PROSine™ 2.0

2000 watt Inverter • Charger

True Sine Wave Output

User's Manual

XANTREX

Smart Choice For Power

Xantrex International

Xantrex Technology Inc. is the world's leading supplier of advanced power electronics with products from 50 watts to 1 megawatt in size for commercial, residential, and recreational markets, as well as distributed and renewable energy markets. The Company was formed by the merger of US-based Trace holdings LLC and Canadian-based Xantrex Technology Inc. and was further expanded by the acquisition of Heart Interface Corporation and Cruising Equipment Company.

Xantrex's products include inverters, battery chargers, programmable power supplies, variable speed drives, and a range of sophisticated microprocessor-based controllers with associated software.

Trace Holdings LLC through its divisions, Trace Engineering and Trace Technologies brings to Xantrex market leadership in advanced power electronics for residential, commercial-and utility-scale solar photovoltaic, wind, fuel cell, advanced battery, microturbine, and backup power for grid-connected and standalone applications. Trace products range from one kilowatt to over one megawatt.

Heart Interface and Cruising Equipment Company are major suppliers of power inverters and instrumentation with a focus on the recreational and marine markets. The products range in power from 50 watts to three kilowatts and include advanced charging and monitoring systems.

Xantrex is also a leader in commercial, industrial, consumer, and recreational markets, producing quality products that are easy to integrate into systems. Products range from programmable AC/DC power supplies that convert alternating current to direct current for testing electronics in design and production, to DC/AC inverters to power electrical appliances in heavy duty trucks, run mobile office equipment in a car, or provide AC power in fleet and utility vehicles. In recreational markets, Xantrex is the leading supplier of DC/AC inverters, which power electrical equipment on boats and recreational vehicles as well as portable power sources for outdoors or emergency use. The power range of its products is from 50 watts to six kilowatts.

The company's products are sold under the Trace, Statpower, Heart, CECO, and Xantrex brands.

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Information About Your System

When you first open the PROsine 2.0 Inverter•Charger package, be sure to record the following:

- ❒ Model Number (on DC end) _____
- ❒ Serial Number (on DC end) _____
- ❒ Purchased From _____
- ❒ Purchase Date _____

If you need to contact Customer Service, please record the following details before calling. This information will help our representatives give you better service.

- ❒ Type of installation (e.g. RV, Boat, Home) _____
- ❒ Length of time product has been installed _____
- ❒ Battery bank size _____
- ❒ Battery type (e.g. flooded, sealed gel cell, AGM) _____
- ❒ AC service setting _____
- ❒ AC wiring size & length _____
- ❒ DC wiring size & length _____
- ❒ Options installed on inverter•charger _____
- ❒ Charge or Invert mode when problem occurred _____
- ❒ Warning, Error, or Panel Fault message if any _____
- ❒ Appliance(s) operating when problem occurred _____

Default Values for PROsine 2.0 System

Table 1 lists the default settings for the PROsine 2.0 system. Record your settings in the right-hand column after you have configured the inverter•charger. This information will be valuable if you need to reconfigure your system or call Xantrex Customer Service.

Table 1 Default Values: Inverter•Charger

Item	Default Value	Your Settings
NOTE At a minimum, configure the items marked with a ** after installation.		
Adjustable From the Configure PROsine—Basic Menu		
AC Breaker Size	15 amps	**
Adjustable From the Configure PROsine—Advanced Menu		
Load Sensing	OFF	
Load Sense Power	100 Watts	
Load Sense Interval	1 second	
Low AC Transfer (V)	90V	
Low AC Transfer (Hz)	55Hz	
High AC Transfer (V)	130V	
High AC Transfer (Hz)	65Hz	
AC Series Mode	Standalone	
Inverter Low V Shutdown	10V	
Run Without Panel	OFF	
Inverter Enabled on Reset Without Panel	OFF	
Charger Enabled on Reset Without Panel	OFF	
Auto Restart After Error	OFF	**
Adjustable From the Configure Display Panel Menu		
Audible Alarm	OFF	
LCD Backlight Mode	Auto	
LCD Backlight Brightness	50%	
LCD Backlight Timeout	20 seconds	
Temperature	Farenheit	

Table 1 Default Values: Inverter•Charger

Item	Default Value	Your Settings
Adjustable From the Configure Battery Menu **NOTE** Settings below are for Battery Type = Generic Gel.		
Battery Size	200Ah	**
Default Battery Temperature	Warm	
Battery Type	Generic Gel	**
Battery Temp. Coefficient	–27mV/°C	
Bulk Mode Settings: • Max Voltage • Max Current (%C) • Exit Voltage • Exit Timeout	 • 14.2V • 25% • 13.8V • 3min	
Absorption Mode Settings: • Max Voltage • Max Current (%C) • Max Abs Time • Exit Current (%C) • Exit Timeout	 • 14.2V • 25% • 8hr • 1% • 3min	
Overcharge Mode Settings: • Max Voltage • Max Current (%C) • Overchg Timeout	 • 14.2V • 20% • 0	
Float Mode Settings: • Max Voltage • Max Current (%C) • Max Float Time • Exit Voltage • Exit Timeout	 • 13.8V • 200% • 21days • 12.5V • 15min	
Equalize Mode Settings: • Max Voltage • Max Current (%C) • Max EQ Time • Exit Voltage • Exit Timeout	 • 13.8V • 200% • 0 • 0 • 0	
Constant Mode Settings: • Voltage Setpoint • Current Setpoint	 • 13.5V • 100A	
Charger Mode	Standalone	
Charger Type	3-Step	
NOTE The values opposite the gray bar are set when you select a battery type. If you did not subsequently change these settings, they do not need to be recorded.		

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IMPORTANT SAFETY INSTRUCTIONS

WARNING

This manual contains important safety and operating instructions as prescribed by UL and CSA specifications for inverter•chargers used in residential, RV, and marine applications.

Before you install and use your PROsine® 2.0 Inverter•Charger, be sure to read and save these safety instructions.

General Safety Precautions

1. Before using the inverter•charger, read all instructions and cautionary markings on the inverter•charger, the batteries, and all appropriate sections of this manual.
2. Do not expose the inverter•charger to rain, snow, spray, or bilge water. To reduce risk of fire hazard, do not cover or obstruct the ventilation openings. Do not install the inverter•charger in a zero-clearance compartment. Overheating may result.
3. Do not use attachments not recommended or sold by the manufacturer. Doing so may result in a risk of fire, electric shock, or injury to persons.
4. The inverter•charger is designed to be permanently connected to your AC and DC electrical systems. Xantrex recommends that all wiring be done by a certified technician or electrician to ensure adherence to proper electrical wiring regulations.
5. To avoid a risk of fire and electric shock, make sure that existing wiring is in good condition and that wire is not undersized. Do not operate the inverter•charger with damaged or substandard wiring.
6. Do not operate the inverter•charger if it has received a sharp blow, been dropped, or otherwise damaged in any way. If the unit is damaged, see "Warranty" on page xx.
7. Do not disassemble the inverter•charger. See page xx for instructions on obtaining service. Attempting to service the unit yourself may result in a risk of electrical shock or fire. **Internal capacitors remain charged after all power is disconnected.**
8. To reduce the risk of electrical shock, disconnect both AC and DC power from the inverter•charger before attempting any maintenance or cleaning or working on any circuits connected to the inverter•charger. Turning off controls will not reduce this risk.

9. The inverter•charger must be provided with an equipment-grounding conductor connected to the AC input ground terminal. Grounding and all other wiring must comply with local codes and ordinances.
10. For marine applications in the United States, external connections to the inverter•charger shall comply with the United States Coast Guard Electrical Regulations (33CFR183, Sub part 1).

Explosive Gas Precautions

1. Working in the vicinity of lead-acid batteries is dangerous. Batteries generate explosive gases during normal operation. Therefore you must read this manual and follow the instructions exactly before installing or using your inverter•charger.
2. This equipment contains components which tend to produce arcs or sparks. To prevent fire or explosion, do not install it in compartments containing batteries or flammable materials or in locations that require ignition-protected equipment. This includes any space containing gasoline-powered machinery, fuel tanks, joints, fittings, or other connections between components of the fuel system.
3. To reduce the risk of battery explosion, follow these instructions and those published by the battery manufacturer and the manufacturer of the equipment in which the battery is installed.

Precautions When Working With Batteries

1. Someone should be within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
2. Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
3. Wear complete eye protection and clothing protection. Avoid touching your eyes while working near batteries.
4. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters your eye, immediately flood it with cold running water for at least twenty minutes and get medical attention immediately.
5. Keep a supply of baking soda on hand in the area of the batteries. Baking soda neutralizes lead-acid battery electrolyte.
6. NEVER smoke or allow a spark or flame in the vicinity of the engine or batteries.
7. Use extra caution to reduce the risk of dropping a metal tool on the battery. It could spark or short circuit the battery or other electrical parts and could cause an explosion.

8. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with lead-acid batteries. Lead-acid batteries produce a short-circuit current high enough to weld a ring or the like to metal, and thus cause a severe burn.
9. Use the inverter•charger for charging lead-acid batteries only. Do not use it to charge nickel-cadmium or dry-cell batteries commonly used with home appliances and electronic equipment. These batteries may burst and injure persons and damage property.
10. NEVER attempt to charge a frozen battery. Charging a battery when its temperature is below 32°F (0°C) is inefficient and ineffective. If possible, gradually warm the battery above 32°F (0°C) before charging.
11. If you need to remove a battery, always remove the ground terminal from the battery first. Make sure all accessories are off so you don't cause an arc.
12. Be sure the area around the battery is well ventilated.

FCC INFORMATION TO THE USER

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

MATERIALS LIST

Your PROsine® 2.0 Inverter•Charger package includes the items listed below. See Figure 1.

- ❒ 1 PROsine 2.0 Inverter•Charger
- ❒ 1 Display panel
- ❒ 1 Communications cable (70ft; 21m)
- ❒ 1 Battery temperature sensor with a 25ft (8m) cable
- ❒ 2 DC terminal covers
- ❒ 1 User's Manual
- ❒ 1 Quick Installation Guide (includes inverter•charger mounting template)
- ❒ 1 Mounting template for display panel
- ❒ 1 Quick Reference Guide
- ❒ 1 ABYC Warning label. (See the Note on page xix.)

NOTE

- ❒ DC Wiring Enclosure
  For residential installations, some installation codes may require a wiring enclosure for DC connections and cables. (Installation procedures are shipped with the DC Wiring Enclosure.)
- ❒ Crimp-On Ring Terminals (for DC Wiring Enclosure)
  If you are using the DC Wiring Enclosure, you should use crimp-on ring terminals on the PROsine end of your DC cables. Most box connectors (set screw types) are too large to fit in the enclosure without the risk of the connector shorting to the wall of the DC Wiring Enclosure. Do not use any connector that does not provide at least 2mm clearance to the inside wall with the wire in place and the set screw tightened.
- ❒ Series Sync Cable
  If you are connecting two PROsine inverter•chargers in series, you will need a Series Sync cable.

Contact Xantrex or your distributor about the Wiring Enclosure and the Series Sync cable. Purchase the crimp-on ring terminals from a local supplier.

If any of these materials are missing or are unsatisfactory in any manner, please contact Customer Service:

- ❒ **Phone:** 1-800-670-0707
- ❒ **Fax:** 1-800-994-7827
- ❒ **Email:** support.prosine@xantrex.com

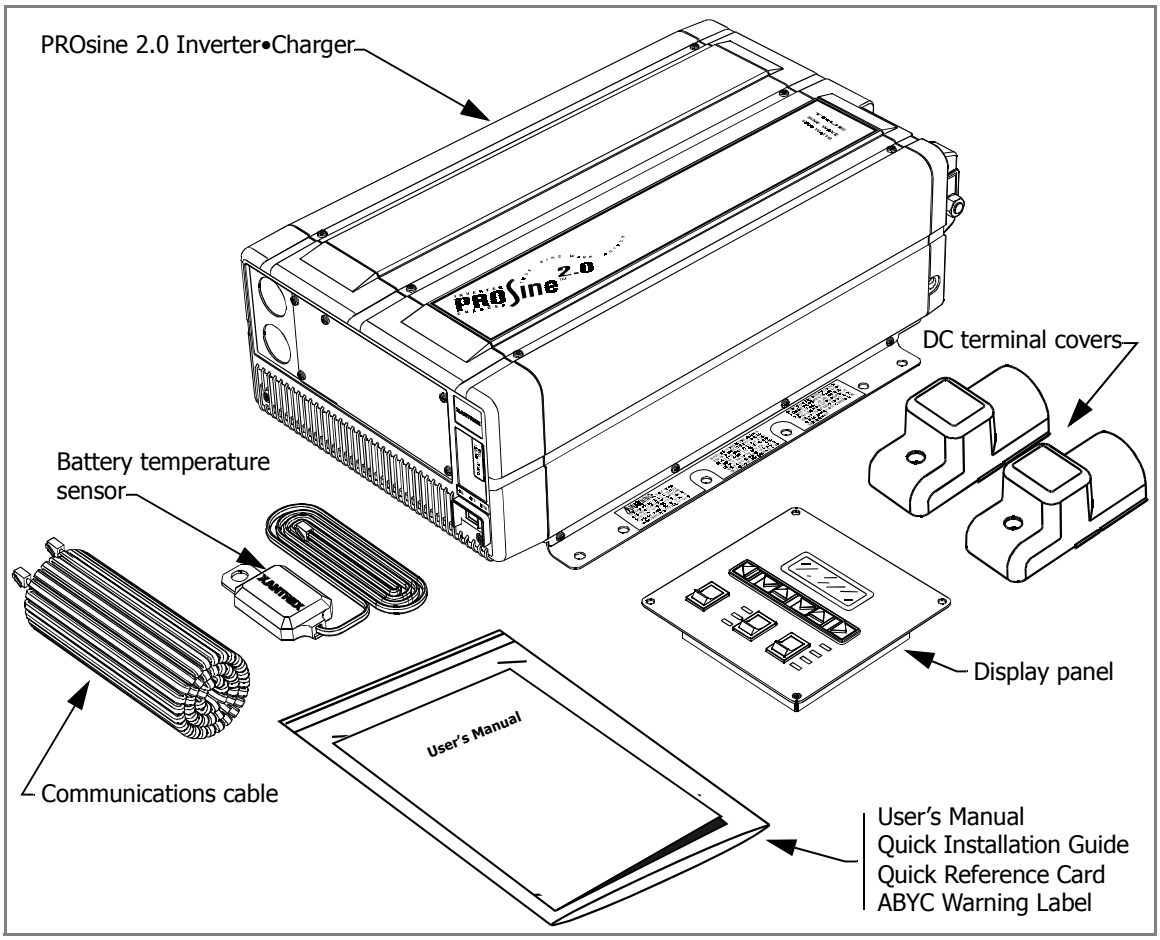


Figure 1 PROsine 2.0 Materials as Shipped

NOTE For Marine Installations

For marine installations, you must attach the ABYC Warning label in a conspicuous location on the AC load panel. The Warning label is supplied with your PROsine 2.0 Inverter•Charger and is illustrated below:

WARNING. SHOCK HAZARD. VESSEL IS EQUIPPED WITH A DC TO AC POWER INVERTER. DISCONNECT ALL ELECTRICAL SOURCES INCLUDING THE INVERTER'S AC AND DC INPUTS BEFORE SERVICING VESSEL'S ELECTRICAL SYSTEMS.

WARRANTY

What does this warranty cover? Xantrex manufactures its products from parts and components that are new or equivalent to new, in accordance with industry-standard practices. This warranty covers any defects in workmanship or materials.

How long does the coverage last? This warranty lasts for twenty four months from the date of purchase. Implied warranties of merchantability and fitness for a particular purpose are limited to twenty four months from the date of purchase. Some jurisdictions do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

What does this warranty not cover? This warranty will not apply where the product has been misused, neglected, improperly installed, physically damaged or altered, either internally or externally, or damaged from improper use or use in an unsuitable environment. Xantrex does not warrant uninterrupted operation of its products. Xantrex shall not be liable for damages, whether direct, incidental, special, or consequential, or economic loss even though caused by the negligence or fault of Xantrex. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

What will Xantrex do? Xantrex will, at its option, repair or replace the defective product free of charge. Xantrex will, at its own option, use new and/or reconditioned parts made by various manufacturers in performing warranty repair and building replacement products. If Xantrex repairs or replaces a product, its warranty term is not extended. Xantrex owns all parts removed from repaired products.

How do you get service? To qualify for the warranty, dated proof of purchase must be provided and the product must not be disassembled or modified without prior authorization by Xantrex. If your product requires warranty service, please return it to the place of purchase along with a copy of your dated proof of purchase. If you are unable to contact your merchant, or the merchant is unable to provide service, contact Xantrex directly at:

Phone: 1-800-670-0707

Fax: 1-800-994-7828

Email: support.prosine@xantrex.com

Return Material Authorization Policy

You must obtain a Return Material Authorization (RMA) number from Xantrex before returning a product directly to Xantrex. Products returned without an RMA number or shipped collect will be refused. When you contact Xantrex to obtain service, be prepared to supply the serial number of your product and its date of purchase as well as information about the installation or use of the unit. Record this information on page ii of this manual.

Return Material Procedure

If you are returning a product from the USA or Canada, follow this procedure:

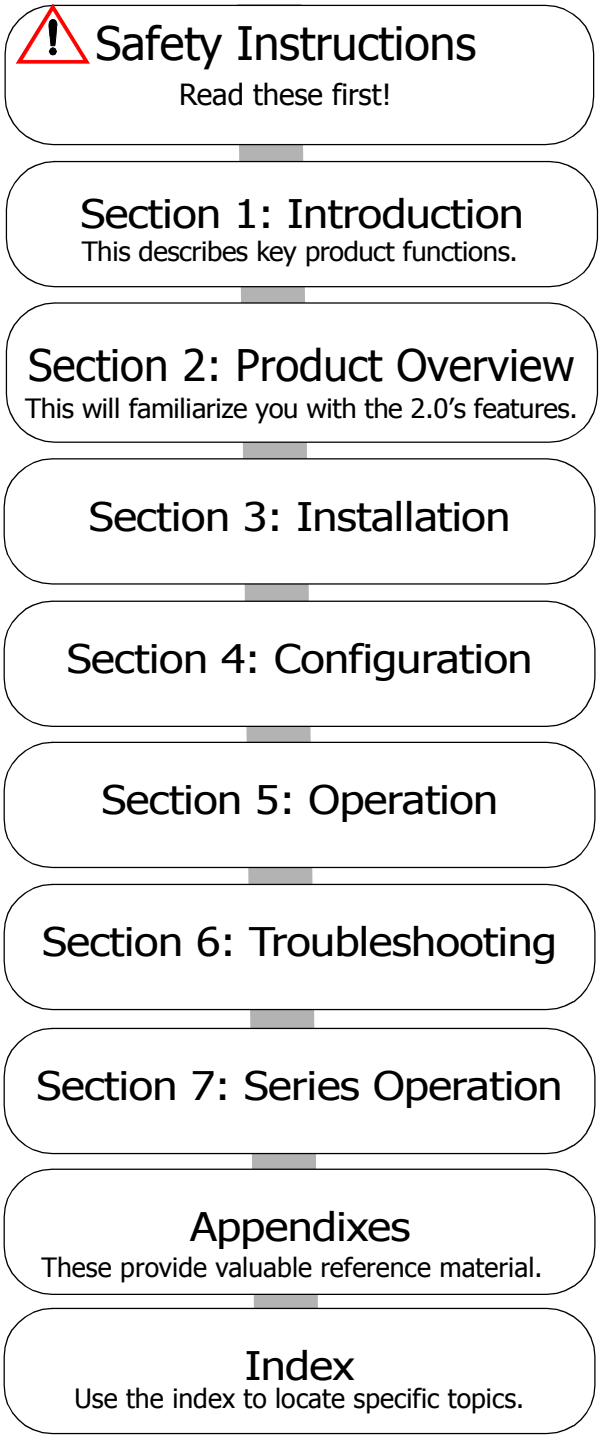
1. Obtain an RMA number and a shipping address from Xantrex.
2. Package the unit safely, preferably using the original box and packing materials. Include the following:
   - ❒ The RMA number
   - ❒ A copy of your dated proof of purchase
   - ❒ A return address where the repaired unit can be shipped
   - ❒ A contact telephone number
   - ❒ A brief description of the problem
3. Ship the unit to the address provided in step 1, freight prepaid.

How do other laws apply? This warranty gives you specific legal rights, and you may also have other rights which vary from jurisdiction to jurisdiction.

For our Canadian customers: When used herein “implied warranties of merchantability and fitness for a particular purpose” includes all warranties and conditions, express or implied, statutory or otherwise, including without limitation implied warranties and conditions of merchantability and fitness for a particular purpose.

CONTENTS & ORGANIZATION OF THIS MANUAL

This manual is a complete guide to installing, configuring, using, and troubleshooting the PROsine 2.0 Inverter•Charger and is also a source of valuable reference information. Here's an overview of the contents.



RELATED DOCUMENTS

- ❒ **PROsine 2.0 Inverter•Charger Quick Installation Guide**

  Part Number: 445-0099-01-01: This document is included with your inverter•charger. It is a job aid that provides instructions for installing the inverter•charger and its display panel. It also provides a mounting template for the inverter•charger.

- ❒ **PROsine 2.0 Inverter•Charger Display Panel Mounting Template**

  Part Number: 445-0101-01-01: This is provided with your inverter•charger.

- ❒ **PROsine 2.0 Inverter•Charger Quick Reference Guide**

  Part Number: 445-0100-01-01: This document is included with your inverter•charger. It provides frequently used information about configuring and operating the unit as well as system default values.

For additional product and company information, have a look at our website: **www.xantrex.com**

Section 1 Introduction

Congratulations on your purchase of the PROsine® 2.0 Inverter•Charger! As part of the PROsine Inverter•Charger family, the 2.0 gives you quality power, worry-free operation, and outstanding reliability. Its integrated inverting–charging functions and numerous power management features make it ideal for marine installations, recreational and commercial vehicles, and residential back-up systems.

Quality Power The PROsine's true sine wave output is identical to (or better than) the power supplied by your utility. A few of the benefits of true sine wave power are less interference on your TV set, more consistent cooking in your microwave, better handling of sensitive loads, and the ability to use dimmer switches and appliances with speed controls. In effect, the PROsine 2.0 gives you a high quality, mobile wall socket!

Comprehensive Protection The PROsine's built-in protection features safeguard your batteries and equipment to give you worry-free operation:

- The adjustable **low battery cutout** prevents your batteries from becoming completely discharged.
- The **battery temperature sensor** ensures that the charge delivered to the batteries is adjusted according to their actual temperature.
- The **multi-stage charging capability** ensures that batteries receive the "best" charge with minimal wear and tear.
- If the PROsine detects "bad" AC voltage, it **switches seamlessly** to Invert mode and supplies your equipment with pure sine wave power derived from the batteries. When "good" AC becomes available again, the inverter•charger allows the AC to pass through to your loads and automatically begins to recharge the batteries.

Reliable Back-up If utility-supplied power fails, the PROsine 2.0 automatically detects the failure and instantly becomes an independent power source that supplies quality AC to your loads. There's no interruption in service and no degradation in performance.

The Heart of a Sophisticated, Independent Power System . . .

Your PROsine 2.0 Inverter•Charger has been designed to be the heart of a sophisticated, independent power system. While the inverter•charger is an extremely "friendly" product to operate, Xantrex wants to ensure that you get the best performance from your system. So please take a few minutes to read the next few pages: they'll give you an excellent understanding of the 2.0's features and capabilities.

In basic terms, the PROsine 2.0 Inverter•Charger is designed to:

- ❒ Invert
- ❒ Charge
- ❒ Manage your power system

Inverting

The PROsine 2.0's inverting function:

- ❒ Produces 120Vac from your 12V batteries
- ❒ Delivers 2kW of power on a continuous basis and 4.5kW of surge power to start heavy loads like air conditioners, fridges, and pumps

Much of the time the inverter may not be powering loads. During these times, you don't want power to be drawn needlessly from the batteries. To reduce idle current to an absolute minimum, Xantrex has included three features:

- ❒ Low standby battery demand
- ❒ Load sense (search) mode
- ❒ Remote Shutdown

Low Standby Battery Demand When the 2.0 Inverter•Charger is inverting (producing 120Vac output without a load), it draws less than 2A of current from the batteries.

Load Sense (Search) Mode To reduce battery draw even further, you can turn on **Load Sense mode**. In Load Sense mode, the inverter•charger periodically sends out a search pulse to see whether a load is present. If it finds a load, it will turn on. You can adjust the interval between search pulses, and you can also adjust the load power at which the inverter•charger will turn on.

Note that in Load Sense mode, there's a short time delay (up to the interval you've set) between the time you turn on a load and the time the inverter•charger delivers power. Of course, you can disable Load Sense mode at any time if you find the delay inconvenient.

Remote Shutdown Naturally, when you are not using the inverter•charger, you will disable the inverter to conserve your battery. The inverter•charger still draws up to 50mA of battery current, however—and this will eventually discharge the battery. So when you don't need the inverter•charger for an extended period of time, you can reduce battery draw to less than 1mA by setting the inverter•charger's ON/OFF/REM switch to OFF.

This disables all circuitry in the inverter•charger and removes all power from the display panel. Setting the inverter•charger's ON/OFF/REM to REMOTE lets you achieve the same result using a conveniently located system "kill" switch. This feature is particularly valuable for vehicles like ambulances where it is imperative that the system not draw power when the vehicle motor is not running.

Charging

Built-in Charge Formulas For the inverter to perform at the highest level, the batteries must be charged correctly. Every battery has a unique charge formula (or "algorithm") dictated by the manufacturer for optimal performance. The PROsine 2.0 has **twenty-one built-in formulas** to charge your batteries correctly—and you have the ability to fine tune these formulas to meet the needs of new models or specialized batteries.

Battery Temperature Sensor Since battery temperature is a key factor in correct charging, the charging formula must be adjusted (automatically and in real time) according to the actual battery temperature to ensure that batteries are fully, but not over charged. For this reason, Xantrex has included a battery temperature sensor with your PROsine 2.0 Inverter•Charger and has temperature compensated the charge algorithm.

Manual Equalization Mode Over a period of time, the cells in a flooded battery can develop uneven chemical states. This can result in a weak (undercharged) cell which, in turn, can reduce the overall capacity of the battery. To improve the life and performance of a non-sealed flooded battery, the PROsine 2.0's multi-stage charging cycle includes a manual Equalize mode that should be used occasionally to restore an equal chemical state to all cells.

Dead Battery Charging In addition to the numerous features which let you maximize your battery's life and performance, the PROsine 2.0—unlike many chargers—also has the ability to recharge batteries even if the voltage is near zero.

Power System Management

As we pointed out at the beginning of this introduction, the PROsine 2.0 Inverter•Charger is designed to be the heart of your power system. In addition to refined charging and inverting functions, the PROsine 2.0 is the control center for managing your power system. As the interface between your batteries, loads, and AC source, the PROsine 2.0:

- ❒ Takes 12Vdc and produces 120Vac to power your loads
- ❒ Takes 120Vac, when available and, via its intelligent, automatic, and fast Transfer Relay, passes the 120Vac to your loads
- ❒ Uses its Power Share capability to tap off power to charge the batteries while 120Vac is being passed to the loads

And finally, the PROsine 2.0 Inverter•Charger allows for the expansion of your system to meet changing power requirements.

Load Management The 2.0 Inverter•Charger has a built-in **Transfer Relay** that connects AC shorepower or inverter output to your loads. Because the usual AC power sources (marina and campground outlets or small generators, for example) often have limited current availability, having the ability to manage your AC loads is extremely valuable, and therefore the 2.0 provides a number of features to facilitate this:

- ❒ The charger is power factor corrected to use AC current as efficiently as possible and only requires 15 amps to provide rated charger output—some other chargers require as much as 22 amps to provide the same output. Minimizing the AC current used by the charger means more current for your loads.
- ❒ The PROsine 2.0 uses a Power Share feature which senses the AC load on the system and gives priority to your AC loads, thereby reducing the charger current to avoid nuisance tripping of the breaker.
- ❒ Sometimes the usual AC shorepower sources have low voltage. To avoid loading these weak sources any further, the charger automatically reduces its AC current draw as the AC voltage approaches the minimum acceptable level (as set by the user).

Expandability As your power needs grow, you can connect two PROsine 2.0 Inverter•Chargers in **series mode** to create a 120/240Vac split phase system which is capable of supplying 4kW (continuously).

