



PV Module Installation Manual



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1.DISCLAIMER OF LIABILITY

The installation, handling and use of Taoistic Solar Crystalline modules are beyond company control. Taoistic Solar does not assume any responsibility for loss, damage, injury or expense resulting from the improper installation, handling, use or maintenance.

Taoistic Solar assumes no responsibility for any infringement of patents or other rights of third parties that may result from use of the module. No license is granted by implication or under any patent or patent rights.

Specifications are subject to change without prior notice.

2.SAFETY PRECAUTIONS

- Potentially lethal DC voltages can be generated whenever PV Modules are exposed to a light source therefore, avoid contact with electrically active parts and be sure to isolate live circuits before attempting to make or break any connections.
- Only authorized and trained personnel should have access or perform work on the modules or solar system.
- When working on electrical connections, remove all metallic jewelry, use properly insulated tools
 and wear appropriate personal protective equipment to reduce the risk of electric shock.
- Do NOT stand or step on, damage or scratch the front or backside surfaces of the module.
- Broken modules cannot be repaired and contact with any module surface or frame can lead to electrical shock. Do NOT use a module with broken glass or torn substrate.
- Do NOT disassemble the modules or remove any part of the module.
- Protect the electrical plug contacts against corrosion and soiling. Make sure that all connectors
 are corrosion free and clean before making the connection.
- Do NOT install or handle modules when they are wet or during periods of high wind.
- Ensure sure that all connections are securely made with no gap between the contacts. Any gap
 can result in electrical arcing that can cause a fire hazard and/or an electric shock.



- Make sure that the polarity of each module or a string is not reversed considering the rest of the modules or strings.
- Do NOT artificially concentrate sunlight on these solar modules.
- Taoistic Solar modules are certified for operating in Class A (safety class II according to IEC 61140) installations at voltages below 1500Vdc. This maximum voltage should not be exceeded at any time and, as the voltage of the module increases, above data sheet values, at operating temperatures below 25° C, then these need to be taken into account when designing a PV system.
- Do NOT use water to extinguish fires of an electrical origin.
- Under normal conditions, a solar photovoltaic module is likely to produce more current and /or
 voltage than reported under standard test conditions. Accordingly, the value of lsc marked on
 this module should be multiplied by a factor of 1.25 when determining the conductor current
 ratings, fuse sizes and size of controls connected to the SPV output.

3.UNPACKING AND STORAGE

- At time of receipt, verify that the product delivered is in fact the product ordered the product name, subname, and serial number of each laminate are clearly marked on the outside of each packing box.
- Leave the product in its original packing box until you are ready to install.
- Store packing boxes in a clean, dry area with relative humidity below 85% and ambient temperatures between -20° C and 40° C.
- Do NOT stack more than the maximum amount of allowable pallets on top of each other.
- At the installation site, take care to keep modules and particular their electrical contacts clean
 and dry before installation. If connector cables are left in damp conditions then the contacts may
 corrode. Any module with corroded contacts should not be used.
- If pallets are stored temporarily outside then place a protective covering over the pallet to protect it from direct weathering and do not stack more than one pallet high.



- Two people are required to unpack the modules from the packing box, when handling modules always use both hands.
- Do NOT use a knife to cut the zip-ties, but use wire cutting pliers.
- Do NOT place modules directly on top of each other.

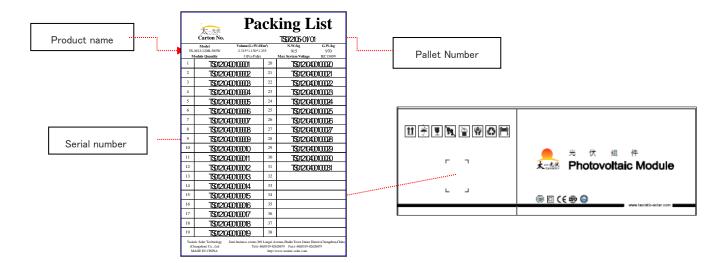


Figure 1

3.1. PRODUCT IDENTIFICATION

Each individual module has a unique serial number laminated behind the glass and another permanently attached to the back-sheet of the module. Note all serial numbers in an installation for your future records.

