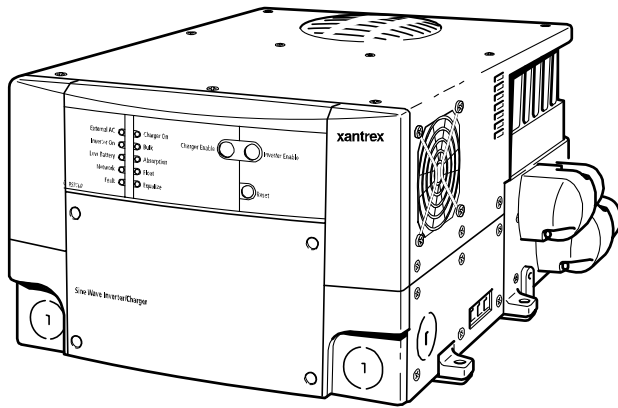


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RS3000

## Installation Guide

### RS3000 Sine Wave Inverter/Charger



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# **RS3000 Sine Wave Inverter/Charger**

## **Installation Guide**

## **About Xantrex**

Xantrex Technology Inc. is a world-leading supplier of advanced power electronics and controls with products from 50 watt mobile units to one MW utility-scale systems for wind, solar, batteries, fuel cells, microturbines, and backup power applications in both grid-connected and stand-alone systems. Xantrex products include inverters, battery chargers, programmable power supplies, and variable speed drives that convert, supply, control, clean, and distribute electrical power.

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# About This Guide

## Purpose

The *RS3000 Sine Wave Inverter/Charger Installation Guide* describes the procedure for installing the RS3000 Sine Wave Inverter/Charger (RS3000).

## Scope

The Installation Guide provides safety guidelines, detailed planning and setup information, and procedures for installing the inverter/charger. It does not provide information on operation, configuration, troubleshooting, and warranty and product information. Refer to the *RS3000 Sine Wave Inverter/Charger Operation Guide*.

This guide does not provide details about particular brands of batteries. You need to consult individual battery manufacturers for this information.

## Audience

The Installation Guide is intended for qualified installers who need to install the RS3000. Installers should be certified technicians or electricians.

---

## Conventions Used

The following conventions are used in this guide.



### WARNING

Warnings identify conditions or practices that could result in personal injury or loss of life.

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### CAUTION

Cautions identify conditions or practices that could result in damage to the unit or other equipment.

---

**Important:** Important notes provide information that is important for you to know. They are not as critical as Cautions or Warnings.

---

## Symbols Used

The following symbols are used on the product labels or in this guide.



In this guide: Important information, warnings or cautions.  
On the product: Important information, warnings or cautions with further explanation in the product guides.

---



AC – Alternating current

---



DC – Direct current

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Warning: Hot surface. Do not touch.

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DC ground connection point

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AC safety ground connection point from incoming AC source

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AC safety ground connection point for AC output (to AC loads)

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## Abbreviations and Acronyms

For a listing of abbreviations and acronyms, refer to the *RS3000 Sine Wave Inverter/Charger Operation Guide*.

## Related Information

For related materials on this Xanbus-enabled product and its available accessories, see also:

*RS3000 Sine Wave Inverter/Charger Operation Guide (975-0170-01-01)*

*Automatic Generator Start Owner's Guide (975-0082-01-01)*

*System Control Panel Owner's Guide (975-0083-01-01)*

*Xanbus System Installation Guide (975-0136-01-01)*

More information about Xantrex Technology Inc. as well as its products and services, including a complete list of Xanbus-enabled devices, is available at **[www.xantrex.com](http://www.xantrex.com)**

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# Important Safety Instructions

## READ AND SAVE THESE INSTRUCTIONS

The *RS3000 Sine Wave Inverter/Charger Installation Guide* contains important safety instructions.

Before you install and use your RS3000 Sine Wave Inverter/Charger, be sure to read, understand, and save these safety instructions and those in the other product guides.

Read all cautionary markings on the inverter/charger, the batteries, and all appropriate sections of this guide.



### **WARNING: Risk of injury or loss of life**

The RS3000 Sine Wave Inverter/Charger shall not be used in connection with life support systems or other medical equipment or devices.



### **WARNING**

The following warnings identify conditions or practices that could result in personal injury or loss of life.

1. Use of accessories not recommended or sold by Xantrex Technology, Inc. may result in a risk of fire, electric shock, or injury to persons.
2. 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 the local and national electrical codes applicable in your application.
3. To avoid a risk of fire and electric shock, make sure that the existing wiring is in good condition and that the wire is not undersized. Do not operate the inverter/charger with damaged or substandard wiring.
4. To reduce risk of damage and injury, charge only rechargeable lead-acid batteries (flooded, gel, or absorbed glass mat (AGM) types). Other types of batteries may burst causing personal injury and damage.
5. 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 the Warranty and Product Information section in the *RS3000 Sine Wave Inverter/Charger Operation Guide*.

6. Do not disassemble the inverter/charger; it does not contain user serviceable parts. Take it to a qualified service person when service or repair is required. Incorrect reassembly may result in a risk of electrical shock or fire. Internal capacitors remain charged after all power is disconnected. For instructions on obtaining service, see the section in the *RS3000 Sine Wave Inverter/Charger Operation Guide*.
7. Do not expose the inverter/charger to rain, snow, or water.
8. To reduce the risk of electric shock, disconnect all sources of AC and DC power from the Inverter/Charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.
9. The inverter/charger must be provided with equipment grounding conductors connected to the AC input ground and chassis ground terminals.



### **CAUTION**

Cautions identify conditions or practices that could result in damage to the unit or other equipment.

---

To reduce the risk of overheating, keep the ventilation openings clear and do not install the inverter/charger in a compartment with limited airflow or inadequate clearances around the unit. The minimum recommended clearance is 3 inches (76 mm).

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## Explosive Gas Precautions

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### **WARNING: Risk of explosive gases**

Working in the vicinity of a lead-acid battery is dangerous. Batteries generate explosive gases during normal battery operation. For this reason, it is of utmost importance that each time before servicing equipment in the vicinity of the battery, you must read this guide and follow the instructions closely.

---

1. To reduce the risk of battery explosion, follow these instructions and those published by the battery manufacturer and the manufacturer of any equipment you intend to use in the vicinity of a battery. Review the cautionary markings on these products and on the engine.
2. This equipment contains components which tend to produce arcs or sparks. To prevent fire or explosion, do not install the inverter/charger in compartments containing batteries or flammable materials or in locations that require ignition-protected equipment. This includes any space containing gasoline-power machinery, fuel tanks, as well as joints, fittings, or other connections between components of the fuel system.

## Personal 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 your 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 your skin or clothing, wash immediately with soap and water. If acid enters your eye, immediately flood the eye with running cold water for at least ten minutes and get medical attention immediately.
5. Never smoke or allow a spark or flame in the vicinity of the battery or engine.
6. Be extra cautious to reduce the risk of dropping a metal tool onto a battery. It might spark or short-circuit the battery or other electrical parts that may cause an explosion.

7. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a lead-acid battery. A lead-acid battery can produce a short-circuit current high enough to weld a ring or the like to metal, causing a severe burn.
8. Never charge a frozen battery.
9. If it is necessary to remove a battery, always remove the grounded terminal from the battery first. Make sure all the accessories are off, so as not to cause an arc.
10. Be sure the area around the battery is well ventilated.
11. Clean the battery terminals. Be careful to keep corrosion from coming in contact with your eyes.
12. Study all battery manufacturer's specific precautions such as removing or not removing the cell caps while charging and the recommended rates of charge.
13. For refillable (flooded) batteries, add distilled water in each cell until the battery acid reaches the level specified by the battery manufacturer. This helps to purge excessive gas from cells. Do not overfill. Carefully follow the manufacturer's recharging instructions.

## 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 when the equipment is operated in a residential environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction guide, 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 the 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.

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# Installation

The Installation Guide provides detailed information for installing the RS3000 Sine Wave Inverter/Charger and the battery temperature sensor, wiring the inverter/charger to the AC and DC circuits, and connecting the inverter/charger to the Xanbus® system.

The RS3000 is a Xanbus-enabled device that typically powers the Xanbus system. For information on installing the Xanbus system, see the *Xanbus System Installation Guide* which is available for download at **[www.xantrex.com](http://www.xantrex.com)**

This Installation Guide provides:

- safety instructions that must be observed during installation
- a typical Xanbus system diagram
- information on additional AC and DC components required
- a list of installation tools and materials
- detailed procedures for a typical installation
- installation testing procedures
- battery information

For information on operating the RS3000, see the *RS3000 Sine Wave Inverter/Charger Operation Guide*.

## Installation Information

### Before You Begin the Installation

Before beginning your installation:

- Read the entire Installation Guide so you can plan the installation from beginning to end.
- Read the *Xanbus System Installation Guide* to plan your network requirements.
- Assemble all the tools and materials you require for the installation.
- Review the Important Safety Instructions on page v.
- Be aware of all safety and electrical codes which must be met.



#### **WARNING: Electrical shock and fire hazards**

Xantrex® recommends all wiring be done by qualified personnel. 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.

It is the installer's responsibility to ensure compliance with all applicable installation codes and regulations.

