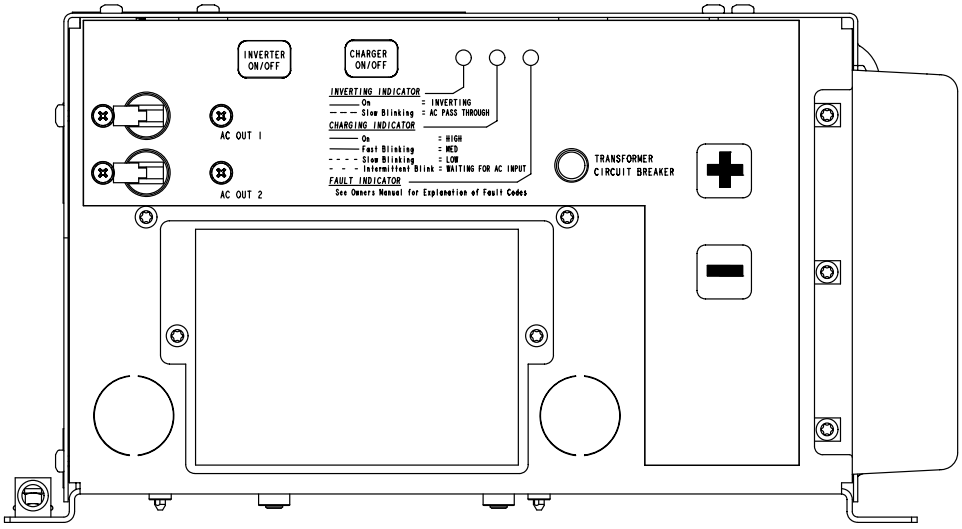
Onan Equinox Inverter-Chargers

Operation, Installation, Service

Series HJBAA



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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 AGS (Automatic Genset Starting) 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 AGS 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

Section 1. 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 replacement 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 1-1).

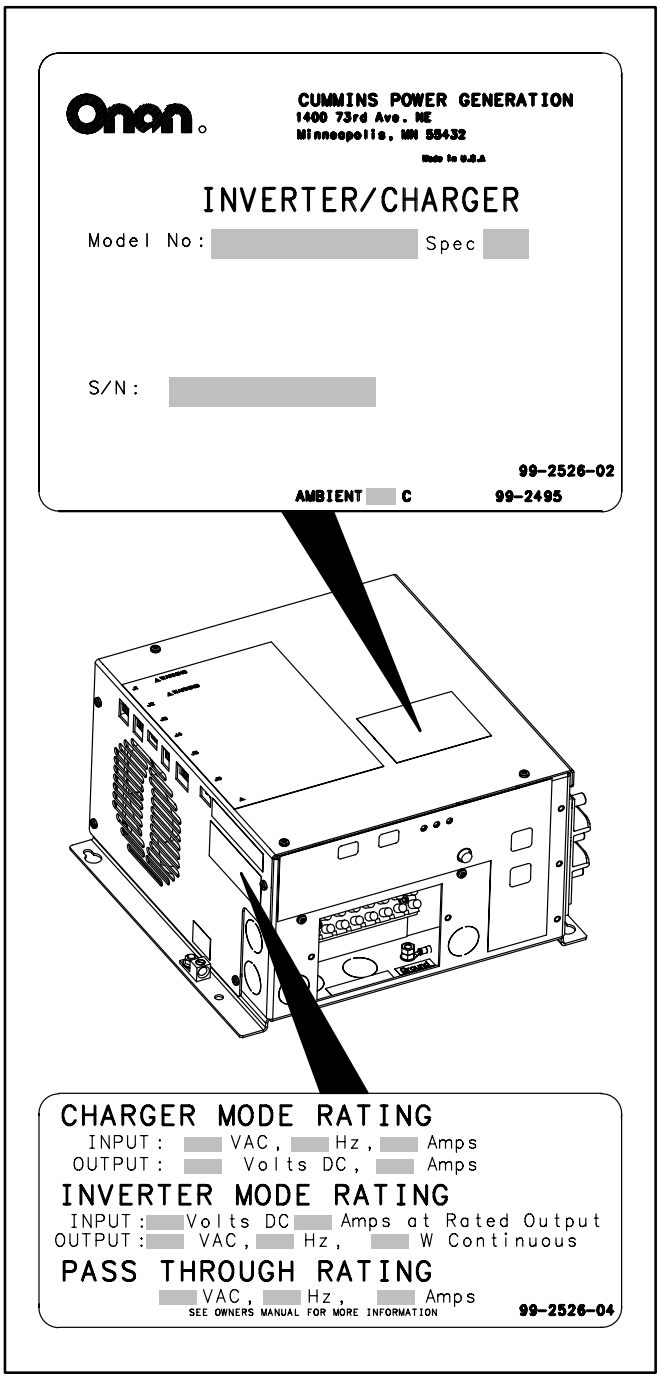


FIGURE 1-1. NAME AND RATING LABELS

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. Internet site *www.onan.com* has information for contacting our distributors worldwide.

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 1-1)*
2. *Date of purchase*
3. *Nature of problem. See Section 8. Troubleshooting.*

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

Section 2. 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. 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 supplies AC by converting 12 Volts DC (Direct Current) from the battery bank into 120 Volts AC (Alternating Current).

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. Pages A-3 and A-4 illustrate typical connections.

LOCAL CONTROL—INVERTER-CHARGER FRONT PANEL

See *Section 3. Local Control—Front Panel* for Instructions on how to use the controls on the front panel to operate the Inverter-Charger.

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. See *Section 4. Remote Control—Digital Display* on how to use the Digital Display to operate the Inverter-Charger.

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. See Figure 2-1.

LOW BATTERY CUT-OUT

When the Low Battery Cut-Out (LBCO) feature is enabled (p. 4-20), 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.

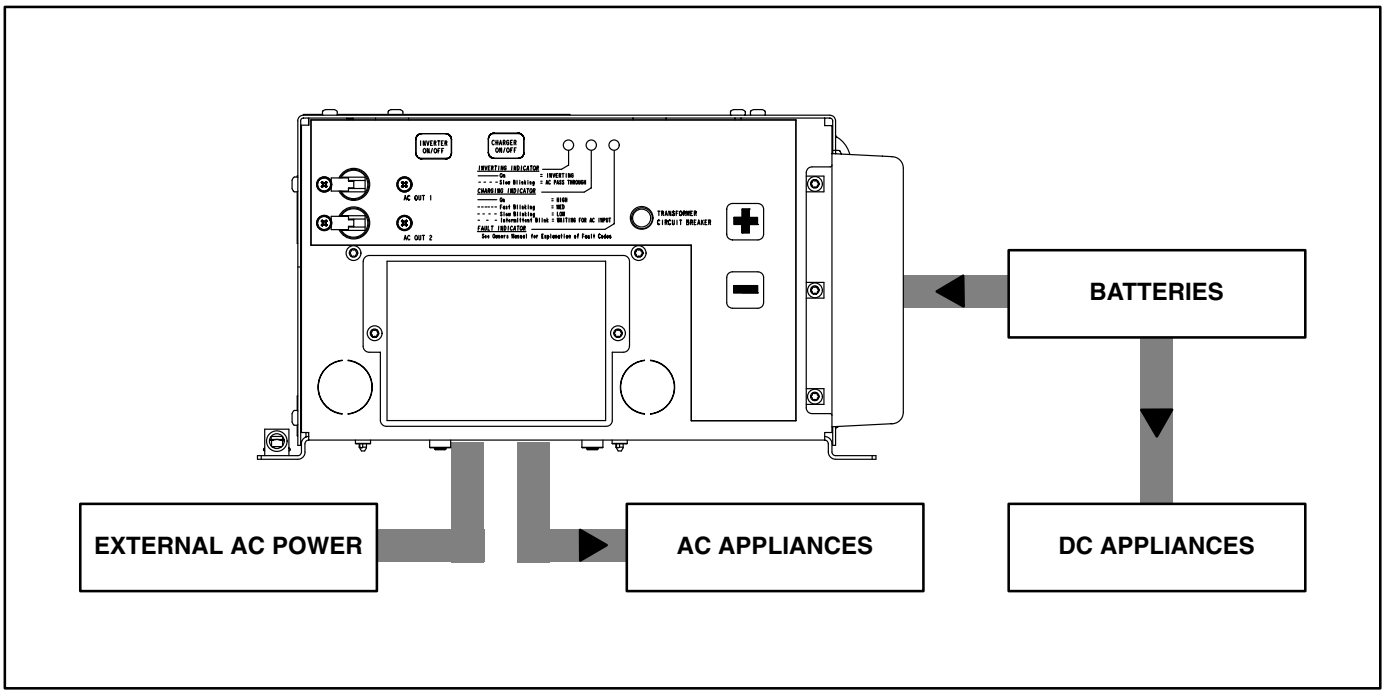


FIGURE 2-1. FLOW OF POWER FROM BATTERIES TO APPLIANCES WHEN INVERTING

CHARGING

When the Inverter-Charger is in charger mode (*Charging*), it draws external AC power (genset or shore power) to recharge the battery bank. See Figure 2-2. 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 is too high or too low.

POWER SHARING

While the Inverter-Charger is passing external AC power through directly to the tools and appliances, it also charges the battery bank. See Figure 2-2. *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. 4-21).

AUTOMATIC GENSET STARTING (AGS)

Automatic Genset Starting (AGS) is a feature available for automatically starting and stopping the genset to maintain battery charge and/or power loads such as air conditioners. An *Equinox Digital Display* (p. 4-1) is required to enable AGS.

See *Appendix C. AGS Events and User Action*s for a summary of the events and user actions that affect automatic genset starting and stopping.

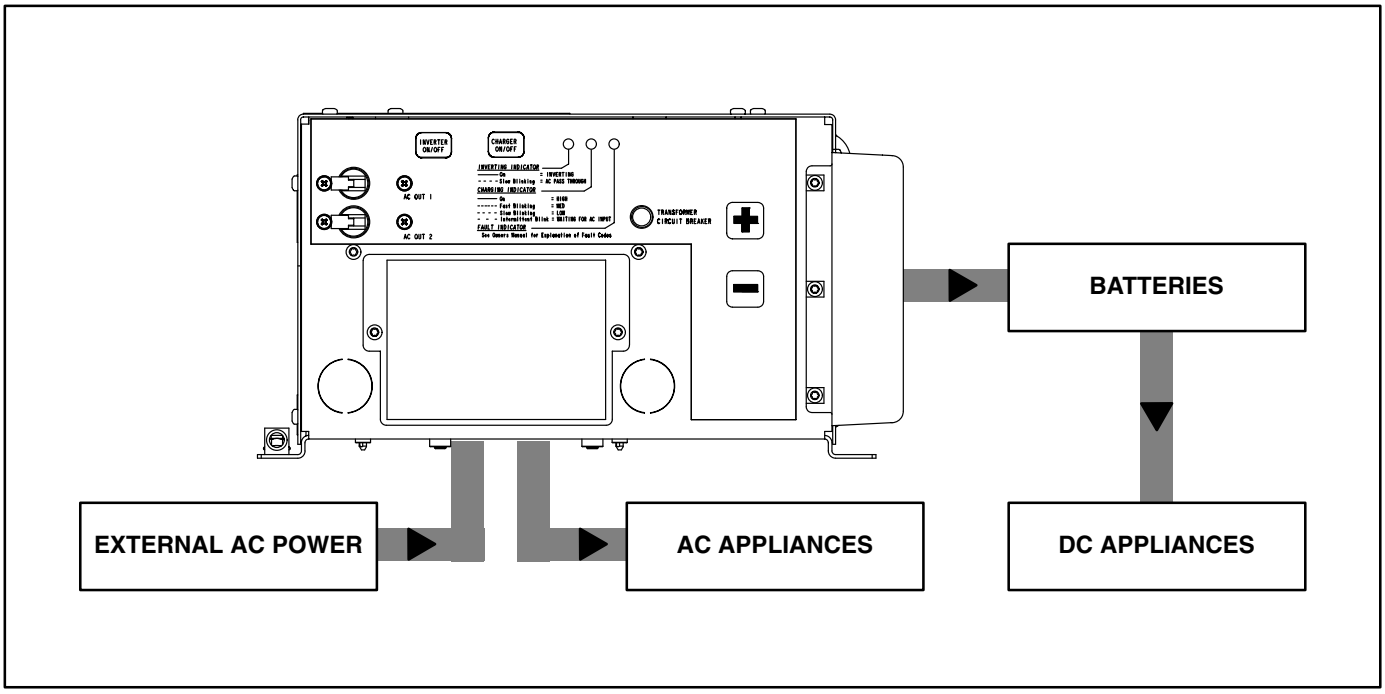


FIGURE 2-2. FLOW OF POWER TO BATTERIES AND APPLIANCES WHEN CHARGING

Section 3. Local Control—Front Panel

Figure 3-1 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: Press and release 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. 4-7). Connect AC power to recharge the batteries and re-enable *Inverting*.**

TO ENABLE/DISABLE AND MONITOR CHARGING

CHARGER ON/OFF Button: Press and release 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 *Section 8. Troubleshooting* 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.***

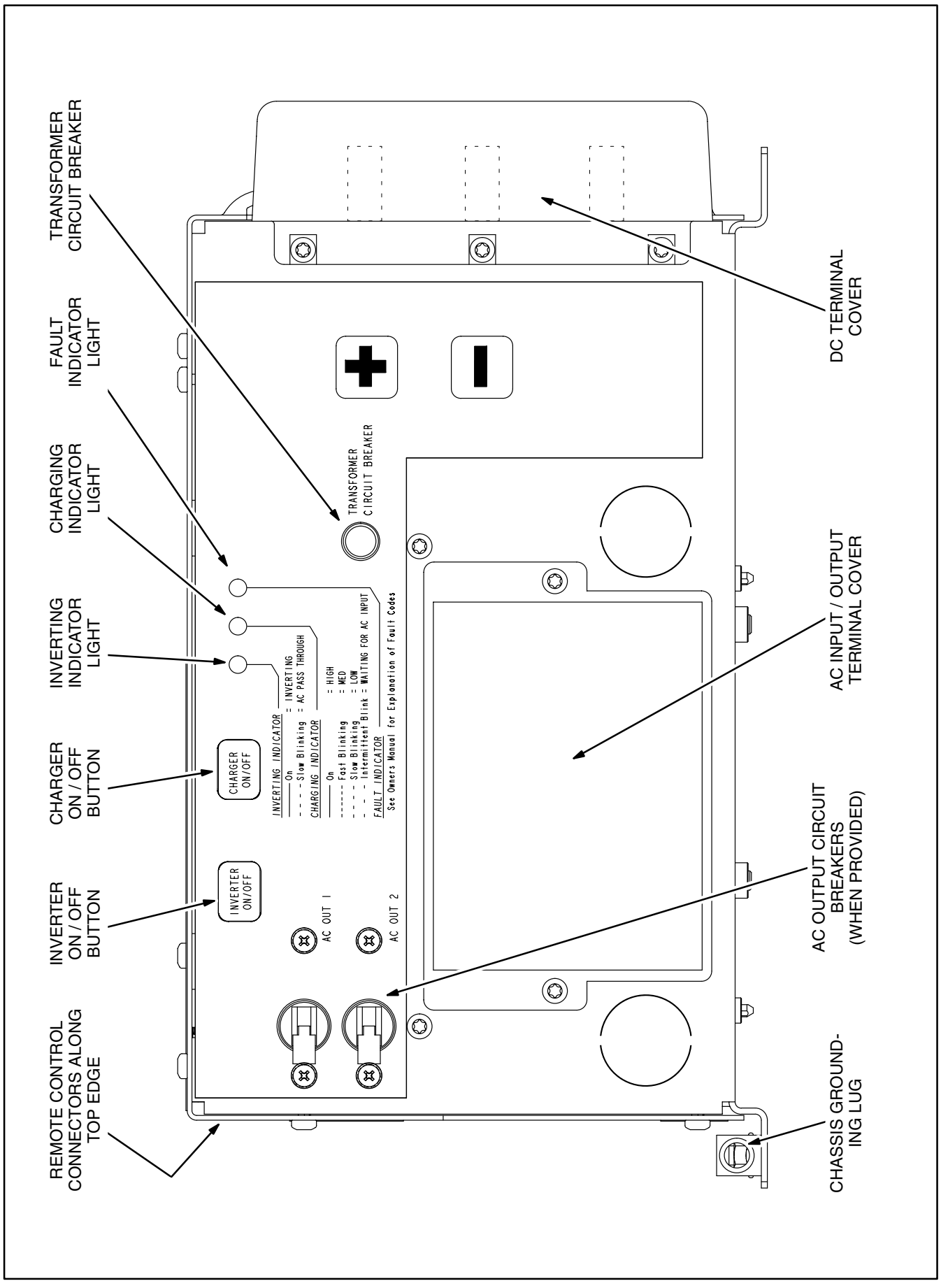


FIGURE 3-1. FRONT PANEL OF TYPICAL INVERTER-CHARGER

Section 4. Remote Control—Digital Display

ABOUT THE EQUINOX DIGITAL DISPLAY

The *Equinox Digital Display* (Figure 4-1) 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.

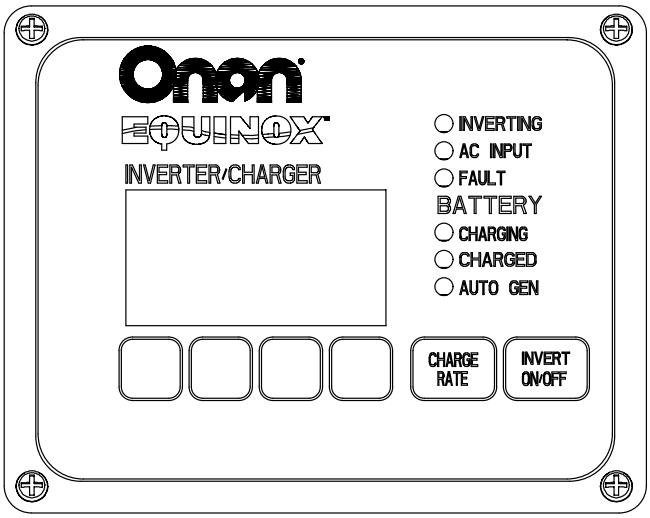


FIGURE 4-1. EQUINOX DIGITAL DISPLAY

LED STATUS INDICATORS

Table 4-1 identifies what each LED indicates about the status of the Inverter-Charger.

TABLE 4-1. 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 4-1) 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.

DISPLAY AND SOFT-KEY BUTTONS

To Turn On Digital Display

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 4-16 to adjust Display brightness and contrast and the length of time the backlight stays on.

To Navigate 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.

CHARGE RATE BUTTON

Press this button (Figure 4-1) to take you to a special screen (Figure 4-2) to enable or disable *Charging* or to reset maximum AC current draw during charging. (There is no other path to this screen.)

To Enable/Disable Charger

On the CHARGE RATE screen (Figure 4-2), 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.

To Set Maximum Charge 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.

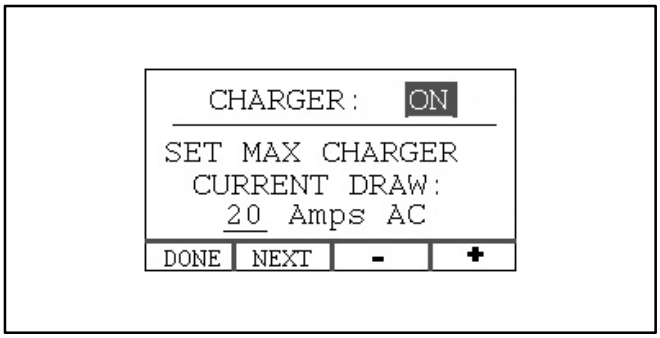


FIGURE 4-2. SCREEN TO TURN CHARGER ON/OFF & SET MAX CHARGER CURRENT DRAW

HOME SCREEN (SYSTEM STATUS PG1)

System Status

Unless there is an active fault condition, the Home Screen, SYSTEM STATUS PG1 (Figure 4-3), 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.

  INVERTING LED is on.

- **CHARGING: High Charge** (Also referred to as Bulk Charge.) The Inverter-Charger is maintaining a constant charging current. See *Appendix B. Specifications* for the maximum charging current of your Inverter-Charger. Current is limited by the maximum charging current, maximum charger current draw (p. 4-3), and/or AC Circuit Breaker Rating (p. 4-21).

  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. 6-9).

  CHARGING LED is on.

- **CHARGING: Med Charge** (Also referred to as Absorption Charge.) 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 5-1). The absorption current level depends upon battery type and battery bank size (Table 7-2).

  CHARGING LED is on.

- **CHARGING: Low Charge** (Also referred to as Float Charge.) The Inverter-Charger is maintaining the float voltage appropriate for the battery type for which it was configured (p. 6-9). 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.

  CHARGED LED is on; CHARGING LED is off.

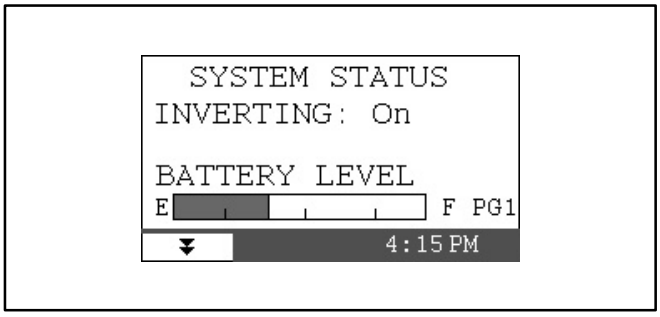


FIGURE 4-3. HOME SCREEN

- **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. 4-1). Press the CHARGE RATE button to bring up the CHARGER ON / OFF screen (p. 4-3).
- **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. 4-3).

Battery Level Meter

The BATTERY LEVEL meter on the Home Screen indicates the level of *usable* battery charge remaining. Review BATTERY SETUP (p. 4-24) regarding the EMPTY reference point.

Clock

The current time is displayed in the lower right corner. See Page 4-16 if it is necessary to reset the clock.

SYSTEM STATUS SCREENS (PG1–PG3)

There are 3 SYSTEM STATUS screens (Figure 4-4). PG1 is the Home Screen (p. 4-4). PG2 and PG3 are menu screens. Select and enter any menu item to open the next screen in that menu stream. See *Appendix D. Digital Display Menu Map.*

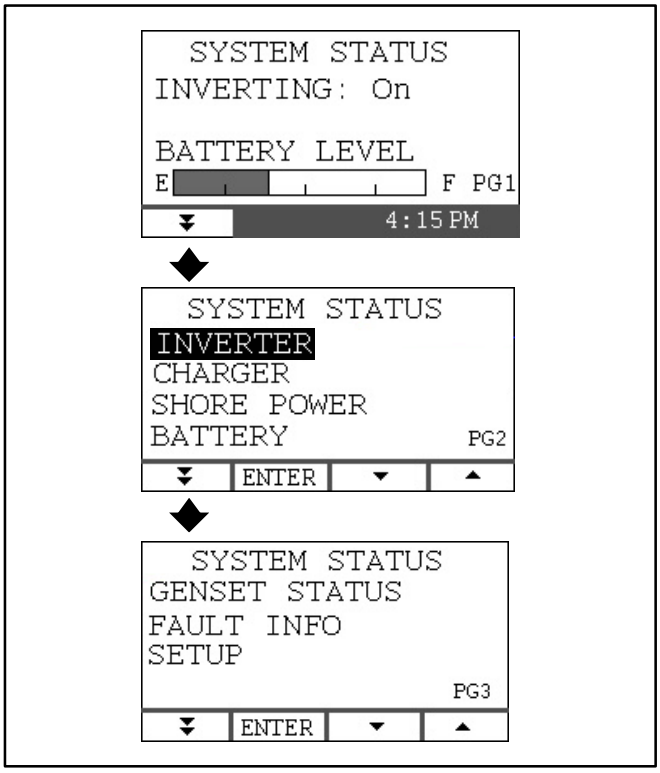


FIGURE 4-4. SYSTEM STATUS (PG1-PG3)

INVERTER

Inverter Amps

Go to the INVERTER OUTPUT screen (Figure 4-5) 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 4-5) 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, or two-thirds, 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 to help determine which appliances to run at the same time without causing Inverter-Charger shutdown.

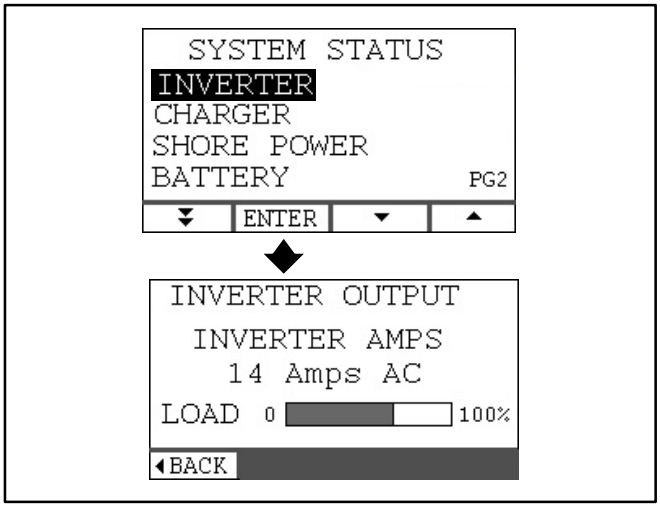


FIGURE 4-5. INVERTER

CHARGER

Charge Rate

Go to the BATT CHARGE RATE screen (Figure 4-6) 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 4-6) indicates how much of the available AC input current is being used. *100%* is the maximum available current.

