# Professional Solar Mounting Systems
## Mounting and Project Planning

SCHLETTER GmbH

**Our company is certified according to**

DIN EN ISO 9001:2008

DIN EN ISO 3834 Part 2
Comprehensive quality requirements to the welding process

DIN EN 15085-2
Certification level CL1

DIN 6700-2 component class C2

Manufacturer qualification according to DIN 18800-7:2002-09 class E

Manufacturer's qualification according to DIN V 4113-3 class C aluminium

This **Mounting and Planning guideline** is designed to provide you with important information relating to planning and mounting. Please read this manual and the other named documents carefully prior to proceeding with the assembly and observe all relevant advice. The Schletter Solar Mounting System offers solutions for almost every mounting variation and comprises components of only the highest quality and durability. It is important to note, however, that the correct selection, mounting and deployment of these components is critical to the entire system and that the assembly of the solar and photovoltaic plants should therefore be carried out by trained experts. We would be happy to respond to any questions you may have relating to application and mounting.

## 1 General instructions for use and further information

- Quick and easy mounting saves costs
- 10 year warranty creates customer confidence
- Modular construction allows for bespoke configuration and thus for a solution to (almost) every problem
- Useful calculation tools and support programs save valuable time in the drawing up of proposals
- Seamless documentation and structural dimensioning tables allow for optimal and cost-effective -design
- Continuous development

We highly recommend that you read our other documentation in addition to this mounting manual to ensure optimal dimensioning and mounting of your photovoltaic plant.

- **Structural analysis**
  Program-assisted load calculations and clearly laid out tables provide important recommendations for dimensioning which also serve as an independent structural specification. Recommendations presented in the system structural analysis are generally to be observed as supplementary, mandatory guidelines in this manual.

- **The system overview**
  presents an overview of the various possible system combinations and solutions.

- **The component overview**
  provides a clear presentation of all available components with images.

- **Autokalkulator and planning programme+**
  is an efficient program which facilitates plant dimensioning including price calculation and the generation of item lists. The schematic provides useful recommendations for mounting.

- **Product Sheets and utilization guidelines**
  These contain further system-specific information, mounting examples and new developments.

- **Internet**
  Up-to-date information is always available for download.

- **Load determination / Superimposed load calculation**
  For simple project planning, we offer our regular customers access to our location-specific load determination and superimposed load calculation software.

- **Certification**
  We comply with the highest standards of quality. VDE, TÜV, …

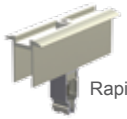
The RAL Solar workgroup is actively engaged, on our behalf, in the further development of quality standards across all brands in the area of mounting systems. Please ensure, therefore, that you also take note of our general summaries relating to specific mounting issues.

➲ Laminate mounting - general recommendations
➲ Module mounting - general recommendations
➲ Façade mounting - general recommendations
➲ Flat roof mounting - general recommendations
➲ Earthing and lightening protection in PV plants
and others ...

## 2 System characteristics (see also System Overview)

For the purpose of further development, our priority focus is with system safety, durability and quick mounting times. Additional factors include the universal compatibility of all system components and the most extensive utilization possible of standard parts (screws, nuts etc.).

Klick-system



Rapid$^{2+}$

**Module clamping**

The fastening points for the module clamps can be selected freely along the duct of the aluminium beam. The M8 steel nuts are clicked into the duct at the required points and the modules mounted using clamps and screws.

The Rapid$^{2+}$ system is even simpler to deploy, given that all pre-assembled clamps can simply be clicked in and secured with screws.

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**The cross beam program**

The standard cross beam is the interface between roof fastening and module fastening.

Face up to the module the duct offers flexibility in the choice of fastening points for the square nuts (click system) and Rapid$^{2+}$ clamps

Face down to the roof, the M10 standard or square nuts are inserted in the lower groove of the cross beam and are screwed to the respective fastening element (e.g. roof hook).

Alternatively, Rapid$^{2+}$ and KlickTop offer mounting friendly screw connections from above. Position - tighten - that's it!

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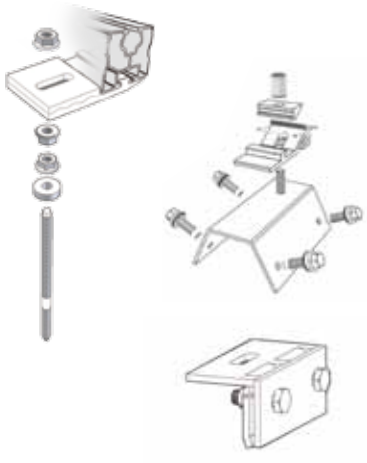


**Universal fastening elements** for (almost) every roof type, incl.

- Tiled Roof
- Trapez. roof
- Corrugated roof
- Sandwich roof
- Standing seam roof
  and others ...

We only use high-quality and durable materials (certified aluminium alloys, high-grade steel in 1.4301, rubber moulds of vulcanized UV-resistant EPDM etc.). The majority of fastening elements are universally deployable for pitched roof fastenings and elevations.
Structural suitability tables or application programs are available for all fastening elements.

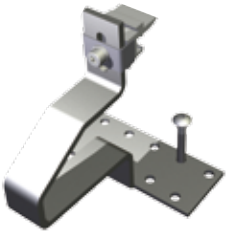
## Roof types and fastening elements

In the following pages, we will present an overview of all important fastening elements as well as offering recommendations for mounting.

### 3.1 Tiled and pantiled roofs

Standard roof hooks are used with grooved-tiled or pantiled roofs. Customized roof hooks are available for special tile designs (see also Component Overview).

**Tools:**
- Hand angle grinder with small diamond grinding wheel
- Socket wrench 13 or Torx T40 with ratchet or drill with torque limiter
- Grease and brush for wood screws
- Drill with 6mm bit



**❶ Determination of the position of the cross beam**
The cross beams should be positioned at an approx distance of 1/4-1/5 of the module height from the upper and lower module edge. The position of the junction boxes should be taken into account. In installations comprising rows of modules positioned one above the other, the cross beam should be aligned to the tile rows.

**❷ Selection and distribution of roof hooks**
Roof hooks are arranged vertically and according to the intended cross beam positions. Adjustable roof hooks are used for height adjustment on uneven roofs. If the substructure offers no appropriate fastening points for cross rails, the deployment of a cross rail system is often recommended. More information on this subject can be found under
➲ item 6.1.2 GridNorm

**❸ Fastening of roof hooks**
The covering tile is lifted or removed. The roof hook bracket is placed in the hollow or flat area of the pantile. A distance of 3-5mm must be maintained between roof hook and tile. The area beneath the base plate may need to be underlaid (2mm and 5mm spacers and distance pieces are available as accessories - see Component Overview). The roof hook is fastened to the rafter with at least 2 x 8mm screws - predrill to approx 2/3 of the entire wooden thread. Ensure that at least 70mm of the screw grips the rafter - use longer screws if necessary! Greasing screws prevents them shearing off while tightening. Screw-lengths of 80mm for unboarded roofs and of 120mm for boarded roofs have been well-proven. Only screws approved in the system structural analysis should be used - no basic Spax-screws!

**❹ Inserting of covering tiles**
Grinding may be necessary depending on the type of roof tile being used (an angle grinder with a small diamond grinding wheel is recommended!) to ensure tiles fit neatly over the roof hooks.

➲ Continue with item 6: System mounting

**Structural analysis:**

**Load-bearing profile:**
The maximum span widths of the load-bearing profiles for wind- and snow loads should be referenced in the structural dimensioning tables. On a pitched roof the profile span width is not generally a constraint (e.g.: Profile Solo 05 approx. 1.6m for normal snow loads).
With standard installations, the profile should protrude, laterally, to a length of between 0.2 and max 0.4m.

**Roof hooks:**
Please ensure that the structural configuration of the roof hooks is sufficient to avoid damage due to snow loads! In regions with extensive snow loads, distribution of roof hooks to every rafter is generally advised to ensure a uniform loading of the roof. Similarly, substitute sheet metal tiles are generally recommended in the event of high loads to avoid the risk of stress imposed on roof tiles by roof-hooks, depending on the structural configuration.

The required number of roof hooks per square meter of module surface can be referenced in the structural dimensioning tables. Information relating to local wind and snow loads is provided by the Schletter GmbH internet service "Lastermittlung" (Load determination). When dimensioning the number of roof hooks, consideration should be given to the fact that volumes may need to be increased for edge and corner zones of the roof. One roof hook is generally recommended for each of the first two edge rafters to compensate for increased stress due to wind turbulence.

**Roof impermeability!**

The utmost care must be taken when inserting roof hooks on a very flat roof. There is a risk that the PV installer be held responsible in the event of leaks. It should be acknowledged that the tile manufacturers guarantee only very limited impermeability in the case of flat roof pitches!

Additional sealing tape should be used with particularly flat roofs ➲ Product Sheet Sealing Tape

The following example data relating to a known tile manufacturer should help you to better understand the issues:

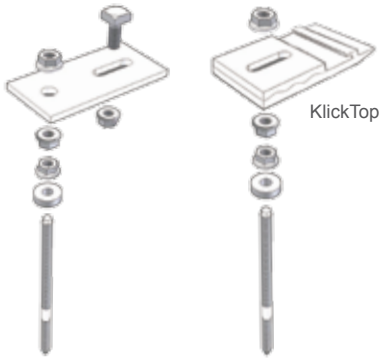
**Interlocking tiles and Biberschwanz (plain) tiles**
- generally recommended for roof inclinations of 30 degrees or more.
- only recommended for inclinations of at least 24 degrees in special cases (tight underlay, glued if necessary)

**Flat roof pantile MZ3 and Frankfurt concrete pantile**
- generally recommended for roof inclinations of 22 degrees or more
- only recommended for inclinations of at least 16 degrees in special cases (tight underlay, glued if necessary)

## 3.2 Corrugated Eternit (and trapezoidal sheet metal roof)

### Hanger bolts

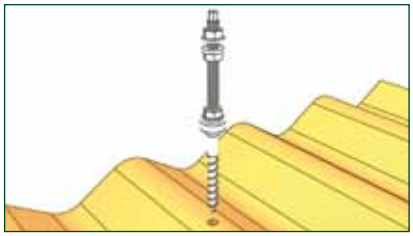
For corrugated eternit or trapezoidal sheet metal roofs, so-called corrugated roof fastening kits are used, comprising a special hanger bolt with EPDM-sealing and a mounting plate. A fastening kit with hanger bolt M12x300/ M12x200 is generally recommended. The item M10x200 is also available for special types of fastening element with reduced horizontal distances.



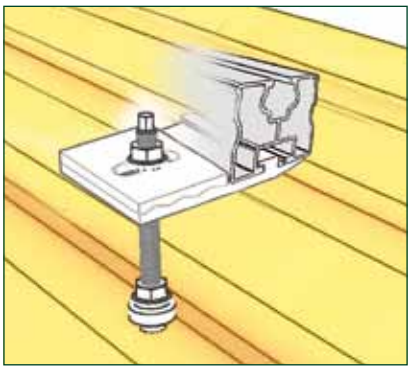

**Tools, Drilling diameter:**

| **Hanger bolts** | **M10** | **M12** |
|---|---|---|
| • Combination wrench | SW15 | SW18 |
| • Impact wrench with socket | 7mm | 9mm |
| • Pre-drill into wood | 7mm | 8.5mm |
| • Pre-drill into corrugation top | 15mm | 16mm |

**❶ Fastening of mounting kits**
- Drill through the roof covering into the rafter
- Re-bore the skin covering with larger diameter bit
- Align the hanger bolt on the corrugation crest
- Tighten the hanger bolt and seal with a flange nut



Hanger bolts should be screwed through the entire thread of the wood. The hanger bolt should be tightened such that only the metric thread protrudes from the roof cladding with, if possible, a little of the smooth shaft which can be used as a seat for the seal. Greasing screws prevents them shearing off while tightening. Prior to tightening the flange nut over the seal, we recommend an application of thread sealant between nut and seal to avoid capilliary action.



