400 Rinehart Road
Lake Mary, Florida 32746
www.AdvancedSolarPhotonics.com
info@ AdvancedSolarPhotonics.com
Tel: (407) 804-1000

Safety and Installation Instructions

This document applies to the following PV Modules:

BLACKSTAR™ SERIES

AP-230MK, AP-235MK, AP-240MK, AP-245MK, AP-250MK

TRUBLU™ SERIES

AP-220PK, AP-225PK, AP-230PK, AP-235PK, AP-240PK,

Version Date March 7, 2012

1.0 Introduction

Thank you for purchasing ASP Photovoltaic (PV) modules.

The modules you have chosen are highly efficient, use unique proprietary technology, are extremely rugged and are designed to provide the longest life span of any photovoltaic module in the industry.

Artificially concentrated sunlight shall not be directed on the module or panel.

This manual provides safety and installation instructions for ASP Photovoltaic modules.

1.1 Disclaimer of Liability

The installation techniques, handling and use of this product are beyond company control. Therefore, ASP does not assume responsibility for loss, damage or expense resulting from improper installation, handling or use.

1.2 Limited Warranty

Module Limited warranties are described in the ASP warranty certificates.

ASP module warranty describes as below:

- ***Free from defect in materials and workmanship for 5 years***
- ***90% of minimum warranty power output for 10 years***
- ***80% of minimum warranty power output for 25 years***

2.0 Safety Precautions

Before installing this module, read all safety instructions in this manual.

Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of Isc and Voc marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacities, fuse sizes, and size of controls connected to the PV output.

Refer to section 690.8 of the National Electrical Code for an additional multiplying factor of 125 percent (80 percent derating) which may be applicable.

The module or panel should be installed in accordance with the latest National Electrical Code (USA), Canadian Electrical Code (Canada) or applicable national/international electric standards for installation country.

The modules are class C fire rated and evaluated at 30lb/ft2 as maximum load.

Warning!

During sunlight hours even at low light levels, there is a risk of shock. This hazard increases when multiple modules are connected together to provide higher system voltage or current levels. To reduce the risk of electrical shock or burns, modules may be covered with an opaque material during installation to avoid shock or burns. Do not touch live terminals with bare hands. Dangerous voltages may also be present at night from connections to batteries and feedback from inverters or other parts of the system.

- Cover all modules in the PV array with an opaque cloth or material before making or breaking electrical connections.
- All installations must be performed in compliance with all applicable regional and local codes.
- There are no user serviceable parts within the module. Do not attempt to repair any part of the module.
- Installation should be performed only by authorized personnel.
- Remove all metallic jewelry prior to installing this product to reduce the chance of accidental exposure to live circuits.

- Use insulated tools to reduce your risk of electric shock.
- Do not stand on, drop, scratch or allow objects to fall on modules.
- If the front glass is broken, or the back sheet is torn, contact with any module surface or module frame can cause electric shock.
- Do not install or handle the modules when they are wet or during periods of high wind.
- Artificially concentrated sunlight shall not be directed on the module or panel.
- Do not expose backside of the module to sunlight.
- In order to prevent water from entering the junction box, which could present a safety hazard, modules should not be mounted such that the front glass faces downward (e.g. on a tracking structure that positions the modules with the junction box facing skyward during sleep mode.)
- Contact your module supplier if maintenance is necessary.
- Save these instructions!

3.0 Procedure for Installation

i. ASP modules should be installed by a minimum of two qualified personnel. The system involves electricity, can be dangerous if the operators are not familiar with the appropriate safety procedures.

ii. ASP PV modules can be mounted by various methods, using the four (or six) mounting holes located on the module frame or may also be mounted using pressure clips on the channels with the mounting holes located on the module frame. (please refer to Figure 1)

iii. Secure the module using the four (or six) mounting holes provided using stainless steel bolts, nuts and spring and pan washers for long-term security.

iv. Put the ASP PV modules on the channels, using the bolts, nut and washers then, tighten to 9.5N.m to 10N.m., or 7.00 to7.50 foot pounds, on the bolt and nut with proper tools as described in Figure.1.

