Trace™ DR Series

Inverter/Charger

Installation & Operator's Manual

XANTREX

Smart Choice For Power

DR Series
Inverter/Charger

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Disclaimer of Liability

Since the use of this manual and the conditions or methods of installation, operation, use and maintenance of the unit are beyond the control of Xantrex Technology Inc., the company does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of or any way connected with such installation, operation, use or maintenance.

IMPORTANT SAFETY INSTRUCTIONS

This manual contains important safety instructions that should be followed during the installation and maintenance of this product.

To reduce the risk of electrical shock, and to ensure the safe installation and operation of this product, the following safety symbols have been placed throughout this manual to indicate dangerous conditions and important safety instructions.

WARNING - A dangerous voltage or condition exists in this area.
Use extreme caution when performing these tasks.

AVERTISSEMENT - Une tension ou condition dangereuse existe dans cette zone.
Faire preuve d'extrême prudence lors de la réalisation de ces tâches.

CAUTION - This procedure is critical to the safe installation or operation of the unit. Follow these instructions closely.

ATTENTION - Cette procédure est essentielle à l'installation ou l'utilisation de l'unité en toute sécurité. Suivre ces instructions de près.

☞ **NOTE -** This statement is important. Follow instructions closely.

NOTE - Cette déclaration est importante. Suivre les instructions de près.

- All electrical work must be done in accordance with local, national and/or international electrical codes.
- Before installing or using this device, read all instructions and cautionary markings located in (or on) the manual, the inverter, the controller, the batteries and the PV array.
- Do not expose this unit to rain, snow or liquids of any type. This product is designed only for indoor installation.
- To reduce the chance of short-circuits when installing or working with the inverter, the batteries or the PV array, use insulated tools.
- Remove all jewelry such as rings, bracelets, necklaces, etc., prior to installing this system. This will greatly reduce the chance of accidental exposure to live circuits.
- The inverter contains more than one live circuit (batteries and AC line). Power may be present at more than one source.
- This product contains no user serviceable parts. Do not attempt to repair this unit.
- Do not install 120 volt AC stand-alone inverters onto 120/240 volt AC <u>multi-branch circuit</u> wiring. This could pose a fire hazard due to an overloaded neutral return wire in this configuration.

SAVE THESE INSTRUCTIONS

BATTERY SAFETY INFORMATION

- Always wear eye protection, such as safety glasses, when working with batteries.
- Remove all loose jewelry before working with batteries.
- Never work alone. Have someone assist you with the installation or be close enough to come to your aid when working with batteries.
- Always use proper lifting techniques when handling batteries.
- Always use identical types of batteries.
- Never install old or untested batteries. Check each battery's date code or label to ensure age and type.
- Batteries are temperature sensitive. For optimum performance, they should be installed in a stable temperature environment.
- Batteries should be installed in a well vented area to prevent the possible buildup of explosive gasses. If the batteries are installed inside an enclosure, vent its highest point to the outdoors.
- When installing batteries, allow at least 1 inch of air space between batteries to promote cooling and ventilation.
- NEVER smoke in the vicinity of a battery or generator.
- Always connect the batteries first, then connect the cables to the inverter or controller. This will greatly reduce the chance of spark in the vicinity of the batteries.
- Use insulated tools when working with batteries.
- When connecting batteries, always verify proper voltage and polarity.
- Do not short-circuit battery cables. Fire or explosion can occur.
- In the event of exposure to battery electrolyte, wash the area with soap and water. If acid enters the eyes, flood them with running cold water for at least 15 minutes and get immediate medical attention.
- Always recycle old batteries. Contact your local recycling center for proper disposal information.

1.0 INTRODUCTION

Thank you for purchasing the DR Series inverter/charger from Xantrex Technology Inc. The DR Series is one of the finest inverter/chargers on the market today, incorporating state-of-the-art technology and high reliability. The inverter features an AC pass-through circuit, powering your home appliances from utility or generator power while charging the batteries. When utility power fails, the battery backup system keeps your appliances powered until utility power is restored. Internal protection circuits prevent over-discharge of the batteries by shutting down the inverter when a low battery condition occurs. When utility or generator power is restored, the inverter transfers to the AC source and recharges the batteries.

The front panel features LEDs for reading system status, and controls to customize the inverter settings for your battery bank.

Figure 1
The DR Series Inverter/Charger

1.0 INTRODUCTION

Unpacking and Inspection

- Carefully unpack the inverter/charger from its shipping carton.

☞ NOTE: The unit weighs 35–45 lb/15.9–20.4 kg (depending on model). Have additional help available if necessary, to assist in lifting the unit during installation.

- Verify all of the items listed on the packing material sheet are present. Please call Xantrex Customer Service at (360) 435-8826 if any items are missing.

- Save your proof-of-purchase. This is required if the unit should require 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, serial number and date of purchase in the appropriate fields in section 10.0 SERVICE INFORMATION.

☞ NOTE: Due to continual improvement through product updates, photographs and/or illustrations used in this manual may not *exactly* match your unit. Xantrex Technology Inc. reserves the right to update this product without notice or releasing an updated manual when *fit, form or function* are not affected.

Model Identification and Numbering Conventions

The DR Series inverter/charger is identified by the model/serial number label located next to the AC access cover. All the necessary information is provided on the label such as AC output voltage, power and frequency (punch holes).

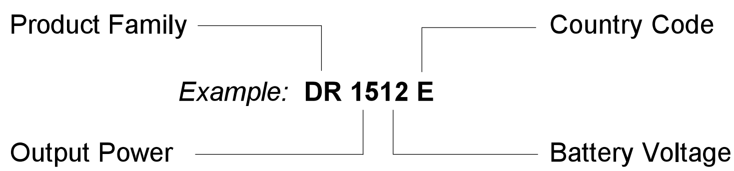
The inverter also has a letter designator followed by 4 or 5 digits (depending on revision). The model number describes the type of inverter, the output specifications, the required battery voltage and the output voltage and frequency.

"**DR**" indicates the type of inverter/charger - DR Series.

"**15**" the first two digits of the numerical designator indicate the inverter's output power - 1500 Watts.

"**12**" the second two digits indicate the required nominal battery bank voltage - 12 VDC.

"**E**" the letter suffix code indicates the output voltage and frequency of the inverter - 230 VAC/50 Hz.



Letter Suffix	Output Voltage	Output Frequency
(no letter)	120 VAC	60 Hz
E	230 VAC	50 Hz
J	105 VAC	50 Hz
K	105 VAC	60 Hz
W	220 VAC	60 Hz

Figure 2
Product Identification

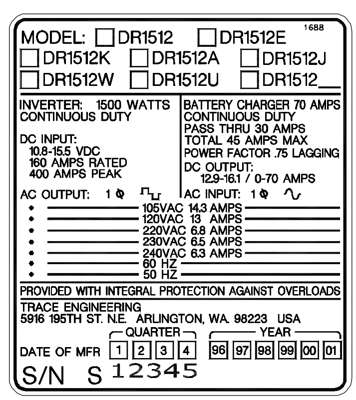


Figure 3
Model/Serial Number Sticker

1.0 INTRODUCTION

Certification

120 VAC/60 Hz models of the DR Series inverter/charger models are listed to UL Standard 1741, *Power Conditioning Units for use in Residential and Commercial Photovoltaic Power Systems*. These units are also ETL listed to CAN/CSA-22.2, No. 107.1-M91, the Canadian safety standard. These standards guarantee that the inverter/charger has been tested to nationally recognized safety standards (UL for the US and CSA for Canada) and have been found to be free from reasonably foreseeable risk of fire, electric shock and related hazards.

The inverter/charger is intended to be used for residential or commercial applications. Do NOT use this unit for applications for which it is not listed (i.e., land vehicles or marine craft). It may not comply with the safety code requirements, or could possibly present other operational or safety hazards.

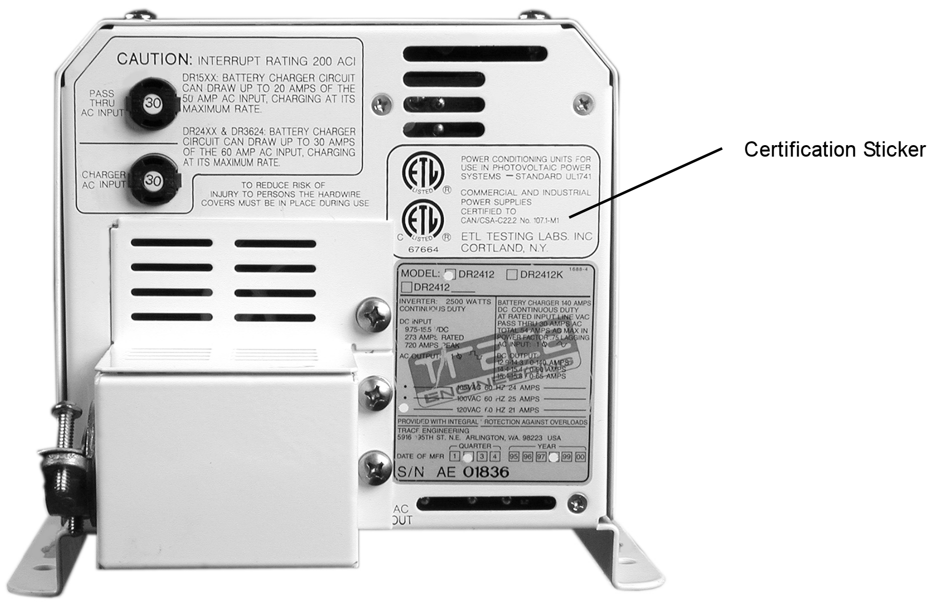


Figure 4
UL/CSA Certification Sticker

The DR Series inverter/charger is an economical product designed to provide a reliable supply of electricity to all the essential circuits in the home or business during a power outage. The critical loads can be powered for hours or days, depending on the size of the system battery bank. When utility grid power returns, the batteries are quickly recharged to ensure they will be ready to supply backup power during the next outage.

Accessories allow the DR Series to also serve as a central hub of a renewable energy system.

Features

- **Modified Sine Wave Power**
  The DR Series inverters provide a modified sine wave output which operates most AC appliances and equipment.
- **Battery Charger/AC Transfer Relay**
  The inverter/charger includes a 3-stage battery charger designed to recharge any type of battery in the shortest possible time. The built-in, fully automatic AC transfer relay automatically transfers power from the utility to the inverter and handles a full 60 amps of current at 120 VAC (30 amps for pass-through plus 30 amps for charging).
- **Simplicity**
  The DR Series is simple to operate. All inverter and battery charger controls are located on the front panel.
- **High Efficiency**
  The inverter/charger operates at over 90% efficiency through most of its power range.
- **Low Power Consumption**
  DR Series inverters use extremely low current while in the search mode, consuming little more than one watt of power. In the ON mode, the inverter/charger uses less than 20 watts of power.

Options

The following options are available for the DR Series inverter/chargers:

- **RC4/RC8**
  The RC4/RC8 allows the inverter to be switched ON or OFF remotely and includes an LED status indicator.
- **DRI**
  The DRI stacking interface provides 3-wire 120/240 VAC at twice the power using dual DR Series inverters (120 VAC/60 Hz units only).
- **DRCB**
  The DRCB conduit box connects to the DC side of the inverter and accepts a DC conduit run.

2.0 INSTALLATION

Pre-installation

☞ NOTE: Before installing the inverter/charger, read all instructions and cautionary markings located in this manual.

☞ NOTE: The inverter/charger can weigh up to 45 lb. (20.4 kg) depending upon configuration. Always use proper lifting techniques during installation to prevent personal injury.

Location

- 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. Exposure to saltwater is particularly destructive and potentially hazardous.

☞ NOTE: If the inverter is installed in a location where it is exposed to a corrosive or condensing environment, and fails due to corrosion, it will not be covered under warranty.

- Locate the inverter as close to the batteries as possible in order to keep the battery cable length short. However, do not locate the inverter above the batteries or in the same compartment as vented batteries. Batteries generate hydrogen sulfide gas which is corrosive to electronic equipment. They also generate hydrogen and oxygen. If accumulated, an arc caused by connecting the battery cables or switching a relay could ignite this mixture. Mounting the inverter in a ventilated enclosure with sealed batteries is acceptable.

☞ NOTE: Inverters can generate RFI (Radio Frequency Interference). Locate any sensitive electronic equipment susceptible to RFI as far away from the inverter as possible. This includes radios and TVs.

Mounting

- UL Standard 1741 requires the inverter be mounted on a vertical surface (or wall). The keyhole slots must not be used as the only method of mounting. The purpose of the wall mounting requirement is to orient the inverter so that its bottom cover, which has no holes, will not allow burning material to be ejected in the event of an internal fire. Use 0.25 inch diameter bolts for mounting. The mounting surface must be capable of supporting twice the weight of the inverter to comply with UL 1741.

Ventilation

- 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.

- The inverter contains an internal fan. Ensure the air vents and intakes are not obstructed in any way. Provide a minimum clearance of 1-1/2 inches around the top and sides of the inverter for ventilation.

Pre-Installation (continued)

Tools required:

#2 Phillips screw driver	Level
Slotted screw driver	Wire strippers
Assorted open-end wrenches	Torque wrench
Socket wrench and fittings	Electrical tape
Multimeter (True rms)	Pencil
Hole saw	Utility knife

Hardware / Materials required:

4 ft. x 4 ft. sheet of 3/4" plywood or 2 x 4's studding material
#12 wood screws (or 1/2" x 1-1/4" lag bolts)
Conduit and appropriate fittings
Wire nuts

Wiring:

- All wiring and installation methods should conform to applicable electrical and building codes.
- Pre-plan the wire and conduit runs. The AC circuits accept cable sizes up to #6 AWG. The DC circuits accept cable sizes up to #4/0 AWG.
- For maximum safety, run both AC and DC cables in conduit.
- Refer to the Figure 25 (page 29) for an example of AC wiring to the sub-panel for 120 VAC circuits.

AC Connections:

- Use #6 AWG THHN wire for all AC wiring.

DC Connections:

- Battery to inverter cabling should be only as long as required. If #4/0 AWG cables are used for example, do not exceed 5 feet (one way) in 12 VDC systems; do not exceed 10 feet (one way) in 24 VDC systems. For optimum performance, use pre-assembled battery cables designed specifically for this application (available from Xantrex).

Grounding:

AC Grounding

- The inverter/charger should be connected to a grounded, permanent wiring system. Neutral and ground conductors should only be bonded at the main utility service panel.

DC Grounding

- The negative battery conductor should be bonded to the grounding system at only one point in the system. The size for the conductor is usually based on the size of the largest conductor in the DC system.

Pre-Installation (continued)

Batteries:

- 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 DR1512 is a 12 volt inverter and requires a 12 VDC battery system. The DR2424 is a 24 volt inverter and requires a 24 VDC battery system.

Battery Location:

- Locate the batteries in an accessible location. 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 left of a wall mounted inverter for easy access to the DC side of the inverter and shorter cable runs.

- For safety and to limit access to the batteries, a lockable, ventilated, battery enclosure or dedicated room should be used. If an enclosure is used, it should be vented to the outside via a one inch vent pipe located at the top of the enclosure. Install an intake vent at the bottom of the enclosure to promote air circulation. These vents exhaust explosive hydrogen gases and must not be overlooked when designing an enclosure.

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

- Place a layer of baking soda on the shelves to neutralize any acid that may be spilled in the future (lead-acid batteries only).

- Enclosures located outside must be rainproof and screened to prevent access by rodents or insects.

Battery Temperature

The battery enclosure should provide a fairly stable temperature for the batteries. If it is installed in a cold environment, insulation should be used to protect the batteries from the cold. The insulation also provides a more consistent temperature and better system performance.

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

Pre-Installation (continued)

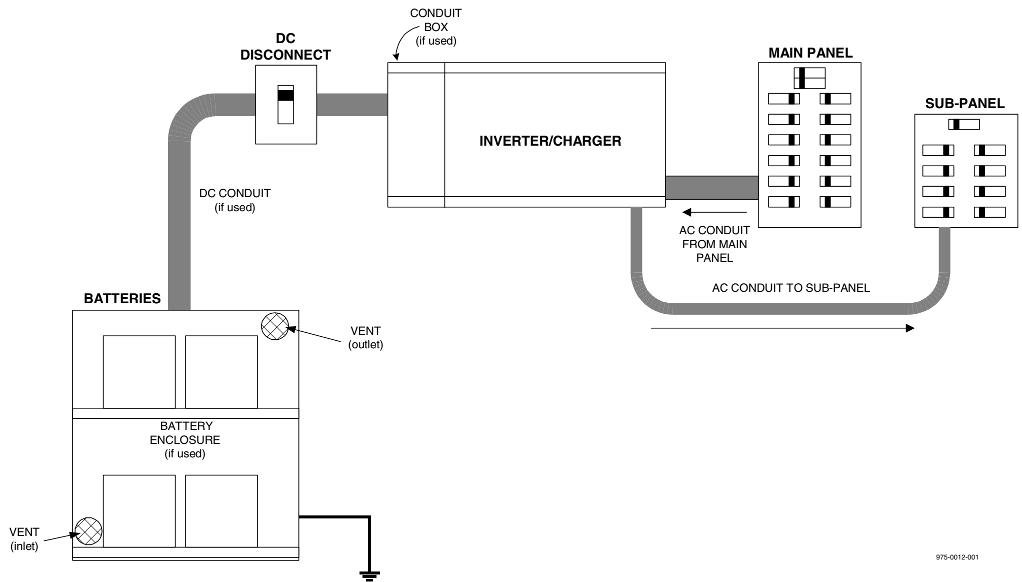


Figure 5
Planning Example Layout
Basic Setup

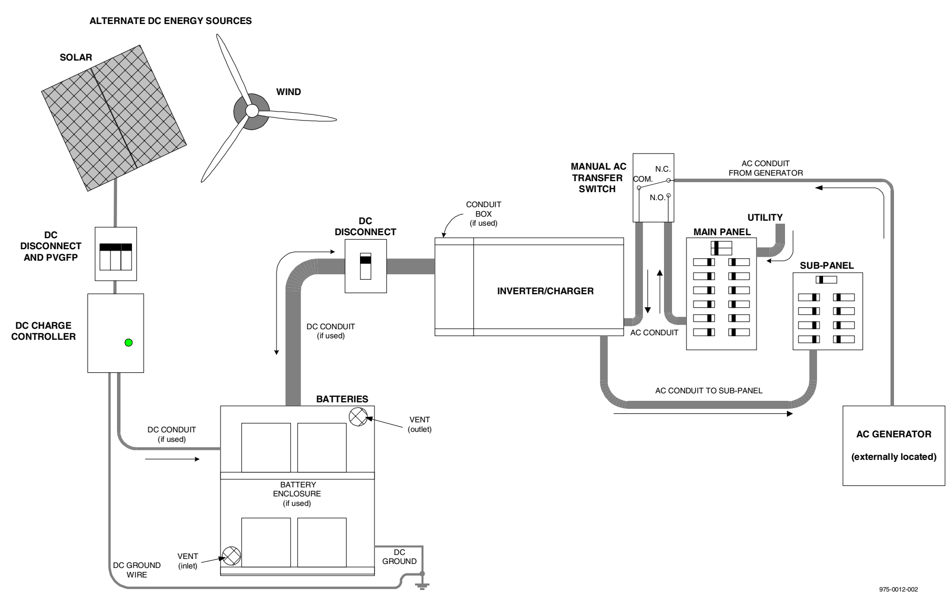


Figure 6
Planning Example Layout
RE Setup

2.0 INSTALLATION

Main Service Panel:

The input to the inverter requires a minimum 60 amp breaker (for each inverter if stacked). This circuit breaker must be located in the utility service panel.

Sub-Panel:

Loads backed up by the inverter will need to be rerouted from the main service panel to a sub-panel. This can be done several different ways, depending upon the installation. Always refer to electrical codes for safe wiring practices.

AC Circuit Breakers:

Always use a properly rated circuit breaker. Depending upon the application, circuit breakers used to protect the load can be removed from the main service panel and put into the sub-panel ONLY if the two panels are from the <u>same</u> manufacturer.

DC Disconnect:

Install a DC disconnect breaker or fuse in the positive 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 whenever servicing the batteries.

