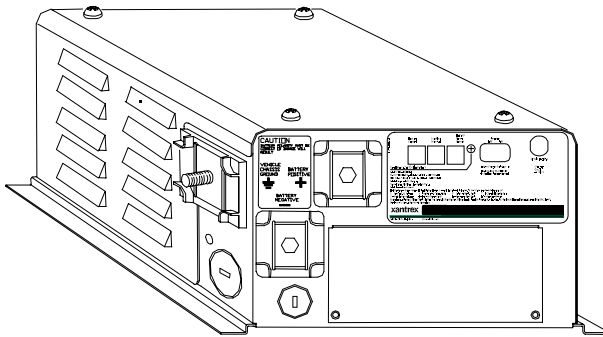


Smart choice for power

**xantrex**



**RV2012  
2512  
3012**

**Owner's Manual**

**Xantrex  
RV Series  
Inverter/Charger**

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

## **TABLE OF CONTENTS**

<b>IMPORTANT SAFETY INSTRUCTIONS</b> .....	<b>1</b>
<b>THEORY OF INVERTER OPERATION</b> .....	<b>4</b>
Waveform.....	4
Regulation .....	4
Search Sense Mode Using Optional RC7 Remote.....	5
<b>BATTERY CHARGER</b> .....	<b>6</b>
Theory of Operation.....	6
Transfer Switching Speed .....	6
Battery Terminology .....	6
Charger Terminology .....	7
Three Stage Battery Charging.....	7
<b>BATTERY CHARGER CONTROLS AND LED INDICATOR</b> .....	<b>8</b>
Charger LED .....	8
Generator Requirements.....	8
Batteries.....	9
Selection of Battery Type.....	9
Battery Care and Maintenance .....	10
Battery Installation.....	11
Battery Sizing.....	12
Battery Hookup Configurations.....	13
<b>INSTALLATION</b> .....	<b>14</b>
Environment.....	14
<b>AC WIRING</b> .....	<b>15</b>

Overview .....	15
AC Connections .....	15
Important Precautions .....	15
Ground Fault Interrupting Outlets (GFIs).....	16
<b>DC WIRING .....</b>	<b>16</b>
Safety Instructions.....	16
DC Over-Current Protection.....	16
Connection of Grounding and Battery Systems.....	17
<b>STACKING INVERTERS.....</b>	<b>18</b>
Precautions.....	18
DC Connections for Stacked Inverters.....	18
AC Wiring for Stacked Inverters.....	19
Operation .....	19
Theory of Operation.....	19
Search Sense Mode Operation with Stacked Pairs.....	20
<b>RC6 REMOTE CONTROL.....</b>	<b>21</b>
Installation .....	21
<b>RC7 REMOTE CONTROL.....</b>	<b>22</b>
Installation .....	22
Programming the RC7 .....	22
User Menu .....	23
Meters Menu .....	24
Setup Menu .....	24
<b>BATTERY CABLE CONNECTION.....</b>	<b>26</b>
Battery Cable Sizing.....	26
Installation with External Transfer Relay (120/240 System).....	27

**Mobile Installation.....28**

**TROUBLESHOOTING GUIDE ..... 29**

**APPLICATIONS ..... 30**

**Resistive Loads.....30**

**Inductive Loads .....30**

**Problem Loads .....30**

**Typical Battery Draw of Common Appliances .....32**

**English to Metric Wire Conversion .....33**

**RC7 Menu Map .....34**

**TECHNICAL INFORMATION ..... 36**

**RV Series Specifications.....36**

**LIMITED WARRANTY ..... 37**

**Notice of Copyright**

*Xantrex RV Series Inverter/Charger* © December 2002 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** December 2002, Revision 2

**Part Number** 445-0202-01-01

**Contact Information**

Web: [www.xantrex.com](http://www.xantrex.com)      Email: [CustomerService@xantrex.com](mailto:CustomerService@xantrex.com)  
Phone: 1-800-670-0707 (toll free) 1-604-422-2777 (direct)  
Fax: 1-604-420-2145



# IMPORTANT SAFETY INSTRUCTIONS

## SAVE THESE INSTRUCTIONS!

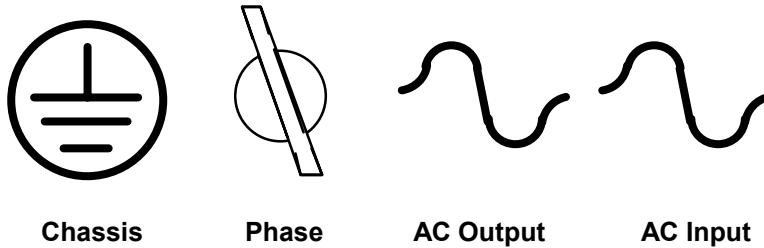
This manual contains important safety and operating instructions as prescribed by UL specifications for inverters used in land vehicle applications. This manual covers Xantrex RV Series Inverter/Chargers models RV2012, RV2512, and RV3012.

---

## General Precautions

1. Before using the inverter/charger, read all instructions and cautionary markings on (1) the inverter/charger, (2) the batteries and (3) all appropriate sections of this instruction manual.
2. **CAUTION:** To reduce 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. Do not expose inverter/charger to rain, snow or liquids of any type. The inverter is designed for indoor mounting only. Protect the inverter from splashing when used in vehicle applications. Do not mount the inverter in unventilated enclosures or in the engine compartment.
4. Do not disassemble the inverter/charger; take it to a qualified Xantrex service center when service or repair is required. Incorrect reassembly may result in a risk of electric shock or fire.
5. To reduce risk of electric shock, disconnect all wiring before attempting any maintenance or cleaning. Turning off the inverter will not reduce this risk. Solar modules produce power when exposed to light—cover them with opaque material before servicing any connected equipment.
6. **WARNING: WORKING IN THE VICINITY OF A LEAD ACID BATTERY IS DANGEROUS. BATTERIES GENERATE EXPLOSIVE GASES DURING NORMAL OPERATION.** Provide ventilation to outdoors from the battery compartment. The battery enclosure should be designed to prevent accumulation and concentration of hydrogen gas in “pockets” at the top of the compartment. Vent the battery compartment from the highest point.
7. NEVER charge a frozen battery.
8. No terminals or lugs are required for hook-up of the AC wiring. AC wiring must be no less than 10 AWG (5.3 mm<sup>2</sup>) gauge copper wire and rated for 75 °C or higher. Battery cables must be rated for 75 °C or higher and should be no less than #2 AWG (67.4 mm<sup>2</sup>) gauge. 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.
9. Torque all AC wiring connections to 20 inch-pounds. Torque all DC cable connections to 12 foot-pounds. Be extra cautious to reduce the risk of dropping a metal tool onto batteries. It could short-circuit the batteries or other electrical parts, resulting in sparks that could cause an explosion.

10. Symbols used in this manual and on the inverter/charger are:



1. Tools 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.
2. This inverter/charger is intended to be used with a battery supply with a nominal voltage of 12 volts DC.
3. For instructions on shelf mounting, see "Installation" on page 14. For battery installation and maintenance: read the battery manufacturer's installation and maintenance instructions prior to operating.
4. No AC or DC disconnects are provided as an integral part of this inverter. Both AC and DC disconnects must be provided as part of the system installation. See **SYSTEM SAFETY WIRING REQUIREMENTS** section of this manual.
5. No over-current protection for the battery supply is provided as an integral part of this inverter. Over-current protection of the battery cables must be provided as part of the system installation. See "DC Over-Current Protection" on page 16.
6. 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. See **SYSTEM SAFETY WIRING REQUIREMENTS** section of this manual.
7. **DC GROUNDING INSTRUCTIONS:** 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.
8. **AC GROUNDING INSTRUCTIONS:** 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.

## Personal Precautions

1. Someone should be within range of your voice to come to your aid when you work near batteries.
2. Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
3. Wear complete eye protection and clothing protection. Avoid touching eyes while working near batteries. Wash your hands when done.
4. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cool water for at least 15 minutes and get medical attention immediately.
5. Baking soda neutralizes lead acid battery electrolyte. Keep a supply on hand in the area of the batteries.
6. **NEVER** smoke or allow a spark or flame in the vicinity of a battery or generator.
7. Be extra cautious to reduce the risk of dropping a metal tool onto batteries. It could short-circuit the batteries or other electrical parts, resulting in a spark that could cause an explosion.
8. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a battery. A battery can produce a short-circuit current high enough to weld a ring or the like to metal, causing severe burns.
9. To prevent accidental starting during servicing, disable the automatic starting circuit and/or disconnect the generator from its starting battery if a remote or automatic generator start system is used.

