PVPowered™

PVP30kW Inverter

INSTALLATION & OPERATION MANUAL

55-600100-02

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.

Contact Information

PV Powered, Inc.
150 SW Scalehouse Loop
Bend, OR 97702

Tel: 541-312-3832
Technical Support: 1-877-312-3832
Fax: 541-383-2348

www.pvpowered.com
email: support@pvpowered.com

Revisions and Certification

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

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.

Acronyms and Abbreviations

A/D	Analog to Digital Conversion
ANSI	American National Standards Institute
CFM	Cubic Feet per Minute
DSP	Digital Signal Processor
EMI	Electromagnetic Interference
ESD	Electro Static Discharge
GFDI	Ground Fault Detector Interruptor
IEEE	Institute of Electrical and Electronics Engineers
IGBT	Insulated Gate Bipolar Transistor
IPM	Intelligent Power Module
LOTO	Lockout Tagout
MCM	1000 circular mils utilized in wire sizing
MPPT	Maximum Power Point Tracking
NEC	National Electric Code
NFPA	National Fire Protection Association
PCB	Printed Circuit Board
PLL	Phase Lock Loop
PPE	Personal Protective Equipment
PV	Photovoltaic
PWM	Pulse Width Modulation
VFD	Vacuum Fluorescent Display

Document Copyright

Table of Contents

List of Figures and Tables

1. Introduction

1.1 Design Features

The PVP30kW Inverter is designed to act exclusively as a grid-tied inverter for photovoltaic (PV) systems. This means the PVP30kW Inverter must be tied to the utility grid and a photovoltaic system in order to operate properly and it is not suitable for any other applications (such as a battery back-up or wind powered systems). The PVP30kW Inverter contains everything needed to convert the DC voltage generated by a solar array into AC electrical power. Because the inverter is tied to a local utility source, if electrical load exceeds the power generated by the solar array, the grid automatically supplies the additional electricity needed. Likewise, if the inverter produces more power than is needed, it feeds the excess power back into the electrical grid. For larger systems, PVP30kW Inverter units can perform in parallel.

This manual provides all the information necessary to successfully install and operate the PVP30kW Inverter.

Easy Installation

The PVP30kW Inverter is built for easy installation. To minimize installation efforts, this inverter features an integrated isolation transformer and integrated AC & DC disconnects in a compact single cabinet.

Simple, Innovative Design

The PVP30kW Inverter is a fully integrated solution with standard integrated data monitoring. It is field configurable for 208VAC or 480VAC output. The modular design enables rapid field service and upgrades. The DC MPPT range is 295VDC to 500VDC with a maximum input voltage of 600VDC. The PVP30kW Inverter can quickly and easily be installed in any preferred location, indoors or out.

Versatility

The PVP30kW Inverter is designed for flexibility. It can be used for a range of commercial applications, and it will accommodate most PV system configurations.

1.2 Product Characteristics

See *Appendix A-Specifications* for the Product Specifications Data Sheet.

Weight

The inverter is shipped assembled on a pallet. The shipping weight of the inverter is approximately 760 pounds. PV Powered recommends moving the inverter with a pallet jack or forklift.

Dimensions

The inverter fits through a standard-sized door. The overall dimensions are 47-3/4 inches tall, 30-3/8 inches wide, and 25-3/4 inches deep (Figure 1-1).

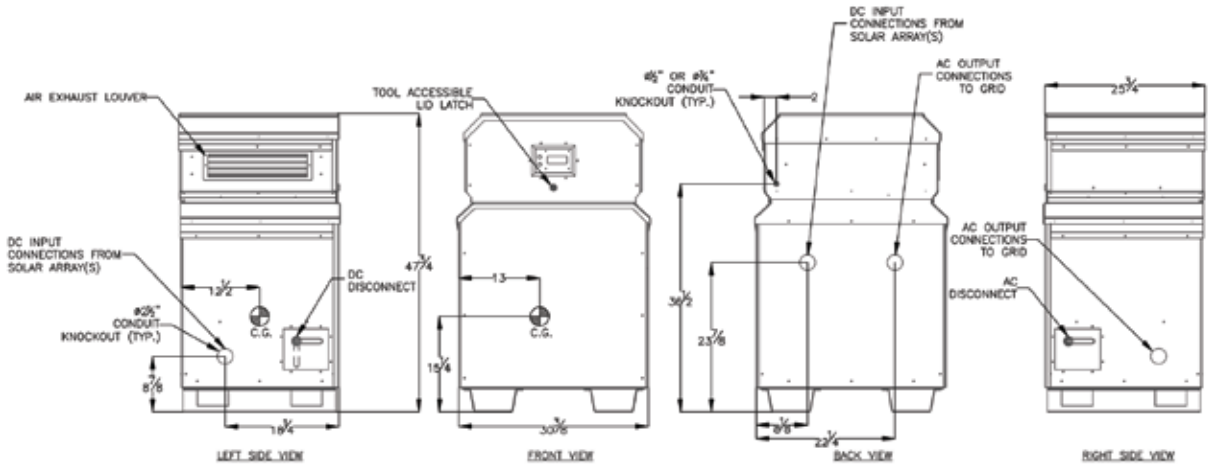


Figure 1-1 Inverter Overall Dimensions

Major Components

Main Enclosure

The modular design of the PVP30kW makes it easy to access and service. The main enclosure is comprised of two main sections:

- The upper compartment contains the power conversion electronics, control printed circuit board (PCB), power distribution PCB, ground fault detector/interrupter PCB, power supply transformer and active cooling system.
- The lower compartment houses the isolation transformer, main inductor, AC sub panel, integrated AC and DC disconnects, AC output filtering and AC and DC connection points.

Power Module

The PVP30kW Inverter uses an Insulated Gate Bipolar Transistor (IGBT) Intelligent Power Module (IPM) for converting DC power into three phase AC power. The IPM features both over-current and over-temperature protection. If either protection system is activated, the IPM will cease power conversion and send an interrupt signal to the Digital Signal Processor (DSP).

Control Printed Circuit Board

The intelligence of the PVP30kW Inverter is built into the Control PCB (Figure 1-2). This PCB contains a powerful DSP that controls Pulse Width Modulation (PWM), communications, logic functions and protection activities. All analog and digital inputs and outputs are routed to the Control PCB and fed to the DSP. The Control PCB is mounted on the IPM to enable direct communication with the IPM.

The DSP used in the PVP inverter product line is specialized for converter control applications. It is very efficient at computing control and signal processing tasks. The DSP also has built-in on-chip peripherals, including a PWM driver, A/D converters, and other related features.

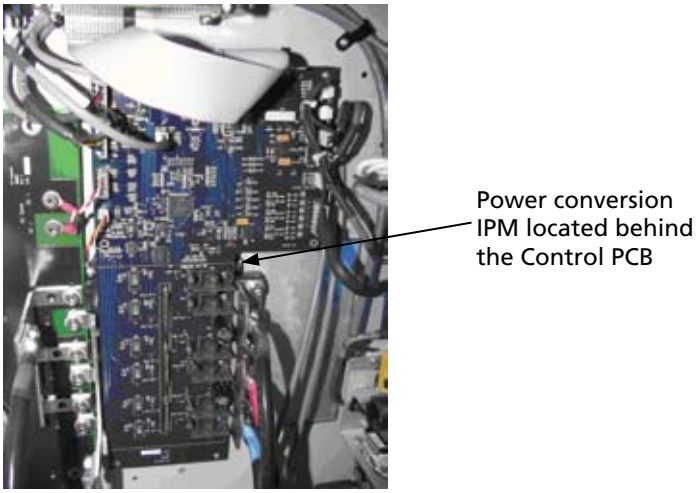


Figure 1-2 Control PCB

Power Distribution PCB

Located in the upper cabinet, the Power Distribution PCB (Figure 1-3) contains the low voltage DC control power supply that powers various circuit board level electronics in the inverter. The power supply selected is approved to UL2601-1, EN60601-1 and CSA22.2 No. 601.

The Power Distribution PCB also contains the pilot relay system, which controls the main contactor, soft-start contactor and the cooling fan. The Power Distribution PCB serves

as a configuration point for field selecting the utility AC voltage output of the inverter. See *4.3 Electrical Connections* for specific AC voltage configuration instructions. The Power Distribution PCB also houses the communications hardware which enables communications via Ethernet and modbus over RS-485.

Figure 1-3 Power Distribution PCB

Ground Fault Detector/Interrupter PCB

The Ground Fault Detector/Interrupter (GFDI) PCB (Figure 1-4) is located in the upper front portion of the cabinet. The GFDI PCB detects and interrupts a ground fault condition and shuts down the inverter.

Figure 1-4 GFDI PCB

Power Supply Transformer

The power supply transformer is a multi-voltage device that supplies low voltage power to the control electronics.

Active Cooling

The PVP30kW Inverter includes a blower that activates as needed to keep the power electronics within preset temperature limits. This blower is located under the top lid of the inverter.

Isolation Transformer

The PVP30kW is equipped with an integral isolation transformer (Figure 1-5). The isolation transformer is designed for class-leading inverter efficiency. The isolation transformer has selectable taps for 208VAC or 480VAC installations.

Inductor

The inductor (Figure 1-5) is used to smooth out the AC waveform generated by the power module, effectively eliminating any high frequency noise.

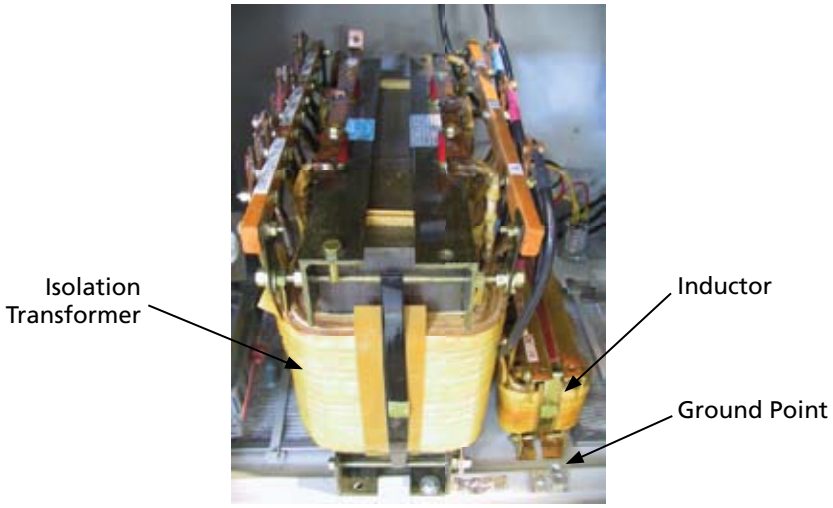


Figure 1-5 Integral Isolation Transformer and Inductor

AC Sub Panel

The AC filtering and fusing takes place in the AC sub panel (Figure 1-6). The AC sub panel also includes the main transformer contactors, surge board and the soft start circuit. The AC sub panel is located on the right side of the lower enclosure.

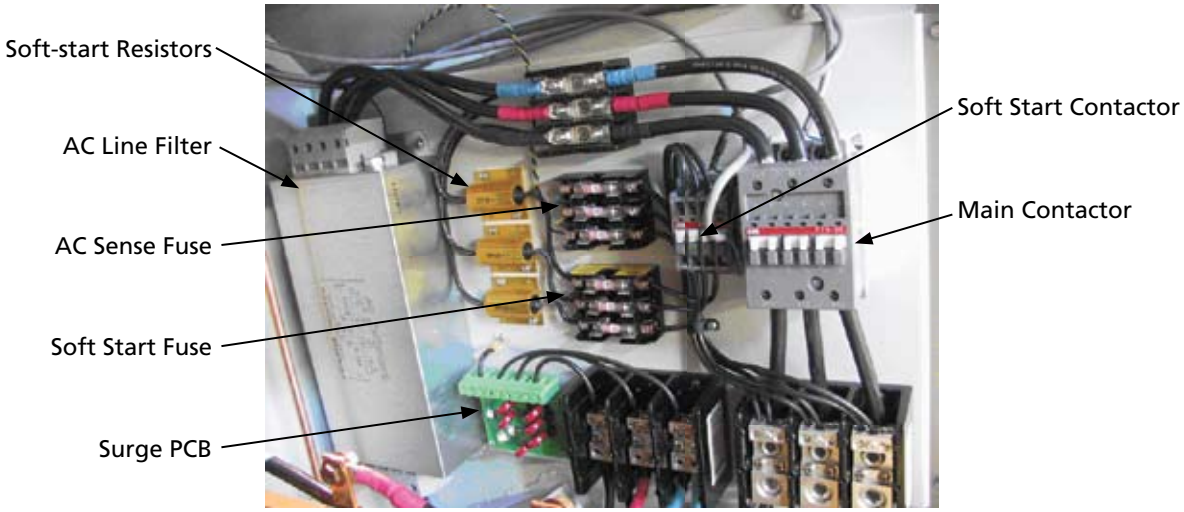


Figure 1-6 AC Sub Panel

1.3 Clearances

Right and Left of Inverter

PV Powered recommends placing the inverter so there is a minimum of 18 inches to each side of the inverter (working clearances must also comply with NEC 110.26). This allows access to the AC and DC disconnects.

Behind Inverter

The minimum clearance behind the inverter is 14 inches (working clearances must also comply with NEC 110.26). This allows the top of the inverter to be opened for maintenance or service.

Above Inverter

The minimum clearance above the inverter is 14 inches (working clearances must also comply with NEC 110.26).

1.4 Voltage Input

This inverter was designed to be connected to three phase power. The input voltage is user-selectable between 208VAC or 480VAC in Y (WYE) configurations. To change the voltage configuration of the inverter, see *4.3 Electrical Connections (Changing the AC Output Voltage).*

2. Safety

2.1 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.

Symbols Utilized within the PVP30kW Inverter

Item Type	Symbol
Direct Current Supply	⎓
Alternating Current Supply	∿
Phase	⏀ or ∅
Equipment Grounding Conductor	⏚
On or Off	⏻

SAVE THESE INSTRUCTIONS: This manual contains important instructions for the PVP30kW Inverter that must be followed during installation and maintenance of the PVP30kW Inverter.

DANGER

Risk of Electrical Shock. High voltages are present within the PVP30kW Inverter cabinet. Both AC and DC disconnects must be in the OFF position when working on the unit. Wait five minutes to discharge high voltage before removing the front panels of the inverter.

DANGER
Risk of Electrical Shock. When exposed to light, PV arrays create electrical energy that could cause a hazardous condition.

DANGER
Risk of Electrical Shock. Before connecting the inverter to the electrical utility grid, your utility company must grant approval. Only qualified electricians should make the connection to the utility grid.

CAUTION
Risk of Electrical Shock. All electrical installations should be accomplished in accordance with local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70.

2.2 Electrical Safety

Islanding Prevention - Electrical Safety Features

The PVP30kW Inverter is designed for safety, reliability, and efficiency. Power for the inverter control circuitry is drawn from the utility grid. This ability, along with an advanced anti-islanding scheme, ensures power can never be generated during a utility grid failure. The isolation transformer guarantees isolation of the utility grid and PV modules. The inverter also incorporates an integral ground fault detector/interrupter (GFDI) circuit.