**❷ Prepare and check seal efficacy**
The rubber seal is pushed down as far as possible, and is lightly pressed into the roof cladding with the flange nut. Care should be taken when mounting on corrugated Eternit that the seal is not broken or damaged when pressed!

**❸ Alignment of mounting plates**
Where cross rails are mounted, an upwards arrangement of the plates is recommended. If vertical rails are to be used, then the plates should be arranged according to the symmetrical load distribution and secured with flange nuts.


➲ Continue with item 6: System mounting

The number of fastening points per $m^2$ of module surface must be dimensioned to comply with the structural tables as well as local wind and snow loads. Depending on the location, it may not always be possible to fasten the system to the rafters. If the installation is be mounted onto cross purlins or cross battens, a vertical rail must be mounted. In such cases, it should be investigated as to whether the modules can be fastened transversely to two vertical rails; this assembly design achieves the maximal structural bond while deploying the lowest number of rails.

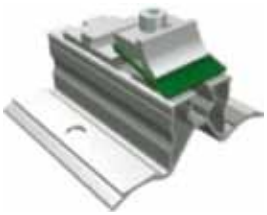
## Fastening element FixW-1876

This fastener has the advantage that it is fitted across two corrugation tops, facilitating optimum load distribution on the corrugation profile - ideal for larger snow loads. In contrast, the corrugated profile is not subject to stress by wind suction forces as these loads are transmitted directly into the substructure through the anchoring. The fastening can be deployed on both wood and steel constructions.

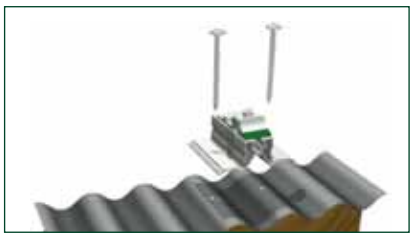
**Bore diameter:**

If self-tapping screws are deployed to a steel profile substructure, the substructure must be pre-drilled according to the diameter of the screws.

| Profile thickness | Drilling diameter |
|---|---|
| up to 4 mm | 6.8 mm |
| up to 11 mm | 7.0 mm |
| 11 mm or more | 7.2 mm |

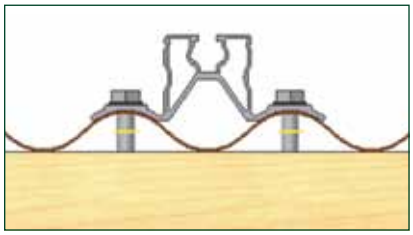


❶ Pre-drill profile d=10 mm, pre-drill steel substructure if necessary
❷ Position FixW-1876 and secure to wood with self drilling flat-head screws or to steel with self-tapping threaded screws



The tightening torque is selected according to the respective substructure; the FixW-1876 system must be securely connected to the substructure but with no risk of deformation to the corrugated profile.

A variety of load-bearing profile rails can be fastened to the FixW-1876, for example: profiles Eco05, Solo05, Profi05, ProfiPlus05, DN0, DN1, DN2,5 or the supplementary elevation FixZ-7. The profile length should be limited to 10m to allow for thermal expansion

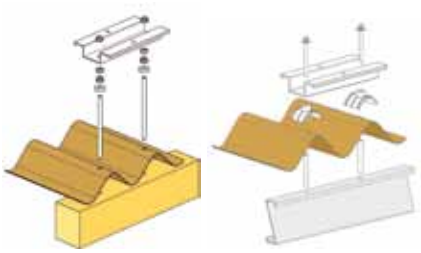


FixW-1876 is designed exclusively for roof areas where corrugated sheeting is deployed for the entire covering. The application of the product on roof openings (partial PV roof integration) may require the approval of the patent owner EP1985944B1.
Edge distances and screwing depths must comply with structural requirements according to the valid technical norms.

## Fastening elements for Eternit - FixE

Universal fastening system for eternit roofing

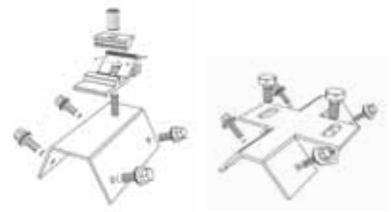
➲ Mounting instructions - additional recommendations for FixE (available for wood and steel)



## 3.3 Trapezoidal sheet metal roof

### Fix2000 KlickTop / Fix 2000

In some cases, fastening to the substructure (for example with hanger bolts - see 3.2) is favored due to the unknown structural characteristics of the sheet metal roof. In cases where this is not possible, (for example on self-supporting trapezoidal sheet metal roofs or on sheet metal roofs comprising sandwich elements), Fix2000 (here an example mounting with KlickTop), provides an unrivalled quick and easy fastening solution!



**Tools:**
- Impact wrench with socket 8mm

- The utmost care must be taken not to over-tighten screws during assembly (use a depth-stop!)
- Screwing depth from 0.5mm in steel, and from 0.8mm in aluminium.
- The roof load-bearing capacity must be sufficient to accommodate the additional weight of the PV-plant.
- The trapezoidal sheet fastening must be capable of absorbing the wind suction forces. (A roof-parallel PV plant does not increase uplift forces).
- When deploying sandwich components, a mutually sufficient holding force must be guaranteed between the layers.

➲ Continue with item 6: System mounting

➲ Product Sheet Fix2000
➲ Check lists Fix2000

**Structural analysis:**
The Fix2000 elements must be able to transfer precisely defined forces, to ensure that an authoritative structural analysis can be presented for the entire system. Wind load is significantly more relevant to the structural dimensioning of the Fix2000 than the snow load. In the event of snow loads on the plant, the forces are transferred into the roof across all ribs of the trapezoidal sheet metal; The ribs between the Fix2000 clamps are also loaded due to slight elastic deformation. The cross beams should therefore always be arranged vertically to the ribs.

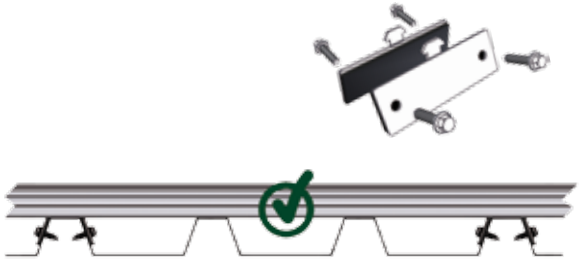
Prerequisite to the effective transfer of wind load, is that the trapezoidal sheet metal is adequately secured to the substructure. Only then can the Fix2000 mounting be approved. The adhesive force of the clamps onto sheet metal can be guaranteed as per the structural dimensioning tables, through the selection of an adequate number of Fix2000 elements. Strictly speaking, the transfer of forces in trapezoidal sheet metal should be measured under the various specific conditions; a distance of 1.2-1.4m between clamps is generally sufficient, however, additional clamps should be set at the edges.

Elevations on the Fix2000 are only recommended if the retention force of the roof plates can be proven!
➲ ® Please observe the instructions for use relating to the Fix2000!

## **System VarioFix-V** (Fastener: SingleFix-V

Contrary to the Fix2000, with the VarioFix-V system, 2 SingleFix-V plates are twisted directly into the lower groove of the profile and are secured to the trapezoidal sheet with self-drilling screws. The plates should be secured on alternate sides of the respective crests (see diagram).

➲ Product Sheet VarioFix-V

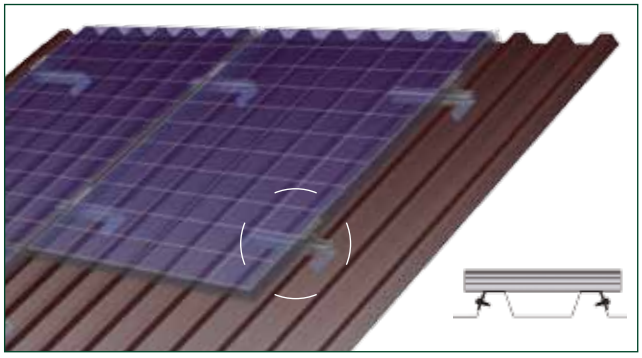


As a general rule, the recommended rail length of 10m should not be exceeded. Similarly we recommend the application of rubber underlay pieces on all crests.

## SingleFix-V Mounting kit

The SingleFix-V mounting kit is mounted as described above. Increased economical efficiency is achieved with this system through the deployment of short 450mm profile pieces for fastening. These are to be distributed to correspond with the module clamping points.

➲ Product Sheet SingleFix-V

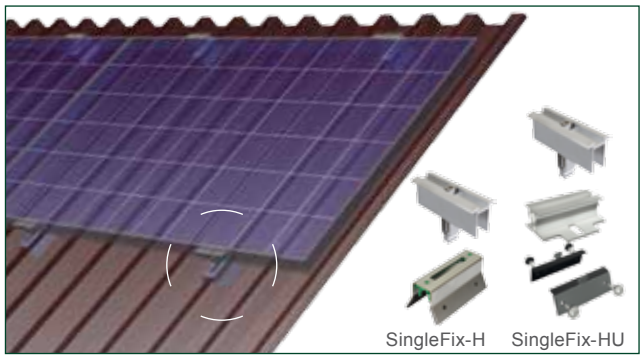


## SingleFix-H / SingleFix-HU

**SingleFix-H** is designed for the quick and cost-efficient mounting of horizontally arranged modules on trapezoidal roofing. The fasteners are distributed in the same manner as for Fix2000, to correspond to the module clamping points. The assembly is secured with Rapid$^{2+}$ clamps.

The universal **SingleFix-HU system**, covers all crest dimensions from 20-60mm.

➲ All documents relating to SingleFix-H, SingleFix-HU

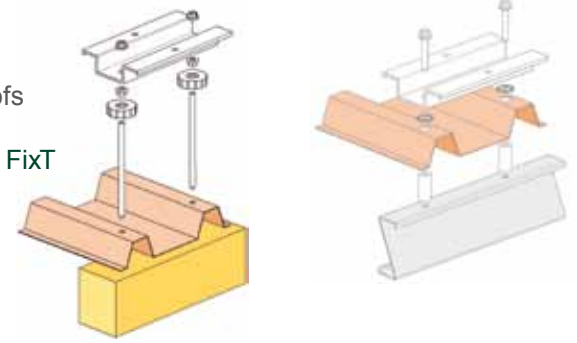



For systems not incorporating continuous aluminium rails we recommend the potential connection by means of an alu earthing strap. Each of these is connected with, for example, a clamp fastening screw.

## FixT

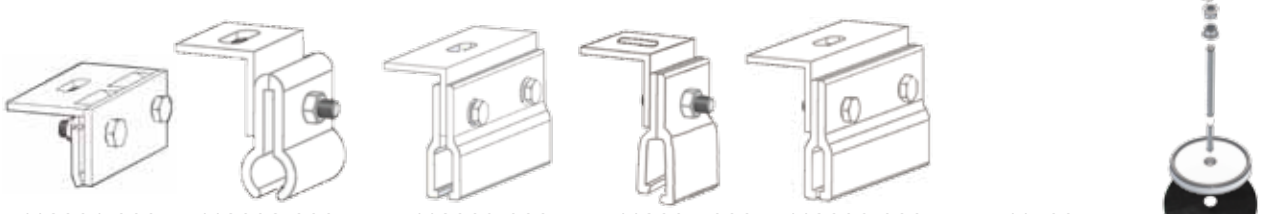
Universal fastening system for trapezoidal sheet metal roofs

➲ Mounting instructions - additional recommendations for FixT (available for wood and steel)



## 3.4 Standing seam and sheet metal system roofs

Fastening is by means of special standing seam clamps onto which the cross beam profile is screwed. A variety of designs are available for the different roof systems. As an alternative, the FixPlan system allows for mounting onto the substructure.



| 112001-000 | 112002-000 | 112003-000 | 112004-000 | 112006-000 | 11400.-... |
|---|---|---|---|---|---|
| Standing seam | KalZip, Bemo | Zambelli Baureihe 465 | Zambelli Baur.500 | Fischer KlipTec | Altern.: FixPlan |

➲ For KlickTop mounting: Component overview

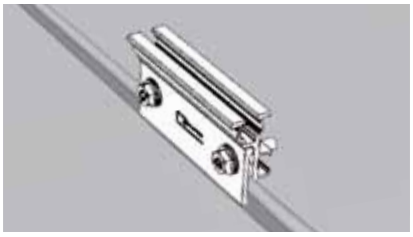
➲ FixPlan Mounting Instructions

➲ BituPlan Product Sheet

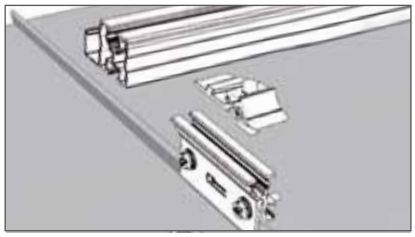
**Tools:**
- Ring wrench 13
- Socket wrench 13
- Ratchet, impact wrench (ideally with torque setting)

Alternative FixPlan: Tools as for corrugated roof kit mounting (see above).

