

PLEASE READ THIS MANUAL CAREFULLY BEFORE USING THE MODULES

INSTALLATION MANUAL PHOTOVOLTAIC MODULES- NA-V121HR, NA-V128HR, NA-V135HR

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USER MANUAL -PHOTOVOLTAIC MODULE-

IMPORTANT SAFETY INSTRUCTIONS

This manual contains important safety instructions for the photovoltaic (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 to ensure system integrity and safety.
2. The installation is only allowed after referring to and understanding the GENERAL INSTALLATION MANUAL and the INSTALLATION MANUAL -PHOTOVOLTAIC MODULE. If you don't have your personal copy, please contact your installer or local Sharp office listed on the Sharp Solar web site: <http://www.sharpusa.com/SolarElectricity.aspx>
3. Do not pull the PV cables.

4. Do not touch any surface of module.
5. Do not place/drop objects on the PV module.
6. Do not disassemble or attempt to repair the PV module by yourself.
7. Do not drop the PV module.
8. Do not damage, pull, bend, or place heavy material on cables.
9. 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.
10. 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.
11. Consult your local building and safety department for required permits and applicable regulations.

CAUTION: HIGH VOLTAGE
To reduce the risk of electric shock, do not touch.



GENERAL INSTALLATION MANUAL

FOR SHARP PV MODULES

PLEASE READ THIS MANUAL CAREFULLY BEFORE INSTALLING OR USING THE MODULES.
INSTALLERS SHOULD PROVIDE THIS MANUAL TO YOUR CUSTOMER.

1. INTRODUCTION

This Installation Manual contains essential information for the electrical and mechanical installation that you must know before installing SHARP PV modules. This also contains safety information you need to be familiar with. All the information described in this Manual is the intellectual property of SHARP and based on the technologies and experiences that have been acquired and accumulated in the long history of SHARP. This document does not constitute a warranty, expressed or implied. SHARP does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected with installation, operation, use or maintenance of the PV modules. No responsibility is assumed by SHARP for any infringement of patents or other rights of third parties that may result from use of PV module. SHARP reserves the right to make changes to the product, specifications or Installation Manual without prior notice.

2. GENERAL INFORMATION **(INCLUDING WARNING AND SAFETY)**

The installation of PV modules requires a great degree of skill and should only be performed by a qualified and appropriately licensed professional, including licensed contractors and licensed electricians. Please be aware that there is a serious risk of various types of injury occurring during the installation including the risk of electric shock. SHARP PV modules are either equipped with a permanently attached junction terminal box that will accept a variety of wiring applications or equipped with a pre-terminated cable assembly for ease of installation.

< 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 module 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. PV systems 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 loads such as motors since the variable output power of the PV modules (dependent on solar irradiation) may cause damage to the connected motor.

< GENERAL SAFETY >

1. Consult local codes and other applicable laws concerning required permits on regulations concerning installation and inspection requirements.
2. Before installing a PV module, contact appropriate authorities to determine permit, installation and inspection requirements that should be followed.
3. Install PV modules and ground frames in accordance with applicable rules and regulations.
4. PV modules should be installed and maintained by qualified personnel. Only installer/servicer personnel should have access to the PV module installation site.
5. No matter where the PV modules are installed, either roof mounted construction or any other type 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.
6. For PV modules that are non-integral type, the modules are to be mounted over a fire-resistant roof.
7. PV modules connected in series should have the same cell size.
8. Follow all safety precautions of other components used in the system.
9. 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 about PV modules or the measures that should be taken when PV modules are damaged.

10. Do not shade portions of the PV module surface from the sunlight for a long time. Shaded cells may become hot (hot spot phenomenon) which may result in permanent damage, e.g., solder joints peeling off.
11. 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 reduced energy generation.
12. Do not install the PV module horizontally. It may cause dirt or white efflorescence (glass disease) due to water. A minimum tilt of 5 degrees from the horizontal is required; a tilt of 10 degrees or more is recommended (a higher tilt angle will contribute to cleaning the surface during rainstorms).
13. Do not cover the water drain holes of the frame. There is a risk of frost damage when the frame has water in it.
14. When sliding snow load has to be considered, an appropriate measure must be taken so that the lower edge of the PV module frame will not be damaged.
15. Do not expose PV modules to sunlight concentrated with mirrors, lenses or similar means.
16. Should a problem occur, immediately turn off inverters and circuit breakers.
17. In case the glass surface of a PV module is broken, wear goggles and tape the glass to keep the broken pieces in place prior to removing the module.
18. A defective PV module may generate power even if it is removed from the system. It may be dangerous to handle the PV module while exposed to sunlight. Place a defective PV module in a carton so PV cells are completely shaded.
19. In case of series connection, the maximum open circuit voltage, when considering the effect of temperature, must not be greater than the specified maximum system voltage. Voltage is proportional to the number of PV modules in series. In case of parallel connection, please be sure to take proper measure (e.g., fuse for protection of module and cable from over current, and/or blocking diode for prevention of unbalanced strings voltage) to block reverse current flow; otherwise, current may easily flow in reverse.

