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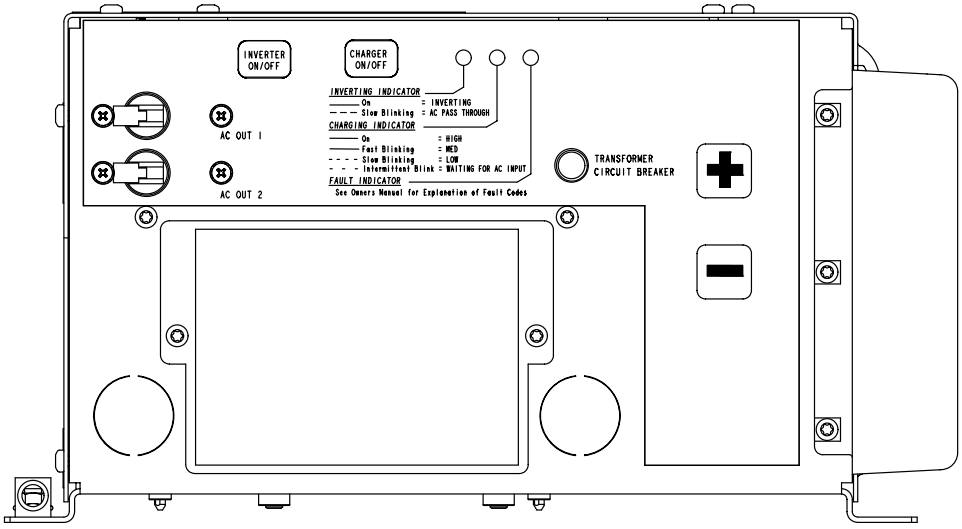
Power Generation

Onan® Equinox™ Inverter-Chargers

Operation, Installation, Service

Series HJBAA



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Power Generation

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Safety Precautions

Electricity, fuel, engine exhaust, moving parts, and batteries present hazards which can result in severe personal injury or death.

Thoroughly read this manual before operating the Inverter-Charger. Safe operation and top performance can only be attained when equipment is operated and maintained properly.

The following symbols in this manual alert you to hazards to operators, service personnel and equipment.

⚠ DANGER ***alerts you to an immediate hazard that will result in severe personal injury or death.***

⚠ WARNING ***alerts you to a hazard or unsafe practice that can result in severe personal injury or death.***

⚠ CAUTION ***alerts you to a hazard or unsafe practice that can result in personal injury or equipment damage.***

ENGINE EXHAUST

Engine exhaust gases include CARBON MONOXIDE (CO), an odorless, colorless gas that can cause severe personal injury or death. Symptoms of carbon monoxide poisoning include:

- Dizziness, Headache or Throbbing Temples
- Weakness or Muscular Twitching
- Sleepiness or Confusion
- Nausea or Vomiting

If you or anyone else experiences any of these symptoms, get out into fresh air immediately. Get medical attention if symptoms persist.

To reduce the risk of CO poisoning, always disable Auto GenStart before:

- Sleeping in the vehicle, unless the vehicle has a working CO detector
- Parking the vehicle in a garage or other confined space
- Parking the vehicle for storage

MOVING PARTS AND ELECTRICITY

All electrical connections must be made by trained and experienced electricians in accordance with applicable codes.

Use caution when working on live electrical equipment. Remove jewelry, use tools with insulated handles, make sure clothing and shoes are dry and stand on a dry wooden platform or insulating pad.

Disconnect all sources of AC and DC power from the Inverter-Charger before servicing.

To reduce the risk of exposure to hazardous moving parts and electricity, always disable Auto GenStart before:

- Servicing the genset
- Servicing batteries
- Servicing electrical appliances
- Fueling the vehicle

BATTERIES

Carefully read and follow all of the battery manufacturer's instructions and safety precautions.

Do not smoke when servicing batteries. Wear safety glasses. If acid gets in your eyes or on your skin, flush with water for 15 minutes and get medical attention.

To keep sparks from igniting explosive battery gases, always disconnect AC power to the Inverter-Charger and turn off all DC loads before disconnecting the battery cables.

The high capacitance of the Inverter-Charger can cause sparking whenever battery cables are disconnected or reconnected. This is normal, do not be alarmed. Take the following precautions:

1. Do not disconnect or reconnect the Inverter-Charger when fuel fumes are present.
2. ***To keep sparking away from the batteries when disconnecting battery cables:***
   A. Disconnect the negative (**–**) cable from the Inverter-Charger and then the Batteries,
   B. Disconnect the positive (**+**) cable from the Inverter-Charger and then the Batteries.
3. ***To keep sparking away from the batteries when reconnecting battery cables:***
   A. Reconnect the positive (**+**) cable at the Batteries and then at the Inverter-Charger,
   B. Reconnect the negative (**–**) cable at the Batteries and then at the Inverter-Charger.

SAVE THIS MANUAL — IMPORTANT SAFETY INSTRUCTIONS

Specifications

MODEL	1.5HJBAA	2.0HJBAA	2.5HJBAA	3.0HJBAA
INVERTER FUNCTION				
Maximum Continuous AC Output (Watts)	1500	2000	2500	3000
Output Voltage (60 Hz, modified-sine $Volts_{rms}$)	120	120	120	120
Peak Surge Output Current (300% Rated)	37	50	62	75
15/15 Amp Output Breakers	Optional	Optional	Optional	Optional
20/20 Amp Output Breakers	Optional	Optional	Optional	Optional
Automatic Low Battery Cutout	Standard	Standard	Standard	Standard
AC Input / Output Connections	Terminal Block			
TRANSFER SWITCH FUNCTION				
120 VAC, 60 Hz Pass-Through Amps	30	30	30	30
Power Sharing	Standard	Standard	Standard	Standard
CHARGER FUNCTION				
AC Input Voltage (60 Hz)	120	120	120	120
Maximum Charging Current (DC Amps)	75	100	120	140
Recommended Class T DC Fuse Rating (Amps)	200	300	300	400
Charge Control	3-Stage	3-Stage	3-Stage	3-Stage
Internal Shunt (for battery charge monitoring)	Optional	Optional	Standard	Standard
Temperature Compensation Charging	Standard	Standard	Standard	Standard
Equalization Charging	Standard	Standard	Standard	Standard
Available Battery Type Settings	wet/gel/agm	wet/gel/agm	wet/gel/agm	wet/gel/agm
Battery Voltage (VDC)	12			
DC Connections	Terminal Block			
REMOTE CONTROL				
Equinox Digital Display	Optional	Optional	Optional	Optional
Auto Genset Start/Stop (Diesel Only)	Standard	Standard	Standard	Standard
INSTALLATION				
Weight: lbs (kg)	45 (20.5)	47 (21.4)	50 (22.7)	51 (23.2)
Width x Depth x Height: Inches (mm)	12.8 x 12.2 x 7.2 (325 x 310 x 181)			
Temperature Range	–4° F to 104° F (–20° C to 40° C)			
Enclosure Type	Metal			
Cooling	Forced Air			
FAULT DIAGNOSTICS—STANDARD				

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Introduction

ABOUT THIS MANUAL

This manual covers operation, maintenance, troubleshooting, installation and service of the Equinox™ Series HJBAA Inverter-Chargers. Refer to Parts Catalog 901-0200 for replacing parts.

⚠WARNING ***This Inverter-Charger is not a life support system. It will stop supplying power if the batteries become discharged and genset and shore power are not available. Children, persons with physical or mental limitations, and pets could suffer personal injury or death. A personal attendant, redundant power or an alarm system must be used if operation is critical.***

NAME AND RATING LABELS

The name and rating labels are located on the top and side of the Inverter-Charger (Figure 1).

HOW TO OBTAIN SERVICE

In North America: Call 1-800-888-ONAN for the nearest Cummins/Onan distributor in the United States or Canada. Press 1 (OPTION 1) to be automatically connected.

If you are unable to contact a distributor using the automated service, consult the Yellow Pages. Typically, our distributors are listed under:

GENERATORS – ELECTRIC,
ENGINES – GASOLINE OR DIESEL, or
RECREATIONAL VEHICLES – EQUIPMENT,
PARTS AND SERVICE.

Outside North America: Call Onan Corporation at 1–763–574–5000 from 7:30 AM to 4:00 PM (Central Standard Time), Monday through Friday, or fax 1–763–528–7229.

Information to have available when calling:

1. *Model Number, including Spec Letter, and Serial Number (gray boxes in Figure 1)*
2. *Date of purchase*
3. *Nature of problem (Troubleshooting,p. 47).*

⚠WARNING ***Improper service can result in severe personal injury or death and damage to equipment. Service must be performed by trained and experienced persons.***

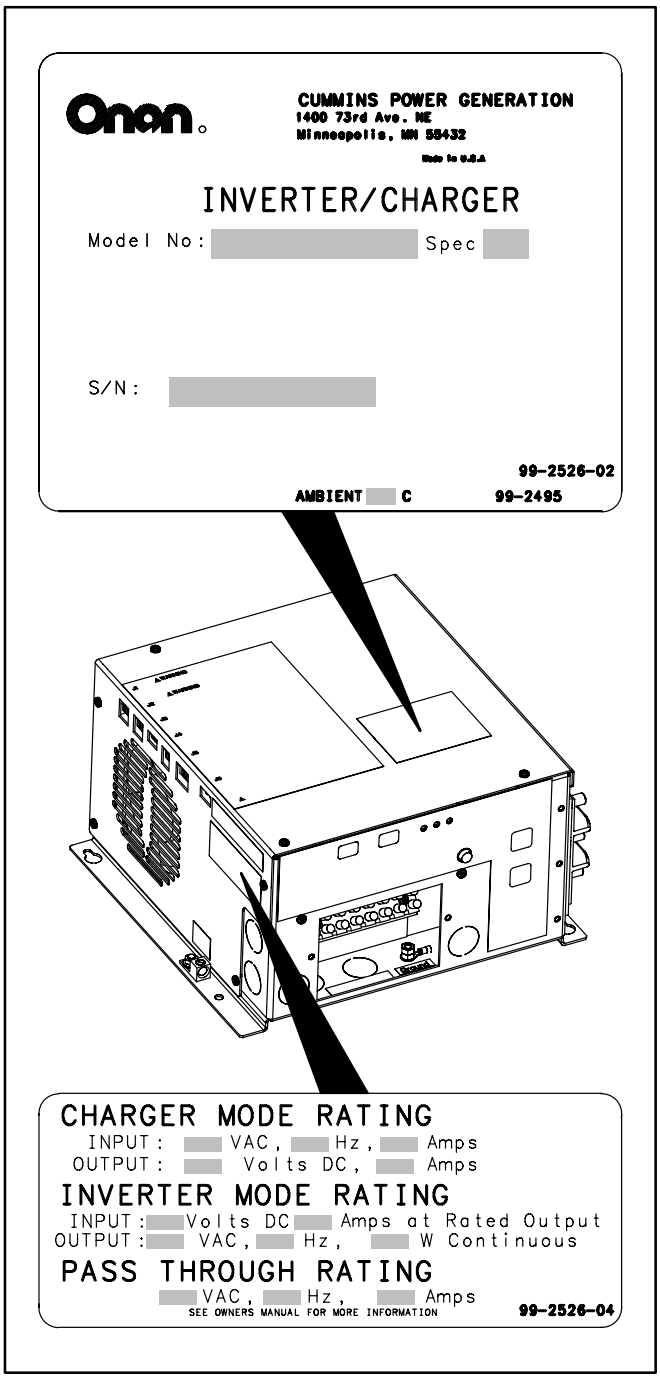

FIGURE 1. NAME AND RATING LABELS

Overview of Operation

The Inverter-Charger is a means of supplying selected AC and DC lights, tools, appliances and outlets with electrical power when shore power is not available and/or when starting the genset is prohibited or not desirable.[1] When external AC power is available (genset or shore power), the Inverter-Charger stores a portion of the power in a bank of batteries. When external AC power is no longer available, the Inverter-Charger converts 12 Volts DC (Direct Current) from the battery bank into 120 Volts AC (Alternating Current) to supply the AC tools, appliances, lights and outlets.

LOCAL CONTROL—INVERTER-CHARGER FRONT PANEL

Instructions for operating the Inverter-Charger from its front panel begin on Page 3.

REMOTE CONTROL—EQUINOX DIGITAL DISPLAY (OPTIONAL)

Up to three *Equinox Digital Displays* (Digital Displays) may be connected to control, monitor and configure the Inverter-Charger. Instructions for operating the Inverter-Charger using the Digital Display begin on Page 5.

INVERTING

When the Inverter-Charger is in inverter mode (*Inverting*), it draws power from the battery bank (12 Volts DC) and delivers 60 Hz, modified-sine 120 $Volts_{rms}$ electrical power to the connected lights, tools, appliances and outlets.

LOW BATTERY CUT-OUT

When the Low Battery Cut-Out (LBCO) feature is enabled (p. 21), the Inverter-Charger will automatically disable *Inverting* when battery voltage drops to the LBCO setpoint. Enabling LBCO will promote longer battery life by preventing the batteries from being overly discharged. If LBCO is disabled, *Inverting* will stop if battery bank voltage falls to 10 Volts.

CHARGING

When the Inverter-Charger is in charger mode (*Charging*), it draws external AC power (genset or shore power) to recharge the battery bank. It is a three-stage, temperature-compensating charger. Models equipped with an internal battery shunt (p. A-6) keep track of the battery State of Charge (SOC) by continuously measuring DC current to and from the batteries. Models not equipped with a shunt estimate SOC on the basis of battery voltage and temperature.

LOAD TRANSFERRING

When external AC power is available, the Inverter-Charger passes it through directly to the connected appliances. When external AC power is disrupted, the Inverter-Charger immediately begins *Inverting* and transfers the appliance loads to itself. When external AC power is restored, the Inverter-Charger transfers the loads back to the genset or shore power. (Transfer is delayed 4 seconds to allow AC power to stabilize and synchronize.) To protect the connected tools and appliances, the Inverter-Charger disconnects external AC power when voltage or frequency falls outside over/under limits.

POWER SHARING

While the Inverter-Charger is passing external AC power through directly to the tools and appliances, it will also be charging the battery bank. *The connected AC tools and appliances have priority over battery charging.* The battery charging rate is reduced, as necessary, so that total AC input current to the Inverter-Charger does not exceed the AC circuit breaker rating (p. 22).

AUTOMATIC GENSET STARTING (AGS)

Automatic Genset Starting (AGS) is a feature available for automatically starting and stopping the ***diesel*** genset to maintain battery charge. An *Equinox Digital Display* (p. 5) is required to enable AGS.

See Table 2 (p. 14) for a summary of the events and user actions that affect automatic genset starting and stopping when AGS is enabled.

1. Look for a vehicle wiring diagram or check with the vehicle manufacturer if it is not clear which lights, tools, appliances and outlets are served by the Inverter-Charger.

Local Control—Inverter-Charger Front Panel

Figure 2 illustrates the Inverter-Charger front panel. When both *Inverting* and *Charging* are enabled, the Inverter-Charger will automatically perform, as required, all of the functions related to inverting, charging and load transferring.

TO ENABLE/DISABLE AND MONITOR INVERTING

INVERTER ON/OFF Button: Momentarily press this button to enable or disable *Inverting*. When *Inverting* is enabled, the inverting indicator light will come on or blink.

> **Note: *Inverting* is not automatically enabled when the Inverter-Charger is reconnected to the batteries. Press this button to enable *Inverting* after reconnecting the batteries.**

Inverting Indicator Light: When *Inverting* is enabled, this green light will come on or blink as follows:

- **On** indicates Inverting
- **Slow blinking** indicates that external AC power is passing through to the appliances.

> **Note: If the Indicator light goes out a few minutes after enabling *Inverting*, Battery Voltage is probably low. Check the Digital Display, if installed, for a message that inverting has been disabled due to low battery voltage (p. 11). Connect AC power to recharge the batteries and re-enable *Inverting*.**

TO ENABLE/DISABLE AND MONITOR CHARGING

CHARGER ON/OFF Button: Momentary press this button to enable or disable *Charging*. When *Charging* is enabled, the charging indicator light will come on or blink.

> **Note: *Charging* is automatically enabled when the Inverter-Charger is reconnected to the batteries. ON is the default.**

Charging Indicator Light: When *Charging* is enabled, this green light will come on or blink as follows:

- **On** indicates High (Bulk) Charging
- **Fast blinking** indicates Medium (Absorption) Charging
- **Slow blinking** indicates Low (Float) Charging
- **Intermittent blinking** indicates that the Inverter-Charger is waiting for AC input and will start *Charging* as soon as connected.

FAULT INDICATOR LIGHT

When a fault occurs, the red fault indicator light will blink the numeric Fault Code. Refer to *Troubleshooting* (p. 47) for a description of the conditions associated with each Fault Code Number, the corrective actions that may be taken, and how to clear the fault.

TRANSFORMER CIRCUIT BREAKER

This circuit breaker protects the Inverter-Charger transformer from overload. Push the button to reset. Connect fewer appliances if it keeps tripping.

AC OUTPUT CIRCUIT BREAKERS

These circuit breakers, when provided, protect the AC power output leads connected to the Inverter-Charger. If either circuit breaker trips, the circuit has shorted or has too many connected appliances.

If a circuit breaker trips, disconnect or turn off as many appliances as possible and reset the circuit breaker.

After resetting the circuit breaker, connect the AC appliances one by one to determine which ones can be used at the same time without causing the circuit breaker to trip. If the circuit breaker trips right away when an appliance is connected, the appliance probably has a short.

Electrical appliances and tools must be used and maintained properly and have proper grounding to cause the circuit breakers to trip when short circuits occur.

⚠WARNING ***Short circuits in electrical appliances and tools can cause fire and electrical shock leading to severe personal injury or death. Read and follow the equipment and tool manufacturer's instructions and warnings regarding use, maintenance and proper grounding.***

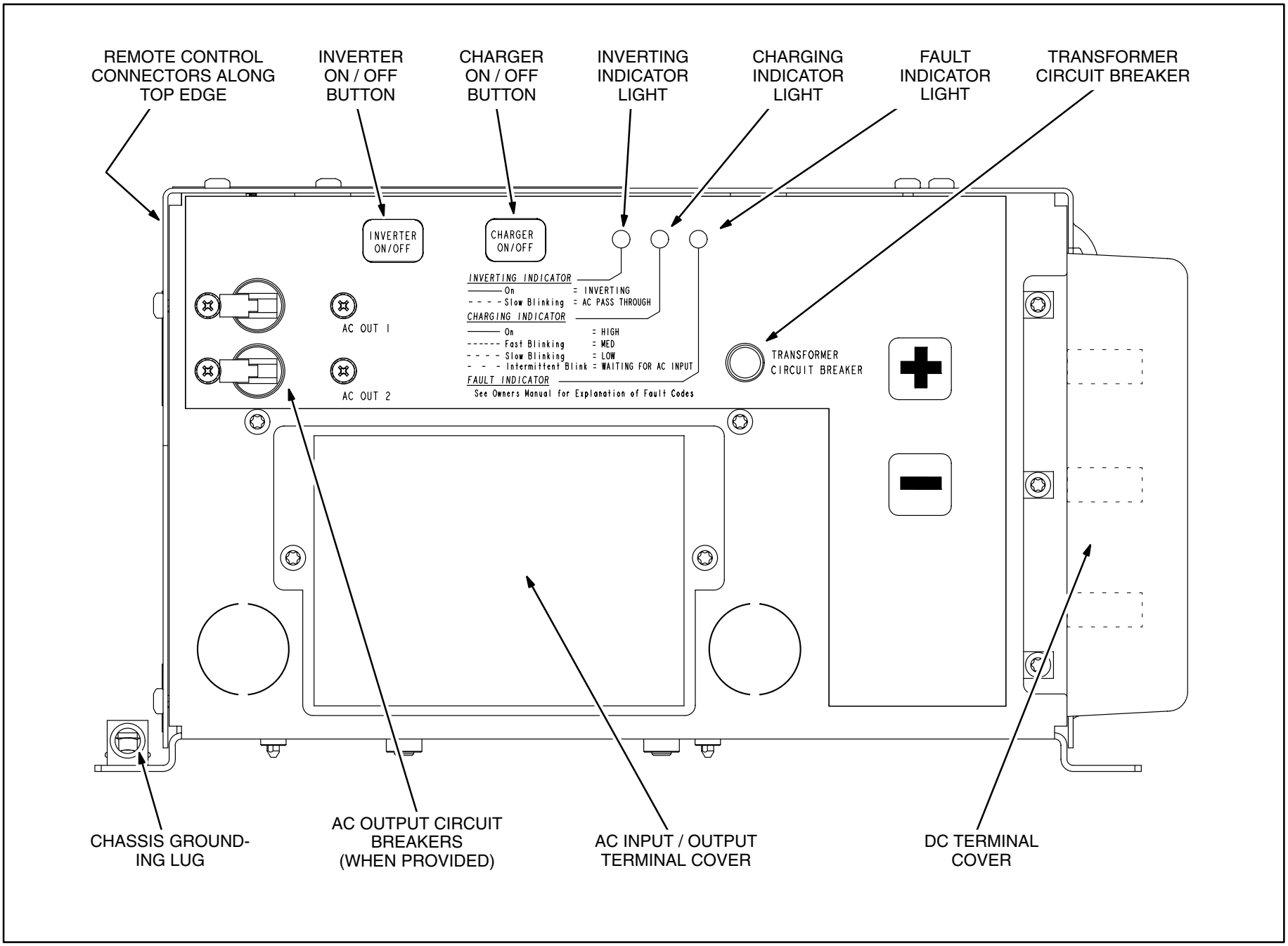

FIGURE 2. FRONT PANEL OF TYPICAL INVERTER-CHARGER

Remote Control—Equinox Digital Display

ABOUT THE EQUINOX DIGITAL DISPLAY

The *Equinox Digital Display* (Figure 3) enables remote control and monitoring of an *Equinox Inverter-Charger*. An Inverter-Charger may have up to three Digital Displays connected to it. A Digital Display has the following features for interaction between the operator and the Inverter-Charger:

- Six LED status indicators
- Two fixed-action user buttons (INVERT ON/OFF and CHARGE RATE)
- An LCD display panel with 4 soft-key user buttons to monitor system status, display the fault codes, start / stop the genset, enable / disable AGS (Automatic Genset Starting) and configure the Inverter-Charger.

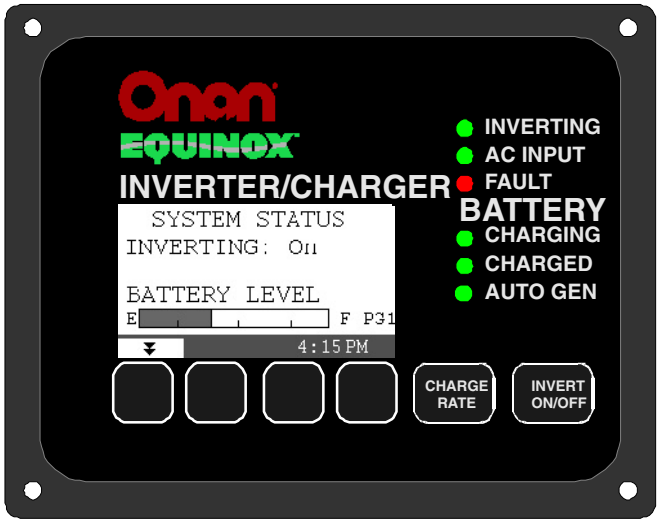

FIGURE 3. EQUINOX DIGITAL DISPLAY

LED STATUS INDICATORS

Table 1 identifies what each LED indicates about the status of the Inverter-Charger.

TABLE 1. LED INDICATORS

LED	Color	Status Indicated
INVERTING	Green	**ON–**Inverter-Charger is *Inverting* **BLINKING–**AC input is available, *Inverting* in Standby **OFF–**Inverter-Charger is **not** *Inverting*
AC INPUT	Green	**ON–**AC input is available **OFF–**AC input is **not** available
FAULT	Red	**ON–**Active Fault is present **OFF–No** Active Fault is present
CHARGING	Green	**ON–**Inverter-Charger is *Charging*—Stage 1 (high) or Stage 2 (medium) **OFF–**If CHARGED is on, Inverter-Charge is *Charging*—Stage 3 (low)
CHARGED	Green	**ON–**Inverter-Charger is *Charging*—Stage 3 (low) **OFF–***Charging* is off, or in Stage 1 or Stage 2
AUTO GEN	Green	**ON–**AUTO GEN is enabled **BLINKING–**AUTO GEN is in standby (Quiet Time in effect) **OFF–**AUTO GEN is not enabled

INVERT ON/OFF BUTTON

Press this button (Figure 3) to enable or disable *Inverting*. Unless there is an active fault or the Inverter-Charger is *Charging*, the INVERTING LED and LCD Display will indicate that *Inverting* is on or in standby.

Note: This button must be pushed to enable *Inverting* after reconnecting the batteries.

CHARGE RATE BUTTON

Press this button (Figure 3) to take you to a special screen (Figure 4) to enable or disable *Charging* or to reset maximum AC current draw during charging. (There is no other path to this screen.)

Enable/Disable Charger: On the CHARGE RATE screen (Figure 4), press NEXT to move to CHARGER and then **+ / –** to turn CHARGER, ON or OFF. Press DONE to save the setting and return to the home screen.

Set Maximum Charger Current Draw: Press NEXT to SET MAX CHARGER CURRENT DRAW and then **+ / –** to Increase / Decrease current draw (5 amp increments). Press DONE to save the setting and return to the home screen.

Reasons for Reducing Maximum Current Draw: Depending upon power rating, Inverter-Chargers can draw up to 30 amps AC while charging. Reducing the maximum charger current draw might be enough to keep the genset or main vehicle circuit breaker from tripping during periods of heavy AC current draw—on a hot day, for instance, when two or three air conditioners are running (15 amps each).

Note: Lowering the maximum charger current draw can increase the time that it takes to recharge the batteries. Increase or decrease the maximum charger current draw to suit current conditions.

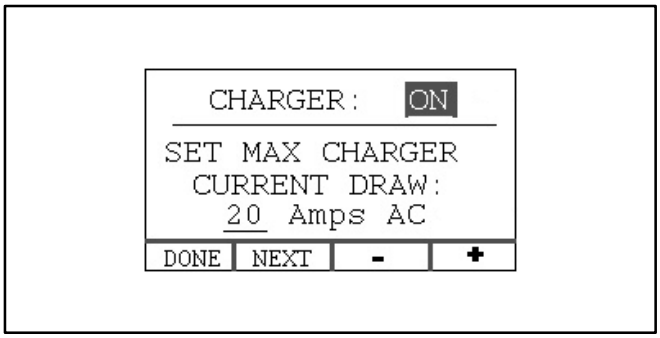

FIGURE 4. SCREEN TO TURN CHARGER ON / OFF & TO SET MAX CHARGER CURRENT DRAW

DISPLAY AND SOFT-KEY BUTTONS

Turning on Digital Display

On first power-up press any button to turn on the Display LCD. The Display backlight will remain on as long as there is an active fault. See Page 16 to adjust Display brightness and contrast and the length of time the backlight stays on.

Navigating Menus with Soft-Key Buttons

The display has four (4) soft-key buttons to navigate through the LCD menus, change configuration parameters and perform other actions. Each button changes action as you work through the menus. The action of each button is indicated immediately above it. The following symbols denote common button actions:

⏬ /⏫ Go to Next / Previous Page. Menu Pages are numbered PG1, PG2 and so forth.

🔽 / 🔼 Scroll through Menu. The selection appears in reverse text (INVERTER).

ENTER Enter Selected Menu Item. The next screen will appear.

NEXT Move to Next Data Field in Menu. The field appears in reverse text (20 Amps AC).

+ / – Increase / Decrease the Value of the Data in the reverse text Data Field.

◀**BACK** Return to Previous Screen and save any settings changed, or clear a fault.

START/STOP, **AUTO**, **EQUAL**, **HIST** Perform a Specific Action or go to a Specific Screen.

DONE Close Screen, return to HOME SCREEN and save any changed settings.

The menu map is on Page A-13.

SYSTEM STATUS SCREENS: PG1–PG3

There are 3 SYSTEM STATUS screens (Figure 5).

SYSTEM STATUS PG1 – This is the Home Screen. It indicates the operating mode of the Inverter-Charger. Each operating mode is described on Page 8.

SYSTEM STATUS PG2 and **PG3 –** These are menu screens. Select and enter any menu item to open the next screen in that menu stream. Pages 9 through 24 work through each menu stream in detail.

