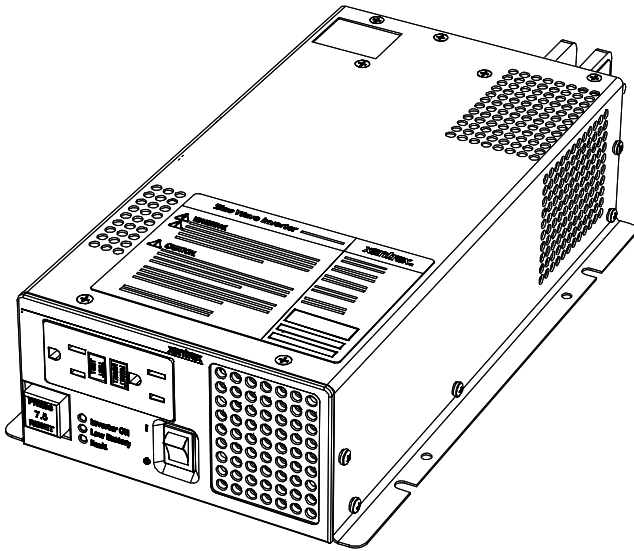


Smart choice for power

**xantrex**



**Owner's Guide**

TS400 Sine Wave Inverter

[www.xantrex.com](http://www.xantrex.com)



# TS400 Sine Wave Inverter

## Owner's 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.

## **Trademarks**

TS400 Sine Wave Inverter is a trademark of Xantrex International. Xantrex is a registered trademark of Xantrex International.

Other trademarks, registered trademarks, and product names are the property of their respective owners and are used herein for identification purposes only.

## **Notice of Copyright**

*TS400 Sine Wave Inverter Owner's Guide* © July 2003 Xantrex International. All rights reserved.

## **Disclaimer**

UNLESS SPECIFICALLY AGREED TO IN WRITING, XANTREX TECHNOLOGY INC. ("XANTREX")

(a) MAKES NO WARRANTY AS TO THE ACCURACY, SUFFICIENCY OR SUITABILITY OF ANY TECHNICAL OR OTHER INFORMATION PROVIDED IN ITS MANUALS OR OTHER DOCUMENTATION.

(b) ASSUMES NO RESPONSIBILITY OR LIABILITY FOR LOSS OR DAMAGE, WHETHER DIRECT, INDIRECT, CONSEQUENTIAL OR INCIDENTAL, WHICH MIGHT ARISE OUT OF THE USE OF SUCH INFORMATION. THE USE OF ANY SUCH INFORMATION WILL BE ENTIRELY AT THE USER'S RISK.

## **Date and Revision**

July 2003 Revision A

## **Part Number**

975-0055-01-01

## **Contact Information**

Telephone: 1-800-670-0707 (toll free in North America)

1-604-422-2777 (direct)

Fax: 1-604-420-2145

Email: [CustomerService@xantrex.com](mailto:CustomerService@xantrex.com)

Web: [www.xantrex.com](http://www.xantrex.com)

# About This Guide

## Purpose

The TS400 Sine Wave Inverter Owner's Guide contains information for installing, operating, and troubleshooting the TS400 Sine Wave Inverter (TS400).

## Scope

This Guide provides safety guidelines, installation, operation, troubleshooting, and warranty information for the TS400.

Basic information on battery types and sizes is provided in Appendix B, "Battery Types and Sizes". For comprehensive information about your battery, refer to the battery manufacturer's guide.

Service information is not included as the unit does not contain user-serviceable parts.

## Audience

This Guide is intended for anyone who needs to install and operate the TS400 Sine Wave Inverter. Installers should be certified technicians or electricians.

## Organization

The Owner's Guide is organized into four chapters and two appendixes.

Chapter 1, "Introduction", outlines the main performance and safety features of the TS400. Reading this chapter will give you a clear understanding of the inverter's capabilities.

Chapter 2, "Installation", provides detailed information for installing the TS400.

Chapter 3, “Operation”, provides information about operating the TS400. Details are provided on how to read the front panel indicators to monitor the TS400.

Chapter 4, “Troubleshooting”, explains how to identify and solve problems that can occur with the TS400.

Appendix A, “Specifications”, provides the electrical and physical specifications of the TS400.

Appendix B, “Battery Types and Sizes”, provides information that will help you to select, connect, and maintain batteries that are most appropriate for your application.

“Warranty and Product Information”, contains the product warranty, explains how to return a product for service, and describes how to prepare for a call to Xantrex Customer Service.

## Conventions Used

The following conventions are used in this guide.



### **WARNING**

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

---



### **CAUTION**

Cautions identify conditions or practices that could result in damage to the TS400 Sine Wave Inverter or to other equipment.

---

**Note:** Notes describe additional information which may add to your understanding of how to use the TS400.

---

**Important:** These notes describe an important action item or an item that you must pay attention to.

---

## Acronyms and Terminology

AC	Alternating current
DC	Direct current
CSA	Canadian Standards Association
FCC	Federal Communications Commission
GFCI	Ground fault circuit interrupter
UL	Underwriters Laboratories Inc.
Hardwiring	to make a permanent electrical connection

## Related Information

You can find more information about Xantrex Technology Inc. as well as its products and services at [www.xantrex.com](http://www.xantrex.com)





# Important Safety Instructions



## WARNING

This Owner's Guide contains important safety and operating instructions.

Before using your TS400 Sine Wave Inverter, be sure to read, understand, and save these safety instructions.

---



## WARNING: Restrictions on Use

The TS400 Sine Wave Inverter shall not be used in connection with life support systems or other medical equipment or devices.

---



## WARNING: Shock hazard

The TS400 has On/Standby mode only. It does not have an Off mode, that is, DC power is permanently connected to the unit.

---

## General Precautions

1. Before installing and using the inverter, read all appropriate sections of this guide and any cautionary markings on the inverter and the batteries.
2. Do not operate the inverter if it has received a sharp blow, been dropped, or otherwise damaged. If the unit is damaged, see "Warranty and Product Information" on page WA-1.
3. Do not dismantle the inverter; it contains no user-serviceable parts. Attempting to service the unit yourself could cause electrical shock or fire. **Internal capacitors remain charged after all power is disconnected.** See "Warranty" on page WA-1 for instructions on obtaining service.

## Important Safety Instructions

---

4. To reduce the risk of electrical shock, disconnect DC power from the inverter before working on any circuits connected to the inverter. Turning the On/Standby switch to Standby (⊖) will not reduce this risk.
5. Protect the inverter from rain, snow, spray, and water.
6. To reduce the risk of overheating, keep the ventilation openings clear, and do not install the inverter in a compartment with limited airflow.

## Precautions When Working With Batteries



### **WARNING: Explosion and Fire Hazard**

---

1. To reduce the risk of battery explosion, follow all instructions published by the battery manufacturer and the manufacturer of the equipment in which the battery is installed.
2. Make sure the area around the battery is well ventilated.
3. Never smoke or allow a spark or flame near the engine or batteries.
4. Use 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.

## Explosive Gas Precautions

1. Batteries generate explosive gases during normal operation. Be sure you follow all relevant instructions exactly before installing or using your inverter.
2. This equipment contains components which tend to produce arcs or sparks. To prevent fire or explosion, do not install the inverter 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, as well as joints, fittings, or other connections between components of the fuel system.

## FCC Information to the User

This Class B device complies with Part 15 of the FCC Rules and all requirements of the Canadian Interference-Causing Equipment Regulations. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.



# Contents

## Important Safety Instructions

General Precautions	vii
Precautions When Working With Batteries	viii
Explosive Gas Precautions	viii
FCC Information to the User	ix

## 1 Introduction

How TS400 Works	1-2
Premium Power and Ease of Use	1-2
Comprehensive Protection	1-3
TS400 Features	1-4
Front Panel	1-4
Back Panel	1-5
Optional Accessory: Remote Switch	1-6
Dimensions of Remote Switch	1-6
Part number of Remote Switch	1-6

## 2 Installation

Introduction	2-2
Preparing for Installation	2-3
Installation Codes	2-3
Materials List	2-4
Installation Tools and Materials	2-4
Installing the TS400	2-6
Overview	2-6
Step 1: Designing Your Installation	2-6
Step 2: Mounting Your Inverter	2-10
Step 3: Connecting the Chassis Ground	2-11
Step 4: Installing the Optional S400 Remote Switch	2-12
Step 5: Getting Ready to Connect the DC Cables	2-14
Step 6: Routing the DC Cables	2-15
Step 7: Connecting the DC Cables	2-16
Step 8: Connecting Your Equipment to the GFCI Outlets	2-18
Step 9: Hardwiring the AC Output	2-19
Step 10: Performing Checks Prior to Initial Start-up	2-22
Step 11: Testing Your Installation	2-22

### **3 Operation**

Front Panel Features	3-2
Operating the TS400	3-3
Turning the TS400 On	3-3
Turning the TS400 to Standby When Not in Use	3-3
Using the Optional S400 Remote Switch	3-4
Recharging Your Batteries	3-5
Recovering from Low Battery Voltage Shutdown	3-5
Restarting or Operating Multiple Pieces of Equipment	3-5
Monitoring the Operating Status	3-6
Resetting After a Fault or Shutdown	3-7

### **4 Troubleshooting**

Troubleshooting Reference	4-2
---------------------------	-----

### **A Specifications**

Electrical Specifications	A-2
Physical Specifications with Projections	A-2
Regulatory Approvals	A-3
Fan Cooling System	A-3

### **B Battery Types and Sizes**

Battery Types	B-2
Automotive Starting Batteries	B-2
Deep-Cycle Batteries	B-2
Battery Size	B-3
Estimating Battery Requirements	B-4
Battery Sizing Example	B-4
Battery Sizing Worksheet	B-5
Using Multiple Batteries	B-6
Two Batteries Connected In Parallel	B-6
Two Separate Battery Banks	B-6
Battery Tips	B-7

### **Warranty and Product Information**

Warranty	WA-1
Disclaimer	WA-2
Product	WA-2

---

Exclusions	WA-2
Warning: Limitations On Use	WA-2
Return Material Authorization Policy	WA-3
Return Procedure	WA-3
Out of Warranty Service	WA-3
Information About Your System	WA-4
<b>Index</b>	<b>IX-1</b>





# 1

## Introduction

Congratulations on your purchase of the Xantrex TS400 Sine Wave Inverter!

The TS400 has been designed to give you premium power, ease of use, and outstanding reliability.

Please read this chapter to familiarize yourself with the main performance and protection features of the TS400.

To ensure quality customer service for your inverter, be sure to keep your proof of purchase. Also, take a few minutes at this time to complete the form, “Information About Your System” on page WA-4.

## How TS400 Works

TS400 is a sine wave inverter which converts 12 volts direct-current (DC) power from your battery to 120 volts alternating current (AC) power. This AC power is the same as the electricity you get from your utility. In terms of output, TS400 provides 400 watts of sine wave power for operating your equipment.

## Premium Power and Ease of Use

TS400 provides premium power for your portable power needs. The inverter's sine wave output provides clean power for small power tools, test equipment, television monitors and battery chargers.

Superior features and rugged durability have been combined with ease of use:

- 400 watt inverter with 800 watt surge
- Filtered sine wave output will not cause distortion on sensitive electronics
- DSP control technology starts complex loads with ease
- Two GFCI outlets and hardwire AC connections
- Easy-to-read indicator lights on the front panel
- Optional S400 Remote Switch provides On/Standby control from a convenient location
- Audible alarm for low battery voltage
- Automatic cooling fan

## Comprehensive Protection

TS400 is designed to meet UL 458 and CSA C22.2 No. 107.1 safety standards and it is compliant with FCC Class B.

