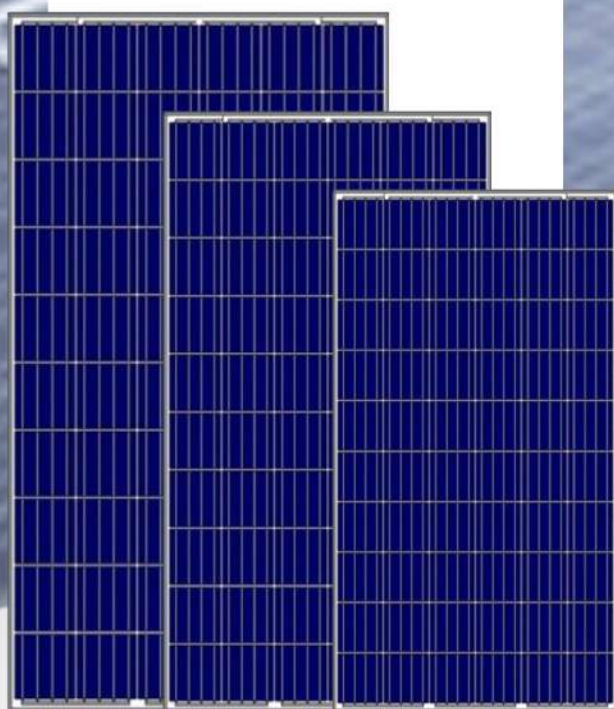




User Manual

Polycrystalline PV Module



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General Information

1.1. Overview

Thank you for choosing APS Polycrystalline PV modules. In order to ensure the PV modules to be installed correctly, please read the following operation instructions carefully before modules installed and used.

Please remember that the products would generate electricity and certain safety measures need to be taken to avoid danger.

1.2. Applicable Products

Please make sure the array of modules installed within the Maximum permitted system voltage and the rating current and voltage of the sub-equipment such as regulators and inverters. The maximum permitted system voltage (DC) of the modules supplied is 1000VDC.

Assembly is to be mounted over a fire resistant roof covering rated for the application. Before mounting the module, please consult your local building department to determine approved roofing materials.

The modules are qualified for application class A: Hazardous voltage (IEC 61730: higher than 50V DC; EN 61730: higher than 120V), hazardous power applications (higher than 240W) where general contact access is anticipated (Modules qualified for safety through EN IEC 61730-1 and 2 within this application class) are considered to meet the requirements for Safety Class II.

1.3. Warnings

- a) PV module generate DC electrical energy when exposed to sunlight or other light sources. Active parts of module as terminal can result in burns, sparks, and lethal shock.
- b) Artificially concentrated sunlight shall not be directed on the module or panel. Back sheet shall be not exposed to the sunlight
- c) Front protective glass is utilized on module. Broken solar module glass is an electrical safety hazard (may cause electric shock and fire). These modules cannot be repaired and should be replaced immediately.
- d) 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 value of I_{sc} and V_{oc} marked on this module should be multiplied by 1.25 when determining component voltage ratings, conductor current ratings, fuse sizes, and size of controls connected to the PV output.

- e) To reduce the risk of electrical shocks or burns, modules may be covered with an opaque material during installation to avoid shocks or burns.
- f) The installation work of the PV array can only be done under the protection of sun-sheltering covers or sunshades and only qualified person can install or perform maintenance work on this module.
- g) Follow the battery manufacture's recommendations if batteries are used with module
- h) Do not use this module to replace or partly replace roofs and walls of living buildings.
- i) Do not install modules where flammable gas may be present.
- j) Do not touch live terminals with bare hands. Use insulated tools for electrical connections.
- k) Do not remove any part installed by APS or disassemble the module.



- l) All instructions should be read and understood before attempting to install, wire, operate and maintain the module.
- m) Please don't lift up PV modules using the attached cables or the junction box.
- n) All PV systems must be earthed. If there is no special regulation, please follow the National Electrical Code or other national code.
- o) Once the PV module has been shipped to the installation site, all of the parts should be unpacked properly with care.
- p) Do not stand or step on the PV module like below pictures show, this is prohibited and there can be risks of micro-crack which may cause a sharp decline of module's power performance; what's more, it may threat your safety.
- q) Only PV modules with the same cell size should be connected in series.

