Voyager Series

Inverter / Charger

Owner's Manual

P/N 975-0006-01-01 Rev. A 3/00

inside front cover

IMPORTANT SAFETY INSTRUCTIONS

This manual contains important safety and operating instructions that should be followed during the installation, operation and maintenance of this product as prescribed by UL for inverters used in marine applications.

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 the operator's manual.
- Do not expose this unit to rain, snow or liquids of any type. This product is designed only for indoor mounting.
- To reduce the chance of short-circuits when installing or working with the inverter or the batteries, use insulated tools.
- Remove all jewelry such as rings, bracelets, necklaces, etc., while 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 unless fully qualified.

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 build-up 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. 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 the skin is 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 the local recycling center for proper disposal information.

SAVE THESE INSTRUCTIONS

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Figure 1
The Voyager Inverter/Charger
(Series II shown)

1.0 INTRODUCTION

1.1 Features and Benefits

Congratulations on purchasing one of the most flexible, reliable, easy-to-install inverters ever produced for the marine industry: the Voyager Series from Trace Engineering.

Built and tested to withstand even the toughest marine environment, Voyager's rugged aluminum construction and corrosion resistant design make it the inverter of choice for boaters, professional marine installers and original equipment manufacturers throughout the world.

Voyager is flexible enough to meet even the most demanding powering needs, yet simple to operate. With the optional menu-driven remote control, configuration and setup is as simple as pressing a button - no more jumpers or DIP switches to worry about.

Installation is easy: connect the inverter's output to the distribution panel's input; connect the AC (shore power) cable to the inverter's front panel terminal block; connect the batteries, and then switch on the power.

To ensure the highest level of electrical safety, Voyager is UL Listed and meets the stringent requirements of UL458. Add to that a 3-year warranty and the backing of the world's largest and most successful inverter manufacturer and what you have is one powerful marine inverter.

1.2 Standard Features

- Continuous inverter power

  Voyager Series I –

  V1012 – 1,000 watts

  V1512 – 1,500 watts

  Voyager Series II -

  V2012 – 2,000 watts

  V2512 – 2,500 watts

  V3012 – 3,000 watts
- 3-stage battery charging with temperature compensation
- Battery temperature sensor
- Selectable charging profiles for Liquid Lead Acid, GEL or AGM battery types
- High / low battery protection circuitry
- Over-temperature / over-current protection
- Automatic neutral / ground bond switching (per UL and NEC)
- Dual AC outputs with built-in circuit breakers (except 2.5 and 3.0 KW models)
- 30 amp transfer relay
- 36 month warranty

1.3 Optional Features

- RC8 - remote ON/OFF switch and status indicator
- RC5 - full function, programmable remote control
- URC - full function, digital remote control
- TFB - high current, class T fuse in fuse block
- BCx - UL listed battery cable kits

1.0 INTRODUCTION

Figure 2
Inverter Mode

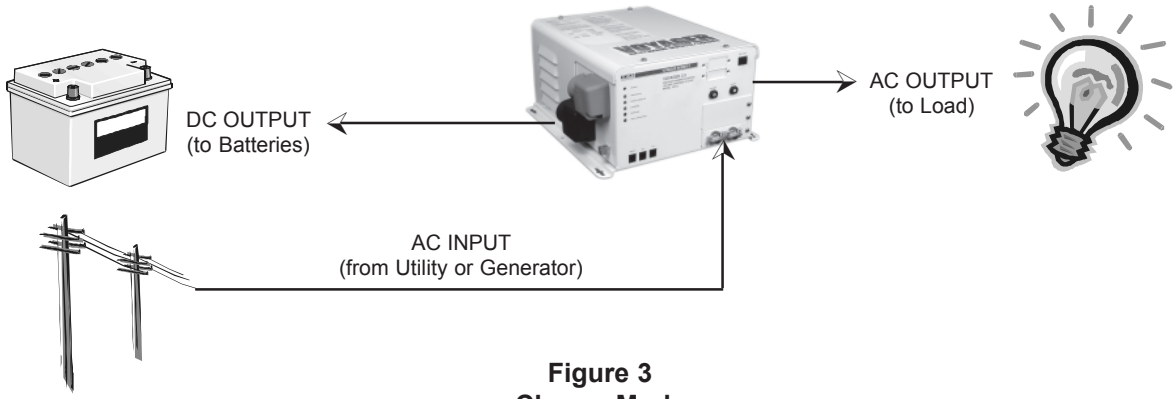


Figure 3
Charge Mode

1.0 INTRODUCTION

1.4 How an Inverter/Charger Works

An inverter essentially transforms direct current (DC) into alternating current (AC). It also takes alternating current and transforms it back into direct current.

Inverter Mode:
Direct current (DC) is taken from the batteries and transformed to alternating current (AC) for use with household appliances (figure 2).

Charge Mode:
Alternating current (AC) is taken from the utility (shore power) and passed directly to the connected load (household appliances). A portion of the AC is transformed back to DC and used to recharge the batteries (figure 3).

1.5 What an Inverter Can Power

The Voyager Series inverter/charger can power a wide range of loads such as household appliances, small motors and other electrical devices. Actual run time depends on several variables including the size and the type of load. Battery type, capacity, and age; the battery's state of charge; and temperature also affect run times.

Size of the Load (Watts or Volt Amps)
Electrical appliances are rated by the amount of power they consume (table 1). The rating is printed on the product's nameplate label, usually located on its chassis near the AC power cord.

Type of Load (Resistive or Inductive)
Toasters, coffee pots and incandescent lights are typical resistive loads. They are the simplest and most efficient for an inverter to power. Large resistive loads, such as electric stoves and water heaters, are impractical to use with an inverter since the high current demands would quickly drain the batteries.

TVs, VCRs, stereos, computers, etc., contain transformers and are considered inductive. These loads require more current than a resistive load of the same wattage rating because of the transformer's start-up characteristics. Electric motors are also inductive; however, depending upon the size of the motor, it can require 2 to 6 times its running current to start, momentarily exceeding the inverter's maximum output rating. Only testing a specific load will determine if it can be started and how long it will run.

RUN TIME IN MINUTES		**5**	**15**	**30**	**60**	**120**	**240**
Appliance	**Watts**						
Fluorescent Lamp	10	0.1	0.3	0.7	1.3	2.7	5.3
B&W TV	50	0.4	1	2	4	8	17
Computer	100	1	2	4	8	17	34
Color TV	200	2	4	8	17	34	67
Blender	400	3	8	17	34	67	133
Circular Saw	800	6	17	34	67	133	266
Toaster	1000	8	23	46	93	185	370
Microwave	1200	10	28	57	114	227	455
Hot Plate	1800	15	44	88	176	353	706
		BATTERY AMP-HOURS REQUIRED (12 Volt System)					

Table 1
Typical Power Consumption of Common Appliances

1.0 INTRODUCTION

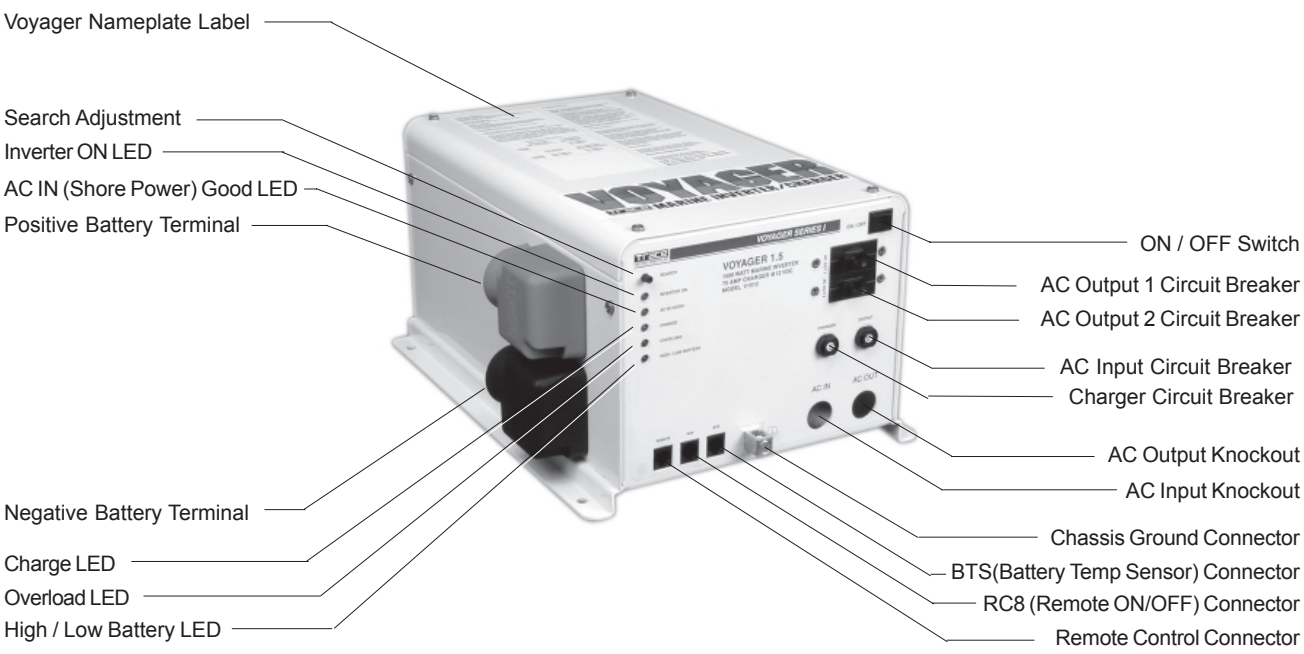


Figure 4
The Voyager Series I Inverter/Charger

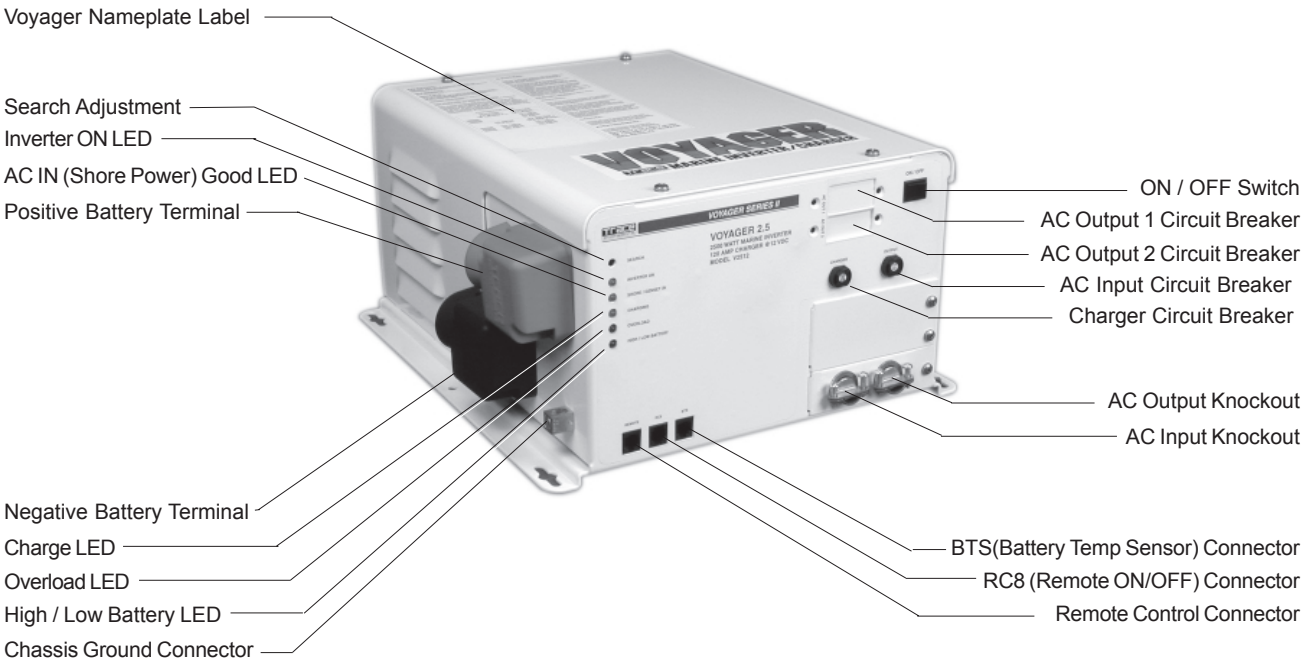


Figure 5
The Voyager Series II Inverter/Charger

1.0 INTRODUCTION

1.6 A Quick Tour

Voyager Series I and Voyager Series II inverter/chargers differ slightly in size of the units and in the layout of control features. Each unit is designed to allow easy access to wiring, circuit breakers, controls and status indicators.

ON / OFF Switch - manually switches the inverter ON and OFF.

Search Adjustment Potentiometer - sets the minimum load required to automatically switch the inverter's output ON.

LED Indicators - displays the operational status of the inverter:

- **Inverter ON** - connected loads are being powered from the batteries.
- **AC IN (Shore Power) Good** - connected loads are being powered by utility AC (shore power).
- **Charge** - batteries are being charged.
- **Overload** - inverter is output is overloaded or the inverter is overheated.
- **High / Low Battery** - inverter has shutdown due to a high or low battery condition.

Remote Control Connector - accepts the RC5 or URC remote control cable.

RC8 Connector - accepts the RC8 remote ON / OFF switch cable.

BTS Connector - accepts the remote battery temperature sensor cable.

Positive Battery Terminal - accepts the positive (+) cable from the house batteries.

Negative Battery Terminal - accepts the negative (-) cable from the house batteries.

Chassis Ground Connector - accepts chassis ground cable.

AC Input Knockout - routes AC input (shore power) conduit (hot, neutral and ground wiring) to the internal terminal block.

AC Output Knockout - routes AC output conduit (with hot, neutral and ground wiring) from the internal terminal block.

AC Input Circuit Breaker - protects main AC (shore power) input circuit.

AC Output 1 Circuit Breaker - protects the primary AC output circuit.

AC Output 2 Circuit Breaker - protects secondary AC output circuit.

Charger Circuit Breaker - protects DC charging circuit.

Voyager Nameplate Label - contains useful product and safety information.

2.0 INSTALLATION

2.1 Unpacking and Inspection

Carefully remove the inverter from its shipping container and inspect all contents listed on the packaging checklist. If items appear to be damaged or missing, contact Trace Engineering's Customer Service department at (360) 435-8826. It is recommended that you retain the shipping container in the event the unit ever needs to be returned for factory service.

2.2 Pre-Installation

Before installing the inverter, read all instructions and cautionary markings located in this manual. On U.S vessels, installations must conform to the requirements of 33 CFR 183.410.

NOTE: The inverter is quite heavy. Always use proper lifting techniques during installation to prevent personal injury.

2.2.1 Locating the Inverter

The inverter must be mounted in a clean, dry, ventilated environment where the ambient temperature will not exceed 122 ºF (50 ºC). The location must be fully accessible and protected from exposure to dry engine exhaust and other heat producing devices. The inverter can be mounted either horizontally or vertically and must be securely fastened to bulkheads or other vessel structural parts.

The base of the inverter must be at least two feet above normal bilge water or protected so that it is not subject to bilge splash. Additional protection, such as a drip shield, must be installed to protect the inverter from falling objects or drippage.

Allow adequate clearance to remove the inverter's cover (Series I) and to access the front panel and controls (Series I and II).

The inverter should be located as close as possible to the batteries in order to keep the battery cables short; however, it should not be mounted directly above them. Due to the corrosive nature of batteries, especially with electronics, make sure the area is adequately ventilated to the outside.

CAUTION: Do not mount the inverter in the engine room or near the fuel tanks of gasoline-fueled vessels.

2.2.2 Locating the Batteries

Like the inverter, the batteries must be mounted in a clean, dry, ventilated environment where they are protected from high and low ambient temperatures. The location must be fully accessible and protected from exposure to dry engine exhaust and other heat producing devices. The batteries must be mounted upright (liquid batteries only) and securely fastened to the mounting surface.

The base of the batteries must be at least two feet above normal bilge water and protected so that they will not subject to bilge splash. For optimum performance, a ventilated battery enclosure is recommended.

The batteries should be located as close as possible to the inverter in order to keep the battery cables short; however, they should not be mounted directly under the inverter. Due to the corrosive nature of batteries, especially with electronics, make sure the area is adequately ventilated to the outside.