TS400 comes equipped with numerous protection features to guarantee you safe and worry-free operation.

Protection feature	This protection feature...
Low voltage alarm and shutdown	Protects the battery from becoming completely discharged. The Low Battery light and audible alarm indicate that input voltage is low (10.7 volts). If the input voltage drops below 10.3 volts, the TS400 shuts down automatically and the Inverter ON light turns off. The TS400 recovers automatically when the input voltage comes up to about 12.6 volts.
High voltage shutdown	Protects the TS400 by disabling the AC output when the input voltage rises to 15.3 volts or more. The AC output is enabled when the input voltage drops to 14.5 volts.
Over-temperature shutdown	Disables the AC output of the TS400 when the internal temperature rises to unacceptable levels due to higher ambient temperature or overloading. The TS400 recovers automatically when it cools down.
Overload protection	Disables the AC output of the TS400 if the appliance connected to the inverter exceeds the 400 watt rating of the inverter. The TS400 will have to be reset. (See “Resetting After a Fault or Shutdown” on page 3–7.)
Supplemental circuit protection	Trips and disables the AC output when a current in excess of 7.5 amps is drawn from the TS400. The supplemental circuit protector can be reset to enable the unit to operate again after clearing the overload condition. (See “Resetting After a Fault or Shutdown” on page 3–7.)
Short circuit protection	Disables the AC output of the TS400 when a short circuit is applied on the AC output. Once the short circuit is cleared, the TS400 will have to be reset. (See “Resetting After a Fault or Shutdown” on page 3–7.)
Ground fault circuit interrupter (GFCI)	Trips and disables the output of the TS400 when a ground fault current is detected. The output can be enabled again by resetting the GFCI, once the ground fault is cleared. (See “Ground Fault” on page 3–7.)

# TS400 Features

## Front Panel

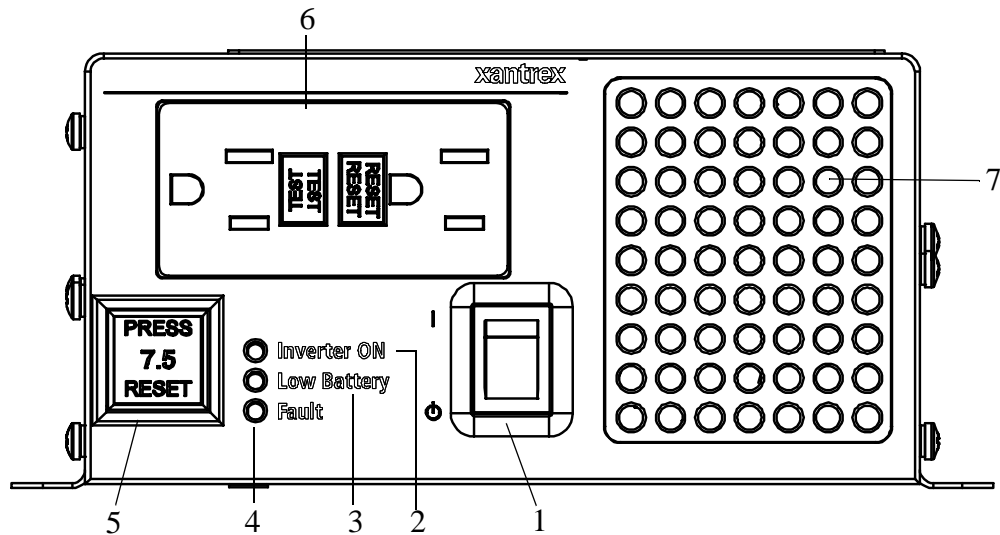


Figure 1-1 Front Panel of the TS400

Table 1-1 Front Panel Features

Feature	Description
1	<b>On/Standby Switch</b> turns the inverter to On (I) or to Standby (ϕ).
2	<b>Inverter ON light</b> illuminates when the TS400 is powering equipment from the battery.
3	<b>Low Battery light</b> illuminates when your battery voltage is lower than 10.7 volts.
4	<b>Fault light</b> illuminates for fault conditions such as over temperature, output overload, or battery over voltage.
5	<b>Supplemental Circuit Protection button</b> trips if there is an over-current (over 7.5 amps) or a short circuit.
6	<b>GFCI outlets</b> for connecting your equipment.
7	<b>Ventilation openings</b> provide air circulation for peak performance.

## Back Panel

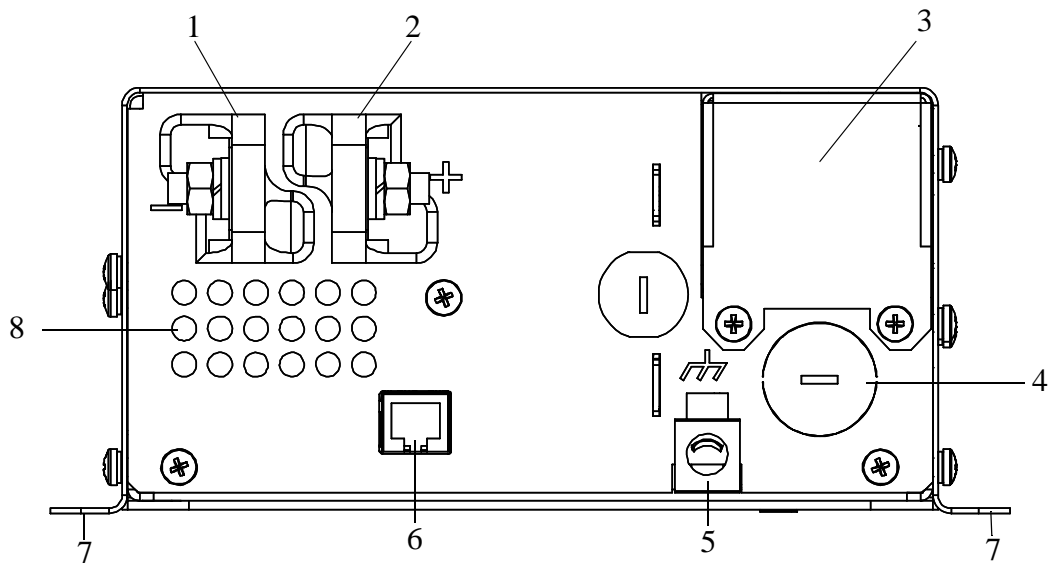


Figure 1-2 Back Panel of the TS400

Table 1-2 Back Panel Features

Feature	Description
1	DC terminal, negative
2	DC terminal, positive
3	Wiring box access panel (For a view with the panel removed, see “Completing the Hardwiring” on page 2–21.)
4	Knockout for AC output hardwiring
5	Chassis ground lug
6	Jack for optional remote switch
7	Mounting flanges
8	Ventilation openings provide air circulation.

## Optional Accessory: Remote Switch

An optional remote switch can be plugged into the remote switch jack at the back of the TS400. It lets you switch the TS400 from on to standby from a convenient location—up to 25 feet (7.5 m) away from the inverter (using the cable supplied with the switch).

### Dimensions of Remote Switch

<b>Height</b>	2.5 inches (63.5 mm)
<b>Width</b>	2 inches (50.8 mm)
<b>Depth</b>	1.1 inches (28.3 mm)
<b>Cable length</b>	25 feet (7.5 m)

### Part number of Remote Switch

To purchase a remote switch, please contact Customer Service for a referral to a distributor. Please provide the part number 808-2400. See page ii for contact information.

---

**Note:** The remote switch jack at the back of the TS400 may not be accessible once the inverter has been mounted. If you intend to use the remote switch with an TS400 that has already been installed, consult a qualified service technician before installing and connecting the remote switch.

---

# 2

## Installation

Chapter 2, “Installation”, provides detailed information for installing the TS400 and the optional S400 Remote Switch. This chapter provides:

- a system diagram
- safety instructions and installation codes that must be observed during installation
- a list of installation tools and materials
- detailed installation procedures
- chassis ground and DC cabling information
- procedures for hardwiring the AC output
- an illustration of inverter dimensions



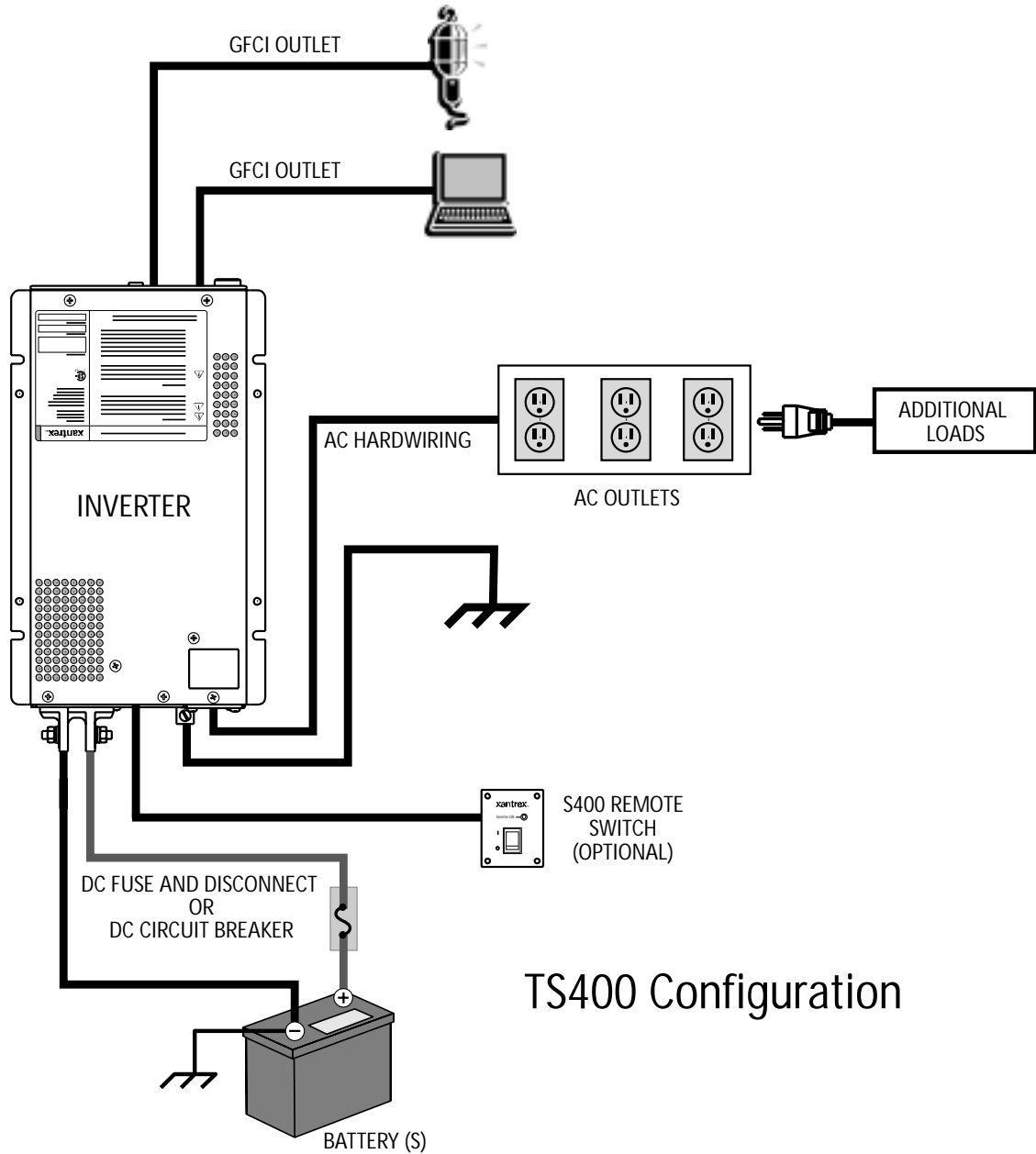
### CAUTION

Be sure to read all instructions before installing and operating the TS400.