- r) During all transportation situations, please make sure no huge shock for the vehicle or the modules, as this may damage the module or lead the cell to be crack.
- s) During all transportation situation, never let the module fall down from the vehicle, house or hands. This will break the cells of the modules.
- t) Do not clean the glass with chemicals.
- u) Do not disconnect any of the modules when it is under load.

Installation

2.1. Installation Safety

- Always wear protective head gear, insulating gloves and safety shoes (with rubber soles).
- Keep the PV module packed in the carton until installation.
- Do not touch the PV module unnecessarily during installation. The glass surface and the frame may be hot. There is a risk of burns and electric shock.
- Do not work in rain, snow or windy conditions.
- Due to the risk of electrical shock, do not perform any work if the terminals of the PV module are wet.
- Use insulated tools and do not use wet tools.
- When installing PV modules, do not drop any objects (e.g., PV modules or tools).
- Make sure flammable gasses are not generated or present near the installation site.
- Insert interconnect connectors fully and correctly. Check all connections. The interconnect cable should be securely fastened to the module frame, Cable support should be done in a way to avoid the connector from scratching or impacting the back sheet of the module.
- Do not touch the terminal box and the end of the interconnect cables (connectors) with bare hands during installation or under sunlight, regardless of whether the PV module is connected to or disconnect from the system.
- Do not expose the PV module to excessive loads on the surface of the PV module or twist the frame.
- Do not hit or put excessive load on the glass or back sheet, this may break the cells or cause micro crack.
- Do not drill holes on the frame. It may cause corrosion of the frame.
- For roof mounting structure, when install the modules, please try to follow the “from top to

bottom” and/or “from left to right” principle, and don’t step on the module, that will damage the module and would be dangerous for personal safety.

2.2. Installation Condition

2.2.1. Climate Condition

- 1) Relative humidity: within 45% to 95%.
- 2) Operating temperature: within -40°C (-4°F) to 85°C (185°F)

****Note:** The mechanical load bearing (include wind and snow loads) of the module is based on the mounting methods. The professional system installer must be responsible for mechanical load calculation according to the system design.

2.2.2. Site Selection

In most applications, APS Polycrystalline PV 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 percent of their power output. If the module faces 60 degrees away from true South (or North), the power loss will be 20 to 30 percent.

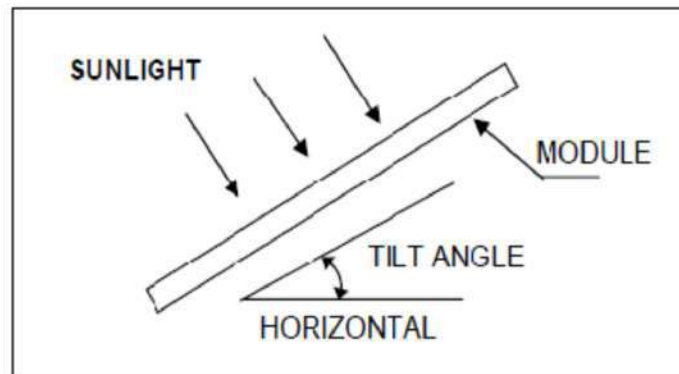
When choosing a site, avoid trees, buildings or obstructions, which could cast shadows on the solar photovoltaic modules especially during the winter months when the arc of the sun is lowest over the horizon. Shading causes loss of output, even though the factory fitted bypass diodes of the PV module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

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

When solar modules are used to charge batteries, the battery must be installed in a manner which will protect the performance of the system and the safety of its users. Follow the battery manufacturer's guidelines concerning installation, operation and maintenance recommendations. In general, the battery (or battery bank) should be away from the main flow of people and animal traffic. Select a battery site that is protected from sunlight, rain, snow, debris, and is well ventilated. Most batteries generate hydrogen gas when charging, which can be explosive. Do not light matches or create sparks near the battery bank. When a battery is installed outdoors, it should be placed in an insulated and ventilated battery case specifically designed for the purpose. Do not install the PV module in a location where it would be immersed in water or continually exposed to water from a sprinkler or fountain etc.

2.2.3. Tilt angle Selection

The tilt angle of the PV module is measured between the surface of the PV module and a horizontal ground surface (Figure 1). The PV module generates maximum output power when it faces the sun directly.



