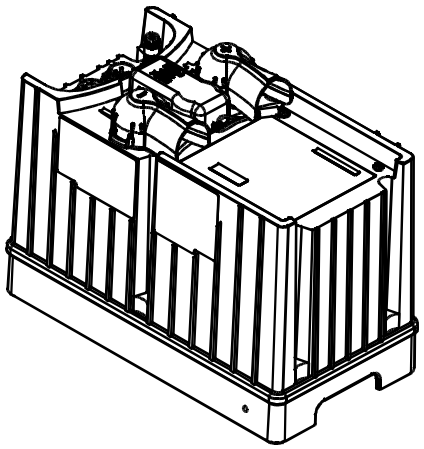
Xantrex™
Heavy Duty Inverter•Charger 1012 with Ignition Protection



Installation Guide

xantrex™

About Xantrex

Xantrex Technology develops, manufactures, and markets leading advanced power electronic and control products for the Distributed, Mobile, and Programmable Power markets. The company's enabling technology converts raw electrical power from any central, distributed, or backup power source into high-quality power required by electronic and electrical equipment.

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Important Safety Instructions

WARNING
This section contains important safety and operating instructions as prescribed by UL and CSA standards for inverter•chargers used in residential, RV, and other applications. Read and keep this Installation Guide for future reference.

1. Before using the inverter•charger, read all instructions and cautionary markings on the charger, the batteries, and all appropriate sections of this guide.
2. While this unit is sealed, Xantrex does not recommend that it be continuously exposed to rain, snow, spray, or bilge water. Do not install the charger in a zero-clearance or small-clearance compartment. It may reduce the usable power range.
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. The inverter•charger is designed to be permanently connected to your AC and DC electrical systems. Xantrex recommends that all wiring be done by a certified technician or electrician to ensure adherence to the local and national electrical codes applicable in your application.
5. 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 inverter•charger with damaged or substandard wiring.
6. Do not operate the inverter•charger if it has received a sharp blow, been dropped, or otherwise damaged in any way. If the unit is damaged, see the Warranty section in Appendix B, “Product and System Information” in the Operation Guide.

7. Do not disassemble the inverter•charger. See Appendix D, “Product and System Information” in the Operation Guide for instructions on obtaining service. Attempting to service the unit yourself may result in a risk of electrical shock or fire. Internal capacitors remain charged after all power is disconnected.
8. To reduce the risk of electrical shock, disconnect both AC and DC power from the inverter•charger before attempting any maintenance or cleaning or working on any circuits connected to the unit. Turning off controls will not reduce this risk.
9. The inverter•charger must be provided with an equipment-grounding conductor connected to the AC input ground.

Explosive Gas Precautions

1. 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 inverter•charger.
2. The IP1012 has been approved as Ignition Protected. It may be installed in areas containing gasoline tanks and fittings which require Ignition Protected equipment. Xantrex recommends, nevertheless, that it is safest not to install electrical equipment in these areas.
3. 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

1. Have someone within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
2. Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
3. Wear complete eye protection and clothing protection. Avoid touching your eyes while working near batteries.
4. If battery acid contacts 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.

FCC Information to the User

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction guide, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

1 Installation Planning

Chapter 1 provides information to help you plan for a suitable installation for the IP1012. The chapter provides a system diagram showing the components of an installation, and provides information about each component. It also discusses other installation considerations such as neutral to ground bonding and the physical location of the unit.

Introduction

All types of inverter•charger installations, residential or mobile, share common components. This chapter describes each component.

The system shown in Figure 1-1 is a basic installation. If your requirements are more complex than this, Xantrex recommends that you consult a qualified installer or electrician.

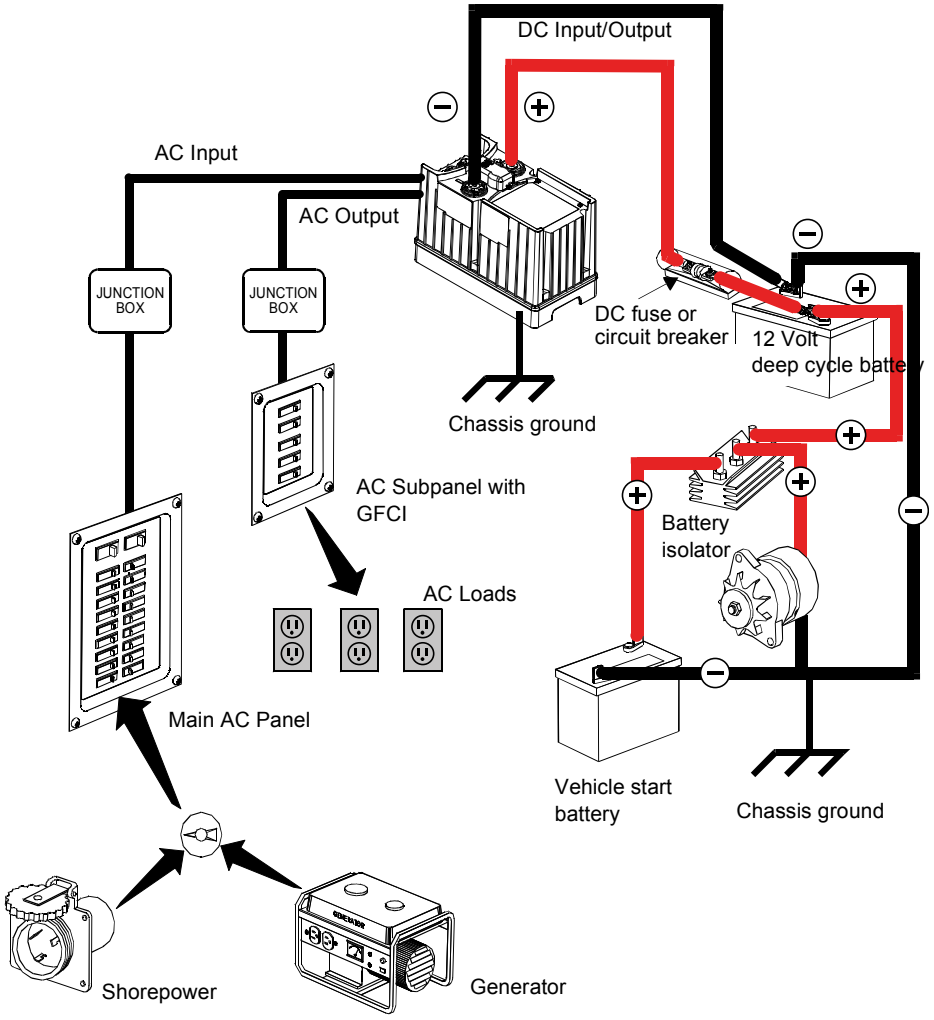
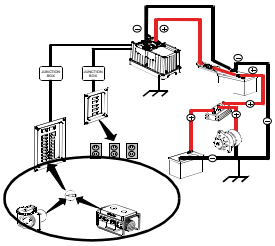


Figure 1-1 Typical IP1012 installation

AC Components

Shorepower

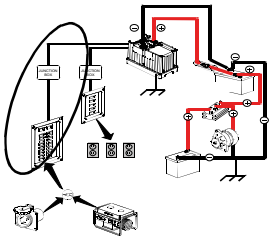


A source of 120 volt, 60 Hz alternating current is needed to provide energy for charging batteries and to pass through to AC loads. This source could be the utility grid (power company) or an AC generator. Multiple sources of good-quality shorepower can be used

Note: Throughout this manual, the term "shorepower" refers to AC input power from a utility grid, high-quality generator, or other source.