❶ Arrangement of standing seam clamps
The clamps are arranged vertically to the corresponding cross beam positions. With horizontal application: Generally, one clamp should be positioned on each standing seam. Cross beams must protrude to a length of 0.2m to max 0.4m to the left and right.



❷Fasten standing seam clamps
The clamp is placed on the seam and is loosely tightened. Alignment is carried out as the cross beams are fastened. In each case the clamp should be pushed as far as possible onto the seam. The clamp has to shifted onto the seam as far as possible!



➲ Continue with item 6: System mounting

**Structural analysis:**
Torque for standing seam clamp screws: 15 Nm;
Rule of thumb: Secure tightly with a short ratchet!
In each case, when fastening a PV plant onto a sheet metal roof, the roof cladding must be capable of absorbing the wind suction forces. The required retention forces of the roof must be verified by the installer on the installation site.

Warning! With system roofs (e.g. Kalzip etc.) care must be taken that standing seams are not deformed while fastening clamps, or the roofing membranes may become blocked in the event of thermal expansion.

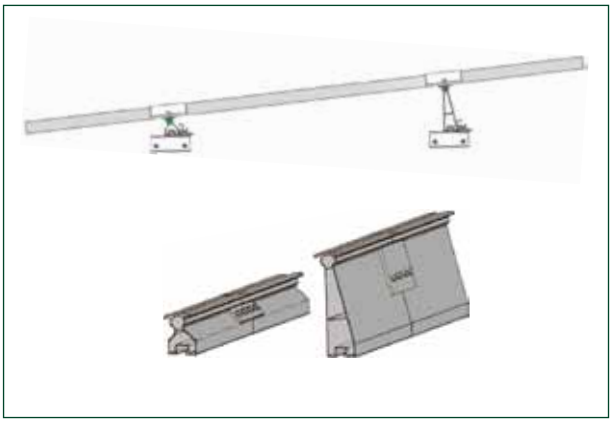
Warning! With titanium sheeting please verify that the standing seams can withstand loading!

## 4 Elevation elements

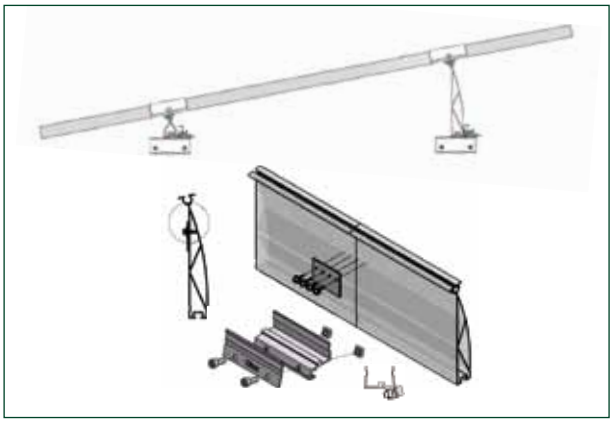
for the optimization of yield on flat roofs. The high loads on the fastening elements and on the roof must be taken into account here.

### 4.1 Yield optimization for trapezoidal sheet metal roofs - FixZ-7 and FixZ-15

the ideal supplementary elevation system for flat, trapezoidal, sheet metal roofs.



FixZ-7, elevation: 5-7 degrees



FixZ-15, elevation: 12-15 degrees

**Please note,** that the systems **FixZ-7** and **FixZ-15** are designed for module heights of approx. 1.3 m - 1.7 m. For technical reasons this form of elevation is suitable only for framed modules in vertical mounting. A horizontal mounting with linear support and linear clamping is, however, possible up to a module width of 850 mm.

The effective angle setting is dependent upon the position of the clamping points. These should be positioned within a range of 1/4 to 1/5 of the module height (or according to manufacturer specifications). Please also take into account the mandatory distances of 1.5 m to the lateral roof edges and 1.2 m respectively to the north- and the south-facing roof edges.

Distance acc. to module height  Rows acc. to shading distance

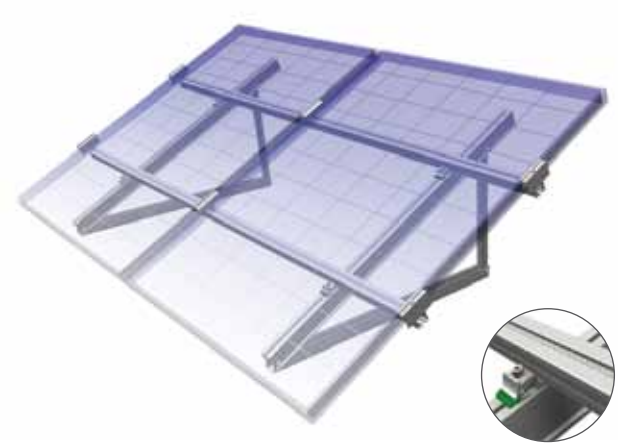
In each of the designs **FixZ-7** (5-7°) and **FixZ-15** (12-15°) the module frame itself is integrated into the support structure. Each of the specific profiles is mounted at an incline relative to the roof plane. Mounting positions of the front and rear cross beams are therefore to be established prior to installation of the modules and according to module height. Care must be taken that the module frames are not twisted during assembly. This design is therefore only approved for framed modules.

Please check in advance the evenness of East-West facing sheet metal roofs. As the module-bearing FixZ-7 and FixZ-15 rails are extremely stiff and absolutely straight, problems may occur when fastening if the roof is particularly uneven. When deploying the "older" version of the Fix2000 design, such cases may be better corrected using underlay than, for example, with the Fix2000 KlickTop.

## 4.2 Standard support designs

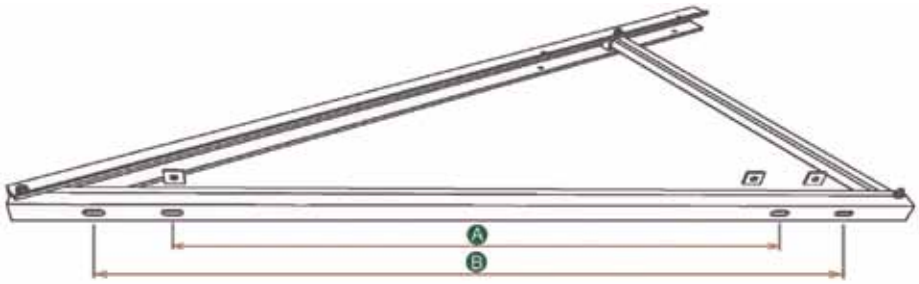
Pre-assembled flat roof supports are used if the installations can be screwed directly onto the subsoil or onto concrete ballast on to the flat roof. Additional flexibility is achieved through the use of special washers for screw sizes M10 and M12.

- The support series **Light** provides particularly light-weight and cost-effective for modules of between 0.8m - 1.6 m. Light 10/13/15
- The support series **Profi** is designed for application with high snow loads, for example. Module heights: Profi 15: approx. 1.3m - 1.7m; Profi 22: up to approx. 2.2m
- The **Flat Roof Support XL** is particularly suited to larger modules or to two-row elevations generally up to 3.6m



➲ Product Sheet FlexConsole

Customized sizes available on request. Further detailed information relating to optimal support designs can be found in the structural analysis charts.
Unfold the pre-assembled supports and bolt together gently using socket head screws M8 and self-locking nuts M8 (maximal 5 Nm). Connection to the fastening element is generally through a groove or more commonly through long holes (13 mm) with 10mm adapter plates, depending on the individual design.
Connection of the module-bearing profiles is effected using the **Support Program 07** with square head bolts and nuts. Alternatively the **FlexConsole** provides a quick and easy mounting solution using KlickTop.




| Bottom beam Hole distances | Light U07 1m Item No. 150001-100 | LightU07 1.3m Item no.: 150001-130 | Light U07 1.5m Item no.: 150001-150 | Profi U07 1.5m Item no.: 151001-150 |
|---|---|---|---|---|
| A | 537mm +/-8mm | 635mm +/-8mm | 940mm +/-8mm | 940mm +/-8mm |
| B | 757mm +/-8mm | 855mm +/-8mm | 1160mm +/-8mm | 1160mm +/-8mm |

**Structural analysis:** Diagonal struts or tensile struts must be checked individually

**No** - if the support is tightly bolted- for example concrete, FixT
**Yes** - if the row is not horizontal; for example east/west facing roof, elevation to the south
- if the fastening is susceptible to vibrations (e.g. direct fastening on hanger bolts)

## 4.3 Special support designs

### Grundach

The flat roof support **Gründach (vegetated roof)** is a variation of the Light/Profi support designs. Due to the higher module level, it is particularly suited to vegetated roofs. The mounting is implemented using the same methods as with Light/Profi supports. Available angles: 15, 20, 25 and 30°

### VarioTop

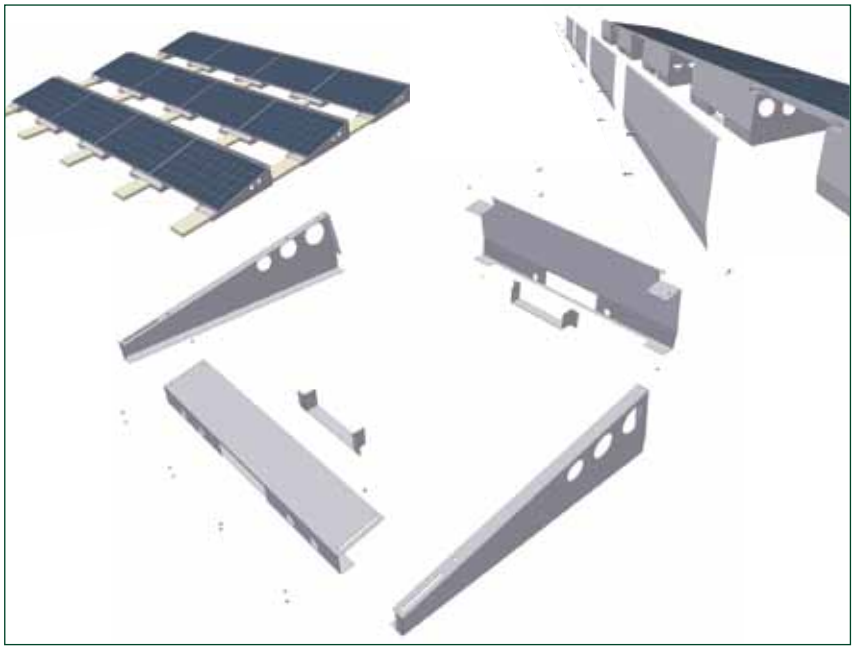
The **VarioTop** is particularly suited to flat roof installations in schools, public buildings, community and shareholding projects etc. Thus, a module string mounted on a row of supports can be inclined at angles of 10 to 60 degrees in 10-degree stages.