CAUTION: Do not mount the batteries in the engine room or near the fuel tanks of gasoline-fueled vessels.

2.0 INSTALLATION

2.2.3 Battery Selection

Proper battery selection is critical to the optimum performance of an inverter system. Batteries come in variety of sizes, types (starting, deep cycle), capacities (amp-hours), voltages (6 VDC, 12 VDC), chemistries (NiFe, NiCAD, Lead Acid), and construction (sealed or vented), each designed for a specific application.

The 3 types of batteries recommended for use with Voyager Series inverters are: Liquid Lead Acid (LEAD), Sealed Gell Cells (GEL) and Sealed Absorbed Glass Mat (AGM).

NOTE: DO NOT use automotive (starting) batteries - they are designed to provide high starting current for short periods of time; whereas, batteries used in inverter applications must provide low, constant current for long periods of time (deep cycled).

2.2.3.1 Liquid Lead Acid Batteries (LEAD)

Liquid Lead Acid batteries are designed to be deep cycled before being recharged, making them suitable for inverter applications. These batteries require periodic maintenance consisting mainly of adding distilled water to the cells, checking battery cable connectors for tightness and keeping the terminals clean.

RV and Marine ("Group 24" or "Group 27")

"OK" for small systems
Designed for limited cycling
Do not last as long as the other "true" deep cycle batteries
Typically rated at 12 volts DC (80 to 100 amp-hours)

Golf Cart ("T-105," "CG220," or "L16")

"Better" for small systems
Designed for repeated discharge (up to 80%) without damage
Rugged, long lasting
Typically rated at 6 volts DC (220 to 350 amp-hours)

2.2.3.2 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 overcharging.

Gel Cell

Gelled electrolyte instead of liquid
Long life (up to 1500 cycles, typical)
Low self-discharge
Virtually maintenance-free

Absorbed Glass Mat

"Best" for inverter-type applications
Electrolyte is contained in glass-fiber mats between battery plates
Good low temperature performance
Virtually maintenance-free

2.0 INSTALLATION

2.2.4 Tools Required

- Drill
- 1/4" (6mm) slotted screw driver
- 1/2" (13mm) open-end wrench
- Socket wrench and fittings
- Level
- Pliers
- Pencil
- Utility knife
- Wire strippers
- Electrical tape
- Multimeter
- Torque wrench

2.2.5 Hardware / Materials Required

- 1/4" mounting bolts and lock washers
- 3/16” screws (with washers, lock washers, nuts)
- Flexible (vibration absorbent) washers
- Conduit, strain-reliefs and appropriate fittings
- Wire ties

2.2.6 Wiring

All wiring and installation methods must conform to applicable electrical and marine codes. AC wiring must be no less than #10 AWG copper wire and rated for 75 °C or higher. Battery cables must be rated for 75 °C or higher and should be no less than the minimum size wire recommended by this manual. Wiring must be installed in a manner that will avoid magnetic loops in the area of the compass and magnetically sensitive devices.

Pre-plan the wire and conduit runs. For maximum safety, run both AC and DC wires/cables in (separate) conduit. Direct current wiring, due to its potential to generate RFI, must be tied together with electrical tape.

NOTE: Run DC cabling in twisted pairs, keeping the runs as short as practical.

2.2.6.1 AC Connections

External connections to this unit must comply with United States Coast Guard electrical regulations (33 CFR 183, Sub part I). Use #10 AWG (or larger) THHN wire for all AC wiring. The inverter’s AC terminal blocks accept up to #6 AWG wire.

2.2.6.2 DC Connections

Battery to inverter cabling should be only as long as required. If #2/0 AWG cables are used for example, do not exceed 5 feet (one way) in 12 VDC systems. For optimum performance, use pre-assembled battery cables from Trace Engineering, designed specifically for this application.

Crimped and sealed copper ring terminal lugs with a 5/16” hole should be used to connect the battery cables to the inverter’s DC terminals.

2.2.6.3 AC Grounding

The inverter/charger includes neutral-to-ground switching for the AC electrical system.

WARNING: The shore power neutral must only be grounded through the shore power cable. Do not permanently ground it on board the vessel.

2.0 INSTALLATION

2.2.6.4 DC Grounding

The inverter/charger should be connected to a grounded, permanent wiring system. For most installations, the negative battery conductor should be bonded to the vessel safety-grounding conductor (green wire) at only one point in the system as per ABYC standard E-8.5 and E-9.20. The size for the conductor is usually based on the size of the largest conductor in the DC system. DO NOT connect the battery negative (-) cable to the vessel safety ground; connect it to the battery negative terminal of the inverter. NO NOT connect equipment DC negatives to the safety ground, connect only to the negative bus of the DC load center.

2.2.7 Torque Requirements

Torque all AC wiring connections to 16 inch pounds. Torque DC cable connections to 10-12 foot pounds.

2.2.8 Main Service Panel

The input to the inverter requires a minimum 60 amp circuit breaker at the main service panel.

2.2.9 Sub Panel

Loads powered by the inverter 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.

2.2.10 Circuit Protection

Use only input circuits provided with the correct ampere branch circuit protection in accordance with the National Electric Code, ANSI/ NFPA70. 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 same manufacturer and are the same type of service panel.

☞ NOTE: Both AC and DC disconnects / overcurrent protection must be provided as part of the installation.

2.2.11 Wire Routing

Determine all wire routes both to and from the inverter. Current carrying conductors must be routed as high as practical above the bilge water level and other area where water can accumulate. If conductors must be routed in the bilge or other areas where water can accumulate, the connections must be watertight.

Conductors that may be exposed to physical damage must be protected by conduit, tape, raceways, or other equivalent protection. Conductors passing through bulkheads or structural members must be protected to minimize insulation damage such as chafing. Conductors must also be routed clear of sources of chafing such as steering cable and linkages, engine shafts, and control surfaces.

Possible routing scenarios include:

AC Input wiring from the main service panel (or shore power source) to the inverter
AC Input wiring from the generator to the inverter
DC Input wiring from the batteries to the inverter
AC Output wiring from the inverter to the sub-panel
Battery Temperature Sensor cable from the inverter to the batteries
Remote Control cable to the inverter
Ground wiring from the inverter to an external ground

Check for existing electrical, plumbing or other potential areas of accidental damage prior to making cuts in structural surfaces, bulkheads or decks.

2.0 INSTALLATION

Figure 6
Series I Mounting

Figure 7
Series II Mounting

2.0 INSTALLATION

2.3 Installation

Before installing the inverter and batteries, read all instructions and cautionary markings located at the beginning of this manual and in the pre-installation section. On U.S vessels, installations must conform to the requirements of 33 CFR 183.410.

2.3.1 Inverter Mounting

- Place the inverter in the designated mounting location either horizontally or vertically. Allow adequate clearance to remove the inverter's cover (Series I) and to access the front panel (Series I and II). Also allow for air flow in to and around the inverter, especially near the cooling fan (approximately 3").

- Mark the mounting holes in the base of the inverter's chassis. Drill out pilot holes in the mounting surface.

- If the inverter is mounted in an area or potential exposure to spray or splashing, install the drip shield above the inverter. The drip shield does not mount to the inverter's chassis. This is required per UL for bulkhead mounting.

CAUTION: DO NOT mount the inverter in the engine room or near the fuel tanks of gasoline-fueled vessels.

- Remove the four cover screws (Voyager Series I only) and remove the cover. Loosen the front panel conduit clamps to accept the AC Input and Output wiring and conduit.

- Remove the two coverplate screws (Voyager Series II only) and remove the coverplate. Loosen the front panel conduit clamps to accept the AC Input and Output wiring and conduit.

2.0 INSTALLATION

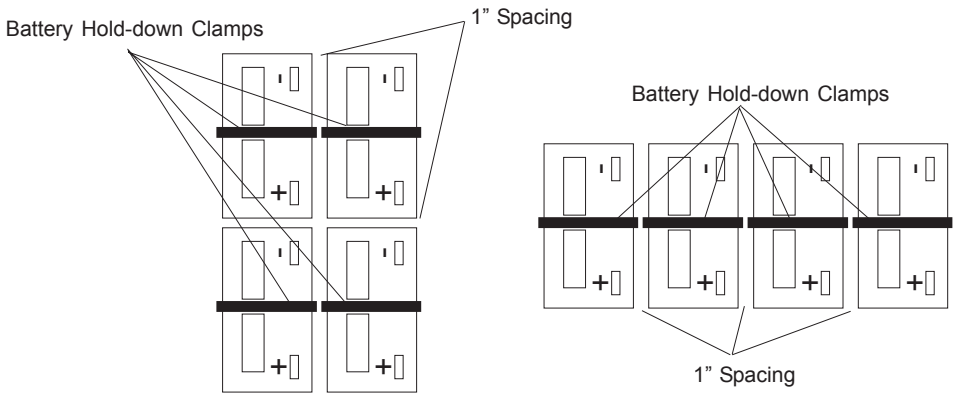


Figure 8
Battery Position and Mounting
(four 12 VDC Batteries)

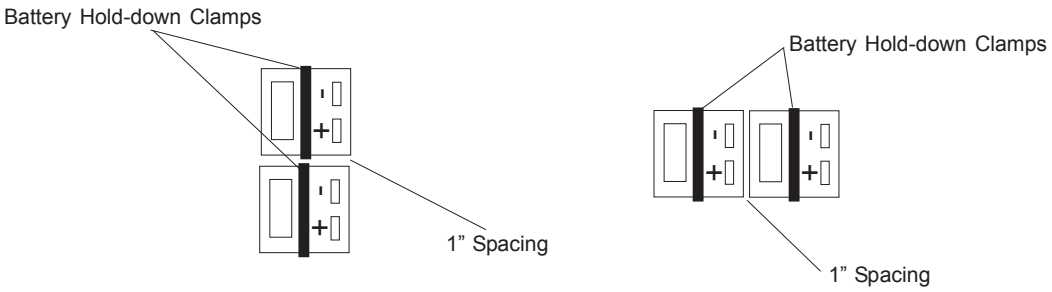


Figure 9
Battery Position and Mounting
(two 6 VDC Batteries)

Inverter Model #	DC Rating (typical)	1 to 3 feet (one way)	3 to 5 ft (one way)	5 to 10 ft (one way)
V1012	100 Amps	2/0 AWG	4/0 AWG	4/0 AWG
V1512	150 Amps	2/0 AWG	4/0 AWG	4/0 AWG
V2012	200 Amps	2/0 AWG	4/0 AWG	4/0 AWG
V2512	250 Amps	4/0 AWG	4/0 AWG	4/0 AWG
V3012	300 Amps	4/0 AWG	4/0 AWG	2x2/0 AWG
Trace Engineering Battery Cables				
Trace P/N	2/0 Cables	BC3-2/0	use BC5-4/0	use BC10-4/0
Trace P/N	4/0 Cables	BC3-4/0	BC5-4/0	BC10-4/0

Table 2
Recommended Battery Cable Sizes (Free Air Rating)

2.0 INSTALLATION

2.3.2 Battery Installation

Refer to the battery safety information at the beginning of the manual and in the pre-installation section before proceeding. To ensure optimum performance from your inverter system, never use old or untested batteries. All batteries must be of the same size, type, rating and age.

To ensure maximum performance from the batteries, as well as provide protection from high and low temperatures, mount the batteries in an insulated enclosure, ventilated to the outside from the top of the enclosure (1" diameter opening).

CAUTION: DO NOT mount the batteries in the engine room or near the fuel tanks of gasoline-fueled vessels.

NOTE: Flooded Lead Acid batteries must be mounted upright.

NOTE: Align the batteries so that all positive terminals are located on the same side (figures 8 and 9). This will help ensure proper wiring and polarity identification.

- Place the batteries as close as practical to the inverter, preferably in an insulated and ventilated enclosure. Allow adequate space above the batteries (+/- 6" above the batteries) to access the terminals and vent caps (if applicable). Also allow at least 1" of space between the batteries to provide good air flow. DO NOT mount the batteries directly under the inverter.

- Secure the batteries to the mounting surface with battery hold down clamps.

2.3.3 Battery Cables and Sizing

Using the proper size (gauge) and length of battery cable is critical to the safe and efficient operation of the inverter. Undersized cables result in lower efficiency, reduced surge power and lower peak output voltage. They can also pose a potential fire hazard. Long cable runs also reduce efficiency due to resistance in the cable. Always keep cable runs a short as practical.

Battery cables must be color coded with colored tape or heat shrink tubing: RED for positive (+); BLACK for negative (-); and GREEN for DC ground.

All battery cables must have soldered and crimped lugs, crimped copper compression lugs, or aluminum mechanical lugs. Soldered connections alone are not acceptable for marine applications.

UL Listed, Trace Engineering battery cables with lug connectors, designed specifically for inverter applications, are available from your Trace dealer (table 2). Cables come color-coded with pressure crimped, sealed ring terminals and are available in both 2/0 or 4/0 AWG sizes, ranging in lengths from 1 to 10 feet.

Figure 10
Trace Battery Cable with Color-coded Lug Connector

2.0 INSTALLATION

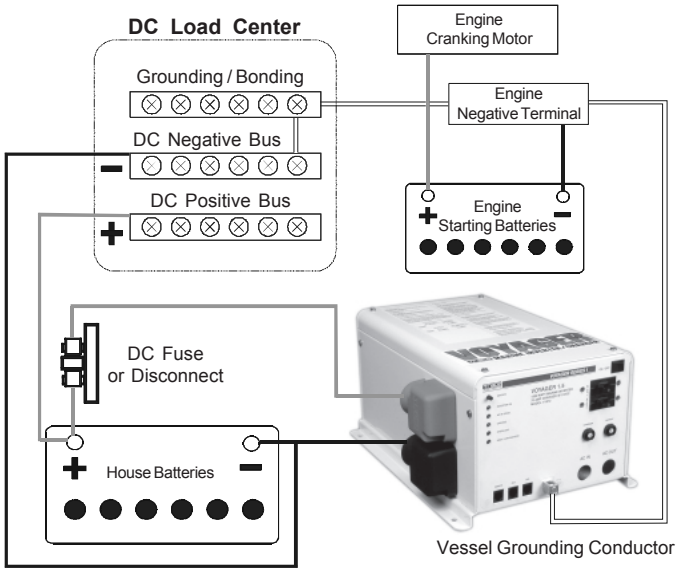


Figure 11
Typical DC Wiring
(Voyager Series I)

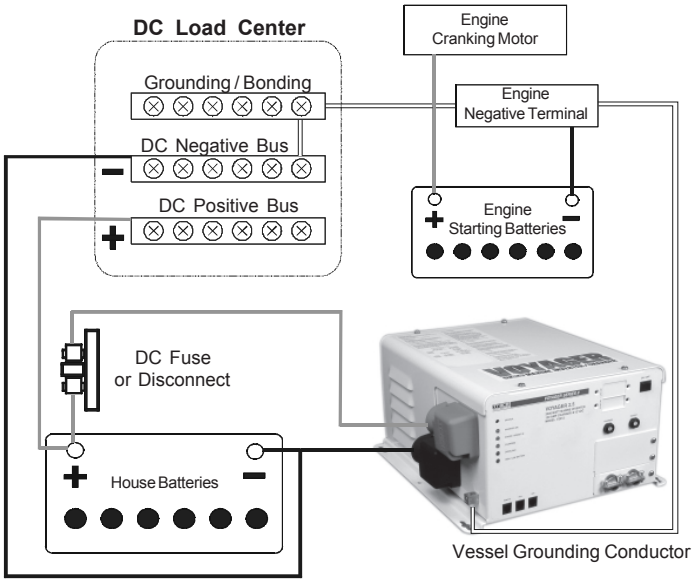


Figure 12
Typical DC Wiring
(Voyager Series II)

2.0 INSTALLATION

2.3.4 DC Wiring (Refer to figures 11 (Series I) and 12 (Series II) wiring diagrams).

Refer to the safety information at the beginning of the manual and in the pre-installation section before proceeding. DC wires and cables must be tied together with electrical tape every 6 inches. Avoid magnetic loops in the area of the compass and magnetically sensitive devices.

Conductors passing through bulkheads or structural members must be routed clear of steering cable, linkages, engine shafts, and control surfaces to protect against insulation damage such as chafing.

WARNING: De-energize all on-board sources of power including batteries (DC), shore power (AC), and AC generator (if applicable).