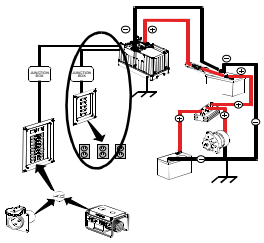
Disconnect and Over-Current Protection Device

To meet UL 458, and electrical code requirements, the inverter•charger AC inputs and outputs must be provided with over-current protection (such as a circuit breaker or fuse) and a disconnect device on both the AC input and output:



AC Input The circuit breaker or fuse used to protect the IP1012 Inverter•Charger must be rated no more than 15 amps and must be approved for use on 120 VAC branch circuits. This circuit breaker or fuse is often in the shorepower source. If the shorepower rating is more than 15 amps, you need to add an additional 15 amp breaker or fuse at the junction box or electrical panel to which the IP1012 AC input is wired.

The wire used between the breaker and the inverter•charger input must be sized to match the circuit breaker, in accordance with the electrical codes or regulations applicable to your installation.



AC Output The circuit breaker or fuse must be rated at no more than 15 amps and must be approved for use on 120 VAC branch circuits. The wire used between the inverter•charger and the AC output breaker must be sized to match the AC output circuit breaker's rating (#14 AWG or larger). The wire from the AC output breaker to your loads must be matched to the rating of the AC output breakers.

GFCI requirements Installations in recreational vehicles may require GFCI protection of branch circuits connected to the AC output of the inverter•charger. In addition, electrical codes require GFCI protection of certain receptacles in residential installations.

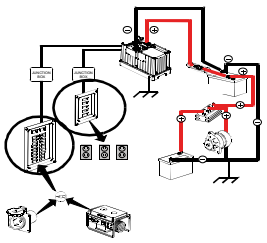
Tested GFCIs Compliance with UL standards requires that Xantrex test and recommend specific GFCIs. Xantrex has tested the GFCI-protected 15 amp receptacles listed in Table 1-1 and found that they function properly when connected to the AC output of the IP1012.

Table 1-1 Tested GFCI Models

Manufacturer	Model number
Pass &Seymour / Legrand	1591-WCN
Leviton	6598W
Bryant	GFR82FTI
Hubbell	GF5252GYA
Yatai Switch	YT15-G

Disconnect Devices: Each system requires a method of disconnecting the AC circuits. If the over-current protection device is a circuit breaker, it will also serve as the disconnect. If fuses are used, separate AC disconnect switches are needed ahead of the fuses.

Distribution panels

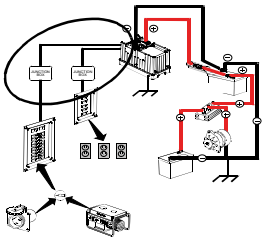


Most systems incorporate distribution centers both ahead of the inverter•charger and between the inverter•charger and the loads (the AC load panel). A source panel includes a main circuit breaker, which serves as over-current protection and as a disconnect for the AC shorepower supply line. Additional circuit breakers serve individual circuits, one of which serves the inverter•charger. The AC load panel can incorporate both the main 15 amp breaker or fuse with disconnect if the AC output cable is directly wired into the panel.

Note: The IP1012 is designed to be connected only to single phase wiring circuits (line, neutral, and ground)

AC wiring

Definition



AC wiring includes all the wires and connectors between the AC source and the inverter•charger and all wiring between the inverter•charger and the AC panels, circuit breakers, and loads.

Size and type

The type and size of the wiring varies with the installation and load. For marine and some RV applications, flexible multiple-strand wire is required. For residential installations, solid armored cable is often used. Local installation codes may specify solid or stranded, overall size of the conductors, and type and temperature rating of the insulation around the wire. Xantrex recommends stranded wire for high-vibration environments.

Size and AC breaker rating

AC wiring must be sized to match the current rating of the AC breakers you provide on the input and output AC circuits in accordance with the electrical codes or regulations applicable to your installation. Xantrex recommends a breaker size of 15 amps, and minimum wire size of 14 AWG.

Other codes and regulations may be applicable to your installation.

AC Output Neutral Bonding

Bonding system

The IP1012 provides an non-defeatable system that automatically connects the neutral conductor of the inverter AC output circuit to safety ground (“bonding” it) during inverter operation, and disconnects it (“un-bonding” it) when the inverter•charger is connected to AC shorepower. This system is designed to conform to installation codes that require single-phase AC sources such as inverters and generators to have their neutral conductors tied to ground in the same way that the neutral conductor from the utility is tied to ground.

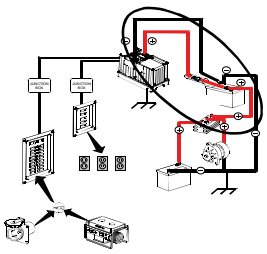
Transfer relay

These same codes specify that the neutral can only be connected to ground in one place at any one time. Any AC source feeding the IP1012 is required to have its neutral already connected to ground. Therefore, to keep from connecting the neutral to ground in a second place, the transfer relay breaks its own neutral ground connection when connected to shorepower.

Suitability	This automatic neutral-to-ground bonding system is suited for installations in which the AC shorepower source is known to have a bonded neutral. This will be the case in most situations: in a utility feed after the AC source panel, at a shorepower hook-up, or a generator with a bonded neutral.
Neutral conductor	The neutral conductor of the inverter•charger's AC output circuit is automatically connected to the chassis ground during inverter operation. When AC utility power is present and the inverter•charger is in charge mode, this connection is not present, so that the utility neutral is only connected to ground at your source panel. This conforms to National Electrical Code requirements that separately derived AC sources (such as inverters and generators) have their neutral conductors tied to ground in the same way that the neutral conductor from the utility is tied to ground at the AC source panel.

