

The SunPower logo is displayed in white, uppercase, sans-serif font against a black rectangular background. The letter 'O' in 'POWER' is stylized with a glowing effect, appearing as a bright white circle with a soft, circular glow around it.

SPR-3200, SPR-2900 and SPR-2000
Installation and Operation Manual



SunPower Inverter SPR-3200, SPR-2900 and SPR-2000

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IMPORTANT SAFETY INSTRUCTIONS

This product has been engineered and manufactured to ensure your personal safety. Improper use may result in potential electrical shock or burns. Please read and follow all instructions for installation, use and servicing of this product.

Note: A locking tab has been designed into the SPR-3200, SPR-2900 and the SPR-2000. It is the sole responsibility of the end user to provide a locking mechanism that utilizes the tab, and permanently secures the cover on the inverter.

SAVE THESE INSTRUCTIONS – This manual contains important instructions for the SunPower Inverter model numbers SPR-3200, SPR-2900 and the SPR-2000 that must be followed during installation and maintenance of the SunPower Inverter.

CAUTION:

- ◆ All electrical installations should be done in accordance with local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70.
- ◆ Before connecting the SunPower Inverter to the electrical utility grid, approval must be granted by your utility company. Only qualified electricians should make the connection.
- ◆ When exposed to light, PV-arrays create electrical energy that could cause a hazardous condition. To avoid this, completely cover the surface of all PV-arrays with opaque (dark) material before wiring them.
- ◆ The SunPower Inverter contains no user-serviceable parts. Refer servicing to qualified service personnel.
- ◆ Do not touch the heat sink located at the top of the SunPower Inverter. Temperatures can exceed 158 degrees (70° C).

Please read all safety warnings and instructions before beginning the installation or operation of the SunPower Inverter.



SAVE THESE INSTRUCTIONS

1.0 INTRODUCTION

The SunPower Inverter is a utility interactive inverter for photovoltaic (PV) systems. The SunPower Inverter is tied to an electrical source provided by the local utility company (i.e. on-grid), as well as to the photovoltaic system. The SunPower Inverter contains everything needed to convert the DC voltage generated by the solar arrays into the AC voltage required to power a house. Because the inverter is tied to a local utility source, if a house's electrical needs exceed the power generated by the solar arrays, the house automatically taps into its local power supply for that additional electricity. Likewise, if a house does not utilize all the power generated by the solar panels, the inverter actually reverses the flow of electricity (i.e. electricity is fed back into the grid). Think of it as accumulating credits of electricity with the utility for future use.

The information contained within this manual will provide all the information necessary for successful installation and use of the SunPower Inverter.

Product Features

Easy Installation

The custom designed mounting bracket and easy-to-follow instructions make installation simple and quick.

Simple, Innovative Design

Everything needed to power up the SunPower Inverter is contained within the inverter box, including AC and DC connections and circuits. Low part count keeps costs down and simplifies the manufacturing, and installation processes.

Safety Features

The SunPower Inverter is designed for safety. Control power comes from the utility grid, ensuring that power can never be generated during a utility grid failure. The output stage transformer guarantees isolation of the utility grid and PV modules.

Expandability

The SunPower Inverter is designed with growth in mind, from residential to commercial use. Most PV system configurations can be accommodated.



2.0 INSTALLATION

2.1 Selecting a Location for the SunPower Inverter

In choosing a location for the SunPower Inverter, consideration should be given to the following criteria:

- ◆ The heat sink temperatures can exceed 158 degrees (70° C). The SunPower Inverter must be installed so that the top of the unit will not be contacted by persons.
- ◆ The SunPower Inverter is suitable for installation both indoors and outdoors and the enclosure has been given a NEMA 3R rating.
- ◆ When the SunPower Inverter is installed outdoors, it should be shielded from rain and direct sunlight, if possible.
- ◆ The SunPower Inverter is designed to handle the temperature extremes of most climates. The operating and non-operating ambient temperature range is from -25° C to 40° C.
- ◆ The following clearances are recommended for proper placement of the SunPower Inverter:
 - A minimum 36" clearance between the bottom of the inverter box and the ground.
 - A minimum 12" clearance above the inverter box for ventilation.
 - A minimum 8" clearance around the side of the inverter box so that all Warning and Caution labels are clearly visible and able to be easily read.
 - Visibility of the operating LED's and display located at the top front of the inverter box should also be considered.
- ◆ If the SunPower Inverter is to be installed in an enclosed cabinet or closet, external ventilation must be provided to allow for sufficient heat dissipation.
- ◆ At all times, air circulation around the inverter box must be sufficient.

2.2 Mounting the SunPower Inverter

The SunPower Inverter should be mounted vertically to a flat, solid surface such as wallboard, concrete or wood siding. The inverter should be located in close proximity to the solar panels to minimize the DC wire length.

The mounting bracket provided makes mounting the SunPower Inverter quick and simple. The two screw holes at either end of the bracket are 16 inches apart. Once the wall studs are located, anchoring the bracket becomes an easy task.

WARNING: Prior to drilling holes to mount the SunPower Inverter in the location selected; ensure there are no electrical wires or plumbing in the area.

CAUTION:

The National Electrical Code (NEC) requires that the inverter be connected to a dedicated circuit with no other outlets or devices connected to the same circuit. See NEC Section 690-64(b)(1). The NEC also places limitations on the size of the inverter and the manner in which it is connected to the utility grid. See NEC Section 690-64(b) (2).

2.2. A Steps to Mount the SunPower Inverter

1. Locate the wall studs in the desired location and align the mounting bracket over the studs. Mark the mounting holes. Ensure that locations A and B (as indicated in Figure 1 below) are aligned over the wall studs.

2. **MAKE SURE BRACKET IS LEVEL.** Ensure points A and B are aligned with wall studs. Drill 1/8" pilot holes for the screws. Use heavy-duty 1/4" x 2" coarse thread lag screws to secure points A and B to the wall. Use an 1/8" screw to secure point C. See Figure 1.

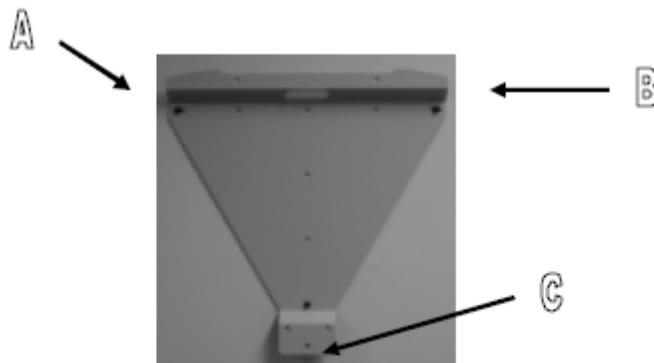


Figure 1: Mounting Bracket

5. Carefully hang the inverter on the upper part of the bracket so that the hooks located at the rear of the inverter hang over the bracket.
6. **Verify that the inverter is level.**
7. Remove the front cover of the inverter by unscrewing the two cover screws located at the bottom of the inverter.
8. Locate the two inverter mounting holes below the power board. (See Figure 2) Insert the two mounting screws through the inverter and tighten securely.

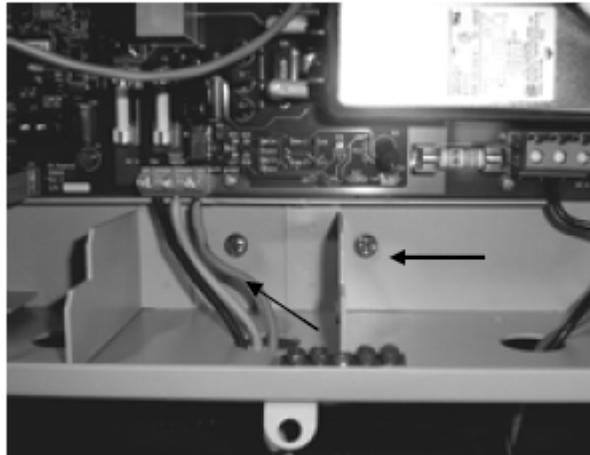


Figure 2: Mounting screws, located below the power board



Figure 3: Mounted SunPower Inverter with Mounting Bracket in Place

PLEASE NOTE: Remove the lower inverter cover to allow for electrical connection in section 2.3

2.3 Electrical Connection

Do not proceed with the electrical connection of the SunPower Inverter until it has been properly mounted.

