Philadelphia Solar

Installation Manual
UL

Prepared By: Quality Assurance Dept.

Certified Modules

PS-M72S-190 / PS-M72S-185 / PS-M72S-180.

PS-M36S-95 / PS-M36S-90.

PS-P72-290 / PS-P72-285/PS-P72-280 / PS-P72-275/PS-P72-270.

PS-P60-250 / PS-P60-245 / PS-P60-240 / PS-P60-235/PS-P60-230/PS-P60-225/PS-P60-220.

PS-P54-225 / PS-P54-220 / PS-P54-215 /PS-P54-210/ PS-P54-205/PS-P54-200.

PS-P36-145/ PS-P36-140/PS-P36-135/PS-P36-130.

Installation Manual–Crystalline Photovoltaic Module-

Please Read this manual carefully before using the modules:

Important Safety Instructions:

This manual contains important safety instructions for the PV module that must be followed during the maintenance of PV modules. To reduce the risk of electric shock, do not perform any servicing unless you are qualified to do so.

1. The installation must be performed by a certified installer /servicer..
2. The installation is only allowed after referring and understanding of Installation manual.
3. Do not pull the PV cables.
4. Do not touch any surface of module.
5. Do not place/drop objects onto the PV module.
6. Do not disassemble or attempt to repair the PV module by yourself.
7. Do not damage, pull, bend or place heavy material on cables.
8. Upon completion of any service or repairs, ask the installer /servicer to perform routine checks to determine that the PV modules are in safe and proper operating condition.
9. When replacement parts are required, be sure the installer /servicer uses parts Specified by the manufacturer with same characteristics as the original parts. Unauthorized substitutions may result in fire, electric shock or other hazard.
10. Consult your local building and safety department for required permits and applicable regulations

General Instructions:

Introduction:

This installation manual contains essential information for the electrical and mechanical installation that you must know before installation modules. This also contains safety information you need to be familiar with. All the information described in this manual are the in intellectual property and based on technologies and experiences that have been acquired and accumulated throughout years even it is short period of time but it is enough to prepare such comprehensive report about installation. This document does not constitute a guarantee, expressed or implied. Philadelphia Solar does not assume responsibility and expressly disclaims liability for loss, damage, or expanse arising out of or in any way connected with installation, operation, use or maintenance of the PV modules. No responsibility is assumed by Philadelphia Solar for any infringement of patents or other rights of third parties that may results from use of PV module. Philadelphia Solar reserves the right to make changes to the product, specifications or installation manual without prior notice.

GENERAL INFORMATION

The installation of PV modules requires a great degree if skill and should only be performed by a qualified licensed professional, including licensed contractors and licensed electrifications. Please be aware that there is a serious risk of various types of injury occurring during the installation including the risk of electric shock. All modules are equipped with a permanently attached Junction box that will accept variety of wiring applications or with a special cable assembly for

ease of installation, and they do not require special assembly.

GENERAL WARNING

1. PV modules are heavy. Handle with care.
2. Before you attempt to install, wire, operate and maintain the PV module, please make sure that you completely understand the information described in this installation manual.
3. Contact with electrically active parts of a PV module such as terminals can result in burns, sparks, and lethal shock whether the PV modules is connected or not.
4. PV modules produce electricity when the sufficient sunlight or other sources illuminate the module surface.

When the modules are connected in series, voltage is cumulative. When the modules are connected in parallel current is cumulative .As a result, a large – scale PV system can produce high voltage and current which could present an increased hazard and may cause serious injury or death

5. Do not connect the PV modules directly to the loads such as motor since the variation of the output power depending on the solar irradiation causes damage for the connected motor.

In case of a brushless motor, the lock function becomes active and the hall IC is most likely to be damaged.

In the case of a brush type motor, the coil is most likely to be damaged.

