



**TRINA SOLAR LIMITED**

**INSTALLATION INSTRUCTION MANUAL**

**CRYSTALLINE SPV MODULE**

REVISIONS					Changzhou Trina Solar Energy Company Limited, China	
REV	ECN / NPA	DESCRIPTION OF CHANGE	CHK'D/DATE	APP'D/DATE	<b>TITLE:</b> <b>INSTALLATION INSTRUCTION</b> <b>MANUAL FOR THE</b> <b>CRYSTALLINESOLAR</b> <b>PHOTOVOLTAIC MODULE</b>	
A	11-2007	Release to Market for 72cell Module with 125x125mm Mono crystalline	Yang XiaoWu 20 <sup>th</sup> Nov 2007	Chaudary 20 <sup>th</sup> Nov 2007		
B	06-2008	Added 60cell Module with 156x156mm Mono and Multi Crystalline	Yang XiaoWu 12 <sup>th</sup> June 2008	Chaudary 12 <sup>th</sup> June 2008		
					SPECIFICATION NO: <b>PS-M-0013</b>	PART NO: <b>N/A</b>
					SPEC DRAWN BY: <b>Chaudary</b>	REV: <b>B</b>
					SHEET <b>1</b> OF <b>1</b>	

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## 1. INTRODUCTION

Trina Solar Energy Company Limited has a long history of successful innovation within the solar industry. The company was founded in 1997 and has made significant investments in research and development, creating over 20 patents during the company' history.

The company has several fully integrated product lines including ingots, casting, wafers, Cells and Modules of Mono and Multicrystalline Silicon Solar Photovoltaic (SPV) modules and those products are also exported to overseas markets. With an experienced international management team and a strong reputation for innovation, Trina Solar is one of the leaders in China's solar energy sector and provides the highest quality SSPV modules in a range of sizes designed to meet the requirements of the most demanding energy and power users worldwide.

## 2. POWER MODULE

Trina Solar Photovoltaic modules consist of a series of electrically interconnected crystalline silicon solar cells. Which are permanently encapsulated between a tempered glass superstrate and substrate. The entire laminate is secured within an anodized aluminum frame for structural strength; ease of installation and to protect the cells from the most severe environmental conditions.

## 3. APPLICATIONS

Trina SPV modules are a highly reliable, virtually maintenance-free direct current (DC) power source, designed to operate most efficiently in sunlight. Trina series modules are ideal to power remote homes, recreational vehicles, water pumps, telecommunication systems and many other applications either with or without the use of storage batteries.


## 4. PERMIT

Before installing your system, contact local authorities to determine the necessary permit, installation and inspection requirements.

## 5. CLIMATE CONDITION

Install the Trina Solar Crystalline series modules in the following conditions:

- Ambient temperature: -20°C to +40°C.
- Operating temperature: -40°C to +85°C.
- Storage temperature: -40°C to +40°C,
- Humidity: below 85RH%
- Wind pressure: below 50.12lb / ft<sup>2</sup> (2400Pa).
- Corrosion resistance: Except for corrosive salt area and sulfurous area.

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## 6. SITE SELECTION

In most applications, Trina SPV modules should be installed in a location where they will receive maximum sunlight throughout the year. In the Northern Hemisphere, the module should typically face south, and in the Southern Hemisphere, the modules should typically face north. Modules facing 30 degrees away from true South (or North) will lose approximately 10 to 15 per cent of their power output. If the module faces 60 degrees away from true South (or North), the power loss will be 20 to 30 per cent.

When choosing a site, avoid trees, buildings or obstructions, which could cast shadows on the solar photovoltaic modules especially during the winter months when the arc of the sun is lowest over the horizon. Shading causes loss of output, even though the factory fitted bypass diodes of the SPV module will minimize any such loss.

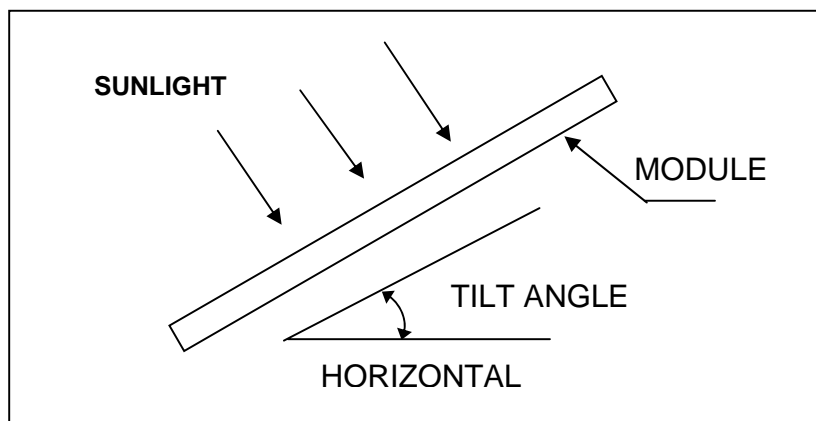
Do not install the SPV module near naked flame or flammable materials.