---

# Introduction

The system diagram shown in Figure 2-1 is the basic installation. Review this diagram carefully before installing the TS400.



TS400 Configuration

Figure 2-1 System Diagram



---

## Preparing for Installation

Read this entire installation chapter so you can plan the installation from beginning to end. Prior to beginning your installation, review the “Important Safety Instructions” on page vii.



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

Xantrex recommends all wiring be done by qualified personnel. Disconnect all power sources to prevent accidental shock. Disable and secure all disconnect devices and automatic generator starting devices.

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

---



### **WARNING: Fire hazard**

To meet regulatory requirements, the TS400 must be mounted on a flat horizontal surface with the front panel in the upright position.

---

## Installation Codes

It is the installer’s responsibility to determine which codes apply and to ensure that all applicable installation requirements are met.

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) requirements for installation in RVs.



### **WARNING: Restrictions on use**

The TS400 Sine Wave Inverter shall not be used in connection with life support systems or other medical equipment or devices.

---

## Materials List

Your TS400 Sine Wave Inverter package includes:

- One TS400 Sine Wave Inverter
- TS400 Sine Wave Inverter Owner's Guide

After you unpack your TS400, be sure to record the product information in the form "Information About Your System" on page WA-4.

If any of these materials are missing or unsatisfactory, please contact Customer Service.

Telephone 1-800-670-0707 (toll free in North America)

1-604-422-2777 (direct)

Fax 1-604-420-2145

Email CustomerService@xantrex.com

Web www.xantrex.com

## Installation Tools and Materials

You will need the following tools and materials to install the TS400 and the optional S400 Remote Switch:

### Tools

To install the TS400, you need:

- Phillips screwdriver: #2
- Slot screwdrivers: 1/8 inch and 1/4 inch
- Wrench for DC terminals: 10 mm or adjustable
- Wire stripper

To install the optional S400 Remote Switch, you need:

- Power drill with 1/8-inch bit
- Jigsaw (optional)
- Feed wire (optional)

### Materials for TS400 and Optional S400 Remote Switch

To install the TS400 and optional S400 Remote Switch, you require:

- DC cables (See Table 2-1 on page 2-9.)

- Appropriately sized connectors. Two DC connectors suitable for ¼ inch (6 mm) that go on the DC input cable terminals. The other cable connectors will depend on your installation.
- Crimping tool for fastening lugs and terminals on DC cables (You may find it more convenient to have the crimp connectors attached by the company that sells you the cable.)
- DC fuse and Disconnect or DC circuit breaker (See page 2–9.)
- Four #10 hardware fasteners to mount the TS400
- Four #6 self-tapping screws to mount the S400 Remote Switch

### Materials for AC output hardwiring

- Cable requirements:
  - within the range of No. 14 to No. 18 AWG (minimum size)
  - 3 conductors
  - solid or stranded
- 1/2 inch cable clamp

# Installing the TS400

## Overview

This chapter provides detailed information on installing the TS400. The overall procedure is divided into 11 steps:

1. Designing your installation (page 2–6)
2. Mounting your inverter (page 2–10)
3. Connecting the chassis ground (page 2–11)
4. Installing the optional S400 Remote Switch (page 2–12)
5. Getting ready to connect the DC cables (page 2–14)
6. Routing the DC cables (page 2–15)
7. Connecting the DC cables (page 2–16)
8. Connecting your equipment to the GFCI outlets (page 2–18)
9. Hardwiring the AC output (page 2–19)
10. Performing checks prior to initial start-up (page 2–22)
11. Testing your installation (page 2–22)

## Step 1: Designing Your Installation

Before doing anything else, you need to determine how you are going to use your TS400, and then design a power system that will give you maximum performance. The more thorough your planning, the better your power needs will be met. In particular, you will need to:

- Be aware of installation codes
- Choose an appropriate location
- Calculate your battery requirements and appropriate battery size
- Calculate the DC cable size
- Select the correct DC fuse and Disconnect or the DC circuit breaker

## Installation Codes

See “Installation Codes” on page 2–3 for more information.

---

## Choosing a Location



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

Dry	Choose a dry location. Do not allow water or other fluids to drip or splash on the inverter. Do not expose to rain, snow or splashing water.
Cool	Normal air temperature should be between 32 °F (0 °C) and 104 °F (40 °C) — the cooler the better within this range.
Ventilated	The inverter 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. Allow as much space around the ventilation openings as possible. Xantrex recommends that other objects be at least 3 inches (76 mm) away from the ventilation openings for best performance. The air vented through the openings should also have a path to circulate away from the inverter.
Safe	Do not install the inverter in the same compartment as batteries or in any compartment containing flammable liquids like gasoline.

## Installation

---

Close to battery compartment	Long DC cables must be very large (and expensive), so they should be kept short (see Table 2-1 on page 2-9). However, 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 allow battery acid to drip on the inverter or its wiring when filling the batteries or reading their specific gravity. Do not mount the unit where it will be exposed to gases produced by the batteries. These gases are corrosive and prolonged exposure will damage the inverter.
Orientation	To meet regulatory requirements, the TS400 must be mounted on a flat horizontal surface with the front panel in the upright position.

## Battery Requirements



### CAUTION

The TS400 Sine Wave Inverter must only be connected to batteries with a nominal output voltage of 12 volts. The TS400 Sine Wave Inverter will not operate from a 6 volt battery and will be damaged if connected to a 24 volt battery.

---

The batteries that you use strongly affect the performance of the TS400. It is important to connect the inverter to the correct size and type of battery. See Appendix B, “Battery Types and Sizes” on page B-1 for more information.

---

## DC Cables

For the best load starting performance, the DC cables should be as short and large as possible. See Table 2-1 for minimum recommended cable size. Using a smaller cable may cause the inverter to shut down under heavy load. A larger cable may be used.

**Table 2-1** Minimum Recommended DC Input Cable (copper) — AWG

<b>Cable Length: Battery to Inverter (each cable)</b>	<b>Minimum Recommended Cable Size – AWG</b>
0–10 feet (0–3 meters)	No. 6
10–15 feet (3–4.5 meters)	No. 4
15–30 feet (4.5–9 meters)	No. 2
30–40 feet (9–12 meters)	No. 0

## DC Fuse and Disconnect or DC Circuit Breaker

If you are using a DC fuse and Disconnect, a maximum 80 amp Class T fuse shall be used for the DC fuse. A fuse of lower rating can be used, but it shall not be lower than 60 amp Class T. The Disconnect shall be rated at least 50 amps.

Additionally, a DC circuit breaker rated 50 amps can be used.

## Step 2: Mounting Your Inverter

Mount your inverter before you connect any wires or cables.

For your convenience, the inverter dimensions are provided in Figure 2-9 on page 2–23.



### **WARNING: Fire hazard**

To meet regulatory requirements, the TS400 must be mounted on a flat horizontal surface with the front panel in the upright position.

---

#### **To mount your TS400:**

1. Turn the On/Standby switch on the front panel of the inverter to Standby (⏻) position.
2. Select an appropriate mounting location and orientation. See “Choosing a Location” on page 2–7.
3. Hold the inverter against the mounting surface, mark the position of the mounting screws, and then remove the inverter.

OR

Use “Inverter Dimensions” on page 2–23 to mark the position of the mounting screws.

You can also download a full-scale version of the mounting template from [www.xantrex.com](http://www.xantrex.com)

4. Pilot drill the four mounting holes.
5. Fasten the inverter to the mounting surface with four #10 hardware fasteners.



---

## Step 3: Connecting the Chassis Ground

The chassis ground lug is used to connect the chassis of the inverter to your system's chassis grounding point, as required by installation codes.

Use copper cable that is either bare or provided with green insulation. Do not use the chassis ground lug for your AC output grounding wire.

### To connect the chassis ground:

Refer to Figure 2-2.

1. Using the 1/4 inch slot screwdriver, loosen the screw on the chassis ground lug.
2. Connect a No. 8 AWG copper cable between the inverter's chassis ground lug and the DC grounding point for your system.

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

3. Tighten the screw to a torque of 6–7 lbf-in (0.68–0.79 Nm).

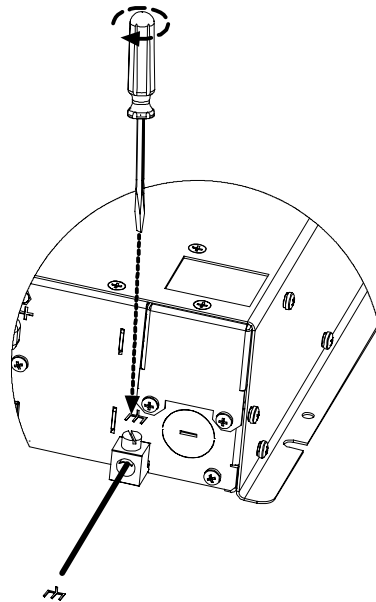


Figure 2-2 Connecting the Chassis Ground

---

## Step 4: Installing the Optional S400 Remote Switch

---



### **WARNING: Shock hazard**

Before making an opening in a wall, bulkhead or panel, ensure there is no wiring or other obstruction within the wall.

---



### **WARNING: Shock hazard**

Ensure both the S400 Remote Switch and the TS400 are in Standby (⏻) mode before installing.

---

Installing the S400 Remote Switch (Xantrex product number 808-2400) is optional. The TS400 operates normally without the remote switch.

The S400 Remote Switch is designed to be flush mounted on a wall, bulkhead or panel. A 25 foot (7.5 meter) telephone cable is supplied with the remote switch.

If you want to extend the cable, use a high quality, 4-wire telephone extension cable with 6-position, 4-contact connectors. The maximum recommended cable length is 50 feet (15 meters).

For your convenience, a full-scale mounting template is provided on page 2-24.

---

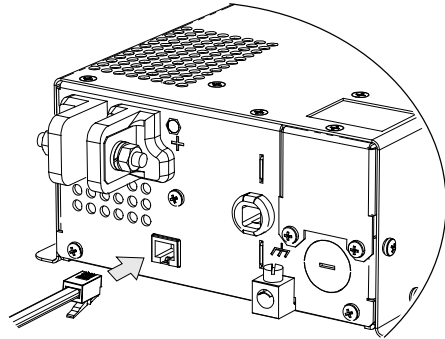
**Note:** The S400 Remote Switch connects to a jack at the back of the inverter. See “System Diagram” on page 2-2.

---

### **To install the remote switch:**

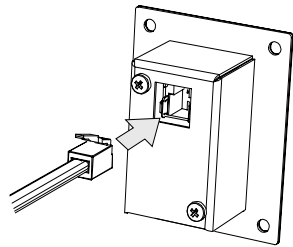
1. Choose a location that is dry, free from corrosive or explosive fumes, and otherwise appropriate for installing an electronic device.
2. Using the template, pilot-drill the mounting holes. Cut an opening about 2 inches x 1.2 inches (50 mm x 30 mm) and 1.4 inches (35 mm) deep.
3. Route the telephone cable inside the wall and through the opening to the inverter.

