

# OWNER'S MANUAL

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## FREEDOM 458 Series COMBI™ INVERTER/CHARGER



Model 10  
Model 15, 15 S/D  
Model 20, 20 S/D  
Model 25 D/D  
Model 30, 30 D/D

\*Manual includes all models of Freedom 458 Series Combi™ Inverter/Chargers



**INFORMATION IN THIS MANUAL IS SUBJECT TO CHANGE WITHOUT NOTICE**



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The statements, specifications and instructions in this publication are believed to be correct. No warranty is made, expressed or implied by the seller or manufacturer with respect to any results or lack thereof from the use of information in this publication and no liability is assumed for any direct or consequential damages, personal loss or injury. All statements made herein are strictly to be used or relied on at the user's risk.

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# INTRODUCTION

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Thank you for purchasing a Heart Interface Freedom 458 Series Combi<sup>™</sup> Inverter/Charger. Heart Interface takes pride in manufacturing quality products specifically designed to meet your power requirements.

Freedom Inverter/Chargers provide silent, efficient and reliable AC power for a variety of applications. They feature “hands-free” operation, automatic 3-stage battery charging and automatic AC transfer switching. For your convenience, service is available worldwide by qualified service centers.

## ***Technical Support***

If you have any questions about your Freedom Inverter/Charger, please contact Heart Interface toll-free in the U.S. and Canada, at **(800) 446-6180** (outside 253 area code) or at **(253) 872-7225**.

For technical support and additional information about Heart Interface products, visit our web site at **www.heartinterface.com** or send us e-mail at:

- [techhelp@heartinterface.com](mailto:techhelp@heartinterface.com)
- [sales@heartinterface.com](mailto:sales@heartinterface.com)

## ***Servicing***

Qualified service personnel should perform all servicing of your Freedom Inverter/Charger.



### **Caution**

- *Risk of electrical shock.*
- *Do not open this unit. There are no user serviceable parts inside.*
- *Both AC & DC voltage sources are terminated inside this equipment. Disconnect all inputs and outputs before servicing.*

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## Warranty

Your Heart Interface Freedom 458 Series Combi<sup>TM</sup> Inverter/Charger has a 30-month limited warranty, from date of purchase.

**Terms of this warranty are detailed on the warranty registration card. Please complete this card and return it to Heart Interface. Returning the card will register your warranty.**

If your unit requires service, phone Heart Interface at the number listed below. Please have the model number, and serial number ready for the service technician. You can find these numbers on the unit's mounting flange or on the manual's front cover. The model number will look like "81-XXXX-12."

Phone numbers: (253) 872-7225

Toll-free in U.S. and Canada,  
outside 253 area code (800) 446-6180

The service technician will issue a return authorization number for all returns. **All returns must have a return authorization number.**

Ship the unit freight prepaid, to Heart Interface or to the field service center. Write the return authorization number on the outside of the packaging.

## Features

### DC to AC Power Inverting

Your Freedom Inverter/Charger provides 120-volt, AC power to run your appliances from deep cycle DC batteries.

### Automatic Transfer Switching

The Freedom Inverter/Charger automatically switches between inverter power and incoming AC power. The unit can use external AC as its power source in addition to batteries. The internal transfer switch allows the unit to transfer the AC power through directly to the loads.

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When the external AC power source is disconnected, the transfer switch allows automatic switching back to the inverter.

## Automatic 3-Stage Battery Charging

The Freedom Inverter/Charger is designed to rapidly and optimally charge wet, gel, or Absorbed Glass Mat cell deep-cycle batteries. The battery charger automatically proceeds through the bulk, acceptance, and float charging stages, resulting in an efficient, complete charge.

Additionally, you can use Remote Control Panel or the LINK instrument to manually equalize wet cell batteries. Equalizing restores your wet cell batteries to their optimal, operating condition.

## Unit Protection

Fast-acting electronic circuits protect your Freedom Inverter/Charger from overloads and short circuits. Your unit also has low and high battery voltage cutoff, and automatic shutdown if it gets too hot.

