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**SOLAR PANEL
INSTALLATION MANUAL**

FOR CRYSTALLINE SILICON SOLAR PHOTOVOLTAIC MODULES

1. INTRODUCTION

Thank you for choosing API solar Photovoltaic modules. API Solar is one of the leaders in the world solar energy sector and provides the highest quality crystalline silicon solar photovoltaic modules in a range of sizes designed to meet the requirements of the most demanding energy and power users worldwide. Please read this manual completely before installation or use modules. This manual applies to all API solar modules and contains important installation, maintenance and safety information.

General Information

The installation of solar modules requires a great degree of skill and should only be performed by qualified licensed professionals, including, without limitation, licensed contractors and electricians.



WARNING

The solar modules generate electricity when exposed to light. Array of many modules can cause lethal shock and burn hazards. Only authorized and trained person should have access to these modules. Cover the modules 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 solar modules. Modules falling from high place will cause death, injury or damage.

Solar modules have a protective glass front. Broken solar module glass is an electrical safety hazard (electric shock and fire). These modules cannot be repaired and should be replaced immediately.

The solar module has a pair of male and female waterproof connectors. For a series electrical connection, connect positive (+) connector of first solar module to negative (-) connector of the following module. Do not short the positive and the negative. Do not disconnect under load. Be sure connector has no gap between the connector plugs. A gap between the connector plugs could cause, a fire and/or an electrical shock.

Artificially concentrated sunlight must not be directed on the solar module. The electrical characteristics are indicated value of Pmax under standard test conditions (Irradiance of 1000W/m², 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 I_{sc} and V_{oc} 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 solar output. Refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 1.25 which may also be applicable.

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

2. INSTALLATION

Permit

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

Site Selection

In most applications, API solar 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 solar module will minimize any such loss.

Do not install the solar module near flame or flammable materials.

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

Handling and Use

There are typically two or more modules in a shipping container. These containers are heavy. To safely transport these containers multiple people and/or equipment should be used to avoid injury.

Protective gloves should be worn when handling solar modules. The gloves will help protect installers against sharp objects and burns.

Always transport and store the modules in the shipping containers provided. Do not leave the module unsupported prior to installation. Avoid application of excessive bending or twisting forces to the module. Avoid stepping on the module or subjecting it to impact.

Mounting

--Climate condition

Install the API 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 ² (2400Pa).
Corrosion resistance:	Except for corrosive salt area and sulfurous area.

--Module tilt angle

API solar modules connected in series should be installed at the same orientation and angle. Different orientation or angles may cause loss of output power due to difference of amount of sunlight exposed to the module. API solar modules produce their full power when oriented towards the sun directly. For off grid installations, the solar 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 (Figure1). Optimal tilting of solar module is almost the same as the latitude of installation location. For grid tied systems the optimum angle is usually between 20 & 30 degrees and optimizes summer power production, not winter.

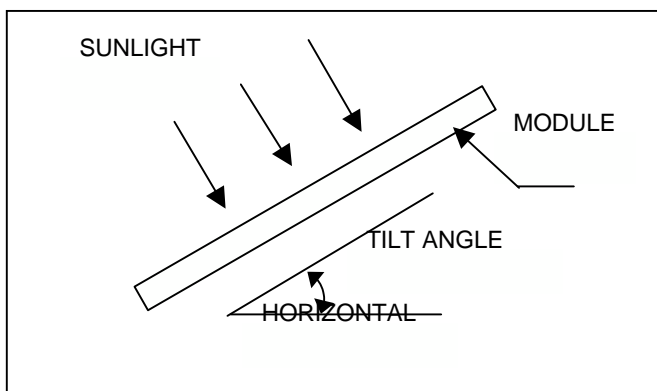


Figure 1 Solar Module Tilt Angle

--Mounting

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.

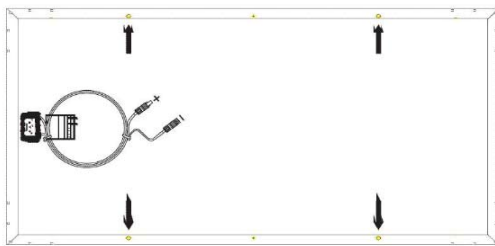


The module frame is made of anodized aluminum, and therefore corrosion can occur if the module is subject to a salt water environment with contact to a rack of another type of metal (Electrolysis Corrosion). If required, PVC or stainless steel washers can be placed between the solar module frame and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

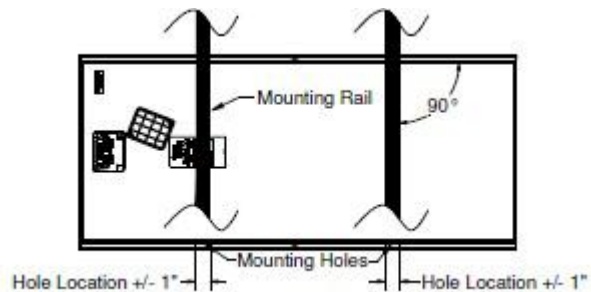
API solar modules should be mounted as follows:

--Using stainless steel screws (M8) on the existing installing holes in the module frame.

