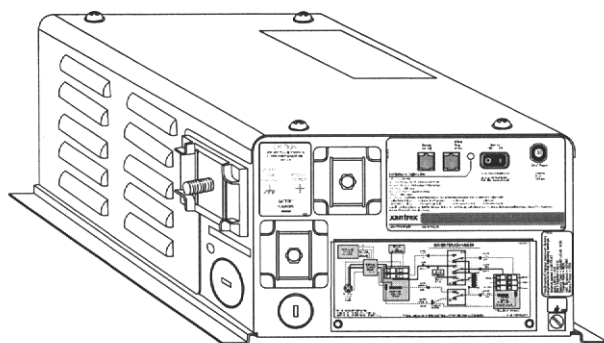


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RV2012GS
RV2012GS-15/20B
RV2012GS-20B
RV2512GS
RV3012GS

Owner's Manual

RV GS Series Inverter/Charger

www.xantrex.com

About This Manual

Purpose

The purpose of this Owner's Manual is to provide explanations and procedures for installing, operating, and troubleshooting the RV Series Inverter/Charger.

Scope

The Manual provides safety guidelines, detailed planning and setup information, procedures for installing the inverter, as well as information about operating and troubleshooting RV Series Inverter/Charger models RV2012GS, RV2012GS-15/20B, RV2012GS-20B, RV2512GS, RV3012GS. It does not provide details about particular brands of batteries. You need to consult individual battery manufacturers for this information.

Audience

The Manual is intended for anyone who needs to install and operate the RV Series Inverter/Charger. Installers should be certified technicians or electricians.

Organization

This Manual is organized into four chapters and one appendix.

Chapter 1 introduces you to the RV Series Inverter/Charger and describes its features and performance characteristics.

Chapter 2 contains information and procedures to install the RV Series Inverter/Charger.

Chapter 3 contains information about operating the RV Series Inverter/Charger.

Chapter 4 contains information and procedures to troubleshoot the RV Series Inverter/Charger.

Appendix A contains the electrical and physical specifications for the RV Series Inverter/Charger.

Conventions Used

The following conventions are used in this guide.



WARNING

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



CAUTION

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

Important: These notes describe things that are important for you to know, but not as serious as a caution or warning.

Symbols Used



AC ground



Chassis ground



Alternating current (AC)

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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RV Series Inverter/Charger

Owner's Manual

About Xantrex

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

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Date and Revision

June 2005 Revision A

Part Number

975-0209-01-01

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Important Safety Instructions



WARNING

This chapter contains important safety and operating instructions. Read and keep this Owner's Manual for future reference.

General Precautions

1. Before installing and using the RV Series Inverter/Charger, read all instructions and cautionary markings on the RV Series Inverter/Charger, the batteries, and all appropriate sections of this Manual.
2. Do not expose the RV Series Inverter/Charger to rain, snow, spray, or bilge water. To reduce risk of fire hazard, do not cover or obstruct the ventilation openings. Do not install the RV Series Inverter/Charger in a zero-clearance compartment. Overheating may result.
3. Use only attachments recommended or sold by the manufacturer. Doing otherwise may result in a risk of fire, electric shock, or injury to persons.
4. To avoid a risk of fire and electric shock, make sure that existing wiring is in good condition and that wire is not undersized. Do not operate the RV Series Inverter/Charger with damaged or substandard wiring.
5. Do not operate the RV Series Inverter/Charger if it has received a sharp blow, been dropped, or otherwise damaged in any way. If the RV Series Inverter/Charger is damaged, see the Warranty section.
6. Do not disassemble the RV Series Inverter/Charger. It contains no user-serviceable parts. See Warranty for instructions on obtaining service. Attempting to service the RV Series Inverter/Charger yourself may result in a risk of electrical shock or fire. Internal capacitors remain charged after all power is disconnected.
7. To reduce the risk of electrical shock, disconnect both AC and DC power from the RV Series Inverter/Charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.
8. The RV Series Inverter/Charger must be provided with an equipment-grounding conductor connected to the AC input ground.



CAUTION: Equipment damage

The output side of the inverter's AC wiring should at no time be connected to public power or a generator. This condition is far worse than a short circuit. If the unit survives this condition, it will shut down until corrections are made.

Installation should ensure that the inverter's AC output is, at no time, connected to its AC input. Also the AC input neutral must be isolated from the AC output neutral connections. Review the installation diagrams included before you start making connections.

Explosive gas precautions



WARNING: Risk of explosive gases

Working in the vicinity of lead-acid batteries is dangerous. Batteries generate explosive gases during normal operation. Therefore, you must read this guide and follow the instructions exactly before installing or using your RV Series Inverter/Charger.

1. This equipment contains components that tend to produce arcs or sparks. To prevent fire or explosion, do not install the RV Series Inverter/Charger in compartments containing batteries or flammable materials, or in locations that require ignition-protected equipment. This includes any space containing gasoline-powered machinery, fuel tanks, as well as joints, fittings, or other connections between components of the fuel system.
2. To reduce the risk of battery explosion, follow these instructions and those published by the battery manufacturer and the manufacturer of the equipment in which the battery is installed.

Precautions When Working With Batteries



WARNING: Explosion or fire hazard

-
1. Follow all instructions published by the battery manufacturer and the manufacturer of the equipment in which the battery is installed.
 2. To reduce the risk of injury, charge only deep-cycle lead acid, lead antimony, lead calcium gel cell, absorbed mat, or NiCad/NiFe type rechargeable batteries. Other types of batteries may burst, causing personal injury and damage.
 3. Make sure the area around the battery is well ventilated.
 4. Never smoke or allow a spark or flame near the engine or batteries.

5. 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.
6. Remove all metal items, like rings, bracelets, and watches when working with lead-acid batteries. Lead-acid batteries produce a short circuit current high enough to weld metal to skin, causing a severe burn.
7. Have someone within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
8. Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
9. Wear complete eye protection and clothing protection. Avoid touching your eyes while working near batteries.
10. 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.
11. If you need to remove a battery, always remove the ground terminal from the battery first. Make sure all accessories are off so you don't cause a spark.

Precautions for Using Rechargeable Appliances



CAUTION: Equipment damage

Most rechargeable battery-operated equipment uses a separate charger or transformer that is plugged into an AC receptacle and produces a low voltage charging output.

Some chargers for small rechargeable batteries can be damaged if connected to the modified sine wave output of the RV Series Inverter/Charger. When first using a rechargeable device with the RV Series Inverter/Charger, monitor its temperature for 10 minutes to ensure that it does not become abnormally hot. Use caution when using the following with the RV Series Inverter/Charger:

- Small battery-operated appliances like flashlights, razors, and night lights that can be plugged directly into an AC receptacle to recharge.
- Lightweight, "transformer-less" cordless power tool chargers. Affected chargers may display a warning label stating that dangerous voltages are present at the battery terminals.

Important: If you are unsure about using your rechargeable appliance with the RV Series Inverter/Charger, contact the equipment manufacturer to find out if the equipment is compatible with the modified sine wave output of the RV Series Inverter/Charger.

Contents

Important Safety Instructions	v
-------------------------------------	---

1 Introduction

Features	1-2
Inverter to Charger Transition	1-2
Transfer Switching Speed	1-3
Front Panel Features	1-3
Accessories	1-4
Remote Controls	1-4
Battery Temperature Sensor	1-5

2 Installation

Choosing a Location	2-2
Wiring the Inverter/Charger	2-4
AC Wiring	2-5
AC Input Wiring	2-6
General Precautions	2-7
Installation with an External Transfer Relay (120/240 System)	2-7
Tools and Materials Required	2-8
Connecting the AC Wiring	2-9
GFCI Requirements	2-9
DC Wiring	2-10
Safety Instructions	2-10
Battery Requirements	2-10
DC Over-Current Protection	2-10
Connection of Grounding and Battery Systems	2-11
Battery Cable Sizing	2-12
Battery Cable Connection	2-13
Connecting the Battery Temperature Sensor	2-16
Mounting Options	2-16
Option A: Mounting to the Negative Battery Terminal	2-16
Option B: Mounting to the Side of the Battery Case	2-17
Wiring to a Generator	2-18
Generator Requirements	2-18
Auto Gen Start connections	2-19
Generator Wiring Diagrams	2-21
Wiring to a Thermostat	2-22

3 Operation

Remote Operation	3-2
Stand-Alone Operation	3-2
Search Mode	3-2
Powering Loads	3-3
Resistive Loads	3-3
Inductive Loads	3-4
Low Battery Dropout	3-4
Problem Loads	3-4
Typical Battery Draw of Common Appliances	3-6
Battery Charging	3-7
Stage One: Bulk Charge (Constant Current)	3-7
Stage Two: Absorption (Constant Voltage)	3-7
Stage Three: Float Voltage	3-7
Temperature-Compensated Charging	3-7
Dead Battery Charging	3-8
Battery Equalization	3-8
LED Indicator	3-10
Error Conditions	3-11

4 Troubleshooting

Troubleshooting Guide	4-2
-----------------------	-----

A Specifications

Electrical Specifications	A-2
Environmental Specifications	A-2
Physical Specifications	A-3
Accessories	A-3
Regulatory Approvals	A-3

Warranty and Return Information	WA-1
---------------------------------	------

1

Introduction

Chapter 1 introduces you to the RV Series Inverter/Charger and describes its features and performance characteristics. This chapter also contains information about the accessories available for the RV Series Inverter/Charger.

