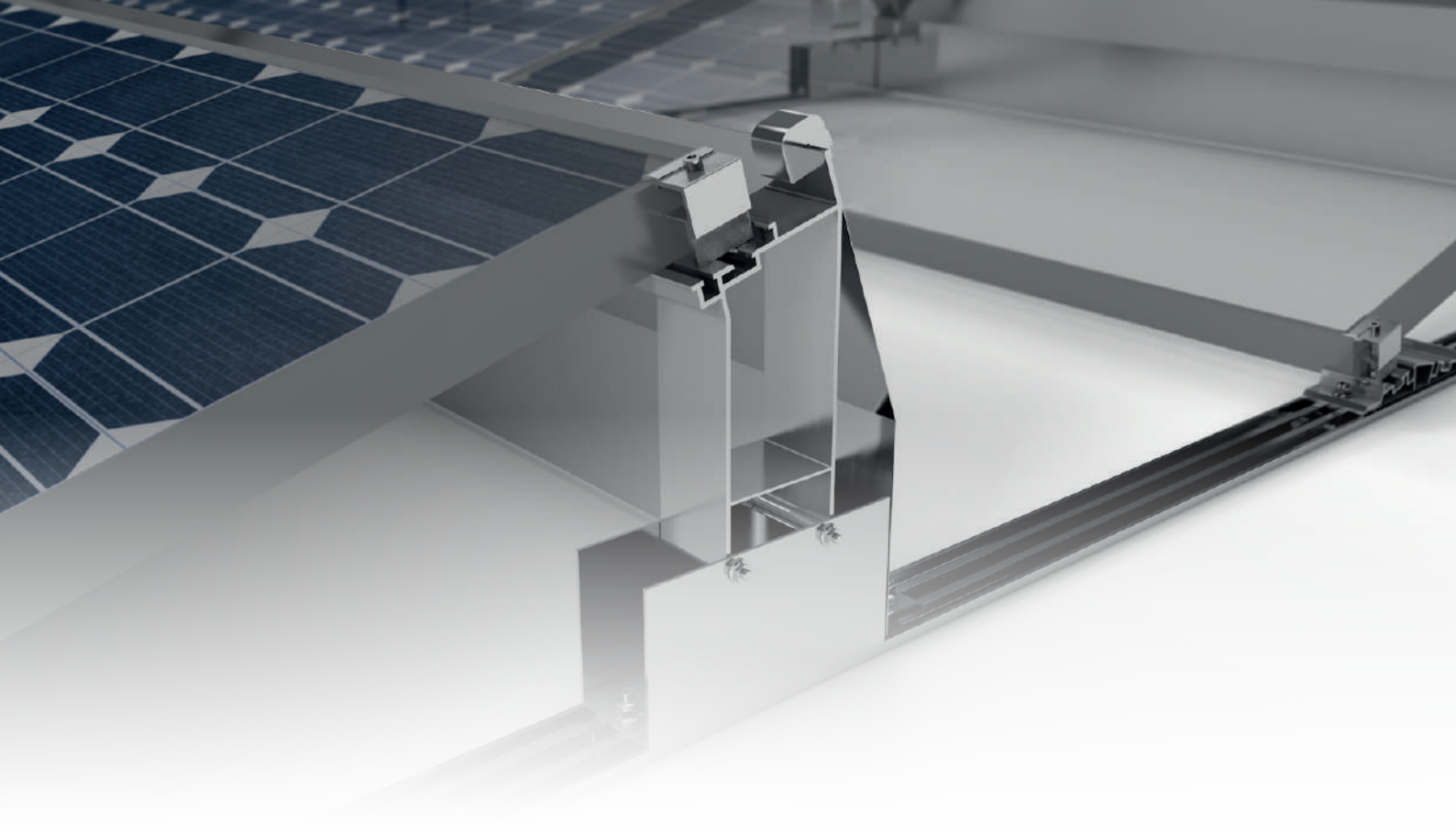


PROINSO PV Rack

PROINSO PV RACK
TRIANGLE S PRO

Robust aluminium structures
designed and made in Europe

CONTENTS

1. INTRODUCTION

1.1. SHORT DESCRIPTION

The Triangle S Pro flat roof system is a rugged frame system for the assembly of PV modules on flat roofs. The Triangle S Pro system allows for the connection of several rows of modules in East-West direction. The standard pitches of the system are 10° and 15°. Triangle S Pro is used for module areas of at least 10m^2. Triangle S Pro was especially designed for applica- tions on flat roofs with low admissible load capacity. The design of all components ensures easy assembly. The tried and tested Clickstone technology, standard preassembly and clever product design on the basis of only a few individual parts allow for short assembly times and minimum tool requirements. The parts used are made of aluminium and stainless steel. Their high degree of corrosion resistance guaran- tees maximum service life and full recyclability.

1.2. ABOUT THESE INSTRUCTIONS

CONTENT

These instructions describes the assembly of the Triangle S Pro flat roof system as well as any system-specific info mation on planning, components and safety instructions. The drawings in the first part of the instructions show the assembly of the system for the corner clamping of framed modules. The additional steps which are required for rail clamping at the long module side are separately described in chapter 6.

APPLICABLE DOCUMENTS

In addition to this document, the document "Installation Manual - General Information" is together with each system. Here you can find general information on standards, safety, transport, maintenance, disassembly and disposal applicable to PROINSO PV Rack's place of assembly. Both this Installation Manual and the "Installation Manual - General Information" are an integral part of the Triangle S Pro mounting system and must be observed for each installation.

It is crucial to carefully read these Instructions as well as all applicable documents prior to carrying out any installation, maintenance or disassembly work. You are provided with the information required for the safe and complete installation, maintenance and disassembly. Should you have any questions, please contact PROINSO PV Rack.