NOTE: DO NOT connect the battery cables to the inverter until all wiring is complete and the correct DC voltage and polarity is confirmed.

NOTE: All cables must have a smooth bend radius. Place the long cable runs in dedicated flex conduit (plastic) and follow existing wire runs where possible. Dress the runs neatly with wire ties.

DC Grounding

- Verify the ground connection between the DC negative bus and ground bus in DC load center.
- Verify the ground connection between the engine negative terminal and the ground bus in DC load center.
- Route the vessel grounding cable between the negative engine terminal and the inverter's ground lug. Connect the grounds.

Negative Cables

- Route a negative cable from the DC negative bus in the DC load center to the house battery bank.
- Route a negative cable from the house battery bank to the inverter's negative terminal connector.
- Co-connect both cables (inverter negative and DC negative bus) on the negative battery terminal (refer to figure 13 for battery wiring).
- Connect the negative inverter cable to the inverter's black negative terminal connector.

Positive Cables

- Route a positive cable from the DC positive bus in the DC load center to the house battery bank.
- Route a positive cable from the house battery bank to the Fuse Block assembly (DC Disconnect).
- Route a positive cable from the Fuse Block assembly (DC Disconnect) to the inverter's positive terminal connector.
- DO NOT connect the positive cables to the batteries or inverter at this time.

2.0 INSTALLATION

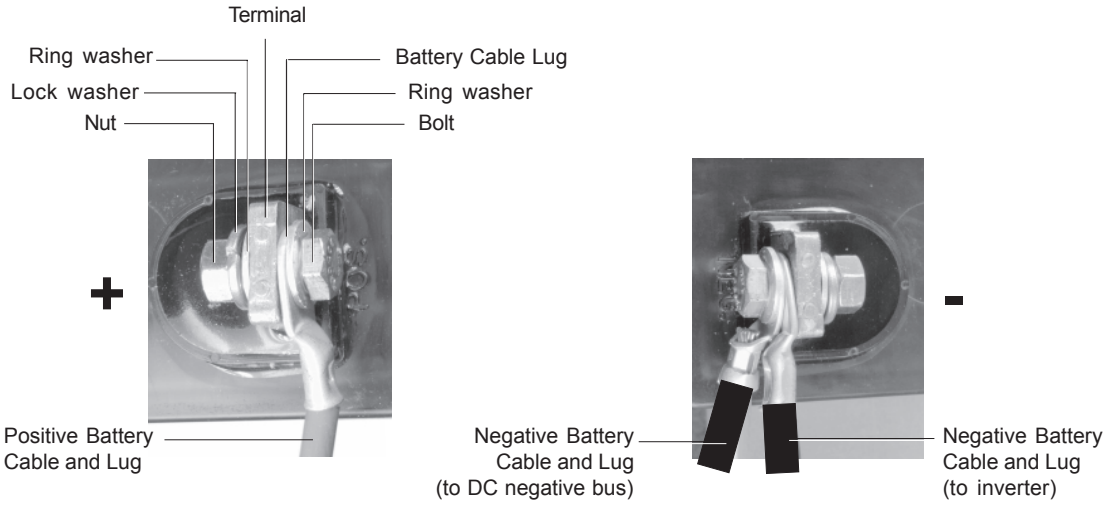


Figure 13
Negative and Positive Terminal Wiring (all batteries)
NOTE: Terminal and cable photos are for illustrative purposes only

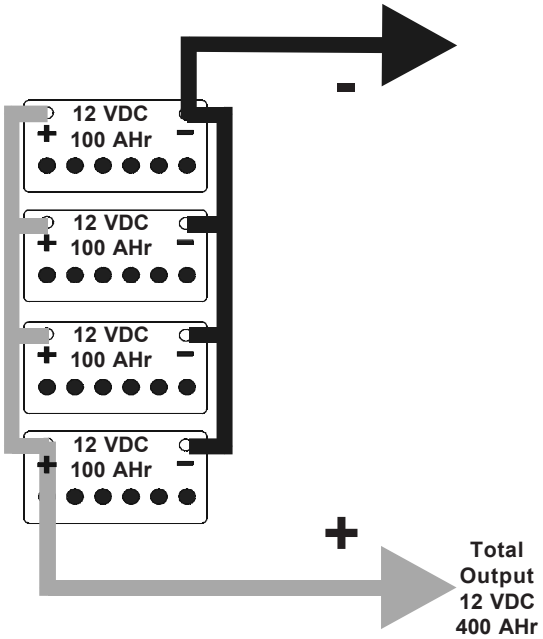


Figure 14
12 VDC Parallel Configuration
(using four 12 Volt, 100 AHr batteries)

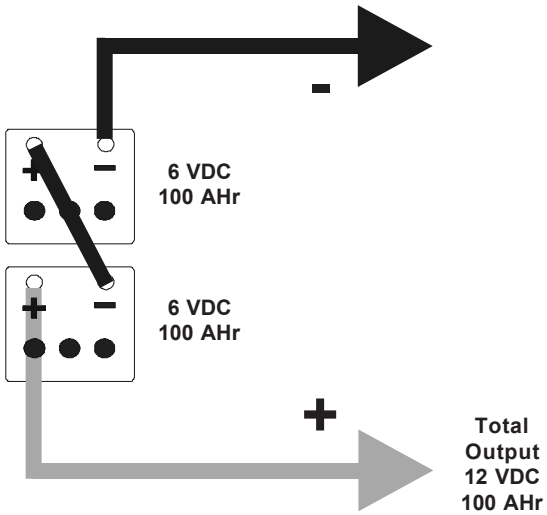


Figure 15
12 VDC Series Configuration
(using two 6 Volt, 100 AHr batteries)

2.0 INSTALLATION

2.3.5 Battery Wiring

Depending upon the type of battery used in the installation (6 or 12 VDC), the batteries must be wired in series, parallel or series/parallel to provide 12 VDC. The interconnecting battery cables must be sized and rated the same as those that used to connect to the inverter.

Follow the battery terminal wiring example (figure 13) to ensure the cables are properly connected to the batteries. As a general guideline hardware should be installed in the following order: bolt, ring washer, cable lug, (battery terminal), ring washer, lock washer, nut. Tighten terminal connections to at least 10 to 12 foot pounds.

When two cable lugs are connected to a single terminal (such as with the negative terminal), the hardware should be installed in the following order: bolt, ring washer, DC negative cable lug, inverter negative cable lug, (battery terminal), ring washer, lock washer, nut.

Once the batteries are completely wired and tested, coat the terminals with an approved anti-oxidizing spray.

WARNING: Cover exposed cable ends with electrical tape to prevent shorting the cables.

NOTE: DO NOT connect the positive cable to the inverter at this time.

2.3.5.1 Parallel Connection (multiple 12 VDC batteries to create a 12 VDC string)

A parallel connection combines the overall capacity by the number of batteries in the string while the voltage remains the same. In the example (figure 14), four, 12 VDC, 100 AHr batteries are combined into a single string resulting in a 12 VDC, 400 AHr bank.

- Connect the negative battery terminals together using short cables (figure 14).
- Connect the positive battery terminals together using short cables.
- Connect the long battery cable (from the inverter) to the negative terminal of the end battery. At the same time, connect a DC ground cable between the negative terminal and the vessel's DC grounding bus.
- Connect the other long battery cable (from the inverter) to the positive terminal of the opposite end battery. This is essential to ensure even charging and discharging across the entire battery string.

NOTE: A fuse must be placed between the positive terminal and the long battery cable to the inverter.

2.3.5.2 Series Connection (two 6 VDC batteries to create a 12 VDC string)

A series connection combines the overall voltage by the number of batteries in the string while the capacity remains the same. In the example (figure 15), two, 6 VDC, 100 AHr batteries are combined into a single string resulting in a 12 VDC, 100 AHr bank.

- Connect the negative battery terminal of one battery to the positive of the other using a short cable (figure 13).
- Connect the long battery cable (from the inverter) to the open negative terminal of one battery. At the same time, connect a DC ground cable between the negative terminal and the vessel's DC grounding bus.
- Connect the other long battery cable (from the inverter) to the open positive terminal of the other battery.

NOTE: A fuse must be placed between the positive terminal and the long battery cable to the inverter.

2.0 INSTALLATION

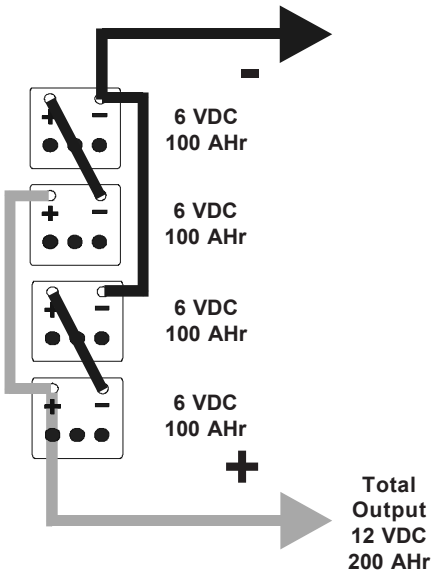


Figure 16
12 VDC Series/Parallel Configuration
(using four 6 volt batteries)

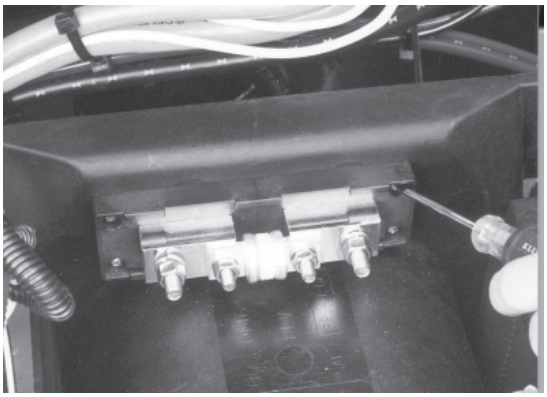


Figure 17
Fuse Block Assembly

Cable Size	Rating (in Free Air)	Fuse Size (Max)	Trace P/N
2/0 AWG	265 amps (max)	300 amps	TFB300
4/0 AWG	360 amps (max)	400 amps	TFB400

Table 3
Recommended DC Protection

2.0 INSTALLATION

2.3.5.3 Series/Parallel Connection (multiple 6 VDC batteries to create a 12 VDC string)

A series/parallel connection increases both voltage and capacity using smaller, lower-voltage batteries. In the example (figure 16) four, 6 VDC, 100 AHr batteries are combined into two pairs resulting in a 12 VDC, 200 AHr bank.

- Connect the negative battery terminal of one 6 VDC battery to the positive of the next (creating a pair) using a short battery cable.
- Connect the negative battery terminal of another 6 VDC battery to the positive of its next (creating a second pair) using a short battery cable.
- Connect the remaining negative battery terminal of the first pair to that of the second pair using a short battery cable.
- Connect the remaining positive battery terminal of the first pair to that of the second pair using a short battery cable.
- Connect the long negative battery cable (from the inverter) to the end battery's negative terminal. At the same time, connect a DC ground cable between the negative terminal and the vessel's DC grounding bus.
- Connect the long positive battery cable (from the inverter) to the opposite end battery's positive terminal.

☞ NOTE: A fuse must be placed between the positive terminal and the long battery cable to the inverter.

2.3.6 DC Fuse Block (or Circuit Breaker Assembly) Installation and Wiring

The ABYC and Federal Regulations require a fuse or circuit breaker to be located within 72 inches of the battery to protect the DC wiring system. The device must be rated to match the size of the cable, but can be rounded up to the next size (i.e., a cable rated at 150 amps can accept a 175 amp fuse) as necessary.

DC-rated class T fuses and safety-covered fuse blocks, recommended for use with the Voyager Series inverter, are available in 110, 200, 300, and 400 amp sizes from your Trace dealer.

- Mount the fuse block (or circuit breaker assembly) as near as practical to the batteries using (4) 3/16" screws (with washers, lock washers, nuts).
- Remove the fuse (or open the circuit breaker) and connect a short cable (same rating as the battery cables) to one end of the fuse block.
- Connect the short cable to the positive battery terminal (figure 13).
- Connect the long positive cable (from the inverter) to the assembly. DO NOT connect the positive cable to the inverter at this time.
- Securely tighten the fuse block's lugs and put the plastic cover on the fuse block.

After the entire installation is complete, reinsert the fuse into the fuse block prior to connecting the positive cable to the inverter (section 2.6).

2.0 INSTALLATION

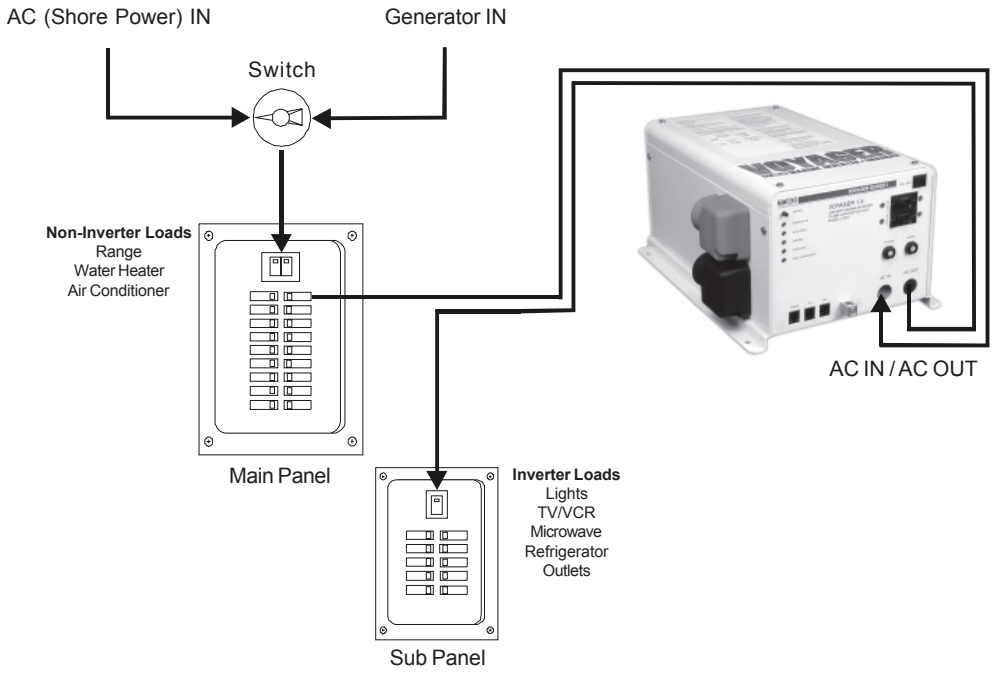


Figure 18
Typical AC Wiring
(Voyager Series I)

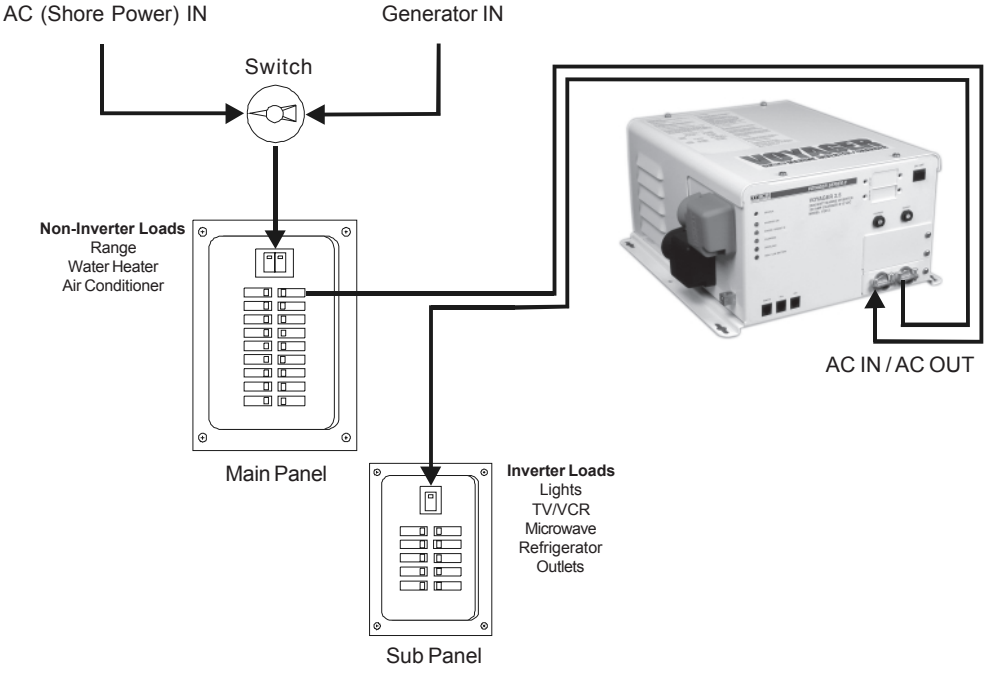


Figure 19
Typical AC Wiring
(Voyager Series II)

2.0 INSTALLATION

2.3.7 AC Wiring (refer to figures 18 (Series I) and 19 (Series II) wiring diagrams).

Refer to the safety information at the beginning of the manual and in the pre-installation section before proceeding. ABYC standards require a disconnect switch or main service panel within 10 feet of the shore power input receptacle.

