Safety and Installation Instructions

For United States and Canada

This document applies to all SunPower Modules
listed in Section 3 of this document

SunPower Corporation
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Safety and Installation Instructions
(United States and Canada)

1.0 Introduction

This manual provides safety and installation instructions for UL-listed SunPower photovoltaic (PV) modules carrying the UL logo on the product label (Figure 1).

Figure 1

> ***Important-!*** ***Read this instruction sheet in its entirety before installing, wiring, or using this product in any way. Failure to comply with these instructions will invalidate the SunPower Limited Warranty for PV Modules.***

1.1 Disclaimer of Liability

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

1.2 Underwriters Laboratories (UL) Listing Information

This product meets or exceeds the requirements set forth by UL1703 for PV Modules. This UL Standard covers flat-plate PV modules and panels intended for installation on buildings or those intended to be freestanding. To satisfy the listing for this product the modules must be mounted with a rack or standoff structure. The UL listing does not include integration into a building surface because additional requirements may apply. This product is not intended for use where artificially concentrated sunlight is applied to the module.

1.3 Limited Warranty

Module limited warranties are described in full in the SunPower warranty certificates obtainable at www.sunpowercorp.com. In summary, the Limited Warranties do not apply to any of the following;

PV modules which in SunPower's absolute judgment have been subjected to: misuse, abuse, neglect or accident; alteration, improper installation, application or removal (including but not limited to installation, application or removal by any party other than a SunPower authorized dealer; non-observance of SunPower's installation, users and/or maintenance instructions; repair or modifications by someone other than an approved service technician of SunPower; power failure surges, lightning, flood, fire, accidental breakage or other events outside SunPower's control.

2.0 Safety Precautions

Before installing this device, read all safety instructions in this document.

> ***Danger!*** Module interconnection cables pass direct current (DC) and are sources of voltage when the module is under load and when it is exposed to light. ***Direct current can arc across gaps and may cause injury or death if improper connection or disconnection is made, or if contact is made with module leads that are frayed or torn.*** Do not connect or disconnect modules when current from the modules or an external source is present.

- Cover all modules in the PV array with an opaque cloth or material before making or breaking electrical connections.
- It is imperative use the supplied locking connectors and safety clips in order to defend against untrained personnel disconnecting the modules once they have been installed.
- All installations must be performed in compliance with the National Electrical Code (NEC) and any applicable 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.
- Broken j-boxes and/or broken connectors are electrical hazards as well as laceration hazards. The dealer or installers should remove the module from the array and contact the supplier for disposal instructions.
- Do not install or handle the modules when they are wet or during periods of high wind.
- Contact your module supplier if maintenance is necessary.
- Save these instructions!

3.0 Electrical Characteristics

The module electrical ratings are measured under Standard Test Conditions (STC) of 1 kW/m² irradiance with Air Mass of 1.5 spectrum and a cell temperature of 25º C. SunPower modules deliver specific electrical characteristics (Figure 2).