For standalone systems with batteries where the PV modules are attached to a permanent structure, the tilt angle of the PV modules should be selected to optimize the performance based on seasonal load and sunlight. In general, if the PV output is adequate when irradiance is low (e.g., winter), then the angle chosen should be adequate during the rest of the year. For grid-connected installations where the PV modules are attached to a permanent structure, PV modules should be tilted so that the energy production from the PV modules will be maximized on an annual basis.

2.3. Mechanical Installation Introduction

Solar PV modules usually can be mounted by using the following methods: screws and clamps.

***Note:**

- a) All installation methods herein are only for reference, and APS will not provide related mounting components, the system installer or trained professional personnel must be responsible for the PV system's design, installation, and mechanical load calculation and security of the system.
- b) Before installing, you should confirm below important things:
 - (a) Visual check before installation, make sure there is no bug in the packing and junction box as well as the surface of module, If have, remove and clean it.
 - (b) Check the series number is right or not.

- c) APS Polycrystalline modules are designed to meet a maximum positive (or upward) pressure of 5400Pa (Only refer to the mentioned module type in this manual) and negative (or downward,) pressure of 2400 Pa. 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.

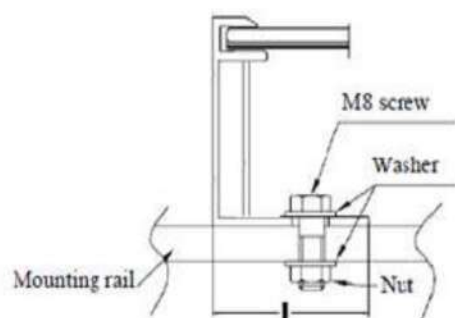
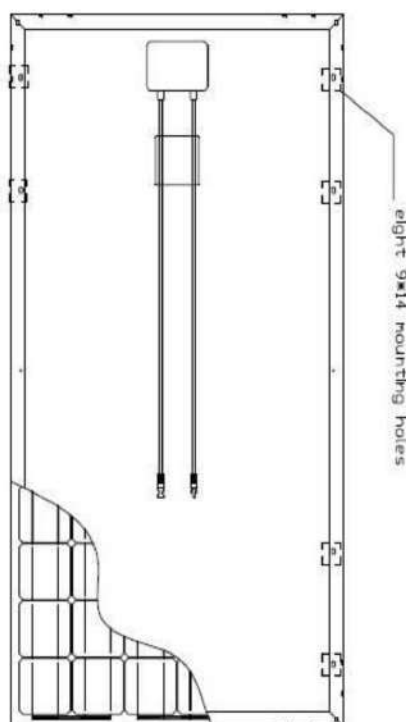
2.3.1. Mechanical Installation

1) Select the appropriate support

- a) Must follow the attached instruction guidance and safety rules of the support.
- b) Don't drill the surface of the module, will cause the module scrap, warranty failure.
- c) Don't put another mounting holes on the frame, the warranty will fail.
- d) During the normal installation, set the module on the support by the four holes inside the frame.
- e) The support material must be durable, corrosion prevention, resistance to ultraviolet light.

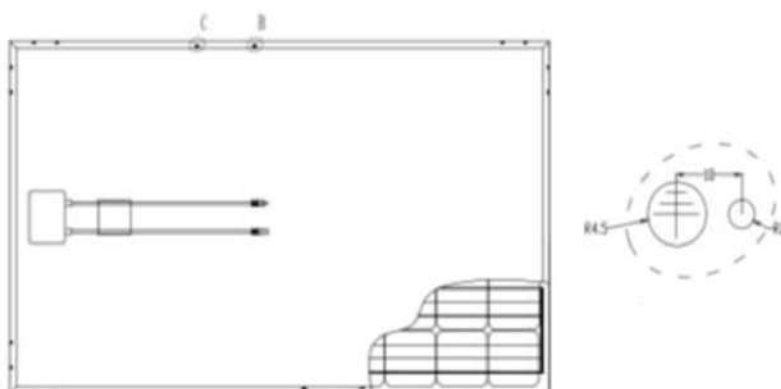
2) Fixation with screws

The frame of each module has 8 mounting holes (Length* Width: 14x9 mm) used to secure the modules to support structure. Always use all the eight mounting holes to secure the modules. The module frame must be attached to a mounting rail using M8 corrosion-proof screws together with spring washers and flat washers in eight symmetrical locations on the PV module. The applied torque should be big enough to fix it steadily. Please find detailed mounting information in the below illustration,