3.2. ELECTRICAL RATING

Tested in STC condition (Irradiance 1000W/m 2 , Module Temperature 25 $^{\circ}$ C , Air Mass 1.5)

Module	TS-	TS-	TS-	TS-	TS-
	M10/108H	M10/120H-	M10/144H-	M10/144H-	M12/80H-
	-410W	460W	545W	550W	400W
Open-circuit voltage(tolerance ±3%) [V]:	37.32	41.48	49.52	49.62	29.40



Short-circuit current (tolerance ±3%) [A]:	13.80	14.01	13.94	14.03	17.40
Voltage at max. power [V]:	31.06	34.20	40.80	40.90	24.40
Current at max. power [A]:	13.21	13.45	13.36	13.45	16.39
Max. power (with tolerance ±3%) [W]:	410	460	545	550	400
Series Fuse Rating [A]	25	25	25	25	35
Temperature Coefficient of Isc	+0.048%/ °C	+0.048%/°C	+0.048%/°C	+0.048%/°C	+0.040%/°C
Temperature Coefficient of Voc	- 0.270%/°C	-0.270%/°C	-0.270%/°C	-0.270%/°C	-0.250%/°C
Temperature Coefficient of Pmax	- 0.350%/°C	-0.350%/°C	-0.350%/°C	-0.350%/°C	-0.340%/°C

Module	TS- M12/100H- 500W	TS- M12/110H- 545W	TS- M12/110H- 550W	TS- M12/120H- 595W	TS- M12/120H- 600W
Open-circuit voltage(tolerance ±3%) [V]:	34.50	37.70	37.90	41.30	41.50
Short-circuit current (tolerance ±3%) [A]:	18.55	18.47	18.52	18.47	18.52
Voltage at max. power [V]:	28.80	31.40	31.60	34.20	34.40
Current at max. power [A]:	17.36	17.37	17.40	17.40	17.44
Max. power (with tolerance ±3%) [W]:	500	545	550	595	600
Series Fuse Rating [A]	35	35	35	35	35
Temperature Coefficient of Isc	+0.040%/℃	+0.040%/℃	+0.040%/℃	+0.040%/℃	+0.040%/℃
Temperature Coefficient of Voc	-0. 250% /℃	-0. 250%/℃	-0. 250%/℃	−0. 250% / °C	-0. 250%/℃
Temperature Coefficient of Pmax	-0.340%/℃	-0.340%/℃	-0.340%/℃	-0.340%/℃	-0.340%/℃

Module	TS- M12/120H- 610W	TS- M12/132H- 655W	TS- M12/132H- 670W	TS- M12/132H- 675W	TS- M10/144G- 545W
Open-circuit voltage(tolerance ±3%) [V]:	41.90	45.40	46.00	46.20	49.52
Short-circuit current (tolerance ±3%) [A]:	18.63	18.50	18.65	18.70	13.94
Voltage at max. power [V]:	34.80	37.60	38.20	38.40	40.80



Current at max. power [A]:	17.52	17.42	17.54	17.58	13.36
Max. power (with tolerance ±3%) [W]:	610	655	670	675	545
Series Fuse Rating [A]					
	35	35	35	35	30
Temperature Coefficient of Isc					
	+0.040%/℃	+0.040%/℃	+0.040%/℃	+0.040%/℃	+0.048%/℃
Temperature Coefficient of					
Voc	-0. 250%/℃	-0.250%/℃	-0. 250%/℃	−0. 250%/°C	-0. 270%/℃
Temperature Coefficient of Pmax	-0.340%/℃	-0.340%/℃	-0.340%/°C	-0.340%/℃	- 0 .350%/℃

