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Owner's Manual

Sine Wave Plus Inverter/Charger

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About Xantrex

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

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Due to continuous quality improvement and product updates, the photographs shown in this manual may not exactly match the unit purchased.

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About This Manual

Purpose

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

Scope

The Manual provides safety guidelines, detailed planning and setup information, procedures for installing the inverter, as well as information about operating and troubleshooting the unit. It does not provide details about particular brands of batteries. You need to consult individual battery manufacturers for this information.

Audience

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

Organization

This guide is organized into nine chapters and nine appendices.

Chapter 1, "Introduction" lists and describes the basic features and parts of the Sine Wave Plus Inverter/Charger.

Chapter 2, "System Configuration" contains information to help you plan for a Sine Wave Plus installation in an off-grid, on-grid, or backup power application.

Chapter 3, "Installation" describes how to mount and install the Sine Wave Plus Inverter/Charger and perform wiring and cabling procedures for various configurations.

Chapter 4, "Functional Test" explains how to conduct a functional test of the inverter.

Chapter 5, "Navigation" explains how to navigate through the Sine Wave Plus Inverter/Charger menus using the Control Module and the menu maps.

Chapter 6, "Basic Setup Programming" explains how to program the Sine Wave Plus Inverter/Charger to operate under basic conditions.

Chapter 7, "Advanced Setup" explains how to program the Sine Wave Plus Inverter/Charger to operate under special, advanced conditions, such as automatic generator starting, energy management and auxiliary load applications.

Chapter 8, "Operation" explains how to operate the Sine Wave Plus Inverter/Charger. It also explains how to read the LED indicators and User Menus to determine system status.

Chapter 9, "Troubleshooting" contains information and procedures for solving possible problems with the Sine Wave Plus.

Appendix A, "Inverter Specifications" provides the electrical and environmental specifications of this inverter. This section also provides information about how an inverter works, as well as efficiency statistics.

Appendix B, "Configuration Settings" provides worksheets for programming your inverter/charger for user-specific parameters. Use this chapter to record the settings specific to your installation. This will make programming or reprogramming easier.

Appendix C, "Battery Information" supplies general information about batteries such as battery types, battery bank sizing, battery configurations, and battery care. For detailed information, see your battery manufacturer or your system designer. Reading this chapter will help you determine the battery bank specifications required by your specific system (e.g., types of batteries, size of battery bank, configuration of the battery bank etc.).

Appendix D, "Generators" supplies information about generator starting. Reading this chapter will help you determine what kind of generator to use, if any.

Appendix E, “Over-Charge Protection” supplies information about options for over-charge protection.

Appendix F, “Multi-wire Branch Circuit Wiring” supplies information about Multi-wire Branch Circuit Wiring Precautions when using stand-alone 120 Vac inverters or generators. Reading this chapter will provide information regarding identifying and correcting the potential fire hazard that exists when using inverters in this situation.

Appendix G, “Emergency Power Off Switches” supplies information about the requirements for installing an Emergency Power Off Switch.

“Glossary” contains a glossary of technical terms used in this manual. The glossary also defines some common electrical terms. It also provides a list of acronyms used in this manual.

“Warranty and Product Information” Reading this chapter will provide clarification of the Limited Warranty and instructions for obtaining a Return Material Authorization, if the product needs to be returned to Xantrex or one of its authorized service centers.

Conventions Used

The following conventions are used in this guide.

WARNING

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

CAUTION

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

Related Information

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

You may also need to reference the following installation guides to assist with this installation. These guides (with the exception of the NEC/CEC Reference Guides) are all provided with the specific components when purchased.

- Generator Start Module (GSM) Installation Guide
- Auxiliary Load Module (ALM) Installation Guide
- Inverter Stacking Control – Series (ISC-S) Cable Owner’s Guide
- Inverter Communications Adapter (ICA) Owner’s Guide
- Inverter Control Module (ICM) Installation Guide
- AC Conduit Box (ACCB) Owner’s Guide
- DC Conduit Box (DCCB) Installation Guide
- AC and/or DC Conduit Installation Instructions
- T240 Autotransformer Installation Guide
- Manufacturer’s instructions for Electrical Panels (Main, Sub, and generator disconnect panels)
- Manufacturer’s instructions for battery installation and use
- Manufacturer’s instructions for generator installation and use
- NEC Guide for related electrical, grounding, and bonding information.
- CEC Guide for related electrical, grounding, and bonding information.

Important Safety Instructions

WARNING

This chapter contains important safety and operating instructions as prescribed by UL and CSA standards for inverters used in residential applications. Read and keep this Installation Guide for future reference.

1. Before using the inverter, read all instructions and cautionary markings on the unit, the batteries, and all appropriate sections of this manual.
2. Use only attachments recommended or sold by the manufacturer. Doing otherwise may result in a risk of fire, electric shock, or injury to persons.
3. The inverter 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 jurisdiction.
4. To avoid a risk of fire and electric shock, make sure that existing wiring is in good condition and that wire is not undersized. Do not operate the inverter with damaged or substandard wiring. See Appendix, F "Multi-wire Branch Circuit Wiring" for information about multi-wire branch circuits.
5. Do not operate the inverter if it has been damaged in any way. If the unit is damaged, see the Warranty and Product Information section at the end of this manual.
6. This unit does not have any user-serviceable parts. Do not disassemble the inverter. See "How do you get service?" on page I–1 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.
7. To reduce the risk of electrical shock, disconnect both AC and DC power from the inverter before attempting any maintenance or cleaning or working on any components connected to the inverter. Turning off controls will not reduce this risk.
8. The inverter must be provided with an equipment-grounding conductor connected to the AC input ground.

9. Do not expose this unit to rain, snow, or liquids of any type. This product is designed for indoor use only. Damp environments will significantly shorten the life of this product and corrosion caused by dampness will not be covered by the product warranty.
10. To reduce the chance of short-circuits, always use insulated tools when installing or working with the inverter, the batteries, or the PV arrays.
11. Remove all jewelry while installing this system. This will greatly reduce the chance of accidental exposure to live circuits.

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. 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.

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 in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, 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 the 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 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 ratio/TV technician for help.

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1 Introduction

Chapter 1, “Introduction” lists and describes the basic features and parts of the Sine Wave Plus Inverter/Charger.

Basic Features

Congratulations on your purchase of a Sine Wave Plus Inverter/Charger from Xantrex Technology, Inc. The Sine Wave Plus is one of the finest inverter/chargers on the market today, incorporating state-of-the-art technology, high reliability, and convenient control features.

Specific features include:

- FCC Part B compliant
- 2.5 kW, 4.0 kW, or 5.5 kW continuous output of sine wave power for 120 Vac/60 Hz applications (depending on model)
- expandable up to 11 kW for 120/240 Vac/60 Hz applications by combining dual inverters using the Inverter Stacking Control – Series (ISC-S) cable
- 24-volt or 48-volt models
- multi-stage battery charging
- battery temperature sensor which provides automatic temperature compensation for battery charging
- push-button control module with a liquid crystal display (LCD) for easy programming and troubleshooting
- light emitting diode (LED) display of system operational status
- automatic on/off control of electric-start generators (requires additional equipment)
- remote monitoring (requires additional equipment)
- auxiliary load control (requires additional equipment)
- high surge/current capacity (depending on the unit, it will surge up to 5.9 times the continuous current rating for a minimum of 2 seconds). See Appendix A, “Electrical Specifications”.
- energy management features control utility and/or generator usage
- energy efficient to 95% peak and less than 20 watts of idle current; less than 2 watts in Search Mode

The default settings of the Sine Wave Plus Inverter/Charger allow the system to perform in many installations without the need for additional setup. However, if additional setup parameters are required, the push-button features on the Inverter Control Module (ICM) display on the front panel of the unit enables the system to be easily reprogrammed to meet specific customer configurations.

Figure 1-1 The Sine Wave Plus

Front Panel

The front of the Sine Wave Plus has the following features:

- the Inverter Control Module (ICM) Display
- the AC Access Cover

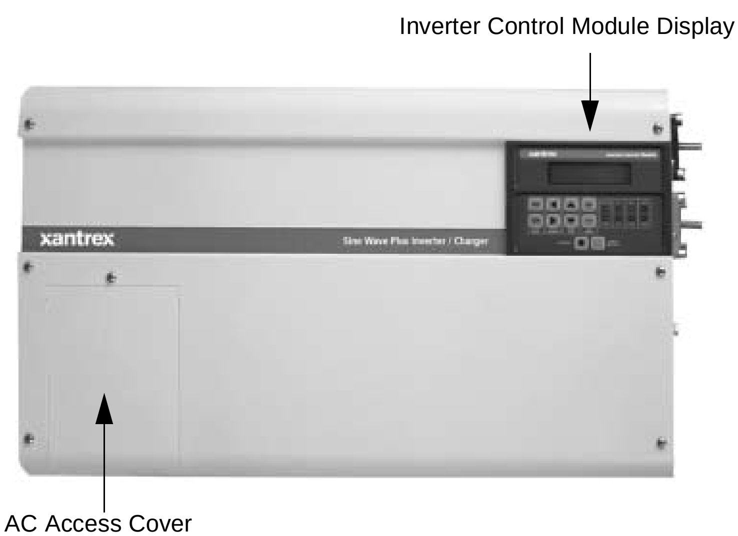


Figure 1-2 The Front Side of the Sine Wave Plus

AC Side

The AC side of the Sine Wave Plus has the following features:

- The Remote Monitor Port for connecting a remote Inverter Control Module (ICM) or the Inverter Communications Adapter (ICA)
- The Stacking Port for connecting two Sine Wave Plus inverters
- The AUX Port for connecting the Auxiliary Load Module (ALM)
- The GEN Port for connecting the Generator Start Module (GSM)
- The EPO Port for connecting an Emergency Power Off (EPO) switch
- Certification Label
- The Grid Tie Interface Port. The Grid Tie feature is currently not available with the Sine Wave Plus models. However, the port has been included in the event that the feature can be enabled with an upgrade at a future date. Continue to check our website www.xantrex.com for more information and future enhancements on the Sine Wave Plus Inverter/Charger.
- The Serial Number Sticker is on the rail as shows in Figure 1-3.

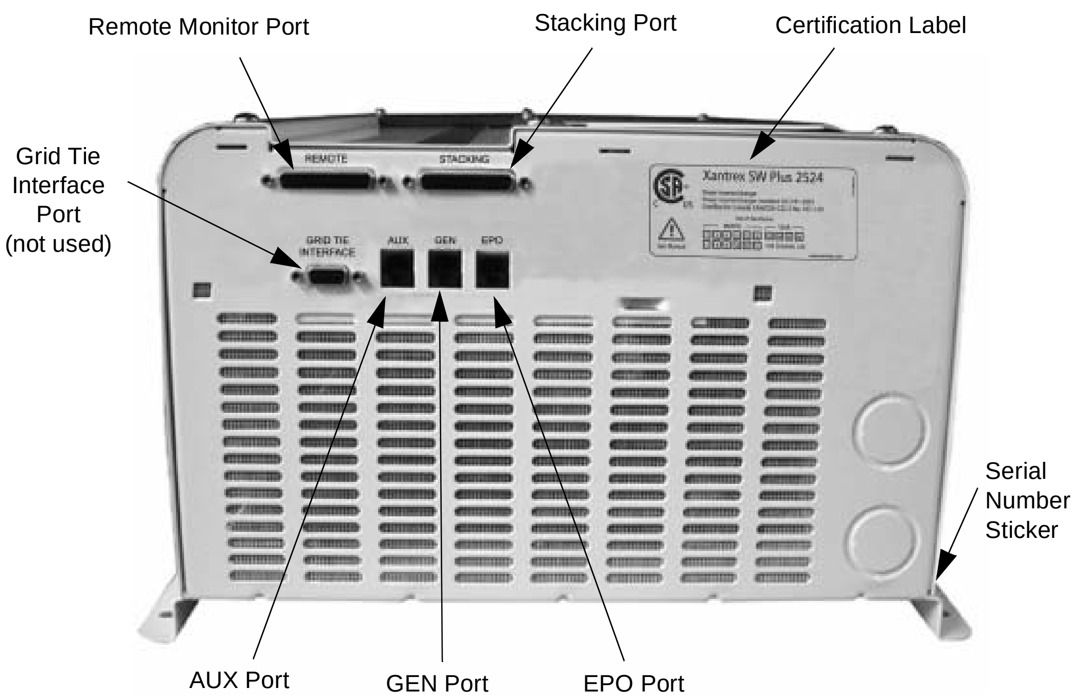


Figure 1-3 The AC side of the Sine Wave Plus

Emergency Power Off (EPO) Option

The Sine Wave Plus offers an Emergency Power Off (EPO) option through the use of the EPO Port. The EPO feature is designed to shut down the inverter from a remote location (or switch).

Since the type of the switch will be dependent on the installation, EPO switches are not provided with the Sine Wave Plus. However, many commonly available emergency shut off switches will work with the Sine Wave Plus EPO. Consult your local system designer or qualified technician for assistance.

The EPO is connected to the Sine Wave Plus with a telephone cord (RJ11type connector) to the dedicated EPO port on the AC (left) side of the inverter.

See Appendix G, “Emergency Power Off Switches” for additional information about this feature and how to prepare a cable for it.

Certification Label

The Sine Wave Plus has been tested to nationally recognized safety standards and has been found to be free from reasonably foreseeable risk of fire, electric shock, and related hazards when installed and operated in accordance with all the instructions provided in this manual and in accordance with all applicable local and national codes.

Please refer to the Certification Label affixed to the AC side of the inverter for specific agency information.

See Figure 1-3, “The AC side of the Sine Wave Plus” on page 1–4 for the location of this information.

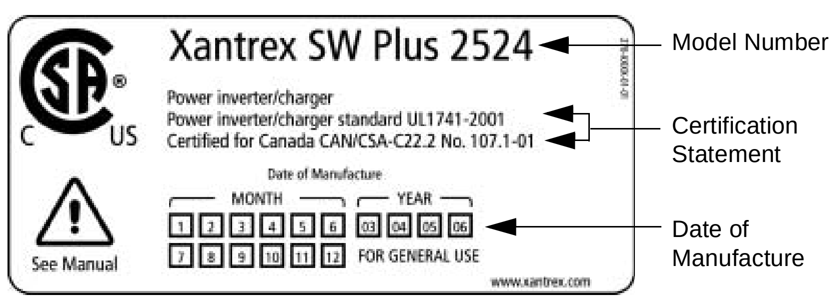


Figure 1-4 Certification Label

DC Side

The DC side of the Sine Wave Plus has the following features:

- the positive (+) battery terminal
- the negative (–) battery terminal
- the battery temperature sensor port
- the chassis ground lug

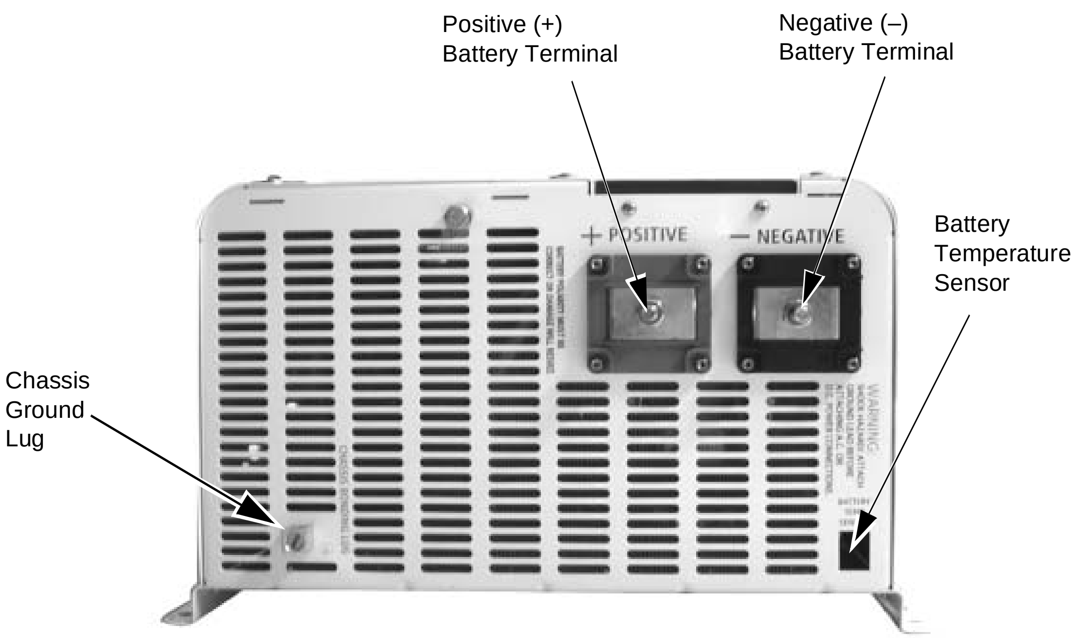


Figure 1-5 The DC side of the Sine Wave Plus

Battery Temperature Sensor (BTS)

A BTS is provided with each Sine Wave Plus Inverter/Charger. This sensor can easily be installed in the system to ensure proper charging of the batteries based on temperature. Installing a BTS extends battery life by preventing overcharging in warm temperatures and undercharging in cold temperatures.

If more than one BTS is being used, install them adjacent to each other so that they all detect a common temperature.

Figure 1-6 Battery Temperature Sensor (BTS)

See Table C-4, "Variances in Charging Voltage based on Battery Temperature" on page C–14 and Table C-5, "Temperature Compensation Calculation" on page C–14 for additional information.

Top

The top of the unit has the following features:

- Circuit Breaker - This circuit breaker protects the unit's internal wiring while the unit is inverter or charging. It is not used for the pass-through current. This is not a branch-circuit rated breaker. Separate output breakers are still required. If the button is protruding from the chassis as shown in Figure 1-7, it means the circuit breaker has tripped open. Press the breaker back in to reset it.
- Warnings Label
- Ratings Label

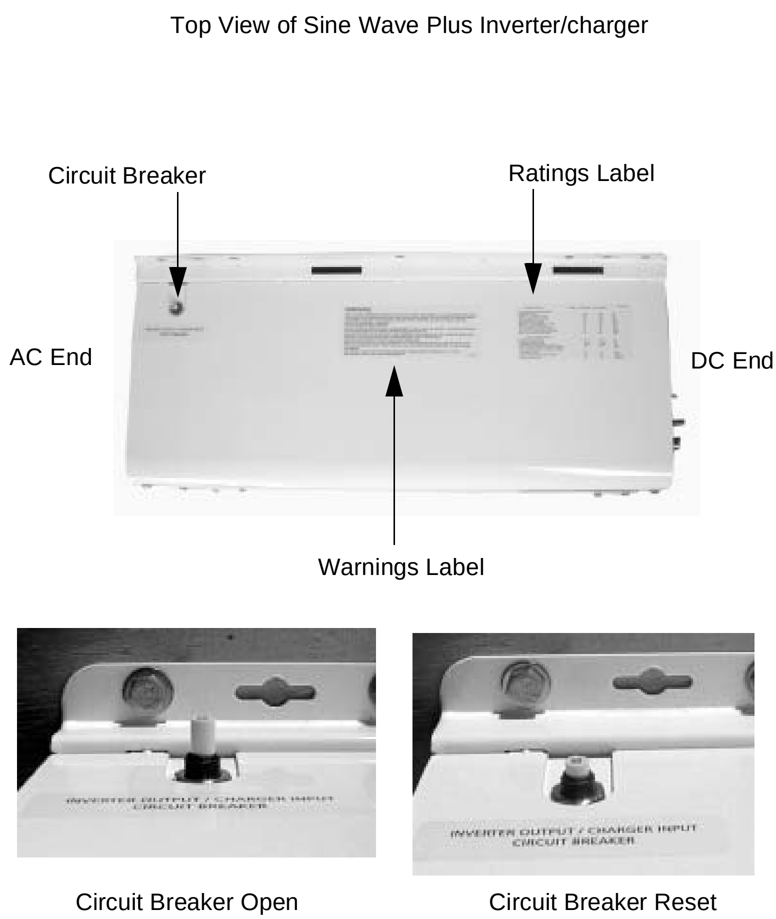


Figure 1-7 External Output Circuit Breaker

2

System Configuration

Chapter 2, “System Configuration” contains information to help you plan for a Sine Wave Plus installation in an off-grid, on-grid, or backup power application.

Pre-Configuration Planning

Importance

Pre-configuration planning is essential to ensure optimal performance for your system. This section outlines the components of a system and how you can plan for them.

Types of Applications

The Sine Wave Plus Inverter/Charger can be configured for the following applications:

- OFF-GRID (stand-alone) applications where no utility power is available.

  See Figure 2-17 through Figure 2-20 for illustrations of off-grid applications.
- ON-GRID applications where it can operate the AC loads when the Utility System (grid) fails, keep the batteries charged, and/or function as an energy management controller.

  See Figure 2-21 and Figure 2-22 for illustrations of on-grid applications.

Important: Be sure to consult with your local utility company and/or permit office to ensure that the desired configuration will be code-compliant. Be sure to obtain the proper licenses and permits as required by law.

Important: Installations of this equipment should only be performed by skilled personnel such as qualified electricians and Certified Renewable Energy (RE) System Installers. For a list of Xantrex Certified RE dealers, please visit our website at www.XantrexREdealers.com.

System Considerations

You need to consider the following issues as you design your system.

System output

How much power will be required and how it will be produced:

❒ Single or dual inverters (based on output voltage and output watts required)

❒ Output watts required (i.e., continuous capacity and surge capacity)

❒ Output voltage (120 Vac or 240 Vac)

See “System Output Requirements” on page 2–4 for more information.

System input

What are the sources of power for your system:

❒ Utility power

❒ AC generator (See “Generator Considerations” on page 2–19)

- ❐ Renewable energy systems (e.g., PV arrays, wind turbines etc.)

See “System Input Requirements” on page 2–4 for more information.

Location

What are the safe, physical environmental requirements for your installation:

- ❐ Mounting location for optimal performance and easy access of all components
- ❐ Ventilation and clearance requirements for all components
- ❐ Mounting method (wall or shelf)
- ❐ Additional items/materials required for mounting
- ❐ RFI or EMI considerations

See “Location Considerations” on page 2–5 for additional information.

Grounding

What methods of protection and grounding are required:

- ❐ Grounding type (i.e., ground bar, ground bus, or ground rod)
- ❐ Neutral-to-ground bonding requirements
- ❐ Lightning and surge protection

See “Grounding Considerations” on page 2–7 for additional information.

Battery

What kind of DC storage will be used:

- ❐ Battery type and size
- ❐ Battery cables and sizes
- ❐ Size of the battery bank and it’s configuration
- ❐ Location of battery bank to rest of system

See “Battery Considerations” on page 2–11 for additional information.

Wiring

What is needed/required for the AC and DC wiring for this installation:

- ❐ Types and sizes of wires needed
- ❐ Types and sizes of conduits needed
- ❐ Types and sizes of fuses, disconnects and/or circuit breakers
- ❐ Additional equipment for code compliance (e.g., service panels, conduit boxes, emergency shutoff switches etc.)
- ❐ Wire routing

See “Wiring Considerations” on page 2–18 for additional information.

Generator

Will a generator be used:

❒ Voltage Output Requirements
(120 Vac only, 120/240 Vac, or 240 Vac only)

❒ Auto-Start or Manual-Start

Important: Auto-start generators require the addition of the GSM to enable the inverter to control the operation of the generator.

See “Generator Considerations” on page 2–19 for additional information.

Additional equipment

What additional equipment is needed:

❒ Remote monitors, interface cables, stacking cables, DC charge controllers, auxiliary load controllers, T240 autotransformers etc.

See “Additional/Optional Equipment Considerations” on page 2–22 for additional information.

System Output Requirements

Determination

Determine the inverter output size requirements by calculating the maximum, continuous capacity and surge (inrush current) capacity the system will demand.

- Add all potential loads which would be on at once to determine continuous power requirements.
- Add the surge current of all loads which might start at once to determine surge requirements (e.g., washer spinner, waterpump and refrigerator compressor could all start at once).

More information

See Appendix C, “Understanding Amp-hour Requirements” for assistance in determining the System Output Requirements.

System Input Requirements

Determination

Determine the input requirements based on the output requirements. In other words, is grid power available or will renewable energy equipment be used? Will a generator be used to supplement or backup the other input sources?

More information

See “Generator Considerations” on page 2–19 and Appendix D, “Generators” for additional information regarding using generators for system input.

Location Considerations

Dry	Inverters contain sophisticated electronic components and should be located in a well-protected, dry environment away from sources of fluctuating or extreme temperatures and moisture. The better the environment, the longer the inverter will last. Consider installing your inverter in the same type of location in which you would store high quality electronic equipment of equal value.
Avoid saltwater	Exposure to saltwater is particularly destructive and potentially hazardous. Internal corrosion caused by improper installation may cause the inverter to prematurely fail and additionally will void the warranty.
Close to battery bank	Locate the inverter as close to the batteries as possible in order to keep the battery cable length short. However, note the following warnings and important notes about inverter location.

WARNING: Explosion and Corrosion Hazard

Do not locate the inverter directly above the batteries or in the same compartment as vented batteries.

Vented batteries generate hydrogen and oxygen, which if accumulated, can be ignited by an arc caused by connecting the battery cables or switching a relay. Vented batteries also generate hydrogen-sulfide gas, which is corrosive to electronic equipment.

Batteries can sometimes release explosive gas, please see the battery manufacturer's recommendations for ventilation requirements.

CAUTION: Damage to Inverter

Do not mount the inverter in the same space as the generator. The heat and dust from the generator can damage the inverter.

RFI Interference	Inverters can generate radio frequency interference (RFI). Locate any sensitive electronic equipment susceptible to RFI as far away from the inverter as possible. This includes radios and televisions.
Electromagnetic Interference	Inverters can emit strong electromagnetic fields. This should be considered when choosing an installation location. See "FCC Information to the User" on page viii for additional information regarding RFI requirements.

Fire Safety	All Sine Wave Plus inverter/chargers meet UL fire safety standards as outlined in UL 1741. As such, in the event of a failure, the Sine Wave Plus is designed to fail safe. Be sure the specific mounting and ventilation requirements outlined in this Owner’s Manual are followed carefully. Do not locate the inverter near readily flammable materials such as cloth, paper, straw, plastic etc. Flammable materials should be kept a minimum distance of 24 inches (60 cm.) from the top surface (when wall mounted) and 12 inches (27 cm.) from either side surface and the front of the Sine Wave Plus. Readily flammable materials refers to instantly combustible substances such as cloth, paper, straw, and plastic sheeting.

Mounting Considerations

Method	The inverter can be mounted on a vertical surface (or wall) or on a shelf. The advantage of the wall mounting is to provide easier access to the controls and displays.
Securing	The mounting surface (wall or shelf) must be capable of supporting twice the weight of the inverter. The keyhole slots should not be used as the only method of securing the unit to the mounting surface. Use all ten mounting holes and all four keyhole slots for securing the unit and use 0.25-inch diameter bolts for mounting.

Ventilation Requirements

Location	Install the inverter in a well-ventilated area/enclosure for proper operation. The inverter’s thermal shutdown point will be reached sooner than normal in a poorly ventilated environment resulting in reduced peak-power output and surge capability as well as shorter inverter life.
Requirements	Provide a minimum clearance of 6 inches (12 inches is preferred) around the top and 6 inches at the AC- and DC-side of the inverter for ventilation. A fan-forced, fresh-air vent (on the inverter’s AC side) allows cool air to enter the unit and exit from the DC-end of the inverter. Ensure that this vent is not obstructed with foreign objects, such as dirt and dust and that the minimum clearances are met.
Airflow clearance	All air ventilation openings should have 6 inches of clearance and there should be no nearby cover over the top of the unit. This is to prevent warm, exhausted air from the unit from being drawn back into it. The warm air could cause premature shutdown due to overheating.
Screening	The unit is equipped with screening to prevent insects and rodents from entering. This screening needs to be checked and cleaned regularly from the outside to prevent dust buildup.

Grounding Considerations

Types

Whether you are installing a new system or integrating new parts into an existing system, the four types of grounding to consider are:

- DC system grounding
- Inverter grounding
- Chassis grounding
- Bonding the grounding system

Important: The grounding requirements vary by country and by application. All installations must comply with national and local codes and ordinances. Consult local and/or national codes and the NEC/CEC for specific grounding and bonding requirements for the desired installation.

DC System Grounding

Systems

The Sine Wave Plus can be used in either a positive or negative grounded system. However, unless you are installing the inverter into an existing positive grounded system (i.e., a telecommunications system), it is highly recommended to use negative grounding.

Positive ground In a positive ground, the positive conductor from the battery bank is bonded to earth ground. This arrangement is most often used in telecommunications systems where an isolated ground is a requirement.

Negative ground In a negative ground, the negative conductor from the battery bank is bonded to earth ground. This is the most common form of grounding methods used for residential and commercial applications. The Sine Wave Plus meets FCC part 15 Class B regulations in a negative grounded system. See “FCC Information to the User” on page viii for additional information.

Convention

The remainder of this guide will assume the negative ground convention.

Important: The bonding of the DC negative (or positive in positive ground applications) to ground can only be in one location in the DC system. This DC ground bond must be made in a non-serviceable item in the DC system. The Xantrex DC175 and DC250 can have the optional DC Bonding Block (DCBB) installed to provide the DC system bond. Additionally, the Xantrex PVGFP can also provide this bond and comply with NEC/CEC requirements for roof mounted PV arrays installed on dwelling units (homes).

Inverter Grounding

WARNING: Shock Hazard

Attach the ground lead BEFORE attaching any AC or DC power connections.

Requirement

The inverter/charger should be connected to a grounded, permanent wiring system with the AC and DC grounds commonly bonded to each other and should be bonded to the grounding system at only one point in the system. See "Bonding the Grounding System" on page 2–10 for additional information.

Conductor size

The size for the grounding conductor is usually based on the size of the circuit breaker in the DC system. Table 2-1 provides battery DC disconnect sizes and minimum wire sizes of copper ground wires for grounding systems.

It is recommended that the size and gauge of grounding wire should be more than the NEC/CEC minimum requirements when installing power sources such as inverter/chargers or generators.

Table 2-1 Recommended Minimum Safety Ground Wire and DC Disconnect Sizes per NEC

Battery DC Disconnect Size	Minimum Size of Copper Ground Wire
30 amp or 60 amp	#10 AWG
100 amp	#8 AWG
200 amp	#6 AWG
300+ amp	#2 AWG or greater

Note: Field experience has demonstrated that long distances or high impedance grounds can cause equipment malfunction or damage.

WARNING: Explosion Hazard

Never use a gas pipe or gas line for grounding purposes. The inverter is a power source and it is intended to be grounded at the service/main ground rod.

Equipment or Chassis Grounding

WARNING: Shock Hazard

Attach the ground lead BEFORE attaching AC or DC power connections.

Equipment or chassis grounding connects the metallic chassis of the various enclosures together to have them at the same voltage potential, thus reducing the possibility for electric shock. It also provides a path for fault currents to flow through to blow fuses or trip circuit breakers. The size of the connecting conductors should be coordinated with the size of the over-current devices involved. Under some circumstances, the conduit and enclosures themselves will provide the current paths.

Grounding Electrodes/Ground Rods

Purpose

The purpose of the grounding electrode (often called a ground rod) is to maintain the potential of equipment tie to it at "ground" potential to avoid a shock hazard. It also shunts to ground fault currents and currents due to ground tied filtering.

Size

The size for the conductor to the grounding electrode or grounding system is usually based on the size of the largest conductor in the system. Most systems use a copper-plated rod as the grounding electrode. The rod should be 5/8 inch (16 mm) round by 8 feet (2 meters) long and driven into the earth. It is also common to use copper wire placed in the concrete foundation of the building as a grounding system. Either method may be acceptable, but the local code will prevail. Connection to the ground electrode should be done with special clamps located above ground where they can be periodically inspected.

Note: This inverter, along with all other power electronic devices in your system, are subject to severe damage from the effects of lightning. **Lightning damage is not covered by your warranty**. If your installation is in an area of high probability for lightning, you should consult with a local lightning expert or your authorized Xantrex installer to determine what extra precautions should be taken to protect your equipment.

Number of rods

Many large systems use multiple ground rods. The most common example is providing a direct path from the solar array to earth near the location of the solar array. Most electrical codes expect multiple ground rods to be connected by a separate wire with its own set of clamps. If this connection is done, it is a good idea to make the connection with a bare wire located outside of the conduit (if used) in a trench. The run of buried wire may be a better grounding electrode than the ground rods. Well casings and water pipes can also be used as grounding electrodes. Under no circumstance should a gas pipe or line be used.

Important: Consult local codes and the NEC/CEC for more information.

Bonding the Grounding System

Definition

Bonding means connecting one of the current-carrying conductors (usually the AC neutral and DC negative) to the grounding system. When the other ungrounded conductor (the hot or positive) touches the grounding system, current will flow through it to the point of connection to the grounded conductor and back to the source. This will cause the over-current protection to stop the flow of current, protecting the system. This point of connection between the grounding system (ground rod), the current carrying grounded conductor (AC neutral and DC negative), and the equipment grounding conductor (green ground wire, equipment ground) is called a “bond”.

Bonding locations

Bonding is usually located in the over-current protection device enclosures (both AC and DC).

Residential systems In residential systems bonding is located at the utility panel, after the power has gone through the kilowatt-hour meter of the utility (if present).

Renewable energy systems Renewable energy systems, with no grid connection, can be grounded at the main AC distribution panel. Renewable energy systems should be grounded to the same grounding electrode as the AC distribution panel.

Bonding should not be done at the inverter. Codes do not generally allow it because the inverter is considered a “serviceable” item that may be removed from the sytem, in which case, the bonding would be broken.

Bonding at one point

Bonding must be done at only one point in an electrical system. Inherently, Xantrex systems have two separate electric systems; a DC system and an AC system. This means that two bonding points will occur in all inverter applications. The bonding point will also be connected to the equipment (chassis) grounding conductors. It is common to have two separate conductors connect the ground electrode and the two bonding points. Each conductor should use a separate clamp.

Guidelines

The ground and neutral **must be bonded at one place, and only one place,** in the system. Use the following guidelines for ground and neutral bonding:

Generator If the generator is the main source of power, (that is, no utility grid power) then the neutral and ground connections are bonded at the main AC distribution panel.

Utility grid If the utility grid is the main source of power, then the bond should be at the utility AC distribution panel.

No utility or generator If there is no utility or generator in the system, then the ground/neutral bond should be in the inverter AC distribution panel.

Battery Considerations

CAUTION: Damage to Equipment

The Sine Wave Plus is intended to operate with batteries as its source of DC power. **Do not** connect DC charging sources, such as PV arrays, wind turbines, or micro-hydro turbines, directly to the Sine Wave Plus. If DC charging sources are connected directly to the inverter, the DC rating of the inverter can be exceeded and the inverter can be damaged.

Accessibility

Locate the batteries in an accessible location if maintenance is required. Two feet clearance above the batteries is recommended for access to the battery caps. They should be located as close to the inverter as possible without limiting access to the inverter’s disconnects. Install the batteries to the right of a wall-mounted inverter for easy access to the DC side of the inverter and shorter cable runs. The battery bank may also be placed on the opposite side of the wall on which the inverter is mounted.

Vented enclosures

For safety and to limit access to the batteries, the batteries should be housed in an enclosure or dedicated room that can be locked or screened, and ventilated. It should be vented to the outside by a 1-inch minimum vent pipe located at the top of the enclosure. An intake vent should be installed at the bottom of the enclosure to promote air circulation.

Important: These vents exhaust corrosive and explosive hydrogen sulfide gases and must not be overlooked when designing an enclosure.

Enclosure requirements

The enclosure should be made of an acid resistant material or have a finish that resists acid to prevent corrosion and must be capable of containing the electrolyte from at least one battery should a leak occur.

Enclosures located outside must be rainproof and screened to prevent access by rodents or insects and insulated from extreme temperatures.

Batteries will give their best performance and service life when operating in a 20 to 25 °C (68 to 77° F) environment.

More information

Consult your battery vendor for additional information on battery enclosure requirements.

Battery Bank Requirements

Note: Based on the peak current of the inverter, the minimum allowed battery bank is 100 Ah. The recommended battery bank size is determined by the battery bank worksheet in Appendix C (Table C-1, "Determining Average Daily Load in Amp-hours" on page C–7). The inverter is designed to operate with batteries and should not be operated without them.

Determining requirements

To determine your battery requirements you need to know what type of batteries to use, the number of batteries for the battery bank, and how to configure the bank to optimize voltage output according to system requirements.

See Appendix C, "Battery Information" for additional information on determining battery bank type and configuration.

The DC voltage of your inverter must match the DC voltage of your system and all of its accessories. If you have a 24-volt inverter, then the battery bank and all other DC devices in the system must be configured for 24 volts.

WARNING: Fire Hazard

Undersized cables can overheat and melt, creating a fire hazard when subjected to heavy (peak) loads. Always use a cable of proper size and length, rated for the amperage of the inverter and batteries.

Battery Cable Requirements

Important: Use only fine, stranded copper cables for battery and inverter DC connections. Do not use coarse, stranded wire, as the lack of flexibility may damage battery and inverter terminals.

Size and length

Battery cables must be the correct size and length to optimize performance and ensure the safety of the system. Larger diameter cables (smaller AWG number) have less voltage drop and are, therefore, more efficient when transferring power to and from the batteries. The use of oversized cables (e.g., 4/0 cables) will allow you to take advantage of the improved surge performance of the Sine Wave Plus inverters.

Important recommendation

Follow the battery cable recommendations listed in this guide. It is absolutely imperative that you adhere to the battery cable size (wire gauge) and length recommendations provided in this section. If cables are used that are too long or of insufficient gauge (i.e., the diameter is too small), then inverter performance will be adversely affected.

In addition to poor inverter performance, undersized cables can result in fire caused by overheating wires. Any damage to the inverter caused by overheating from undersized wire is **not** covered by the Xantrex warranty.

Important: Figure 2-1 is for reference only. Sizes shown are for the conductor. Do not include any insulation, or sheathing, when determining your wire size. Due to printing anomalies, these dimensions may not be to scale.

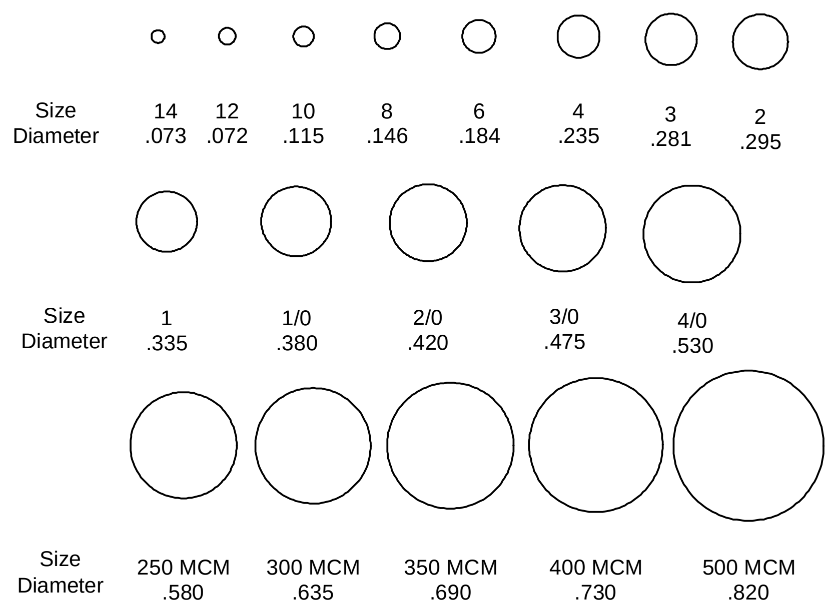


Figure 2-1 AWG Wire Size Reference Chart

Battery cable length

Cable length is another important factor. Runs should be kept as short as practical. Longer cable runs increase resistance, thus lowering the overall efficiency of the system. This is especially true in lower voltage systems where, depending upon the length of the cable run, it may be necessary to oversize the diameter of the wire, or parallel (double) the cables. Table 2-2 provides recommended minimum cable sizes for various cable lengths and inverter amperage per NEC/CEC guidelines. It is recommended that the cable has battery acid resistant insulation and is rated for 90 °C (32 °F) or better.

Be sure to check with any local regulatory agencies for additional requirements.

Battery cable lugs

Battery cables must have crimped copper compression lugs or crimped and soldered copper compression lugs. Soldered connections alone are not acceptable.

High quality battery cables are available from Xantrex in an assortment of lengths from 1½ to 10 feet in #2/0 AWG and from 1½ to 15 feet in #4/0 AWG sizes. These cables are color-coded with pressure crimped, sealed ring terminals.

Overcurrent protection

For safety and compliance with regulations, battery overcurrent protection is required. Fuses and disconnects must be sized to protect the wiring in the system and are required to open before the wire reaches its maximum current carrying capability.

Table 2-2 Recommendced Battery Cable Size Versus Length

Inverter Model	Maximum Continuous DC amps[a]	NEC amps[b]	Up to 5 Feet One-way	Up to 10 Feet One-way	Up to 15 Feet One-way
2524	134	167	#2/0 AWG (67.4 mm^2)	#4/0 AWG (107 mm^2)	Not Recommended
2548	67	84	#2/0 AWG (67.4 mm^2)	#4/0 AWG (107 mm^2)	#4/0 AWG x 2 (107 mm^2 x 2)
4024	214	267	#4/0 AWG (107 mm^2)	#4/0 AWG x 2 (107 mm^2 x 2)	Not Recommended
4048	107	134	#2/0 AWG (67.4 mm^2)	#4/0 AWG (107 mm^2)	Not Recommended
5548	147	184	#4/0 AWG (107 mm^2)	#4/0 AWG x 2 (107 mm^2 x 2)	Not Recommended

a. “Maximum Continuous DC amps”, as shown in this table, is based on low battery voltage with an efficiency of 85%.
b. “NEC amps”, as shown in this table, is based on low battery voltage, and efficiency of 85%, and a 125% NEC derating.

Xantrex DC175 and DC250

The NEC/CEC requires both overcurrent protection and a disconnect switch for residential and commercial electrical systems. These items are not supplied as part of the inverter. However, Xantrex offers a DC circuit breaker disconnect module specifically designed for use with Xantrex inverters to meet NEC/CEC compliance. Two amperage ratings are available: a DC250 (250 amps) and a DC175 (175 amps) in either single- or double-pole configurations for single or dual inverter installations.

See “DC Disconnect Boxes (DC175/DC250)” on page 2–24 for additional information on the Xantrex DC175 and DC250.

After selecting battery cables based on the distance from the battery bank to the inverter, add battery overcurrent protection in the battery cable line, based on Table 2-3. This table will help you to determine your maximum breaker/fuse size based on the cable size you selected previously.

Table 2-3 Battery Cable to Maximum Breaker/Fuse Size

Cable Size Required	Rating in Conduit	Maximum Breaker/Fuse Size	Rating in “Free Air”[a]	Maximum Breaker/Fuse Size
#2/0 (00) AWG	175 Amps	175 Amps	265 Amps	300 Amps[b]
#4/0 (0000) AWG	250 Amps	250 Amps	360 Amps	400 Amps[b]

a. The term “free air” is defined by the NEC/CEC as cabling that is not enclosed in a conduit or a raceway. Cables enclosed in conduit or raceways have substantially lower continuous current carrying ability due to heating factors.

b. The NEC/CEC allows rounding to the next highest standard fuse size from the cable rating (i.e., 150 amp cable size rounds up to a standard 175 amp size).

Fuse Block (TFB)

Some installations may not require conduit(s) or a disconnect device, however, overcurrent protection is still required. Xantrex offers a fuse block (TFBxxx) providing the code-required inverter overcurrent protection for these applications. These fuses are available in 110, 200, 300 and 400 amp sizes.

Important: From this point on in this guide, any reference made to a “DC disconnect” means either a DC breaker or a fuse with a disconnect switch, which will depend on your specific type of installation.

Battery Requirements for Dual Inverter Systems

The success of “stacked” or “dual” inverter systems is dependent on the quality and maintenance of the DC connections. Stacked inverter sets are far less forgiving to long, undersized, uneven, and/or poor connections than are single inverters.

Dual inverters (not stacked)

Dual inverter configurations can be used without using the stacking interface cable. In this configuration, two inverters separately run isolated loads from the same battery bank or individual battery banks.

Series stacked	When inverters are "stacked" they must operate from a common battery bank. In other words, the DC negative of one inverter must be common with the second inverter and likewise for the DC positive. *For example:* *If you have eight 6-volt batteries in a 24-volt configuration, they would be arranged in two rows of four batteries (see Appendix C for diagrams of various arrangements).* *The negative ends of the two "strings" of batteries must be jumpered together to become common with each other.* *Likewise, the positive ends of the two "strings" must also be jumpered together so that they are also common with each other.*
Shunts near the inverter	Losses from the cables will cause each inverter to measure slight differences in actual voltages, in spite of having the battery bank common to both inverters. It is easy to have the DC negatives common closer to the inverters if an in-line metering shunt is installed near the inverters before the negative cables attach to the negative battery terminal.
Jumpers	The use of optional bonding jumpers can improve how each inverter measures the DC voltage. These measurements are used to determine when charging amperages should be reduced as the batteries become charged. The bonding jumpers allow the inverters to agree better on what the voltage actually is. The longer the DC cables are, the more likely you will need bonding jumpers.
Shunts near the batteries	If a shunt is installed closer to the battery bank than the inverters, a bonding jumper should be installed from one inverter's negative terminal to the other inverter's negative terminal. By using a negative bonding jumper and/or a metering shunt near the inverters, the inverters will have a better zero volt (DC negative) reference to measure the DC voltage.
DC disconnects	The DC positive is more difficult due to the need to have DC disconnects in each cable for the inverters. The primary reason for the DC disconnects is for overcurrent protection for the cable it is installed in. By using a positive bonding jumper the inverters will have a more accurate DC positive reference to measure the DC voltage.
Bonding Jumpers	A bonding jumper may be installed from one inverter's positive terminal to the other inverter's positive if a warning is placed near the DC disconnects. This means that either DC disconnect can energize both inverters while the other DC disconnect is not yet turned on. This is called "backfeeding" a disconnect or circuit breaker. The 2002 NEC, Section 404.6, C, Exception, allows switches to be backfed if a warning such as the following is permanently marked on or adjacent to the

disconnect switches. A sample of this warning label is provided in Figure 2-2. *These labels are not available or provided by Xantrex, but may be available from your local electrical warehouse.*

> **WARNING: Shock Hazard**
>
> Load side terminals may be energized by backfeed.

Not provided by Xantrex. May be available at your local electrical warehouse.

Figure 2-2 Sample Warning Sticker for Backfeed Conditions

DC disconnects and overcurrent devices

The size of the bonding jumper must be the same gauge as that of the primary battery cable in which the overcurrent device (DC disconnect) is installed, and as always, the overcurrent device must be sized appropriately for all cables attached to it. If one overcurrent device trips then there will be only half the amount of current available for both inverters to run from. If you want to run only one inverter while the other is shut down (for example, for maintenance procedures), the positive bonding jumper must be removed or there must be an appropriately sized switch installed in the bonding jumper.

Battery Temperature

Cold temperatures

Cold temperatures drastically reduce battery capacity and performance. Therefore, the battery enclosure should provide a fairly stable temperature for the batteries. If batteries are installed in a cold environment, insulation should be installed to protect the batteries from the cold. The insulation will act as a barrier to the cold and also keeps the heat generated by the batteries inside the enclosure providing a more stable temperature and better system performance.

Hot temperatures

High battery temperatures shorten the life of the batteries. The battery enclosure should not be installed in direct sunlight where the sun can overheat the batteries. Locate the enclosure where it will be protected from the sun and provide vents in the top and bottom of the enclosure to provide air flow throughout the enclosure.

For best performance, locate the batteries where they are in a room temperature of 20 to 25 °C (68 to 77 °F)

Battery temperature sensor

A Battery Temperature Sensor (BTS) is provided with each Sine Wave Plus. This sensor can easily be installed in the system to ensure proper charging of the batteries based on temperature. Installing a sensor extends battery life by preventing overcharging in warm temperatures and undercharging in cold temperatures.

See "Installing the Battery Temperature Sensor (BTS)" on page 3–18 for instructions on installing the Battery Temperature Sensor.

Wiring Considerations

Important: Be sure to consult the local and national electrical codes to confirm grounding and bonding requirements specific to the intended system. All wiring and installation methods should conform to applicable electrical codes and building codes.

Conduit boxes

For maximum safety and, in some cases, for code-compliance, run the AC and DC cables in conduit(s). Pre-plan the wire and conduit runs carefully before installing any components.

Main AC distribution panel (utility fed)

The AC1 input to the inverter requires a 60-amp breaker maximum be installed into the main AC distribution panel (double-poled if stacked) to protect the wiring in accordance with NEC. This breaker supplies utility grid power to the inverter. AC1 is not used in off-grid applications.

Generator disconnect switch

Installing a disconnect switch with an appropriately sized circuit breaker (60 amp maximum) between the generator and inverter provides over-current protection for the wiring between the generator and the inverter's AC2 terminal. This is also a good safety practice as it also provides a means to prevent the inverter wiring from becoming energized in the event that an electric-start generator starts unexpectedly while the inverter is being serviced.

Subpanel/Inverter Panel

In on-grid applications, loads backed up by the inverter will need to be rerouted from the main AC distribution panel to a subpanel. In off-grid application, the inverter panel functions as the main electrical panel. Always use properly rated circuit breakers.

WARNING: Fire Hazard

Check existing structure wiring for "multi-branch wiring". For new construction, do not use "multi-branch wiring".
For both cases refer to Appendix F, "Multi-wire Branch Circuit Wiring" for additional information.

Fuses and/or DC disconnects

Install a DC disconnect breaker or fuse in the positive, ungrounded, battery line. This breaker protects the DC wiring in the event of an accidental short. Size the breaker in accordance with the battery cables. Switch this breaker OFF (or remove the fuse) whenever servicing the batteries or inverter(s).

Note: A fuse without a switchable disconnect alone does not meet NEC/CEC code.

Wire size for AC connections

A minimum of #6 AWG THHN wire is recommended for all AC wiring (input and output).

Wiring scenarios

Determine all wire routes both to and from the inverter and which knockouts are best suited for connecting the AC conduits. Possible routing scenarios include the following.

- AC and DC grounds to an external ground rod
- AC input wiring from the main service panel to the inverter/charger (on-grid applications only)
- AC input wiring from the generator to the inverter/charger (if used)
- AC output wiring from the inverter/charger to the subpanel
- DC input wiring from the PV array to the controller/batteries
- DC input wiring from the batteries to the inverter/charger
- BTS cable from the batteries to the inverter/charger (keep separate from battery cables)
- Remote ICM cable to the inverter/charger (if used)
- Load circuit wiring rerouted from the main service panel to the subpanel (on-grid applications only)

Important: Check for existing electrical wiring or plumbing prior to making cuts in the walls. Cut holes in the walls at appropriate locations for routing wiring/cables.

Generator Considerations

Important: The information contained in this guide is basic wiring information which can aid the generator manufacturer or electrician in assisting with your installation. Xantrex is not responsible for providing detailed technical support or wiring instructions for generator operation.

Purpose

An engine generator can be used as follows:

- as an input power source instead of (or in conjunction with) the utility power
- as a backup power source (connected with additional hardware) to automatically power the loads when utility is not present (utility outage)
- as a means to charge the batteries.

Stable Voltage

The generator should provide a stable voltage and frequency output for the inverter to synchronize with.

AC wind turbines and small scale AC water turbines are not recommended for use as AC power sources as they may not be able to provide a stable voltage and frequency as loads and charger requirements change. The only way to practically use sources such as these is to take the AC power and rectify it into DC. Be sure to include a diversion type controller (e.g., Xantrex C-Series) to protect the batteries from overcharging.

Types of Generators

There are AC generators and DC generators.

AC Generators

AC generators can power AC loads and charge batteries. An AC generator is better suited for residential applications, since the majority of loads require AC power.

DC Generators

DC generators can power DC loads and charge batteries. In a residential application, DC generators are primarily used to charge the batteries.

Output Requirements

An AC generator can output 120 Vac only, 120 Vac and 240 Vac together, or 240 Vac only depending on the overall needs of the system. The generator must be large enough to provide adequate power to charge the batteries and support a certain amount of AC loads. If the generator is not large enough, the amount of time it takes the inverter to charge the batteries will increase.

A DC generator is used primarily to charge the batteries. AC loads are only powered by the energy stored in the batteries. The generator must be large enough to provide adequate power to charge the batteries.

Generator start types

Starting types

Generators can either be manually started, or when properly equipped, automatically started. The Sine Wave Plus can operate well with either kind of generator. It is recommended, however, to consult the desired generator's manufacturer to ensure the generator of choice is best suited for the desired application.

Manual-start and electric-start generators

When using a manual-start or electric-start generator, the generator is connected to the inverter AC2 input but is not controlled by the inverter. The starting and stopping of the generator occurs at the generator. Manual-start generators are started with a recoil-start pull cord. Electric-start generators are started by turning an ignition/starter key, switch, or similar means.

Manual-start and electric-start generators typically do not have self-protection features to shut down the generator in the event of low oil pressure, over-heating, overcranking, etc., and, therefore, are not designed for unattended starting and operation.

If using a manual-start or electric start generator, be sure that the generator is located where it can be easily accessed to be started.

Auto-start generators

When using an auto-start generator, the generator is connected to the inverter AC2 input. The inverter controls the operation of the generator with the assistance of the optional GSM. Auto-start generators are equipped with terminals for signal wires to be routed and connected to a remote switch/relay (a "dry contact") to signal the generator to run and/or stop.

Auto-start generators are equipped with self-protection features to disable starting and/or to shut down a generator in the event of low oil pressure, over-heating, overcranking, etc. When generators are equipped with these protection features, they are designed for unattended starting and operation and may be compatible with the Sine Wave Plus with the optional GSM.

Be sure to locate an auto-start generator in a place protected from extremes of temperature so it can successfully start and operate without assistance.

Important: The automatic generator start feature of the Sine Wave Plus can only function on generators equipped with two- or three-wire auto-start operation. Most auto-start generators have this feature. Check with your generator supplier and make sure this feature is available. Additional hardware may be required.

Starting requirements

The generator can be set to start based on four different, user-specified, scenarios with different requirements for each:

- battery voltage
- inverter load current
- time of day
- exercise time

If used with an application that includes utility power, the generator will be started only if utility power is not available, as it is not possible to use both generator and utility power at the same time (except for the scheduled exercise time).

It is safe for both the utility and generator inputs to be energized at the same time, although the inverter can only take power from one source at any given time.

See “Generator Starting Scenarios” on page 7–23 of this guide for specific instructions on setting the generator-start/stop conditions.

Additional/Optional Equipment Considerations

The following components are available for use with the Sine Wave Plus. Some of these items may be required depending upon the intended use of the inverter to make the installation code-compliant. These components are not provided with the inverter and must be purchased separately.

Important: Be sure to consult with your local inspector and/or utility company to ensure complete compliance with local regulations.

AC Conduit Box (ACCB)

The AC Conduit Box (ACCB) connects to the AC side of the inverter and accepts AC conduit runs. The AC conduit box includes bypass/disconnect breakers.

Figure 2-3 AC Conduit Box

DC Conduit Box (DCCB)

The DC Conduit Box (DCCB) connects to the DC side of the inverter and accepts DC conduit runs.

Figure 2-4 DC Conduit Box

Figure 2-5 Sine Wave Plus with AC and DC Conduit Boxes Installed

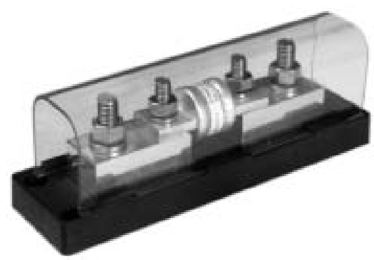
Fuse Block

The Xantrex fuse block (TFBxxx) protects the power system's DC wiring should an overcurrent condition occur. The fuse block is placed between the battery's ungrounded conductor (usually the positive cable) and the DC input terminal of the inverter.

The fuse block includes a fast acting, current limiting class-T fuse providing extremely fast protection when a short circuit occurs. When the fuse is properly matched to the system current, its time delay allows the inverter to surge to full power without blowing the fuse. A plastic cover prevents accidental short circuits to the fuse terminals. Fuse sizes include 110, 200, 300, and 400 amps.

There are two types of fuse blocks available. The TFBxxxC fuse block has "set" screw lugs for cables with no terminal connector's on the ends (known as C-type or stripped-end battery cables). The TFBxxx fuse block has stainless steel bolt connections for cables with ring terminals (known as ring-lugged battery cables). Both fuse blocks include a black poly carbonate, fiberglass reinforced base and a clear poly carbonate snap-on cover.

Fuse Block for C-type (stripped end) Battery Cables (TFBxxxC)



Fuse Block for Ring-lugged Battery Cables (TFBxxx)

Figure 2-6 Fuse Blocks

DC Disconnect Boxes (DC175/DC250)

Xantrex provides two options for disconnect boxes. The DC175 and DC250 protects your batteries, inverter, and DC cables from damage caused by short circuits and overloads through use of a UL listed, high interruption capacity circuit breaker. This breaker is designed to interrupt the tremendous amount of power a battery can deliver when short circuited. It is also designed to have a long enough time delay to allow the inverter to surge to full power without nuisance tripping of the breaker. If the breaker does trip, it's easily reset.

Battery Status Meter (TM500A)

The TM500A features six data monitoring functions and three indicators including:

- State-of-charge/amp-hour content (full or percent of capacity)
- State-of-charge/voltage (real-time voltage level, historical high and low system voltage)
- Amps (real-time amps, total charging amps, total load amps)
- Amp hours removed
- Days since fully charged
- Cumulative amp hours
- Recharge indicator
- Low-voltage indicator
- Full-charge indicator

The unit is configurable for specific system or application functions such as setting the CHARGED indication parameters, battery capacity, charging efficiency, low-battery warning conditions and a recharge reminder. The TM500A can monitor any battery supply from approximately 8 to 65 volts, track energy consumption, and estimate remaining battery life.

The TM500A operates on 12-, 24-, or 48-volt battery systems (48-volt systems require an optional shunt board).

Figure 2-7 DC250 Disconnect Box and TM500A Battery Status Meter

Remote Monitors

Three options are available for remote control and monitoring.

- Use a remote ICM, which is identical to the inverter control module display on the inverter, for distances of 25 or 50 feet (7.5 or 15 meters).
- Use a personal computer to monitor system status using an optional ICA (for distances up to 50 feet/15 meters). The ICA can be used with cables up to 500 feet (152.4 meters). These longer cables, however, are not provided by Xantrex.
- Use a personal computer off-site to monitor the system using an external modem at the inverter site and the ICA.

Note: The ICM and the ICA use the same input port on the inverter. Both of these options cannot be used at the same time.

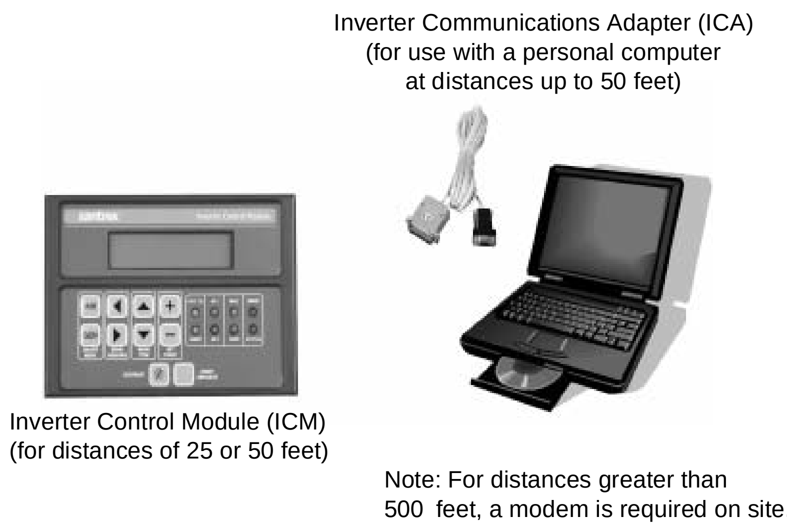


Figure 2-8 Accessories for Remote Monitoring

CAUTION: Damage to Equipment

Never connect a grounded PC to the Remote Port if the inverter is configured in a positive ground arrangement. Connecting a grounded PC to this port (in this configuration) will damage both the PC and the inverter. Xantrex will not cover damages to the PC or honor warranty claims on the inverter under these circumstances.

Inverter Control Module (ICM)

The remote ICM allows control, monitoring, and adjustment of all inverter settings from a location other than the ICM display on the front of the inverter. The remote ICM comes with cables in lengths of 25 feet (7.5 meters) or 50 feet (15 meters). The remote ICM duplicates all the functions and controls of the ICM display on the front panel of the unit.

For distances greater than 50 feet (15 meters), see the Inverter Communications Adapter (ICA).

Figure 2-9 Inverter Control Module

Inverter Communications Adapter (ICA)

The ICA allows the inverter to be connected directly to a PC for monitoring and adjustment. The ICA comes with a 50-foot cable. The ICA can also be used up to 500 feet away, but additional cabling will be needed and Xantrex does not provide longer cables at this time. It may also be operated remotely with the addition of a modem at the inverter site.

Figure 2-10 Inverter Communications Adapter

CAUTION: Damage to PC

Do not connect a PC to the inverter when it is configured in a positive ground system. Damage to the PC and the inverter may occur which is not covered under warranty.

Generator Start Module (GSM)

The GSM is an accessory that enables the inverter to start and stop generators equipped with auto-start features.

Figure 2-11 Generator Start Module

See “Generator Considerations” on page 2–19, for information on using generators and Appendix D, “Generators” for additional information regarding generator types.

Auxiliary Load Module (ALM)

The ALM is an accessory that enables the inverter to start and stop auxiliary loads such as alarms, water pumps, or ventilation fans.

Figure 2-12 Auxiliary Load Module

See “Auxiliary Load Module (ALM)” on page 3–42 for additional information regarding connecting the Auxiliary Load Module to the inverter.

240 Vac Application Requirements

There are two options available for creating 240 Vac output using a 120 Vac inverter:

- using an autotransformer to step-up or step-down the voltage, or
- stacking two identical inverters.

Autotransformer for 240 VAC Applications (T240)

The T240 allows a single inverter to increase it's output voltage from 120 volts to 240 volts or it will take 240 Vac from a generator and "step-down" the voltage to 120 Vac for the single inverter. For step-up and step-down functions, two T240s will be required.

A T240 Autotransformer can optimize the generator output of smaller generators (≤ 3.9 kW) and improves charging time.

Figure 2-13 T240 Autotransformer

Inverter Stacking Control – Series (ISC-S) Cable

The ISC-S cable is a special communications cable that allows two Sine Wave Plus inverters to be connected together in "series" to provide power to both 120 Vac loads and 240 Vac loads.

See the ISC-S Owner's Guide for more information on stacked inverter applications.

Figure 2-14 ISC-S Cable

Renewable Energy DC Input Sources

Renewable energy (RE) sources (for example, photovoltaic (PV) arrays, wind turbines, DC micro-hydro generators) can be used with the inverter to provide power for all applications—off grid and on grid. However, in addition to the actual RE equipment being used, other items may be needed to ensure safety in the overall system, such as charge controllers, diversion load controllers, and/or PV ground fault protection.

Important: Be sure to consult your authorized dealer and all local/national electric codes to determine what additional equipment may be required for your installation.

Important: Installations of this equipment should only be performed by skilled personnel such as qualified electricians and Certified Renewable Energy (RE) System Installers. For a list of Xantrex Certified RE dealers, please visit our website at www.XantrexREdealers.com.

Note: The “charger” built into the Sine Wave Plus is only for AC power connected to either of the AC inputs on the inverter/charger. The Sine Wave Plus cannot control or regulate DC voltages from DC sources. DC charge controllers must be used for all DC sources such as PV arrays, wind turbines, and water turbines.

Charge controller

A charge controller must be used to regulate the charge supplied to the batteries and prevents over-charging (or high battery conditions). A charge controller prevents the batteries from exceeding a user-specified voltage level. This preserves and extends the life of the battery by preventing the damage caused by over-charging. The charge controller can also take over the functions of bulk and equalize charging.

Diversion load control

Wind turbines and hydro-electric generators may be damaged if the DC loads are suddenly removed from them. This can happen if the DC disconnect should open (trip) or the batteries are fully charged and no other DC loads are connected in the system. A diversion load controller prevents damage to the generator system by diverting the power from the generator to a diversion load device. This keeps a load on the generator and controls over-spin if the batteries should be disconnected. Refer to the controller manual for proper types of diversion load devices.

Figure 2-15 Xantrex C-Series Charge Controllers

PVGFP

The PV Ground Fault Protection (PVGFP) is designed to minimize the possibility of a fire resulting from ground faults in a PV array (in accordance with NEC/CEC for rooftop-mounted PV systems on dwellings). It is not designed or intended to prevent electrical shock or to be used for PV DC overcurrent.

Figure 2-16 PV Ground Fault Protection (PVGFP)

Off-Grid Applications

The Sine Wave Plus can be used as a primary source of AC power to support off-grid, stand-alone systems where no utility power is available. Sine Wave Plus applications in an off-grid situation include:

- renewable energy systems (with or without generator backup), and
- generator-only systems
- inverter only systems (charger in the inverter/charger is not used, but batteries are maintained by an external DC charger).

Renewable Energy Systems with/without Generator Backup

In this configuration, the main power is generated by renewable energy sources, such as solar, wind, micro-hydro or some other form of a regulated DC charging source, and is stored in a battery bank. The Sine Wave Plus will operate all AC loads from the power stored in this battery bank.

In the event that renewable energy sources are insufficient to power the required loads or keep the batteries charged, a generator can be used to supplement the system.

Single-Inverter Configurations (120 Vac)

If only 120 Vac output is required from the system, a single inverter is adequate to provide the required power, depending on the wattage (output) requirements of the total system.

Single-Inverter Configurations (120/240 Vac)

If 240 Vac output is required from the system and the total of the loads does not exceed the wattage output of the inverter, a step-up autotransformer can be added to the output of the system to increase the voltage output.

See Appendix F, “Multi-wire Branch Circuit Wiring”, for more information on using single inverters with multi-wire branch circuits.

See Figure 2-17 for an example of both configurations (120 Vac and 240 Vac output) with all optional equipment. Disregard any part of this illustration that does not apply to the components being installed. For purposes of this publication, the main breaker (utility) panel is referred to as the “inverter AC distribution panel” or simply “inverter panel”.

NOTES:

1. Always refer to your local electric codes for proper wiring instructions.
2. For purposes of this illustration, the ground for the AC generator is run through the inverter.
3. Separate grounding runs are shown in this illustration to demonstrate a single point ground.
4. If using a PC to monitor the system, the Xantrex ICA is required. If using a PC to monitor from off-site, an external modem is required at the inverter site.
5. Ensure all the DC negatives in the system are bonded to earth ground in only one place (single point bond). If you are using a PVGFP, allow this single “DC Negative to earth ground bond” to be provided through the PVGVP.
6. If this is not a separately derived system (per the NEC), the AC neutrals should be bonded to earth ground in only one place.

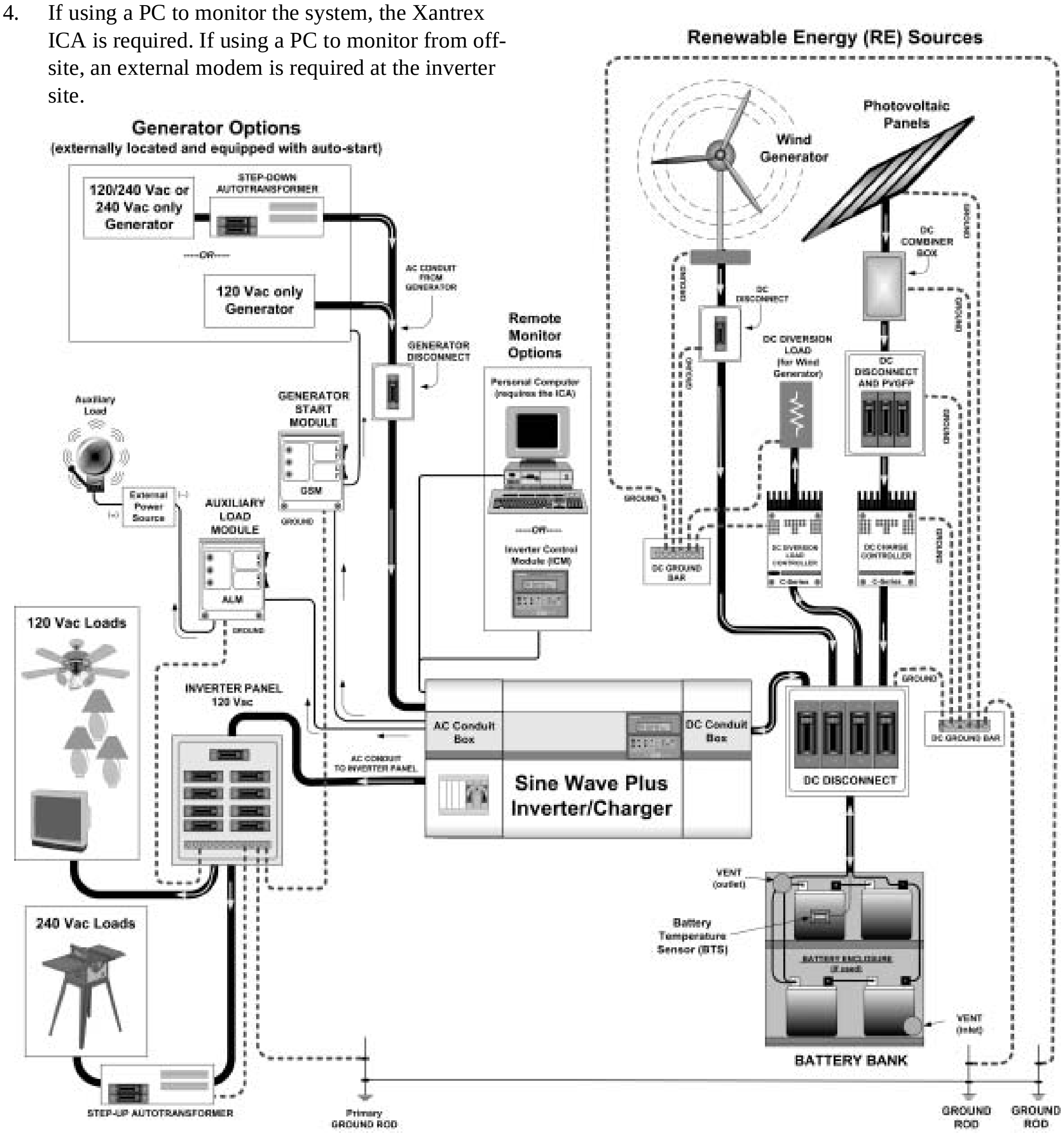


Figure 2-17 Off-Grid Application – Renewable Energy System using a Single Inverter

Dual-Inverter Configurations (240 Vac)

If 240 Vac power is required and the wattage required exceeds the wattage output of a single inverter, it may be necessary to add a second inverter. Two inverters can be “series” stacked to provide both 120 Vac and 240 Vac, 60 Hz, power to the AC loads.

