Phoenix TectoSun 3
Installation instructions

THE TECTOSUN 3 MOUNTING SYSTEM FROM PHOENIX SOLAR – THE ADVANTAGES AT A GLANCE

- Tested by TÜV, RAL seal of quality for all components
- Quick and easy installation reduces the installation costs
- Self-explanatory due to a small number of perfectly matched parts
- Very good price/performance ratio
- Long service life due to aluminium and stainless steel components
- Suitable for all framed modules

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1. Safety instructions

FOR YOUR OWN PROTECTION, THE PROTECTION OF OTHERS AND PROTECTION OF THE SOLAR SYSTEM WE ASK THAT YOU TAKE NOTE OF THE FOLLOWING POINTS:

- These installation instructions are intended for mounting solar energy systems up to a maximum roof ridge height of 25 metres. The system must be modified for installation at heights above this. In this case, please contact your electrician, your Phoenix distribution partner or Phoenix Solar.

- All work on solar modules is work on live electrical components. The full open-circuit voltage of the solar modules can be generated as soon as light shines on them. The only way to achieve zero voltage is to cover the modules with some type of opaque material.

- The maximum permissible system voltage of the solar system must never be exceeded.

- When working in the vicinity of electrical overhead lines, or with string open-circuit voltages exceeding 120V DC, you are no longer within the safe low voltage range. In these cases, please be sure to observe the special accident prevention regulations.

- Electrical work must always be performed using insulated tools.

- When working at heights above three metres, appropriate safety mechanisms must be installed to prevent personnel from falling.

- The electrical installation between inverters and the public mains grid must be performed by a qualified and approved electrician.

LIABILITY NOTICE

Since the circumstances or methods of installation, commissioning, use and/or maintenance of the solar system lie outside the control of Phoenix Solar the company accepts no liability of any kind for loss, damages or costs resulting from incorrect installation, commissioning, use and/or maintenance of the solar system.

2. Tools required

- Pencil
- Tape measure/folding ruler
- Tension string
- Hexagonal wrench key (spanner size 6)
- Angle grinder with a concrete or stone cutting disc
- Diamond cutting disc for angle grinder
- Cordless screwdriver with Torx bit, size 40

3. Overview of the components

Rail

Rail connector bracket

Module end clamp set
(pre-assembled)

Roof hook set
(pre-assembled)

Module middle clamp set
(pre-assembled)

Rail intersection
connector

4. Installation instructions

4.1 DETERMINING THE EXTERNAL DIMENSIONS OF THE SOLAR ENERGY SYSTEM

Special care must be taken when measuring the roof. The more precision taken in this installation step, the easier the later installation will be.

Note: The edge and corner areas of the roof should not be built on.

System height = module height x number of rows + ((number of rows – 1) x 5 mm)
System or row width = (module width + 20 mm) x number of modules + 40 mm

The row width is the decisive factor for cutting the rails to the required length.

Note: When the rail does not fit flush with the end clamp, the clearance between the end of the rail and the module end clamp must be added to the calculated system width (see Figure 13).

4.2 POSITIONING THE ROOF HOOKS

Different roof fastenings must be chosen depending on the type of roof cladding. The most common type of roof (tiled roof) is described here. For all other roof types please consult your Phoenix Solar contact partner.

Figure 1: Top view of a roof

Figure 2: Pushed up roof tiles

Remove the roof tiles at each position where a roof hook is to be installed. In most cases it is sufficient to push the roof tile upwards (see Figure 2). The recommended distribution of roof hooks depends on the snow and wind loads at the installation site of the solar energy system.

4. Installation instructions

Note: Check the rafters for adequate stability before installing the roof hooks. If in doubt then consult a roofing expert or carpenter.

Figure 3: Screwing the roof hook tight

Figure 4: Modifying the roof tile

Important: The rafters must be at least 5 cm wide.