Handling, Service and Maintenance

Only qualified personnel should perform the transportation, installation operation and maintenance of the PVP30kW Inverter in accordance with NEC ANSI/NFPA 70, as well as all state and local code requirements. Follow all national and state accident prevention regulations.

WARNING
Crush Hazard. The inverters have a specific balance point that correlates to their Center of Gravity. While the units meet UL1741 Stability tests, they should not be tipped beyond 10° of tilt, as the unit could topple over and crush anyone trapped underneath.

WARNING
Risk of Amputation. The inverter contains a high volume blower capable of high rpm speeds. Do not operate this inverter without the air louvers in place. Keep away from unguarded blower blades.

WARNING
Risk of Burn. The inverter components can become extremely hot during normal operation. Use caution when working around the exposed components.

WARNING
Risk of Damage to Equipment. The inverter contains ESD sensitive circuitry. Discharge any static charge by touching bare skin to earth potential prior to contacting any internal components.

Equipment Precaution/ Warning Labels

Observe all warning decals, placards and symbols posted within the 30kW Inverter for safe operation.

Disconnect Switches

The unit is equipped with both AC and DC Disconnect (power OFF) switches to stop power conversion within the inverter unit. Before accessing the interior of the cabinet, these switches must be in the off position. Since these disconnects stop only power conversion within the unit, both the DC (photovoltaic array) and AC (utility grid) circuits must be isolated in order to fully ensure the inverter is de-energized. See 2.5 De-energize/ Isolation Procedures for information on how to perform this task.

DANGER
AC and DC voltages will still be present at the inverter AC and DC landing points unless utility connection circuit breaker and PV array inputs are disconnected.

DANGER
Risk of Electrical Shock. Allow five (5) minutes for internal power to dissipate prior to entering the enclosure cabinet. Ensure all terminals are voltage free with the use of a multimeter.

2.3 Personal Safety

Safety Zone

Ensure any personnel entering a safety zone within a four foot area around any operating PVP30kW Inverter wear appropriate Personal Protective Equipment (PPE) as mandated by national, state and local authorities.

Medical and First Aid Treatment

Personnel working in and around operating power generation equipment should be trained in Arc Flash Hazard, Fire Extinguisher selection and use, First Aid, Cardio Pulmonary Resuscitation (CPR) and Automated External Defibrillator (AED) use (if available).

Safety Equipment

Minimum Requirements

Authorized service personnel performing operations on this unit should have the following available:

- Consult NFPA 70E for PPE requirements on switch gear operating at less than 600V
- Electrical Hazard Footwear (ANSI Z41/Z85 rated)
- LOTO (Lock Out Tag Out) Kit
- Appropriate meter to verify the circuits are safely de-energized (1000VAC and DC rated, minimum)
- Any other equipment as applicable to your operation as required by national, state and local regulations

2.4 Wiring Requirement

WARNING
In accordance with the NEC, ANSI/NFPA70, connect only to a circuit provided with 125 amps for 208VAC or 50 amps for 480VAC maximum branch circuit overcurrent protection.

Fire and Explosion Prevention

Care must be exercised when installing DC and AC hookups within the PVP30kW Inverter. Follow all instructions in this manual to ensure proper and safe operation of this unit.

DANGER
Risk of Electrical Shock. In the event of a fire, disconnect power to the inverter and do not attempt to use a water based fire extinguisher. Utilize only a Class C extinguisher rated for electrical fire.

Wiring Information

All wiring methods and materials shall be in accordance with the NEC ANSI.NFPA 70 as well as all state and local code requirements. Use only conductors with an insulation rating of 90ºC (minimum).

The PVP30kW Inverter has a three-phase output. It is field configurable for 208VAC or 480VAC, depending on user requirements.

The PVP30kW Inverter interfaces with the utility grid at the AC landing on the lower right side of the inverter. Ensure similar cables run together in conduit runs which allows any inductive currents produced to be cancelled out. See *4.3 Electrical Connections* for AC Wiring instructions.

CAUTION
Risk of Equipment Damage. There shall be no connection of the AC Neutral terminals (H0 and X0) on the main transformer, and shall be left floating.

The PVP30kW Inverter is interfaced with the DC photovoltaic array at the DC landing located in the lower left (as viewed from the front) DC section within the inverter enclosure. Do not connect the negative pole (PV-) of the PV array directly to ground (or + pole in a positively grounded system), as this will bypass the critical GFDI and violate the NEC. See *4.3 Electrical Connections* for DC Wiring instructions.

This equipment is intended to be installed as part of a permanently grounded electrical system as per the NEC ANSI/NFPA 70 as well as all state and local requirements. A copper clad earth grounding electrode must be installed within 3 feet (1 meter) of the unit. The AC ground bus bar located in the AC section, lower front cabinet, must be used as the single point connection to the earth grounding electrode for the inverter system.

AC over-current protection for the utility interconnect must be provided by installers as part of the installation.

2.5 De-energize/Isolation Procedures

The following procedure should be followed to de-energize the PVP30kW Inverter for maintenance:

DANGER
AC and DC voltages will still be present at the inverter AC and DC landing points unless utility connection circuit breaker and PV array inputs are disconnected.

DANGER
Risk of Electrical Shock. Allow five (5) minutes for internal power to dissipate prior to entering the enclosure cabinet. Ensure all terminals are voltage free with the use of a multimeter.

1. Open the utility connection circuit breaker.
2. Disconnect the PV using the external PV disconnect (not shown).
3. Position the AC Disconnect lever to the OFF position as shown in Figure 2-1.
4. Position the DC Disconnect lever to the OFF position as shown in Figure 2-1.
5. Install LOTO devices on the equipment as necessary to comply with LOTO requirements.

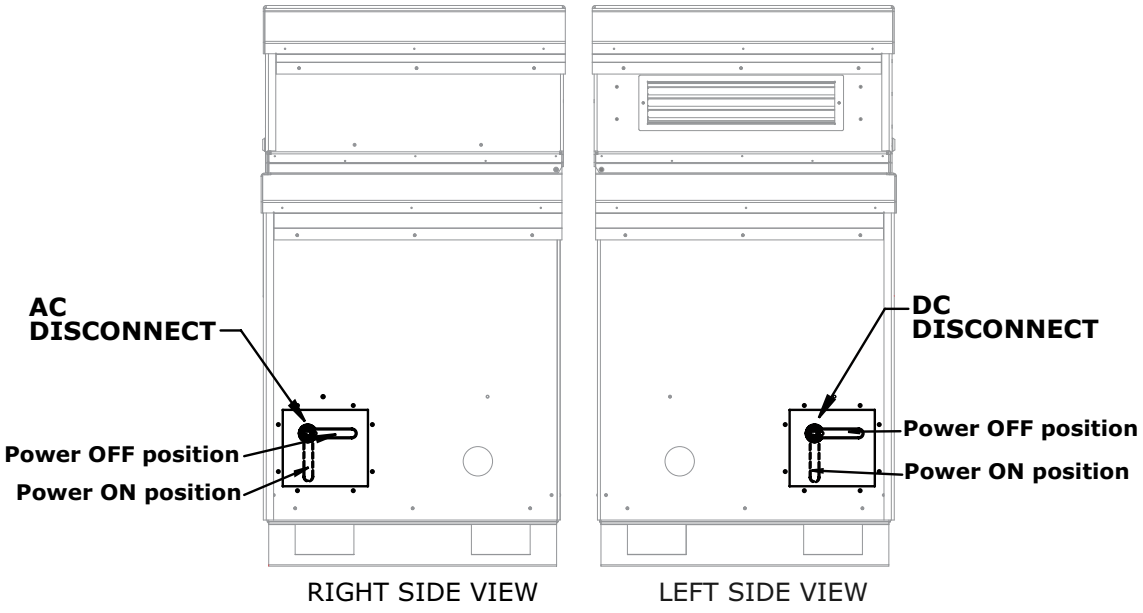


Figure 2-1 AC and DC Disconnect Power OFF

3. Planning

3.1 Select a Location

Select a suitable location to install the inverter. The inverter should be installed on a flat, solid surface, such as a concrete pad. The inverter should be located near the solar panels to minimize the DC wire length.

When choosing a location for the PVP30kW Inverter, consider the following criteria:

- The PVP30kW Inverter is suitable for both indoor and outdoor installation. The enclosure has a NEMA 3R rating.
- When the inverter is installed outdoors, shield it from rain and direct sunlight if possible.
- The inverter is designed to handle the temperature extremes of most climates. The operating and storage temperature range of the inverter is -25ºC to 45ºC.
- PV Powered recommends the following clearances for proper placement of the PVP30kW Inverter:
    1. An 18 inch setback to allow access to the AC and DC disconnects on either side of the inverter enclosure.
    2. 14 inches behind the inverter to allow the lid to fully open.
    3. 14 inches above the inverter.
    4. 36 inches in front of the inverter
    5. In addition, provide working clearances as required in NEC 110.26.

If the inverter is installed in an enclosed space, provide adequate ventilation.

Requirements

Planning for a system requires complete understanding of the processes involved to successfully install the PVP30kW Inverters and meet all required local, state and national codes.

Installation of this equipment should only be performed by qualified technicians. Installers must meet all local and state code requirements for licensing and training for the installation of Electrical Power Systems with AC and DC voltages to 600 volts.

The inverter must be anchored to a concrete pad. The mounting pad must meet local seismic requirements. See *Figure 4.1 Mounting Dimensions* for concrete pad mounting specifications.

Location and Clearances

Left and Right Sides

PV Powered recommends placing the inverter so there is a minimum of 18 inches of clearance on each side of the inverter (working clearances must also comply with NEC 110.26).

Rear

A rear clearance of 14 inches behind the inverter is required.

Front

A front clearance of 36 inches is required.

Top

A top clearance of 14 inches is required.

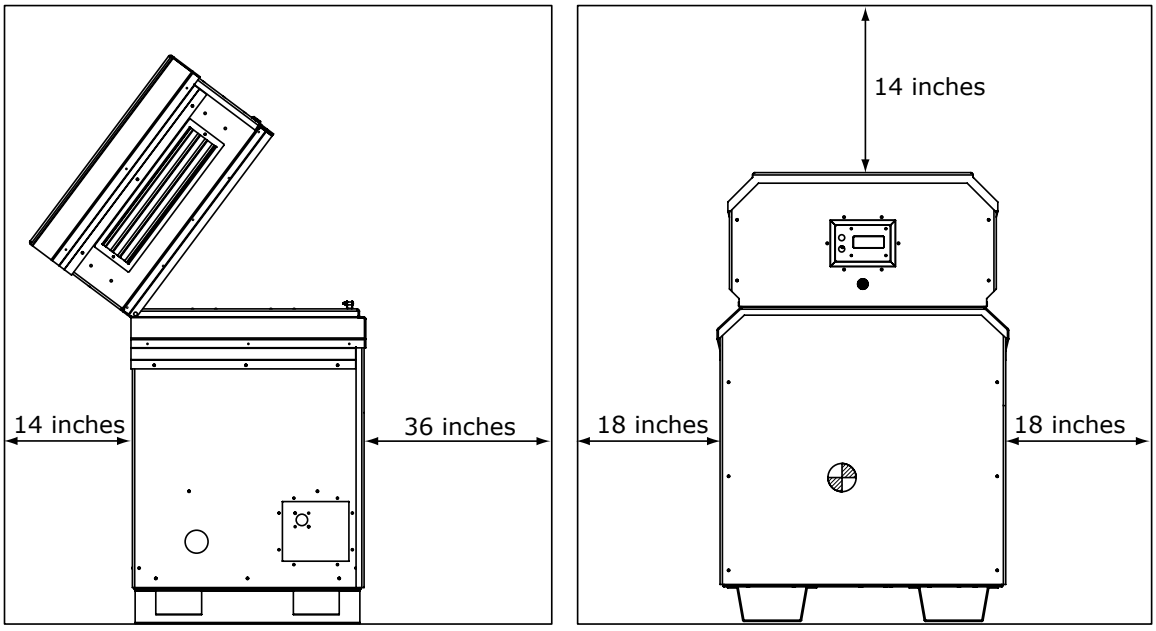


Figure 3-1 Inverter Clearances

Conduits and Conductors

All the external conduits and conductors are to be supplied by the installer. See *Appendix C- Mechanical Drawings* for cable entry locations.

All interconnect wiring and power conductors interfacing to the inverter must be in accordance with the NEC ANSI/NFPA 70 and any applicable state and local codes.

Large gauge wire must conform to the minimum bend radius specified in the NEC, Article 373-6B, Ninth Edition.

All conductors shall be rated for 90°C (minimum).

External Cable Interfaces: *See Appendix C- Mechanical Drawings* for details.

Environmental

The unit may be installed either indoors or outdoors. If the installation of the inverter is outdoors, all interconnect conduit and fittings must be rated NEMA 4 as required by the NEC. For hot locations a shade structure should be placed over the unit in order to reduce thermal stress and extend product life.

Ambient Temp: The unit maximum ambient air temperature must not exceed 45°C otherwise power output will be derated.

Cooling Air Requirements: Contact PV Powered if you need assistance with cooling air rates.

PV Array Frame Grounding

The PVP30kW Inverter incorporates an integral GFDI device. The PV array safety ground (frame ground) may be attached to the grounding bus bar provided. The grounding bus bar is located in the left hand base of the inverter cabinet. The PV array is grounded internally by means of the GFDI.

DANGER

Do not connect the PV negative or positive to the ground bus bars provided. The PV array is grounded through the integral GFDI. Connecting the PV array positive or negative to ground at any other point in the system would defeat the ground fault protection circuit.

The inverter is shipped pre-configured with positive or negative PV array grounding based on the preference provided at the time of order. To identify if your inverter is configured for positive or negative ground, read the label next to the DC landing bus bar. Verify that the grounding configuration matches your installation grounding plan.

CAUTION

The PVP30kW Inverter may be factory configured for either positive or negative ground. It may NOT be field configured to a different grounding once it is shipped from the factory. To identify if your inverter is configured for positive or negative ground read the label next to the DC landing bus bar. Verify that the grounding configuration matches your installation grounding plan. If you need to reconfigure the ground, contact PV Powered for assistance. DO NOT ground either DC lead at the time of installation. This will defeat the integral GFDI circuit.

System Neutral

WARNING

The AC output/neutral must not be bonded to ground within the equipment.

NOTE: The PVP30kW Inverter has been certified to UL1741 for installation without a neutral conductor. Do NOT pull a neutral conductor from the AC service panel to the inverter.

Tools Required

You need the following tools to complete the installation of the inverters:

- 3/16 inch, 5/16 inch and 3/8 inch Allen wrenches (Allen wrench adaptor for a socket wrench recommended)
- Digital multimeter
- 1/4 inch flat blade (common) screwdriver
- #2 Phillips screwdriver
- 1/4 inch drive socket wrench, minimum 1/2 inch deep
- 7/16 inch socket (for reconfiguring AC voltage only)
- 7/16 inch end wrench (for reconfiguring AC voltage only)
- Adjustable pliers
- Crescent wrench (adjustable)
- Hex tool set
- Wire strippers
- Utility knife
- 70 inch/pound torque wrench
- 120 inch/pound torque wrench
- 600 volt rated fuse pulling device
- Tools for installing 1/2 inch anchor bolts
- RJ45 specialized crimping tool (to make a CAT5 Cable)

Utility Connection Requirements

Review all NEC 690, local codes, and utility requirements before installing the PVP30kW Inverter. NEC 690 has specific requirements for the size of the electrical service and the amount of current that is allowed to be fed into the panel by the inverter.