WARNING: AC wiring must be performed by a qualified person or licensed electrician.

WARNING: De-energize all on-board sources of power including batteries (DC), shore power (AC), and AC generator (if applicable). Verify circuits are de-energized using a multimeter.

WARNING: The inverter/charger includes neutral-to-ground switching for the AC electrical system. In marine installations, loads powered by the inverter must have the AC neutral physically isolated from the ground. Isolate the sub panel's neutral bus from its frame using an appropriate insulator.

CAUTION: DO NOT connect the inverter's output to an AC power source.

CAUTION: DO NOT connect the battery cables to the inverter until all AC wiring is complete.

NOTE: All cables must have a smooth bend radius. Place cables in conduit and follow existing wire runs where possible. DO NOT place AC cabling in the same conduit with DC cabling. Conductors passing through bulkheads or structural members must be routed clear of steering cable, linkages, engine shafts, and control surfaces to protect against insulation damage such as chafing.

NOTE: Heavy loads such as the water heater, air conditioner, electric range and conventional oven should not be run from the inverter. Those circuits should remain connected to the main electrical panel. Other circuits, for loads such as lights, standard electrical outlets, etc., should be rerouted from the main panel to the sub panel.

AC Input (Shore Power) Routing

- Route the 30 amp service (shore power) to the main panel. If the installation includes a generator, route the 30 amp service (shore power) to an approved selector switch and then to the main panel.

AC Input (Generator) Routing

- Route the 30 amp service (generator) to an approved selector switch and then to the main panel.

Main Panel Routing

- Route the AC output from the main panel's 30 amp breaker to the inverter's internal terminal block.

Sub Panel Routing

- Route the AC output from the inverter's internal terminal block to the sub panel's main breaker.

Inverter Model #	Power Rating	AC Input Breaker	AC Input (120 VAC)	AC Output (120 VAC)
V1012	1000 VA	30 Amp	10 AWG	10 AWG
V1512	1500 VA	30 Amp	10 AWG	10 AWG
V2012	2000 VA	30 Amp	10 AWG	10 AWG
V2512	2500 VA	30 Amp	10 AWG	10 AWG
V3012	3000 VA	30 Amp	10 AWG	10 AWG

Table 4
Recommended AC Wire Sizes

2.0 INSTALLATION

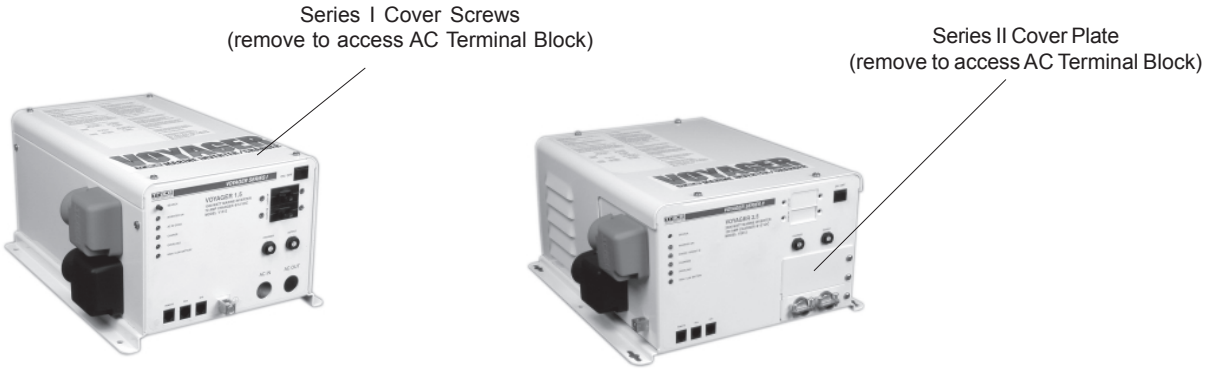


Figure 20
AC Terminal Block Access

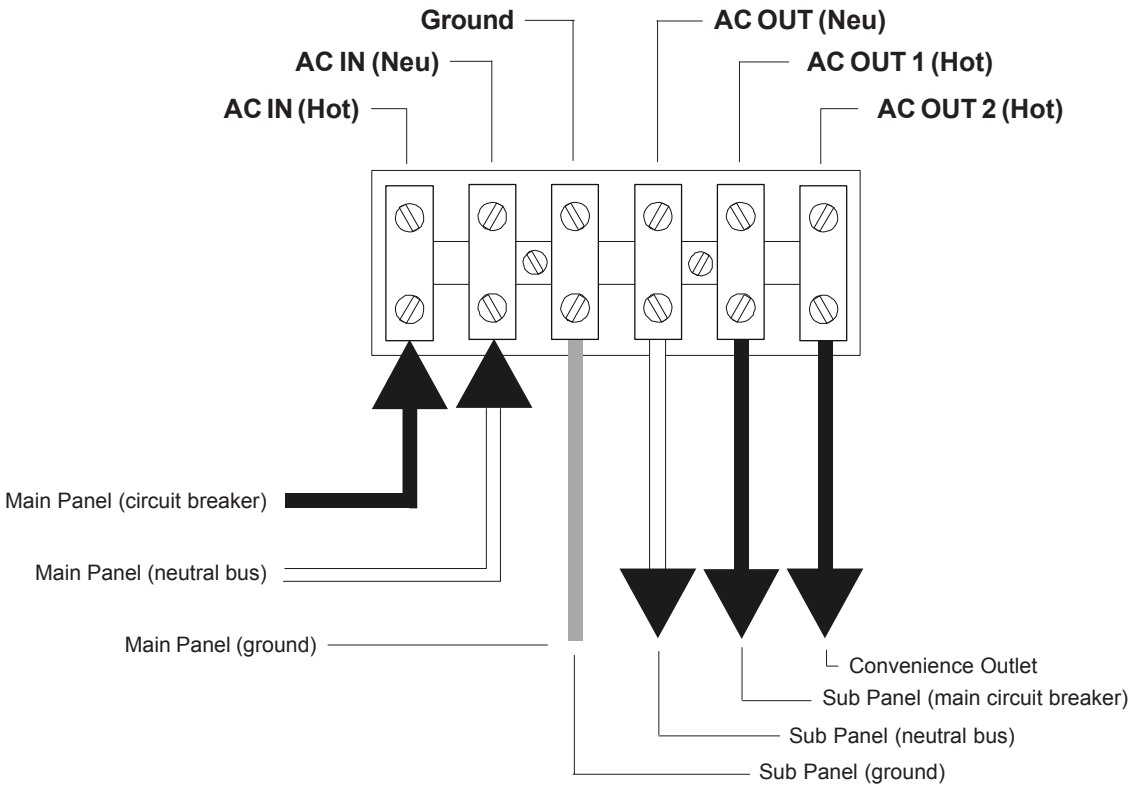


Figure 21
Internal AC Terminal Block

2.0 INSTALLATION

2.3.7.1 Inverter AC Input

- Route the cable and conduit from the main panel to the inverter's AC INPUT conduit clamp. Tighten the clamp securely on the conduit. Always leave a little extra slack in the wiring.
- Remove the chassis cover (Series I) or the front panel (Series II) to access the internal terminal block.
- Connect the black wire (HOT) from the main panel's dedicated 30 amp breaker to the left hand "AC INPUT (HOT)" terminal. Tighten the terminal to 16 inch-pounds.
- Connect the white wire (NEU) from the main panel's neutral bus bar to the "AC INPUT (NEU)" terminal. Tighten the terminal to 16 inch-pounds.
- Connect the green wire (GROUND) from the main panel's neutral bus bar to the "GROUND" terminal. Tighten the terminal to 16 inch-pounds.

2.3.7.2 Inverter AC Output

- Route the cable and conduit from the sub panel to the inverter's AC OUTPUT conduit clamp. Tighten the clamp securely on the conduit. Always leave a little extra slack in the wiring.
- Remove the chassis cover (Series I) or the front panel (Series II) to access the internal terminal block.
- Connect the black wire (HOT) to the "AC OUTPUT 1 (HOT)" terminal. Tighten the terminal to 16 inch-pounds.
- Connect the white wire (NEU) to the "AC OUTPUT (NEU)" terminal. Tighten the terminal to 16 inch-pounds.
- Connect the green wire (GROUND) to the "GROUND" terminal. Tighten the terminal to 16 inch-pounds.

2.3.7.3 Final Inspection

- Verify all cables / conduit runs are secured with wire ties or other nonconductive fasteners to prevent chafing or damage from movement and vibration.
- Verify strain reliefs or grommets are in place to prevent damage to the wiring or conduit where it passes through bulkheads or other openings.
- Verify all AC connections are correct and torqued to 16 inch pounds.
- Replace the covers on the main electrical panel and sub panel.
- Affix the "Warning…Vessel is equipped with a DC to AC power inverter…" decal to the main electrical panel or the sub panel (powered by the inverter).
- Reinstall the chassis cover (Series I) or the front panel access panel (Series II).
- Verify the inverter's front panel switch is in the "OFF" position.
- If required by code, have the installation inspected by an electrical inspector.

2.0 INSTALLATION

Neutral-to-Ground System "Bonding" is provided by the inverter (internal relays in).

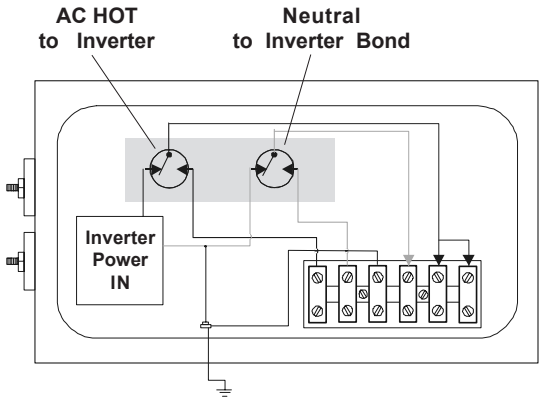


Figure 22
Neutral-to-Ground Switching (Inverter Mode)

Neutral-to-Ground System "Bonding" is provided by the Shore Power source (internal relays out).

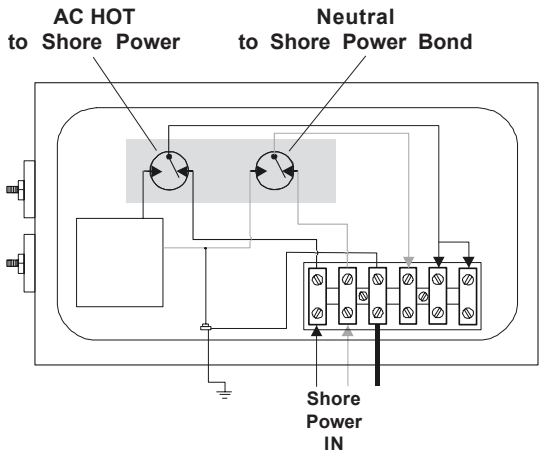


Figure 23
Neutral-to-Ground Switching (External AC "Shore Power" Mode)

WARNING: Always check local electrical code requirements before disabling the neutral-to-ground switching feature.

Figure 24
Disabling the Neutral-to-Ground Switching

2.0 INSTALLATION

2.3.8 Neutral-to-Ground Bonding

Voyager Series inverters employ an internal neutral-to-ground switching feature, in accordance with NEC electrical safety standards and ABYC A-25.6, to ensure the neutral conductor in a three-wire system is "bonded" to ground at one point only. This prevents a voltage differential from developing between the shore power's neutral and the vessel's neutral which, otherwise, would create an electrical shock hazard.

Neutral-to-Ground Switching (Inverter Mode)
When the inverter is operating from the batteries, the AC output neutral is connected to the chassis ground by an internal relay, creating the bond within the inverter (figure 22).

Neutral-to-Ground Switching (External AC "Shore Power" Mode)
When operating from an external AC power source, the inverter's internal relay opens and removes the ground from the neutral conductor, thus providing the "bond" at the external AC source (figure 23).

2.3.8.1 Disabling the Neutral-to-Ground Switching Feature

Some countries do not require neutral-to-ground switching. In Canada, for example, this feature must be disabled before installation.

WARNING: Always check local electrical code requirements before disabling the neutral-to-ground switching feature.

- De-energize all AC and DC sources (if the inverter is already installed).
- Remove the chassis cover (Series I) or the front panel (Series II) to access the internal terminal block.
- Locate the green (ground) wire that runs from the circuit board to the chassis ground bolt (figure 24) and remove it. The wire is co-terminated with the ground from the AC terminal block. DO NOT remove the terminal block ground from the chassis ground bolt.
- Wrap the terminal end of the wire with electrical tape.
- Replace the chassis cover (Series I) or the front panel access (Series II).
- Energize all AC and DC sources (if the inverter is already installed).

NOTE: Connect the chassis ground to the chassis even if ground switching has been disabled.

2.0 INSTALLATION

Figure 25
Option Ports (both Voyager Series)

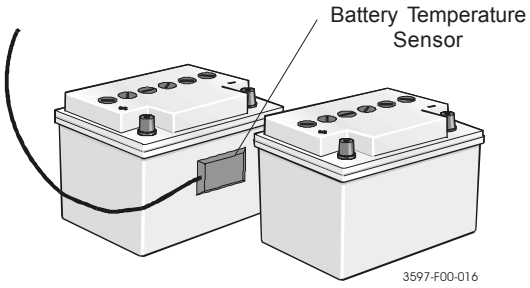


Figure 26
Battery Temperature Sensor

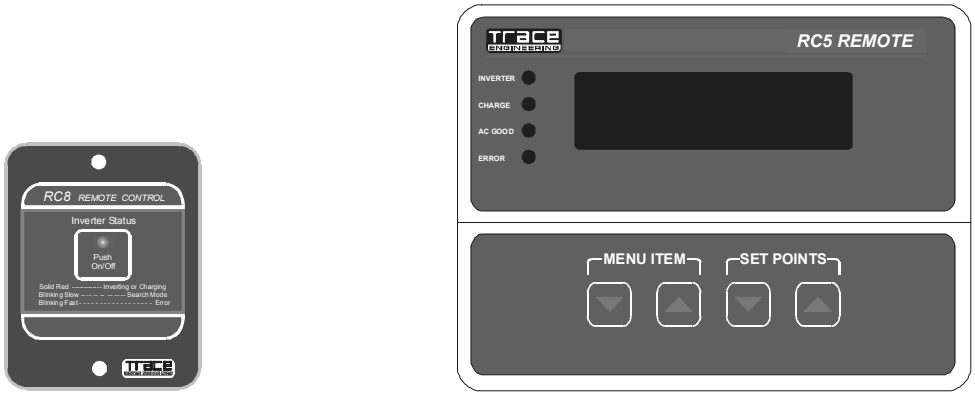


Figure 27
RC8 Remote ON/OFF and RC5 Full Function Remote

2.0 INSTALLATION

2.4 Options

The Voyager Series inverter/charger features several options such as a remote battery temperature sensor (BTS), a remote ON/OFF switch, and a full function remote control (RC5).

2.4.1 Battery Temperature Sensor Installation and Wiring

- Remove the self-adhesive covering from the battery temperature sensor.
- Attach the sensor to the side of one of the batteries (as close to the center of the battery as possible) and, if possible, between two batteries.
- Route the sensor's cable to the inverter following existing wire runs where possible. Dress the run neatly with wire ties.
- Connect the cable to the BTS connector on the inverter's front panel.

2.4.2 RC8 Installation and Wiring

- Mount the RC8 in a convenient location using two mounting screws.
- Route the cable to the inverter following existing wire runs where possible. Dress the run neatly with wire ties.
- Connect the cable to the RC8 connector on the inverter's front panel.