Electrical Characteristics

	At Standard Test Conditions (STC)									Basic Temperature Data		
Module	Rated Power (W)	Power Tolerance (%)	Voltage at Rated Power (Vmpp)	Current at Rated Power, Impp (A)	Open Circuit Voltage (Voc)	Short Circuit Current, Isc (A)	Maximum Series Fuse (A)	Maximum System Voltage UL (Vmax)	Maximum System Voltage IEC (Vmax)	Current (Isc) Temp. Coeff. (mA/°C)	Voltage (Voc) Temp. Coeff (mV/°C)	Power Temp. Coeff. (%/°C)
SPR-410-WHT	410	+/- 5	72.9	5.62	85.3	5.87	15	600	1000	3.5	-235.5	-0.38%
SPR-400-WHT	400	+/- 5	72.9	5.49	85.3	5.74	15	600	1000	3.5	-235.5	-0.38%
SPR-385-WHT	385	+/- 5	72.9	5.28	85.3	5.52	15	600	1000	3.5	-235.5	-0.38%
SPR-375-WHT	375	+/- 5	72.9	5.14	85.3	5.37	15	600	1000	3.5	-235.5	-0.38%
SPR-320E-WHT	320	+/- 5	54.7	5.86	64.8	6.24	15	600	1000	3.5	-176.6	-0.38%
SPR-315E-WHT	315	+/- 5	54.7	5.76	64.6	6.14	15	600	1000	3.5	-176.6	-0.38%
SPR-310-WHT	310	+/- 5	54.7	5.67	64.4	6.05	15	600	1000	3.5	-176.6	-0.38%
SPR-305-WHT	305	+/- 5	54.7	5.58	64.2	5.96	15	600	1000	3.5	-176.6	-0.38%
SPR-305E-WHT	305	+/- 5	54.7	5.58	64.2	5.87	15	600	1000	3.5	-176.6	-0.38%
SPR-300E-WHT	300	+/- 5	54.7	5.49	64.0	5.87	15	600	1000	3.5	-176.6	-0.38%
SPR-295-WHT	295	+/- 5	54.2	5.45	63.3	5.83	15	600	1000	3.5	-176.6	-0.38%
SPR-290-WHT	290	+/- 5	53.3	5.45	62.1	5.83	15	600	1000	3.5	-176.6	-0.38%
SPR-280-WHT	280	+/- 5	51.9	5.43	60.9	5.82	15	600	1000	3.5	-182.4	-0.38%
SPR-270-WHT	270	+/- 5	51.9	5.20	60.9	5.58	15	600	1000	3.5	-182.4	-0.38%
SPR-230-WHT	230	+/- 5	41.0	5.61	48.7	5.99	20	600	1000	3.5	-132.5	-0.38%
SPR-225-BLK	225	+/- 5	41.0	5.49	48.5	5.87	20	600	1000	3.5	-132.5	-0.38%
SPR-217-WHT	217	+/- 5	39.8	5.45	47.5	5.84	20	600	1000	3.5	-132.5	-0.38%
SPR-215-WHT	215	+/- 5	39.8	5.40	48.3	5.80	15	600	1000	3.5	-136.8	-0.38%
SPR-210-WHT	210	+/- 5	40.0	5.25	47.7	5.75	15	600	1000	3.5	-136.8	-0.38%
SPR-210-BLK	210	+/- 5	40.0	5.25	47.7	5.75	15	600	1000	3.5	-136.8	-0.38%
SPR-205-BLK	205	+/- 5	40.0	5.13	47.8	5.53	15	600	1000	3.5	-136.8	-0.38%
SPR-200-WHT	200	+/- 5	40.0	5.00	47.8	5.40	15	600	1000	3.5	-136.8	-0.38%

Figure 2

Bypass diodes for each module are rated and factory installed in the modules. The diodes are one of the following ratings;

1. 8A, 45 PIV (Peak Inverse Voltage) for 72 & 96 cell modules.
2. 12A, 200 PIV (Peak Inverse Voltage) for 96 (commercial use) & 128 cell modules.

A photovoltaic module may produce more current and/or voltage than reported at STC. Sunny, cool weather and reflection from snow or water can increase current and power output. Therefore, the values of I_{sc} marked on the module should be multiplied by a factor of 1.25 when determining component ampacity ratings to comply with NE, Article 690.8(A). An additional 1.25 multiplier may be required by the NEC for sizing fuses and conductors as described in NEC Section 690-8(B).
V_{oc} should be increased by a factor based on the lowest ambient temperature recorded for the location. To determine the corrected value for Maximum System Voltage follow the guidelines in NEC Article 690.7, SunPower recommends the use of open-circuit voltage temperature coefficients listed in Figure 2 when determining Maximum System Voltage

3.1 Fire Rating

The module is Class C fire rated.

4.0 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 modules in a combined source circuit.

