Solar systems by Schweizer:
Mounting Instructions – Solrif®

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Scope of application

– This system has been designed solely for the generation of electricity from solar energy and as weather protection.
– The mounting of full-surface PV installations, where the PV field extends to the roof edges, is possible, but is not covered by these mounting instructions.
– Solrif® modules are solely designed for in-roof mounting in accordance with this manual.
– Information on electrical connections, earthing and wiring can be found in the relevant plans and component instructions.
– Correct use includes observing all the information in this manual.
– These instructions apply to the Solrif® N as well as to the Solrif® D system.
– The sheet metal surround is designed and tested for typical interlocking tiles. Its suitability for other roof coverings or connection to roof edges and roof superstructures must be assessed by a specialist; if necessary, transition sheets must be made by a roofing materials specialist. Suggested solutions can be found at www.solrif.com.

Any use of the system that goes beyond correct use, as well as any different use of the system or of the Solrif® modules, counts as incorrect use and can lead to dangerous situations.

Illustrations in this manual are intended for basic understanding, and may deviate from the actual design of the system.

Exclusion of liability

– The information and safety instructions in this manual have been compiled taking into account the currently applicable norms, guidelines and regulations, the latest technology and the accumulated experience of Ernst Schweizer AG.
– The shipment contents, or the design of the system, can deviate from the descriptions and diagrams specified in this manual because of optional items ordered, manufacture of customised designs or the latest technological changes.
– Apart from the contractually agreed obligations, the manufacturer's General Terms and Delivery Conditions apply. These are subject to the laws that were valid at the juncture when the contract was concluded.
– Ernst Schweizer AG reserves the right to make technical changes to the system as part of further development to improve performance characteristics and safety.
– Ernst Schweizer AG accepts no liability for damages and accidents arising from the following causes:
  – Inappropriate use of the mounting system
  – Non-observance of the information and instructions in this manual
  – Work carried out on or with the system by non-qualified or unauthorised personnel
  – Yield losses due to electrical defects of the modules

Explanation of symbols


Warning of electric shock


Note


Follow SPT software report


Use a harness


Wear safety goggles


Wear working gloves


Wear safety shoes


Wear a helmet


Wear ear protection


Sawing/cutting work step


Make electrical connection

Requirements for the roof

– Roof pitch: 10° to 75° (with foil underroof)
– Underlay, sub-roof membrane against condensate and moisture according to ZVDH/SIA 232/1, temperature resistance up to 80° C
– Wooden substructure: analogous to tiled roof or on vertical counter battens.
– Wood quality: Strength category C24


Allow an additional requirement of 10% for wood offcuts compared to the batten plan. In addition, keep a range of auxiliary material to hand to smooth out any irregularities in the roof construction or to be able to implement connections or linings.


Note
Permissible deviation from the flatness of the substructure 0,5 % (5 mm per metre)


Note
Stepping on modules that have already been laid can lead to cell breakage and, in the long term, to a reduction in performance. If unavoidable, please follow the manufacturer's instructions or only use the appropriate devices.

Hazards due to electrical energy

WARNING

– Solar modules produce electricity when light falls on them.
– Have work on the electrical system carried out only by qualified electricians.
– Observe the regulations applicable at the installation site.
– If modules are found to be damaged, please contact the supplier.
– In case of damage to the cable insulation, immediately disconnect the power circuit and arrange for repair.
– Do not connect or disconnect cable assemblies if they are carrying current.
– Make sure that the maximum permissible system voltage is not exceeded when connecting the modules in series.

Note

– Make sure that when modules are connected in parallel, each row is individually protected by a fuse.
– Observe the instructions of the module manufacturer and of the system planner.
– Observe the information sheet on equipotential bonding and lightning protection at www.solrif.com.

Transport and packaging

Please observe the handling instructions on the packaging. If the goods or the packaging show any defects, please contact the supplier.

– Do not set the module down on its glass rim. Risk of damage to property!
– Leave the module in its original packaging until immediately prior to insertion into the PV array.
– Never hold or carry the module under any circumstances by its connection cables or junction box.

Supplementary information

You will find further information at www.solrif.com in the following documents:

– Application range of Solrif with regard to watertightness and minimum requirements for the roof underlay
– Lightning protection concept
– Information sheet for lightning and overvoltage protection with Solrif®
– Fire protection requirements with Solrif® in Switzerland
– Application range for Solrif® with elevated snow loads
– Leaflet on the use of Solrif® on curved roofs
– Blind Modules leaflet for Solrif® in-roof PV system


Solar systems by Schweizer:
Short installation manual – Solrif®
Additional information for the mounting of inner corners

Mounting inside corners

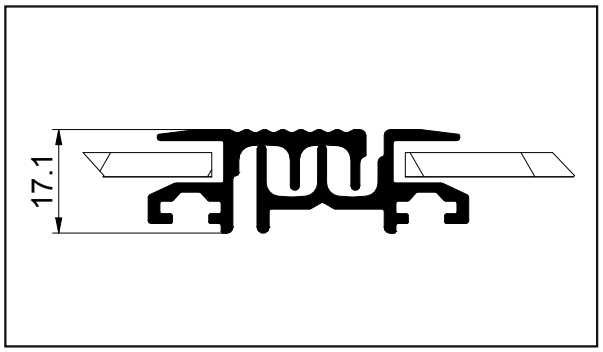
The mounting of the sheet metal surround for PV fields with inner corners is described in the supplementary document ‘Short mounting instructions – Solrif®, supplementary information for the installation of inner corners’.

Preparation
Before installation, the following documents must be checked for completeness and taken into account:
– Solar.Pro.Tool documentation (SPT), incl. parts list and CAD plan
– Electrical planning (cable routing plan)
– Protection concepts (lightning protection, earthing, equipotential bonding)
– Roof Plan

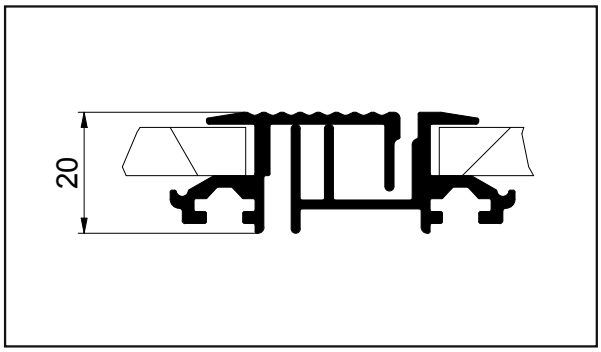
Working area
– Safety equipment such as scaffolding etc. must be professionally installed before installation.
– Observe the local and national regulations for the installation of PV systems, safety equipment and electrical systems.
– Check goods and auxiliary equipment for completeness and damage.

Solrif® N to Solrif® D
The mounting of the two systems is identical. The systems differ in the module frame and edge profile geometry, which means that different mounting brackets are required. The same grid dimensions are assumed for both systems.

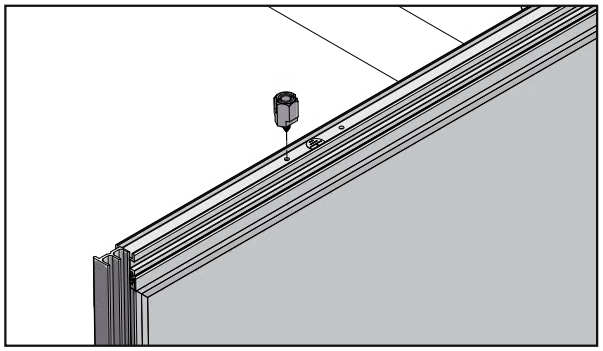
Solrif® N profiles



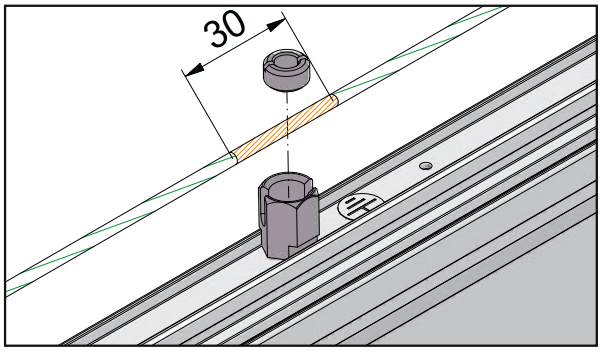
Solrif® D profiles



Earthing
If the modules are earthed, then attach the earthing terminal* (article number 21899) as follows:



Preparation: Screw on earthing terminal



To connect: Remove 30 mm insulation of the earthing cable and press into earthing terminal

*Alternative: Earthing cable set 10mm2 (15092)