DC Components

DC Cabling



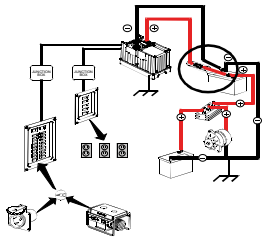
DC cabling includes all the cables and connectors between the batteries, the DC disconnect and over-current protection device, and the inverter•charger. All installations require multi-strand insulated cables as well as disconnect and over-current devices. DC cable sizes are indicated by AWG notation or MCM notation. Under the AWG standard, a larger gauge number indicates a smaller wire diameter. Under the MCM standard, a larger number indicates a larger cable. Wire size is usually marked on the cables for sizes this large.

Xantrex offers a DC cable kit (808-0795) containing two six-foot lengths of DC cables designed for the IP1012. If you require cables of a different length see Table 1-2 for minimum DC cable size and maximum fuse size for the IP1012. **The DC cables must be copper and must be rated 75 °C minimum.** For some applications you may require higher temperature wires.

Table 1-2 Required DC Cable and Fuse Size

DC Cable Length	Cable Size	Fuse Amps
Less than 6 feet	2/0 AWG or larger	300A class T
Between 6 and 10 feet	4/0 AWG or larger	300A class T

DC Disconnects and Over-Current Devices



The DC circuit from the battery to the inverter•charger must be equipped with a disconnect and over-current device. This 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. The rating of the fuse or breaker must be matched to the size of cables used in accordance with the applicable installation codes. The breaker or disconnect and fuse should be located as close as possible to the battery, in the positive cable. Applicable codes may limit how far the protection can be from the battery.

Batteries

Every IP1012 system requires a 12 volt, flooded lead-acid deep-cycle battery or group of batteries to provide the DC current that the inverter•charger converts to AC.

Chapter 3 provides more information about battery configurations for normal and heavy loads.

Note: The IP1012 does *not* charge GEL or AGM batteries. It only uses 12-volt flooded, lead-acid battery banks.

Locating the Inverter•Charger

The inverter•charger should only be installed in locations meeting the following requirements:

Sheltered	While the unit is sealed, Xantrex does not recommend that fluids or water should be allowed to continuously drip or splash on the unit.
Cool	Normal air temperature should be between 32°F and 77°F (0°C and 40°C)—the cooler the better.
Ventilated	Allow at least 4 inches (10 cm) of clearance all around the unit. The more clearance for ventilation around the unit, the better the performance.

Safe	The unit is ignition protected and can be stored in the same area containing gasoline tanks and fittings which require ignition protected equipment. Xantrex recommends, nevertheless, it is safest not to install electrical equipment in these areas, if possible.
Close to batteries	Avoid excessive cable lengths (which reduce input and output power due to wire resistance). Use the recommended cable lengths and sizes.
Protected from battery acid and gases	Never allow battery acid to drip on the inverter•charger or its wiring when reading specific gravity or filling the battery. Also, do not mount the unit where it will be exposed to gases produced by the batteries. These gases are very corrosive, and prolonged exposure will damage the inverter•charger.
Close to AC junction box	Avoid excessive cable lengths and use the recommended wire length and sizes. Undersized or unnecessarily long cables may affect charging accuracy.

2 Installing the IP1012

Chapter 2 lists the tools and materials you need to install the IP1012. The chapter also suggests methods for mounting the unit, and provides procedures to install and test the system.

Important: The installer is responsible for meeting all electric codes for installing an inverter•charger.

About the Installation

Before beginning your installation:

- Read the entire chapter before you begin the installation.
- Assemble all tools and materials you require for the installation.
- Review all the safety instructions on page vii.

Materials List

Contents

The following materials should be in the shipping box:

- ❒ Inverter•Charger
- ❒ Battery terminal covers (1 red, 1 black)
- ❒ Ground lug (with mounting screw and washer)
- ❒ Remote switch (with mounting screws)
- ❒ Battery temperature sensor
- ❒ AC input and output cables
- ❒ Battery terminal nuts, lock washers and flat washer
- ❒ M8x20 mounting bolts, washers, and lock washers
- ❒ Installation Guide
- ❒ Operation Guide

Optional

You may purchase an optional DC Cable Kit (808-0795) or a DC Cable and Mounting kit (808-0796) from Xantrex.

Recording information

After unpacking the unit and checking the material list, record the serial number of the IP1012 and other purchase information in Appendix B of the Operation Guide. If you need to call Xantrex Customer Service, you will be asked for this information.

Tools and Materials

You need the following tools and materials to install the inverter•charger, remote switch, and battery temperature sensor:

- ❒ Wire stripper
- ❒ #2 Phillips screwdriver
- ❒ Needle-nose pliers
- ❒ 1 slot screwdriver
- ❒ Wrench for DC terminals (9/16 inch or 14 mm or adjustable)

- ❒ Wire connectors or crimp connectors for AC wire and appropriate tools
- ❒ Two strain-relief clamps for AC cables
- ❒ DC battery or welding cables, 2 x6 feet of 2/0 or 2 x 10 feet of 4/0 if you have not purchased the optional kit.
- ❒ 4 x 2/0 or 4 x 4/0 lugs if you have not purchased the DC cable kit

  OR
- ❒ 6 x 2/0 or 6 x 4/0 lugs for using a fused disconnect
- ❒ Crimping tools, if necessary
- ❒ AC and DC disconnects and over-current protective devices
- ❒ AC output GFCI
- ❒ Copper wire for grounding

Installing the IP1012

Overview

There are six main steps in the installation of the IP1012:

1. Mounting the inverter•charger
2. Connecting the AC input flexible cord
3. Connecting the AC output flexible cord
4. Grounding the DC ground
5. Connecting the battery temperature sensor.
6. Mounting and connecting the remote switch

Mounting the Inverter•Charger

Requirements

To meet regulatory requirements the IP1012 must be mounted securely so that the bottom surface is horizontal. You can meet this requirement by securing the unit to a platform or custom bracket from the underside of the unit. Then the platform or bracket must be firmly secured to the floor or wall.

Optional

Xantrex offers a bracket designed specifically for the IP1012, part number 808-0272. You may contact Customer Service for details. The bracket is shown in Figure 2-3.

Floor mounting

Figure 2-1 shows the position and distance between the mounting holes on the base of the unit.

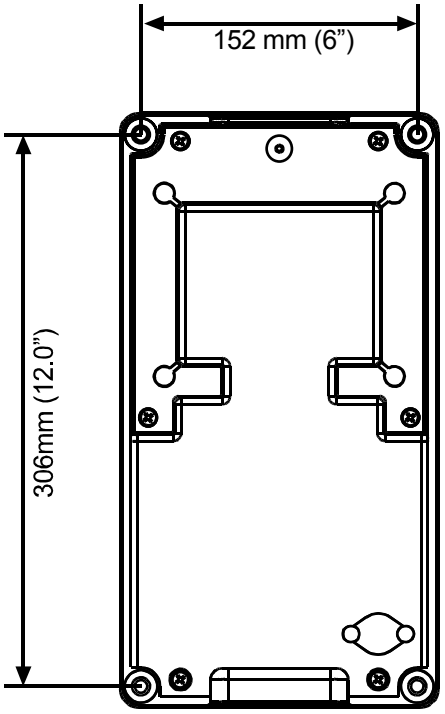


Figure 2-1 Mounting holes on base

To floor mount the IP1012:

1. Place the unit on a flat mounting surface with the holes drilled according to Figure 2-1.
2. Mount each corner as shown in Figure 2-2.
3. Torque bolts to 5.6 to 6.2 ft-lbs.
4. Secure the mounting surface to the floor.

