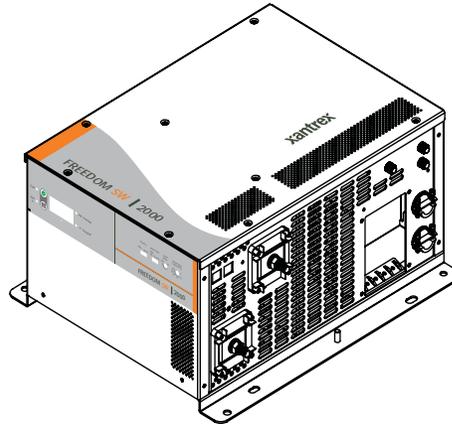
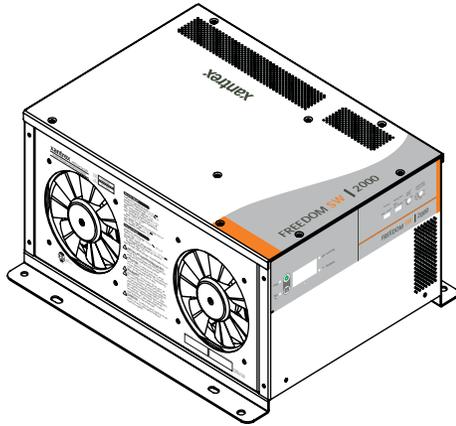


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Freedom SW 2000 Sine Wave Inverter/Charger

Installation Guide

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About This Guide

Purpose

The purpose of this Installation Guide is to provide procedures for installing the Freedom SW 2000 Inverter/Charger.

Scope

The guide provides safety guidelines as well as information on installing the inverter/charger. It does not provide details about particular brands of batteries. You need to consult individual battery manufacturers for this information.

Audience

The guide is intended for qualified installers who need to install and configure the Freedom SW 2000 Inverter/Charger.

The installer should have knowledge and experience in installing electrical equipment, knowledge of the applicable installation codes, and awareness of the hazards involved in performing electrical work and how to reduce those hazards. A qualified technician or electrician has this knowledge and experience.

Conventions Used

The following conventions are used in this guide.

DANGER

STATEMENT OF HAZARD

Contains statements of avoidance or strict compliance.

Failure to follow these instructions will result in death or serious injury.

WARNING

STATEMENT OF HAZARD

Contains statements of avoidance or strict compliance.

Failure to follow these instructions can result in death or serious injury.

CAUTION

STATEMENT OF HAZARD

Contains statements of avoidance or strict compliance.

Failure to follow these instructions can result in minor or moderate injury.

CAUTION

STATEMENT OF HAZARD

Contains statements of avoidance or strict compliance.

Failure to follow these instructions can damage the unit and/or damage other equipment.

IMPORTANT: These notes describe things which are important for you to know, however, they are not as serious as a caution or warning.

Related Information

You can find more information about Xantrex Technology Inc. as well as its products and services at www.xantrex.com.

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Important Safety Instructions

IMPORTANT: READ AND SAVE THIS INSTALLATION GUIDE FOR FUTURE REFERENCE.

This chapter contains important safety and installation instructions for the Freedom SW 2000 Inverter/Charger (Freedom SW 2000). Each time, before using the Freedom SW 2000, READ ALL instructions and cautionary markings on or provided with the inverter/charger, the batteries, and all appropriate sections of this guide.

NOTE: The Freedom SW 2000 contains no user-serviceable parts. See “Warranty and Return Information” on page 65 of the Owner’s Guide for guidance.

DANGER

ELECTRICAL SHOCK HAZARD

- Do not expose the Freedom SW 2000 to rain, snow, spray, or bilge water. This inverter/charger is designed for indoor use only.
- Do not operate the inverter/charger if it has received a sharp blow, been dropped, has cracks or openings in the enclosure including if the fuse cover has been lost, damaged, or will not close, or otherwise damaged in any other way.
- Do not disassemble the inverter/charger. Internal capacitors remain charged after all power is disconnected.
- 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. See note below.
- Do not operate the inverter/charger with damaged or substandard wiring. Make sure that all wiring is in good condition and is not undersized.

Failure to follow these instructions will result in death or serious injury.

NOTE: Turning off the inverter/charger using the on/off switch on the front panel will not reduce an electrical shock hazard.

 **DANGER**

FIRE AND BURN HAZARD

Do not cover or obstruct the air intake vent openings and/or install in a zero-clearance compartment.

Failure to follow these instructions will result in death or serious injury.

 **DANGER**

EXPLOSION HAZARD

- Charge only properly rated (such as 12 V) lead-acid (GEL, AGM, or Flooded) rechargeable batteries because other battery types may explode and burst.
- Do not work in the vicinity of lead-acid batteries. Batteries generate explosive gases during normal operation. See note #1.
- Do not install and/or operate in compartments containing flammable materials or in locations that require ignition-protected equipment. See notes #2 and #3.

Failure to follow these instructions will result in death or serious injury.

NOTES:

1. Follow these instructions and those published by the battery manufacturer and the manufacturer of any equipment you intend to use in the vicinity of the battery. Review cautionary markings on these products and on the engine.
2. This inverter/charger contains components which tend to produce arcs or sparks.
3. Locations include any space containing gasoline-powered machinery, fuel tanks, as well as joints, fittings, or other connections between components of the fuel system.

