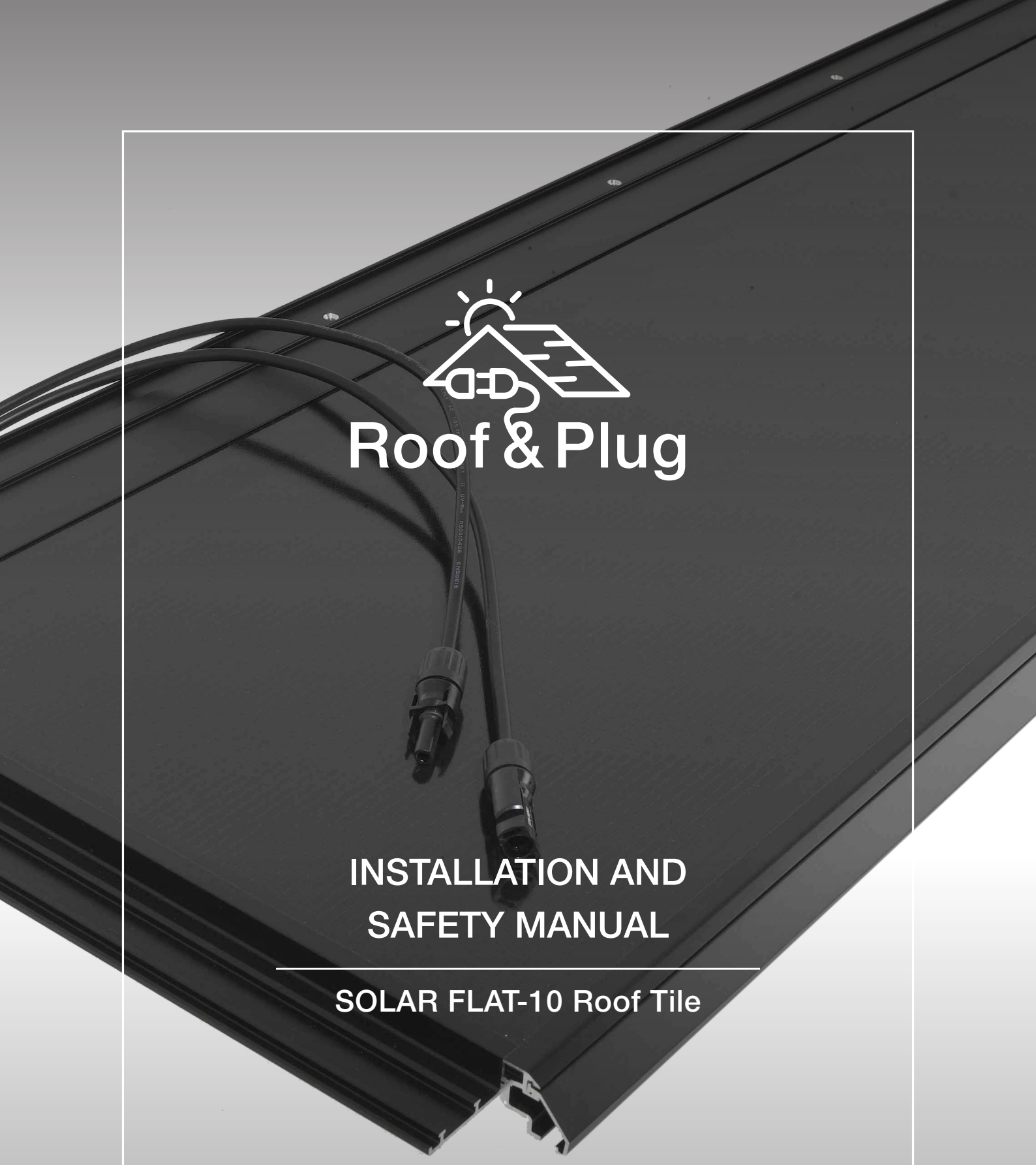


Roof & Plug

INSTALLATION AND SAFETY MANUAL

SOLAR FLAT-10 Roof Tile

TEJAS BORJA
Since 1899

SOLAR FLAT-10

Roof Tile

INSTALLATION AND SAFETY MANUAL

IMPORTANT

Before beginning to install SOLAR Flat-10 tiles, make sure you know and understand the product's technical characteristics and installation features. Keep this manual for future reference.

To ensure the safety of the installer, equipment and property, this manual must be read carefully before beginning the installation. The instructions in this manual must be followed during transport, installation, testing and maintenance.

Version 1 - February 2021

All the specifications and descriptions in this document are correct at the time of publication. However, and because continuous improvement is one of Tejas Borja's objectives, we reserve the right to make changes to these data at any time. To notify us of any possible inaccuracies or omissions in this document, please send an email to the following address: solar@tejasborja.com.

The data added to the latest versions of our product data sheets may not be in this document. If any information provided in this document conflicts with the information in a data sheet for a product described herein, the latest version of the data sheet takes precedence and prevails over this document. The illustrations, drawings, diagrams and other images in this document are for illustrative purposes only. The products depicted in this document may be slightly different to the real products.

CONTENTS

1 INTRODUCTION

This manual contains information about the installation and correct handling of the photovoltaic modules model **SOLAR FLAT-10 Roof Tile** made by Tejas Borja S.A.U.

Installers must read and understand the contents of this manual before beginning installation.

If in any doubt, please send a message to Tejas Borja Technical Support by emailing solar@tejasborja.com to ask for more information.

When installing the **SOLAR FLAT-10 Roof Tile**, installers must use all the safety measures detailed in this manual as well as complying with all local rules and regulations whether mandated by law or official bodies.

Before installing a solar photovoltaic system, installers must be familiar with its mechanical and electrical requirements. Keep this manual in a safe place for future reference.

The specifications in this manual are subject to change without notice. Always consult the latest version on the Tejas Borja website at tejasborja.com.

The real images included in this document represent the product and give the closest reflection of its real physical appearance. However, Tejas Borja recommends in-person viewing of product samples through its distributors and sales network.

2 LIABILITY NOTICE

This manual provides basic information about the **SOLAR FLAT-10 Roof Tile**.

Tejas Borja will not be liable for any damages, losses, costs or legal liability arising from the use of other equipment or components, incorrect installation, mounting, operation, application and maintenance which is not under the control of Tejas Borja.

Tejas Borja will not be liable for breaches of patent laws or third party rights caused by installation methods or the use of the product.

If method of installation used deviates from the instructions in this manual, ensure the installation method and the application of the product are viable.

The user does not have the right to sub-licence any of the intellectual property rights or patents associated with the **SOLAR FLAT-10 Roof Tile**.

Tejas Borja reserves the right to modify this manual, technical specifications and all information about the **SOLAR FLAT-10 Roof Tile** at any time.

The installation must always and only be carried out by a qualified installer.

Before beginning the installation, the installer must know all the electrical requirements of the photovoltaic system.

This manual must be read together with the product data sheet and the specifications for the Flat-10 ceramic roof tile and its installation guidelines.

3 GENERAL PROVISIONS AND OVERVIEW

Tejas Borja's solar photovoltaic energy solutions can be adapted to meet the specific energy generation requirements of each project and cut electricity bills while helping to reduce our carbon footprint by providing an alternative, environmentally-friendly way to generate electricity.

The choice of material for the roof tiles is crucial to guarantee the durability, protection and energy efficiency of the property, and nor should the importance of the roof's aesthetic appearance be overlooked.

To combine efficiency and style, Tejas Borja's solar solutions are integrated into the ceramic roofing tiles so they impact the original project design as little as possible.

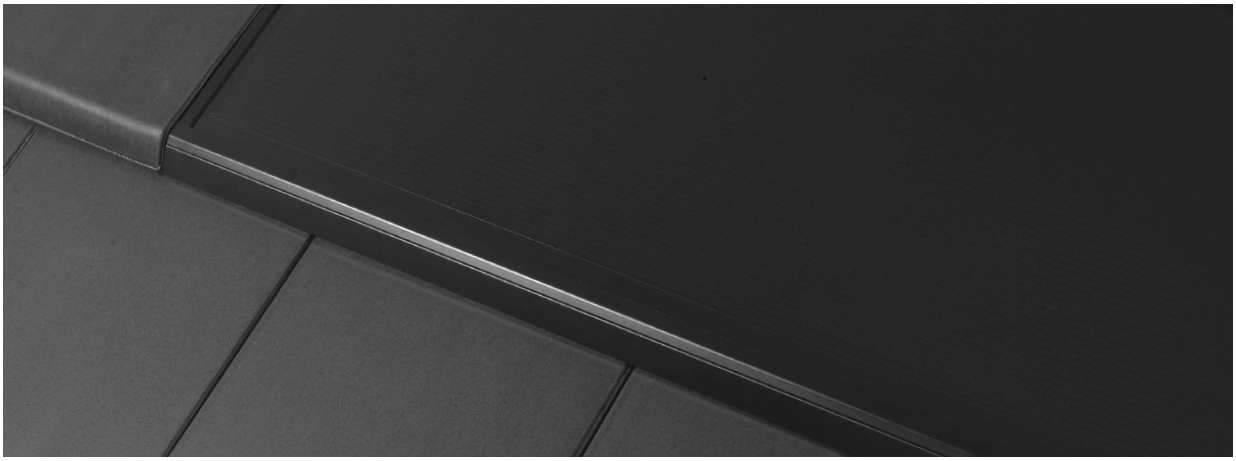
The products in our SOLAR range and our ceramic tiles must always be installed using dry installation systems. Using standard international connections, it guarantees an optimal level of security, being hidden from the naked eye. In this way, the maximum tightness and durability of the roof is achived.

The importance of self-consumption: save while protecting the environment.

Photovoltaic energy is a clean and environmentally-friendly form of energy, ideal for self-consumption and to reduce monthly electricity bills, both for homes and company premises.

A technology which is widely used around the world, photovoltaic panels convert solar energy into electricity.

Photovoltaic electrical energy systems are the only ones which, using a renewable source, can produce electricity in the place it is consumed.



3.1 SOLAR FLAT-10 ROOF TILE

Thanks to its integration, it confers all the benefits of capturing renewable photovoltaic solar energy as well as presenting excellent reliability in terms of watertightness throughout the roof.

The **Solar Flat-10 tile** is a photovoltaic tile manufactured using the latest photovoltaic cell technology. Denoted by the acronym CIGS (copper, indium, gallium and selenium), it is the most effective technology when it comes to operating in the shade. Using this technology, we can produce high-efficiency solar cells with a high output which are also environmentally-friendly as they are **free of cadmium and lead**.

Durability is reinforced by the structure of the product itself and the use of glass-glass panel (double tempered glass) that ensures a durable and watertight encapsulation.

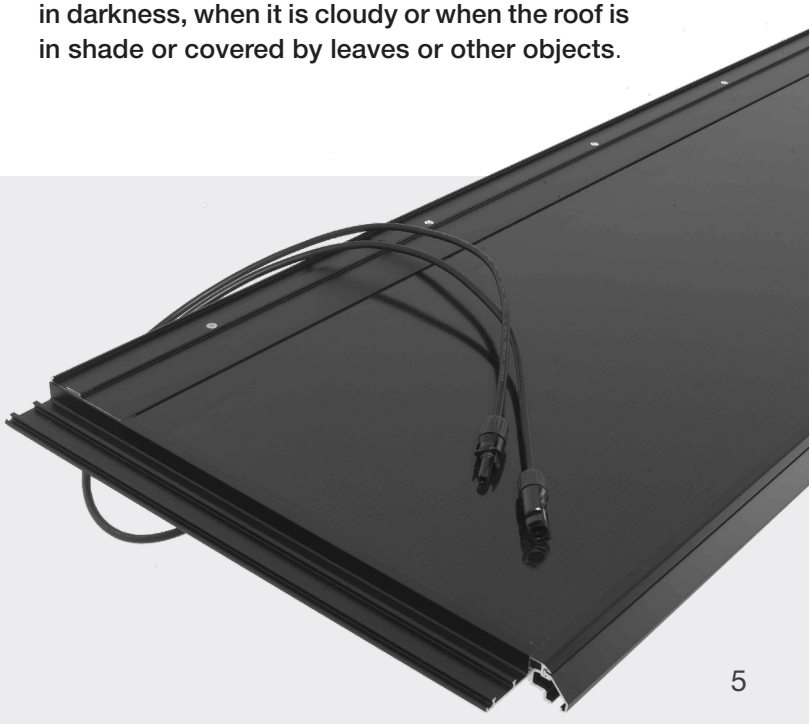
The anodized aluminium base (which is highly resistant to corrosion) makes the **SOLAR Flat-10 tile** lightweight and highly resistant. This material is ideal for making frames and bases for photovoltaic products. We recommend that stainless steel, structural grade screws are used to guarantee they have a similar useful life to the panels..

All the electrical components included in the **Solar Flat-10 tile** have been carefully selected to guarantee the highest quality of the product. The junction box is compact and extremely reliable in harsh environments, its IP67 certification means it provides protection against moisture and its **bypass diode means it also protects against the flow of inverse currents in darkness, when it is cloudy or when the roof is in shade or covered by leaves or other objects**.

The **FULL-BLACK** finish, with a uniform anti-reflective coating and no visible connections, enhances the aesthetic value of the **SOLAR Flat-10 tile**.

The **Solar Flat-10 tile** is designed for a roof or facade made from **Flat-10 tile** ceramic tiles and their complementary special ceramic pieces.

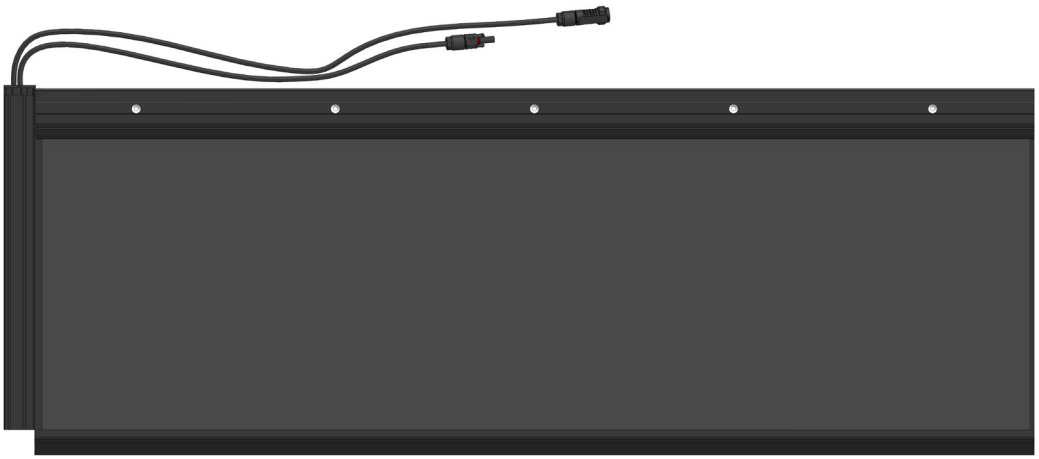
The **SOLAR FLAT-10 tile** integrates perfectly into the roof, maintaining the same aesthetic appearance as a ceramic tile, being the equivalent of five Flat-10 ceramic tiles.