Both of these 2.0 Inverter•Chargers can be connected to operate from a single (but larger) battery bank, and will work in tandem to provide the fastest possible, accurate charge.

Auto Restart After Errors The PROsine 2.0 protects itself against numerous conditions (e.g. AC overload or over temperature) by shutting down. You can program the inverter•charger to restart automatically when the cause of the shutdown has corrected itself.

NOTE

Auto Restart After Errors is factory-set to **OFF** since this feature can cause the inverter•charger to start unexpectedly and supply AC.

Run Without Panel The **Run Without Panel** configuration setting is an excellent recovery feature that enables your inverter•charger to continue running if the display panel is disconnected or if its communication cable is damaged. **Run Without Panel** is factory-set to **OFF**.

Section 2 Product Orientation

This section will familiarize you with the following components of a PROsine 2.0 system:

- Inverter•charger features. (Start on page 8.)
- Display panel features. (Start on page 11.)
- Battery temperature sensor. (See page 16.)

INVERTER•CHARGER FEATURES

Inverter•Charger: AC End

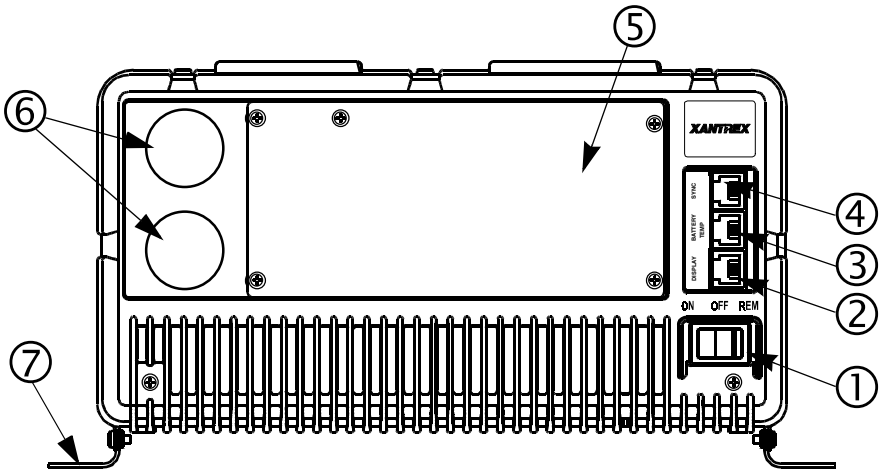


Figure 2 AC End View (Blank Panel Option)

Feature	Description
①	**ON/OFF/REM Switch:** **ON:** Normal operation according to the way the unit has been configured via the display panel. **OFF:** The inverter and charger are off; shorepower is not passed through to the loads. The unit draws the lowest battery current possible (less than 2mA). **REM:** With the switch in this position, the unit can be turned on and off remotely. (For details, see "ON/OFF/REMote Control of Inverter•Charger Operation," on page 63.)
②	**DISPLAY:** Jack for the display panel.
③	**BATTERY TEMP/REMOTE:** Jack for the battery temperature sensor. Also provides a connection for remote shutdown. See "Step 10: Connecting the Remote Shutdown," on page 38.
④	**SYNC:** Jack for synchronizing a second PROsine 2.0 Inverter•Charger to produce 120/240V split phase AC. For details, see Section 7: "Series Operation" starting on page 83.
⑤	Removable panel. The blank panel option is shown. For details, see "AC Panel Options," on page 9. The AC wiring compartment is located behind the panel.
⑥	Knockouts for AC wiring
⑦	Mounting flange

AC Panel Options

The PROsine 2.0 has two AC panel options, each of which includes one 30A hardwire output circuit:

- Blank access panel: one hardwire output circuit. See Figure 2.
- Panel equipped with 15A GFCI receptacle and one hardwire output circuit. See Figure 3.

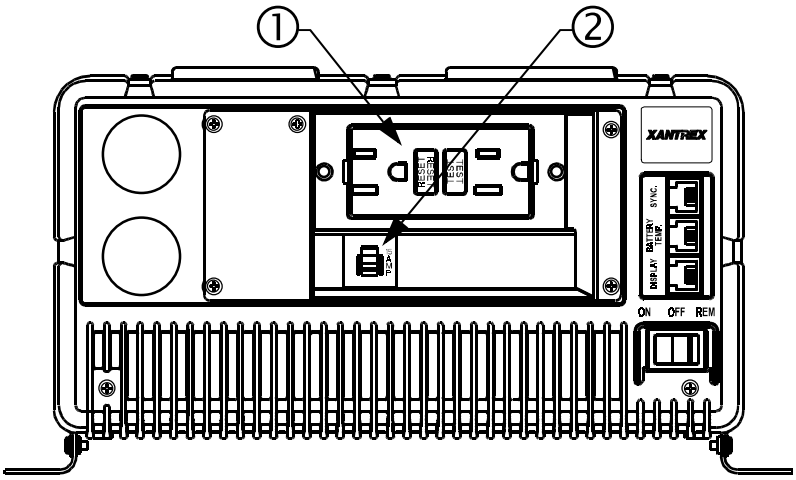


Figure 3 Panel Equipped With GFCI and Circuit Protector

Feature	Description
①	GFCI Duplex Receptacle
②	15A circuit protector for GFCI

Inverter•Charger: DC End

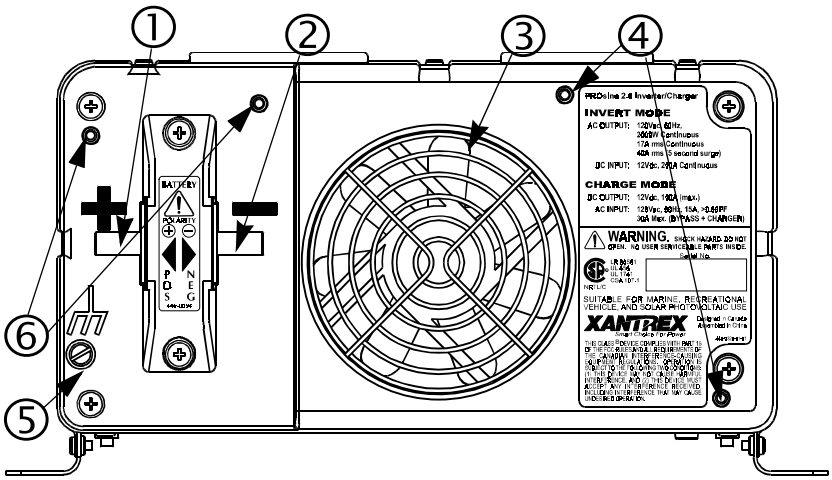


Figure 4 Inverter•Charger: DC End

Feature	Description
①	Positive DC cabling terminal
②	Negative DC cabling terminal
③	Cooling fan. (For details, see "Fan Operation," on page 63.)
④	Screw holes for mounting accessory modules
⑤	Chassis ground lug. Provides a ground path for the inverter•charger chassis to the DC system ground.
⑥	Screw holes for mounting the optional DC wiring enclosure. See "Materials List," on page xviii for information about the crimp-on ring terminals to be used with this option.

DC Terminal Covers

Two covers—red for positive and black for negative—are supplied to prevent accidental contact with the cabling connectors after installation.

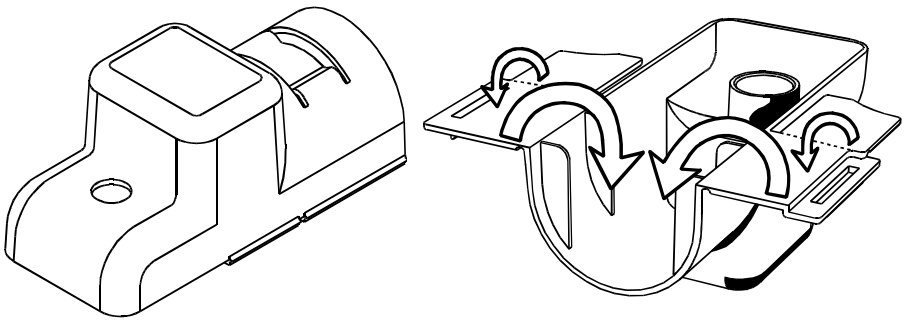


Figure 5 DC Terminal Cover: Top View on Left; Bottom View on Right

DISPLAY PANEL FEATURES

The display panel lets you monitor and control the PROsine 2.0 system. For convenience, the liquid crystal display (LCD) is backlit and the panel can be configured so an audible tone alerts you to any warnings or system faults that occur. The panel's features are described below.

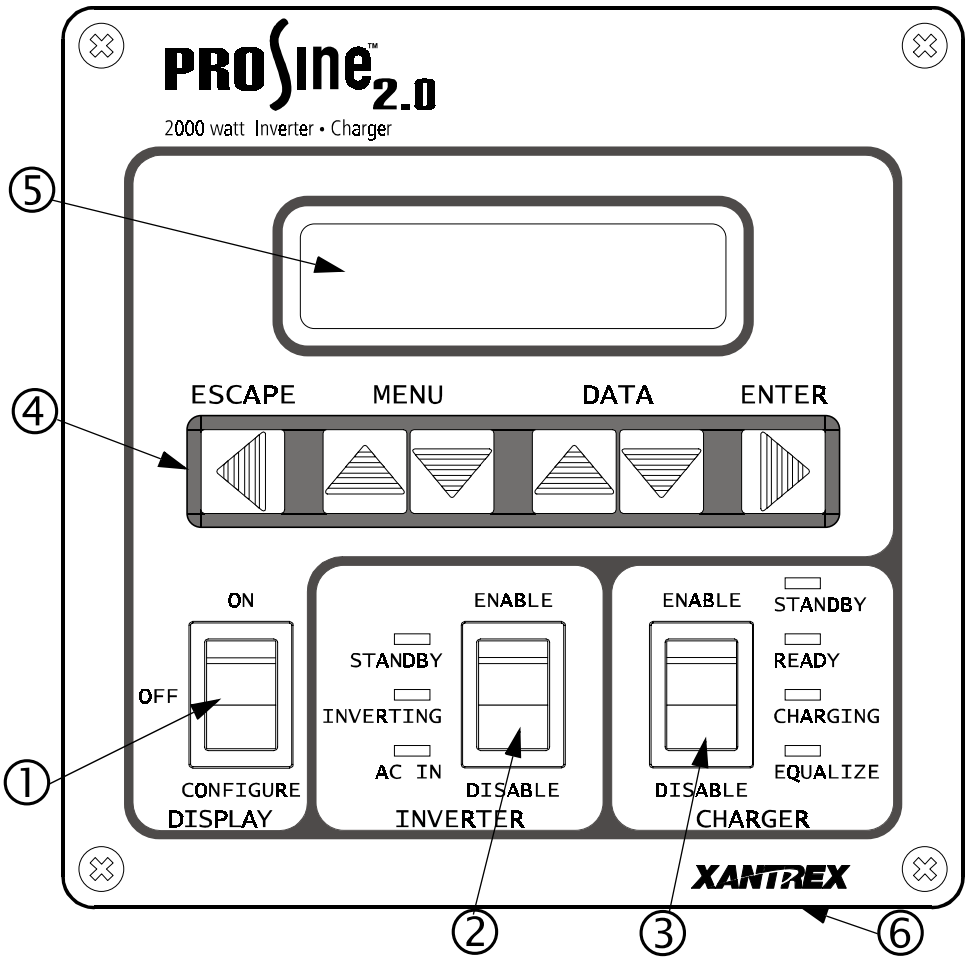


Figure 6 PROsine 2.0 Inverter•Charger Display Panel

Feature	Description
①	DISPLAY mode switch
②	INVERTER switch and status LEDs
③	CHARGER switch and status LEDs
④	Menu navigation and data selection buttons
⑤	LCD display
⑥	Two input jacks (not illustrated) on the bottom of the unit behind the faceplate. Either jack can be used for the communication cable that connects the panel to the inverter•charger. The second jack can be used to connect future accessories.

DISPLAY Mode Switch

Switch Position	Description
ON	Puts the unit in Display mode. Data Display screens are shown so you can monitor system performance.
OFF	Power continues to be available to the panel so vital data like system errors and warning statuses can be checked.
CONFIGURE	Puts the inverter in Configure mode. Configuration screens are available, and you can configure the system without turning on the inverter and charger functions.

INVERTER Switch

This switch is active in all Display modes: ON, OFF, CONFIGURE.

Switch Position	Description
ENABLE	The inverter is enabled and will run if there is no shorepower. (**NOTE:** Throughout this manual, the term "shorepower" refers to AC input power from a utility grid, generator, or other source.)
DISABLE	When the AC power does not meet configuration parameters (i.e. is "bad"), the inverter is off and will consume minimal power. When the AC power is good, the inverter is off and will consume minimal power. The inverter•charger's transfer relay is in the "Pass Through" position. (The transfer relay allows shorepower to pass through the inverter•charger to the AC output terminals whenever AC is connected unless there is an error, or the PROsine is turned Off with the inverter•charger ON/OFF/REM switch.)

INVERTER LEDs

The LEDs are continuously updated whenever the Display Mode switch is set to ON or CONFIGURE.

LED	Description		
STANDBY ***and*** ***INVERTING***	STANDBY LED Status	INVERTING LED Status	
	OFF	OFF	Inverter is not running because it has not been enabled or a system error has occurred.
	OFF	ON	The unit is inverting.
	ON	OFF	Invert is enabled, but the unit is not inverting because of an error or because shorepower is "good."
	INVERT FLASHING		Unit is searching in Load Sense mode.
AC IN	OFF		"Good" shorepower has not been detected.
	ON		"Good" shorepower has been detected.

CHARGER Switch

This switch is active in all Display modes: ON, OFF, CONFIGURE.

Switch Position	Description
ENABLE	The charger is enabled and will charge the battery according to the way the unit is configured if shorepower is "good."
DISABLE	The charger is off and will consume minimal power.

CHARGER LEDs

The LEDs are continuously updated whenever the Display Mode switch is set to ON or CONFIGURE.

<table>
<tr><th>LED</th><th colspan="3">Description</th></tr>
<tr><td rowspan="4">STANDBY

and

CHARGING</td><td>STANDBY LED Status</td><td>CHARGING LED Status</td><td></td></tr>
<tr><td>OFF</td><td>OFF</td><td>The charger is not running because it is not enabled, the charge cycle has been completed, or a system error has occurred.</td></tr>
<tr><td>OFF</td><td>ON</td><td>The charger is running.</td></tr>
<tr><td>ON</td><td>OFF</td><td>The charger is enabled but is not running because shorepower is not "good."</td></tr>
<tr><td rowspan="3">EQUALIZE</td><td colspan="2">OFF</td><td>Equalize mode has not been selected.</td></tr>
<tr><td colspan="2">ON</td><td>The charger is in Equalize mode and the batteries are charging.
CAUTION: Battery voltage may go up to 17V.</td></tr>
<tr><td colspan="2">FLASHING</td><td>Equalize mode has been selected; the charger is presently executing the basic charge cycle in preparation for Equalization mode. (The CHARGING LED is also on in this stage.)</td></tr>
<tr><td rowspan="2">READY</td><td colspan="2">OFF</td><td>The charger is not running, or the Charge cycle is not finished.</td></tr>
<tr><td colspan="2">ON</td><td>The Charge cycle is complete. The battery is fully charged.</td></tr>
</table>

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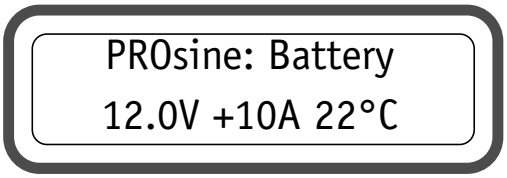
LCD Panel

The LCD panel lets you monitor the PROsine 2.0 system and change its configuration settings. It operates in two basic modes: Data Display and Configuration.

Data Display Mode

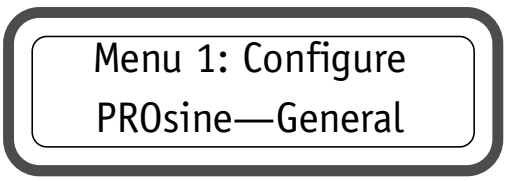
- In Data Display mode the screens provide information about PROsine 2.0 system performance.
- You can cycle through them by pressing the Up ▲ and Down ▼ Menu buttons. (In Data Display mode, the other buttons have no function.)
- Typically, the top line indicates the type of data being displayed and the actual data appears on the bottom line. A sample screen is shown below:

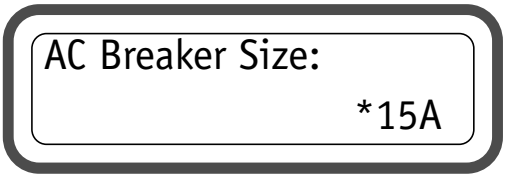


- Examples of all the Display screens are shown on page 69.

Configuration Mode

- In Configuration mode, the screens show data that can be changed as well as read-only data. (For details about each Configuration screen, see Section 4, "Configuration".) Using these screens, you can:
  - Define the operating parameters of the PROsine 2.0 (including AC breaker size, battery size, battery type, types of charge, load sense capability, etc.)
  - Adjust the display characteristics of the panel (including an audible alert, screen contrast, and screen backlighting)
  - View current operational data, Warning messages, Error messages, and Panel fault messages in order to monitor and troubleshoot system performance
- Two samples screens are shown below:





Menu Navigation and Data Selection Buttons

When the DISPLAY switch is set to CONFIGURE, the menu navigation and data selection buttons operate as follows:

Press This Button	To
ESCAPE 	• Cancel changes made to data • Back up one menu level
MENU Up 	Back up one menu item
MENU Down 	Proceed to next menu item
DATA Up 	Increase data value or cycle through available options
DATA Down 	Decrease data value or cycle through available options
ENTER 	Save changes or proceed to next menu level

Examples of how to change configuration settings are given on page 43.

Further information about viewing Display mode screens is provided on page 69

BATTERY TEMPERATURE SENSOR

The temperature sensor continuously measures the temperature of the battery and adjusts charger output for a more accurate, temperature-compensated charge.

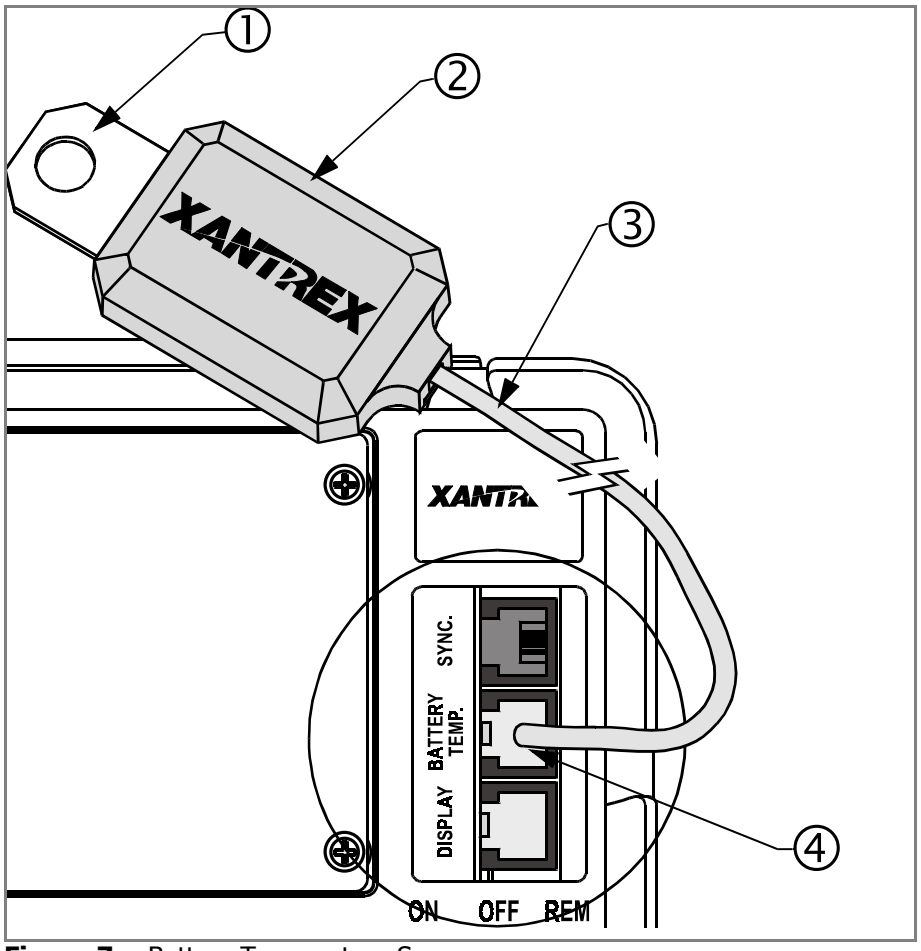


Figure 7 Battery Temperature Sensor

Feature	Description
①	Mounting plate. Connects to the negative battery terminal.
②	Sensor. Reverse side has peel-off backing and self-adhesive strip so you can attach the sensor to the side of the battery case.
③	Sensor cable (25ft; 8m).
④	Connector. Plugs into the Battery Temp jack on the PROsine 2.0.
NOTE: The battery temperature sensor is electrically isolated from the mounting plate.	

Section 3 Installation

This section gives complete information for installing a PROsine 2.0 Inverter•Charger system. Specifically, this section describes:

- Safety instructions and installation codes that must be observed during installation
- Installation tools and materials
- Appropriate locations and environments for mounting the inverter•charger, display panel, and battery temperature sensor
- AC cabling, DC cabling, and grounding information
- Detailed installation procedures. (Start on page 18.)

For information about installing two inverter•chargers in series, see Section 7: "Series Operation".

Safety Instructions

WARNING

Xantrex Technology recommends that all wiring be done by a certified technician or electrician to ensure adherence to approved electrical wiring regulations.

- Before you begin the installation, review the "Important Safety Instructions" on page xv, and read the entire "Installation" section so you can plan your installation from beginning to end.
- Disconnect all AC and DC power sources to prevent accidental shock. Disable and secure all AC and DC disconnect devices and automatic generator starting devices.

Installation Codes

Governing installation codes vary depending on the specific location and application of the installation. Some examples include the following:

- The U.S. National Electrical Code (NEC)
- The Canadian Electrical Code (CEC)
- The American Boat and Yacht Council (ABYC) and the US Coast Guard requirements for installations on marine vessels
- The U.S. Code of Federal Regulations (CFRs)
- Canadian Standards Association (CSA) and the RV Industry Association (RVIA) for installations in RVs

It is the installer's responsibility to ensure that all applicable installation requirements are met.

Installation Tools and Materials

You will need the following to install the inverter•charger, display panel, and battery temperature sensor:

- ❒ Wire stripper
- ❒ Mounting screws or bolts
- ❒ #2 Phillips screwdriver
- ❒ Wrench for DC terminals (1/2 inch or 13mm or adjustable)
- ❒ AC cable (i.e. 2-conductor-plus-ground cable), sized appropriately for load and application
- ❒ Wire nuts or crimp connectors for AC wire and appropriate tools
- ❒ Two 1/2 inch strain-relief clamps for AC cables
- ❒ DC cable, sized appropriately for load and application
- ❒ Lugs and terminals for the DC cables as well as appropriate tools (e.g. crimping tool)
- ❒ AC and DC disconnects and over-current protective devices

NOTE
For residential installations, installation codes may require a wiring enclosure for DC connections and cables. Contact Xantrex or your distributor for this part.

Installation Procedures

This section provides detailed installation information. For your convenience, the overall procedure is divided into ten main steps:

- ❒ **Step 1:** Designing an installation. (Start on page 19.)
- ❒ **Step 2:** Choosing a location for the inverter•charger. (Start on page 23.)
- ❒ **Step 3:** Mounting the inverter•charger. (Start on page 24.)
- ❒ **Step 4:** Connecting the AC input wiring. (Start on page 25.)
- ❒ **Step 5:** Configuring the output neutral bonding system. (Start on page 27.)
- ❒ **Step 6:** Connecting the AC output wires. (Start on page 29.)
- ❒ **Step 7:** Connecting the DC cables. (Start on page 31.)
- ❒ **Step 8:** Mounting the display panel. (Start on page 34.)
- ❒ **Step 9:** Connecting the battery temperature sensor. (Start on page 35.)
- ❒ **Step 10:** Connecting the remote shutdown feature. (Start on page 38.)

Step 1: Designing the Installation

All types of inverter•charger installations share common components, and these are briefly described below. Figure 8 shows these components and their relationship to each other in a typical recreational vehicle or fleet vehicle installation. (For diagrams of typical residential backup and marine systems as well as series installations, see Appendix B: "Typical System Diagrams".)

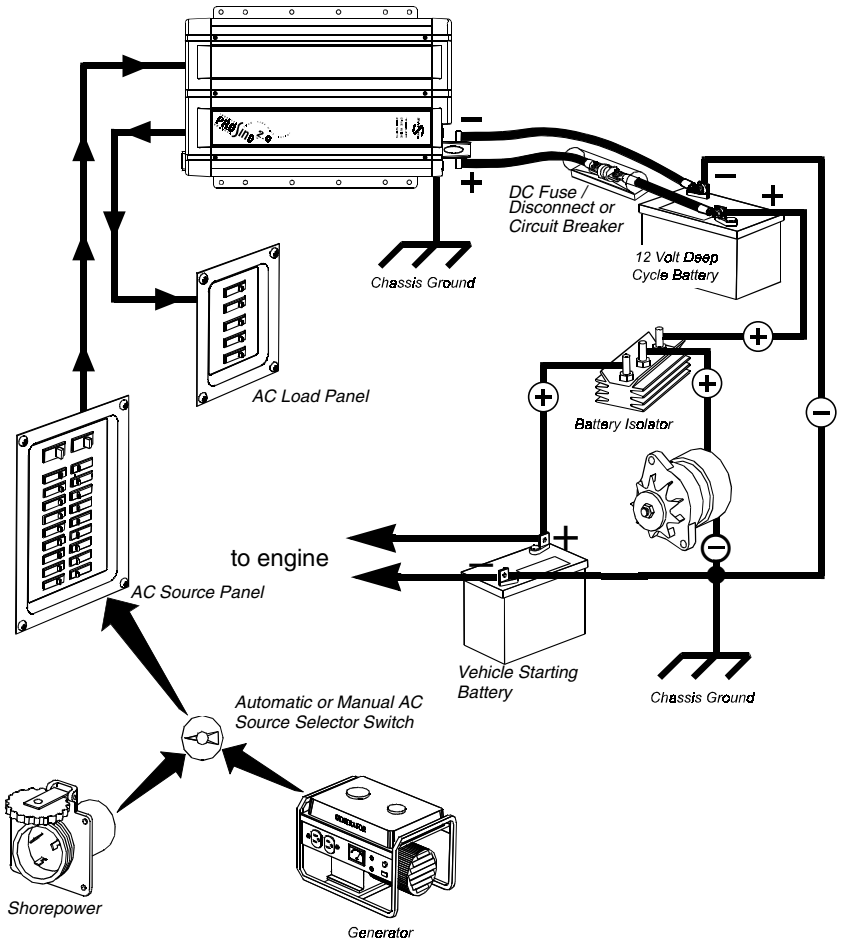


Figure 8 Typical Recreational Vehicle and Fleet Vehicle Installation

AC shorepower A source of 120 volt, 60Hz alternating current is needed to provide energy for charging batteries and to pass through to AC loads. This source could be the utility grid (power company) or an AC generator. Multiple sources of shorepower can be used.

NOTE

Throughout this manual, the term "shorepower" refers to AC input power from a utility grid, generator, or other source.

Generator When a generator or any other secondary AC power source is included, a manual or automatic **AC source selector switch** must be installed ahead of the circuit breaker in the line leading to the inverter•charger.

AC Disconnect and Over-Current Protection Device To meet CSA, UL, and electrical code requirements, the inverter•charger's AC and DC inputs and outputs must be provided with over-current protection (such as a circuit breaker or fuse) and a disconnect device, as follows:

AC Input: The circuit breaker or fuse used to protect the PROsine 2.0 Inverter•Charger must be rated no more than 30A and must be approved for use on 120Vac branch circuits. The wire used between the breaker and the inverter•charger input must be sized to match the circuit breaker, in accordance with the electrical codes or regulations applicable to your installation. The "AC Service Rating" setting of the inverter•charger must also be set to match the size of the breaker provided. (See Section 4: "Configuration" on page 41 and following.)

