



PV Grid-tied Residential Inverters

INSTALLATION & OPERATION MANUAL



Preface

PV Powered

PV Powered designs, manufactures, and markets the solar power industry's most reliable photovoltaic solar inverter solutions. We've assembled a highly experienced solar power electronics design team. Our vision is to spur the widespread adoption and success of solar power, by assisting our distributors, dealers and installers in this dynamic market while ensuring that our products are the best supported, easiest to install, and most reliable solar inverters in the industry. Our innovative approach to performance monitoring provides secure and easy access to system performance and inverter status over the Internet.

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Safety Information and Conventions

Designation of Danger, Warning and Caution



DANGER

The Danger statement is used to inform the installer/operator of a situation requiring the utmost attention. Failure to heed this warning will result in serious injury or death to personnel and destruction of equipment.



WARNING

The Warning statement is used to inform the installer/operator of a situation requiring serious attention. Failure to heed this warning may result in serious injury or death to personnel and destruction of equipment.



CAUTION

The Caution statement is used to inform the installer/operator of a situation requiring attention. Failure to heed this Caution may result in injury to personnel and damage to equipment.

Revisions

For applicability of technical information with your specific product, contact PV Powered Customer Service and Technical Support at support@pvpowered.com.

Certifications

UL 1741

IEEE 1547

FCC Class A & B

CEC Efficiency Testing

Acronyms and Abbreviations

AC	Alternating Current
ANSI	American National Standards Institute
AWG	American Wire Gage
CEC	California Energy Commission
CPU	Controlled Processing Unit
DC	Direct Current
EGC	Equipment Grounding Conductor
FCC	Federal Communications Commission (US)
GEC	Grounding Electrode Conductor
GFI	Ground Fault Interrupt
IEEE	Institute of Electrical and Electronics Engineers
LED	Light-Emitting Diode
LOTO	Lockout Tagout
LP	Low Power
MPPT	Maximum Power Point Tracking
NEMA	National Electrical Manufacturers Association
NEC	National Electric Code
NFPA	National Fire Protection Association
Nm	A unit of torque
PLL	Phase Lock Loop
PPE	Personal Protective Equipment
PV	Photovoltaic
STC	Standard Test Condition
UL	Underwriters Laboratory
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VFD	Vacuum Fluorescent Display
VOC	Voltage Open Circuit
VOC_TC	Voltage Open Circuit, Temperature Coefficient

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1. Introduction and Safety

1.1 Introduction

The PV Powered Grid-Tied Inverter is a utility interactive inverter for photovoltaic (PV) systems.

The inverter is tied to an electrical source provided by the local utility company as well as the PV system. The inverter contains everything needed to convert the DC energy generated by the PV array(s) into AC energy required to power a house.

This manual provides information necessary for the successful installation and use of the PV Powered Grid-Tied Inverter.

1.2 General Safety

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. Read and follow all instructions for installation, use and servicing of this product. Read all safety warnings before installing or operating the inverter.

NOTE: A locking tab has been designed into the PV Powered Grid-tied Inverter. Locking the inverter is the sole responsibility of the end user. Secure the lid to prevent unauthorized access or damage to the inverter.

SAVE THESE INSTRUCTIONS: This manual contains important instructions for the PV Powered Grid-Tied Inverter that must be followed during installation of the PV Powered Grid-Tied Inverter.

INSTRUCTIONS IMPORTANTES CONCERNANT LA SÉCURITÉ CONSERVER CES INSTRUCTIONS. CETTE NOTICE CONTIENT DES INSTRUCTIONS IMPORTANTES CONCERNANT LA SÉCURITÉ.



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 inverter to the electrical utility grid, your utility company must grant approval. Only qualified electricians should make the connection.
- When exposed to light, PV arrays form electrical energy that creates a potentially hazardous condition. To avoid this, completely cover the surface of all PV arrays with opaque (dark) material before wiring them.
- The inverter contains no user-serviceable parts. Refer maintenance to qualified service personnel.

1.3 FCC Compliance

The PV Powered Grid-Tied Inverters have been tested and found to pass FCC Class B radio interference standards with proper installation of the inverter. This is not a guarantee that there will be no interference at every installation. If you notice interference at your installation, try the following potential solutions:

- Move or re-orient the affected device.
- Increase the distance between the devices.
- Connect the device to a different AC circuit.



CAUTION

Read all safety warnings and instructions before installing or operating the inverter.

2. Planning

2.1 Selecting a Location for the Inverter

When choosing a location for the inverter, consider the following criteria:

- The inverter is suitable for both indoor and outdoor installation; the inverter enclosure has a NEMA 3R rating.
- The optimum location of the inverter is outside, shielded from direct exposure to sunlight (i.e. not on the south facing side of the building).
- The heat sink temperature can exceed 158°F (70°C). The inverter should be installed so that people can not touch the top of the unit.
- The inverter is designed and tested to produce maximum continuous output power within the ambient temperature range of -15°F to 105°F (-25°C to 40°C).

Location and Clearances

The following clearances are recommended for proper placement of the inverter:

- A minimum of 36 inches between the bottom of the inverter box and the ground.
- A minimum of 12 inches above the heat sink.
- Approximately one half inch of width clearance on the right and left sides of the inverter cabinet.

Visibility of the operating LEDs and display located at the top front of the inverter box should also be considered. Refer to Figure 2-1 for these within the inverter's box.

If the inverter is installed in an enclosed space, adequate ventilation must be provided.

2.2 Guidelines for Mounting the Inverter

The inverter should be mounted vertically to a flat, solid surface such as strut, concrete, or wood siding. It should be located near the PV arrays to minimize the DC conductor length.

The bracket and paper mounting template provided make mounting the inverter quick and simple.

The small bracket:

- Has a vertical row of screw holes down the center and is designed for a single-stud mount. Refer to Figure 3-2.

The large bracket:

- Has two top screw holes at either end of the large bracket, 16" apart which are designed to match standard stud spacing. Refer to Figure 3-1.

The inverter also has an internal mounting screw. Refer to Figure 2-1 for the location of this screw.



WARNING

Before drilling holes to mount the inverter, verify that there are no electrical wires or plumbing in the area.