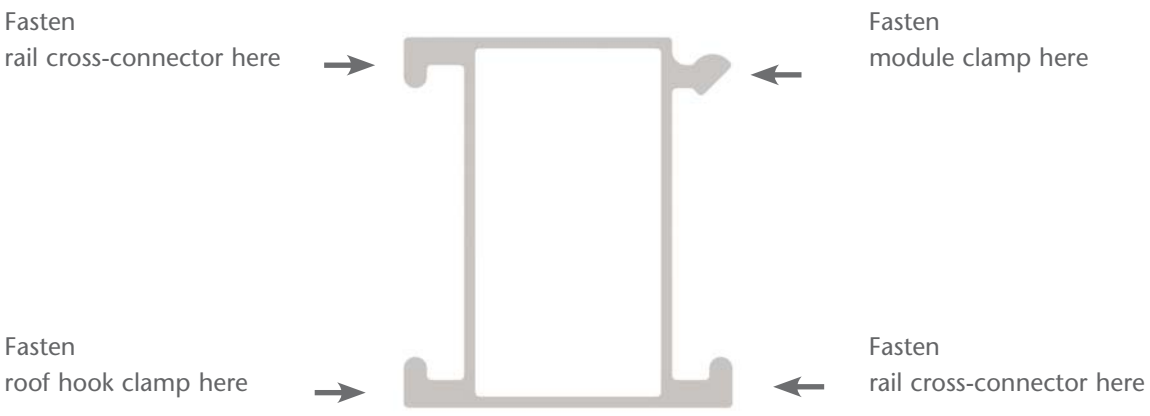
Fasten the roof hooks to the rafters with two SPAX screws for each roof hook (see Figure 3). These screws do not require pilot holes to be drilled.

Note: The roof hooks must not press against the roof tiles underneath. It may be necessary to shim the roof hooks.

If necessary, use an angle grinder to remove the ribs from the underside of the tile (see Figure 4).

Note: Always wear protective gloves, protective glasses and hearing protection when working with an angle grinder.

4.3 MOUNTING THE RAILS



4. Installation instructions

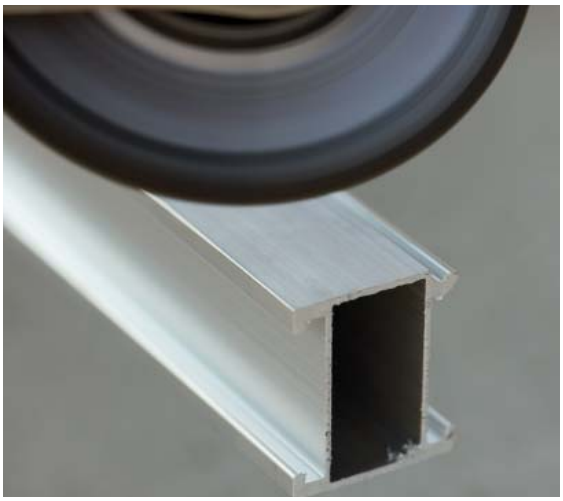


Figure 5: Cutting the rail to length

Figure 6: Fastening the rail to the roof hooks

Cut the rails to the previously calculated system width (see Figure 5). A special aluminium cutting disc is required when using an angle grinder for this. Clamp the rail under the previously mounted roof hook clamp and tighten the screw to a minimum torque of 20 Nm.

Important: The clamp must always be mounted above the rail.

Note: Make sure that the rails are perfectly levelled to avoid mechanical stress on the modules when they are mounted.

Figure 7: Aligning the rail using a tension string

Figure 8: Rail connector brackets

4. Installation instructions

Two rails must run levelled under each module. The clearance between the rails and the upper or lower module edge should be about $^1/_4$ to $^1/_5$ of the module height. Use a tension string to vertically align the clearance between the rails so that they run vertically.

Important: **Always follow the manufacturer's installation instructions when mounting the modules.**

To connect multiple rails, insert the rail connector bracket onto the end of the rail profile (see Figure 8). The pre-installed screw prevents the rails from lying completely flush with each other. A gap of approx. 3 to 5 mm must exist between the rails to compensate for expansion at high temperatures.