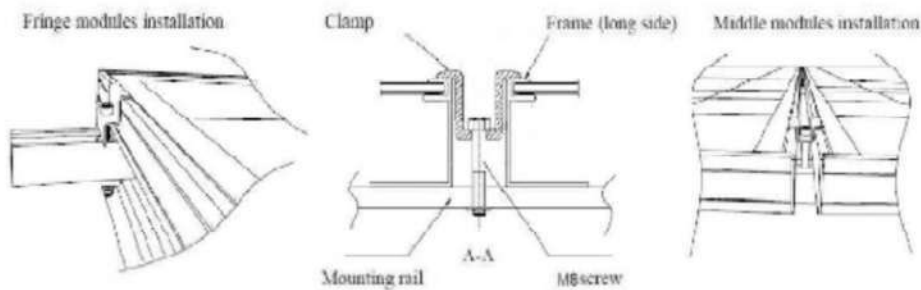
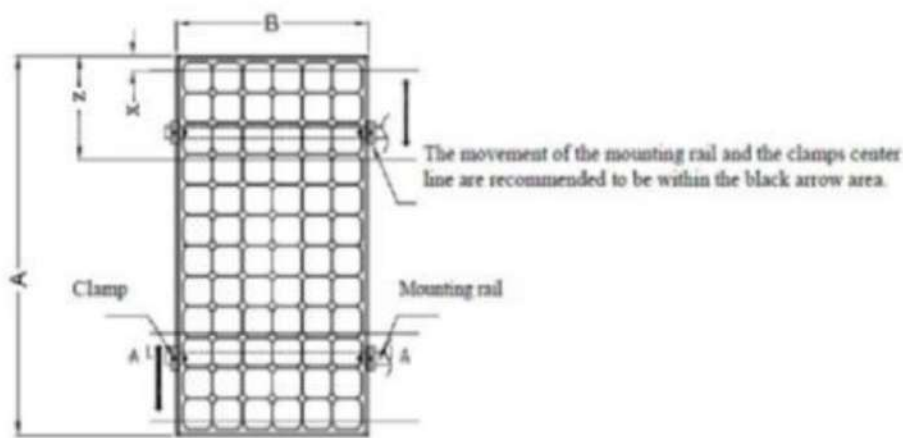
3) Fixation with clamps

The applicable products please refer to Table 2, and only allow using clamps at long side of frames.



The module 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, please be sure to use at least four clamps on

each module, two clamps should be attached on each long sides of the module. Depending on the local wind and snow loads, if excessive pressure load is expected, additional clamps or support would be required to ensure the module can bear the load. The applied torque should be big enough to fix it steadily about 8 Nm) , for safety, you'd better follow the clamps manufacture's recommendation. Please find detailed mounting information in the below illustration, the mounting place distance is suggested bigger than J and less than K as shown below.



4) Ground mount

Select the height of the mounting system to prevent the lowest edge of the module from being covered by snow for a long time in winter in areas that experience heavy snow falls. In addition, assure the lowest portion of the module is placed high enough so that it is not shaded by plants or



trees or damaged by sand and stone driven by wind.

5) Roof mount

- a) When installing a module on a roof or building, ensure that it is securely fastened and cannot fall as a result of wind or snow loads.
- b) Keep back of module smooth and ventilate for the module cooling. (Distance between module and installation surface is minimum 100mm).
- c) On the roof installation, make sure roof structure strong and appropriate. Besides ensure seal the holes made by installation which cause the roof penetrate, to prevent water leakage.
- d) It may need some special mounting support at some situations.
- e) The modules are rated fire Class C, and are suitable for mounting over a class A roof. Do not install modules on a roof or building during strong winds in case of accidents.

6) Pole mount

Choose the right pole and installation structure which can bear the expected wind load.

7) Mechanical Installation introduction

- a) Module mounting must use the pre-drilled mounting holes in the frame. The most common mounting is achieved by mounting the module using the four symmetry points close to the inner side on module frames.
- b) Do not lift the module by grasping the module's junction box or electrical leads.
- c) Do not stand or step on module.
- d) Do not drop module or allow objects to fall on module.
- e) To avoid glass breakage, do not place any heavy objects on the module. f) Do not set the module down hard on any surface.
- g) Inappropriate transport and installation may break module.

