



# FLEXpower™ ONE

## Installation Manual



## About OutBack Power Technologies

OutBack Power Technologies is a leader in advanced energy conversion technology. OutBack products include true sine wave inverter/chargers, maximum power point tracking charge controllers, and system communication components, as well as circuit breakers, batteries, accessories, and assembled systems.

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OutBack Power Technologies warrants that the products it manufactures will be free from defects in materials and workmanship for a period of five (5) years subject to the conditions set forth in the warranty detail found inside the back cover of this manual.

OutBack Power Technologies cannot be responsible for system failure, damages, or injury resulting from improper installation of their products.

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## Date and Revision

November 2011, Revision B

## Part Number

900-0102-01-00 Rev B

# Important Safety Instructions

## READ AND SAVE THESE INSTRUCTIONS!

This manual contains important safety instructions for the FLEXpower ONE. Read all instructions and cautionary markings on the FLEXpower ONE and on any accessories or additional equipment included in the installation. Failure to adhere to these instructions could result in severe shock or possible electrocution. Exercise extreme caution at all times to prevent accidents.

### Symbols Used

Symbol	Description
	Ground
	AC Current
	DC Current
	Single-Phase
	Sine Wave

**WARNING: Hazard to Human Life**

This type of notation indicates that the hazard could be harmful to human life.

**CAUTION: Hazard to Equipment**

This type of notation indicates that the hazard may cause damage to the equipment.

**IMPORTANT:**

This type of notation indicates that the information provided is important to the installation, operation and/or maintenance of the equipment. Failure to follow the recommendations in such a notation could result in voiding the equipment warranty.

# Important Safety Instructions

## Audience

These instructions are for use by qualified personnel who meet all local and governmental code requirements for licensing and training for the installation of electrical power systems with AC and DC voltage up to 240 Vac and 150 Vdc.

## Definitions

The following is a list of initials, terms, and definitions used with this product.

**Table 1 Terms and Definitions**

Term	Definition
AC	Alternating Current; refers to voltage produced by the inverter, utility grid, or generator
DC	Direct Current; refers to voltage produced by the batteries or renewable source
DCC	DC Cover
DVM	Digital Voltmeter
GFDI	Ground Fault Detector Interruptor; a safety device for PV systems
Grid-interactive, grid-intertie, grid-tie	Utility grid power is available for use and the inverter is capable of returning (selling) electricity back to the utility grid
NEC	National Electric Code (North America)
Off-grid	Utility grid power <b>is not</b> available for use
On-grid	Utility grid power is available for use (does not imply grid-interactive capability)
PV	Photovoltaic
RTS	Remote Temperature Sensor; accessory that measures battery temperature for charging
Turbo Kit	External cooling fan used in place of the DCC on sealed FX inverters
UL	Underwriters Laboratories; refers to a set of safety standards governing electrical products
Utility grid	The electrical service and infrastructure supported by the electrical or utility company; also called "mains", "utility service", or "grid"

## General Safety

	<b>WARNING: Limitations on Use</b> This equipment is NOT intended for use with life support equipment or other medical equipment or devices.
	<b>CAUTION: Equipment Damage</b> Only use components or accessories recommended or sold by OutBack Power Technologies or its authorized agents.
	<b>IMPORTANT:</b> Do not attempt to install this equipment if it appears to be damaged in any way. See the Warranty section for instructions on returning the equipment.

## Personal Safety

	<b>WARNING: Personal Injury</b> <ul style="list-style-type: none"><li>➤ This equipment weighs approximately 98 lbs (44.5 kg). Use safe lifting techniques when lifting this equipment as prescribed by the Occupational Safety and Health Association (OSHA) or other local codes.</li><li>➤ Use standard safety equipment such as safety glasses, ear protection, steel-toed safety boots, safety hard hats, etc. as prescribed by the Occupational Safety and Health Association (or other local codes) when working on this equipment.</li><li>➤ Use standard safety practices when working with electrical equipment (e.g., remove all jewelry, use insulated tools, wear cotton clothing, etc.)</li><li>➤ Never work alone when installing or servicing this equipment. Have someone nearby that can assist if necessary.</li></ul>
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## FLEXpower ONE System Safety

	<b>WARNING: Lethal Voltage</b> <ul style="list-style-type: none"><li>➤ Review the system configuration to identify all possible sources of energy. Ensure ALL sources of power are disconnected before performing any installation or maintenance on this equipment. Confirm that the terminals are de-energized using a validated voltmeter (rated for a minimum 1000 Vac and 1000 Vdc) to verify the de-energized condition.</li><li>➤ Do not perform any servicing other than that specified in the installation instructions unless qualified to do so or as instructed to do so by OutBack Power Technologies Technical Support personnel.</li></ul>
	<b>WARNING: Burn Hazard</b> Internal parts can become hot during operation. Do not remove the cover during operation or touch any internal parts. Be sure to allow them sufficient time to cool down before attempting to perform any maintenance.

## Important Safety Instructions



### **WARNING: Fire Hazard**

- In residential installations: check for multi-wire branch circuit wiring at the location for the installation. A possible fire hazard can exist if AC sources (such as inverters and generators) that only generate 120 Vac are wired incorrectly into 120/240 Vac panels containing multi-wire branch circuits. Consult the local electric code for assistance.
- Do not place combustible or flammable materials within 12 feet (3.7 m) of the equipment.
- Use only the recommended cable sizes (or greater) for AC and DC conductors in compliance with local codes. Ensure all conductors and connections are in good condition. Do not operate the unit with damaged or substandard cabling.



### **CAUTION: Equipment Damage**

- When connecting cables from the inverter to the battery terminals, ensure the proper polarity is observed. Connecting the cables incorrectly can damage or destroy the equipment.
- Thoroughly inspect the equipment prior to energizing. Verify that no tools or equipment have been inadvertently left behind.
- Ensure clearance requirements are strictly enforced and that all vents are clear of obstructions that can prevent proper air flow around or through the unit.
- Sensitive electronics inside the equipment can be destroyed by static electricity. Be sure to discharge any static electricity built up before touching the equipment and wear appropriate protective gear.

## PV Safety



### **WARNING: Shock Hazard**

Photovoltaic (PV) arrays can be energized with minimal ambient light available. Therefore to ensure a safe disconnect from the system, be sure to install a PV disconnect, circuit breaker, or accessible fuse box (depending on local code requirements).



### **CAUTION: Equipment Damage**

PV Arrays must be wired with correct polarity (positive-to-positive, negative-to-negative). Connecting the cables incorrectly can damage or destroy the equipment.

## Battery Safety



### **WARNING: Explosion, Electrocution, or Fire Hazard**

- Use the battery types recommended by OutBack Power Technologies. Follow the battery manufacturer's recommendations for installation and maintenance.
- Ensure the cables are properly sized. Failure to size the cables properly can result in a fire hazard.
- Ensure clearance requirements are strictly enforced around the batteries.
- Ensure the area around the batteries is well ventilated and clean of debris.
- Never smoke, or allow a spark or flame near, the batteries.
- Always use insulated tools. Avoid dropping tools onto batteries or other electrical parts.
- Keep plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
- Wear complete eye and clothing protection when working with batteries. Avoid touching bare skin or eyes while working near batteries.
- If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters the eye, immediately flood it with running cold water for at least 20 minutes and get medical attention as soon as possible.
- Never charge a frozen battery.
- Insulate batteries as appropriate against freezing temperatures. A discharged battery will freeze more easily than a charged one.
- If a battery must be removed, always remove the grounded terminal from the battery first. Make sure all devices are de-energized or disconnected to avoid causing a spark.
- If a remote or automatic generator control system is used, disable the starting circuit and/or disconnect the generator from its starting battery while performing maintenance to prevent accidental starting.



### **IMPORTANT:**

Baking Soda neutralizes lead-acid battery electrolyte.  
Vinegar neutralizes NiCad and NiFe battery electrolyte.  
Have a supply of either substance readily available if using these types of batteries.

### Regulatory Specifications

See the individual manuals for each component for all specifications and regulatory information, including certifications.

### Required Resources

This product is required to be installed according to pertinent safety codes and standards. If installed in the United States, wiring practices must meet the requirements of the National Electrical Code (NEC). If installed in Canada, wiring practices must meet the requirements of the Canadian Electrical Code.

- National Electrical Code (NEC)/NFPA 70, Current Edition
- Canadian Electrical Code, C22.1, Current Edition

### Additional Resources

These references may be used when installing this equipment. Depending on the nature of the installation, it may be highly recommended to consult these resources.

- National Electrical Code (NEC)/NFPA 70 Handbook, Current Edition
- UL 1741, Current Edition, Static Inverter and Charge Controllers for Use in Photovoltaic Power Systems
- International Building Code (IBC), Current Edition
- Photovoltaic Power Systems and the 2005 National Electrical Code: Suggested Practices

## Recycling Information



### **IMPORTANT: Recycle Electronics and Batteries**

Batteries are considered hazardous waste and must be recycled according to local jurisdiction. Inverters and other electronics contain metals and plastics that should also be recycled. The following web sites and phone numbers provide additional information for recycling electronic products and batteries.

### **Earth 911, USA**

Web site: <http://www.Earth911.com>  
Address: 14646 N. Kierland Blvd., Suite 100  
Scottsdale, AZ 85254  
Phone: +1.480.337.3025 (direct)

### **OurEarth.org, USA**

There is a place on the website for contacting OurEarth.org using email. No direct email address is provided.

Web site: <http://www.ourearth.org>  
Address: P.O. Box 62133  
Durham, NC 27715  
Phone: +1.410.878.6485

### **Environmental Protection Agency, USA**

Web site: <http://www.epa.gov/wastes/consERVE/materials/ecycling/donate.htm>  
Address: EPA USA  
Office of Resource Conservation and Recovery (5305P)  
1200 Pennsylvania Avenue NW  
Washington, DC 20460

### **Keep America Beautiful, USA**

Web site: <http://www.kab.org/>  
Email: [info@kab.org](mailto:info@kab.org)  
Address: 1010 Washington Boulevard  
Stamford, CT 06901  
Phone: +1.203.659.3000 (Main number)  
Fax: +1.203.659.3001

### **National Institute of Recyclers, Mexico**

Web site: <http://www.inare.org.mx/>  
Email: [a57841279@prodigy.net.mx](mailto:a57841279@prodigy.net.mx), [6H6Hmargarita@inare.org.mx](mailto:6H6Hmargarita@inare.org.mx)  
Phone: +1.55.57.85.9160  
Fax: +1.55.57.84.1279

### Natural Resources Canada

Web site: <http://www.nrcan-rncan.gc.ca/mms-smm/busi-indu/rec-rec-eng.htm>  
Address: 580 Booth,  
Ottawa, Ontario K1A 0E8  
Phone: +1.613.995.0947  
TTY: +1.613.996.4397  
(Phone and TTY: Monday to Friday, 8:30 a.m. to 4:30 p.m. ET)

### Office of Waste Management, Canada

Web site: [http://www.portaec.net/library/recycling/recycling\\_in\\_canada.html](http://www.portaec.net/library/recycling/recycling_in_canada.html)  
Address: Office of Waste Management  
Conservation and Protection  
Environment Canada  
Ottawa, Ontario K1A 0H3  
Phone: +1.819.997.2800

### EuroRecycle.net, Europe

The following website provides general information about recycling in Europe. It also provides a list of companies and organizations that provide recycling information or assistance.

Web site: <http://euro.recycle.net>  
E-mail: <http://euro.recycle.net/cgi-bin/feedback1.cgi?w=27>  
(This is an online form providing a means to contact the owners of the website.)



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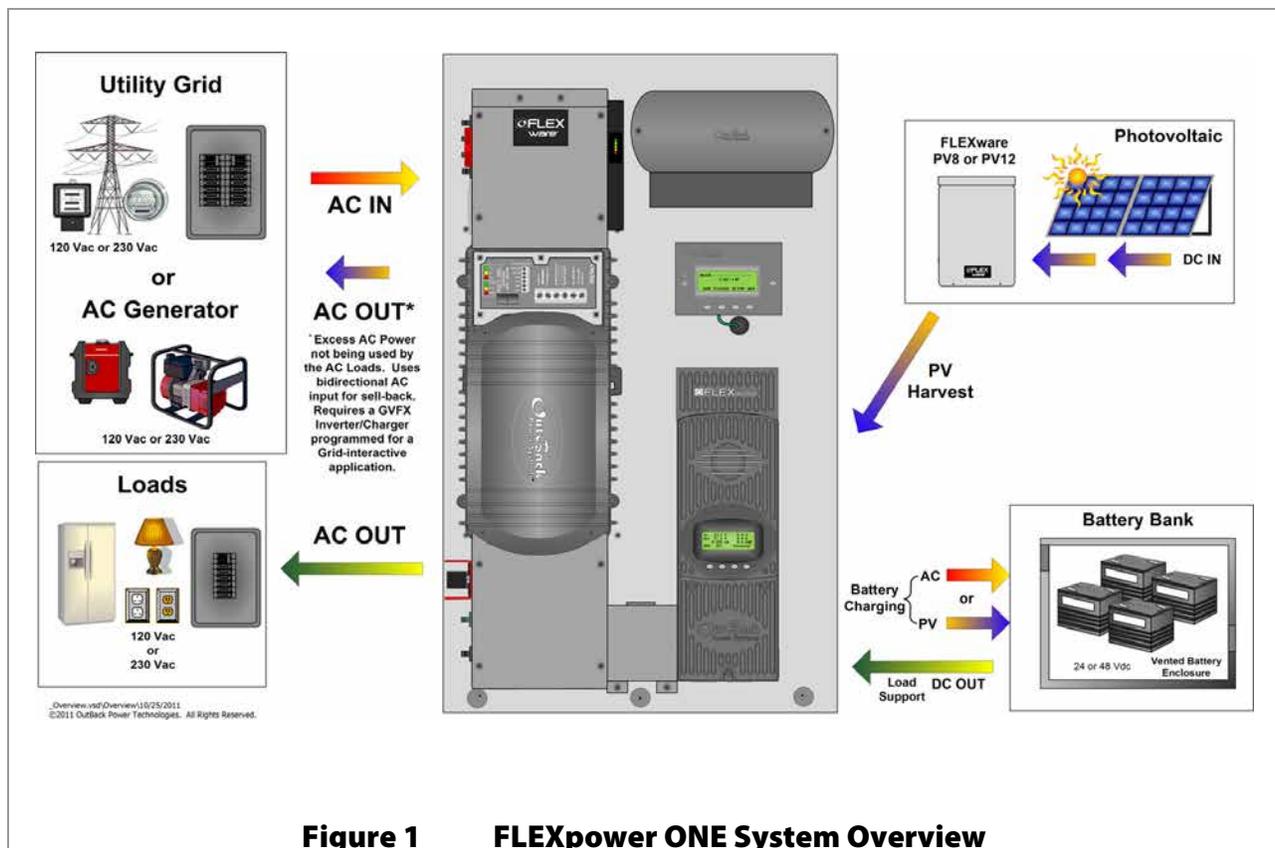
# Introduction

Thank you for choosing a FLEXpower ONE system from OutBack Power Technologies. FLEXpower ONE is an integrated power system solution designed to be quick to install and easy to use.

The FLEXpower ONE system is intended for off-grid and on-grid applications up to 3.6 kW. It is intended for use with photovoltaic (PV) modules for harvesting energy and a battery bank for energy storage. FLEXpower ONE can also be configured as “grid-interactive” meaning that excess energy (energy that exceeds usage) will be returned to the grid (Sell Mode).

The FLEXpower ONE system is designed with combinations of the following features:

- 2.5, 3.0, 3.5, and 3.6 kW inverters
- 120 Vac/60 Hz configurations or 230 Vac/50 Hz configurations
- Rated for indoor installations
- Includes mounting bracket for wall-mounting
- Charge controller uses MPPT technology to maximize the harvest from solar modules
- Grid-interactive capable (requires a configuration that features a GVFX inverter)
- Battery status monitor takes independent shunt measurements of PV and inverter power
- Includes OutBack’s surge protector for additional protection against damaging power surges

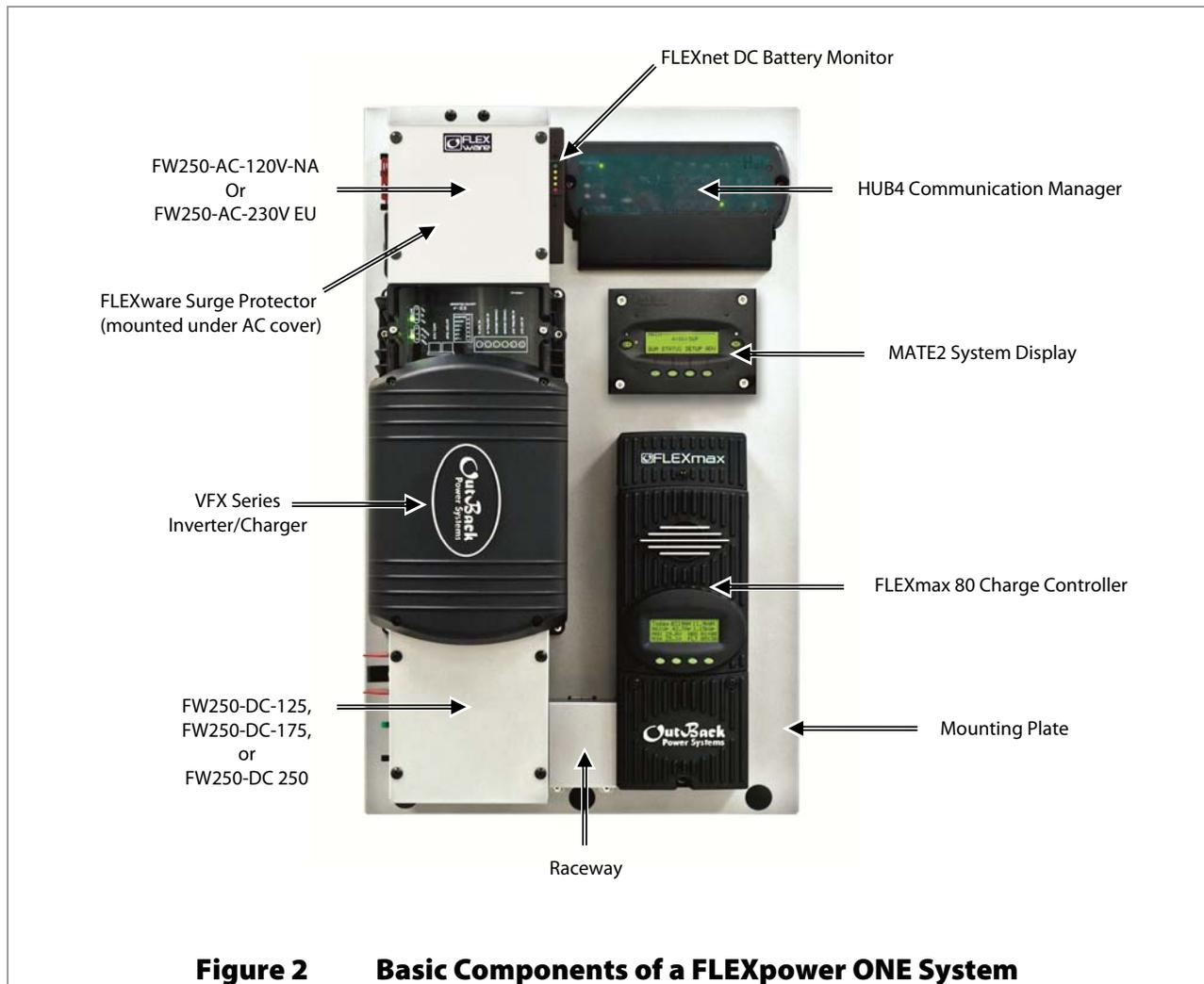


## Components

A complete FLEXpower ONE is composed of the following components. Some configurations do not include certain options. See page 51 for details on specific configurations.

**Table 2 Basic Components of a FLEXpower ONE System**

Components	Documentation
FX Series Inverter/Charger (FX, VFX, GTFX, or GVFX)	FLEXpower ONE Installation Manual (this book)
Mounting Plate (with mounting bracket)	
MATE2 System Display and Controller	
AC Enclosure (120 V-NA or 230 V-EU)	<b>Additional Reference Documents</b>
DC Enclosure (125 A, 175 A, or 250 A)	
FLEXnet DC Battery Monitor	MATE Series Owner's Manual
FLEXmax 80 Charge Controller	FLEXnet DC User's Guide
Raceway	FX or Grid-Interactive Programming Manual
HUB4 Communication Manager	FLEXmax 80 User's Manual
FLEXware Surge Protector	HUB4 Communication Manager User's Manual



**Figure 2 Basic Components of a FLEXpower ONE System**



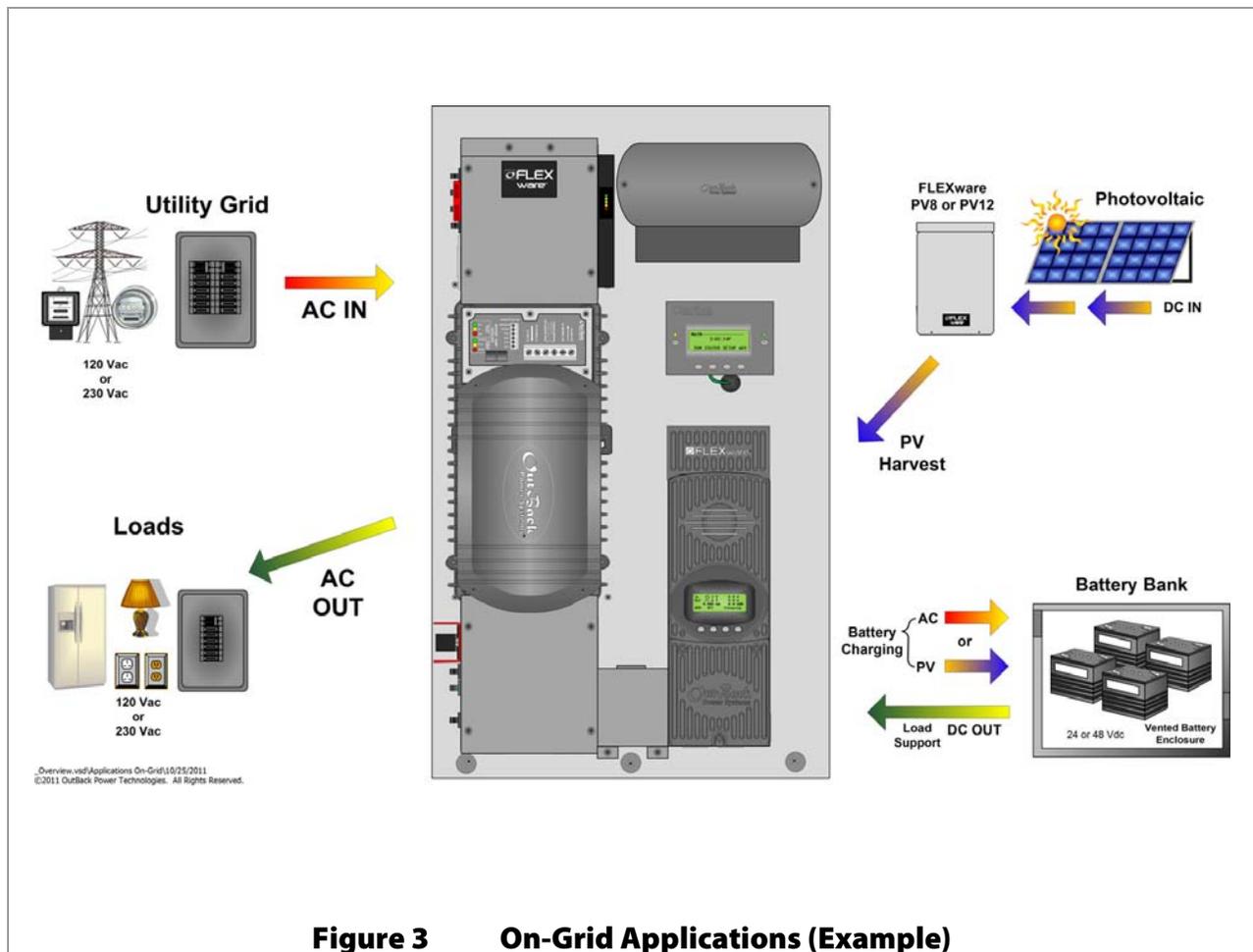
# Planning

## Applications

The FLEXpower ONE is intended for on-grid, off-grid, and grid-interactive applications. It is designed to use photovoltaic (PV) panels to harvest solar energy and a battery bank to store the harvested energy.