Contact your Local Utility

Contact your electrical utility before connecting the inverter to ensure there are no local restrictions or special requirements. Your local utility company may require specific inspections, equipment, or other procedures not covered in this document.

Voltage Inputs

This inverter was designed to be connected to three phase power. The AC input voltage is field configurable for either 208VAC or 480VAC in Y (WYE) configurations.

AC and DC power requirements are shown in *Appendix A- Specifications*.

3.2 Monitoring

PVP30kW Inverters are equipped with a Data Monitoring Module that can be used to connect to the internet on an Ethernet connection or connect to a modbus network via RS-485. To use the modbus communications option refer to the *Modbus Network Installation* in Chapter 5. To connect the Data Monitoring Module to a pre-installed Ethernet network, connect it to a broadband internet router with continuous internet access. For instructions on installing and using the Data Monitoring Module, or if your site does not have Ethernet with continuous internet access, contact PV Powered Customer Service and Technical Support at 1-877-312-3832 for assistance.

3.3 PV Array Input

The PV array open circuit voltage shall never exceed 600 volts. The PV Powered web site at http://www.pvpowered.com/installation_support.php includes a string calculator. Contact your system installer or PV Powered if you require additional assistance.

3.4 AC Output Voltage

The PVP30kW Inverter utility input AC voltage can be field configured to 208 VAC or 480 VAC. See *4.3 Electrical Connections* for instructions to field configure your AC voltage. (Wye configurations only. Delta configuration is not supported.)

4. Installation

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.*

SAVE THESE INSTRUCTIONS: *This manual contains important instructions for the PV Powered inverter model PVP30kW that must be followed during installation and maintenance of the PVP30kW.*

DANGER

High voltages are present within the PVP30kW cabinet. Both AC and DC disconnects must be in the OFF position when working on the unit. Wait five minutes to discharge high voltage before removing the front panels of the 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 inverter to the electrical utility grid, your utility company must grant approval. Only qualified electricians should make the connection to the utility grid.
- When exposed to light, PV arrays create electrical energy that could cause a hazardous condition.
- The inverter contains one user-serviceable screen on the air inlet. All other components are not serviceable by the user.

4.1 Mounting the Unit

1. Select a suitable location to install the inverter. The PVP30kW Inverter should be installed on a flat, solid surface, such as a concrete pad. The inverter should be located near the solar panels to minimize the DC wire length.
2. Using the dimensions shown in Figure 4-1, install four of the ½ inch concrete anchors into the floor.

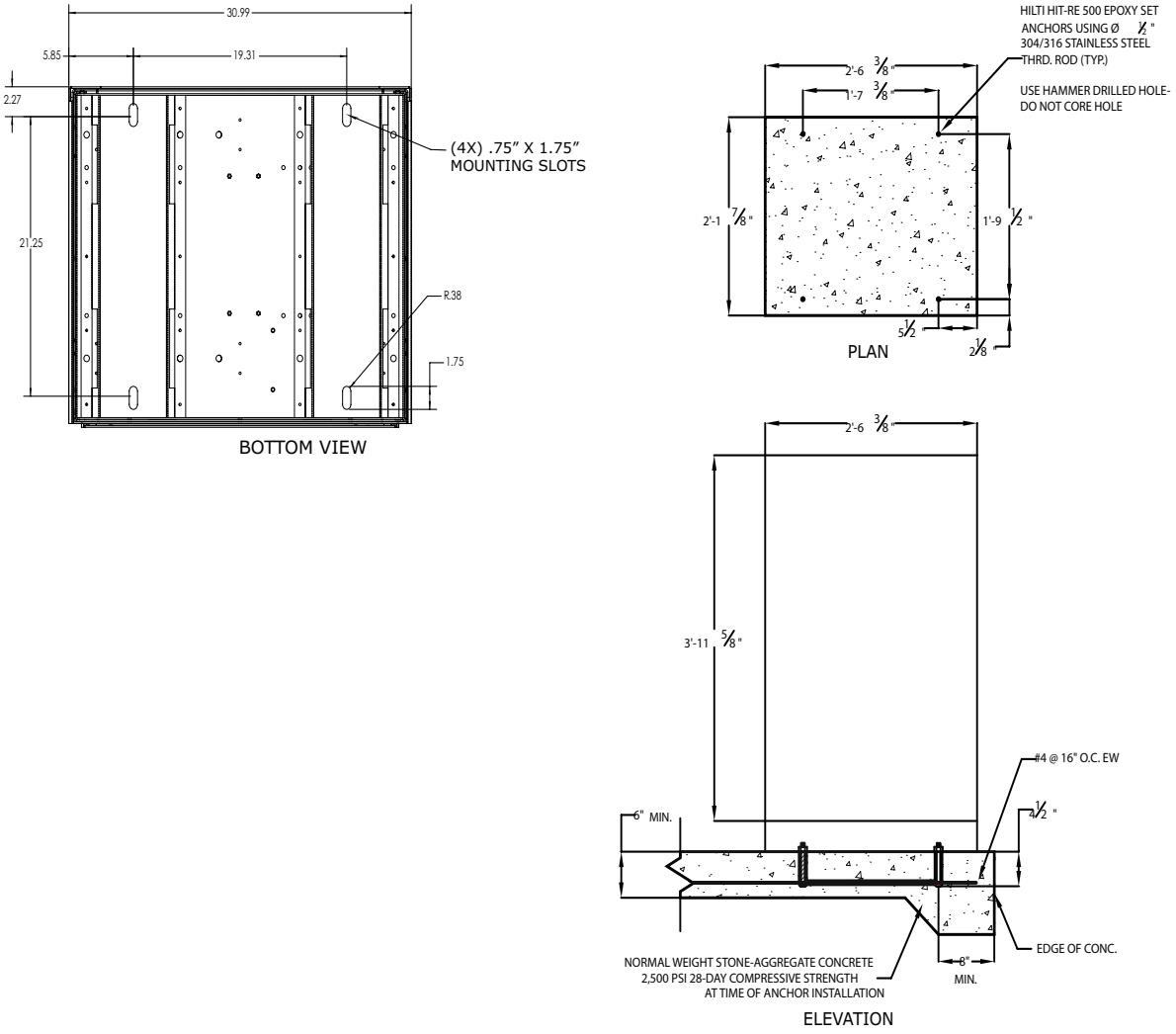


Figure 4-1 Mounting Dimensions and Seismic Compliant Anchoring

3. Lift the PVP30kW Inverter with a forklift by positioning the forks under the enclosure and through the openings in the bottom of the inverter. The inverter skid is designed to allow a forklift to lift it from the front, back or either side. Lower the inverter into position so the concrete anchors protrude through the mounting holes in the bottom of the enclosure.
4. Secure the concrete anchors to the inverter.

4.2 Grounding

The PVP30kW incorporates an integral GFDI device. The PV array safety ground (frame ground) may be attached to the ground lugs provided. Grounding lugs are located in the lower right-hand side of the PVP30kW Inverter cabinet. The PV array is grounded internally by means of the GFDI.

NOTE: *Do not connect the PV negative or positive to the ground lugs provided. The PV array is grounded through the integral GFDI. Connecting the PV array positive or negative to ground at any other point in the system would defeat the ground fault protection circuit.*

The inverter is shipped pre-configured with positive or negative PV array grounding based on the preference provided at the time of order.

NOTE: *The PVP30kW Inverter may be factory configured for either positive or negative ground. It may NOT be field configured to a different grounding once it is shipped from the factory. To identify if your inverter is configured for positive or negative ground read the label next to the DC landing lugs. Verify that the grounding configuration matches your installation grounding plan. If you need to reconfigure the ground, contact PV Powered for assistance. DO NOT ground either DC lead at the time of installation. This will defeat the integral GFDI circuit.*

For FCC emissions compliance, install the provided ferrite beads (Steward P/N 28B1250-000) around the utility ground wire. See Figure 4-2.

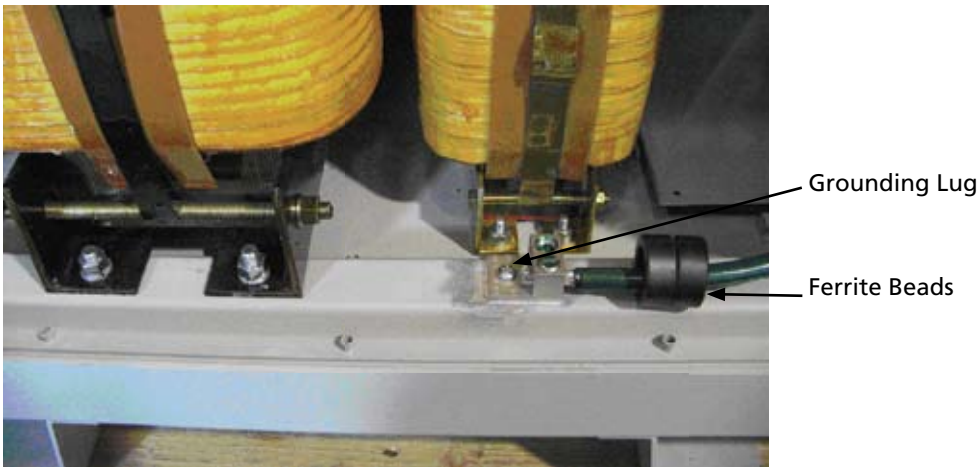


Figure 4-2 Ferrite Beads and Grounding Lug

4.3 AC Wiring

IMPORTANT: *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: *The PVP30kW is UL approved for installation without a neutral conductor. Do NOT pull a neutral conductor from the AC service panel to the inverter.*

DANGER
Make sure the main breaker in the main utility breaker box is switched OFF before wiring the PVP30kW Inverter. This breaker should be switched ON only after all wiring has been properly connected.

WARNING
Follow the order listed in this section to wire the PVP30kW Inverter. Failure to do so may result in hazardous voltages or disconnection of contacts.

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).

CAUTION
To reduce the risk of fire, connect the PVP30kW to a circuit with 125 amps maximum at 208VAC or 50 amps maximum at 480VAC branch-circuit over current protection in accordance with the National Electrical Code (NEC), ANSI/NFPA 70.

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.

CAUTION
This unit or system is provided with fixed trip limits for frequency and shall not be aggregated above 30kW on a single point of common connection.

WARNING
The AC output/neutral must not be bonded to ground within the equipment.

Changing the AC Output Voltage

The PVP30kW Inverter is designed to work with both 208VAC and 480VAC three phase systems. The inverter's standard shipping configuration is 208VAC, but it can be factory configured for 480VAC operation if requested. Follow the procedures listed below if your installation requires changing the inverter AC output voltage.

1. The transformer installed in the PVP30kW has taps for 208VAC and 480VAC. Two 7/16 inch sockets will be needed to change the taps. See Figure 4-3 for the tap configuration.
2. Make sure the AC and DC power are disconnected from the inverter.

WARNING
Wait at least five minutes for any voltage to drain down before working on the inverter.

3. Remove the upper and lower front enclosure covers.
4. Locate the voltage taps on the top left side of the transformer (see Figure 4-3). They should be at either the 208VAC or 480VAC locations.

   NOTE: *To eliminate confusion, move one wire at a time to the voltage tap you need. Start at the front with the closest wire, disconnect the wire, and move it forward to the voltage you require at your installation.*

5. After moving the three wires, re-torque all three bolts to 70 inch-pounds.
6. Once you reconfigure the transformer taps for the new AC voltage, move the voltage configuration cable on the power distribution PCB (Figure 4-4) to the corresponding connector (480 for 480VAC and 208 for 208VAC).

CAUTION
The wiring in the lower cabinet must match the voltage selection you made in the upper cabinet and the voltage available at your installation. Mismatched wiring will result in improper operation of the inverter.

7. Re-attach the enclosure covers.

Figure 4-3 Tap Configuration

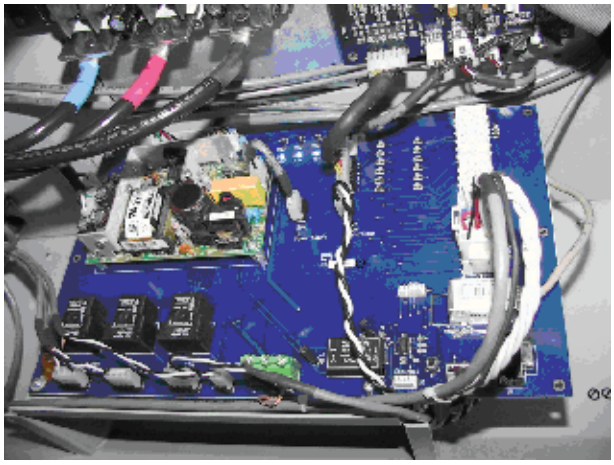


Figure 4-4 Power Distribution PCB

Wiring for 208VAC Service

In a 208VAC installation, PV Powered recommends using a minimum of #2 AWG copper wire. The total impedance of the grid plus the interconnecting AC wires should be less than 0.1 Ohm per phase. You may need a larger size, depending on voltage drop or distance requirements. Install the inverter on a dedicated branch circuit with a maximum 125A circuit breaker. The PVP30kW Inverter does not have internal AC fusing so it is important to size the branch circuit protection appropriately.

When installed on a 208VAC electrical panel, the operational voltage range for the inverter is 183VAC – 228VAC. Voltages outside this range will cause the inverter to fault on a voltage high or low condition.

Wiring for 480VAC Service

In a 480VAC installation, PV Powered recommends using a minimum of #6 AWG copper wire. The total impedance of the grid plus the interconnecting AC wires should be less than 0.1 Ohm per phase. You may need a larger size, depending on voltage drop or distance requirements. Install the inverter on a dedicated branch circuit with a maximum 50A circuit breaker. The PVP30kW Inverter does not have internal AC fusing so it is important to size the branch circuit protection appropriately.

When installed on a 480VAC electrical panel the operational voltage range for the inverter is 422 VAC – 528 VAC. Voltages outside this range will cause the inverter to fault on a voltage high or low condition.

Connecting AC Wires

DANGER

Make sure the main breaker at the circuit breaker panel is switched OFF before you connect the AC terminal block. This breaker should be switched ON only after all wiring has been properly connected.

CAUTION

To avoid an increase in AC voltage to unacceptable values while the PVP30kW Inverter is connected, the grid impedance value at the connection point should be as low as possible. By keeping the grid impedance value low, the system will achieve higher efficiency.