- **Installing Modules**

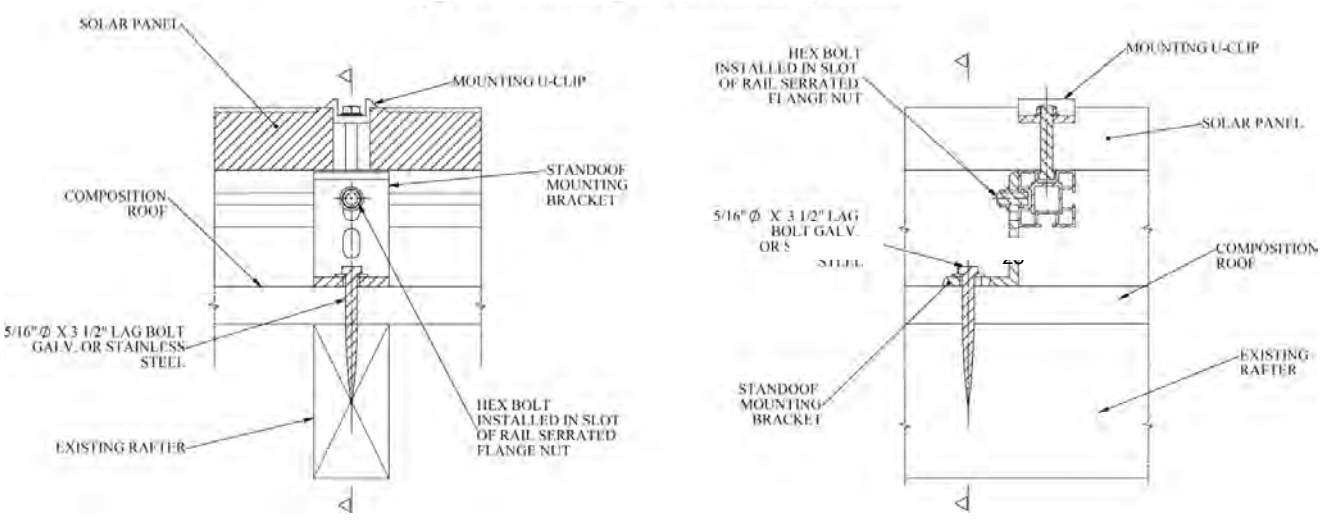


Figure 1 - Basic Mounting Structure

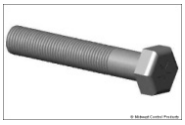
- **Roof Mounting**

  Clearance between the module frame and the mounting surface is required to prevent the junction box from touching the surface, and to circulate cool air around the back/underneath of the module. If the modules are to be installed on the roof or wall of a building, a stand-off or rack mounting method is recommended.

  Stand-Off/Rack-Mounting Method: The modules are supported parallel to the surface of the building wall or roof. Clearance between the module frames and surface of the wall of roof is required to prevent wiring damage and to allow air to circulate behind the module.

- **Mounting hardware size and torque**

Size Threads Per Inch		
	Assembly Torque (LB)	
	Max.	Min.
7/16 – 14 (M6)	43	31
3/4 – 10 (M12)	210	155
1 - 8 (M16)	462.5	360

Size	**Newton Meters**	**Foot Pounds(Approx.)**	**Class**
	Unplated	**Unplated**	
M6 x 1.00 Pitch	9.5	7.13	
M12 x 1.75 Pitch	79.0	59.25	
M12 x 1.25 Pitch	87.0	65.25	
M12 x 1.50 Pitch	83.0	62.25	
M16 x 2.00 Pitch	195.0	146.25	

CAUTION

Never leave a module unsupported or unsecured. If a module should fall, the glass could break. A module with broken glass cannot be repaired and must not be used.

4.0 Electrical Characteristics

The module electrical ratings are measured at Standard Test conditions (STC) of 1000 W/㎡ irradiance with air mass 1.5G spectrum and a cell temperature of 25℃. Electrical characteristics for specific ASP PV modules are on the product label and product data sheet.