USER GROUPS

PROINSO PV Rack's installation instructions are intended for the following persons (user group):

- skilled personnel
- instructed personnel

SKILLED PERSONNEL

Skilled personnel are individuals who, on the basis of their professional training, are able to execute installation, maintenance, and disassembly work appropriately.

INSTRUCTED PERSONNEL

Instructed personnel are individuals who have been instructed and taught appropriately regarding the assigned tasks and the possible risks in the event of improper conduct. An instructed individual must have received instructions regarding the required safety policies, precautions, relevant regulations, accident prevention regulations, as well as operating conditions and must have demonstrated his/her competence. The implemented work must be approved by skilled personnel.

ORIENTATION GUIDE

The following pictograms allow for the easier orientation in this manual:

PICTOGRAMS

This symbol indicates important information and useful notes.

This symbol indicates tips and tricks for easier procedures.

1.3. WARNING NOTICES

The warning notices used in this Installation Manual indicate safety-relevant information. They include:

- warning symbol (pictogram)
- signal word indicating the hazard level
- information on the type and source of hazard
- information on possible consequences if hazards are disregarded
- measures to be taken in order to prevent
- hazards and avoid injuries or damage

The signal words of the warning notices indicate the following hazard levels:

DANGER

Indicates a great, exceptional danger which, if not avoided, will result in severe personal injury or death.

WARNING

Indicates a potentially dangerous situation which may result in severe or moderate personal injury and damage to property.

CAUTION

Points out a possibly dangerous situation which, if not avoided, may result in minor or light personal injury and damage to property.

ATTENTION

Indicates a potential danger which may result in damage to property.