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Precautions When Working With Batteries

WARNING

BURN FROM HIGH SHORT-CIRCUIT CURRENT, FIRE AND EXPLOSION FROM VENTED GASES HAZARDS

- Always wear proper, non-absorbent gloves, complete eye protection, and clothing protection. Avoid touching your eyes and wiping your forehead while working near batteries. See note #4.
- Remove all personal metal items, like rings, bracelets, and watches when working with batteries. See notes #5 and #6 below.
- Never smoke or allow a spark or flame near the engine or batteries.
- Never charge a frozen battery.

Failure to follow these instructions can result in death or serious injury.

NOTES:

1. Locate the Freedom SW 2000 Inverter/Charger unit away from batteries in a well ventilated compartment.
2. Always have someone within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
3. Always have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
4. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters your eye, immediately flood it with running cold water for at least twenty minutes and get medical attention immediately.

5. 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.
6. Batteries can produce a short circuit current high enough to weld a ring or metal bracelet or the like to the battery terminal, causing a severe burn.
7. When removing a battery, always remove the negative terminal from the battery first for systems with grounded negative. If it is grounded positive, remove the positive terminal first. Make sure all loads connected to the battery and all accessories are off so you don't cause an arc.

Precautions When Preparing to Charge

WARNING

EXPOSURE TO CHEMICALS AND GASES HAZARD

- Make sure the area around the battery is well ventilated.
- Make sure the voltage of the batteries matches the output voltage of the inverter/charger.
- Be careful to keep corrosion from coming into contact with your eyes and skin when cleaning battery terminals.

Failure to follow these instructions can result in death or serious injury.

NOTES:

- Study and follow all of the battery manufacturer's specific precautions, such as removing or not removing cell caps while charging, whether equalization is acceptable for your battery, and recommended rates of charge.
- For flooded non-sealed batteries, add distilled water in each cell until battery acid reaches the level specified by the battery manufacturer. This helps to purge excessive gas from cells. Do not overfill. For a battery without removable cell caps, carefully follow manufacturer's instructions.

Precautions When Placing the Inverter/Charger

CAUTION

RISK OF DAMAGE TO THE INVERTER/CHARGER

- Never allow battery acid to drip on the inverter/charger when reading gravity, or filling battery.
- Never place the Freedom SW 2000 Inverter/Charger unit directly above batteries; gases from a battery will corrode and damage the inverter/charger.
- Do not place a battery on top of the inverter/charger.

Failure to follow these instructions can damage the unit and/or damage other equipment.

This guide for use by qualified installers only.

Regulatory

The Freedom SW 2000 Inverter/Charger is certified to appropriate US and Canadian standards. For more information see “Regulatory Approvals” on page 68 of the Owner’s Guide.

The Freedom SW 2000 Inverter/Charger is intended to be used for RV, marine, and commercial truck applications. It is not intended for other applications as it may not comply with the additional safety code requirements needed for those other applications. See “Limitations On Use” below.

WARNING

LIMITATIONS ON USE

- Do not use in connection with life support systems or other medical equipment or devices.
- Do not use in ambulances or other life-saving emergency vehicles.

Failure to follow these instructions can result in death or serious injury.

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Introduction

The Installation Guide provides detailed information for installing the Freedom SW 2000 Inverter/Charger and the battery temperature sensor and wiring the inverter/charger to the AC and DC circuits.

This Installation Guide provides:

- safety instructions that must be observed during installation,
- information on additional required AC and DC components,
- a list of installation tools and materials, and
- detailed procedures for a typical installation.

This guide for use by qualified installers only.

Materials List

The Freedom SW 2000 ships with the following items:

- one Freedom SW 2000 unit,
- owner's and installation guides,
- Battery Temperature Sensor (BTS),
- Freedom SW remote panel with 25-foot communications cable,
- DC terminal covers (one red, one black) with two sets of screws, and
- two sets of nuts and washers for the DC terminals.

NOTE: If any of the items are missing, contact Xantrex or any authorized Xantrex dealer for replacement. See "Contact Information" on page i.

IMPORTANT: Keep the carton and packing material in case you need to return the Freedom SW 2000 for servicing.

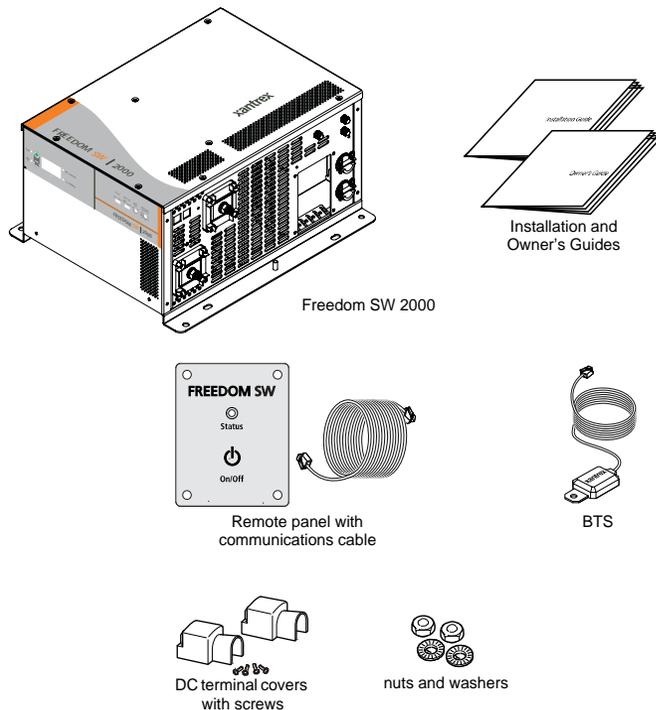


Figure 1 Materials List

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.
- Assemble all the tools and materials you require for the installation.
- Review the Important Safety Instructions on page iv.
- Be aware of all safety and electrical codes which must be met.