A photovoltaic module may produce more current and/or voltage than reported at STC. As we have mentioned previously, sunny, cool weather and reflection from snow or water can increase current and power output. Therefore, the values of Isc and Voc marked on the module should be multiplied by using NEC standards when

determining component voltage ratings, conductor amperage, fuse sizes, and size of controls connected to PV output.

Model	Max. System Voltage (V dc)	Max. Power (Wp)	Max. Power Voltage (Vmp)	Max. Power Current (Imp)	Open Circuit Voltage (Voc)	Short Circuit Current (Isc)	Dimensions (mm)	Max. Series Fuse (A)	Weight (kg)
AP-230MK	UL–600V IEC–1000V	230	30.00	7.67	36.00	8.59	1650(L) 992(W) 46(T)	15	18.5
AP-235MK		235	30.00	7.83	36.00	8.77			
AP-240MK		240	30.00	8.00	36.00	8.96			
AP-245MK		245	30.60	8.03	36.70	8.97			
AP-250MK		250	30.70	8.14	36.80	8.99			
AP-220PK	UL–600V IEC–1000V	220	29.07	7.57	36.46	8.12	1650(L) 992(W) 46(T)	15	19.6
AP-225PK		225	29.44	7.65	36.66	8.21			
AP-230PK		230	29.81	7.72	36.86	8.30			
AP-235PK		235	30.18	7.79	37.06	8.39			
AP-240PK		240	30.54	7.87	37.26	8.48			

Table.1 Electrical Specifications

※ The electrical characteristics are within ±10% of the indicated values of ISC, VOC and Pmax under standard test conditions (irradiance of 1000W/㎡. AM 1.5 spectrum and a cell temperature of 25℃)

5.0 Electrical Connections

Modules may be connected in series and/or parallel to achieve the desired electrical output as long as certain conditions are met. Please use only the same type of module in a combined source circuit.

5.1 General Wiring

ASP recommends that all wiring be double insulated with a minimum rating of 90℃. All wiring should use flexible copper (Cu) conductors. The minimum size should be determined by the applicable codes. We recommend a size not less than 12AWG.

Details for wiring in accordance with the NEC, and that the grounding method of the frame of arrays shall comply with the NEC, article 250.

- Wire information is as followings.

Part Number	CONDUCTOR		FINISHED WIRE			
	Number of Strands/Maximum	Maximum Diameter	Outer Diameter(mm)			
			Lower	Target	Upper	Maximum

	Stranding(mm)	(mm)	Spec. Limit		Spec. Limit	Weight (Kg/Km)
0.6 / 1kV CV	7 / 0.85	2.55	5.1	5.25	5.4	90

- Junction Box information is as below;

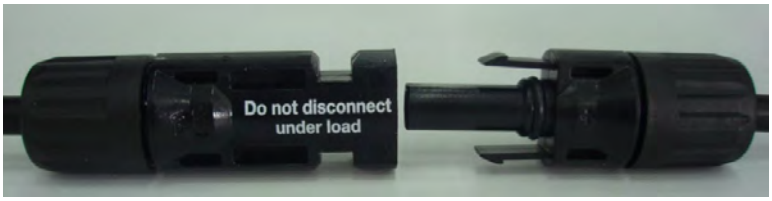
	Model	Manufacturer	Imax	Vmax	Temperature
Assembly		Tyco	30 A	600 VDC	- 40 ~ 105 ℃
Cable	Tyco	Tyco	25A	600 VDC	- 40 ~ 90 ℃
Connector	Tyco SolarLok	Tyco	20 A	600 VDC	- 40 ~ 105 ℃

5.2 Module to Module Interconnection

ASP PV modules are designed to be readily interconnected. Each PV modules has two cables, one has a positive (+) terminal and the other has a negative terminal, which are terminated inside the junction box. Modules are interconnected by inserting the positive connector from one module into the negative connector of the next module in the array string. The mated connector pair is then securely attached to the inside flange of the module frame to protect them from damage (as shown in Figure 2).

If the modules are not provided with these connectors, please contact our representatives for detailed instructions.