### On-Grid Applications

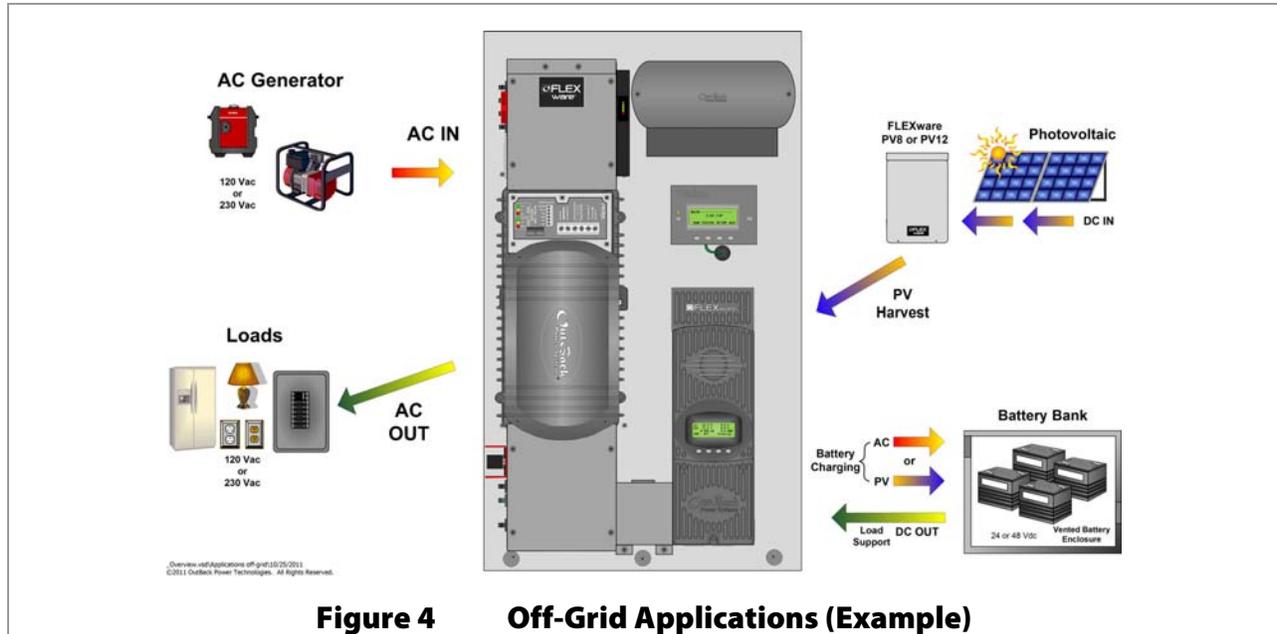
In on-grid applications, the FLEXpower ONE can use the grid power as the primary power source or as the backup source of power. If the FLEXpower ONE is used as backup to the grid, the FLEXpower ONE will take over when the grid fails. If the FLEXpower ONE is used as the primary source, the grid power will be used when the batteries have been drained. In this situation, the AC power or PV harvest can be used to recharge the battery bank.



**Figure 3 On-Grid Applications (Example)**

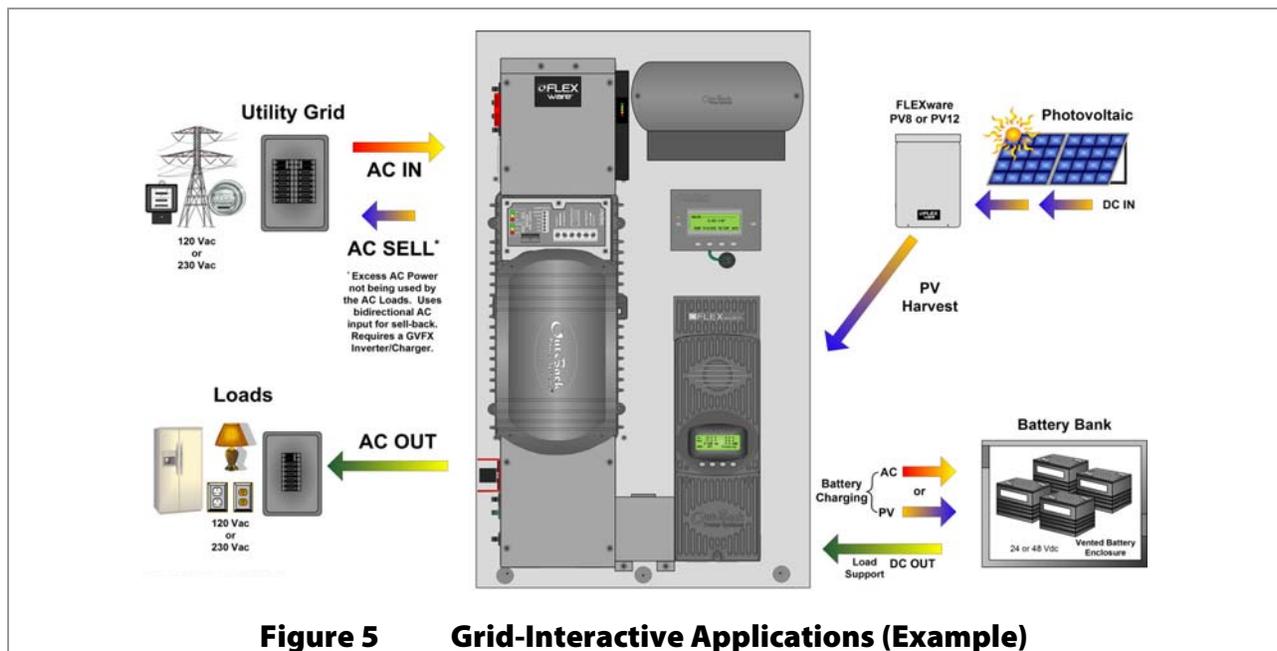
## Off-Grid Applications

In off-grid applications, the FLEXpower ONE can use the harvested energy from the battery bank as the primary power source. An AC generator can also be connected to support the system when required.



## Grid-Interactive Applications

In grid-interactive applications, grid power is used to run the loads. When excess PV is available from the batteries, the FLEXpower ONE supports those loads with the PV. When the PV exceeds the load requirements, the FLEXpower ONE sells that excess power back through its input, to the utility grid. When the utility grid is not available, the FLEXpower ONE takes over to run the loads with PV and energy stored in the battery bank.



## PV Array Planning

The FLEXpower ONE is designed to use PV input to charge the battery bank. The FLEXmax 80 charge controller(s) integrated into the FLEXpower ONE system uses maximum power point tracking (MPPT) technology to maximize the PV harvest. A PV Combiner box (not included) may be required for multiple PV strings. PV combiner boxes are available from OutBack Power Technologies for 8 to 12 PV strings.

FLEXpower ONE includes one FLEXmax 80 Charge Controller. The charge controller allows input from a single PV array. The PV input can support the following PV sizes.

- 4,000  $W_{STC}$  on 48 Vdc system, 2,000  $W_{STC}$  on 24 Vdc system
- 150  $V_{OC}$  including local temperature correction factor per NEC 690.7
- 64 A  $I_{SC}$  maximum PV array current per NEC 690.8

For a PV planning tool, see the following website.

[http://outbackpower.com/resources/string\\_sizing\\_tool/](http://outbackpower.com/resources/string_sizing_tool/)

## Battery Bank Planning

### Types of Batteries

- The FLEXpower ONE system supports a 24 or 48 Vdc battery bank, depending on the inverter that is featured in the configuration. Before constructing a battery bank, check the model number on the side of the inverter to confirm the nominal battery voltage.
- A vented enclosure for the battery bank may be required by electric code.

### Bank Sizing

In general, the size of the loads (watts) and the required backup period (hours) will determine best size for the battery bank. To calculate this, use the information provided on page 56 through page 60. Worksheets are provided for assistance.

# Generator Requirements



### IMPORTANT:

- All connections must comply with local electric code.
- Generator grounding and neutral-to-ground bonding should be provided in accordance with specific system configuration and national/local code requirements.
- Follow the manufacturer's recommendations for fuel type and maintenance.

The following are general requirements for using a generator with the FLEXpower ONE.

- Electrical requirements
  - ~ North American applications: 120 Vac / 60 Hz
  - ~ European applications: 230 Vac / 50 Hz
- Minimum available generator power should be equal to or greater than nominal inverter rating<sup>1</sup>.
  - ~ A generator with a derated power specification smaller than that of the inverter may not be able to handle all downstream AC loads and/or the built-in battery charger.
  - ~ A generator with a derated power specification larger than that of the inverter may be required to handle the built-in battery charger as well as all downstream AC loads.
  - ~ Available power from the generator may be further limited by ratings for circuit breakers and/or generator output connectors. "Full" generator output power may not be available from a single generator connector.
  - ~ Generator sizing may be affected by startup surge current requirements of 3x to 6x normal operating current for some loads (i.e., motors with large loads).
  - ~ The inverter and/or downstream loads may have difficulty operating from poorly-regulated generators (voltage, frequency, load).
- Grid-interactive inverters typically require inverter-type generators.
- Split-phase generators (i.e., 120/240 Vac / 60 Hz) can be adapted to a single-phase inverter using an autotransformer such as the PSX-240 or the FW-X240. For additional information, see...
  - ~ PSX-240 Manual: [http://www.outbackpower.com/pdf/manuals/PSX-240\\_Installation\\_Manual.pdf](http://www.outbackpower.com/pdf/manuals/PSX-240_Installation_Manual.pdf)
  - ~ FW-X240 Manual: <http://www.outbackpower.com/pdf/manuals/fw-x240.pdf>
- The OutBack MATE can be used to program an inverter's AUX output to start and stop a generator. This 12 V output can often control a two-wire-start generator directly. Three-wire-start generators require an interface such as an Atkinson module. For additional information, see the following.
  - ~ OutBack Power Technologies AGS Brochure: [http://www.outbackpower.com/pdf/brochures/Automatic\\_Generator\\_Start.pdf](http://www.outbackpower.com/pdf/brochures/Automatic_Generator_Start.pdf)
  - ~ OutBack Power Technologies MATE Manual: <http://www.outbackpower.com/pdf/manuals/mate.pdf>
  - ~ Atkinson Electronics: <http://atkinsonelectronics.com/>

<sup>1</sup> This is the wattage value after deratings for the following: peak versus continuous power, load power factor considerations, fuel type, altitude, and ambient temperature.

## Preparation

### Tools Required

The following tools may be required for installing this equipment.

- Wire cutters/strippers
- Torque wrenches
- Assorted insulated screwdrivers
- Drill and drill bits
- Ratchet drives
- Digital voltmeter

### Materials Required

The following materials may be required for installing this equipment.

- Conductors for wiring
- Conduits, bushings
- Anchor bolts (x4) or screws (x6) for mounting
- Plywood (optional, for additional wall support)

### Accessories

The following accessories are available for purchase.

- PV8/PV12 combiner box
- See the OutBack catalog for a complete list of other parts and components that are available.

### Location

- FLEXpower ONE is rated for indoor installations.
- In areas where seismic activity is a concern, consult local code for seismic safety requirements.

### Environmental

- This unit is performance rated at 25°C (77°F). Exposure to extreme hot temperatures can reduce the unit's performance. When used in an outdoor installation, use a shading structure to avoid direct exposure to sunlight.
- The mounting surface should be vertical, smooth, and able to support three (3) times the weight of the enclosure (98 lb/44.5 kg). This may require additional support for wall-mounted installations.

# Clearance and Access Requirements



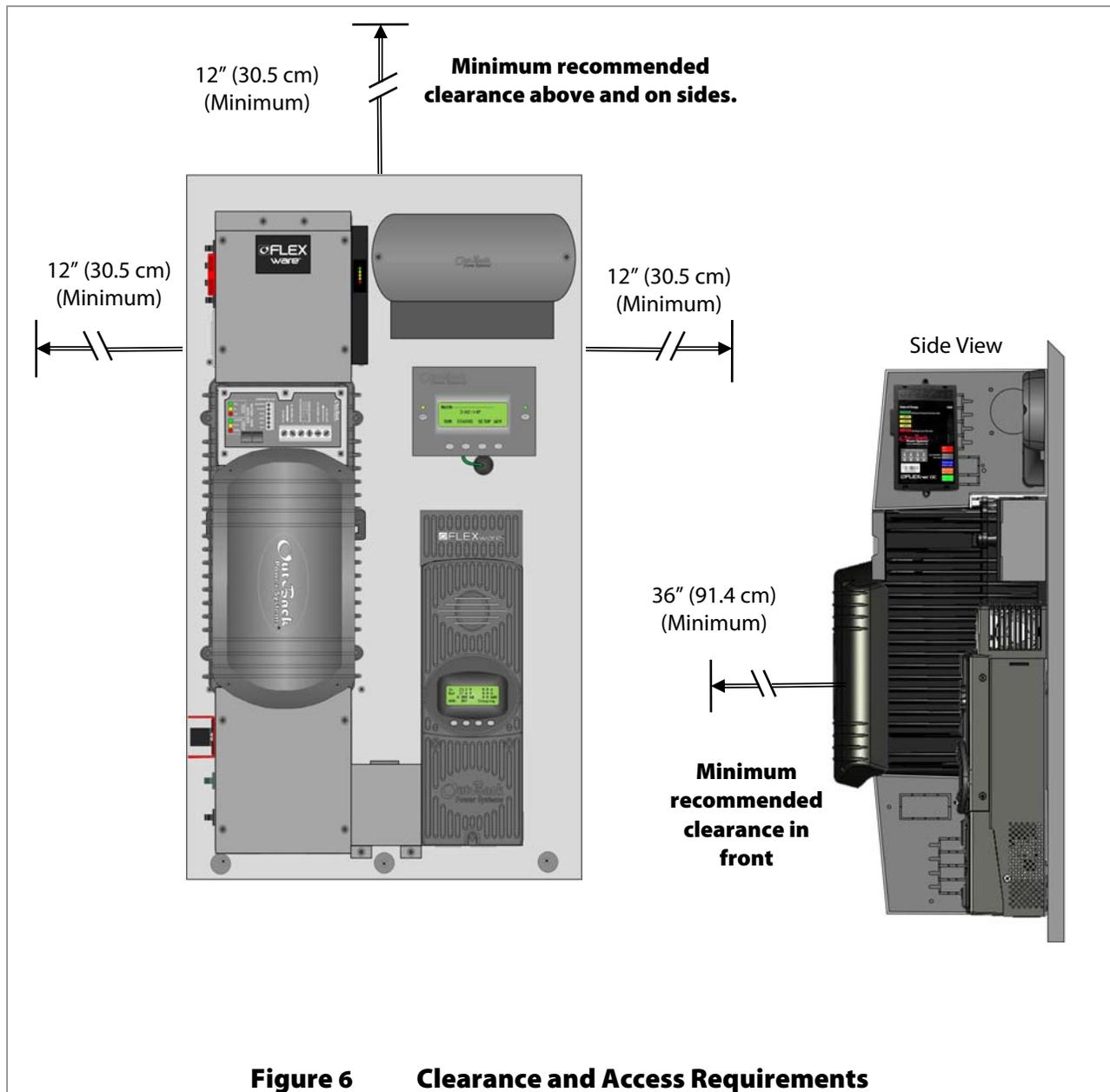
**WARNING: Fire/Explosion Hazard**

Do not place combustible or flammable materials within 12 feet (3.7 m) of the equipment. This unit employs mechanical relays and is not ignition-protected. Fumes or spills from flammable materials could be ignited by sparks.

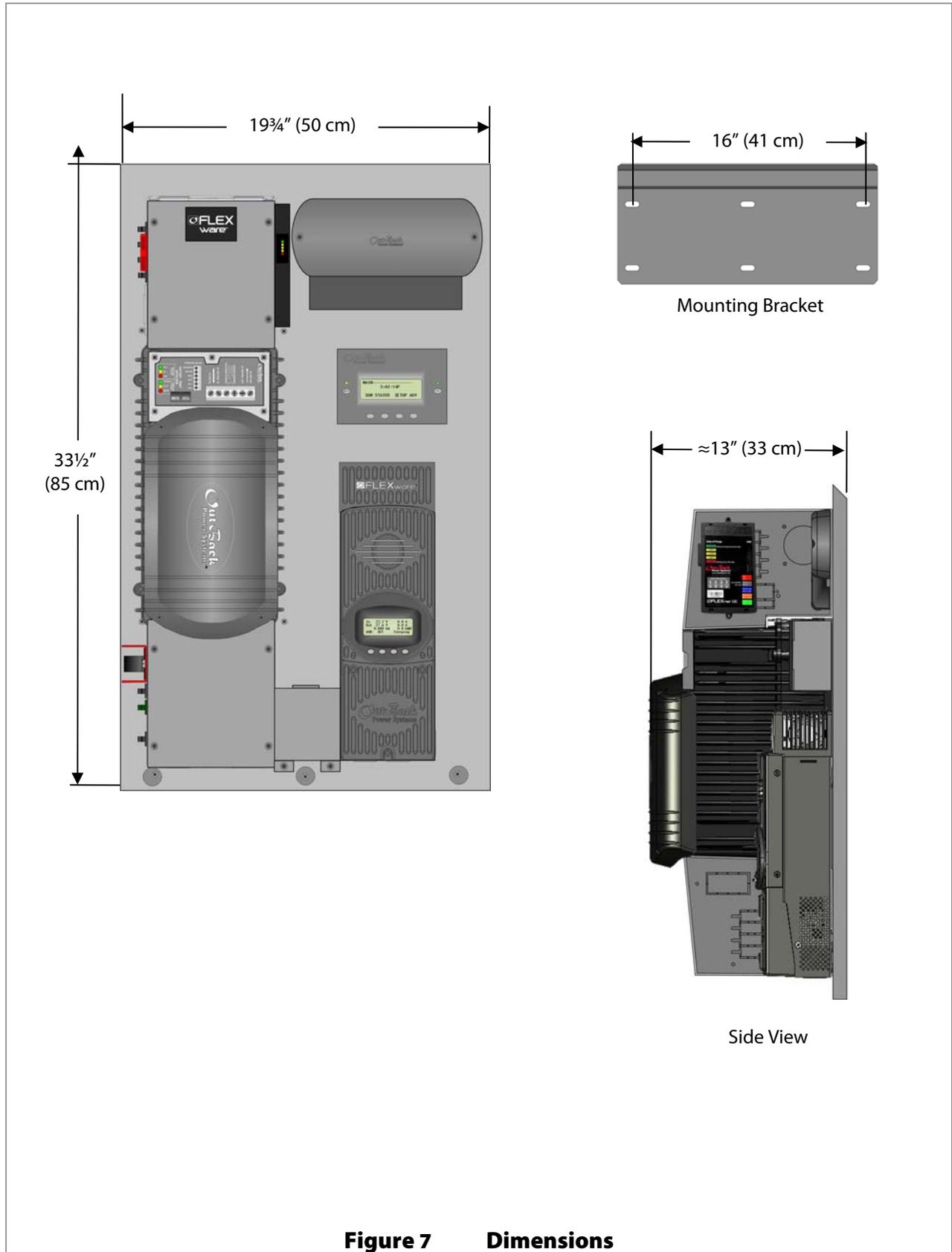


**IMPORTANT:**

Clearance and access requirements may vary by location. Maintaining a 36" (91.4 cm) clear space in front of the system for access is recommended. Consult local electric code to confirm clearance and access requirements for the specific location.



# Dimensions

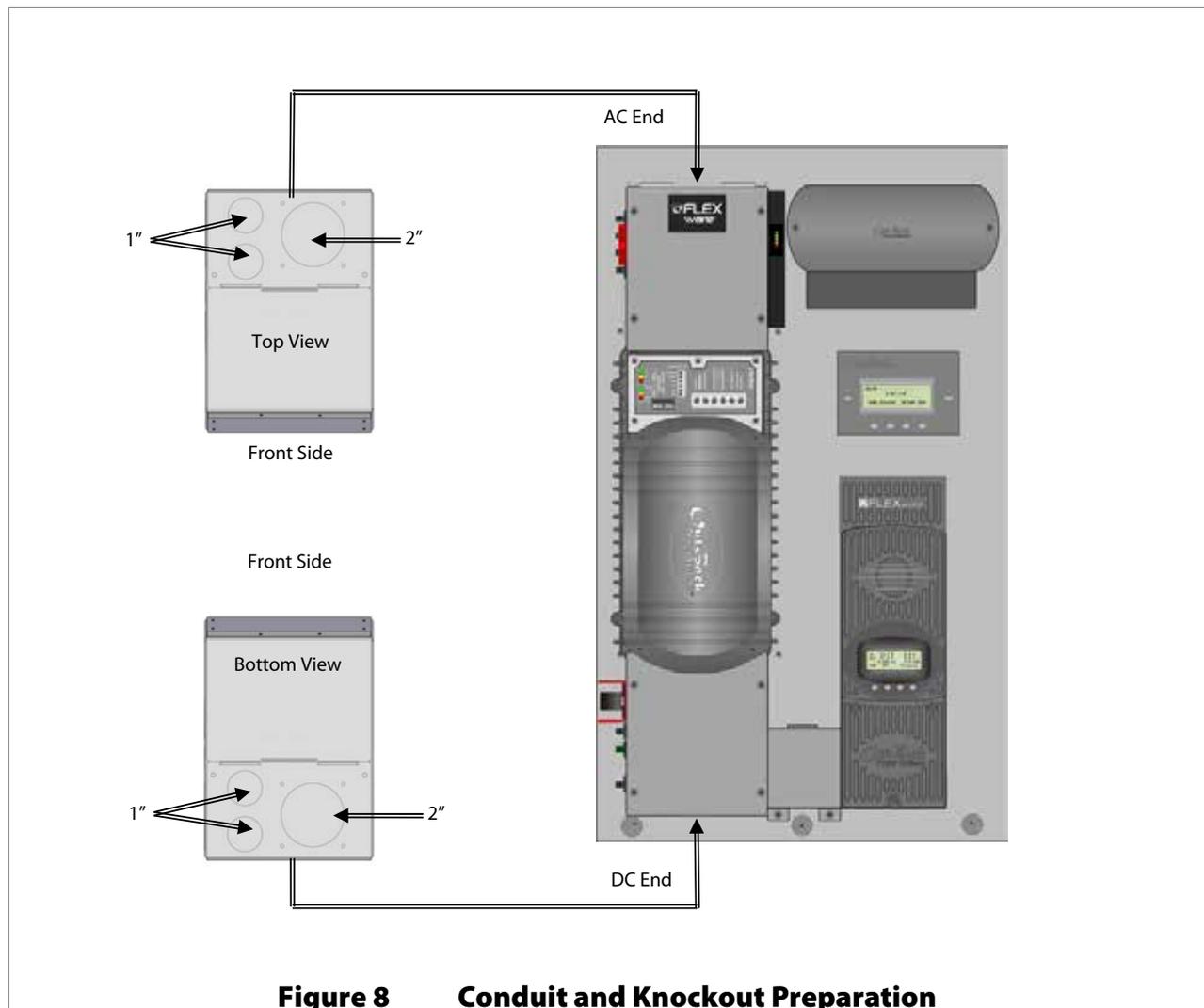


**Figure 7 Dimensions**

# Conduit and Knockout Preparation

Knockouts (two 1-inch, one 2-inch) are provided on the ends of the AC and DC enclosures for routing cable into the enclosures. Conduit and bushings are recommended to prevent damage to conductors from sharp edges along knockout holes.

1. Remove the 2-inch knockout on the DC end to accommodate the larger battery cables and Remote Temperature Sensor cable.
2. Remove the 1-inch knockout(s) on the AC end to accommodate the AC cabling.
3. Install conduit and bushings to protect the cable from damage from the sharp edges of the hole.
4. Ensure no debris or metal shavings have fallen into the enclosures.





# Installation

The FLEXpower ONE system is designed for flexibility and easy installation. The system comes attached to a mounting plate with the selected components pre-installed and wired. The Mounting Plate connects to a mounting bracket that attaches to a wall.