DANGER

ELECTRICAL SHOCK AND FIRE HAZARDS

- All wiring should be done by qualified personnel to ensure compliance with all applicable installation codes and regulations.
- Disconnect all AC and DC power sources.
- Disable and secure all AC and DC disconnect devices and automatic generator starting devices.

Failure to follow these instructions will result in death or serious injury.

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, and
- ABYC E11 - Alternating Current and Direct Current Electrical Systems on Boats, and
- ABYC A31 - Battery Chargers and Inverters.

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Planning the Installation

This section provides information to help you plan for a basic installation of the Freedom SW 2000.

As your system configuration is determined, record the details in Information About Your System of the *Freedom SW 2000 Sine Wave Inverter/Charger Owner's 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 11.

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 Freedom SW 2000

To choose an appropriate location for mounting the inverter/charger, see “Step 1: Choosing a Location for the Inverter/Charger” on page 15.

AC and DC Components including wire and breaker sizes

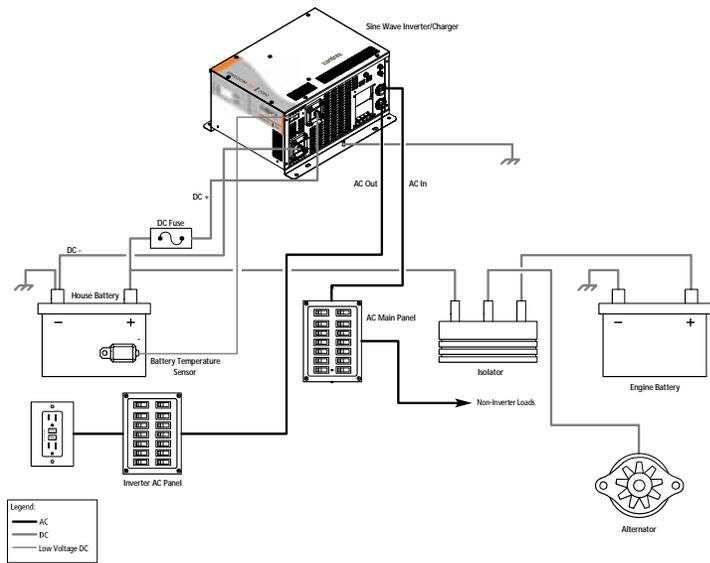
For a successful installation, you need to plan for AC and DC components including planning for wire and breaker sizes to be used in the power system. The AC and DC components are described in this section.

AC components include:

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

DC components include:

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



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IMPORTANT: Figure 2 does not show all required grounding and overcurrent protection.

Figure 2 Sample Vehicle Electrical System Configuration

IMPORTANT: Read Owner's and Installation Guides prior to installation. Always refer to local and national electrical codes for proper wire and breaker sizes prior to installation.

For wire and breaker size information:

1. See "AC Input Protection" on page 7.
2. See "AC Output Protection" on page 8.
3. See "GFCI Requirements" on page 8.
4. See "AC Wiring" on page 9.
5. See "DC Cabling" on page 11.
6. See "DC Grounding" on page 11.

