



PHOTOVOLTAIC SOLAR ENERGY POLYCRYSTALLINE MODULES - SI-ESF-M-P156-48



These PV modules use squared, high-efficiency, polycrystalline silicon cells (the cells are made of several crystals of high purity silicon) to transform the energy of sunlight into electric energy. Each cell is electrically rated to optimize the behavior of the module.

The cell circuit is laminated using EVA (Ethylene-Vinyl Acetate) as an encapsulant in combination with a tempered glass on its front and a plastic polymer (Tedlar) on the back which provides complete protection and seals against environmental agents and electrical insulation.

The junction boxes with IP-65, are made from high temperature resistant plastics and containing terminals, connection terminals and protection diodes (by-pass).

Its performance is excellent over the entire range of light spectrum, with particularly high yields in low light situations or cloudiness to direct sunlight (diffuse radiation).

The compact, anodized aluminum frame provides an optimal relationship-weight moment of inertia, to obtain greater rigidity and resistance to twisting and bending. It has several holes to attach the module to the support structure and ground if necessary.

The design of these modules makes their integration in both industrial and residential buildings (one of the most emerging sectors in the photovoltaic market), and other infrastructure, simple and aesthetic.

WARRANTIES

Our manufacturing plants have been prepared in accordance with the ISO 9001:2008, ISO 14001:2004 and OHSAS 18001:2007.

We have quality control divided into three elements:

- ✓ Regular inspections allow us to guarantee the quality of the raw material.
- ✓ Quality control in the process of our manufacturing procedures.
- ✓ Quality control of finished products, we conduct through inspections and tests of reliability and performance.

Our PV modules are certified by internationally recognized laboratories and are proof of our strict adherence to international safety standards, long term performance and overall quality of products.



PHOTOVOLTAIC SOLAR ENERGY

POLYCRYSTALLINE MODULES - SI-ESF-M-P156-48

| ELECTRICAL CHARACTERISTICS | | | | | | | | | | |
|---------------------------------|----------|-----------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Maximum power (Pmpp) | Wp | 170 | 175 | 180 | 185 | 190 | 195 | 200 | 205 | 210 |
| Tolerance | Wp | 0 ~ + 5 | | | | | | | | |
| Voltage at maximum power (Vmpp) | Volts | 23.41 | 23.41 | 23.72 | 23.76 | 23.83 | 23.99 | 24.18 | 24.34 | 24.49 |
| Current at maximum power (Impp) | Amperes | 7.26 | 7.48 | 7.59 | 7.79 | 7.97 | 8.13 | 8.27 | 8.42 | 8.57 |
| Open circuit voltage (Voc) | Volts | 28.9 | 28.9 | 29.28 | 29.33 | 29.42 | 29.62 | 29.86 | 30.05 | 30.24 |
| Short circuit current (Isc) | Amperes | 7.99 | 8.06 | 8.32 | 8.38 | 8.5 | 8.63 | 8.77 | 8.83 | 8.97 |
| Maximum system voltage (Vsyst) | Volts | 600 (UL) / 1000 (IEC) | | | | | | | | |
| Diodes (By-pass) | Quantity | 6 | | | | | | | | |
| Maximum series fuse | Amperes | 15 | | | | | | | | |
| Efficiency (ηm) | % | 12.94 | 13.32 | 13.7 | 14.09 | 14.47 | 14.85 | 15.23 | 15.61 | 15.99 |
| Form Factor | % | ≥ 73 | | | | | | | | |

| MECHANICAL CHARACTERISTICS | | | |
|----------------------------|------------|---|---------------------------|
| Size | Height | 1324 mm | 52.1 inches |
| | Width | 992 mm | 39.1 inches |
| | Thickness | 40 mm | 1.57 inches |
| Weight | Net | 15 kg | 33.1 lbs |
| Frame | Material | Anodized aluminum AL6063-T5, minim 15 μm | |
| Front | Material | High transmissivity toughened glass | |
| | Thickness | 3.2 ± 0.2 mm | 0.13 inches |
| Cells | Type | Polycrystalline | |
| | Quantity | 6 x 8 | |
| | Size | 156 x 156 mm | 6 inches |
| Serial connection | Quantity | 48 | |
| Parallel connection | Quantity | 1 | |
| Encapsulation | Material | EVA | |
| | Thickness | 0.50 ± 0.03 mm | 0.020 ± 0.0012 inches |
| Back-Sheet | Material | TPT | |
| | Thickness | 0.32 ± 0.03 mm | 0.013 ± 0.0012 inches |
| Junction box | Material | PVC | |
| | Protection | IP-65 | |
| | Isolation | Versus humidity and inclement weather | |
| Cables | Type | Polarized and Symmetric in length | |
| | Length | 900 mm | 35.4 inches |
| | Section | 4 mm ² | 0.006 inches ² |
| | Features | Low contact resistance Minimal losses for voltage drop | |
| Connectors | Material | PVC | |
| | Type | MC4 | |
| | Protection | IP-67 | |

