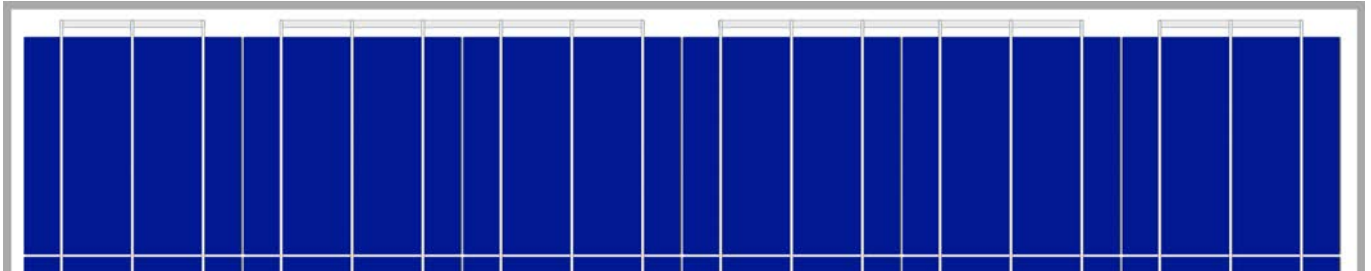




## PHOTOVOLTAIC SOLAR ENERGY

### POLYCRYSTALLINE MODULES - SI-ESF-M-P156-54



Solar Innova uses the latest materials to manufacture photovoltaic modules. Our modules are ideal for any application that uses the photoelectric effect as a clean energy source because of its minimal chemical pollution and no noise pollution.

The front of the module contains a tempered solar glass with high transmissivity, low reflectivity and low iron content.

These PV modules use 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 a 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.

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 junction boxes with IP67, are made from high temperature resistant plastics and containing terminals, connection terminals and protection diodes (by-pass). These modules are supplied with symmetric lengths of cable, with a diameter of copper section of 4 mm and an extremely low contact resistance, all designed to achieve the minimum voltage drop losses.

Our modules comply with all safety requirements not only flexibility but also double insulation and high resistance to UV rays, all are suitable for use in outdoor applications. 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.

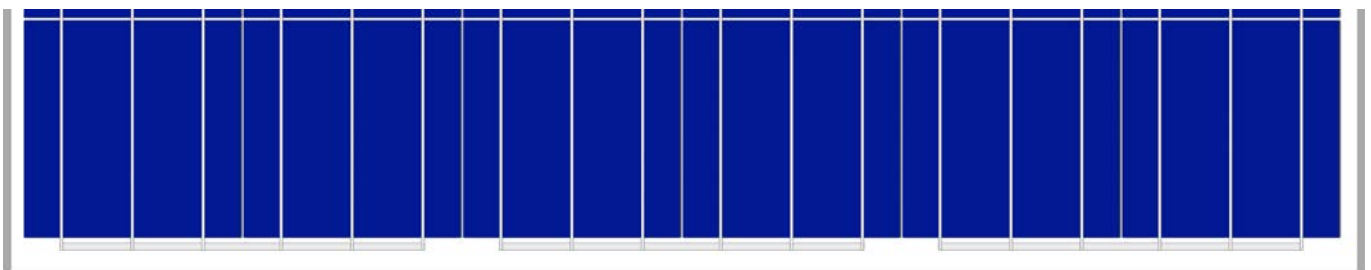
#### WARRANTIES

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-P156-54

ELECTRICAL CHARACTERISTICS (STC)						
Maximum power (Pmpp)	Wp	215	220	225	230	235
Tolerance	Wp	0 ~ + 5				
Voltage at maximum power (Vmpp)	Volts	26.81	26.99	27.08	27.38	27.56
Current at maximum power (Impp)	Amperes	8.02	8.15	8.31	8.40	8.53
Open circuit voltage (Voc)	Volts	33.10	33.32	33.43	33.80	34.02
Short circuit current (Isc)	Amperes	8.50	8.63	8.70	8.83	8.97
Maximum system voltage (Vsyst)	Volts	600 (UL) / 1,000 (IEC)				
Diodes (By-pass)	Quantity	6				
Maximum series fuse	Amperes	15				
Efficiency (ηm)	%	14.62	14.96	15.30	15.64	15.98
Form Factor	%	≥ 73				