Wire Routing:

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:

- AC Input wiring from the main utility service panel to the inverter/charger
- AC Input wiring from the generator to the inverter/charger (if used)
- DC Input wiring from the PV array (wind, hydro, etc.) to the inverter/charger (if used)
- DC Input wiring from the batteries to the inverter/charger
- AC Output wiring from the inverter/charger to the sub-panel
- Battery Temperature Sensor cable from the batteries to the inverter/charger (if used)
- Remote Control cable to the inverter/charger (if used)
- DC Ground from the batteries to an external ground rod
- Load circuit wiring rerouted from the main service panel to the sub-panel

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

Inverter Mounting (continued)

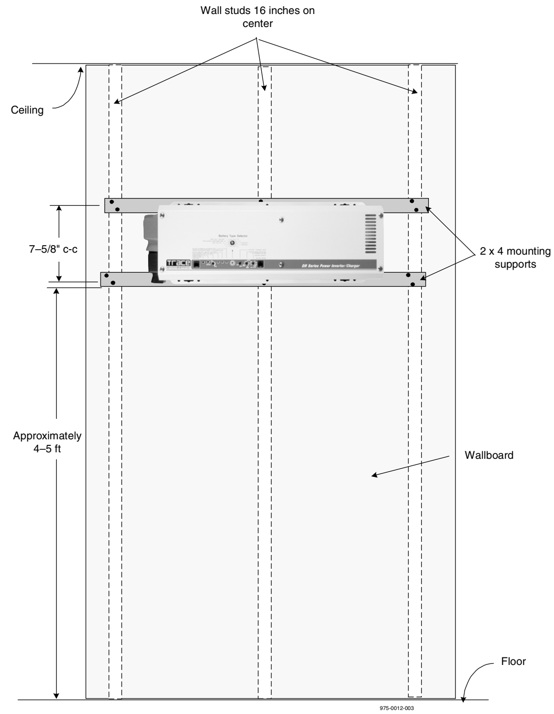


Figure 7
Suggested Mounting Method

Inverter Mounting

The DR Series inverter can weigh as much as 45 lb. (20.4 kg). Wallboard is not strong enough to support its weight so additional support must be added. The easiest method for securing it 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.

WARNING: USE APPROPRIATE LIFTING TECHNIQUES. HAVE EXTRA PEOPLE ON HAND TO ASSIST IN LIFTING THE INVERTER INTO POSITION WHILE IT IS BEING SECURED.

Procedure

- Locate the studs and mark their location on the wall.
- Measure the desired height from the floor for the inverter to be mounted.
- Using a level, run a horizontal line. The length of the line must span at least 3 studs.
- Place a pre-cut 2 x 4 on the marked location and drill pilot holes through the 2 x 4's and studs.
- Secure the 2 x 4 with #10 wood screws (length to penetrate 1-1/2 inches into the studs).
- Repeat the procedure for the remaining 2 x 4.

2.0 INSTALLATION

- Referring to Figure 8, drill out the mounting hole locations for the inverter.
- With assistance, lift the inverter into position and install it onto the 2 x 4's using 1/4 x 1-1/2 inch lag bolts and washers.

Alternatively, a half or quarter sheet of 3/4 inch plywood can also be used as a backing, with the inverter mounted directly to the plywood using 1/4 inch diameter lag bolts and washers. The plywood must span three studs for adequate support.

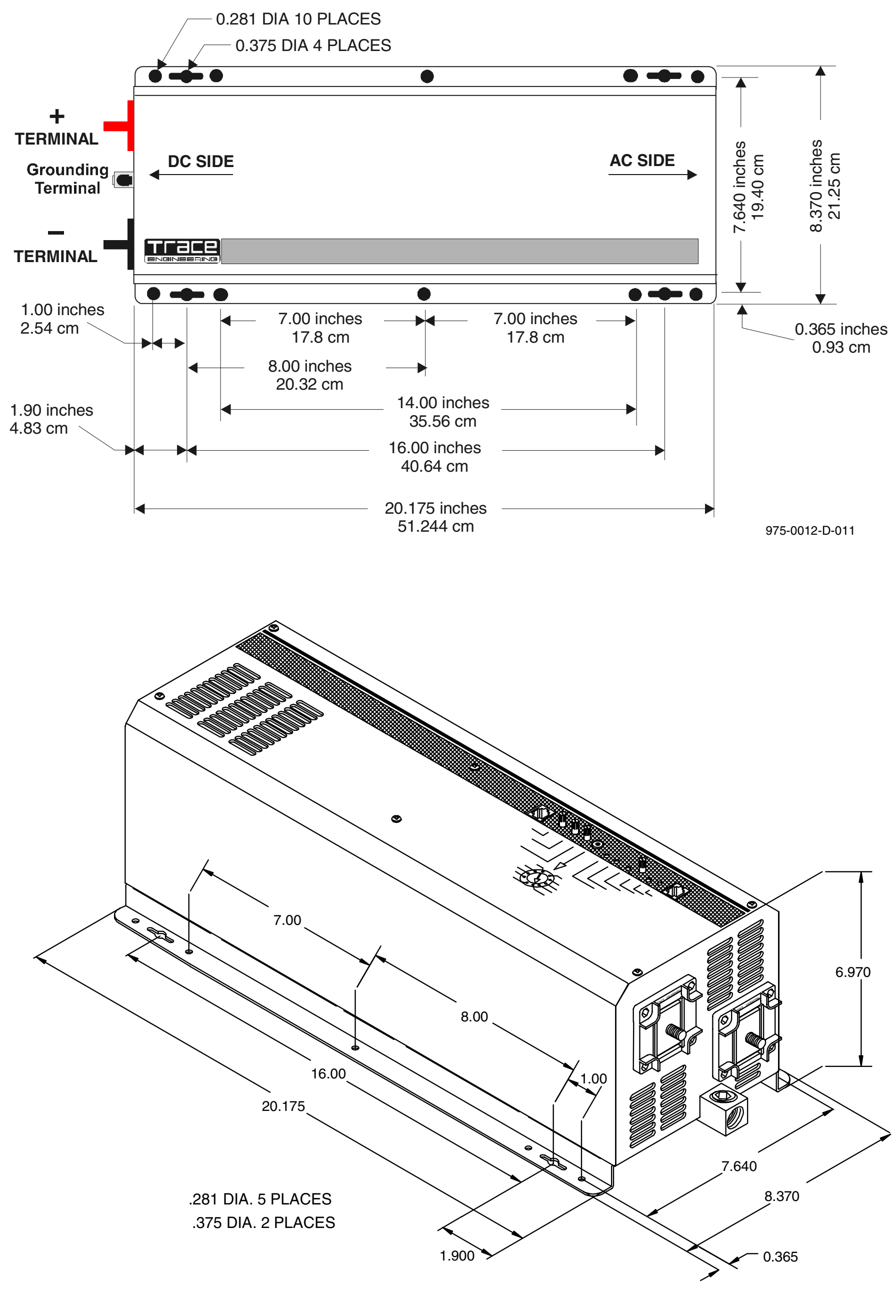


Figure 8
Dimensional Drawings for Screw Hole Placement

Wiring

DC Wiring (Batteries)
Battery Cable Sizing

Proper cable sizing (diameter and length) is critical to the safe and efficient operation of an inverter system. Larger diameter cables (smaller AWG number) have less voltage drop and are, therefore, more efficient when transferring power to and from the batteries. If a cable is undersized (diameter too small), it could potentially overheat, creating a fire hazard.

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 (i.e., 12 VDC) 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.

Always use a properly sized cable and length rated for the amperage of the inverter and batteries.

WARNING: UNDERSIZED CABLES CAN OVERHEAT AND MELT, CREATING A FIRE HAZARD WHEN SUBJECTED TO HEAVY (PEAK) LOADS.

NOTE: If the system will be operated at the inverter's peak power rating exceeding one hour, larger cables and disconnects MUST be used (see Tables 1 and 2).

NOTE: If the system includes a large battery bank or large DC source (such as a micro-hydroelectric plant or wind generator), increasing the size of the cables and disconnects will greatly reduce the number of nuisance outages associated with breaker tripping and open fuses.

Table 1 provides recommended minimum cable sizes for various cable lengths and inverter amperages. These recommendations may not meet all local or NEC requirements.

NOTE: Use only copper cables.

NOTE: Run the positive and negative battery cables as close to each other as possible by taping them together. This reduces the effects of inductance and produces a better waveform thus increasing efficiency.

Inverter Model	Typical Amperage	1 to 3 Feet (one-way)	3 to 5 Feet (one-way)	5 to 10 Feet (one-way)
DR1512	150 A	#2/0 AWG (67.4 mm^2)	#2/0 AWG (67.4 mm^2)	#4/0 AWG (107 mm^2)
DR2412	240 A	#4/0 AWG (107 mm^2)	#4/0 AWG (107 mm^2)	NOT RECOMMENDED
DR1524	75 A	#2/0 AWG (67.4 mm^2)	#2/0 AWG (67.4 mm^2)	#4/0 AWG (107 mm^2)
DR2424	120 A	#2/0 AWG (67.4 mm^2)	#4/0 AWG (107 mm^2)	#4/0 AWG (107 mm^2)
DR3624	180 A	#4/0 AWG (107 mm^2)	#4/0 AWG (107 mm^2)	#4/0 AWG (107 mm^2)

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Table 1
Minimum Recommended Battery Cable Size VS. Length

Wiring (continued)

DC Disconnect and Over-current Protection

For safety and to comply with regulations, battery over-current 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.

The National Electrical Code (NEC) requires both over-current 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 rated, DC250/175 ETL listed, circuit breaker disconnect module specifically designed for use with Trace™ inverters to meet NEC compliance. Two amperage ratings are available: a DC250 (250 amps) and a DC175 (175 amps) in either single or dual breaker configurations for single or dual inverter installations.

☞ NOTE: Trace™ DC disconnects are not designed to accept doubled (paralleled) cables which may be required for long cable runs. Also, the plastic red and black covers on the DC inverter inputs are not designed to accommodate dual cables. If dual cables are used, the optional conduit box (DRCB) must be used.

Some installations may not require conduit or a disconnect device, although over-current protection is still required. Xantrex offers a fuse block (TFB) providing the code required inverter over-current protection for these applications. Refer to the table below for the proper size disconnect device for specific cable diameters.

Cable Size Required	Rating in Conduit	Maximum Breaker Size	Rating in "Free Air"	Maximum Fuse Size
#2 AWG	115 amps max	N/A	170 amps max	TFB200
#2/0 AWG	175 amps max	DC175	265 amps max	TFB300
#4/0 AWG	250 amps max	DC250	360 amps max	TFB400

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Table 2
Battery Cable to Maximum Breaker/Fuse Size

☞ NOTE: The NEC allows rounding to the next standard fuse size from the cable rating (i.e., 150 amp cable size rounds up to a standard 175 amp size). The term “free air” is defined by the NEC 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.

Wiring (continued)

Battery Cable Connections

Battery cables must have crimped (or preferably, soldered and crimped) copper compression lugs unless aluminum mechanical lugs are used. Soldered connections alone are not acceptable. High quality, UL-listed battery cables are available from Trace Engineering in an assortment of lengths: 1-1/2 to 10 feet, and in #2/0 AWG or #4/0 AWG sizes. These cables are color-coded with pressure crimped, sealed ring terminals.

Figure 9 illustrates the proper method to connect the battery cables to the DR Series inverter/ charger terminals.

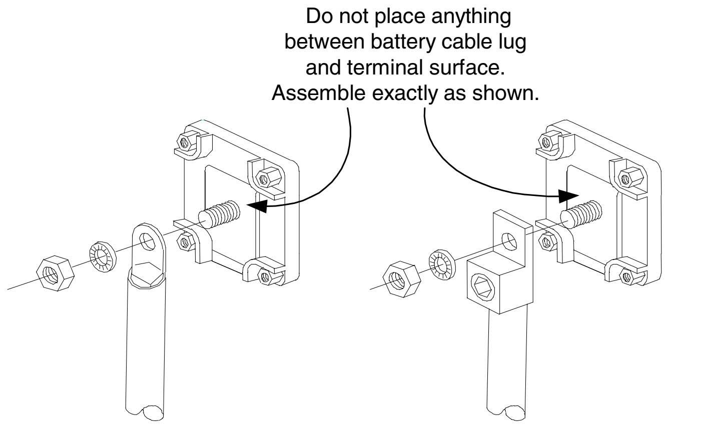

Figure 9
Battery Cable Connections to Inverter

CAUTION: 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.

WARNING: ENSURE THE INVERTER IS OFF BEFORE CONNECTING OR DISCONNECTING THE BATTERY CABLES, AND THAT AC POWER IS DISCONNECTED FROM THE INVERTER INPUT.

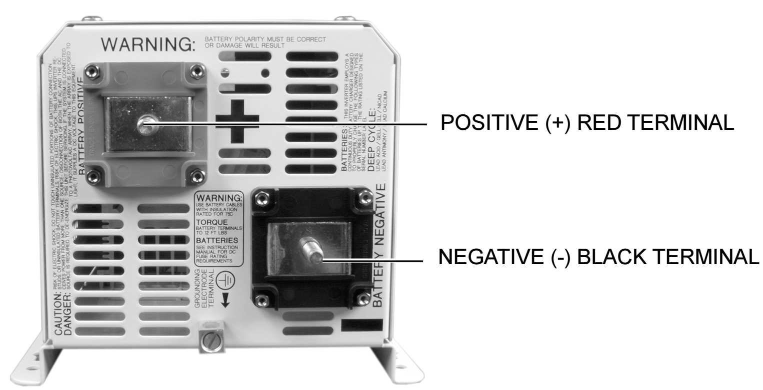

Figure 10
Battery Cable Connections

Wiring (continued)

Battery Bank Sizing

The size of the battery bank determines how long the AC loads will operate in a backup mode without utility power. The larger the battery bank, the longer the run time. Size the battery bank to the systems AC load requirements and length of time required to run from the batteries. In general, the battery bank should not be discharged more than 50%. Additional DC charging devices such as solar, wind, hydro, etc., can provide longer run times by recharging the batteries in the absence of AC utility or generator power.

Additional details on estimating battery bank size and capacity can be found in the Appendix section of this manual.

Battery Types

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. Only the deep discharge types are recommended for inverter applications. Choose the batteries best suited for the inverter installation and cost. Use only the same battery type for all batteries in the bank. For best performance, all batteries should be from the same lot and date. This information is usually printed on a label located on the battery.

Additional information regarding batteries can be found in the Appendix section of this manual.

Battery Configuration

The battery bank must be wired to match the inverter's DC input voltage specifications (12, 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 (to match the inverter's DC requirements).

PARALLEL
Wiring the batteries in parallel increases the total run time the batteries can operate the AC loads.

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.

Wiring (continued)

Wiring Batteries in Series

Wiring the batteries in a series configuration increases the voltage of the battery string. 6 volt batteries can be combined to form 12 V, 24 V, or 48 V battery banks. In the same way, 12 volt batteries connected in series form 24 V or 48 V battery banks. The total current capacity of the bank does not increase and it retains the same amp-hour rating as a single battery.

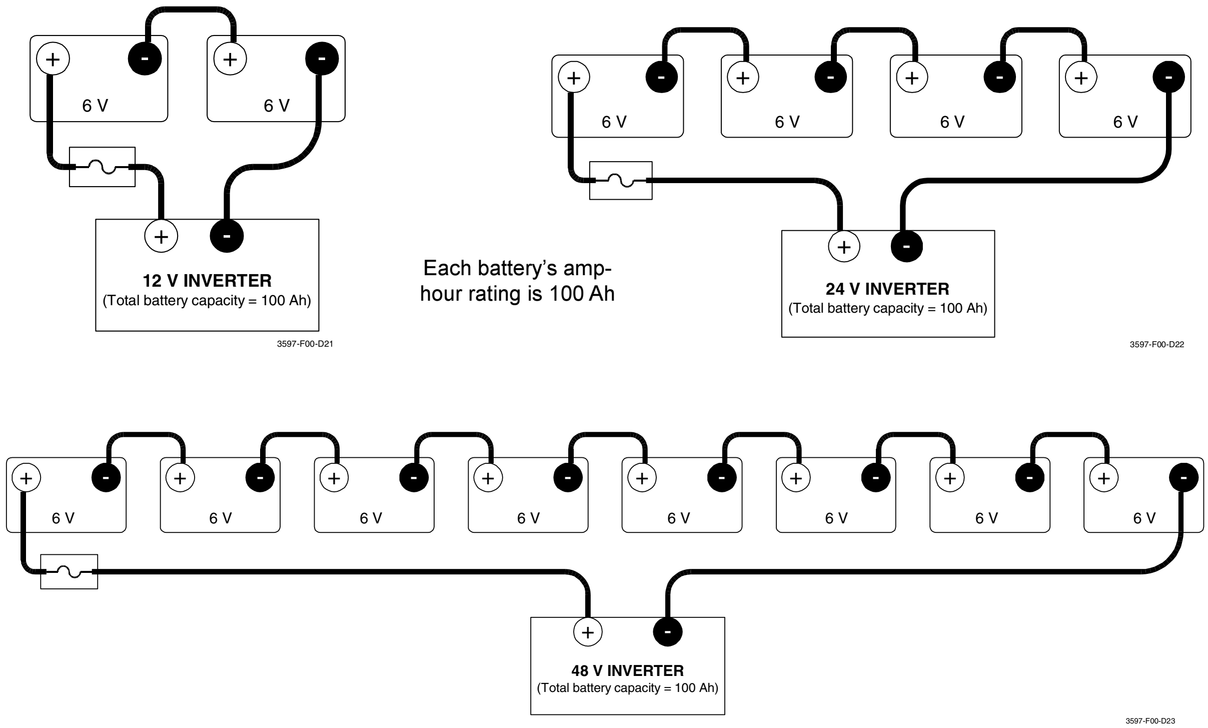

Figure 11
6 Volt Battery Wiring–Series Configuration

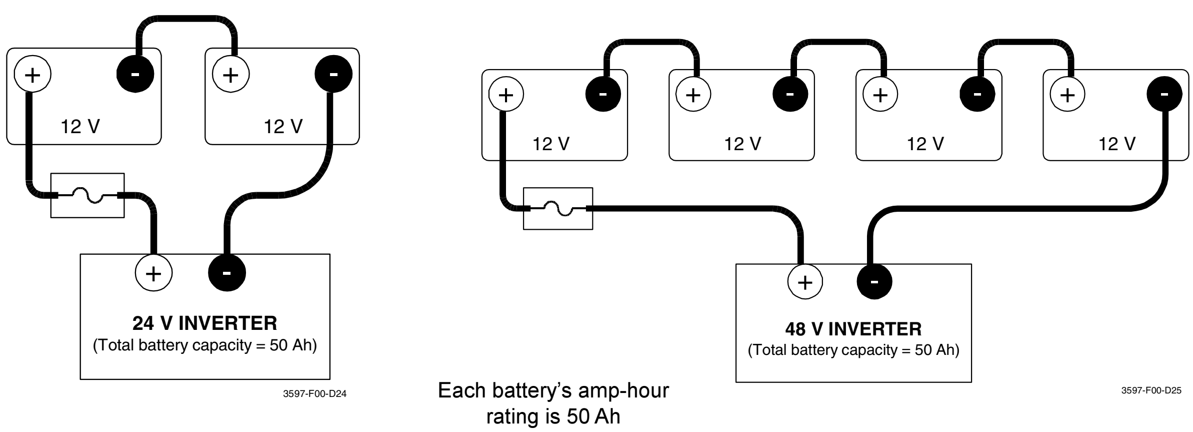

Figure 12
12 Volt Battery Wiring–Series Configuration

Wiring (continued)

Wiring Batteries in Parallel

Wiring the batteries in a parallel configuration increases the current of the battery string. This is commonly used in 12 volt configurations. 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 of the negative battery terminals are connected together and all of the positive battery terminals are connected together.

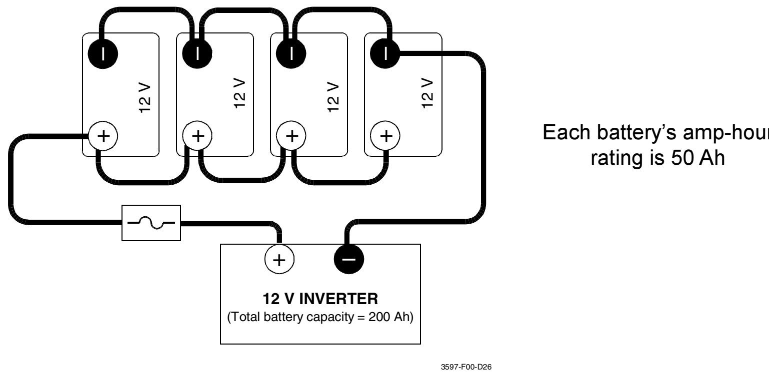

Figure 13
12 Volt Battery Wiring–Parallel Configuration

Wiring Batteries in Series-Parallel

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.

To construct a series-parallel battery bank follow these instructions:

Step 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.
- Repeat this step for the next battery string.
- Two identical strings of batteries are now wired in series.

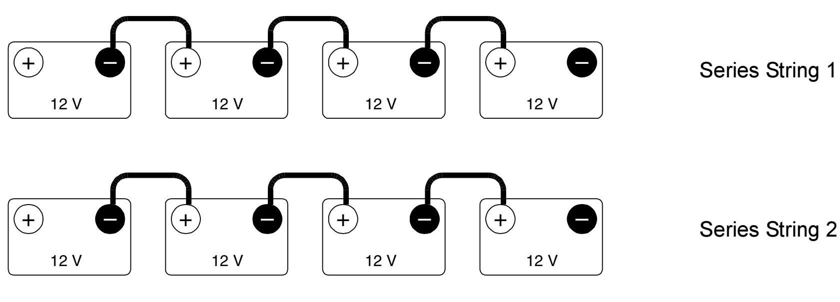

Figure 14
Step 1–Wire Batteries in Series

Wiring (continued)

Wiring Batteries in Parallel (continued)

Step 2

- Connect the POSITIVE terminal of the first battery string to the POSITIVE terminal of the second battery string.
- Connect the NEGATIVE terminal of the first battery string to the NEGATIVE terminal of the second battery string.