Features

The RV Series Inverter/Charger produces up to 3000 watts (depending on model) of continuous, modified sine wave power from a 12-volt battery bank. It is ideal for simultaneous applications including microwaves, TV entertainment systems, fax machines, computers, and power tools.

The RV Series Inverter/Charger provides automatic, multistage battery charging, manual battery equalization and temperature sensitive charging with an optional battery temperature sensor. The charger is designed for use with electricity supplied from your generator or RV campground hookup.

The RV Series Inverter/Charger also has automatic generator start (AGS) capability. When the inverter/charger is connected to an Onan QuietDiesel, Generac or Powertech generator, it will start the generator to charge the batteries when battery power is low, or in response to a signal from a thermostat. An RC/GS remote control is required to configure and use the AGS feature.

Three RV Series Inverter/Charger models are available. Each model has a different maximum continuous output power rating and surge power rating—the power necessary to operate motor-driven appliances, which require high current at startup (see “Inductive Loads” on page 3–4).

Table 1-1 RV Series Inverter/Charger model specifications

Model	Output power AC (max. continuous)	Surge rating (AC amps)
RV2012GS	2000 W	44 A
RV2012GS-15/20B	2000 W	44 A
RV2012GS-20B	2000 W	44 A
RV2512GS	2500 W	48 A
RV3012GS	3000 W	52 A

Inverter to Charger Transition

The RV Series Inverter/Charger includes a built-in transfer switch that automatically transfers between inverter power and incoming AC power. To operate the RV Series Inverter/Charger as a charger, an external source of AC power (such as shore power or a generator) must be supplied to the inverter AC input. The inverter/charger automatically stops inverting and begins charging batteries whenever AC power is connected to its AC inputs. When AC power is connected, the RV Series Inverter/Charger will begin charging even when the inverter itself is turned off (with the on/off switch).

There is a minimum 5-second delay from the time the inverter senses that AC is present at the input terminals to when the transfer is made. This delay is built in to provide time for a generator to spin-up to a stable voltage and avoid relay chattering. The inverter will not transfer to generator until it has locked onto the generator's output. The inverter's AC input is internally connected to the inverter's AC output while in the battery charger mode.

Transfer Switching Speed

While this inverter is not designed as an uninterruptible power supply (UPS) system, its transfer time is normally fast enough to hold up most computers. The transfer time is typically 16 milliseconds.

Front Panel Features

Before installing and operating the RV Series Inverter/Charger, review the front panel features shown in Figure 1-1 and described in Table 1-2.

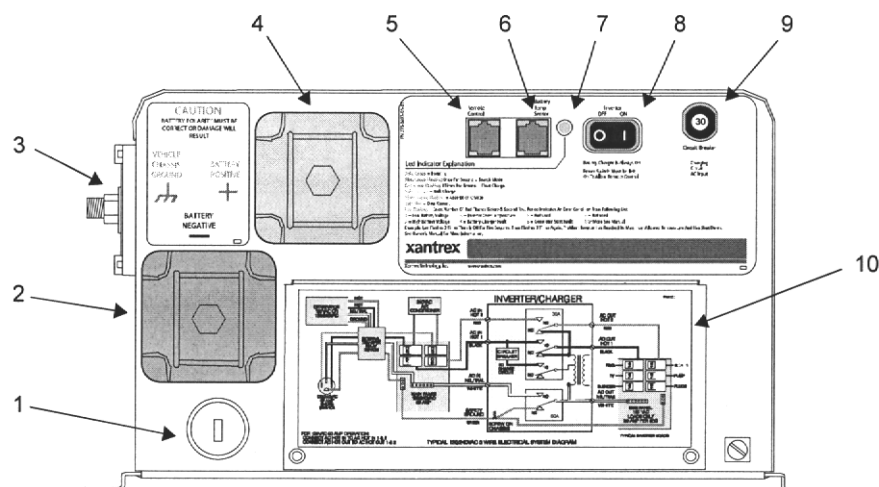


Figure 1-1 RV Series Inverter/Charger Front Panel Features

Table 1-2 Front Panel Features

Feature	Description
1	AC wiring knockout
2	Negative DC terminal (black)
3	RV ground terminal (green)
4	Positive DC terminal (red)
5	Remote control jack
6	Battery Temp. Sensor jack
7	LED indicator light
8	Inverter ON/OFF switch
9	Charger circuit breaker
10	AC wiring compartment cover (with wiring diagram)

Accessories

Remote Controls

Three remote control panels are available for the RV Series Inverter/Charger—RC/GS, RC6 and RC7.

For inverter/charger on/off control and basic system monitoring, use the RC6 remote.

For complete inverter/charger configuration capability, use the RC7 or RC/GS remotes. (The RV Series Inverter/Charger has an internal memory to retain its configuration settings even with a loss of power.)

All RV Series inverter/chargers have a built-in shunt, which when paired with the optional RC/GS remote control enables advanced battery monitoring and inverter/charger control. To use the shunt, the inverter/charger must be wired correctly, using the green RV ground terminal.

The RV Series Inverter/Charger also has the necessary built-in hardware to be connected to your generator, enabling automatic generator starting when paired with the optional RC/GS remote control.

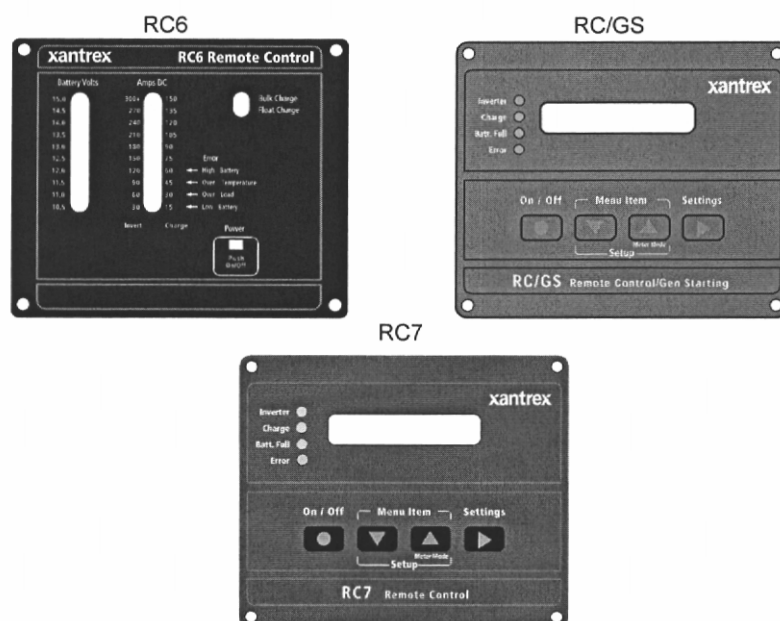


Figure 1-2 Remote Control Panels

The RC6, RC7, and RC/GS use a telephone-style cord to connect to the RV Series Inverter/Charger (models RV2012GS, RV2012GS-15/20B, RV2012GS-20B, RV2512GS, and RV3012GS).

Use only Xantrex-recommended accessories. Remote cables are available in three lengths:

Part number	Cable Length
31-6257-00	25 feet
31-6262-00	50 feet
31-6275-00	70 feet

Battery Temperature Sensor

The battery temperature sensor (BTS) allows the inverter/charger to monitor the battery temperature and adjust charging voltage according to the temperature. The BTS can extend the life of a battery by preventing overcharging in warm temperatures and undercharging in cold temperatures.

The BTS attaches to a battery terminal post or to the side of the battery using a self-adhesive backing.

Table 1-3

Part number	Details
130-0004-01-01	15 foot cord, surface mount only
130-0004-02-01	25 foot cord, surface mount only
130-0004-03-01	35-foot cord, surface mount only
808-0231	25-foot cord, surface or terminal mount (shown in Figure 1-3)

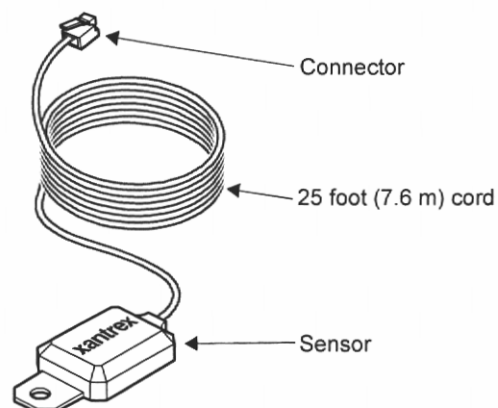


Figure 1-3 Battery Temperature Sensor (808-0231)

2

Installation

Chapter 2 contains information and procedures to install the RV Series Inverter/Charger.