	TS-	TS-	TS-	TS-	TS-
Module	M10/144G-	M12/120G-	M12/120G-	M12/132G-	M12/132G-
	550W	595W	600W	655W	670W
Open-circuit voltage(tolerance ±3%) [V]:	49.62	41.30	41.50	45.40	46.00
Short-circuit current (tolerance ±3%) [A]:	14.03	18.47	18.52	18.50	18.65
Voltage at max. power [V]:	40.90	34.20	34.40	37.60	38.20
Current at max. power [A]:	13.45	17.40	17.44	17.42	17.54
Max. power (with tolerance ±3%) [W]:	550	595	600	655	670
Series Fuse Rating [A]					
	30	35	35	35	35
Temperature Coefficient of Isc					
·	+0.048%/℃	+0.040%/℃	+0.040%/℃	+0.040%/℃	+0.040%/℃
Temperature Coefficient of Voc	−0. 270%/°C	−0. 250%/°C	-0. 250%/℃	−0. 250%/°C	−0. 250%/°C
Temperature Coefficient of Pmax	-0. 350%/℃	-0.340%/℃	-0.340%/℃	-0.340%/℃	-0.340%/℃

4.ENVIRONMENTAL CONSIDERATIONS

4.1.CLIMATE CONDITIONS

Taoistic Solar Crystalline series modules may be installed in the following conditions for more than 25 years. And it is intended to use in the below condition.



Environment

• Ambient temperature: -40°C to +40°C.

· Operating temperature: -40°C to +85°C.

• Storage temperature: -20°C to +50°C.

• Mechanical Load Pressure*: The design pressure is 3600 Pa (front)/1600 Pa (back) and the safety factor is 1.5

*Notes:

- The mechanical load bearing is dependent upon the mounting methods used and failure to follow the instructions of this manual may result in different capabilities to withstand snow and wind loads. The system installer must ensure that the installation methods used meet these requirements and any local codes and regulations.

5.SITE SELECTION

Consult your local authority for guidelines and requirements for building or structural fire safety. Taoistic Solar Crystalline series modules have been certified as Spread flame Class C and burning brand Class C according to ANSI/UL 790 standard.

Roof constructions and installations may affect the fire safety of building. Improper installation may create hazards in the event of a fire.

Use appropriate components such as fuses, circuit breaker and grounding connector as requires by local authority.

Do not use Modules where flammable gasses may be generated and should be subject to local codes or regulations.

Do not use Modules where shall be subject explosive codes or regulations.

When Modules are mounted on rooftops; the roof coverings must have fire resistant which is be subject to local building regulations or codes.

- Taoistic Solar Modules can be mounted in landscape and portrait orientation however the impact
 of dirt shading the solar cells can be minimized by orienting the product in portrait.
- For optimum energy production, solar modules should normally be mounted facing the equator
 at an angle to the horizontal plane equivalent to the latitude of the installation. In the event that
 you mount the solar modules at a different angle or orientation then the annual energy
 production may potentially be adversely impacted.



- When installing solar modules on a roof always leave a safe working area between the edge of the roof and the external edge of the solar array.
- Position the modules to minimize the chances of shading at any time of the day. Shading can
 normally be minimized by ensuring that the distance between the obstruction and solar array is
 greater than three times the obstruction's height.
- In order not to affect the fire rating, installation angle must be less than 5 in/ft.
- Avoid using a mounting method that will block the drainage holes in the module frame.
- When all solar modules are mounted in the same plane and orientation then all can be expected
 to have similar performance throughout the day and can be connected together to the same
 inverter channel.
- If solar modules on the same installation are mounted at different angles or orientations then
 energy production can normally be optimized by connecting the different orientations to
 different inverters (or different MPPT if the inverter has more than one MPPT). Refer to inverter
 manufacturers for further guidelines.
- Do not install modules in a location where they will be immersed in or continually exposed to water.
- Taoistic Solar Modules application altitude: <2000m.

6.MOUNTING INSTRUCTIONS

6.1. MOUNTING METHODS

PV modules can be mounted to the substructure using specially designed module clamps.