AC Output: The circuit breaker or fuse must be rated at no more than 30A and must be approved for use on 120Vac branch circuits. The wire used between the inverter•charger and the AC output breaker must be sized to match the AC input circuit breaker's rating. The wire from the AC output breaker to your loads must be matched to the rating of the AC output breakers.

Disconnect Devices: Each system requires a method of disconnecting the AC circuits. If the over-current protection device is a circuit breaker, it will also serve as the disconnect. If fuses are used, separate AC disconnect switches will be needed ahead of the fuses.

AC Distribution Panels Most systems incorporate distribution centers both ahead of the inverter•charger (the AC source panel) and between the inverter•charger and the loads (the AC load panel). A source panel includes a main circuit breaker, which serves as over-current protection and as a disconnect for the AC shorepower supply line. Additional circuit breakers serve individual circuits, one of which serves the inverter•charger. The AC load panel can incorporate both the main 30A AC output circuit breaker and breakers for individual load circuits.

NOTE

Do not connect the output of a single PROsine 2.0 to what is known as a "multi-wire branch circuit". These are 4-wire circuits consisting of a ground, neutral, and two lines that are 180 degrees out of phase with each other (from a standard 120/240V "split phase" circuit). These circuits are commonly used in kitchens to power "split receptacles" where the top and bottom halves of a duplex receptacle are connected to different lines. If you need to run multi-wire branch circuits from your inverter system, you will need to use two PROsine 2.0 Inverter•Chargers in a series system to create 120/240Vac split-phase power. For details, see Section 7: "Series Operation". For more information about multi-wire branch circuits, refer to the US National Electrical Code (NFPA 70, 1999) para 210–4 and the Canadian Electrical Code (CSA C22.1-1998) section 26–710.

AC Cabling AC cabling includes all the wires and connectors between the AC source and the inverter•charger and all cabling between the inverter•charger and the AC panels, circuit breakers, and loads. The type and size of the wiring varies with the installation and load. For marine and some RV applications, flexible multiple-strand wire is required. For residential installations, solid Romex™ cable is often used. Installation codes may specify solid or stranded, overall size of the conductors, and type and temperature rating of the insulation around the wire.

AC wiring must be sized to match the current rating of the AC breakers you provide on the input and output AC circuits in accordance with the electrical codes or regulations applicable to your installation. Table 1 is based on the U.S. National Electrical Code and the Canadian Electrical Code, assuming 2-conductor-plus-ground cable. Other codes and regulations may be applicable to your installation.

Table 1 Required AC Wire Size vs Breaker Rating

Breaker Size	10A	15A	20A	30A
Minimum Wire Size	14AWG	14AWG	12AWG	10AWG

AC Output Neutral Bonding The neutral conductor of the inverter•charger's AC output circuit is automatically connected to the safety ground during inverter operation. When AC utility power is present and the inverter•charger is in Charger mode, this connection is not present, so that the utility neutral is only connected to ground at your source panel. This conforms to National Electrical Code requirements that separately derived AC sources (such as inverters and generators) have their neutral conductors tied to ground in the same way that the neutral conductor from the utility is tied to ground at the AC source panel.

DC Cabling This includes all the cables and connectors between the batteries, the DC disconnect and over-current protection device, and the inverter•charger. All installations require multi-strand insulated cables as well as disconnect and over-current devices. DC cable sizes are indicated by AWG notation or MCM notation. Under the AWG standard, a larger gauge number indicates a smaller wire diameter. Under the MCM standard, a larger number indicates a larger cable. Wire size is usually marked on the cables for sizes this large. Table 2 specifies the minimum DC cable size and maximum fuse size for the PROsine 2.0. **The DC cables must be copper and must be rated 75°C minimum.**

Table 2 Required DC Cable and Fuse Size

DC Cable Length	Cable Size	Fuse Amps
Less than 6 feet	250MCM	300A class T
Between 6 and 12 feet	350MCM	300A class T

DC Disconnects and Over-Current Devices The DC circuit from the battery to the inverter•charger must be equipped with a disconnect and over-current device. This usually consists of a circuit breaker, a "fused-disconnect," or a separate fuse and DC disconnect. Do not confuse AC circuit breakers with DC circuit breakers. They are not interchangeable. The rating of the fuse or breaker must be matched to the size of cables used in accordance with the applicable installation codes. The breaker or disconnect and fuse should be located as close as possible to the battery, in the positive cable. Applicable codes may limit how far the protection can be from the battery.

Batteries Every PROsine 2.0 system requires a deep-cycle battery or group of batteries that provide the DC current that the inverter•charger converts to AC. Different battery types and sizes are available; many of these are discussed in Appendix C: "Batteries". Automotive-type starting or "cranking" batteries are not recommended, except for temporary emergency use. The PROsine 2.0 Inverter•Charger uses 12-volt battery banks.

Ground Fault Circuit Interrupters (GFCIs) A GFCI is a device that de-energizes a circuit when a current to ground exceeds a specified value that is less than that required to blow the circuit breaker. GFCIs are intended to protect people from electric shocks and are usually required in wet or damp locations.

Installations in marine and recreational vehicles may require GFCI protection of branch circuits connected to the AC output of the inverter•charger. In addition, electrical codes require GFCI protection of certain receptacles in residential installations.

While the true sine wave output of the PROsine Inverter•Charger is equivalent to the waveform provided by utilities, compliance with UL standards requires that Xantrex test and recommend specific GFCIs. Xantrex has tested the GFCI-protected 15A receptacles listed in Table 3 and found that they function properly when connected to the AC output of the PROsine 2.0.

Table 3 Tested GFCI Models

Manufacturer	Model Number
Leviton	6599/701
Leviton	6598/722 (with polarity check and indicator light)
Eagle Eagle Pass & Seymore	Shock Sentry GF15GY 1591-WCN
Hubbell	GF5252GYCN
Hubbell	GF252GYA
Bryant	GFR52FTI
Bryant	GFR82FTI

Step 2: Choosing a Location for the Inverter•Charger

WARNING

This equipment contains components that tend to produce arcs or sparks. To prevent fire or explosion, do not install the PROsine 2.0 Inverter•Charger in compartments containing batteries or flammable materials or in locations that require ignition-protected equipment. This includes any space containing gasoline-powered machinery, fuel tanks, or joints, fittings, or other connections between components of the fuel system.

WARNING

To reduce the risk of fire, do not cover or obstruct the ventilation openings. Do not install the PROsine in a zero-clearance compartment. Overheating may result.

The inverter•charger should only be installed in locations that meet the following requirements:

- ❒ **Dry.** Do not allow water or other fluids to drip or splash on the inverter•charger. **Do not mount the inverter•charger in an area subject to splashing water or bilge water.**
- ❒ **Cool.** Normal air temperature should be between 32°F and 77°F (0°C and 40°C)—the cooler the better.
- ❒ **Ventilated.** Allow at least 5 inches (13cm) of clearance at the DC end of the inverter•charger for air flow, 1 inch (2.5cm) on each side, and 2 inches (5cm) at the AC end. For cooling, the volume of the enclosure is not as important as the overall supply of air. The more clearance for ventilation around the unit, the better the performance. Do not allow the ventilation openings on the ends of the unit to become obstructed.
- ❒ **Safe.** Do not install the inverter•charger in the same compartment as batteries or in any compartment capable of storing flammable liquids like gasoline.
- ❒ **Close to the battery compartment and the AC source and load panels.** Avoid excessive cable lengths (which reduce input and output power due to wire resistance). Use the recommended cable lengths and sizes.
- ❒ **Protected from battery acid and gases.** Never allow battery acid to drip on the inverter•charger or its wiring when reading specific gravity or filling the battery. Also do not mount the unit where it will be exposed to gases produced by the batteries. These gases are very corrosive, and prolonged exposure will damage the inverter•charger.

Step 3: Mounting the Inverter•Charger

➢ **To mount the PROsine Inverter•Charger**

1. Remove the inverter•charger from its shipping container, verify that all components are present, and record relevant product information on page xviii.
2. Turn off the ON/OFF/REM switch on the AC end.
3. Select an appropriate mounting location and orientation. (See Figure 9.) To meet regulatory requirements, the PROsine must be mounted in one of the following orientations:
   - In a horizontal position on a vertical surface with the AC knockouts at the top as shown in Figure 9.
   - On a horizontal surface with the DC terminals on the low side
   - Under a horizontal surface

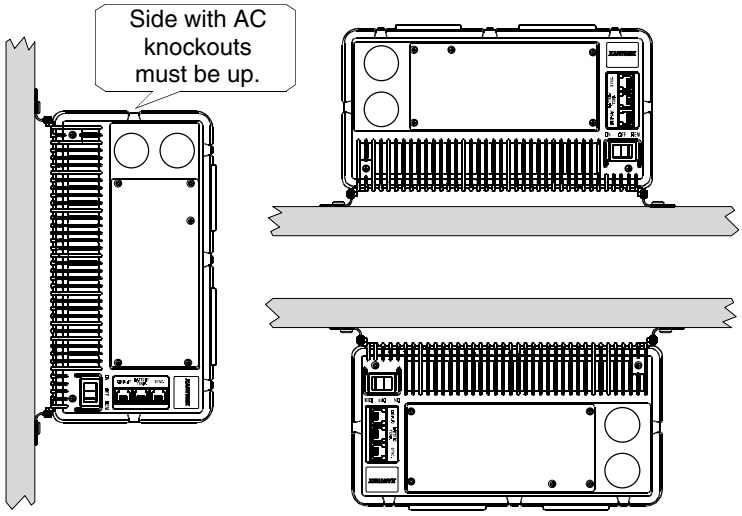


Figure 9 Approved Mounting Orientations

4. The *PROsine 2.0 Quick Installation Guide* has a mounting template printed on it. Tape it to the mounting surface and pilot-drill the desired number of mounting holes. Remove the template.
5. Fasten the inverter•charger to the mounting surface. If you are mounting the unit on a wall or bulkhead, use #12 or #14 pan-head wood or sheet metal screws to secure it to the framing behind the wall or bulkhead. Alternatively, use nut inserts and 1/4-20 machine screws.

Step 4: Connecting the AC Input Wires

WARNING: Fire, Shock, and Energy Hazards

Make sure wiring is disconnected from all electrical sources before handling. All wiring must be done in accordance with local and national electrical wiring codes. Do not connect the output terminals of the inverter•charger to any incoming AC source.

General AC Wiring Considerations

AC Wiring Connectors

Connect AC wires with twist-on wire nuts or crimp-on splice connectors according to the type of installation:

- On a boat, use crimp-on splice connectors to meet the American Boat and Yacht Council's Standards and Recommended Practices for Small Craft, which do not allow twist-on connectors for AC connections.
- For non-marine installations subject to vibration, you should still use crimp-on connectors.
- For non-marine installations in locations not subject to vibration, twist-on wire nuts may be used instead of crimp-on connectors.
- The amount of insulation you strip off individual wires will be specified by the connector manufacturer and is different for different types of connectors.

AC and DC Wiring Separation

Do not mix AC and DC wiring in the same conduit or panel. Where DC and AC wires must cross, make sure they do so at 90° to one another. Consult code for details about DC and AC wiring in vicinity to each other.

AC Wiring Compartment

For your reference, the AC Wiring Compartment is shown in Figure 10.

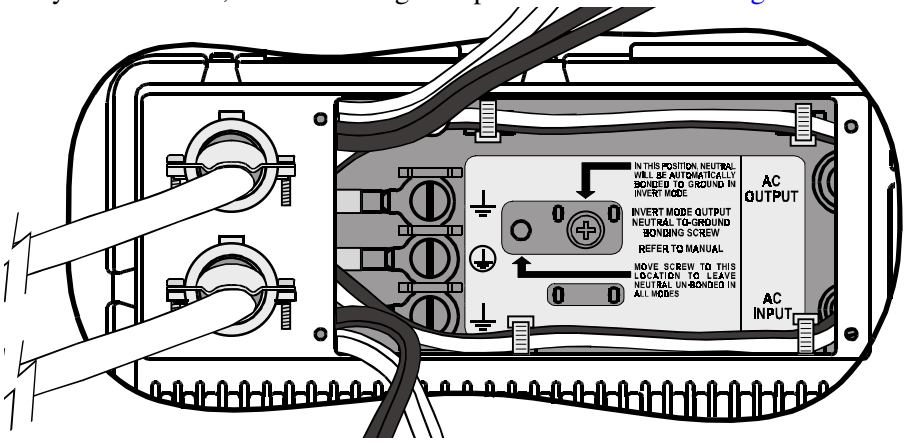


Figure 10 Interior of AC Wiring Compartment

AC Input Connections

Figure 11 is a cutaway top view of the PROsine 2.0 wiring compartment. It shows one incoming AC cable and its connections to the PROsine 2.0 wires.

➢ **To make the AC input connections**

1. Run 10AWG 2-conductor-plus-ground cable through one of the cable clamps on the AC end.
2. Strip about two inches of the jacket from the AC cable and separate the three wires.
3. Connect the incoming black and white (line and neutral) wires to the PROsine AC input black and white wires.
4. Connect the incoming ground wire to the screw on the chassis marked ⏚. Use a crimp-on ring terminal if the AC input ground wire is stranded. Solid wire can be screwed directly under the head of the screw.

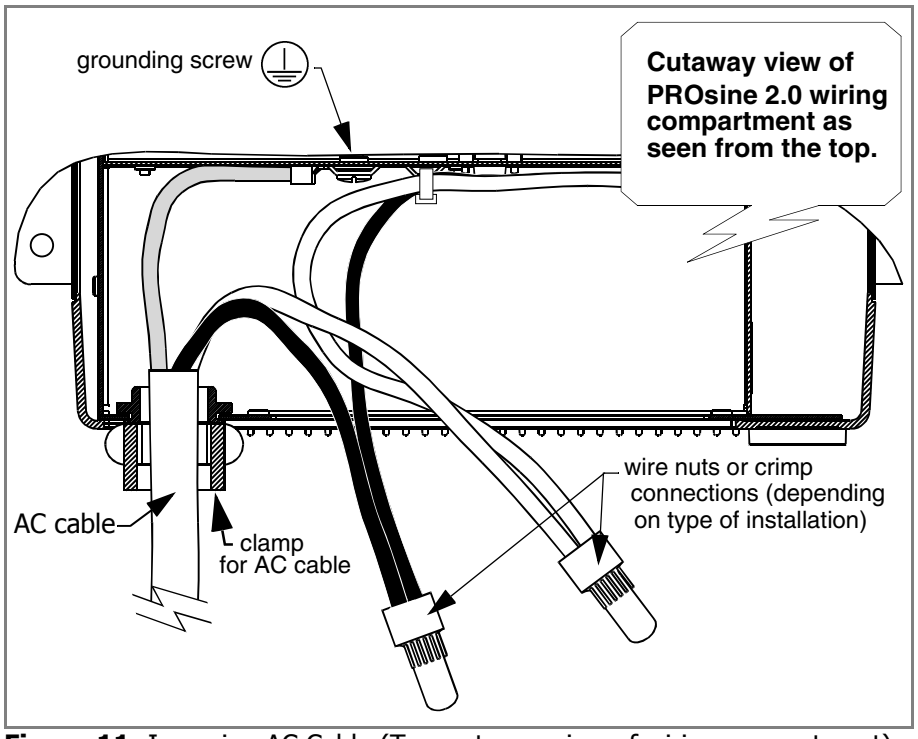


Figure 11 Incoming AC Cable (Top, cutaway view of wiring compartment)

Step 5: Configuring the Output Neutral Bonding System

AC Output Neutral-to-Ground Bonding System

The PROsine 2.0 Inverter•Charger provides an installer-defeatable system that automatically connects the neutral conductor of the inverter AC output circuit to safety ground ("bonding" it) during inverter operation, and disconnects it ("un-bonding" it) when the inverter•charger has connected to AC shorepower. This system is designed to conform to installation codes that require single-phase AC sources such as inverters and generators to have their neutral conductors tied to ground in the same way that the neutral conductor from the utility is tied to ground.

These same codes specify that the neutral can only be connected to ground in one place at any one time. Any AC source feeding the PROsine is required to have its neutral already connected to ground. Therefore, to keep from connecting the neutral to ground in a second place, the PROsine transfer relay breaks its own neutral ground connection when connected to shorepower.

This automatic neutral-to-ground bonding system is suited for installations in which the AC shorepower source is known to have a bonded neutral. This will be the case in most situations: in a utility feed after the AC source panel, at an RV park hook-up, at a marina's shorepower hook-up, or with a generator with a bonded neutral.

In some installations, however, the AC shorepower source will not have a bonded neutral. This is true on some generators and it is true in certain utility-feed situations. To accommodate these situations, the PROsine automatic neutral bonding system can be defeated, so the PROsine will not bond the neutral in any mode of operation. This allows the installer to bond the neutral in the AC load panel to provide the required single-point bonding of the neutral.

➢ To enable and disable the automatic AC output neutral-to-ground bonding system

WARNING: Fire and Shock Hazard

AC neutral bonding system settings should only be changed by a qualified installer aware of the implications of the changes. Disconnect all AC and DC sources before working in the AC wiring compartment or before making a setting change.

You enable and disable the system using a screw in the AC wiring compartment, identified as the "Invert Mode Output Neutral-to-Ground Bonding Screw". (See Figure 10.) This screw is identified with a label that indicates two different holes that the screw can be mounted in. One hole is

identified as the one that enables the automatic bonding system, and the other hole defeats it so that the neutral is not bonded by the PROsine in any mode.

The PROsine is shipped with the screw in the position that enables the automatic bonding system.

- To disable the system, move the screw to the other hole.
- Do not remove the screw from the product: make sure it is always installed in one position or the other, as appropriate for the configuration of the rest of the system.

Table 4 AC Output Neutral-to-Ground Bonding Screw Settings

Bonding Screw Setting	Status of Bonding Internal to the PROsine		Neutral Bonding Required External to the PROsine	
	AC shorepower not present (unit Inverting or in Standby)	AC shorepower present (unit Charging or in Standby)	In the AC input shorepower source	In the AC load panel
Automatic bonding	Output neutral bonded	Output neutral un-bonded	Yes	No
Un-bonded in all modes	Output neutral un-bonded	Output neutral un-bonded	No	Yes

Step 6: Connecting the AC Output Wires

Two options are available for AC output wiring:

- Hardwire output. (See page 29.)
- Single hardwire output plus GFCI receptacle. (See page 30.)

Connections for Hardwire Option

➢ **To make the AC output wiring connections**

1. Run 10AWG 2-conductor-plus-ground cable through one of the cable clamps on the AC end.
2. Strip about two inches of the jacket from the AC cable and separate the three wires. Strip insulation from each of the wires according to the guidelines given by the connector manufacturer.
3. Connect the outgoing black and white (line and neutral) AC wires to the PROsine AC output black and white wires.
4. Connect the incoming ground wire to the chassis using one of the screws marked ⏚.
5. Connect the outgoing AC wires to an AC load panel equipped with circuit breakers.

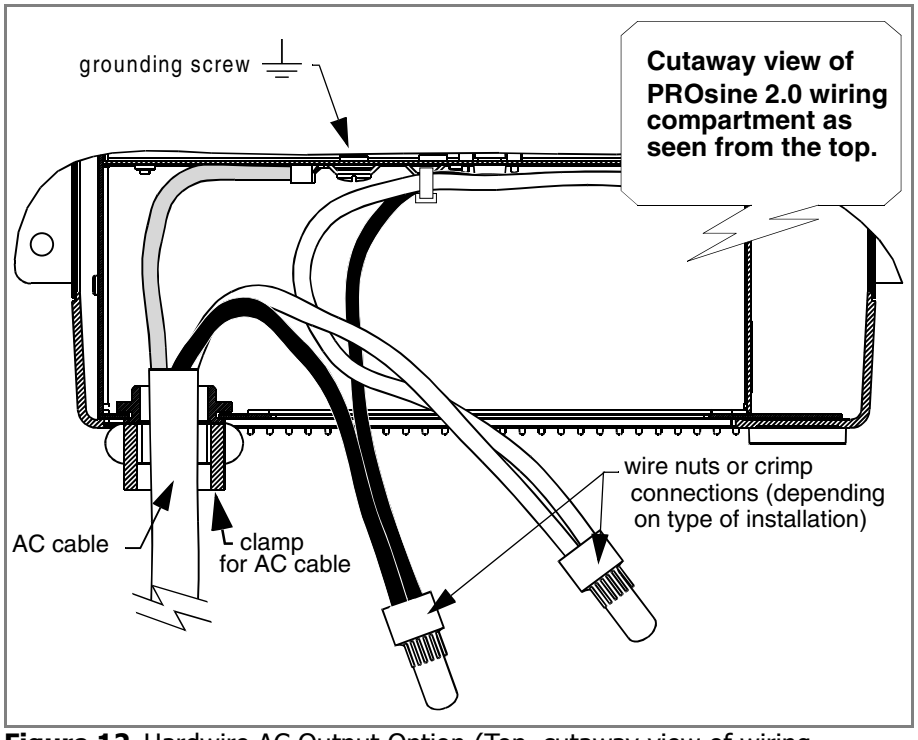


Figure 12 Hardwire AC Output Option (Top, cutaway view of wiring compartment)

Connections for Single Hardwire Output With GFCI

Figure 13 is a cutaway top view of the PROsine 2.0 wiring compartment showing one set of outgoing AC wires with the GFCI option.

➢ **To make the AC output wiring connections**

1. Run 10AWG 2-conductor-plus-ground through one of the cable clamps on the AC end.
2. Strip about two inches of the jacket from the AC cable and separate the wires. Strip insulation from each of the wires according to the guidelines given by the connector manufacturer.
3. Connect the outgoing black and white (line and neutral) AC wires to the PROsine black and white AC output wires.
4. Connect the outgoing ground wire to the chassis using one of the screws marked ⏚.
5. Tuck the wires into the left-hand side of the wiring compartment so they don't interfere with the GFCI assembly.

WARNING: Shock Hazard

If you are not using the hardwire output circuit, you must cap off its line and neutral wires.

Use twist-on wire nuts where allowed; use crimp-on wire caps in other applications.

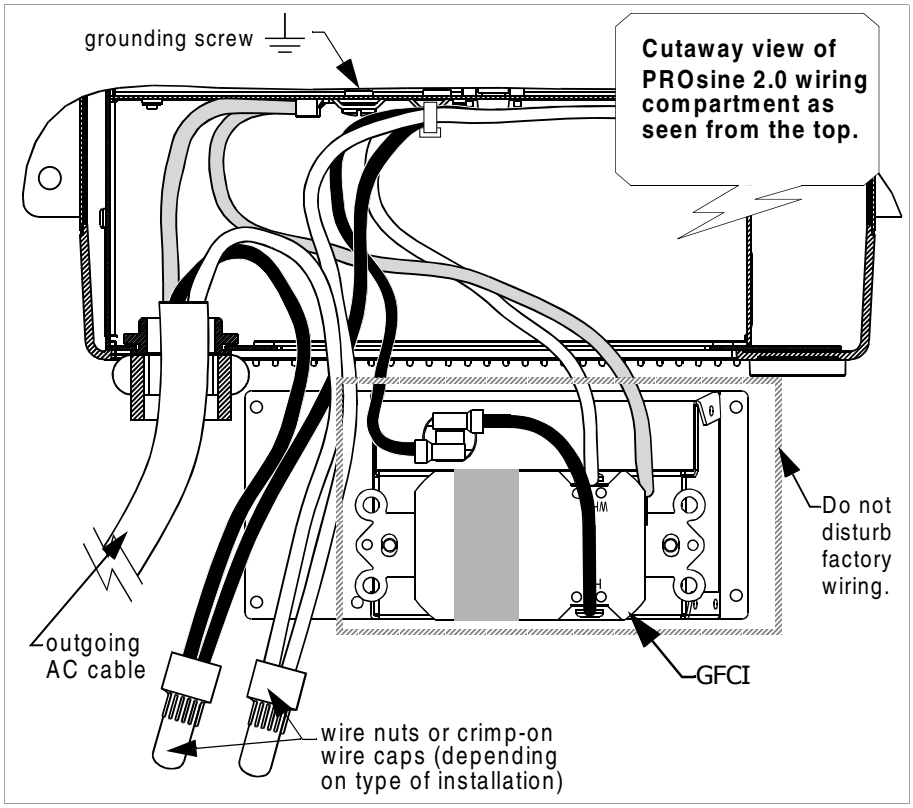


Figure 13 Single Hardwire Output With GFCI

Step 7: Connecting the DC Cables

CAUTION

Before making the final DC connection, check cable polarity at both the battery and the inverter•charger. Positive must be connected to positive; negative must be connected to negative.

Reversing the positive and negative battery cables will damage the inverter•charger and void your warranty. This type of damage is easily detected.

WARNING: Fire Hazard

Use only copper wire rated 75°C minimum. Make sure all DC connections are tight to a torque of 216–240 inch-pounds (24–27Nm). Loose connections will overheat.

Follow the procedure given below to connect the battery leads to the terminals on the DC end. The cables should be as short as possible and large enough to handle the required current, in accordance with the electrical codes or regulations applicable to your installation. Table 2 on page 21 specifies the minimum DC cable size and maximum fuse size for the PROsine 2.0.

Do not route your DC cables through an electrical distribution panel, battery isolator, or other device that will cause additional voltage drops.

Figure 14 shows the DC end for your reference.

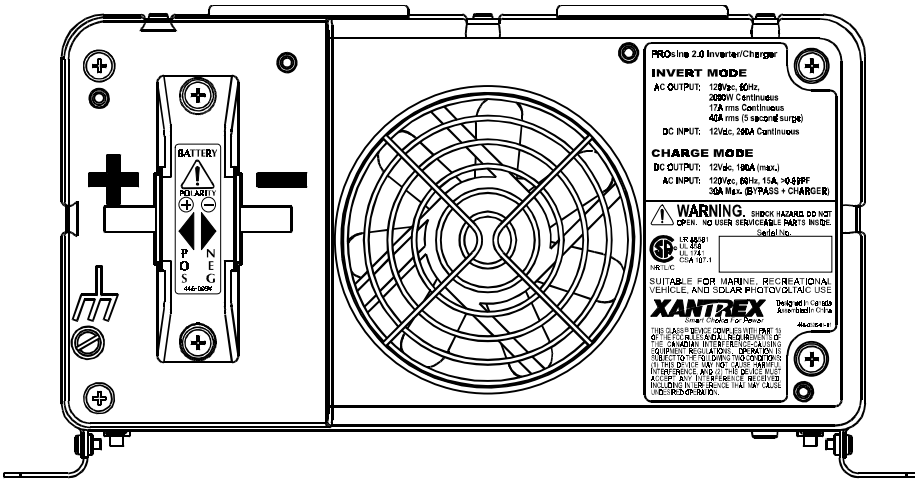


Figure 14 DC End

➢ To make the DC connections

Refer to Figure 15.

1. Cut the cables to the correct length with enough insulation stripped off so you can properly install the type of terminals you will be using.

   The terminals on the DC end are designed to fit up to 500MCM crimp-on ring terminals (either AMP or ILSCO) or box connectors.

2. Attach the connectors to both cables.

   If you are using crimp connectors, use the tool recommended by the terminal manufacturer. Make sure no stray wire strands protrude from the terminals.

NOTE

For residential installations, the installation code may require a DC wiring enclosure for DC connections and cables. If you are using this accessory, secure it to the inverter•charger before routing cables. Be sure to use crimp-on ring terminals on the PROsine end of the DC cables (as specified on page xviii), and follow the installation procedure provided with the wiring enclosure. Contact Xantrex or your distributor for this part.

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3. Route the DC supply cables from the battery bank to the inverter•charger.
4. Install a fuse and disconnect or breaker between the inverter•charger and the battery. They must be installed in the positive side of the DC circuit, as close as possible to the battery. This protects your battery and wiring in case of accidental shorting. (See Table 2 on page 21 for required fuse size.)
5. Attach one connector on the positive cable to the positive DC terminal on the DC end, and then attach the other connector to the POSITIVE (+) terminal on the fuse or breaker.

   Observe the polarities carefully while completing the installation. Use a wrench to tighten to a torque of 216–240 inch-pounds (24–27Nm). Test that the cable is secure.

6. Connect one connector on the negative cable to the negative terminal on the DC end. Before proceeding, check that cable polarity is correct, and then connect the other end of the cable to the NEGATIVE (–) terminal on the battery.

   This is the last cable connection you make. A spark is normal when it is made. Use a wrench to tighten to a torque of 216–240 inch-pounds (24–27Nm). Test that the cable is secure.