➲ VarioTop Product Sheet

### AluLight

With the Flat Roof system **AluLight** framed modules are fastened to flat roofs in fully closed rows with a fixed elevation angle and minimal superimposed loads.

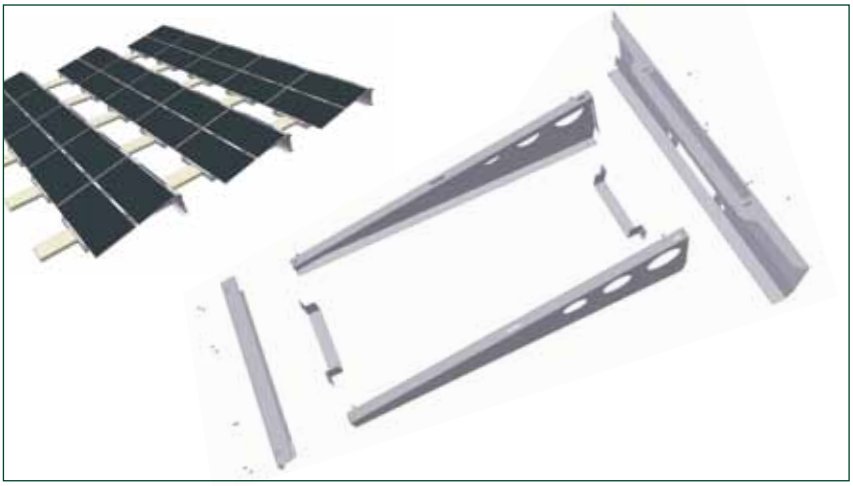
Concrete border stones fulfil a triple function here:
The loading of trays at defined points, the interconnection of trays and the safeguarding of an even distribution of pressure loads into the roof surface.



➲ Product Sheet AluLight
➲ Mounting Instructions AluLight

### AluLight TF

With the development of **AluLight TF** for thin-film modules a variant was designed specifically for First Solar modules and for thin-film modules with comparable dimensions.



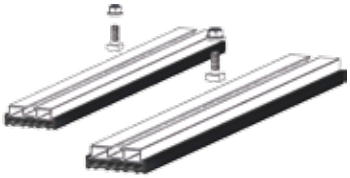
➲ Product Sheet AluLight TF
➲ Mounting Instructions AluLight TF

## 4.4 Fastening of supports

It is the modularity of the Schletter systems which allows for many combinations of supports with various fastening and loading options. The most important of these are listed here.

### Loading kit

A loading kit contains 2 aluminium profiles with a special EPDM-profile. Each profile is positioned at right angles to the support, secured with one bolt and is then loaded with concrete slabs or similar ballast material. The special EPDM-profile distributes the loads evenly across the roof cladding. A surface protection mat is not required.



### SolRack

If loading elements are used, additional weight is added to the flat roof. The load bearing capacity of the flat roof is often already strained to the limit by the gravel loading. The SolRack plastic plate provides a cost-effective and stable opportunity to load a support construction using the existing gravel ballast. A roof protection mat may be required.

➲ SolRack Product Sheet

**❶ Distribute SolRack plastic plates**
The lateral spacing must be determined according to the boundary conditions (building height, snow load, wind load, module height) In normal cases, distances of 1.4m to 2.0m are usual between modules. The lateral overhang of the profile should be max 0.2m - 0.4m.

**❷ Fasten continuous beams (in the case of single supports, fasten bottom beams)**
- Feed square head bolts into the groove of the continuous beam, or, in the case of single supports into the designated slotted holes (use shims)
- Position bolts accordingly and insert into the SolRack plates (if necessary drill 2 x 10mm holes in each plate) and bolt together with flange nuts and washers

**❸ Unfold the supports and bolt to the beam**
Use fastening kits with continuous beams (c.f. 5.1 CompactVario)

**❹ Gravel loading**
Remove the gravel ballast from the intended area (ensure roof cladding is not damaged) and place a protection mat if necessary. Please note! No sharp stones should remain under the tray!

**❺ Position the rack and refill gravel ballast**
**❻ Fully tighten all screws on the substructure**

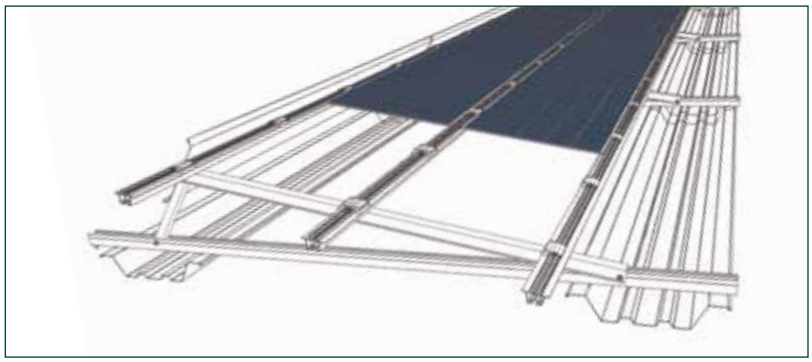
➲ Continue with item 7: Note: Module mounting

When deploying plastic components, a blanket acceptance should not be issued by inspecting structural engineers for all cases. This is to be determined individually in the planning phase. The SolRack plastic plates should not be exposed to direct sunlight.

## SolTub

- Loading with gravel or concrete blocks
- Good load distribution on roof
- Trays available in a range of breadths
- All metal construction!

A roof protection mat may be required. Similar mounting process to that of the SolRack.

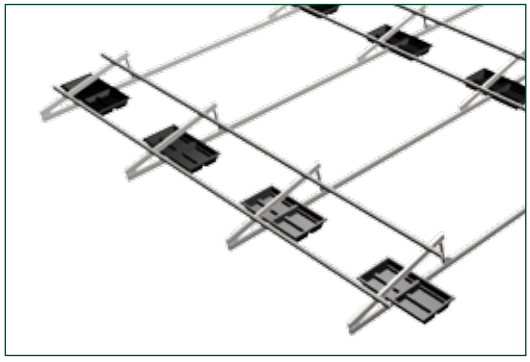


➲ SolTub Product Sheet

## SolCube

- Loading with gravel or concrete blocks
- Optimum load distribution
- Reliable and quick loading
- Subsequent loading possible

A roof protection mat may be required.



Mounting with DN0

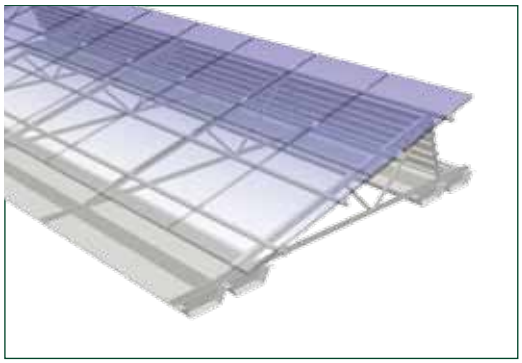
Mounting with DN1

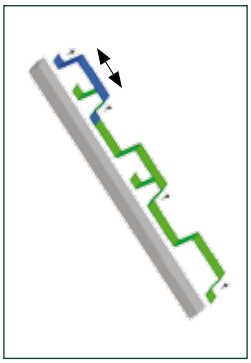
Contrary to previous systems, connected for the most part by means of continuous beams, the plastic **SolCube** tray can be simply positioned across the continuous profile DN0 / DN1, bolted and then loaded with gravel or concrete plates.

➲ Mounting Instructions SolCube

## Windsafe

- Significant reduction of required ballast weight
- Wider span widths of the module-bearing profiles possible
- Significantly less stress on the roof construction
- Verification of structural safety against "tilting" and "lifting off" possible with smaller superim posed loads





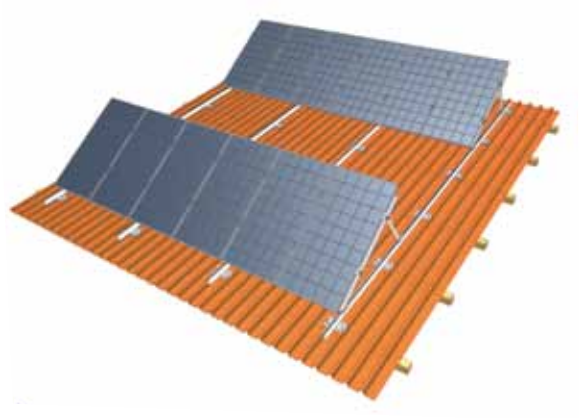
When combining different breadths of sheeting, the shortest raised bead is overlapped with the longest raised bead of the next sheet. The supplied sheet metal screws (6x25, self drilling, JT3-2 A2) are used for fastening sheeting to **each support** of the elevation. Sheeting is screwed at each end and at the point of overlap - see image. Overlap and fastening (both horizontal and vertical) are always effected at the rear support strut. Distribute horizontally and, as far as possible, with equal projection.

➲ Mounting instructions Windsafe

## 5 Combined support designs

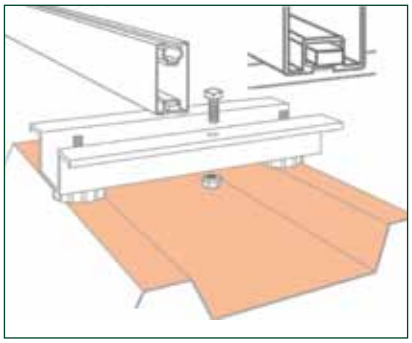
The compact support constructions are designed for optimal integration of the roof structure into the structural arrangement of the modules or for an optimized, even load distribution into the roof. If the arrangement allows for the supports to be screwed directly onto the roof structure (CompactDirect), then the span of the purlins must be aligned to the distances of the roof construction when carrying out the structural planning. Please note with all constructions that the length of the continuous beam and the length of the purlins must be limited to ensure that thermal expansion is kept within acceptable parameters. The whole plant may therefore need to be sub-divided into individual blocks.

### 5.1 Continuous beam vertical CompactVario



The CompactVario© fastening system is a very flexible elevation system for flat and pitched roofs, and is particularly suited to bridging large distances between purlins. A complete series of double-groove profiles DN0 - DN3 is available for deployment as distribution beams in a north-south direction. Therefore, the most economic solution can be compiled for any mounting application respectively for any span length.

➲ CompactVario mounting instructions



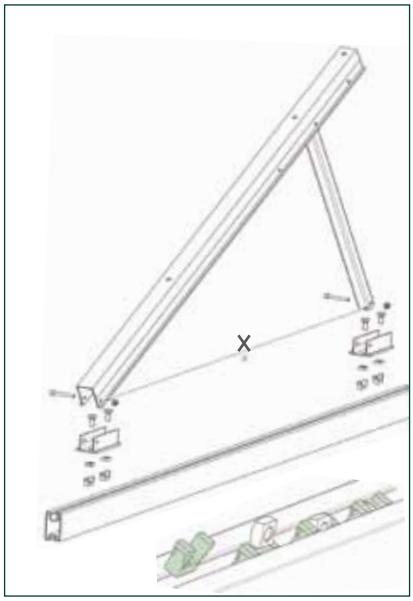
The construction is so designed that drilling at the installation site is generally not necessary. A wide range of fastening elements is available for different roof systems. Please also consider:

➲ Product Sheet FixT (Trapez- and sandwich roofs)

➲ Product Sheet FixE (Eternit roofs)

❶ First define the positions of the continuous beams then attach the fastening elements (FixT, FixE, Fix2000 etc.). To mount the cross beams, feed standard bolts and / or square head bolts M10x25 into the lower groove of the cross beam. Position bolts and insert into designated holes in the fastening elements. Tighten with flange nuts M10.

❷ Click square nuts M10 into the upper groove and secure fittings with hexagon head screws M10x20.




Please observe corresponding measurement X (image right) We recommend the use of a distance piece.