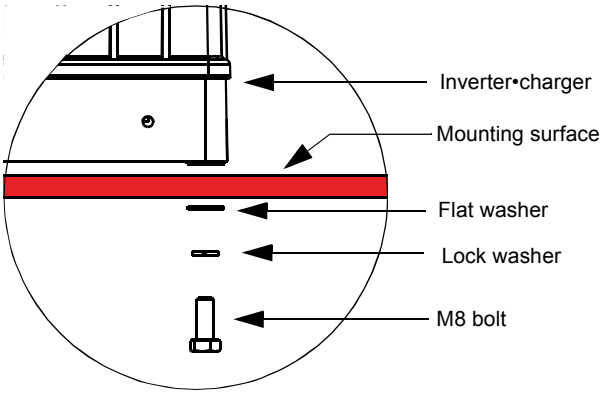


Figure 2-2 Mounting the IP1012

Bracket mounting

You may also mount the IP1012 in a custom bracket, then secure it to the floor or wall. Figure 2-3 shows the Xantrex mounting bracket.

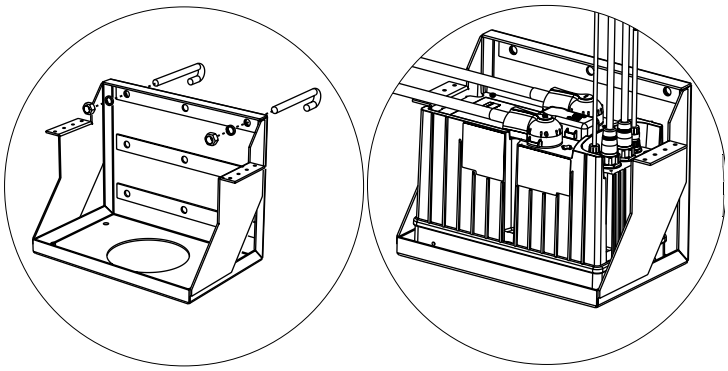


Figure 2-3 Bracket mounting option

Connecting the AC Input Flexible Cord

WARNING: Fire, Shock, and Energy Hazards
Make sure wiring is disconnected from all electrical sources before handling. All wiring must be done in accordance with local and national electrical wiring codes. Do not connect the output terminals of the inverter•charger to any incoming AC source.

Wiring considerations

Connectors

Connect AC wires to shorepower with twist-on wire connectors or crimp-on splice connectors according to the type of installation:

- For installations subject to vibration, use crimp-on connectors.
- For installations in locations not subject to vibration, twist-on wire connectors may be used instead of crimp-on connectors.

Stripping insulation

The amount of insulation you strip off individual wires will be specified by the connector manufacturer and is different for different types of connectors.

AC Input Connections

To make the AC input connections:

1. Strip about two inches off the jacket from the AC cord (15 ft/4.5 m) with the female connector and separate the three wires.Strip insulation from each of the wires according to the guidelines given by the connector manufacturer.
2. Feed the wire into a junction box, electrical panel or other source.

3. Secure with a strain relief clamp.
4. Connect wires as follows:
   - the IP1012 green wire to the shorepower green or bare copper ground wire to the appropriate ground screw inside the junction box or electrical panel as per local electrical codes.
   - the IP1012 white wire to the shorepower white wire (neutral) connection or to the neutral bus in the case of an electrical breaker panel.
   - the IP1012 black to the shorepower black (hot) feed, or directly to a breaker.
5. Plug the AC input cord into the unit as shown in Figure 2-5. You must line up the small slot on the connector with the equivalent key on the input IP1012 as shown in Figure 2-4. Rotate the connector back and forth to align them, then insert fully.

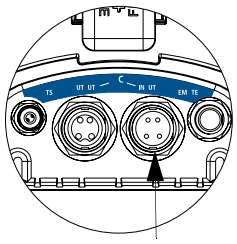


Figure 2-4 AC input terminal

6. Turn the collar of the connector clockwise about 1/2 turn until you feel it lock in place. Test that it is firmly seated and cannot be pulled out.

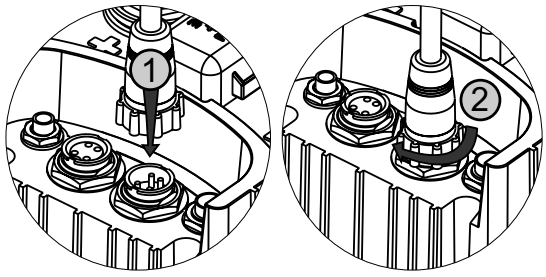


Figure 2-5 Making the AC input connection

Connecting the AC Output Flexible Cord

To make the AC output wiring connections:

1. Strip about two inches of the jacket from the end of the AC cord (15 ft/4.5 m) with the male connector and separate the three wires. Strip insulation from each of the wires according to the guidelines given by the connector manufacturer.
2. Feed the wires into a knock-out with a strain relief in an AC load panel or junction box through a 15 amp circuit breaker and GFCI.
3. Tighten the strain relief.
4. Connect the black wire (line) to the breaker, white to the AC load neutral wire or neutral terminal strip, the green wire to the AC load ground wire green or bare copper, and/or the ground screw according to your local electrical code.
5. Connect the AC output connector in a similar fashion to the AC input as shown in Figure 2-5. The connector slots and key must line up before the connector can be inserted.

Connecting the DC Cables

CAUTION: Reverse Polarity
Before making the final DC connection, check cable polarity at both the battery and the inverter•charger. Positive must be connected to positive; negative must be connected to negative. Reversing the positive and negative battery cables will damage the inverter•charger and void your warranty. This type of damage is easily detected.

WARNING: Fire Hazard
Use only copper wire rated 75 °C minimum. Some applications may require a higher temperature rated wire. Make sure all DC connections are tight to a torque of 12-15 ft-lbs (16–20 Nm). Loose connections will overheat and may cause fire.

Preparation

If you are not using the DC cable kit, your DC cables should be as short as possible and large enough to handle the required current, in accordance with the electrical codes or regulations applicable to your installation. Table 1-2 on page 1–6 specifies the minimum DC cable size and maximum fuse size for the IP1012.