## Neutral Bonding

The Freedom Inverter/Charger automatically bonds the internal AC output neutral (white) to the internal AC output ground (green), when the unit is off or in the inverter mode. No additional wiring is needed for this process.

When incoming AC power is applied and the transfer switch engages, and the internal neutral-to-ground bond is automatically lifted.

This insures safety in all conditions and meets the National Electrical Code (NEC) requirements.

## Power Sharing

When the unit is connected to an external AC source, the battery charger and transfer functions are engaged. A unique Power Sharing feature automatically reduces the AC power consumption of the battery charger. This allows the necessary

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AC power to go to the loads and helps to prevent the source AC input circuit breaker from tripping.

The Power Sharing set point is set to factory default of 30 amps. This can be changed using the Remote Control Panel or LINK instrument.

### **Inverter Idle Circuit**

This automatic, energy saving feature reduces battery power consumption when you do not have an AC load connected to the Freedom Inverter/Charger's output. You can use the Remote Control Panel or LINK instrument to adjust the idle threshold. The factory default setting is 5 watts.

To bring the unit out of the idle condition, apply a load. Response from idle is instantaneous.

### **Thermostat Controlled Cooling**

Your Freedom Inverter/Charger is equipped with a thermostatically controlled fan. This cools the unit so it can operate continually at its rated output.



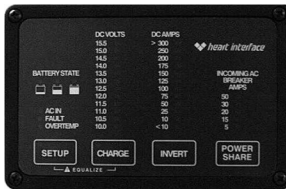
# REMOTE CONTROLS

You can purchase two types of Heart Interface remote controls to use with your Freedom Inverter/Charger:

1. Remote Control Panel
2. LINK instruments

Installation and operations instructions for your remote control are packed with the panel.

## Remote Control Panel



The remote control panel has:

- LED bar graphs to show you the battery voltage and DC current in both inverter and charger modes.
- Easy to see red, yellow and green LEDs to show you the state of the battery charge.
- Controls for charger ON/OFF, inverter ON/OFF and Power Sharing.
- Set up features includes selection of Idle Threshold, Battery Type and Battery Capacity.

## LINK Instrument

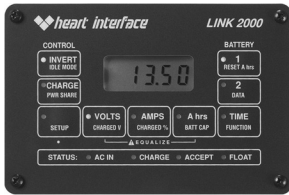
Heart Interface offers three advanced remote control panels: LINK 1000, LINK 2000, and LINK 2000R. All LINK instruments provide:

- State of the battery charge information. This includes the DC voltage, current, amp-hours consumed, how much time remains on the batteries and historical data.
- Freedom Inverter/Charger controls



### LINK 1000

The LINK 1000 provides information and controls for a single battery bank. It also measures the voltage of an auxiliary battery.



### LINK 2000

The LINK 2000 monitors two battery banks.

### LINK 2000R

The LINK 2000R adds the ability to regulate an engine-driven alternator. The precision regulator in the LINK 2000R allows the alternator to be controlled as a 3-stage battery charging system.

# BATTERIES

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## *Selecting Batteries*

When you choose your batteries, look for true, deep cycle batteries that are rated in amp-hours (AH) and sized to match your power requirements. Use the “Typical Power Consumption” chart on page 10 to help you calculate how many batteries you need to purchase. Check with your battery manufacturer for the specifications.

Deep-cycle batteries fall into three broad categories: wet cell, gel cell and advanced AGM (Absorbed Glass Mat) batteries.

### **Wet Cell Batteries**

True deep-cycle wet cell batteries have relatively thick internal plates that are alloyed with antimony. Look for the following types:

- 12-volt **marine/RV** deep-cycle batteries are acceptable.
- 6-volt **golf cart** batteries perform well and may have a longer life. These batteries must be used in series and connected in pairs.
- **High quality deep-cycle batteries** offer good performance and are available in a wide variety of sizes.