The connectors on SunPower modules ship with a locking safety clip, which once connected requires the use of a tool to disconnect module-to-module connections. This defends against untrained personnel disconnecting the modules when under load (which may cause injury or death as stated in Section 2.0) and complies with the NEC 2008 code for safety with PV connectors,

4.1 Equipment Grounding

To reduce the possibility of electrical shock, ground the frame of the module or array before wiring the circuit using a grounding method that meets NEC requirements for grounding solar electrical systems. In order to install in accordance with the UL listing of this product, SunPower modules shall be grounded using grounding hardware that has been UL certified to meet requirements for grounding systems in UL467, UL1703, or UL1741 on anodized aluminum frames. SunPower recommends the following two methods of grounding the module frame. In addition, avoid corrosion due to the use of dissimilar metals (we suggest stainless steel between copper and aluminum).

1) Attach a ground conductor to a grounding lay-in lug mounted at one of the four designated 0.17" grounding holes on the module frame. Alternatively, any unused mounting hole can be used to mount the lug. Use a grounding lug such as Ilsco GBL-4DBT or Burndy CL50-DB-T, and stainless steel hardware (bolt, washers, and nut). A star washer should be used between the grounding lug and the module frame in order to break through the anodizing and establish electrical contact with the aluminum. The assembly must end with a nut and be torqued between 20 inch-pound to 25 inch-pound for a #10-32 bolt. A lock washer or other locking mechanism is needed to maintain tension between the bolt and the assembly. The copper conductor must be attached to the ground lug using the stainless steel set screw provided by the manufacturer. Please refer to NEC Article 690 on grounding PV arrays for specific requirements.

2) SunPower systems may also be grounded through the use of SunPower supplied "IFF clips" which are UL Listed (1703 and 1741). A minimum torque of 10 in-lbs is required for grounding, however higher torque values will be required to ensure structural integrity. General torque values are 35 to 45 in-lbs for a 1/4-20 bolt, but may be higher in specific applications. To ensure system safety and structural integrity, strict adherence to application-specific SunPower documentation is required.

4.2 System Grounding

Important! For optimal performance, SunPower PV modules must only be used in configurations where the positive polarity of the PV array is connected to ground. ***Failure to comply with this requirement will reduce the performance of the system and invalidate SunPower's Limited Power Warranty for PV Modules.***

For more information on grounding the system correctly, visit our website at www.sunpowercorp.com/inverters or contact SunPower technical support at 1-877-SUN-0123.

4.3 Series Connection

The modules may be wired in series to produce the desired voltage output. Do not exceed the maximum system voltage shown in Figure 2.

4.4 Parallel Connection

The modules may be combined in parallel to produce the desired current output. Each series string or module may be required to be fused prior to combining with other strings. Figure 2 describes the maximum fuse size allowed (number of modules which can be connected in parallel and protected by one fuse). Please refer to the NEC Article 690 for additional fusing requirements.

5.0 Module Mounting

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

5.1 Site Considerations

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

Operating Temperature: All SunPower modules must be mounted in environments that ensure SunPower modules will operate within the following maximum and minimum operating temperatures:

Maximum Operating Temperature	+85 ˚ Celsius, +185 ˚ Fahrenheit
Minimum Operating Temperature	-40 ˚ Celsius, -40 ˚ Fahrenheit

Care should be taken to provide adequate ventilation behind the modules, especially in hot environments.

Design Strength: SunPower modules are designed to meet a maximum positive (or upward, e.g. wind) and negative (or downward, e.g. static load) design pressure of 50 lb/ft² when mounted in one of the mounting configurations specified in Section 5.2.

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 SunPower modules, and are excluded from the SunPower Limited Warranty of these modules. Request the regional dealer to contact SunPower if there are any unanswered questions concerning the operating environment.

5.2 Mounting Configurations

For a non-integral module, the assembly is to be mounted over a fire resistant roof-covering rated for the application. Modules may be mounted at any angle, from horizontal to vertical. Class C fire rating is maintained at all installation slopes. Select the appropriate orientation to maximize sunlight exposure. Specific information on module dimensions and the location of mounting and grounding holes is shown in (Figures 3, 4 and 5).

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/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.