## **WARNING: Personal Injury**

- This equipment weighs 98 lb (44.5 kg). Use safe lifting techniques when lifting this equipment as prescribed by the Occupational Safety and Health Association (OSHA) or other local codes.
- Use standard safety equipment such as safety glasses, ear protection, steel-toed safety boots, safety hard hats, etc. as prescribed by the Occupational Safety and Health Association (or other local codes) when working on this equipment.
- Use standard safety practices when working with electrical equipment (e.g., remove all jewelry, use insulated tools, wear cotton clothing, etc.)
- Never work alone when installing or servicing this equipment. Have someone nearby that can assist if necessary.

## Mounting

The FLEXpower ONE is designed to be wall-mounted, indoors. The mounting bracket has six holes in it with the outside holes measuring 16 inches center-to-center. This allows the mounting bracket to be secured to wall studs 16 inches apart. If the wall studs are 24 inches apart, the center mounting holes should be used to secure the bracket to the wall stud and the outside holes should be used for extra stability.

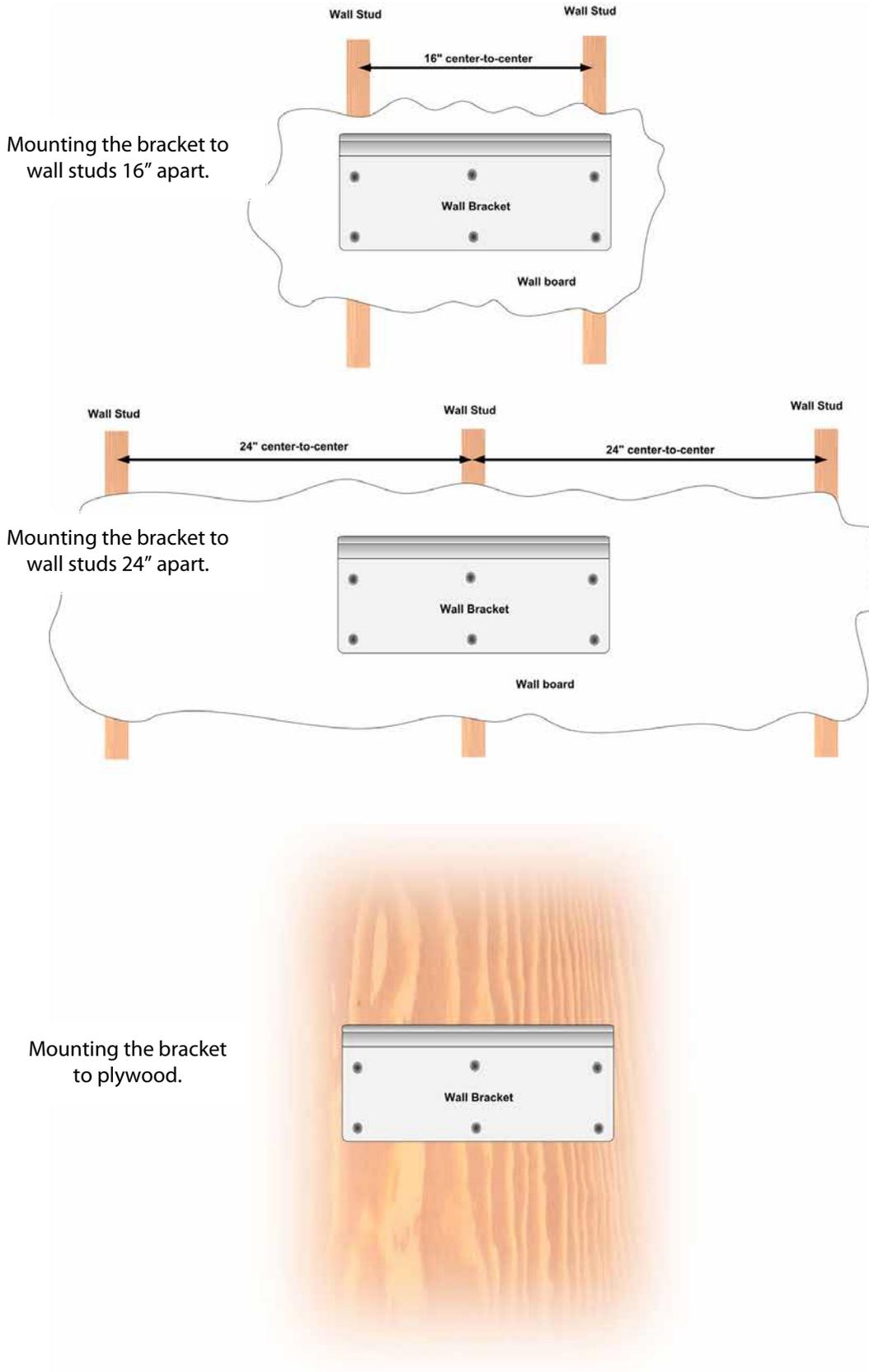


## **IMPORTANT:**

The mounting surface should be able to hold three times the combined weight of all the components. A sheet of 3/4-inch plywood may be required to meet this requirement. Check with local code to ensure regulatory compliance for stability and cabling.

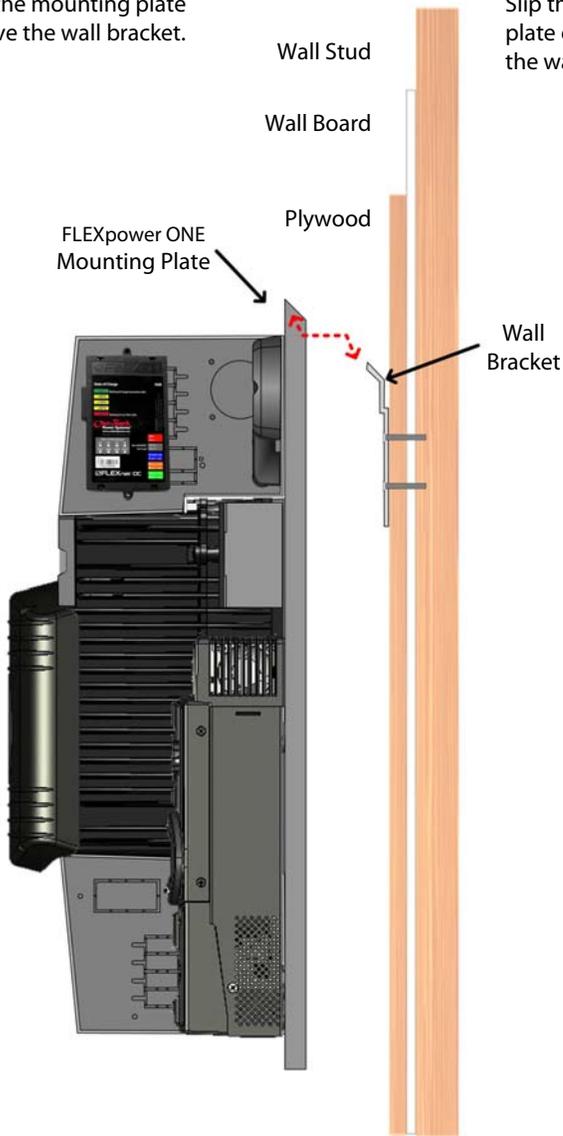
### **To install the mounting bracket:**

1. Note the height of the mounting plate as indicated in Figure 7.
2. Place the mounting bracket at the desired height for the panel. The bottom of the bracket is recommended to hang at about eye level.
3. Secure the mounting bracket to the wall as shown in Figure 9. Use all six mounting slots provided on the bracket, if possible.
4. Lift the mounting plate above the mounting bracket. Slip the top of the mounting plate over the angled lip of the mounting bracket. See Figure 10 on page 25.
5. Secure the lower back flange of the mounting plate to the wall (with appropriate hardware), using the rear flange slots as shown in Figure 10 on page 25.
6. Insert all three 1-inch nylon hole plugs into the rear slot access holes.

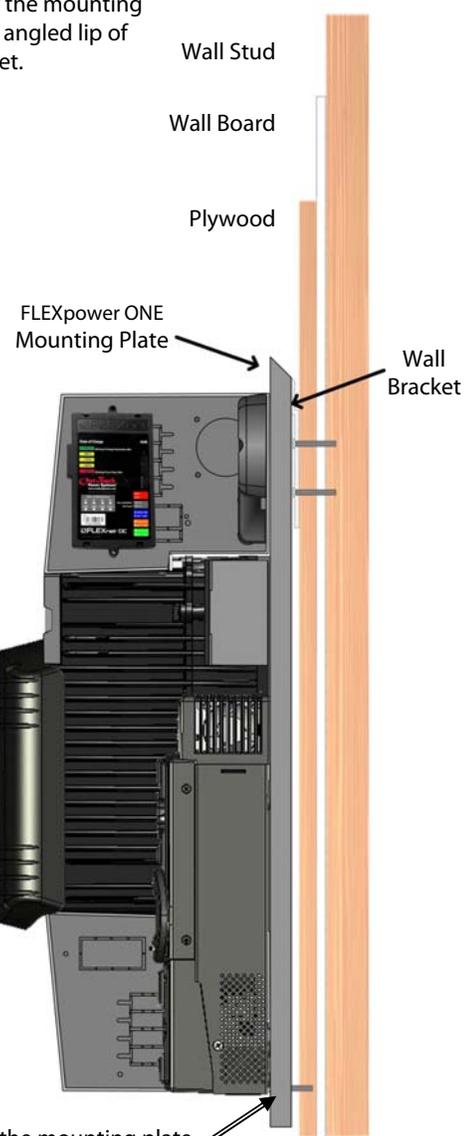


**Figure 9 Installing the Mounting Bracket**

Lift the mounting plate above the wall bracket.

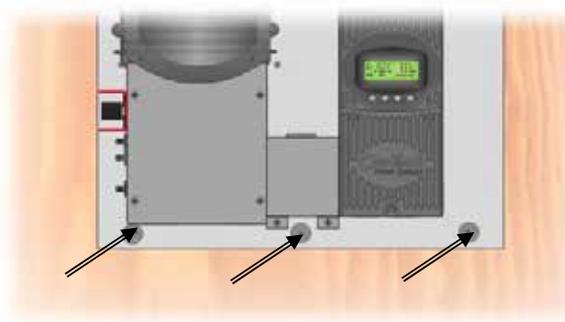


Slip the top of the mounting plate over the angled lip of the wall bracket.



Secure the mounting plate to the wall at the three locations shown below.

Secure the mounting plate to the wall at the three locations shown here.



**Figure 10 Attaching the Mounting Plate to the Mounting Bracket**

Remove the screws (x4) on the **AC Enclosure Front Cover**. Gently pull the front cover away from the chassis being careful not to disconnect or damage the wiring for the surge protector. *The front cover cannot be completely removed due to the surge protector wiring (see page 55).*

Remove the screws (x2) on the **AC Access Cover**.

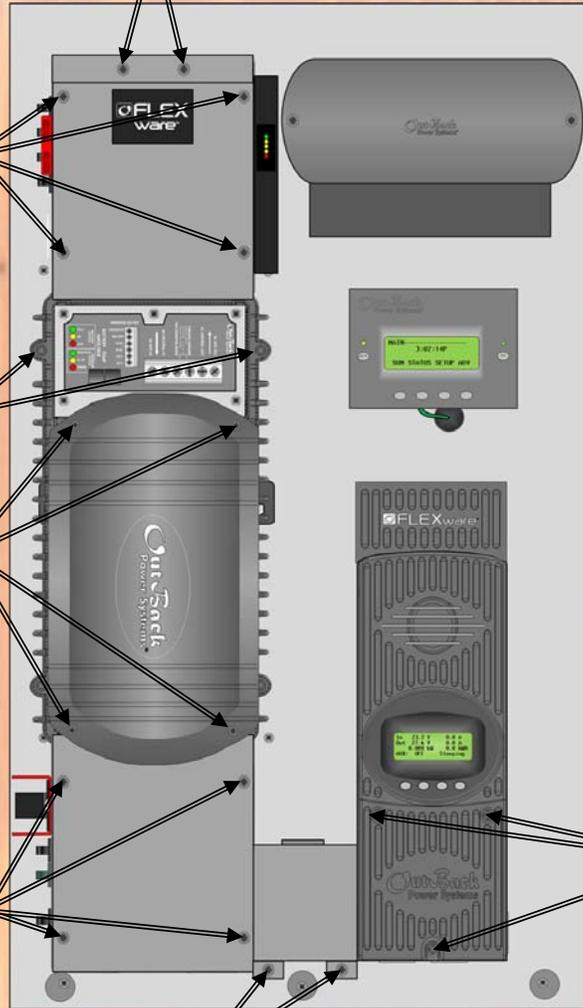
**NOTE:** The AC enclosure has two covers: the access cover and the front cover. Both covers need to be opened to make conductor connections. Once connections are made, the access cover can be used for visual inspection, so that the wiring will not be disturbed when inspected by the local electrical authority.

Remove the screws (x2) on the **Inverter Terminal Access**.

Remove the screws (x4) on the **Inverter DC Cover**.

If you have a **Turbo Fan** instead of a **DCC**, see the **FX Turbo Kit Installation Instructions** for the next step.

Remove the screws (x4) on the **DC Enclosure Front Cover**.



<sup>1</sup>Remove the screws (x3) on the **FLEXMax 80 Charge Controller**.

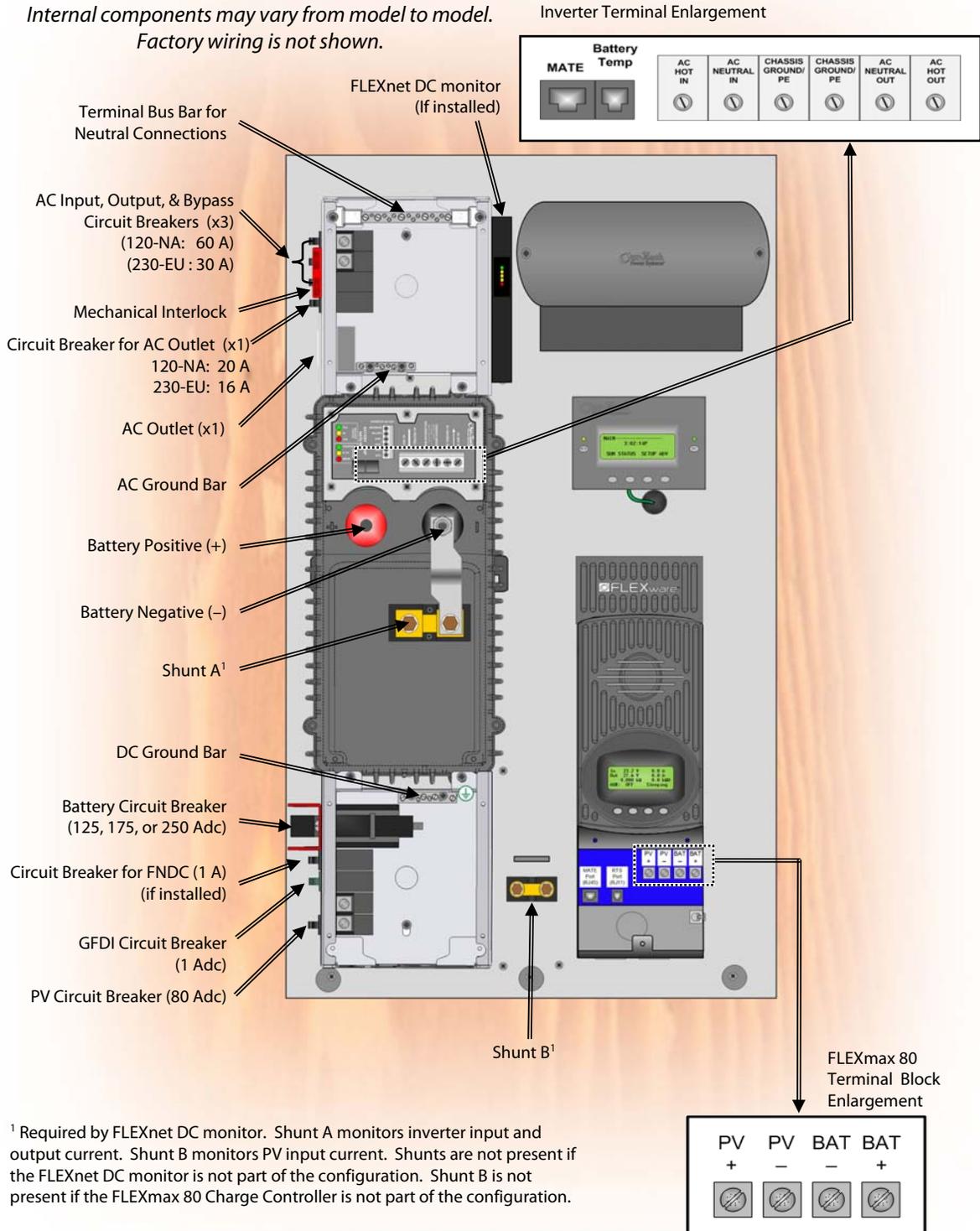
<sup>1</sup>Remove the screws (x2) on the **Raceway**.

<sup>1</sup>The raceway and front cover on the FLEXmax 80 Charge Controller only need to be removed if the FLEXnet DC monitor is included in the configuration.

**Figure 11 Removing the Covers**

# Accessing the Wiring Compartments

Internal components may vary from model to model.  
Factory wiring is not shown.



**Figure 12 Wiring and Circuit Breaker Compartments**

## Wiring



**IMPORTANT:**

- All connections must comply with local electric code. Local code may require sizes other than those recommended in this manual. For all wiring, use copper conductors rated at 75°C minimum.
- If the installation involves grid-tie activities such as selling power back to the grid, per NEC 690, ensure the total value of the circuit breakers installed in either the main AC distribution panel or the AC sub-panel does not exceed the total rating on the terminal distribution bus in the distribution panel. In other words, if the main terminal distribution bus in the panel is rated for 100 amps, then the total value of all the circuit breakers installed can not exceed 100 amps.
- The size of the circuit breaker installed to support the inverter should not exceed 60 A maximum for 120 Vac units (30 A maximum for 230 Vac units).
- When smaller AC sources are used, smaller AC wiring may be used (down to the minimum sizes indicated in Tables 4 and 6). The external AC circuit breakers must be sized accordingly to protect smaller wires.

## Grounding



**IMPORTANT:**

- System grounding is the responsibility of the installer.
- Grounding requirements may vary by location depending on the local electric code. In North America, inverter systems are considered two separate electrical systems and, therefore, are required by code to have each system (AC and DC) connected to a ground electrode conductor (also known as a primary system ground).
- The AC and DC ground connections are not electrically common to the FLEXware enclosure. Therefore, it will be necessary to ground the enclosure as well as the circuits. Consult local code for additional requirements.
- The equipment ground is marked with this symbol: 

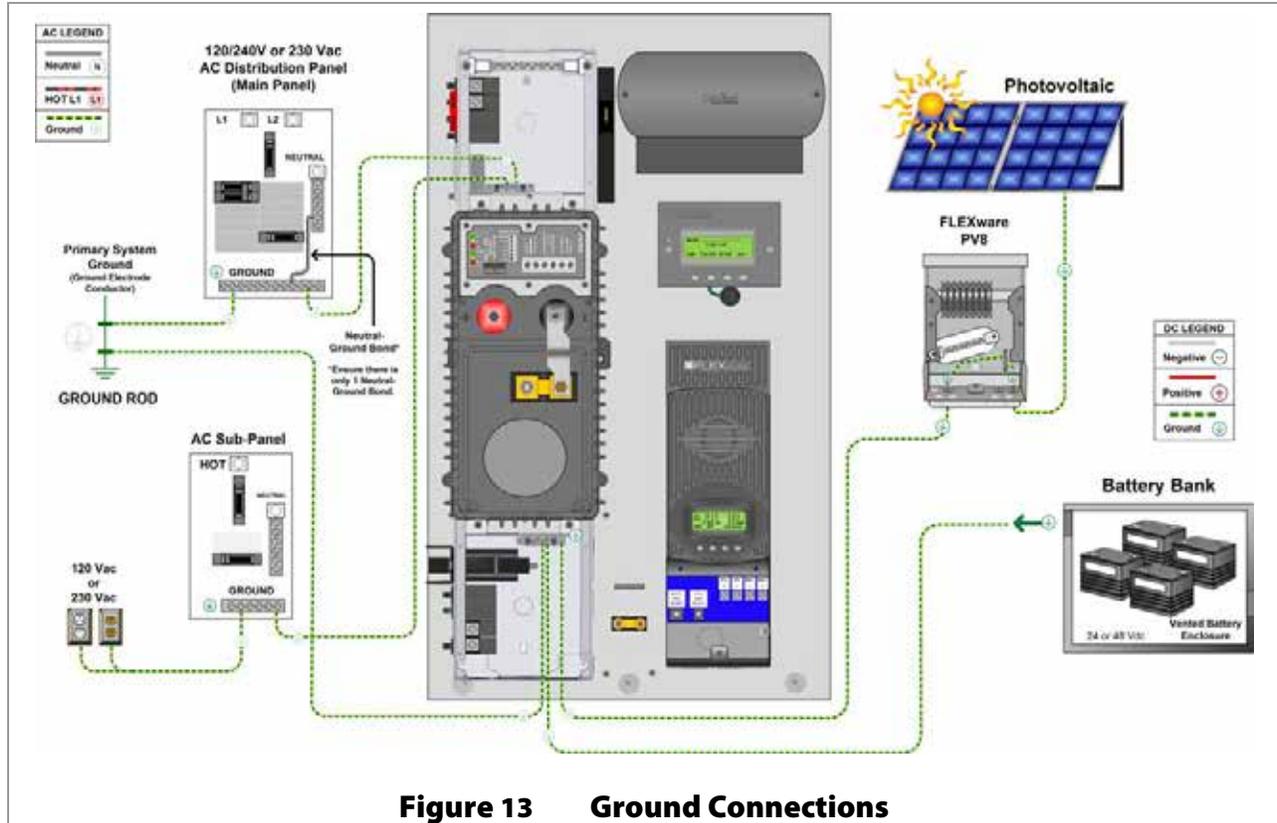


**WARNING: SHOCK HAZARD**

If a bond is made between neutral and ground, make sure only one bond is present in the AC system at any time. The FLEXpower ONE comes with a neutral-ground bond installed. If a neutral-ground bond exists elsewhere in the system, the neutral-ground bond in the FLEXpower ONE will need to be removed. See Figure 18. Check local code for specific requirements.

