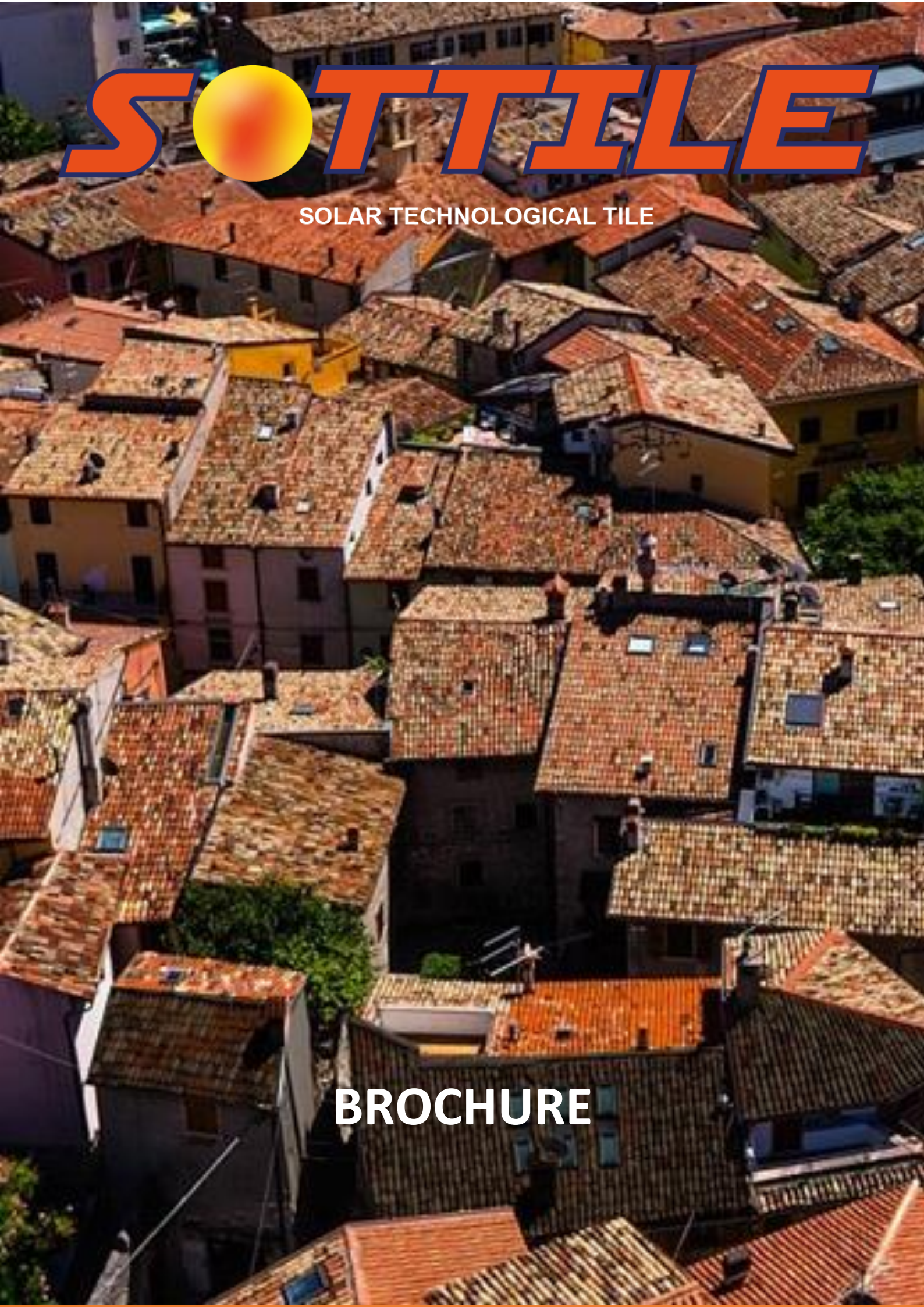
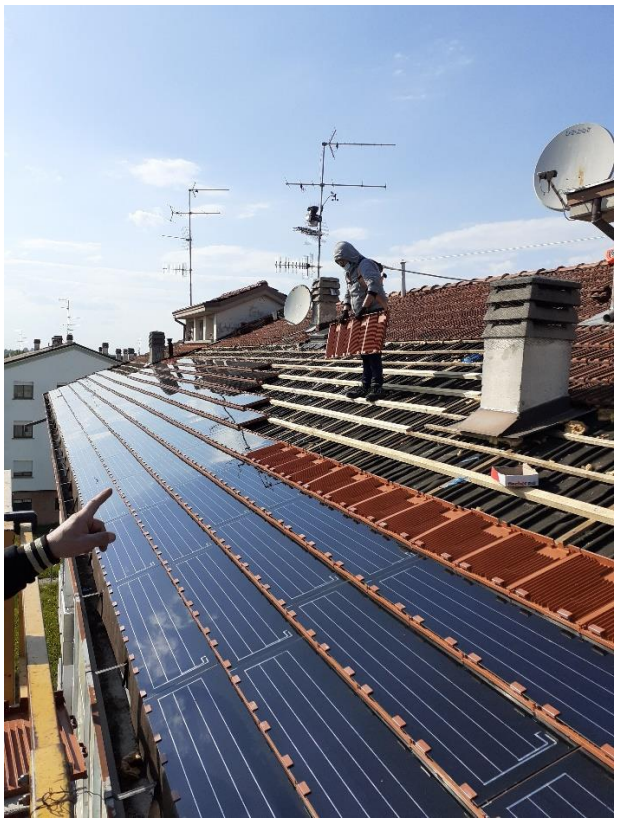
SOTTILE