< HANDLING SAFETY >

1. Do not cause an excessive load on the surface of PV module or twist the frame. The glass surface can easily break.
2. Do not stand or step on the PV module. The surface glass of PV module is slippery.
3. Do not hit or put excessive load on the glass or back sheet. The PV cell is very thin and can be easily broken.
4. Do not scratch or hit the back sheet. The back sheet is vulnerable.
5. Do not hit the terminal box; do not pull the cables. The terminal box can crack and break.
6. Never touch the terminal box or the ends of output cables with bare hands when the PV module is illuminated. During handling and installation, cover the surface of PV module with cloth or other suitable sufficiently opaque material to shield the PV module from incident light and handle the wires with rubber-gloved hands to avoid electric shock.
7. Do not scratch the output cable or bend it with force. The cable insulation can break and may result in electricity leakage or shock.
8. Do not pull the output cable excessively. The output cable may come undone and cause electricity leakage or shock.

9. Do not drill holes in the frame. It may compromise the frame strength and cause corrosion of the frame.
10. Do not scratch the coating of the frame (except for grounding connection). It may cause corrosion of the frame or compromise the frame strength.
11. Do not loosen or remove the screws in the frame. It may compromise the strength of PV module and cause corrosion.
12. Do not handle the PV module with bare hands. The frame has sharp edges and may cause injury.
13. Do not drop PV module or allow objects to fall down on the PV module.
14. Do not artificially concentrate sunlight on the PV module.
15. Do not lift the PV module by only one side. The frame may bend. Lift the PV module by holding two (opposite) sides.

< INSTALLATION SAFETY >

1. Always wear protective head gear, insulating gloves and safety shoes (with rubber soles).
2. If the PV modules are delivered in cartons, keep them packed in the cartons until installation.
3. Do not touch the PV module unnecessarily during installation. The glass surface and the frames may become hot. There is a risk of burn, or electric shock.
4. Do not work under rain, snow or windy conditions.
5. Use insulated tools.
6. Do not use wet tools.
7. Do not drop tools or hard objects on PV modules.
8. When installing PV modules far above ground, do not drop any object (e.g., PV module or tools).
9. Make sure flammable gases are not generated near the installation site.
10. Completely cover the PV module surface with an opaque material during PV module installation and wiring.
11. For modules with connectors, ensure connections are fully plugged together.
12. Due to the risk of electrical shock, do not perform any work if the terminals of PV module are wet.
13. Do not touch the terminal box or the cable ends (connectors) with bare hands during installation or under sunlight, regardless of whether the PV module is connected to or disconnected from the system.
14. Do not unplug the connectors if the system circuit is connected to a load. The connectors are not rated for load-break.
15. Do not stand or stomp on the glass. There is a risk of injury or electric shock if glass is broken.
16. Do not work alone (always work as a team of 2 or more people).
17. Wear a safety belt if working far above the ground.
18. Do not wear metallic jewelry which can cause electric shock during installation.
19. Do not damage the back sheet of PV modules when fastening the PV modules to a support structure.
20. Do not damage the surrounding PV modules or mounting structure when replacing a PV module.
21. Use UV rated cable ties or other methods to cinch loose cables. Drooping cables could cause various problems such as facilitating damages by animals or electricity leakage (from cables lying in puddles).
22. Take proper measures for preventing the laminate (consisting of cells, glass, back sheet, etc.) from dropping out of the frame in case the glass is broken.
23. Cables shall be located so that they will not be exposed to direct sunlight after installation to prevent degradation of cables.
24. Do not put anything (e.g. tools, clothes, etc.) on the modules

during their installation; if only a portion of a module is shaded, the shaded part may heat up.