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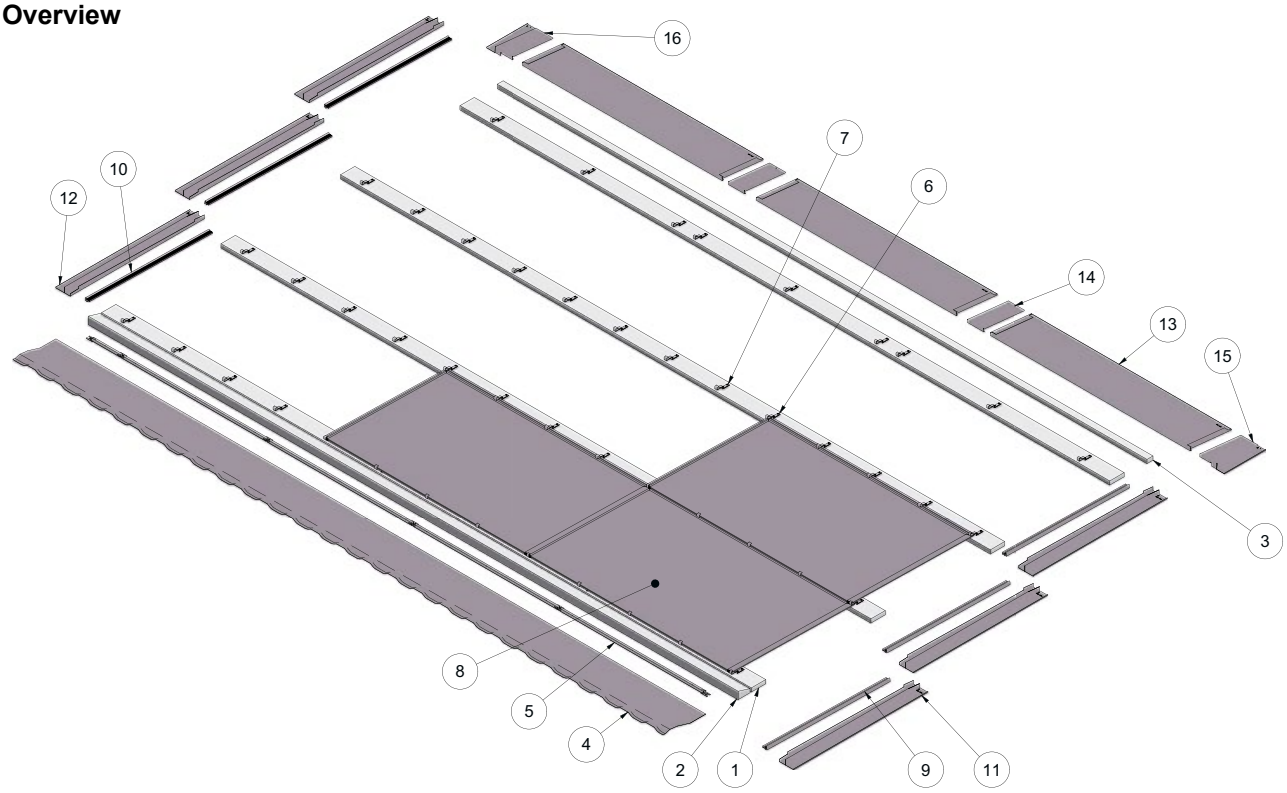
Solar systems by Schweizer:
Mounting Instructions – Solrif®

Overview



① Solrif®batten
② Wedge plank
③ Supporting batten
④ Connecting sheet
⑤ Eaves profile
⑥ Mounting clamp profile
⑦ Mounting clamp glass
⑧ Solrif® PV module
⑨ Flashing profile right
⑩ Flashing profile left
⑪ Side flashing right
⑫ Side flashing left
⑬ Top flashing
⑭ Top flashing joiner
⑮ Corner flashing right
⑯ Corner flashing left

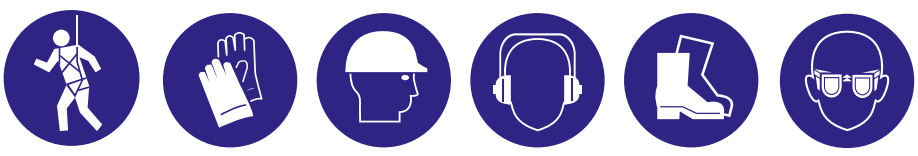
Materials needed for assembly

– Suitable wood screws for fastening the battens
– ① Solrif® battens 120 × 30 mm
– ② Wedge plank
– ③ Supporting batten
– SPT project report

Tools required

– Cordless screwdriver with Torx T20 bit insert
– Hammer
– Measuring equipment
(e.g. tape measure and chalk line)
– Mounting gauge (recommended)
– Guide line
– Metal saw

Safety



Solar systems by Schweizer:
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Horizontal section

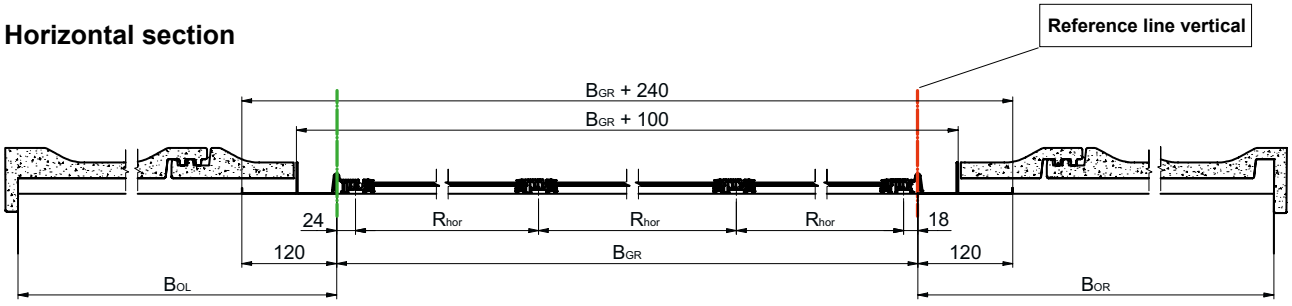

Illustration: horizontal section Solrif®

Vertical section

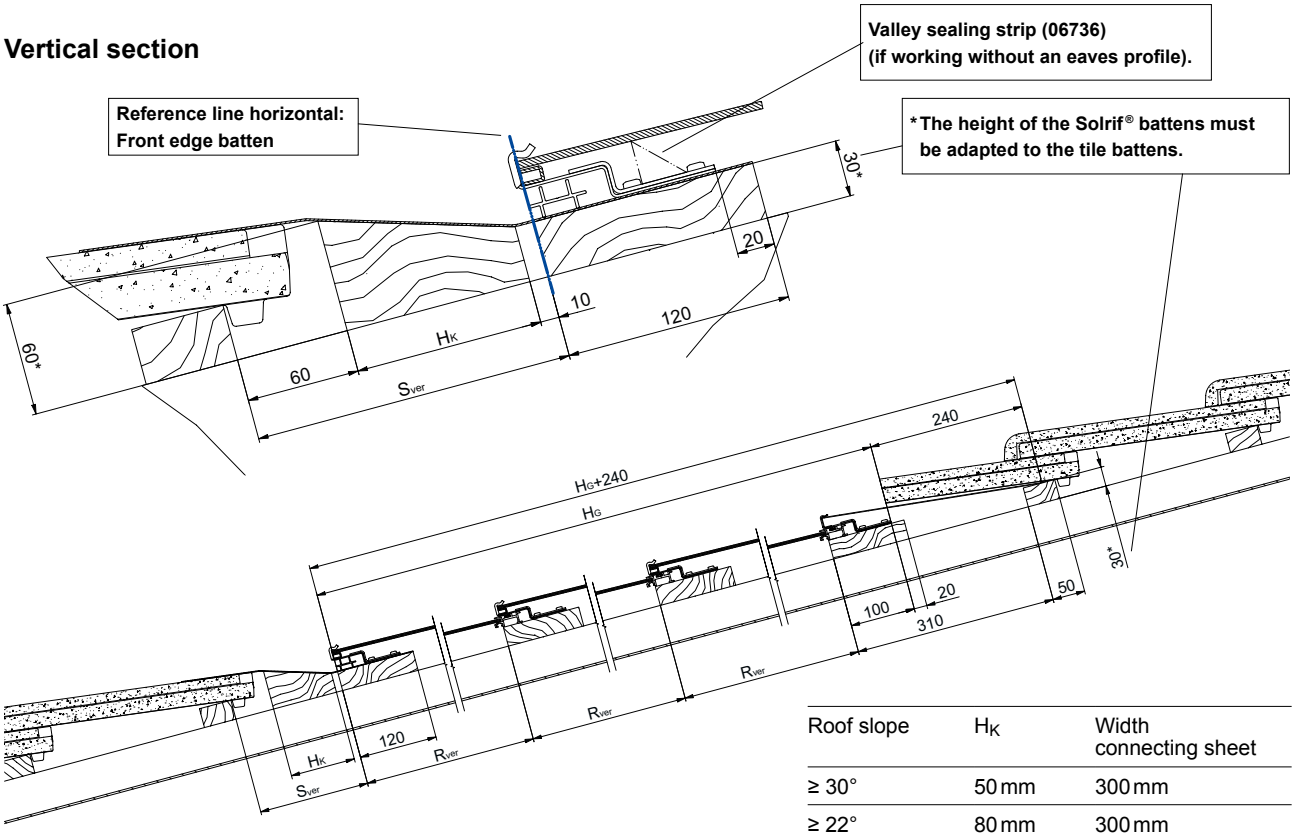

Illustration: vertical section Solrif®

Roof slope	H_K	Width connecting sheet
≥ 30°	50 mm	300 mm
≥ 22°	80 mm	300 mm
≥ 15°	120 mm	2 × 300 mm
≥ 12°	160 mm	2 × 300 mm
≥ 10°	240 mm	3 × 300 mm