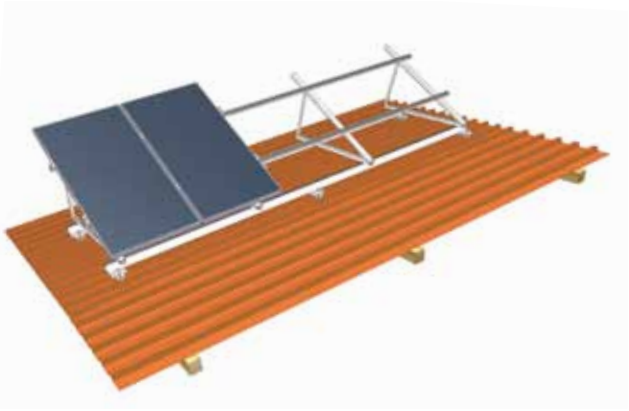
**Measurement X with support series 07:**
Light 1.0 m = 811 mm
Light 1.3 m = 965 mm
Light 1.5 m = 1360 mm
Profi 1.5 m = 1360 mm

❸ Now unfold the supports and assemble these using bolts M8 and self-locking nuts M8 (max. 5Nm).

❹ Next bolt the cross beams onto the supports with standard or square head bolts M10x25 and flange nuts M10.

➲ Continue with item 7: Module mounting

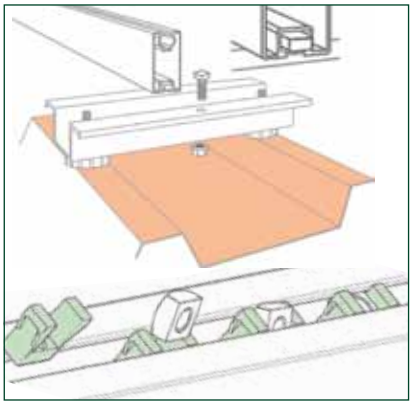
## 5.2 Continuous beam vertical CompactGrid

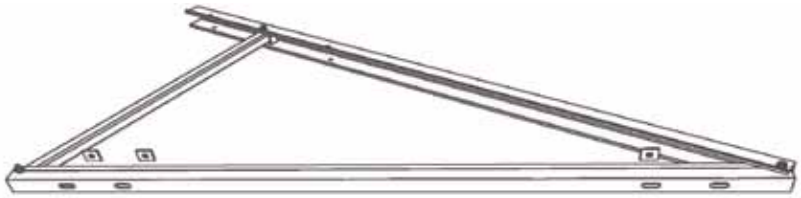


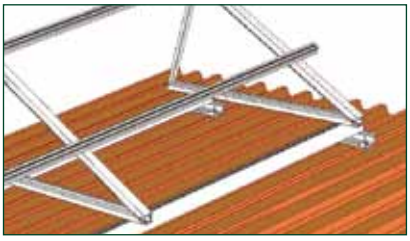
With the CompactGrid system (formerly: standard + continuous beams) we offer an optimum solution for the mounting of elevated PV-plants for example on roofs inclined to the east respectively to the west. The application of our proven double groove mounting beams allows for the optimization of support distances and for the distribution of associated loads evenly and safely into the roof cladding or into the substructure. The installation of diagonal strut kits prevents twisting of the module rows.

➲ CompactGrid mounting instructions

We provide individual solutions to correspond with our fastening elements. As with the CompactVario, the system is connected to the substructure by means of proven FixT connectors. Distances between the continuous beams must be aligned as far as possible to the existing support holes. An additional hole (11mm) may need to be drilled for fastening supports according to the corresponding distances. Fasten supports by clicking square nuts M10 into the upper groove of the cross beam and screwing them together with hexagon head screws M10 x 20. Shims (see below) are required here. The deployment of diagonal strut kits prevents twisting of the module rows.





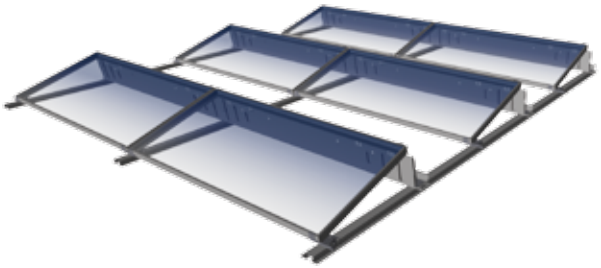


## 5.3 with no continuous beam - CompactDirect

East-West facing roofs with North-South facing purlins or with flat roofs, arranged with rafters in a southerly direction, may allow for direct mounting of the supports. In such cases, the existing roof construction is utilized and the flat roof supports are mounted directly, using hanger bolts or FixT/FixE on the wood or steel substructure. In each case the fastenings must be placed close to the support joints. All standard supports from our product range are suited to this combination. At your request we would be pleased to scope a design for this type of arrangement.

## 5.4 Load-optimized Flachdachsystem AluGrid

On many flat roofs, the area that can be used for photovoltaic installations can be enlarged by using load-optimized systems. With the **AluGrid** system, we have added to our range of well proven systems including CompactVario, SolRack, Windsafe, SolTube and AluLight, to produce a material- and tool-optimized system designed for fastening modules onto flat roofs with minimal superimposed load, in closed rows and with an elevation angle of 15 degrees.

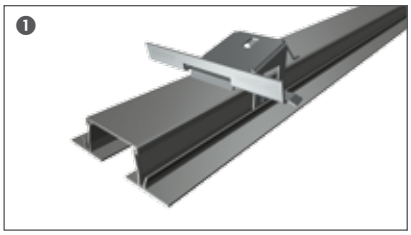


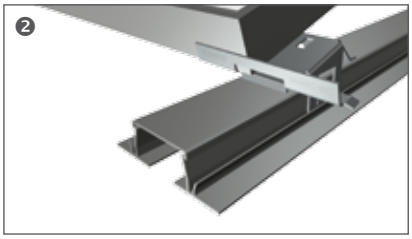
➲ Mounting Instructions AluGrid

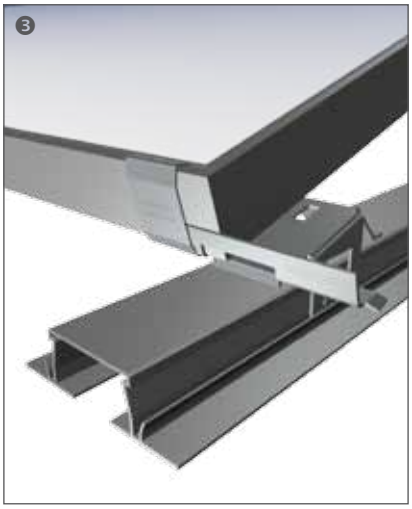
The components are connected using our well-proven Klick-system. The module mounting is carried out using screw-less module clamps (spring clamps) to the substructure.

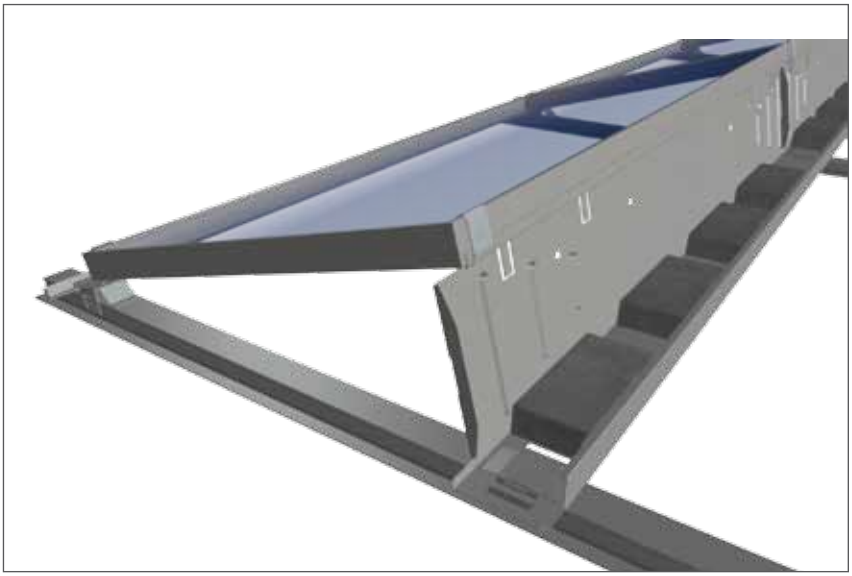
The loading can be optimized according to the to the structural requirements.

By using approved aluminum materials, both a virtually unlimited duration even with high UV-irradiations and certain acceptance in structural expertises is safeguarded.



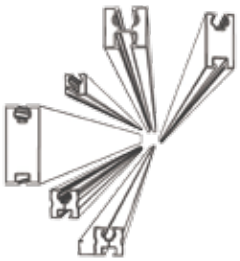



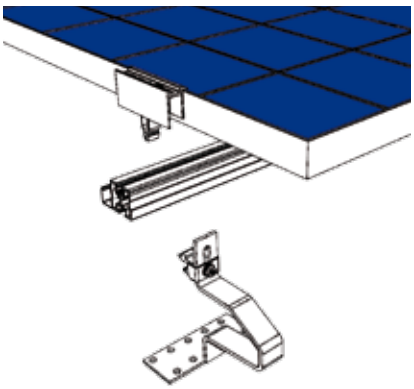
**Loading:** Concrete slabs (for example curb stones, paving stones), gravel etc. A special structural analysis must be carried out in order to determine the required ballast. This structural analysis is available on our website or in combination with an shade distance calculation within the framework of an offer calculation.

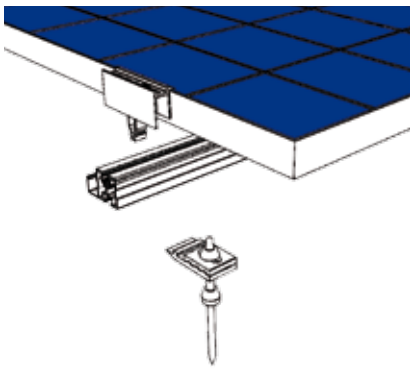
# 6 System mounting

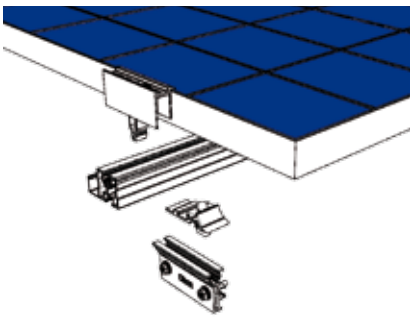
Once the fastening elements (item 3) are mounted, the next step is to apply the profiles (cross beams or cross rails).



## 6.1 Pitched roof mounting







### 6.1.1 Mounting cross beam beams

In the case of classic pitched roof assemblies, two rows of roof hooks or roof fastening elements are installed on the supporting roof substructure. The cross beam profile is mounted on these elements. Two cross beam profiles can bear one module row, which is aligned and fixed to the cross beams by means of end and middle clamps. The modules are generally mounted vertically.

**Warning!**
Thermal expansion must be taken into account when calculating row length! Long rows must be subdivided. Autokalkulator offers tips on thermal expansion.

- Max. approx. 20m on tiled roofs
- Max. approx. 10m on sheet metal roofs with no compensation potential

Where plug-in connectors are installed in profiles with cable ducts, drainage drillings should be incorporated in the cable ducts.

**Warning!**
Profiles within the array should be linked, exclusively, by means of fixed screw joints. ➲ Component overview: Standard profiles and accessories

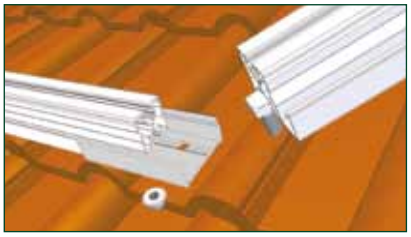
**Tools:**
- Combination wrench SW 15
- Torx T40
- Inbus 6mm

**❶ Screw cross beams onto the fastening points**

With the **Rapid²⁺** and **KlickTop** systems the cross beam is simply positioned then bolted to the fastening points.