7. Attach the DC terminal covers. (See Figure 15, on page 33.)

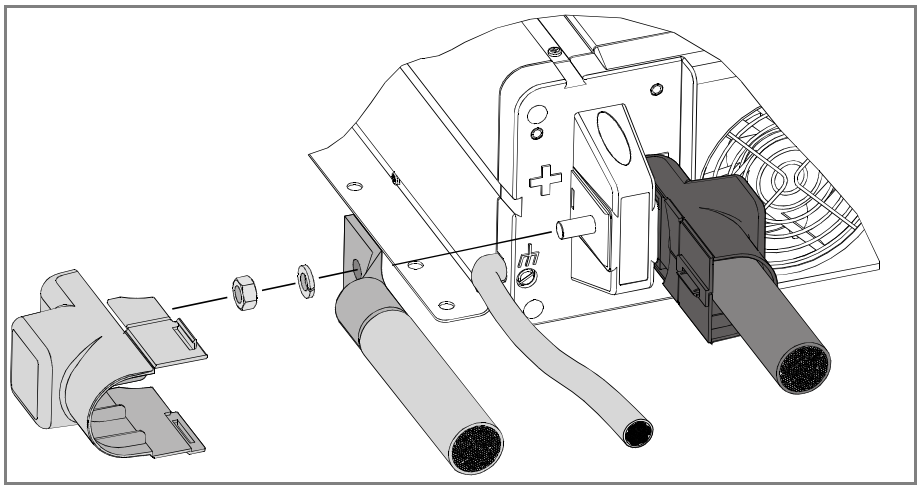


Figure 15 DC Cable Connections

DC Grounding

➢ **To connect the DC ground**

The Chassis Ground lug on the DC end of the inverter•charger is used to connect the chassis of the inverter•charger to your system's DC grounding point as required by regulations for some installations. Use copper wire that is either bare or provided with green insulation. Do not use the DC Ground Lug for your AC grounding. (See the AC wiring instructions in this section.)

Follow the guidelines below that correspond to your type of installation. These guidelines assume you are using the code-compliant DC supply cable and fuse sizes indicated in this manual. If you are using different sizes, refer to the applicable code for DC grounding details.

- **Recreational Vehicle** Use 8AWG copper wire and connect it between the Chassis Ground lug and the vehicle's DC grounding point (usually the vehicle chassis or a dedicated DC ground bus).
- **Marine** Use 2AWG copper wire that is bare or has insulation rated min. 90°C, and connect it between the Chassis Ground lug and the boat's DC grounding bus or engine negative bus.
- **Residential** Use 4AWG wire and connect it between the Chassis Ground lug and your system's DC grounding point. This will usually be the AC service entrance grounding point or a separate ground rod. For a solar PV installation, this will usually be the same ground rod used to ground the PV array.

Step 8: Mounting the Display Panel

The communications cable supplied with the display panel is 70 feet long (21 meters). If you want to replace the cable with one that is longer or shorter, use a high quality, 6-wire telephone extension cable. You can install the panel up to 100 feet (30 meters) away from the inverter•charger.

Flush mounting the panel on a wall, bulkhead, or panel requires an opening that is approximately 4 inches x 4 inches (10cm x 10cm). About 1 1/4 inches (3cm) of free space is required within the wall to accommodate the depth of the panel. Be sure there is no wiring or other obstructions within the wall before you make an opening.

➢ **To mount the display panel**

1. Choose a location that is dry, out of direct sunlight, free from corrosive or explosive fumes, and otherwise appropriate for mounting an electronic device.
2. Tape the mounting template (in the PROsine 2.0 Inverter•Charger package) to the mounting surface and mark the locations of the mounting holes and the area to be cut away.
3. Pilot-drill the mounting holes and cut out the hole in which the panel will be inserted.
4. Route the communications cable(s) inside the wall and through the opening.
5. Insert one of the cable's connectors in either jack on the bottom of the panel.
6. Place the panel in the opening and secure it with appropriate fasteners.
7. Route the communications cable to the inverter•charger and insert the connector in the jack labelled DISPLAY.

Step 9: Connecting the Battery Temperature Sensor

Mounting Options

You can mount the battery temperature sensor (BTS) in one of two ways:

- Mounting the sensor to the negative battery post allows the internal battery temperature to be sensed and provides the most accurate results.
- Attaching the sensor to the side of the battery using the self-adhesive backing also provides good results in most situations.

WARNING: Energy and Explosion Hazard

Review the "Important Safety Instructions," on page xv.

Mounting to the Negative Battery Terminal

➢ **To mount the sensor on the negative battery terminal**

See Figure 16.

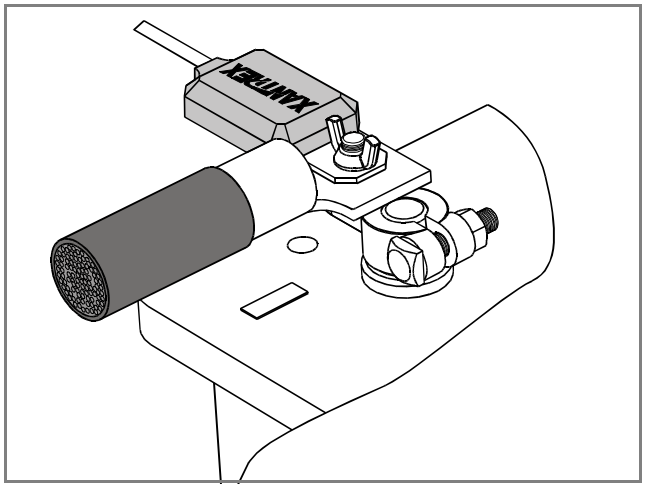


Figure 16 BTS Attached to Negative Battery Terminal

1. Decide which battery is to be monitored.

   When all battery banks are located in the same compartment, select the battery that requires the most frequent charging (in a boat or an RV, this is usually the "house" battery). Where a battery is located in a separate compartment from other batteries, and where temperatures are constantly high (as in an engine room), it is a good idea to monitor this battery to keep it from being overcharged as a result of its constant high temperature. In this situation, the cooler battery bank will be slightly undercharged since it will be at a lower temperature than the battery being monitored, but this procedure will prolong the warmer battery's life.

2. Switch off all devices operating from the battery, or open the battery switch, if present, to disconnect the battery.
3. If the charger has been operating, wait ten minutes for any explosive battery gasses to dissipate.
4. Remove the nut that secures the existing negative DC wire to the battery.
5. Move or reorient the existing negative DC wire so there is a flat surface on which to seat the battery temperature sensor mounting plate. You may need to bend the ring terminal and/or wires downward to allow the sensor to seat on the top surface of the upper ring terminal.
6. Mount the sensor directly on top of the negative DC wire terminal, as shown in Figure 16, and tighten the terminal nut firmly.
7. Check that the sensor and all wires are fastened securely.
8. Turn the battery switch on again (if you opened it in step 2).
9. Route the sensor cable to the inverter•charger and plug it into the BATTERY TEMP jack. Secure the cable along its length.

NOTE

In this procedure, you must install the DC wire on the battery terminal first. Then the sensor is installed on top of the DC wire. This sequence is required to provide the best connection to the battery and to thereby ensure correct performance of the sensor.

Mounting to the Side of the Battery Case

➢ **To mount the sensor on the battery case**

See Figure 17.

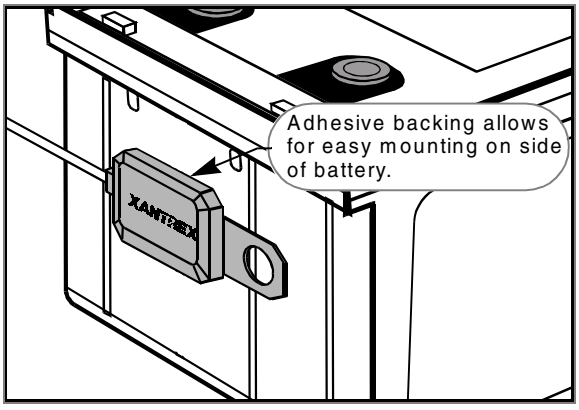


Figure 17 BTS Attached to Battery Case

1. Select the battery to be monitored (see step 1 in the preceding procedure).
2. Select a side suitable for attaching the sensor.

The surface where the sensor is to be mounted must be flat and free from reinforcing ribs or other raised features. As well, this surface must be in direct internal contact with battery electrolyte, so do not install the sensor on a side near the top of the battery or on the battery's top surface.

3. Clean the selected area thoroughly to remove any oil or grease that could prevent the sensor from adhering to the battery case, and allow the battery case to dry thoroughly.
4. Peel the protective backing from the self-adhesive strip on the rear of the sensor.
5. Press the sensor firmly against the clean side of the battery to fix it in place.
6. Route the sensor cable to the inverter•charger and plug it into the BATTERY TEMP jack. Secure the cable along its length.

Step 10: Connecting the Remote Shutdown

WARNING: Shock Hazard

This step should only be completed by qualified installers or technicians who have a knowledge of DC circuits.

Connect only to an isolated Class 2 extra-low voltage power source as described below.

Some installations may require remote shutdown capability. This feature enables you disable all circuitry in the inverter•charger and remove all power from the display panel using a remote shutdown switch (e.g. the ignition switch in a vehicle). This also removes all power (inverter and shorepower) from the AC loads.

The remote shutdown signal (RS+/RS–) requires a source of 5–18Vdc, which is capable of supplying 5–18mA, to enable the inverter•charger. This power source must be limited to Class 2 levels by an approved 1A fuse. The power source will often be one of the existing system batteries: the vehicle starting battery or the inverter•charger battery. In this case, the 1A fuse must be located in the positive (+) side of the circuit, as close as possible to the power source.

Note that the remote shutdown feature will only function when the ON/OFF/REM switch is set to REM.

Materials Required

You need two high quality 26AWG, 4-conductor telephone cables with connectors attached (one 10 feet maximum; one 100 feet maximum), one 1:2 phone line splitter, and a 1A fuse and in-line fuseholder. In addition, you might require a single pole, single throw switch (or alternatively, you can use a vehicle ignition-switched circuit). You can obtain these from local hardware, electronics, and automotive stores.

Installation Steps

See Figure 18 and Figure 19.

➢ **To connect the remote shutdown feature**

1. Select one of the two cables and cut it at a convenient location for connecting to your Remote Shutdown Switch.
2. See Figure 18 to identify the RS+ and RS– wires.
3. Insulate the two middle wires so they don't short.
4. Connect RS+ to the positive of a switched, fused voltage source of 5–18V.
5. Connect the RS– to the return of this voltage source.

6. Plug the cables into the splitter and connect to the PROsine 2.0 as shown in Figure 18.

The Remote Shutdown feature is now ready for use. For operating information, see "ON/OFF/REMote Control of Inverter•Charger Operation," on page 63.

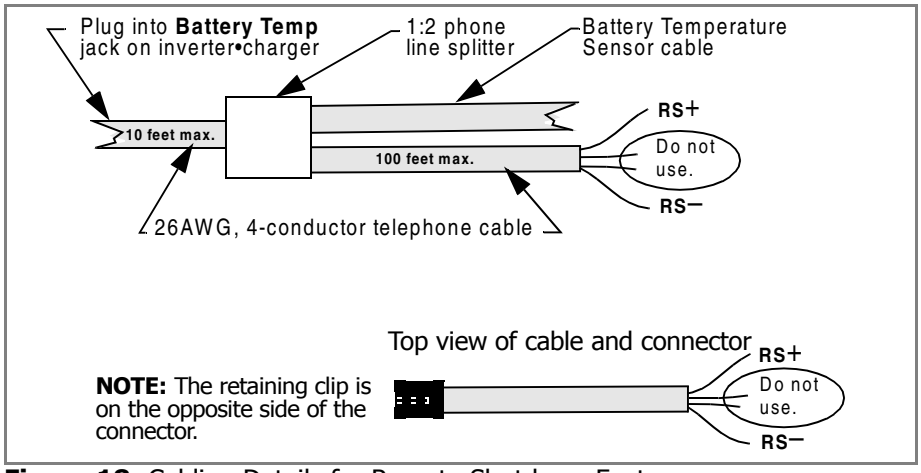


Figure 18 Cabling Details for Remote Shutdown Feature

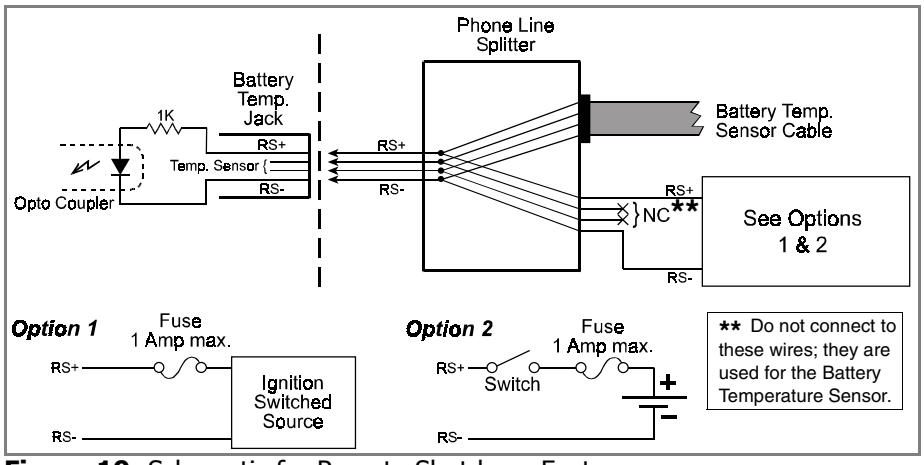


Figure 19 Schematic for Remote Shutdown Feature

Next Steps

At this point, you have installed the inverter•charger system and are now ready to configure it.

1. Read the configuration procedures in Section 4: "Configuration".
2. Reconnect the AC shorepower supply.
3. Use the display panel to configure the inverter•charger.

Section 4 Configuration

This section explains how to configure the PROsine 2.0 Inverter•Charger to best meet your electrical system requirements. It is divided into three parts:

- Part 1: General Configuration Information. (See page 42 and following.)

  Tells you how to enter Configure mode and Installer mode, how to scroll through the configuration screens, and how to change configuration settings.

- Part 2: Configuration Screens. (See page 44 and following.)

  Shows how the configuration menus and screens are organized.

- Part 3: Configuration Options. (See page 46 and following.)

  Lists all the configuration options as well as the available configuration values or settings. Refer to Part 3 when you want to set specific configuration values.

NOTE

The *Quick Reference Guide* supplied with your PROsine 2.0 Inverter•Charger provides an overview of the configuration menus and options as well as a list of selected default settings.

PART 1: GENERAL CONFIGURATION INFORMATION

All changes to the operation of the PROsine 2.0 Inverter•Charger are made via the display panel. The unit must be in Configure mode or Installer-Only mode before you can change system settings. It is essential that you understand the implications of changing User and Installer settings. Be sure to study Section 3 before you configure your system. Procedures for changing modes and values are given below.

Entering Configure Mode

➢ To enter Configure mode

- Set the DISPLAY switch to CONFIGURE.

  This gives you access to all user-configurable items.

Entering Installer-Only Mode

WARNING

The following information is for qualified installation/service personnel only. Incorrect configuration can lead to battery damage and risk of fire.

If a parameter is "Installer-Only," it is meant to be configured by a professional installer who is not only familiar with the system settings on the inverter but also the ramifications of changing those settings. Setting these parameters incorrectly could damage connected equipment (e.g. batteries) or could severely affect the performance of your system. You will not be able to change parameters that are Installer-Only unless you place the display panel in Installer-Only mode.

If you try to change settings on a screen that contains installer-only data and the panel is not in Installer mode, this message appears for one second:

To Change; Enter Installer Mode

➢ To enter Installer-Only mode

- While the unit is in Configure mode, hold down the ESCAPE and DATA Down ▼ buttons for 3–4 seconds.

  A message cautions you that the panel is now in Installer mode and explains how to exit Installer mode.

  The next time you press a key, a message appears to remind you that the panel is still in Installer mode.

  Exit Installer-Only mode before you put the inverter•charger into service.

Changing Settings

NOTE
All configuration settings are stored in the PROsine's memory and will not be lost even if all power is disconnected.

➢ **To change system settings**

1. Set the DISPLAY switch to CONFIGURE.
2. Press Up ▲ MENU or Down ▼ MENU to display the menu you want.
3. Press ENTER once, and then press Up ▲ MENU or Down ▼ MENU until the menu item you want appears.
4. Press Up ▲ DATA or Down ▼ DATA until the value you want appears.
5. Press Up ▲ MENU or Down ▼ MENU until the setting you want appears.
6. When the correct value is displayed, you can do one of three things:
   - Press ENTER to save the new setting.
   - Press ESCAPE to restore the old setting.
   - Press Up ▲ MENU or Down ▼ MENU to restore the old setting and move to another item on the same menu.

NOTE
Wherever you are in the menu structure, you can return to the highest level by repeatedly pressing ESCAPE.

Changing Settings: Example 1

The Audible Alarm is set to Disabled by default. If you want to change it to All Faults, here are the steps you take:

1. Set the DISPLAY switch to CONFIGURE.
2. Press Down ▼ MENU until **Configure Display Panel** appears.
3. Press ENTER once. The **Audible Alarm** menu item appears with an asterisk (*) beside **Disabled**.
4. Press down ▼ DATA until **All Faults** appears.
5. Press ENTER to save this setting. (An * appears to the left of **All Faults**.)

Changing Settings: Example 2

Let's say you need to adjust the Breaker Size setting. Here's how you do it:

1. Set the DISPLAY switch to CONFIGURE: **Configure PROsine—Basic** appears.
2. Press the ENTER button once. **AC Breaker Size** appears.
3. Press Down ▼ DATA or Up ▲ DATA until the value you want appears.
4. Press ENTER to save this setting.

PART 2: CONFIGURATION MENUS AND SCREENS

Table 5 shows the organization of the configuration menus and screens. The screens are grouped into five menus:

- **Configure PROsine—Basic**
- **Configure PROsine–Advanced**
- **Configure Display Panel**
- **Configure Battery**
- **Diagnostics**

Table 5 Menu Structure—Overview

Configure PROsine—Basic	Configure PROsine—Advanced	Configure Display Panel	Configure Battery	Diagnostics

AC Breaker Size
Load Sensing
Equalize
	Load Sensing
	Load Sense Power
	Load Sense Interval
	Low AC Transfer (V)
	Low AC Transfer (Hz)
	High AC Transfer (V)
	High AC Transfer (Hz)
	AC Series Mode
	Inverter Low V Shutdown
	Run Without Panel
	Inverter Enabled on Reset Without Panel
	Charger Enabled on Reset Without Panel
	Auto Restart After Error
	Reset to Defaults
		Audible Alarm
		LCD Backlight Mode
		LCD Backlight Brightness
		LCD Backlight Timeout
		Temperature (C/F)
			Battery Size
			Default Battery Temp
			Battery Type
			View/Change Battery Details:
			• Battery Temp. Coefficient
			• Bulk Charge Mode Settings
			  • Max Voltage
			  • Max Current (%C)
			  • Exit Voltage
			  • Exit Timeout
			• Absorption Mode Settings:
			  • Max Voltage
			  • Max Current (%C)
			  • Max Time
			  • Exit Current (%C)
			  • Exit Timeout
			• Overcharge Mode Settings:
			  • Max Voltage
			  • Max Current (%C)
			  • Max Time
			• Float Mode Settings:
			  • Max Voltage
			  • Max Current (%C)
			  • Max Time
			  • Exit Voltage
			  • Exit Timeout
			• Equalize Mode Settings:
			  • Max Voltage
			  • Max Current (%C)
			  • Max Time
			  • Exit Change
			  • Exit Timeout
			• Constant Mode Settings:
			  • Voltage Setpoint
			  • Current Setpoint
			Charger Mode
			Charger Type
				PS System Mode
				View Last 20 PROsine Faults
				View Last 10 Panel Faults
				AC Bad Cause
				View Software Versions:
				• LVP Software Revision
				• HVP Software Revision
				• Display Software Revision
				• Display EEPROM Revision
				View System Temperatures:
				• Temperature at Panel
				• PROsine Unit Temp. 1
				• PROsine Unit Temp. 2

NOTE: When there is a system error, the following top level configuration menu appears: **Clear Error?**

PART 3: CONFIGURATION OPTIONS

This section gives you information about the options on each configuration menu. Refer to this section when you are changing system settings.

The information in this section is arranged as follows:

- Each configuration menu is identified by a heading (e.g. **Configure PROsine—Basic Menu**).
- The heading is followed by a two-column table that gives you a "thumb nail" overview of the menu.
  - The left column lists the items on this menu.
  - The right column indicates whether the access mode is: **User**, **Installer-Only**, or **Read-Only.**
  - The menu items or information displayed is explained after the table.

NOTE

If you try to change data on a screen that contains read-only data, the following message appears for one second:

Read-Only Data

Press any key to remove this message.

Clear Errors in PROsine

Menu Item	Access
Clear Errors **Note:** This configuration menu only appears when an error is active in the PROsine.	**User**

Menu Choices or Information Displayed

When an error has occurred, you can select:

- **Yes**
- **No**

  This acknowledges the error and tells the inverter•charger that you have attempted to clear the error condition and it should attempt a restart.

  Whichever action you choose, the last twenty faults are recorded, and you can view them for diagnostic or troubleshooting purposes. For information about Warnings, Errors, and Panel Faults, see the "Troubleshooting" section that starts on page 71.

Configure PROsine—Basic Menu

Menu Items	Access
AC Breaker Size	**User**
Load Sensing	**User**
Equalize	**User**

Menu Choices or Information Displayed

AC Breaker Size

Set the AC breaker size to match the shorepower circuit breaker size to reduce circuit breaker "nuisance" tripping. Values range from **0–30 amps**.

Load Sensing

Select **Enabled** if you want the unit to only turn on when a load is present. In Load Sense mode, the unit will periodically search for the presence of an AC load while it is inverting. The unit will "sleep" if the load it detects is less than the Load Sensing setting or if there is no load.

Select **Disabled** if you want the inverter on full-time rather than only when a load is present.

For further information about load sensing, see "Load Sensing Mode" on page 64.

Equalize

Select **Enabled** or **Disabled**. You can only select Enabled when the unit is charging and battery type is set to **Flooded**.

An equalization charge must only be performed on flooded (non-sealed or "wet") batteries and only as often as recommended by the battery manufacturer. For details about Equalization mode, see Appendix C: "Batteries" starting on page 105.

WARNING

If you select **Enabled**, you must monitor the electrolyte specific gravity and level during the equalization phase to prevent over-heating and battery damage.

CAUTION

During the equalization phase, the DC system voltage may exceed 17VDC, and therefore you should disconnect any sensitive DC loads.

Configure PROsine—Advanced Menu

Menu Items	Access
Load Sensing	**User**
Load Sense Power	**User**
Load Sense Interval	**User**
Low AC Transfer (V)	**User**
Low AC Transfer (Hz)	**User**
High AC Transfer (V)	**User**
High AC Transfer (Hz)	**User**
AC Series Mode	**Installer**
Inverter Low V Shutdown	**User**
Run Without Panel	**User**
Inverter Enabled on Reset Without Panel	**User**
Charger Enabled on Reset Without Panel	**User**
Auto Restart After Error	**User**
Reset to Defaults: • Load Factory • Save Custom • Load Custom	 **Installer** **Installer** **Installer**

Menu Choices or Information Displayed

☐ Load Sensing

Select **Enabled** if you want the unit to periodically search for the presence of an AC load while it is inverting. The unit will "sleep" if the load it detects is less than the Load Sensing setting.

Select **Disabled** if you do not want the unit to search for an AC load.

For further information about load sensing, see "Load Sensing Mode" on page 64.

☐ Load Sense Power

This setting determines what power the inverter needs to detect before it will start automatically (if Load Sensing is **Enabled**). Settings range between **10** and **255W**.

Load Sense Interval

This is the amount of time between checks for the presence of an AC power load. To save power while the unit is load sensing, increase the interval. The range is **0.5** to **25** seconds.

Low AC Transfer (V)

This is the voltage below which the unit will no longer recognize AC as "good", will open the relay, and will attempt to transfer to Invert mode if Invert is **Enabled**. The range of values is **85–110Vac**.

Low AC Transfer (Hz)

This the frequency at which the unit will no longer recognize AC as "good" and will attempt to transfer to Invert mode. The range is **40–59Hz**.

High AC Transfer (V)

This is the voltage above which the unit will no longer recognize AC as "good" and will attempt to transfer to Invert. The range is **120–135Vac**.

High AC Transfer (Hz)

This the frequency at which the unit will no longer recognize AC as "good" and will attempt to transfer to Invert. The range is **61–70Hz**.

AC Series Mode

Select **Standalone** if you are operating a single inverter•charger to produce 120V single phase.

If you are installing two PROsine 2.0 inverter•chargers as a 240 split-phase system, set one inverter•charger as **Master** and the other as **Slave**.

Inverter Low V Shutdown

At or below this battery voltage, the inverter will shut down. The values range from **10–16Vdc**.

Run Without Panel

Select **Yes** if you want the inverter•charger to continue running if the display panel is disconnected or the communication cable is damaged.

Inverter Enabled on Reset Without Panel

Select **Yes** if you want the inverter to be enabled on startup if no panel is detected after 10 seconds.

Charger Enabled on Reset Without Panel

Select **Yes** if you want the charger to be enabled on startup if no panel is detected after 10 seconds.

Auto Restart After Error

WARNING

If **Auto Restart** is selected, AC voltage can reappear at the loads without notice after a fault has occurred and cleared.

If you select **Yes**, the inverter•charger will attempt to restart (five attempts) after a fault has occurred.

If you select **No**, the inverter•charger ceases operation when an error occurs. It then requires that you manually restart the unit by going to the **Configuration** menu and clearing the error.

Exception: If the inverter•charger shuts down in Invert mode because of low battery and the charger is enabled and AC is then supplied to the inverter•charger, it will automatically charge the battery.

Reset to Defaults

You can only apply **Load Factory**, **Save as Custom**, or **Load Custom** if both the charger and the inverter are disabled. The display panel should respond with **OK**. If **Error** appears, disable invert and charge and try again.

Load Factory

If you select **Load Factory**, all inverter•charger settings will be reset to their default values.

Save Custom

If you want to change the settings temporarily, you may want to save your current system settings. To save the current configuration of the inverter•charger, select **Save Custom**. You can then restore this configuration to the inverter•charger at a later time.

Load Custom

Select **Load Custom** to restore your custom settings to overwrite the current PROsine settings.

Configure Display Panel Menu

Menu Items	Access
Audible Alarm	**User**
LCD Backlight Mode	**User**
LCD Backlight Brightness	**User**
LCD Backlight Timeout	**User**
Temperature (C/F)	**User**

Menu Choices or Information Displayed

This menu lets you change display panel settings to suit your preferences and environment.

■ Audible Alarm

Select **All Faults** if you want a beeper to alert you to each Warning and Error that occurs. If you prefer, choose **Errors Only**. Or choose **Off** if you don't want to hear any alerts.

■ LCD Backlight Mode

The default setting is **Auto**, which means that the display remains off until an Error or a Warning occurs or until you press any button on the display panel. **Auto** is a power-save feature. You can also choose to have the backlight **On** at all times or **Off** at all times.

■ LCD Backlight Brightness

Depending on the location of the display panel, you may want to adjust the brightness of the LCD. The default setting is **50%**, and you can adjust this down to **0%** or up to **100%** in **10%** increments.

■ LCD Backlight Timeout

If you set the LCD Backlight Mode to **Auto**, you can then choose when the display will turn off automatically. Time ranges are from **15 seconds** to **10 minutes**.

■ Temperature

Choose to display temperatures in **Celsius** or **Fahrenheit** (default) according to your preference.