<b>STC:</b>	 Irradiance: 1.000 W/m <sup>2</sup>	 Module temperature: 25° C	 Air quality: 1,5
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ELECTRICAL CHARACTERISTICS (NOCT)						
Maximum power (Pmpp)	Wp	159	162	166	170	173
Voltage at maximum power (Vmpp)	Volts	24.41	24.57	24.66	24.93	25.09
Current at maximum power (Impp)	Amperes	6.51	6.62	6.75	6.82	6.93
Open circuit voltage (Voc)	Volts	30.25	30.45	30.56	30.89	31.09
Short circuit current (Isc)	Amperes	6.89	7	7.06	7.16	7.27

<b>NOCT:</b>	 Irradiance: 800 W/m <sup>2</sup>	 Air temperature: 20° C	 Air quality: 1,5	 Wind speed: 1 m/s
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MECHANICAL FEATURES			
<b>Size</b>	Height	1,480 mm	58.26 inches
	Width	982 mm	38.66 inches
	Thickness	40 mm	1.57 inches
<b>Weight</b>	Net	17.5 kg	38.6 lbs
<b>Frame</b>	Material	Anodized aluminum AL6063-T5, minim 15 μm	
<b>Front</b>	Material	High transmissivity toughened glass	
	Thickness	3.2 ± 0.2 mm.	0.13 inches
<b>Cells</b>	Type	Polycrystalline	
	Quantity	6 x 9 units	
	Size	156 x 156 mm	6 inches
Serial connection	Quantity	54 units	
Parallel connection	Quantity	1 unit	
<b>Encapsulation</b>	Material	EVA	
	Thickness	0.50 ± 0.03 mm	0.020 ± 0.0012 inches
<b>Back-Sheet</b>	Material	TPT	
	Thickness	0.32 ± 0.03 mm	0.013 ± 0.0012 inches
<b>Junction box</b>	Material	PVC	
	Protection	IP67	
	Isolation	Versus humidity and inclement weather	
<b>Cables</b>	Type	Polarized and symmetric in length	
	Length	900 mm	35.4 inches
	Section	4 mm <sup>2</sup>	0.006 inches <sup>2</sup>
	Features	Low contact resistance	
		Minimal losses for voltage drop	
<b>Connectors</b>	Material	PVC	
	Type	MC4	
	Protection	IP67	

THERMAL CHARACTERISTICS		
Temperature coefficient of short circuit current α (Icc)	%/° C	+ 0.0825
Temperature coefficient of open circuit voltage β (Voc)	%/° C	- 0.4049
Temperature coefficient of maximum power γ (Pmpp)	%/° C	- 0.4336
Temperature coefficient of current at maximum power (Impp)	%/° C	+ 0.10
Temperature coefficient of voltage at maximum power (Vmpp)	%/° C	- 0.38
NOCT (Nominal Operating Cell Temperature)	° C	+ 47 ± 2



## PHOTOVOLTAIC SOLAR ENERGY POLYCRYSTALLINE MODULES - SI-ESF-M-P156-54

TOLERANCES				
<b>Working temperature</b>	° C	° F	- 40 ~ + 85	- 40 ~ + 185
<b>Dielectric Isolation Voltage</b>	Volts		3.000	
<b>Relative humidity</b>	%		0 ~ 100	
<b>Wind resistance</b>	m/s		60	
	kg/m <sup>2</sup>	Pa	245	2,400
	lbs/feet <sup>2</sup>		491.56	
<b>Mechanical load-bearing capacity</b>	kg/m <sup>2</sup>	Pa	551	5,400 (IEC)
	lbs/feet <sup>2</sup>	Pa	75.2	3,600 (UL)
<b>Fire resistance</b>	Clase		C	








MEASUREMENTS PERFORMED IN ACCORDANCE WITH STANDARD TEST METHODS EN 60904-3 AND ASTM E1036, CORRECTED TO STANDARD TEST CONDITIONS (STC)		
<b>Air quality/Spectral distribution</b>	AM	1.5 ASTM G173-03e1 (2,008)
<b>Luminous intensity/Radiation</b>	W/m <sup>2</sup>	1,000
<b>Cell temperature</b>	° C	25

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

STRUCTURAL CHARACTERISTICS	
<b>Cells</b>	High efficiency cells with anti-reflective layer of Silicon Nitride.
<b>Electric conductors</b>	Flat Copper (Cu) bath in a Tin (Sn) and Silver (Ag) alloy, which improves weldability.
<b>Welding</b>	Of cells and drivers in sections for stress relief.
<b>Laminate</b>	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.
<b>Junction box</b>	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.