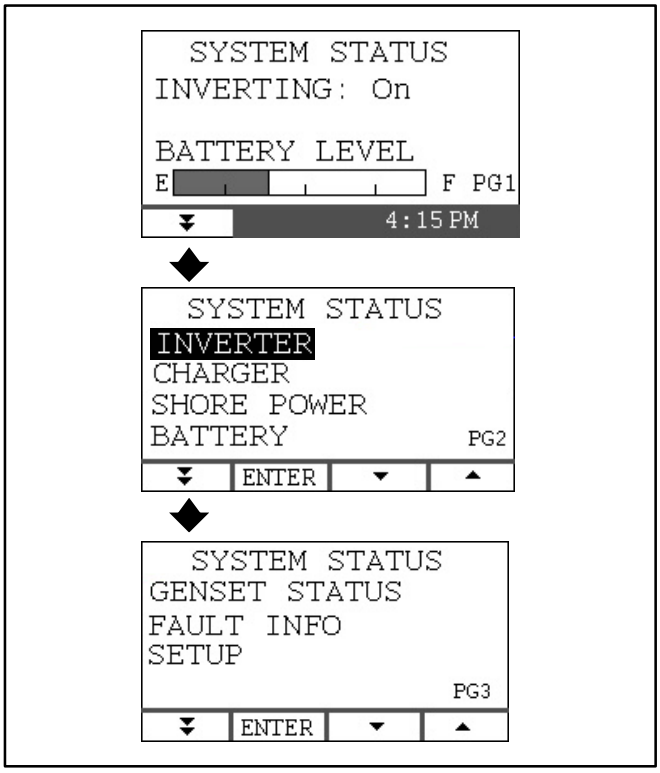

FIGURE 5. SYSTEM STATUS (PG1-PG3)

HOME SCREEN (SYSTEM STATUS PG1)

System Status: Unless there is an active fault condition (p. 15), the Home Screen, SYSTEM STATUS PG1 (Figure 5), will indicate one of the following as system status:

- **INVERTING: On** The Inverter-Charger is drawing power from the battery bank (12 Volts DC) and delivering modified sine, 60 Hz, 120 V_{rms} electrical power to the connected appliances.
- The INVERTING LED is on.
- **CHARGING: High Charge** (Also referred to as the Bulk Charge Stage.) The Inverter-Charger is maintaining a constant charging current. See *Specifications* (p. vii) for the maximum charging current of your Inverter-Charger. Current is limited by the maximum charging current, maximum charger current draw (p. 6), and/or AC Circuit Breaker Rating (p. 22).
- The Inverter-Charger maintains High Charge (Stage 1) until reaching the high charge voltage (bulk voltage) appropriate for the battery type for which it was configured (p. 33).
- The CHARGING LED is on.
- **CHARGING: Med Charge** (Also referred to as the Absorption Charge Stage.) The Inverter-Charger is maintaining the high charge voltage. It will remain in Medium Charge (Stage 2) until the charging current drops to the absorption current level or the absorption time expires (Table 3, p. 25). The absorption current level depends upon battery type and battery bank size (Table 20, p. 44).
- The CHARGING LED is on.
- **CHARGING: Low Charge** (Also referred to as the Float Charge Stage.) The Inverter-Charger is maintaining the float voltage appropriate for the battery type for which it was configured (p. 33). It is also supplying the DC loads connected to the battery bank. The Inverter-Charger will remain in Low Charge (Stage 3) until *Charging* is disabled or external AC power is removed.
- The CHARGED LED is on.
- **CHARGING: NO AC Input** The Inverter-Charger is waiting for AC input and will enable *Charging* as soon as AC input is reconnected.
- **INVERTER / CHARGER OFF** Both *Inverting* and *Charging* have been disabled. Press the INVERT ON/OFF button to enable *Inverting* (p. 5). Press the CHARGE RATE button to bring up the CHARGER ON / OFF screen (p. 6).
- **CHARGER OFF** *Charging* has been manually disabled. The AC INPUT LED is on indicating that AC input is available. Press the CHARGE RATE button to bring up the CHARGER ON / OFF screen (p. 6).

Battery Level Meter: The BATTERY LEVEL meter on the Home Screens indicates the level of *usable* battery charge remaining. Review BATTERY SET-UP (p. 23) regarding the EMPTY reference point.

Clock: The current time is displayed in the lower right corner. See Page 16 to reset.

INVERTER

Inverter Amps

Go to the INVERTER OUTPUT screen (Figure 6) to monitor the current (AC Amps) flowing from the Inverter-Charger to the connected AC tools, appliances and outlets.

Note: When shore power is available, or the genset is running, the value shown is the current passing through to the appliances.

Inverter LOAD Meter

The LOAD meter (Figure 6) indicates how much of the available current is being used. For instance, the maximum available current from an Inverter-Charger rated 2500 Watts is approximately 21 amps. An output current of 14 amps is 67 percent of 21 amps—approximately what the load meter in the illustration shows.

If the Inverter-Charger keeps shutting down due to Fault 38, 59, 67 or 68, there may be a short in the connected AC circuits or too many appliances on at the same time. Use the LOAD meter on this screen to help you determine which appliances can be run at the same time without causing Inverter-Charger shutdown.

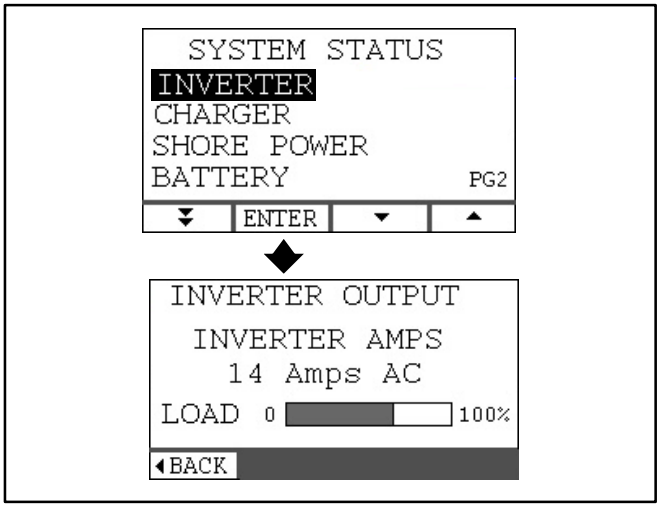

FIGURE 6. INVERTER

CHARGER

Charge Rate

Go to the BATT CHARGE RATE screen (Figure 7) to monitor the amount of AC current being used to charge the batteries and supply the DC loads.

Charger LOAD Meter

The LOAD meter (Figure 7) indicates how much of the available AC input current is being used. *100%* is the maximum available current.

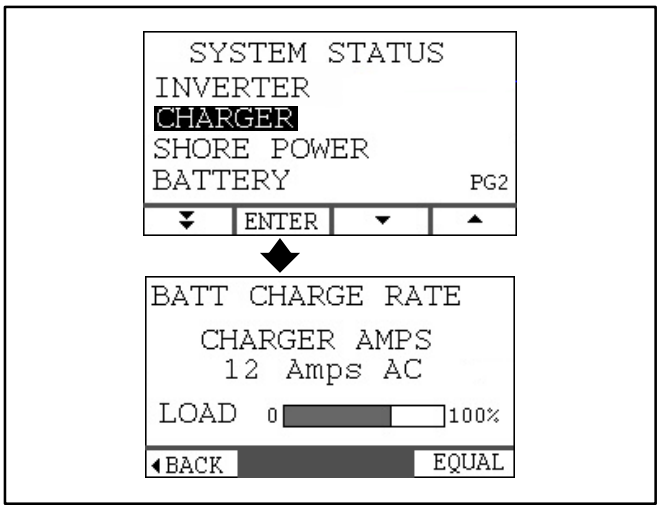

FIGURE 7.CHARGER

SHORE POWER

Go to the SHORE POWER screen (Figure 8) to monitor external AC voltage, frequency and current, *whether from shore power or genset*.

Note: The Inverter-Charger immediately begins *Inverting* when external power is disrupted, voltage falls outside the range of 90–135 VAC or frequency falls outside the range of 54–66 Hz.

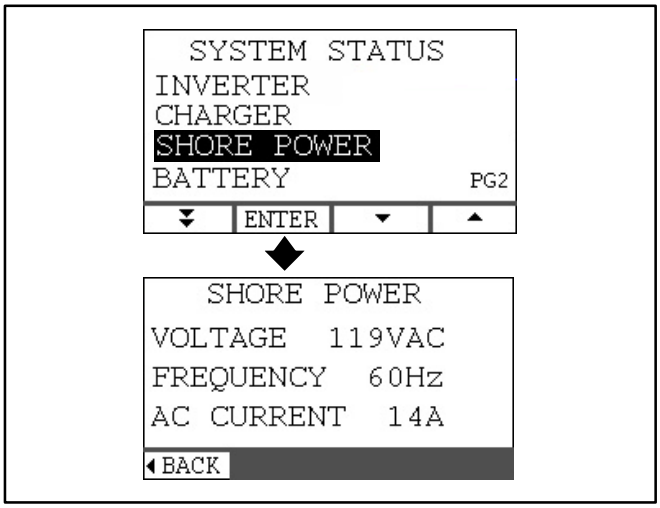

FIGURE 8. SHORE POWER

EQUALIZE CHARGE

Note: Equalize charging is enabled only when the Inverter-Charger is configured for Wet Cell batteries. If the Inverter-Charger is configured for any other type of battery, EQUAL will not appear on the BATT CHARGE RATE screen (Figure 9).

Before Starting

It can take up to 6 hours to equalize charge. Batteries must be attended while equalizing. Someone who has read and understood EQUALIZE CHARGING (p. 26 and 27) must be present to stop charging if a battery overheats or a cell overflows, splits or cracks.

⚠WARNING ***Lead-Acid Batteries produce explosive hydrogen gas that can lead to severe personal injury. Do not smoke near batteries. Wear safety glasses. Keep sparks and other sources of ignition away. Make sure you understand all of the safety precautions on Page 27 before equalize charging your batteries.***

⚠CAUTION ***Disconnect all DC appliances before equalizing to prevent damage from the high equalize charging voltage. Liability for damage to appliances left connected is the sole responsibility of the person performing equalize charging.***

Starting Equalize Charging

Go to BATT CHARGE RATE (Figure 9) to get to the EQUALIZE CHARGE screen. Press EQUAL. Heed the WARNING on the screen by reviewing Pages 26 and 27 and then press **START**.

If the batteries are not fully charged, the EQUALIZE CHARGE SCREEN will notify you that the batteries must be fully charged before equalizing. Press OK to return to the BATT CHARGE RATE screen and wait for the batteries to be fully charged.

If the batteries are fully charged, the EQUALIZE CHARGE SCREEN will post 6 hours as the time remaining to complete equalizing. Charging current will ramp up to 5 percent of battery bank capacity. (For example, the charging current for a 400 AHR battery bank would ramp up to 20 amps DC.) Once equalize voltage is reached (15.5 V), it is held for 30 minutes and the time remaining recalculated. The total charging time, including up to 30 minutes for cooling, will not exceed 6 hours.

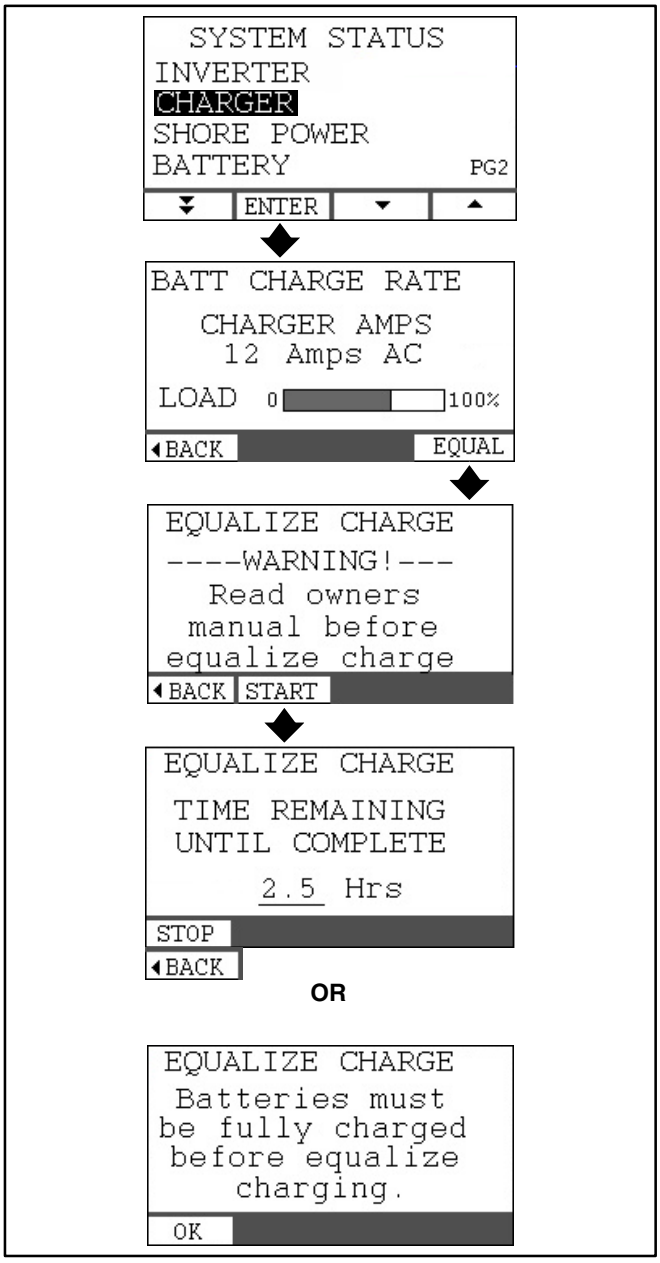

FIGURE 9. EQUALIZE CHARGE

Stopping Equalize Charging

Press **STOP** at any time. Normally, let equalize continue until it times out. ◂BACK will replace STOP when STOP is pressed or when equalize times out.

The CHARGED LED should come back on after the battery has cooled down, indicating resumption of low (float) charging.

BATTERY

Go to the BATTERY screen (Figure 10) to monitor battery voltage and the expected number of hours left before the current *Inverting* load discharges the batteries.

Inverter-Chargers With Optional Shunt: The battery State of Charge (SOC) is calculated on the basis of continuously measured current to and from the battery bank and various other factors such as battery type, battery bank capacity and battery temperature.

The LIFE REMAINING field indicates life remaining at the current load. Life remaining is recalculated every 4 minutes on the basis of the average load over that period.

Inverter-Chargers Without Optional Shunt: The LIFE REMAINING field does not appear on the screen. The Inverter-Charger estimates the battery State of Charge (SOC) on the basis of battery voltage and temperature or the current stage of charging (High, Medium or Low).

For a truer reading of battery voltage, disconnect all AC loads from the Inverter-Charger and DC loads from the battery bank and wait 15 to 30 minutes for the voltage to stop changing.

Inverter Disabled: When battery voltage reaches the Low Battery Cut Out (LBCO) setpoint *Inverting* is disabled and a Screen pops up so to notify you (Figure 11). Connect shore power or start the genset to recharge the batteries. Press the INVERT ON/OFF button to enable *Inverting* (p. 5).

See INVERTER SETUP (p. 21) to Enable / Disable LBCO or change its setting.

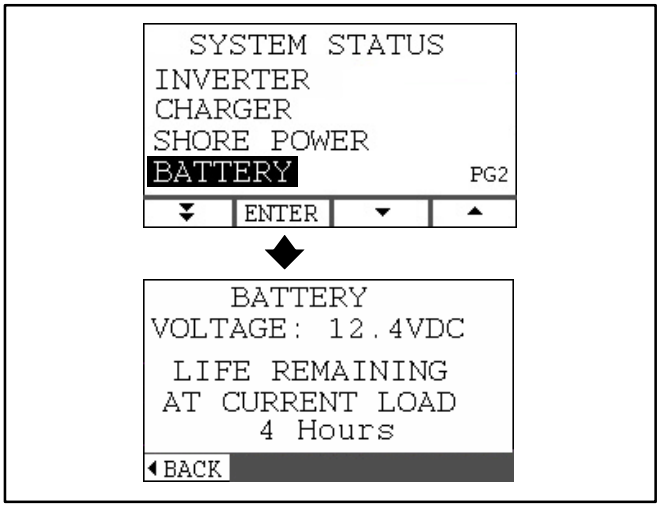

FIGURE 10. BATTERY

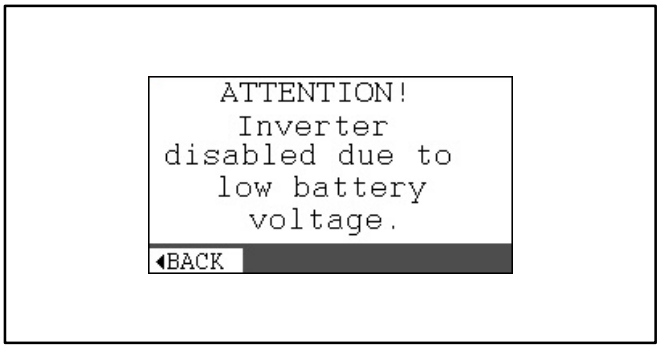

FIGURE 11. INVERTER DISABLED

START / STOP GENSET

Go to the GENSET STATUS screen to Start and Stop the genset (Figure 12 if Onan, Figure 14 if Non-Onan). GENSET STATUS will indicate that the genset is RUNNING, STOPPED, STARTING or PRIMING.

Start Genset

Momentarily press **START** to start the genset.

Genset Starts: The genset should crank and start. The screen will change from GENSET STOPPED to GENSET STARTING. The screen will change to GENSET RUNNING when the genset starts. The STOP button will appear and the START button will disappear (Figure 12 if Onan, Figure 14 if Non-Onan).

Genset Fails to Start: The Inverter-Charger will crank the genset engine for the maximum cranking period recommended by the manufacturer (28 seconds for an Onan diesel genset). The screen will change from GENSET STARTING to GENSET STOPPED.

Prime: If the Inverter-Charger is configured for starting an Onan genset, PRIME appears on the GENSET STATUS screen (Figure 12). Momentarily press **PRIME** to cause the genset fuel pump to run for 60 seconds and prime the fuel system. The screen will change to GENSET PRIMING, the START and STOP buttons will appear and the PRIME button will disappear (Figure 13). Pressing STOP will stop priming. Pressing START will stop priming and start the genset.

PRIME the genset before attempting to restart it if it failed to start or ran out of fuel.

Stop Genset

Momentarily press **STOP** to stop the genset (Figure 12 if Onan, Figure 14 if Non-Onan).The screen will change to GENSET STOPPED.

Note: See Table 2 (p. 14) for a summary of the events and user actions that affect automatic genset starting and stopping when AGS is enabled.

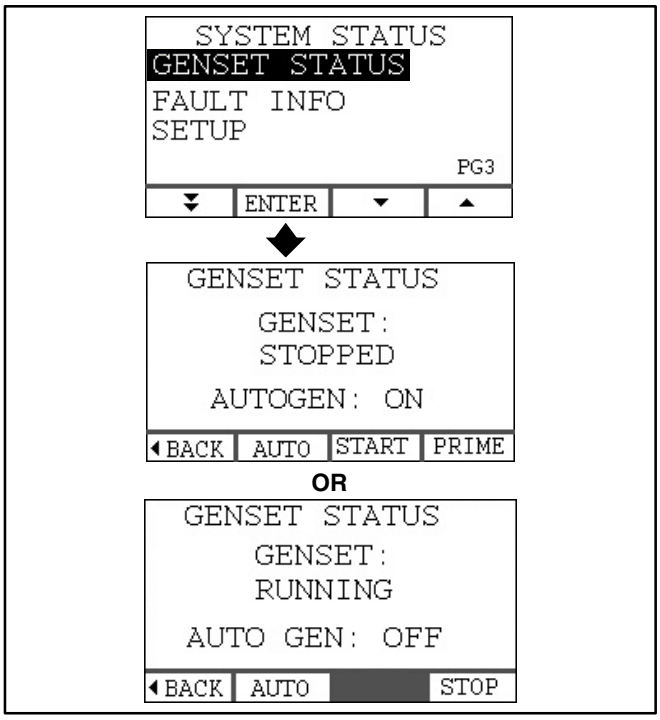

FIGURE 12. START/STOP ONAN GENSET

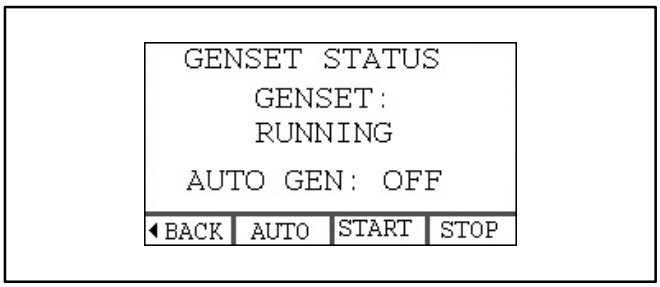

FIGURE 13. PRIMING ONAN GENSET

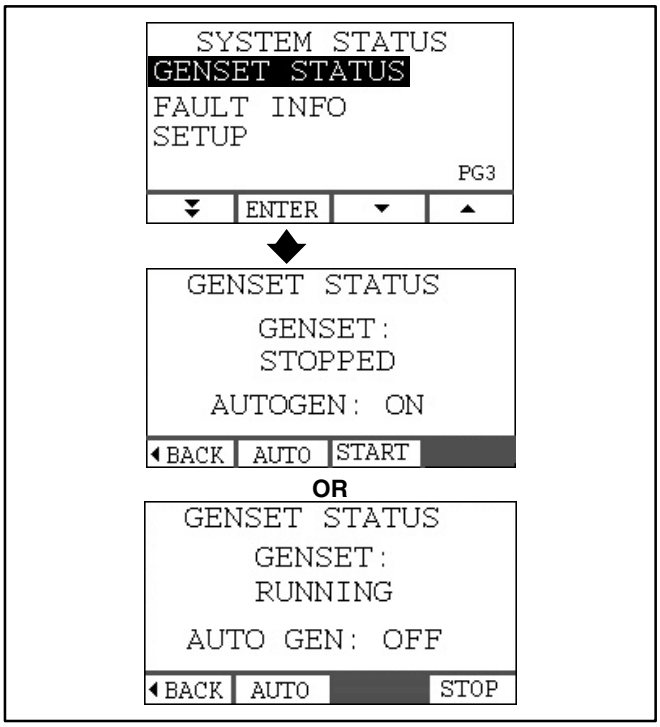

FIGURE 14. START/STOP NON-ONAN GENSET

ENABLE / DISABLE AUTO GENSTART

⚠WARNING ***Do not enable AGS for a Gasoline or LP fueled genset. Carbon Monoxide can accumulate to a dangerous level when the vehicle is parked in a confined area such as a garage.***

⚠WARNING ***CARBON MONOXIDE is deadly! MOVING PARTS and ELECTRICITY can cause severe personal injury or death. To reduce exposure to these hazards, always Disable AGS before:***

- ***Sleeping in vehicle, unless vehicle has a working CARBON MONOXIDE detector***
- ***Parking vehicle in garage or confined space***
- ***Parking vehicle for storage***
- ***Servicing genset***
- ***Servicing batteries***
- ***Servicing electrical appliances***
- ***Fueling vehicle.***

Enable / Disable AGS

When AGS is enabled, the Inverter-Charger will start the genset to recharge the batteries when battery charge drops to the AGS start point (p. 20). AGS will make up to three attempts to start the genset, allowing 60 second rest periods between each attempt. It will declare Fault 36—Genset Failed to Start—if the genset does not start.

Go to the AUTO GENSTART screen to Enable/ Disable AGS (Figure 15). Press NEXT to scroll to the STATUS field. Press **+ / –** to change STATUS, ON or OFF. A warning will pop up each time STATUS is turned ON (Figure 16).

Note: See Table 2 (p. 14) for a summary of the events and user actions that affect automatic genset starting and stopping when AGS is enabled.

Change Number of Days Enabled

Press NEXT on the AUTO GENSTART screen to move to the "ENABLE FOR: __ days" field. Press **+ / –** to Increase / Decrease the number of days for which AGS is to be enabled (120 days maximum). The number will decrease by 1 every day at 12:00 AM until expiration. At expiration a notice will appear indicating that AGS has expired (Figure 17). Since this is a notice and not a fault, the FAULT LED does not come on. Enable AGS to continue use.

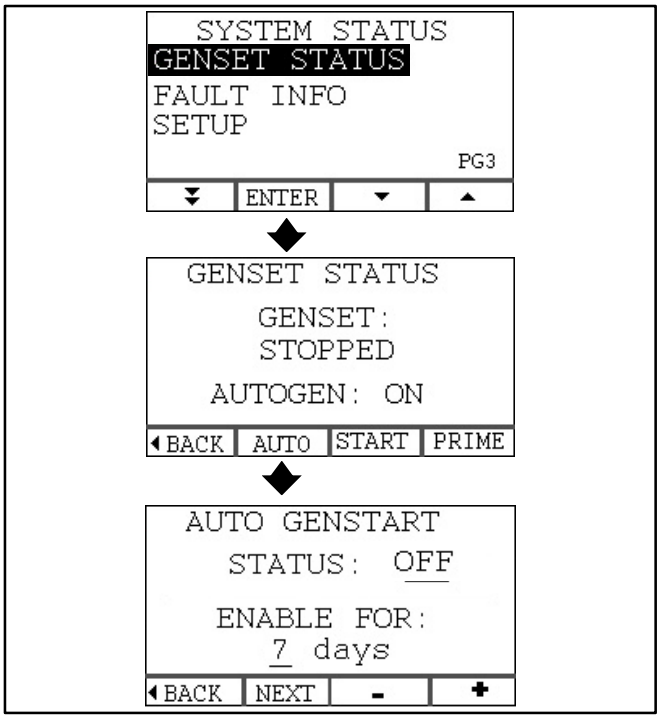

FIGURE 15. ENABLE AUTO GENSTART

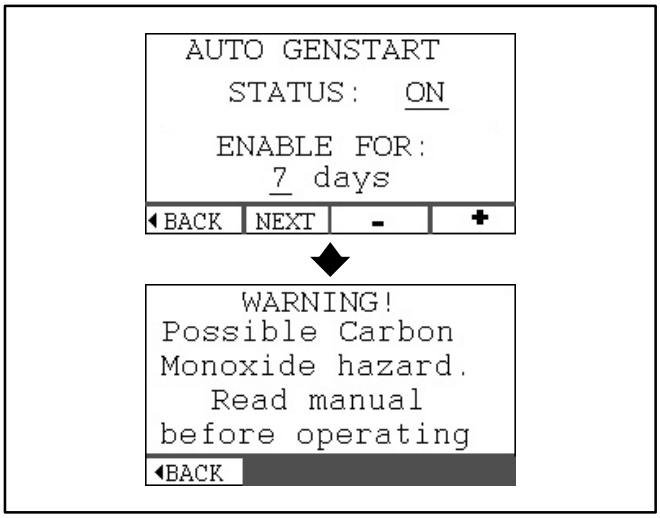

FIGURE 16. AUTO GENSTART ENABLED WARNING

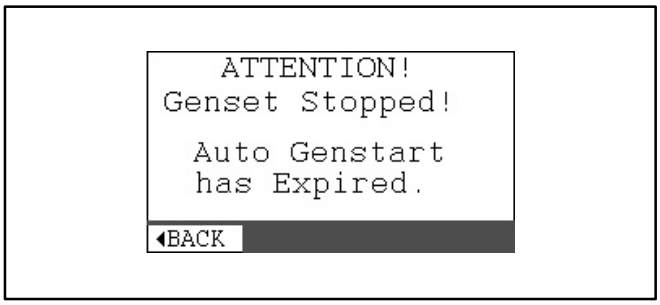

FIGURE 17. AUTO GENSTART EXPIRED NOTICE

TABLE 2. EVENTS AND USER ACTIONS THAT AFFECT AUTOMATIC GENSET STARTING (AGS)

EVENT OR USER ACTION	EFFECT ON AGS
Battery Charge drops to the AGS Start point (p. 20), but Quiet Time is in effect	AGS will not start the genset until Quiet Time ends. *Inverting* will be disabled when the LBCO threshold is reached (p. 21). The AUTO GEN light will blink, as long as Quiet Time is in effect, indicating that AGS is in standby.
AGS starts the Genset and then Quiet Time goes into effect	AGS will stop the Genset. The AUTO GEN light will blink indicating that AGS is in standby. AGS will start the genset when Quiet Time expires if battery charge is still at the AGS Start point.
The User manually starts the Genset when AGS is enabled	The User must stop the Genset manually for AGS to become active. *If AGS did not start the Genset, it will not stop the Genset.* The AUTO GEN light will blink indicating that AGS is in standby.
The User manually starts the Genset and then enables AGS (p. 13)	The User must stop the Genset manually for AGS to become active. *If AGS did not start the Genset, it will not stop the Genset.* The AUTO GEN light will blink indicating that AGS is in standby.
The User manually starts the Genset when AGS is enabled and Quiet Time is in effect or later goes into effect	AGS will stop the Genset.
The User manually disables *Charging* (p. 6) when AGS is enabled	AGS will not start the Genset when Battery Charge drops to the AGS Start point (p. 20) because *Charging* is not enabled to charge the batteries. *Inverting* will be disabled when the LBCO threshold is reached (p. 21).
AGS starts the Genset and then the User manually disables *Charging* (p. 6)	The Genset will run until the User manually stops it. The AUTO GEN light will blink indicating that AGS is in standby.
AGS starts the Genset and then the User manually stops the Genset at a remote switch (not at Inverter-Charger Display) or the Genset shuts down due to a Genset fault	AGS will make three attempts to restart the Genset. If the Genset does not start, the Display will declare Fault 36, GENSET FAILED TO START (p. 15). AGS will be disabled and the AUTO GEN light will turn off. *Inverting* will be disabled when the LBCO threshold is reached (p. 21).
AGS starts the Genset and then the User presses the genset STOP button on the Display (p. 12)	The Genset will stop running. AGS will be disabled and the AUTO GEN light will turn off. See Page 13 to re-enable AGS.
AGS starts the Genset and then the User disables AGS	The Genset will continue to run until the User stops the Genset manually.
AGS starts the Genset and then Shore Power becomes available	AGS cannot tell the difference between Genset and Shore Power. AGS will stop the Genset when Battery Charge rises to the AGS Stop point (p. 20) or Quiet Time goes into effect.
AGS starts the Genset and then the Inverter-Charger loses the Genset RUN signal (Connector J4)	The Genset will run until the User presses the Genset STOP switch. The Display will indicate that the Genset stopped because of the loss of the RUN signal. AGS will remain enabled. See GENSET START / STOP / RUN TEST (p. 41) to repair.
AGS starts the Genset and then the Display connection is lost	AGS will continue to start and stop the Genset normally. The Display will post the message, “WARNING! COMMUNICATIONS LOST WITH MAIN CONTROL.” A working Display must be connected to disable or reset AGS once it has been enabled. Disconnecting the batteries and AC input will also reset AGS to its default position, which is OFF. See REMOTE COMMUNICATIONS TESTS (p. 39) to repair Display communications.

