reduction in power output usually is not obvious.

Negative environmental effects such as foreign objects which may cast shadows or lay directly on the roof may adversely affect the power output of the Product. **Roofit.solar** advises that there should be no obstruction of the Product's surface at any time. How often the Product requires cleaning depends on the environmental factors. In many instances the glass is sufficiently cleaned with naturally occurring rain, and the necessity to explicitly clean it reduces.

When cleaning the Product, it is recommended to wipe the glass surface with a wet sponge or soft cloth – without touching any electrical connections. Do not clean the glass with a cleaning agent which contains acid or alkali.

### Visual inspection

Inspect the Products visually to determine any possible defects such as breakage of the glass.

It is recommended to implement the following preventive maintenance every 12 months (if accessible):

Check if the connectors are intact and encapsulated (i.e. cables are not exposed).

Check the sealing gel of the junction box to locate any possible cracks or a crevices.

### Decommissioning and Disposal

**Roofit.solar** is strongly committed to protecting the environment. The Products will last for decades and are built using non-dangerous materials. When the Products reach the end of their life cycle, they should be disposed appropriately in accordance with local recycling guidelines.

## » 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](http://www.roofitsolar.com).

## » Appendix 1

### Electrical and Thermal Characteristics

**Standard Test Conditions (irradiance 1000 W/m<sup>2</sup>, cell temperature 25 °C, spectrum AM1.5)**

Acronym	Unit	3x8/110W/ RR33/B/DS	3x10/135W/ RR33/B/DS	3x12/160W/ RR33/B/DS
Nominal Power	$P_{max}$ (W)	110	135	160
Power Tolerance	0...+5 %			
MPP Voltage	$V_{max}$ (V)	12.8	15.8	19.0
MPP Current	$I_{max}$ (A)	8.57	8.54	8.44
Open Circuit Voltage	$V_{oc}$ (V)	15.9	19.9	23.9
Short Circuit Current	$I_{sc}$ (A)	9.11	9.04	9.00

**Normal Operating Conditions (irradiance 800 W/m<sup>2</sup>, cell temperature 20 °C, spectrum AM1.5)**

Nominal Power	$P_{max}$ (W)	80.8	99.2	117.5
MPP Voltage	$V_{mpp}$ (V)	11.9	14.7	17.6
MPP Current	$I_{max}$ (A)	6.78	6.75	6.67
Open Circuit Voltage	$V_{oc}$ (V)	14.7	18.4	22.0
Short Circuit Current	$I_{sc}$ (A)	7.24	7.19	7.16

Power Measurement Tolerances ±3 %. Other Parameter Tolerances 0...5 %

### Thermal Characteristics

Normal Operating Cell Temperature	NOCT	45 ± 2 °C
Temperature Coefficient of $P_{mpp}$	$\gamma$	-0.39 %/K
Temperature Coefficient of $V_{oc}$	$\beta$	-0.30 %/K
Temperature Coefficient of $I_{sc}$	$\alpha$	0.06 %/K