4. Connect one end of the telephone cable to the back of the inverter as shown in Figure 2-3.



**Figure 2-3** Connecting Cable to the TS400

5. Connect the other end of the telephone cable to the remote switch as shown in Figure 2-4.



**Figure 2-4** Connecting Cable to the S400 Remote Switch

6. Place the remote switch in the opening and secure it with the four #6 fasteners.

## Step 5: Getting Ready to Connect the DC Cables

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. The minimum recommended DC cable size is specified in Table 2-1 on page 2-9. For the recommended DC fuse and Disconnect or DC circuit breaker, see page 2-9.

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

Refer to Figure 2-5, “Connection Order for DC Cables” on page 2-16.

1. Cut the negative cable to the recommended length. (See Table 2-1 on page 2-9 for DC cable size.) Strip off enough insulation so you can install the terminal you will be using.

Xantrex recommends the use of crimp connectors such as a ring lug type. The connector should be designed for a 6 mm or 1/4 inch stud size to connect to the TS400 Sine Wave Inverter. If a crimp connector is used, it should be crimped using the tool indicated by the connector manufacturer.

2. Cut two lengths of positive cable. One cable (maximum 18 inches) goes from the battery to the DC fuse and Disconnect or to the DC circuit breaker. The other cable goes from the DC fuse and Disconnect or to the DC circuit breaker to the positive DC terminal.
3. Attach the connectors to the ends of both cables. Make sure no stray wire strands protrude from the terminals.

---

## Step 6: Routing the DC Cables



---

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

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

---

### Guidelines for Routing the DC Cables

- 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 interference, keep the positive and negative cables close together—ideally, tied together at regular intervals as shown in Figure 2-5, “Connection Order for DC Cables” on page 2–16.
- To ensure maximum performance from the inverter, 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 to protect the DC wiring.

## Step 7: Connecting the DC Cables

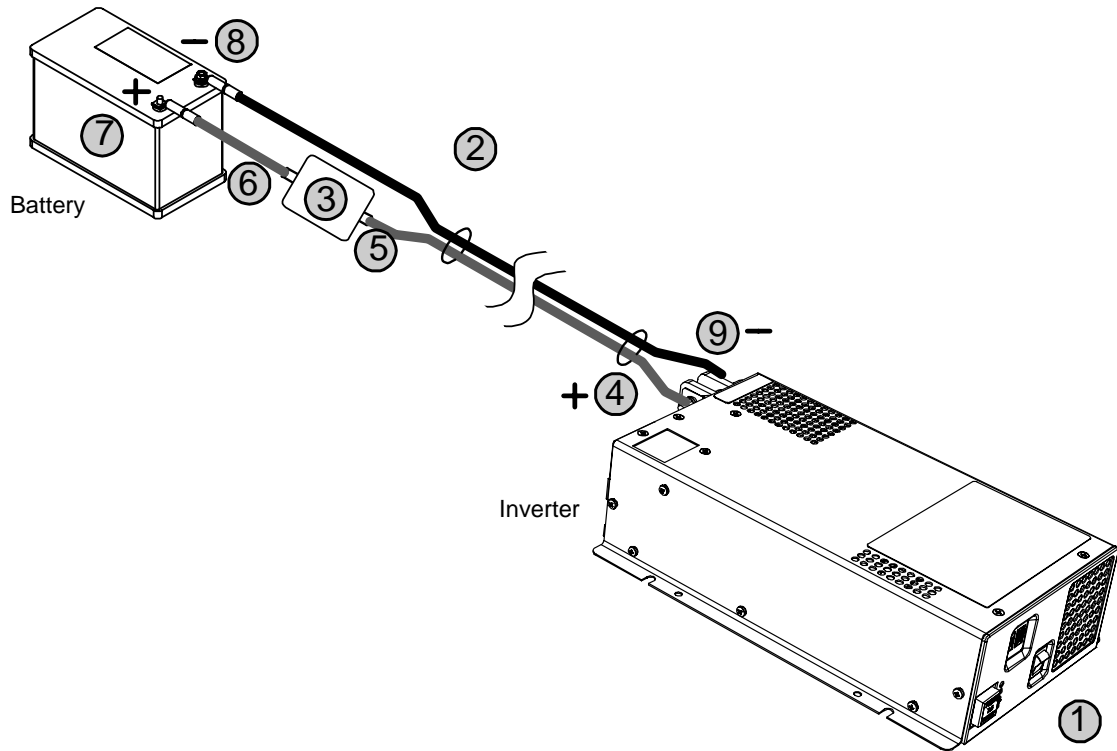


Figure 2-5 Connection Order for DC Cables



### CAUTION: Reverse polarity

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

Reversing the positive (+) and negative (-) battery cables will damage the inverter and void your warranty.



### WARNING: Fire hazard

Use only appropriately sized copper cable. Make sure all DC connections are tightened to a torque of 2.2–2.6 lbf-ft (3.0–3.5 Nm). Loose connections will overheat.

---

**To connect the DC cables:**

Connect the DC cables as shown in Figure 2-5, in the order shown by the numbers.

1. Switch the On/Standby switch to the Standby ( $\Phi$ ) position.
2. Route the DC cables from the battery bank to the inverter.  
See “Step 6: Routing the DC Cables” on page 2–15.
3. Install a DC fuse and Disconnect or a DC circuit breaker in the positive side of the circuit within 18 inches of the battery.  
This protects your battery and wiring in case of accidental shorting. (See “DC Fuse and Disconnect or DC Circuit Breaker” on page 2–9 for recommended fuse size and type.) Open the DC fuse and Disconnect or turn off the DC circuit breaker.
4. Connect one connector on the POSITIVE (+) cable to the POSITIVE DC terminal on the inverter. Tighten the nut to a torque of 2.2–2.6 lbf-ft (3.0–3.5 Nm).
5. Connect the other connector to the positive (+) terminal DC fuse and Disconnect or to the DC circuit breaker. Use a wrench to tighten the connection according to the manufacturer’s recommendations. Test that the cable is secure.
6. Attach a short DC cable from the unconnected end of the DC fuse and Disconnect or DC circuit breaker. Tighten appropriately.
7. Observing polarity carefully, connect the other end of the fused cable to the POSITIVE (+) terminal of the battery. Tighten this connection to the battery manufacturer’s recommended torque.
8. Connect one connector on the NEGATIVE (–) cable to the NEGATIVE (–) battery terminal. Tighten the connection according to the battery manufacturer’s recommended torque.
9. Check that the polarity of the DC connections is correct: positive (+) on the inverter is connected to the positive (+) on the battery, and negative (–) is connected to the negative (–).
10. Connect the other connector of the NEGATIVE (–) cable onto the NEGATIVE (–) terminal on the TS400 Sine Wave Inverter.
11. Use a wrench to tighten the nut to a torque of 2.2–2.6 lbf-ft (3.0–3.5 Nm). Test that the cable is secure.

## Step 8: Connecting Your Equipment to the GFCI Outlets

**To connect your AC equipment to the GFCI outlets:**

1. Turn the inverter's On/Standby switch to Standby (⏻).
2. Turn your AC equipment off.
3. Connect your AC equipment to the GFCI outlets in the front panel.
4. If you wish to connect more equipment, use a multiple-outlet extension cord. Ensure that the total power drawn does not exceed 400 watts.

---

**Note:** Ensure that the Reset button on the GFCI outlets is not tripped.

---

**Important:** If you have more permanent loads to connect to the inverter, Xantrex recommends that they be hardwired. See “Step 9: Hardwiring the AC Output” on page 2-19.

---



---

## Step 9: Hardwiring the AC Output

If you wish to permanently connect additional AC outlets, Xantrex recommends hardwiring the AC output connections.



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

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

---

#### **To hardwire the AC output connections:**

1. Turn the On/Standby switch to Standby ( $\phi$ ).
2. Remove the knockout using a slot screwdriver as shown in Figure 2-6. Do not leave the knockout inside the wiring box.

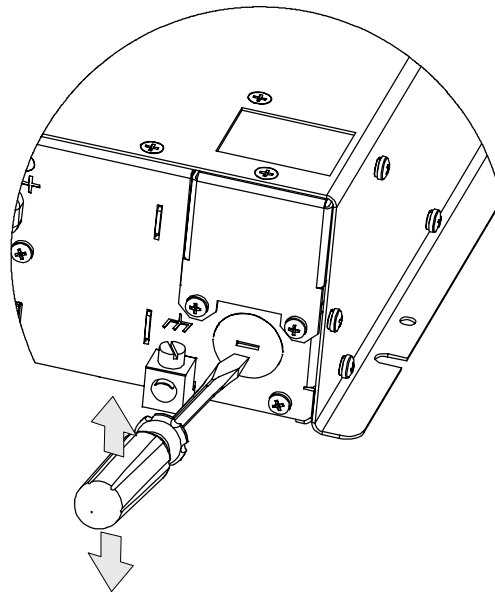
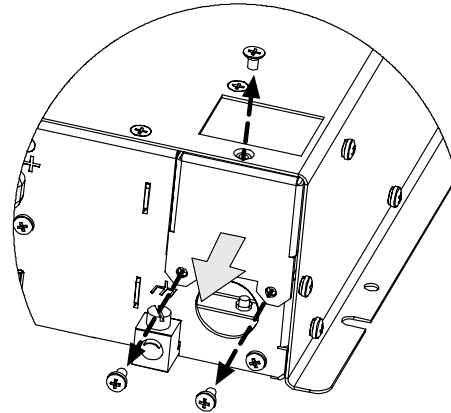


Figure 2-6 Removing the Knockout

3. Locate the wiring box access panel, and remove the three screws to access the wiring box as shown in Figure 2-7.



**Figure 2-7** Removing the 3 Screws on the Wiring Box Access Panel

4. Remove the wiring box access panel from the unit.
5. Install a 1/2 inch cable clamp.
6. Locate the terminal block.  
The three terminals are labelled as follows:
  - **L** Line
  - **N** Neutral
  - **⏚** Ground
7. Strip about 2 inches (50 mm) off the jacket of the AC output cable.  
The AC output cable must be either solid or stranded, within the range of No. 14 to No. 18 AWG, and have three conductors.
8. Strip approximately 3/8 inch (10 mm) off the insulation of the cable.
9. Run the AC cable through the cable clamp and into the wiring box.
10. Using the 1/8 inch slot screwdriver, loosen the wire attachment screws on the terminals by five turns.
11. Insert and fasten the Ground wire into the corresponding terminal.
12. Insert the Line and Neutral wires into the corresponding terminals.

13. Tighten the wire attachment screws to a torque of 1.3–1.8 lbf-ft (1.76–2.44 Nm) as shown in Figure 2-8. Leave some slack inside the output wiring box.
14. Secure the cable clamp on the cable jacket.
15. Attach the wiring box access panel and tighten the three screws.