WARNING: Electrical connections must be done in accordance with local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70. Use 10 AWG, minimum 90° (194°F), copper wire for the SPR-5200, SPR-4600 connections. Voltage drop as well as other considerations may dictate that larger wire sizes be used.

WARNING: Make sure the main 240-volt breaker in the main utility breaker box is switched OFF before wiring the SunPower Inverter. This breaker should be switched ON only after all wiring has been completed as set forth in this manual.

WARNING: Follow the order listed below in wiring the SunPower Inverter. Failure to do so may result in hazardous voltages or disconnection of contacts.

IMPORTANT: Only rain tight or wet location conduit hubs that comply with the requirements in the Standard for Fittings for Conduit and Outlet Boxes, UL 514B, are to be used.

Terminal connections for the SunPower Inverter are located inside the inverter on the circuit board at the bottom of the box. Solid wires up to 8 AWG (6mm²) and flexible wires up to 10 AWG (4mm²) are accepted by the AC terminals. Wires up to 6 AWG are accepted by the DC terminals.

CAUTION: The input and output circuits are isolated from the enclosure. System grounding, when required by Sections 690-41, 690-42, and 690-43 of the National Electric Code (NEC), ANSI/NFPA 70-1999, is the responsibility of the installer.



Figure 4: Communications, AC and DC ports.

2.3.b Grounding

- ◆ A single point ground connection is located in the lower right hand side of the SunPower Inverter cabinet. The PV panel grounding wire is terminated there. The AC ground connection is terminated next to the Line and Line 2/Neutral connections on the circuit board. The PV ground is bolted to the cabinet with a ¼- 20 bolt. (Refer to Figure 6.)
- ◆ Figure 5 includes schematic representations of the SPR-5200, SPR-4600 single point grounding. The front cover is grounded through the two cover mounting screws.