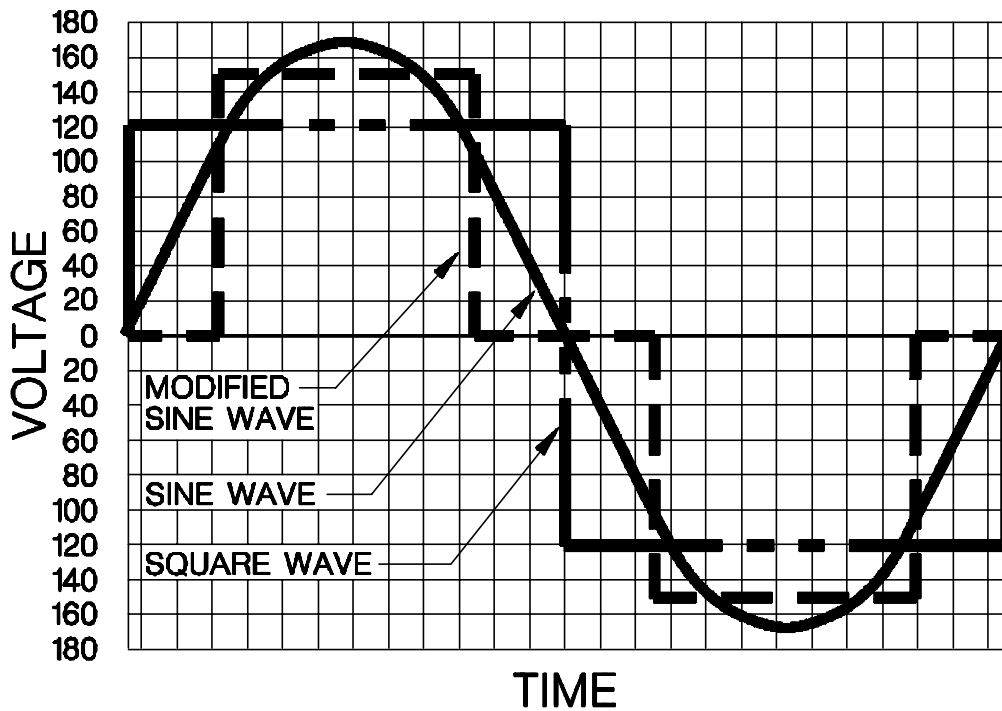


---

# Theory of Inverter Operation

## Waveform

The output waveform of the inverter is referred to as a modified sine wave. This waveform is suitable for a wide variety of applications—induction motors (such as in refrigerators and drill presses), resistive loads (such as heaters and toasters), universal motors (such as in hand tools and vacuum cleaners) as well as microwave ovens and computers.



Comparison of Output Waveforms

The waveform could be more accurately described as a pulse width modulated square wave. The illustration above shows the relationships between square wave, sine wave and modified sine wave formats.

---

## Regulation

The inverter is RMS voltage regulated. RMS regulation ensures that resistive loads will always have the same amount of power delivered to them as battery voltage changes. Regulation is achieved by varying the width of each pulse. Peak voltage is the product of the battery voltage times the turns ratio of the inverter's power transformer and is therefore not actively regulated.

---

## Search Sense Mode Using Optional RC7 Remote

The **SEARCH SENSE** menu on the RC7 is used for adjusting the sensitivity of the search mode circuit. The RV inverter's search sensitivity can only be set using the optional RC7 remote. However, once the mode is set the remote may then be removed and the inverter will retain the settings. The RV Series inverters feature an adjustable search mode circuit. It 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.

**Example:** With the SEARCH WATTS control 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 mode state. If the sensitivity is increased by setting the control to 10, a 20-watt load will bring the inverter out of the search mode, while a 5-watt load will not.

When in the search mode, the green power LED will blink and the inverter will make a ticking sound. At full output voltage, the green power LED will burn steadily and the inverter will make a steady humming sound. When the inverter is used as an "uninterruptible" power supply the search 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 mode. Simply plug the light into any AC outlet. When the inverter is in the search mode the light will blink. If the inverter is running a load, the light will be solid.

### Exceptions

**Example A:** If the SEARCH WATTS control 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 control 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 SEARCH WATTS control 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 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.

---

# Battery Charger

## Theory of Operation

---

### Inverter to Charger Transition

The internal battery charger and automatic transfer relay allows operation as either a battery charger or inverter (but not both at the same time). An external source of AC power (such as shorepower or a generator) must be supplied to the inverter AC input in order to allow it to operate as a battery charger. The RV series charger will always charge when there is AC power present, even when the inverter itself is turned off (by the on/off switch). When operating as a charger, the AC output is powered by the external source (such as a generator or public power).

The inverter automatically becomes a battery charger whenever AC power is connected to its AC inputs. There is a minimum 20-second time 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 specifically 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.

Several PC magazines have run tests indicating a transfer time up to 100 milliseconds will normally hold up the present generation of PCs.

When switching from inverter to charger, the inverter waits a minimum of 20 seconds to ensure the AC source is stable (as the generator gets up to speed).

---

### Battery Terminology

Describing the battery charger's operation requires the use of terms with which you may not be familiar. The following terms will be referred to in the description of the battery charger operation.

- **Electrolyte:** Typically a mixture of water and sulfuric acid, it is commonly referred to as battery acid.
  - **Plates:** Originally made of lead, they are now made of lead oxide. Plates are the part of the battery that collects current and are connected to the battery terminals. There are several plates in each cell, each insulated from the other by separators.
  - **Sulphating:** As a battery discharges, its plates are progressively covered with lead sulfate. During recharging, the lead sulfate is removed from the plates and recombines with the electrolyte. If the lead sulfate remains on the plates for an extended period of time (over two months), it hardens, and recharging will not remove it. This reduces effective plate area and the battery capacity is diminished.
  - **Stratification:** Over time the batteries' electrolyte (liquid) tends to separate. The electrolyte at the top of the battery becomes watery while at the bottom it becomes more acidic. This effect is corrosive to the plates.
  - **Deep Cycle:** A deep cycle occurs when a battery has been discharged such that less than 20% of its capacity remains (80% discharge).
-

- **Temperature Compensation:** The optimum voltage is temperature dependent. As temperature decreases the proper voltage for each charge stage needs to be increased. The optional temperature probe will automatically rescale charge voltage settings for ambient temperature. The compensation slope based on cell voltage is -2.17 mV per degree F per cell.

---

## Charger Terminology

- **Bulk Voltage:** This is the maximum voltage at which the batteries will be charged during a normal charging cycle. The normal range is 2.367 to 2.4 volts per cell. For a 12 VDC battery (6 cells) this is 14.1 volts for gel cell type batteries and 14.4 volts for lead acid batteries.
- **Float Voltage:** This is the voltage at which the batteries will be maintained after they have been charged. In 12-volt systems 13.4 volts for gel cell batteries and 13.5 volts for lead acid batteries will be maintained by the charger.
- **Absorption Stage:** During this part of the charge cycle, the batteries are held at the bulk voltage and accept whatever current is required to maintain this voltage.
- **Battery Temperature Compensation:** When installed this adjusts the bulk and float voltages depending on the battery temperature. As battery temperature increases the voltages are reduced, and as temperature decreases the voltages are increased. This is highly recommended for sealed batteries.

---

## Three Stage Battery Charging

The battery charger in standby models normally charges in three stages—**bulk**, **absorption** and **float**—to provide rapid and complete charge cycles without undue battery gassing.

### **Stage One: Constant Current/Bulk Charge**

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

Stage one charges the batteries at a constant current. The level of charge for this phase is set using the BATTERY CHARGER RATE control on the front panel. The constant current phase is terminated when the batteries reach the bulk charge voltage. During this stage the Charger LED glows orange.

### **Stage Two: Constant Voltage/Absorption**

Absorption is initiated 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 is terminated 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 programmed return amps setting, the voltage is allowed to fall to the **FLOAT** (float voltage) setting—stage three.
2. If there are DC loads on the batteries, the current may never fall to a level low enough to initiate the float voltage stage. A timer is used to ensure that the battery voltage does not remain indefinitely at the bulk charge voltage. The timing circuit terminates stage two if the charge current does not reach the return amps value setting within 12 hours.

### **Stage Three: Float Voltage**

The purpose of stage three is to maintain 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 status LED will show fast flashing 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.

---

## **Battery Charger Controls and LED Indicator**

A three-color LED reports on the activity of the battery charger. The optional RC7 remote allows custom control over the charger section of the inverter, including battery type.

---

### **Charger LED**

The LED indicates charge status as follows:

- **Solid Green:** this indicates that the unit is inverting
- **Slow flashing Green:** Search Mode
- **Solid Orange:** this indicates that the charger is in the bulk-charging mode.
- **Blinking Orange:** this indicates that the charger is in the absorption stage.
- **Fast Flashing Green (four times per second):** Float charge mode
- **Solid Red:** Over current
- **Flashing Red:** An error has occurred. The number of flashes before a five-second rest period indicates one of the error conditions listed below.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7 or more</b>
Low battery voltage	High battery voltage	Inverter over temp	Charger fault	PV controller fault	Generator start fault	Consult Xantrex support

---

## **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 output is rated on the basis of typical public power input, which has a peak voltage of approximately 164 V.

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 (typically 5 kW for 2500-watt models and 2.5 kW for 1500-watt models). Smaller generators will have the tops of their waveform clipped under such 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 exacerbate this problem. See the appendix for specific generator types and peak voltage vs. maximum charge amps information.

## Batteries

Batteries come in different sizes, types, chemistries, amp hours, and voltages. There are nearly as many descriptions of how batteries should be used as there are people willing to offer explanations. It is not possible here to discuss all aspects in detail. However, there are basic guidelines you can follow that will help in battery selection and ensure that your batteries are well maintained.

---

## Selection of Battery Type

---

### Starting Batteries

Starting batteries are not recommended for your inverter/charger. They are designed for high cranking power, but not deep cycling. They do not hurt the inverter, but will not last long in a deep-cycle application. The way they are rated should give a good indication of their intended use—"cold cranking amps," a measure of the amperage output that can be sustained for 30 seconds. Starting batteries use lots of thin plates to maximize the surface area of the battery. This allows very high starting current but lets the plates warp when the battery is cycled.

---

### Deep-Cycle Batteries

This type of battery is best suited for use with inverter/chargers. They are designed to have the majority of their capacity used before being recharged. They are available in many sizes and types. The most common type is the non-sealed, liquid electrolyte battery. Non-sealed types have battery caps. The caps should be removed periodically to check the level of electrolyte. When a cell is low, distilled water should be added. The electrolyte level should be checked monthly and topped up if needed after recharging.

#### Group 27 Batteries

The most common deep-cycle battery is the type used with boats and motor homes. They typically are called "Group 27" batteries and are similar in size to a large truck battery. They are 12-volt batteries rated at 80 to 100 amp hours. Often the deep cycle claim is overstated. They do work better than a car battery, but are not recommended for anything but the smallest systems.

#### Golf Cart Batteries

Another popular and inexpensive battery of this type is the "golf cart" battery. It is a 6-volt battery rated at 220 amp hours. They can be cycled repeatedly to 80% of their capacity without being damaged. This is the minimum quality of battery that should be used with the RV Series inverter in normal applications.