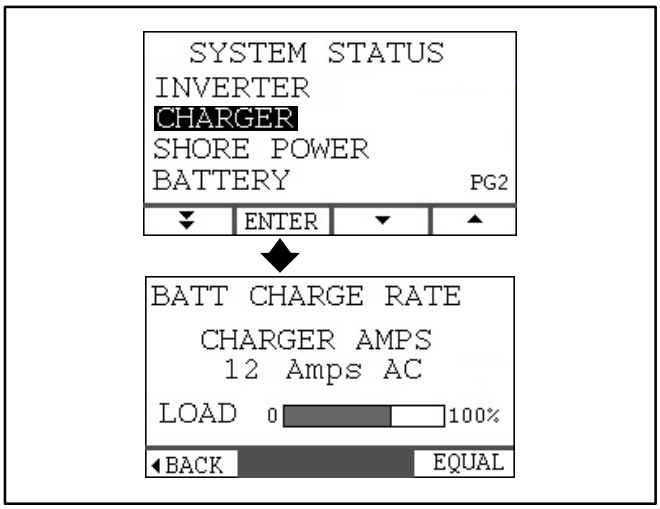


FIGURE 4-6.CHARGER

SHORE POWER

Go to the SHORE POWER screen (Figure 4-7) to monitor external AC voltage, frequency and current, *whether from shore power or genset.* The AC current displayed is only the current flowing to the Inverter-Charger. See Figure 2-2.

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.

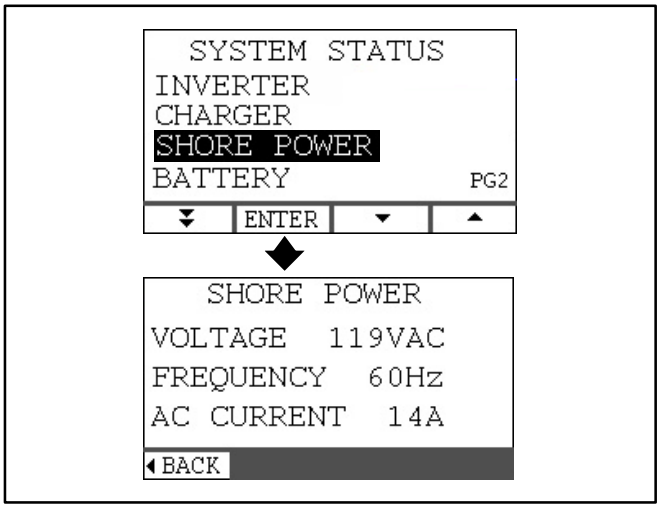


FIGURE 4-7. SHORE POWER

BATTERY

Go to the BATTERY screen (Figure 4-8) 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 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. 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.

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.

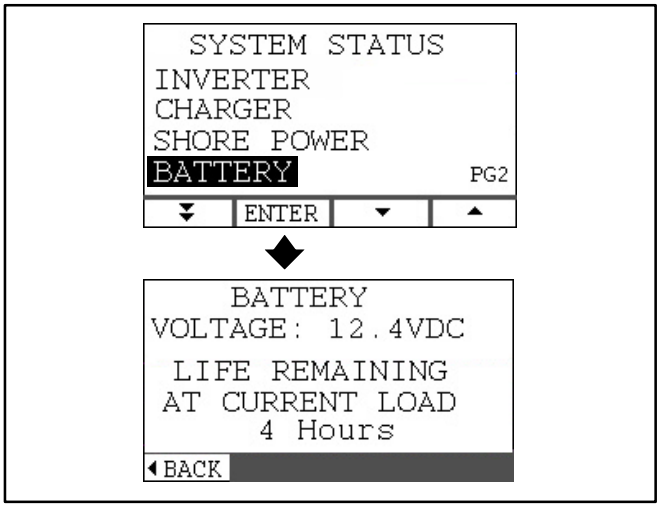


FIGURE 4-8. BATTERY

INVERTER DISABLED WARNING SCREEN

When battery voltage reaches the Low Battery Cut Out (LBCO) setpoint *Inverting* is disabled and a screen appears to notify you (Figure 4-9). Connect shore power or start the genset to recharge the batteries. Press the INVERT ON/OFF button to enable *Inverting* (p. 4-1) when the batteries are charged.

See INVERTER SETUP (p. 4-20) to Enable / Disable LBCO or change its setting.

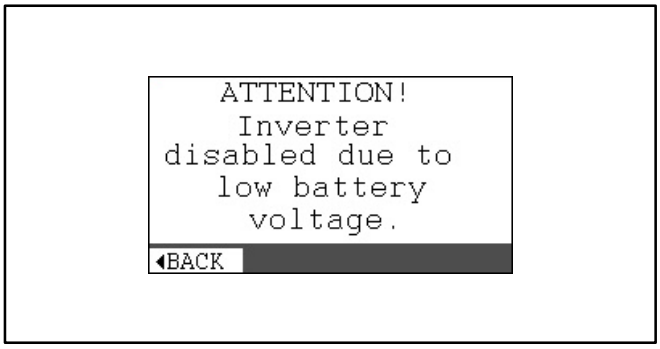


FIGURE 4-9. INVERTER DISABLED

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 4-10).

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 (Pages 5-2 and 5-3) must be present to press STOP on the EQUALIZE CHARGE screen (Figure 4-10) 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 5-3 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.***

To Start Equalize Charging

Go to BATT CHARGE RATE (Figure 4-10) to get to the EQUALIZE CHARGE screen. Press EQUAL. Heed the WARNING on the screen by reviewing Pages 5-2 and 5-3 and then press **START**.

If 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 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 is recalculated. The total charging time, including up to 30 minutes for cooling, will not exceed 6 hours.

To Stop 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.

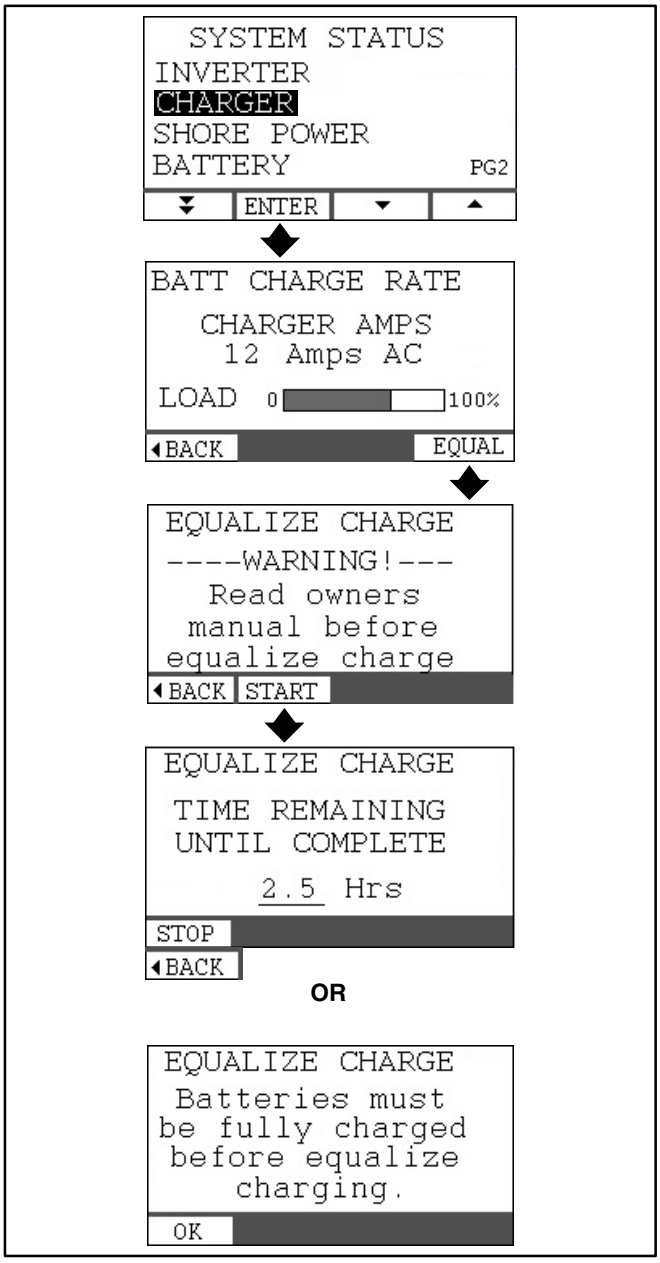


FIGURE 4-10. EQUALIZE CHARGE

GENSET STATUS

Go to the GENSET STATUS screen (Figure 4-11) to Start and Stop the genset and Enable or Disable AGS.

START / STOP GENSET

Go to the GENSET STATUS screen to Start and Stop the genset (Figure 4-12). GENSET STATUS will indicate that the genset is RUNNING, STOPPED, STARTING or PRIMING.

To Start Genset

Press and release **START** to start the genset (Figure 4-12).

When 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.

When 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.

To Prime Genset

If the Inverter-Charger is configured for starting an Onan genset, PRIME appears on the GENSET STATUS screen (Figure 4-12). Press and release **PRIME** to cause the genset fuel pump to to prime the fuel system for 60 seconds. The screen will change to GENSET PRIMING, the START and STOP buttons will appear and the PRIME button will disappear (Figure 4-13). Pressing STOP will stop priming. Pressing START will stop priming and start the genset.

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

Note: Onan Model KV and KVD gensets do not have a priming feature. Press START to stop priming and start the genset.

To Stop Genset

Press and release **STOP** to stop the genset. The screen will change to GENSET STOPPED.

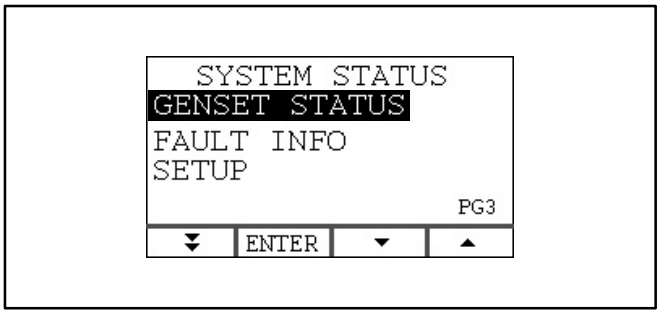


FIGURE 4-11. GENSET STATUS

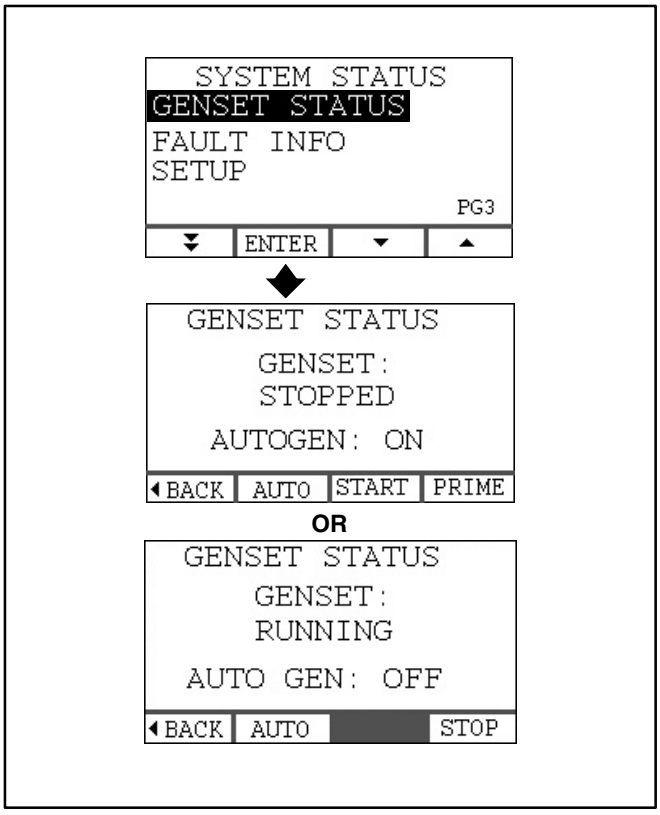


FIGURE 4-12. START/STOP GENSET

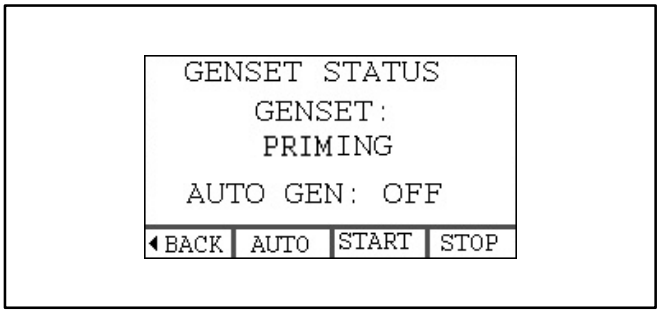


FIGURE 4-13. PRIMING ONAN GENSET

ENABLE / DISABLE AGS

The AUTO GEN light on the Digital Display (p. 4-1) tells whether AGS (Automatic Genset Starting) is enabled. If it is blinking, AGS is enabled but in standby because of Quiet Time (p. 4-17).

When AGS is enabled the Inverter-Charger will automatically start the genset to recharge the batteries (p. 4-19) or satisfy a load demand, such as for air conditioning (p. 4-26). AGS will make up to three attempts to start the genset, allowing it to rest 60 seconds between attempts. Fault 36—Genset Failed to Start—will be declared if the genset does not start.

Note: See *Appendix C. AGS Events and User Actions* for a summary of the events and user actions that affect AGS.

AGS is setup to be disabled by means of a safety signal whenever the vehicle or trailer is moved. See AGS Setup on Page 4-25. For example, if the ignition key is the safety signal device, AGS will be disabled whenever you turn the key to START *or* STOP the vehicle engine.

The purpose of having to manually re-enable AGS each time you park the vehicle is to give YOU the opportunity to determined that it is safe under the conditions to enable AGS. Carefully observe the following warning whenever you consider enabling AGS.

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

To Enable AGS

Vehicle / Trailer Parked Less Than 30 Days: Go to the GENSET STATUS screen and press AUTO (Figure 4-14). A Carbon Monoxide Warning screen will appear (third screen). Press ◂**BACK** on the warning screen to enable AGS. The GENSET STATUS screen (last screen shown) should reappear and indicate that AGS has come ON. The AUTO GEN light should also come on. If there is a genset start condition, AGS will attempt to start the genset.

Vehicle / Trailer Unattended for 30 Days: When you press ◂**BACK** on the Warning screen the next screen down in Figure 4-14 will appear. It will instruct you to "cycle" the Ignition, Parking Brake, Brake Light or Park/Neutral signal. See AGS Setup on Page 4-25. To cycle the signal, turn it ON if is OFF when parked or OFF if is ON when parked, and hold it for 3 seconds.

⚠ **CAUTION** ***If the parking brake or shift lever is the safety signal device, keep your foot on the brake to keep the vehicle from rolling.***

If the safety circuit is sound, the next-to-the-last screen shown in Figure 4-14 will recognize the signal. Before pressing ◂**BACK** to enable AGS, cycle the signal device back to its park position. Then press ◂**BACK** to enable AGS. The AUTO GEN light should come on.

If the safety circuit is faulty, the signal will not be recognized. *AGS will not be enabled*. The AUTO GEN light will not come on. Press ◂**BACK** to return to the GENSET STATUS screen. Have a trained and experienced person repair the faulty safety circuit. See AGS Safety Input Tests on Page 7-6.

Note 1: The AGS safety signal has a timer that expires in 30 days when the vehicle or trailer is left unattended—that is, when the safety signal is not continually being turned ON and OFF (cycled), as when you are on the road. The timer is reset for another 30 days each time the signal is turned ON or OFF.

Note 2: It will also be necessary to cycle the safety signal whenever the batteries are disconnected or the Inverter-Charger is in Battery Saver Mode (p. 6-10).

To Disable AGS

Go to the GENSET STATUS screen and press AUTO.

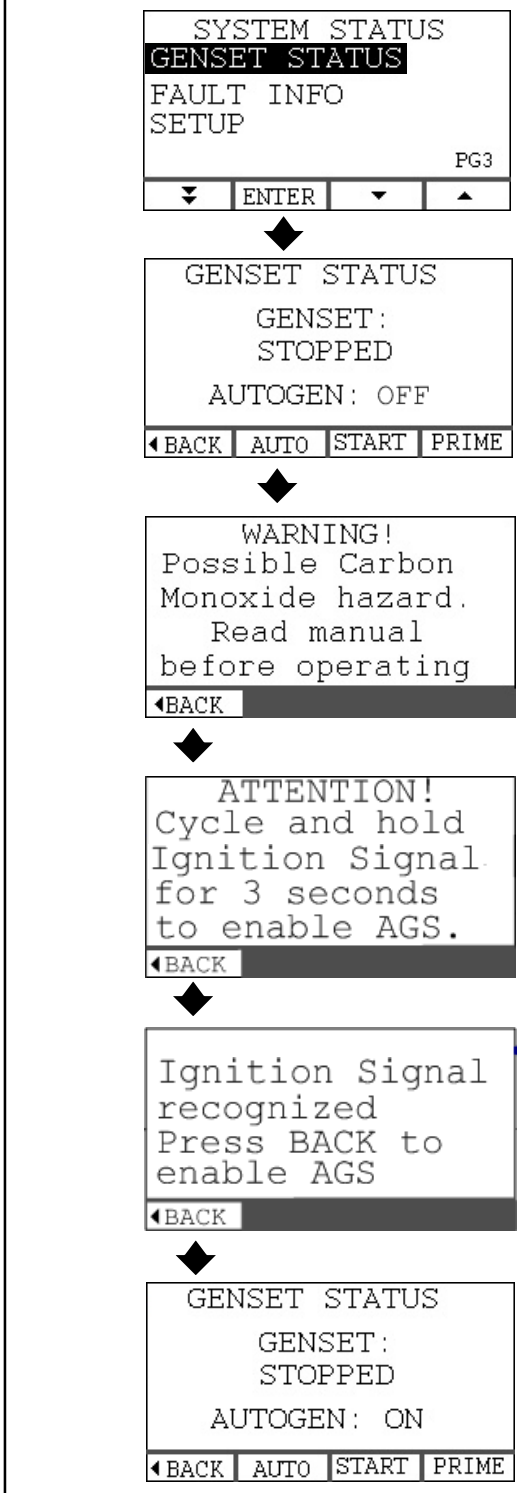


FIGURE 4-14. TO ENABLE AGS

AGS STATUS WARNING SCREENS

One of three screens may appear warning that AGS has been disabled or is soon to expire (Figure 4-15). Enabling AGS or resetting AGS back to a 30 day active period requires cycling the safety input device. See To Enable AGS on Page 4-12.

Note: The warning that AGS will expire begins at midnight 5 days before expiration. Each day thereafter the count drops by one day until expiration, unless the safety input device is cycled.

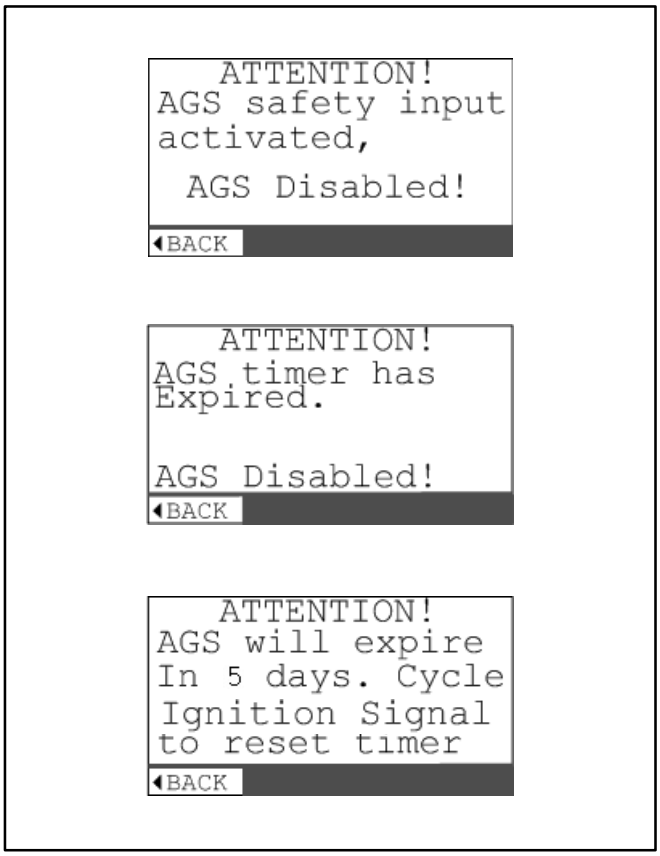


FIGURE 4-15. AGS STATUS WARNING SCREENS

FAULT INFO

When a Fault Occurs

When a fault occurs the FAULT INFO screen (Figure 4-16) will appear. 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 *Section 8. Troubleshooting* 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. 4-3).

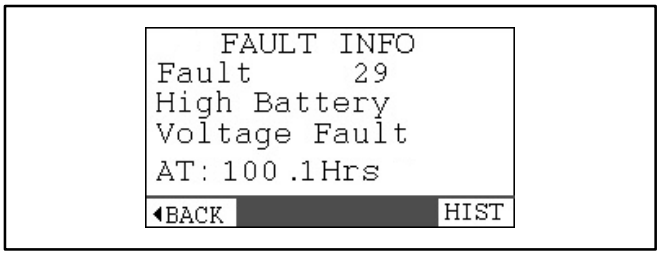


FIGURE 4-16. FAULT SCREEN

To Check for Active Fault

To check for an active Fault, go to FAULT INFO (Figure 4-17). 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.”

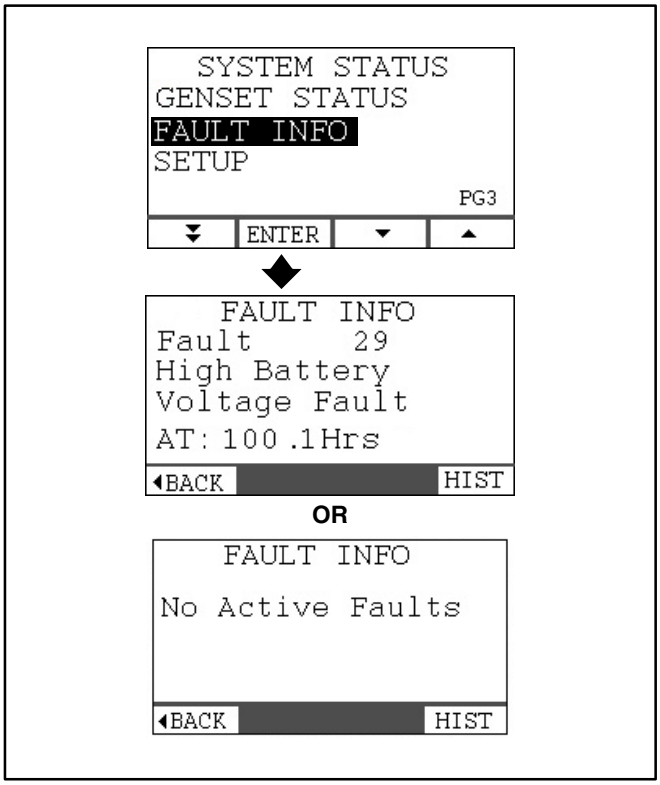


FIGURE 4-17. ACTIVE FAULT

FAULT 65 INFO SCREEN AND RESET

Charger Fault 65 (Charger Overtemp) has a special FAULT INFO screen and RESET button (Figure 4-18). Press INFO to open the FAULT INFO screen. See Page 8-11 in *Section 8. Troubleshooting* to determine the cause of the fault and the corrective actions that may be taken.

Press RESET after the Inverter-Charger has cooled down.