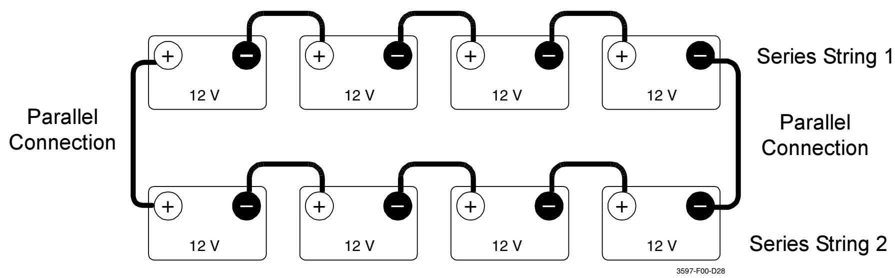

Figure 15
Step 2–Two Series Strings Wired in Parallel

Step 3

- Connect a wire from the POSITIVE terminal of the first battery string to the inverter's POSITIVE DC terminal (via a fused device).
- Connect the NEGATIVE terminal of the second battery string to the inverter's NEGATIVE DC terminal.

NOTE: Connecting the positive and negative wires to the inverter from different strings ensures a balanced charge/discharge through the batteries, resulting in longer run times and improved battery life.

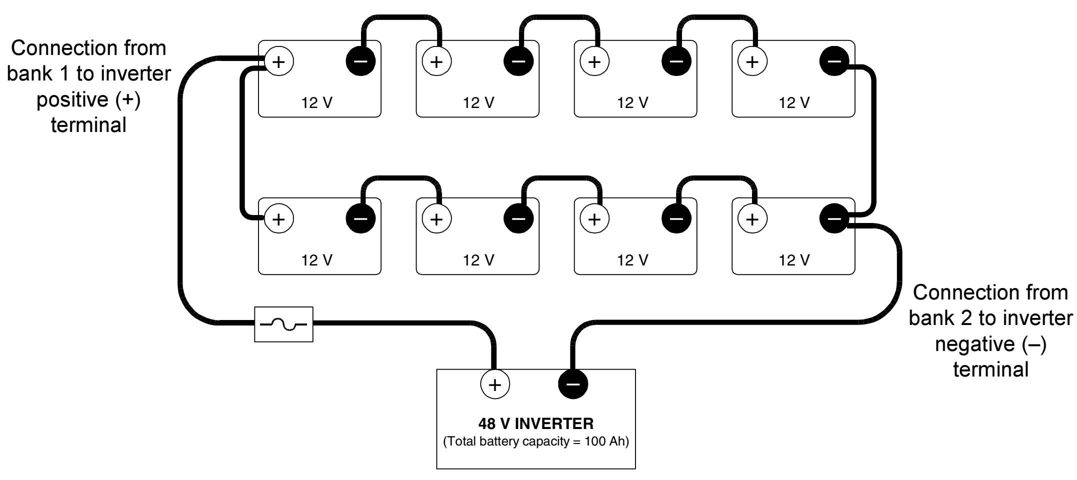

Figure 16
Step 3–Series-Parallel Configuration Wired to the Inverter

Wiring (continued)

Series/Parallel Configurations and Cross-Tying

To reduce the imbalances between the batteries in a series/parallel bank and improve the overall battery bank performance, the batteries can be cross-tied. In this arrangement, the batteries wired in the series part of one string are also wired in parallel with the batteries in the second string making each battery in the bank a (parallel) pair. This technique is not a requirement, but can improve the overall performance of the batteries and further increase the battery life as each battery receives a more even charge/discharge cycle. However, cross-tying the batteries involves additional expense of the extra battery cables and labor to wire them.

Cross-tying is shown in the following series/parallel configurations and is indicated by a light, dashed line. If cross-tying is not desired, ignore these dashed lines.

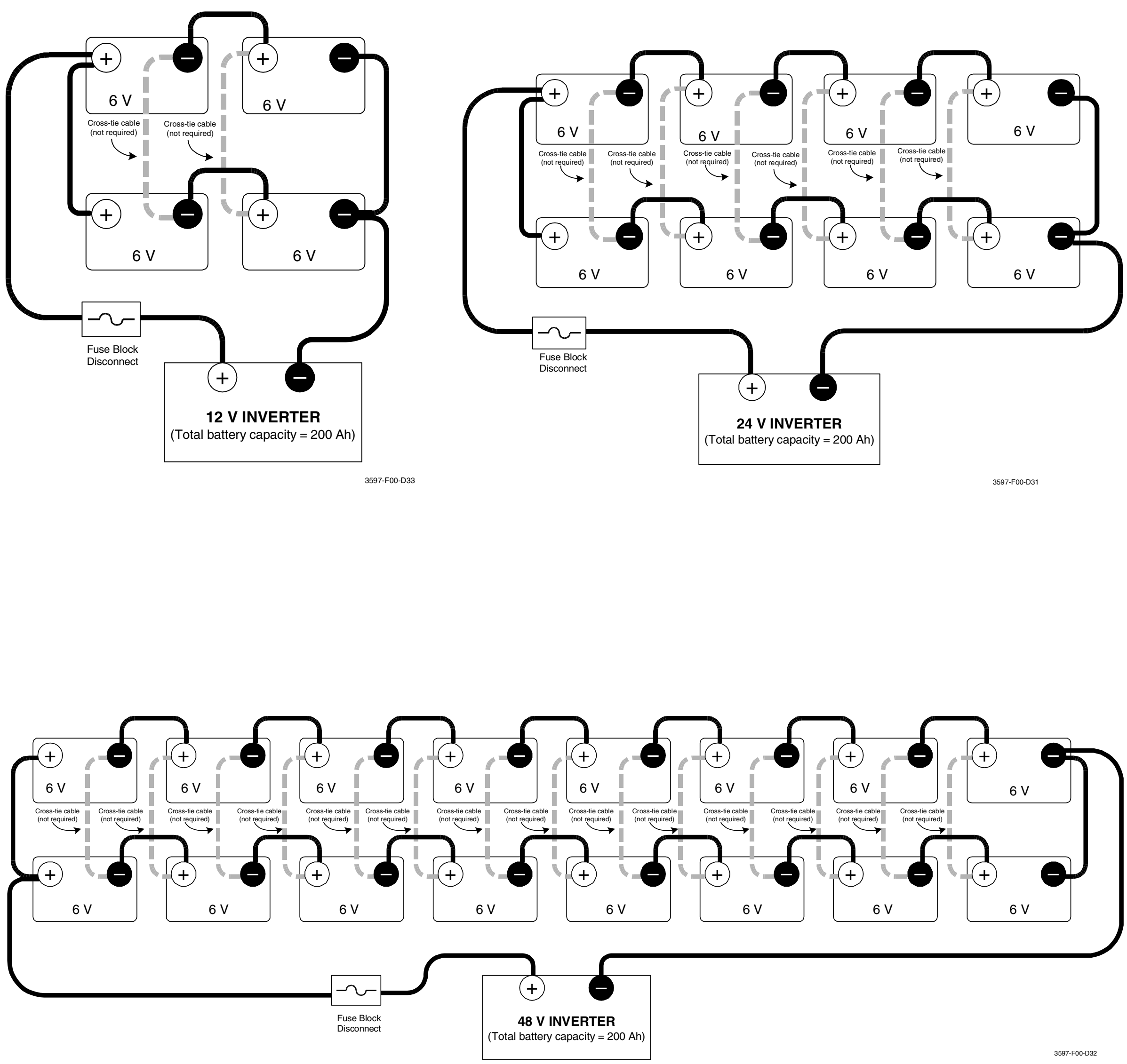

Figure 17
6 Volt Battery Wiring–Series/Parallel Configuration
(with optional cross-tie wiring)

Wiring (continued)

Cross-Tying Series/Parallel Configurations (continued)

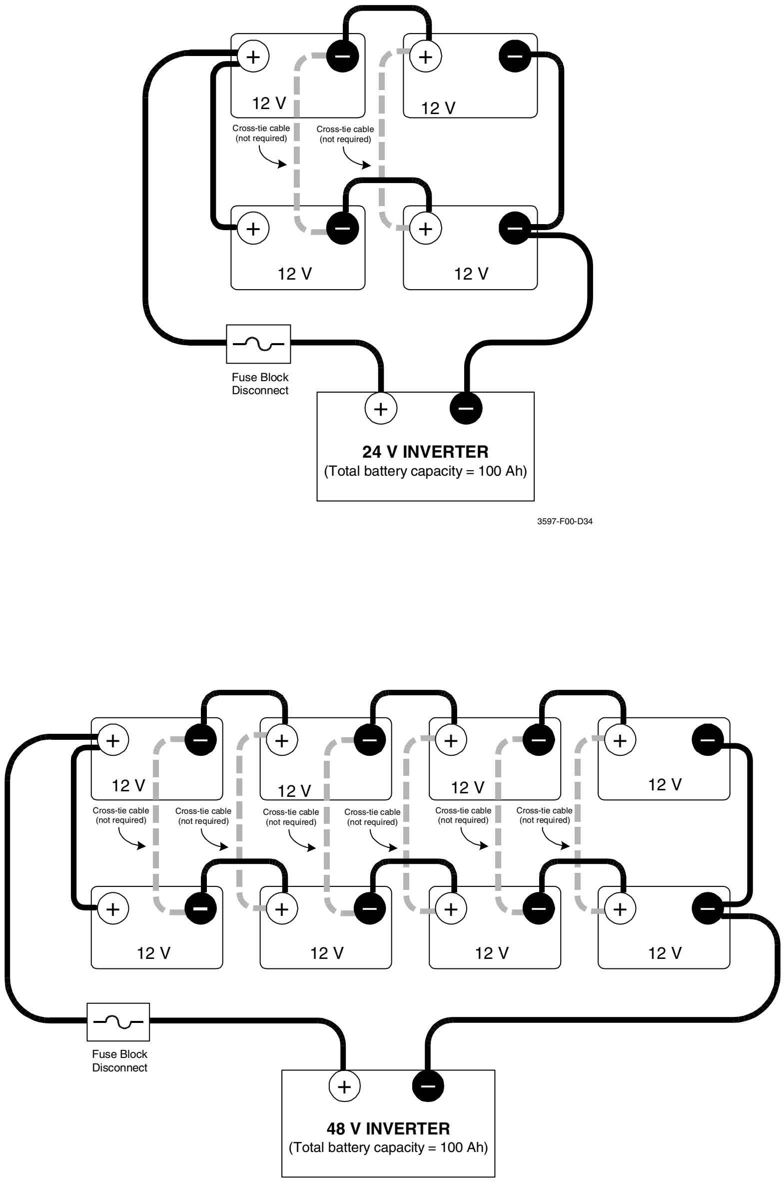

Figure 18
12 Volt Battery Wiring–Series/Parallel Configuration (with optional cross-tie wiring)

2.0 INSTALLATION

Installation Guidelines

WARNING: ENSURE THE INVERTER IS OFF BEFORE CONNECTING OR DISCONNECTING THE BATTERY CABLES AND THAT ALL AC POWER IS DISCONNECTED FROM THE INVERTER'S INPUTS.

- Determine the correct size battery cable to use for installation from Table 1.
- Determine the correct size disconnect/fuse for installation from Table 2.
- Color code the cables with tape or heat shrink tubing. The standard colors are red for positive (+) and black for negative (-).
- Connect the negative cable to the battery's negative terminal (torque to manufacturer's recommendations).
- Install the over-current device (fuse or circuit breaker) between the battery's positive terminal and the inverter's positive terminal (as close to the batteries as possible).
- Connect the (short) positive cable to the battery's positive terminal (torque to manufacturer's recommendations).
- Ensure the correct polarity of the cables with a DC voltmeter (DVM).
- Observing battery polarity, connect the positive battery cable (from the over-current device) to the inverter's positive terminal.

NOTE: The next step may cause a small spark and snapping sound when connecting the cable to the inverter. This is normal, and is caused by the inverter's capacitors charging up.

- Observing battery polarity, connect the negative battery cable to the inverter's negative terminal.
- 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.

CAUTION: DO NOT PUT ANYTHING BETWEEN THE CABLE RING TERMINAL AND THE FLAT METAL PART OF THE TERMINAL. OVERHEATING OF THE TERMINAL MAY OCCUR. DO NOT APPLY ANY TYPE OF ANTIOXIDANT PASTE UNTIL AFTER THE BATTERY CABLE WIRING IS TIGHTENED.

- Apply antioxidant paste to the battery and inverter terminals.
- Install the battery terminal connection covers (red for positive, black for negative) over the inverter's DC terminals and secure with the screws and washers provided.

DC Circuit Grounding

Grounding is an important part of the system installation and must be performed correctly to ensure safe operation of the equipment. Grounding requirements vary by country and application. Consult the NEC for specific requirements.

The ground conductor should be sized appropriately for the over-current protection device being used and according to NEC 250-95 (see table below for a portion of the NEC code).

Size of Over-current Device Protecting the Conductor	Minimum Size of Copper Ground Wire
30 or 60 amp	#10 AWG
100 amp	#8 AWG
200 amp	#6 AWG
300 amp	#4 AWG
400 amp	#3 AWG

3597-000-018

Table 3
Safety Ground Wire Size

General DC Grounding Requirements

- Connect the negative (-) terminal of the battery bank to an appropriately sized conductor and connect it to a solid earth ground, such as a grounding rod, driven 6–8 feet into the earth.

This procedure will properly ground the DC circuits.

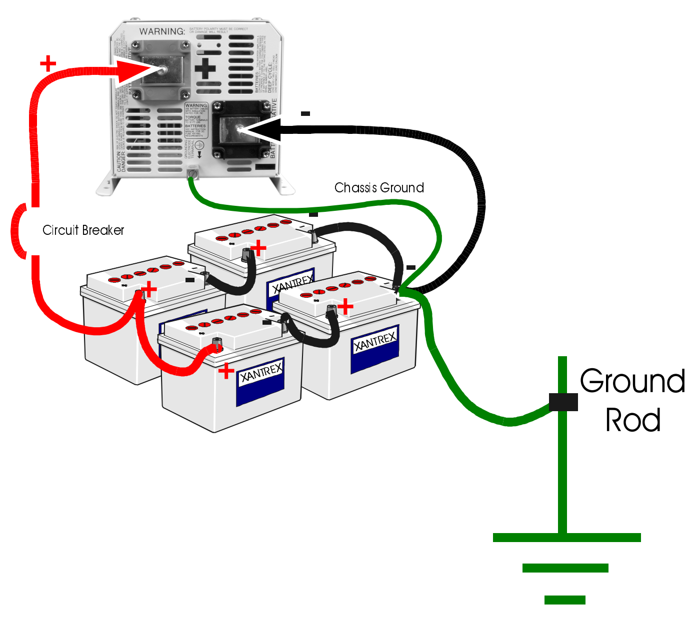

Figure 19
DC Grounding

Installing a Battery Temperature Sensor

A battery temperature sensor (BTS) option 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.

Installing the sensor:

- Run the battery temperature sensor wire in the DC conduit (if used) and route the RJ11 connector end to the BATTERY SENSE jack located on the front of the inverter.
- Secure the sensor to one of the batteries located in the center the battery pack.

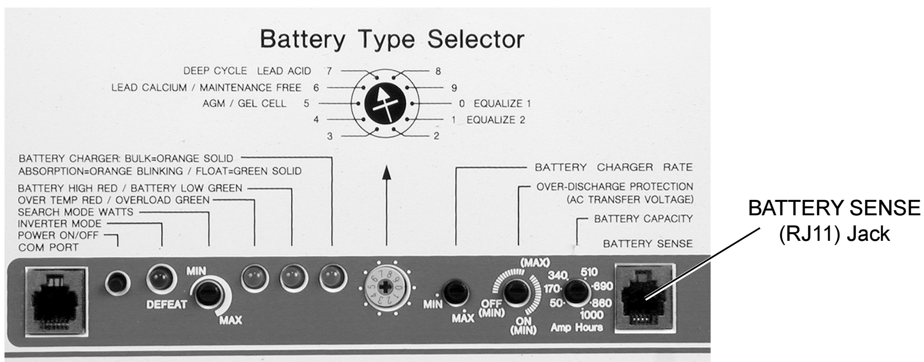

Figure 20
BTS (RJ11) Jack Location

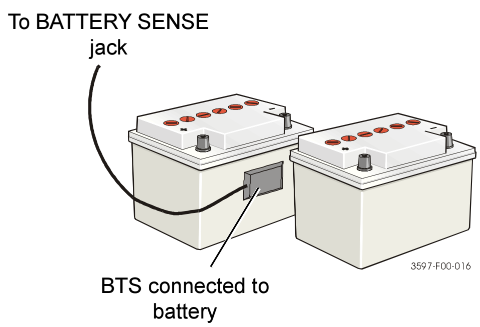

Figure 21
BTS Installed on Battery

AC Wiring

Sub-panel Mounting and Conduit Installation

NOTE: The installation of sub-panels and wiring should be performed by a qualified person or a licensed electrician following all local and NEC codes.

- Determine the location of the sub-panel and install it according to the manufacturer's directions.
- Install the AC conduit between the sub-panel (output) and inverter.

WARNING: DISCONNECT THE POWER FROM THE UTILITY'S MAIN BREAKER BOX BEFORE PROCEEDING.

- Install conduit between the inverter (input) and the main breaker box.
- Determine which circuits require backup. Install the appropriate circuit breakers into the sub-panel.
- Install a 60 amp (disconnect) circuit breaker in the sub-panel. This will later be wired to the inverter's output. If two inverters are being used in a stacked configuration, install two 60 amp circuit breakers for 240 VAC service (one in each leg of the circuit for L1 and L2).

Input to the Inverter

CAUTION: 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.

All AC wiring connects to the terminal block located on the right-hand side of the inverter.

- To access the terminal block, remove the side cover panels (if installed) by removing the two (or three) Phillips screws. Units are shipped without the covers installed (packed in a small plastic bag with additional hardware).
- Locate the AC input and output terminals on the block. Refer to Figure 23.

NOTE: The lower AC cover varies depending on the system's power level. Higher power units are equipped with a conduit box and not a plate. The conduit box is required for the larger diameter wire providing ample bending radius.

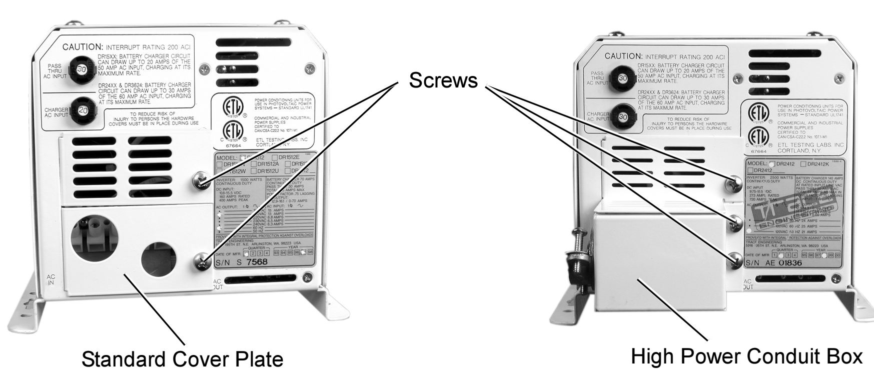

Figure 22
AC Wiring Access Cover Plates

AC Wiring

Before wiring the input of the inverter, refer to the table below for the minimum recommended wire size.

☞ NOTE: Refer to the NEC for actual wire sizes for specific installations.

Inverter Model	AC Input		AC Output	
	120 VAC	220-240 VAC	120 VAC	220-240 VAC
DR1512	#8 or 6 AWG	#10 AWG	#12 AWG	#16 AWG
DR2412	#6 AWG	#10 AWG	#10 AWG	#14 AWG
DR1524	#8 or 6 AWG	#10 AWG	#12 AWG	#16 AWG
DR2424	#8 AWG	#10 AWG	#10 AWG	#14 AWG
DR3624	#6 AWG	Not Available	#8 AWG	Not Available

975-0012-007

Table 4
Minimum Recommended Wire Size (Input and Output)

AC Wiring (continued)

NOTE: The U.S. requires conduit be used in this type of installation. Refer to the NEC and local codes. Conduit fittings can be replaced with strain reliefs where code permits.

Refer to the table on the previous page for minimum recommended wire sizes.

Procedure

AC Input Wiring to Inverter

WARNING: DISCONNECT THE BATTERY CONNECTIONS FROM THE INVERTER IF THEY ARE ALREADY CONNECTED.

ALL WIRING SHOULD BE PERFORMED BY A QUALIFIED OR LICENSED ELECTRICIAN.

DISCONNECT THE MAIN BREAKER AT THE MAIN UTILITY BREAKER BOX.