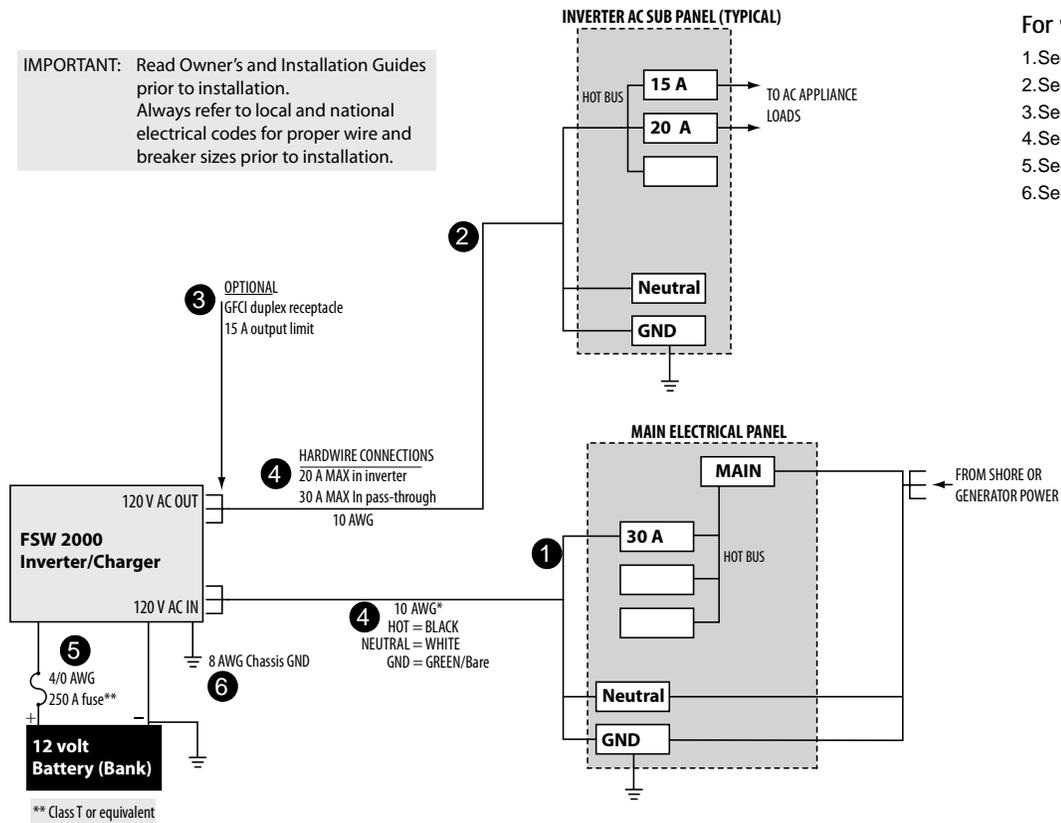


Figure 3 Wiring and Breakers Block Diagram

AC Components

AC Input

AC input to the Freedom SW 2000 can be supplied from a single-phase 120-volt 60-Hz AC source such as the utility grid (power company), a generator, or the output of a transfer switch.

AC Output

AC output from the Freedom SW 2000 is 120 Vac/60 Hz.

AC Loads

The Freedom SW 2000 is intended to power loads consisting of 120 Vac appliances.

In Invert mode, the Freedom SW 2000 provides 120 Vac to loads connected to AC output. In AC pass-through mode, the source connected to the AC input is passed through (sometimes called bypass current or pass-through power) to the load. Because of the way invert mode operates, only 120 Vac appliances can be connected to the Freedom SW 2000 output.



ELECTRICAL SHOCK HAZARD

Do not connect 240 Vac loads to the Freedom SW 2000 outputs. Doing so may result in 120 Vac on exposed parts of the appliance.

Failure to follow these instructions will result in death or serious injury.

AC Disconnect and Over-Current Protection Devices

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 breaker protecting the AC input of the Freedom SW 2000 must be approved for use on 120 Vac branch circuits. The breaker must be rated at no more than 30 amps. This single input breaker must provide the Freedom SW 2000 with sufficient power for operating the battery charger including pass-through power (to operate downstream AC appliance loads). The Freedom SW 2000 does not have a power sharing feature. Refer to the owner's guide for more details on AC current that is required to charge batteries.

This guide for use by qualified installers only.

Planning the Installation

AC Output Protection

The breaker between the Freedom SW 2000 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 30A pass-through current rating, then a 30A 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 de-energizes 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 Freedom SW 2000.

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 AC 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 Input AC Wire Size

Breaker Size Used	30 A
Wire Size	10 AWG
Color Coding	L: black: N: white G: green

Size of AC Output Wiring Wire size must be coordinated with the current the wiring will carry. This current may be determined by the 20 A maximum inverter current, or by the pass-through current, which is determined by the overcurrent protection provided ahead of the Freedom SW 2000.

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 Freedom SW 2000 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 20.

This guide for use by qualified installers only.

DC Components

Batteries

The Freedom SW 2000 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 37 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 41.

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. The DC cables must be copper and must be rated 105 °C minimum.

Size and Length See Table 3 for required DC cable length, cable size and required fuse size for the Freedom SW 2000. 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 Freedom SW 2000 (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	300A class T or equivalent

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.

Consult your local electrical codes and other applicable electrical standards for specific requirements and applications.

This guide for use by qualified installers only.

Unpacking and Inspecting the Freedom SW 2000 Inverter/Charger

 **CAUTION**

HEAVY LOAD

The Freedom SW 2000 Inverter/Charger is heavy (see “Inverter/Charger Physical Specifications” on page 36). 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.

Failure to follow these instructions can result in minor or moderate injury.

To unpack and inspect:

IMPORTANT: Keep the carton and packing material in case you need to return the Freedom SW 2000 for servicing.

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 i.
2. Record the serial number of the Freedom SW 2000 and other purchase information in the “Warranty and Product Information” section of the *Freedom SW 2000 Sine Wave Inverter/Charger Owner’s 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 Freedom SW 2000 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 Freedom SW 2000 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 (not provided): 1"
- DC battery cables sized according to Table 3 on page 11
- Terminals and/or crimp connectors for DC cables (for 5/16" DC stud size on the Freedom SW 2000 inverter while the battery/fuse cable end may require larger size such as 3/8")
- Copper wire for DC grounding: No. 8 AWG. See "DC Grounding" on page 11
- 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 10.
- AC output and input wire.
- Six 1/4"-20 1.25" length steel screws or bolts to mount the Freedom SW 2000

This guide for use by qualified installers only.

Installing the Inverter/Charger

Overview

This section provides detailed information on installing the Freedom SW 2000. 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: Performing Checks Prior to Initial Start-Up

Step 7: Testing Your Installation

Step 1: Choosing a Location for the Inverter/Charger

DANGER

FIRE AND EXPLOSION HAZARD

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.

Failure to follow these instructions will result in death or serious injury.

DANGER

HEAT HAZARD

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

Failure to follow these instructions will result in death or serious injury.

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.

Dry

Do not allow water or other fluids to drip or splash on the inverter/charger. Do not expose to rain, snow or water.

Cool

Normal air temperature should be between 32 °F and 122 °F (0 °C and 50 °C)—the cooler the better within this range.

Clearance

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.

This guide for use by qualified installers only.

Installing the Inverter/Charger

Safe	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.
Close to battery compartment	The length and size of your DC cables will affect performance. Use the DC cables recommended in Table 3 on page 11. The unit should not be installed in the battery compartment due to the possible presence of explosive hydrogen gas from the batteries.
Protected from battery acid and gases	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.
Orientation	To meet regulatory requirements, the Freedom SW 2000 must be mounted in one of the approved mounting orientation. See Figure 1 on page 18.