The topics in this chapter are organized as follows:

- “Choosing a Location”
- “Wiring the Inverter/Charger”
- “Wiring to a Generator”

Choosing a Location

Inverters are sophisticated electronic devices and should be treated accordingly. When selecting the operating environment for the inverter, don't think of it in the same terms as other equipment that works with it, such as batteries, diesel generators, motor generators, washing machines, and so on. It is a highly complex microprocessor-controlled device, similar in nature to stereo equipment, television sets, or computers. The use of conformal-coated circuit boards, plated copper bus bars, powder-coated metal components, and stainless steel fasteners improves tolerance to hostile environments. However, in a condensing environment (one in which humidity and/or temperature change causes water to form on components) all the ingredients for electrolysis are present: water, electricity and metals. In a condensing environment the life expectancy of the inverter is indeterminate and the warranty is voided.



CAUTION

Install the inverter in a dry, protected location away from sources of high temperature and moisture. Exposure to salt water is particularly destructive and potentially hazardous.

The inverter/charger 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. 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.
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 2-2 on page 2-12. 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 inverter/charger must be mounted in one of the approved mounting orientations:

- Desktop (as shown in Figure 2-1)
- Upside down
- Wall mounted with the AC terminal block facing up.

Wiring the Inverter/Charger



WARNING: Fire, shock, and energy hazards

Make sure all AC and DC wiring being connected to the RS 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. Xantrex recommends all wiring be done by a qualified installer or electrician.

For a successful installation, you need to plan the AC and DC wiring, as well as the remote control and generator connections. These connections are described in this section and illustrated in Figure 2-1.

AC components include:

- Sources of AC input
- AC wiring
- Over-current protection and disconnect devices
- AC distribution panels

DC components include:

- Sources of DC power (batteries, for example)
- DC cables
- DC over-current protection and disconnect devices
- DC load center

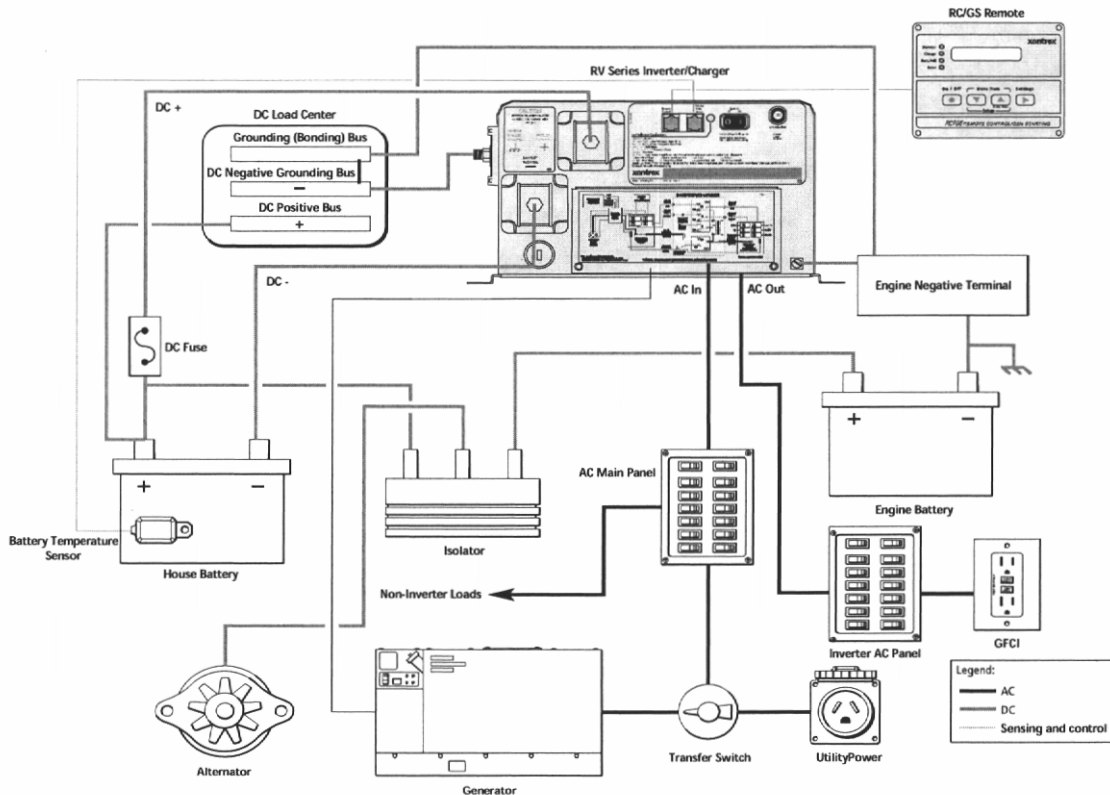


Figure 2-1 RV Electrical System Diagram

Important: Figure 2-1 does not show all required grounding or over-current protection.

AC Wiring

Overview

The U.S. National Electrical Code (NEC) defines the standards for AC and DC installation wiring in RV applications, but there are still many installation variables. Most are determined by the level of automatic switching desired and the amount of external AC power to be switched.

Installation should be done by a qualified electrician. Consult local code for the proper wire sizes, connectors and conduit.

The AC and DC terminals are located on the same end of the chassis as the status LED and power switch. A six station terminal block is provided to connect the AC input and AC output. All terminals are labeled on the inverter. Consult your local code for proper wire sizes, connectors, conduit, and so on. See Table 2-1 for minimum recommended wire sizing. Code requires that an external disconnect switch be used in the AC input wiring circuit. The AC breakers in a sub panel will meet this requirement.

AC Input Wiring

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

- **Split phase:** This source type has two lines, one neutral, and one ground. The two 120 VAC lines are 180 degrees out of phase with each other, so that the two voltages total to 240 VAC. The voltage between each line and neutral is still 120 VAC, and the voltage between the neutral and ground is approximately zero.
- **Dual input:** This source type has two line inputs, one neutral, and one ground. Unlike the split-phase type, the two lines are in phase (not out of phase), and must come from the same source. The voltage between the two lines is zero. The voltage between each line and the neutral is 120 VAC, and the voltage between the neutral and ground is approximately zero.
- **Single input:** This source type uses only one line input, one neutral, and one ground. Use line 1 ("AC Input Hot 1") for AC input if only one line is necessary. If only line 2 is used, the inverter/charger will not transfer power.

Wiring requirements

The type of wiring required varies according to the electrical codes or regulations applicable to your installation. Wire size must be coordinated with the over-current protection provided ahead of the wire involved, in accordance with the electrical codes or regulations applicable to your installation.

The AC circuit from the AC source to the inverter/charger input should be wired using one four-conductor cable (two lines, one neutral and one ground).

The requirements for this configuration are as follows:

Requirement	Details
Breaker Size and Type	30A two-pole
AC Wiring Temperature Rating	75 °C or higher
Color Coding	Black: L1, Red: L2 White: N1 Bare or green: Gnd

Explanation of Wiring Size When the AC source is split-phase (two lines out of phase), the currents from each line subtract in the neutral, and the neutral current will be approximately zero if the loads are equal. For example, if Line 1 is supplying 20A and Line 2 is supplying 15A, the current in the neutral will be 5A. In single source input, only one line is used and therefore the neutral current will never exceed the line current.

However, when the AC source is dual-input (two lines in phase), the currents from each line add together in the neutral. For example, if line 1 and line 2 is each supplying 30A, the current in the neutral will be 60A. Therefore, No. 6 AWG wire is required.

General Precautions

AC disconnects	No AC disconnects are provided as an integral part of this inverter. AC disconnects must be provided as part of the system installation.
Over-current protection	No over-current protection for the AC output wiring is provided as an integral part of this inverter. Over-current protection of the AC output wiring must be provided as part of the system installation.
AC neutral-ground bonding instructions	<p>This inverter/charger includes neutral ground switching for the AC electrical system. The AC system must have the neutral isolated from the grounding system throughout the load distribution circuits. AC generators must have the neutral bonded to the grounding system when used with this inverter.</p> <p>The inverter/charger 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.</p>

Installation with an External Transfer Relay (120/240 System)



WARNING: Shock hazard

Do not connect 240 Vac loads to the inverter/charger outputs. Doing so may result in 120 Vac on exposed parts of the appliance.