Note: Series-stacking inverters require the use of the ISC-S cable. This interface cable is connected to the series stacking port of the inverters (see “Inverter Stacking Control – Series (ISC-S) Cable” on page 2–29).

Series stacking is an excellent choice for providing power to multi-wire branch circuits where single (120 Vac) inverters may require extensive rewiring within the building.

See Figure 2-18 for an example of this configuration with all options shown. Disregard any part of this illustration that does not apply to the system configuration being installed.

NOTES:

1. Always refer to your local electric codes for proper wiring instructions.
2. For purposes of this illustration, the ground for the AC generator is run through the inverter.
3. Separate grounding runs are shown in this illustration to demonstrate a single point ground.
4. If using a PC to monitor the system, the Xantrex ICA is required. If using a PC to monitor from off-site, an external modem is required at the inverter site.
5. Ensure all the DC negatives in the system are bonded to earth ground in only one place (single point bond). If you are using a PVGFP, allow this single “DC Negative to earth ground bond” to be provided through the PVGVP.
6. If this is not a separately derived system (per the NEC), the AC neutrals should be bonded to earth ground in only one place.

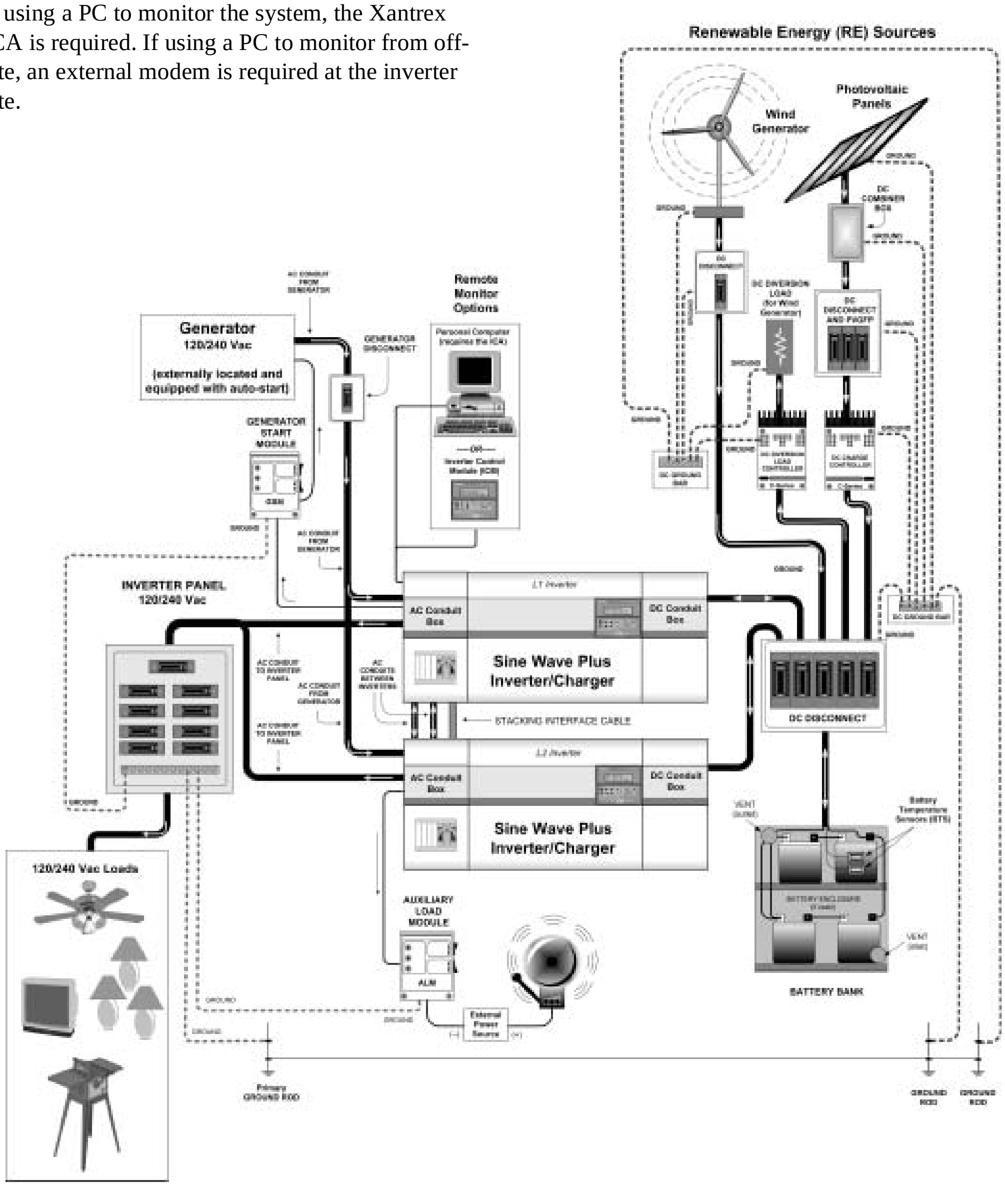


Figure 2-18 Off-Grid Application – Renewable Energy System using Dual Inverters

Generator-Only Systems

In these applications, an AC generator serves as the main AC source when batteries are insufficient to power the loads. Both an AC and a DC generator can provide a power source for the battery charger. With the aid of the Xantrex Generator Start Module (GSM), the Sine Wave Plus can turn on automatically most remote-starting generators, on demand.

See “Generator Considerations” on page 2–19 and Appendix D, “Generators” for additional information regarding using generators for system input.

Single-Inverter Configurations

A single-inverter system is usually adequate to power most 120 Vac loads. If 240 Vac is required from the system and doesn’t exceed the wattage output of a single inverter, a step-up autotransformer can be added to the output of the system to increase the voltage output.

See Figure 2-19 for an illustration of a 120 Vac generator-only system using a single inverter. Disregard any part of this illustration that does not apply to the system configuration being installed.

NOTES:

1. Always refer to your local electric codes for proper wiring instructions.
2. For purposes of this illustration, the ground for the AC generator is run through the inverter.
3. Separate grounding runs are shown in this illustration to demonstrate a single point ground.
4. If using a PC to monitor the system, the Xantrex ICA is required. If using a PC to monitor from off-site, an external modem is required at the inverter site.
5. Ensure all the DC negatives in the system are bonded to earth ground in only one place (single point bond). If you are using a PVGFP, allow this single “DC Negative to earth ground bond” to be provided through the PVGVP.
6. If this is not a separately derived system (per the NEC), the AC neutrals should be bonded to earth ground in only one place.

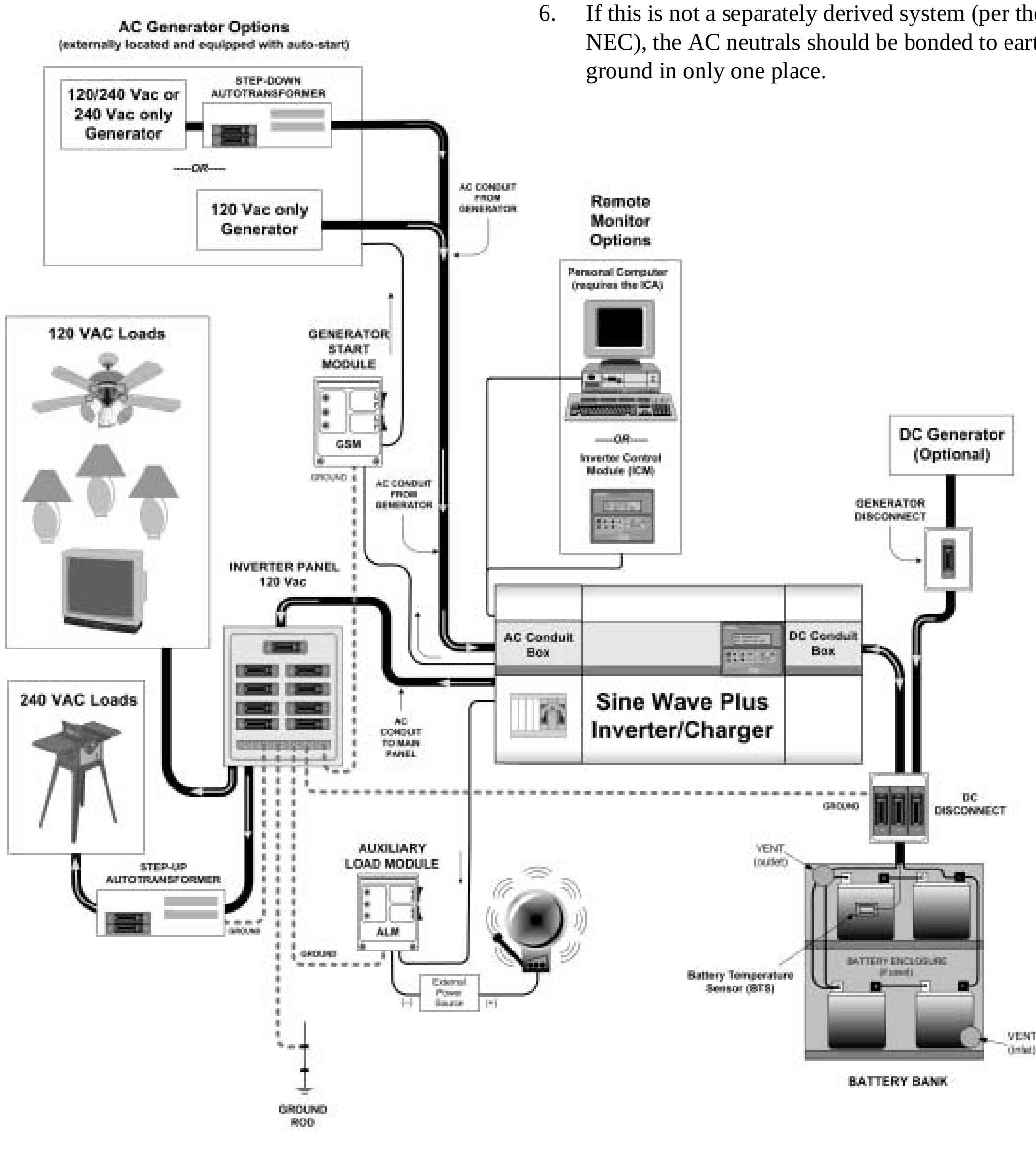


Figure 2-19 Off Grid Application - Generator-only System using a Single Inverter

Dual-Inverter Configurations

If 240 Vac power is required and the wattage required exceeds the wattage output of a single inverter, it may be necessary to add a second inverter. Two inverters can be “series” stacked to provide both 120 Vac and 240 Vac, 60 Hz, power to the AC loads.

Note: Series-stacking inverters require the use of the ISC-S cable. This interface cable is connected to the series stacking port of the inverters (see “Inverter Stacking Control – Series (ISC-S) Cable” on page 2–29).

Series stacking is an excellent choice for providing power to multi-wire branch circuits where single (120 Vac) inverters may require extensive rewiring within the building.

See Appendix F, “Multi-wire Branch Circuit Wiring” for information on identifying and correcting multi-wire branch circuit wiring.

See Figure 2-20 for an illustration of a 240 Vac Generator-Only System using dual inverters

240 Vac-only Input Source

Important: When using a 240 Vac-only input source (with a L1 and L2 connection but no neutral) with a dual-inverter configuration, a neutral connection needs to be provided from the 240 Vac source to the inverter’s common neutral.

NOTES:

1. Always refer to your local electric codes for proper wiring instructions.
2. For purposes of this illustration, the ground for the AC generator is run through the inverter.
3. Separate grounding runs are shown in this illustration to demonstrate a single point ground.
4. If using a PC to monitor the system, the Xantrex ICA is required. If using a PC to monitor from off-site, an external modem is required at the inverter site.
5. Ensure all the DC negatives in the system are bonded to earth ground in only one place (single point bond). If you are using a PVGFP, allow this single "DC Negative to earth ground bond" to be provided through the PVGVP.
6. If this is not a separately derived system (per the NEC), the AC neutrals should be bonded to earth ground in only one place.

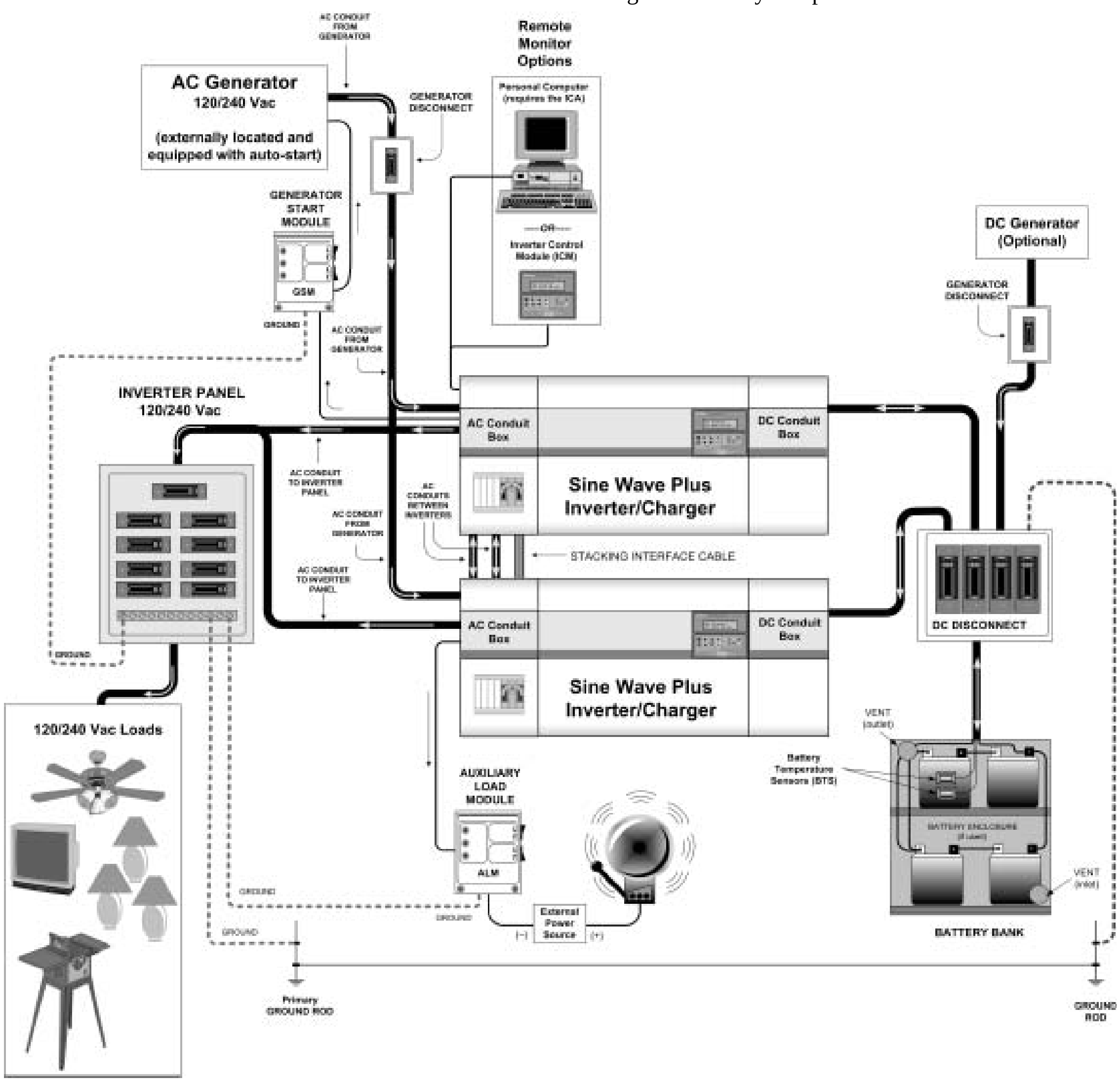


Figure 2-20 Off Grid Application – Generator-only System using Dual Inverters, Series-stacked

On-Grid Applications

The Sine Wave Plus can be combined with utility power to provide backup power in the event of a primary power source failure. It can use utility power to backup renewable energy systems. It can use renewable energy and/or a generator to backup utility grid power. It can be used as an energy management tool to optimize energy consumption.

Backup Systems

Renewable Energy Backup (BX Mode)
This configuration uses renewable energy sources as the primary source of power to operate the AC loads and grid power as an automatic backup source.

Utility Backup (SB Mode)
In this configuration, the utility grid is the main source of power. The energy stored in the batteries only provide backup power in the event of a grid failure. Batteries can be charged by the utility grid when available, RE sources, or with a backup generator.

Single-Inverter Configurations (120 Vac)

If only 120 Vac output is required from the system, a single inverter is adequate to provide the required power, depending on the wattage requirements of the total system.

See Appendix F, “Multi-wire Branch Circuit Wiring”, for information on multi-wire branch circuits.

Single-Inverter Configurations (240 Vac)

If 240 Vac output is required from the system and the total of the loads does not exceed the wattage output of the inverter, a step-up autotransformer can be added to the output of the system to increase the voltage output.

See Figure 2-21 for an example of a single inverter configuration for either 120 Vac or 120/240 Vac output. Disregard any part of this illustration that does not apply to the system configuration being installed.

NOTES:

1. Always refer to your local electric codes for proper wiring instructions.
2. For purposes of this illustration, the ground for the AC generator is run through the inverter.
3. Separate grounding runs are shown in this illustration to demonstrate a single point ground.
4. If using a PC to monitor the system, the Xantrex ICA is required. If using a PC to monitor from off-site, an external modem is required at the inverter site.
5. Ensure all the DC negatives in the system are bonded to earth ground in only one place (single point bond). If you are using a PVGFP, allow this single "DC Negative to earth ground bond" to be provided through the PVGVP.
6. If this is not a separately derived system (per the NEC), the AC neutrals should be bonded to earth ground in only one place.

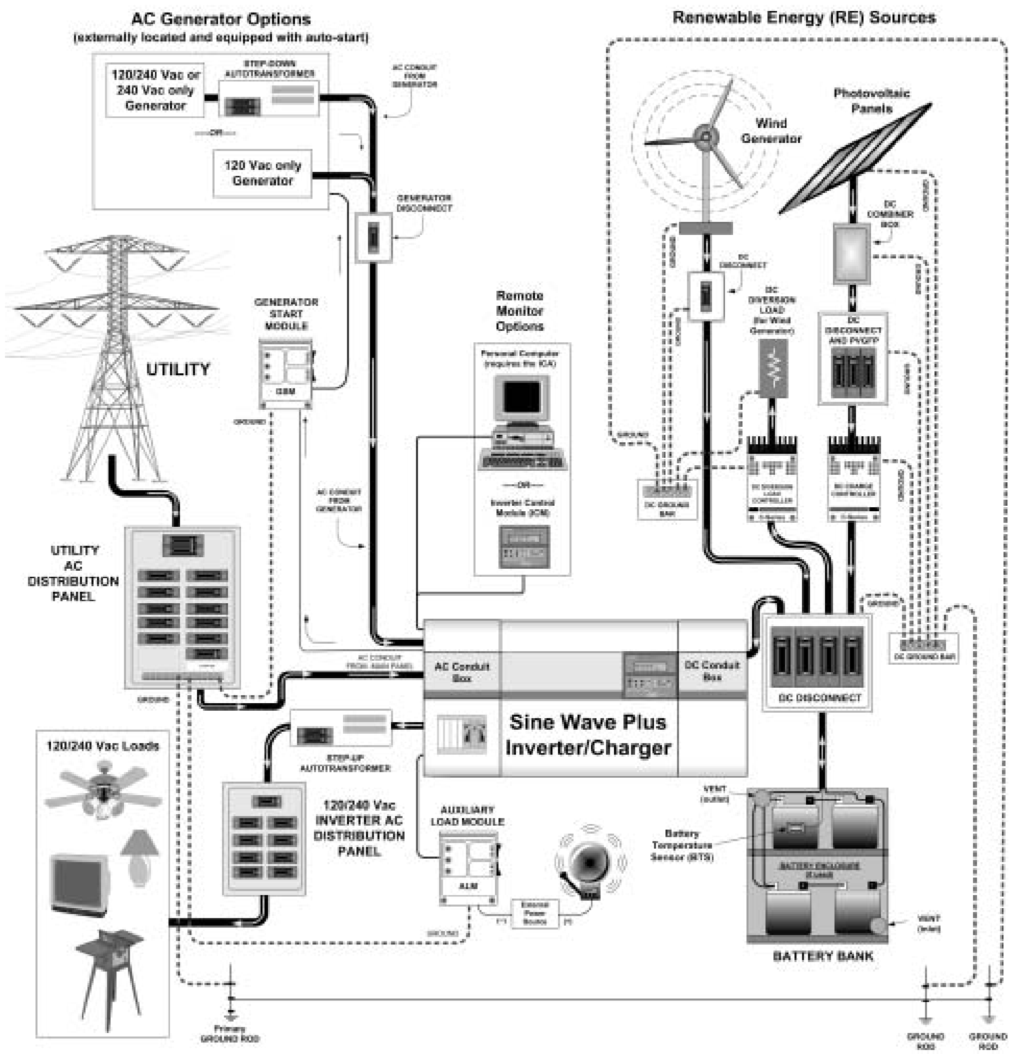


Figure 2-21 On-Grid Application – Backup System using a Single Inverter

Dual-Inverter Configurations (240 Vac)

If 240 Vac power is required and the wattage required exceeds the wattage output of a single inverter, it may be necessary to add a second inverter. Two inverters can be “series” stacked to provide both 120 Vac and 240 Vac, 60 Hz, power to the AC loads.

Note: Series-stacking inverters require the use of the ISC-S cable. This interface cable is connected to the series stacking port of the inverters (see “Inverter Stacking Control – Series (ISC-S) Cable” on page 2–29).

Series stacking is an excellent choice for providing power to multi-wire branch circuits where stand-alone (120 Vac) inverters may require extensive rewiring within the building.

See Appendix F, “Multi-wire Branch Circuit Wiring” regarding multi-wire branch circuits.

See Figure 2-22 for an example of this configuration showing all the optional equipment. Disregard any part of this illustration that does not apply to the system configuration being installed.

NOTES:

1. Always refer to your local electric codes for proper wiring instructions.
2. For purposes of this illustration, the ground for the AC generator is run through the inverter.
3. Separate grounding runs are shown in this illustration to demonstrate a single point ground.
4. If using a PC to monitor the system, the Xantrex ICA is required. If using a PC to monitor from off-site, an external modem is required at the inverter site.
5. Ensure all the DC negatives in the system are bonded to earth ground in only one place (single point bond). If you are using a PVGFP, allow this single “DC Negative to earth ground bond” to be provided through the PVGVP.
6. If this is not a separately derived system (per the NEC), the AC neutrals should be bonded to earth ground in only one place.

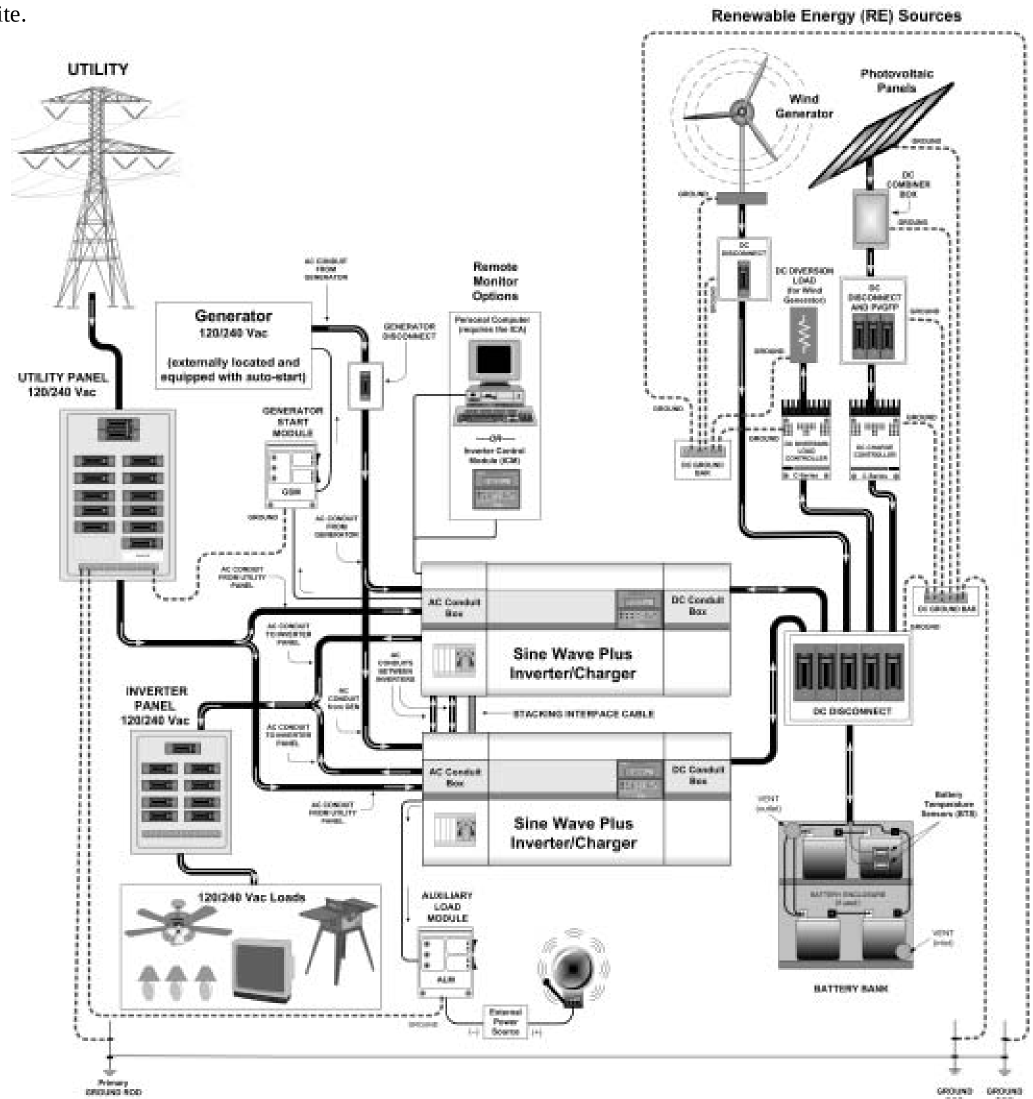


Figure 2-22 On-Grid Application – Backup System using Dual Inverters, Series-stacked

Energy Management

The Sine Wave Plus can be programmed to control how and when to use utility power. Advanced features allow for peak load management and time-of-use billing. Utility management features also allow the Sine Wave Plus to use renewable energy sources on a first priority basis and only use utility power if renewable energy is insufficient or unavailable to power the loads.

See “21 Grid (AC1) Usage Menu” on page 7–16 for more information about programming these applications.

RE Backup with Utility (SB Mode)

In Standby (SB) Mode, the Sine Wave Plus will automatically use power from the DC source, generated by the RE source, over grid power even when the inverter shows it is “charging” from the grid. When there is excess DC power from the RE source, the inverter will automatically reduce the current draw from the grid and power the loads from RE generated power. During a time when loads exceed what the RE can provide, the inverter will automatically bring in enough AC power from the grid to power the loads.

See “SB (Standby) - Utility Backup” on page 7–17 for instructions for setting these parameters.

Peak Load Management

Many utilities impose a surcharge on their customers based on the peak load used by a facility. To reduce utility peak demand charges, the inverter can be configured to limit the maximum draw the AC loads place on the utility. The inverter can be programmed to provide power above a specified level, eliminating the surcharge. When the utility current draw reaches the maximum level, the inverter assists by providing battery powered AC to the loads.

See “13A Grid (AC1) Amps AC” on page 6–27 for instructions for setting these parameters.

For Peak Load Shaving to be effective, all loads must be connected to the inverter. For large loads, multiple (or stacked) inverters may be required.

To further ensure the batteries are able to supplement the power requirements of the connected load, an additional source of power (solar, wind or hydroelectric) is recommended.

Peak Load Shaving can also be used in addition to the Time-of-Use (TOU) metering.

Time-of-Use (TOU) Metering

Utilities use TOU metering to determine utility charges during peak usage hours and to impose a surcharge. The inverter can be configured to overcome these peak charges by using a battery (or battery bank) to store energy during the inexpensive energy hours and consumes the battery energy during expensive energy hours.

When in this mode, the inverter is programmed to only use utility power during user-specified times during the day. This helps the consumer take advantage of lower utility rates by using power from the battery bank during times that utility power is most expensive.

See “21 Grid (AC1) Usage Menu” on page 7–16 for instructions for setting these parameters.

Energy management determines when utility power is used. Start and Stop times are programmed into Menu Items 21B and 21C depending on when you want the inverter to use utility power.

In the example below, Figure 2-23 shows the inverter disconnects from the utility grid at 6:00 PM and supports the connected load from batteries. It continues to run until 9:00 PM. It then reconnects to the utility grid, passing AC through to the connected load, and begins maintaining the batteries based on the battery charger settings in the Basic Setup Menu (Float or Silent).

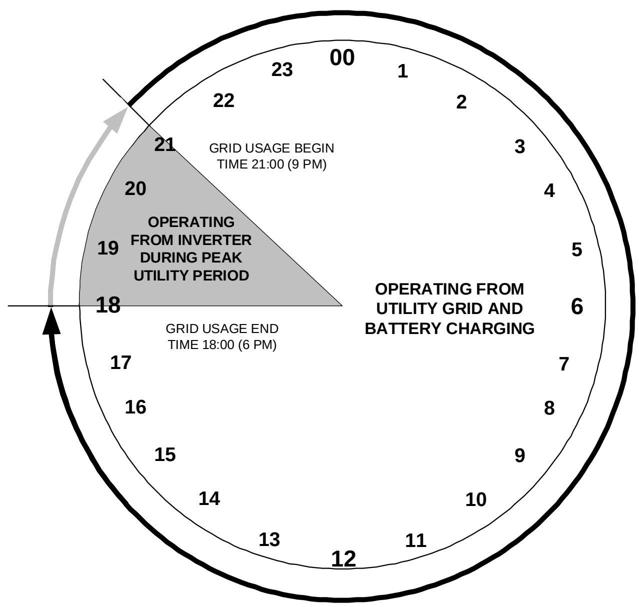


Figure 2-23 Time-of-Use Metering

When using the system for TOU metering, the system should be designed with a battery capacity large enough to support the load during the entire peak rate period without reaching the **11C Low Battery Cut Out VDC** voltage.

To further ensure the batteries are able to support the load, an additional source of power (solar, wind or hydroelectric) is recommended. Depending upon the capacity of the system, certain heavy loads should only be run during non-peak periods.

Note: In the event the batteries reach their **11C Low Battery Cut Out VDC** voltage, the inverter will automatically reconnect to the utility grid to maintain the connected load.

Note: TOU Mode is usually used in conjunction with a renewable energy system. Often these systems will provide their peak output at the high billing times. Battery power used to supplement the renewable energy used during peak times is replenished during non-peak times.

AC Load Support

This feature allows power to be automatically drawn from the batteries to assist either the utility grid or an AC generator support heavy loads (i.e., loads that exceed the available current from either the generator or the utility grid). When the grid or generator requires additional AC current to support the loads, current is drawn from the batteries.

Generators have a limited output current and it is possible to reach this limit when operating heavy loads. The Sine Wave Plus is designed to assist the generator when heavy current demands load down the generator by supplying additional power from the batteries. In this way, the generator can operate loads heavier than it would otherwise be capable of running. When the inverter is in this mode, the batteries are not charging even though the LED indicators on the inverter may indicate the charge mode is on.

In addition, the battery charger can back off its charging current to the batteries so the combined load of the charger and load support does not load down the generator or trip its output breakers or fuses.

AC support parameters are controlled by the **13A Grid (AC1) Amps AC** and or **13B Gen (AC2) Amps AC** depending on the application.

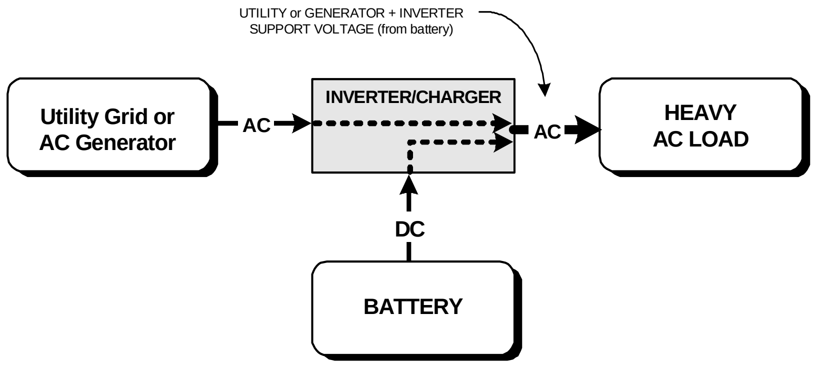


Figure 2-24 AC Support Mode

Note: Running and Start-up (Peak) currents are limited to the maximum current limits of the inverter.

Note: In the AC support ModeMode, the BULK or FLOAT charge indicator LEDs may be ON even though the batteries are draining. Use the **04 Meters Menu** heading and **04C INV/CHR Amps AC** menu item to view the actual amperage. A negative reading indicates the inverter is supporting the generator from the batteries.

See “21 Grid (AC1) Usage Menu” on page 7–16 for instructions on setting these parameters.

Renewable Energy with Grid Backup (BX Mode)

To have the inverter operate independently of the grid but use the grid in times of low battery voltage, the inverter can be set up in the "BX" Mode.

In this mode, the inverter powers the AC loads using the RE sources and only uses AC power from the grid to run the loads when the battery voltage drops below user-specified levels.

When the batteries have recharged to a specified voltage by the renewable energy sources, the inverter transfers from the utility grid to inverter supplied AC power.

See “22 Battery Xfer (BX) Menu” on page 7–18 for instructions for setting these parameters.

3 Installation

Chapter 3, "Installation" describes how to mount and install the Sine Wave Plus Inverter/Charger and perform wiring and cabling procedures for various configurations.

Pre-Installation

Before installing the Sine Wave Plus, read all instructions and cautionary markings located in this manual.

Important: Be sure to obtain the appropriate permits, if necessary, prior to starting this installation.

Important: *Installations should meet all local codes and standards.* Installations of this equipment should only be performed by skilled personnel such as qualified electricians and Certified Renewable Energy (RE) System Installers. For a list of Xantrex Certified RE dealers, please visit our website at www.XantrexREdealers.com.

WARNING: Personal Injury

The Sine Wave Plus is can weight up to 145 lbs. Always use proper lifting techniques and have someone available to assist with lifting it during installation to prevent personal injury.

Although the DC electrical system may be “low voltage”, significant hazards may still be present, particularly from short-circuits of the battery system. Inverter systems, by their nature, involve power from multiple sources (inverter, generator, utility, batteries, solar arrays, etc.) that add hazards and complexity that can be very challenging.

Tools Required

The following tools may be required for installing this equipment:

- ❐ Assorted Phillips screw drivers
- ❐ Level, pencil, and utility knife
- ❐ Slotted screw driver
- ❐ Wire strippers
- ❐ Assorted open-end wrenches
- ❐ Torque wrench
- ❐ Socket wrench and sockets
- ❐ Electrical tape
- ❐ Multi-meter (AC/DC volts)

Hardware / Materials Required

The following materials may be required for completing this installation.

- ❒ 4' x 8' sheet of ¾" plywood for mounting
- ❒ 2 x 4 boards for mounting
- ❒ #10 and/or #12 wood screws (or ½" x 1¼" lag bolts)
- ❒ Conduits and appropriate fittings for wire runs (e.g., wire nuts)
- ❒ Electrical wire of appropriate size and length
- ❒ Battery cable lugs (depending on types of battery cables used)
- ❒ Breaker panels
- ❒ Ground busses, bars, bonding blocks, and/or rods

Optional System Accessories

The following optional system accessories can be used in the installation of the Sine Wave Plus. These accessories are available from any authorized Xantrex dealer. Consult with your local system designer to determine what optional equipment will be needed for your specific installation.

Conduit boxes:

- ❒ ACCB with input/output/bypass breakers
- ❒ DCCB

Battery cables:

- ❒ BC1.5 (Single) Battery Interconnects
- ❒ BC2/0 AWG (Pair), available in 5 and 10 foot lengths
- ❒ BC4/0 AWG (Pair), available in 5, 10, and 15 foot lengths

DC disconnects and fuses:

- ❒ DC175 (175 Amp DC Disconnect with Bonding Bar)
- ❒ DC250 (250 Amp DC Disconnect with Bonding Bar)
- ❒ TFB 200 (200 Amp Class-T Fuse)
- ❒ TFB 300 (300 Amp Class-T Fuse)
- ❒ TFB 400 (400 Amp Class-T Fuse)
- ❒ PV Ground Fault Projection (PVGFP1, PVGFP2, PVGFP3, PVGFP4)

Remote monitors:

- ❒ ICM/25 (Inverter Control Module with 25 foot cable connection)
- ❒ ICM/50 (Inverter Control Module with 50 foot cable connection)
- ❒ ICA (Inverter Communications Adapter with 50 foot cable), for use with your computer. (Can be used with a modem on site. A modem is required for distances greater than 50 feet.)

Other accessories which might be required:

- ❒ Generator Start Module (GSM)
- ❒ Auxiliary Load Module (ALM)
- ❒ C-Series Charge Controllers (C35, C40, C60)
- ❒ TM500A Battery Status Meter
- ❒ ISC-S Cable

Battery Bank Preparation

Important: The inverter is not reverse polarity protected. Reversing the battery polarity on the DC input connections will cause permanent damage to the inverter which is not covered under warranty. Always check polarity BEFORE making connections to the inverter

Be sure to have read the section titled “Battery Considerations” on page 2–11 in the previous chapter before starting this procedure. For more information, see Appendix C, “Battery Information”.

Prepare the battery bank as follows:

1. Determine the type of batteries to be used.

   See “Battery Types” on page C–2 in Appendix C for information on types of batteries and their applications.

2. Determine the appropriate battery bank size and battery configuration.

   See “Battery Requirements for Dual Inverter Systems” on page 2–15 for information on stacked (dual) inverter systems.

   See “Battery Bank Sizing” on page C–4 for additional information on calculating battery bank size and “Battery Configurations” on page C–9 for information about how to wire the selected battery configuration.

3. Determine the correct size of battery cables to use.

   See Table 2-2, “Recommendced Battery Cable Size Versus Length” on page 2–14 for additional information and recommended battery cable sizing.

4. Determine the correct size of DC breaker/fuse to use.

   See Table 2-3, “Battery Cable to Maximum Breaker/Fuse Size” on page 2–15 for additional information and recommended DC breaker/ fuse sizing.

5. Color code the cables with tape or heat shrink tubing. The standard colors for DC cables are red for positive (+) and black for negative (–).

Important: The battery voltage MUST match the voltage requirements of the inverter. To determine the correct voltage for the system, check the last two digits on the inverter’s model number. For example, the Sine Wave Plus 2524 is a 24-volt inverter and requires a 24 Vdc battery system.

Unpacking and Inspecting the Inverter

WARNING: Personal Injury

Do not attempt to mount this unit on the wall by yourself as the unit is too heavy for one person. Have additional help available to assist in lifting the unit during installation.

Before installing your Sine Wave Plus Inverter/Charger, perform the following.

❐ Carefully unpack the Sine Wave Plus from its shipping carton.

❐ Inspect for shipping damage and contact the shipping company if there is damage.

❐ Verify that all of the following items are present. Please call your authorized Xantrex dealer if any items are missing.

- The Sine Wave Plus Inverter/Charger
- The Sine Wave Plus Inverter/Charger Owner’s Guide
- The Battery Temperature Sensor
- Battery Terminal Covers (with associated hardware)

❐ Save your proof-of-purchase. This is required if the unit should need warranty service.

- ❒ Save the original shipping carton and packing materials. If the inverter ever needs to be returned for service, it should be shipped in the original carton. This is also a good way to protect the inverter if it ever needs to be moved.
- ❒ Record the unit's model number, serial number, and date-of-purchase in the appropriate locations provided on page I–5 in the Warranty and Product Information section at the back of this manual.
  - Model Number information can be found on the Certification Label located on the AC end of the unit. See Figure 3-1 for the location of the this label.
  - Serial Number information can be found on the Serial Number Sticker located on the inverter rail adjacent to the AC side dual knockouts and terminal access cover. See Figure 3-2, "Serial Number Sticker and Knockout Locations and Sizes" on page 3–7 for the location of this sticker.

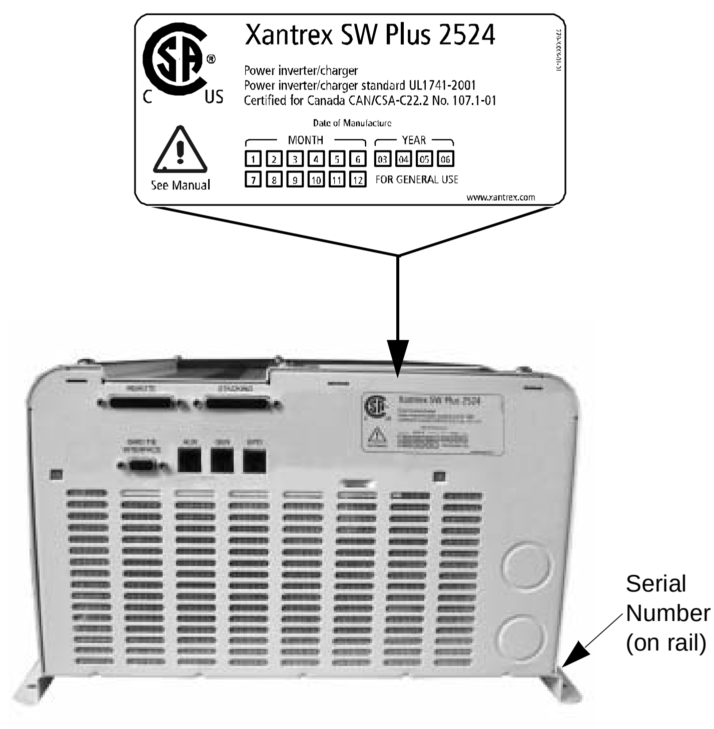


Figure 3-1 Certification Label Location

Important: The exclamation symbol below the CSA logo on the certification label indicates the need to add overcurrent protection. It shall be installed at the battery as part of the installation in accordance with your local electrical code. Table 2-3, “Battery Cable to Maximum Breaker/Fuse Size” on page 2–15 specifies the type and rating of the overcurrent protection needed.

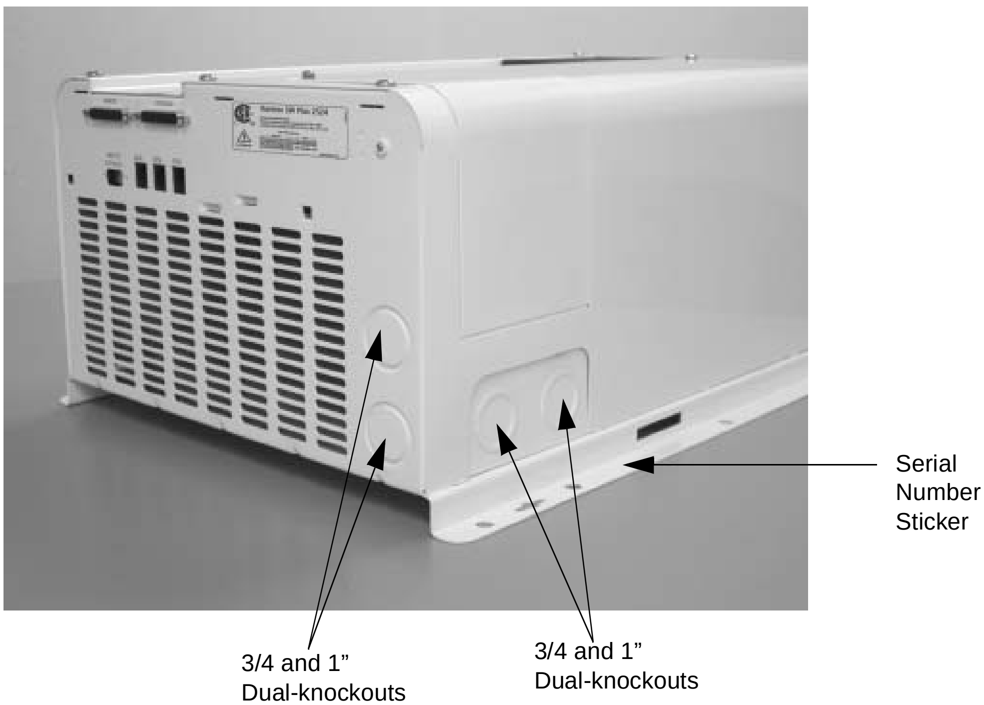


Figure 3-2 Serial Number Sticker and Knockout Locations and Sizes

Knockout Preparation

Remove your choice of knockouts from the chassis to facilitate conduit installation for wire runs. This is much easier to do prior to mounting the inverter. Figure 3-2 shows the locations and sizes of chassis knockouts.

Important: Ensure there are no metal shavings left in the inverter after removing the knockouts. Be sure to install bushings or conduits in the knockout holes to protect the wires from damage.

Mounting

WARNING: Personal Injury Hazard

Do not attempt to mount this unit on the wall by yourself. Have additional help available to assist in lifting the unit during installation.

The Sine Wave Plus can be either shelf-mounted or wall-mounted. Be sure to use appropriate lifting techniques and have extra people available to assist in lifting the inverter into position while it is being secured. Also make sure the supporting surface is strong enough to support the weight of the inverter.

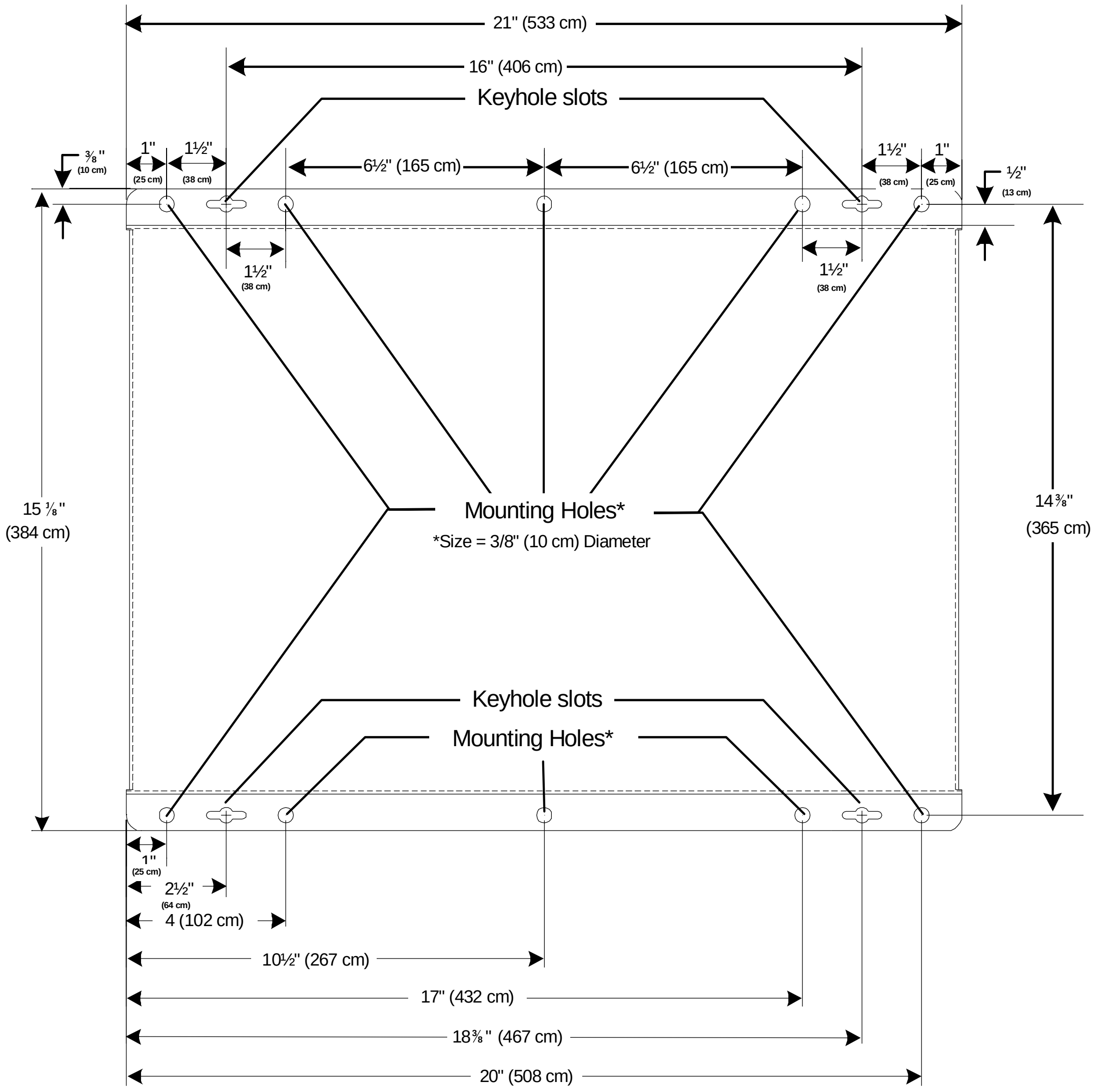
Refer to "Location Considerations" on page 2–5 for information on proper location of the Sine Wave Plus.

Be sure to use all ten mounting holes in addition to the four keyhole slots provided for mounting. Just using the keyhole slots will not be sufficient to safely mount the inverter.

Shelf-Mounting

To mount the Sine Wave Plus on a shelf, follow the instructions below.

1. Ensure that the desired shelf location is strong enough to support the inverter weight and allows adequate clearance for ventilation and access to the indicators and controls.
2. Drill mounting holes in the shelf by one of the following methods. Be sure to use all of the inverter mounting holes and keyhole slots for mounting.
   a) Using the measurements from Figure 3-3 drill out the mounting hole locations for the inverter.
   b) Create a cardboard template by tracing around the inverter and marking the mounting holes and keyhole slots on the cardboard. Use the cardboard template to locate and drill the mounting holes.
3. With assistance, lift the inverter into position and install it onto the shelf, using appropriately sized lag bolts and washers.



*****NOT TO SCALE*****

Figure 3-3 Dimensional Drawing

Wall-Mounting

Wallboard is not strong enough to support the weight of the inverter, so additional support must be added. This can be in the form of reinforcing 2 x 4’s or a half sheet (4 ft x 4 ft) of ¾-inch plywood.

Wall Mounting using 2 x 4’s

The easiest method for securing the inverter to an existing wall is to place two 2 x 4’s horizontally on the wall (spanning at least three studs) and securing the inverter to the 2 x 4’s.

To mount the Sine Wave Plus on a wall, follow the instructions below.

1. Locate the studs and mark their location on the wall.
2. Measure the desired height from the floor for the inverter to be mounted. The height should place the inverter’s control module at the operator’s eye level for easy viewing and setting.
3. Using a level, run a horizontal line. The length of the line must span at least 3 studs.
4. Place a pre-cut 2 x 4 on the marked location and drill pilot holes through the 2 x 4’s and studs.
5. Secure the 2 x 4 with #10 wood screws (length to penetrate 1½ inches or more into the studs).
6. Repeat the procedure for the remaining 2 x 4 (paint the 2 x 4’s, if desired, to match the surrounding wall).
7. Drill mounting holes in the 2 x 4 mounting rails by one of the following methods. Be sure to use all of the inverter mounting holes and keyhole slots for mounting.
   a) Using the measurements from Figure 3-3 drill out the mounting hole locations for the inverter.
   b) Create a cardboard template by tracing around the inverter and marking the mounting holes and keyhole slots on the cardboard. Use the cardboard template to locate and drill the mounting holes.
8. Ensure that the 2 x 4’s are securely fastened to the wall before mounting the inverter to them.
9. With assistance, lift the inverter into position and install it onto the 2 x 4’s using ¼ x 1½-inch lag bolts and washers.

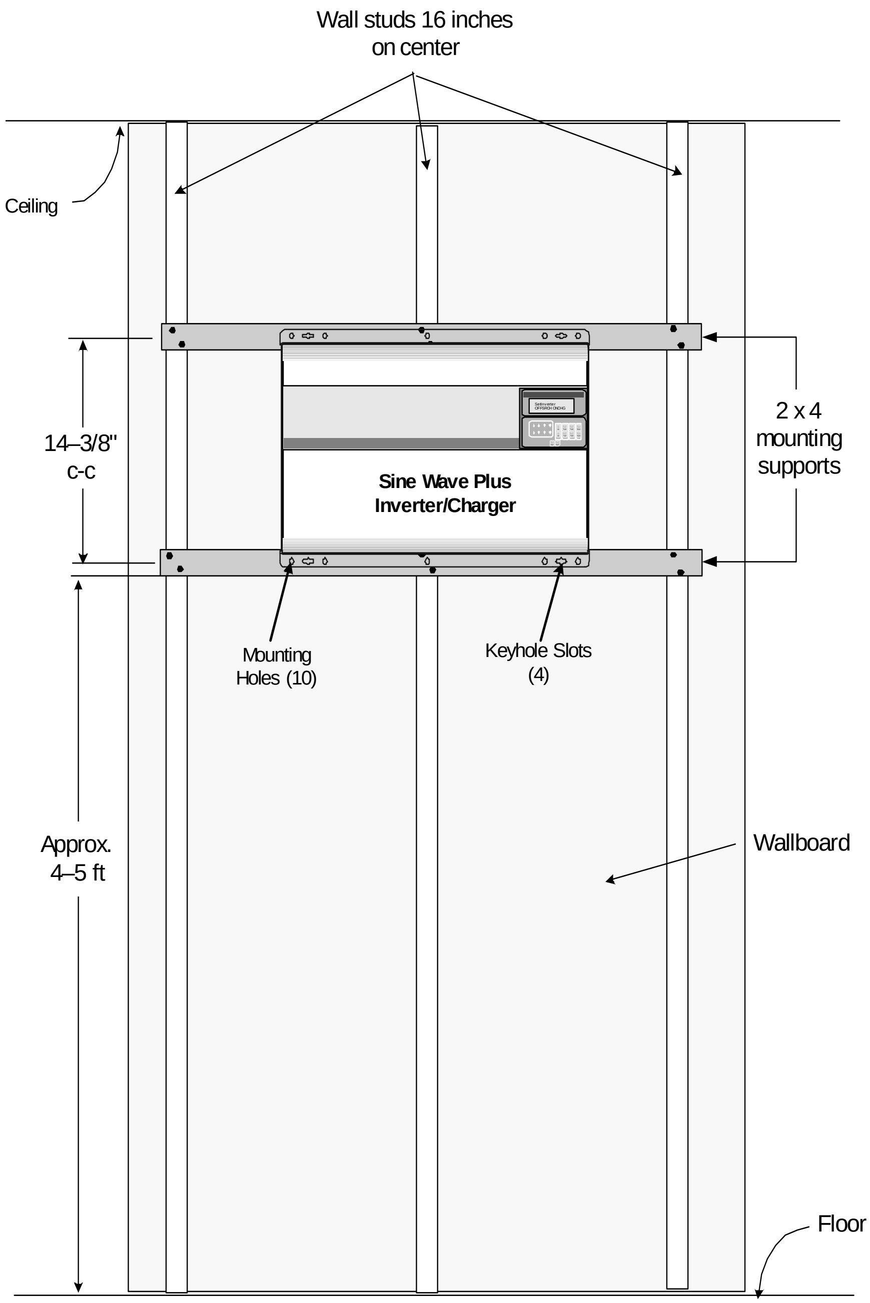


Figure 3-4 Wall-Mounting Method using 2 x 4's

Wall Mounting using Plywood

Alternatively, a half sheet (4 ft x 4 ft) of ¾-inch plywood can also be used as a backing, with the inverter mounted directly to the plywood using ¼-inch diameter lag bolts and washers. The plywood must span three studs for adequate support.

1. Drill the mounting holes in the plywood sheet by one of the following methods. Be sure to use all the mounting holes and keyhole slots for mounting.
   a) Using the measurements from Figure 3-3 drill out the mounting hole locations for the inverter.
   b) Create a cardboard template by tracing around the inverter and marking the mounting holes and keyhole slots on the cardboard. Use the cardboard template to locate and drill the mounting holes.
2. Ensure the plywood is securely fastened to the wall before mounting the inverter on it.
3. With assistance, lift the inverter into position and install it onto the plywood using ¼ x ¼-inch lag bolts and washers.

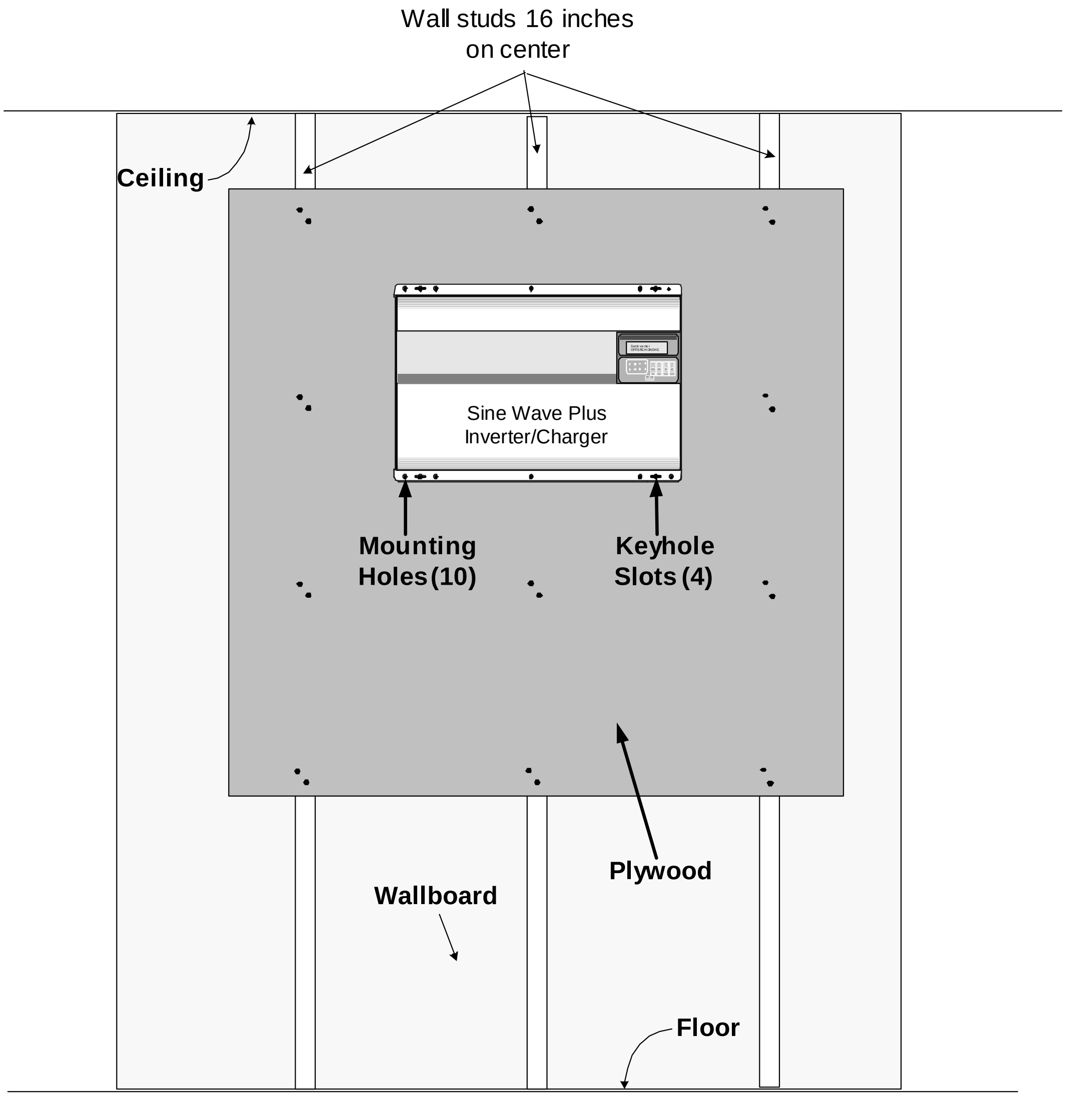


Figure 3-5 Wall Mounting using Plywood

DC Wiring

DC wiring includes the following (described in the following locations).

- ❐ Preparing the Battery bank - See “Preparing the Battery Bank” on page 3–14.
- ❐ Preparing Grounding - See “Grounding the DC System” on page 3–15.
- ❐ Connecting DC Input Sources - See “Connecting DC Input Sources – Renewable Energy Configurations” on page 3–18.
- ❐ Providing over-charge protection. See “Overvoltage Protection using a Charge Controller” on page E-2.
- ❐ Providing diversion loads if necessary. See “Diversion Load Control” on page E-3.
- ❐ Connecting the Battery Temperature Sensor - See “Installing the Battery Temperature Sensor (BTS)” on page 3–18.
- ❐ Connecting “Connecting the Batteries to the Inverter” on page 3–20.

WARNING: Shock Hazard

Ensure that all AC and DC breakers are switched OFF before connecting or disconnecting the battery cables and that all sources of power (both AC and DC) are disconnected from the inverter’s inputs.

Preparing the Battery Bank

Prepare the battery bank according to type of battery selected and configure the battery bank to optimize voltage output according to system requirements. See your battery manufacturer’s installation guide for recommendations.

See Appendix C, “Battery Information” for additional information on determining battery bank type and configuration.

Run the positive and negative battery cables as close to each other as possible by taping them together after all the connections are made. This reduces the effects of inductance, improves surge capacity, and reduces RFI and EMI emissions.

Install a DC disconnect between the battery bank and the inverter. Following the manufacturer’s installation instructions.

WARNING: Fire Hazard

Undersized cables can overheat and melt creating a fire hazard when subjected to heavy (peak) loads. Always use a properly sized cable and length rated for the amperage of the inverter and batteries.

Grounding the DC System

WARNING: Shock Hazard

Always attach ground leads before attaching AC or DC power connections.

The inverter's chassis ground lug (see Figure 3-6) is used to connect the chassis of the inverter to the DC grounding system. The terminal accepts wires from #14 AWG to #2 AWG.

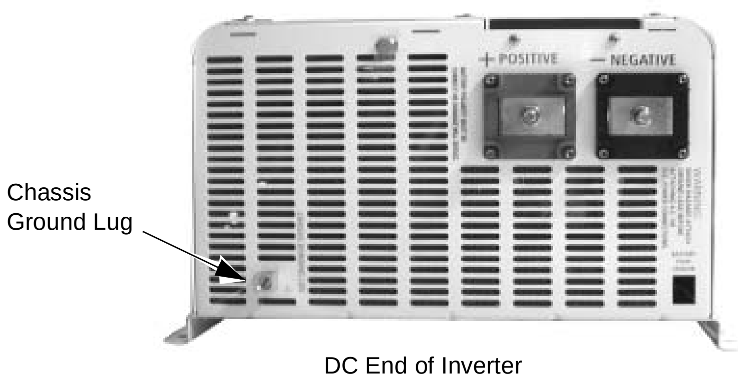


Figure 3-6 Chassis Ground Lug Location on Inverter DC End

The Xantrex DC175 and DC250 have optional grounding blocks to simplify grounding procedures and can be used as the DC disconnect as shown in Figure 3-7 on page 3–16.

Single Inverter

To ground a single inverter:

1. Connect the ground bond in the DC disconnect to the primary grounding electrode, in accordance with local and national electrical codes.
2. Connect the NEGATIVE (–) terminal of the battery bank to the ground bond inside the DC disconnect.
3. Connect an appropriately sized GROUND wire from the Chassis Bonding Lug on the inverter DC end to the ground bond inside the DC disconnect.

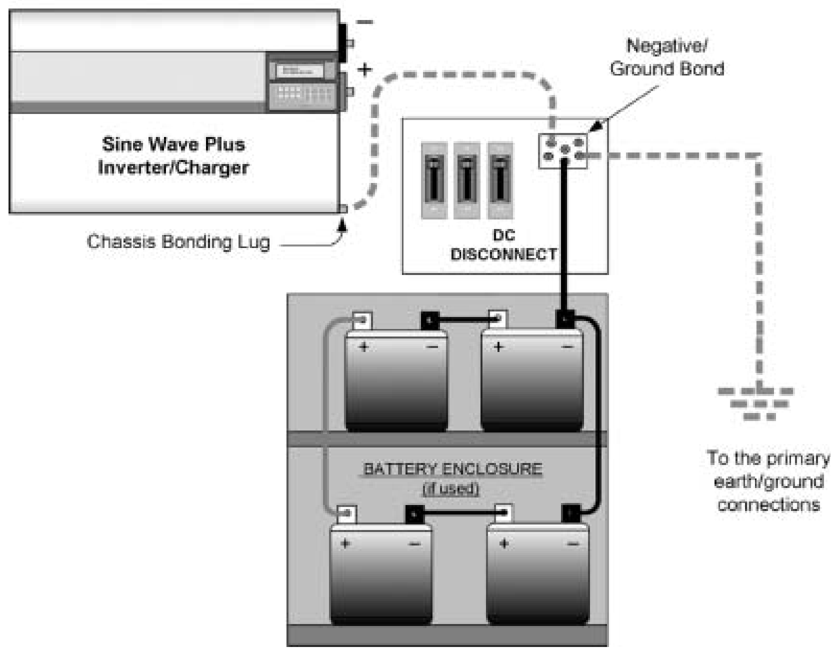


Figure 3-7 DC Grounding of a Single Inverter

Dual Inverters

To ground a dual-inverter configuration:

1. Connect the ground bond in the DC disconnect between the inverters and the batteries to the primary grounding electrode, in accordance with local and national electrical codes.
2. Connect the NEGATIVE (–) terminal of the battery bank to the ground bond inside the DC disconnect.
3. Connect an appropriately sized GROUND wire from the Chassis Bonding Lug on the L1 inverter DC end to the ground bond inside the DC disconnect.
4. Connect a second appropriately sized GROUND wire from the Chassis Bonding Lug on the L2 inverter DC end to a different terminal in the ground bond inside the DC disconnect.

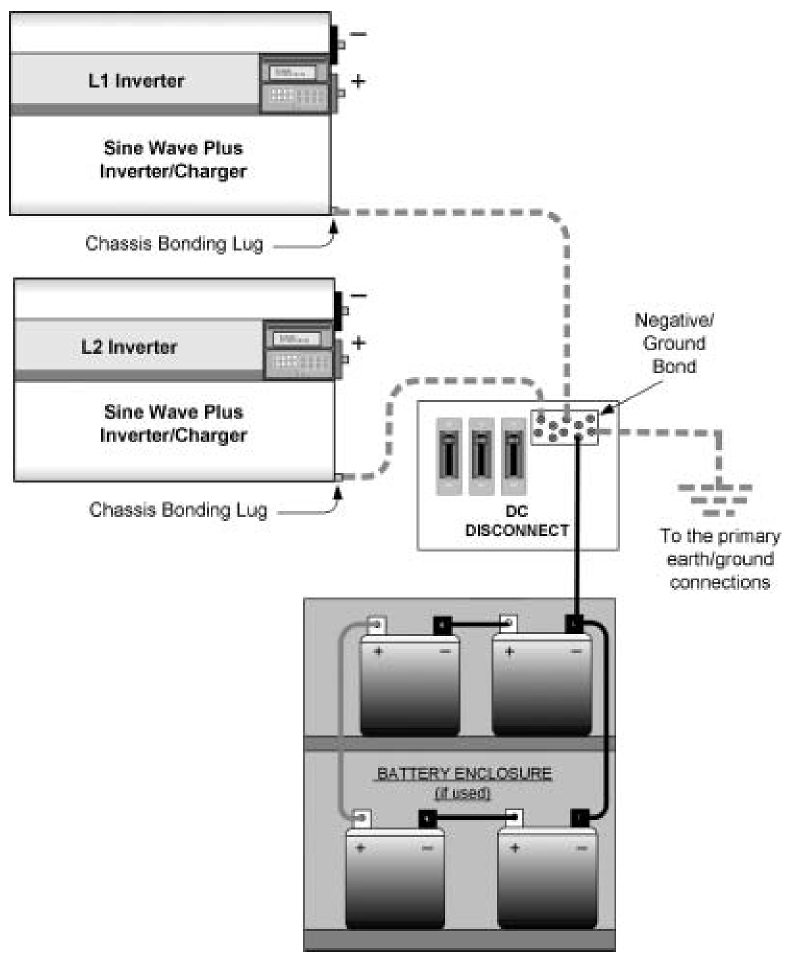


Figure 3-8 DC Grounding of Dual Inverters

Connecting DC Input Sources – Renewable Energy Configurations

Renewable energy sources (e.g., PV arrays, wind turbines etc.) may require additional equipment such as charge controllers, diversion load controllers, PV Ground Fault Protection, and additional fuses and/or disconnects. Since every configuration is unique, specific installation instructions cannot be provided. Follow your manufacturer's instructions for installation of these components.