- Install a 60 amp circuit breaker in the utility service panel. This will serve as both an AC disconnect and over-current protection.
- Feed the HOT, NEUTRAL and GROUND wires (via conduit) from the inverter to the main utility box. Leave several inches of extra wire at each end.
- Make the connections to the inverter first. Wiring to the utility breaker box is performed after all connections have been made in the inverter.
- Connect the GROUND (green) wire to the inverter's AC GROUND terminal.
- Connect the NEUTRAL (white) wire from the main utility panel to the inverter's NEUTRAL INPUT terminal.
- Connect the HOT (black) wire from the main utility panel to the inverter's AC HOT INPUT terminal.
- Torque all connections to 16 inch-pounds.

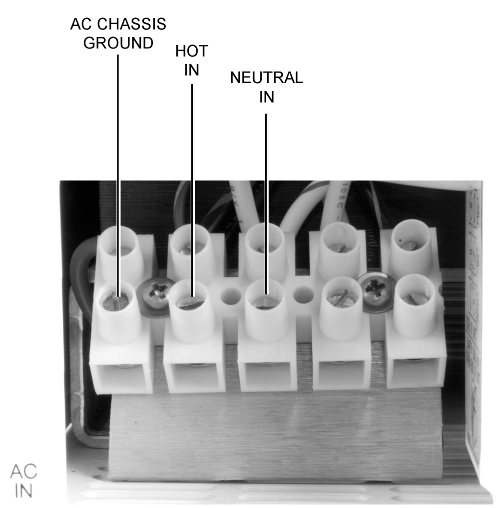

Figure 23
AC Input Wiring

AC Wiring (continued)

AC Output Wiring to the Sub-panel

WARNING: ENSURE THE SUB-PANEL DOES NOT HAVE A NEUTRAL TO GROUND BOND. IF IT DOES, REMOVE IT. ALL AC NEUTRAL-GROUND BONDING IS DONE AT THE MAIN UTILITY BREAKER BOX (SERVICE ENTRANCE).

- Connect the GROUND wire to the inverter's AC GROUND chassis terminal. Connect the other end of this wire to the GROUND bus in the sub-panel.

- Connect the NEUTRAL (white) wire to the inverter's NEUTRAL OUTPUT terminal. Connect the other end of this wire to the NEUTRAL bus in the sub-panel.

- Connect the HOT (black) wire to the inverter's terminal labeled AC HOT OUTPUT. Connect the other end of this wire to the sub-panel's input circuit breaker.

- Torque all inverter terminal block connections to 16 inch-pounds. Refer to the sub-panel manufacturer's specifications for wire torques.

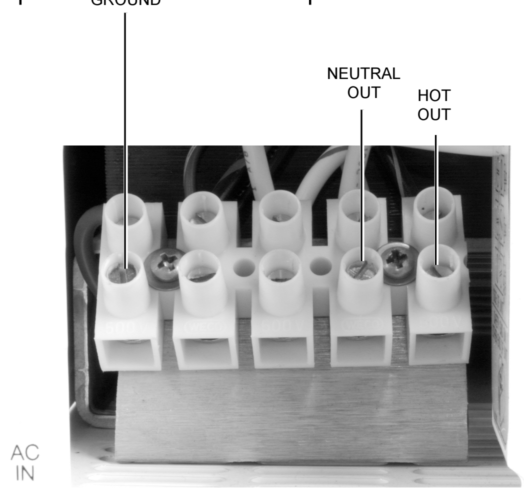

Figure 24
AC Output Wiring

NOTE: The two neutral connections (input and output) are common to one another and may be used in any combination.

AC Wiring (continued)

AC Input Wiring to the Main Utility Breaker Box (single inverter installations)

WARNING: MAKE CERTAIN THE POWER TO THE MAIN UTILITY BOX IS DISCONNECTED! NEVER WORK ON LIVE CIRCUITS.

- Remove the MAIN UTILITY BOX's cover plate.
- Connect the ground (green) wire to the GROUND bus in the main utility box.
- Connect the neutral (white) wire to the NEUTRAL bus.
- Connect the hot (black) wire to the 60 amp circuit breaker (installed for the inverter).
- Torque all wires to the manufacturer's specifications.

CAUTION: INSPECT ALL WIRING FOR PROPER INSTALLATION BEFORE REINSTALLING THE COVER PLATE.

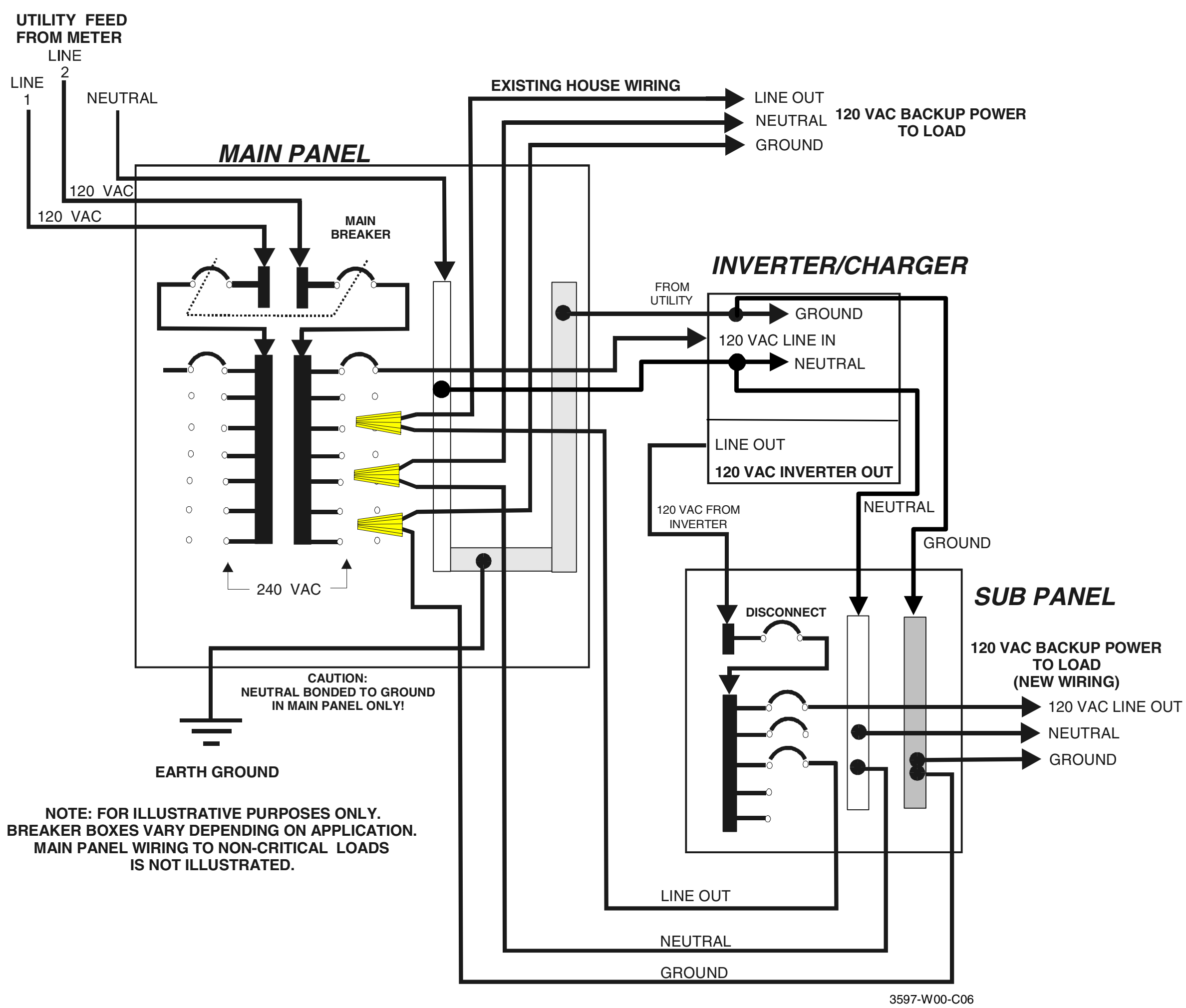

Figure 25
Single Inverter 120 VAC Wiring Diagram

Generators

An AC generator can be used as an input source instead of the utility power, or can be connected (via additional hardware) to power the loads when utility is not present (utility outage), and to charge the batteries. The generator must be of the permanently installed type and not a portable type unit used for emergency power. Small emergency type generators may not have a stable enough voltage or frequency output for the inverter to synchronize to, or provide enough current to fully charge the batteries.

Generator Requirements

The maximum charge rate the battery charger can deliver is dependant upon the peak AC voltage available. Since the battery charger uses only the top portion of the input sine wave, small variations in peak voltage result in large variations in the amount of energy to the charger. The charger's rated output is based on a utility voltage of 120 VAC_{rms} which has a peak voltage of 169 VAC_p (230 VAC_{rms} has a peak voltage of 325 VAC_p).

Low power generators may not produce enough voltage under heavy load conditions to fully charge the batteries as the voltage peaks may be clipped, limiting the maximum charge rate. Size the generator appropriately for the system, including battery charge and load current.

The following table demonstrates how the peak voltage available affects the charging current:

Peak Voltage Available	DR1512	DR2412	DR1524	DR2424	DR3624
170 VAC_P	70 amps	120 amps	35 amps	70 amps	70 amps

975-0012-012

Table 5
Peak Input Voltage vs Charging Current

Generator Type	Inverter Type	Typical MAX charge Rate amps
Honda 800	DR1512	43 amps
Honda 2200	DR1512	57 amps
Homelite 2500	DR1512	11 amps
Honda 3500	DR1512	39 amps
Honda 6000	DR1512	70 amps
Honda 1600	DR1524	25 amps
Westerbeke 7.0 kW	DR1512	Approx. 45 amps
Westerbeke 12.5 kW	DR1512	Approx. 65 amps

975-0012-013

Table 6
Generator Types

Generators (continued)

Because generator hookups can vary widely, only basic hookup information is given. Complex hookups, involving both the utility and generator, require additional hardware such as a manual AC transfer switch and possibly an autotransformer for load balancing.

Basic 120 VAC Generator Hookup (non-utility applications only)

- Connect the ground wire on the generator to the GROUND terminal on the inverter.
- Connect the generator neutral wire to the NEUTRAL terminal on the inverter.
- Connect the generator HOT wire to the HOT input on the inverter.
- Bond the neutral to the ground on the output of the generator (only if used in non-utility installations) or in the MAIN SERVICE PANEL (not both).
- Drive a ground rod 6–8 feet into the ground and connect the generator's ground to the ground rod.

☞ NOTE: The ground and neutral must be bonded at one place, and only one place, in the system. If the generator is the main source of power, (i.e., no utility grid power) then the neutral and ground connections are bonded at the generator. If the generator is acting as a backup for the utility grid, then the bond should be at the main utility service entrance box. In this case, ensure that no bond exists at the generator output.

- Manually start the generator and check for proper operation of the inverter (i.e., the inverter transfers from battery to generator power).

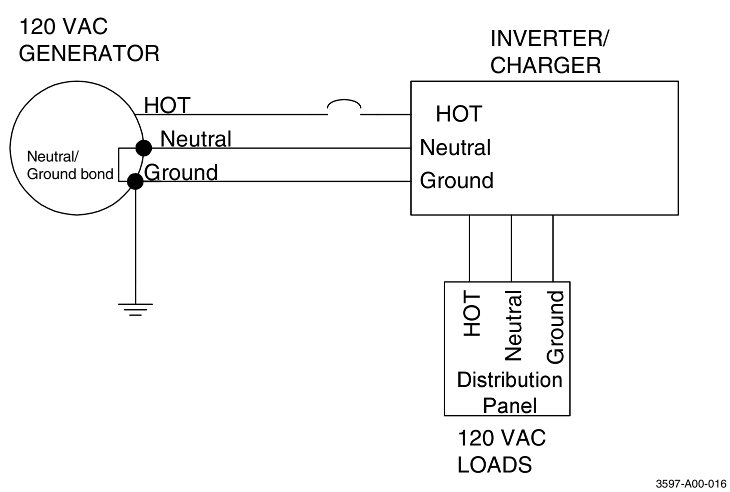

Figure 26
Basic 120 VAC Generator Block Diagram (for non-utility applications)

Generators (continued)

Basic 120 VAC Utility/Generator Hookup

If a generator is used as a backup for the utility, then a manual transfer switch must be added to provide a means to switch the generator power to the inverter's inputs. The generator can be used during extended outages to recharge the batteries and provide pass through power for the loads. Start and stop the generator manually using the generator's pull-cord, ON/OFF switch, etc.

Generator Connections (to manual bypass switch)

- Connect a (green) ground wire between the generator's GROUND terminal and the GROUND terminal in the manual bypass switch.
- Connect a (white) neutral wire between the generator's NEUTRAL terminal and the NEUTRAL bus in the manual bypass switch.
- Connect a (black - HOT) wire between the generator's HOT OUT terminal and the GENERATOR (HOT) contact in the manual bypass switch.

☞ NOTE: Refer to the bypass switch installation manual for contact details, torque specifications, etc.

Utility Connections (to manual bypass switch)

- Connect a (green) wire between the GROUND terminal in the MAIN UTILITY PANEL and the GROUND terminal in the manual bypass switch.
- Connect a (white) wire between the NEUTRAL bus in the MAIN UTILITY PANEL and the NEUTRAL bus in the manual bypass switch.
- Connect a (black) wire between the inverter circuit breaker in the MAIN UTILITY PANEL and the UTILITY HOT contact in the manual bypass switch.

Inverter Connections (to manual bypass switch)

- Connect a (green) wire between the GROUND terminal in the manual bypass switch and the inverter's AC GROUND terminal.
- Connect a (white) wire between the NEUTRAL terminal in the manual bypass switch and the inverter's NEUTRAL IN terminal.
- Connect a (black) wire between the COMMON terminal in the manual bypass switch and the inverter's HOT IN terminal.
- Torque all wires 16 in/lb.

Sub-panel Connections

- Connect a (green) wire between the inverter's AC GROUND terminal and the GROUND terminal in the sub-panel.
- Connect a (white) wire between the inverter's NEUTRAL OUTPUT terminal and the NEUTRAL bus in the sub-panel.
- Connect a (black) wire between the inverter's terminal labeled AC HOT OUTPUT and the SUB-PANEL's INPUT circuit breaker.
- Torque all inverter terminal block connections to 16 inch-pounds. Refer to the sub-panel manufacturer's specifications for wire torques.
- Recheck all connections.

Refer to the illustration on the next page.

Generators (continued)

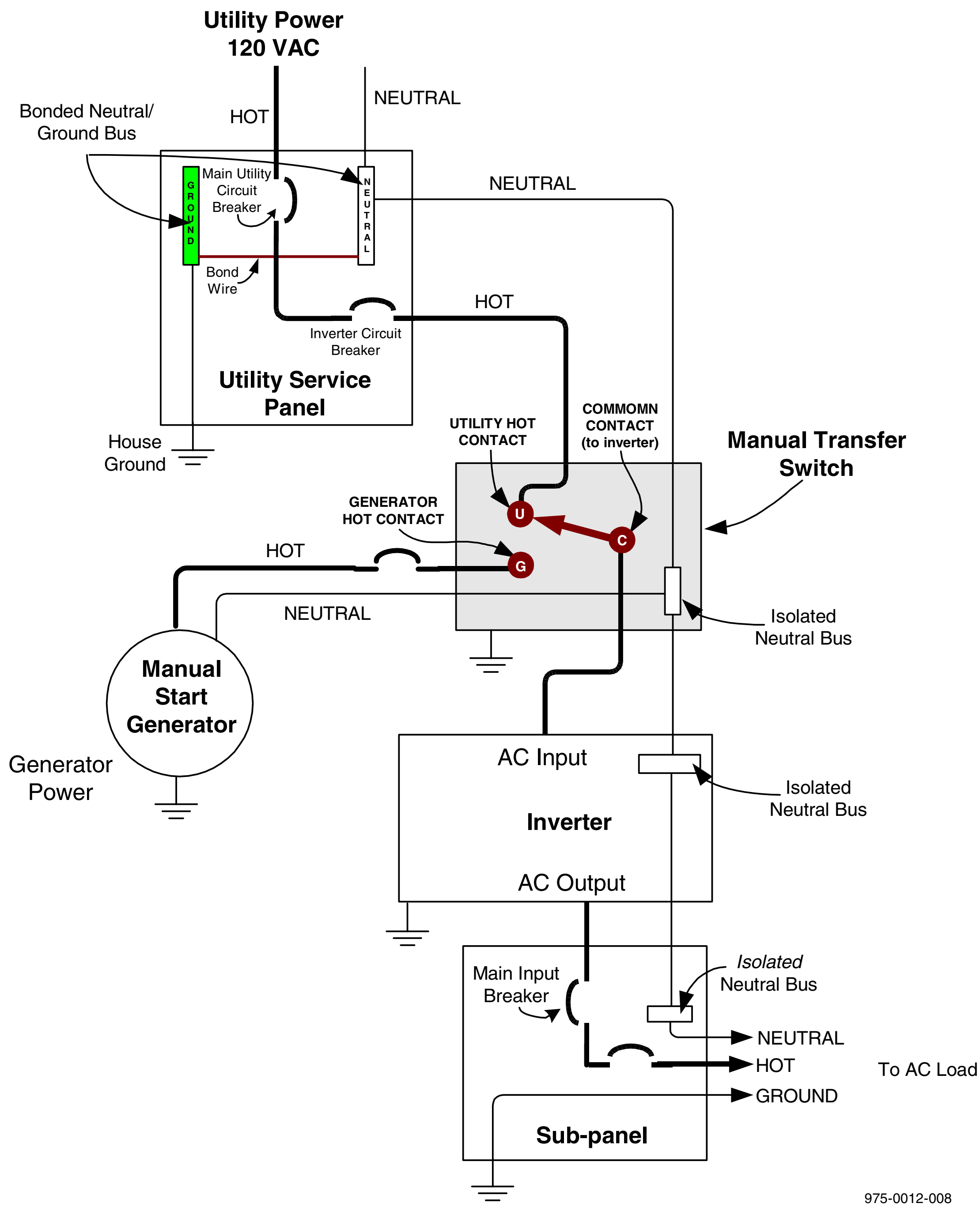

Figure 27
Basic 120 VAC Utility/Generator Block Diagram

Series Stacking

This COM port allows two DR Series inverter/chargers to be used in the same system in a "SERIES" configuration to operate 240 VAC loads. Series stacking can also be used to connect to 240 VAC only power systems providing both 120 and 240 VAC outputs. A series stacking interface cable (DRI) is required to connect the series stacking port of the inverters. In this mode, one of the inverters will function as the "primary" and the other inverter becomes the "secondary." The *first* unit switched ON becomes the *primary* and ensures the secondary's output is 180 degrees out of phase for 240 VAC operation. Both units can charge the batteries or provide battery backup power during a utility outage.

The following illustrations provide a general overview of AC and DC wiring configurations and output voltages supplied by stacked inverters. Detailed wiring and operating instructions are provided with the DRI interface kit available from Xantrex Technology Inc.

NOTE: Only 120 VAC/60 Hz models can be stacked.

