SOLARSTONE

Solarstone® Solar Full Roof™

Technical Specifications & Installation Manual

Table of Contents

Description

The Solarstone® Solar Full Roof™ is an award-winning building-integrated photovoltaic (BPIV) product developed in-house by Solarstone® in Estonia. The roof generates electricity for self-consumption, and any surplus energy can be sold back to the grid, allowing the Solar Full Roof™ to pay for itself. The building-integrated solar modules used in the product are designed for resource efficiency, an attractive appearance, and water-tightness. **The product has been tested for wind uplift, water tightness, and fire safety.**

Solarstone® 's patented Click-on® technology is designed to be used in combination with 370W+ solar modules, achieving high productivity and best performance. The Solar Full Roof™ has been developed to withstand a wide range of environmental conditions and can be installed on almost any type of sloped roof.

The Solarstone® Solar Full Roof™ system can be installed in either **landscape or portrait mode**. Roof perimeter or obstacles will be covered with passive modules that provide both safety and equal aesthetic appeal. The passive modules are equally easy to assemble and can be cut on-site.

Why people choose Solar Full Roof™:

- Solar power for self-consumption.
- 2in1 system – technology and functionality.
- Streamlined aesthetics for building skins.
- Making the world a greener place.

Disclaimer: This guide is intended to provide comprehensive instructions for installing the Solarstone® Solar Full Roof™. If you have any questions or concerns that are not addressed in this document, please do not hesitate to reach out to the Solarstone® technical support team at support.tech@solarstone.com.

It is imperative that you adhere to all safety precautions outlined in this guide as well as any applicable local regulations. Please note that the installation of the Solar Full Roof™ requires professional skills and knowledge, and should only be carried out by qualified personnel or by a

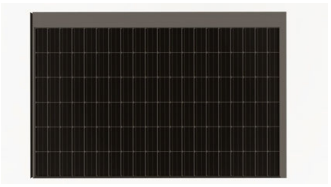
qualified installation partner. If the latter is avoided, therefore the guarantee applies only to details with defects. Solarstone does not cover any costs regarding defect products.

Additionally, Solarstone® and its guarantee does not cover any form of damage done to other subject or subjects financially including loss of income. To ensure a successful installation, please read this manual and familiarize with warranty conditions in its entirety before beginning the installation process. It is essential that the installation personnel are familiar with the mechanical and electrical requirements of the system and conditions under which the warranty conditions might not be applicable.

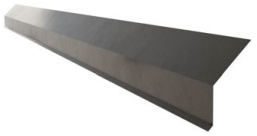
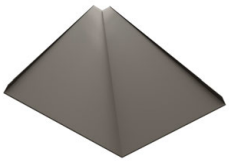
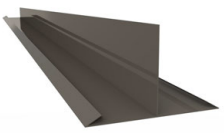
Specifications | Solar Full Roof™

- Solarstone® advises using following module models with specific parameters to ensure the proper installation and electrical output with version 1.0 in 2023.

Mechanical Specifications		
SOLAR MODULE	**JASOLAR**	**RISEN**
SOLAR CELL	Monocrystalline	
MODULE DIMENSIONS (WxLxH)	1769X1052X35 (mm)	1754x1069x30 (mm)
WEIGHT	21.3 (kg)	20.7 (kg)
SNOW LOAD	5400 PA	
WIND LOAD	2400 PA	
WARRANTY	25-Year Linear Power Output Warranty	
Electrical Specifications		
INVERTER	Only allowed with AFCI (Arc-Fault Circuit Interrupter) available	
MODULE EFFICIENCY	19.6%	20.3%
MODULE OUTPUT	370W	390W
NO OF CELLS	120	120
MAXIMUM POWER VOLTAGE - VMPP	32.3 V	31.68 V
MAXIMUM POWER CURRENT - IMPP	8.66 A	9.40A
CONNECTOR	MC4 (1000V) or MC4-EVO2 (1500V)	MC4-EVO2 (1500V) IP68 or Risen Twinsel PV-SY02

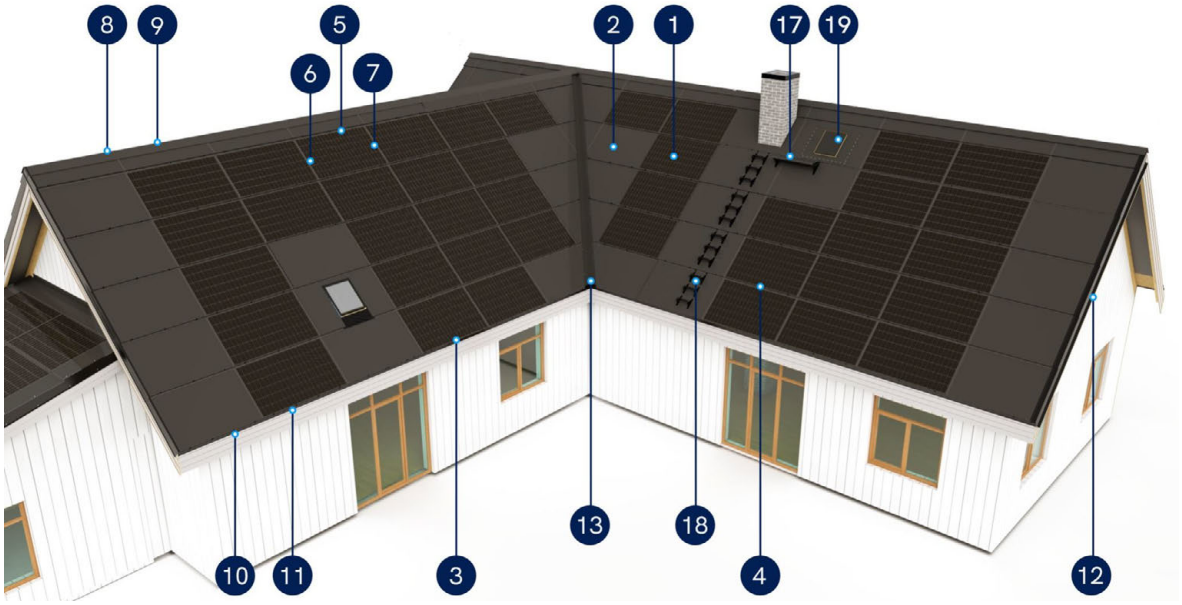
Component List Specification		
SOLARSTONE® SOLAR FULL ROOF™ COMPONENTS	**ITEM**	**PRODUCT**
MODULE	1	
DUMMY MODULE	2	
STARTER CLAMP	3	
REGULAR CLAMP	4	
TOP CLICK PROFILE	5	

LEFT CLICK PROFILE	6	
RIGHT CLICK PROFILE	7	
RIDGE FLASHING	8	
RIDGE VENTILATION FLASHING	9	
EAVE VENTILATION FLASHING	10	

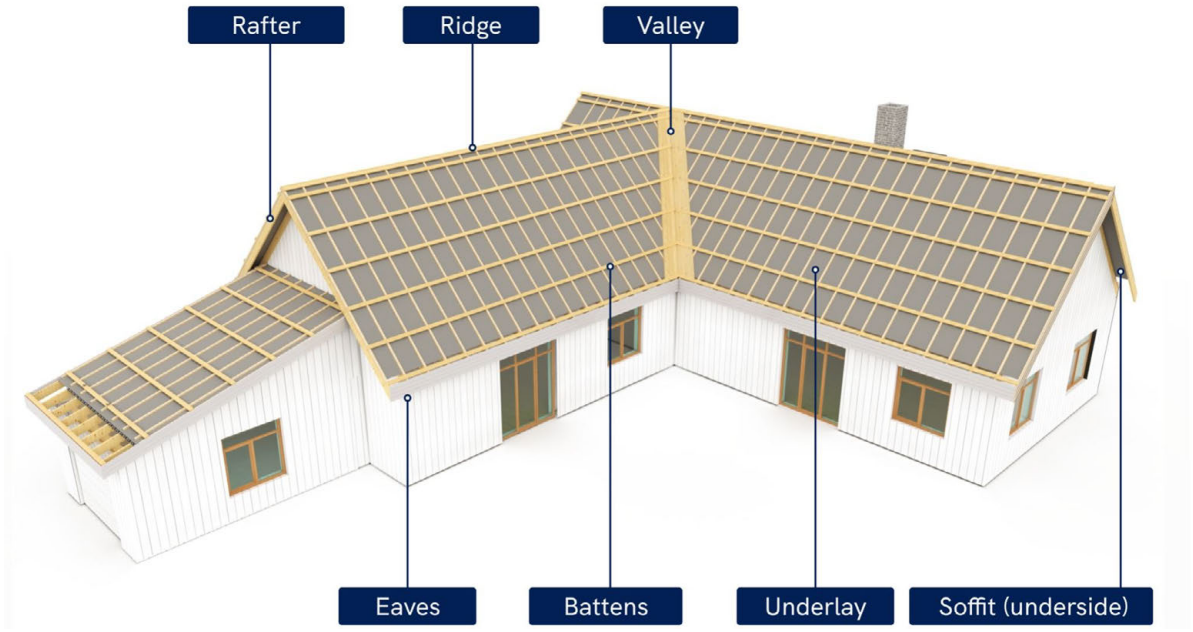
DRIP EDGE FLASHING	11	
VERGE FLASHING	12	
VALLEY FLASHING	13	
JOINT FLASHING	14	
SNOW GUARD	15	

VENTILATION OUTLET	16	
ROOF WALKWAY	17	
ROOF LADDER	18	
ROOF HATCH ACCESS	19	

Solarstone® Solar Full Roof™ Component List



Roof Elements



Necessary tools

Underlayment and marking out tools:

Circular saw

Sheet metal scissors

Chalk Line Tools

Measuring tape

Roofing blade or utility knife

Tacker or Stapler

Hammer

Roofing nail gun

Electrical Tools:

Digital Multimeter and Insulation Tester

Clamp Meter

MC4 Solar PV Cable Crimping Tool Kit with Stripper, Cutter, Spanner

Oxide inhibitor

Safety & Protective Equipment

We advise you to protect yourself with protective equipment at all times and abide by all safety precautions in this guide and local regulations. Nevertheless, it is mandatory to use safety harness equipment, helmet, gloves, safety glasses, etc.

Solarstone® will not take any responsibility for safety nor health issues that have come up during the installation.

Protective equipment

General Roof Safety Harnesses	Safety glasses	Gloves	Other personal protective equipment
			

Steps 1-6 | Roof preparation

Step 1 | Structural Analysis Before Installation

Ensure that the method used for installing roofing materials and the supporting substructure is strong and able to properly support the chosen product and meet its weight requirements. Additionally, the supporting system should be installed in accordance with local, national, and international standards.

Factors to consider include the weight of the materials, the slope of the roof, the perpendicularity of the structure, the condition of the existing rafters, the suitability of the batten material, and applicable wind and snow load parameters.

Step 2 | Underlay

Install a watertight breathable underlay which evacuates all moisture out of the building structure. Only high quality underlay should be used (in accordance with harmonized European Standard BS EN 13859-1:2014) with a high resistance and stiffness against wind uploads. Other configurations are applicable such as SBS/PVC underlay, which must be applied if the roof angle is below 18°.

Disclaimer: No roof is 100% waterproof. Proper underlayment helps condensed water or minor leaks (occurring with heavy rainfall) escape directly into the gutter or naturally ventilated soffits.

Step 3 | Counter and Ventilation Battens

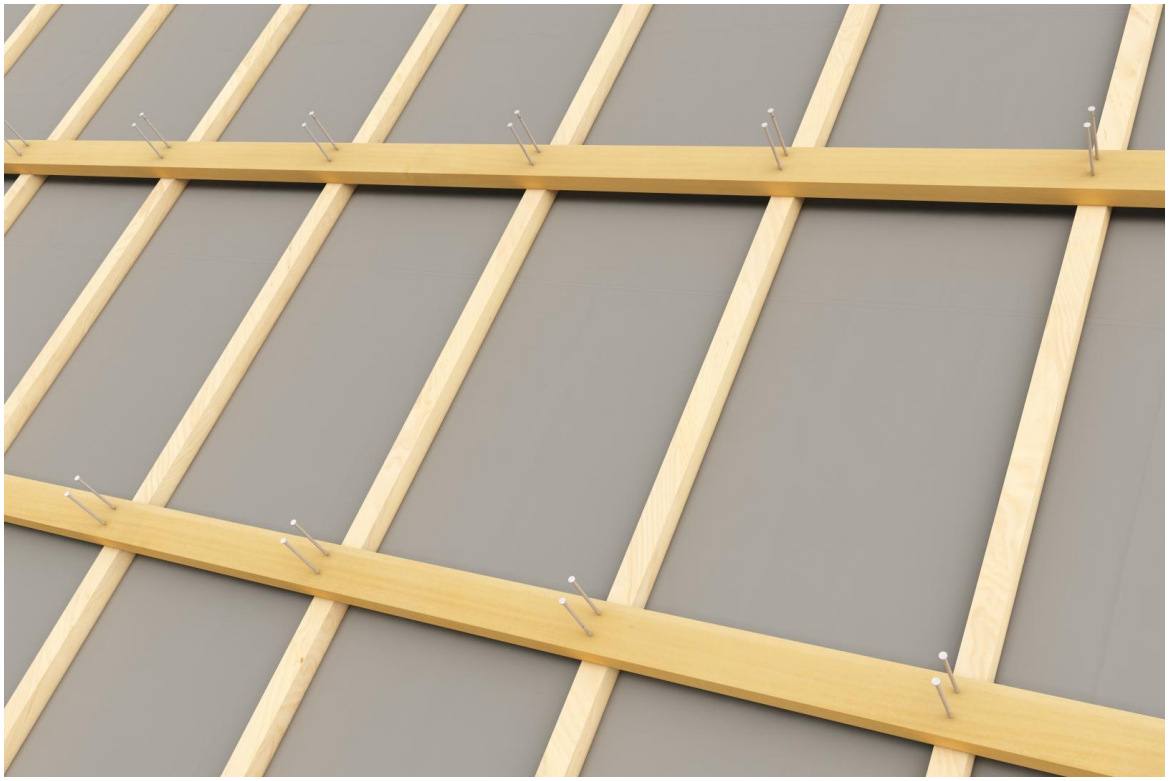
Battens must be fixed in place with two screws or nails. The length of the screw or nails must be sufficient to penetrate ventilation battens and counter-battens and enter rafters ⅓ of its length. Battens must comply with the Eurocode specifications according to the wind and snow zones in your region. For improved ventilation Solarstone® recommends using following batten specifications.

- Ventilation battens

  45...53 x 45...53mm

- Counter battens

  45...53 x 95...103mm

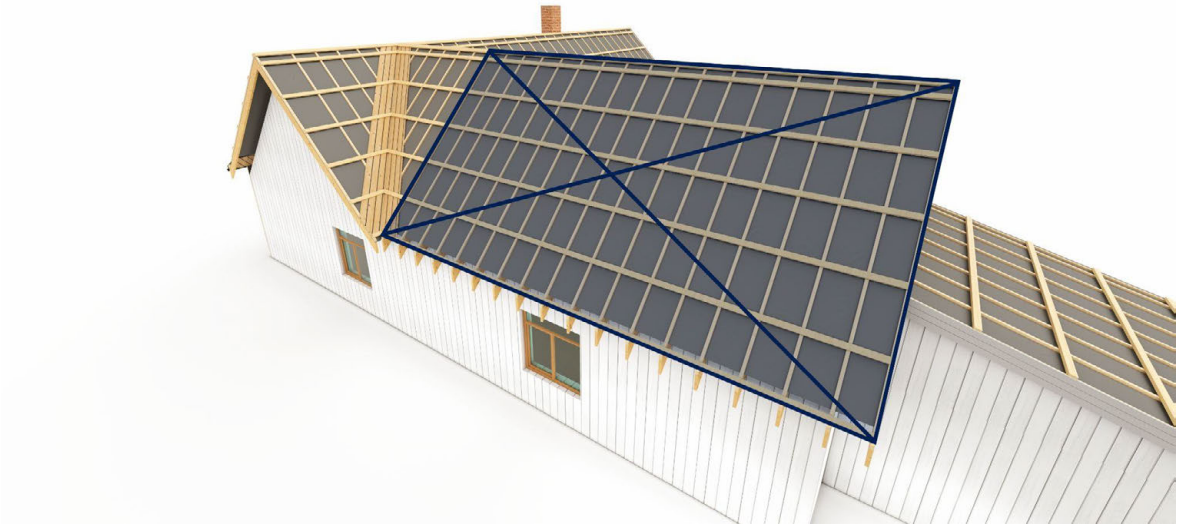


Step 4 | Diagonals and Slope

- While measuring roofing diagonals and right angle, make sure that the diagonals match on ends and the roof is at the right angle

- If diagonal measurements of the roof area do not match, contact your roofing partner to fix or prepare to use custom size dummy modules or transitional flashings

- Roof pitch must be greater or equal to 18°. In case of lower slopes full SBS underlay is required.



Step 5 | Eaves and Gutters

To continue with installation of battens, the next step would be to choose which eaves type is applicable. If you have selected one of the eave types provided below, the accessories offered by Solarstone® will also be compatible with your roof.