### Types of Wet Cell Batteries to Avoid

- Do not use **ordinary car batteries** or **engine starting batteries**. If the battery is rated only in Cold Cranking Amps (CCA) and reserve capacity, it is designed to start an engine.
- Most **hybrid type, wet cell batteries** will have limited life if deeply discharged. These batteries are described as suitable for either engine starting or deep-cycle applications.
- Do not use **maintenance-free, wet cell batteries**. They will not hold up well to deep discharging and repeated cycling.

### Wet Cell Battery Maintenance

- **Frequently check the electrolyte level in wet cell batteries**. These batteries will give off gas as a natural result of charging; therefore they will lose water. When necessary,

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you should add distilled water. Follow the battery manufacturer's recommendations for maintenance.

- Never allow the tops of the battery plates to be exposed to air. This will contaminate the battery cells. When necessary, add distilled water to the battery.
- Keep the battery tops and terminals clean.
- Always provide adequate ventilation in the battery storage compartment.

### **Gel Cell Batteries**

Gel cell batteries are sealed, lead-acid batteries. They have the following features:

- No Maintenance
- Low Self-Discharge Rate
- Low Internal Resistance

Even though gel cells are sealed batteries, you should ventilate the battery compartment.

### **Advanced AGM Batteries**

AGM batteries are sealed, lead acid batteries. They are similar to gel cell batteries. The charging parameters are similar to wet cell batteries.

## ***Battery Bank Ratings and Sizing***

Deep-cycle batteries are rated in amp-hours. The amp-hour rating is based on a 20-hour discharge rate; therefore, a 100 amp-hour battery can deliver 5 amps for 20 hours.

When the discharge rate is greater than 5 amps, the available amp-hours are decreased. As the discharge rate increases, the effective battery capacity is reduced. For example, if the discharge rate is increased to 100 amps, the battery can deliver about 45 amp-hours.

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## Battery Discharge/Charge Cycling

Deep-cycle batteries can be discharged about 80% of capacity before damage occurs. Shallow cycling will result in a longer battery life. A 50% discharge cycle is generally considered to be a good compromise between long battery life and battery bank size. To achieve 50% cycling, you should calculate your amp-hour consumption between charging cycles and use a battery bank with twice that capacity.

## Calculating Your Amp-Hour Usage Between Battery Recharges

1. Find the amp-hour usage for each AC appliance or tool that will draw its power from the inverter by:
  - Figuring out how long you plan on using each appliance between battery recharges.
  - Finding the appliance in the “Typical Power Consumption” chart, on page 10.
  - Reading across the row, until you find the amp-hour usage in the appropriate column.
2. If your AC appliance or tool is not listed in the “Typical Power Consumption” chart, calculate its power usage by:
  - Looking for the rating plate on the appliance or tool. It will be rated in AC Amps, Watts, or AC VA (Volt-Amps) apparent power.
  - Using one of the formulas in the “Amp-Hour Consumption Formulas” chart to calculate the DC amp-hour draw on a 12-volt system.
3. Add up the amp-hour usage figures for all the appliances or tools. This gives you the total amp-hour load requirement.
4. Your battery bank should be a minimum of 2 times larger than the total amp-hour load requirement. You should plan on recharging your batteries when they are 50% discharged.

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### Amp-Hour Consumption Formulas

$$(\text{AC Amps} \times 10) \times 1.1^{**} \times \text{Hours of Operation} = \text{DC Amp-Hours}$$

$$(\text{AC Watts/DC Voltage}^*) \times 1.1^{**} \times \text{Hours of Operation} = \text{DC Amp-Hours}$$

$$(\text{AC Volt-Amps/DC Voltage}^*) \times 1.1^{**} \times \text{Hours of Operation} = \text{DC Amp-Hours}$$

\*DC Voltage is 12, 24 or 32 volts, depending on your system.

\*\*1.1 is the inverter-efficiency correction factor.

### *Typical Power Consumption*

The chart identifies typical power consumption for common AC loads. Use it as a guide when identifying your power requirements.

Many electric motors have momentary starting requirements well above their operational rating. Start-up watts are listed where appropriate. Individual styles and brands of appliances may vary.

**Note:** The output power is a modified sine wave. Certain laser printers, bread-makers, dimmer lights, variable speed tools, digital clocks and appliance/tool chargers may not operate on the inverter's output power.