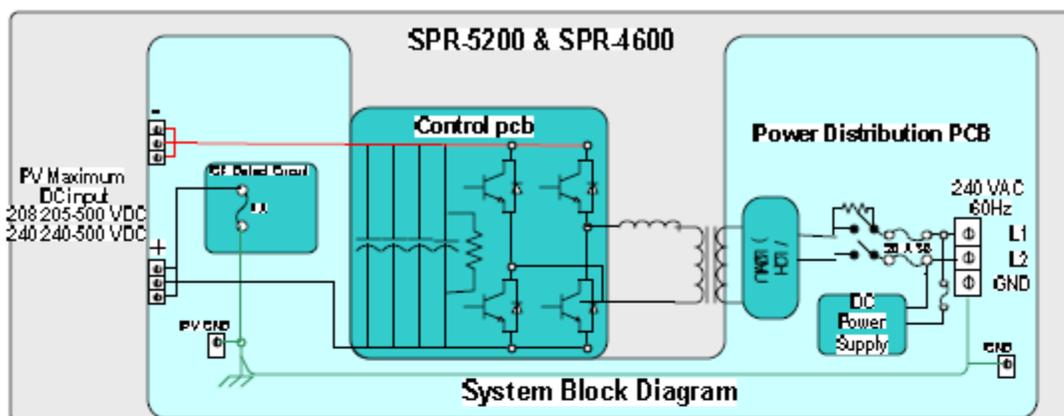


Figure5: System Block Diagram showing single point ground point

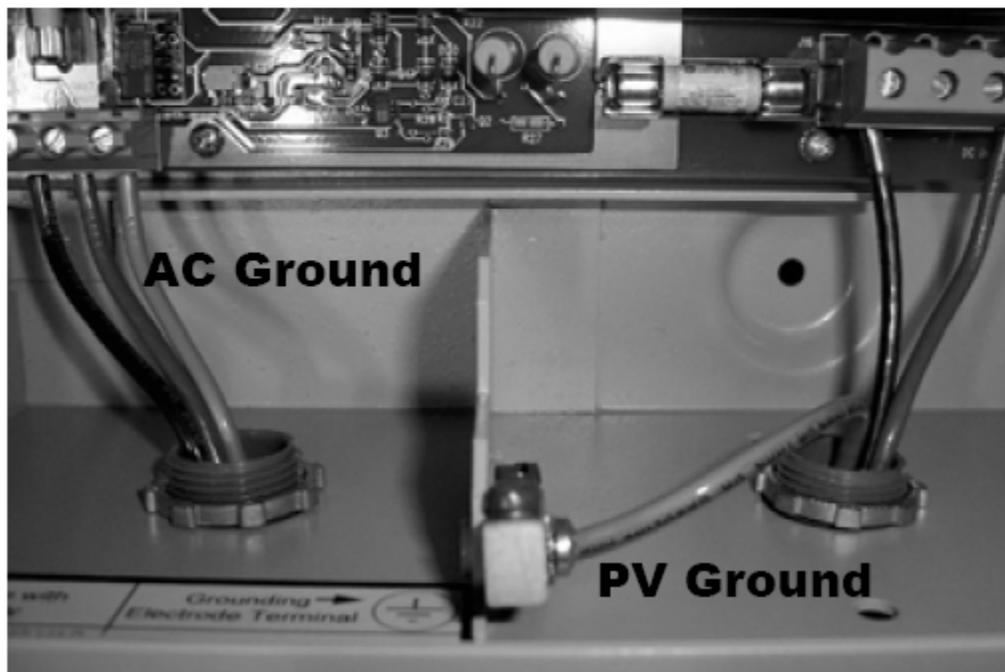


Figure 6: AC and PV Grounding



2.3.b Connecting the SunPower Inverter to the Electrical Grid

Inside the SunPower Inverter are two circuit boards:

- ◆ The Control Board
- ◆ The Power Distribution Board:
 - The AC connection terminal
 - The DC connection terminal
 - The Internal AC grid fuse(s)
 - The Internal Ground Fault Interrupt fuse

WARNING: For continued protection against risk of fire, replace only with same type and ratings of fuse. The SPR-5200 and SPR-4600 both use only Littelfuse 30 AMP 250V AC rated fuse.

SunPower provides overcurrent protection on the Power Distribution Board with two 30 AMP fuses in the SPR-5200 and SPR-4600 (See warning above). Additional over current protection for the inverter's AC output is provided by circuit breakers at the breaker panel.

WARNING: Replace GFI fuse with only same type and rating of fuse. The SPR-5200 and SPR-4600 uses only Littelfuse KLKD001 1A/600V.

The SunPower Inverter is connected to the electrical grid using 3 wires - the LINE 1, LINE 2/NEUTRAL and GROUND.

Please Note: To avoid an increase in AC voltage to unacceptable values while the SunPower Inverter is connected, the grid impedance value at the connection point should be as low as possible. By keeping the grid impedance value low, higher system efficiency will be achieved.

The total impedance of the grid plus the interconnecting AC wires should be less than 1.25 Ohm.

WARNING: Make sure the main 120/208/240 V breaker at the circuit breaker panel is switched off before you connect the AC terminal block.

To wire the SunPower Inverter to the main utility grid, follow the steps outlined below (Refer to Figure 7):

1. Run the conduit from the main breaker panel to the bottom of the SunPower Inverter and insert the fitting in the center opening of the SunPower Inverter, fastening with a locking nut.