3. COMPONENTS

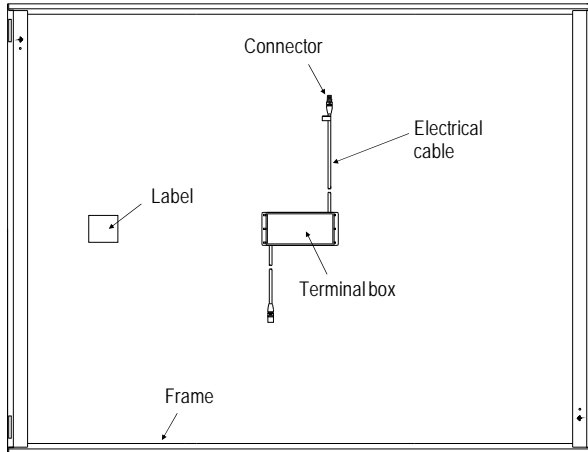


Figure 1. The exact location of the label and terminal box is product-specific.

4. SITE SELECTION

PV modules should be installed in a location where the PV modules will be unshaded throughout the year. In the Northern Hemisphere, the PV modules should typically face south, and in the Southern 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 / Installations over, or near, water / Areas where installations are prone to salt water damage(*) / Small islands or desert areas.

(*) If you are planning to use the PV modules where salt water may cause damage, please consult with SHARP in advance to determine an appropriate installation method, or to determine whether the installation is possible.

5. TILT ANGLE

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

For standalone systems with a battery where the PV modules are attached to a permanent structure, the tilt angle of the PV modules should be determined based on matching monthly output to monthly load; for loads that are relatively constant throughout the year, the optimum tilt is determined when 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 an angle between the latitude and latitude-minus-15-degrees of the installation site so that the power generation from the PV module will be optimum throughout the year. It is recommended to use software intended for PV system design to determine the optimum tilt angle for your location and application.

6. WIRING

To ensure proper system operation and to maintain your warranty, observe the correct cable connection polarity (Figures 2 & 3) when connecting the modules to a battery or to other modules. If not connected correctly, the bypass diodes 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. Figure 2 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 on the next module. Figure 3 shows modules connected in parallel. Note that 3 bypass diodes per module are illustrated. Some module models may have as few as one bypass diode; other models have as many as four bypass diodes.

Figure 2. SERIES for more voltage

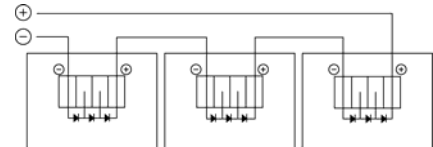
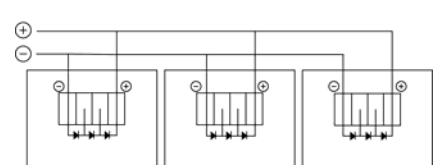


Figure 3. PARALLEL for more current



7. INSTALLATION

Refer to Installation Manual of specific model PV module.

8. ELECTRICAL RATINGS

Refer to Installation Manual of specific model PV module.

9. GROUNDING

All PV modules must be grounded by electrical connection of the module frames to ground. 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 marked holes (marked with the symbol for an earth ground) on the frame for either bolt, nut and washer, a ground lug fastened by bolt or screw, or appropriate screw (hardware not provided). An example of acceptable ground connection using a bolt, nut and washer retaining a ground lug is shown in Figure 4. In a connection of this type, the hardware (such as a toothed lock washer / star washer) must score the frame surface to make positive electrical contact with the frame. The ground wire must be selected according to the requirement of local applicable regulations.

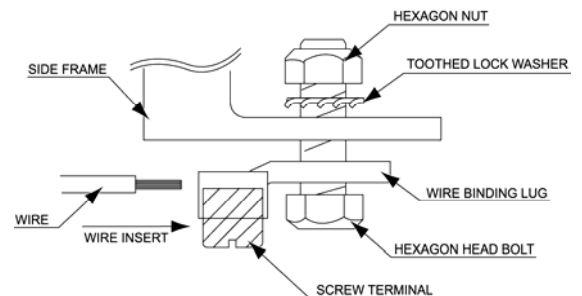


Figure 4. Example of acceptable ground connection

10. MOUNTING

Please make sure that all the information described in the installation

manual is still valid and proper for your installation. The mounting method has been verified by SHARP (NOT CERTIFIED by a third party organization).