SOLAR TECHNOLOGICAL TILE



BROCHURE

Table of content



1 Concept

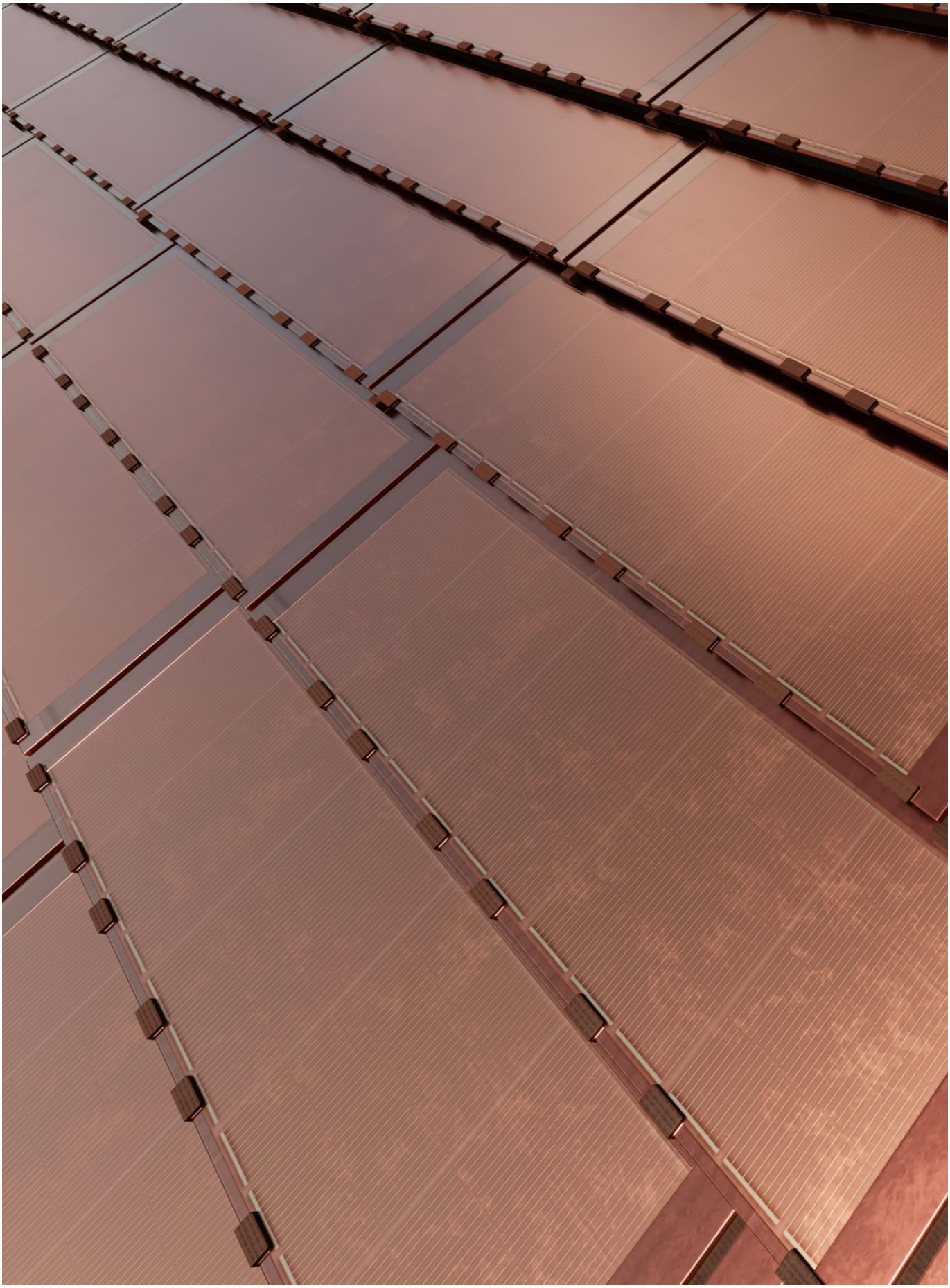
SOTTILE is a play on words between the acronym for Solar Technological Tile and the lightness of a practical, efficient and innovative component intended for building integration of photovoltaic systems. The concept is led by the logic of Sustainable Architecture and Circular Economy, and its application makes it possible to easily transform a traditional roof into a solar electricity generator, in combination with virtually any type of tile.

SOTTILE is a complete system, consisting of modular elements according to the desired geometry and dimensions and specially designed for installation on pitched roofs, in combination with virtually any type of tile. In fact, it can be used in place of clay roofing exclusively in the portions intended for the solar system, while the remaining portions of the roof can be covered with traditional elements.

SOTTILE was developed as part of the HEART (Holistic Energy and Architectural Retrofit Toolkit) project, coordinated by the Politecnico di Milano as part of the Horizon2020 Research and Innovation Program sponsored by the European Union.

Each element of SOTTILE consists of a 4 singular modular supports made of recycled plastic, on which the photovoltaic laminate with crystalline silicon cells, is connected . The entire system and its sub-components are designed to be quickly assembled and disassembled, greatly facilitating installation, maintenance and decommissioning practices.

The color of the modular support, as the photovoltaic laminate, can be customized in order to increase the integration with existing context.