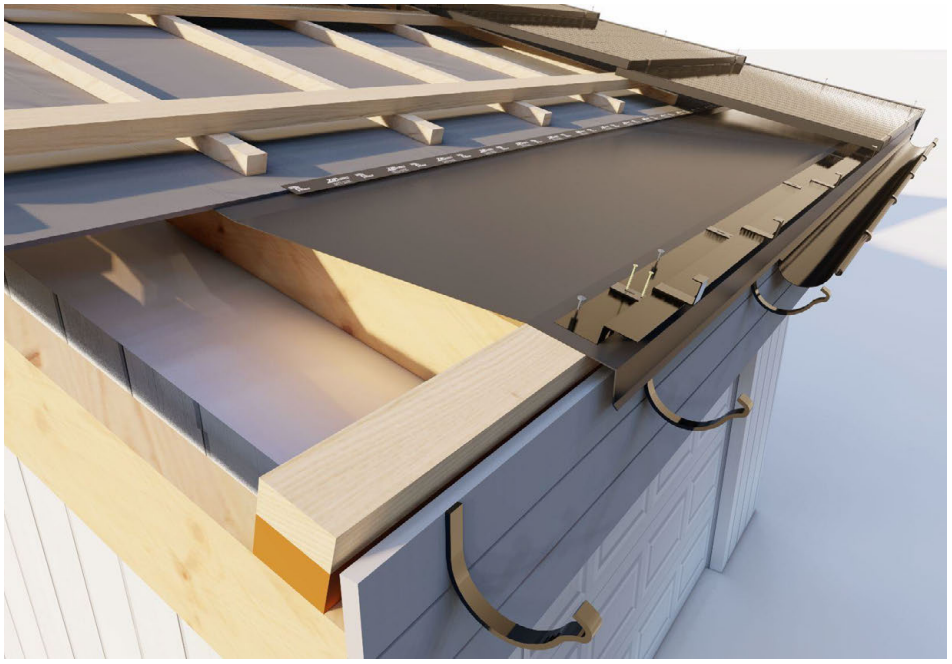
Roof angle	Ver 1	Ver 2	Ver 3	SBS/PVC underlay
<18 °				
>18 °				
>30 °				

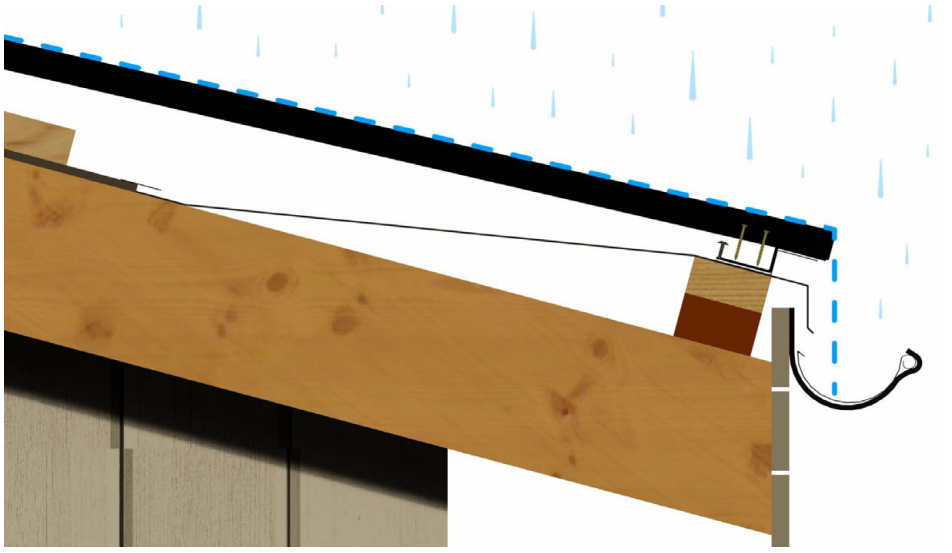
Version 1: Pitched roofs above 30 degrees

- Soffited eaves without drip/anti-ponding flashing
- Pitched roofs above 30 degrees. Condensed water is ventilated naturally and not diverted into the gutter.
- Water must be diverted to the center of the gutter. For proper gutter installation follow the manufacturer's manual.

Version 2: Soffited eaves with drip/anti-ponding flashing

- Water must be diverted to the center of the gutter. For proper gutter installation follow the manufacturer manual.





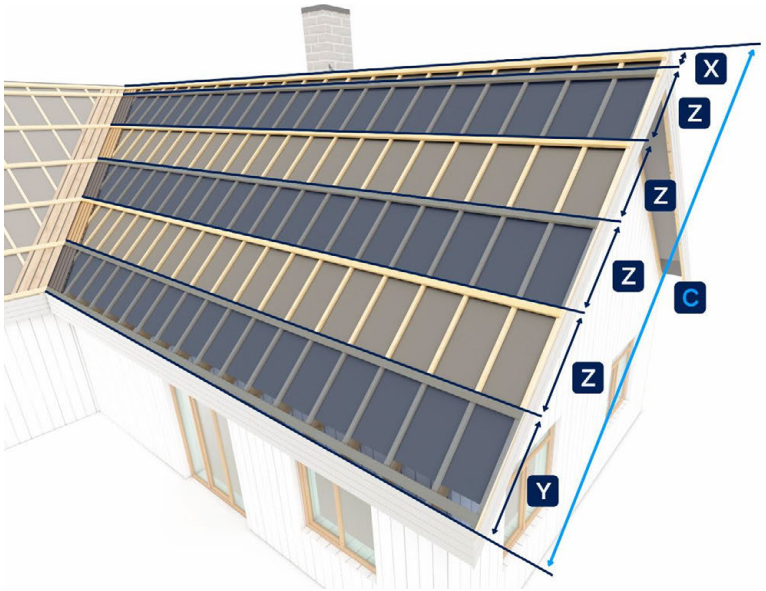
Version 3: Modern roofs without eaves

- Condensed water must be drained into the gutter using footplate and drip flashings (both hidden and exposed variation of gutter system).
- Water must be diverted to the center of the gutter. For proper gutter installation follow the manufacturer manual.

Step 6 | Batten Step

Batten step depends whether modules will be installed in landscape or in portrait mode. Bear in mind that the first batten step gauge (Y) differs from the next steps (Z and X). Value C is the total height of the roof.

- Version 1: Starting with PV - module and ending custom size dummy module



Portrait formula

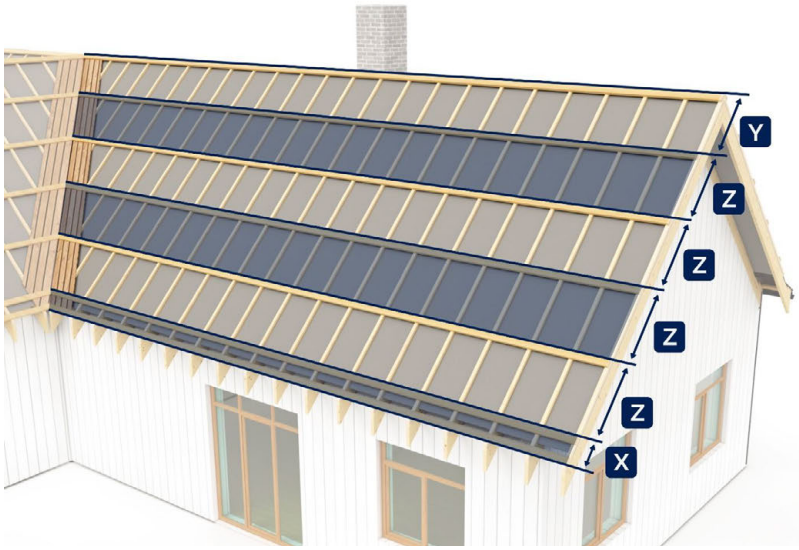
C = roof height
Z = panel height + 40 mm
Y = panel height + 70 mm
X = C-(4×Z)-Y

Landscape formula

C = roof height
Z = panel width + 40 mm
Y = panel width + 70 mm
X = C-(4×Z)-Y

* Batten spacing may vary ±20 mm on both formulas

- Version 2: Starting with custom size dummy module and ending with PV - module



Portrait formula

X = min 300 mm
Z = panel width + 40 mm
Y = min 300 mm

Landscape formula

X = min 300 mm
Z = panel width + 40 mm
Y = min 300 mm

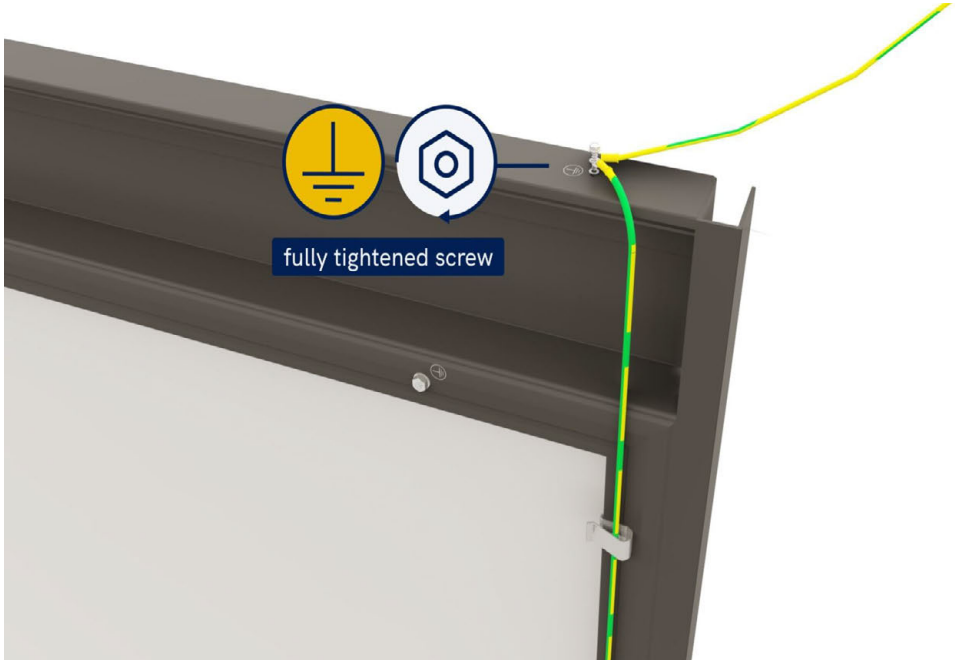
Steps 7 - 20 | Module Installation

Step 7 | Grounding

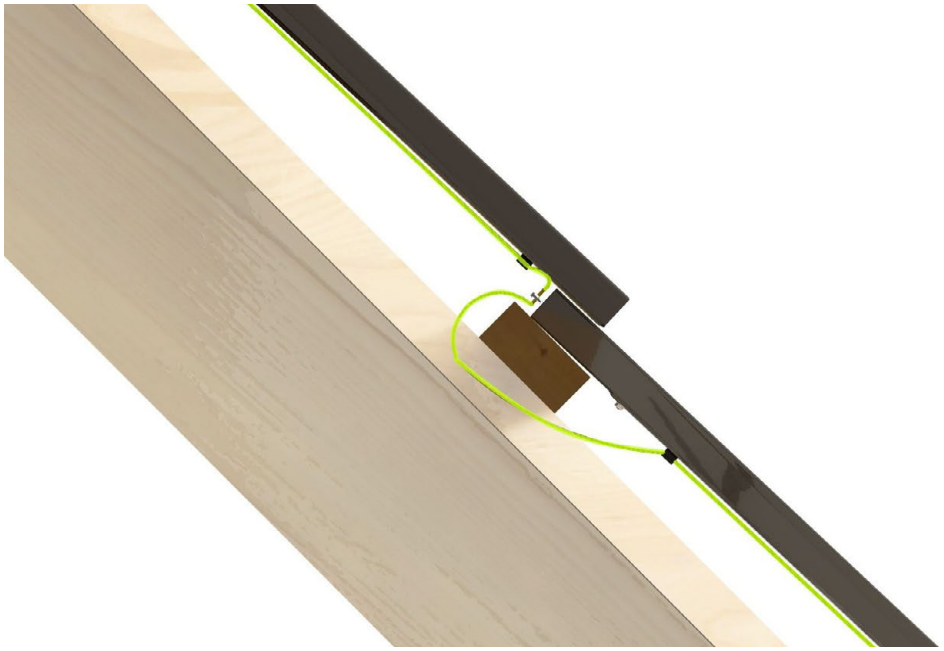
- For grounding the Solarstone® Solar Full Roof™ make sure the module has the grounding sign with the hole next to it.

- It is obligatory to use a grounding washer that has teeth that **will damage** the color of the profile. This will provide conductivity which is needed for grounding. Connect PV-module and top Click-on® profile with grounding washer and a bolt.

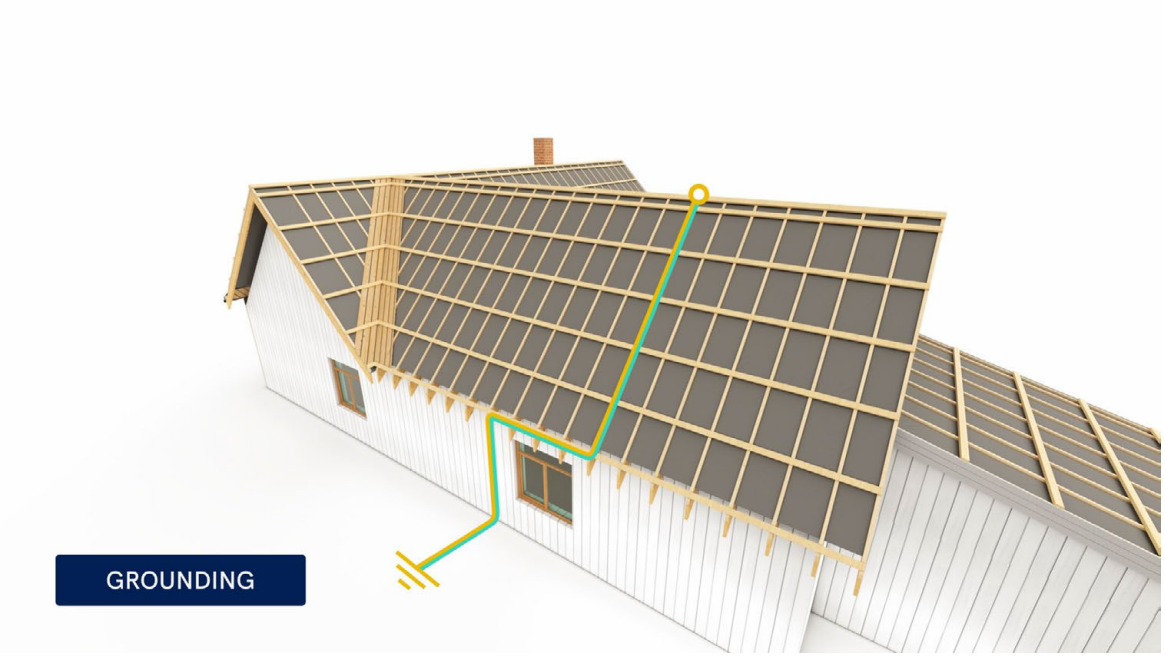
- Repeat the process by connecting the earth wire between the grounding washer and the bolt.



- Connect each PV-module with grounding/earth wire.



- Bring the earth wire down to the ground.



Step 8 | Starter and Ventilation Flashing Installation

In the following installation interpretations we have used the most common eave solution (version 1) shown in step 5 - pitched roof > 30 degrees.

- Install starter flashing, assuring the water from the modules is always diverted into the gutter.

- Install ventilation flashing.

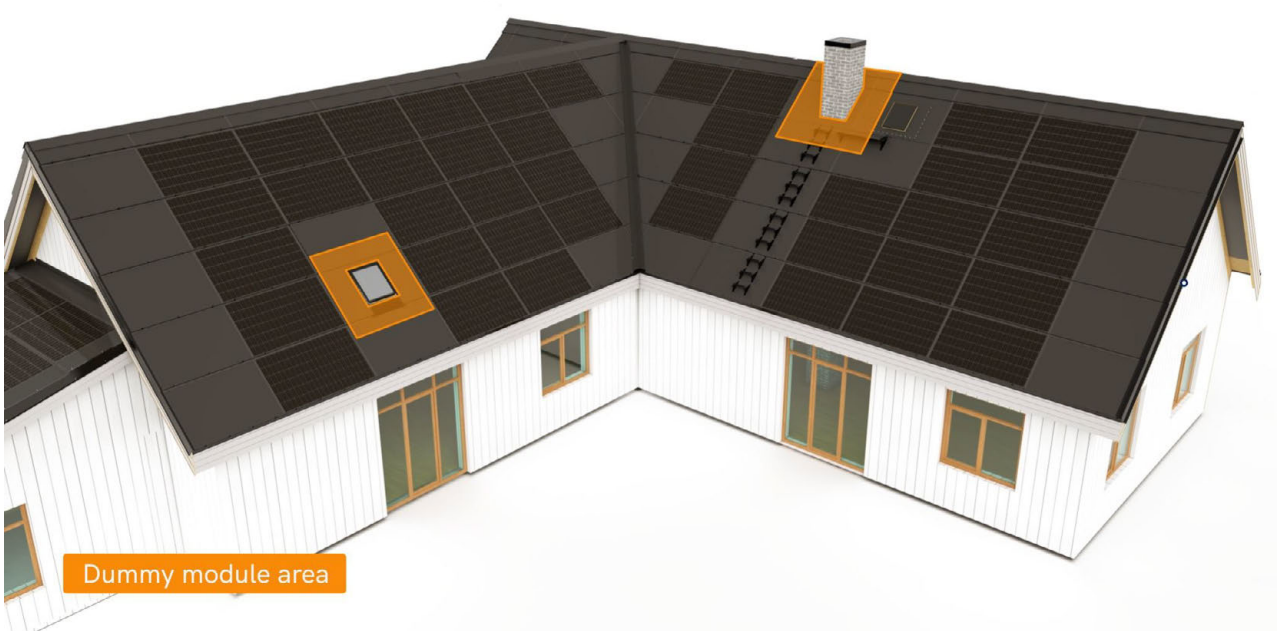
- Module and the gutter must be in the correct alignment so the water does not run over the gutter.

Correct placement can be found in the gutter installation manual.

Step 9 | Solar System Planning

When installing Solarstone® Solar Full Roof™, it is essential to carefully consider all complex geometries on the roof, such as chimneys, roof windows, valleys, ventilation systems, and access hatches. Instructions for installing these specific elements can be found in steps 21 through 24 of the installation guide. Furthermore, it is crucial to take into account any potential shading caused by the roof's geometries or surrounding objects such as trees or street light posts, as this may necessitate different design principles and the use of optimization tools. Additionally, the active module should be placed at least 80 cm from the chimney due to common fire safety regulations.