FAULT INFO

When a Fault Occurs

When a fault occurs the FAULT INFO screen (Figure 18) will pop up. It displays the numeric Fault Code, a brief description of the fault and the time when the fault occurred (accumulated run time in hours).

Press ◂BACK to clear the fault. The red FAULT LED on the Display will turn off. See *Troubleshooting* (p. 47) to determine the cause of the fault and the corrective actions that may be taken.

Depending upon the severity of the fault, it may be necessary to re-enable *Inverting* and/or *Charging* (p. 6).

Checking for Active Fault

To check for an active Fault, go to FAULT INFO (Figure 19). If there is an active fault, the FAULT INFO screen will display the numeric Fault Code, a brief description of the fault and the time when the fault occurred. If there is no active fault, the FAULT INFO screen will state, “No Active Faults.”

Fault History

To check up to 5 of the most recent faults (fault history), press HIST on the FAULT INFO screen (Figure 20). Press ⏬ / ⏫ to page through the 5 faults. If there is no fault history, the screen will state, “No Stored Faults.”

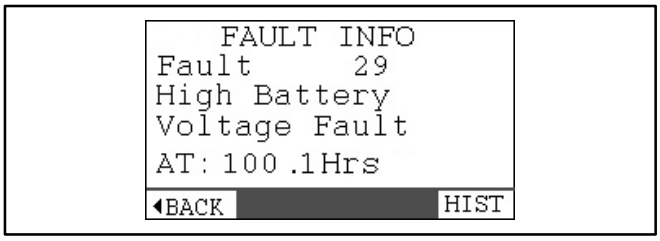

FIGURE 18. FAULT SCREEN

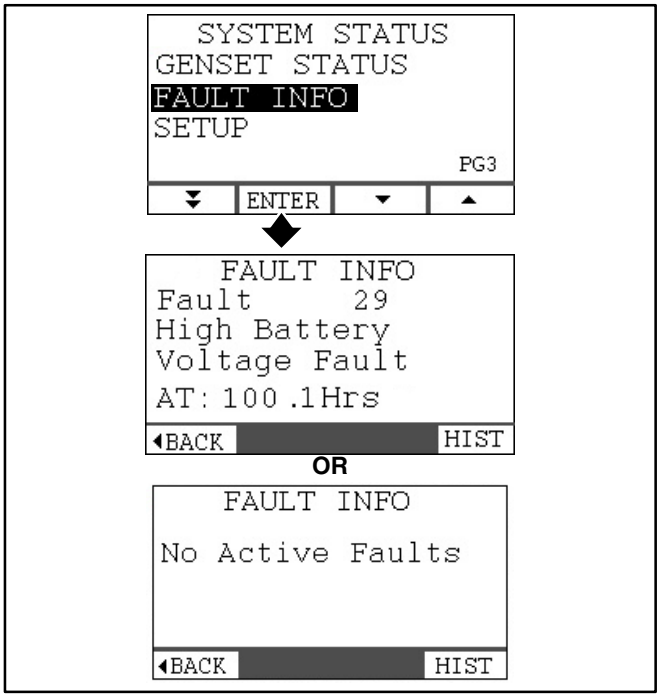

FIGURE 19. ACTIVE FAULT

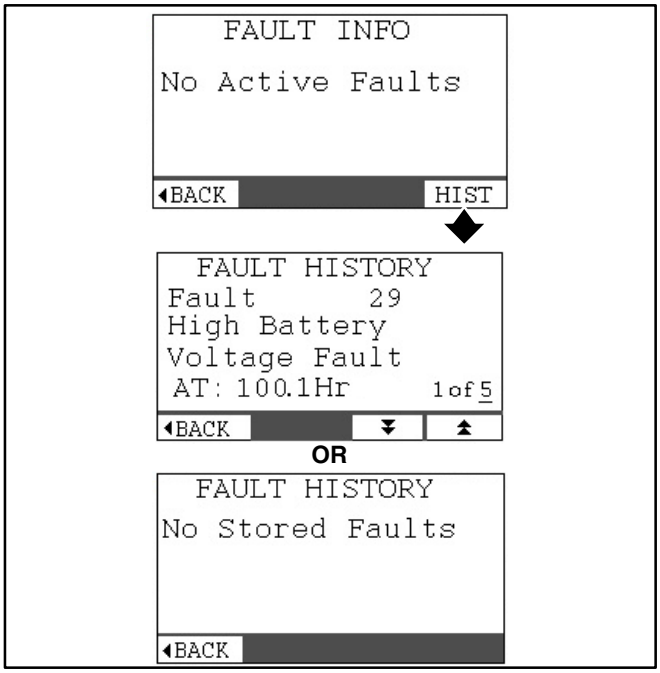

FIGURE 20. FAULT HISTORY

CLOCK ADJUST

The time is displayed on SYSTEM STATUS PG1 (Home). The clock must be reset each time the batteries are reconnected to the Inverter-Charger. *The time must be correct for QUIET TIME to start and stop as expected (p. 17).*

To reset the time, go to CLOCK ADJUST (Figure 21). Select the hour or minute field and press **+ / –** to Increase / Decrease the hour or minute. Make sure AM / PM is correct.

Press ◂BACK to save the settings and return to the previous screen.

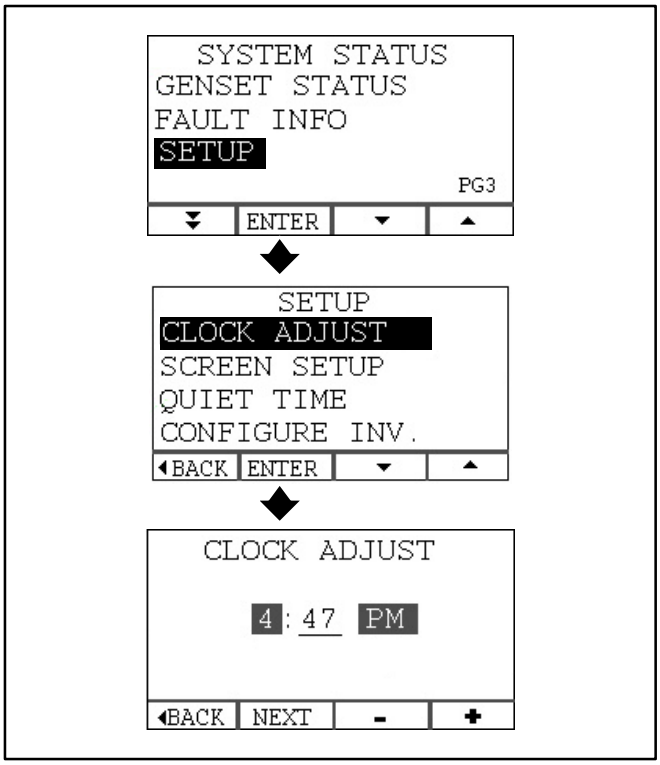

FIGURE 21. CLOCK ADJUST

SCREEN SETUP

To change screen Contrast, Brightness and/or Backlight Timer, go to SCREEN SETUP (Figure 22).

CONTRAST and BRIGHTNESS – Select the CONTRAST or BRIGHTNESS field and press **+ / –** to Increase / Decrease contrast or brightness to suit. Note that the bar meter next to CONTRAST or BRIGHTNESS increases or decreases in length to indicate the proportion of available contrast or brightness being used.

BACKLIGHT TIMER – Select the BACKLIGHT TIMER field and press **+ / –** to Increase / Decrease the length of time before the timer turns off the screen backlight after the last screen touch. The timer is adjustable between 10 and 250 seconds. The backlight will stay on if the timer is turned OFF.

Press ◂BACK to save the settings and return to the previous screen.

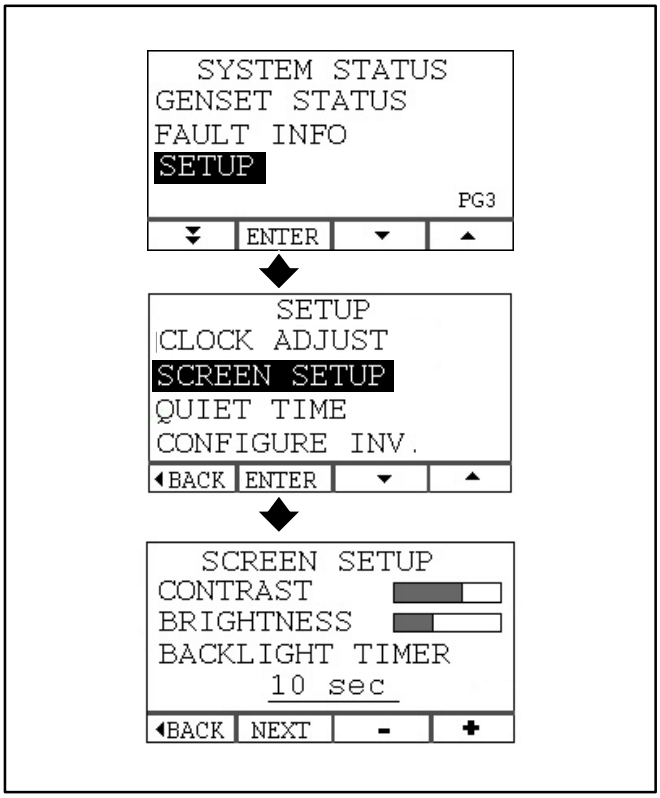

FIGURE 22. SCREEN SETUP

QUIET TIME

Quiet Time is associated with AGS. When AGS is enabled, the Inverter-Charger could automatically start the genset at anytime*, except during Quiet Time.*

Note 1: When AGS is enabled, the AUTO GEN LED on the Digital Display will blink during QUIET TIME, indicating that AGS is in standby. As a general rule, if AGS is enabled, and Quiet Time is active, the genset will not start. If it is manually started, it will shut down.

Note 2: See Table 2 (p. 14) for a summary of the conditions, settings and events that affect the operation of AGS.

To enable Quiet Time and/or reset the Start and Stop times, go to QUIET TIME (Figure 23). Select the STATUS, Start, or Stop field and press **+ / –** to Increase / Decrease the value in the field. Make sure AM / PM is correct.

Press ◂BACK to save the settings and return to the previous screen.

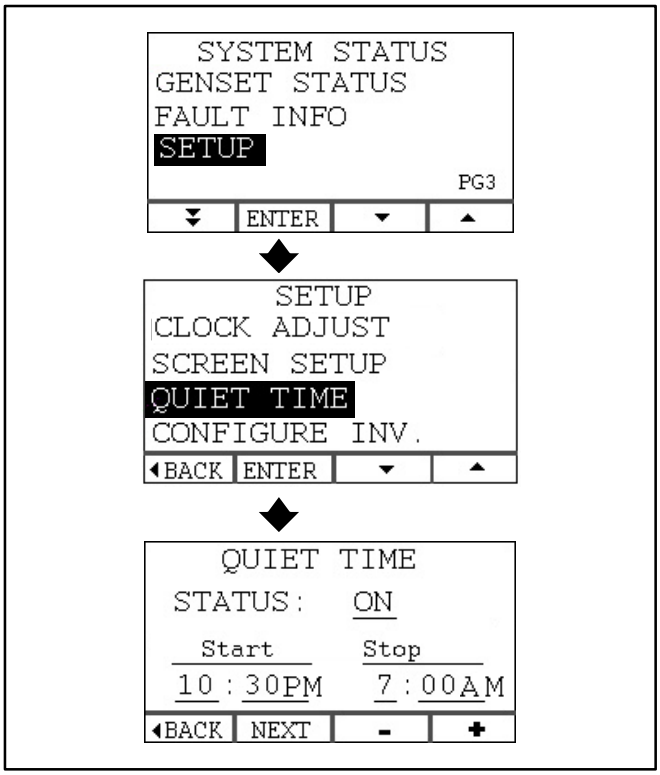

FIGURE 23. QUIET TIME

CONFIGURE INVERTER

⚠ CAUTION ***Read these instructions carefully before changing Inverter-Charger configuration parameters. Inverter-Charger operation and/or performance will change.***

Go to CONFIGURE INV. under SETUP to change Inverter-Charger configuration parameters (Figure 24). The instructions that follow on Pages 19 through 24 work through each configuration screen in detail. Before CONFIGURE INV. PG1 opens, a CAUTION screen appears with instructions to read the manual. Heed this caution by carefully reading the instructions that accompany each configuration screen. Then press OK.

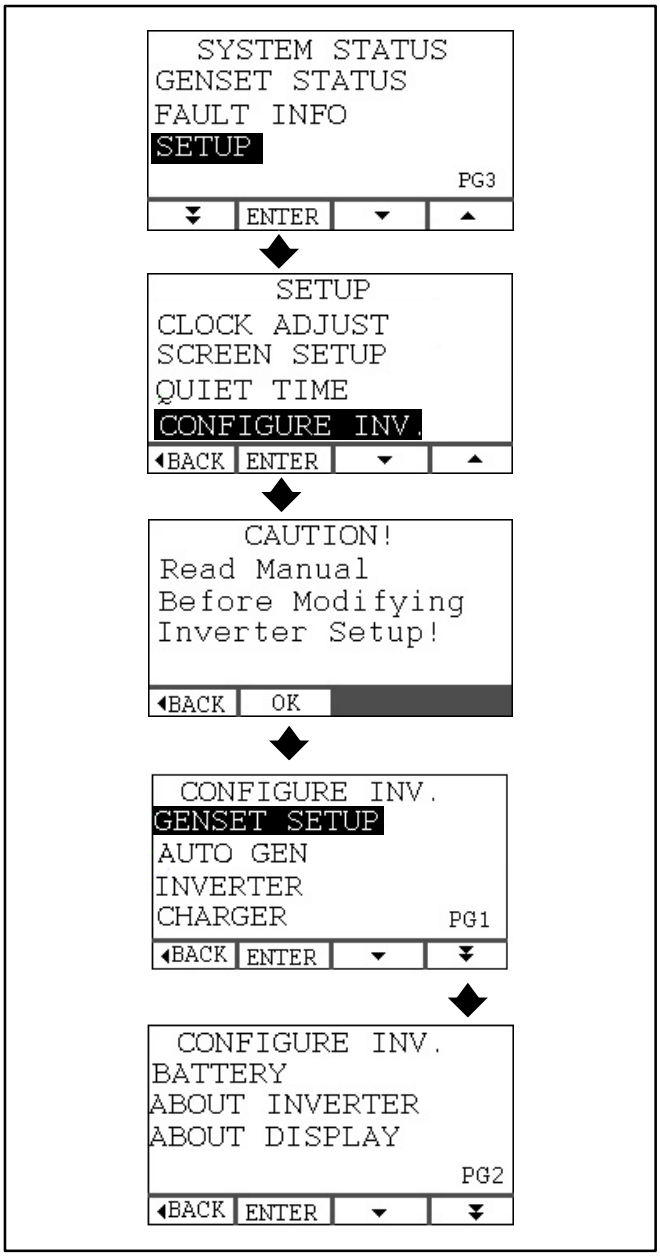

FIGURE 24. CONFIGURE INVERTER

GENSET SETUP

⚠CAUTION ***Read these instructions carefully before changing the GENSET SETUP configuration parameters. Inverter-Charger operation and/or performance will change.***

Select GENSET SETUP on CONFIGURE INV. PG1 and press ENTER (Figure 25). On the GENSET SETUP screen press the **+ / –** buttons to select the GENSET TYPE name. For non-Onan gensets select the appropriate 2-wire, 3-wire or 4-wire genset Start/Stop method.

Note 1: GENSET TYPE must be configured properly to Start and Stop the genset and Prime an Onan genset (p. 12).

Note 2: GENSET connections (p. 35) and GENSET SETUP must correspond.

Press ◂BACK to save the settings and return to the previous screen.

AGS (AUTOMATIC GENSET STARTING) IS NOT AVAILABLE FOR GASOLINE OR LP GENSETS – If a gasoline or LP genset model is selected for GENSET TYPE, a notice will be posted about the CO Hazard Risk (Figure 26). Press ◂BACK to return to to CONFIGURE INV. PG1.

⚠WARNING ***Do not enable AGS for a Gasoline or LP fueled genset. Carbon Monoxide can accumulate to a dangerous level when the vehicle is parked in a confined area such as a garage.***

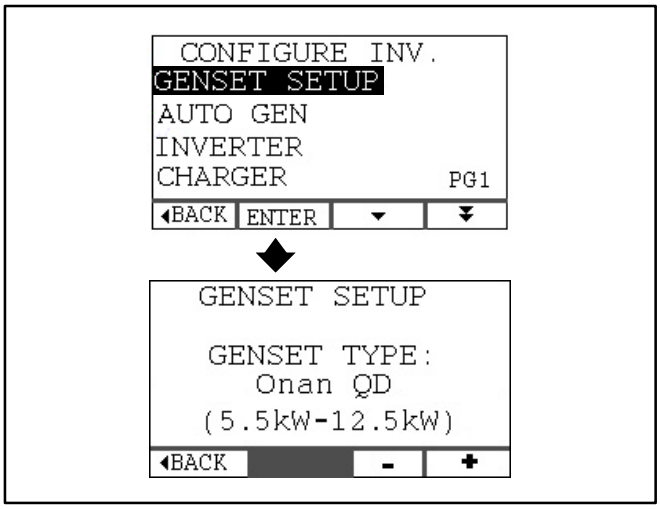

FIGURE 25. GENSET SETUP

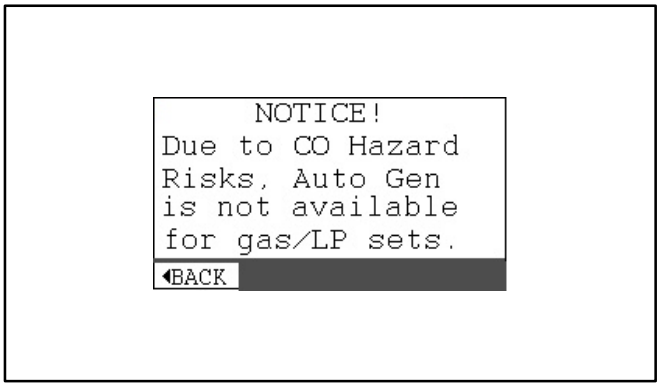

FIGURE 26. AUTO GEN NOT AVAILABLE NOTICE

AUTO GEN (AGS) SETUP

⚠CAUTION ***Read these instructions carefully before changing the AUTO GEN configuration parameters. Inverter-Charger operation and/or performance will change.***

Select AUTO GEN on CONFIGURE INV. PG1 and press ENTER. On the AUTO GEN SETUP screen press the NEXT button to scroll between the START and STOP fields (Figure 27, if the Inverter-Charger has a shunt, Figure 28 if it does not).

Models With Shunt (p. A-6)

Start: Press **+ / –** to Increase / Decrease the Percent State of Charge of the battery when the genset is to be Started (Figure 27). The range is 40 to 90 percent and changes in increments of 10 percent. The choices also include *Low Battery Cut-Out*. See Page 21.

Stop: Press **+ / –** to Increase / Decrease the Percent State of Charge of the battery when the genset is to be Stopped. The range is 70 to 100 percent and changes in increments of 10 percent. The choices also include *Float / Low Charge* and *Absorption / Medium Charge*.

Models Without Shunt (p. A-7)

Start: The Start field is fixed and cannot be changed (Figure 28). The genset will be started when battery voltage drops down to the Low Battery Cut-Out setpoint (p. 21).

Stop: Press **+ / –** to change the the Charging Stage when the genset is be stopped. The choices include *Float / Low Charge* and *Absorption / Medium Charge*.

Press ◂BACK to save the settings and return to the previous screen.

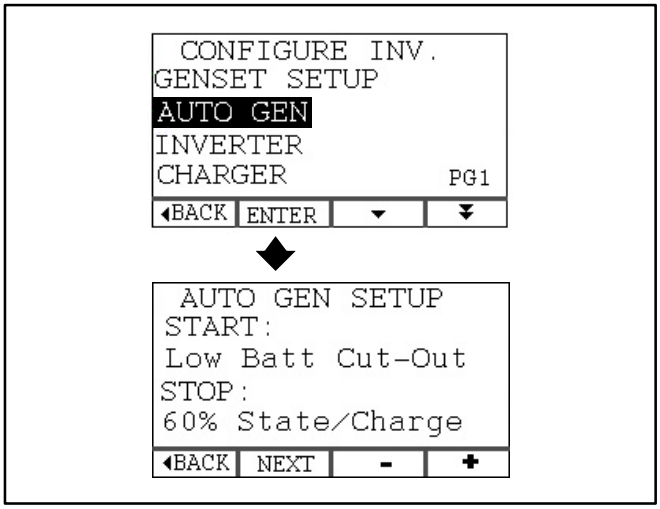

FIGURE 27. AUTO GEN SETUP (MODELS WITH SHUNT)

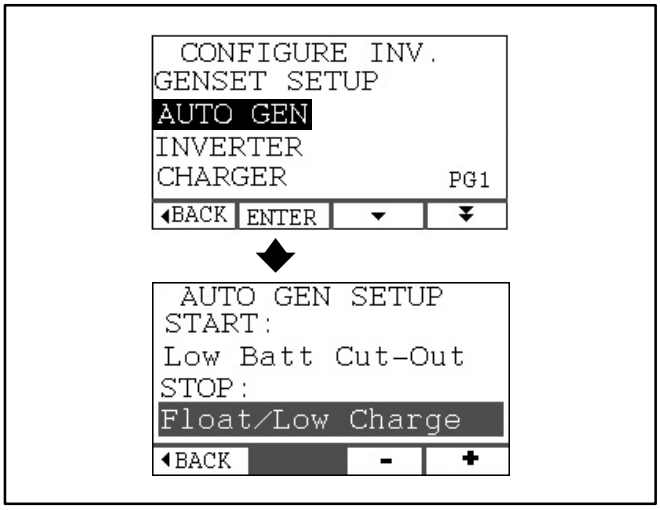

FIGURE 28. AUTO GEN SETUP (MODELS WITHOUT SHUNT)

INVERTER SETUP

⚠CAUTION ***Read these instructions carefully before changing the INVERTER configuration parameters. Inverter-Charger operation and/or performance will change.***

Select INVERTER on CONFIGURE INV. PG1 and press ENTER (Figure 29). On the INVERTER SETUP screen press the NEXT button to scroll between the LOW BATTERY CUT–OUT (LBCO) and LOW BATTERY VOLTAGE fields.

Low Battery Cut-Out: Press **+ / –** to turn Low Battery Cut-Out, ON or OFF.

If LBCO is disabled, the Inverter-Charger will shutdown if battery voltage falls to10 volts while *Inverting* (Fault No. 39, Low Battery Voltage). It is recommended that LBCO be enabled.

Low Battery Cut-Out Voltage: Press **+ / –** to Increase / Decrease Low Battery Cut-Out voltage. Voltage changes in increments of 0.1 volts. The minimum Cut-Out is 10.5 volts. Default is 11.0 volts.

If AGS is configured to start the genset at LBCO (p. 20), this voltage is used as the set point for starting the genset. LBCO does not need to be enabled for AGS to automatically start the genset at this setpoint.

Press ◂BACK to save the settings and return to the previous screen.

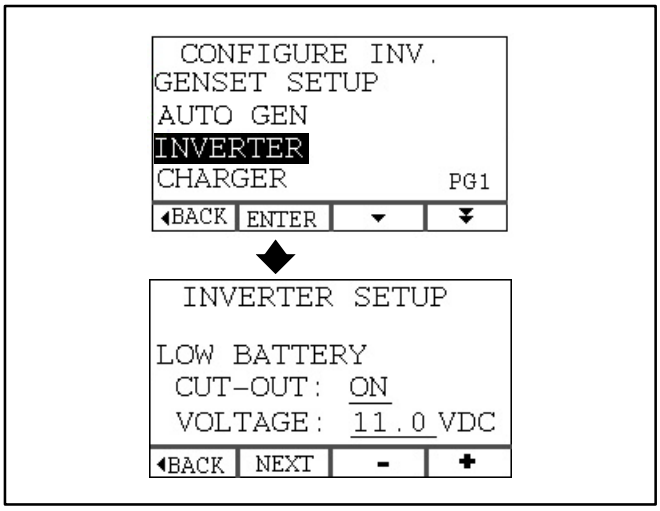

FIGURE 29. INVERTER SETUP

CHARGER SETUP

⚠CAUTION ***Read these instructions carefully before changing the CHARGER configuration parameters. Inverter-Charger operation and/or performance will change.***

Select CHARGER on CONFIGURE INV. PG1 and press ENTER (Figure 30). On the CHARGER SET-UP screen press the NEXT button to scroll between CIRCUIT BREAKER RATING, CEF RECALC and CEF.

Note: The CEF RECALC line will appear only if your Inverter-Charger has a shunt.

Circuit Breaker Rating: Press **+ / –** to Increase / Decrease the AC circuit breaker rating. Default is 30 amps. The value can be varied from 5 to 30 amps in increments of 5 amps. This should be set to the size of the external AC branch circuit breaker feeding the Inverter-Charger.

CEF RECALC: Press **+ / –** to select AUTO or OFF.

Select OFF when the value for CEF (Charge Efficiency Factor) is known for the batteries being used and entered the value in the CEF field. CEF varies between battery types and manufacturers.

Select AUTO when CEF is unknown. CEF is the ratio of amp-hrs consumed to the amp-hrs charged in a complete charge / discharge cycle. It may take several charge / discharge cycles for the Inverter-Charger to automatically compute the CEF and display it in the CEF field.

CEF: Press **+ / –** to Increase / Decrease the CEF the Inverter-Charger will use for calculations if OFF is selected for CEF RECALC.

Press ◂BACK to save the settings and return to the previous screen.