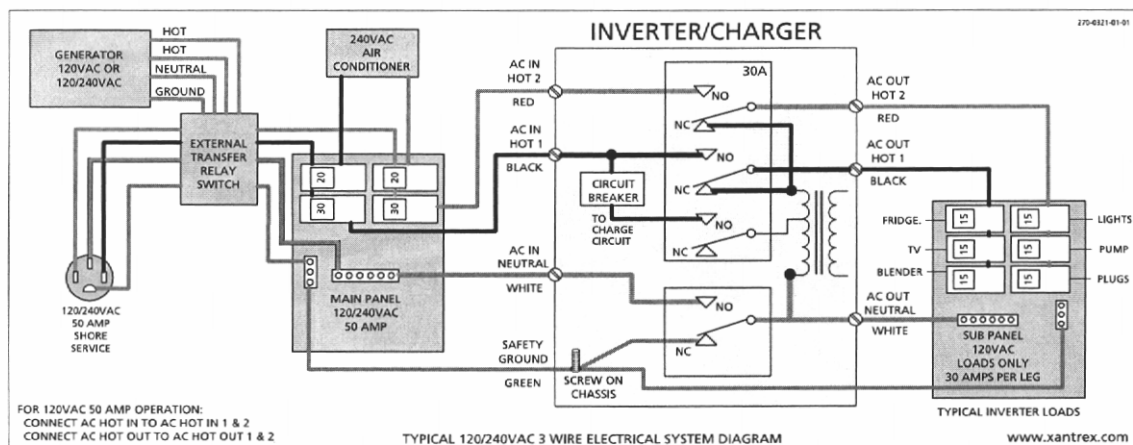


Figure 2-2 Installation with an External Transfer Relay

When the generator is running the main AC panel, leg 1 and leg 2 of the generator are connected independently to the two halves of the main AC panel. When the inverter is operating, both sides of the main AC panel are automatically connected together. Only 120 Vac is available when the inverter is operating.

Use line 1 for AC input if only one line is necessary. If only line 2 is used, the inverter/charger will not transfer power.

Tools and Materials Required

No terminals or lugs are required to connect the AC wiring.

Tools and materials required to make AC wiring connections:

- ☐ Wire strippers
- ☐ 1/2" (13 mm) open-end wrench or socket
- ☐ Phillips screwdriver #2
- ☐ Slotted screwdriver 1/4" (6 mm) blade.
- ☐ Four conductor wire, sized according to Table 2-1.

Table 2-1 Minimum Recommended AC Wire Size (Four-Conductor Cable)

Model	Split Phase/Single Input		Dual Input	
	Input Wiring	Output Wiring	Input Wiring	Output Wiring
RV2012GS	10 AWG	10 AWG	6 AWG	6 AWG
RV2012GS-15/20B	12 AWG	14*/12** AWG	8 AWG	14*/12** AWG
RV2012GS-20B	12 AWG	12 AWG	8 AWG	12 AWG
RV2512GS	10 AWG	10 AWG	6 AWG	6 AWG
RV3012GS	10 AWG	10 AWG	6 AWG	6 AWG

* for 15 A output breaker.

** for 20 A output breaker.

Torque all AC wiring connections to 20 inch-pounds.

Connecting the AC Wiring

AC connections are made on the terminal block located inside the front panel of the inverter.

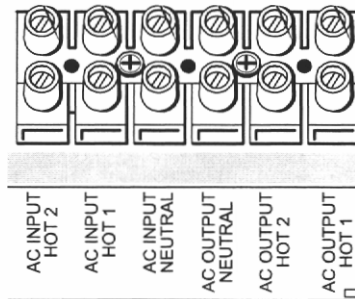


Figure 2-3 RV Series AC Wiring terminal block

To connect AC wiring:

1. Disconnect the inverter from the battery.
2. Remove the AC wiring compartment cover.
3. Feed the wires through the Romex connectors on the right side of the inverter's case. Romex strain reliefs can be replaced with conduit fittings. See Figure 2-2 on page 2-7.
4. Following the wiring guide located in the AC wiring compartment and page 2-7, connect the hot (black) and neutral (white) wires to the terminal block and tighten securely. The safety (green) wire is connected to the external ground screw terminal.
5. Replace the AC wiring compartment cover.

GFCI Requirements

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

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



WARNING: Shock hazard

Not all makes and models of GFCIs work properly with all inverters. Use only GFCIs that are listed as usable for your model of inverter in Xantrex Application Note "Using GFCI Receptacles on Xantrex Inverters and Inverter/Chargers" available at www.xantrex.com or by calling customer service; see page WA-1 for contact information.

DC Wiring

Safety Instructions



CAUTION: Equipment damage

THIS INVERTER IS NOT REVERSE POLARITY PROTECTED. If the positive terminal of the battery is connected to the negative terminal of the inverter the probable result is failure of the whole power stage. This type of failure is not covered under warranty.

The inverter's maximum peak current requirements are high. If battery cables are too small and/or connections are loose, efficiency and maximum output power are degraded. Small cables or loose connections can also cause dangerous overheating of the wire and/or terminals.

Make the battery cables as large and as short as possible. Tape the battery cables together. This reduces the inductance of the wire, resulting in a better waveform and reduced stress on the inverter's filter capacitors.

Refer to Table 2-2 on page 2-12 for recommended battery cable size. Crimped and sealed copper ring terminal lugs with a 5/16" hole should be used to connect the battery cables to the DC terminals of the inverter/charger. Soldered cable lugs are also acceptable.

Code your battery cables with colored tape or heat-shrink tubing.

No DC disconnects are provided as an integral part of this inverter. DC disconnects must be provided as part of the system installation.

Battery Requirements

Type	Lead-acid deep-cycle battery or group of batteries. The batteries may be a flooded, gel, or AGM type.
Volts	12 volts
More Information	Go to www.xantrex.com/support for more information about batteries. For detailed information about specific brands of batteries, you will need to consult individual battery manufacturers.

DC Over-Current Protection

DC fusing	<p>In order to comply with the U.S. NEC, an approved form of battery over-current protection is required. These installation parts are not supplied with the unit. Standard-type DC fuses or circuit breakers may be obtained from your dealer, electrical supply houses.</p> <p>Xantrex offers a DC rated fuse and holder designed specifically for the RV Series inverters. This fuse holder is available in a 200, 300, 350 and 400-amp sizes (refer to Table 2-2 for proper fuse size). See the latest Xantrex RV Catalog or visit www.xantrex.com for more information.</p>
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DC disconnects	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. The U.S. NEC (NFPA 70) specifies that the protection can be no further than 18 inches from the battery. If using a fuse and disconnect, the disconnect must be installed between the battery and the fuse.

Connection of Grounding and Battery Systems

This inverter/charger should be connected to a grounded, permanent wiring system. For most installations, the negative battery conductor should be bonded to the grounding system at one (and only one) point in the system. All installations should comply with all national and local codes and ordinances.



CAUTION

- DO NOT connect the black battery negative (–) terminal to the vehicle chassis ground.
- DO NOT connect the DC load negative to the black battery negative (–). Connect only to the green chassis ground terminal on the inverter or to the vehicle chassis. The purpose of this terminal is to ensure that all DC load current into or out of the battery bank will flow through the internal shunt of the inverter. The internal shunt is connected between the black battery negative terminal and the green chassis ground terminal of the inverter. Because all DC loads in a vehicle are generally connected to a common chassis ground and not directly to the battery negative (in a negative-ground system), all DC current in the system will at some point pass through the chassis and then into the battery bank. If the inverter is in this loop the net current flow is easily monitored. Thus, the remote control's battery fuel gauge feature is possible. You may connect the system without going through the chassis ground terminal, but the fuel gauge feature will not work properly.

Figure 2-4 outlines proper connections for the RV Series inverter/chargers.

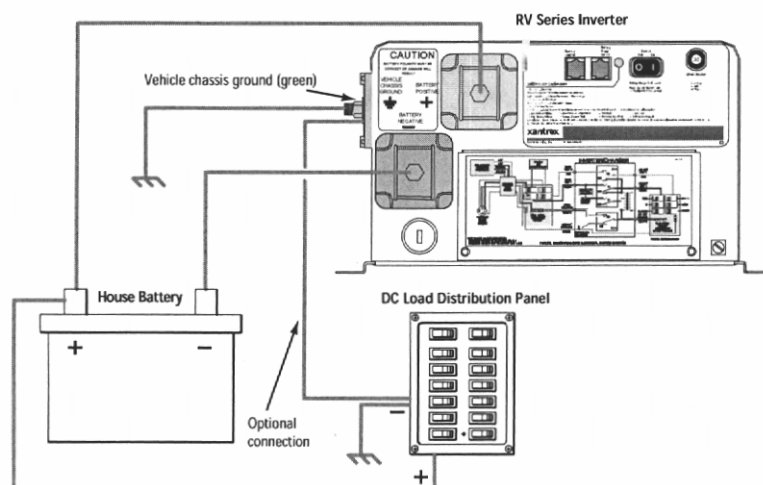


Figure 2-4 RV Series Grounding Diagram

Connect DC loads to Vehicle Chassis or optionally to the Inverter's Vehicle Chassis Ground Terminal (Green). The optional connection shown in Figure 2-4 is for ungrounded DC load distribution panels. Do not connect DC loads to battery negative (-).

Battery Cable Sizing

The bigger the battery cables, the better. Undersized cables result in additional stress on the inverter, lower efficiency, reduced surge power, and lower peak output voltage. Don't use cables that are too small in diameter because they can degrade the RV Series Inverter/Charger's efficiency or generate enough heat to become a fire hazard. The following table gives recommended cable sizes for various cable run lengths and inverter voltages.