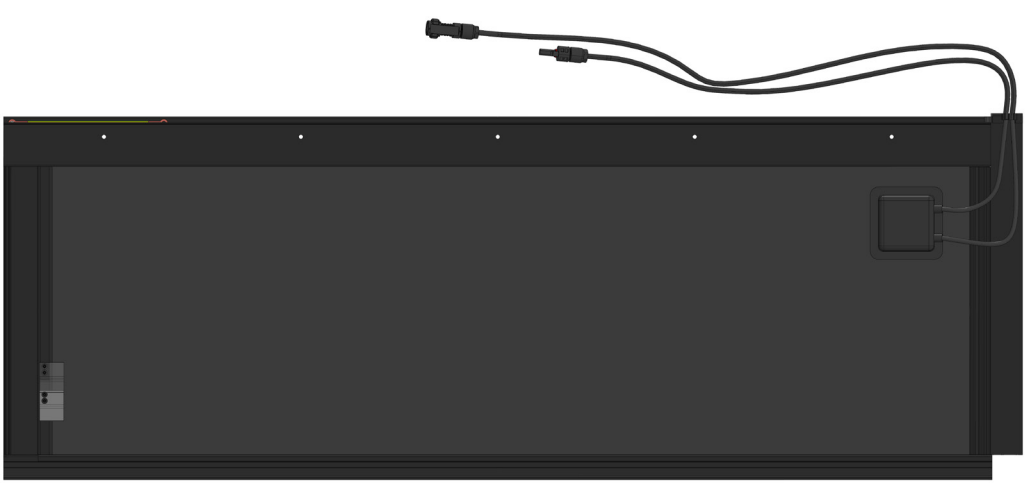


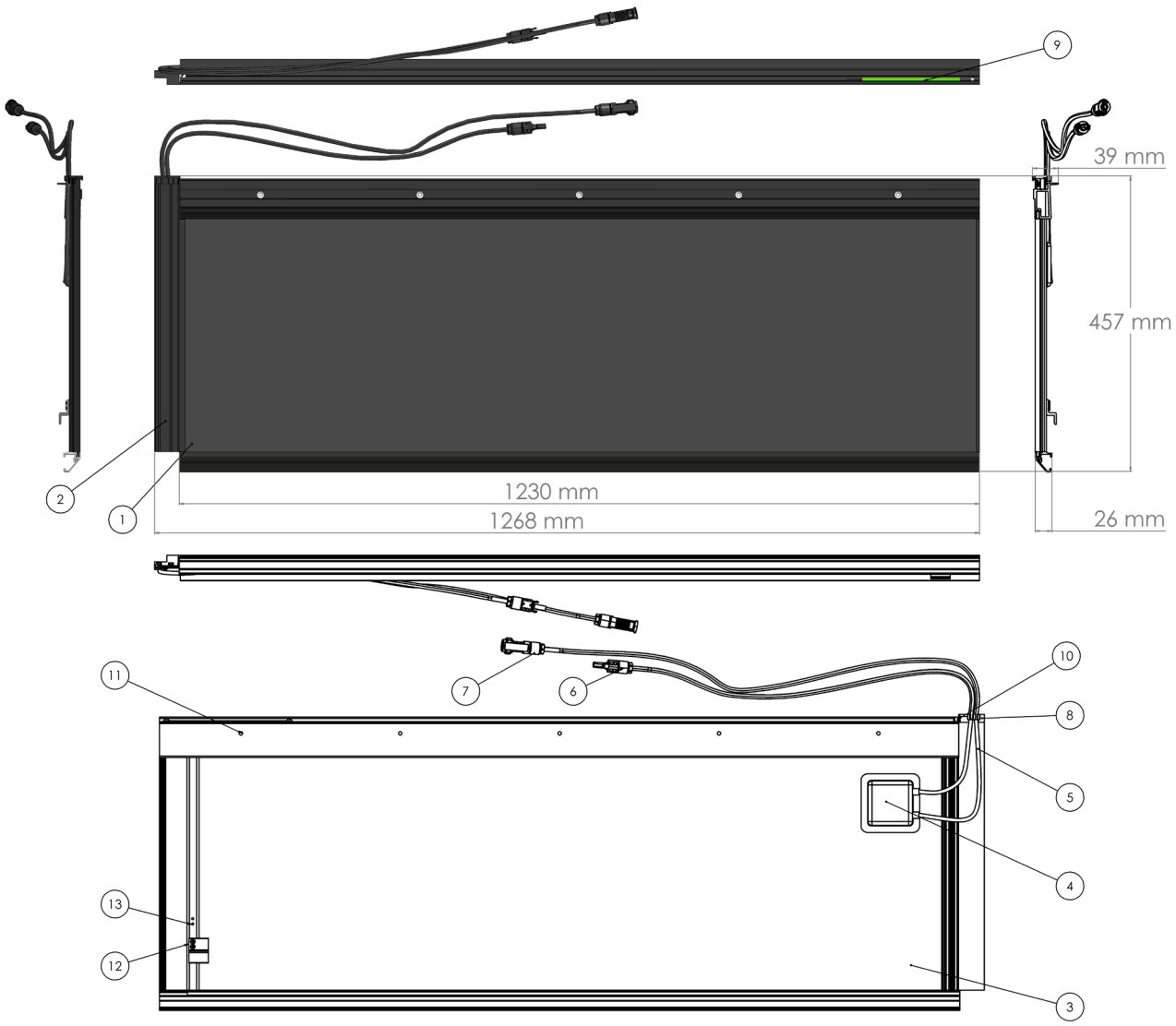
3.1.1 Identification of the product

Each **SOLAR Flat-10 Tiles** carries a unique serial number. Do not remove any labels. The information on them is important for the traceability of the product.

3.1.2 Characteristics and specifications







Key box:

1 - Glass-Glass photovoltaic panel

2 - Anodized aluminium base

3 - Backsheet

4 - Junction box

5 - Connection cables (1,2 m)

6 - MC4 connector (+) positive terminal

7 - MC4 connector (-) negative terminal

8 - Cable track

9 - Grounding cable

10 - Grounding connection *

11 - Holes for fixing to the batten**

12 - Safety fixing bracket (2 screws included)

13 - Holes for fixing saftey bracket
(as per batten spacing).

* Requires an ISO 7049 screw (Thread size: ST 4,2 / Thread length: from 9,5 to 13 mm) for ground connection.
** Requires 5 screws for fixing to the batten (per solar tile unit): diameter from 3,5 to 4,2 / thread length 45 - 55 mm, depending on the batten type.

Characteristics: SOLAR FLAT-10 Roof Tile - CIGS

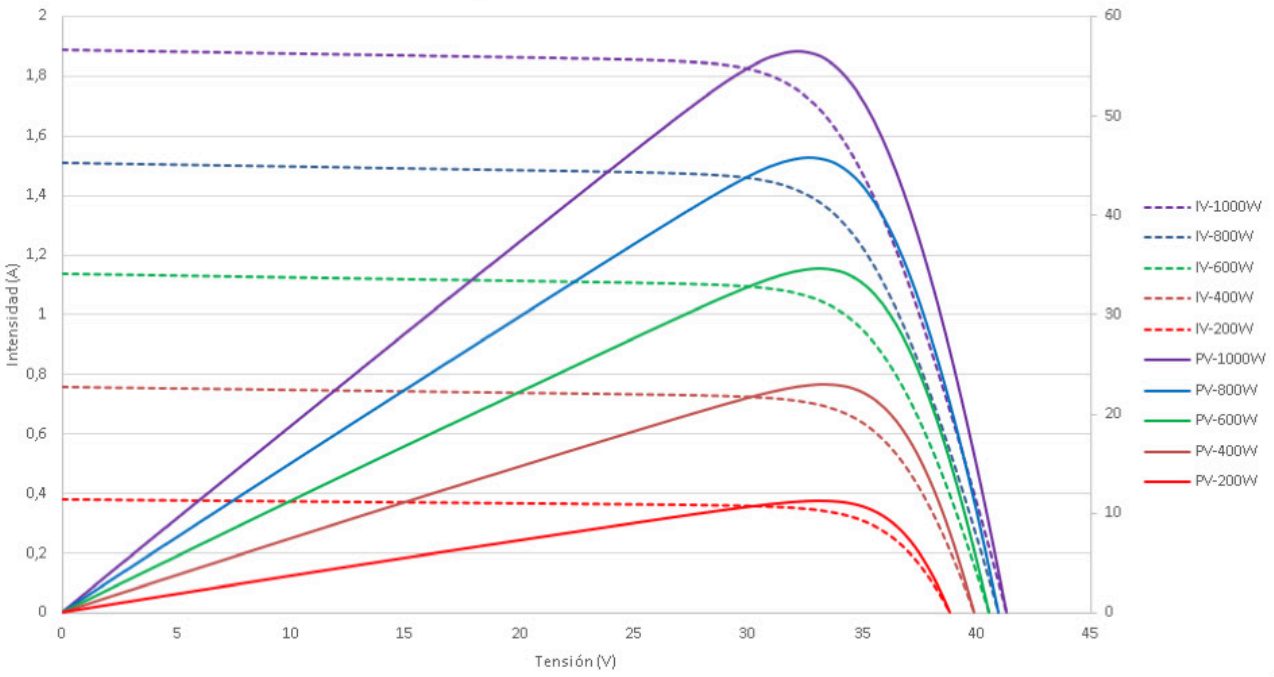
Dimensions:	457 x 1 268 mm
Individual weight:	9,30 kg
Finish:	Black / FULL-BLACK Glass
Cell type:	CIGS (free from Cd and Pb) [1]
Base:	Anodized aluminium base
Fixing system:	5 batten fixing holes
Panel dimensions:	345 x 1215 mm
Equivalence to ceramic tiles:	5 FLAT-10 Roof tiles
Placing:	Depending on the Flat-10 roof tile*
Connection:	Mixed (series – parallel)
Maximum power (P_{max}):	**56 Wp**
Maximum power tolerance:	-3% / +5 %
Maximum power current (I_{mpp}):	1,7 A
Maximum power voltage (V_{mpp}):	33 V
Short circuit current (I_{sc}):	1,89 A
Open circuit voltage (V_{oc}):	41,3 V
Temperature coefficient of P_{max} (δ):	-0,34 %/K
Temperature coefficient V_{oc} (β):	-0,37 %/K
Temperature coefficient I_{sc} (α):	+0,01 %/K
Application class:	Class C
Maximum system voltage:	1.000 V (IEC)
Maximum series fuse rating (I_{sf}):	5 A
Operating temperature:	-40 °C a 85 °C.
Mechanical load pressure:	5.400 Pa (550 kg/sq. m.) max. on the front side (snow) 2.400 Pa on the rear side (wind)
Standard*:**	IEC 61646 - IEC 61730
Front glass panel:	3,2 mm. Tempered glass
Back glass panel:	1,8 mm. Tempered glass
Encapsulation:	EVA with perimeter seal
Backsheet:	Combination of polymers
Junction box:	IP 67
Bypass diode – voltage ratio:	45 V
Bypass diode – intensity ratio:	20 A
Bypass diode - quantity:	3 units
Connectors:	MC4 or compatible connectors
DC cable:	4,0 sq. m., (12 AWG)
DC cable length:	2 x 900 mm
Units /sq. m.:	2,22 - 2,02 uds
Maximum power/sq. m.:**	**123 Wp/sq. m.**
sq. m. – 1 kWp:	**8,12 sq. m.**
Units/kWp:	**17.86 units.**

CE

All measurements are approximate.
Note: The SOLAR FLAT-10 roof tile has an entirely black (FULL-BLACK), anti-reflective finish, with none of the typically visible connections. It is is entirely compatible with the FLAT-10 ceramic tile (see available finishes on the Tejas Borja website).
* SOLAR Flat-10 Tile must always be installed on ventilated roofs using a double batten system or equivalent.
** The certification process is pending.
*** Depending on batten spacing.
STC standard conditions: irradiance = 1,000 W/sq. m.; cell temperature = 25ºC; AM = 1,5.
[1] CIGS (copper, indium, gallium and selenium) is an acronym which describes the latest development in high efficiency solar cell technology (this technology is the most effective in shady conditions) providing high performance while being free from cadmium and lead.

3.1.3 Voltage curve

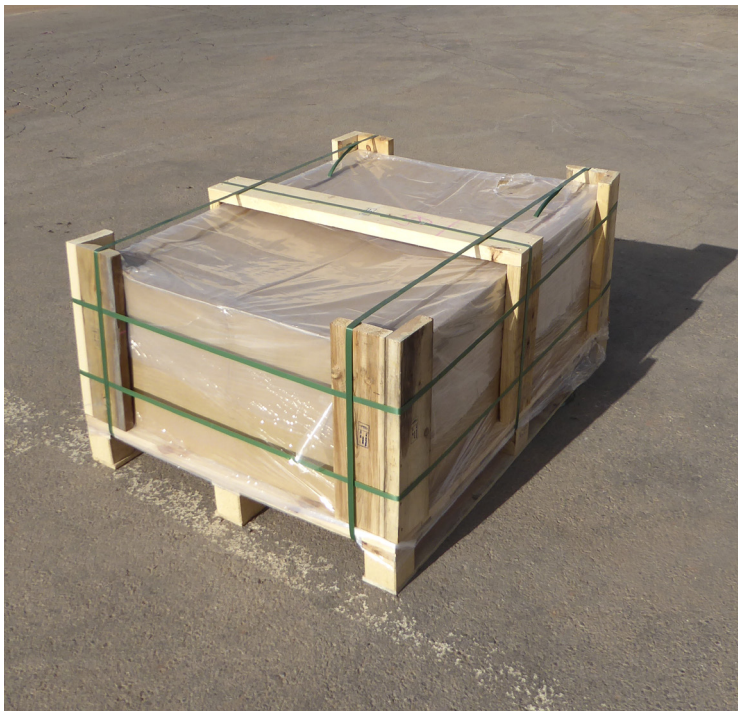
(I-V and P-V curves at different irradiance levels)



The graph shows two curves. The first is the I-V curve, represented by a dotted line. This shows the relationship between current and voltage at different irradiance levels. Each irradiance level is shown in a different colour.

The other is the P-V curve, represented by a continuous line. This shows the relationship between power and voltage at different irradiance levels.

3.1.4 Packaging



· Units / pallet: 32 SOLAR FLAT-10 roof tiles.

· Pallet weight: 340 kg.

· Dimensions: 1.060 x 1.400 x 676 (mm).

· Stackable: up to 3 tiers.

4 RECEIPT AND STORAGE

Upon receipt, check that the product delivered matches that ordered.

Upon receiving the product and before sending it on to its final destination, the packaging must be checked for any damage. If the packaging is damaged, a photograph must be taken of the packaging and all the solar tiles inside it must be checked for any damage.

Due to the special characteristics of the product, **SOLAR FLAT-10 roof tiles** must be handled carefully.

Store the packing boxes in a clean, dry place with a relative humidity below 85% and at an ambient temperature between -20°C and 50°C.

DO NOT stack more than the maximum permissible quantity of pallets (up to 3 pallets).

Keep the product in its original packing box until ready to install it.

When they are at the installation site and before beginning the installation, make sure to keep **SOLAR FLAT-10 roof tiles** clean and dry, particularly their electrical contacts. The contacts may corrode if their cables are exposed to humid conditions. Any **SOLAR FLAT-10 roof tile** with contacts affected by corrosion must not be used.

To ensure the safety of personnel and the product when handling **SOLAR FLAT-10 roof tiles**, two people must work together to unpack the modules from their packing boxes.

Do not remove the edges of the modules if the modules are to be temporarily stored off the pallet.

Never use a blade cutting tool (such as a box cutter, knife or similar) to cut the straps; use scissors or pliers.

Never place a **SOLAR FLAT-10 roof tile** directly on top of another.

5 SAFETY

5.1 General safety

Specialized skills and knowledge are required to install solar photovoltaic systems. Installation must only be carried out by qualified, trained personnel.

Installers must follow all security precautions when installing **SOLAR FLAT-10 roof tiles**.

Never install solar tiles which are physically damaged and/or present defects in any of their parts or elements.

Only use equipment, tools, connectors, cables, etc. which are appropriate for solar electrical systems.

Follow the laws regarding health and safety at work and local safety regulations regarding fall prevention.

5.2 Warnings

When exposed to direct sunlight, one module alone can generate more than 30 V of DC. Safety measures must be used during installation because contact with a voltage of 30 V or more of DC is dangerous. Avoid contact with electrically charged components and make sure live circuits are isolated before making or breaking any connections.

Installers must assume the risk of injuries which may occur during installation including, but not limited to, electric shock.

When installing the system you must follow all local, regional and national regulations. When necessary, obtain a building permit.

5.3 Precautions

Do not attempt to remove **SOLAR FLAT-10 roof tiles** once they have been installed. Do not remove any label or component from the tiles.

Do not apply paints or adhesives to the upper surface or the backsheet of **SOLAR FLAT-10 roof tiles**.

Do not use mirrors or magnifying lenses to concentrate the light onto the solar tiles. Never use artificial means to concentrate sunlight onto the solar modules.

Store on a flat surface in a place which is well ventilated and dry.

5.4 Manual handling safety

Do not disconnect **SOLAR FLAT-10 roof tiles** when they are charging.

When handling **SOLAR FLAT-10 roof tiles**, always wear appropriate safety footwear and Class 0 insulating gloves which meet the requirements of UNE standard EN 60903:2005 to protect the handler against electric shocks and to prevent the product from falling.

Only work in dry conditions and use dry tools. Unless you have the appropriate protective equipment, do not handle **SOLAR FLAT-10 roof tiles** or electric components if they are wet.