#### L16-type Batteries

Some systems use the L16 type of battery. These are 6-volt batteries rated at 350 amp hours and are available from a number of manufacturers. They are 17 inches in height and weigh up to 130 pounds each, which may be troublesome in RV or marine installations.

#### Type 8D Batteries

Type 8D batteries are available with either cranking or deep-cycle construction. The deep-cycle versions are 12-volt batteries rated at about 200 amp hours. Since they are most commonly used to start truck engines, you should make sure you purchase the deep-cycle version. Type 4D batteries are very similar in construction.

## Sealed Gel Cell

Another type of battery construction is the sealed gel cell. They don't use battery caps. The electrolyte is in the form of a gel (instead of a liquid) that allows the batteries to be mounted in any position without spilling. The advantages are no maintenance, long life (800 cycles claimed) and low self-discharge. The disadvantage is high initial cost and the possibility of damage from overcharging.

While there are many manufacturers of quality non-sealed batteries, there are only a few manufacturers of suitable gel cells. Don't confuse sealed batteries with maintenance-free batteries—the latter is typically a standard liquid electrolyte-type battery without caps for adding water. When the electrolyte gets low you replace the battery.

AGM (absorbed glass mat) batteries are similar to gel cells and may be used in inverter applications.

## Battery Care and Maintenance

If you have read the battery charger mode section of this manual, you already have a good idea of the stages of battery charging that combine to promote fast charging and ensure long battery life. Basically, there are five charger-related considerations to properly care for your batteries.

- **Charge Rate:** The maximum safe charge rate is related to the size and type of your batteries. Standard vented lead acid batteries (with battery caps) can be charged at a high rate—equal to their capacity. Small batteries may require a lower charge rate. Check with the battery manufacturer. Using the optional RC7 remote control the **CHARGE RATE** setting may be adjusted to control the charging rate as a percentage of available charger output.
- **Bulk Voltage:** This is the maximum voltage the batteries reach during the normal charging process. Gel cell batteries are charged to 14.2 volts, while non-sealed batteries are charged to 14.4 volts. Adjust the **BATTERY TYPE** setting to either gel cell or liquid lead.
- **Float Voltage:** The batteries experience less gassing if they are maintained at a lower voltage than the voltage at which they are charged. The float voltage will automatically be adjusted when the proper battery type has been selected.
- **Temperature Compensation:** Temperature affects the optimum voltage values for the bulk and float charging stages. The temperature probe automatically fine-tunes these voltages for you.

**Typical BULK and FLOAT Setpoints for Common Battery Types (12 V System)**

Battery Type	Bulk Volts	Float Volts
Gel Cell (sealed)	14.1 volts	13.5 volts
Lead Acid (non-sealed)	14.4 volts	13.4 volts

### Monthly Maintenance

At the minimum, check the level of the electrolyte in each battery cell once a month. It should be above the top of the plates but not completely full. Most batteries have a plastic cup that the electrolyte should just touch when full. Don't overfill the batteries or the electrolyte will spill out of the batteries when they are being charged. Only refill the batteries with distilled water. "Spring" water and regular tap water may have high levels of minerals, which can poison the battery chemistry and reduce battery life.

It is also good to check the battery interconnections for tightness and corrosion. If any corrosion is found, disconnect the cables and carefully clean with a mild solution of baking soda and water.

**DO NOT ALLOW THE SOLUTION TO ENTER THE BATTERY.** Rinse the top of the battery with clean water when finished.

To reduce the amount of corrosion on the battery terminals, coat them with a thin layer of petroleum jelly or anti-corrosion grease available from automotive parts stores or battery suppliers. Do not apply any material between the terminal and the cable lugs—the connection should be metal to metal. Apply the protective material after the bolts have been tightened.

---

## Battery Installation

**WARNING: Batteries can produce extremely high currents if they are short-circuited. Be very careful when working around them. Read the important safety instructions at the start of this manual and the battery supplier's precautions before installing the inverter and batteries.**

### Battery Location

Batteries should be located in an accessible location with nothing restricting the access to the battery caps and terminals on the tops. At least 2 feet of clearance above is recommended. They must be located as close as possible to the inverter, but cannot limit the access to the inverter and the inverter's over-current protection device. With the RV Series inverter, the batteries are best located to the left of the inverter.

The over-current protection device must be located per code within 18" of the battery installation, and must be covered to prevent possibility of a short circuit.

### Battery Enclosures

The batteries must be protected inside of a ventilated enclosure. The enclosure should be ventilated to the outdoors from the highest point to prevent accumulation of hydrogen gasses released in the battery charging process. An air intake should also be provided at a low point in the enclosure to allow air to enter the enclosure to promote good ventilation. For most systems, a 1-inch diameter vent pipe from the top of the enclosure is adequate to prevent accumulation of hydrogen.

### Battery Temperature

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

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

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

The batteries should also be protected from high temperature as well. This can be caused by high ambient temperatures, solar heating of the battery enclosure, or heat released by a closely



located generator. High battery temperatures will result in short battery life and should be avoided by ventilating the enclosure and reducing the external heat sources by shading and insulation.

### **Battery Cabling**

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

It is usually preferable to first connect the batteries in series and then in parallel when connecting smaller batteries together. The best configuration is to connect the batteries both in series and parallel—a configuration often called “cross-tying.” This requires additional cables but reduces imbalances in the battery and can improve the overall performance. Consult your battery supplier for more information regarding the hook-up configuration required for your system.

---

## **Battery Sizing**

Batteries are the inverter's fuel tank. The larger the batteries, the longer the inverter can operate before recharging is necessary. An undersized battery bank results in reduced battery life and disappointing system performance.

Batteries should not be discharged more than 50% of their capacity on a regular basis. Under extreme conditions cycling to a discharge level of 80% is acceptable. Totally discharging a battery may result in permanent damage and reduced life.

### **Estimating Battery Requirements**

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

You can compute your battery requirements using the nameplate rating of your appliances. The critical formula is **WATTS = VOLTS × AMPS**. Divide the wattage of your load by the battery voltage to determine the amperage the load will draw from the batteries.

If the AC current is known, then the battery amperage will be:

$$\frac{(\text{AC current}) \times (\text{AC voltage})}{(\text{battery voltage})} = \text{DC amps}$$

Multiply the amperage by the number of hours the load will operate and you have, reasonably enough, amp hours.

Motors are normally marked with their running current rather than their starting current. Starting current may be 3 to 6 times running current. Manufacturer literature may provide more accurate information compared to the motor nameplate. If large motors will be started, increase the battery size to allow for the high demand startups require.

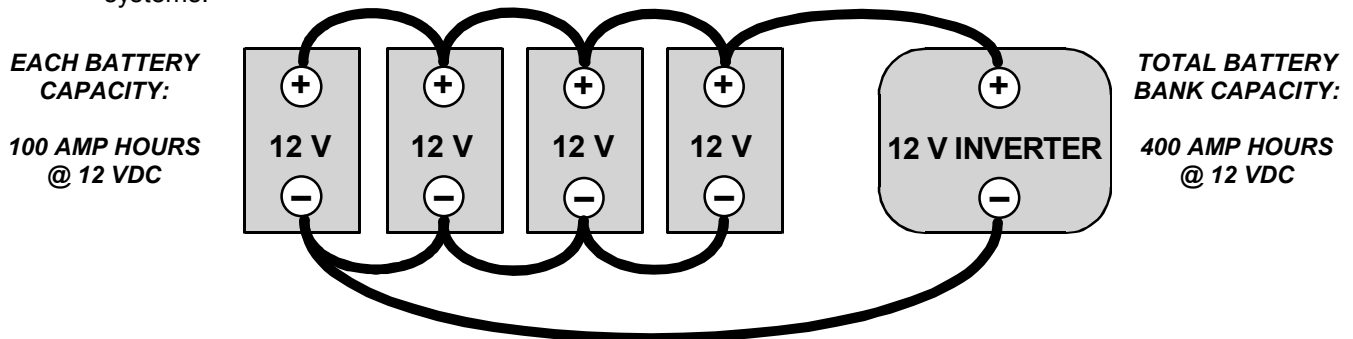
Follow this procedure for each item you want to use with the inverter. Add the resulting amp-hour requirements for each load to arrive at a total requirement. The minimum properly sized battery bank will be approximately double this amount. This will allow the battery to be cycled only 50% on a regular basis.

## Battery Hookup Configurations

Battery banks of substantial size are generally created by connecting several smaller batteries together. There are three ways to do this. Batteries can be connected in parallel, series, or series-parallel.

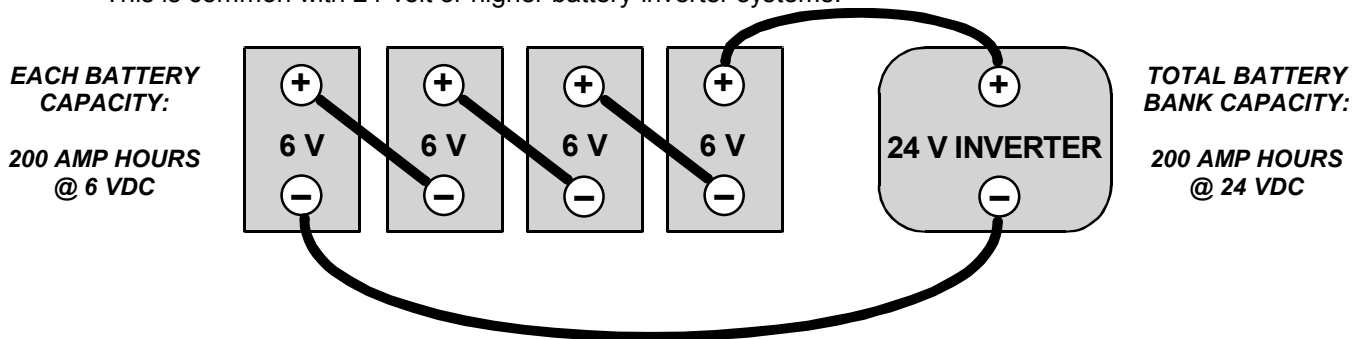
### Parallel Connection

Batteries are connected in parallel when all the positive terminals of a group of batteries are connected and then, separately, all the negative terminals are connected. In a parallel configuration, the battery bank has the same voltage as a single battery, but an amp-hour rating equal to the sum of the individual batteries. This is usually only done with 12-volt battery-inverter systems.