Table 2-2 Minimum Recommended Battery Cable Size (In Free Air)

Model	Typical Amps	Maximum Fuse Size	Individual Cable length	
			Under 5 ft	5 to 10 ft
RV2012GS	200 amps	250 A	00	0000
RV2512GS	250 amps	350 A	0000	0000
RV3012GS	300 amps	400 A	0000	0000

The U.S. NEC requires that the cables be protected by a fuse or breaker rated to match the cables' ampacity at 90 °C.

**WARNING: Fire hazard**

Use only appropriately sized copper cable. Loose connections or improper connections will overheat. Make sure the bolts supplied by Xantrex on the inverter/charger are tightened to a torque of 15–16 ft-lbs (20.4–21.7 Nm). Torque all other connections to the manufacturer's specifications. Make sure the DC cable, washers, and bolt are assembled in the order shown in Figure 2-5.

**WARNING: Energy hazard**

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

Battery Cable Connection

Observe battery polarity!

**CAUTION: Reverse polarity damage**

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

To connect the DC cables:

1. Route the DC cables from the battery bank to the inverter/charger.
2. If using a DC fuse and disconnect switch, connect the portion of the positive DC cable that is to run between these two components. Use a wrench to tighten the bolt to the torque recommended by the fuseholder or breaker manufacturer.
3. Open the DC disconnect switch or turn off the DC circuit breaker.
4. Place the ring terminal of the POSITIVE (+) cable over the bolt and directly against the inverter's battery terminal. Place a lock washer over the terminal. Do not place the lock washer under the cable terminal. Figure 2-5.

Use a wrench to tighten the nut to a torque of 12 ft-lbs (16.3 Nm).

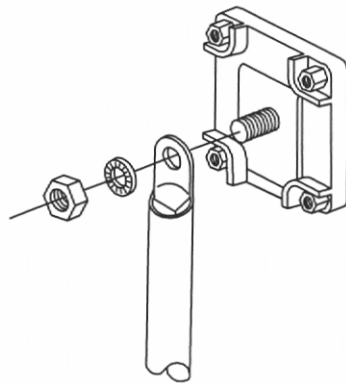


Figure 2-5 DC Cable Connection

5. Connect the connector at the other end of this cable to one of the terminals on the fuse or breaker.
6. Use a wrench to tighten the bolt to the torque recommended by the fuseholder or breaker manufacturer.
7. Connect one connector on the other section of the POSITIVE (+) cable to one of the terminals on the disconnect switch (or to the other terminal on the breaker). Use a wrench to tighten the bolt to the torque recommended by the fuseholder or breaker manufacturer.
8. Connect the connector at the other end of this POSITIVE (+) cable to the POSITIVE (+) DC terminal on the battery. Use a wrench to tighten the bolt to the torque recommended by the battery manufacturer.
9. Connect one connector on the NEGATIVE (–) cable to the NEGATIVE (–) terminal on the battery. Use a wrench to tighten the bolt to the torque recommended by the battery manufacturer.

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 battery.

Note: Connecting the battery cables to the inverter battery terminals will cause an arc, usually accompanied by a “snap.”

10. Place the ring terminal of the NEGATIVE (–) cable over the bolt and directly against the inverter’s battery terminal. Place a lock washer over the terminal. Do not place the lock washer under the cable terminal. Figure 2-5.
Use a wrench to tighten the nut to a torque of 12 ft-lbs (16.3 Nm).
11. To protect the DC terminals, attach the supplied DC terminal covers, using the screws provided.

Disconnecting
battery cables



CAUTION: Equipment damage

Never disconnect the battery cables while the inverter is delivering power or the battery charger is operating. Disconnecting the battery cables could cause a rapid voltage increase that could damage the charger or other DC loads. Keep in mind that the Inverter ON/OFF switch on the inverter/charger does not turn off the charger section; it only turns off the inverter.

To disconnect the batteries for service:

1. Turn the Inverter ON/OFF switch OFF.
2. Disconnect all AC inputs.
3. Disconnect the battery cables.

Connecting the Battery Temperature Sensor

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.

Mounting Options

You can mount the BTS in one of two ways, depending on which BTS model you have:

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

Option A: Mounting to the Negative Battery Terminal

To mount the sensor on the negative battery terminal:

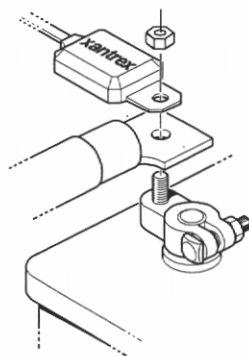


Figure 2-6 BTS Mounted on the Negative Battery Terminal

1. Select the battery to be monitored as follows:
 - Identify the battery bank that is directly connected to the inverter/charger.
 - Within that bank, if the batteries are in a row, select a battery in the middle of the row. If the batteries are in a block, select a battery whose negative battery terminal faces into the block.
2. Switch off all devices operating from the battery, and disconnect the battery by opening the DC disconnect switch or the DC circuit breaker.
3. Wait sufficient time 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 2-7, and firmly tighten the terminal nut.



WARNING: Fire hazard

You must install the DC cable on the battery terminal, then install the sensor on top of the DC cable. This sequence is required to provide the best connection to the battery and the DC negative cable.

7. Check that the sensor and all wires are held firmly and cannot be moved.
8. Turn the battery switch on again (if you opened it in Step 2.)
9. Route the sensor cable to the inverter/charger and plug it into the Battery Temp jack. Secure the cable along its length.

Option B: Mounting to the Side of the Battery Case

To mount the sensor on the battery case:

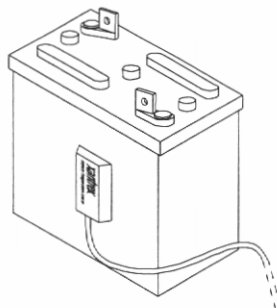


Figure 2-7 BTS Mounting

1. Select the battery to be monitored as follows:
 - Identify the battery bank that is directly connected to the inverter/charger.
 - Within that bank, if the batteries are in a row, select a battery in the middle of the row.
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 backing from the self-adhesive strip on the rear of the sensor. Press the sensor firmly against the clean side of the battery to fix it in place, as shown in Figure 2-7.
5. Route the sensor cable to the inverter/charger and plug it into the Battery Temp. jack. Secure the cable along its length.

Wiring to a Generator

The RV Series Inverter/Charger is equipped with a sophisticated automatic generator start (AGS) feature that can be accessed through the RC/GS Remote Control. The RV Series Inverter/Charger AGS uses three dry contact relays to operate the auto-start function of your AC generator. Proper installation and setup of the generator is essential for correct operation of the inverter/charger. The RC/GS contains the software code to work with various generators listed on its Select Genset menu.

The RV Series Inverter/Charger AGS can be configured to start Onan QuietDiesel, PowerTech and Generac-brand generators. For more information about selecting a generator configuration, see the *RV Series Remote Control Owner's Manual*.

Generator Requirements

The maximum charge rate of the battery charger is dependent upon the peak AC voltage available. Because this type of battery charger uses only the peak part of the input sine wave, small variations in peak voltage result in large variations in the amount of energy available to the charger. The charger's rated output is based on a utility voltage of 120 Vac_{rms}, which has a peak voltage of approximately 164 Vac_p.

It takes a powerful AC generator set to maintain the full 164-volt peak while delivering the current necessary to operate the charger at its maximum rate. As a guideline, the rated output of the generator should be double the inverter output (for example, a 5,000 W generator for a 2500 W inverter/charger). Smaller generators will have the tops of their waveform clipped under such charger loads. Running at these reduced peak voltages will not harm the charger, but it will limit the maximum charge rate. Large auxiliary AC loads may make this problem worse.

Auto Gen Start connections

The connections between the inverter/charger and the generator are made on the terminal strip. All these components are located inside the AC compartment of the inverter. See Figure 2-8.

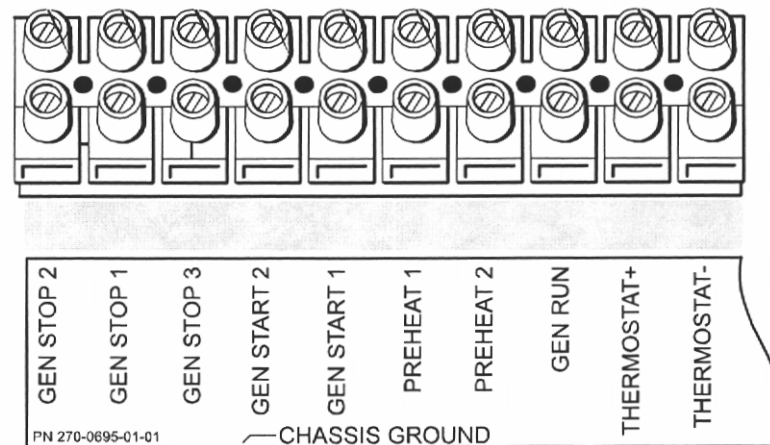


Figure 2-8 RV Series Auto Gen Start terminal block

Terminal Name	Relay	Description
GEN STOP 2	Relay 1	normally open contact
GEN STOP 1	Relay 1	common contact
GEN STOP 3	Relay 1	normally closed contact
GEN START 2	Relay 2	normally open contact
GEN START 1	Relay 2	common contact
PREHEAT 1	Relay 3	normally open contact
PREHEAT 2	Relay 3	common contact
GEN RUN	n/a	Generator run signal input. This connection is required for the inverter/charger to be able to detect when the generator is running. For example, Power Tech supplies a gray wire marked "12V power or +12V with engine running." This gray wire must connect to the GEN RUN input.
THERMOSTAT +	n/a	Thermostat 5V–30V input.
THERMOSTAT –	n/a	Thermostat return (ground)

Relay
timing

This diagram shows the activity of each internal relay during a generator start sequence.