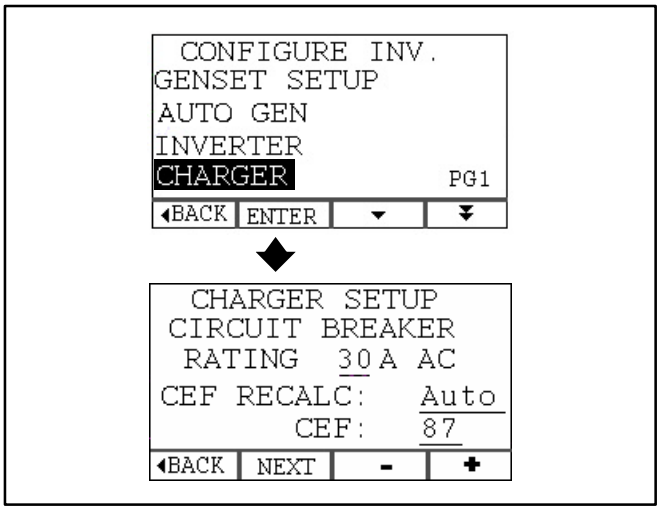

FIGURE 30. CHARGER SETUP

BATTERY SETUP

⚠ CAUTION ***Read these instructions carefully before changing the BATTERY configuration parameters. Inverter-Charger operation and/or performance will change.***

Select BATTERY on CONFIGURE INV. PG2 and press ENTER (Figure 31). On the BATTERY SET-UP screen press the NEXT button to scroll between TYPE, TOTAL AHRS and SET EMPTY CAPACITY AT. Use the **+ / –** buttons in each field to Increase / Decrease the value.

Type: Select Wet Cell, Gel#1 (Standard), Gel#2 (Fast Charge) or AGM as appropriate to match the type of batteries in the battery bank.

Total AHRS (Battery Bank Capacity): Enter the total Amp-Hour Rating of the battery bank. See BATTERY BANK VOLTAGE AND CAPACITY (p. 28). This value is used in calculations for the Battery Level Meter (Home Screen, Page 8) and for the number of hours of Life Remaining (Battery Status screen, p. 11).

Set Empty Capacity: EMPTY CAPACITY is the reference value for Empty on the Battery Level Meter (Home Screen, p. 8). If, for instance, EMPTY CAPACITY is set at 60 (default), the meter will indicate 100 percent charge as full, 80 percent charge as half full and 60 percent charge as empty.

This value is also used in calculations for the number of hours of Life Remaining (Battery Status screen, Page 11).

Custom Battery: See CUSTOM BATTERY PARAMETERS (p. 43).

Press ◂BACK to save the settings and return to the previous screen.

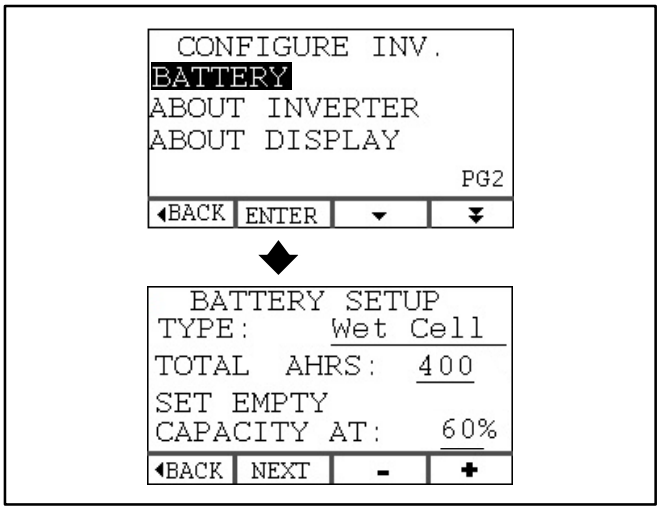

FIGURE 31. BATTERY SETUP

ABOUT INVERTER

Select ABOUT INVERTER on CONFIGURE INV. PG2 and press ENTER. This screen (Figure 32) displays the hour meter and information about the Inverter-Charger software.

Press ◂BACK to return to previous screen.

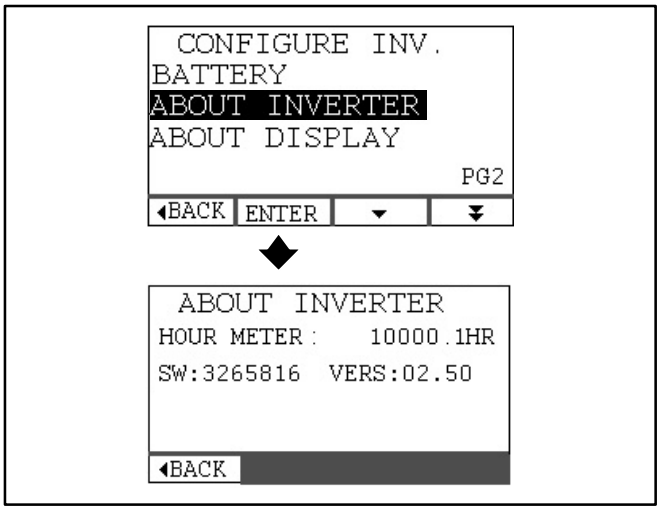

FIGURE 32. ABOUT INVERTER

ABOUT DISPLAY

Select ABOUT DISPLAY on CONFIGURE INV. PG2 and press ENTER. This screen (Figure 33) displays information about the Digital Display software.

Press ◂BACK to return to previous screen.

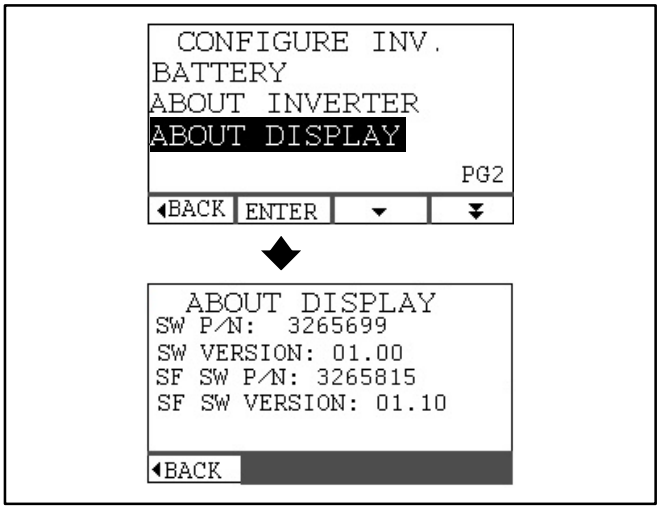

FIGURE 33. ABOUT DISPLAY

Battery Charging, Maintenance & Storage

BATTERY CHARGING STAGES

Stage 1—High (Bulk) Charging

The Inverter-Charger maintains constant charging current during Stage 1 Charging. See *Specifications* (p. vii) for the maximum charging current of your Inverter-Charger. Current is limited by the maximum charging current, maximum charger current draw (p. 6), and/or AC Circuit Breaker Rating (p. 22).

The Inverter-Charger starts in Stage 1 Charging when external AC power is applied and *Charging* is enabled. It maintains Stage 1 Charging until reaching the high charge (bulk) voltage appropriate for the battery type for which it was configured (p. 33).

Stage 2—Medium (Absorption) Charging

The Inverter-Charger switches to Stage 2 Charging when the high charge (bulk) voltage is reached. The Inverter-Charger maintains the high charge voltage until the charging current drops to the absorption current level or the absorption time expires (Table 3). The absorption current level depends upon battery type and bank size (Table 20, p. 44).

TABLE 3. ABSORPTION CHARGE TIME LIMIT

	Maximum Time (Minutes)	
Battery Bank Capacity	**Wet Cell**	**Gel & AGM**
0 - 125 Amp-Hrs	90	60
125 - 250 Amp-Hrs	90	90
250 - 400 Amp-Hrs	90	120
400 - 500 Amp-Hrs	90	150
500 - 1000 Amp-Hrs	90	180

Stage 3—Low (Float) Charging

The Inverter-Charger switches to Stage 3 Charging when the charging current drops to the absorption current level or the absorption time expires. It will maintain the float voltage appropriate for the battery type for which it was configured (p. 33). It will also supply the DC loads connected to the battery bank. The Inverter-Charger will remain in Stage 3 Charging until *Charging* is disabled or external AC power is removed.

BATTERY MAINTENANCE

Carefully read and follow all of the battery manufacturer's recommendations for maintenance and storage and observe all safety precautions. In addition, note the following:

1. Discharging more than 80 percent of a battery's total capacity can reduce its life, as can leaving it discharged more than 50 percent for extended periods of time. For maximum battery life, do not discharge more than 40 percent of a battery's capacity. See Page 11 for instructions on how to check battery charge.
2. The electrolyte level in Wet Cell batteries should the checked at least once a month. Always keep the level just above the top of the plates in each battery cell by adding as much distilled water as necessary. Allowing the electrolyte level to fall below the top of the plates will lead to shorter battery life.

   ⚠ CAUTION ***Allowing the electrolyte level to fall below the top of the plates in a Wet Cell battery will lead to shorter battery life.***
3. Equalize charging is an important maintenance procedure for Wet Cell batteries, *though not all Wet Cell batteries require equalization.* See EQUALIZE CHARGING (p. 26).
4. Always replace the battery fuse with a UL Listed, DC Rated, Slow Blow fuse of the specified amp rating (Table 11, p. 32).
5. Make sure each Inverter-Charger, Battery and fuse holder terminal stud has the proper flat washer, lock washer and nut to secure the connection (p. A-10). Torque the terminals in accordance with Table 10 (p. 32). Always secure protective covers after connections have been made.

CONNECTING / DISCONNECTING BATTERIES

Always First Disconnect AC Power and DC Loads

To keep sparks from igniting explosive battery gases, always disconnect AC power to the Inverter-Charger and turn off all DC loads before disconnecting the battery cables.

⚠WARNING ***Battery acid can cause severe burns. Always wear safety glasses and protective clothing when working with batteries. If acid gets in your eyes or on your skin, flush with water for 15 minutes and get medical attention.***

⚠WARNING ***Remove hanging jewelry, rings and bracelets before working on batteries. They can short and weld to battery terminals causing severe burns.***

⚠WARNING ***Lead-Acid Batteries produce explosive hydrogen gas that can lead to severe personal injury—Do not smoke near batteries—To reduce sparking, always disconnect AC power to the Inverter-Charger, turn off all DC loads before disconnecting the battery cables and observer the Proper Battery Terminal Connection / Disconnection Sequence below.***

Always Observe Proper Battery Terminal Connection / Disconnection Sequence

The high capacitance of the Inverter-Charger can cause sparking whenever the battery cables are disconnected or reconnected. This is normal, do not be alarmed. Take the following precautions:

1. Do not disconnect or reconnect the Inverter-Charger when fuel fumes are present.
2. ***To keep sparking away from the batteries when disconnecting battery cables:***
   A. Disconnect the negative (**–**) cable from the Inverter-Charger and then the Batteries,
   B. Disconnect the positive (**+**) cable from the Inverter-Charger and then the Batteries.
3. ***To keep sparking away from the batteries when reconnecting battery cables:***
   A. Reconnect the positive (**+**) cable at the Batteries and then at the Inverter-Charger,
   B. Reconnect the negative (**–**) cable at the Batteries and then at the Inverter-Charger.

Always Observe Proper Battery Polarity

Always observe proper battery polarity when making battery connections to the Inverter-Charger. Positive (**+**) must always be connected to Positive (**+**) and Negative (**–**) to Negative (**–**). See Page A-6.

⚠CAUTION ***Damage as a result of reverse polarity is not covered under Warranty.***

EQUALIZE CHARGING

Equalize charging is an important maintenance procedure for wet cell batteries, *though not all wet cell batteries require equalization.* Equalize Charging can only be performed when the Inverter-Charger is configured for *Wet Cell* batteries (p. 33) and has a Digital Display (p. 5). See Page 10 for instructions.

Reasons for Equalize Charging

1. Batteries produce electricity as the electrolyte (sulfuric acid and water) chemically reacts with the lead plates to form lead sulfate. Charging with electricity reverses the process: the lead plates are restored and the sulfate ion is returned to the electrolyte. Normal charging does not, however, completely restore the lead plates. After many cycles lead sulfate can accumulate on the plates reducing the effective plate area, thus robbing battery capacity. Over time the lead sulfate will crystallize, further increasing battery resistance. Equalize charging removes most of the accumulation of lead sulfate by controlled over-charging at a higher charging voltage for a specific length of time.
2. Because sulfuric acid is denser than water (higher specific gravity), stratification of water and acid takes place over time. The bubbling action involved in equalize charging remixes the water and acid to restore the uniform specific gravity throughout the battery cell necessary for optimum battery performance.

3. Equalize charging is also useful for determining whether a battery should be replaced. The higher the specific gravity, the higher the State of Charge (SOC). If specific gravity after equalization is still less than that specified by the battery manufacturer:
   A. The battery might be old, approaching the end of its life
   B. The battery might have been left discharged for too long
   C. Electrolyte might have been lost or spilled
   D. A bad cell might be developing
   E. Too much water might have been added to the electrolyte.
4. Many battery experts recommend that wet cell batteries be equalized periodically, anywhere from once a month to once a year, depending on usage. Follow the battery manufacturer's recommendations.

Safety Precautions for Equalize Charging

1. Equalizing will evaporate water from the battery cells. Add just enough distilled water before and after equalizing to cover the tops of the plates.
2. Open up the battery compartment as much as possible for better cooling and ventilation.
3. Disconnect all DC appliances before equalizing to prevent damage from the high equalize charging voltage.

   ⚠CAUTION ***Disconnect all DC appliances before equalizing to prevent damage from the high equalize charging voltage. Liability for damage to appliances left connected is the sole responsibility of the person performing equalize charging.***
4. Batteries must be attended while equalize charging. Be prepared to stop charging if a battery cell overflows, splits or cracks.

   ⚠CAUTION ***Equalize charging can destroy batteries for which it is not a suitable maintenance procedure. Read the battery manufacturer's instructions to make sure equalize charging is a suitable maintenance procedure.***

REPLACING BATTERIES

1. The Inverter-Charger is designed for use only with deep-cycle batteries of the Wet Cell (lead-acid), Gel Cell (GEL) or Absorbed Glass Mat (AGM) types. Other types of batteries can explode when subjected to the charging-inverting duty cycle of this application. (Engine starting batteries are not suitable for deep-cycle service. They have thin plates designed for brief, high-current service. They tend to warp and become unserviceable as a result of the heat generated in deep-cycle service.)

   ⚠WARNING ***Do not use batteries of other types than specified for use with this Inverter-Charger (Table 12, p. 33). They can explode causing severe personal injury.***
2. Do not mix different types of batteries (Wet Cell, GEL, AGM). Each type has a different set of optimal charging parameters. Performance will not be optimal if there is a mix of battery types: some will be overcharged, others undercharged. Overcharging reduces battery life.
3. During installation the Inverter-Charger should have been configured for the type of batteries installed (p. 33). When replacing the entire bank of batteries with a different type, it will be necessary to reconfigure the Inverter-Charge for the new type of batteries.
4. Make sure to reconnect the batteries properly (p. A-5). The batteries must be connected for an output of 12 Volts to match the 12 Volt DC Input/Output of the Inverter-Charger. Check Battery Bank Voltage before connecting the Inverter-Charger.
5. Used batteries must be disposed of in accordance with local environmental regulations.

STORING BATTERIES

When parking the vehicle for off-season storage make sure that the batteries are fully charged, that each cell in a wet-cell battery has the proper level of electrolyte and that the battery bank is disconnected from all loads.

To prevent the Inverter-Charger from drawing down the batteries when the vehicle is in storage, it is suggested that the Inverter-Charger be disconnected from the batteries, unless the External Wake Feature (p. 34) has been enabled.

Follow all storage recommendations provided by the battery manufacturer.

Installation

⚠WARNING ***Improper installation can result in severe personal injury, death or damage to equipment. The installer must be trained and experienced in the installation of electrical and mechanical equipment.***

INSTALLATION CODES AND STANDARDS FOR SAFETY

The vehicle builder or installer bears sole responsibility for the appropriate selection of components, for proper installation and for obtaining approvals from the authorities having jurisdiction. These Inverter-Chargers are suitable for installation in accordance with:

- ANSI A1192 (NFPA No. 1192)—Standard on Recreational Vehicles
- NFPA No. 70, Article 551—Recreational Vehicles and RV Parks
- CAN/CSA-Z240.6.2 Recreational Vehicles

Federal, State and local codes, such as the California Administrative Code—Title 25 (RV installation), might also be applicable. Installation codes and recommendations may change over time and vary between countries, states and municipalities. It is recommended that the standards in Table 4 be obtained for reference.

TABLE 4. REFERENCE CODES AND STANDARDS

Code of Federal Regulations, Title 49: Chapter III, Part 393	Superintendent of Documents P. O. Box 371954 Pittsburgh, PA 15250-7954
NFPA 70, National Electric Code	National Fire Protection Association 470 Atlantic Avenue Boston, MA 02210
ANSI A119.2 (NFPA 1192) Standard on Recreational Vehicles	Recreational Vehicle Industry Association 14650 Lee Road Chantily, VA 22021
California Administrative Code—Title 25, Chapter 3	State of California Documents Section P.O. Box 1015 North Highlands, CA 95660
CAN/CSA-Z240.6.2 Recreational Vehicles	Canadian Standards Association Housing and Construction Materials Section 178 Rexdale Blvd. Rexdale, Ontario, Canada M9W 1R3

DETERMINING BATTERY BANK VOLTAGE AND CAPACITY

Battery Bank Voltage

The Battery Bank must be connected to match the 12 Volt Input/Output of the Inverter-Charger. Refer to the diagrams on Page A-5 for connecting 12 Volt or 6 Volt batteries to obtain 12 Volts.

Determining Individual Battery Capacity

Battery capacity is rated in terms of Amp-Hours (AHRS). A 10 amp draw for 10 hours, for instance, would consume 100 AHRS of battery charge. Further, deep cycle battery ratings are often in terms of a “20 hour rate”—the maximum AHRS a battery can deliver in 20 hours before its output drops to 10.5 volts. Refer to the diagrams on Page A-5 for connecting 12 Volt or 6 Volt batteries to obtain the required Battery Bank Capacity (AHRS).

Determining Battery Bank Capacity

1. Estimate the Total Power Consumption of the AC and DC appliances, lights and outlets served by the battery bank during periods when external AC power (genset, shore power) is *not* available. Calculate power consumption in terms of *Watt-Hours*. Example calculation:

5 x 60 Watt Lamps x 2 Hrs	=	*600 Watt-Hrs*
1200 Watt Microwave x 1/2 Hr	=	*600 Watt-Hrs*
500 Watt Refrigerator x 2 Hrs	=	*1000 Watt-Hrs*
50 Watt TV/VCR/Stereo x 4 Hrs	=	*200 Watt-Hrs*
Total Power Consumption	=	*2400 Watt-Hrs*

2. Divide Watt-Hours by battery voltage (12 V) to obtain the estimated power consumption in terms of AHRS. Example calculation:

Total Power Consumption = 2400 ÷ 12 = 200 AHRS

3. Double the estimated Total Power Consumption to obtain the Required Battery Bank Capacity. Doubling capacity is necessary to meet estimated consumption without having to drop below half charge, at which (approximate) point *Inverting* is disabled (p. 21) to preserve maximum battery life. Example calculation:

   Required Battery Bank Capacity = 200 x 2 = 400 AHRS

4. A battery bank of 400 AHRS should therefore be sufficient for the estimated power consumption in the example calculation.

SELECTING INVERTER-CHARGER RATING

Once the *Required Battery Bank Capacity* has been determined, it is recommended that Table 5 be used to select the required Inverter-Charger rating.

TABLE 5. INVERTER-CHARGER RATING VS. BATTERY BANK CAPACITY

	INVERTER-CHARGER RATING			
	1500 W	2000 W	2500 W	3000 W
BATTERY BANK CAPACITY	400 to 600 AHRS	400 to 800 AHRS	400 to 1000+ AHRS	600 to 1000+ AHRS

INVERTER-CHARGER LOCATION AND MOUNTING

Location

The compartment or space in which the Inverter-Charger is located, must:

- Be dry and afford protection from rain, snow, and road splash
- Isolate the Inverter-Charger (which can cause sparks) from batteries and fuel tanks and other sources of flammable or explosive gases
- Allow for free air flow through the space or compartment. (The Inverter-Charger has an internal cooling fan. Air flow is from left to right through the Inverter-Charger. *The compartment must be designed to prevent recirculation of the cooling air back into the Inverter-Charger.*)
- Afford space for all electrical connections
- Afford access for removal of the Inverter-Charger for service or replacement
- Afford easy access to the front control panel to operate the Inverter-Charger.

Mounting

The Inverter-Charger is designed to be mounted horizontally on a shelf. Secure it to the compartment floor or to sturdy frame members with four (4) 1/4 inch bolts or screws. See *Specifications* (p. vii) for the weight of the Inverter-Charger.

Compartment Dimensions

Refer to the Inverter-Charger Outline Drawing on Page A-1 for overall dimensions and terminal and mounting hole locations.

Provide at least 2 inches (50.8 mm) of clearance to the right and left sides for good cooling air flow and wiring connections, and 1/2 inch (12.7 mm) to front, back and top. If the Inverter-Charger has circuit breakers, or AC wiring is brought in through the front, provide at least 2 inches (50.8 mm) of clearance to the front panel. See Table 6.

TABLE 6. MINIMUM COMPARTMENT DIMENSIONS

	WIDTH x DEPTH x HEIGHT Inches (mm)
When AC Connections are at Side or Bottom	15-1/8 x 12-3/4 x 7-5/8 (388 x 324 x 194)
When Circuit Breakers are Provided or AC Connections are at Front	15-1/8 x 14-3/4 x 7-5/8 (388 x 375 x 194)

AC CONNECTIONS

All AC connections must be performed or supervised by a trained and experienced electrician in accordance with the NEC (National Electric Code, NFPA No. 70).

AC Branch Circuit Protection

AC Input: Each AC Input to the Inverter-Charger must have appropriately sized branch circuit protection. Pages A-3 and A-4 illustrate typical AC input and output connections.

AC Output: Each branch circuit connected to an AC Output from the Inverter-Charger must have appropriately sized branch circuit protection.

Note: Branch circuit rated protective devices are required for all circuits supplied by pass-through shore power.

AC Wire Routing

Pay special attention to sealing all conduit openings into the vehicle interior to keep out exhaust gas. Apply silicone rubber or equivalent sealant inside and outside each conduit connector. (Flexible conduit is not vapor-tight and will allow exhaust gas to enter along the wires if not sealed.)

⚠WARNING ***EXHAUST GAS IS DEADLY! Seal all wiring openings into the vehicle interior to keep out exhaust gas.***

AC Terminal Block

The Inverter-Charger has a terminal block for all AC Input and Output connections (p. A-2). Pages A-3 and A-4 illustrate typical AC input and output connections. The terminals are suitable for wire sizes up to No. 10 AWG. Knockouts for 1/2 inch trade size wiring conduit are provided in the front, left side and bottom of the terminal block compartment.

Torque the terminals screws to 5 lb-in.

When all AC connections have been made to the terminal block secure the cover with its 2 screws.

AC Grounding

Each AC input and output wiring branch must include a grounding conductor, which must be connected to the grounding stud or terminal block inside the Inverter-Charger (p. A-2) and to the corresponding grounding point in the connected equipment. Pages A-3 and A-4 illustrate typical connections.

⚠WARNING ***Faulty grounding can lead to fire or electrocution and severe personal injury or death. Grounding must be in accordance with applicable codes.***

External Grounding Lug

The Inverter-Charger must be bonded to the vehicle frame by means of a No. 8 AWG conductor. Secure the conductor by means of the grounding lug on the left foot of the Inverter-Charger (p. A-2). Torque the screw to 5 lb-in.

GFCIs

See Table 7 regarding GFCIs (ground fault circuit interrupters) that are acceptable for use with these Inverter-Chargers. These are 2-pole, 3-wire grounding receptacles.

⚠WARNING ***Risk of electric shock. Use only the GFCIs in Table 7. Other types may not function properly with this equipment.***

TABLE 7. RECOMMENDED GFCI MODELS

LEVITON	6599 or 8599 Series
TBA INC.	CGF20011
EAGLE ELECTRIC	GF15V-K

BATTERY CONNECTIONS

All DC connections must be performed or supervised by a trained and experienced electrician in accordance with the NEC (National Electric Code, NFPA No. 70).

⚠WARNING ***Batteries can cause severe personal injury due to sparks, explosion and acid. Always connect or disconnect a battery in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26).***

Sizing Battery Cables

The NEC requires the use of stranded copper conductors for all low-voltage circuits in a recreational vehicle. The cable must be marked every 4 feet or less with the name or logo of the manufacturer, the specification designation, and the wire gauge. (NEC 2002, Article 551). The cables connected to the Inverter-Charger must also be marked as having insulation rated at least 75° C.

The Inverter-Charger determines battery voltage on the basis of the voltage at its own terminals. It is important therefore that the voltage drop in the cables between the batteries and the Inverter-Charger not exceed 2 percent. See Table 8 for recommended battery cable sizes. Cables up to 15 feet which are sized in accordance with NEC Article 310 for general wiring are also acceptable. Generally, the heavier the battery cable, the better.

Note: Fuses, disconnect switches and terminals between the batteries and Inverter-Charger also cause voltage drop. The voltage drop between the batteries and the Inverter-Charger should be measured in every installation to verify that it is within acceptable limits while the Inverter-Charger is *Inverting* at its maximum power rating. This is especially important when cable sizes are other than as recommended in Table 8.

TABLE 8. RECOMMENDED BATTERY CABLE SIZES

		Cable Size (AWG) vs One-Way Length between Batteries & Inverter			
Inverter Rating (W)	Max Current (Amps)	1–3 (ft)	3–5 (ft)	5–10 (ft)	10–15 (ft)
1500	150	2/0	2/0	4/0	4/0
2000	200	2/0	2/0	4/0	4/0
2500	250	4/0	4/0	4/0	–
3000	300	4/0	4/0	4/0	–

Routing Battery Cables

Battery cables must be accessible for inspection and replacement, protected from damage and secured to prevent chafing due to vibration.

Battery Cable Lugs

Battery cable lugs must be UL Recognized and CSA Certified and be crimped on using approved tools. See Table 9 for recommended cable lugs and associated crimping tools. Insulate the lug shanks with shrink-wrap insulation to prevent stray wire strands from shorting to other conductors.

TABLE 9. RECOMMENDED BATTERY CABLE LUGS

Terminal Size	Thomas & Betts	Amp
2 AWG Ring Terminal	BAL 238	321600
1/0 AWG Ring Terminal	BAL 1038	321868
2/0 AWG Ring Terminal	BAL 2038	321871
3/0 AWG Ring Terminal	BAL 3038	321875
4/0 AWG Ring Terminal	BAL 4038	321878
Crimp Tool/Dies	TBM5–SV or TBM5V	45433(2) 45436(1/0) 45439(2/0) 45442(3/0) 45445(4/0)*

*These crimping nest and indent dies are recommended for use only with AMP Hydraulic Foot Pump (AMP PN 69325–3), and with Dyna–Crimp Hydraulic Power Units (Amp PNs: 69120–1 [115 VAC] and 69120–2 [230 VAC]), and are to be used with the “C” style head.

Threaded-Stud Terminal Torques

⚠CAUTION ***An impact wrench can break the threaded-stud terminal block on the Inverter-Charger, requiring replacement of the complete Inverter-Charger. To prevent damage, always use a hand tool to tighten or loosen a threaded-stud terminal.***

Take extra care not to over-tighten or damage high-current treaded-stud terminals. Make sure the terminals are clean and free of corrosion. Torque the terminals in accordance with Table 10.

TABLE 10. THREADED-STUD TERMINAL TORQUES

Terminal	Maximum Torque
Threaded-Stud Battery Terminals	120–180 lb-inch
Inverter-Charger Cable Terminals	130–160 lb-inch
Fuse Holder Terminals	150–200 lb-inch

Protective DC Terminal Covers

Secure all DC terminal protective covers after connections have been made.

Battery Shunt Connections

The SHUNT, on Inverter Models so equipped, is a bus bar inside the inverter between the SHUNT terminal and the NEG (–) terminal. The inverter control continuously monitors current through the Shunt (by measuring the millivolt drop across it) to determine how much battery charge is being consumed during *Inverting* or being stored during *Charging* , and thus keeps track of the State of Charge (SOC) of the batteries. See Page A-6 for connection details.

Battery Fuse and Fuse Holder

The NEC requires installation of a fuse in the Positive (**+**) cable within 18 inches of the battery to protect the battery and battery cables in the event of a short circuit (p. A-10). It must be readily accessible for replacement.

Fuse Size: A UL Listed, DC Rated, Slow-Blow fuse must be used. See Table 11 for recommended fuses and fuse holders. To select the appropriate fuse size, determine the maximum Inverter current and round up to the next available fuse size.

Fuse Holder Label: Affix the label in the kit to the fuse cover or at a location where it will be visible when making connections at the terminals. (p. A-10).

Terminal Hardware Stackup and Torque: Make sure each terminal has the proper flat washer, lock washer and nut to secure the connection (p. A-10). Torque the terminals in accordance with Table 10.