Step 2: Mounting the Inverter/Charger

Considerations

Before mounting the Freedom SW 2000, 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 1 on page 18.

CAUTION

HEAVY LOAD

The Freedom SW 2000 Inverter/Charger is heavy (see “Inverter/Charger Physical Specifications” on page 36). 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.

Failure to follow these instructions can result in minor or moderate injury.

The Freedom SW 2000 approved mounting orientations are illustrated in Figure 1 on page 18.

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

To mount the inverter/charger:

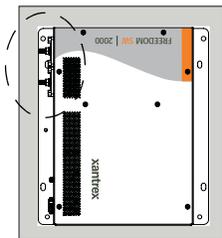
1. Remove the inverter/charger from its shipping container.
2. Verify that all components are present, and record relevant product information on form WA-4 in the *Freedom SW 2000 Sine Wave Inverter/Charger Owner's Guide*.
3. Select an appropriate mounting location and orientation. To meet regulatory requirements, the Freedom SW 2000 must be mounted in one of the orientations shown in Figure 1 on page 18.
4. Mark the position of the mounting holes.
5. Pilot drill the four mounting holes.
6. Fasten the inverter/charger to the mounting surface with four 1/4"-20 steel screws or bolts.

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Installing the Inverter/Charger

Figure 1 Mounting Orientations

Orientation	Approved Mounting Orientation?	Comment
Desktop Mount	Yes	Ideal.
Upside-down Mount	Yes (for non-marine applications only)	Suitable only for non-marine applications with no risk of condensation or dripping water.
Wall Mount DC on Left	Yes	On a vertical surface with DC terminals facing left. IMPORTANT: This orientation is also suitable for marine applications only with the installation of additional drip protection.



Orientation

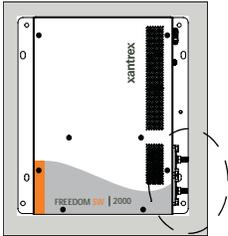
Approved Mounting Orientation?

Comment

Wall Mount DC on Right

Yes

On a vertical surface with DC terminals facing right.

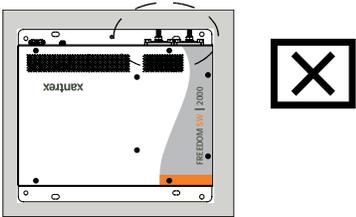


IMPORTANT: This orientation is also suitable for marine applications only with the installation of additional drip protection.

Wall Mount DC Up

No

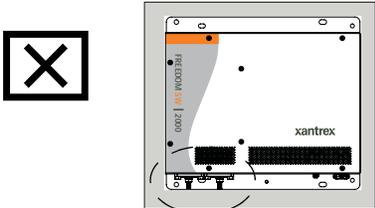
Not acceptable. This orientation does not meet regulatory requirements.



Wall Mount DC Down

No

Not acceptable. This orientation does not meet regulatory requirements.



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Step 3: Connecting the AC Input and AC Output Wires

DANGER

FIRE, ELECTRICAL 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.

Failure to follow these instructions will result in death or serious injury.

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 2 on page 21.

AC Knockouts There are two 1" trade-size knockouts on the front panel of AC wiring box. 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 9 for required sizes.

Connecting AC Input Wires

Figure 2 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).

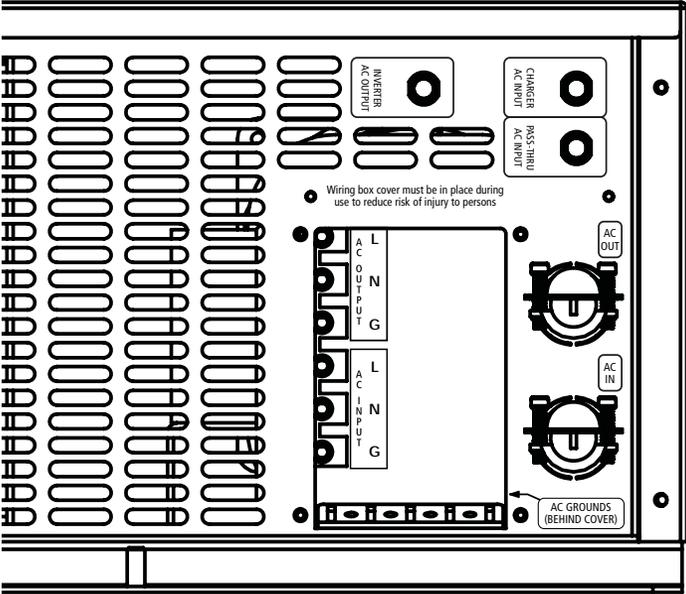


Figure 2 AC Wiring Compartment

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.

Failure to follow these instructions can damage the unit and/or damage other equipment.

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 9.

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.

This guide for use by qualified installers only.

Installing the Inverter/Charger

8. Connect the line and neutral wires to the input terminals (labeled AC Input on the terminal block, Figure 2 on page 21). Connect Line to L, Neutral to N, and Ground to G.
9. Tighten the terminal screws. Leave some slack wire inside the wiring box.
10. Secure the strain-relief clamp on the AC input cable jacket.

Connecting AC Output Wires

CAUTION

EQUIPMENT DAMAGE

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

Failure to follow these instructions can damage the unit and/or damage other equipment.