Configure Battery Menu

Menu Items	Access
Battery Size	**Installer**
Default Batt Temp	**User**
Battery Type	**Installer**

View / Change Battery Details:
• Battery Temp. Coefficient
• Bulk Charge Mode Settings
  • Max Voltage
  • Max Current (%C)
  • Exit Voltage
  • Exit Timeout
	
	Installer
	
	Installer
	Installer
	Installer
	Installer

• Absorption Mode Settings:
  • Max Voltage
  • Max Current (%C)
  • Max Time
  • Exit Current (%C)
  • Exit Timeout
	
	Installer
	Installer
	Installer
	Installer
	Installer

• Overcharge Mode Settings:
  • Max Voltage
  • Max Current (%C)
  • Max Time
	
	Installer
	Installer
	Installer

• Float Mode Settings:
  • Max Voltage
  • Max Current (%C)
  • Max Time
  • Exit Voltage
  • Exit Timeout
	
	Installer
	Installer
	Installer
	Installer
	Installer

• Equalize Mode Settings:
  • Max Voltage
  • Max Current (%C)
  • Max Time
  • Exit Change
  • Exit Timeout
	
	Installer
	Installer
	Installer
	Installer
	Installer

• Constant Mode Settings:
  • Voltage Setpoint
  • Current Setpoint
	
	Installer
	Installer

Charger Mode	**Installer**
Charger Type	**Installer**

NOTE: Explanation of %C

%C is used as the unit of measure for the current setpoints in the **Configure Battery** menu. The meaning of **%C** is as follows:

Charging current generally varies with battery bank size. Therefore, current setpoints are generally expressed as **%C** where C is the capacity (Ah) of the battery bank. For example, to charge a 200Ah battery bank at 40A, a setting of 20% should be used.

Menu Choices or Information Displayed

WARNING: Risk of Fire or Explosion

Incorrect settings can damage or destroy your batteries. When making any battery configuration settings, ensure that the values are correct according to the battery manufacturer's specifications. Settings should be changed by qualified personnel only.

The **Configure Battery** menu lets you read (as a user) and change (installer-only) settings associated with the battery system. The parameters that can be set include battery size, temperature, and type. For more detailed information about batteries, including types and sizes, read Appendix C: "Batteries" starting on page 105. For information about charge cycles, see Appendix D: "Battery Charging Reference" starting on page 119.

Battery Size

This is the capacity of the battery or battery bank in ampere-hours. The PROsine will alter the charging rate based on battery bank size. Charging at a rate that is too high for your batteries can damage or destroy them.

Select the appropriate value between **50** and **2000** Ah.

Default Batt Temp

Select a battery temperature that is closest to the average ambient temperature in the location where the battery is installed. The choices are:

- **Cold: 5°C (41°F)**
- **Warm: 20°C (68°F)**
- **Hot: 35°C (95°F)**

When the battery temperature sensor is installed, this setting is ignored and the actual battery temperature is used.

Battery Type

From the list of options available, select the type of battery(s) that you have installed. See Appendix D: "Battery Charging Reference" starting on page 119.

When you select a charging algorithm, the battery details listed below (see "View / Change Battery Details:," on page 54) are automatically given default settings. These default values are the most appropriate for the selected battery type.

If you have a battery type that isn't on the list, you can modify the charging algorithm settings according to the manufacturer's guidelines. (This requires you to be in Installer mode.)

View / Change Battery Details:

The screens associated with these menu items display information about the way the inverter•charger will charge the battery.

Battery Temp Coefficient

This is the relationship between temperature and voltage levels on the battery. The correct value depends on battery type. For the correct value, consult the battery manufacturer.

Bulk Charge Mode Settings:

Max Voltage

This is the maximum available charging voltage for the Bulk charging stage.

Max Current (%C)

The maximum available charging current (in A) as a percentage of battery capacity (in Ah) for the Bulk charging stage.

Exit Voltage

When the battery voltage goes above this value for the Exit Timeout specified, the unit goes into Absorption charging stage.

Exit Timeout

When the battery voltage goes above the Exit Voltage for this time period, the unit goes into the Absorption charging stage.

Absorption Mode Settings:

Max Voltage

This is the maximum charging voltage for the Absorption charging stage. Typically, the battery will be at this voltage for the duration of this stage.

Max Current (%C)

The maximum available charging current (in A) as a percentage of battery capacity (in Ah) for the Absorption charging stage.

Max Time

This is the maximum amount of time that the unit will stay in the Absorption stage in minutes.

Exit Current (%C)

When battery current goes below this value (A as % of battery capacity in Ah) for the Exit Timeout, the unit goes into the next charging stage.

Exit Timeout

When the battery current goes below the Exit Current for this time period in minutes, the unit goes into the next charging stage.

- **Overcharge Mode Settings:**
  - **Max Voltage**

    This is the maximum charging voltage for the Overcharge charging stage. Typically the battery will be at this voltage for the duration of this stage.
  - **Max Current (%C)**

    The maximum available charging current (in A) as a percentage of battery capacity (in Ah) for the Overcharge charging stage.
  - **Max Time**

    The amount of time in minutes that the Overcharge stage will run.
- **Float Mode Settings:**
  - **Max Voltage**

    This is the maximum available charging voltage for the Float charging stage. Typically the battery will be at this voltage for the duration of this stage.
  - **Max Current (%C)**

    The maximum available charging current (in A) as a percentage of battery capacity (in Ah) for the Float charging stage.
  - **Max Time**

    This is the maximum amount of time that the charger will be in Float stage in hours.
  - **Exit Voltage**

    When the battery voltage goes below this value for the Exit Timeout specified, the unit goes into Bulk charging mode.
  - **Exit Timeout**

    When the battery voltage goes below the Exit Voltage for this time period, the unit goes into the Bulk charging stage.
- **Equalize Mode Settings:**
  - **Max Voltage**

    This is the maximum available charging voltage for the Equalize charging stage.
  - **Max Current (%C)**

    This is the maximum available charging current (in A) as % of battery capacity in (Ah) for the Equalize charging stage.
  - **Max Time**

    This is the maximum amount of time, in minutes, that the unit will stay in Equalize stage.

- **Exit Change**

  When the battery voltage changes by less than this value for the Exit Timeout specified, the unit goes to the next charging stage.

- **Exit Timeout**

  When the battery voltage exceeds the Exit Voltage for this time, the unit goes to the next charging stage.

Constant Mode Settings:

Voltage and current setpoints will be set, but the unit will likely be able to satisfy only one of these setpoints at any given time.

Example: For setpoints of 13.5V and 50A, the unit will supply 13.5V up to 50A and at higher loads, the current is held at 50A and the voltage will drop.

- **Voltage Setpoint**

  The inverter•charger will attempt to charge the battery at this target voltage. The default value is **13.5V**.

- **Current Setpoint**

  The inverter•charger will attempt to charge the battery at this target current. The default value is **100A**.

- **Exit Criteria**

  None. Unless a fault occurs, the unit will run continuously. Care must be taken to ensure that the voltage and current setpoints are correct for your battery type and loads to avoid damage.

Charger Mode

Select Standalone when a single PROsine 2.0 Inverter•Charger is being used to charge a battery.

When multiple PROsine 2.0 Inverter•Chargers are charging a single battery bank, the secondary chargers only operate during the Bulk charge phase, and the primary charger finishes charging the battery.

In this situation, select one charger as **primary** and all others as **secondary**.

Standalone
Primary
Secondary

Charger Type

Choose one of the three charger types listed below. For information about multi-stage charging, see Appendix C: "Batteries".

3-step

The inverter•charger will perform the Bulk, Absorption/Overcharge, and Float steps

2-step

The inverter•charger will only perform the Bulk, Absorption/ Overcharge, and Standby steps. Some battery manufacturers and users believe that batteries should not be Float charged.

CVCC

Constant Voltage Constant Current mode (also called “Constant Mode”). This mode is not intended as a standalone battery charger. It may be used as a power supply mode but still requires the presence of a battery in the system.

Diagnostics Menu

Menu Items	Access
PS System Mode	**Read-Only**
View Last 20 PROsine Faults • PROsine Fault #0 • — • PROsine Fault #19	**Read-Only**
View Last 10 Panel Faults • Panel Fault #0 • — • Panel Fault #9	**Read-Only**
AC Bad Cause	**Read-Only**
View Software Versions: • LVP Software Revision • HVP Software Revision • Display Software Revision • Display EEPROM Revision	**Read-Only**
View System Temperatures: • Panel ambient temp • Unit Temp #1 • Unit Temp #2	**Read-Only**

Menu Choices or Information Displayed

The screens on the **Diagnostics** menu are **Read-Only.** They let you monitor and troubleshoot the status of your PROsine system. For example, if the unit is continually recording Warnings about low battery voltage, you can view the messages and take appropriate corrective action.

The following items appear on this menu:

■ PS System Mode

This screen indicates the present operating mode of the inverter•charger: invert, bulk charge, absorption charge, etc.

■ View Last 20 PROsine Faults

The inverter•charger records the last twenty PROsine Warnings and Errors. You can examine these for diagnostic and troubleshooting purposes. (See Section 6: "Troubleshooting" starting on page 71.)

Warnings end with these characters: **-W** (e.g,. **Batt too hot -W**). Error message are displayed in the same way without the **-W** at the end.

View Last 10 Panel Faults

The display panel records the last ten faults that have occurred in the display panel. You can view these for diagnostic and troubleshooting purposes. (See "Display Panel Faults" starting on page 80.)

AC Bad Cause

If the input AC is not acceptable according to the configuration values you set, this screen indicates why: causes included low frequency, low voltage, etc. For a complete list of causes, see "AC Bad Causes," on page 74.

View Software Versions

This information can help Xantrex Customer Service Representatives troubleshoot problems you might have with the inverter•charger.

- **LVP Software Revision**
- **HVP Software Revision**
- **Display Software Revision**
- **Display EEPROM Revision**

View System Temperatures

These readings show temperatures in the inverter•charger and the display panel.

Next Steps

At this point, you have configured the inverter•charger and display panel, and you are now ready test and use the unit.

- Go to "Part 1: System Startup Check," on page 62.

Section 5 Operation

This section begins with a system startup check that you carry out after installation and configuration to verify that the PROsine 2.0 Inverter•Charger is operating correctly. The section also provides information that will guide you during routine, ongoing operations.

For your convenience, the information is divided into four parts:

- Part 1: System Startup Check. (See page 62.)
- Part 2: Operating Considerations. (See page 63.)
- Part 3: Operation in Inverter Mode. (Start on page 64.)
- Part 4: Operation in Charger Mode. (Start on page 66.)
- Part 5: Display Mode Screens. (Start on page 69.)

PART 1: SYSTEM STARTUP CHECK

WARNING
Review the "Important Safety Instructions" on page xv before operating the inverter•charger.

➢ To test the charging and inverting functions

1. Close the battery disconnect and turn on the inverter•charger's ON/OFF/REM switch.
2. To test the inverter, set the INVERTER switch to ENABLE and disconnect the AC input source breaker.
3. Place a load on the inverter (e.g. plug a light into an outlet that the inverter is powering) and make sure it works. The INVERTING LED should come on and the inverter should run the load using battery power.
4. To test the charger, connect the AC input source breaker. Set the display's CHARGER switch to ENABLE. After a short delay, the CHARGING LED should come on. Any AC loads powered by the inverter will also work at this time.
5. Remove the AC shorepower. The inverter•charger should transfer to Inverter mode immediately. (The transfer relay will make a clicking sound and the INVERTING LED will come on.) Loads should continue to operate uninterrupted.

If any part of this procedure fails, determine the cause before using the inverter•charger. Consult the "Troubleshooting" section starting on page 71.

PART 2: OPERATING CONSIDERATIONS

Fan Operation

The internal cooling fan operates for a number of conditions:

- One of the internal operating temperatures is greater than 55°C.

NOTE
This temperature may be caused by heat in the inverter•charger or by high ambient temperature.

The fan will continue to run until one minute after the temperature drops to 45°C.

- The AC input or output current is greater than 20A (15A if the internal temperature is greater than 40°C)—even in bypass mode, to keep the relay cool. It will shut off one minute after the current drops below 13A.

ON/OFF/REMote Control of Inverter•Charger Operation

The ON/OFF/REM switch is located on the AC end of the inverter•charger.

- **ON:** The inverter•charger operates normally according to the configuration and Display switch settings.
- **OFF:** The inverter and charger are disabled regardless of configuration or Display switch settings. Shorepower will not be passed to the AC loads. In this state, the battery current is minimal (less than 2mA). This state guarantees that the inverter•charger does not discharge the battery bank.
- **REMote:** In this position, the remote control signal that the user provides to the BATTERY TEMP jack turns the inverter•charger on or off. (For details about the Remote Shutdown switch, see page 38.) When this signal is active, the inverter•charger operates normally according to the configuration and Display switch settings.

NOTE
The inverter•charger will enter Invert or Charge modes only if enabled from the display panel (or if it is configured to run without panel). When the remote control signal is inactive, the inverter•charger is OFF, as described above.

PART 3: OPERATION IN INVERTER MODE

WARNING
Review the "Important Safety Instructions" on page xv before operating the inverter•charger.

Once the inverter•charger is installed, you can operate it in Inverter mode.

➢ **To operate in Inverter mode**

1. Place inverter•charger's ON/OFF/REM switch in the ON position.
2. Set the INVERTER switch to ENABLE.
3. If AC is present, the STANDBY LED will come on. If AC is present, remove it and the inverter will come on.

   Once the INVERTING LED is on, the inverter•charger is ready to deliver AC power to the loads.

NOTE
If you are having problems with any of your loads, refer to "Inverter Applications," on page 81.

Load Sensing Mode

The PROsine's Load Sensing mode reduces power consumption in order to conserve battery capacity.

When the inverter is ENABLED, the inverter•charger can be configured to search for an acceptable AC load. (It does this when you Enable **Load Sensing** on the "Configure PROsine—Basic Menu" and set **Load Sensing** parameters on the "Configure PROsine—Advanced Menu".) The unit will "sleep" if it doesn't detect a load that meets the Load Sense parameters. This "sleep" mode shuts off much of the inverter•charger's power control circuitry and thereby reduces the standby current draw considerably. When an acceptable load is detected, full output power is available.

In Load Sense mode, the INVERTING LED flashes approximately once a second.

Operating Limits for Inverter Operation

Power Output

The continuous output rating for the PROsine 2.0 is 2000 watts or 17 amps @ 120Vac; surge to 4.5kW. It can deliver this power in an ambient (surrounding) temperature that is up to 40°C. Above this temperature, you must reduce the demand or the unit may shut down. (See the chart on page 99 for details.)

The inverter•charger should be able to operate all AC loads rated at or below its power rating. Some high horsepower induction motors used in pumps and other motor-operated equipment require very high surge currents to start, and the inverter•charger may have difficulty starting these loads. (See page 81 for more information.) If you have problems starting certain loads, ensure that the battery connections are solid, the DC cabling is short and of sufficient size, the AC wiring is of sufficient size, and the battery is of sufficient capacity and is fully charged.

As with all inverters, the amount of continuous power that the PROsine 2.0 can deliver without overheating is limited by the ambient air temperature. It will operate and deliver its continuous power rating at higher temperatures, but the ambient temperature as well as the input voltage from the battery limits the extent to which it can do this. Operating the inverter•charger in conditions outside the power and temperature limits will result in thermal shutdown and/or significantly decreased performance. In addition, operation in this range is outside the ratings covered by the regulatory approvals of the product. (See page 99.)

Input Voltage

The input voltage limits are shown in Table 6.

Table 6 PROsine Operating Voltage Limits

Operating Condition	Voltage Range	Comment
Normal	10V–16V	
Peak Performance	12V–16V	
High Voltage Alarm	≥15.5V	
Unit Shuts Down	≥16V	Protects inverter against excessive input voltage.
Low Voltage Alarm	≤10.5V	
Unit Shuts Down	≤10.0V	Protects battery from being over-discharged.
Unit Restarts	≥12.5V	The inverter•charger will not restart unless input voltage exceeds 12.5V or the inverter is turned ON manually with the DISABLE/ENABLE switch. If the inverter is already enabled (STANDBY LED is on), move the switch to DISABLE to turn the inverter OFF, and then move it to ENABLE again to restart the inverter (as long as the battery voltage is between 10–16 volts).

PART 4: OPERATION IN CHARGER MODE

WARNING

Review the "Important Safety Instructions," on page xv before operating the inverter•charger.

During charging, batteries may generate explosive gasses. Thoroughly ventilate the area around the batteries and ensure that there are no sources of flames or sparks in the vicinity.

Study all battery manufacturer's precautions such as removing or not removing cell caps while charging and recommended rates of charge.

➢ To operate the inverter•charger in Charger mode

1. Turn on the PROsine's ON/OFF/REM switch.
2. Connect AC shorepower.
   - The batteries are charged according to the three-step algorithm you have selected.
   - The READY LED comes on when the charge cycle is complete.
   - You can interrupt the charge cycle any time if you don't have time to wait for a full charge.
   - To maintain optimal performance in flooded batteries, an occasional equalize cycle may be required.
3. While the batteries are being charged, you can monitor which stage they are in by viewing **PROsine System Mode** on the **PROsine—Diagnostics** menu. See page 58.

NOTE

If you are charging a non-sealed battery, add distilled water to each cell until battery acid reaches the level specified by the manufacturer. This helps prevent over-heating and purges excessive gases from the cells. Do not overfill. For a battery without cell caps, follow the manufacturer's recharging instructions carefully.

For more detailed descriptions of Bulk, Absorption, and Float charging modes, see Appendix C: "Batteries".

Operation in Equalization Mode

WARNING

Equalization generates explosive gases. Ensure adequate ventilation.

CAUTION

Sealed lead-acid batteries and gel batteries must NEVER be equalized or premature battery failure will result. Equalize mode is disabled if you have selected “Gel” as the Battery Type.

Only flooded lead-acid batteries should be equalized. As a general rule, do not equalize a battery unless there are provisions to add water to it and the manufacturer recommends equalization.

NOTE

If carried out too frequently or done improperly, equalization can damage your batteries. Never equalize a battery more than necessary. Always check electrolyte level before AND after equalization. Fill with distilled water only. Monitor electrolyte specific gravity (S.G.) throughout the equalization phase.

Follow the battery manufacturer’s recommendations for equalizing your batteries. Appendix C: “Batteries” provides some background on different batteries. As a guide, a heavily used flooded battery may need to be equalized once a month and a battery in light service every two to four months.

The PROsine 2.0 delivers a high quality charge so batteries do not need to be equalized as often as may be necessary when a lower quality charger is used.

Equalization Procedure

➢ To equalize your batteries

1. Turn off or disconnect all loads on the battery.

   The voltage applied to the battery during equalization may damage some electronic equipment. As well, equalization won’t proceed correctly if loads are drawing current from the battery.

2. Check electrolyte level.

   Fill with distilled water if the electrolyte level is low. Measure the specific gravity (S.G.) of each cell using a hydrometer. For fully charged lead-acid batteries, the reading should be approximately 1.265. (Consult your battery manufacturer.) Equalization is needed if one or more cells have a substantially lower specific gravity than the others.

3. To request the equalization charge, the charger must already be in operation. Set the CHARGER switch to ENABLE, and then select **Enabled** on the **Configure PROsine—General** menu (see page 47).

   Equalization will be carried out after an absorption charge (if the batteries

are not fully charged) or right away if fully charged. When equalization has been requested, the CHARGING LED is on and the EQUALIZE LED is flashing. When the system is in equalization, CHARGING is on and EQUALIZE is on.

4. During equalization, measure the S.G.

   When all cells have an S.G. of approximately 1.265, terminate the charge by setting the CHARGER switch to DISABLE. As a safety feature, the PROsine will exit Equalize mode after a specified period (depending on battery type). If the S.G. is still rising just before the charger exits equalization, restart the process by requesting an equalization charge.

5. When equalization is finished, check the battery electrolyte level. Top up as necessary with distilled water only.

Operating Limits for Charger Operation

Output Current: The maximum output current for the PROsine 2.0 is 100 amps. You can reduce the total output if you change the **Battery Size** setting on the **Configure Battery** menu (see page 52) or the maximum **AC Breaker Size** setting on the **Configure PROsine—General** menu (see page 47).

Input Voltage: The charger can operate over the range of 90–135Vac. This wide range allows the PROsine to deliver a maximum current to your batteries even when incoming AC voltage is less than ideal. A built-in surge protector protects the inverter•charger from surges and spikes on the AC power line.

Power Share

The PROsine 2.0 shares power with AC loads. It senses pass-through current going to AC loads and subtracts this current from 80% of the breaker setting. The current that is left over is available for charging the batteries.

In Charge mode, the inverter•charger operates from a breaker-protected 120Vac circuit. Therefore the total power for AC loads and charger operation is limited to 80% of the breaker rating (80% is the regulatory maximum permitted for continuous loads). In this limited power environment, the PROsine 2.0 gives priority to user-connected AC loads (pass-through current).

Example

A 30 amp circuit breaker is allowed to have a 24 amp continuous load.

If you have AC loads of 15 amps, the PROsine will give priority to your loads and allow the charger to draw up to 9 amps AC.

PART 5: DISPLAY MODE SCREENS

When the DISPLAY switch is ON, you can view the screens shown below. (The values shown here are examples only.) Display Mode screens are updated continuously to show current PROsine 2.0 operating data. You can scroll through them by pressing the Up ▲ and Down ▼ MENU buttons.

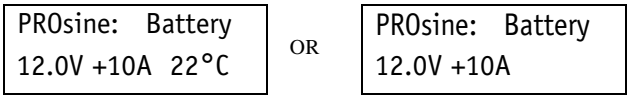
NOTE

In the screens below current polarity is indicated as follows:

+ indicates current going into the battery (i.e. + indicates charging).

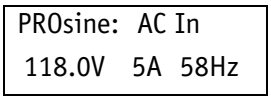
– indicates current coming out of the battery (i.e. – indicates that the battery is supplying loads or the inverter•charger is inverting).

Screen 1



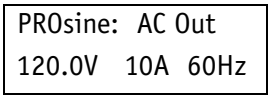
Shows the PROsine 2.0's voltage and current readings from the battery as well as the battery temperature. If the battery temperature sensor is not installed, the screen on the right is displayed.

Screen 2



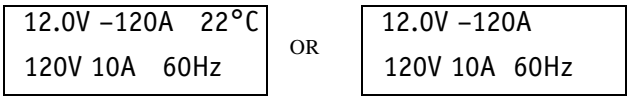
Shows the voltage, current, and frequency of the shorepower (i.e. input AC).

Screen 3



Shows the voltage, current, and frequency of the output AC.

Screen 4



Combines the battery display (Screen 1) with the AC output display (Screen 3).

The left-hand screen appears if the battery temperature sensor is installed. Output AC is shown on the bottom. The PROsine's voltage and current readings from the battery as well as the battery temperature appear on top.

The bottom of the right-hand screen shows the output AC. The top shows battery voltage and current as read by the PROsine. (This is the screen that appears if the battery temperature sensor is not installed.)

Section 6 Troubleshooting

WARNING: Shock and Energy Hazards

Do not disassemble the PROsine 2.0 Inverter•Charger. It does not contain any user-serviceable parts. Attempting to service the unit yourself could result in an electrical shock or burn.

NOTE

If you need to obtain service, see page xx.

Before you call Xantrex Customer Service, record the information that is asked for on page ii ("Information About Your System").

This section is divided the following parts:

- General Troubleshooting Guidelines. (See page 72.)
- Shutdown / Restart Without Error Message (See page 73.)
- AC Bad Causes. (See page 74.)
- Warning Messages. (See page 75.)
- Error Messages. (See page 78.)
- Display Panel Faults. (See page 80.)
- Inverter Applications (Loads). (See page 81.)

General Troubleshooting Guidelines

This section will help you narrow down the source of any problem you encounter. Before contracting Xantrex, please work through the steps listed below:

1. Check for a Warning, Error, or Panel Fault message. (See Table 8, Table 9, and Table 10 for descriptions of these messages and specific actions to take.) If a message is displayed, record it before doing anything further.
2. As soon as possible, record (on page ii) the conditions at the time the problem occurred so you can provide details if you need to contact Xantrex. These details should include the following as well as anything else asked for on page ii:
   - What loads the PROsine 2.0 was running or attempting to run
   - What the battery condition was at the time (voltage, state of charge, etc.) if known
   - Recent sequence of events (e.g. charging had just finished, we disconnected shorepower as we were preparing to leave the dock, but the inverter didn't come on, etc.)
   - Any known unusual AC shorepower factors such as low voltage, unstable generator output, etc.
   - Whether any extreme ambient conditions existed at the time (temperature, vibrations, moisture, etc.)
3. Attempt the solution indicated in Table 8, Table 9, or Table 10.
4. If your PROsine is not displaying a Warning, Error, or Panel Fault message, check the following to make sure the present state of the installation allows proper operation:
   - Is the inverter located in a clean, dry, adequately ventilated place?
   - Are the battery cables adequately sized and short enough and is the battery in good condition, and are all DC connections tight?
   - Are the AC input and output connections and wiring in good condition?
   - Are the configuration settings correct for your particular installation?
   - Are the display panel and the communications cable properly connected and undamaged?
   - Are the battery temperature sensor and its cable properly connected and undamaged?
5. Contact Xantrex for further assistance. Please be prepared to describe details or your system installation and to provide the model and serial number of the unit. See page xviii for contact numbers.

Shutdown / Restart Without Error Message

While inverting, the inverter•charger could shut down for a few seconds and then restart inverting without reporting an error.

This has likely been caused by a reset of the internal microprocessor, which was probably caused by a discharged and/or weak battery. In particular, this may occur when the battery is weak and the unit is starting loads which demand a high surge (e.g. air compressor, air conditioner, fridge).

You can try recharging the battery bank. If the problem persists, an equalize cycle (only on batteries which permit equalization) may help. If this does not correct the situation, the battery bank may require upgrading or replacement.

AC Bad Causes

If the input AC is not acceptable according to the configuration values you have set, the **AC Bad Cause** screen in the **Diagnostics** menu indicates why. Specific causes are listed in Table 7. You have the option of leaving the values or changing them depending on your circumstances. If you want to change configuration settings, see "Configure PROsine—Advanced Menu," on page 48.

Table 7 AC Bad Causes

AC Bad Cause	Details
None	There is no problem with the AC input.
Low Cycle V In	The rms voltage as calculated over one cycle (0.016s) was less than the user-set minimum acceptable operating voltage.
High Cycle V In	The rms voltage as calculated over one cycle (0.016s) was greater than the user-set maximum acceptable operating voltage.
Low Average V In	The rms voltage as calculated over 16 cycles (0.25s) was less than the user-set minimum acceptable operating voltage.
Hi Average V In	The rms voltage as calculated over 16 cycles (0.25s) was greater than the user-set maximum acceptable operating voltage.
Low Frequency	The frequency was less than the user-set minimum acceptable operating frequency.
High Frequency	The frequency was greater than the user-set maximum acceptable operating frequency.
V In Cycle Delta	The present cycle of shorepower is significantly different from the previous cycle. This is a fast method of recognizing an imminent power failure and is caused by a sudden change in the waveshape, magnitude, or frequency of the shorepower AC.
V In Step Delta	The shorepower contains large, repetitive, sharp edges which are incompatible with the PROsine and which you may not want to pass to your loads. This might be caused by a "modified sinewave" inverter or generator.

Warning Messages

Warning messages appear on the display panel LCD to alert you to an impending system change. Warnings do not affect operation.

- You can retrieve the previous twenty Warning and/or Error messages by placing the unit in Configure mode and then selecting **View Last 20 PROsine Faults** from the **Diagnostics** menu. Warnings end with the characters **-W** (e.g. **Batt too hot -W**).
- To clear a Warning message, press the ESCAPE key.
- If the audible alarm is enabled, press ESCAPE twice. The first key press deactivates the alarm and the second removes the message from the screen. (The warning is not cleared from the system, however.)

Some Warning messages appear as
Internal Error nnnn
where **nnnn** is the number of the error.

If one of these errors occurs, call Xantrex.

Other warnings are listed in Table 8. The text in the **Warning Message** column appears as the second line on the LCD; the first line displays the text: **PROsine Warning.**

Table 8 Warning Messages

Warning Message	Details	Action
Battery too hot	PROsine battery temperature too high.	Check the tightness of all connections. Check electrolyte level. Check charger and battery settings.
Battery too cold	PROsine battery temperature too low.	Extreme cold may require a battery heater. If the battery is frozen, thaw it gradually to avoid damage.
Int Tmp1 Too Hot	PROsine internal temperature 1 too high.	Reduce loads on the system. Ensure that the PROsine is being adequately ventilated.
Int Tmp2 Too Hot	PROsine internal temperature 2 too high.	
Int Tmp1 TooCold	PROsine internal temperature 1 too low.	Raise the ambient temperature.
Int Tmp2 TooCold	PROsine internal temperature 2 too low.	