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### Installation Codes

Applicable installation codes vary depending on the specific location and application of the installation. Some examples are:

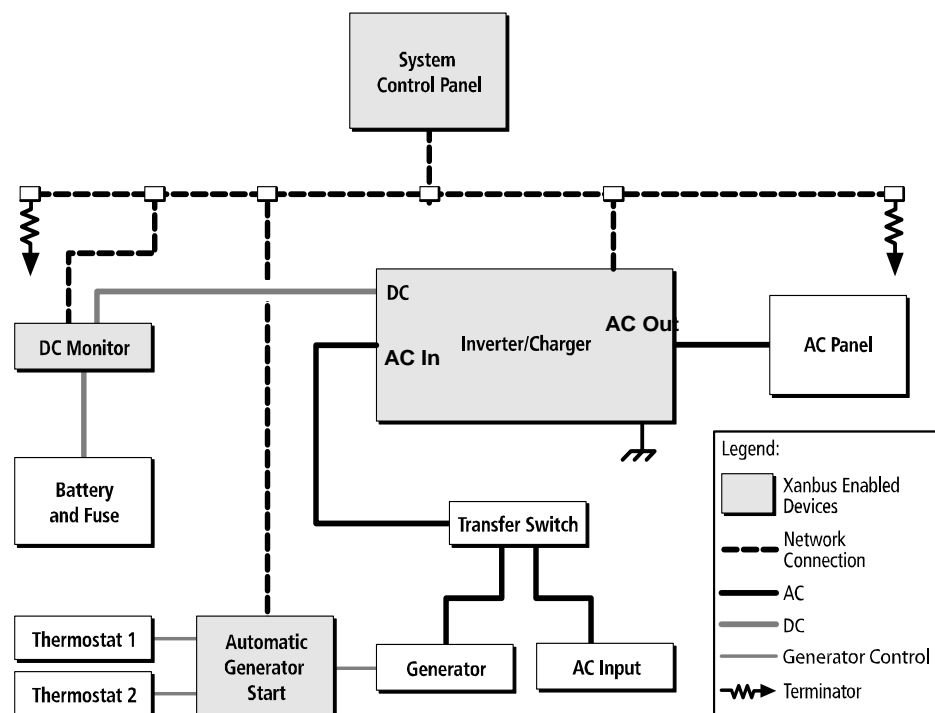
- The U.S. National Electrical Code (NEC)
- The Canadian Electrical Code (CEC)
- Canadian Standards Association (CSA) and RV Industry Association (RVIA) for installation in RVs.

## About the Xanbus System

The Xanbus system includes the RS3000 Sine Wave Inverter/Charger and other Xanbus-enabled devices, as shown in Figure 1, “Typical Xanbus System Diagram”. Each Xanbus-enabled device interacts and communicates with the other devices on the network, creating a power system that can be precisely configured to your needs.

The RS3000 is the device that typically provides power in a Xanbus system. The System Control Panel provides configuration and monitoring capability for each device connected to the Xanbus system, such as the Automatic Generator Start and the RS3000.

In Figure 1, network connections are represented by dotted lines and conventional electrical connections are represented by solid lines. Your system requirements may be more complex than the basic installation shown in Figure 1. Xantrex recommends that you consult a qualified installer or electrician to customize your installation to meet your requirements.



**Figure 1** Typical Xanbus System Diagram

## Xanbus Enabled



The Xanbus-enabled designation means that this product will work on a Xanbus network. Xanbus-enabled products are:

- Easy to use. The Xanbus network simplifies operation and automates routine tasks.
- Reliable. Software control eliminates analog signalling errors.
- Accurate. Digital information is less susceptible to interference and line loss.
- Upgradeable. Firmware upgrades mean your purchase will remain up to date.

For detailed instructions and a complete list of Xanbus-enabled devices, visit the website at [www.xantrex.com](http://www.xantrex.com).

## System Accessories

System accessories currently available which are Xanbus-enabled include the System Control Panel and Automatic Generator Start. These system accessories are available from any authorized Xantrex dealer or at [www.xantrex.com](http://www.xantrex.com). Please provide the part number of the accessory to the dealer.

Other Xanbus-enabled devices will become available in the future.

## Planning the Installation

This section provides information to help you plan for a basic installation of the RS3000.

As your system configuration is determined, record the details in Information About Your System on page WA-4 of the *RS3000 Sine Wave Inverter/Charger Operation Guide*.

## Two Key Performance Factors

Two key factors in particular will have a major impact on system performance.

### Size and Length of DC Cables

To select the appropriate size and length of DC cables, see “DC Cabling” on page 14.

The DC 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. If there are long battery cables which are in excess of 10 feet each and not of sufficient size, the voltage drop across the cables will have a negative impact on overall system performance.

### Mounting Location of the RS3000

To choose an appropriate location for mounting the inverter/charger, see “Step 1: Choosing a Location for the Inverter/Charger” on page 17.

## Planning

### AC, DC, and Network Components

For a successful installation, you need to plan for AC, DC, and network components of the power system. The AC and DC components are described in this section and illustrated in Figure 2 on page 7.

AC components include:

- AC Input
- AC Loads
- AC Disconnect and Over-Current Protection Device
- Distribution Panels
- AC Wiring
- AC Output Neutral Bonding

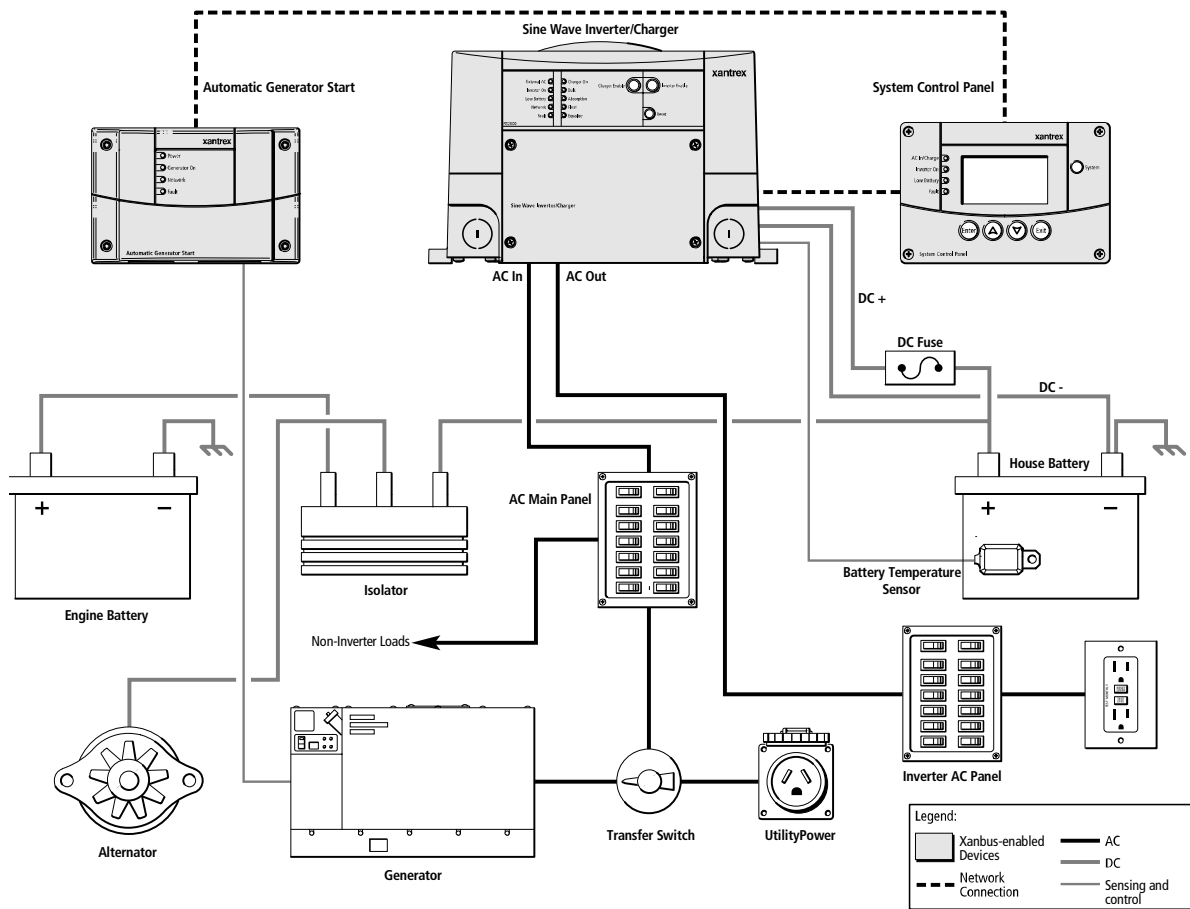
DC components include:

- Batteries
- DC Disconnects and Over-Current Devices
- DC Cabling
- DC Grounding

Network considerations include:

- Cables, connectors, network connectors, and terminators for the System Control Panel and Automatic Generator Start, if installing.

Detailed information on planning and installing your network is available in the *Xanbus System Installation Guide*. Refer to the system guide to determine the type of network layout to install, as well as guidelines for installing the network. This guide is available for download at **[www.xantrex.com](http://www.xantrex.com)**



**Figure 2** Typical Recreational Vehicle Electrical System

**Important:** Figure 2 does not show all required grounding or overcurrent protection.

## AC Components

### AC Input

AC input to the RS3000 can be supplied from a split-phase or dual-input AC source such as the utility grid (power company), a generator, or the output of a transfer switch. The RS3000 can be operated from the following types of 120 volt 60 Hz AC sources:

- **Split phase:** This source type has two lines, one neutral, and one ground. The two 120 VAC lines are 180 degrees out of phase with each other, so that the two voltages total to 240 VAC. The voltage between each line and neutral is still 120 VAC, and the voltage between the neutral and ground is approximately zero.

Because the two lines are out of phase, the currents from each line subtract in the neutral, and the neutral current will be approximately zero if the loads are equal. For example, if Line 1 is supplying 20A and Line 2 is supplying 15A, the current in the neutral will be 5A.

- **Dual input:** This source type has two line inputs, one neutral, and one ground. Unlike the split-phase type, the two lines are in phase (not out of phase), and must come from the same source. The voltage between the two lines is zero. The voltage between each line and the neutral is 120 VAC, and the voltage between the neutral and ground is approximately zero.