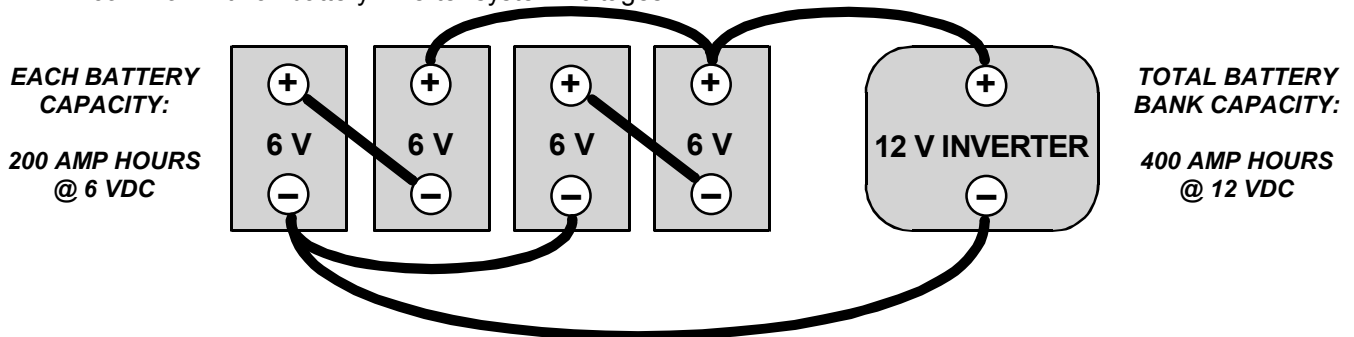
### Series Connection

When batteries are connected with the positive terminal of one to the negative terminal of the next, they are connected in series. In a series configuration, the battery bank has the same amp-hour rating of a single battery, but an overall voltage equal to the sum of the individual batteries. This is common with 24-volt or higher battery-inverter systems.



### Series-Parallel Connection

As the name implies, both of the above techniques are used in combination. The result is an increase in both the voltage and the capacity of the total battery bank. This is done very often to make a larger, higher voltage battery bank out of several smaller, lower voltage batteries. This is common with all battery-inverter system voltages.



# Installation

## Environment

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: It is in your best interests to 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.**

Locate the inverter as close to the batteries as possible in order to keep the battery cables short. However, do not locate the inverter in the same compartment as the batteries. Batteries generate hydrogen sulfide gas, which is very corrosive to electronics equipment—and everything else. They also generate hydrogen and oxygen. If allowed to accumulate, this mixture could be ignited by an arc caused by the connecting of battery cables or the switching of a relay. Mounting the inverter in a ventilated enclosure with sealed batteries is acceptable.

Do not mount the inverter in a closed container. To operate at high power for sustained periods of time, unrestricted airflow is required. Without it, the protection circuitry will activate and reduce the maximum power available, or cause complete shutdown of the inverter.

**UL specification 458 (land vehicle installations) requires that the inverter be mounted on a flat surface (on a shelf).** The purpose of this requirement is to orient the inverter so that its bottom cover has no holes that would allow burning material to be ejected in the event of an internal fire.

# AC Wiring

## Overview

The 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.

## AC Connections

**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 make the AC connections. The terminal block is used to hardwire 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. The table below gives suggestions for 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.

**Step 1** Disconnect the inverter from the battery.

**Step 2** 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 page 27.

**Step 3** Following the wiring guide located in the AC wiring compartment and page 27, 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.

**Step 4** Replace the cover using the two 6-32 screws and lock washers to secure it.

### **MINIMUM RECOMMENDED AC WIRE SIZES**

<b>MODEL</b>	<b>120 VAC Input</b>	<b>AC Output</b>
RV2012	10 gauge	12 gauge
RV2512	8 gauge	10 gauge
RV3012	8 gauge	10 gauge

## Important Precautions

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.

---

## Ground Fault Interrupting Outlets (GFIs)

Xantrex has tested the following GFIs and found them to work satisfactorily with our inverters:

LEVITON	6599
PASS & SEYMOUR	1591RI 4A957
ACE Hardware	ACE 33238

---

## DC Wiring

### Safety Instructions

**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 every power FET. To compound your misfortune, this type of failure is very obvious, and **is not covered under the warranty.** So, pay close attention and double-check when making the battery connections.

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 less current in the inverter's filter capacitors.

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

Cable ends must have crimped and/or soldered copper ring terminals.

---

### DC Over-Current Protection

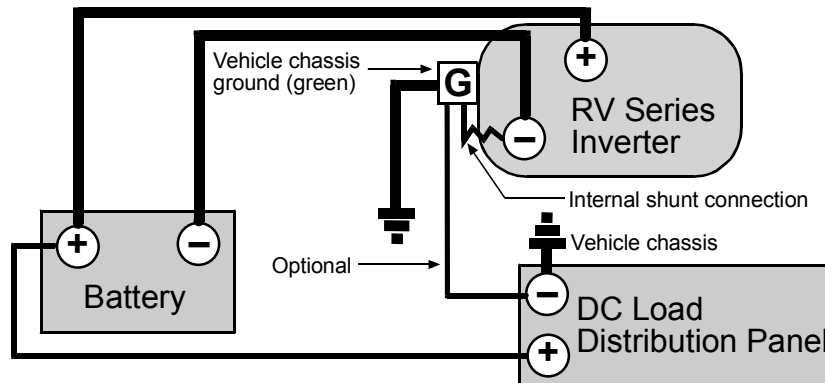
In order to comply with the UL 458 safety standard (Land Vehicle installations) a UL approved form of battery over-current protection is required. These installation parts are not supplied by Xantrex. Standard-type DC fuses or circuit breakers may be obtained from your dealer, electrical supply houses or:

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 the table on page 26 of this manual for proper fuse size). See the latest Xantrex RV Catalog or visit [www.xantrex.com](http://www.xantrex.com) for more information.

## Connection of Grounding and Battery Systems

The following diagram outlines proper connections for the RV Series inverter/chargers. Several points of caution are:

- **DO NOT** connect the battery negative (-) terminal to the vehicle chassis ground.
- **DO NOT** connect the DC load negative to the battery negative (-). Connect only to the chassis ground terminal on the inverter or to the vehicle chassis.



**Do NOT connect battery negative to vehicle chassis or vehicle chassis ground. Terminal connection to chassis ground is made inside the inverter.**

Connect DC loads to Vehicle Chassis or optionally to the Inverter's Vehicle Chassis Ground Terminal (Green). **Do not connect DC loads to battery negative (-)**

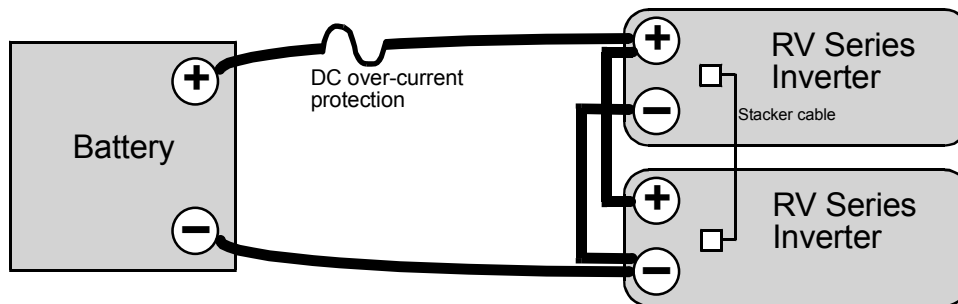
# Stacking Inverters

## Precautions

- Only stack the same models of the RV inverter. For example, stack an RV2012 only with an RV2012.
- Use only a Xantrex stacker cable, available in RV Series External Shunt Kit (part #2813). It is not a standard telephone cable.
- Connect AC neutrals together close to the inverters. Keep input and output neutrals isolated.
- Connect the inverter's battery negative terminals together according to this manual.
- Make all AC and DC connections and verify that they are made in accordance with this manual. Make sure that all connections are tight (especially the DC side). Connect the stacker cable to each inverter's stacking port.
- Each inverter must be turned on individually before AC power will be available.

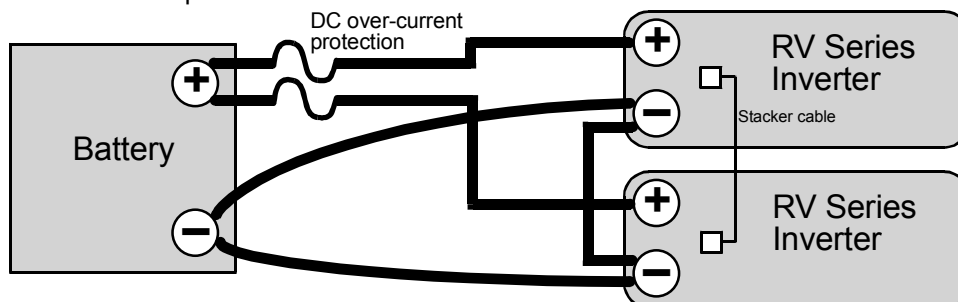
## DC Connections for Stacked Inverters

**Connection with One DC Over-Current Device:** When stacking two RV units with one DC disconnect device, connect the units and battery as follows: Connect the negative terminals of the inverters together, and then attach one of the negatives to the battery. Next connect the positive terminals of the inverters together, and attach one to the battery. Place the DC over-current device in the positive line between the inverter and the battery. (See the following diagram for proper connection)



**Connection with Two DC Over-Current Devices:** If individual over-current devices are to be used between the battery positive and each inverter, connect the stacked system as follows: Connect the negative terminals of the inverters together and connect each negative terminal to the battery also. Connect each positive terminal of the inverter to the battery through a DC disconnect in each positive line. Do not tie the positives together between inverters. (See the following diagram for proper connection)

Once the inverters are connected to the battery as described above, connect the Xantrex stacker cable between stacker ports.