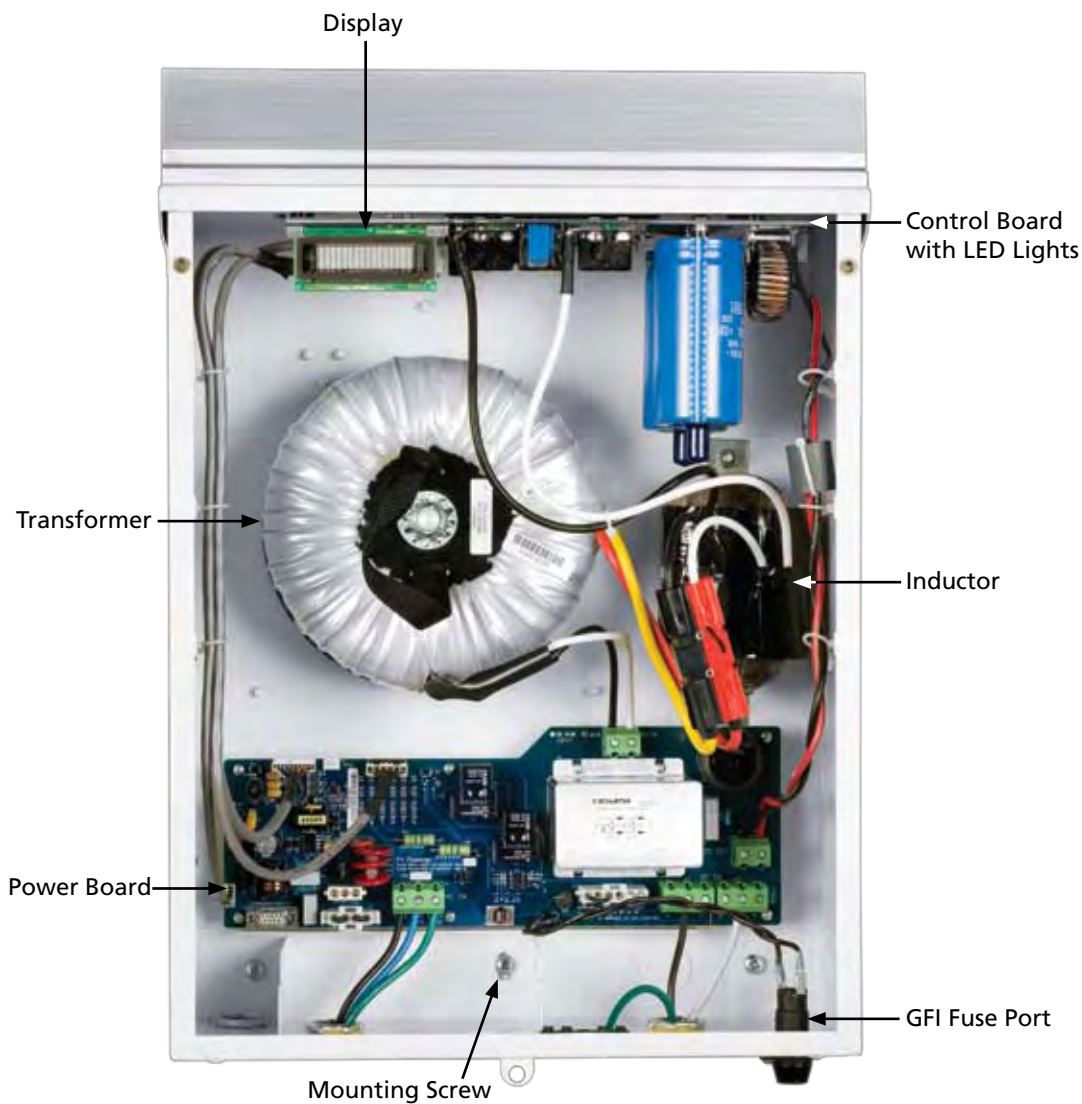


Figure 2-1 View of the Inverter's Interior Components

3. Installation

3.1 Mounting and Anchoring the Inverter

After you have determined a suitable location for the inverter, the bracket is anchored to the wall stud(s).

Models PVP1100, PVP2000, PVP2500, PVP2800, PVP3000 and PVP3500

1. Locate a wall stud in the desired location and align the mounting bracket or paper mounting template with the vertical row of screw holes over it for a single-stud mount. Mark the mounting holes ensuring holes C through F are directly over the single stud.
2. **VERIFY THE BRACKET IS LEVEL.** Ensure points C through F are aligned with the wall stud. Drill 1/8" pilot holes for the screws.
 - Use heavy-duty 1/4" x 2" coarse thread lag screws to secure points C, D and F.
 - Use an 1/8" screw (and anchor if necessary) to secure point E. Refer to Figure 3-1.

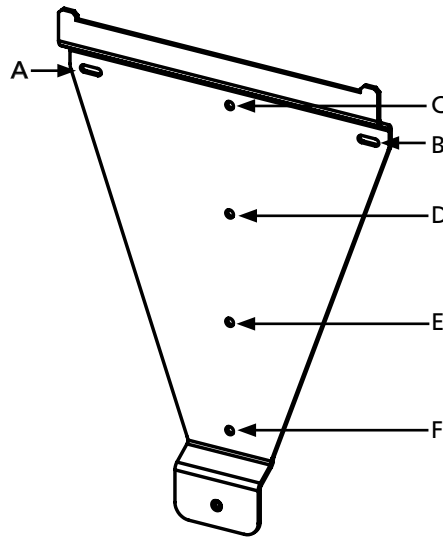


Figure 3-1 Small Mounting Bracket

3. Carefully hang the inverter on the upper part of the bracket. The hooks located at the rear of the inverter should hang over the bracket.
4. Verify the inverter is level.
5. Remove the front lid of the inverter by unscrewing the two cover screws located at the bottom perimeter of the inverter.
6. Locate the inverter mounting hole below the power board (see Figure 3-3). Insert the mounting screw through the inverter and tighten securely.

Models PVP4600, PVP4800 and PVP5200

1. Locate the wall studs in the desired location and align the mounting bracket or paper mounting template over the studs. Mark the mounting holes. Ensure that locations A and B (see Figure 3-2) are aligned over two wall studs.
2. **VERIFY THE BRACKET IS LEVEL.** Ensure points A and B are aligned with the 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 (and anchor if necessary) to secure point C.

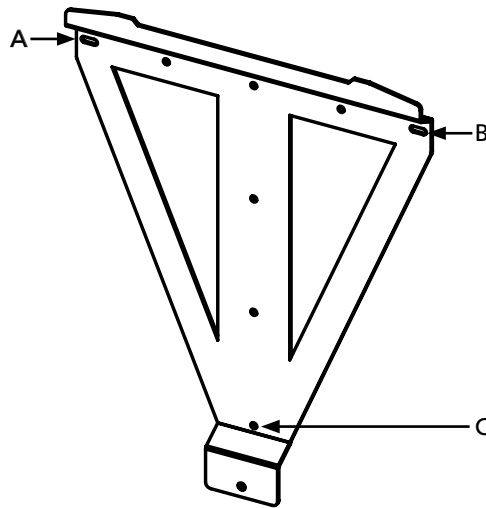
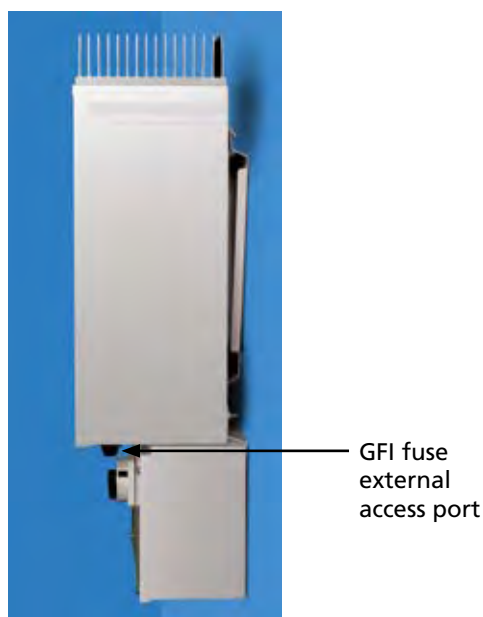


Figure 3-2 Large Mounting Bracket

3. Carefully hang the inverter on the upper part of the bracket. The hooks located at the rear of the inverter should hang over the bracket.
4. Verify the inverter is level.
5. Remove the front lid of the inverter by unscrewing the four screws located around the front perimeter of the inverter.
6. Locate the inverter mounting hole below the power board. Refer to Figure 3-3. Insert the mounting screw through the inverter and tighten securely.



Figure 3-3 Inside Screw - Below the Power Board



**Figure 3-4 Inverter and PV System Disconnect
with Mounting Bracket in Place**

***NOTE:** Leave the inverter lid off to allow for completing the electrical connections described in the next section, **Electrical Connections**.*

3.2 Electrical Connections



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).

To reduce the risk of fire, connect the inverter to the appropriate size breaker (see Table 3-1 for required branch circuit protection). Maximum branch-circuit over-current protection is calculated in accordance with the National Electrical Code (NEC), ANSI/NFPA 70.

Inverter Model	Circuit Breaker Required
PVP1100	1 pole 15A
PVP2000	2 pole 15A
PVP2500	2 pole 20A
PVP2800	2 pole 20A
PVP3000	2 pole 20A
PVP3500	2 pole 20A
PVP4600	2 pole 30A
PVP4800	2 pole 30A
PVP5200	2 pole 30A

Table 3-1 Required Branch Circuit Protection

Inverter Voltage and Frequency Limits

The inverter is factory calibrated to the voltage and frequency limits specified in Table 3-2. This voltage range can be adjusted by PV Powered field technicians under special circumstances.

Condition	Factory Setting	Adjustable Range (VAC) Models 2000, 2500, 2800, 3000, 3500, 4600, 4800, 5200	Adjustable Range (VAC) Models 1100	Maximum Trip Time(s)
Voltage phase high	132.0	132.0 - 142.0	132.0 - 142.0	< 1 second
Voltage phase low	105.6	95.6 - 105.6	95.6 - 105.6	< 2 seconds
Voltage phase fast high	144.0	144.0 - 156.0	144.0 - 156.0	< 160ms
Voltage phase fast low	60.0	< 60.0	< 60.0	< 160ms
Voltage high line to line (240V inverters)	264.0			
Voltage low line to line (240V inverters)	211.0			
Voltage high line to line (208V inverters)	228.8			
Voltage low line to line (208V inverters)	183.0			
Line frequency low	59.3 Hz	n/a		< 160ms
Line frequency high	60.5 Hz	n/a		< 160ms

Table 3-2 Inverter Voltage Frequency Limits

NOTE: Do not proceed with making the inverter's electrical connections until it is properly mounted.