Be sure to consult your local authority to ensure code compliance for your configuration.

Installing the Battery Temperature Sensor (BTS)

Install the sensor on the side of the battery below the electrolyte level so as to measure the average battery temperature. If using multiple charging devices (inverters and charge controllers), install all sensors together with each other so they all measure the same temperature. It is best to mount the sensor(s) between the batteries in an insulated box to reduce the influence of the ambient temperature outside the battery enclosure. Ventilate the battery box at the highest point to prevent hydrogen accumulation.

To install the BTS, follow the steps below.

1. Run the BTS wire in the DC conduit (if used) and route the RJ11 connector end (via one of the knockouts) to the BTS port located on the DC end of the inverter.
2. Secure the sensor to one of the batteries located in the center of the battery pack.
3. If other devices are using battery temperature sensors, place all of them on the same battery so that they all measure the same temperature.

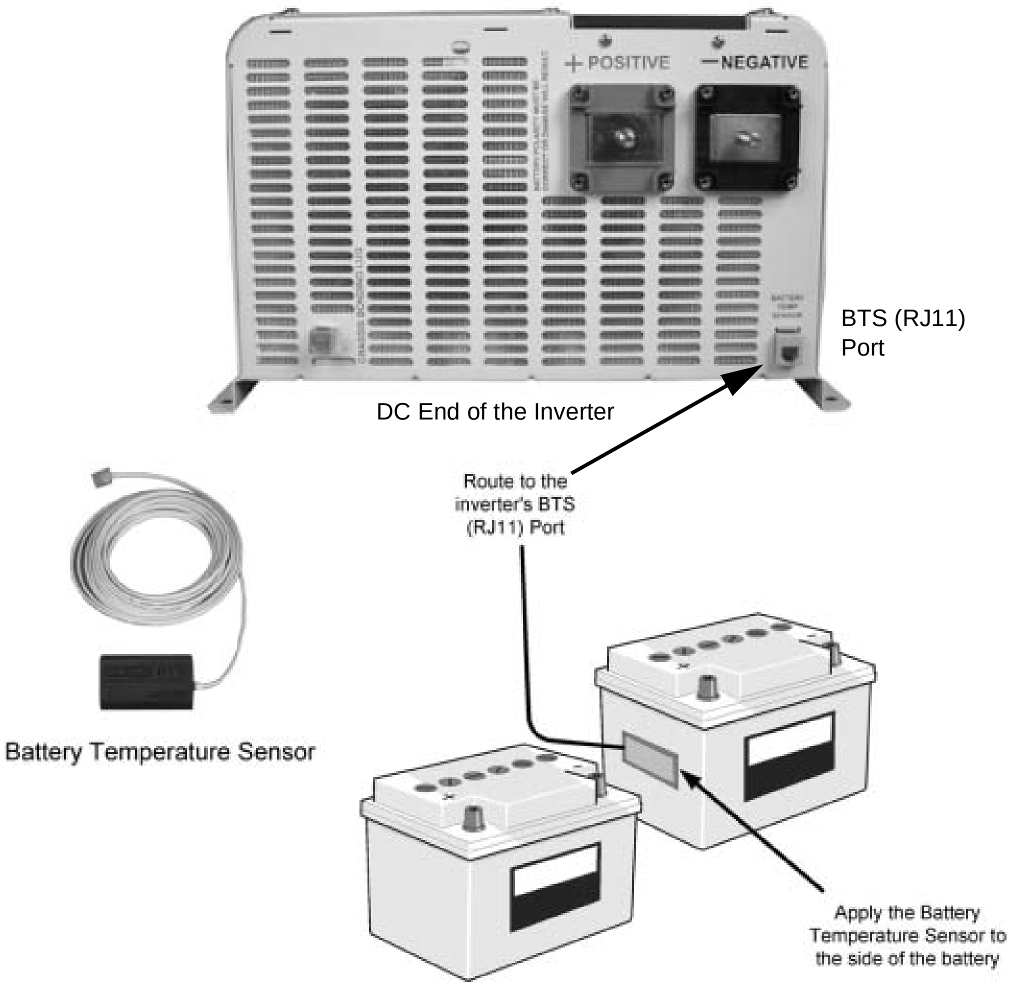


Figure 3-9 BTS (RJ11) Port Location and Installation

Connecting the Batteries to the Inverter

WARNING: Shock Hazard

Before making any connections, verify that the DC disconnect device is switched OFF.

DC terminal connections are located on the DC end of the inverter.

Figure 3-10 shows the locations of the DC connectors.

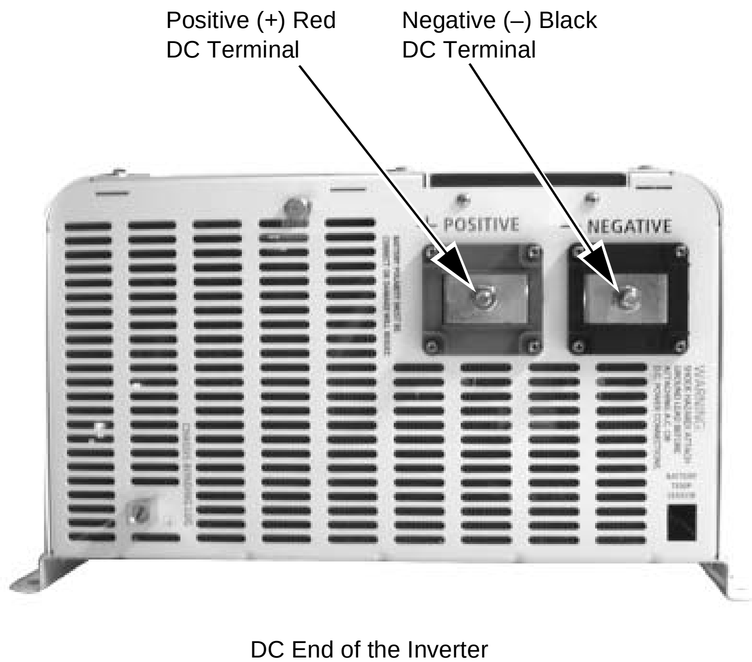


Figure 3-10 DC Terminal Connections on the Inverter

Figure 3-11 shows the proper method to attach the cables to the inverter.

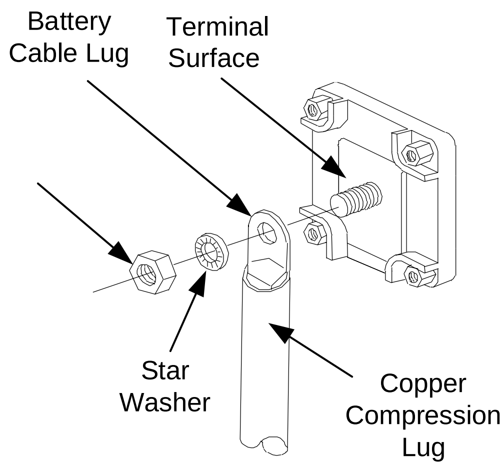


Figure 3-11 Battery Cable Connection

CAUTION: Damage to Equipment

Do not put anything between the battery cable lug and the terminal surface. Overheating of the terminal may occur. Do not apply any type of antioxidant paste until after the battery cable wiring is tightened. The same applies for all DC connections.

Figure 3-12 shows the battery terminal covers and associated hardware.

Figure 3-12 Battery Terminal Covers and Associated Hardware

Procedure for Single Inverter Systems

Before starting this procedure, please review Figure 3-10, “DC Terminal Connections on the Inverter” on page 3–20 and Figure 3-11, “Battery Cable Connection” on page 3–21 for the locations of the terminals and details on attaching positive (+) and negative (–) cables to terminals on the inverter DC end. Ensure the unit is properly grounded before proceeding.

While performing the following procedure, please refer to Figure 3-13, “DC Connections to a Single Inverter” on page 3–23.

Use the following procedure to connect the battery (or battery bank) to the inverter.

1. Connect POSITIVE cables:
   a) Connect one cable from the battery POSITIVE terminal to a circuit breaker in the DC disconnect (torque to manufacturer’s recommendations). The DC disconnect should be located as close to the batteries as possible.
   b) Connect another cable from the other side of the same circuit breaker to the inverter’s POSITIVE (+) terminal.
2. Connect a NEGATIVE cables:
   a) Connect one cable from the battery NEGATIVE terminal (torque to manufacturer’s recommendations) to the ground bond in the DC disconnect.
   b) Connect another cable from the ground bond to the inverter’s NEGATIVE (–) terminal.
3. Ensure the correct polarity of the cables with a DC voltmeter (DVM).
4. Use an insulated 1/2-inch wrench or socket to tighten the 5/16 SAE nuts to 10-15 foot/lb for each inverter input terminal.
5. Apply antioxidant paste to the battery terminals, if desired.
6. Install the battery terminal covers (if used)—red for positive, black for negative—over the inverter DC terminals and secure with the screws and washers provided.

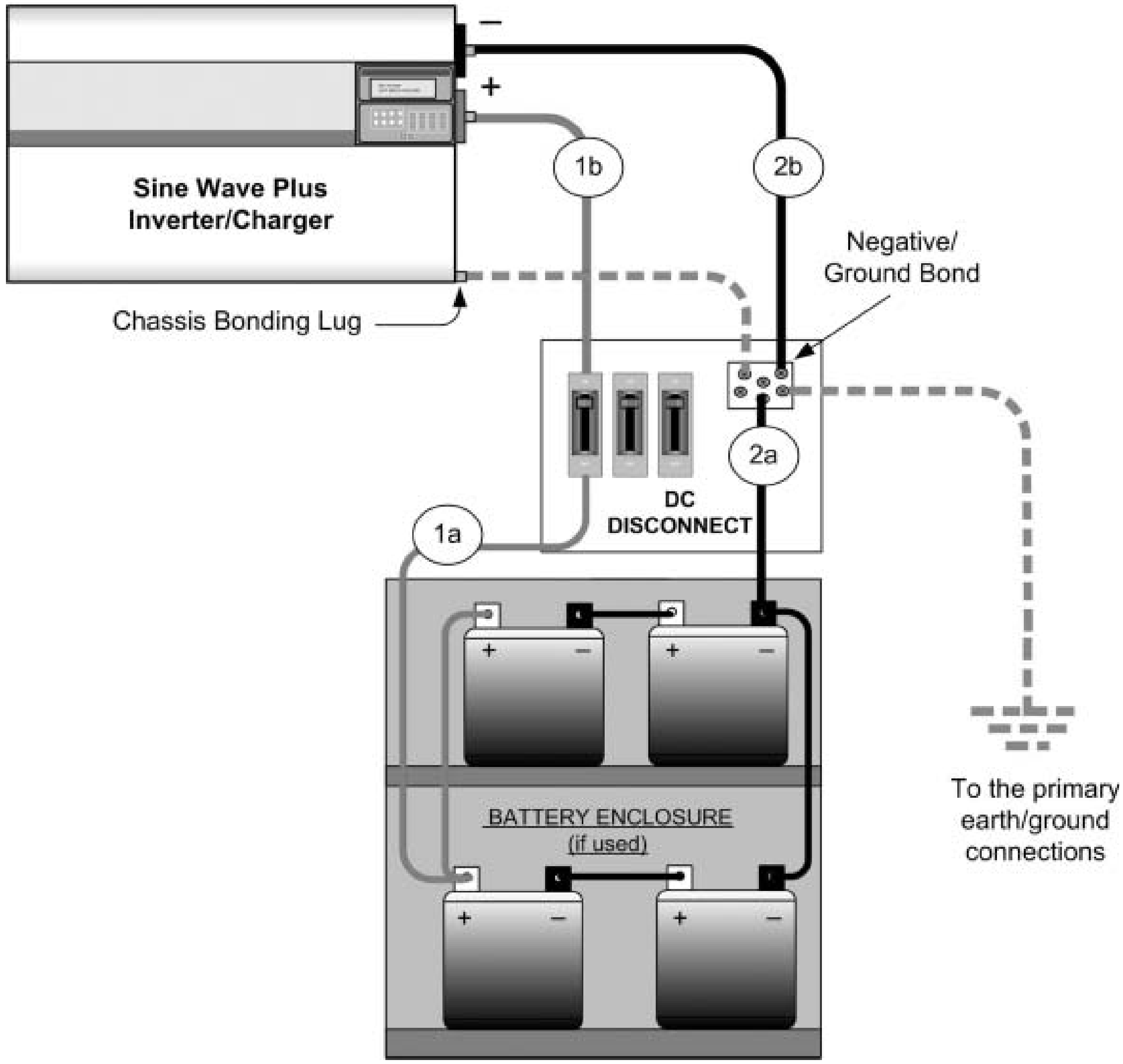


Figure 3-13 DC Connections to a Single Inverter

Procedure for Dual-Inverter Systems

Before starting this procedure, please review Figure 3-10, “DC Terminal Connections on the Inverter” on page 3–20 and Figure 3-11, “Battery Cable Connection” on page 3–21 for the locations of the terminals and details on attaching positive (+) and negative (–) cables to terminals on the inverter DC end. Ensure the unit is properly grounded before proceeding.

While performing the following procedure, please refer to Figure 3-14.

Use the following procedure to connect the battery (or battery bank) to the inverters.

1. Connect POSITIVE cables:
   a) one cable from the battery POSITIVE terminal to a circuit breaker in the DC disconnect (torque to manufacturer’s recommendations). The DC disconnect should be located as close to the batteries as possible.
   b) a second cable from the same battery POSITIVE terminal to another circuit breaker in the DC disconnect.
   c) a third cable from the first circuit breaker in the DC disconnect to the L1 inverter POSITIVE (+) terminal.
   d) a fourth cable from the second DC disconnect to the L2 inverter POSITIVE (+) terminal.
2. Connect NEGATIVE cables:
   a) one cable from the same battery NEGATIVE terminal (torque to manufacturer’s recommendations) to the ground bond in the DC disconnect.
   b) a second cable from the same battery NEGATIVE terminal (torque to manufacturer’s recommendations) to the ground bond in the DC disconnect.
   c) a third one from the ground bond in the DC disconnect to the L1 inverter NEGATIVE (–) terminal.
   d) a fourth one from the ground bond in the DC disconnect to the L2 inverter NEGATIVE (–) terminal.
3. Ensure the correct polarity of the cables with a DC voltmeter (DVM).
4. Use an insulated 1/2 inch wrench or socket to tighten the 5/16 SAE nuts to 10-15 foot/lb for each inverter input terminal.
5. Apply antioxidant paste to the battery terminals, if desired.
6. Install the battery terminal covers (if used)—red for positive, black for negative—over the inverter DC terminals and secure with the screws and washers provided.

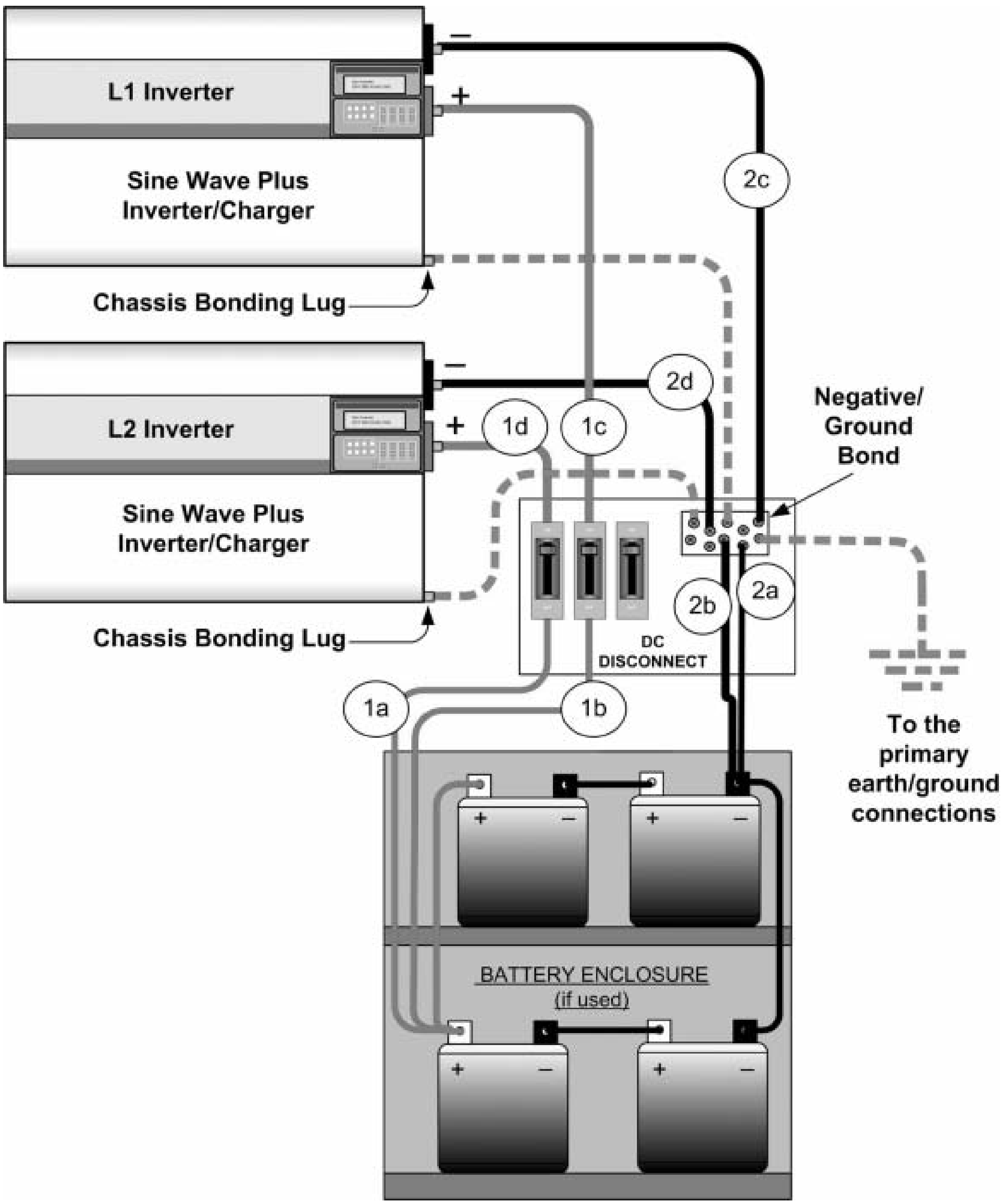


Figure 3-14 DC Connections to Dual Inverters

AC Wiring

This section describes:

- “Accessing the AC Terminal Block and Ground Bar” on page 3–28, and
- “AC Wiring for Single Inverter Systems” on page 3–30.

Disregard installation sections and illustrations that do not apply to your configuration (for example, installing utility panels in Off-Grid applications or wiring for generators when no generator is used, etc.)

Before wiring the input of the inverter, refer to Table 3-1 below for Maximum AC wire sizes and disconnects devices. Determine the correct AC wire size and disconnect size to use for installation.

The Sine Wave Plus inverter has two AC inputs, AC1 GRID and AC2 GEN. The AC1 GRID input is intended to be used with grid power and the inverter can do “grid features” (BX Mode, time-of-day usage) with this input. The AC2 GEN input is intended to be used with AC generators and the inverter can do “generator features” (auto-start) with this input.

The inverter will accept and use AC power on either of these inputs. Be aware that the inverter menu structure is organized and the features are optimized around AC1 receiving grid power and AC2 receiving generator power. If you install grid power on the AC2 GEN input or generator power on the AC1 grid input the results may be different that expected or noted in your users manual.

Examples of using an input source other than its factory designation.

1. An off-grid site with two generators, an auto-start generator connected to AC2 and spare manual-start generator connected to AC1.
2. An on-grid site with a generator wired into a main grid/generator transfer switch. The AC2 input would need to be used to utilize the auto start feature of the inverter. Note: the inverter's “grid features” would not be available in this wiring configuration.”

Table 3-1 AC Disconnect and Wire Sizing

Full Pass-Through Capability	Maximum Fuse/Breaker Required	Cable Size Required in Conduit
60 Amps	60 Amps	#6 AWG (THHN)

WARNING: Fire Hazard

There is risk of fire if 120 Vac only sources (such as inverters and generators) are wired incorrectly into 120/240 Vac distribution panels containing multi-wire branch circuits.

See Appendix F, "Multi-wire Branch Circuit Wiring", which describes how to check for multi-wire branch circuits in the load center and offers some possible solutions/alternatives to this wiring method.

WARNING: Shock Hazard

Be sure to connect the ground wires first when connecting AC wiring to prevent a potential shock hazard.

CAUTION: Damage to the Inverter

The inverter's AC output must never be wired to the utility or generator output. This will cause severe damage to the inverter which is not covered under warranty.

Accessing the AC Terminal Block and Ground Bar

All AC wiring connects to the AC terminal block located on the left-hand side of the inverter beneath the AC access cover.

To remove the AC access cover:

1. Remove the Phillips screw from above the access cover. Place the loose screw somewhere safe where it will not be lost.
2. Slide the access cover off of the front panel.

To replace the AC access cover:

1. Slide the access cover back into place.
2. Replace the Phillips screw that was removed and tighten into place. Be sure not to over-tighten this screw.

The following photograph show the AC terminal block and AC ground bar located beneath the AC access cover.

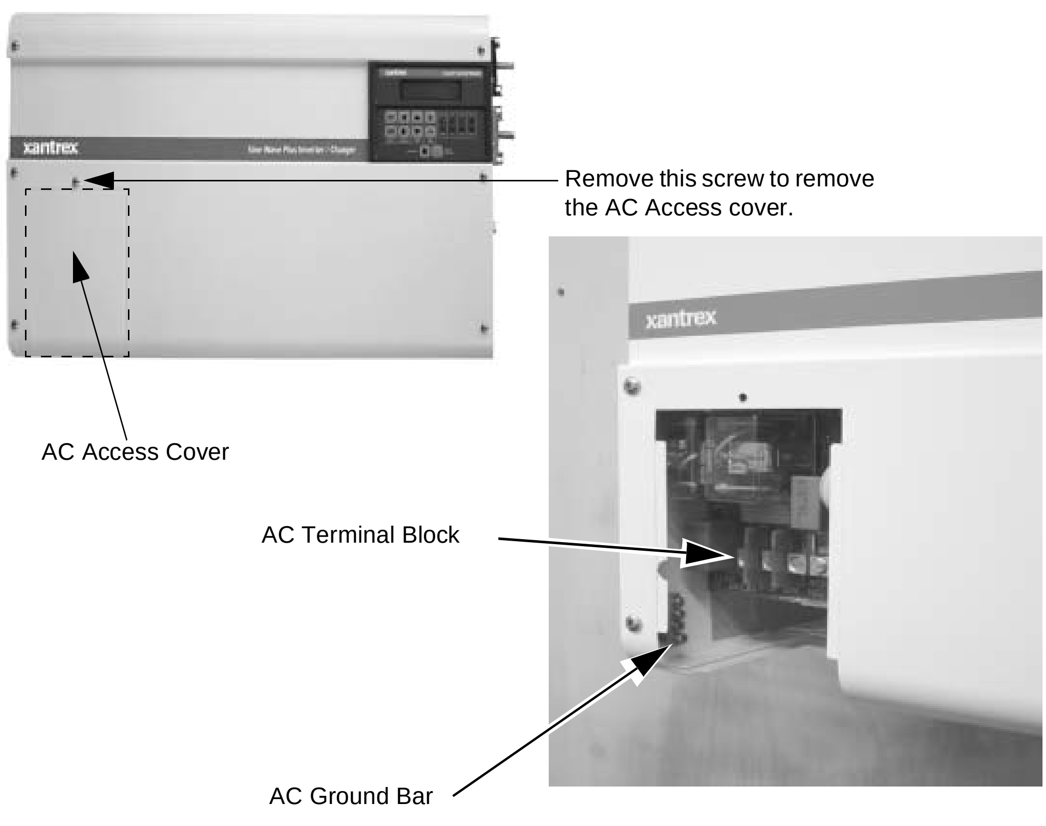
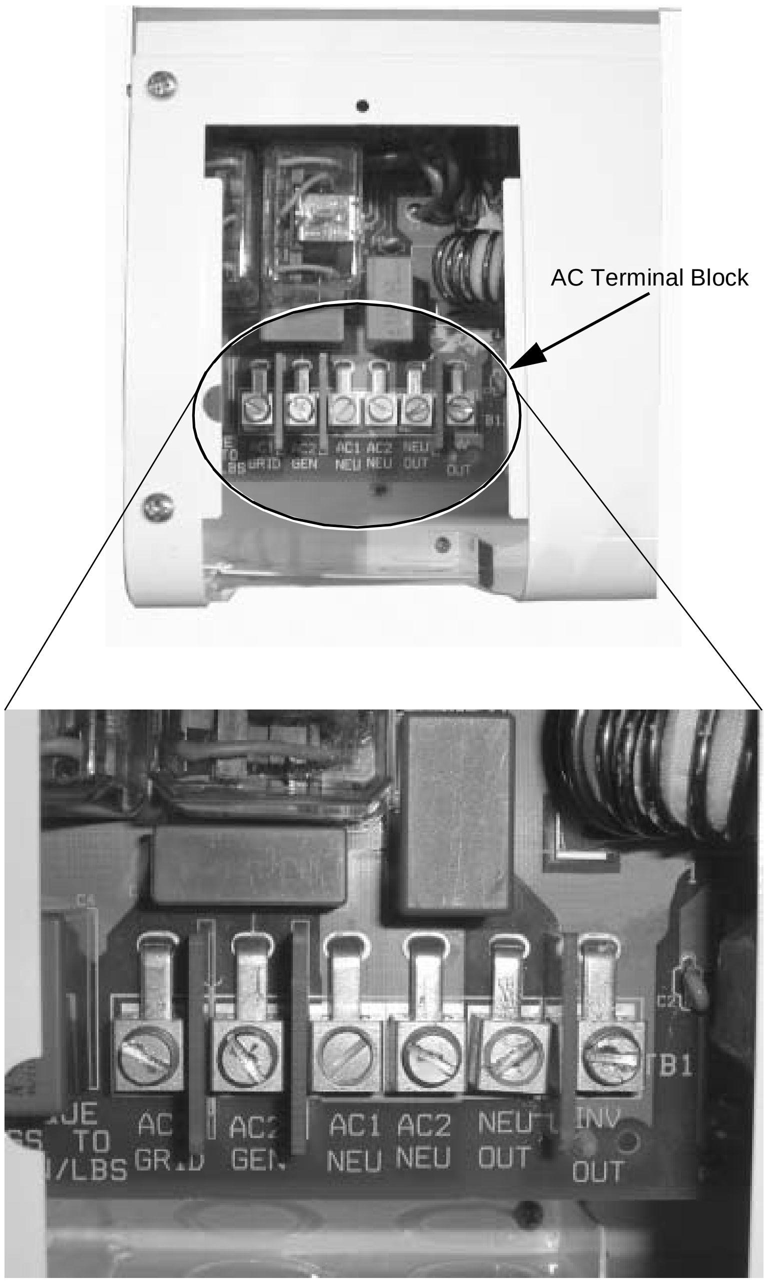


Figure 3-15 AC Wiring Access Cover Plate



AC Terminal Block Enlargement

Figure 3-16 AC Input/Output Wiring Terminals

AC Wiring for Single Inverter Systems

There are three major steps in the procedure for AC wiring of single-inverter systems. They are described in detail on the following pages:

1. "Install AC Output Wiring to the Inverter AC Distribution Panel" on page 3–33.
2. "Install Generator Wiring to the Inverter" on page 3–35.
3. "Install Utility Wiring to the Inverter Input (On-Grid Applications only)" on page 3–38.

The completed wiring is shown in Figure 3-18, "AC Input and Output Wiring to a Single Inverter with an Auto-Start AC Generator" on page 3–32. This illustration shows an auto-start generator; a manual-start generator would be wired in the same way except that there would be no GSM. The T240 Autotransformer and generator disconnect switch are optional, but the generator disconnect switch is strongly recommended.

Important: Wiring to the utility panel is performed after all other connections have been made in the inverter. Be sure to make all the other connections to the inverter first (steps 1 and 2 above).

Manual and Auto Start Generators

Some generators must be started manually at the generator. These kinds of generators do not require the use of the Generator Start Module (GSM).

Some generators allow automatic starting. In this case, the addition of the GSM is required for the inverter to start/stop the generator and to transfer the AC input voltage to the inverter.

Exact wiring instructions cannot be given for auto-start generators as the wiring configuration may vary depending on the type of auto-start circuit used.

See "Generator Starting Scenarios" on page 7–23 and the GSM Installation Guide for specific installation instructions for connecting a generator to the GSM.

WARNING: Shock Hazard

Auto-start generators can start automatically at any time.

Affix the warning label (supplied with the GSM) regarding auto-start generators on or near the main AC distribution panel and near the generator. This will remind the operator that AC power may still be supplied from the generator and additional steps may be required to make the panel and the generator safe.

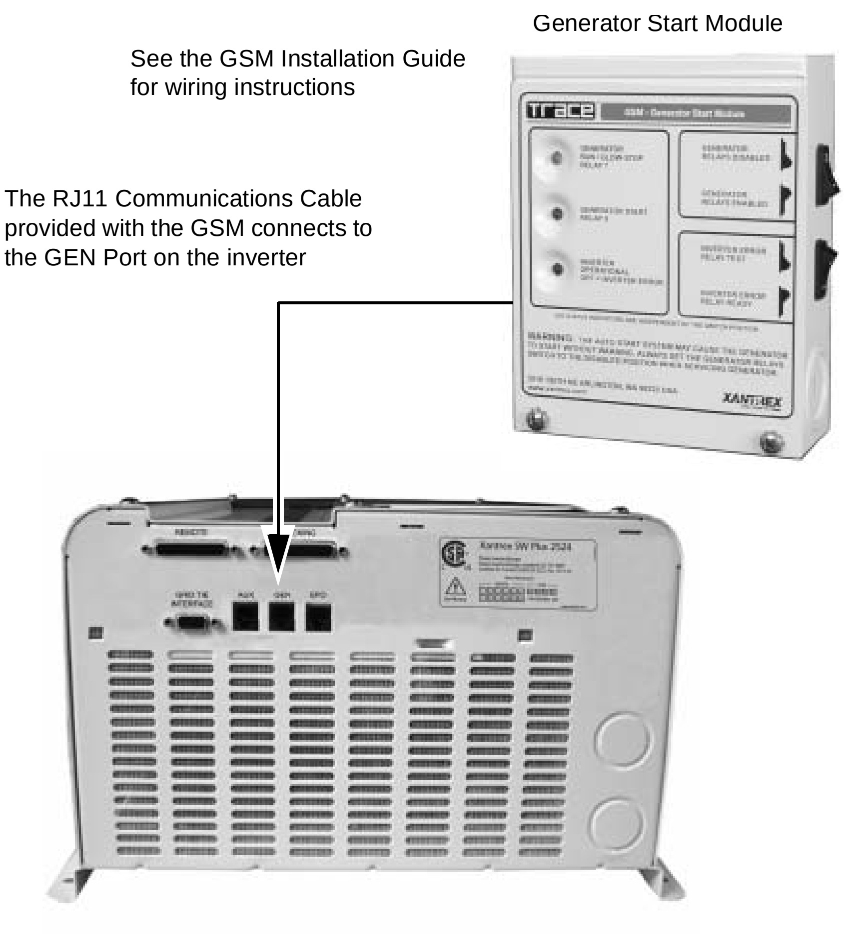


Figure 3-17 Connecting the GSM Communications Cable to the Sine Wave Plus

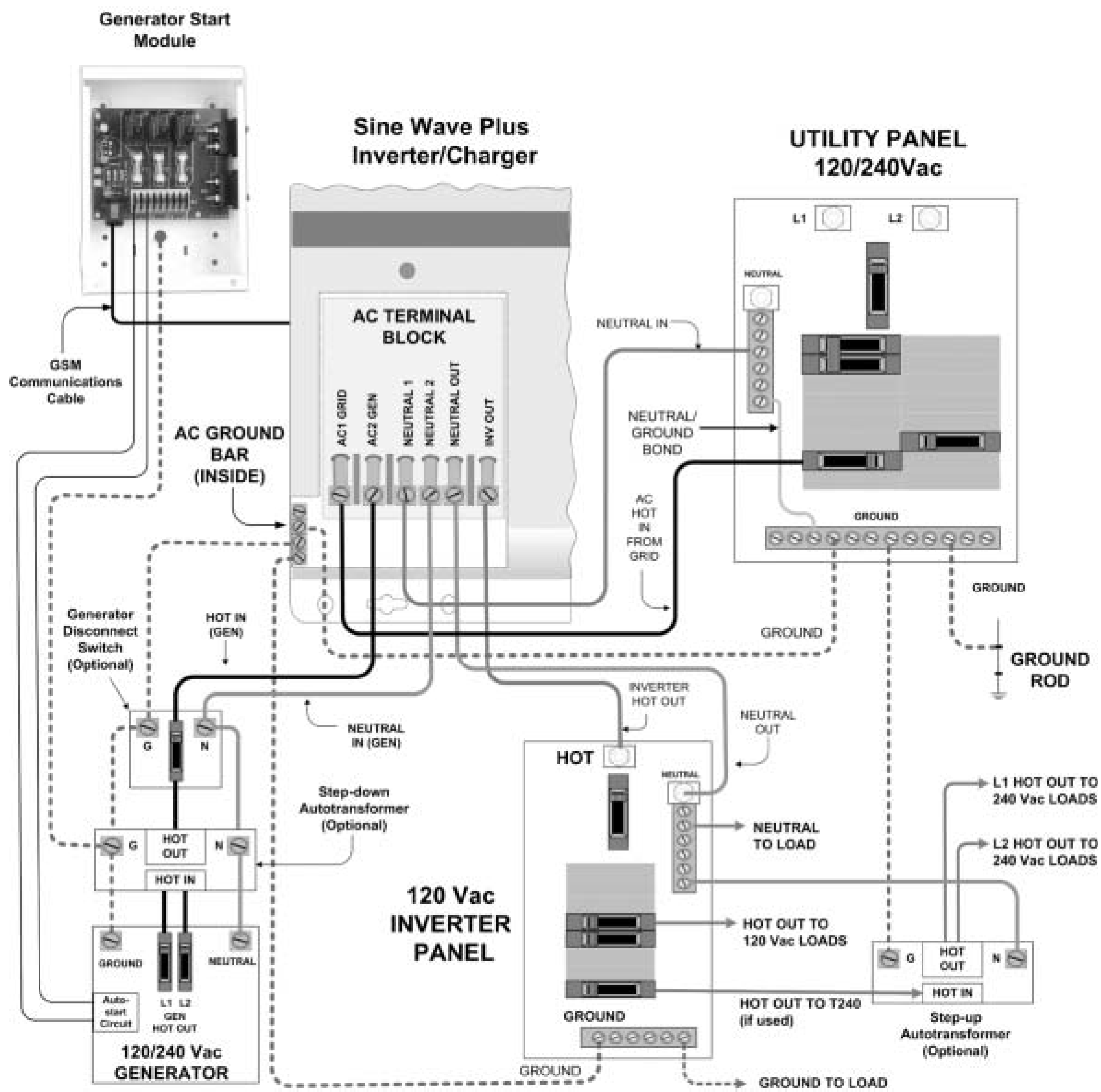


Figure 3-18 AC Input and Output Wiring to a Single Inverter with an Auto-Start AC Generator

Install AC Output Wiring to the Inverter AC Distribution Panel

An inverter AC distribution panel (referred to here as the inverter panel) and AC conduit must be installed before AC output wiring is connected to the inverter. The inverter panel is a subpanel.

Install the inverter AC distribution panel and conduit as follows:

1. Determine the location for the inverter AC distribution panel and install it according to the manufacturer's directions.
2. Install an AC conduit to the inverter panel and the inverter.
3. Determine which circuits the inverter will power and install the appropriate circuit breakers into the inverter panel.
4. For On-Grid systems:
   a) Disconnect all power to the main utility panel.
   b) Determine which circuits will be backed by the inverter(s) and remove their wires from the main panel.
   c) Reroute these wires to the new inverter subpanel.
5. Remove unused breakers from utility panel. It is now safe to re-energize the main utility panel.
6. Install a 60-amp maximum (disconnect) main circuit breaker in the inverter panel. This will later be wired to the inverter's output.

CAUTION: Equipment Damage

Verify that only one neutral/ground bond exists in the system. Having more than one neutral to ground bond in a system may create a shock hazard and cause some sensitive equipment to malfunction.

On-Grid systems always have a ground-to-neutral bond provided by the utility meter or service entrance, therefore, you do not need a ground to neutral bond made in the inverter panel.

See "Bonding the Grounding System" on page 2–10 for details.

Important: Under no circumstances should utility power or generator power energize the inverter panel directly while the inverter also energizes the inverter panel.

Make connections from the inverter to the inverter panel as follows:

1. Connect the GROUND (green or bare) wire:
   a) from the inverter AC GROUND bar
   b) to the inverter panel GROUND bar
2. Connect the NEUTRAL (white) wire:
   a) from the inverter NEUTRAL OUT terminal
   b) to the inverter panel NEUTRAL bus
3. Connect the HOT (black) wire:
   a) from the inverter AC OUT terminal
   b) to the inverter panel main input circuit breaker
4. Torque all inverter terminal block connections to 25 inch-pounds.

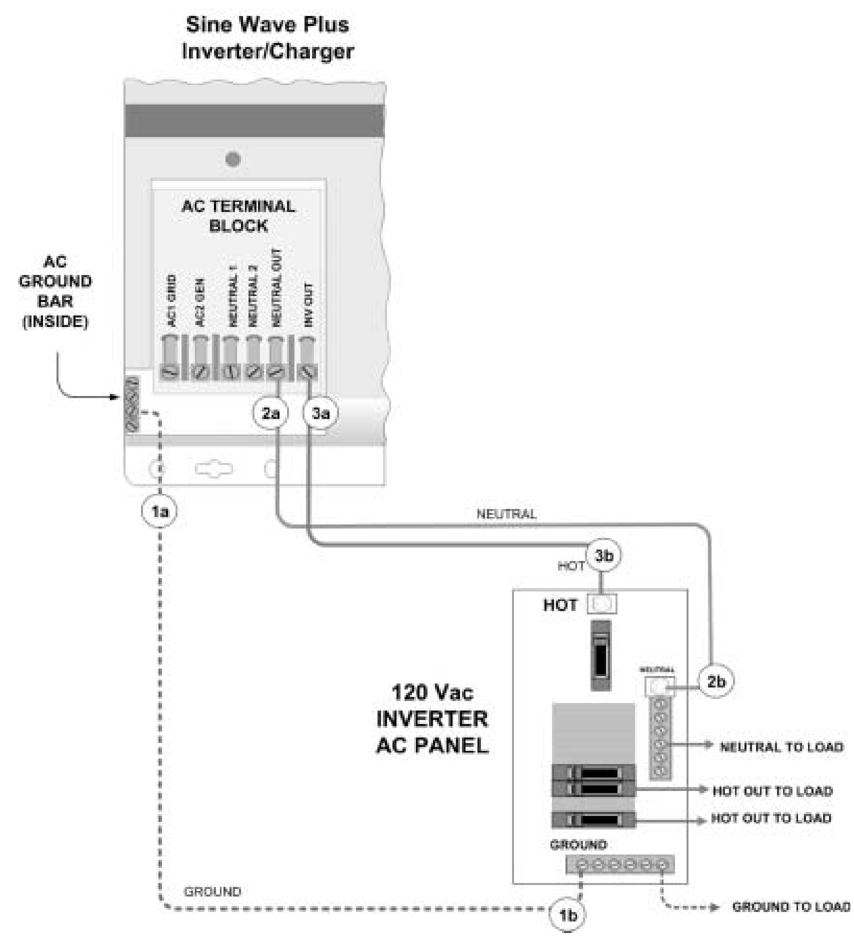


Figure 3-19 AC Output Wiring to the Inverter AC Panel

Install Generator Wiring to the Inverter

WARNING: Shock Hazard

Before connecting any AC wiring, ensure that there is no DC energy accessible by the inverter by opening the DC disconnect switch.

Generator Disconnect Switch (If used)

Having a generator disconnect switch between the inverter and the generator is strongly recommended. This will provide overcurrent protection for the wiring between the inverter and the generator. It also prevents the generator wiring inside the inverter from becoming energized while the inverter is being serviced.

Important: Be sure that the circuit breaker(s) within the switch are appropriately sized to protect the wires between the inverter and the generator. This is based on the generator's output capacity.

To install a generator disconnect switch:

◆ Determine a location for the generator disconnect switch and install it according to the manufacturer's directions.

  A conventional load center (breaker box) can be used to distribute the power from the generator to the inverter input and to loads that cannot be powered by the inverter. Loads such as air conditioners, large well pumps, and arc welders are typically better suited to run directly from the generator than to be "passed through" the inverter transfer relay. If the load is too big for the inverter to operate from battery power, do not install the load in the inverter powered electrical panel.

  A good location for a generator disconnect switch is adjacent to the inverter.

With Step-down Autotransformer and using a 120/ 240 Vac Generator

The following instructions are illustrated in Figure 3-20, “Generator Input Wiring to a Single Inverter” on page 3–37.

To install the AC wiring from the generator to the inverter:

1. Connect GROUND (green or bare) wires:
   a) from the generator GROUND connector to the Step-down autotransformer GROUND connector,
   b) from the Step-down autotransformer GROUND connector to the generator disconnect switch GROUND connector, and
   c) from the generator disconnect switch GROUND connector to the inverter AC GROUND bar.
2. Connect NEUTRAL (white) wires:
   a) from the generator NEUTRAL connector to the Step-down autotransformer NEUTRAL connector,
   b) from the Step-down autotransformer NEUTRAL connector to the generator disconnect switch Neutral connector, and
   c) from the generator disconnect switch NEUTRAL connector to the inverter NEUTRAL 2 terminal.
3. Connect HOT (black) wires:
   a) from the generator L1 HOT OUT to the Step-down autotransformer L1 HOT IN,
   b) and from the generator L2 HOT OUT to the Step-down autotransformer L2 HOT IN,
   c) from the Step-down autotransformer HOT OUT to the generator disconnect switch HOT connector, and
   d) from the generator disconnect switch HOT connector to the inverter AC2 GEN terminal.
4. Torque all inverter terminal block connections to 25 inch-pounds.

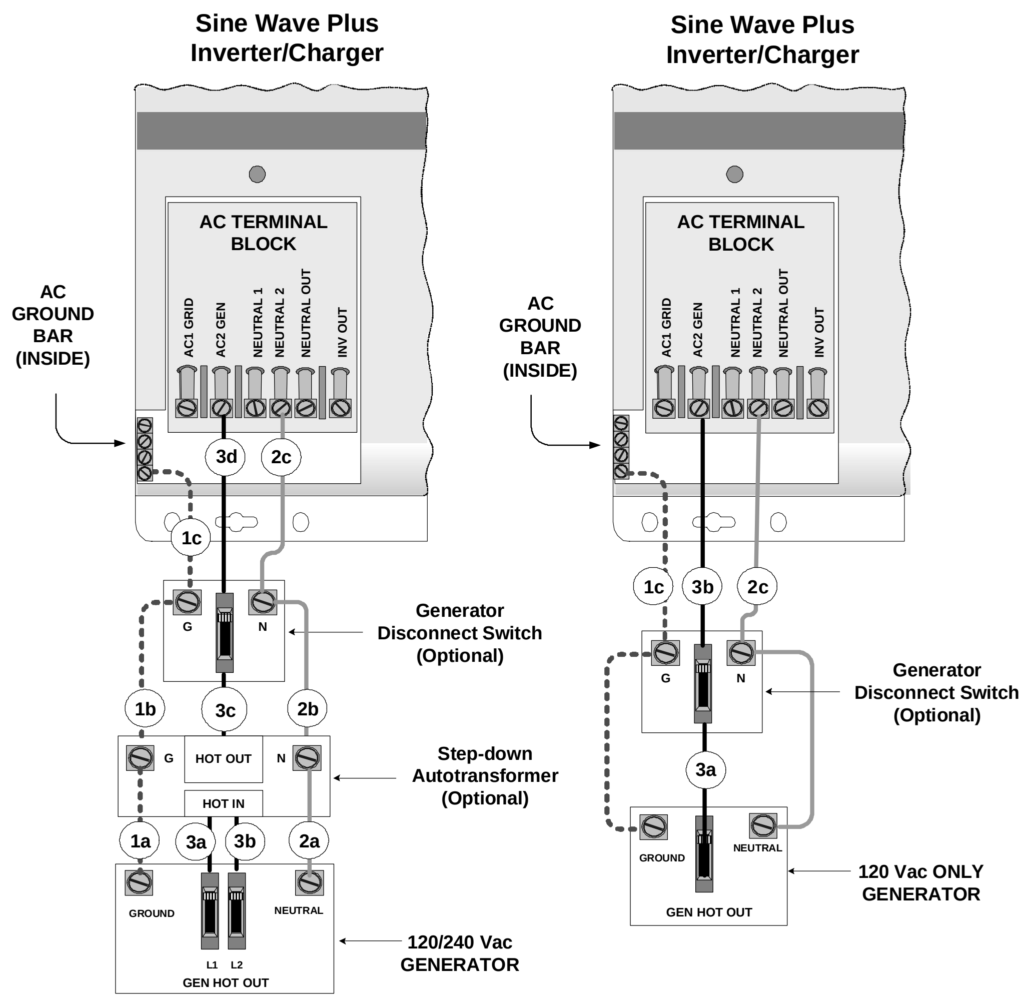
Without a Step-down Autotransformer Using a 120 Vac-Only Generator

If not using a Step-down Autotransformer, install the AC wiring from the generator to the inverter through the generator disconnect as follows:

1. Connect GROUND (green or bare) wires:
   a) from the generator GROUND connector to the ground in the generator disconnect, and
   b) from the ground in the generator disconnect to the ground bar in the inverter.
2. Connect NEUTRAL (white) wires
   a) from the generator NEUTRAL connector to the neutral in the generator disconnect, and

b) from the neutral in the generator disconnect to the inverter NEUTRAL 2 terminal.

3. Connect HOT (black) wires:
   a) from the generator GEN HOT OUT terminal to the circuit breaker in the generator disconnect, and
   b) from the circuit breaker in the generator disconnect to the inverter AC2 GEN terminal.
4. Torque all inverter terminal block connections to 25 inch-pounds.



Generator connections using a T240, a generator disconnect and a 120/240 Vac Generator

Generator connections using a generator disconnect and a 120 Vac Generator

Figure 3-20 Generator Input Wiring to a Single Inverter

Install Utility Wiring to the Inverter Input (On-Grid Applications only)

CAUTION: Damage to Equipment

The inverter's AC output must never be wired to any AC source voltage such as a generator output or utility panel. This will cause severe damage to the inverter which is not covered under warranty.

Important: Make the connections to the inverter first. Wiring to the inverter's main breaker in the utility panel is performed after all connections have been made in the inverter.

The following instructions are illustrated in Figure 3-21, "Utility Wiring to the Inverter Input" on page 3–39.

Install the wiring from the inverter to the utility panel as follows:

1. Feed the HOT, NEUTRAL, and GROUND input wires (via conduit) from the inverter to the utility panel. Leave three to six inches of extra wire at each end.
2. Connect a GROUND (green or bare) wire:
   a) from the inverter AC GROUND bar, and
   b) to the utility panel GROUND bar.
3. Connect a NEUTRAL (white) wire:
   a) from the inverter NEUTRAL 1 terminal, and
   b) to the utility panel NEUTRAL bus.
4. Connect a HOT (black) wire:
   a) from the inverter AC1 GRID terminal, and
   b) to the appropriate utility panel circuit breaker.
5. Torque all inverter terminal block connections to 25 inch-pounds.

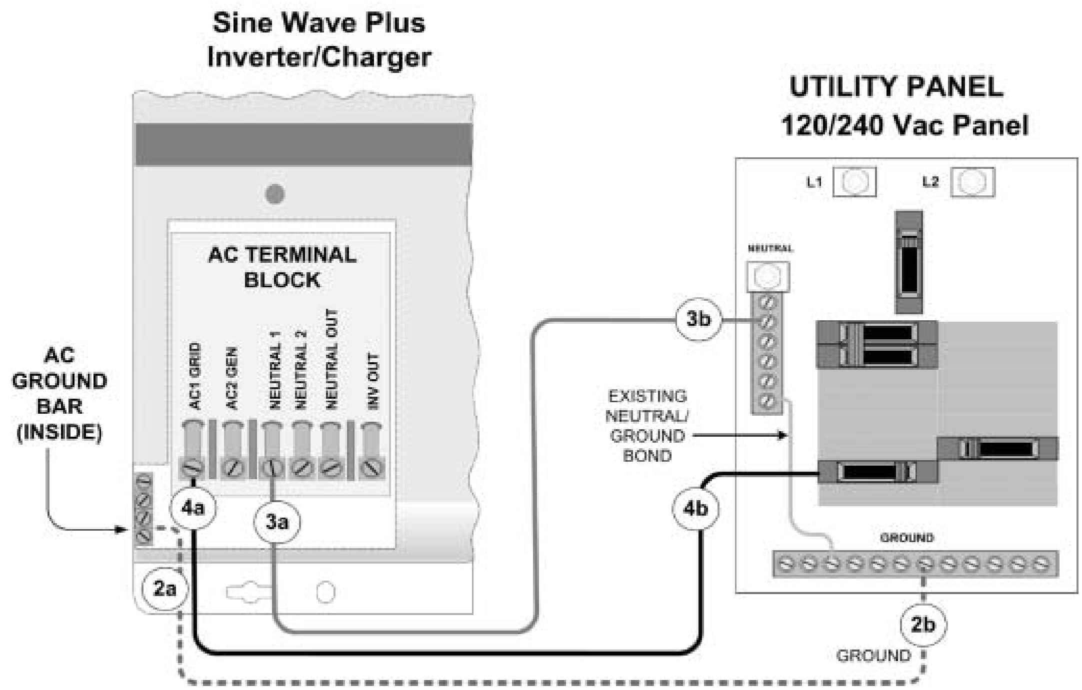


Figure 3-21 Utility Wiring to the Inverter Input

Optional Equipment

Stacking Dual Inverter Systems

To power 120/240 Vac loads you can link or stack two identical inverters together in series by using the ISC-S cable. The ISC-S cable connects to the stacking ports on the AC end of the Sine Wave Plus.

This cable is not provided with the inverter and must be purchased separately. Install this cable prior to making the AC wiring connections.

For complete installation and wiring instructions for using the ISC-S cable, please see the ISC-S Cable Owner's Guide.

The ISC-S cable does not allow programming or access to the display from one inverter to the other. If there are changes to the default setting necessary, each inverter must be programmed separately.

Installing the ISC-S Cable

CAUTION: Equipment Damage

Damage can occur if the ISC-S cable is not properly installed. Do NOT use a standard computer cable in place of the ISC-S cable.

To install the ISC-S cable on the inverters:

1. Connect one end of the ISC-S cable to the Stacking Port on one inverter.
2. Connect the other end of the ISC-S cable to the Stacking Port on the other inverter.

The following diagram is for connecting the cable to the inverters only. For information on wiring dual, stacked inverter systems please refer to the ISC-S Cable Owner's Guide.

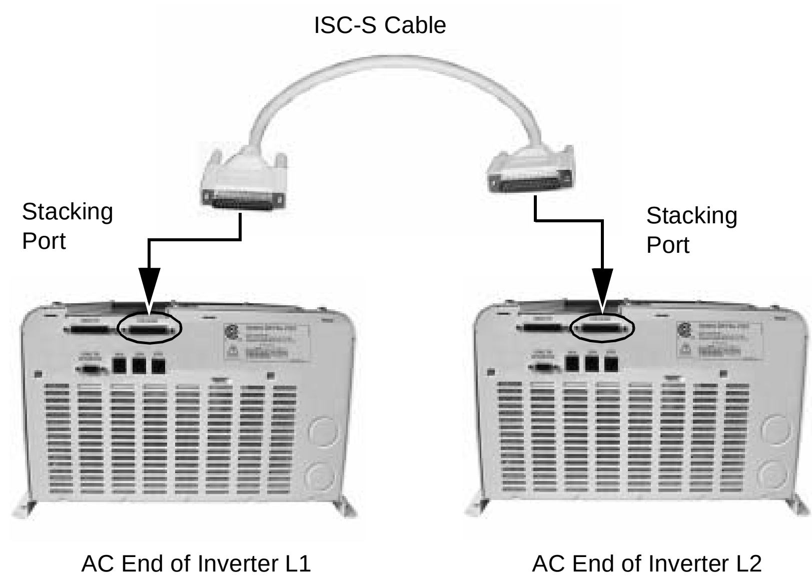


Figure 3-22 Series-stacked Inverters with ISC-S Cable

Remote Monitoring Options

The Sine Wave Plus can be controlled remotely by connecting an additional ICM or by using an ICA connected to a personal computer. The ICM operates identically to the ICM display on the front of the Sine Wave Plus.

See the ICM Installation Guide for specific installation instructions for installing the remote ICM.

See the ICA Owner’s Guide for specific installation instructions for installing the ICA.

To install the remote monitor’s cable:

◆ Connect the appropriate end of the cable from the remote monitor of choice to the “REMOTE” port on the AC end of the inverter.

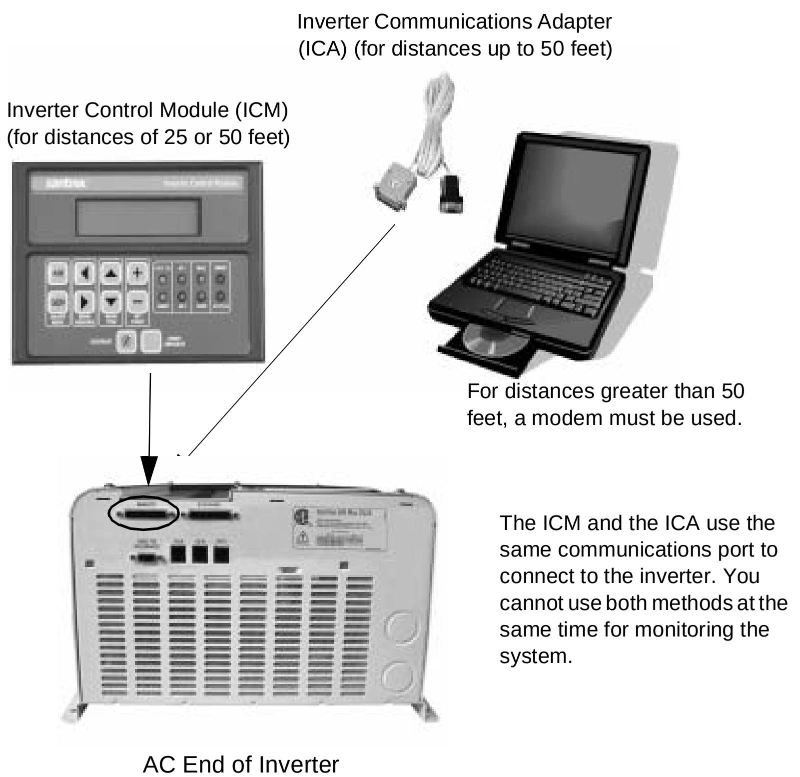


Figure 3-23 Remote Monitor Port Locations

Auxiliary Load Module (ALM)

The ALM can be used to signal loads to turn on and off based on battery voltage. The ALM has a DC voltage controlled relay (switch) that require the Sine Wave Plus in order to operate.

The DC voltage set points for energizing and de-energizing the relays are adjustable as are the time delays.

To connect the ALM to the Sine Wave Plus:

◆ Connect the ALM communications cable from the ALM to the AUX port on the AC end of the inverter.

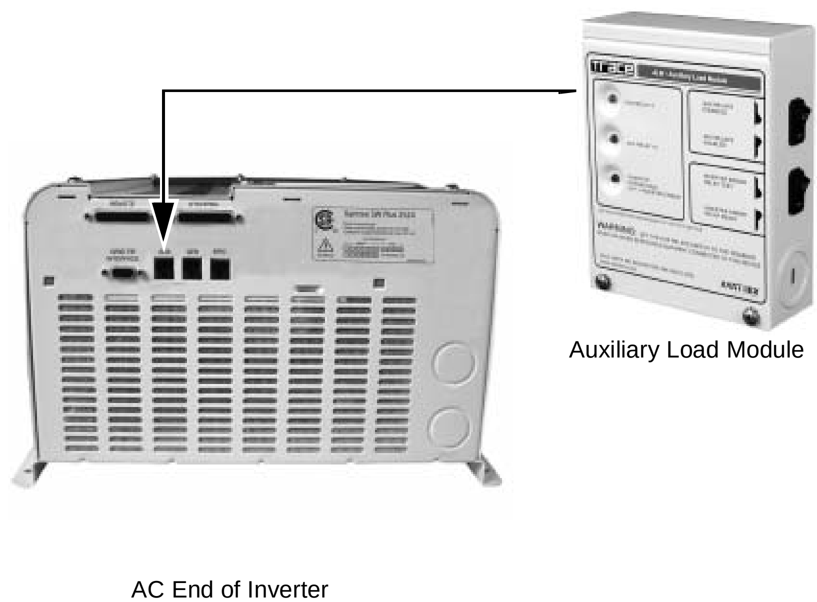


Figure 3-24 Connecting the ALM Communications Cable to the Sine Wave Plus

See "23 ALM Relays Menu" on page 7–19 for instructions on programming the parameters required to use this feature.

Emergency Power Off (EPO)

The Sine Wave Plus has an EPO communications port that is designed to allow a disconnect switch, using an RJ11-type jack, to function as an emergency shutoff switch. Many different switches are available for this purpose. Consult your local system designer or qualified technician for specific installation instructions.

See Appendix G, "Emergency Power Off Switches" for additional information about this feature and how to prepare a cable for it.

EPO Port

The EPO switch is connected to the Sine Wave Plus with a telephone cord (RJ11 type connector) to the dedicated EPO port on the AC (left) side of the inverter.

Important: The purpose of an EPO is to provide fire fighters and other emergency personnel a means to turn off all sources of power to a building prior to entering. For this reason, it is imperative to locate the remote EPO switch close to other sources of power which may enter your building. For example, if your building is serviced by utility and inverter, then the EPO should be located next to the utility meter.

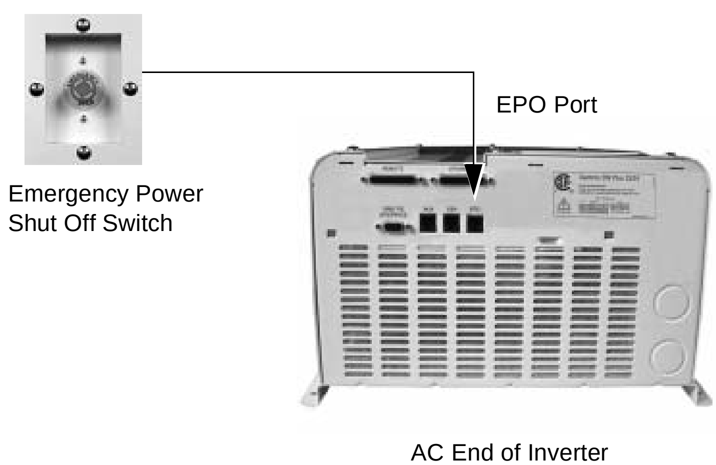


Figure 3-25 Connecting the EPO

4 Functional Test

Chapter 4, "Functional Test" explains how to conduct a functional test of the inverter.

Basic Functional Test

The following steps will complete a basic functional test of the Sine Wave Plus. If any test fails, please refer to Chapter 9, “Troubleshooting” for assistance.

Confirm all Connections

Once the AC and DC wiring have been installed and connected, take a moment to go back over all connections and make sure they are secure and have been installed properly.

Applying Battery Power to the Inverter

Important: The inverter is NOT reverse polarity protected. Reversing the battery polarity on the DC input connections will cause permanent damage to the inverter which is not covered under warranty. Always check polarity BEFORE making connections to the inverter.

To apply battery power to the inverter:

1. Before applying DC power to the inverter, measure the voltage and polarity of the cables (measure at the battery side of the disconnect or breaker).
2. Apply battery (DC) power to the inverter by turning on the battery bank DC disconnect.

   The inverter will power up, the LCD display will illuminate, but the inverter will remain in the OFF Mode (as shown in Figure 4-1).

Turning ON the Inverter

WARNING

Prior to turning on the inverter, ensure that all AC loads are disconnected from the output of the inverter.

To turn on the inverter:

1. Ensure that the LCD display is as shown in Figure 4-1.

Figure 4-1 Power Up Display

2. Press the red inverter ON/OFF MENU switch twice (SRCH, then ON) to turn on the inverter.
3. Monitor the INVERT (yellow) LED to confirm which mode the inverter is in:
   - Off – The inverter/charger is off. This is the default position of the inverter upon power-up. No inverter or pass-through power will be applied to the AC loads.
   - One blink/sec – The inverter/charger is in the Search Mode and is looking for an AC load greater than the Search Watts setting (default = 8 watts).
   - On – The inverter/charger is on. The inverter will produce a low audible “buzz” and is able to provide power to the AC loads.

If the inverter does not produce an low audible “buzz” or illuminates the INVERT LED, check all connections. Check the inverter’s DC voltage on the positive (+) and negative (–) terminals. If the DC voltage is low, the battery bank needs to be charged externally. Charge the battery bank and restart the functional test.

AC Voltage Check

To perform an AC voltage check:

1. With the inverter on (INVERT (yellow) LED on solid), verify with a handheld voltmeter the AC voltage from INV HOT to NEU OUT terminals of the inverter and ensure you get the correct AC voltage for your particular unit.
2. Verify that neutral is bonded to ground in the system by measuring the hot and neutral voltages relative to ground (See “Bonding the Grounding System” on page 2–10). Neutral to ground should equal zero (0) volts.
3. After confirming the correct AC voltage, turn on your AC output breaker and place a load on the inverter (plug in a light or other load to an outlet the inverter is powering).
4. Confirm that the AC load that was just applied works properly.

Confirming Battery Charger Operation

Important: Unless the inverter/charger settings have been changed, the inverter will charge as if it has a large (> 700 Ah) liquid battery bank. Note that ALL systems will need to have the battery charging set points “fine tuned” to validate your battery warranty with your battery supplier.

To confirm that battery charging is operating correctly:

◆ Depending on your configuration, provide AC power to the AC1 GRID and AC1 NEU or AC2 GEN and AC2 NEU.
  - The AC1 or AC2 (green) LED will initially blink until AC power has synchronized and then turn solid to indicate the AC power is getting to the inverter.
  - After a 20-second to 2-minute delay depending on which AC terminals were wired, the Battery BULK (yellow) LED or FLOAT (green) LED should illuminate. This indicates the charger is working properly.
  - The control module lights should indicate which charge stage (bulk or float) the inverter is currently in.
  - Any AC loads powered by the inverter should also work at this point since a portion of the AC input power (Utility or Generator) is passed through the inverter to power the loads.

Confirming Inverter Operation

To confirm that the inverter is operating correctly:

◆ Disconnect the AC input power by turning the input AC power breaker off or unplugging the AC power cord.

- The inverter should transfer to inverter mode immediately. This will be indicated by the INVERT (yellow) LED illuminating.
- The inverter will begin to produce an low audible “buzz” as it takes power from the batteries and uses it to power the loads.
- The loads should continue to operate uninterrupted.

This completes the functional test. If all tests pass, the inverter is ready for use. If any of the inverter’s internal set points are to be adjusted, consult the programming chapters of this manual.

5 Navigation

Chapter 5, “Navigation” explains how to navigate through the Sine Wave Plus Inverter/Charger menus using the Control Module and the menu maps.

Navigating the Sine Wave Plus

The Sine Wave Plus is programmed using the inverter control module (ICM) to access “User” and “Setup” menus. Navigating through the menus requires an understanding of the ICM and its features, what menus are required to do specific functions, and to set or change parameters.

Check defaults

The factory default settings may be adequate for most installations. Check the factory default settings shown on the following model-specific tables to see if your installation will require changes to these settings:

- Table 6-1, “Basic Setup Menu Default Settings for the Sine Wave Plus 2524 and 2548 Models” on page 6–2
- Table 6-2, “Basic Setup Menu Default Settings for the Sine Wave Plus 4024 and 4048 Models” on page 6–4
- Table 6-3, “Basic Setup Menu Default Settings for the Sine Wave Plus 5548 Model” on page 6–6
- Table 7-1, “Advanced Setup Default Settings for the Sine Wave Plus 2524 and 2548 Models” on page 7–2
- Table 7-2, “Advanced Setup Default Settings for the Sine Wave Plus 4024 and 4048 Models” on page 7–5
- Table 7-3, “Advanced Setup Default Settings for the Sine Wave Plus Plus 5548 Models” on page 7–7

Record changes

If your installation will require that the settings be altered, changes can be made using the features of the inverter control module. Record these changes on the model-specific tables provided in Appendix B, “Configuration Settings”. This provides a written record of the necessary changes in the event that the inverter needs to be reprogrammed.

- Table B-2, “Basic Setup Default and User Settings for the Sine Wave Plus 2524 and 2548 Models” on page B–5
- Table B-3, “Basic Setup Default and User Settings for the Sine Wave Plus 4024 and 4048 Models” on page B–6
- Table B-4, “Basic Setup Default and User Settings for the Sine Wave Plus 5548 Model” on page B–8
- Table B-5, “Advanced Setup Default and User Settings for the Sine Wave Plus 2524 and 2548 Models” on page B–10
- Table B-6, “Advanced Setup Default and User Settings for the Sine Wave Plus 4024 and 4048 Models” on page B–12
- Table B-7, “Advanced Setup Default and User Settings for the Sine Wave Plus 5548 Model” on page B–14

Most installations will require that the user perform the Basic Setup routine.

The Inverter Control Module (ICM)

The ICM is located on the front panel of the Sine Wave Plus. It's used to display status information regarding the operation and performance of the unit. It is also used to access the "Basic Setup", "Advanced Setup", and "User Menus". All settings (except for Time of Day) can be saved in non-volatile memory so they are not lost when DC power is removed from the inverter.

If a remote ICM is installed, you may do all the same programming from the remote control module instead.

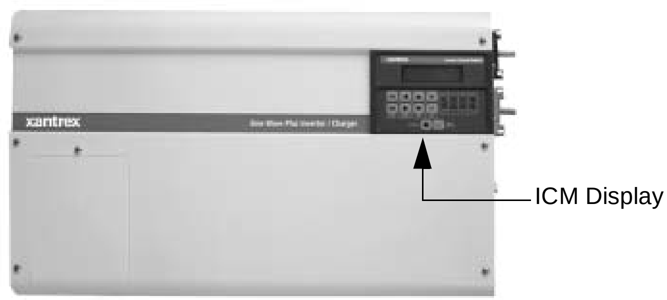


Figure 5-1 ICM Display Location

Inverter Control Module Features

There are nine push-buttons, eight Light Emitting Diodes (LEDs), one contrast adjustment and one Liquid Crystal Display (LCD) on the front of the ICM. The push-buttons are grouped into sets depending on their function. The LEDs also are grouped by function.

The display

The system information, menu items, and set points are all displayed on a Liquid Crystal Display (LCD). The contrast of the display can be adjusted by the Contrast Adjustment screw at the bottom of the panel.

The cursor

When navigating through the menu system, the selected item is indicated in the LCD by a shaded, flashing box over the first letter/number of the set point. This special highlighting is called the "cursor". Pressing the SET POINT buttons will move the cursor left (–) or right (+) within the available options.

Display contrast

To change the display contrast, use a small, flat-blade screwdriver in the slot provided to make the adjustment.

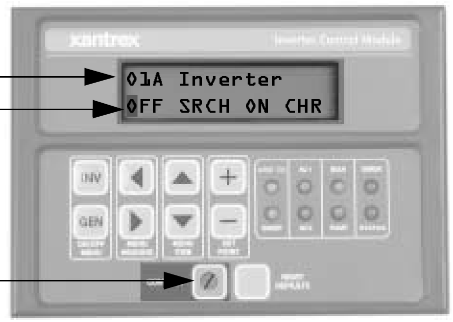


Figure 5-2 ICM Display and Contrast Adjustment

Push-buttons

Eight push-buttons enable access to internal software to program user-specific parameters and to monitor the system. These push-buttons access the User Menu, Basic Setup Menu, and the Advanced Setup Menu. One push-button is available for resetting factory defaults.

ON/OFF Menu Buttons

These push-buttons directly access either the Inverter User Menu or the Generator User Menu.