**Table 3 Ground Conductor Size and Torque Requirements**

Terminal Location	Minimum Allowed Conductor Size	Maximum Conductor Size	Torque Requirements
Ground Bar	#12 AWG (3.3 mm <sup>2</sup> )	1/0 AWG (53.5 mm <sup>2</sup> )	35 in-lb (4 Nm)



## DC Connections

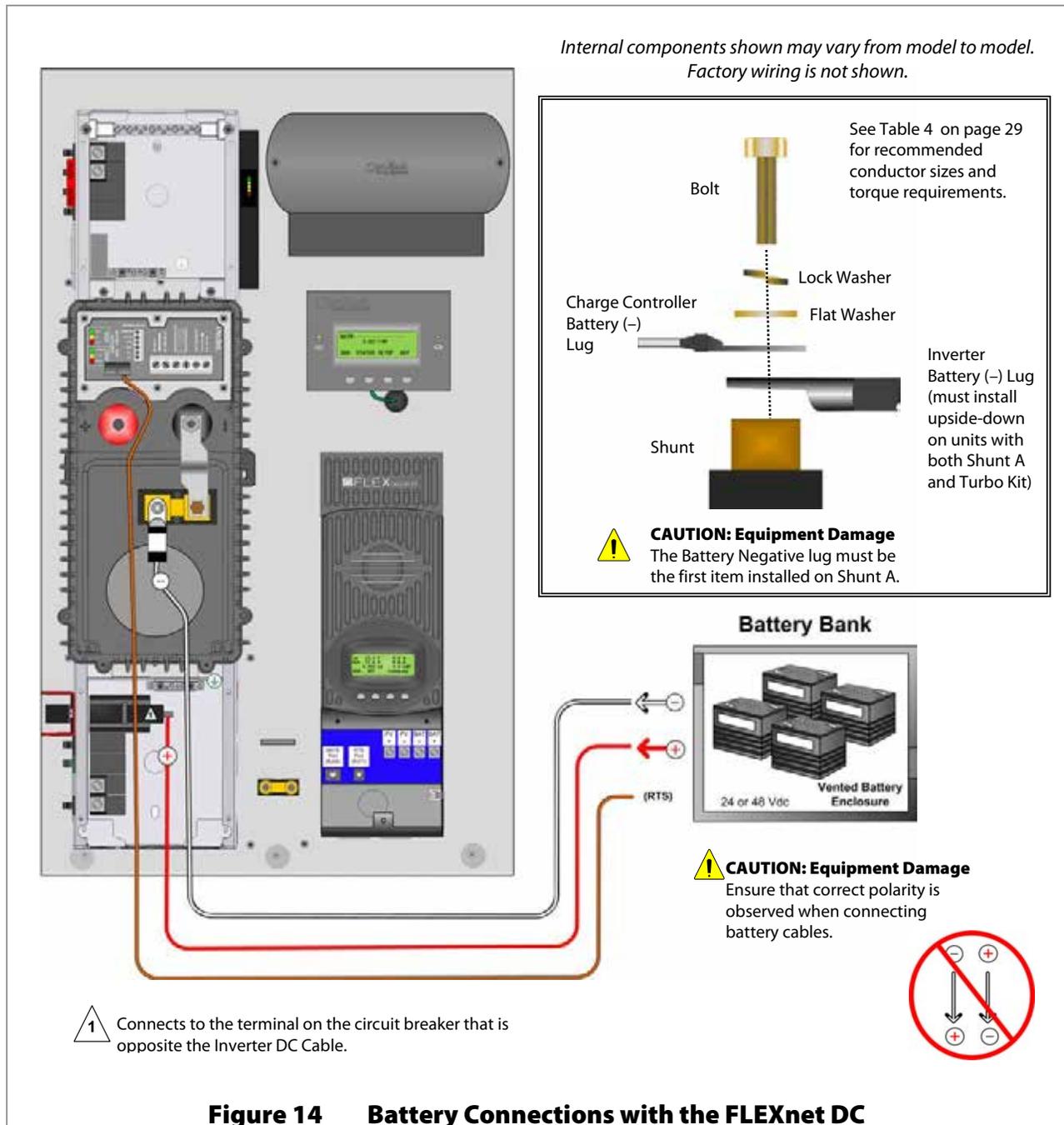
**Table 4 DC Conductor Size and Torque Requirements**

DC Terminal	Minimum Allowed Conductor Size	Maximum Conductor Size	Torque Requirements	Breaker Size
Battery Positive (+)	2/0 AWG (67.5mm <sup>2</sup> )	N/A (ring terminal)	50 in-lb (5.7 Nm)	175 Adc
Battery Negative (-) (Shunt)	2/0 AWG (67.5 mm <sup>2</sup> )	N/A (ring terminal)	50 in-lb (5.7 Nm)	N/A
PV Positive (+)	#4 AWG (21.2 mm <sup>2</sup> )	#2 AWG (33.6 mm <sup>2</sup> )	35 in-lb (4 Nm)	80 Adc
PV Negative (-)	#4 AWG (21.2 mm <sup>2</sup> )	#2 AWG (33.6 mm <sup>2</sup> )	35 in-lb (4 Nm)	N/A
Ground Bus Bar	#12 AWG (3.3 mm <sup>2</sup> )	1/0 AWG (53.5 mm <sup>2</sup> )	35 in-lb (4 Nm)	N/A

- To make the battery connections in systems that have the FLEXnet DC monitor, see Figure 14 on page 30.
- To make the battery connections in systems that do not have the FLEXnet DC monitor, see Figure 15 on page 31.
- To make the PV connections, see Figure 16 on page 32.

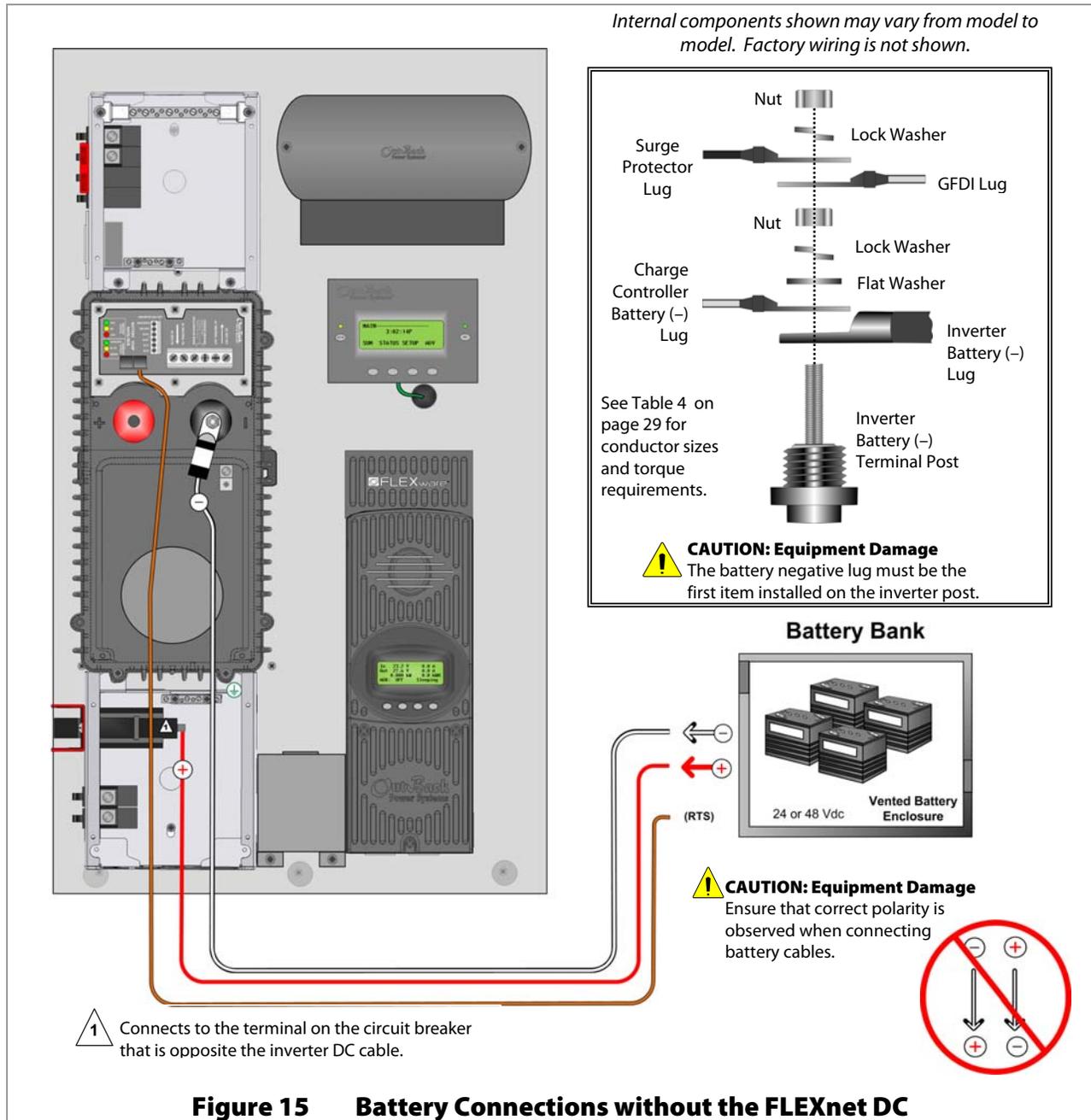
## To make the battery connections in a system with the FLEXnet DC monitor:

1. Remove all hardware from the side of Shunt A that is not connected to the Inverter.
2. Place the inverter negative (-) cable lug and charge controller negative (-) cable lug onto Shunt A. Secure in place with the flat washer, lock washer and nut. Torque to 50 in-lb (5.7 Nm).
3. Connect the battery (+) conductor to the DC circuit breaker lug opposite the inverter's DC (+) connection. Torque to 50 in-lb (5.7 Nm).
4. Attach one end of the Remote Temperature Sensor (RTS) cable to the BATT TEMP port on the Inverter and the other end to the side of one of the batteries (in the middle of the battery bank).



## To make the battery connections in a system without the FLEXnet DC monitor:

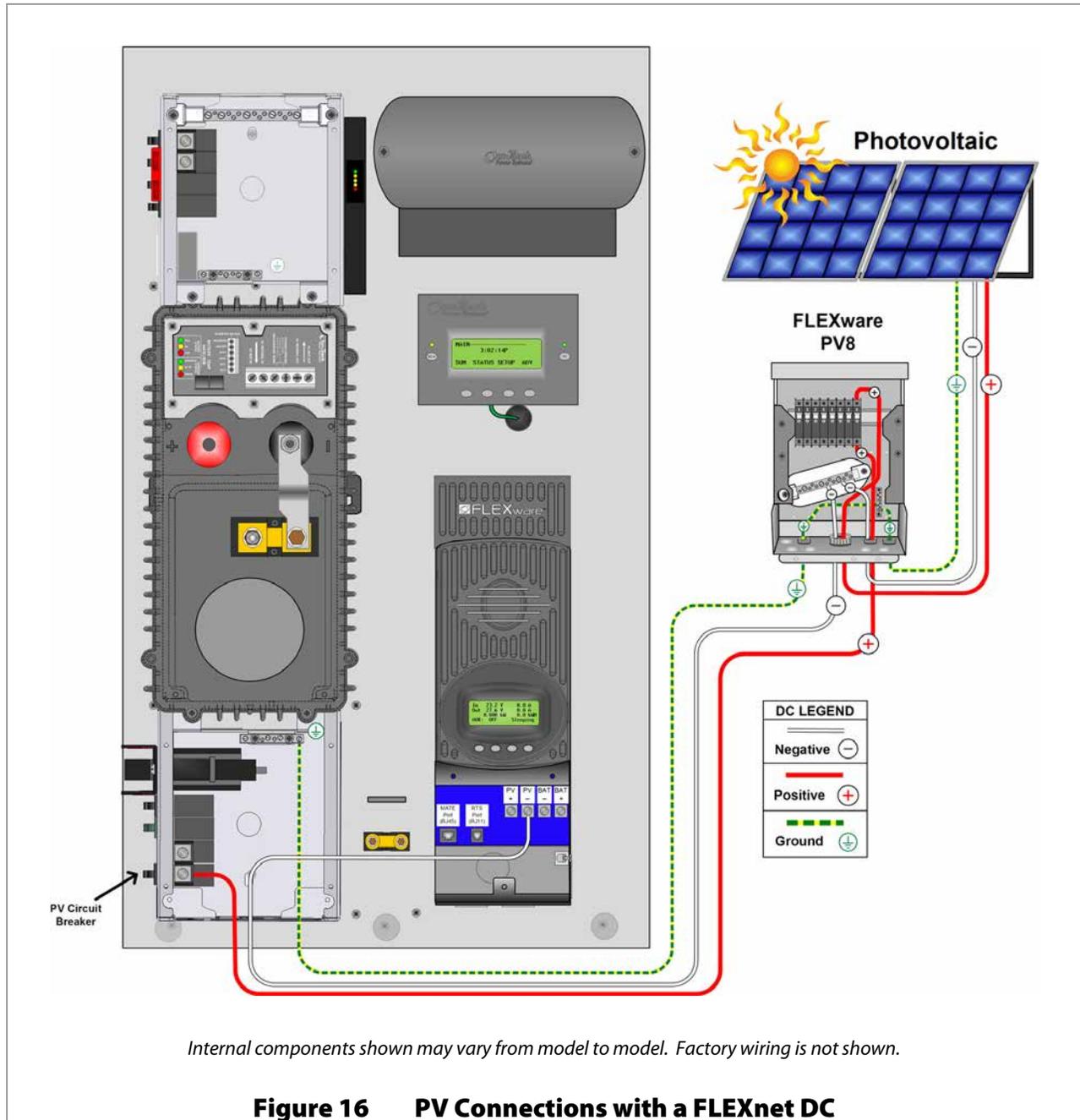
1. Remove all hardware from the inverter's battery negative (-) terminal post.
2. Place the inverter negative (-) cable lug and charge controller negative (-) lug onto the terminal post. Secure in place with the flat washer, lock washer, and nut. Torque to 50 in-lb (5.7 Nm).
3. Place the GFDI cable lug and surge protector DC negative (-) cable lug onto the terminal post. Secure in place with the next lock washer, and nut. Torque to 35 in-lb (4 Nm)
4. Connect the battery (+) conductor to the DC circuit breaker lug opposite the inverter's DC (+) connection. Torque to 50 in-lb (5.7 Nm).
5. Attach one end of the Remote Temperature Sensor (RTS) cable to the BATT TEMP port on the inverter and the other end to the side of one of the batteries (in the middle of the battery bank).



**Figure 15 Battery Connections without the FLEXnet DC**

## To make the PV connections:

1. Ensure the PV array is properly grounded.
2. Route the PV (-) through the bottom of the DC enclosure and into the wiring compartment of the FLEXmax 80 (FM80) charge controller. Connect the PV (-) conductor to the PV (-) terminal in the FM80 charge controller. Torque to 35 in-lb (4 Nm).
3. Connect the PV (+) to the top terminal of the PV circuit breaker in the DC enclosure. Torque to 35 in-lb (4 Nm).



## AC Connections

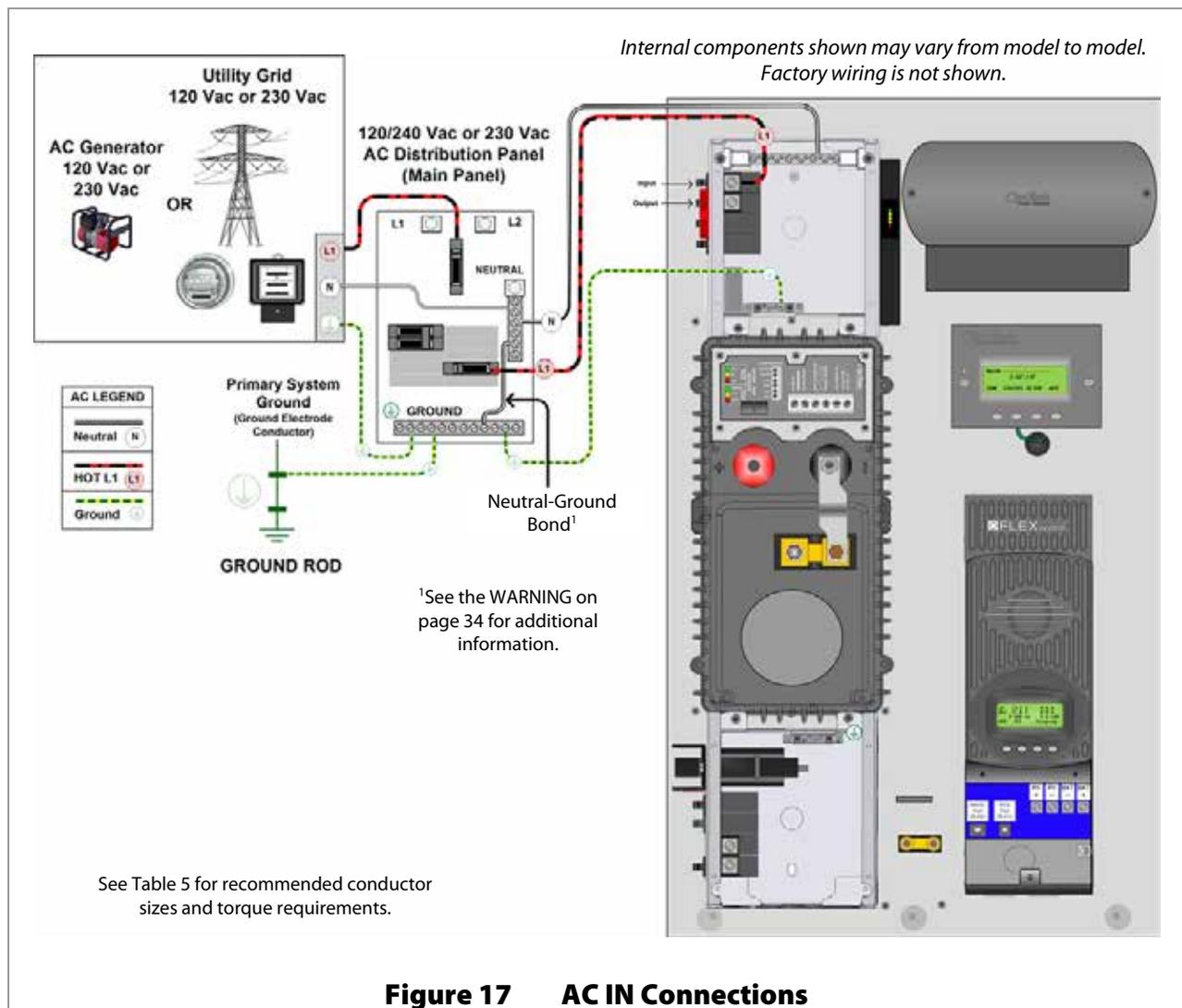


### WARNING: Fire Hazard

Multiwire branch circuits in residential installations can create a potential fire hazard with inverter installations. Be sure to check for multiwire branch circuits before making any AC connections and make any changes required to remove the hazard.

**Table 5 AC Conductor Size and Torque Requirements**

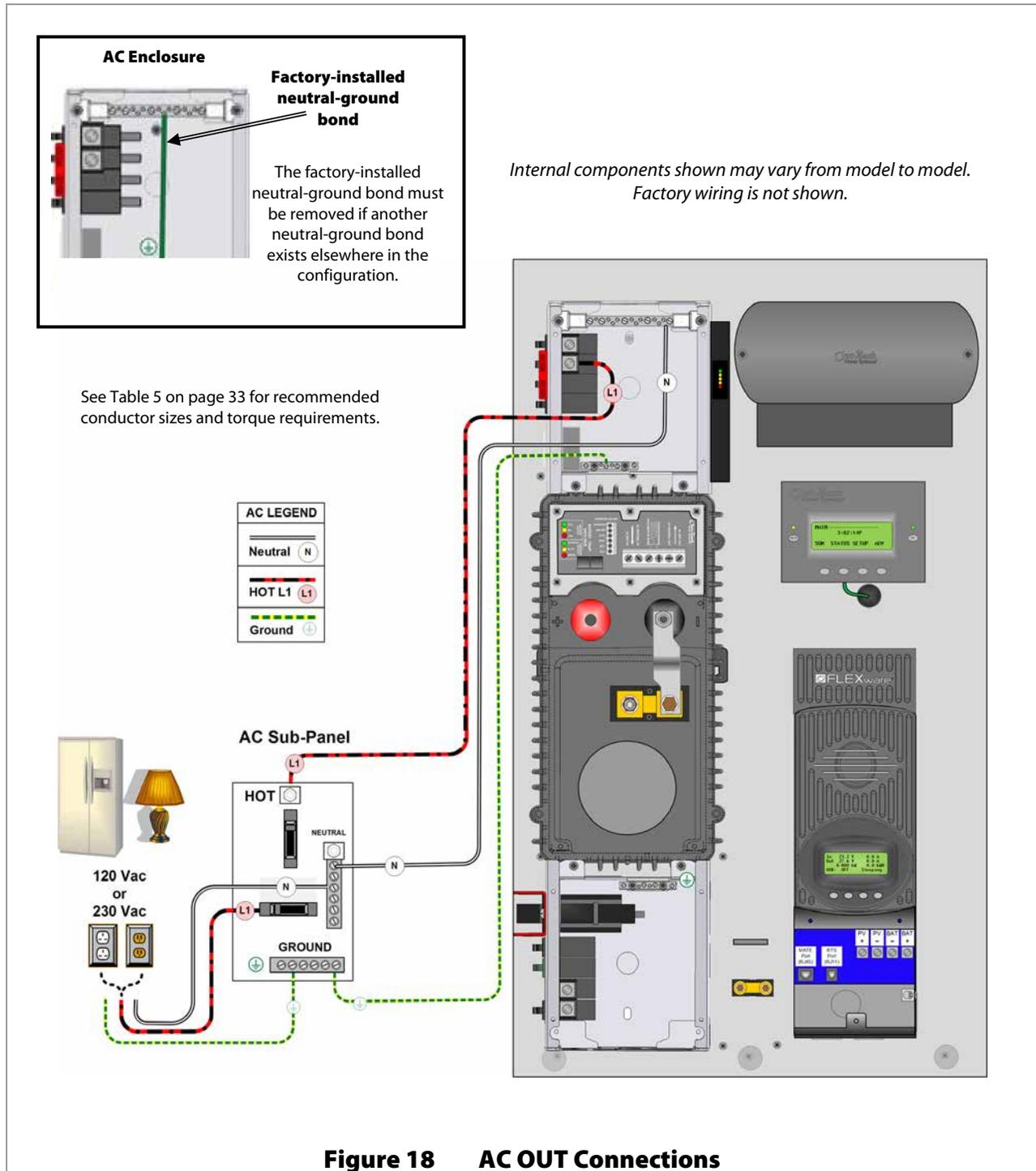
AC Terminal	Minimum Allowed Conductor Size	Maximum Conductor Size	Torque Requirements	Circuit Breaker Size (max.) (120 Vac units)	Circuit Breaker Size (max.) (230 Vac units)
AC IN	#14 AWG (2.5 mm <sup>2</sup> )	1/0 AWG (70 mm <sup>2</sup> )	35 in-lb (4 Nm)	60 Aac	30 Aac
AC OUT	#14 AWG (2.5 mm <sup>2</sup> )	1/0 AWG (70 mm <sup>2</sup> )	35 in-lb (4 Nm)	60 Aac	30 Aac
Neutral Bus Bar	#14 AWG (2.5 mm <sup>2</sup> )	1/0 AWG (70 mm <sup>2</sup> )	35 in-lb (4 Nm)	N/A	N/A





## WARNING: SHOCK HAZARD

If a bond is made between neutral and ground, make sure only one bond is present in the AC system at any time. The FLEXpower ONE comes with a neutral-ground bond installed. If a neutral-ground bond exists elsewhere in the system, the neutral-ground bond in the FLEXpower ONE will need to be removed. See Figure 18. Check local code for specific requirements.



**Figure 18 AC OUT Connections**

# Functional Test/Commissioning

## Pre-startup Procedures

1. Double-check all wiring connections.
2. Inspect the enclosure to ensure no tools or debris has been left inside.

## Energize/Startup

**To energize or start up the system:**

1. Using a digital voltmeter (DVM), verify 24 or 48 Vdc on the battery terminals (i.e., place DVM leads on ①+ and ①- in Figure 20). Confirm that the voltage is correct for the inverter model. Confirm the polarity.