Do not pick up a **SOLAR FLAT-10 roof tile** by the junction box or the electric cables.

Do not sit, step or walk on a **SOLAR FLAT-10 roof tile**. Do not step on the front or rear surface of **SOLAR FLAT-10 roof tiles** either before or after installation.

Do not scratch the surface of the glass or panel.

Do not drop **SOLAR FLAT-10 roof tiles**, do not drop objects on top of them or subject them to heavy blows.

Do not place any heavy object on top of **SOLAR FLAT-10 roof tiles** or on top of any of its components, cables or connectors.

Take care when positioning **SOLAR FLAT-10 roof tiles** on the roof surface, particularly when working at a corner.

Do not damage the cables. Do not pinch, twist or stretch them using excessive force.

Improper transport or installation may break the **SOLAR FLAT-10 roof tiles** and void the warranty.

Do not scratch the anodized layer of the frame (except to make the earth connection at the rear of the module). Scratches may cause the deterioration of the frame or reduce its resistance.

SOLAR FLAT-10 roof tiles with damaged glass (whether it is broken or scratched) or which have a damage backsheet cannot be repaired. Contact with any damaged surface of a **SOLAR FLAT-10 roof tile** may cause an electric discharge. Never use a **SOLAR FLAT-10 roof tiles** which has broken glass or a damaged backsheet.

Be sure to protect the connector contacts against corrosion and dirt. Check that all the connectors are free of corrosion and clean before connecting them.

Keep the **SOLAR FLAT-10 roof tiles** out of the reach of children at all times.

5.5 Electrical safety

You must comply with safety regulations for electrical installations and the electrical code in accordance and national and/or local legislation depending on the location of the installation.

Under normal conditions, the current and/or voltage produced by a **SOLAR FLAT-10 roof tiles** will probably be superior to those recorded under standard measurement conditions. Consequently, the values for Isc and Voc given for the **SOLAR FLAT-10 roof tiles** should be multiplied by 1,25 to determine the voltage of the components, the fuse sizes and the size of the controls connected to the photovoltaic output.

Under no circumstances should the open circuit voltage of the installation exceed the maximum voltage of the system (IEC 1.000V / UL 1.000V).

The maximum voltage of the system should not be exceeded under any circumstances. If the voltage of the **SOLAR FLAT-10 roof tiles** were expected to surpass the values detailed in the data sheet under operating temperatures lower than 25°C, this must be taken into account when designing the photovoltaic system.

Only personnel qualified to work with photovoltaic capture systems should access or work with **SOLAR FLAT-10 roof tiles** or on the solar system.

Before connecting the **SOLAR FLAT-10 roof tiles** to the inverter, open the circuit breakers and turn off the inverter.

To prevent electrical discharges, do not carry out the installation when the **SOLAR FLAT-10 roof tiles**, installation tools or installation area are exposed to water.

Before switching on the system, make sure all the **SOLAR FLAT-10 roof tiles** are connected and use a multimeter to check the total voltage of the entire solar tile installation.

Make sure that all connections have been made safely, without any space between the contacts. Any space between contacts may cause an electric arc which is capable of causing a fire and/or electric discharges.

To prevent the appearance of electric arcs and discharges, NEVER disconnect a solar tile when it is charging. If this were ever necessary, cover the surface of the tile with an opaque covering before disconnecting it.

Make sure that the polarity of each **SOLAR FLAT-10 roof tile** or string is not inverted in relation to the rest of the tiles or the strings.

For all connections with inverters, regulators, batteries or to the general control panel, take into account the manufacturer's specifications in each case.

The rated electrical characteristics are within a range of +5% to -3% of the values measured under standard test conditions (STC): 1,000 W/sq. m., with a cell temperature of 25°C and a solar spectrum corresponding to an air mass of 1,5.

5.6 Installation safety

Solar photovoltaic tiles convert light energy from sunlight into direct current electricity. They are designed to be installed outdoors on sloping roofs or facades. The proper design of the structures which support the tiles is the responsibility of the system designers and the installers.

Always use tools and PPE which comply with standards for electrical installations and working at height.

All electronic components used in the photovoltaic system (including cables, connectors, charge regulators, inverters, batteries, etc.) must comply with safety regulations.

Never unplug connectors or open the electrical circuit at any point while the circuit is charging or receiving electric current.

To prevent electrical discharges while handling the **SOLAR FLAT-10 roof tiles**, we recommend you cover the surface of the solar tiles with an opaque material both while installing and removing them to stop them from generating electricity.

Contact with the electrically charged parts of a **SOLAR FLAT-10 roof tile**, such as the terminals, may cause burns, sparks and even lethal shocks, either if the tile is connected or if it is not.

During the installation, do not touch the photovoltaic modules unless necessary. The glass surface and the frame may heat up excessively and there is a risk of burns or electric shock.

Never install or handle **SOLAR FLAT-10 roof tiles** if they are wet. Do not carry out the installation in adverse or severe weather conditions such as high winds, heavy rain, snow or hail.

To prevent damage to the cables, keep them out of direct sunlight as much as possible and do not let them be stained by any product used in assembling the roof (foam, adhesives, mortar, asphalt, etc.) before installation.

Only use insulated tools which are authorized for use in electrical installations.

During the installation, repair or removal of photovoltaic systems, metallic accessories (bracelets, watches, rings, earrings or metal piercings anywhere on the body) must not be worn.

Respect safety regulations (e.g. regulations concerning working in power plant stations) for all the other components of the system such as wires and cables, connectors, load regulators, inverters, storage batteries, rechargeable batteries, etc.

To connect the **SOLAR FLAT-10 roof tiles** in series or to connect them to another device, only use identical or compatible connectors. The warranty will be void if the connectors are removed.

During the transport and installation of the mechanical and electrical components, no-one other than installation personnel should be in the immediate area.

5.7 Fire safety

Consult the local authorities regarding the guidelines and requirements for fire safety in buildings and structures. Always comply with the regulations in force.

The construction and installation of roofs (sloping roofs and terraced roofs) may affect the fire safety of the building; improper installation may increase fire risks.

Use the components required by local regulations such as ground fault circuit interrupters and fuses as required by local regulations.

Do not use **SOLAR FLAT-10 roof tiles** near to equipment or in places where they could generate flammable gases.

The **SOLAR Flat-10 CISG tile** has been given a Class C fire rating and meets all the criteria to be installed on Class A roofs.

The fire rating of the **SOLAR Flat-10 CISG tile** is only valid if they are installed in accordance with the mechanical assembly instructions in this installation manual.

NEVER use water to extinguish electrical fires.

6 GENERAL INSTALLATION INFORMATION

6.1 Installation design

To create an optimal design for an installation using **SOLAR FLAT-10 roof tiles**, we recommend you take the following into account:

- Consider the location of the project (area, environment, orientation, shade, etc.).
- Draw up an appropriate design for the sloping roof (gradient, structural load, materials, execution, etc.).
- Ensure compliance with regulations and local rules before proceeding.
- Define the type of installation (limited self-consumption, with sale of excess power generated, with storage, or isolated from the national power grid).

Upon request, Tejas Borja can provide a preliminary project study, together with an installation proposal for a solar photovoltaic energy system made using **SOLAR FLAT-10 roof tiles**. The information in any such study serves only as a guide for the design of the photovoltaic installation. Tejas Borja does not undertake any commitment or assume any responsibility for the execution of the project. It will be the accredited installer who must assume responsibility for fulfilling the design criteria and the requirements of the installation.

The design of the installation must take into account local climatic conditions and the characteristics of the inverter, always complying with current regulations.

6.2 Location selection

Choose an appropriate place for the installation of the **SOLAR FLAT-10 roof tiles**.

For the best results, **SOLAR FLAT-10 roof tile** installations in the northern hemisphere must be orientated towards the south, and in the southern hemisphere towards the north. The minimum recommended gradient for sloping roofs is 30% (*) to maximise energy production. As a general rule, a tilt angle equal to the latitude facing the equator may be used. However, the installation must always be designed according to local conditions to obtain the best angle.

(*) Minimum recommended gradient for sloping roofs with FLAT-10 ceramic tiles. In zone 1, a protected location, installed in a staggered formation with waterproof sheet and a batten distance of 365 mm on a roof slope of up to 6.5 m. Please consult the table of minimum slope data depending on the roof length and geographical area in accordance with standard UNE-136020.

For detailed information about the best slope gradient, please get in touch with us via email: solar@tejasborja.com.

Although **SOLAR FLAT-10 roof tiles** are guaranteed to give high performance and produce the specified energy output, and are highly effective in the shade, their installation in areas where the tiles may be shaded at any time is not recommended. Avoid installing the **SOLAR FLAT-10 roof tiles** in places which are frequently shaded. If a **SOLAR FLAT-10 roof tile** is affected by total or partial shade, its performance will be impeded, causing a lower power output.

Do not use **SOLAR FLAT-10 roof tiles** near to equipment or in places where they could generate flammable gases.

6.3 Climatic conditions

SOLAR FLAT-10 roof tiles are guaranteed to function with a linear output of up to 80% for 25 years in the following environmental:

- Operating temperature: -40°C to 85°C.
- Mechanical load pressure *:
  - 8.100 Pa (825 kg/sq. m.) max. on the front side (snow);
  - 3600 Pa on the rear side (wind).

The mechanical load capacity depends on the assembly systems used. Failure to follow the instructions in this manual may mean that the resistance to snow load and wind are different to those quoted. The system installer must make sure that the installation methods used comply with these requirements and any other code or regulations in force.

We will advise you on the design and specification for your installation using the SOLAR FLAT-10 roof tile according to your requirements. Contact us!

FLAT-10

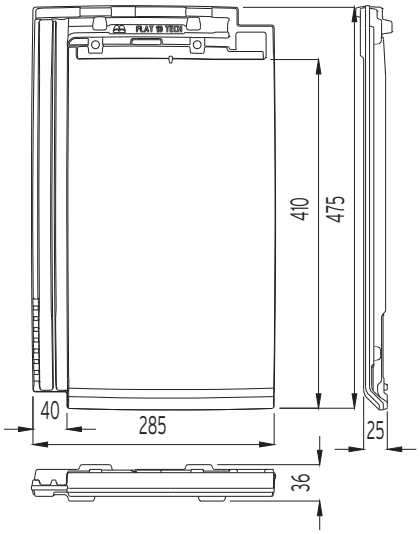
Perfect, deep fit

Large format - 9,9 units per sq. m.

Exclusive BorjaJET finishes

Lightweight

> Klinker



Maximum Surface Flatness

Mountain climate

Longitudinal Overlap 35 mm

Dimensions	475 mm x 285 mm
Minimum pitch recommended	30% - 17° (*)
Weight	3,5 Kg./Unit
Units / sq. m.	9,9 Units
Units per LM eave line	4 Units
Useful width	250 mm
Useful length (Batten distance) VARIABLE	365-400 mm
Pallet data	(T1) 240 Units / 850 Kg. (T2) 320 Units / 1.130 Kg.
Minimum order	6 Units**

Mountain climate According D.3 RP34,02

Perfectly watertight MobyDick II tested (CTMNC - Paris)

Approximate values: If the roof tiles are installed on battens, the useful length must be calculated on site. A tolerance of ± 2% is allowed on the dimensions of the roof tiles according to EN 1024.

The certified characteristics for the NF Terracotta tiles are: Structural faults, the geometric characteristics, resistance to flexural strength , impermeability, frost resistance for all products made with red clay. AFNOR Certification / 11 rue Francis de Pressensé / 93571 LA PLAINE / SAINT-DENIS CEDEX / www.marque-nf.com

(*) In zone 1 (protected area), arranged in staggered formation with waterproof membrane and batten distance of 365 mm on a skirt of up to 6.5 m. Check pitch pannel according to the roof length and the geographical area according to EN 136020.

** The tiles are subject to minimum order and must be multiples thereof.

6.4 Compatibility

6.4.1 Ceramic tile - roof covering

The **SOLAR FLAT-10 roof tiles** is entirely compatible with the FLAT-10 ceramic tile.

(https://tejasborja.com/en/roof-tile/flat-10-tech/)

The FLAT-10 ceramic tile is part of the new generation of flat tiles, lighter, more resistant, with less absorption and with greater definition. Its very deep fittings make this tile the perfect choice for all types of projects, both on sloping roofs and on facades. FLAT-10 flat roof tile, combined with BorjaJET finishes, gives any architectural design a unique character.

6.4.2 Inverters

The choice of inverter will be determined by the project manager in accordance with the project's specifications and requirements while always keeping in mind and complying with local regulations regarding the generation of electrical energy in isolated systems or those connected to the public power grid.

The inverter must be located as near as possible to the property's main switchboard, or very close to the meter, while always being kept out of direct sunlight.

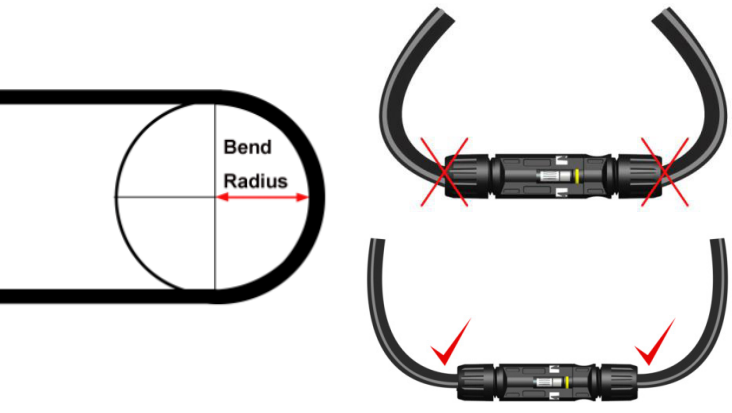
Modifications to the aforementioned system must be carried out under the supervision of the project manager.

6.4.3 Cables and Connectors

To prevent overheating of cables and connectors, the choice of the cross section of the cables and the capacity of the connectors must be contingent upon the maximum short circuit current of the system. The recommended cable to ensure complete safety is a photovoltaic cable with a cross section of 4 sq. mm.

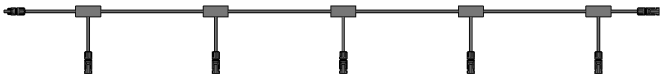
Tejas Borja supplies **SOLAR FLAT-10 roof tiles** with connectors used for electrical connections in the system. The recommended connectors are Multi-Contact MC4 or equivalent. To correctly connect the Multi-Contact MC4 connectors, they must be pushed together until you hear a click.

The cable bend radius must be at least six times the exterior diameter of the cable.



All the cabling in the installation must be appropriate for photovoltaic installations in accordance with current regulations.

To make connections in parallel, Multi-Contact MC4 connectors or equivalents must be used, whether you are using string connectors or Y connectors.



Example of a string connector

Example of a Y connector

6.4.4 Obligatory safety features (*)

Fuses - Protection against reverse current. A string fuse must be installed between the inverter and **SOLAR FLAT-10 roof tiles**.

Thermal magnetic circuit breaker - Protection against short circuits and overloads in the system. It must be installed between the inverter and the property's electrical system.

Residual current device (RCD) - Protection against contact with live parts of the installation or leakage due to lack of insulation. It must be installed between the inverter and the property's electrical installation.

* According to current regulations in Spain. Please consult local regulations for each project.

6.4.5 Optimizers

Due to the characteristics of the **SOLAR FLAT-10 roof tiles**, the use of optimizers in their installation is unnecessary.

6.4.6 DC isolator switch breakers

Should it be necessary, the type and specifications of the DC isolator switch breaker will be determined, along with its location in the specified string.

In the event an isolator switch breaker is used, check that the voltage and the current of the isolator switch breaker meet the requirements of the installation. You must ensure that the isolator switch breaker is correctly located and labelled.

6.4.7 Battery

In the case of an autonomous installation with a storage system, batteries must be correctly connected to each other and to the property's electrical circuit through a regulator or an inverter/charger.

These batteries must also be large enough to supply sufficient electricity to the property for the desired number of days the property needs to be powered by the electricity stored in the batteries in the event of adverse weather events which impede the proper operating of the **SOLAR FLAT-10 roof tile** array.

6.4.8 Inverter/charger

If the installation includes a storage system, the inverter may be replaced by an inverter/charger which combines the functions of the inverter and a regulator in one single device.

6.4.9 Meter

It is possible to install a meter to precisely measure the electricity generated or supplied to the grid at a certain point in the installation through the **SOLAR FLAT-10 roof tile** array.