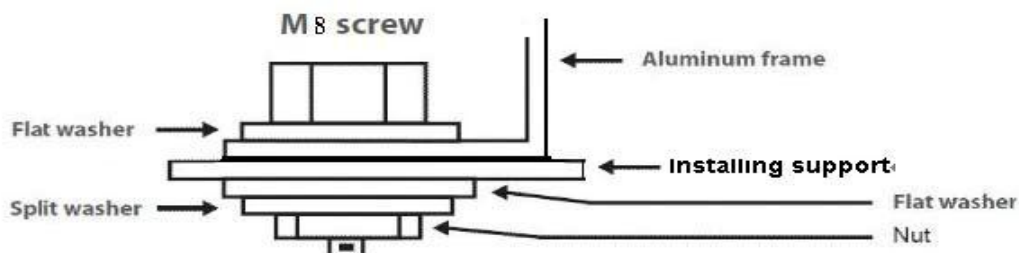
Modules must be securely attached to the mounting structure using four mounting points for normal installation. If additional wind or snow loads are anticipated for this installation. Refer to the drawing, below. Load calculations are left to the system designer or installer.



↑ Mounting holes for normal installation



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



The modules have been evaluated by UL for a maximum positive or negative design loading of 30 lbs/ft² using the 4 provided mounting holes in the frame.

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. If other mounting means are employed this may affect the UL Listing. Do not mount solar module in such way that the drain holes of solar module frame get block up.

Do not step on the module, although solar 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.

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 bare wire and grounding clip. The wire may be bare 12 AWG copper bonding wire. The grounding clip assembly consists of a slider base, and a self-captivating thread-cutting screw or 8 –32 screw and hex nut.

The screw is used to mount the grounding clip to the frame (of the solar panel). The slider is used to hold the wire. The slider features a multi-dimensional curved wire slot that provides enhanced wire retention. The base is used to terminate the wire. The base features pointed lances that provide four points of contact to the frame for high reliability and anti-rotation of the grounding clip. The removal slot accepts the tip of a flat-head screwdriver which is used to disengage the slider. When the slider is disengaged, the wire can be removed, and the screw is exposed for removal (Figure 2).

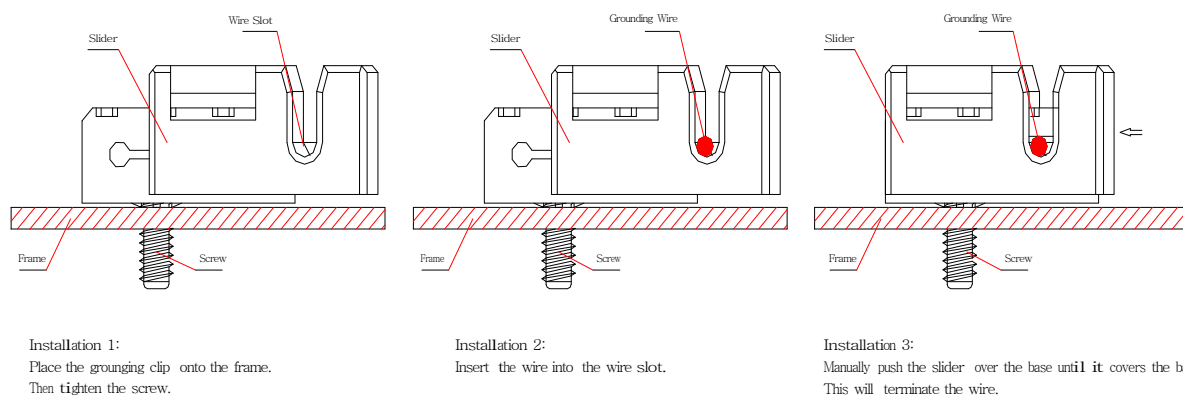


Figure 2 Grounding Clip Installations

API solar modules and mounting assemblies can also be grounded utilizing UL listed Weeb grounding systems and plates as long as manufacturers installation guidelines are followed. Grounding methods shall comply with NEC Art. 250.