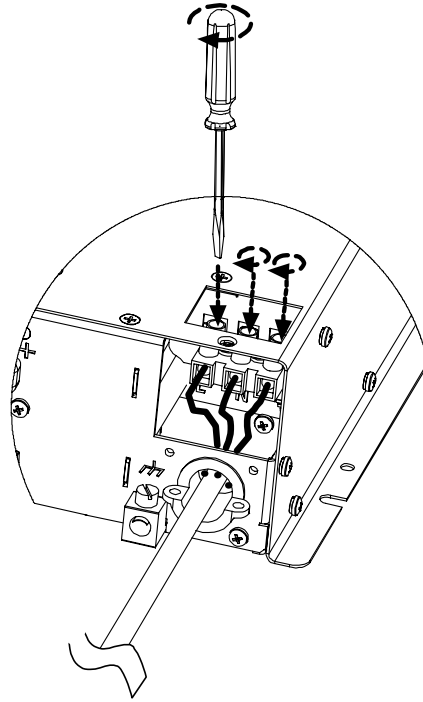


Figure 2-8 Completing the Hardwiring

---

## Step 10: Performing Checks Prior to Initial Start-up

Before starting up your inverter, ensure these conditions are met:

- Chassis ground is properly installed
- On/Standby switch is in the Standby (⏻) position on the TS400
- Positive (+) battery cable is connected to the positive (+) battery terminal through the DC fuse and Disconnect 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 Fuse is intact (not blown)

## Step 11: Testing Your Installation



### **WARNING: Shock hazard**

The On/Standby switch on the TS400 does not disconnect DC power to the TS400.

---

When you are ready to test your installation and operate the TS400, close the DC fuse and Disconnect or the DC circuit breaker to supply DC power to the TS400.

#### **To test the TS400:**

1. Turn the inverter's On/Standby switch to the On (⏻) position. If the optional S400 Remote Switch is installed, turn the On/Standby switch on the remote switch to the On (⏻) position.  
The green Inverter ON indicator illuminates.
2. Plug an appliance of 400 watts or less into one of the GFCI outlets.
3. Turn the appliance on to verify that it operates.
4. If the appliance operates, your installation is successful.
5. If the red Fault light illuminates, see “Troubleshooting” on page 4–1.



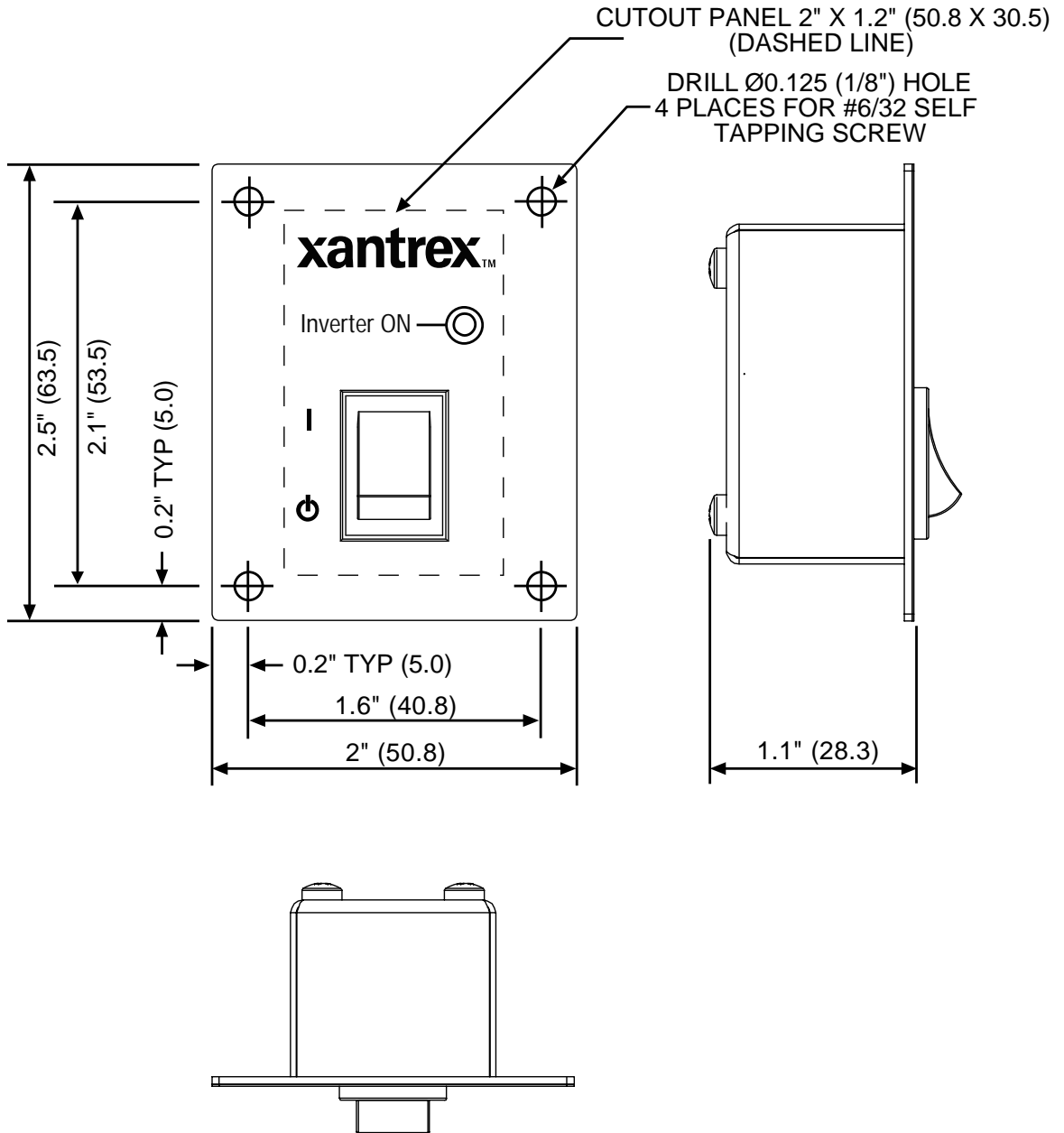


Figure 2-10 S400 Remote Switch Mounting Template (Scale approximately 1:1)

# 3

## Operation

Chapter 3, “Operation” explains how to use your TS400 effectively. This chapter explains how to turn the TS400 to On (I) or Standby (⏻) from the front panel or from the optional S400 Remote Switch, monitor the status of the TS400, and reset the inverter.



### **CAUTION**

Read this chapter before operating the TS400 Sine Wave Inverter.

---



### **WARNING: Restrictions on use**

The TS400 Sine Wave Inverter shall not be used in connection with life support systems or other medical equipment or devices.

---

## Front Panel Features

Before you begin to operate the TS400, review the front panel features in Figure 3-1.

For a detailed description of each of the different features, see “Front Panel of the TS400” on page 1–4 in the “Introduction” chapter.

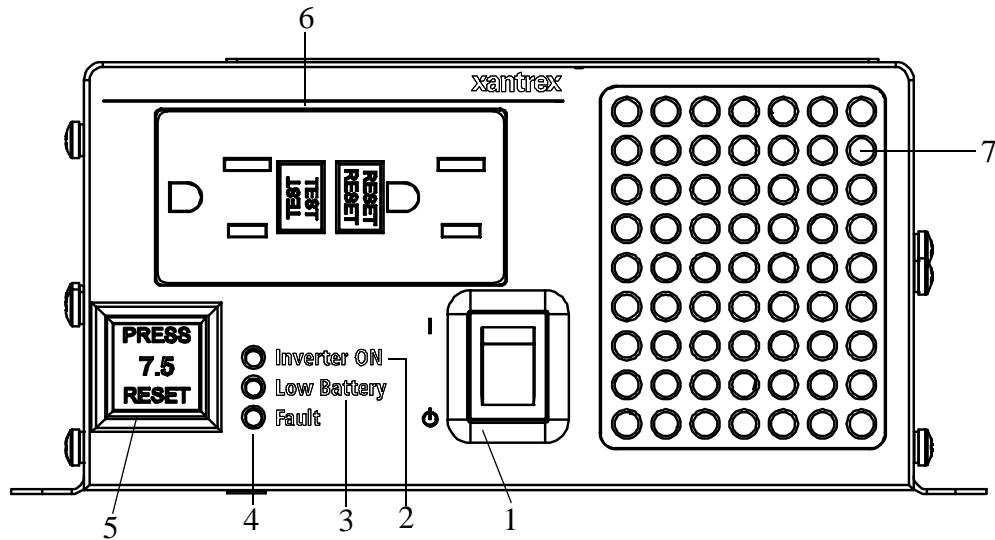


Figure 3-1 Front Panel of the TS400

Table 3-1 Front Panel Features

Feature	Description
1	On/Standby Switch
2	Inverter ON light
3	Low Battery light
4	Fault light
5	Supplemental Circuit Protection button
6	Two GFCI outlets
7	Ventilation openings



---

## Operating the TS400



### **WARNING: Shock hazard**

The TS400 has On mode and Standby mode only. It does not have an Off mode, that is, DC power is permanently connected to the unit.

---

On/Standby switch	You can turn the TS400 to On (I) or to Standby (⊖) using the On/Standby switch (see “Front Panel of the TS400” on page 3–2).
Optional remote switch	If you have installed the optional S400 Remote Switch, you can also use the remote switch to turn the TS400 to On (I) or to Standby (⊖). See “Using the Optional S400 Remote Switch” on page 3–4.
Resetting the TS400	The On/Standby switch on the TS400 or the S400 Remote Switch is also used to reset the TS400 after a Fault condition. See “Resetting After a Fault or Shutdown” on page 3–7.

### Turning the TS400 On

When the On/Standby switch is turned to On (I), the TS400 powers your equipment using energy from the battery.

#### **To turn the TS400 on:**

1. Turn the On/Standby switch on the TS400 to the On (I) position.  
The Inverter ON light illuminates on the TS400.  
AND  
If you have installed the S400 Remote Switch, turn the S400 Remote Switch to On (I).
2. Operate your equipment.

### Turning the TS400 to Standby When Not in Use

When you are not using the TS400 and want to conserve battery power, turn the inverter’s On/Standby switch to the Standby (⊖) position.

#### **To turn the TS400 to standby:**

1. Turn your equipment off.
2. Turn the On/Standby switch on the TS400 or the optional S400 Remote Switch to the Standby (⊖) position.  
The Inverter ON light turns off.

With the On/Standby switch in Standby (⊖) position, the TS400 draws no current from the battery.

## Operation

---

If the On/Standby switch on the TS400 is in the On (I) position and the optional S400 Remote Switch is in the Standby (⏻) position (see “Important” on page 3–4), the TS400 draws very little current (about 1 mA) from the battery.

## Using the Optional S400 Remote Switch

The S400 Remote Switch performs the same function as the On/Standby switch on the TS400.

---

**Important:** For the Remote Switch to function, the On/Standby switch on the TS400 must be turned to the On (I) position.

---

### Purpose

The S400 Remote Switch provides On/Standby control of the TS400 from a convenient location of up to 25 feet (7.5 meters) away using the supplied telephone cable.

### Cable length

You can use a longer cable up to a maximum recommended length of 50 feet (15 meters). Xantrex recommends using a high quality 4-wire telephone cable with 6-position, 4-contact connectors.