6.4.10 Load regulator

If the installation includes a storage system which uses a conventional inverter, a load regulator must be installed between the **SOLAR FLAT-10 roof tile** array and the inverter. This regulator is the device which connects the batteries to the electrical circuit and controls the charge level of the batteries, thereby guaranteeing their optimal charge and extending the useful life of the batteries.

6.4.11 Electrical switchboard

If the property's electrical switchboard does not have enough space to house the necessary protective components for the photovoltaic generator circuit, a switchboard will have to be installed outside the property which can house the necessary protective components.

6.4.12 Monitoring systems

If the client wishes to monitor all the energy flows, opt for zero injection into the grid or manage charging, an energy management device must be installed in the property's electrical circuit after the electric meter.

6.5 Installation requirements

The structure to which **SOLAR FLAT-10 roof tiles** are attached must be made from a durable material which is resistant to corrosion, ultraviolet rays and adverse weather conditions.

All the components and materials used in the installation must be made from durable materials which are resistant to corrosion, ultraviolet rays and adverse weather conditions.

In areas which experience heavy snowfalls, take into account the slope of the roof where the photovoltaic system is to be located to prevent the lower edge of the **SOLAR FLAT-10 roof tiles** getting covered in snow at any time. Moreover, make sure that the lowest part of the tiles is high enough so as not to be shaded by nearby plants or trees or damaged by sand carried by the wind.

SOLAR FLAT-10 roof tiles are to be installed on sloping roofs together with Flat-10 ceramic tiles and their complementary special ceramic pieces. When installing **SOLAR FLAT-10 roof tiles** on the roof, always leave a safe working area between the edge of the roof and the outer edge of the solar array.

Never place **SOLAR FLAT-10 roof tiles** in the first row of tiles at the eaves, in the rows next to the gables, in the rows of tiles below the ridge or next to other joins or singular points in the roof. It is particularly important not to install **SOLAR FLAT-10 roof tiles** near to chimney pieces.

SOLAR FLAT-10 roof tiles must be safely attached to the mounting structure. **SOLAR FLAT-10 roof tiles** must be attached using 5 self-drilling, rustproof screws.

SOLAR FLAT-10 roof tiles must always be installed on ventilated roofs using a double batten system or equivalent. Make sure there is adequate ventilation under the **SOLAR FLAT-10 roof tiles** in accordance with current regulations. In general, we recommend a minimum distance of 45 mm between the roof surface and the solar tile frame.

Always follow the instructions and safety precautions which are included with the solar tiles support structures.

When installing **SOLAR FLAT-10 roof tiles** onto a roof, make sure that the construction of the roof is adequate. Moreover, to prevent leaks, any perforation made in the roof support in order to install the solar tiles must be properly sealed.

The accumulation of dust on the surface of the solar tiles may reduce their output. Tejas Borja recommends that **SOLAR FLAT-10 roof tiles** are installed at a minimum gradient of 30% to help the rain to wash dust from the tiles and ensure the watertightness of the roof.

Make allowances for the linear thermal expansion of the **SOLAR FLAT-10 roof tiles** frames (we recommend leaving a minimum distance of 2 mm between one **SOLAR Flat-10 tile** and another).

Make sure the solar tiles are not subject to wind or snow loads which exceed the maximum approved loads or excessive forces due to the thermal expansion of the support structures.

All **SOLAR FLAT-10 roof tiles** must be securely attached so they are able to withstand wind and snow loads lower than the maximum approved loads.

We will advise you on the design and specification for your installation using the SOLAR FLAT-10 roof tile according to your requirements. Contact us!

6.6 Pre-installation preparation and precautions

Install the components described in the manual and follow its instructions. Tejas Borja will not be liable for any damages caused due to an installation which does not comply with the instructions in this manual.

Before beginning the installation, the installers must ensure that the amount of **SOLAR FLAT-10 roof tiles** and the cabling are compatible with the installation area and must follow the instructions for the installation of the inverter and other system components in accordance with their respective manuals.

When installing the sloping roof with the **SOLAR FLAT-10 roof tile** system, the installation personnel must include a ceramic tile installer and an electrician to install the solar tiles.

SOLAR Flat-10 Tiles are installed in the same way as Flat-10 Tiles , the former having been designed to combine perfectly with the latter. Due to its dimensions, one **SOLAR Flat-10 Tile** is the same size as 5 Flat-10 Tile units.

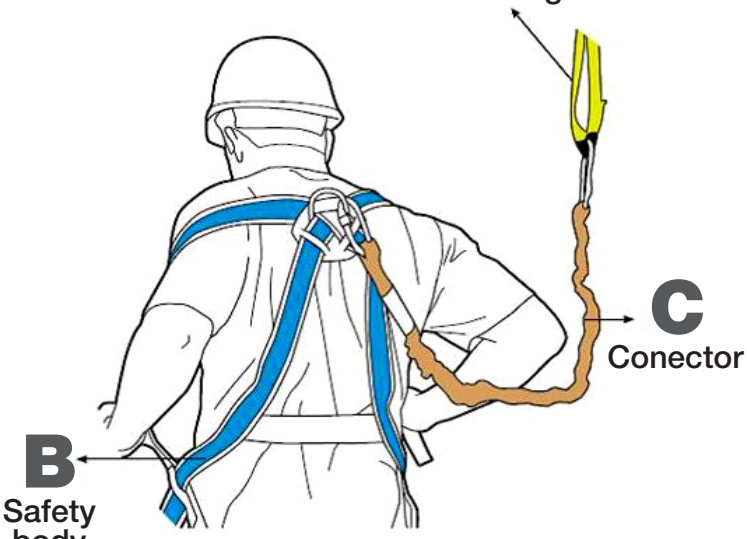
Before beginning the installation, we recommend you mark out the area where the solar array will be located. Similarly, we recommend having marked out the location of the other elements which make up the solar installation (inverter, fuses, optimizer, etc.) and checked that the solar tiles operate correctly before installing them.

6.6.1 6.6.1 Accessories and tools for the installation

Personal protection (PPE):

Slip-resistant footwear

Insulating gloves



Fall protection system for working at height

The type of screw used to fix the SOLAR Flat-10 Tiles in place will depend on the type of batten the Tiles are to be fixed to (metal or wood).

Cables to connect the strings in parallel and connectors (see 6.3.4 Cables and connectors).

Pieces included:

Fixing bracket + 2 screws for each Solar Flat-10 Tile

The fixing brackets are particularly important in areas which experience strong winds. They are used to reinforce the fixing of the **SOLAR Flat-10 Tiles** from the second row of Tiles upwards.

6.6.2 Batten installation

The roof must be waterproofed before installing both the primary and secondary mounting battens.

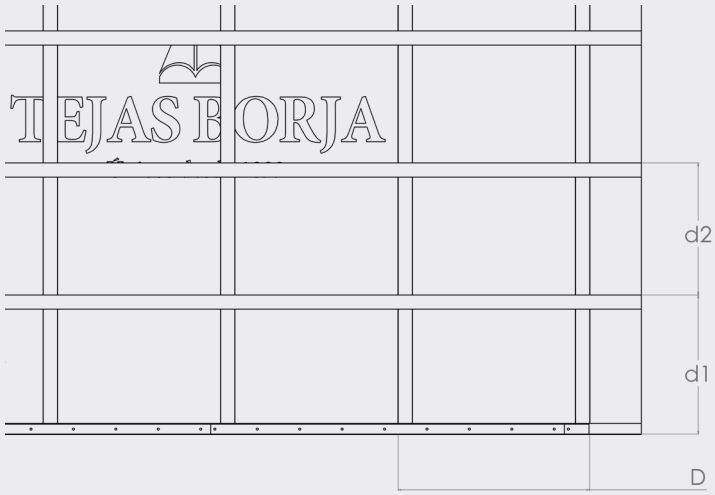
Insulating the roof when installing **SOLAR Flat-10 tiles** and completing the roof with Flat-10 ceramic tiles and their associated accessories is not an essential requirement. However, Tejas Borja recommends using the BORJATHERM insulation system to further improve the property or project.

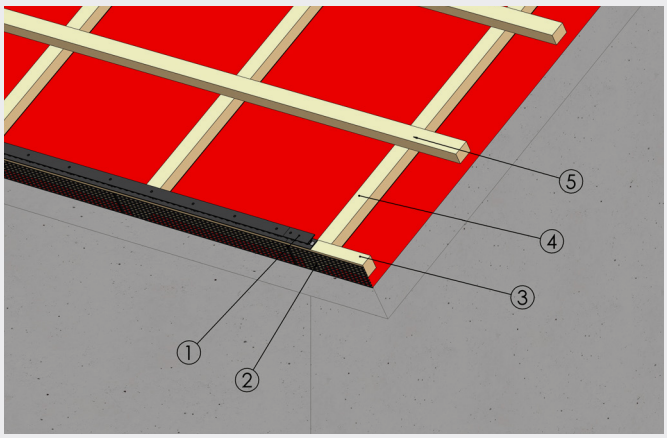
Installers must make sure installations comply with national and/or local regulations to ensure the compatibility of the mounting battens with the dimensions of the **SOLAR Flat-10 tiles** . If using wooden battens, these must be at least 40 mm (width) x 30 mm (depth). Primary and secondary battens must be used to create an air chamber under the tiles and enable the routing of cables underneath them.

The **SOLAR Flat-10 tile** is completely compatible with the Flat-10 ceramic tile. Consequently, the distance between two horizontal battens is variable, using the same spacing as that for the ceramic tile (from 365 to 400 mm).

The primary battens are installed in the direction of the slope. The recommended spacing between primary battens is from 400 to 600 mm. For other configurations, please consult the Tejas Borja Technical Department. When the roof support structure is protected by a waterproof/breathable membrane, the underside of the battens must be protected with under-batten tape, installed before the primary battens are fixed in place, to prevent water seeping through the screw holes.

The first batten at the eaves must be at least 2 cm higher than the rest to preserve the slope on the first row of tiles. To achieve this, an eaves batten which is thicker than the rest may be used and/or an additional batten may be added.

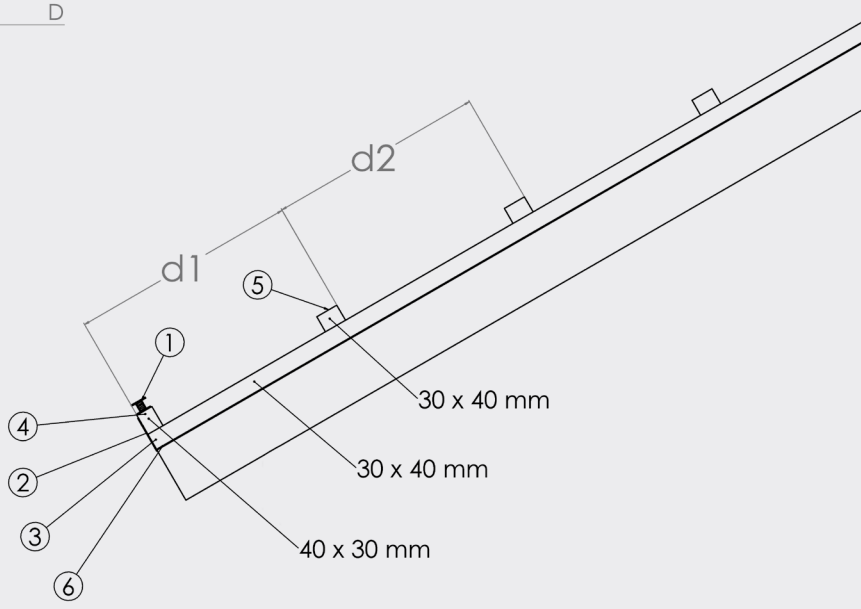




Key:

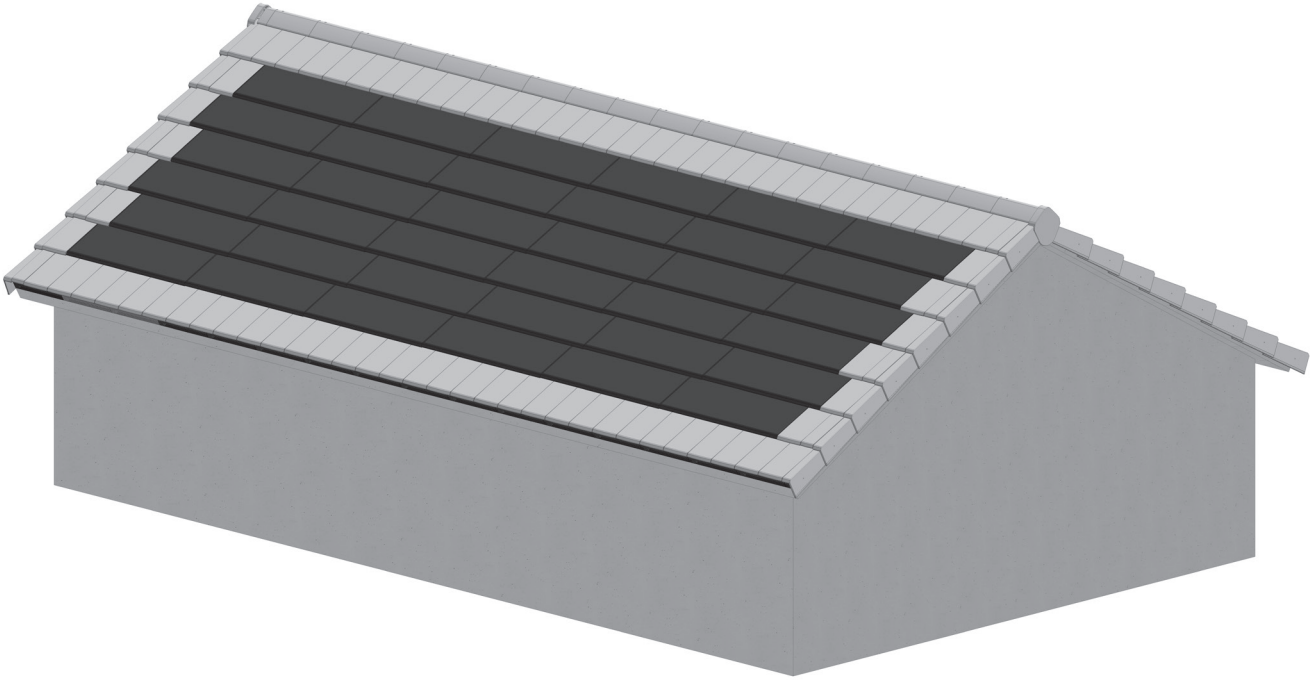
D - distance between primary battens (400-600 mm)
d1 - distance to first secondary batten
(ensure tile overlap) (370 - 390 mm)
d2 - distance to secondary batten (365 - 400 mm)

1 - additional eaves batten
2 - eaves grate
3 - secondary eaves batten
4 - primary batten
5 - secondary batten
6 - under-batten tape



Air is allowed to flow in through the lowest part of the roof at the eaves by keeping the space between the roof support and the tiles open. Eaves grates and/or combs cover the space under the eaves, preventing birds from entering the gap while allowing air to circulate.

The combination of Flat-10 ceramic tiles and **SOLAR Flat-10 tiles** means that the perimeter of the roof must always be completed using Flat-10 ceramic tiles and their complementary accessories.



6.7 Installation instructions

The installation will always be made on a double batten system or similar to enable ventilation and the cabling for the photovoltaic system to be laid beneath the tiles.

Take into account that the perfect architectural integration of the **SOLAR Flat-10 tiles** into sloping roofs is completed through the use of Flat-10 ceramic tiles and their complementary accessories. Flat-10 model tiles must always be installed from right to left.