| THERMAL CHARACTERISTICS | | |
|--|------|----------|
| Temperature coefficient of short circuit current α (Icc) | %/°C | + 0.055 |
| Temperature coefficient of open circuit voltage β (Voc) | %/°C | - 0.347 |
| Temperature coefficient of power γ (Pmpp) | %/°C | - 0.48 |
| Maximum power temperature coefficient (Impp) | %/°C | + 0.10 |
| Voltage temperature coefficient of maximum power (Vmpp) | %/°C | - 0.38 |
| NOCT (Nominal Operating Cell Temperature) | °C | + 47 ± 2 |

| TOLERANCES | | |
|----------------------------------|-----------------------|-------------------|
| Working temperature | °C | - 40 ~ + 85 |
| Dielectric Isolation Voltage | V | 3000 |
| Relative humidity | % | 0 ~ 100 |
| Wind resistance | m/s | 60 |
| | kg/m ² | 2400 |
| | lbs/feet ² | 491.56 |
| Mechanical load-bearing capacity | kg/m ² | 551 (5400 Pa) IEC |
| | lbs/feet ² | 75.2 (3600 Pa) UL |
| Fire resistance | Class | C |



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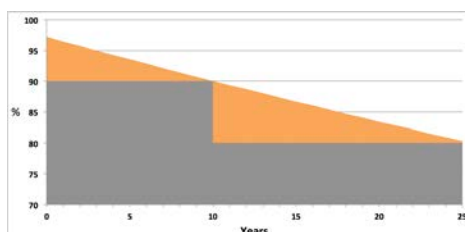
| MEASUREMENTS PERFORMED IN ACCORDANCE WITH ASTM STANDARD TEST METHODS E1036, CORRECTED TO STANDARD TEST CONDITIONS (STC) | | |
|---|------------------|---------------------------|
| Air quality/Spectral distribution | AM | 1.5 ASTM G173-03e1 (2008) |
| Luminous intensity/Radiation | W/m ² | 1000 |
| Cell temperature | ° C | 25 |








| MEASUREMENTS PERFORMED IN SOLAR SIMULATOR | |
|---|--------------------------------|
| Class | AAA (according to IEC 60904-4) |
| Power measurement uncertainty is within | ± 3 % |

| STRUCTURAL CHARACTERISTICS | |
|----------------------------|---|
| Cells | High efficiency cells with anti-reflective layer of Silicon Nitride. |
| Electric conductors | Flat Copper (Cu) bath in a Tin (Sn) and Silver (Ag) alloy, which improves weldability. |
| Welding | Of cells and drivers in sections for stress relief. |
| Laminate | Composed of ultra-clear tempered glass on the front, thermostable, EVA encapsulant embedding cells and electrical insulation on the rear formed by a tedlar and polyester compound. |
| Junction box | Hoses and quick connectors with anti-error. Include bypass diodes, interchangeable thanks to the wiring system has no welds, all electrical contacts are made by pressure, thus avoiding the possibility of cold welding. |

| CHARACTERISTICS OF WORK | |
|-------------------------|--|
| | - The power of solar cells vary in the output of the production process. The different power specifications of these modules reflect this dispersion. |
| | - Cells during the early months of light exposure, may experience a degradation photonics could decrease the value of the maximum power of the module up to 3 %. |
| | - The cells, in normal, operating conditions, reach a temperature above the standard measurement conditions of the laboratory. The NOCT is a quantitative measure of the increase. NOCT measurement is performed under the following conditions: radiation of 0.8 kW/m ² , temperature 20° C and wind speed of 1 m/s. |
| | - The electrical data reflects typical values of the modules and laminates as measured at the output terminals at the end of the manufacturing process. |