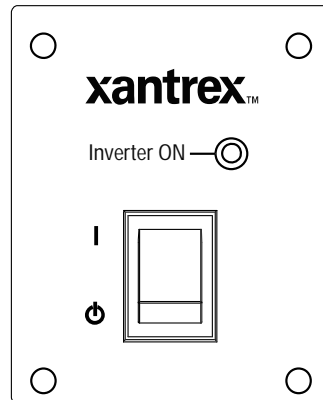


Figure 3-2 S400 Remote Switch

---

## Recharging Your Batteries

Low Battery light	<p>If the Low Battery light illuminates on the TS400 and you hear the low battery alarm, your battery level is low (less than 10.7 volts). As long as the Inverter ON light is illuminated on the TS400, the unit will continue to supply inverter power to your equipment.</p> <p>However, Xantrex highly recommends that you recharge your battery. Turn off your equipment and recharge your battery. When the Low Battery light and the audible alarm turn off (at 12.6 volts), you can restart your equipment. See “Restarting or Operating Multiple Pieces of Equipment”.</p>
Importance of recharging	<p>Xantrex recommends that you recharge your batteries before they are 50% discharged. This gives them a much longer life cycle than recharging them when they are almost completely discharged. See “Battery State of Charge” on page B-8.</p>
More information	<p>For more information about battery chargers and battery monitors, see the Xantrex web site at <a href="http://www.xantrex.com">www.xantrex.com</a>.</p>

## Recovering from Low Battery Voltage Shutdown

If the Low Battery light illuminates, you hear an alarm, and the Inverter ON light on the front panel turns off when you are operating the unit, the TS400 has shut down due to low battery voltage (10.3 volts). Output power is interrupted.

### To recover from a low battery voltage shutdown:

1. Turn off your equipment and recharge your battery. The alarm will turn off when battery voltage reaches 11.6 volts.
2. When the Low Battery light turns off (12.6 volts) and the Inverter ON light illuminates, you can restart your equipment.

## Restarting or Operating Multiple Pieces of Equipment

The TS400 can handle several pieces of equipment simultaneously as long as they do not draw more than 400 watts in total.

### To restart or operate several pieces of equipment:

- ◆ Turn each device on separately after the TS400 has started.
 

This action ensures that the TS400 does not have to deliver the starting current for all the loads at once and will help to prevent an overload shutdown.

## Monitoring the Operating Status

The operating status of the TS400 is indicated by three lights on the front panel and an audible alarm. See Table 3-2.

For an illustration of the indicator lights on the front panel, see “Front Panel of the TS400” on page 3-2.

If none of the front panel lights are on, see “Troubleshooting Reference” on page 4-2.

**Table 3-2** Status of Indicator Lights and Alarm

Light	Color	Status	Action
<b>Inverter ON</b>	Green	When the TS400 is on, the Inverter ON light illuminates.	You can run your equipment using energy from the battery.
<b>Low Battery &amp; Inverter ON (with audible alarm)</b>	Yellow & Green	When the Low Battery and Inverter ON lights illuminate, your battery level is low. (The battery voltage has dropped below 10.7 volts DC.)	You can run your equipment but your battery level is low. Charge your battery.
<b>Low Battery (with audible alarm)</b>	Yellow	When only the Low Battery light illuminates, your battery level is critically low. (The battery voltage has dropped below 10.3 volts DC.)	You cannot run equipment. Charge your battery.
<b>Fault</b>	Red	The Fault light illuminates whenever there is a battery over-voltage fault condition (exceeds 15.3 volts), output overload fault condition or over-temperature fault condition.	You cannot run equipment as the AC output is disabled. Clear the fault condition. Reset the TS400 by turning the On/Standby switch to Standby (⏻) and then to On (⏻).

## Resetting After a Fault or Shutdown

This section provides explanations and procedures for resetting the TS400 after a fault or shutdown.

If you are unable to resolve the problem after referring to Table 3-3, refer to the “Troubleshooting” section on page 4-2.

Table 3-3 Resetting After a Fault or Shutdown

Fault	Status	Action
<b>Shutdown</b>	The TS400 needs to be reset.	Turn the On/Standby switch on either the inverter’s front panel or the optional S400 Remote Switch to Standby (⏻) and then to On (⏻).
<b>Short Circuit</b>	If there is a short circuit, the Supplemental Circuit Protection button trips.	Remove the short circuit condition then press the Supplemental Circuit Protection button.
<b>Ground Fault</b>	When a fault condition is detected, the Reset button on the GFCI outlet trips and power to the appliance is interrupted.	<p><b>Reset:</b> To resume normal operation, determine and correct the ground fault, then press the Reset button.</p> <p><b>Test:</b> Press the Test button on the GFCI outlet with the TS400 turned to On (⏻). The Reset button should trip. Press the Reset button to reset the GFCI and continue with normal operation. This test should be performed on a monthly basis.</p> <p>If the Reset button does not trip, the GFCI may have failed. Contact your dealer to have a qualified service person examine the TS400.</p>
<b>Overload</b>	The TS400 is designed to provide 400 watts continuously and 800 watts surge capability for five seconds. If the connected equipment draws more than the rated power, the TS400 will shut down and the red Fault light illuminates.	<p>Disconnect the equipment connected to the inverter and then turn the On/Standby switch on either the inverter’s front panel or the S400 Remote Switch to Standby (⏻) and then to On (⏻).</p> <p>See also “Recharging Your Batteries” on page 3-5.</p>



# 4

## Troubleshooting

The TS400 is designed for high reliability and has a number of protection features for trouble-free operation. If, however, you have any problems operating your inverter, refer to the “Troubleshooting Reference” on page 4–3.

Read this troubleshooting chapter before calling your dealer or Xantrex Customer Service. See page ii for contact information.

If you cannot resolve the problem, record the information asked for on the form, “Information About Your System” on page WA–4. Providing this information to our Customer Service Representatives will help them to assist you better.

## Troubleshooting Reference



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

Do not disassemble the TS400. It does not contain any user-serviceable parts. Attempting to service the unit yourself could result in electrical shock or fire.

This section provides you with troubleshooting tips to identify and solve most problems that can occur with the TS400.

Before contacting your dealer or customer service, please refer to the table, “Troubleshooting Reference”.

If the “Troubleshooting Reference” table does not help you resolve the problem, contact your dealer or Xantrex customer service.

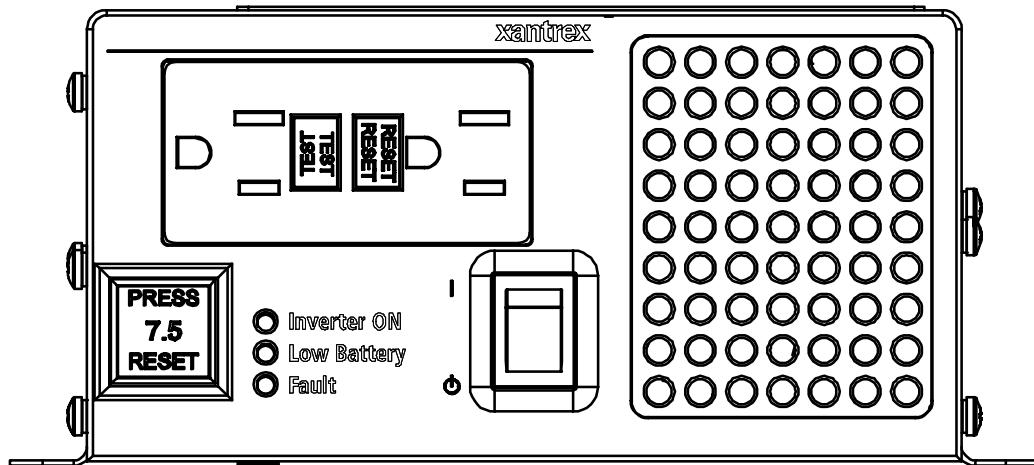


Figure 4-1 Front Panel

For a detailed description of the different features, see “TS400 Features” on page 1-4.



**Table 4-1** Troubleshooting Reference

<b>Problem</b>	<b>Possible Cause</b>	<b>Solution</b>
No output voltage. No indicator lights are illuminated.	The switch is in Standby (⏻) mode.	Turn the On/Standby switch on the inverter to On (⏻).
	No input power to the inverter.	Check the DC wiring to the inverter for loose connections, frayed wiring or an open DC Disconnect.
	DC fuse open (external)	Have a qualified service technician check and replace the fuse.
No output voltage. Inverter ON light is illuminated.	Supplemental Circuit Protection button has tripped.	Disconnect all equipment to reduce the overload. Check the AC wiring and reset the Supplemental Circuit Protection button.
	GFCI has tripped.	Clear the ground fault, and reset the GFCI by pressing the Reset button on the GFCI.
No output voltage. Fault light is illuminated.	Inverter may be overloaded.	Disconnect all equipment connected to the inverter, and reset the inverter by turning the On/Standby switch to Standby (⏻) and then to On (⏻).
	Battery voltage may be too high.	The inverter will restart if the battery voltage drops below 14.5 volts DC.
	Over temperature.	Allow the inverter to cool down. The inverter will restart automatically.
No output voltage. Low Battery light is illuminated and alarm is on.	Battery voltage is too low.	Recharge the battery to more than 12.6 volts DC. The inverter will restart automatically.
	Poor DC wiring.	Turn the inverter to Standby (⏻). Disconnect the DC wiring. Use proper wiring and ensure all connections are tight.

## Troubleshooting

**Table 4-1** Troubleshooting Reference

<b>Problem</b>	<b>Possible Cause</b>	<b>Solution</b>
Output voltage is present. Inverter ON light and Low Battery light are illuminated and alarm is on.	Battery voltage is low.	Disconnect all equipment. Charge the batteries.
Fan does not turn on.	The internal components of the inverter are not warm.	No action. The fan will run automatically when necessary to cool the internal components of the inverter.
Fan runs all the time.	The amount of power being consumed by the equipment is high.  The ambient temperature is high.	No action. The fan will run at lower speeds and stop automatically when the internal temperature of the inverter falls.  No action. The fan will run at lower speeds and stop automatically when the ambient temperature falls.  For more information on the “Fan Cooling System”, refer to page A-3.

# A

# Specifications

Appendix A, “Specifications”, contains the electrical and physical specifications for the TS400.

All specifications are subject to change without notice.

## Electrical Specifications

Output power at 12 VDC input	
• Continuous	400 VA <sup>1</sup> , 32 °F to 104 °F (0 °C to 40 °C), derated linearly to 300 VA at 122 °F (50 °C)
• Surge capacity for 5 seconds	800 VA
Input voltage	12 VDC nominal 10.3 to 15.3 VDC
Output voltage	120 VAC RMS $\pm$ 3 VAC
Output frequency	60 Hz $\pm$ 0.05 Hz
Output wave form	Sine wave
Total harmonic distortion of output waveform	<3%
High battery shutdown	15.3 $\pm$ 0.3 VDC
Low battery indication and audible alarm	10.7 $\pm$ 0.3 VDC
Low battery shutdown	10.3 $\pm$ 0.3 VDC
Maximum efficiency	88%
No load current draw with switch turned to On (I)	1.25 ADC Maximum
No load current draw with switch set to Standby (Ⓟ)	0 ADC
Supplemental circuit protector	7.5 AAC

<sup>1</sup>The term “watts” has been used throughout the guide to refer to output power. More correctly, the actual unit of power used is “VA”.

## Physical Specifications with Projections

Length	13.5 inches (343 mm)
Width	7.36 inches (187 mm)
Height	3.27 inches (83 mm)
Weight	10 lb (4.54 kg)

---

## Regulatory Approvals

CSA/NRTL approved to CSA C22.2 No. 107.1 and UL 458
---

FCC Class B
-------------

## Fan Cooling System

A fan cools the internal heat-generating components of the inverter. The fan begins to operate when the internal temperature rises. The speed of the fan increases with internal temperature.

The fan turns off if the internal temperature of the inverter drops.



# B

## Battery Types and Sizes

The batteries that you use strongly affect the performance of the TS400. It is important to connect the inverter to the correct size and type of battery.

The information in Appendix B will help you to select, connect, and maintain batteries that are most appropriate for your application.