- INV ON/OFF (Red) Button - Pressing the red INV ON/OFF button directly accesses the menu item **01A Inverter**.
- GEN ON/OFF (Green) Button - Pressing the green GEN ON/OFF button directly accesses menu item **02A Generator**.

Figure 5-3 ICM ON/OFF Push-buttons

Menu Heading Buttons

The Menu Heading push-buttons are used to move either forward or backward through the Menu Heading selections.

- Press the ▶ Menu Heading button to move forward.
- Press the ◀ Menu Heading button to move backward.

Figure 5-4 ICM Menu Heading Push-buttons

Menu Item Buttons

Below the Menu Headings are subdirectories called Menu Items. Menu Items contain the selectable parameters or set points.

- Press the ▲ Menu Item button to move up.
- Press the ▼ Menu Item button to move down.

Figure 5-5 ICM Menu Item Push-uttons

Set Point Buttons

The SET POINT buttons change the value of a parameter or select a mode from the displayed menu.

- Press the SET POINT button (+) to move the cursor to the right or raise an adjustable value.
- Press the SET POINT button (–) to move the cursor left or lower an adjustable value.

Figure 5-6 ICM Set Point Push-buttons

Reset Factory Defaults

The Reset Defaults push-button at the bottom of the ICM refreshes the LCD display.

Pressing this button when the “Press Resets for Factory Default” menu is displayed resets the unit to the factory defaults. See “Press Reset for Factory Defaults” on page 8–21 for instructions on using this feature.

Figure 5-7 ICM Reset Defaults button

CAUTION: Equipment Damage

Ensure all devices connected to the ALM or GSM are disabled prior to pressing the Reset Factory Defaults button.

Menu Map

Introduction

The menu system contains three main menu maps. Each Menu Map is made up of:

- Menu Headings,
- Menu Items, and
- Set Points.

A set point is selected when the cursor highlights the first letter, or number, of the selection.

Each of the Menu Headings will have "END Menu" menu items to indicate the end of the Menu Heading category.

The "User" Menu

- The User Menu contains the basic operational functions of the unit and provides system status information. The User Menu uses Menu Headings 1-7.

The "Basic Setup" Menu

- The Basic Setup Menu contains the basic setup information to run the equipment in basic inverter/charger Mode. Basic programming includes setting the time-of-day clock, configuring the inverter functions, determining the battery charging parameters, and selecting the AC input characteristics. The Basic Setup Menu uses Menu Headings 10-14 with applicable menu items to support each function.

The "Advanced Setup" Menu

- The Advanced Setup Menu contains the setup information for the system to use to perform special (or advanced) features such as automatic generator starting, auxiliary load control, remote monitoring, and energy management features. The Advanced Setup Menu uses Menu Headings 20-27.

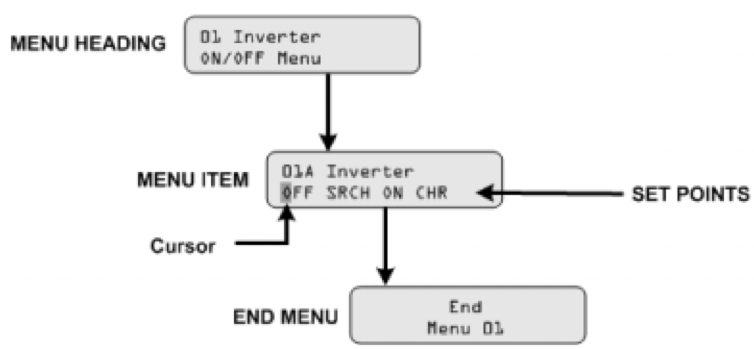


Figure 5-8 Menu Structure

User Menu (01-07) The USER MENU allows access to the daily operational functioning of the unit. These Menu Headings do not set configuration parameters, but do provide system performance information.

See “The User Menu Summary” on page 8–11 for a summary of the default settings and display descriptions.

See “Accessing the User Menu” on page 8–14 for instructions on accessing the User Menu.

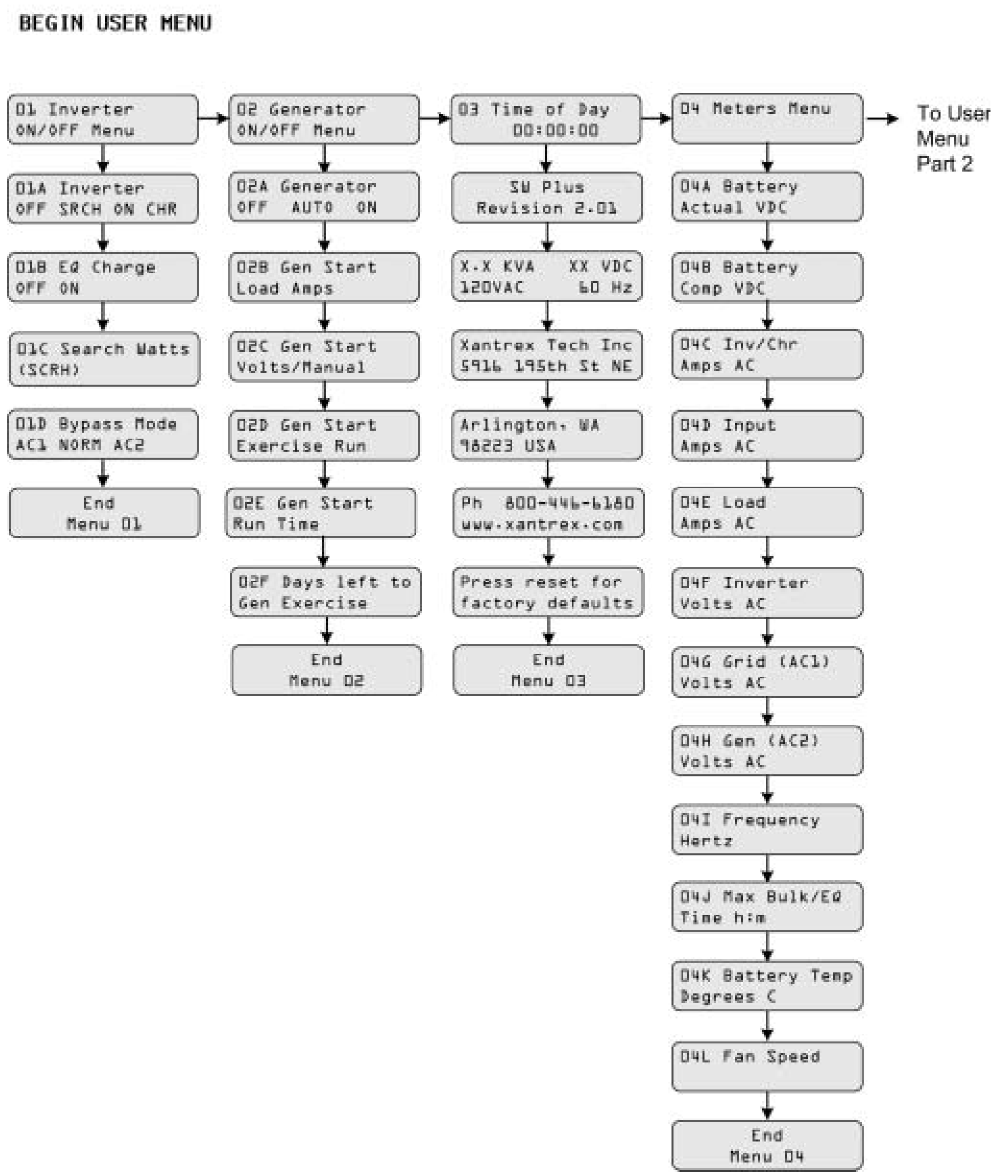


Figure 5-9 User Menu Map - Part 1

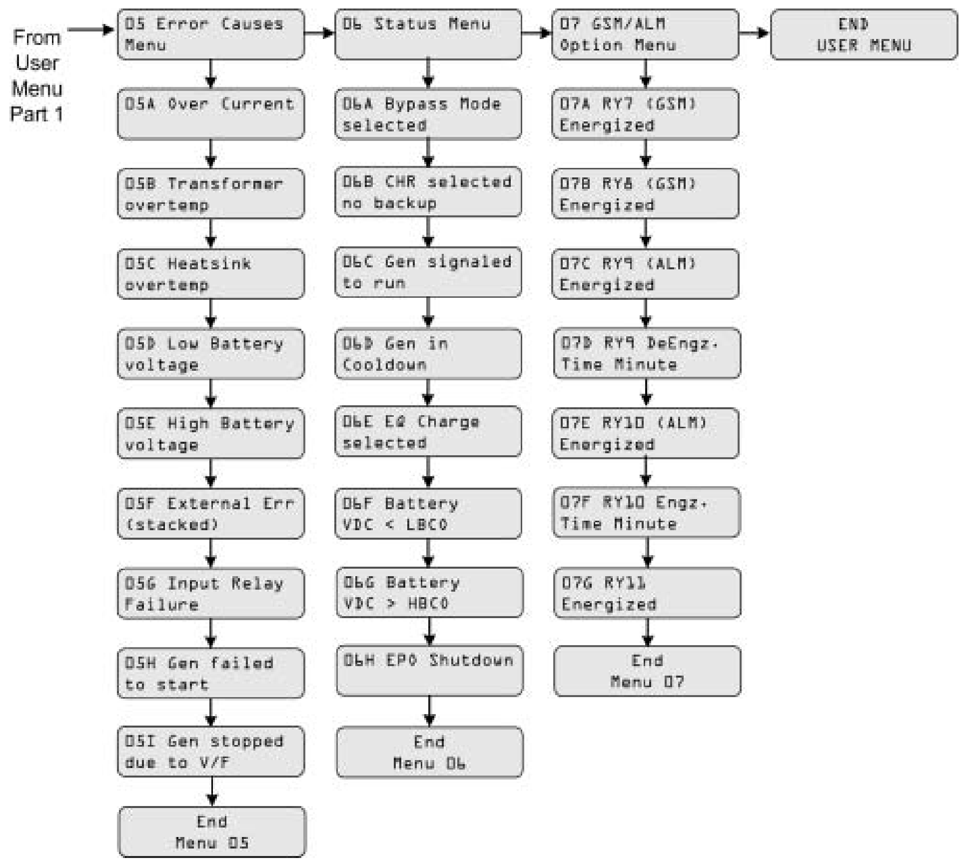


Figure 5-10 User Menu Map - Part 2

Basic Setup Menu (10-14)

The BASIC SETUP MENU follows the User Menu in the menu architecture. This menu allows access to the settings required for system configuration and modes of operation. Establishing these parameters upon initial power-up will be required.

See "Basic Setup Process" on page 6–9 for overview instructions on programming the Basic Setup.

See "Accessing the Basic Setup Menu" on page 6–10 for instructions on accessing the Basic Setup Menu.

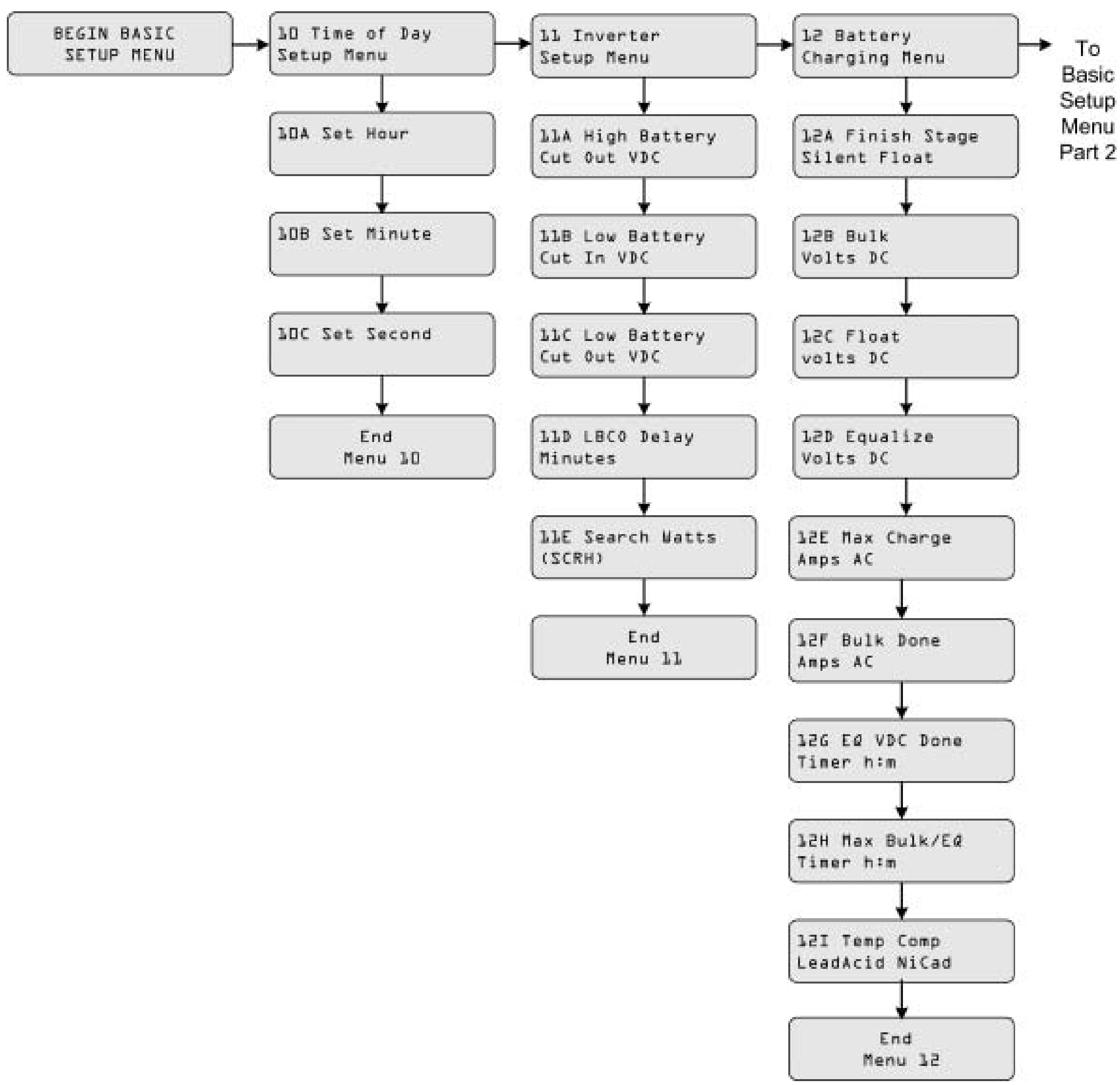


Figure 5-11 Basic Setup Menu Map Part 1

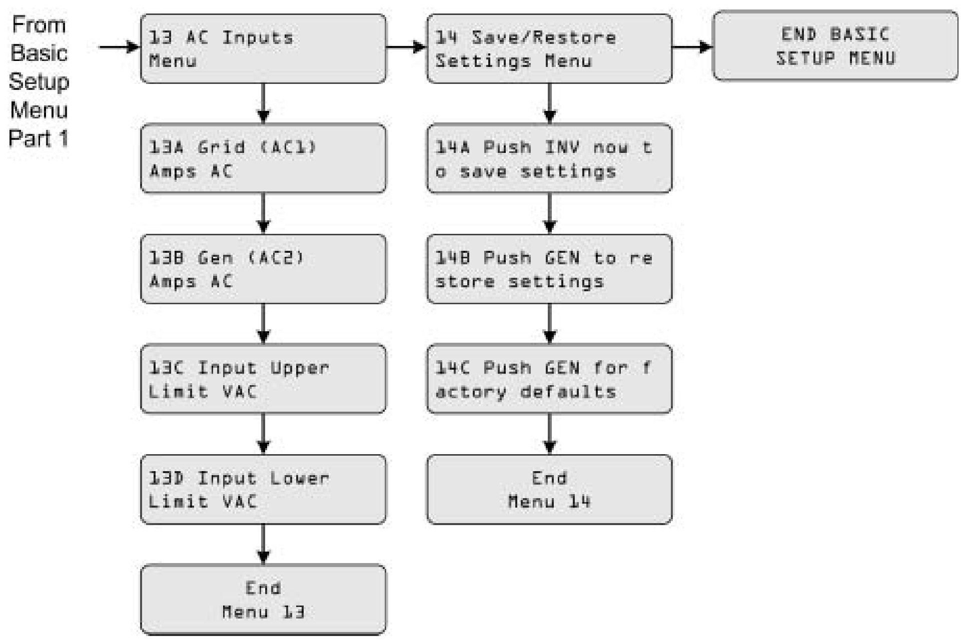


Figure 5-12 Basic Setup Menu Map Part 2

Advanced Setup Menu (20-27)

The ADVANCED SETUP MENU contains specialized configuration settings such as automatic generator starting details, auxiliary load usage, and energy management (grid usage) parameters.

See “Advanced Setup Summary” on page 7–2 for a listing of all the default settings for this menu structure.

See “Accessing the Advanced Setup Menu” on page 7–11 for specific instructions on accessing the Advanced Setup Menu.

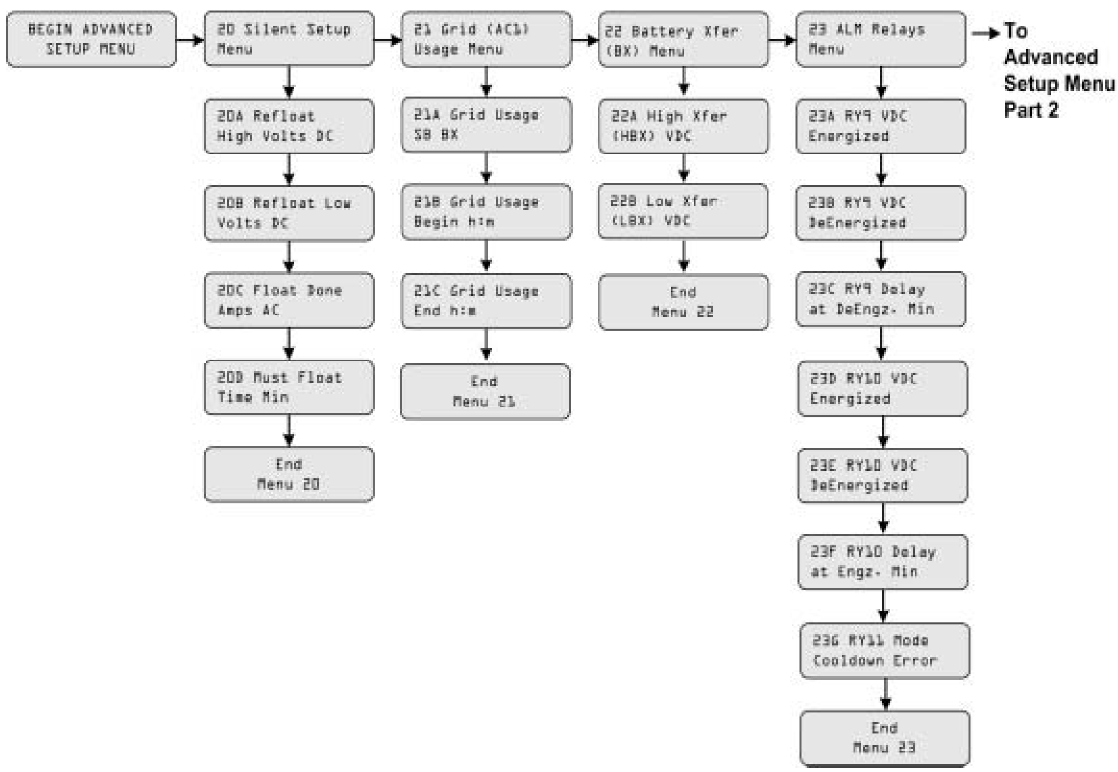


Figure 5-13 Advanced Setup Menu Map Part 1

Figure 5-14 Advanced Setup Menu Map Part 2

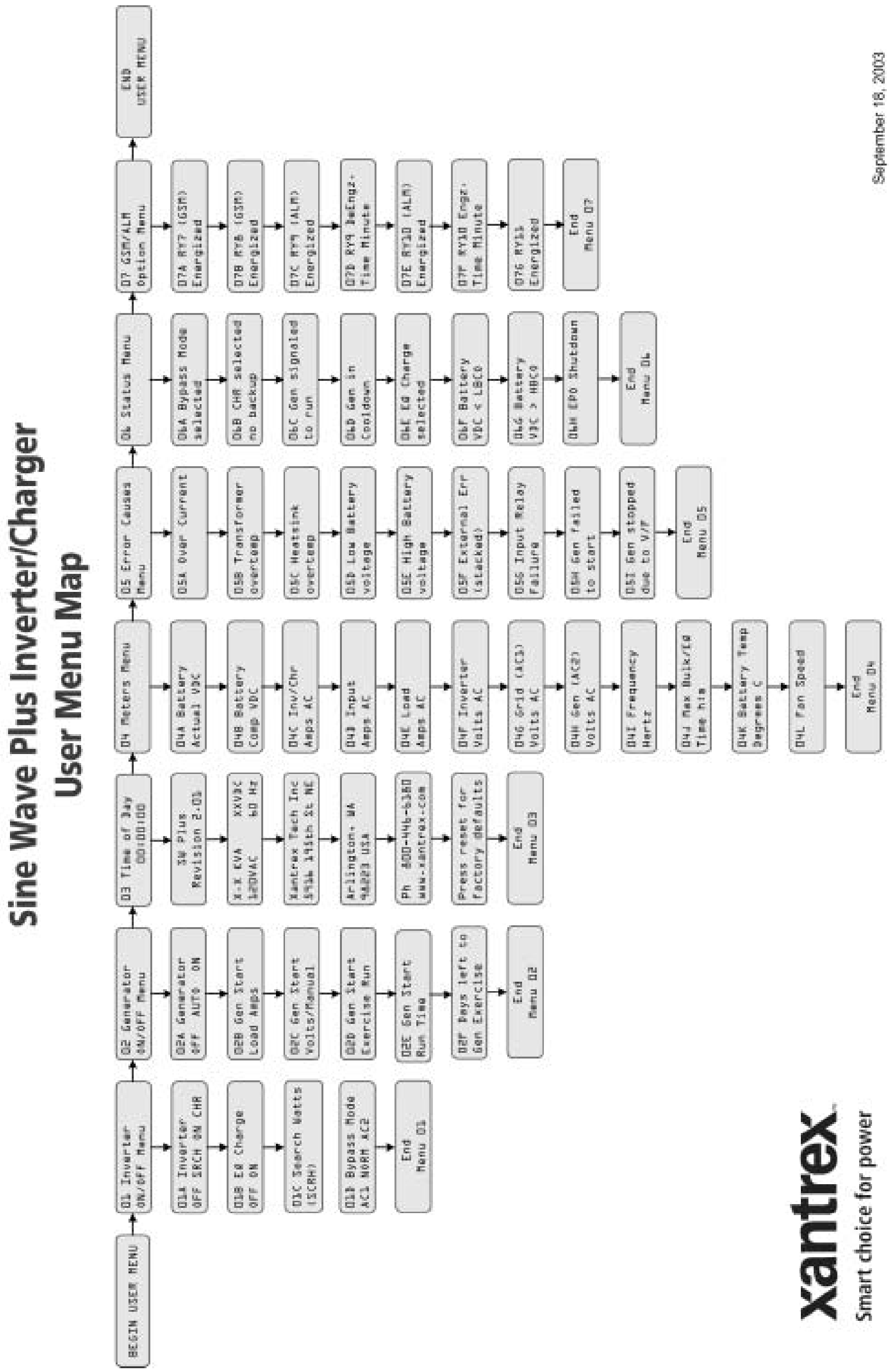


Figure 5-15 Complete User Menu Map

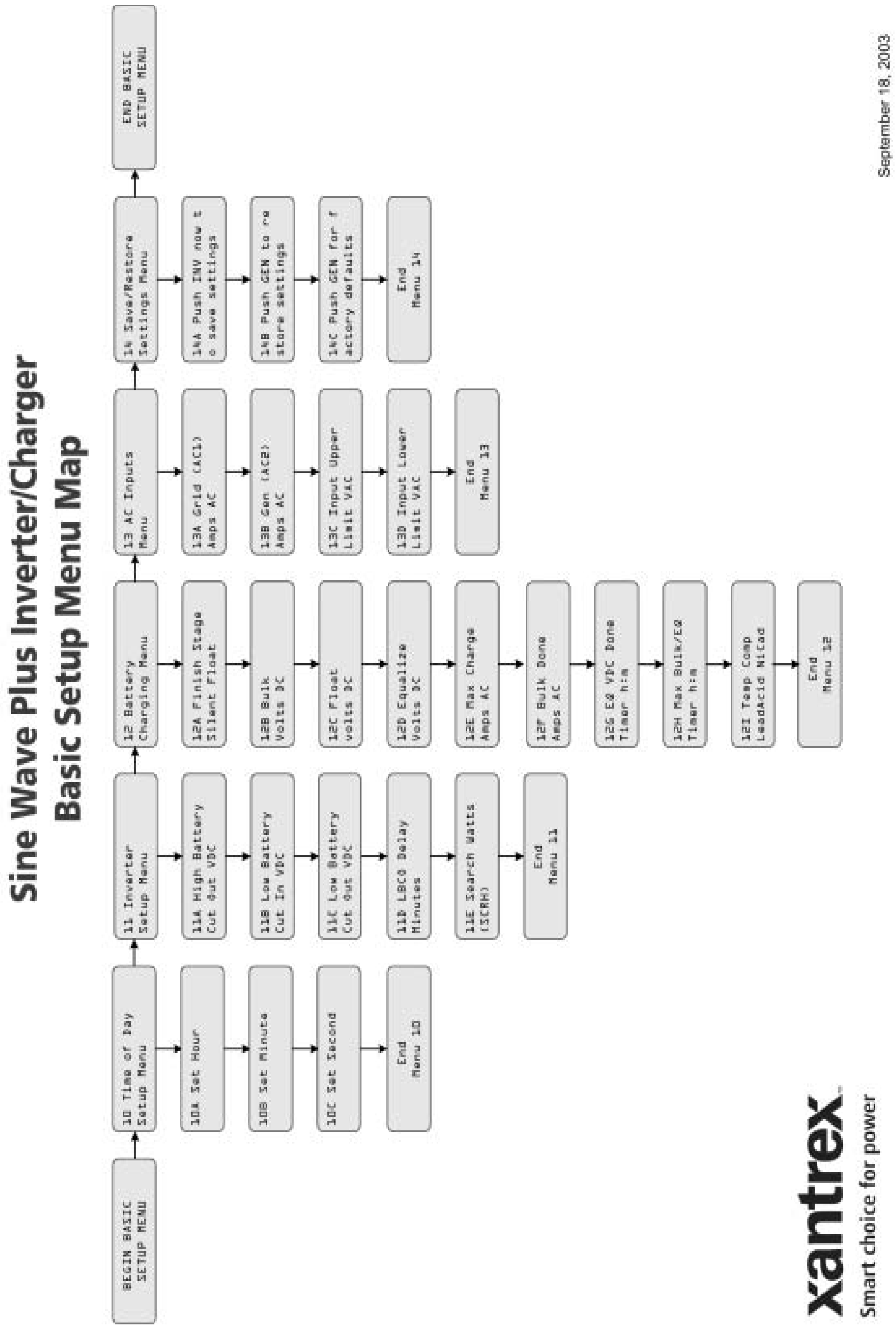


Figure 5-16 Complete Basic Setup Menu Map

Figure 5-17 Complete Advanced Setup Menu Map

6 Basic Setup Programming

Chapter 6, “Basic Setup Programming” explains how to program the Sine Wave Plus Inverter/Charger to operate under basic conditions.

Basic Setup Summary

Check Defaults

The following tables provides the default settings for the Sine Wave Plus Basic Setup Menu for each model and the cross-reference pages for locating information on each menu item.

- Table 6-1, “Basic Setup Menu Default Settings for the Sine Wave Plus 2524 and 2548 Models” on page 6–2
- Table 6-2, “Basic Setup Menu Default Settings for the Sine Wave Plus 4024 and 4048 Models” on page 6–4
- Table 6-3, “Basic Setup Menu Default Settings for the Sine Wave Plus 5548 Model” on page 6–6

Record Changes

If your system requires changes to these default settings, record the changes on the model-specific tables in Appendix B, “Configuration Settings” before your start programming. These tables are found on the following pages:

- Table B-2, “Basic Setup Default and User Settings for the Sine Wave Plus 2524 and 2548 Models” on page B–5
- Table B-3, “Basic Setup Default and User Settings for the Sine Wave Plus 4024 and 4048 Models” on page B–6
- Table B-4, “Basic Setup Default and User Settings for the Sine Wave Plus 5548 Model” on page B–8

For directions on how to access the Basic Setup Menu, see “Accessing the Basic Setup Menu” on page 6–10.

Table 6-1 Basic Setup Menu Default Settings for the Sine Wave Plus 2524 and 2548 Models

	Sine Wave Plus 2524		Sine Wave Plus 2548		
Basic Setup Menus	**Range/ Display**	**Default**	**Range/ Display**	**Default**	**See Page**
10 Time of Day Setup Menu	See “10 Time of Day Setup Menu” on page 6–11 for details.				
10A Set Hour	00:00:00 to 23:50:00	00:00:00	00:00:00 to 23:50:00	00:00:00	page 6–11
10B Set Minute	00:00:00 to 00:09:00	00:00:00	00:00:00 to 00:09:00	00:00:00	page 6–11
10C Set Second	00 to 59	00:00:00	00 to 59	00:00:00	page 6–12
End Menu 10					
11 Inverter Setup Menu	See “11 Inverter Setup Menu” on page 6–12 for details.				
11A High Battery Cut Out Vdc	16.1 to 34.0	32.0	32.2 to 68.0	64.0	page 6–12
11B Low Battery Cut In Vdc	16.1 to 33.9	26.0	32.2 to 67.8	52.0	page 6–12

Table 6-1 Basic Setup Menu Default Settings for the Sine Wave Plus 2524 and 2548 Models

Basic Setup Menus	Sine Wave Plus 2524 Range/ Display	Sine Wave Plus 2524 Default	Sine Wave Plus 2548 Range/ Display	Sine Wave Plus 2548 Default	See Page
11C Low Battery Cut Out Vdc	11.0 to 33.9	22.0	32.0 to 67.8	44.0	page 6–13
11D LBCO Delay Minutes	01 to 255	15	01 to 255	15	page 6–13
11E Search Watts (SRCH)	00 to 248	08	00 to 248	08	page 6–14
End Menu 11					
12 Battery Charging Menu	See “12 Battery Charging Menu” on page 6–19 for details.				
12A Finish Stage	SILENT FLOAT	FLOAT	SILENT FLOAT	FLOAT	page 6–19
12B Bulk Volts DC	20.0 to 32.0	28.8	40.0 to 64.0	57.6	page 6–20
12C Float Volts DC	20.0 to 32.0	26.8	40.0 to 64.0	53.6	page 6–20
12D Equalize Volts DC	20.0 to 32.0	28.8	40.0 to 64.0	57.6	page 6–20
12E Max Charge Amps AC	01 to 20	20	01 to 20	20	page 6–22
12F Bulk Done Amps AC	00 to 20	10	00 to 20	10	page 6–23
12G EQ Vdc Done Timer	00:00 to 23:50	02:00	00:00 to 23:50	02:00	page 6–24
12H Max Bulk/EQ Timer	00:00 to 23:50	05:00	00:00 to 23:50	05:00	page 6–25
12I Temp Comp	LeadAcid NiCad	LeadAcid	LeadAcid NiCad	LeadAcid	page 6–25
End Menu 12					
13 AC Inputs Menu	See “13 AC Inputs Menu” on page 6–26 for details.				
13A Grid (AC1) Amps AC	00 to 60	60	00 to 60	60	page 6–27
13B Gen (AC2) Amps AC	00 to 60	30	00 to 60	30	page 6–27
13C Input Upper Limit Vac	125 to 150	130	125 to 150	130	page 6–28
13D Input Lower Limit Vac	80 to 115	110	80 to 115	110	page 6–28
End Menu 13					
14 Save/Restore Settings Menu	See “14 Save/Restore Settings Menu” on page 6–29 for details.				
14A Push INV now to save settings	Push INV now to save settings				page 6–29
14B Push GEN to restore settings	Push GEN to restore settings				page 6–29

Table 6-1 Basic Setup Menu Default Settings for the Sine Wave Plus 2524 and 2548 Models

Basic Setup Menus	Sine Wave Plus 2524		Sine Wave Plus 2548		See Page
	Range/ Display	Default	Range/ Display	Default	
14C Push GEN for factory defaults	Push GEN for factory defaults				page 6–30
End Menu 14					
END BASIC SETUP MENU					

Table 6-2 Basic Setup Menu Default Settings for the Sine Wave Plus 4024 and 4048 Models

Basic Setup Menus	Sine Wave Plus 4024		Sine Wave Plus 4048		See Page
	Range/ Display	Default	Range/ Display	Default	
10 Time of Day Setup Menu	See "10 Time of Day Setup Menu" on page 6–11 for details.				
10A Set Hour	00:00:00 to 23:50:00	00:00:00	00:00:00 to 23:50:00	00:00:00	page 6–11
10B Set Minute	00:00:00 to 00:09:00	00:00:00	00:00:00 to 00:09:00	00:00:00	page 6–11
10C Set Second	00 to 59	00:00:00	00 to 59	00:00:00	page 6–12
End Menu 10					
11 Inverter Setup Menu	See "11 Inverter Setup Menu" on page 6–12 for details.				
11A High Battery Cut Out Vdc	16.1 to 34.0	32.0	32.2 to 68.0	64.0	page 6–12
11B Low Battery Cut In Vdc	16.1 to 33.9	26.0	32.2 to 67.8	52.0	page 6–12
11C Low Battery Cut Out Vdc	11.0 to 33.9	22.0	32.0 to 67.8	44.0	page 6–13
11D LBCO Delay Minutes	01 to 255	15	01 to 255	15	page 6–13
11E Search Watts (SRCH)	00 to 248	08	00 to 248	08	page 6–14
End Menu 11					
12 Battery Charging Menu	See "12 Battery Charging Menu" on page 6–19 for details.				
12A Finish Stage	SILENT FLOAT	FLOAT	SILENT FLOAT	FLOAT	page 6–19
12B Bulk Volts DC	20.0 to 32.0	28.8	40.0 to 64.0	57.6	page 6–20
12C Float Volts DC	20.0 to 32.0	26.8	40.0 to 64.0	53.6	page 6–20
12D Equalize Volts DC	20.0 to 32.0	28.8	40.0 to 64.0	57.6	page 6–20

Table 6-2 Basic Setup Menu Default Settings for the Sine Wave Plus 4024 and 4048 Models

	Sine Wave Plus 4024		Sine Wave Plus 4048		
Basic Setup Menus	**Range/ Display**	**Default**	**Range/ Display**	**Default**	**See Page**
12E Max Charge Amps AC	01 to 30	30	01 to 30	30	page 6–22
12F Bulk Done Amps AC	00 to 30	10	00 to 30	10	page 6–23
12G EQ Vdc Done Timer	00:00 to 23:50	02:00	00:00 to 23:50	02:00	page 6–24
12H Max Bulk/EQ Timer	00:00 to 23:50	05:00	00:00 to 23:50	05:00	page 6–25
12I Temp Comp	LeadAcid NiCad	LeadAcid	LeadAcid NiCad	LeadAcid	page 6–25
End Menu 12					
13 AC Inputs Menu	See "13 AC Inputs Menu" on page 6–26 for details.				
13A Grid (AC1) Amps AC	00 to 60	60	00 to 60	60	page 6–27
13B Gen (AC2) Amps AC	00 to 60	30	00 to 60	30	page 6–27
13C Input Upper Limit Vac	125 to 150	130	125 to 150	130	page 6–28
13D Input Lower Limit Vac	80 to 115	110	80 to 115	110	page 6–28
End Menu 13					
14 Save/Restore Settings Menu	See "14 Save/Restore Settings Menu" on page 6–29 for details.				
14A Push INV now to save settings	Push INV now to save settings				page 6–29
14B Push GEN to restore settings	Push GEN to restore settings				page 6–29
14C Push GEN for factory defaults	Push GEN for factory defaults				page 6–30
End Menu 14					
END BASIC SETUP MENU					

Table 6-3 Basic Setup Menu Default Settings for the Sine Wave Plus 5548 Model

Basic Setup Menus	Sine Wave Plus 5548 Range/ Display	Sine Wave Plus 5548 Default	See Page
10 Time of Day Setup Menu	See “10 Time of Day Setup Menu” on page 6–11 for details.		
10A Set Hour	00:00:00 to 23:50:00	00:00:00	page 6–11
10B Set Minute	00:00:00 to 00:09:00	00:00:00	page 6–11
10C Set Second	00 to 59	00:00:00	page 6–12
End Menu 10			
11 Inverter Setup Menu	See “11 Inverter Setup Menu” on page 6–12 for details.		
11A High Battery Cut Out Vdc	32.2 to 68.0	64.0	page 6–12
11B Low Battery Cut In Vdc	32.2 to 67.8	52.0	page 6–12
11C Low Battery Cut Out Vdc	32.0 to 67.8	44.0	page 6–13
11D LBCO Delay Minutes	01 to 255	15	page 6–13
11E Search Watts (SRCH)	00 to 248	08	page 6–14
End Menu 11			
12 Battery Charging Menu	See “12 Battery Charging Menu” on page 6–19 for details.		
12A Finish Stage	SILENT FLOAT	FLOAT	page 6–19
12B Bulk Volts DC	40.0 to 64.0	57.6	page 6–20
12C Float Volts DC	40.0 to 64.0	53.6	page 6–20
12D Equalize Volts DC	40.0 to 64.0	57.6	page 6–20
12E Max Charge Amps AC	01 to 45	40	page 6–22
12F Bulk Done Amps AC	00 to 50	10	page 6–23
12G EQ Vdc Done Timer	00:00 to 23:50	02:00	page 6–24
12H Max Bulk/EQ Timer	00:00 to 23:50	05:00	page 6–25
12I Temp Comp	LeadAcid NiCad	LeadAcid	page 6–25
End Menu 12			

Table 6-3 Basic Setup Menu Default Settings for the Sine Wave Plus 5548 Model

Basic Setup Menus	Sine Wave Plus 5548 Range/ Display	Sine Wave Plus 5548 Default	See Page
13 AC Inputs Menu	See "13 AC Inputs Menu" on page 6–26 for details.		
13A Grid (AC1) Amps AC	00 to 60	60	page 6–27
13B Gen (AC2) Amps AC	00 to 60	30	page 6–27
13C Input Upper Limit Vac	125 to 150	130	page 6–28
13D Input Lower Limit Vac	80 to 115	110	page 6–28
End Menu 13			
14 Save/Restore Settings Menu	See "14 Save/Restore Settings Menu" on page 6–29 for details.		
14A Push INV now to save settings	Push INV now to save settings		page 6–29
14B Push GEN to restore settings	Push GEN to restore settings		page 6–29
14C Push GEN for factory defaults	Push GEN for factory defaults		page 6–30
End Menu 14			
END BASIC SETUP MENU			

Before You Begin Programming

Some items must be pre-determined or confirmed before you start programming the inverter/charger for use. These items include the voltage levels to operate the inverter, charging parameters for the battery charger, and AC input amperage limits.

DC Amps verses AC Amps

Some of the settings in the Basic Setup Menu may require you to convert DC amps to AC amps.

Inverters convert DC power into AC power. Since the DC voltage will be lower than the AC voltage, the DC amps will be higher than the AC amps.

The formula or ratio of DC amps to AC amps is the actual AC voltage divided by the actual DC voltage. This ratio is not exact as there will be losses, although small, in the power conversion process.

Actual AC Voltage ÷ Actual DC Voltage ≈ Amp ratio

Note: The AC ammeters have an approximate 1 amp tolerance.

There are two “rules of thumb” using this inverter to estimate the amperages.

- If you are running on battery power:

  24 Vdc inverters have about a 5 to 1 ratio of DC amps to AC amps.

  48 Vdc inverters have about a 2.5 to 1 ratio of DC amps to AC amps.
- If you charging battery from AC power:

  24 Vdc inverters have about a 4 to 1 ratio of DC amps to AC amps.

  48 Vdc inverters have about a 2 to 1 ratio of DC amps to AC amps.

For example:

- *A 24 Vdc inverter operating from a battery at 25 Vdc and making 120 Vac will use approximately 4.8 amps DC for every 1 amp AC consumed by the loads (120 Vac/25 Vdc = 4.8)*
- *A 48 Vdc inverter charging a battery at 60 Vdc from a generator supplying the inverter with 120 Vac will make approximately 2 amps DC for every 1 amp AC (120 Vac/60 Vdc = 2)*

Basic Setup Process

The Basic Setup procedure is comprised of the following items:

1. Setting the Time of Day – This sets the internal clock for all the features requiring time functions.

   See “10 Time of Day Setup Menu” on page 6–11 for instructions on setting the Time of Day.

2. Selecting Inverter functions – This selects basic inverter operating functions.

   See “11 Inverter Setup Menu” on page 6–12 for instructions on setting the Inverter functions.

3. Selecting Charger functions – This selects the basic charger functions.

   See “12 Battery Charging Menu” on page 6–19 for instructions on setting the Charger functions.

4. Selecting Grid Usage functions – This selects basic Grid Usage functions.

   See “13 AC Inputs Menu” on page 6–26 for instructions on setting the Grid Usage functions.

5. Saving programmed parameters.

   See “14 Save/Restore Settings Menu” on page 6–29 for instructions on saving programmed parameters.

Accessing the Basic Setup Menu

To access the Basic Setup Menu:

1. If you have not already done so, turn on the inverter.
2. Press the ▶ button to move forward within the Menu Headings until the **END USER MENU** is displayed.
3. Press and hold down the green GEN button.
4. While holding the green GEN button down, press the red INV button to move into the Basic Setup Menu.

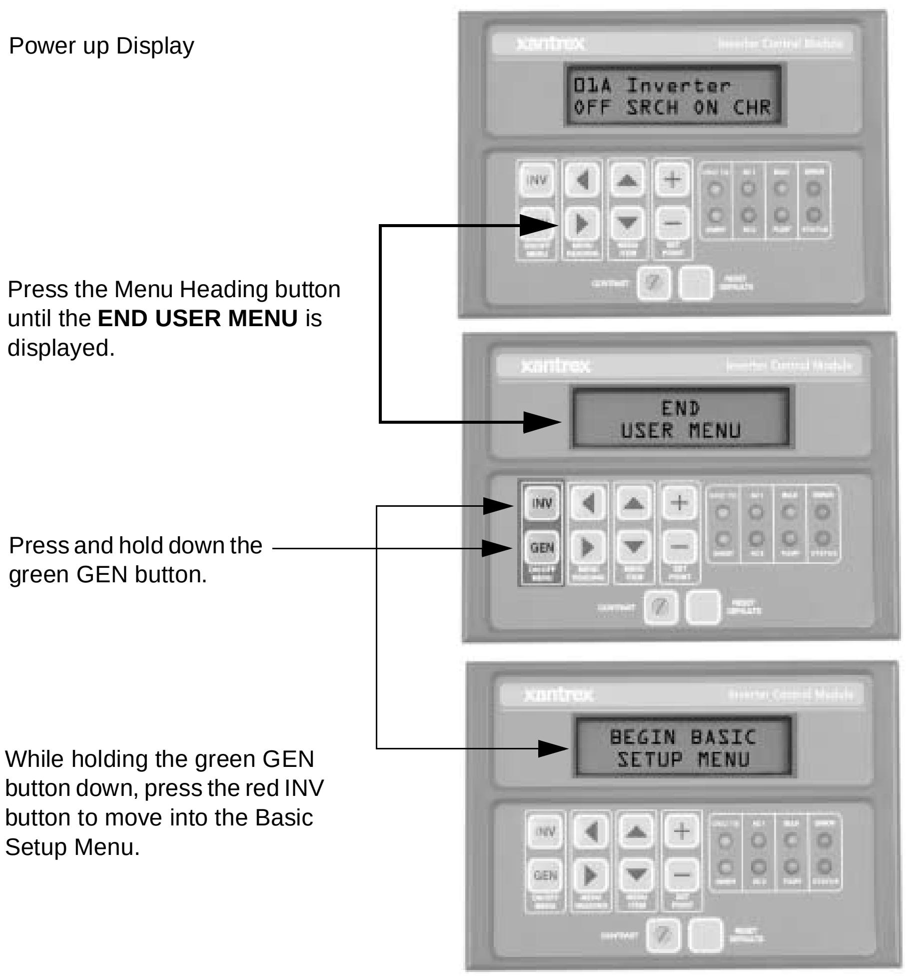


Figure 6-1 Accessing the Basic Setup Menu

Menu Item Descriptions

10 Time of Day Setup Menu

```
10 Time of Day
Setup Menu
```

This menu allows for setting the time of day in hours, minutes, and seconds. The time is displayed in a 24-hour format (i.e., 00:00:00 to 23:59:59 hours).

Important: If the system is being setup for the first time or the DC batteries were disconnected from the inverter, then the time must be reset. The programmed time does not reset when the “Press for Factory Defaults” button is pressed.

To set the time of day:

◆ When the **BEGIN BASIC SETUP MENU** is displayed, press the ▶ button to move forward until **10 Time of Day Setup Menu** is displayed.

10A Set Hour

```
10A Set Hour
```

To set the hour display:

1. When the **10 Time of Day Setup Menu** is displayed, press the ▼ button to select **10A Set Hour**.
2. When **10A Set Hour** is displayed, press the SET POINT buttons (+) or (–) to change the time displayed. The "minute" section of the display will change in 10-minute increments.
3. Keep pressing the SET POINT buttons until the appropriate hour is displayed.

10B Set Minute

```
10B Set Minute
```

To set the minute display:

1. Press the ▼ button to select **10B Set Minute**.
2. When **10B Set Minute** is displayed, press the SET POINT buttons (+) or (–) to change the time displayed. The "minute" section of the display will change in 1-minute increments.
3. Press the SET POINT buttons (+) or (–) until the proper minutes are displayed.

10C Set Seconds

```
10C Set Seconds
```

To set the second display:

1. Press the ▼ button to select **10C Set Second**.
2. When **10C Set Second** is displayed, press the SET POINT buttons (+) or (–) to change the time displayed. The “seconds” section of the display will change in 1-second increments.
3. Press the SET POINT buttons (+) or (–) until the proper seconds are displayed. Seconds will stay fixed as set until you exit the display.

11 Inverter Setup Menu

```
11 Inverter
Setup Menu
```

The following inverter settings are intended to protect the batteries from excessive discharging. These settings prevent the inverter from drawing excessive DC voltage from the batteries. To do this, it is necessary to determine the voltage levels where the inverter will start and stop drawing power from the battery bank.

The factory default settings for inverter functions are set to protect most types of batteries. It may not be necessary to alter these settings. Before changing the default settings, check with your battery dealer/installer.

Important: Both **11A High Battery Cut Out (HBCO)** and **11C Low Battery Cut Out (LBCO)** values lock the upper and lower limits of the inverter/charger and will override and/or readjust other settings programmed.

Be sure to recheck and reset, if necessary, all settings affected by changes to **11B Low Battery Cut in VDC**, **20A Refloat High Volts DC, 20B Refloat Low Volts DC, 22A High Xfer (HBX) Vdc, 22B Low Xfer (LBX).**

11A High Battery Cut Out VDC

```
11A High Battery
Cut Out VDC
```

This voltage level is the maximum voltage the batteries will be allowed to reach. If the battery voltage exceeds this limit for more than 1 minute, the inverter will shut down. The inverter will not support AC loads when in this condition. The inverter automatically restarts when the voltage drops to 3 Vdc (24-volt models) or 6 Vdc (48-volt models) below the HBCO setting. This setting is not temperature compensated.

11B Low Battery Cut In VDC

```
11B Low Battery
Cut In VDC
```

This menu item sets the battery voltage level that turns the inverter back on after being shut down by the LBCO setting. Set this voltage level lower than the Bulk or Float volts DC setting.

This voltage level is used to indicate that the batteries have a sufficient level of charge for the inverter to start using power from the battery bank.

11C Low Battery Cut Out VDC

```
11C Low Battery
Cut Out VDC
```

When the batteries discharge to the level set in **11C Low Battery Cut Out VDC**, and are held at or below this level for the **11D LBCO Delay** time, the inverter output shuts down and transfers any available AC source (generator or grid) to the charger to bring the battery level back up to the **11B Low Battery Cut In Vdc** level. The inverter will not support any AC loads when in this condition. AC loads will have to be powered by either a generator or grid power. This is the lowest voltage level acceptable for battery use by the inverter.

11D LBCO Delay Minutes

```
11D LBCO Delay
Minutes
```

Menu item **11D LBCO Delay Minutes** is used to set the length of time (in minutes) that the inverter is allowed to continuously operate at or below the LBCO level set in menu item **11C Low Battery Cut Out** before it shuts off.

Once the inverter has shut off, the battery voltage must rise above the value (set in menu **11B Low Battery Cut In**) for inverter operation to resume.

Guidelines for setting this menu item:

- If using an automatic generator starting system, do not set this delay period shorter than the amount of time it takes the generator to start and connect. Otherwise, the power will go OFF and then back ON when the generator auto-starts due to the LBCO condition.

11E Search Watts

```
11E Search Watts
SRCH
```

This menu item sets the inverter's search sensitivity. Any load that is below this setting does not cause the inverter to produce an AC output voltage when running from batteries. The SRCH function must be selected in **01A Inverter**.

Note: This item is duplicated for your convenience in menu item 01C and 11E. Changes to settings made at 01C will also change the setting in 11E. Likewise, changes to 11E will also change the setting in 01C.

How does Search Sense work

While idling in the Search Sense Mode, the inverter sends out a pulse about once per second. This electrical pulse travels through the AC wiring "looking" for loads that are connected to the system.

When a load is detected, the inverter then has to make a decision as to whether or not the load is large enough to provide power to. This decision point is user adjustable using the Search Sensitivity control on the inverter.

Why use search sense

Search sense allows you to selectively power only items that draw more than a certain amount of power, but the bigger reason lies in power savings.

For example:

Imagine an inverter that has a no-load idle power of 8 watts. This means the inverter needs 8 watts to power itself even if no loads are present.

If a water pump is driven by the inverter for only one hour total per day then the other twenty-three hours out of the day the inverter is using 8 watts per hour just to sit there and do nothing. That power comes from the batteries.

If search sense is set so that the inverter sleeps until the pump wants to run, the scenario described above greatly improves. Now instead of the inverter idling at 8 watts, only ½ watt is drawn while in Search Mode. This is a savings of 7½ watts per hour or 172.5 watt-hours. This converts directly to 7 amp-hours for a 24 volt battery system.

In systems with small batteries or limited charging capability, this could be a substantial savings.

How to set up the Search Mode feature on the inverter

The Search Sense feature on the inverter is only valuable if the inverter can spend a fair amount of time "sleeping" each day. Therefore, if Search Sense is to be utilized it must be adjusted properly. The initial adjustment should be made so that the inverter comes on only when needed.

The sensitivity control should be adjusted so that the smallest load being run can "wake" the inverter up and cause it to deliver power to the load.

If loads change significantly, then re-tuning of the search sensitivity will be required. It may take several adjustments to tweak the sensitivity to just the right point.

Certain types of loads can cause Search Mode to not work as expected. These types of loads are described on page 9–3 of the Troubleshooting Section. If these kinds of loads are in the system, follow the suggestions given to eliminate the problem. Some televisions with instant on circuits have a menu or control to disable it. If clocks are the problem load, consider using battery powered units.

If the problem loads just can't be eliminated in one of the suggested manners, there are two work-around solutions:

1. disable the search sense feature, causing the inverter to always remain at full output voltage, or
2. use a “search-friendly companion load” whose only purpose is to be switched on to “wake up” the inverter to power the load that is unable to bring the inverter out of Search Mode.

Guidelines for setting this menu item:

- Setting this mode to 00 disables this function. Default is 08 watts.
- When the inverter is searching the output for loads, lights that have a wattage lower than this setting, may flash momentarily.

Note: Search Mode, by function cannot work with timers or devices that need power 24 hours a day.

Examples of devices with timers include coffee makers with brew timers, refrigerators, and freezers with defrost timers.

Examples of devices that need power 24 hours a day include telephone answering machines, alarm systems, motion detection lights, and some thermostats.

Battery Charger Functions

When AC power is available, the inverter can operate as a battery charger. Different batteries will require different charging voltage levels. Not charging batteries at the required levels can shorten battery life or possible damage them. It will be necessary to select the voltage levels required and to set the voltage limits for the various stages of charging. Battery charging parameters are set in **12 Battery Charging Menu**.

Important: The default settings of the Sine Wave Plus may or may not work for your specific installation. Take the time to review the default settings to make sure they are appropriate for your installation. If not, you will need to adjust the settings according to the battery manufacturer's recommendations. The following information is provided to help you make the necessary calculations.

Note: This information is provided for guidance only. Variations in battery chemistry, as well as, site specific environmental considerations mean that you should consult your system designer or battery manufacturer for specific recommendations for appropriate battery voltage and current settings.

Multi-Stage Charging Process

The charging cycle uses a multi-stage charging process to maintain the batteries. Whenever AC power that is within the range of the inverter's settings is present at the inverter's input, it passes power through to the connected load and begins charging the batteries, indicated by the Bulk or Float charge indicator LED on the control module.

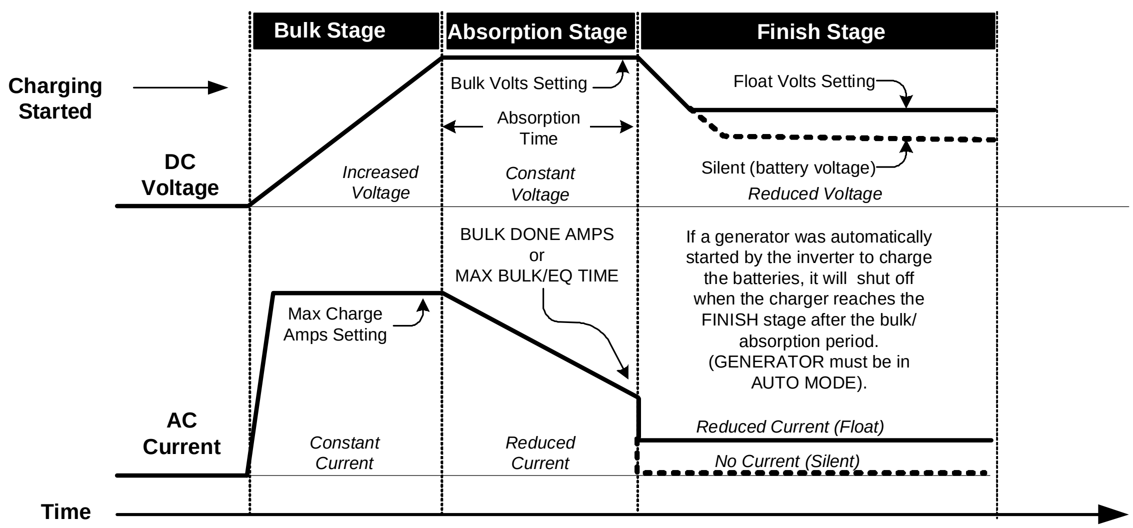


Figure 6-2 Multi-Stage Battery Charging Process

Bulk Stage

Bulk charge is the first stage in the charging process and provides the batteries with a controlled, constant current. Once the battery voltage rises to the bulk voltage threshold, the charger switches to the Absorption Stage.

Note: If there are DC loads on the batteries, the charger's current may never decrease to a level to initiate the finish stage of charging. To ensure the charger does not stay indefinitely in the bulk stage, set the adjustable timer menu item **12H Max Bulk/EQ Timer h:m** to limit the time the batteries are bulk charged. This timing circuit is activated at the start of the Absorption stage and terminates bulk charging if the charge current does not decrease to the setting in menu item **12F Bulk Done Amps AC** before the **12H Max Bulk/EQ Timer h:m** setting is reached.

Absorption Stage

Absorption charge is the second stage of battery charging and provides the batteries a controlled, constant voltage for a set period of time. During this stage, the current supplied to the batteries slowly decreases. When this current decreases to or below the setting in menu item **12F Bulk Done Amps AC**, the charger switches to the Finish stage.

Finish Stage

The Finish Stage contains two selections for the final stage of battery charging: Silent or Float Modes as described below.

Float Mode Float charge maintains a trickle charge on the batteries whenever AC is present on the inverter's input. Float charging reduces battery gassing, minimizes watering requirements (for flooded batteries), and ensures the batteries are in a constant state of readiness. When this mode is selected, the charger will automatically switch to the float stage after the batteries have received a bulk and absorption charge. The batteries will be maintained at the level set in menu item **12C Float Volts DC**.

Note: The battery voltage can increase above the float voltage when using an external charging device such as PV arrays, wind turbines, micro-hydro generators, etc. Be sure to include appropriate charge management equipment with all external DC sources.

Silent Mode After a bulk and absorption charge cycle is complete, the charger will shut down (go silent). AC voltage on the inverter's input will pass-through to the loads. The charger continues to monitor the battery voltage in this mode and starts a float charge when certain conditions are met:

- The batteries have discharged below the setting in menu item **20A Refloat Low Volts DC**.
- The battery voltage has increased above the value set in menu **20B Refloat High Volts DC**.

Notes:

- When in Silent Mode after entering the Float Charge, the charger remains in the Float Mode until the time set in **20F Must Float Time** and the level set in **20E Float Done Amps** have been reached.
- In Silent Mode, the transfer time between utility power and the inverter is slower than in Float Mode. If your application is dedicated to sensitive loads (such as computers), we recommend Float Mode. Silent Mode is not recommended for off-grid applications.
- If the AC input should fail or drops below the lower Vac limit (as set in menu item **13D Input Lower Limit VAC**), the complete multi-stage charge cycle (Bulk, Absorption, Finish) will be re-initiated once the source AC returns to an in-tolerance condition.
- Selecting Silent Mode for the Battery Charging Finish Stage is an Advanced Setup Application and requires additional parameters be established in Menu Heading **20 Silent Setup Menu**.

Equalize Charging the Batteries

Many battery manufacturers recommend periodic equalize charging to level out the voltage between individual cells resulting in better battery performance and life.

Over time, the battery's electrolyte can become "stratified" causing inactive areas in the plate material. If this condition is allowed to continue for extended periods, the battery plates can "sulfate" and become unusable. Equalizing the batteries is a controlled overcharging method that mixes up the electrolyte and reactivates the unused areas of the plate material, restoring batteries to a full state of charge.

Consult the battery manufacturer's recommendation for equalize charging settings.

WARNING: Explosion Hazard

Only flooded or vented batteries should be equalize-charged. Hydrogen and oxygen gases are produced when batteries are equalize-charged. Provide adequate ventilation and remove all sources of ignition to prevent explosion.

12 Battery Charging Menu

CAUTION: Damage to DC Loads and Batteries

DC loads should be disconnected from the batteries during equalization charging to protect DC loads from high battery voltages.

Equalization was designed for use on standard, liquid electrolyte (lead acid) batteries. Other battery types can be permanently damaged if equalized. If you have sealed or gel cell batteries, do not use the equalization charging function without first checking with the battery manufacturer.

Batteries will heat up when equalize charging. Always monitor the battery temperature in **04K Battery Temp Degrees C** and shut down the charger if the temperature exceeds the manufacturer's specifications. The BTS must be installed for the inverter to monitor battery temperature.

```
12 Battery
Charging Menu
```

Battery Charging parameters are programmed in **12 Battery Charging Menu** using the following menu items. Some of the menu items will require making calculations. Others just require making selections between the set points.

The voltage level settings should be adjusted with the battery at a reference temperature of 25 °C (77° F).

Important: Please consult your system designer or battery manufacturer for specific battery charging recommendations.

12A Finish Stage

```
12A Finish Stage
Silent    Float
```

This menu item determines the Charging Mode (Silent or Float) after the bulk and absorption charge have finished. Select either mode depending on your installation.

See "Finish Stage" on page 6-17 for additional information.

Additional programming will be required if Silent Mode is selected. See "20 Silent Setup Menu" on page 7–13 for additional information on the Silent Mode programming.

12B Bulk Volts DC

```
12B Bulk
Volts DC
```

This is the voltage level at which the charger switches to the absorption stage. The charger will use up to the parameter set in **12E Max Charge Amps AC** until the parameter set in **12B Bulk Volts DC** is reached. The actual battery charging voltage will be adjusted from this value when the BTS is used.

See Table 6-4, “Battery Voltages For Setting Charging Parameters” on page 6–21 for recommended bulk voltages.

12C Float Volts DC

```
12C Float
Volts DC
```

This is the voltage level at which the charger will maintain the batteries after a bulk and absorption charge. The actual battery charging voltage will be adjusted from this value when the BTS is used.

See Table 6-4, “Battery Voltages For Setting Charging Parameters” on page 6–21 for recommended float voltages.

12D Equalize Volts DC

```
12D Equalize
Volts DC
```

This the voltage level at which the charger performs an “equalize charge” on the batteries. The factory default setting is the same as the **12B Bulk Volts DC** settings. This is to prevent accidental damage to batteries from an unintentional equalize charge. The actual battery charging voltage will be adjusted from this value when the BTS is used.

Guidelines for setting this menu item:

- Be sure to adjust the equalize voltage level up or down depending upon your battery chemistry and whether or not you desire an equalize charge on the system.
- If this feature is not desired, set this parameter to be identical to the **12B Bulk Volts DC** setting.

See Table 6-4, “Battery Voltages For Setting Charging Parameters” on page 6–21 for recommended voltages for equalize charging.

Table 6-4 Battery Voltages For Setting Charging Parameters

Battery Type	BULK VOLTS 24-volt models	BULK VOLTS 48-volt models	FLOAT VOLTS 24-volt models	FLOAT VOLTS 48-volt models	Equalization Charge Process	Set Temp Comp
Sealed Gel Lead Acid	28.2 Vdc	56.4 Vdc	27.2 Vdc	54.4 Vdc	Not recommended - consult manufacturer	LeadAcid
AGM Lead Acid	28.8 Vdc	57.6 Vdc	26.8 Vdc	53.6 Vdc	Charge to 31.0 Vdc (24-volt models) or 62 Vdc (48-volt models) or as per manufacturer recommendations	LeadAcid
Maintenance-Free RV/Marine Lead Calcium Battery	28.8 Vdc	57.6 Vdc	26.8 Vdc	53.6 Vdc	Not recommended - consult manufacturer	LeadAcid
Deep-cycle, Liquid Electrolyte Lead Antimony Battery	29.2 Vdc	58.4 Vdc	26.8 Vdc	53.6 Vdc	Charge to 31.0 Vdc (24-volt models) or 62 Vdc (48-volt models) or as per manufacturer recommendations	LeadAcid
NiCad or NiFe Alkaline Battery (using 10 cells in series)	32.0 Vdc	64.0 Vdc	29.0 Vdc	58.0 Vdc	Consult Manufacturer	NiCad

The following settings (Table 6-5) are guidelines only. Refer to your battery vendor for specific settings and battery maintenance guidelines.

Table 6-5 Battery Charging Current and Timer Default Settings

Menu Item	SW Plus 2524 Default Settings	SW Plus 2548 Default Setting	SW Plus 4024 Default Settings	SW Plus 4048 Default Setting	SW Plus 5548 Default Setting
12E Max Charge Amps	20 amps	20 amps	30 amps	30 amps	40 amps
12F Bulk Done Amps AC	10 amps	10 amps	10 amps	10 amps	10 amps
12G EQ Vdc Done Timer h:m	02:00	02:00	02:00	02:00	02:00
12H Max Bulk/EQ Timer h:m	05:00	05:00	05:00	05:00	05:00
12I Temp Comp	LeadAcid	LeadAcid	LeadAcid	LeadAcid	LeadAcid

12E Max Charge Amps AC

```
12E Max Charge
Amps AC
```

This is the maximum AC amperage the inverter will provide to the battery charger to get the battery voltage up to the level set in one of the following menu items depending on which mode the battery charger is in as indicated by the LEDs on the inverter's display:

- **12B Bulk Volts DC**,
- **12C Float Volts DC**, or
- **12D Equalize Volts DC**.

Use menu **12E Max Charge Amps AC** to reduce the charging current to 10% (or less) of the battery capacity.

Guidelines for setting this menu item:

- Small battery banks may overheat if charged at too high of a current. Setting this value higher than the default and continuously drawing the maximum current may put the inverter in an Overtemp Error condition.

The following settings are guidelines only. Refer to your battery vendor for specific settings and battery maintenance guidelines.

Calculating Maximum Charging Amps

To calculate the 12E Max Charge Amps AC:

1. Multiply the battery amp hours by 10%. This is the DC Maximum Charge Rate.
2. Convert the DC Maximum Charge Rate to AC amps by dividing the DC Maximum Charge Rate by 3.5 for a 24-volt system or 1.75 for a 48-volt system.
3. The result is the approximate amp setting that should be entered for the **12E Set Max Charge Amps AC** menu item.

For stacked inverters, use half the battery amp hour rating in the calculations.

Table 6-6 Calculating the Maximum Charge Amps for a 24-volt, 700 amp-hour Battery

Step	Instruction	Equation
1	Multiply the total battery amp hours by 10%	700 x 10% = 70 (DC Max Charge Rate)
2	Divide the DC Max Charge Rate by 3.5	70 ÷ 3.5 = 20
3	Set the **12E Max Charge Amps AC** parameter.	20

Table 6-7 Calculating the Maximum Charge Amps for a 48-volt, 350 amp-hour Battery

Step	Instruction	Equation
1	Multiply the total battery amp hours by 10%	350 x 10% = 35 (DC Max Charge Rate)
2	Divide the DC Max Charge Rate by 1.75	35 ÷ 1.75 = 20
3	Set the 12E Max Charge Amps AC parameter.	20

12F Bulk Done Amps AC

12F Bulk Done
Amps AC

This is the AC current threshold where the battery charger will transfer from Absorption Charging to Finish Charging. It is recommended to set this value at 2 to 4% of the battery bank's total amp-hour capacity.

Guidelines for setting this menu item:

- Setting the **12F Bulk Done Amps AC** to 0 (zero) will keep the charger in the Bulk Mode until the setting in **12G Max Bulk/EQ Timer h:m** is reached.
- If there are any DC loads connected to the batteries (and are actively drawing current), this additional current must be added to the **12F Bulk Done Amps AC** setting (after conversion from DC amps). If this additional current is not accounted for, the charger will continue to charge at the bulk voltage until the **12G Max Bulk/EQ Timer h:m** period is reached and switches the charger out of the bulk stage.

To calculate the 12F Bulk Done Amps AC:

1. Multiply the battery amp hours by 2% to 4%. This is the AC Bulk Done Charge Rate.
2. Convert the AC Bulk Done Charge Rate to AC amps by dividing the AC Bulk Done Charge Rate by 4 for a 24-volt system or 2 for a 48-volt system.
3. The result is the approximate amp setting that should be entered for the **12F Bulk Done Amps AC** menu item.

For stacked inverters, use half the battery amp-hour rating in the calculations.

Table 6-8 Calculating the Bulk Done Amps for a 24-volt, 700 amp-hour Battery

Step	Instruction	Equation
1	Multiply the total battery amp hours by 2% (3%, 4%)	700 x 2% (3%, 4%) = 14 (21, 28) (AC Bulk Done Charge Rate)
2	Divide the AC Bulk Done Charge Rate by 4	14 ÷ 4 = 3.5 (for 2%) 21 ÷ 4 = 4 (for 3%) 28 ÷ 4 = 7 (for 4%)
3	Set the **12F Bulk Done Amps AC** parameter.	3 to 7 amps AC

Table 6-9 Calculating the Bulk Done Amps for a 48-volt, 350 amp-hour Battery

Step	Instruction	Equation
1	Multiply the total battery amp hours by 2% (3%, 4%)	350 x 2% (3%, 4%) = 7 (10.5, 14) (AC Bulk Done Charge Rate)
2	Divide the AC Bulk Done Charge Rate by 2	7 ÷ 2 = 3.5 (for 2%) 10.5 ÷ 2 = 5.25 (for 3%) 14 ÷ 2 = 7 (for 4%)
3	Set the **12F Bulk Done Amps AC** parameter.	3 to 7 amps AC

12G EQ VDC Done Timer

```
12G EQ VDC Done
Timer h:m
```

This is the maximum time the batteries will be allowed to charge at the equalize voltage level set in **12D Equalize Volts DC**. This setting is limited by **12H Max Bulk/EQ Timer h:m**, which sets the maximum period for the EQ charge stage. This is a safety feature that ensures that abnormal conditions will not cause the charger to hold the batteries at high voltages for prolonged periods of time. This timer starts when the EQ voltage is reached as set in menu item **12D Equalize Volts DC**.

12H Max Bulk/EQ Timer h:m

```
12H Max Bulk/EQ
Timer h:m
```

This is the maximum time the charger is allowed to keep the batteries in the Bulk or EQ Charge Stage. This timer starts when either the Equalize Charge starts or when the Bulk Charge starts. Ensure this setting doesn't interfere with the **12G EQ Vdc Done Timer h:m** or the **12F Bulk Done Amps AC** settings.

Guidelines for setting this menu item:

- Check menu item **04J Max Bulk/EQ Time h:m** (see page 8–24 for information) for the amount of time the charger has been in the Bulk or EQ charge stage.
- This is a safety feature ensuring that abnormal conditions (e.g., DC loads connected to the batteries) will not cause the battery charger to hold the batteries at high voltage levels for prolonged periods of time. As a protection feature, this timer overrides settings programmed in **12F Bulk Done Amps AC** and **12G EQ Vdc Done Timer** menu items.