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2. Feed the LINE 1, LINE 2/NEUTRAL and GROUND wires through the conduit and into the center opening of the SunPower Inverter.
3. Connect the GROUND wire to the terminal marked 'earth ground' inside the SunPower Inverter.
4. Connect the LINE 2/NEUTRAL wire to the terminal marked 'line 2/neutral' inside the SunPower Inverter.
5. Connect the LINE wire to the terminal marked 'line' inside the SunPower Inverter.
6. Ensure all connections are wired correctly and properly torqued. Tighten the terminal block screws to 1.7Nm.

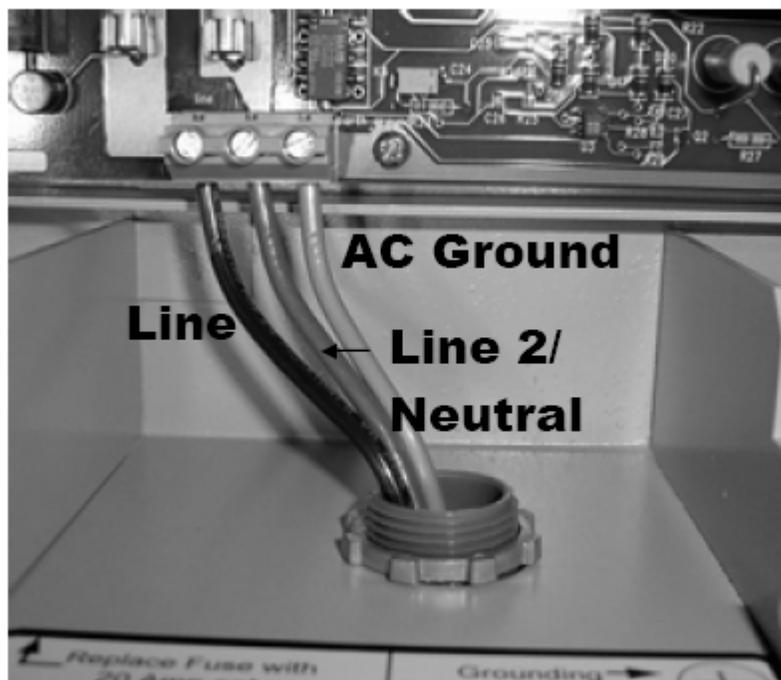


Figure 7: AC wiring for the line, line 2/neutral and ground wires.

2.3.c Connecting DC Wires/PV Panels

WARNING: Before proceeding with the DC wiring, completely cover the surface of all PV-arrays with dark material to avoid the production of electrical current.

WARNING: Make sure the polarity and the PV panel voltage between the + and the - cable connectors of the PV panels are correct. Then connect the panels to the DC terminal block on the power distribution board.

WARNING: The SPR-4600-208 and SPR-5200-240 are configured for positive ground fault



The PV panel open circuit voltage should be at or below the listed voltages in Figure 8 under all circumstances. Each DC input to the DC terminal block must be less than the voltages listed in Figure 8.

SunPower Inverter Model	PV Panel Open Circuit Voltage	DC Input to DC Terminal Block
SPR-3200-240	500VDC	500VDC
SPR-2900-208	500VDC	500VDC
SPR-2000-120	450VDC	450VDC

Figure 8: PV open circuit voltages.

To wire the DC inputs from the PV panels to the SunPower Inverter (Refer to Figure 9): Note: Each DC input connection must carry the same input voltage. The SunPower Inverter allows up to three connections for both the + and the - pole.