2.3.2. Electrical Installation

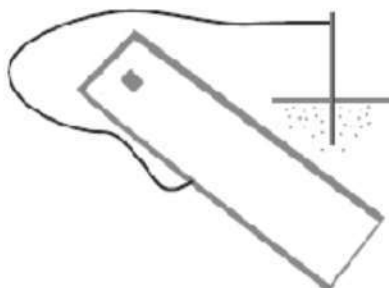
This guide describes some of the most important typical uses as representative examples. The DC electrical energy generated by photovoltaic systems may also be converted to AC and connected to a utility grid system. As local utilities' policies on connecting renewable energy systems to their grids vary from region to region. Consult a qualified system designer or integrator to design such a system. Permits are normally

required for installing such a system and the utility must formally approve and inspect such a system before it can be accepted.



1) Grounding

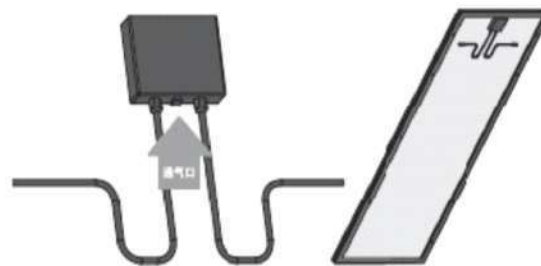
- a) The module frame must be properly grounded. The grounding wire must be properly fastened to the module frame to assure good electrical contact. Use the recommended type, or an equivalent, connector for this wire.



- b) If the support frame is made of metal, the surface of the frame must be electroplated and have excellent conductivity.
- c) We recommend the lay-in lug (Cat. No. GBL4-DBT is recommended by APS solar) when grounding. First strip 16mm insulating jacket from the end of the ground wire carefully to avoid nicking or cutting conductors, insert the wire to the feet of the lug (see the picture), and screw down the slotted screw. Be careful not to damage the wire core. And then tighten up the screw.

Next, assemble the recommended ILSCO grounding lug to the aluminum frame using stainless steel M5 screw and hardware as shown below. Note: there are two different size grounding holes, the smaller of which is being phased out. Further, buildup of hardware for mounting the grounding lug are the same. The star washer is fitted directly under the grounding lug and makes electrical

contact by penetrating the anodized coating of the aluminum frame, the screw assembly is further fitted with a flat washer, then a split lock washer and finally a nut to secure the entire assembly, as shown. Recommended torque of M5 screw assembly is 1.5 N.M.



2) General installation

Do not use modules of different configurations in the same system. The max. Number of module (N) = $V_{\text{max system}} / V_{\text{oc (at STC)}}$. Several modules are connected in series and then in parallel to form a PV array, especially for application with a high operation voltage. If modules are connected in series, the total voltage is equal to the sum of individual voltages.

The cross section area of cable and the capacity of connector must be selected to suit the maximum system short circuit current (Recommended cross section area of cable is 4mm² for a single module and rated current of a connector is larger than 10A), otherwise the cable and connector will be overheated under large current. Please note that the upper limit temperature of cable is $\geq 85^{\circ}\text{C}$ and the connector is $\geq 105^{\circ}\text{C}$. The junction box has a breather port. The breather port must be mounted facing down and can't be exposed to rain. Therefore, the junction box must be on the higher side of the module when it is mounted