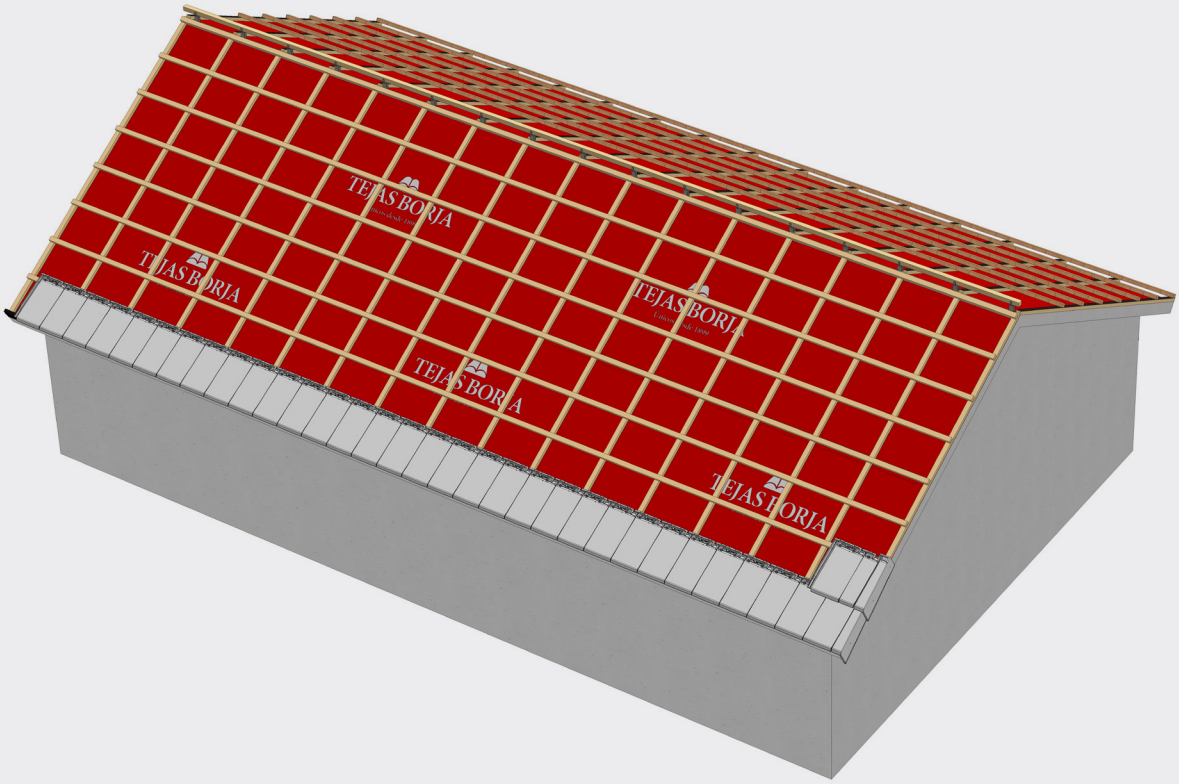
The installation of the roof must always begin with the installation of Flat-10 ceramic tiles along the eaves. Always use Flat-10 ceramic tiles in the eaves course, in rows next to side walls and along the ridge.

The ceramic pieces which make up the perimeter of the roof must always be fixed to the support structure mechanically, using screws. Never use mortar in roofs with solar energy systems. In the case of the Flat-10 ceramic tiles which are used for the eaves course, in addition to mechanical fixings we also recommend you secure the front part of the tiles using adhesive or hooks so the tiles at the eaves do not lift up in the event of high winds.

We recommend the installation of ceramic edge pieces at the sides of the roof. The installation of roofs using Flat-10 ceramic tiles must start at the right side with a right edge piece. Edge pieces are specifically designed for these points of the roof, and are prepared to be watertight and for fixing to the battens with screws.

All the tiles have two pre-drilled holes to facilitate their fixing to the battens.

Once the area where the solar array is to be installed has been marked out and before the installation of the **SOLAR Flat-10 Tile**, install the eaves course using Flat-10 Tiles , starting at the right side of the roof. Continue by installing the second row of Tiles from the right side of the roof using a half Flat-10 Tile first and then whole Flat-10 Tiles until reaching the area marked out for the solar array. The installation of the half Flat-10 Tile at the start of the second row ensures the recommended staggered pattern is created, which should be continued by using a half Flat-10 Tile at the start of alternate rows.



Installing SOLAR Flat-10 tiles

Appropriate screws, depending on the type of batten, must be used to attach **SOLAR Flat-10 tiles**. Each piece must be fixed in place using the five holes provided for its installation.

During their installation, the circuit voltage in each string of **SOLAR Flat-10 tiles** must be checked.

We advise that the installation of each **SOLAR Flat-10 Tile** is done in such a way as to facilitate electrical checks.

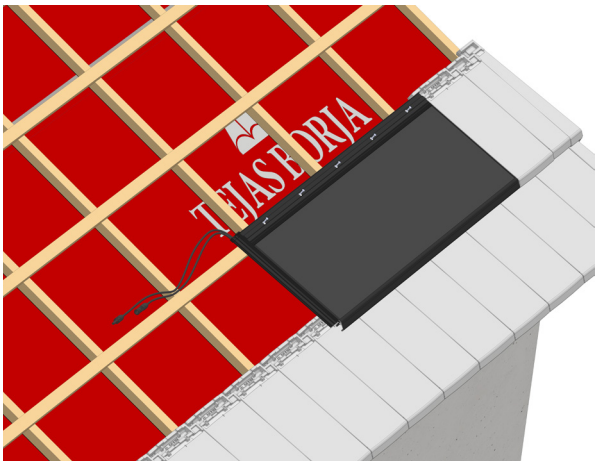
Note: the diagram in this manual places the connections on the left side of the roof to provide, where necessary, ease of access for possible repairs.

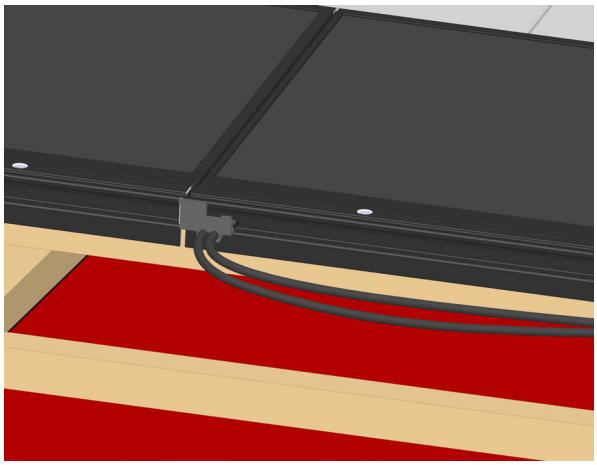
STEP 1

To begin installing the first string of solar Tiles, position the first **SOLAR Flat-10 Tile** overlapping the Flat-10 Tile, making sure to keep the connection cables (through the holes or tracks provided) and connectors in sight. Then fix the SOLAR Flat-10 Tile in place using 5 screws (depending on the type of batten).

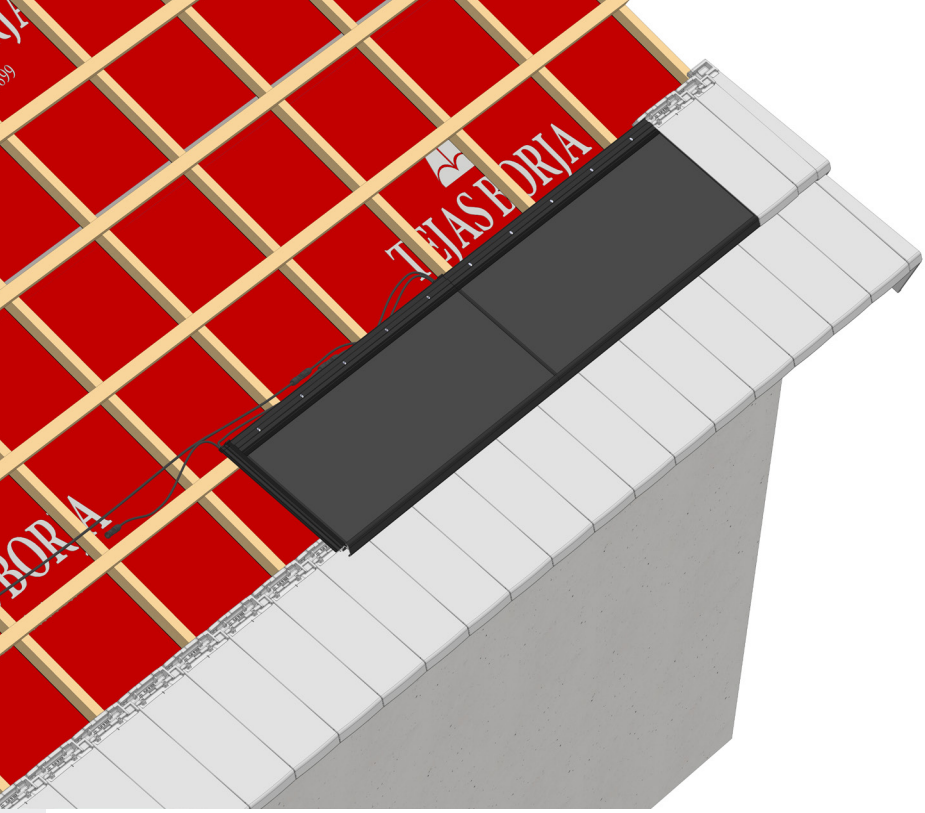
IMPORTANT: Do not drill the glass or other areas of the **SOLAR Flat-10 tile**. Make sure the screws are securely fastened.

It is advisable to use a power drill with torque control to prevent over-fastening the screws.





Note: The **SOLAR Flat-10 tile** has a cable track to keep the cables safe for installation.

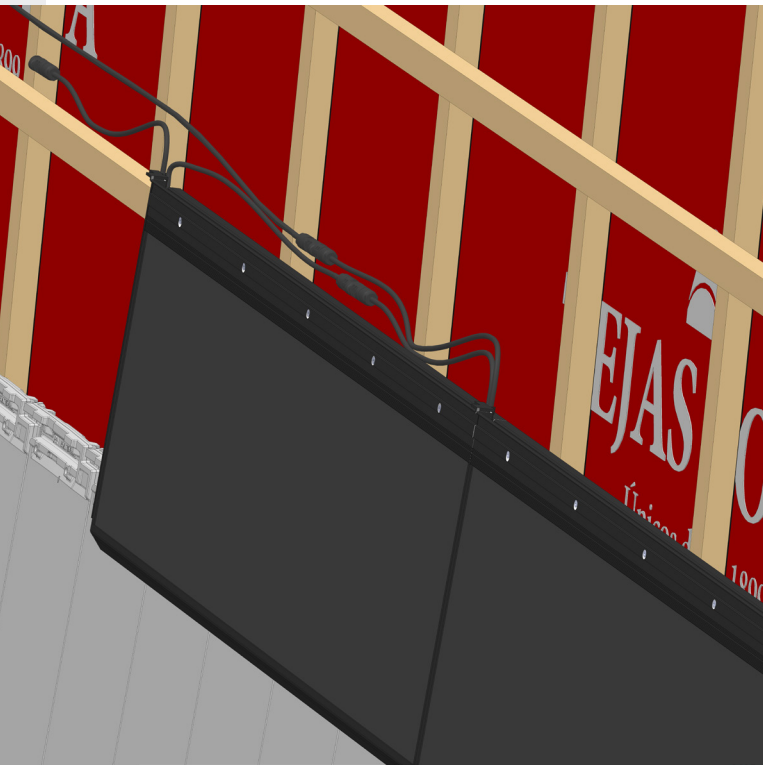


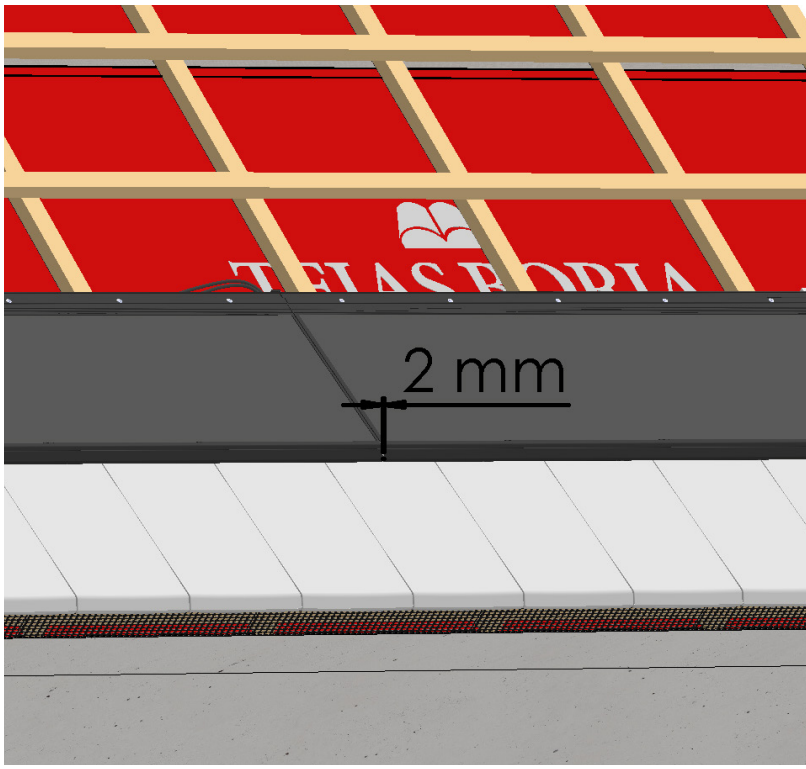
STEP 2

Position the second **SOLAR Flat-10 tile** so it overlaps the previous solar tile which has just been installed. A 2 mm space must be left between the frames of the solar tiles to allow for expansion. Fix the second tile in place 5 screws, making sure the connection cables and connectors are always kept in view and beneath the secondary batten.

Make the series connection by connecting the first two solar tiles to each other: the negative terminal of the first **SOLAR Flat-10 tile** to the positive terminal of the second.

The positive terminal of the first **SOLAR Flat-10 tile** is connected to a cable long enough to reach the position of the parallel connection.





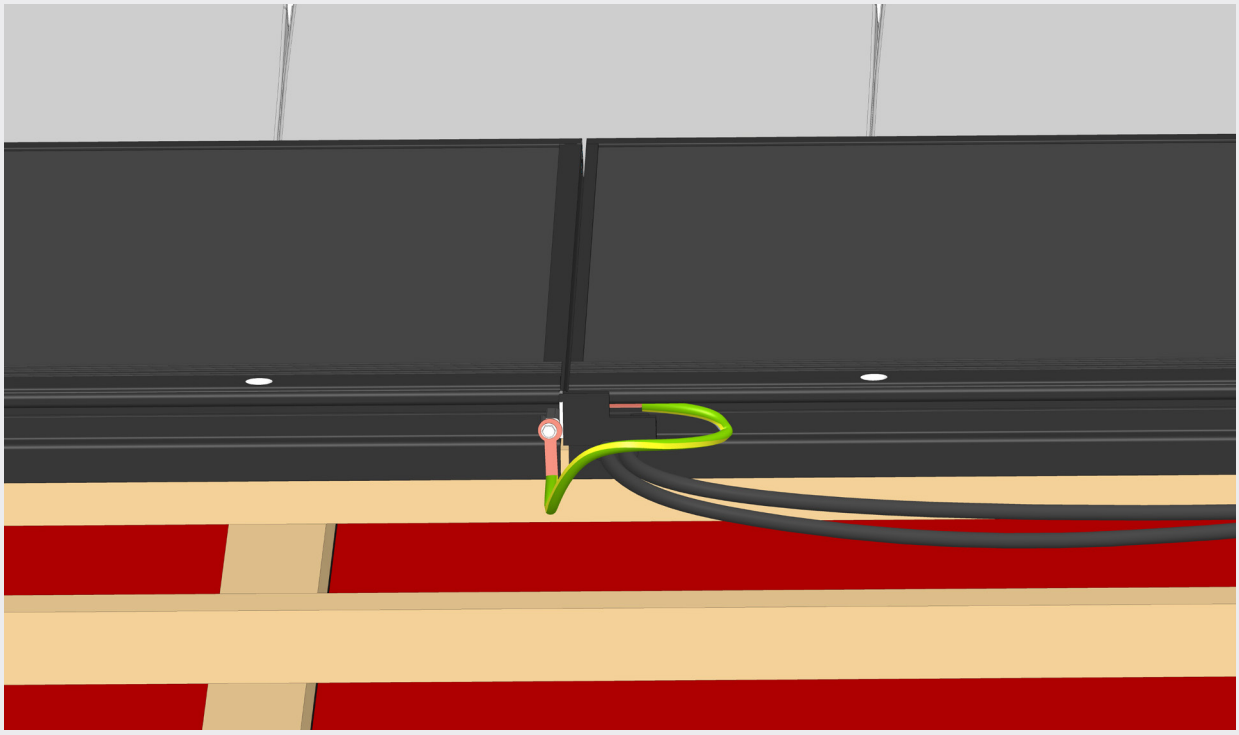
NOTE: When making any connection using MC4 connectors, you will hear a click if you make the connection correctly. Locate the cables behind the solar tile and fix them to the secondary batten using corrosion-resistant clamps in such a way that the connections will never come into contact with the roof supports.