TABLE 11. RECOMMENDED BATTERY FUSES AND FUSE HOLDERS

Inverter Current & Fuse Ratings			UL Rated Class T Fuse Kits	Class T Fuse / Fuse Holder Kits
Inverter Rating (W)	Maximum Current (Amps)	Maximum Fuse Size (Amps)	Onan PN	Onan PN
1500	150	200	541-0928	541-0924
2000	200	300	541-0929	541-0926
2500	250	300	541-0929	541-0926
3000	300	400	541-0930	541-0927

BATTERY COMPARTMENT

⚠WARNING ***Arcing can ignite the explosive hydrogen gas given off by the battery, causing severe personal injury. The battery compartment must be ventilated and must isolate the battery from spark-producing equipment.***

Batteries must be mounted in a compartment isolated from spark-producing equipment such as the Inverter-Charger or Genset. The compartment must have openings of at least 1.7 square inches (11 square centimeters) per battery at the top and bottom for ventilation of battery gasses. It should be located such that spills and leaks will not drip acid on fuel lines, wiring and other equipment that could be damaged.

BATTERY TYPE CONFIGURATION

The installer must configure the Inverter-Charger for the type of batteries installed, unless Wet Cell, which is the default. This can be done at the Digital Display or at the Inverter-Charger control panel. *Inverting* and *Charging* are disabled during battery type configuration. Normal operation resumes in 5 minutes or when configuration is completed.

Configuring Battery at Digital Display

Refer to Page 23.

Configuring Battery at Inverter-Charger Front Panel

Checking Battery Type Configuration: To check configuration, press and hold the **Inverter ON / OFF** button on the front panel for 5 seconds. The three (3) indicator lights will turn ON, and then after 1 second, flash the current battery type in accordance with Table 12.

TABLE 12. BATTERY CONFIGURATION CODE

Number of Flashes	Battery Type
1	Wet Cell
2	Gel Type No. 1 (Standard)
3	Gel Type No. 2 (Fast Charge)
4	AGM (Absorbed Glass Mat)

Changing Battery Type Configuration: To change battery type configuration, press the **Charger ON / OFF** button once to advance flashing to the next battery type. Each push advances flashing as follows: 1 flash to 2 flashes to 3 flashes to 4 flashes to 1 flash, and so on. When the correct battery type is being flashed, press the **Inverter ON / OFF** button once to save the battery type to Inverter-Charger memory. Then enable *Inverting* and *Charging* to continue normal operation.

BATTERY TEMPERATURE SENSOR

The battery temperature sensor is shipped in the bag with this manual. It is a thermistor incorporated in the 3/8 inch ring terminal for bolting directly to the battery Positive (**+**) terminal. The other end of the sensor lead has a connector for plugging into the **J3** connector on the Inverter-Charger. Pages A-2 and A-9 illustrate connections.

It is recommended that the sensor be located on a battery near the middle of the bank or against the back wall of the compartment to be on the warmest Positive (**+**) terminal of the bank. Refer to the diagrams on Page A-5 for various arrangements of batteries and their interconnections.

The battery temperature sensor must be installed for optimum Inverter-Charger performance and battery use. The Inverter-Charger will work without the battery temperature sensor, but may cause increased battery gassing and/or take longer to charge the batteries.

EXTERNAL WAKE

The external wake feature is designed to place the Inverter-Charger in a “sleep” state when storing the vehicle and to wake it when taking the vehicle out of storage. During sleep the Inverter-Charger draws less than 0.5 mA from the batteries.

Pages A-2 and A-8 illustrate typical connections where opening / closing the DC load disconnect switch removes / restores the 12 VDC signal necessary for the Inverter-Charger to remain awake.

To Enable

The Inverter-Charger leaves the factory with the external wake feature disabled. To enable the external wake feature:

1. Remove the jumper across the left two pins of connector **J6** (Figure 34).
2. Provide for a 12 VDC signal through connector **J5**, in accordance with Table 13. Polarity must be correct for the signal to wake the Inverter-Charger.

TABLE 13. EXTERNAL WAKE CONNECTIONS

Connection	Description
J5-3	External Wake Signal (12 VDC)
J5-7	Ground for External Wake Signal

Onan wiring harness 541-0973 is available for connections to an external 12 VDC signal. It has the mating plug to connector **J5** and 6 inch long pigtails. A wiring harness supplied by others must use an 8-pin Mini-Mate-N-Lok Plug (TYCO PN 770579-1 plug with PN 770988-3 gold sockets) and 24-18 AWG insulated wiring.

Note: The Inverter-Charger will wake whenever external AC power is connected, whether external wake is enabled or not.

To Leave Disabled

Do not remove the jumper across connector **J6** if external wake is to be left disabled, that is, if the Inverter-Charger is always to remain awake when connected to the batteries.

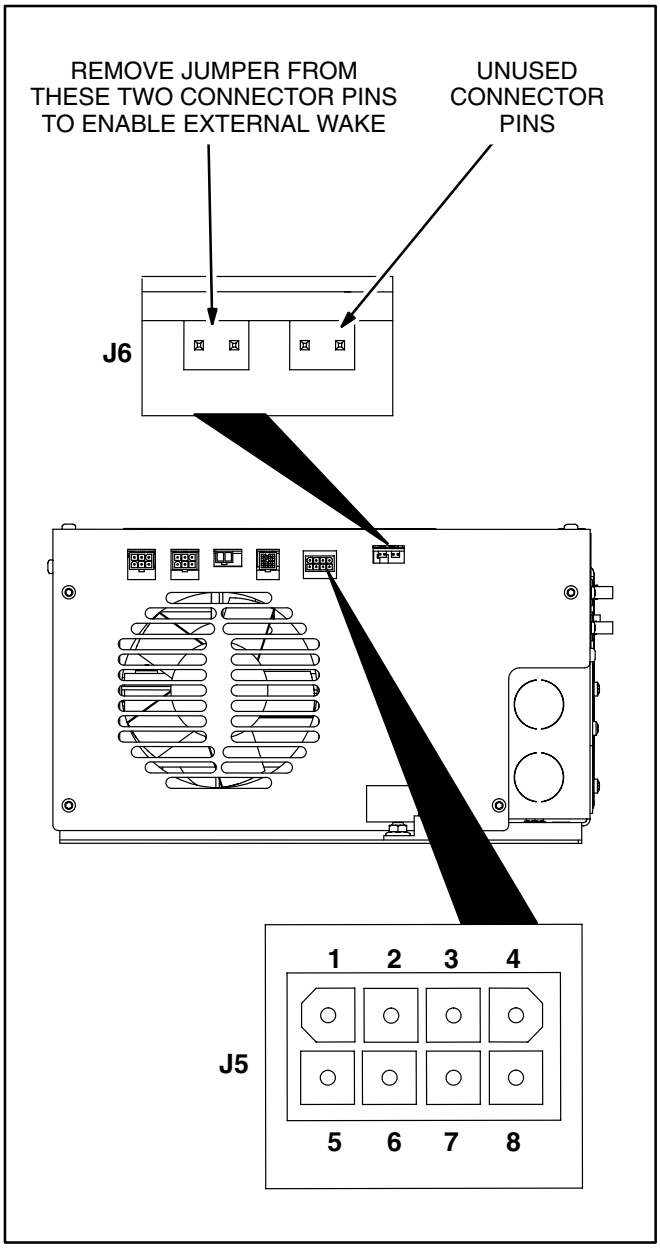

FIGURE 34. EXTERNAL WAKE JUMPER ON CONNECTOR J6

EQUINOX DIGITAL DISPLAY

Up to three *Equinox Digital Displays* may be connected to the Inverter-Charger at **J-1** and/or at **J-2**. Pages A-2 and A-11 illustrate typical connections. Install the *Equinox Digital Display* in accordance with its instruction sheet. Regarding connections:

- The 6-pin connections at the Inverter-Charger and Digital Display are pin-for-pin compatible (Table 14).

TABLE 14. RS485 CONNECTIONS FOR EQUINOX DIGITAL DISPLAY

Connection	Description
J1-1, J2-1	RS485 + Bus Line
J1-2, J2-2	RS485 – Bus Line
J1-3 J2-3	Battery Pos (+)
J1-4, J2-4	Ground
J1-5, J2-5	Not used at this time
J1-6, J2-6	Not used at this time

- Onan wiring harnesses 541-0919 (25 feet) and 541-0932 (50 feet) are available with connectors on both ends.
- A wiring harness supplied by others must use 6-circuit Mini-Mate-N-Lok Plugs (TYCO PN 172168-1 plugs with PN 770988-3 gold sockets) and 22 AWG, 4-conductor twisted pair telecommunications cable or 18 AWG single-strand CCXL conductors up to 150 feet.
- Seal all wire openings into the vehicle interior with silicone rubber or equivalent sealant to keep out exhaust gas.

⚠WARNING ***EXHAUST GAS IS DEADLY! Seal all wire openings into the vehicle interior to keep out exhaust gas.***

- To reduce the effects of Electromagnetic Interference (EMI), keep the harness at least 5 inches (127 mm) away from AC power sources. Avoid passing the harness through electrical panels or near transformers or other high voltage equipment. Do not run the harness parallel to AC wiring.

⚠CAUTION ***EMI can cause signal distortion resulting in unintended equipment operation. Carefully follow these wiring guidelines.***

GENSET CONNECTIONS

Connections

Connector **J-4** is provided on the Inverter-Charger for connections to Start and Stop a genset. Pages A-2 and A-12 illustrate typical connections. Onan wiring harness 541-0969 is available for mating with connector J-4.

A wiring harness supplied by others must use a 4-circuit Universal Mate-N-Lok Plug (TYCO PN 172167-1 plug with PN 770988-3 gold sockets) and 24-18 AWG insulated wiring.

Refer to Tables 15 through 18 for the pin-to-pin or pin-to-wire correspondence between the Inverter-Charger and various makes of genset.

TABLE 15. PIN-TO-PIN CORRESPONDENCE: INVERTER-CHARGER — ONAN GENSETS

Inverter Connector Pin	Onan Diesel Connector Pin	Signal Name
J4–3	P8–E	STOP
J4–4	P8–F	Run Signal
J4–1	P8–C	START/Crank
J4–2	P8–A	Ground

TABLE 16. PIN-TO-WIRE CORRESPONDENCE: INVERTER-CHARGER — 4-WIRE GENSETS

Inverter Connector Pin	Generac Diesel Wire No	Signal Name
J4–3	18	STOP
J4–4	14	Run Signal
J4–1	17	START/Crank
J4–2	0	Ground

TABLE 17. PIN-TO-WIRE CORRESPONDENCE: INVERTER-CHARGER — 3-WIRE GENSETS

Inverter Connector Pin	PTS Diesel Wire Color	Signal Name
J4–3	YELLOW	STOP
J4–4	GRAY	Run Signal
J4–1	BLUE	START/Crank
J4–2	GROUND	Ground

TABLE 18. PIN-TO-WIRE CORRESPONDENCE: INVERTER-CHARGER — 2-WIRE GENSETS

Inverter Connector Pin	PTS Diesel Wire Color	Signal Name
J4–4	GRAY	Run Signal
J4–1	RED	START/Crank
J4–2	GROUND	Ground

Configuration

If the AGS feature of the Inverter-Charger is to be enabled it will be necessary to configure the genset type under GENSET SETUP (p. 19). GENSET connections and GENSET SETUP configuration must correspond.

Warning Labels

A sheet of 5 peel-off warning labels (Figure 35) is included in the bag with this manual. If the AGS feature of the Inverter-Charger is to be enabled, affix one label at or near each of the following locations:

- Inverter-Charger
- Genset service access panel
- Genset Start/Stop switch
- Vehicle AC distribution cabinet
- Vehicle AC transfer switch.

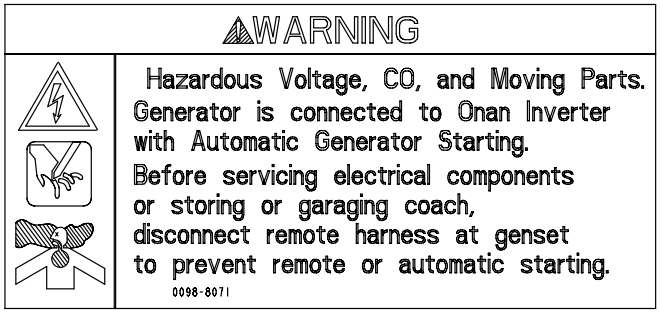

FIGURE 35. AGS WARNING

Service

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. ONLY TRAINED AND EXPERIENCED PERSONS MAY PERFORM INVERTER-CHARGER SERVICE.***

⚠WARNING ***Batteries can cause severe personal injury due to sparks, explosion and acid. Always connect or disconnect a battery in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26).***

REPLACING FAN ASSEMBLY

Replace the fan assembly in accordance with the following steps. Refer to Figure 36.

1. Turn OFF the AC circuit breaker supplying power to the Inverter-Charger.
2. Disconnect the batteries from the Inverter-Charger in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26).
3. Remove the cover over the AC terminal block and disconnect all wires from the AC terminal block.
4. Remove all of the plug-in connectors to external circuits (p. A-2).
5. Remove the Inverter-Charger.
6. Use a torx T20 bit to remove the 12 screws that attach the cover to the base.
7. Remove the cover by sliding it straight back 3/4 inch and then lifting it straight up.
8. Disconnect the 3-pin fan connector.
9. Remove the fan assembly mounting hardware: 2 screws (T20) to control board and 2 nuts (10 mm) to base and withdraw the assembly. (It may be necessary to loosen the 2 control board mounting screws pointed out in Figure 36 to enable withdrawal of the fan assembly.)
10. Install the new fan assembly in reverse order of removal. Make sure to reconnect the 3-pin connector and ground wire as shown.
11. Conduct a Fan Function Test (p. 42).

REPLACING CIRCUIT BREAKERS

Replace the circuit breakers in accordance with the following steps. Refer to Figure 36.

1. Turn OFF the AC circuit breaker supplying power to the Inverter-Charger.
2. Disconnect the batteries from the Inverter-Charger in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26).
3. Remove the cover over the AC terminal block and disconnect all wires from the AC terminal block.
4. Remove all of the plug-in connectors to external circuits (p. A-2).
5. Remove the Inverter-Charger.
6. Use a torx T20 bit to remove the 12 screws that attach the cover to the base.
7. Remove the cover by sliding it straight back 3/4 inch and then lifting it straight up.
8. Disconnect the two (2) wires from the circuit breaker to be removed (quick-connects). Note the terminals so that the leads can be reconnected properly.
9. Remove the two (2) mounting screws (Philips head), mount the new circuit breaker in place of the old and reconnect the wires. Make sure the replacement circuit breaker has the same rating as the old one (15 amps or 20 amps). Note that the cover label located just above the circuit breakers indicates the proper ratings.
10. Complete the installation in reverse order of removal and test for proper operation.

REPLACING AC TERMINAL BLOCK

Replace the AC terminal block in accordance with the following steps. Refer to Figure 36.

1. Turn OFF the AC circuit breaker supplying power to the Inverter-Charger.
2. Disconnect the batteries from the Inverter-Charger in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26).
3. Remove the cover over the AC terminal block and disconnect all wires from the AC terminal block. Note the terminal block label (p. A-3 or A-4) and the marking on each lead end so that it can be reconnected properly.
4. Remove the two (2) terminal block mounting screws (T20).
5. Connect and tighten all leads to the new terminal block and mount the terminal block with the two (2) mounting screws.
6. Torque all terminals to 5 lb-in.
7. Complete the installation in reverse order of removal and test for proper operation.

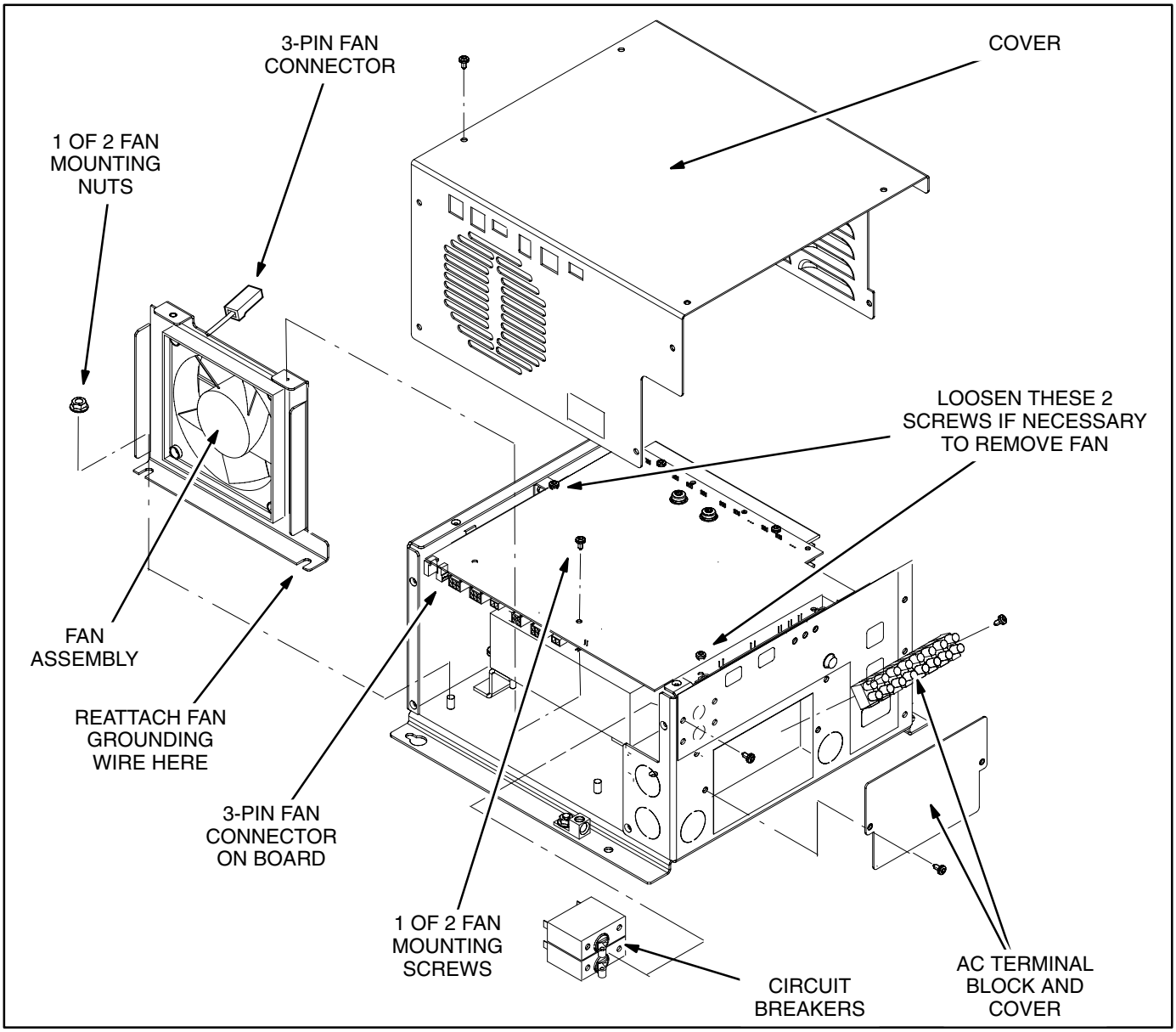

FIGURE 36. REPLACEABLE PARTS OF THE INVERTER-CHARGER

REMOTE COMMUNICATIONS TESTS

Conduct the following tests to determine that the communications ports and Digital Displays are functioning properly. The 6-pin connectors at the Inverter-Charger and Digital Display are pin-for-pin compatible. Refer to Table 19, Figure 37 and Page A-11.

1. Connect the batteries to the Inverter-Charger in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26) and check for 12 VDC across the Inverter-Charger terminals.
2. Check for 12 VDC between pins **J1–3** (B+) and **J1–4** (B–) and between pins **J2–3** (B+) and **J2–4** (B–) on the Inverter-Charger. Replace the Inverter-Charger if there is no voltage.
3. Remove a Display that is not working and disconnect its wiring harness or harnesses (see Page A-11). Check for 12 VDC between pin receptacles **3** (B+) and **4** (B–) in the connector of the harness that is connected on the other end to **J1** or **J2** at the Inverter-Charger. If there is voltage at the Inverter-Charger (Step 2), but not at the end of the Display wiring harness, repair or replace the harness as necessary.
4. To test a Digital Display, plug it into either port that has 12 VDC between pins **3** and **4**. Replace a Digital Display that does not wake up when any key is pressed. Navigate through the Display menu screens. If the warning: "WARNING! COMMUNICATIONS LOST WITH MAIN CONTROL" appears on the Display:
   A. Connect the Display to the Inverter-Charger with a test harness known to have electrical continuity between the ends of all four wires. Harness 541-0919 (25 ft) or 541-0932 (50 ft) is recommended.
   B. If the test harness works, repair or replace, as necessary, the harness in the vehicle.
   C. If the communications warning still appears on the Display, connect a Display that is known to function properly. Replace the Display in the vehicle if communications is established with the test Display. Replace the Inverter-Charger if communications cannot be established with a good Display.

TABLE 19. RS485 CONNECTIONS

Connection	Description
J1-1, J2-1	RS485 + Bus Line
J1-2, J2-2	RS485 – Bus Line
J1-3 J2-3	Battery Pos (+)
J1-4, J2-4	Ground
J1-5, J2-5	Not used at this time
J1-6, J2-6	Not used at this time

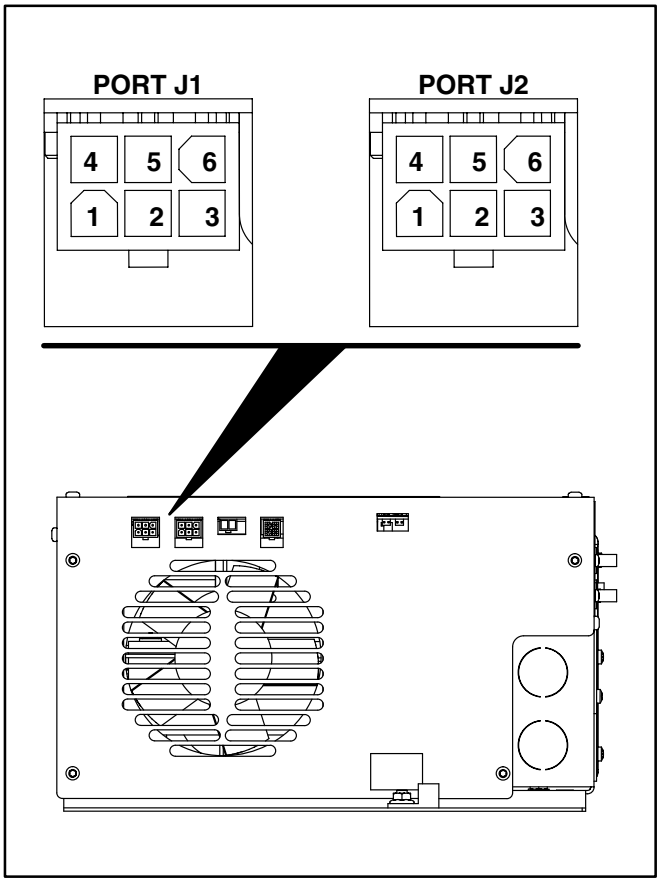

FIGURE 37. LCD COMMUNICATION PORTS J1 &J2

EXTERNAL WAKE TESTS

Conduct the following tests to determine that the external wake feature functions properly. Refer to Figure 38.

1. Verify that the jumper across the left two pins of connector **J6** has been removed. ***If it has not been removed, external wake has not been enabled and this test is not necessary.***
2. Turn OFF the AC circuit breaker supplying power to the Inverter-Charger.
3. Connect the batteries to the Inverter-Charger in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26) and check for 12 VDC across the Inverter-Charger terminals.
4. Disconnect the wire harness from connector **J5** and press the INVERTER ON/OFF button on the control panel (p. 4). The *Inverting Indicator Light* should remain off and there should be no AC voltage (0 VAC) at the output terminals.
5. With the wire harness still disconnected from connector **J5**, turn ON the DC load disconnect switch (p. A-8). Check for 12 VDC across **J5–3** (B+) and **J5–7** (B–). Repair or rewire as necessary if there is no signal or the signal is not of the proper polarity.
6. Plug in the wire harness for connector **J5**, turn ON the DC load disconnect switch (p. A-8), and press the INVERTER ON/OFF button on the control panel (p. 4). The *Inverting Indicator Light* should come on and there should be 120 VAC at the Inverter-Charger output terminals. (A 9-volt dry-cell battery can be used as the external wake signal for this test.)
7. Turn OFF the DC load disconnect switch while *Inverting*. AC output voltage should go to 0 VAC and all LEDs on the Inverter-Charger and Digital Display should turn off.
8. With the DC load disconnect switch OFF, connect AC power to the Inverter-Charger and enable *Charging*. Verify that the *Charging Indicator Light* comes on. (*Charging* ON is the default state of the Inverter-Charger)

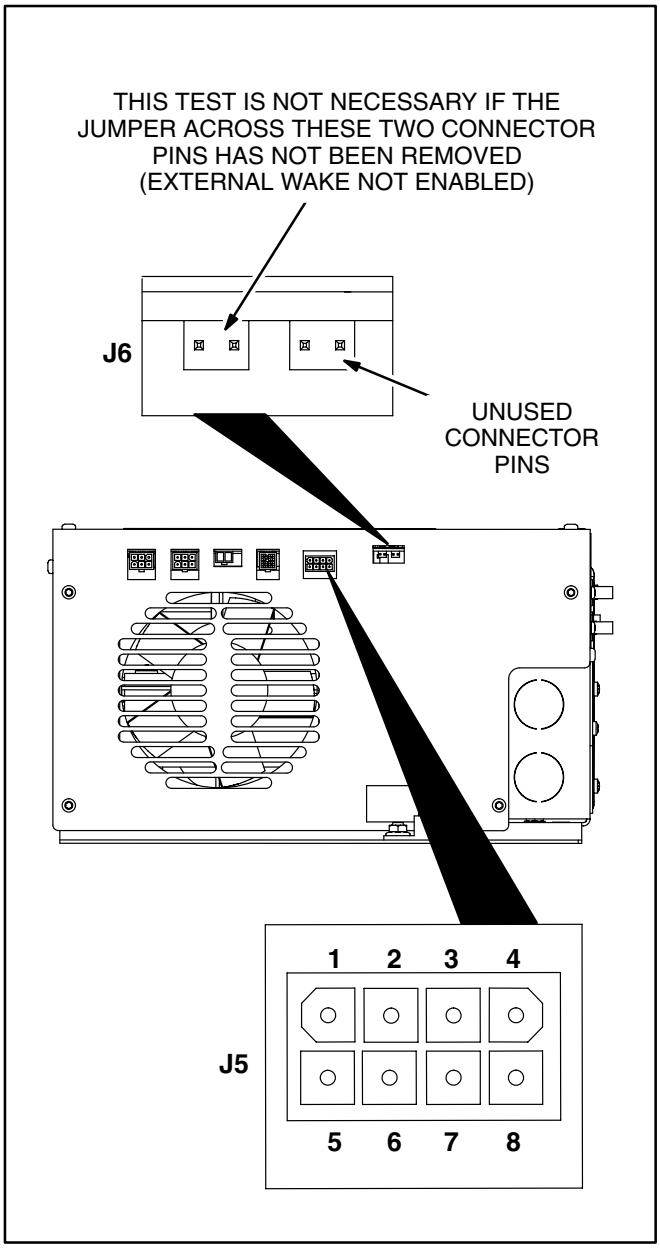

FIGURE 38. EXTERNAL WAKE CONNECTORS J5 AND J6

GENSET START/STOP/RUN TESTS

Conduct the following tests to determine that genset control functions properly. Refer to Figure 39.

1. Verify that a remote switch other than the Digital Display can start and stop the genset.
2. Disable AGS (p. 13) and Quiet Time (p. 17).
3. Re-configure the Inverter-Charger for an Onan QD genset (p. 19), if not already so configured. This is necessary for the test in Step 8.
4. Connect the batteries to the Inverter-Charger in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26) and check for 12 VDC across the Inverter-Charger terminals.
5. Disconnect the genset wire harness from connector **J4** on the Inverter-Charger. It is recommended that pigtail harness 541-0969 be obtained to plug into **J4** as a test harness.
6. Measure electrical resistance across **J4–1** and **J4-2** using the test harness. The circuit should be open (∞ ohms).
7. Press START on the Display GENSET STATUS screen (p. 12) and again measure electrical resistance across **J4–1** and **J4-2**. The circuit should close (0 ohms) and the Display should indicate genset STARTING. Press STOP and the circuit should open (∞ ohms).
8. Press PRIME on the GENSET STATUS screen. Measure electrical resistance across **J4–3** and **J4-2** using the test harness. The circuit should close (0 ohms) and the Display should indicate genset PRIMING. Press STOP and the circuit should open (∞ ohms).
9. Be prepared to apply a 12 VDC source, *fused at not more than 5 amps*, or a 9-volt dry-cell battery, across **J4–4** (B+) and **J4-2** (B–) using the test harness. Press START on the GENSET STATUS screen and then apply the voltage across **J4–4** and **J4-2**. The Display should change from genset STARTING to genset RUNNING. It should change to genset STOPPED when voltage is removed.