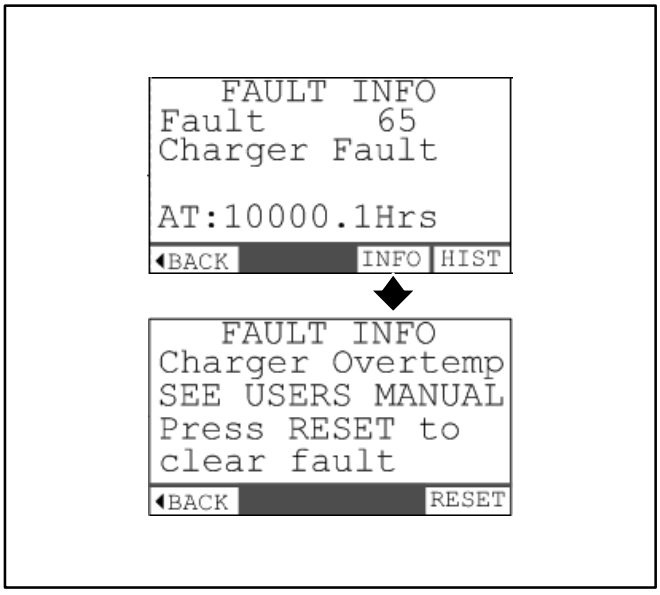


FIGURE 4-18. FAULT 65 INFO SCREEN AND RESET

To Check Fault History

To check up to 5 of the most recent faults (fault history), press HIST on the FAULT INFO screen (Figure 4-19). Press ⏬ / ⏫ to page through the 5 faults. If there is no fault history, the screen will state, “No Stored Faults.”

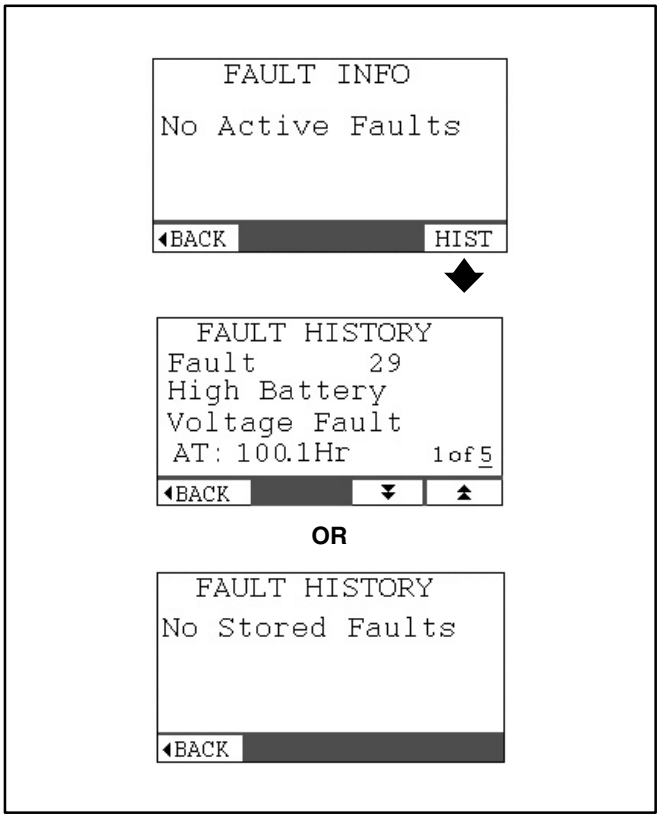


FIGURE 4-19. FAULT HISTORY

SETUP

Go to SETUP on SYSTEM STATUS PG 3 and press ENTER to setup or configure the Inverter-Charger. The instructions that follow work through each setup and configuration screen in detail.

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 or the Battery Saver feature (if enabled) wakes the Inverter-Charger. *Reset the clock for local time if it is necessary to observe local QUIET TIME (p. 4-17).*

To reset the time, go to CLOCK ADJUST (Figure 4-20). 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.

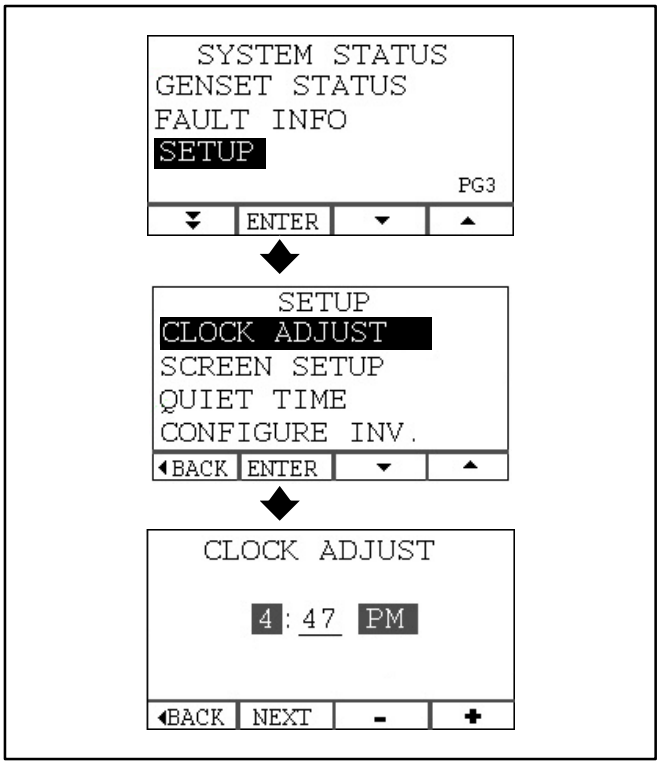


FIGURE 4-20. CLOCK ADJUST

SCREEN SETUP

To change screen Contrast, Brightness and/or Backlight Timer, go to SCREEN SETUP (Figure 4-21).

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.

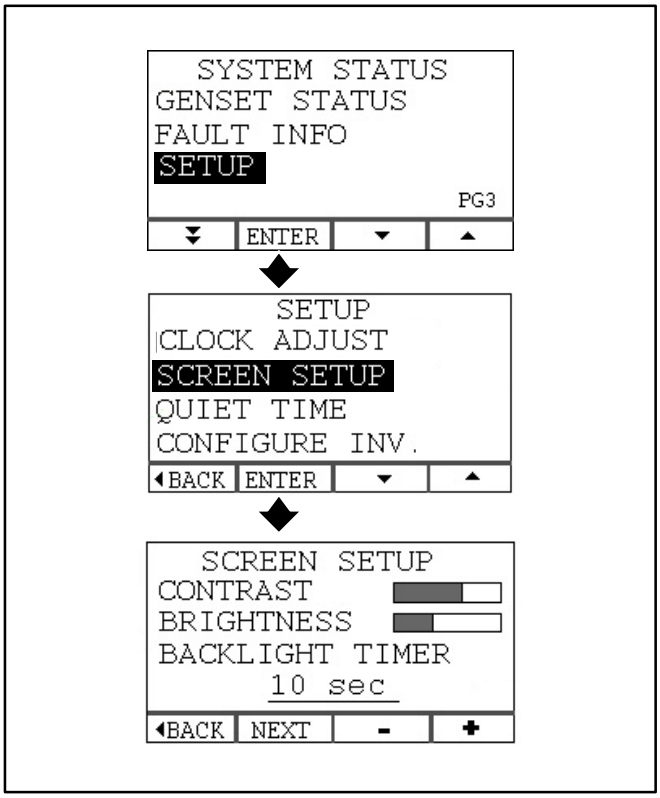


FIGURE 4-21. SCREEN SETUP

QUIET TIME

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

Note: When Quiet Time is in effect the AUTO GEN LED on the Digital Display will blink indicating that AGS is in standby, if AGS is enabled. See *Appendix C. AGS Events and User Action*s for a summary of the events and user actions that affect AGS.

To enable Quiet Time and/or reset the Start and Stop times, go to QUIET TIME (Figure 4-22). 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.

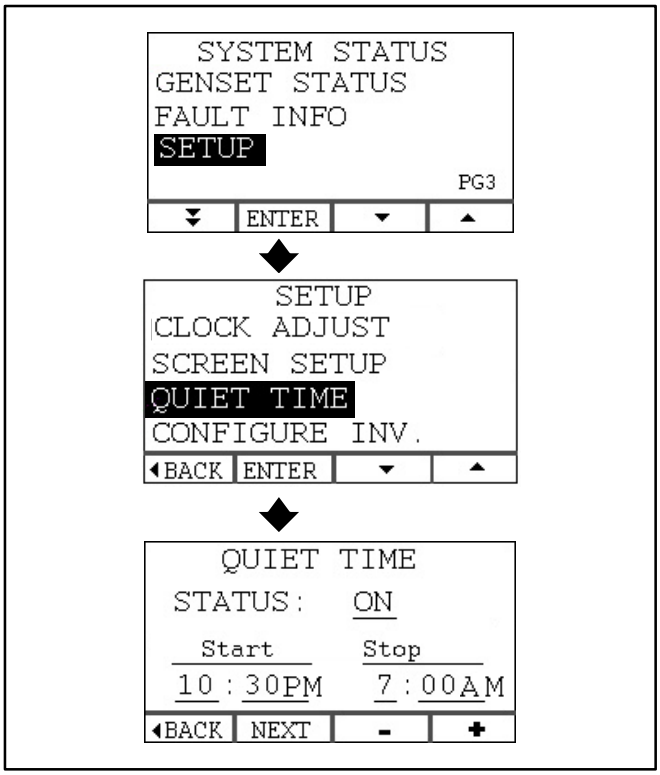


FIGURE 4-22. QUIET TIME

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 4-23). The instructions that follow 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.

Press ⏬ to page between CONFIGURE INV. PG1 and CONFIGURE INV. PG2

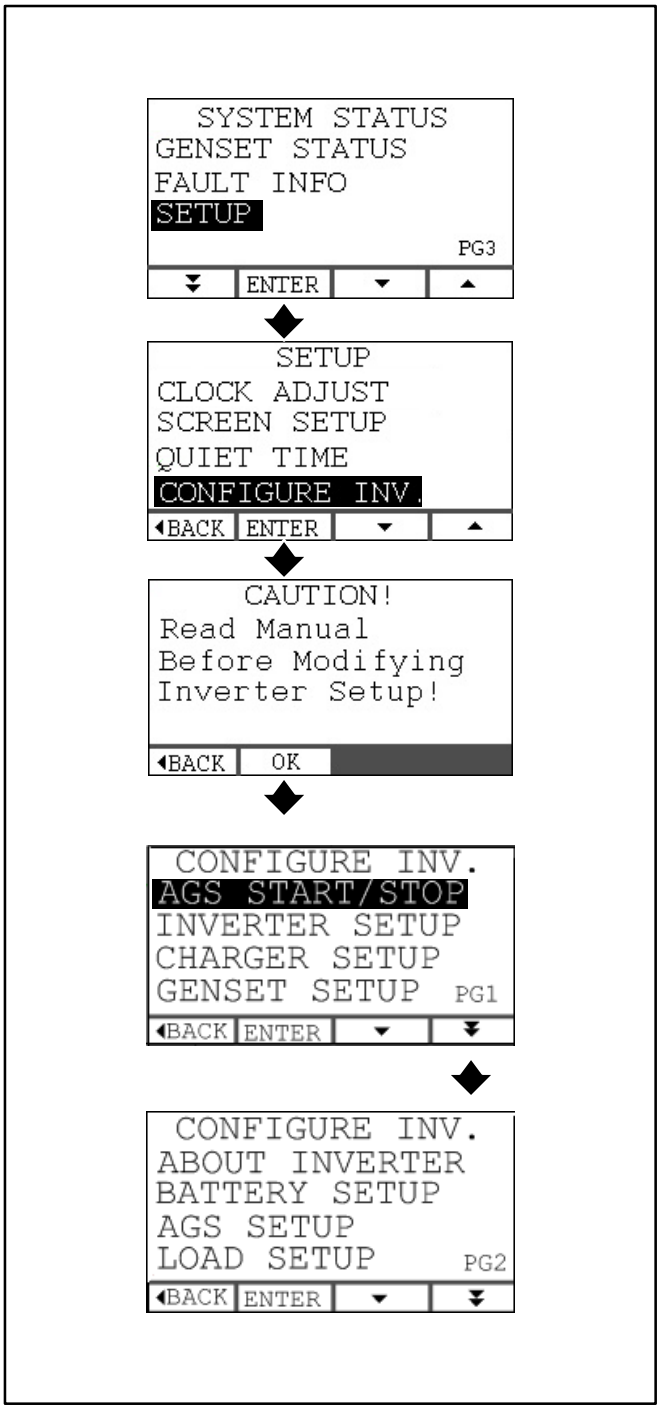


FIGURE 4-23. CONFIGURE INVERTER

AGS START / STOP

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

Select AGS START/STOP on CONFIGURE INV. PG1 and press ENTER. On the AGS START/STOP screen press the NEXT button to scroll between the START and STOP fields (Figure 4-24, if the Inverter-Charger has a shunt, Figure 4-25 if it does not).

Models With Shunt (See Page A-6)

Start: Press **+ / –** to Increase / Decrease the Percent State of Charge of the battery when the genset is to be Started (Figure 4-24). The range is 40 to 90 percent and changes in increments of 10 percent. The choices also include *Low Battery Cut-Out*. See Page 4-20.

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 (See Page A-7)

Start: The Start field is fixed and cannot be changed (Figure 4-25). The genset will be started when battery voltage drops down to the Low Battery Cut-Out setpoint (p. 4-20).

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.

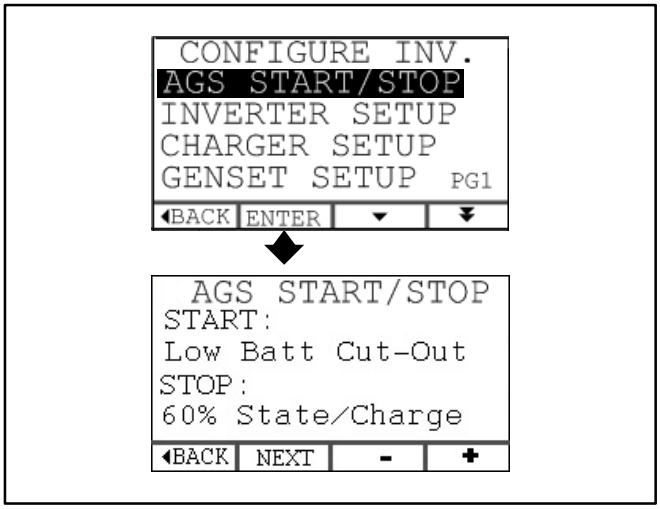


FIGURE 4-24. AGS START/STOP (MODELS WITH SHUNT)

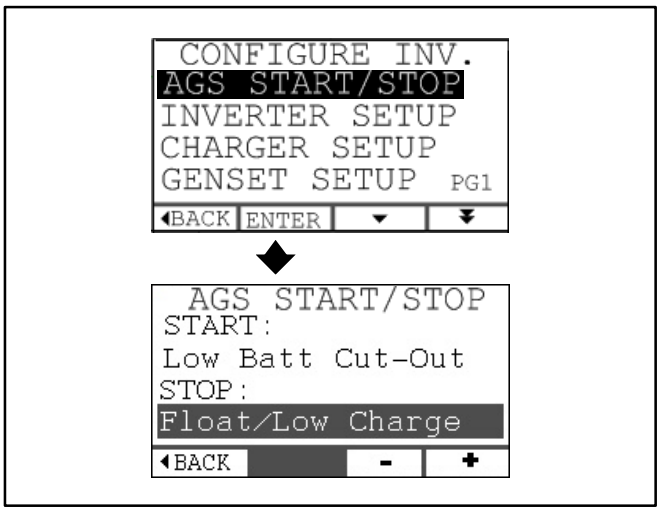


FIGURE 4-25. AGS START/STOP (MODELS WITHOUT SHUNT)

INVERTER SETUP

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

Select INVERTER SETUP on CONFIGURE INV. PG1 and press ENTER (Figure 4-26). 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 to 10 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. 4-19), 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.

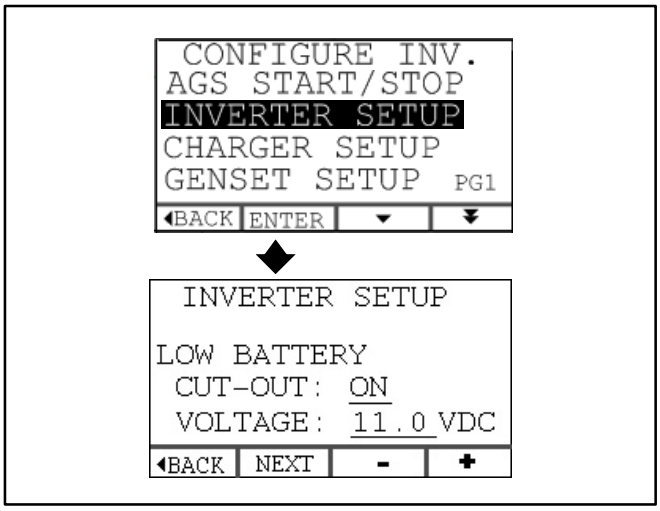


FIGURE 4-26. INVERTER SETUP

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 4-27). On the CHARGER SETUP 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.

When Value for CEF Is Known: 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.

When Value for CEF Is Unknown: 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.

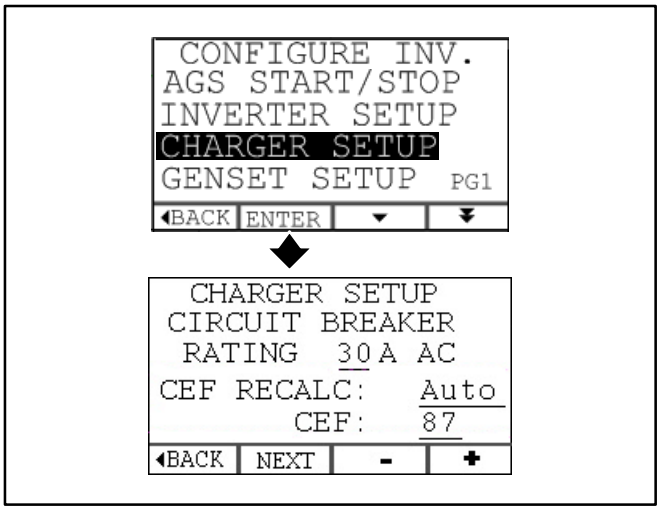


FIGURE 4-27. CHARGER SETUP

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 4-28). 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. 4-10).

Note 2: GENSET connections (p. 6-13) and GENSET SETUP must correspond.

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

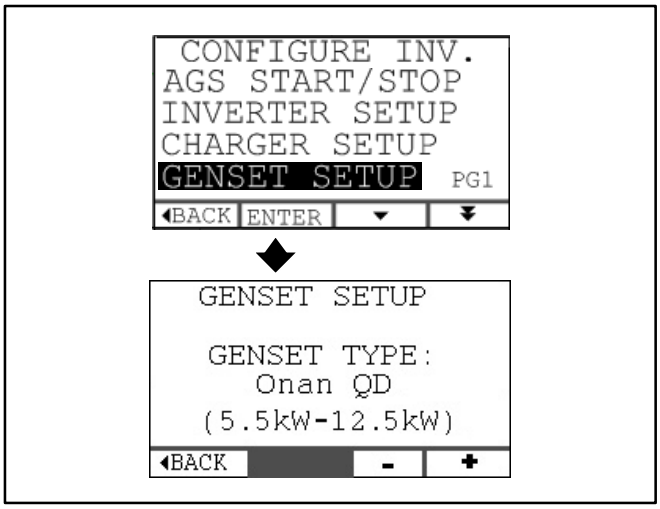


FIGURE 4-28. GENSET SETUP

ABOUT INVERTER

Select ABOUT INVERTER on CONFIGURE INV. PG2 and press ENTER. This screen (Figure 4-29) displays the hour meter and information about the Inverter-Charger software.

ABOUT DISPLAY

Select ABOUT INVERTER on CONFIGURE INV. PG2 and press ENTER. Then press ⏬ to page to the ABOUT DISPLAY screen. This screen (Figure 4-29) displays information about the Digital Display software.

Press ◀BACK to return to previous screen.

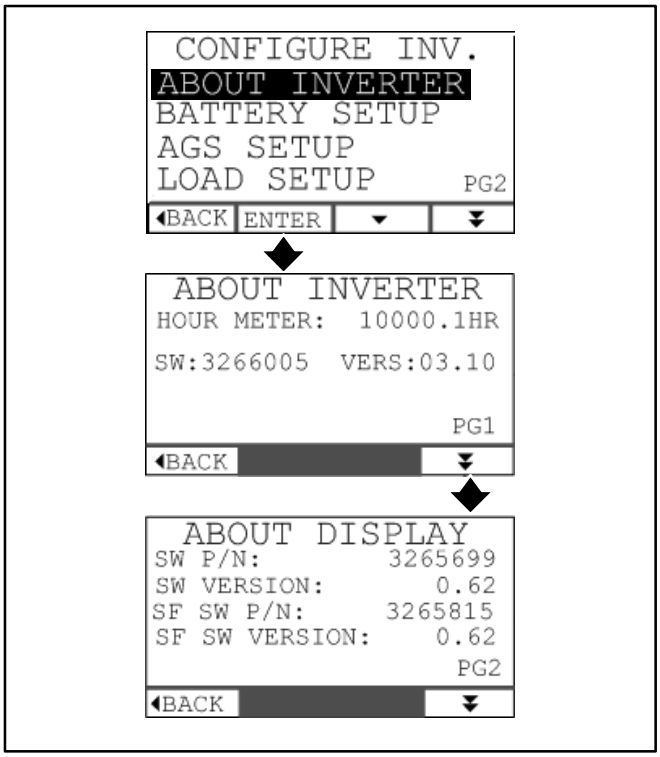


FIGURE 4-29. ABOUT INVERTER/DISPLAY

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 4-30). On the BATTERY SETUP 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. See also CUSTOM BATTERY PARAMETERS (p. 7-9).

Total AHRS (Battery Bank Capacity)

Enter the total Amp-Hour Rating of the battery bank. See BATTERY BANK VOLTAGE AND CAPACITY (p. 6-2). This value is used in calculations for the Battery Level Meter (Home Screen, p. 4-5) and for the number of hours of Life Remaining (Battery Status screen, p. 4-7).

Set Empty Capacity

EMPTY CAPACITY is the reference value for Empty on the Battery Level Meter (Home Screen, p. 4-5). 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 4-7).

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

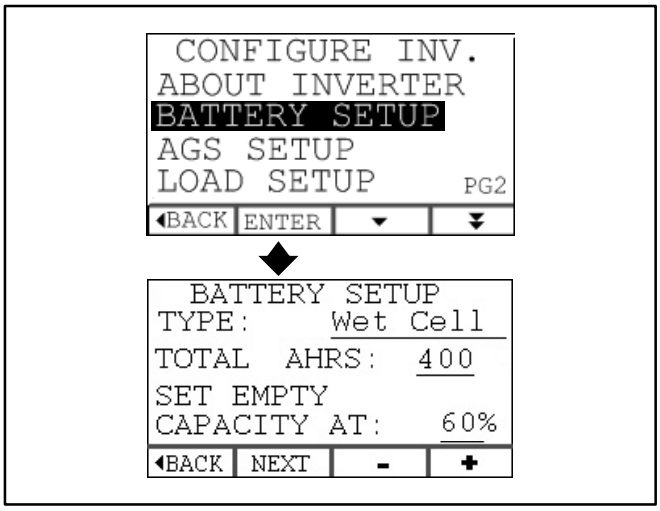


FIGURE 4-30. BATTERY SETUP

AGS SETUP

A safety input signal must be connected to the Inverter-Charger to enable AGS (p. 6-12). The signal timer must be cycled (turned ON or OFF) at least once every 30 days. See To Enable/Disable AGS on Page 4-12.

Select AGS SETUP on CONFIGURE INV. PG2 and press ENTER (Figure 4-31). Use the **+ / –** buttons to select one of the following signal names:

- Ignition Signal
- Parking Brake
- Brake Light
- Park/Neutral

Select the signal name that corresponds to the type of signal that has been connected to send the AGS safety signal (p. 6-12). This is the name that will be displayed on the screens that appear when confirming the AGS safety signal (p. 4-12).

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

This screen will also indicate whether the Safety Input is ON or OFF. See Table 4-2.

TABLE 4-2. AGS SAFETY INPUT SIGNAL STATUS

Signal Type	Signal Status ON	Signal Status OFF
Ignition	Ignition Key ON	Ignition Key OFF
Parking Brake	Brake Set	Brake Released
Brake Light	Brake Light ON	Brake Light OFF
Park/Neutral	In Park/Neutral	Out of Park/Neutral

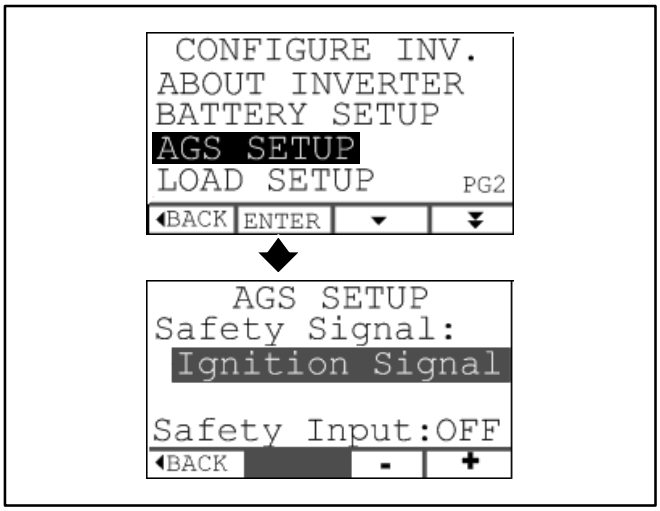


FIGURE 4-31. AGS SETUP

LOAD SETUP

Note: No entries are required on this screen if the load demand feature has not been activated.