Because the two lines are in phase, the currents from each line add together in the neutral. For example, if Line 1 is supplying 20A and Line 2 is supplying 15A, the current in the neutral will be 35A.

---

**Important:** The RS3000 is designed to be connected to AC sources that energize both L1 and L2 inputs, and cannot be powered by single-phase input where only one of L1 or L2 is energized. To connect the RS3000 to a single-phase AC supply, install an appropriate transfer switch to energize both L1 and L2 inputs. Consult a qualified installer for further support.

---

### AC Output

AC output from the RS3000 is 120 VAC, and can be wired as single output or dual output.

### AC Loads

The RS3000 is intended to power loads consisting of 120 VAC appliances.

In Invert mode, the RS3000 connects L1 and L2 output lines together to provide 120 VAC to loads on either line. In AC Bypass mode, the source connected to the AC input is passed through to the load. Because of the way invert mode operates, only 120 VAC appliances can be connected to the RS3000 output.



**WARNING: Shock Hazard**

Do not connect 240 VAC loads to the RS3000 outputs. Doing so may result in 120 VAC on exposed parts of the appliance.

**AC Disconnect and Over-Current Protection Device**

To meet CSA, UL, and electrical code requirements, and to protect system wiring, the AC inputs and outputs of the inverter/charger must be provided with over-current protection on both the AC input and output. This protection may be a circuit breaker or a fuse with a disconnect device (for simplicity the following refers to breakers). Refer to your applicable installation codes and the following requirements:

**AC Input Protection**

The breakers protecting the AC input of the RS3000 must be approved for use on 120 VAC branch circuits, and must be located in each Line. The breakers must be rated as shown below:

- Split-phase input: No more than 50 amps max in each line.
- Dual input: The neutral current in a dual-input system is the sum of the two line currents, and must be limited to 60A maximum to protect the transfer relay in the RS3000. Each breaker must not exceed 50A, and the total (sum) of the ratings of the two breakers must not exceed 60A. For example, if Line 1 has a 40A breaker, the Line 2 breaker cannot exceed 20A.

**AC Output Protection**

The breaker between the RS3000 AC output and the AC loads must be rated to protect the AC output wire size used. If the AC output wiring is based on the full 50A pass-through rating, then a 50A output breaker is acceptable. If the AC output wiring is smaller, then the breaker size will have to be smaller as well, in accordance with applicable electrical installation codes.

**GFCI Requirements**

A GFCI (ground fault circuit interrupter) is a device that deenergizes a circuit when a current to ground exceeds a specified value that is less than that required to open the circuit breaker. GFCIs are intended to protect people from electric shocks and are usually required in wet or damp locations.

Installation in recreational vehicles requires GFCI protection of certain branch circuits. Consult all applicable codes.

### Tested GFCIs

Compliance with UL standards requires that Xantrex test and recommend specific GFCIs for use on the output of the inverter. Table 1 lists models that have been tested and will function properly when connected to the AC output of the RS3000.

**Table 1** Tested GFCI Models

Manufacturer	Model Number
Hubbell	GFR5252WA
Leviton	8599-GY
Pass & Seymour	1594-W

### 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 between the source and the fuses.

### Distribution Panels

Some systems incorporate distribution panels both ahead of the inverter/charger (the AC source panel) and between the inverter/charger and the loads (the AC load panel). The AC source panel includes a main circuit breaker, which serves as over-current protection for the panel. Additional circuit breakers serve individual circuits, one of which serves the inverter/charger.

### AC Wiring

#### Definition

AC wiring includes input wiring (all the wires and connectors between the AC source and the inverter/charger input) and output wiring (all the wires between the inverter/charger and the AC load panels, circuit breakers, and loads).

#### Type

The type of wiring required varies according to the electrical codes or regulations applicable to your installation. For RV applications, this may be solid wire in multi-conductor cables, but stranded wire is required if single conductors are used. All wiring must be rated 90 °C or higher.

**Size of Input Wiring** Wire size must be coordinated with the overcurrent protection provided ahead of the wire involved, in accordance with the electrical codes or regulations applicable to your installation.

Therefore, the wiring used between the AC input circuit breaker and the inverter/charger input must be sized to match the input breaker rating.

**Table 2 AC Wire Size In and Out of the Inverter/Charger**

	Split phase	Dual input
Breaker Size Used	50 A	30 A
Wire Size	No. 8 AWG	No. 6 AWG
Color Coding	L1: black: N: white L2: red Gnd: green	L1: red or black N: white L2: red or black Gnd: green

For dual input, the wire may be red or black; consult the documentation provided with the AC source (utility or generator).

**Size of Output Wiring**

Wire size must be coordinated with the current the wiring will carry. This current may be determined by the 25 A maximum inverter current, or by the bypass current, which is determined by the overcurrent protection provided ahead of the RS3000.

- If the input wiring is split-phase, the output wiring must be sized to coordinate with the breakers used on the input. Refer to your applicable installation codes. For a 50 A input breaker, the output wiring is usually No. 8 AWG.
- If the input wiring is dual-input and the output wiring is single-input, the following rules apply: If the input breaker on L1 is greater than 25 A, the wire size must be coordinated for that amperage. If the input breaker on L1 is less than 25 A, the wire size must be coordinated for 25 A. The wire size must not be sized for anything lower than 25 A.
- If both the input and the output wiring are dual-input, the output wiring for each line (L1 and L2) must be calculated separately, following these rules: If the input breaker on the specific line is greater than 25 A, the wire size for that line and its neutral must be coordinated for that amperage. If the input breaker on the specific line is less than 25 A, the wire size for that line and its neutral must be coordinated for 25 A. The wire size must not be sized for anything lower than 25 A.

**Size of Wiring Downstream of the AC Output Breaker**

The wiring used between the AC output breaker and your loads must be sized to match the output breaker.

## AC Output Neutral Bonding

The AC source must have its neutral conductor bonded to ground.

### Bonding system

The RS3000 provides a system that automatically connects the neutral conductor of the inverter's AC output circuit to safety ground ("bonding" it) while the inverter/charger is inverting, and disconnects it ("unbonding" it) when the inverter/charger is connected to external AC power. This system is designed to conform to installation codes that require AC sources such as inverters and generators to have their neutral conductors tied to ground at the source of power 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.

### Suitability

This automatic neutral-to-ground bonding system requires AC input sources with bonded neutral. This will be the case in most situations: in a utility feed, at an external AC hook-up, or a generator with a bonded neutral. If not, have an electrician look into bonding the source's neutral to ground. See also "AC Input and Output Isolation" on page 21.

---

## DC Components

### Batteries

The RS3000 system requires a 12 volt, lead-acid deep-cycle battery or group of batteries to provide the DC current that the inverter/charger converts to AC power. The battery may be a flooded, gel, or AGM type.

See “Battery Information” on page 40 for information on:

- Estimating the battery size that will meet your requirements.
- Designing battery banks.
- Restrictions on the size of appliances.

For information on cabling and hooking up batteries, see “Cabling and Hook-up Configurations” on page 44.

For detailed information about specific brands of batteries, you’ll need to consult individual battery manufacturers for this information.

### 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 protection device. (Refer to your applicable installation code.)

Type	This device 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.
Rating	The rating of the fuse or breaker must be matched to the size of cables used in accordance with the applicable installation codes.
Location	The breaker or fuse and disconnect 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.

## DC Cabling

Definition	DC cabling includes all of the cables and connectors between the batteries, the DC disconnect and over-current protection device, and the inverter/charger.
Type	All installations require multi-strand insulated cables. <b>The DC cables must be copper and must be rated 105 °C minimum.</b>
Size and Length	See Table 3 for required DC cable length, cable size and required fuse size for the RS3000. Wire size is usually marked on the cables.

---

**Important:** Using a smaller gauge cable or a longer cable may cause the inverter to shut down under heavy load.

---

**Table 3** Recommended DC Input Cable and Fuse Size

Maximum DC Cable Length: Battery to RS3000 (one way)	Total Length (two way)	Minimum Recommended Cable Size	Maximum Battery Fuse or Breaker
10 feet (3 meters)	20 feet (6 meters)	No. 4/0 AWG	400A class T

## DC Grounding

The inverter/charger DC (chassis) ground terminal needs to be connected to the vehicle chassis by a minimum No. 8 AWG copper conductor that is either insulated (green) wire rated 90 °C or bare copper.

## Unpacking and Inspecting the Inverter/Charger



### WARNING: Heavy load

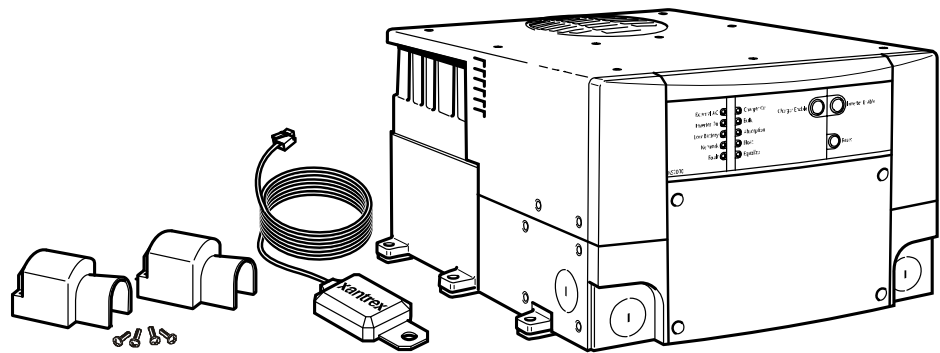
The RS3000 Sine Wave Inverter/Charger is heavy (see “Inverter/Charger Physical Specifications” on page 38). The unit is too heavy for one person to safely lift and mount. Xantrex recommends that two people lift and mount the unit. Always use proper lifting techniques during installation to prevent personal injury.