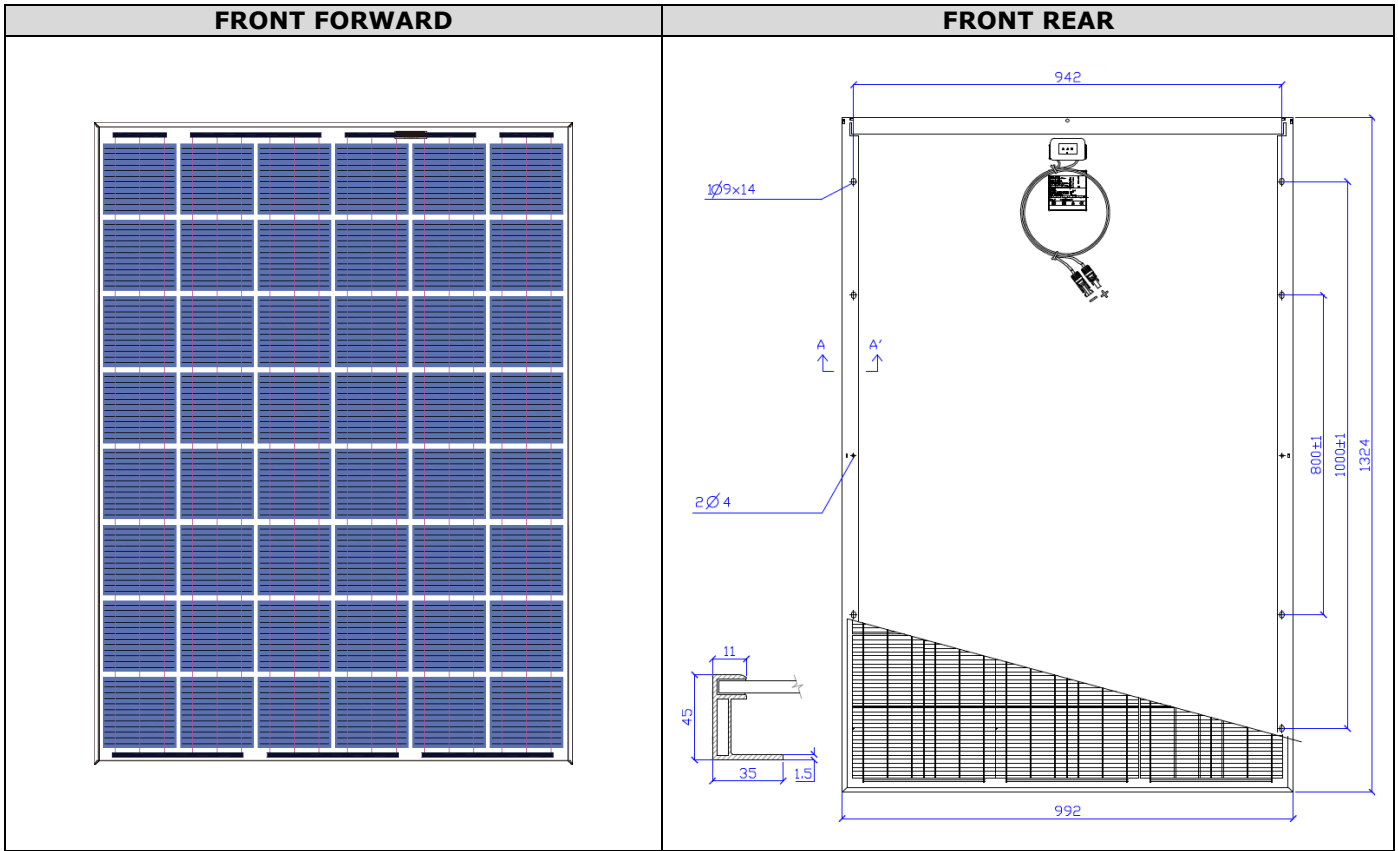
| WARRANTIES | | |
|-----------------------|-----------------------------|--|
| Manufacturing defects | Years | 12 |
| Performance | Minimal Rated Power %/Years | 90 % at 12 years, 80 % at 25 years. |