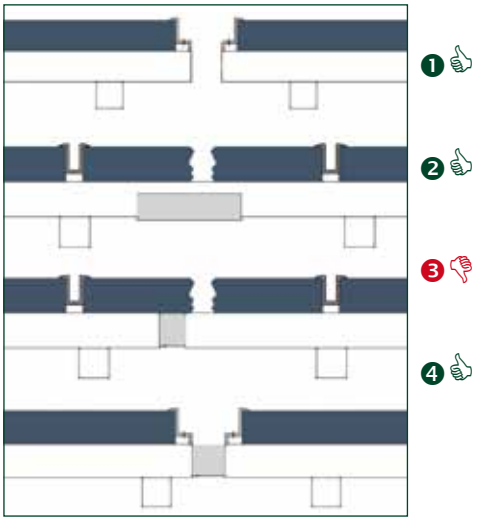
For standard mounting the procedure is as follows:
Insert bolts (generally M10x25 hexagon head or square head) into the grooves of the cross beam profiles and arrange to approximate distances. Then insert the first cross beam element (starting with the first bolt) into the fastening row (roof hooks, corrugated roof fastenings, standing seam clamps). Ideally, you should secure the first bolt with a nut at the roof fastening, then lift the rail slightly at an angle and insert remaining bolts, one after another, securing each with a nut (do not fully tighten at this point).

If necessary, extend the cross beam profile with a connector plate.
A slide connector (see image to the right ❹) is recommended if a general support (e.g. roof hooks) is to be used for both sub-fields. This should not, however, be placed between the module rows, (example ❸) or there is a risk of overstress to the module frame due to thermic change.



As a general rule, the recommended rail length should not be exceeded, e.g.: **10m** for Fix2000-installations mounted directly onto trapezoidal sheet metal, **20m** for pitched roof installations on roof hooks and **30m** for rail connectors on supports, as here, the angle deviation of the longer rail is minimal.

When deploying profiles with cable ducts (Profi05) we recommend drilling through the duct corrugation (min. 8mm) at one meter intervals to allow collected water to drain, thus **preventing** the plug connections from standing in water.




Compensate for different heights in uneven roofs

**a) in tiled- or pantiled roofs:**
Use height adjustable roof hooks, or fasten using longer M10 bolts and underlay.
➲ Component overview: Roof hook accessories

**b) with corrugated eternit or trapezoidal sheet metal roofs:**
Align the mounting plate at the hanger bolt by adjusting the nuts.

**c) with standing seam metal roofs:**
longer M10-screws and underlay can be used for fastening if necessary.

The lower rail is then precisely aligned. Once the lowest row of rails has been fastened, the remaining rails can be placed. Ensure precise alignment with the roof covering. Important: Ensure a lateral alignment of 90 degrees to the lowest rails or a precise arrangement of joints across the entire module field will not be possible! The right angle can be attained by means of a "number triple" (e.g. 60cm, 80cm results in a diagonal of 100cm). Once all cross beam rails are aligned, tighten all connection bolts fully. Use specifically defined nuts with a serrated profile! When integrating an installation with the lightning protection system of a building, please observe the information in the last paragraph!

**❷ Fully tighten and check all screws on the substructure**

➲ Continue with item 7: Module mounting

**Tip:**
If the wiring is to be channelled through the cable duct, an accumulation of water must be avoided at all costs. This can be achieved through a customized alignment, or by the drilling of several holes at the lowest point of the duct and should be considered particularly when plugs are to be installed within the cable duct.

## 6.1.2 Mounting cross rails- GridNorm with KlickTop

- can be assembled with cost-efficient standard rails
- flexible mounting
- can be combined with all Schletter system components
- with cross-rail connector KlickTop for short mounting times

**Tip:**
The cross rail mounting (regardless of the mounting system) should be used when the substructure does not offer fastening points for cross rails.
The cross rail mounting is not designed to reduce the number of roof hooks in a given module arrangement. The number of required roof hooks per square meter is determined by the structural requirements and, as a rule, is not influenced by the type of mounting system deployed.

For all normal installations, we continue to recommend the Standard Schletter System, the uniquely simple, flexible and rapid mounting of cross rails directly onto the substructure. In contrast, the cross rail system GridNorm is ideal for cases in which the substructure offers minimal or no appropriate fastening points or where the position of the cross beams needs to be better aligned to the module rows. Schletter GridNorm thus enhances the range of simple, easy to mount Schletter systems.

Examples of deployment can be seen in the module mountings on all eternit or trapezoidal sheet metal roofs with only horizontal battens, or in the horizontal mounting of modules on pantiled roofs with unfavourable row partitioning.

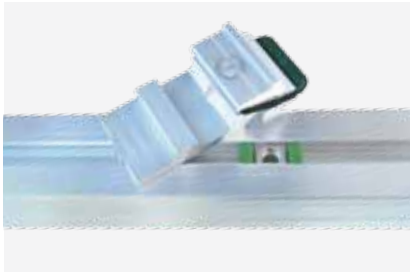
**Special instructions for GridNorm mounting:**

- **Arrangement**
  First the lower profiles are arranged vertically from the eaves to the ridge and are secured at the fastening points (roof hooks, corrugated roof sets etc). Cross rails are then arranged on the vertically mounted profiles in appropriate distances according to the modules used. The KlickTop cross rail connector can be secured easily from above.

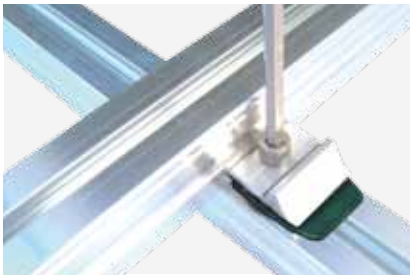
- **Profile distances and span widths**
  The approved distances of profiles and support points can be referenced in the system structural analysis. Please note: The minimum number of fastening points per square meter must be observed!

- **Calculation and compilation**
  As with the standard system, the GridNorm can also be compiled using Autokalkulator enabling a quick overview of the rail assembly.

- **Conventional cross rail mounting**
  In addition to the GridNorm mounting, the VA plate can also be used as a cross rail connector (see component overview).



❶Hook in cross connector to the lower profile



❷Screw can be tightened conveniently and quickly from above

## 6.2 Flat roof mounting

### 6.2.1 General information

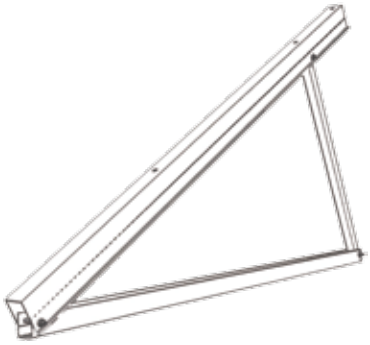
In the case of flat roof elevations, a row of vertically arranged modules is generally secured to a pair of cross beams. The cross beams themselves, are mounted on a row of supports.

Most supports are available in variety of angle specifications. A module angle of 25-30 degrees achieves the optimal annual utilisation ratio for grid-connected plants in Germany, for example; 45 degrees can optimize yield during the winter season in island locations and 20 degrees can be used as an additional elevation on slightly inclined flat roofs. The cross beam profiles are attached to the support elements. Two cross beam profiles generally bear one module row, which is aligned and fixed to the cross beams by means of end and middle clamps. customized module alignments are also possible. Different types of supports allow for adaptation depending on the conditions.

**Tip:**
An automatic shading calculator is available on our website: www.schletter.de to help determine row distances.

- Structural constraints are taken into account when calculating the placement of all supports (building height, snow zones, module height, etc.) Approved support distances can be referenced in our system structural analysis.
- It is to be verified that the roof can safely bear the additional loads i.e. of self-weight of the PV plant, of ballast loads and of snow.
- It should be noted, with respect to wind load, that very large, concentrated forces may occur, particularly at the fastening points of the elevations. Where supports are combined with fastening elements, (for example, supports on hanger bolts, clamps, etc....), the verification of structural safety must be carried out within the framework of a structural type analysis as these cases are not defined in the general system structural analysis. Structural verification is also to be carried out of conditions on the construction site.
- Fastenings using gravitational forces can be referenced in the system structural analysis. In such cases, it is critical to note that the roof substructure must bear the weight of the PV-plant plus the required superimposed loads!
- Structural calculations for the supports generally refer to vertical loads and not to the customized side and tilt stabilities. It is to be determined, on a case by case basis, as to whether each support combination should be stabilized by adding diagonal struts or similar. Schletter **WindSafe**-sheets carry out the equivalent, parallel function of a strut support.
- Often, if the roof covering is tight, only one fastening using gravitational forces is possible without penetrating the covering. Particular care should be taken in such cases, that no stones from the gravel filling or similar are left beneath the ballast which could potentially damage the roof covering (surface protection mat is recommended).

## 6.2.2 Mounting



**Tools:**
Extended socket wrench 15mm

**❶ Mount the supports and arrange them in a row on the roof surface**
The lateral distance of the supports must be determined according to the boundary conditions (building height, snow load, wind load, module height) - generally 1.6m to 1.8m. The lateral protrusion of the profile should be between approx. 0.2 and max. 0.4m.

**❷ For mounting on concrete elements only: Bolt each support individually onto the elements.**

**❸ Arrange the supports in a row**

**❹ Fasten the cross beams loosely onto the supports**
Insert screws into the groove of the cross beam profile and roughly distribute according to specification. Loosely fasten the first cross beam element into the first support (starting with the first screw). Then arrange all supports, one by one, in a row. The cross beam is connected by means of a connector on the underside.

Once all cross beam rails are aligned on the supports, tighten all connection screws fully.
Use only the specifically defined nuts with a serrated profile! When integrating an installation with the lightning protection system of a building, please observe the information in the last section under Point 10!

**❺ Move the rack into the correct position if necessary**

**❻ Fully tighten and check all bolts on the substructure**
(M8: 5 or 15Nm; M10: 40Nm: Gently hand-tighten M8 bolts on the supports).

**❼ Cross beam mounting**
Next, bolt cross beams onto the supports with standard or square head screws M10x25 and flange nuts M10.

➲ Continue with item 7: Module mounting

## 6.3 Façade fastening

The façade fastening represents a special case of module mounting, usually onto vertical walls. For plants to be mounted on visible surface areas, the fastening components can be delivered together with the prepared surfaces (e.g. anodized or powder coated). Warning! Anodized or coated elements have only limited conductivity (capacitive charging, lightning protection). Please observe the guidelines relating to overhead glazing.


➲ Façade assemblies- general.

Please note:

**❶ Draft the plant configuration and identify the desired positions of the facade supports**

Cross beams must protrude to a length of approx. 0.2m to 0.4m to the left and right. The maximum support distance is defined according to the structural dimensioning table.

- Mount bottom beam
- Hook in module beam / strut and secure (tighten screws very gently, max. 5Nm)

**❷ Check the position of the cross beams according to the module height**

The cross beams should be positioned at an approx distance of 1/4 - 1/5 module height from the upper and lower module edge. The position of the junction boxes should be taken into account. It should be verified that existing bore holes in the supports are suitable for the deployed modules. If not, please submit an order for façade supports with the appropriate measurements.

**❸ Analyse the substructure and select an appropriate fastening system**

The substructure and fastening system should be approved for the bearing of local forces (particularly snow and wind). Heavy duty anchors or adhesive anchors are generally provided. Fastening points are to be included in the structural analysis of the plant if required.

**❹ Level and mount the supports in a row**

To align the supports, first secure the two outermost elements at the same height (horizontal alignment e.g. with the aid of a water level gauge or laser measurement). Extend a cord between the external supports, from the top corner to the bottom corner and align the inner supports to the cord (using underlayments if necessary).