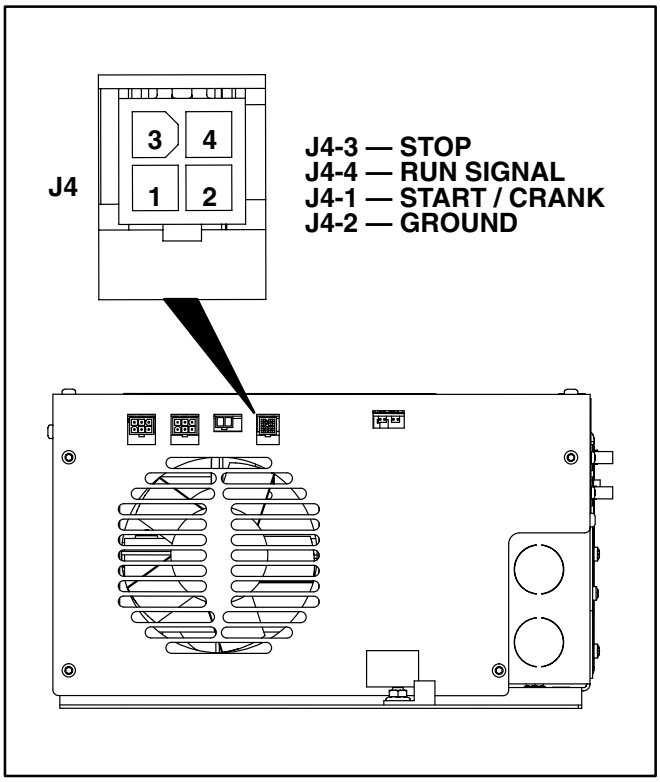

FIGURE 39. GENSET CONNECTOR J4

10. If all the genset control circuits inside the Inverter-Charger are good, re-enable AGS and Quiet Time and re-configure for the proper genset, if changed in (Step 2).
11. Reconnect the genset wire harness to **J4** on the Inverter-Charger and press START on the GENSET STATUS screen. If the genset does not start, replace or repair broken or missing wires and corroded or bent terminals between the Inverter-Charger and the genset. See Page A-12 and Table 15, 16, 17 or 18 on Page 35.

BATTERY TEMPERATURE SENSOR TEST

Conduct the following tests to determine that the battery temperature sensor functions properly.

1. Disconnect the sensor at the Inverter-Charger (p. A-9) and measure electrical resistance across the two leads of the sensor. Replace the sensor if resistance is not 8000 to 15,000 Ohms at room temperature.
2. While the sensor is disconnected, cycle power to the Inverter-Charger by disconnecting and then reconnecting the batteries in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26). After approximately 5 minutes the Display should indicate Fault 24, Battery Temp Sensor Error.
3. Reconnect the sensor, cycle power to the Inverter-Charger and wait 10 minutes. The fault will not be declared if the sensor circuit is within operating limits.

FAN FUNCTION TEST

Conduct the following tests to determine that the cooling fan functions properly.

1. Connect the batteries to the Inverter-Charger in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26) and check for 12 VDC across the Inverter-Charger terminals. Verify that the *Charging Indicator Light* starts to blink intermittently, indicating that the Inverter-Charger is waiting for AC input.
2. Connect AC input. High Charging will begin and the fan should come on and blow air out the right side of the Inverter-Charger (battery terminal side). See REPLACING FAN ASSEMBLY (p. 37) if the fan does not function or a fan fault is declared after a few minutes of *Charging*.

CUSTOM BATTERY PARAMETERS

⚠ CAUTION ***Only trained and experienced persons may change BATTERY configuration parameters. Consult the battery manufacturer for the specific parameters that apply to the installed batteries and read these instructions through carefully, including the notes in Table 20. Incorrect parameter settings can cause excessive battery gassing and affect Inverter-Charger and battery performance. If the specific battery parameters are not known, select the Onan preset battery type configuration that applies (Wet Cell, Gel #1, Gel #2 or AGM on the BATTERY SETUP screen).***

Inverter-Chargers can be optimized to match the specific charging recommendations of the battery manufacturer if different from the Inverter-Charger default values presented in Table 20 for the various battery types. To change these values to match the manufacturer's battery parameters:

1. Press the INVERT ON / OFF button to disable *Inverting*.
2. Select BATTERY on CONFIGURE INV. PG2 and press ENTER (Figure 40). See Page 18 for instructions on how to get to the CONFIGURE screen.
3. On the BATTERY SETUP screen simultaneously press and hold both the **+** button and the **–** button for 5 seconds.
4. On the CUSTOM BATTERY screen press the NEXT button to scroll between fields and the **+ / –** buttons to Increase / Decrease the values in the selected fields. Enter the manufacturer's battery parameters.
5. Press ◂DONE to save the settings and return to the BATTERY SETUP screen. If changes have been made, the battery TYPE field will indicate CUSTOM.
6. *To restore the Onan preset battery configuration, go back to the BATTERY SETUP screen (second screen in Figure 40) and pick Wet Cell, Gel #1, Gel #2, or AGM, as appropriate.*

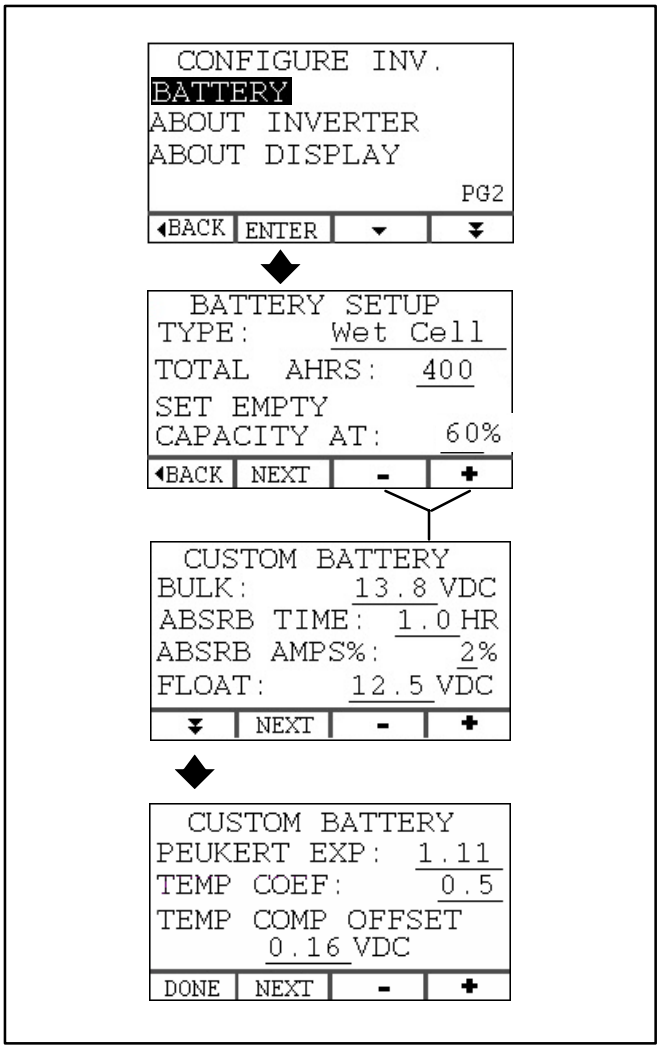

FIGURE 40. CUSTOM BATTERY PARAMETERS

TABLE 20. DEFAULT BATTERY CHARGING PARAMETERS

Parameter	Wet Cell	Gel (Standard)	Gel (Fast)	AGM
Bulk Voltage (VDC)[1]	14.2	14	14.3	14.2
Float Voltage (VDC)[1]	13.3	13.5	13.7	13.2
Maximum Absorption Time (Hours)[2]	1.5	3	3	1.5
Absorption Amps (% of Battery Bank Size)[3]	2%	2%	2%	2%
Peukert's Exponent[4, 6]	1.25	1.11	1.11	1.11
Temperature Coefficient[5, 6]	0.5	0.5	0.5	0.5
Temperature Compensation Offset (VDC)[7]	0.03	0.03	0.03	0.03

1. The default Bulk and Float Voltages shown are at the default battery temperature of 77° F (25° C). Inverter-Chargers that have a battery temperature sensor connected will automatically recalculate charge voltage based on battery temperature. The Inverter-Charger attains Bulk Voltage during Bulk (High) Charging and maintains it during Absorption (Med) Charging. See the diagram.
2. The Maximum Absorption Time is also based on battery bank size. See Table 3 (p. 25). Limiting absorption time limits the time the batteries are exposed to the elevated Bulk Voltage. See the diagram.
3. Absorption Amps is the current level at which the 3-Stage Charging Algorithm transitions to Float (Low) Charging. It is entered as a percentage of battery bank capacity. For example, when the default value of 2% is retained, the transition to float charge for a 400 AHR battery bank will occur when charging drops to 8 amps (2% x 400 = 8). See the diagram.
4. Peukert's Equation accounts for the way high discharge rates shrink battery capacity. Typically, a battery that provides 200 AHRS when discharged over 20 hours may only provide 95 AHRS when discharged over 1 hour. The Inverter-Charger therefore bases time remaining and SOC calculations on Peukert's equation ($C_p = I^n \times t$, where C_p is Peukert's Capacity, I is current drawn through the shunt, t is time and n is Peukert's exponent). The value of Peukert's exponent n is supplied by the battery manufacturer.
5. The Temperature Coefficient accounts for the effect of temperature on battery bank capacity. It is used for SOC calculations. Overall battery capacity drops as battery temperature drops.
6. These parameters can be changed only on Models with an internal shunt.
7. The Temperature Compensation Offset is the voltage offset per cell per 10° F (5.6° C) increment in battery temperature greater or less than 77° F. The voltage offset is added to charging voltage for temperatures below 77° F and subtracted for temperatures above. Using the default value in the table, the voltage offset for 12 VDC is plus or minus 0.18 volts per 10° F (0.03 x 6 cells = 0.18). (A 12-volt battery consists of 6, 2-volt cells in series.)

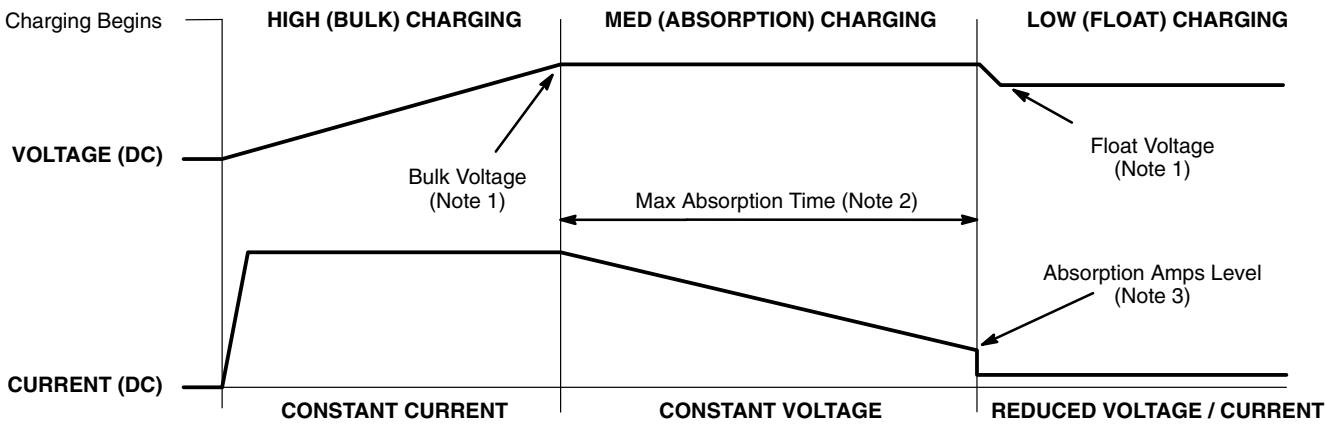

DIAGRAM OF 3-STAGE CHARGING VOLTAGE AND CURRENT

RECOVERING DEEPLY DISCHARGED BATTERIES

A battery nearing the end of its life can easily become deeply discharged (less than 3 VDC across its terminals). Parasitic loads can deeply discharge batteries when the vehicle is not in use. Good batteries can be deeply discharged by the DC loads when *Charging* is hindered in some way, such as by:

- AC power not being available for *Charging*
- *Charging* having been disabled
- The DC fuse having blown (p. A-6 or A-7)
- A DC switch between the Inverter-Charger and batteries (not a recommended installation) having been left open
- Loose or corroded DC connections
- Damaged or missing DC cables.

Note: It is recommended that LBCO be enabled (p. 21) for longer battery life. However, to protect the batteries from being overly discharged by *Inverting* if LBCO is disabled, *Inverting* shuts down when the batteries drop to 10 VDC for 10 seconds (Fault 39—Low Battery Voltage).

Repair Connections

As a first step in recovering deeply discharged batteries, disable *Inverting* and *Charging*, disconnect all DC loads, disconnect AC power from the Inverter-Charger and measure voltage across the terminals of the battery bank and across the DC terminals of the Inverter-Charger. *The voltages should be the same*. (If the DC load disconnect switch also disconnects the Inverter-Charger from the batteries [not a recommended installation], re-close the switch and disconnect the loads at the DC Load Panel.)

If the voltages are not the same, replace a blown DC fuse, close any open DC switch, clean and tighten DC connections and replace or repair DC cables, as necessary. Pages A-6, A-7 and A-8 illustrate typical DC connections.

⚠WARNING ***Batteries can cause severe personal injury due to sparks, explosion and acid. Always connect or disconnect a battery in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26).***

Recovery from less than 3 Volts

If there is less than 3 volts across the DC terminals of the Inverter-Charger after all necessary repairs have been made to connections between the Inverter-Charger and the battery bank:

1. Make sure again that all DC loads have been disconnected. Check that external wake (if enabled) has turned off the Inverter-Charger (p. A-8). Only the Inverter-Charger and batteries and battery temperature sensor (p. A-9) should be connected.
2. Let the batteries rest for several hours (to recover from the DC loads) or until voltage increases to 3 volts. If voltage increases to 3 volts or more, go to *Recovery from less than 10 Volts*. If the voltage does not increase, go to Step 3.
3. Reconnect AC power to the Inverter-Charger and enable *Charging*.
4. If the CHARGING indicator light comes on, indicating High Charging, go to *Recovery from less than 10 Volts*.

5. If the CHARGING indicator light blinks, indicating low charge, let the batteries charge for 30 minutes or until Fault 71 occurs.[1] Go to Step 6 if Fault 71 occurs. *During Charging*, check for the same voltage at the *battery* terminals as at the Inverter-Charger and make any necessary reconnections. *Discontinue charging if the batteries become warmer than usual*, indicating a shorted cell, and replace the batteries.
6. After 30 minutes of charging, or after Fault 71 occurs, disable *Charging* and measure battery terminal voltage. If voltage increased to 3 volts or more, go to *Recovery from less than 10 Volts*. If not, and if the batteries have not overheated, re-enable *Charging* and charge for another 30 minutes.
7. Replace the batteries if they do not recover to 3 volts or more during the second 30 minute charging period.

Recovery from less than 10 Volts

If there is less than 10 volts across the DC terminals of the Inverter-Charger after all necessary repairs have been made to connections between the Inverter-Charger and the battery bank, reconnect AC power to the Inverter-Charger and enable *Charging*. The CHARGING indicator light should come on indicating High Charge. (The Inverter-Charger will automatically start out charging at a slower rate to safely recover the batteries.) When the batteries are fully charged, let the Inverter-Charger continue with Low (Float) Charging for 24 hours without any DC loads connected and then, if appropriate, Equalize Charge (p. 10).

1. The Inverter-Charger limits DC output to 25 amps when it senses less than 2 VDC at its terminals, due either to dead batteries or to being disconnected from the batteries. During recovery, dead batteries will draw more and more current. The Fault 71 shutdown will occur if the batteries begin to draw more than 25 amps. This is not a failure of the Inverter-Charger but an indication of possible battery recovery.

Troubleshooting

USING THE INVERTER-CHARGER CONTROL PANEL

See Page 4 regarding the Inverter-Charger control panel.

Fault Indication

When a fault occurs, the red fault indicator light will blink the numeric Fault Code. To indicate Fault No. 29, for example, the light will blink 2 times, pause, blink 9 times, pause for a longer time, and repeat the cycle. Find the numeric Fault Code in Table 21 and take the suggested corrective actions. Call an authorized Onan dealer for help if the fault persists.

Clearing Faults

To clear the fault and stop the fault indicator light from blinking, press the **INVERTER ON / OFF** or **CHARGER ON / OFF** button. If the fault was minor, the Inverter-Charger will continue normal operation. If the Inverter-Charger shut down due to a major fault, press the **INVERTER ON / OFF** or **CHARGER ON / OFF** button again to restore operation. (The button has to be pressed twice to restore operation if shutdown was due to a fault.)

Viewing Last Fault

To view the last fault at any time, press and hold down the **INVERTER ON / OFF** and **CHARGER ON / OFF** buttons together. Let go in 3 seconds when the fault indicator light starts blinking. To stop the fault indicator light from blinking, press either the **INVERTER ON / OFF** or **CHARGER ON / OFF** button. The last fault will stop being displayed after 1 minute (if there is no active fault).

USING THE EQUINOX DIGITAL DISPLAY

See Page 15 regarding the Digital Display fault screen.

Fault Indication

When a fault occurs, the red fault indicator light will come on and the Digital Display will indicate the numeric Fault Code and provide a brief description of the fault. Find the numeric Fault Code in Table 21 and take the suggested corrective actions. Call an authorized Onan dealer for help if the fault persists.

Clearing Faults

To clear a fault on the display, press any button. Depending upon the severity of the fault, it may be necessary to re-enable *Inverting* and/or *Charging* (p. 6).

Viewing Last 5 Faults

See Page 15 for instructions on how to display the last 5 faults.

TABLE 21. TROUBLESHOOTING

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. Only trained and experienced persons may perform service.***	
PROBLEM	**CORRECTIVE ACTION**
The Digital Display is not communicating	A. Check for broken or missing wires and corroded or bent terminals between the Inverter-Charger and the Digital Display, or between any two Displays that are not communicating (p. A-11). B. If only one of the two Display connectors (J1 or J2) is being used, switch to the unused connector on the Inverter-Charger (p. A-11). C. If only one of the two connectors on the back of the Display is being used, switch to the unused connector. D. Conduct a Communications Port Test (p. 39) and reconnect or replace components as necessary.
The Digital Display will not turn on	A. Verify that the external wake feature has been enabled (p. 34), and if so, that the DC load disconnect switch is ON and that the wires are properly connected. B. Connect AC input to the Inverter-Charger and enable *Inverting* and *Charging* by the buttons on the control panel (p. 4) or by the Digital Display (p. 6). Check that the Inverter-Charger indicator lights are on. C. Check for broken or missing wires and corroded or bent terminals between the Inverter-Charger and the Digital Display, or between any two Displays that are not communicating (p. A-11). D. If only one of the two Display connectors (J1 or J2) is being used, switch to the unused connector on the Inverter-Charger (p. A-11). E. If only one of the two connectors on the back of the Display is being used, switch to the unused connector. F. Conduct a Communications Port Test (p. 39) and reconnect or replace components as necessary.

TABLE 21. TROUBLESHOOTING (CONT.)

⚠WARNING *Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. Only trained and experienced persons may perform service.*	
PROBLEM	**CORRECTIVE ACTION**
The Inverter-Charger will not turn on	A. Turn on the battery disconnect switch if so equipped (p. A-6, A-7, A-8). B. Replace the battery fuse if blown (p. A-10). C. *If the external wake feature has not been enabled*, make sure Jumper J6 is in place (p. 34). D. *If the external wake feature has been enabled*, conduct and External Wake Test (p. 40). E. Try enabling the Inverter-Charger at its control panel (p. 4) and then at the Digital Display (p. 5). Conduct a Communications Port Test (p. 39) if the Inverter-Charger can be enabled from the control panel but not from a Digital Display. F. Replace the Inverter-Charger if 12 VDC is present across its **+** and **–** terminals and across connector J5 (p. A-2, A-8) but it cannot be enabled.
All 3 Indicator Lights remain on or the Inverter-Charger turns on when DC power is connected	A. Push the **INVERTER ON / OFF** and **CHARGER ON / OFF** buttons to make sure they are not stuck. B. Replace the Inverter-Charger.
The genset is running but the Digital Display indicates that the genset has stopped	A. Check that the remote Start/Stop switches are working. Have the genset serviced if it cannot be started or stopped using the remote Start/Stop switch or the hour meter does not increment while the genset is running (faulty genset switched B+ circuit). B. If the genset can be started and stopped normally, but not by the Digital Display, conduct a Genset Start/Stop Test (p. 41).
The genset will not start or stop when START/STOP is pressed on the Digital Display	A. Check that the genset Start/Stop switches are working. Have the genset serviced if it cannot be started or stopped normally. B. If the genset can be started and stopped normally, but not by the Digital Display, conduct a Genset Start/Stop Test (p. 41).
The Inverter-Charger is off, the Digital Display is on, but no faults are being indicated	A. When LBCO (Low Battery Cut Off) is enabled, the Inverter-Charger will automatically turn itself off to protect the batteries from further discharging (p. 21). B. If LBCO is off, verify that the fault history does not show any recent faults that would have disabled the Inverter-Charger (p. 15).

TABLE 21. TROUBLESHOOTING (CONT.)

⚠WARNING *Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. Only trained and experienced persons may perform service.*	
PROBLEM	**CORRECTIVE ACTION**
The batteries take a long time to charge	A. Press the CHARGE RATE button on the Digital display and increase the charger current draw setting to the maximum (p. 6). B. In ambient temperatures above 90° F the Inverter-Charger automatically reduces the charge rate to protect the batteries. C. Turn off as many pass-through loads as possible. The Inverter-Charger Power Share feature may be reducing the charge rate to supply power to the loads (p. 22). Check the Charge Rate screen on the Digital Display (p. 9) to verify charger current. D. Disconnect less important DC loads. E. If wet cell batteries are being used, perform Equalize Charge (p. 10) to restore full capacity. F. Note that absorption charging of GEL and AGM type batteries can take 1 to 3 hours (Table 3, p. 25). G. Have the batteries tested. Replace old, failing batteries (p. 27).
The AC input circuit breaker trips when the charger is turned on while running other loads	A. The AC power source may be overloaded by loads external to the Inverter-Charger. Press the CHARGE RATE button on the Digital display and reduce the charger current draw setting (p. 6). B. **Example:** If the vehicle has a 30 amp shore power service and the air conditioner (15 amps) and water heater (7 amps) are running, only 8 amps are left for everything else (30 – 15 – 7 = 8). By reducing the charging rate to 5 amps AC, it might be possible to slowly charge the batteries and keep the air conditioner and other loads running without tripping the circuit breaker. (Depending upon rating, the Inverter-Charger could draw up to 30 amps AC while charging.) C. Lowering the charge rate will increase the time that it takes to recharge the batteries. Increase and decrease the battery charging rate to suit current conditions.

TABLE 21. TROUBLESHOOTING (CONT.)

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. Only trained and experienced persons may perform service.***

PROBLEM	CORRECTIVE ACTION
AGS is enabled but did not start the genset when the batteries were low (Refer also to Table 2, p. 14 for other conditions, settings and events that affect the operation of AGS)	A. Quiet Time could be in effect. If the AutoGen Indicating Light on the Digital Display is flashing, AGS is in standby. Disable Quiet Time to start the genset (p. 17). B. Check that the Charging Indicator Light is on or blinking (p. 4). The genset will not start if charging is not enabled. C. Check that the genset Start/Stop switches are working. Have the genset serviced if it cannot be started or stopped normally. D. If the genset can be started and stopped normally, but not by the Digital Display, conduct a Genset Start/Stop Test (p. 41).
AGS is enabled and the batteries are charged but the Inverter-Charger does not automatically stop the genset (Refer also to Table 2, p. 14 for other conditions, settings and events that affect the operation of AGS)	A. If the AutoGen Indicating Light on the Digital Display is flashing, AGS is in standby. The Inverter-Charger will stop the genset *only* if it was responsible for starting it. *If the genset was manually started, it must be manually stopped. Further, the Inverter-Charger allows the genset to run at least 5 minutes before shutting it off.* B. Check that the genset Start/Stop switches are working. Have the genset serviced if it cannot be started or stopped normally. C. If the genset can be started and stopped normally, but not by the Digital Display, conduct a Genset Start/Stop Test (p. 41).
AC input does not pass through the Inverter-Charger to the AC loads	A. Enable the Inverter-Charger to verify that no faults are present. B. Reset tripped circuit breakers (p. 4). C. Verify that input voltage is between 90 and 135 VAC (p. 9). If voltage is outside these limits the Inverter-Charger will not let AC power pass through. D. Have a trained and experienced electrician check the AC connections to the Inverter-Charger (p. A-2). E. Have the Inverter-Charger serviced.
The SHORE POWER Display screen (p. 9) indicates higher than normal AC input voltage when *Charging* is taking place with genset power	A. The Display does not indicate true RMS voltage. Functions such as *Charging* can distort the genset AC waveform causing the Display to “read high.” To get an truer AC voltage indication, add resistive loads (pass through) to the genset to reduce the waveform distortion.

TABLE 21. TROUBLESHOOTING (CONT.)

⚠WARNING *Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. Only trained and experienced persons may perform service.*	
PROBLEM	**CORRECTIVE ACTION**
Fault 12—AC Input Over Voltage	A. AC input voltage exceeded 135 VAC. The Inverter-Charger will automatically clear the fault when voltage stabilizes. B. If this is a recurring problem, have trained and experienced person investigate the power source(s). C. Functions such as *Charging* can distort the *genset* AC waveform causing the Inverter-Charger to “read high.” It could help to add resistive loads (pass through) to the genset to reduce the waveform distortion. D. Verify AC input voltage with a meter. If it is high when the genset is running, service the genset to attain proper voltage.
Fault 13—AC Input Under Voltage	A. AC input voltage fell below 90 VAC, but not below 45 VAC. The Inverter-Charger will automatically clear the fault when voltage stabilizes. B. If this is a recurring problem, have trained and experienced persons investigate the power source(s). On some gensets this fault might appear when the genset has shut down. C. Verify AC input voltage with a meter. If it is low when the genset is running, service the genset to attain proper voltage.
Fault 14—AC Input Over Frequency	A. AC input voltage frequency exceeded 66 Hz. The Inverter-Charger will automatically clear the fault when frequency stabilizes. B. If this is a recurring problem, have trained and experienced persons investigate the power source(s). C. Verify AC input frequency with a meter. If it is high when the genset is running, service the genset to attain proper frequency.
Fault 15—AC Input Under Frequency	A. AC input voltage frequency fell below 54 Hz. The Inverter-Charger will automatically clear the fault when frequency stabilizes. B. If this is a recurring problem, have trained and experienced persons investigate the power source(s). C. Verify AC input frequency with a meter. If it is low when the genset is running, service the genset to attain proper frequency.

TABLE 21. TROUBLESHOOTING (CONT.)

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. Only trained and experienced persons may perform service.***	
PROBLEM	**CORRECTIVE ACTION**
Fault 24—Battery Temp Sensor Error	A. Check for proper battery temperature sensor connections (p. A-3). B. Conduct a Battery Temperature Sensor Test (p. 42). **Note: the Inverter-Charger will continue to function if the temperature sensor is disconnected or faulty, but will not charge as efficiently. It may cause higher battery temperatures, which can reduce the life of the batteries.**
Fault 29—High Batt Voltage	A. Battery Voltage exceeded 15.5 VDC (except during equalize charging). Inspect the batteries.
Fault 34—Inverter Over Temp	A. The Inverter-Charger overheated. Let it cool down before re-enabling it. Check for and remove anything that might be blocking cooling air flow. ***The Inverter-Charger compartment must not be used for storage.*** B. If the Inverter-Charger continues to shut down on this fault, conduct the Fan Function Test (p. 42). C. Check Fault History (p. 15) and replace the Inverter-Charger if there is a Fault 69, Charger Temp Sensor Error in the fault history.
Fault 35—Inverter Control Failure	A. Replace the Inverter-Charger.
Fault 36—Genset Failed to Start (Fault after 3 Attempts)	A. Check the level of fuel in the fuel tank supplying the genset and refill if necessary. B. Try to start the genset at the Digital Display (p. 12). C. Check that the genset Start/Stop switches are working. Have the genset serviced if it cannot be started or stopped normally. D. If the genset can be started and stopped normally, but not by the Digital Display, conduct a Genset Start/Stop Test (p. 41).
Fault 38—Inverter Overload	A. Check for shorts in the AC load circuits and re-enable *Inverting*. B. Remove excessive AC loads and re-enable *Inverting*. Check the inverter output load meter on the Digital Display (Figure 6, p. 9). C. Check AC output with a meter. If the Display indicates much higher current than the meter, replace the Inverter-Charger, the current sense circuit probably has failed.