GERNERAL SAFETY

- Consult local codes and other applicable laws concerning required permits on regulations concerning installation and inspection requirements.
- Before installing a PV module, contact appropriate authorities to determine permit, installation and inspection requirements that should be followed.
- Install PV modules and ground frames in accordance with applicable rules and regulations.
- PV modules should be installed and maintained by qualified personnel. Only installer/servicer personnel should have access to the PV modules installation site.
- No matter where the PV modules are installed ,either roof mounted construction or any other types of structures above the ground ,appropriate safety practices should be followed and required safety equipment should be used in order to avoid possible safety hazards. Note that the installation of some PV modules on roofs may require the addition of fireproofing, depending on local building /fire codes.
- In the case that the PV modules are non-integral type, the modules us to be mounted over a fire resistant roof.
- Please use PV modules with same cell size within series,
- Follow all safety precautions of other components used in the system.
- In order to avoid a risk of injury or electrical shock, do not allow anyone to approach the PV module if the person has little knowledge on PV module or on the measures that should be taken when PV modules are damaged.
- Do not shade portions of the PV modules surface from the sunlight for a long time .The shaded cell may become hot (hot spot phenomenon) which results in solder joints peeling off.
- Do not clean the glass surface with chemicals. Do not let water stay on the glass surface of PV modules for a long time. This creates a risk of white efflorescence (glass disease) which may result in the deterioration of energy generation.
- Do not install the PV module horizontally. it may cause dirt or white efflorescence(glass disease) due to water
- Do not cover the water drain holes of the frame. There is a risk of frost damage when the frame is filled with water cumulation.
- When sliding snow load has to be considered, an appropriate measure has to be taken so that PV module frames on lower edge of PV modules will not be damaged.
- Do not expose PV module to sunlight concentrated with mirrors, lenses or similar means.

- Turn off inverters and circuit breakers immediately, should a problem occur.
- In case the glass surface of a PV module is broken, wear goggles and tape the glass to keep the broken pieces in place.
- A defective PV module may generate power even if it is removed from the system. It may be dangerous to handle the PV while exposed to sunlight. Place a defective PV module in a carton so PV cells are completely shaded.
- In case of series connection, the maximum open circuit voltage must not be greater than the specified maximum system voltage; the voltage is proportional to the number of series. In case of parallel connection please be sure to take proper measure (e.g. fuse for protection of module and cable form over current, and /or blocking diode for prevention of unbalanced strings voltage) to block the reverse current flow. The current may easily flow in a reverse direction.

HANDLING SAFETY

- Do not cause an excessive load on the surface of PV module or twist the frame. The glass surface can easily break.
- Do not stand or step on the PV module. The surface glass of PV is slippery.
- Do not hit or put excessive load on the glass or on the back sheet. The backsheet is vulnerable.
- Do not hit on the terminal box or do not pull the cables. The terminal box can crack and break.
- Never touch terminal box or the end of output cables with bare hands when the PV module is irradiated. Cover the surface of PV module with clothes or other suitable sufficiently opaque material to isolate the PV module from incident light and handle the wires with rubber-gloved hands to avoid electric shock.
- Do not scratch the output cable or bend it with force. The insulation of output cable can break and may result in electricity leakage of shock.
- Do not pull the output cable excessively. The output cable may unplug and cause electricity leakage or shock.
- Do not drill holes in the frame. it may compromise the frame strength and cause corrosion of the frame.
- Do not scratch the insulation coating of the frame (except for grounding connection. it may cause corrosion of the frame or compromise the framework strength.
- Do not loosen or remove the screws of the PV module. It may compromise the joint strength of PV module and cause corrosion.
- Do not touch the PV module with bare hands. The frame of PV module has sharp edges and may cause injury.
- Do not drop PV module or allow objects to fall down on the PV module.
- Do not try artificially to concentrate sunlight on the PV module.
- Do not grab the PV module at only one side. The frame may bend. Grab the PV module at two sides facing each other.

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 frames get hot. There is a risk of burn, or you may collapse because of electric shock.
- Do not work under rain, snow or windy conditions.
- Use insulated tools.
- Do not use wet tools.
- Do not drop tools or hard objects on PV modules.
- When installing PV modules far above ground do not drop any object (e.g. PV module or any tool).
- Make sure flammable gases are not generated near the installation site.
- Completely cover the PV module surface with an opaque material during PV module installation and wiring.