Do not install the SPV module in a location where it would be immersed in water or continually exposed to water from a sprinkler or fountain etc.


## 7. MODULE TILT ANGLE

Trina SPV modules connected in series should be installed at same orientation and angle. Different orientation or angle may cause loss of output power due to difference of amount of sunlight exposed to the module.

Trina SPV modules produce the most power when they are pointed directly at the sun. For installations where the SPV modules are attached to a permanent structure, the SPV modules should be tilted for optimum winter performance. As a rule, if the system power production is adequate in winter, it will be satisfactory during the rest of the year. The module tilt angle is measured between the solar modules and the ground (Figure 1). Optimal tilting of SPV module is almost the same as the latitude of installation location.



**Figure 1 SPV Module Tilt Angle**

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## 8. MOUNTING AND NOTES

Systems should be installed by qualified personnel only. It involves electricity, and can be dangerous if the personnel are not familiar with the appropriate safety procedures.

The module frame is made of anodized aluminum, and therefore corrosion can occur if the module is subject to a salt water environment with contact to a rack of another type of metal (Electrolysis Corrosion). If required, PVC or stainless steel washers can be placed between the SPV module frame and support structure to prevent this type of corrosion. Module support structures that are to be used to support SPV modules at correct tilt angles should be wind and snow load rated for use by the appropriate local and civil codes prior to installation.

Trina SPV modules can be mounted as following method:

- Using corrosion-proof screws (M8) on the existing installing holes in the module frame, see drawing 2 and 4.
- Using suitable module clamps on the module frame, see drawing 2 and 4.
- Using insertion systems.

The frame of each module has 4 mounting holes (12mm\*9mm) used to secure the modules to supporting structure. The module frame must be attached to a supporting structure using M8 stainless steel hardware together with spring washers and flat washers in four places symmetrical on the SPV module. The applied torque is about 8 Newton-meters.

The module clamps must not come into contact with the front glass and must not deform the frame. Avoid shadowing effects from the module clamps and the insertion systems. It is not permitted to modify the module frame under any circumstances. Recommended distance between 2 Solar modules is 5mm considering linear thermal expansion of the module frames.

Clearance between the module frame and mounting surface may be required to prevent the junction box from touching the surface, and to circulate cooling air around the back of the module.

The modules are not designed for integral mounting as part of a roof or wall. The mounting design may have an impact on the fire resistance. If the modules are to be installed on the roof or wall of a building, the fire resistance of roof covering or wall should be rated for the application. Here the standoff method or the rack method is recommended. The modules are supported parallel to surface of the building wall or roof. Clearance between the module frames and surface of the wall or roof is required to prevent wiring damage and to allow air to circulate behind the module. The recommended stand-off height is 115mm. Any slope less than 5in/ft (127mm/305mm) required to maintain a fire class rating. Do not mount SPV module in such way that the drain holes of SPV module are intended to block up.

Do not step on the module, although SPV modules are quite rugged, the glass can be broken (and the module will no longer work properly) if it is dropped or hit by tools or other objects.

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## 9. GROUNDING

All module frames and mounting racks must be properly grounded in accordance with the National Electrical Code. Proper grounding is achieved by connecting the module frame(s) and structural members contiguously one to another using a suitable grounding conductor. The grounding conductor or strap may be copper, copper alloy, or other material acceptable for use as an electrical conductor per NEC. The grounding conductor must then make a connection to earth using a suitable earth ground electrode.

Attach a separate conductor to one of the 4mm diameter grounding holes marked 'GR' on the module frame with a bolt and nut that incorporates an external tooth washer. This is to ensure positive electrical contact with the frame.

The rack must also be grounded unless they are mechanically connected by nuts and bolts to the grounded SPV modules. The array frame shall be grounded in accordance with NEC Art250.