Note: The generator field should not be wider than 20 metres.

Note: The cantilever length of the rail (overhang from the last roof hook in a module row) must not exceed 30 cm.

A cap should be installed on every open rail end.

4.4 INTERSECTING RAILS

In some cases it is necessary to construct the framing with intersecting rails.

Note: If the first rail runs from above to below then you must use the special TectoSun 3 rails for vertical installation.

Important: Using intersecting rails does not allow you to use fewer roof hooks. The number of roof hooks required depends on the loading capacity of the individual roof hooks and the maximum span of the rails used.

Figure 9: Mounting the rail cross-connector

Figure 10: Intersecting rails

4. Installation instructions

4.5 LAYING THE MAIN DC CABLES

The main DC cables should be laid before mounting the solar modules. Lay the main DC cables using the shortest possible path because unnecessarily long cables lead to higher costs and energy losses. A cable feed-through must be installed in the roof in order to connect the main DC cable between the solar system and the inverter. The cables are either laid directly on the roof hooks or through an existing ventilation tile. Make sure that the cables are not laid over sharp edges or crushed by roof tiles. Fill the feed-through point with suitable insulation material to prevent heat loss.

4.6 INSTALLING THE MODULES

We recommend that you always install the modules starting at the upper left.

Figure 11: Screwing in the end clamp

Figure 12: Positioning the end clamp

Fasten the module end clamp by screwing it into the rail as shown in Figures 11 and 12.

Note: For easier installation the module end clamp should always be mounted below the rail.

4. Installation instructions

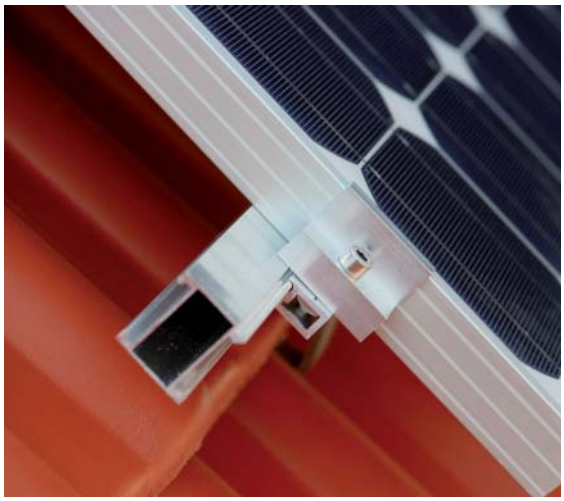


Figure 13: Module with module end clamp set

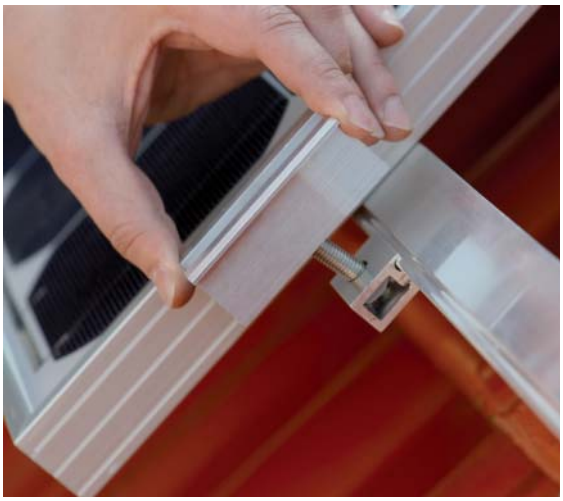


Figure 14: Module with module middle clamp set

Slide in the module until it lies flush with the module end clamps (see Figure 13) and then tighten the cheese head hexagonal bolts to a torque of 12 Nm.

The modules can be fitted with transverse bolts as anti-slip protection to make installation easier. The transverse bolts have no static loading task in the finished system.

Screw a module middle clamp into each of the rails on the opposite side of the module. Slide in the module until it lies flush with the module middle clamps and tighten the cheese head hexagonal bolts to a torque of 12 Nm. A module end clamp is used for fastening the last module in each row.