## Materials List

### Contents

The following materials are in the shipping box:

- RS3000 Sine Wave Inverter/Charger
- DC terminal covers (one red, one black) and four screws
- Bag containing DC terminal hardware:
  - Two flat washers
  - Two lock washers
  - Two 3/8" bolts
- Battery temperature sensor
- *RS3000 Sine Wave Inverter/Charger Installation Guide*
- *RS3000 Sine Wave Inverter/Charger Operation Guide*



**Figure 3** RS3000 Hardware Materials as Shipped

### To unpack and inspect:

1. Unpack the unit and check the materials list. If anything is missing from the shipping box, contact Xantrex Customer Service. See “Contact Information” on page ii.
2. Record the serial number of the RS3000 and other purchase information in the “Warranty and Product Information” section of the *RS3000 Sine Wave Inverter/Charger Operation Guide*. You will be asked for this product information if you need to call Xantrex Customer Service.

3. Save your purchase receipt to use as proof-of-purchase. This receipt is required if the inverter/charger should need warranty service.
4. Save the original shipping carton and packing materials. If the inverter/charger needs to be returned for service, it should be shipped in the original carton. Packing the RS3000 in the original shipping carton is also a good way to protect the inverter/charger if it ever needs to be moved.

## Installation Tools and Materials

### Tools

You will need the following tools to install the RS3000 and the battery temperature sensor.

- Wire stripper
- Crimping tools for fastening lugs and terminals on DC cables
- Phillips screwdriver: #2
- Slot screwdriver (1/4" wide blade max.)
- Needle-nose pliers
- Wrench for DC terminals: 9/16"

### Materials

You will need the following materials to complete your installation:

- Strain-relief clamp(s) for AC cables: 3/4" and/or 1"
- DC battery cables sized according to Table 3 on page 14
- Terminals and/or crimp connectors for DC cables (for 3/8" stud size)
- Copper wire for DC grounding: No. 8 AWG. See "DC Grounding" on page 14
- Terminal or crimp connector for DC grounding cable (for 1/4" stud size)
- AC and DC disconnect switches and over-current protective devices and connectors as required. See page 9 and page 13
- AC output and input wire. See Figure 2 on page 11
- If the AC ground wire is stranded, each ground wire requires a ring terminal
- Six 1/4"-20 1.25" length steel screws or bolts to mount the RS3000

For a list of tools and materials required to install the network, refer to the *Xanbus System Installation Guide*, which is available for download at [www.xantrex.com](http://www.xantrex.com).



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# Installing the Inverter/Charger

## Overview

This section provides detailed information on installing the RS3000. The overall procedure is divided into eight steps:

- Step 1: Choosing a Location for the Inverter/Charger
- Step 2: Mounting the Inverter/Charger
- Step 3: Connecting the AC Input and AC Output Wires
- Step 4: Connecting the DC Cables
- Step 5: Connecting the Battery Temperature Sensor (BTS)
- Step 6: Connecting to the Network
- Step 7: Performing Checks Prior to Initial Start-Up
- Step 8: Testing Your Installation

## Step 1: Choosing a Location for the Inverter/Charger



### **WARNING: Risk of fire or explosion**

This equipment contains components that could produce arcs or sparks. To reduce the risk of fire or explosion, do not install this equipment 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: Fire hazard**

Do not cover or obstruct the ventilation openings. Do not install this equipment in a compartment with limited airflow. Overheating may result.

---

The location of the inverter/charger is a key factor in system performance. Allow sufficient clearance around the unit (recommended minimum 3 inches (76 mm)) and install in a well-ventilated compartment to prevent overheating and premature shutdown of the inverter/charger.

The inverter should only be installed in a location that meets the following requirements:

#### **Ventilated**

Do not operate the inverter/charger in a closed-in area or restrict ventilation in any way. The inverter/charger requires air circulation to maintain optimum operating temperature and provide best performance. If the unit has inadequate ventilation, it may shut down due to overheating.

The air vented through the openings should also have a path to circulate away from the inverter/charger.

<b>Dry</b>	Do not allow water or other fluids to drip or splash on the inverter. Do not expose to rain, snow or water.
<b>Cool</b>	Normal air temperature should be between 32 °F and 122 °F (0 °C and 50 °C)—the cooler the better within this range.
<b>Clearance</b>	Allow as much space around the inverter/charger as possible. Xantrex recommends that other objects and surfaces be at least 3 inches (76 mm) away from the ventilation openings for best performance.
<b>Safe</b>	Locate the inverter/charger away from battery in a separate well ventilated compartment. Do not install the inverter/charger in any compartment containing flammable gases or liquids like gasoline.
<b>Close to battery compartment</b>	The length and size of your DC cables will affect performance. Use the DC cables recommended in Table 3 on page 14. The unit should <b>not</b> be installed in the battery compartment due to the possible presence of explosive hydrogen gas from the batteries.
<b>Protected from battery acid and gases</b>	Never place the inverter/charger directly above the batteries—gases from battery will corrode and damage the inverter/charger. If the inverter/charger is installed in a compartment above the batteries, make sure there is a solid, gas-impermeable wall dividing the two compartments. Never allow battery acid to drip on the inverter/charger or its wiring when filling the batteries or reading their specific gravity.
<b>Orientation</b>	To meet regulatory requirements, the RS3000 must be mounted in one of the approved mounting orientation. See Figure 4 on page 20.



**WARNING: Fire Hazard**

Mount the RS3000 only in an approved orientation.

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## Step 2: Mounting the Inverter/Charger

### Considerations

Before mounting the RS3000, take the following two factors into account.

1. The weight of the inverter/charger requires two people to install it.
2. Mounting considerations are shown in Figure 4 on page 20.



### **WARNING: Heavy load**

The RS3000 Sine Wave Inverter/Charger is heavy (see “Inverter/Charger Physical Specifications” on page 38). The unit is too heavy for one person to safely lift and mount. Xantrex recommends that two people lift and mount the unit. Always use proper lifting techniques during installation to prevent personal injury.

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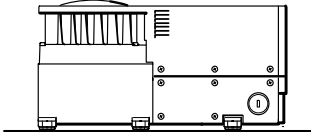
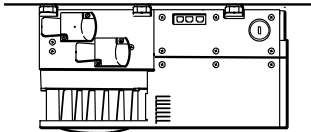
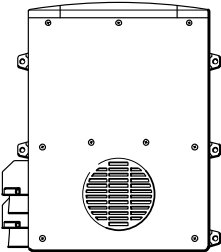
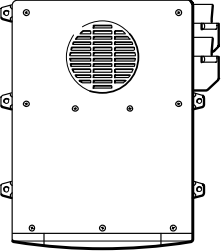
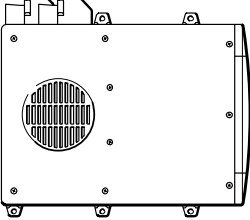
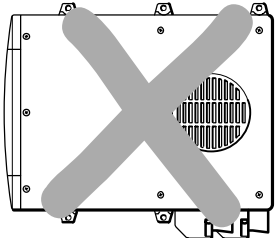
The RS3000 dimensions and location of the mounting holes are provided in Figure 15 on page 39.

Mount your inverter/charger before you connect any wires or cables.

#### **To mount the inverter/charger:**

1. Remove the inverter/charger from its shipping container.
2. Verify that all components are present, and record relevant product information on form WA-4 in the *RS3000 Sine Wave Inverter/Charger Operation Guide*.
3. Select an appropriate mounting location and orientation. To meet regulatory requirements, the RS3000 must be mounted in one of the orientations shown in Figure 4 on page 20.
4. Mark the position of the mounting holes. Refer to Figure 15 on page 39.
5. Pilot drill the six mounting holes.
6. Fasten the inverter/charger to the mounting surface with six 1/4"–20 steel screws or bolts.

**Figure 4** Mounting Orientations

Orientation	Approved Mounting Orientation?	Comment
Desktop Mount	Yes	
		
Upside-down Mount	Maybe	Suitable only for applications with no risk of condensation or dripping water.
		
Wall Mount DC on Left	Yes	On a vertical surface with DC terminals facing left.
		
Wall Mount DC on Right	Maybe	On a vertical surface with DC terminals facing down. This orientation is suitable only for applications with no risk of condensation or dripping water.
		
Wall Mount DC Up	Maybe	On vertical surface with DC terminals facing up. This orientation is suitable only for applications with no risk of condensation or dripping water.
		
Wall Mount DC Down	No	Not acceptable. This orientation does not meet regulatory requirements.
		

---

## Step 3: Connecting the AC Input and AC Output Wires



### **WARNING: Fire, shock, and energy hazards**

Make sure wiring being connected to the inverter/charger is disconnected (physically or by opening the breaker) from all electrical sources before handling. All wiring must be done in accordance with local and national electrical wiring codes.

---

### General AC Wiring Considerations

**AC and DC Wiring Separation** Do not mix AC and DC wiring in the same conduit or panel. Consult the applicable installation code for details about DC wiring and AC wiring in vicinity to each other.

**AC Input and Output Isolation** The AC input and output circuits of this inverter/charger are isolated from each other when in invert mode to ensure safe operation. This isolation must be maintained in the installation, by being sure not to connect AC input and output wiring to a common point. For example, do not route the AC input and output neutrals to a common neutral bus.

**AC Wiring Compartment** For your reference, the AC wiring compartment is shown in Figure 5 on page 22.

**AC Knockouts** There are two 3/4" trade-size knockouts on the front panel for AC wiring. For easier wiring access, there are also 1" trade-size knockouts on either side of the unit (not shown). Use the same trade size of strain relief as the trade size of the knockout(s) you are using.

**AC Wiring Terminals** The AC wiring terminals accept cables of a specific size. See "AC Wiring" on page 10 for required sizes.