The module is only UL Listed for use when its factory frame is fully intact. 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. Four 1/4" stainless steel bolts, with nuts, washers, and lock washers are recommended per module. Refer to Figures 3, 4 and 5 for the module dimensions and hole locations. This method has been certified by a third-party organization according to UL 1703.
2) **Pressure Clamps or Clips**: Mount the module with the clips on the side frame of the module. The side frames are attached to the longer sides of the module. The centerline of the clips should be 6″to15″from the end of the side frame. Installers should ensure the clamps are of sufficient strength to allow for the maximum design pressure of the module.
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 dimensions of the module). The end-mounting rail and clips or clamps must be of sufficient strength to allow for the maximum design pressure of the module. Verify this capacity with the mounting system vendor before installation.

4) **Center Mount**: A continuous clamp may be used to clamp the bottom flange of the frame at the center of the long sides. Minimum clamping length shall be 6" on top of flange and 4" on bottom. The clamps must be of sufficient strength to allow for the maximum design pressure of the module. Verify this capacity with the mounting system vendor before installation.
5) **SunPower specified or SunPower supplied mounting systems**: Modules mounted with strict adherence to SunPower documentation, using hardware systems supplied by or specified by SunPower.

5.3 Handling of Modules during Installation

Does not place modules face-forward in direct contact with abrasive surfaces like roofs, driveways, wooden pallets, railings, stucco walls, etc…. The module front surface glass is sensitive to oils and abrasive surfaces, which may lead to scratches and irregular soiling.

Modules that feature antireflective coated glass are prone to visible finger print marks if touched on the front glass surface. SunPower recommends handing modules with anti-reflective glass with gloves or limiting touching of the front surface. Any finger print marks resulting from installation will naturally disappear over time or can be reduced by following the washing guidelines in Section 6.0 below. Product datasheets specify the glass type used by a particular module.

6.0 Maintenance

Visually inspect all modules annually for safe electrical connections, sound mechanical connection, and freedom from corrosion. This visual inspection should be performed from ground level, unless performed by trained SunPower dealers or trained SunPower support personnel.

Periodic cleaning of modules is recommended, but is not required. Periodic cleaning has resulted in improved performance levels, especially in regions with low levels of annual precipitation (less the 18.25 inches (46.3cm)). Consult your dealer or supplier about recommended cleaning schedules for your area.

To clean a module, wash with potable, non-heated, water. Normal water pressure is more than adequate, but pressurized water up to1500psi may be used. Fingerprints, stains, or accumulations of dirt on the front surface may be removed as follows: first rinse off area and let soak for a short period of time (5-minutes). Re-wet and use a soft sponge or seamless cloth to wipe glass surface in a circular motion. Fingerprints typically can be removed with a soft cloth or sponge and water after wetting. Do not use harsh cleaning materials such as scouring powder, steel wool, scrapers, blades, or other sharp instruments to clean the glass surface of the module. Use of such materials or cleaning without consultation will invalidate the product warranty.

- **Module figures 3, 4 and 5** are on the next page;