## Battery Types

### Automotive Starting Batteries

The lead-acid battery you are most familiar with is probably the starting battery in your vehicle. An automotive starting battery is designed to deliver a large amount of current for a short period of time (so it can start your engine). Only a small portion of the battery's capacity is used when starting the engine, and the spent capacity is quickly recharged by the running engine.

The starting battery in your vehicle is not designed for repeated deep-discharge cycles where the battery is almost completely discharged and then recharged. If a starting battery is used in this kind of deep discharge service, it will wear out very rapidly.

### Deep-Cycle Batteries

Deep-cycle batteries are designed for deep discharge service where they will be repeatedly discharged and recharged. They are marketed for use in recreational vehicles, boats, and electric golf carts—so you may see them referred to as RV batteries, marine batteries, or golf cart batteries.

For most applications of the TS400, Xantrex recommends that you use one or more deep-cycle batteries that are separated from the vehicle's starting battery by a battery isolator.

A battery isolator is a solid-state electronic circuit that allows equipment to be operated from an auxiliary battery without danger of discharging the vehicle's starting battery. During vehicle operation, the battery isolator automatically directs the charge from the alternator to the battery requiring the charge.

Battery isolators are available at marine and RV dealers and most auto parts stores.



---

## Battery Size

---



### CAUTION

The TS400 Sine Wave Inverter must only be connected to batteries with a nominal output voltage of 12 volts. The TS400 Sine Wave Inverter will not operate from a 6 volt battery and will be damaged if connected to a 24 volt battery.

---

Battery size or capacity is as important as the battery type for efficient operation of your loads. Xantrex recommends that you purchase as much battery capacity as you need.

A number of different standards are used to rate battery energy storage capacity. Automotive and marine starting batteries are normally rated in cranking amps. This is not a relevant rating for continuous loads like an inverter. Deep-cycle batteries use a more suitable rating system, either “amp-hours” (“Ah”) or “reserve capacity” in minutes.

**Battery Reserve Capacity** Battery reserve capacity is a measure of how long a battery can deliver a certain amount of current—usually 25 amps. For example, a battery with a reserve capacity of 180 minutes can deliver 25 amps for 180 minutes before it is completely discharged.

**Amp-hour (Ah) Capacity** Amp-hour capacity is a measure of how many amps a battery can deliver for a specified length of time—usually 20 hours. For example, a typical marine or RV battery rated for 100 Ah can deliver 5 amps for 20 hours ( $5 \text{ A} \times 20 \text{ hours} = 100 \text{ Ah}$ ).

This same battery can deliver a higher or lower current for less or more time, limited approximately by the 100 Ah figure (for example, 50 A for 2 hours, or 200 A for 1/2 hour), but usually the capacity figure given is only accurate at the specified rate (20 hours).

To calculate the battery capacity you require, read “Estimating Battery Requirements” on page B-4 and “Battery Sizing Example” on page B-4, and then complete the “Battery Sizing Worksheet” on page B-5.

## Estimating Battery Requirements

**To determine how much battery capacity you need:**

1. Determine how many watts are consumed by each appliance that you will operate from the TS400. You can normally find the watt rating labelled on the product. If only the current draw is given, multiply it by 115 to get the power consumption in watts.
2. Estimate how many hours each appliance will be operating each day.
3. Calculate the daily watt-hours needed for each appliance.
4. Add the total number of watt-hours needed for all the equipment and multiply it by the number of days between charges.
5. Divide the total watt-hours of AC load between charges by 10. This gives the battery Ah used between charges.
6. Double the total Ah used between charges to get the recommended battery size in Ah.

See the battery sizing example that follows.

### Battery Sizing Example

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

Appliance	(A) Power Consumption (Watts)	(B) Operating Time per Day (Hours)	Daily watt-hours needed for this appliance (= A x B)
TV	100 W	4 hours	400 Wh
Fan	60 W	4 hours	240 Wh
3 lamps, 60 W each	180 W	4 hours	720 Wh
Laptop computer	60 W	4 hours	240 Wh
Small hand drill	300 W	1 hours	300 Wh
Other loads	100 W	3 hours	300 Wh
Total daily watt-hours of AC load			2200 Wh
x Number of days between charges			2
= Total watt-hours of AC load between charges			4400 Wh
Battery Ah used between charges (divide by 10)			440 Ah
Recommended Battery Bank Size in Ah (multiply by 2)			880 Ah

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

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

## Battery Sizing Worksheet

Use the following worksheet to calculate your battery needs. To ensure sufficient battery capacity, be generous when estimating the operating time per day for each of the loads you will run.

Appliance	(A) Power Consumption (Watts)	(B) Operating Time per Day (Hours)	Daily watt-hours needed for this appliance (= A x B)
	W	hours	Wh
	W	hour	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
	W	hours	Wh
Total daily watt-hours of AC load			Wh
x Number of days between charges			
= Total watt-hours of AC load between charges			Wh
Battery Ah used between charges (divide by 10)			Ah
Recommended Battery Bank Size in Ah (multiply by 2)			Ah

## Using Multiple Batteries

As your power requirements increase, you may need to use more than one battery to obtain sufficient capacity. Read “Two Batteries Connected In Parallel” on page B-6 and “Two Separate Battery Banks” on page B-6 to determine whether two batteries or two battery banks are more appropriate for your applications.

### Two Batteries Connected In Parallel

Two identical batteries can be connected positive (+) to positive (+) and negative (-) to negative (-) in a parallel system. A parallel system doubles capacity and maintains the voltage of a single battery.



#### CAUTION

Do not connect the following in parallel:

- batteries made by different manufacturers
- different types of batteries
- batteries that have different Ah ratings

Decreased battery life and improper charging will result.

---

### Two Separate Battery Banks

If you need more than two batteries (or are using different makes or models of batteries), Xantrex recommends that you install two separate battery banks and a battery selector switch.

By installing a battery selector switch, you can select between the two battery banks, use both banks in parallel, or disconnect both banks from the load. Battery selector switches are available at marine and RV dealers.

---

## Battery Tips



### **WARNING: Explosion and fire hazard**

Review “Precautions When Working With Batteries” on page viii before you work with the batteries in your system.

**Explosive/Corrosive Gases** Lead-acid batteries may emit hydrogen gases, oxygen, and sulfuric acid fumes when recharging. To reduce the risk of explosion:

- Vent the battery compartment to prevent the accumulation of gases.
- Do not install electronic or electrical equipment in the battery compartment.
- Do not smoke or use an open flame when working around batteries.

**Temperature Sensitivity** The capacity of lead-acid batteries is temperature sensitive. Battery capacity is rated at 77 °F (25 °C). At 0 °F (–20 °C), the Ah capacity is about half the rated capacity. You should consider temperature when designing your system.

- **Low Temperatures** If extremely low temperatures are expected where the inverter is going to be located, you should consider a heated equipment room. If the system is located in an unheated space, an insulated battery enclosure is recommended.
- **High Temperatures** The batteries should also be protected from high temperatures. These can be caused by high ambient temperatures, solar heating of the battery enclosure, or heat released by a nearby engine or generator. High battery temperatures shorten battery life and therefore you should ventilate the enclosure and use shade and insulation as appropriate.

**Discharged Batteries** Do not leave batteries in a discharged state for more than a day or two. They will undergo a chemical process (sulfation) that can permanently damage the battery. As well, batteries self-discharge over a period of three to six months, and they should be recharged periodically even if they are not being used.

**Electrolyte Level** If your batteries are not the “maintenance-free” type, check the electrolyte level at least once a month. Excessive fluid loss is a sign of overcharging. Replenish the electrolyte using only distilled water.

**Battery Connections** Connections to battery posts must be made with permanent connectors that provide a reliable, low-resistance connection. Do not use alligator clips. Clean the connections regularly and prevent corrosion by using a protective spray coating or Vaseline.

**Battery State of Charge** You can measure battery state of charge with a hydrometer or approximate state of charge with a voltmeter. Use a digital voltmeter that can display tenths or hundredths of a volt when measuring 10 to 30 volts. Make your measurements when the battery has not been charged or discharged for several hours. For a deep-cycle battery at 77 °F (25 °C), use the following table:

Battery Voltage	State of Charge
12.7–13.0	100%
12.5–12.6	80%
12.3–12.4	60%
12.1–12.2	40%
11.9–12.0	20%

# Warranty and Product Information

## Warranty

**What does this warranty cover?** This Limited Warranty is provided by Xantrex Technology, Inc. ("Xantrex") and covers defects in workmanship and materials in your TS400 Sine Wave Inverter. This warranty lasts for a Warranty Period of 12 months from the date of purchase at point of sale to you, the original end user customer.

**What will Xantrex do?** Xantrex will, at its option, repair or replace the defective product free of charge, provided that you notify Xantrex of the product defect within the Warranty Period, and provided that Xantrex through inspection establishes the existence of such a defect and that it is covered by this Limited Warranty.

Xantrex will, at its option, use new and/or reconditioned parts in performing warranty repair and building replacement products. Xantrex reserves the right to use parts or products of original or improved design in the repair or replacement. If Xantrex repairs or replaces a product, its warranty continues for the remaining portion of the original Warranty Period or 90 days from the date of the return shipment to the customer, whichever is greater. All replaced products and all parts removed from repaired products become the property of Xantrex.

Xantrex covers both parts and labor necessary to repair the product, and return shipment to the customer via a Xantrex-selected non-expedited surface freight within the contiguous United States and Canada. Alaska and Hawaii are excluded. Contact Xantrex Customer Service for details on freight policy for return shipments outside of the contiguous United States and Canada.

**How do you get service?** If your product requires troubleshooting or warranty service, contact your merchant. If you are unable to contact your merchant, or the merchant is unable to provide service, contact Xantrex directly at:

Phone: 1-800-670-0707 (toll free)

1-604-422-2777 (direct)

Fax: 1-604-420-2145

Email: [CustomerService@xantrex.com](mailto:CustomerService@xantrex.com)

Direct returns may be performed according to the Xantrex Return Material Authorization Policy described in your product manual. For some products, Xantrex maintains a network of regional Authorized Service Centers. Call Xantrex or check our website to see if your product can be repaired at one of these facilities.

In any warranty claim, dated proof of purchase must accompany the product and the product must not have been disassembled or modified without prior written authorization by Xantrex.

Proof of purchase may be in any one of the following forms:

- The dated purchase receipt from the original purchase of the product at point of sale to the end user, or
- The dated dealer invoice or purchase receipt showing original equipment manufacturer (OEM) status, or
- The dated invoice or purchase receipt showing the product exchanged under warranty

## Disclaimer

---

**What does this warranty not cover?** This Limited Warranty does not cover normal wear and tear of the product or costs related to the removal, installation, or troubleshooting of the customer's electrical systems. This warranty does not apply to and Xantrex will not be responsible for any defect in or damage to:

- a) the product if it has been misused, neglected, improperly installed, physically damaged or altered, either internally or externally, or damaged from improper use or use in an unsuitable environment;
- b) the product if it has been subjected to fire, water, generalized corrosion, biological infestations, or input voltage that creates operating conditions beyond the maximum or minimum limits listed in the Xantrex product specifications including high input voltage from generators and lightning strikes;
- c) the product if repairs have been done to it other than by Xantrex or its authorized service centers (hereafter "ASCs");
- d) the product if it is used as a component part of a product expressly warranted by another manufacturer;
- e) the product if its original identification (trade-mark, serial number) markings have been defaced, altered, or removed.