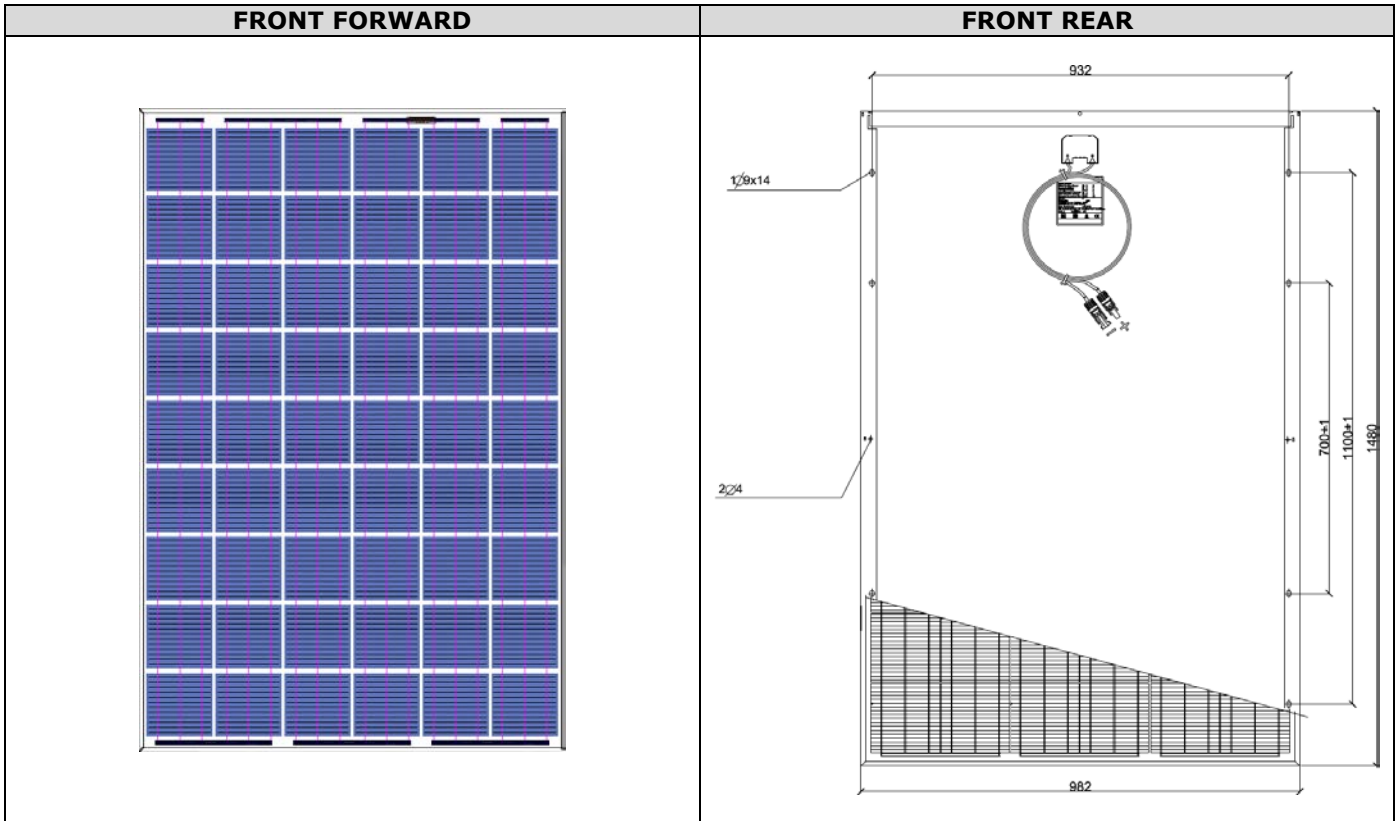
CHARACTERISTICS OF WORK
- The power of solar cells vary in the output of the production process. The different power specifications of these modules reflect this dispersion.
- Cells during the early months of light exposure, may experience a degradation photonics could decrease the value of the maximum 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 <sup>2</sup> , 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		
<b>Manufacturing defects</b>	Years	12
<b>Performance</b>	Minimal Rated Power %/Years	90 % at 10 years, 80 % at 25 years.