The Inverter-Charger can be connected to receive a load signal from different kinds of AC equipment, such as air conditioners, to automatically start the genset to supply AC power directly to the equipment. The load signal must be active for at least 2 seconds to start the genset and inactive for at least 2 seconds to stop the genset. Once started, the Inverter-Charger will run the genset for at least 5 minutes.

Select LOAD SETUP on CONFIGURE INV. PG2 and press ENTER (Figure 4-32). Use the **+ / –** buttons to select Active HIGH or Active LOW as the signal type. Active HIGH is the default setting. This must correspond to the type of load demand signal provided by the installed equipment that is to be powered (p. 6-11).

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

This screen will also indicate whether the Load Demand signal is ON or OFF. See Table 4-3.

TABLE 4-3. LOAD DEMAND SIGNAL STATUS

Signal Type	Signal Status ON	Signal Status OFF
Active HIGH	7 to 32 VDC	Less than 7 VDC
Active LOW	Less than 7 VDC	7 to 32 VDC

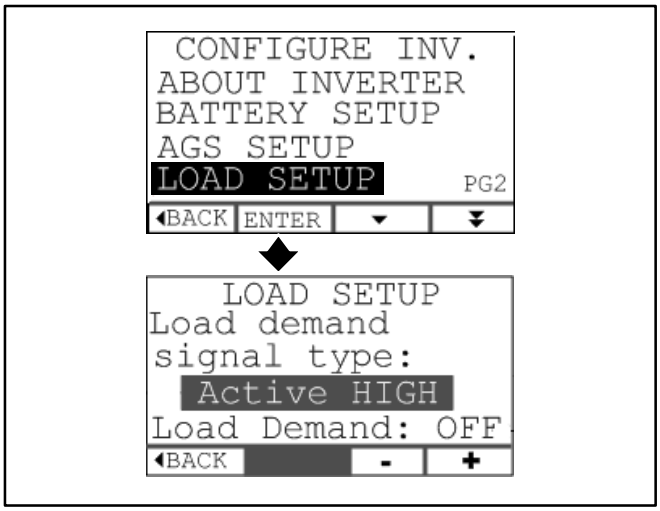


FIGURE 4-32. LOAD SETUP

CHARGER OVERLOAD WARNING SCREEN

This screen (Figure 4-33) appears when *Charging* has been disabled to check whether the batteries are connected. See *Section 8. Troubleshooting,* Page 8-14.

FIGURE 4-33. CHARGER OVERLOAD WARNING SCREEN

VERY LOW BATTERY WARNING SCREEN

This screen (Figure 4-34) appears if the Inverter-Charger determines that that batteries are connected but severely discharged. See *Section 8. Troubleshooting,* Page 8-14.

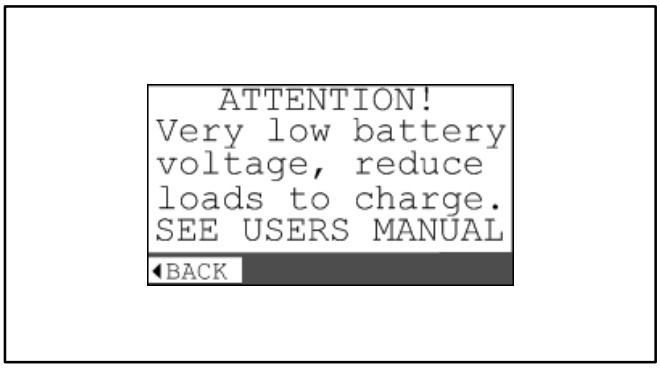


FIGURE 4-34. VERY LOW BATTERY WARNING SCREEN

Section 5. Battery Charging & Maintenance

BATTERY CHARGING STAGES

Refer to the charging voltage and current diagram in Table 7-2 while working through the following description.

Stage 1—High (Bulk) Charging

The Inverter-Charger maintains constant charging current during Stage 1 Charging. See *Appendix B. Specifications* for the maximum charging current of your Inverter-Charger. Current is limited by the maximum charging current, maximum charger current draw (p. 4-3), and/or AC Circuit Breaker Rating (p. 4-21).

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. 6-9).

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 5-1). The absorption current level depends upon battery type and bank size (Table 7-2).

TABLE 5-1. 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. 6-9). 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 4-7 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. 5-2).
4. Always replace the battery fuse with a UL Listed, DC Rated, Slow Blow fuse of the specified amp rating (Table 6-8).
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 6-7. 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.***

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

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 secure DC terminal protective covers when making connections to prevent accidental shorting with metal tools.

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-5.

⚠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. 6-9) and has a Digital Display (p. 4-1). See Page 4-8 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 6-9). 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. 6-9). 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 highly recommended that the battery saver mode (p. 6-10) be enabled.

Follow all storage recommendations provided by the battery manufacturer.

Section 6. 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 6-1 be obtained for reference.

TABLE 6-1. 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

INSTALLATION CHECK LIST

Before placing the Inverter-Charger in service, the installer must be able to check off each item in *Appendix E. Installation Check List* and make all necessary repairs and reconnections.

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. That way the battery bank will be sized so that the batteries will not have to operate below half charge. Operation at less than half charge reduces 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 6-2 be used to select the required Inverter-Charger rating.

TABLE 6-2. 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. See Figure 6-1. The Inverter-Charger has an internal cooling fan. Cooling air flow is from left to right through the Inverter-Charger. *The compartment must be designed for fresh air to enter and warm air to leave without recirculating back into the cooling fan inlet.*

  ⚠ CAUTION ***Inadequate cooling air flow or recirculation of warm air back into the cooling fan inlet will result in Inverter-Charger shutdowns due to over heating.***
- Afford space for all electrical connections
- Afford access for removal of the Inverter-Charger for service or replacement
- Afford easy access to the control panel (Figure 3-1).

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 *Appendix B. Specifications* for the weight of the Inverter-Charger.

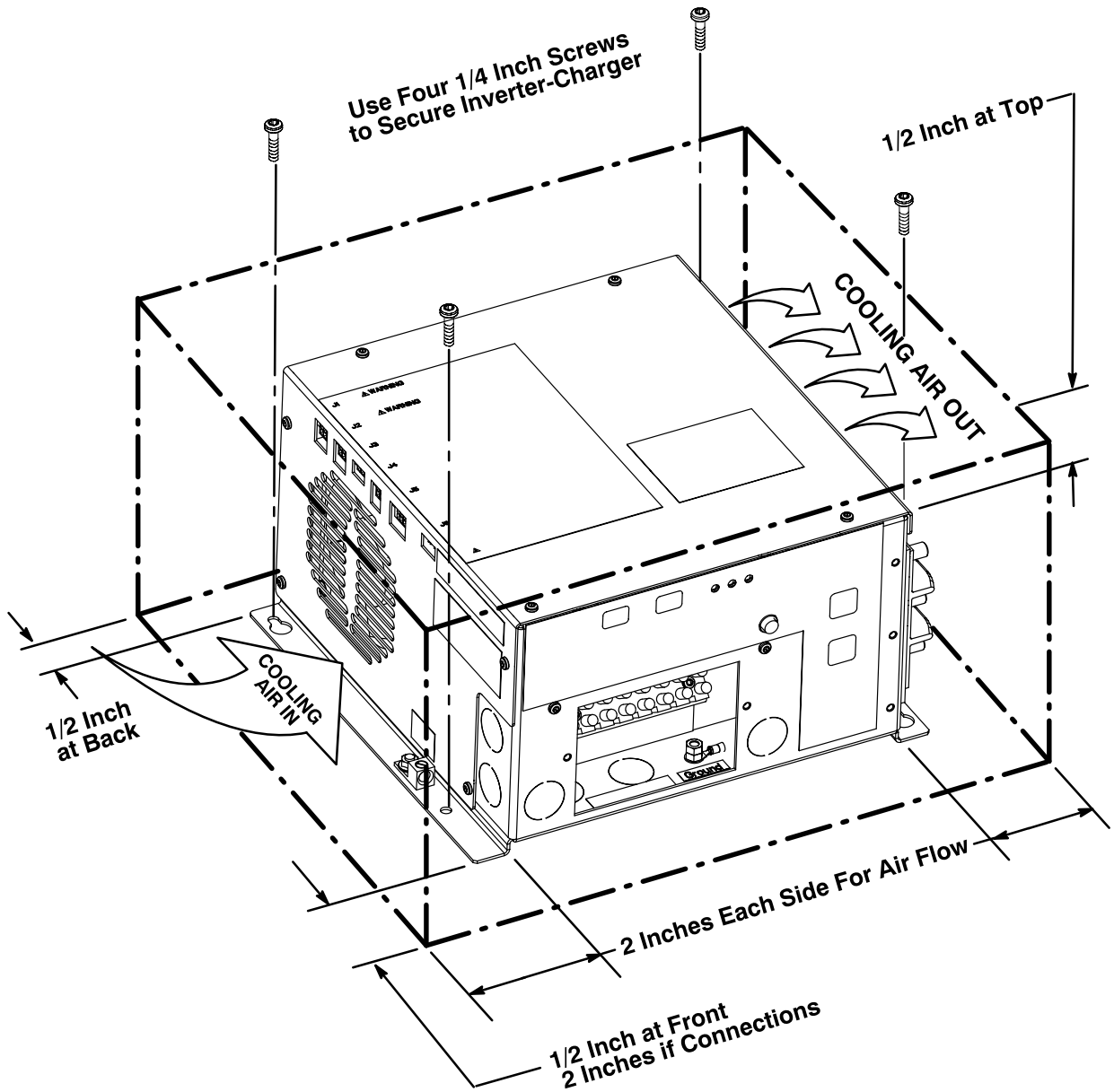
Compartment Dimensions

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 6-3 and Figure 6-1.

TABLE 6-3. 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)



Note: The compartment must be designed for fresh air to enter and warm air to leave without recirculating back into the cooling fan inlet.

FIGURE 6-1. MOUNTING, MINIMUM COMPARTMENT CLEARANCES AND COOLING AIR FLOW

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 6-4 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 6-4. Other types may not function properly with this equipment.***

TABLE 6-4. 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. 5-2).***

Direct Connection to Battery Bank

The Inverter-Charger must be connected directly to the battery bank through the appropriate fuse. Do not connect it through a common pass-through lug or to the DC load panel or other terminal. Pages A-6 and A-7 illustrate recommended connections. Direct connection is necessary:

- To allow the Inverter-Charger to charge the batteries anytime AC power is available. A DC disconnect switch would prevent charging. Enabling the battery saver mode makes disconnection unnecessary.
- To prevent the Inverter-Charger from powering the DC loads without the batteries being connected. *The Inverter-Charger is not designed for powering DC loads directly.*

  ⚠CAUTION ***Damage to the Inverter-Charger as a result of powering DC loads without the batteries connected is not covered by Warranty.***

DC Load Disconnect Switch

Because direct connection is required between the Inverter-Charger and battery bank, the DC load disconnect switch must NOT be installed between the Inverter-Charger and battery bank. Pages A-6 and A-7 illustrate recommended connections.

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.

Routing Battery Cables

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

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 assumes that battery voltage is the same as 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 6-5 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.

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 6-5.

TABLE 6-5. 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	–

Battery Cable Lugs

Battery cable lugs must be UL Recognized and CSA Certified and be crimped on using approved tools. See Table 6-6 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 6-6. 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 damage high-current treaded-stud terminals by over tightening. Make sure the terminals are clean and free of corrosion. Torque the terminals in accordance with Table 6-7.

TABLE 6-7. 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

⚠ CAUTION ***The voltage drop across loose DC terminals causes significant loss of performance. Always torque DC terminals to specifications and make sure the hardware stackup is correct.***

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 6-8 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 6-7.

DC Terminal Protective Covers

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

⚠WARNING ***Batteries can cause severe personal injury due to sparks, explosion and acid. Always secure DC terminal protective covers when making connections to prevent accidental shorting with metal tools.***

TABLE 6-8. 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 4-24.

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 6-9.

TABLE 6-9. 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. See Page A-9.

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.

BATTERY SAVER MODE

The battery saver mode enables the Inverter-Charger to “sleep” while the vehicle is in storage, drawing less than 0.5 mA from the batteries.

Enabling battery saver mode is highly recommended. It makes it unnecessary to disconnect the Inverter-Charger from the batteries or install a disconnect switch. Leaving the batteries connected during storage allows the Inverter-Charger to charge the batteries if AC power becomes available (AC power wakes the Inverter-Charger). Also, a smaller, less expensive switch can be used for DC load disconnect when it does not have to carry large Inverting currents.

Page A-8 illustrates typical connections where opening / closing the DC load disconnect switch removes / restores the 12 VDC signal necessary for the Inverter-Charger to stay awake.

Connector J6

To enable the battery saver mode remove and discard the factory jumper across the left two pins of connector **J6** (Figure 6-2).

Do not remove the jumper across connector **J6** if the battery saver mode is not to be enabled.

Connector J5

Provide for a 12 VDC signal through connector **J5** (Figure 6-2) in accordance with Table 6-10. Polarity must be correct.

TABLE 6-10. BATTERY SAVER MODE CONNECTOR

Connection	Description
J5-3	Battery Saver Mode (7 to 32 VDC Input)
J5-7	Ground for Battery Saver Mode Signal

Wiring Harness

Wiring harness 541-1182 has the mating 8-pin plug to connector **J5** and six 18 AWG pigtails. Use insulated butt-splice connectors for connections to the 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.

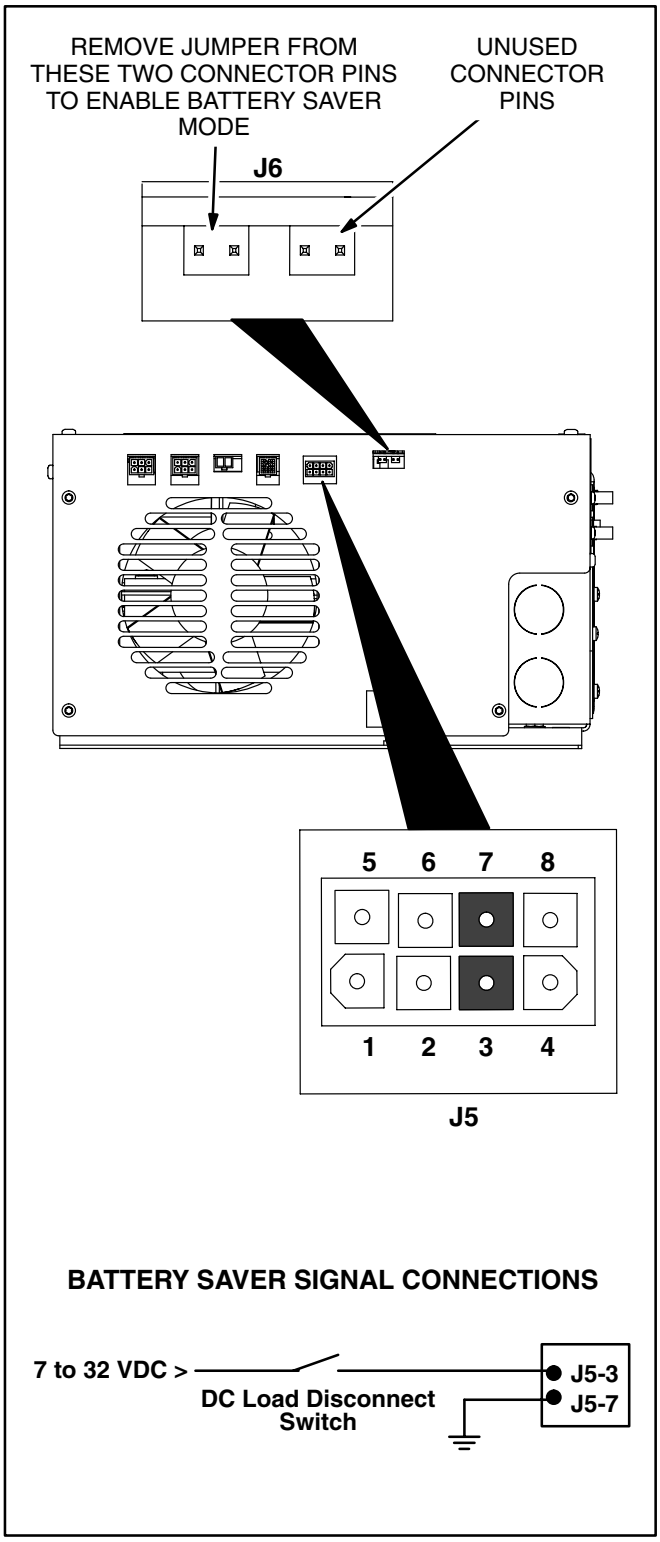


FIGURE 6-2. BATTERY SAVER MODE SIGNAL

LOAD DEMAND

Note: No connections or reconfigurations are required if this feature is not used.

The Inverter-Charger can be connected to receive a load signal from different kinds of AC equipment, such as air conditioners, to automatically start the genset to supply AC power directly to the equipment. The load signal must be active for at least 2 seconds to start the genset and inactive for at least 2 seconds to stop the genset. Once started, the Inverter-Charger will run the genset for at least 5 minutes.

The Inverter-Charger will not start the genset if external AC is available or Quite Time is in effect. *AGS must be enabled (p. 4-11).*

Connector J5 and Signal Type

Provide for a 12 VDC signal through connector **J5** (Figure 6-3) in accordance with Table 6-11. Polarity must be correct. The switching contacts may be in either the positive (**+**) or negative (**–**) side of the circuit. The Inverter-Charger will accept either an active HIGH or active LOW signal. See LOAD SETUP, p. 4-26.

TABLE 6-11. LOAD DEMAND CONNECTOR

Connection	Description
J5-2	Load Demand (7 to 32 VDC Input)
J5-6	Ground for Load Demand

Wiring Harness

Wiring harness 541-1182 has the mating 8-pin plug to connector **J5** and six 18 AWG pigtails. Use insulated butt-splice connectors for connections to the 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.

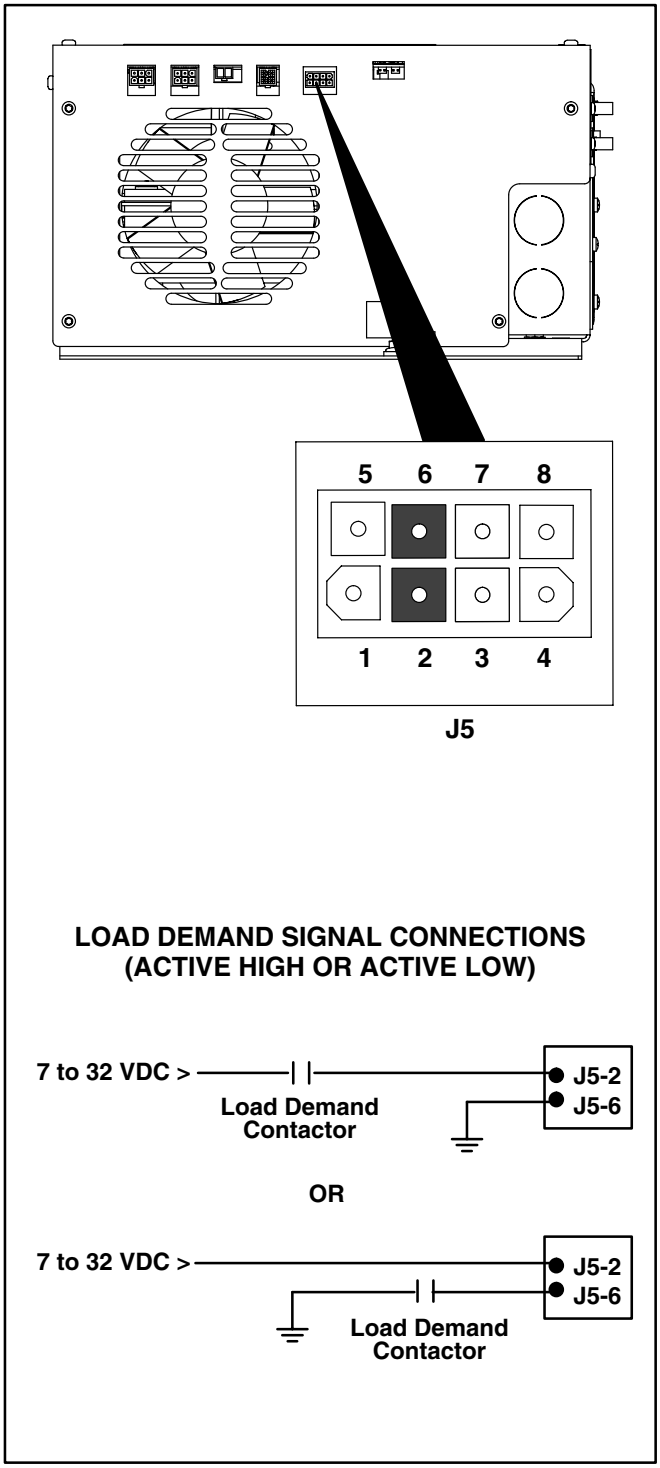


FIGURE 6-3. LOAD DEMAND SIGNAL

AGS SAFETY INPUT SIGNAL

A safety input signal must be connected to the Inverter-Charger to enable AGS. The signal must be cycled (turned ON and OFF or OFF and ON) at least once every 30 days. See To Enable AGS on Page 4-12.

Diagrams of typical signal devices are shown in Figure 6-4. See AGS SETUP on Page 4-25 to set up the Display to indicate which device was connected to send the safety signal.

Connector J5

Provide for a 12 VDC signal through connector **J5** (Figure 6-4) in accordance with Table 6-12. Polarity must be correct. The switching contacts may be in either the positive (**+**) or negative (**–**) side of the circuit. It is the transition from ON to OFF or OFF to ON that allows AGS to be enabled. See ENABLE/DISABLE AGS (p. 4-11).

TABLE 6-12. AGS SAFETY INPUT SIGNAL CONNECTOR

Connection	Description
J5-1	AGS Safety Input (7 to 32 VDC Input)
J5-5	Ground for AGS Safety Input

Wiring Harness

Wiring harness 541-1182 has the mating 8-pin plug to connector **J5** and six 18 AWG pigtails. Use insulated butt-splice connectors for connections to the 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.

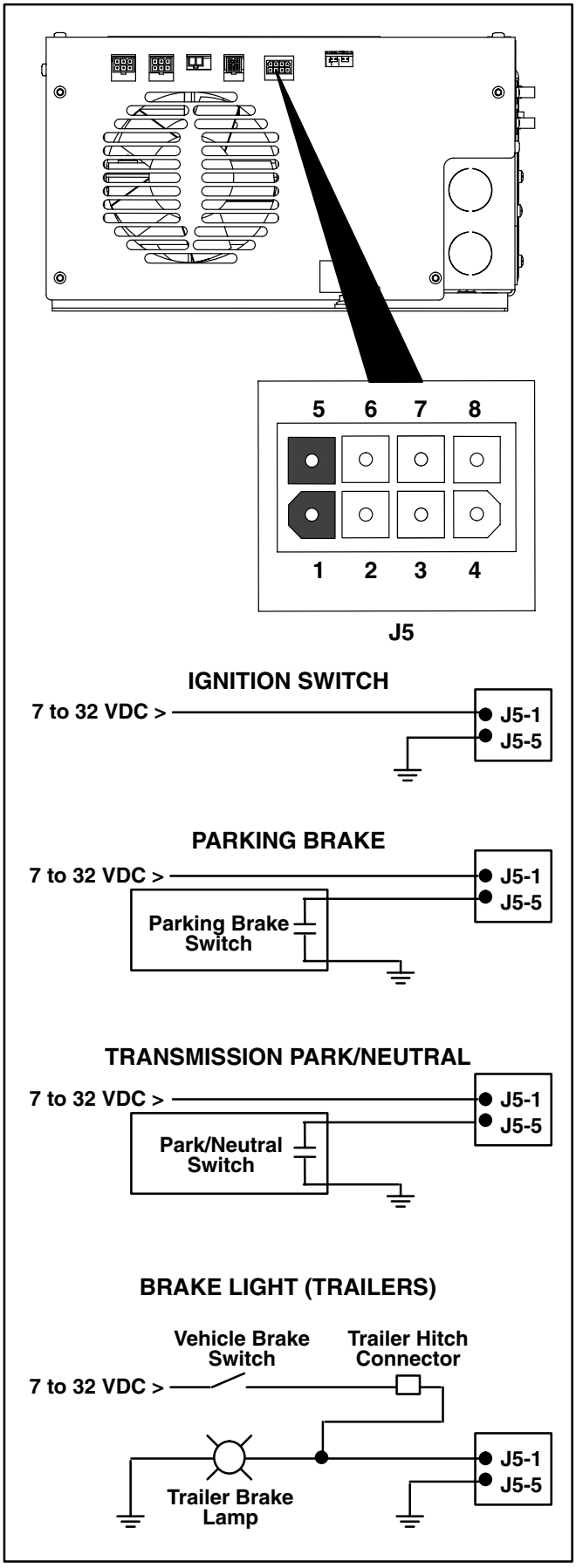


FIGURE 6-4. AGS SAFETY INPUT SIGNAL

EQUINOX DIGITAL DISPLAY

Up to three *Equinox Digital Displays* may be connected to the Inverter-Charger at **J-1** and/or at **J-2**. Page A-11 illustrates 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 6-13).