### Typical Power Consumption

Appliance	Typical Wattage	Continuous Appliance Run Times in 12-Volt, DC Amp-Hours							
		5 Min.	15 Min.	30 Min.	1 Hr.	2 Hr.	3 Hr.	8 Hr.	24 Hr.
13" Color TV	50	0.33	1	2	4	8	12	32	96
19" Color TV	100	0.66	2	4	8	16	24	64	192
VCR	50	0.33	1	2	4	8	12	32	96
Lamp	100	0.66	2	4	8	16	24	64	192
Blender	300	2	6	12					
Laptop Computer	50	0.33	1	2	4	8			
Curling Iron	50	0.33	1	2					
3/8" Power Drill	500	3.3	10	20					
Icemaker*	200			2.6	5.2	10.4	15.6	41.6	83.2
Coffee Maker	1000	6.6	20	40	80	160			
3 cu. ft. Refrigerator*	150			2	4	8	12	32	96
20 cu. ft. Refrigerator*	750			21	42	84	126	336	672
Compact Microwave	750	5	15	30	60	120	180		
Full Size Microwave	1500	10	30	60	120	240	360		
Vacuum	1100	7.3	22	44	88	176	264		

\*Refrigeration is typically calculated using a 1/3-duty cycle.

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## Connecting Batteries

In most cases, you will be using a bank of two or more batteries with your Freedom Inverter/Charger. Depending on your batteries' voltage, you may connect batteries:

- In **series** to increase the battery bank's voltage
- In **parallel** to increase the battery bank's amp-hour capacity

You should increase the voltage of a battery bank connected in series until it matches your system's voltage. Your battery bank's final DC voltage depends on your system. It should be 12, 24 or 32 volts.

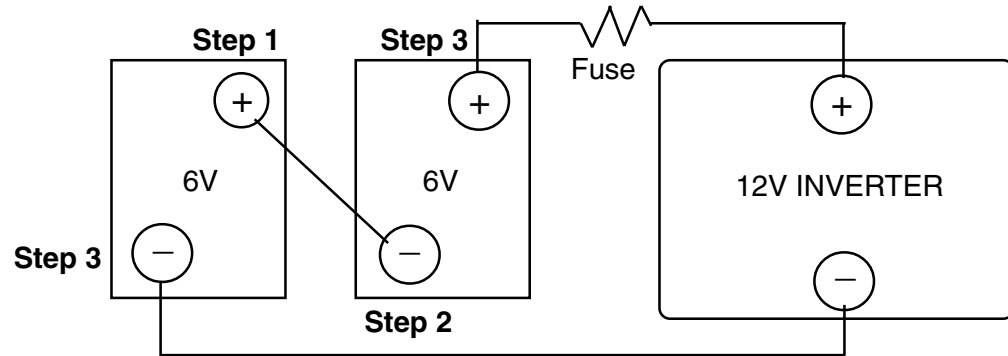
Then you should connect the batteries in parallel to increase the available amp-hours.

### Installation Notes

- Always use properly sized wire and terminals for the interconnecting battery cables. The cables must be, at a minimum, the same AWG as those connected to the inverter/charger. For size information, refer to National Electrical Code (NEC) requirements or contact your local electrician. See "Selecting battery cables" on page 24 for more information.
- Only similar batteries should be connected together in one bank. Do not connect wet cell, gel cell or AGM batteries together.
- Do not connect batteries with different case sizes or amp-hour ratings in the same battery bank.
- Do not connect old and new batteries together.
- Use hex nuts and lock washers on the battery terminals. If your battery comes with wing nuts, replace them with hex nuts.