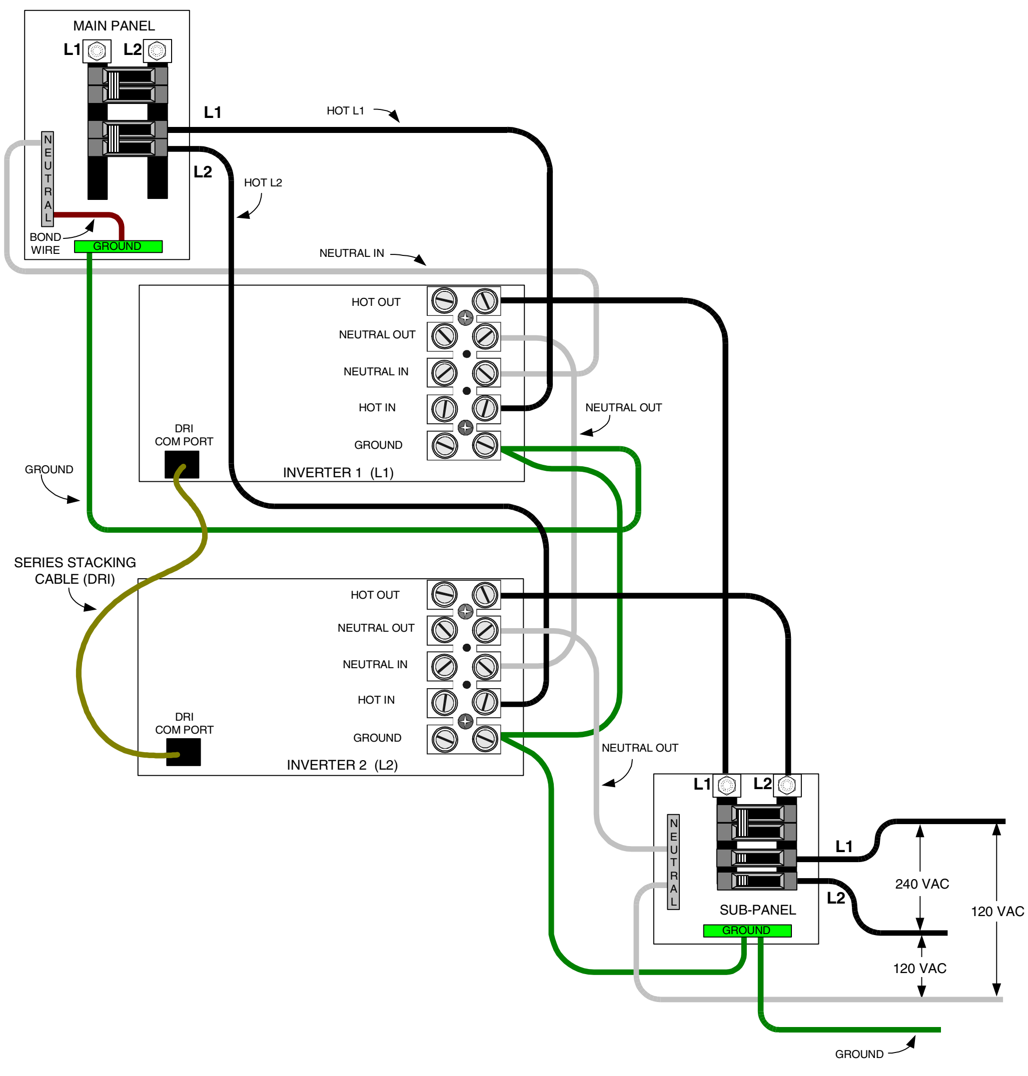

Figure 28
Series Stacking AC Wiring
(120 VAC/60 Hz models only)

Series Stacking (continued)

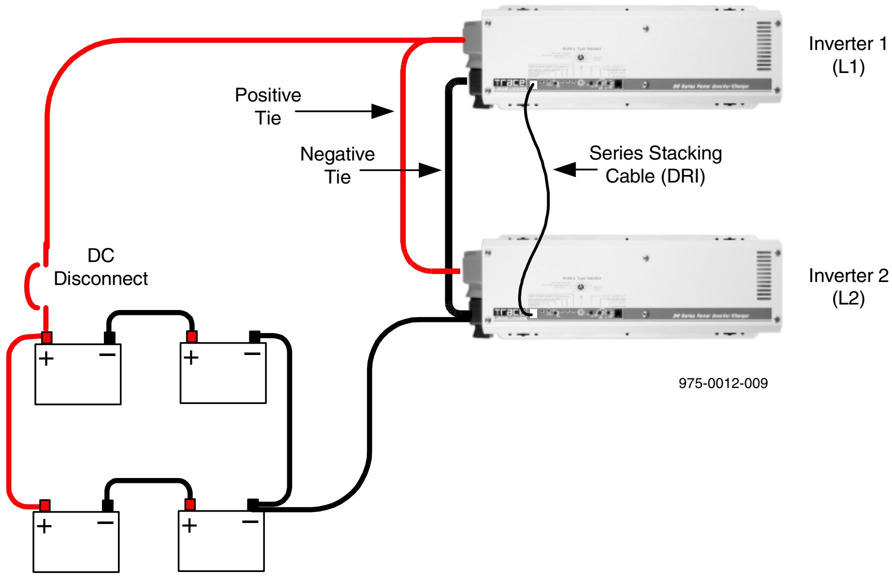

Figure 29
Stacking Port and Battery Wiring with One Disconnect
(120 VAC/60 Hz models only)

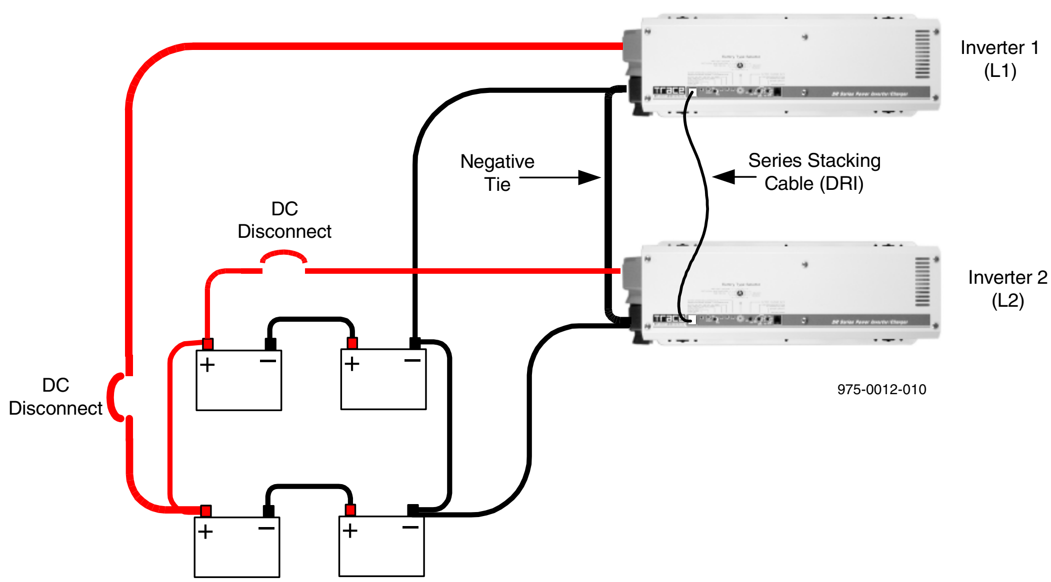

Figure 30
Stacking Port and Battery Wiring with Two Disconnects
(120 VAC/60 Hz models only)

3.0 OPERATION

Front Panel Controls and Indicators

All operating controls, indicators and sense connectors are located on the front panel of the unit. The controls are easily accessible, and the LEDs provide inverter/charger status at a glance.

POWER ON/OFF Switch

The POWER ON/OFF control is a momentary contact switch that turns the inverter/charger ON or OFF by pressing it once. When the inverter is first connected to the batteries, it will run through a self test consisting of flashing the LEDs in sequence, operating the cooling fan momentarily and switching the transfer relay three times. Once the self test has successfully completed, the POWER ON/OFF switch is activated. Pressing the switch once turns the inverter ON. Another press turns the inverter OFF.

Ports

There are two ports on the inverter/charger. Both ports are RJ11 type telephone style connectors and are used for controlling the inverter and regulating the charger voltage based on temperature.

COM PORT

COM PORT (J1) is a dual function RJ11 (6-pin) connector. Its primary function is to provide serial communications to an optional Trace™ remote control unit (RC4 or RC8). The port also acts as a stacking interface control when two DR Series inverters are used in a series configuration. When two inverters are stacked, a remote control cannot be used with either unit.

Remote Controls (RC4 or RC8)

DR Series inverters are designed to operate with either an RC4 or RC8 remote control units. Both remotes incorporate a membrane switch with a single red LED display combination to start and stop the inverter, as well as provide overall system operating status.

Solid

With AC line power present, the unit is charging the batteries while directing AC to the load. With no AC line power present, the inverter is running on the batteries and supplying AC to the load.

Blinking Slow (1 to 3 flashes @ 1 second intervals)

The inverter is in search mode (no load connected).

Blinking Fast (3 to 5 flashes @ 1 second intervals)

The inverter is charging the batteries.

Flickering (3 to 5 flashes @ 1 second intervals)

The inverter has detected an over-current error. The LED (and inverter) will turn OFF whenever an over-current condition exceeds eight seconds.

Erratic Blinking (0 to 3 and 2 to 5 flashes @ 2 second intervals)

The inverter has detected an error condition caused by overheating, low battery voltage, or high battery voltage.

OFF

The inverter is OFF.

The remote control must be connected prior to switching the inverter ON; otherwise, the micro-controller will not recognize (or respond to) the remote. If the remote is not recognized, switch the inverter OFF and then ON using the inverter's front panel POWER ON/OFF switch.

Stacking Interface

Whenever two DR Series inverters are used in a series (stacked) configuration, one unit (primary) controls the other unit (secondary). Communication between the two inverters is done via the COM port (J1). The first unit switched ON, using its front panel POWER ON/OFF switch, becomes the controlling (primary) inverter.

Front Panel Controls and Indicators (continued)

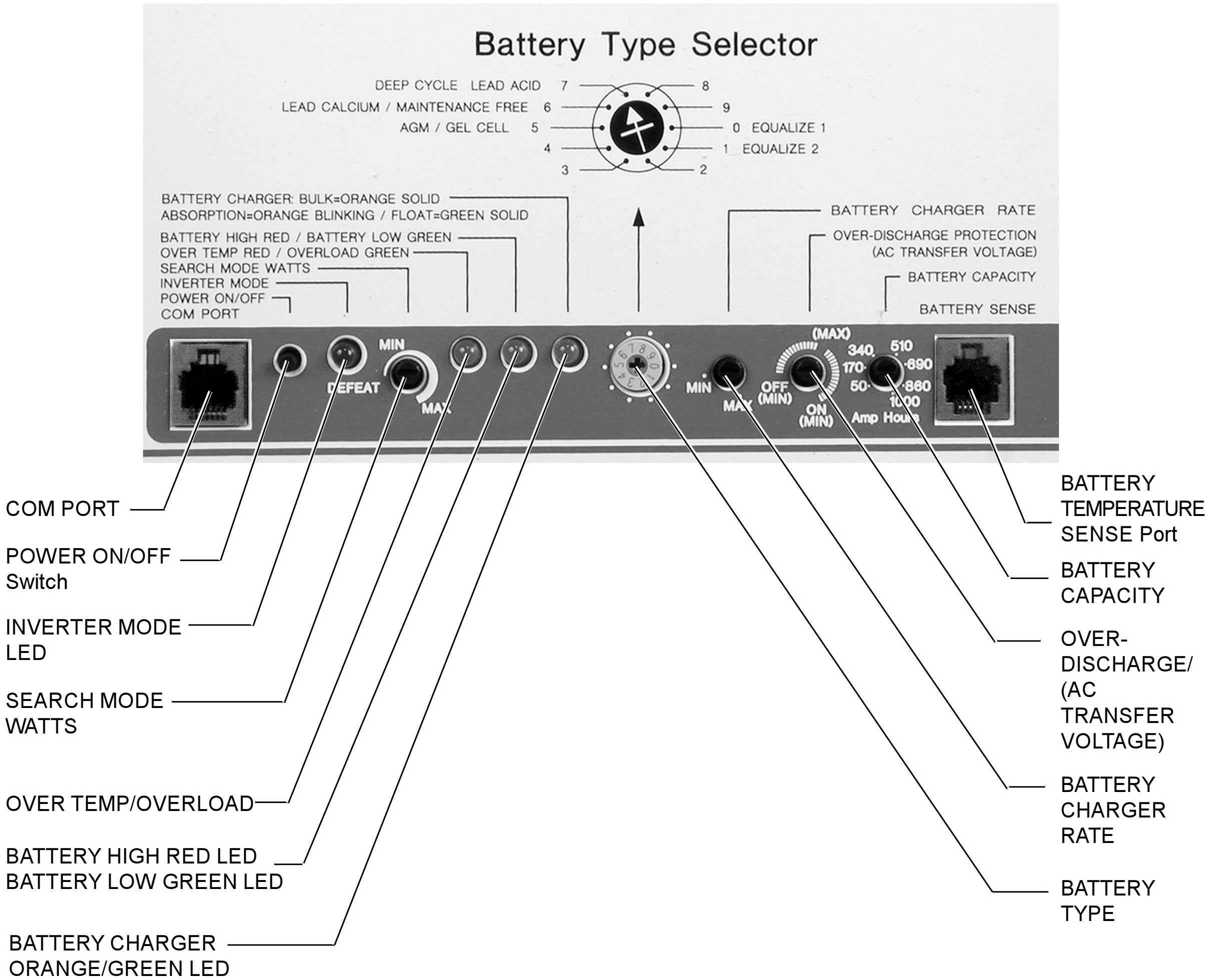

Figure 33
Front Panel Controls and Indicators

BATTERY SENSE Port

The BATTERY SENSE Port is used for connecting a battery temperature sensor (BTS) to control the charging rate based on battery temperature. The sensor should be taped onto the side of one of the batteries. The information received in this port adjusts the charger’s output higher in cold temperatures, assuring the batteries receive a full charge, and lowers it during warm temperatures, reducing battery gassing and providing overcharge protection.

Refer to the Installation section for the BTS location on the battery.

Front Panel Controls and Indicators (continued)

Controls

There are several controls on the inverter's front panel that provide adjustments for the battery charger, and AC output energy saving mode.

DC Controls

Battery Type Selector

The Battery Type Selector is a 10 position rotary switch used to set the inverter's charger for the proper Float and Bulk voltage levels. These levels are selected depending on the type of batteries used. There are also 2 positions (0 and 1) which allow the batteries to be equalized. Equalizing batteries should only be done on liquid lead acid batteries and <u>never</u> on sealed batteries. Refer to the table below for the charge voltages in the various switch positions.

Switch Position	Description	12 Volt Models		24 Volt Models		Equalize	
		Float Voltage	Bulk/Equalize* Voltage	Float Voltage	Bulk/Equalize* Voltage	Charge Rate	Time
0	Equalize 1	13.2	*15.0	26.4	*30.0	Battery Capacity Setting (C/40)	6 hours minimum 12 hours maximum
1	Equalize 2	13.2	*15.5	26.4	*31.0	Battery Charger Rate Setting (manual)	6 hours minimum 12 hours maximum
2	Deep Cell Lead Acid 2	13.3	15.0	26.6	30.0		
3	Not Specified	13.6	14.3	27.2	28.6		
4	Gel Cell 2	13.7	14.4	27.4	28.8		
5	Gel Cell 1	13.5	14.1	27.0	28.2		
6	PbCa–Lead Acid	13.2	14.3	26.4	28.6		
7	Deep Cycle Lead Acid 1 (Default Setting)	13.4	14.6	26.6	29.2		
8	NiCad 1	14.0	16.0	28.0	32.0		
9	NiCad 2	14.5	16.0	29.0	32.0		

NOTES:
Switch positions "0" and "1" are for monthly battery maintenance only. Return the switch to the appropriate position for the system's batteries when Equalize charging has completed. NEVER EQUALIZE SEALED BATTERIES! Use together with BATTERY CHARGER RATE potentiometer (position 1) or BATTERY CAPACITY potentiometer (position 0).

Equalize voltages are displayed in the table with an asterisk (*)–switch positions "0" and "1" only.

Switch position "7" is the default value as shipped from the factory.

Always refer to the battery manufacturer's specifications for Float, Bulk and Equalize (if applicable) voltages.

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Table 7
Battery Type Selector Switch Settings

Switch Positions
0 and 1–Equalize 1 and 2

These positions are used to equalize lead acid batteries. When selected, the batteries are held at the Bulk voltage for a minimum of 6 hours. Position "0" equalizes at a rate equal to the battery bank capacity (in amp-hours) divided by 40. Position "1" charges at a rate set by the BATTERY CHARGER RATE control.

2–Deep Cycle Lead Acid 2

Provides an additional Float and Bulk settings for deep cycle, lead acid batteries. Refer to the battery manufacturer's recommendation for Float and Bulk settings.

3–Not Specified

Provides an additional set of Bulk and Float voltages.

Front Panel Controls and Indicators (continued)

Switch Positions (continued)

4–GEL Cell 2

Recommended for gel cell batteries that specify high float voltages. Check with the battery's manufacturer.

5–GEL Cell 1

Typical gel cell setting.

6–PbCa - Lead Calcium

Use this setting for sealed type car batteries.

7–Deep Cycle Lead Acid

Factory setting for typical deep cycle lead acid batteries.

8–NiCad 1

Use for NiCad battery systems.

9–NiCad 2

Recommended for use with nickel iron batteries.

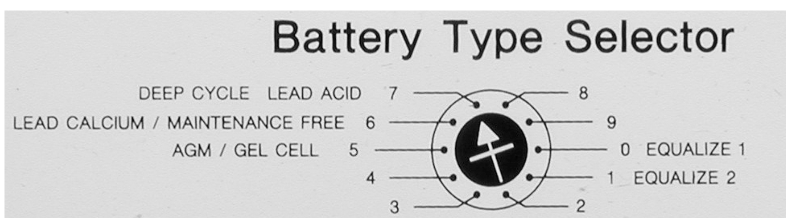

Figure 34
Battery Type Selector Graphic

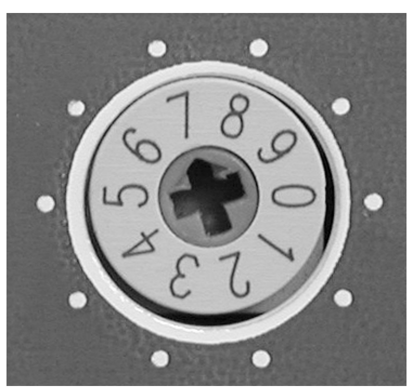

Figure 35
Battery Type Selector Adjustment

Front Panel Controls and Indicators (continued)

SEARCH MODE WATTS Potentiometer

The Search Mode Watts potentiometer adjusts the current threshold required to bring the inverter out of search mode into full wave operation. With search mode enabled, the inverter pulses the AC output looking for an applied load. With no load detected, the inverter goes into the search mode to minimize energy consumption. When a load is applied, the load current is sensed, bringing the inverter into full power operation. Disabling the threshold (setting the potentiometer fully CCW) causes the inverter to remain ON (in full power operation) regardless of an applied load.

To set the Search Mode Watts:

- Remove the AC input source from the inverter. The inverter switches to battery operation. Ensure all inverter supported appliances are switched OFF.
- Turn the potentiometer completely CW (to MAX).
- Switch on the load which will trigger the inverter to full power. This could be a lamp located in a convenient location if the power goes out. The light may flicker as the inverter searches the line for a load. The green INVERTER MODE LED blinks 2-3 times a second, indicating the inverter is in the SEARCH MODE.
- Slowly turn the potentiometer CCW (toward MIN) when the proper setting is found, the lamp and INVERTER MODE LED will light steady.
- Turn the lamp OFF for a moment, the inverter should switch back to the SEARCH MODE. Turn the lamp ON, ensure the inverter comes out of the Search Mode. Adjust the potentiometer up or down as necessary.

☞ NOTE: The Search Mode only activates when the unit is operating in the inverter mode (from batteries) to prevent unnecessary battery discharge when electrical power is not required. If the inverter is supporting loads that must constantly be powered, turn the search mode OFF by setting the potentiometer fully CCW to the DEFEAT position.

☞ NOTE: Some loads constantly draw power even though they are switched OFF. These include: TVs with instant-ON circuits, microwaves with digital displays, VCRs, etc. It is best to operate these devices from another circuit or install a switch to turn these OFF completely.

☞ NOTE: When the SEARCH MODE is used with series stacked inverters, only 120 VAC loads connected to the “master” inverter will bring the unit out of the search mode. Refer to Series Stacking in the Installation section of this manual.

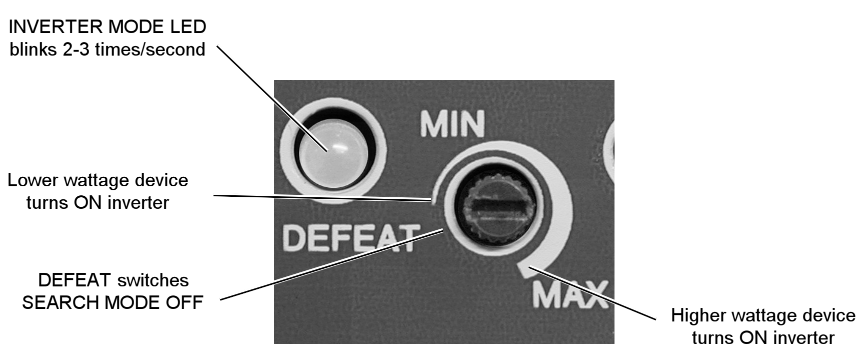

Figure 36
Search Mode Sensitivity Adjustment Potentiometer

Front Panel Controls and Indicators (continued)

Battery Charger Rate

The Battery Charger Rate potentiometer sets the maximum charge current supplied to the battery bank and is also used to regulate constant current in the Bulk Charge Mode. The level should be adjusted to provide a charge rate less than or equal to the amp-hour capacity of the battery bank divided by a factor between 3 or 5 (5=gelled batteries and 3=lead-acid batteries).

Example:

1. Inverter DR1512 has a maximum charge rate of 70 amps.
   Battery bank amp-hour capacity = 500 amp-hours using gel cell batteries.
   Divide the amp-hour capacity by 5 (500/5 = 100).
   Set the potentiometer to MAX (70 amps) as it is less than 100.

2. Inverter DR1512 has maximum charge rate of 70 amps.
   Battery bank amp/hour capacity is 250 amp-hours using gel cell batteries.
   Divide the amp-hour capacity by 5 (250/5 = 50).
   Set the potentiometer to approximately 71% (50 amps).