Disclaimer: Solar modules can be inherently of different color due to manufacturing processes. Every projected roof should be installed with modules from the same batch. Nevertheless, due to the raw materials and production process, monocrystalline silicon crystals might have a slightly different reflection on light, which may result in undesirable end-result. Additionally, PV-modules and dummy modules have a different look due to different materials used.



Step 10 | Determining the Position of the Modules

Mark the exact location of the modules and dummies.

- The label on the back of the module shows the width of the module. You have to add 23mm (Click-on® frame width) to the original module width to get the correct dimensions for marking.
- Vertical gap added by Click-on® framing of 5 mm is already predefined in the design calculations.
- Consider the vertical gap tolerance is ±3mm between modules while marking out.
- Width of the dummy module must be selected according to the size of the roof.

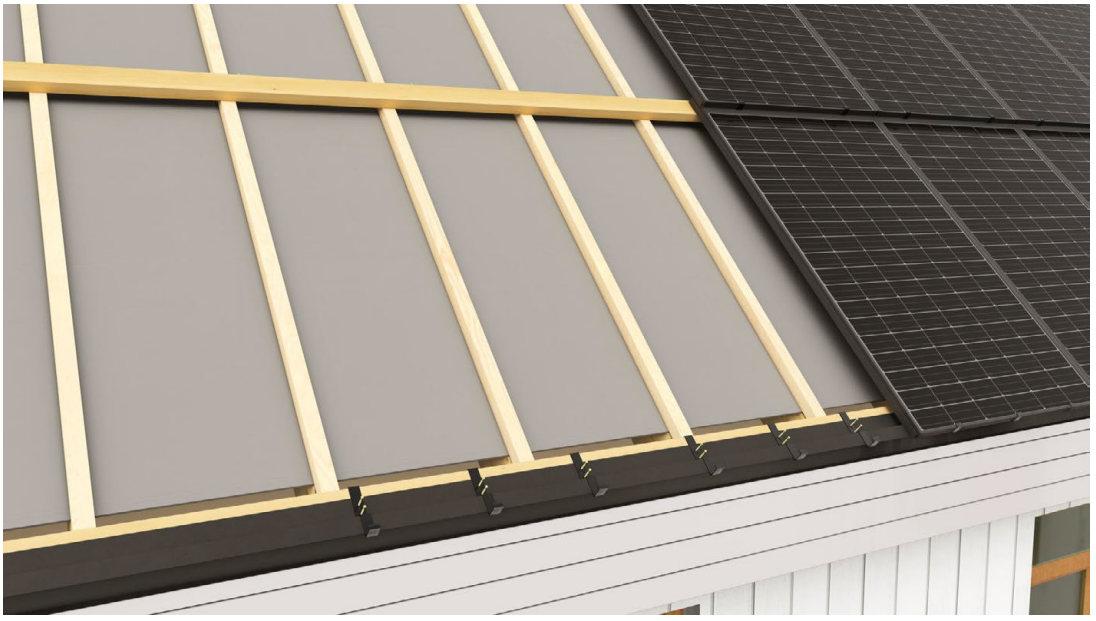
Step 11 | First Row Clamps

This chapter illustrates the method for landscape and portrait installations. Apply an applicable method to your project. Number of clamps needed for the roof is derived from the local wind uplift factor. The standard solution is shown below:

- Every dummy and active module in the first row requires 4 clamps.
- Starter clamps are positioned 50mm inwards from both sides of the module.
- Two clamps in the middle must be equally spaced.
- Maximum spacing between clamps is 45cm.
- If a dummy module is smaller than 50% of the full size module requires a minimum of 2 clamps. Dummy module minimum height must be minimum 300mm according to the batten step.
- Solarstone® uses a 5,0X50 ESSDRIVE PP model screw for fastening the clamps. Manufacturer advises using 400-1200 rates per minute while fastening the screw.

Version 1: Landscape Method Installation

Version 2: Portrait Method Installation

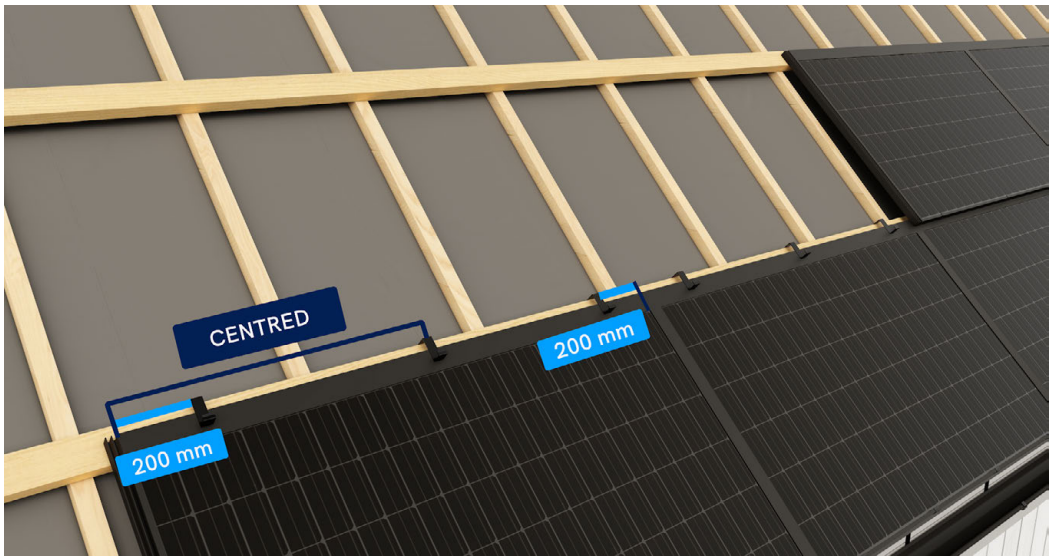


Step 12 | Installation of Regular Clamps

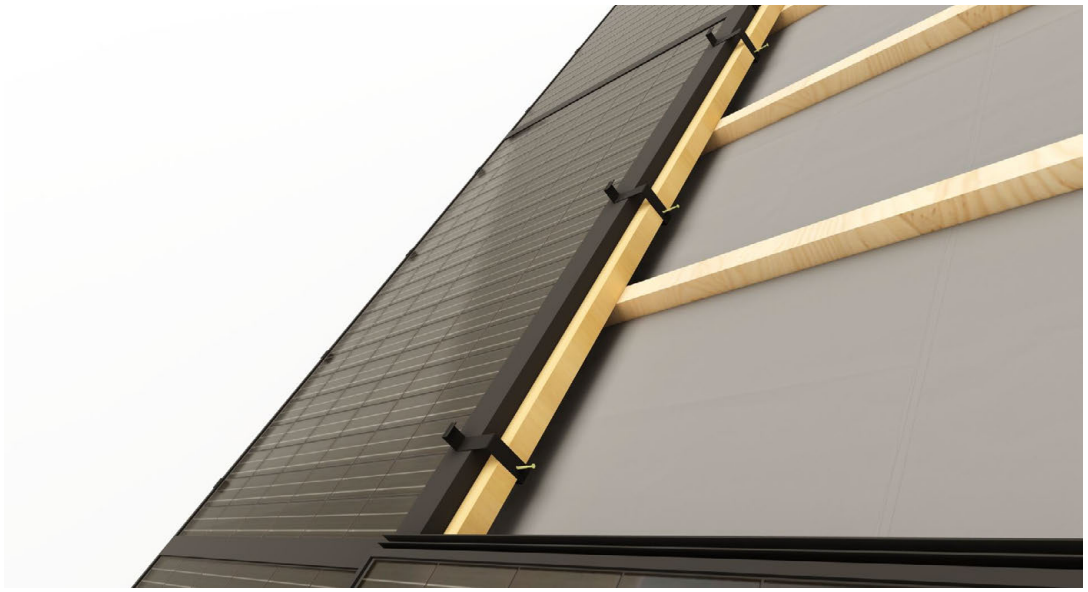
This chapter consists of landscape and portrait method installation illustrations. Apply an applicable method to your project.

- **Version 1: Landscape Method Installation**

- Regular clamps shall be used for dummies and active modules.

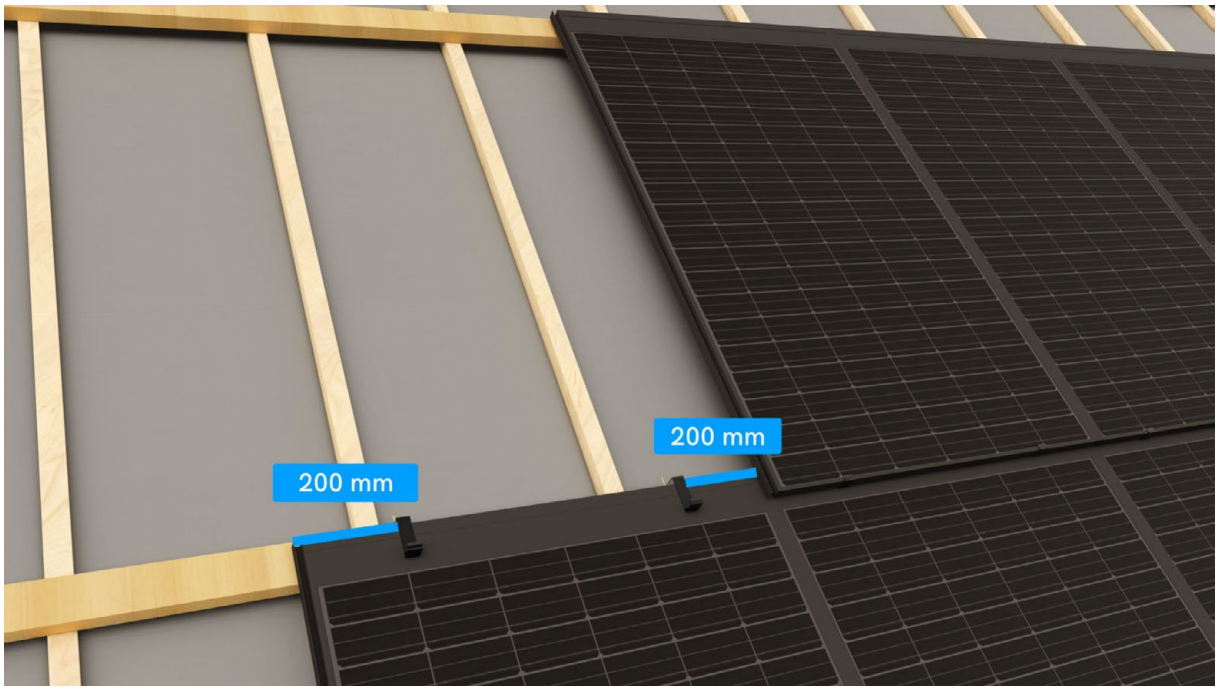


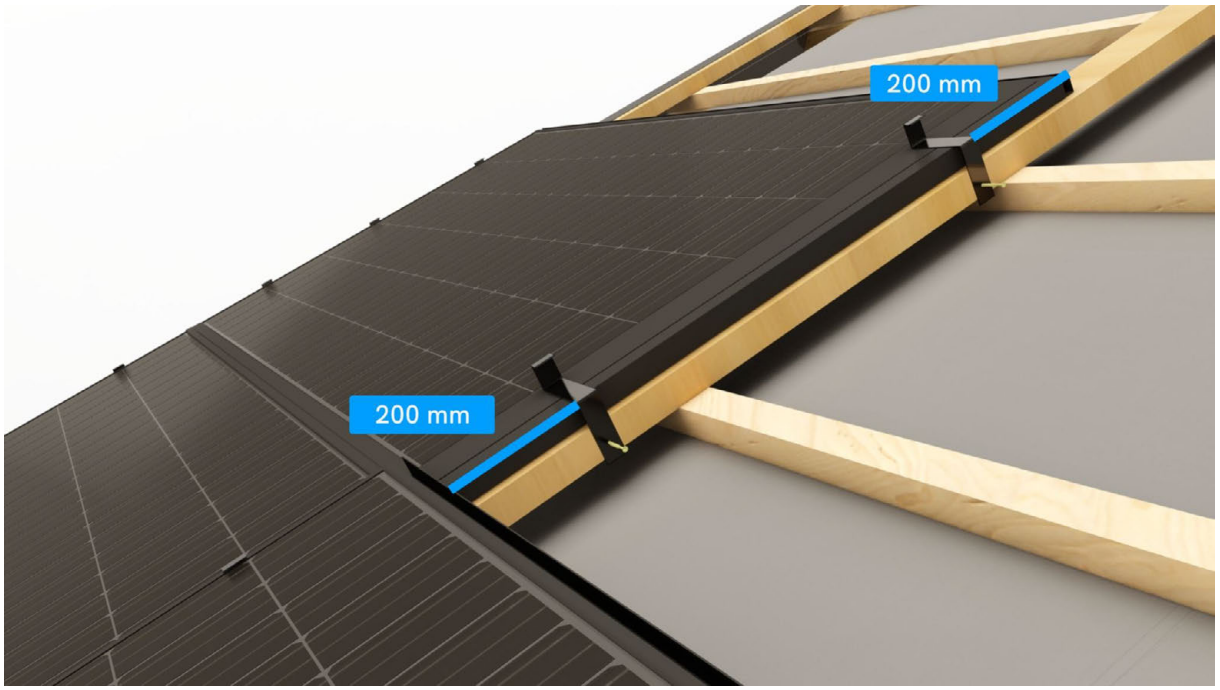
- Drive screws through the hole in the clamp into the batten.



- 15mm gap must remain between the bracket and the module so that the modules can be removed later if necessary.

Version 2: Portrait Method Installation





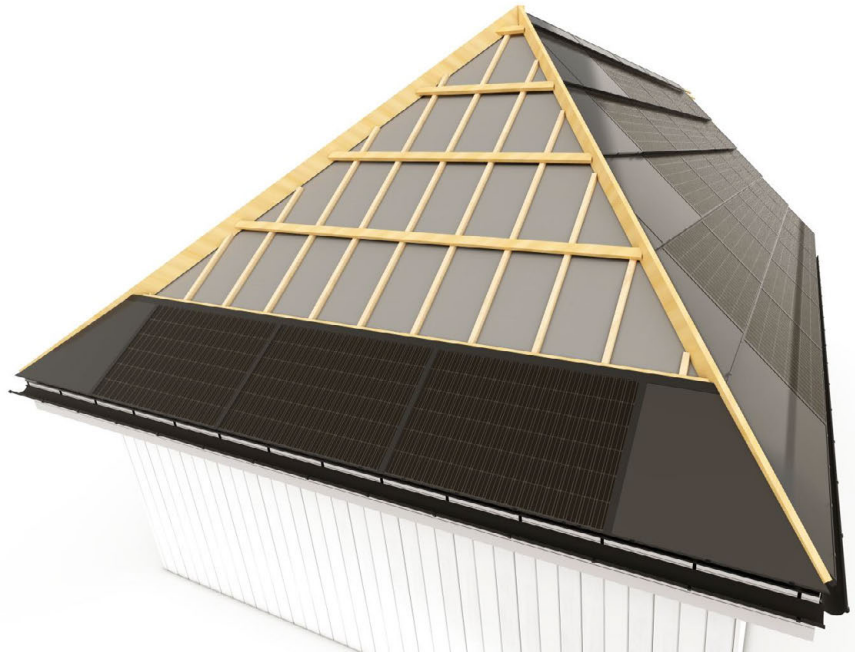
Step 13 | Solar Module Installation Method

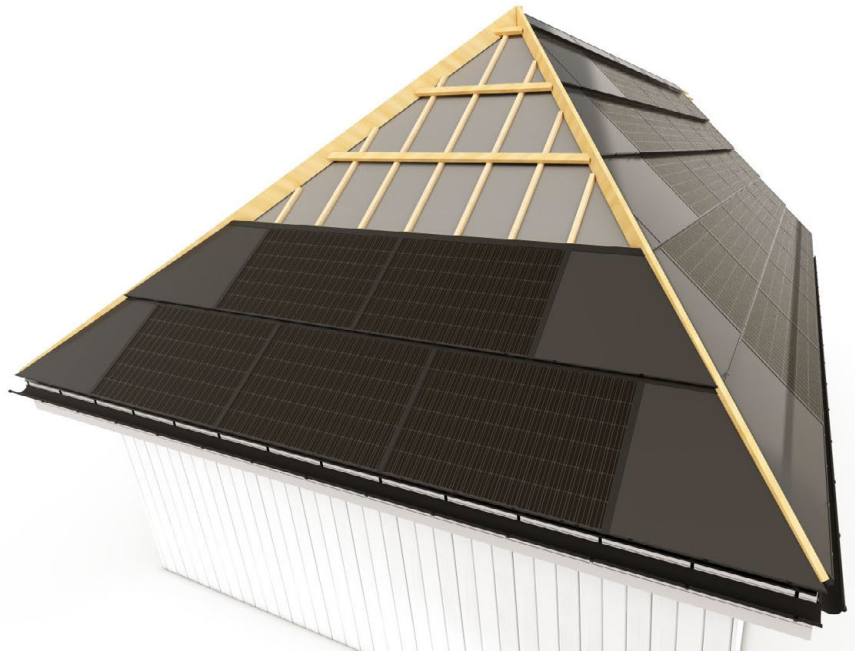
It is possible to install Solarstone® Solar Full Roof™ in landscape and in portrait mode. The installation process can be executed in a column or in a row method. In order to minimize the amount of extension cables connecting rows and columns, the length of original cables and position of MC4 connectors must be evaluated in the design process.