---

## AC Wiring for Stacked Inverters

Due to the neutral ground switching design of the RV Series Inverter/charger, it is mandatory that the AC input and AC output neutrals be isolated from one another. In a stacked pair configuration, connect the two AC input neutrals together then the two AC output neutrals and then attach each pair to isolated neutral locations.

---

## Operation

The power switch of one unit turns both inverters on and off—this unit becomes the “master.” The other unit is the “slave” and will follow the master throughout its modes of operation. Whichever unit is turned on first becomes the master inverter.

For example, the inverters will both charge when AC line power is available to the master unit. This will take place after the generator spin-up delay of 20 seconds (minimum) has passed and the inverter has synchronized to the generator's output. Accordingly, both units will transfer back to inverter mode when the master unit senses a loss of AC input power.

The only situation in which the slave may shut down the master inverter is during fault conditions such as high/low battery, over-current, or over-temperature conditions. Both inverters will auto reset after a fault condition has been cleared. The exception is that an over-current condition will generate a shutdown for both inverters that will require a manual restart of the system.

**NOTE:** The RV series inverters, unlike the “U series,” are **series stacking**, meaning the outputs are connected in series providing 120/240 VAC output with twice the power at 240 VAC. The RV inverters **cannot** be paralleled for twice the power at 120 VAC.

---

## Theory of Operation

The inverter is designed to accept power input from single-phase, 3-wire 120/240 VAC system, 120 volts to each inverter. The **HOT IN** terminal of each inverter accepts one leg of 120 volts each and the **NEUTRAL IN** terminals of both inverters are tied together and connected to the power source neutral leg.

Any AC loads being powered while AC input is present to the inverters will be in addition to the power being drawn for battery charging. Each unit of the pair can provide full pass-through current of 50 amps for 120-volt systems.

When AC input power is lost, the units switch from charger to inverter mode. Once this switch is made 120 VAC is available from each individual inverter, or 240 VAC is available across the **HOT OUT** terminals of the stacked pair.

Stacked inverters will typically support about twice the surge power of one stand-alone unit. For example, an RV3012 stacked pair will surge about 9000 watts of incandescent lights at 240 VAC. Keep in mind that typical incandescent light bulbs require about five times normal run current at startup.

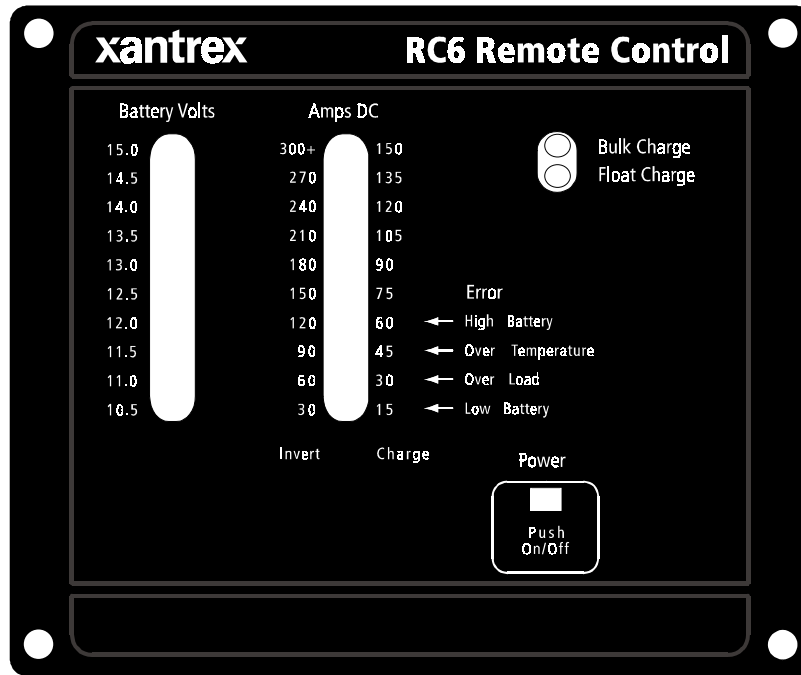


## **Search Sense Mode Operation with Stacked Pairs**

When two RV inverters are stacked the search control on the master unit will determine how much load must be present to “wake-up” both inverters. As a result, loads that will be used to bring the inverters out of search mode must be wired to the master unit's 120 VAC output or across both units' 240 VAC output. See “Search Sense Mode Using Optional RC7 Remote” on page 5 for operation of the search sense mode control.

## RC6 Remote Control

The optional RC6 remote control unit duplicates the Power On/Off Switch on the RV Series Inverter/charger. It connects directly to the port labeled **REMOTE CONTROL** on the front of the inverter using a standard phone jack. You are recommended to use the included Xantrex remote cable because of its high quality cable and connectors.



RC6 Front Panel

The front panel of the RC6 monitors the inverter's output and shows the status of several different modes of the inverter. The bar graph on the far left shows battery voltage from 10.5–15 volts. The bar graph in the middle of the panel indicates DC amps in either the inverter or charger modes and will automatically switch between them as the RV Series Inverter changes modes. The four error lights on the lower right of this graph use the bottom four LEDs to indicate four different error conditions: High Battery, Low Battery, Over Temp, and Over Load. One of these four lights will blink when an error condition occurs. The Bulk Charge and Float Charge lights will blink slowly to indicate the inverter is in either the bulk or float stage of the charging process.

In order for the inverter to recognize the RC6, the unit must be turned off and then on with the RC6 connected.

## Installation

Using the faceplate as a template, drill 1/16-inch holes for the mounting screws. The cutout for the RC6 should be 4-1/8" wide by 4-3/16" high by at least 15/16" deep. Next route the cable through the faceplate, then to the inverter. The last step is to attach the switch to the faceplate by pressing it into place. Plug the RC6's cable into the port labeled **REMOTE CONTROL** on the inverter, turn the inverter off and then on and the pair will be ready for service.

# RC7 Remote Control

The optional RC7 remote control has the ability to communicate and adjust settings in the RV Series Inverter/Chargers.

---

## Installation

### To hook up the RC7 Remote Control:

1. Connect the included phone cable between the port labeled **REMOTE CONTROL** on the front panel of the inverter and the RC7 **before** DC and AC power are applied to the inverter. It is recommended that the supplied cable be used instead of standard phone cable due to its higher quality cable and connectors.
2. Connect DC power to the inverter.
3. Do not connect AC power or turn the inverter power switch on until the RC7 display reads "Waiting for AC." Once the display reads "Waiting for AC," the RC7 power ON/OFF switch may be pressed or user settings changed.

If the remote must be connected after DC power is connected to the inverter, turn the inverter power switch to OFF and disconnect AC shorepower. The inverter will recognize that the remote is connected **only if it is not inverting, charging, or in search mode**.

The RC7 displays its information on an LCD screen and has multiple modes. A menu tree is provided in this manual to help navigate the RC7's many features. The RC7 is the only way to change the set points of the inverter. Once the desired changes have been made, the RC7 may be unplugged and these changes will be retained, even if the inverter is completely powered down. When the RC7 is connected to the inverter the inverter's status LED still operates normally.

---

## Programming the RC7

During programming, the inverter may be in the power-off mode, inverting, charging, or in search mode. The only requirements are that the power switch position must not change during programming (if off, leave it off, or if on, leave it on.) and the mode must not change for 20 seconds after programming is complete. If the unit is charging, inverting, in sleep mode, ("Waiting for AC") or in search mode, it must remain in these modes for the 20-second period in order to "remember" the user settings. Note: an inverter in search mode will automatically go into inverter mode when the **Settings** button is pressed so that it can save the user settings. After the settings have been saved the inverter will return to the search mode if the search sensitivity threshold is adjusted to cause the unit to remain in search mode.

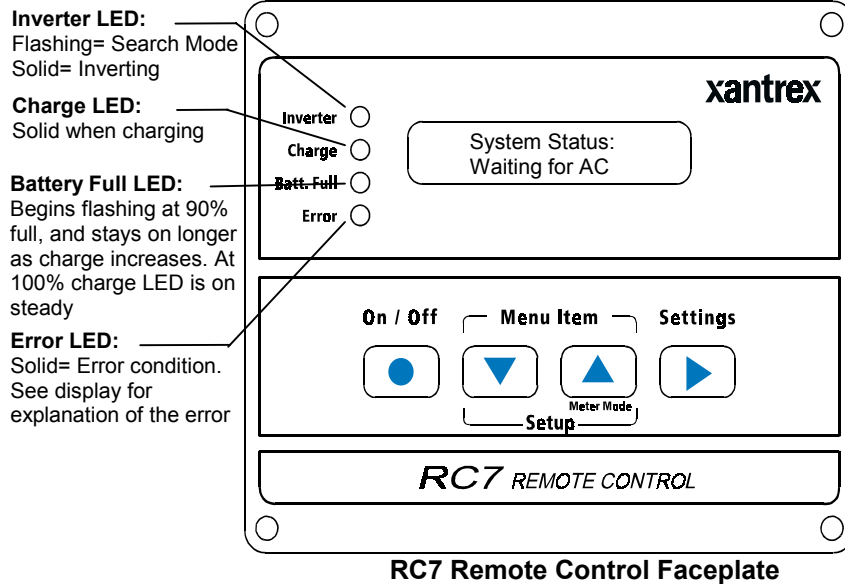
To program the RC7, the **Setup** buttons must be depressed simultaneously for five seconds. The RC7 will then beep, and be ready to accept any setting changes. The setup values are stored in a nonvolatile memory chip in the inverter itself. The values are stored whenever the **Settings** button is pressed to change them. If the remote is programmed from search mode, the inverter will switch into inverter mode for about 20 seconds, long enough to save the current setup values after which it will switch back into search mode.