2.4.3 Remote (RC5 and URC) Installation and Wiring

- Mount the RC5 (or URC) in a convenient location using four mounting screws.
- Route the cable to the inverter following existing wire runs where possible. Dress the run neatly with wire ties.
- Connect the cable to the REMOTE connector on the inverter's front panel.

2.0 INSTALLATION

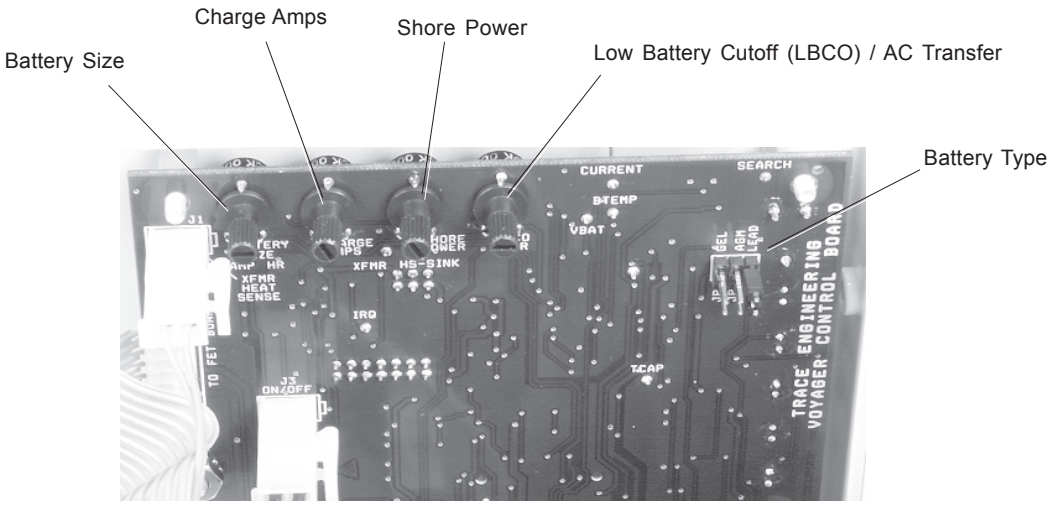


Figure 28
Control Board Configuration

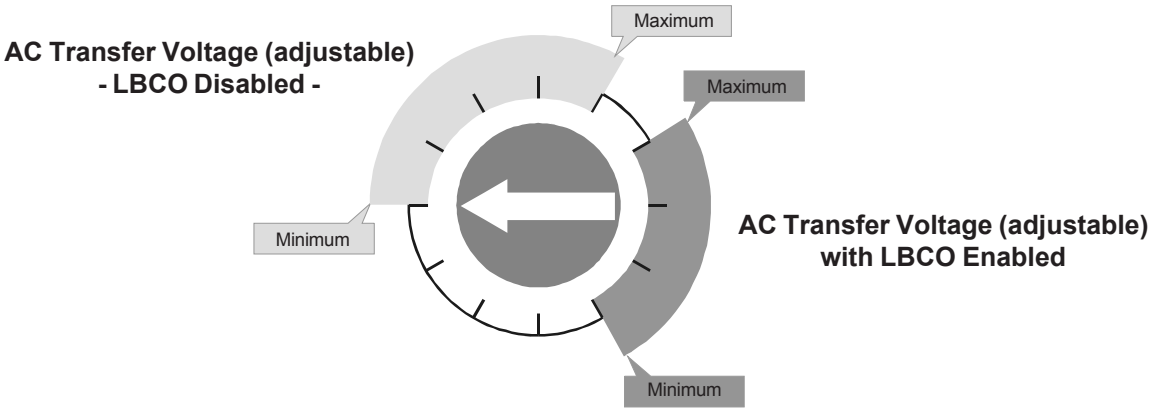


Figure 29
Low Battery Cutoff / AC Transfer Voltage Potentiometer

LBCO Adjustment		AC Transfer Voltage
LBCO Disabled	LBCO Enabled	120 VAC Models
9:00	5:00	80 VAC
Approximate	Approximate	85 VAC
Approximate	Approximate	90 VAC
Approximate	Approximate	95 VAC
Approximate	Approximate	100 VAC
1:00	2:00	105 VAC

Table 5
Low Battery Cutoff / AC Transfer Voltages

2.0 INSTALLATION

2.5 Configuration (without RC5 or URC Remote Control)

The Voyager Series inverter/charger must be configured for Low Battery Cutoff (LBCO), Shore Power Current, Charger Amps, Battery Size and Battery Type. The four potentiometers and one pin jumper are located on the control board, directly behind and above the LED display. To access the board, the chassis cover must first be removed.

☞ NOTE: If an RC5 or URC remote control are installed on the inverter, adjust the inverter's SEARCH potentiometer to its midway position, skip the remainder of this section and proceed to battery connection and start-up and test (section 2.5 and 2.6).

2.5.1 Low Battery Cutoff (LBCO) / AC Transfer Voltage

The Low Battery Cutoff / AC Transfer Voltage potentiometer performs two related functions. When set between the 2 and 5 o'clock position (right), both LBCO and the AC Transfer Voltage function simultaneously (table 5). When the potentiometer is set between the 9 and 1 o'clock position (left), only the AC Transfer Voltage is functional (LBCO is disabled).

Low Battery Cutoff (LBCO)

When enabled, LBCO shuts the inverter down at a specified voltage (low battery cutoff) to protect the batteries from over discharge damage. The microcontroller calculates the lowest (safe) DC voltage (leaving approximately 80% battery capacity) based on the LBCO potentiometer setting, the position of the Battery Type Selector jumper and the amount of load sensed by the inverter.

☞ 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 R3 with LBCO enabled.

☞ NOTE: When LBCO is disabled (set points between 9 and 1 o'clock), the microcontroller is programmed to shut the inverter off when the batteries reach approximately 8.5 VDC (1.42 V/cell).

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 (12 volt inverter system):

- Potentiometer is set to 9:00 o'clock with LBCO disabled. Whenever the incoming AC voltage drops to 80 volts or below, the inverter will switch to battery power.

- Potentiometer is set to 2:00 o'clock with LBCO enabled. Whenever the incoming AC voltage drops to 105 volts or below, the inverter will switch to battery power.

☞ NOTE: LBCO does not affect the operation of the AC Transfer Voltage. LBCO is either on or off, depending upon the position of potentiometer.

☞ NOTE: To achieve the fastest transfer time (typically less than 16 ms, set the potentiometer near the 2:00 o'clock position (with the LBCO enabled); or, near the 1:00 o'clock position (with the LBCO 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 LBCO enabled; or 1 o'clock toward 9 o'clock with LBCO disabled).

2.0 INSTALLATION

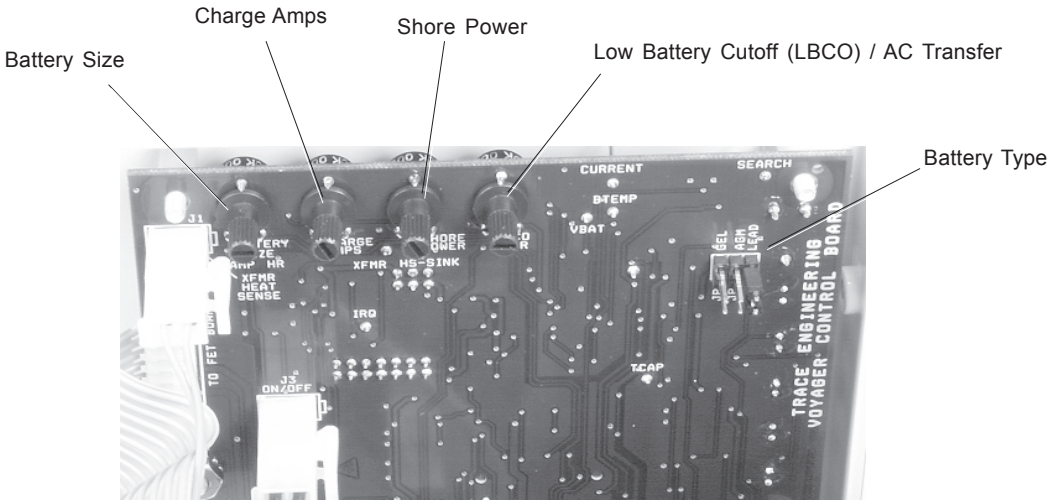


Figure 30
Control Board Configuration

Potentiometer Setting	Actual Amp Hour Rating
9 o'clock	50
10 o'clock	125
11 o'clock	250
12 o'clock	370
1 o'clock	500
5 o'clock	1000 or greater

Table 6
Battery Capacity (amp hours)

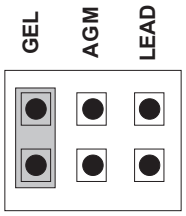


Figure 31
Battery Type Pin Jumpers

2.0 INSTALLATION

2.5.2 Shore Power Amps

The Shore Power Amps potentiometer sets a maximum current threshold for power being drawn by both the battery charger and the AC loads connected to the inverter. Whenever the level approaches the setting, the battery charger "backs off" its current draw to prevent tripping and loss of power to the AC loads.

NOTE: Only the AC loads powered by the inverter are monitored. Large loads, powered directly from the main panel, are not monitored. This may result in occasional nuisance tripping of the shore power circuit breaker when the total load exceeds 30 amps.

- Adjust the potentiometer counterclockwise to clockwise. The range is 5 amps (full counter-clockwise) to 30 amps (full clockwise).

2.5.3 Charger Amps

The Charger Amps potentiometer sets the maximum charge current supplied to the battery bank. It also regulates the constant current when the charger is in its Bulk Charge mode. The highest charge rate recommended is determined by dividing the battery bank's total amp hour capacity by a factor between 3 and 5 (5 for gel cell - 3 for lead acid). Setting the charger amps at a higher level is best for quickly recharging the batteries where AC power is only available for short periods of time. This, however, can put additional stress on the batteries. A lower setting is recommended for typical installations. For example, a 400 amp hour battery bank can be sufficiently recharged in 24 hours at a 25 amp setting (25 amps x 24 hours = 600 amp hours).

- Adjust the potentiometer counterclockwise to clockwise. The range is gelled batteries (full counter-clockwise); AGM batteries (12 o'clock); and Lead Acid batteries (full clockwise).

2.5.4 Battery Capacity

The Battery Capacity potentiometer sets the correct charging profile for the amp hour capacity of the batteries used with the inverter (see Table 6).

- Adjust the potentiometer as close as possible to the actual capacity of the battery bank. The range is 50 amp hours (full counterclockwise) to 1,000 amp hours (full clockwise).

NOTE: Most battery manufacturers list the amp hour rating on the battery label. If the batteries are wired in series or series/parallel, the total amp hour rating will be higher than the individual battery rating (see section 2.3.5).

2.5.5 Battery Type

The Battery Type pin jumper selects the type of battery used in the system. Since battery types differ greatly, requiring different charging profiles, the type of battery must be selected. The default setting is for Gel batteries.

- Lift the pin jumper from its current position and place it onto the appropriate pin pair: GEL, AGM, or LEAD ACID.

Once the settings are complete, replace the inverter's cover and proceed to battery connection and start-up and test (sections 2.6 and 2.7).

2.0 INSTALLATION

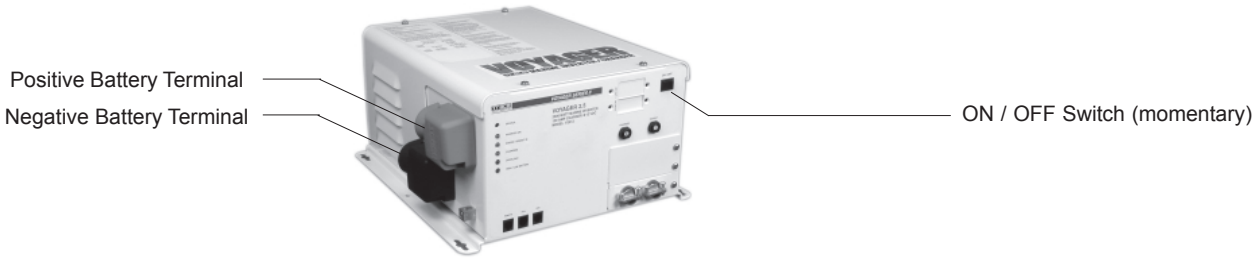


Figure 32
Final Connections and Start-up (both Voyager Series)

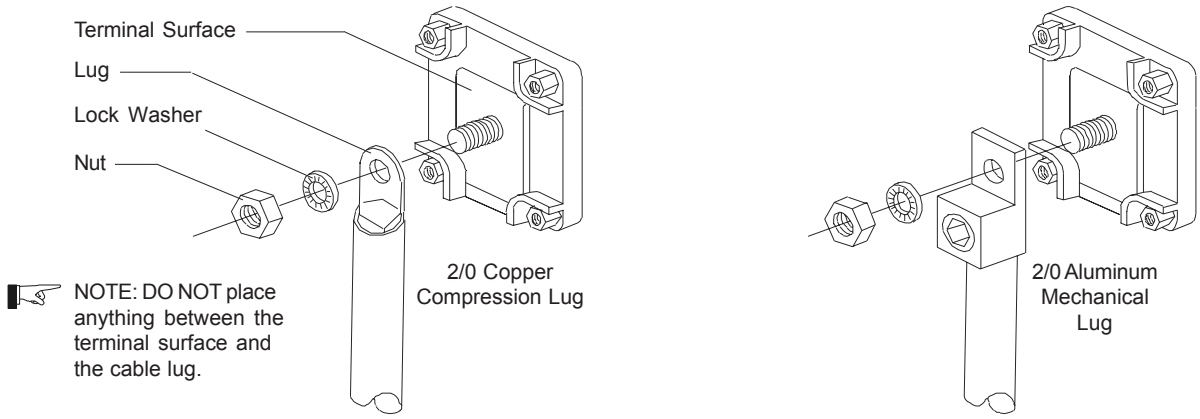


Figure 33
DC Connections at the Inverter

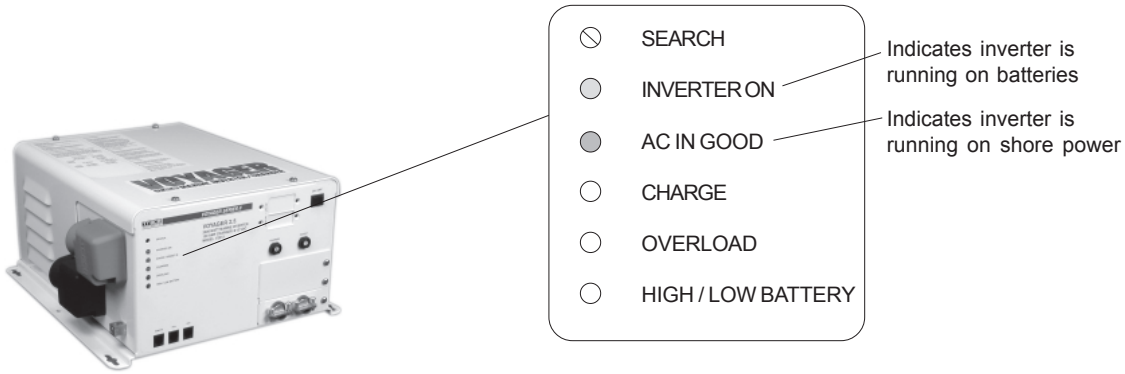


Figure 34
Voyager (Series I and II) Start-up and Test

2.0 INSTALLATION

2.6 Connecting the Batteries to the Inverter

After all other electrical connections have been made, the batteries should be connected to the inverter.

CAUTION: Verify correct battery voltage and polarity before connecting the cables to the inverter.

- Replace the fuse or (close the breaker) at the DC disconnect located next to the batteries.
- Verify 12 VDC at the cable connectors using a multimeter. Verify correct polarity: Black is negative (-); Red is positive (+).
- Connect the negative (black) cable to the inverter's negative terminal. The cable lug must be flush to the terminal's surface. Place a lock washer and nut over the lug (figure 33). Torque the connection to 10 to 15 foot pounds.
- Connect the positive (red) cable to the inverter's positive terminal. The cable lug must be flush to the terminal's surface. Place a lock washer and nut over the lug (figure 33). Torque the connection to 10 to 15 foot pounds. The inverter's LEDs will flash indicating DC power and the start-up sequence.