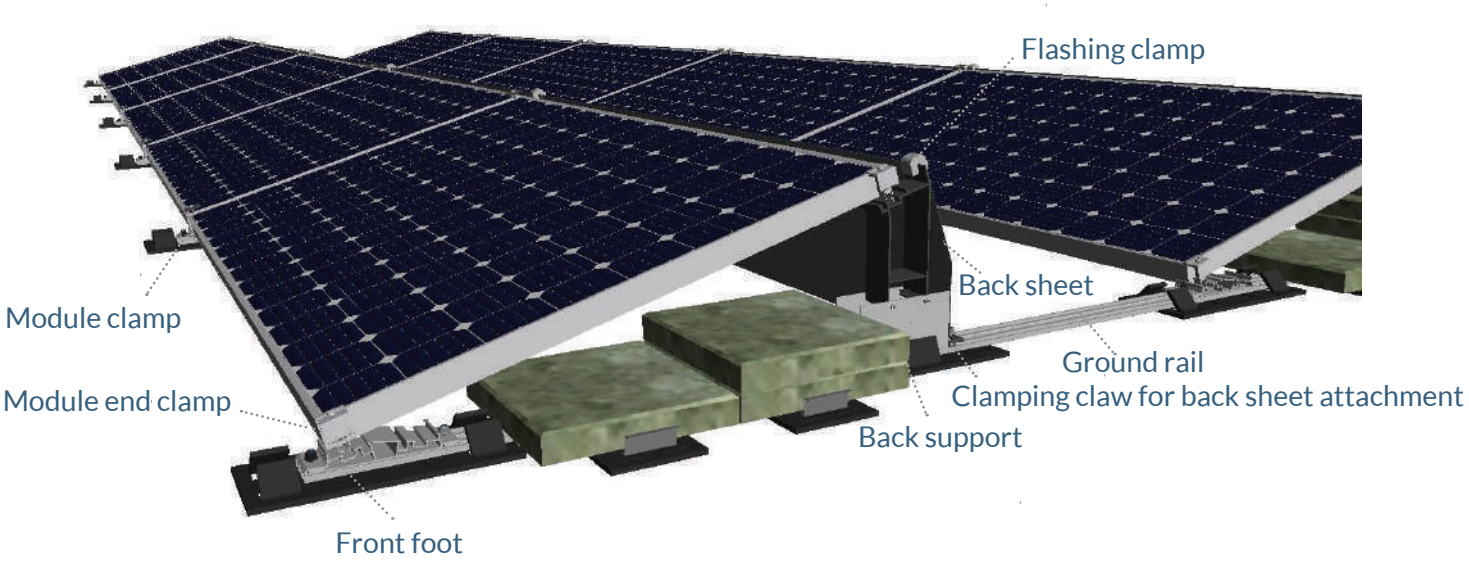
1.4. SAFETY

The complete general safety regulations for the frame systems supplied by PROINSO PV Rack are included in the further applicable document "Installation Manual - General Information". Read this document with care and always observe the notices containeduse the frame only in compliance with its intended purpose. Observe the duties of the principal and follow the general as well as the specific safety instructions. For any jobs you accomplish, the specific safety notes which precede the instruction steps in this productspecific Installation Manual must also be observed.

2. TECHNICAL DESCRIPTION

2.1. SYSTEM OVERVIEW

The following illustration shows all system parts.



The design of each system part may vary. It depends on:

- type of roof
- type of module
- number of modules
- local conditions

2.2 TECHNICAL DATA

APPLICATION	Flat roofs
ROOFING	For all roof coverings (also gravel)
ROOF INCLINATION	5°
BUILDING HEIGHT	Depends on wind loads on site
PV-MODULES	Framed, frameless
MODULE WIDTH	900-1050mm
MODULE LENGTH	Up to 1675mm (longer modules on request)
MODULE LAYOUT	In connection
MODULE ORIENTATION	Landscape
PITCH	10° or 15°
SIZE OF MODULE ARRAY	Min. 10m2
POSITION OF THE MODULE ARRAY	No special requirements
STANDARDS	Eurocode 0 – Basis of structural design Eurocode 1 – Action on structures Eurocode 9 – Design of aluminium structures
SUPPORTING PROFILES	Extruded aluminium profiles (EN AW 6063 T6)
RAIL FIXATIONS	Galvanised steel (DX51A+Z275)
SMALL PARTS	Stainless steel (V2A)
COLOUR	Aluminium: plate finish
WARRANTY	10 years

2.3. COMPONENTS

The following illustration shows all parts of the Triangle S Pro frame which can be included in the scope of delivery. The exact scope of delivery as well as the number of individual frame parts depend on your order. Building protection mats can be ordered at PROINSO PV Rack as an option but are required for assembly.