- Plug in the connector tight and ensure the wiring work.
- Due to the risk of electrical shock do not perform any work if the terminals of PV module are wet.
- Do not touch the terminal box and the end of output cables the cable ends (connectors) with bare hands during installation or under sunlight, regardless of whether the PV module is connected to or disconnected to a load.
- Do not stomp on the glass at work. There is a risk of injury or electric shock if glass is broken.
- Do not work alone and work as a team.
- Wear a safety belt if working far above the ground.
- Do not wear metallic jewelry which can cause electric shock during installation.
- Do not damage the back sheet of PV modules when fastening the PV modules to a support by bolts.
- Do not damage the surrounding PV modules or mounting structure when replacing a PV module.
- Bind cables by the installation locks. Drooping down of cables from the terminal box could possibly cause various problems such as animal biting, electricity leakage in puddle.
- Take proper measures for preventing the laminate (consisted of resin, cells, and glass, back sheet …etc) from dropping out of the frame in case the glass is broken.
- Cables shall be located so that they will not be exposed to direct sunlight after installation to prevent degradation of cables.

SITE SELECTION

In most applications, the PV modules should be installed in a location where there is no shading throughout the year. In the Northern Hemisphere, the PV modules should typically face north.

Please make sure that there are no obstructions in the surroundings of the site of installation. Take proper steps in order to maintain reliability and safety, in case the PV modules are used in areas such as: Heavy snow areas/Extremely cold areas /strong wind areas/installation over, or near, water/Areas where installations are prone to salt water damage/small islands or desert areas.

TILT ANGLE

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

5 degrees or more is recommended for the tilt angle of the PV module for the maintenance.

For the stand alone systems with a battery where the PV modules are attached to a permanent structure, the tilt angle of the PV modules should be determined to optimize the performance when the sunlight is the scarcest, In general, if the electric power generation is adequate when the sunlight is the scarcest. 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, it is recommended to tilt the PV module at the angle equal to the latitude of the installation site so that the power generation from the PV module will be optimum throughout the year.

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

WIRING

To ensure proper system operation and to maintain your guarantee, observe the correct cable connection polarity (Fig 1& 2) other modules. If not connected correctly, the bypass diode could be destroyed.

PV modules can be wired in series to increase voltage. Connect wires from the positive terminal of one module to the negative terminal of the next module. **Fig 1:** Shows modules connected in series.

Connect PV modules in parallel to increase current. Connect wires from the Positive terminal of one module to the positive terminal of the next module.**Fig2**: Shows modules connected in parallel.

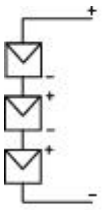

Fig1: In series.

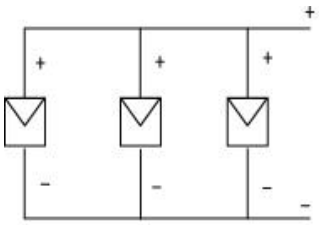

Fig2: In Parallel.

GROUNDING

The frame grounding must consider the local requirements and regulations at the site of installation. When grounding is required please refer to the below example connection **(Fig3).**

Please be careful in arranging the system ground so that the removal of one module from the circuit will not interrupt the grounding of any other modules.

The modules should be grounded to the same electrical point as described below.

Each PV module has a hole on the side frame for a bolt, nut and washer grounding the module to the frame, a ground lug fastened by bolt or screw or appropriate screw. Near the hole for ground you will find an etching mark

Is indicated as ground symbol. ⏚ An example of accepted ground method is described below in **Fig: 3** using bolt, nut and washer retaining a ground lug. In a connection of this type, the hardware (such as toothed locked washer/Star washer) must score the frame surface to make positive electrical contact with the frame. The ground wire must be considered within the requirement of local and regulation at the site of installation.

The ground wire cross sectional area 4mm^{2,} - the minimum size of ground wire 14AWG per Table 250.122 of NEC code. Conductor Type: Copper material-Color of wire: Green color with yellow stripe.

The hardware components (Toothed washer, cup washer, flat washer and hexagon unit) as mentioned in the drawing below must be fit to 4mm hole.

Torque Value: **1.5 N-m** on 4 mm size bolt and nut necessary to secure grounding connection.