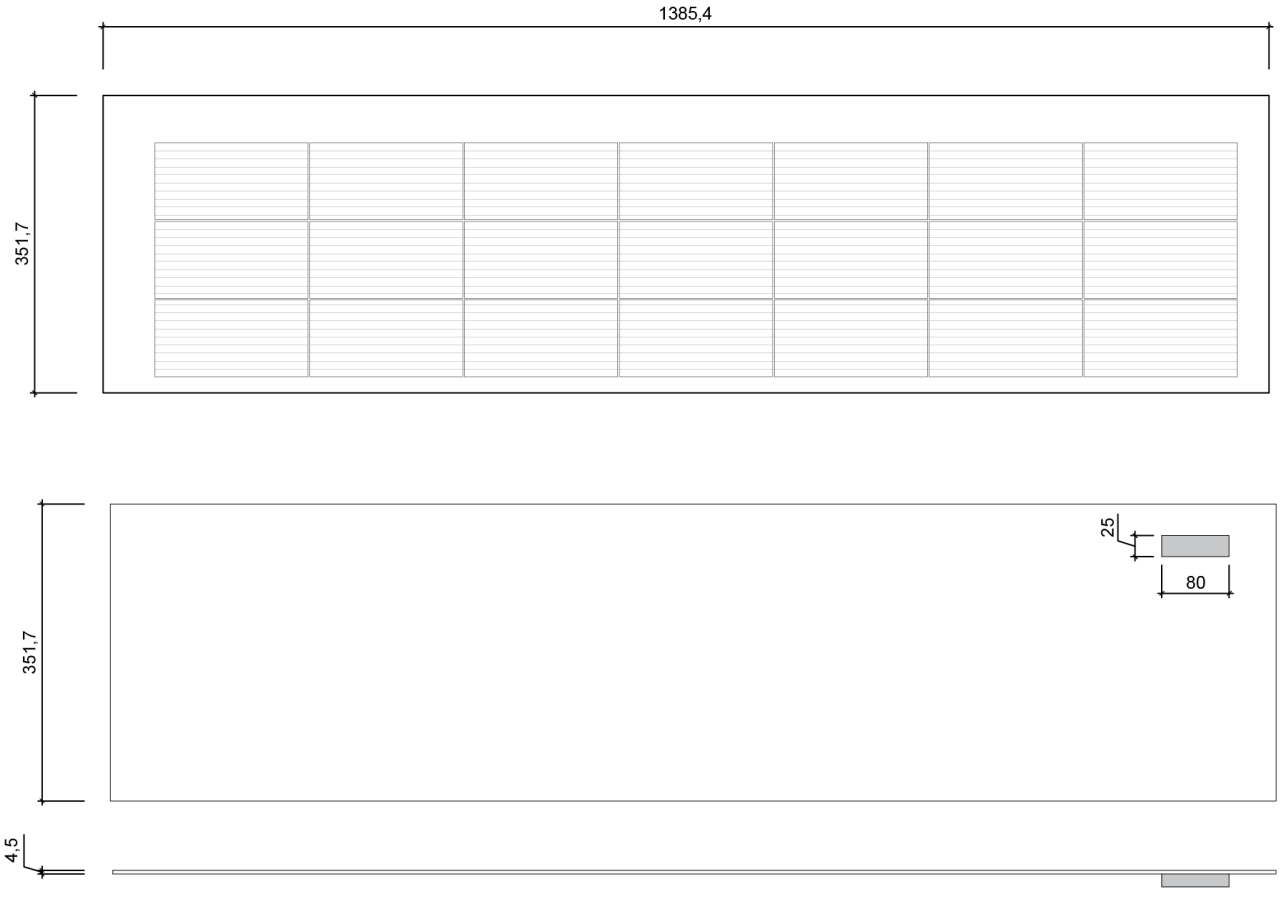
2 Technical information

2.1 PV laminates

The (black) PV module is manufactured with monocrystalline cells connected in series, laminated between an antireflective glass (3 mm thick) and a backsheet layer. Each module is able to provide a power of 85 Wp and 70W at STC in the black and red/orange color respectively. The detailed electrical features of the module are reported in the following table.

Color	P_{mpp} [W]	V_{oc} [V]	I_{sc} [A]	V_{mpp} [V]	I_{mpp} [A]
BLACK	86	13.05	7.05	12.7	6.77
RED	76	12.22	6.83	11.90	6.38