Front foot

Back support

Ground rail

Back sheet

Clamping claw

Module clamp

Module end clamp

Ballast profile

L-profile for ballast

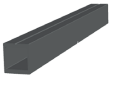
M8 x 20 T-head bolt
for ballast L-profile

Self-retaining M8 nut
for ballast L-profile

building protection mat,
300 x 100 x 10mm

Module support clamp
(only for rail clamping)

Base rails
(only for rail clamping)



Inner connector
(only for rail clamping)

Flashing clamp

3. IMPORTANT ASSEMBLY NOTES

3.1 APPLICATION CONDITIONS

Ballast stones are applied on the ground rails in order to secure the mounted flat roof system. The arrangement of the ballast stones is provided in your individual ballast plan. The ballast plan is included in the scope of delivery. The customer must ensure that the roof is capable of carrying the additional weight of the system and the ballast stones.

3.2 ASSEMBLY PREPARATION

PROINSO PV Rack recommends gathering information on the on-site conditions before ordering Triangle S Pro. In particular, you should familiarise yourself with:

- the roof structure (e.g. surface material)
- the admissible additional load reserves of the roof
- the adequate fixation of the supporting construction on the roof surface

3.3 ASSEMBLING AID AND REQUIRED TOOLS

The following tools are required for the assembly of the frame system:

- Allen wrench, 5mm
- Impact wrench with a tightening torque of min. 180 Nm or an M13 ring spanner wrench
- Elongation for impact wrench
- Attachment for impact wrench, 13mm nut
- Chalk line
- Spirit level
- Folding rule / measuring tape
- Lifting gear (e.g. roofer lift, harness)
- Plunger elevator
- Spacing template (included in the scope of delivery)
- Gloves

3.4 EXPANSION JOINTS

Due to thermal expansion, the system must be designed with joints which must be taken into account for the ballast plan. The following data can be used for module design:

CORNER CLAMPING:

In North-South direction	every 6 modules
In East-West direction	every 10 modules

RAIL CLAMPING:

In North-South direction	every 6 modules
In East-West direction	every 6 modules

3.5 ON THE ASSEMBLY DESCRIPTION

The following chapters describe all steps necessary for the planning and assembly of Triangle S Pro in their correct order. Chapter 5 describes the assembly steps for the corner clamping of the modules at the short side, chapter 6 includes the additional assembly steps necessary for the rail clamping of the modules at every quarter of the long side. Follow these assembly steps and make absolutely sure to observe the safety instructions.

DANGER

DANGER TO LIFE DUE TO FALLING PARTS!

Parts falling from the roof may cause severe injury or death!

- Before starting assembly, make sure that the material used meets the on-site static requirements.

DANGER

DANGER TO LIFE DUE TO DAMAGE TO THE ROOF

Excessive load may severely damage the roof!

- Before starting assembly, make sure that the building and in particular the roof cladding meet the static requirements which will increase due to the PV system and during assembly work.

DANGER

DANGER TO LIFE DUE TO DAMAGE TO THE ROOF

Excessive load may severely damage the roof!

• Before starting assembly, make sure that the building and in particular the roof cladding meet the static requirements which will increase due to the PV system and during assembly work.

DANGER

DANGER TO LIFE DUE TO FALLING PARTS!

Parts falling from the roof may cause severe injury or death!

• Before starting assembly, make sure that the material used meets the on-site static requirements.

4. PLANNING OF THE MODULE AREA

Before you can start assembly, the following tasks must be accomplished:

• Clean the roof surface.
• The first row must always be mounted towards the front roof edge (South).
• Align the installation area because roof areas are not always at right angles.
• Apply, for example, a chalk line at the first row to align the front side.

We highly recommend using building protection mats in order to avoid damage to the waterproofing of the roof. Building protection mats are supplied as an option and can be ordered at PROINSO PV Rack. Depending on the surface structure of the roof, we recommend the following building protection mats:

ROOF	BUILDING PROTECTION MAT
Bitumen-coated	Standard
Foil roof	Coated on one side with aluminium
Gravel-covered and green roof	Standard

Two building protection mats for each elevation must be placed under each ground rail (one each under every front foot and every back support). If additional ballast support components such as ballast profiles or L-profiles are used, additional building protection mats are required. The following calculation applies:

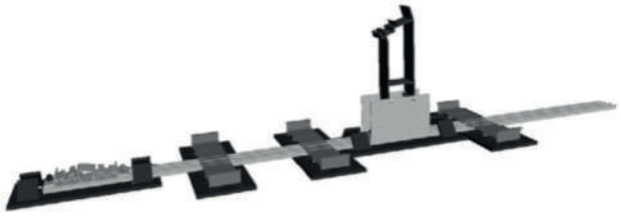
• Ballast profile: one additional building protection mat for every two ballast profiles

• L-profile: two additional building protection mats for every two L-profiles

• Building protection mats are cut out such that safety tabs can be fold out in order to prevent lateral slipping (for example caused by thermal expansion)

Make sure that the building protection mat protrudes from both ends of the ground rail by approx. 50mm. This is to ensure optimal protection for the roof surface.

4-1



4-2

DANGER

DANGER TO LIFE DUE TO FALLING!

Falling from the roof may cause severe injury or death!

- Wear the protective equipment stipulated by the law!
- Secure yourself against falling!
- Do not work on the roof during high wind!

DANGER

DANGER TO LIFE DUE TO FALLING PARTS!

Parts falling from the roof may cause severe injury or death!

- Seal off the danger zone on the ground prior to starting assembly work in order to prevent persons from being injured by falling parts!
- Make sure to secure the parts so that they cannot fall down the roof!
- Wear the protective equipment stipulated by law!
- Do not stand in the danger zone!
- Do not work in high wind!
- After having completed assembly, check the frame system and the modules whether they are tightly secured!

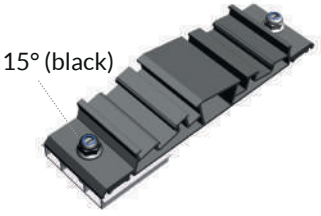
5. CORNER CLAMPING ASSEMBLY

5.1 LAYING AND MOUNTING THE FIRST MOUNTING FRAME ROWS

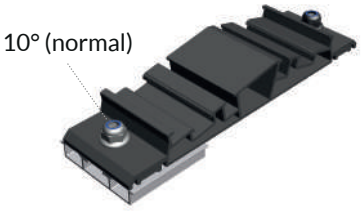
Each frame row is started with a short ground rail piece (60 mm). Thus it is recommended to preassemble the short ground rail pieces (60mm) with the front support of the first rows.

In this context, the front support is used as a connection between the rails as well as for module alignment. Keep in mind that the front support is design both for 10° and 15° frames.

The 15° side of the foot is marked by the black nut. So, in order mount a 15° system, make sure that the black nut are pointing forwards south direction.



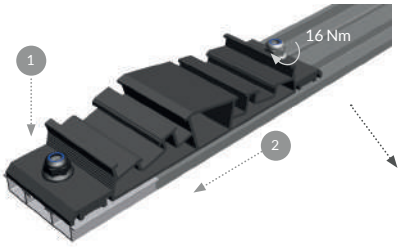
5.1 – 1



5.1 – 2

ASSEMBLY STEPS:

- Preassemble the short ground rails (60mm) at the front foot.
- Push the next rail piece to the short rail piece without clearance and mount it with the front support.
- Align the preassembled ground rails at right angles to the alignment line using a cord.
- The distance between the supports corresponds approximately to the module length. We recommend that you precisely realign this distance when assembling the modules.
- Screws not yet tightened (also identifiable by the vertical slot)
- Tightened screws (also identifiable by the horizontal slot)