4.7 CABLING THE MODULES

Cable the modules immediately after mounting them. If row connectors are required (see chapter 5 Lightning protection) these should be installed at this point.

Note: Measure the open-circuit voltage and insulation resistance of every string immediately after installation. This allows potential mistakes and their sources to be quickly identified.

4.8 MOUNTING THE INVERTERS

Please follow the installation instructions of the respective manufacturer when mounting the inverter.

5. Lightning protection

5.1 EXTERNAL LIGHTNING PROTECTION AND GROUNDING

If the building is equipped with an external lightning protection system then the solar system must be connected to it over the shortest possible path (as per DIN VDE 0185 Lightning Protection System). If this is not possible then (with reference to the regulations for antenna systems) this conductor can be connected internally through the building – but not through rooms and areas containing inflammable or explosive materials. To avoid flashover and induction dangers, the conductor must be kept away from other electrical circuits.

To avoid lightning flashovers, make sure to maintain a separation distance between the solar energy system and the lightning conductor.

Calculation of the separation distance:

S = ki* (kc / Km)* i (m)

S = separation distance
kc = coefficient, dependent on the geometric arrangement
ki = coefficient, dependent on the selected lightning protection class
Km = coefficient, dependent on the material in the separation

If the building does not possess a lightning protection system then it is currently a matter of contention as to whether the DIN VDE 0855 standard can be applied to solar systems. If this standard is used, the mounting system and the module frames must be grounded. If the DIN VDE 0855 standard is not used then the solar generator does not need to be grounded. However, connection to the building grounding is always recommended.

Conversely, when using transformerless inverters, all conducting parts of the solar system and the mounting system must be grounded. If the system is not grounded then this can result in capacitive voltages that are dangerous to humans.

The grounding can be achieved (e.g.) via the system connection to the equipotential bonding bar of the house or via an external grounding stake. Type NYM-J or NYY-Y grounding cables with a minimum cross section of 16 mm² satisfy the current regulatory requirements.

The grounding device to which the solar system is connected must be tested for correct operation. The results of this test should be recorded in a test or commissioning log for the system.

5. Lightning protection

5.2 INTERNAL LIGHTNING PROTECTION – OVERVOLTAGE PROTECTION

The internal lightning protection minimises damage caused by overvoltages that may occur. Impermissibly high voltages at the solar modules can be reduced via simple measures when laying the module cables. In the case of a lightning strike near to the solar modules the extremely high rate of change of current from the lightning can induce high induction voltages across the mounted modules and module cables.

Attention: The larger the effective area generated by the modules and cables, the higher the induced voltage.

This type of overvoltage can be reduced through careful consideration when laying the DC cables.

Figure 15 shows an unsuitable cable layout that can result in very high induction voltages capable of destroying the solar modules and the inverter. Figure 16 shows a correct cable layout that reduces the effective area generated by the cables and thus reduces the danger to the solar modules and inverter.

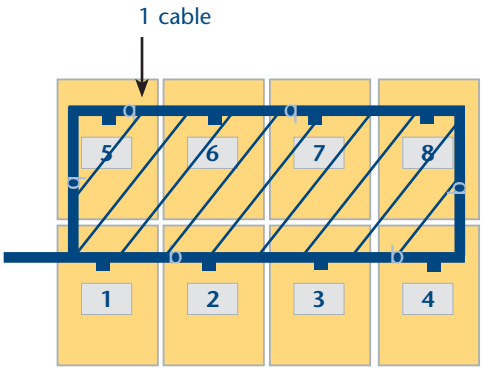


Figure 15: Incorrect cabling without row connectors (the cables generate a large area)

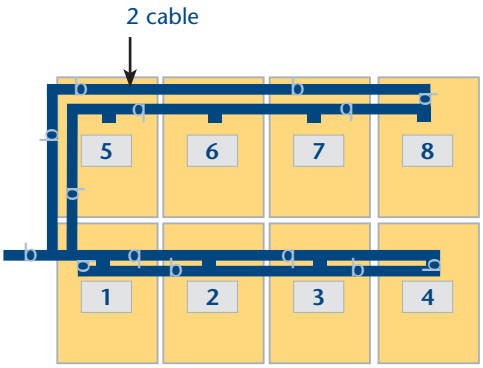


Figure 16: Correct cabling with row connectors (the cables generate a small area)

Surge arresters at the solar generator and the inverter can also help to reduce overvoltages. Inverters usually have a built-in varistor for limiting overvoltages.