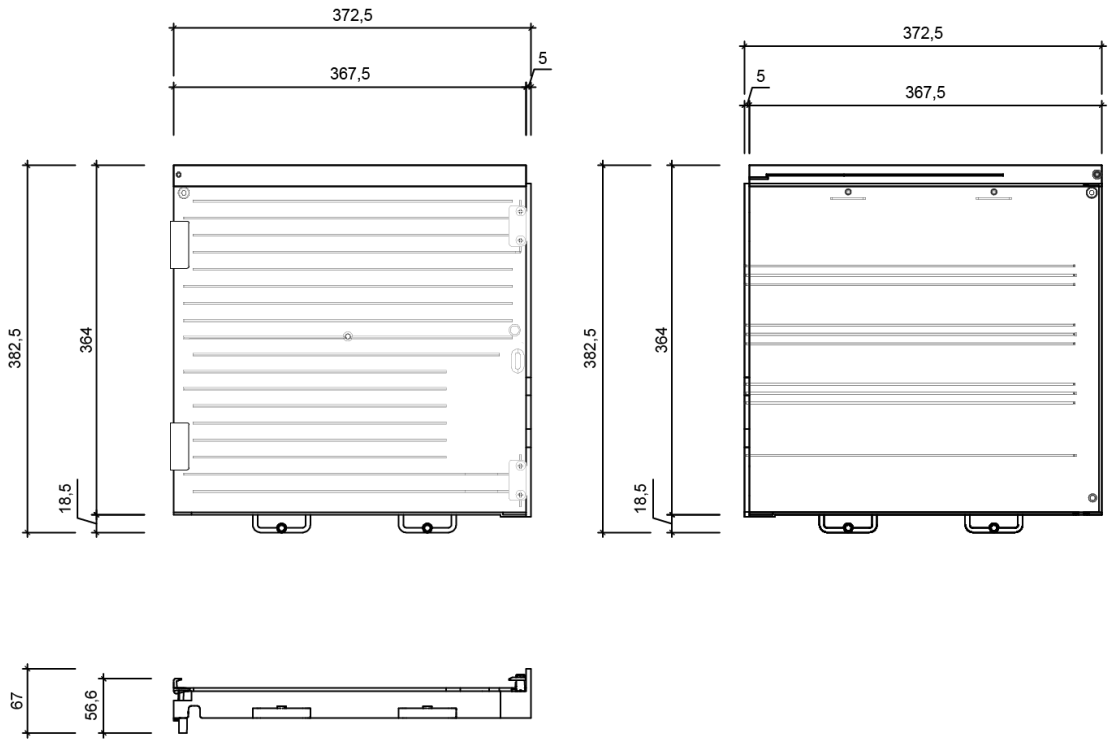
The laminate is (L x W) 1385,4 mm x 351,7 mm, as shown in the following figure. The junction box, completely watertight (IP 67), is placed in the corner on the back side attached with silicon adhesive. It encapsulates solar bypass diodes that keep solar power flowing in one direction and prevent it from feeding back to the solar PV laminate.
Besides, such component allows the installation of Multi-Contac connectors (MC4) with 6 mm^2 cables.



Front, back and side views of the PV laminate (all measures are reported in mm)

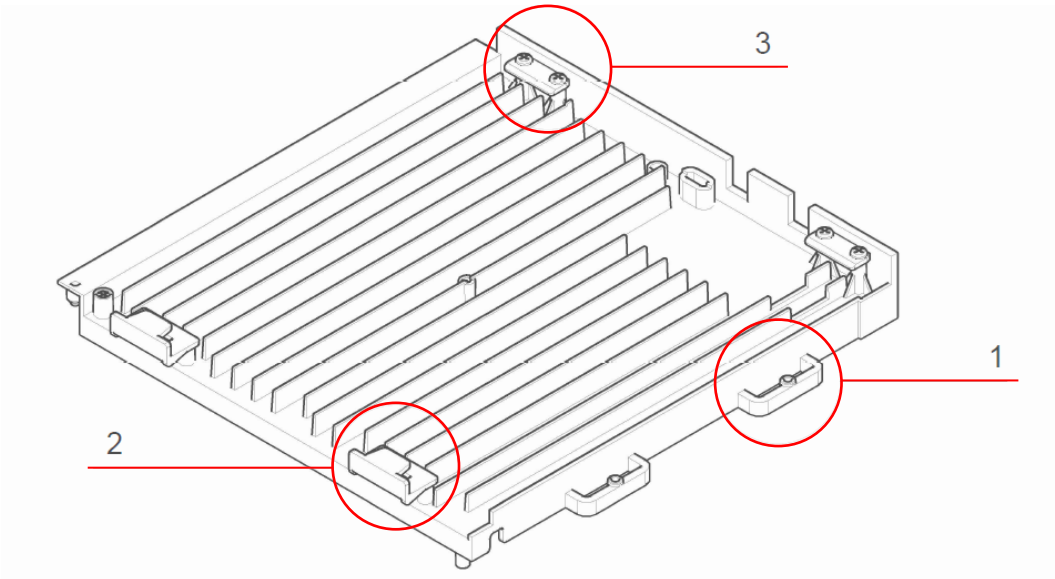
2.2 Modular supporting frame

The supporting frame which holds one PV laminate is made up by 4 recycled plastic modular elements, designed to be light-weighted, easy to handle and characterized by a snap-in connection. Each element in fact is a sort of a square, smaller than 0.16 m^2, easy to handle by only one worker and linked to the other elements through easy plug-snaps. In the following figure the main views of the supporting frame are reported.



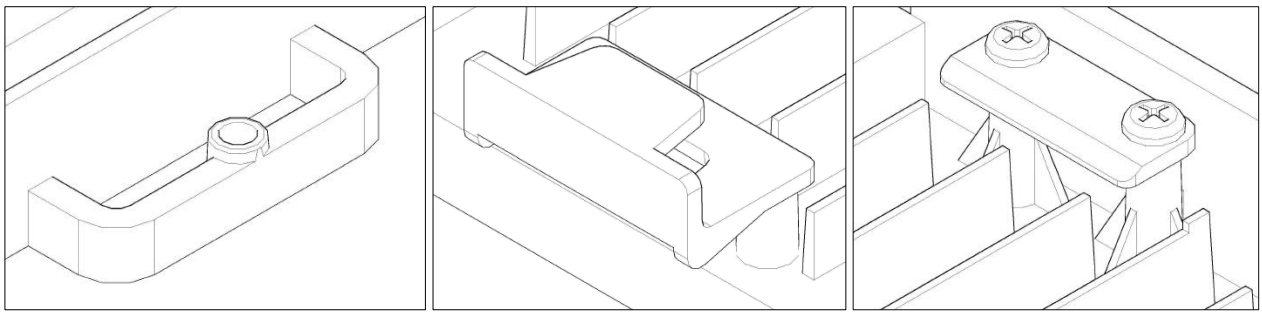
Front, back and sides views of one modular supporting frame (all the measures are reported in mm)

Both sides of each modular element are stiffened with ribs (16 mm high and 2 mm thick) that guarantees mechanical resistance avoiding the bending of the surface. In the main front the ribs are interrupted in correspondence of the location of the PV laminate's junction box, in order to ensure its flatness.