Regardless of the fixing method the final installation of the modules must ensure that:

A clearance of at least 115mm is provided between modules frame and the surface of the wall or roof.

The minimum distance between two modules is 10 mm.

The mounting method does not block the module drainage holes.

Panels are not subjected to wind or snow loads exceeding the maximum permissible loads, and are not subject to excessive forces due to the thermal expansion of the support structures.



The mounting method must not result in the direct contact of dissimilar metals that will result in galvanic corrosion. An addendum to Table J.1 of IEC 60950-1:2005, which recommends metal combinations not exceed an electrochemical potential difference of 0.6 Volts.

Mounting with Clamps:

A) Module should be attached on a supporting structure rail by metal clamps.

Use at minimum 4 clamps to fix modules on the mounting rails.

Modules clamps should not come into contact with the front glass and must not deform the frame.

Be sure to avoid shadowing effects from the module clamps.

The module frame is not to be modified under any circumstances.

When choosing this type of clamp-mounting method, use at least four clamps on each module, two clamps should be attached on each long sides of the module (for portrait orientation) and each short sides of the module (for landscape orientation). Depending on local wind and snow loads, additional clamps may be required to ensure that modules can bear the load.

B) It is recommended to use the clamps under the following condition or approved by system installation:

Width: Clamp A no less than 50 mm, Clamp B no less than 50 mm;

Thickness: No less than 5 mm

Material: Aluminum Alloy 6063-T5

Bolt: Stainless Steel, M6

Nut: Stainless Steel, M6

Washer: Stainless Steel, M6

C) Recommended bolt torque range: 8 N·m to 16 N·m.

D) Front side design load 3600 Pa, backside design load 1600 Pa, and both safety factor is 1.5 The use of clamps which have an EPDM or similar insulating washer, fixing bolt of at least M6. The clamp must overlap the module frame by at least 7mm but no more than 10 mm.



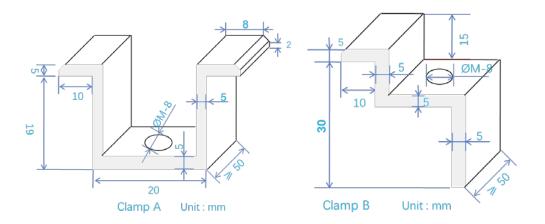


Figure 2. Clamp

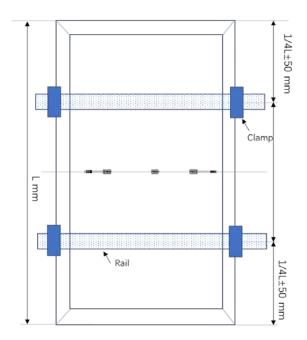


Figure 3. Clamp zone



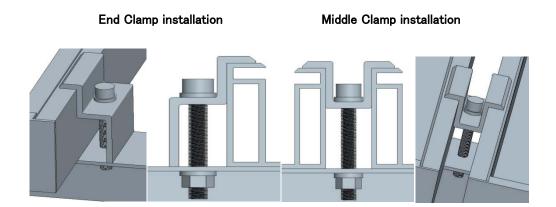


Figure 4. Module installed with clamp fitting method

Other mounting configurations can be used however, failure to comply with the above recommendations will result in a lowering of the load handling (snow/wind load) capabilities below the product specification 3600/1600 Pa and product failure as a result of an overload situation will not be covered by the guarantee.

6.2. Equipotential bonding

- The equipotential bonding between modules shall be in accordance with appropriate respective
 National Electrical Code.
- Proper equipotential bonding is achieved by connecting the module frame(s) and all metallic structural members together continuously using a suitable bonding conductor. The bonding conductor or strap may be copper, copper alloy, or any other material acceptable for use as an electrical conductor per respective National Electrical Codes.
- The bonding method must not result in the direct contact of dissimilar metals that will result in galvanic corrosion. An addendum to Table J.1 of IEC 60950-1:2005, which recommends metal combinations not exceed an electrochemical potential difference of 0.6 Volts.
- Taoistic Solar recommends using the following bonding ways:



a) Using Schleter for grounding. Connecting modules to the support structure according to the picture below. (Grounding accessories need pass the UL467 standard test.)