12I Temp Comp

```
12I Temp Comp
LeadAcid NiCad
```

This menu item provides for the selection of the appropriate temperature compensation for your particular battery type. Temperature compensation reduces the battery charge voltage when the environmental temperature is hot to prevent battery over-gassing or overcharging. In cold temperatures, the voltage is increased to assure complete battery charging. Temperature compensation only occurs if the BTS is installed.

The BTS automatically fine tunes the charging process of the SW Plus inverter.

When the BTS is installed, the battery charging set points (**12B Bulk Volts DC, 12C Float Volts DC**, and **12D Equalize Volts DC**) are automatically adjusted based on the temperature of the battery being 25 °C (77 °F). Actual charging voltage may vary above or below these setting due to adjustments for battery temperature.

The Sine Wave Plus inverter adjusts the bulk, float, and equalizing set point by 60 mV for 24 Vdc systems and 120 mV for 48 Vdc systems per degree Celsius for the “LeadAcid” temperature compensation setting. For the “NiCad” setting, the inverter adjusts the set points by 40 mV for 24 Vdc systems and 80 mV for 48 Vdc systems per degree Celsius.

If the wiring to the sensor is damaged and the wires are shorted or cut, the inverter will charge at non-temperature compensated settings and the inverter may not charge as expected.

Temperature compensation calculations are derived from the following table:

Table 6-10 Inverter Temperature Compensation Calculation using the BTS

Battery Type	24-volt Systems	48-volt Systems
Lead Acid	0.060 volts (60 mV) per degree Celsius	0.120 Volts (120 mV) per degree Celsius
NiCad	0.040 volts (40 mV) per degree Celsius	0.080 volts (80 mV) per degree Celsius

Temperature compensation is based on battery type: 5 mv/cell for Lead Acid type batteries and 2 mv/cell for alkaline type batteries (NiCad or NiFe).

Note: If the battery temperature is allowed to fall to extremely cold temperatures, the inverter with a BTS may not be able to properly recharge cold batteries due to maximum voltage limits of the inverter. Ensure the batteries are protected from extreme temperatures.

The default for this menu item is LeadAcid. This setting only needs to be changed if using NiCad or Alkaline type batteries. Before changing the default settings, check with your battery manufacturer.

13 AC Inputs Menu

```
13 AC Inputs Menu
```

The AC input parameters establish the voltage settings and current limits for AC power usage. AC input is the AC power that the inverter draws on to either power the loads (pass through) or power the battery charger. AC power can be provided by the utility grid or an AC generator. These settings provide the limit at which the inverter will start drawing power from the batteries in order to meet the demand of the AC loads.

Configuring the AC inputs includes determining the following parameter values. These settings are programmed into **13 AC Inputs Menu** under the following menu items:

- **13A Grid (AC1) Amps**
- **13B Gen (AC2) Amps**
- **13C Input Upper Limit Vac**
- **13D Input Lower Limit Vac**

13A Grid (AC1) Amps AC

```
13A Grid (AC1)
Amps AC
```

This is the maximum amount of current that can be drawn from the grid (AC1 input) by the loads and battery charger combined. This settings determines the amperage level at which point the inverter starts drawing power from the batteries to add to the utility power to meet the demand of the loads. This is the AC load support feature.

If the loads exceed this setting, the inverter will draw from the batteries and add it to the utility power to meet the demand of the loads.

Typically, this value is set to the size of the AC circuit breakers feeding the inverter's AC input.

13B Gen (AC2) Amps AC

```
13B Gen (AC2)
Amps Ac
```

This is the maximum amount of current that can be drawn from the generator (AC2 input) by the loads. This settings determines the amperage level at which point the inverter starts drawing power from the batteries to add to the generator power to meet the demand of the loads. This is the AC load support feature.

If the loads exceed this setting, the inverter will draw from the batteries and add it to the generator power to meet the demand of the loads.

Typically, this value is set to the size of the generator's AC circuit breaker feeding the inverter's input or the maximum output amperage capacity of the generator.

This setting is very dependent on the performance of the generator. Other factors such as altitude, line losses between the generator and the inverter will require lowering this setting to below what the generator is rated for. For best results, begin with a setting half your expected generator current capacity and gradually increase this setting while verifying the AC voltage on the AC2 inverter terminals stays at lease several volts above the **13D Input Lower Limit VAC** setting.

13C Input Upper Limit VAC

```
13C Input Upper
Limit VAC
```

This menu item sets the highest voltage at which the inverter is allowed to connect to either AC1 or AC2 inputs. When this voltage is reached the inverter disconnects from the grid or generator and provides power to the loads from the batteries as long as the inverter selection in menu **01A Inverter** is ON or SRCH.

The inverter reconnects to the AC source when the voltage drops below this setting.

Guidelines for setting this menu item:

- Ensure this value is within the upper limits of any AC operated equipment connected to the inverter.

13D Input Lower Limit VAC

```
13D Input Lower
Limit VAC
```

This menu item sets the lowest voltage at which the inverter is allowed to connect to either AC1 or AC2 inputs.

This setting determines the voltage level at which point the inverter starts drawing power from the batteries to aid to the grid power (AC1) or GEN (AC2) power depending on which one is being used to meet the demands of the loads.

When the AC voltage reaches this level, the inverter stops battery charging and operates in parallel (in the inverter mode) with the AC source, to aid the utility power to meet the demands of the load. This reduces the loading effect on the AC source.

If the voltage drops below this level, the inverter disconnects the AC source and powers the load directly from the batteries as long as the inverter's selection in **01A Inverter** is ON or SRCH. This is part of the AC support feature.

Guidelines for setting this menu item:

- Ensure this value is within the lower limits of any AC operated equipment connected to the inverter.

CAUTION: Damage to Loads

Adjusting upper and lower AC voltage parameters allows the higher and lower voltages than the inverter output to pass through to connected AC loads. Ensure that all connected AC loads will not be damaged by the higher and lower settings.

14 Save/Restore Settings Menu

```
14 Save/Restore
Settings Menu
```

This menu provides the means to:

- save user programmed settings,
- restore previously saved programmed settings, or
- restore factory default settings.

If DC power is removed from the inverter, all user defined set points will be intact if they were saved before the power was removed. If new settings are not saved, the inverter will restart with the last saved set points or with the factory defaults (if none were ever saved).

Note: The settings in this menu are identical to Menu 27. Saving or restoring settings at either menu will apply to all menu settings (Basic and Advanced).

14A Push INV now to Save Settings

```
14A Push INV now
to save settings
```

This menu item provides the means to save settings currently programmed into the inverter.

To save settings:

1. Press the ▼ button until **14A Push Inv Now to Save Settings** is displayed.
2. Press the red INV button to save the settings.

14B Push GEN to Restore Settings

```
14B Push GEN to
restore settings
```

This menu item provides the means to restore settings previously set and saved on the inverter.

To restore settings previously programmed into the inverter:

1. Press the ▼ button until **14B Push Gen to Restore Settings** is displayed.
2. Press the green GEN button to restore previously programmed settings.

14C Push GEN for Factory Defaults

```
14C Push GEN for
factory defaults
```

This menu item provides the means to restore the factory default settings.

To restore the factory default settings:

1. Press the ▼ button until **14C Push Gen For Factory Defaults** is displayed.
2. Press the green GEN button to restore the factory default settings.

End Basic Setup Menu

```
END BASIC
SETUP MENU
```

You have reached the end of the Basic Setup Menu.

To exit the Basic Setup Menu and go on to the Advanced Setup Menu:

1. Press the ▶ Menu Heading button until **END BASIC SETUP MENU** is displayed.
2. Press the green GEN button and hold it down.
3. While holding down the green GEN button, press the red INV button. This will move you forward to the **ADVANCED USER SETUP MENU**.

7

Advanced Setup

Chapter 7, “Advanced Setup” explains how to program the Sine Wave Plus Inverter/Charger to operate under special, advanced conditions, such as automatic generator starting, energy management and auxiliary load applications.

Advanced Setup Summary

Check Defaults

The following model-specific tables provide the default settings for the Sine Wave Plus Advanced Setup Menu and cross-reference pages for locating information on each menu item.

- Table 7-1, "Advanced Setup Default Settings for the Sine Wave Plus 2524 and 2548 Models" on page 7–2
- Table 7-2, "Advanced Setup Default Settings for the Sine Wave Plus 4024 and 4048 Models" on page 7–5
- Table 7-3, "Advanced Setup Default Settings for the Sine Wave Plus Plus 5548 Models" on page 7–7

Record Changes

If your system requires changes to these default settings, record the changes on the model-specific tables in Appendix B, "Configuration Settings" before your start programming. These tables are found on the following pages:

- Table B-5, "Advanced Setup Default and User Settings for the Sine Wave Plus 2524 and 2548 Models" on page B–10
- Table B-6, "Advanced Setup Default and User Settings for the Sine Wave Plus 4024 and 4048 Models" on page B–12
- Table B-7, "Advanced Setup Default and User Settings for the Sine Wave Plus 5548 Model" on page B–14

For directions on how to get to the Advanced Setup Menu, see "Accessing the Advanced Setup Menu" on page 7–11.

Table 7-1 Advanced Setup Default Settings for the Sine Wave Plus 2524 and 2548 Models

	Sine Wave Plus 2524		**Sine Wave Plus 2548**		
Advanced Setup Menus	**Range/Display**	**Default Settings**	**Range/Display**	**Default Settings**	**See Page**
20 Silent Setup Menu	See "20 Silent Setup Menu" on page 7–13 for details.				
20A Refloat High Volts DC	16.1 to 33.9	28.4	32.2 to 67.8	56.8	page 7–15
20B Refloat Low Volts DC	16.1 to 33.8	25.0	32.2 to 67.8	50.0	page 7–15
20C Float Done Amps AC	00 to 40	10	00 to 40	10	page 7–15
20D Must Float Time Min	00 to 255	05	00 to 255	05	page 7–15
End Menu 20					
21 Grid AC1 Usage Menu	See "21 Grid (AC1) Usage Menu" on page 7–16 for details.				
21A Grid Usage	SB BX	SB	SB BX	SB	page 7–17
21B Grid Usage Begin h:m	00:00 to 23:50	21:00	00:00 to 23:50	21:00	page 7–17

Table 7-1 Advanced Setup Default Settings for the Sine Wave Plus 2524 and 2548 Models

	Sine Wave Plus 2524		Sine Wave Plus 2548		
Advanced Setup Menus	**Range/Display**	**Default Settings**	**Range/Display**	**Default Settings**	**See Page**
21C Grid Usage End h:m	00:00 to 23:50	21:00	00:00 to 23:50	21:00	page 7–18
End Menu 21					
22 Battery Xfer (BX) Menu	See “22 Battery Xfer (BX) Menu” on page 7–18 for details.				
22A High Xfer (HBX) Vdc	16.1 to 33.9	27.0	32.2 to 67.8	54.0	page 7–19
22B Low Xfer (LBX) Vdc	16.1 to 33.8	23.0	32.2 to 67.8	46.0	page 7–19
End Menu 22					
23 ALM Relays Menu	See “23 ALM Relays Menu” on page 7–19 for details.				
23A RY9 VDC Energized	22.1 to 35.5	26.0	44.2 to 71.0	52.0	page 7–20
23B RY9 VDC DeEnergized	20.0 to 35.5	22.0	40.0 to 71.0	44.0	page 7–20
23C RY9 Delay at DeEngz. Min	00 to 255	10	00 to 255	10	page 7–20
23D RY10 VDC Energized	10.0 to 32.0	28.8	20.0 to 64.0	57.6 Vdc	page 7–20
23E RY10 VDC DeEnergized	10.0 to 32.0	26.8	20.0 to 64.0	53.6 Vdc	page 7–21
23F RY10 Delay at DeEngz. Min	00 to 255	10	00 to 255	10	page 7–21
23G RY11 Mode	Cooldown Error	Error	Cooldown Error	Error	page 7–21
End Menu 23					
24 Generator Timers Menu	See “24 Generator Timers Menu” on page 7–26 for details.				
24A Gen Run Time Start h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	page 7–27
24B Gen Run Time Stop h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	page 7–27
24C Quiet Time Begin h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	page 7–27
24D Quiet Time End h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	page 7–28
24E Gen Exercise Period Days	00 to 255	30	00 to 255	30	page 7–28
24F Gen Exercise Timer Min	00 to 255	15	00 to 255	15	page 7–28
24G Gen Cooldown Timer Min	00 to 255	02	00 to 255	02	page 7–28
24H RN2/Max Gen Run h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	page 7–29
End Menu 24					
25 Gen Starting Details Menu	See “25 Gen Starting Details Menu” on page 7–29 for details.				

Table 7-1 Advanced Setup Default Settings for the Sine Wave Plus 2524 and 2548 Models

	Sine Wave Plus 2524		Sine Wave Plus 2548		
Advanced Setup Menus	**Range/Display**	**Default Settings**	**Range/Display**	**Default Settings**	**See Page**
25A RY7 Mode	GS RN1 RN2	GS	GS RN1 RN2	GS	page 7–30
25B Gen Warm-up Second/Minute	0 to 127 /0 to 127	10 Seconds	0 to 127 /0 to 127	10 Seconds	page 7–37
25C Pre Crank Seconds	00 to 255	10	00 to 255	10	page 7–37
25D Max Cranking Seconds	01 to 15	10	01 to 15	10	page 7–37
25E Post Crank Seconds	00 to 255	30	00 to 255	30	
End Menu 25					
26 Gen Auto Run Setup Menu	See “26 Gen Auto Run Setup Menu” on page 7–38 for details.				
26A Load Start Amps AC	00 to 63	20	00 to 63	20	page 7–38
26B Load Start Delay Min	00.0 to 25.5	05.0	00.0 to 25.5	05.0	page 7–38
26C Load Stop Delay Min	00.0 to 25.5	05.0	00.0 to 25.5	05.0	page 7–38
26D 24 hr Start Volts DC	10.0 to 35.5	24.6	20.0 to 71.0	49.2	page 7–38
26E 2 hr Start Volts DC	10.0 to 35.5	23.6	20.0 to 71.0	47.2	page 7–38
26F 15 min Start Volts DC	10.0 to 35.5	22.6	20.0 to 71.0	45.2	page 7–39
26G Read LBCO 30 sec Start	LBCO setting (11C)	22.0 Read Only	LBCO setting (11C)	44.0 Read Only	page 7–39
End Menu 26					
27 Save/Restore Settings Menu	See “27 Save/Restore Settings Menu” on page 7–39 for details.				
27A Push INV now to save Settings	Push INV now to Save Settings				page 7–39
27B Push GEN to restore settings	Push GEN to restore settings				page 7–40
27C Push GEN for factory defaults	Push GEN for factory defaults				page 7–40
End Menu 27					
END ADVANCED SETUP MENU					

Table 7-2 Advanced Setup Default Settings for the Sine Wave Plus 4024 and 4048 Models

Advanced Setup Menus	Sine Wave Plus 4024		Sine Wave Plus 4048		See Page
	Range/Display	**Default Settings**	**Range/Display**	**Default Settings**	
20 Silent Setup Menu	See “20 Silent Setup Menu” on page 7–13 for details.				
20A Refloat High Volts DC	16.1 to 33.9	28.4	32.2 to 67.8	56.8	page 7–15
20B Refloat Low Volts DC	16.1 to 33.8	25.0	32.2 to 67.8	50.0	page 7–15
20C Float Done Amps AC	00 to 40	10	00 to 40	10	page 7–15
20D Must Float Time Min	00 to 255	05	00 to 255	05	page 7–15
End Menu 20					
21 Grid AC1 Usage Menu	See “21 Grid (AC1) Usage Menu” on page 7–16 for details.				
21A Grid Usage	SB BX	SB	SB BX	SB	page 7–17
21B Grid Usage Begin h:m	00:00 to 23:50	21:00	00:00 to 23:50	21:00	page 7–17
21C Grid Usage End h:m	00:00 to 23:50	21:00	00:00 to 23:50	21:00	page 7–18
End Menu 21					
22 Battery Xfer (BX) Menu	See “22 Battery Xfer (BX) Menu” on page 7–18 for details.				
22A High Xfer (HBX) Vdc	16.1 to 33.9	27.0	32.2 to 67.8	54.0	page 7–19
22B Low Xfer (LBX) Vdc	16.1 to 33.8	23.0	32.2 to 67.8	46.0	page 7–19
End Menu 22					
23 ALM Relays Menu	See “23 ALM Relays Menu” on page 7–19 for details.				
23A RY9 VDC Energized	22.1 to 35.5	26.0	44.2 to 71.0	52.0	page 7–20
23B RY9 VDC DeEnergized	20.0 to 35.5	22.0	40.0 to 71.0	44.0	page 7–20
23C RY9 Delay at DeEngz. Min	00 to 255	10	00 to 255	10	page 7–20
23D RY10 VDC Energized	10.0 to 32.0	28.8	20.0 to 64.0	57.6 Vdc	page 7–20
23E RY10 VDC DeEnergized	10.0 to 32.0	26.8	20.0 to 64.0	53.6 Vdc	page 7–21
23F RY10 Delay at DeEngz. Min	00 to 255	10	00 to 255	10	page 7–21
23G RY11 Mode	Cooldown Error	Error	Cooldown Error	Error	page 7–21
End Menu 23					
24 Generator Timers Menu	See “24 Generator Timers Menu” on page 7–26 for details.				
24A Gen Run Time Start h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	page 7–27

Table 7-2 Advanced Setup Default Settings for the Sine Wave Plus 4024 and 4048 Models

	Sine Wave Plus 4024		Sine Wave Plus 4048		
Advanced Setup Menus	**Range/Display**	**Default Settings**	**Range/Display**	**Default Settings**	**See Page**
24B Gen Run Time Stop h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	page 7–27
24C Quiet Time Begin h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	page 7–27
24D Quiet Time End h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	page 7–28
24E Gen Exercise Period Days	00 to 255	30	00 to 255	30	page 7–28
24F Gen Exercise Timer Min	00 to 255	15	00 to 255	15	page 7–28
24G Gen Cooldown Timer Min	00 to 255	02	00 to 255	02	page 7–28
24H RN2/Max Gen Run h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	page 7–29
End Menu 24					
25 Gen Starting Details Menu	See “25 Gen Starting Details Menu” on page 7–29 for details.				
25A RY7 Mode	GS RN1 RN2	GS	GS RN1 RN2	GS	page 7–30
25B Gen Warm-up Second/Minute	0 to 127 /0 to 127	10 Seconds	0 to 127 /0 to 127	10 Seconds	page 7–37
25C Pre Crank Seconds	00 to 255	10	0 to 255	10	page 7–37
25D Max Cranking Seconds	01 to 15	10	01 to 15	10	page 7–37
25E Post Crank Seconds	00 to 255	30	00 to 255	30	
End Menu 25					
26 Gen Auto Run Setup Menu	See “26 Gen Auto Run Setup Menu” on page 7–38 for details.				
26A Load Start Amps AC	00 to 63	33	00 to 63	33	page 7–38
26B Load Start Delay Min	00.0 to 25.5	05.0	00.0 to 25.5	05.0	page 7–38
26C Load Stop Delay Min	00.0 to 25.5	05.0	00.0 to 25.5	05.0	page 7–38
26D 24 hr Start Volts DC	10.0 to 35.5	24.6	20.0 to 71.0	49.2	page 7–38
26E 2 hr Start Volts DC	10.0 to 35.5	23.6	20.0 to 71.0	47.2	page 7–38
26F 15 min Start Volts DC	10.0 to 35.5	22.6	20.0 to 71.0	45.2	page 7–39
26G Read LBCO 30 sec Start	LBCO setting (11C)	22.0 Read Only	LBCO setting (11C)	44.0 Read Only	page 7–39
End Menu 26					
27 Save/Restore Settings Menu	See “27 Save/Restore Settings Menu” on page 7–39 for details.				

Table 7-2 Advanced Setup Default Settings for the Sine Wave Plus 4024 and 4048 Models

Advanced Setup Menus	Sine Wave Plus 4024 Range/Display	Sine Wave Plus 4024 Default Settings	Sine Wave Plus 4048 Range/Display	Sine Wave Plus 4048 Default Settings	See Page
27A Push INV now to save Settings	Push INV now to Save Settings				page 7–39
27B Push GEN to restore settings	Push GEN to restore settings				page 7–40
27C Push GEN for factory defaults	Push GEN for factory defaults				page 7–40
End Menu 27					
END ADVANCED SETUP MENU					

Table 7-3 Advanced Setup Default Settings for the Sine Wave Plus Plus 5548 Models

Advanced Setup Menus	Sine Wave Plus 5548 Range/Display	Sine Wave Plus 5548 Default Settings	See Page
20 Silent Setup Menu	See “20 Silent Setup Menu” on page 7–13 for details.		
20A Refloat High Volts DC	32.2 to 67.8	56.8	page 7–15
20B Refloat Low Volts DC	32.2 to 67.8	50.0	page 7–15
20C Float Done Amps AC	00 to 40	10	page 7–15
20D Must Float Time Min	00 to 255	05	page 7–15
End Menu 20			
21 Grid AC1 Usage Menu	See “21 Grid (AC1) Usage Menu” on page 7–16 for details.		
21A Grid Usage	SB BX	SB	page 7–17
21B Grid Usage Begin h:m	00:00 to 23:50	21:00	page 7–17
21C Grid Usage End h:m	00:00 to 23:50	21:00	page 7–18
End Menu 21			
22 Battery Xfer (BX) Menu	See “22 Battery Xfer (BX) Menu” on page 7–18 for details.		
22A High Xfer (HBX) Vdc	32.2 to 67.8	54.0	page 7–19
22B Low Xfer (LBX) Vdc	32.2 to 67.8	46.0	page 7–19
End Menu 22			

Table 7-3 Advanced Setup Default Settings for the Sine Wave Plus Plus 5548 Models

	Sine Wave Plus 5548		
Advanced Setup Menus	**Range/Display**	**Default Settings**	**See Page**
23 ALM Relays Menu	See “23 ALM Relays Menu” on page 7–19 for details.		
23A RY9 VDC Energized	44.2 to 71.0	52.0	page 7–20
23B RY9 VDC DeEnergized	40.0 to 71.0	44.0	page 7–20
23C RY9 Delay at DeEngz. Min	00 to 255	10	page 7–20
23D RY10 VDC Energized	20.0 to 64.0	57.6 Vdc	page 7–20
23E RY10 VDC DeEnergized	20.0 to 64.0	53.6 Vdc	page 7–21
23F RY10 Delay at DeEngz. Min	00 to 255	10	page 7–21
23G RY11 Mode	Cooldown Error	Error	page 7–21
End Menu 23			
24 Generator Timers Menu	See “24 Generator Timers Menu” on page 7–26 for details.		
24A Gen Run Time Start h:m	00:00 to 23:50	08:00	page 7–27
24B Gen Run Time Stop h:m	00:00 to 23:50	08:00	page 7–27
24C Quiet Time Begin h:m	00:00 to 23:50	08:00	page 7–27
24D Quiet Time End h:m	00:00 to 23:50	08:00	page 7–28
24E Gen Exercise Period Days	00 to 255	30	page 7–28
24F Gen Exercise Timer Min	00 to 255	15	page 7–28
24G Gen Cooldown Timer Min	00 to 255	02	page 7–28
24H RN2/Max Gen Run h:m	00:00 to 23:50	08:00	page 7–29
End Menu 24			
25 Gen Starting Details Menu	See “25 Gen Starting Details Menu” on page 7–29 for details.		
25A RY7 Mode	GS RN1 RN2	GS	page 7–30
25B Gen Warm-up Second/Minute	0 to 127 /0 to 127	10 Seconds	page 7–37
25C Pre Crank Seconds	00 to 255	10	page 7–37
25D Max Cranking Seconds	01 to 15	10	page 7–37
25E Post Crank Seconds	00 to 255	30	
End Menu 25			
26 Gen Auto Run Setup Menu	See “26 Gen Auto Run Setup Menu” on page 7–38 for details.		

Table 7-3 Advanced Setup Default Settings for the Sine Wave Plus Plus 5548 Models

Advanced Setup Menus	Sine Wave Plus 5548 Range/Display	Sine Wave Plus 5548 Default Settings	See Page
26A Load Start Amps AC	00 to 63	45	page 7–38
26B Load Start Delay Min	00.0 to 25.5	05.0	page 7–38
26C Load Stop Delay Min	00.0 to 25.5	05.0	page 7–38
26D 24 hr Start Volts DC	20.0 to 71.0	49.2	page 7–38
26E 2 hr Start Volts DC	20.0 to 71.0	47.2	page 7–38
26F 15 min Start Volts DC	20.0 to 71.0	45.2	page 7–39
26G Read LBCO 30 sec Start	LBCO setting (11C)	44.0 Read Only	page 7–39
End Menu 26			
27 Save/Restore Settings Menu	See “27 Save/Restore Settings Menu” on page 7–39 for details.		
27A Push INV now to save Settings	Push INV now to Save Settings		page 7–39
27B Push GEN to restore settings	Push GEN to restore settings		page 7–40
27C Push GEN for factory defaults	Push GEN for factory defaults		page 7–40
End Menu 27			
END ADVANCED SETUP MENU			

Before You Begin Advanced Programming

The Sine Wave Plus is designed to provide advanced application programming. Advanced applications include:

- SILENT SETUP - Sets the parameters for the Silent finish stage of battery charging. This feature is programmed in Menu Heading 20.

  See “20 Silent Setup Menu” on page 7–13 for information on programming this feature.
- GRID USAGE - Sets parameters for when and how the utility grid is used. It supports energy management applications such as Time-of-Use Metering and Peak Load Shaving (SB Mode). It also controls transfer of grid power to protect the batteries (BX Mode). These features are programmed in Menu Heading 21 and 22.

  See “21 Grid (AC1) Usage Menu” on page 7–16 and “22 Battery Xfer (BX) Menu” on page 7–18 for information on programming this features.
- AUXILIARY LOADS - Sets the parameters by which the relays in the ALM are used. This feature is programmed in Menu Heading 23.

  See “23 ALM Relays Menu” on page 7–19 for information on programming these parameters.
- GENERATOR CONTROL AND SUPPORT - Sets the parameters for starting a generator based on time, type of generator being used, and the inverter’s voltage and current. This feature is programmed in Menu Headings 24, 25 and 26.

  See “24 Generator Timers Menu” on page 7–26 for information on programming the generator to run based on “time” settings.

  See “25 Gen Starting Details Menu” on page 7–29 for information on programming the generator to run based on type of generator being used.

  See “26 Gen Auto Run Setup Menu” on page 7–38 for information on programming the generator to run based on voltage or current settings.
- SAVING/RESTORING SETTINGS - Saves or restores previously programmed user settings. This feature can also restore factory defaults.

Accessing the Advanced Setup Menu

To access the Advanced Setup Menu from the User Menu:

1. Press the ▶ button to move forward within the Menu Headings until the **END USER MENU** is displayed.
2. Press and hold down the green GEN button.
3. While holding the green GEN button down, press the red INV button to move into the **BEGIN BASIC SETUP MENU**.
4. Release the GEN and INV buttons.

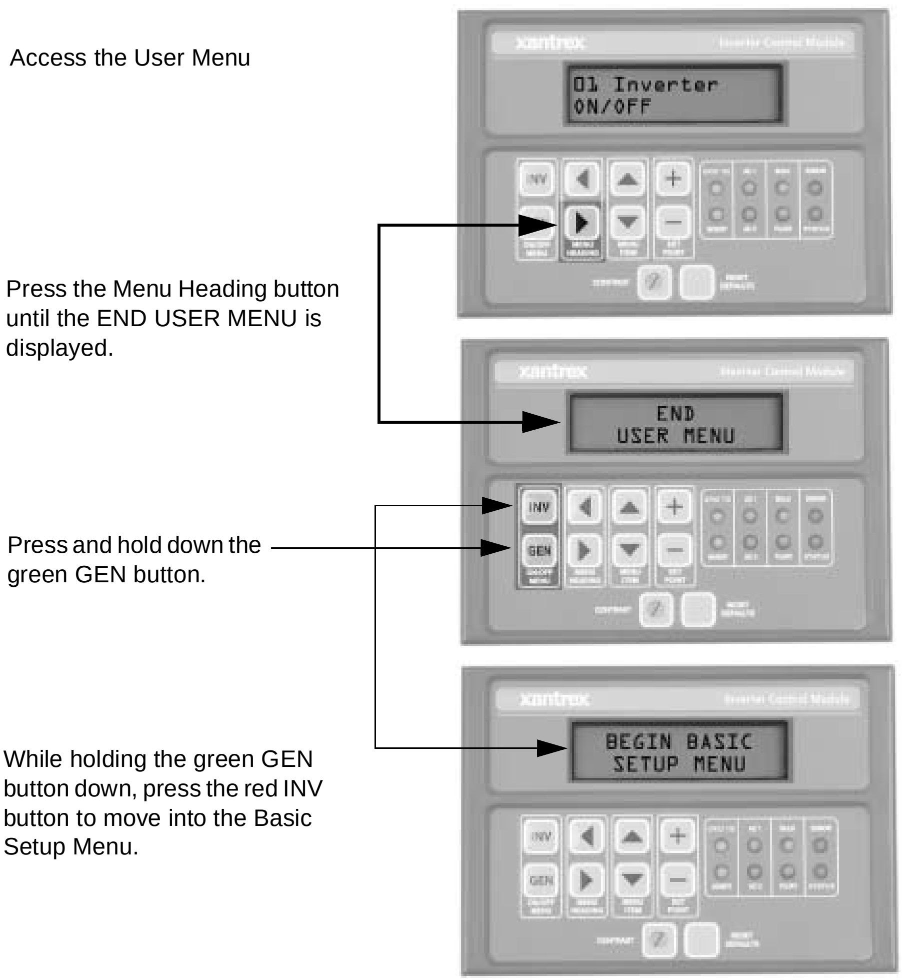


Figure 7-1 Accessing the Advanced Setup Menu - Method 1

5. From here you can, either:
   a) Press the ▶ button to move forward within the Menu Headings until the **END BASIC SETUP MENU** is displayed.
   b) Or proceed to Steps 6 and 7.
6. Press and hold down the green GEN button.
7. While holding the green GEN button down, press the red INV to move into the **ADVANCDED SETUP MENU**.

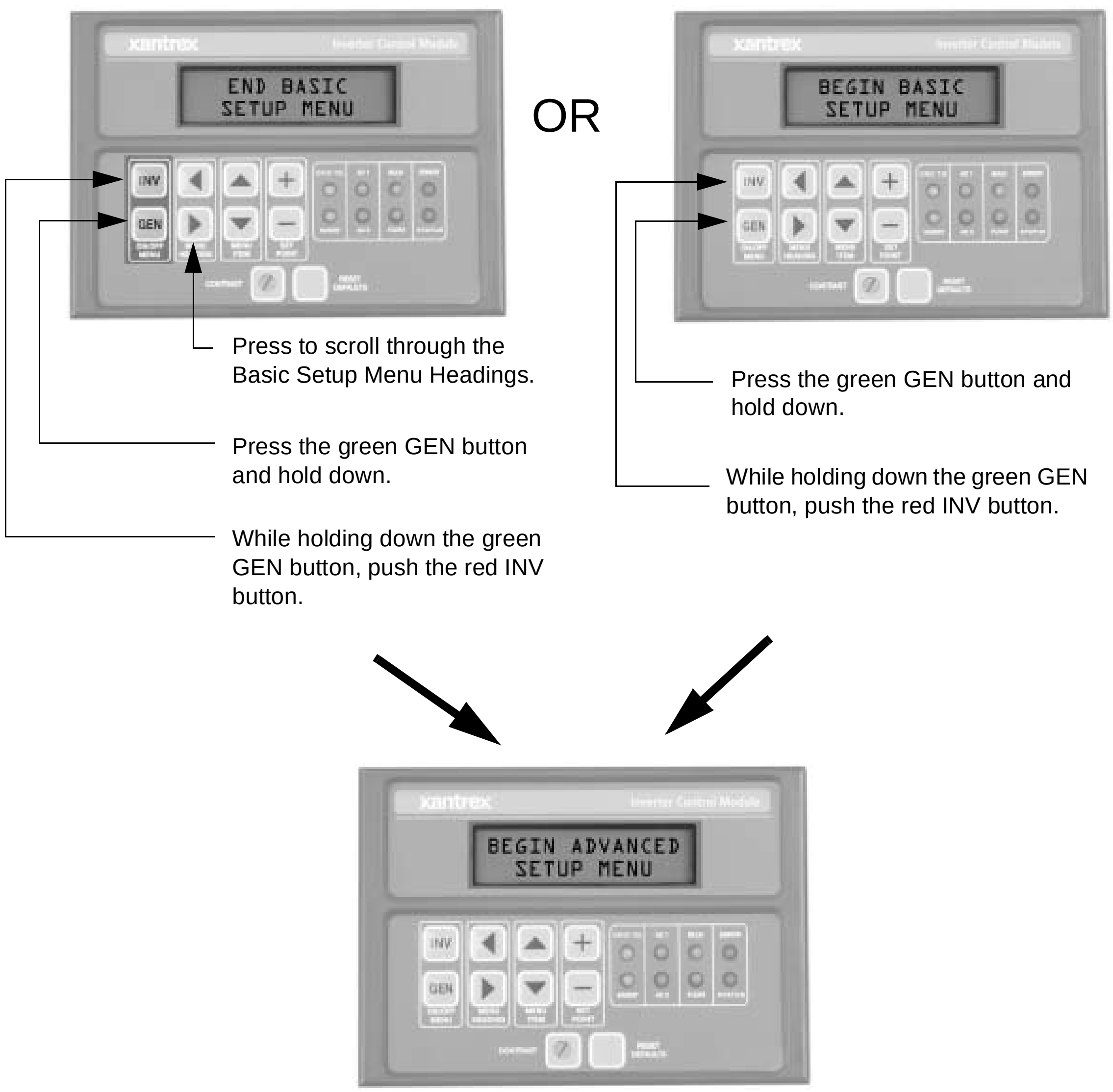


Figure 7-2 Accessing the Advanced Setup Menu - Method 2

Menu Item Descriptions

20 Silent Setup Menu

```
20 Silent Setup
Menu
```

This menu is used only when SILENT is selected in menu **12A Finish Stage**. When the Silent Modeis selected, the charger is turned OFF and does not supply any charging current to the batteries until certain conditions based on battery voltage are met.

Silent Modeis defined as no inverting or charging and the input AC (if available) will pass-through to the output and is recommended for use only if utility power is the AC source.

When it works

This menu provides the settings which will maintain the float voltage on the batteries by:

- Turning ON the charger when the batteries drain to the level set in menu **20B Refloat Low VDC**.
- Attempts to maintain the battery voltage at the float level by diverting the excess power to the loads when the battery voltage increases to the level set in menu **20A Refloat High VDC**

The battery voltage can only go above the **20A Refloat High VDC** limit if an external source is used to provide power to the batteries such as a PV array, wind generator, micro-hydro generator, etc. When this level is met or exceeded, the unit turns on the charger and directs the excess DC power to the AC loads and attempts to maintain the battery at the float voltage level.

Whenever one of these conditions is met, the batteries will be maintained at the float level for both:

- the period of time set in menu **20D Must Float Time**, then
- the level set in menu **20C Float Done Amps AC**.

How it works

The Silent Mode does not maintain the battery at float voltage all the time. The battery charger only operates if required and the AC power from the utility grid is passed through the inverter to the loads 24 hours a day. This option is recommended only if utility power is the only AC source.

After the batteries are given a bulk and absorption charge cycle, the inverter will then go totally silent and will wait for the DC voltage to fall or until utility power fails. If the battery voltage falls, the inverter will allow the AC source to recharge the battery. If there is a power outage, the inverter will perform another bulk and absorption charge cycle and return to the Silent Mode once the AC source has returned.

Silent Mode will begin after the charge routine has finished the bulk/absorption charge and if the Silent charge has been selected (from Menu Item **12A Finish Stage**). After entering the Silent mode, there will be a minimum 60 second delay, then the inverter will monitor the battery voltage to determine if the voltage is at or above the **20A Refloat High Volts DC** setting or if the voltage has fallen to or below the **20B Refloat Low Volts DC** setting.

If the battery voltage has reached one of these Refloat Vdc settings (**20A Refloat High Volts DC** or **20B Refloat Low Volts DC**) then the inverter will come out of Silent Mode and begin to maintain the batteries at the float voltage level.

If the battery voltage falls below the float level, the inverter will use current from the utility grid connected to the AC1 input to continue to maintain the float voltage level.

External charging sources

If some external current (renewable energy source) is used to increase the battery voltage above the float voltage level, the inverter will use this excess power above the float voltage requirements to power the inverter output loads.

If the external current source provides more current that what is needed to maintain the batteries at the float voltage and power the inverter loads, the battery voltage will rise.

The inverter will continue to maintain the batteries at the float voltage level until the **20D Must Float Time Min** time has expired and the current (as read on the **04C INV/CHR Amps AC** meter display) has fallen below the **20C Float Done Amps** setting. At this time, the inverter will return to the Silent mode.

If AC power is lost, after it has returned, the inverter will complete another Bulk and Absorption charge to the battery and again return to the silent stage.

Advantages

The advantage of the Silent stage is slightly less power consumption under most conditions and quieter operation since the battery charger is off most of the time.

Disadvantage

The disadvantages of Silent charge is the loss of the natural power conditioning ability of the inverter, the ability to provide the AC load support (except during the time that the inverter is charging) and a longer transfer to inverter power from the loss of utility power. These disadvantages are only present when the inverter is not charging batteries.

Summary

Silent Mode engages on based on DC volts as programmed in **20A Refloat High Volts DC** and **20B Refloat Low Volts DC** (after 60 second delay)

Silent Mode terminates based on time **20D Must Float Time Min**, then amps **20C Float Done Amps**.

Note: This information is provided for guidance only. Variations in battery chemistry, as well as site specific environmental considerations, mean that you should consult your system designer or battery manufacturer for specific recommendations for appropriate battery voltage and current settings. An amp-hour meter (e.g., Xantrex TM500A) would be useful to verify your settings are correct to maintain a proper charge on the batteries.

20A Refloat High Volts DC

```
20A Refloat High
Volts DC
```

This menu item sets the upper battery voltage level that triggers the float charge. When this level is met or exceeded, the unit turns on the charger and directs the excess DC power to the AC loads and attempts to maintain the battery at the float voltage level.

20B Refloat Low Volts DC

```
20B Refloat Low
Volts DC
```

This menu item sets the lower battery voltage level to which the batteries are allowed to discharge. When the batteries drop to or below this level the charger will turn ON and provide a float charge to the batteries. It will not initiate a bulk charge.

20C Float Done Amps AC

```
20C Float Done
Amps AC
```

This menu item is used by the charger to determine the AC current level (after the **20D Must Float Time Min** period has been reached) when it should change back to the Silent mode.

As the batteries charge, their current demands decrease. This setting specifies at what point the current supplied to the batteries is allowed to decrease to in order to trigger the Silent mode.

The **20C Float Done Amps AC** setting is usually set to 1% of the total battery bank capacity.

To calculate the 20C Float Done Amps AC:

1. Multiply the battery amp hours by 1%. This is the DC Max Charge Rate changed to float done amps expressed in DC terms.
2. Convert the DC Max Charge Rate to AC amps by dividing the DC Max Charge Rate by 4 for a 24-volt system or 2 for a 48-volt system.
3. The result is the approximate amp setting that should be entered for the **20C Float Done Amps AC** menu item.

For stacked inverters, use half the battery amp-hour rating in the calculations.

Table 7-4 Calculating the Float Done Amps for a 24-volt, 700 amp-hour Battery

Step	Instruction	Equation
1	Multiply the total battery amp hours by 1%	700 x 1% = 7 (DC Max Charge Rate)
2	Divide the DC Max Charge Rate by 4	7 ÷ 4 = 1
3	Set the **20C Float Done Amps AC** parameter.	1 amps AC

Table 7-5 Calculating the Float Done Amps for a 48-volt, 350 amp-hour Battery

Step	Instruction	Equation
1	Multiply the total battery amp hours by 1%	350 x 1% = 3.5 (DC Max Charge Rate)
2	Divide the DC Max Charge Rate by 2	3.5 ÷ 2 = 1
3	Set the **20C Float Done Amps AC** parameter.	1 amps AC

20D Must Float Time Min

```
20D Must Float
Time Min
```

This menu item sets the minimum amount of time after the **20A Refloat High Volts DC** and **20B Refloat Low Volts DC** settings have been reached that the inverter will maintain the float voltage level on the batteries before it reaches the **20C Float Done Amps AC** setting and returns to the Silent mode.

21 Grid (AC1) Usage Menu

```
21 Grid AC1 Usage
Menu
```

This menu sets the conditions that determine how and when the inverter's AC1 (grid) input will be used.

To program grid usage parameters, the Advanced Setup Menu Headings **21 Grid (AC1) Usage Menu** and **22 Battery Xfer Menu** are used.

21A Grid Usage

```
21A Grid Usage
SB BX
```

This menu item allows you to select between the set points SB and BX as described below.

SB (Standby) - Utility Backup This set point is the first set point selection in the **21A Grid Usage** menu. It sets the inverter to be used as a backup power supply. When AC power is available at the inverter's AC1 input, the batteries are maintained until the AC power is lost. At which point, the inverter supplies AC power to the load from the batteries.

This is the default setting for grid usage. This mode also allows for energy management features such as Time-of-Use Metering and Peak Load Shaving which are programmed in menu items **21B Grid Usage Begin h:m** and **21C Grid Usage End h:m**.

See "Energy Management" on page 2–44 for information regarding Energy Management Features.

BX (Battery Transfer) - Renewable Energy Backup This set point is the second selection in **21A Grid Usage** and works in conjunction with Menu Heading **22 Battery Xfer (BX)**. It allows the batteries to power the AC loads until the batteries discharge to the settings in menu **22B Low Xfer (LBX) VDC** and then transfers to the utility.

Utility grid power is then used as a backup source to keep the loads powered. When the batteries have recharged from an external DC source to the setting in menu **22A High Xfer (HBX) VDC**, the inverter transfers from the utility grid back to inverter supplied AC power.

Guidelines for setting this menu item:

- In the BX Modethe batteries will only be charged from the DC source, not by the Sine Wave Plus. The utility grid is only used to pass-through the AC to the loads when the batteries are discharged to a preset level.
- The BX Mode and Grid Usage Timer are not optimized to work together. These two features can have different priorities and may conflict with each other.

21B Grid Usage Begin h:m

```
21B Grid Usage
Begin h:m
```

This menu sets the daily begin time when the inverter is allowed to be connected to the grid. This timer is only used when SB is selected in **21A Grid Usage**. When the timer allows the inverter's AC1 input to connect to the grid, the inverter samples the utility grid power, and if within acceptable tolerances, starts to charge the batteries at the bulk then float voltage levels or goes Silent (based on the selection made in menu item **12A Finish Stage**.

The clock is in a 24-hour format (00:00 to 23:59 hours).

Guidelines for setting this menu item:

- Ensure the current time is set correctly in menu **10 Time Of Day Setup Menu**.
- The timer function is deactivated if the **21C Grid Usage Begin h:m** is the same as the **21D Grid Usage End h:m** time.
- This setting only operates with the AC1 input (Grid Input).

Note: The Grid Usage Timer feature is designed to work with the SB Mode, selected under the **21A Grid Usage** menu, and is enabled by setting the **21B Grid Usage Begin h:m** and **21C Grid Usage End h:m** times differently. If BX Mode is selected and the Grid Usage Timer is also enabled, the results cannot be guaranteed as these two features can have conflicting priorities (i.e., to use or not use grid power.)

21C Grid Usage End H:M

```
21C Grid Usage
End h:m
```

This menu sets the time the inverter stops using the grid to charge the batteries or power the loads. This timer is only used when SB is selected in menu **21A Grid Usage**.

Guidelines for setting this menu item:

- Ensure the current time is set correctly in menu **10 Time Of Day Setup Menu.**
- The timer function is deactivated if the **21C Grid Usage Begin h:m** is the same as the **21D Grid Usage End h:m** time.
- This setting only operates with the AC1 input (grid input).

22 Battery Xfer (BX) Menu

```
22 Battery Xfer
(BX) Menu
```

This menu heading provides settings that determine the transfer levels when the loads will be powered from the inverter or from the utility power (pass-through only). These menu items are only used when BX is selected in menu **21A Grid Usage**.

Guidelines for setting this menu item:

- These settings only operate with the AC1 input (grid input).
- The upper and lower ranges of these settings are locked by the set point levels in Menus **11A High Battery Cut Out VDC** and **11C Low Battery Cut Out**.

22A High Xfer (HBX) VDC

```
22A High Xfer
(HBX) VDC
```

This menu is used to set the voltage transfer point when the inverter turns back on and resumes powering the AC loads from the batteries. When this setting is reached, the inverter transfers from the AC1 input (grid) to the batteries to power the loads.

An external DC charging source (wind, solar, etc.) must raise the battery voltage above this setting before the system resumes inverter operation. There is no delay in transferring from the grid to the inverter after the battery voltage reaches this level. This setting is not temperature compensated.

22B Low Xfer (LBX) VDC

```
22B Low Xfer
(LBX) VDC
```

This menu is used to set the voltage transfer point from the batteries to the AC1 input (grid) due to a low battery condition. The transfer occurs only if the battery voltage reaches or remains below this setting for 10 seconds. The system returns to powering the AC loads from the battery once the battery voltage increases to the level set in menu **22A High Xfer (HBX) VDC** above. This setting is not temperature compensated.

23 ALM Relays Menu

```
23 ALM Relays
Menu
```

Auxiliary load functions are controlled by setting parameters in Menu Heading **23 ALM Relays**. Using this feature requires the additional purchase of a Xantrex Auxiliary Load Module (ALM).

The ALM can be used to operate auxiliary loads such as water pumps or alarms. The two auxiliary relays operate independently of the inverter/ charger status (inverter being ON or OFF). As long as the control circuit is powered, as evident by the text on the ICM LCD screen being visible, the AUX relays will operate.

Two voltage-controlled relays (RY9 and RY10) and an AC Output Fault Relay (RY11) are provided on the optional ALM.

RY9 RY9 (load control relay) is dedicated for use as a load control relay to prevent battery discharge and is not temperature compensated for the battery. This relay operates in both the inverter and charger modes.

RY10 RY10 (charge control relay) is dedicated as a control relay for regulating either a source of DC power or for controlling a load to utilize excess power from DC sources. This relay is temperature compensated and uses the **04B Battery Comp VDC** display to determine its DC value. This relay operates in both the inverter and charger modes.

RY11 RY11, when ERROR is selected, is used as an inverter error detection indicator device to display or sound an alarm when the inverter AC output is lost. If COOLDOWN is selected, this will allow both inverters to have a cooldown period when used in a series-stacked configuration.

23A RY9 VDC Energized

```
23A RY9 VDC
Energized
```

This menu item sets the voltage trip point for relay RY9. When the battery voltage reaches or exceeds this setting, the relay closes (energizes) between the N.O. and COM terminals. There is a 2-second time delay on the reaction of this setting, allowing fast response to rapid voltage changes in the system. This setting is not temperature compensated when a BTS is installed.

23B RY9 VDC DeEnergized

```
23B RY9 VDC
DeEnergized
```

This menu item sets the voltage trip point for the auxiliary relay RY9. When the battery voltage drops to or below this setting for the variable time period set in menu **23C RY9 Delay At DeEngz. Min**, the relay de-energizes and closes the contacts between the N.C. and COM terminals. This setting is not temperature compensated when a BTS is installed.

23C RY9 Delay At DeEngz. Min

```
23C RY9 Delay at
DeEngz. Min
```

This menu item sets the delay time period in minutes at which the voltage level must remain at or below before relay RY9 is deenergized. This is an “active low” type of control. The relay closes between the N.C. and COM terminals when the battery voltage falls to or below the level set in menu **23B RY9 VDC DeEnergized** for the time period set here.

23D RY10 VDC Energized

```
23B RY10 VDC
Energized
```

This menu item sets the voltage trip point for the auxiliary relay RY10. When the battery voltage, based on the **04B Battery Comp VDC** display, rises to or above this setting for the time period set in menu **23F RY10 Delay At Engz. Min**, the relay energizes and closes the contacts between the N.O. and COM terminals. This setting is temperature compensated when the optional BTS is installed.

23E RY10 Vdc DeEnergized

```
23E RY10 Vdc
DeEnergized
```

This menu item sets the trip point where the relay de-energizes. When the voltage, based on the **04B Battery Comp VDC** display, drops to or below this setting, the relay de-energizes and opens the contacts between the N.O. and COM terminals immediately. There is no time delay on the reaction of this setting, allowing fast response to rapid voltage changes in the system. This setting is temperature compensated when a BTS is installed and operates in both inverter and charger modes.

23F RY10 Delay at Engz. Min

```
23F RY10 Delay at
Engz. Min
```

This menu item sets the delay time period in minutes at which the voltage level must remain at or below before relay RY10 is deenergized. This is an "active low" type of control. The relay closes when the battery voltage falls to or below the level set in menu **23E RY10 VDC DeEnergized** for the time period set here.

23G RY11 Mode

```
23G RY11 Mode
Cooldown Error
```

These two settings allow the RY11 relay in the ALM or GSM to function differently based on your selection.

Cooldown In a multiple Sine Wave Plus inverter installation and using the inverter's automatic generator feature, you can use the cooldown selection to enable an external contactor to allow both legs of a generator to go through a cooldown period.

When using the generator "AUTO" selection and connecting two inverters in a "series-stacked" installation (for 120/240Vac operation), the inverter that controls the generator will disconnect from the generator to allow a cooldown period prior to stopping the generator. The other inverter not controlling the generator does not know the generator is about ready to be stopped; so it cannot disconnect from the generator to allow this leg a cooldown period. Selecting "cooldown" under RY11 mode and using the RY11 relay to control an external contactor - that feeds both inputs to the inverters - will allow both legs of the generator to be disconnected and unloaded at the same time and go thru the cooldown period prior to shutting down.

See Figure 7-3 on page 7–22 for the installation diagram using this feature.

Error This selection allows the RY11 relay to function as an Error Detection Relay. The blue LED (controlled by the RY11 relay) on the GSM or ALM is on to indicate that the inverter is on (or in SCRCH mode). If the blue LED does not turn on, the inverter is not powered (or OFF), is in CHR mode or there is an error condition.

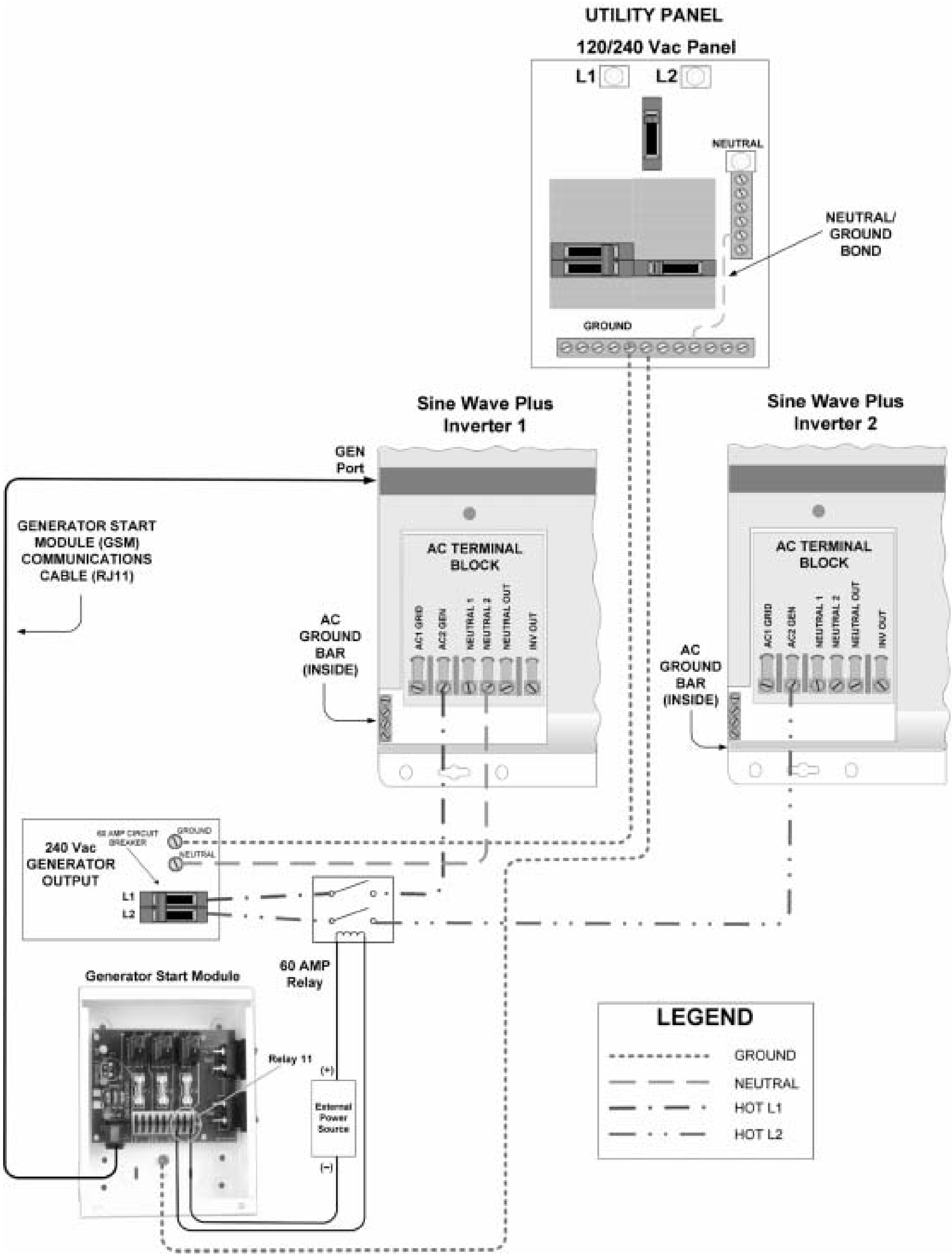


Figure 7-3 Relay 11 Wiring Example to Dual Inverters with Cooldown selected

Generator Starting Scenarios

Important: Automatic generator control features require the additional purchase of the Xantrex GSM.

The Sine Wave Plus can be configured to start and stop a majority of backup generators, either manually or automatically. Automatic operation can be triggered based on time, AC current, battery voltage, or to exercising the generator.

CAUTION: Damage to Generator

Generators used with this feature must have automatic-start capabilities and be designed for stand-alone operation. Engine systems should self-protect against any conditions that may cause the generator to malfunction or become damaged.

Using automatic generator control features will require the programming of the following Advanced Menu Headings:

- **24 Generator Timers Menu** – This Menu sets parameters for starting the generator based on time. In this menu, you can set the generator to start and stop at a specified time. You can specify a quiet time, an exercise time, and a cooldown period for the generator.

  See "24 Generator Timers Menu" on page 7–26 for specific instructions on programming these menu items.
- **25 GEN Starting Details Menu** – This Menu sets parameters for starting the generator based on type of generator used.

  See "25 Gen Starting Details Menu" on page 7–29 for specific instructions on programming these menu items into the Sine Wave Plus.
- **26 GEN Auto Run Setup Menu** – This Menu sets parameters for starting the generator based on AC current and/or battery voltage.

  See "26 Gen Auto Run Setup Menu" on page 7–38 for more information on setting the parameters for starting generators based on AC current and battery voltage.

Manual Generator Control

The generator equipped for remote starting capabilities can be remotely started by selecting ON from **02A Generator**. If the generator started in this manner, the **02C GEN Start Volts/Manual** menu item will display YES.

The generator will continue to run unless one of the following procedures is performed:

1. Manual Stop – Manually stop the generator by selecting OFF from the **02A Generator** menu item. The generator will receive the stop command immediately if manually stopped.
2. Auto Stop – Select AUTO directly (without allowing the cursor to pass through OFF) will allow the generator to automatically stop. It will shut off once the bulk and absorption stages of the battery charging have completed, thus fully recharging the batteries.

Automatic Generator Control

The generator can be programmed to start and stop automatically based on the following scenarios:

- AC Current
- Battery Voltage
- Time of Day
- Required Exercise Period

AC Current

The generator starts whenever the current demand through the inverter to the AC loads remains above the **26A Load Start Amps AC** setting for the selected **26B Load Start Delay Min** period. The current can be monitored by the **04E Load Amps AC** menu item under the **04 Meters Menu**.

The generator will start, unless the timer is in the “quiet time” period, at which time it will only start if the **26G Read LBCO 30 Sec Start Vdc** setting is reached.

Whenever the generator starts automatically, based on load amps, it will shut off once the load current drops below the **26A Load Start Amps** value for the selected **26B Load Stop Delay Min** period.

Battery Voltage

The generator starts whenever the battery voltage reaches one of the four adjustable low-battery voltage levels for the selected delay periods (24 hours, 2 hours, 15 minutes, or 30 seconds).

The low-battery voltage levels are set under the **26 Gen Auto Run Setup** Menu. Actual battery voltage can be monitored from the **04A Battery Actual Volts DC** menu item.

If set point RN1 is selected in **25A RY7 Mode**, the generator will automatically shut off once the BULK and ABSORPTION stages of the battery charging have completed or if the **24H RN2/Max Gen Run h:m** has elapsed.

If RN2 is selected in menu item **25A RY7 Mode**, the generator will automatically shut off once the **24H RN2/Max Gen Run Time h:m** period has elapsed.

Time of Day

The generator is automatically started each day at a pre-selected time determined by the **24A GEN Run Time Start h:m** value. Whenever the generator starts automatically, based on this time, it will shut off once the Time of Day clock has reached the **24B Gen Run Time Stop h:m** value.

Exercise Period Days

The generator is automatically started at a pre-selected time (based on the **24D Quiet Time End h:m**) whenever it exceeds a set number of days without running.

Once the start command is initiated, the generator starts and runs for the time period set by the **24F Gen Exercise Timer Minute** setting. This is to ensure that it remains fully operational and that the generator's starting battery is maintained at an optimal state of charge.

If the **24D Quiet Time End h:m** is set for 13:00 and **24E Gen Exercise Period Days** is set to 10, the generator will start at 1:00 p.m. every tenth day of continuous non-operation. To disable this feature, set the value **24E Gen Exercise Period Days** to zero.

If the generator starts for any reason and runs for at least 5 minutes, this timer counter resets.

Notes:

1. The generator will be prevented from automatically starting when the inverter's time of day is in the "quiet time" period–between **24C Quiet Time Begin h:m** and **24D Quiet Time End h:m**. At which time, it will only start if the **11C Set Low Battery Cut Out VDC** or **26G Read LBCO 30 Sec Start** setting for the LBCO delay period is reached.
2. If the generator is automatically stopped (except for Gen exercise), the stop command will be provided after the adjustable cooldown period (**24G Gen Cooldown Timer Minutes**) has finished.
3. Most generators will shut down immediately after receiving an automatic shutdown command. Some generators may have an internal automatic cooldown period and continue to run.
4. During Quiet Time, the auto-start generator is prevented from automatically starting unless the battery voltage reaches the LBCO setting for the LBCO delay period.
5. An auto-start generator will turn off if an AC source is connected to the AC1 terminal (unless AUTO start was based on exercise start or RN 2 Mode was selected for the RY7 Mode.)
6. If the inverter is OFF or in Bypass Mode (AC1 or AC2 selected) and RY7 Mode is not RN2, all generator auto-start functions (except for exercise start) are disabled.
7. The auto-start generator will stop immediately under any condition if OFF is selected under the **02 Generator** Menu Item.
8. No battery charging occurs if the auto-start generator is started based on exercise period.
9. The inverter will attempt up to six auto-generator starts if RY7 Mode = GS or RN1. The inverter will attempt one auto-generator start if RY7 Mode = RN2.
10. The auto-start generator will always finish with cooldown unless turned off or exercise start/stop.
11. The auto-start generator does not shut down, but begins the cooldown period when the **24C Quiet Time h:m** is reached.

24 Generator Timers Menu

```
24 Generator
Timers Menu
```

This menu heading sets parameters for starting the generator based on time. In this menu, you can set the generator to start and stop at a specified time each day. You can specify a quiet time, an exercise time, and a cooldown period for the generator.

24A Gen Run Time Start h:m

```
24A Gen Run Time
Start h:m
```

This menu item sets the hour and minute for the generator to start. This will occur each day at the same time. The set points for this menu item change in 10-minute increments.

24B Gen Run Time Stop H:M

```
24B Gen Run Time
Stop h:m
```

This menu item sets the hour and minute for the generator to stop. This will occur each day at the same time. The set points for this menu item change in 10-minute increments.

24C Quiet Time Begin h:m

```
24C Quiet Time
Begin h:m
```

This menu item specifies the start time (hour and minutes) when the generator will not run or allowed to be started unless the actual battery voltage reaches the level set in menu **11C Low Battery Cut Out VDC** (for a continuous period of 30 seconds). If you want to override this generator start feature and not have the generator start, select OFF in the **02A Generator ON/OFF** menu item.

During quiet time the automatic generator start system ignores the AC load start and the 24 hr, 2 hr, and 15 min battery voltage start settings and the Generator run time.

Guidelines for setting this menu item:

- Before setting this function, verify the internal clock has been properly set to your current local time. The setting can quickly be viewed under USER MENU heading **03 Time Of Day** and changed, if required, in **10 Time Of Day Setup Menu** (24-hour clock). Remember to reset the time-of-day setting if DC power is lost.
- The generator will stop at this time, even if it is started prior to the **24C Quiet Time Begin h:m**.
- The set points for this menu item change in 10-minute increments.

24D Quiet Time End h:m

```
24E Quiet Time
End h:m
```

This menu item ends the quiet time, after which the generator can be started if required, if an auto-start condition exists.

To completely disable the quiet-time feature, set the start and stop times to the same value.

The generator exercise timer uses this setting to determine when to start the generator exercise. The generator will start and run for the time set in menu **24F Gen Exercise Time Min** at the end of the quiet time. If the selection in menu **24E Gen Exercise Period Days** has been set for 01 (every day), the generator will run every day at the end of the quiet time. To disable the generator exercise system, set the number of days to zero.

The set points for this menu item change in 10-minute increments.

24E Gen Exercise Period Days

```
24E Gen Exercise
Period Days
```

This menu item sets the maximum number of days between generator operation. When the internal counter reaches the number of days set, the generator starts (at the end of the quiet time setting). If the generator is run for 5 minutes at any time during this period, this counter resets, and the period starts again. If the menu item is set to 1, the generator runs every day at this time.

Setting this value to 00 disables this function.

24F Gen Exercise Timer Min

```
24F Gen Exercise
Timer Min
```

This menu item sets the number of minutes the generator will perform an exercise run after being started by the setting in menu item **24E Gen Exercise Period Days**.

The set points for this menu item change in 1-minute increments.

24G Gen Cooldown Timer Min

```
24G Gen Cooldown
Timer Min
```

This menu item sets time the generator is allowed to run unloaded (the inverter is now powering the loads). It is good practice to allow the generator to run unloaded for a period of time, to properly cool off before shutting it down. Refer to the manufacturer’s specifications on cooldown time.

The set points for this menu item change in 1-minute increments.

24H RN2/Max Gen Run h:m

```
24H RN2/Max Gen
Run h:m
```

This menu item sets the limit on how long a generator can run when the RY7 Relay is programmed for RN2 under menu item **25A RY7 Mode**.

The set points for this menu item change in 10-minute increments.

25 Gen Starting Details Menu

```
25 Gen Starting
Details
```

Menu Heading **25 Gen Starting Details** provides menu items for setting the starting parameters for specific kinds of generators and the cranking requirements for each.

Generator Start Module (GSM)

The GSM controls many types of auto-start generators. Two relays, RY7 and RY8, provide the control signals for the generator:

- RY7 provides either a STOP or a RUN signal. It can also provide a GLOW signal for diesel generator engines. This mode is selected in menu item **25A RY7 Mode**.
- RY8 provides a crank signal to the generator's starter (not used on two-wire auto-cranking generators). These parameters are set in Menu Items **25B Gen Warm-up second/minute**, **25C Pre Crank Seconds, 25D Max Cranking Seconds**, and **25E Post Crank Seconds.**

To accommodate a wide variety of generators, three different start configurations (GS, RN1, and RN2) are provided.

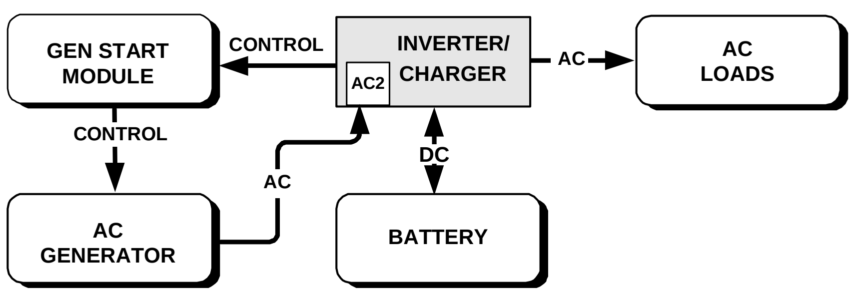


Figure 7-4 Generator Control Mode (GS and RN1)

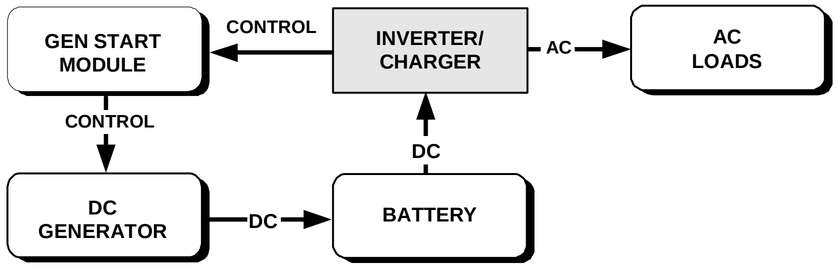


Figure 7-5 Generator Control Mode (RN2)

Guidelines for setting this menu item:

- When using a DC generator as a charging source, none of the inverter's charge control features (bulk, absorption, float) will be available. For battery protection, insure that external charge management equipment is installed between the charger and the batteries.

25A RY7 Mode

```
25A RY Mode
GS RN1 RN2
```

This menu item allows relay 7 (RY7) to provide three different relay functions to accommodate either AC or DC generators.

The settings available for AC generators are GS and RN1. These selections are monitored from the AC2 (generator) input, which tell the inverter the generator is running.

The setting available for DC generators (or AC generators which do not require monitoring) is RN2. Since there is no monitoring of the generator by the inverter in this mode, only one attempt is made to start the generator.

GS This selection (GlowStop) provides a momentary contact closure between contacts N.O. (Normally Open) and COM.

When GS is selected as the function of the RY7 relay, the RY7 COM and RY7 N.O. contacts remain open while the generator is running. The contacts close when it is time for the generator to be stopped, then they reopen. This is useful for generators that require a stop signal to shut down the generator.

The glowstop setting can also be used for a diesel generator. This relay can be used to provide both the glow and stop signals. RY7 is signaled to close (between RY7’s COM and N.O. contacts) before cranking (Glow Plug warming) and when stopping.

RN1 This selection provides a run signal by holding the RY7 relay closed between contacts N.O. and COM. and requires the AC generator output to be monitored by the inverter's AC2 input.

RN2 This selection provides a run signal by holding the RY7 relay closed between contacts N.O. and COM. but does not require the generator output to be monitored by the AC2 terminal. This selection can allow the DC generator to be started/stopped by the inverter.

Guidelines for setting this menu item:

- Many diesel generators provide their own glow and stop signals as well as powering the glow plugs during the cranking signal period. Check with the generator's manufacturer for specific details.
- The RN1 setting requires AC2 input to sense the generator output to stop cranking.
- The RN2 setting does NOT require AC2 input to sense the generator output to stop cranking.
- When either RN1 or RN2 is selected as the function of the RY7 relay, the RY7 COM and RY7 N.O. contacts remain closed while the generator is running. The RY7 N.C. (Normally Closed) contact is open (not connected to the common terminal) while the generator is running.
- When the generator is off, the RY7 N.C. terminal is connected to the RY7 COM terminal. This configuration is useful for starting a two wire (auto-crank) type generator.

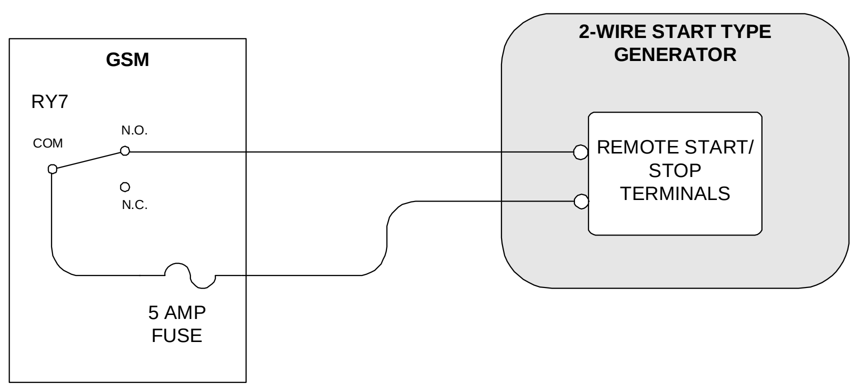


Figure 7-6 RY7's COM and N.O. Contacts Close (energize) to Run Generator

RY8 Relay (GS and RN1 only)

The RY8 is energized (COM and N.O. contacts remain closed) only during the **25D Max Cranking Seconds**. This is usually wired to the starter solenoid (relay) of the generator engine. The RY8 relay energizes after an initial **25C Set Pre Crank Seconds** delay period or de-energizes once the inverter senses AC voltage above 80 Vac on its AC2 input terminal.