- Connectors



Currently, ASP is using Tyco SolarLoki locking type connectors. Each locking type connector has a double pole, two conductor wire that not only connects the module in series, but provides a built in return connection from the end of the string.

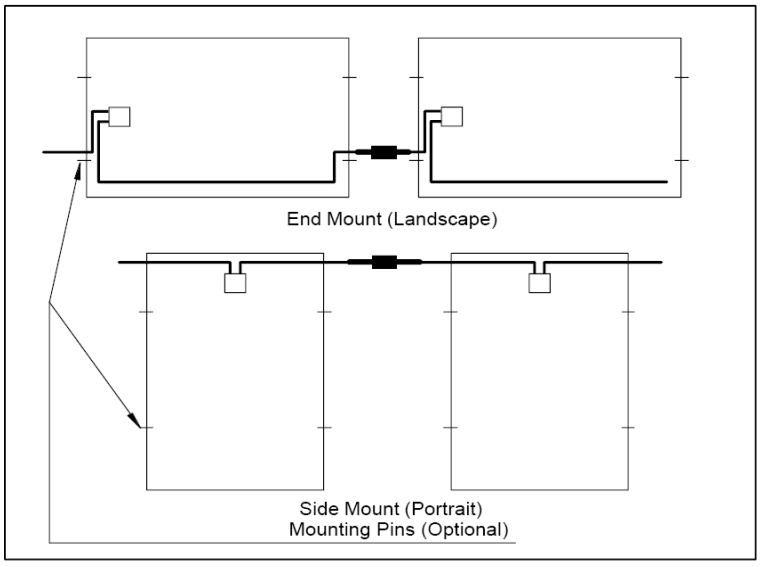


Figure 2 - Module Orientation

5.3 Equipment Grounding

Please refer to the applicable regional and local codes on grounding PV arrays and mounting frames for specific requirements.

- We recommend you attach all module frames to an earth ground.
- Attach a separate ground wire to one of the holes marked ⏚ on the module frame with Star Washer, Cup Washer, pan washer and spring washer.
- After inserting Bolt into the frame, insert Spring Washer and Nut

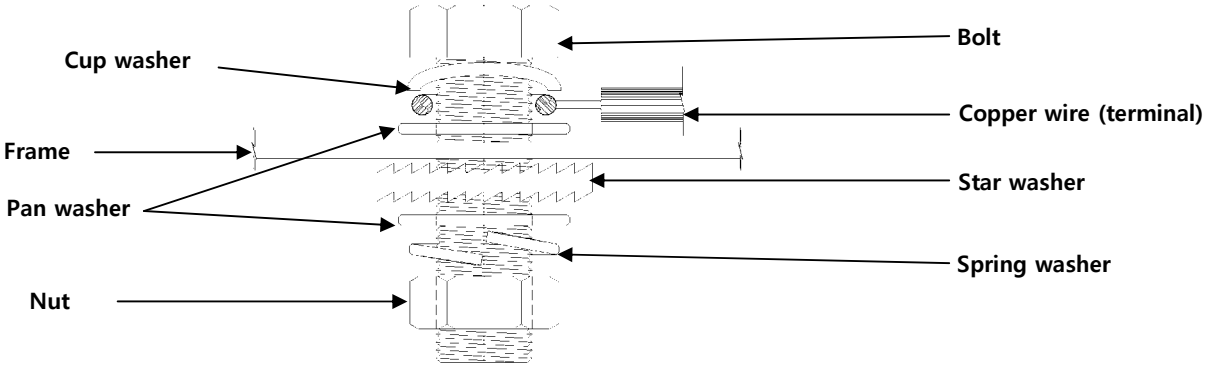


Figure 3 – Basic Grounding Structure

Grounding Hardware	size & material	Remarks
Bolt	M6, Stainless(STS304)	25mm
Cup Washer	M6, Stainless(STS304)	
Copper wire	10 AWG	
Star washer	M6, Stainless(STS304)	
Pan washer	M6, Stainless(STS304)	
Spring washer	M6, Stainless(STS304)	
Nut	M6, Stainless(STS304)	9.5 N.M torque

Grounding Hardware Size & Materials

5.4 Module Grounding

- Insert STS Bolt M6 into frame grounding hole with associated hardware as shown in Figure 3; or
- Use solar approved grounding lugs expressly for this purpose.