Table 8 Warning Messages

Warning Message	Details	Action
Inv Low Batt Vlt	Low battery voltage, invert mode.	Check battery state of charge and re-charge if necessary. Check for proper DC cable size. Check all connections for tightness.
Inv High Bat Vlt	High battery voltage, invert mode.	Check for external charging sources and disable if necessary.
Chg High Bat Vlt	Charger high battery voltage.	
ACInRevPolarity	Input AC line and neutral wiring polarity is reserved. Check to see that the Line side of the AC source (shorepower) has a voltage to ground and the neutral side does not.	The unit will continue to operate. For safest operation, however, you should correct the AC input polarity
AC Out Overload	AC output overload.	Reduce the AC load so that even for short times, AC output current does not exceed 26A.
AC In V Too Low	AC input voltage too low.	Check for bad cabling. There may be too many loads on the AC supply line. Reduce the AC dropout level.
AC In V Too High	AC input voltage too high.	Check the AC input (shorepower) source voltage and correct if necessary or raise the AC input high voltage limit.
Bat Tmp SnsrShrt	Battery temperature sensor short detected.	Install a new sensor.
Memory Warning	EEPROM memory CRC is incorrect	Call Xantrex.
Equalizing!	The unit is equalizing.	Refer to page 122: disconnect any sensitive loads and monitor battery electrolyte level and S.G. throughout.
Unit will now attempt to restart after an error occurs.	Auto Restart After Error has been enabled.	The unit will re-start and provide 120VAC output without warning. Disconnect any AC loads that could be hazardous if they were to become re-energized without warning.
Unit attempting to restart.	Auto Restart After Error has been enabled, the error has cleared, and the unit is restarting.	

Table 8 Warning Messages

Warning Message	Details	Action
Unit will now run w/o Panel	Run without panel is enabled. Loss of the display panel or damage to its cable will not prevent the inverter•charger from operating.	The inverter•charger can provide 120VAC without warning.
Unit will start with INV Enabled	Inverter enabled on reset without panel feature is enabled.	The inverter•charger can provide 120VAC without warning.
Unit will start with CHG Enabled	Charger enabled on reset without panel feature is enabled.	The inverter•charger can provide 120VAC and battery power without warning.

Error Messages

Error messages indicate that there has been a change in system operation due to a detected condition.

- You can retrieve the previous twenty Error messages by placing the unit in Configure mode and then selecting **View Last 20 PROsine Faults** from the **Diagnostics** menu.
- To clear an Error message, press the ESCAPE key.
- If the audible alarm is enabled, press ESCAPE twice. The first key press deactivates the alarm and the second removes the message from the screen. (The error is not cleared from the system, however.)

Some Error messages appear as
Internal Error nnnn
where **nnnn** is the number of the error.

If one of these errors causes the inverter•charger to shut down, attempt to restart the unit. If the error occurs again, call Xantrex.

Other errors are listed in Table 9. The text in the **Error Message** column appears as the second line on the LCD; the first line displays **PROsine Error.**

Table 9 Error Messages

Error Message	Details	Action
Internal Error 2817	Low bus voltage detected	Clear the error in the **Configure** menu and then recharge the batteries. If the problem persists, contact Xantrex.
Battery Too Hot	PROsine battery temperature too high.	Check the tightness of all connections. Check electrolyte level. Check charger and battery settings.
Battery TooCold	PROsine battery temperature too low.	Extreme cold may require a battery heater. If the battery is frozen, thaw it gradually to avoid damage.
Int.Temp1 TooHot	PROsine internal temperature 1 too high.	Reduce the loads on the system. Ensure that the PROsine is being adequately ventilated.
Int.Temp2 TooHot	PROsine internal temperature 2 too high.	
Int.Temp1TooCold	PROsine internal temperature 1 too low.	Raise the ambient temperature.
Int.Temp2TooCold	PROsine internal temperature 2 too low.	

Table 9 Error Messages

Error Message	Details	Action
Inv Low Batt Volts	Inverter battery voltage low.	Check battery state of charge and re-charge if necessary. Check for proper DC cable size. Check all connections for tightness.
Inv High Batt Volts	Inverter battery voltage high.	Check for external charging sources and disable if necessary.
AC Out Overload	AC output overload.	Reduce the AC load so that even for short times, the AC output current does not exceed 26A.
Ext Comm Timeout	PROsine external communications timeout	Check that the connections on the communications cable between the PROsine and the display panel are secure. Check whether the communications cable has been damaged. Check the proximity of the communications cable to DC and AC cables. If the cable crosses DC or AC cables, ensure that it does so at right angles.
Chg Low Batt V	Battery voltage did not rise above 10V within 30 seconds of the charger starting. This may indicate a problem with the battery (e.g. a damaged battery), but will also occur if the battery was very dead at the start of the charge cycle.	Clear the error and restart the charging process. If battery V does not come to 10V after a few of charging cycles, have your battery tested.
SeriesComTimeout	Series communication timeout	Ensure that both inverter•chargers have power. Ensure that the ON/OFF/REM switch for both units is ON (or REM if Remote Shutdown is being used). Ensure that both inverter•chargers are configured correctly and are enabled.
RelayWeldDetect0	The internal transfer relay is unable to switch between shorepower and inverter output. Charge/passthrough or Invert modes may be unavailable.	Call Xantrex.
RelayWeldDetect1		
RelayWeldDetect2		
AC Backfeed	You have applied an AC source (shorepower) to the inverter output. This has been caused by improper wiring.	Check AC input and output wiring. The AC output wiring should not be connected to an AC source at any time.

Display Panel Faults

A message is displayed for any fault that is detected in the display panel. If a Panel Fault message appears, you can clear it from the screen by pressing any button on the panel. Since this type of fault does not trigger a shutdown, operation of the system after the error occurs depends on the type of fault and the setup of the system.

You can view the last ten Panel Fault messages by placing the unit in Configure mode and then selecting **View Last 10 Panel Faults from** the **Diagnostics** menu. The most recent fault is displayed first.

The majority of Panel Fault messages appear as
Internal Error nnnn
where **nnnn** is the number of the error.

If one of these errors causes the inverter•charger to shut down, attempt to restart the unit. If the error occurs again, call Xantrex.

Other faults are listed in Table 10.

Table 10 Panel Faults

Panel Faults	Error	Details
Panel Fault: COMM1 Timeout	External communications timeout Comm. Port 1	No transmission has been received for 2 seconds. Check the communications cable between the display panel and the inverter•charger as well as the connectors.
Panel Fault: COMM2 Timeout	External communications timeout Comm. Port 2	No transmission has been received for 2 seconds. Check the communications cable between the display panel and the inverter•charger as well as the connectors.
Panel Fault: Data Not Sent	Menu data failed to be sent.	After 5 retries, the data being altered on a menu could not be updated to the destination device.
Panel Fault: Panel Unusable	The panel's internal memory has been corrupted.	The panel will not work. The inverter•charger itself is not affected and will continue to operate if you have selected Run Without Panel.

Inverter Applications

The inverter•charger performs differently depending on the AC loads connected to it. If you are having problems with any of your loads, read this section.

Resistive Loads

These are the loads that the inverter finds the simplest and most efficient to drive. Voltage and current are in phase (i.e. in step with one another). Resistive loads usually generate heat in order to accomplish their tasks. Toasters, coffee pots, and incandescent lights are typical resistive loads. It is usually impractical to run larger resistive loads—such as electric stoves and water heaters—from an inverter due to their high current requirements. Even though the inverter can most likely accommodate the load, the size of battery bank required would be impractical if the load is to be run for long periods.

Motor Loads

Induction motors (motors without brushes) require two to six times their running current on start up. The most demanding are those that start under load (e.g. compressors and pumps). Of the capacitor start motors (typical in drill presses, band saws, etc.), the largest you can expect to run is 1/2 to 1 hp (the transfer relay is rated at 1 1/2 hp.) Universal motors are generally easier to start. Since motor characteristics vary, only testing will determine whether a specific load can be started and how long it can be run.

If a motor fails to start within a few seconds or loses power after running for a time, it should be turned off. When the inverter attempts to start a load that is greater than it can handle, it will turn itself off after a few seconds.

Problem Loads

Very Small Loads

If the power consumed by a device is less than the threshold of the Load Sense mode circuitry, the device will not run. See the "Configure PROsine—Basic Menu," on page 47 and the "Configure PROsine—Advanced Menu," on page 48 for ways to solve this problem. Most likely the solution will be to defeat the Load Sense mode feature.

Fluorescent Lights & Power Supplies

Some devices cannot be detected when scanned by Load Sense circuitry. Small fluorescent lights are the most common example. Some computers and sophisticated electronics have power supplies that do not present a load until line voltage is available. When this occurs, each unit waits for the other to

begin. To drive these loads, either a small companion load must be used to bring the inverter out of its search mode, or the inverter may be programmed to remain on by defeating the search mode feature. See the "Configure PROsine—Basic Menu," on page 47 and the "Configure PROsine—Advanced Menu," on page 48 for ways to solve this problem.

Clocks

The inverter's crystal-controlled oscillator keeps the frequency accurate to within a few seconds a day. Most clocks do not draw enough power to trigger the load sensing circuit. In order to operate without other loads present, the load sensing will have to be defeated. See "Configure PROsine—Basic Menu," on page 47 and "Configure PROsine—Advanced Menu," on page 48 for ways to do this. The best solution is to buy a battery-operated clock or a clock that is not dependent on line frequency or voltage. Any clock with a crystal-controlled oscillator will probably work fine.

Searching

If the amount of power a load draws decreases after it turns on, and if this "on" load is less than the load sensing threshold, it will be turned alternately on and off by the inverter. Incandescent light bulbs may present this problem when the search threshold is set near the wattage rating of the bulb. The solution is to reduce the load sense power threshold.

Electronics

AM radios will pick up noise, especially on the lower portion of their band. Inexpensive tape recorders are likely to pick up a buzz.

Computers

When the inverter is called on to start a large load—particularly a motor load—the output voltage may dip briefly. This dip may cause computers powered by the inverter to crash.

Section 7 Series Operation

This section provides the following information about installing and operating two PROsine 2.0 Inverter•Chargers in series:

- Part 1: Designing a series system. (See page 84.)
- Part 2: Installing a series system. (See page 87.)
- Part 3: Configuring a series system. (See page 91.)
- Part 4: Series system startup test. (See page 92.)
- Part 5: Series system operation. (See page 93.)

PART 1: DESIGNING A SERIES SYSTEM

System Overview

Series operation refers to a specific wiring configuration that allows you to connect two PROsine 2.0 Inverter•Chargers in a way that produces two 120V phases which are synchronized to produce 240V. This is commonly referred to as a "120/240Vac split-phase" supply or "240V single-phase with a center-tap neutral" and is the same as the utility connection to most houses. This series system can power both 120Vac and 240Vac single-phase loads. Two PROsine Inverter•Chargers connected in series can provide up to 4kW continuous power to almost any combination of 120V and 240V loads.

NOTE

Each inverter•charger is still limited to 17A continuous. For example, you cannot put 9A of load on one phase and 25A of load on the other.

System Components

A two-unit series operation system requires the same components that a single inverter•charger system requires. In many cases, however, two components are required, some are applied differently, and a 10 foot series sync cable is required. See Figure 20.

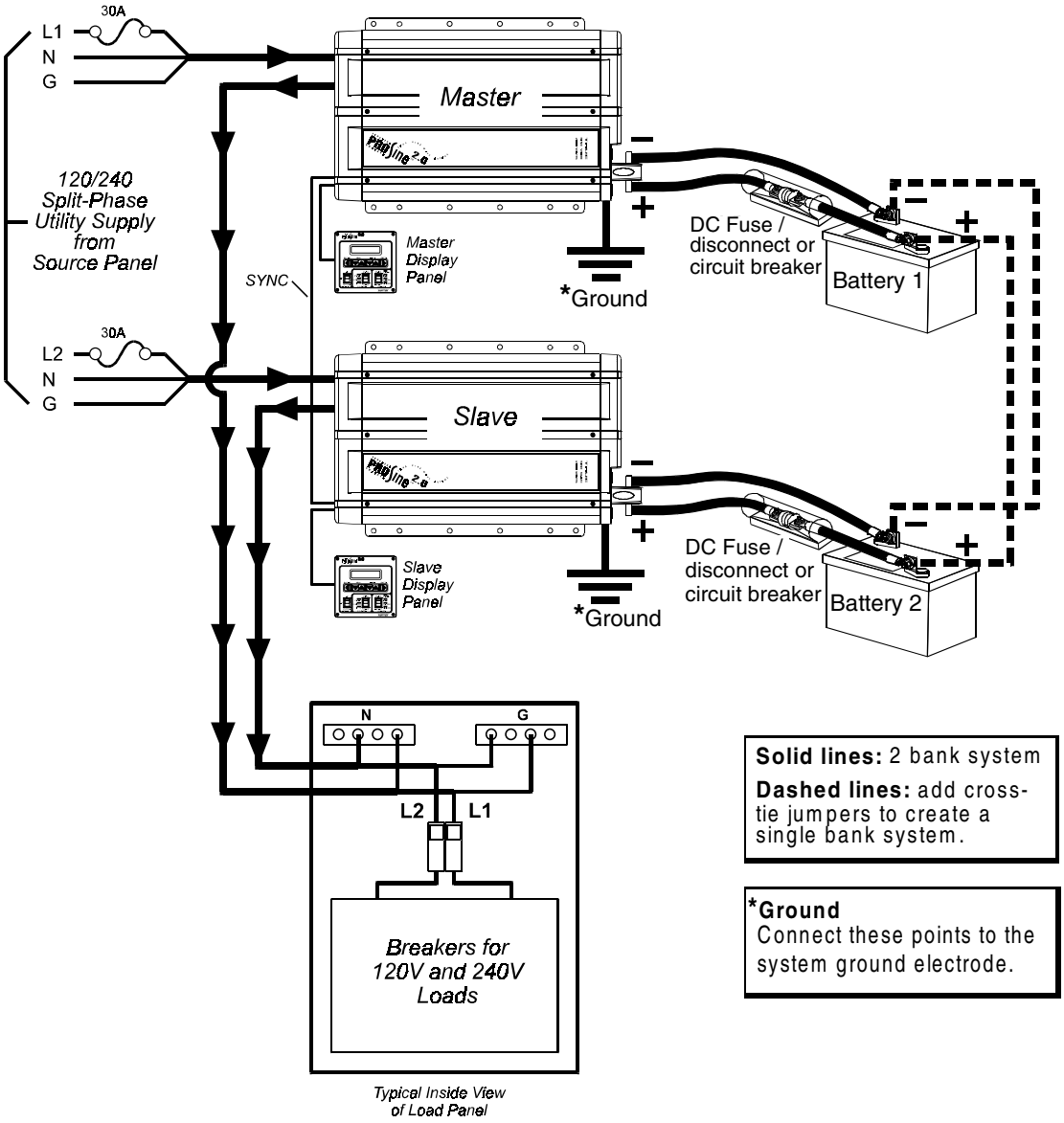


Figure 20 Two Inverter•Charger Series Operation System

AC Input

The AC input (shorepower) supply to the system must be a 120/240Vac split-phase system that provides two line conductors (referred to as L1 and L2), a neutral, and ground. Each PROsine requires a line, neutral, and ground run to it, so 2-conductor-plus-ground cable is needed with a 30A max circuit breaker installed in the line conductor. Typically these AC input cables originate in a distribution panel, providing a main disconnect and the separate 30A circuit breaker required for the AC input of each PROsine. That distribution panel, referred to as the "source panel," also provides neutral and ground busses, allowing for easy connection of the neutral and ground conductors in the cables.

AC Output

The AC output of each inverter•charger requires a separate 2-conductor-plus-ground cable (line, neutral, and ground) run from the inverter•charger to a 120/240Vac split-phase sub-panel for the loads. The sub-panel, referred to as the "load panel," must be equipped with a double-pole circuit breaker rated 30A max, 240Vac for the two line conductors (L1 and L2), and neutral and ground busses for the neutral and ground conductors from each unit. The load panel then provides circuit breakers for the 120Vac and 240Vac branch circuits powering the loads. Since the neutral-to-ground bonding is provided upstream (by one of the inverter•chargers in Invert mode, and by the utility otherwise) this load panel must not bond the neutral to ground. Most panels have a removable screw that allows the neutral to be unbonded.

Battery Disconnect and Over-Current Protection Requirements

As with a single inverter•charger system, batteries must have a fuse and disconnect or a DC-rated circuit breaker in the positive side, matched to the cable size. The recommendations about wire sizes, over-current protection, disconnection means, and other important details discussed in Section 3: "Installation" apply here. Refer to "Step 1: Designing the Installation" starting on page 19 for details. Each PROsine must be wired to the battery separately (whether a single bank or two banks are used).

Series Sync Connection

The SYNC connectors on the inverter•chargers are connected by a series sync cable. If this cable becomes damaged or lost, you can replace it with standard 4-conductor telephone cable, but the length must be ten feet or less.

NOTE

The series sync cable is an option and is not supplied with the PROsine 2.0 Inverter•Charger. Contact Xantrex or your distributor for this part.

PART 2: INSTALLING A SERIES SYSTEM

WARNING

Xantrex Technology recommends that all wiring be completed by a certified technician or electrician to ensure adherence to approved electrical wiring regulations.

WARNING: Fire, Shock, and Energy Hazards

Make sure wiring is disconnected from all electrical sources before you handle. All wiring must be done in accordance with local and national electrical wiring codes. Do not connect the output terminals of the inverter•chargers to any incoming AC sources.

- Xantrex recommends that you have an electrician set up the two inverter•chargers because knowledge of the electrical code, split-phase systems, and load balancing is required.
- See page 18 for a list of tools and materials required for installation. In addition, you will need a ten foot series sync cable. Contact Xantrex or your distributor for this part.
- See page 19 and following for information about wire sizes, over-current protection, and disconnection means.
- Connect the system as shown in Figure 20, on page 85.

Detailed procedures for setting up an AC series system are given below.

Connecting AC Input Wiring

➢ **To connect each inverter•charger to the utility 120/240Vac split-phase supply**

1. Assign one inverter•charger to Line 1 and one to Line 2 and maintain the same assignment throughout the AC input and AC output wiring steps.
2. Connect 2-conductor-plus-ground cable to a 30A breaker on Line 1 in the source panel, and to the panel's neutral bus and ground bus.
3. Run the 2-conductor-plus-ground cable to the Line 1 inverter•charger and connect:
   - The Line 1 conductor to its AC Input Line conductor (black)
   - The neutral to its AC Input neutral conductor
   - The ground to its AC Input ground terminal ⏚
4. Repeat steps 2 and 3, connecting the 30A breaker on Line 2, neutral, and ground from the source panel to the input wires and ground ⏚ of the L2 inverter•charger.

Connecting AC Output Wiring

➢ **To connect each inverter•charger to the load panel**

1. Connect 2-conductor-plus-ground cable to the Line 1 PROsine Inverter•Charger's AC Output line and neutral conductors, and connect the cable's ground wire to one of the output ground screws ⏚ on the inverter•charger.
2. Run the 2-conductor-plus-ground cable to the load panel and connect:
   - The Line 1 conductor to the panel's Line 1 input breaker
   - The neutral to the panel's neutral bus
   - The ground to the panel's ground bus
3. Repeat steps 2 and 3, connecting the Line 2, neutral, and ground from the Line 2 inverter•charger to the load panel's Line 2 input breaker, neutral bus, and ground bus.

Configuring the Inverter Output Neutral Bonding

Electrical codes require that you unbond the neutral-ground connection of one of the inverter•chargers. Otherwise when the units are inverting, they will both connect the neutral to safety ground through a relay. Installation codes stipulate that the neutral be connected to safety ground in one—and only one—location.

➢ **To unbond the neutral in one of the inverter•chargers**

1. Select one inverter•charger in which to unbond the neutral.

   Generally, it does not matter which inverter•charger you select, but your system may dictate that one unit in particular be unbonded.
2. Locate and remove the neutral-ground bonding screw at the back of the AC wiring compartment.
3. Install the screw in the extra hole (identified as the position in which the neutral is NOT automatically bonded) so it is available for future use if you change your system.
4. Tighten the screw so it will not back out over time.
5. Leave the other inverter•charger's neutral-ground bonding screw in the automatic bonding position.

Connecting the DC Cables

CAUTION

Before making the final DC connection, check cable polarity at both the battery and the inverter•charger. Positive must be connected to positive; negative must be connected to negative.

Reversing the positive and negative battery cables will damage the inverter•charger and void your warranty. This type of damage is easily detected.

WARNING: Fire Hazard

Make sure all DC connections are tight to a torque of 216–240 inch-pounds (24–27Nm). Loose connections will overheat.

The system can be run from a single battery bank or from two separate banks. A large single bank provides better surge capability for 120V loads and ensures that unbalanced 120V loads don't run down the battery on one inverter before the other. The two PROsine 2.0 Inverter•Chargers charge the single battery bank cooperatively. If you prefer to run separate battery banks, the units can be configured to charge the batteries separately. In either case, Xantrex recommends that you use batteries of the same type, size, and condition.

- Connect each PROsine 2.0 to the battery, making sure the polarity is correct. For DC wiring steps, refer to "Step 7: Connecting the DC Cables" starting on page 31.
- Do not attempt to run the DC cabling from the battery to one PROsine and then from that PROsine to the next. The cable and fuse sizes required would be much larger than are practical, and performance would suffer.

Your system may include some kind of battery monitor (e.g. a current sensing shunt) where all battery current must pass through one terminal for the sake of accurate data. If this is the case, the wires between the battery and the shunt must be very short and heavy because they carry the current of two PROsines: up to 500A continuous, which will require extremely large wire. The wires from the shunt to each PROsine must be 250MCM with a 300A fuse in each of the positives to protect the wiring.

Connecting the DC Ground

- Ground both inverter•chargers according to the procedures given on page 33.

Installing the Display Panels

- Mount and connect the display panel for each inverter•charger. (For details, see "Step 8: Mounting the Display Panel," on page 34.)

NOTE
Each inverter•charger must have its own panel so you can properly monitor and control the system.

Installing the Battery Temperature Sensors

For optimal charging, each inverter•charger must have its own battery temperature sensor.

WARNING: Explosion Hazard
If the charger has been operating, wait ten minutes for any explosive battery gases to dissipate.

- **Single Bank:** If your system has a single bank, install both sensors on the battery (or batteries) which will be the hottest.
- **Two Separate Banks:** If your system has two separate battery banks, connect one sensor to either inverter•charger and then to the battery it is charging; connect the second sensor to the second inverter•charger and then to the battery it is charging.
- For additional installation details, see page 35.

Installing the Series Sync Cable

➢ **To install the series sync cable**

1. Connect the series sync cable from the SYNC jack on one inverter•charger to the SYNC jack on the other unit.
2. Secure the cable to prevent strain on the connections.

PART 3: CONFIGURING A SERIES SYSTEM

Configure each inverter•charger through its display panel. Refer to "Part 2: Configuration Menus and Screens," on page 44 for an overview of configuration options. Refer to "Part 3: Configuration Options" on page 46 and following for specific configuration items.

➢ To configure the series system

1. Set up the usual parameters (battery size and type, AC transfer conditions, etc.) and make sure both inverter•chargers are configured the same.
2. Select one unit to be the "master" and the other to be the "slave". Configure **AC Series Mode** (on the **PROsine Advanced** menu) as **master SP** and **slave SP** respectively. (**SP** refers to "Split Phase.")

   Any 120Vac loads that require the fastest possible transfer should be powered by the "master" unit.
3. If the two PROsines are connected to the same battery bank, configure **Charger Mode** (on the **Battery** menu) to be **Primary** for the master and **Secondary** for the slave. If the two inverter•chargers are connected to separate battery banks, set **Charger Mode** to **Standalone** for both inverter•chargers.

Your system is now ready for operation.

PART 4: SERIES SYSTEM STARTUP TEST

➢ **To test the system's inverting and charging functions**

1. Apply DC to both inverter•chargers by closing the battery disconnect(s). Remove AC by opening the AC input source breaker. On both inverter•chargers, set the ON/OFF/REM switch to On.
2. Set the INVERTER switch on one display to ENABLE.

   The INVERTER STANDBY LED on that display should light.
3. Enable the inverter on the second display.

   The INVERTING LED on both displays should light.
4. Place a 120V load on the master inverter (e.g. plug a light into an outlet that it is powering) and make sure it works. Place a second 120V load on the output of the slave inverter and verify that both loads work. Place a 240V load on the 240V circuit formed by the two series inverters and verify that it works correctly.
5. To test Charge mode, apply AC to both inverter•chargers by closing the AC input source breaker.

   After a few seconds both units should transfer: the INVERTING LEDs will go dark and the AC IN LEDs will light. Enable the charger on both displays: the CHARGING LED on both displays should light and battery current should be registered. Any AC loads powered by the inverter will also work from shorepower at this time.
6. Check a transfer by opening the AC source breaker. The inverter•chargers should transfer to Invert mode immediately: the transfer relays will make a clicking sound and the INVERTING LED on both displays will come on. Loads will continue to operate uninterrupted.

If any part of this procedure fails, determine the cause before using the inverter•chargers. Consult the "Troubleshooting" section starting on page 71 as necessary.

PART 5: SERIES SYSTEM OPERATION

Invert Mode

The two inverter•chargers will operate strictly as a pair in Invert mode. Before each cycle of AC output, the two units confer over the sync cable to verify that the other unit has no errors and is ready to put out the next cycle. A number of conditions must be met for the pair of inverter•chargers to invert:

- Invert mode must be enabled on *both* displays.
- No errors can be present *in either unit.*
- The sync cable must be good.
- One (or both) sides of the AC input (shorepower) must be outside the transfer limits you have configured (e.g., low voltage).

If shorepower becomes valid on both phases when the PROsine is inverting, both units will synchronize to it and, as a pair, transfer to shorepower. Any transfers or shutdowns, etc. will occur on both phases within one cycle of each other.

Charge Mode

Both phases of the shorepower must be "good" before either unit will transfer to shorepower and be able to charge. Therefore neither unit will charge unless both phases of shorepower are good. However it is not necessary that both units have Charge mode enabled for one to operate.

NOTE

If both inverter•chargers are connected to one battery bank and are configured as primary/secondary, the charge operation is somewhat different than normal:

- The primary charger performs the entire charge cycle.
- The secondary charger completes the Bulk stage only, allowing the primary charger to accurately finish the charging cycle.

Appendix A Specifications

This appendix contains specifications and performance graphs for the inverter•charger and its display panel.