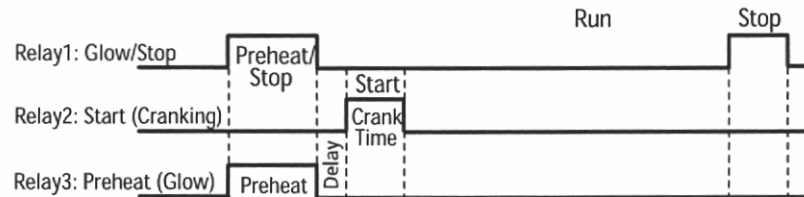


Figure 2-9 Relay activity during a start sequence

Table 2-3 Stop/Stop Sequence Timing

	Onan configuration	Power Tech configuration	Generac configuration
B+ Hold Time	2 seconds	15 seconds	2 seconds
Preheat Time	15	7	25
Preheat to Crank Delay	2	1	0
Crank Time	25	15	15
Crank Retry Time	30	15	15
Spindown Time	3	3	3
Stop Pulse Time	60	9	60
Post Stop Pulse Wait Time	0	5	0
Max Stop Tries	1	4	1
Starter Cooldown Time	60	120	30
Max Start Tries	3	3	3

Wiring size

You need #16 or #18 AWG wire to make generator connections. The wire gauge depends on the distance between the RV Series Inverter/Charger and the generator.

0 to 30 ft. (9 m)	Over 30 ft. (9 m)
18 AWG	16 AWG

Circuit
protection

Important: All circuits (except for ground connections) connecting to the Auto Gen Control relays must be protected with fuses rated at 5 amps or less.

Generator Wiring Diagrams

Onan

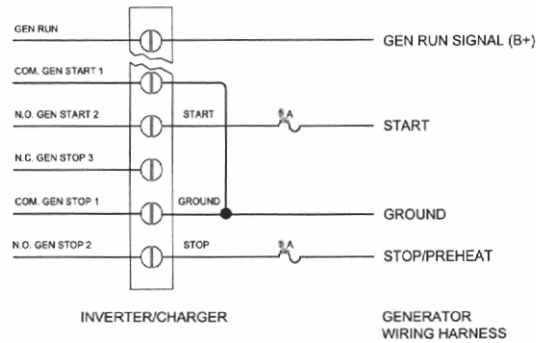


Figure 2-10 Onan QuietDiesel Wiring Diagram

Power Tech

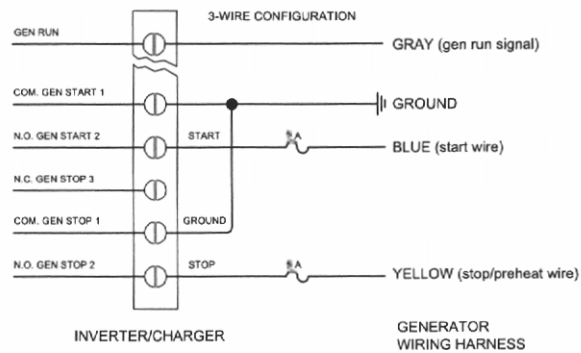


Figure 2-11 Power Tech Wiring Diagram

Generac

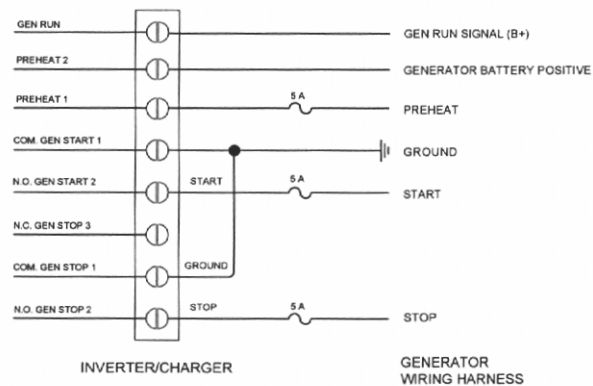


Figure 2-12 Generac Wiring Diagram

Wiring to a Thermostat

With the RC/GS remote control, you can enable the RV Series Inverter/Charger AGS to start the generator in response to 5 to 30 V output signal from a thermostat. Once connected and enabled, the AGS will automatically start the generator when the air conditioner or furnace needs to be run. You cannot program the thermostat itself with the RC/GS. Thermostat connections are made on the terminal block (see Figure 2-8 on page 2-19).

Terminal name	Connects to...
Thermostat +	Thermostat input (5–30 V)
Thermostat –	Thermostat return (ground)

For specific information about thermostat wiring and where AGS connections should be made, please consult your thermostat documentation or contact the thermostat manufacturer.

3

Operation

Chapter 3 contains information about operating the RV Series Inverter/Charger.

Topics in this chapter include:

- “Remote Operation” on page 3–2
- “Stand-Alone Operation” on page 3–2
- “Search Mode” on page 3–2
- “Powering Loads” on page 3–3
- “Battery Charging” on page 3–7.

Remote Operation

The RV Series Inverter/Charger is designed to operate stand alone or with a remote panel. The supported remote panels are the RC/GS, RC7, and RC6. The RC/GS enables advanced monitoring as well as configuration of the inverter/charger and Automatic Generator Start feature. The RC7 offers inverter/charger monitoring and configuration. RC6 is a basic status monitoring device with an on/off button to enable or disable the inverter. Both the RC6 and RC7 connect to the inverter/charger with a standard phone cord.

Stand-Alone Operation

When it is powered on, the RV Series Inverter/Charger performs a self-diagnostic routine during which the indicator light on the front of the unit flickers red and green. During this short boot-up interval, you will also hear a relay click. After performing the self-diagnostic routine and the indicator light has stopped flashing, the inverter/charger is ready for operation.

The inverter/charger features a front panel switch used to enable or disable the inverter. When the switch is in the ON position, the inverter is enabled and will either provide steady 120Vac or send out pulses if search sense mode is enabled. See "Search Mode" for more information. When the switch is OFF, the inverter/charger begins charging if qualified AC power (power that is within a usable voltage range—above 70 V) is connected to the inverter/charger input.

If qualified AC power (from shore power or a generator) is applied to the unit it will transfer from inverter power to AC input power after approximately five seconds and begin charging the batteries and powering any additional AC loads. Because the charger is enabled by default, the unit is always ready to charge your battery bank when qualified AC power is present.

Search Mode

The RV Series Inverter/Charger features an adjustable search sense mode. This mode minimizes power drain by reducing the inverter's output to small test pulses when there is no load connected. These pulses are used to detect the presence of a load. When a load is detected the inverter's output goes to full voltage. The sensitivity of the detection threshold is adjustable.

The RV Series Inverter/Charger's search sense threshold can only be set using the Set Idle menu on the optional RC/GS or RC7 remote. However, once the mode is set the remote may then be removed and the inverter will retain the settings.

Example

With Set Idle set to detect a 40-watt load, a 50-watt load will bring the unit to full output voltage. However, a 30-watt load will leave the inverter in its energy-saving search sense mode. If the sensitivity is increased by changing Set Idle to 20, a 30-watt load will bring the inverter out of the search sense mode, while a 10-watt load will not.

When in the search sense mode, the green power LED will blink and the inverter will make a ticking sound. At full output voltage, the green power LED will light steadily and the inverter will make a steady humming sound. When the inverter is used as an “uninterruptible” power supply the search sense mode function should be defeated.

A neon-type nightlight can also be used as a good indicator to determine if the inverter is in search sense mode. Simply plug the light into any AC outlet. When the inverter is in the search sense mode the light will blink. If the inverter is running a load, the light will be solid.

Exceptions

Example A If Set Idle is set to detect a 40-watt load and a 30-watt incandescent light is turned on, the inverter will detect the light. The light is a bigger load than 40 watts when its filaments are cold. When the light gets bright the filaments heat up and the light becomes a 30-watt load. Since this is below the Set Idle setting of 40, the inverter will not detect it and the light will go out, beginning the process all over again.

Example B If the Set Idle is set to detect a 30-watt load and a 40-watt fluorescent light is turned on, the inverter will not detect the light. The light presents a smaller load than 30 watts until the gas in the fluorescent tube ionizes.