5.5 System Grounding

Important! For optimal performance, ASP modules must only be used in configurations with galvanic insulated inverters where the positive (+) polarity of the PV array is connected to ground protected by a fuse. Failure to comply with this requirement will reduce the performance of the system and invalidate ASP Limited

Power Warranty for PV Modules. For more information on grounding the system correctly, or for additional assistance, contact ASP technical support at info@AdvancedSolarPhotonics.com.

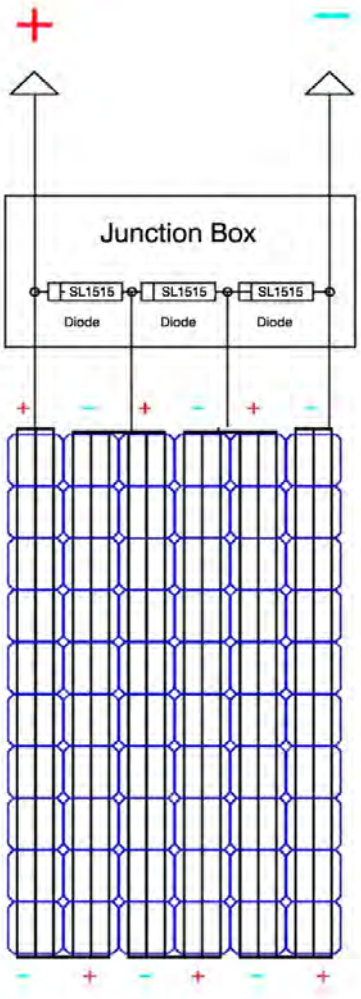


Figure 4 - Cell & Diode Circuit Diagram

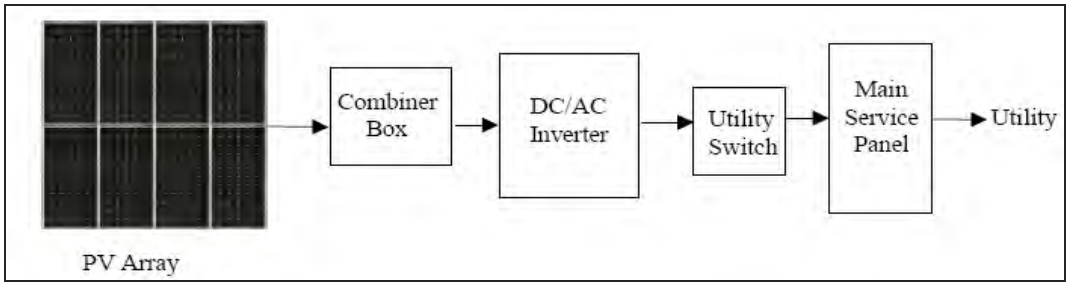


Figure 5 - Simplified PV System Diagram

5.6 Series Connection

The modules may be combined in series to produce the desired current output. The maximum Vmax to be connected in series is recommended up to 480V. Every series string or module must be fused prior to combining with other strings. The maximum fuse size allowable is 15A. Bypass diodes are factory installed in the modules. Please refer to the applicable local and regional codes as well as the inverter requirements for additional fusing and limitations on the maximum number of modules in series.

6.0 Module Mounting

The ASP Limited Warranty for PV Modules is contingent upon modules being mounted in accordance with the requirements described in this section.

6.1 Site Considerations

ASP modules should be mounted in locations that meet the following requirements:

Operating Temperature:

All ASP modules must be mounted in environments that ensure the modules will operate within the maximum and minimum operating temperatures. Care should be taken to provide adequate ventilation behind the modules, especially in hot environments.

Design Strength:

ASP modules are designed to meet a specified maximum positive (or upward, e.g. wind) and negative (or downward, e.g. static load) when mounted in one of the standard mounting configurations.