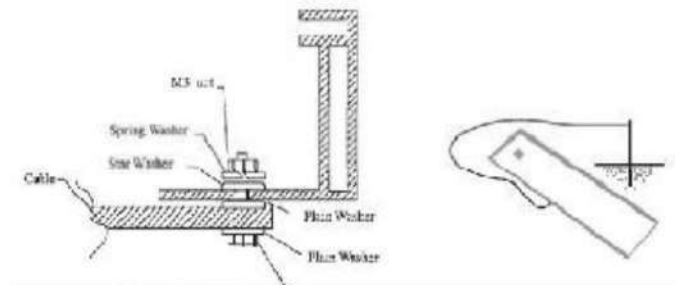


Insert ground wire hear 

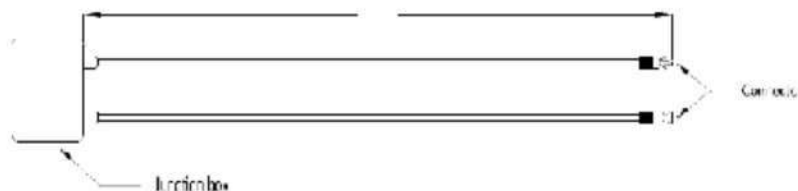
Wiring and Connection

- a) PV module connected in series should have similar current. Modules must not be connected together to create a voltage higher than the permitted system voltage(1000VDC), as reference the maximum number of modules in series (N) can be easily calculated by dividing the Maximum System Voltage of the modules by the respective Voc value of the module. Any more please always take into consideration the variation of the voltage under different temperatures, the Voc of the modules will be rise when the temperature drops.
- b) PV module connect in parallel should have similar voltage. As reference the maximum number of modules in parallel (M) can be easily calculated by dividing the maximum rated current (indicated in the electrical specification below) by Isc value of the module, and then plus 1. Any more please always take into consideration the variation of the current under different temperatures, the Isc of the modules will be rise when the temperature goes up.
- c) Open the connection box of the control system and connect the cabled from the PV arrays to the connection box in accordance with the installation indication of the PV control systems. The cross-sectional area and cable connector capacity must satisfy the maximum short-circuit of PV system (For a single component, we recommended the cross-sectional area of cables is 4mm² and the rated current of connectors is more than 10A), otherwise cables and connectors will become overheating for large current. Please pay attention: the temperature limit of cables is 85°C and the temperature limit of connector is 105°C.

- d) All module frames and mounting racks must be properly grounded in accordance with local and national electrical codes. Attach the equipment grounding conductor to the module frame using the hole and hardware provided. Not that a stainless steel star washer is used between the ground wire and module frame (see picture below). This washer is used to avoid corrosion due to dissimilar metals. Tighten the screw securely.



- e) Follow the requirements of applicable local and national electrical codes.
- f) These modules contain factory installed bypass diode. If these are connected to each other, the bypass diodes, cable or junction box may be damaged.
- g) The cable of the junction box is standard module. For APS standard module, L is 900/1200mm; and for customized module, L can be based on your condition. Please take the cable length into consideration before designing the wiring layout modules are incorrectly.



Maintenance and care

It is required to perform regular inspection and maintenance of the modules, especially within warranty scope. To ensure optimum module performance, APS recommends the following maintenance measures:

4.1. Visual Inspection

Inspect the Modules visually to find whether there are appearance defects, the following need to be paid more attention especially:

- a) Whether the glass is broken;
- b) No sharp objects are in contact with the PV module surfaces
- c) PV modules are not shaded by unwanted obstacles and/or foreign material
- d) Corrosion along the cells bus-bar. The corrosion is caused by the dampness infiltrated into the Modules because that the surface encapsulation materials are damaged during the installation or transportation.
- e) Whether there is burning vestige on the back sheet.
- f) Check fixing screws and mounting brackets are tight, adjust and tighten as necessary.

4.1. Cleaning

- a) A built up of dust or dirt on the module(s) front face will result in a decreased energy output. Clean the panel(s) preferably once per annum if possible (depend on site conditions) using a soft cloth dry or damp, as necessary. Water with high mineral content may leave deposits on the glass surface and is not recommended.
- b) Never use abrasive material under any circumstances
- c) Order to reduce the potential for electrical and thermal shock, APS recommends cleaning PV modules during early morning or late afternoon hours when solar radiation is low and the modules are cooler, especially in regions with hotter temperatures.
- d) Never attempt to clean a PV module with broken glass or other signs of exposed wiring, as this presents a shock hazard.

4.3 Inspection of Connector and Cable

- a) It's recommended to implement the following preventive maintenance every 6 months:
- b) Check the sealing gels of the junction box to ensure it have no crack or crevice.
- c) Examine the PV module(s) for signs of deterioration. Check all wiring for possible rodent damage, weathering and that all connections are tight and corrosion free. Check electrical leakage to ground.