## Connecting Batteries in Series



Each battery capacity:  
220 amp-hours  
@ 6 volts DC

Total battery bank  
capacity:  
220 amp-hours  
@ 12 volts DC

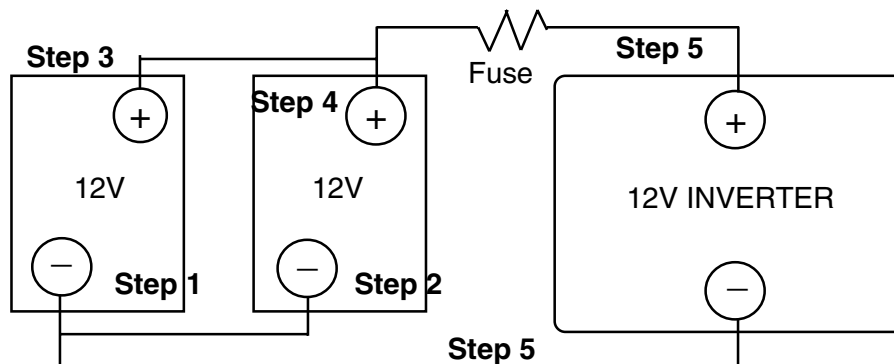
When you connect two batteries in series, you will double the voltage of the battery bank. The amp-hour capacity of the battery bank will be the same as the amp-hour capacity of each individual battery.

For example, two 6-volt, 220 amp-hour batteries connected in series will produce one 12-volt, 220 amp-hour battery bank.

### To connect batteries in series

1. Attach the battery cable to the first battery's positive (+) terminal.
2. Attach the other end of the battery cable to the second battery's negative (-) terminal.
3. To connect the battery bank to the Freedom Inverter/Charger, see Installation "Step 4: Connect the battery cables" on page 23.

## Connecting Batteries in Parallel



Each battery capacity:  
105 amp-hours  
@ 12 volts DC

Total battery bank capacity:  
210 amp-hours  
@ 12 volts DC

When you connect two batteries in parallel, you will double the amp-hour rating of the battery bank. The bank's voltage will be the same as each individual battery's voltage.

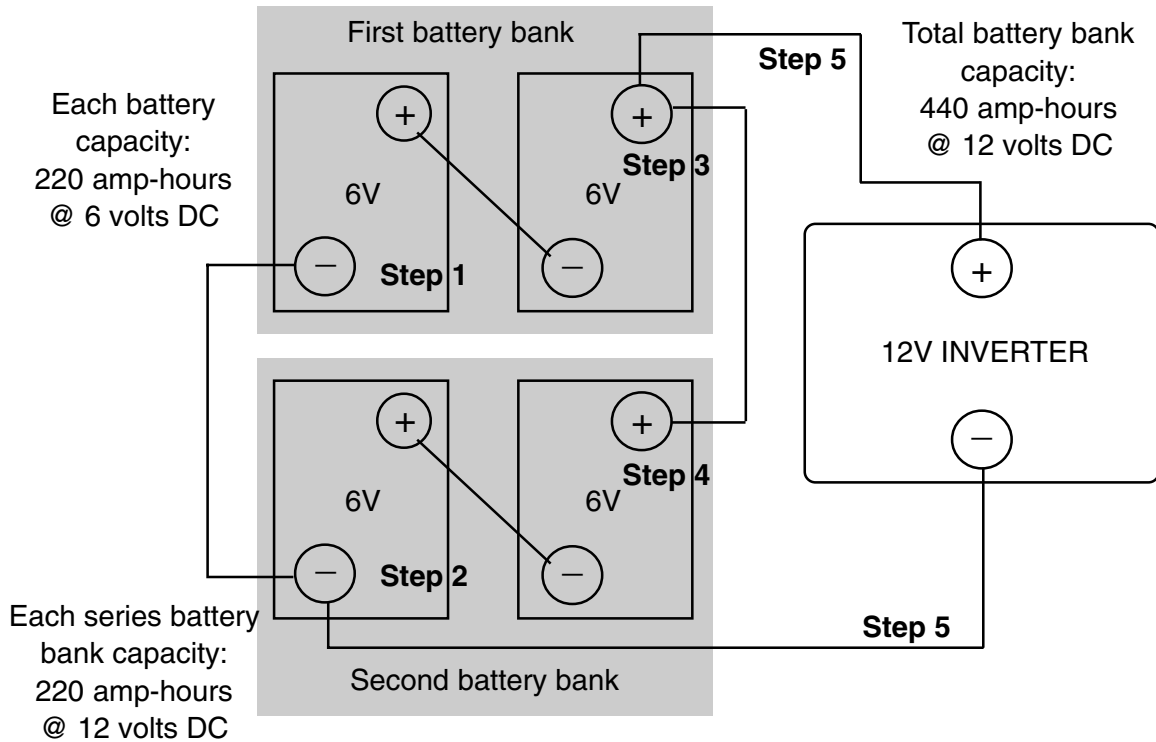
For example, two 12-volt, 105 amp-hour batteries in parallel will produce one 12-volt, 210 amp-hour battery bank.