When mounting modules in snow prone or high wind environments, special care should be taken to mount the modules in a manner that provides sufficient design strength while meeting local code requirements.

Excluded Operating Environments:

Certain operating environments are not recommended for specific ASP modules and are excluded from the ASP Limited Warranty for these modules. No ASP modules should be mounted at a site where it may be subject to direct contact with salt water.

6.2 Mounting Configurations

Modules may be mounted at any angle from horizontal to vertical. Select the appropriate orientation to maximize sunlight exposure. Specific information on module dimensions and the location of mounting and grounding holes is provided below. In order to prevent water from entering the junction box, which could present a safety hazard, module should not be mounted such that the front/top glass faces downward (e.g, on a tracking structure that positions the modules with the junction box facing skyward during sleep mode).

Clearance between the module frames and structure or ground is required to prevent wiring damage and allows air to circulate behind the module.

When installed on a roof, the module shall be mounted over a fire resistant roof covering rated for the application. We recommend you install the modules on roof with a 3" to 6" air gap.

Do not remove or alter the module frame. Creating additional mounting holes may damage the module and reduce the strength of the frame.

Modules may be mounted using the following methods only:

1) **Frame Holes**: Secure the module to the structure using the factory mounting holes. For M6 stainless steel bolts with nuts, pan washers and spring washers are recommended per module. The module consists of 6 holes (ϕ8) located at 327mm from the end of modules each sides and 2 holes for grounding. Also, there are 8 holes for draining. Refer to the following figure for the module dimensions and mounting holes locations.

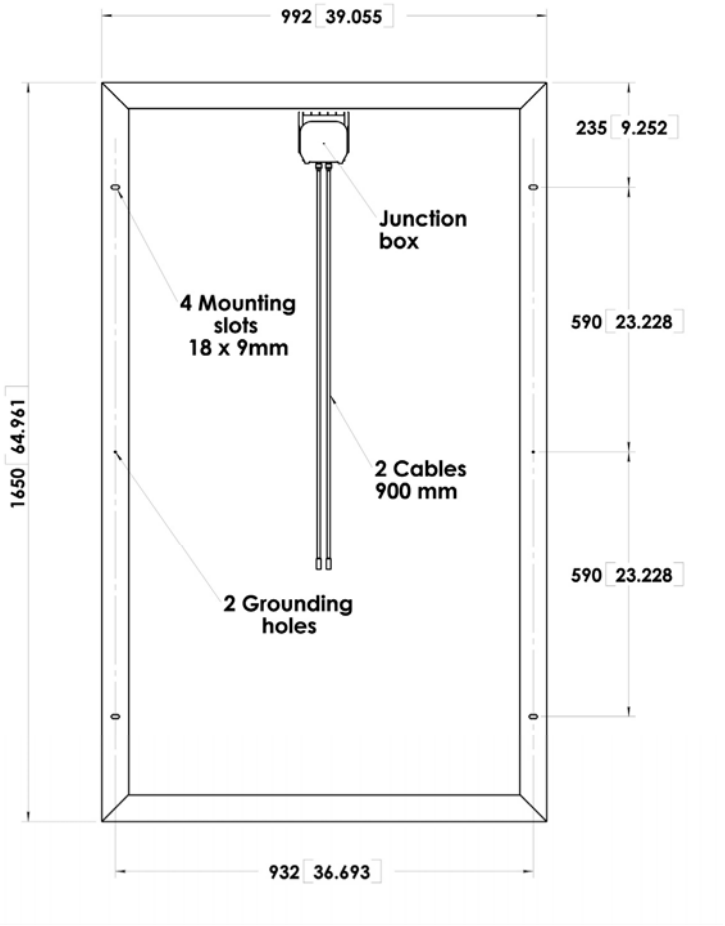


Figure 6 - Product Drawing

2) **Pressure Clamps or Clips**: Mount the module with the clamps on the side frame of the module. The side frames are the longer sides of the module. The centerline of the clips should be located on appropriate positions for your requirement from the end of the module. Installer should ensure the clamps are of sufficient strength to allow for the maximum design pressure of the module. Clips and clamps are not provided with the module. We recommend you use aluminum (material) clamps as shown in Figure 7.