## Connecting AC Input Wires

Figure 5 shows the wiring compartment, which contains a grounding bus (used to wire the AC input and output ground wires) and a terminal block (used to wire the AC input and AC output connections).

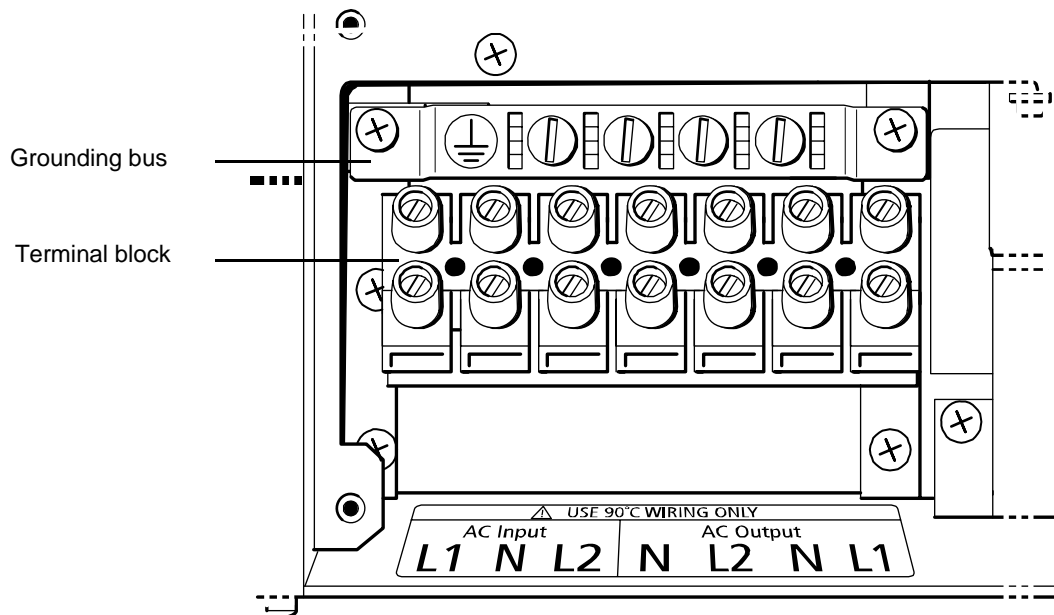


Figure 5 AC Wiring Compartment



### CAUTION: Equipment damage

The terminal block is split into INPUT and OUTPUT sections. Damage may occur if the unit is wired incorrectly.

Do not remove or loosen factory installed wiring.

When making the AC input and AC output connections, observe the correct color code for the appropriate AC wire, as described in Table 2 on page 11.

#### To make the AC input connections:

1. Locate the wiring compartment cover panel and remove the four screws.
2. Remove the cover panel from the unit to access the wiring compartment.
3. Remove one of the AC knockouts from the front or side of the unit. Do not leave the knockout inside the wiring compartment.
4. Install a strain-relief clamp in the AC knockout.
5. Run the AC wiring through the strain-relief clamp.
6. Strip approximately 2 inches (50 mm) off the jacket from the AC cable and separate the wires.

7. Using a 1/4" blade slot screwdriver, loosen the terminal screws on the terminals. Do not remove the screws.
8. Connect the line and neutral wires to the input terminals (labeled AC Input on the terminal block, Figure 5 on page 22). Connect Line 1 to L1, Neutral to N, Line 2 to L2.
9. Tighten the terminal screws. Leave some slack wire inside the wiring box.
10. Connect the ground wires to a free position on the ground bus, Figure 5 on page 22. If solid ground wire is being used, the wire can be connected directly under the screw heads. If stranded ground wire is being used, ring terminals must also be used.
11. Secure the strain-relief clamp on the AC input cable jacket.

## Connecting the AC Output Wires



### **CAUTION: Risk of equipment damage**

Do not connect the output of the inverter to any incoming AC source.

#### **To make the AC output wiring connections:**

1. Remove one of the AC knockouts from the front or side of the unit. Do not leave the knockout inside the wiring compartment.

**Important:** The applicable installation code may not allow you to run the AC input and AC output wiring through the same AC knockout.

2. Install a strain-relief clamp in the AC knockout and run the AC wiring through the strain-relief clamp.
3. Strip approximately 2 inches (50 mm) off the jacket from the AC cable and separate the wires.
4. Using a 1/4" blade slot screwdriver, loosen the terminal screws on the AC output terminals. Do not remove the screws.
5. Connect the line and neutral wires to the output terminals (labeled AC Output on the terminal block, Figure 5 on page 22) as follows:

Terminals	Line for Dual Output	Lines for Single Output
N	Neutral 2	Unused
L2	Line 2	Unused
N	Neutral 1	Neutral
L1	Line 1	Line

6. Tighten the terminal screws. Leave some slack wire inside the wiring box.
7. Connect the ground wires to a free position on the ground bus, Figure 5 on page 22. If solid ground wire is being used, the wire can be connected directly under the screw heads. If stranded ground wire is being used, ring terminals must also be used.
8. Secure the strain-relief clamp on the AC output cable jacket.
9. Attach the wiring compartment cover panel and tighten the four screws.
10. Connect the outgoing AC wires to an AC load panel equipped with circuit breakers.



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## Step 4: Connecting the DC Cables

### DC Connection Precautions



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#### **WARNING: Energy hazard**

Connect and disconnect DC wiring only after opening the disconnect switches or breakers at all AC and DC sources.

---

### Recommended Cable Sizes and Lengths and Fuse Size

For recommended DC cables and fuse size, see Table 3 on page 14.

### Preparing the Cables

#### **To prepare the DC cables:**

1. Cut the negative and positive cables to the required length. Strip off enough insulation so you can install the terminals you will be using.  
Xantrex recommends the use of crimp connectors. The connector should be designed for a 3/8" stud size to connect to the RS3000. If a crimp connector is used, it should be crimped using the tool indicated by the connector manufacturer.
2. Cut the DC ground cable to the required length. Strip off enough insulation so you can install the terminals you will be using.  
Xantrex recommends the use of crimp connectors. The connector should be designed for a 1/4" stud size to connect to the RS3000. If a crimp connector is used, it should be crimped using the tool indicated by the connector manufacturer.
3. Attach the connectors to the ends of both cables. Make sure no stray wire strands protrude from the connectors.

## Guidelines for Routing the DC Cables

Follow these guidelines to ensure maximum performance.



### **WARNING: Fire and shock hazard**

Route the cables away from sharp edges that might damage the insulation. Avoid sharp bends in the cable.

---

- Do not attempt to use the chassis in place of the battery negative connection for grounding. The inverter requires a reliable return path directly to the battery.
- To reduce the chance of radio frequency interference, keep the positive and negative cables close together—ideally, held together by straps, loom, or insulated clamps at regular intervals.
- To ensure maximum performance from the inverter/charger, do not route your DC cables through a DC distribution panel, battery isolator, or other device that will cause additional voltage drops. The exception is the DC fuse and Disconnect or the DC circuit breaker which is required at the battery to protect the DC wiring.
- To help avoid damage caused by reverse polarity battery connection, it is a good idea to mark each end of each cable to identify it as a positive (red) or negative (black) cable before routing the wiring.

---

## Connecting the DC Cables to the Inverter/Charger



### **WARNING: Fire hazard**

Use only appropriately sized copper cable. Loose connections or improper connections will overheat. Make sure the bolts supplied by Xantrex on the inverter/charger are tightened to a torque of 15–16 ft-lbs (20.4–21.7 Nm). Torque all other connections to the manufacturer's specifications. Make sure the DC cable, washers, and bolt are assembled in the order shown in Figure 6.

---



### **CAUTION: Reverse polarity damage**

Before making the final DC connection or closing the DC breaker or disconnect, check cable polarity at both the battery and the inverter/charger. Positive (+) must be connected to positive (+). Negative (–) must be connected to negative (–).

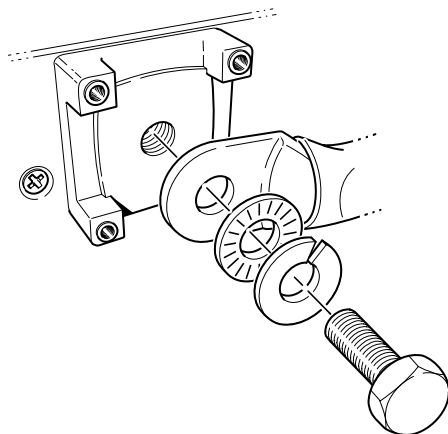
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#### **To connect the DC cables:**

1. Route the DC cables from the battery bank to the inverter/charger. Observe the “Guidelines for Routing the DC Cables” on page 26.
2. Install a DC fuse and disconnect switch or a DC circuit breaker between the inverter/charger and the battery. It 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 3 on page 14 for required fuse or breaker size.
3. Open the DC disconnect switch or turn off the DC circuit breaker.
4. Connect one connector on the POSITIVE (+) cable to the POSITIVE DC terminal on the inverter/charger, as shown in Figure 6. The connector goes on first, then the flat washer (steel), lock washer (steel), and 3/8" bolt (brass).
5. Connect the other connector to the POSITIVE (+) terminal on the fuse or breaker. Observe polarity carefully while completing the installation.  

Use a wrench to tighten the bolt to a torque of 15–16 ft-lbs (20.4–21.7 Nm) at the inverter/charger end. Observe the fuseholder or breaker manufacturer's recommendation at the other end.
6. Connect one connector on the NEGATIVE (–) cable to the NEGATIVE (–) DC terminal on the inverter/charger, as shown in Figure 6. The connector goes on first, then the flat washer (steel), lock washer (steel), and 3/8" bolt (brass).