Example C There are some appliances that draw power even though they are turned off. TVs with instant-on circuits, microwave ovens with digital displays and VCRs are examples. These loads present a dilemma. If the sensitivity is set higher than the combination of these loads, then an auxiliary load must be used to bring the inverter out of the search sense mode before the appliances can be turned on. If the sensitivity is set lower than this combination of loads, the loads will be left on and will put an additional drain on the batteries. (Three such 15-watt loads would amount to an additional 90 amp hours per 24 hours in a 12 Vdc system.) One solution is to turn these items off at the wall. Use an extension cord with a rocker switch, a switch at the outlet, or the appropriate circuit breaker.

Powering Loads

Resistive Loads

These are the loads that the inverter finds the simplest and most efficient to drive. Voltage and current are in phase, or, in this case, in step with one another. Resistive loads usually generate heat in order to accomplish their tasks. Toasters, coffee pots and incandescent lights are typical resistive loads. Larger resistive loads—such as electric stoves and water heaters—are usually impractical to run off an inverter. Even if the inverter could accommodate the load, the size of battery bank required would be impractical.

Inductive Loads

Any device that has a coil of wire in it probably has an inductive load characteristic. Most electronics have transformers (TVs, and stereos, for example) and are therefore inductive. Typically, the most inductive loads are motors. The most difficult load for the inverter to drive will be the largest motor you manage to start. With inductive loads, the rise in voltage applied to the load is not accompanied by a simultaneous rise in current. The current is delayed. The length of the delay is a measure of inductance. The current makes up for its slow start by continuing to flow after the inverter stops delivering a voltage signal. How the inverter handles current that is delivered to it while it is essentially “turned off” affects its efficiency and “friendliness” with inductive loads. The best place for this out-of-phase current is in the load, and the RV Series Inverter/Charger’s impulse phase correction circuitry routes it there.

Inductive loads, by their nature, require more current to operate than a resistive load of the same wattage rating, regardless of whether power is being supplied by an inverter, a generator or grid. An air conditioner is a common inductive load in an RV.

Induction motors (motors without brushes) require two to six times their running current on startup. The most demanding are those that start under load, such as compressors and pumps. Of the capacitor start motors, typical in drill presses and band saws, the largest you may expect to run is ½ to 1 hp. Universal motors are generally easier to start. Since motor characteristics vary, only testing will determine if a specific load can be started and how long it can be run.

If a motor fails to start within a few seconds, or it begins to lose power after running for a time, it should be turned off. When the inverter attempts to start a load that is greater than it can handle, it will turn itself off after about 10 seconds.

Low Battery Dropout

The inverter will turn off to protect itself if your battery bank cannot deliver the necessary amperage to drive a particular load without falling below the low voltage protection point (10.5 V) for three seconds. With the inverter off, the battery voltage will rise and then it will resume operation.

Problem Loads

Xantrex inverters can drive nearly every type of load. However, there are special situations in which inverter power may behave differently than utility power.

Very small loads If the power consumed by a device is less than the threshold of the search mode circuitry, it will not run. This can usually be solved by plugging in an additional load such as a 100-watt light bulb.

Fluorescent lights and power supplies Some devices when scanned by the load sensor cannot be detected. Small fluorescent lights are the most common example. (Try altering the plug polarity by turning the plug over.) Some computers and sophisticated electronics have power supplies that do not present a

load until line voltage is available. When this occurs, each unit waits for the other to begin. To drive these loads either a small companion load must be used to bring the inverter out of its search mode, or the inverter may be programmed to remain at full output voltage. See "Search Mode" on page 3-2.

Microwave ovens Microwave ovens are sensitive to peak output voltage. The higher the voltage, the faster they cook. Inverter peak output voltage is dependent on battery voltage and load size. The high power demanded by a full-sized microwave will drop the peak voltage several volts due to internal losses. Therefore, the time needed to cook food will be increased if battery voltage is low.

Printers Most inkjet printers work well in inverter applications. Laser printers, however, require high current for their fusing circuit and are not recommended for use with an inverter.

Clocks The inverter's crystal-controlled oscillator keeps the frequency accurate to within a few seconds a day. However, external loads in the system may alter the inverter's output waveform, causing clocks to run at different speeds. This may result in periods during which clocks keep time and then mysteriously do not. Most clocks do not draw enough power to trigger the load-sensing circuit. In order to operate without other loads present, the load sensing will have to be defeated. (See "Search Mode" on page 3-2.) Clock accuracy is also affected by the accuracy of the generator.

Dimmer Switches Most dimmer switches lose their ability to dim the lights and operate either fully on or off.

Rechargeable Devices When first using a rechargeable device, monitor its temperature for 10 minutes to ensure that it does not become abnormally hot. Excessive heat will indicate that it is incompatible with the inverter.

Electronics AM radios will pick up noise, especially on the lower half of their band. Inexpensive tape recorders are likely to pick up a buzz. Large loads should not be started while a computer is operating off the inverter. If a load is large enough to require "soft starting" it will "crash" the computer, causing it to reboot.

Typical Battery Draw of Common Appliances

Appliance	Watts	Amp Hours Consumed Over Time					
		5 min	10 min	30 min	1 hr	2 hr	4 hr
Single PL light	10	.1	.3	.7	1.3	2.7	5.3
Computer	100	1	2	4	8	17	34
Color TV 13"	200	2	4	8	17	34	67
Blender	400	3	8	17	34	67	133
Skil Saw	800	6	17	34	67	133	266
Toaster	1000	8	23	46	93	185	370
Microwave	1200	10	28	57	114	227	455
Hot Plate	1800	15	44	88	176	353	706

If the current draw at 120 Vac is known, then the battery amperage at 12 Vdc will be 10 times the AC amperage divided by the efficiency (90% in this table).

Motors are normally marked with their running rather than their starting current. Starting current can be five times running current.

Refrigerators and ice makers typically run about one-third of the time. Therefore, their average battery current draw is one-third of what their amp rating would indicate.

Battery Charging

The RV Series Inverter/Charger battery charger uses three-stage charging to provide rapid and complete charge cycles without undue battery gassing. The three stages are bulk, absorption, and float.

Stage One: Bulk Charge (Constant Current)

This stage begins when qualified AC is applied to the AC input of the inverter.

The bulk charging stage charges the batteries at a constant current. The level of charge for this phase is set using the Max Charge Rate menu on the RC/GS or RC7. The constant current phase ends when the batteries reach the bulk charge voltage. During this stage the Charger LED glows orange.

Stage Two: Absorption (Constant Voltage)

Absorption begins when the bulk voltage setting has been reached. At this point the charge current begins to taper off at whatever rate is required to hold the voltage constant. During this stage the Charger LED blinks orange. The absorption phase ends in one of two ways.

1. Normally, as the charge cycle progresses, the current required to hold the battery voltage constant gradually reduces. When this current equals the internal return amps setting, the voltage is allowed to fall to the float voltage setting—stage three. This is a variable stage that can be affected by DC load and battery condition.
2. After a time interval determined by the Battery Capacity setting. With a 125 Ah battery bank, the charger will leave the absorption phase after 1 hour. With a 1000 Ah battery bank, the charger will leave the absorption phase after 3 hours.

Stage Three: Float Voltage

Float voltage maintains the batteries at a voltage that will hold full charge but not gas the batteries. The charger remains in the float stage until the AC input is removed. During this stage the Charger LED flashes green four times per second.

Note: When DC loads are placed on the battery, the charger will deliver currents up to the Maximum Charge Rate setting while maintaining the float voltage.

Temperature-Compensated Charging

The RV Series Inverter/Charger is designed to provide temperature compensated battery charging for optimal battery charging when used with a battery temperature sensor (BTS). The BTS attaches to the side of your battery and continuously measures the temperature of the battery and adjusts the charger output for a more accurate, temperature-compensated charge.

When batteries are cold, their chemical reaction is sluggish, and they do not absorb charge as easily. Therefore, a charge level optimized for room temperature will not charge the batteries sufficiently if they are cold. The charger must compensate by increasing its voltage to achieve the compensated equivalent of a room temperature charge.

If the batteries are hot, the chemical reaction is hyperactive and they absorb energy too easily. Therefore, a standard room-temperature charge would tend to overcharge a hot battery. Therefore, the main charger compensates by reducing its voltage.

With a BTS, the charger automatically, and continuously, makes adjustments to the charger output voltage to properly charge your batteries. The actual charge compensation slope based on cell voltage is -2.17mV per degree F per cell.

If a BTS is not present, the charger uses voltage settings as shown in Table B-1 on page B-7.

Dead Battery Charging

Unlike many chargers, the RV Series Inverter/Charger can recharge batteries even if the battery voltage is very low—as low as 5.5 V for a 12 V battery. Of course, it is not recommended to ever discharge deep-cycle batteries this much.

Battery Equalization

To improve the life and performance of non-sealed, flooded lead-acid batteries, the inverter/charger's multi-stage charging cycle includes a manual equalize mode that can be used if recommended by the battery manufacturer.

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

Follow the battery manufacturer's recommendations for equalizing your batteries. As a guide, a heavily used flooded battery may need to be equalized once a month, and a battery in light service may only need to be equalized every two to four months.



WARNING: Explosive gases

Equalization generates explosive gases. Ensure adequate ventilation.