NOTE: There may be a spark (and audible snap) when the cable lug first contacts the inverter's positive terminal. This is normal.

- Verify all cables and connectors are properly secured.
- Place the red and black terminal covers on the inverter. Secure the covers with enclosed hardware.
- If the batteries are in an enclosure, perform a final check of the hold down brackets and all connections. Close and secure the battery enclosure.

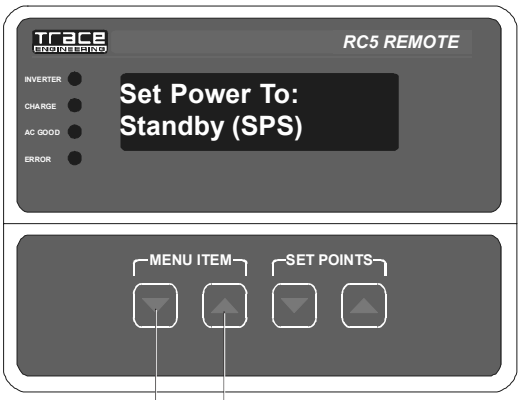
2.7 Start-up and Test

Prior to starting the inverter, make sure all connected loads are switched OFF or disconnected from the AC receptacles.

- Use a multimeter to verify 12 VDC at the inverter's DC connectors.
- Press the inverter's momentary front panel switch ON. Verify the inverter starts and the INVERTER LED pulsates or remains ON (solid) depending upon the position of the SEARCH potentiometer.
- Verify the breakers on the sub panel are switched ON.
- Use a multimeter to verify 120 VAC at the vessel's AC outlets.
- Connect the vessel to shore power and switch the main circuit breaker ON.
- Verify the inverter's LED switches from INVERTER to AC IN (SHORE POWER) GOOD.
- Use a multimeter to verify 120 VAC at each of the vessel's AC outlets.
- Switch the main circuit breaker OFF and verify the inverter's LED switches from AC IN (SHORE POWER) GOOD to INVERTER.
- Installation is complete.

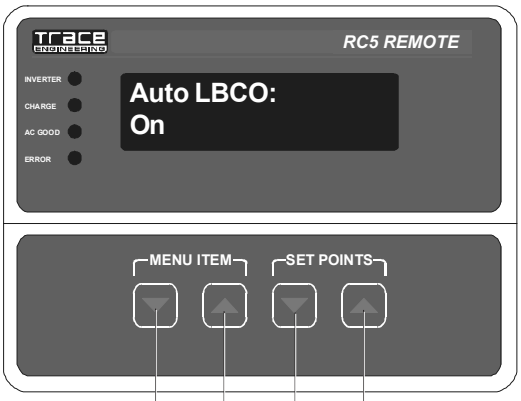
2.0 INSTALLATION

IMPORTANT NOTE
When first powering the RC5 remote with the inverter, switch the inverter OFF, plug the remote's cable into the inverter's REMOTE port, switch the inverter ON / OFF / ON to initialize the remote.



Hold down both keys (approximately 1 second) to enter and exit the SETUP menu

Figure 35
RC5 Full Function Remote



Scroll UP or DOWN through the menu selections

Scroll UP or DOWN through the set points to select the value

Figure 36
RC5 Menu and Set Points

2.0 INSTALLATION

2.8 Configuration (with the optional RC5 or URC Remote Control)

Once the Voyager Series inverter/charger has been started and tested, it must be configured for Low Battery Cutoff (LBCO), Shore Power Current, Charger Amps, Battery Size and Battery Type. Once the inverter is switched ON, the remote control will go through a short start and self-test sequence.

NOTE: If SEARCH SENSE is going to be set using the remote, the inverter's front panel SENSE potentiometer MUST be set to the midway position (approximately 11 o'clock).

NOTE: The remote must be plugged into the inverter's front panel REMOTE port BEFORE DC power is applied to the inverter. If necessary, remove DC and AC power from the input (switch the main breaker OFF), plug the remote into the front panel connector, and then reapply DC and AC power to the inverter.

Hold down both MENU keys (approximately 1 second) to enter the SETUP menu. Scroll UP or DOWN through the menu selections. Use the SET POINT keys to select the desired value. The value displayed becomes the setting. Use the MENU keys to move to the next menu.

2.8.1 Low Battery Cutoff (LBCO) / AC Transfer Voltage

The Low Battery Cutoff / AC Transfer Voltage setting performs two related functions.

Low Battery Cutoff (LBCO)

When enabled, LBCO shuts the inverter down at a specified voltage (low battery cutoff) to protect the batteries from over discharge damage. The microcontroller calculates the lowest (safe) DC voltage (leaving approximately 80% battery capacity) based on the LBCO potentiometer setting, the position of the Battery Type Selector jumper and the amount of load sensed by the inverter.

NOTE: When LBCO is disabled, the microcontroller is programmed to shut the inverter off when the batteries reach approximately 8.5 VDC (1.42 V/cell).

- Scroll through the menu items to Auto LBCO. Select either ON or OFF from the SET POINT keys.

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 setting, the inverter switches to battery power in order to maintain the connected load.

NOTE: To achieve the fastest transfer time (typically less than 16 ms), increase the transfer voltage value. If a high number of "nuisance transfers" caused by transients on the AC line occur, lower the AC transfer voltage value.

- Scroll through the menu items to VAC Dropout. Select the desired transfer voltage (80 VAC to 105 VAC) from the SET POINT keys.

2.0 INSTALLATION

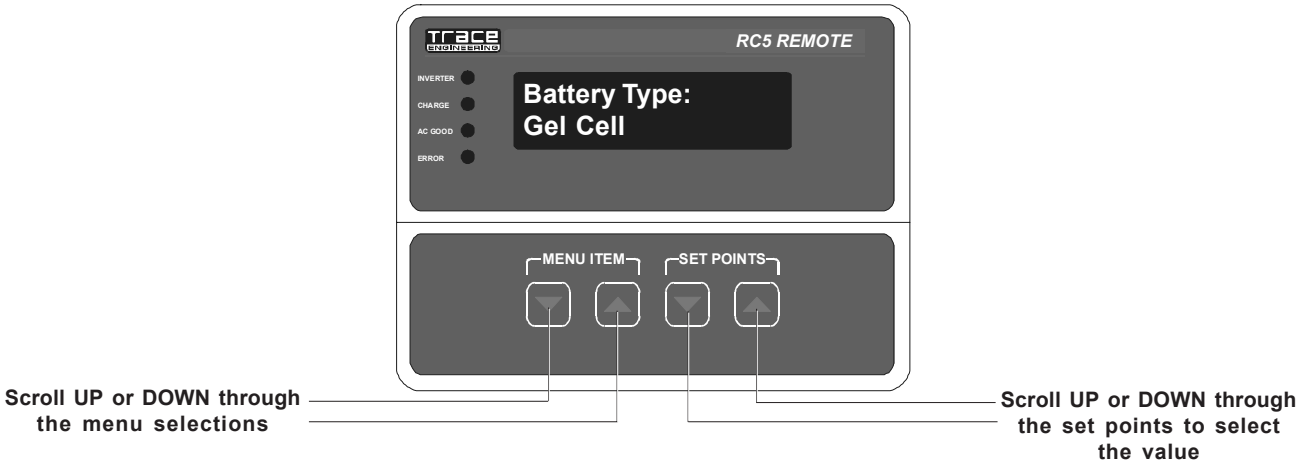


Figure 37
RC5 Menu and Set Points

Available Settings	Actual Amp Hour Rating
50	50
125	125
250	250
375	375
500	500
1000	1000 or greater

Table 7
Battery Capacity (amp hours)

2.0 INSTALLATION

2.8.2 Shore Power Amps

The Shore Power Amps setting establishes a maximum current threshold for power being drawn by both the battery charger and the AC loads connected to the inverter. Whenever the level approaches the setting, the battery charger "backs off" its current draw to prevent tripping and loss of power to the AC loads.

NOTE: Only the AC loads powered by the inverter are monitored. Large loads, powered directly from the main panel, are not monitored. This may result in occasional nuisance tripping of the shore power circuit breaker when the total load exceeds 30 amps.

- Scroll through the menu items to SHORE POWER AMPS. Select the desired current threshold (5 Amps to 30 Amps) from the SET POINT keys.

2.8.3 Charger Amps

The Charger Amps setting establishes the maximum charge current supplied to the battery bank. It also regulates the constant current when the charger is in its Bulk Charge mode. The highest charge rate recommended is determined by dividing the battery bank's total amp hour capacity by a factor between 3 and 5 (5 for gel cell - 3 for lead acid). Setting the CHG AMP control at a higher level is best for quickly recharging the batteries where AC power is only available for short periods of time. This, however, can put additional stress on the batteries. A lower setting is recommended for typical installations. For example, a 400 amp hour battery bank can be sufficiently recharged in 24 hours at a 25 amp setting (25 amps x 24 hours = 600 amp hours).

- Scroll through the menu items to CHARGE RATE. Select the desired current setting from the SET POINT keys.

2.8.4 Battery Capacity

The Battery Capacity setting establishes the correct charging profile based on the amp hour capacity of the batteries used with the inverter (table 7).

- Scroll through the menu items to BAT CAPACITY. Select the desired setting (50 amp hours to 1,000 amp hours) from the SET POINT keys.

NOTE: Most battery manufacturers list the amp hour rating on the battery label. If the batteries are wired in series or series/parallel, the total amp hour rating will be higher than the individual battery rating (see section 2.3.5).

2.8.5 Battery Type

The Battery Type setting configures the charger for the type of batteries used in the system. Since battery types differ greatly, requiring different charging profiles, the type of battery MUST be selected. The default setting is for GEL batteries.

- Scroll through the menu items to BATTERY TYPE. Select the desired setting (GEL, AGM, or LEAD ACID) from the SET POINT keys.

This completes the configuration section. Press both MENU keys (and hold approximately 1 second) to return the remote to normal operation.

3.0 OPERATION

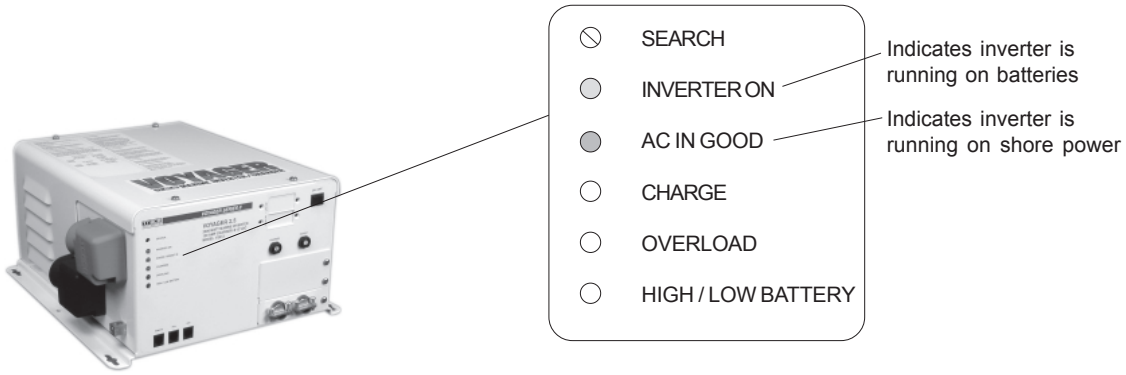


Figure 37
Voyager (Series I and II) LED Display

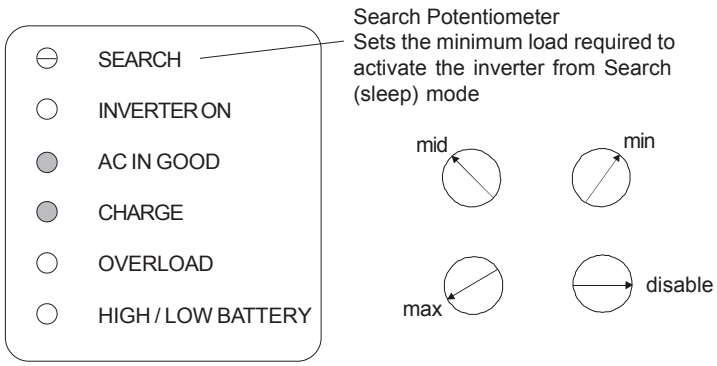


Figure 38
Search Potentiometer

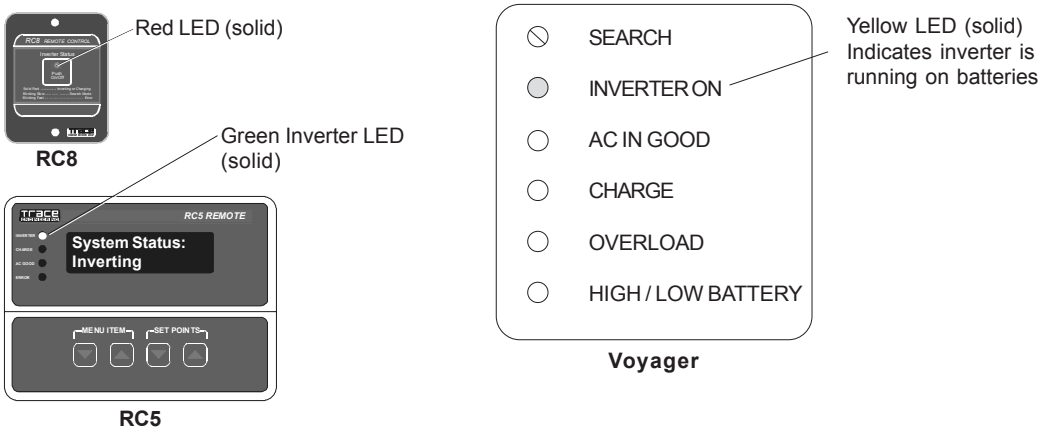


Figure 39
Inverter Mode
(RC8 and RC5 options shown)

3.0 OPERATION

3.1 Operating the Inverter

The Voyager Series inverter/charger has basically two modes of operation: INVERTER (running from battery power) and AC (running from shore power or a generator). Whenever the inverter is in its AC mode, it passes power directly on to the connected load and, at the same time, recharges the batteries. The 3-stage battery charger (Bulk, Absorption and Float) provides rapid and complete charging cycles without placing undue stress on the batteries. Other than several adjustments for configuring the inverter, operation is fully automatic.

3.1.1 Search

The Search potentiometer, located on the inverter's front panel, adjusts the current threshold required to bring the inverter out of search mode into full operation. With search mode enabled, the inverter pulses the AC output looking for an applied load (typically 5 to 100 watts, depending upon the setting). When no load is detected, the inverter goes into search mode (sleep) to minimize energy consumption. During this time, the INVERTER ON LED flashes to indicate SEARCH mode. When a load is applied, the search circuit recognizes the wattage and starts the inverter (figure 38).

NOTE: If the potentiometer is set fully CW, the search circuit is disabled causing the inverter to remain on regardless of an applied load.

NOTE: If an RC5 or URC remote control is connected to the inverter, the search potentiometer MUST be set to the midway position.

3.2 Start-up Sequence

When DC power is first applied to the inverter, the front panel LEDs sequence ON and OFF while the unit performs a self-test. The internal fan also starts and then stops. When the start-up sequence is complete, press the momentary power switch to start the inverter. It then enters into AC or INVERTER mode, depending upon the power source.

RC8 Remote

If the RC8 remote is installed, it must be started by the ON / OFF switch or the inverter's momentary power switch. The red LED will blink through the start-up and then stay ON.

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, the LEDs will cycle similar to the Voyager front panel LEDs. Once installed, the inverter's front panel momentary power switch becomes inoperative as does the RC8's switch (if installed).

3.3 Inverter Mode

When AC is not sensed at the input, the inverter instantly transfers to battery power with no interruption to the connected load. The yellow "INVERTER ON" LED lights and remains ON solid (figure 39).

RC8 Remote

If the RC8 remote is installed, the red LED will be ON solid.

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, the green "INVERTER" LED will be ON solid.