WARNING

Electrical connections must be completed in accordance with local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70. Use 12 AWG minimum, 90°C copper wire for all inverter electrical connections. Voltage drop as well as other considerations may dictate using larger wire sizes.

NOTE: To avoid an increase in AC voltage level, which may lead to nuisance faults, PV Powered recommends sizing the conductor for a drop of less than 2%.



WARNING

Ensure the breaker in the main utility service panel is switched OFF before wiring the inverter. This breaker should be switched ON only after all wiring has been completed as described in this manual.



WARNING

Follow the order listed below to wire the inverter. Failure to do so may result in hazardous voltages or disconnection of contacts.

IMPORTANT: When mounting the inverter outside, use rain-tight or wet-location conduit hubs that comply with the requirements in the Standard for Fittings for Conduit and Outlet Boxes, UL 514B.

NOTE: Terminal connections for the inverter are located inside the inverter on the circuit board at the bottom of the cabinet. The AC and DC terminals accept wires up to 6 AWG.



CAUTION

The DC/AC input and output circuits are isolated from the enclosure. The PV equipment grounding conductor (EGC), where required by Sections 690-41, 690-42, and 690-43 of the National Electric Code (NEC), ANSI/NFPA 70, is the responsibility of the installer. Failure to properly install the ground conductor for the PV equipment can result in exposed metallic surfaces becoming energized to the full potential of the PV array.

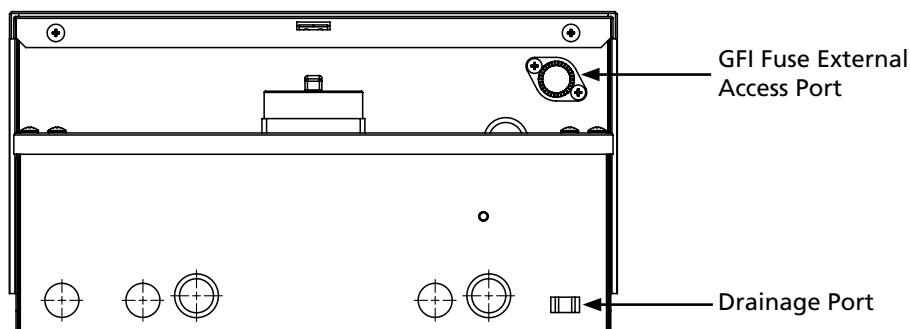


Figure 3-5 Communications, AC and DC Ports

Separation of Circuits

The lower part of the inverter circuit board is divided into three sections:

1. The left side is dedicated to the low voltage DC communications (PVM1010 data monitoring module).
2. The center is dedicated to the AC.
3. The right side is dedicated to the DC.

Each section has one to three knockouts. UL 1741 requires a straight run of conductor, with no loops or crossover to the other circuits (sections) and low voltage versus high voltage in each section (see Figure 3-5).

1. Left knockouts (up to the divider) are for low voltage communications only (PVM1010 Data Monitoring Module).
2. Center knockouts are for AC.
3. Right knockouts are for DC.

Grounding

A single-point ground conductor connection is located in the lower right-hand side of the inverter cabinet. This is where the DC grounding electrode conductor (GEC) is terminated. The AC equipment grounding conductor (EGC) is terminated next to the Line 1 and Line 2 connections on the circuit board.

The grounding lug is attached to the cabinet with a 10-32 bolt. The equipment ground connector or grounding lug is provided, utilizing the PV equipment and AC ground conductor. This is the only place the PV ground should be connected to the inverter.

- Do not tie the GEC to the PV array positive or negative. This would defeat the PV ground fault interrupt protection circuit. Refer to Figure 3-8 for illustrated information.
- See Table 3-3 for appropriate sizing of the grounding electrode conductor. Use the maximum current AC or DC - whichever is larger - and multiply it by 1.25 to get the maximum current rating per NEC 690.

Maximum Current Rating	Minimum Size of Grounding Electrode Conductor AWG	
	Copper	Aluminum Copper Clad
15	8	6
20	8	6
30	8	6
40	8	6
60	8	6

Table 3-3 Grounding Electrode Sizing

Figure 3-6 is a schematic representation of the PV Powered single-point grounding. The front lid is grounded through the cover's mounting screws.

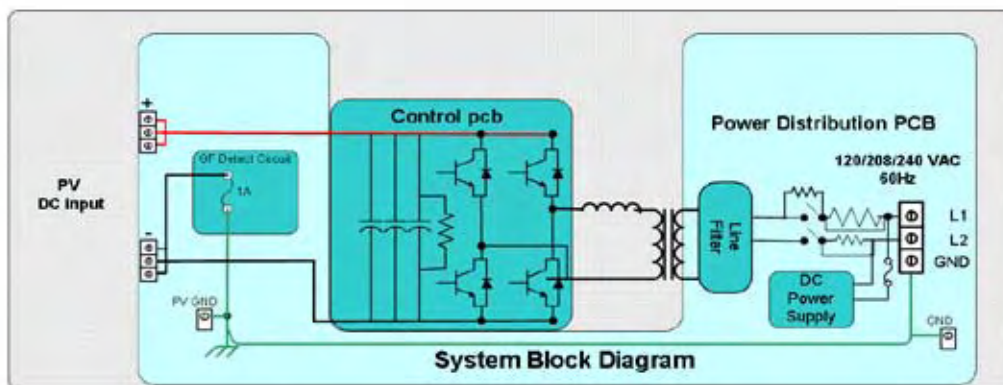


Figure 3-6 System Block Diagram Showing Single-Point Ground

Ground Fault Interruption Circuit (GFI)

The purpose of the GFI circuit is to detect a ground fault current, interrupt the flow of a fault current, and provide an indication of the fault.

A ground fault is defined as “unintended current flow to ground” which presents a hazardous condition.

- For the GFI circuit to function as designed, the GEC must be connected only at the ground terminals detailed in Figure 3-8.
- Bonding the GEC to the grounded leg of the array anywhere but through the inverter bypasses the GFI circuit.
- The GFI operates by bonding the PV array negative or positive to earth ground through a 600 VDC 1 amp fuse. (The negative and positive schema is determined through the selection of a GFI jumper. See Figure 3-10.)
- The GFI circuit activates if any DC ground fault currents are greater than 1 amp. The GFI circuit opens or “blows” the 1 amp fuse, interrupting the fault current path, disabling the inverter’s power production and displaying a unique error message shown in Figure 3-7.



WARNING

Replace the GFI fuse with the same type and rating of fuse. The inverter uses Littlefuse KLKD1 1A/600VDC.

- The GFI is a latching circuit which prevents the inverter from operating until the fault is repaired and the inverter is reset. The inverter will not operate, even if the fault is repaired, unless manually reset by turning the AC source circuit off and then on.

```
Fault 0400 0000  
Ground Fault
```

Figure 3-7 Ground Fault Message

If the inverter displays “Ground Fault”, turn OFF the PV System Disconnect and refer to the fault examples in this manual.

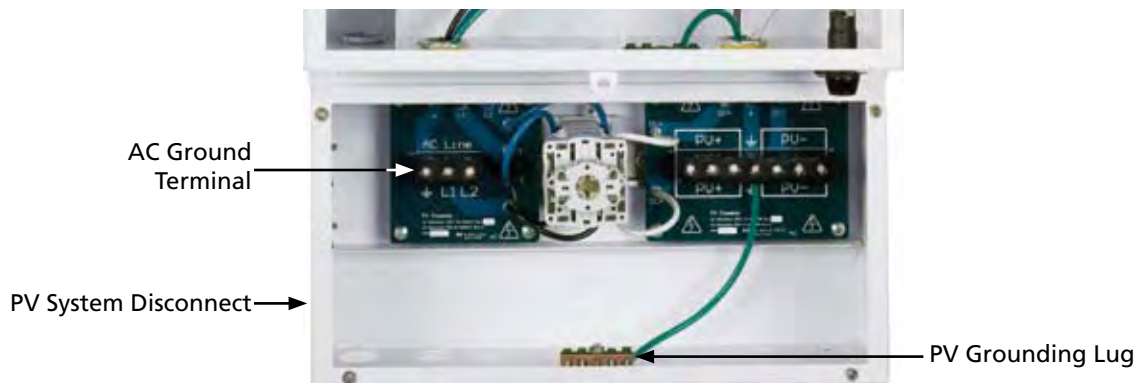


Figure 3-8 AC and PV Grounding

Connecting the Inverter to the Electrical Grid

Two circuit boards are located inside the inverter:

1. The Control Board (at the top of the inverter).
2. The Power Distribution Board, at the bottom of the inverter, with the following terminals:
 - AC connection terminal
 - DC connection terminal
 - External Ground Fault Interrupt fuse

The inverter is connected to the electrical grid using three wires: LINE 1, LINE 2/N and GROUND.