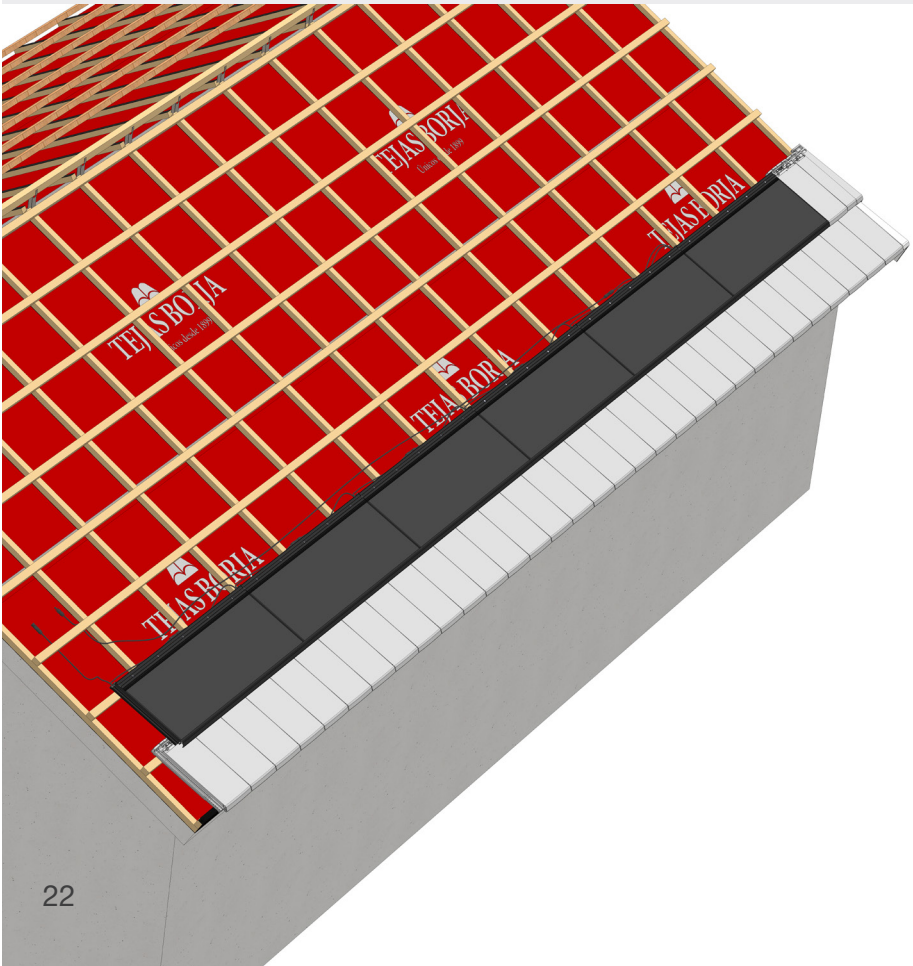
MC4 Connection

STEP 3

Use flat head screws to attach the ground cable to the ground hole marked on the adjacent **SOLAR Flat-10 tile**.

Technical information about ground screws: ISO 7049 (Thread size: ST 4,2 / Thread length: from 9,5 to 13 mm).





STEP 4

Complete the first string by installing **SOLAR Flat-10 tile** from right to left, repeating steps 2 and 3.

STEP 5

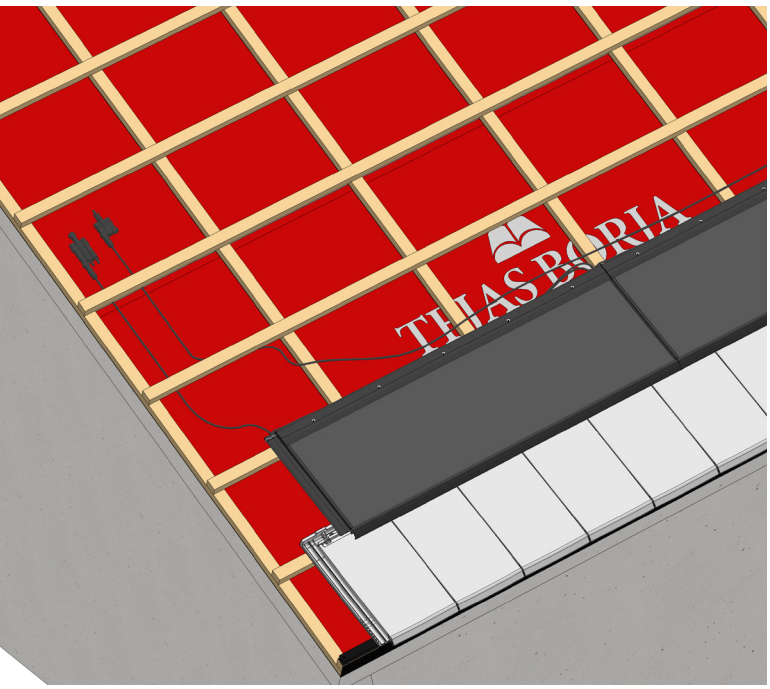
Check that all the connections in the string are correctly connected and that the string voltage is also correct.

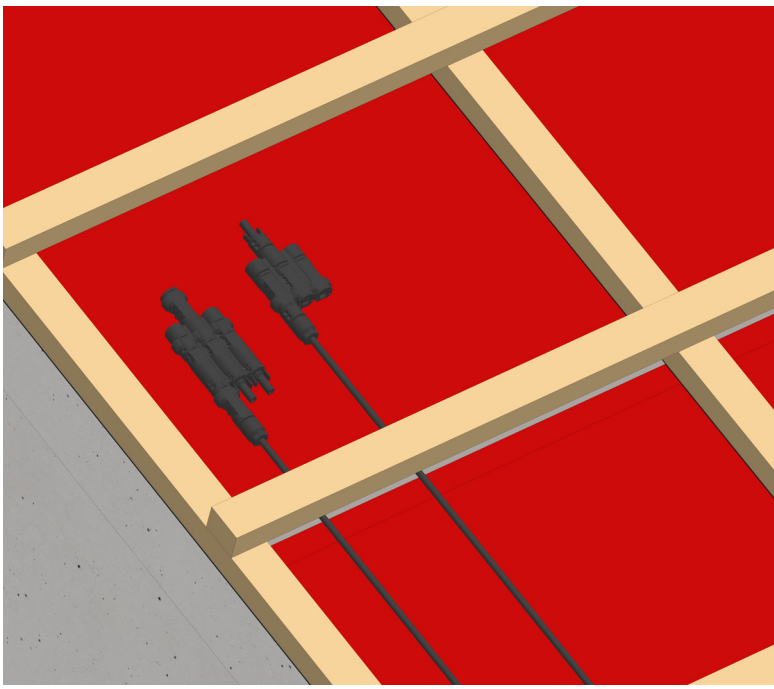
Note: A string will not always finish where the row of solar tiles does.

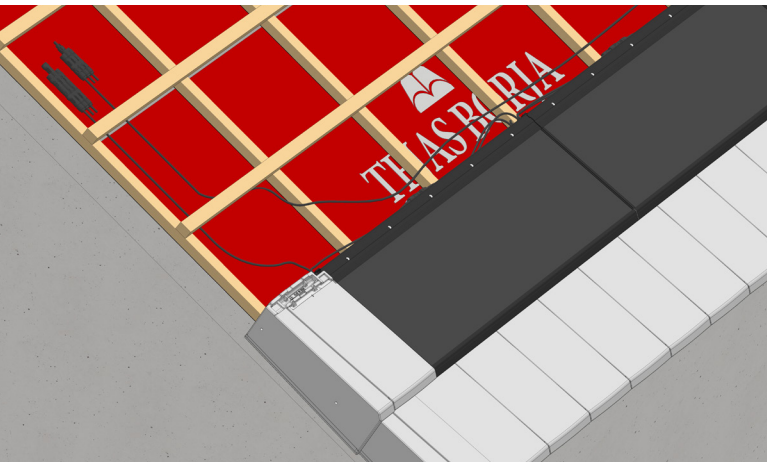
STEP 6

On the left side of the roof, under the secondary batten, position MC4 splitter cables to make the parallel connections between all the strings in the solar array.

The positive terminal of the first solar tile is connected to the corresponding MC4 splitter cable and the negative terminal of the last solar tile in the string is connected to its respective MC4 splitter cable.

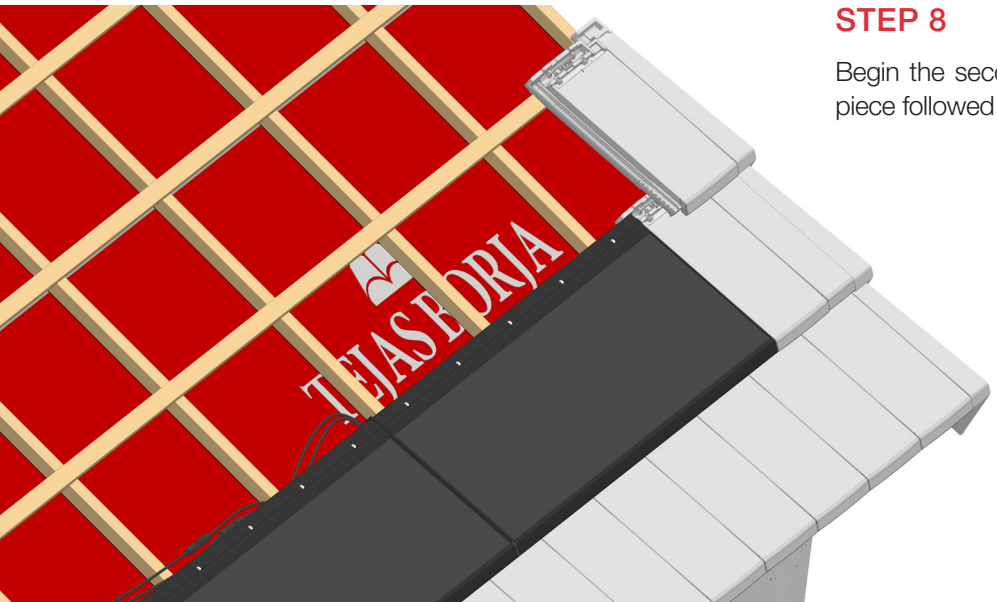






STEP 7

Complete the left side of the roof using a Flat-10 ceramic tile and a left Flat-10 edge piece. If necessary to maintain the staggered tile pattern, use a Half Flat-10 tile.



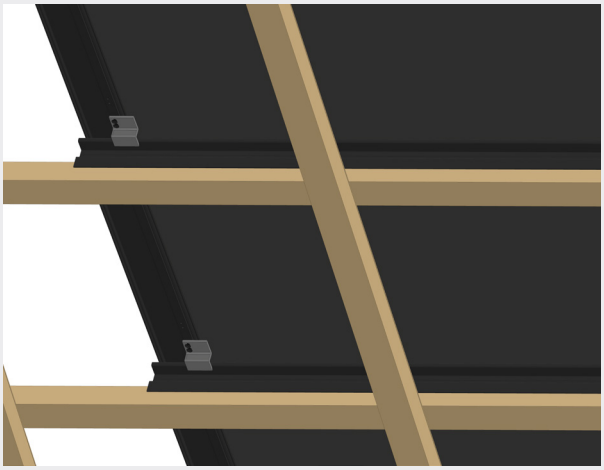
STEP 8

Begin the second row with a right Flat-10 edge piece followed by a Flat-10 ceramic tile.

The **SOLAR Flat-10 tile** is supplied together with a fixing bracket which is used to secure the tile in position, depending on the batten spacing.

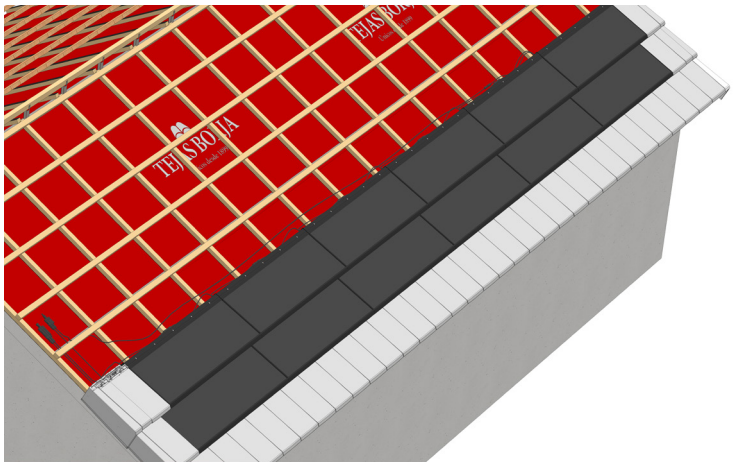
The fixing bracket must be positioned before beginning to install the tiles, according to the batten spacing used in the installation. From the second row of solar tiles (string), the bracket will hold the solar tiles firmly in place relative to each other.

From the second string upwards, make sure that the fixing bracket is correctly positioned according to the batten spacing and firmly attached to the **Solar Flat-10** in the previous string. If the installation is in an area which experiences high winds, the fixing bracket must be positioned on the batten before overlapping the **Solar Flat-10** tile below. In this case, attach the fixing bracket first and find a place on the batten to finish fixing the tile using screws and to attach the cabling.



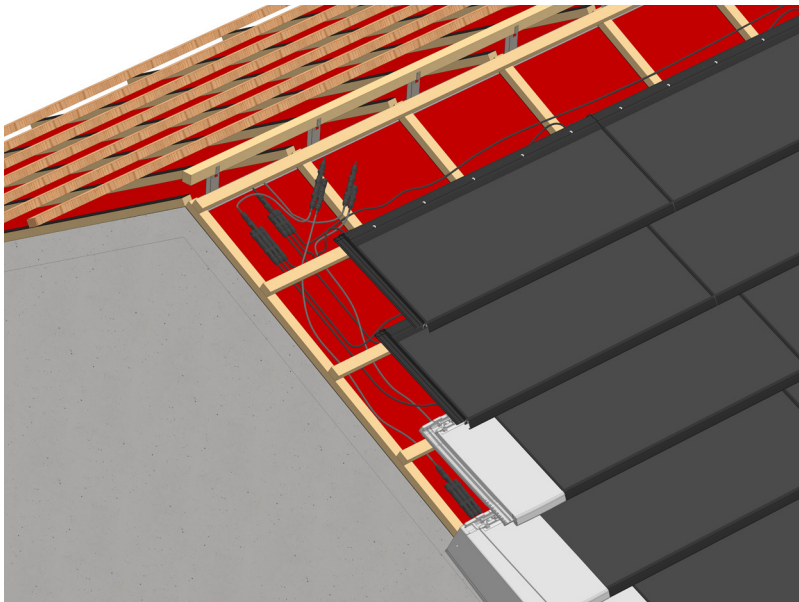
STEP 9

Begin and complete the second string, securing the solar tiles according to the instructions in step 8 and the fixings and connections in accordance with steps 2, 3, 4, 5 and 6, finishing on the left side of the roof with a tile and edge piece as detailed in step 7.