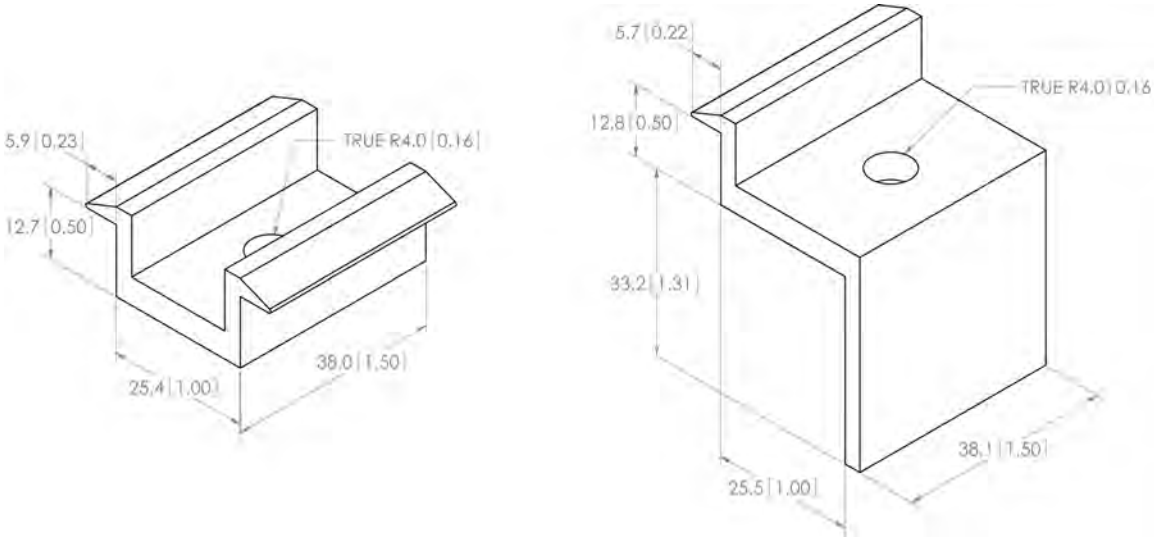


Figure 7 - Clamp Dimension

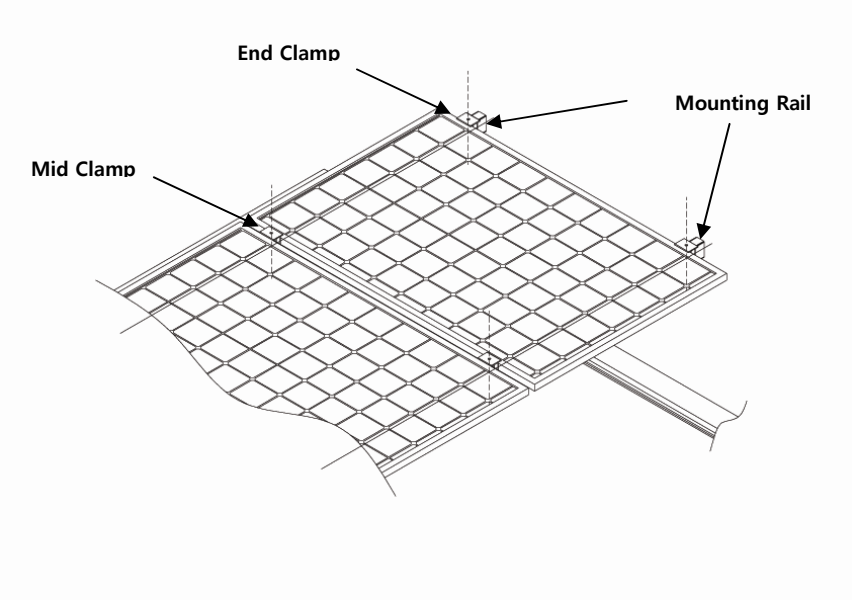


Figure 8 - Basic Arrangement of Clamps

3) **End Mount**: End mounting is the capture mounting of the length of the module's end frame to a supporting rail. The end frames are on the shorter sides of the module. The end-mounting rail and clips or clamps must be of sufficient strength to allow for maximum design pressure of the module. Verify this capacity with the mounting system vendor before installation.