NOTE: To avoid an increase in AC voltage level, which may lead to nuisance faults, PV Powered recommends sizing the conductor for a drop of less than 2%.



WARNING

Ensure the main 240VAC (or 208VAC for the PVP2800 and PVP4600, or 120VAC for PVP1100) breaker at the circuit breaker panel is switched OFF before connecting to the AC terminal block.

To wire the inverter/disconnect unit to the main utility grid, follow these steps while referring to Figure 3-9.

1. Ensure the PV System Disconnect is in the OFF position
2. Run a conduit from the main breaker panel into the PV System Disconnect. Insert a fitting into one of the conduit holes of the PV System Disconnect and fasten securely with a locking nut.
3. Feed the Line 1, Line 2, and Ground conductors through the conduit and into the wire raceway in the PV System Disconnect.
4. Connect the Ground conductor to the terminal marked with the ground symbol  located on the left hand side of the AC circuit board inside the PV System Disconnect.
5. Connect the Line 2 conductor to the terminal marked line L2 on the AC circuit board inside the PV System Disconnect.
6. Connect the Line 1 conductor to the terminal marked L1 on the AC circuit board inside the PV System Disconnect.
7. Ensure all connections are wired correctly and properly torqued. Tighten the terminal block screws to 1.5 Nm (4 in-lbs).

NOTE: In the PVP1100 units the Line 1 conductor is the only phase voltage wire, Line 2 is neutral, and Line 3 is the EGC.

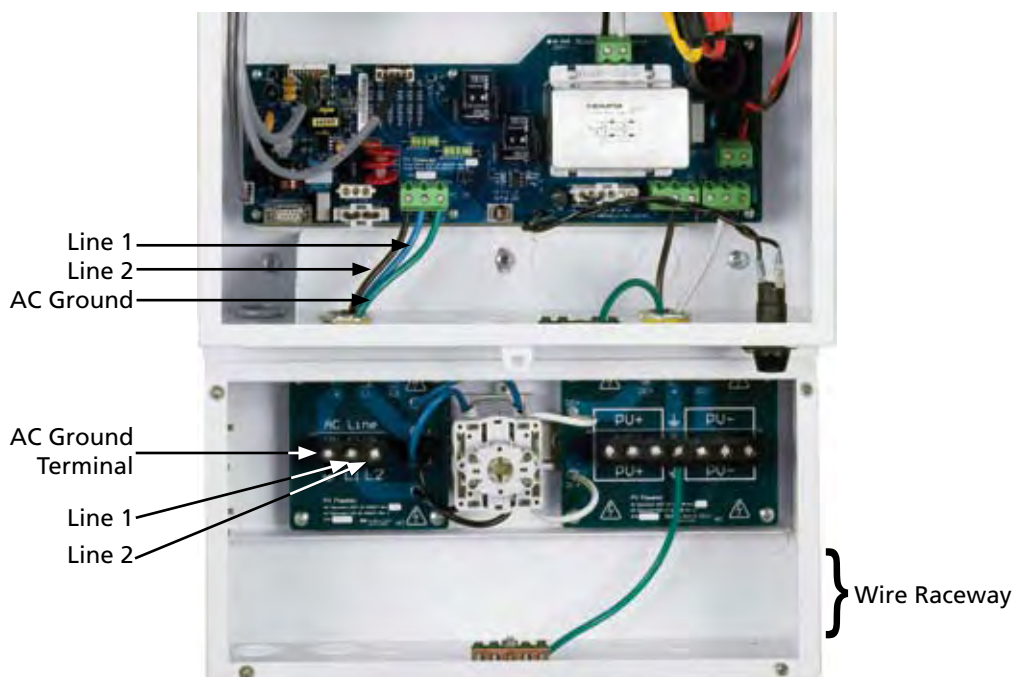


Figure 3-9 AC Wiring for the Line 1, Line 2 and Ground Conductors

Connecting DC Wires and PV Panels



WARNING

Before proceeding with the DC wiring, completely cover the surface of all PV panels with dark material to avoid the production of electrical energy.



WARNING

Make sure the grounding scheme and the PV panel voltage between the positive and the negative cable connectors of the PV panels are correct before connecting the panels to the DC terminal block on the power distribution board.

Note: *For all temperature conditions the VOC for each series connection must total less than 500 VDC for all residential inverter models.*

Inverter Model	Maximum Inverter Start Voltage	Absolute Maximum Input Voltage
PVP1100	450VDC	500VDC
PVP2000	450VDC	500VDC
PVP2500	450VDC	500VDC
PVP2800	450VDC	500VDC
PVP3000	450VDC	500VDC
PVP3500	450VDC	500VDC
PVP4600	450VDC	500VDC
PVP4800	450VDC	500VDC
PVP5200	450VDC	500VDC

Table 3-4 PV Open Circuit Voltages

DC Connections

To wire the DC inputs from the PV array to the inverter/disconnect system, refer to Figure 3-11.

The PV System Disconnect accepts wire gauges up to multi-stranded 6 AWG from the PV array.

1. Calculate the maximum open circuit voltage (VOC) for each individual series of modules per the NEC 690-7.
2. Clearly label the positive and negative conductors from the PV system array.
3. Ensure the PV System Disconnect handle is in the OFF position.
4. Route and wire the PV system array conductors to their respective positive and negative terminals marked inside the PV System Disconnect.
 - Wire the array positive conductor(s) to the terminals marked positive.
 - Wire the negative array conductor(s) to the terminals marked negative.



WARNING

Negative grounded array: On a negatively grounded PV array, break only the positive conductor(s) in the PV System Disconnect. Do NOT break the negative conductor(s).

Positive grounded array: On a positively grounded PV array, break only the negative conductor(s) in the PV System Disconnect. Do NOT break the positive conductor(s).

5. Connect the PV equipment ground conductor to the ground lug located on the front inside portion of the PV System Disconnect. Refer to Figure 3-8.
 6. Verify all connections are properly torqued to 1.5 Nm or 4 in-lbs.
 7. Remove the 1A fuse from the external port by unscrewing the cap housing the fuse. Refer to Figure 3-5.
-



WARNING

Do not connect or disconnect the GFI jumper shown in Figure 3-11 while the inverter is supplied with DC or AC power.

8. Determine which GFI jumper to use based on the PV manufacturer's grounding scheme recommendation. Refer to the following figure.



Figure 3-10 Positive and Negative GFI Jumpers

9. Install the GFI jumper with the white wire on the right, into connector J3 on the power board inside the inverter. Refer to Figure 3-11.

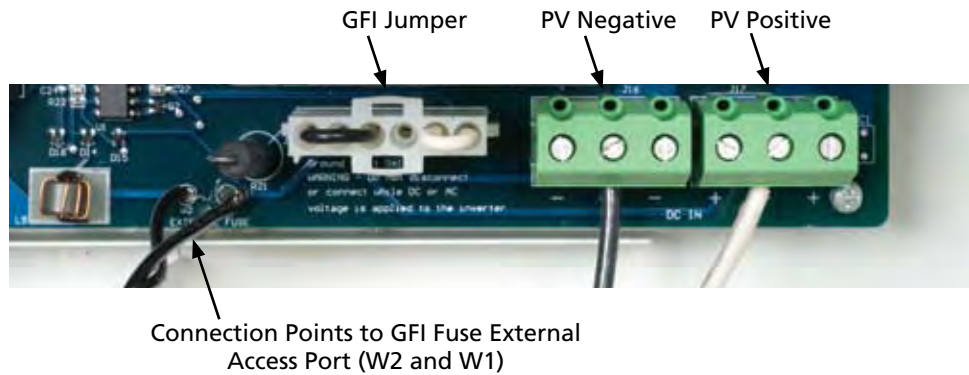


Figure 3-11 Power Board Connections

10. Confirm the PV System Disconnect is in the OFF position, and remove the PV array covering material.

The PV Array should now be exposed to sunlight, and the PV side of the system is now energized.