## Disclaimer

### Product

THIS LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY PROVIDED BY XANTREX IN CONNECTION WITH YOUR XANTREX PRODUCT AND IS, WHERE PERMITTED BY LAW, IN LIEU OF ALL OTHER WARRANTIES, CONDITIONS, GUARANTEES, REPRESENTATIONS, OBLIGATIONS AND LIABILITIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE IN CONNECTION WITH THE PRODUCT, HOWEVER ARISING (WHETHER BY CONTRACT, TORT, NEGLIGENCE, PRINCIPLES OF MANUFACTURER'S LIABILITY, OPERATION OF LAW, CONDUCT, STATEMENT OR OTHERWISE), INCLUDING WITHOUT RESTRICTION ANY IMPLIED WARRANTY OR CONDITION OF QUALITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE TO THE EXTENT REQUIRED UNDER APPLICABLE LAW TO APPLY TO THE PRODUCT SHALL BE LIMITED IN DURATION TO THE PERIOD STIPULATED UNDER THIS LIMITED WARRANTY.

IN NO EVENT WILL XANTREX BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, COSTS OR EXPENSES HOWEVER ARISING WHETHER IN CONTRACT OR TORT INCLUDING WITHOUT RESTRICTION ANY ECONOMIC LOSSES OF ANY KIND, ANY LOSS OR DAMAGE TO PROPERTY, ANY PERSONAL INJURY, ANY DAMAGE OR INJURY ARISING FROM OR AS A RESULT OF MISUSE OR ABUSE, OR THE INCORRECT INSTALLATION, INTEGRATION OR OPERATION OF THE PRODUCT.

### Exclusions

If this product is a consumer product, federal law does not allow an exclusion of implied warranties. To the extent you are entitled to implied warranties under federal law, to the extent permitted by applicable law they are limited to the duration of this Limited Warranty. Some states and provinces do not allow limitations or exclusions on implied warranties or on the duration of an implied warranty or on the limitation or exclusion of incidental or consequential damages, so the above limitation(s) or exclusion(s) may not apply to you. This Limited Warranty gives you specific legal rights. You may have other rights which may vary from state to state or province to province.

### Warning: Limitations On Use

Please refer to your product manual for limitations on uses of the product.



SPECIFICALLY, PLEASE NOTE THAT THE TS400 Sine Wave Inverter SHOULD NOT BE USED IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, XANTREX MAKES NO REPRESENTATIONS OR WARRANTIES REGARDING THE USE OF THE XANTREX TS400 Sine Wave Inverter IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES.

Please note that the TS400 Sine Wave Inverter is not intended for use as an uninterruptible power supply and Xantrex makes no warranty or representation in connection with any use of the product for such purposes.

## Return Material Authorization Policy

Before returning a product directly to Xantrex you must obtain a Return Material Authorization (RMA) number and the correct factory "Ship To" address. Products must also be shipped prepaid. Product shipments will be refused and returned at your expense if they are unauthorized, returned without an RMA number clearly marked on the outside of the shipping box, if they are shipped collect, or if they are shipped to the wrong location.

When you contact Xantrex to obtain service, please have your instruction manual ready for reference and be prepared to supply:

- The serial number of your product
- Information about the installation and use of the unit
- Information about the failure and/or reason for the return
- A copy of your dated proof of purchase

Record these details in "Information About Your System" on page WA-4.

## Return Procedure

1. Package the unit safely, preferably using the original box and packing materials. Please ensure that your product is shipped fully insured in the original packaging or equivalent. This warranty will not apply where the product is damaged due to improper packaging.
2. Include the following:
  - The RMA number supplied by Xantrex Technology, Inc. clearly marked on the outside of the box.
  - A return address where the unit can be shipped. Post office boxes are not acceptable.
  - A contact telephone number where you can be reached during work hours.
  - A brief description of the problem.
3. Ship the unit prepaid to the address provided by your Xantrex customer service representative.

**If you are returning a product from outside of the USA or Canada** In addition to the above, you MUST include return freight funds and are fully responsible for all documents, duties, tariffs, and deposits.

**If you are returning a product to a Xantrex Authorized Service Center (ASC)** A Xantrex return material authorization (RMA) number is not required. However, you must contact the ASC prior to returning the product or presenting the unit to verify any return procedures that may apply to that particular facility.

## Out of Warranty Service

If the warranty period for your TS400 Sine Wave Inverter has expired, if the unit was damaged by misuse or incorrect installation, if other conditions of the warranty have not been met, or if no dated proof of purchase is available, your inverter may be serviced or replaced for a flat fee.

## Information About Your System

---

To return your TS400 Sine Wave Inverter for out of warranty service, contact Xantrex Customer Service for a Return Material Authorization (RMA) number and follow the other steps outlined in "Return Procedure" on page WA-3.

Payment options such as credit card or money order will be explained by the Customer Service Representative. In cases where the minimum flat fee does not apply, as with incomplete units or units with excessive damage, an additional fee will be charged. If applicable, you will be contacted by Customer Service once your unit has been received.

## Information About Your System

As soon as you open your TS400 Sine Wave Inverter package, record the following information and be sure to keep your proof of purchase.

- Serial Number \_\_\_\_\_
- Purchased From \_\_\_\_\_
- Purchase Date \_\_\_\_\_

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

- Type of installation (e.g. RV, truck) \_\_\_\_\_
- Length of time inverter has been installed \_\_\_\_\_
- Battery/battery bank size \_\_\_\_\_
- Battery type (e.g. flooded, sealed gel cell, AGM) \_\_\_\_\_
- DC wiring size and length \_\_\_\_\_
- Alarm sounding? \_\_\_\_\_
- Description of indicators on front panel \_\_\_\_\_
- Equipment operating when problem occurred \_\_\_\_\_
- Description of problem \_\_\_\_\_

---

---

# Index

## A

AC output cable, requirements 2-20  
amp-hour (Ah) capacity B-3

## B

back panel features 1-5  
batteries  
    amp-hour (Ah) capacity B-3  
    automotive starting B-2, B-3  
    connecting two in parallel B-6  
    deep-cycle lead-acid B-2  
    depth of discharge B-5  
    discharged B-7  
    electrolyte level B-7  
    golf cart B-2  
    marine B-2  
    recharging 3-5  
    reserve capacity B-3, B-5  
    RV B-2  
    self-discharge B-7  
    temperature sensitivity B-7  
    using multiple B-6  
    using two battery banks B-6  
battery banks  
    connecting 2-17  
    described B-6  
battery chargers 1-2, 3-5  
battery connections B-7  
battery isolator  
    avoiding voltage drops 2-15  
    using B-2  
battery monitors 3-5  
battery reserve capacity B-3  
battery selector switch B-6  
battery size  
    estimating example B-4  
    estimating worksheet B-5  
    estimating your needs B-3, B-4  
battery tips B-7  
battery voltage, range of 2-22

## C

cable clamp

    installing 2-20  
    size of 2-5  
Canadian Electrical Code (NEC) 2-3  
Canadian Standards Association (CSA) 2-3  
chassis ground lug, connecting 2-11  
chassis ground, connecting 2-11  
clearance, recommended 2-7  
connectors, appropriately sized 2-5  
copper cable, recommended 2-9, 2-11, 2-16  
crimp connectors, recommended 2-14  
Customer Service  
    email WA-1  
    fax number WA-1  
    phone number WA-1  
    preparing to call WA-4

## D

DC cables  
    connecting 2-17  
    guidelines for routing 2-15  
    lengths 2-9  
    preparing 2-14  
DC circuit breaker  
    See DC fuse and Disconnect.  
DC distribution panel 2-15  
DC fuse and Disconnect  
    80 amps 2-9  
    closing 2-22  
    installing 2-17  
    location of 2-14  
    required 2-15  
DC ground bus (dedicated) 2-11  
DC grounding point 2-11  
depth of discharge (DOD) B-5

## E

electrolyte level B-7  
email, contacting Customer Service by WA-1  
equipment  
    current draw B-4  
    power consumption B-4  
explosive gases B-7

## F

- fan
  - cooling system A-3
- Fault light
  - described 1-4
  - illustrated 1-4, 3-2
- fax number for Customer Service WA-1
- front panel features
  - described 1-4, 3-2
  - illustrated 1-4, 3-2
- fuse type 2-9

## G

- gases, explosive 2-8, B-7
- GFCI
  - protection 1-3
  - resetting 3-7
- GFCI outlets 1-2
  - connecting appliances to 2-18
  - described 1-4
  - illustrated 1-4, 3-2

## H

- hardwire, AC output connections 2-19
- high voltage shutdown 1-3
- hydrometer B-8

## I

- Information about Your System form WA-4
- installation codes 2-3
- installation procedures
  - choosing a location 2-7
  - connecting the chassis ground 2-11
  - connecting the DC cables 2-16
  - mounting inverter 2-10
  - testing 2-22
- invert mode
  - operating in 3-3
- inverter
  - purchase date WA-4
  - serial number WA-4
- Inverter ON light
  - described 1-4
  - illuminated 2-22
  - illustrated 1-4, 3-2

## K

- knockout for AC (output) hardwiring
  - illustrated 1-5
  - removing 2-19

## L

- location, choosing 2-7
- Low Battery light
  - described 1-4
  - illustrated 1-4, 3-2
- low battery voltage shutdown 1-3, 3-5

## M

- materials, AC output hardwiring 2-5
- materials, list of 2-4
- mounting requirements
  - S400 Remote Switch 2-12
  - TS400 2-10

## O

- On/Standby switch
  - described 1-4
  - illustrated 1-4, 3-2
  - optional remote switch 1-6
  - turning on 2-22
- overload protection 1-3
- overload, resetting after 3-7
- over-temperature shutdown 1-3

## P

- polarity of DC connections 2-17
- polarity, avoiding reverse 2-16
- power output 1-2
- power tools 1-2
- preparing for installation 2-3
- proof of purchase WA-4
- protection features 1-3
- purchase date WA-4

## R

- recreational vehicles, chassis grounding 2-11
- regulatory approvals A-3
- reserve capacity B-3
- reverse polarity, caution 2-16

---

RV Industry Association (RVIA) 2-3

## S

S400 Remote Switch  
  convenience of 1-2  
  installing 2-12  
  mounting template 2-12  
  part number 1-6  
  resetting 3-7  
serial number WA-4  
short circuit protection 1-3  
shutdown  
  high voltage 1-3  
  low voltage 1-3  
  over-temperature 1-3  
sine wave, effect on sensitive electronics 1-2  
specifications of TS400  
  electrical A-2  
  physical A-2  
standby  
  definition 3-3  
  TS400 not in use 3-3  
starting batteries B-3  
start-up, checklist 2-22  
state of charge B-8  
Supplemental Circuit Protection button  
  described 1-3  
  illustrated 1-4, 3-2  
  resetting 3-7

## T

telephone number for Customer Service WA-1  
television monitors 1-2  
test equipment 1-2  
tools, list of 2-4  
troubleshooting 4-3  
TS400  
  limitations on use WA-2  
  specifications A-1

## U

U.S. National Electrical Code (NEC) 2-3

## V

vehicle chassis 2-11

ventilation B-7  
ventilation openings  
  described 1-4  
  illustrated 1-4, 3-2  
  recommended clearance 2-7  
voltage drop, avoiding 2-15  
voltmeter B-8

## W

warranty  
  out of warranty service WA-3  
  terms and conditions WA-1  
  voiding 2-16





**Xantrex Technology Inc.**

604 422 2777 Tel  
604 420 2145 Fax  
800 670 0707 Toll Free North America  
CustomerService@xantrex.com  
www.xantrex.com