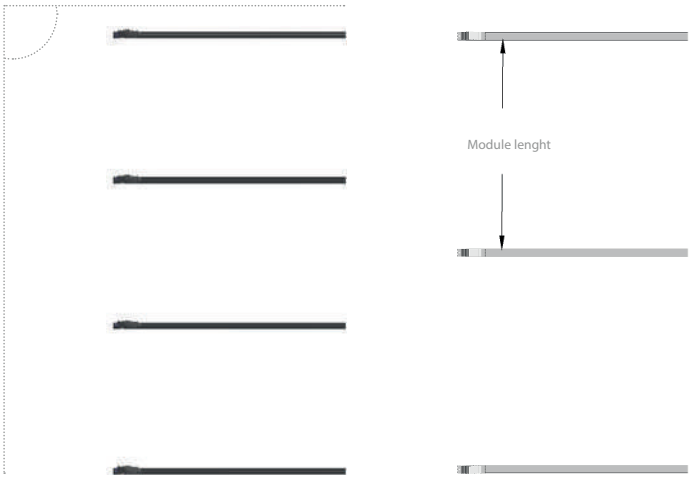
5.1 – 3

5.1 – 4

5.1 – 5

5.1 – 6

5.1 – 7



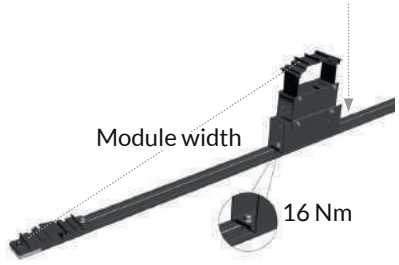
5.1 – 8

5.1– 9

5.2. MOUNTING THE CENTRE SUPPORT

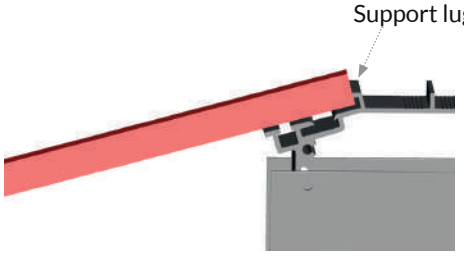
ASSEMBLY STEPS:

- The back support is mounted using the supplied gauge. To this end, the gauge is placed between the two lugs.
- Tighten the back support as well as the front support on the ground rail.



5.2 – 1

5.2 – 2

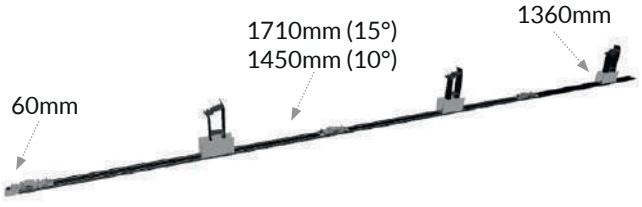


5.2 – 3

5.3. MOUNTING THE NEXT FRONT SUPPORT

ASSEMBLY STEPS:

- Push the next front support onto the front ground rail with the front support protruding into the front ground rail by 60 mm.
- Now mount the next ground rail without clearance and attach the front support to both ground rails. In this context, we recommend that you put one foot onto the front support so that it does not get out of place when being tightened.
- Align the next front support and mount it as described in 5.2.
- Make sure that each mounting frame row always ends with the 1360mm ground rail so that the last front support and the last back support are attached on this ground rail.
- Repeat these steps until the mounting frame row is complete.



5.3-1

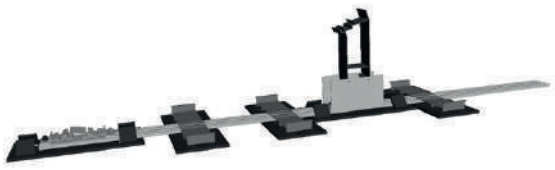
5.3-2

End of the row of mounting frames

5.4 APPLYING BALLAST

ASSEMBLY STEPS:

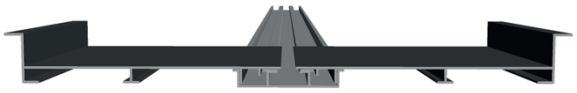
Before finally mounting the modules, ballast must be applied. Depending on the amount of the ballast, there are two variants for applying ballast to the Triangle S Pro system. Both variants as well as their assembly are presented in this chapter.