The PVP30kW Inverter is connected to the electrical grid using four wires: Phase A voltage, Phase B voltage, Phase C voltage and GROUND (Figure 4-5, ground not shown, See Figure 4-2 for ground) There is one lug available per phase to connect the AC input. Each lug can accept up to a 2/0 cable (note the second lug in the lower section of the terminal block in figure 4-5 is used for internal inverter wiring and is not available to the installer). Do NOT connect a neutral wire to the WYE point of the isolation transformer. The AC voltage connections in the PVP30kW are terminated in the AC disconnect located within the lower enclosure on the right side.

PV Powered has engineered an auto-phasing feature to assist installers with connecting their inverter system. This feature allows the installer to pull the three AC lines into the inverter assembly and connect them without having to measure phase relationships between individual lines. The microprocessor determines the phase relationship and sets the PWM to match the phasing of the pre-wired inverter. Complete the following steps to connect the PVP30kW Inverter to the electrical grid.

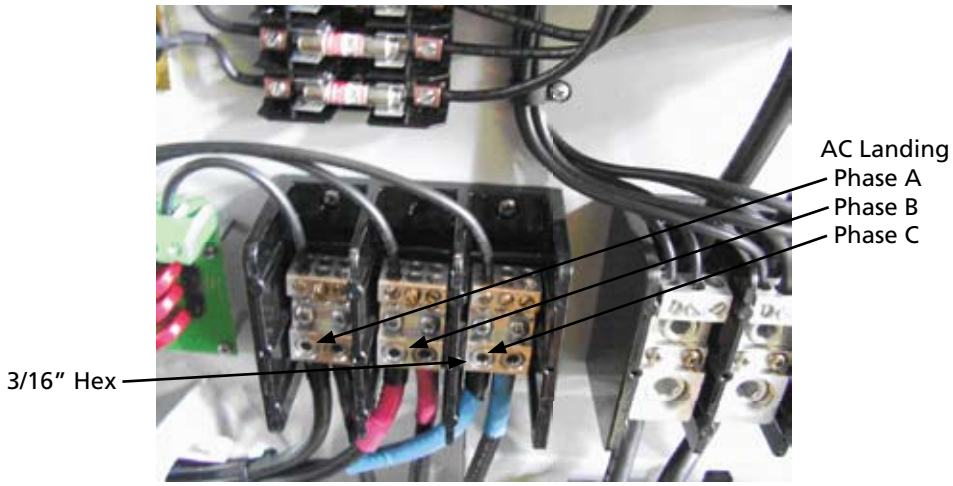


Figure 4-5 Inverter Connections

WARNING
Do not connect a neutral wire to the Wye point of the isolation transformer. Doing so will cause the PVP30kW to malfunction and will void the warranty.

AC Wiring Procedure

1. Run the conduit from the main breaker panel to the right side or back side of the PVP30kW and insert the fitting in the right side or back side opening of the PVP-30kW Inverter, fastening with a locking nut.
2. Feed the PHASE A, PHASE B, PHASE C and GROUND wires through the conduit and into the PVP30kW Inverter.
3. Connect the GROUND wire to the terminal marked 'EARTH GROUND' inside the PVP30kW Inverter (see Figure 4-2).
4. Connect any of the three phases (A, B or C) to the terminal marked 'PHASE A' on the AC terminal inside the PVP30kW Inverter (see Figure 4-5).
5. Connect any of the three phases (A, B or C) to the terminal marked 'PHASE B' on the AC terminal inside the PVP30kW Inverter (see Figure 4-5).
6. Connect any of the three phases (A, B or C) to the terminal marked 'PHASE C' on the AC terminal inside the PVP30kW Inverter (see Figure 4-5).
7. Ensure all connections are wired correctly and properly torqued. Tighten the AC terminal screws to 120 inch-pounds.

Adjustable Voltage Range

The PVP30kW Inverter is factory calibrated to the voltage and frequency limits detailed in *Appendix B- Limits and Fault Codes*. These ranges are adjustable and can be set by PV Powered field technicians.

4.4 DC Wiring

DANGER
Before proceeding with the DC wiring, confirm that the PV array has been disconnected from the inverter using the external DC disconnect.

DANGER
Make sure the PV array polarity and voltage between the positive and negative cables are correct before connecting the PV array cables to the DC terminal block.

DC Input Voltage

The PV panel open circuit voltage should be at or below 600 VDC under all circumstances. Each DC input to the DC terminal block must be less than 600 VDC. Contact PV Powered if you require assistance calculating the maximum DC input voltage.

DC Inputs

Each DC input connection must carry the same input voltage. The PVP30kW Inverter allows up to three #4-14 AWG connections and one 350kcmil-#6 connection for both the positive and negative poles. The DC positive input is protected with a 125A fuse.

DC Wiring Procedure

WARNING
Confirm that the external DC disconnect is turned OFF to assure that there is no DC energy present in the inverter.

Follow these steps to wire the DC inputs from the PV panels to the PVP30kW Inverter. Refer to Figure 4-6.

1. Calculate the maximum open circuit (no load) voltage for each series panel connection. **FOR ALL TEMPERATURE CONDITIONS, THE OPEN CIRCUIT VOLTAGE FOR EACH SERIES CONNECTION MUST BE LESS THAN OR EQUAL TO 600 VDC.** Contact PV Powered if you require assistance.
2. Keep track of the array positive and negative leads, and mark them clearly.
3. Route the PV array leads through either the left side or back side opening in the PVP30kW Inverter.
4. Connect positive DC lead(s) to the positive terminals located on the terminal block shown in Figure 4-6. The DC landing torque spec is 70 inch-pounds.
5. Connect negative DC lead(s) directly to the negative terminals located on the terminal block shown in Figure 4-6. The DC landing torque spec is 70 inch-pounds.
6. Connect the PV frame ground wire(s) to the ground lug (see Figure 4-2).

Figure 4-6 DC Wiring Procedure

4.5 Performance Monitoring

The PVP30kW Inverter has an integrated Data Monitoring Module. The Data Monitoring Module enables access to the inverter performance data via the internet using an Ethernet connection or modbus using RS-485.

PV Powered offers a free basic monitoring service through the MyPVPowered.com web site. To access the MyPVPowered data monitoring information, customers need an Ethernet connection to the inverter based on the following specifications:

- DHCP-enabled broadband internet connection that is always ON. This can be cable internet, a DSL line or equivalent.
- Hard-wired, Ethernet-enabled connection available at the inverter location. Internet service should be connected using one of the following preferred methods:
- Hard wire an outdoor-rated CAT5 Ethernet cable between the inverter Data Monitoring Module and the DHCP-enabled Internet connection.
- If multiple inverters are commissioned to a single site, you can use an Ethernet hub located in an outdoor-rated enclosure to distribute Ethernet cables to the inverters.

NOTE: *The Data Monitoring Module does not support dial-up modem connectivity.*

Network Connections

Internet service must be set up properly at the installation site before you can access your inverter on the MyPVPowered.com web site. There are many ways to configure networks for accessing the internet, and these are dependent on the specific needs and configuration located at the installation site. The Data Monitoring Module supports only hard-wired solutions to the inverter. It does NOT support wireless configurations.

NOTE: *Some complex networks might require a system administrator to add the inverter and the Data Monitoring Module to the network.*

IMPORTANT: *This wiring configuration complies with T-568B standards, and it is the only configuration supported by the Data Monitoring Module. OTHER WIRING CONFIGURATIONS WILL NOT WORK.*

Connecting the Inverter to the Internet

To complete the connection of the Data Monitoring Module, route the CAT5 cable from the Internet enabled router at the site through the data knockout on the back of the upper cabinet to the Data Monitoring Module located on the Power Distribution Board. Once an internet connection is established, go to www.mypvpowered.com to register the inverter and begin using the monitoring tools. Contact PV Powered if additional information is needed on how to use this online tool.

Modbus via RS-485

For instructions on how to use the modbus network option, refer to *Chapter 5, Modbus Network Installation.*

5. Modbus Network Installation

5.1 Overview

PV Powered commercial inverters are supplied with an integrated RS-485 modbus slave connection on the Data Monitoring Module. This chapter explains how to connect a PV Powered commercial inverter to a modbus network using the modbus serial communication protocol. This chapter is written for PV installers and modbus network programmers.

5.2 Modbus communication protocol

Modbus is a serial communications protocol for use with Programmable Logic Controllers (PLCs). Modbus has become a standard communications protocol and is now the most commonly available means of communicating with industrial electronic devices such as PV Powered inverters. Modbus also allows for communication between a modbus master and multiple slave devices connected to the same network. RS-485 is the protocol standard used by PV Powered as the hardware's serial interface while modbus is the communication protocol that runs on the PV Powered inverters.

5.3 Networking using the modbus option

The following steps can be performed by a qualified installer to set up a modbus network. These steps are:

A. Field installation process (to be performed on-site)

The first three steps can be completed by a PV installer that does not have working knowledge of a modbus network:

1. Installing the modbus cable.
2. Using jumpers to set the pins.
3. Setting the modbus address for each slave inverter.

B. Modbus network configuration process (can be completed on-site or remotely)

The last two steps should be completed by the modbus network programmer:

1. Setting the communication parameters.
2. Using modbus commands.

A. Installation Process

Before you start, disconnect the power to the inverter.

DANGER
AC and DC voltages will still be present at the inverter AC and DC landing points unless utility connection circuit breaker and PV array inputs are disconnected.

1. Installing the modbus cable

1. Route the cable from your master device on your RS-485 modbus network through the gland plate or knockout on the inverter using the appropriate water-tight conduit connections. Connections are made using insulated, twisted-pair communication cable rated for outdoor operation at 600V, such as Belden #9341.

   Use the ¾" knockout on the back left side of the upper section of the inverter.

Figure 5-1 Power interface and data comm sections on PVP30kW inverter

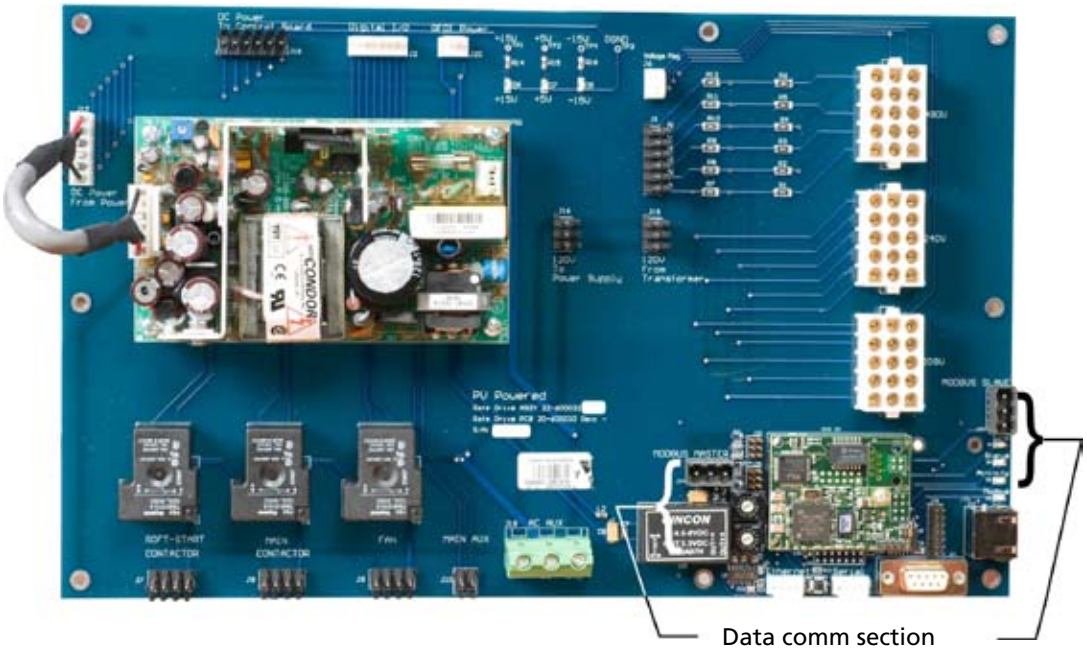


Figure 5-2 Close-up view of data comm section on the PVP30kW inverter

2. Connect the modbus cable.

   The end of the modbus cable connects to the modbus slave connector on the inverter. The modbus master connector is not enabled at this time.

   This connection resides on the data comm section in the upper cabinet of the inverter. See Figures 1 and 2 above. The MODBUS SLAVE connection is on the upper right of the data comm section. The connections are GND on top, plus (+) connection in the middle and minus (-) on the bottom. Refer to Figure 4 below.

   Connect the plus (+) cable to all plus (+) connections and the minus (-) cable to all other minus (-) connections so they correspond throughout the network.

   Note: The modbus master connections are reserved for future use.

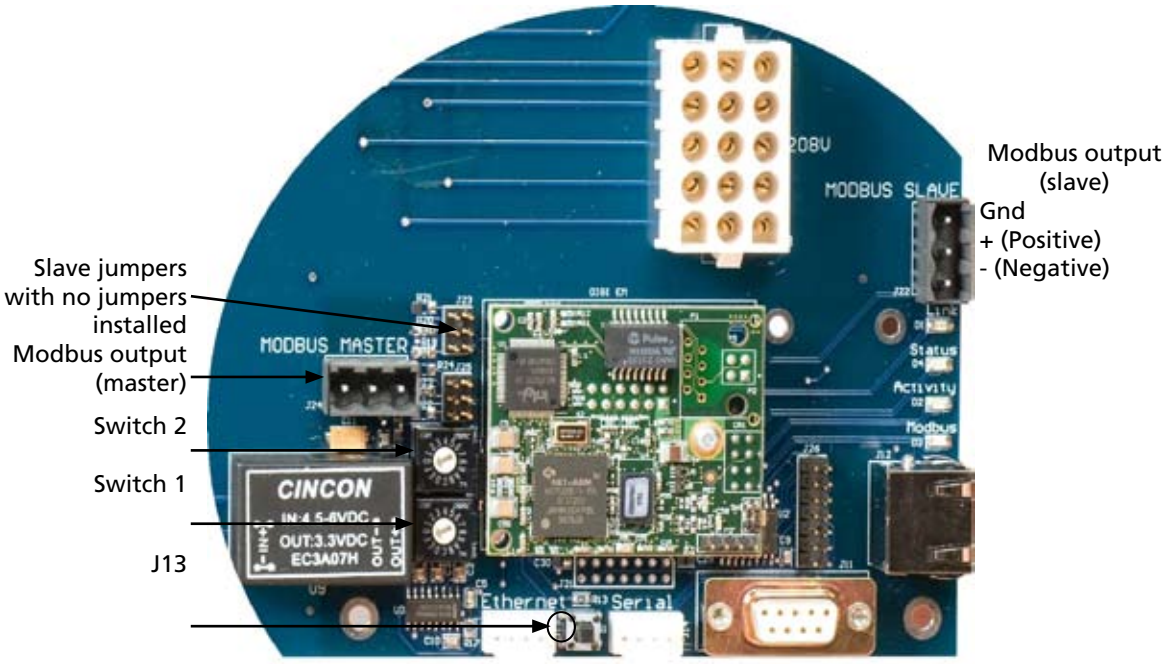


Figure 5-3 Data comm section

3. Connect a ground reference line to the third connection on the modbus slave connector. It is recommended that PV Powered devices have connected grounds when possible. The "ref line" (r connector) in Figure 5-4 below shows the ground connection. This is the top or GND connection of the MODBUS SLAVE connector.