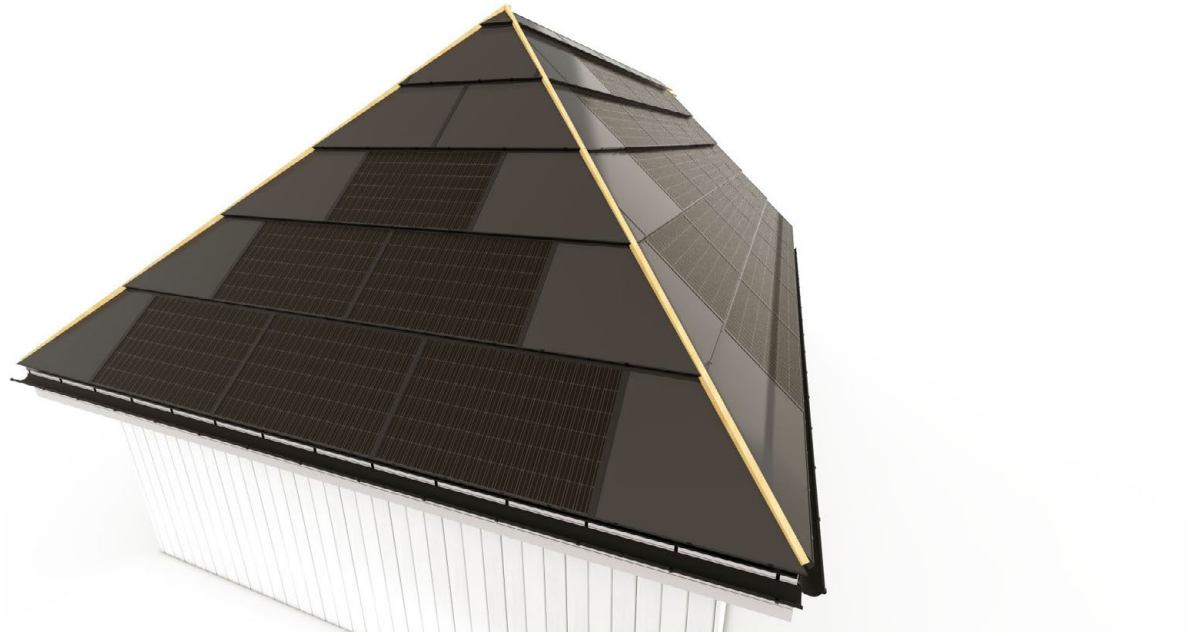
- Version 1: Installation in a column

- Version 2: Installation in a row

- Version 3: Installation on a hip roof. Off-centered layout.

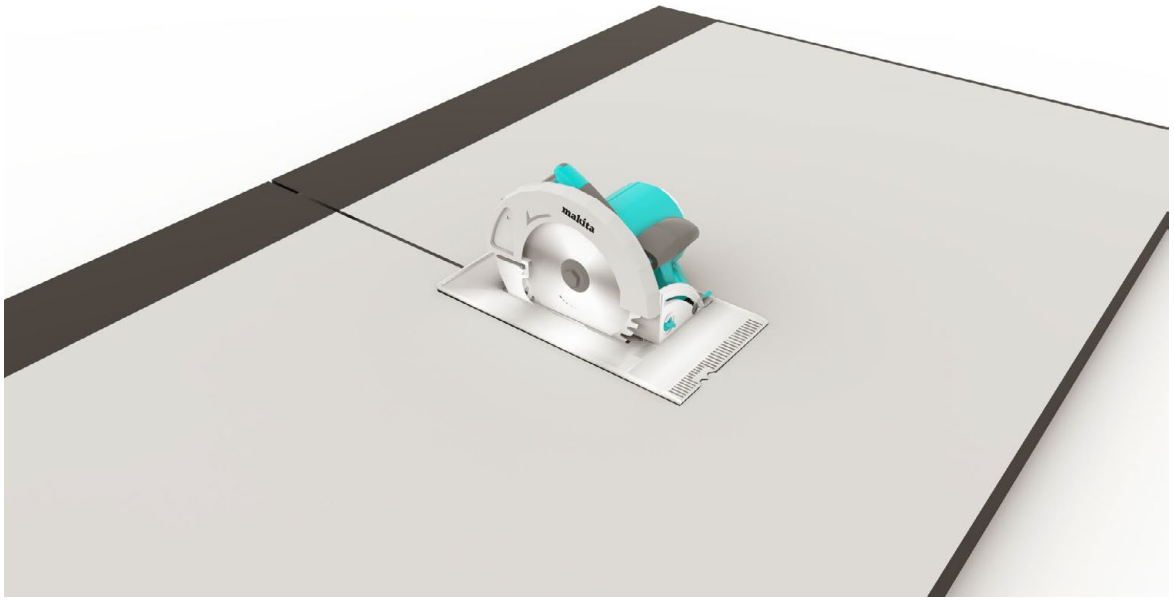






Step 14 | Dummy Module Cutting

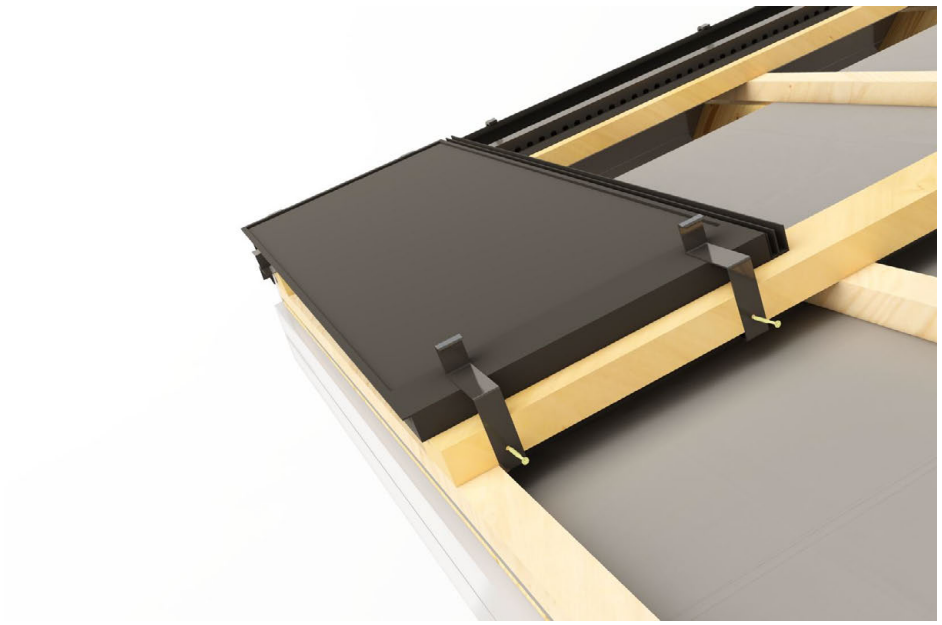
- Passive dummy modules can be cut with a circular saw.
- Perform the cut from the back side of the module. This will not damage the top paint coat.
- Take safety precautions and use protective equipment.
- Module edges might be sharp after cutting, blunt the edges before installing. Safety measures must be taken.



Step 15 | Installation of 1st Column

- Install the dummy module that is already cut to size.

- Similar clamps shall be used for dummies and active modules. Drive screws through the holes in the clamps into the batten to secure the modules.



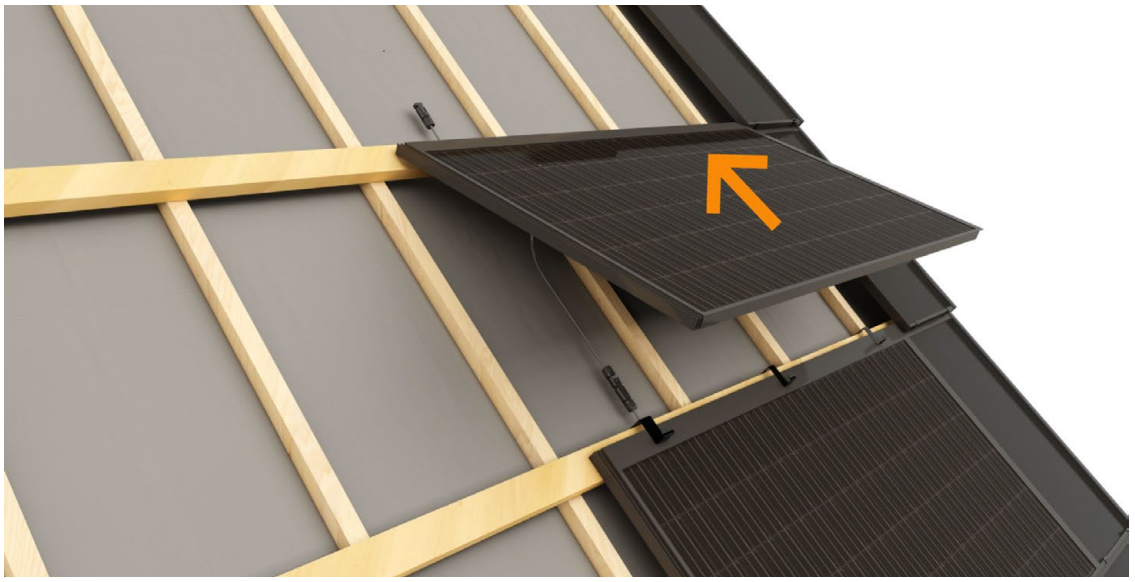
- Finalize the 1st column.

Step 16 | Mechanical Installation of the Module

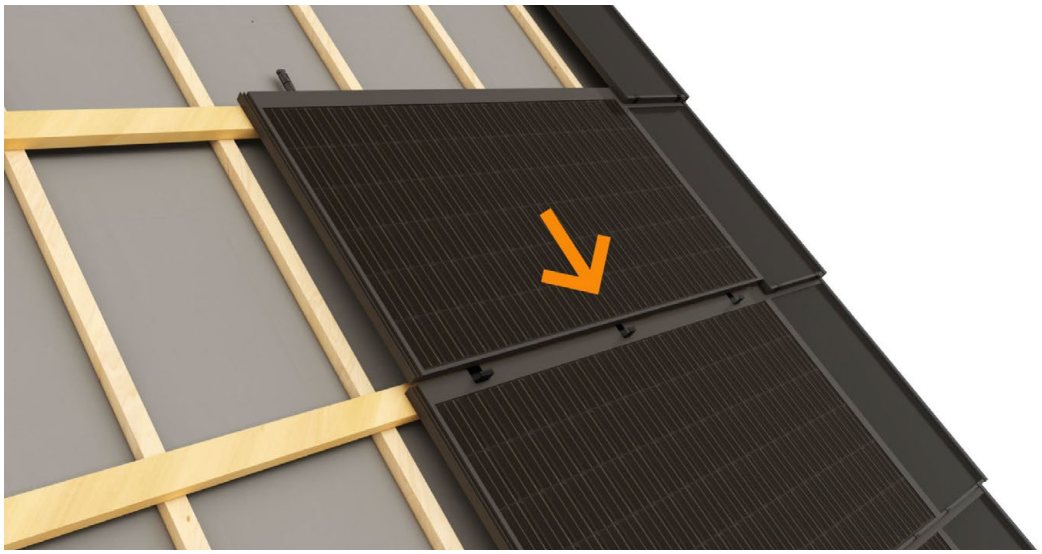
Step 16 and 17 are performed at the same time simultaneously, therefore consider working through these two steps before installing the modules.

Solar modules are installed in landscape mode from right to left, progressing with full columns. Follow the regular solar installation principles and manufacturer's instructions when connecting the solar cables.

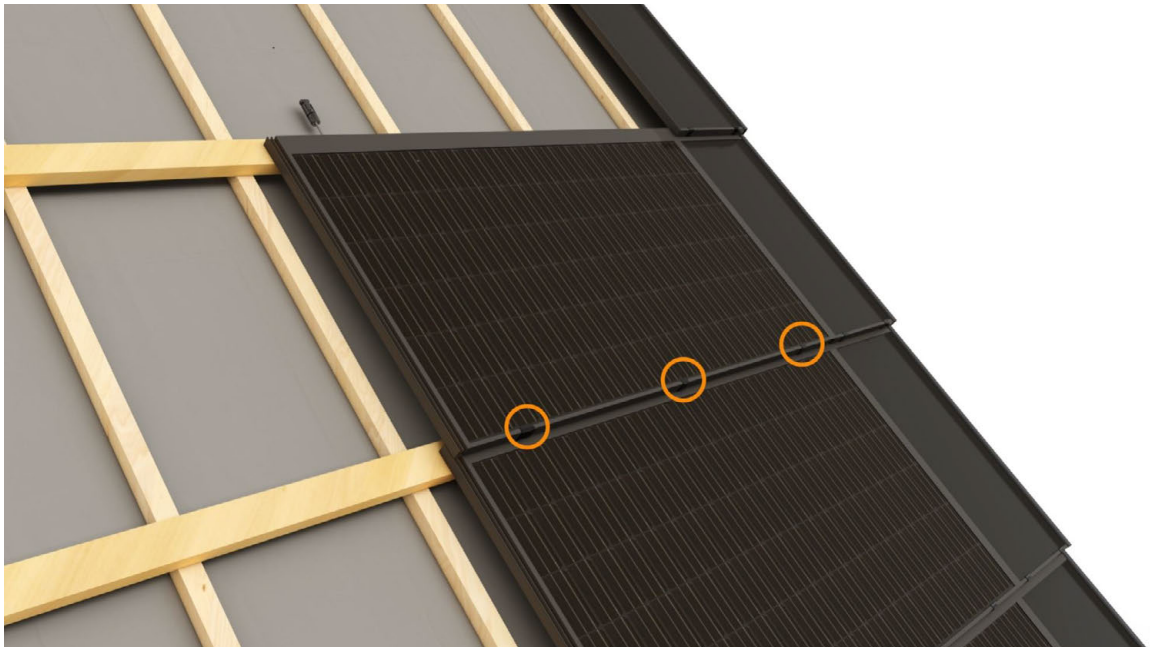
- Push the upper right corner of the module under the lower corner of the upper module.



- Drop the lower part of the module into the clamp slot.

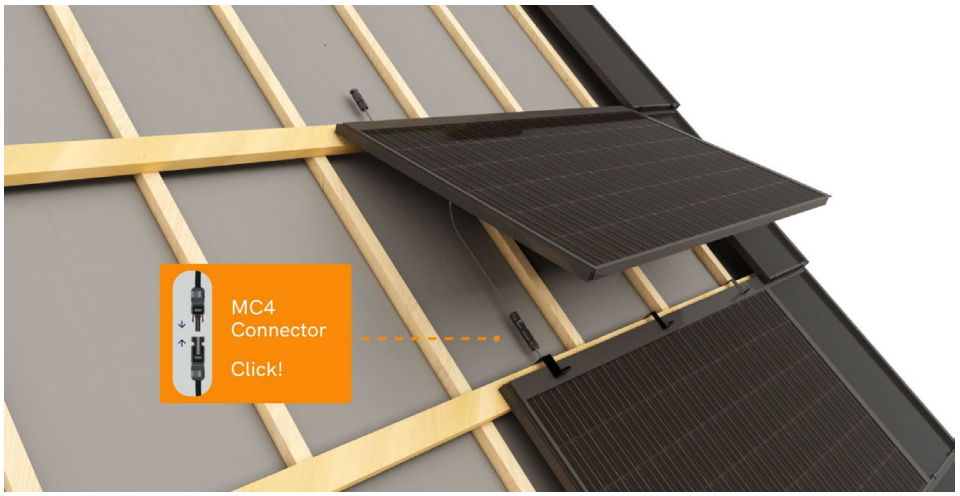


- Press the module into the clamps until it clicks into it. Make sure the clamps are entirely locked in with the module.

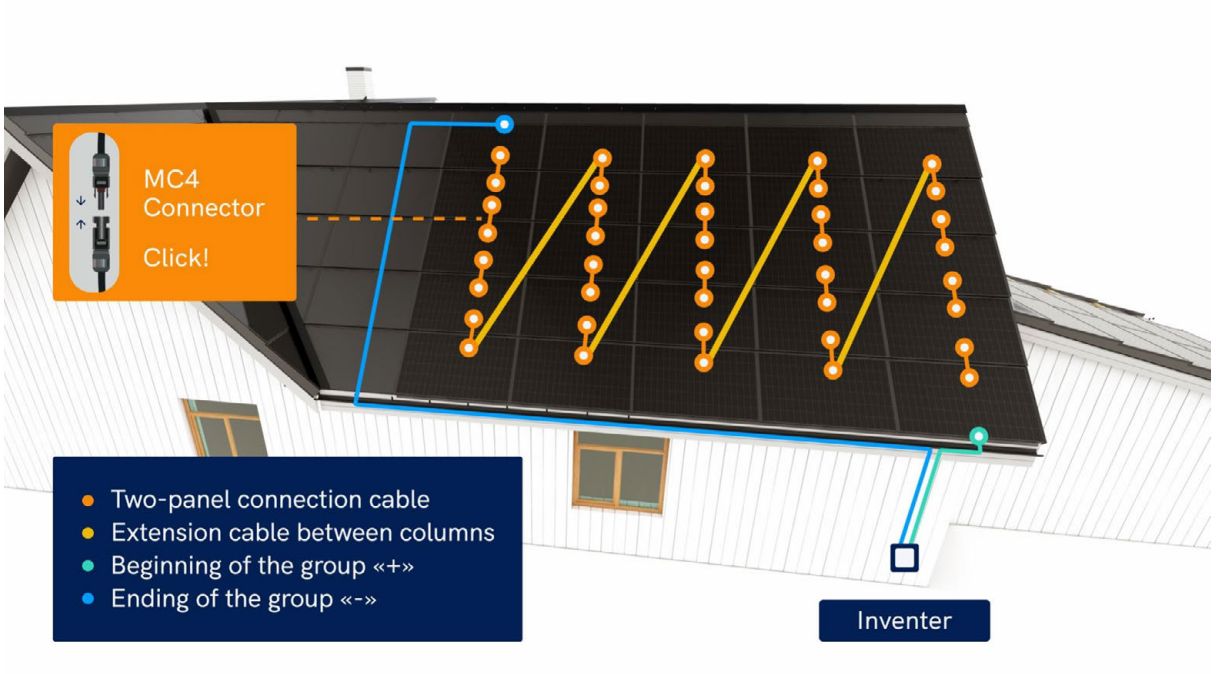


Step 17 | Cable Connections

- Connected MC4 connectors must be lifted and not laid on the underlay.
- Check the compatibility of MC4 connectors when field and module cables are mated. Connectors made by different manufacturers may be sometimes described as "MC compatible", but may not conform to the requirements for a safe electrical connection with long term stability.
- Use only MC4 connectors recommended by the PV-module manufacturers, which is noted under installation manual specifications.
- Certified electrician is only allowed to perform electrical operations.
- MC4 connectors are connected correctly if both connectors click to each other.
- Use of electrical contact grease (applied to male MC4 connector) is allowed only when validated by the module producer and/or MC4 manufacturer.
- Always refer to local solar guidelines, PV module manuals and best practices.