If the generator does not start, RY8 will energize again after a **25E Post Crank Seconds** delay period. The inverter attempts to start the generator up to six times.

Guidelines for setting this menu item:

- If the required voltage level is not reached, relay RY7 closes (in the GS mode) to stop the generator before another attempt is started. This reduces the chance the starter motor will engage on a spinning generator engine. This protection is inherent in the RN1 mode.

RY8 Relay (RN2 only)

The RY8 relay remains energized (COM and N.O. contacts remain closed) during the **25D Max Cranking Seconds**. This is usually wired to the starter solenoid (relay) of the generator engine. This relay energizes after an initial **25C Set Pre Crank Seconds** delay period. The inverter attempts to energize RY8 (start the generator) only once.

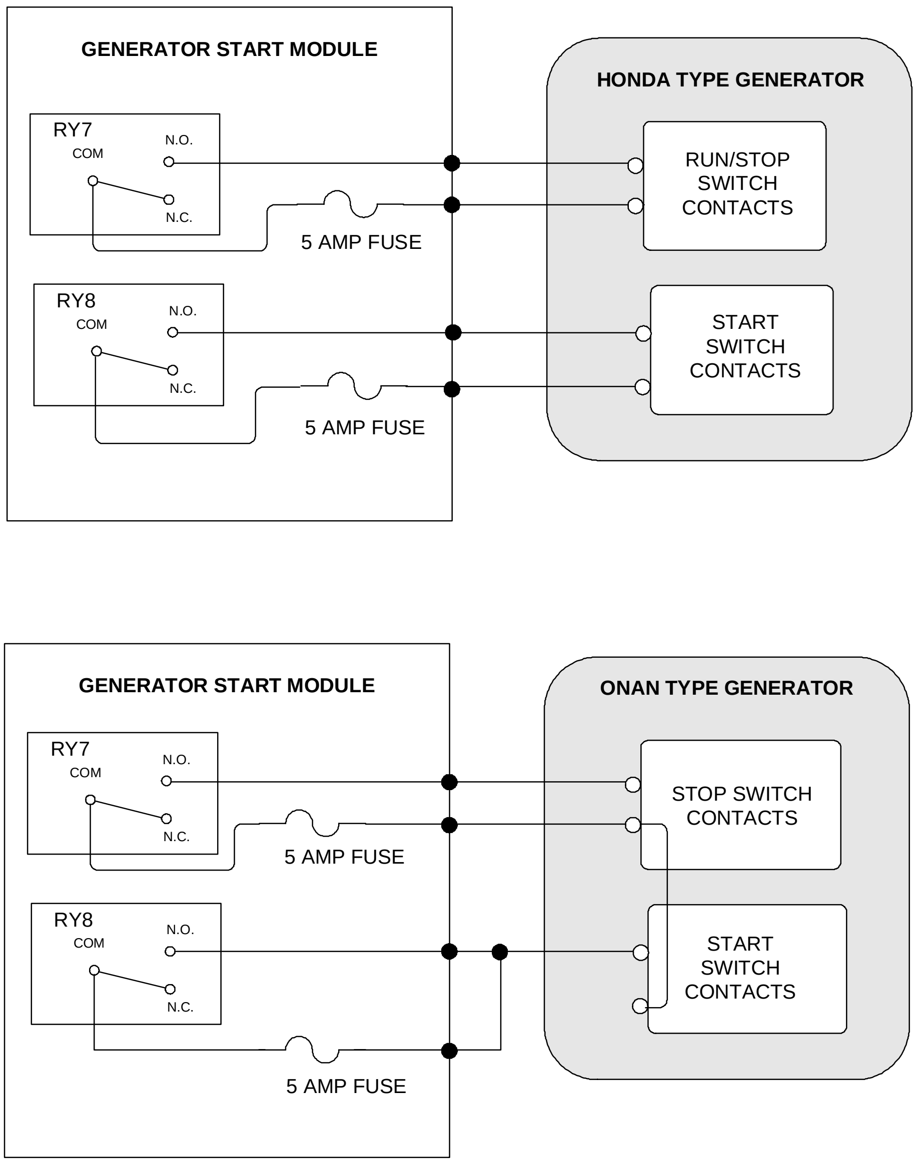


Figure 7-7 Wiring examples of Honda™ and Onan™ Generators

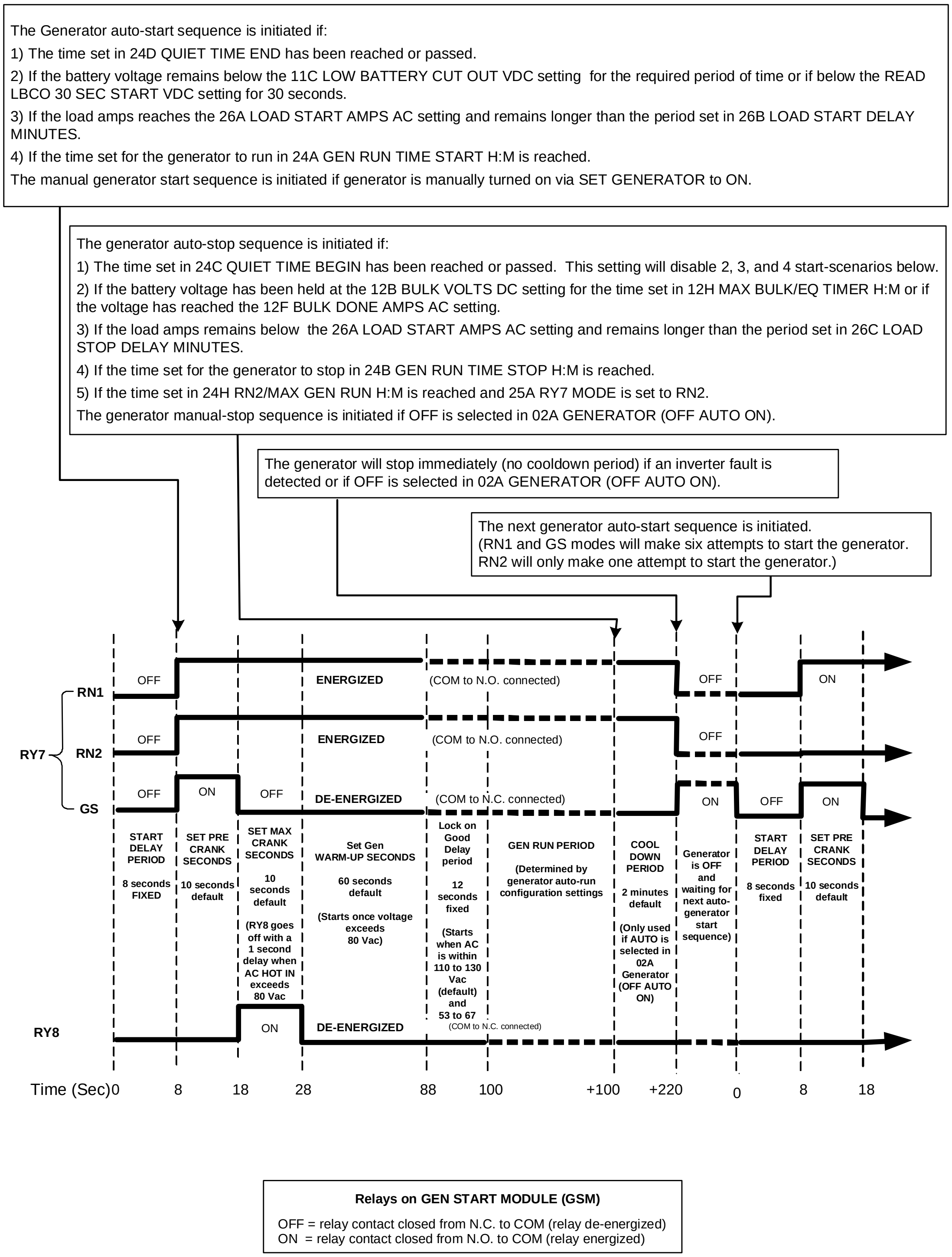


Figure 7-8 RY7 and RY8 Timing Diagram

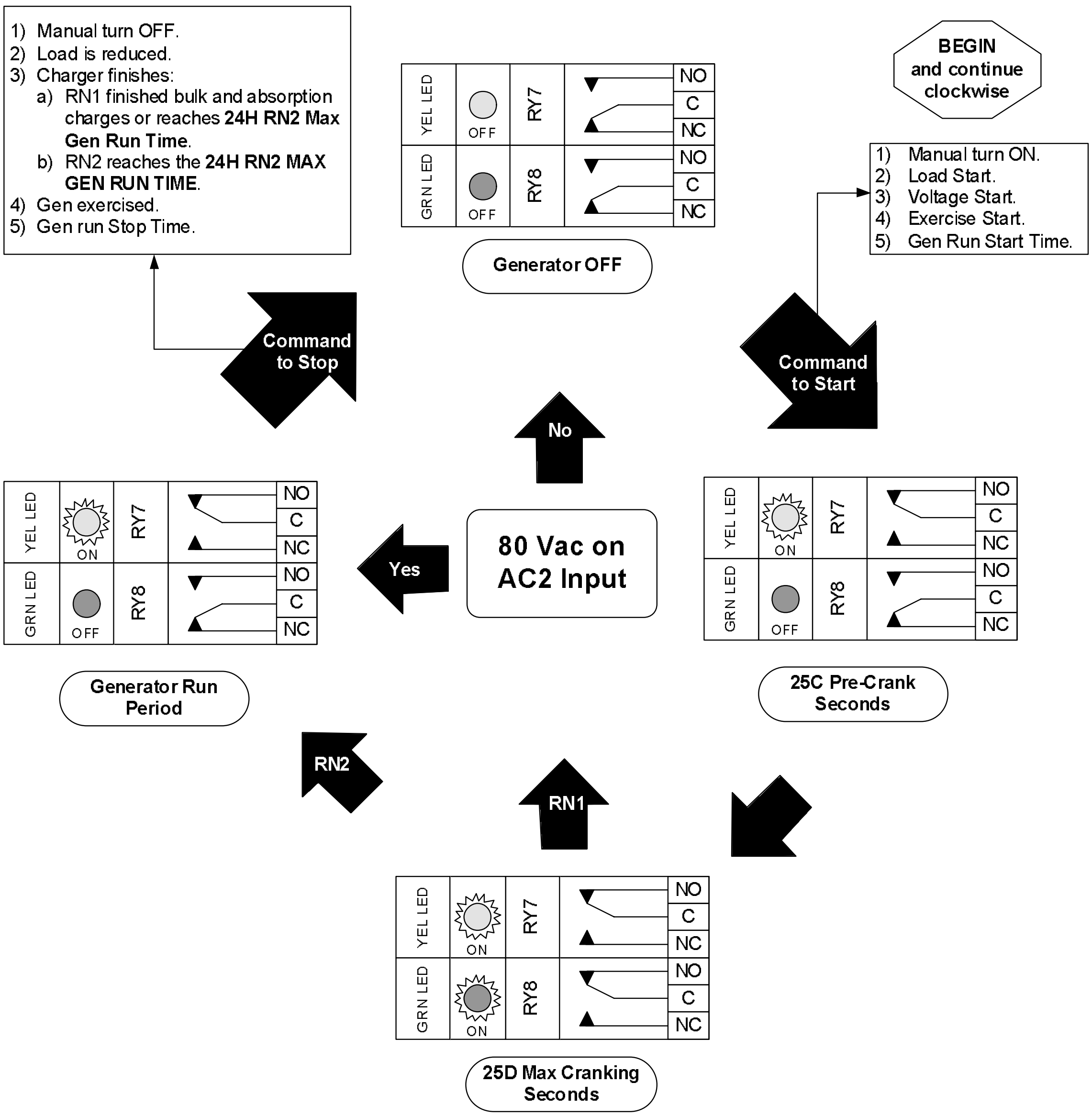


Figure 7-9 RY7/RY8 Sequence of Events for RN1 or RN2 Selection

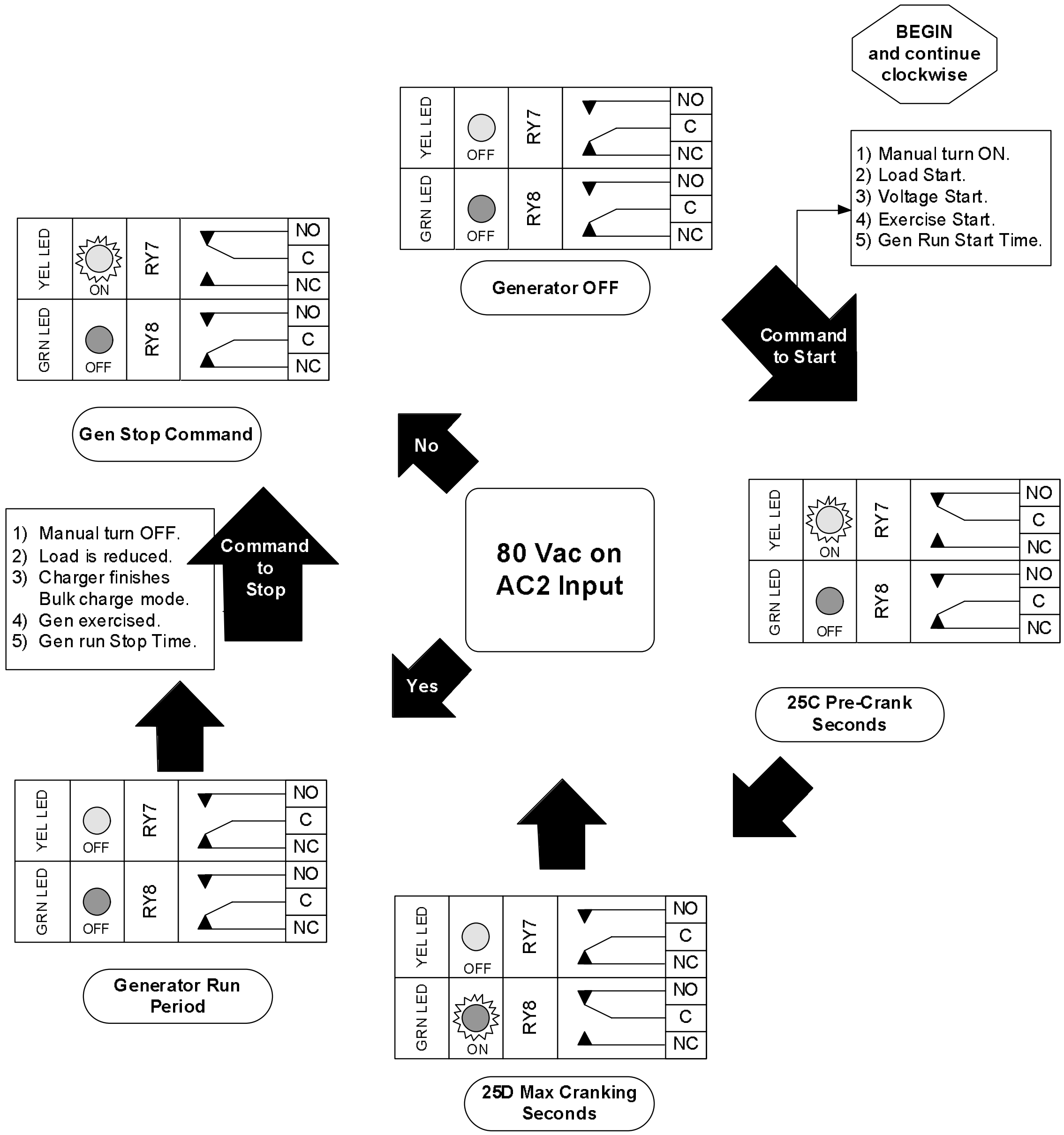


Figure 7-10 RY7/RY8 Sequence of Events for GS Selection

25B Gen Warm-up Seconds/minutes

```
25B Gen Warm-up
Seconds/Minutes
```

This menu item sets the number of seconds or minutes the generator is allowed to warm up before the load is connected and the battery charger started. If the generator is located in a cold location, a longer setting may be required.

25C Pre Crank Seconds

```
25C Pre Crank
Seconds
```

This menu item sets the number of seconds the system delays engaging RY8 (the crank signal relay) once relay RY7 is engaged. Also if GS is selected from **25A RY7 Mode**, this setting will allow selection of the delay time between RY7 disengaging and RY8 engaging. If this number is even, the delay is immediate. If the number is odd the delay is three seconds.

Refer to “Automatic Generator Control” on page 7–24 for more information. This period may also be the amount of time the glow plug is ON if it is connected to the automatic-start system.

25D Max Cranking Seconds

```
25D Max Cranking
Seconds
```

This menu item sets the maximum number of seconds the starter is cranked during the starting sequence by engaging relay RY8.

Guidelines for setting this menu item:

- If GS or RN1 (RY7 Mode) are selected, RY8 will disengage when the generator AC output is sensed (> 80 Vac) on the inverters AC2 input.
- If RN2 (RY7 Mode) is selected, RY8 will stay engaged (crank) for the entire time set in menu **25D Max Cranking Seconds**.

25E Post Crank Seconds

```
25E Post Crank
Seconds
```

This menu item sets the number of seconds after an unsuccessful crank attempt, the system will delay before attempting another auto-start sequence. If the generator has not started, this sequence is repeated up to five times.

This period is provided to allow the starter motor to cooldown. It can also allow generators with built-in warm-up delay contactors to provide AC output before the inverter attempts a re-crank cycle.

26 Gen Auto Run Setup Menu

```
26 Gen Auto Run
Setup Menu
```

Menu Heading **26 Gen Auto Run Setup Menu** provides the menu items for setting the parameters for starting the generator based on AC current and/or battery voltage.

26A Load Start Amps AC

```
26A Load Start
Amps AC
```

This menu items sets the AC load current that initiates automatic generator start. When the current remains above this setting continuously for time set in **26B Load Start Delay Min**, the generator starts.

26B Load Start Delay Min

```
26B Load Start
Delay Min
```

This menu items sets the time delay period that initiates automatic generator starting. When the current remains above the **26A Load Start Amps AC** setting continuously for this period, the generator starts.

26C Load Stop Delay Min

```
26C Load Stop
Delay Min
```

This menu item sets the amount of time the generator continues to run after the load current (determined by the **04E Load Amps AC** meter) decreases below the **26A Load Start Amps AC** setting.

26D 24 Hr Start Volts DC

```
26D 24 Hr Start
Volts DC
```

This menu item sets the battery's DC voltage level which initiates automatic generator starting whenever the voltage drops below this setting continuously for 24 hours. This item is not temperature compensated and is defeated during the quiet time period set in the **24 Generator Timers Menu**.

26E 2 Hr Start Volts DC

```
26E 2 Hr Start
Volts DC
```

This menu item sets the battery's DC voltage level which initiates automatic generator starting whenever the voltage drops below this setting continuously for 2 hours. This item is not temperature compensated and is defeated during the quiet time period set in the **24 Generator Timers Menu**.

26F 15 Min Start Volts DC

```
26F 15 Min Start
Volts DC
```

This menu item sets the battery's DC voltage level which initiates automatic generator starting whenever the voltage drops below this setting continuously for 15 minutes. This item is not temperature compensated and is defeated during the quiet time period set in the **24 Generator Timers Menu**.

26G Read LBCO 30 Sec Start

```
26G Read LBCO 30
Sec Start
```

This menu item monitors the **11C Low Battery Cut Out VDC** level and initiates automatic generator starting whenever the voltage drops below the LBCO setting continuously for 30 seconds. The LBCO setting is not temperature compensated. This display is linked and adjusted in menu **11C Low Battery Cut Out VDC**. The 30 second start attempts to auto-start the generator even if the quiet time (as set in menu **24 Generator Timers Menu**) is enabled. This is a read-only display.

27 Save/Restore Settings Menu

```
27 Save/Restore
Settings Menu
```

This menu provides the means to:

- save recently programmed settings,
- restore previously programmed settings, or
- to restore factory default settings.

Note: The settings in this menu are identical to Menu 14. Saving or restoring settings at either menu will apply to all menu settings (Basic and Advanced).

27A Push INV now to Save Settings

```
27A Push INV Now
to Save Settings
```

This menu item provides the means to save settings currently programmed into the inverter.

To save settings:

1. When **27 Save/Restore Settings** Menu is displayed, press the ▼ button to select **27A Push INV Now to Save Settings**.
2. Press the red INV button to save the settings.

27B Push GEN to Restore Settings

```
27B Push GEN to
Restore Settings
```

This menu item provides the means to restore settings previously set and saved on the inverter.

To restore settings previously programmed into the inverter:

1. Press the ▼ button to select **27B Push Gen Now To Restore Settings**.
2. Press the green GEN button to save the settings.

27C Push GEN for Factory Defaults

```
27C Push GEN for
Factory Defaults
```

This menu item provides the means to restore the factory default settings.

To restore the factory default settings:

1. Press the ▼ button to select **27C Push Gen For Factory Defaults**.
2. Press the green GEN button to restore the factory default settings.

End Advanced Setup Menu

```
END ADVANCED
SETUP MENU
```

There are two ways to exit the Advanced Setup Menu:

Method 1:

◆ Press the red INV button to go straight to the **01A Inverter** Menu.

Method 2:

◆ Press the green GEN button to go straight to the **02A Generator** Menu.

8 Operation

Chapter 8, “Operation” explains how to operate the Sine Wave Plus Inverter/Charger. It also explains how to read the LED indicators and User Menus to determine system status.

Operating the Sine Wave Plus

User Menu

The Sine Wave Plus uses the User Menu architecture to navigate through the operational functions of the inverter/charger. The User Menu contains Operational Menus (01-02) and Operational Status Menus (03-07) to assist the user to determine what the system is doing at any given time.

Startup checks

When you first power up the system, perform the following system checks. Use these same checks to monitor the system performance throughout it's operation.

❐ Check the LED indicators for system status information.

See "LED Indicators" on page 8–3 for the description of their meaning.

❐ Check the **04 Meters Menu** to confirm current, voltage, frequency, battery temperature, and fan speed.

See "Accessing the User Menu" on page 8–14 for instructions on accessing the User Menu system.

❐ If the Status LED is illuminated, check the **06 Status Menu** to ensure the system is in the proper operational mode.

❐ If using GSM and/or ALM accessories, check the **07 GSM/ALM Options Menu** to determine the status of the GSM and/or ALM.

❐ If the Error Status LED is illuminated, check the **05 Error Causes Menu**. Correct any error conditions immediately.

Operational Status Indicators

The Sine Wave Plus uses a combination of LED indicators and User Menu Headings (2-7) to display system status. Use both of these features to assess operational status.

LED Indicators

Eight, colored status LEDs indicate the various operating conditions of the inverter. Unless otherwise indicated, the LEDs will be ON solid and not flashing or blinking. The LEDs also are grouped by function.

LEDs provide system status indication for the following areas.

- Inverter Operation Status: INVERT or GRID TIE
  (Grid Tie feature is not available at this time.)
- AC Input Status (AC1 or AC2)
- Charging Status (BULK or FLOAT)
- Operational Conditions (ERROR or STATUS)

Figure 8-1 LED Indicators

Inverter Operation Status (Yellow)

There are two yellow LEDs to indicate the following inverter operational modes.

- GRID TIE LED - This feature is not available at this time.
- INVERT LED

Figure 8-2 Inverter Operation Status LEDs

GRID TIE LED — The Grid Tie feature is not enabled on these models. Therefore, the GRID TIE LED will not be illuminated during normal operation. It might, however, flash during initial startup or during an LED test.

INVERT LED — The INVERT LED indicates the inverter is operational and inverter power to the AC output is available to power the load if needed. Therefore, this LED will be illuminated during normal operation.

Search Mode Indication If the INVERT LED is blinking and no other LEDs are illuminated, the inverter is in the energy saving SEARCH Mode and monitoring the output for a load greater than the **01C** and **11E Search Watts** setting.

Standby Mode Indication If the INVERT LED blinks and the AC1 or AC2 LEDs are illuminated, the inverter is in Standby Mode and is ready to engage and provide power if the AC source is lost.

AC Input Status (Green)

Status LEDs

There are two green LEDs to indicate AC status conditions.

- AC1 LED (grid)
- AC2 LED (generator)

Figure 8-3 AC Status LEDs

AC1 (Grid) LED

The AC1 LED indicates power has been applied to the inverter's AC1 (grid) input terminals. When AC is initially detected, the LED blinks slowly (once per second). If the AC source is within the user's input settings, the inverter will connect to the source and the LED will be ON solid. If the AC source falls out of tolerance, the LED will start to blink and the AC input source will be disconnected. If using BX Modeor the Grid Usage Timer, this LED will continue to blink even if the source is within tolerance.

AC2 (Generator) LED

The AC2 LED indicates power has been applied to the inverter's AC2 (generator) input terminals. When AC is initially detected, the LED blinks slowly (once per second). If the AC source is within the user's input settings, the inverter will connect to the source and the LED will be ON solid. If the AC source falls out of tolerance, the LED will start to blank and the AC input source will be dropped.

Bypass Mode

If the inverter is being used in Bypass Mode, the AC1 or AC2 LEDs, along with the STATUS LED will illuminate solidly, depending on which AC input source is selected. However, the inverter will not monitor the AC inputs for power quality.

Charge Status (Yellow and Green)

Charging indicators

There are two LEDs for battery charging indications.

- Bulk Charge LED (yellow)
- Float Charge LED (green)

Figure 8-4 Charge Status LEDs

Bulk Charge LED (Yellow)

The BULK charge LED indicates if the inverter is in the Bulk or Absorption charge stage. The LED will illuminate solidly during the bulk and absorption charging stages.

The BULK LED turns off when the battery voltage is held at the **12B Bulk Volts DC** setting and the charge current equals or is below the **12F Bulk Done Amps AC** setting or meets the **12H Max Bulk/EQ Timer h:m** value, which ever comes first. The inverter then switches over to the FINISH stage of charging.

This LED is also used to indicate an equalization charge. When this LED is blinking, it indicates the battery is being charged to the EQ volts DC setting for the equalize period.

Float Charge LED (Green)

The FLOAT charge LED turns ON when the battery voltage reaches the float stage of charging.

Float provides a maintenance charge to the batteries until another bulk charge cycle is initiated or the AC source is disconnected.

The Float Mode of charging can be changed to Silent mode, where float charging only occurs if certain conditions are met. When the LED is not illuminated, the inverter is not actively float charging (Silent Mode only).

Operational Status Indication (Red and Yellow)

There are two LEDs for Error and Status Indications:

- ERROR LED (red)
- STATUS LED (yellow)

Figure 8-5 Error and Status LEDs

ERROR LED (Red)

The ERROR LED indicates an operating error occurred or an error condition exists. Select Menu Heading **05 Error Causes** to determine which error condition has occurred.

Error conditions include:

- Over-current (menu item 05A)
- Transformer Over-temp (menu item 05B)
- Heatsink Over-temp (menu item 05C)
- Low Battery Voltage (menu item 05D)
- High Battery Voltage (menu item 05E)
- External Error (Stacked) (menu item 05F)
- Input Relay Failure (menu item 05G)
- Gen Failed to Start (menu item 05H)
- Gen Stopped due to Voltage or Frequency (menu item 05I)

For a complete description of the Error Menus, see “05 Error Causes Menu” on page 8–25.

Error LED Reset

Reset	To reset the inverter after resolving an error condition, press the red INV button (INVERTER ON/OFF Menu) and select OFF and then ON with the SET POINT buttons.
STATUS LED (Yellow)	The STATUS LED illuminates to indicate various conditions of the inverter/charger. This is not an error condition, but an indication that the inverter/charger is in a special mode or condition (i.e., such as Bypass Mode, Charger-only Mode, Generator Cooldown Period etc.)

Status conditions include:

- Bypass Mode was selected (06A)
- Charger only (CHR) was selected (06B)
- Generator was signaled to run (06C)
- Generator is in cooldown (06D)
- EQ charge is selected (06E)
- Battery Vdc is less than the LBCO (06F)
- Battery Vdc is greater than the HBCO (06G)
- EPO Shutdown command was received (06H)

For a complete description of the Status Menus, see “06 Status Menu” on page 8–28.

LED Summary

Table 8-1 summarizes the LED indicators.

Table 8-1 LED Summary Table

LED Name	OFF	ON	FLASHING
GRID TIE LED (yellow)	Not available		
INVERT LED (yellow)	Inverter is OFF. No power is available from the batteries in case of a power failure.	The inverter is on and is currently providing power from the batteries to the load(s).	SLOW FLASH (1 blink/4 sec): Inverter is in Standby Mode and is waiting to provide power to the loads if the AC power is lost. FAST FLASH (1 blink/1 sec): Inverter is on in Search Mode and is waiting for a load to be turned on that meets or exceeds the Search Watts parameter set in menu items 01C and 11E.
AC1 LED (green)	There is no AC power present (less than 80 volts) on the AC1 input terminal.	AC power present on the AC1 terminal has been qualified (i.e., is within voltage and frequency limits) and is providing pass-thru power to the loads or AC1 is selected under the **01D Bypass Mode** menu item.	AC power is present on the AC1 input terminal. The AC power may not be within voltage or frequency limits or may be waiting to be used depending on the user settings (e.g., BX mode, grid usage timer).
AC2 LED (green)	There is no AC power present (less than 80 volts) on the AC2 input terminal.	AC power present on the AC2 terminal has been qualified (i.e., is within voltage and frequency limits) and is providing pass-through power to the loads. This is only possible if there is no AC power present on the AC1 terminal or AC2 is selected under the **01D Bypass Mode** menu item.	AC power is present on the AC1 input terminal. The AC power may not be within voltage or frequency limits or voltage may be present on the AC1 terminals (AC1 input has priority).
BULK LED (green)	Bulk or EQ charges are not enabled	A Bulk Charge is being performed.	An Equalize (EQ) charge is being performed.
FLOAT LED (green)	Float Charge is not enabled.	Float charge is enabled.	

Table 8-1 LED Summary Table

LED Name	OFF	ON	FLASHING
ERROR LED (red)	No error has been detected.	An Inverter error condition has been detected. Use **05 Error Causes Menu** to determine the cause of the error. This error LED will be on if either an inverter and/or a generator error condition has been detected.	A generator error has been detected. Use **05 Error Causes Menu** to determine the cause of the Error. If the Error LED flashes and no Error cause is displayed in **05 Error Causes**, then the AC input frequency is in need of adjustment.
STATUS LED (yellow)	No Status condition has been detected.	A Status condition has been detected as described in “STATUS LED (Yellow)” on page 8–8. Use **06 Status Menu** to determine your particular status condition.	A Status condition has been detected and a pending error condition may occur if this status condition continues. Use **06 Status Menu** to determine your particular status condition.

The User Menu Summary

The User Menu provides all the controls and settings that may be required on a daily basis such as turning ON the inverter and/or generator, reading the AC and DC meters, checking the possible causes of an error, or adjusting the inverter's real-time clock.

Most menu headings in the User Menu do not set configuration parameters (Read Only) but do provide system performance information. Those menu items which are not specified as "Read Only" may be configured through the user menu.

Table 8-2 User Menu

	Sine Wave Plus 2524 and 4024		Sine Wave Plus 2548,4048, and 5548		
User Menus	**Range/ Display**	**Default Settings**	**Range/ Display**	**Default Settings**	**See Page**
01 Inverter ON/OFF Menu	See "01 Inverter ON/OFF Menu" on page 8–15 for details.				
01A Inverter	OFF SRCH ON CHR	OFF	OFF SRCH ON CHR	OFF	page 8–15
01B EQ Charge	OFF ON	OFF	OFF ON	OFF	page 8–16
01C Search Watts (SRCH)	00 to 248	08	00 to 248	08	page 8–16
01D Bypass Mode	AC1 NORM AC2	NORM	AC1 NORM AC2	NORM	page 8–17
End Menu 01					
02 Generator ON/OFF Menu	See "02 Generator ON/OFF Menu" on page 8–17 for details.				
02A Generator	OFF AUTO ON	OFF	OFF AUTO ON	OFF	page 8–18
02B Gen Start Load Amps	YES NO	Read Only	YES NO	Read Only	page 8–19
02C Gen Start Volts/Manual	YES NO	Read Only	YES NO	Read Only	page 8–19
02D Gen Start Exercise Run	YES NO	Read Only	YES NO	Read Only	page 8–19
02E Gen Start Run Time	YES NO	Read Only	YES NO	Read Only	page 8–19
02F Days left to Gen Exercise	00 to 255	Read Only	00 to 255	Read Only	page 8–19
End Menu 02					
03 Time of Day (00:00:00)	See "03 Time Of Day Menu" on page 8–20 for details.				
SW Plus Version 2.01	Info. Displayed	Read Only	Info. Displayed	Read Only	page 8–20
X.X KVA ** 120 Vac 60 Hz (where X.X = 2.5, 4.0 or 5.5)	**24 Vdc	Read Only	**48 Vdc	Read Only	page 8–20

Table 8-2 User Menu

User Menus	Sine Wave Plus 2524 and 4024		Sine Wave Plus 2548,4048, and 5548		See Page
	Range/ Display	Default Settings	Range/ Display	Default Settings	
Xantrex Tech Inc 5916 195th St NE	Info. Displayed	Read Only	Info. Displayed	Read Only	page 8–20
Arlington, WA 98223 USA	Info. Displayed	Read Only	Info. Displayed	Read Only	page 8–20
Ph 1-800-446-6180 www.xantrex.com	Info. Displayed	Read Only	Info. Displayed	Read Only	page 8–20
Press reset for factory defaults	Press to refresh the LCD display.				page 8–21
End Menu 03	Info. Displayed	Read Only	Info. Displayed	Read Only	
04 Meters Menu	See “04 Meters Menu” on page 8–22 for details.				
04A Battery Actual VDC	13.2 to 35.5	Read Only	20.0 to 71.0	Read Only	page 8–22
04B Battery Comp VDC	13.2 to 35.5	Read Only	20.0 to 71.0	Read Only	page 8–23
04C Inv/Chr Amps AC	-63 to 63	Read Only	-63 to 63	Read Only	page 8–23
04D Input Amps AC	00 to 63	Read Only	00 to 63	Read Only	page 8–23
04E Load Amps AC	00 to 63	Read Only	00 to 63	Read Only	page 8–23
04F Inverter Volts AC	00 to 163	Read Only	00 to 163	Read Only	page 8–23
04G Grid (AC1) Volts AC	00 to 163	Read Only	00 to163	Read Only	page 8–24
04H Gen (AC2) Volts AC	00 to 163	Read Only	00 to 163	Read Only	page 8–24
04I Frequency Hertz	52 to 68	Read Only	52 to 68	Read Only	page 8–24
04J Max Bulk/EQ Time him	00:00 to 23:50	Read Only	00:00 to 23:50	Read Only	page 8–24
04K Battery Temp Degrees C	-28 to 60, OL	Read Only	-28 to 60, OL	Read Only	page 8–24
04L Fan Speed	00, 01, 02, 03, 04	Read Only	00, 01, 02, 03, 04	Read Only	page 8–24
End Menu 04					
05 Error Causes Menu	See “05 Error Causes Menu” on page 8–25 for details.				
05A Over Current	NO YES	Read Only	NO YES	Read Only	page 8–25
05B Transformer overtemp	NO YES	Read Only	NO YES	Read Only	page 8–25
05C Heatsink overtemp	NO YES	Read Only	NO YES	Read Only	page 8–26
05D Low Battery Voltage	NO YES	Read Only	NO YES	Read Only	page 8–26
05E High Battery Voltage	NO YES	Read Only	NO YES	Read Only	page 8–27

Table 8-2 User Menu

User Menus	Sine Wave Plus 2524 and 4024		Sine Wave Plus 2548,4048, and 5548		See Page
	Range/ Display	Default Settings	Range/ Display	Default Settings	
05F External err (stacked)	NO YES	Read Only	NO YES	Read Only	page 8–27
05G Input Relay Failure	NO YES	Read Only	NO YES	Read Only	page 8–27
05H Gen Failed to Start	NO YES	Read Only	NO YES	Read Only	page 8–28
05I Gen Stopped due to V/F	NO YES	Read Only	NO YES	Read Only	page 8–28
End Menu 05					
06 Status Menu	See “06 Status Menu” on page 8–28 for details.				
06A Bypass Mode Selected	NO YES	Read Only	NO YES	Read Only	page 8–29
06B CHR Selected (no backup)	NO YES	Read Only	NO YES	Read Only	page 8–29
06C Gen Signalled to Run	NO YES	Read Only	NO YES	Read Only	page 8–29
06D Gen in Cooldown	NO YES	Read Only	NO YES	Read Only	page 8–29
06E EQ Charge Selected	NO YES	Read Only	NO YES	Read Only	page 8–30
06F Battery Vdc < LBCO	NO YES	Read Only	NO YES	Read Only	page 8–30
06G Battery Vdc > HBCO	NO YES	Read Only	NO YES	Read Only	page 8–30
06H EPO shutdown	NO YES	Read Only	NO YES	Read Only	page 8–30
End Menu 06					
07 GSM/ALM Menu	See “07 GSM/ALM Options Menu” on page 8–30 for details.				
07A RY7 (GSM) Energized	NO YES	Read Only	NO YES	Read Only	page 8–30
07B RY8 (GSM) Energized	NO YES	Read Only	NO YES	Read Only	page 8–31
07C RY9 (ALM) Energized	NO YES	Read Only	NO YES	Read Only	page 8–31
07D RY9 DeEngz. Time Minute	00 to 255	Read Only	00 to 255	Read Only	page 8–31
07E RY10 (ALM) Energized	NO YES	Read Only	NO YES	Read Only	page 8–31
07F RY10 Engz. Time Minute	00 to 255	Read Only	00 to 255	Read Only	page 8–31
07G RY11 Energized	NO YES	Read Only	NO YES	Read Only	page 8–31
End Menu 07					
END USER MENU					

Accessing the User Menu

To directly access the 01A Inverter User Menu:

◆ Press the red INV button to go directly to **01A Inverter**.

Figure 8-6 Inverter ON/OFF Display

To directly access the 02 Generator User Menu:

◆ Press the green GEN button to go directly to **02A Generator**.

Figure 8-7 Generator ON/OFF Display

User Menu Description

01 Inverter ON/OFF Menu

```
01 Inverter
ON/OFF
```

The INVERTER ON/OFF Menu Heading accesses the startup and shutdown function of the inverter.

01A Inverter

```
01A Inverter
OFF SRCH ON CHR
```

The **01A Inverter** menu item has four set points to select from for inverter operation: OFF, SRCH, ON, and CHR. This display will be the initial power up display and is the first display to appear whenever the red INV button is pushed.

OFF If in Bypass mode, this selection disables the inverter and charger, but can provide pass through AC power on the inverter's outputs. OFF is the default when the inverter is first powered up. The batteries will not be charging in this mode.

SRCH This is the automatic load search function of the inverter. When AC power is not present on the inverter's input, the inverter will not provide an output voltage to the load until the load exceeds the value set for the **01C Search Watts** and **11E Search Watts** setting. Use this function to conserve battery power when AC power is not required.

ON This mode turns the inverter ON and supplies inverter output power from the batteries plus allows an external AC source (i.e., utility or generator power), connected to the inverter's input, to begin charging the batteries.

CHR This charger mode puts the unit into the Charger-only mode, allowing the inverter to act as a stand-alone battery charger. In this mode, the charger will maintain the batteries based on your charge configuration (Silent or Float). The inverter will not function if there is a utility outage. The Charge mode is intended to be used at times when no loads are required to be operated if the utility fails.

01B EQ Charge OFF ON

```
01B EQ Charge
OFF ON
```

OFF When OFF is selected in the menu, the inverter is not set to equalize the batteries.

ON This selection triggers the battery charger to initiate the equalization process. If the AC source is present on the AC1 grid or AC2 GEN terminals, the equalization process will begin. The cursor automatically returns to OFF after the EQ cycle is finished.

If the only AC source is connected to the AC2 GEN terminal (generator input) but not present (that is, waiting for the generator to start), the generator will start the equalization process the next time the generator is started. After the EQ cycle has finished, the generator is stopped, after cooldown if started automatically, and the cursor returns to OFF.

A BULK charge can be initiated by moving the cursor to ON, then OFF.

01C Search Watts (SRCH)

```
01C Search Watts
(SRCH)
```

This menu item sets the inverter's search sensitivity. Any load that is below this setting does not cause the inverter to produce an AC output voltage when running from batteries. The SRCH function must be selected in **01A Inverter**.

Setting this mode to 00 disables this function.

The default setting for this menu item is 8 watts.

See "11E Search Watts" on page 6–14 for additional information about how this feature works and how to determine the value for this setting.

Note: This item is duplicated for your convenience in menu item 01C and 11E. Changes to settings made at 01C will also change the setting in 11E.

01D Bypass Mode

```
01D Bypass Mode
AC1 NORM AC2
```

The Bypass Modecloses the internal bypass relays and allows the AC connected to the selected input (AC1 or AC2) to pass directly through to the loads without being monitored for AC voltage or frequency quality.

Important: All system functions are disabled in this mode and can only be restored by selecting NORM. After returning to NORM, you must reselect your user settings in the **01A Inverter** menu item.

NORM When NORM is selected in the menu, the available inputs are monitored for voltage and frequency.

AC1, AC2 If AC1 or AC2 is selected in this menu, the AC applied to that input will not be monitored for voltage or frequency problems which will pass directly through to the load, bypassing the inverter's monitoring circuits.

CAUTION: Damage to AC Loads

When Bypass Mode is selected, the Sine Wave Plus allows any AC power supplied (utility or generator) to pass through the inverter to AC loads. If the source of AC is not adequately regulated it can cause instability in voltage and frequency which can damage connected AC loads. Xantrex does not recommend use of Bypass Mode in areas of unstable AC power supply.

02 Generator ON/OFF Menu

```
02 Generator
ON/OFF Menu
```

The **02 Generator ON/OFF Menu** is used for controlling a generator equipped with remote start features and connected to the inverter by way of the optional GSM. The generator can be manually switched ON or OFF using the inverter control module or set to run automatically based on programmed usage parameters. This menu heading also provides generator status menus (02B through 02F) to help determine "why" a generator started.

Note: Auto-starting or controlling a generator with the inverter is only possible with generators that have an electric starter and are compatible with two- or three-wire external relay control. The optional GSM accessory is required to perform automatic-generator starting operations.

02A Generator

```
02A Generator
OFF AUTO ON
```

The **02A Generator** menu item provides three set points to choose from for generator control.

OFF This set point disables the auto-start system or immediately turns OFF a generator (without cooldown) started by the inverter. It is also used to reset the automatic generator start system after an ERROR condition occurs.

AUTO This set point enables the auto-start system features and allows the generator to be started automatically based on battery voltage, load amps, exercise time, or a preset time. The generator may be started based on battery voltage, load amps, or exercise time with the following distinctions:

- If the generator is started automatically based on battery voltage, it will shut off after the charger completes its Bulk and Absorption battery charging stages or if the **24H RN2/Max Gen Run Timer** is met.
- If the generator started automatically based on load amps, it will turn off when the current, as shown on the **04E Load Amps AC** display, decreases below the **26A Load Start Amps** setting for the **26C Load Stop Delay Min** period.
- If the generator started automatically based on exercise time, it will turn off after the setting in menus **24F Exercise Time Min** and **24G Gen Cooldown Time Min** periods has been reached.

Note: The "AUTO" generator start/stop function is disabled if the inverter is OFF or Bypass Mode is selected.

ON This set point turns on the generator connected to the GSMs generator control relays. When ON is selected, the generator must be stopped by selecting the OFF setting.

Note: By pausing the cursor at ON then selecting AUTO (Do not pass-through OFF), the generator is manually turned ON and will be automatically stopped after the Bulk/Absorption charge is finished.

Generator Status Menu Items

Menu Items 02B through 02F are generator status menus. They are Read-Only displays for determining "why" the generator has started. They will indicate either NO or YES depending on whether the generator has started based on the parameters of time, voltage, or current.

Menu items 02B through 02F will indicate "NO" unless the generator-start parameters are met as programmed in the **Advanced Setup Menu** (Menu items 24, 25, and 26).

02B Gen Start Load Amps

```
02B Gen Start
Load Amps
```

A "YES" displayed in this menu item indicates the generator has or is about to start and run as the current has maintained the **26A Load Amp Start** setting continuously for the time set in **26B Load Start Delay Min**.

02C Gen Start Volts/Manual

```
02C Gen Start
Volts/Manual
```

A "YES" displayed in this menu item indicates the generator has or is about to automatically start and run because the battery voltage reached one of the "start volts" settings, selected in 26D through 26G, or has been manually started by selecting ON from menu **02A Generator**.

This automatic start setting is delayed by the time period set by the **26 Gen Auto Run Setup Menu** settings (e.g., 24 hours (26D), 2 hours (26E), 15 minutes (26F), 30 seconds (26G).

02D Gen Start Exercise Run

```
02D Gen Start
Exercise Run
```

A "YES" displayed in this menu item indicates the generator has or is about to start because the **24E Exercise Period Days** setting in menu item 24E has been reached. The generator will continue to run for the time set in menu item **24F Gen Exercise Time Min**.

This automatic start setting is delayed by the time period set in menu **24E Exercise Period Days**.

02E Gen Start Run Time

```
02E Gen Start
Run Time
```

A "YES" displayed in this menu item indicates the generator is starting or running because the setting in menu **24A Gen Run Time Start h:m** has been reached. The generator will stop when the time set in menu **24B Gen Run Time Stop h:m** or **24C Quiet Time Begin h:m** setting has been reached.

02F Days Left To Gen Exercise

```
02F Days Left to
Gen Exercise
```

Displays the number of days left before the generator will be exercised (run) again. This time is based on the last time it was exercised as set in menu heading **24E Exercise Period Days**. This setting will be reset if the generator is turned on and sensed at the AC2 terminals.

03 Time Of Day Menu

```
03 Time of Day
```

Menu Heading **03 Time Of Day** displays information such as the current time of day, software revision number, system information (e.g., model type), Xantrex's mailing address and phone/fax numbers.

Use the information contained in this menu when contacting Xantrex for technical assistance or service request.

03A SW Plus Software Level

```
SW Plus
Revision 2.01
```

This menu item displays the software revision level. You will need to know the software revision level if you have to contact Xantrex Customer Service.

03B System Information

```
X.X KVA    **Vdc
120 Vac    60 Hz
```

The System Information menu item displays system information such as rated load output, DC system voltage, AC output voltage, and output frequency. Depending on your model, either 2.5 KVA, 4.0 KVA or 5.5 KVA will be displayed in this menu item.

03C Company Name and Address

```
Xantrex Tech Inc
5916 195th ST NE
```

Menu item 03C displays the company name and street address where the Sine Wave Plus Inverter/Charger was built.

03D City, State, and Zip Code

```
Arlington, WA
98223 USA
```

Menu item 03D displays the City, State and Postal Code where the Sine Wave Plus Inverter/Charger was built.

Important: Do not return units to the address displayed in menu item 03C and 03D for replacement or service. Contact the Xantrex Customer Service Department for an RMA to obtain the appropriate mailing address.

03E Xantrex Phone Numbers

```
Ph 1-800-446-6180
www.xantrex.com
```

Menu item 03E displays the toll-free phone number for Xantrex Customer Service. It also displays the name of the website for Xantrex Technology Inc.

Press Reset for Factory Defaults

```
PRESS RESET FOR
FACTORY DEFAULTS
```

In addition to providing information, this menu includes a reset function that allows all system settings to be returned to their original default values.

Pressing the RESET DEFAULTS button while this menu item is displayed resets the inverter to the factory default settings. Only the system clock will remain unchanged using the reset function.

It also runs an LED and relay test which allows users to check the LEDs on the inverter display and the relays and LEDs on any ALM or GSM that is connected.

WARNING: Personal Injury

Ensure all devices connected to the ALM or GSM are disabled prior to pressing the Reset Factory Defaults button.

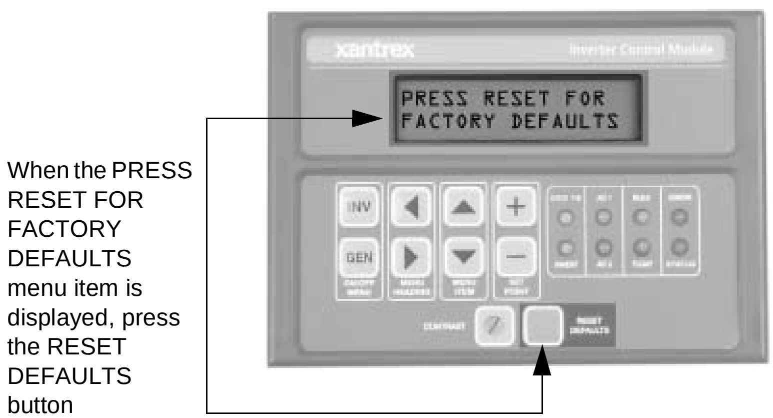


Figure 8-8 Resetting Factory Default Settings

04 Meters Menu

```
04 Meters Menu
```

The Meters Menu provides information about system performance. The menus under this heading are read-only. This information includes the following menu items to assist the user in monitoring system performance:

- **04A Battery Actual Volts DC**
- **04B Battery Compensated Volts DC**
- **04C Inverter/Charger Amps AC**
- **04D Input Amps AC**
- **04E Load Amps AC**
- **04F Inverter Volts AC**
- **04G Grid (AC1) Volts AC**
- **04H Generator (AC2) Volts AC**
- **04I Frequency Hertz**
- **04J Maximum Bulk/EQ Time**
- **04K Battery Temp Degrees C**
- **04L Fan Speed**

Note: The AC ammeters have an approximate 1-amp tolerance. Additionally, the meters provided in menus 04C, 04D and 04E measure the real, in-phase AC component of the current. This is the portion of the power that is actually drawn from the batteries, allowing better estimation of the DC power consumed by the load or the battery charger. Measurements taken with conventional AC DVMs usually read apparent current and may differ from these readings.

04A Battery Actual Vdc

```
04A Battery
Actual Vdc
```

This menu item displays the actual DC battery voltage. This value is used for setting the following menu items.

- **11C Low Battery Cut Out Vdc**
- **11A High Battery Cut Out Vdc**
- **22B Low Battery Xfer Vdc**
- **11B Low Battery Cut In Vdc**
- **22A High Battery Xfer Vdc**

04B Battery Comp Vdc

```
04B Battery
Comp Vdc
```

This menu item display shows the battery voltage after it has been compensated based on the battery temperature and the input current. These two compensation values are used by the battery charger for its regulation settings and are only used when the inverter is charging.

The temperature compensation value will decrease from the actual battery voltage if the battery is cold and will increase if the battery is hot. This improves the performance of the battery in cold weather and reduces gassing in hot weather.

The current compensation helps coordinate a large difference in current requirements between two units on the same battery bank. The compensation is usually not enabled unless one unit is using a large amount of battery current to power its AC loads and the other unit is using a large amount of current to keep the battery charged.

Note: The BTS must be installed for the battery voltage to be adjusted based on temperature.

04C Inverter/Charger Amps AC

```
04C Inv/Chrg
Amps AC
```

This menu item displays the AC amperage. A positive (+) amp reading indicates the inverter/charger is charging the batteries. A negative (–) reading indicates the inverter/charger is powering the AC loads and the batteries are being discharged.

04D Input Amps AC

```
04D Input
Amps AC
```

This menu item displays the total AC amperage supplied to the inverter/charger from the AC HOT IN terminals. This meter indicates the inverter/charger is drawing power from the AC source to charge the battery or power the AC loads.

04E Load Amps AC

```
04E Load
Amps AC
```

This menu item displays the AC amperage supplied to the AC loads.

04F Inverter Volts AC

```
04F Inverter
Volts AC
```

This menu item displays the inverter’s AC output voltage. When synchronized to the AC source, the inverter’s output voltage matches the AC source.

04G Grid (AC1) Volts AC

```
04G Grid (AC1)
Volts AC
```

This menu item displays the AC input voltage connected to the inverter's AC1 terminals. This input voltage display may drift slightly before the inverter has synchronized to the grid.

04H Gen (AC2) Volts AC

```
04H Gen (AC2)
Volts AC
```

This menu item displays the AC input voltage connected to the inverter's AC2 terminals. This input voltage display may drift slightly before the inverter has synchronized to the generator.

04I Frequency Hertz

```
04I Frequency
Hertz
```

This menu item displays the frequency of the active AC source (inverter, grid or generator). This value may drift slightly until the inverter fully synchronizes to an external AC source. Once synchronized, the inverter follows the frequency of the AC source.

04J Max Bulk/EQ Time h:m

```
04J Max Bulk/EQ
Time h:m
```

This menu item display shows the time the system has been charging the batteries in either bulk, absorption, or equalize mode.

04K Battery Temp Degrees C

```
04K Battery Temp
Degrees C
```

This menu item display shows actual battery temperature as measured by the BTS. Use this menu item to monitor or check the temperature of the batteries.

If the BTS is not installed, this display will show “OL”.

04L Fan Speed

```
04L Fan Speed
```

The inverter/charger contains two internal cooling fans. The speed of the fans is determined by the internal temperature of the unit and is controlled automatically.

This menu item displays the current fan speed by displaying the number 00, 01, 02, 03, or 04. The slowest speed is 1 and the fastest speed is 4. “00” indicates the fan is off or not running.

05 Error Causes Menu

```
05 Error Causes
Menu
```

Detected inverter errors cause the red ERROR LED to illuminate. These menu items help determine the cause of error conditions.

These menu items normally display “NO” for all menu items in which no error is detected. The display changes to “YES” for menu items where errors were detected.

Note: All errors except “**05A Overcurrent**”, “**05F External Err (Stacked)**”, and “**05G Input Relay Failure**” will allow the external AC source (if within acceptable tolerances) to pass-through to the inverter’s output.

05A Over Current

```
05A Over Current
             YES
```

If “Yes” is displayed, the AC output wiring of the inverter is short-circuited or has had an excessive load connected for too long.

To clear this fault, disconnect the loads and restart the inverter by pressing the red INV ON/OFF MENU button to directly access the **01A Inverter** menu item and select OFF, then ON or SRCH. Reconnect the loads (one at a time) to find the load, or combination of loads, causing the problem.

Note: An over-current condition will shut down the inverter.

05B Transformer Overtemp

```
05B Transformer
Overtemp     YES
```

If “yes” is visible in this display, the transformers have exceeded their designed operating temperature and the inverter will shut off.

If the unit is operating as a battery charger when this error condition occurs, the inverter stops charging to prevent further overheating.

In the inverter mode, overheating can be caused by:

- powering an excessive load for too long,
- blocked air vents or a fan failure, and/or
- insufficient circulation that allows the exhaust from the unit to be drawn back into the unit.

When the inverter has this error condition, AC current from the source (utility grid or generator) is passed through the inverter to power the loads. Power management features provided by the inverter are not available with this error.

The inverter automatically resets when it has cooled.

05C Heatsink Overtemp

```
05C Heatsink
Overtemp     YES
```

If “yes” is visible in this display, the power transistors have exceeded their designed operating temperature and the inverter is shut off.

When this error condition occurs, if the unit is operating as a battery charger, the inverter stops charging to prevent further overheating.

In the inverter mode, overheating can be caused by:

- powering an excessive load for too long,
- blocked air vents or a fan failure, and/or
- insufficient circulation that allows the exhaust from the unit to be drawn back into the unit.

When the inverter has this error, AC current from the source (utility grid or generator) is passed through the inverter to power the loads. Power management features provided by the inverter are not available with this error.

The inverter automatically resets when it has cooled.

05D Low Battery Voltage

```
05D Low Battery
Voltage      YES
```

If “yes” is visible in this display, the battery voltage has dropped below the **11C Low Battery Cutout VDC** setting continuously for the **11D LBCO Delay Minutes** period.

When a battery protection fault occurs (due to either a high or low battery charge condition), the yellow STATUS LED will flash. If this condition continues without being corrected, then the inverter will shut down and the red ERROR LED will illuminate solidly.

After shutting down from a low battery protection condition, the inverter will return to normal operation when:

- the AC source power is restored and the inverter operates as a battery charger,
- the inverter is manually restarted by pushing the red INV button on the control module to access the **01A Inverter** menu item and selecting OFF, then SRCH or ON from the display, or
- the battery voltage rises above the setting in menu setting **11B Low Battery Cut In VDC**.

AC current is still passed-through to the load if an AC source within acceptable tolerance is available.

05E High Battery Voltage

```
05E High Battery
Voltage      YES
```

If “Yes” is displayed, the DC battery voltage has increased above the value set in the **11A High Battery Cut Out VDC** menu item.

This can be caused by a solar array or other charging source not being regulated. Check the operational status of all the DC controllers in the system.

If NiCad batteries are used, it might be necessary to increase the value in the **11A High Battery Cut Out VDC** menu item.

The inverter automatically resets once the battery voltage decreases to 3 volts for 24-volt models, or 6 volts 48-volt models, below the HBCO setting.

AC current is still passed-through to the load if the AC source is within acceptable tolerances.

05F External Err (Stacked)

```
05F External Err
(Stacked)    YES
```

If “Yes” is displayed, then the inverter showing the error (Inverter 1) has received a shutdown command from the stacked inverter (Inverter 2). Check the stacked inverter (Inverter 2) for error conditions and clear the error condition.

After the error condition is resolved, on the primary inverter (Inverter 1), go to **01A Inverter** and turn the inverter OFF, then back ON to clear this error message.

Note: The External Error condition will shut down both inverters.

05G Input Relay Failure

```
05G Input Relay
Failure      YES
```

If “Yes” is displayed, an internal AC transfer relay (AC1 or AC2) has failed. This condition maybe caused by an AC backfeed (AC plugged into the inverter’s output) or a welded relay condition.

Note: This condition will shut down the inverter.

05H Gen Failed to Start

```
05H Gen Failed to
Start         YES
```

If “Yes” is displayed, the automatic generator-start system did not successfully start the generator.

The system completes six start cycles and requires the generator to operate for a minimum of five minutes before the starting attempts counter is cleared.

To manually clear this error, press the green GEN buttons to directly access the menu item **02A Generator** and select OFF.

05I Gen Stopped Due to V/F

```
05I Gen Stopped
Due to V/F  YES
```

If “Yes” is displayed, the automatic generator-start system did not successfully connect to the generator after it was running. If the generator runs for 20 minutes without meeting the AC voltage and frequency tolerance window, the automatic start-system stops the generator (after the cooldown period) and indicates the error.

Whenever this error occurs, the inverter is prevented from starting the generator until this error is cleared.

To clear this error, select OFF from menu item **02A Generator**.

Determine and correct the reason the generator was out-of-tolerance, then select AUTO from menu item **02A Generator** if you want the generator start system to be enabled.

06 Status Menu

```
06 Status Menu
```

The **06 Status Menu** displays various conditions or special operating modes of the inverter/charger in one convenient location. The information in these displays is read-only and cannot be altered. Refer to this menu whenever the yellow STATUS LED is illuminated.

A “No” displayed in this series of menu items indicate that no status condition has occurred and provides no additional information. If the Status light is on, scroll through the Menu Items under this Menu Heading to look for a “Yes” to determine what’s happening.

06A Bypass Mode Selected

```
06A Bypass Mode
Selected     YES
```

If “Yes” is displayed, the Bypass Mode is selected for either the AC1 or AC2 input.

When the inverter is setup to operate in the Bypass Mode it does not check the AC inputs for quality and will allow any anomalies appearing on the grid (AC1) or generator output (AC2) to pass through to the loads.

This is a special operating mode which bypasses the inverter’s internal sensing circuits and disables the inverter/charger’s normal operation. Backup power and charging functions are not available in this operating mode.

06B Chr Selected (No Backup)

```
06B Chr Selected
no backup    YES
```

If “Yes” is displayed, the CHR (charger only) Mode is selected.

In this mode, the inverter will not supply AC power if the AC input source fails. Whenever AC is present on the input (AC1 or AC2), it will pass through to the loads and the charger will continue to charge the batteries, providing a float charge if Float is selected or a silent charge (as necessary) if Silent is selected.

06C Gen Signaled to Run

```
06C Gen Signaled
to Run       YES
```

If “Yes” is displayed, the generator was issued a command to start. This menu item only acknowledges that a generator run command was issued.

If you need to know why the generator has been signaled to run, check menu items **02B Gen Start Load Amps**, **02C Gen Start Volts/Manual** and **02D Gen Start Exercise Run** for either a load amps start, voltage or manual start, or an exercise start.

If the generator is not running, but has received a signal to start, check the Menu Items 07 to determine which relay did, or did not, energize. Or check the troubleshooting section of your generator’s owner’s manual.

06D Gen In Cooldown

```
06D Gen in
Cooldown     YES
```

If “Yes” is displayed, the generator’s AC output is no longer synchronized to the inverter’s input and the generator is in its cooldown cycle (set in menu **24G Gen Cooldown Period**).

Once the cooldown time has elapsed, the generator is sent a command to stop.

06E EQ Charge Selected

```
06E EQ Charge
Selected     YES
```

If “Yes” is displayed, the charger is set to run in the Equalize Charge Mode.

Be sure to monitor menu items **04I Battery Temp** and **04K Read Bulk/ EQ Time** when equalize charging the batteries.

6F Battery VDC < LBCO

```
06F Battery
VDC < LBCO    YES
```

If “Yes” is displayed, the battery voltage has dropped below the voltage set in menu **11C Low Battery Cut Out VDC**.

When the batteries have dropped below the setting for the time set in menu **11D LBCO Delay Minutes**, the inverter will shut off.

6G Battery VDC > HBCO

```
06F Battery
VDC < HBCO    YES
```

If “Yes” is displayed, the battery voltage has risen to or exceeded the voltage set in menu **11A High Battery Cut Out VDC**.

When the battery voltage has risen above the setting in menu **11A High Battery Cut Out VDC** and remains there for approximately one minute, the inverter will shut off.

06H EPO Shutdown

```
06H EPO Shutdown
             YES
```

If “Yes” is displayed, the inverter has received an Emergency Power OFF Shutdown command from an externally located shut off switch to the inverter’s EPO Port.

07 GSM/ALM Options Menu

```
07 GSM/ALM
Options Menu
```

The **07 GSM/ALM Options Menu** displays the various conditions of the relays on the GSM and ALM. The information provided here can assist in finding the reason for an auto-generator start or to determine the GEN and AUX relay state which can be used as a troubleshooting aid if necessary.

Using the GSM for auto-starting or controlling a generator is only possible with generators that have an electric starter and are compatible with two- or three-wire external relay control.

07A RY7 (GSM) Energized

```
07A RY7 (GSM)
Energized    YES
```

If “Yes” is displayed, the inverter has sent out a command to energize the relay (between the N.O. to COM connections) in the GSM.

This display can be used for troubleshooting purposes by helping to isolate the cause of a generator problem.

07B RY8 (GSM) Energized

```
07B RY8 (GSM)
Energized    YES
```

If “Yes” is displayed, the inverter has sent out a command to energize the relay (between the N.O. to COM connections) in the GSM.

This display can be used for troubleshooting purposes by helping to isolate the cause of a generator problem.

07C RY9 (ALM) Energized

```
07C RY9 (ALM)
Energized    YES
```

If “Yes” is displayed, the inverter has sent out a command to energize the RY9 relay (between the N.O. to COM connections) in the ALM.

This display can be used for troubleshooting purposes by helping to isolate the cause of an ALM problem.

07D RY9 DeEngz. Time Minute

```
07E RY9 DeEnerz.
Time Minute
```

This menu item displays the delay time period in minutes at which the DC voltage level has been displayed at or below the level set in menu item **23B RY9 DeEnergized**.

07E RY10 (ALM) Energized

```
07E RY10 (ALM)
Energized    YES
```

If “Yes” is displayed, the inverter has sent out a command to energize the RY10 relay (between the N.O. to COM connections) in the ALM.

This display can be used for troubleshooting purposes.

07F RY10 Engz. Time Minute

```
07E RY10 Enerz.
Time Minute
```

This menu item displays the delay time period in minutes at which the DC voltage level has been at or below the level set in menu **23E RY10 Vdc DeEnergized**.

07G RY11 Energized

```
07G RY 11
Energized    YES
```

If “Yes” is displayed, the inverter has sent out a command to energize the RY11 relay (between the N.O. to COM connections) in the GSM or ALM.

This display can be used for troubleshooting purposes.

This display applies to both the GSM and ALM

9 Troubleshooting

Chapter 9, “Troubleshooting” contains information and procedures for solving possible problems with the Sine Wave Plus.

Inverter Troubleshooting

If the red ERROR LED illuminates on the control module, see "05 Error Causes Menu" on page 8–25 to determine the cause of the error condition then refer to the troubleshooting solutions below to resolve the situation.

Problem	Possible cause	Solution
Unit will not come on (no LEDs are on) and the ICM display is blank or off.	DC voltage on the inverter's DC terminals is incorrect.	Check the battery voltage, fuses or breakers and DC cable connections to the inverter. If the DC voltage on the inverter's DC terminals is correct, have unit serviced.
Unit comes on, but goes off quickly (several attempts made).	Excessive load on output, unit is in over-temperature protection and needs to cooldown, incorrect battery voltage.	Look under the **05 Error Causes Menu**.
No AC power output. INVERT LED is on, with no ERROR LED.	Open AC output breakers or fuses and bad output wire connections.	Look at the ICM display under **04F Inverter Volts AC** and check AC voltage on the inverter AC terminal block. If there is correct AC voltage on the ICM display but no AC voltage on the inverter AC terminal block, check for open circuit breaker on the inverter. If the circuit breaker is open, press it back in to reset it. If circuit breaker on the inverter is not open, the inverter may need to be serviced. If there is correct AC voltage on the ICM display and on the inverter AC terminal block, check for open AC output breakers or fuses and bad output wire connections. If AC voltage on the ICM display or inverter AC terminal block is incorrect, have unit serviced.
No AC power output. INVERT LED is flashing.	AC load too small for Search Mode circuit to detect.	Reduce search watts setting, increase load above search watts setting, or defeat Search Mode by selecting ON. If the AC1 LED is on, check inverter output connections/voltage.

Problem	Possible cause	Solution
Low AC power output or Low surge power INVERT LED is on. AC inductive loads are not running at full speed.	Insufficient DC current being provided to the inverter to operate the AC loads.	Check the battery voltage, fuses or breakers and cable connections. Ensure the battery bank is sufficient (check for low DC voltage while running the load). Ensure the cable length and size is correct (see owner's manual for correct cable). Tie the battery cables together to reduce inductance.
Inverter turns on and then off or doesn't turn on at all.	Search Sense setting is too low or high. Potential problem loads for Search Sense: Incandescent Lights: These have a higher starting wattage when the filament is cold than the continuous rating of the bulb. Fluorescent Bulbs: These work the opposite of incandescent light bulbs. If the inverter is set to detect a 30 watt load and a 40 watt fluorescent is switched on, the inverter will not detect it, This is because the fluorescent tube is less than 30 watts until the gas in the tube ionizes. Other loads: There are some appliances which draw power even though they are turned off. TV's with instant on circuits, microwaves with digital clocks, VCR's, and clocks.	If the search sensitivity is set higher than the combined loads, then an auxiliary load must be used to bring the inverter out of Search Mode before the appliances can be turned on. If the sensitivity is set lower than the combination of the loads, the loads will remain on and excess battery drain will occur since the inverter won't ever go to sleep. One solution is to turn the item off at the wall, use an extension cord with a rocker switch, a switch at the outlet, or an appropriate circuit breaker.

Battery Charger Troubleshooting

If the red ERROR LED illuminates on the ICM display, see “05 Error Causes Menu” on page 8–25 to determine the cause of the error condition. Then use the solutions below to resolve the situation.

Problem	Possible Cause	Solution
AC1 LED is flashing, but will not start charging (allow 40 seconds to synchronize).	Battery voltage is below the **22B Low Xfer (BX) VDC** setting. You are outside of the **21 Grid Usage** timer period.	Check for the correct AC voltage or frequency at the AC input terminal. If it is normal: 1) Check to see if the BX Mode is enabled. The AC input is not allowed to synchronize and pass-through unless the battery voltage reaches the **22B Low Xfer (BX) VDC** setting. 2) Check to see if the **21 Grid Usage** timer (21B and 21C) is enabled and that you are outside of the **21 Grid Usage** timer period. The AC is not allowed to synchronize and charge unless you are within the **21 Grid Usage** timer period.
AC1 or AC2 LED is flashing, but will not start charging (allow 40 seconds to synchronize).	AC frequency at the AC input terminal may be out-of-tolerance (too high or low) or the AC voltage may be outside the **13C Input Upper Limit VAC** or **13D Input Lower Limit VAC** settings.	Check for the correct AC voltage or frequency at the AC input terminal. If the AC source is a generator, adjust the AC voltage or frequency accordingly.
AC1 or AC2 LED is flashing and repeatedly connects and disconnects to the source.	AC frequency at the AC input terminal may be out-of-tolerance (too high or low) or the AC voltage may be outside the **13C Input Upper Limit VAC** or **13D Input Lower Limit VAC** settings. Or the inverter circuit breaker has opened.	Check for the correct AC voltage or frequency at the AC input terminal. If the AC source is a generator, adjust the AC voltage or frequency accordingly. If the circuit breaker is open, press it back in to reset it. If circuit breaker on the inverter is not open, the inverter may need to be serviced.