Electrical Specifications: Invert Mode

DC Input	
Operating voltage range	10.0V–16.0V
Safe non-operating voltage range	0–18Vdc
Nominal current at full load	200A
AC Output	
Output voltage	117Vac
Continuous power	2.0kW, 2.0kVA to 40°C max. ambient
Surge power	4.5kW for 5s
Max short-circuit current	55Arms, 55Apk
Frequency	60.0Hz ±0.05%
Wave shape	Sine
THD (over load range of 0–2.0kW resistive)	≤2%
Power derating above 40°C ambient temp	See "Invert Power Derating vs Ambient Temperature," on page 99.
Peak efficiency	≥87%
Full load efficiency	≥83%
Other	
Load power factor range	0–1, inductive, capacitive, or nonlinear, to 2kVA
No load input power (producing output voltage)	≤25W
Load sense power	≤4W (1s interval) ≤2W (3s interval)
Standby mode power draw (no output, display off)	≤0.5W
Off mode current draw	≤2mA

Electrical Specifications: Charge Mode

AC Input	
Operating voltage range	90–135Vac
Nominal current	15Aac at 100A charge, 120Vac in
Voltage wave shape	Sine. The unit will not operate on, or pass through, a modified sine-wave waveform.
Power factor (100A charge, 120Vac in)	≥0.98 on sine input
Nominal frequency	60Hz
DC Output	
Nominal voltage	12.0Vdc
Min battery voltage for charging	0.0Vdc
Max output voltage	17.5Vdc
Nominal output current	100A @ ≤15.0Vdc
Equalize mode max current	≥10A @ ≤17.5Vdc

Charger current derating	Automatically reduce charger current as internal temperature exceeds 80°C, input Vac approaches low transfer, and ac input current approaches 80% of breaker setting.
Efficiency at nominal output	≥84%
Other	
Battery type settings	Gel, Flooded, AGM, Pb-Ca
Battery size settings	50–2000 Ahr
Charge algorithms	Custom 3-stage with factory default set points. Custom 2-stage as above. Manually engaged, equalize, with factory defaults. CV/CC. User programmable setpoints.
Independent battery banks	1

Environmental Specifications

Ambient Temperature: Operating Temperature Range Storage Temperature Range	 –20–60ºC, with output derated above 40°C –40–70ºC
Humidity: Operation/Storage	5–95% RH, non-condensing

System

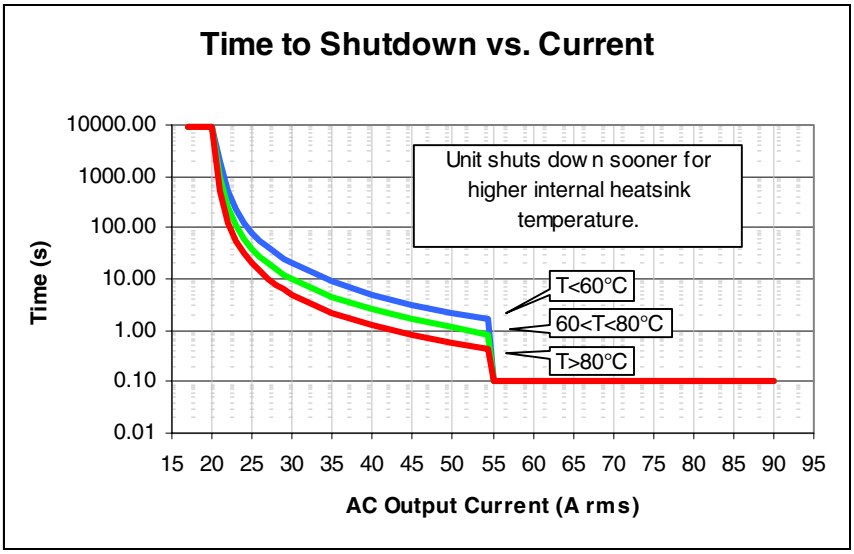
Transfer relay rating	30A, 1.5hp
Transfer time	16ms
Transfer on bad voltage	85–110V for low AC and 120–135 for high AC, user-adjustable.
Transfer on bad frequency	40–70Hz user-adjustable for high and low frequency limits.
Inverter synchronized to line before transfer	Yes
Remote ON/OFF	An isolated input to the unit where, with 5–18V applied the unit operates normally, with <1V the unit is off.
Cooling	Fan, activated by any of the following: High internal temperature High AC input current High AC output current

Regulatory Approvals

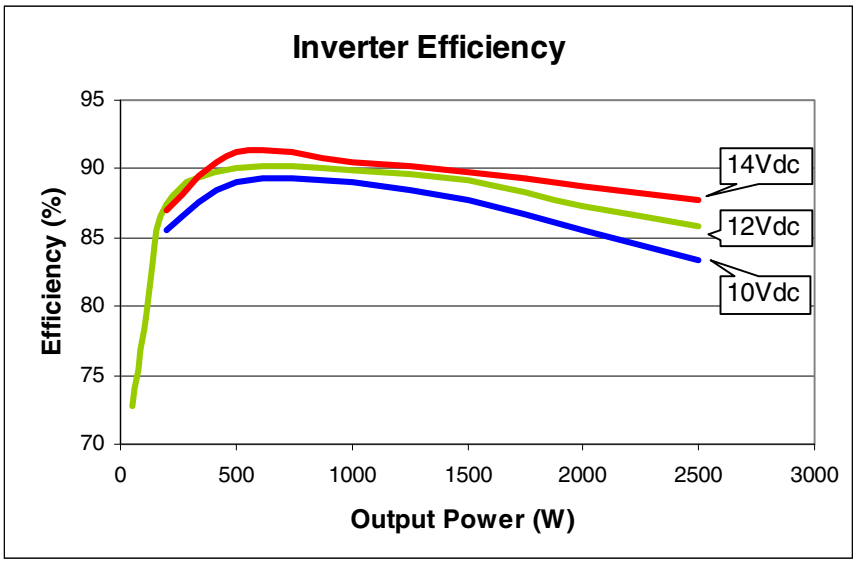
CSA/NRTL approved to CSA 107.1, UL458 (including Marine Supplement), and UL1741
FCC Class B
Complies with ABYC recommended practices E-8, E-9, A-20, and A-25 for marine use
Compliance to KKK-A-1822D for use in “Star-of-Life” ambulances available on request

Inverter Overload Operation

This graph shows how long the inverter•charger will operate for given output current.

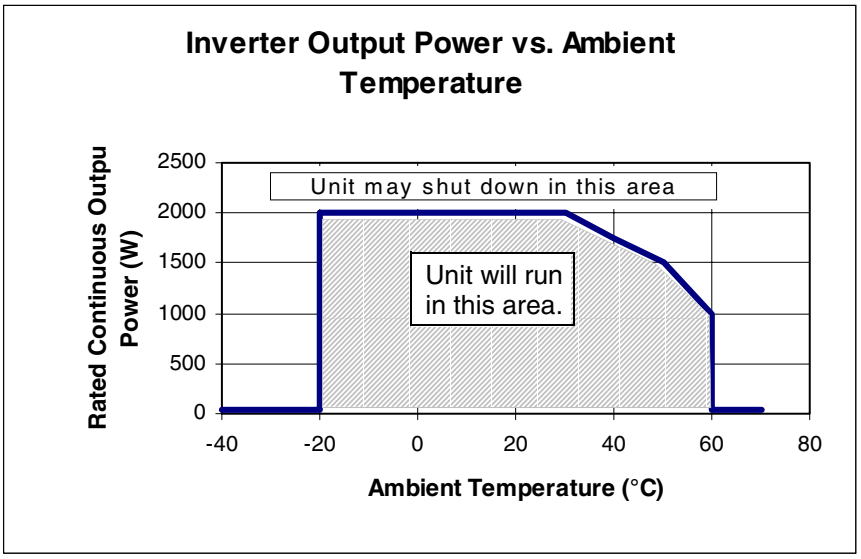


Typical Inverter Efficiency

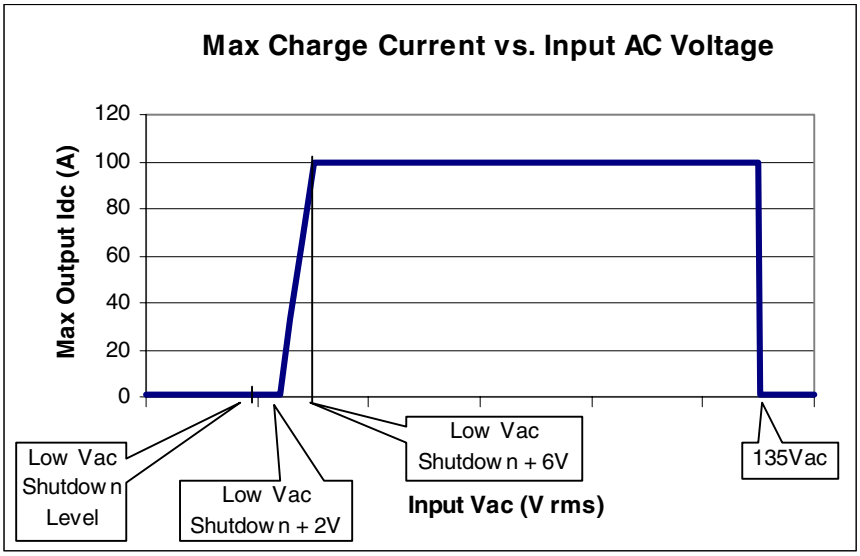


Invert Power Derating vs Ambient Temperature

If the unit is in elevated ambient temperature above 40°C, you are required to reduce power draw according to the following chart to maintain regulatory compliance and to avoid over-temperature shutdown.



PROsine Charger Output Current vs AC Input Voltage



Inverter•Charger Dimensions

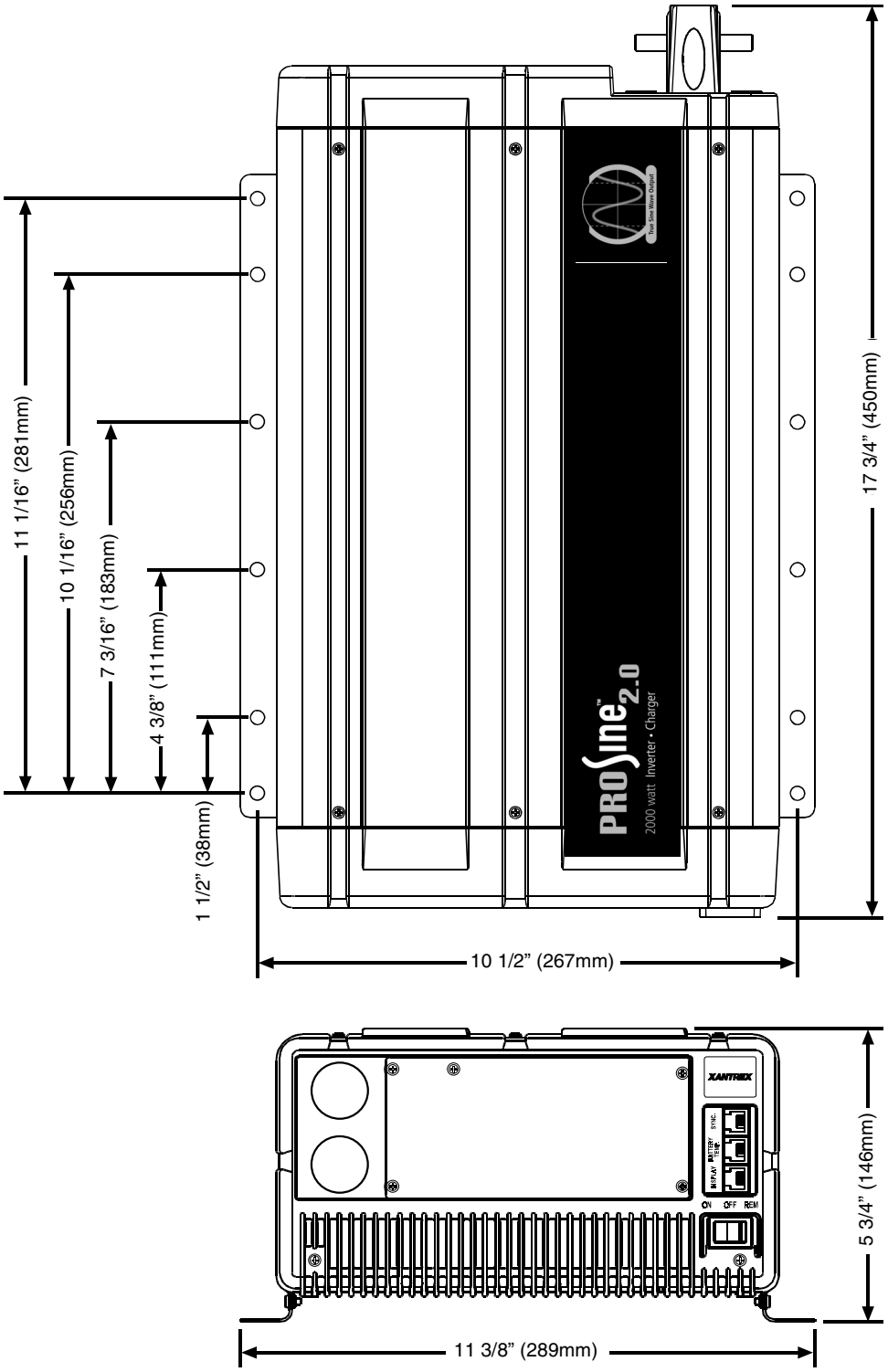


Figure 21 Inverter•Charger Dimensions

Appendix B Typical System Diagrams

Each PROsine 2.0 Inverter•Charger installation is a custom-designed system. The diagrams in this appendix illustrate typical designs for:

- Residential backup. (See page 102.)
- Marine installations. (See page 103.)

For a typical RV or Fleet Vehicle installation, see Figure 8, on page 19.

Residential Backup System

Figure 22 illustrates a typical residential backup system with the following features:

1. AC power supplied by a utility system
2. DC power supplied by a battery bank and protected by a DC fuse in the positive cable
3. An AC source panel that includes a Max 30A circuit breaker that supplies the inverter•charger
4. An AC load panel with branch circuit breakers that supply only loads that run off the inverter•charger
5. An earth ground

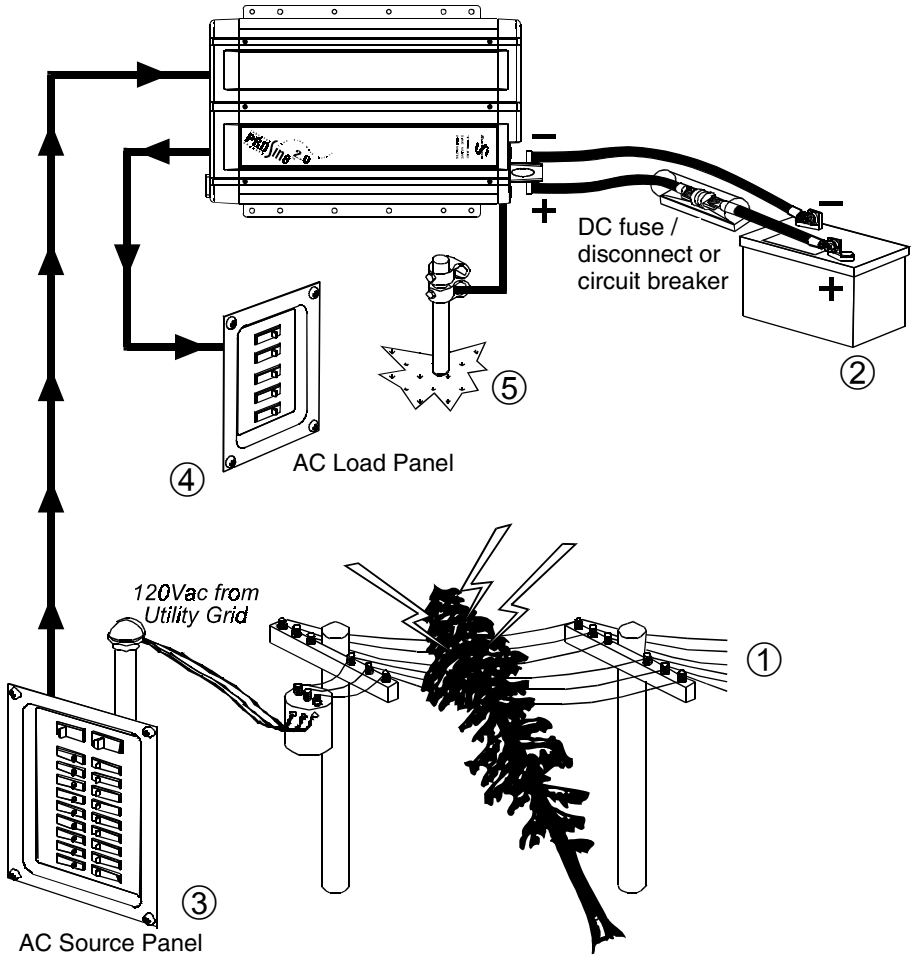


Figure 22 Residential Backup System

Marine System

Figure 23 illustrates a typical marine system with the following components:

1. AC power supplied from a shorepower connector
2. An AC source panel that includes a Max 30A circuit breaker that supplies the inverter•charger
3. An AC load panel with branch circuit breakers that supply only loads that run off the inverter•charger
4. Engine negative bus or DC ground bus
5. DC power supplied by a battery bank and protected by a DC fuse in the positive cable
6. Battery isolator
7. DC alternator
8. Starting battery

See the Note on page 101 for information about the ABYC Warning label that must be used in marine installations.

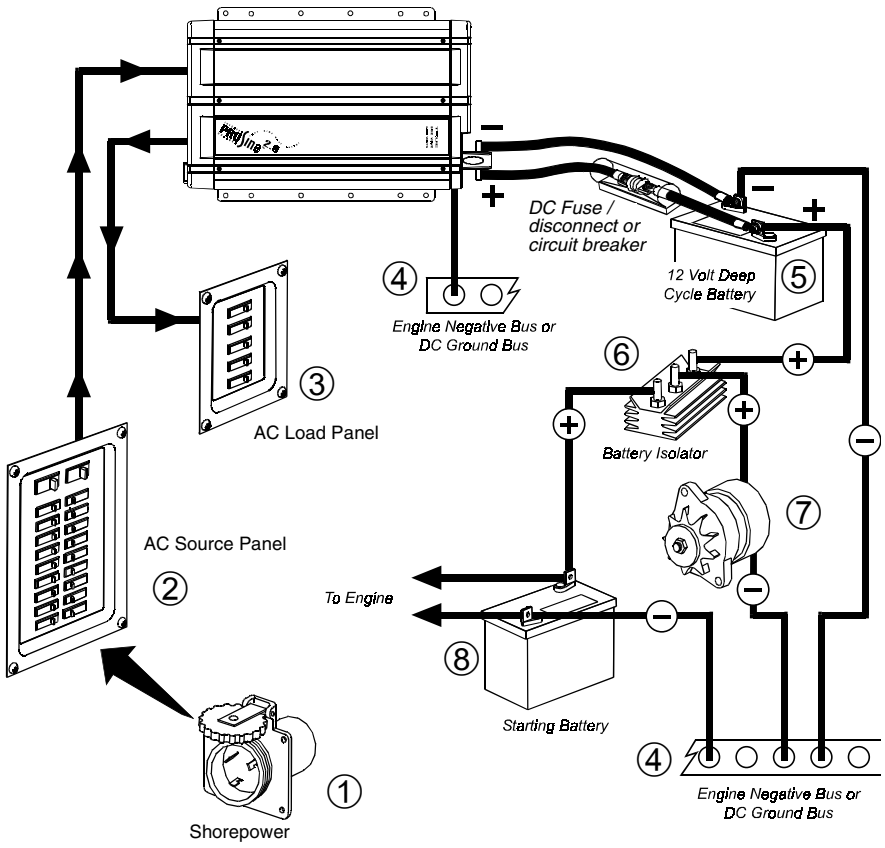


Figure 23 Typical Marine System

Appendix C Batteries

This appendix discusses the physical make-up and characteristics of chemical storage batteries and will help you understand the factors involved in battery selection, charging, care, and maintenance. This information is a guideline only. The manufacturer of each battery is the best authority on its use and care.

Terminology

A description of battery charger operation requires the use of terms that you may not be familiar with. The following terms appear throughout the manual.

Electrolyte Typically sulfuric acid. It is commonly referred to as battery acid and is the fluid inside a typical lead-acid battery.

Plates Made of lead and connected to the battery terminals. These are the terminals inside each cell of the battery. The essential chemical reactions of the battery occur at the plates, and they are the source of the current/voltage produced by the battery.

Sulfating As a battery discharges, its plates become covered with lead sulfate. With regular recharging, the lead sulfate leaves the plates and recombines with the electrolyte. If the lead sulfate remains on the plates for an extended period of time (over two months), it hardens, and recharging does not remove it. This reduces the effective plate area and the battery's capacity. Equalization of flooded batteries helps reduce sulfation.

Stratification Over time, electrolyte tends to separate. The electrolyte at the top of the battery becomes watery while it becomes more acidic at the bottom. This effect is corrosive to the plates. Equalization of flooded batteries helps reduce stratification.

Deep Cycle A deep cycle occurs when a battery is discharged to less than 50% of its capacity (50% depth of discharge). A deep-cycle battery is one that is intended to be repeatedly, deeply discharged and charged.

Temperature Compensation Optimal battery charging voltage is temperature dependent. As the ambient temperature falls, the proper voltage for each charge stage needs to be increased. The Prosine 2.0 battery temperature sensor automatically re-scales charge-voltage settings to compensate for ambient temperatures.

Battery Types

For the purpose of this discussion, there are two principal battery types: starting and deep-cycle. There are several different types of battery chemistries including flooded and gel lead-acid, nickel-iron (NiFe), nickel-cadmium (NiCad), alkaline, and gel-cell. Batteries are either sealed or vented. However, there are even different kinds of these batteries. This section explains some of the differences among lead-acid batteries to help you choose a battery that best suits your needs.

Your PROsine Inverter•Charger is designed for use with deep-cycle, lead-acid batteries. These batteries are designed for deep discharge service where they will be repeatedly charged and discharged. This type of battery is often labeled as a marine, recreational vehicle, or golf cart battery. Xantrex recommends that you use one or more deep-cycle batteries separated from the starting battery of your vehicle or boat.

Starting Batteries

Do not use starting batteries with your inverter: they will wear out rapidly in a deep-cycle application. The way they are rated gives a good indication of their intended use: "Cold Cranking Amps" is a measure of the amperage output of a battery intended for starting or "cranking" an engine.

Starting batteries use many thin plates to maximize the surface area of the battery. This allows very high starting current but allows the plates to warp when the battery is cycled.

Deep-Cycle Batteries

Deep-cycle batteries are best suited for use with inverters. They are designed to have the majority of their capacity used before being recharged. Available in many sizes and types, the most common is the non-sealed, liquid electrolyte type referred to as a "flooded" battery, commonly used in boats and RVs. Non-sealed types have removable battery caps. The caps should be removed at least monthly so the electrolyte level can be checked. When a cell is low, only distilled water should be added.

The many different types of deep-cycle, lead-acid batteries can be grouped into four categories: flooded (or wet), sealed flooded ("maintenance free"), recombinant flooded (often "starved electrolyte"), and gel batteries.

Another popular and inexpensive battery of this type is the "golf cart" (T-105 or CG220) battery. These six-volt batteries can be connected in series to form a 12V system and be discharged repeatedly to 80% of their capacity without being damaged. This is the minimum quality of battery that should be used with the inverter in normal applications.

Some systems use the L16 type of battery. These are 6-volt batteries rated at 350Ah and are available from a number of manufacturers. They are 17 inches (43cm) high and weigh up to 130 pounds (60kg) each—which may be troublesome in some installations.

Type 8D batteries are available in either cranking or deep-cycle construction. The deep-cycle versions are 12-volt batteries rated at approximately 200Ah. Since they are most commonly used to start truck engines, you should make sure you purchase the deep-cycle version, not the cranking version. Type 4D batteries are very similar in construction but are somewhat smaller (approximately 170Ah).

Sealed Gel-Cell

Another type of deep-cycle battery is the sealed gel-cell. The electrolyte is in the form of a gel rather than a liquid and never requires topping up. Battery caps are not removable. The sealed construction allows the batteries to be mounted in any position without spilling. The advantages are no maintenance (to the battery itself; the system still requires routine maintenance), long life (800 cycles claimed), and low self-discharge. The disadvantages are high initial cost and the possibility of damage from overcharging.

While many manufacturers produce quality flooded batteries, only a few produce suitable gel-cells. Don't confuse gel batteries with maintenance-free batteries. The latter are typically standard flooded electrolyte batteries without caps for adding water, and when the electrolyte gets low, you replace the battery.

AGM (absorbed glass mat) batteries are similar to gel-cells and deep-cycle types and can be used in inverter applications.

Environment

For long life and good performance, batteries need to be located in protected, ventilated enclosures insulated from temperature extremes.

Location

Batteries should be located in an accessible location that allows for access to the battery caps and terminals. At least twelve to eighteen inches of clearance above is recommended. They must be located as close as possible to the inverter•charger to keep the cable run short. However, do not locate the batteries in the same space as the inverter•charger unless they are of the sealed gel-cell type.

Enclosures

Batteries must be protected inside a ventilated enclosure. The enclosure should be ventilated to the outdoors from the highest point to prevent the accumulation of hydrogen gases released in the charging process. An air intake should also be provided at a low point in the enclosure to allow air to enter the enclosure to promote good ventilation.

Temperature

The effective capacity of a battery is reduced when the battery is cold. This phenomenon is more significant with lead-acid type batteries compared to alkaline types. When the internal temperature of a lead-acid battery is 32°F (0°C), the capacity can be reduced by as much as 50%. This effectively reduces the size of the system's "gas tank," requiring more frequent "refueling" by the charger. This should be considered when you design the system. If extremely low temperatures are expected where the system is going to be located, a heated equipment room should be considered.

If the system is located in an unheated space, an insulated enclosure is highly recommended for the batteries. During the charging process, the batteries release heat due to the internal resistance of the battery. If the batteries are insulated, the heat can be kept in the batteries to keep them warmer. This will substantially increase the performance of the system.

Insulated battery enclosures also ensure that the temperatures of individual battery cells are more consistent. This prevents unequal charging, which can cause battery failure (some cells being overcharged while others are undercharged).

The batteries should also be protected from high temperature. This can be caused by high ambient temperatures, solar heating of the battery enclosure, or heat released by an engine or generator located close by. High battery temperature results in short battery life and should be avoided by ventilating the enclosure and reducing the external heat sources by shading and insulation.

Battery Bank Sizing

Just as important as the type of battery selected for use with your PROsine Inverter•Charger is the battery size or capacity. The batteries are the most important part of your system, so Xantrex recommends that you purchase as much battery capacity as possible. A large battery will extend running time and ensure that your inverter•charger delivers full rated surge. Your inverter•charger can be configured to work with batteries from 50Ah (120 reserve minutes) to 2000Ah (4800 reserve minutes).

A number of different standards are used to rate battery energy storage capacity. Automotive and marine starting batteries are normally rated in cranking amps. This is not a relevant rating for continuous loads like an inverter. Deep-cycle batteries use a more suitable rating system, either "amp-hours" ("Ah") or "reserve capacity" in minutes. Battery reserve capacity is a measure of how long a battery can deliver a certain amount of current—usually 25 amps. For example, a battery with a reserve capacity of 180 minutes can deliver 25 amps for 180 minutes before it is completely discharged. Amp-hour capacity is a measure of how many amps a battery can deliver for a specified length of time—usually 20 hours. For example, a typical marine or RV battery rated for 100Ah can deliver 5 amps for 20 hours (5A x 20 hours = 100Ah). This same battery can deliver a higher or lower current for less or more time, limited approximately by the 100Ah figure (e.g. 50A for 2 hours, or 200A for 1/2 hour), but usually the capacity figure given is only accurate at the specified rate (20 hours).

The minimum battery size you can use with the PROsine Inverter•Charger is 50Ah. However, you can expect performance to suffer with such a small battery. Even if your battery is in excellent shape and is fully charged, you will likely experience poor surge power performance and unsatisfactory operating time with anything but a small AC load. **Xantrex recommends a minimum battery size of 200Ah for moderate loads (<1000W) and greater than 400Ah for heavy loads.**

Estimating Battery Requirements

To determine the proper battery bank size, you need to compute the number of amp-hours that will be used between charging cycles. When the required amp-hours are known, size the batteries at approximately twice this amount. Doubling the expected amp-hour usage ensures that the batteries will not be overly discharged and extends battery life. To compute total amp-hour usage, the amp-hour requirements of each appliance that is to be used can be determined and then added together, or the watt-hours can be totaled and converted to amp-hours.

Start with the nameplate ratings of your appliances. If the wattage is marked on the appliance, you can use that number directly; otherwise, multiply the marked voltage and amperage: WATTS = VOLTS X AMPS. Once you know the AC wattage drawn from the inverter, multiply that by the length of time the appliance will be used to determine the energy the load will require: WATT-HOURS = WATTS X HOURS. You can then convert this to an estimate of the battery amp-hours that the appliance requires:

BATTERY AMP-HOURS USED = AC WATT-HOURS / 10 (for a 12-volt battery)

—or—

BATTERY AMP-HOURS USED = AC WATT-HOURS / 20 (for a 24-volt battery)

For example, a 100W light bulb that is used for 4 hours will use 400 watt-hours (Wh) and the inverter will consume approximately 40Ah from a 12V battery, or 20Ah from a 24V battery.

Another useful rule of thumb is that the current drawn from the battery can be estimated from the AC output watts by using these same factors (10 for 12V systems, 20 for 24V systems). For example, when running an 800W microwave oven, the inverter will draw approximately 800 divided by 10 = 80A from a 12V battery.

Motors are normally marked with their running current rather than their starting current. Starting current may be three to six times running current. The manufacturer's literature may provide more accurate information than the motor nameplate. If large motors will be started, you may need to increase the battery size to allow for the high start-up demand.

Battery Bank Sizing Example

The following battery sizing example illustrates a typical calculation, assuming an opportunity to charge the batteries every three days:

Table 11 Battery Sizing Example

Appliance	(A) Power Consumption	(B) Operating Time per Day	Daily watt-hours needed for this appliance (= A x B)
TV & VCR	200 W	2 hours	400Wh
Small microwave oven	800 W	15 mins = 1/4 hour	200Wh
3 lamps, 60W each	180 W	4 hours	720Wh
Coffee maker	600 W	15 mins = 1/4 hour	150Wh
Hair dryer	1500W	6 mins = 1/10 hour	150Wh
		Total Daily watt-hours of AC load	1620Wh
		x Number of Days between charges	3
		= Total Watt-hours of AC load between charges	4860Wh
		Battery Ah used between charges (divide by 10 for 12V system; divide by 20 for 24V system)	486Ah
		Recommended Battery Bank Size in Ah (multiply by 2)	**972Ah**

This example illustrates how quickly your battery needs can escalate. To reduce the required battery bank size, you can either conserve energy by eliminating or reducing the use of some loads, or re-charge more frequently.