11. With a voltmeter, check the PV array positive conductor(s) in the PV System Disconnect. Confirm that the voltage is positive when referring to the negative conductors.

The system voltage should match the VOC of the string configuration.

12. Secure the PV System Disconnect's lid.

13. Turn ON the PV System Disconnect.

14. Measure the DC voltage potential across the GFI fuse extension points, W1 and W2, inside the inverter. Verify it is less than 25 volts DC, either positive or negative. Refer to Figure 3-11.

15. If the voltage is not less than 25 volts, turn OFF the disconnect, wait 10 minutes, and repeat steps 11 and 12.

If the voltage reading is not within the 25 volt limit, check for a ground fault in your PV array. If the problem persists contact PV Powered Customer Service.

16. Replace the inverter's lid and turn the PV System Disconnect switch back to the OFF position.

17. Re-install the GFI fuse and cap.

This completes the PV array wiring for your system.

4. Operations



WARNING

Before turning on the inverter, ensure that the front cover is closed properly.



WARNING

The heat sink can reach temperatures in excess of 158°F (70°C). Do not touch the heat sink when in use, and do not place anything on top of the heat sink.

4.1 Start up Procedures

To start up the inverter, complete the following steps in the order indicated.

NOTE: *All steps are assumed completed in previous sections; including but not limited to:*

- *VOC calculation*
- *Checking the system for ground faults*

1. Turn the AC breaker ON.

Verify that the red LED light is illuminated. The LEDs are located in the upper left hand corner of the inverter's display.

- If the red LED is not illuminated or is blinking, refer to the *Troubleshooting* section.

2. Turn the PV System Disconnect ON.

The green LED should illuminate. If not, refer to the *Troubleshooting* section.

- If no green LED illuminates, verify DC voltage is present in the PV System Disconnect. The DC voltage present should be at least 15 volts greater than the minimum operating voltage stated in Appendix A.

After five minutes the inverter starts to produce power if all necessary operating conditions are met.

NOTE: *PV Powered recommends that a lock be attached to prevent unauthorized access or damage to the inverter.*

4.2 Inverter Front Panel Status Indicators

The inverter continuously monitors:

1. The AC grid connection to ensure the AC voltage and frequency levels are within safe operating limits per UL1741.
2. The DC voltage and current from the PV array to ensure safe operating conditions per UL 1741.

3. The inverter's internal operational parameters to ensure safe operating conditions exist within the operating environment.

The inverter has two LED indicator lights visible through the upper left corner of the lid. These lights indicate the inverter's status.

Green LED is illuminated when:

- All three monitored operating conditions are met.
- Inverter's operating environment is safe to export power to the AC grid.

Red LED flashes when:

- Any one of the monitored operating conditions are not met.
- When a fault condition exists.
- The operating environment moves outside the safe operating limits governed by UL 1741, IEEE 1547, and IEEE 519.

Red LED is illuminated when:

- The PV array voltage is not within required operating limits, such as:
 - At sunset, when the inverter turns off for the night.
 - When clouds reduce the amount of available sunlight or when portions of the PV array are covered with debris.
 - Any time the DC output from the PV array drops below the inverter's minimum DC operating voltage, the inverter turns off.

When the array is once again exposed to enough sunlight, the green LED illuminates, the inverter's auto-start feature begins, and after five minutes the inverter begins to export power.

If the red LED continues to illuminate when there is sufficient sunlight for operation, verify that no wiring connections are loose. If the wiring is secure, see the Troubleshooting section for additional information.

The vacuum fluorescent display (VFD) indicates the inverter's status and real-time power output into the AC grid. This display provides the following information:

- Inverter model type.
- AC power produced in real time (watts).
- Lifetime energy produced (kWh).
- AC voltage in real time (VAC).
- PV voltage input in real time (VDC).
- During start-up, a count-down timer.
- Fault code message if a fault exists or recently occurred.

Normal Display Cycle

The display changes every two seconds to show a different set of information as shown in Figures 4-1 and 4-2.



Figure 4-1 Normal Startup Screens



Figure 4-2 Running Screens

If a fault occurs, the display also provides a corresponding fault code. Refer to the Troubleshooting section for additional information.

5. Troubleshooting

The inverter provides two indicator lights in the form of Light Emitting Diodes, or LEDs. The LEDs are the primary indicators of the system status: O.K., Sleep or Faulted. The LEDs are located above the inverter display in the upper left hand corner on the front lid.

5.1 LED Status

Red LED

1. The light on the left is a red LED and is the primary indicator of system stand-by or fault condition.
2. A solid red LED and a blank screen indicates the system is in normal sleep or stand-by mode. This mode occurs if there is not enough sunlight present to generate DC voltage at night and the AC properties are within the provided specifications.
3. The red LED blinks if the inverter has had a fault condition, and the vacuum fluorescent display (VFD) displays a fault code. If the red LED is blinking, carefully record the numerical error code and text describing the error. Possible faults are listed in Table 5-1.

Green LED

1. The light on the right is a green LED and is the primary indicator the system is generating power.
2. The green LED illuminates any time the DC voltage is above the inverter's DC start voltage and all operational parameters are met. When the green light illuminates, the inverter tries to convert power from the PV array.

Red and Green LED Lights On

If both LED lights are solid at the same time, contact PV Powered Technical Support for assistance.

Ground Fault Error



WARNING

Replace the GFI fuse with the same type and rating of fuse. The inverter uses Littelfuse KLKD1 1A/600VDC.

1. The inverter's GFDI circuit reports a ground fault error if the 1 amp fuse is blown and the voltage potential between ground and the grounded terminal of the PV array is greater than +25 VDC, or less than -25 VDC. This voltage potential can only occur if the ground fault fuse in the inverter has opened.
2. A ground fault occurs when unintended current has a path to ground. The most common source of a PV system ground faults are crossed wires, a nicked PV module conductor touching a grounded surface, or cables inside a conduit have metal exposed through the insulation.
3. A less likely cause is limited to multiple inverter installations, when the positive and negative array strings are crossed. Crossed wires occur when a positive or negative

conductor from array 1 is connected with wires in array 2. An example is if inverter A has the positive conductor from array 1 and the negative conductor from array 2 connected.

4. If the fuse is blown or open, then a ground fault condition exists.
 - Check the DC voltage between the grounded terminal of the array and earth ground.
 - The voltage should be less than 25 VDC with the GFI fuse removed. If the voltage is greater than this, check the array wiring as there may be a ground fault. For the best results, perform this test with the PV System Disconnect on and off. If you are not comfortable conducting this test, DO NOT ATTEMPT IT. (See *PV System Disconnect, Installation and Operations Manual* for AC and DC disconnect information).
 - If a ground fault condition is not present because it is now repaired or intermittent, replace the fuse with a similar fuse rated at 600VDC and 1A.
5. Make sure the grounded leg of the PV array is not broken in the PV System Disconnect.

Note: *The GFI is a latching circuit which prevents the inverter from operating until the fault is repaired and the inverter is reset. The inverter will not operate, even if the fault is repaired, unless it is manually reset by turning the AC source circuit off and then on.*

5.2 Displayed Fault Codes

The vacuum fluorescent display (VFD) provides the codes shown in Figures 5-1 and 5-2 when a fault has occurred.

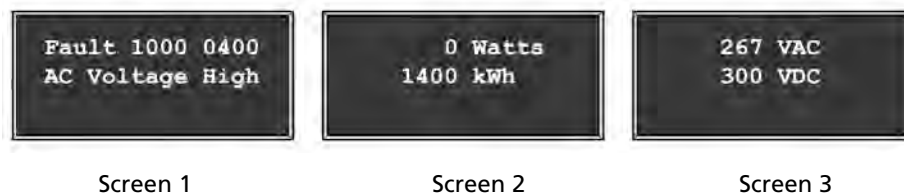


Figure 5-1 Faulted

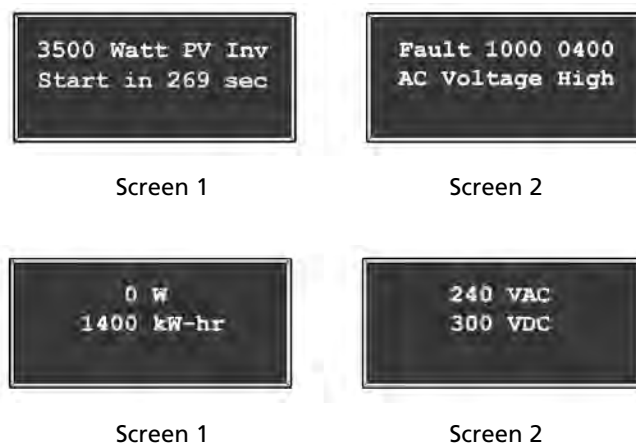


Figure 5-2 Starting Up From a Faulted State

NOTE: In this case the fault refers to the last fault detected.