1. Calculate the maximum open circuit (no load) for each series panel connection. **FOR ALL TEMPERATURE CONDITIONS, THE OPEN CIRCUIT VOLTAGE FOR EACH SERIES CONNECTION MUST TOTAL LESS THAN THE OPEN CIRCUIT VOLTAGE INDICATED IN FIGURE 8 FOR THE SPR-3200, SPR-2900 and SPR-2000 SUNPOWER INVERTER MODEL.** Review your panel's data sheet for operating temperature ranges.
2. Keep track of the array positive and negative leads and mark them clearly.
3. Route the PV array leads through the far right opening in the SunPower Inverter.
4. Connect each series positive DC lead to the positive terminals of the power distribution board.
5. Connect negative DC leads directly to the negative terminal on the power distribution board.
6. Connect the ground wire(s) to the ground lug.
7. Confirm that the DC disconnect is turned off and remove the material from the array. With a voltmeter, check the PV array positive leads and confirm that the voltage is positive when referenced to the negative leads. The reading should match your series Voc total.

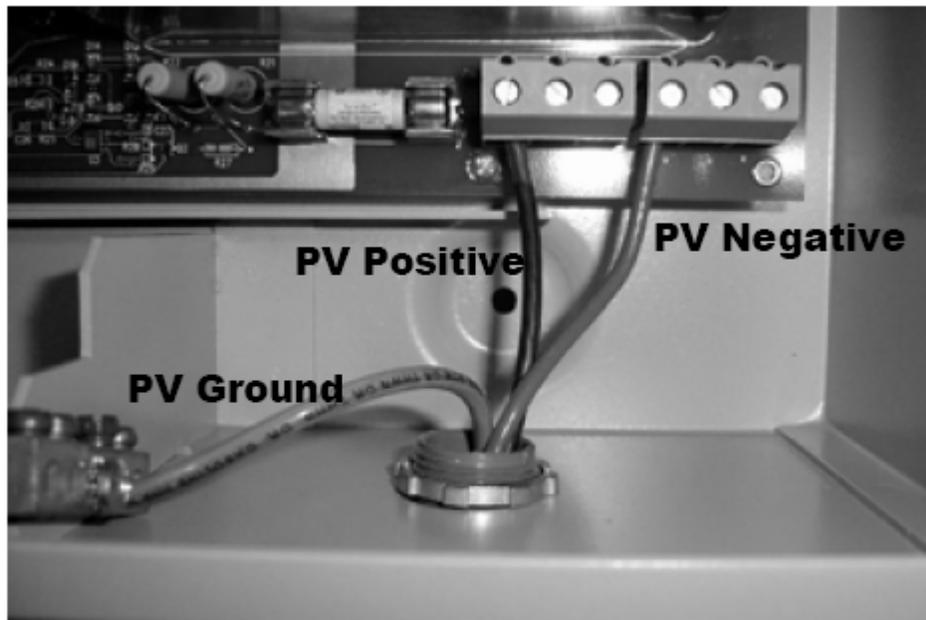


Figure 9: DC Wiring

3.0 OPERATION

3.1 Start Up Procedures for the SunPower Inverter

WARNING: Before turning on the SunPower Inverter ensure that the front panel is closed properly.

WARNING: The heat sink can reach temperatures in excess of 158° (70°C). Care must be taken to not touch the heat sink when in use. Nothing should be placed on top of the heat sink.

Starting up the SunPower Inverter requires the following steps in the order indicated below:

1. Turn the **AC breaker ON**.
2. Verify that a red LED light is illuminated.
3. Remove the dark cover from the PV panels.
4. Check the polarity to make sure the + and - are wired correctly and confirm that the PV panel open circuit voltage is at or below the level specified in Figure 8.
5. Turn the **DC breaker ON** (If installed).



6. **IT IS RECOMMENDED THAT YOU ATTACH A PADLOCK AT THIS TIME TO PREVENT UNAUTHORIZED ACCESS OR DAMAGE TO THE INVERTER.**
7. After 5 minutes, the SunPower Inverter will start to produce power into the AC grid if all necessary operating conditions are met.

NOTE: During the initial 5 minutes prior to producing power, the inverter will display "0000 0000 0000". This is a normal.

3.2 LED Indicator Lights/Vacuum Fluorescent Display

LED INDICATOR LIGHTS

The SunPower Inverter SPR-5200, SPR-4600 all display 2 LED indicator lights visible through the upper left corner of the front panel. These lights will indicate the SunPower Inverter's status.