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 2 on page 21) as follows:

Table 4 Output AC Wire Size

Wire Size	No. 10 AWG
Color Coding	L: black: N: white G: green

6. Tighten the terminal screws. Leave some slack wire inside the wiring box.
7. Secure the strain-relief clamp on the AC output cable jacket.
8. Attach the wiring compartment cover panel and tighten the four screws.
9. Connect the outgoing AC wires to an AC load panel equipped with circuit breakers.

Step 4: Connecting the DC Cables

DC Connection Precautions

DANGER

ELECTRICAL SHOCK HAZARD

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

Failure to follow these instructions will result in death or serious injury.

Recommended Cable Sizes and Lengths and Fuse Size

For recommended DC cables and fuse size, see Table 3 on page 11.

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 5/16" DC stud size on the Freedom SW 2000 inverter, while battery/fuse cable end may require a larger size such as 3/8" to connect to the Freedom SW 2000. 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 Freedom SW 2000. 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.

DANGER

ELECTRICAL SHOCK AND FIRE HAZARD

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

Failure to follow these instructions will result in death or serious injury.

- 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

DANGER

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 10–11 ft-lbs (13.6–14.9 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 3.

Failure to follow these instructions will result in death or serious injury.

CAUTION

EQUIPMENT DAMAGE DUE TO REVERSE POLARITY

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 (–).

Failure to follow these instructions can damage the unit and/or damage other equipment.

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 25.
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 11 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 3. The connector goes on first, then the flat washer (steel), lock washer (steel), and nut 5/16” (steel).
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 nut to a torque of 10–11 ft-lbs (13.6–14.9 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 3. The connector goes on first, then the flat washer (steel), and nut 5/16” (steel).

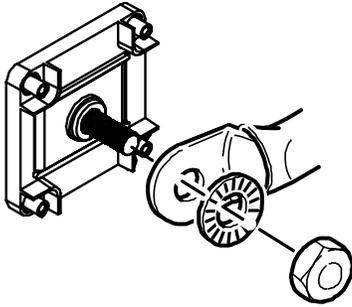


Figure 3 DC Cable Connections

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 nut to a torque of 10–11 ft-lbs (13.6–14.9 Nm) at the inverter/charger end.
10. To protect the DC terminals, attach the DC terminal covers (Figure 4) to the inverter/charger, using the screws provided.

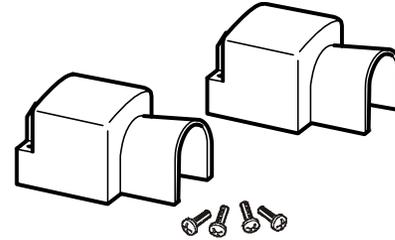


Figure 4 DC Terminal Covers

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 11. 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 5.
2. Connect the grounding cable 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 nut to a torque of 4.7–5.4 ft-lbs (6.6–7.3 Nm).

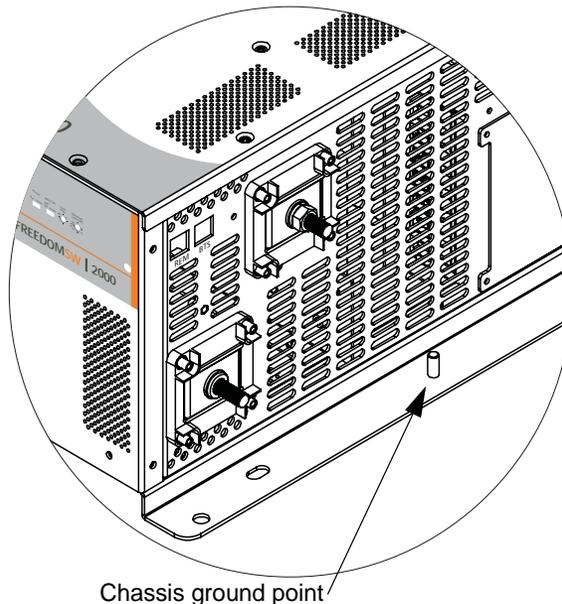


Figure 5 DC Wiring and DC Grounding

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 below.

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.

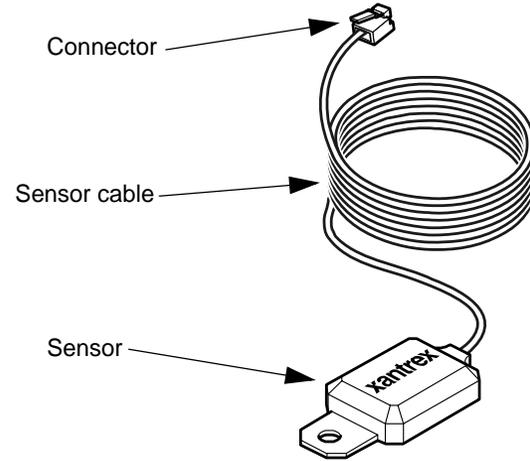


Figure 6 BTS with Cable

Mounting to the Negative Battery Terminal

To mount the sensor on the negative battery terminal:

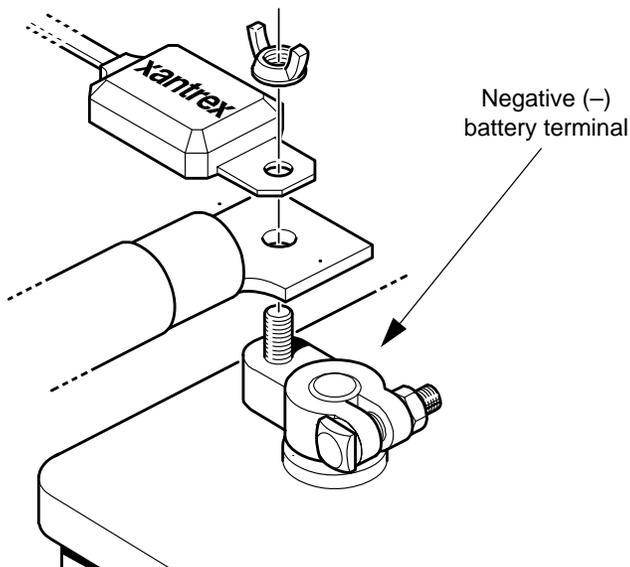


Figure 7 BTS Mounted on the Negative Battery Terminal

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 7, and firmly tighten the terminal nut.