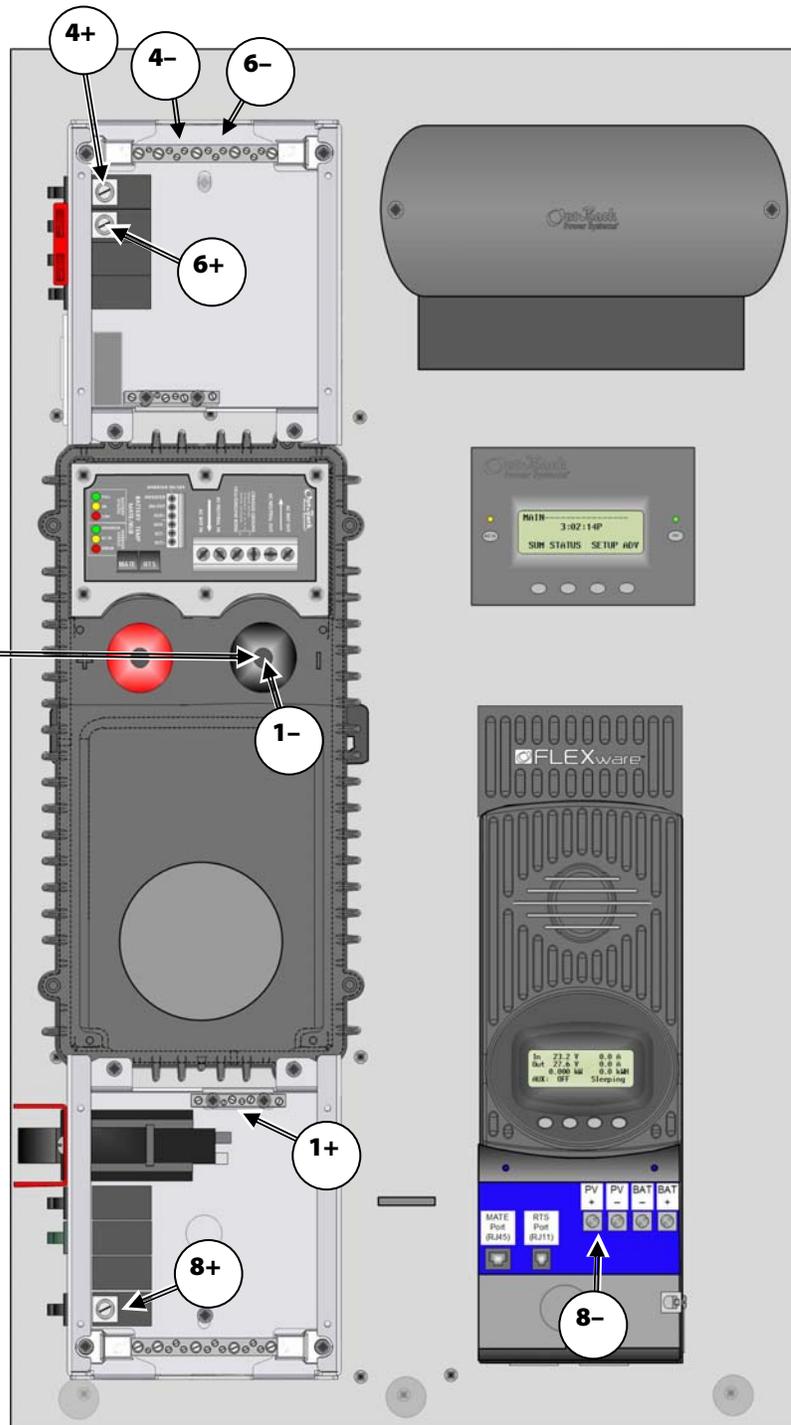
**⚠ CAUTION: Equipment Damage**  
Incorrect battery polarity will damage the inverter

2. Close the DC circuit breakers from the battery bank to the inverter. ②
3. Close the AC output circuit breakers. ③
4. Using a digital voltmeter, verify 120 Vac on the AC circuit breakers (i.e., place voltmeter leads on ④+ and ④- in Figure 20).
5. Close the AC input circuit breakers. ⑤
6. Using a digital voltmeter, verify 120 Vac on the AC circuit breakers (i.e., place voltmeter leads on ⑥+ and ⑥- in Figure 20).
7. Close the PV input circuit breakers. ⑦
8. Using a digital voltmeter, verify the voltage on the PV terminal does not equal zero (i.e., place voltmeter leads on ⑧+ and ⑧- in Figure 20).
9. Connect a small AC load and test for proper functionality.

**A** Outlets are model-dependent.  
120-volt systems will have a 120 Vac outlet.  
230-volt systems will have a 230 Vac outlet.

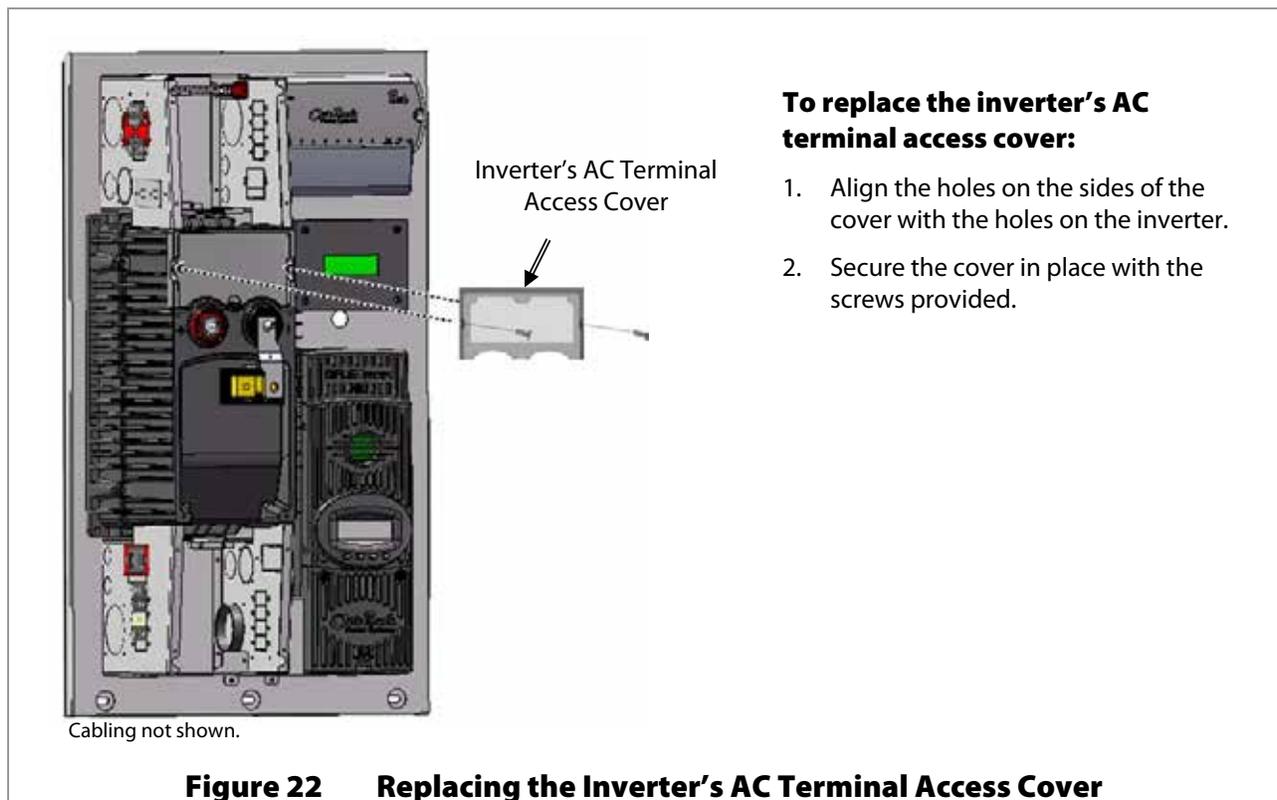
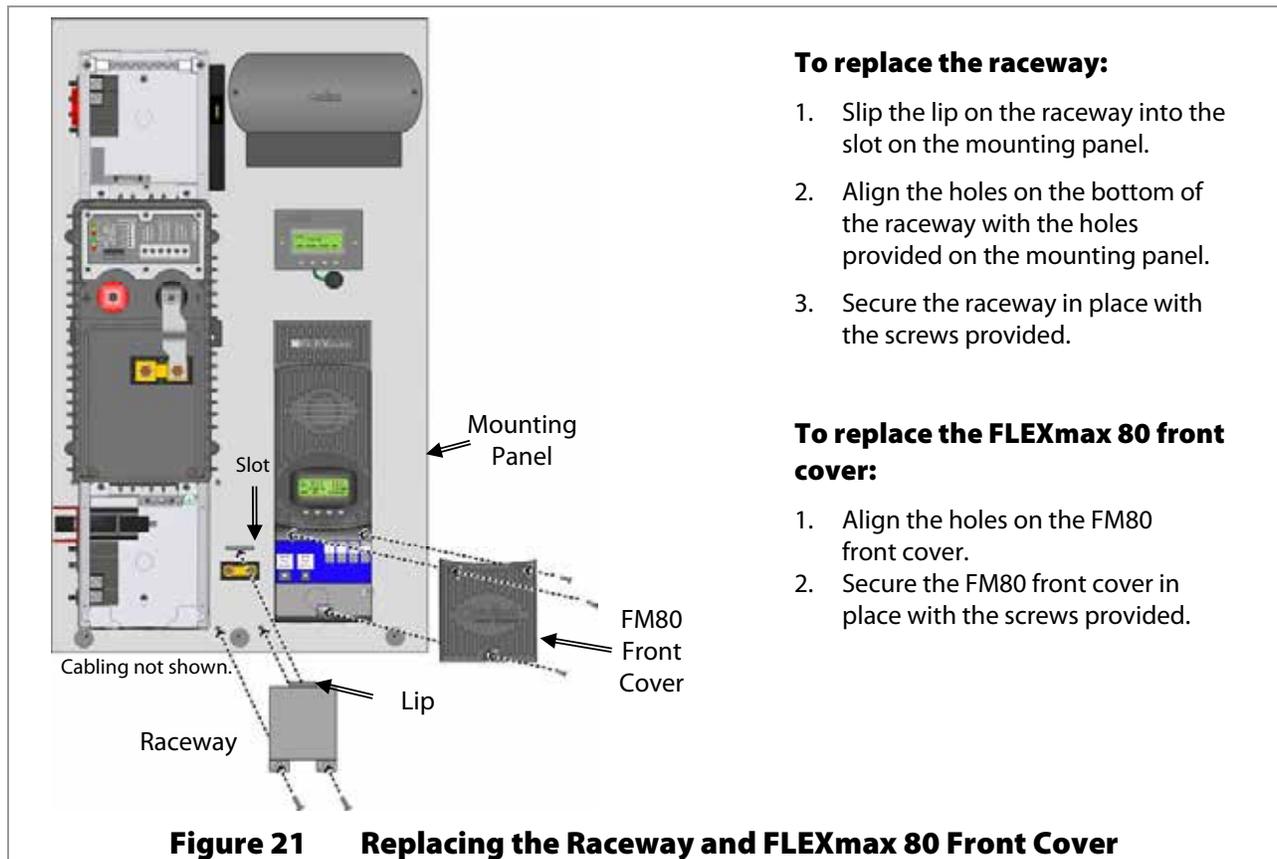
**Figure 19 Energize Procedures**

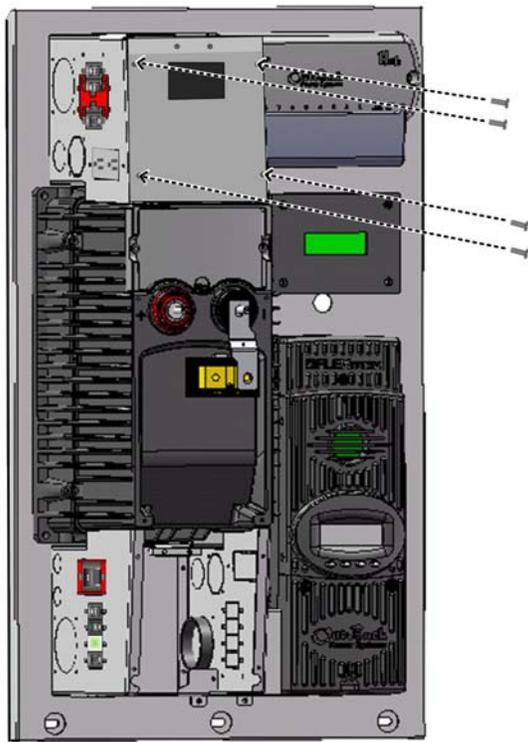
**NOTE:** The shunt may or may not be installed. Use the same test point in all cases.



**Figure 20 Functional Test Points for Energizing Systems**

## Reassembling the Enclosures





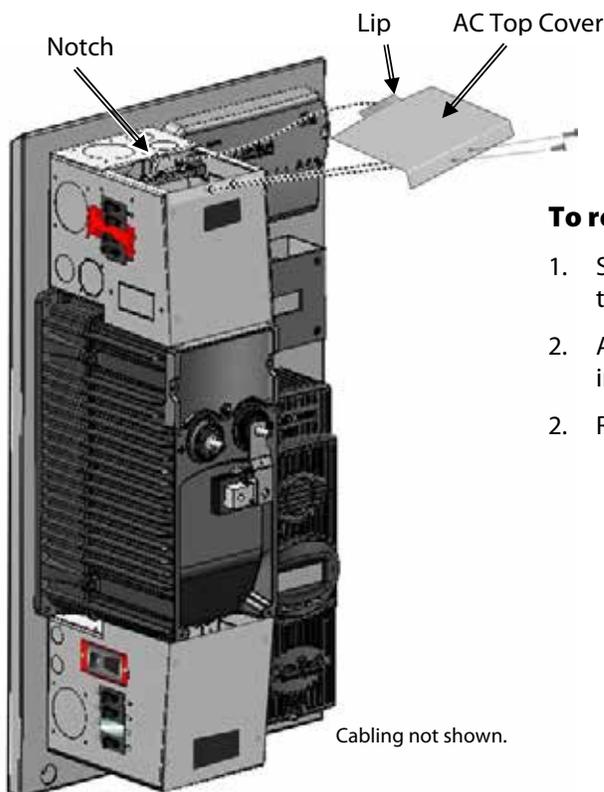
Cabling not shown.

The front cover of the AC enclosure will not be completely removed due to the surge protector cabling. Work with care not to damage the surge protector or dislodge the cabling while replacing the front cover.

**To replace the front of AC enclosure:**

1. Align the holes (x4) in the enclosure front cover with the holes in the chassis.
2. Replace the screws (x4) removed in the beginning.

**Figure 23 Replacing the AC Enclosure Front Cover**

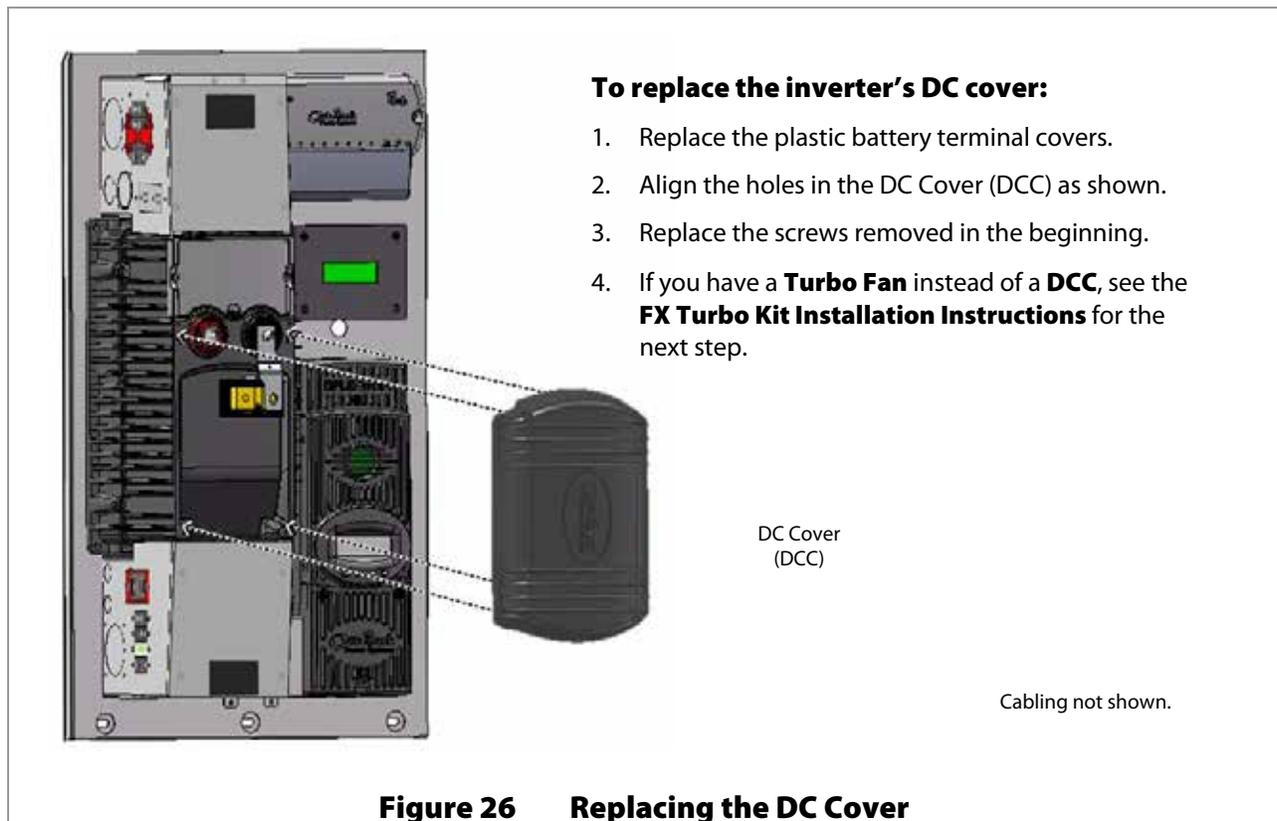
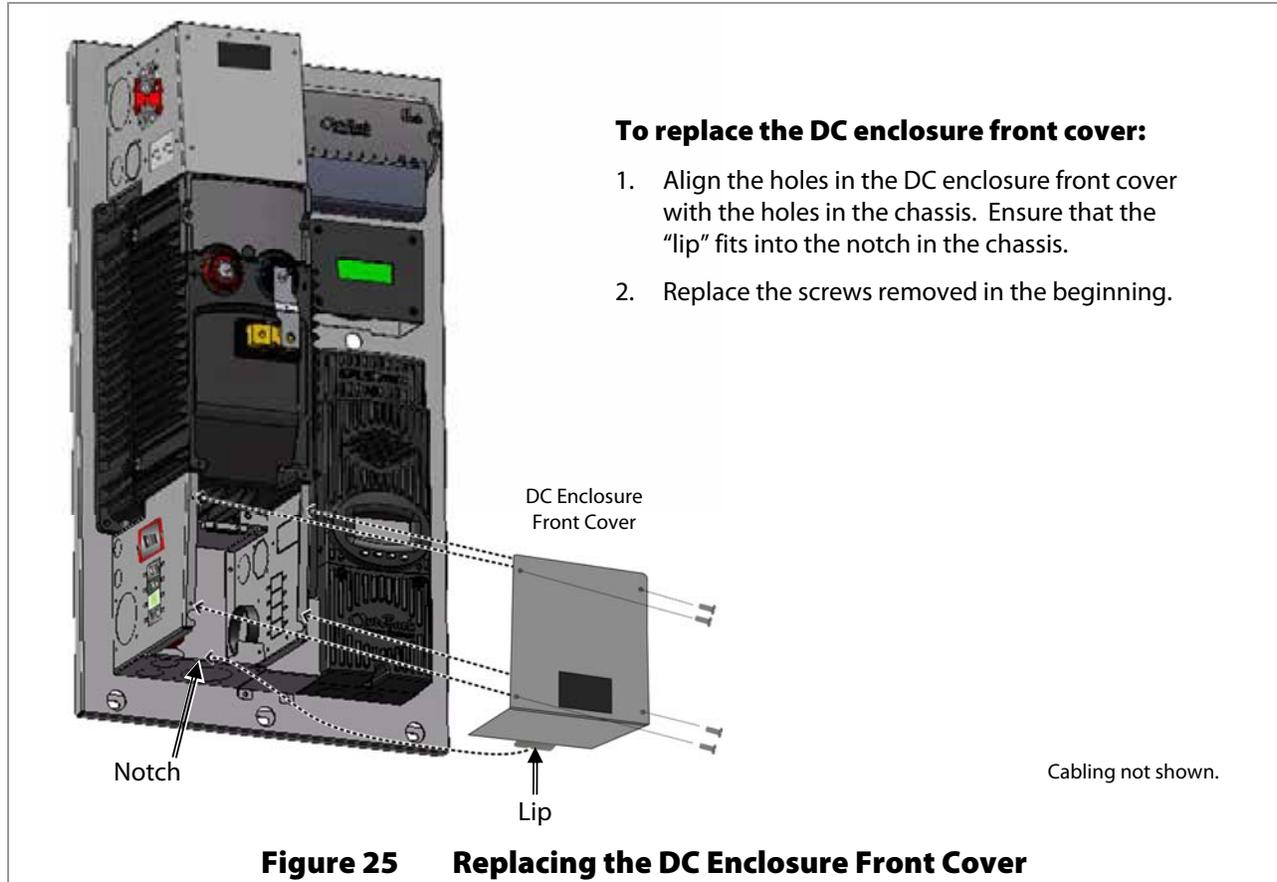


Cabling not shown.

**To replace the top of AC enclosure:**

1. Slip the lip on the AC top cover into the notch in the chassis.
2. Align the holes (x2) in the top cover with the holes in the front cover.
2. Replace the screws (x2) removed in the beginning.

**Figure 24 Replacing the AC Enclosure Top Cover**



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# Operation

## Setting Basic Parameters



### IMPORTANT:

This section assumes that the operator is familiar with the basic operation and navigation of the installed components. *Detailed information about component settings is provided in each of the components respective manuals.*

Although some of the programming will be preset at the factory (i.e., grid-tie features for grid-interactive units, charging for 24 or 48 Vdc battery banks), the following parameters may need to be adjusted on-site depending on the configuration of the system.

### MATE2 Settings

The MATE2 may need to have basic operational parameters set prior to first use. The time, date, and display features are available in the Setup Screen for the MATE2. For instructions on setting the time and date settings, follow the menu maps on page 42 and 43.

### Inverter Settings

The VFX/GVFX Series inverter/charger only has one AC input, therefore, the selected input will need to be identified—Grid or Generator. It will also be necessary to set the AC Input Current Limit for either the Grid (60 Aac Max) or Generator (60 Aac Max). For instructions for setting the AC Input Current, follow the menu map on page 44. For instructions on setting other inverter features, see the *MATE Series Manual*.

### Charger Settings

Charging settings include charging current limit and the voltage and time limits for each stage of the charge cycle (e.g., absorb, float). These parameters will be preset at the factory. However, these settings may still need to be adjusted by individual installer depending on the battery manufacturer's recommendations.

Charger settings are located in the FX Advanced Menu and/or the FLEXmax 80 Charge Controller menu. The configuration will dictate which device will need adjustment.

➤ For instructions on accessing the **FX Advanced Menu**, see page 45 in this manual.

➤ **FLEXnet DC Monitor Settings**

If the FLEXnet DC monitor is installed, the Battery Amp-hours and Return Amps will need to be set. For instructions on setting these two parameters, see page 46 in this manual.

➤ **FLEXmax 80 Charge Controller Settings**

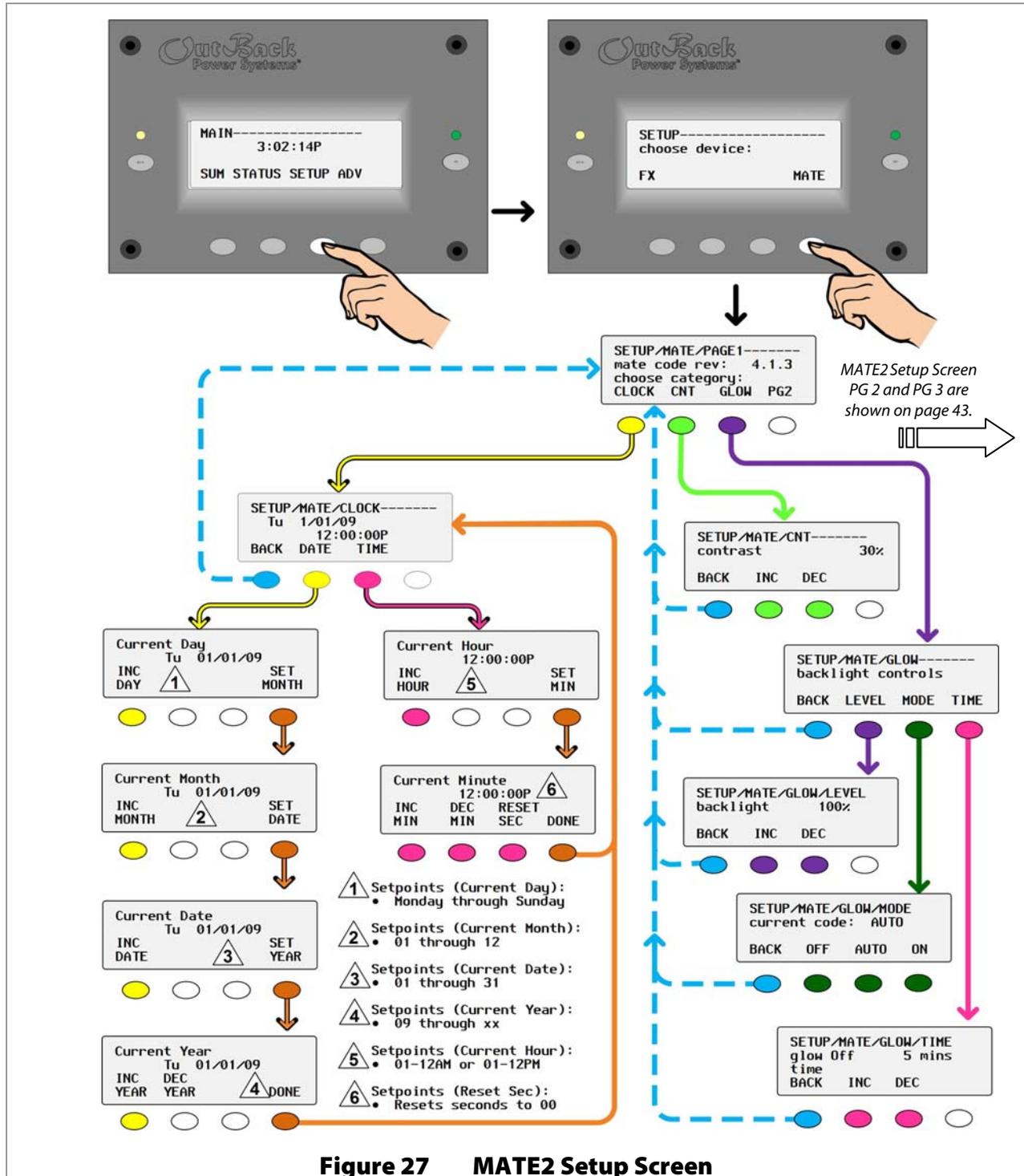
Charging parameters will be dependent on the type and size of batteries and the size of the PV array. Basic parameters for either 24 Vdc or 48 Vdc will be preset at the factory. Consult the battery manufacturer for charging recommendations. Refer to the *FLEXmax 80 Owner's Manual* for additional programming information.