## 10. BYPASS DIODES AND BLOCKING DIODES

Partial shading of an individual module can cause a reverse voltage across the shaded SPV module. Current is then forced through the shaded area by the other modules.

When a bypass diode is wired in parallel with the series string, the forced current will flow through the diode and bypass the shaded SPV module, thereby minimizing module heating and array current losses.

In system utilizing a battery, blocking diodes are typically placed between the battery and the SPV module output to prevent battery discharge at night.


Diodes that are used as blocking diodes must: Have a Rated Average Forward Current [ $I_{F(AV)}$ ] **above** maximum system current at highest module operating temperature. Have a Rated Repetitive Peak Reverse Voltage [ $V_{RRM}$ ] **above** maximum system voltage at lowest module operating temperature.

## 11. WARNING AND NOTES

The SPV modules generate electricity when exposed to light. Array of many modules can cause lethal shock and burn hazards. Only authorized and trained personnel should have access to these modules. To reduce the risk of electrical shock or burns, modules maybe covered with an opaque material during installation to avoid shocks or burns. Do not touch live terminals with bare hands. Use insulated tools for electrical connections.

Use appropriate methods to mount SPV modules. Fall of modules from high place will cause death, injury or damage.

The SPV module has a pair of male and female waterproof connectors. For a series electrical connection, connect positive (+) connector of first SPV module to negative (-) connector of the following module.

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Do not short the positive and the negative. Do not disconnect under load. Be sure connector no gap between the insulators. In case there is a gap, a fire and/or an electrical shock may occur.

Artificially concentrated sunlight shall not be directed on the SPV module. The electrical characteristics are indicated value of Pmax under standard test conditions (Irradiance of 1000W/m<sup>2</sup>, AM 1.5 spectrum, and cell temperature of 25°C).

Under normal conditions, a solar photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly the value of Isc and Voc marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current ratings, fuse sizes, and sizes of controls connected to the SPV output. Refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 1.25 which may also be applicable.

The installation in Canada shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

## 12. MODULE WIRING

Each module has two #12 AWG type standard 90°C sunlight resistant output cables each terminated with plug & ply connectors. This cable is suitable for applications where wiring is exposed to the direct rays of the Sun. We recommend that all wiring and electrical connections comply with the National Electrical Code (NEC).

For field connections, use the minimum No. #12 AWG copper wires insulated for a minimum of 90°C and Sunlight resistant as well.

The minimum and maximum outer cable diameters of the cable are 5 to 7mm. Refer to table 1 for the maximum electrical rating of series fuse.

## 13. MAINTENANCE

Under most weather conditions, normal rainfall is sufficient to keep the SPV module glass surface clean. If dirt build-up becomes excessive, clean the glass only with a soft cloth using mild detergent and water. **USE CAUTION WHEN CLEANING THE BACK SURFACE OF THE MODULE TO AVOID PENETRATING THE SUBSTRATE MATERIALS.** SPV Modules that are mounted flat (0° tilt angle) should be cleaned more often, as they will not "self clean" as effectively as modules mounted at a 15° tilt or greater. Once a year, check the tightness of terminal screws and the general condition of the wiring. Also, check to be sure that mounting hardware is tight. Loose connections will result in damage for array.

Changed SPV module must be the same kind and type. Do not touch live parts of cables and connectors. Use appropriate safety equipment (insulated tools, insulating gloves, etc.), when touching them.

Cover the front surface of the SPV module by an opaque or other material when repairing. The SPV modules when exposed to sunlight generate high voltage and are dangerous.



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**14. SPECIFICATIONS:** Table 1: Electrical and Mechanical Specifications.