**Figure 6** DC Cable Connections

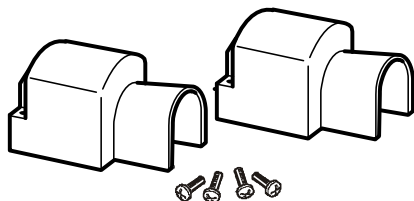
7. Before proceeding, check that the cable polarity is correct: **POSITIVE (+)** on the inverter/charger is connected to the **POSITIVE (+)** on the battery, and **NEGATIVE (-)** cable is connected to the **NEGATIVE (-)** terminal on the inverter/charger.

---

**Important:** The next step is the last cable connection you need to make. A spark is normal when this connection is made.

---

8. Connect the other end of the cable to the **NEGATIVE (-)** terminal on the battery.
9. Use a wrench to tighten the bolt to a torque of 15–16 ft-lbs (20.4–21.7 Nm) at the inverter/charger end.
10. To protect the DC terminals, attach the DC terminal covers (Figure 7) to the inverter/charger, using the screws provided.



**Figure 7** DC Terminal Covers

The completed DC terminal wiring with covers is shown in Figure 8.

## DC Grounding

The Chassis Ground point on 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.

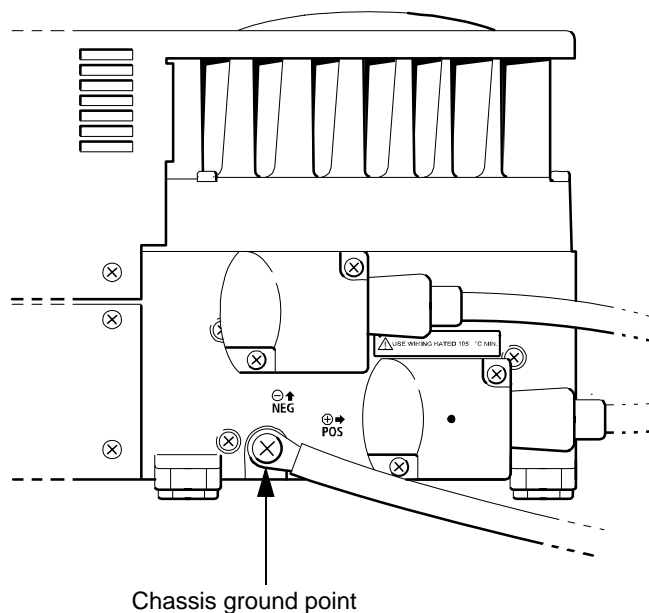
The grounding guideline given below assumes you are using the code-compliant DC supply cable and fuse sizes indicated on page 14. If you are using different sizes, refer to the applicable code for DC grounding detail.

### To connect the chassis ground:

1. Using the appropriate wrench, loosen the bolt on the chassis ground point shown in Figure 8.
2. Connect the grounding cable (see page 25) between the chassis ground point and the DC grounding point for your system.

In an RV or vehicle installation, the DC grounding point will usually be the vehicle chassis or a dedicated chassis ground bus.

3. Tighten the screw to a torque of 1.0–1.25 ft-lbs (1.47–1.7 Nm).



**Figure 8** Completed DC Wiring and DC Grounding

## Step 5: Connecting the Battery Temperature Sensor (BTS)

Installing a battery temperature sensor (BTS) extends the life of a battery by preventing overcharging in warm temperatures and undercharging in cold temperatures. With a BTS monitoring the battery temperature, the voltage delivered to the battery is adjusted according to the battery's actual temperature.

The BTS has a self-adhesive backing and attaches to the side of the battery. A 25-foot (7.6 m) cable is supplied with the BTS, as shown in Figure 9.

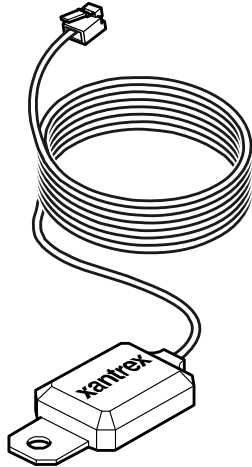


Figure 9 BTS with Cable



### **WARNING: Energy and explosion hazard**

Review the "Important Safety Instructions" on page v.

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### Mounting Options

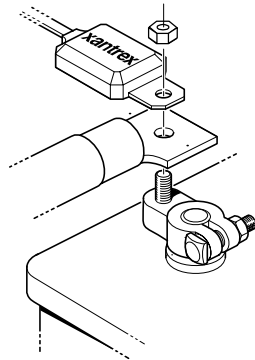
You can mount the BTS in one of two ways:

- 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.

## Mounting to the Negative Battery Terminal

### To mount the sensor on the negative battery terminal:

See Figure 10.



**Figure 10** BTS Mounted on the Negative Battery Terminal

1. Select the battery to be monitored. The BTS should be connected to the battery bank that is directly connected to the inverter/charger.
2. Switch off all devices operating from the battery, or open the battery switch (if present) to disconnect the battery.
3. Wait 10 minutes for any explosive battery gases to dissipate.
4. Remove the nut that connects existing wiring ring terminals to the battery negative terminal stud.
5. Move or reorient the existing wiring ring terminals on the battery negative terminal stud, so there is a flat surface on which to seat the BTS mounting plate.

You may need to bend the ring terminal crimp and/or wires slightly downward to allow the sensor to seat flush to the top surface of the upper ring terminal.

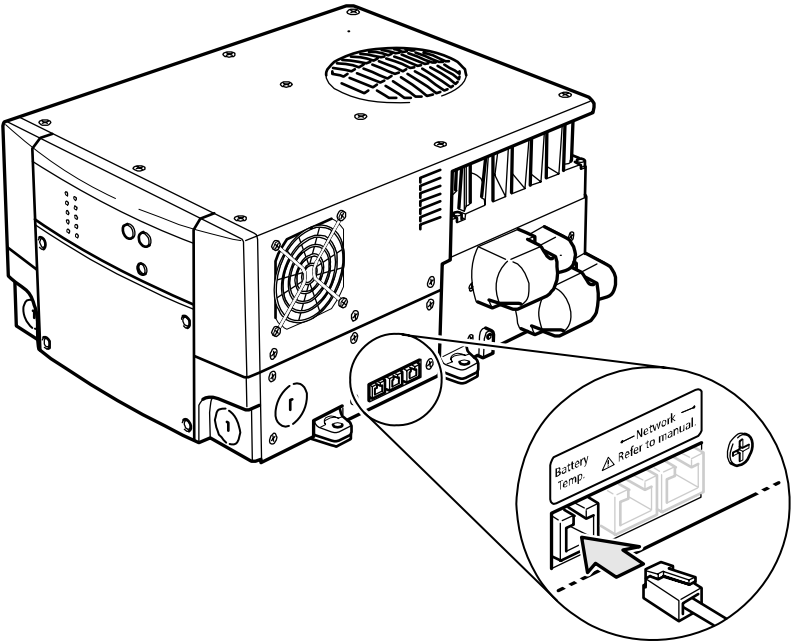
6. Mount the sensor directly on top of the ring terminal, as shown in Figure 10, and firmly tighten the terminal nut.



### **WARNING: Fire hazard**

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

7. Check to ensure that the sensor and all wires are held firmly and cannot be moved.
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, as shown in Figure 11. Secure the cable along its length.



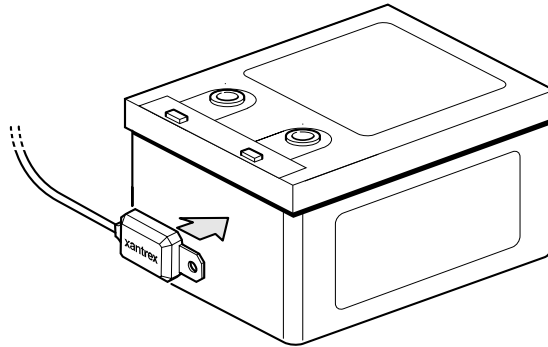
**Figure 11** Connecting the BTS Cable to Battery Temp. jack



## Mounting to the Side of the Battery Case

### To mount the sensor on the battery case:

See Figure 12.



**Figure 12** BTS Mounted on the Battery Case

1. Select the battery to be monitored.  
The BTS should be connected to the battery bank that is directly connected to the inverter/charger.
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. This surface must be in direct internal contact with the battery electrolyte. Do not install the sensor 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. 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, as shown in Figure 12.
6. Route the sensor cable to the inverter/charger and plug it into the Battery Temp. jack, as shown in Figure 11. Secure the cable along its length.

## Step 6: Connecting to the Network

For your reference, Figure 13 shows where the network connections are made on the RS3000.

### To connect the RS3000 to the Xanbus network:

- ◆ Plug a network cable connected to the Xanbus network into either one of the two network jacks on the RS3000.



### CAUTION: Equipment damage

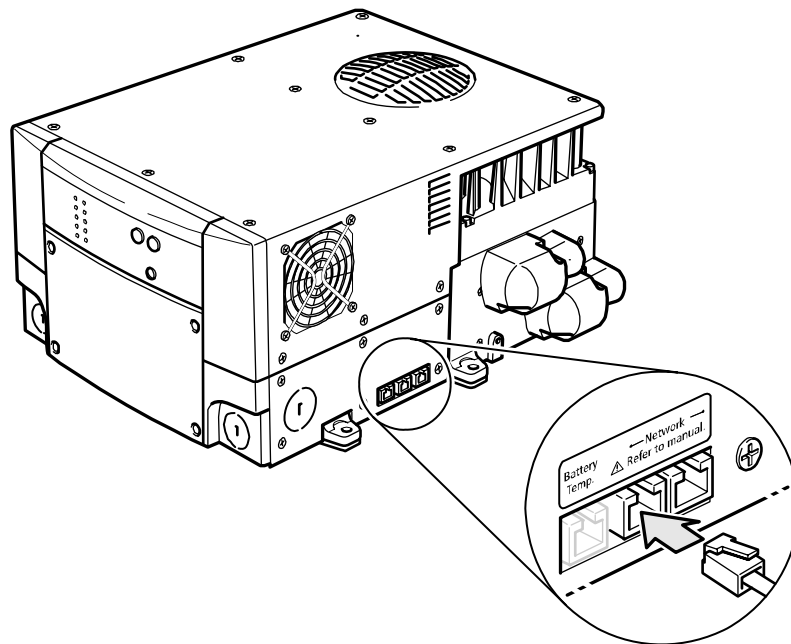
Connect the RS3000 only to other Xanbus compatible devices.