   Note: If your modbus device does not have a ground connection, it is not required to connect it to a ground cable.

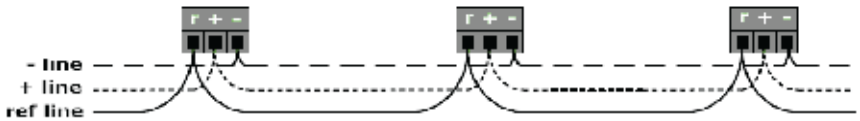


Figure 5-4 Daisy chain layout for RS-485 network

When multiple inverters or other modbus slave devices are connected to a single modbus master device, the multiple devices need to be connected in a daisy chain as shown in Figure 5-4. A daisy chain means that all plus (+) connections are chained together and all minus (-) connections are chained together across the network.

Other network layouts are not recommended when using the RS-485 standard.

Note: On the PVP30kW inverter, confirm that the 5-wire cable from the control board is connected to the J13 connector labeled Ethernet. This is required in order to

collect the inverter's data by both modbus and Ethernet data monitoring. Refer to Figure 5-3 to verify the location of J13.

2. Using jumpers to set the pins

By default, the termination pins have all three slave jumpers installed when the inverter is shipped. By modifying the location of the jumpers on the termination pins you can make the following settings to an inverter:

- Terminate the network
- Set an inverter as a slave device
- Turn on biasing

Jumper setting options:

1. Terminate the network.

   The performance of your modbus network requires each end of the network to be terminated. When multiple devices are on a network in a daisy chain layout, a jumper is used to terminate the devices at each physical end of the network.

   Remove jumpers one and three and leave the jumper on the middle pair of pins of J23 for a network with only one slave device or for the device on the end of a network.

2. Set the slave devices.

   Remove the three jumpers from all the J23 pins for any device in the middle of your network.

3. Set the biasing.

   Biasing sets the voltage levels on the network cables. It is not required but can make communications more reliable as it maintains a constant voltage level on the data lines of an inactive or idle network. Only one device on the network needs to have the biasing jumpers installed.

   Install a jumper on the first pair and last pair of pins of J23.

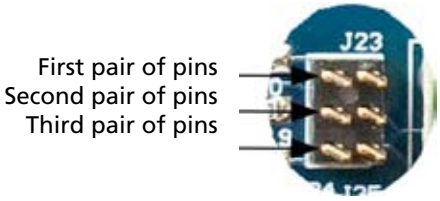


Figure 5-5 J23 pins on data comm section

3. Setting the modbus address for each slave device

A modbus network containing slave devices requires a unique address for each slave. This allows the master device to identify and communicate with each slave. The modbus network administrator must assign an unique modbus address to each PV Powered inverter.

To set the address:

1. Determine each slave address.

   The addresses are represented using the hexadecimal representation of digits 0 through 9 and letters A through F. For example, slave 1 is set to 01, slave 10 is set to 0A, and so forth. Refer to the following inverter address conversion table to select a unique address for each slave device by locating the number of the slave device in the "Address" column. Move right to the "Switch" column to find the converted address value of this slave device.

   Note: 0 is not an allowed address.

Address	Switch		Address	Switch		Address	Switch		Address	Switch		Address	Switch	
	1	2		1	2		1	2		1	2		1	2
1	0	1	21	1	5	41	2	9	61	3	D	81	5	1
2	0	2	22	1	6	42	2	A	62	3	E	82	5	2
3	0	3	23	1	7	43	2	B	63	3	F	83	5	3
4	0	4	24	1	8	44	2	C	64	4	0	84	5	4
5	0	5	25	1	9	45	2	D	65	4	1	85	5	5
6	0	6	26	1	A	46	2	E	66	4	2	86	5	6
7	0	7	27	1	B	47	2	F	67	4	3	87	5	7
8	0	8	28	1	C	48	3	0	68	4	4	88	5	8
9	0	9	29	1	D	49	3	1	69	4	5	89	5	9
10	0	A	30	1	E	50	3	2	70	4	6	90	5	A
11	0	B	31	1	F	51	3	3	71	4	7	91	5	B
12	0	C	32	2	0	52	3	4	72	4	8	92	5	C
13	0	D	33	2	1	53	3	5	73	4	9	93	5	D
14	0	E	34	2	2	54	3	6	74	4	A	94	5	E
15	0	F	35	2	3	55	3	7	75	4	B	95	5	F
16	1	0	36	2	4	56	3	8	76	4	C	96	6	0
17	1	1	37	2	5	57	3	9	77	4	D	97	6	1
18	1	2	38	2	6	58	3	A	78	4	E	98	6	2
19	1	3	39	2	7	59	3	B	79	4	F	99	6	3
20	1	4	40	2	8	60	3	C	80	5	0	100	6	4

Table 5-1 Inverter address conversion for switches 1 and 2

2. Set the switch address on each slave device.

The slave address for each PV Powered inverter is set using two rotary switches. Each switch is hexadecimal, containing 0 through 9, followed by A through F. Set the switches using the following guideline:

- The first switch is always set to the value in the “1” column below the “Switch” heading
- The second switch is always set to the value in the “2” column below the “Switch” heading

For example, if you are setting the address of the first slave device, inverter 1 of your network, to the hexadecimal address 05, the first switch is set to 0, the first digit of the hexadecimal address, and the second switch is set to 5, the second digit of the address.

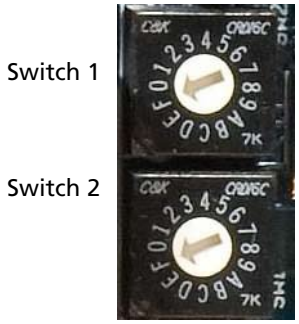


Figure 5-6 Rotary switches for setting the inverter number

The switches are located to the right and below the MODBUS MASTER. They are stacked with SW2 on top and SW1 on the bottom as they appear in Figure 5-6.

If you need more device addresses than the 100 listed in the above table, refer to a complete digital to hexadecimal conversion table.

Note: Some modbus master devices do not allow addresses above the decimal value of 126. PV Powered recommends keeping the number of slave devices between 2 and 100.

B. Network configuration process

1. Setting the communication parameters

The RS-485 modbus master communication settings need to be set to the values in Table 5-2. This allows your modbus master device to communicate with the inverter. Follow the instructions in the manual for your master device to complete these settings.

Parameter	Setting
Baud	9600
Parity	N
Data bits	8
Stop bit	1
Flow control	None

Table 5-2 Communication settings

2. Using modbus commands

PV Powered inverters provide basic modbus commands. The supported commands are listed in the following table.

Command Name	Command Number	Description
Read Holding Register	03	Retrieves the voltage, power and energy values from the inverter.
Write (Preset) Single Register	06	Enables/disables the inverter.
Return Slave ID	17	Returns a text string containing the ID number of the inverter.

Table 5-3 Supported modbus commands

Format of modbus commands and responses

Each of the following command sections contain two tables. The first table describes the format of a modbus command request while the second table contains the format of the command's response.

Then the next section, *Modbus register maps*, provides additional information about these commands and their valid registers.

Read Holding Register

The **Read Holding Register** command is used frequently. Typically the modbus master continually reads the values from registers containing the desired information.

Command Information	Command Layout
Slave ID	nn (1-126)
Command number	03
First register MSB	xx
First register LSB	xx
Number of registers MSB	xx
Number of registers LSB	xx
CRC LSB	xx
CRC MSB	xx

Table 5-4 Format for Read Holding Register, command 03

Response Information	Response Layout
Slave ID	nn (1-126)
Command number	03
Number of bytes of data	n
Fist register MSB	xx
First register LSB	xx
Second register MSB	xx
Second register LSB	xx
Nth register MSB	xx
Nth register LSB	xx
CRC LSB	xx
CRC MSB	xx

Table 5-5 Format for Read Holding Register, response to command 03

Write Single Register

The **Write Single Register** command is used to write to one of the command registers found in Table 13. Using this command does not change the inverter's data in registers described in Tables 10, 11 or 12.

Command Information	Command Layout
Slave ID	nn (1-126)
Command number	06
First register MSB	xx
First register LSB	xx
Data MSB	xx
Data LSB	xx
CRC LSB	xx
CRC MSB	xx

Table 5-6 Format for Write Single Register, command 06

Response Information	Response Layout
Slave ID	nn (1-126)
Command number	06
Number of bytes of data	n
First register MSB	xx
First register LSB	xx
Data MSB	xx
Data LSB	xx
CRC LSB	xx
CRC MSB	xx

Table 5-7 Format for Write Single Register, response to command 06

Return Slave ID

Command Information	Command Layout
Slave ID	nn (1-126)
Command number	11h

Table 5-8 Format for Return Slave ID, command 11h

Response Information	Response Layout
Slave ID	nn (1-126)
Command number	11h
Number of bytes of data	n
Data 1	xx
Data 2	xx
Data n	xx
CRC LSB	xx
CRC MSB	xx

Table 5-9 Format for Return Slave ID, response to command 11h

Modbus register maps

The following tables list the modbus registers with their location and a description of the data stored in the register. For more information describing the data format contained in column six, the "Format" column of each table, see Table 19 at the end of this chapter.

Description	Start Register	End Register	Nbr. of Registers	MB Address	Format	Range	Notes
Modbus base address = 0							
Inverter ID number	0	7	8	40001	ASCII	16 char	Unique number for each inverter
Firmware version	8	11	4	40009	ASCII	8 char	Example: V1.9
Inverter configuration	12	12	1	40013	UINT 16	0-2	AC Volt_code: 0=208; 1=240; 2=480
Map version	13	13	1	40014	UINT 16	2	Increment sequentially as the map changes

Table 5-10 Fixed information registers

Description	Start Register	End Register	Nbr. of Registers	MB Address	Format	Range	Notes
Modbus base address = 1000							
VoltsA L-N	1000	1001	2	41001	FLOAT	+/- 9999.9999	
VoltsB L-N	1002	1003	2	41003	FLOAT	+/- 9999.9999	
VoltsC L-N	1004	1005	2	41005	FLOAT	+/- 9999.9999	
Current A[1]	1006	1007	2	41007	FLOAT	+/- 9999.9999	
Current B	1008	1009	2	41009	FLOAT	+/- 9999.9999	
Current C	1010	1011	2	41011	FLOAT	+/- 9999.9999	
DC input voltage	1012	1013	2	41013	FLOAT	+/- 9999.9999	
DC input current[2]	1014	1015	2	41015	FLOAT	+/- 9999.9999	
Line frequency	1016	1017	2	41017	FLOAT	+/- 9999.9999	
Line kW	1018	1019	2	41019	FLOAT	+/- 9999.9999	
Total kWH delivered	1020	1021	2	41021	UINT 32	0 - 4.29 e9	

Table 5-11 Data registers

1. Phase A current is calculated from phase B and C currents.

2. DC input current is not measured and always reports back as 0 amps.

Description	Start Register	End Register	Nbr. of Registers	MB Address	Format	Range	Notes
Modbus base address = 2000							
Inverter operating status (state)	2000	2000	1	42001	UINT 16	bit mapped	See Table 14
Inverter fault word 0	2001	2001	1	42002	UINT 16	bit mapped	See Table 15
Inverter fault word 1	2002	2002	1	42003	UINT 16	bit mapped	See Table 16
Inverter fault word 2	2003	2003	1	42004	UINT 16	bit mapped	See Table 17
Data comm status codes	2004	2004	1	42005	UINT 16	bit mapped	See Table 18

Table 5-12 Status and fault code registers

To set the following command registers, you need to use the **Write Single Register** command.

Description	Start Register	End Register	Nbr. of Registers	MB Address	Format	Range	Notes
Modbus base address = 3000							
Clear fault command	3000	3000	1	43001	UINT 16	CF hex	Write this value to clear faults and try a restart.
Disable inverter[3]	3001	3001	1	43002	UINT 16	DD hex	Write 0xDD to disable Write 0xEE to enable
Enable inverter	3002	3002	1	43003	UINT 16	EE hex	Write 0xDD to disable Write 0xEE to enable
Reset data comm section	3003	3003	1	43004	UINT 16	99 hex	Write 99 hex to this register to reset the Comm X board.

Table 5-13 Command registers

3. Reading this register returns 0 after bootup, or either DD after a disable or EE hex after an enable command is sent.

Response values for status and fault registers

The following tables contain the status and fault bitmap information for each status register in Table 12. The command's response values are returned as hexadecimal values which you need to convert to the decimal value in order to understand the returned information.

Description	Hex Value	Decimal Value
Modbus register number = 42001		
Powering up	0	0
Transformer pre charge	1	1
Contractor delay	2	2
Idle	10	16
Peak power tracking	15	21
Faulted (fault words 0, 1, 2 below provide details about the fault type)	80	128

Table 5-14 Inverter operating status (state) values

In tables 15 through 17, each type of fault in the "Description" column can have a value of "0" indicating no fault or a "1" indicating a fault.

Description	Bit Nbr.	Hex Value	Decimal Value
Modbus register number = 42002			
Module fault	15	8000	32768
Undefined	14	4000	16384
Undefined	13	2000	8192
Voltage fault	12	1000	4096
Undefined	11	800	2048
Ground fault	10	400	1024
Low power fault	9	200	512
CPU load fault	8	100	256
Undefined	7	80	128
Over current fault	6	40	64
Pre-charge fault	5	20	32
Undefined	4	10	16
Undefined	3	8	8
Heatsink temperature fault	2	4	4
Watchdog timer fault	1	2	2
Ambient temperature fault	0	1	1

Table 5-15 Fault word 0

Description	Bit Nbr.	Hex Value	Decimal Value
Modbus register number = 42003			
Undefined	15	8000	32768
Undefined	14	4000	16384
Undefined	13	2000	8192
Undefined	12	1000	4096
Undefined	11	800	2048
Fan 2 fault	10	400	1024
Fan 1 fault	9	200	512
Over current phase C	8	100	256
Over current phase B	7	80	128
Over current phase A	6	40	64
Drive C hi fault	5	20	32
Drive C lo fault	4	10	16
Drive B hi fault	3	8	8
Drive B lo fault	2	4	4
Drive A hi fault	1	2	2
Drive A lo fault	0	1	1

Table 5-16 Fault word 1

Description	Bit Nbr.	Hex Value	Decimal Value
Modbus register number = 42004			
Undefined	15	8000	32768
Undefined	14	4000	16384
Undefined	13	2000	8192
Undefined	12	1000	4096
PLL fault	11	800	2048
AC overvoltage fault	10	400	1024
AC undervoltage fault	9	200	512
AC under frequency fault	8	100	256
AC over frequency fault	7	80	128
Undefined	6	40	64
DC under voltage fault	5	20	32
DC overvoltage fault	4	10	16
Floating power supply fault	3	8	8
-15V fault	2	4	4
+15V fault	1	2	2
+5V fault	0	1	1

Table 5-17 Fault word 2

Description	Bit Nbr.	Hex Value	Decimal Value
Modbus register number = 42005			
OK		0	0
Rebooting		1	1
Inverter communication fault		2	2
Web post fault		4	4
DNS server fault		5	5

Table 5-18 Inverter data comm status word

Data Format	Description	Notes
ASCII	Two ASCII characters per register	For a text string the left most character is in the lowest register number.
UINT16	Unsigned integer: 16 bits	Range: 0 to 65535
SINT16	Signed integer: 16 bits	Range: -32767 to +32767
UINT 32 (requires two registers)	Unsigned integer: 32 bits	Range: 0 to 4,294,967,295
SINT 32 (requires two registers)	Signed integer: 32 bits	Range: -2,147,483,647 to +2,147,483,647
FLOAT (requires two registers)	IEEE 754 standard 32-bit floating point number	

Table 5-19 Data formats for registers

Information about the Data Monitoring Module

For additional information on how to use the modbus Data Monitoring Module, contact PV Powered Customer Service and Technical Support at 1-877-312-3832.