7.0 Maintenance

Inspect all modules annually for safe electrical connections, sound mechanical connection and freedom from corrosion. Periodically clean the module surface with water and a soft cloth or sponge. Fingerprints may be removed with standard glass cleaner. Do not use harsh cleaning materials such as scouring powder, steel wool, blades or other sharp instruments to clean the glass surface of the module. Use of such materials will invalidate the product warranty.

8.0 Troubleshooting

A photovoltaic module will produce electricity when illuminated. Treat solar modules in the same way you would treat any electrical device. Only personnel trained in the use and handling of PV modules should attempt any diagnostic work.

Photovoltaic system malfunctions can, in rare cases be caused by module failures. Therefore it may become necessary to field check modules for proper operation. Field conditions vary widely. Since the module output is a function of sunlight and temperature, it can be difficult to determine what an appropriate field electrical reading should be. Subtle problems will not likely be determined in the field, however gross ones should be detectable.

One of the best ways to determine if a module is malfunctioning is to compare readings between modules. Similar readings would indicate that the module in question is within specifications. Wide differences, >20%, would most likely indicate a module problem.

There are two module electrical parameters that can be readily measured in the field that will give an indication if the module is functioning properly. These two parameters are the short circuit current (Isc) and the open circuit voltage (Voc). They are typically measured with a multi-meter (an instrument that measures current, voltage, and resistance in circuits).

Reading the voltage across the positive (+) and the negative (-) terminal / leads of the disconnected module will give the Voc. Shorting the leads together and placing an ammeter in the circuit will give you the Isc.

Comparing these readings between several modules will identify any under or non performing module(s).

It is also possible to compare these readings to the module specifications. However, the specifications are determined at a designated solar irradiance and a designated ambient temperature, e.g., "STC". If the field measurements are not made under conditions which match STC, the Isc and Voc values will be different.

For larger systems another useful test can be made using a current probe attachment for the multi-meter. A current probe is a device that has jaws that open to allow it to be placed around the wire instead of in-line with the wire. This device can measure current without breaking the circuit.

Using the current probe, current can be easily measured at many different points in the array and compared one to another to see if they are the same. If they are the same it is likely the module(s) in question is functioning properly and if different, it is likely that the module(s) in question is not functioning properly.

When evaluating the readings one should keep in mind that module current is directly proportional to the amount of solar irradiation and module voltage is dependent on the module temperature. The published specifications are referenced to STC conditions, 100mW/㎠, AM=1.5 spectrum, and a cell temperature of 25℃. A decrease in light intensity of 50% will reduce the current by 50% with voltage remaining essentially unchanged. An increase in the cell temperature by 10℃, caused by the sun striking the module at a more direct angle or by the ambient air temperature rising, will reduce the voltage by 3.6% with the current remaining essentially unchanged.

Abnormal readings should alert the user to possible module problems. Replacing suspicious modules with known good ones will help confirm the diagnosis. Any module problems should be brought to the attention of your dealer, distributor, or ASP.

9.0 Repair

With the exception of module to module cabling and connections, all module repairs must take place at the factory. Before sending a module back, contact the module seller for authorization and return. Make sure you have the module serial number (on the module label).

If should be noted that most problems that occur in a photovoltaic power system are not caused by the photovoltaic modules. The most common problem is a bad or improper connection. Before considering returning a suspect module to the factory, check the tightness of the connection to adjacent modules. If the connector or wiring appears to be damaged, a trained technician should be able to repair the module at the site. If connections and wiring look good but the module does not seem to be working properly, return the module to the sellers.

For additional information:

Visit our website at www.AdvancedSolarPhotonics.com

Or contact our factory at :

Advanced Solar Photonics
400 Rinehart Road - Suite 1060
Lake Mary, Florida 32746
www.AdvancedSolarPhotonics.com
info@ AdvancedSolarPhotonics.com
Tel: (407) 804-1000