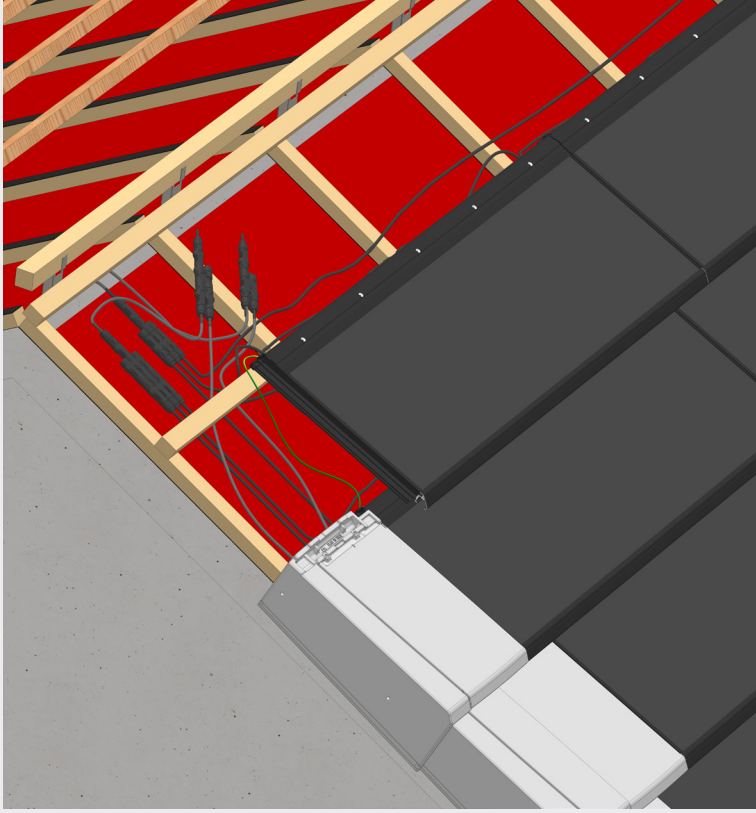
STEP 10

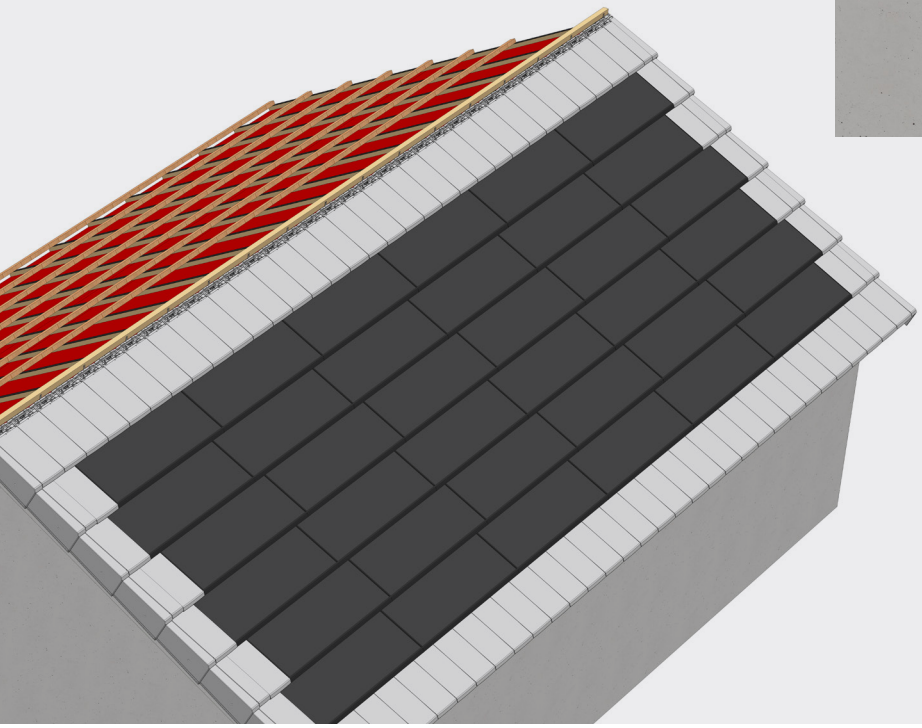
Complete the array with all its component strings, installing a Flat-10 half Tile in alternate rows. Follow the same installation steps securing the solar Tiles following the instructions in step 8 and complete the fixings and connections following steps 2, 3, 4, 5, 6, 7, 8 and 9, finishing on the left side of the roof with a Flat-10 Tile and edge piece following the instructions in (step 7).



STEP 11

Connect the installation to the inverter and ensure that the connections in parallel are correctly executed and the ground connections have been made both between tiles and between rows.

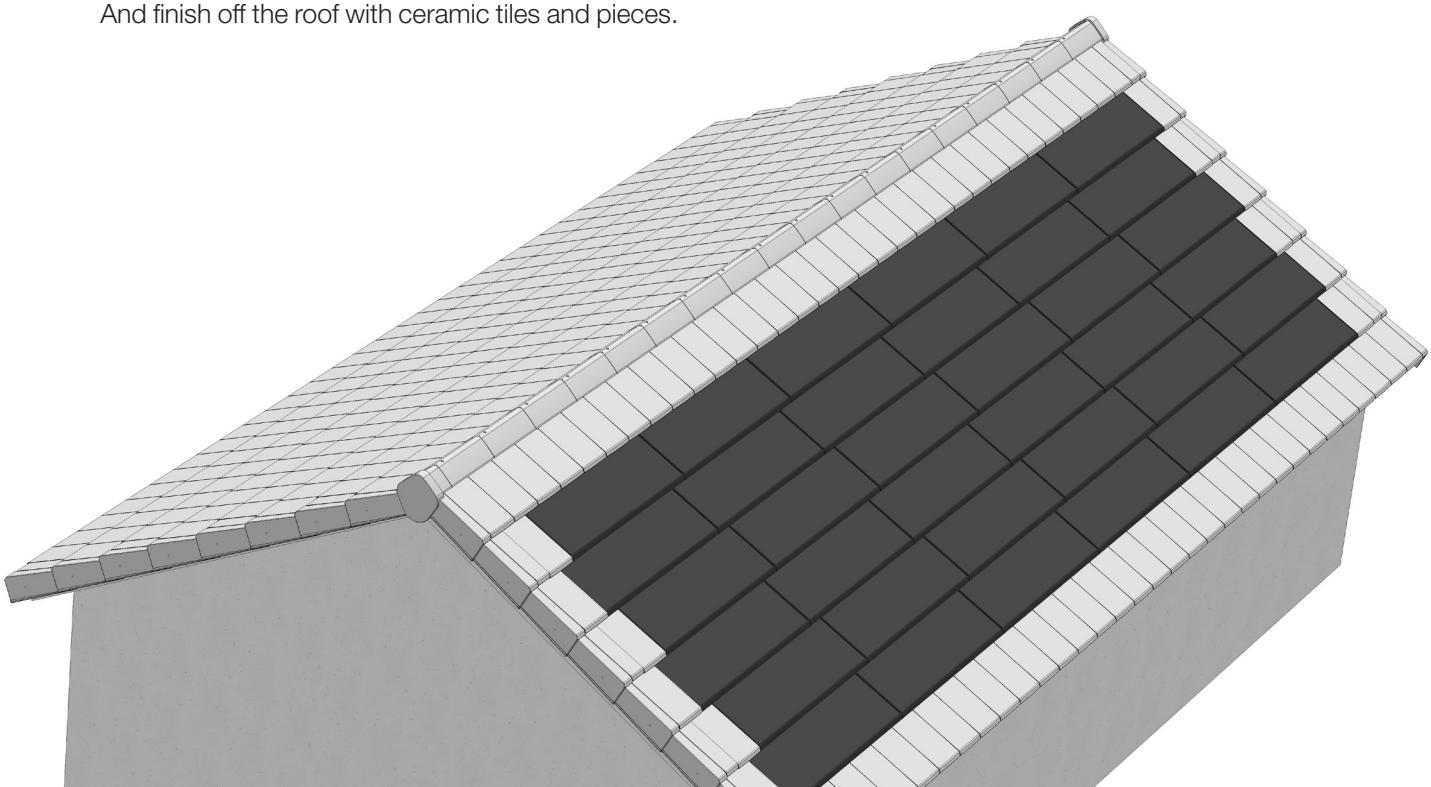




STEP 12

Finally, complete the roof with the installation of Flat-10 ceramic tiles and their complementary accessories on the left side of the roof.

And finish off the roof with ceramic tiles and pieces.



6.8 Electrical installation

You must use components which are compatible with the mounting structure to prevent galvanic corrosion.

Do not mix other modules or different solar tiles (ground connection, cabling) in the same system.

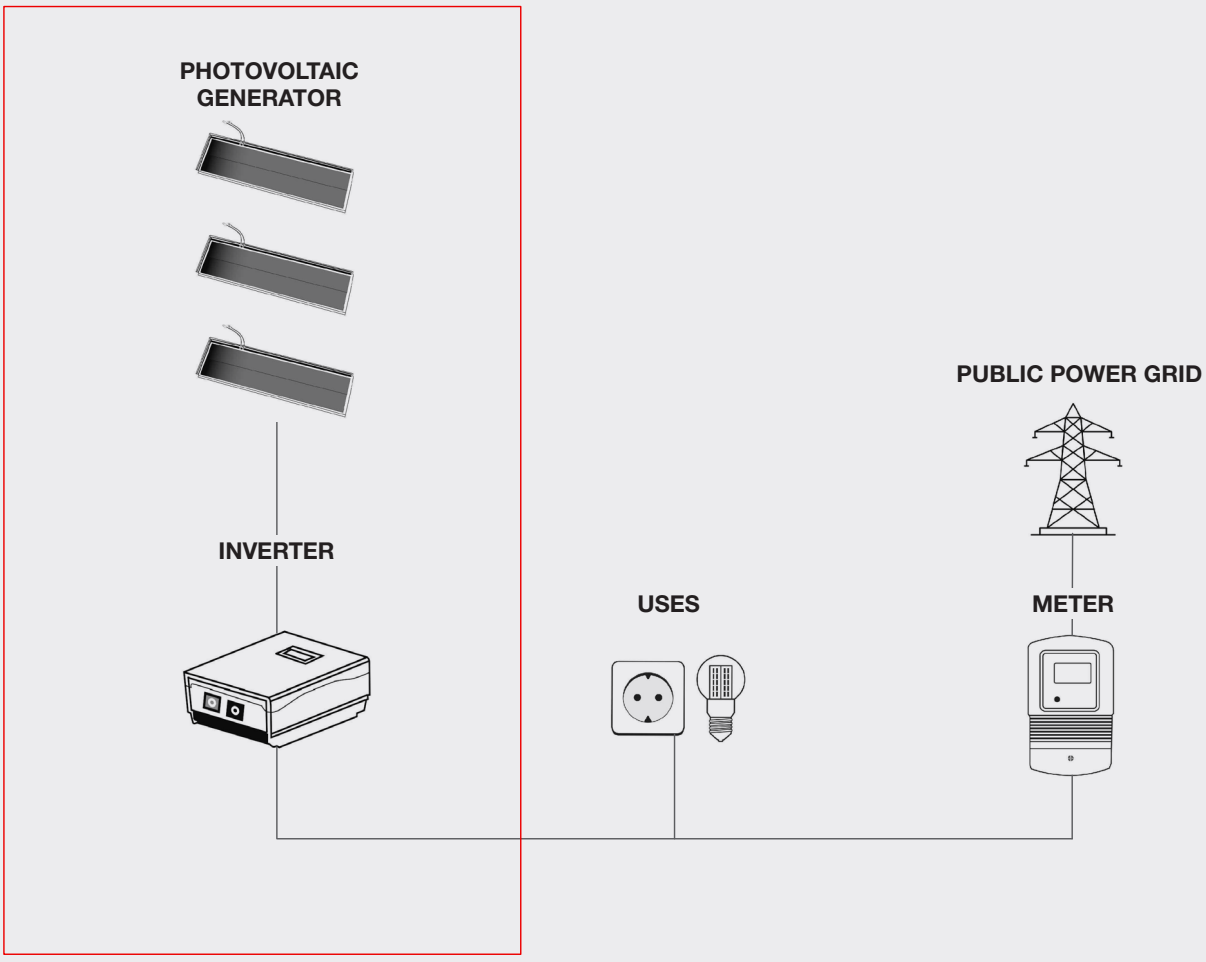
Excess cabling must be organized or fixed in place adequately. For example, fixing cables to the mounting structure using non-metallic cable clamps. Prevent the connectors remaining in contact with the roof supports at all costs.

In the case of applications which require a high operating voltage, various **SOLAR Flat-10 tiles** may be connected in series; the total voltage will be the sum of the voltages across each tile.

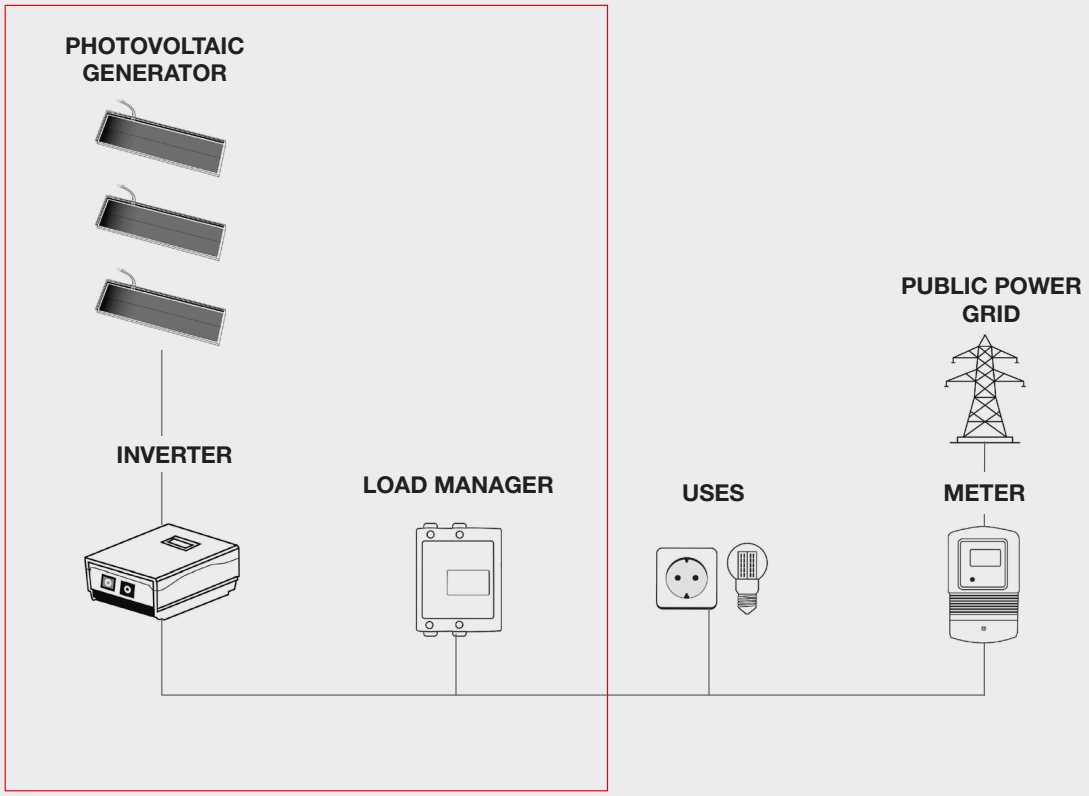
In the case of applications which require high operating currents, various string of tiles may be connected in parallel; the total current will be the sum of the current in each string.