Use the table below to find the approximate setting of the Battery Charge Rate potentiometer. The settings do not need to be exact, but should be as close as possible to the actual value required.

NOTE: The potentiometer does not have an arrow to indicate its position. Use a small blade screwdriver and rotate the control completely CCW to find the start position. Rotate the potentiometer CW to the desired position (i.e., halfway between the stops for a 50% setting).

	Percent of Potentiometer Rotation (between stops)				
Model	0% MIN	25%	50%	75%	100% MAX
DR1512 DR2424 DR3624	0 amps	17.5 amps	35 amps	52.5 amps	70 amps
DR2412	0 amps	30 amps	60 amps	90 amps	120 amps
DR1524	0 amps	8.75 amps	17.5 amps	26.25 amps	35 amps

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Table 8
Approximate Charge Rate Setting/Amperage

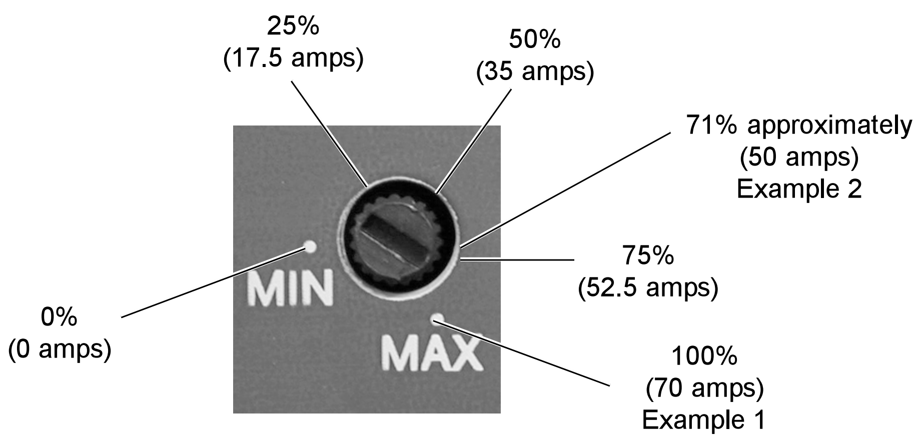

Figure 37
Battery Charger Rate Potentiometer (DR1512 values used)

Front Panel Controls and Indicators (continued)

Over Discharge Protection/AC Transfer Voltage

The Over Discharge Protection/AC Transfer Voltage potentiometer performs two related functions. When set between the 2 and 5 o'clock position (right), both ODP and the AC Transfer Voltage function simultaneously (see table on next page). When the potentiometer is set between the 9 and 1 o'clock position (left), only the AC Transfer Voltage is functional (ODP is disabled).

Over Discharge Protection (ODP)

When enabled, ODP shuts down the inverter at a specified voltage (low battery cutoff) to protect the batteries from over discharge damage. The inverter circuitry calculates the lowest (safe) DC voltage (leaving approximately 20% battery capacity) based on the position the Battery Type Selector switch and the amount of current drawn by the load. Under no-load conditions this level is typically between 11.8 and 12.0 VDC (for a 12 volt battery bank).

☞ NOTE: The range of set points between 2 and 5 o'clock also determine the low AC Transfer Voltage. This must be considered when adjusting this potentiometer with ODP enabled (see next page).

☞ NOTE: When ODP is disabled (set points between 9 and 1 o'clock), the inverter is programmed to shut OFF when the batteries reach approximately 8.5 VDC (1.4166 V/cell).

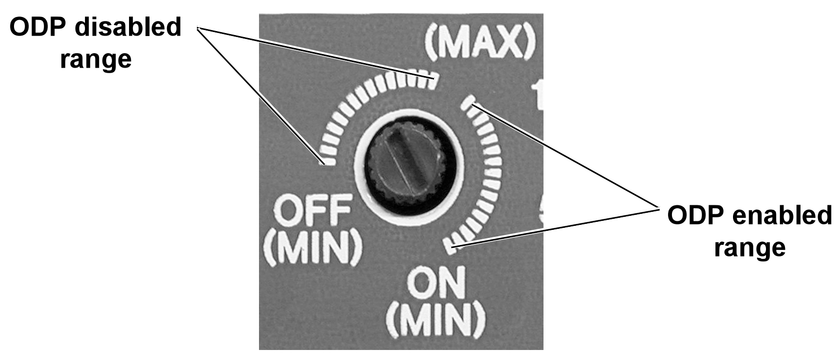

Figure 38
ODP Enabled/Disabled Positions

Front Panel Controls and Indicators (continued)

Over Discharge Protection/AC Transfer Voltage, (continued)

AC Transfer Voltage

During normal operation, the inverter supplies AC power to the applied loads through the pass-through circuit and simultaneously charges the system batteries. Whenever the external AC source drops below the AC Transfer Voltage (set by the potentiometer), the inverter switches to battery power in order to maintain the connected load.

Examples (120 VAC inverter system):

- The AC Transfer Voltage potentiometer is set to 9:00 o'clock with ODP disabled. Whenever the incoming AC voltage drops to 40 volts or below, the inverter will switch to battery power.
- The AC Transfer Voltage potentiometer is set to 2:00 o'clock with ODP enabled. Whenever the incoming AC voltage drops to 105 volts or below, the inverter will switch to battery power.

☞ NOTE: ODP does not affect the operation of the AC Transfer Voltage. ODP is either ON or OFF, depending upon the position of the potentiometer.

☞ NOTE: There are 6 settings available for the AC Transfer Voltage for both ODP OFF and ON as shown in the Table 9 below.

☞ NOTE: To achieve the fastest transfer time (typically less than 16 ms), set the AC Transfer Voltage potentiometer near the 2:00 o'clock position (with the ODP enabled); or, near the 1:00 o'clock position (with the ODP disabled). If a high number of "nuisance transfers" caused by transients on the AC line occur, adjust the potentiometer from the maximum position toward the minimum position (i.e., 2 o'clock toward 5 o'clock with ODP enabled; or 1 o'clock toward 9 o'clock with ODP disabled).

ODP Adjustment		AC Transfer Voltage		
ODP Disabled	ODP Enabled	100 - 105 VAC (-J / -K) Models	120 VAC Models	220 - 230 VAC (-W / -E) Models
9:00	5:00	36 VAC	45 VAC	90 VAC
Approximate	Approximate	77 VAC	85 VAC	170 VAC
Approximate	Approximate	81 VAC	90 VAC	180 VAC
Approximate	Approximate	86 VAC	95 VAC	190 VAC
Approximate	Approximate	90 VAC	100 VAC	200 VAC
1:00	2:00	95 VAC	105 VAC	210 VAC

Table 9
ODP/AC Transfer Voltage

Front Panel Controls and Indicators (continued)

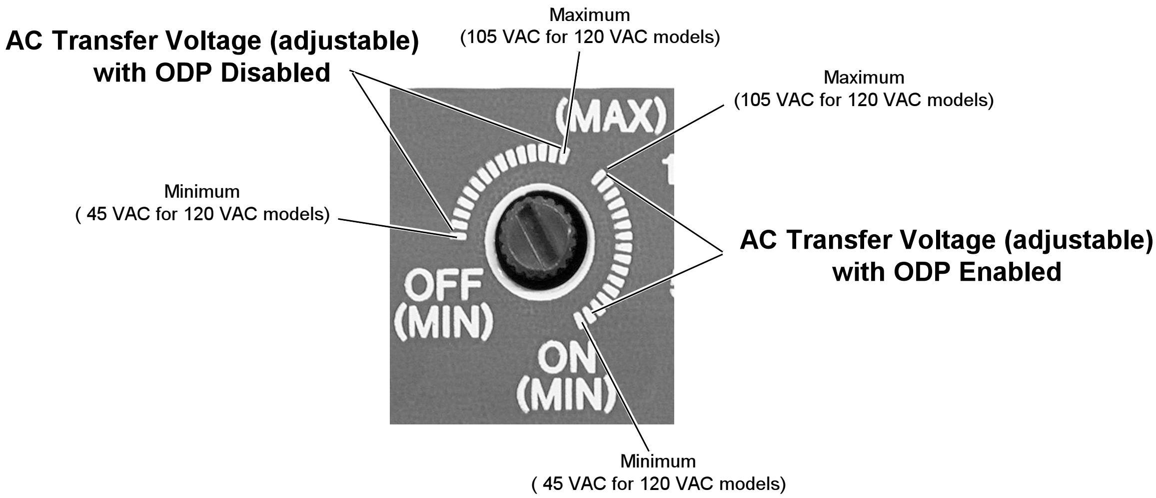

Figure 39
AC Transfer Voltage Potentiometer

NOTE: Most AC appliances will operate properly with an AC pass-through voltage between 95 and 105 volts. Setting the AC Transfer Voltage potentiometer between these values will allow the incoming source voltage to drop to this level and still operate the connected appliances (load). If the appliances do not operate properly at the lower AC utility pass-through voltage, increasing the setting of the potentiometer (toward MAX) allows the inverter to transfer to battery power (providing full AC output) during these periods.

NOTE: When setting the AC Transfer Voltage potentiometer for generator applications, the setting may need to be lowered if high powered loads cause the generator voltage to momentarily drop.

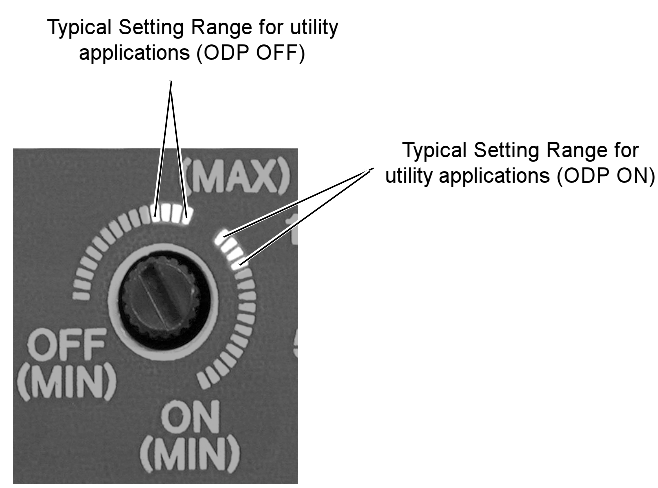

Figure 40
Typical Setting for Most Utility Applications

Front Panel Controls and Indicators (continued)

Battery Capacity

The Battery Capacity potentiometer is used to set the correct charge profile for the battery capacity (amp-hours) used with the inverter (see illustration below). The setting allows the inverter to calculate over-discharge protection values and also the end of the Bulk/Absorption charge mode, at which point the inverter switches to the Float mode of battery charging.

The potentiometer should be adjusted as close as possible to the actual capacity of the battery bank for optimum charging. If the system's battery bank is larger than 1000 amp-hours, set the potentiometer for 1K.

☞ NOTE: Most battery manufacturers list the amp/hour rating on the battery label.

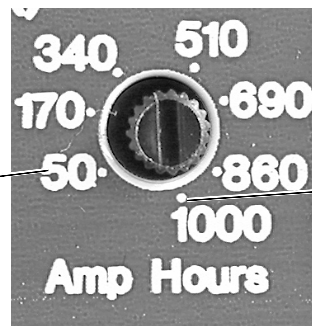

Figure 41A
Battery Capacity Potentiometer
(New)

☞ NOTE: The Battery Capacity (Amp/Hrs) potentiometer values have changed between the minimum value of 50 Ah and 1 kAh. Please use the photo that matches your unit.

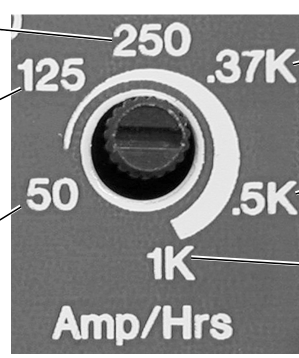

Figure 41B
Battery Capacity Potentiometer
(Old)

Front Panel Controls and Indicators (continued)

LED Indicators

There are four LEDs on the inverter's front panel, indicating inverter status, battery condition, over temperature/overload conditions and charger status. These LEDs blink or change color depending on the condition or function they are displaying.

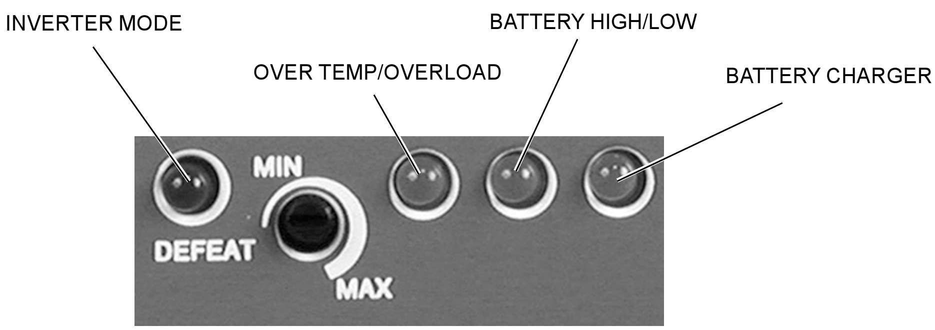

Figure 42
LED Indicators

Inverter Mode LED - Green

The green Inverter Mode LED lights (solid) to indicate the inverter is running on batteries (full wave operation). When the inverter is in search mode (no load applied) the LED flashes 2 to 3 times per second. During AC line operation, with AC passing directly through to the connected load, the LED remains OFF.

Over Temp / Overload LED - Red / Green (error condition)

The Over Temp / Overload LED is a dual color, dual function indicator. When the inverter's temperature is too high for safe operation, the LED lights (red) to indicate the Over Temp condition. When the temperature returns to a safe level, the LED turns OFF. If the condition persists, the inverter will shut down, cool and then restart.

Whenever the current draw exceeds a value programmed into the micro-controller, the LED lights (green) to indicate the Overload condition. The LED can remain ON for up to one hour (before inverter shutdown) if the condition is caused by a fault in the charger circuit. When the fault condition clears, the LED turns OFF. If the condition is caused by backfeed (connecting the AC line to the inverter's output) the LED will remain ON for approximately 10 seconds before the inverter shuts down.

Front Panel Controls and Indicators (continued)

Battery High/Battery Low LED - Red/Green (error condition)

The Battery Hi / Battery Low LED is a dual color, dual function indicator. Whenever battery voltage exceeds a safe value, the LED lights red to indicate the condition. This value is typically 15.5 volts DC for a 12 volt system (31 volts DC for a 24 volt system). If the condition persists, the inverter will shut down until the battery voltage returns to a safe level and then restart.

☞ NOTE: In renewable energy applications (solar, wind, hydro, etc.) the DC charge controllers must be set to a level below the inverter's maximum input voltage or the inverter shuts OFF.

Whenever the battery voltage drops to its lowest (safe) level (approximately 20% of battery capacity), the LED lights green to indicate the condition. If the condition persists, the inverter will shut down until the battery voltage returns to a safe level and then restart.

☞ NOTE: The inverter automatically restarts when the following error conditions are detected: LOW/ HIGH BATTERY, OVER TEMPERATURE, or a quick duration SHORTED OUTPUT or OVER-CURRENT. The inverter shuts OFF and requires a MANUAL restart if the following conditions are detected: a *prolonged* overload condition (approximately 10 seconds) or the inverter's output is connected directly to an AC power source (utility grid or generator).

Charger LED - Orange / Green

The Charger LED is a dual color, triple function indicator. When the charger is in Bulk mode, the LED lights orange. When the charger is in Absorption mode, the LED blinks orange. When the charger is in Float mode, the LED lights green.

☞ NOTE: The battery charger control circuit operates from the battery voltage. If the battery voltage falls below 7 volts, the inverter/charger will not operate. The batteries must first be recharged using a stand-alone charger to bring the voltage up to a level where the inverter/charger can operate.

Audible Indicator (internal)

A buzzer is located on the control board as an audible alert to fault conditions such as Battery High/Battery Low, or Overload. Steady buzzing indicates an impending inverter shut down. A pulsing chirp indicates the inverter is temporarily off-line due to a fault condition (either within the inverter or related to the system).

Front Panel Controls and Indicators (continued)

Circuit Breakers

The DR inverter/charger contains two circuit breakers located on the right-hand side of the chassis, directly above the AC input terminal block. The pass-through AC input circuit breaker protects the AC wiring and connected load. The charger AC input circuit breaker protects the charger circuit. The breakers are rated for the maximum charge rate and pass-through current allowed according to the rating of the internal relay.

Models	DR15xx	DR24xx	DR36xx
120 VAC	30 amps	30 amps	30 amps
240 VAC	15 amps	15 amps	N/A

Table 10
AC Pass-through Circuit Breakers

Models	DR15xx	DR24xx	DR36xx
120 VAC	20 amps	30 amps	30 amps
240 VAC	8 amps	15 amps	N/A

Table 11
Battery Charger Circuit Breakers

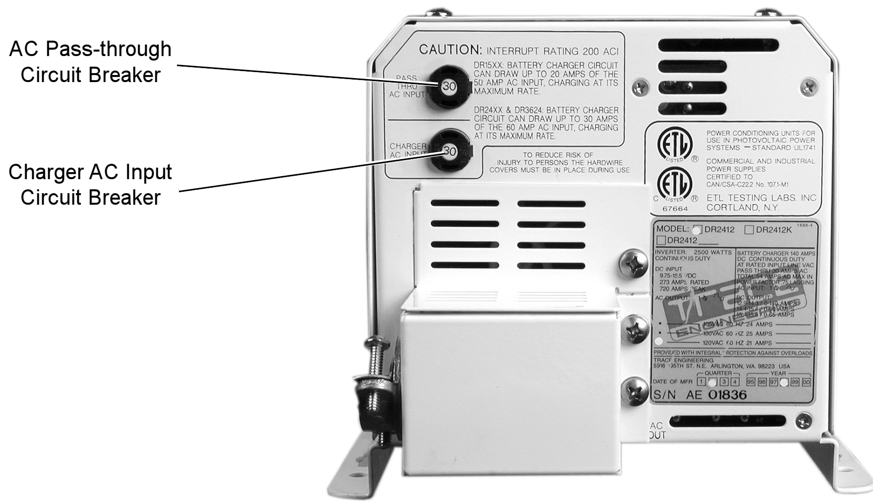

Figure 43
AC Pass-through and Charger AC Input Circuit Breakers

Start-up

Once the inverter is properly connected to the batteries, utility (or generator) and loads (via a sub-panel) the inverter is ready for operation. Recheck the controls (previously discussed) and ensure they are in the proper position. Recheck all wiring and ensure it is correct.

Starting the inverter:

- Apply DC power to the inverter by switching on the DC disconnect circuit breaker. The inverter will go through a self-test and then shut OFF.
- Apply AC power to the inverter by switching ON the utility circuit breaker located in the utility service entrance.
- Press the ON/OFF button once. The inverter will sound an audible chirp.
- The inverter starts charging the batteries in the Bulk mode, indicated by the CHARGER LED illuminating a solid orange.
- Using a true rms AC voltmeter, check the output voltage of the inverter. This voltage can be checked at either the AC terminal block or in the sub-panel (between the HOT and NEUTRAL lines). The voltage should be 120 VAC (230 VAC for “E” models, 220 VAC for “W” models, or 105 VAC for “J” and “K” models).
- Switch the AC disconnect circuit breaker to OFF. The inverter will go into the inverter mode (if a sufficient load is applied to the AC output while in the search mode). The green INVERTER MODE LED will light solid indicating the inverter is active. The voltage on the AC output of the inverter will remain the same as above (± 5% maximum).

☞ NOTE: If the inverter is in the SEARCH MODE (INVERTER MODE LED flashing) and a sufficient load is not available to bring the inverter up to full voltage, turn the SEARCH MODE WATTS potentiometer fully CCW to defeat the search function.

- Reapply the AC power by switching the AC disconnect to ON. Allow the batteries to fully recharge.

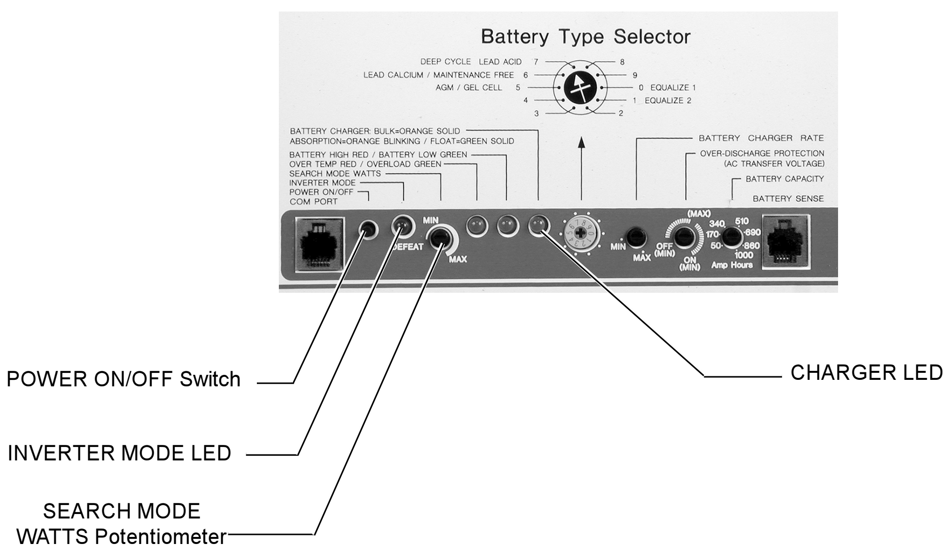

Figure 44
Start-up Items

3.0 OPERATION

Charger Mode

3-Stage Charging Process

The charging cycle uses a 3-stage charging process to maintain the batteries. Whenever nominal AC is present at the inverter's input, it passes power through to the connected load and begins charging the batteries, indicated by the dual color BATTERY CHARGER LED.