The approved way to mount Sharp PV modules to a support structure is using the bolt holes provided as described in the Specifications. Although Sharp does not specify or warrant frame clips or clamps, using frame clips (not provided) or clamps (not provided) is also possible when they are designed for PV modules and with minimum dimensions on the sides of the module in accordance with the instructions and drawings provided. If using frame clips or clamps, the modules should be fixed rigidly and there shall be no damage to the modules by deforming mounting structure against design load. The Sharp module warranty may be void if customer-selected frame clips are improper or inadequate with respect to the module properties (including strength or material) or installation. Note that if metal clips are used, there must be a path to ground from the clips, (for instance, using star washers in the clip hardware set).

Please review the descriptions and drawings carefully; not mounting the modules according to one of the methods described in the Manual may void your warranty. This module satisfies the requirement of mechanical load test at 2400Pa in accordance with IEC61646. Support structures that PV modules are mounted on should be rigid. Sharp PV modules are designed to deliver their electric performance under the condition that they are mounted on rigid support structures.

Deformation of a support structure may damage a PV module mounted to the structure, thereby affecting safety, output, and longevity and possibly voiding the warranty.

PV module temperature can be affected by airflow beneath the module. Because the module produces more power when operating at a cooler temperature, it is important to provide for air flow beneath the module. Ensure that at least 25 mm of clearance exists between the lowest part of the PV module and the underlying surface (e.g., roof surface); when practical this clearance should be at least 100 mm..

11. MAINTENANCE

PV modules are designed for long life and require very little maintenance. If the angle of the PV module is 5 degrees or more, normal rainfall is sufficient to keep the module glass surface clean under most weather conditions. If dirt build-up becomes excessive, clean the glass surface only with a soft cloth using water. The use of distilled water will minimize residue on the glass surface. If cleaning the back of the module is required, take utmost care not to damage the backside materials. In order to ensure the operation of the system, please check wiring connections and the condition of the wire insulation every now and then.

INSTALLATION MANUAL - PHOTOVOLTAIC MODULES- NA-V121HR, NA-V128HR, NA-V135HR

1. INSTALLATION

The mounting methods described herein have been verified by SHARP and NOT CERTIFIED by a third party organization. Please review the descriptions and drawings carefully; not mounting the modules according to this method may void your warranty. This module satisfies the requirement of mechanical load test at 2400Pa in accordance with IEC61646.

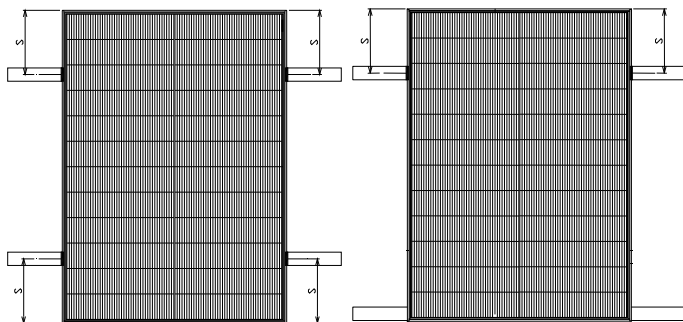
Mounting Using Clips on Long Edge of Module: Long Edge Perpendicular to Array Rails (Figure 1)

The modules may be mounted using clips on the long sides of the module when the array rails are perpendicular to the long sides, as shown in Figure 1. The clip centerlines must be between 6.2" (157.5 mm) and 16.44" (417.5 mm) from the ends of the module. Note that the mounting clips should meet the minimum dimensions (catch width of 0.2" (5 mm) and length of 1.2" (30 mm) shown in Figure 2. The array rails must support the bottom of the modules and must be continuous pieces (no breaks in the rail). The rails should not be twisted or out-of-flat. As depicted in Figure 1, the rails should be parallel.

Installation orientation

The PV module's cells are defined by a striped line pattern. Avoid shade from covering the cell area.

PV modules must be installed in the vertical position (aka "portrait") as shown in Figure 1. Installation in a horizontal position (aka "landscape") as shown in Figure 3 is prohibited. Permanent damage may occur, or a delamination of thin film silicon may appear if PV modules are installed horizontally and are covered by snow, dust or dirt.