Installations diagram

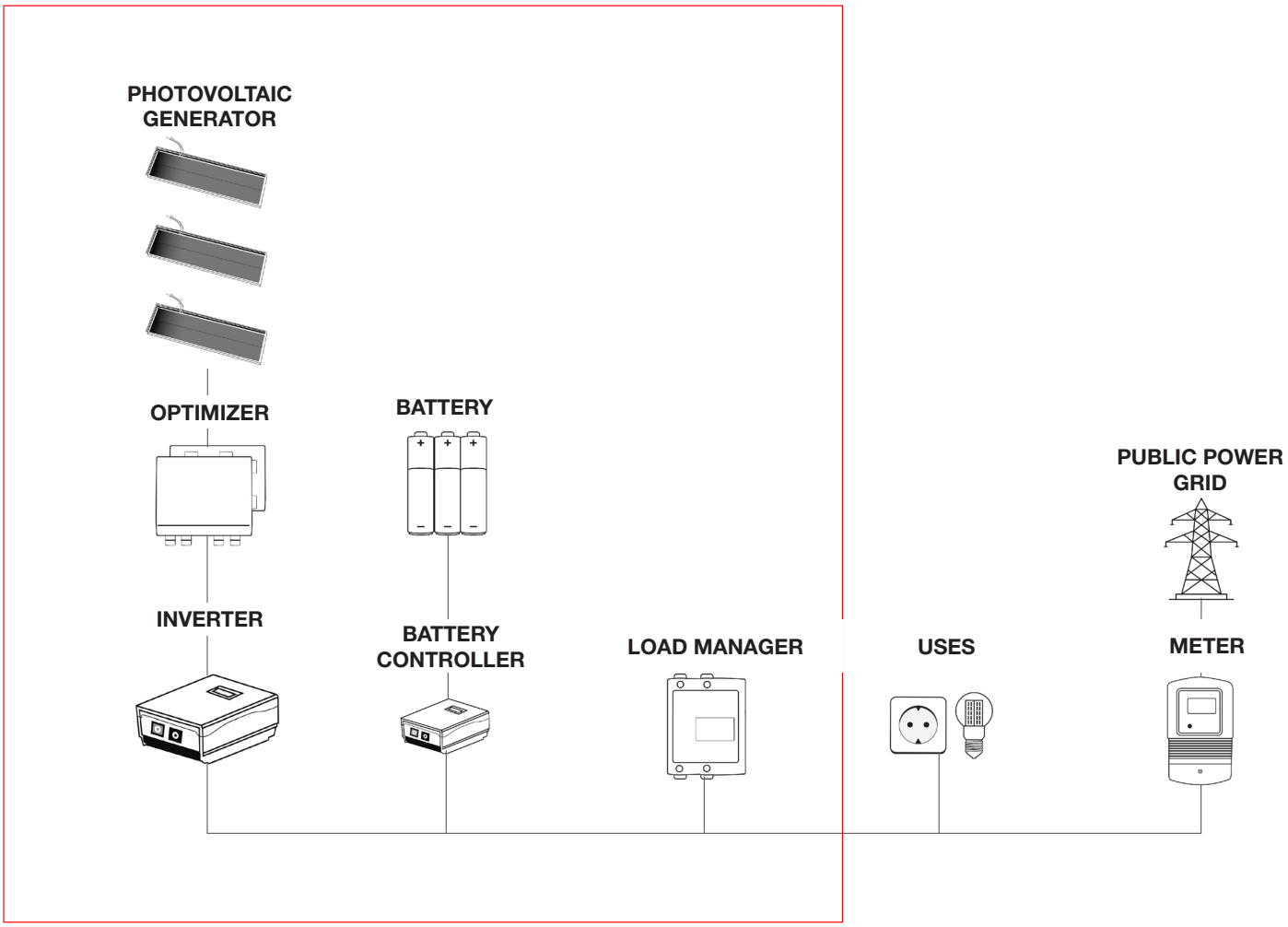
BASIC SYSTEM



RECOMMENDED SYSTEM



EXTENDED SYSTEM



The maximum number of solar tiles which may be connected in series depends on the system design, the type of inverter used and the environmental conditions.

The number of connections in parallel is determined by the system design parameters such as the current or output power.

Long term exposure to wet environments may cause poor connector connectivity, giving rise to current leakage and poor conductivity. Tejas Borja recommends appropriate handling of all cables and connectors to prevent moisture intrusion. Depending on the amount of moisture it is exposed to, Tejas Borja recommends regular inspections of the installation system to maintain optimum module performance.

The direct current generated by photovoltaic systems, once converted into alternating current, may be fed into the public power grid. The policies of electricity companies regarding the connection of renewable energy systems to their networks varies from one country to another. You must always consult a qualified systems designer or integrator. Normally, work permits, inspections and authorizations from relevant bodies are required.

6.9 Connection to the inverter

For safety reasons, please follow the following instructions and recommendations for the connection of the **SOLAR Flat-10 tile** array to the inverter.

The inverter must be located as close as possible to the **SOLAR Flat-10 tile** array so the connection cables can be as short as possible.

All the cabling between the solar tiles and the inverter must be secured using clamps or cable clips. Always use corrosion-resistant fixing elements.

The inverter must always be installed in a vertical position. Check local regulations, the technical specifications for the inverter and its installation manual before starting the installation.

Always follow the wiring diagram.

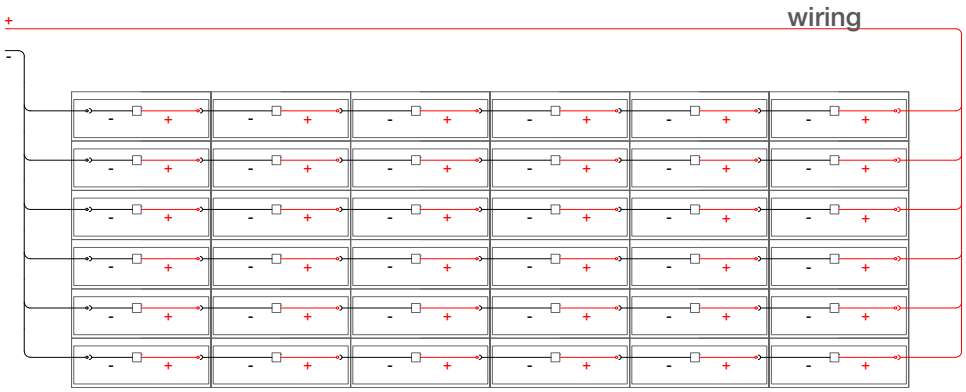
6.10 System wiring diagram

Before beginning the installation, consult the wiring diagram and check the batten layout is suitable to hold the array of Solar Flat-10 tiles, the connections between them and the other elements in the installation.

A solar installation array made using **Solar Flat-10 tiles** will always be formed by series and parallel connections.

Solar Flat-10 tiles include individual pre-connected wires to connect one tile to another.

The diagram below shows the recommended cabling for 36 Solar Flat-10 tiles in 6 strings which each contain 6 tiles (the diagram is not to be scaled up).



Wiring diagram for the system with Solar Flat-10 tiles

The recommended installation direction is from right to left for strings, and from below to above for parallel connections, placing the negative terminal to the left and the positive terminal to the right. To connect the inverter, use a MC4 cable or equivalent cable of the same length. This cable (bridge) may be used to check that each row of solar tiles is correctly interconnected, once a complete row has been installed and before beginning the installation of the row above.

Notes: All the tile-to-tile connections and connections to the inverter must be completed by connecting a negative terminal to a positive terminal, with all the connectors having been designed for this purpose (male - female).

The maximum number of connections and **Solar Flat-10 tiles** is determined by the type of inverter used. Check that the inverter has sufficient capacity for the **Solar Flat-10 tile** array installation. For higher power levels, it may be necessary to install more than one inverter.

6.11 Grounding

This manual refers to the grounding/earthing of the frame of the **SOLAR Flat-10 tile**. If you require a grounding connection, make sure that the frames (exposed metal) are always connected to earth.

When using common grounding materials (nuts, bolts, washers, etc.) to connect a grounding or bonding device, the connection must be made following the manufacturer's instructions for this grounding device.

The size of the ground cable's cross section must be at least 2,5 sq. mm. and its insulation resistance must be above 90ºC or meet the requirements in local regulations.

In the upper part of the **SOLAR Flat-10 tile** frame there is a symbol to denote the grounding hole (4mm in diameter). All the **SOLAR Flat-10 tile** frames in an installation MUST be correctly grounded.

The ground connection is completed between tiles using an ISO 7049 standard screw (Thread size: ST 4,2 / Thread length: from 9,5 to 13 mm) for each ground connection.

For information about grounding and connection requirements, consult regional and national regulations concerning electrical safety. If a ground connection is required, use the type of connector recommended for the ground cable.

For the ground connection, the grounding cable must be firmly fixed to the module frame to guarantee good electrical contact.

6.12 Commissioning

Inspect all the cabling and check the mechanical fixings of the cabling and the rest of the elements.

Check that the segmentation of DC and AC in the installation is correct.

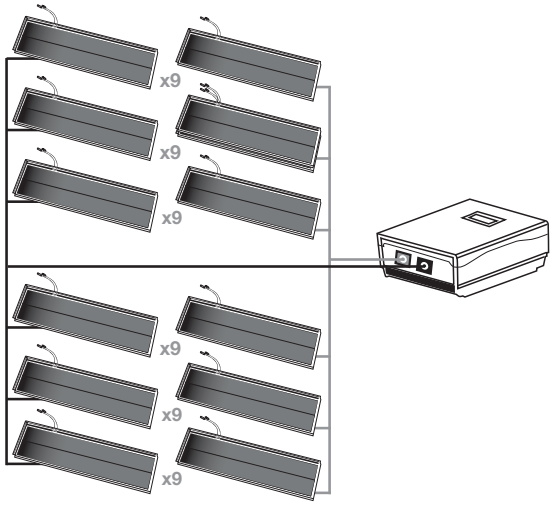
If the installation design includes string fuses, check these are installed and working.

Follow the instructions for installing the inverter contained in the relevant manual.

7 INSTALLATION EXAMPLE

For a 3 kW installation with a 3.000 W inverter, 54 SOLAR Flat-10 tiles will be required. The optimum configuration features 6 strings in parallel with 9 panels in each string. The power output of this configuration is 3.024 Wp, producing an annual energy output of 4.736 kWh.

The financial saving is estimated to be up to €18.944 over 20 years compared to alterative annual electricity costs. The installation also reduces the property's carbon footprint by 1.780 kg/year.



STRING CONFIGURATION

9 // 9 // 9
+
9 // 9 // 9

We will advise you on the design and specification for your installation using the SOLAR FLAT-10 roof tile according to your requirements. Contact us! solar@tejasborja.com

8 MAINTENANCE

The manufacturer recommends that any kind of work or maintenance on sloping roofs made using Tejas Borja products be carried out by trained personnel always following the instructions in the relevant manual and current regulations. Always use PPE.

To ensure the optimal performance of the **SOLAR FLAT-10 roof tiles**, Tejas Borja recommends the following maintenance measures:

An annual service is recommended. Clean the glass surface of the solar tiles. When cleaning, always use clean water and a sponge or non-abrasive cloth.

Carry out a visual inspection of the **SOLAR FLAT-10 roof tiles** to check for any possible damage and/or defects.

Inspect all the visible cabling and check the mechanical fixings of the cabling. Make repairs where necessary.

Check the inverter is operating correctly and check the error code logs if available.

Check the performance of the registration system and test the voltage. The voltage and current report must be within the parameters of the system design.

If a problem occurs, contact Technical Support.

In the event it is necessary to replace any piece of the installation, the installer must make sure that the new pieces are specified by the manufacturer and their characteristics are the same as those of the original pieces. Non-authorized substitutions may lead to fires, electric discharges or other hazards and the voiding of the warranty.

Warning: maintenance must be carried out by trained personnel, respecting the manufacturer's instructions for each system component (solar tiles, inverters, batteries, etc.).

Compile a maintenance report, including the expected electricity output and the real output. Note any time of inactivity or failures in the system during the maintenance process. The completed report must include the date and must be duly signed.

9 PRECAUTIONS FOR SYSTEM SHUTDOWN

When in operation, the installation has a high voltage and current which may put the lives of those handling it at risk.

To prevent the generation of electricity during removal, **SOLAR FLAT-10 roof tiles** must be completely covered with an opaque material.

Removal of the tiles must only be carried out AFTER the system has been turned off. Follow the instruction manuals for each component in the system. Only trained personnel may detach and remove the solar tiles.

10 WARRANTY

The first year, output will be above 97% and above 80% for 25 years from the start of the WARRANTY.

The **SOLAR FLAT-10 roof tile** has a 10-year warranty.

Check the terms and conditions of the warranty for the **SOLAR FLAT-10 roof tile** on our website.

11 GLOSSARY

A

Accumulator: An installation component capable of storing electrical energy by converting it into chemical energy. It is made up of several batteries connected in series or parallel.

Air mass: Measurement of the distance light travels through the atmosphere in its path to the surface of the Earth.

Alternating current: In an alternating current (AC) the electrons, from their fixed position in the cable (mean), oscillate from one side of the mean to the other within the same space or amplitude and at a determined frequency (number of oscillations per second)

B

Battery: Batteries or accumulators store excess energy generated by the photovoltaic system so it can be supplied at times when the system is not generating power (for example at night or on cloudy days).

Bypass diode: A device connected in parallel to the modules to divert the flow of current when solar cells are shaded or a cell fails.

C

Cell efficiency: The percentage of solar energy (captured by a solar cell exposed to full sunlight) which is transformed into electrical energy.

Charge regulator: Also called the control unit or charge controller. A component which controls the flow of current towards the battery and from the battery to devices in order to protect the battery from electrical surges and discharges.

Connection to the public power grid: A system generating electricity may be connected to the public power grid.

D

Direct current: Direct current (DC) is generated from a continuous stream of electrons (negatively charged) always travelling in the same direction, from the negative terminal to the positive terminal. As the electrons set off in this direction, the gaps or absence of electrons (positive charged particles) move in the opposite direction, from the positive to the negative terminal.

E

Electric intensity (Current): Electrical magnitude defined as the amount of electricity that passes through a section of conductor cable in one second. It is measured in amperes (A).

Electric tension (Voltage): Difference in electric potential which must exist between connection terminals or between two live points in a system for current to flow through said system. The unit of measurement is the volt (V).

Electrical conductor: Any material capable of conducting an electric current.

Electrical installation: Group of devices and associated circuits for a specific purpose: the production, conversion, transformation, transmission, distribution or use of electrical energy.

Electrical power: The capacity of electrical devices to produce work (the amount of energy consumed per unit time). The unit of measurement is the watt (W) or kilowatt (kW).

Electricity consumption: Number of watt hours (Wh) or kilowatt hours (kWh) used to make an electrical device function for a given time. Depends on the power of the device and the amount of time it is using electricity.

Electricity meter: An instrument which measures the electrical energy consumed. It may be the property of the client or the electricity company. It measures consumption in kWh.

G

Grounding (Earthing): Connection to the ground to use as a backup pathway, providing an alternative route for the current to flow back to the ground in an electrical circuit and arbitrarily as a zero potential point.

I

I-V curve: Current (I) and voltage (V) curves show the I and V characteristics of a particular photovoltaic module, measured under specific radiation conditions. Essential information to characterize photovoltaic modules.

J

Junction box: A box integrated into the solar tile which houses the cables used for electrical connections.

K

Kilowatt (kW): A thousand watts (1 kW = 1.000 W)

L

Load: Any electrical component that consumes electric power. This will depend on each system and varies during the day in accordance with the way in which the system works.

Load controller: A component in the photovoltaic system which regulates battery charging.

M

Maximum power current: Current corresponding to the maximum power point.

Maximum power point: Point on the I-V curve where the product of I x V (power) has its maximum value (the top of the curve).

Maximum power voltage: Voltage corresponding to the maximum power point.

Module or solar photovoltaic module: A group of interconnected solar cells within a sealed unit.

N

Nominal power: Power according to the specifications or nameplate of a generating unit.

O

Open circuit voltage: Voltage measured at the terminals in a photovoltaic system at zero current.

Orientation (Azimuth): Angle of orientation of the surface of a panel in relation to the solar south. The geographical south (or true solar south) should not be confused with the magnetic south, which is shown by a compass, although in Spain the difference between the two is not very significant.

P

Parallel connection: Connection method in which all the positive terminals of a module are connected together at one point in the circuit and all the negative terminals are connected together at another point. If the modules in the circuit are all the same, the total circuit current is equal to the sum of the individual module currents. The voltage is equal across all modules in the circuit.

Peak sun hours: Hours in which the solar irradiance reaches an average of 1 kWh/sq. m..

Performance: The relationship between the energy which is really converted into useful energy and that which a certain device needs to function.

Pitch: The angle between the photovoltaic panel and a perfectly horizontal or level surface.

S

Series connection (String): Connection method in which the positive terminal of a module is connected to the negative terminal of the next module and so on. If the modules are all the same, the voltage across the circuit is the sum of the individual voltage drops across each module and the current that flows through the modules is the same.

Short circuit: An unintended connection between two conductors of different phases or a connection between these and a neutral conductor.

Short circuit current: Current which is measured at the terminals of a module when a short circuit occurs.

Solar array: A group of solar photovoltaic modules installed and electrically connected.

Solar cell or photovoltaic cell: A device which converts sunlight (photons) into electricity. It is the fundamental element in solar photovoltaic panels.

Solar radiation: Amount of energy from the sun which reaches a surface in a certain period of time.

Solar Tile : A Tile with photovoltaic properties and characteristics. In addition to generating clean and renewable energy, it is an element which integrates completely into the outer layer of the roof, ensuring the watertightness of the roof and contributing aesthetic value.

Standard test conditions (STC): Conditions under which photovoltaic modules are tested in the laboratory (1 kWh/sq. m. solar radiation, cell temperature at 25°C and solar spectrum corresponding to an air mass of 1,5).

String: See Series connection.

Switch: Device used to connect or disconnect part of an electrical installation.

W

Wp (Watt peak): Unit of measurement for a solar photovoltaic module which denotes the maximum power the module can generate under standard operating conditions (1.000 W/sq. m., 25°C and air mass of 1,5).

Roof & Plug

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