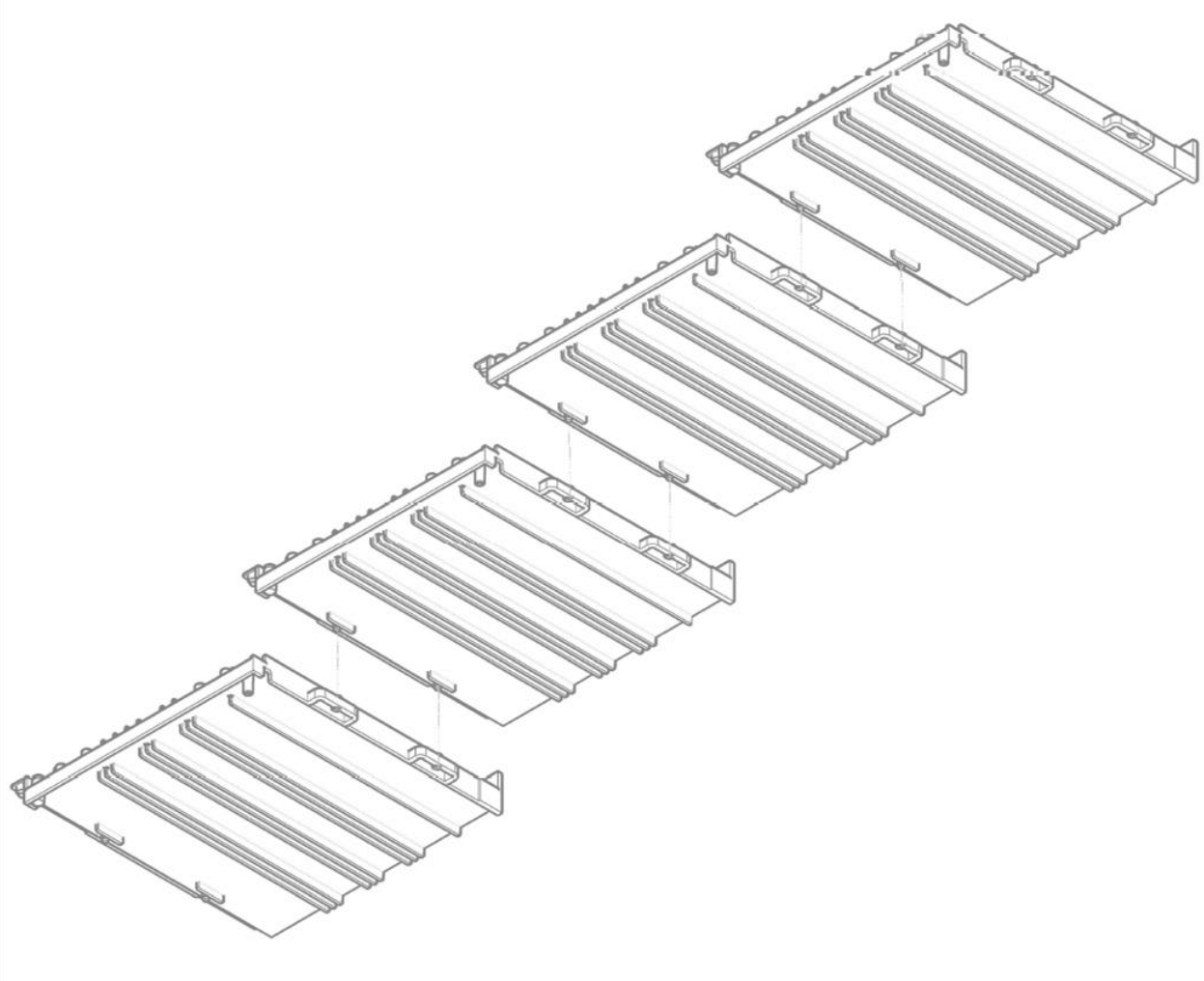
Isometric view of the frame (the numbers are related to the details reported in the next figures)

The link among frames of the same row is provided by tongue and groove joint protruding on the external side of the frame as shown in the next figure (detail 1). Moreover, thanks to the specific designed shape, such joints absorb effectively the geometrical expansion of the material due to temperature.