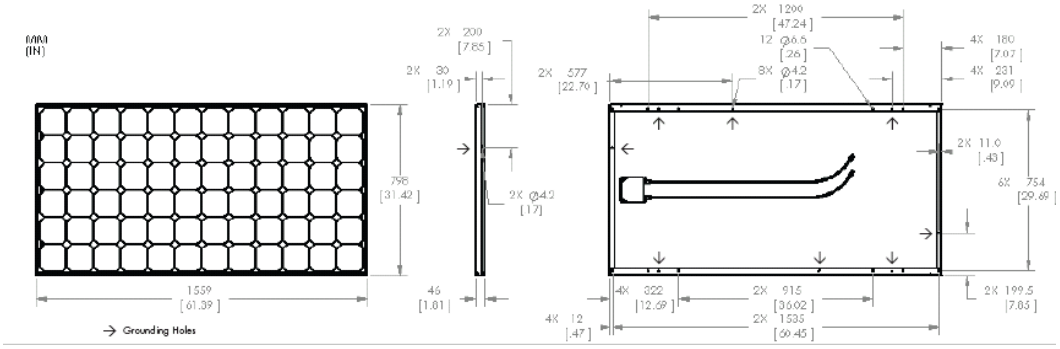

Figure 3: 72-cell

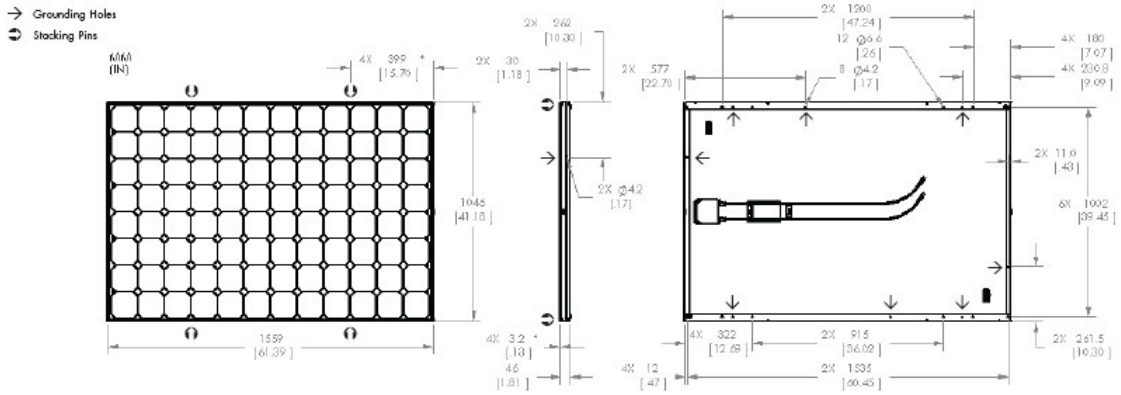

Figure 4: 96-cell (Note: Stacking pins are not included on all models – check the models datasheet for details).

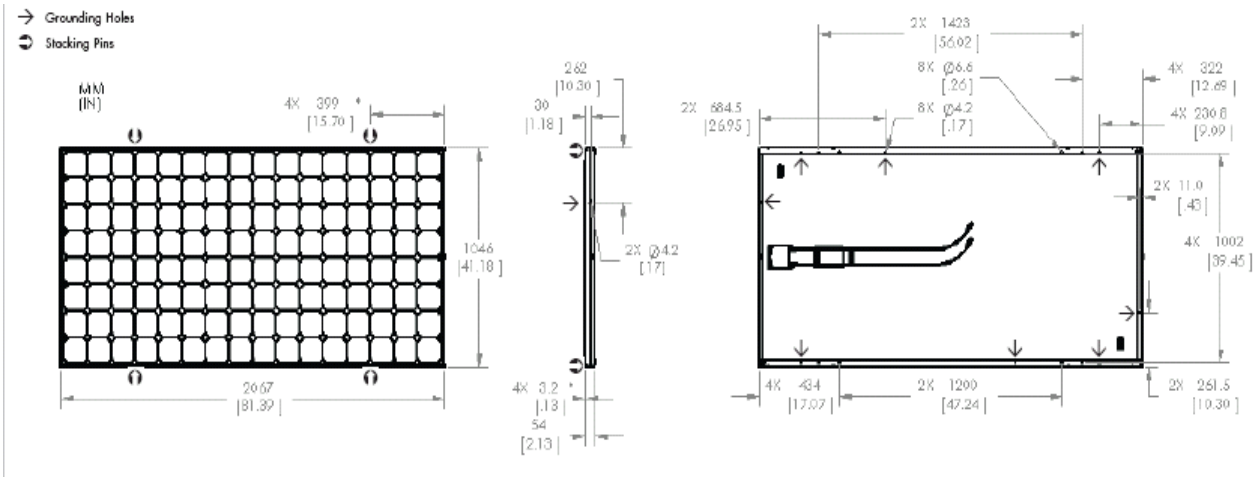

Figure 5: 128-cell.