To prepare the DC cables:

1. Cut the negative cable to a six-foot length with enough insulation stripped off so you can install the terminal you will be using.

The DC terminals are designed to fit up to 500 MCM crimp-on ring (lug) terminals or box connectors which have a 3/8 inch hole.

2. Cut two lengths of positive cable; one length to go from the battery to the DC breaker or fuse with disconnect; the other to go from the DC breaker to the IP1012 terminal.
3. Attach the connectors to the ends of the cables.

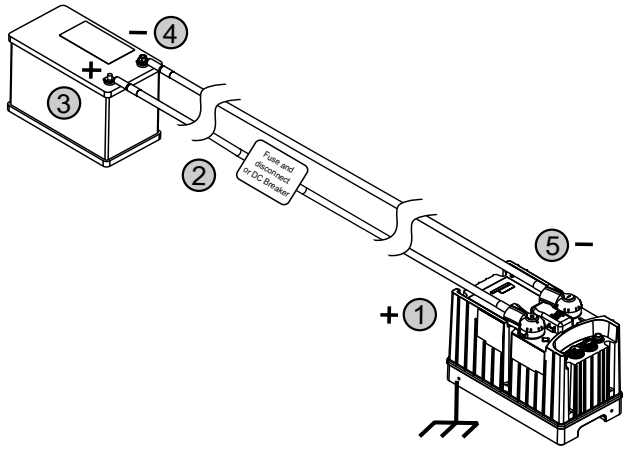


Figure 2-6 Connection order for DC cables

Figure 2-6 shows the connection order for the DC cables.

To connect the DC cables:

1. Route the DC cables from the battery bank to the inverter•charger but don't connect them yet.

   Do not route your DC cables through an electrical distribution panel, battery isolator, or other device that will cause additional voltage drops.
2. Install a fuse and disconnect or DC breaker in an approved enclosure, according to your local electrical code, between the inverter•charger and the battery (2 in Figure 2-6) and secure the enclosure.

   Fuses and breakers must be installed in the positive side of the DC circuit, as close as possible to the battery, but not in the battery enclosure. This protects your battery and wiring in case of accidental shorting. (See Table 1-2 on page 1–6 for required fuse size.)
3. Attach one connector on the positive cable to the positive DC terminal on the IP1012 as shown in Figure 2-7, and then attach the other connector to the POSITIVE (+) terminal DC breaker or fused disconnect. (1 in Figure 2-6)

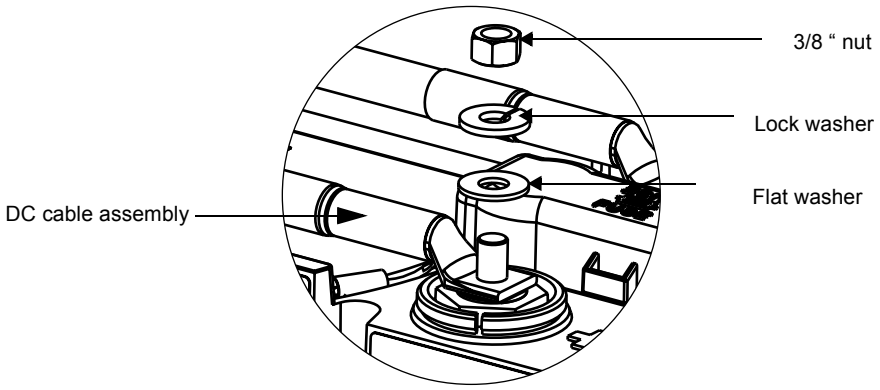
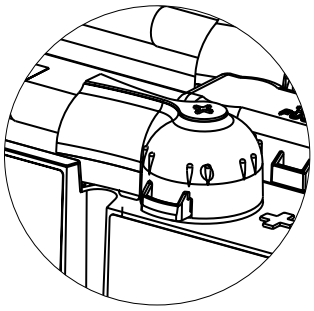


Figure 2-7 Connection at DC terminal of the IP1012

4. Use a wrench to tighten all connections to a torque of 12 to 15 ft-pounds (16 to 20 Nm). Test that the cable is secure.
5. Attach the red terminal cover to the IP1012 by laying it over the positive terminal and pressing it firmly until it “snaps” into place.



6. Attach a short DC cable from the unconnected end of the DC breaker (2 in Figure 2-6). Tighten appropriately.
7. Observing polarity carefully, attach the other end of the short cable to the POSITIVE (+) terminal of the battery (3 in Figure 2-6). Figure 2-8 shows the details of the connection. Tighten this connection to the battery manufacturer’s recommended torque.

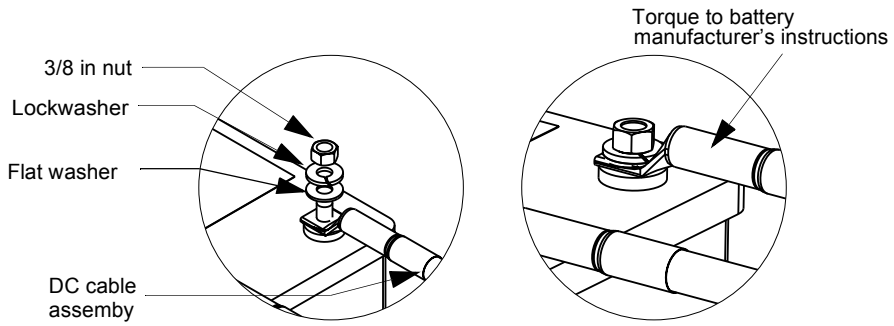


Figure 2-8 Connection at the battery

8. Connect one connector on the negative cable to the negative terminal on the battery and tighten (4 in Figure 2-6). Before proceeding, check that cable polarity is correct, and then connect the other end of the cable to the NEGATIVE (–) terminal on the IP1012 (5 in Figure 2-6).

   This is the last cable connection. Sparking is normal when it is made. Use a wrench to tighten to a torque of 12–15 foot-pounds (16–20Nm). Test that the cable is secure.

9. Attach the black DC terminal cover to the negative terminal.

DC Grounding

The supplied Chassis Ground lug, to be installed on the base of the inverter•charger in one of three locations, is used to connect the chassis of the inverter•charger to your system's DC grounding point as required by regulations for some installations.

Installation guidelines

Install the grounding wire along with its "wire protector" inserted and bent around the lug as shown in Figure 2-9.

Use copper wire that is either bare or provided with green insulation. Do not use the DC Ground Lug for your AC grounding.