## Setting Time, Date & Display on the MATE2



**IMPORTANT:**

The following information assumes the installer is familiar with the basic operation of a MATE2 System Display and Controller. If the installer is not familiar with basic operation, please refer to the *MATE Series Manual* for general information.



← Continued from previous page.

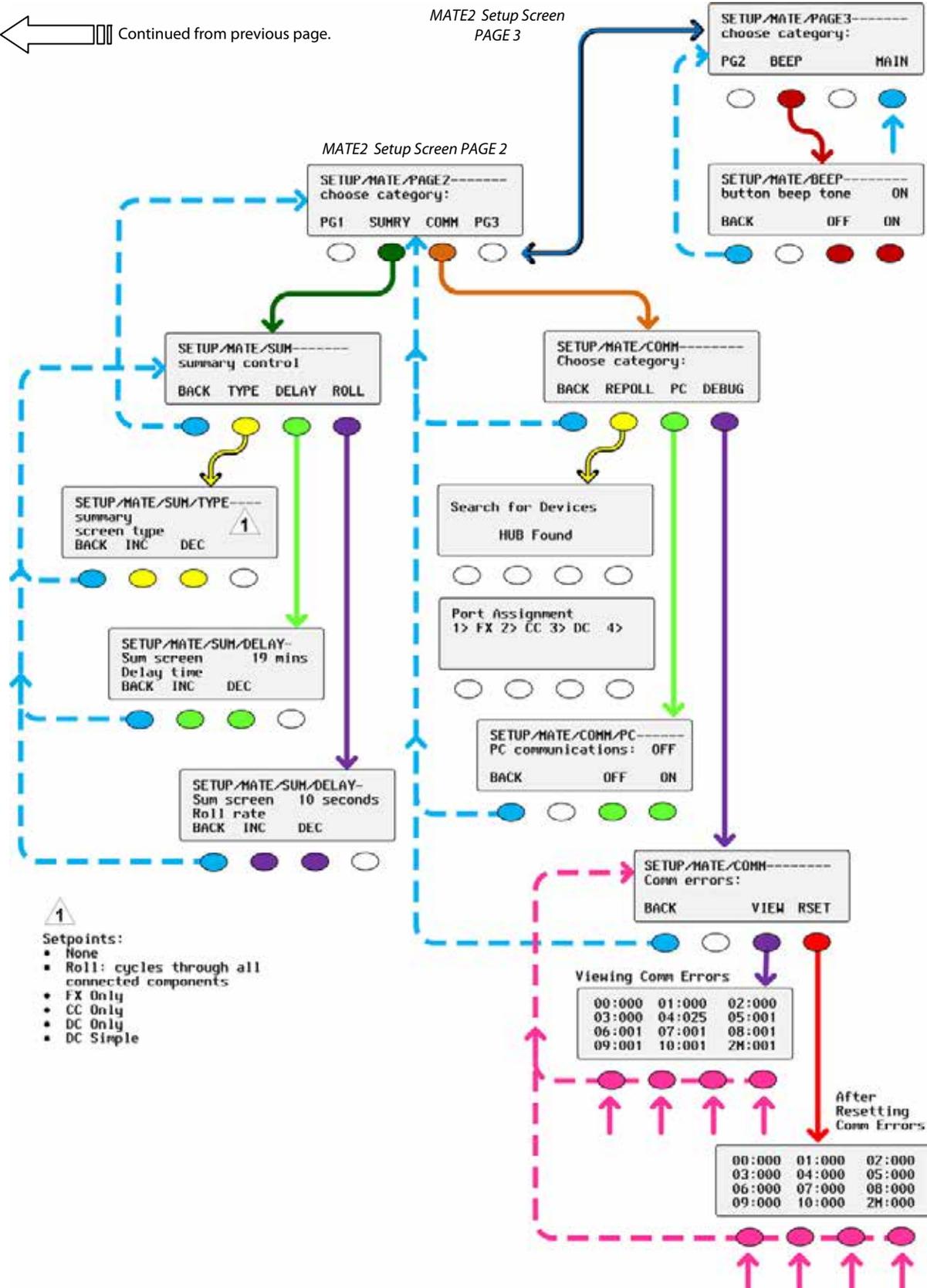
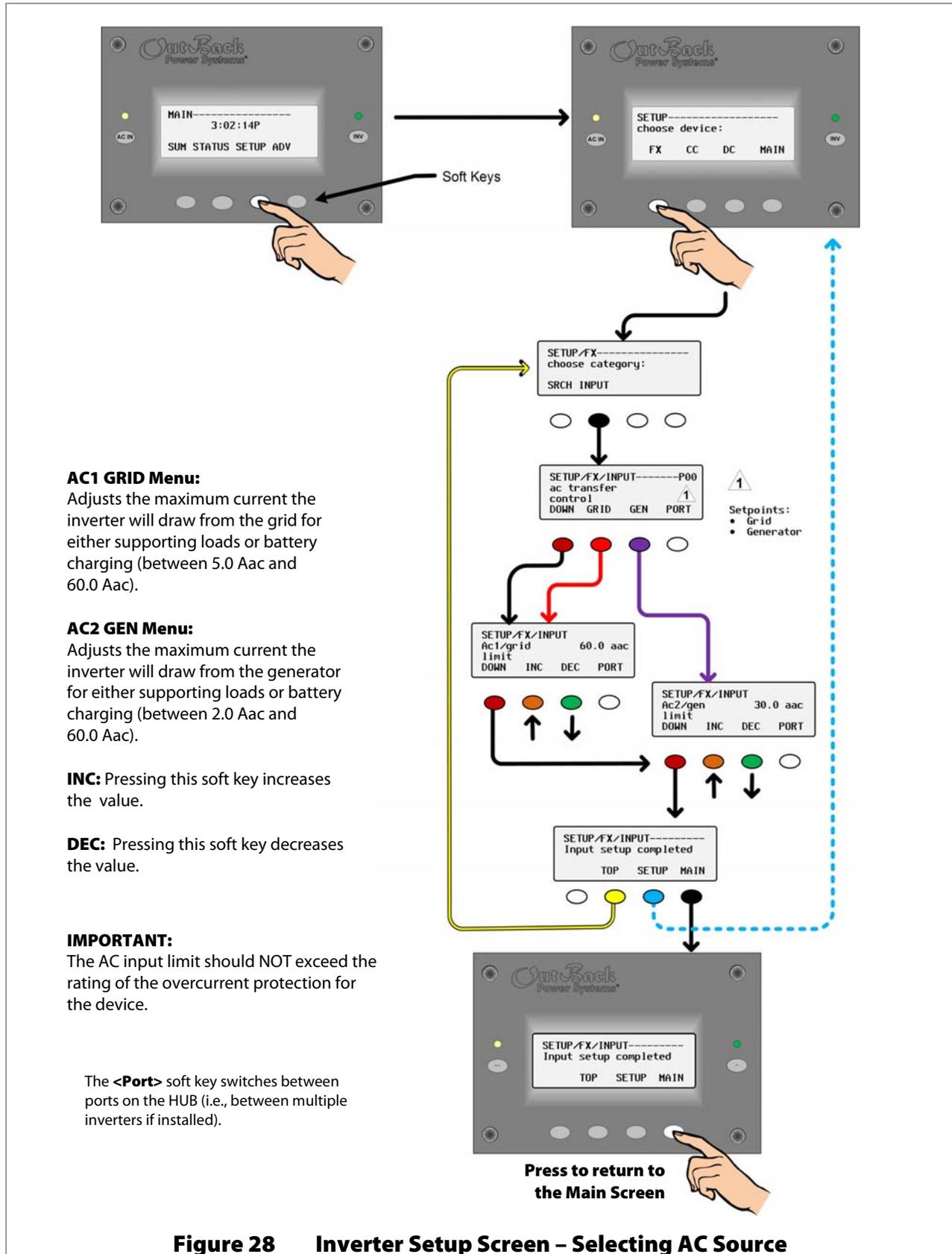


Figure 27 MATE2 Setup Screen (continued)

## Selecting the AC Source and AC Input Limit on the Inverter



**Figure 28 Inverter Setup Screen – Selecting AC Source**

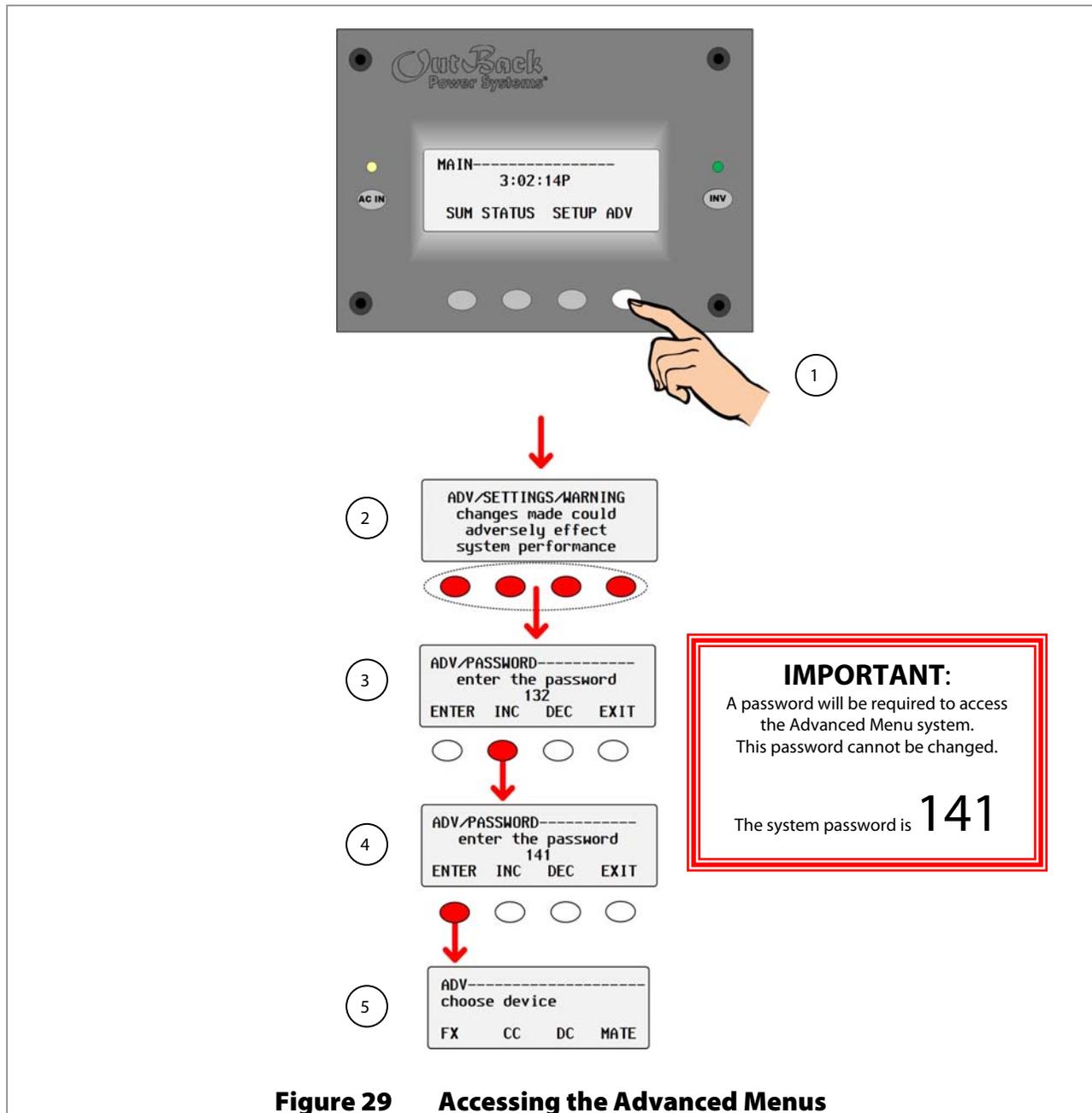
## Accessing the Advanced Menu

In most cases, the charging parameters set at the factory will work for most systems. However, if changes are required, these parameters are set using the Advanced Menu system. This includes the charging input current limit and the voltage and time limit for each stage of charging.



**IMPORTANT:**

Making changes to the Advanced Settings could adversely affect current system performance. Only make changes to the factory default settings if you are qualified to do so.

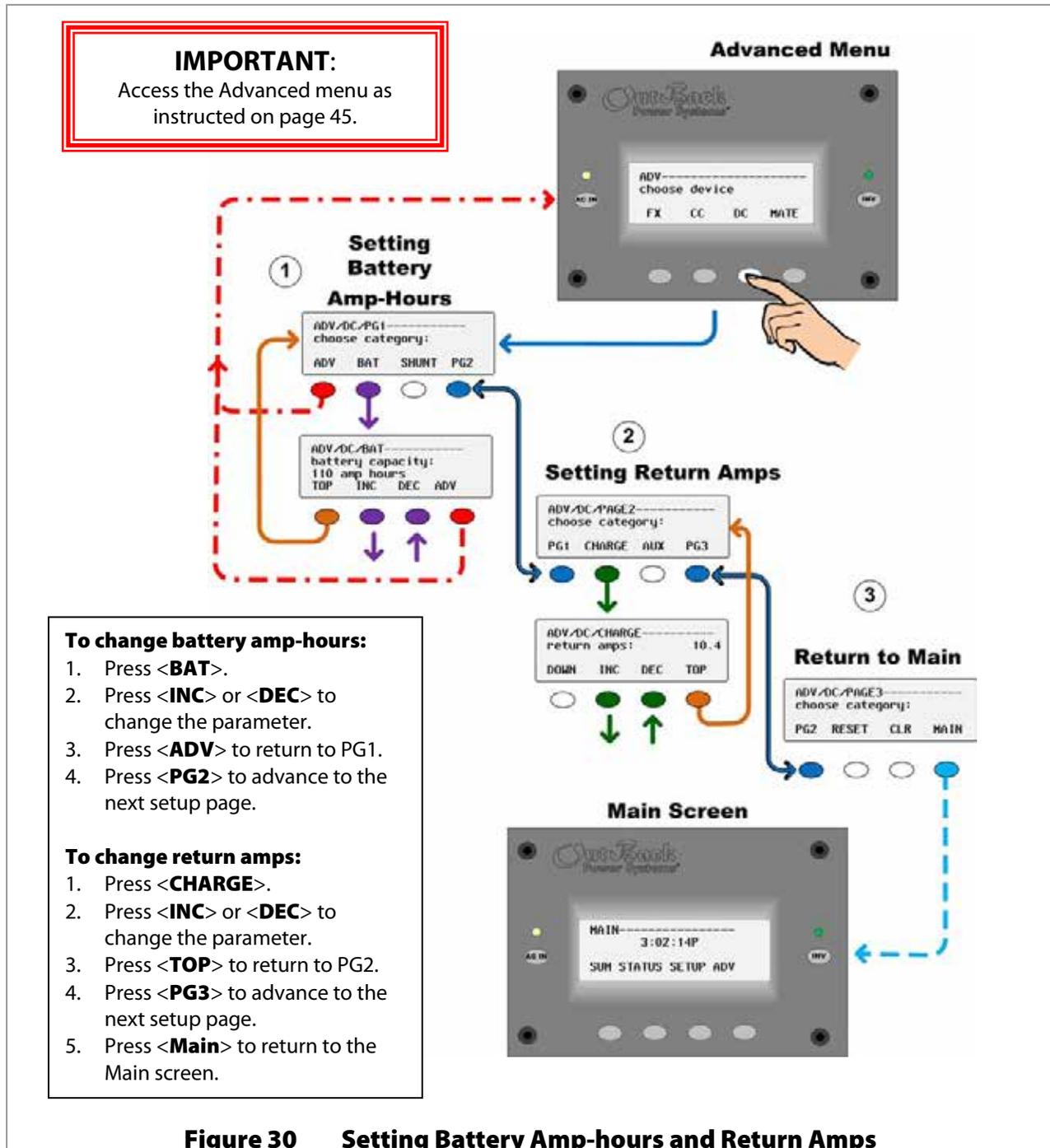


**Figure 29 Accessing the Advanced Menus**

## Setting Battery Amp-Hours and Return Amps using the FLEXnet DC Monitor

If a FLEXnet DC monitor is installed in the configuration, the following parameters will need to be set.

- Battery amp-hours refers to the total amp-hour capacity of the battery bank (not just amp-hour rating of the individual batteries within the battery bank).
- Return amps is the low limit to which an absorption current must decrease, while still maintaining the absorption voltage, before the battery is judged to be full. Use the battery manufacturer's specifications or 2% of the battery bank capacity.



**Figure 30 Setting Battery Amp-hours and Return Amps**

## Setting Charging Parameters

If changes need to be made to charging parameters, follow the menu map below.

### IMPORTANT:

Access the Advanced Menu as instructed on page 45.

#### To Set Charging Limits:

1. Press <CHGR>.
2. Press <INC> or <DEC> to change the parameter.
3. Press <DOWN> to advance to the next parameter.
4. Continue pressing <DOWN> to cycle through all the settings.

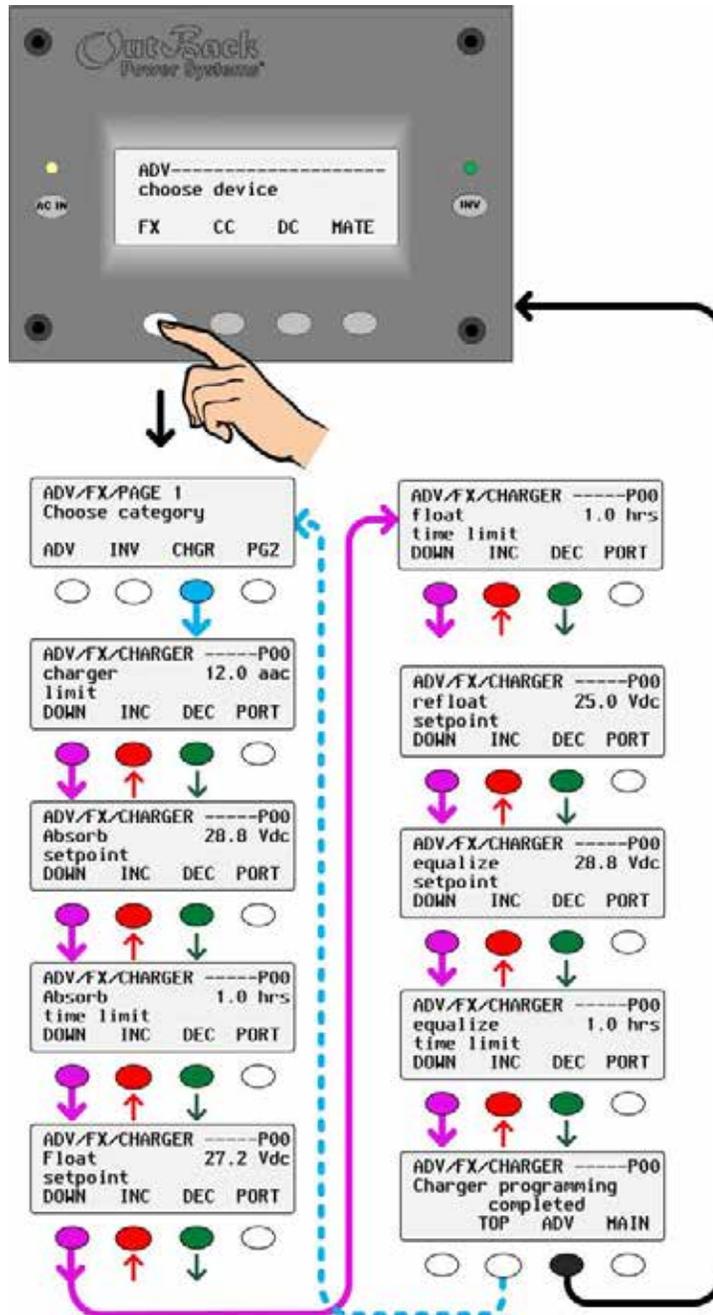
### IMPORTANT:

Battery charger settings need to be correct for a given battery type. Always follow battery manufacturer recommendations. Making incorrect settings, or leaving them at factory default settings, may cause the batteries to be undercharged or overcharged.



### CAUTION: Battery Damage

- Do not equalize any sealed battery types (VRLA, AGM, Gel, or other) unless approved by the manufacturer. Some batteries may suffer severe damage from equalization.
- Contact the battery manufacturer for recommendations on equalization voltage, duration, schedule, and/or advisability. Always follow manufacturer recommendations for equalization.



When the screen reads "Charger Programming Completed",

- press <TOP> to return to the "Choose Category" screen, or
- press <ADV> to return to the "Choose Device" screen, or
- press <MAIN> to return to the Main screen.

**Figure 31** Setting Input Source and Current Limit

## De-energize/Shutdown



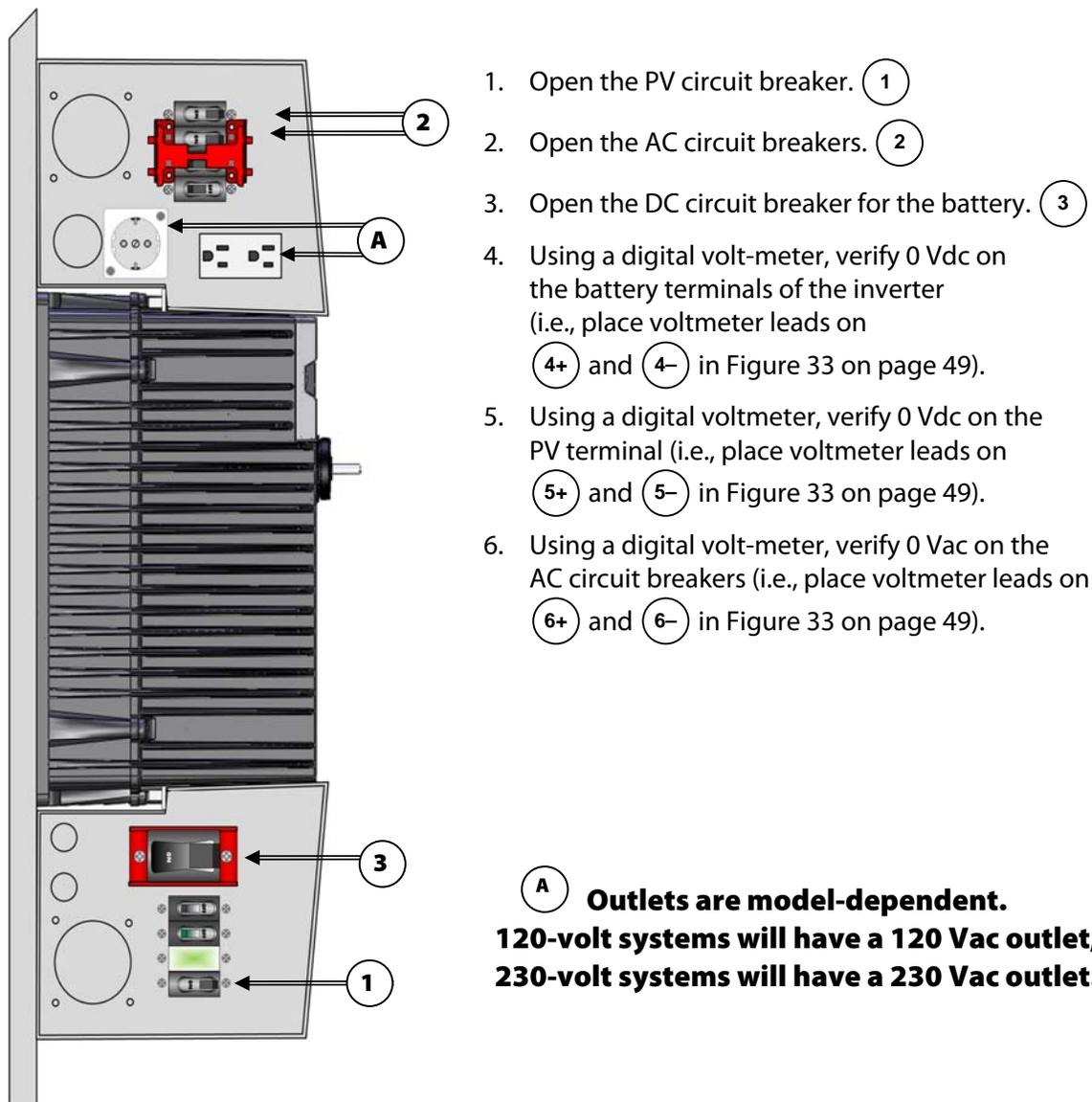
### WARNING: Lethal Voltage

Review the system configuration to identify all possible sources of energy. Ensure ALL sources of power are disconnected before performing any installation or maintenance on this equipment. Confirm that the terminals are de-energized using a validated voltmeter (rated for a minimum 1000 Vac and 1000 Vdc) to verify the de-energized condition.