TABLE 21. TROUBLESHOOTING (CONT.)

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. Only trained and experienced persons may perform service.***	
PROBLEM	**CORRECTIVE ACTION**
Fault 39—Low Battery Voltage	A. Battery voltage was less than 10 VDC for 10 seconds. This is a safety shutdown to protect the batteries from being overly discharged. Enable Low Battery Cut-Out (p. 21) if disabled. B. Connect AC and charge the batteries. C. If wet cell batteries are being used, perform Equalize Charge (p. 10) to restore full capacity. D. Have the batteries tested. Replace old, failing batteries (p. 27). E. Check battery voltage at the Inverter-Charger with a meter. If the Display (p. 11) indicates much low voltage than the meter, replace the Inverter-Charger, the battery voltage sense circuit probably has failed.
Fault 42—Inverter Control Failure	A. Replace the Inverter-Charger.
Fault 43—Inverter Control Failure	A. Replace the Inverter-Charger.
Fault 51—Inverter Control Failure	A. Replace the Inverter-Charger.
Fault 58—High Battery Temp	A. Battery temperature reached 120° F. Charging was disabled to protect the batteries. Charging at temperatures above 120° F will greatly reduce the life of most types of batteries. Let the batteries cool down before re-enabling the charger. Check for and remove anything that might be blocking cooling air flow in the battery compartment. ***The battery compartment must not be used for storage.*** B. A battery cell may have shorted, which can cause battery temperatures to rise rapidly when charging. Inspect and replace batteries as necessary. C. Conduct a Battery Temperature Sensor Test (p. 42).

TABLE 21. TROUBLESHOOTING (CONT.)

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. Only trained and experienced persons may perform service.***

PROBLEM	CORRECTIVE ACTION
Fault 59—Inverter Overload	A. Check for shorts in the AC load circuits and re-enable *Inverting*. B. Remove excessive AC loads and re-enable *Inverting*. Check the inverter output load meter on the Digital Display (Figure 6, p. 9). C. Check AC output with a meter. If the Display indicates much higher current than the meter, replace the Inverter-Charger, the current sense circuit probably has failed. **Note: The inrush current of some loads, such as incandescent lights, can be as high as six times normal running current. The Inverter-Charger can handle surge currents of up to three times its rating. See *Specifications*. Fault 59 might be tripped if a significant number of these high inrush current devices come on at the same time. Turning on incandescent lights one at a time after *Inverting* begins could prevent this fault.**
Fault 62—Charger Fault (fan failure)	A. Conduct a Fan Function Test (p. 42). (The Inverter-Charger may continue to supply light *Inverting* loads, but will not perform *Charging* as long as it senses this fault.) Replace the fan if necessary. B. Replace the Inverter-Charger.
Fault 63—Charger Over-Temp	A. The Inverter-Charger overheated. Let it cool down before re-enabling it. Check for and remove anything that might be blocking cooling air flow. ***The Inverter-Charger compartment must not be used for storage.*** B. If the Inverter-Charger continues to shut down, conduct a Fan Function Test (p. 42). C. Check Fault History (p. 15) and replace the Inverter-Charger if there is a Fault 64, Charger Temp Sensor Error in the fault history.
Fault 64—Charger Temp Sensor Error	A. Replace the Inverter-Charger. An internal temperature sensor in the Inverter-Charger has failed.

TABLE 21. TROUBLESHOOTING (CONT.)

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. Only trained and experienced persons may perform service.***	
PROBLEM	**CORRECTIVE ACTION**
Fault 65—Charger Circuit Fault (*Inverting* may function though *Charging* and *AC Pass-Through* are disabled.)	A. To reset the Inverter-Charger, perform the following in order: disconnect all DC loads, disconnect AC power, disconnect the batteries, reconnect the batteries, reconnect AC power, wait 10 seconds, enable *Charging*. The Charging Indicator Light (p. 4) should come on, indicating HIGH charge. ⚠WARNING ***Batteries can cause severe personal injury due to sparks, explosion and acid. Always connect or disconnect a battery in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26).*** B. If the fault recurs, replace the Inverter-Charger.
Fault 67—Inverter Overload	A. Check for shorts in the AC load circuits and re-enable *Inverting*. B. Remove excessive AC loads and re-enable *Inverting*. C. Replace the Inverter-Charger.
Fault 68—Inverter Overload	A. Check for shorts in the AC load circuits and re-enable *Inverting*. B. Remove excessive AC loads and re-enable *Inverting*. C. Replace the Inverter-Charger.

TABLE 21. TROUBLESHOOTING (CONT.)

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. Only trained and experienced persons may perform service.***	
PROBLEM	**CORRECTIVE ACTION**
Fault 69—Charger Temp Sensor Error	A. Replace the Inverter-Charger.
Fault 71—Charger Overload (The Inverter-Charger limits DC output to 25 amps whenever it senses less than 2 volts at its DC terminals—batteries disconnected or in a very low state of charge.)	A. The charger has been overloaded. Remove excessive DC load and re-enable *Charging*. B. Check battery connections. If not connected, perform the following in order: disconnect all DC loads, disconnect AC power, reconnect the batteries, reconnect AC power, wait 10 seconds, enable *Charging.* The Charging Indicator Light (p. 4) should come on, indicating HIGH charge. ⚠WARNING ***Batteries can cause severe personal injury due to sparks, explosion and acid. Always connect or disconnect a battery in accordance with CONNECTING / DISCONNECTING BATTERIES (p. 26).*** C. If the Charging Indicator Light blinks, indicating LOW charge, repeat Step B. D. If the Charging Indicator Light continues to blink, indicating LOW charge, see RECOVERING DEEPLY DISCHARGED BATTERIES (p. 45).

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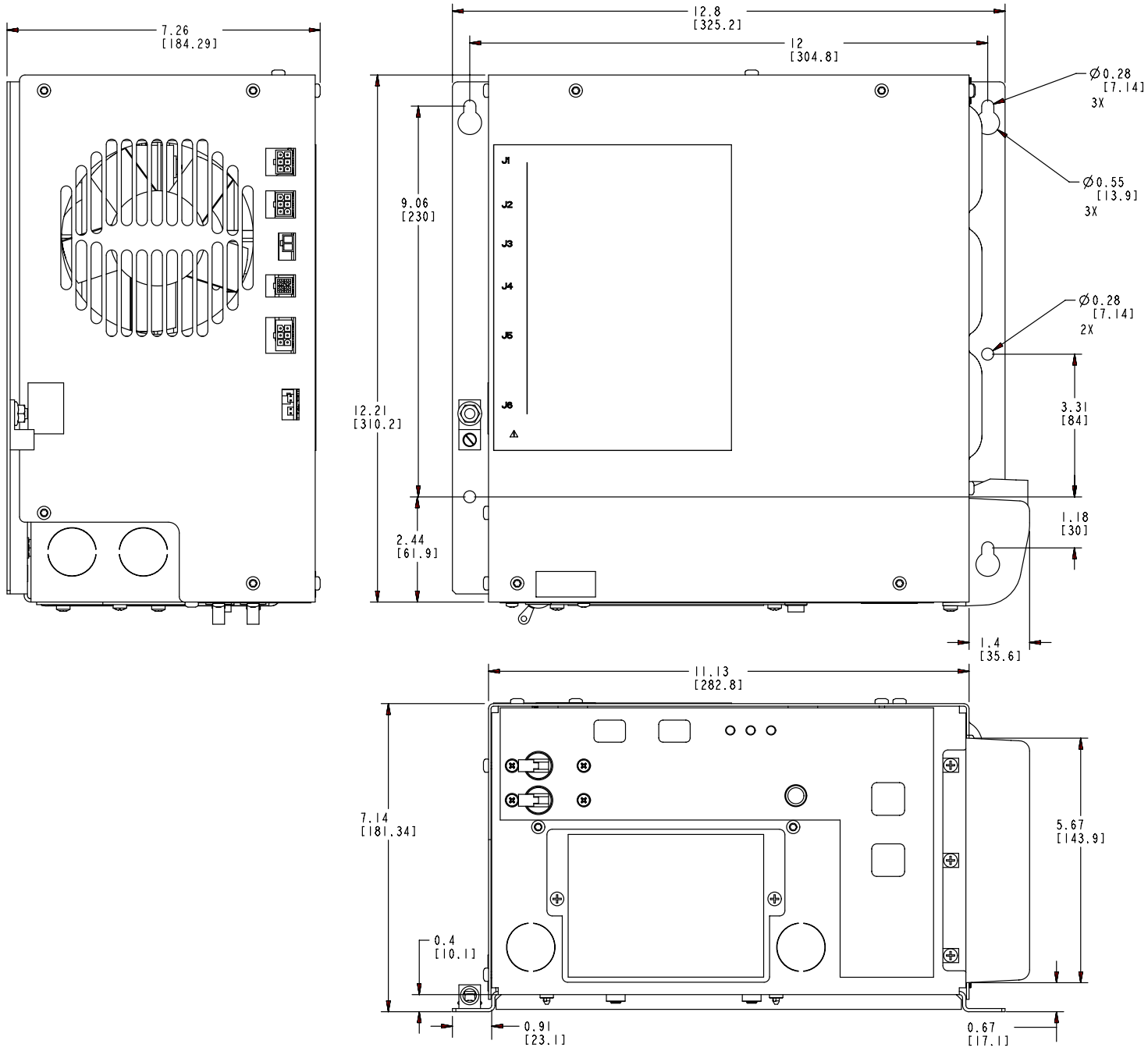
OUTLINE DRAWING



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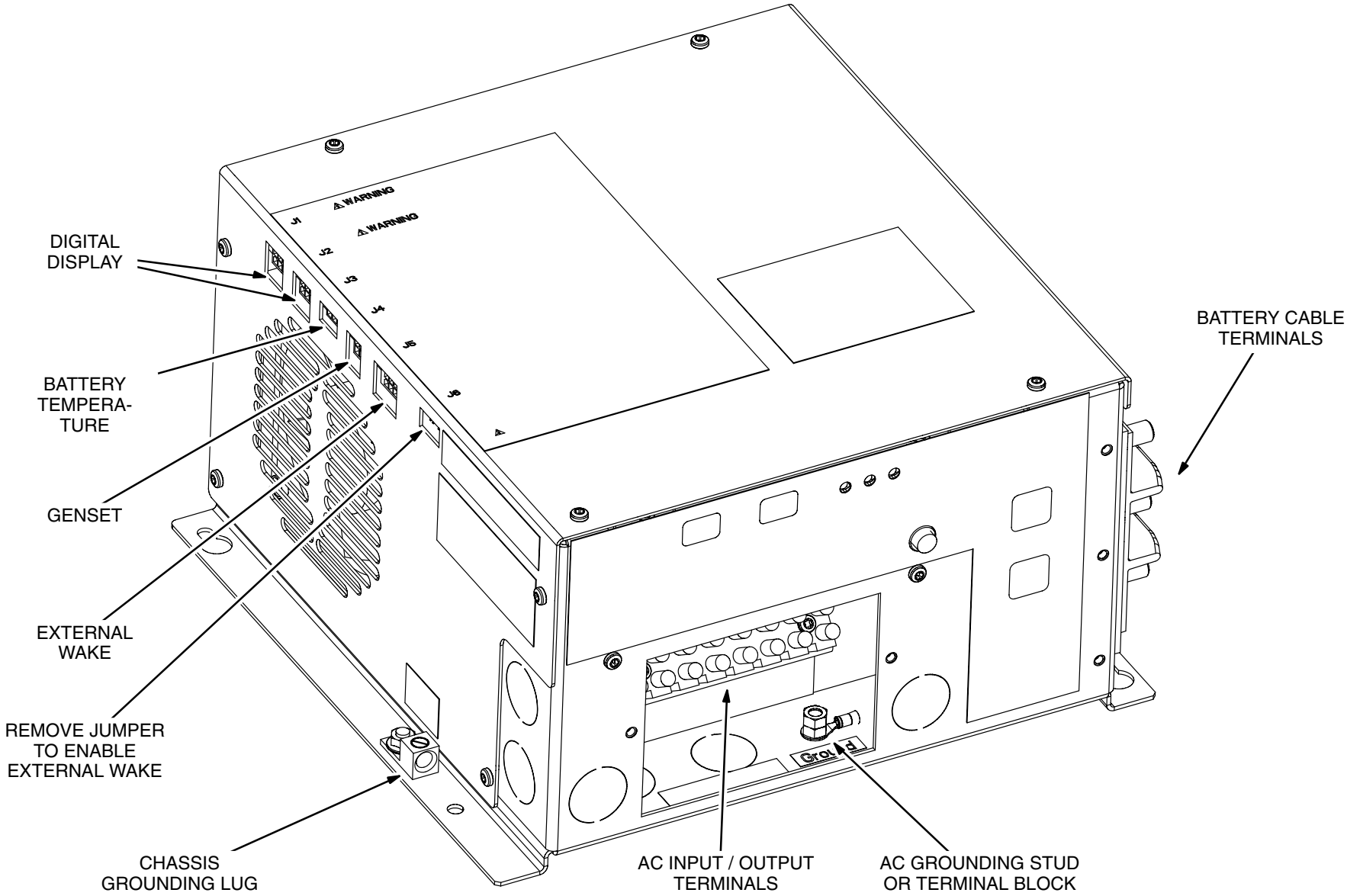
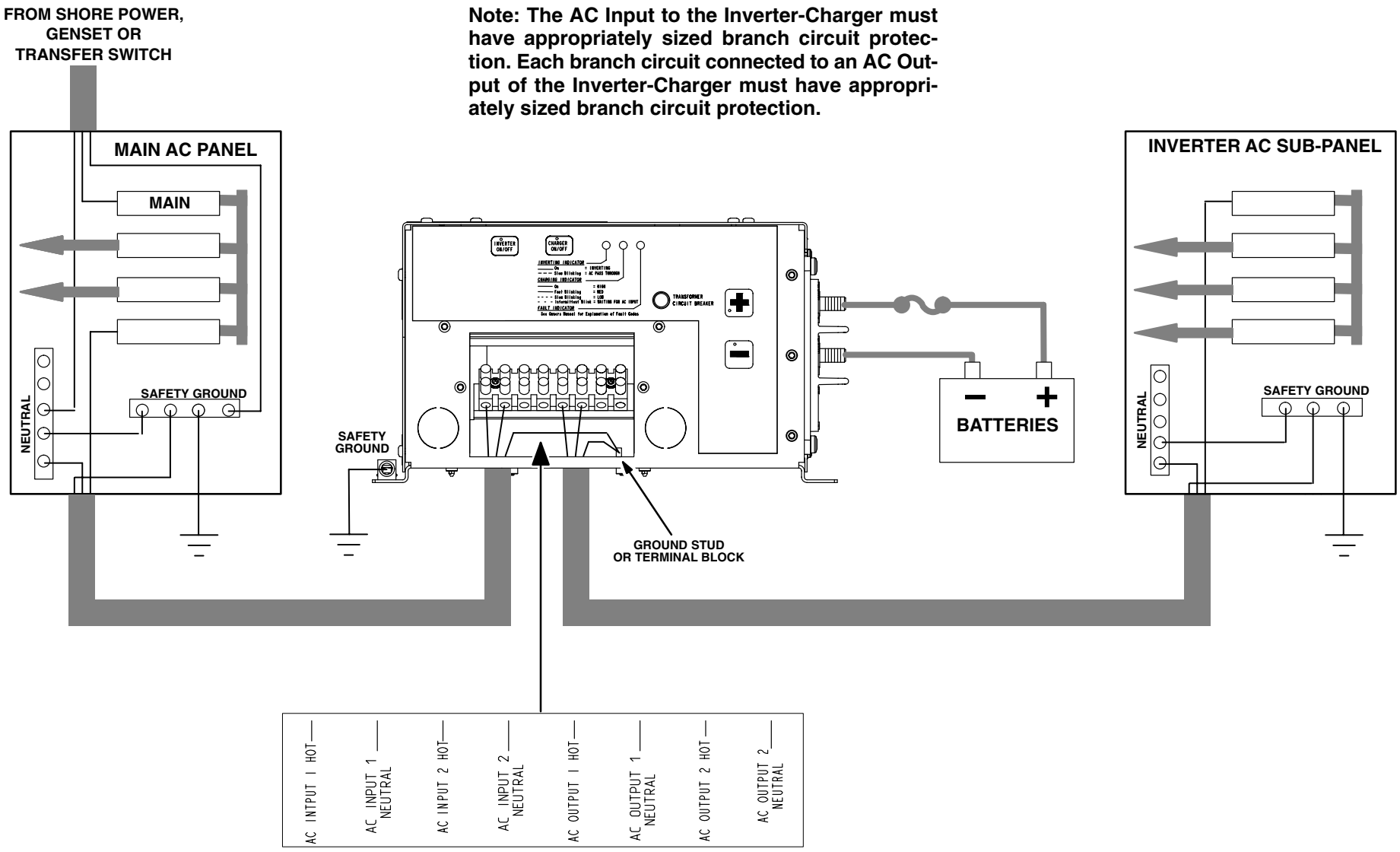
A-1

ALL EXTERNAL ELECTRICAL CONNECTION POINTS



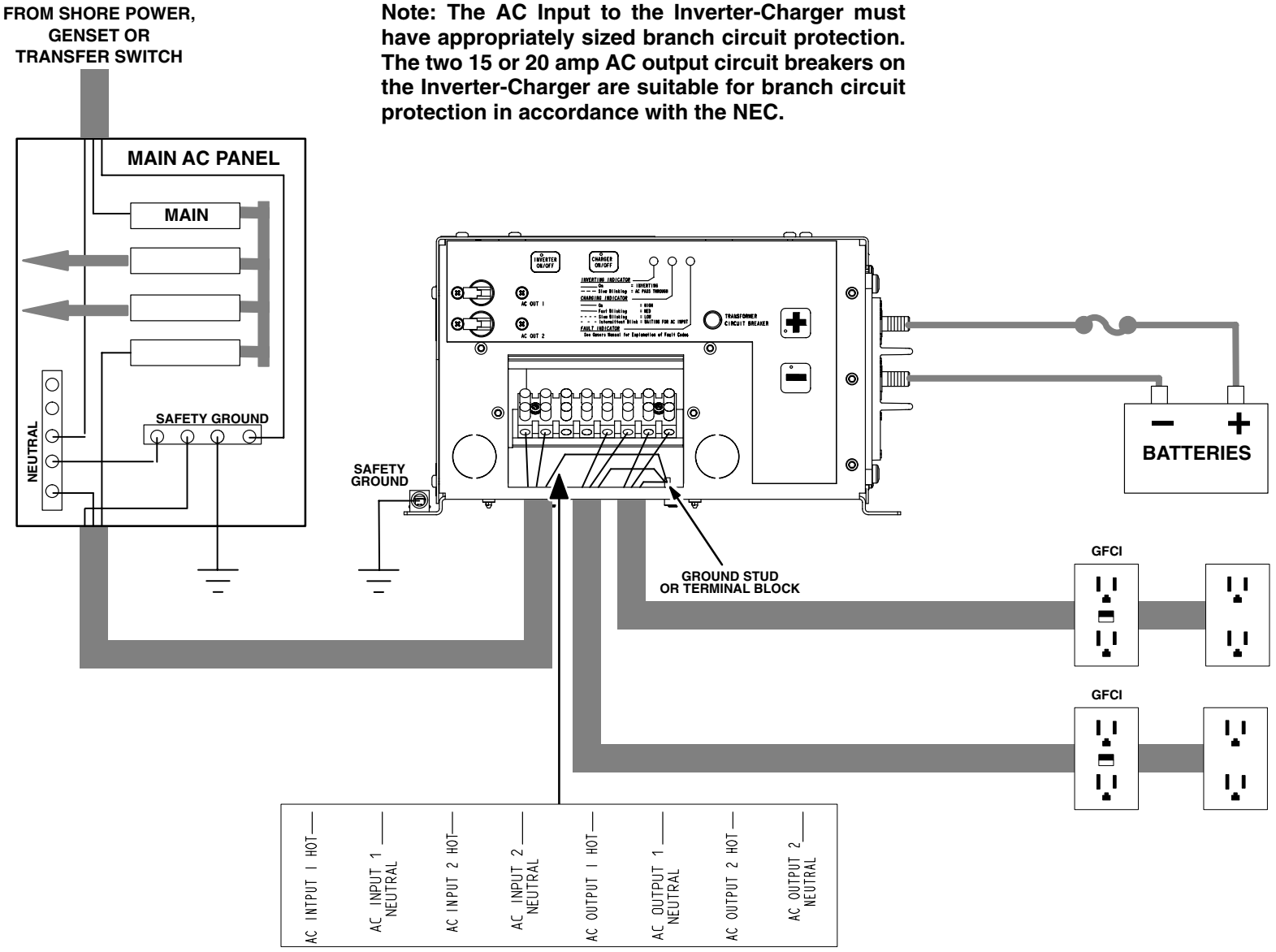
TYPICAL AC CONNECTIONS—NO OUTPUT CIRCUIT BREAKERS



AC TERMINAL BLOCK LABEL

TYPICAL AC CONNECTIONS—TWO OUTPUT CIRCUIT BREAKERS

Note: The AC Input to the Inverter-Charger must have appropriately sized branch circuit protection. The two 15 or 20 amp AC output circuit breakers on the Inverter-Charger are suitable for branch circuit protection in accordance with the NEC.



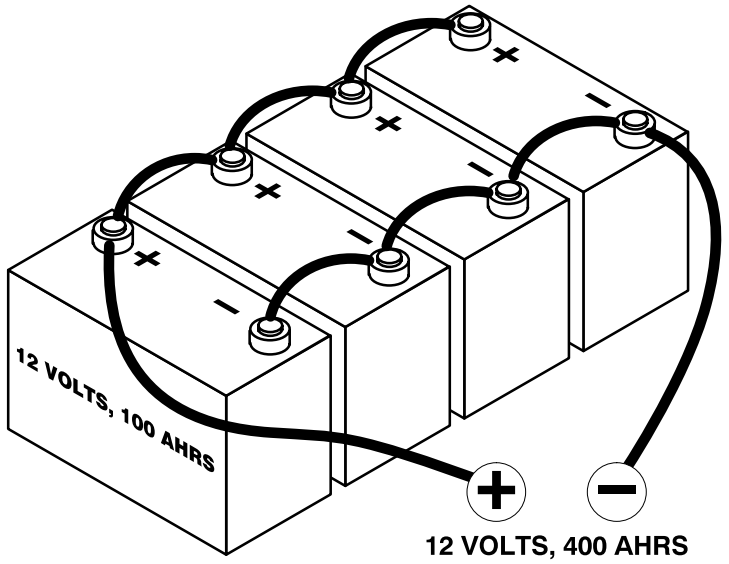
AC TERMINAL BLOCK LABEL

TYPICAL BATTERY BANK CONNECTIONS TO OBTAIN 12 VOLTS AND REQUIRED AHRS

12 VOLT BATTERY CONNECTIONS

Connect 12 Volt batteries in PARALLEL: **+** to **+**, **–** to **–**. The Voltage of the Battery Bank is the same as individual Battery Voltage: 12Volts. The Capacity of the Battery Bank is the sum of the individual Battery Capacities. In this example of four batteries, each rated 100 AHRS:

Battery Bank Capacity = 100 + 100 + 100 + 100 = 400 AHRS



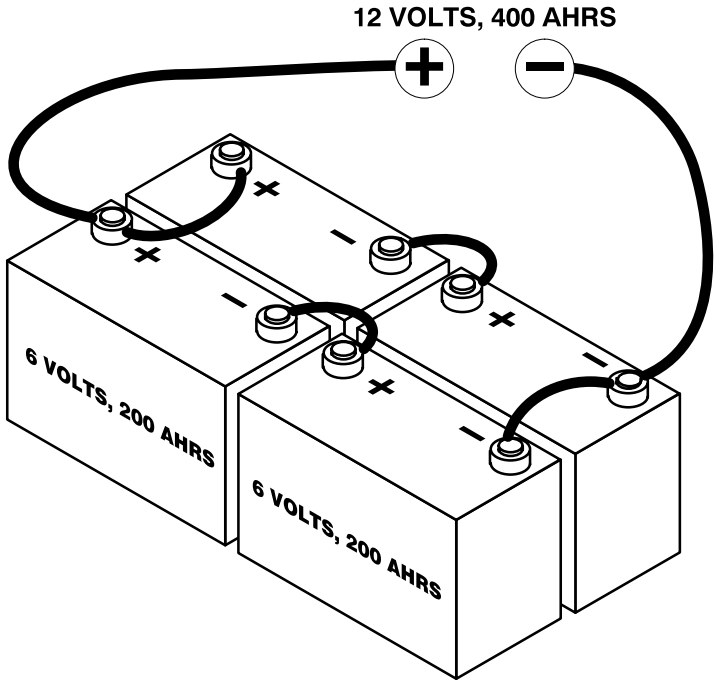
Note: A slight voltage drop occurs across each inter-battery cable during *Inverting* or *Charging*. For maximum battery bank output and even battery charging, it is important that each battery have the same number of inter-battery cables in its current path as all the rest of the batteries. The illustrations show how this can be done by connecting the 12 Volt DC supply cables at diagonally opposite terminals of the battery bank.

6 VOLT BATTERY CONNECTIONS

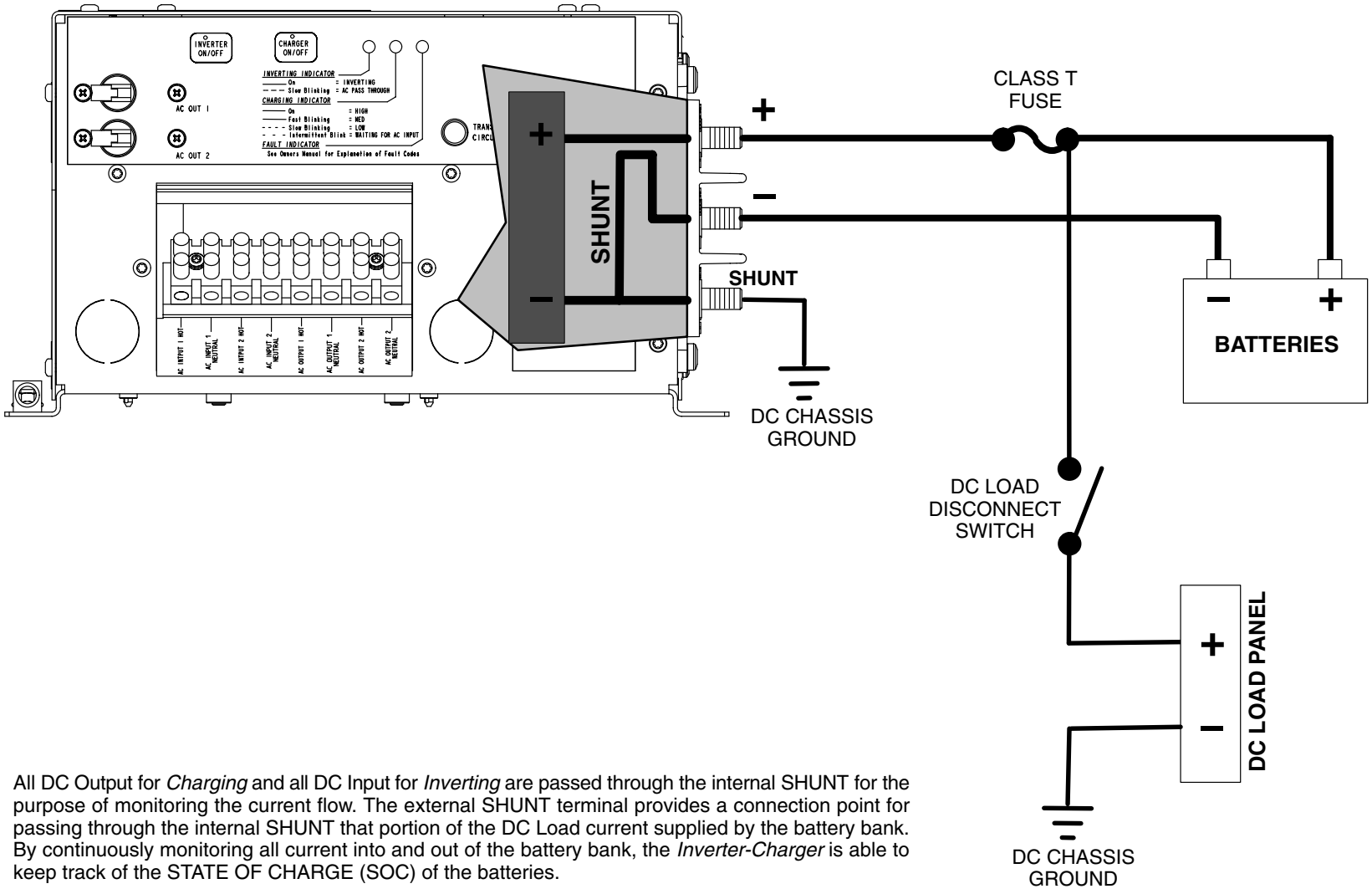
First connect pairs of 6 Volt batteries in SERIES: **+** to **–**, **+** to **–** to obtain 12 Volts (6 Volts + 6 Volts = 12 Volts). SERIES connections increase Voltage, not AHRS.