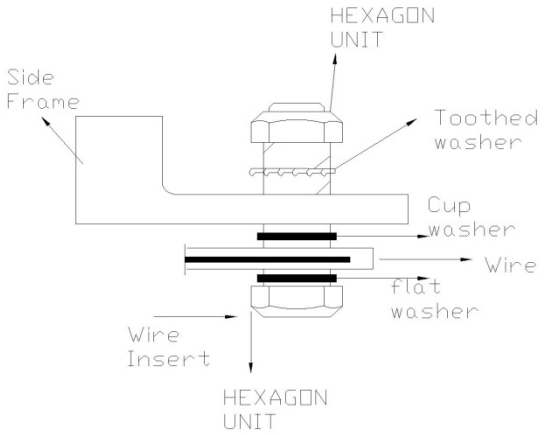

Fig3: Grounding Method.

Recommended Maximum Series / Parallel module configurations.

Series:

(Number modules)*$V_{oc(module)}$*1.25<1000 V

Parallel:

Maximum 2 modules, because max. over current protection rating =15A.

Over- current protection rating=15A.

Type of diode: 1545.

Forward Current: 15A.

Reverse Voltage: 45V.

MOUNTING

1. Mounting using frame bolt holes : There are two openings on each side of the module used to accommodate dedicated bolts intended for direct roof mounting, the modules must be fastened to a support using the bolt holes in the bottom of the frames (size of hole :9mm), the module should be fastened with four bolts -8mm-(Stainless Steel). The module should be mounted by using either on the long end or short end of the frame.

2. **This method designed to allow module loading 30PSF (1436Pa) per UL 1703, Third Edition Standard.** .Support structures that PV modules are mounted on should be rigid. The modules are designed to secure their electric performance under the condition that they are mounted on rigid support structures.

(Deformation of support structure may damage PV module with its electric performance).

3. The modules shall be mounted so that the junction box shall be in the uppermost position to minimize the ingress of water.

4. Do not stand or step on the PV module, Glass, Frame, Backsheet, and Junction Box.

Note: The modules are to be mounted over a fire resistant roof, class C covering rated for the application.

MAINTENANCE

The modules are designed for long life and require very little maintenance .If the angle of the PV module is 5 degree or more, normal rainfall is sufficient to keep the module glass surface clean under most weather conditions. If dirt build-up surface becomes excessive .clean the glass surface with a soft cloth using water. IF cleaning the back of the module is required take utmost care not to damage the back side materials. In order to insure the operation of the system, please check the connection of wiring and the state of the jacket of wires every now and then.

Electrical Characteristics

Rated Electrical Characteristics of Isc, Voc, P max are within ±10% of the indicated below values under STC conditions, Irradiance of 1000W/m^2 , Am 1.5spectrum, and a cell Temperature of 25C°.
The operating Temperature range:
(-40C° to +90C °).

Under Normal Conditions, a photovoltaic module is likely to experience 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 capacities, fuse sizes and size of controls connected to the module output.

Refer to Section 690-8 National Code for an additional multiplying factor of 125 percent

(80 percent derating) which may be applicable.

Per NEC, Section 690-8 circuit conductors and over-current devices shall be sized to carry not less than 125% of the maximum current as calculated in above.

ELECTRICAL INSTALLATION INSTRUCTION:

Cable Characteristics:
Conductor size:4.0mm^2
Cable Type: PV cable.

FIRE RATING:

Rated as Fire Safety Class C according to IEC 61730.

APPLICATION CLASS:

Rated as Application Class A.