If the inverter is in a faulted state, the red LED blinks and the VFD scrolls through the screens shown in the faulted example above. The text of the fault describes the specific fault condition that the inverter experienced.

If the inverter is no longer experiencing the condition that caused the fault (e.g. the AC voltage climbs above 264V then drops below 264V), the red LED stops blinking and the inverter starts the five minute count-down timer. During these five minutes, the display also shows the last fault.

Multiple Faults

If the inverter detects multiple faults at one time, the inverter displays the text of the first fault detected.

For multiple faults, the numerical values of the fault codes are added as shown in Figure 5-3.



Figure 5-3 AC Voltage High/DC Voltage Low Fault

Figure 5-3 displays the AC Voltage High fault (1000 0400), plus a DC Voltage Low fault (1000 0020). This might occur at night, when the panel voltage is low, due to darkness, and the utility voltage was above the limits defined in Table 3-2.



Figure 5-4 Power Low Fault

Figure 5-4 shows a Power Low fault. After the fault occurrence, the inverter had a DC Voltage High fault. In this case, the display added the fault codes 0200 0000 plus 1000 0040 to become 1200 0040.

If the faults have the same first digit (such as 1000 XXXX) the 1 remains the same and only the second block of four numbers add to the original fault code.



WARNING

These servicing instructions are for 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.

5.3 Fault Codes

Fault Code	VFD Text	Fault Description
8000 0000	Power Module	Generated by the power electronics to protect the switching module.
4000 0000	Power Module	Generated by the power electronics to protect the switching module.
1000 0800	PLL Fault	The inverter was unable to match the grid frequency. This is usually caused by an unstable power grid.
1000 0400	AC Voltage High	The grid voltage exceeded the limits in Table 3-2.
1000 0200	AC Voltage Low	The grid voltage dipped below the AC limits in Table 3-2.
1000 0100	AC Freq Low	The grid frequency went below the limits in Table 3-2.
1000 0080	AC Freq High	The grid frequency went above the limits in Table 3-2.
1000 0020	DC Voltage Low	The DC voltage is below the startup voltage.
1000 0010	DC Voltage High	DC voltage is above upper operating limit 450V.
1000 0002	Power Supply +15	Housekeeping DC power supply 15VDC is out of tolerance.
1000 0001	Power Supply +5	Housekeeping DC power supply 5VDC is out of tolerance.
0400 0000	Ground Fault	The inverter detected a blown GFI fuse.
0200 0000	Power Low	The inverter shut down because it was producing less than 60W for 5 minutes.
0100 0000	CPU Fault	The inverter encountered a problem in the CPU.
0040 0000	Over Current	Safety protection. The inverter encountered an over-current fault.
0020 0000	Pre-charge	The inverter experienced trouble energizing the transformer.
0004 0000	Heatsink Temp	The heat sink is above or below the operating limits of -25oC to 95oC.
0002 0000	Watchdog Fault	The CPU experienced a watch-dog fault.
0001 0000	Ambient Temp	The temperature detected inside the inverter is outside the normal operating limits of -25oC to 95oC.

Table 5-1 Fault Codes

The following fault codes indicate the inverter will restart once conditions are within normal operating conditions listed in Appendix A, Table A: 1000 0400, 1000 0200, 1000 0100, 1000 0080, 1000 0020, 1000 0010, 1000 0002, 1000 0001, 0200 0000, 0004 0000, and 0001 0000.

If the following fault codes occur, please contact PV Powered Technical Support for service: 8000 0000, 4000 0000, 1000 0800, 0400 0000, 0100 0000, 0040 0000, 0020 0000, and 0002 0000.

Appendix A - Specifications

The specifications detailed below are expected operational parameters, and should be used in designing your PV system in accordance with the NEC.

Specifications	PVP1100	PVP2000	PVP2500	PVP2800
Maximum DC Input Voltage (VOC)	500VDC			
DC Voltage Operating Range (V)	115VDC-450VDC	115VDC-450VDC	140VDC-450VDC	180VDC-450VDC
DC MPPT Range (V)	115VDC-380VDC	115VDC-380VDC	140VDC-380VDC	180VDC-380VDC
DC Imp Maximum Current (A)	10A	18A	20A	18A
DC Isc Maximum Current (A)	26A			
AC Operating Range (V)	105.6V-132.5V	211V-264V	211V-264V	183V-229V
AC Frequency Range (Hz)	59.3Hz-60.5Hz			
AC Nominal Voltage (V)	120V	240V	240V	208V
Normal Output Frequency	60Hz			
Synchronization in Rush Current	< 2.0A		8.4A	< 2.0A
Power Factor	0.99 - 1.0 at > 50% Power			
AC Maximum Continuous Current (A)	10A	9A	11A	13A
Continuous Output Power (Watts)	1100	2000	2500	2800
Maximum Continuous Output Power (Watts)	1100	2000	2500	2800
Enclosure	Steel- NEMA 3R to UL 50 Standards			
Dimensions (H x W x D)	22 1/2" x 15 5/8" x 8 1/4"			
With PV System Disconnect (H x W x D)	30 3/8" x 15 5/8" x 8 1/4"			
Weight (lbs)	55	65	70	80
Cooling	Natural Convection - Heat Sink			
Relative Humidity	0% to 100% Condensing			
Ambient Temperature Range	-25°C to + 40°C			
Environmental Rating	NEMA 3R			
Listings	UL 1741, IEEE 1547, IEEE 519, IEEE 929, IEEE 620			

Table A-1 PVP1100 through PVP2800 Specifications

Specifications	PVP3000	PVP3500	PVP4600	PVP4800	PVP5200
Maximum DC Input Voltage (VOC)	500VDC				
DC Voltage Operating Range (V)	170VDC-450VDC	200VDC-450VDC	205VDC-450VDC	200VDC-450VDC	240VDC-450VDC
DC MPPT Range (V)	170VDC-380VDC	200VDC-380VDC	205VDC-380VDC	200VDC-380VDC	240VDC-380VDC
DC Imp Maximum Current (A)	18A	18A	25A	26A	25A
DC Isc Maximum Current (A)	26A	26A	48A		
AC Operating Range (V)	211V-264V	211V-264V	183V-229V	211V-264V	211V-264V
AC Frequency Range (Hz)	59.3Hz-60.5Hz				
AC Nominal Voltage (V)	240V	240V	208V	240V	240V
Normal Output Frequency	60Hz				
Synchronization in Rush Current	< 2.0A	8.4A			
Power Factor	0.99 - 1.0 at > 50% Power				
AC Maximum Continuous Current (A)	13A	15A	23A	21A	23A
Continuous Output Power (Watts)	3000	3500	4600	4800	5200
Maximum Continuous Output Power (Watts)	3000	3500	4600	4800	5200
Enclosure	Steel - NEMA 3R to UL 50 Standards		Steel - NEMA 3R to UL 50 Standards		
Dimensions (H x W x D)	22 1/2" x 15 5/8" x 8 1/4"		27 1/8" x 18 1/8" x 8 5/8"		
With PV System Disconnect (H x W x D)	30 3/8" x 15 5/8" x 8 1/4"		35" x 18 1/8" x 8 5/8"		
Weight (lbs)	80	85	135		
Cooling	Natural Convection - Heat Sink				
Relative Humidity	0% to 100% Condensing				
Ambient Temperature Range	-25°C to +40°C				
Environmental Rating	NEMA 3R				
Listings	UL 1741, IEEE 1547, IEEE 519, IEEE 929, IEEE 620				

Table A-1 (continued) PVP3000 through PVP5200 Specifications

Abnormal Specifications

The specifications listed below are classified as abnormal and are not representative of normal operation.