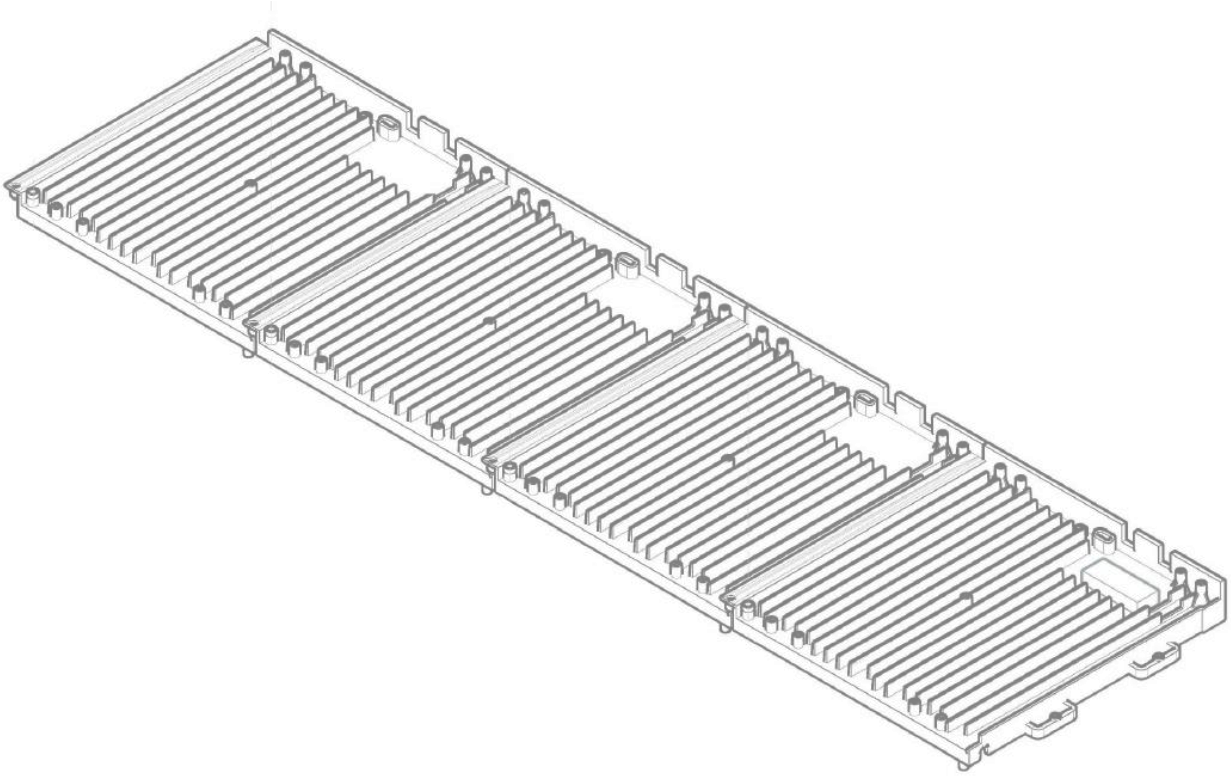


Isometric view of the joint connection between modules detail 1(left) and anchor profiles detail 2 (center) and 3 (right)

The coupling of each supporting frame with the PV laminate is obtained with 4 cramps (anchor profiles): 2 snapped in the lower part (detail 2) and 2 screwed in the upper part of the frame (detail 3). On the opposite side compared to the joints, a protruding lag covers the gap between frames, providing hence the waterproofing among frames in the same row.



Isometric backside view of the 4 supporting frames



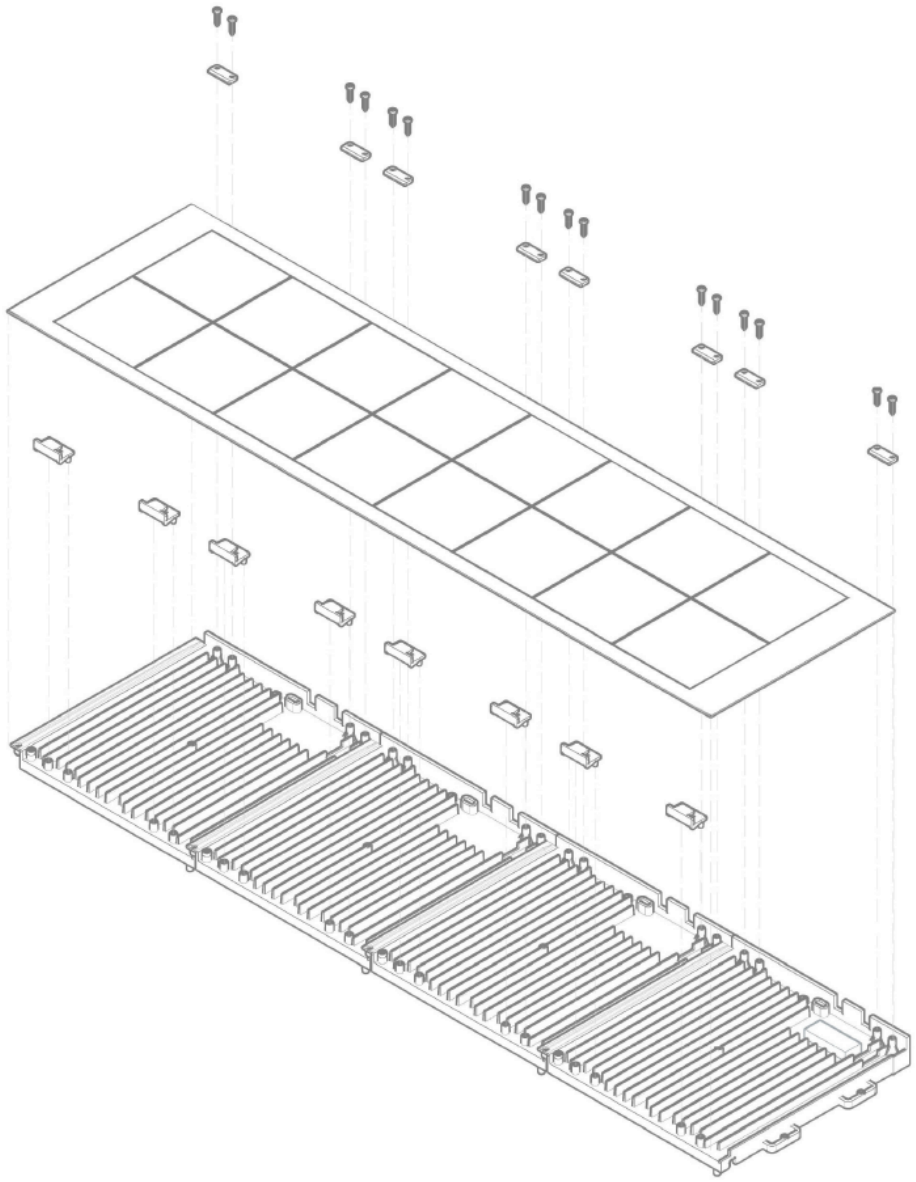
Isometric front view of the 4 linked supporting frames

It should be noted that the waterproofing of the roof is provided by the connection of the supporting frame, without the need to add additional layers, as described in the next section.