Then connect two or more pairs of batteries in PARALLEL to increase AHRS. In this example of two pairs of batteries, each rated 200 AHRS:

Battery Bank Capacity = 200 + 200 = 400 AHRS

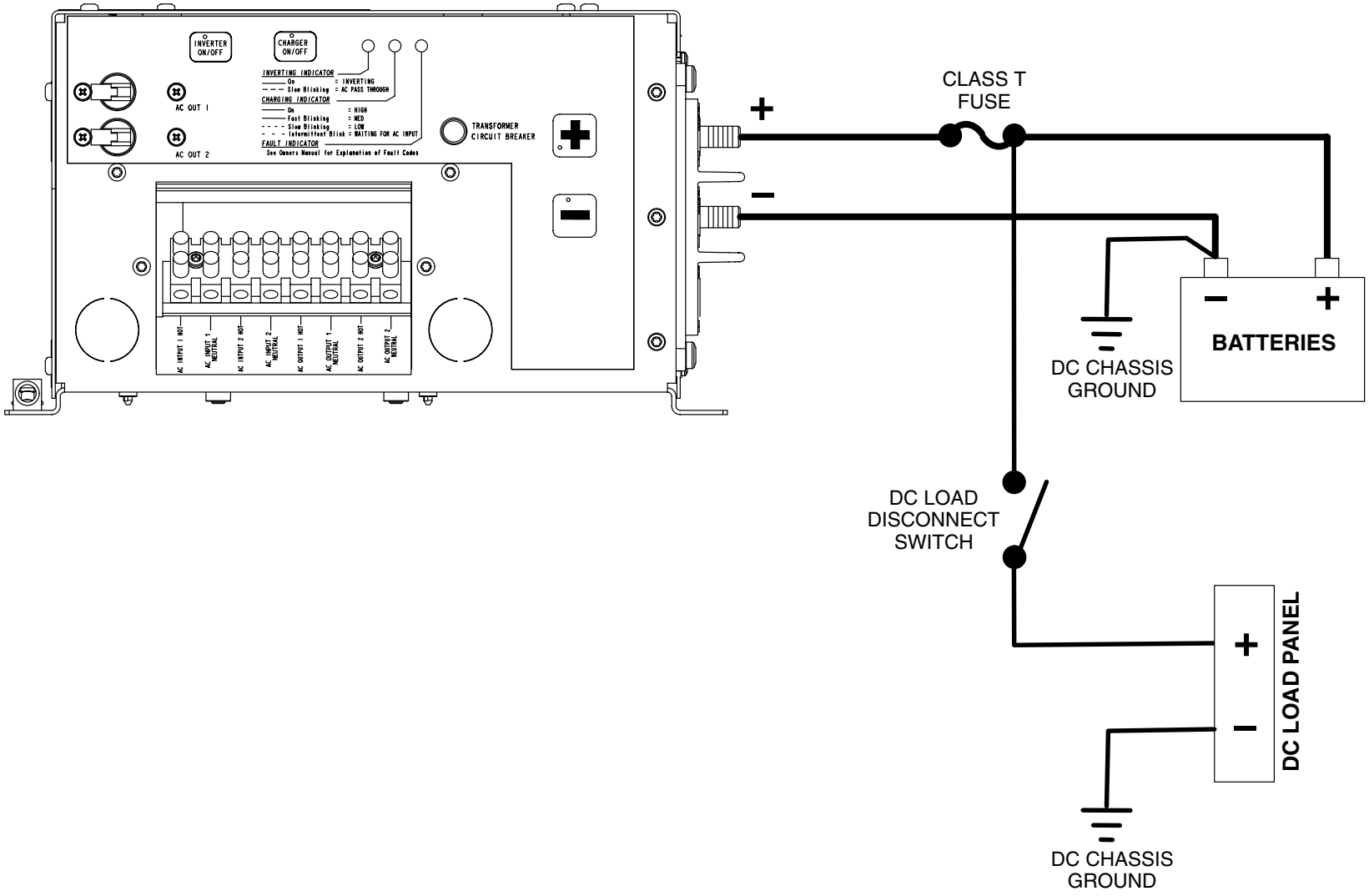


TYPICAL INVERTER-CHARGER BATTERY AND DC LOAD CONNECTIONS—MODELS WITH INTERNAL SHUNT

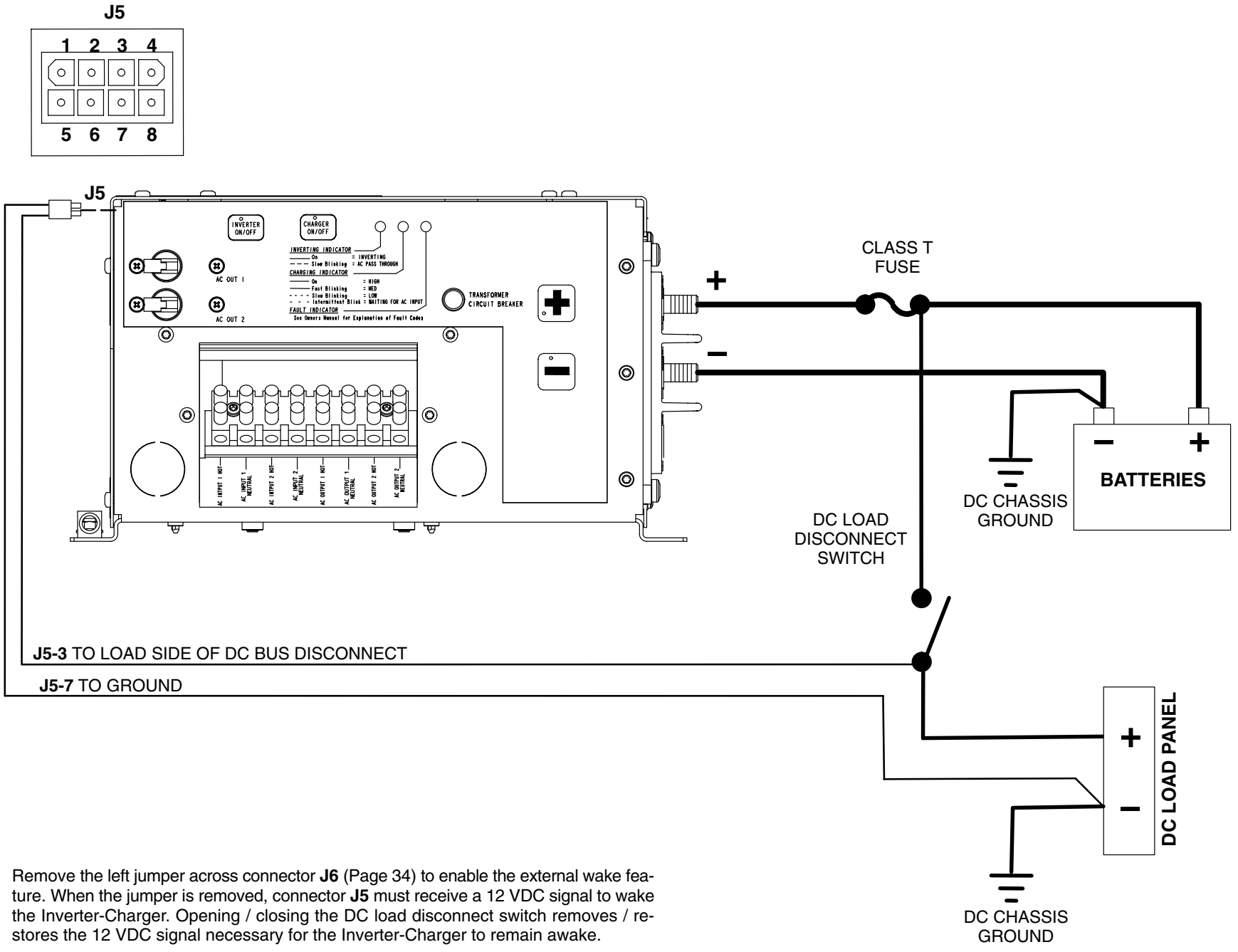


All DC Output for *Charging* and all DC Input for *Inverting* are passed through the internal SHUNT for the purpose of monitoring the current flow. The external SHUNT terminal provides a connection point for passing through the internal SHUNT that portion of the DC Load current supplied by the battery bank. By continuously monitoring all current into and out of the battery bank, the *Inverter-Charger* is able to keep track of the STATE OF CHARGE (SOC) of the batteries.

TYPICAL INVERTER-CHARGER BATTERY AND DC LOAD CONNECTIONS—MODELS WITHOUT INTERNAL SHUNT

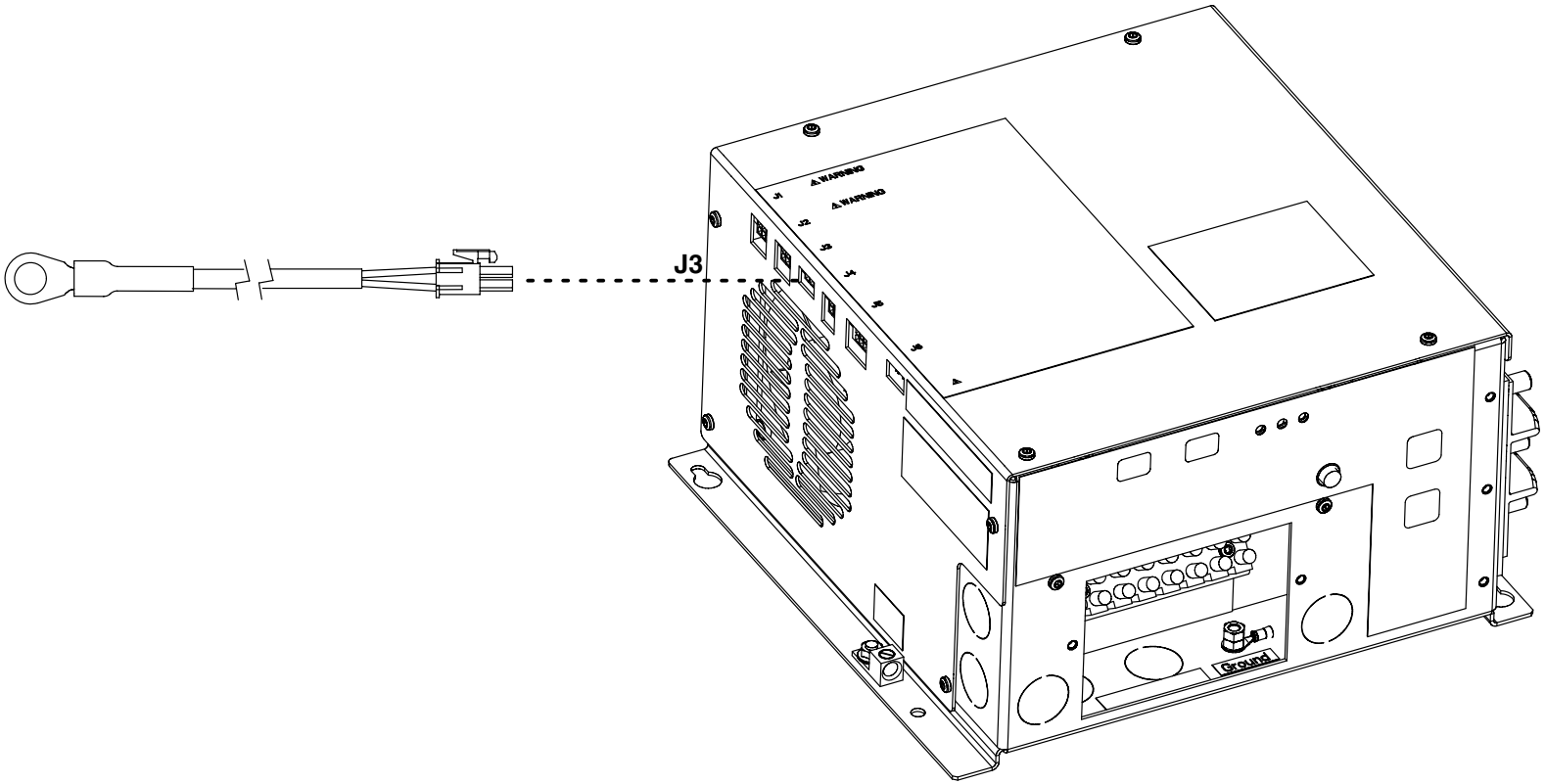


TYPICAL EXTERNAL WAKE CONNECTIONS



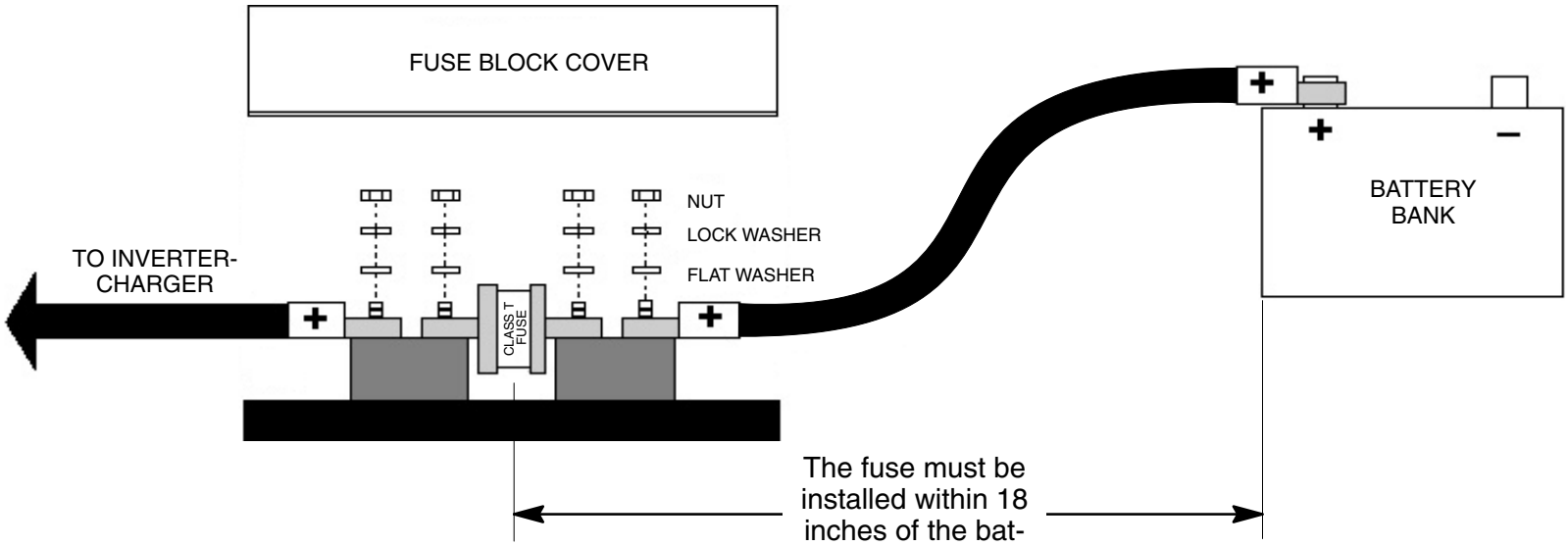
Remove the left jumper across connector **J6** (Page 34) to enable the external wake feature. When the jumper is removed, connector **J5** must receive a 12 VDC signal to wake the Inverter-Charger. Opening / closing the DC load disconnect switch removes / restores the 12 VDC signal necessary for the Inverter-Charger to remain awake.

BATTERY TEMPERATURE SENSOR CONNECTIONS



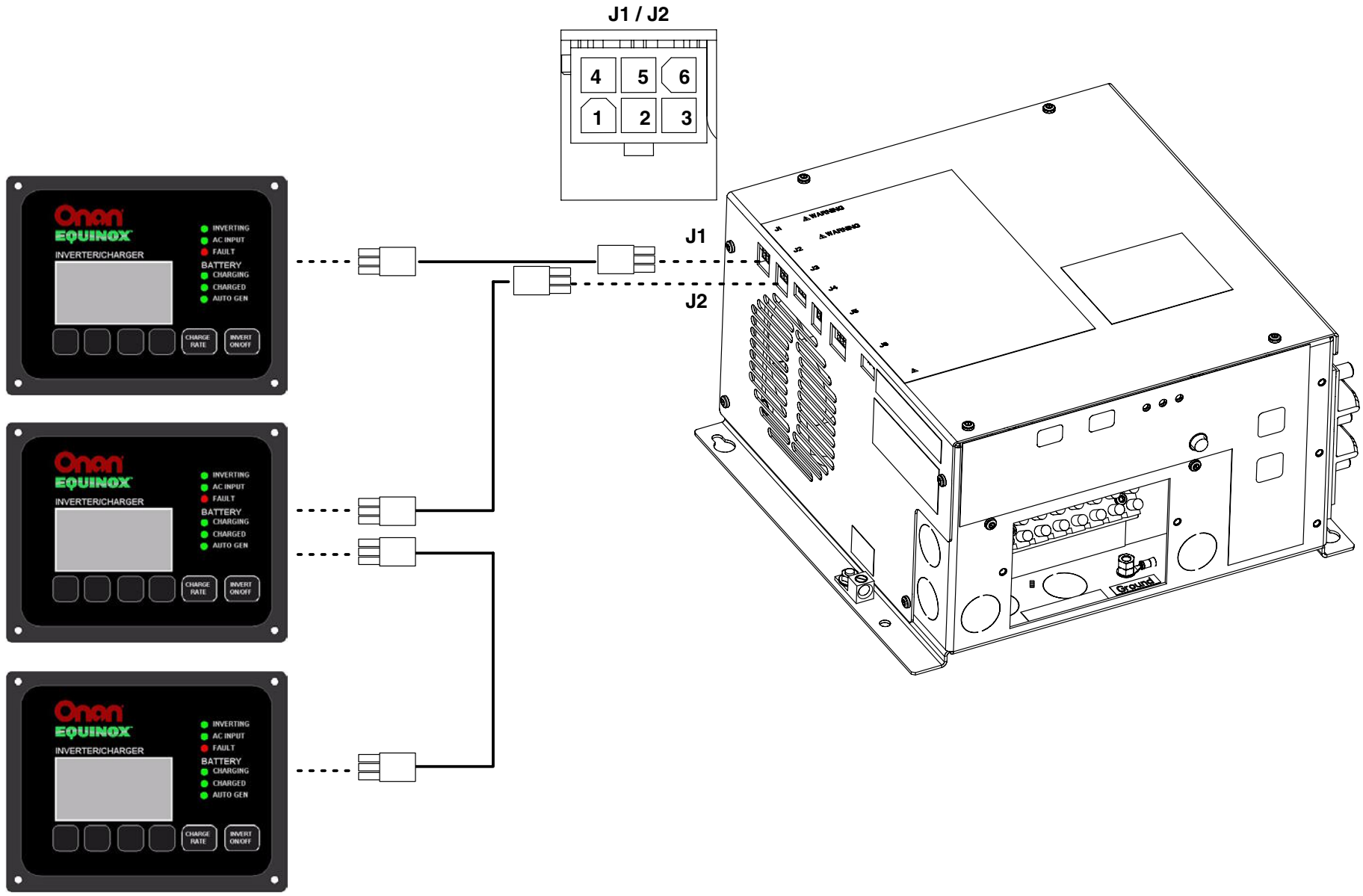
DC FUSE BLOCK INSTALLATION AND PROPER HARDWARE STACKUP

ILLUSTRATES FUSE BLOCK COVER LABEL

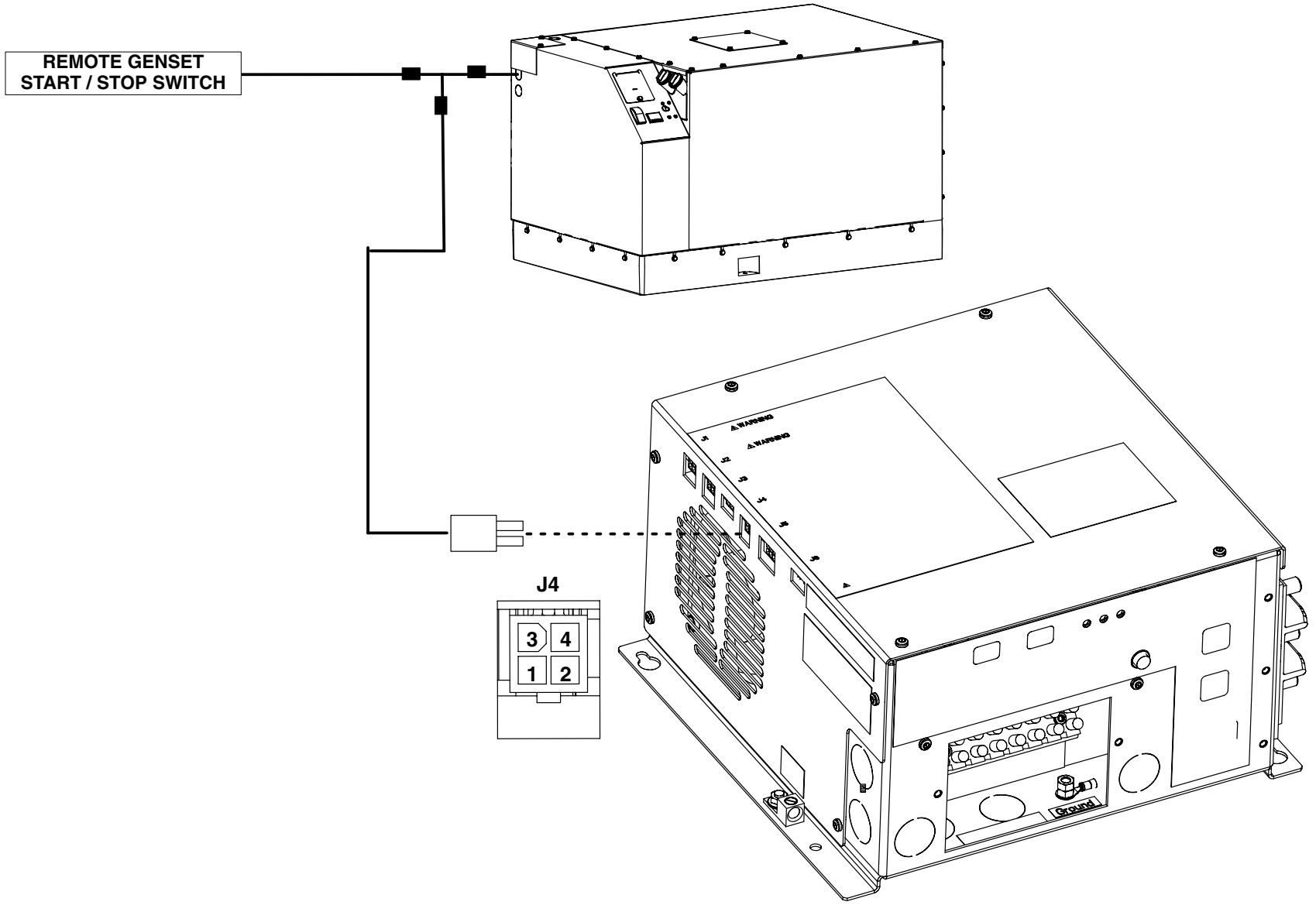


Make sure each terminal has the proper flat washer, lock washer and nut to secure the connection. Torque the nuts to 120-180 lb-in

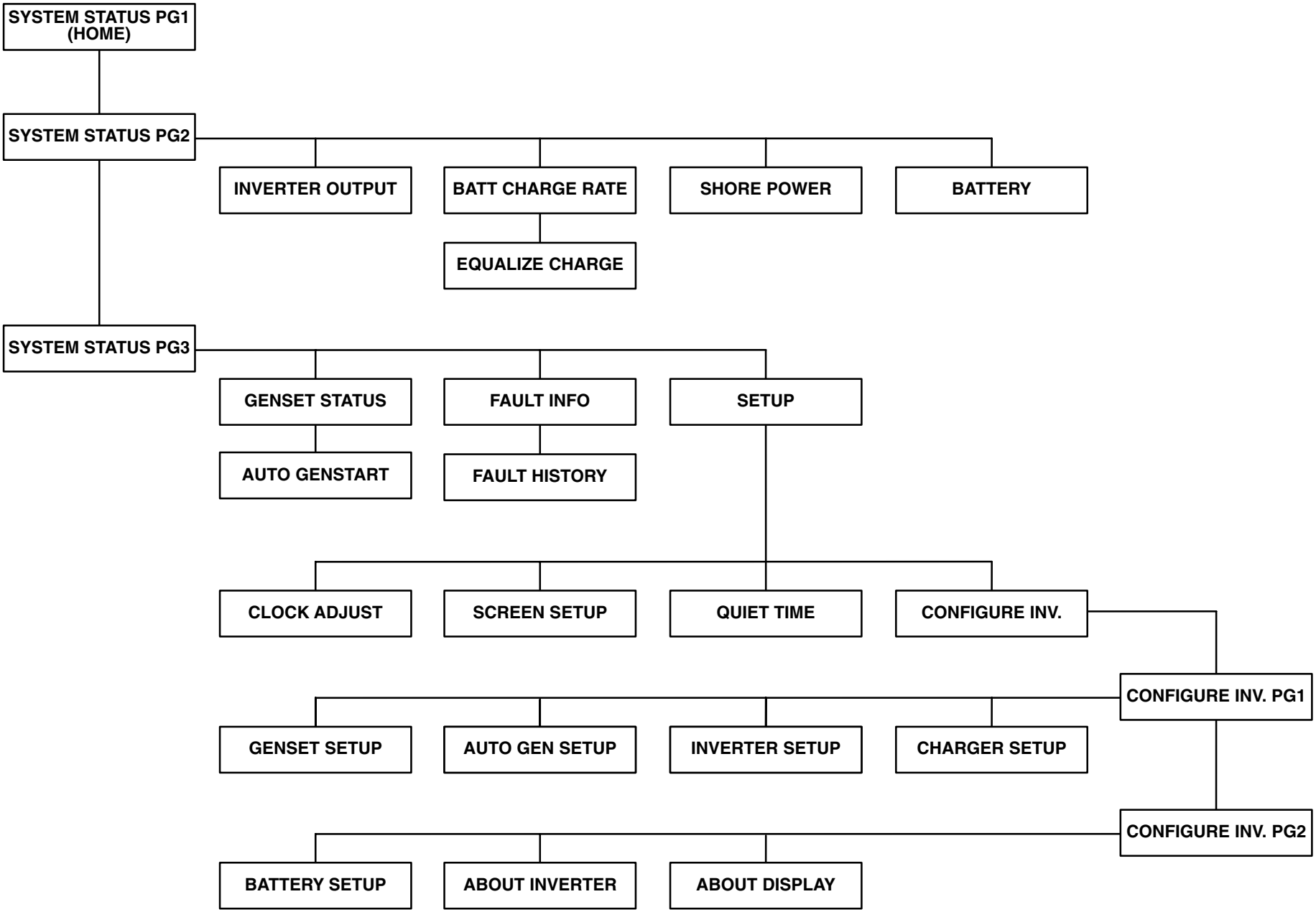
TYPICAL EQUINOX DIGITAL DISPLAY CONNECTIONS



TYPICAL GENSET CONNECTIONS



EQUINOX DIGITAL DISPLAY MENU MAP



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