- Recommended cable routing method



Disclaimer: It is mandatory to use only inverters with arc fault detection features.

Step 18 | Verge Flashing

Specific architectural appeal must be considered to match the flashing type used on other inactive roof facets. This is equally important in renovation and new-builds. Verge flashings are designed to cover the barge boards, however custom design options are permitted. It is important to keep in mind that different modules may require different length of verge flashings. Flashings are fastened with roofing screws for flashings with ESSVE 4,8 X 28MM RR33 screws. Manufacturer advises using 1800-2400 rates per minute while fastening the screw with a drill driver.

- Install verge flashing and fasten it with screws. Screw can be installed only into the profile that is added to the module. There must not be any screws in active or dummy modules.

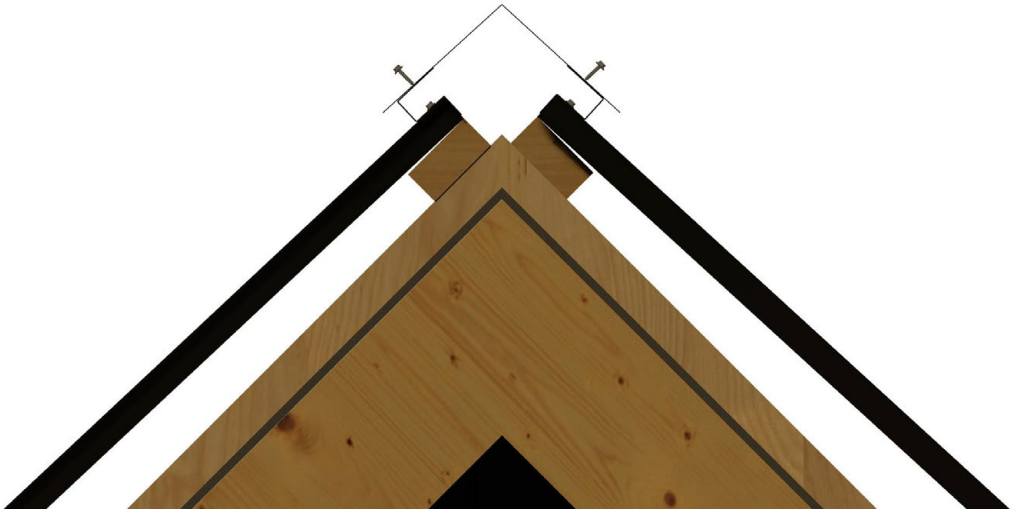
Step 19 | Ridge Ventilation and Ridge Flashing

Installing ventilation flashing is always mandatory on the side where the solar module is. If the other side is not with solar modules we advise ordering special sized ridge flashing. Bear in mind that the fastenings are different for ridge ventilation and ridge flashing.

- Install ventilation flashing

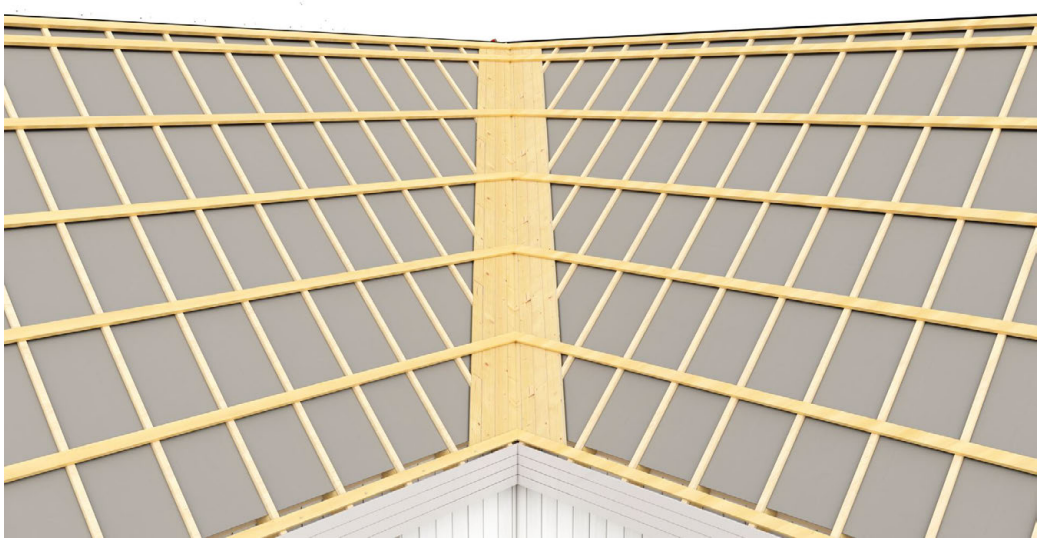
- Install ridge flashing

- Final result



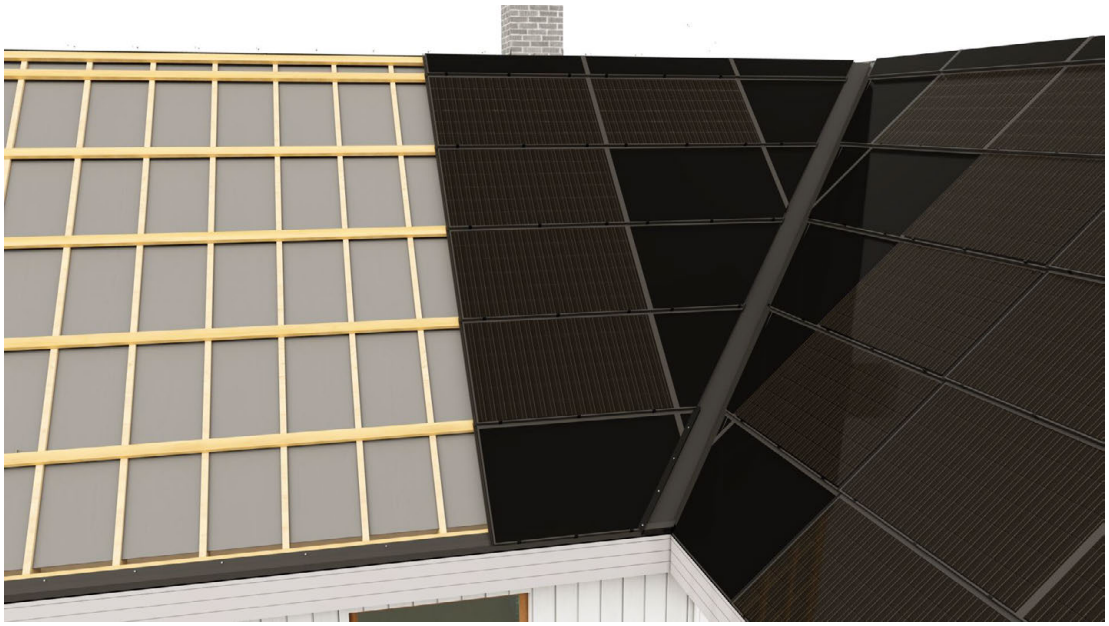
Step 20 | Valley Installation

While starting to install the valley flashing, take into account that flashings come in different sizes and positions depending on which side the valley is being installed. For a complete valley, it is important to have a proper valley deck.



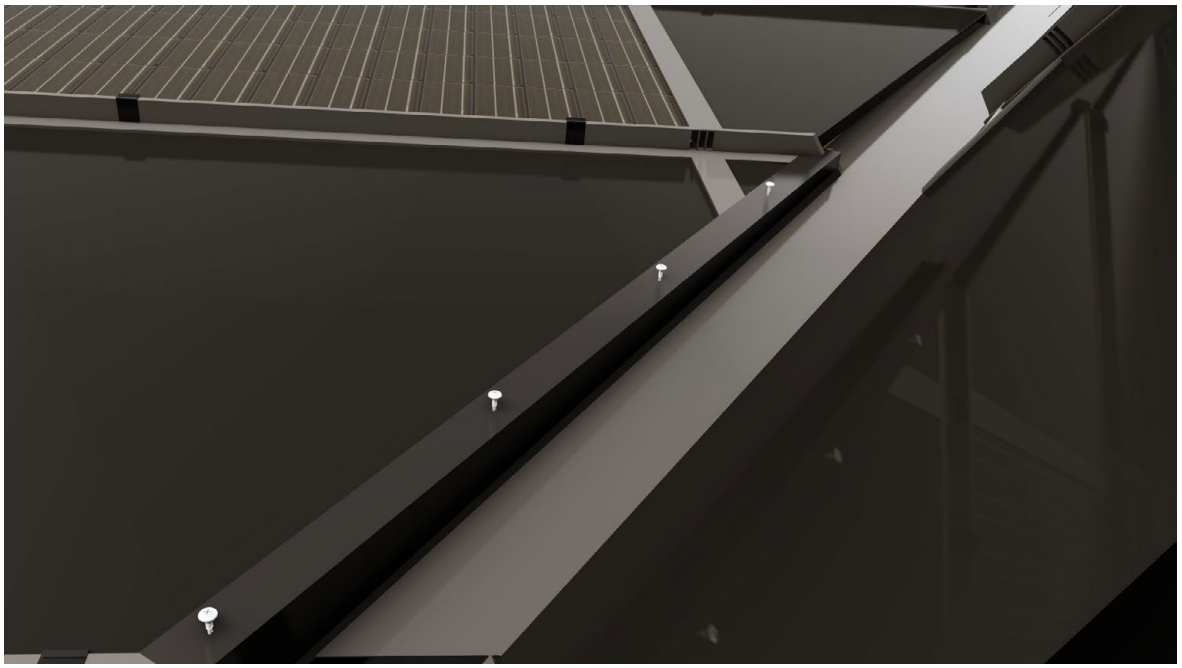
- Install the valley flashing.

- If valley flashing is fastened, dummy modules and active modules can be fitted.



- If small triangular pieces are required to complete the roofspace, where clamps cannot be installed, the dummy item can be screwed directly into the batten from the top part.

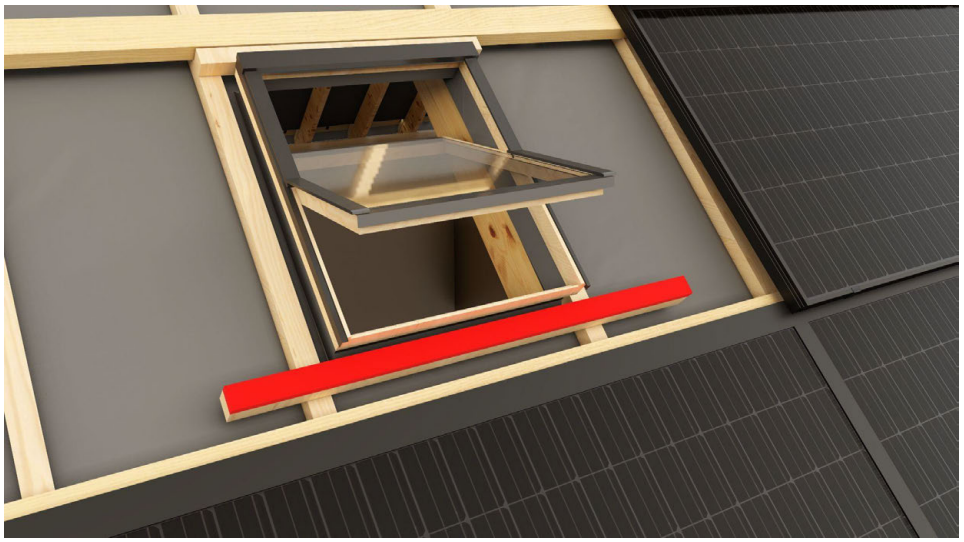
- Add cover flashing to seal the cut section of the dummy.



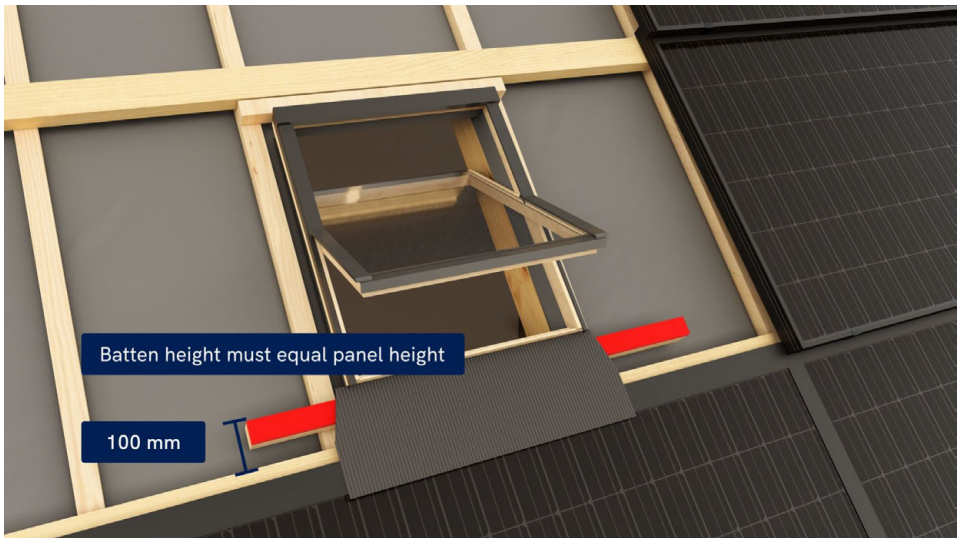
Extras

Step 21 | Roof Window

- Make proper measurements and start by adding the batten below the roof window.

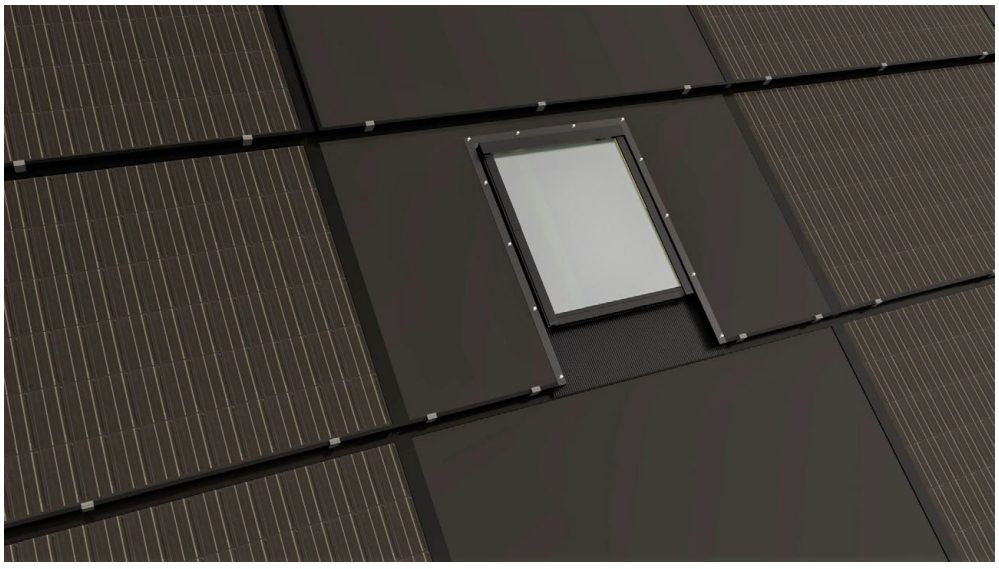


- After adding the batten, it is necessary to add the flashing in front of the roof window.



- If the dummy module is cut start by adding silicone to seal the roof window and dummy module frame.

- If the frame is sealed with silicone, finish it by screwing two parts together.
- Install the dummy module to the roof.



Disclaimer: Bottom roof window flashing must extend to another module. It must not lay between battens or be on battens.

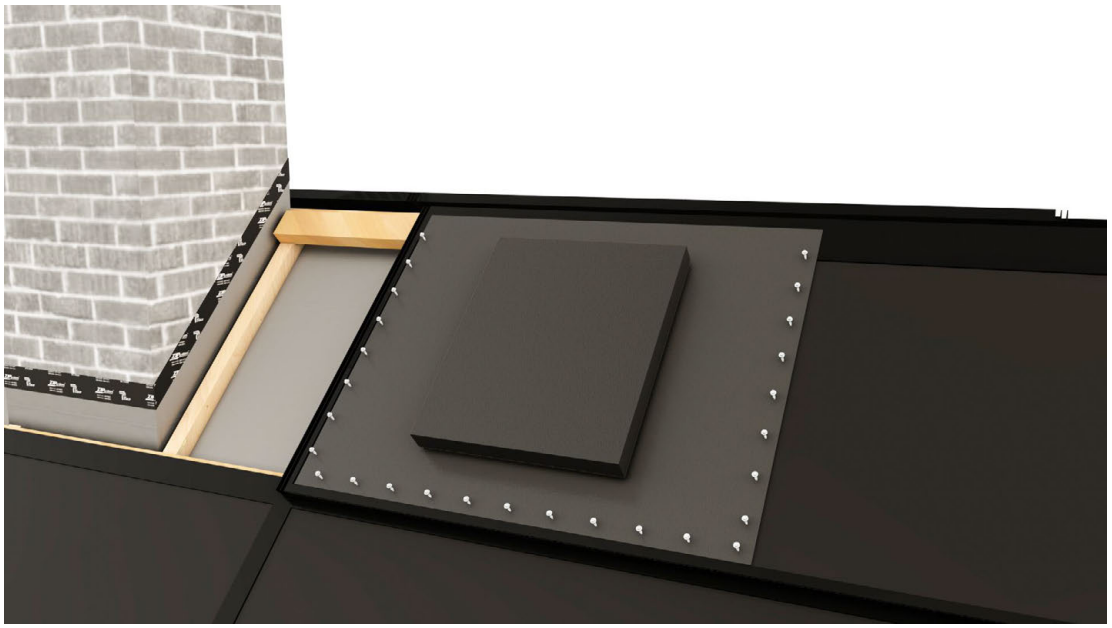
Step 22 | Roof Access Hatch

Roof access hatch can be implemented only with a dummy module. Solarstone® will advise you with the most suitable access hatches for our product.