TABLE 6-13. DIGITAL DISPLAY 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

- 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 CONTROL CONNECTIONS

Connections

⚠CAUTION ***Do not install more than one AGS system in the vehicle. Multiple AGS systems can conflict with each other causing unanticipated starting and stopping of the genset.***

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 6-14 through 6-18 for the pin-to-pin or pin-to-wire correspondence between the Inverter-Charger and various makes of genset.

TABLE 6-14. PIN-TO-PIN CORRESPONDENCE: INVERTER-CHARGER — ONAN DIESEL GENSETS

Inverter Connector Pin	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 6-15. PIN-TO-PIN CORRESPONDENCE: INVERTER-CHARGER — ONAN GASOLINE/PROPANE GENSETS

Inverter Connector Pin	Connector Pin	Signal Name
J4–3	P8–B	STOP
J4–4	P8–E*	Run Signal
J4–1	P8–C	START/Crank
J4–2	P8–A	Ground
* – Connect to Pin P8-F if Model KV or KVD		

TABLE 6-16. 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 6-17. 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 6-18. 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. 4-22). GENSET connections and GENSET SETUP configuration must correspond.

Warning Labels

A sheet of 5 peel-off warning labels (Figure 6-5) 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.

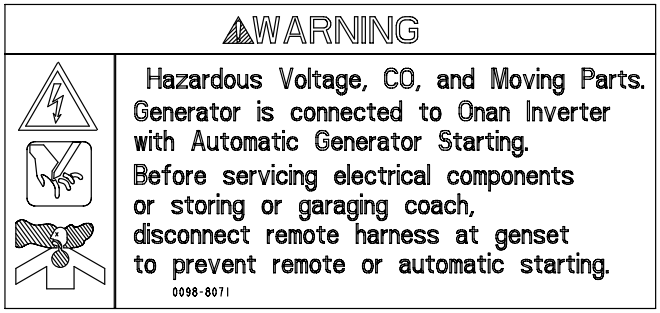


FIGURE 6-5. AGS WARNING

Section 7. Service

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

⚠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. 5-2).***

REPLACING FAN ASSEMBLY

Replace the fan assembly in accordance with the following steps. Refer to Figure 7-1.

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. 5-2).
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 7-1 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. 7-8).

REPLACING CIRCUIT BREAKERS

Replace the circuit breakers in accordance with the following steps. Refer to Figure 7-1.

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. 5-2).
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 7-1.

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. 5-2).
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.

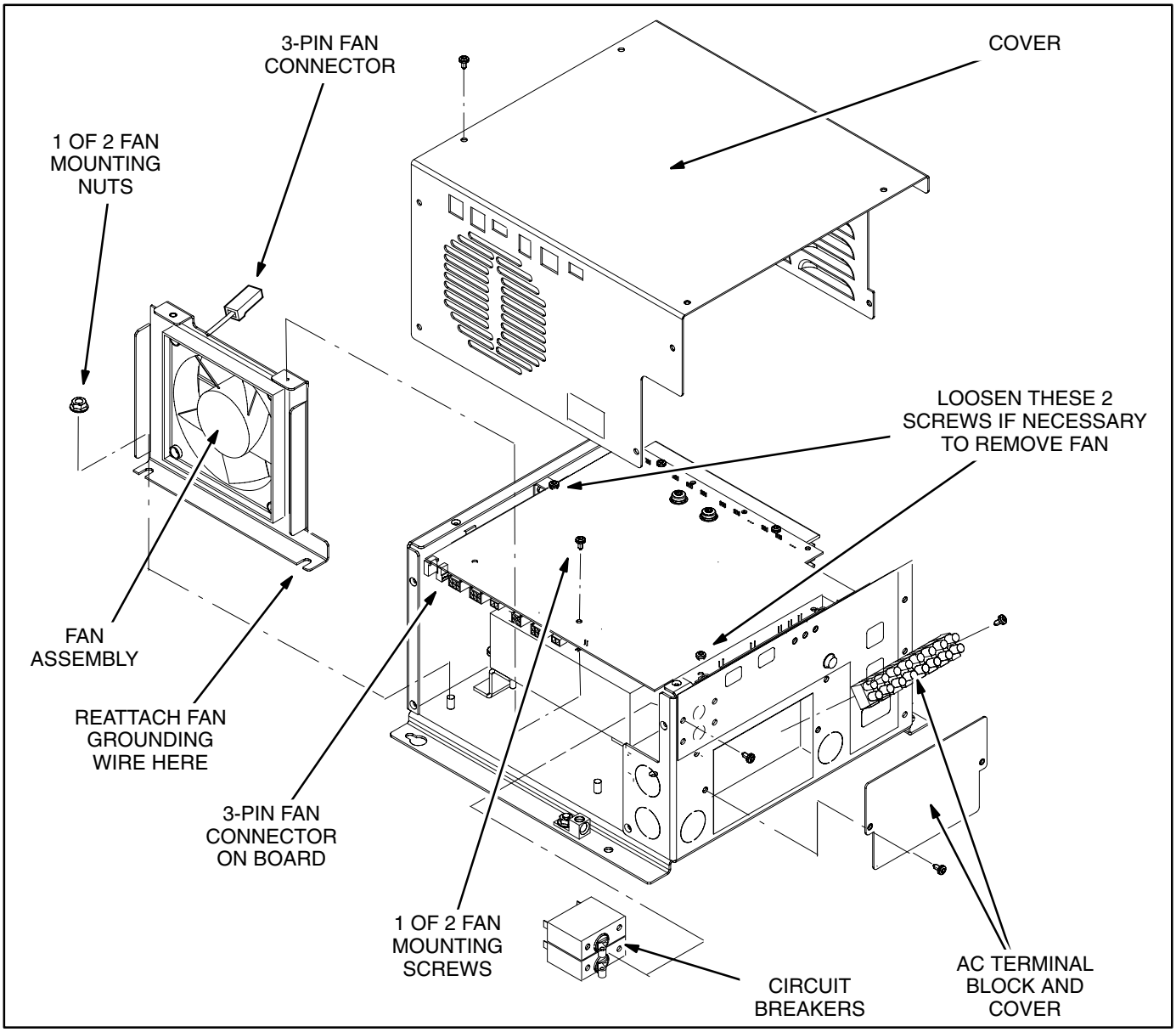


FIGURE 7-1. REPLACEABLE PARTS OF THE INVERTER-CHARGER

DIGITAL DISPLAY COMMUNICATIONS TESTS

Plug-in harness 541-0919 (25 feet) or 541-0932 (50 feet) is recommended for these tests.

The 6-pin connectors at the Inverter-Charger and Digital Displays are pin-for-pin compatible in accordance with Table 7-1.

TABLE 7-1. DIGITAL DISPLAY 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

Referring to Figure 7-2 and Page A-11, conduct the following tests if not functioning properly:

1. Check for 12 VDC across the Inverter-Charger DC output terminals.
2. Using a plug-in harness, check for 12 VDC across connector pins **J1–3** and **J1–4** and across connector pins **J2–3** and **J2–4**. Replace the Inverter-Charger if there is no voltage across either set of pins.
3. Remove a display that is not working and disconnect the wiring harness or harnesses. Check for 12 VDC between pin sockets **3** and **4** in the harness plug. If there is voltage at the Inverter-Charger (Step 2), but not at the Display, repair or replace the vehicle harness.
4. Plug the Digital Display into the Inverter-Charger at either **J1** or **J2** using a test harness known to have electrical continuity.
   A. Replace a Digital Display that does not wake up when any key is pressed.
   B. If a COMMUNICATIONS LOST warning appears when the Display is connected by way of the vehicle harness but not by way of the test harness, repair or replace the vehicle harness.
   C. If the COMMUNICATIONS LOST warning appears with a test harness, connect a Display known to function properly. If communications is established, replace the faulty Display with the good Display. Replace the Inverter-Charger if communications cannot be established with a good Display.

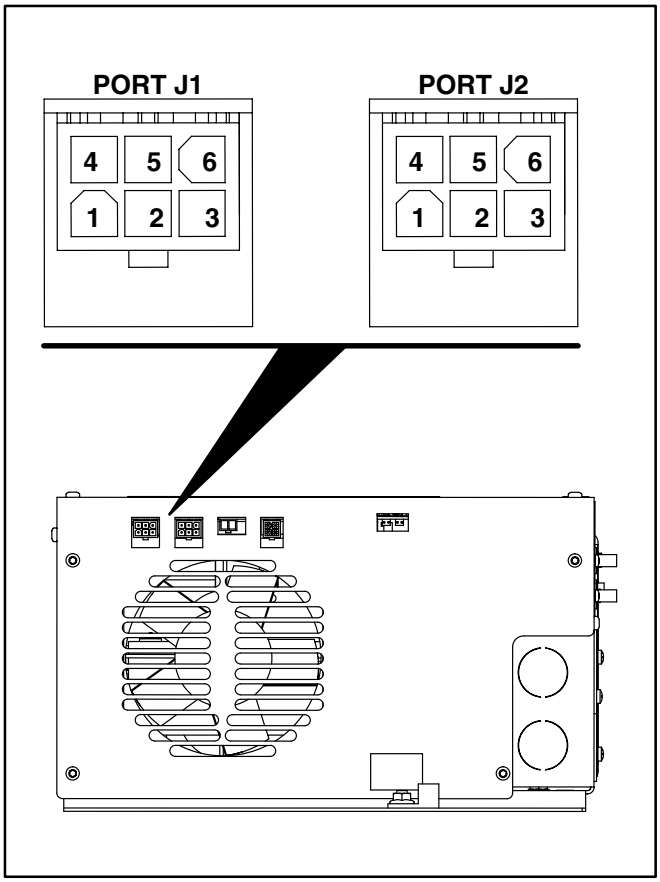


FIGURE 7-2. LCD COMMUNICATION PORTS J1 &J2

BATTERY SAVER MODE TESTS

Referring to Figure 7-3, conduct the following tests if the battery saver mode is not functioning properly:

1. Verify that the jumper across the left two pins of connector **J6** has been removed. ***If it has not been removed, battery saver mode has not been enabled and this test is not necessary.***

2. Turn OFF the AC circuit breaker supplying power to the Inverter-Charger.

3. Check for 12 VDC across the Inverter-Charger DC output terminals.

4. Disconnect the **J5** plug-in harness and press the INVERTER ON/OFF button on the control panel (p. 3-2). The *Inverting Indicator Light* should remain off and there should be no AC voltage (0 VAC) at the output terminals.

5. Turn ON the DC disconnect switch (p. A-8). Check for 12 VDC across **J5–3** (**+**) and **J5–7** (**–**) in the harness plug-in connector. Repair and/or reconnect the plug-in harness if polarity is wrong or there is no signal.

6. Reconnect the **J5** plug-in harness.

7. Turn ON the DC disconnect switch (p. A-8) and press the INVERTER ON/OFF button (p. 3-2). The *Inverting Indicator Light* should come on and there should be 120 VAC at the Inverter-Charger output terminals.

8. Turn OFF the DC 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.

9. With the DC disconnect switch OFF, connect AC power to the Inverter-Charger and enable *Charging*. Verify that the *Charging Indicator Light* comes on. (*Charging* ON is default.)

10. Replace the Inverter-Charger if it does not perform as required in Step 7, 8 or 9.

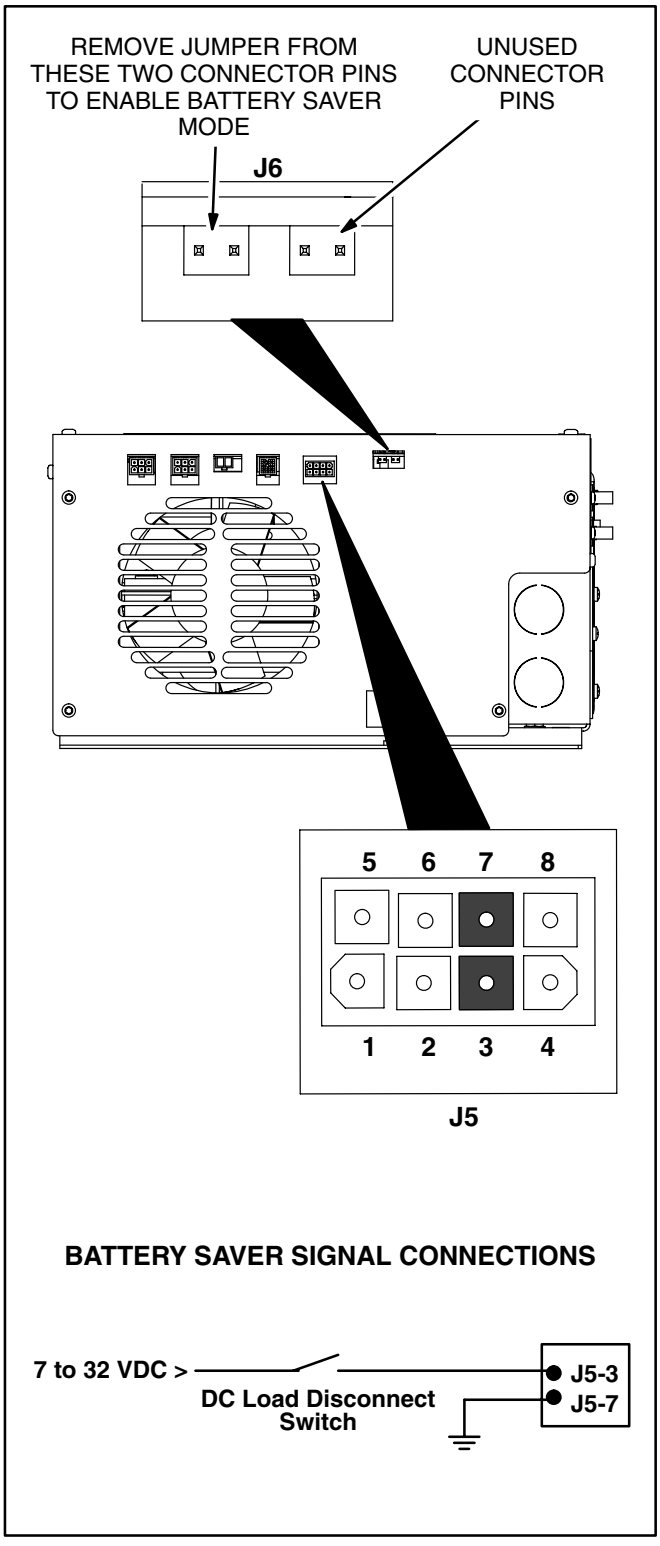


FIGURE 7-3. BATTERY SAVER MODE

LOAD DEMAND TESTS

1. Check for 12 VDC across the Inverter-Charger DC output terminals.
2. If battery saver mode is enabled (p. 6-10) make sure the DC disconnect switch is ON.
3. Leave the **J5** plug-in harness connected for these tests. Prepare to check for 7 to 32 VDC across pins **J5–2** (**+**) and **J5–6** (**–**). (The meter probes can be pushed in along side the leads at the back of the plug-in connector. Disconnecting the harness will disable the Inverter-Charger if battery saver mode has been enabled.)
4. Cycle the Load ON and OFF. If polarity is wrong or voltage does not switch between 0 VDC and 7 to 32 VDC at the **J5** plug-in connector when the load is cycled, repair and reconnect the load signal device and/or plug-in harness.
5. Navigate to the LOAD SETUP screen (p. 4-26) and cycle the load ON and OFF.
   A. If the voltage is 7 to 32 VDC when the load is ON, select Active HIGH.
   B. If the voltage is 7 to 32 VDC when the load is OFF, select Active LOW.
6. Replace the Inverter-Charger if the Demand Load field on the LOAD SETUP screen does not switch between ON and OFF when the demand signal voltage at **J5** is cycled between 0 VDC and 7 to 32 VDC.

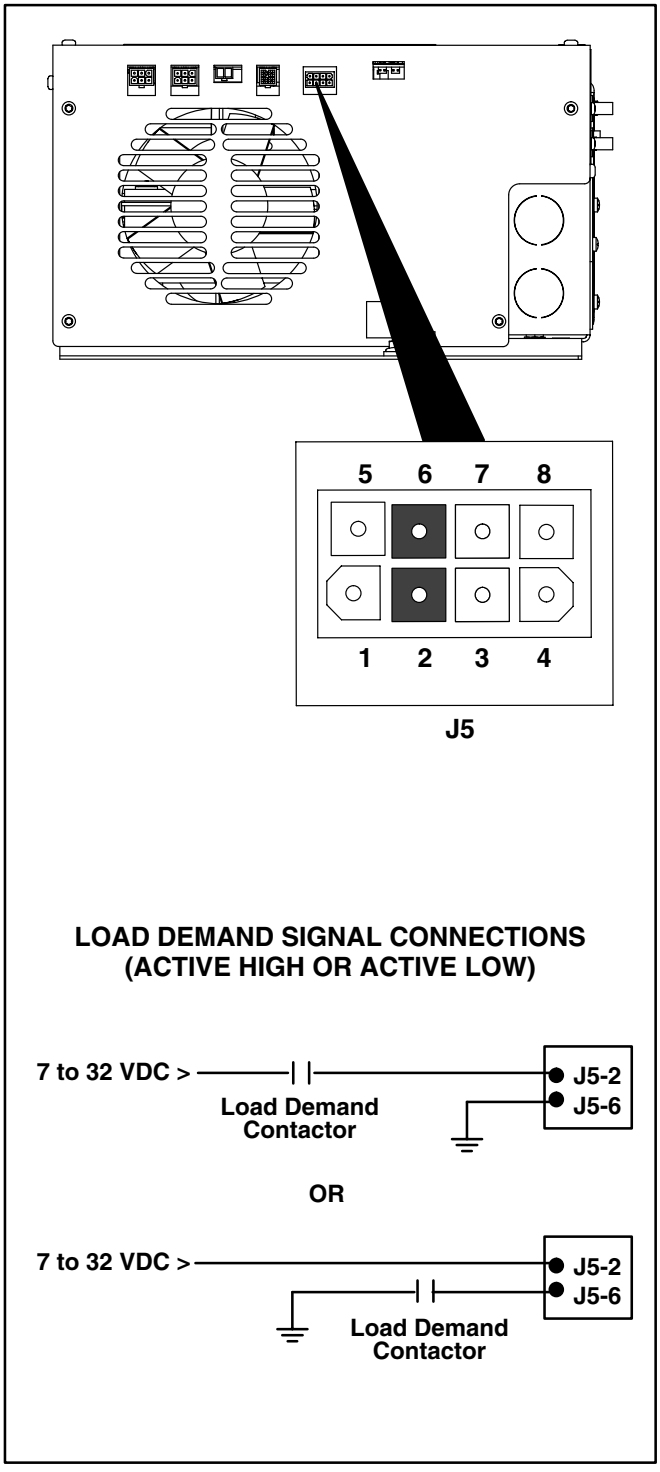


FIGURE 7-4. LOAD DEMAND

AGS SAFETY INPUT TESTS

1. Check for 12 VDC across the Inverter-Charger DC output terminals.
2. If battery saver mode is enabled (p. 6-10) make sure the DC disconnect switch is ON.
3. Leave the **J5** plug-in harness connected for these tests. Prepare to check for 7 to 32 VDC across pins **J5–1** (**+**) and **J5–5** (**–**). (The meter probes can be pushed in along side the leads at the back of the plug-in connector. Disconnecting the harness will disable the Inverter-Charger if battery saver mode has been enabled.)
4. Cycle the safety input device ON and OFF. If polarity is wrong or voltage does not switch between 0 VDC and 7 to 32 VDC at the **J5** plug-in connector when the signal is cycled, repair and reconnect the load signal device and/or plug-in harness.
5. Navigate to the AGS SETUP screen (p. 4-25) and cycle the safety signal device ON and OFF. Replace the Inverter-Charger if the Safety Input field on the AGS SETUP screen does not switch between ON and OFF when the safety signal voltage at **J5** is cycled between 0 VDC and 7 to 32 VDC.

   (AGS will still operate properly if ON and OFF on the screen are reversed from the actual signal.)

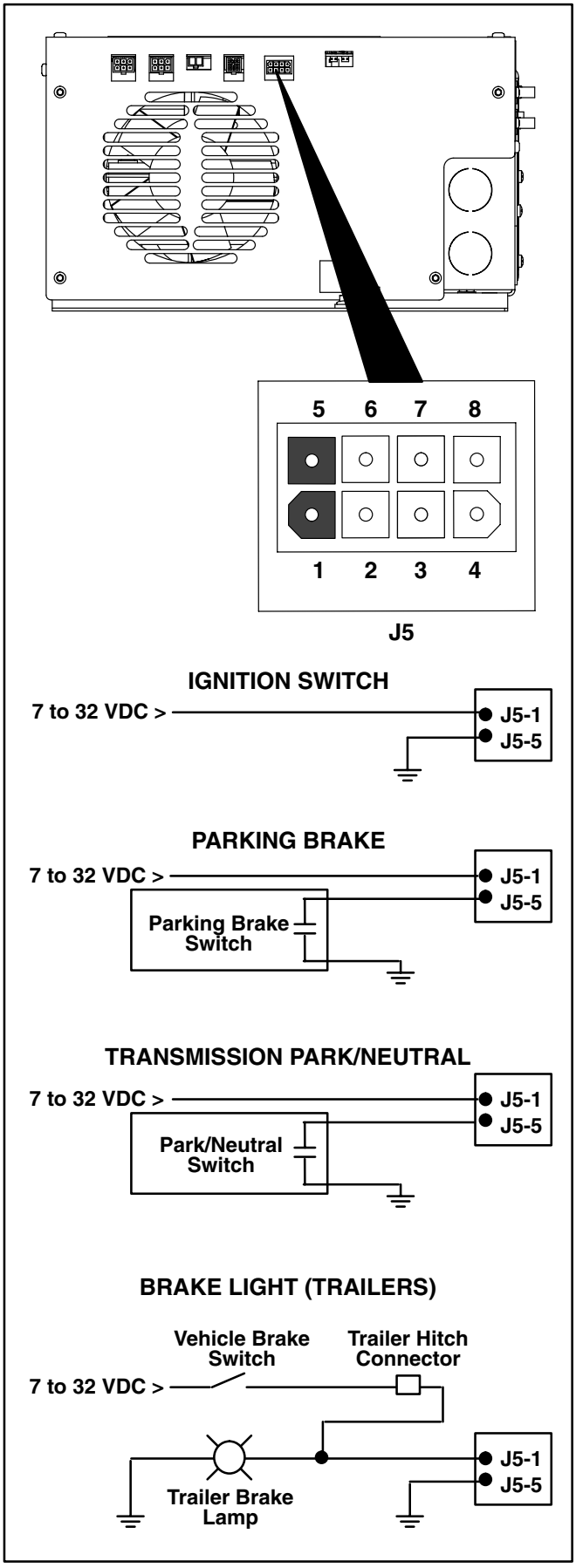


FIGURE 7-5. AGS SAFETY INPUT

GENSET START/STOP/RUN TESTS

Referring to Figure 7-6, conduct the following tests if genset control does not function properly:

1. Verify that the genset starts at a local or remote switch.
2. Disable AGS (p. 4-12) and Quiet Time (p. 4-17).
3. Check for 12 VDC across the Inverter-Charger DC output terminals.
4. Disconnect the plug-in harness at **J4**.
5. Measure electrical resistance across pins **J4–1** and **J4-2**. The circuit should be open (∞ ohms).
6. Press START on the GENSET STATUS screen (p. 4-10) 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).
7. For this test only, re-configure the Inverter-Charger for an Onan genset (p. 4-22), if not already so configured. Press PRIME on the GENSET STATUS screen. Measure electrical resistance across pins **J4–3** and **J4-2**. The circuit should close (0 ohms) and the Display should indicate genset PRIMING. Press STOP and the circuit should open (∞ ohms).
8. Connect a 9-volt dry-cell battery and plug-in test harness (541-0969) across pins **J4–4** (**+**) and **J4-2** (**–**) and press START. The Display should change from genset STARTING to genset RUNNING. It should change to genset STOPPED when the voltage is removed.
9. If the genset control circuits of the Inverter-Charger function properly, re-enable AGS and Quiet Time and re-configure for the proper genset, if changed in Step 7. Replace the Inverter-Charger if the genset control circuits do not function properly.
10. Reconnect the plug-in harness to **J4**. Press START on the GENSET STATUS screen. If the genset does not start, refer to GENSET CONTROL CONNECTIONS (p. 6-13) and make sure the plug-in harness is connected to receive the correct signals from the genset. Repair and reconnect as necessary.