SPT

These measurements may be found in the SPT report:
B_{GR}: PV field width = (R_{hor} × no. of modules horizontal) +42 mm
B_{OL}: peripheral distance left
B_{OR}: peripheral distance right
H_G: PV field height = (R_{ver} × no. of modules vertical) +100 mm
R_{hor} horizontal grid measurement = module width -18 mm
R_{ver} vertical grid measurement = module height - 32 mm
S_{ver}: distance 1st Solrif® batten

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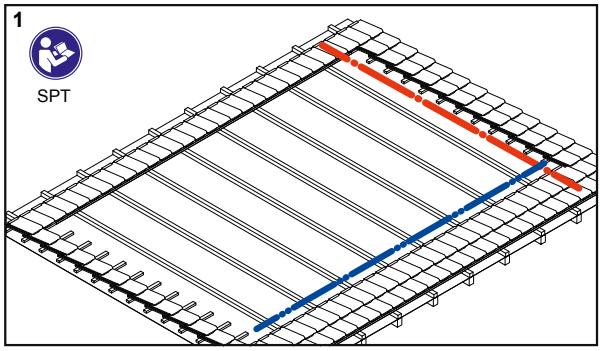
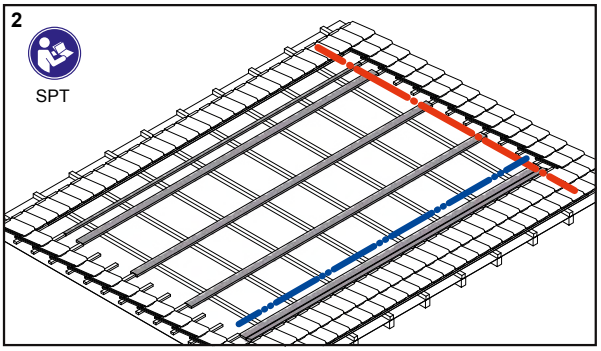
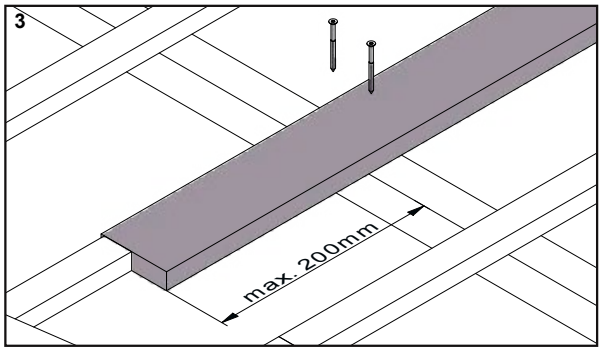
Mounting the Solrif® field



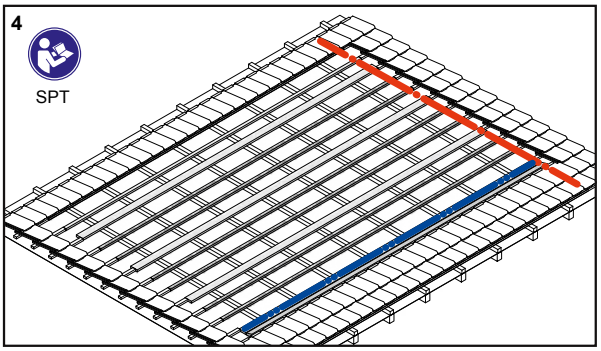
Remove tiles and, if necessary, also the tile battens in the area of the module surface on a generous scale.



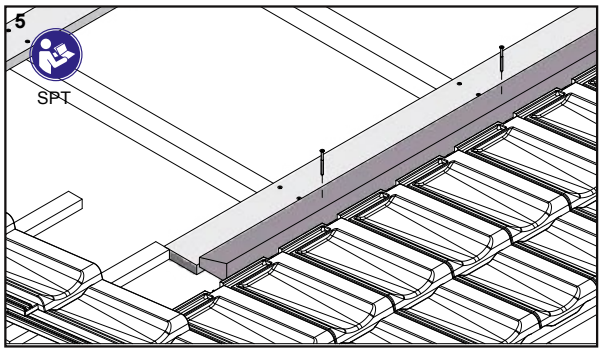
Assemble Solrif® battens, wedge plank and supporting batten in accordance with instructions.



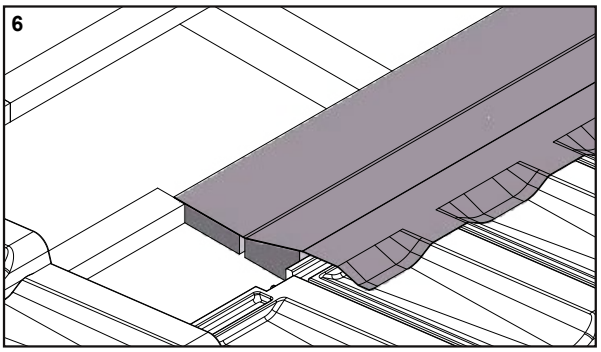
Fix Solrif® battens with suitable wood screws in the vertical grid R_{ver}.



Additional supporting battens 30 × 50 mm for high snow loads if required.
Attention: Avoid collision with module junction box



Place wedge plank.



Lay and install the eaves skirting. If the eaves skirting is composed of several sections of flashing tape, the sections must overlap by at least 100 mm.

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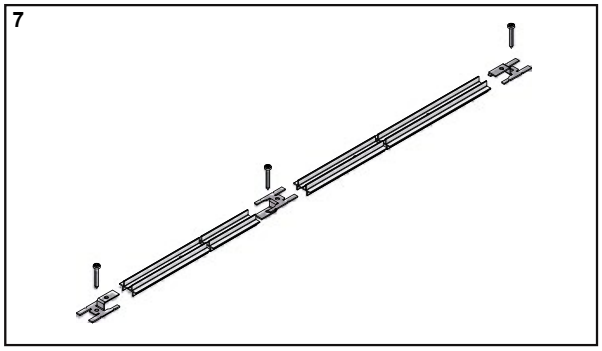
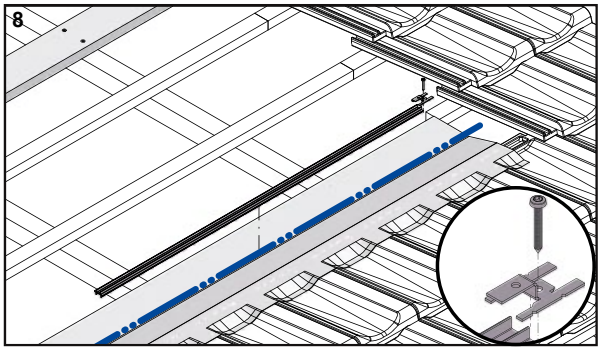
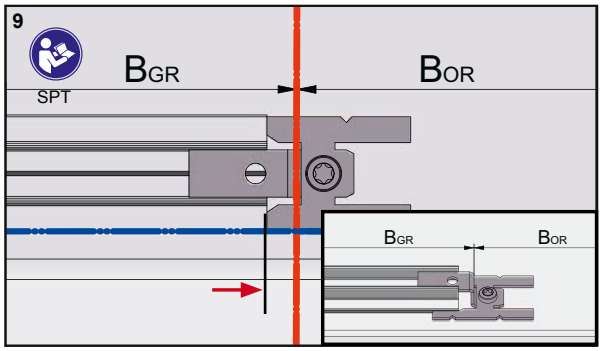


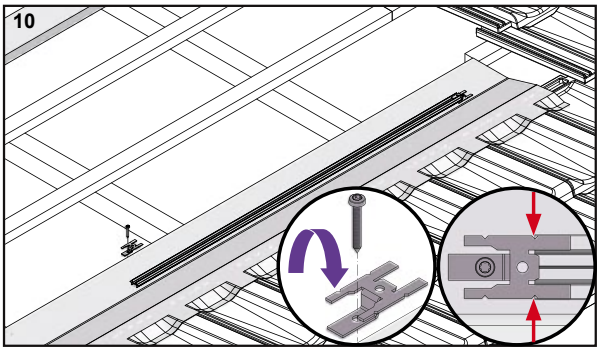
Overview of eaves profile installation.



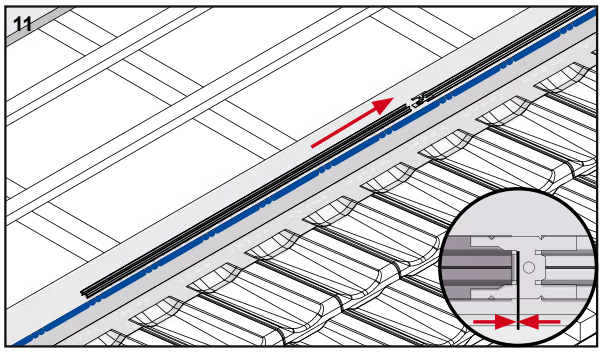
Position the eaves profile and profile fixing.