Laboratory testing of connections on prototypes

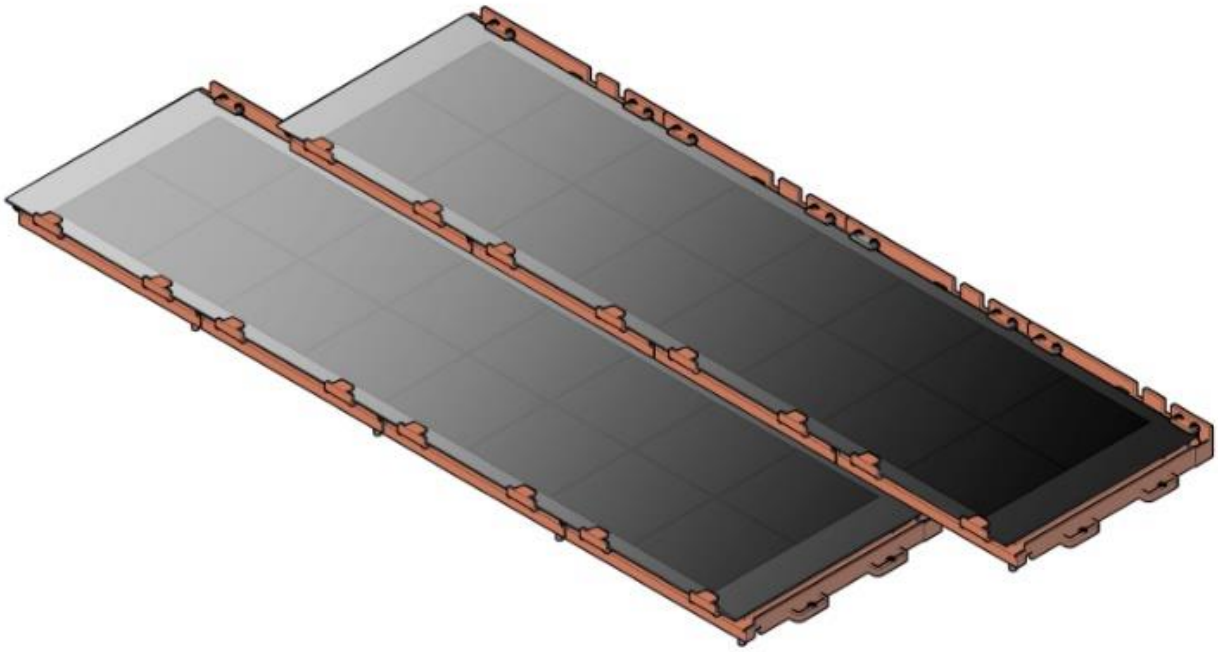
2.3 Overall component and connections

As already mentioned, the coupling of the 4 supporting frames with the PV laminate is fulfilled with 16 cramps (anchor profiles); in such respect, when the 4 frames are placed next to each other, the snap joints can be added, the PV laminate is overlapped to the frames and finally the screwed joints mechanically secure the PV module. The assembly steps are shown in the next figure.

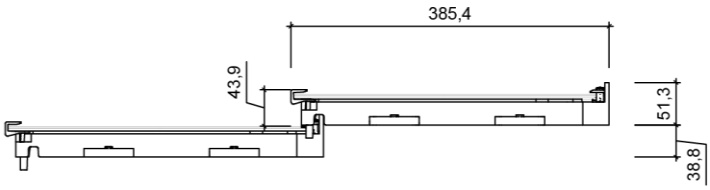


Assembly of the 4 frames with the PV laminate

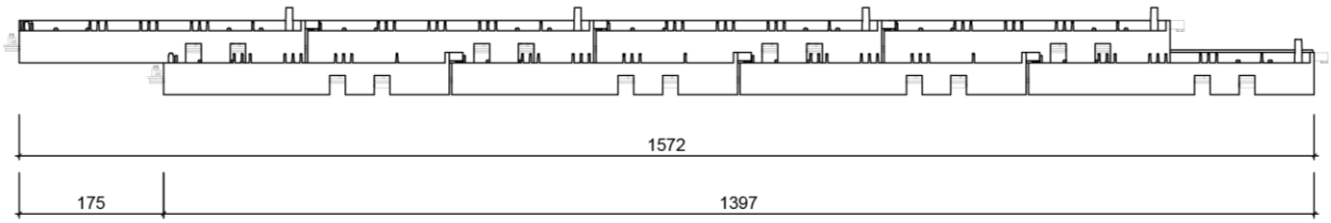
The figure of the final PV tile is reported below. It should be noted that the whole component must be assembled directly on the roof.