Abnormal Specifications	PVP1100	PVP2000	PVP2500	PVP2800
Momentary current transient obtained during abnormal operation	100 A-pk / 0.54 ms	142 A-pk / 0.663 ms	88 A-pk	166 A-pk / 0.608 ms
Maximum input source backfeed current to input source	0A			

Abnormal Specifications	PVP3000	PVP3500	PVP4600	PVP4800	PVP5200
Momentary current transient obtained during abnormal operation	166 A-pk / 0.608 ms	88 A-pk	88 A-pk	88 A-pk	88 A-pk
Maximum input source backfeed current to input source	0A				

Table A-2 Abnormal Specifications

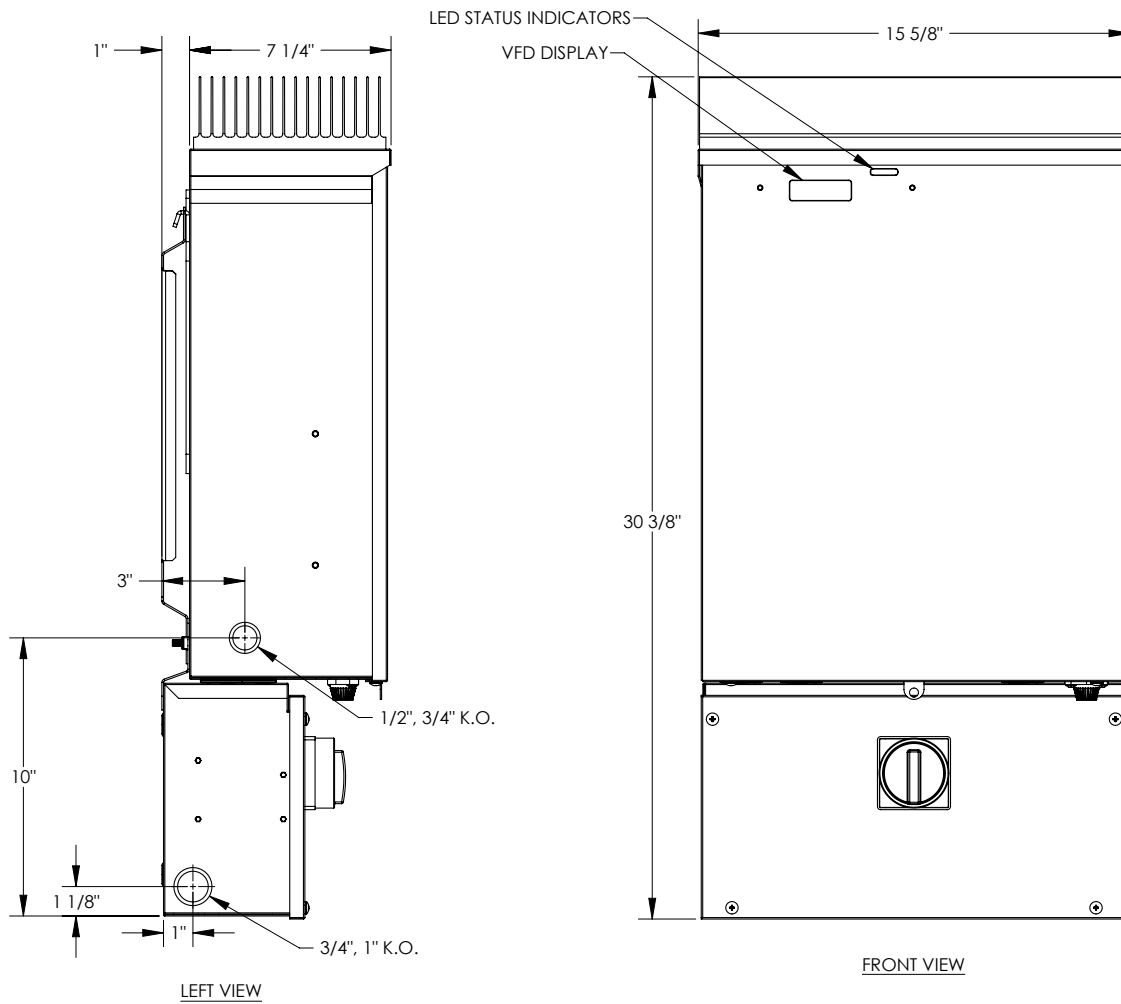


Figure B-1 Side and Front Views of PVP1100W, PVP2000W, PVP2500W, PVP2800W, PVP3000W, and PVP3500W Inverter Cabinet

APPENDIX B

The drawing consists of two views of a rectangular enclosure:

- BACK VIEW:** Shows the rear of the enclosure. It features a V-shaped internal structure. Key dimensions include:
 - Top width: 10"
 - Top height: 7"
 - Distance from top edge to the start of the V: 3 3/4"
 - Height of the V: 7 1/2"
 - Total height: 11"
 - Bottom width: 1 7/8"
 - Distance from center to side mounting holes: 3 5/8"
 - Bottom edge thickness: 1"
 - Side edge thickness: 1"
- BOTTOM VIEW:** Shows the base of the enclosure. Key dimensions include:
 - Left side thickness: 1"
 - Distance from left edge to first hole: 7/8"
 - Distance between first two holes: 3"
 - Distance from second hole to center: 4 3/8"
 - Distance from center to third hole: 4 1/2"
 - Distance from third hole to right edge: 3 1/8"
 - Overall width: 6 1/2"
 - Labels on the right side: 1/2" K, 1/2", 3, and DRAIN.

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B.2 Schematics for PVP4600W, PVP4800W, and PVP5200W Inverter Cabinet

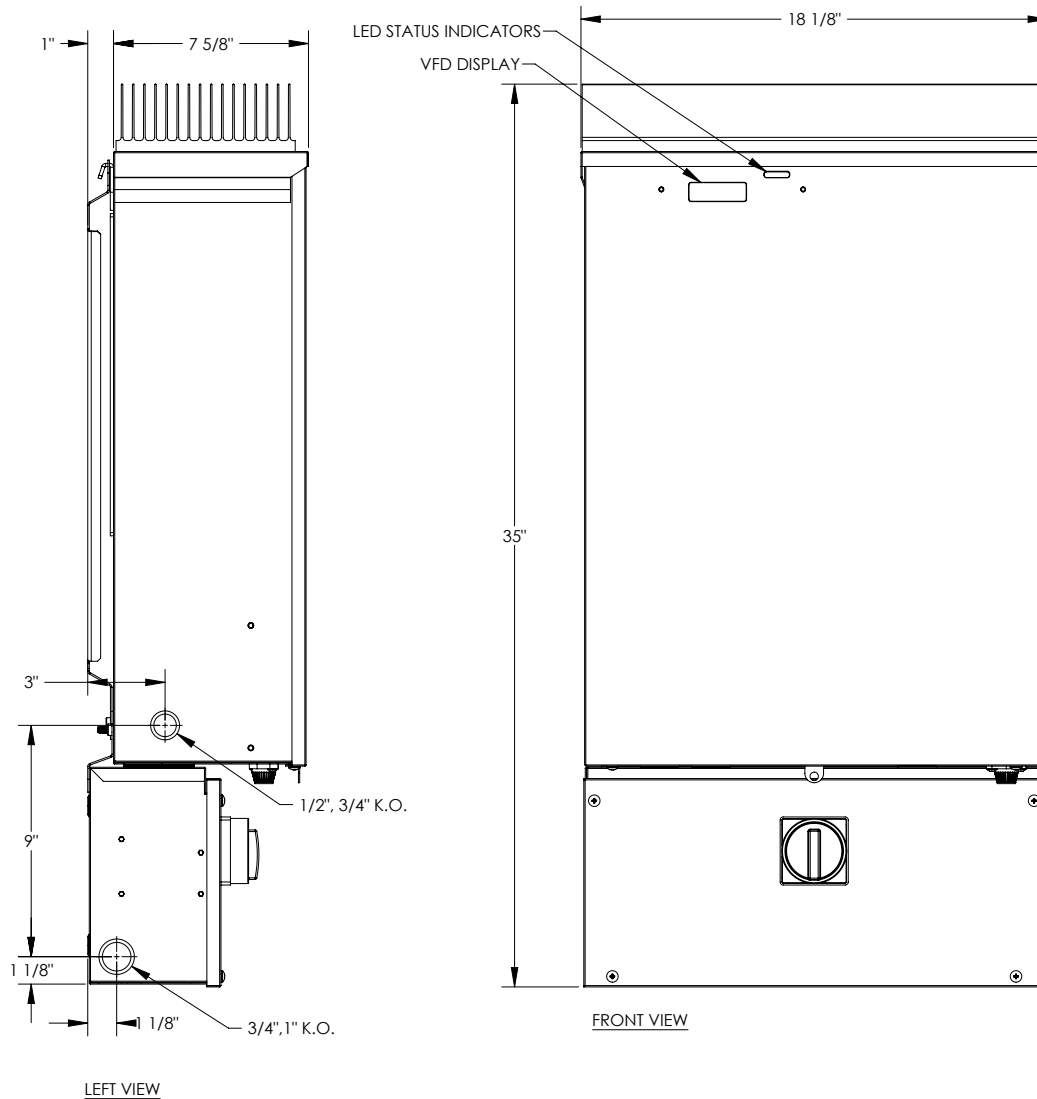


Figure B-3 Side and Front Views of the PVP4600W, PVP4800W, and PVP5200W Inverter Cabinet