- If the dummy module is cut to size, start by sealing the outer distance of the roof access hatch with silicone.

- Add the bottom cover of the roof access hatch.

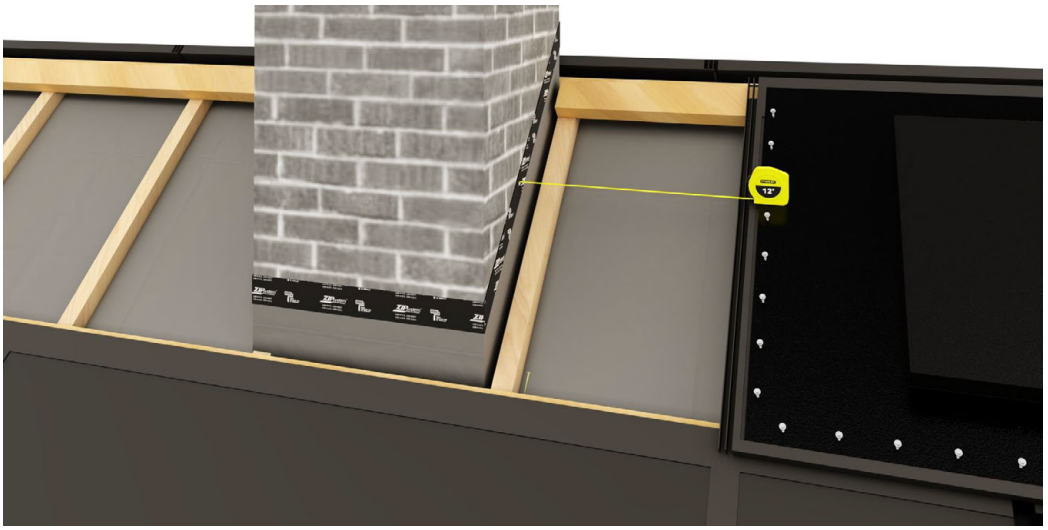
- Add the top cover of the roof access hatch.



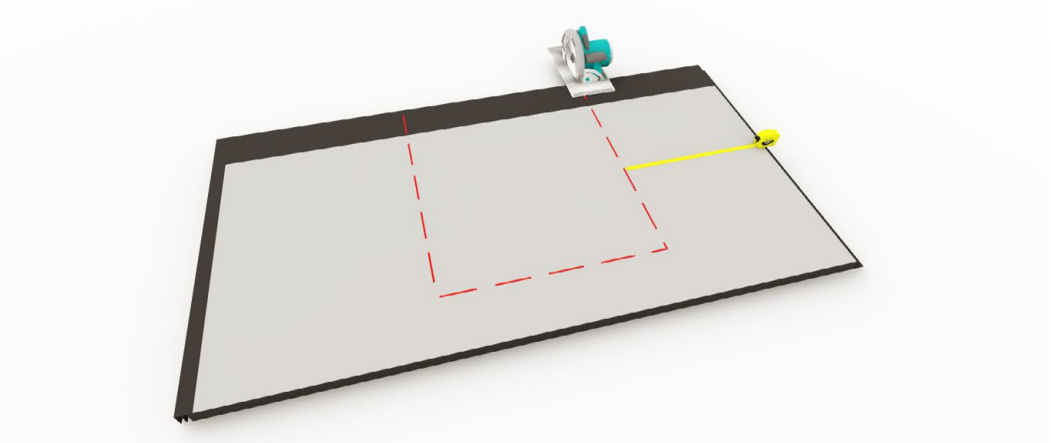
Step 23 | Chimney

Dummy module distance from chimney must be 20mm according to EVS 812-3:2018. It is not allowed to install it closer. Always abide by the local, national and international laws.

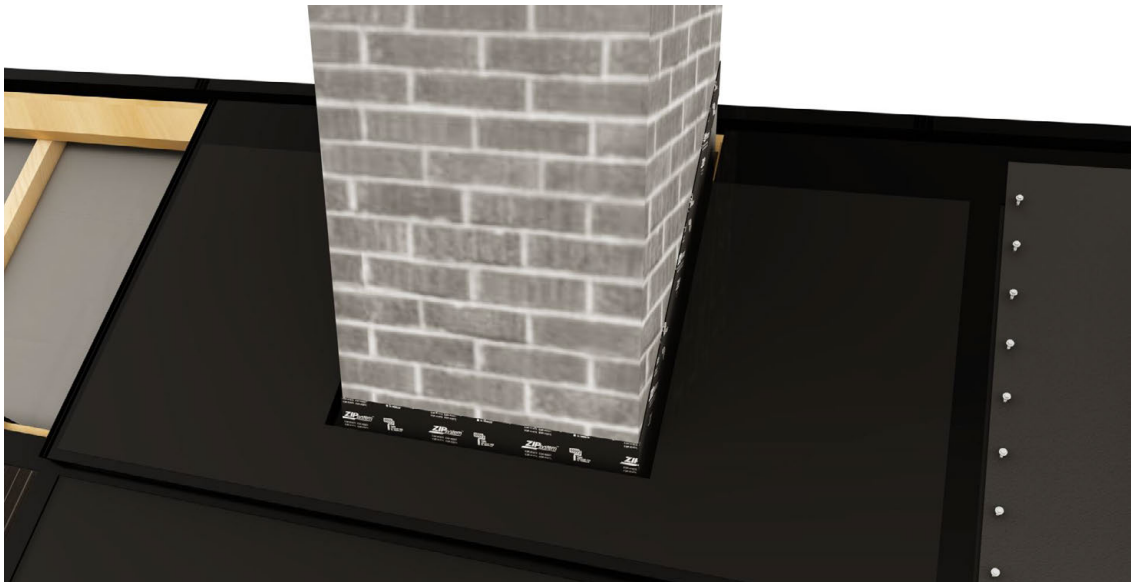
- Always make sure that the distance between the chimney and the active module is 80cm. In addition, as previously mentioned, the dummy module distance from the chimney is 20mm.



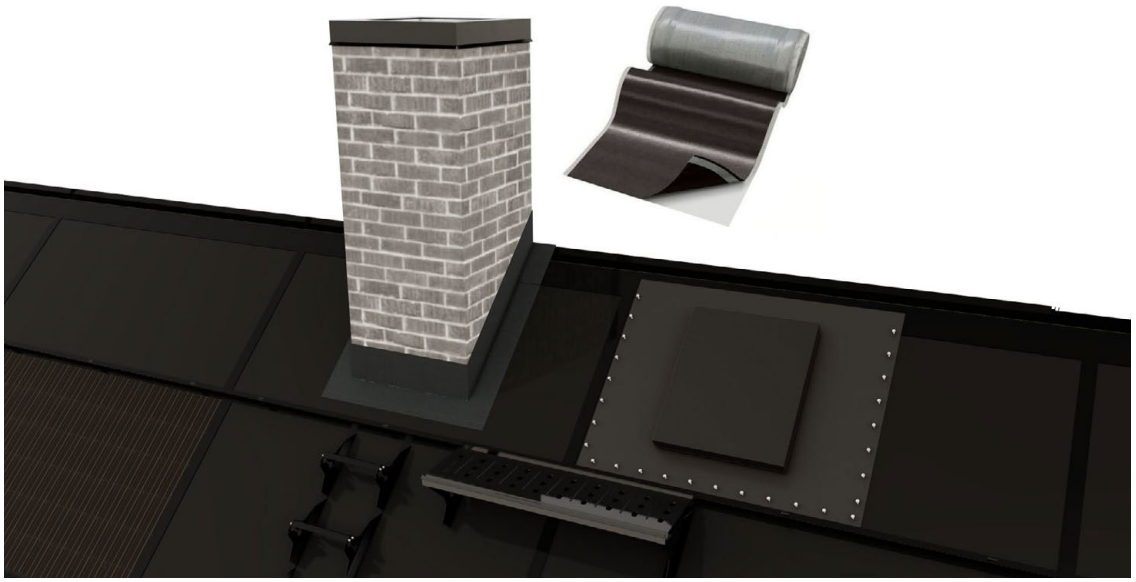
- Cut the dummy module into the correct size. Always perform the cut from the back side to protect the front side from damaging the top coat layer.



- Install the dummy module.



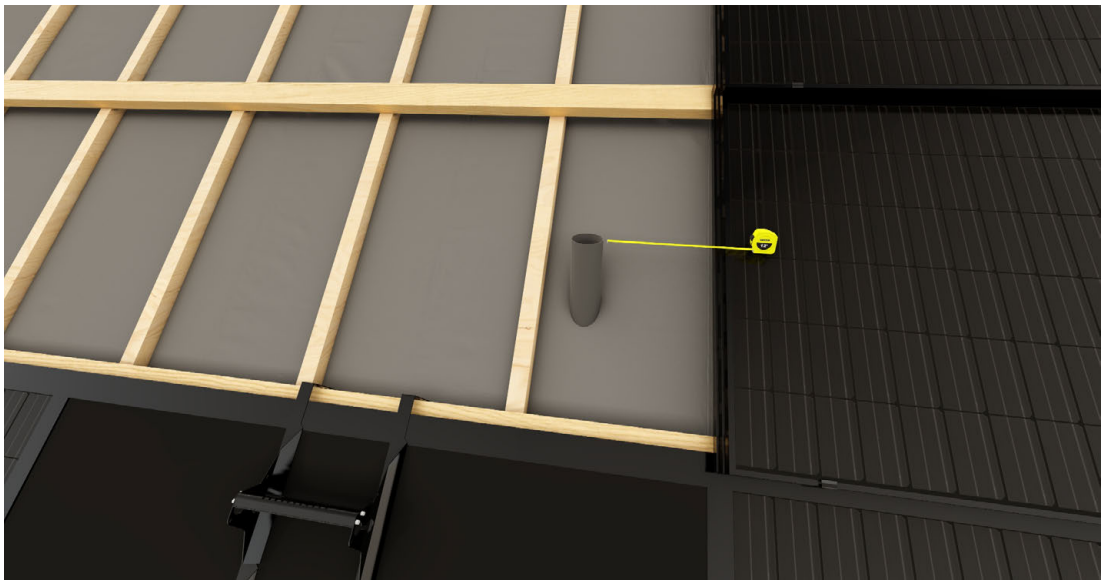
- Add the chimney wakaflex overlay.



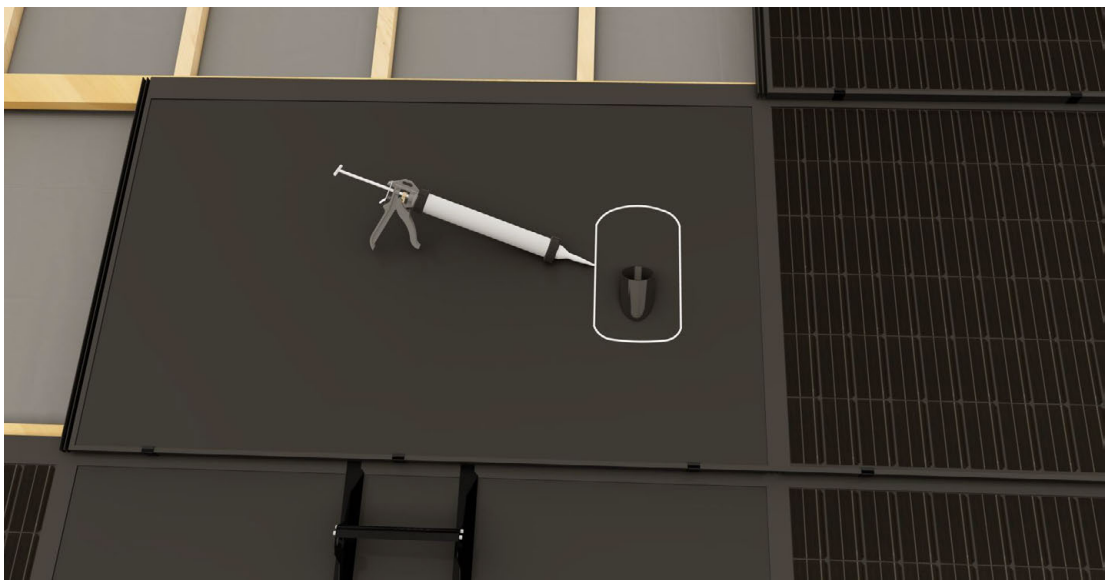
Step 24 | Ventilation Outlets

Ventilation outlets must have 0.8m distance from the active modules.

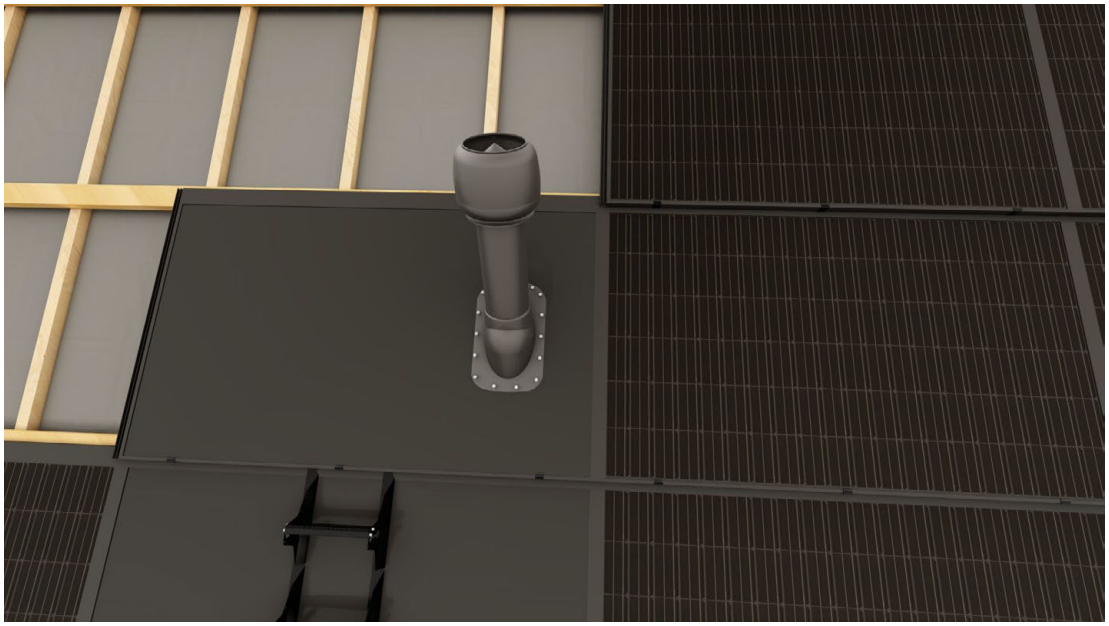
- Start off by measuring the correct distance.



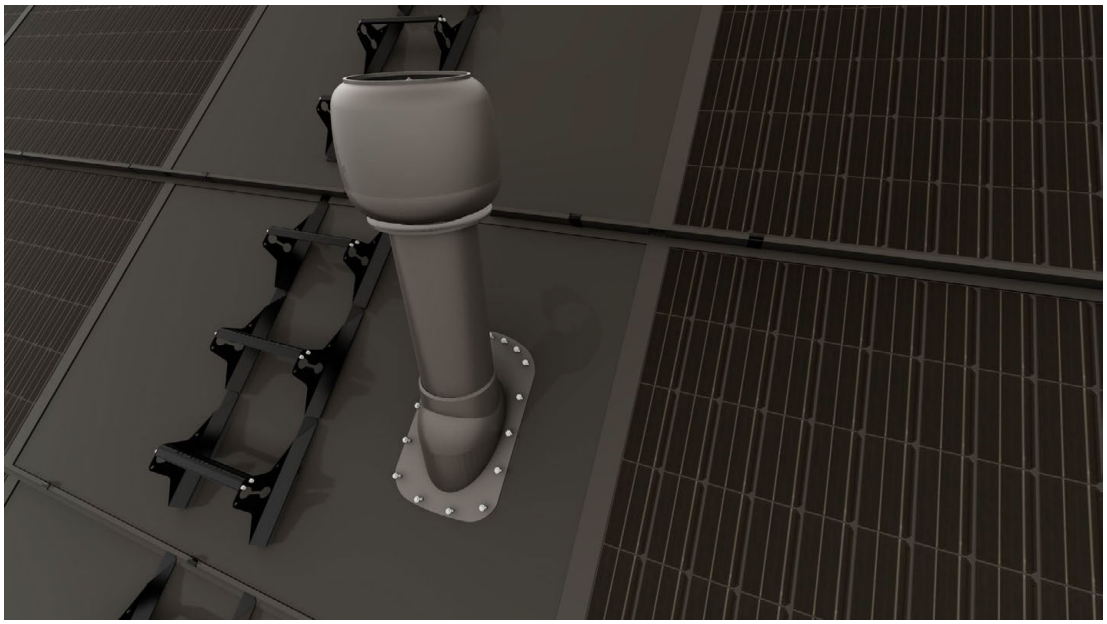
- Use silicone to seal against the weather conditions.



- Add the ventilation outlet and bolts.