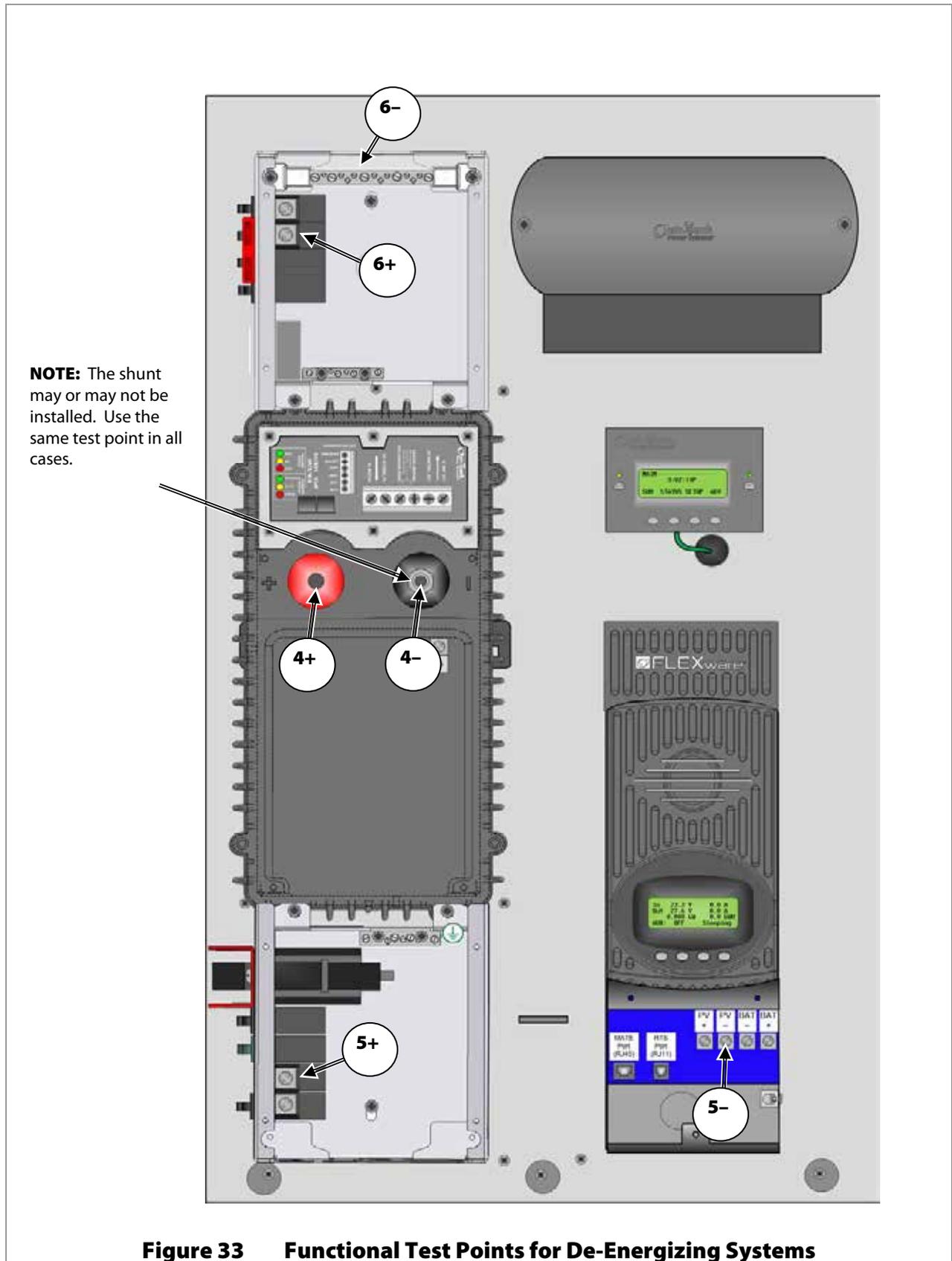


### WARNING: Burn Hazard

Internal parts can become hot during operation. Do not remove the cover during operation or touch any internal parts. Be sure to allow them sufficient time to cool down before attempting to perform any maintenance.



**Figure 32 Shutdown Procedures**



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# Specifications

## Feature Matrix

The following Matrix shows the FLEXpower ONE models that are described in this manual.

**Table 6 Feature Matrix**

MODEL	INVERTER MODEL	GRID TIE	FM80	FLEXnet DC Monitor		HUB	Surge Protector	MATE2	GFDI	AC Enclosure		DC Enclosure	
				FNDC SHUNT A	FNDC SHUNT B					120 Vac	230 Vac	175 A	250 A
FP1-1	VFX3524		X	X	X	X	X	X	X	X			X
FP1-2	VFX3648		X	X	X	X	X	X	X	X		X	
FP1-3	GVFX3524	X	X	X	X	X	X	X	X	X			X
FP1-4	GVFX3648	X	X	X	X	X	X	X	X	X		X	
FP1-5	VFX3024E		X	X	X	X	X	X	X		X		X
FP1-6	VFX3048E		X	X	X	X	X	X	X		X	X	
FP1-25	GTFX3048	X	X			X	X	X	X	X		X	
FP1-26	FX3048T		X	X	X	X	X	X	X	X		X	
FP1-27	FX2524T		X	X	X	X	X	X	X	X		X	

## Specifications

# Models FP1-1, FP1-2, FP1-3, FP1-4

## Electrical Specifications, 120 Vac/60 Hz Models

Product Name		FP1-1	FP1-2	FP1-3	FP1-4
Inverter Model		VFX3524	VFX3648	GVFX3524	GVFX3648
Grid-Interactive		No	No	Yes	Yes
Anti-Islanding Protection		N/A	N/A	UL1741-2005/ IEE1547	UL1741-2005/ IEE1547
Total Harmonic Distortion	Sell Current	N/A	N/A	< 5%	< 5%
	Invert Voltage	2% Typical	2% Typical	2% Typical	2% Typical
Output Waveform		True Sine Wave			
Battery Voltage	Nominal	24 Vdc	48 Vdc	24 Vdc	48 Vdc
	Operating Range	20-30 Vdc	40-60 Vdc	20-30 Vdc	40-60 Vdc
Recommended Minimum Battery Capacity		200 amp-hours	100 amp-hours	200 amp-hours	100 amp-hours

For Models with FM80 Charge Controller:

Maximum PV Array Wattage	2000 Wd <sub>STC</sub>	4000 Wd <sub>STC</sub>	2000 Wd <sub>STC</sub>	4000 Wd <sub>STC</sub>
PV Input Voltage Range	30-150 V <sub>OC</sub>	60-150 V <sub>OC</sub>	30-150 V <sub>OC</sub>	60-150 V <sub>OC</sub>
PV Operating Voltage Range	30-145 Vdc	60-145 Vdc	30-145 Vdc	60-145 Vdc
PV Maximum Open Circuit Voltage	150 V <sub>OC</sub> including local temperature correction factor			
PV Maximum Short Circuit Current	64 A I <sub>SC</sub>			

Protection

AC and DC Surge Protection	MOV Current Diversion with LED Warnings
PV Ground Fault Protection	80 Adc Circuit Breaker (Detection >0.5 amp)

For Models with FLEXnet DC Battery Monitor:

State of Charge Display	5-LED Bar Graph, or 1% - 100% scale, using MATE2
Battery Capacity Range	100 to 10,000 amp-hours
Current Resolution	0.1 Adc
Shunt A	500 amp, 50 mV
Shunt B	100 amp, 10 mV
Certifications	ETL Listed to UL 1741, CSA 22.2 #107.1
Warranty	5-year limited warranty standard

## Mechanical Specifications, 120 Vac/60 Hz Models

Product Name	FP1-1	FP1-2	FP1-3	FP1-4
Part Numbers	VFX3524	VFX3648	GVFX3524	GVFX3648
Dimensions (H x W x D)	33.50" (85 cm) x 19.75" (50 cm) x 12.87" (33 cm)			
Weight	98 lb (44.5 kg)			
Enclosure and Mounting Plate Materials	Aluminum			
Mounting	Wall Mount (Bracket Included)			
AC Inputs	60 Aac Bypass Assembly			
AC Outputs	20 Aac Outlet and Circuit Breaker			
AC and PV terminals	Accepts #12 AWG to 1/0 AWG			
Charge Controller Terminals	Accepts #12 AWG to 1/0 AWG			
Integrated Communications	MATE2 for system operation information; FLEXnet DC battery monitor for battery information			

# Models FP1-25, FP1-26, FP1-27

## Electrical Specifications, 120 Vac/60 Hz Models

Product Name		FP1-25	FP1-26	FP1-27
Inverter Model		GTFX3048	FX3048T	FX2524T
Grid-Interactive		Yes	No	No
Anti-Islanding Protection		UL1741-2005/ IEEE1547	N/A	N/A
Total Harmonic Distortion	Sell Current	< 5%	N/A	N/A
	Invert Voltage	2% Typical	2% Typical	2% Typical
Output Waveform		True Sine Wave		
Battery Voltage	Nominal	48 Vdc	48 Vdc	24 Vdc
	Operating Range	40-60 Vdc	40-60 Vdc	20-30 Vdc
Recommended Minimum Battery Capacity		100 amp-hours	100 amp-hours	200 amp-hours

For Models with FM80 Charge Controller:

Maximum PV Array Wattage	4000 Wdc <sub>STC</sub>	4000 Wdc <sub>STC</sub>	2000 Wdc <sub>STC</sub>
PV Input Voltage Range	60-150 V <sub>OC</sub>	60-150 V <sub>OC</sub>	30-150 V <sub>OC</sub>
PV Operating Voltage Range	60-145 Vdc	60-145 Vdc	30-145 Vdc
PV Maximum Open Circuit Voltage	150 V <sub>OC</sub> including local temperature correction factor		
PV Maximum Short Circuit Current	64 A I <sub>sc</sub>		

Protection

AC and DC Surge Protection	MOV Current Diversion with LED Warnings
PV Ground Fault Protection	80 Adc Circuit Breaker (Detection >0.5 amp)

For Models with FLEXnet DC Battery Monitor:

State of Charge Display	5-LED Bar Graph, or 1% - 100% scale, using MATE2
Battery Capacity Range	100 to 10,000 amp-hours
Current Resolution	0.1 Adc
Shunt A	500 A, 50 mV
Shunt B	100 A, 10 mV
Certifications	ETL Listed to UL 1741, CSA 22.2 #107.1
Warranty	5-year limited warranty standard

## Mechanical Specifications, 120 Vac/60 Hz Models

Product Name	FP1-25	FP1-26	FP1-27
Part Numbers	GTFX3048	FX3048T	FX2524T
Dimensions (H x W x D)	33.50" (85 cm) x 19.75" (50 cm) x 12.87" (33 cm)		
Weight	98 lb (44.5 kg)		
Enclosure and Mounting Plate Materials	Aluminum		
Mounting	Wall Mount (Bracket Included)		
AC Inputs	60 Aac Bypass Assembly		
AC Outputs	20 Aac Outlet and Circuit Breaker		
AC and PV terminals	Accepts #12 AWG to 1/0 AWG		
Charge Controller Terminals	Accepts #12 AWG to 1/0 AWG		
Integrated Communications	MATE2 for system operation information; FLEXnet DC battery monitor for battery information		

## Specifications

### Models FP1-5, FP1-6

#### Electrical Specifications, 230 Vac/50 Hz Models

Product Name	FP1-5	FP1-6	
Inverter Model	VFX3024E	VFX3048E	
Output Waveform	True Sine Wave		
Battery Voltage	Nominal	24 Vdc	48 Vdc
	Operating Range	20-30 Vdc	40-60 Vdc
Recommended Minimum Battery Capacity	200 amp-hours	100 amp-hours	

For Models with FM80 Charge Controller:

Maximum PV Array Wattage	2000 Wd <sub>CSTC</sub>	4000 Wd <sub>CSTC</sub>
PV Input Voltage Range	30-150 V <sub>OC</sub>	60-150 V <sub>OC</sub>
PV Operating Voltage Range	30-145 Vdc	60-145 Vdc
PV Maximum Open Circuit Voltage	150 V <sub>OC</sub> including local temperature correction factor	
PV Maximum Short Circuit Current	64 A I <sub>SC</sub>	

Protection

AC and DC Surge Protection	MOV Current Diversion with LED Warnings
PV Ground Fault Protection	80 Adc Circuit Breaker (Detection >0.5 amp)

For Models with FLEXnet DC Battery Monitor:

State of Charge Display	5-LED Bar Graph, or 1% - 100% scale, using MATE2
Battery Capacity Range	100 to 10,000 amp-hours
Current Resolution	0.1 Adc
Shunt A	500 A, 50 mV
Shunt B	100 A, 10 mV
Warranty	5-year limited warranty standard

#### Mechanical Specifications, 230 Vac/50 Hz Models

Product Name	FP1-5	FP1-6
Part Numbers	VFX3024E	VFX3048E
Dimensions (H x W x D)	33.50" (85 cm) x 19.75" (50 cm) x 12.87" (33 cm)	
Weight	98 lb (44.5 kg)	
Enclosure and Mounting Plate Materials	Aluminum	
Mounting	Wall Mount (Bracket Included)	
AC Inputs	30 Aac Bypass Assembly	
AC Outputs	16 Aac Outlet and Circuit Breaker	
AC and PV terminals	Accept #12 AWG to 1/0 AWG	
Charge Controller Terminals	Accept #12 AWG to 1/0 AWG	
Integrated Communications	MATE2 for system operation information; FLEXnet DC battery monitor for battery information	

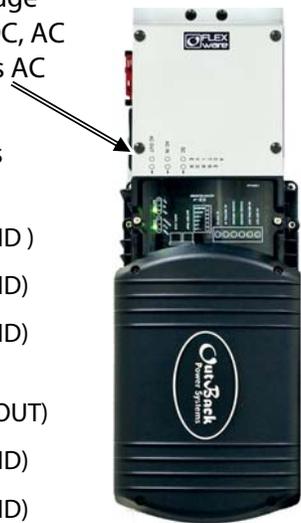
## Surge Protector

The FLEXware Surge Protector is designed to protect the FLEXpower ONE's sensitive components from excessively high voltages (e.g., electrical storms). Thermally-fused metal oxide varistors (MOVs) limit ("clamp") these voltages and transfer the resulting current to a lower-voltage port. The FLEXware Surge Protector features ACTIVE and ERROR LEDs for the DC, AC IN, and AC OUT circuits. The Surge Protector is located in the FLEXpower ONE's AC wiring compartment.



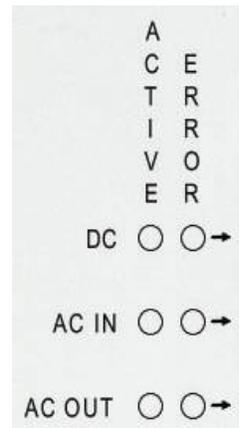
The FLEXware Surge Protector shunts excess current from:

- DC+ (to GROUND)
- AC HOT IN (to GROUND)
- AC NEUTRAL IN (to GROUND)
- AC HOT OUT (to AC NEUTRAL OUT)
- AC HOT OUT (to GROUND)
- AC NEUTRAL OUT (to GROUND)



## LEDs

- ACTIVE LEDs are yellow. If these LEDs are illuminated, power is present in that circuit. It is normal for these LEDs to be illuminated.
- ERROR LEDs are red. A red ERROR light indicates a problem. The LED means a significant surge has damaged the FLEXware Surge Protector, and protection in that circuit is compromised. Although decreased protection remains, it is recommended that the FLEXware Surge Protector be replaced at this time, before further damage occurs. Further damage to the Surge Protector will eventually lead to damage to other FLEXpower ONE components.
- For an ERROR LED to illuminate, its circuit must be powered; its ACTIVE LED will also glow. Note that if the circuit is not powered, the ERROR LED will not indicate a problem even if one is present.



## Specifications

Nominal Voltage	Voltage Protection	Max Surge Current	Energy Rating	Frequency	Protection Type	Protected Circuit
120-240 Vac 12-48 Vdc	390 Vac 150 Vdc	30 kA per circuit	2500 Joules	50/60 Hz	Thermally Fused MOV	x2 AC x1 DC

## Replacement Boards

Replacement boards for the Surge Protector are available in the event that a power surge damages the one currently installed. To obtain a replacement board, contact your local OutBack dealer.

# Renewable Energy Input & Storage

## PV Sizing

Single charge control systems can support photovoltaic arrays with the following specifications. Dual charge controller systems can handle 2 arrays with the following specifications.

### Maximum Array Size

- 4,000  $W_{STC}$  on 48 Vdc system, 2,000  $W_{STC}$  on 24 Vdc system
- 145 Vdc (150  $V_{OC}$  including local temperature correction factor per NEC 690.7)
- 64 A  $I_{SC}$  maximum PV array current per NEC 690.8

A PV string-sizing tool is available on the following website link:

- [http://outbackpower.com/resources/string\\_sizing\\_tool/](http://outbackpower.com/resources/string_sizing_tool/)

## Battery Bank Sizing

In general, the size of the loads (watts) and the required backup period (hours) will determine best size (amp-hour capacity) for the battery bank.

### Running Time and Size

The battery bank's size determines the length of time the inverter can supply AC output power. The larger the bank, the longer the inverter can run and the longer the recharge time.

### Depth-of-Discharge

The battery bank should be designed so the batteries do not discharge more than 50-60% of their capacity on a regular basis. Discharging up to 80% is acceptable on a limited basis, such as a prolonged utility outage. Totally discharging a battery can reduce its effective life or permanently damage it. Consult the battery manufacturer for specific depth-of-discharge recommendations.

### Days of Autonomy

Days of autonomy may vary depending upon the availability of the charging source(s), the critical nature of the load and other factors. If the system is to be powered by renewable energy sources such as solar, determine the appropriate number of days of autonomy by allowing for cloudy weather as well as other seasonal variations in available energy.

Back up power systems which use utility power for recharging should use the estimated number of days of maximum power outage for determining days of autonomy.

## Amp-Hour Requirements

Amp-hour requirements will vary with each installation depending on the loads that are connected and the desired amount of time for those loads to be supported in the event that utility power is unavailable

### Amp-hour Capacity

Deep cycle batteries have a capacity measured in amp-hours. Amp-hours are a measure of current flow over time. An amp-hour figure is derived by multiplying current (amperes) by the amount of time the current flows (hours). This applies equally to the amount taken out of a battery (discharging) or the amount put into it (charging).

## Discharge Rate

Deep cycle batteries express the amp-hour rating as "at the x-hour rate". This is an average rate of current flow that would take x number of hours to discharge the batteries. Common amp-hour figures are at the 6-hour rate, the 20-hour rate, and the 100-hour rate. A battery is classified as having fewer amp hours if it is discharged at a faster rate, such as the 6-hour rate. There is an inevitable amount of heat associated with the flow of current through a battery. The higher the amount of current, the greater the amount of heat generated. The heat is energy which is no longer available to the battery to power loads. Hence, at a higher discharge rate, the batteries effectively have fewer amp-hours available. Generally, the 20-hour rate is the most common one.

## Estimating Amp Hours

To estimate the battery bank requirements, first calculate the amount of power to be drawn from the batteries during the period of autonomy. This power draw is then translated into amp hours (Ah)—the unit of measure to express deep-cycle battery capacity.

Amp-hours are calculated multiplying the current drawn by the load by the length of time it will operate.

## Watts to Amps

To calculate amps when the power consumption is expressed in watts, use the following equation:

$$A = W/V$$

where W = watts and V = volts DC

*For example:*

A 100 watt light bulb will draw approximately 4.17 amps from a 24-volt battery system.

$$4.17 = 100 / 24$$

If the light runs for three hours it will consume (4.17 x 3) or 12.5 Ah of power.



### **IMPORTANT:**

For these calculations, do not use the AC amp rating of a device. AC amps are measured on a different scale and will not give correct results.

## Time and Power

The length of time a load is operated will affect the power draw. In some cases, an appliance which draws a large wattage may not consume as many amp-hours as a load drawing fewer watts but running for a longer period of time.

## Amps to Watts

All electrical appliances have labels which state their energy consumption. Look for an amps rating on motors and a watts rating on other appliances.

If the label plate has expressed power consumption in AC amps, multiply by volts for the watts required (watts = volts x amps).

Things to consider:

- Motors typically require 3 to 6 times their running current when starting. Check the manufacturer's data sheets for their starting current requirements. If you will be starting large motors from the inverter, increase the battery bank size to allow for the higher start-up current.

## Specifications

- Refrigerators and ice-makers typically run only about 1/3 of the time, therefore, the running wattage is 1/3 of the total wattage of the appliance. Divide the total wattage of the appliance by 3 when determining the battery requirements.

### Calculating Amp-Hours

To determine the amp-hours that will be consumed, list the anticipated loads and the length of time they will operate. Use the specifications noted on the labels of each AC load that is to be connected to the system. Determine the number of hours per day and the number of days during the week that the load will be used.

Use the worksheet on page 59 to list the respective values and calculate the amp-hour requirement.

In summary, to calculate the amp-hour requirements:

1. Determine the loads the system will power and enter their wattage.
2. Determine the number of hours (or decimal portion of hours) the appliance is used each day.
3. Determine the number of days the appliance will be used during the week.
4. Multiply hours x days for each load identified to determine the watt-hours per week.
5. Add the total watt-hours per week for all loads then divide by 7 to obtain the average total watt-hours per day.
6. Divide the total average per day by the DC nominal voltage.

This figure represents the average amp-hours per day that will be used.



## Worksheet for Calculating Battery Bank Size

Use the following worksheet to calculate the battery bank size.

**Table 8      Worksheet for Determining Battery Bank Size**

Average amp-hours per day (from Table 7)	
Divided by inverter efficiency	
Divided by battery efficiency (usually 0.75)	
Adjusted amp-hours per day	
Divided by depth-of-discharge (usually 60%)	
Multiplied by days of autonomy	
Battery bank size required	



# Wiring Configurations

The following wiring configurations are provided as examples only. Actual wiring requirements may vary depending on local electric code. All installations must comply with local electric code.