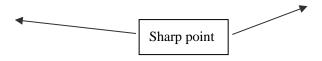
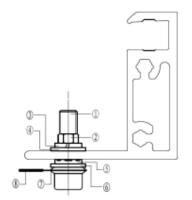


Figure 5

- ➤ Recommended torque is 20.5 Nm
- For more information, please contact the supplier Schletter (http://www.solar.schletter.de)
- b) The traditional way of grounding (Grounding accessories need pass the UL467 standard test and UL E34440/E6207 test.)



- ① Stainless steel bolt M4×30
- ② Stainless steel nut M4
- 3 Stainless steel spring washer M4
- 4) 6) Stainless steel flat washer M4
- Stainless steel lock-toothed washer M4
- Stainless steel cup washer M4
- ③ Grounding wire

Figure 6

- For fully grounding, grounding hardware should penetrate the anodic oxidation layer of frame.
- ➤ Recommended 4-6 mm² (10-12 AWG) bare copper grounding wire.



6.3. MODULE WIRING

Under normal conditions, the photovoltaic Modules may experience conditions that produce more current and/or voltage than reported at Standard Test Conditions. Accordingly, the values of short circuit current, Isc, and open circuit voltage, Voc, marked on Modules should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor capacities, fusing sizes, and size of controls connected to the Modules output. Voltages are additive when Modules are connected directly in series, and Modules currents are additive when Modules are connected directly in parallel. Modules with different electrical characteristics must not be connected directly in series. To reduce the magnitude of lightning-induced overvoltages and radio interference, the PV array wiring should be laid in such a way that the area of conductive loops is minimized as figure 6 (a), figure 6(b) and figure 6(c).

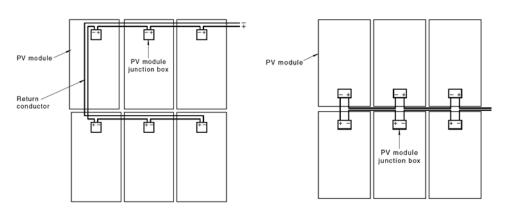


Figure 7(a)

Figure 7 (b)



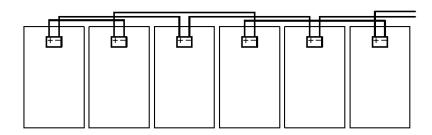


Figure 7 (c)

Modules with different electrical characteristics must not be connected directly in series.

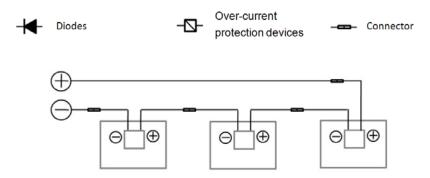


Figure 8 (a) Connection in series

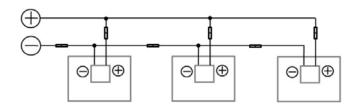


Figure 8 (b) Connection in parallel



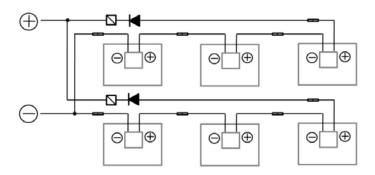


Figure 8 (c) Connection in parallel after series

The maximum number of Modules that can be connected in a series string must be calculated in accordance with applicable regulations in such a way that the specified maximum system voltage of the Modules and all other electrical DC components will not be exceeded in open-circuit operation at the lowest temperature expected at the PV system location.

The PV module maximum voltage is equal to Voc MOD corrected for the lowest expected operating temperature, as follows: VMOD MAX = VOC MOD + α (Tmin - 25), T is the lowest expected ambient temperature at the system location. α (%/°C) is the temperature coefficient of the selected module Voc .Also the clause 7.2 of IEC 62548 describe how to confirm the Voc modifying factor for temperature.