Once programming is complete, depress and hold the **Setup** switches simultaneously for five seconds to exit the programming mode. At this point the remote control has programmed the inverter, and all new values will be completely saved 20 seconds after the last press of the **Settings** button.

The new settings will now be saved in the nonvolatile memory in the inverter and will be available upon the next power up either with or without the RC7 remote control connected.

## User Menu

The ON/OFF switch on the RC7 operates the same as the inverter's ON/OFF switch. In order for the RC7 to remotely power up the inverter, the inverter must be started up with the RC7 connected so the inverter knows it is present. Once this has been done the inverter's power switch should be left in the **on** position and the RC7 used to turn it on and off. When pressed to turn on, the RC7 will beep and go through a power-up routine, after which it will go to the **User Menu**. In this mode the display will show the inverter's status and monitor batteries. Pressing the **Menu Item** buttons will scroll the display vertically, and the **Settings** button will cycle the display left to the next item in the menu tree.



RC7 Remote Control Faceplate

The system status mode is the first mode you will see. It monitors and displays all of the inverter's activities—it shows what the inverter is "thinking." The following indications will be shown under the System Status heading.

**Waiting for AC:** This shows that the inverter is waiting for an AC input. Once AC is present the inverter will switch to charger mode and begin charging the batteries.

**Searching:** The inverter is in search sense mode and is "looking" for loads to run. **Inverter** LED will flash.

**Inverting:** Shows that the inverter is taking power from the batteries and inverting it to 120 VAC, 60 Hz power. This will also be shown on the LED labeled **inverter** as a solid green light

**Bulk Charging/Absorption Chg/Float Charging:** These indicators show the charger section is working and define which of the three stages of charge the charger is in. See "Three Stage Battery Charging" on page 7 for details. The **charge** LED to the left of the LCD display will be on solid when the inverter is in the charger mode.

**Hibat/Stop Chrg:** The batteries' voltage is too high and the charger has shut down. The **Batt. Full** LED will begin to flash when the batteries reach 90% of their maximum charge capacity. As the batteries continue to charge toward 100% the LED will stay on longer and longer until, at 100% charge, it will remain on steadily. Once the batteries reach 100% charge the charger will go into the float mode.

**Lobat/Start Chrg:** The batteries have reached their minimum allowable charge and the charger will now take over and begin recharging them if AC power is present to the inverter. If no AC power is present then the automatic Low Battery Cut-Off (auto LBCO) will take over to protect the batteries from over discharge and to protect the AC loads from unregulated power (brown-out conditions).

**Otemp/Less Load:** The inverter's internal temperatures are too high and the loads need to be reduced. The inverter will automatically reset after the internal temperature has dropped to a safe level. If the loads are still too great the inverter may heat up and fault again. This will go on indefinitely until the problem is remedied. This may be caused by installation in a poorly ventilated area, but usually it is the result of trying to power too many loads at one time.

**Oload/Less Load:** The loads that are being driven by the inverter are more than it can handle. The loads must be reduced and then the inverter will automatically attempt a reset.

**Bat State of Chg:** This menu shows the state of charge of the storage batteries as either a percentage of full or in an "E-----F" gas gauge format.

**Time Left To Run:** Displays the calculated approximate time in hours and tenths of hours that are left in the storage batteries. This time is based on the usage of the system during the past "X" minutes, and is updated constantly.

**Time Left To Charge:** Displays the calculated approximate time in hours and tenths of hours that are remaining in the charging process.

---

## Meters Menu

Six meters are available on the RC7. These meters may be accessed from any point in the display by pressing and holding the right **Menu Item** button for five seconds. The **Menu Item** buttons are then used to scroll through the different meters. **Solar Panel DC Amps, Battery Voltage DC, DC current, AC Input Volts AC and Volts Peak, AC Output, and Pass-thru Amps** are all available to accurately monitor both AC and DC sides of the system.

To exit the Meters menu, press and hold the right **Menu Item** button for five seconds, and the RC7 will return to the User Menu.

---

## Setup Menu

The Setup menu allows the different settings in the inverter to be altered. The RC7 is the only way that the inverter's set points may be changed. The Setup menu is accessed by pressing and holding both **Menu Item** buttons for five seconds. Once in the Setup menu use the **Menu Item** buttons to move about vertically and use the **Settings** button to move left in the menu tree. The Setup menu has the following categories:

**Search Sense:** The search sense is the sensitivity or the minimum load needed to "wake up" the inverter. See "Search Sense Mode Using Optional RC7 Remote" on page 5. This setting is given in increments starting at **Defeat** up to the **>40 W** setting. Defeat will disable the search sense mode and the inverter will always sit at full voltage ready to power a load.

**Auto LBCO:** Or automatic low battery cut-off mode. This mode is set either on or off. In the **on** position the inverter will automatically disconnect from the battery if battery voltage drops below a set point of 10.5 volts. The inverter status LED and **user menu** display will show the error condition. This protects the batteries from over-discharge and the AC loads from unregulated power (brown out). In order to restart the system the batteries will need recharging from an outside source. The Auto LBCO defeat (off position) is meant only as a means of emergency

operation with the remaining power in the battery. In the **off** position the battery voltage will drop to roughly 8–8.5 volts DC before the inverter will shut down.

**Bat Capacity:** This mode allows the user to input the battery bank size in amp hours. This custom tailors the charger's decision-making as to what charge rate to use. See the section on batteries for more information. See the RC7 Menu Map on page 34 for all available settings. An "Auto" setting is provided which automatically determines the optimum charge rate for the battery bank capacity. The RC7 will require several charge/discharge cycles to optimize this parameter. The "Auto" setting is the default.

**Battery Type:** Sets the type of batteries being used in the system. Either **gel cell** or **liquid lead acid** may be selected. See the section on batteries for more information on battery types and charging methods. If you have questions about a specific battery type or don't know what type of batteries you have consult the battery manufacturer or a dealer.

**Charge Rate:** Menu allows the user to set the charger's output as a percentage of its maximum capability. This limits the amount of current that the charger may draw, leaving that current available to power loads. This setting is available so that small battery banks will not be charged at too high a charge rate.

**VAC Dropout:** Sets the minimum voltage that may be present before the unit switches from charger to inverter mode. It is adjustable from 40 to 105 VAC. For example: The VAC dropout default is set at 40 volts AC. When the AC input voltage drops to 40 volts, the inverter will switch from charge mode to inverter mode. This protects AC loads from utility outages.

**Shore Pwr Amps:** This mode adjusts the maximum power that may be drawn through the shorepower cord. This is a safety feature since the inverter may be capable of drawing more power through the shore cord than the cord is rated for. Care should be taken when choosing this setting since a shorepower setting that is too low will cause a shutdown if the loads exceed the **shorepower** limit. The RV series is not designed to add power from the batteries to make up for the low shorepower capacity. The unit can either invert or pass AC power but cannot mix the inverted power with the shorepower.

**RC7 Setup:** Allows adjustment of the RC7's display. Three modes are available. The **Last Key** mode leaves the screen on the RC7 where it was when last used. **Power Saver** mode turns the RC7 off after five minutes with no key press, conserving energy. Selecting the **Rolling Display** mode causes the display to cycle through the user menu one item at a time for an indefinite period until a key is pressed.

**LCD Contrast:** This menu allows adjustment of the LCD display's contrast.

**Two Fuel Gauges:** This menu allows selection of two fuel gauges when two RV series units are working together. The selections in the menu also allow the user to select which RC7 remote control will be the master fuel gauge display if two RC7s are being used. The default is one fuel gauge only.

**Fuel Gauge Cutout:** Selects the voltage scale on which the RC7 will base the empty and full reading of the fuel gauge. For example: the default setting of 9.5 VDC = 0% SOC (State of Charge) will cause the RC7 to register an empty indication when the battery voltage drops to 9.5 VDC.

# Battery Cable Connection

**Observe Battery Polarity!** Place the ring terminal over the bolt and directly against the inverter's battery terminal, place a lock washer over the terminal and tighten the 5/16" nut to 10–15 ft./lbs. Do not place the lock washer under the cable terminal.

Note: Connecting the battery cables to the inverter battery terminals will cause an arc, usually accompanied by a "snap". This is normal—don't let it scare you.

Never disconnect the battery cables while the inverter is delivering power or the battery charger is operating. Keep in mind that the on/off switch on the RV does not turn off the charger section, it only turns off the inverter. To disconnect the batteries for service, follow these steps: (1) Turn the power switch **OFF**, (2) disconnect all AC inputs, and (3) disconnect the battery cables.

## 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 and degrade the RV Series Inverter/Charger's efficiency. The following table gives recommended cable sizes for various cable run lengths and inverter voltages.