6. Operation

6.1 Start Up Procedure

WARNING
Before turning on the PVP30kW Inverter, ensure that the front panels are closed properly.

To start the PVP30kW Inverter, complete the following steps in order:

1. Prior to engaging the disconnect switches, check the polarity of the DC positive and negative connectors to ensure they are wired correctly and confirm the PV panel open circuit voltage is below 600 VDC.
2. Close and secure the front panel.
3. Turn the AC Disconnect to the power ON position (Figure 6-2).
4. Turn the DC Disconnect to power ON position (Figure 6-2). The VFD on the upper front panel should now be active if there is DC voltage present from the array.
5. After five minutes, the PVP30kW Inverter will start to produce power into the AC grid if all necessary operating conditions are met.

NOTE: If a fault other than 0000 0000 0000 is displayed on the VFD display after the five minute startup period, refer to Chapter 7 Maintenance and Troubleshooting.

6.2 Operation of Display

The display indicates the PVP30kW Inverter status and real-time power output into the AC utility grid. The initial startup displays are shown in Figures 6-3.

If a fault occurs, the display also provides a fault code that corresponds to a set of pre-defined fault descriptions as detailed in *Appendix B- Limits and Fault Codes*.

6.3 Ground Fault Interrupt Device

The PVP30kW Inverter is equipped with a GFDI (Ground Fault Detector/Interrupter) as shown in Figure 1-4. The purpose of the GFDI is to detect a ground fault (unintended current flow from the solar panels to earth ground).

WARNING

For the GFDI circuit to function as designed, the solar array safety ground must not be connected to the PV array positive or negative leads.

Bonding the safety ground to the grounded leg of the array anywhere but through the inverter will cause the GFDI circuit to be bypassed. This would defeat the operation of the GFDI and potentially create an unsafe operating condition.

- The GFDI functions using a 2A fuse to connect or bond the solar array Negative (or the solar array Positive, if using a positively grounded panel array) to earth ground on the GFDI PCB.
- If the ground fault current exceeds 2A between the grounded array terminal and the earth ground, the fuse will "blow" and disconnect the solar panels from their ground reference, interrupting the ground fault. In this situation, the inverter will cease operation and display a fault message (see Figure 6-1). Additionally, the LED on the GFDI PCB will illuminate.

Figure 6-1 Ground Fault Error Message

If the inverter displays a ground fault as shown in Figure 6-1, turn OFF the AC and DC to the inverter and refer to *7. Maintenance and Troubleshooting*.

6.4 Shutdown Procedure

To shutdown your PVP30kW Inverter, complete the following steps in order:

1. Turn the AC power off by rotating the AC disconnect to the OFF position as shown in Figure 6-2.

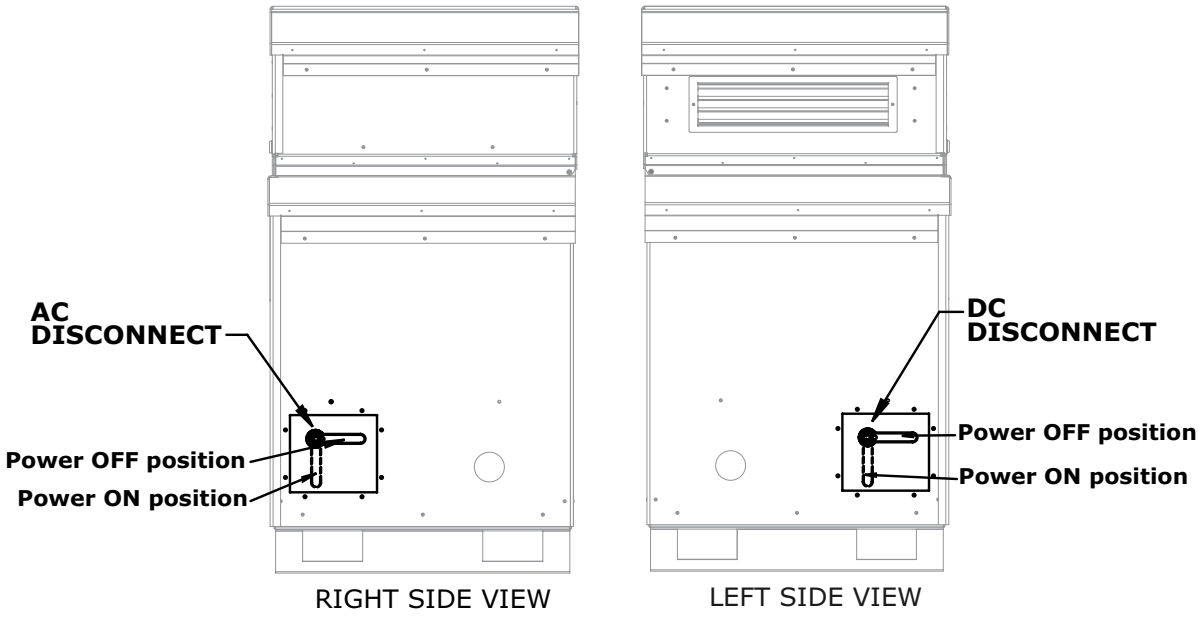


Figure 6-2 AC and DC Power OFF Levers

2. Turn the DC power off by rotating the DC disconnect to the OFF position as shown in Figure 6-2.

DANGER
High voltages are present within the PVP30kW cabinet. Both AC and DC disconnects must be in the OFF position when working on the unit. Wait five minutes to discharge high voltage before removing the front panels of the inverter.

7. Maintenance & Troubleshooting

DANGER
Before attempting any maintenance, turn OFF AC and DC power to the inverter.

WARNING
Wait at least five minutes for any voltage to drain down before working on the inverter.

7.1 Visual Inspection

PV Powered recommends visually inspecting the inverter every time it is serviced. Start by observing the front, back and sides of the inverter for damage, foreign objects, or dust and debris that may have accumulated around the inverter. Remove dirt and debris from the area around the inverter at least every six months. Pay particular attention to the area under the inverter as this is where the exhaust is directed out of the cabinet.

7.2 Fan Intake Screen

PV Powered recommends washing the fan intake screen every six months. To accomplish this task, you need a Phillips screwdriver and a bucket of warm soapy water. Remove the screws holding the louver plate on the left side of the inverter as shown in Figure 7-1.

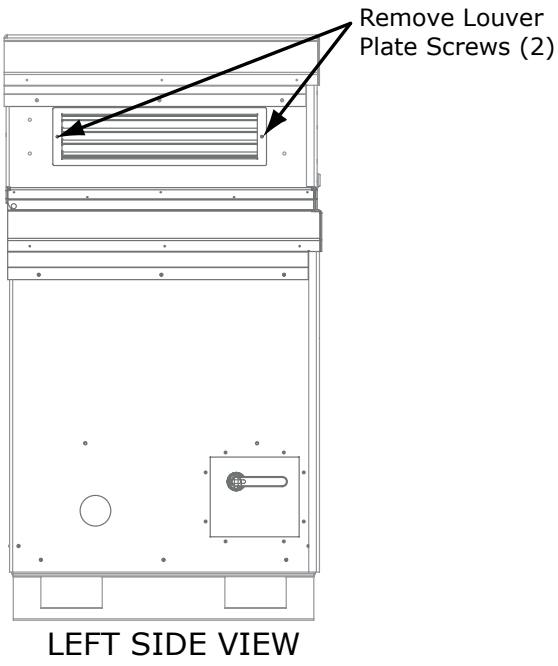


Figure 7-1 Remove Louver Plate Screws

Remove the screen (Figure 7-2) and then wash it in the bucket of water. Dry the screen by gently squeezing it. Replace the screen and re-attach the louvers to the cabinet.

Figure 7-2 Remove Louver and Screen

DANGER
Before attempting any maintenance, turn OFF AC and DC power to the inverter.

DANGER
Wait at least five minutes for any voltage to drain down before working on the inverter.

7.3 Annual Preventative Maintenance

Maintenance Checklist

The following maintenance should be performed annually by a qualified service person. See *Appendix D- Annual Maintenance Requirements Checklist* for a checklist of these required maintenance items.

A. General Inspection & Cleaning

1. Record general site conditions.
2. Record inverter performance data from inverter display.
3. Record environmental conditions.
4. Remove dirt and debris from underneath inverter.
5. Inspect and clean interior of inverter
6. Inspect air filter and replace or clean
7. Confirm presence of required site-specific safety equipment.
8. Confirm presence of product documentation.

B. Connections and Wiring

9. Complete visual inspection of electrical connections and wiring.
10. Complete mechanical inspection of connections and wiring.
11. Measure torque of all electrical connections and re-torque as needed.
12. Complete thermal scan of inverter connections, wiring and electronics

C. Testing

13. Confirm the inverter operating modes including standby, startup, and on
14. Check operation of protective circuits and alarms
15. Check operation of relays and contacts
16. Confirm power supply and transformer output
17. Validate display data accuracy

D. Repair or Replace

18. Repair or replace items that have been determined to be near the end of their useful life.

E. Reporting

19. Repair or replace items that have been determined to be near the end of their useful life.

F. Documentation of Annual Preventative Maintenance Checklist

Complete the maintenance checklist included in Appendix D- Annual Maintenance Requirements Checklist and save the information for your records. This checklist is also available on the www.pvpowered.com web site.

7.4 Display Screens and Fault Codes

The inverter displays the text messages shown below.

Startup

Upon startup, the inverter will automatically scroll between the four startup screens shown in Figure 6-3.

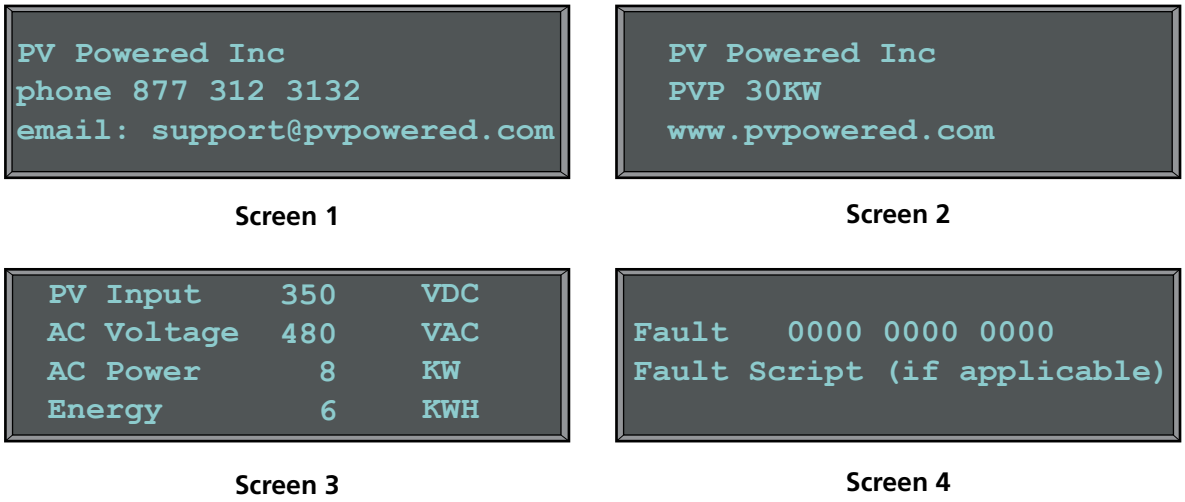


Figure 7-3 Startup Screens

Fault Codes

The display provides codes when a fault occurs. A detailed list of these faults can be found in *Appendix D - Limits and Fault Codes*.

Single Fault Example

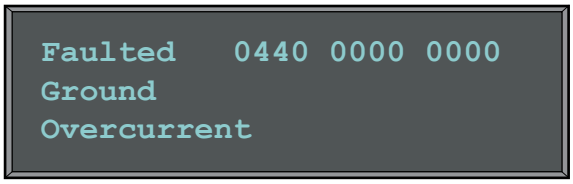


Figure 7-4 Fault Example Screen

The sample screen shown in Figure 7-4 displays a ground fault.

Multiple Faults Example

In the event that the inverter detects multiple faults at one time, the numerical values will be combined. An example is shown in Figure 7-5.

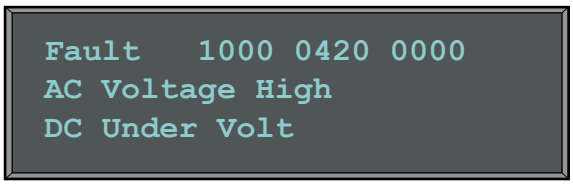


Figure 7-5 AC Voltage High/DC Voltage Low Fault

The fault in Figure 7-5 shows the AC Voltage High fault 1000 0400 plus a DC Voltage Low fault 1000 0020. (The “1” in the thousands digit of the first code indicates a voltage fault in the second block of four digits.) This fault may occur at night, when the panel voltage is low and the utility voltage is above the limits shown in *Appendix B - Limits and Fault Codes.*

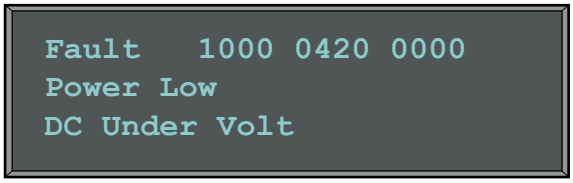


Figure 7-6 Power Low Fault

Figure 7-6 shows a Power Low fault. After the fault, the inverter had a DC Voltage High fault 0200 0000 plus 1000 0040. If the faults have the same first digit (as with a 1000 XXXX fault), the 1 will stay the same and only the second block of four numbers will be combined.

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 for someone of your qualifications.

7.5 Communication Board LED Lights

Definition of LED Lights

All PV Powered commercial inverters include four status LED lights to help troubleshoot system operation:

1. Link – Indicates presence of a hardware Ethernet connection.
2. Activity (or ACT) – Indicates internet traffic.
3. Status – Indicates communication status.
4. Modbus – Indicates activity on the modbus network.

Location of Communication Board LED Lights

The four communication board LED lights are surface mount LEDs. The LEDs are located on the power distribution board, refer to Figure 7-7 below, which is vertically mounted on the right side of the upper cabinet between the Ethernet connector and the modbus slave connector. Labels on the board indicate the name of each LED light.