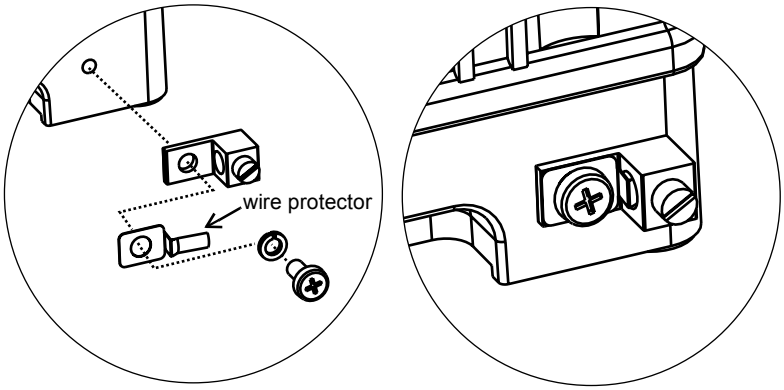


Figure 2-9 DC Grounding

Guidelines

Follow the guidelines below that correspond to your type of installation. These guidelines assume you are using the code-compliant DC supply cable and fuse sizes indicated in this guide. If you are using different sizes, refer to the applicable code for DC grounding details.

Recreational Vehicle Use 8 AWG copper wire and connect it between the Chassis Ground lug and the vehicle's DC grounding point (usually the vehicle chassis or a dedicated DC ground bus).

Residential Use 4 AWG wire and connect it between the Chassis Ground lug and your system's DC grounding point. This will usually be the AC service entrance grounding point or a separate ground rod.

Connecting the Battery Temperature Sensor

WARNING Energy and Explosion Hazard

Review the Important Safety Instructions on page vii

Mounting Options

You can mount the battery temperature sensor (BTS) in one of two ways:

- On the negative battery terminal. This allows the internal battery temperature to be sensed and provides the most accurate results.
- To the side of the battery using the self-adhesive backing. This also provides good results in most situations

Mounting to the Negative Battery Terminal

Note: In this procedure, you must install the DC cable on the battery terminal first. Then the sensor is installed on top of the DC cable. This sequence is required to provide the best connection to the battery and to thereby ensure correct performance of the sensor.

To mount the sensor on the negative battery terminal

1. Decide which battery is to be monitored.

   When all battery banks are located in the same compartment, select the battery that requires the most frequent charging (in an RV or other applications, this is usually the “house” battery). Where a battery is located in a separate compartment from other batteries, and where temperatures are constantly high (as in an engine room), it is a good idea to monitor this battery to keep it from being overcharged as a result of its constant high temperature. In this situation, the cooler battery bank will be slightly undercharged since it will be at a lower temperature than the battery being monitored, but this practice of monitoring the warmer battery will prolong the warmer battery’s life.
2. Switch off all devices operating from the battery, then allow approximately 10 minutes for any explosive gasses to dissipate.
3. Open the battery switch, if present, to disconnect the battery.
4. Remove the nut that secures the existing negative DC wire to the battery.
5. Move or reorient the existing negative DC wire so there is a flat surface on which to seat the battery temperature sensor mounting plate. You may need to bend the ring terminal and/or wires downward to allow the sensor to seat on the top surface of the upper ring terminal.
6. Mount the sensor directly on top of the negative DC wire terminal, as shown in Figure 2-10, and tighten the terminal nut firmly.

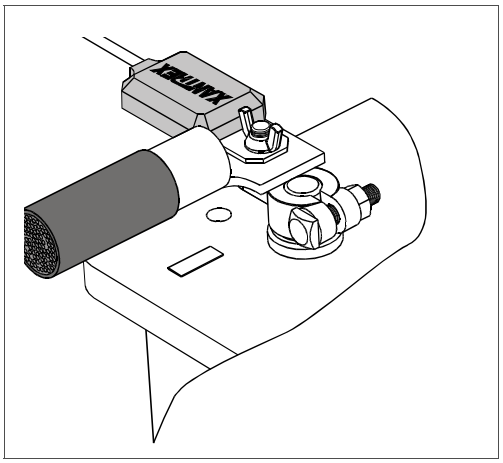


Figure 2-10 BTS on Negative Battery Terminal

7. Check that the sensor and all wires are fastened securely.
8. Turn the battery switch on again (if you opened it in step 3).
9. Route the sensor cable to the inverter•charger and attach cable as shown in Figure 2-12. You may need to use needle-nose pliers to grasp the collar and turn it. Secure the cable along its length.

Mounting to the Side of the Battery Case

To mount the sensor on the battery case

1. Select the battery to be monitored (see step 1 in the preceding procedure).
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. As well, this surface must be in direct internal contact with battery electrolyte, so do not install the sensor on a side 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, and allow the battery case to dry thoroughly.
4. Peel the protective backing from the self-adhesive strip on the rear of the sensor.
5. Press the sensor firmly against the clean side of the battery to fix it in place as shown in Figure 2-11.

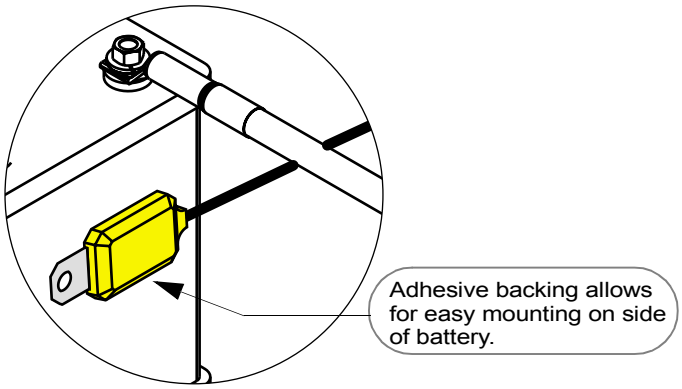


Figure 2-11 BTS Attached to Battery Case

6. Route the sensor cable to the inverter•charger and plug it into the BTS connector as shown in Figure 2-12. You may need to use needle-nose pliers to grasp the collar and turn counter clockwise.
7. Secure the cable along its length.

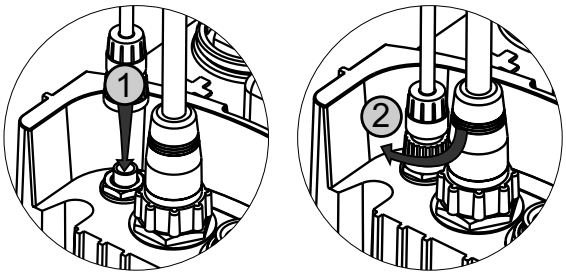


Figure 2-12 Connecting the battery temperature sensor

Mounting the Remote Switch

Before mounting

Flush-mounting the remote switch on a wall, bulkhead or panel requires an opening approximately 1.25 in x 2.0 in as shown in Figure 2-13. You need about 1½ inches of free space behind the mounting surface to accommodate the depth of the switch and wire. Be sure there is no wiring or other obstructions within the wall before you cut the opening.