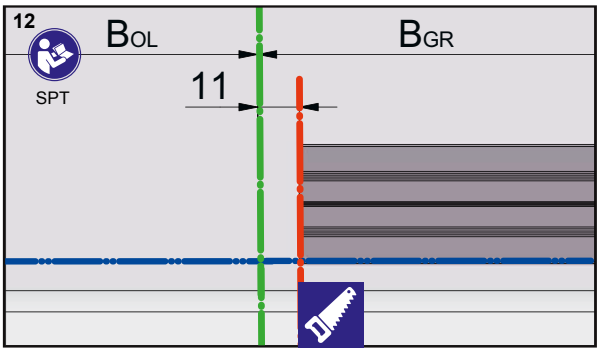
Align eaves profile with reference (blue) and profile fixing to B_{OR}. Insert eaves profile up to the stopping point of the profile fixing.



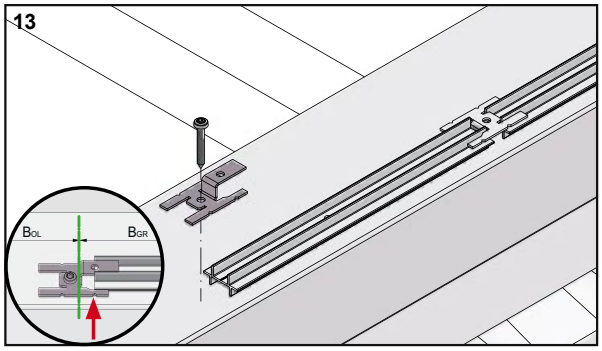
Turn and screw the profile fixing.
Observe position marks: approx. 3 mm clearance to the end of the eaves profile.



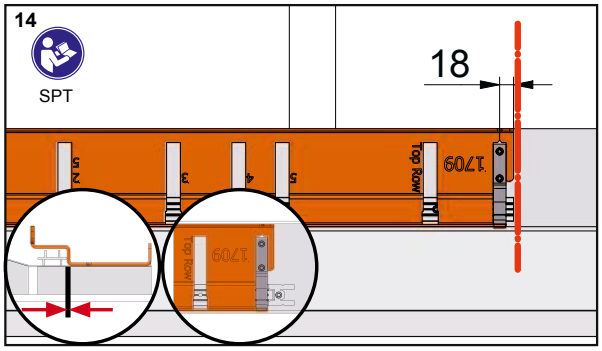
Slide the next eaves profile under the profile fixing to the stopping point and align with the reference. Repeat until the end of the PV field.



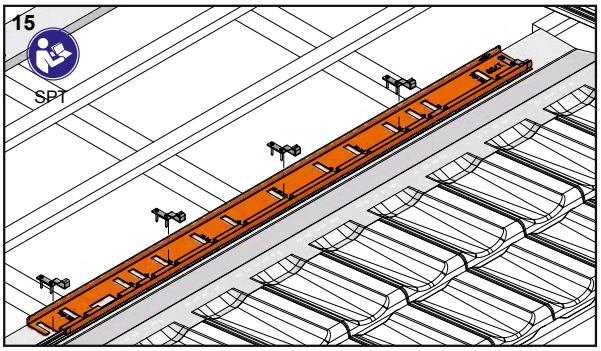
Shorten last eaves profile compared to B_{GR} by a minimum of 11 mm.



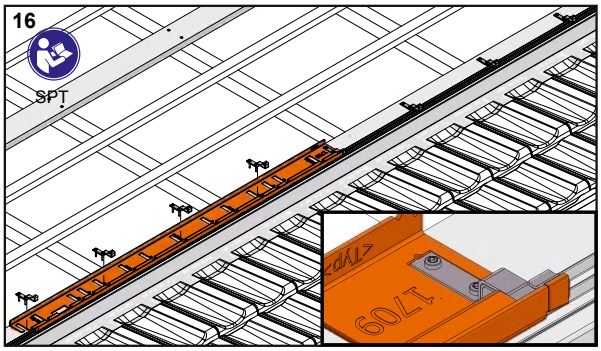
Place and screw the last profile fixing.
Have regard to the position marks.



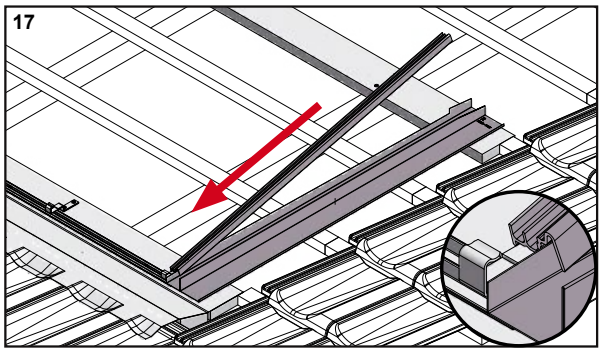
Fasten the mounting gauge to the eaves profile, place the mounting clamp profile with the help of the mounting gauge.



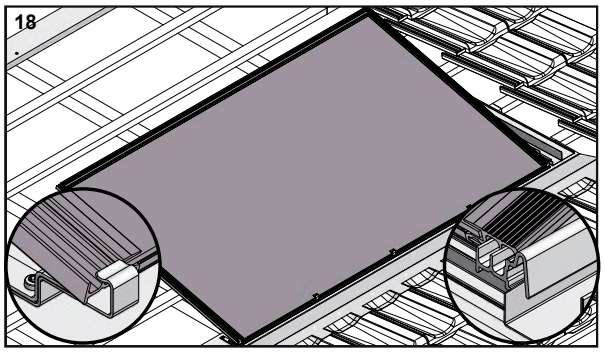
Screw on further profile mounting brackets and glass mounting brackets (number as per SPT report).



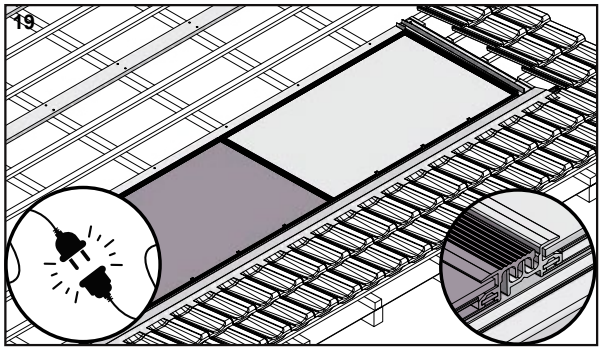
Attach further mounting brackets for the following modules.



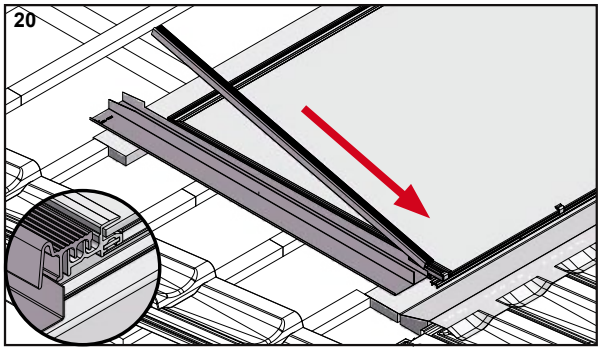
Insert right side flashing with flashing profile into bracket.



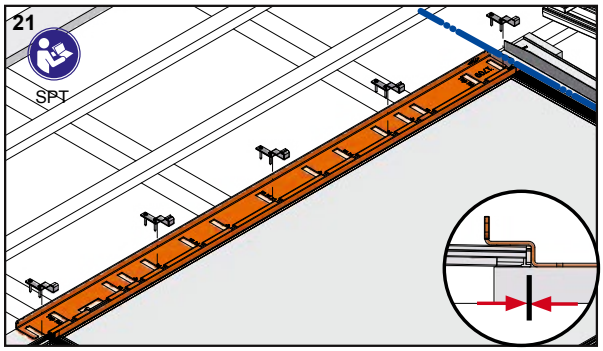
First place the module with the left frame profile in the mounting bracket, then lay it down.



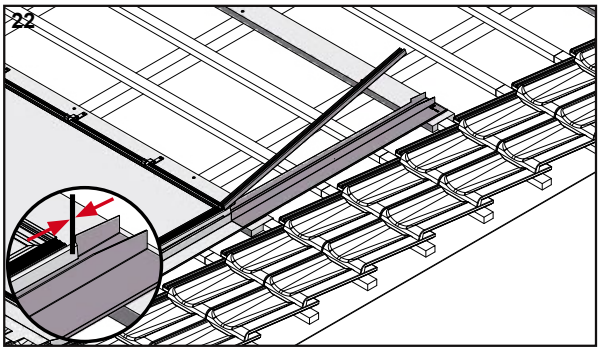
Lay further modules and connect electrically.



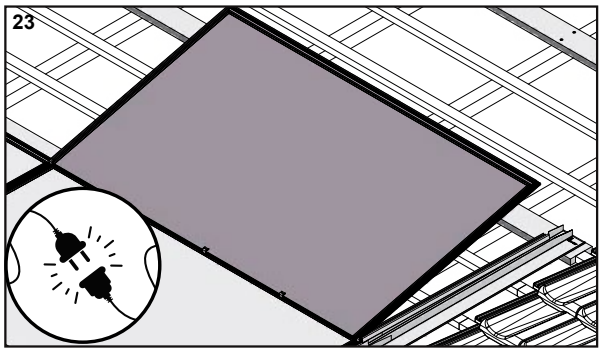
Close off at the left edge with side flashing and flashing profile.