- FLEXpower ONE with FLEXnet DC Monitor and GFDI
- FLEXpower ONE with FLEXnet DC Monitor Only (No GFDI)
- FLEXpower ONE with GFDI Only (no FLEXnet DC Monitor)
- FLEXpower ONE (no FLEXnet DC Monitor or GFDI)

## Wiring Configuration

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# FLEXpower ONE with FLEXnet DC Monitor and GFDI

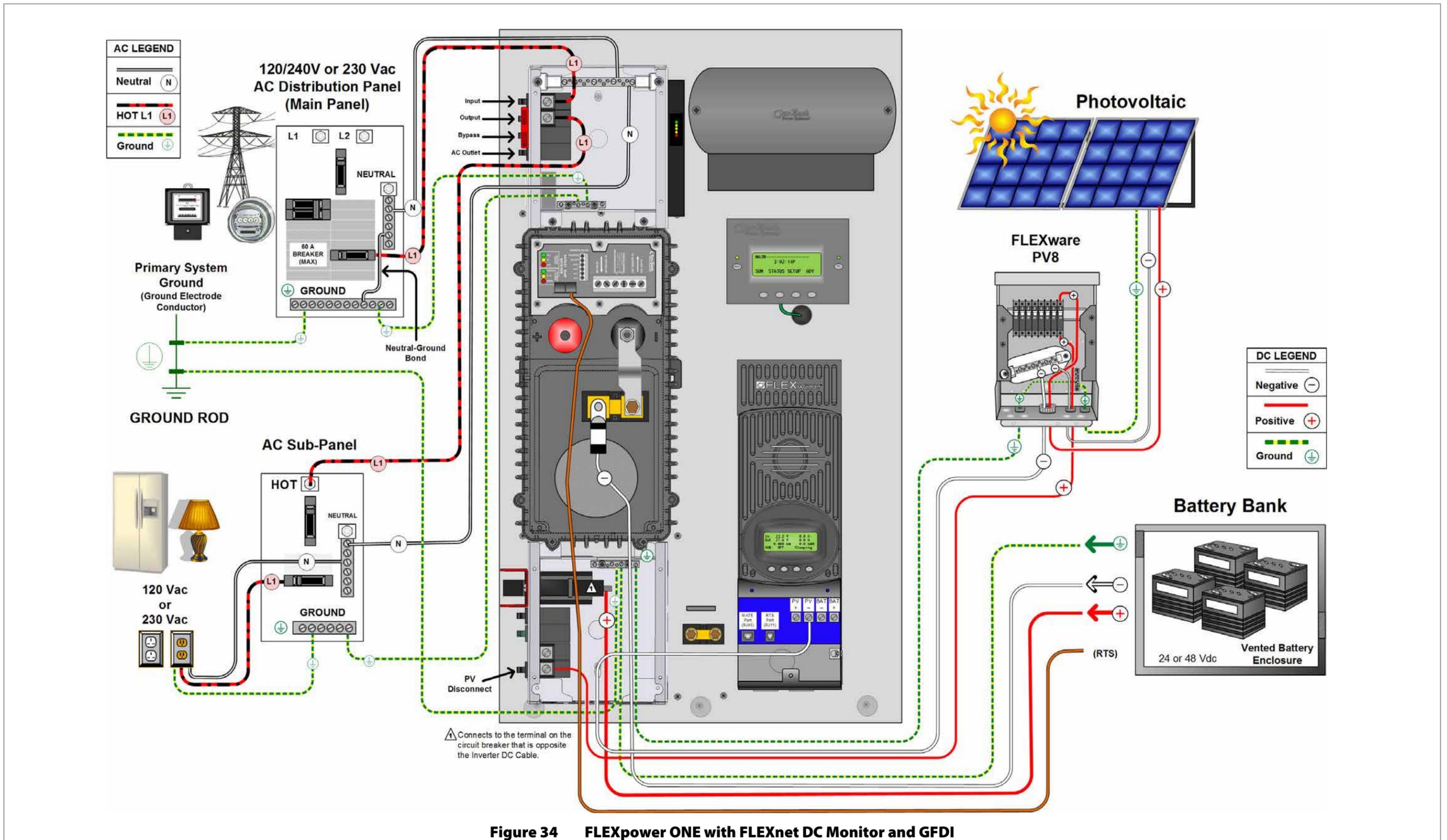


Figure 34 FLEXpower ONE with FLEXnet DC Monitor and GFDI

FLEXpower ONE with FLEXnet DC Monitor Only (no GFDI)

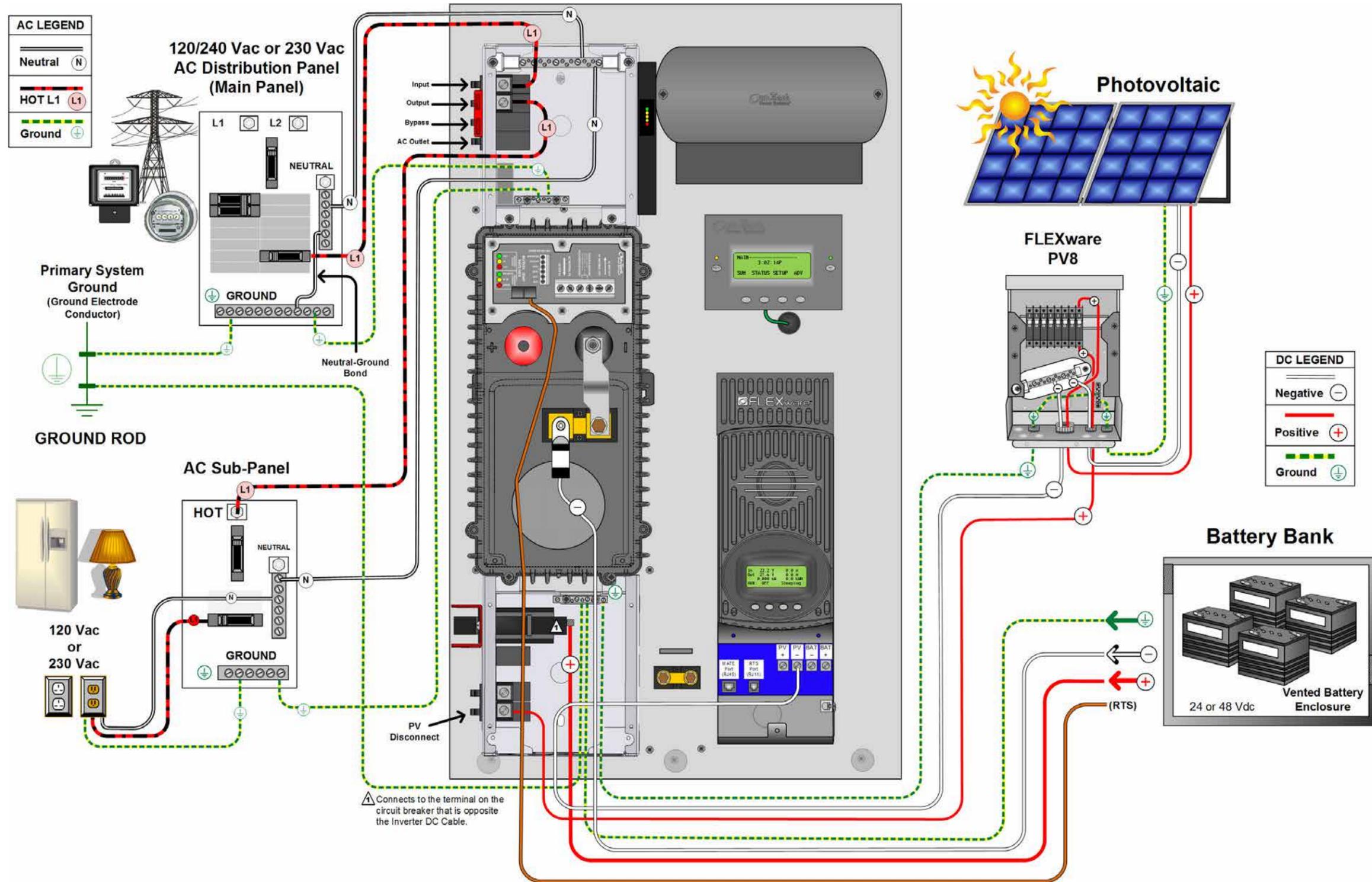


Figure 35 FLEXpower ONE with FLEXnet DC Monitor Only (No GFDI)

# FLEXpower ONE with GFDI Only (no FLEXnet DC Monitor)

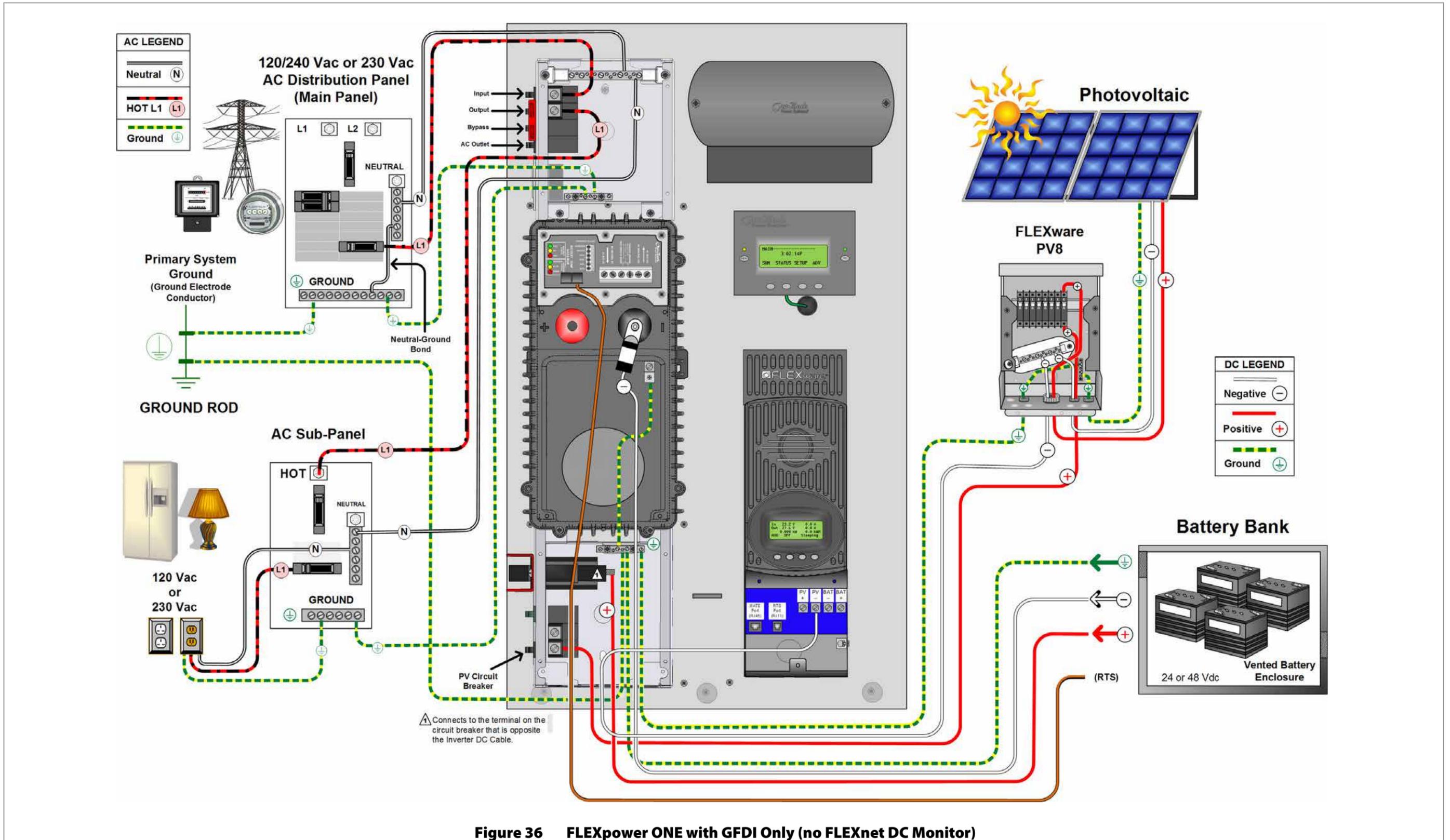
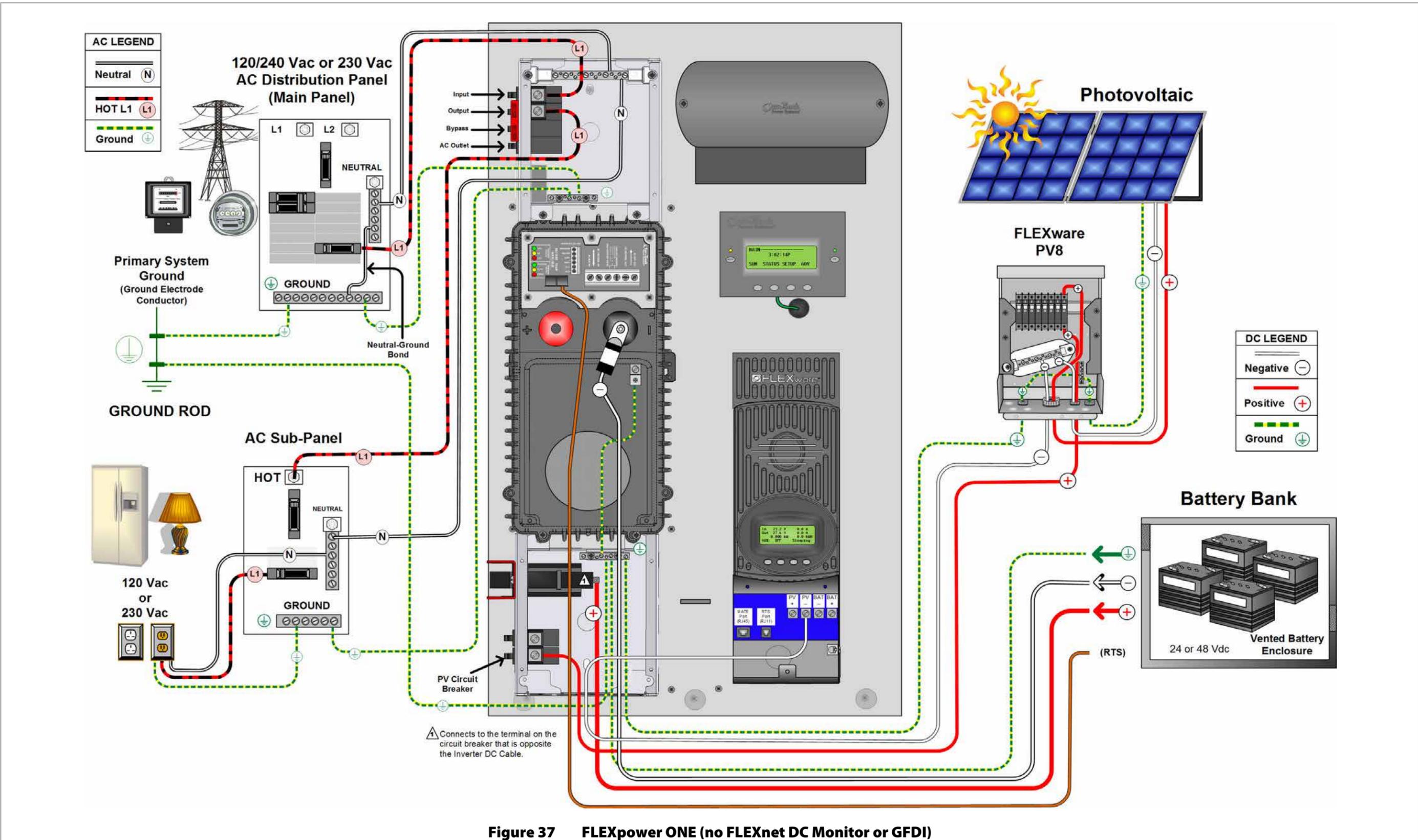


Figure 36 FLEXpower ONE with GFDI Only (no FLEXnet DC Monitor)

FLEXpower ONE (no FLEXnet DC Monitor or GFDI)





# Product Registration

The purchase of an OutBack Power Technologies product is an important investment. Registering the products will help OutBack maintain the standard of excellence expected in terms of performance, quality and reliability.

Please take a moment to register and provide us with some important information.

Registration can be done as follows:

- Go to the following website.  
<http://www.outbackpower.com/resources/warranty/>  
or
- Fill out the information on this form (pages 67 and 68) and return a paper copy using a postal service to the following address:

## OutBack Power Technologies

Attn: Warranty Registration  
5917 – 195<sup>th</sup> Street N.E., #7  
Arlington, WA 98223 USA

**Be sure to keep a copy for your records.**

SYSTEM OWNER	
Name	
Address	
City, State, Postal or Zip Code	
Country	
Telephone Number	
E-mail	
SYSTEM PURCHASE	
Product Model Number	
Product Serial Number	
Sold by	
Purchase Date	

## INSTALLATION INFORMATION

System Install/Commission Date	
System Array Size	
System Array Nominal Voltage	
Type of PV Modules	
System Battery Bank Size (Amp-Hours)	
Brand and Model of Batteries	
Does this system include an auxiliary AC generator?	
If yes, please specify brand and model of generator	

## INSTALLER INFORMATION

Contractor Number	
Installer Name	
Installer Address	
Installer City, State, Postal or Zip Code, Country	
Installer Telephone/E-mail	

**Please check ALL factors affecting purchase decision:**

- Grid-Interactive Capability
- Product Reputation
- Back-up Capability
- Reputation of OutBack Power Technologies
- Value
- Outdoor Installation Option
- Looks
- Other

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# Warranty

## 5-Year Limited Warranty for the FLEXpower ONE

OutBack Power Technologies, Inc. (“OutBack”) provides a five-year (5) limited warranty (“Warranty”) against defects in materials and workmanship for its FLEXpower ONE (“Product”).

The term of this Warranty begins on the Product(s) initial purchase date, or the date of receipt of the Product(s) by the end user, whichever is later. This must be indicated on the invoice, bill of sale, and/or warranty registration submitted to OutBack. This Warranty applies to the original OutBack Product purchaser, and is transferable only if the Product remains installed in the original use location. The warranty does not apply to any Product or Product part that has been modified or damaged by the following:

- Installation or removal;
- Alteration or disassembly;
- Normal wear and tear;
- Accident or abuse;
- Corrosion;
- Lightning;
- Repair or service provided by an unauthorized repair facility;
- Operation or installation contrary to manufacturer product instructions;
- Fire, floods or acts of God;
- Shipping or transportation;
- Incidental or consequential damage caused by other components of the power system;
- Any product whose serial number has been altered, defaced or removed;
- Any other event not foreseeable by OutBack.

OutBack’s liability for any defective Product, or any Product part, shall be limited to the repair or replacement of the Product, at OutBack’s discretion. OutBack does not warrant or guarantee workmanship performed by any person or firm installing its Products. This Warranty does not cover the costs of installation, removal, shipping (except as described below), or reinstallation of Products or parts of Products.

THIS LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY APPLICABLE TO OUTBACK PRODUCTS. OUTBACK EXPRESSLY DISCLAIMS ANY OTHER EXPRESS OR IMPLIED WARRANTIES OF ITS PRODUCTS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. OUTBACK ALSO EXPRESSLY LIMITS ITS LIABILITY IN THE EVENT OF A PRODUCT DEFECT TO REPAIR OR REPLACEMENT IN ACCORDANCE WITH THE TERMS OF THIS LIMITED WARRANTY AND EXCLUDES ALL LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION ANY LIABILITY FOR PRODUCTS NOT BEING AVAILABLE FOR USE OR LOST REVENUES OR PROFITS, EVEN IF IT IS MADE AWARE OF SUCH POTENTIAL DAMAGES. IF YOU ARE A CONSUMER THAT PURCHASED THIS PRODUCT IN A MEMBER STATE OF THE EUROPEAN UNION, YOU MAY HAVE ADDITIONAL STATUTORY RIGHTS UNDER DIRECTIVE 1999/44/EC. THESE RIGHTS MAY VARY FROM EU MEMBER STATE TO EU MEMBER STATE. SOME STATES (OR JURISDICTIONS) MAY NOT ALLOW THE EXCLUSION OR LIMITATION OF WARRANTIES OR DAMAGES, SO THE ABOVE EXCLUSIONS OR LIMITATIONS MAY NOT APPLY TO YOU.

## How to Arrange for Warranty Service

During the warranty period beginning on the invoice date, OutBack Power Technologies will repair or replace products covered under this limited warranty that are returned to OutBack Power Technologies' facility or to an OutBack Power Technologies authorized repair facility, or that are repaired on site by an OutBack Power Technologies authorized repair person.

**IMPORTANT:**

For full Warranty description, see previous page.

## Contacting OutBack

To request warranty service:

- call OutBack Technical Support at **+1.360.435.6030**, or direct at **+1.360.618.4363**, or
- send an email to Technical Support at **support@outbackpower.com**.

To ensure warranty coverage, this contact must be within the effective warranty period. If service is required, the OutBack Technical Support representative will issue a Return Material Authorization (RMA) number.

## Troubleshooting

In the event of a Product failure, the customer will need to work with an OutBack Technical Support representative to perform the necessary troubleshooting. This is a required step before a return can be performed. Troubleshooting requires a qualified technician to be present at the site of the Product, with a quality voltmeter that measures both DC and AC. The OutBack representative will request voltmeter readings, Product error messages, and other information. Many, many problems can be resolved on-site. If the customer is not willing or able to provide these readings (or is not willing or able to visit the site), and the Product is found to have no problems upon return, OutBack may choose to charge additional labor and handling fees up to \$180.00 U.S.

## Return Material Authorization (RMA)

A request for an RMA number requires all of the following information:

Product model and serial number;

4. Proof-of-purchase in the form of a copy of the original Product purchase invoice or receipt confirming the Product model number and serial number;
5. Description of the problem; and
6. Shipping address for the repaired or replacement equipment.

Upon receiving this information, the OutBack representative can issue an RMA number.

### Returning Product to OutBack

After receiving the RMA number, the customer must pack the Product(s) authorized for return, along with a copy of the original purchase invoice and warranty certificate, *in the original Product shipping container(s) or packaging providing equivalent or reasonable protection*. The RMA number must be written on the outside of the packaging where it is clearly visible.

If Product is within the warranty period, OutBack will cover prepaid shipping with prior arrangement.

The Product(s) must be shipped back to OutBack Power Technologies in their original or equivalent packaging, to the following address:

**OutBack Power Technologies**

RMA # \_\_\_\_\_

6115 192nd Street NE

Arlington, WA 98223 USA

The customer must insure the shipment, or accept the risk of loss or damage during shipment. If a shipping box is needed for return of a Product, OutBack will send a shipping box upon request.



**IMPORTANT:**

*OutBack is not responsible for shipping damage caused by improperly packaged Products, the repairs this damage might require, or the costs of these repairs.*

If, upon receipt of the Product, OutBack determines the Product or Product part is defective and that the defect is covered under the terms of this Warranty, OutBack will then, and only then, ship a repaired or replacement Product or Product part to the purchaser freight prepaid, non-expedited, using a carrier of OutBack's choice, where applicable.

If Product fails in ninety (90) or fewer days from original purchase date, OutBack will replace with a new Product. If Product fails after ninety (90) days and up to expiration of warranty, OutBack will, at its discretion, either repair and return a Product, or ship a replacement Product. OutBack will determine whether a Product is to be repaired or replaced in accordance with Product age and model. OutBack will authorize advance shipment of a replacement based on Product age and model.

In cases where an OutBack dealer or distributor replaces a Product more than ninety (90) days old with a new Product, OutBack will NOT compensate that dealer or distributor with new stock unless the exchange was authorized in advance by OutBack.

### **Out of Warranty**

If Product is out of warranty, OutBack will repair and return Product for a fee. Alternately, if applicable, upon request, OutBack will advance-ship replacement parts for a fee.

If a shipping box is needed for return of out-of-warranty Product, OutBack will send a shipping box upon request. The customer is responsible for paying shipping to OutBack.

The warranty period of any repaired or replacement Product or Product part is ninety (90) days from the date of shipment from OutBack, or the remainder of the initial warranty term, whichever is greater.

This Warranty is void for any Product that has been modified by the customer without authorization by OutBack. A Product with a voided warranty will be treated the same as one with an expired warranty.





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Thank you for supporting OutBack Power Technologies by installing this product. Your patronage is greatly appreciated.

This product was proudly assembled in the United States of America and demonstrates the quality and pride of this great team of employees.

We sincerely hope your experience has been pleasant, positive, and professional and hope that you'll consider OutBack Power Technologies for future purchases.

Sincerely,

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