An appropriately rated over-current protection device must be used when the reverse current could exceed the value of the maximum fuse rating of the Modules. An over-current protection device is required for each series string if more than two series strings are connected in parallel. When over-current protection device determined, which should be of an overcurrent and short current protective type suitable for PV complying with IEC 60269-6. And that shall have a voltage rating equal or greater than the PV array maximum system voltage.

6.3.1 Cable

Taoistic Solar modules are provided with junction boxes which have been designed to be easily interconnected in series for their well-connected cable and the connector with IP67 protection degree. Each Modules has two single-conductor wires, one positive and one negative, which are prewired inside the junction box. The connectors at the opposite end of these wires allow easy series connection of adjacent Modules by firmly inserting the positive connector of a Module into the negative connector of an adjacent Module until the connector is fully seated.

The junction box with stranded copper cables with a cross sectional area of 4 mm² which are designed to H1Z2Z2-K 1x4mm² or 62930 IEC 131 1x4mm² type. Taoistic Solar recommend that all cables are run in appropriate conduits and sited away from areas prone to water collection and



mechanical damage. All wiring should be performed, by qualified installers, in accordance with the local codes and regulations. While the cables are sunlight resistant and waterproof, where possible, avoid direct sunlight exposure and water immersion of the cables. Besides, it should avoid lube, oil and pesticide and these may cause cable lifetime.

When for the PV array connecting at least H1Z2Z2-K 1x4mm2 or 62930 IEC 131 1x4mm2 designed copper insulated PV cable is recommended for field wiring. The minimum bending radius cables should be 43 mm. And the PV cable shall have a voltage rating equal or greater than the PV array maximum system voltage and a capacity current rating equal or greater than 1.25 Isc. When for PV cable capacity current rating, the method of installation and Current rating conversion factors for different ambient temperatures should be used to the application scenario.



Figure 9

6.3.2 Connector

Before connecting modules always ensure that the contacts are corrosion free, clean and dry, and ensure that connector caps are hand tight before connecting the Modules. Do not attempt making an electrical connection with wet, soiled, or otherwise faulty connectors. Avoid sunlight exposure and water immersion of the connectors. Avoid connectors resting on the ground or roof surface.

Faulty connections can result in arcs and electrical shock. Check that all electrical connections are securely fastened. Make sure that all locking connectors are fully engaged and locked to keep designed IP protection degree. For the detailed electrical parameter, see the below list:

Standard	Manufacture	Туре	System voltage	Rated Current	Temperature Rating
IEC 62852	Ningbo huayu Photovoltaic Technology Co., Ltd.	PV-H4 , (IP68, defined by Manufacture)	DC 1500V	35A	-40ºC to +85ºC
IEC 62852	Zerun Co., Ltd.	Z4S-abcde,	DC 1500V	40A	-40°C to +85°C



	(IP68, defined by		
	Manufacture)		

The connector enclosed is polymer material, should avoid lube, oil and pesticide and these may cause the connector crack. Besides, the connectors mated together in a PV system shall be of the same type from the same manufacturer, i.e. a one from one manufacturer and the other from another manufacturer or vice versa shall not be used to make a connection.

7. ELECTRICAL CONFIGURATION

Photovoltaic (electric) systems operate automatically and require very little day-to-day supervision. The solar array generates DC electricity whenever light falls on it similarly the inverter automatically turns ON as soon as there is sufficient energy from the solar array to efficiently convert this into grid quality AC power.

*Caution:

- The module is rated to operate at potentially lethal DC voltages which have the potential can cause severe electrical shock, arcing and fire hazards. Whilst some solar modules, manufactured by Taoistic Solar, are certified to operate up to 1500V always check the module label to confirm the actual rating of your product before making connections.
- Always use a suitably rated isolator (DC switch) to interrupt the current flow before disconnecting the connectors.