When sizing your battery, be conservative and resist the temptation to skip the last step of this calculation (multiply by 2). More capacity is better since you will have more reserve capacity, be better able to handle large loads and surge loads, and your battery won't be discharged as deeply. Battery life is directly dependent on how deeply the battery is discharged. The deeper the discharge, the shorter the battery life.

As your power requirements increase, you may need to use more than one battery to obtain sufficient capacity. Batteries can be connected in parallel or in series to create higher capacity systems. It is not recommended to connect batteries from different manufacturers, different types, or that have different amp-hour ratings in parallel. Improper charging and decreased battery life will result. See "Cabling & Hook-up Configurations," on page 116 for more information about battery inter-connection schemes.

Battery Bank Sizing Worksheet

The following worksheet is a guide to help you determine your battery needs. Be generous in estimating the time for which you will run each of the loads to ensure sufficient battery capacity.

Table 12 Battery Sizing Worksheet

Appliance	(A) Power Consumption	(B) Operating Time per day	Daily watt-hours needed for this appliance (= A x B)
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
Total Daily watt-hours of AC load			Wh
x Number of Days between charges			
= Total Watt hours of AC load between charges			Wh
Battery Ah used between charges (divide by 10 for 12V system, divide by 20 for 24V system)			Ah
Recommended Battery Bank Size in Ah (multiply by 2)			**Ah**

Monthly Battery Maintenance

WARNING

Wear appropriate eye protection and rubber gloves when carrying out maintenance activities.

WARNING

Use caution when working with metal tools around batteries. Do not allow any metal object to contact both battery terminals at the same time. Battery explosion or failure can occur.

At a minimum, check the level of the electrolyte in each battery cell once a month (for non-sealed batteries). It should be above the top of the plates, but not completely full. Most batteries have a plastic cup that just touches the electrolyte when the cell is full. Don't overfill the batteries, or the electrolyte will spill out when the batteries are being charged. Refill the batteries with distilled water only—"spring" water and regular tap water may have high mineral levels. These can poison the battery chemistry and reduce battery life.

It is also good to periodically check the battery connections for tightness and corrosion. If you find any corrosion, disconnect power from the PROsine, disconnect the cables, and carefully clean them with a mild solution of baking soda and water. Ensure that all caps are on tight so solution doesn't enter the battery. Rinse the top of the battery with clean water when you have finished.

To reduce the amount of corrosion on the battery terminals, coat them with anti-corrosion grease or liquid neoprene (liquid electrical tape) after re-assembly. This is available from automotive parts stores or battery suppliers. Do not apply anything between the terminal and the cable lugs. The connection should be metal to metal. Apply the protective material only after the bolts have been tightened.

Dirty batteries can leak current and tend to run warmer. Cleaning batteries when necessary is easy and safe when you follow the instructions below.

Preparation

The appropriate clothing, tools, equipment, and supplies are listed below. Gather what you need before beginning.

Clothing

Appropriate clothing could include old clothes, rubber boots, or old shoes. Battery acid is highly corrosive, so wear something you can live without just in case you splash some on yourself. Be sure to wear rubber gloves and eye protection.

Tools

- ❒ Ajustable wrench or appropriately sized sockets and ratchet
- ❒ Adjustable and/or locking pliers
- ❒ Torque wrench (suggested, not required)
- ❒ Soft-bristled brush (a discarded toothbrush works fine)
- ❒ 6 inch scrub brush
- ❒ Inexpensive 1/2 inch chip brush or soldering brush

Equipment

- ❒ Eye protection
- ❒ Rubber gloves
- ❒ Water hose with spray nozzle or five gallon watering bucket
- ❒ Empty spray bottle

Supplies

- ❒ Baking soda. (Always keep on hand in the event of a spill.)
- ❒ Hand cleaner or soap
- ❒ Towel
- ❒ After reattaching cables: liquid neoprene or white lithium grease (available at auto, RV, and marine stores)

Procedure

WARNING

Review the "Important Safety Instructions" on page xv before you begin.

Battery Enclosure and Batteries

Mix four ounces of baking soda with a gallon of fresh water and fill a spray bottle. Spray the solution on all exposed surfaces of the battery compartment, and wash down the exposed surfaces of the batteries and their enclosure. Scrub stubborn areas with the scrub brush. Baking soda will neutralize any acid that may have collected on these surfaces. Finish by rinsing with water.

Terminals & Lugs

Loose battery terminals and lugs exposed to open air corrode rapidly. The corrosion appears as a white powder or granular foam on the terminals and any nearby exposed metal parts. This is actually a crystallized form of sulfuric

acid. If it contacts your skin, it will cause burns unless you rinse it off immediately. Most textiles that are exposed to this corrosive eventually dissolve.

The most common cause of battery system failure is loose or corroded battery terminals and cable lugs. If any white powdery residue forms between the battery cable lug and the battery terminal, remove the cable for cleaning. When it is necessary to detach a battery cable from the battery, disconnect all loads and charging sources. Using the appropriate tool, remove the Negative battery cable first and re-install it last.

To remove any stubborn residue, sprinkle baking soda directly on the area, scrub with a wet toothbrush (or other soft-bristle brush), add water as required, and then rinse.

Reconnect the battery cable terminals to the battery lugs and tighten to approximately 10–15 foot-pounds using the torque wrench. If you do not have a torque wrench, use an appropriate tool to tighten the bolts reasonably snug. Do not over-tighten.

After tightening the cables, evenly coat all the exposed metal surfaces of the battery terminals and lugs with liquid neoprene. This will cure to form an airtight protective layer. If liquid neoprene is not available, use a light coating of white lithium grease or other sealant. Do not let anything come between the mating surfaces of the lugs and terminals.

Cables

Inspect all battery cables for missing or damaged insulation or loose connections. Inspect any openings that the cables pass through. All such openings must be equipped with a rubber grommet or conduit to prevent chafing on the cable. If necessary, replace worn grommets. If the cable insulation is worn, replace the cable.

Cabling & Hook-up Configurations

Several smaller batteries can be connected to create a battery bank of substantial size. You can connect batteries in three ways: in parallel, series, or series–parallel ("cross-tied").

To make a larger battery bank, connect individual batteries with heavy cables. The actual size of the cable depends on whether the batteries are connected in parallel or series. Generally, the cables should not be smaller than the inverter cables—if the main cables are 4/0AWG, the battery interconnects should be 4/0AWG.

The best configuration is to connect the batteries in series and parallel—a configuration often called "cross-tying." This requires additional cables but reduces imbalances in the battery bank and can improve the overall performance. Consult your battery supplier for more information regarding the hook-up configuration required for your system.

Parallel Connection

Batteries are connected in parallel when all the positive terminals of a group of batteries are connected and then, separately, all the negative terminals are connected. In a parallel configuration, the battery bank has the same voltage as a single battery, but an Ah rating equal to the sum of the individual batteries. See Figure 24.

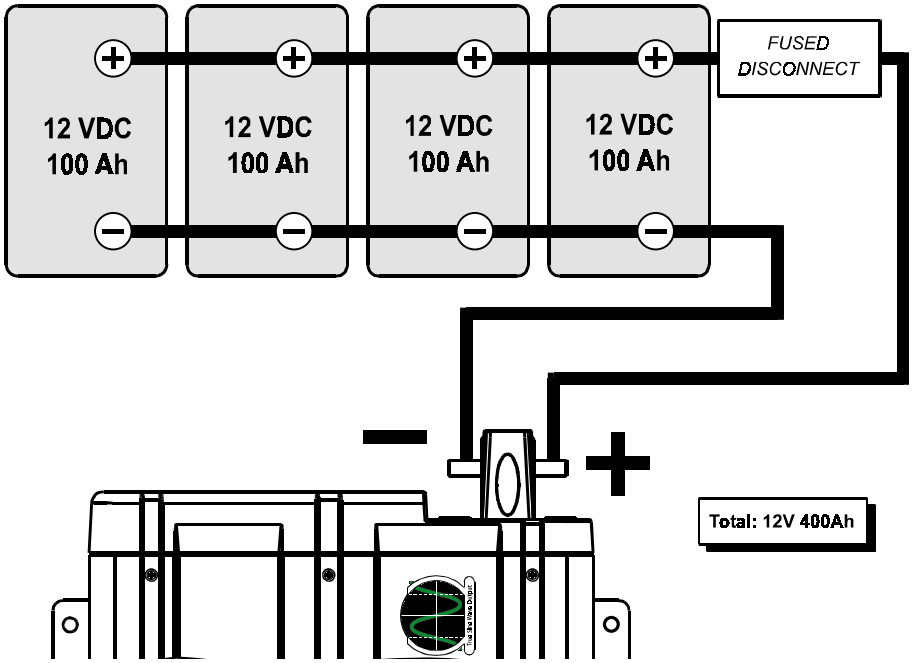


Figure 24 Batteries Connected in Parallel

Series Connection

When batteries are connected with the positive terminal of one to the negative terminal of the next, they are connected in series. In a series configuration, the battery bank has the same Ah rating of a single battery, but an overall voltage equal to the sum of the individual batteries. See Figure 25.

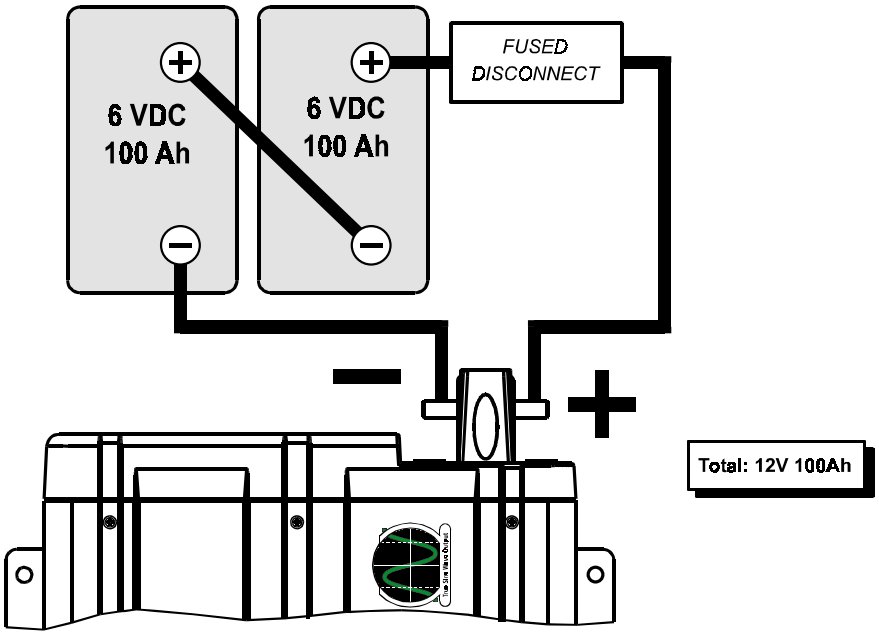


Figure 25 Batteries Connected in Series

Series–Parallel and "Cross-Tied" Connections

As the name series–parallel implies, both the series and parallel techniques are used in combination. The result is an increase in both the voltage and the capacity of the total battery bank. Cross-tying is used frequently to make a larger, higher voltage battery bank out of several smaller, lower voltage batteries. This is common with all battery-inverter system voltages. The smaller, lower voltage batteries are first connected in series to obtain the needed voltage, and then these "batteries connected in series" sets are connected in parallel to increase the battery bank capacity.

The best arrangement when using a series–parallel configuration is to connect all the smaller, lower voltage batteries in parallel, and then to connect all these "batteries in parallel" into series sets to obtain the needed voltage. This configuration is often called "cross-tying." It is less convenient and requires additional cables but reduces imbalances in the battery, can improve overall performance, and in a "shorted cell" scenario, will cause only the battery(s) that are actually in parallel with the "shorted" battery to discharge. This will allow you to reconfigure your battery bank with the other batteries that are in parallel with the shorted/discharged battery(s) and still be operational (only at a lower capacity).

The more effective cross-tying method is shown by the dashed line. If you don't want to cross-tie, ignore the dashed line.

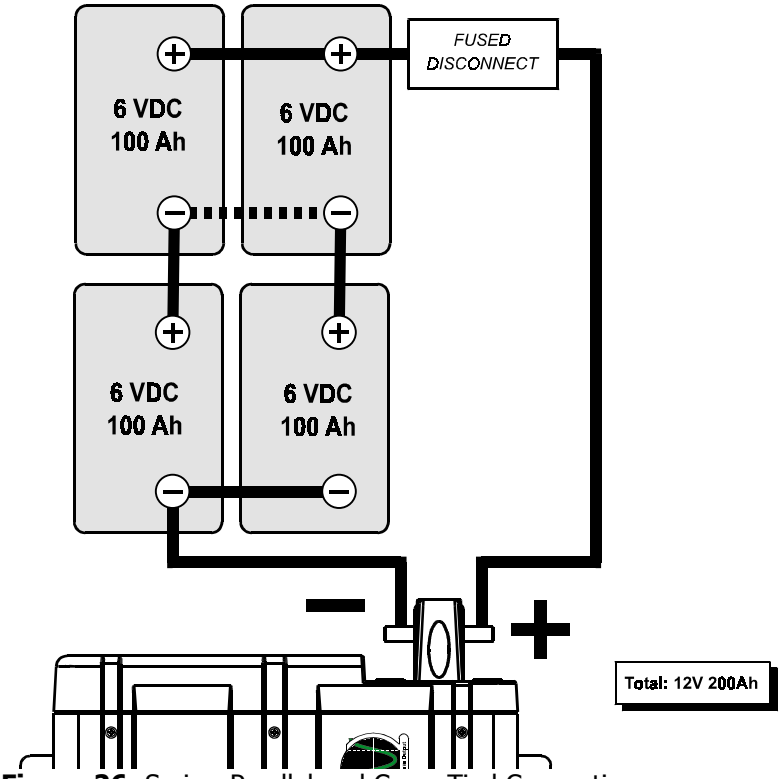


Figure 26 Series–Parallel and Cross-Tied Connections

Appendix D Battery Charging Reference

This appendix provides information about the following aspects of battery charging:

- Three-stage charging. (See page 120.)
- Two-stage charging. (See page 122.)
- Charging times. (See page 123.)
- Charging algorithms and charge types. (See Table 14 on page 125 and Table 15 on page 126.)

Multi-Stage Charging

The PROsine 2.0 Inverter•Charger has a fully configurable multi-stage battery charger. Anytime an acceptable (within frequency and voltage parameters) AC source is presented to the unit and the charger is enabled, it charges the batteries connected to it. When AC is present, the charger will charge the battery bank regardless of the position of the inverter's Enable/Disable switch.

Three-Stage Charging Profile

Modern lead-acid batteries last longer and charge faster if they are charged in a particular sequence known as a **three-stage charge**. The PROsine 2.0 Inverter•Charger implements the three-stage charging process, plus a user-triggered **equalization charge**. The charging current and voltage delivered to the battery vary depending on:

- Battery type setting
- Battery temperature (by configuration or battery temperature sensor)
- AC input breaker setting (AC service setting)
- Battery bank size (capacity)

While the batteries are being charged, you can monitor which stage they are in by viewing **PROsine System Mode** on the **PROsine—Diagnostics** menu. See page 58.

Figure 27 shows how DC voltage and current change with time through the different charge stages.

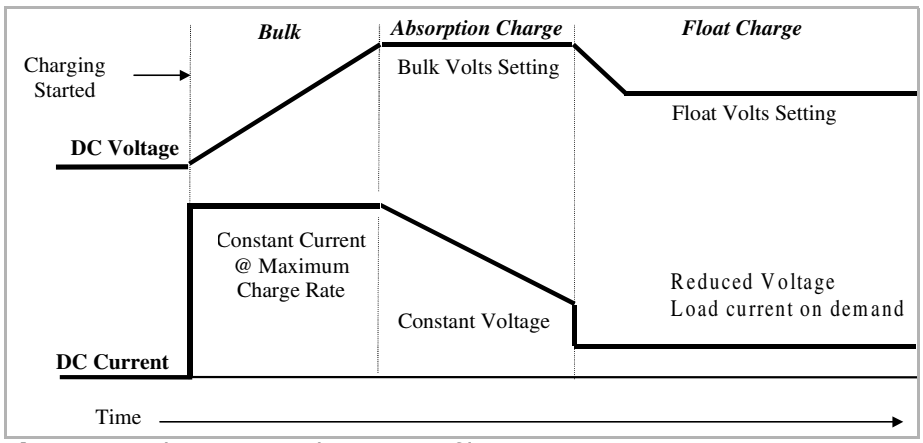


Figure 27 Three-Stage Charging Profile

Bulk Charge

In the first stage, known as the **bulk charge**, the PROsine Inverter•Charger delivers the maximum current allowable given the settings noted above: that is, battery type and temperature, maximum AC input setting, and battery bank size. This current is delivered to the batteries until the battery voltage approaches its gassing voltage—typically around 14.4 volts for 12 volt batteries. (This voltage can vary depending on battery type and other settings.) The bulk charge stage restores about 75% of the battery's charge. The gassing voltage is the voltage at which the electrolyte in the battery begins to break down into hydrogen and oxygen gases. Under normal circumstances, a battery should not be charged at a voltage above its gassing voltage since this causes the battery to lose electrolyte and dry out over time. Therefore the PROsine Inverter•Charger transfers to the next stage, known as the **absorption charge**.

Absorption Charge

During the **absorption charge**, the charging voltage is held constant near the gassing voltage, and the battery gradually reduces charging current demand as it attains full charge. When the charging current has decreased to a predetermined limit, based on battery size settings, the inverter•charger moves to the float stage. (For flooded batteries, the absorption charge is maintained for approximately one more hour—the **overcharge** stage.) The absorption charge stage restores the remaining 25% of the battery's charge.

Overcharge

The **overcharge** stage, used only on flooded batteries, ensures that the batteries are fully topped up by maintaining the absorption charge voltage for one additional hour.

Overcharge is not used on gel batteries.

Float Charge

The **float charge** is a maintenance mode in which the output voltage of the inverter•charger is reduced to a lower level, typically about 13.5 volts to maintain the battery's charge without losing electrolyte through gassing. Unlike many standalone chargers, the PROsine Inverter•Charger can be left connected to your battery indefinitely without risk of overcharging. The inverter•charger then provides up to 100A (limited by the AC breaker setting and AC load current) to your DC loads so the batteries remain fully charged.

Equalization Charge

WARNING: Explosion Hazard

Equalization produces explosive gases which must be allowed to vent. Any sparks can cause an explosion.

WARNING

Equalization can charge batteries to 17.5V, which may be damaging to DC appliances. Xantrex recommends disconnecting any sensitive DC loads during equalization.

CAUTION

Check the specific gravity of each cell periodically during equalization. Terminate the cycle when all cells read ≥1.265.

The fourth charging stage, the **equalization charge**, is manually initiated because it is not required each time the battery is recharged. Equalization is a deliberate overcharge designed to reduce sulfation and stratification in the battery. This helps it reach and maintain peak capacity by equalizing the chemistry in the individual battery cells.

An equalization charge should only be performed on vented, flooded (non-sealed or "wet") batteries and only as often as recommended by the battery manufacturer.

Two-Stage Charging Profile

In a two-step charge, the charger finishes Absorption but does not go to Float mode because some battery manufacturers advise against floating their batteries. The PROsine 2.0 goes into a monitoring mode instead where the inverter•charger monitors the batteries but does not charge or float them. In this mode, the PROsine 2.0 will not supply current to power loads.

In a two-step charge, the charging current and voltage delivered to the battery vary depending on:

- Battery type setting
- Battery temperature (by configuration or battery temperature sensor)
- AC input breaker setting (AC service setting)
- Battery bank size (capacity)

While the batteries are being charged, you can monitor which stage they are in by viewing **PROsine System Mode** on the **PROsine—Diagnostics** menu. See page 58.

Battery Charging Times

Charging time depends on the capacity of your battery bank and on how deeply it is discharged. The following equation gives an approximate charging time:

$$\text{Charging Time} = \frac{\text{CAP x DOD}}{\text{CC x 80}}$$

where:

Charging Time = Battery recharge time in hours

CAP = Battery capacity in amp hours

DOD = Battery depth of discharge in %. (A fully discharged battery has 100% DOD.)

CC = Charge current, the current output of the charger in amps. (Charge current depends on battery size and breaker size settings.)

Example

The battery bank is made up of two 8D Group size batteries with a rated capacity of 200Ah each. The bank is 80% discharged (i.e. DOD = 80). The approximate charging time with the inverter•charger will be:

$$\frac{400 \times 80}{100 \times 80} = 4 \text{ hours}$$

Battery Charging and Equalization Guide

Table 13 provides general charging information about standard battery types. This information will help you use your PROsine 2.0 to give your batteries the best charge. Note in particular, the information in the "Equalization" column.

Table 13 Battery Charging and Equalization Guide—General

Category	Examples	Identifying Features	Advantages	Disadvantages	Equalization
Flooded	**Trojan:** Golf Card, Superior, Pacer **West Marine:** Sea Volt **Motomaster:** Nautilus	Vents that can be removed to fill the battery with water. Low price and higher maintenance.	More resistant to over-charging since it can be filled with water. Cheaper than other batteries	Must be filled with DISTILLED water and usually requires equalization. Maintenance required.	Equalize every one or two months when in heavy use. Equalize every four to six months in light duty periods.
Sealed Flooded	**Delco:** voyager	Vents that look like they are removable but are not. Sold as "Maintenance Free" at attractive prices.	Less maintenance required than Flooded. No need to fill with water. Less expensive than gel.	Less resistance to over-charging because they consume water but cannot be refilled.	Do not equalize unless specified by the battery manufacturer.
Recombinant Flooded (sealed)	**Hawker Energy:** Genesis **Optima:** Yellow top **GNB Industrial:** Evolyte	Expensive. Vents are often concealed. Sold using the following phrases: Recombinant, Valve Regulated, Maintenance Free, Starved Electrolyte.	Require no maintenance. Non-spillable.	Can be damaged by equalization. Generally more expensive.	Do not equalize unless specified by the battery manufacturer.
Gel (sealed)	**Sonnenschein:** Prevailer **West Marine:** SeaGel	Expensive. Sold either as "Gel" or "Gelled Electrolyte" batteries.	Require no maintenance. Often can be used on its side. Non-spillable. Low self-discharge. Less damage from being left discharged.	Damaged by equalization. Generally more expensive.	Do not equalize.

PROsine 2.0 Charge Algorithms

Table 14 summarizes the voltage and current setpoints for the charging algorithms. These voltage setpoints are applied for a battery temperature of 20°C. To determine the voltage setpoints at other temperatures, apply the temperature coefficient as follows:

$$V_{T_X} = V_{20°} + \frac{TC \times (T_X - 20°)}{1000}$$

For example, generic gel float voltage at 50° will be

$$V_{50°} = 13.8V + \frac{-27\frac{mV}{°C} \times (50° - 20°)}{1000} = 13.0V$$

Table 14 Charge Algorithms

Charge Algorithm	Comment	Temp Coeff.	Bulk / Absorption		Float*	Equalize
			Max V	Max I	Max V	Max V
		(MV/°C)	(V)	(%C)**	(V)	(V)
1	Generic Flooded	–27	14.4	30	13.5	17.5
2	Generic Gel	–27	14.2	25	13.8	***
3	Generic AGM	–21	14.3	30	13.45	***
4	Generic PB–Ca	–27	15.5	30	13.5	17.5
5		–27	14.1	25	13	17.5
6		–27	14.2	25	13.5	***
7		–30	14.5	25	13.5	17.5
8		–30	15.3	25	14.3	17.5
9		–30	14.4	30	13.5	17.5
10		–30	14.15	30	13.5	14.2
11		–27	14.4	30	13.8	***
12		–21	15.5	25	13.75	16
13		–21	14.8	25	13.6	15.5
14		–27	15	200	13.7	***
15		–21.66	14.2	12.5	13.7	16.5
16		–21.66	14	10	13.5	16.5
17		–27	16	20	13.5	17.5
18		–16	14.2	20	13.2	15.5
19		–15	14.7	200	13.5	17.5
20		–15	13.5	200	13.5	17.5
21		–27	14.6	20	13.5	17.5

* The charger delivers maximum available current to power the DC loads: it is not limited by battery size.
** See "Max Current (%C)" on page 54 and page 55.
*** The algorithms marked *** do not permit Equalize.

Battery Type—Charge Algorithm Guide

Use the information in the following table to match your battery type with the appropriate Charge Algorithm and Charger Type.

Table 15 Battery Type – Charge Algorithm Guide

If you have this kind of battery	Select Charge Algorithm	And set Charger Type to
Canadian Tire Nautilus by Exide	5	3 Step
Canadian Tire, Gel by Exide	6	3 Step
Concorde AGM Valve Regulated	3	3 Step
Delco 1150 by Delphi	17	3 Step
Delco 1200 by Delphi	17	3 Step
Delco 2000 by Delphi	17	3 Step
Delco Voyager by Delphi	17	3 Step
Douglas Marine/Deep Cycle	21	3 Step
Dulalast Deep Cycle Flooded, Deep Cycle/Starting (by Johnson Controls)	13	3 Step
Dulalast Deep Cycle Flooded, Starting/Deep Cycle (by Johnson Controls)	12	3 Step
Energizer Deep Cycle Flooded, Deep Cycle/Starting (by Johnson Controls)	13	3 Step
Energizer Deep Cycle Flooded, Starting/Deep Cycle (by Johnson Controls)	12	3 Step
Eveready Deep Cycle Flooded, Deep Cycle/Starting (by Johnson Controls)	13	3 Step
Eveready Deep Cycle Flooded, Starting/Deep Cycle (by Johnson Controls)	12	3 Step
Exide Flooded	5	3 Step
Exide Gel Master	6	3 Step
GNB Action Pac	7	3 Step
GNB Evolyte	9	3 Step
GNB Stowaway	8	3 Step
GNB Sunlyte	10	3 Step
Hawker Energy, Genesis	14	3 Step
Interstate Deep Cycle Flooded, Deep Cycle/Starting (by Johnson Controls)	13	3 Step
Interstate Deep Cycle Flooded, Starting/Deep Cycle (by Johnson Controls)	12	3 Step
Interstate Optima, Normal	19	3 Step
Johnson Controls Flooded - Deep Cycle/Starting	13	3 Step
Johnson Controls Flooded - Starting/Deep Cycle	12	3 Step
Keystone Solid Energy (Flooded)	16	3 Step

Keystone Solid Energy (Gel)	15	3 Step
Metra Electronic - Tsunami, Normal	19	3 Step
Optima Blue Top	19	3 Step
Optima Red Top	19	3 Step
Optima Yellow Top	19	3 Step
Rolls Deep Cycle by Surrette	18	3 Step
Sears Canada, Marine by Delco	17	3 Step
Sears Canada, Marine Flooded by Exide	5	3 Step
Sears USA, by Johnson Controls, Flooded Deep Cycle/Starting	13	3 Step
Sears USA, by Johnson Controls, Flooded Starting/ Deep Cycle	12	3 Step
Sears USA, Gel by Johnson Ctls	11	3 Step
Sonnenshien P300/500, SP300 Powerfit AGM	2	3 Step
Sonnenshien A400 Dryfit Gel	2	3 Step
Sonnenshien A500 Dryfit Cyclic Gel	2	3 Step
Sonnenshien A600 Dryfit OpzV Gel	2	3 Step
Sonnenshien A700 Dryfit Gel	2	3 Step
Sonnenshien Gel A200/300 Dryfit	2	3 Step
Sonnenshien L400 Powerfit, Long Life AGM	2	3 Step
Sonnenshien S300/500 Powerfit AGM	2	3 Step
Surrette Deep Cycle	18	3 Step
Trojan Gel Safe	1	3 Step
Trojan Golf	1	3 Step
Trojan Mileage Master	1	3 Step
Trojan Mustang	1	3 Step
Trojan Pacer	1	3 Step
Trojan Rider	1	3 Step
Trojan Sea Stallion	1	3 Step
Westmarine Sea Gel by Sonnenshien	2	3 Step
Westmarine Sea Volt by Trojan	1	3 Step

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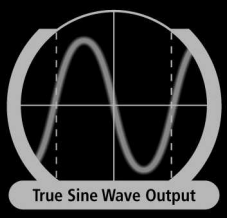

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