**❺ Screw and align the cross beam on to the facade supports**

Insert screws (generally M10x25 hexagon head or square head) into the grooves of the cross beam profiles and arrange to approximate distances. Insert the first cross beam element into the outermost support (starting with the first screw). Ideally, you should secure the first screw with a nut to the support, then lift the rail slightly and insert the remaining screws, one by one, securing each with a nut (do not fully tighten at this point). Compensation for uneven walls can be made by adding underlay beneath the contact face of the façade support or between the support and the cross beam (using longer screws if necessary).
Cross beams can be extended by means of cross rail connectors. The lower rail is then precisely aligned. Once the lower rail of a module row is secure, the upper rail can be placed, while ensuring precise lateral alignment. Important: The lateral alignment must constitute an angle of 90 degrees, or as close as possible, to the lower rail. Once all cross beam rails are aligned, tighten all connection screws fully. Use only the specifically defined screws with locking teeth. When integrating an installation with the lightning protection system of a building, please observe the information in the last paragraph!

**❻ Fully tighten all screws on the substructure**

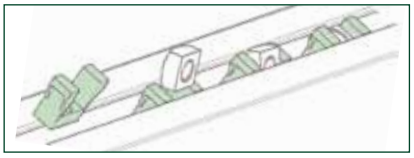
➲ Continue with item 7: Module mounting

# 7 Guidelines for mounting modules

## 7.1 Framed modules

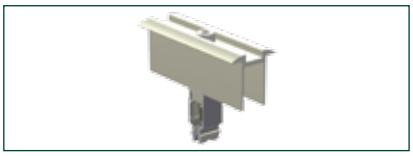
**❶ Prepare for mounting of the modules**
Cabling to the module rows must be prepared. Note: When apportioning strings and preparing cabling, please observe all guidelines pertaining to lightning protection! (see last paragraph). Preparation of module cabling: A corresponding plug / socket must be mounted at the end of each string cable, depending on module type. Connect up the first module to the string cable according to manufacturer specifications then link the further modules.

Push click components (item no. 129010-008).into the upper groove of the cross beam profile, insert square nuts into the click components and distribute at approximate distances along the length of the profile. Loosely attach the first two end clamps with serrated M8 screws (or screws with locking nuts) at the end of the cross beam rail. Then position the first module and loosely secure with end clamps (the end clamps should be placed at least 5mm from the outer edge of the cross beam). Now adjust the first module in line with the cross beam.



Klick-system

When mounting with Rapid$^{2+}$clamps, click these into the required position, arrange flush with the modules and tighten screws.



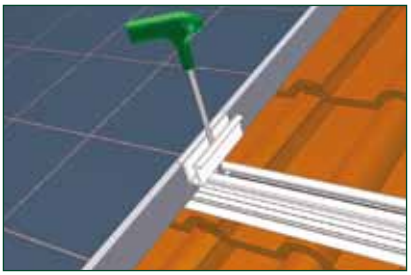
Rapid$^{2+}$

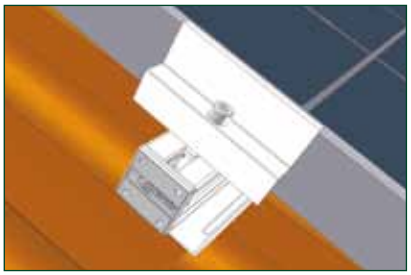
**❷ Mounting of module rows**
After aligning the first module in each row, a middle clamp is loosely fastened to the corresponding cross beam. The next module is then connected, shifted beneath the module clamp and secured.
The next middle clamp is secured accordingly. The cables can now be run through the cable duct of the rail. These must be secured to the cross beam by means of UV-resistant cable straps.
A further end clamp is placed at the end of the module row.

As an option, cables can be routed through Schletter cable clips. ➲ Product Sheet Cable Clips

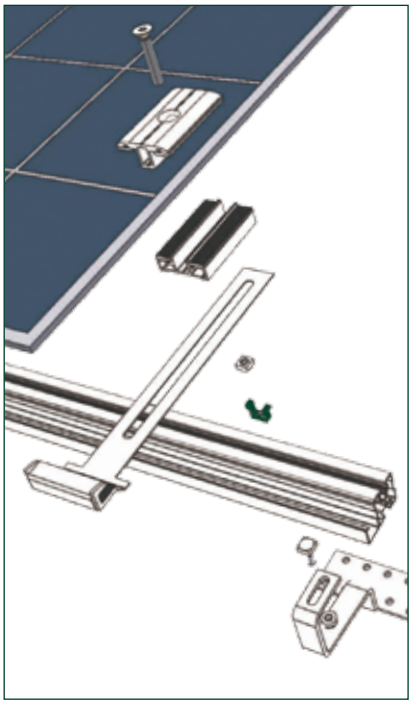
**❻ Fully tighten and / or check all screws used to secure the modules.**

**❹ End caps**: If desired, the cross beam profile may be finished with an end cap (for Solo and Profi).





## 7.2 Unframed modules



The laminate clamping system was designed as an adaptation of the Schletter standard system to include laminated modules. The clamps are so designed that the laminate only ever comes into contact with rubber on all sides, including the front and is not braced across metal within the rack.

➲ Mounting laminate modules - Please observe these general guidelines!
➲ LaminatEco Product Sheet
➲ LaminatGS Product Sheet

**Warning!**

Mount laminated modules on tension-free substructures only! If in doubt, then only in combination with a cross rail system!

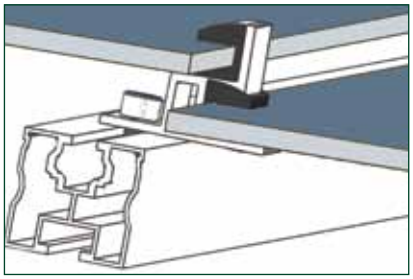
As a general rule, unframed modules should be mounted exclusively to manufacturer specification!

- **Mounting of clamps**
  The mounting of end- and middle clamps follows the same procedure as that of the normal clamps for framed modules.

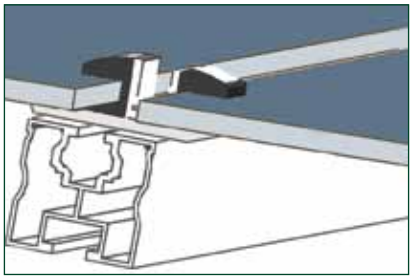
- **Mounting of safety hooks**
  Laminates cannot be friction-locked tightly enough to exclude the possibility of displacement on sloping roofs. A safety hook is therefore bolted in with each lower module clamp to ensure that the module cannot slide. The safety hook is inserted beneath the module clamp and is secured with a clamp screw once the respective module has been correctly aligned. In the case of two-piece middle clamps, it should be ensured that the module clamps are not fastened too tightly.

- **In the case of laminated modules with very narrow edges,** the module should not be obscured too much by the clamp. The use of distance strips in the mounting is recommended here.
  However, given that the distances between modules are greater as a result, care must be taken to order and install **longer rails**.
  The Autokalkulator results must be amended accordingly.

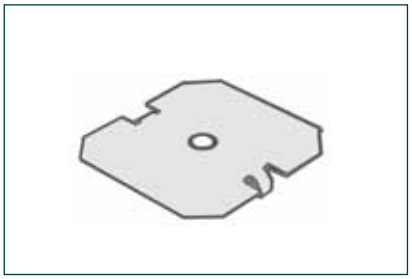
- **With larger laminates or horizontal in mounting,** the laminate should not be extended, unsupported between the clamps, but should be propped in the middle with an additional support rubber or shim (available as an accessory).



Cross mounting with **LaminatGS**



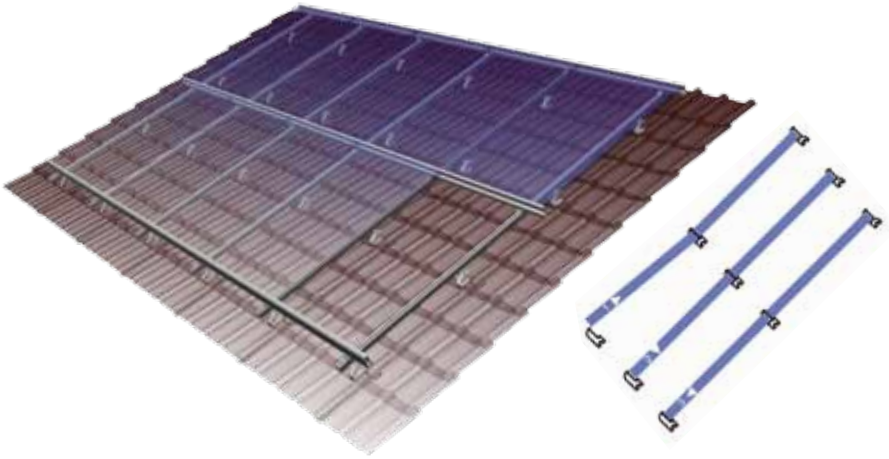
Cross mounting with**LaminatEco**



**Shim** for LaminatEco
to raise the supporting surface.

## 7.3 Roof-In

- Material-optimized rack dimensioning
- Shorter mounting times
- universally applicable
- Price-efficient



The Roof-In system is the logical application of roofing lay-in systems.

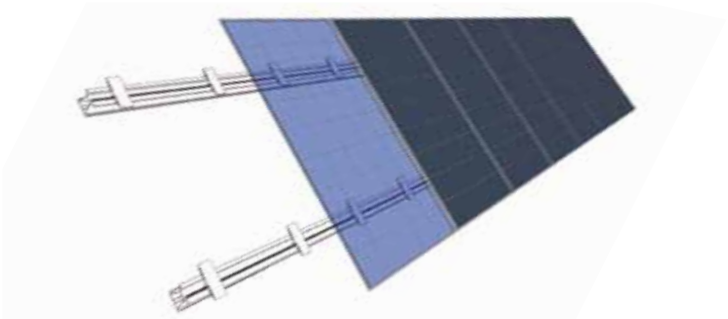
As with the open area system,
the lay-in system should only be used with modules with the corresponding certification. The warranty for the modules is otherwise invalidated.
With this lay-in technology the module is safeguarded against sliding as per regulation.

The module can be mounted horizontally or vertically between two horizontal profiles. The module is positioned with the upper edge first and is shifted upwards into the rail. The module is subsequently pulled downwards into the lower rail.

➲ Product Sheet Roof-In

## 7.4. OptiBond

- Structurally optimized for large modules
- Minimum mounting time
- with anti-theft device



Due to cost pressure caused by the annual decrease of compensation for electricity fed into the grid, there is an increasing tendency towards modules with thin layer technology, particularly with large and open-area plants. The objective of many module manufacturers is therefore to produce large-surface, double-glazed modules, whereby cost-optimization can be anticipated both in module production and in the PV systems. Increased bearing capacity, and with this an extension in module measurements, can only be made possible through the application of appropriate fasteners within the mounting systems.

Schletter GmbH is therefore developing suitable bonding techniques in cooperation with numerous module manufacturers to connect these large surface modules in a mechanically optimized manner to the substructure.

➲ Product Sheet OptiBond

# 8 Special systems

## 8.1. Roof-integrated systems

### Plandach5

- Optimal water-tightness
- Flexible and modular, Applicable for all module types and sizes
- Optimal yield through defined rear airing
- Attractive appearance

A conventional roofing membrane from the industrial roof sector (e.g. Alwitra Evalon V) is laid onto the roof boarding e.g. wooden material plate V100 G or massive boarding plus fire protection mat) or onto a correspondingly pressure-stable on-roof insulation. Vertical system rails are laid on the roofing membrane and screwed with the boarding; the perforations are laminarily sealed between the rail and the roofing membrane (EPDM-rubber form part). Clamping is effected by means of corresponding clamping components which can be hooked into the rail and screwed at any point along the rail. On request, a linear clamping with an end-to-end covering rail is also possible. The system is suited to roof inclinations of approx. 20 degrees or more. In contrast to the framed modules, a cross rubber is required for unframed modules.