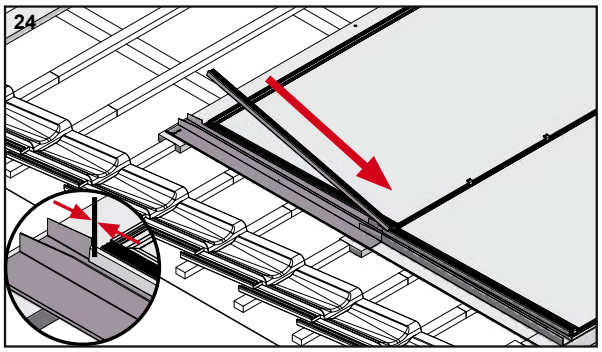
Mount the next row of mounting clamps.
If you are working without a mounting gauge, leave **15 mm** distance between mounting clamp and module.



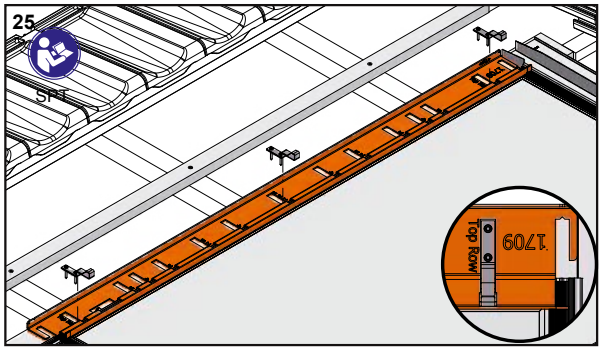
Insert the connection plate and edge profile in the profile bracket as far as they will go.



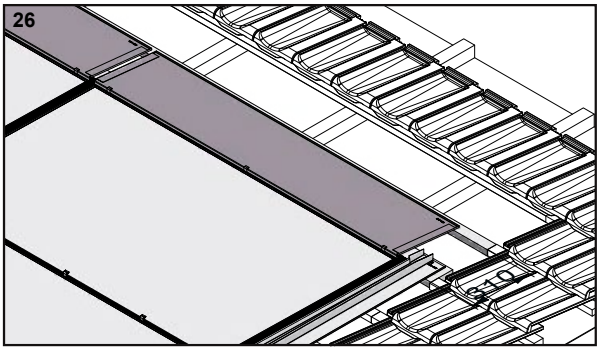
Lay further modules and connect electrically.



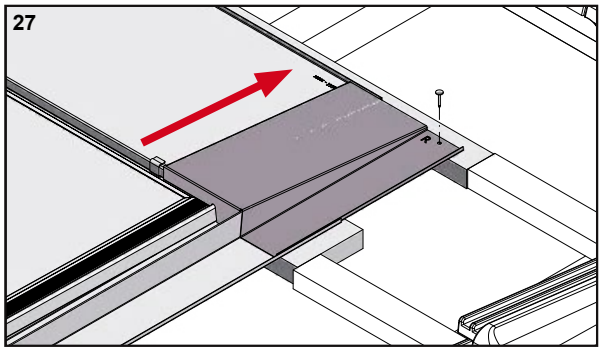
Close off on the left with side flashing and flashing profile.



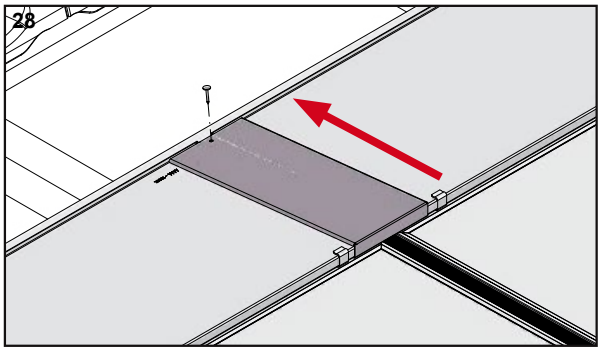
Lay top profile bracket row (‘top row’ position).



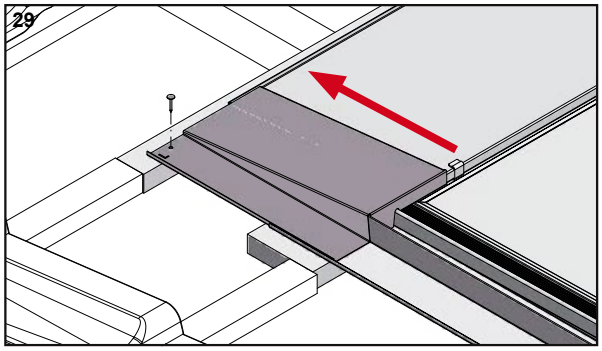
Insert top flashing.



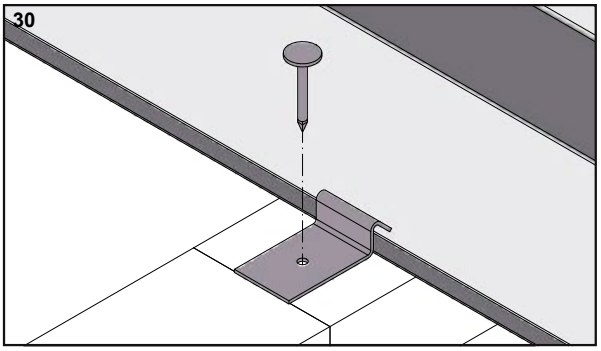
Insert the corner plate on the right and fix it with a wide-headed pin.



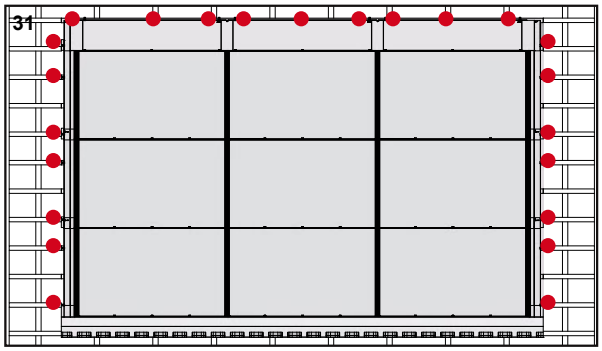
Push in the bumper plates and fix them with a wide-headed pin.



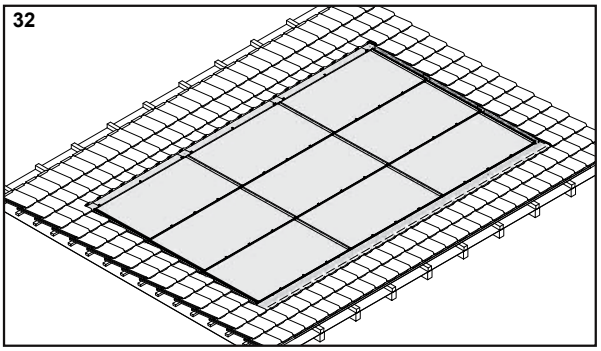
Push in the corner plate on the left and fix it with a wide-headed pin.



Attach sheet metal clamps and fix them with a wide-headed pin.



Flashing fixing positions:
2 per side flashing;
3 per top flashing;
1 per corner flashing.



Replace tiles on roof, where necessary adjust and fix the tiles in a professional manner.

Maintenance and cleaning

Unless otherwise specified by the module manufacturer, it is recommended to check the PV array for damage annually and after severe weather events such as storms or hailstorms. In case of heavy soiling, it is recommended to clean the modules and module drainage channels. If the yield changes, the electrical installation must be checked by a specialist.

Replacing modules

1. Move the module to the left of the defective module upwards, e.g. with the aid of glass suction cups, until it comes free from the mounting brackets at the lower edge (when replacing modules at the left edge of the generator field, the edge profile must be pushed upwards).
2. Lift up the right-hand corner of the module to the left of the defective module by about 3 to 5 cm and secure the module in this position using a wooden wedge.
3. Shift the defective module upwards until it detaches from the mounting clamps on the bottom edge.
4. Lift up the defective module by the bottom edge and pull it downward and out.
5. Disconnect the connections to the neighbouring modules in the cable group and secure the loose cable ends of the neighbouring modules so that these do not ‘disappear’ between the PV array and the roof underlay.
6. Disconnect the equipotential bonding cable.
7. Remove the defective module.
8. Thread the replacement module under the lifted module or edge profile to the left of it until the equipotential bonding cable can be placed in the earthing terminal, and clamp it in place again.
9. Establish connections to the neighbouring modules in the cable group.
10. Now push the replacement module further under the module above it (at the upper edge of the generator field: under the connection plate) until the stop point is reached and lay it down.
11. Pull the replacement module downwards until it clicks into place into the bottom mounting clamps.
12. Remove the wooden wedge under the right-hand bottom corner of the module to the left of the replacement module.
13. Pull the module or the edge profile to left of the replacement module downwards until it clicks into place in the lowermounting clamps.

Disinstallation and disposal

Disinstallation and disposal of PV systems may only be carried out by qualified specialist firms. Have dismantling and disposal carried out only by a specialist company for roof-integrated photovoltaic systems.