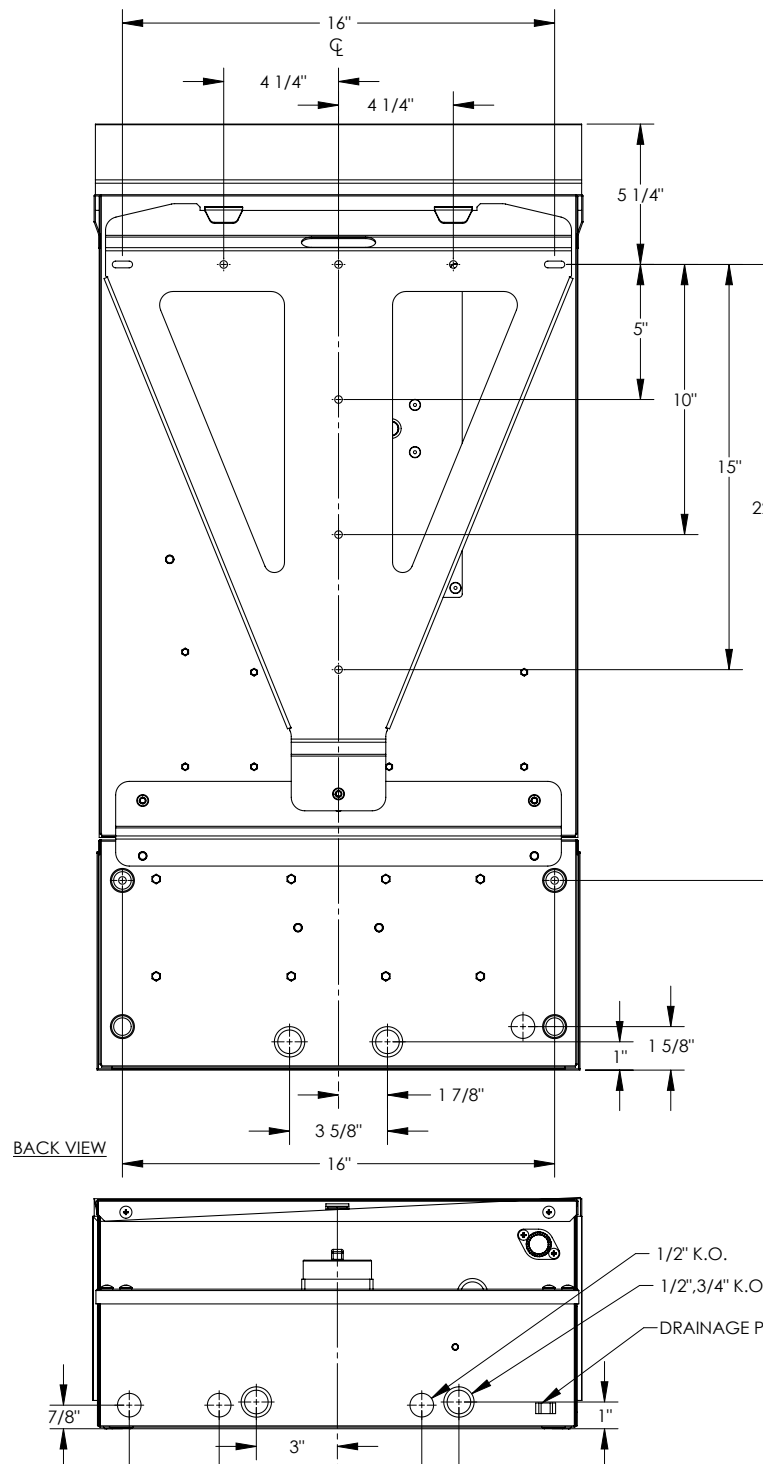


Figure B-4 Back and Bottom Views of the PVP4600W, PVP4800W, and PVP5200W Inverter Cabinet

Limited Warranty

PV Powered, Inc. provides a limited warranty for your residential or commercial inverter and optional data monitoring module for defects caused by material or manufacturing flaws. The inverter and the data monitoring module must be installed and maintained by a qualified installer in order for the warranty to be valid.

Terms of Coverage

The warranty period for the inverter is ten years, and the warranty on the data monitoring module is one year, each beginning on the date of purchase by the original end user.

Coverage

PV Powered will, at its option, repair or replace the defective component(s) free of charge, provided that you notify PV Powered of the defect during the warranty period, have a dated proof of purchase, and PV Powered determines that the defect is covered by the limited warranty set forth above. PV Powered reserves the right to inspect the defective component(s) and determine if the defect is due to material or manufacturing flaws. PV Powered also reserves the right to charge a fee for service time expended if the defect is not due to material or manufacturing flaw or is not for some other reason subject to this limited warranty.

PV Powered will, at its option, use new and/or reconditioned parts in performing warranty repair and in building replacement products. PV Powered reserves the right to use parts or products of original or improved design in the repair or replacement. If PV Powered repairs or replaces a product, its warranty continues for the remaining portion of the original warranty period or 90 days from the date of the return shipment to the customer, whichever period expires later. All replaced products and all parts removed from repaired products become the property of PV Powered.

For defects covered by this limited warranty, PV Powered will provide, at no additional cost to the customer, both parts and labor necessary to repair the product, and return shipment to the customer via a PV Powered selected, non-expedited, surface freight carrier within the United States and Canada.

What is Not Covered

PV Powered does not warrant its products from any and all defects or damage caused by:

- Normal wear and tear.
- Shipping or transportation damages.
- Improper installation.
- Improper maintenance.
- Excessive voltage or current conditions from the electrical grid or PV panels.
- Exposure to unsuitable environmental conditions (including but not limited to damage due to lightning strikes, storm, fire, flood, etc.).
- Unauthorized or abnormal use, repair, modification, or operation.
- Negligence or accidents.

- Material or workmanship not provided by PV Powered or its authorized service centers.

This warranty also does not cover costs related to the removal, installation, or troubleshooting of your electrical systems.

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Arbitration

IN THE EVENT OF A DISPUTE BETWEEN PV POWERED AND ANY PURCHASER COVERED UNDER THIS WARRANTY, TO THE MAXIMUM EXTENT ALLOWED BY LAW, THE PURCHASER AGREES TO RESOLVE ANY AND ALL SUCH DISPUTES USING BINDING ARBITRATION IN ACCORDANCE WITH THE RULES AND PROCEDURES OF THE ARBITRATION SERVICE OF PORTLAND, INC., AND JUDGMENT UPON AWARD RENDERED PURSUANT TO SUCH ARBITRATION SHALL BE BINDING ON THE PARTIES. THE LOCATION FOR ANY ARBITRATION HEARINGS SHALL BE BEND, OREGON. THE PRICE FOR THE INVERTER OR PVM1010 DEVICE AND PV POWERED'S OBLIGATIONS UNDER THIS EXPRESS LIMITED WARRANTY ARE CONSIDERATION FOR THIS BINDING ARBITRATION PROVISION.

Return Procedure

Before returning the product directly to PV Powered, you must first obtain a Return Materials Authorization Number (RMA) from PV Powered. You must also pre-pay for shipping. When you contact a PV Powered 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 PV Powered, PV Powered advises that you use the original packaging or its equivalent, and that you fully insure the shipped product. PV Powered is not responsible for damage to the product due to improper packaging.

On the packaging, please include the following:

1. Clearly mark the Return Materials Authorization Number (supplied by PV Powered) 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 PV Powered 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 _____

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