**Minimum Recommended Battery Cable Size (In Free Air)**

Model	Typical Amps	Minimum Fuse Size	Cable length		
			Under 5 ft	5 to 10 ft	10 to 20 ft
RV2012	200 amps	250 A	00	0000	0000
RV2512	250 amps	300 A	0000	0000	----
RV3012	300 amps	400 A	0000	0000	----

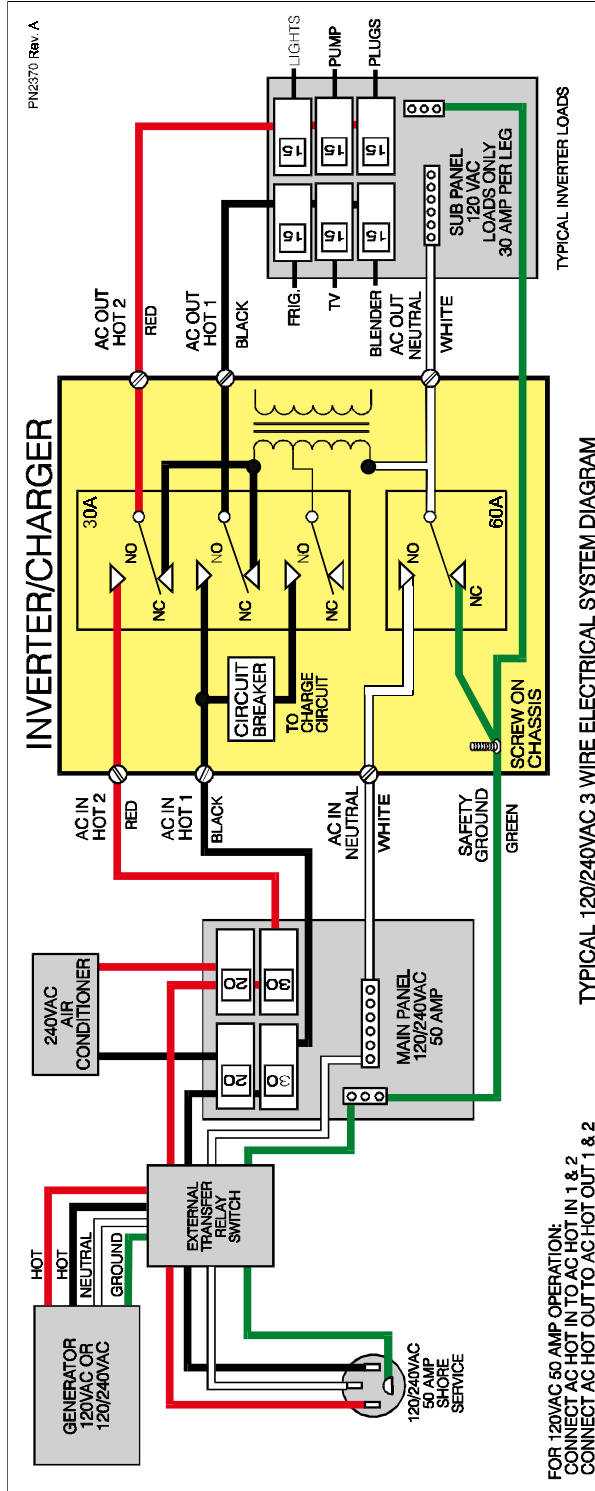
The National Electric Code requires that the cables be protected by a fuse or breaker rated to match the cables' ampacity at 75 °C.

Cable Size	Rating in Conduit	Rating in Free Air
2 AWG cable	115 amps maximum	170 amps maximum
00 AWG	175 amps maximum	265 amps maximum
0000 AWG	250 amps maximum	360 amps maximum

The National Electrical Code (NEC) allows rounding up to the next fuse size from the cable rating. For example, a 150-amp cable size rounds up to a 175-amp fuse size.

**WARNING! Battery cables that are very small will melt and burn the first time the inverter is asked to produce high power.**

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

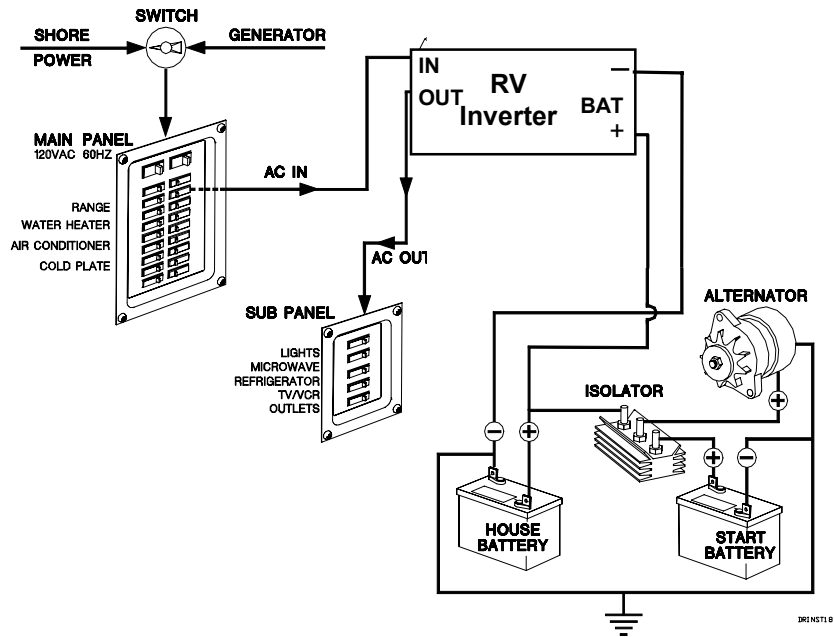


When the generator is running the main AC panel, leg 1 and leg 2 of the generator are connected independently to the two halves of the main AC panel. When the inverter is operating, both sides of the main AC panel are automatically connected together. Only 120 VAC is available when the inverter is operating.

**Do not use this system if there are 240 VAC loads!**



## Mobile Installation



# Troubleshooting Guide

Symptoms	Problem	Remedy
No power output and no warning LEDs	Battery voltage at the inverter's terminals is too high or low	Check the battery voltage, fuses or breakers and cable connections
No power output and LED indicator is flashing	Load too small for Search Mode circuit to detect	Reduce search threshold setting or defeat search mode
No power output and warning LEDs "ON"	<ul style="list-style-type: none"> <li>• High or Low battery LED "ON"</li> <li>• Overload LED is "ON"</li> <li>• High temp LED is "ON"</li> </ul>	<ul style="list-style-type: none"> <li>• Check the battery voltage at the inverter's terminals</li> <li>• Remove loads from the inverter and restart</li> <li>• Remove loads and let inverter cool down before restarting</li> </ul>
Power output is low and inverter turns loads on and off	<ul style="list-style-type: none"> <li>• Low battery</li> <li>• Loose or corroded battery connections</li> <li>• Loose AC output connections</li> </ul>	<ul style="list-style-type: none"> <li>• Check condition of batteries and recharge if possible</li> <li>• Check and clean all connections</li> <li>• Check all AC output connections</li> </ul>
Inverter clicks every 20 seconds	Output of inverter wired back to its own input	Check for proper AC input and output wiring
Charger is inoperative or Overload LED is "ON"	<ul style="list-style-type: none"> <li>• AC input voltage does not match inverter spec</li> <li>• Charger controls improperly set</li> </ul>	<ul style="list-style-type: none"> <li>• Check AC input for proper voltage and frequency of your model</li> <li>• Refer to owner's manual for proper setting</li> </ul>
Overload LED "ON" while charging	Charger circuit may be damaged	Have inverter serviced
Low charge rate	<ul style="list-style-type: none"> <li>• Low <u>peak</u> AC input voltage(164 volts peak required for full charger output)</li> <li>• AC current output of generator too small to handle load</li> </ul>	<ul style="list-style-type: none"> <li>• Use larger generator, speed up generator, check AC input wiring size, adjust charge rate, cable too small or too long</li> <li>• Reduce charge amps setting or reduce pass-through loads</li> </ul>
Low AC output voltage	Measuring with the wrong type voltmeter (displays 80–100 VAC)	Voltmeter must be a true RMS reading meter (most are not)
Low surge power	Weak batteries, battery cables 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 down until problem is gone

# Applications

## 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.

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.

## Problem Loads

Xantrex inverters can drive nearly every type of load. However, there are special situations in which inverters may behave differently than public 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. See “Search Sense Mode Using Optional RC7 Remote” on page 5 for ways to solve this problem.

**Fluorescent lights & 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—turn 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 the sections on Search Sense Mode on pages 5 and 20.

**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.

**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 the sections on Search Sense Mode on pages 5 and 20.) Clock accuracy is also affected by the accuracy of the generator.

**Searching:** If the amount of power a load draws decreases after it turns on, and if this "on" load is less than the load sensing threshold, it will be turned alternately on and off by the inverter.

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

**Rechargeable Devices:** Sears "First Alert" flashlights fail when charged by the inverter. Skill rechargeable products are questionable. Makita products work well. When first using a rechargeable device, monitor its temperature for 10 minutes to ensure that it does not become abnormally hot. That will be your indicator that it should not be used with the inverter.

**Laser Printers:** While many laser products are presently operating from Xantrex inverters, and we have personally run a Texas Instruments Microlaser and HP IIP, we have had reports of an HP III and a Macintosh Laser Writer failing under inverter power. We, therefore, do not recommend the use of laser printers.

**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.

**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 for three seconds. With the inverter off, the battery voltage will rise and then it will resume operation.

## Typical Battery Draw of Common Appliances

APPLIANCE	WATTS	TIME IN MINUTES					
		5	15	30	60	120	240
Single PL Light	10	.1	.3	.7	1.3	2.7	5.3
B & W TV	50	.4	1	2	4	8	17
Computer	100	1	2	4	8	17	34
Color TV	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

AMP HOURS

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 1/3 of what their amp rating would indicate.