### To connect batteries in parallel

1. Attach the negative (-) battery cable to the first battery's negative (-) terminal.
2. Attach the other end of the battery cable to the second battery's negative (-) terminal.
3. Attach the positive (+) battery cable to the first battery's positive (+) terminal.
4. Attach the other end of the battery cable to the second battery's positive (+) terminal.
5. To connect the battery bank to the Freedom Inverter/Charger, see Installation "Step 4: Connect the battery cables" on page 23.

**Note:** The load is cross-connected in the drawing, i.e., it is connected to the positive terminal of the first battery and the negative terminal of the last battery. This helps to balance the battery bank.

## Connecting Battery Banks



When your battery bank is connected in series, and you need to increase the available amp-hours, you can connect two or more battery banks together in parallel. This forms a series/parallel battery bank.

### To connect battery banks in parallel

1. Attach the negative (-) battery cable to the first battery bank's empty negative (-) terminal.
2. Attach the other end of the battery cable to the second battery bank's empty negative (-) terminal.
3. Attach the positive (+) battery cable to the first battery bank's empty positive (+) terminal.
4. Attach the other end of the battery cable to the second battery bank's empty positive (+) terminal.
5. To connect the battery bank to the Freedom Inverter/Charger, see Installation "Step 4: Connect the battery cables" on page 23.

**Note:** The load is cross-connected in the drawing. This helps to balance the battery bank.

# INSTALLATION

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We recommend that an authorized Heart Interface technical dealer or experienced electrician install your Freedom Inverter/Charger.

Consult the NEC and your local electrical codes for electrical wiring specifications.

## **Confirm that your shipping carton contains:**

- Inverter/charger
- Owners manual (this manual)
- Warranty card
- TSC temperature sensor with 15' cable
- Wire nuts
- Two battery terminal covers, one red and one black

## ***Before You Install Your Freedom Inverter/Charger***

### **Gather the following supplies:**

- Fuse—UL Listed, DC Rated slow blow class “T” fuse as required by NEC. See “Recommended Fuses” chart on page 27.
- 10-gauge electrical wire for AC input wiring.
- Electrical wire for AC output wiring. Select the correct gauge for your Freedom Inverter/Charger model, and type of installation. Consult the NEC for further information.
- Battery Cables: one negative (-) cable, one short positive (+) cable (maximum 18”) and one longer positive (+) cable. Consult NEC for proper cable size. See “Selecting Battery Cables” on page 24.
- Four mounting screws or 1/4” bolts.

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### **Purchase the batteries:**

1. Determine your power usage. Refer to “Typical Power Consumption” on page 10.
2. Determine which type of batteries you want to buy.
3. Buy sufficient batteries to meet your power usage needs.

### **Gather the following tools:**

- Flathead and Phillips screwdrivers
- 3/16” Allen (Hex) wrench
- 9/16” wrench
- Wire cutters
- Wire strippers
- Wire ties and connectors
- Hand help voltmeter