5.4 – 1

APPLYING BALLAST WITH ADDITIONAL BALLAST PROFILES

ASSEMBLY STEPS:



5.4 – 2

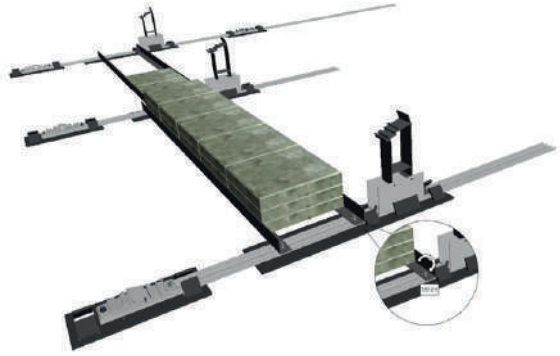
- Simply insert the ballast profiles in the ground rail. This variant also offers the option of using 30x30x4cm paving stones in addition to the ballast stones.
- It is mandatory to apply building protection mats under the ballast profiles!
- When inserting the ballast profiles, make sure that both outer lugs of the ballast profiles are positioned in the outer channel of the ground rail.
- Depending on pitch and module width, only a limited number of ballast stones can be applied (see the following table):

CONFIGURATION	MODULE WIDTH	NUMBER OF PAVING STONES ON THE GROUND RAIL AND BALLAST PROFILES
10°	900–1050 mm	max 5 (approx. 40 kg)
15°	900–1050 mm	max 9 (approx. 72 kg)

APPLYING BALLAST WITH ADDITIONAL L-PROFILES

ASSEMBLY STEPS:

- Prepare the T-head bolts and nuts at the on the L- profile for ballast.
- The L-profile for ballast on the back support is flush with the back support.
- Irregularities can be compensated by means of the oblong hole in the ballast L-angle.
- Depending on the angle of inclination and module width, only a certain number of ballast blocks can be accommodated:

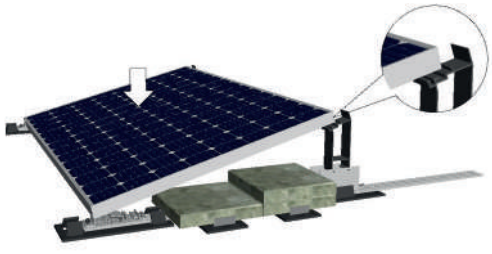


5.4 – 3

CONFIGURATION	MODULE WIDTH	NUMBER OF PAVING STONES UNDER THE MODULE
10°	900–1050 mm	max 10 (approx. 80 kg)
15°	900–1050 mm	max 15 (approx. 120 kg)

5.5 MOUNTING THE MODULES

Clickstones are used for mounting the modules. Clickstones are special clips for fitting the module clamp in the rail channel. You only need an hexagon socket screw (5mm) for assembly. You can insert the Clickstone into the rail channel from above. Each module end clamp can hold one module. The module clamp is positioned between two modules.



5.5-1

ASSEMBLY STEPS:

- Apply the module so that it rests on the supports by approx. 21.5mm.
- Insert the Clickstone into the rail channel at a slightly slanted position.
- Press down the Clickstone and engage it in the rail until you hear a clicking sound.
- Tighten the hexagon socket screw with a torque of 8 Nm.

The lugs at the inside of the Clickstone are designed such that any mechanical release is ruled out once the screw has been tightened. So if you want to remove the Clickstone from the rail by pressing it together and lifting it up, you must first unscrew the Allen screw to above the lug.

DANGER

NOTE!

The shape of the Clickstone corresponds exactly to the profile of the rail channel. It has been consciously constructed not to run easily in order to prevent unintentional slipping in vertical rail tracks. To move the Clickstone, press lightly on the bolt, from above, and move the stone with a little pressure along the rail channel.

CAUTION

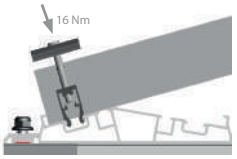
MATERIAL DAMAGE CAUSED BY DEFORMED CLICKSTONES

If clearly deformed Clickstones are used, the safety of the module fastening is not guaranteed. PV modules can fall and be damaged.

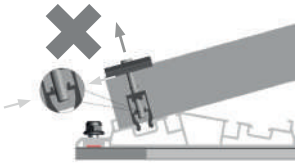
- Only use Clickstones where the lugs are parallel to each other and you can clearly hear them clicking into the rail channel.
- Replace deformed Clickstones prior to installation.

5.5 – 2

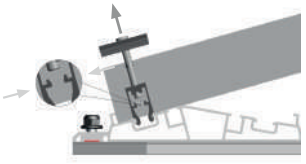
5.5 – 3



5.5 – 4



5.5 – 5



5.5 – 6

5.6 MOUNTING THE BACK SHEET

The back sheet can be mounted without screws using the clamping claw.