Module Series	Model	Dimensions (mm)	Weight (kg)	Electrical Performance @ STC					Max- System Voltage (VDC)	Max-Series Fuse (A)		
				Max-Power P <sub>m</sub> (W)	Max-Power Voltage V <sub>Pm</sub> (V)	Max-Power Current I <sub>Pm</sub> (A)	Open-Circuit Voltage V <sub>OC</sub> (V)	Short-Circuit Current I <sub>sc</sub> (A)				
72pcs 125×125mm Monocrystalline Silicon SPV Module	TSM-160D	1581×809×40	15.60	160±3%	34.90	4.60	42.8	5.15	UL1703: 600VDC & IEC61215/IEC61730:1000VDC	7.0		
	TSM-165D			165±3%	35.60	4.65	43.2	5.20				
	TSM-170D			170±3%	35.80	4.75	43.6	5.25				
	TSM-175D			175±3%	36.20	4.85	43.9	5.30				
	TSM-180D			180±3%	36.80	4.90	44.2	5.35				
	TSM-185D			185±3%	37.50	4.95	44.5	5.40				
60pcs 156×156mm Monocrystalline Silicon SPV Module	TSM-200D	1650×992×46	19.50	200±3%	28.7	6.97	36.0	7.75			UL1703: 600VDC & IEC61215/IEC61730:1000VDC	11.0
	TSM-210D			210±3%	29.2	7.19	36.4	7.86				
	TSM-220D			220±3%	29.8	7.39	36.8	8.00				
	TSM-230D			230±3%	30.0	7.66	37.0	8.18				
	TSM-240D			240±3%	30.6	7.84	37.5	8.38				
	Multicrystalline Silicon SPV Module			TSM-200P	200±3%	28.7	6.97	36.0	7.75			
				TSM-210P	210±3%	29.2	7.19	36.4	7.86			
				TSM-220P	220±3%	29.8	7.39	36.8	8.00			
TSM-230P		230±3%	30.0	7.66	37.0	8.18						

**Notes**

- Standard Test Condition(STC) of Irradiance of 1000W/m<sup>2</sup>, AM1.5 Solar Spectrum & 25 °C cell temperature
- Nominal Operating Cell Temperature (NOCT):47±2
- The tolerance of Voltage and Current within ±10%
- Temperature coefficient of Current is 0.05%/°K, Temperature coefficient of Voltage is -0.35%/°K.
- See SPV Module drawing for mounting and grounding holes locations

Add: No.2 Tian He Road, Electronics Park, New District, Changzhou, P.R. China

http: //www.trinasolar.com E-mail: [sales@trinasolar.com](mailto:sales@trinasolar.com) Tel: 0086-519-85485801, Fax: 0086-519-85485936

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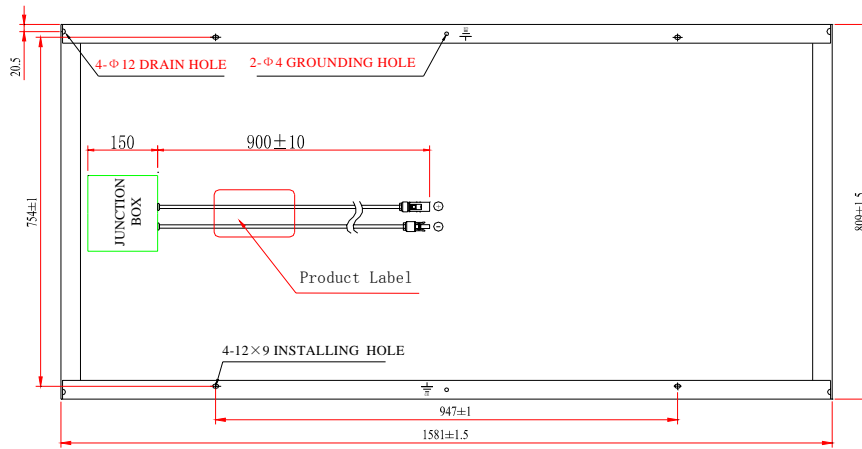
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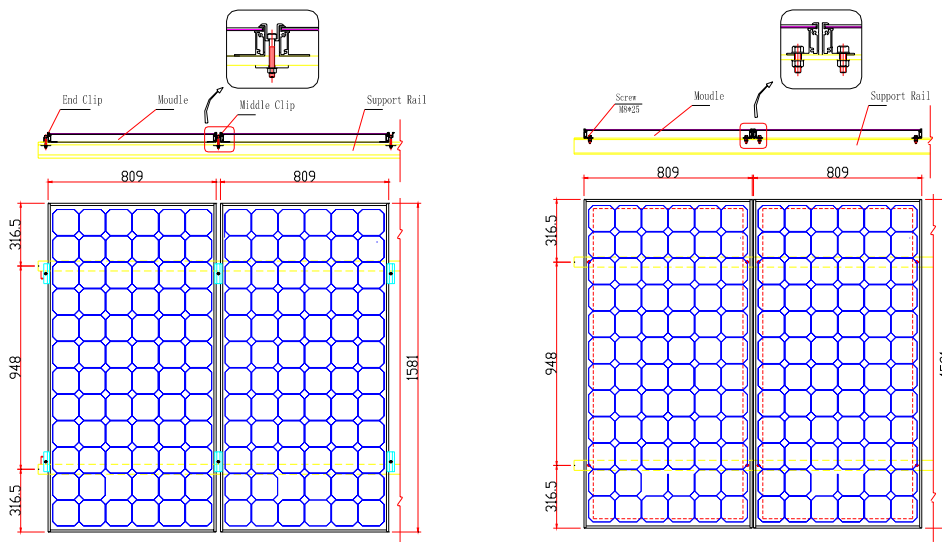
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**Drawing 1 Back view of 6\*12-125 SPV Module**