The remote switch communication cable is 15 feet long (4.5) meters. Check to see that the communication cable will reach to the mounting location from the inverter•charger.

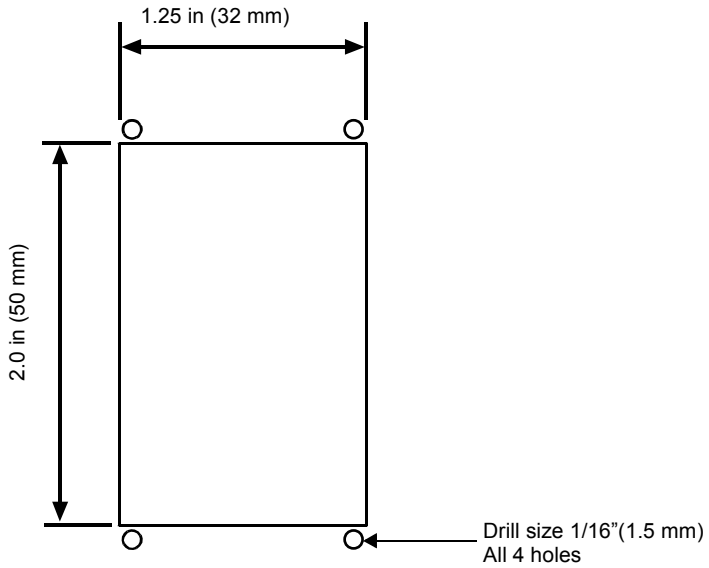
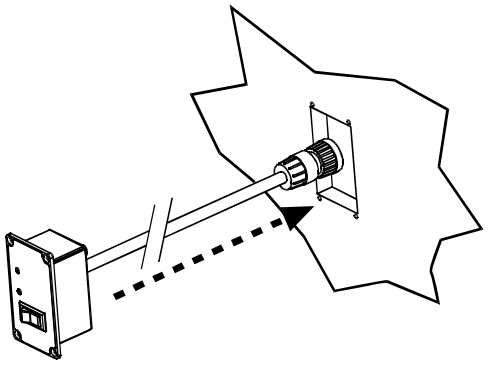


Figure 2-13 Remote switch dimensions

To mount the display panel:

1. Choose a location that is dry, out of direct sunlight, free from corrosive or explosive fumes, and otherwise appropriate for mounting an electronic device.
2. Pilot-drill the mounting holes and cut out the hole in which the panel will be inserted.
3. Route the communications cable to the inverter•charger and connect to the inverter•charger.



4. Place the panel in the opening and secure it with appropriate fasteners.

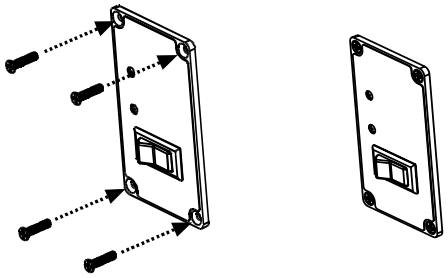


Figure 2-14 Final mounting of the remote switch

Starting the Inverter•Charger

Starting

Start the IP1012 by turning it on at the remote switch. If you are connected to shorepower the AC light illuminates steadily after an initial startup of 30 seconds.

If you have disconnected shorepower the Battery Power light should illuminate steadily.

Checking installation

If shorepower is connected and the Shore Power light does not illuminate, check that all breakers and GFCIs are reset and fuses are not blown. Check all input and output wiring connections.

If the Battery Power light does not illuminate, check that

- all DC connections are torqued to the correct specification and that none are loose
- the remote switch cable is properly connected
- the DC disconnect or fused disconnect is closed
- there is no reverse polarity.

If all connections are correctly made and the unit still fails to start, contact Xantrex Customer Service at the number provided at the front of this guide.

Testing the Installation

Purpose

The purpose of testing the installation, even if it appears to be working as expected, is to help check that the DC connections are tight and that there are no voltage drops across the connections. Loose connections increase the risk of fire and degrade the performance of the inverter•charger

Tools

You will require a digital voltmeter with a minimum resolution of 0.001 VDC(1mV).

Cable size

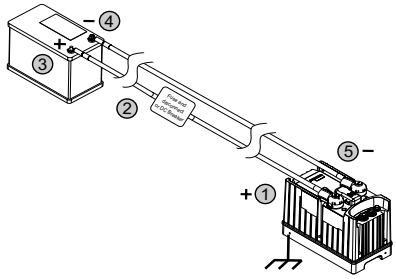
The tests are based on the cable lengths and size supplied in Table 1-2 on page 1–6.

Tests

There are two tests which may be performed. The first measures the voltage difference between battery and the IP1012. The second test measures the voltage drop on individual cable connections.

To measure voltage difference between the battery and the IP1012:

1. Remove the terminal covers from the IP1012.
1. Ensure the AC output breaker and the GFCI are reset.
2. Plug in and operate a hand-held hair dryer or other 1000 to 1500 watt load.
3. With the digital voltmeter leads placed directly on the battery studs, measure the voltage at the battery between the positive and negative terminals (3 and 4) while the load is operating.



4. Check the DC voltage on the IP1012 studs (1 and 5) while the load is operating.
5. Calculate the difference between the readings. The voltage difference should be as follows:

Load size	Voltage drop with fuse	Voltage drop without fuse
1000–1500 watts	less than 0.35 VDC	less than 0.2 VDC

6. If the voltage difference is greater than shown in the table, shut the system down and re-check the tightness of all connections.

To measure the individual connection voltage drop:

1. Place one voltmeter test lead on the battery cable lug and the other on the stud (or terminal) to which it is connected. Check to see that the voltage drop (with full load test current) is less than 0.003 mV (3 mV).
2. Perform this voltage check between all stud and lug connections including the fuse (or DC disconnect) terminals and battery cable lugs.

Customer Service

If tightening the connections does not result in the desired test results, record the readings and call Xantrex Customer Service.

3 Battery Types and Sizes

The batteries you use strongly affect the performance of the IP1012. It is important to connect the inverter to the correct size and type of battery. The information in Chapter 3 will help you select, connect, and maintain batteries that are most appropriate for your application.

Battery Types

Automotive Starting Batteries

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

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

Deep-Cycle Lead-Acid Batteries

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

For most applications of the IP1012, Xantrex recommends that you use one or more deep-cycle batteries that are separated from the vehicle's starting battery by a battery isolator.

A battery isolator is a solid-state electronic circuit that allows equipment to be operated from an auxiliary battery without danger of discharging the vehicle's starting battery. During vehicle operation, the battery isolator automatically directs the charge from the alternator to the battery requiring the charge. Figure 3-1 and Figure 3-2 show a battery isolator in configurations for normal and heavy-duty loads.