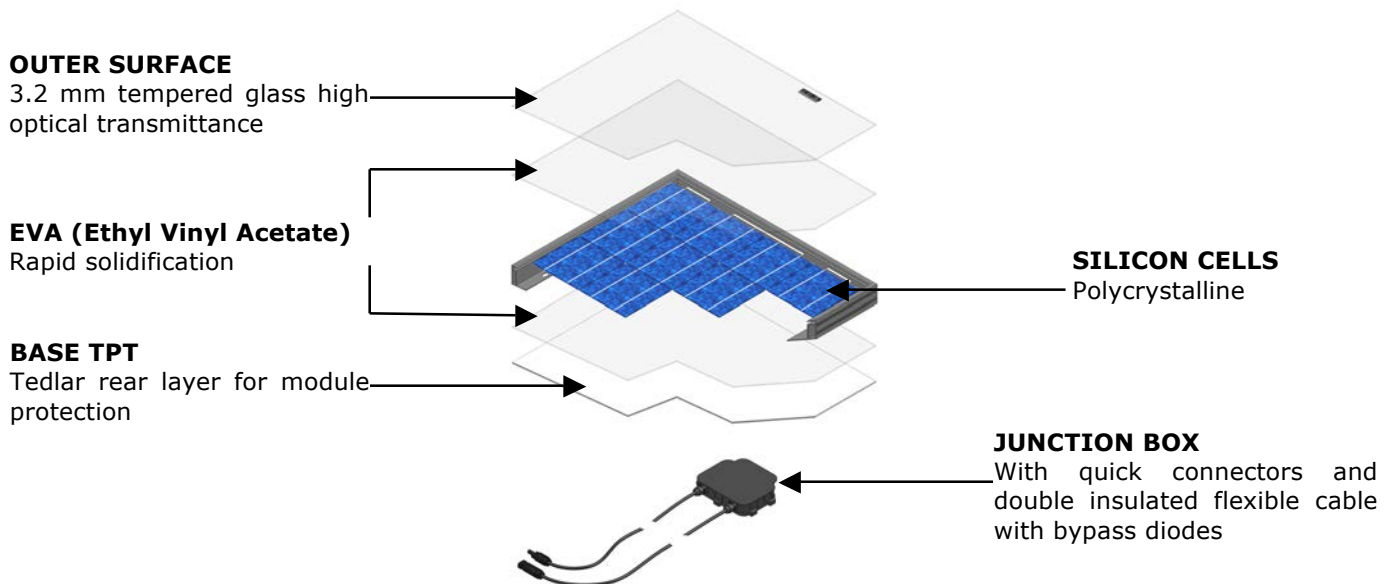
CERTIFICATES			
			
			