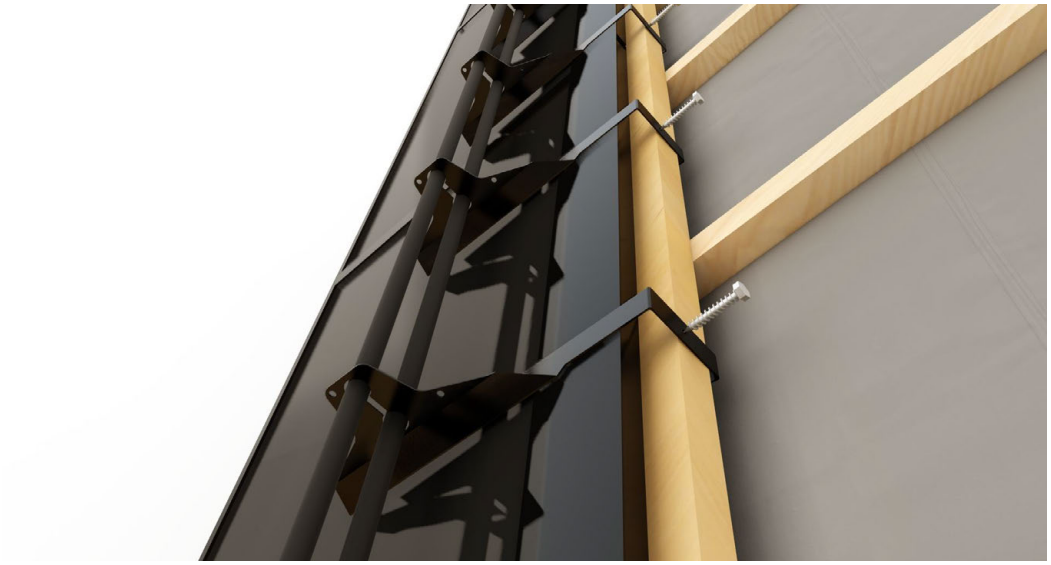
- Final result



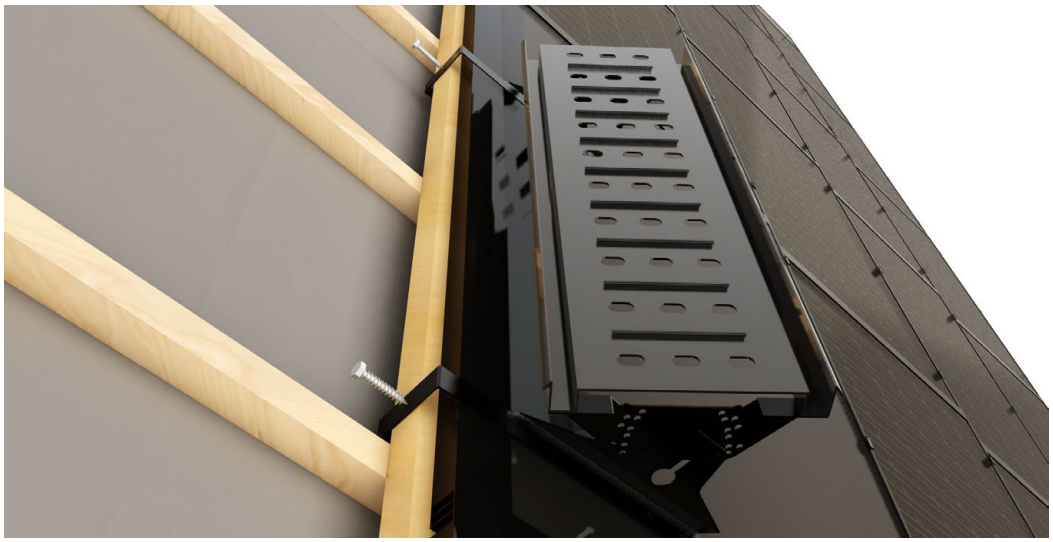
Step 25 | Installation of Roof Accessories

Installation of roof accessories is only permitted on dummy modules. Never install roof accessories on active modules. For fastening roof accessories Solarstones® advises using fastening bolts 8 x 50, which are included in the roof accessories package if not agreed otherwise.

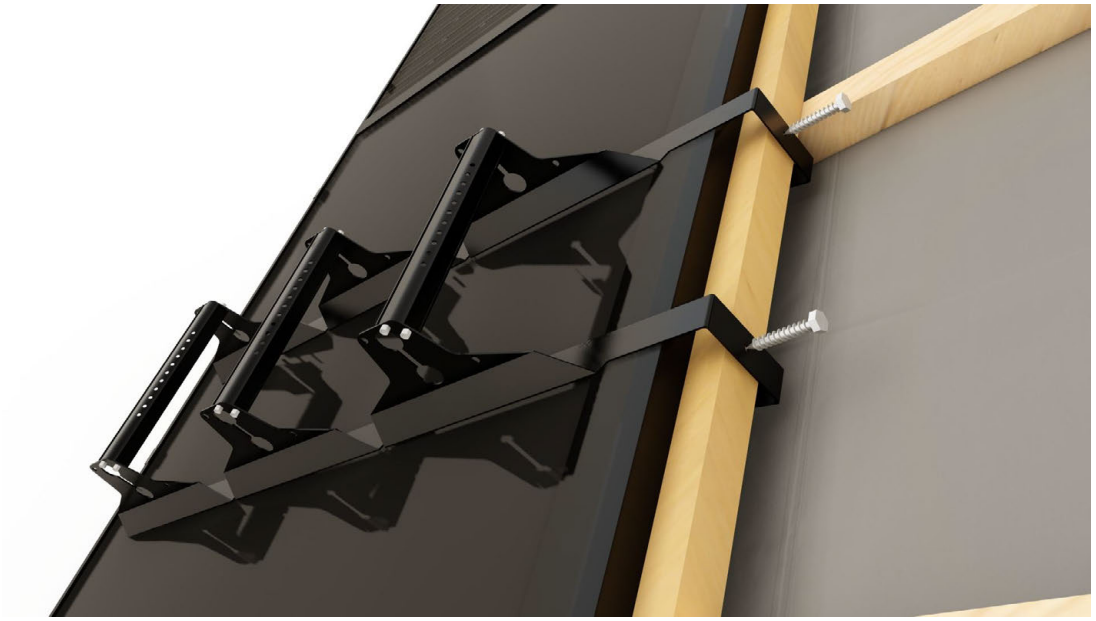
- Snow guards installation.



- Roof walkway installation



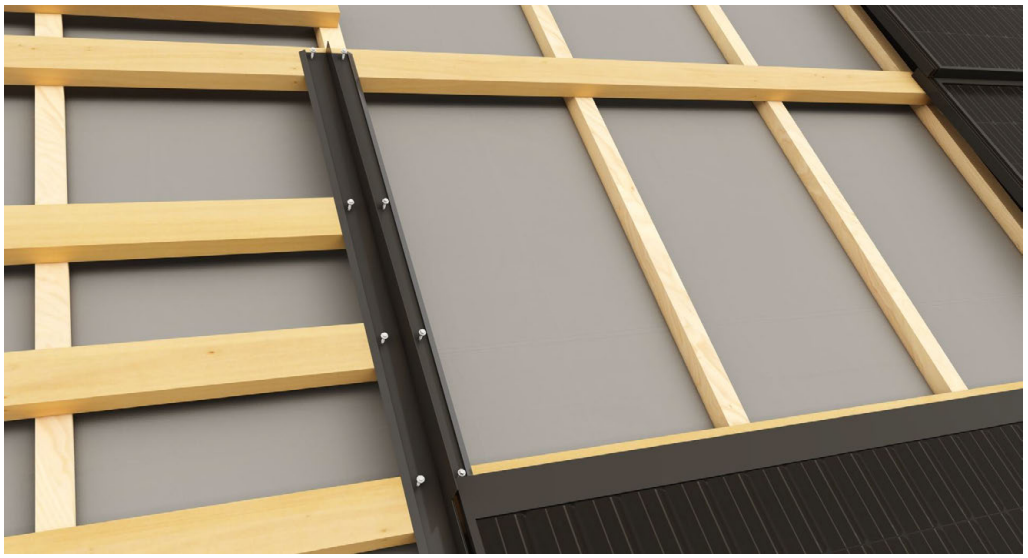
- Roof ladder



Step 26 | Installation of the Joint Flashing

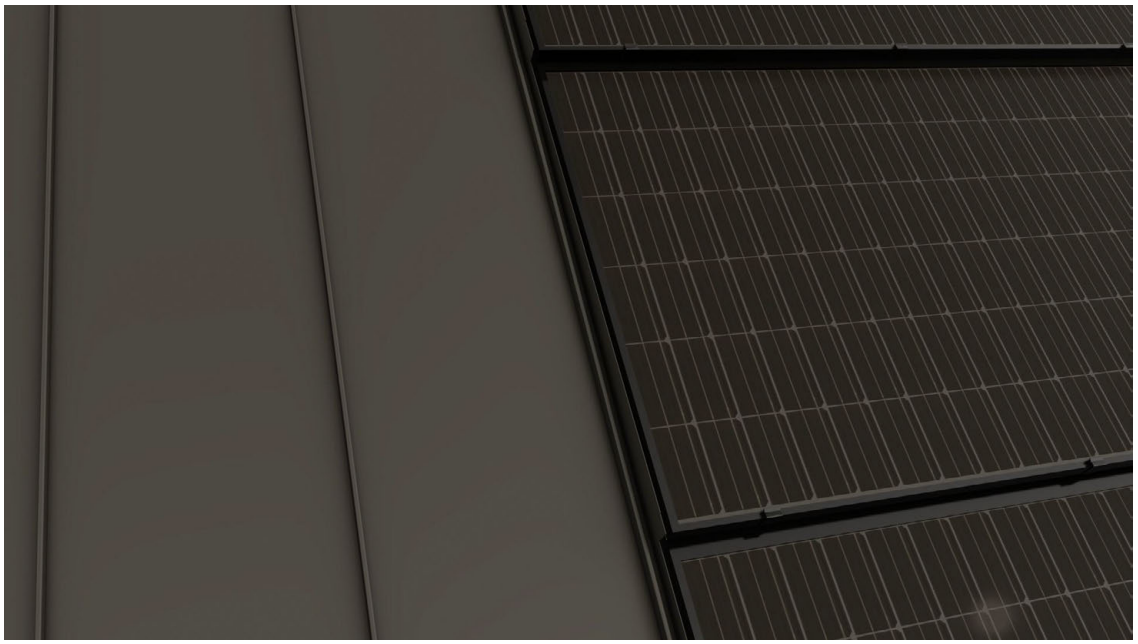
Joint flashing (reversed T-shape) is used when passive dummy modules are entirely excluded from the Solar Full Roof™ project design. Joint flashing enables functional transition to conventional roofing materials (tiles, standing seam, shingles, etc) providing necessary water-tightness and anticipated functionality of the solar roof. Relevant battening layout plan must be followed to accommodate other roofing materials outside the Solar Full Roof™ module array.

- Installing joint flashing between the modules, fixing with screws.



- Foam sealing tape is added on top of the joint flashing for providing water-tightness. Foam sealing tape is added on both sides.

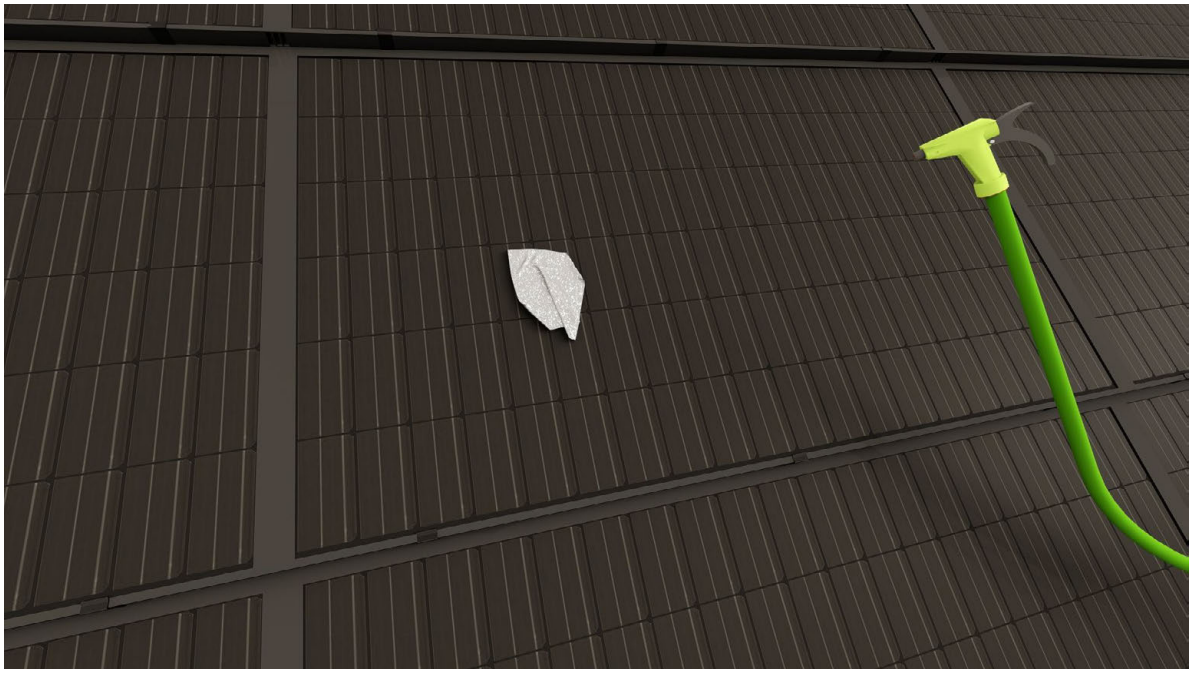
- Final result with seamless compatibility between two roofing types.



Step 27 | Maintenance of the Modules

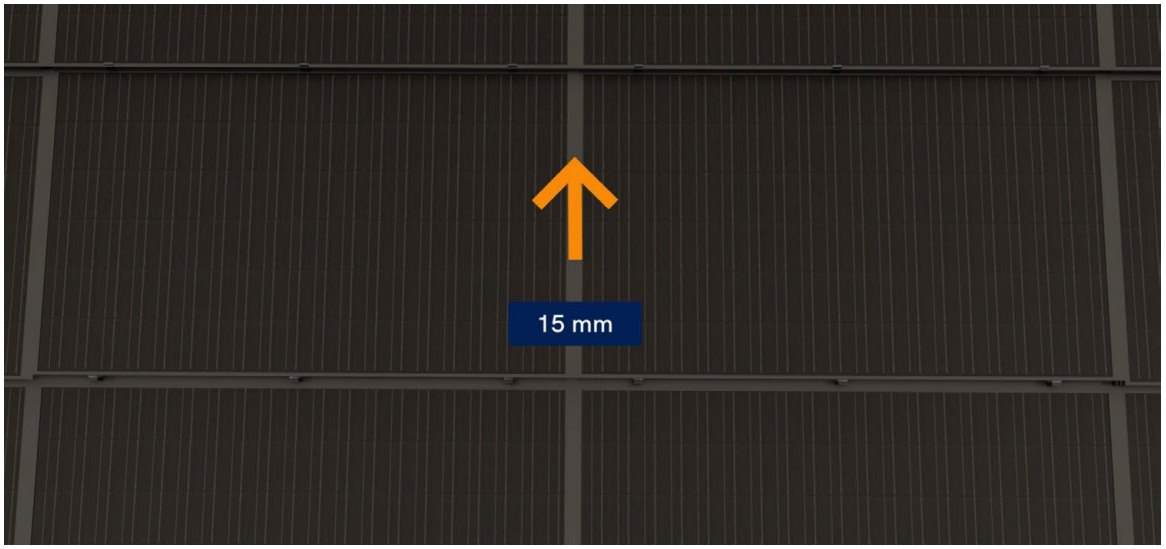
Keeping the modules maintained delivers better efficiency of the Solar Full Roof™. In regions where there is a high amount of dust, plant or tree pollination or other types of pollution regular wash should be executed.

- Modules can be cleaned with the help of the simplest means such as water and a cloth.
- Cleaning should take place only in the morning, evening or on a rainy day when the irradiance isn't high.
- It's not permitted to step on a module whilst cleaning (during installation or once installed). Use a ladder or remotely operated boom lift.
- Visual inspection once a year to see if the panel mounting brackets may have come loose.
- Do not use metal tools such as spades, knives or abrasive sponges for cleaning.
- Make sure that all visible cables and plugs in the technical room are properly secured and not loose.
- When cleaning with a pressure washer, the pressure must be less than 690 KPa.
- Do not use steam or corrosive chemicals to speed up cleaning.

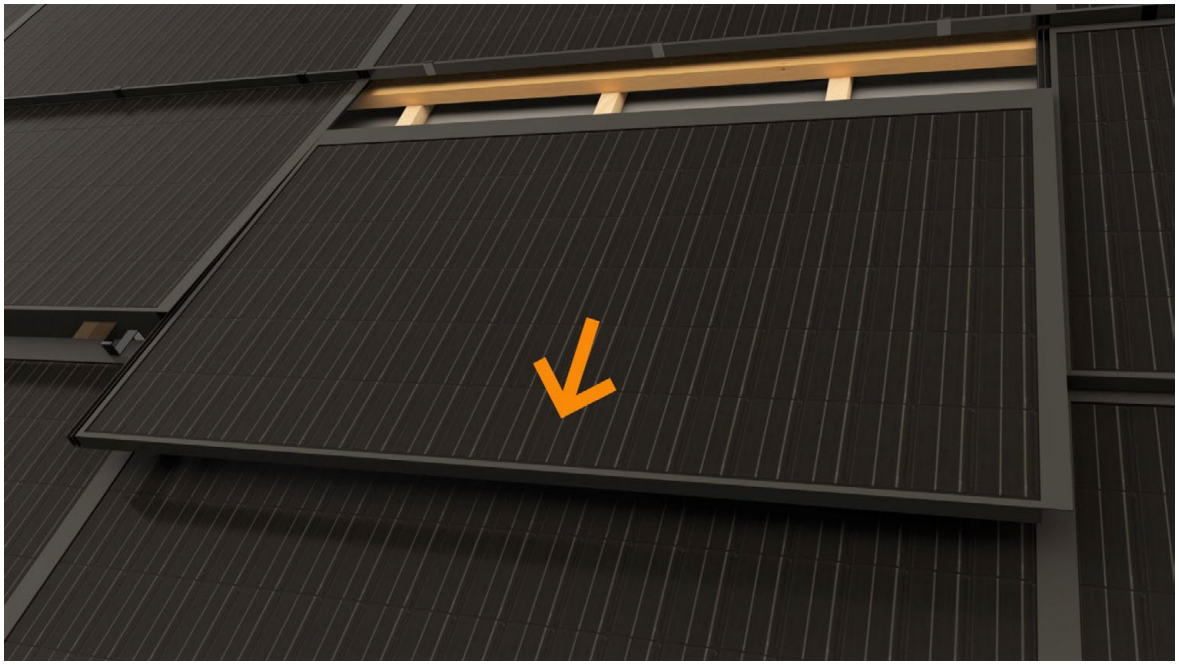


Step 28 | Replacing Modules

In order to change the module (either visibly damaged or non-functional), access the module carefully (by not stepping on the adjacent modules eg. using a ladder or remotely operated boom lift), push the damaged module 15 millimeters upwards so that module would click-out from the clamps. Also release the clamps of the adjacent module on the left, which disengages the interlocking properties of the modules for easy operation.