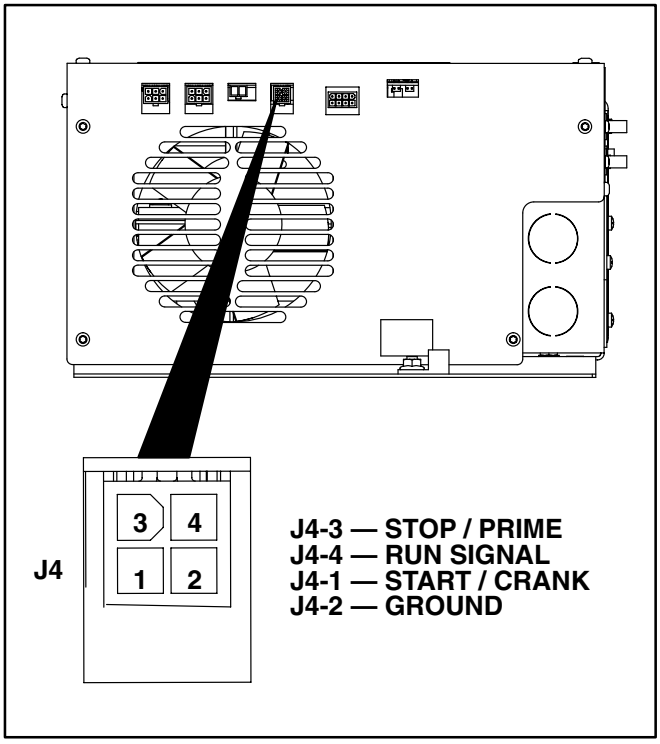


FIGURE 7-6. GENSET CONNECTOR J4

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. 5-2). 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. 5-2) 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. 7-1) 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 7-2. 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 7-2 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 7-7). See Page 4-18 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 7-7) and pick Wet Cell, Gel #1, Gel #2, or AGM, as appropriate.*

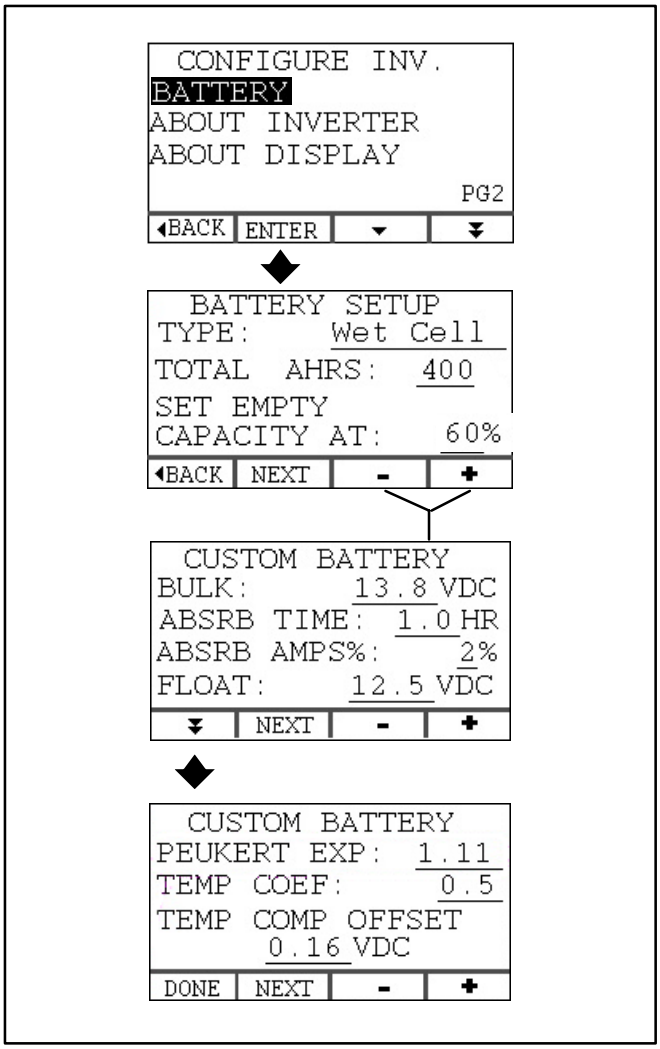


FIGURE 7-7. CUSTOM BATTERY PARAMETERS

TABLE 7-2. 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 5-1. 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.)

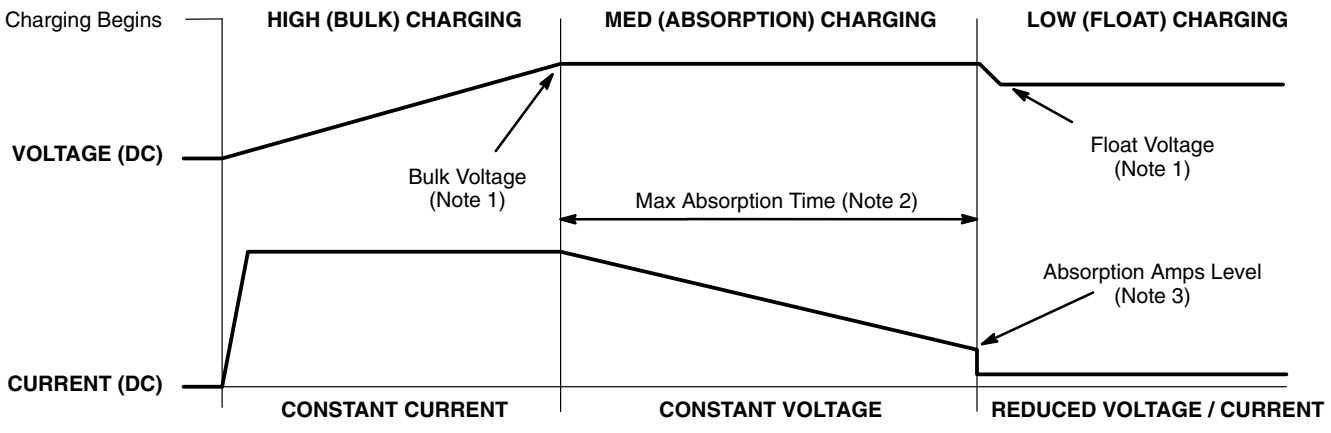


DIAGRAM OF 3-STAGE CHARGING VOLTAGE AND CURRENT

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. 4-20) 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. 5-2).***

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 the battery saver mode (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. 4-8).

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.

Section 8. Troubleshooting

USING THE EQUINOX DIGITAL DISPLAY

See Page 4-14 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 the following troubleshooting table 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. 4-3).

Viewing Last 5 Faults

See Page 4-15 for instructions on how to display the last 5 faults.

USING THE INVERTER-CHARGER CONTROL PANEL

See Page 3-2 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 the following troubleshooting table 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).

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

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. 7-3) and reconnect or replace components as necessary.
The Digital Display will not turn on	A. Verify that the battery saver mode has been enabled (p. 6-10), 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. 3-2) or by the Digital Display (p. 4-3). 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. 7-3) and reconnect or replace components as necessary.

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

PROBLEM	CORRECTIVE ACTION
The Inverter-Charger will not turn on	A. Turn on the battery disconnect switch if so equipped. B. Replace the battery fuse if blown (p. A-10). C. *If the battery saver mode has not been enabled*, make sure Jumper **J6** is in place (p. 6-10). D. *If the battery saver mode has been enabled*, conduct and Battery Saver Mode Tests (p. 7-4). E. Try enabling the Inverter-Charger at its control panel (p. 3-2) and then at the Digital Display (p. 4-1). Conduct a Communications Port Test (p. 7-3) 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.
Recycling AGS safety input, as requested, does not enable AGS	A. Check for broken or missing wires and corroded or bent terminals (connector **J5**). B. Conduct an AGS safety input test (p. 7-6) and reconnect or replace components as necessary.
Load Demand is enabled but the genset will not start	A. Verify that the AUTO GEN light is on. The genset will not start automatically unless AGS is enabled. B. Verify that the load demand signal type (active HIGH or active LOW) is correct (p. 4-26). C. Check for broken or missing wires and corroded or bent terminals (connector **J5**). D. Conduct a load demand signal test (p. 7-5).
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. 7-7).

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

PROBLEM	CORRECTIVE ACTION
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. Refer to GENSET CONTROL CONNECTIONS (p. 6-13) and make sure the plug-in harness at **J4** is connected to receive the correct signals from the genset. Operation can be erratic if **J4-4** receives anything other than the genset run signal. C. If the genset can be started and stopped normally, but not by the Digital Display, conduct a Genset Start/Stop Test (p. 7-7).
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. 4-20). B. If LBCO is off, verify that the fault history does not show any recent faults that would have disabled the Inverter-Charger (p. 4-15).
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. 4-3). 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. 4-21). Check the Charge Rate screen on the Digital Display (p. 4-6) to verify charger current. D. Disconnect less important DC loads. E. If wet cell batteries are being used, perform Equalize Charge (p. 4-8) to restore full capacity. F. Note that absorption charging of GEL and AGM type batteries can take 1 to 3 hours (Table 5-1). G. Have the batteries tested. Replace old, failing batteries (p. 5-3).

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

PROBLEM	CORRECTIVE ACTION
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. 4-3). 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.
AGS is enabled but did not start the genset when the batteries were low (Refer also to *Section C. AGS Events and User Actions* 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. 4-17). B. Check that the Charging Indicator Light is on or blinking (p. 3-2). 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. 7-7).
AGS is enabled and the batteries are charged but the Inverter-Charger does not automatically stop the genset (Refer also to *Section C. AGS Events and User Actions* 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. 7-7).

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

PROBLEM	CORRECTIVE ACTION
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. 3-2). C. Verify that input voltage is between 90 and 135 VAC (p. 4-6). 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). If there is only one set of AC input connections, make sure they are connected at AC INPUT 1 HOT and AC INPUT 1 NEUTRAL. E. Have the Inverter-Charger serviced.
The SHORE POWER Display screen (p. 4-6) 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.
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.

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

PROBLEM	CORRECTIVE ACTION
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.
Fault 24—Battery Temp Sensor Error	A. Check for proper battery temperature sensor connections (p. A-9). B. Conduct a Battery Temperature Sensor Test (p. 7-8). **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.

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

PROBLEM	CORRECTIVE ACTION
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. 7-8). C. Check Fault History (p. 4-15) 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. 4-10). 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. 7-7).
Fault 38—Inverter Overload (Timed 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 (p. 4-6). 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.

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

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. 4-20) if disabled. B. Connect AC power and charge the batteries. C. If wet cell batteries are being used, perform Equalize Charge (p. 4-8) to restore full capacity. D. Have the batteries tested. Replace old, failing batteries (p. 5-3). E. Check battery voltage at the Inverter-Charger with a meter. If the Display (p. 4-7) 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. 7-8).

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

PROBLEM	CORRECTIVE ACTION
Fault 59—Inverter Overload (Inrush)	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 4-5, p. 4-6). 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 *Appendix E. 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. 7-8). (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. 7-8). C. Check Fault History (p. 4-15) and replace the Inverter-Charger if there is a Fault 64, Charger Temp Sensor Error in the fault history.
Fault 64—Transformer Temp Sensor Error	A. Replace the Inverter-Charger. An internal temperature sensor in the Inverter-Charger has failed.

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

PROBLEM	CORRECTIVE ACTION
Fault 65—Charger Circuit Fault (*Inverting* may function though *Charging* and *AC Pass-Through* are disabled.)	A. A Fault 65 indicates inadequate cooling air flow for *Charging.* Let the Inverter-Charger cool down, remove objects that may be blocking air flow and RESET with the Digital Display as instructed on Page 4-14. B. If there is no Digital Display but the battery saver mode has been enabled, RESET by performing the following steps in order: disconnect AC power and turn the DC disconnect switch OFF. Wait 5 seconds to turn it back ON and then reconnect AC power. C. If there is no Digital Display or battery saver, RESET the Inverter-Charger by performing the following steps in order: disconnect AC power, disconnect all DC loads, disconnect the batteries, reconnect the batteries, reconnect AC power, wait 20 seconds, enable *Charging.* The Charging Indicator Light (p. 3-2) 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. 5-2).*** D. If the fault will not reset, replace the Inverter-Charger.
Fault 67—Inverter Overload (Left Bank Overcurrent FET)	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 (Right Bank Overcurrent FET)	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 69—FET Temp Sensor Error	A. Replace the Inverter-Charger.

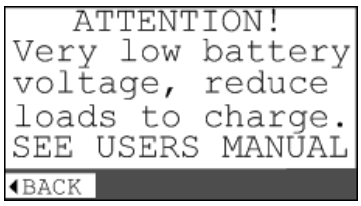
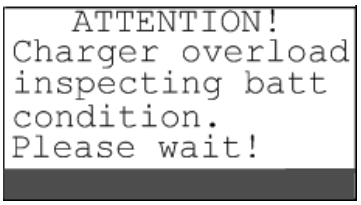
⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

PROBLEM	CORRECTIVE ACTION
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. Inspect Fault History (p. 4-15) for Fault 73 and troubleshoot accordingly. C. Check the DC fuse with an ohmmeter. An open fuse indicates a shorted charger output. Troubleshoot according to Fault 73. D. Check battery connections. If not connected, perform the following in order: disconnect AC power, disconnect all DC loads, disconnect the batteries, reconnect the batteries, reconnect AC power, wait 20 seconds, enable *Charging.* The Charging Indicator Light (p. 3-2) 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. 5-2).*** E. If the Charging Indicator Light blinks, indicating LOW charge, verify that all DC connections are correct. No DC load may be connected directly to the Inverter-Charger. Pages A-6, A-7 and A-8 illustrate recommended connections. Repeat Step D. F. If the Charging Indicator Light continues to blink, indicating LOW charge, see RECOVERING DEEPLY DISCHARGED BATTERIES (p. 7-11).

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

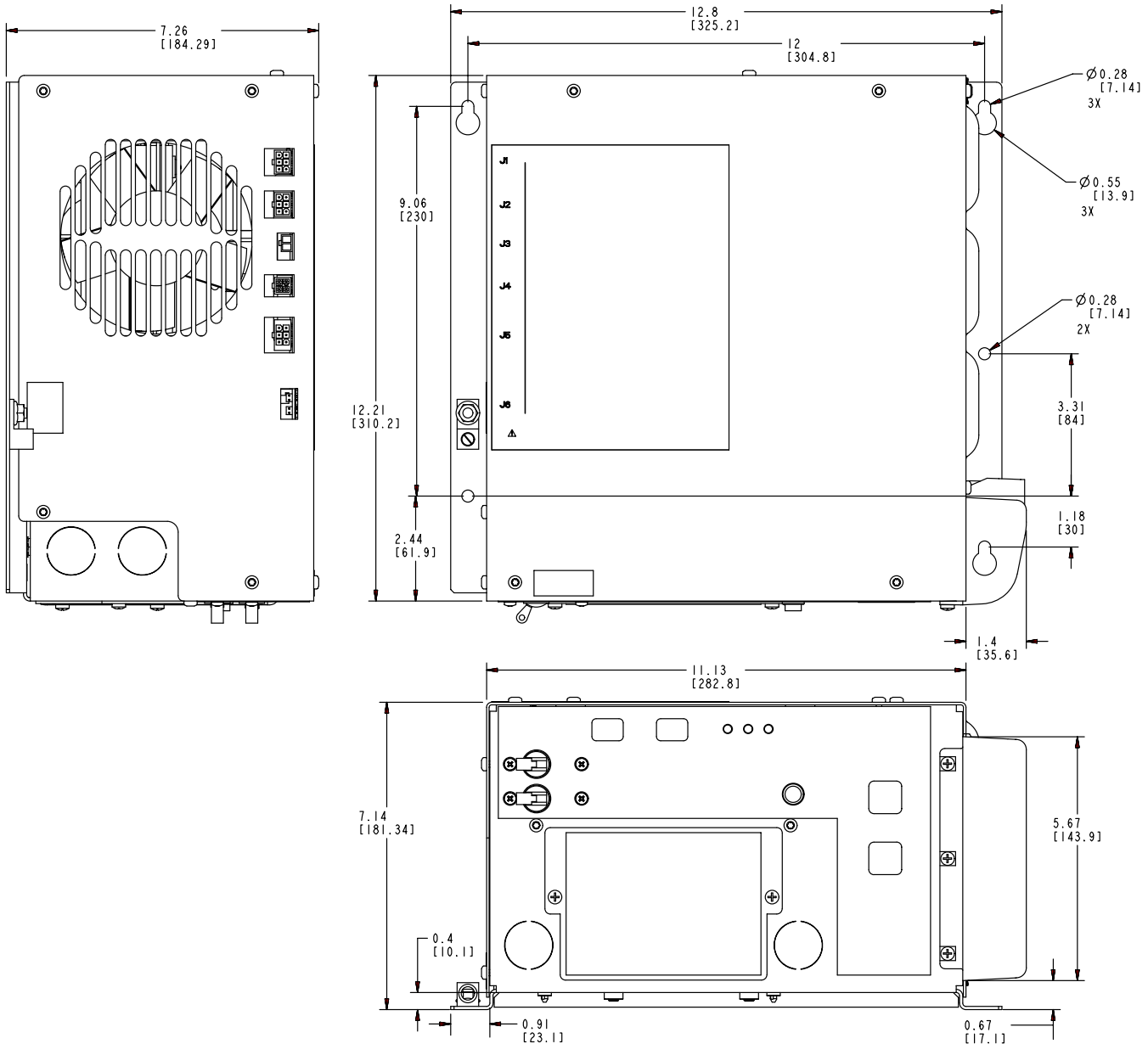
PROBLEM	CORRECTIVE ACTION
Fault 73—Charger Overload	A. The charger has been overloaded. This fault is indicated when the Battery voltage at the inverter terminals is less than 1.0 VDC and the charger current draw is greater than 3 amps for 10 continuous seconds. This can be an indication of a shorted charger output (DC short circuit). Inspect the DC fuse. An blown fuse is an indicator of a DC short circuit. Follow the below steps before replacing the fuse. B. Disable the AC input voltage to the Inverter-Charger. Inspect battery connections. Verify that the DC cables are not damaged or shorted to the Inverter-Charger case or any surrounding metal parts. Inspect the cable for damage. C. Disconnect the negative (**–**) cable from the Inverter-Charger. Disconnect the negative (**–**) cable from the batteries. Remove all DC loads. Disable all external battery chargers (including solar) such that the batteries are isolate from the vehicle loads and measure the voltage at the battery. Verify that voltage is roughly 9-14 VDC. If less than 4 VDC, see charging deeply discharged batteries (p. 7-11). Using an Ohmmeter, inspect for shorts between the positive (**+**) cable and disconnected negative (**–**) cable. Repair any shorts. When a short is found and corrected, replace the DC fuse, if necessary, before reconnecting the battery cables.

⚠WARNING ***Some Inverter-Charger service procedures present hazards that can result in severe personal injury or death. YOU MUST BE TRAINED AND EXPERIENCED TO SERVICE AN INVERTER-CHARGER.***

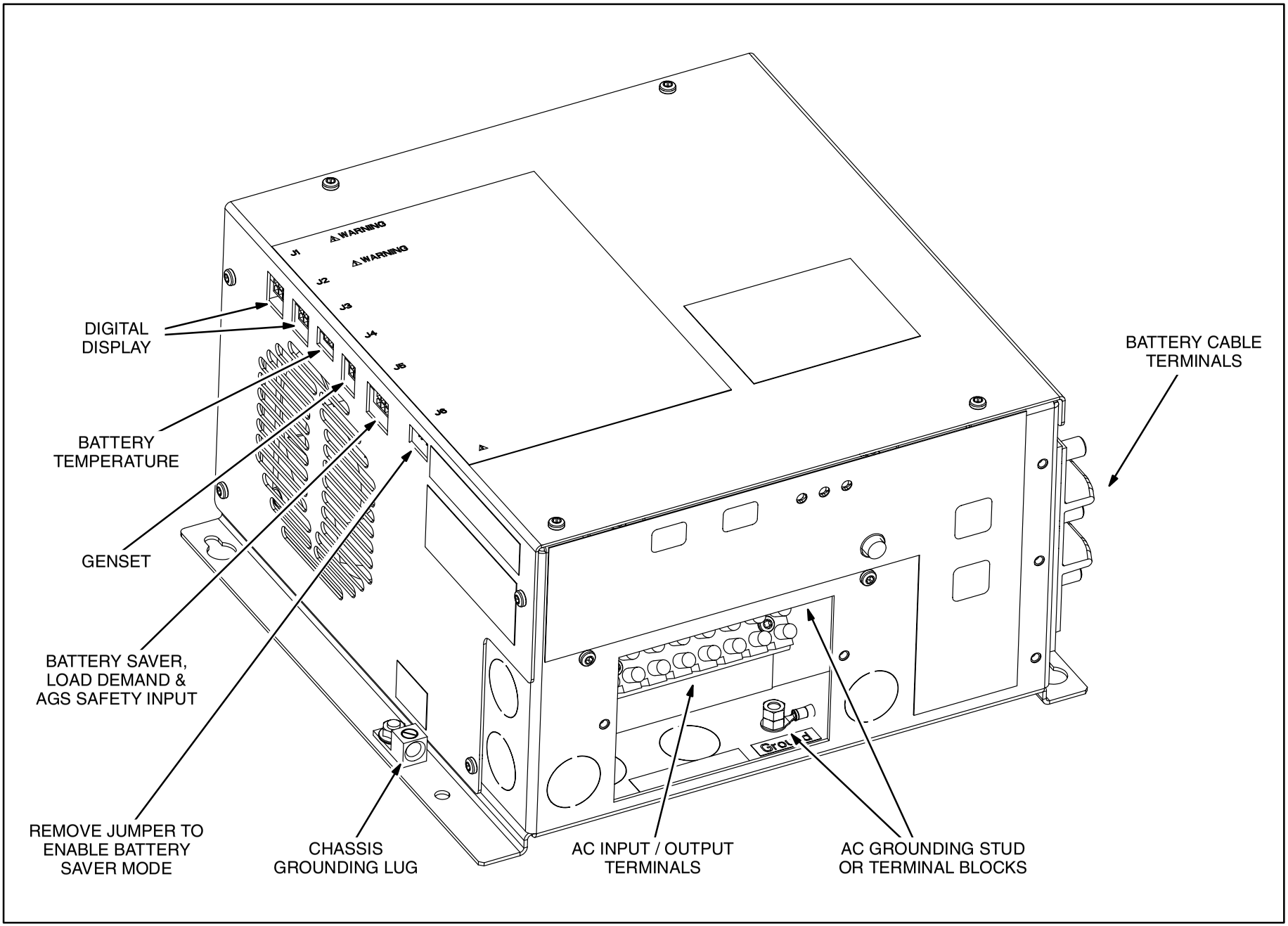
PROBLEM	CORRECTIVE ACTION
Either or both of the following two screens appears on the Digital Display, indicating that the charger has been charging but the batteries are not recovering.  	A. There is excessive AC pass–through current. The Inverter-Charger power sharing feature reduces the amount of power that goes to charging the batteries as AC pass-through loads are turned on, to prevent tripping the input circuit breaker. Navigate to the Shore Power screen (p. 4-6) on the Digital Display. If AC input current is greater than AC charger current (Batt Charge Rate screen [p. 4-6]), turn off AC loads downstream of the Inverter-Charger until AC CURRENT is roughly equal to CHARGER AMPS. B. The Circuit Breaker rating, which is used for power sharing, may be set too low. Typically this is set to 30 amps or 20 amps for most vehicles. See Page 4-21. C. There is excessive DC load draining the batteries and overloading the Inverter-Charger. DC loads draw energy from the Inverter-Charger that would normally go to the batteries. Reduce or remove all DC loads until the batteries have recovered. Inspect the DC loads for signs of excessive current draw and replace if faulty. D. Press the CHARGE RATE button on the Digital Display to show the CHARGER screen (p. 4-3) and increase MAX CHARGER CURRENT DRAW to allow the Inverter-Charger to recover the batteries before reconnecting AC or DC loads. E. The Batteries may have become disconnected from the Inverter-Charger due to a blown fuse or loose connection or an external charger may be tricking the Inverter-Charger into thinking that a battery is connected. Disconnect all other battery chargers (main engine, solar panel, other AC). Turn off all AC and DC loads. Using a voltmeter, verify that the voltage at the Inverter-Charger DC terminals is equal to voltage *at the battery*. If not, check the DC cables and fuses. If the voltage is the same but very low (less than 6 VDC), see RECOVERING DEEPLY DISCHARGED BATTERIES (p. 7-11). Note 1: Loads can be reapplied as needed once the batteries begin to draw reduced charging current and voltage is greater than12 VDC. It is recommended that the batteries be allowed to fully recover before heavily loading them. Equalize Charging may recover batteries (p. 5-2). Note 2: Leaving batteries in a discharged state for extended periods of time can result in reduced battery performance and life. Follow the battery manufacturer's recommendations.