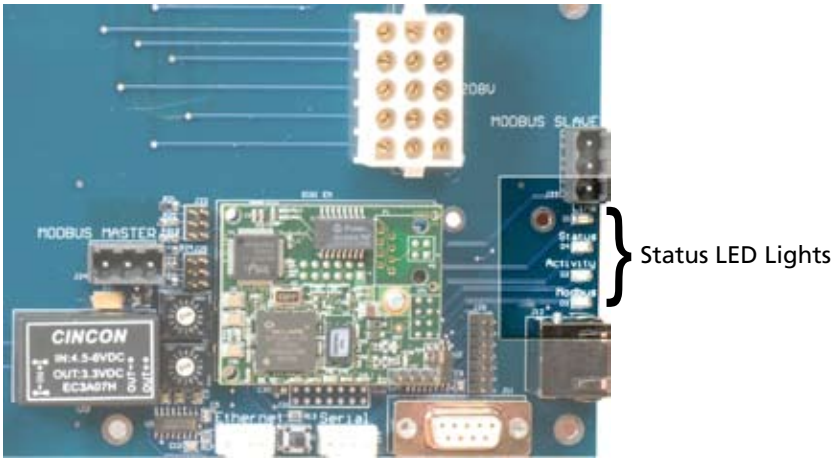


Figure 7-7 Status light location for PVP30kW

Link LED Operation and Signaling

The Link LED remains on if a hardware Ethernet connection is detected. The LED is off when there is no hardware Ethernet connection. There are no flash codes for the Link LED.

Activity LED Operation and Signaling

The Activity LED (called ACT on some circuit boards) flashes to indicate the presence of internet traffic. There are no flash codes for the Activity LED.

Status LED Operation and Signaling

During the startup sequence the Status LED is solid for a few seconds, then flashes quickly for several seconds while the communications device looks for an internet

connection. After a few seconds, the flashing stops whether or not an internet connection is found, and then flashes more slowly while it establishes serial communication with the inverter's main processor. After serial communication is established, the Status LED remains on unless a fault occurs.

The Status LED displays a flash code if a problem is found. Each code consists of a series of three flashes followed by a pause. Each one of the three flashes can be either a short or long flash.

- A short flash is approximately 0.2 seconds.
- A long flash is approximately 0.5 seconds.

The pause between each flash is one second. The following table lists the flash codes and their meaning.

Status	Flash Code
Normal operation	On solid (no flashing)
Serial communication fault	Short-long-short
DNS failure	Long-short-short
Network connection fault	Short-short-long

Table 7-1 Status LED Flash Codes

Status LED Code Descriptions

Normal operation: Inverter communications are operating normally.

Serial Communication Fault: The communication board in the inverter communicates with the inverter's main processor using serial communication. If the communication board cannot establish communication with the main processor, this Serial Communications Fault code will flash. (NOTE: It is normal for this status code to flash for a few seconds during startup.)

DNS Failure: The inverter uses a Domain Name Service (DNS) server to resolve the IP address of the PV Powered database when it posts data. (Data is posted once every 15 minutes.) If the DNS server is not found or does not return a valid IP address, the DNS Failure code will flash for about a minute while the inverter is attempting to post the data. After a few retries, the inverter will try to force a post to a hard-coded IP address. If this post succeeds, the LED returns to normal operation until the next post again attempts to connect to the DNS server.

Network Connection Fault: This status code will flash when the inverter cannot post data to the PV Powered database server. The Network Connection Fault status code will start flashing after the inverter has tried to post data to the PV Powered server. The Status LED may indicate normal operation before this occurs. This can happen in the following circumstances:

- The network cable is not connected.
- The network does not have a DHCP server or the DHCP server did not provide a valid IP address to the inverter.
- The PV Powered server is down for maintenance.
- Any other network problem that does not allow the data post to reach the PV Powered server.

Modbus LED Operation and Signaling

When the inverter is connected as a slave device to a modbus network, the Modbus LED flashes quickly whenever there is activity on the network. The quick flashes occur even if the modbus commands are not addressed to the inverter. These quick flashes enable the installer to troubleshoot the system by verifying that communications are occurring on the network. If the inverter receives and responds to a message that is addressed to it, the flashes are longer in duration. A series of longer (slower) flashes indicates the inverter is responding to the modbus master interrogation.

Periodic short and long flashes are seen when communications occur on a modbus network that contains multiple modbus slave devices. If only short flashes are seen, the inverter modbus address switches need to be checked to verify they correspond to the address programmed into the modbus master. In addition, the baud rate and other communication parameters of the modbus master need to be verified. For additional modbus network configuration details, see *Chapter 5 Modbus Network Installation.*

7.6 AC Under Voltage Fault

If the inverter displays an AC Under Voltage fault and all the voltages going into the inverter are within the tolerances specified in *Appendix A- Specifications*, refer to the troubleshooting tips below.

- If the main branch circuit breaker is not tripped, check the small fuses located on the AC Sub Panel (there are six in two sets of three). If one or more of these fuses have opened, replace them with like parts (600VAC, 5A).
- If any of the fuses have opened visually inspect the wiring. Look for frayed wires, carbon marks indicating a short, or burnt traces on the circuit boards. If any of these conditions are present, DO NOT START THE INVERTER. Call PV Powered Technical Support at 1-877-312-3832, or email support@pvpowered.com for replacement parts or service.

Ground Fault Diagnosis

The PVP30kW Inverter reports a ground fault error if it detects a voltage potential between ground and the grounded terminal of the solar array. This condition can occur if the ground fault fuse in the inverter has opened.

A ground fault occurs when a current of more than two amps flows from the solar array to ground.

This may be caused by the following:

1. A configuration error during commissioning.
2. Switching the grounded conductor in the DC disconnect. For a negatively grounded system, the positive leg should be broken in the DC disconnect. For a positively grounded system, the negative leg should be broken in the DC disconnect.
3. A pinched wire in the installation connecting some part of the array or DC wiring to earth ground.
4. In the case of a multiple inverter installation, mismatched array strings.

Repairing a Ground Fault

DANGER
Risk of Electrical Shock. Allow five (5) minutes for internal power to dissipate prior to entering the enclosure cabinet. Ensure all terminals are voltage free with the use of a multimeter.

DANGER
Verify that no shock hazard exists between both fuse terminals and earth ground before removing the fuse. A 600V rated fuse pulling device is required.

Open the front cover and find the GFDI PCB (Figure 1-7). Inspect the 2A fuse for continuity using a multimeter. If the fuse is open, replace the fuse. Close the door and restart the inverter following the instructions described in *5.1 Start Up Procedures*.

If the fuse is not open, continue troubleshooting by following the steps below.

With the ground fault fuse removed:

1. Check for continuity (ohms) across the fuse. If the meter indicates no continuity then a ground fault likely exists.
2. If the fuse is open, replace it only with a 600VDC, 2A fuse. DO NOT insert the new fuse until you ensure there is no longer a ground fault condition.

   To ensure there is no longer a ground fault condition:

3. Check the DC voltage between the grounded terminal of the array and earth ground. The voltage should be less than 30 volts with the GFDI fuse removed. If the voltage is higher than 30 volts, a ground fault likely still exists. Check the array wiring. For the best results, perform this test with the DC disconnect in both the ON and OFF positions.
4. Make sure the grounded leg of the solar array is not switched in the DC disconnect.
5. Once the ground fault condition has been eliminated, verify the voltage between earth ground and the grounded side of the PV array is less than 30 volts. Ensure the DC disconnect is in the OFF position, and install the new GFDI fuse. Follow *5.1 Start Up Procedure* to restart the inverter.

If the ground fault can not be eliminated, contact PV Powered Technical Support at 1-877-312-3832, or email support@pvpowered.com.

7.7 Contact Information

PV Powered, Inc.
150 SW Scalehouse Loop
Bend, OR 97702

Tel: 541-312-3832
Technical Support: 1-877-312-3832
Fax: 541-383-2348

www.pvpowered.com
email: support@pvpowered.com

8. Limited Warranty

THIS 10-YEAR LIMITED COMMERCIAL WARRANTY (the "10-Year Warranty") covers defects in your PV Powered commercial inverter caused by material or manufacturing faults for a 10-year period. The warranty period for the 10-Year Warranty begins on the date you commission your PV Powered commercial inverter, or 6 months after the date of purchase, whichever comes first. The 10-Year Warranty applies to the base model commercial inverter and all customer purchased options that were manufactured by PV Powered. The 10-Year Warranty does not apply to customer purchased optional equipment that was not manufactured by PV Powered. Optional equipment not manufactured by PV Powered will be covered by the original manufacturer's warranty.

The 10-Year Warranty may be transferred to subsequent owners, except that the 10-Year Warranty shall be void if, without prior approval of PV Powered, either (i) the PV Powered commercial inverter is moved from its original installation location or (ii) the overall PV system design is altered.

In satisfaction of its obligations under the 10-Year Warranty, PV Powered will, at its discretion, repair or replace the defective component(s) free of charge, as long as PV Powered is notified of the defect during the warranty period. PV Powered reserves the right to inspect the faulty component(s) and determine if the defect is due to material or manufacturing flaws. PV Powered also reserves the right to charge for service time expended if the defect is due to any cause other than a material or manufacturing flaw.

The 10-Year Warranty does not cover defects or damage caused by:

- Normal wear and tear.
- Shipping or transportation damages.
- Improper installation.
- Exposure to unsuitable environmental conditions, including but not limited to damage due to lightning strikes.
- Unauthorized or abnormal use or operation.
- Negligence or accidents, including but not limited to lack of maintenance or improper maintenance.
- Material or workmanship not provided by PV Powered or its authorized service centers.
- Relocation of the commercial inverter from its original installation location or alteration of the overall PV system design without prior approval of PV Powered.
- Acts of God, such as earthquake, flood or fire.

The 10-Year Warranty does not cover costs related to the removal, installation, or troubleshooting of your electrical systems.

PV Powered will, at its discretion, 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, PV Powered's warranty continues for the remaining portion of the original warranty period or 90 days from the date of repair, whichever period expires later. All replaced products and all parts removed from repaired products become the property of PV Powered.

PV Powered covers the parts, travel and labor necessary to repair the product within the United States and Canada.

If your product requires troubleshooting or warranty service, contact your installer or dealer. If you are unable to contact your installer or dealer, or the installer or dealer is unable to provide service, contact PV Powered directly at 1-877-312-3848, or support@pvpowered.com.

EXCEPT FOR THIS 10-YEAR WARRANTY, PV POWERED EXPRESSLY MAKES NO WARRANTIES WITH RESPECT TO THE PV POWERED INVERTER, EXPRESS AND IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTY OF MERCHANTABILITY, THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY WARRANTIES THAT MAY HAVE ARISEN FROM COURSE OF DEALING OR USAGE OF TRADE.

TO THE MAXIMUM EXTENT PERMITTED BY LAW, PV POWERED'S AGGREGATE MONETARY LIABILITY TO YOU FOR ANY REASON AND FOR ANY AND ALL CAUSES OF ACTION, WHETHER IN CONTRACT, TORT OR OTHERWISE, WILL NOT EXCEED THE AMOUNT PAID TO PV POWERED FOR THE PV POWERED INVERTER(S) COVERED BY THIS 10-YEAR WARRANTY. PV POWERED WILL NOT BE LIABLE UNDER ANY CAUSE OF ACTION, WHETHER IN CONTRACT, TORT OR OTHERWISE, FOR ANY INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR PUNITIVE DAMAGES, EVEN IF PV POWERED HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THE PRICE FOR THE PV POWERED INVERTER AND PV POWERED'S OBLIGATIONS UNDER THIS 10-YEAR WARRANTY ARE CONSIDERATION FOR LIMITING PV POWERED'S LIABILITY.

IN THE EVENT OF A DISPUTE BETWEEN PV POWERED AND ANY PARTY COVERED UNDER THIS WARRANTY, TO THE MAXIMUM EXTENT ALLOWED BY LAW, SUCH PARTY AGREES TO RESOLVE ANY AND ALL SUCH DISPUTES USING BINDING ARBITRATION IN ACCORDANCE WITH THE COMMERCIAL ARBITRATION RULES AND EXPEDITED PROCEDURES OF THE AMERICAN ARBITRATION ASSOCIATION, WITH THE PLACE OF ARBITRATION TO BE BEND, OREGON. UNLESS OTHERWISE AGREED IN WRITING, THE ARBITRATOR SHALL BE DRAWN FROM THE NATIONAL ENERGY PROGRAM PANEL OF THE AMERICAN ARBITRATION ASSOCIATION. THE PRICE FOR THE INVERTER AND PV POWERED'S OBLIGATIONS UNDER THIS 10-YEAR WARRANTY ARE CONSIDERATION FOR THIS BINDING ARBITRATION PROVISION.