Although the cabling and connectors used in this network system are the same as Ethernet connectors, **this network is not an Ethernet system**. Equipment damage may result from attempting to connect two different systems.

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Detailed information on planning and installing your network is available in the *Xanbus System Installation Guide*. Refer to this guide to determine the type of network layout to install, as well as guidelines for installing the network.

The Xanbus System Installation Guide is available for download at [www.xantrex.com](http://www.xantrex.com)



**Figure 13** Connecting to a Network Jack

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## Step 7: Performing Checks Prior to Initial Start-Up

Before testing your installation, ensure these conditions are met:

- Chassis and AC grounds are properly installed.
- AC input connections and AC output connections are wired correctly on the terminal block and not reversed.
- Positive (+) battery cable is connected to the positive (+) battery terminal through the DC fuse and disconnect switch or DC circuit breaker.
- Negative (-) battery cable is connected to the negative (-) battery terminal.
- Battery voltage is within the proper range for this unit (10.3–15.3 volts DC).
- DC disconnect switch or breaker is turned off.
- AC input and output breakers are turned off.
- All connections are tight.

## Step 8: Testing Your Installation



### WARNING: Shock hazard

The Inverter Enable button on the RS3000 and the optional accessories do not disconnect DC or AC input power to the RS3000.

There are several tests to be performed for testing your installation. These tests will verify that:

- The RS3000 works in invert mode
- The RS3000 works in charge mode
- The RS3000 works in AC bypass mode

If the test fails at any point, go to “Step 7: Performing Checks Prior to Initial Start-Up” on page 35 and go through the checklist again to check the installation. Then perform the test again. If the test fails again, see the troubleshooting section in the RS3000 Sine Wave Inverter/Charger Operation Guide.

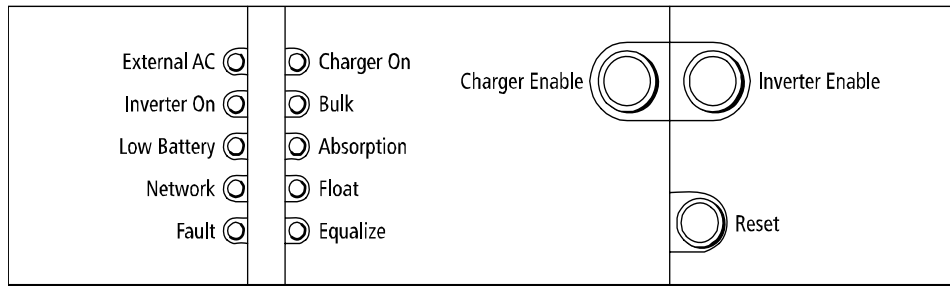


Figure 14 RS3000 Front Panel

### Testing in Invert Mode

**To test the RS3000 in invert mode, using a 100 watt light bulb as the test load:**

1. Close the DC disconnect switch or the DC circuit breaker to supply DC power to the RS3000.

Wait for all the lights on the front panel to flash on and off, indicating that the unit has successfully initialized (10 to 30 seconds).

If the light does not come on, make sure the voltage at the DC terminals on the RS3000 is correct, as described in “Step 7: Performing Checks Prior to Initial Start-Up” on page 35.

2. After the initial flash, verify that the lights on the front panel illuminate as follows:
  - The Charger Enable button light is illuminated
  - The Network light is illuminated
  - All other lights are not illuminated

3. Press the Inverter Enable button. Verify that:
  - The Inverter Enable button light illuminates
  - The Invert On light illuminates
4. Connect the RS3000 to the test load by closing the AC breaker that controls the circuit that the test load is connected to.  
If the light bulb illuminates, the Invert mode is working.
5. Press the Inverter Enable button to disable the inverter. The Invert On light and Inverter Enable button light are off.

### Testing in Charge Mode and AC Bypass Mode

1. Close the AC supply breaker to supply AC power to the unit.

**To verify that the RS3000 starts charging:**

2. After a few seconds, verify that the Bulk light illuminates. Over a period of time, the Absorption or Float light illuminates as charging progresses.
  - In three-stage charging, the Bulk, Absorption and Float lights illuminate in sequence.
  - In two-stage charging, the Bulk and Absorption lights illuminate in sequence.

**To verify that RS3000 correctly switches to Bypass mode:**

3. Press the Charger Enable button to disable the charger. Verify that:
  - The Charger On light and Charger Enable button light turn off.
  - The AC load is still powered.

### Installation Complete

Your installation is now complete. The inverter/charger is ready for use.

The preceding tests use a light load (a light bulb) as a test case. If you encounter problems when using a load over 1000 W (for example, a hairdryer or microwave), see the troubleshooting information in the RS3000 Sine Wave Inverter/Charger Operation Guide.

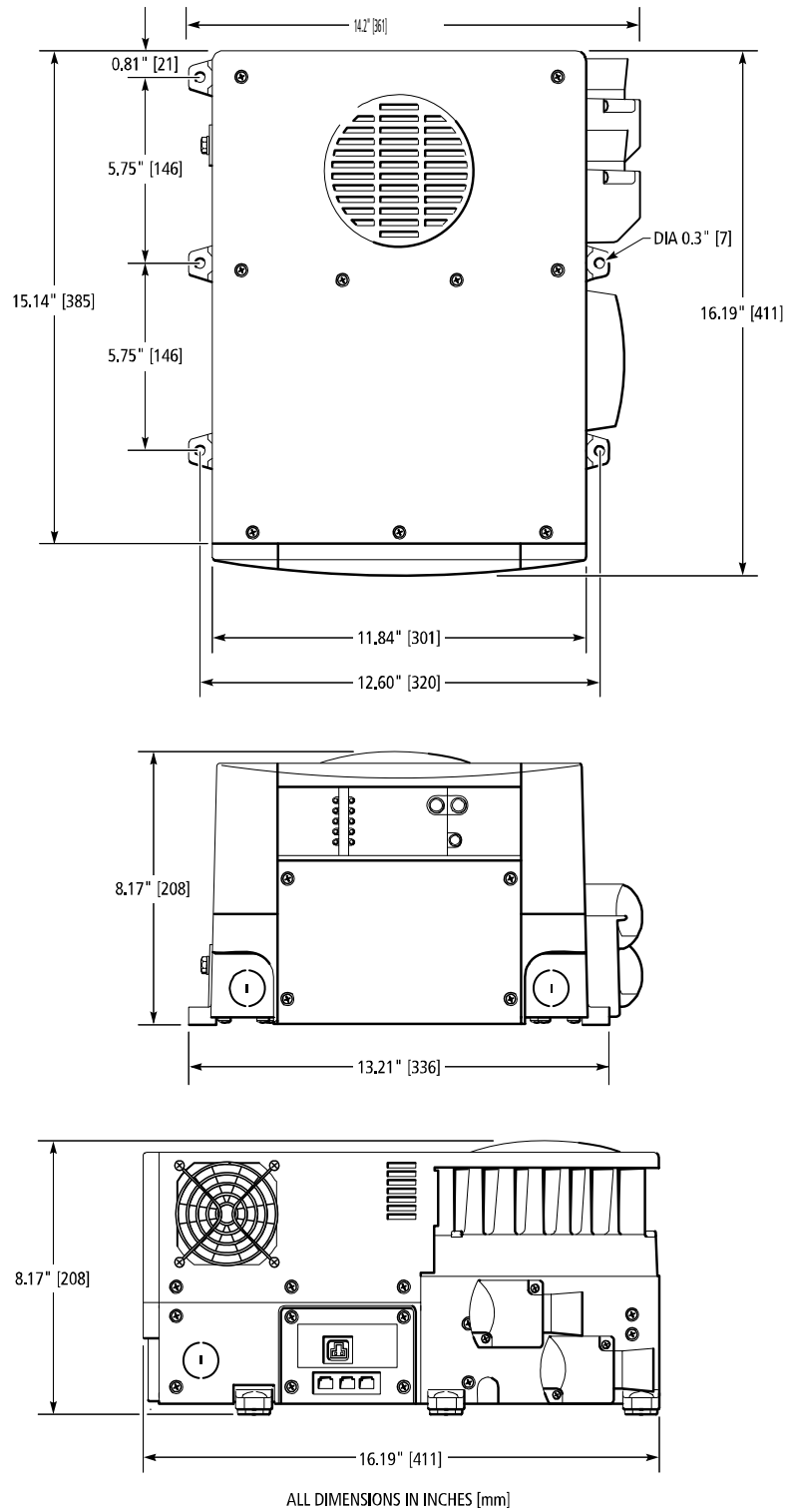
## Inverter/Charger Physical Specifications

For complete inverter/charger specifications, refer to the *RS3000 Sine Wave Inverter/Charger Operation Guide*.

The physical specifications of the RS3000 are shown in Figure 15 on page 39 and described in Table 4.