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Solar systems by Schweizer:

Information sheet – Application range of Solrif® with regard to water tightness and minimum requirements for the subroof.

Summary

This document describes the application range of Solrif® with regard to different roof slopes and the minimum requirements for the subroof. The subroof has the function of safely draining off moister condesation or water entering through the tile-like arrangement in adverse weather conditions, thus preventing structural damage.

The parameters are determined on the basis of:

- Specifications of SIA 232/1 'Inclined Roofs' [Swiss Society of Engineers and Architects]
- Rain tests at the CSTB (Centre Scientifique et Technique du Bâtiment [Scientific, Technical and Buildings Centre], France)
- Rain tests according to CN/TR 15601

Requirements for the subroof with different roof slope

For Solrif®,the following range of application has been defined with regard to rain tightness *)

Roof slope	Minimum requirements
10°	General lower limit for the use of Solrif®.
10° - < 22°	Water-tight subroof for exceptional requirements (dynamic pressure > 50 mm dynamic height); see below.
22° - 32°	Subroof for increased requirements (dynamic pressure up to 50 mm dynamic height); see below.
≤32°	Subroof for normal requirements.
70°	General upper limit for the use of Solrif®

*) Scope of application: For Germany, the rules of the Zentralverband des Deutschen Dachdeckerhandwerks e.V. (ZVDH) [Central Association of the German Roofing Trade] apply. A special information sheet on the subject is available.

Subroof for exceptional requirements

The characteristic feature of a subroof for exceptional requirements is the watertight design of the surface including the seam and butt joints. On watertight subroofs, the counter battens are integrated into the watertight design. Intersections, mounting parts and connections must all be fitted to be watertight. The mounting of the roof foil should be carried out in the upper third of the horizontal overlap. The waterproofing must be run over the counter battens. So, the fixation of the bearing battens penetrated the counter battens at the highest point The greater water load on the subroof is expected, the higher counter battens should be selected. Wood should not be covered on all sides by diffusion-resistant sheets, because humidity that has seeped in and is enclosed cannot be guaranteed to dry out. Alternatively, humidity-resistant materials can be used for the counter battens.

Subroof for increased requirements

The characteristic feature of a rainproof subroof is the watertight design of the surface, including the seam and butt joints. On rain-tight subroofs, the counter battens are not integrated. Intersections, mounting parts and connections must all be fitted to be rain-proof. The mounting of the roof foil should be carried out in the upper third of the horizontal overlap. The entry of blown snow and rain through ventilation openings is unavoidable in ventilated systems.

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Solar systems by Schweizer:

Information sheet – Application range of Solrif® with regard to water tightness and minimum requirements for the subroof.

Illustration 1: Rain-proof roof underlay (after ZVDH)

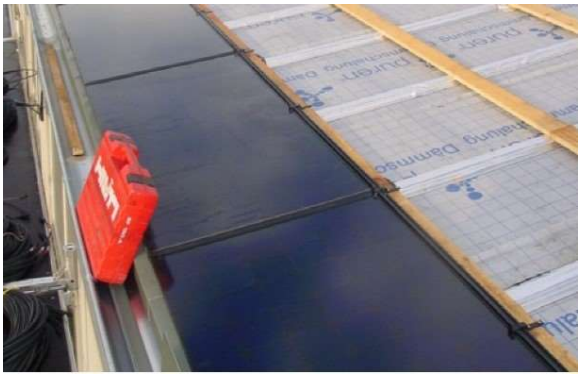

Illustration 2: Roof underlay for exceptional requirements

Additional remarks:
Drainage: We recommend draining the roof foil into the rain gutter.

The French market
As varying requirements for roofs underlay are not common in France and the specifications in the ATEC (Avis Technique: 21/12-22) refer to tests without a subroof CSTB has set a lower limit for the roof slope of 15°. With the measures referred to above, Solrif® can be used with a roof slope of up to 10°.

Increased structural requirements
Special climatic conditions, exposed location of the building, structural peculiarities and large distances between ridge and eaves (> 8 m) require additional rain-proofing measures, such as use of a counter-batten made of moisture-resistant materials or a raised counter-batten.

Requirements for the roof foils
Due to the temperatures that occur, foils with a temperature resistance of up to 80°C must be used when designing a subroof to be water-tight. Suppliers, see e.g.: Product declarations for roof underlay products, Gebäudehülle Schweiz [Swiss Building Envelope Cooperative].

Technical support
Contact for technical support: solrif@ernstschweizer.ch

Solarsysteme von Schweizer:

Merkblatt – Einsatzbereich von Solrif® in Deutschland bezüglich Regendichtigkeit und Mindestanforderungen an das Unterdach.

Einsatzbereich von Solrif®

10° Dachneigung ist die Untergrenze, 75° Dachneigung die Obergrenze für den Einsatz von Solrif® als Dacheindeckung. Einsätze ausserhalb dieses Bereiches erfolgen auf eigene Verantwortung.

Anforderungen an das Unterdach

Das Unterdach hat die Aufgabe, Bauschäden zuverlässig zu verhindern durch sicheres Ableiten von:

- Tropfendem Kondensat
- Wasser, das bei widrigen Witterungsbedingungen durch die ziegelähnliche Anordnung eindringen kann.

Für Solrif® wurden die folgenden Einsatzbereiche mit den dabei erforderlichen Massnahmen und Anforderungen an das Unterdach festgelegt (siehe Tabelle 1). Für das System Solrif® gilt eine Regeldachneigung (RDN) von 22° [1]).

Dachneigung*)	Erhöhte Anforderungen Nutzung – Konstruktion**) – klimatische Verhältnisse			
	keine weitere erhöhte Anforderung	**eine** weitere erhöhte Anforderung	**zwei** weitere erhöhte Anforderungen	**drei** weitere erhöhte Anforderungen
≥ Regeldach-neigung RDN	Klasse 6 Unterspannung	Klasse 5 überlappte oder verfalzte Unterdeckung	Klasse 5 überlappte oder verfalzte Unterdeckung	Klasse 4 verschweißte oder verklebte Unterdeckung oder nahtgesicherte Unterspannung
≥ (RDN - 4°)	Klasse 4 verschweißte oder verklebte Unterdeckung oder nahtgesicherte Unterspannung	Klasse 3 Naht- und perforationsgesicherte Unterdeckung	Klasse 3 Naht- und perforationsgesicherte Unterdeckung	Klasse 3 Naht- und perforationsgesicherte Unterdeckung
≥ (RDN - 8°)	Klasse 2 regensicheres Unterdach	Klasse 2 regensicheres Unterdach	Klasse 1 wasserdichtes Unterdach	Klasse 1 wasserdichtes Unterdach
≥ (RDN - 12°)°	Klasse 1 wasserdichtes Unterdach	Klasse 1 wasserdichtes Unterdach	Klasse 1 wasserdichtes Unterdach	Klasse 1 wasserdichtes Unterdach

*) eine Dachneigung unter 22° ist eine Sonderkonstruktion im Sinne der Fachregeln des ZVDH

Tabelle 1: Anforderungen an das Unterdach gemäss ZVDH in Abhängigkeit von Dachneigung und erhöhten Anforderungen

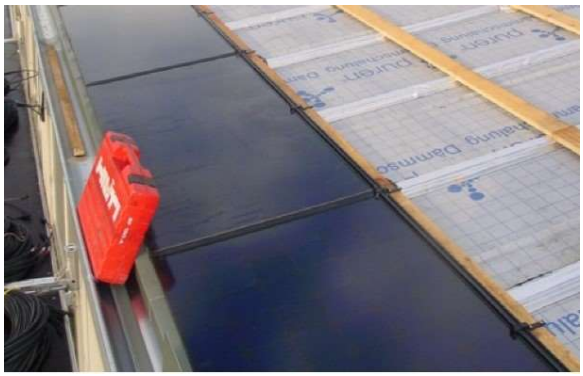

Abbildung1: Wasserdichtes Unterdach mit geschützter Konterlattung

Abbildung 2: Regensicheres Unterdach (nach ZVDH

Entwässerung Unterdach

Bei Anforderungen, die zu einem Unterdach Klasse 1 gemäss ZVDH führen, empfehlen wir die Entwässerung der Dachfolie in die Traufe.

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Solarsysteme von Schweizer:
Merkblatt – Einsatzbereich von Solrif® in Deutschland bezüglich Regendichtigkeit und Mindestanforderungen an das Unterdach.

Erhöhte Anforderungen
Erhöhte Anforderungen im Sinne der Tabelle 1 sind in den Fachregeln für Dachdeckungen mit Dachziegel und Dachsteinen, Regelwerk 5.2 des ZVDH festgelegt.

Temperaturbeständigkeit der Dachfolien
Es sind für die regen- oder wasserdichte Ausführung des Unterdaches Folien mit Beständigkeit für Temperaturen bis 80°C zu verwenden.

Technischer Support
Kontakt für technischen Support: solrif@ernstschweizer.ch

[1]) Die Regeldachneigung (RDN) von Solrif® gem. Zentralverband des deutschen Dachdecker Handwerks (ZVDH), wurde an der TU Berlin nach CEN/TR 15601 bestimmt. Die Festlegung der Parameter erfolgt auf Basis dieser Regenversuche nach CEN/TR 15601, TU Berlin, Deutschland, AZ 130208 und den Vorgaben des ZVDH (Zentralverband des deutschen Dachdeckerhandwerkes).