3.0 OPERATION

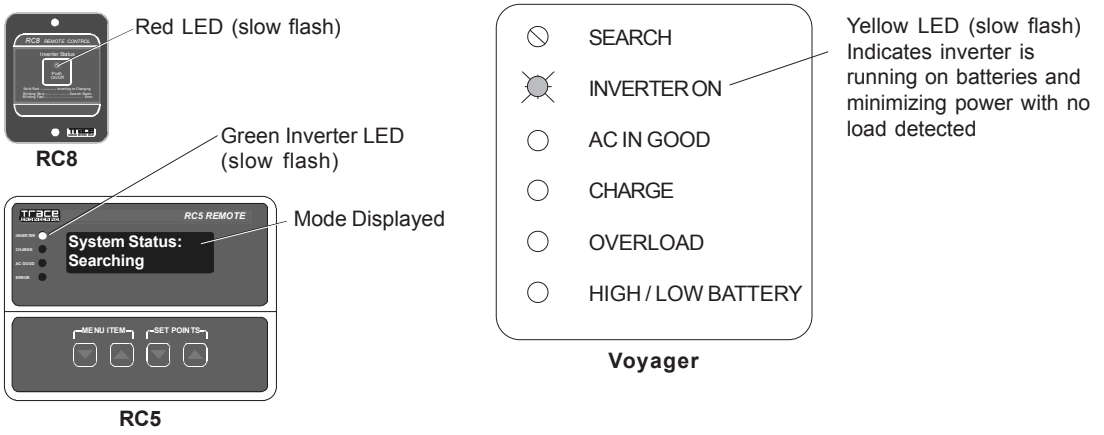


Figure 40
Inverter Mode (Search)
(RC8 and RC5 options shown)

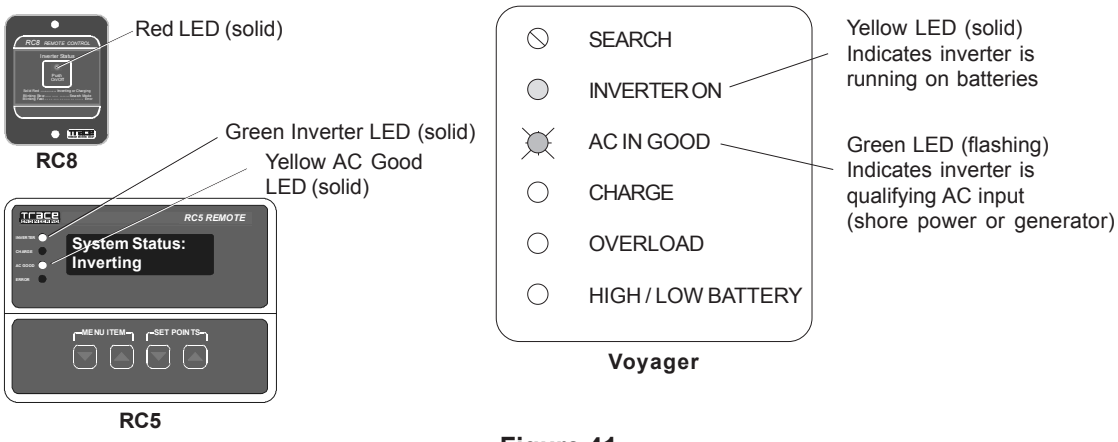


Figure 41
AC Transfer Mode
(RC8 and RC5 options shown)

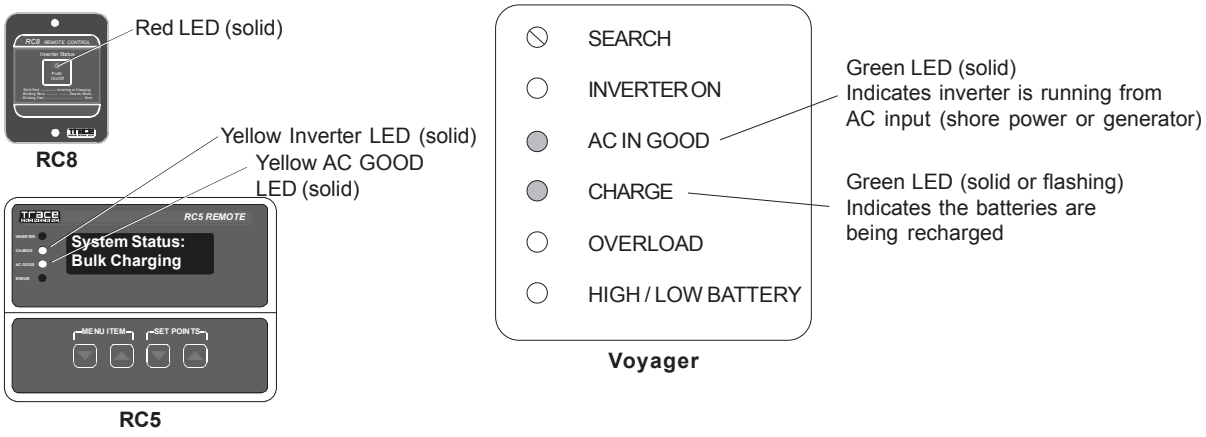


Figure 42
AC Mode
(RC8 and RC5 options shown)

3.0 OPERATION

3.4 Inverter (Search) Mode

When loads connected to the inverter are switched OFF (when running from batteries), the inverter minimizes its power drain by reducing the output to small test pulses. The pulses (sensitivity set by the front panel SEARCH potentiometer) are used to detect the presence of a load. During SEARCH mode, the yellow "INVERTER ON" LED flash slowly (figure 40). When a load is detected, the inverter's returns to INVERTER mode.

RC8 Remote

If the RC8 remote is installed, the red LED will flash slowly (approximately once per second).

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, the green "INVERTER" LED will flash slowly (approximately once per second). "Searching" will appear in the remote's display.

3.5 AC Transfer Mode

When the inverter first senses AC at the input, it qualifies the power before transferring to AC mode. Since the inverter is still running on batteries, the yellow "INVERTER ON" LED remains ON during the short transfer sequence. The green "AC IN GOOD" LED flashes to indicate the AC Transfer mode. There is no interruption of power to the connected load during the transfer (figure 41).

RC8 Remote

If the RC8 remote is installed, the red LED will be ON solid.

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, both the yellow "AC GOOD" and the green "INVERTER" LEDs will be ON solid.

3.6 AC (Shore Power or Generator) Mode

Whenever nominal AC is present at the inverter's input, it passes power through to the connected load and begins charging the batteries. The green "AC IN GOOD" LED lights to indicate AC operation. Depending upon the battery's state of charge, the charger will enter into any of three modes of operation (Bulk, Absorption or Float), indicated by the green "CHARGE" LED (figure 42).

RC8 Remote

If the RC8 remote is installed, the red LED will be ON solid.

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, both the yellow "AC GOOD" and the yellow CHARGE LEDs will be ON solid.

3.0 OPERATION

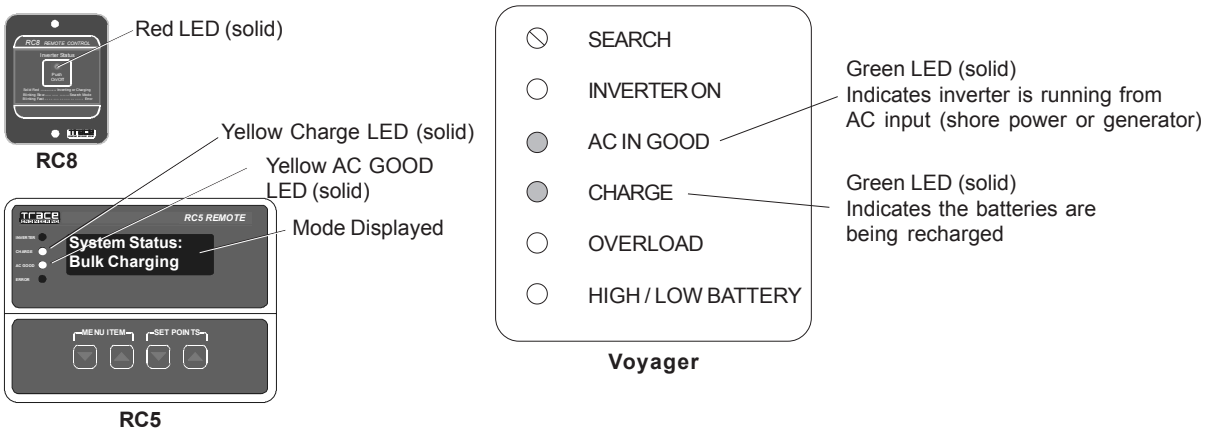


Figure 43
Charge Mode (Bulk)
(RC8 and RC5 options shown)

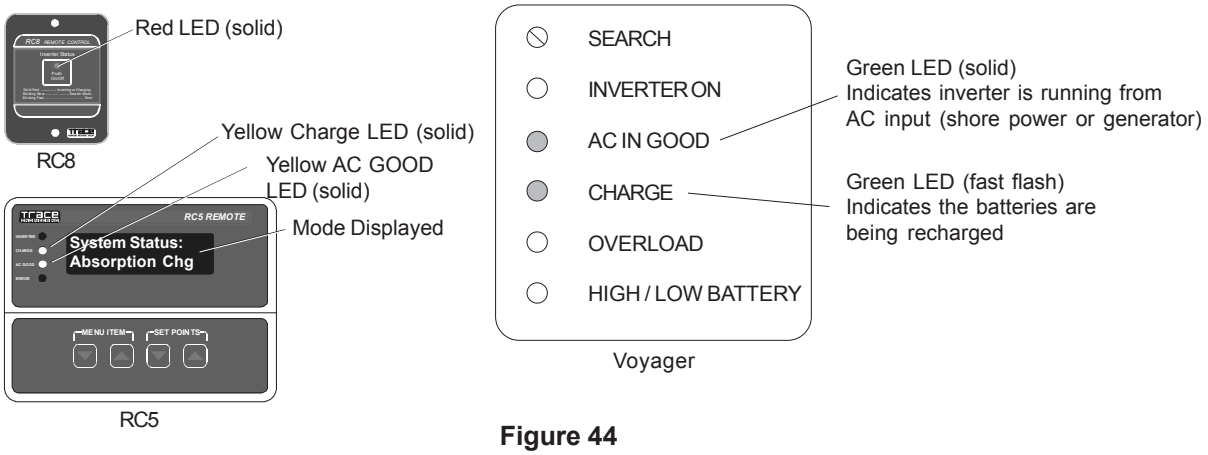


Figure 44
Charge Mode (Absorption)
(RC8 and RC5 options shown)

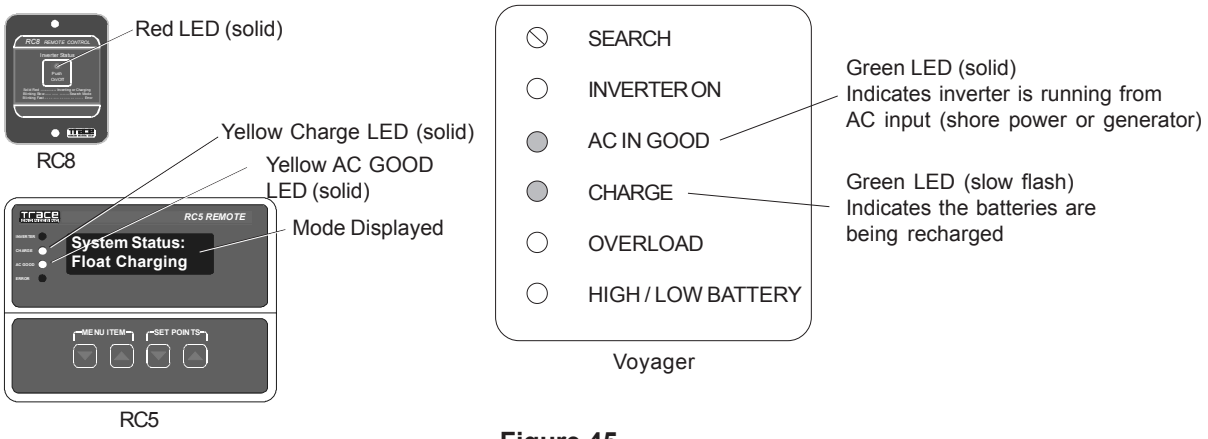


Figure 45
Charge Mode (Float)
(RC8 and RC5 options shown)

3.0 OPERATION

3.7 Bulk Charge Mode

Whenever nominal AC is present at the inverter's input, it passes power through to the connected load and begins charging the batteries. The green "AC IN GOOD" LED lights (solid) to indicate AC operation and the green "CHARGE" LED lights (solid) to indicate the initial stage of charging "BULK" (figure 43).

During bulk charging, the charger supplies the maximum amount of constant current to the batteries. Over time, the battery voltage rises until the bulk voltage threshold is reached (typically 14.1 VDC for GEL, 14.4 VDC for AGM, and 14.6 VDC for liquid lead acid). The charger then switches to ABSORPTION mode.

RC8 Remote

If the RC8 remote is installed, the red LED will be ON solid.

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, both the yellow "AC GOOD" and the yellow CHARGE LEDs will be ON solid. "Bulk Charging" will appear in the remote's display.

3.8 Absorption Charge Mode

As nominal AC input power continues, indicated by the green "AC IN GOOD" LED ON (solid), the charger enters the second stage of charging "ABSORPTION" (figure 44). The green "CHARGE" LED flashes (fast), approximately 10 times per second, to indicate absorption charging.

The charger continues to supply a constant (bulk) voltage to the batteries for approximately 90 minutes (or until the "return amps" value (battery capacity/40) is met. It then slowly reduces the charge current and switches to FLOAT mode.

RC8 Remote

If the RC8 remote is installed, the red LED will be ON solid.

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, both the yellow "AC GOOD" and the yellow CHARGE LEDs will be ON solid. "Absorption Charging" will appear in the remote's display.

3.9 Float Charge Mode

As nominal AC input power continues, indicated by the green "AC IN GOOD" LED ON (solid), the charger enters its third stage of charging "FLOAT" (figure 45). The green "CHARGE" LED flashes (slow), approximately once per second, to indicate float charging.

The batteries are held at the float voltage (typically 13.6 VDC for GEL, 13.4 VDC for AGM, and 13.4 VDC for liquid lead acid) as long as AC is present at the inverter's input. Float charging reduces battery gassing, minimizes watering requirements (for flooded batteries) and ensures the batteries are in constant state of readiness.

RC8 Remote

If the RC8 remote is installed, the red LED will be ON solid.

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, both the yellow "AC GOOD" and the yellow CHARGE LEDs will be ON solid. "Float Charging" will appear in the remote's display.

3.0 OPERATION

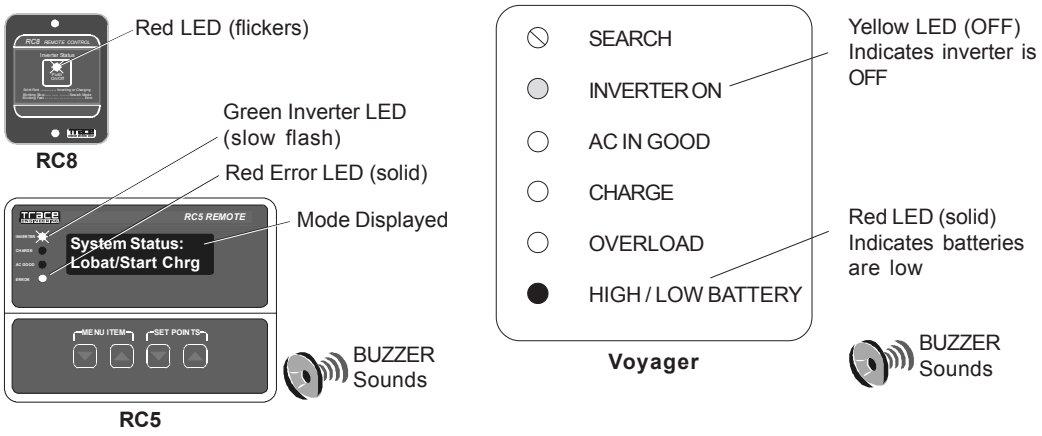


Figure 46
Low Battery Alarm
(RC8 and RC5 options shown)

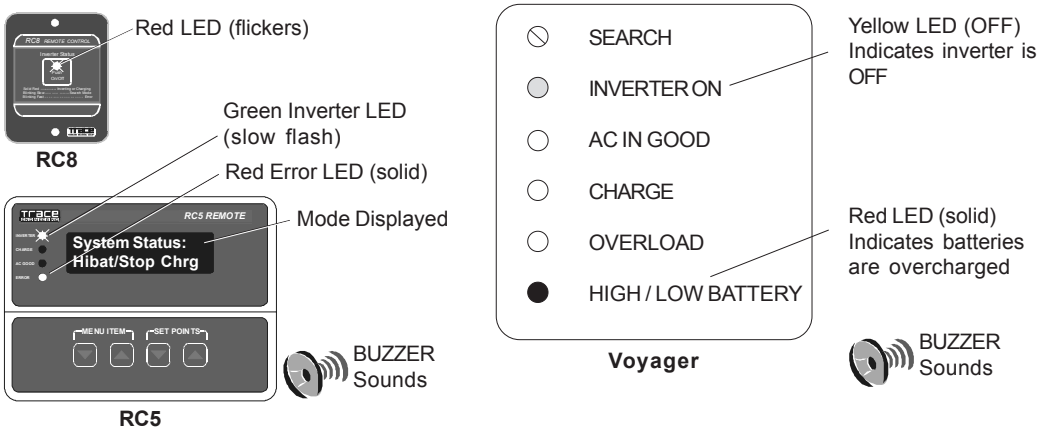


Figure 47
High Battery Alarm
(RC8 and RC5 options shown)

3.0 OPERATION

3.10 Low Battery Alarm

The inverter constantly monitors the batteries. Whenever the battery voltage reaches a low level, the red "HIGH / LOW BATTERY" LED lights and remains ON solid. At the same time, the alarm buzzer is activated and the yellow INVERTER ON LED turns OFF.