Bulk Charge

Bulk charge is the first stage in the charging process and provides the batteries with a controlled, constant current. A solid orange BATTERY CHARGER LED indicates bulk charge. The bulk charge level is adjustable using the BATTERY CHARGER RATE potentiometer. Once the battery voltage rises to the bulk voltage threshold, the charger then switches to the absorption mode.

Absorption Charge

Absorption charge is the second stage of battery charging and provides the batteries a controlled, constant voltage for a set period of time. A blinking orange BATTERY CHARGER LED indicates absorption charge. During this stage the current supplied to the batteries slowly decreases. When the current equals the programmed return amps value (battery bank capacity/ 40) set with the BATTERY BANK CAPACITY potentiometer, the charger switches to the third stage–float.

☞ NOTE: If there are DC loads connected to the battery, the current may never decrease to the level to initiate the float stage. The inverter/charger incorporates a timer circuit which starts counting when AC voltage is applied. To ensure that the charger does not stay indefinitely in the absorption charge mode, the timer automatically switches to the float charge mode when 12 hours have elapsed.

Float Charge

Float charge, the final stage of battery charging, maintains a trickle charge to the batteries whenever AC is present on the inverter's input. A solid green BATTERY CHARGER LED indicates float charging which reduces battery gassing, minimizes watering requirements (for flooded batteries) and ensures the batteries are in a constant state of readiness.

A new 3-stage charging cycle is initiated after an AC source is reapplied to the inverter's AC input terminals such as after a utility outage.

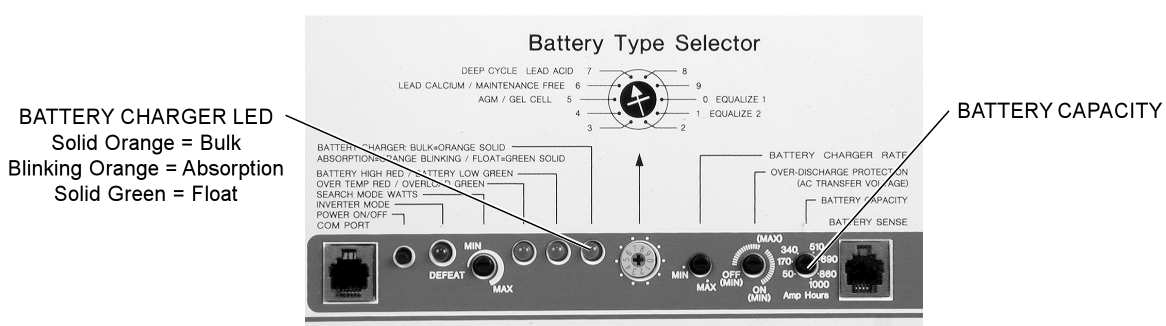

Figure 45
Charger Items

Charger Mode (continued)

Equalize Charging

Equalize charging is a special mode of battery charging. During use, the battery's cells can become unequal in the voltage and current they can deliver. This is due to a buildup of sulfate on the plates as well as stratified electrolyte. Sulfate prevents the cells from receiving or delivering full power. If the sulfate is left on the plates, it will harden, and permanently reduce the battery's capacity. Stratification separates the heaver acid from the water, and the concentrated acid remains at the lower portion of the plates, eventually corroding them.

Equalize charging holds the battery at the Equalize voltage for a minimum of 6 hours. This stirs up the electrolyte, distributing the acid, and removing the sulfate from the plates. Equalizing the batteries every month or two (depending on usage) prolongs the life of the batteries and provides better battery performance.

CAUTION: ONLY UNSEALED OR VENTED BATTERIES SHOULD BE EQUALIZE CHARGED. SINCE HYDROGEN AND OXYGEN GASES ARE PRODUCED WHEN EQUALIZED, PROVIDE ADEQUATE VENTILATION AND REMOVE ALL SOURCES OF IGNITION TO PREVENT EXPLOSION. REMOVE DC LOADS WHILE EQUALIZING AS THEY CAN BE DAMAGED BY THE HIGHER BATTERY VOLTAGE.

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

Setting the Equalize Charge

- Remove all DC loads connected to the batteries.
- Remove all battery vent caps.
- Check the battery water level, it should be just over the top of the plates (do not overfill). Use only distilled water for filling batteries.

NOTE: Recheck the water the level during equalize charging and refill if necessary.

- Set the BATTERY TYPE SELECTOR switch to position “0” or “1” to start the equalization charging process. A solid orange BATTERY CHARGER LED indicates equalize charge.
  - Position “0” equalizes the batteries at the rate of the battery bank capacity divided by 40 (C/40) at a voltage of 15 volts for 12 volt systems or 30 volts for 24 volt systems. This is set with the BATTERY CAPACITY potentiometer.
  - Position “1” equalizes the batteries at the rate set with the BATTERY CHARGER RATE CONTROL at a voltage of 15.5 volts for 12 volt systems or 31 volts for 24 volt systems.

When the voltage condition is met and 6 hours have elapsed, the charger will switch to the float mode. If the condition is not met (i.e., the current draw is above the rate set with the BATTERY CAPACITY potentiometer (position “0”) or BATTERY CHARGER RATE potentiometer (position “1”)), the charger will continue until the condition is met, *or* for a maximum of 12 hours. At this point the charger switches to float at the *equalize 1* or *2* voltage setting (see table on the next page).

- Reset the BATTERY TYPE SELECTOR potentiometer to the appropriate setting for the system's batteries when the Equalize charge has completed.

NOTE: Refer to the *Battery* section of the Appendix for additional battery maintenance information.

Charger Mode (continued)

Switch Position	Description	12 Volt Models		24 Volt Models		Equalize	
		Float Voltage	Bulk/Equalize* Voltage	Float Voltage	Bulk/Equalize* Voltage	Charge Rate	Time
0	**Equalize 1**	**13.2**	***15.0**	**26.4**	***30.0**	**Battery Capacity Setting (C/40)**	**6 hours minimum 12 hours maximum**
1	**Equalize 2**	**13.2**	***15.5**	**26.4**	***31.0**	**Battery Charger Rate Setting (manual)**	**6 hours minimum 12 hours maximum**
2	**Deep Cell Lead Acid 2**	13.3	15.0	26.6	30.0		
3	**Not Specified**	13.6	14.3	27.2	28.6		
4	**Gel Cell 2**	13.7	14.4	27.4	28.8		
5	**Gel Cell 1**	13.5	14.1	27.0	28.2		
6	**PbCa–Lead Acid**	13.2	14.3	26.4	28.6		
7	**Deep Cycle Lead Acid 1** (Default Setting)	13.4	14.6	26.6	29.2		
8	**NiCad 1**	14.0	16.0	28.0	32.0		
9	**NiCad 2**	14.5	16.0	29.0	32.0		

NOTES:
Switch positions "0" and "1" are for monthly battery maintenance only. Return the switch to the appropriate position for the system's batteries when Equalize charging has completed. NEVER EQUALIZE SEALED BATTERIES! Use together with BATTERY CHARGER RATE potentiometer (position 1) or BATTERY CAPACITY potentiometer (position 0).

Equalize voltages are displayed in the table with an asterisk (*)–switch positions "0" and "1" only.

Switch position "7" is the default value as shipped from the factory.

Always refer to the battery manufacturer's specifications for Float, Bulk and Equalize (if applicable) voltages.

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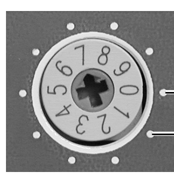

Figure 46
Equalize Positions on BATTERY TYPE SELECTOR Switch

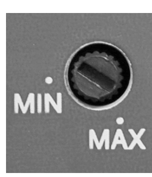

Figure 47
Equalize 1 BATTERY CHARGER RATE Potentiometer (position "1")

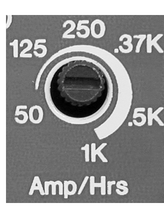

Figure 48
Equalize 2 BATTERY CAPACITY Potentiometer (position "0")

Troubleshooting		
Error Condition	**Possible Cause**	**Solution**
Battery HIGH LED (red) is ON, buzzer is ON.	The battery voltage is above the high battery voltage input tolerance.	Use a DVM and measure the voltage at the inverter's DC input terminals. Ensure the DC source is regulated below the High Battery Cutout voltage.
Battery LOW LED (green) is ON, buzzer is ON.	Battery over-discharge circuit is ON.	Charge batteries or disable the OVER-DISCHARGE PROTECTION.
	Battery voltage is below the low battery discharge tolerance.	Use a DVM and measure the voltage at the inverter's DC input terminals. Check for an external DC load on the batteries. Check the condition of the batteries and recharge if necessary. Check the AC INPUT circuit breaker and reset if necessary.
OVERTEMP LED (red) is ON, buzzer is ON.	AC input voltage may be too high.	Use an AC DVM and measure the input voltatge.
	The inverter is powering a large load for a long time.	Remove excessive loads.
	Ambient temperature may be high or inverter cooling fan may have failed.	Let inverter cool down before restarting. Check inverter's cooling fan.
	Air-vents blocked.	Check for obstructions in air-vents. Clean if necessary.
OVERLOAD LED (green):		
- turns ON after the inverter was running large loads.	Excessive load on the AC output.	Reduce the AC load.
- turns ON when the inverter is OFF.	Indicates the AC source is wired directly to the inverter's output.	Check input and output wiring.
- flickers for 5–10 seconds, then turns ON. Loud hum when an AC source is connected to the inverter.	Indicates the AC source is wired directly to the inverter's output.	Check input and output wiring.
- turns ON and the inverter clicks ON and OFF every 40 seconds.	Indicates the inverter's output is wired to its input.	Check input and output wiring.
- turns ON when charging.	Charging circuit may be damaged.	Have inverter/charger serviced.
INVERTER MODE LED:		
- turns ON with no AC output.	AC source voltage is okay on inverter's input. No AC output.	Check for open AC output breakers or fuses. Check AC wiring connections. Have unit serviced.
- is flashing and no AC output.	The load is too small for the search mode to detect.	Reduce or defeat the AC search watts setting. Increase the AC load.

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Troubleshooting		
Error Condition	**Possible Cause**	**Solution**
No AC output and no warning LEDs are ON.	Battery voltage at the inverter terminals is too high or low.	Check the battery voltage, fuses or breakers, and cable connections.
AC output is low and the inverter turns loads ON and OFF.	Low battery.	Check the condition of the batteries and recharge if possible. Replace the batteries.
AC output is low.	Loose or corroded battery connections. Loose AC output connections.	Check and clean all DC connections. Check all AC output connections.
AC output voltage is low.	Measuring AC output with incorrect type of meter. AC output voltage low using a true rms reading meter or DVM.	Measure AC output voltage with a true rms reading meter or DVM. Have unit serviced.
CHARGER LED: - indicates charging, but no charge is going to the batteries. - is ON, but there is no output power.	 Circuit breaker on the side of the inverter is open. No AC voltage on inverter's AC terminal block. Good AC voltage on inverter's AC terminal block.	 Reset the AC CHARGER circuit breaker on the side of the unit. Check "AC PASS-THRU" circuit breaker on the side of the inverter. Check for open AC output breakers or fuses and AC wiring connections.
Charger is inoperative or supplying a low charge rate.	AC voltage has dropped out-of-tolerance. Charger controls are improperly set. Low peak AC input voltage (169 VAC_p required for full charger output). AC current supplied from generator is too low. Loose or corroded battery connections. Loose AC output connections. Generator is unstable - charger is losing synchronization.	Check the AC voltage for proper voltage and frequency (depending upon model). Refer to the section on adjusting the "CHARGER RATE." Use larger generator (increasing AC voltage/RPM's may help). Reduce charge amps setting or reduce pass-through loads. Check and clean all DC connections. Check all AC output wiring connections. Turn BATTERY CHARGER RATE potentiometer down to less than halfway until problem is gone.
AC lights flicker while charging.	Generator is unstable and charger is losing synchronization.	Turn BATTERY CHARGER RATE potentiometer down to less than halfway until problem is gone.
Charger turns OFF while charging from a generator.	High peak AC input voltages from the generator.	Load the generator down with a heavy load. Turn the generator output voltage down.

975-0012-015B

Batteries

Batteries are available in different sizes, types, amp-hours, voltages and chemistries. It is important the correct battery is chosen in designing a battery bank for your application.

Selection of a Battery Type

There are two principal types of batteries: starting and deep-cycle (with several different types of chemistries). Batteries can be either sealed or non-sealed (vented).

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). DO NOT use automotive (starting) batteries–they are designed to provide high starting current for short periods of time.

Flooded Lead Acid (FLA)

This type of battery is designed to be deep cycled before being recharged, making it suitable for inverter applications. Flooded batteries require periodic maintenance consisting mainly of adding distilled water to the cells, checking battery cable connectors for tightness and keeping the terminals clean. Examples of flooded batteries include:

RV and Marine

- Popular in small systems
- Often referred to as “Group 24” or “Group 27” batteries
- Designed for limited cycling
- Do not last as long as the other “true” deep cycle batteries
- Typically rated at 12 volts (80 to 100 amp-hours)

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)

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)

Both gel and AGM batteries are virtually maintenance free, making them ideal for inverter applications. Since the batteries are completely sealed, they can be mounted in almost any position. The only disadvantages, compared to flooded batteries, are a higher initial cost and greater susceptibility to damage from changes in temperature during charging.

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-fiber mats between battery plates
- Similar to gel cells in characteristics
- Good low temperature performance

CAUTION: IF USING SEALED OF BATTERIES, ENSURE THE BATTERY CHARGER IS SET TO THE APPROPRIATE SETTINGS OR BATTERY DAMAGE WILL RESULT.

Selection of a Battery Type (continued)

NiCad and NiFe Batteries

Trace inverters and battery chargers are optimized for use with lead-acid batteries having a nominal 2.0 volts per cell (i.e., 6 cells for a 12 volt system, 12 cells for a 24 volt system and 24 cells for a 48 volt system). Alkaline batteries, such as NiCads and NiFe types, have a nominal cell voltage of 1.2 volts per cell. The number of cells required in a battery bank for alkaline batteries must be adjusted for a 12, 24 and 48 volt system (i.e., 10 cells for a 12 volt system, 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.

Another option for 24 volt (only) alkaline battery banks is to use only 19 cells instead of 20. This allows the battery charger to operate closer 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.

Battery Bank Sizing

The battery bank's size determines the length of time the inverter can continue to supply AC output power during a utility outage. The larger the bank, the longer the inverter can run. An undersized battery bank results in reduced battery life and short inverter run times.

In general, the battery bank should be designed so the batteries do not discharge more than 50% 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 results in permanent damage and reduced battery life.

For stand-alone applications, design a battery bank that can power the loads for 3–5 days without requiring recharging. To duplicate the conditions on sun-less days or windless periods, the power supplied from other sources (i.e., solar, wind, hydro, etc.) is not included in this calculation. This is often referred to as the "number of days of autonomy." If the system is a hybrid, with daily generator run periods, the battery bank size can be smaller.

Estimating Battery Requirements

To determine the proper battery bank size, it is necessary to compute the number of amp-hours that are required between charging cycles. When the required amp-hours are known, size the batteries at twice this amount to ensure the batteries are not regularly over-discharged.

To compute the amp-hour requirements, the amp-hour ratings of each appliance powered by the inverter must be added together. Use the figures from the nameplate label on the appliances, then use the formula WATTS = VOLTS x AMPS. Then divide the calculated wattage of the load by the system battery voltage to determine the amperage the load will draw from the batteries.

(AC current) x (AC voltage)/(battery voltage) = DC amps.

Example:
Nameplate label specifies 6 amps at 120 VAC.
The system battery voltage is 24 volts DC.

- First determine the wattage by using the formula: WATTS= VOLTS x AMPS = 120 x 6 =720 watts.
- Then divide the wattage by the system battery voltage to determine the DC amperage. 720/24 = 30 amps DC amps.

If the AC wattage is specified on the nameplate label, the battery amperage will be:
(watts)/(battery voltage) = DC amps (720/24 = 30 DC amps).

Multiply the amperage by the number of hours the load will operate to roughly calculate amp-hours. Double this figure to reach the 50% battery capacity level.

Refer to the example and work sheet on the following pages as a guide to determine the battery bank's amp-hour requirements.

☞ NOTE: Motors typically require 3–6 times their running current when starting. Check the manufacturer's data sheets for their starting current requirements. If large motors will be started from the inverter, increase the battery bank size to allow for the higher start-up current.

Battery Bank Sizing (continued)

Example

Complete the following steps to calculate the battery bank capacity requirements. Use the blank table on the next page to enter the values for your system. An example table is shown below.

AC Appliance	Step 1 Appliance Running Watts	Step 2 (x) Hours Used Each Day	Step 3 (x) Days Used Each Week	Step 4 (÷ 7 =) Average Daily Watt-Hours Required
Microwave	600	0.5	7	300
Lights (x 4)	40	6	7	240
Hair Dryer	750	0.25	3	81
Television	100	4	7	400
Washer	375	1	2	107
Refrigerator*	480/3 = 160	24	7	3840
Vacuum Cleaner	1200	1	1	171

Total Daily Watt-Hours Required	Autonomy Battery Size	Rough Battery Size (Watt-Hours)	Safe Battery Size (Watt-Hours)	Safe Battery Size (Amp-Hours)
5,139	15,417	30,834	37,001	1,542

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* 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 and enter it in Step 2.

Step 1 Determine the loads the inverter will power and list them in the Step 1 column.

Step 2 Enter the running wattage of each appliance in the Step 2 column.

Step 3 Determine the number of hours (or fraction of hours) the appliance is used each day. Enter this figure in the Step 3 column.

Step 4 Determine the number of days the appliance will be used during the week. Enter this figure in the Step 4 column.

Step 5 Divide the number (entered into each row of the Step 4 column) by 7 to obtain the AVERAGE DAILY WATT-HOURS REQUIRED figure. Enter these figures in the Step 5 column.

Step 6 Add all the figures entered into the AVERAGE DAILY WATT-HOURS REQUIRED (Step 5) column and enter this number into the TOTAL DAILY WATT-HOURS REQUIRED (Step 6) column in the second table.

Step 7 Multiply the TOTAL DAILY WATT-HOURS REQUIRED (Step 6) figure by the number of days of autonomy (days between recharging expected, usually between 1 to 5. The examples use 3). Enter this figure into the AUTONOMY BATTERY SIZE (Step 7) column.

Step 8 Multiply the AUTONOMY BATTERY SIZE (Step 7) figure by 2 to provide a 50% maximum battery discharge level. Enter this figure in the ROUGH BATTERY SIZE (WATT-HOURS) (Step 8) column.

Step 9 Multiply the ROUGH BATTERY SIZE (WATT-HOURS) figure (Step 8) by 1.2 and enter this figure in the SAFE BATTERY SIZE (WATT-HOURS) (Step 9) column. This figure allows for an efficiency of 80%.

Step 10 Divide the SAFE BATTERY SIZE (WATT-HOURS) (Step 9) figure by the DC system voltage (i.e., 12, 24 or 48 volts). Enter this number in the SAFE BATTERY SIZE (AMP-HOURS) (Step 10) column. Use this figure to determine the number of batteries required to reach the amp-hour rating.

Step 1	Step 2	Step3	Step 4	Step 5
AC Appliance	Appliance Running Watts	(x) Hours Used Each Day	(x) Days Used Each Week	(÷ 7 =) Average Daily Watt-Hours Required

Step 6 Total Daily Watt-Hours Required	Step 7 Autonomy Battery Size	Step 8 Rough Battery Size (Watt-Hours)	Step 9 Safe Battery Size (Watt-Hours)	Step 10 Safe Battery Size (Amp-Hours)

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5.0 APPENDIX

Typical Appliance Wattages

The following chart lists some common appliances and their estimated wattage. These are only rough estimates and not intended as a replacement for the actual label ratings found on the appliances.

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 TV (19")	150	Hair Dryer or Iron	1000
*Refrigerator (3 cu ft)	180	Vacuum Cleaner	1200
*Refrigerator (12 cu ft)	480	Coffee Maker	1200

* Refrigerators and icemakers typically run only 1/3 of the time, therefore, the running wattage is 1/3 or the total wattage of the appliance.