---

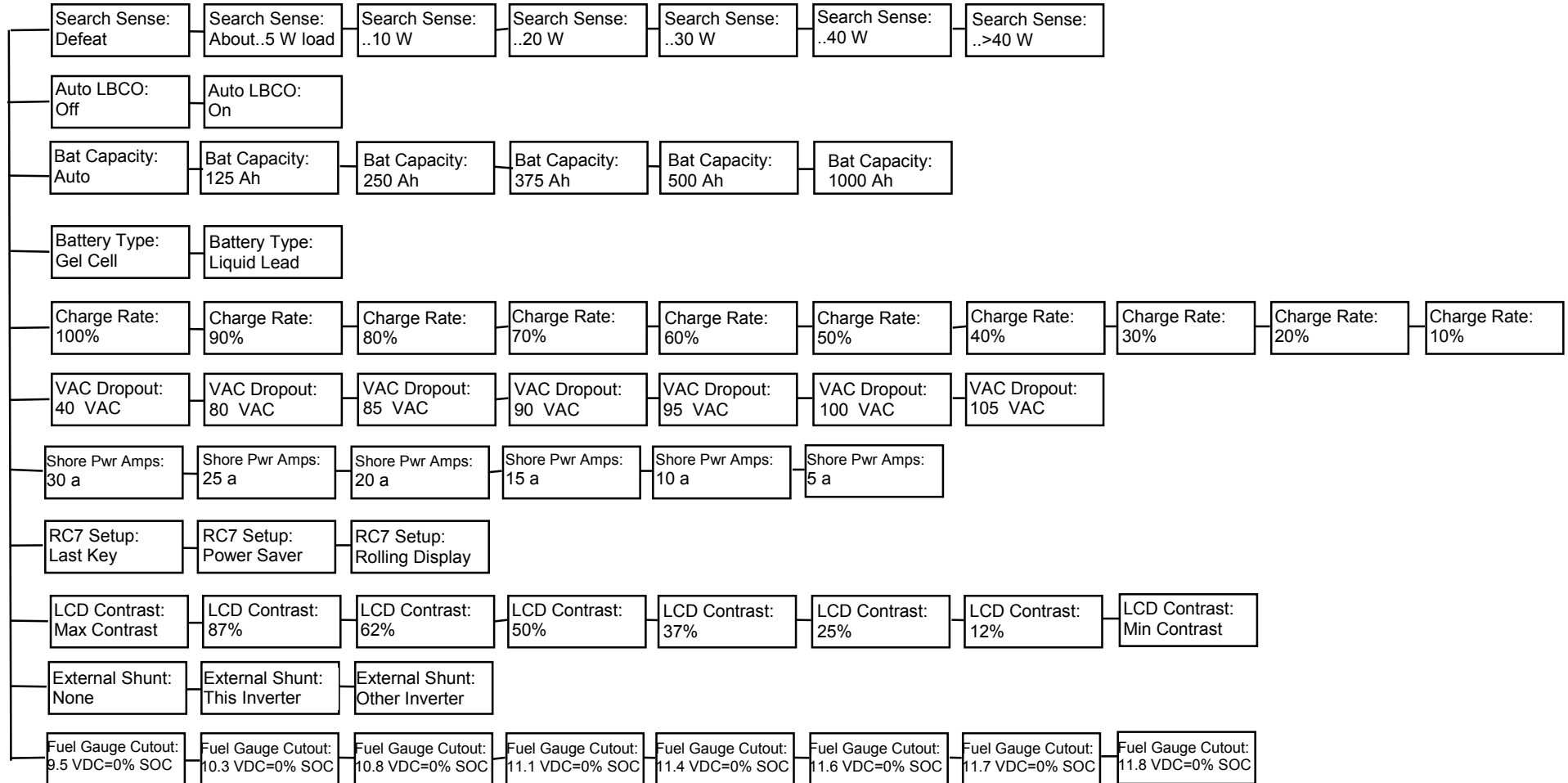
## English to Metric Wire Conversion

<b>AGW</b>	<b>DIAMETER (mm)</b>	<b>AREA (mm<sup>2</sup>)</b>	<b>DC Resistance / 1000 ft</b>
<b>14</b>	1.628	2.082	3.14
<b>12</b>	2.052	3.308	1.98
<b>10</b>	2.588	5.261	1.24
<b>8</b>	3.264	8.367	0.778
<b>6</b>	4.115	13.299	0.491
<b>4</b>	5.189	21.147	0.308
<b>2</b>	6.543	33.624	0.194
<b>1</b>	7.348	42.406	0.154
<b>0</b>	8.525	53.482	0.122
<b>00</b>	9.266	67.433	0.0967
<b>000</b>	10.404	85.014	0.0766
<b>0000</b>	11.684	107.219	0.0608

# RC7 Menu Map

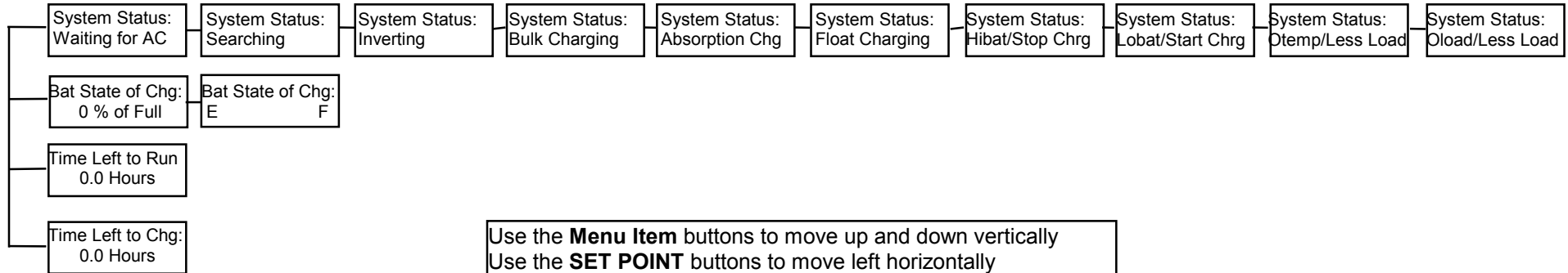
## Setup Menu

To **ENTER** and **EXIT** the **Setup menu** press both the **Menu Item** buttons for five seconds.



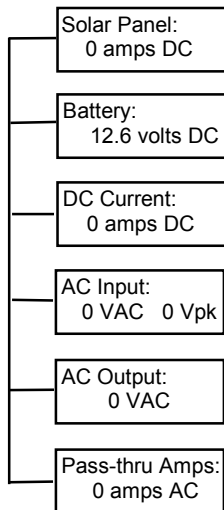
## User Menu

The following is the information normally available to the system users.



Use the **Menu Item** buttons to move up and down vertically  
 Use the **SET POINT** buttons to move left horizontally  
 Values in left-most column are the **DEFAULT** values at startup

**Meters Menu** To **ENTER** and **EXIT** the **METERS MENU** press the right **Menu Item** button for five seconds





# Technical Information

## RV Series Specifications

	Models		
	RV2012	RV2512	RV3012
Continuous Power @ 25°C	2000 watts	2500 watts	3000 watts
Max AC Current	16.6 amps	20.8 amps	25 amps
Efficiency	94% Maximum	94% Maximum	94% Maximum
Input Current			
Search Mode	0.055 amps	0.070 amps	0.080 amps
Full Voltage	0.550 amps	0.600 amps	0.650 amps
At Rated Power	200 amps	250 amps	300 amps
Short Circuit	600 amps	800 amps	900 amps
Nominal Input Voltage	12 VDC	12 VDC	12 VDC
Input Voltage Range	10.2–15.5 VDC	10.2–15.5 VDC	10.2–15.5 VDC
Auto Low Battery Protection	11 V or defeated	11 V or defeated	11 V or defeated
Voltage Regulation—Maximum	±5%	±5%	±5%
Voltage Regulation—Typical	±2.5%	±2.5%	±2.5%
Output Waveform	Modified sine	Modified sine	Modified sine
Power Factor allowed	-1 to +1	-1 to +1	-1 to +1
Frequency Regulation	60Hz ± .04%	60Hz ± .04%	60Hz ± .04%
Standard Output Voltage	120 VAC	120 VAC	120 VAC
Adjustable Load Sensing	5 to 40 watts	5 to 40 watts	5 to 40 watts
Series Operation for 240 VAC	yes	yes	Yes
Forced Air Cooling	Variable Speed	Variable Speed	Variable Speed
Automatic Transfer Relay	30 amps at 240 VAC or 50 amps at 120 VAC (field configurable)		
Adjustable Charge Rate	10–100 amps	10–120 amps	10–140 amps
Number of Charging Profiles	2 (lead acid, sealed)	2 (lead acid, sealed)	2 (lead acid, sealed)
Three-Stage Charging	Yes	Yes	Yes
Temperature Comp Probe	Optional	Optional	Optional
Remote Control	Optional: RC6, RC7, RC7GS	Optional: RC6, RC7, RC7GS	Optional: RC6, RC7, RC7GS
Environmental Characteristics			
Operating Ambient Temp	0°C to +50°C	0°C to +50°C	0°C to +50°C
Non-operating Temp	-55°C to +75°C	-55°C to +75°C	-55°C to +75°C
Unit Weight (lbs./kg)	45/20.5	50/22.7	60/27.2
Dimensions (L × W × H)	15.5" × 13.12" × 7.25"	15.5" × 13.12" × 7.25"	15.5" × 13.12" × 7.25"
Mounting	Shelf mount only	Shelf mount only	Shelf mount only
Approvals	UL and cUL Listed to UL458 and CSA107.1		

---

# Limited 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 Xantrex RV Series Inverter/Charger. This warranty lasts for a Warranty Period of 30 months from the date of purchase at point of sale to you, the original end user customer.

This Limited Warranty is transferable to subsequent owners but only for the unexpired portion of the Warranty Period.

**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

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 Web site 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

**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 (trademark, 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 that may vary from state to state or province to province.

#### **Warning: Limitations On Use**

Please refer to your product user manual for limitations on uses of the product. Specifically, please note that the Xantrex RV Series Inverter/Charger is not intended for use in connection with life support systems and Xantrex makes no warranty or representation in connection with any use of the product for such purposes.

Please note that the Xantrex 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

#### **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.

**Xantrex Technology Inc.**  
Toll free 1 800 670 0707  
Direct 1 604 422 2777  
Fax 1 604 420 2145  
CustomerService@xantrex.com  
www.xantrex.com

445-0202-01-01 Rev. 2

Printed in the U.S.A.