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Solar systems from Schweizer:
Factsheet – Lightning and surge protection with Solrif®

Introduction
The need for protection against lightning and overvoltage will depend on the requirements of the specific building. These requirements in turn are dependent on the size of the building, the purpose for which it is used and the likelihood of a lightning strike. The choice of protective measures for the building needs to be discussed with the fire protection authorities and the insurers.

Design of the protective system
Fundamentally speaking, integrated PV systems do not affect the probability of lightning strikes.
Thus the fitting of a Solrif® system does not affect either the mandatory lightning protection requirements or the lightning protection class of a building. In view of the way the Solrif® system is designed, surge protection and lightning protection need to be considered separately. When the building already has a lightning protection system, the lightning protection strategy of the PV installation must be taken into account as well. Because of the way the Solrif® system is designed, surge protection needs to be considered independently of the lightning protection. This additional measure is necessary in view of capacitative discharge currents which may arise as a result of inverters that are not galvanically isolated.

The following decision tree shows the recommended design for lightning and surge protection systems:

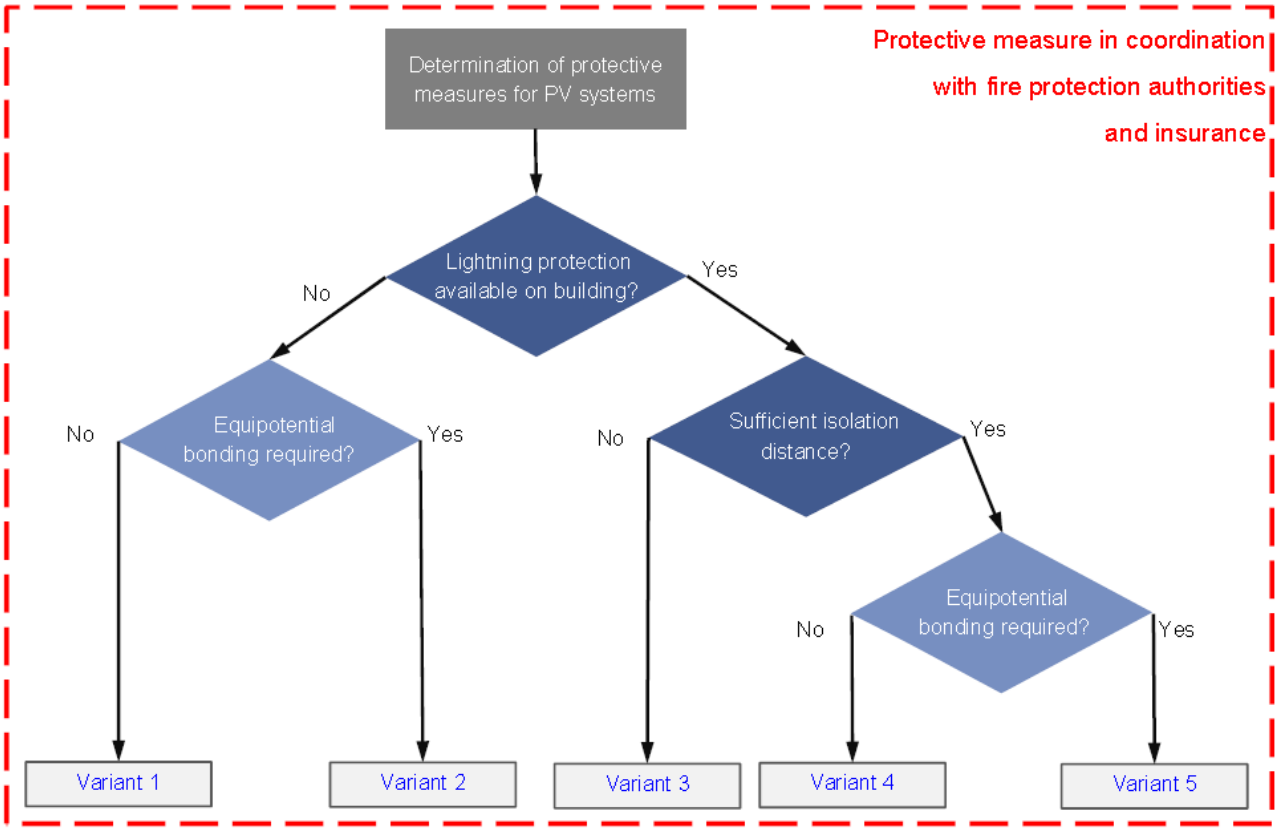

Figure 1: Decision tree for protective systems

Notes on the possible variants
For the purpose of equipotential bonding, in Switzerland cables with at least 10 mm² Cu cross section are mandatory. In the case of variants 2 to 4, the module fields can be earthed by way of the protective tube. For other countries, the applicable standards must be studied and complied with.

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Variant 1
This variant will be used under the following conditions:
– Modules of Protection Class II
– Galvanically isolated inverters (see separate DGS definition in section 4)
Equipotential bonding may be dispensed with. For this variant, no additional surge protection device is needed before the roof entry point.

Variant 2
With transformerless inverters, equipotential bonding based on a protective tube is required. When the Solrif® frame is painted or anodised, the equipotential bonding system needs to be boosted with an earthing cable for each module.

Variant 3
The module field is linked to the external lightning protection system. With transformerless inverters, equipotential bonding based on a protective tube is required. When the Solrif® frame is painted or anodised, the equipotential bonding system needs to be boosted with an earthing cable for each module (this is the commonest protection strategy used in Switzerland).

Variant 4
Equipotential bonding may be dispensed with. Lightning protection is provided when the isolation distances are adhered to.

Variant 5
Equipotential bonding based on a protective tube is required. Lightning protection is provided when the isolation distances are adhered to.

Lightning protection systems on a Solrif® installation when directly struck by lightning
Damage to PV modules from direct lightning strikes can only be prevented by means of an external and separate lightning protection system. Here an isolation distance of at least 0.5 m between the lightning discharge cable and module field must be observed (variants 4 and 5).
In case of non-compliance with the isolation distance (variant 3), lightning discharge can still be provided through the overlapping or interleaving of the installation system (IEC 61024-1). Discharged lightning currents on frame components may however destroy the bypass diodes. These and other consequential damages may result in impaired performance.

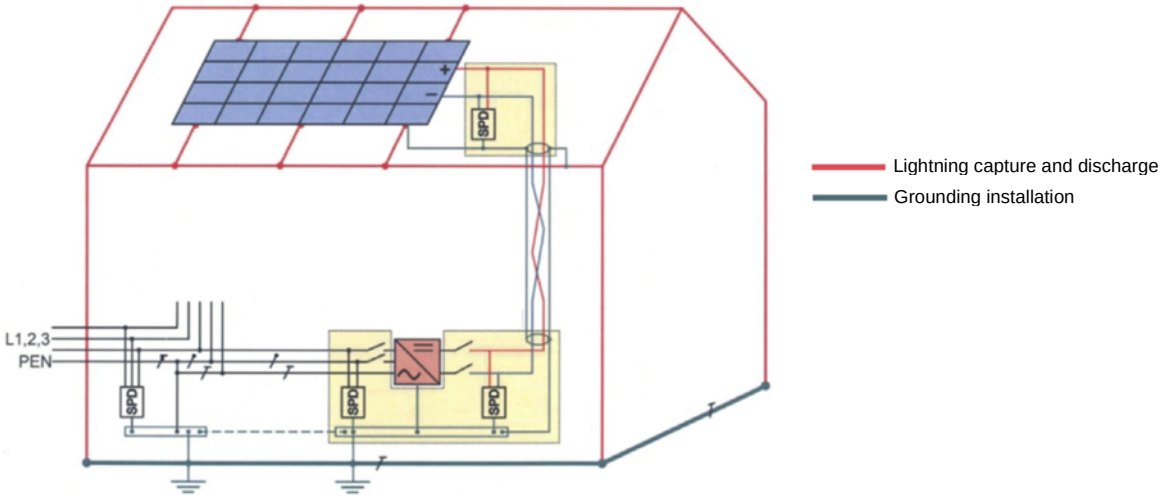

Figure 2: Lightning discharge cable with Solrif® modules where the isolation distance is not observed (variant 3)

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Definition of transformerless inverters based on DGS standards
Only inverters where a sinusoid alternating current percentage amounting to half the AC voltage overlaps with the DC voltage are considered to be transformerless inverters as understood by the DGS. Transformerless devices with dormant potential to earth and just small AC overlaps can be treated in the same way as inverters with transformers.

Standards and guidelines
Recommendations are based on the following authorities and standards:
- DIN EN 62305-3 Supplement 5 (Part 3: Physical damage to structures and life hazard – Supplement 5: Lightning and overvoltage protection for photovoltaic power supply systems), status as at 05/2014
- DGS Photovoltaic Systems, 5th edition
- SNR 464022:2008 (Electrosuisse), status as at 06/2019
- NIN COMPACT NIBT 2015, Folder A5 (D) (Low-voltage installation standard)
- Swissolar: 06/2017 / State-of-the-art paper on solar systems n° 22001
- ESTI: No. 233.0710
- Heinrich Häberlin, Photovoltaik, Strom aus Sonnenlicht für Verbundnetz und Inselanlagen [Photovoltaic systems – power from sunlight for integrated networks and home systems]

Supplementary notes in addition to the official guidelines
Recommendations for installing a Solrif® fitting system must also be scrutinised in the light of the country-specific guidelines, in the most up-to-date version of the latter.