**PHOTOVOLTAIC SOLAR ENERGY**  
**POLYCRYSTALLINE MODULES - SI-ESF-M-P156-54**



**CONSTRUCTION DETAILS**

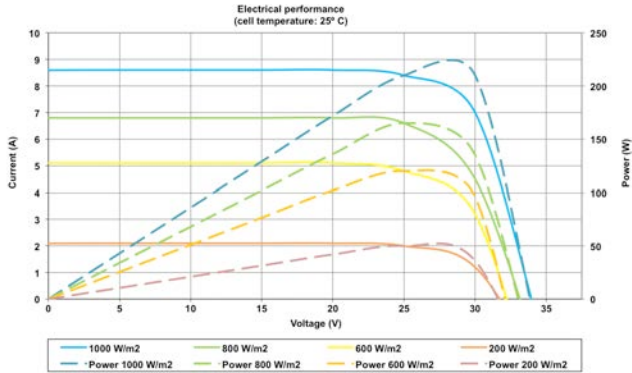




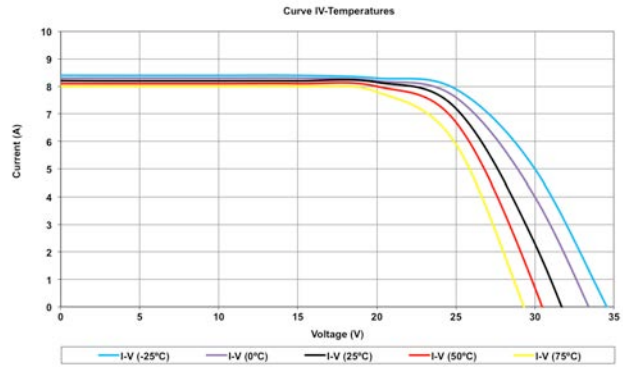
## PHOTOVOLTAIC SOLAR ENERGY POLYCRYSTALLINE MODULES - SI-ESF-M-P156-54

### PERFORMANCE

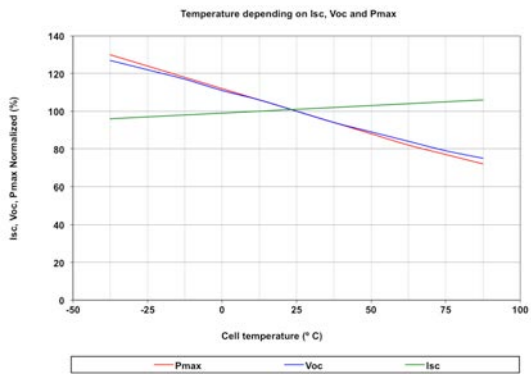
#### CURVES IV-IRRADIANCE



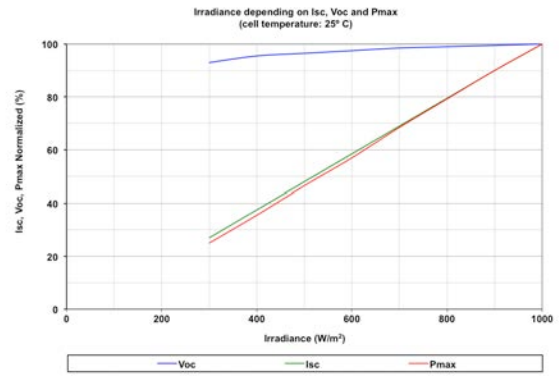
#### CURVES IV-TEMPERATURE



#### TEMPERATURE



#### IRRADIANCE





## PHOTOVOLTAIC SOLAR ENERGY POLYCRYSTALLINE MODULES - SI-ESF-M-P156-54

### PACKAGING AND TRANSPORT



<b>Box 2 Panels</b>	Size	1,482 x 992 x 90 mm
	Weight	35 kg



<b>Box</b>	Size	1,550 x 1,150 x 2,120 mm (20' GP)
		1,550 x 1,150 x 2,500 mm (40' GP)
	Panels	40 pcs/pallet (20' GP)
		48 pcs/pallet (40' GP)
Weight pallet (Empty)	160 kg (20' GP)	
	245 kg (40' GP)	



<b>Container 20' GP</b> (each big pallet add 18 pieces solar modules by 9 boxes)	Size	5.898 x 2.352 x 2.393 m	20' x 8' x 8'6"
	Panels	280 pcs	
	Pallets	7 pcs	
	Weight (Net)	17.5 kg x 40 pcs + 160 kg = 860 kg	
	Weight (Gross)	860 kg x 7 pallets = 6,020 kg	



<b>Container 40' GP</b> (each big pallet add 4 pieces solar modules by 8 boxes)	Size	12.025 x 2.352 x 2.393 m	40' x 8' x 8'6"
	Panels	672 pcs	
	Pallets	14 pcs	
	Weight (Net)	17.5 kg x 48 pcs + 245 kg = 1,085 kg	
	Weight (Gross)	1,085 kg x 14 pallets = 15,190 kg	