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Table 12
Typical Appliance Wattage

Battery Care and Maintenance

To get the best performance from an inverter system, the batteries must be properly set up and maintained. This includes setting the proper voltages for Bulk and Float charging. Monthly, the batteries should be Equalize charged (vented batteries only) and the water level checked and maintained (see Cautions below). 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 reduced battery life.

Charge Rate

The maximum safe charge rate is related to the size and type of the batteries. Standard vented lead acid batteries (with removable caps) can be charged at a high rate, equal to their capacity. Small batteries may require a lower charge rate. Check with your battery manufacturer 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 rate should be adjusted according to the temperature of the battery. This can be accomplished automatically by using a Battery Temperature Sensor (BTS). The sensor attaches directly to the side of one of the batteries in the bank and provides precise battery temperature information.

Equalization Charging

Every month or two the batteries should be Equalize charged. This helps to remove sulfate buildup on the battery plates and balances the charge of individual cells. Batteries that are not equalized charged can be damaged by sulfate buildup, thus sealing off a percentage of the plates and reducing battery capacity.

Equalize charging also produces gassing which stirs up the electrolyte mixture and helps distribute the acid more evenly. Batteries that are not equalize charged may have the 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 is call stratification.

⚠ **CAUTION: BECAUSE A HIGHER VOLTAGE IS USED TO EQUALIZE CHARGE THE BATTERIES, ANY DC LOADS MUST BE DISCONNECTED BEFORE AN EQUALIZATION CHARGE IS STARTED.**

⚠ **CAUTION: 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.**

Battery Care and Maintenance (continued)

Replenish Water Levels

Liquid 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 contaminates 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.

Clean Battery Cables and Posts

WARNING: BEFORE ATTEMPTING TO CLEAN THE BATTERY POSTS, TURN OFF THE DC CIRCUIT BREAKER. USE ONLY INSULATED TOOLS AND REMOVE ALL JEWELRY.

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.

CAUTION: 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.

Battery Care and Maintenance (continued)

Check Battery's State of Charge

The battery's state of charge should be checked monthly and only when the battery is not powering heavy loads or is being actively charged. 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 (i.e., 12.6 V divided by 6 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.

Percent of Full Charge	System Voltage			Individual Cell Voltage
	12 V	24 V	48 V	
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

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Table 13
Battery State of Charge

5.0 APPENDIX

Problem Loads

The inverter can drive most loads, however, there are special conditions that can cause a load to behave differently than expected. The following describes some of the common problems encountered when using an inverter.

Ceiling Fans

Most large diameter, slow turning fans run correctly, but generate more noise than when connected to utility power. High speed fans tend to operate normally.

Cell Phones

Some cellular telephones experience interference in the form of a clicking sound.

Computers and Sensitive Electronics

Some computers and sophisticated electronics have power supplies that do not present a load until correct line voltage is available. When this occurs, each unit waits for the other to begin. This can usually be solved by plugging in an additional load (such as a lamp) to bring the inverter out of its search mode. Also, when using a computer, avoid starting large loads.

Consumer Electronics

AM radios tend to pick up inverter noise, especially on the lower half of their band. Inexpensive tape recorders are likely to experience noise as well. When using sensitive electronic devices, avoid starting large loads.

Clocks

The inverter's crystal controlled oscillator keeps the frequency accurate to within a few seconds a day; however, external loads in the system may alter the inverter's output waveform causing clocks to run at different speeds. There may be periods where clocks keep time and then mysteriously do not. This is because most clocks do not draw enough power to trigger the load sensing circuit. In order to operate, especially with no other loads present, the inverter's load sensing circuit will have to be defeated. Refer to the Operation/Search Mode Watts.

Decreasing Loads

If the amount of power a load draws decreases after it has been switched on (such as with a small motor) and its current draw becomes less than the load sensing threshold, it will be turned alternately ON and OFF by the inverter. This can usually be solved by plugging in an additional load (such as a lamp).

Dimmer Switches

Most dimmer switches lose their ability to dim the lights when used with an inverter and operate only in the fully ON or OFF position. Newer, microprocessor controlled dimmers tend to work better in inverter applications.

Problem Loads (continued)

Fluorescent Lights

Some devices cannot be detected by the inverter's load sensor and will not operate. Small fluorescent lights are the most common example. This can usually be solved by plugging in an additional load. Also, try turning the lamps AC plug over.

Heavy Loads

If the battery bank cannot deliver the necessary amperage to drive a heavy load, the inverter will shut OFF. The battery voltage will then slowly rise back above the low voltage threshold causing the inverter to resume operation. As soon as the heavy load draws the batteries down, the cycle will continue unless the load is reduced or an additional source of power is added.

Microwave Ovens

Microwave ovens are sensitive to peak output voltages. The higher the voltage, the faster they cook. Since the inverter's peak output voltage is dependent upon battery voltage and load size, the microwave's cook time may need to be increased.

Printers

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

Rechargeable Devices

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

Undersized Loads

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

Multiwire Branch Circuits

A potential safety problem exists when installing stand-alone 120 VAC inverters into existing 120/240 VAC wired panels where multiwire branch circuit wiring methods were used.

Multiwire branch circuits are wired differently from “home run” type wiring (Figure 49) 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 separate “romex” for each circuit.

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 50.

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 51. 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.

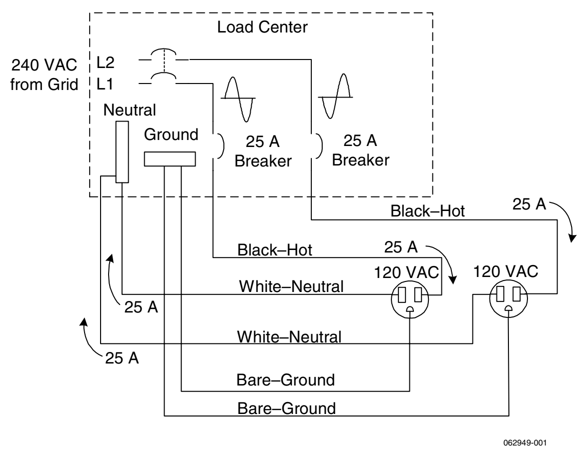

Figure 49
Conventional “Home-run” Type Wiring

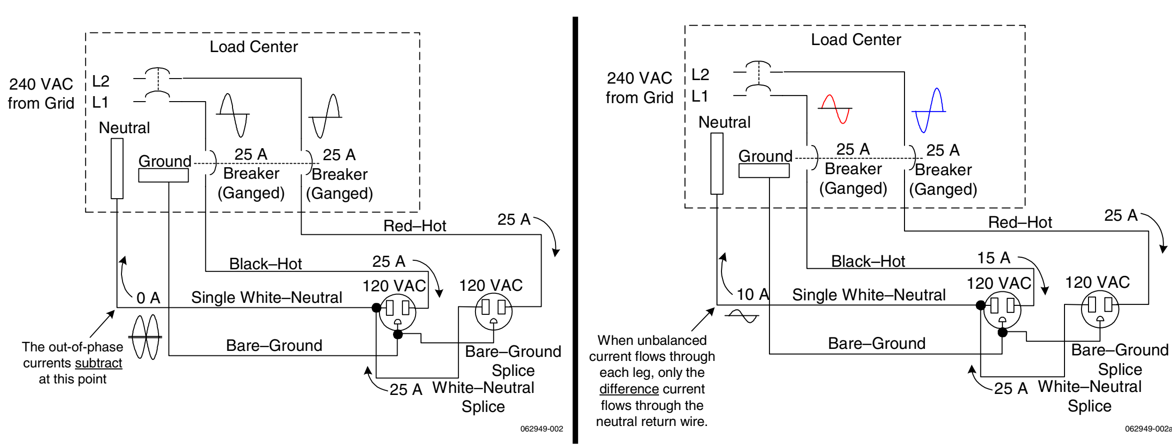

Figure 50
Multiwire Branch Circuit Wiring and Current Flow

Multiwire Branch Circuits (continued)

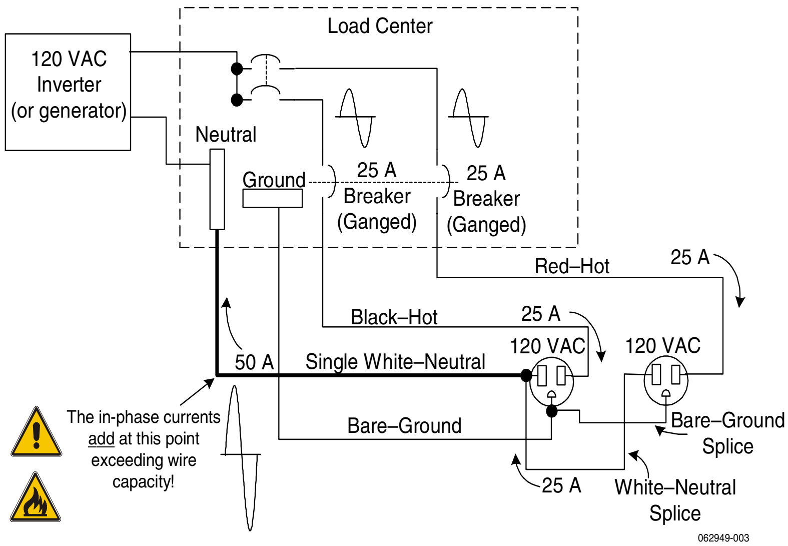

Figure 51
120 VAC Inverter Incorrectly Wired in a Multiwire Branch Circuit

Identifying Multiwire Branch Circuits

WARNING: THE NEXT STEP INVOLVES OPENING THE LOAD CENTER EXPOSING LIVE CIRCUITS. THIS PROCEDURE SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONS OR ELECTRICIANS.

Multiwire 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. Multiwire branch circuits use a 3-wire-plus-ground arrangement (black, red, white and copper) for each circuit run (Figure 49).

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.

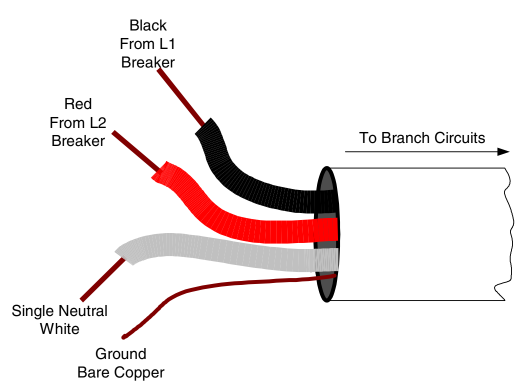

Figure 52
Multiwire Branch Circuit Wiring

Multiwire Branch Circuits (continued)

Correcting Multiwire Branch Circuit Wiring

Correcting multiwire branch circuit wiring is not an easy task. There are several approaches that can be taken, each with its advantages and disadvantages.

- Rewire existing multiwire branch circuits to conventional "home run" wiring. This requires a qualified electrician (knowledgeable of multiwire branch circuit wiring) and is expensive. There may be multiple multiwire 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 multiwire branch circuits, plus it provides increased power backup protection and can power 240 VAC loads.
- Add a T240 Autotransformer to the output of the inverter to restore the split-phase configuration. This is the least expensive and easiest method to correct for multiwire branch circuit wiring. Refer to Figure 53. 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 multiwire branch circuit.

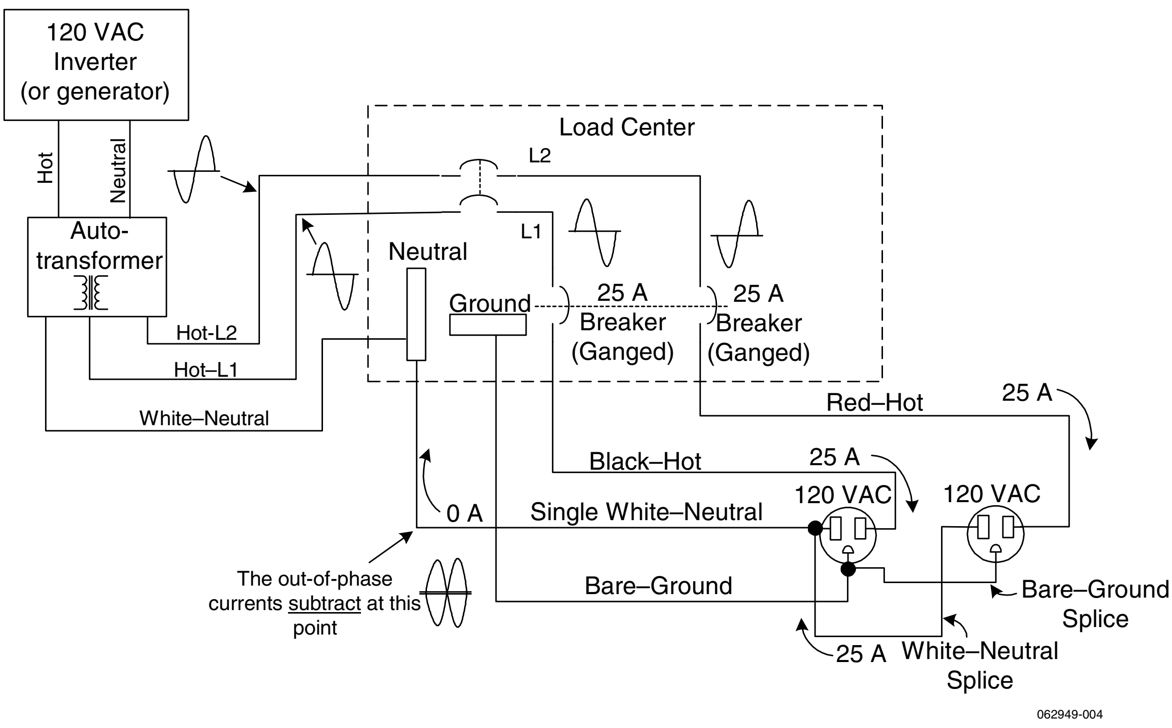

Figure 53
Using A T240 Autotransformer in Multiwire Branch Circuit Wiring

WARNING: UNTIL ONE OF THE SOLUTIONS ABOVE IS IMPLEMENTED, A STAND-ALONE 120 VAC INVERTER (OR GENERATOR) MUST NOT BE INSTALLED WHERE MULTIWIRE BRANCH CIRCUITS EXIST.

Limited Warranty

Xantrex warrants its power products against defects in materials and workmanship for a period of two (2) years from the date of purchase, established by proof of purchase or formal warranty registration, and extends this warranty to all purchasers or owners of the product during the warranty period. Xantrex does not warrant its products from any and all defects:

- arising out of material or workmanship not provided by Xantrex or its Authorized Service Centers;
- when the product is installed or exposed to an unsuitable environment as evidenced by generalized corrosion or biological infestation;
- resulting from abnormal use of the product, alteration, or use in violation of the instructions;
- in components, parts, or products expressly warranted by another manufacturer.

Xantrex agrees to supply all parts and labor to repair or replace defects covered by this warranty with parts or products of original or improved design, at the company's option. Xantrex also reserves the right to improve the design of its products without obligation to modify or upgrade those previously manufactured. Defective products must be returned to Xantrex or its Authorized Service Center in the original packaging or equivalent. The cost of transportation and insurance on items returned for service is the responsibility of the customer. Return transportation (UPS Ground or equivalent) as well as insurance on all repaired items is paid by Xantrex.

All remedies and the measure of damages are limited to the above. Xantrex shall in no event be liable for consequential, incidental, contingent, or special damages, even if Xantrex has been advised of the possibility of such damages. Any and all other warranties, expressed or implied, arising by law, course of dealing, course of performance, usage of trade or otherwise, including, but not limited to, implied warranties of merchantability and fitness for a particular purpose, are limited in duration for a period of two (2) years from the original date of purchase.

Some states or counties do not allow limitations on the term of an implied warranty, or the exclusion or limitation of incidental or consequential damage, which means the limitations and exclusions of this warranty may not apply to you. Even though this warranty gives you specific legal rights, you may also have other rights which vary from state to state.

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6.0 WARRANTY

Life Support Policy

Xantrex does not recommend the use of any of its products in life support applications or direct patient care. This especially applies to situations where the product's failure or malfunction can be reasonably expected to cause the failure or malfunction of the life support device, or to significantly affect its safety or effectiveness.

Examples of life support devices include: neonatal oxygen analyzers, nerve stimulators (whether used for anesthesia, pain relief, or other purposes), autotransfusion devices, blood pumps, defibrillators, arrhythmia detectors and alarms, pacemakers, hemodialysis systems, peritoneal dialysis systems, neonatal ventilator incubators, ventilators for both adults and infants, anesthesia ventilators, and infusion pumps as well as any other devices designated as "critical" by the U.S. FDA.

Xantrex will not knowingly sell its products for use in such applications unless it receives, in writing, assurances satisfactory to The Company, that (a) the risks of injury or damage have been minimized, (b) the customer assumes all such risks, and (c) the liability of Xantrex is adequately protected.

Warranty Registration

To ensure proper registration, complete the Warranty Card and mail it to Xantrex within 10 days from the date of original purchase. Also, keep your bill of sale as proof of purchase.

Warranty Repairs must be performed only at an authorized Xantrex service center or at the Xantrex factory. Unauthorized repairs will void the warranty. A Return Merchandise Authorization (RMA) number must be obtained PRIOR to shipment and must be included with the returned product.

You can also register your product on-line at the Xantrex/Trace Web Site. Go to: www.traceengineering.com and locate "quick links" on the home page. Click on the "Technical Support" window and select "Warranty Registration."

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Xantrex Technology Inc. takes great pride in its products and makes every effort to ensure your unit fully meets your independent powering needs.

If your product needs repair, contact our Service department at: (360) 435-8826 to obtain an RMA# and shipping information; or, fax this page with the following information to: (360) 474-0616.

Please provide:

Model Number: ______________________________

Serial Number: ______________________________

Purchase Date: ______________________________

Problem: ______________________________

Include a telephone number where you can be reached during business hours and a complete return shipping address (P.O. Box numbers are not acceptable).

Name: ______________________________

Address: ______________________________

City: ______________________________

State / Province: ______________________________

Zip / Postal Code: ______________________________

Country: ______________________________

Phone: (___) ______________________________

FAX: (___) ______________________________

E-mail Address: ______________________________

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8.0 SPECIFICATIONS

DR Series Specifications

MODEL	**DR1512**	**DR2412**	**DR1524**	**DR2424**	**DR3624**
Continuous Power (@ 20 °C)	1500 VA	2400 VA	1500 VA	2400 VA	3600 VA
Efficiency	94% max	94% max	94% max	95% max	95% max
Input Current					
Search Mode	0.045 amps	0.055 amps	0.030 amps	0.030 amps	0.030 amps
Full Voltage	0.700 amps	0.900 amps	0.350 amps	0.450 amps	0.500 amps
Rated Power	165 amps	280 amps	80 amps	140 amps	210 amps
Short Circuit	400 amps	800 amps	280 amps	560 amps	720 amps
Input Voltage (Nominal)	12 VDC	12 VDC	24 VDC	24 VDC	24 VDC
Input Voltage Range	10.8-15.5 VDC	10.8-15.5 VDC	21.6-31 VDC	21.6-31 VDC	21.6-31 VDC
Auto Low Battery Protection	11 V or defeated	11 V or defeated	22 V or defeated	22 V or defeated	22 V or defeated
Charger Rate (Adjustable)	0-70 amps	0-120 amps	0-35 amps	0-70 amps	0-70 amps
Unit Weight	35 lb. (16 kg)	45 lb. (21 kg)	35 lb. (16 kg)	40 lb. (19 kg)	45 lb. (21 kg)
"E" models	39 lb. (18 kg)	N/A	39 lb. (18 kg)	45 lb. (21 kg)	N/A

Common Specifications

Voltage Regulation (Max)	+/- 5%
Voltage Regulation (Typ)	+/- 2.5%
Waveform	modified sine wave
Power Factor (allowed)	0 to 1
Frequency Regulation	60 Hz ± 0.04%
"E" models	50 Hz ± 0.04%
"J" models	50 Hz ± 0.04%
"K" models	50 Hz ± 0.04%
Standard Output Voltage	120 VAC @ 60 Hz
"E" models	230 VAC @ 50 Hz
"W" models	220 VAC @ 60 Hz
"J" models	105 VAC @ 50 Hz
"K" models	105 VAC @ 60 Hz
Adjustable Load Sensing	5 watt minimum
Series Operation for 120/240 VAC	yes
"E, W" models	no
Forced Air Cooling	variable speed fan
Automatic Transfer Relay	30 amps
"E" models	20 amps
"W" models	20 amps
Number of Charging Profiles	10
Three Stage Charging	yes (float, absorption, bulk)
Temperature Comp Probe	optional
Remote Control	optional

Environmental Characteristics

Ambient Temp Range	
Operating	0 °C to +50 °C
Nonoperating	-55 °C to +75 °C
Altitude	
Operating	15,000 feet
Nonoperating	50,000 feet
Dimensions*	8.5" W x 7.25" H x 21" D 21.6 cm W x 18.4 cm H x 54.6 cm D
Mounting	wall-mount (with 16" mounting centers) shelf-mount

*Allows for hardware extensions such as mounting rails, DC terminals, and front panel controls.

Specifications subject to change without notice.

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