ASSEMBLY STEPS:

- Apply the back sheet with its bottom the ground rails and slide it towards the back support until the upper side of the back sheet fits the plane at the back support.
- Adjacent backsheets are overlapping (the overlapping area varies with the length of the module, but should be at least 12mm).
- The backsheet respectively both adjacent backsheets are fixed with the clamping claw at the ground rail.
- Afterwards the backsheet(s) are clamped to the back support with the help of the flashing clamp (recommended tightening torque: 12 Nm). It has to be ensured, that each backsheet, despites overlapping, is fixed in all its four corners.

5.6

6. RAIL CLAMPING OF THE MODULES

If the applied module is not approved for corner clamping, it must be clamped to the rail. Applying this variant, the module can be clamped to the quarter points of the long side.

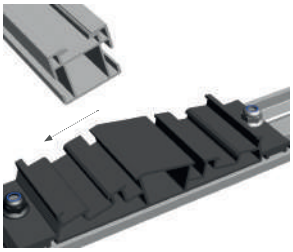
To this end, some additional components must be installed:

- base rail
- module support clamp
- inner connector

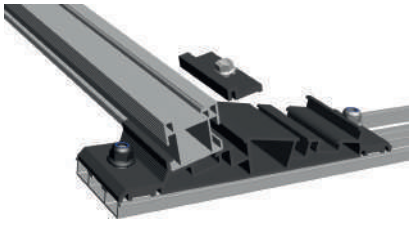
6.1 MOUNTING THE RAIL

ASSEMBLY STEPS:

- First you must carry out the assembly steps 5.1 to 5.4.
- Apply the rails to the lugs of the front foot and the support.
- Attach the rail using the module support clamps. To do so, you must insert the module support clamp at the side of the support channel and insert it into the lug of the rail before tightening.



6.1 – 1



6.1 – 2

6.1 – 3

6.1 – 4

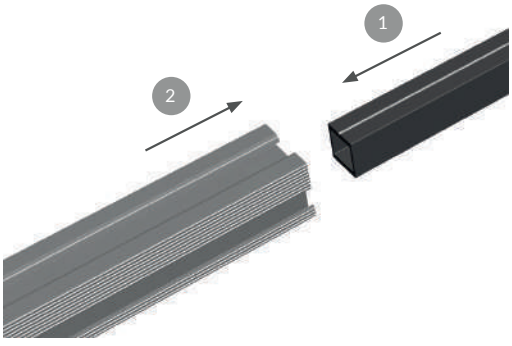
6.1 – 5

6.1 – 6

6.2 ELONGATING THE RAILS

ASSEMBLY STEPS:

- Each rail can be elongated with the inner connector.
- To do so, you must insert the inner connector into the rail until the centre press cut touches the end of the rail, and then push the second rail until the press cuts are reached.



6.2 – 1

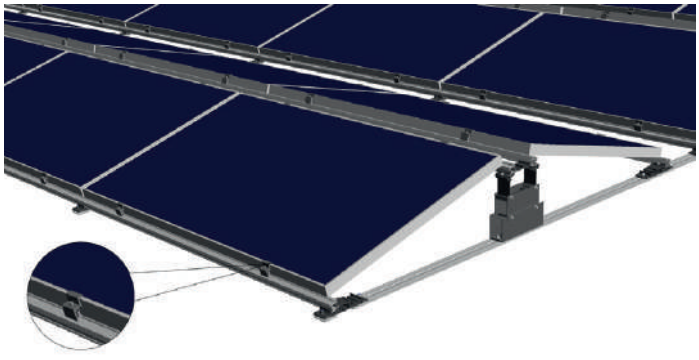
6.3 MOUNTING THE MODULES

Please also follow the assembly instructions in chapter 5.5.

For rail clamping, only module end clamps or laminate end clamps are used.

ASSEMBLY STEPS:

- Four module end clamp are used for each module which is clamped at the long side.
- When applying the module end clamps you must make sure to mind the clamping areas of the module which are specified by the module manufacturer in the module datasheet.



6.3 – 1

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