Appendix A. Installation Drawings

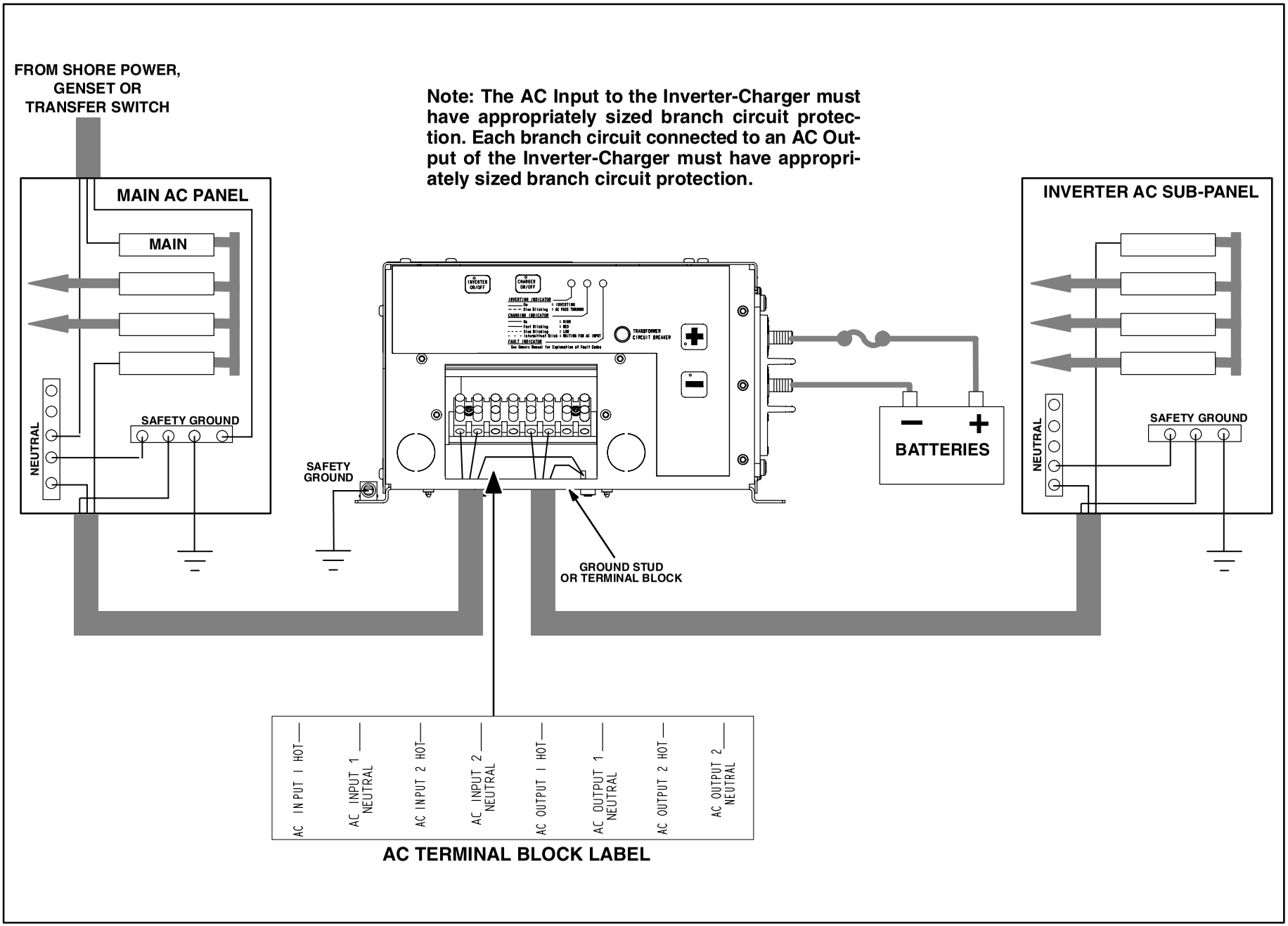
Dimensions are in Inches [mm]



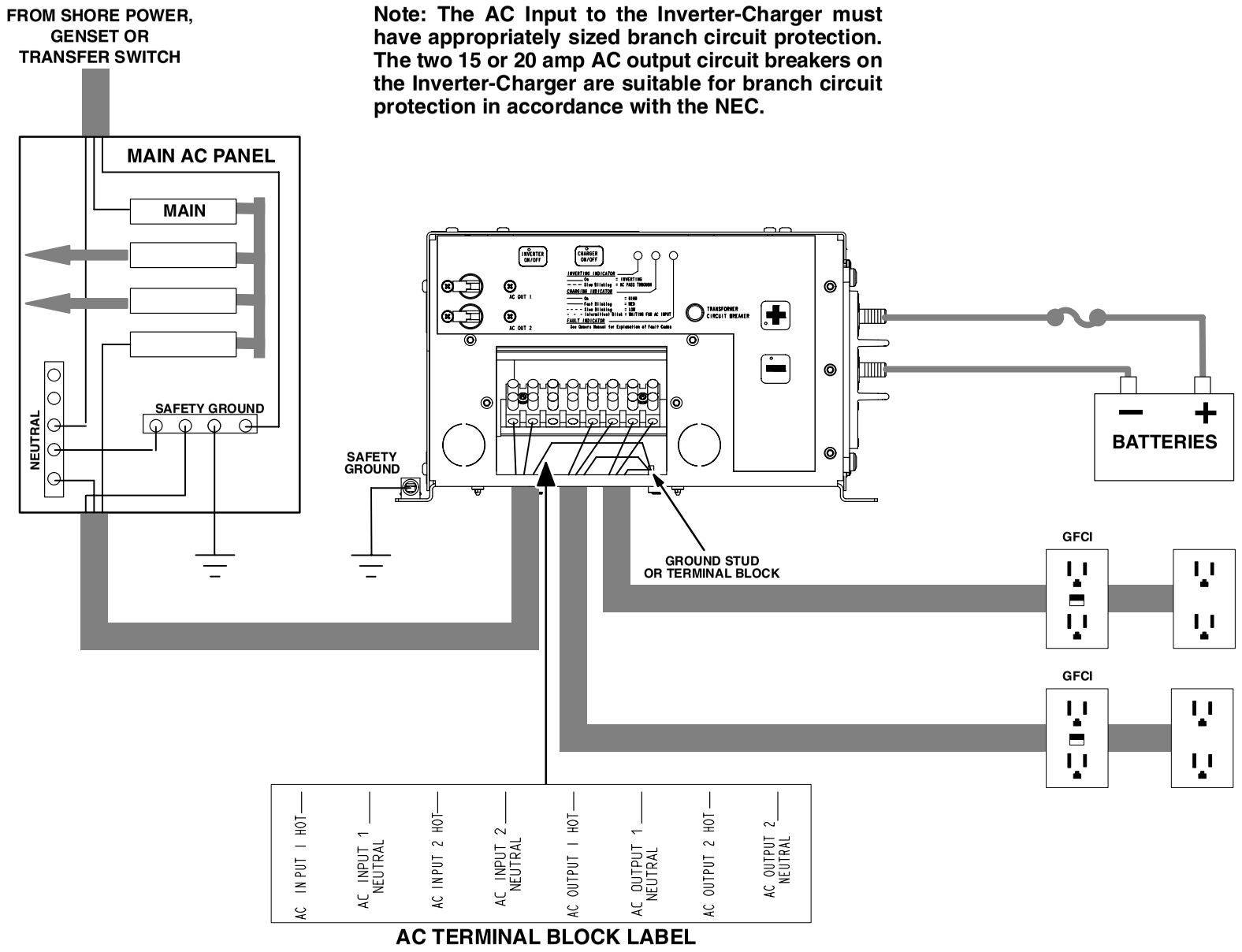
OUTLINE DRAWING



ALL EXTERNAL ELECTRICAL CONNECTION POINTS



TYPICAL AC CONNECTIONS—NO OUTPUT CIRCUIT BREAKERS

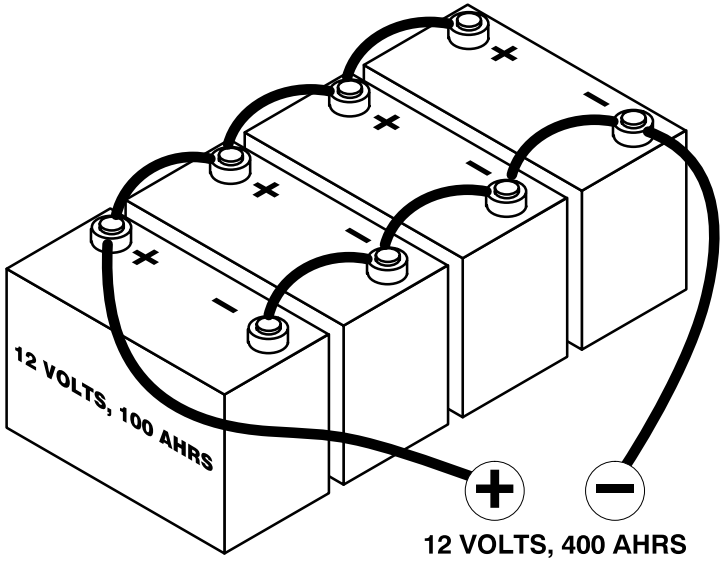


TYPICAL AC CONNECTIONS—TWO OUTPUT CIRCUIT BREAKERS

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



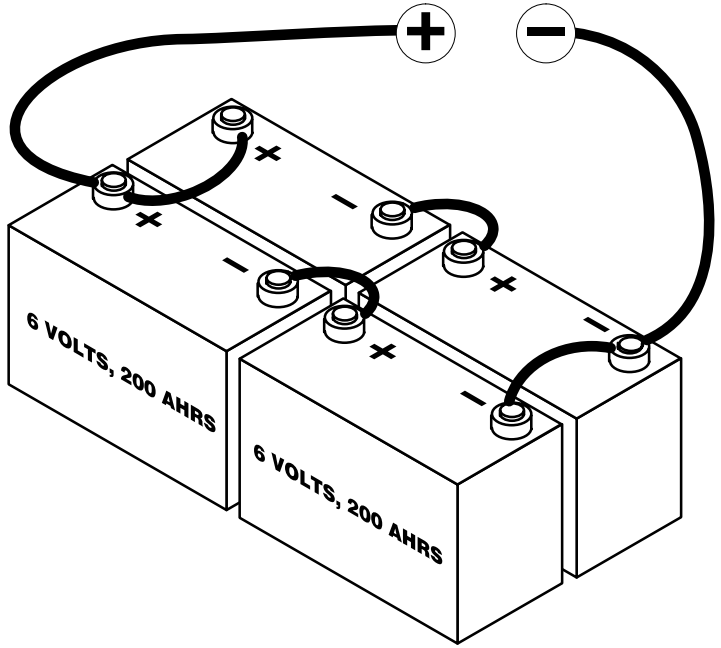
Note: A slight voltage drop occurs across each inter-battery cable during *Inverting* or *Charging*. For maximum battery bank output and even battery charging, it is important that each battery have the same number of inter-battery cables in its current path as all the rest of the batteries. The illustrations 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

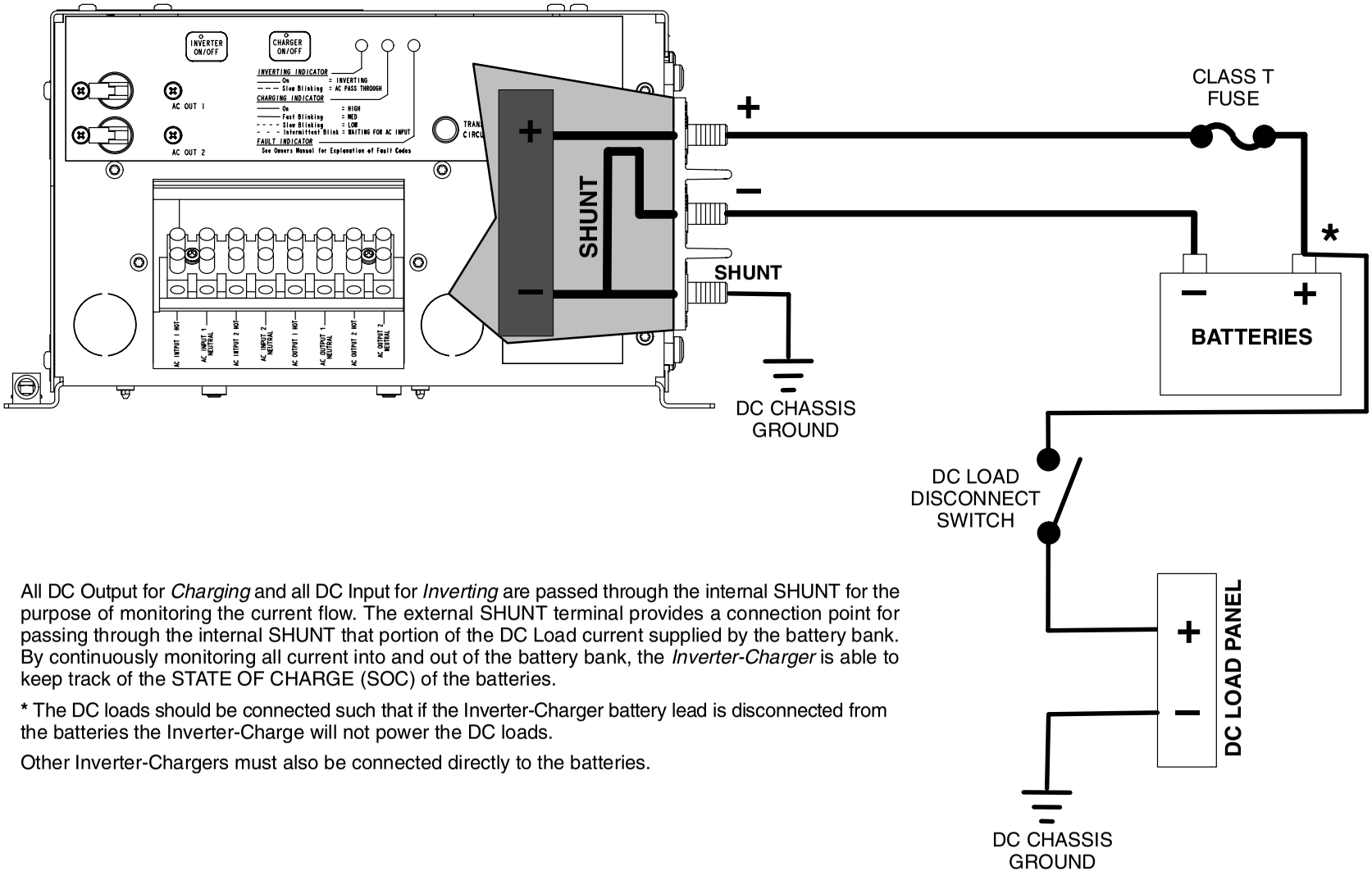
First connect pairs of 6 Volt batteries in SERIES: + to –, + to – to obtain 12 Volts (6 Volts + 6 Volts = 12 Volts). SERIES connections increase Voltage, not AHRS.

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 BATTERY BANK CONNECTIONS TO OBTAIN 12 VOLTS AND REQUIRED AHRS

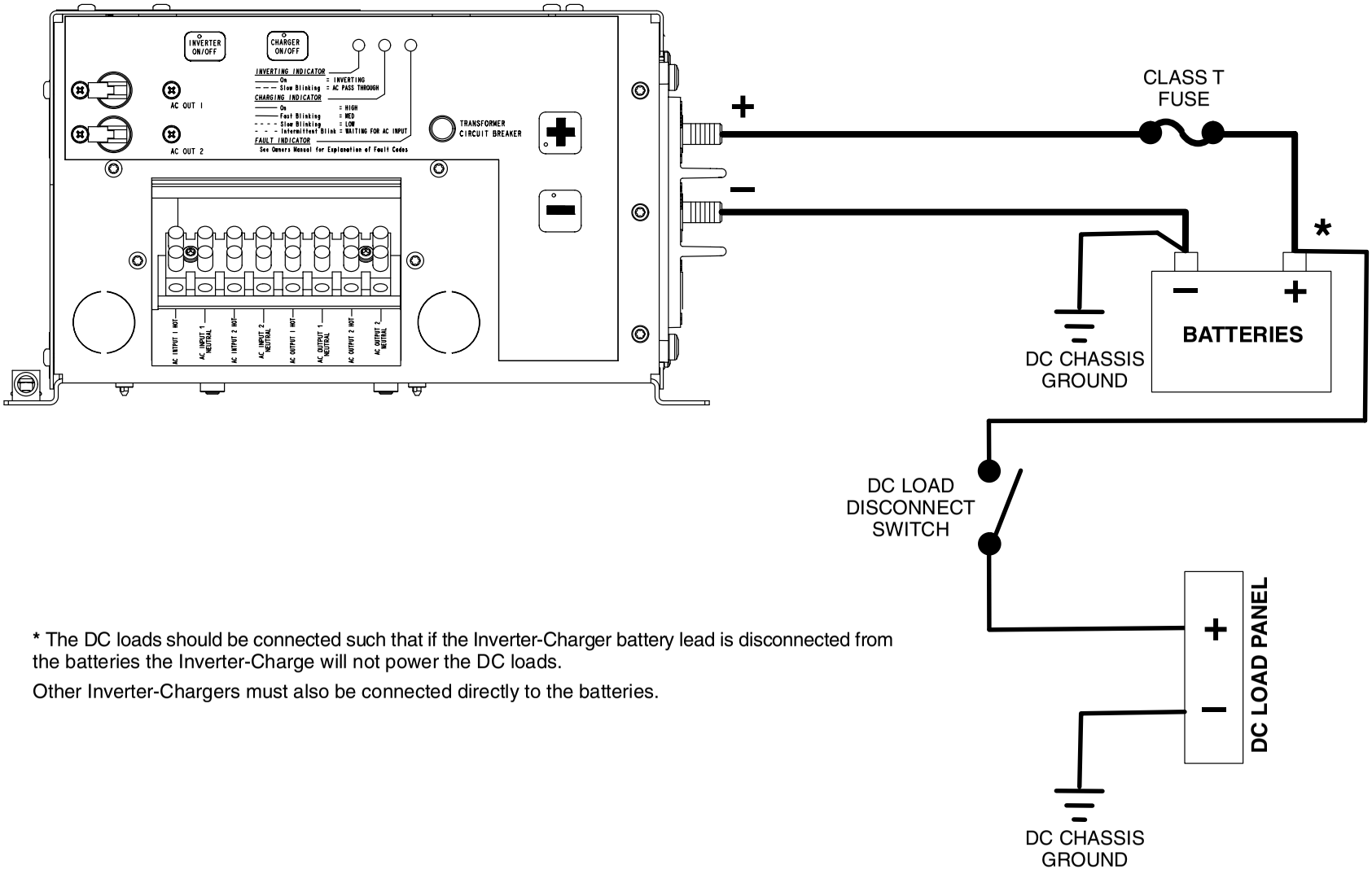


All DC Output for *Charging* and all DC Input for *Inverting* are passed through the internal SHUNT for the purpose of monitoring the current flow. The external SHUNT terminal provides a connection point for passing through the internal SHUNT that portion of the DC Load current supplied by the battery 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.

* The DC loads should be connected such that if the Inverter-Charger battery lead is disconnected from the batteries the Inverter-Charge will not power the DC loads.

Other Inverter-Chargers must also be connected directly to the batteries.

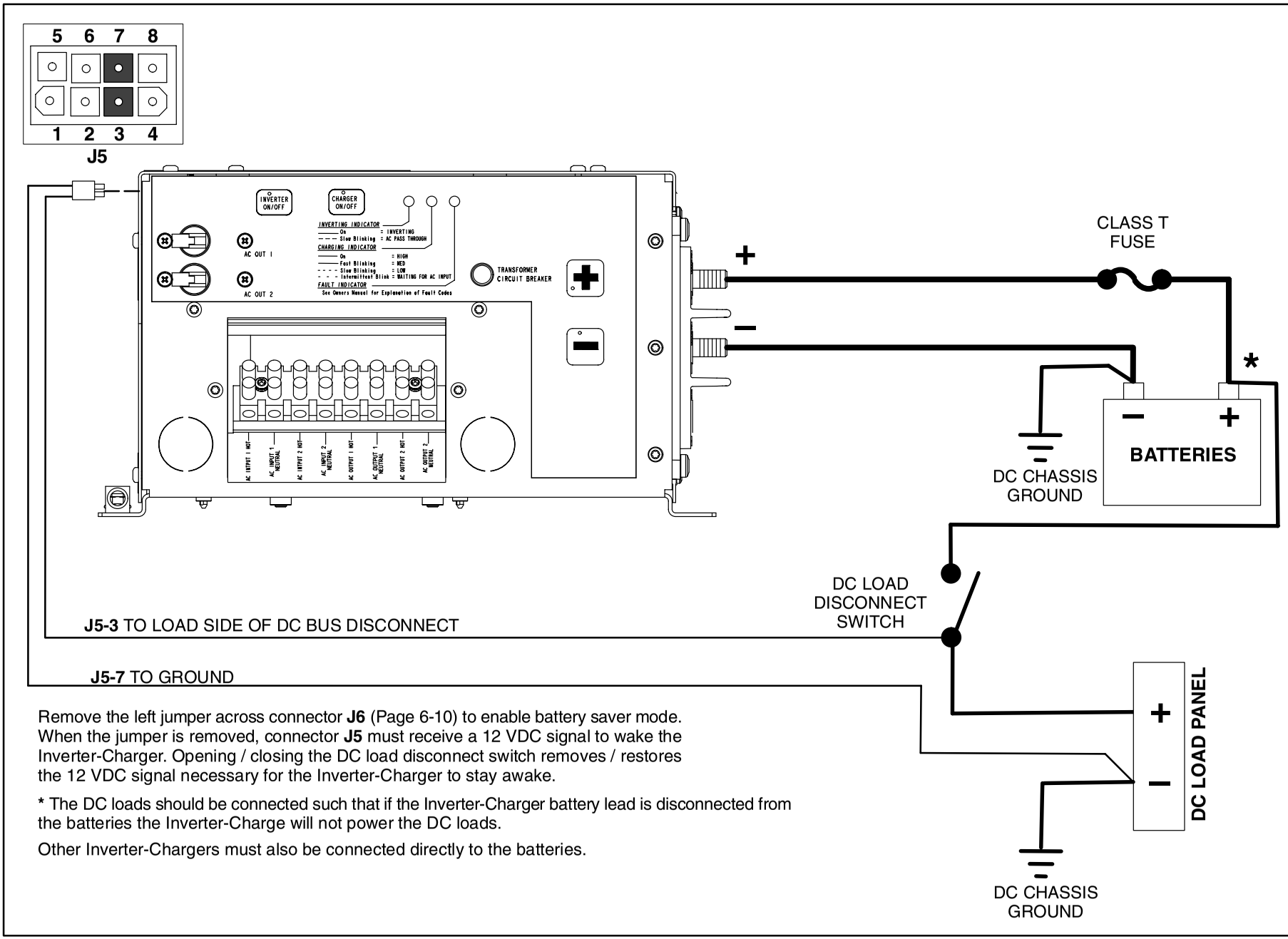
TYPICAL INVERTER-CHARGER BATTERY AND DC LOAD CONNECTIONS—MODELS WITH INTERNAL SHUNT



* The DC loads should be connected such that if the Inverter-Charger battery lead is disconnected from the batteries the Inverter-Charge will not power the DC loads.

Other Inverter-Chargers must also be connected directly to the batteries.