Problem	Possible Cause	Solution
Charger drops off before full charging has finished (no ERROR comes on).	AC frequency at the AC input terminal may be out-of-tolerance (too high or low) or the AC voltage may be outside the **13C Input Upper Limit VAC** or **13D Input Lower Limit VAC** settings.	Check for the correct AC voltage or frequency using the ICM Display. If the AC source is a generator, adjust the AC voltage/frequency accordingly. Reduce your **13A Grid (AC1) Amps AC** or **13B Gen (AC2) Amps AC** setting (based on the input you are using) to limit the pull on the AC source. Open the **13C Input Upper Limit VAC** or **13D Input Lower Limit VAC** settings “window” to allow synchronization.
	Circuit breaker on inverter is open.	Engage circuit breaker on top of unit (press on breaker button to ensure it is engaged).
	Ambient temperature may be high causing unit to overheat and ramp down the charging.	Cool the unit down or check the inverter cooling fan, or check for anything preventing air flow.
Charger drops off before full charging (or equalization) has finished. ERROR LED flashes and AC output drops momentarily.	Cold temperature around batteries with BTS installed may be causing unit to reach **11A High Battery Cut Out VDC** setting.	Disconnect BTS during charging or increase **11A High Battery Cut Out VDC** setting.
Charger drops off before full charging has finished. ERROR comes on.		Check **05 Error Causes Menu** in the ICM display to determine where the failure occurred. Then see the troubleshooting section on page 9–7 for a solution.
Charger output is low.	Loose or corroded battery connections.	Check and clean all connections.
	Loose AC input connections.	Check all AC wiring connections.
	Worn out batteries.	Replace batteries.
	Battery cables too small or too long.	Refer to cable and battery recommendations in owner’s manual.

Problem	Possible Cause	Solution
Batteries being charged above the Bulk/Float setting.	If BTS is installed, it may be in a cold area or have fallen off the batteries. Another DC charging source may be on the batteries.	Monitor the **04B Battery Temp Comp VDC** while charging. NOTE: To bring batteries that are cold to the correct state of charge may require charging at a higher voltage. Remove the BTS and determine if your voltage returns to the bulk/float voltage.
The red Error LED and the STATUS LED illuminate at the same time and the inverter shuts down.	The inverter has detected a low battery voltage condition. In other words, the voltage has dropped below the **11C Low Battery Cut Out VDC** setting for the amount of time set in **11D LBCO Delay Minutes**.	Restore an AC source to allow the inverter to charge the batteries back up to acceptable levels. To manually restart the inverter, press the red INV button to access the **01A Inverter** menu. Then select OFF, then SRCH or ON from the display.

Error Causes

This table refers to **05 Error Causes Menu** messages. Refer to these messages when the ERROR LED is on or flashing.

Message	Problem	Solution
05A Over Current	Excessive load on the AC output.	Reset the inverter by pressing the On/Off switch to OFF, then to SRCH or ON. If unit comes on, then check for a heavy load (above the inverter's capacity) on the inverter's output. If the **05A Over Current** error happens again, disconnect all wires on the AC input and output and reset the inverter again. If the inverter comes on, then check your AC wire system for shorts or miswired connections.
05B Transformer Overtemp or **05C Heatsink Overtemp**	AC input voltage may be too high while charging.	Check for high input AC voltage.
	Operating too large of a load for too long while inverting.	Remove excessive loads.
	Ambient temperature may be high.	Let inverter cooldown and try restarting.
	Inverter cooling fan may have failed.	Hold a piece of paper to inverter vents to check the fan (the fan is hard to hear). If the fan has failed, have the inverter serviced.
	Inverter airflow intake may be blocked.	Increase clearance around the inverter or unclog the fan air intake.
	Charging setting is too high based on ambient temperature around inverter.	Lower the **12E Max Charge Amps AC** setting.
05D Low Battery Voltage	Battery voltage is below the **11C Low Battery Cut Out VDC** settings.	Check for the correct battery voltage at the inverter's DC input terminals. Check for an external DC load on the batteries. Check condition of batteries and recharge if possible or adjust your **11C Low Battery Cut Out VDC** to a lower setting.
05E High Battery Voltage	Battery voltage is above the **11A High Battery Cut Out VDC** settings.	Check for the correct battery voltage at the inverter's DC input terminals. Ensure your DC source is regulated below your high battery cut out or adjust your **11A High Battery Cut Out VDC** to a higher setting.

Message	Problem	Solution
05G Input Relay Failure	The AC transfer relay is bad or an AC source was wired directly to the AC output.	Disconnect the inverter's output wiring. If error continues, have unit serviced.
05H Gen Failed To Start	Indicates that six "auto generator start attempts" have occurred without successfully starting the generator.	Reset the auto-generator control system by selecting OFF at the **02A Generator** menu. Verify that when the generator is running (manually started) that there is voltage on the AC2 input terminals inside the inverter's AC access door. If you do not have an automatic start generator that is started by the inverter, leave it in the OFF selection. If you do have an automatic start generator that is started by the inverter, test by selecting ON.
	Voltage has not reached 80 Vac during the **25D Max Cranking Seconds** period.	Measure the AC voltage on the AC2 input terminals while the generator is starting. Check the setting at **25D Max Cranking Seconds**. Tune up generator if necessary.
	Voltage did not maintain greater than 80 Vac for the majority of time while the inverter was charging.	Measure AC voltage on the AC2 input terminals while generator is running. Check for poor connections or too small of wires between the generator and inverter. Tune up generator if necessary.
05I Gen Stopped Due To V/F	The generator was running but was not operating within the voltage or frequency tolerances and was not able to connect.	Check the generator's output voltage and frequency. Ensure that **13C Input Upper Limit VAC** and **13D Input Lower Limit VAC** are set correctly.
Error LED is flashing and there is no error under **05 Error Causes Menu**.	AC source frequency is just out of tolerance (53 to 57 Hz or 63 to 67 Hz).	No problem with AC source or inverter. The error LED is a visual indicator to fine tune your AC frequency. This error does not affect operation.

A

Inverter Specifications

Appendix A, “Inverter Specifications” provides the electrical and environmental specifications of this inverter.

Electrical Specifications

Electrical Specifications	Sine Wave Plus 2524	Sine Wave Plus 2548
AC Input Voltage (nominal)	120 Vac	120 Vac
AC Input Voltage Range	80 to 150 Vac	80 to 150 Vac
AC Input Current	60 amps AC Pass-through/ 20 amps AC Charging	60 amps AC Pass-through/ 20 amps AC Charging
AC1 Input Frequency Range	55 to 65 Hz	55 to 65 Hz
AC2 Input Frequency Range	54 to 67 Hz	54 to 67 Hz
Continuous Power (@ 25°C)	2500 VA	2500 VA
Efficiency (Peak) in inverter mode	95%	95%
Inverter Voltage (RMS)	120 Vac	120 Vac
Inverter Voltage Regulation	± 3%	± 3%
Frequency (Nominal ±0.04% Crystal Controlled - Invert Mode)	60 Hz	60 Hz
Continuous Output (@25° C)	21 amps rms	21 amps rms
Surge Capability (@25° C)		
5 second rating (resistive)	80 amps RMS	80 amps RMS
Over current trip point	125 amps Peak	175 amps Peak
Inverter Voltage THD (Total Harmonic Distortion) (Resistive Load)	< 5%	< 5%
Automatic Transfer Relay	60 amps rms	60 amps rms
DC Input Voltage (Nominal)	25.2 Vdc	50.4 Vdc
DC Input Voltage Range	22 to 32 Vdc	44 to 64 Vdc
DC Current at Rated Power (Invert Mode, Internal temp. stabilized)	120 amps DC	60 amps DC
Idle Consumption (Invert Mode/No Load)	< 16 watts	< 20 watts
Search Mode Consumption (Default setting)	< 2 watts	< 2 watts
Continuous Charge Rate (at 120 Vac input)	70 amps DC	40 amps DC

Electrical Specifications	Sine Wave Plus 4024	Sine Wave Plus 4048	Sine Wave Plus 5548
AC Input Voltage (nominal)	120 Vac	120 Vac	120 Vac
AC Input Voltage Range	80 to 150 Vac	80 to 150 Vac	80 to150 Vac
AC Input Current	60 amps AC Pass-through/ 30 amps AC Charging	60 amps AC Pass-through/ 30 amps AC Charging	60 amps AC Pass-through/ 45 amps AC Charging
AC1 Input Frequency Range	55 to 65 Hz	55 to 65 Hz	55 to 65 Hz
AC2 Input Frequency Range	54 to 67 Hz	54 to 67 Hz	54 to 67 Hz
Continuous Power (@ 25°C)	4000 VA	4000 VA	5500 VA
Efficiency (Peak) in inverter mode	94%	95%	95%
Inverter Voltage (RMS)	120 Vac	120 Vac	120 Vac
Inverter Voltage Regulation	± 3%	± 3%	± 3%
Frequency (Nominal ±0.04% Crystal Controlled - Invert Mode)	60 Hz	60 Hz	60 Hz
Continuous Output (@25° C)	33 amps rms	33 amps rms	46 amps rms
Surge Capability (@25° C)			
5 second rating (resistive)	85 amps rms	95 amps rms	105 amps rms
Over current trip point	125 amps Peak	175 amps Peak	175 amps Peak
Inverter Voltage THD (Total Harmonic Distortion) (Resistive Load)	< 5%	< 5%	< 5%
Automatic Transfer Relay	60 amps	60 amps	60 amps
DC Input Voltage (Nominal)	25.2 Vdc	50.4 Vdc	50.4 Vdc
DC Input Voltage Range	22 to 32 Vdc	44 to 64 Vdc	44 to 64 Vdc
DC Current at Rated Power (Invert Mode, Internal temp. stabilized)	190 amps DC	95 amps DC	135 amps DC
Idle Consumption (Invert Mode/No Load)	< 16 watts	< 20 watts	< 20 watts
Search Mode Consumption (Default setting)	< 2 watts	< 2 watts	< 2 watts
Continuous Charge Rate (at 120 Vac input)	110 amps DC	60 amps DC	75 amps DC

Mechanical Specifications

Mechanical Specifications	Sine Wave Plus 2524	Sine Wave Plus 2548
Operating Temperature Range		
SPECIFIED (will meet specified tolerances)	32 °F to 77 °F (0 °C to 25 °C)	32 °F to 77 °F (0 °C to 25 °C)
ALLOWED (may not meet specified tolerances)	-13 °F to 140 °F (-25 °C to 60 °C)	-13 °F to 140 °F (-25 °C to 60 °C)
NON-OPERATING (storage)	-67 °F to 284 °F (-55 °C to 140 °C)	-67 °F to 284 °F (-55 °C to 140 °C)
Enclosure Type	Indoor, ventilated, Galvaneel steel chassis with powder coat finish	Indoor, ventilated, Galvaneel steel chassis with powder coat finish
Unit Weight	105 lb (48 kg)	105 lb (48 kg)
Shipping Weight	114 lb (52 kg)	114 lb (52 kg)
Inverter Dimensions (H x W x D)	15 1/8" x 21" x 8 7/8" (38 cm x 53 cm x 22 cm)	15 1/8" x 21" x 8 7/8" (38 cm x 53 cm x 22 cm)
Shipping Dimensions (H x W x D)	20" x 27 7/8" x 14 1/4" (51 cm x 71 cm x 36 cm)	20" x 27 7/8" x 14 1/4" (51 cm x 71 cm x 36 cm)
Mounting	Wall or Shelf Mount	Wall or Shelf Mount

See Certification Label for specific regulatory agency approval information.

Mechanical Specifications	Sine Wave Plus 4024	Sine Wave Plus 4048	Sine Wave Plus 5548
Operating Temperature Range			
SPECIFIED (will meet specified tolerances)	32 °F to 77 °F (0 °C to 25 °C)	32 °F to 77 °F (0 °C to 25 °C)	32 °F to 77 °F (0 °C to 25 °C)
ALLOWED (may not meet specified tolerances)	-13 °F to 140 °F (-25 °C to 60 °C)	-13 °F to 140 °F (-25 °C to 60 °C)	-13 °F to 140 °F (-25 °C to 60 °C)
NON-OPERATING (storage)	-67 °F to 284 °F (-55 °C to 140 °C)	-67 °F to 284 °F (-55 °C to 140 °C)	-67 °F to 284 °F (-55 °C to 140 °C)
Enclosure Type	Indoor, ventilated, Galvaneel steel chassis with powder coat finish	Indoor, ventilated, Galvaneel steel chassis with powder coat finish	Indoor, ventilated, Galvaneel steel chassis with powder coat finish
Unit Weight	117 lb (53 kg)	117 lb (53 kg)	136 lb (62 kg)
Shipping Weight	126 lb (57 kg)	126 lb (57 kg)	145 lb (66 kg)
Inverter Dimensions (H x W x D)	15 1/8" x 21" x 8 7/8" (38 cm x 53 cm x 22 cm)	15 1/8" x 21" x 8 7/8" (38 cm x 53 cm x 22 cm)	15 1/8" x 21" x 8 7/8" (38 cm x 53 cm x 22 cm)
Shipping Dimensions (H x W x D)	20" x 27 7/8" x 14 1/4" (51 cm x 71 cm x 36 cm)	20" x 27 7/8" x 14 1/4" (51 cm x 71 cm x 36 cm)	20" x 27 7/8" x 14 1/4" (51 cm x 71 cm x 36 cm)
Mounting	Wall or Shelf Mount	Wall or Shelf Mount	Wall or Shelf Mount

See Certification Label for specific regulatory agency approval information.

Theory of Operation

The Sine Wave Plus employs a patented inverter design. This design uses a combination of three transformers, each with its own low frequency switches, coupled in series and driven by separate interconnected micro-controllers. In essence, it is three inverters linked together by their transformers.

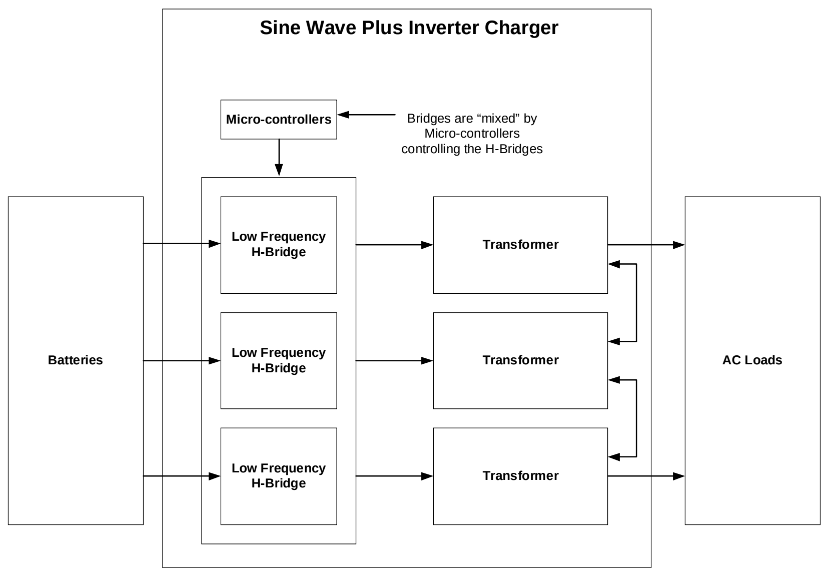


Figure A-1 Sine Wave Plus Simple Block Diagram

Sine Wave Plus Waveform

By mixing the outputs from the different transformers, a sine wave is produced. This waveform is shown in Figure A-2, "Sine Wave Plus Inverter Output Waveform" on page A–7. Notice the "steps" form a staircase that is shaped like a sine wave. The total harmonic distortion in this sine wave approach is typically 3-5%. The multi-stepped output is formed by modulation of the voltage through mixing of the transformers in a specific order. Anywhere from 34-52 "steps" per AC cycle are present in the waveform. The heavier the load or lower DC input voltage the more steps there are in the waveform.

This type of inverter solves many of the problems associated with high frequency or ferroresonant sine wave inverters. The low frequency method described has excellent surge ability, high efficiency (typically 85 to 95%), good voltage and frequency regulation, and low total harmonic distortion.

The inverter runs in two basic formats: as a stand-alone inverter (converting DC to AC), or as a parallel inverter (with its output synchronized to another AC source). In inverter mode, only 60 Hz waveforms are created. As the battery voltage rises, waveforms with progressively fewer steps are generated. More steps are used when battery voltage decreases. Since the battery voltage tends to drop with increased load, the waveform has increased number of steps with heavier AC loads.

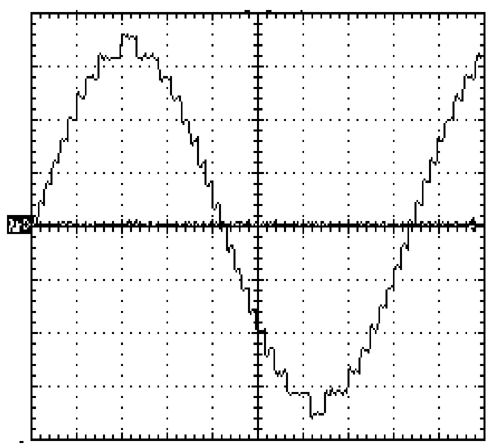


Figure A-2 Sine Wave Plus Inverter Output Waveform

Synchronized with other AC sources

The inverter is able to synchronize with other AC sources before connecting it to the AC load. The frequency of the AC source is tracked and the inverter constantly adjusts its frequency to maintain a lock. A normally open contactor is used to parallel the inverter's output and the AC source.

Bi-Directional Topology

The inverter's power topology is bi-directional. If the waveform created by the inverter has a higher voltage than the paralleled AC source, then power flows from the batteries to the load. If the waveform generated has a lower voltage than the AC source, power flows from the source to the battery.

Waveform Size

The various modes of operation use different algorithms for determining the size of the waveform to be created by the inverter. In battery charger mode, for example, waveforms smaller than the AC source are created to cause current to flow into the batteries. This process is fully regulated to provide a three-stage charge cycle. If the level of AC current exceeds the user programmed generator or grid size, and then the inverter will switch to a generator support mode and create waveforms that are larger than the AC source. This causes power to flow from the batteries to the AC loads to prevent overloading of the AC source.

Power Versus Efficiency

There are two primary losses that combine to create the efficiency curve of the Sine Wave Plus. The first is the energy that is required to operate the inverter at full output voltage while delivering no current. This is the no load or idle power.

At low power levels, the idle power is the largest contributor to efficiency losses. At high power, the largest source of loss is a result of the resistance in the transformer and power transistors. The power lost here is proportional to the square of the output power.

For example, losses at 2,000 watts will be four times higher than losses at 1,000 watts. This graph represents a typical inverter's efficiency while operating resistive loads. Inductive loads, such as motors, are run less efficiently due to the impact of power factor losses.

The Sine Wave Plus offers an extremely good efficiency curve. The inverter reaches high efficiency at very low AC load levels, which is important because the inverter often spends the majority of the time at the lower power range. The high efficiency is maintained over a wide power range. Only when operating at high power levels at or above the continuous power levels does the efficiency begin to drop off. Since this usually only occurs for short periods of time, the impact may be negligible.

If your application involves the inverter powering heavy loads for significant periods of time, selecting a model with a higher continuous power rating and a higher DC input voltage would improve the operation of the system. Since the low power efficiency of the Sine Wave Plus is extremely good, oversizing the inverter does not reduce system performance.

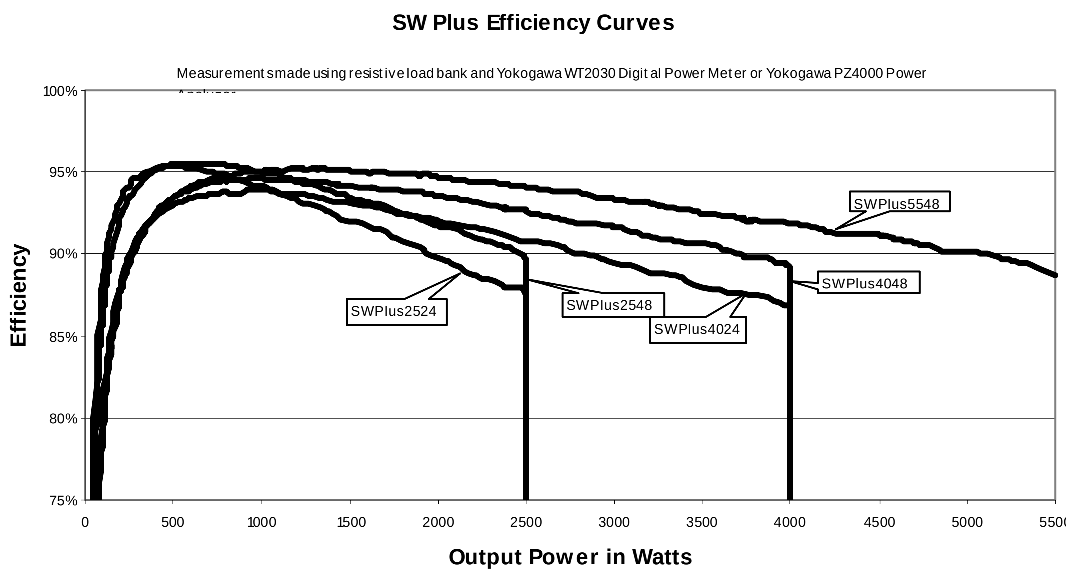


Figure A-3 Power Versus Efficiency Curves for All Models

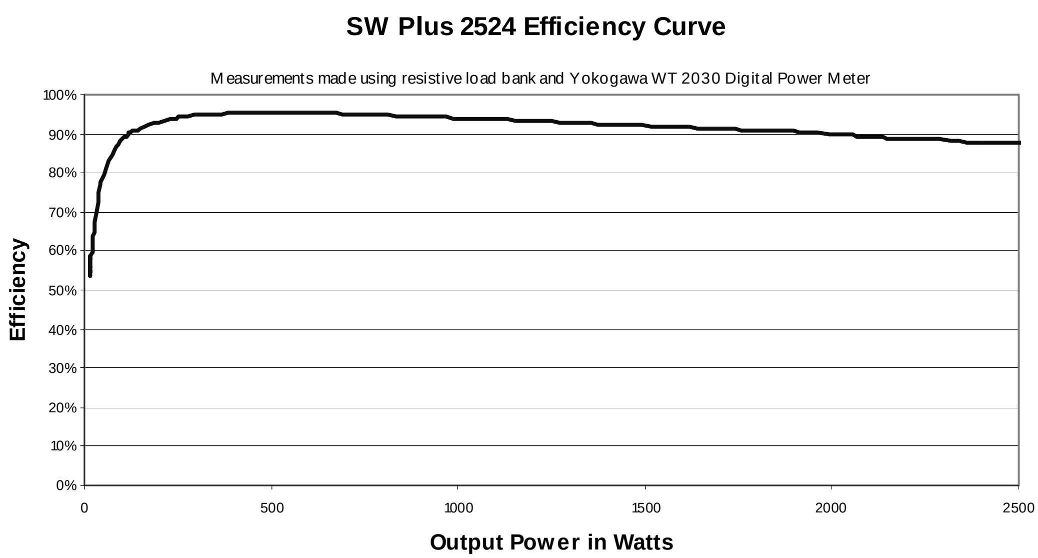


Figure A-4 Sine Wave Plus Efficiency Curve for the SW Plus 2524

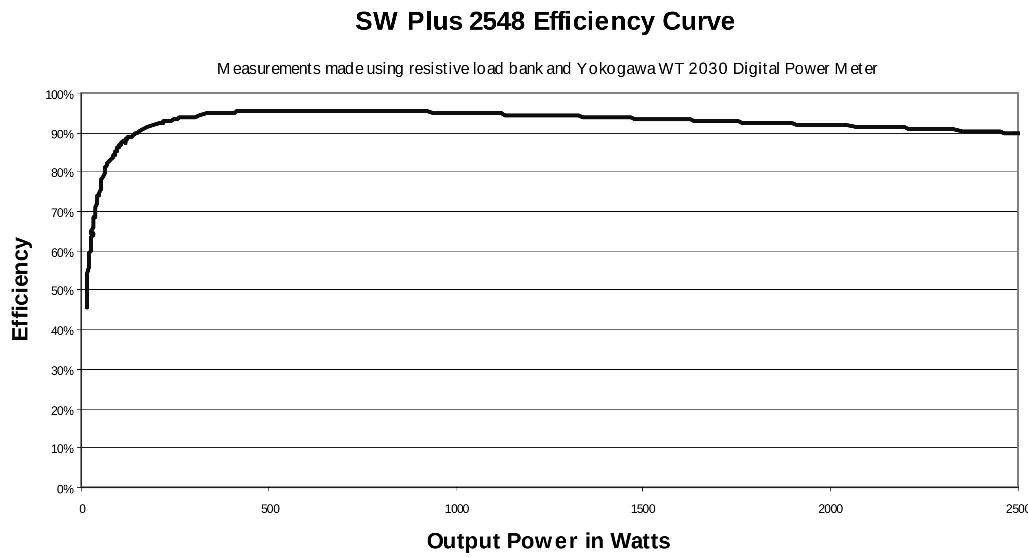


Figure A-5 Sine Wave Plus Efficiency Curve for the SW Plus 2548

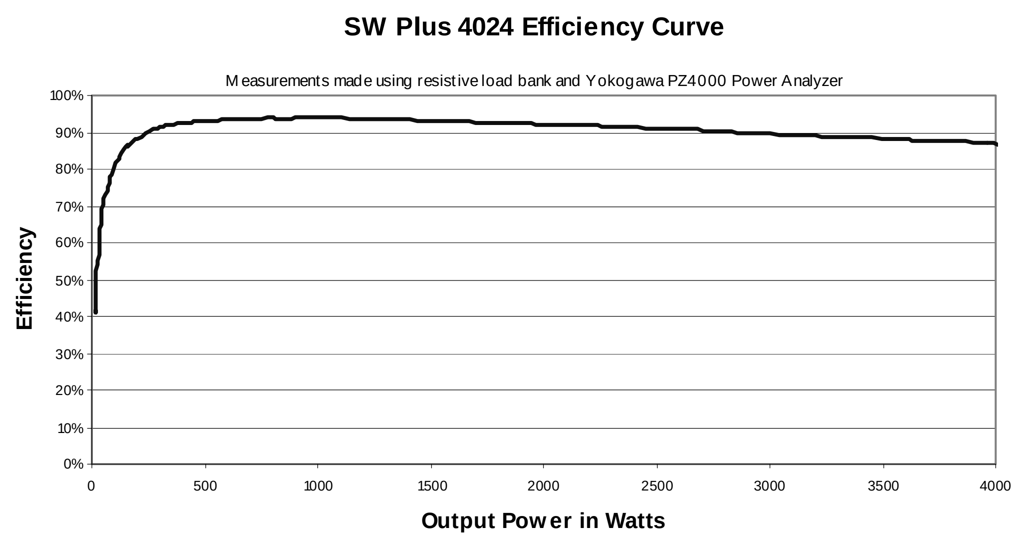


Figure A-6 Sine Wave Plus Efficiency Curve for the SW Plus 4024

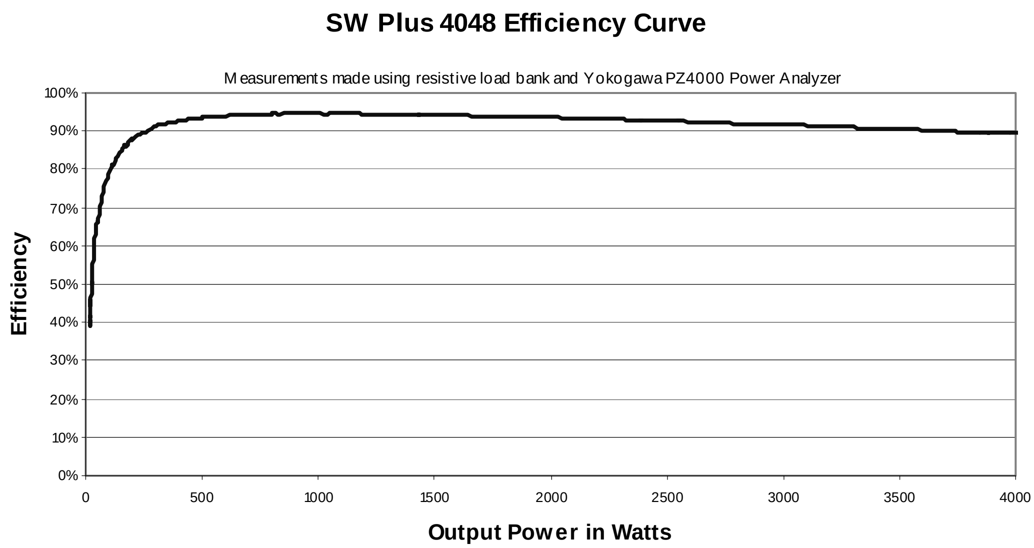


Figure A-7 Sine Wave Plus Efficiency Curve for the SW Plus 4048

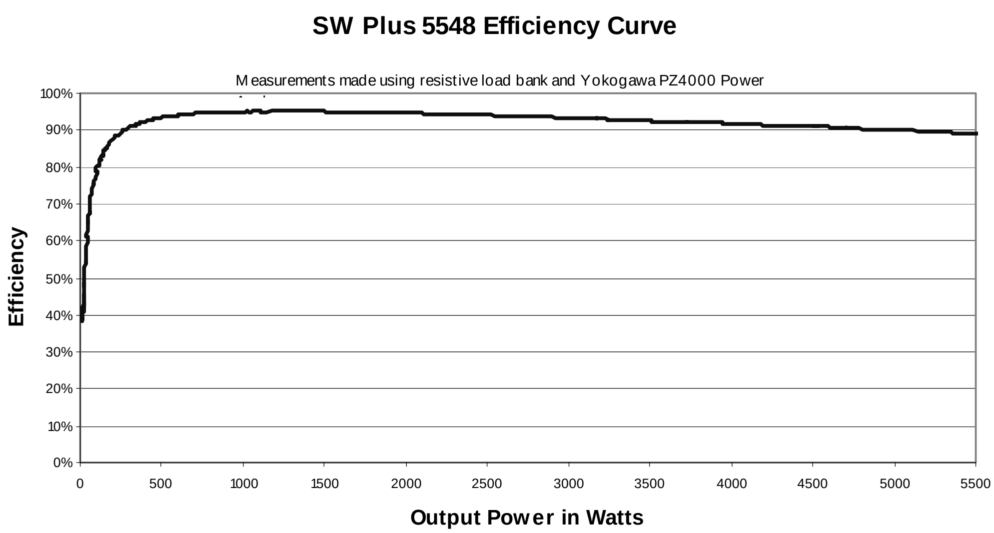


Figure A-8 Sine Wave Plus Efficiency Curve for the SW Plus 5548

Inverter Capacity versus Temperature

The output power of the inverter diminishes as ambient temperature rises. However, as can be seen below, with the exception of the SWP5548, these inverters are sized to be able to run a full rated output power up to 40C.

However, it should be noted that the overcurrent circuit on the unit is temperature compensated to protect the unit and that the thermal circuit breaker will trip at a lower current as the temperature rises. Therefore, the surge ability of the unit decreases with increased temperature.

Table A-1 Derating from continuous power (VA) at elevated ambient temperatures

Model	25° C	30° C	35° C	40° C
SW Plus 2524	No Derating	No Derating	No Derating	No Derating
SW Plus 2548	No Derating	No Derating	No Derating	No Derating
SW Plus 4024	No Derating	No Derating	No Derating	No Derating
SW Plus 4048	No Derating	No Derating	No Derating	No Derating
SW Plus 5548	No Derating	No Derating	No Derating	5.3KVA

This table refers to output VA only. Testing was conducted in a thermal chamber with the inverters as stand-alone units without accessories.

Time versus Current

Loads presented to the inverter are seldom constant. Typically, large loads are operated for only short periods of time. In order to provide the maximum utility, Xantrex inverters are allowed to operate at power levels that exceed their continuous power ratings. This graph shows how loads that are larger than the inverter can sustain continuously can be operated for useful periods of time.

The length of time that the inverter can operate at high power is limited by temperature. When large loads are run, the inverter's temperature increases. At the point where more heat is created in the inverter than can be dissipated, its ability to operate becomes time limited.

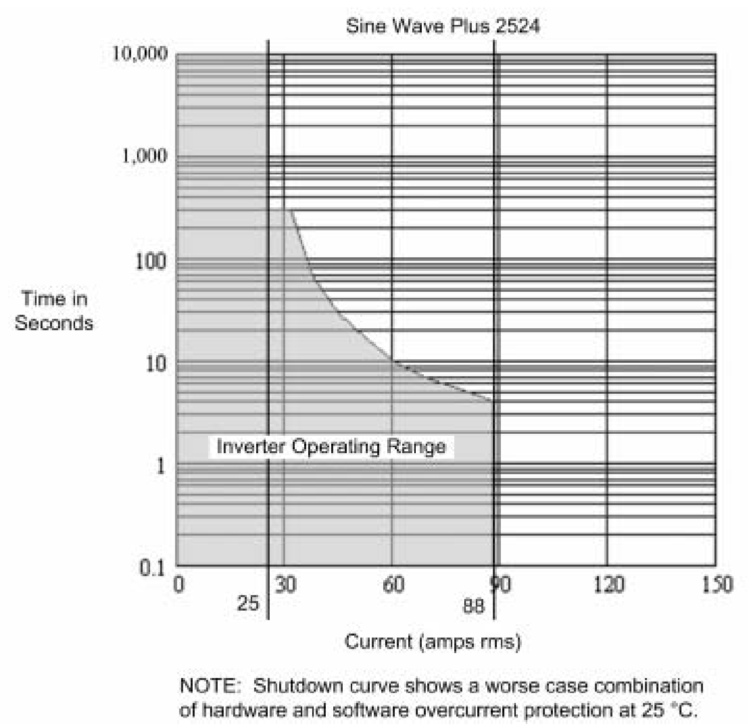


Figure A-9 Time versus Current for the Sine Wave Plus 2524

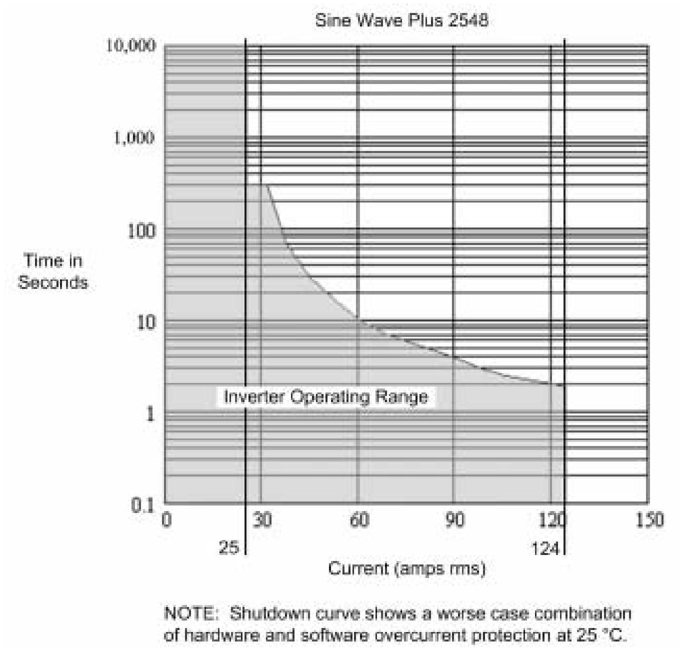


Figure A-10 Time versus Current for the Sine Wave Plus 2548

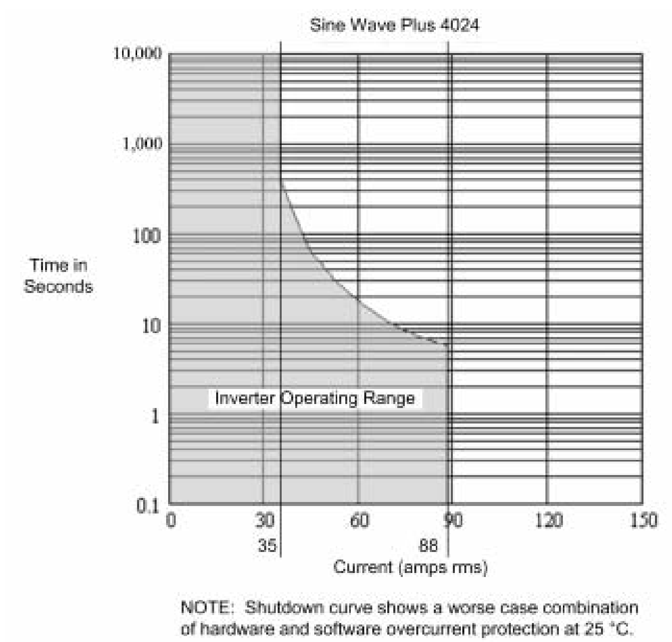


Figure A-11 Time versus Current for the Sine Wave Plus 4024

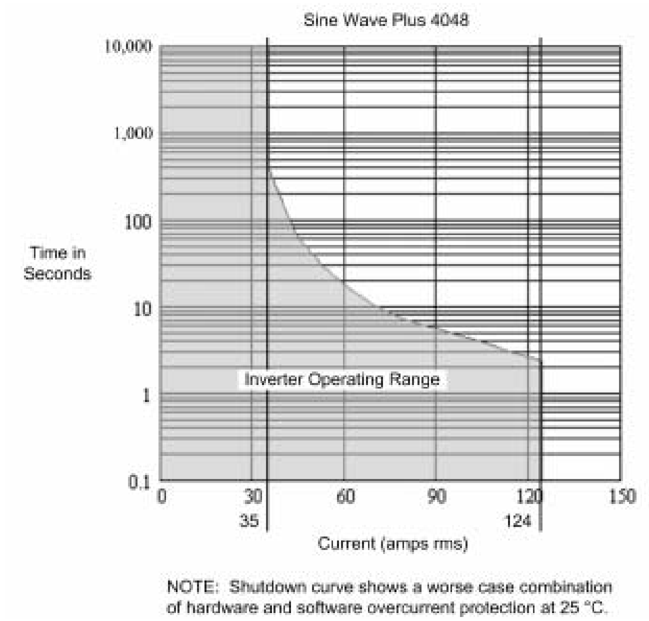


Figure A-12 Time versus Current for the Sine Wave Plus 4048

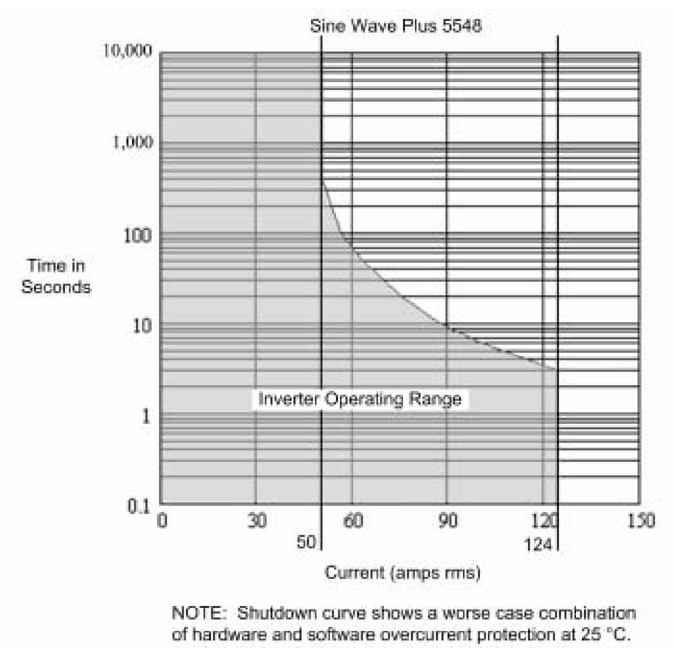


Figure A-13 Time versus Current for the Sine Wave Plus 5548

B

Configuration Settings

Appendix B, "Configuration Settings" provides worksheets for programming your inverter/charger for user-specific parameters.

User Menu Settings

Table B-1 provides a list of User Menu headings and menu items, with available set points. This table also provides the default settings for each menu item as programmed in the factory. The last column “User Settings” is provided for you to write in the settings specific to your installation.

Table B-1 User Menu Default and User Settings

User Menus	Sine Wave Plus 2524 and 4024		Sine Wave Plus 2548, 4048, and 5548		User Settings
	Range/ Display	Default Settings	Range/ Display	Default Settings	
01 Inverter ON/OFF Menu	See “01 Inverter ON/OFF Menu” on page 8–15 for details.				
01A Inverter	OFF SRCH ON CHR	OFF	OFF SRCH ON CHR	OFF	
01B EQ Charge	OFF ON	OFF	OFF ON	OFF	
01C Search Watts (SRCH)	00 to 248	08	00 to 248	08	
01D Bypass Mode	AC1 NORM AC2	NORM	AC1 NORM AC2	NORM	
02 Generator ON/OFF Menu	See “02 Generator ON/OFF Menu” on page 8–17 for details.				
02A Generator	OFF AUTO ON	OFF	OFF AUTO ON	OFF	
02B Gen Start Load Amps	YES NO	Read Only	YES NO	Read Only	
02C Gen Start Volts/Manual	YES NO	Read Only	YES NO	Read Only	
02D Gen Start Exercise Run	YES NO	Read Only	YES NO	Read Only	
02E Gen Start Run Time	YES NO	Read Only	YES NO	Read Only	
02F Days left to Gen Exercise	00 to 255	Read Only	00 to 255	Read Only	
03 Time of Day (00:00:00)	See “03 Time Of Day Menu” on page 8–20 for details.				
SWPlus Revision 2.01	Info. Displayed	Read Only	Info. Displayed	Read Only	
2.5 KVA ** 120 VAC 60 HZ	**24 Vdc	Read Only	**48 VDC	Read Only	
Xantrex Tech Inc 5916 195th St NE	Info. Displayed	Read Only	Info. Displayed	Read Only	
Arlington, WA 98223 USA					

Table B-1 User Menu Default and User Settings

User Menus	Sine Wave Plus 2524 and 4024		Sine Wave Plus 2548, 4048, and 5548		User Settings
	Range/ Display	Default Settings	Range/ Display	Default Settings	
Ph 1-800-446-6180 www.xantrex.com					
Press reset for factory defaults	Press to refresh the LCD display.				
04 Meters Menu	See “04 Meters Menu” on page 8–22 for details.				
04A Battery Actual VDC	13.2 to 35.5	Read Only	20.0 to 71.0	Read Only	
04B Battery Comp VDC	13.2 to 35.5	Read Only	20.0 to 71.0	Read Only	
04C Inv/Chr Amps AC	-63 to 63	Read Only	-63 to 63	Read Only	
04D Input Amps AC	00 to 63	Read Only	00 to 63	Read Only	
04E Load Amps AC	00 to 63	Read Only	00 to 63	Read Only	
04F Inverter Volts AC	00 to 163	Read Only	00 to 163	Read Only	
04G Grid (AC1) Volts AC	00 to 163	Read Only	00 to163	Read Only	
04H Gen (AC2) Volts AC	00 to 163	Read Only	00 to 163	Read Only	
04I Frequency Hertz	52 to 68	Read Only	52 to 68	Read Only	
04J Max Bulk/EQ Time h:m	00:00 to 23:50	Read Only	00:00 to 23:50	Read Only	
04K Battery Temp Degrees C	-28 to 60, OL	Read Only	-28 to 60, OL	Read Only	
04L Fan Speed	00, 01, 02, 03, 04	Read Only	00, 01, 02, 03, 04	Read Only	
05 Error Causes Menu	See “05 Error Causes Menu” on page 8–25 for details.				
05A Over Current	NO YES	Read Only	NO YES	Read Only	
05B Transformer overtemp	NO YES	Read Only	NO YES	Read Only	
05C Heatsink overtemp	NO YES	Read Only	NO YES	Read Only	
05D Low Battery Voltage	NO YES	Read Only	NO YES	Read Only	
05E High Battery Voltage	NO YES	Read Only	NO YES	Read Only	
05F External err (stacked)	NO YES	Read Only	NO YES	Read Only	
05G Input Relay Failure	NO YES	Read Only	NO YES	Read Only	
05H Gen Failed to Start	NO YES	Read Only	NO YES	Read Only	
05I Gen Stopped due to V/F	NO YES	Read Only	NO YES	Read Only	

Table B-1 User Menu Default and User Settings

User Menus	Sine Wave Plus 2524 and 4024		Sine Wave Plus 2548, 4048, and 5548		User Settings
	Range/ Display	**Default Settings**	**Range/ Display**	**Default Settings**	
06 Status Menu	See “06 Status Menu” on page 8–28 for details.				
06A Bypass Mode Selected	NO YES	Read Only	NO YES	Read Only	
06B CHR Selected (No Backup)	NO YES	Read Only	NO YES	Read Only	
06C Gen Signalled to Run	NO YES	Read Only	NO YES	Read Only	
06D Gen in Cooldown	NO YES	Read Only	NO YES	Read Only	
06E EQ Charge Selected	NO YES	Read Only	NO YES	Read Only	
06F Battery Vdc < LBCO	NO YES	Read Only	NO YES	Read Only	
06G Battery Vdc > HBCO	NO YES	Read Only	NO YES	Read Only	
06H EPO shutdown	NO YES	Read Only	NO YES	Read Only	
07 GSM/ALM Menu	See “07 GSM/ALM Options Menu” on page 8–30 for details.				
07A RY7 (GSM) Energized	NO YES	Read Only	NO YES	Read Only	
07B RY8 (GSM) Energized	NO YES	Read Only	NO YES	Read Only	
07C RY9 (ALM) Energized	NO YES	Read Only	NO YES	Read Only	
07D RY9 DeEngz. Time Minute	00 to 255	Read Only	00 to 255	Read Only	
07E RY10 (ALM) Energized	NO YES	Read Only	NO YES	Read Only	
07F RY10 Engz. Time Minute	00 to 255	Read Only	00 to 255	Read Only	
07G RY11 Energized	NO YES	Read Only	NO YES	Read Only	

Basic Setup Menu

Table B-2 provides a list of Basic Setup Menu headings and menu items, with available set points. This table also provides the default settings for each menu item as programmed in the factory. The last column "User Settings" is provided for you to write in the settings specific to your installation.

Table B-2 Basic Setup Default and User Settings for the Sine Wave Plus 2524 and 2548 Models

	Sine Wave Plus 2524		Sine Wave Plus 2548		
Basic Setup Menus	**Range/ Display**	**Default**	**Range/ Display**	**Default**	**User Settings**
10 Time of Day Setup Menu	See "10 Time of Day Setup Menu" on page 6–11 for details.				
10A Set Hour	00:00:00 to 23:50:00	00:00:00	00:00:00 to 23:50:00	00:00:00	
10B Set Minute	00:00:00 to 00:09:00	00:00:00	00:00:00 to 00:09:00	00:00:00	
10C Set Second	00 to 59	00:00:00	00 to 59	00:00:00	
11 Inverter Setup Menu	See "11 Inverter Setup Menu" on page 6–12 for details.				
11A High Battery Cut Out Vdc	16.1 to 34.0	32.0	32.2 to 68.0	64.0	
11B Low Battery Cut In Vdc	16.1 to 33.9	26.0	32.2 to 67.8	52.0	
11C Low Battery Cut Out Vdc	11.0 to 33.9	22.0	32.0 to 67.8	44.0	
11D LBCO Delay Minutes	01 to 255	15	01 to 255	15	
11E Search Watts (SRCH)	00 to 248	08	00 to 248	08	
12 Battery Charging Menu	See "12 Battery Charging Menu" on page 6–19 for details.				
12A Finish Stage	SILENT FLOAT	FLOAT	SILENT FLOAT	FLOAT	
12B Bulk Volts DC	20.0 to 32.0	28.8	40.0 to 64.0	57.6	
12C Float Volts DC	20.0 to 32.0	26.8	40.0 to 64.0	53.6	
12D Equalize Volts DC	20.0 to 32.0	28.8	40.0 to 64.0	57.6	
12E Max Charge Amps AC	01 to 20	20	01 to 20	20	
12F Bulk Done Amps AC	00 to 45	10	00 to 45	10	
12G EQ Vdc Done Timer	00:00 to 23:50	02:00	00:00 to 23:50	02:00	
12H Max Bulk/EQ Timer	00:00 to 23:50	05:00	00:00 to 23:50	05:00	

Table B-2 Basic Setup Default and User Settings for the Sine Wave Plus 2524 and 2548 Models

Basic Setup Menus	Sine Wave Plus 2524 Range/ Display	Sine Wave Plus 2524 Default	Sine Wave Plus 2548 Range/ Display	Sine Wave Plus 2548 Default	User Settings
12I Temp Comp	LeadAcid NiCad	LeadAcid	LeadAcid NiCad	LeadAcid	
13 AC Inputs Menu	See "13 AC Inputs Menu" on page 6–26 for details.				
13A Grid (AC1) Amps AC	00 to 60	60	00 to 60	60	
13B Gen (AC2) Amps AC	00 to 60	30	00 to 60	30	
13C Input Upper Limit Vac	125 to 150	130	125 to 150	130	
13D Input Lower Limit Vac	80 to 115	110	80 to 115	110	
14 Save/Restore Settings Menu	See "14 Save/Restore Settings Menu" on page 6–29 for details.				
14A Push INV now to save settings	Push INV now to Save Settings				
14B Push GEN to restore settings	Push GEN to restore settings				
14C Push GEN for factory defaults	Push GEN for factory defaults				

Table B-3 Basic Setup Default and User Settings for the Sine Wave Plus 4024 and 4048 Models

Basic Setup Menus	Sine Wave Plus 4024 Range/ Display	Sine Wave Plus 4024 Default	Sine Wave Plus 4048 Range/ Display	Sine Wave Plus 4048 Default	User Settings
10 Time of Day Setup Menu	See "10 Time of Day Setup Menu" on page 6–11 for details.				
10A Set Hour	00:00:00 to 23:50:00	00:00:00	00:00:00 to 23:50:00	00:00:00	
10B Set Minute	00:00:00 to 00:09:00	00:00:00	00:00:00 to 00:09:00	00:00:00	
10C Set Second	00 to 59	00:00:00	00 to 59	00:00:00	
11 Inverter Setup Menu	See "11 Inverter Setup Menu" on page 6–12 for details.				
11A High Battery Cut Out Vdc	16.1 to 34.0	32.0	32.2 to 68.0	64.0	
11B Low Battery Cut In Vdc	16.1 to 33.9	26.0	32.2 to 67.8	52.0	
11C Low Battery Cut Out Vdc	11.0 to 33.9	22.0	32.0 to 67.8	44.0	
11D LBCO Delay Minutes	01 to 255	15	01 to 255	15	
11E Search Watts (SRCH)	00 to 248	08	00 to 248	08	

Table B-3 Basic Setup Default and User Settings for the Sine Wave Plus 4024 and 4048 Models

Basic Setup Menus	Sine Wave Plus 4024		Sine Wave Plus 4048		User Settings
	Range/ Display	Default	Range/ Display	Default	
12 Battery Charging Menu	See “12 Battery Charging Menu” on page 6–19 for details.				
12A Finish Stage	SILENT FLOAT	FLOAT	SILENT FLOAT	FLOAT	
12B Bulk Volts DC	20.0 to 32.0	28.8	40.0 to 64.0	57.6	
12C Float Volts DC	20.0 to 32.0	26.8	40.0 to 64.0	53.6	
12D Equalize Volts DC	20.0 to 32.0	28.8	40.0 to 64.0	57.6	
12E Max Charge Amps AC	01 to 30	30	01 to 30	30	
12F Bulk Done Amps AC	00 to 30	10	00 to 30	10	
12G EQ Vdc Done Timer	00:00 to 23:50	02:00	00:00 to 23:50	02:00	
12H Max Bulk/EQ Timer	00:00 to 23:50	05:00	00:00 to 23:50	05:00	
12I Temp Comp	LeadAcid NiCad	LeadAcid	LeadAcid NiCad	LeadAcid	
13 AC Inputs Menu	See “13 AC Inputs Menu” on page 6–26 for details.				
13A Grid (AC1) Amps AC	00 to 60	60	00 to 60	60	
13B Gen (AC2) Amps AC	00 to 60	30	00 to 60	30	
13C Input Upper Limit Vac	125 to 150	130	125 to 150	130	
13D Input Lower Limit Vac	80 to 115	110	80 to 115	110	
14 Save/Restore Settings Menu	See “14 Save/Restore Settings Menu” on page 6–29 for details.				
14A Push INV now to save settings	Push INV now to Save Settings				
14B Push GEN to restore settings	Push GEN to restore settings				
14C Push GEN for factory defaults	Push GEN for factory defaults				

Table B-4 Basic Setup Default and User Settings for the Sine Wave Plus 5548 Model

Basic Setup Menus	Sine Wave Plus 5548 Range/Display	Sine Wave Plus 5548 Default	User Settings
10 Time of Day Setup Menu	See “10 Time of Day Setup Menu” on page 6–11 for details.		
10A Set Hour	00:00:00 to 23:50:00	00:00:00	
10B Set Minute	00:00:00 to 00:09:00	00:00:00	
10C Set Second	00 to 59	00:00:00	
11 Inverter Setup Menu	See “11 Inverter Setup Menu” on page 6–12 for details.		
11A High Battery Cut Out Vdc	32.2 to 68.0	64.0	
11B Low Battery Cut In Vdc	32.2 to 67.8	52.0	
11C Low Battery Cut Out Vdc	32.0 to 67.8	44.0	
11D LBCO Delay Minutes	01 to 255	15	
11E Search Watts (SRCH)	00 to 248	08	
12 Battery Charging Menu	See “12 Battery Charging Menu” on page 6–19 for details.		
12A Finish Stage	SILENT FLOAT	FLOAT	
12B Bulk Volts DC	40.0 to 64.0	57.6	
12C Float Volts DC	40.0 to 64.0	53.6	
12D Equalize Volts DC	40.0 to 64.0	57.6	
12E Max Charge Amps AC	01 to 45	40	
12F Bulk Done Amps AC	00 to 20	10	
12G EQ Vdc Done Timer	00:00 to 23:50	02:00	
12H Max Bulk/EQ Timer	00:00 to 23:50	05:00	
12I Temp Comp	LeadAcid NiCad	LeadAcid	
13 AC Inputs Menu	See “13 AC Inputs Menu” on page 6–26 for details.		
13A Grid (AC1) Amps AC	00 to 60	60	
13B Gen (AC2) Amps AC	00 to 60	30	
13C Input Upper Limit Vac	125 to 150	130	
13D Input Lower Limit Vac	80 to 115	110	
14 Save/Restore Settings Menu	See “14 Save/Restore Settings Menu” on page 6–29 for details.		

Table B-4 Basic Setup Default and User Settings for the Sine Wave Plus 5548 Model

Basic Setup Menus	Sine Wave Plus 5548		User Settings
	Range/Display	Default	
14A Push INV now to save settings	Push INV now to Save Settings		
14B Push GEN to restore settings	Push GEN to restore settings		
14C Push GEN for factory defaults	Push GEN for factory defaults		

Advanced Setup Menu

Table B-5 provides a list of Advanced Setup Menu headings and menu items, with available set points. This table also provides the default settings for each menu item as programmed in the factory. The last column “User Settings” is provided for you to write in the settings specific to your installation.

Table B-5 Advanced Setup Default and User Settings for the Sine Wave Plus 2524 and 2548 Models

	Sine Wave Plus 2524		Sine Wave Plus 2548		
Advanced Setup Menus	**Range/ Display**	**Default Settings**	**Range/ Display**	**Default Settings**	**User Settings**
20 Silent Setup Menu	See “20 Silent Setup Menu” on page 7–13 for details.				
20A Refloat High Volts DC	16.1 to 33.9	28.4	32.2 to 67.8	56.8	
20B Refloat Low Volts DC	16.1 to 33.8	25.0	32.2 to 67.8	50.0	
20C Float Done Amps AC	00 to 40	10	00 to 40	10	
20D Must Float Time Min	00 to 255	05	00 to 255	05	
21 Grid AC1 Usage Menu	See “21 Grid (AC1) Usage Menu” on page 7–16 for details.				
21A Grid Usage SB BX	SB BX	SB	SB BX	SB	
21B Grid Usage Begin h:m	00:00 to 23:50	21:00	00:00 to 23:50	21:00	
21C Grid Usage End h:m	00:00 to 23:50	21:00	00:00 to 23:50	21:00	
22 Battery Xfer (BX) Menu	See “22 Battery Xfer (BX) Menu” on page 7–18 for details.				
22A High Xfer (HBX) Vdc	16.1 to 33.9	27.0	32.2 to 67.8	54.0	
22B Low Xfer (LBX) Vdc	16.1 to 33.8	23.0	32.2 to 67.8	46.0	
23 ALM Relays Menu	See “23 ALM Relays Menu” on page 7–19 for details.				
23A RY9 Vdc Energized	22.1 to 35.5	26.0	44.2 to 71.0	52.0	
23B RY9 Vdc DeEnergized	20.0 to 35.5	22.0	40.0 to 71.0	44.0	
23C RY9 Delay at DeEngz. Min	00 to 255	10	00 to 255	10	
23D RY10 VDC Energized	10.0 to 32.0	28.8	20.0 to 64.0	57.6	
23E RY10 VDC DeEnergized	10.0 to 32.0	26.8	20.0 to 64.0	53.6	
23F RY10 Delay at DeEngz. Min	00 to 255	10	00 to 255	10	
23G RY11 Mode	Cooldown Error	Error	Cooldown Error	Error	

Table B-5 Advanced Setup Default and User Settings for the Sine Wave Plus 2524 and 2548 Models

Advanced Setup Menus	Sine Wave Plus 2524 Range/ Display	Sine Wave Plus 2524 Default Settings	Sine Wave Plus 2548 Range/ Display	Sine Wave Plus 2548 Default Settings	User Settings
24 Generator Timers Menu	See "24 Generator Timers Menu" on page 7–26 for details.				
24A Gen Run Time Start h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	
24B Gen Run Time Stop h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	
24C Quiet Time Begin h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	
24D Quiet Time End h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	
24E Gen Exercise Period Days	00 to 255	30	00 to 255	30	
24F Gen Exercise Timer Min	00 to 255	15	00 to 255	15	
24G Gen Cooldown Timer Min	00 to 255	02	00 to 255	02	
24H RN2/Gen Run h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	
25 Gen Starting Details Menu	See "25 Gen Starting Details Menu" on page 7–29 for details.				
25A RY7 Mode	GS RN1 RN2	GS	GS RN1 RN2	GS	
25B Gen Warmup Second/Minute	0 to 127 /0 to 127	10 Seconds	0 to 127 /0 to 127	10 Seconds	
25C Pre Crank Seconds	00 to 255	10	0 to 255	10	
25D Max Crank Seconds	01 to 15	10	01to15	10	
25E Post Crank Seconds	00 to 255	30	00 to 255	30	
26 Gen Auto Run Setup Menu	See "26 Gen Auto Run Setup Menu" on page 7–38 for details.				
26A Load Start Amps AC	00 to 63	20	00 to 63	20	
26B Load Start Delay Min	00.0 to 25.5	05.0	00.0 to 25.5	05.0	
26C Load Stop Delay Min	00.0 to 25.5	05.0	00.0 to 25.5	05.0	
26D 24-hr Start Volts DC	10.0 to 35.5	24.6	20.0 to 71.0	49.2	
26E 2-hr Start Volts DC	10.0 to 35.5	23.6	20.0 to 71.0	47.2	
26F 15-min Start Volts DC	10.0 to 35.5	22.6	20.0 to 71.0	45.2	

Table B-5 Advanced Setup Default and User Settings for the Sine Wave Plus 2524 and 2548 Models

Advanced Setup Menus	Sine Wave Plus 2524		Sine Wave Plus 2548		User Settings
	Range/ Display	Default Settings	Range/ Display	Default Settings	
26G Read LBCO 30 sec Start	LBCO setting (11C)	22.0	LBCO setting (11C)	44.0	
27 Save/Restore Setup Menu	See “27 Save/Restore Settings Menu” on page 7–39 for details.				
27A Push INV now to save Settings	Push INV now to save Settings				
27B Push GEN to restore settings	Push GEN to restore settings				
27C Push GEN for Factory Defaults	PUSH GEN for Factory Defaults				

Table B-6 Advanced Setup Default and User Settings for the Sine Wave Plus 4024 and 4048 Models

Advanced Setup Menus	Sine Wave Plus 4024		Sine Wave Plus 4048		User Settings
	Range/ Display	Default Settings	Range/ Display	Default Settings	
20 Silent Setup Menu	See “20 Silent Setup Menu” on page 7–13 for details.				
20A Refloat High Volts DC	16.1 to 33.9	28.4	32.2 to 67.8	56.8	
20B Refloat Low Volts DC	16.1 to 33.8	25.0	32.2 to 67.8	50.0	
20C Float Done Amps AC	00 to 40	10	00 to 40	10	
20D Must Float Time Min	00 to 255	05	00 to 255	05	
21 Grid AC1 Usage Menu	See “21 Grid (AC1) Usage Menu” on page 7–16 for details.				
21A Grid Usage SB BX	SB BX	SB	SB BX	SB	
21B Grid Usage Begin h:m	00:00 to 23:50	21:00	00:00 to 23:50	21:00	
21C Grid Usage End h:m	00:00 to 23:50	21:00	00:00 to 23:50	21:00	
22 Battery Xfer (BX) Menu	See “22 Battery Xfer (BX) Menu” on page 7–18 for details.				
22A High Xfer (HBX) Vdc	16.1 to 33.9	27.0	32.2 to 67.8	54.0	
22B Low Xfer (LBX) Vdc	16.1 to 33.8	23.0	32.2 to 67.8	46.0	
23 ALM Relays Menu	See “23 ALM Relays Menu” on page 7–19 for details.				

Table B-6 Advanced Setup Default and User Settings for the Sine Wave Plus 4024 and 4048 Models

Advanced Setup Menus	Sine Wave Plus 4024		Sine Wave Plus 4048		User Settings
	Range/ Display	Default Settings	Range/ Display	Default Settings	
23A RY9 Vdc Energized	22.1 to 35.5	26.0	44.2 to 71.0	52.0	
23B RY9 Vdc DeEnergized	20.0 to 35.5	22.0	40.0 to 71.0	44.0	
23C RY9 Delay at DeEngz. Min	00 to 255	10	00 to 255	10	
23D RY10 VDC Energized	10.0 to 32.0	28.8	20.0 to 64.0	57.6	
23E RY10 VDC DeEnergized	10.0 to 32.0	26.8	20.0 to 64.0	53.6	
23F RY10 Delay at DeEngz. Min	00 to 255	10	00 to 255	10	
23G RY11 Mode	Cooldown Error	Error	Cooldown Error	Error	
24 Generator Timers Menu	See "24 Generator Timers Menu" on page 7–26 for details.				
24A Gen Run Time Start h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	
24B Gen Run Time Stop h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	
24C Quiet Time Begin h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	
24D Quiet Time End h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	
24E Gen Exercise Period Days	00 to 255	30	00 to 255	30	
24F Gen Exercise Timer Min	00 to 255	15	00 to 255	15	
24G Gen Cooldown Timer Min	00 to 255	02	00 to 255	02	
24H RN2/Gen Run h:m	00:00 to 23:50	08:00	00:00 to 23:50	08:00	
25 Gen Starting Details Menu	See "25 Gen Starting Details Menu" on page 7–29 for details.				
25A RY7 Mode	GS RN1 RN2	GS	GS RN1 RN2	GS	
25B Gen Warmup Second/Minute	0 to 127 /0 to 127	10 Seconds	0 to 127 /0 to 127	10 Seconds	
25C Pre Crank Seconds	00 to 255	10	0 to 255	10	
25D Max Crank Seconds	01 to 15	10	01to15	10	
25E Post Crank Seconds	00 to 255	30	00 to 255	30	
26 Gen Auto Run Setup Menu	See "26 Gen Auto Run Setup Menu" on page 7–38 for details.				
26A Load Start Amps AC	00 to 63	33	00 to 63	33	
26B Load Start Delay Min	00.0 to 25.5	05.0	00.0 to 25.5	05.0	
26C Load Stop Delay Min	00.0 to 25.5	05.0	00.0 to 25.5	05.0	

Table B-6 Advanced Setup Default and User Settings for the Sine Wave Plus 4024 and 4048 Models

Advanced Setup Menus	Sine Wave Plus 4024 Range/ Display	Sine Wave Plus 4024 Default Settings	Sine Wave Plus 4048 Range/ Display	Sine Wave Plus 4048 Default Settings	User Settings
26D 24-hr Start Volts DC	10.0 to 35.5	24.6	20.0 to 71.0	49.2	
26E 2-hr Start Volts DC	10.0 to 35.5	23.6	20.0 to 71.0	47.2	
26F 15-min Start Volts DC	10.0 to 35.5	22.6	20.0 to 71.0	45.2	
26G Read LBCO 30 sec Start	LBCO setting (11C)	22.0	LBCO setting (11C)	44.0	
27 Save/Restore Setup Menu	See "27 Save/Restore Settings Menu" on page 7–39 for details.				
27A Push INV now to save Settings	Push INV now to save Settings				
27B Push GEN to restore settings	Push GEN to restore settings				
27C Push GEN for Factory Defaults	PUSH GEN for Factory Defaults				

Table B-7 Advanced Setup Default and User Settings for the Sine Wave Plus 5548 Model

Advanced Setup Menus	Sine Wave Plus 5548 Range/ Display	Sine Wave Plus 5548 Default Settings	User Settings
20 Silent Setup Menu	See "20 Silent Setup Menu" on page 7–13 for details.		
20A Refloat High Volts DC	32.2 to 67.8	56.8	
20B Refloat Low Volts DC	32.2 to 67.8	50.0	
20C Float Done Amps AC	00 to 40	10	
20D Must Float Time Min	00 to 255	05	
21 Grid AC1 Usage Menu	See "21 Grid (AC1) Usage Menu" on page 7–16 for details.		
21A Grid Usage SB BX	SB BX	SB	
21B Grid Usage Begin h:m	00:00 to 23:50	21:00	
21C Grid Usage End h:m	00:00 to 23:50	21:00	
22 Battery Xfer (BX) Menu	See "22 Battery Xfer (BX) Menu" on page 7–18 for details.		
22A High Xfer (HBX) Vdc	32.2 to 67.8	54.0	

Table B-7 Advanced Setup Default and User Settings for the Sine Wave Plus 5548 Model

Advanced Setup Menus	Sine Wave Plus 5548 Range/ Display	Sine Wave Plus 5548 Default Settings	User Settings
22B Low Xfer (LBX) Vdc	32.2 to 67.8	46.0	
23 ALM Relays Menu	See "23 ALM Relays Menu" on page 7–19 for details.		
23A RY9 Vdc Energized	44.2 to 71.0	52.0	
23B RY9 Vdc DeEnergized	40.0 to 71.0	44.0	
23C RY9 Delay at DeEngz. Min	00 to 255	10	
23D RY10 VDC Energized	20.0 to 64.0	57.6	
23E RY10 VDC DeEnergized	20.0 to 64.0	53.6	
23F RY10 Delay at DeEngz. Min	00 to 255	10	
23G RY11 Mode	Cooldown Error	Error	
24 Generator Timers Menu	See "24 Generator Timers Menu" on page 7–26 for details.		
24A Gen Run Time Start h:m	00:00 to 23:50	08:00	
24B Gen Run Time Stop h:m	00:00 to 23:50	08:00	
24C Quiet Time Begin h:m	00:00 to 23:50	08:00	
24D Quiet Time End h:m	00:00 to 23:50	08:00	
24E Gen Exercise Period Days	00 to 255	30	
24F Gen Exercise Timer Min	00 to 255	15	
24G Gen Cooldown Timer Min	00 to 255	02	
24H RN2/Gen Run h:m	00:00 to 23:50	08:00	
25 Gen Starting Details Menu	See "25 Gen Starting Details Menu" on page 7–29 for details.		
25A RY7 Mode	GS RN1 RN2	GS	
25B Gen Warmup Second/Minute	0 to 127 /0 to 127	10 Seconds	
25C Pre Crank Seconds	00 to 255	10	
25D Max Crank Seconds	01 to 15	10	
25E Post Crank Seconds	00 to 255	30	
26 Gen Auto Run Setup Menu	See "26 Gen Auto Run Setup Menu" on page 7–38 for details.		
26A Load Start Amps AC	00 to 63	45	

Table B-7 Advanced Setup Default and User Settings for the Sine Wave Plus 5548 Model

Advanced Setup Menus	Sine Wave Plus 5548 Range/ Display	Sine Wave Plus 5548 Default Settings	User Settings
26B Load Start Delay Min	00.0 to 25.5	05.0	
26C Load Stop Delay Min	00.0 to 25.5	05.0	
26D 24-hr Start Volts DC	20.0 to 71.0	49.2	
26E 2-hr Start Volts DC	20.0 to 71.0	47.2	
26F 15-min Start Volts DC	20.0 to 71.0	45.2	
26G Read LBCO 30 sec Start	LBCO setting (11C)	44.0	
27 Save/Restore Setup Menu	See “27 Save/Restore Settings Menu” on page 7–39 for details.		
27A Push INV now to save Settings	Push INV now to save Settings		
27B Push GEN to restore settings	Push GEN to restore settings		
27C Push GEN for Factory Defaults	PUSH GEN for Factory Defaults		

C Battery Information

Appendix C, “Battery Information” supplies general information about batteries such as battery types, battery bank sizing, battery configurations, and battery care. For detailed information, see your battery manufacturer or your system designer.

Introduction

Batteries

Batteries are available in different sizes, amp-hour ratings, voltage, liquid or gel, vented or non-vented, chemistries, etc. They are also available for starting applications (such as an automobile starting battery) and deep discharge applications.

Recommendations

Consider the following recommendations for battery use.

- Use only the deep discharge types for inverter applications.
- Use the same battery type for all batteries in the bank.
- Use only batteries from the same lot and date in your battery bank. This information is usually printed on a label located on the battery.