Axonometric view of 2 PV tiles

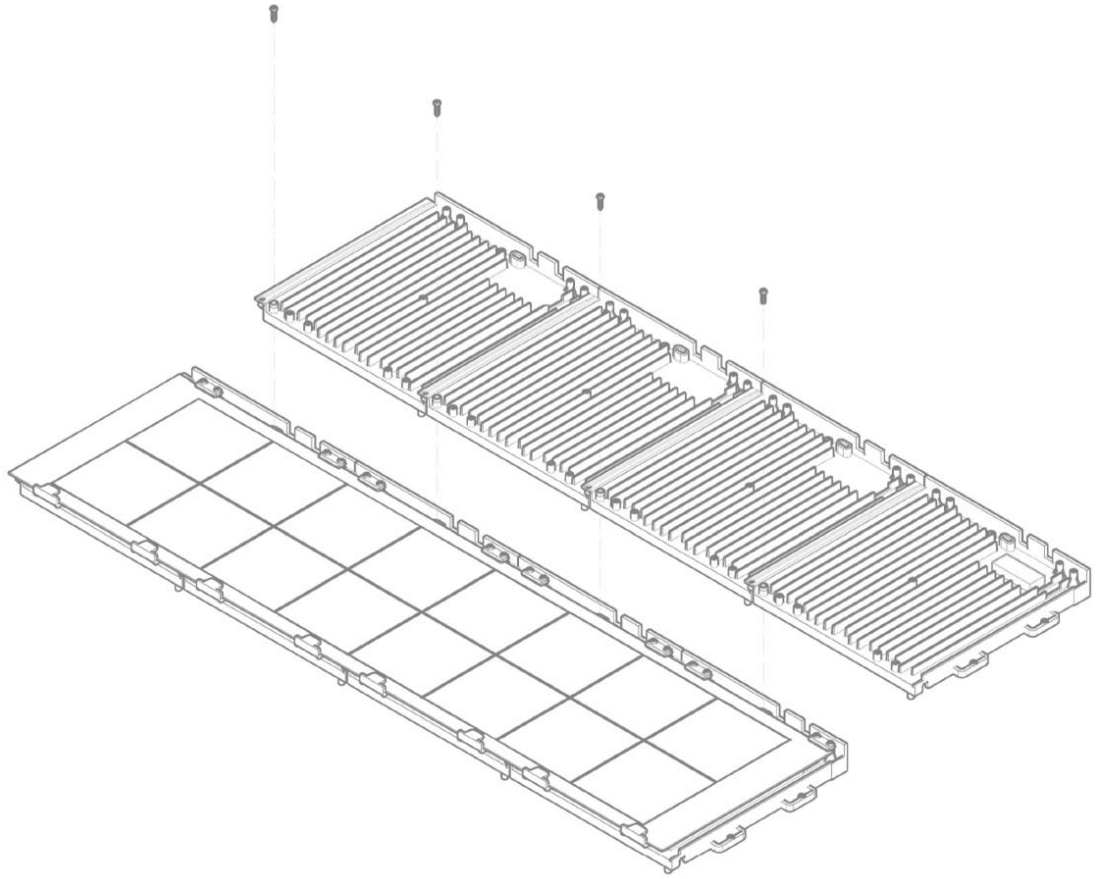


Transversal of 2 PV tiles (sizes in mm)



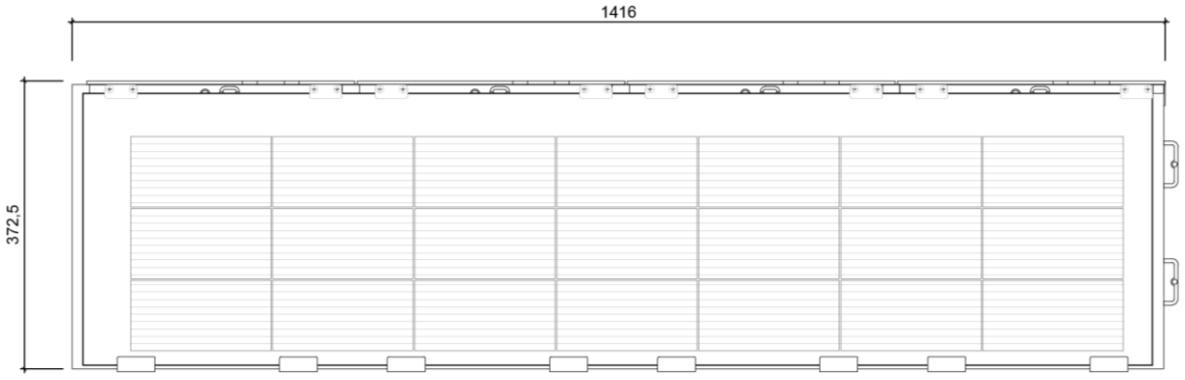
Longitudinal of 2 PV tiles (sizes in mm)

PV tiles in the same row could be easily installed trough the joint connections already shown in detail 1. When the first row is completed, the second one must be overlapped on the upper edge and screwed in the specific slots (4 for each PV tile), as shown in following figure.



Final layout of 2 overlapped PV tiles in different row

The holes and the screws are finally covered with the PV laminate which further guarantee the waterproofing.



Top view of the PV tile

2.4 Summary of the technical information

Dimensional features	**Black tile**	**Red tile**
Size of the PV laminate (Width, Length, Thickness)	351.7 x 1385.4 x 4.0	
Weight of the PV laminates [kg]	≈6 kg	
Size of the modular supporting frame (Width, Length, Thickness)	372.5 x 382.5 x 67	
Weight of the modular Supporting frame [kg]	≈1 kg	

Dimensional features		
Power output in STC [W_p]	86	76
Voltage at MPP [V]	12.7	11.90
Current at MPP [A]	6.77	6.38
Open circuit voltage [V]	13.05	12.22
Short circuit current [A]	7.05	6.83

Installation and operation features	
Minimum operating temperature [°C]	-40°C
Maximum operating temperature [°C]:	+80°C
Minimum operating relative humidity (at min. temperature) [%]	0
Minimum operating relative humidity (at max. temperature) [%]	100

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