The inverter is equipped with a Low Battery Cutoff circuit (LBCO) that automatically shuts the inverter down, along with all connected loads, when the battery voltage reaches the cutoff level. The yellow "INVERTER ON" LED turns OFF indicating inverter shut down, and remains OFF until AC is connected to the input to recharge the batteries (figure 46).

RC8 Remote

If the RC8 remote is installed, the red LED will flicker, indicating an alarm condition.

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, the green "INVERTER" LED will flash slow, the red "ERROR" LED will come on and the alarm buzzer will sound. "LOBAT/START CHRG" will appear in the remote's display.

3.11 High Battery Alarm

During the inverter mode, the system constantly monitors the batteries. In the event the battery voltage reaches a high level threshold, the red "HIGH / LOW BATTERY" LED lights and remains ON solid, plus the alarm buzzer is activated (figure 47).

This condition is rare and usually results from a second charging source in the system such as solar panels or a wind generator.

RC8 Remote

If the RC8 remote is installed, the red LED will flicker, indicating an alarm condition.

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, the green "INVERTER" LED will flash slow, the red "ERROR" LED will come ON and the alarm buzzer will sound. "HIBAT/STOP CHRG" will appear in the remote's display.

3.0 OPERATION

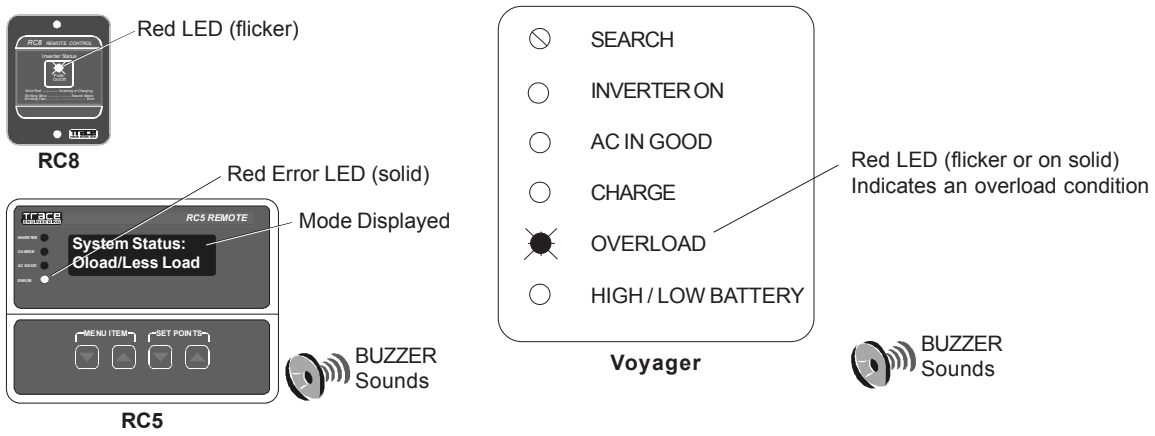


Figure 48
Overload (Error) Alarm
(RC8 and RC5 options shown)

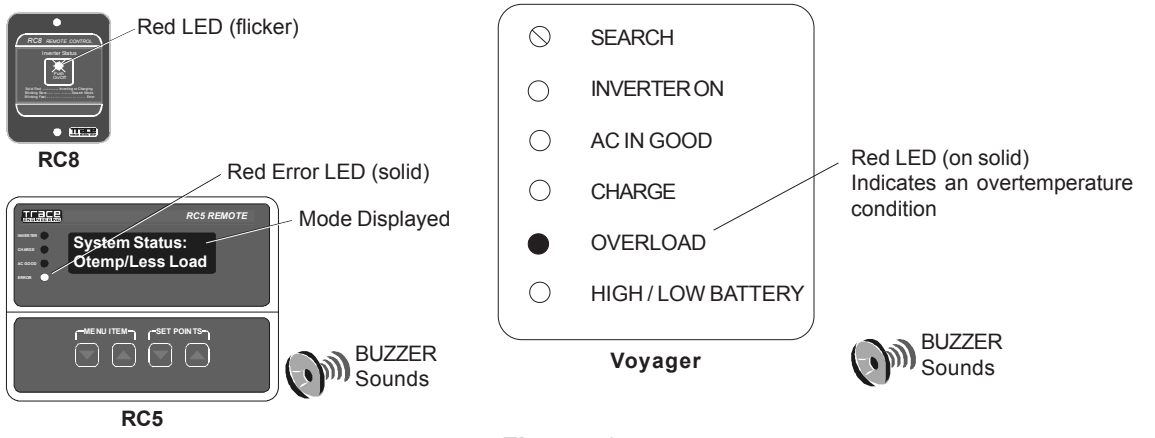


Figure 49
Overtemperature (Error) Alarm
(RC8 and RC5 options shown)

3.0 OPERATION

3.12 Overload (Error) Alarm

Whenever the load connected to the inverter exceeds the rated output, the inverter shuts down for approximately 20 seconds and then restarts. If the overload condition continues, the inverter completely shuts down, indicated by both the yellow "INVERTER ON" and green "AC IN GOOD" LEDs shutting OFF. The red "OVERLOAD" LED lights and remains ON solid until the load has been reduced and the inverter manually restarted (figure 48). At the same time, the alarm buzzer is activated.

RC8 Remote

If the RC8 remote is installed, the red LED will flicker, indicating an alarm condition. If the inverter times out due to an overcurrent event, the RC8 LED will turn OFF.

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, the red "ERROR" LED will come ON and the alarm buzzer will sound. "OLOAD/LESS LOAD" will appear in the remote's display.

3.13 Overtemperature (Error) Alarm

Whenever the inverter's internal temperature rises to its high temperature threshold, the inverter shuts down automatically and then restarts after it has cooled. The red "OVERLOAD" LED is ON solid and the alarm buzzer is activated. Both reset when the inverter restarts (figure 49).

RC8 Remote

If the RC8 remote is installed, the red LED will flicker, indicating an alarm condition.

RC5 or URC Remote Controls

If the RC5 or URC remote control is installed, the red "ERROR" LED will come ON and the alarm buzzer will sound. "OTEMP/LESS LOAD" will appear in the remote's display.

4.0 SPECIFICATIONS

	V1012	V1512	V2012	V2512	V3012
Input (DC)					
Input Voltage (rated)	12 VDC	12 VDC	12 VDC	12 VDC	12 VDC
Input Voltage Range	10.8 to 15.5 VDC	10.8 to 15.5 VDC	10.8 to 15.5 VDC	10.8 to 15.5 VDC	10.8 to 15.5 VDC
Search Mode (typical)	<1 W	<1 W	<1 W	<1 W	<1 W
On Mode (no load - idle)	6 Watts	7 Watts	10 Watts	12 Watts	12 Watts
Input (AC)					
Input Voltage	120 VAC	120 VAC	120 VAC	120 VAC	120 VAC
Input Frequency	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz
Input / Pass-through Current (max)	30 A	30 A	30 A	30 A	30 A
Output					
Output Voltage (rms)	120 VAC	120 VAC	120 VAC	120 VAC	120 VAC
Output Frequency	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz
Continuous Output Current	8.3 A	12.5 A	16.7 A	20.8 A	25 A
Continuous Power	1000 VA	1500 VA	2000 VA	2500 VA	3000 VA
Surge Capability					
1 mSec (1)	25 A (peak)	38 A (peak)	56 A (peak)	56 A (peak)	64 A (peak)
100 mSec (2)	20 A (rms)	22 A (rms)	40 A (rms)	40 A (rms)	48 A (rms)
Peak Efficiency	94%	94%	94%	94%	94%
Battery Charger					
Maximum Charging Rate	50 A	70 A	100 A	120 A	140 A
Factory Default Setting	40 A	40 A	40 A	40 A	40 A
Charger Type	3-stage charger				
Temperature Compensation	with optional, plug-in sensor (BTS)				
Electrical					
AC Waveform	Modified sinewave				
Power Factor Allowed	-1 to 1				
Voltage Regulation	± 5% (at rated voltage)				
Frequency Regulation	± 0.04% (crystal regulated)				
Load Sensing Range	5 to 100 W (adjustable)				
Physical					
Enclosure Type	indoor, ventilated, aluminum chassis (with powdercoat finish)				
Temperature Range (specified)	32 °F to 104 °F (0 °C to 40 °C) - will meet specified tolerances				
Temperature Range (allowed)	-40 °F to 32 °F and 104 °F to 140 °F (-40 °C to 0 °C and 40 °C to 60 °C) - will operate but may not meet specified tolerances				
Altitude Limit (operating)	15,000 feet (5,000 meters)				
Mounting	bulkhead or shelf-mount				
Wiring Requirements (AC)	#14 AWG (min), #6 AWG (max) - depends upon model and wire length				
Wiring Requirements (DC)	#4 AWG (min), #4/0 AWG (max) - depends upon model and wire length				
Wiring Requirements (ground)	#10 AWG (min), #2 AWG (max) - depends upon model and wire length				
Dimensions Series I*	7.25" H x 10.75" W x 14.75" D (18.4 cm H x 27.3 cm W x 37.5 cm D)				
Series II*	7.25" H x 13.50" W x 14.75" D (18.4 cm H x 34.3 cm W x 37.5 cm D)				
Weight	24 lb. (11 kg)	27 lb. (12 kg)	40 lb. (18 kg)	40 lb. (18 kg)	46 lb. (21 kg)
Standard Features					
Easy-to-Use Control Panel	ON/OFF switch, LED display, load sensing potentiometer				
Default and Custom Programming	with RC5 or URC remote controls				
Circuit Protection	front panel AC and charger circuit breakers				
High and Low Battery Protection	automatically shuts down batteries to prevent damage				
Variable Speed, DC Cooling Fan	ensures maximum cooling under heavy loads				
Options					
BTS	Battery Temperature Sensor				
RC5/50	full function remote control with 50 foot (15 meter) cable				
RC8/50	on/off remote control with status LED Indicator and 50 foot (15 meter) cable				
BCK5-4/0	battery / inverter cable (5 foot - #4/0 AWG)				
BCK5-2/0	battery / inverter cable (5 foot - #2/0 AWG)				
Agency Approval	UL458 Marine Supplement CSA C22.2 No. 107.1-95				

NOTES:
(1) Surge "1 mSec" - Maximum 1 ms peak output amps measured when starting AC loads
(2) Surge "100 mSec" - Maximum 100 ms peak output amps measured when starting AC loads
* Includes battery terminal covers, fan louvers, AC input breakers and ground lug

Specifications @ 25 °C Ambient
Specifications subject to change without notice.

5.0 TROUBLESHOOTING

Symptom	Possible Problem	Remedy
No output power. Red warning LEDs are OFF.	Unit is switched OFF or the battery voltage is too low.	Switch the unit ON. Check the battery voltage, fuses, circuit breakers and cable connections.
No output power. Red High/Low battery LED is ON.	Low battery voltage High battery voltage	Check the battery voltage at the inverter's terminals. Charge, discharge, or replace batteries.
No output power. Yellow Inverter LED is flashing.	Load too small for the search mode circuit to detect.	Reduce the search threshold or defeat search mode.
Low output power. Inverter turns loads ON and OFF. High/Low Battery LED is flashing.	Low batteries. Loose or corroded battery connections. Loose AC output connections.	Check and recharge batteries. Check and clean all connections. Check AC output connections.
AC output voltage appears low when using a meter.	Measuring with the wrong type voltmeter (displays 80 - 100 VAC).	Voltmeter must be a true RMS reading meter.
Low surge power.	Weak batteries, battery cables too small or too long.	Refer to cable and battery recommendations in manual.
Low charge rate.	Low peak AC input voltage (when connected to shore power). (when using a generator). Generator output is too small to power load and charger.	Check AC input wiring. Adjust charge rate setting from remote or reduce load. Speed up RPMs (164 volts peak required for full charger output). Reduce load.
Charger is inoperative.	Loose battery cables or bad batteries. Charger controls improperly set. Wrong AC input voltage.	Check cables and batteries. Adjust settings (refer to manual) Check AC input for proper voltage and frequency.

☞ NOTE: The Voyager Series inverter / charger has no internal user serviceable parts. If service is required, refer to section 6.2.

6.0 SERVICE

6.1 Preventive Maintenance

To ensure maximum performance from the system, preventive maintenance should be performed every 4 to 6 months. Prior to performing these checks, switch both the AC and DC circuits OFF.

- Visually inspect the batteries for cracks, leaks, or swelling - replace as necessary
- Clean and remove any electrolyte spills or buildups - use baking soda
- Check the battery hold down clamps - tighten as necessary
- Check the battery terminals and connecting cables - clean and tighten to 10 to 12 foot pounds
- Check water levels (Liquid Lead Acid batteries only) - fill to split ring
- Check individual battery voltages (they should be within 0.3 VDC of each other)
- Check all cable runs for signs of chafing - replace or protect as necessary
- Check the inverter's vents and cooling fan - clean as necessary
- Check the inverter's AC terminal block connections - tighten to 16 foot pounds
- Reapply AC and DC power - test the inverter for proper operation

☞ NOTE: The Voyager Series inverter / charger has no internal user serviceable parts. If service is required, refer to section 6.2.

6.1.1 Storage Checklist

Prior to seasonal storage, perform the following to ensure the system is properly shutdown. This is especially important for maintaining the batteries.

External Storage

- Perform preventive maintenance (see above)
- Make sure the batteries are fully charged
- Make sure that shore power is connected and the breaker to the inverter is switched ON
- Make sure the inverter is switched ON
- Set the SEARCH mode potentiometer for the lowest necessary load
- Switch OFF all unnecessary AC and DC loads

Internal Storage

- Perform preventive maintenance (see above)
- Make sure the batteries are fully charged
- Make sure the inverter is switched OFF
- Switch OFF all AC and DC loads
- Remove shore power and disable the generator (if installed)

6.0 SERVICE

6.2 Service

Trace Engineering 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: _____

5916 - 195th Street N.E., Arlington, WA 98223 Phone: (360) 435-8826 Fax: (360) 435-2229
visit our website at: www.traceengineering.com

7.0 WARRANTY

Life Support Policy

Trace Engineering 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.

Trace Engineering 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 Trace Engineering is adequately protected.

Warranty Registration

To ensure proper registration, complete the Warranty Card and mail it to Trace Engineering 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 Trace service center or at the Trace 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 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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visit our website at: www.traceengineering.com

7.0 WARRANTY

Limited Warranty

Trace Engineering warrants its power products against defects in materials and workmanship for a period of three (3) 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. Trace does not warrant its products from any and all defects:

- arising out of material or workmanship not provided by Trace Engineering 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 or use in violation of the instructions.
- in components, parts, or products expressly warranted by another manufacturer.

Trace Engineering 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. Trace Engineering 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 Trace Engineering 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 Trace Engineering.

All remedies and the measure of damages are limited to the above. Trace Engineering shall in no event be liable for consequential, incidental, contingent, or special damages, even if Trace Engineering 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 three (3) 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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