$6.2" (157.5 \text{ mm}) < s < 16.44" (417.5 \text{ mm})$

Figure 1

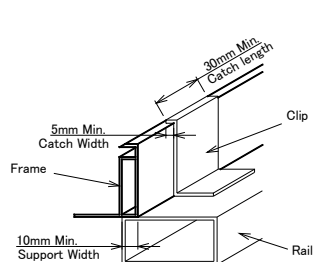


Figure 2

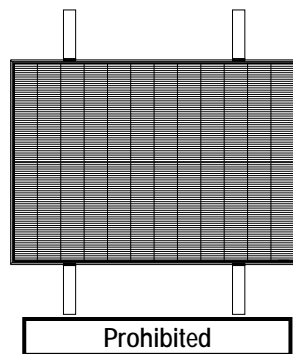


Figure 3

Caution

The mounting methods shown in Fig. 4 are prohibited.

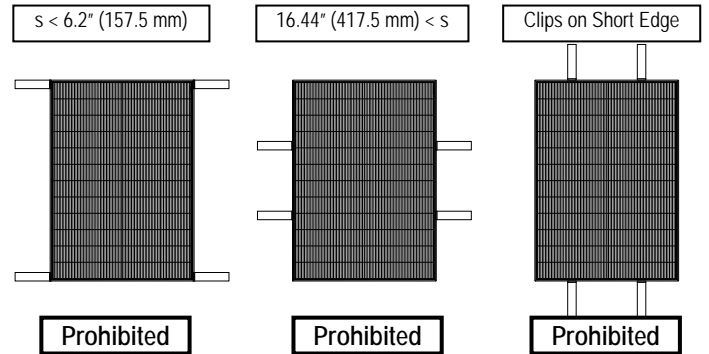


Figure 4

2. ELECTRICAL INSTALLATION INSTRUCTION

Cable characteristics

Size: 2.5 mm² Type: CE cable
Temperature rating of conductor: -40 to 90 °C

Module configuration

Maximum series configuration: please refer to Table 1
(This value is calculated under the condition of Voc at -40°C. Your installation may consider a different temperature; in addition, the number of modules in series should be determined based on the input voltage of the load – such as an inverter)

- # Maximum parallel configuration: (Parallel connections of source circuits must be conducted according to either of the following two options. Any other parallel connections are prohibited.)
- Case of using the fuses: A fuse must be used in each source circuit to protect modules from reverse current over load.
 - Case of using the diodes: Connect a blocking diode every 1 or 2 source circuits to protect modules from reverse current over load.

If reverse current can be prevented through other means, e.g., by power generation control or other system protection, it may be possible to avoid the use of fuses or diodes. Applicable codes should be consulted prior to finalizing the system design.

Inverter

Only inverters that provide for grounding the negative leg of the PV modules shall be used. The negative leg must be grounded; otherwise permanent damage to the PV modules can occur.

3. WARNING

Do not stand or step on the PV module (Frame, Glass, Back skin and Terminal box).

4. ELECTRICAL OUTPUT

Rated electrical characteristics are within ± 10 percent of the indicated values of I_{sc} , V_{oc} , and $+10/-5$ percent of P_{max} under STC (standard test conditions) (irradiance of 1000 W/m^2 , AM 1.5 spectrum as defined in ASTM G-173-03, and a cell temperature of $25 \text{ }^\circ\text{C}$ ($77 \text{ }^\circ\text{F}$). The warranty conditions are specified elsewhere in this Manual.

Table-1. Electrical characteristics (at STC)

Model name	Type ^(*)	Initial / Stable (Nominal)	Maximum Power (Pmax)	Open-Circuit Voltage (Voc)	Short-Circuit Current (Isc)	Voltage at Point of Max. Power (Vmpp)	Current at Point of Max. Power (Impp)	Maximum system voltage	Over-current protection	Application class	Maximum series configuration
NA-V121HR	Tandem	Initial	142.4	243	0.860	196	0.727	1000V	2A	A	3
		Stable (nominal)	121	238	0.830	180	0.673				
NA-V128HR	Tandem	Initial	150.6	243	0.875	202	0.746	1000V	2A	A	3
		Stable (nominal)	128	238	0.846	186	0.688				
NA-V135HR	Tandem	Initial	158.9	252	0.89	202	0.79	1000V	2A	A	3
		Stable (nominal)	135	249	0.87	188	0.72				

(*) Tandem: amorphous silicon / microcrystalline silicon tandem structure cell

System design should consider both initial values and nominal values. Nominal values are reached after a one-time degradation from initial values. This degradation takes place during the first few months of exposure.

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 I_{sc} and V_{oc} 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.