If the SunPower Inverter's operating environment is safe to produce power into the AC grid, the "OK" (Green) LED is illuminated.

If at any moment the operating environment moves outside the safe operating limits, governed by UL 1741, IEEE 519, and NEC 690, the "STAND BY" (Red) LED indicator will be illuminated.

The SunPower Inverter is continuously monitoring:

1. The AC grid connection to ensure the AC voltage and frequency levels are within safe operating limits (per UL and NEC specifications).
2. The DC PV panel input(s) to ensure safe operating conditions (per UL and NEC specifications).
3. The SunPower Inverter itself to ensure only safe operating conditions exist within the operating environment.

If all 3 conditions are met the inverter will illuminate the "OK" (Green) LED.

If any one of the operating conditions is not met there is a fault and the SunPower Inverter will illuminate the "STAND BY" (Red) LED.

The "STAND BY" (Red) LED will illuminate when the PV panel voltage is not within safe operating limits. This will occur at sunset, when the inverter will turn off for the night. Anytime the level of sunlight is too low for the PV panels to produce 205 volts of DC for the SPR-4600 & 240 volts of DC for the SPR-5200's, the inverter will turn off. This ensures only safe and clean (low distortion) power is being generated. When the panels are once again exposed to enough sunlight, the SunPower Inverter's auto-start feature will begin, and after 5 minutes, the "OK" (Green) LED should illuminate



If the "STAND BY" (Red) LED continues to illuminate when there is sufficient sunlight for operation, verify all wiring connections are solid. See Section 4.0 Troubleshooting.

VACUUM FLOURESCENT DISPLAY

The vacuum fluorescent display will indicate the SunPower Inverter status and real-time power output into the AC Grid. This display will provide the following information:

- AC power produced in real-time
- PV input in real-time
- Total Output as kW-hr
- Greenhouse gases saved in lbs

If a fault has occurred, the display will also provide a fault code that corresponds to a set of defined faults. Please refer to Section 4.0 Troubleshooting.

4.0 TROUBLESHOOTING

If the SunPower Inverter's "STAND BY" LED remains solid red or blinking red for a prolonged period (more than 24 hours), the AC breaker or AC disconnect should be turned to the OFF position for 1 minute and then returned to the ON position. After reset, if both AC and DC operational specifications are met, the red LED is OFF and the green LED is illuminated. If after AC is reset the red "STAND BY" light remains illuminated or blinking, double-check all connections and voltage levels. If the red "STAND BY" light is still illuminated or blinking, contact your authorized dealer/distributor for product support.

The LEDs will display the following light indicators when a fault has occurred:

RED FLASHING	Inverter has a fault, refer to fault codes below for diagnosis
GREEN SOLID, RED FLASHING	Inverter has faulted, operational DC range is present. AC/grid-related fault
RED SOLID	DC Limit is too low; inverter is in "STAND BY" mode.



The vacuum fluorescent display will provide the following codes when a fault has occurred:

First Code:

PDPA FAULT	0x8000	power module generated fault
VOLTAGE FAULT	0x1000	General Voltage Fault – Refer to Code 3 for details.
GROUND FAULT	0x0400	
LOW POWER FAULT	0x0200	PV array power too low for max power tracking
CPU LOAD FAULT	0x0100	software overload
OVERCURRENT FAULT	0x0040	
PRECHARGE FAULT	0x0020	
HEATSINK TEMP FAULT	0x0004	
AMBIENT TEMP FAULT	0x0001	

Second Code: 0x0000 will always remain zero

Third Code: (Voltage Faults)

AC SENSE	0x0800	AC voltage sensing missing per UL or Ground Fault
AC OVER VOLTAGE FAULT	0x0400	
AC UNDER VOLTAGE FAULT	0x0200	
AC UNDER FREQUENCY FAULT	0x0100	
AC OVER FREQUENCY FAULT	0x0080	
DC UNDER VOLTAGE FAULT	0x0020	array voltage too low
DC OVER VOLTAGE FAULT	0x0010	
P15 FAULT	0x0002	+15V supply out of specifications
PS FAULT	0x0001	+5V supply out of specifications

As indicated above, there are three 16-bit codes assigned to describe faults, one of which will always remain zero. More than one fault can be represented at a time. This will be indicated by a fault with a code equal to the sum of the individual faults.