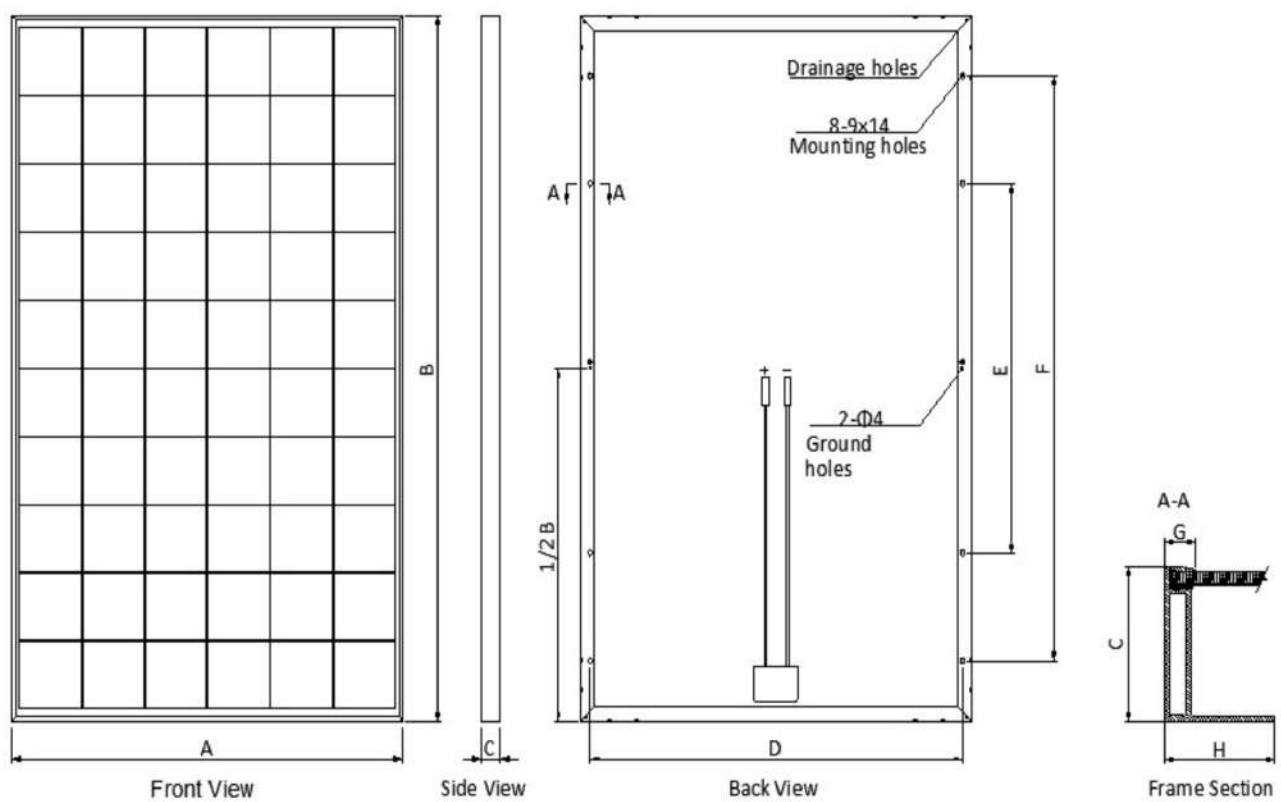
Electrical Specification

The module electrical rating are measured under Standard Test Conditions, which are 1000W/m², irradiance with AM 1.5 spectrum and 25°C (77°F) ambient temperature. The module might produce more or less voltage or current than rating value in uncertainty condition. 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 current ratings, fuse sizes, and size of controls connected to the PV output.

Disclaimer of liability

- 6.1. Because the use of the manual and the conditions or methods of installation, operation, use and maintenance of photovoltaic (PV) product are beyond APS's control, APS does not accept responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected with such installation, operation, use or maintenance. No responsibility is assumed by APS for any infringement of patents or other rights of third parties, which may result from use of the PV product. NO license is granted by implication or otherwise under any patent or patent rights.
- 6.2. The information in this manual is based on APS's knowledge and experience and is believed to be reliable, but such information including product specification (without limitations) and suggestions do not constitute a warranty, expresses or implied. APS reserve the right to change the manual, the PV produce, the specifications, or product information sheets without prior notice.

Module Specification: (see the following figure and table)





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