7.1 INVERTER SELETION AND COMPATIBILITY

When installed in systems governed by IEC regulations, Taoistic Solar modules normally do not need to be electronically connected to earth and therefore can be operated together with either galvanically isolated (with transformer) and transformer less inverters.

Potential Induced Degradation (PID) is sometimes observed in PV modules due to a combination of high humidity, high temperature and high voltage. PID is most likely to cause degradation under the following conditions:

a) Installations in the warm and humid climates



b) Installation close to a source of continual moisture, such as bodies of water

To reduce the risk of PID, we strongly suggest that modules feature Taoistic Solar's Anti-PID technology, which can be applied to any Taoistic Solar product. Alternatively, we recommend the use of an inverter that includes a transformer as well as proper grounding of the negative DC leg of the PV array.

Choose inverters with isolation transformers in hot and wet areas (such as shores, wetlands), to ensure proper module function under positive voltage.

7.2. Blocking diode

In a system that uses a battery, blocking diodes are typically placed between the battery and the module output to prevent battery discharge at night and rainy weather.

Diodes that are used as blocking diodes must have a:

- a) Rated Average Forward Current[IF(AV)] above the maximum system current at the highest module operating temperature.
- b) Rated Repetitive Peak Reverse Voltage [VRRM] above the maximum system voltage [Vmax] at the lowest module operating temperature (IEC: Vmax=1500V;).

7.3. BYPASS DIODE

Partial shading of an individual module can cause a reverse voltage across the shaded module. Current is then forced go 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 module, thereby minimizing module heating and array current losses.

Bypass Diode Model:

Manufacture	Туре	Max. peak reverse	Forward Rectified	Max junction
		voltage(V)	current(A)	temperature
Suzhou Goodark Electronics Co., Ltd.	GFT5050SM	50	50	200°C(≤1h)
Zerun Co., Ltd.	ZERUN 40SQ045	45	40	200°C(≤1h)



8.MAINTENANCE AND CARE

A well designed solar system requires minimal maintenance; however, system performance and reliability can be improved by taking some simple steps.

- Maintenance should be carried out at least once a year by trained personnel.
- Trim any vegetation which may shade the solar array thus impacting performance.
- Check that mounting hardware is properly tightened.
- Inspect all cables to verify that connections are tight; the cables are protected from direct sunlight and sited away from areas of water collection.
- Check that all string fuses in each non/earthed pole are operating.
- In the event that the solar modules need to be cleaned then clean the module use a soft cloth together with a mild detergent and clean water. Take care to avoid severe thermal shocks which might damage the module by cleaning modules with water which has a similar temperature to the modules being cleaned.
- On large systems, the benefit of cleaning dirt and debris from the array is a trade-off between
 the cost of the cleaning, increased energy production as a result of this cleaning, and the time for
 the re-soiling of the modules after cleaning.
- If you are unsure whether the array or section thereof needs to be cleaned then first select an array string that is particularly soiled then
 - > Measure & record the inverter feed in current from that string
 - ➤ Clean all modules in the string
- > Measure the inverter feed in current again and calculate the % improvement from cleaning
- > If the improvement is less than 5% then it is normally nor worth spending the expense on cleaning



- The above verification should only be carried out when the insolation is effectively constant (clear sky, strong sunshine, no clouds)
- The back surface of the module normally does not need to be cleaned but, in the event this is deemed necessary, avoid the use of any sharp projects that might damage the penetrating the substrate material.

9.WARNING

These solar modules do not contain any user serviceable parts,

If you suspect that your installation is not working properly, then contact us immediately.

WARNING: For any electrical maintenance, the PV system must first be shut down. Improper maintenance can cause lethal electric shock and/or burns.



10.0 Contact information

Manufacturer

Taoistic Solar Technology(Changzhou) Co., Ltd. Tel: +86- 0519-82628679

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Web Site: www.taoistic-solar.com

Importer

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Tel: 0420446158 Web Site: http://8horse.com.au/