Model	Max. System Voltage (V dc)	Open Circuit Voltage @ STC, (V dc)	Rated Voltage @ STC, (V dc)	Rated Current @ STC, (A)	Short Circuit Current @ STC, (A)	Rated Maximum Power at STC, (Watts)	Maximum Series Fuse, (A)	NOCT (deg. C)	Total Number of Cells	No. of Diodes	Total Number of Strings	Cells per Diode	Cell Level Current Temperature Coefficient (%/K)	Cell Level Voltage Temperature Coefficient (%/K)	Cell Level Power Temperature Coefficient (%/K)
PS-P72-290	600	44.71	37.15	7.805	8.33	290	15	46	72	3	6	24	0.0514	-0.3196	-0.388
PS-P72-285	600	44.5	36.93	7.709	8.24	285	15	46	72	3	6	24	0.0514	-0.3196	-0.388
PS-P72-280	600	44.17	36.72	7.612	8.12	280	15	46	72	3	6	24	0.0514	-0.3196	-0.388
PS-P72-275	600	43.88	36.54	7.516	8.01	275	15	46	72	3	6	24	0.0514	-0.3196	-0.388
PS-P72-270	600	43.52	36.29	7.42	7.88	270	15	46	72	3	6	24	0.0514	-0.3196	-0.388
PS-P60-250	600	37.62	31.32	7.995	8.51	250	15	46	60	3	6	20	0.0514	-0.3196	-0.388
PS-P60-245	600	37.38	31.08	7.869	8.39	245	15	46	60	3	6	20	0.0514	-0.3196	-0.388
PS-P60-240	600	37.2	30.9	7.773	8.3	240	15	46	60	3	6	20	0.0514	-0.3196	-0.388
PS-P60-235	600	36.9	30.66	7.644	8.16	235	15	46	60	3	6	20	0.0514	-0.3196	-0.388
PS-P60-230	600	36.63	30.48	7.548	8.04	230	15	46	60	3	6	20	0.0514	-0.3196	-0.388
PS-P60-225	600	36.27	30.24	7.42	7.88	225	15	46	60	3	6	20	0.0514	-0.3196	-0.388
PS-P60-220	600	35.91	30	7.292	7.72	220	15	46	60	3	6	20	0.0514	-0.3196	-0.388
PS-P54-225	600	33.85	28.19	7.995	8.51	225	15	46	54	3	6	18	0.0514	-0.3196	-0.388
PS-P54-220	600	33.64	27.97	7.869	8.39	220	15	46	54	3	6	18	0.0514	-0.3196	-0.388
PS-P54-215	600	33.42	27.75	7.741	8.27	215	15	46	54	3	6	18	0.0514	-0.3196	-0.388
PS-P54-210	600	33.13	27.54	7.612	8.12	210	15	46	54	3	6	18	0.0514	-0.3196	-0.388
PS-P54-205	600	32.8	27.32	7.484	7.96	205	15	46	54	3	6	18	0.0514	-0.3196	-0.388
PS-P54-200	600	32.48	27.1	7.356	7.8	200	15	46	54	3	6	18	0.0514	-0.3196	-0.388
PS-P36-145(2 busbar and 3 busbar)	600	22.35	18.57	7.805	8.33	145	15	46	36	2	4	18	0.0514	-0.3196	-0.388
PS-P36-140 (2 busbar and 3 busbar)	600	22.08	18.36	7.612	8.12	140	15	46	36	2	4	18	0.0514	-0.3196	-0.388
PS-P36-135 (2 busbar and 3 busbar)	600	21.76	18.14	7.42	7.88	135	15	46	36	2	4	18	0.0514	-0.3196	-0.388
PS-P36-130 (2 busbar and 3 busbar)	600	21.4	17.928	7.228	7.64	130	15	46	36	2	4	18	0.0514	-0.3196	-0.388
PS-M72S-190	600	45	38	5.01	5.4	190	15	46	72	3	6	24	0.031%/°C	-0.348%/°C	-0.45%/°C
PS-M72S-185	600	44.71	37.62	4.928	5.34	185	15	46	72	3	6	24	0.031%/°C	-0.348%/°C	-0.45%/°C
PS-M72S-180	600	44.35	37.36	4.817	5.278	180	15	46	72	3	6	24	0.031%/°C	-0.348%/°C	-0.45%/°C
PS-M36S-95	600	22.53	19	5.019	5.4	95	15	46	36	2	4	18	0.031%/°C	-0.348%/°C	-0.45%/°C
PS-M36S-90	600	22.17	18.68	4.817	5.278	90	15	46	36	2	4	18	0.031%/°C	-0.348%/°C	-0.45%/°C