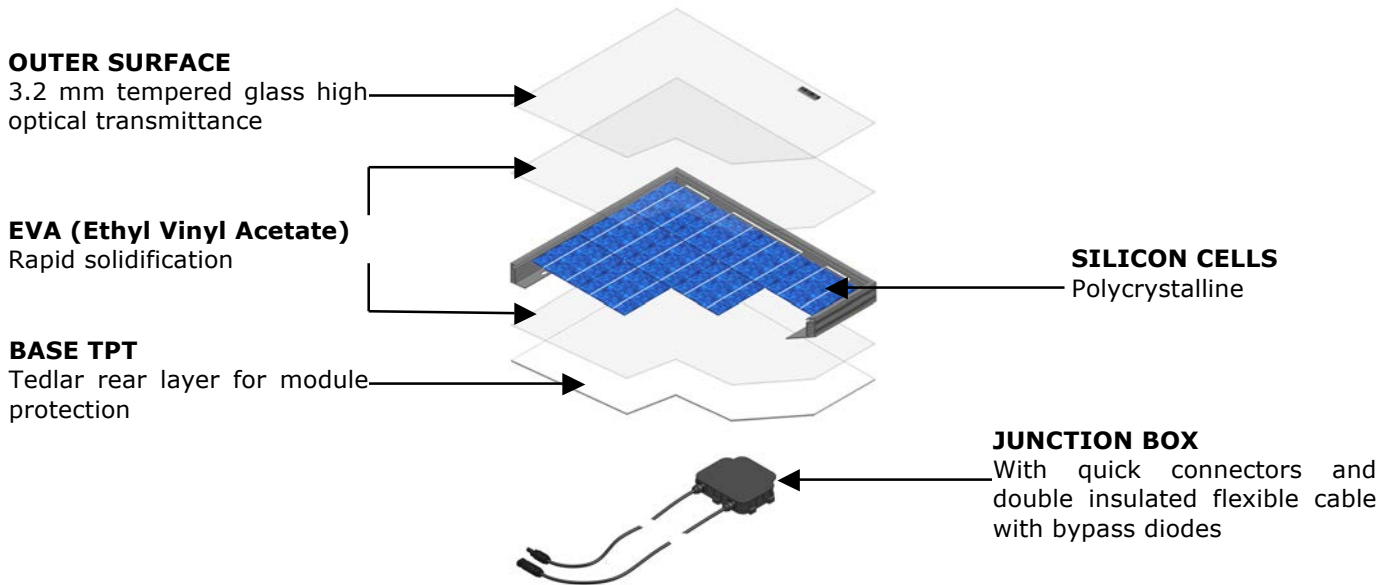
| CERTIFICATES | | | |
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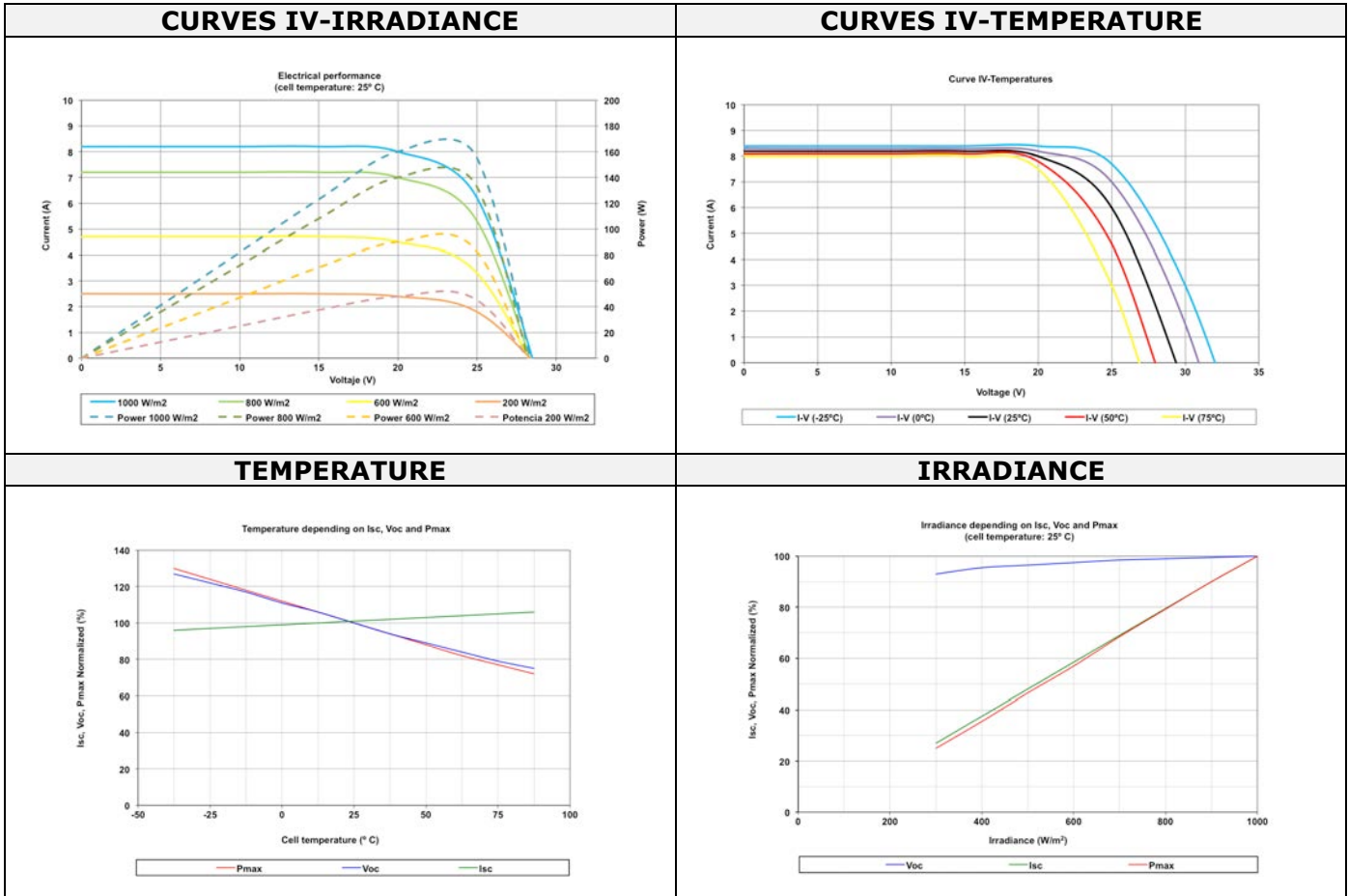
CONSTRUCTION DETAILS