For example:

EX 1: Fault Code 1000 0000 0480
The first code indicates this is a voltage fault of some kind.
The 4 in code three indicates an AC over voltage.
The 8 in code three indicates the AC frequency was out of bounds.

EX 2: Fault Code 8004 0000 0000
The 8 in the first code indicates a power module fault.
The 4 in the first code indicates a heat sink over temperature fault.

WARNING: These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that specified in the operating instructions unless you are qualified.



5.0 SPECIFICATIONS

Specifications	SPR-3200-240	SPR-2900-208	SPR-2000-120
Maximum System Voltage	500VDC	500VDC	450VDC
DC Input Range	240: 230VDC-500VDC	205VDC-500VDC	135VDC-450VDC
DC Operating Voltage Range	240: 230VDC-430VDC	205VDC-430VDC	135VDC-320VDC
DC Operating Start Voltage Range	240: 230VDC-450VDC	205VDC-450VDC	135VDC-360VDC
Maximum DC Operating Current	15A	15A	15A
Maximum Array Short Circuit Current (DC)	18.75A	18.75A	18.75
Operating AC Voltage Range	211V-264V	183V-229V	106V-132V
Operating Frequency Range	59.3Hz-60.5Hz	59.3Hz-60.5Hz	59.3Hz-60.5Hz
Nominal AC Output Voltage	240V	208V	120V
Normal Output Frequency	60Hz	60Hz	60Hz
Maximum Continuous Output AC Current	14A	15A	19A
Maximum Output Fault Current (AC)	16.65A	16.65A	20A
Output Overcurrent Protection	20A	20A	25A
Peak Output Power	3200	2900	2000
Enclosure	Aluminum-NEMA 3R to UL 50 Standards	Aluminum-NEMA 3R to UL 50 Standards	Aluminum-NEMA 3R to UL 50 Standards
Dimensions (WxDxH)	15" x 7.5" x 21.75"	15" x 7.5" x 21.75"	15" x 7.5" x 21.75"
Weight	89lbs	89lbs	76lbs
Cooling	Natural Convection	Natural Convection	Natural Convection
Relative Humidity	0% to 100% Condensing	0% to 100% Condensing	0% to 100% Condensing
Ambient Temperature Range	-25°C to +40°C	-25°C to +40°C	-25°C to +40°C
Environmental Rating	Conformal Coating per UL Standards	Conformal Coating per UL Standards	Conformal Coating per UL Standards
Listings	IEEE 519, IEEE 929, NEC 690	IEEE 519, IEEE 929, NEC 690	IEEE 519, IEEE 929, NEC 690



6.0 Return Procedure

Before returning the product directly to SunPower Corporation, you must first obtain a **Return Authorization Number** from SunPower Corporation. The product must also be shipped prepaid. When you contact a SunPower Corporation representative, please have the following information ready:

1. The serial number of the product
2. The reason for the return
3. A copy of your dated proof of purchase

When you return the product to SunPower Corporation, SunPower Corporation advises that the original packaging or equivalent be used and that the product is shipped fully insured. SunPower Corporation is not responsible for damage to the product due to improper packaging.

On the packaging please include the following:

1. The **Return Authorization Number** supplied by SunPower Corporation clearly marked on the outside of the box.
2. A return address where the product can be shipped.
3. A telephone number where you can be reached during business hours.
4. A brief description of the problem.

Ship the product *prepaid* to the address provided by your SunPower Corporation representative.

Information About Your System

Note the following information for your records and retain your dated proof of purchase:

Serial Number _____

Purchased From _____

Date of Purchase _____



Notes:





SunPower Corporation