**Table 4** RS3000 Physical Specifications

Length	16.19 inches (411 mm)
Width	14.20 inches (361 mm)
Height	8.1 inches (208 mm)
Weight	75 lb (34 kg)



**Figure 15** Inverter/Charger Dimensions

## Battery Information

### Battery Bank Sizing

Battery capacity	<p>Battery size or capacity is just as important as the battery type selected for use with the RS3000. 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.</p> <p><b>Xantrex recommends a minimum battery size of 200 amp-hours (Ah) for moderate loads (&lt;1000W) and greater than 400 Ah for heavy loads.</b></p> <p>See “Estimating Battery Requirements” below for information on a more detailed calculation.</p>
About Amp-hours	<p>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 such as amp-hours (Ah).</p> <p>Amp-hour capacity is the number of amps a battery can continuously deliver during a specified number of hours. It is represented by the product of the two — amps multiplied by hours.</p> <p>A typical marine or RV battery rated for 100 Ah can deliver 5 amps for 20 hours (<math>5A \times 20 \text{ hours} = 100 \text{ Ah}</math>). This same battery can deliver a higher or lower current for less or more time, limited approximately by the 100 Ah figure (50 A for 2 hours or 200 A for 1/2 hour), but usually the capacity figure given is only accurate for the specified duration (20 hours).</p>

## Estimating Battery Requirements

### Calculating Battery Size

Step1: Compute Amp-hours	<p>For each appliance, compute the number of amp-hours that will be used between charging cycles, as follows:</p> <ol style="list-style-type: none"> <li>1. Obtain the wattage. If the wattage is marked on the nameplate rating, use that. Otherwise, multiply the marked voltage and amperage: <math>WATTS = VOLTS \times AMPS.</math></li> <li>2. Obtain the Watt-hours by multiplying that amount by the hours the appliance will be used: <math>WATT-HOURS = WATTS \times HOURS.</math></li> <li>3. Obtain the amp-hours that the appliance requires by dividing that amount by 10 (the factor for the RS3000, which is a 12-volt system): <math>BATTERY \text{ AMP-HOURS USED} = AC \text{ WATT-HOURS}/10</math></li> </ol> <p>For example, a 100 W light bulb that is used for 4 hours will use 400 watt-hours (Wh) and the inverter will consume approximately 40 Ah from a 12 volt battery.</p>
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- Step 2: Calculate Battery Size
4. Enter this information on the blank calculation worksheet (page 42).
  5. Complete the rest of the worksheet; see Table 1-1, “Battery Sizing Example” on page 41 for an example.
- Size the batteries at approximately twice the estimated total amp-hour usage. Doubling the expected amp-hour usage ensures that the batteries will not be overly discharged and extends battery life.
- Resist the temptation to skip this doubling step. 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.
- Troubleshooting
- If you find that the system shuts down when appliances with large motors are started, the problem may be that this motor is too much for the battery. Even though you calculated the amp-hour requirements appropriately, the startup of a large motor makes high demands on the battery. You may find that adding more amp-hours (in the form of extra batteries or replacement with a bigger battery) solves the problem.

**Table 1-1** Battery Sizing Example

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

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 recharge more frequently.

## Battery Banks

As your power requirements increase, you may need to use more than one battery to obtain sufficient capacity. Batteries can be connected in parallel, in series, or in series-parallel to create higher capacity systems.

See “Cabling and Hook-up Configurations” on page 44 for more information about battery inter-connection schemes.

### Mixing Batteries

Batteries connected in parallel should be of the same type and amp-hour rating and from the same manufacturer.

It is not recommended to connect batteries of different types, amp-hour ratings or manufacturers. Improper charging and decreased battery life will result.

## 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.

## Restrictions on Motor Size

An appliance may require three to six times its normal running current in order to start. The RS3000 can handle surges to 7500 VA for 5 seconds, which translates to a locked-rotor-amp rating of no more than 60 A. The locked rotor amp may be specified on the motor nameplate as “LRA” or “LRI”.

When considering appliances with large motors, follow these guidelines:

- Make sure that the motor’s LRA rating is no more than 60 A. The RS3000 may not be able to start a motor with a higher LRA, and the RS3000 will shut down if the attempt is made.
- Make sure the battery bank, DC cables and DC fuses are capable of handling up to 750 A DC for five seconds. A weaker circuit may not be able to provide sufficient power to the RS3000 to allow the RS3000 to start up the appliance. Again if the circuit cannot deliver the required current, the system may shut down or the fuse may open.

**Table 1-2** Battery Sizing Worksheet

Appliance	(A) Power Consumption (Watts)	(B) Operating Time per Day (Hours)	Daily watt-hours needed for this appliance (= A × 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
Total daily watt-hours of AC load			Wh
× Number of days between charges			
= Total watt-hours of AC load between charges			Wh
Battery Ah used between charges (divide by 10 for 12 volt system; divide by 20 for 24 volt system)			Ah
<b>Recommended Battery Bank Size in Ah (multiply by 2)</b>			<b>Ah</b>

## Cabling and Hook-up Configurations

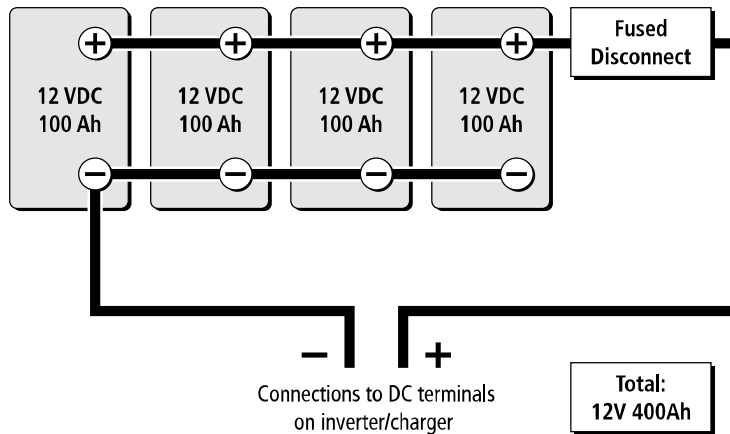
Several smaller batteries can be connected to create a battery bank of substantial size. You can connect batteries in three ways: in parallel, series, or series-parallel.

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 cable should not be smaller than the inverter cables—if the main cables are 4/0 AWG, the battery interconnects should be 4/0 AWG.

The best configuration is to connect the batteries in series and parallel. 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

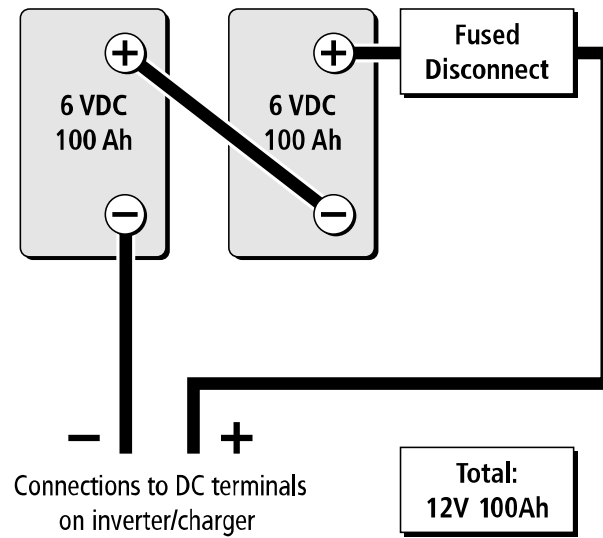
Batteries are connected in parallel when all the positive terminals of a group of batteries are connected and then, separately, all the negative terminals are connected. In a parallel configuration, the battery bank has the same voltage as a single battery, but an Ah rating equal to the sum of the individual batteries. See Figure 16.



**Figure 16** Batteries Connected in Parallel

## Series Connection

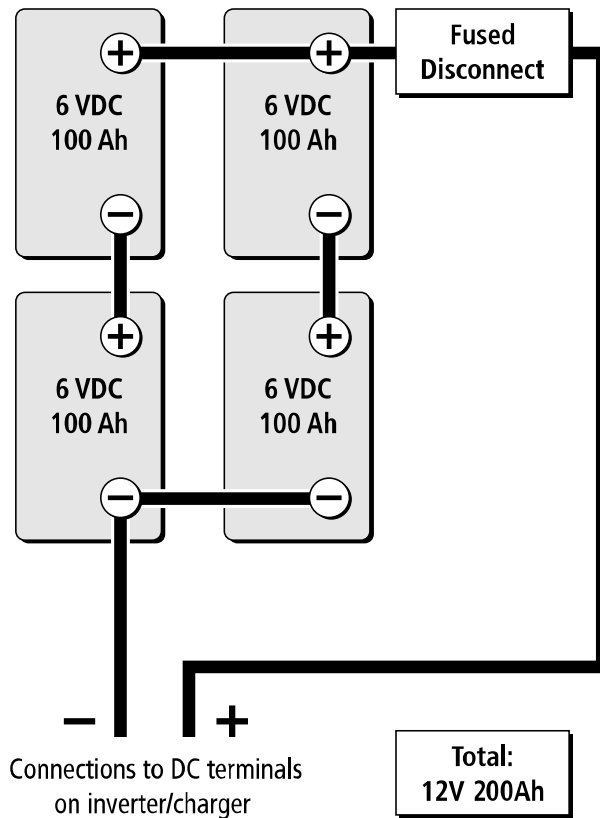
When batteries are connected with the positive terminal of one battery to the negative terminal of the next battery, they are connected in series. In a series configuration, the battery bank has the same Ah rating of a single battery, but an overall voltage equal to the sum of the individual batteries. See Figure 17.



**Figure 17** Batteries Connected in Series

### Series-Parallel Connections

As the name series-parallel implies, both the series and parallel configurations are used in combination. The result is an increase in both the voltage and the capacity of the total battery bank. This is common with all battery-inverter system voltages. The smaller, lower voltage batteries are first connected in series to obtain the necessary voltage, and then these “batteries connected in series” sets are connected in parallel to increase the battery bank capacity. See Figure 18.



**Figure 18** Batteries in Series-Parallel Connections

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