PHOTOVOLTAIC SOLAR ENERGY POLYCRYSTALLINE MODULES - SI-ESF-M-P156-48

PERFORMANCE





PHOTOVOLTAIC SOLAR ENERGY
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PACKAGING AND TRANSPORT



| | | |
|---------------------|--------|--------------------|
| Box 2 Panels | Size | 1324 x 992 x 90 mm |
| | Weight | 30 kg |



| | | |
|-----------------------|-----------------|--------------------------------|
| Box | Size | 1385 x 1150 x 2120 mm (20' GP) |
| | | 1385 x 1150 x 2480 mm (40' GP) |
| | Panels | 44 pcs/pallet (20' GP) |
| | | 52 pcs/pallet (40' GP) |
| Weight pallet (Empty) | 135 kg (20' GP) | |
| | 245 kg (40' GP) | |



| | | | |
|--|-----------------|----------------------------------|-----------------|
| Container 20' GP (each big pallet add 20 pieces solar modules by 10 boxes) | Size | 5.898 x 2.352 x 2.393 m | 20' x 8' x 8'6" |
| | Panels | 352 pcs | |
| | Pallets | 8 pcs | |
| | Weight (Pallet) | 15 kg x 44 pcs + 135 kg = 795 kg | |
| | Weight (Gross) | 795 kg x 8 pallets = 6360 kg | |



| | | | |
|--|-----------------|-----------------------------------|-----------------|
| Container 40' GP (each big pallet add 4 pieces solar modules by 2 boxes) | Size | 12.025 x 2.352 x 2.393 m | 40' x 8' x 8'6" |
| | Panels | 832 pcs | |
| | Pallets | 16 pcs | |
| | Weight (Pallet) | 15 kg x 52 pcs + 245 kg = 1025 kg | |
| | Weight (Gross) | 1025 kg x 16 pallets = 16400 kg | |