CAUTION: Batteries may be damaged

Sealed lead-acid batteries and gel batteries must NEVER be equalized, or premature battery failure will result. Equalize mode is disabled if you have selected "GEL Cell" as the battery type.

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



CAUTION: Batteries may be damaged

If carried out too frequently or done improperly, equalization can damage your batteries. Never equalize a battery more than necessary. Always check electrolyte level before AND after equalization. Fill with distilled water per the battery manufacturer's recommendation.



CAUTION: Risk of damage to DC load equipment

Equalization voltage may be as high as 15.5 volts DC. Disconnect sensitive loads from the battery before equalizing.

To enter equalize charge mode using the RC7 or RC/GS:

- ◆ When the inverter/charger is charging, press and hold the Settings button (right arrow) until the screen clears and "Equalizing" appears (approximately 6 seconds).

The Charge LED will increase its flashing rate to approximately 8 flashes per second (flickering). The Equalize charge will continue for 3 hours and then automatically change back to Float.

To cancel Equalize mode:

- ◆ Press and hold the Settings button for approximately 6 seconds.

If Equalization is cancelled, the screen will indicate the System Status as Absorption chg for approximately 30 seconds before returning to Float charging.

LED Indicator

Charger activity

The RV Series Inverter/Charger has a three-color LED that indicates the activity of the battery charger. The optional RC/GS or RC7 remote allows custom control over the charger section of the inverter, including battery type.

Table 3-1 LED color and Charger Activity

LED color	LED behavior	Charger Activity
Orange	Solid	Bulk charging
Orange	Flashing	Absorption charge
Green	Fast flashing (four times per second)	Float charge
Orange	Flashing	Equalization charge

Inverter activity

In addition to indicating charger activity, the three-color LED reports on inverter activity and error conditions.

Table 3-2 LED color and Charger Activity

LED color	LED behavior	Inverter Activity
Green	Solid	Inverting
Green	Slow flashing (once per second)	Search Mode
Red	Solid	Over current condition
Red	Flashing	Error condition

Error Conditions

When an error condition occurs, the LED will flash red, followed by a five-second rest period. You can identify error conditions by counting the number of times the LED flashes before turning off for five seconds. The following table lists LED flashing patterns and their associated error conditions.

Table 3-3 LED activity and Error Conditions

Number of Flashes	Error Condition	Cause
1	Low battery voltage	Battery voltage has fallen to 10.5 V ^a . The RV Series stops inverting. This error clears when the voltage rises to 11.6 V.
2	High battery voltage	Battery voltage has risen to 15.7 V. The RV Series stops inverting. This error clears when the voltage rises to 15.4 V.
3	Inverter over-temperature	The FET and transformer temperature has risen to 194°F (90°C). The RV Series stops inverting or charging. This error clears when the temperature falls below 194°F (90°C).
4	Battery charger fault	Charger not charging correctly.
6	Generator start fault	The RV Series has tried to start the generator three times without detecting a B+ signal.
8	Internal sensor error	Analog-digital converter is faulty.
9	Internal memory error	Internal processor is faulty.

a.Because voltages vary according to the load on the inverter , all voltages in this table are ± 0.3 V.

4

Troubleshooting

Chapter 4 contains information and procedures to troubleshoot the RV Series Inverter/Charger.

Troubleshooting Guide

Symptoms	Problem	Remedy
No power output and no warning LEDs	Battery voltage at the inverter's terminals is too low or not present.	Check the battery voltage, fuses or switches and cable connections.
No power output and LED indicator is flashing green	Load is too small for search sense mode circuit to detect.	Reduce search threshold setting or defeat search mode ("Set Idle" on the remote).
No power output and Red error LED is on or flashing	<ul style="list-style-type: none"> Battery voltage is too low or too high Overcurrent condition Over-temperature condition 	<ul style="list-style-type: none"> Check the battery voltage at the inverter's terminals Remove loads from the inverter and restart Remove loads and let inverter cool down before restarting
Inverter turns loads on and off	<ul style="list-style-type: none"> Low battery Loose or corroded battery connections Loose AC output connections Search sense threshold is too high 	<ul style="list-style-type: none"> Check condition of batteries and recharge if possible Check and clean all connections Check all AC output connections Disable search sense mode or set search sense mode ("Set Idle") lower.
Inverter clicks every 20 seconds	The output of the inverter is wired back to its own input.	Check for proper AC input and output wiring
Charger is inoperative	<ul style="list-style-type: none"> The AC input voltage does not match the inverter spec. The RV Series charger circuit breaker has blown. 	<ul style="list-style-type: none"> Check AC input for proper voltage and frequency of your model. Reset breaker, check installation.
Batteries apparently not being charged correctly	<ul style="list-style-type: none"> Charge controls are improperly set. The BTS has adjusted the charge voltage. 	<ul style="list-style-type: none"> Ensure Battery Capacity, Battery Type, and Max Charge Rate settings are correct. No remedy if the BTS is installed correctly and operating.
Overload LED "ON" while charging	Charger circuit may be damaged.	Have inverter serviced.
Low charge rate	<ul style="list-style-type: none"> Low peak AC input voltage (164 V peak required for full charger output). AC current output of generator is too small to handle the load. 	<ul style="list-style-type: none"> Use a larger generator, speed up the generator, check AC input wiring size, adjust charge rate, battery cables are too small or too long. Reduce charge amps setting or reduce pass-through loads.
Low AC output voltage	Measuring with the wrong type of voltmeter (displays 80–100 VAC).	Voltmeter must be a true RMS reading meter (most are not).
Low surge power	Weak batteries, battery cables are too small or too long.	Refer to cable and battery recommendations in owner's manual.
AC Lights flicker while charging	Generator is unstable—charger is losing synchronization	Turn battery charger rate ("Max Charge Rate") down until problem is gone.

A

Specifications

Appendix A contains contains the electrical, environmental, and physical specifications for the RV Series Inverter/Charger.

All specifications are subject to change without notice.

Specifications

Electrical Specifications

	RV2012GS	RV2512GS	RV3012GS
Continuous Power @ 25°C	2000 watts	2500 watts	3000 watts
Max AC Current	16.6 amps	20.8 amps	25 amps
Efficiency	94% Peak		
Input Current: Search Mode	0.055 amps	0.070 amps	0.080 amps
Input Current: Full Voltage	0.550 amps	0.600 amps	0.650 amps
Input Current: At Rated Power	200 amps	250 amps	300 amps
Input Current: Short Circuit	600 amps	800 amps	900 amps
Minimum input AC Voltage	40 Vac		
Nominal Input Voltage	12 Vdc		
Input Voltage Range	10.5–15.5 Vdc		
Voltage Regulation—Maximum	±5%		
Voltage Regulation—Typical	±2.5%		
Output Waveform	Modified sine		
Power Factor allowed	-1 to +1		
Frequency Regulation	60Hz ± .04%		
Standard Output Voltage	120 Vac		
Adjustable Search Sense Range	20 to 50 watts		
Forced Air Cooling	Variable Speed		
Automatic Transfer Relay	50 amps at 120/240 Vac split phase or 30 amps at 120 Vac single/dual input (field configurable)		
Adjustable Charge Rate	10–100 amps	10–120 amps	10–140 amps
Number of Charging Profiles	3 (GEL Cell, Flooded lead acid, AGM)		
Three-Stage Charging	Yes		

Environmental Specifications

Operating ambient temperature	0 ° – 50 °C (32 ° – 122 °F)
Non-operating temperature	-55 ° – 75 °C (-67 ° – 167 °F)

Physical Specifications

	RV2012GS	RV2512GS	RV3012GS
Weight	45 lb (20.5 kg)	50 lb (22.7 kg)	60 lb (27.2 kg)
Dimensions (L × W × H)	15.5 × 13.2 × 7.25" (39.4 × 33.5 × 18.4 cm)		
Mounting	Desktop, upside down, wall mount with AC terminal block facing up		

Accessories

Battery Temperature Sensor	Optional
Remote Control	Optional RC6, RC7, RC/GS
Remote Control Cables	31-6257-00 (25 feet), 31-6262-00 (50 feet), 31-6275-00 (70 feet)

Regulatory Approvals

UL Listed to UL458

Warranty and Return 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 RV Series Inverter/Charger. This warranty period lasts for 36 months from the date of purchase at the point of sale to you, the original end user customer. You require proof of purchase to make warranty claims.

This Limited Warranty is transferable to subsequent owners but only for the unexpired portion of the Warranty Period. Subsequent owners also require proof of purchase.

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:

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

1 360 925 5097 (direct)

Fax: 1 360 925 5143 (direct)

Email: 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.

What proof of purchase is required? 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

Warranty and Return

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, 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 RV SERIES INVERTER/CHARGER 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 RV SERIES INVERTER/CHARGER IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES.

Please note that the RV Series Inverter/Charger 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 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 RV Series Inverter/Charger 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 unit may be serviced or replaced for a flat fee.

To return your RV Series Inverter/Charger 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 RV Series Inverter/Charger 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 _____
- ☐ Appliances operating when problem occurred _____
- ☐ Description of problem _____

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