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

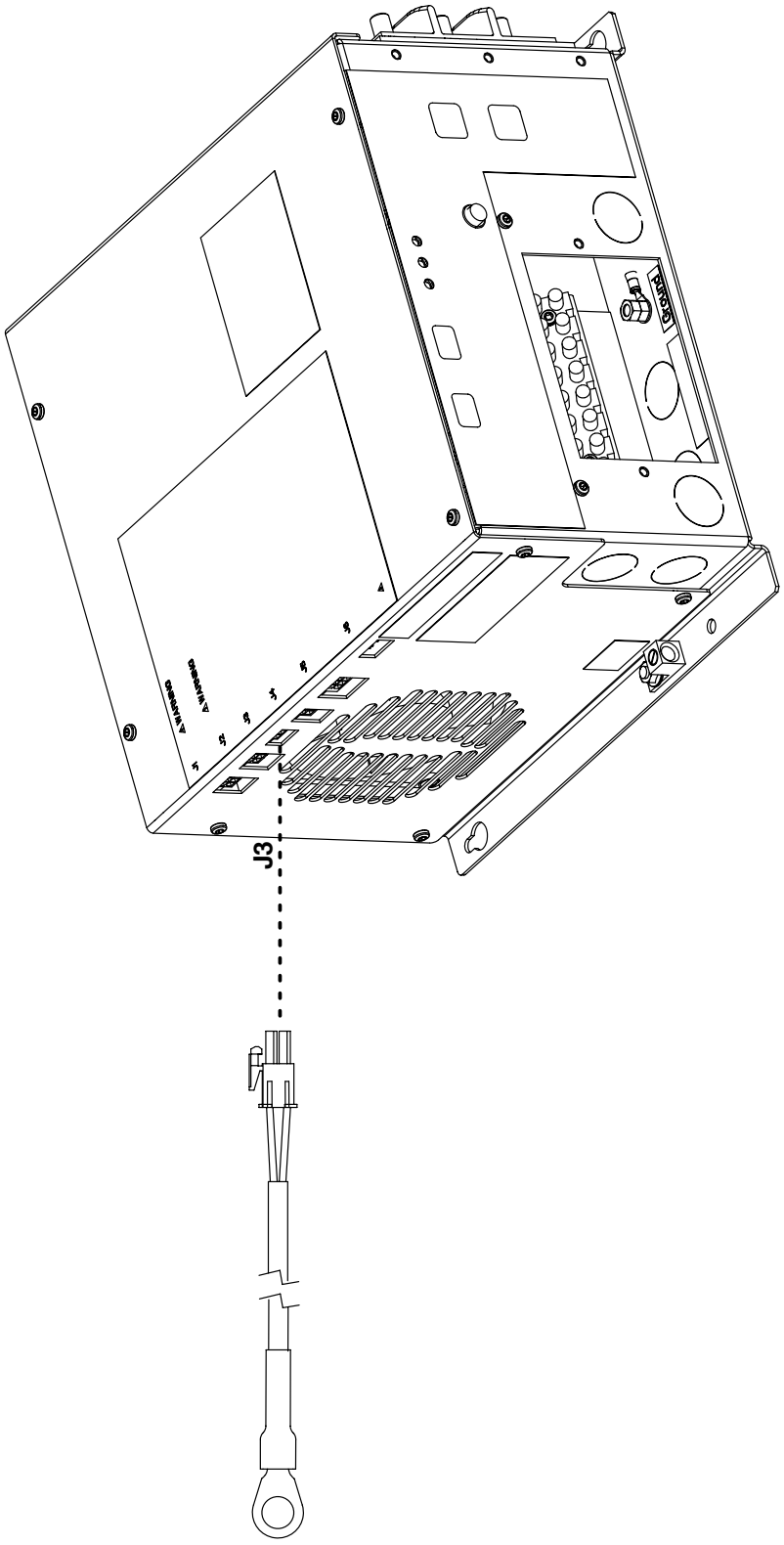


Remove the left jumper across connector **J6** (Page 6-10) to enable battery saver mode. When the jumper is removed, connector **J5** must receive a 12 VDC signal to wake the Inverter-Charger. Opening / closing the DC load disconnect switch removes / restores the 12 VDC signal necessary for the Inverter-Charger to stay awake.

* The DC loads should be connected such that if the Inverter-Charger battery lead is disconnected from the batteries the Inverter-Charge will not power the DC loads.

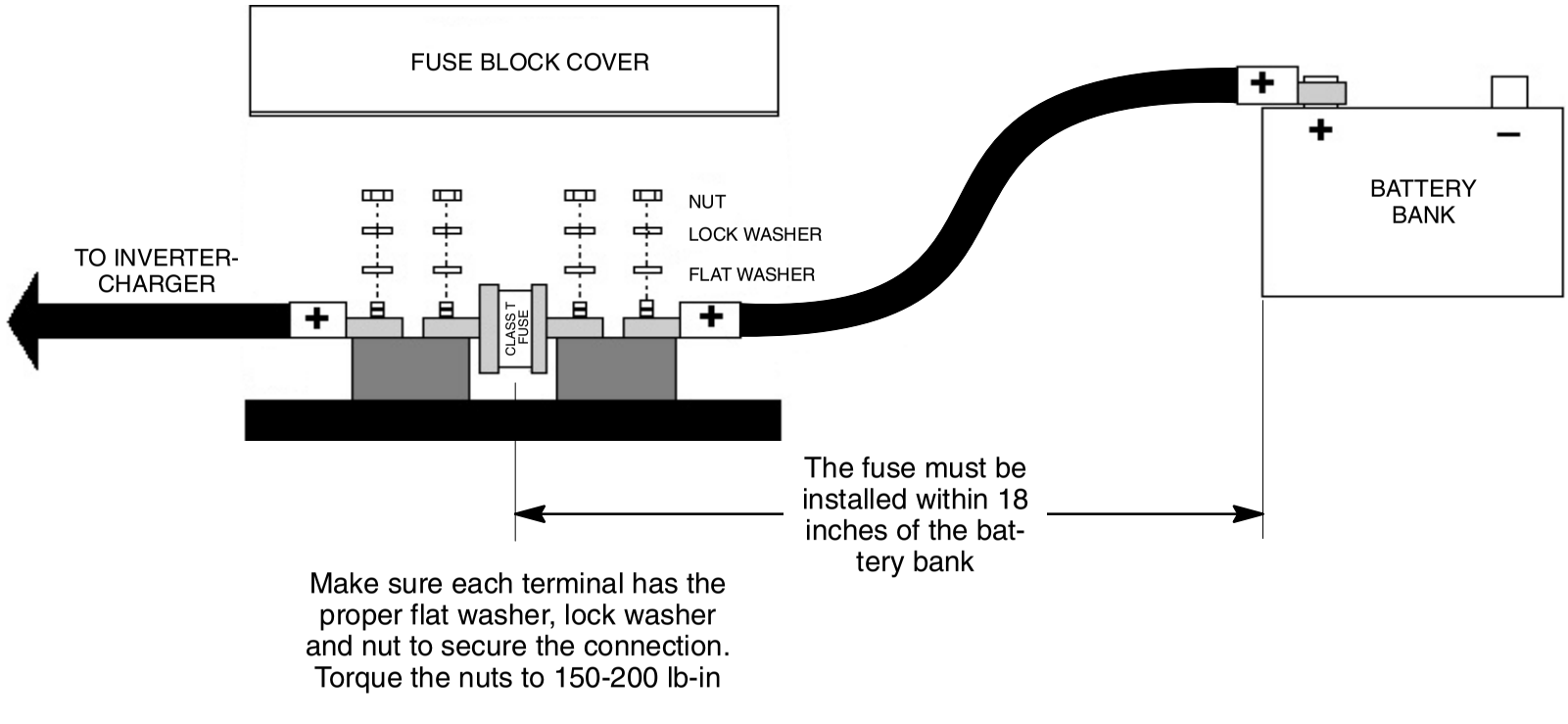
Other Inverter-Chargers must also be connected directly to the batteries.

TYPICAL BATTERY SAVER MODE CONNECTIONS

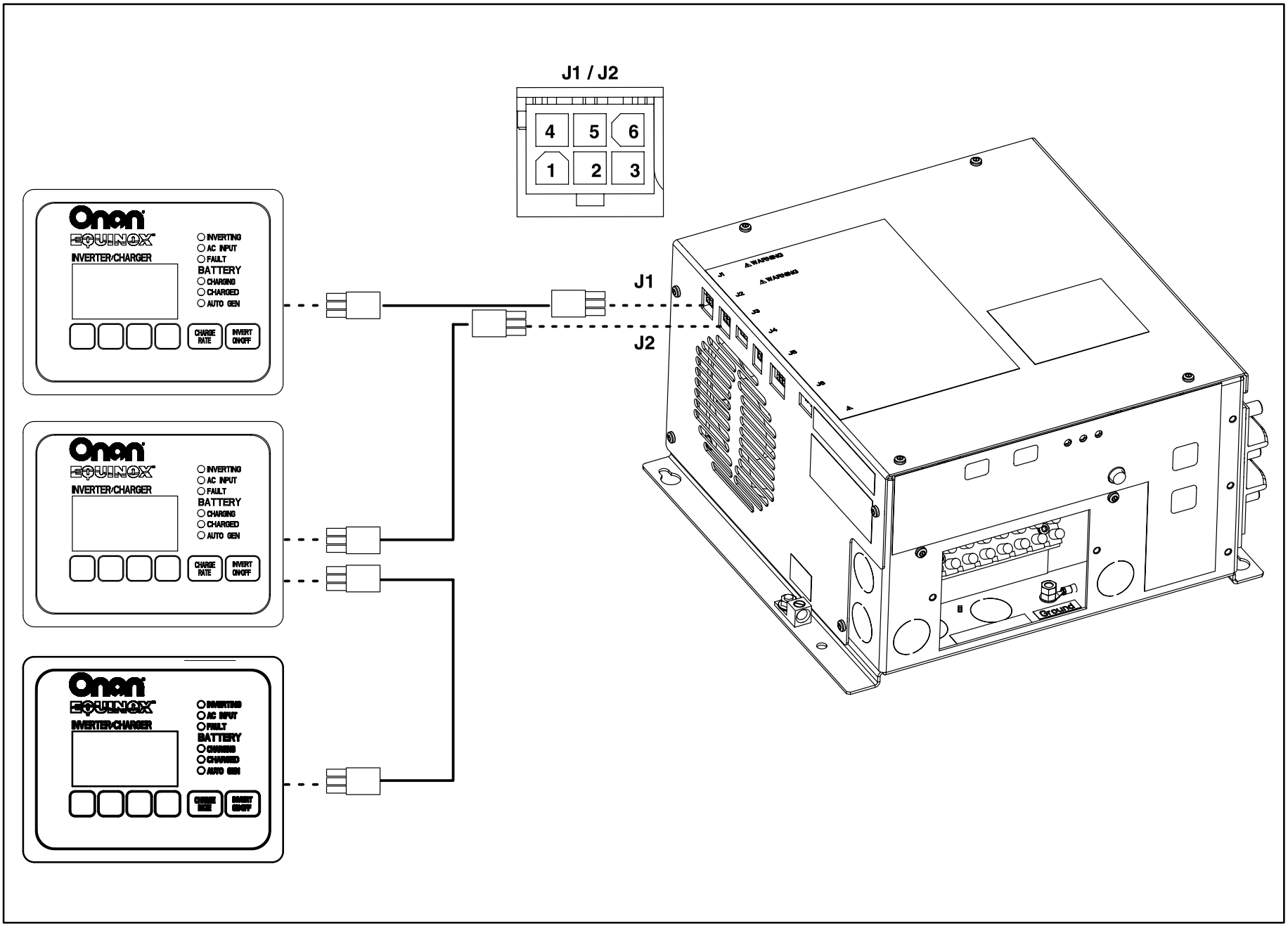


BATTERY TEMPERATURE SENSOR

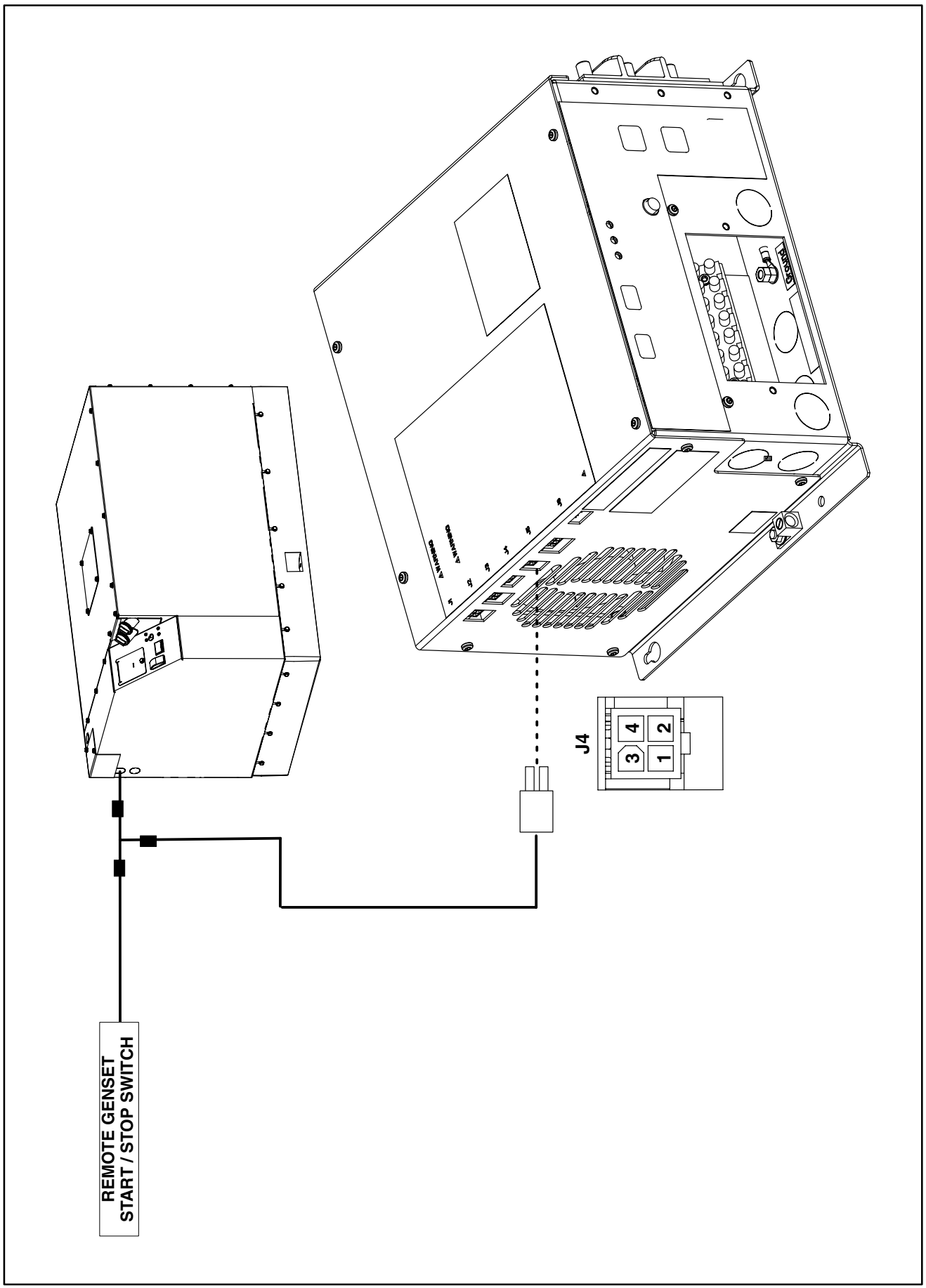
ILLUSTRATES FUSE BLOCK COVER LABEL



TYPICAL DC FUSE BLOCK INSTALLATION AND PROPER HARDWARE TORQUES AND STACKUP



TYPICAL EQUINOX DIGITAL DISPLAY CONNECTIONS



TYPICAL CONNECTIONS FOR GENSET CONTROL

Appendix B. 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	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				

Appendix C. AGS Events and User Actions

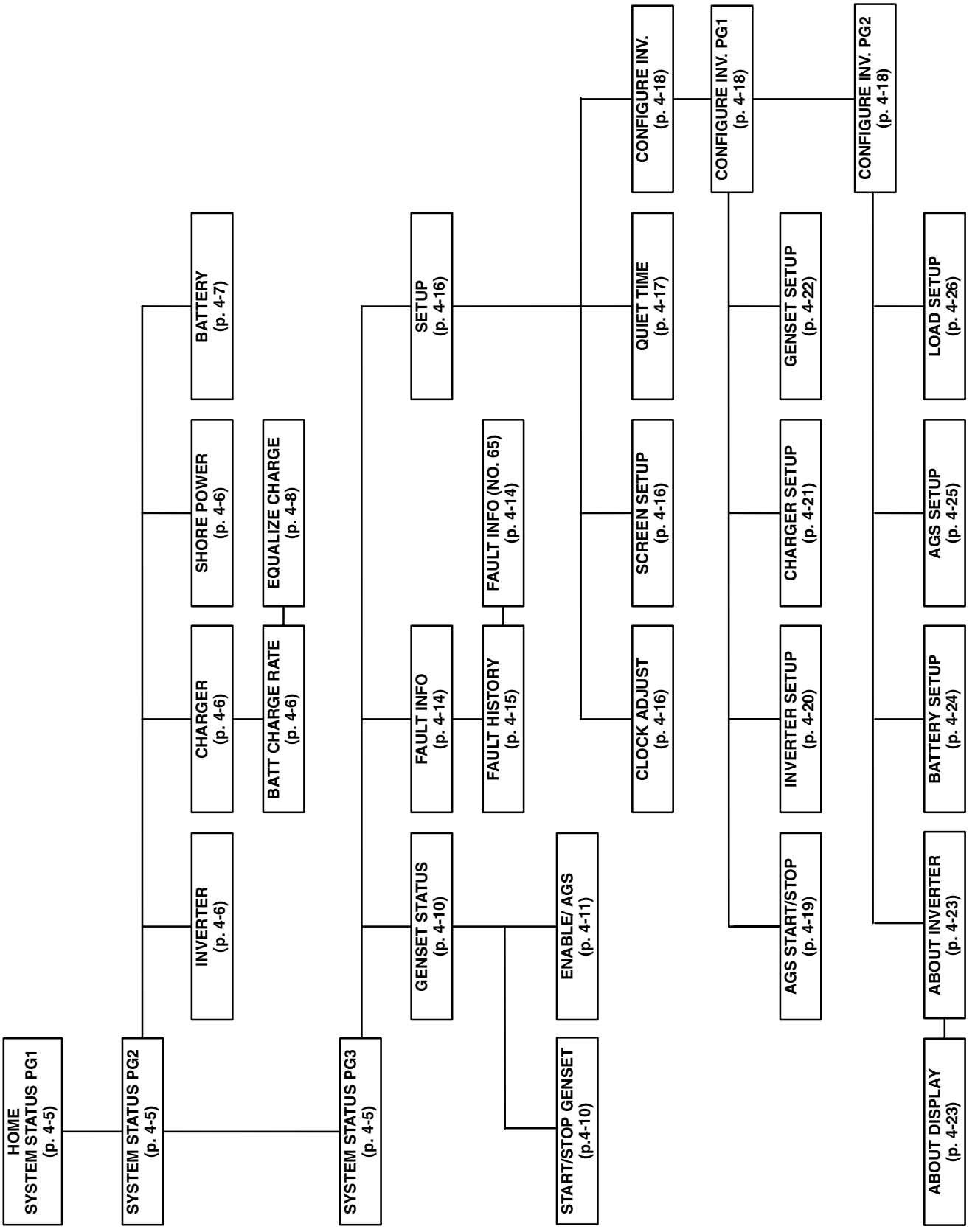
EVENTS AND USER ACTIONS THAT AFFECT AGS

EVENT OR USER ACTION	EFFECT ON AGS (AUTOMATIC GENSET STARTING)
AGS (p. 4-11) is enabled but *Charging* (p. 4-3) is disabled	AGS will not start the Genset if Battery Charge drops to the AGS Start point (p. 4-19). *Inverting* will be disabled if the LBCO threshold is reached (p. 4-20). AGS remains enabled (the AUTO GEN light stays on) and will start the genset if a Load Demand signal (p. 4-26) is received or *Charging* is re-enabled.
AGS is enabled but Quiet Time is in effect (p. 4-17)	AGS will not start the genset to charge the batteries or supply an AC load demand *until* Quiet Time expires. The AUTO GEN light blinks indicating that AGS is in standby. *Inverting* will be disabled if the LBCO threshold is reached (p. 4-20).
AGS starts Genset but then loses the Genset RUN signal	The Genset must be manually stopped. The Display will think the Genset has stopped (p. 4-10). See GENSET START / STOP / RUN TEST (p. 7-7). Loss of the RUN signal also disables AGS. The AUTO GEN light will go out.
AGS starts Genset but then loses the Digital Display connection	AGS will continue to start and stop the Genset as usual. The Display will post the message, "WARNING! COMMUNICATIONS LOST WITH MAIN CONTROL." See REMOTE COMMUNICATIONS TESTS (p. 7-3). *Note that AGS can be enabled only by a working Display.* AGS can be disabled with a working Display or by cycling the AGS safety input device (p. 4-11), by manually starting or stopping the Genset or by disconnecting the batteries or AC input. A Genset or Inverter-Charger fault shutdown of sufficient severity will also disable AGS.
Quiet Time (p. 4-17) is in effect when Genset is manually started	The Genset must be manually stopped. A manual start disables AGS. The AUTO GEN light will go out.
Quiet Time is in effect when Genset is manually started. AGS is then enabled	The Genset will start, but will be stopped when AGS is enabled. The AUTO GEN light will blink indicating that AGS is in standby.
AGS starts Genset but Genset shuts down or is manually stopped	A manual Stop or Shutdown disables AGS. The AUTO GEN light will go out.
AGS is enabled and then Genset is manually started	The Genset must be manually stopped. A manual Start disables AGS. The AUTO GEN light will go out.
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. 4-19) or Quiet Time goes into effect. AGS will keep the genset running until a Load Demand (p. 4-26) is satisfied.

EVENTS AND USER ACTIONS THAT AFFECT AGS (CONT.)

EVENT OR USER ACTION	EFFECT ON AGS (AUTOMATIC GENSET STARTING)
AGS (p. 4-11) is enabled and a start condition occurs (Low Battery [p. 4-19] and/or Load Demand [p. 4-26]) but Shore Power is available	AGS will not start the Genset as long as there is Shore Power.
AGS starts Genset due to Load Demand (p. 4-26) and then is disabled	The Genset must be manually stopped.
AGS started Genset because Shore Power was unstable	AGS will run the Genset until Battery Charge drops to the AGS Stop point (p. 4-19) and/or a Load Demand (p. 4-26) is satisfied. AGS cannot tell the difference between Genset and Shore Power and therefore does not know to stop the genset when Shore Power has stabilized.
AGS tried but could not start Genset	AGS will make three attempts to start the Genset. If the Genset does not start, the Display will declare Fault 36, GENSET FAILED TO START (p. 4-14). AGS will be disabled and the AUTO GEN light will go out. *Inverting* will be disabled if the LBCO threshold is reached (p. 4-20).
AGS is enabled and a Load Demand (p. 4-26) cycles on and off	AGS resets the genset minimum-run-time clock each load cycle. AGS will not stop the genset until the Load Demand signal has been OFF for 5 continuous minutes.
AGS is enabled but the *Inverter-Charger* has been in Battery Saver Mode (p. 4-26)	AGS requires that the safety signal be cycled to re-enable AGS, as indicated by a warning screen (p. 4-13).
AGS Safety Signal is either High (7-32 V) or Low (0 V) for 30 consecutive days	AGS will expire, as indicated by a warning screen (p. 4-13). See Page 4-11 to reset the Safety Signal timer for another 30 days and re-enable AGS.
AGS Safety Signal is either High (7-32 V) or Low (0 V) for 25 to 29 consecutive days	AGS will expire in 5 days, as indicated by a warning screen (p. 4-13). See Page 4-11 to reset the Safety Signal timer for another 30 days. AGS does not need to be re-enabled.

Appendix D. Digital Display Menu Map



Appendix E. Installation Check List

- ☐ Has the Inverter-Charger been mounted in a dry, cool and adequately vented compartment, protected from battery acids and gasses?
- ☐ Has the Inverter-Charger been mounted securely to the chassis?
- ☐ Has the positive (**+**) battery cable been connected directly, through the DC fuse, to the positive (**+**) battery terminal of the battery bank ?
- ☐ Has the negative (**–**) battery cable been connected directly to the negative (**–**) battery terminal of the battery bank?
- ☐ Is the DC fuse installed within 18 inches of the battery, and is the fuse cover in place?
- ☐ Have all DC connections between the batteries and the Inverter-Charger been tightened as specified in the manual?
- ☐ Has the proper DC cable length and wire gauge been used for the size of inverter installed?
- ☐ Have all DC cables been routed and secured away from sharp edges?
- ☐ Is the Inverter-Charger chassis properly grounded to the vehicle chassis?
- ☐ Have all AC input and output connections been tightened correctly, routed and secured away from sharp edges and fastened with properly sized strain reliefs?
- ☐ Have properly sized AC input and AC output breakers been installed?
- ☐ Are all AC and DC terminal covers secure in place?
- ☐ Is the battery temperature sensor mounted on the battery bank in the correct location, and connected to the Inverter-Charger at **J3**? See Page 6-9.
- ☐ Have battery type and battery bank size (when a Digital Display is available) been configured properly? See Pages 6-9 and 4-24.
- ☐ (Optional) Is the Digital Display properly mounted and connected to the Inverter-Charger at **J1** or **J2**, and is it communicating with the Inverter-Charger? See Page 6-13.
- ☐ (Optional) Is the Battery Saver feature installed properly? See Page 6-10. (Does the Digital Display turn off when the battery saver feature is enabled?)
- ☐ (Optional) Is the AGS safety input signal connected at **J5** and operational? See Page 6-12. (Conduct the safety input test.)
- ☐ (Optional) Is the genset connected properly to the Inverter-Charger at **J4**, and configured for the correct genset type)? See Page 6-13. (Can you start and stop the genset from the Digital Display?)
- ☐ (Optional) Is the Load demand input feature connected correctly at **J5** and operational? See Page 6-11. (Conduct the load demand test.)
- ☐ (Optional) Have the AGS Safety Warning labels been placed in the appropriate locations in the Coach? See Page 6-14.

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