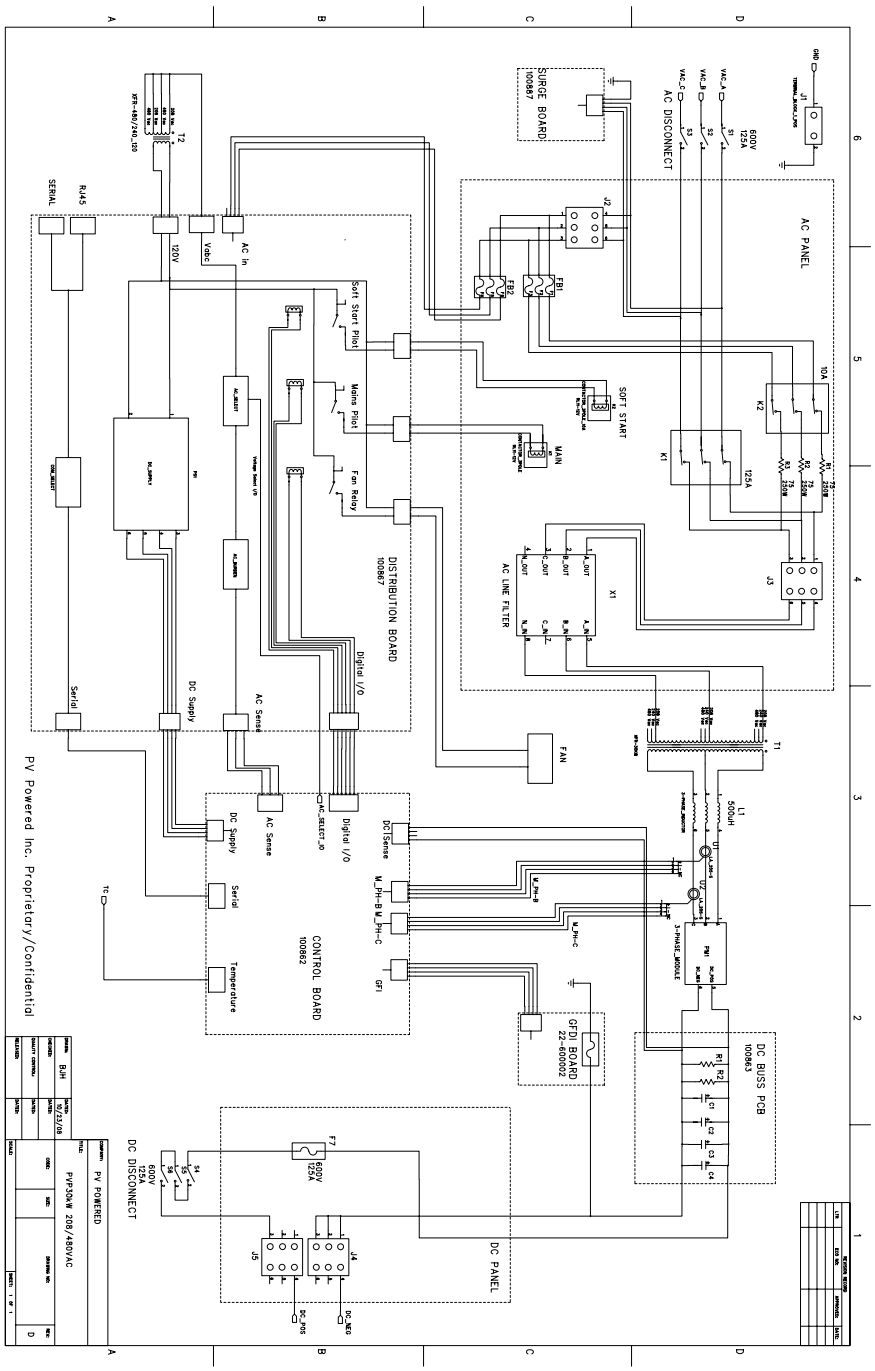
Appendix A - Specifications

MODEL	PVP30kW
ELECTRICAL CHARACTERISTICS	
Continuous Output Power (kW)	**30**
Weighted CEC Efficiency (%)	
208VAC	**93.0**
480VAC	**93.5**
Maximum DC Input Voltage (VOC)	**600**
DC Peak Power Tracking Range (V)	**295 – 500**
DC Imp Nominal Current (A)	**107**
AC Nominal Voltage-Field Configurable (V)	**208VAC and 480VAC**
AC Operating Range (V)	
208VAC (Wye only, not for use with Delta system)	**183 – 228**
480VAC (Wye only, not for use with Delta system)	**422 – 528**
AC Frequency Range (Hz)	**59.3 - 60.5**
AC Maximum Continuous Current (A)	**83 (208VAC), 36 (480VAC)**
Standby Losses (W)	**17**
Harmonic Distortion (%THD)	**< 3%**
Power Factor	**> .99**
MECHANICAL CHARACTERISTICS	
Enclosure	**NEMA 3R**
Construction	**Aluminum**
Mounting	**Pad Mount**
Weight (lbs)	**760**
Cooling	**Forced Convection**
Temperate Range (ºC)	**-25 to 45**
Isolation Transformer	**Yes**
OPTIONS	
UL approved positive grounding	**Y**
Commercial grade data monitoring solutions	**Y**
Preventative maintenance program	**Y**
Extended warranty	**Y**

Table A-1 Product Specifications Data Sheet

Notes

Appendix B - Wiring Diagram

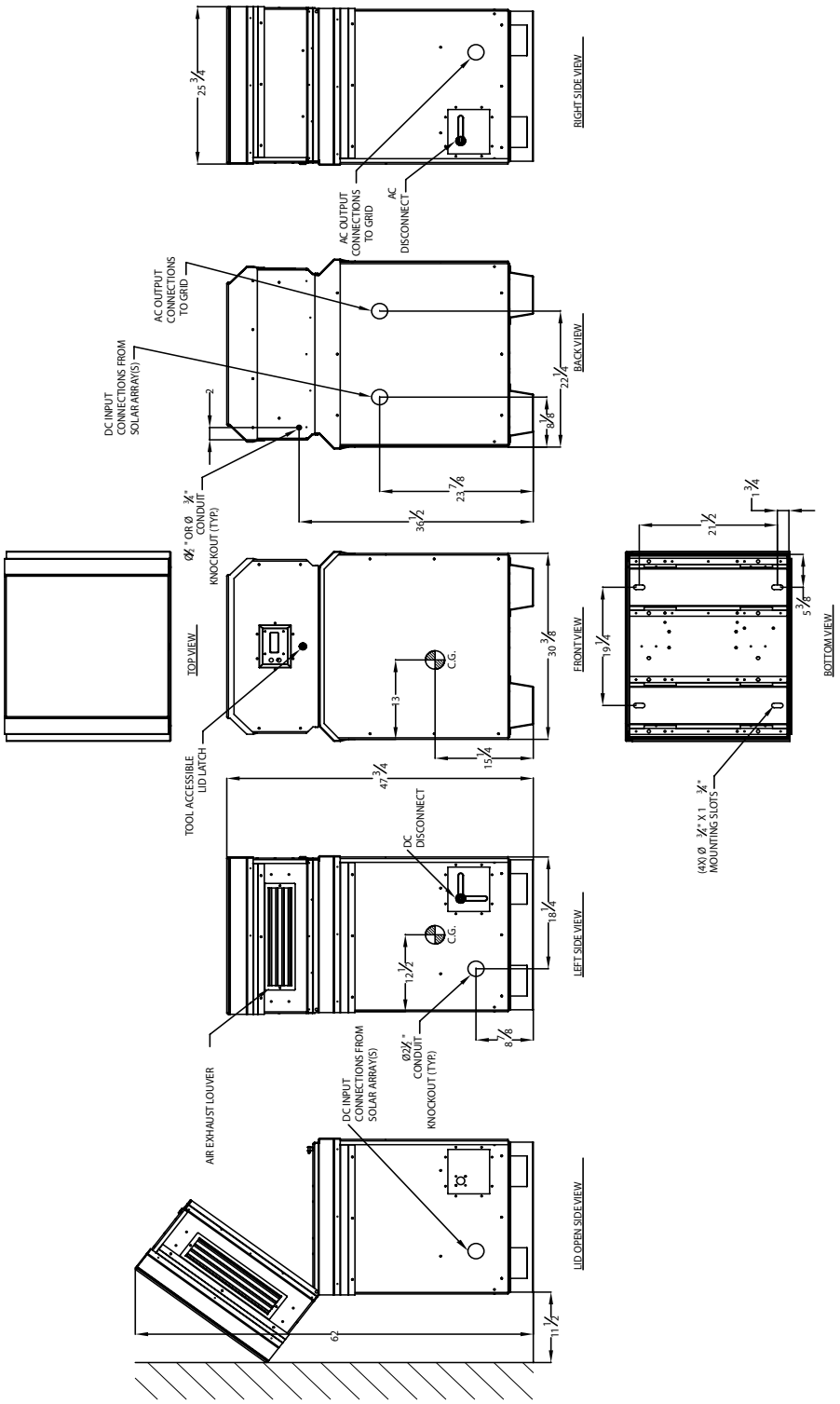


B-1 Wiring Diagram

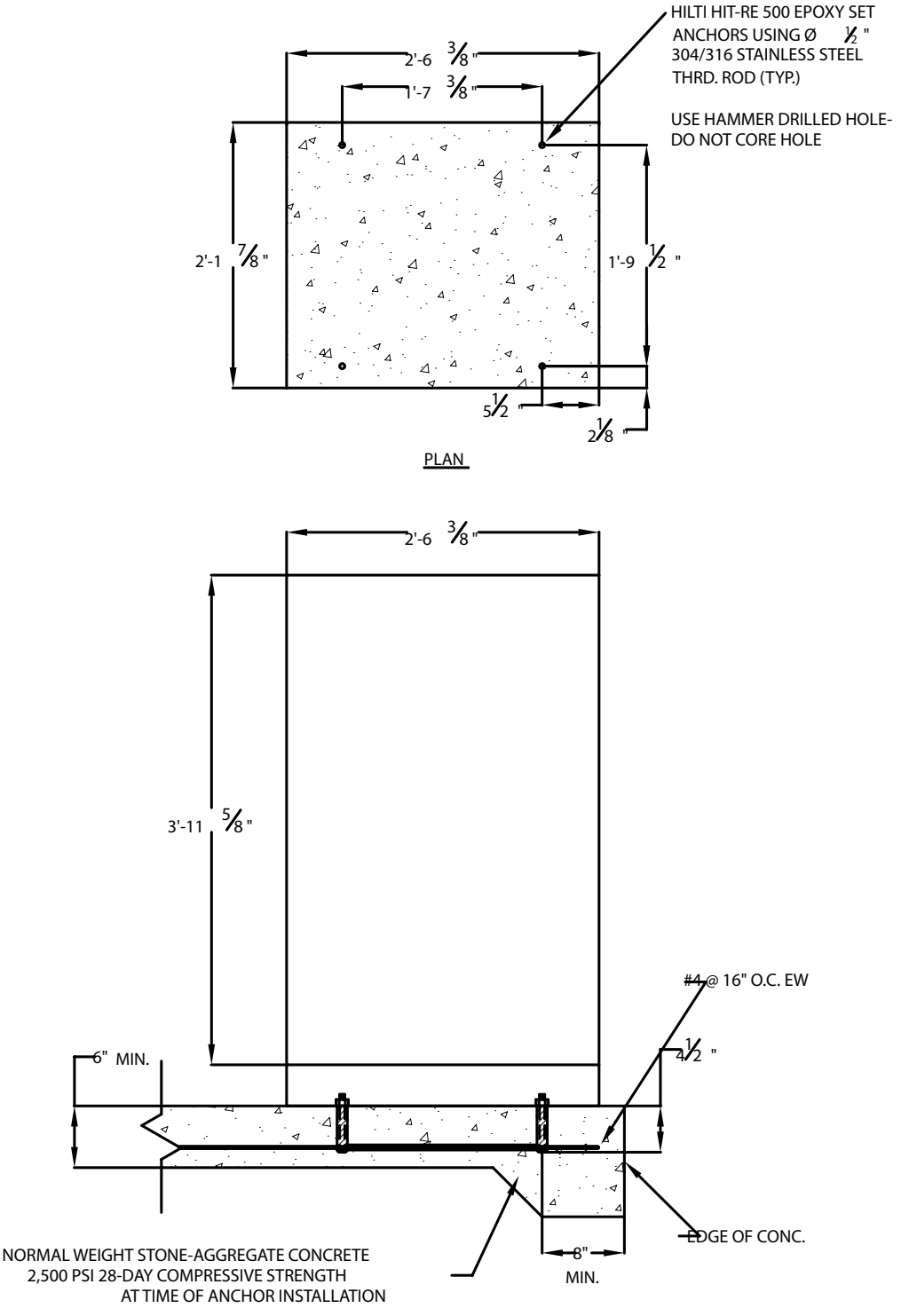
APPENDIX B

Notes

Appendix C - Mechanical Drawings



C-1 Mechanical Drawings



C-2 Seismic Anchoring Drawings

Appendix D - Limits and Fault Codes

Condition	Factory setting (VAC) or (Hz)	Range (VAC)	Maximum Trip Time (s)
208VAC Configuration			
Voltage phase high	132.0	132.0 – 144.0	1.0
Voltage phase low	105.6	94.0 – 105.6	2.0
Voltage phase fast high	144.0	144.0 – 156.0	0.16
Voltage phase fast low	60.0	60.0	0.16
480VAC Configuration			
Voltage phase high	304.8	304.8 – 332.5	1.0
Voltage phase low	243.9	216.1 – 243.9	2.0
Voltage phase fast high	332.5	332.5 – 360.2	0.16
Voltage phase fast low	138.6	138.6	0.16
All Configurations			
Line frequency low	59.3 Hz	59.3	0.16
Line frequency high	60.5 Hz	60.5	0.16

Table D-1 Voltage and Frequency Limits

Fault code	Fault name	Fault description
8000 0000	GATE DRIVER	Generated by the power electronics module to protect itself.
1000 0800	PLL FAULT	The inverter was unable to match the grid frequency; usually caused by an unstable power grid.
1000 0400	AC OVER VOLT	The grid voltage exceeded inverter specification limits.
1000 0200	AC UNDER VOLT	The grid voltage dipped below the inverter specification AC limits.
1000 0100	AC UNDER FREQ	The grid frequency went below the inverter specification limits.
1000 0080	AC OVER FREQ	The grid frequency went above the inverter specification limits.
1000 0020	DC UNDER VOLT	The DC voltage is below the startup voltage. This fault only displays in conjunction with another fault. Example: 1000 0220 is an AC low and a DC low. (DC could be low because of night time or DC disconnect turned off.)
1000 0010	DC OVER VOLT	DC Voltage is above 600V; immediately turn OFF the DC disconnect. The inverter will restart when the voltage is back within safe operating conditions.
1000 0002	POWER_P15	Housekeeping DC power supply 15VDC is out of tolerance.
1000 0001	POWER_P05	Housekeeping DC power supply 5VDC is out of tolerance.
0400 0000	GROUND	The inverter detected that the GFDI fuse is blown. This fault requires an AC power cycle to reset.
0200 0000	LOW POWER	The inverter shut down because it was producing less than 60W for 5 minutes. The inverter will try to restart in 10 minutes.
0100 0000	CPU LOAD	Firmware fault; call PV Powered Technical Support.
0040 0000	OVER CURRENT	Safety protection: the inverter tried to produce too much current.
0020 0000	PRECHARGE	The inverter experienced trouble starting up the transformer. If this occurs again, contact PV Powered Technical Support.
0004 0000	HEATSINK_TMP	The heat sink is above or below the operating limits of -25°C to 95°C.
0002 0000	WD TIMER	The CPU experienced a watch dog fault. If this occurs again, contact PV Powered Technical Support. This fault requires an AC power cycle to reset.
0001 0000	AMBIENT TMP	The Ambient temperature detected inside the inverter is outside normal operating limits.

Table D-2 Fault Codes

Appendix E - Annual Maintenance Requirements Checklist

Item #	Requirement	✔
A	**General Inspection & Cleaning**	
1	Record general site conditions	
2	Record inverter performance data from inverter display	
3	Record environmental conditions	
4	Remove dirt and debris from underneath inverter	
5	Inspect and clean interior of inverter	
6	Inspect air filter and replace or clean	
7	Confirm presence of required site-specific safety equipment	
8	Confirm presence of product documentation	
B	**Connections and Wiring**	
9	Complete visual inspection of electrical connections and wiring	
10	Complete mechanical inspection of connections and wiring	
11	Measure torque of all electrical connections and re-torque as needed	
12	Complete thermal scan of inverter connections, wiring and electronics	
C	**Testing**	
13	Confirm inverter operating modes including standby, startup and on	
14	Check operation of protective circuits and alarms	
15	Check operation of relays and contactors	
16	Confirm power supply and transformer outputs	
17	Validate display data accuracy	
D	**Repair or Replace**	
18	Repair or replace items that have been determined to be near end of their useful life	
E	**Reporting**	
19	Complete preventative maintenance report and recommendations	

Table E-1 Annual Maintenance Requirements Checklist

Notes

Index

G

I

J

L

M

N

O

P

R

S

T

U

V

W

PVPowered™ 150 SW Scalehouse Loop • Bend, OR 97702 • P: 541-312-3832 • www.pvpowered.com