Notes specific to Switzerland
Protective equipotential bonding can only be dispensed with when the system meets the requirements of Protection Class II and the inverter comes with galvanic isolation (ESTI no. 233.0710). For Swiss or ESTI purposes, the equipotential bonding system must always be installed with transformerless inverters.

Technical support
Contact details for technical support: SOLAR@ernstschweizer.ch

Solar systems of Schweizer:
Factsheet – Use of Solrif® with high snow loads.

Summary
- Installing Solrif® framed photovoltaic modules on a roof can significantly change the snow's accumulation and sliding behavior compared to a conventional roof.
- Under severe winter weather conditions and in high snow load zones, the roof must be assessed by a local roofer during the planning phase with regard to snow loads. Compared to tiled roofs, the snow guard devices on PV roof integration systems often have to be reinforced or repositioned.
- The number and duration of the freeze-thaw cycles that occur are co-determining factors for the total snow accumulation and the icing and wetting of the snow on the roof.
- Special attention must be paid to the unimpeded drainage of the roof during dew periods.
- A high heat transfer at the roof surface can accelerate the melting process.

Standards

The current standards for pitched roofs refer to the effects on supporting structures and the requirements for safety devices. The special cases of partial or complete roof-integrated solar systems are not (yet) taken into account.

Important extract from the standards with the most important points concerning snow on pitched roofs are:
- The danger of a roof avalanche exists with every pitched roof.
- Snow retention devices are to be provided on roofs where, due to their position and inclination, snow slides onto used pedestrian paths, playgrounds, forecourts at house entrances or similar areas (e.g. SIA 232 Section 2.1.3).

As an example, chapter 5.6 of SIA 232 also defines the requirements for the safety devices. "Snow guard systems, safety systems, safety stairs and railings must be fastened in such a way that they can permanently fulfil their purpose and withstand the loads that arise. Snow guard supports must be capable of absorbing a tensile load of at least 2 kN per hook or support in the direction of the roof pitch and must be anchored in the supporting structure without hindering temperature-related length changes. Anchoring devices must comply with SN EN 517 or SN EN 795 and be fastened in accordance with the manufacturer's instructions."

Substructure: Load-bearing safety and serviceability

The transfer of roof loads such as dead load, snow loads, wind pressure and suction etc. through the layers of the substructure into the supporting structure of the roof or building must be ensured. The characteristic snow load on roofs as well as the line load for cantilevered components (snow overhang according to e.g. SIA 261) are defined e.g. in SIA Standard 261.

Slipping of snow

As the behavior of solar roofs with regard to snow and ice can change in comparison to conventional roofing, the statics must be checked and the (existing) snow retention measures adapted to the new situation before installing a solar system. For example, with partially snow-free solar systems, the snow typically slides off completely within a short period of time compared to a tiled roof, as the dark surfaces that absorb a lot of radiation heat up, melt the snow and then possibly let it slide off as a "roof avalanche".

Ice load hazard pattern:

Unfavorable freeze-thaw cycles cause high ice loads in the eaves area of pitched roofs. On the one hand, these ice loads are a strain on the eaves, on the other hand, breaking ice leads to personal injury and damage to property. Therefore, in areas with frequent freeze-thaw cycles and correspondingly high ice loads in the eaves area, reinforcements should be provided. However, to avoid personal injury and damage to property due to breaking ice, it is recommended to remove deposits at an early stage.

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Solar systems of Schweizer:
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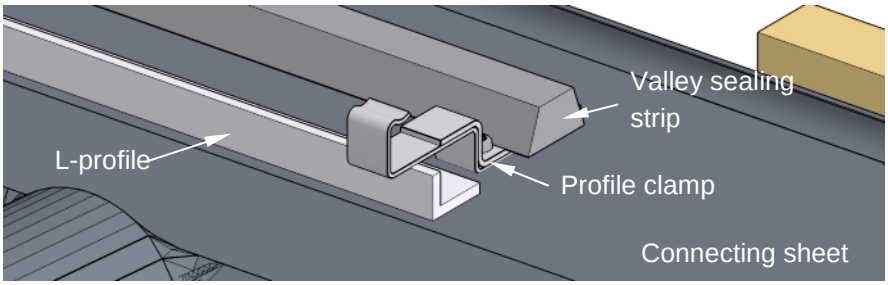
Design recommendations for increased snow loads

- It should be noted that in certain snow-rich and touristic regions, roof pitches are deliberately kept low, even in new buildings, so that the architecture matches the village landscape. Historically, this can be explained by preventing the snow from slipping off in order to additionally insulate residential buildings.
- For the installation of solar systems on existing roofs, the statics must be checked for snow retention.
- In an alpine environment, we recommend interrupting the module field with snow catchers after a maximum of four module rows in order to distribute the accumulations at regular intervals. If possible, accumulations of ice and snow should not be limited to the lowest edge. The accumulation of snow is again dependent on the pitch of the roof.
- In addition, the lowest row of mounting claps should be supported, for example with an "L-profile" or a wooden batten 17mm high. Under high snow loads, this will prevent deformation of the mounting clamps and contact of the clamps with the back sheet of the BIPV roof module.



- Measures due to ice load: Due to possible snow overhang or ice loads, the distance between the lowest module edge and the eaves should be at least 30 cm. The linear load resulting from snow or ice overhang must not be transferred to module edges. Combined systems with collectors and PV require even more stringent measures due to the rapid warming and associated slipping of the snow. Experience shows that a separation with snow traps between collectors and Solrif® modules is highly recommended.
- Above 2400 Pa snow load, two battens of 60 mm (120 mm in total) must be additionally mounted below the BIPV modules, especially with 3.2 mm glass thickness. These battens must be installed with a minimum distance of 20 mm above and below the junction box to ensure that the Solrif® system allows for individual module replacement.

Standards

The recommendation is based on:

- EN 1991-1-3 Eurocode 1 - Actions on structures - Part 1-3: General actions, snow loads
- VKF (Swiss Cantonal Association for Fire Insurance)
- SIA 232/ SIA 261: The standards for pitched roofs (SIA 232/1:2011) and SIA Standard 261 Actions on Structures define both the forces of snow on pitched roofs and the safety measures to be taken. (SIA: Swiss society of Engineers and Architects)

Specific information for Switzerland

In general, we limit the application limit for Solrif® to 5100 Pa due to snow loads. Solrif® can also be used above this limit if special measures are taken with regard to the sliding of the snow or the snow guard and substructure.

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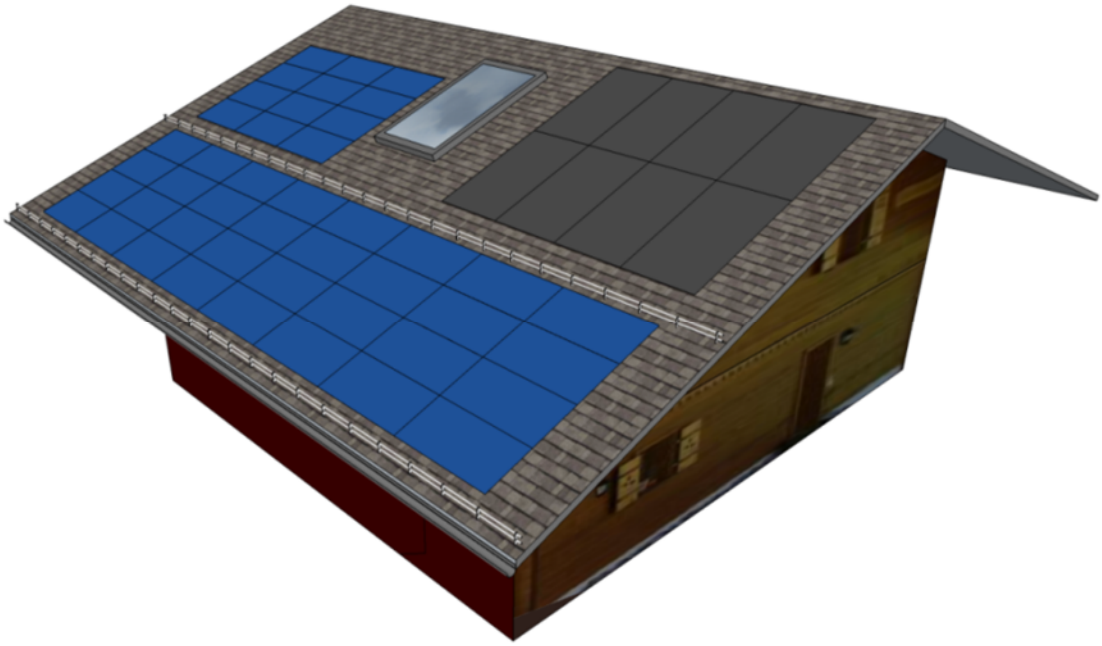

Example of the arrangement of snow catchers in snowy regions for PV and solar thermal combined systems.

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