6. Standards and regulations

The recognized engineering standards and the relevant accident prevention regulations must always be followed when installing a solar system.

The following rules, regulations and standards must be followed:

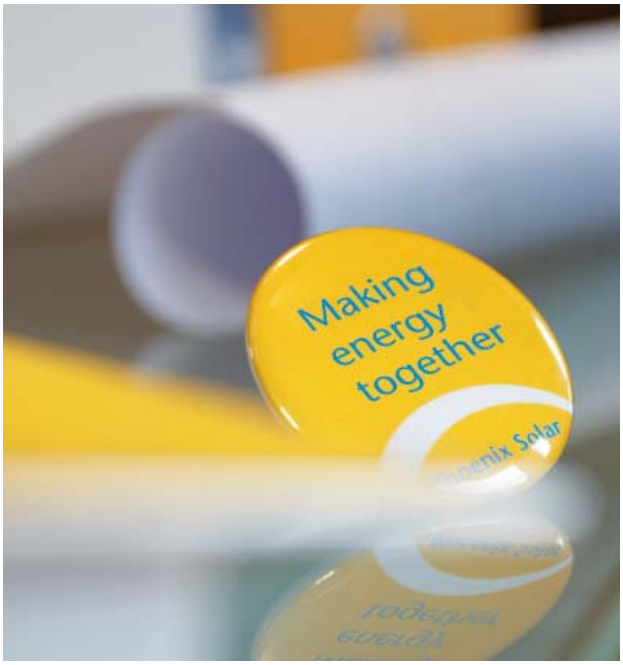
TAB 2000	Technical connection requirements for connecting to the low voltage grid of the energy supply companies
VDEW Guideline	For parallel operation of photovoltaic power generation systems with the low voltage grid of the energy consumer
BGV A2	Electrical systems and equipment
BGV C22	Construction work
BGV D35	Ladders and steps
BGV A1	Accident prevention regulations
DIN VDE 0100	Installation of low voltage systems
DIN 1052-2	Wooden structures: Mechanical connections
DIN 1055	Design loads for buildings
DIN 18299	General rules for all types of construction work
DIN 18338	Roof covering and roof sealing works
DIN 18451	Erection of scaffolding
DIN EN 60728-11	Safety requirements for cable networks and antennas
VDI 6012	Decentralised energy systems in buildings
VDI 6012	Decentralised energy systems in buildings

Important: This document refers to German standards and regulations.

PHOENIX SOLAR
AN INTERNATIONAL LEADING PHOTOVOLTAIC SYSTEMS COMPANY

Having emerged from a solar initiative by the German Energy Users Association (Bund der Energieverbraucher e.V.), Phoenix Solar AG is today one of the largest providers of solar energy systems and accessories. The headquarters of the TecDAX-listed company is in Sulzemoos near Munich. With a branch office in Ulm, sales offices throughout Germany and subsidiaries in Spain, Italy, Greece, France, Singapore and Australia, Phoenix Solar currently (May 2010) employs more than 300 people.

Since the company was founded in 1999, Phoenix Solar's business model has been oriented towards the joint development between partners and customers of optimum photovoltaic system solutions that are tailored to the customer's needs. Phoenix Solar has an extensive product portfolio and offers comprehensive service: from planning, developing, installing and maintaining large-scale solar energy systems to providing advice in investment issues and selling solar energy systems and components to sales partners in the Phoenix Solar network.



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