DANGER

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.

Failure to follow these instructions will result in death or serious injury.

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 BTS jack, as shown in Figure 8. Secure the cable along its length.

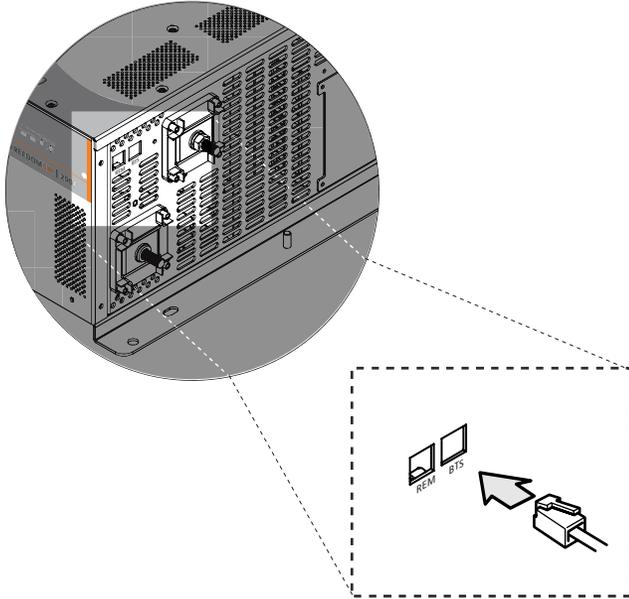


Figure 8 Connecting the BTS Cable to BTS Jack

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Mounting to the Side of the Battery Case

To mount the sensor on the battery case:

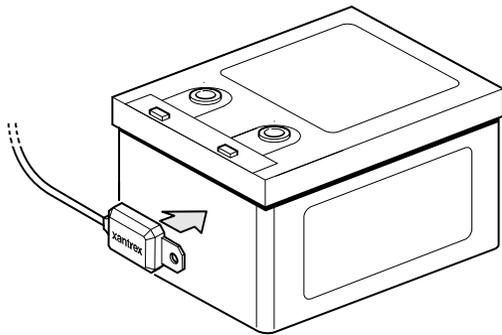


Figure 9 BTS Mounted on the Battery Case

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 9.
6. Route the sensor cable to the inverter/charger and plug it into the Battery Temp. jack, as shown in Figure 8. Secure the cable along its length.

Step 6: 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 (11–15 volts DC).
- DC disconnect switch or breaker is turned off.
- AC input and output breakers are turned off.
- All connections are tight.

Step 7: Testing Your Installation

⚠ WARNING

ELECTRICAL SHOCK HAZARD

The Inverter Enable button on the Freedom SW 2000 and the optional accessories do not disconnect DC or AC input power to the Freedom SW 2000.

Failure to follow these instructions can result in death or serious injury.

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

- the Freedom SW 2000 works in invert mode,
- the Freedom SW 2000 works in charge mode, and
- the Freedom SW 2000 works in AC pass-through mode.

If the test fails at any point, go to “Step 6: Performing Checks Prior to Initial Start-Up” on page 33 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 Freedom SW 2000 Sine Wave Inverter/Charger Owner’s Guide.

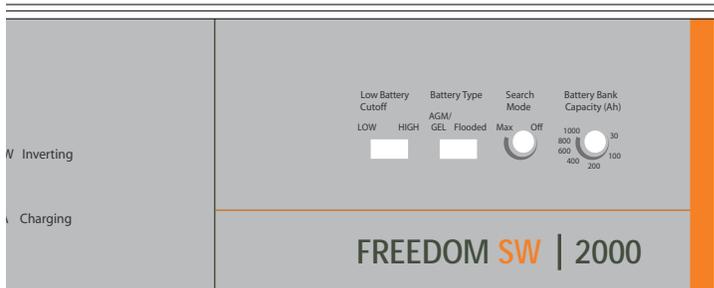


Figure 10 Freedom SW 2000 Front Panel

Testing in Invert Mode

To test the Freedom SW 2000 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 Freedom SW 2000.

Make sure the voltage at the DC terminals on the Freedom SW 2000 is correct, as described in “Step 6: Performing Checks Prior to Initial Start-Up” on page 33.

2. Apply DC power to the inverter by switching on the DC disconnect circuit breaker and then pressing the ON/STANDBY switch once.

The inverter will go through a self-test.

- Each of the indicator lights will flash in sequence,

- the cooling fan will turn on momentarily,
 - the transfer relay will switch, and
 - the temperature sensors will be checked for open or short circuit.
3. After the self-test the unit will start inverting.
 4. Using a true RMS AC voltmeter, check the output voltage of the inverter. This voltage can be checked at either the AC terminal block or in the sub-panel (between the line and neutral). The voltage should be approximately 120 Vac/60Hz.

IMPORTANT: If the inverter is in Search Mode and a sufficient load is not available to bring the inverter up to full voltage, turn the Search Mode potentiometer fully counterclockwise to defeat the search function.