Mounting Drawing 1(with clamping clips)

Mounting Drawing 2(with screws)

**Drawing 2 Mounting drawing for 6\*12-125 SPV Module (with clamping clips and screws)**

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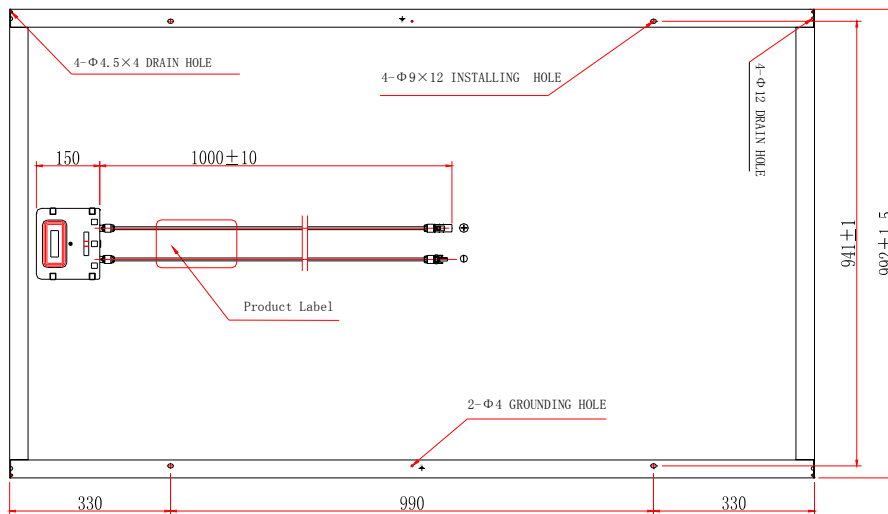
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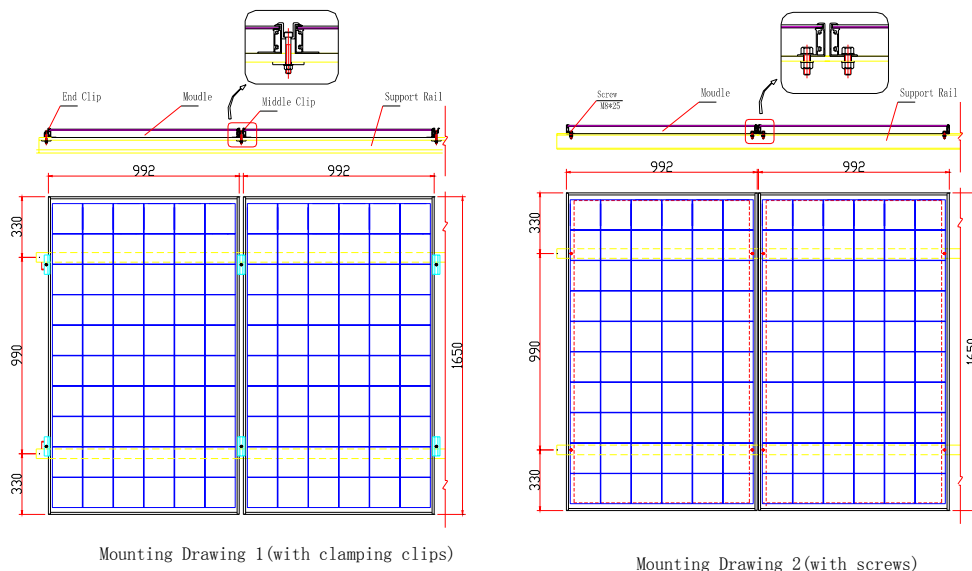
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**Drawing 3 Back view of 6\*10-156 SPV Module**



**Drawing 4 Mounting drawing for 6\*10-156 SPV Module (with clamping clips and screws)**