Each module has two #12 AWG type standard 90°C sunlight resistant output cables each terminated with positive & negative connectors. This cable is suitable for applications where wiring is exposed to direct sun. Refer to NEC for wiring details in accordance with the National Electrical Code (NEC).

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

Bypass diodes and blocking diodes

Partial shading of an individual module can cause a reverse voltage across the shaded solar 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 solar module, thereby minimizing module heating and array current losses. In system utilizing a battery, blocking diodes are typically placed between the battery and the solar module output to prevent battery discharge at night (charge controller).

Diodes that are used as blocking diodes must: Have a Rated Average Forward Current [IF(AV)] above maximum system current at highest module operating temperature. Have a Rated Repetitive Peak Reverse Voltage [VRRM] above maximum system voltage at lowest module operating temperature.

3. MAINTENANCE

Under most weather conditions, normal rainfall is sufficient to keep the solar 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. Solar 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 solar 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 solar module by an opaque or other material when repairing. The solar modules when exposed to sunlight generate high voltage and are dangerous.

For further information, please visit our website www.advancepower.net or contact your API Authorized Representative.

4. SPECIFICATIONS

Notes

1. Standard Test Condition (STC): 1000 W/m², 25°C cell temperature and solar spectral irradiance per ASTM E 892, IEC 60904-3, irradiation of AM 1.5 spectrum.
2. Nominal Operating Cell Temperature (NOCT): 47±2°C
3. Rated electrical characteristics are within 10 percent of measured values at Standard Test Conditions.
4. Temperature coefficient of Current is 0.05%/°K, Temperature coefficient of Voltage is - 0.35%/°K.
5. See solar module drawings for mounting and grounding holes locations (Figure 3).

Module Series	Model	Dimensions (mm)	Weight (kg)	Electrical Performance at STC					Max-System Voltage (VDC)	Max-Series Fuse (A)
				Max-Power P_m (W)	Max-Power Voltage V_{mp} (V)	Max-Power Current I_{mp} (A)	Open-Circuit Voltage V_{oc} (V)	Short-Circuit Current I_{sc} (A)		
72pcs 125x125mm Monocrystalline Silicon Solar Module	API-150	1581x809x40	15.60	150	34.40	4.40	42.6	4.19	UL1703: 600VDC & IEC61215/IEC61730:1000VDC	10
	API-160			160	34.90	4.60	42.8	5.15		
	API-165			165	35.60	4.65	43.2	5.20		
	API-170			170	35.80	4.75	43.6	5.25		
	API-175			175	36.20	4.85	43.9	5.30		
	API-180			180	36.80	4.90	44.2	5.35		
60pcs 156x156mm Multicrystalline Silicon Solar Module	API-156P-200	1650x992x46	19.50	200	28.7	6.97	36.0	7.75		15
	API-156P-210			210	29.2	7.19	36.4	7.86		
	API-156P-220			220	29.8	7.39	36.8	8.00		
	API-156P-230			230	30.0	7.66	37.0	8.18		

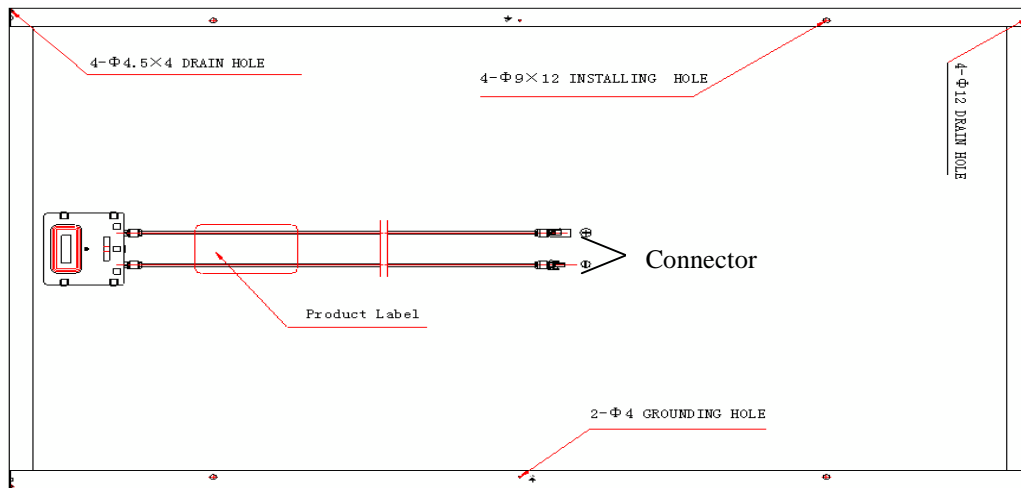


Figure 3 Backside of SOLAR Module