Testing in Charge Mode

1. Apply AC power to the inverter.
2. The inverter starts charging the batteries in the Bulk mode, indicated by the Charge Mode indicator light illuminating orange. It takes about 15 seconds for the unit to transition from invert mode to charge mode after the application of qualified AC.
3. Using a true RMS AC voltmeter, check the output voltage of the inverter. This voltage can be checked at either the AC terminal block or in the sub-panel (between the line and neutral). The voltage should be approximately 120 Vac/60Hz. This ensures the inverter/charger is delivering AC output in pass-through mode.

4. Switch the AC disconnect circuit breaker to OFF. The inverter will go into invert mode (if a sufficient load is applied to the AC output while in the search mode). The Invert Mode indicator light will illuminate indicating the inverter is active. The voltage on the AC output of the inverter will remain the same as above 120 Vac/60Hz ($\pm 5\%$ maximum) except when the unit is set to be in search mode.
5. Reapply the AC power by switching the AC disconnect to ON. Allow the batteries to fully recharge.

IMPORTANT: The unit will not use battery energy for AC output as long as AC input (utility or generator) is available to the inverter.

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 Freedom SW 2000 Sine Wave Inverter/Charger Owner's Guide.

Inverter/Charger Physical Specifications

For complete inverter/charger specifications, refer to the *Freedom SW 2000 Sine Wave Inverter/Charger Owner's Guide*.

The physical specifications of the Freedom SW 2000 are described in Table 5 below.

Table 5 Freedom SW 2000 Physical Specifications

Length	15.2 inches (385 mm)
Width	13.4 inches (340 mm)
Height	7.9 inches (200 mm)
Weight	59.5 lb (27 kg)

Battery Information

Battery Bank Sizing

Battery capacity Battery size or capacity is just as important as the battery type selected for use with the Freedom SW 2000. 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.

Xantrex recommends a minimum battery size of 200 amp-hours (Ah) for moderate loads (<1000W) and greater than 400 Ah for heavy loads.

See “Estimating Battery Requirements” for information on a more detailed calculation.

About Amp-hours 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).

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.

A typical marine or RV battery rated for 100 Ah can deliver 5 amps for 20 hours ($5A \times 20 \text{ hours} = 100 \text{ Ah}$). 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).

Estimating Battery Requirements

Calculating Battery Size

Step 1: Compute Amp-hours

For each appliance, compute the number of amp-hours that will be used between charging cycles, as follows:

1. Obtain the wattage. If the wattage is marked on the nameplate rating, use that. Otherwise, multiply the marked voltage and amperage:
WATTS = VOLTS \times AMPS.
2. Obtain the Watt-hours by multiplying that amount by the hours the appliance will be used:
WATT-HOURS = WATTS \times HOURS.
3. Obtain the amp-hours that the appliance requires by dividing that amount by 10 (the factor for the Freedom SW 2000, which is a 12-volt system):
BATTERY AMP-HOURS USED = AC WATT-HOURS/10

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.

4. Enter this information on the blank calculation worksheet (page 40).

Step 2: Calculate Battery Size

5. Complete the rest of the worksheet; see Table 6, “Battery Sizing Example” on page 38 for an example.

Battery Information

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 6 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 41 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 Freedom SW 2000 can handle surges to 4000 W for ten seconds, which translates to a locked-rotor-amp rating of no more than 32 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 32 A. The Freedom SW 2000 may not be able to start a motor with a higher LRA, and the Freedom SW 2000 will shut down if the attempt is made.
- Make sure the battery bank, DC cables and DC fuses are capable of handling up to 450 A DC for ten seconds. A weaker circuit may not be able to provide sufficient power to the Freedom SW 2000 to allow the Freedom SW 2000 to start up the appliance. Again if the circuit cannot deliver the required current, the system may shut down or the fuse may open.

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Table 7 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
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
Recommended Battery Bank Size in Ah (multiply by 2)			Ah

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 below.

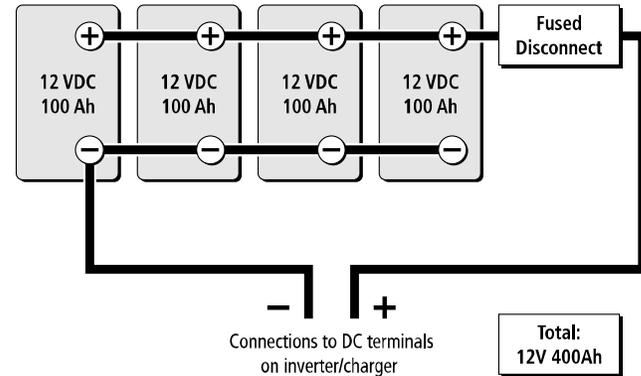


Figure 11 Batteries Connected in Parallel

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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 below.

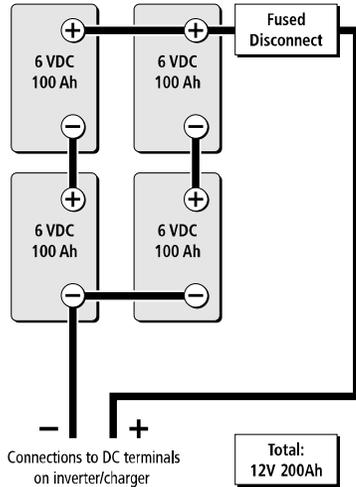


Figure 13 Batteries in Series-Parallel Connections

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