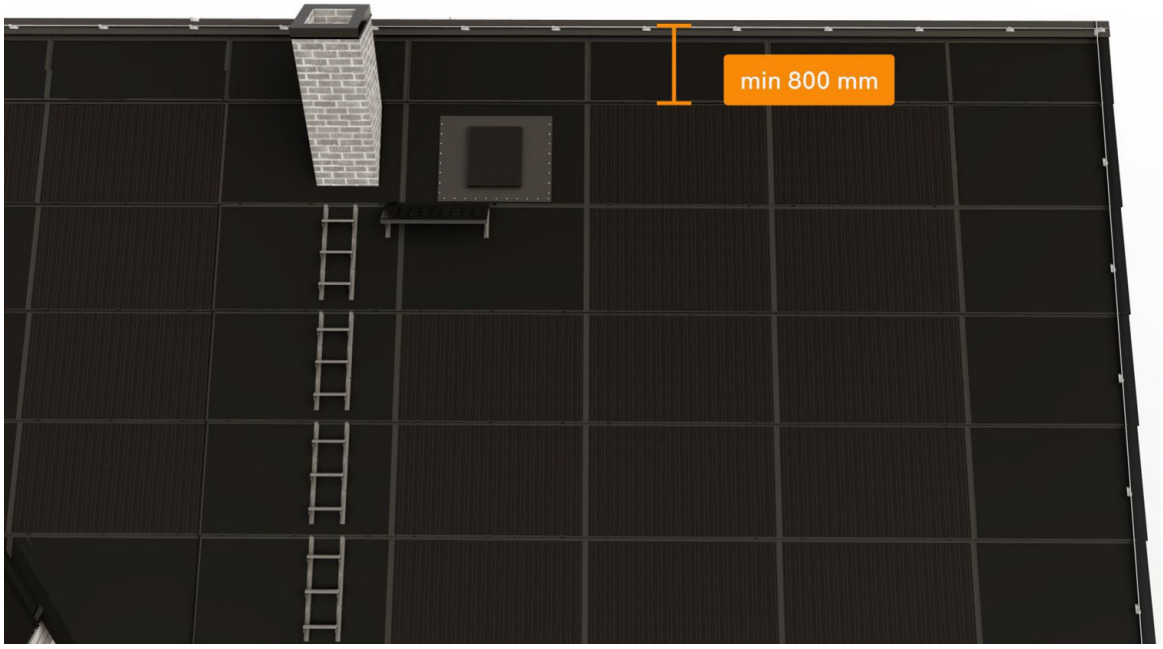
If the module has been freed from the clamps, pull it downward.



While lifting the module the left side of the module might not come off smoothly. Nevertheless, while pulling it downwards gently it can be disassembled from the array.

Step 29 | Lightning Protection

Ring earth electrodes must be in contact with the ground. It must be installed as a closed ring with a depth of 0.8m according to DIN 18014 around the external foundation of the building. Active module must be installed a minimum of 0.8m away from the ring earth electrode. Always abide by your local, national and international regulations.

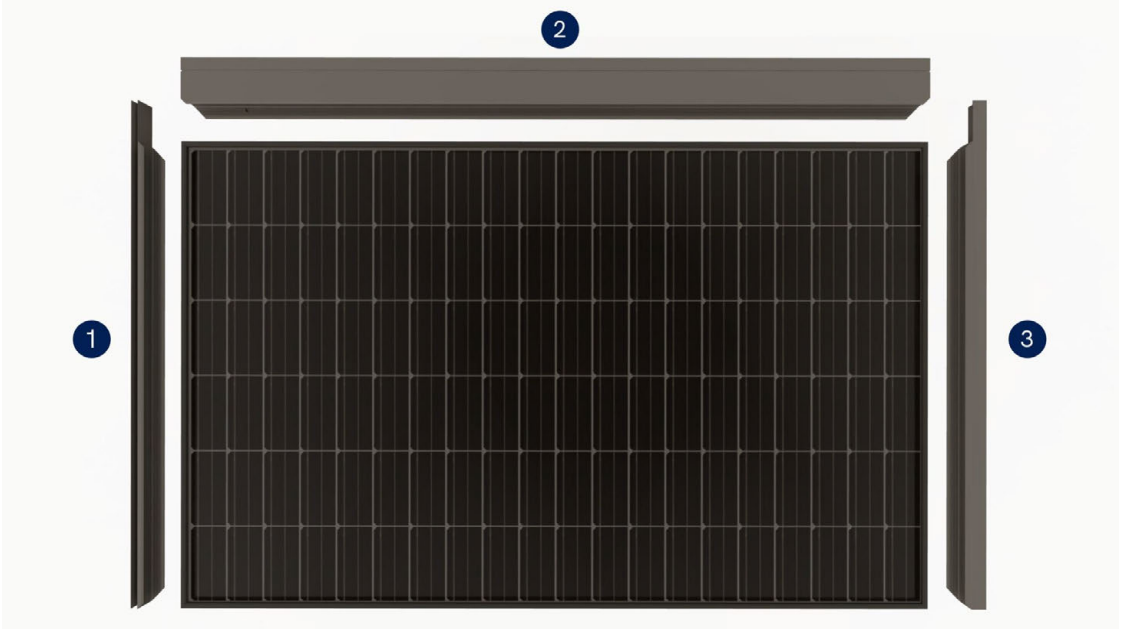


Step 30 | Assembly of Click-on® Kit

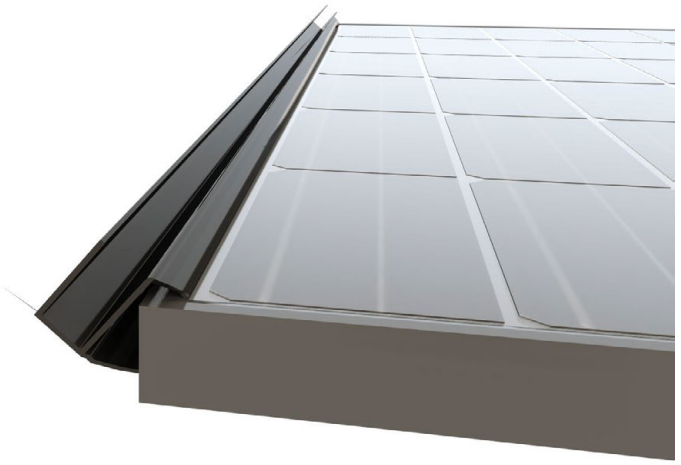
Once the Click-on® kit is clicked/assembled to the module it is not permitted to disassemble components anymore as it may lose its original properties and result in undesirable outcome. Always start clicking the next module in the same order and position as the previous module to ensure the male and female MC4 port connectors stay on the same side. Following instructions apply both for landscape and portrait configurations.

- Use the location of a barcode for easy reference to make sure the clicking sequence is correct.

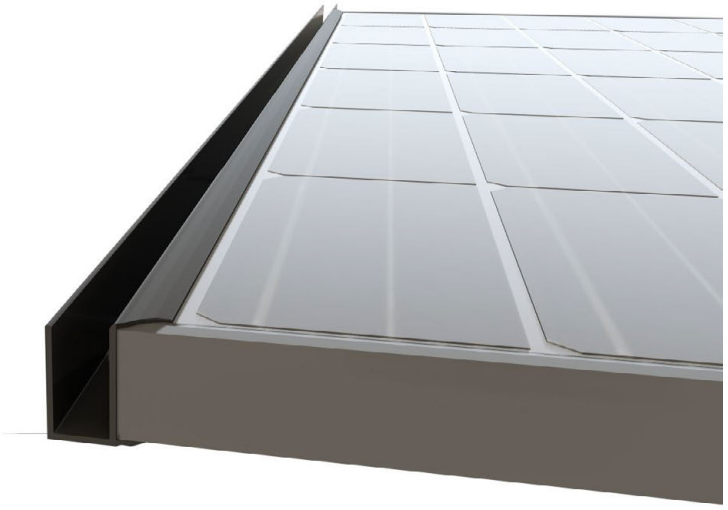
- Click-on® kit consists of 3 profiles - Left, Right and Top profile.



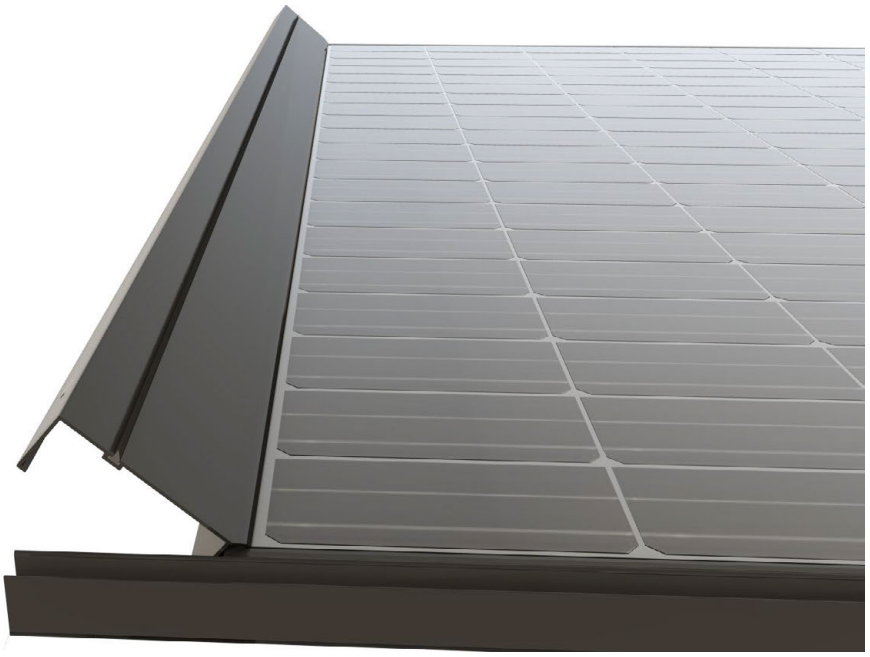
- Always start the clicking process with the left profile by connecting the upper side over the PV module frame.



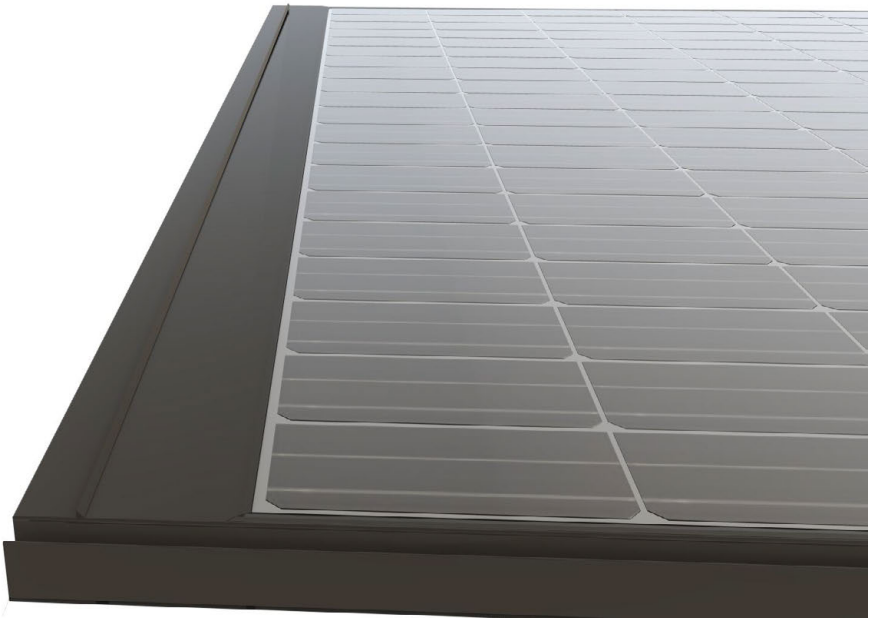
- Firmly push the lower side of the profile under the PV - frame. “Clicking” sound ensures the profile is fully wrapped around the module’s frame. Check visually if the profiles are full aligned.



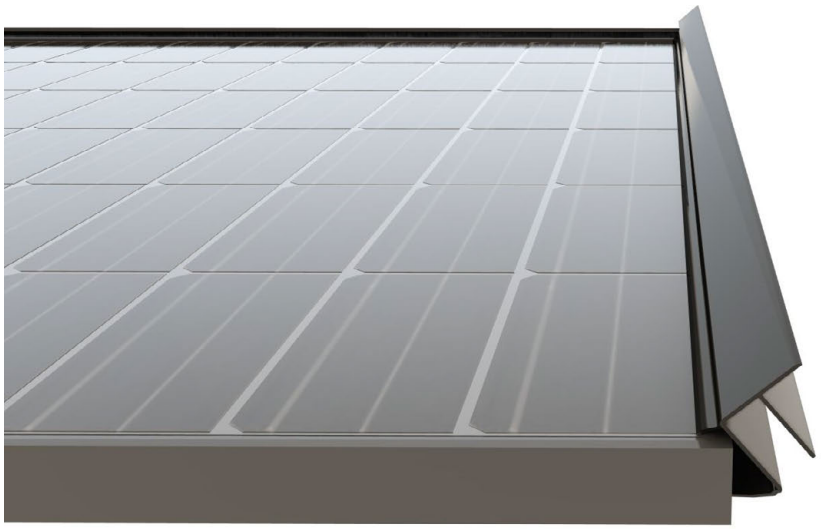
- Repeat the process by connecting the top profile's upper side to the PV-module.



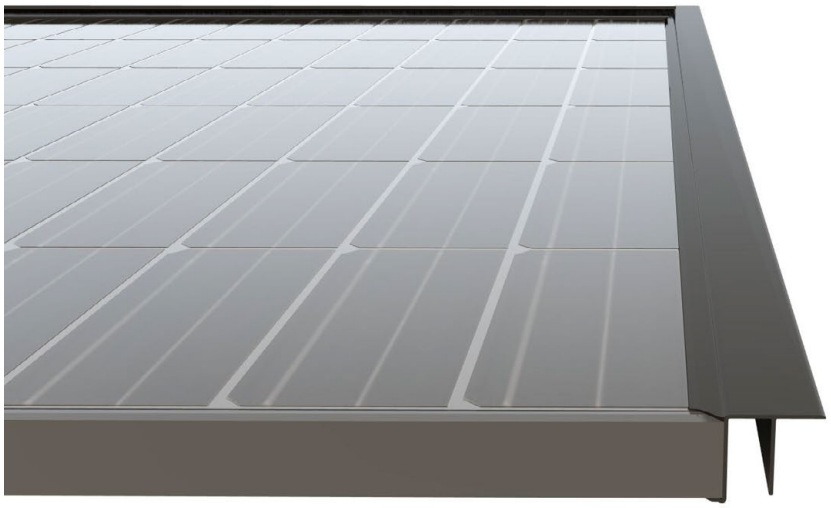
- Firmly push the lower side of the profile under the PV - frame.



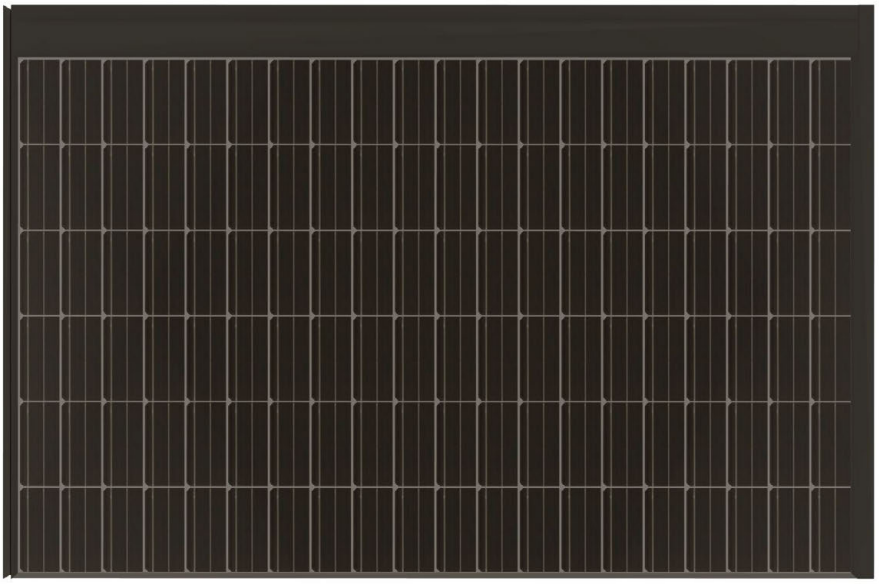
- Repeat the process with the right profile by connecting the upper side of the profile to the PV-module.



- Firmly push the lower side of the profile under the PV - frame.



- Congratulations! You have successfully clicked a solar module and the installation may commence!



Version

NO	DATE	DESCRIPTION	WHO
1.0	11.01.2023	Released version	Mattis Jürimäe, Alari Merbach, Henri Lass
1.01	16.03.2023	Revised batten step formula	Alari Merbach, Kevor Reva, Henri Lass

SOLARSTONE OÜ

12916046 | EE101855882

Tallinna tn 58, 71018 Viljandi, Estonia

sales@solarstone.com | +372 5631 6666