Battery Types

There are two principal types of batteries: starting and deep-discharge (with several different types of chemistries). Batteries can be either sealed or non-sealed (vented).

Deep discharge

The battery types recommended for use in an inverter system are: Flooded Lead Acid (FLA), Sealed Gel Cells (GEL), Sealed Absorbed Glass Mat (AGM); and alkaline types Nickel-iron (NiFe) and Nickel-Cadmium (NiCad).

Starting

Automotive (starting) batteries are designed to provide high starting current for short periods of time and are not appropriate for inverter applications.

Deep-cycle Flooded Lead Acid (FLA)

Description

A flooded lead acid battery is designed to be deep-discharged before being recharged, making it suitable for inverter applications. Flooded batteries require periodic maintenance consisting mainly of adding distilled water to the cells.

Attributes

Types of FLA Batteries	Attributes
Golf Cart	• Popular for smaller off-grid home systems • Many medium sized inverter systems use “L16” batteries • Rugged, long lasting • Typically rated at 6 volts (220 to 350 amp hours)

Types of FLA Batteries	Attributes
Industrial (electric forklift)	• Popular in large inverter systems • Extremely rugged - lasts up to 10 years or more in an inverter system • Typically 2 volt cells (1,000 amp hours or more)

Sealed Batteries (Gel and AGM)

Description

Gel Cell and absorbed glass mat (AGM) batteries are sealed and do not require the addition of distilled water. Since these batteries are valve regulated, over-charging can cause irreversible damage.

Attributes

Attributes of sealed batteries are:

Types of Sealed Batteries	Attributes
Gel Cell	• Gelled electrolyte instead of liquid • Long life (up to 1500 cycles, typical) • Low self-discharge
Absorbed Glass Mat	• Electrolyte is contained in glass-fibre mats between battery plates • Similar to gel cells in characteristics • Good low temperature performance

NiCad and NiFe Batteries

Disadvantages

These types of batteries can be used but are not optimized for the Sine Wave Plus for the following reasons:

- Alkaline batteries, such as NiCad and NiFe types, have a nominal cell voltage of 1.2 volts per cell.

  Xantrex inverters and battery chargers are optimized for use with lead acid batteries having a nominal 2.0 volts per cell (that is, 12 cells for a 24-volt system and 24 cells for a 48-volt system).

  The number of cells required in a battery bank for alkaline batteries must, therefore, be adjusted for a 24- and 48-volt system (i.e, 20 cells for a 24-volt system and 40 cells for a 48-volt system).
- Alkaline batteries require a higher charge voltage to fully recharge, and drop to a lower voltage during discharge compared to a similarly sized lead-acid type battery.

Other options

Another option for 24 volt (only) alkaline battery banks is to use only 19 cells instead of 20. Fewer cells allow the battery charger to operate more closely to the settings used for lead-acid batteries. However, the battery voltage will drop to as low as 18 volts when discharging the batteries.

Consult the battery manufacturer or supplier regarding system requirements and battery charger settings for alkaline type batteries.

Understanding Battery Capacity Ratings

Discharge rate

Deep cycle batteries have their amp-hour rating expressed as “at the x-hour rate”. The hour rating refers to the time it takes to discharge the batteries. A faster hour rate (6 hour rate) means more current is withdrawn from the batteries during their discharge period. There is an inevitable amount of heat associated with the flow of current through a battery and the higher amount of current the greater the amount of heat will be generated. The heat is energy which is no longer available to the battery to power loads. a relatively long discharge rate (72 hour rate) will result in a larger number of amp-hours being available for electrical loads.

Calculation

This calculation shows how to determine the level of current drawn from a battery at any given hour rate—battery capacity divided by the hour rate equals the current drawn from the battery. For example, a battery rated 220 Ah at a 6 hour rate would be discharged at 36 amps (220/6).

For most residential applications of the Sine Wave Plus the 72 hour rate is appropriate because on average a household uses low amounts of current (lights, TV, radio for example) with occasional bursts or higher consumption appliances like toasters or washing machines. For those installations where high continuous electrical consumption rates are anticipated it is more appropriate to use the 20 hour rate.

CCA rating

The CCA rating (cold cranking amps) shown on starting batteries expresses battery capacity in terms of its ability to provide large amounts of current for intervals measured in minutes, not hours. This is why starting batteries are not appropriate for inverter systems.

Battery Bank Sizing

Running time and size

The battery bank’s size determines the length of time the inverter can supply AC output power. The larger the bank, the longer the inverter can run.

Depth of discharge	In general, the battery bank should be designed so the batteries do not discharge more than 60% of their capacity on a regular basis. Discharging up to 80% is acceptable on a limited basis, such as a prolonged utility outage. Totally discharging a battery can reduce its effective life or permanently damage it.
Days of autonomy	For off-grid, stand-alone applications, design a battery bank that can power the loads for three to five days without requiring recharging. This design calculation assumes a worst case scenario where there is no recharging taking place during these days of autonomy.

Days of autonomy may vary depending upon the availability of other charging sources, the critical nature of the load and other factors. If the system is to be powered by renewable energy sources such as solar, wind, and micro-hydro, determine the appropriate number of days of autonomy by allowing for cloudy or calm weather as well as other seasonal variations in available energy.

If an engine generator is part of the system design, the days of autonomy can be determined by simply deciding how often you are prepared to run the generator. Significant battery cost reductions can be achieved by shortening the days of autonomy and allowing a generator to run for a schedule time period daily.

Back up power systems which use utility power for recharging should use the estimated number of days of maximum power outage for determining days of autonomy.

Understanding Amp-hour Requirements

Amp-hours

To estimate the battery bank requirements, you must first calculate the amount of power you will draw from the batteries during your period of autonomy. This power draw is then translated into amp hours (Ah)—the unit of measure to express deep-cycle battery capacity.

Amp hours are calculated multiplying the current drawn by the load by the length of time it will operate.

Watts to amps

To calculate amps when the power consumption is expressed in watts, use the following equation:

A = W/V

where W = watts and V = volts AC

For example:

A 100 watt light bulb will draw approximately 0.83 amps

0.83 = 100 /120

If the light runs for three hours it will consume (0.83 x 3) or 2.5 Ah of power.

Time and power

The length of time a load is operated will affect the power draw. In some cases, an appliance which draws a large wattage may not consume as many amp hours as a load drawing fewer watts but running for a longer period of time.

For Example:

A circular saw draws 1500 watts or 12.5 amps. It takes 5 seconds to complete a cross cut. Twelve such cuts would take a minute and you would consume 12.5 A x 0.016 hour = 0.2 Ah*

**1/60 = 0.016*

Observation The circular saw, while it draws more power, consumed fewer amp hours of electricity because it ran for a short period of time.

Calculating Amp Hours

Calculations

To determine the amp hours you will consume, you need to list your anticipated loads and the length of time you will operate each one. Determine the number of hours per day and the number of days during the week you will use the appliance. For example, you use the microwave every day, but a breadmaker only once a week. If you use an appliance for less than an hour, express the time as a decimal portion of an hour.

Amps to watts

All electrical appliances have labels which state their energy consumption. Look for an amps rating on motors and a watts rating on other appliances.

If the label plate has expressed power consumption in amps, multiply by volts for the watts required. (watts = volts x amps)

Considerations

When calculating battery bank size, consider the following:

- Motors typically require 3 to 6 times their running current when starting. Check the manufacturer's data sheets for their starting current requirements. If you will be starting large motors from the inverter, increase the battery bank size to allow for the higher start-up current.
- Refrigerators and ice-makers typically run only about 1/3 of the time, therefore, the running wattage is 1/3 of the total wattage of the appliance. Divide the total wattage of the appliance by 3 when determining the battery requirements.

Amp Hour Example Worksheet

Complete the following steps to calculate the amp-hour requirements per day for your system. Use and Table C-2 as examples to complete your own.

To calculate amp-hour requirements:

1. Determine the loads the inverter will power and enter their wattage in the watts column.
2. Determine the number of hours (or decimal portion of hours) the appliance is used each day. Enter this figure in the Hours column.
3. Determine the number of days the appliance will be used during the week. Enter this figure in the Days column.
4. Multiply Hours x Days for each load identified to determine the watt/hours per week.
5. Add the total watt/hours per week for all loads then divide by 7 to obtain the average total watt/hours per day.
6. Divide the total average per day by the DC nominal voltage.

   This figure represents the average amp-hours per day that you will use.

Table C-1 Determining Average Daily Load in Amp-hours

Load	Watts	Hours per Day	Days per week used	Weekly watt-hours
5 lights: 15 W CFL	75 W	5	7	2625
Breadmaker	1200	0.75	2	1800
Energy-efficient refrigerator	200 x 0.3	24		10080
Laptop computer	50	6	5	1500
		Total weekly watt-hours of AC load		16005 Wh
		Divided by days per week		7
		Average total watt-hours per day		2286
		Divided by DC nominal voltage		24
		Average amp-hours per day (Ah/d)		95

Battery bank size worksheet

Calculation

To calculate the battery bank size, use the average amp-hours per day that you calculated using Table C-1, then make the other calculation shown in Table C-2 to calculate the battery bank size you need to support your loads.

Table C-2 Determining Battery Bank Size

Average amp hours per day	95
Divided by inverter efficiency (90%) for Sine Wave Plus	0.9
Divided by battery efficiency (usually 0.75)	0.75
Adjusted hours per day	140
Divided by Depth of Discharge (usually 60%)	0.6
Multiplied by days of autonomy	5
Battery bank size required	1173 Ah

Worksheets

Table C-1 and Table C-2 are examples only. Use the specifications noted on the label of each AC appliance and fill in the values specific for the appliances used in this installation on the a work sheet.

Table C-3 provides a typical wattage for selected appliances. However, you should try to find the exact wattage on the appliance label.

Table C-3 Typical Appliance Wattage

Appliance	Watts	Appliance	Watts
Fluorescent Type Light	10	Blender	400
Computer	200-300	Toaster	1000
Microwave (compact)	600-800	Hot Plate	1800
Microwave (full-size)	1500	Washer/Dryer	375-1000
Stereo or VCR	50	3/8" Drill	500
Color Television (19")	150	Hair Dryer or Iron	1000
Refrigerator (3 cu ft)	180	Vacuum Cleaner	1200
Refrigerator (12 cu ft)	480	Coffee Maker	1200

Battery Configurations

The battery bank must be wired to match the inverter's DC input voltage specifications (24 or 48 Vdc). In addition, the batteries can be wired to provide additional run time. The various wiring configurations are:

Series — Wiring batteries in series increases the total bank output voltage. This voltage MUST match the DC requirements of the inverter or inverter and/or battery damage may occur.

Parallel — Wiring the batteries in parallel increases the total run time the batteries can operate the AC loads. The more batteries connected in parallel the longer the loads can be powered from the inverter.

Series-Parallel — Series-parallel configurations increase both the battery voltage (to match the inverter's DC requirements) and run-time for operating the AC loads. This voltage must match the DC requirements of the inverter.

Batteries with more than two or three series strings in parallel often exhibit poor performance characteristics and shortened life.

Wiring Batteries in Series

Effect — Wiring the batteries in a series configuration increases the voltage of the battery string. Six-volt batteries can be combined to form 24-volt or 48-volt battery banks. In the same way, 12-volt batteries connected in series form 24-volt and 48-volt battery banks. The total current capacity of the bank does not increase and remains the same amp-hour rating as it does for a single battery.

Important — The voltage must match the DC requirements of the inverter.

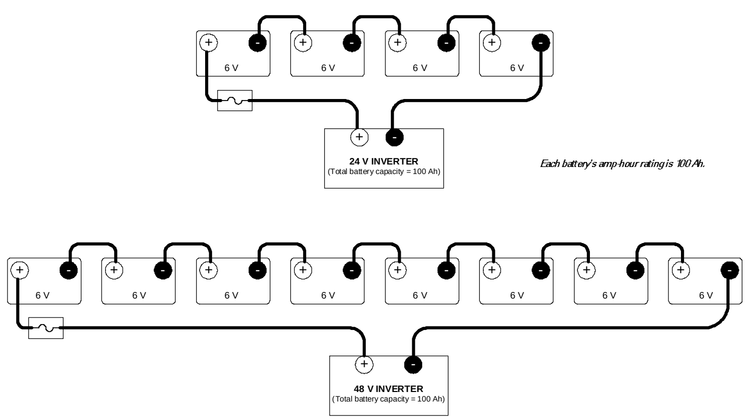


Figure C-1 6-volt Battery Wiring - "Series" Configuration

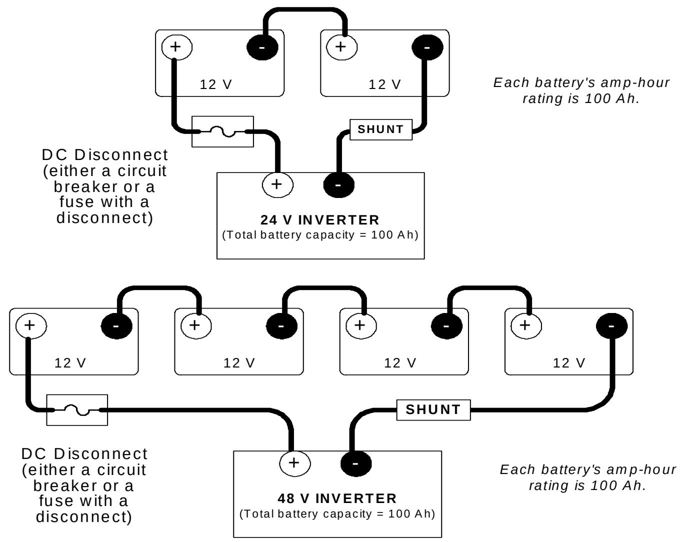


Figure C-2 12-volt Battery Wiring - "Series" Configuration

Wiring Batteries in Parallel

Effect

Wiring the batteries in a parallel configuration increases the current of the battery string. The voltage of the battery bank remains the same as an individual battery. "Parallel" configurations extend the run times of the AC loads by providing increased current for the inverter to draw from. In a parallel configuration, all the negative battery terminals are connected together and all the positive battery terminals are connected together.

Wiring example

Figure C-4 is an example only of how to wire batteries in a parallel configuration. The Sine Wave Plus is not available in a 12-volt unit.

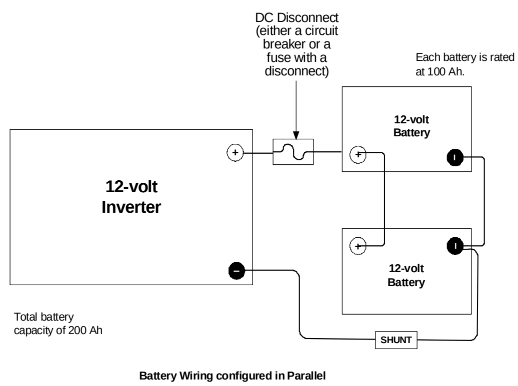


Figure C-3 Battery Wiring in Parallel (Example Only)

Wiring Batteries in Series-Parallel

Effect

Wiring the batteries in a series-parallel configuration increases the current and voltage of the battery bank. “Series-parallel” wiring is more complicated and care should be taken when wiring these banks.

Steps

It is done in three steps; wiring the batteries in series, wiring them in parallel, then wiring the string to the inverter.

Series wiring

To wire in series:

1. First wire the batteries in “series” (voltage adds) with the positive terminal of one battery connected to the negative terminal of the next battery to meet the inverter’s DC input requirements (24 volts shown in Figure C-4 and Figure C-5.)
2. Repeat this step for the next battery string.

   Two identical strings of batteries are now wired in series.

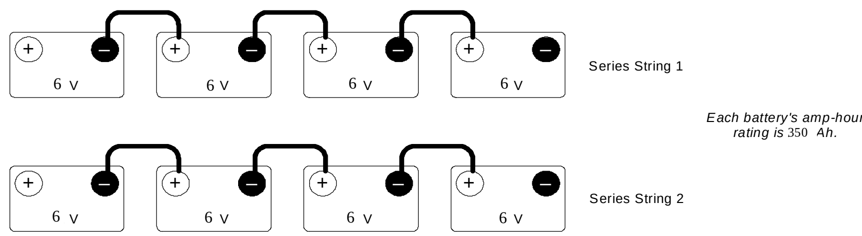


Figure C-4 Step 1 - Wiring Batteries in “Series”

Parallel wiring

To wire the batteries in parallel:

1. Connect the positive terminal of the first battery string to the positive terminal of the second battery string.
2. Connect the negative terminal of the first battery string to the negative terminal of the second battery string.

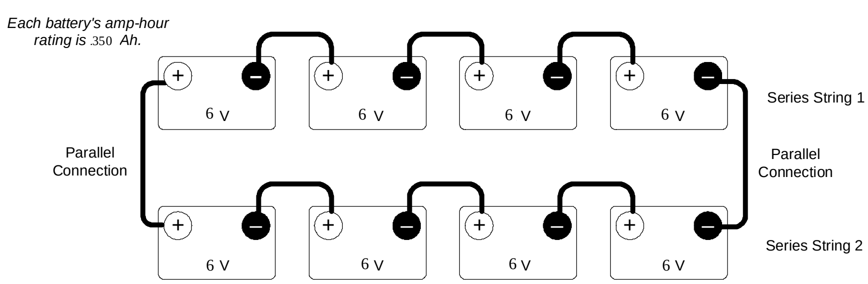


Figure C-5 Step 2 - Two series strings wiring in “Parallel”

Connect to inverter

To connect to the inverter:

1. Connect a cable from the positive terminal of the first battery string to the inverter’s positive DC terminal (via a fused device).
2. Connect the negative terminal of the last battery string to the negative terminal of inverter’s DC terminal.

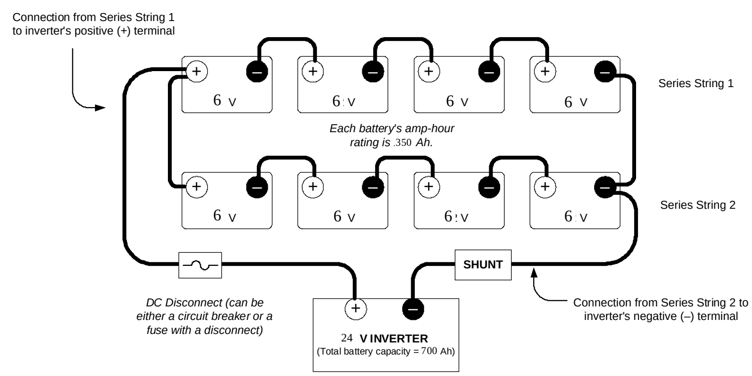


Figure C-6 “Series-Parallel” Configuration Wired to the Inverter

Battery Connections for Stacked Inverters

When using inverters in a stacked configuration, the same battery bank must be used for both inverters. To ensure even charging of the batteries, each inverter must be connected to both strings (i.e., positive cable to string two, and negative cable to string one for inverter 1, and positive cable to string one and negative cable to string two for inverter 2) as shown in the diagram below.

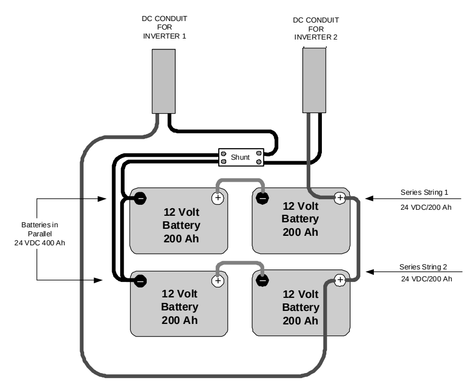


Figure C-7 Example of Battery Connections for Stacked Inverters (24 Vdc shown)

Battery Maintenance

Maintenance strategy

To get the best performance from an inverter system, the batteries must be properly setup and maintained. This includes setting the proper voltages for Bulk and Float charging. See the “CAUTIONS” in the section on Equalization Charging that follows. In addition, the battery terminals should be inspected, cleaned, and re-torqued if necessary.

Neglecting any of these items may result in poor inverter performance and greatly reduce battery life.

Battery charging

Charge Rate

The maximum safe charge rate is related to the size and type of the batteries. Flooded lead acid batteries (with removable caps) can be charged at a high rate. Small batteries may require a lower charge rate. Check with your battery vendor for the proper battery charging rate for the batteries used in the system.

Bulk Voltage

This is the maximum voltage the batteries will be charged to during a normal charge cycle. Gel cell batteries are set to a lower value and non-sealed batteries are set to a higher voltage setting.

Float Voltage

The Float voltage is set lower than the Bulk voltage and provides a maintenance charge on the batteries to keep them in a ready state.

Temperature Compensation

For optimal battery charging, the Bulk and Float charge rates should be adjusted according to the temperature of the battery. This can be accomplished automatically by using a BTS. The sensor attaches directly to the side of one of the batteries in the bank and provides precise battery temperature information.

When battery charging voltages are compensated based on temperature, the charge voltage will vary depending on the temperature around the batteries. The following table describes approximately how much the voltage may vary depending on the temperature of the batteries.

If you have liquid lead acid batteries (non-sealed), you may need to periodically equalize your batteries. Check the water level monthly to maintain it at the appropriate level.

Table C-4 Variances in Charging Voltage based on Battery Temperature

Temperature (around the BTS)		24-volt units		48-volt units	
Celsius	**Fahrenheit**	**Lead Acid**	**NiCad**	**Lead Acid**	**NiCad**
60	140	-2.10	-1.40	-4.20	-2.80
55	131	-1.80	-1.20	-3.60	-2.40
50	122	-1.50	-1.00	-3.00	-2.00
45	113	-1.20	-0.80	-2.40	-1.60
40	104	-0.90	-0.60	-1.80	-1.20
35	95	-0.60	-0.40	-1.20	-0.80
30	86	-0.30	-0.20	-0.60	-0.40
25	77	0.00	0.00	0.00	0.00
20	68	0.30	0.20	0.60	0.40
15	59	0.60	0.40	1.20	0.80
10	50	0.90	0.60	1.80	1.20
5	41	1.20	0.80	2.40	1.60
0	32	1.50	1.00	3.00	2.00
-5	23	1.80	1.20	3.60	2.40
-10	14	2.10	1.40	4.20	2.80
-15	5	2.40	1.60	4.80	3.20
-20	-4	2.70	1.80	5.40	3.60
-25	-13	3.00	2.00	6.00	4.00
-30	-22	3.30	2.20	6.60	4.40
-35	-31	3.60	2.40	7.20	4.80
-40	-40	3.90	2.60	7.80	5.20

Temperature compensation is based on battery type—5 mv/cell for lead acid type batteries and 2 mv/cell for alkaline type batteries (NiCad or NiFe). The temperature compensation calculations are derived from Table C-5.

Table C-5 Temperature Compensation Calculation

Battery Type	24-volt Systems	48-volt Systems
Lead Acid	0.060 volts (60 mV) per degree Celsius	0.120 Volts (120 mV) per degree Celsius
NiCad	0.040 volts (40 mV) per degree Celsius	0.080 volts (80 mV) per degree Celsius

Note: If the battery temperature is allowed to fall to extremely cold temperatures, the inverter with a BTS may not be able to properly recharge cold batteries due to maximum voltage limits of the inverter. Ensure the batteries are protected from extreme temperatures.

Equalization Charging

Purpose	An equalize charge helps to remove sulfate buildup on the battery plates and balances the charge of individual cells.
Effect	Equalize charging also produces gassing which stirs up the electrolyte mixture and helps distribute the acid more evenly.
Non-equalized batteries	Batteries that are not equalize charged can be damaged by sulfate accumulation, thus sealing off a percentage of the plates and reducing battery capacity. They may also have sulfuric acid accumulate at the bottom of the battery, potentially damaging the plates. At the same time, the electrolyte at the top of the battery gets watery. This effect is called stratification.
Frequency	Every month or two the batteries should be equalize charged.

CAUTION: Damage to DC Loads

The high voltages reached during an equalize charge may damage DC loads that are connected to the inverter. Disconnect any DC loads from the inverter before running an equalize charge.

CAUTION: Damage to Batteries

Equalization should be done for standard electrolyte vented batteries only. Sealed or GEL cell batteries should not be equalize charged. Consult your battery supplier for details on equalize charging for the battery type in your system.

General Maintenance

Water Levels

Flooded lead acid batteries require periodic water refills in each battery cell. Only distilled water should be used in a battery, as tap or mineral water may contain contaminants which will upset the battery chemistry and may damage the battery.

When filling the battery, clean the surface first to prevent dirt from entering the cell. Fill the cell to just above the plates or to the bottom of the internal collar inside the battery. Never fill the cells to the top or acid will leak out during charging.

Check the water level in the batteries frequently when performing an equalize charge and add water if necessary. Always follow the safety steps covered in the front of the manual.

Battery Cables and Posts

Battery posts must be clean to reduce the resistance between the battery post and cable connection. A buildup of dirt or oxidation may eventually lead to the cable terminal overheating during periods of high current draw.

Use a stiff wire brush and remove all dirt and corrosion from the battery terminals and cables. Use an alkaline solution of baking soda and water to clean the terminals and neutralize any battery acid on the terminals or cable lugs.

WARNING: Shock Hazard

Before attempting to clean the battery posts, turn off the DC circuit breaker. Use only insulated tools and remove all jewellery.

CAUTION: Damage to Batteries

Never let a baking soda solution get into the battery as it will neutralize the acid resulting in permanent damage.

Torque Battery Connections

After the terminals are clean, reassemble the cable to the battery terminal and torque the connections to the battery manufacturer’s recommendations.

Coat the battery terminals with an antioxidant compound.

State of Charge

The battery's state-of-charge should be checked often and only when the battery at a state of rest (when the battery is not powering loads or actively being charged). First thing in the morning is usually the best time to check the state of charge. If the batteries are readily accessible, measure the voltage across the individual battery terminals. There should be less than a 0.2 volt difference between each battery.

To determine the individual cell voltage, divide the voltage by the number of cells in the battery (25.2 volts divided by 12 cells = 2.1 volts per cell). If a greater difference is measured, the batteries may need to be equalized (liquid lead-acid types only) or replaced.

All batteries in the bank should measure the same voltage (this is not an accurate measurement for cross-tied batteries' as each battery is in parallel with another battery making individual battery measurements impossible).

The voltage should match the following table for the entire battery bank output. These values indicate the overall battery's state of charge for the entire bank. Individual cell voltages (if available) are also shown as a percentage of charge.

The values given are for a temperature of 77 °F (25 °C). Cooler temperatures produce lower voltage measurements.

Table C-6 Battery State-of-Charge

	System Voltage			
Percent of Full Charge	**12 Volt**	**24 Volt**	**48 Volt**	**Individual Cell Voltage**
100%	12.7	25.4	50.8	2.12
90%	12.6	25.2	50.4	2.10
80%	12.5	25.0	50.0	2.08
70%	12.3	24.6	49.2	2.05
60%	12.2	24.4	48.8	2.03
50%	12.1	24.2	48.4	2.02
40%	12.0	24.0	48.0	2.00
30%	11.8	23.6	47.2	1.97
20%	11.7	23.4	46.8	1.95
10%	11.6	23.2	46.4	1.93
0%	≤ 11.6	≤ 23.2	≤ 46.4	≤ 1.93

D Generators

Appendix D, "Generators" supplies information about generator starting.

This information is provided for basic reference only. Because of the wide variety of generator circuits available, Xantrex cannot be held responsible for the accuracy of the information provided. Always refer to the manufacturer's recommendation for specific operating instructions.

Two-Wire Start Circuits

Two-wire starting generators are the easiest to control and are highly recommended for this type of application. A contact closure starts the generator and opening the contacts stops the generator. These types of generators also provide their own cranking control circuit, possibly oil pressure and overtemp protection circuits, and are designed for unattended operation applications.

Three-Wire Start Circuits

The common term “three-wire start” may be misleading, as the actual number of wires required may be four or more. Control of the starter motor is separate in these systems and the protection circuits found in two-wire start systems may not be present. This could lead to the generator running when it is in an over-temperature or low oil condition, etc. Since these generators are not designed for unattended operation, the generator supplier should be consulted regarding additional safety/ protection components that may be required.

Two well-known manufacturers of three-wire starting generators are Honda and Onan. Each uses a different starting sequence and must be wired accordingly.

Honda™ 3-Wire Type Generators

Honda 3-wire type generators incorporate a starting sequence similar to an automotive starting system, the switch is first placed in the RUN position then momentarily held in the START position. When the generator has started, the switch is returned to the RUN position. To STOP the generator, the switch is placed in the OFF position.

In this starting configuration, relay RY7 (in the RN1 mode) duplicates the “RUN” position and RY8 duplicates the “START” position cranking the starter motor.

Onan™ 3-Wire Type Generators

Most Onan 3-wire type generators use a three-position, momentary type switch to control their operation. To start the generator, the switch is held in the “START” position, energizing the ignition system and cranking the starter motor. Once the engine starts, the switch is released and returns to a center off position. The starter motor stops cranking but the ignition system remains energized. To shut down the generator, the switch is held in the “STOP” position until the engine dies. When the switch is released, it returns to the center position.

In this system, RY8 duplicates the “START” position and relay RY7 (in the “GS” mode) duplicates the “STOP” position. Some generators use a similar system with two push-button switches, one to start and one to stop the generator. For diesel engines, select GS.

Many diesel generators are controlled like the Onan 3-wire type with the exception that they also require glow plugs to be operated before a generator start is attempted. The inverter’s automatic generator start system allows for glow plug control. The addition of a relay between the GSM and the generator may be required to operate the glow plugs (due to the amperage) and to separate the stop signal circuit.

3-2 Wire Converters

Another option for three-wire start type generators is to use a 3-to-2 wire converter. These vary from very simple relay types to very advanced microprocessor types. Onan offers a simple 3-to-2 wire converter for some of their generators that are known to work well for many installations. Universal 3-to-2 wire converters can be used with virtually any generator and can control glow plugs for diesel engines as well. These can allow additional system components to signal the generator start system to start.

For more information on these or additional generator hookup information, consult your generator supplier or manufacturer.

E Over-Charge Protection

Appendix E, “Over-Charge Protection” supplies information about options for over-charge protection.

This information is provided for basic reference only. Because of the wide variety of over-charge protection available, Xantrex cannot be held responsible for the accuracy of the information provided. Always refer to the manufacturer’s recommendation for specific operating instructions.

Overvoltage Protection using a Charge Controller

When using a renewable energy source to charge the batteries, a charge controller prevents the batteries from exceeding a user-specified voltage level. This preserves and extends the life of the battery by preventing the damage caused by overcharging. The charge controller can also take over the functions of bulk and equalize charging, and many charge controllers provide the functions of multi-stage charging.

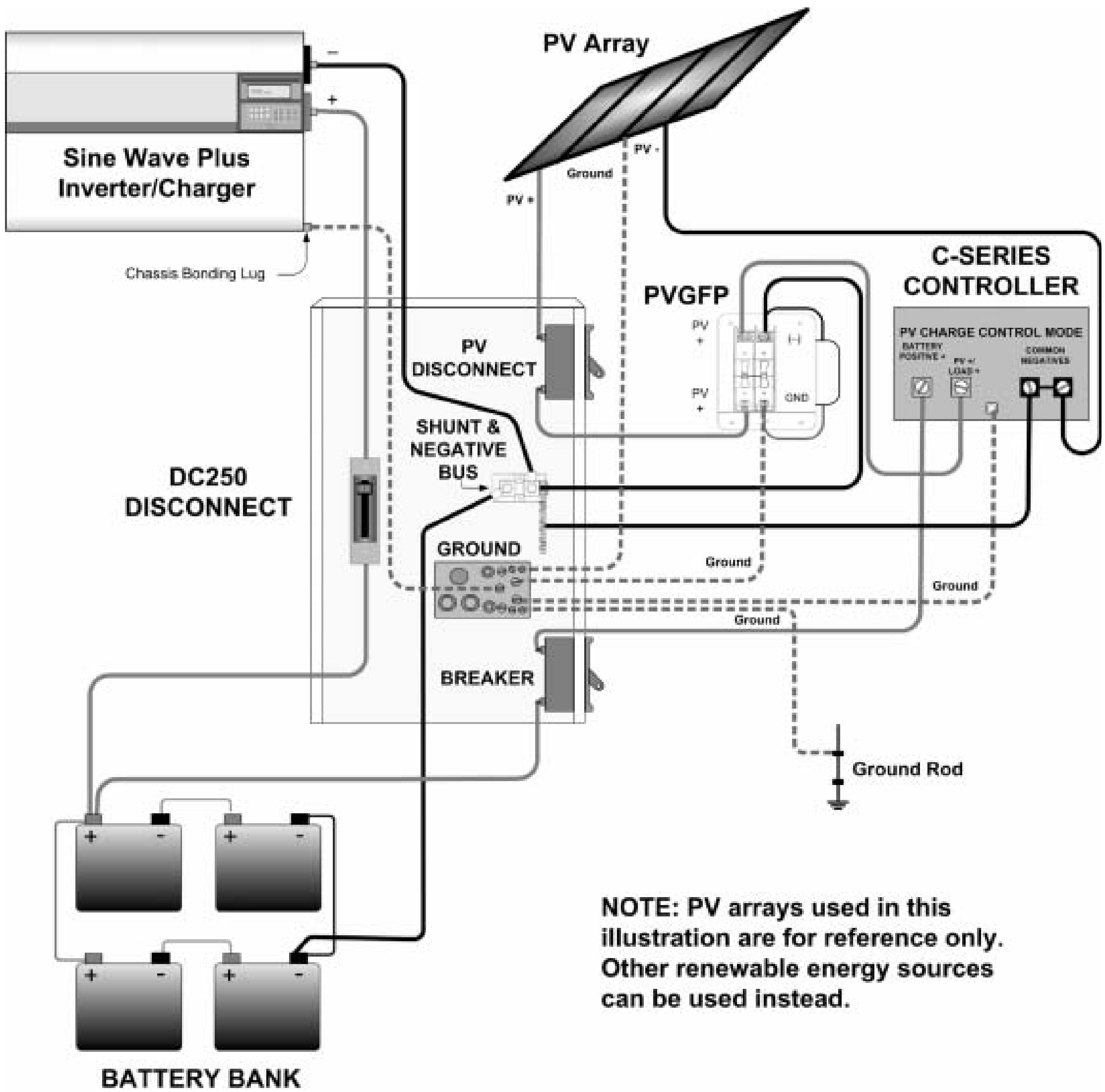


Figure E-1 Overvoltage using a C-Series Charge Controller

Diversion Load Control

DC generator devices, such as wind turbines and hydro-electric generators, may be damaged by over-spinning if the DC loads are suddenly removed from them. This can happen if the DC disconnect should open (trip) or the batteries are fully charged and no other DC loads are connected in the system. A diversion load controller prevents damage to the generator system by diverting the power from the generator to a diversion load device. This keeps a load on the generator and controls over-spin if the batteries should be disconnected. Refer to the controller manual for proper types of diversion load devices.

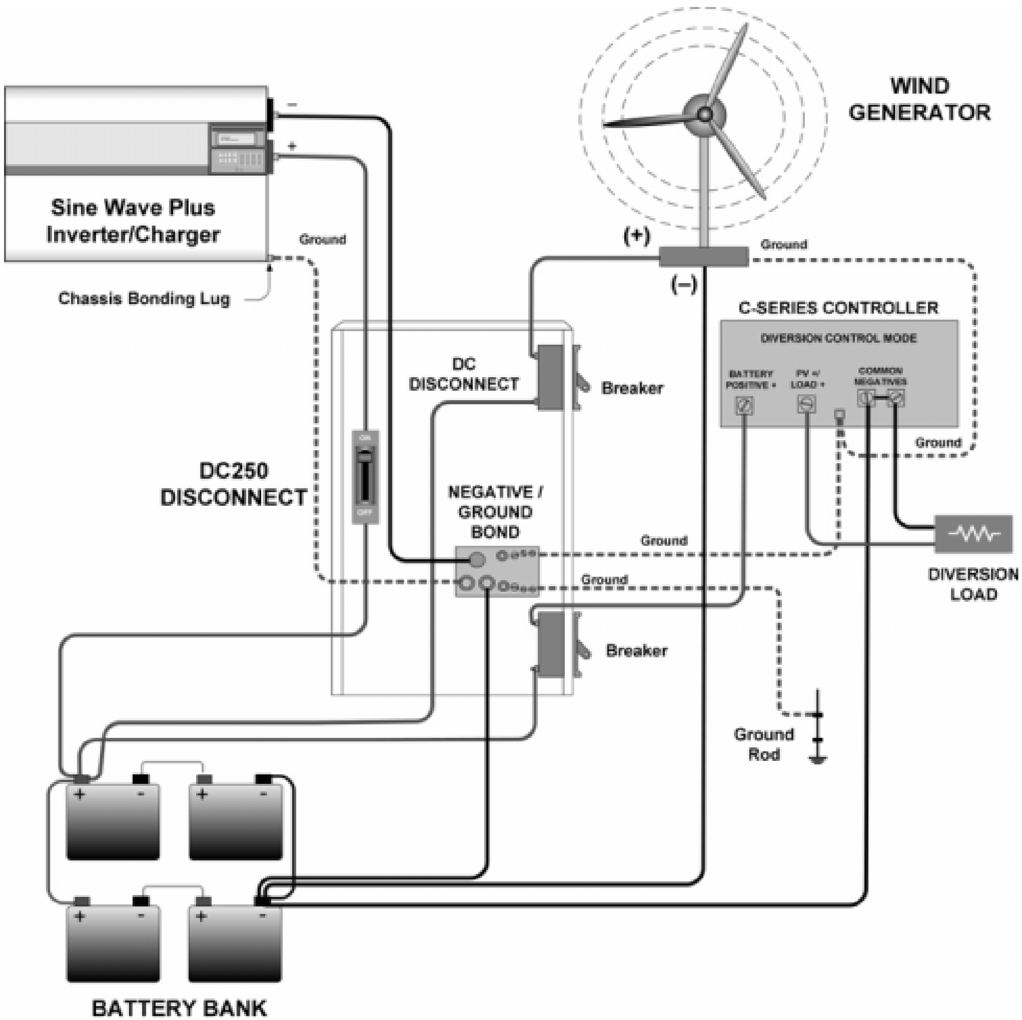


Figure E-2 Diversion Load Control

F

Multi-wire Branch Circuit Wiring

Appendix F, “Multi-wire Branch Circuit Wiring” supplies information about Multi-wire Branch Circuit Wiring Precautions when using stand-alone 120 Vac inverters or generators.

WARNING

A possible fire hazard can exist if 120 Vac only sources (such as inverters and generators) are wired incorrectly into 120/240 Vac panels containing multi-wire branch circuits. This section describes how to check for multi-wire branch circuits in the load center and presents some possible solutions to this wiring method.

Multi-wire Branch Circuits

Problem

A potential safety problem exists when installing stand-alone 120 Vac inverters into existing 120/240 Vac wired panels where multi-wire branch circuit wiring methods were used.

Legacy situation

Multi-wire branch circuits are wired differently from “home run” type wiring (Figure F-1) in that only one neutral wire is used to provide the neutral-return path for each circuit connected to both phases of the AC grid. This method has been employed by electricians in recent years to keep construction costs down by saving copper and labor costs involved in running a separate Romex™ for each circuit.

Normal condition

Under normal conditions, this technique is quite safe and meets code requirements. When used as originally installed, the current for each circuit is 180° out-of-phase with each other, so the neutral wire never receives more current than it was designed to handle as the current from each circuit subtracts (or cancels out, leaving only the difference current between the two circuits). Refer to Figure F-2.

Safety issue

A safety problem occurs when a stand-alone 120 Vac inverter is installed to power these circuits, causing the one neutral wire to now carry the in-phase currents for both circuits. Since the current is in-phase, the two circuits add instead of subtract, potentially doubling the current flow in the neutral return wire! Refer to Figure F-3. The branch circuit breakers do not protect the neutral wire from overload under this condition. This excess current will overheat the neutral wire, potentially creating a fire hazard.

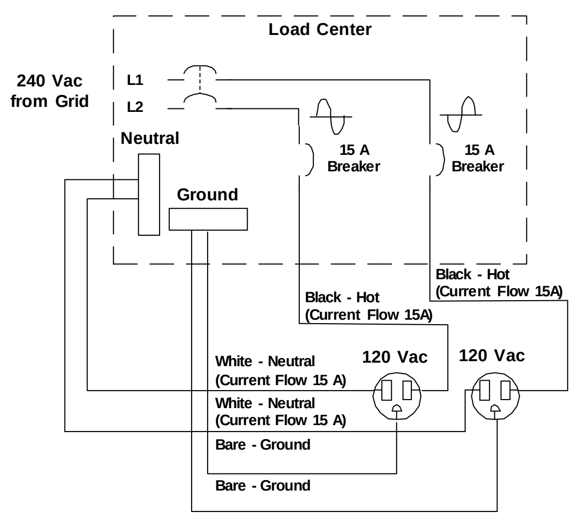


Figure F-1 Conventional Home-type Wiring

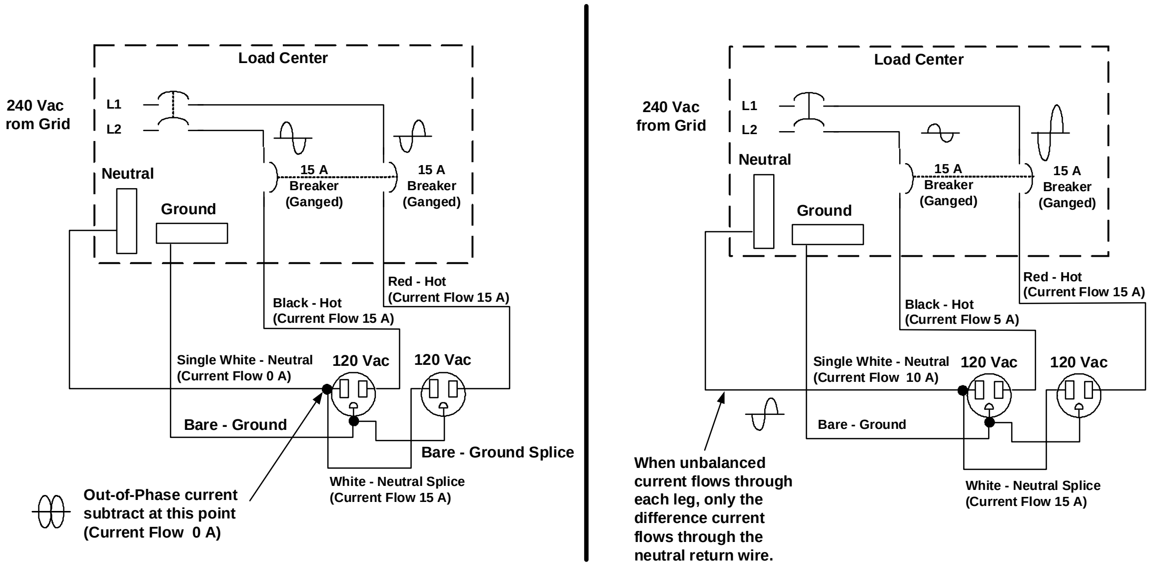


Figure F-2 Multi-wire Branch Circuit Wiring and Current Flow

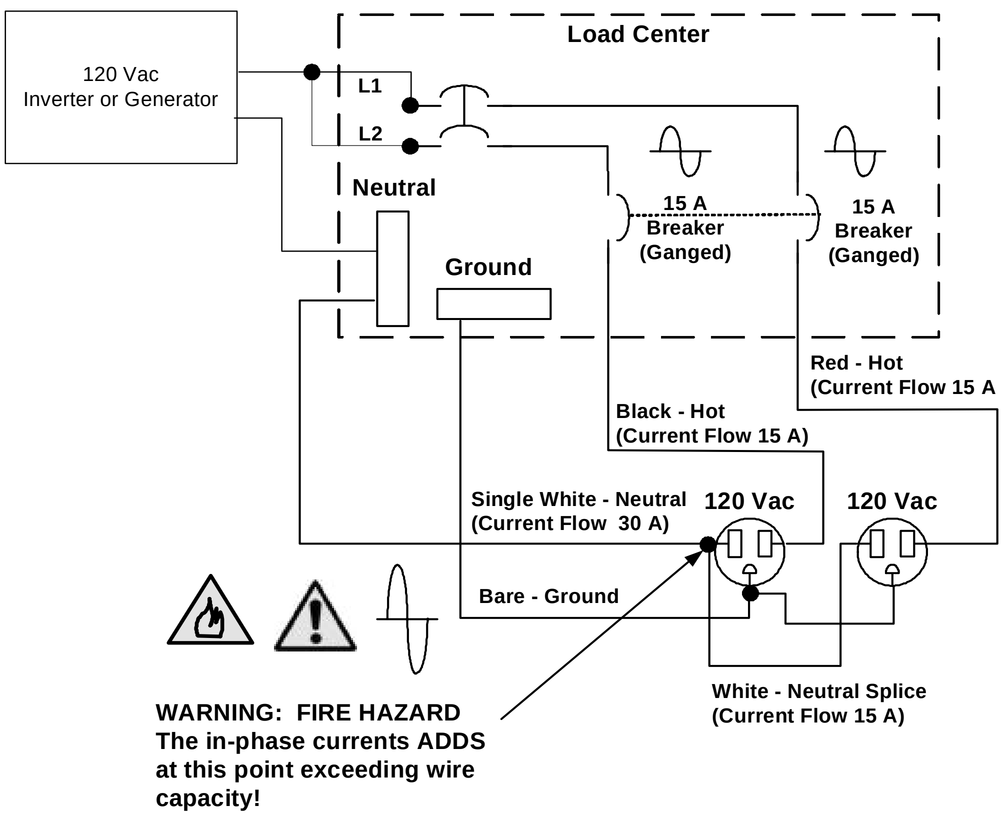


Figure F-3 120 Vac Inverter Incorrectly Wired in a Multi-wire Branch Circuit

Identifying Multi-wire Branch Circuits

WARNING: Shock Hazard

The next step involves opening the load center, exposing live circuits. This procedure should only be performed by qualified persons or electricians.

Identifying characteristic

Multi-wire branch circuits can be identified by removing the cover on the load center and inspecting the wiring. Conventional 120 Vac circuits are identified by a 2-wire-plus-ground (black, white, and copper) “romex” for each circuit. Multi-wire branch circuits use a 3-wire-plus-ground arrangement (black, red, white and copper) for each circuit run.

If this arrangement exists in the panel and it is being powered by a stand-alone 120 Vac inverter, a potential fire hazard exists! For safety, these circuits must be rewired to meet code.

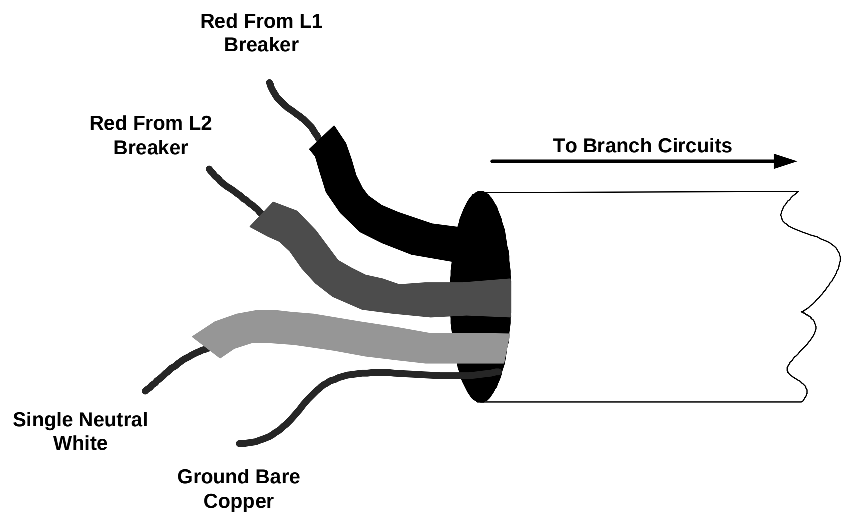


Figure F-4 Multi-wire Branch Circuit Wiring

Correcting Multi-wire Branch Circuit Wiring

Acceptable options

Correcting multi-wire branch circuit wiring is not easy. Two options which will correct multi wiring branch circuit wiring are:

- Rewire existing multi-wire branch circuits to conventional "home run" wiring. This requires a qualified electrician (knowledgeable about multi-wire branch circuit wiring) and is expensive. There may be multiple multi-wire branch circuits located throughout the structure, requiring complete rewiring.
- Add a second inverter in a "series stacked" arrangement. This is an expensive solution, but would restore the original 240 Vac split-phase configuration. This solution may actually be less expensive than having an electrician re-wire the multi-wire branch circuits. It also provides increased power backup protection and can power 240 Vac loads.

Recommended option

Add a step-down autotransformer to the output of the inverter to restore the split-phase configuration. This is the least expensive and easiest method to correct for multi-wire branch circuit wiring. Refer to Figure F-5. Using this method, half of the current is supplied to one leg of the circuit and half to the other in a split-phase arrangement (180° out-of-phase). This will restore the original functionality and safety to the multi-wire branch circuit.

WARNING: Fire Hazard

Until one of the solutions above is implemented, a stand-alone 120 Vac inverter (or generator) must not be installed where multi-wire branch circuits exist.

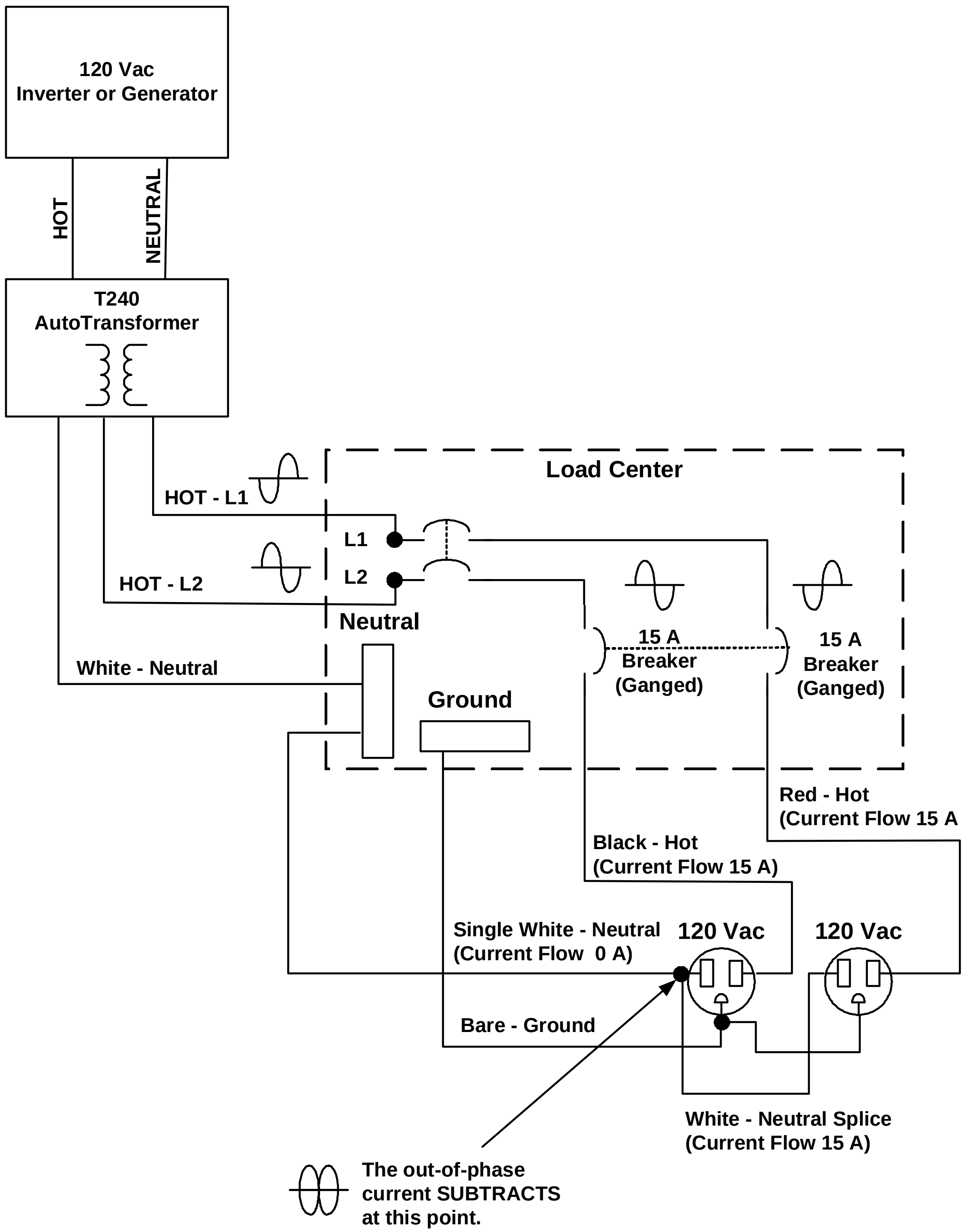


Figure F-5 Using a Step-down Autotransformer in Multi-wire Branch Circuit Wiring

G Emergency Power Off Switches

Appendix G, “Emergency Power Off Switches” supplies information about the requirements for installing an Emergency Power Off Switch.

The Purpose of an EPO switch

In the event an emergency situation, the first priority is to remove power from the house by removing the power meter. However, systems with battery backups can run in inverter mode (i.e., no utility power) for hours providing AC output to the household loads. The inverter can also have several other sources of input power such as AC (generators) or DC sources from wind turbines or photo voltaic arrays. In these situations, if the meter was pulled to remove power, the inverter would continue to provide power to the residence. This can cause a potential hazard to the emergency response crew and possibly hinder rescue or salvage efforts.

To provide a shutdown solution, the Sine Wave Plus includes a feature that when utilized with a properly marked switch, can disable and shutdown the system.

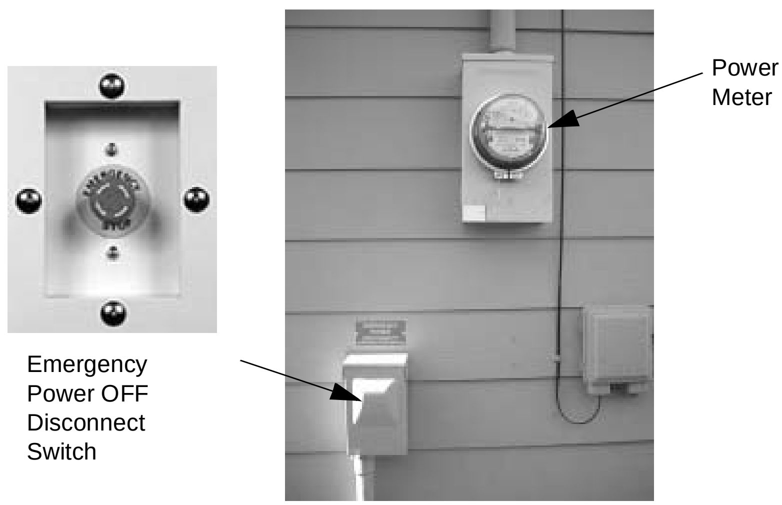


Figure G-1 Emergency Power OFF Disconnect Switch

The Sine Wave Plus is one of the first renewable energy inverters that include this feature. It is designed to provide an emergency power off function that disables the inverter function, output, and power transfer. The unit will then require manual intervention to physically turn the unit back on using the display buttons in the **01 Inverter ON/OFF menu**. This provides a secondary shutdown feature when DC shunt trip circuit breakers are not available, or the local authority having jurisdiction requires some form of externally mounted switched shutdown. This is classified as a shutdown control and does not physically disconnect any circuit breakers.

The intent of this feature is to provide three options:

- Inverter shutdown using an externally mounted switch as described in the 2002 NEC Article 230-70 (a) (no physical disconnect required),
- Inverter shutdown and physical disconnect by using a 2-pole EPO switch, one set of contacts open the AC output breaker, the other set turn off the inverter (Physical shunt trip breaker required), or
- DC and AC circuit shunt trip breakers physical disconnect required (very expensive and not necessary).

During discussion with industry experts, their opinion was that if the DC battery bank was within the vicinity of the unit and the EPO control provided a clear, repeatable shutdown, tested and verified by agency approval, then the control signal shutdown would be allowed and the expensive physical DC disconnect would not be required.

In the case where AC service subpanels are located in separate locations, away for the inverter, other buildings, or unknown wire running through walls, you may be required to install a shunt trip type "physical disconnect" added between the inverter output and the sub "essential loads" panel. When the EPO switch is activated, as described above, the inverter shuts down, and a separate set of contacts provides the signal to trip the shunt trip circuit breaker.

The disconnect mounted on the outside of the house should be at or near the utility meter. The label on the EPO switch should be labeled "EMERGENCY POWER OFF OF SECONDARY SOURCES OF POWER". See Figure G-1, "Emergency Power OFF Disconnect Switch" on page G–2.

See the 2002 NEC Section 3, as shown below.

> SECTION 3. MODIFICATION TO ARTICLE 230 OF THE NATIONAL ELECTRIC CODE, 1999 EDITION
>
> Article 230 of the National Electric Code is hereby modified by amending Subsection 230-70(a) to read as follows:
>
> 230-70(a) Location.
>
> The service disconnecting means shall be installed at a readily accessible location either outside of a building or structure or inside nearest the point of entrance of the service conductors.
>
> Except in one and two family dwellings, the service disconnecting means shall be installed at the exterior of the building or structure in close proximity to the meter location.
>
> Exception: The service disconnecting means can be installed inside the building or structure nearest the point of entrance of the service conductors provided a shunt trip switch is installed at the exterior of

the building at a readily accessible location. The shunt trip switch, when installed should be between six (6) feet and six feet seven inches (6'7") above finish grade. A sign constructed of permanent materials with no less than 1½" high letters designating "Shunt Trip - Main Disconnect" shall be located on the exterior of the building or structure, and approximately one foot (1') above and one foot (1') to one side of the shunt trip mechanism. Service disconnecting means shall not be installed in bathrooms.

How to use the EPO Port for an EPO Switch

The following diagram shows how to modify a 6-conductor cable to connect the Sine Wave Plus for an Emergency Power Off Switch.

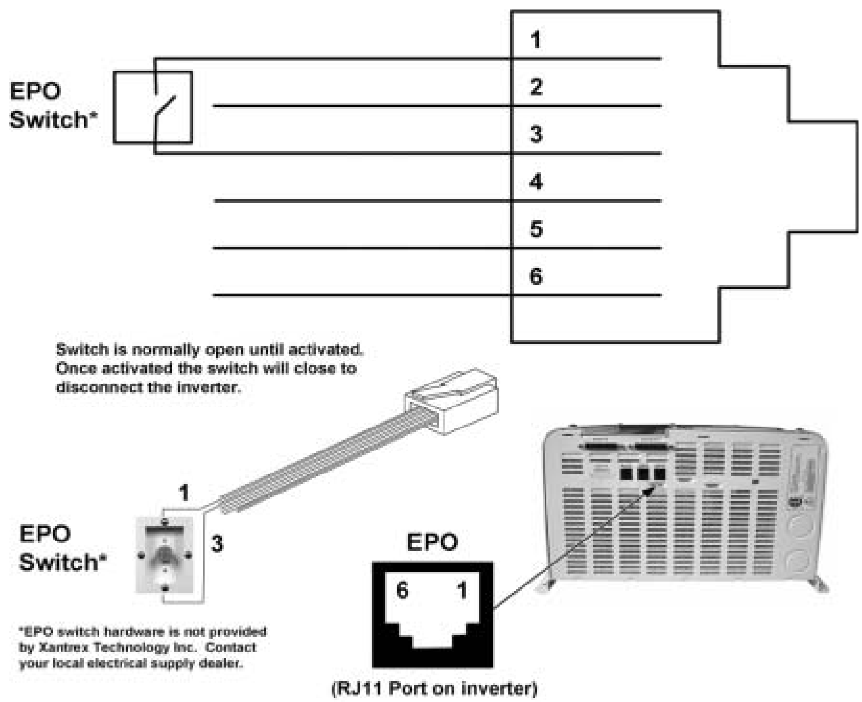


Figure G-2 Modifying a 6-conductor Cable to connect to the EPO Port

Glossary

"Glossary" contains a glossary of technical terms used in this manual. The glossary also defines some common electrical terms.

"Glossary" also defines abbreviations and acronyms associated with the Sine Wave Plus and this manual.

Glossary of Terms

Absorption Charge The second stage of three-stage battery charging. Voltage remains constant and current tapers as internal battery resistance increases during charging. This ensures complete charging.

Alternating Current (AC) The type of electrical power supplied by the power utility. The unique characteristic of this form of electricity is that it reverses direction at regular intervals. For example, 120 Vac 60 Hz power reverses flow 60 times a second, hence the rating 60 Hz (cycles).

Amp A measurement of the flow of electrical current. One amp is equal to the electric force of one volt acting across the resistance of one ohm.

Amp Hour One amp of electrical current flowing for one hour. Expresses the relationship between current (amps) and time. (Ohm's law: A = V/R)

Array A group of solar electric modules wired together.

Bulk Charge The first stage of three-stage battery charging. Current is sent to batteries at the maximum rate they will accept while voltage rises to full charge level.

Current The rate of flow of electrical charge. The flow of amps is often expressed as current.

Direct Current (DC) The type of electricity stored in batteries and generated by solar electric devices. Current flows in a single direction.

Electrolyte A conductive medium in which the flow of electricity takes place; this is the liquid found inside storage batteries.

Float Charge The third stage of three-stage battery charging. After batteries reach full charge, charging voltage is reduced to a lower level to reduce gassing (boiling of electrolyte) and prolong battery life. This is often referred to as a maintenance charge, since rather than charging a battery it keeps an already-charged battery from self-discharging.

Grid When used in reference to utility power, it refers to a system of electrical transmission and distribution lines.

Ground Fault Protection (GFP) A circuit protection device that prevents the flow of electrical current to earth if a short circuit is present. Usually required in wet locations—for example, for outdoor, kitchen, and bathroom circuits.

Hertz (Hz) The frequency, or number of times per second, that the flow of AC electricity reverses itself. Also referred to as cycles (see alternating current).

High Battery Protection A control circuit that disconnects charge current flowing to batteries when voltage reaches a dangerously high threshold. Prevents damage created by excess gassing (or boiling) of electrolyte.

Hydrometer A simple device that measures the specific gravity of battery electrolyte. Specific gravity readings express state of charge/ discharge of battery.

Idle Current The amount of electrical power required to keep an inverter ready to produce electricity on demand.

Inrush Current The peak power that a load will draw at the instant that it starts up.

Kilowatt (kW) One thousand watts of electricity. Ten 100-watt light bulbs use one Kilowatt of electrical power.

Kilowatt hour (kW/h) One kW of electrical power used for one hour. The most common measurement of electrical consumption, most grid connected electrical meters measure kWh for billing purposes.

Light Emitting Diode (LED) A device used to display various status functions.

Line Loss A voltage drop caused by resistance in wire during transmission of electrical power over distance.

Line tie An electrical system that is connected to a utility distribution grid. For example, Xantrex SW line tie inverters are designed to connect to and interact with utility power.

Load Any device that consumes electricity in order to operate. Appliances, tools, and lights are examples of electrical loads.

Low Battery Protection A control circuit that stops the flow of electricity from batteries to loads when battery voltage drops to dangerously low levels.

Maximum Power Point Tracking (MPPT) Every PV (solar electric) device has a point where maximum current is delivered. MPPT electronically adjusts the output of a PV device to the maximum power point.

Modified Sine Wave An AC wave form (generated by many inverters) that is a pulse width modified square wave.

National Electric Code The electrical wiring and installation standards used in the United States.

Off Grid An electrical system that is not connected to a utility distribution grid.

Oscilloscope A device that displays the wave form created by an electrical generating device such as a generator, inverter, or utility.

Overload/ Overcurrent Protection A control circuit designed to protect an inverter or similar device from loads exceeding its output capacity. (A fuse, for example, is an overcurrent protection device.) All Xantrex inverters have internal circuitry to protect themselves from overload/overcurrent conditions.

Parallel Wiring A group of electrical devices, such as batteries or PV modules, wired together to increase ampacity, while voltage remains constant. Two 100 amp hour 12 VDC batteries wired in parallel will form a 200 amp-hour 12 VDC battery bank.

Photovoltaic System The components that form a solar electric generating system, usually consisting of PV modules, charge controller, circuit protectors (fuses or breakers) and batteries.

Series Wiring A group of electrical devices, such as batteries or PV modules, wired together to increase voltage, while ampacity remains constant. Two 100 amp hour 12 Vdc batteries wired in series form a 100 amp hour 24 Vdc battery bank.

Sine Wave The output wave form of an electric generator or utility. A smooth wave going above and below zero is created.

Surge Capacity The amount of current an inverter can deliver for short periods of time. Most electric motors draw up to three times their rated current when starting. An inverter will “surge” to meet these motor-starting requirements. Most Xantrex inverters have surge capacities at least three times their continuous ratings.

Transfer Switch A switch designed to transfer electricity being supplied to loads (appliances, for example) from one source of power to another. A transfer switch may be used to designate whether power to a distribution panel will come from a generator or inverter.

Volts A unit of measure of the pressure in an electrical circuit. Volts are a measure of electric potential. Voltage is often explained using a liquid analogy, comparing water pressure to voltage: a high pressure hose would be considered high voltage, while a slow-moving stream could be compared to low voltage.

Watt(s) A quantitative measurement of electrical power. Watts are calculated by multiplying volts times amps. Using a liquid analogy, watts are similar to liquid flow such as litres or gallons. (watts = volts × amps)

Watt Hour (W/h) Electrical power measured in terms of time. One watt hour of electricity is equal to one watt of power being consumed for one hour. A one-watt light operated for one hour would consume one watt hour of electricity.

Abbreviations and Acronyms

Acronym or Abbreviation	Definition
AC	Alternating Current
ACCB	AC Conduit Box
Ah	amp hour
ALM	Auxiliary Load Module
ASC	Authorized Service Center
AUX	Auxiliary
AWG	American Wire Gauge
BTS	Battery Temperature Sensor
BX	Battery Transfer
CSA	Canadian Standards Association
DC	Direct Current
DCCB	DC Conduit Box
EMI	Electro-Magnetic Interference
EPO	Emergency Power Off
FLT	Float (relates to battery charging)
FCC	Federal Communications Commission
GEN	Generator
GFP	Ground Fault Protection
GSM	Generator Start Module
HBCI	High-Battery Cut In
HBCO	High-Battery Cut Out
Hz	Hertz
ICA	Inverter Communications Adapter
ICM	Inverter Control Module
ISC-S	Inverter Stacking Control – Series
LBCI	Low-Battery Cut In
LBCO	Low-Battery Cut Out
LBX	Low-Battery Transfer

Acronym or Abbreviation	Definition
LCD	Liquid Crystal Display
LED	Light Emitting Diode
NEC	National Electric Code
NEU	Neutral
OEM	Original Equipment Manufacturer
PC	Personal Computer
PV	Photovoltaic (solar electric panels)
PVGFP	PV Ground Fault Protection
RE	Renewable Energy
RFI	Radio Frequency Interference
RMA	Return Material Authorization
SB	Stand By
SLT	Silent (relates to battery charging)
TOU	Time Of Use
UL	Underwriters Laboratory
Vac	Volts AC
Vdc	Volts DC
Xfer	Transfer

Warranty and Product Information

Warranty

What does this warranty cover? This Limited Warranty is provided by Xantrex Technology, Inc. ("Xantrex") and covers defects in workmanship and materials in your Sine Wave Plus Inverter/Charger. This warranty lasts for a Warranty Period of two years 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 this 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)
	1-360-925-5097 (direct)
Fax:	1-800-994-7828 (toll free)
Fax:	1-360-925-5143 (direct)
Email:	customerservice@xantrex.com

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

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 (trade-mark, serial number) markings have been defaced, altered, or removed.

Disclaimer

Product

THIS LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY PROVIDED BY XANTREX IN CONNECTION WITH YOUR XANTREX PRODUCT AND IS, WHERE PERMITTED BY LAW, IN LIEU OF ALL OTHER WARRANTIES, CONDITIONS, GUARANTEES, REPRESENTATIONS, OBLIGATIONS AND LIABILITIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE IN CONNECTION WITH THE PRODUCT, HOWEVER ARISING (WHETHER BY CONTRACT, TORT, NEGLIGENCE, PRINCIPLES OF MANUFACTURER'S LIABILITY, OPERATION OF LAW, CONDUCT, STATEMENT OR OTHERWISE), INCLUDING WITHOUT RESTRICTION ANY IMPLIED WARRANTY OR CONDITION OF QUALITY,

MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE TO THE EXTENT REQUIRED UNDER APPLICABLE LAW TO APPLY TO THE PRODUCT SHALL BE LIMITED IN DURATION TO THE PERIOD STIPULATED UNDER THIS LIMITED WARRANTY.

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

Exclusions

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

Warning: Limitations On Use

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

SPECIFICALLY, PLEASE NOTE THAT THE SINE WAVE PLUS INVERTER/CHARGER SHOULD NOT BE USED IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, XANTREX MAKES NO REPRESENTATIONS OR WARRANTIES REGARDING THE USE OF THE XANTREX SINE WAVE PLUS INVERTER/CHARGER IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES.

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

Return Material Authorization Policy

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

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

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

Record these details in on page I–5.

Return Procedure

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

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

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

Out of Warranty Service

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

To return your Sine Wave Plus Inverter/Charger for out of warranty service, contact Xantrex Customer Service for a Return Material Authorization (RMA) number and follow the other steps outlined in "Return Procedure" on page I–4.

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

Information About Your System

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

- ❐ Serial Number ________________________________
- ❐ Purchased From ________________________________
- ❐ Purchase Date ________________________________

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

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

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