➲ Plandach 5 Mounting and Project Planning
➲ Plandach 5 Product Sheet

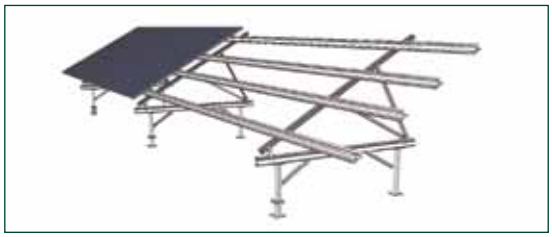
### BiPv 2-11

- Quick and simple mounting requiring no special tools
- Free selection of module sizes
- No additional sealing layer required (other than the standard underlay)
- can be completely integrated with the existing roof covering
- Fulfills all requirements for full integration according to French law (maximally 2cm above the roof cladding)

The BiPV 2-11 system is a sophisticated in-roof system and can be integrated as a defined section of an existing roof or can be deployed as a complete roof covering of a new building. Modules are integrated into the existing roof surface and can be combined with all conventional roofing tiles. Systems are custom-built and module sizes are compiled to customer specifications. A complete roof covering can be planned in advance with an architect. The system can also be applied to very large roofs (following eaves and/or slope) and can thus also be mounted to industrial roofs. Thermal expansion is already taken into account in such cases.

➲ Product Sheet / Mounting instruction BiPv 2-11 - Important: Please observe these guidelines!

## 8.2 Membrane roofs of industrial buildings – IsoTop

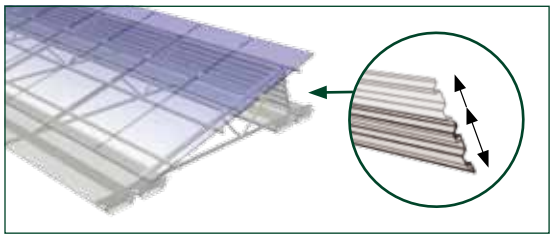


- Supporting widths up to 10m are possible
- Direct load application into the supporting structure of the building
- We will assist you in the planning of your project.

The constructions are generally optimized such that only few penetration points are necessary and at large distances apart. These can be welded safely and cost-effectively by a roofer. The trade warranties are thus clearly separated.

➲ IsoTop Product Sheet

## 8.3 Specific project planning for flat roofs Windsafe



- Considerable reduction of the required load ballast
- Broader span widths of the module bearing profiles are possible
- Considerably reduced load of the roof construction
- Verification against "tilting" and "uplift" is possible with lower superimposed loads

The modular Windsafe system comprises an extra, specifically designed wind deflector, which contributes to the stability of the plant, with considerably less load than with other conventional structures.

➲ Windsafe Product Sheet

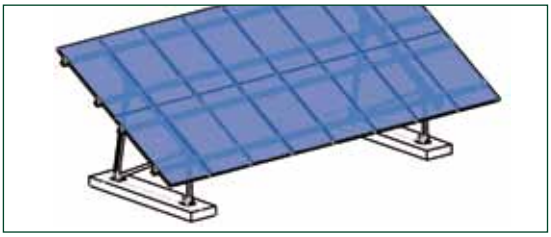
## 8.4 Park@Sol

Parking areas with solar carports are a welcome supplement for the photovoltaic generation of electricity over a wide area, particularly as car port roof areas are eligible for the maximum compensation according to the electricity feed-in law!

➲ Park@Sol Product Sheet

## 8.5 Open area

SystemFS



PvMax3

The FS open area system is customized to each respective location. In addition to the pile-driving technology deployed with the FS system, a system for concrete foundations is also available with the PvMax3.

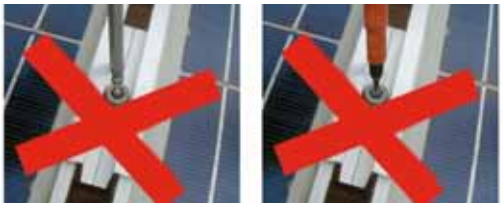
➲ FS/PvMax3 Product /mounting sheets

# 9 Accessories

## 9.1 Anti-theft device

**Schletter SecuFix** stands ahead of all competition in its simplicity, can be retro-fitted at any time and can only be demounted with an electric tool and a significant amount of time and effort. **How does it work?** On request, quality steel ball-bearings with the exact diameter for conventional socket head screws can be delivered on request. Once the plant becomes operational (and once you are sure that no further connection needs to be opened) all screws can be secured by hammering in the **SecuFix-ball-bearings** – that's it! Schletter SecuFix can, of course, be equally deployed with pitched or flat roofs or with open area plants alike, either in new constructions or as a retrofit!

**Hammer in the ball bearing - that's it**



**Do not open the screw with normal tools!**
Loosening with pliers also not possible driver due to a very narrow middle clamp

**Unscrew (e.g. in the event of defect modules)** Cut a groove and loosen the screw with a large screw

**SecuFix2** is the logical extension to the SecuFix system. Additional "lateral protection" at the ends of module rows substantially increases resistance to theft. SecuFix2 supplements the SecuFix system, providing additional protection to the module clamp connections and can, of course, be combined favorably with other design concepts (electronic plant surveillance, etc.).

**Important information:**
It should be noted that, fundamentally, the mechanical safety measures are designed to delay attempted theft rather than prevent it and these should, therefore, be deployed in combination with other protective measures.

## 9.2 Cable laying

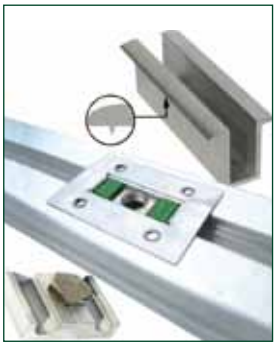
In addition to the bearing beam profile Profi 05 with cable duct, we deliver a flexible cable duct together with the cable clips and cable duct extensions.
Further variations can be seen in the Component Overview.

## 9.3 Lightening protection and potential equalization

The following components can be used for the integration of anodized module frames into the system for potential equalization:

- Middle clamps with **earthing pin** (Series 135...) instead of the standard middle clamp
- **Earthing shim** (item no. 135004-000) in combination with normal middle clamps

The lightning protection clamp (item no. 135003-000) can be used for the internal potential equalization in the rack (for example vertical connection of all cross beams with 8mm aluminium wire). A connection to an existing lightening protection system (depending on the BS concept) is possible with this clamp.



# 10 Important information

## 10.1 Lightening and overvoltage

Lightening protection and overvoltage protection are **not** included in the scope of this overview!
**We recommend requesting advice from a specialist company should further information be required in this area**. A few basic tips may, however, be of help in planning.

➲ Earthing and lightning protection in PV plants

As a matter of principal, it should be clarified with the customer at the planning stage as to whether or not measures for external lightning protection (arrestors, conductors, etc.) and internal lightning protection are to be taken. Particular care should be taken in cases where a plant is to be mounted on a roof with existing external lightning protection. In such cases, the customer is to be informed and advised that an examination and a retrofit of the lightening protection system is generally required.

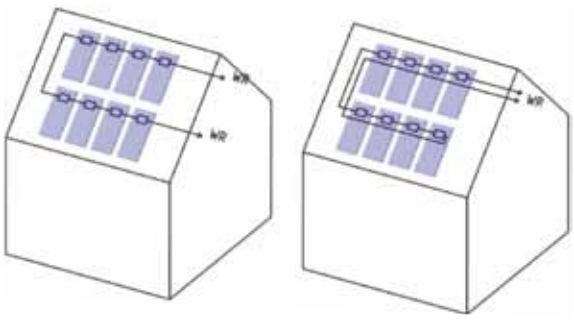
As a rule, the PV plant should be installed at an approved distance away from the existing lightening protection system. In this case, the potential equalization of the PV-rack must be implemented independently of the lightening protection system - this also applies for sheet metal roofs, for example.

Should structural constraints prevent deployment of approved separation distances, an alternative solution can be found by integrating the mounting rack with the lightening protection system, according to approved lightening protection standards. This is to be effected at several points (e.g. using lightning protection clamps item no. 135003-000). In this case, care should be taken to ensure that all components of the internal lightning protection system are lightening-proof.

**Literature:**
Useful information on lightning protection, as well as for the complete dimensioning of PV plants can be found, for example, in the planning file "Photovoltaische Anlagen" (photovoltaic plants) published by DGS.

## 10.2 Cable laying

When laying cables, particular consideration should be given to the protection of the plant from close-range lightening strikes. Damage to the plant (for example destruction of the inverters through overvoltage) is often caused by induction voltage in the module wiring. A lightning strike close to the PV plant induces a very high current flow. This current flow (or its temporal change di/dt) triggers an induction voltage into the "looped circuit" created by the module wiring installed on the roof.



bad better

It is therefore to be considered during planning, apportioning of strings and cable-laying, that looped circuits should be avoided wherever possible. Ideally, having run the cabling through serially connected modules, it should be returned through the same string and should re-enter the roof at the point through which it emerged. The cable duct on the cross beam profile can be used as a return path through the module rows.

## 10.3 Safety and liability

### 10.3.1 Electrical installation

Information pertaining to electrical installation lies inherently outside of the scope of this overview!
The following general tips should nevertheless be considered:

- Installation and implementation of the system may be effected only by certified electricians
- The current, valid conditions and safety regulations are to be observed.
- Electrical installation is to be strictly avoided in damp conditions
- Even at times of little sun-light, extremely high voltages occur at array connection points and can be fatal if touched. The possibility of secondary injury due to electric shock should taken into particular account!

### 10.3.2 Working on the roof

Current and valid accident prevention regulations must be adhered to when carrying out work on the roof (including on flat roofs) have to be considered.
The Accident Prevention & Insurance Association can offer information on the pre-defined safety measures.
In working heights of 3ms and over, the use of capture equipment is mandatory.
Should the setup of such facilities not be possible, then safety harnesses are to be worn and fastened according to official regulations. All tools are to be secured appropriately and where necessary, the danger area on the ground is to be cordoned off.

### 10.3.3 Exclusion of liability

This guide offers useful tips as to the mounting of the Schletter GmbH fastening system.

- The company responsible for the installation is obligated to observe the valid regulations and rules of technology as well as the guidelines provided in this manual.
- The dimensioning guidelines included in this manual are drafted solely from practical experience; The recommendations outlined in the respective system structural analysis however, are mandatory.
- The installing company is responsible for the dimensioning of the plants. Schletter GmbH provides the corresponding instructions in the system structural analysis.
- Schletter GmbH accepts no liability for dimensioning recommendations presented in commercial proposals as, generally, not all factors (snow loads, building heights, wind loads etc.) can be determined for a definitive technical scope at the point of offer. We would be happy to assist you in the detailed planning!
- The installing company is responsible for the mechanical durability of the installed interface connections at the building surface and particularly for ensuring water resistance. Components manufactured by Schletter GmbH are designed to accommodate pre-defined loads and according to state-of-the-art technology.
- Schletter GmbH accepts no liability for inappropriate handling of installed components.

Schletter GmbH provides a voluntary 10-year warranty for the service-life and durability of all rack systems in so far as the following conditions are fulfilled:
Correct handling, dimensioning according to the structural framework requirements (in so far as a separate agreement has not been drafted to this end), normal conditions pertaining to environment and surroundings. This applies within the scope of environmental conditions as stipulated, for example, in the DIN 1055.

- The expected product durability is considerably higher than that of the photovoltaic modules.
- Given that the structural dimensioning of the plants cannot take all possible environmental conditions into account but is drafted according to the valid approved standards, we recommend that supplementary insurance is procured to cover all eventualities.

SCHLETTER GmbH

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For a comprehensive and competent consulting during the planning of your plant and for questions concerning logistics and order processing, our members of staff are available from Monday to Friday from 7 am to 5 pm.