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

Battery Size

CAUTION
The IP1012 must only be connected to batteries with a nominal output voltage of 12 volts. The IP1012 will not operate from a 6 volt battery and may be damaged if connected to a 24 volt battery.

Importance

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

Battery Capacity Standards

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

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

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

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

To calculate the battery capacity you require, read "Estimating Battery Requirements" on page 3–3 and "Battery Sizing Example" on page 3–4, and then complete the "Battery Sizing Worksheet" on page 3–5.

Estimating Battery Requirements

To determine how much battery capacity you need:

1. Determine how many watts are consumed by each appliance that you will operate from the IP1012. You can normally find this on a label on the product. If only the current draw is given, multiply it by 115 to get the power consumption in watts.
2. Estimate how many hours each appliance will be operating each day.
3. Calculate the daily watt-hours needed for each appliance.
4. Add the total number of watt-hours needed for all the appliances and multiply it by the number of days between charges.
5. Divide the total watt-hours of AC load between charges by 10. This gives the battery Ah used between charges.
6. Double the total Ah used between charges to get the recommended battery size in Ah.

See the battery sizing example that follows.

Battery Sizing Example

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

Appliance	(A) Power Consumption	(B) Operating Time per Day	Daily watt-hours needed for this appliance (= A x B)
TV & VCR	115 W	3 hours	345 Wh
Microwave oven	1500 W	15 min = 1/4 hour	375 Wh
3 lamps, 60 W each	180 W	4 hours	720 Wh
Coffee maker	750 W	15 min = 1/4 hour	187.50 Wh
Coffee grinder	100 W	1 min = 1/60 hour	1.70 Wh
Hair dryer	1500 W	6 min = 1/10 hour	150 Wh
Sewing machine	150 W	30 min = 1/2 hour	75 Wh
Washing machine	1500 W	30 min = 1/2 hour	750 Wh
Steam iron	700 W	6 min = 1/10 hour	70 Wh
Total daily watt-hours of AC load			2674.20 Wh
x Number of days between charges			3
= Total watt-hours of AC load between charges			8022.60 Wh
Battery Ah used between charges (divide by 10)			802.70 Ah
Recommended Battery Bank Size in Ah (multiply by 2)			1600 Ah

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

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

dependent on how deeply the battery is discharged. The deeper the discharge, the shorter the battery life.

Battery Sizing Worksheet

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

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

Using Multiple Batteries

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

Two Batteries Connected In Parallel

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

Figure 3-2 shows batteries connected in parallel. Figure 3-1 shows a battery configuration suitable for normal loads; Figure 3-2 shows a configuration that is recommended for heavy loads.

In these configurations, the IP1012 will charge any batteries connected to it, but will not charge batteries through the battery isolator. The vehicle starting batteries in the configuration shown in the figures will only be charged by the alternator.

The deep cycle batteries can, however, be charged from the IP1012 and the alternator. The batteries could be subject to a high charging current.

CAUTION

Do not connect the following in parallel: batteries made by different manufacturers, different types of batteries, batteries that have different Ah ratings. Decreased battery life and improper charging will result.

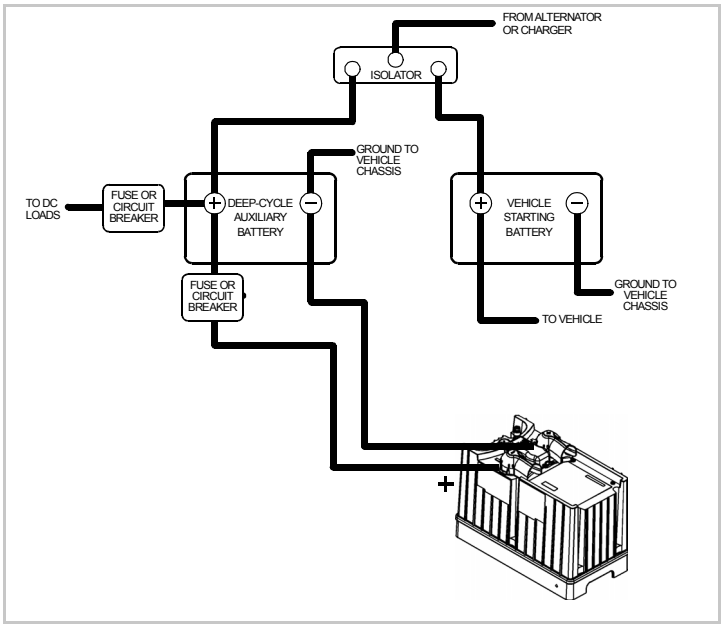


Figure 3-1 Configuration for Normal Loads

Two Separate Battery Banks

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

Figure 3-2 shows two separate battery banks and a battery selector switch. This configuration is recommended for heavy-duty applications.

Battery Selector Switch

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

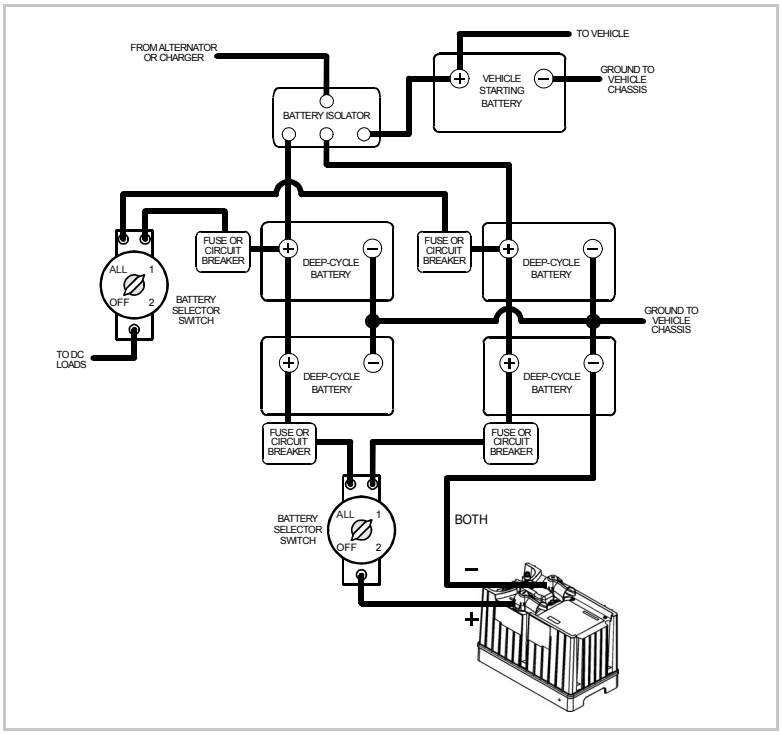


Figure 3-2 Configuration for Heavy Loads

Battery Tips

WARNING

Review the "Important Safety Instructions" before working with the batteries in your system.

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

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

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

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

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

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

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

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

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

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