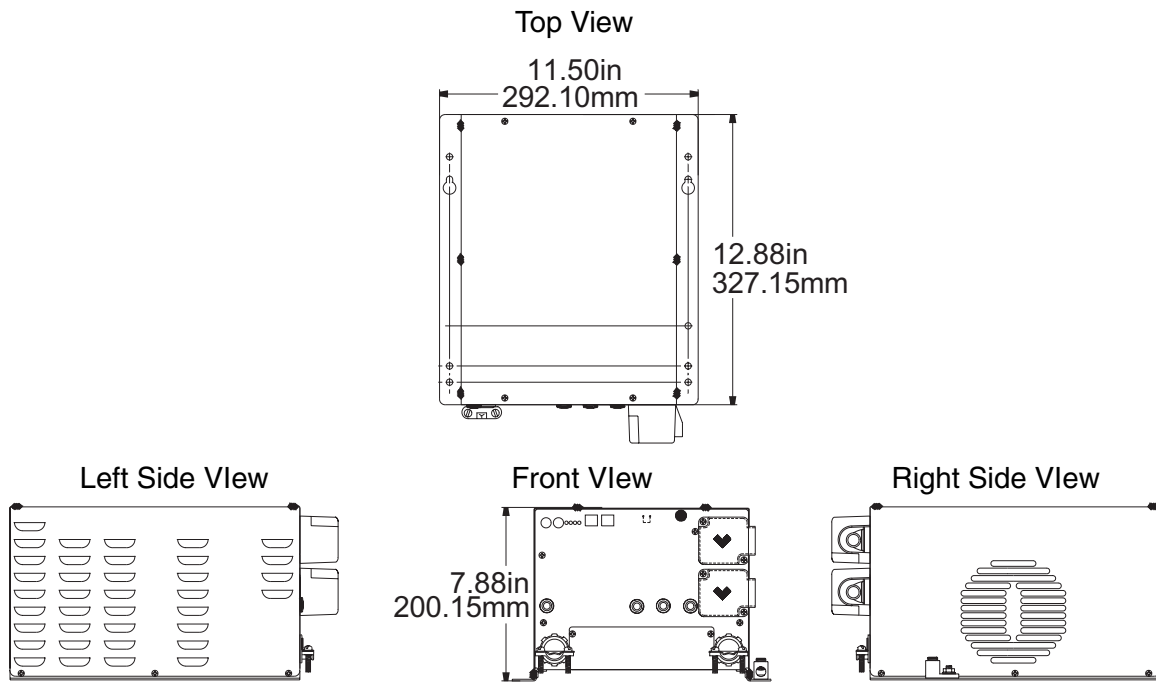
## ***Installing the Freedom Inverter/Charger***

Determine the appropriate installation for your model and your intended usage by referring to the “Installation Examples” on pages 33-50 before you install your Freedom Inverter/Charger.

To install your unit follow the steps listed below. Each step is covered in detail in the following sections.

1. Mount the Freedom Inverter/Charger:
  - Determine where to mount the unit
  - Place the unit in your selected location.
  - Bolt it down.
3. Connect the AC wiring:
  - Connect the AC input wiring
  - Connect the AC output wiring
  - Connect the grounding wires
4. Install ground fault circuit interrupter (GFCI).
5. Connect the battery cables.

## Freedom Inverter/Charger Views



6. Install the battery cable fuses.
7. Install the optional remote control panel.
8. Install the Temperature Sensitive Charging (TSC) sensor, if you are using it.
9. Check over your unit to make sure it is properly installed. Make sure all wiring conforms to local and national electrical codes. If in doubt, consult a qualified electrician.

### Step 1: Mount the Freedom Inverter/Charger

Determine where to mount the unit

Follow these guidelines when you determine where to mount the unit:



1. **Do not install the unit in:**
  - Enclosed battery compartment.
  - Unvented compartment with batteries or flammable gasses.

- Areas which require ignition-protected equipment.
2. Mount the unit as close to the battery bank as possible. The overall length of each battery cable should be less than 10 feet.



3. Make sure the unit is not in the presence of flammable fumes.
4. Mount the unit horizontally (i.e., place on a shelf).
5. Allow several inches of clearance around the unit. This allows fresh air to reach the cooling fan.



6. Do not block any of the vents or louvers.
7. Make sure that the unit will stay dry and clean.

#### Install the unit

1. Place the unit in your selected location.
2. Bolt it down. Make sure that it is securely mounted.

## Step 2: Connect the AC wiring

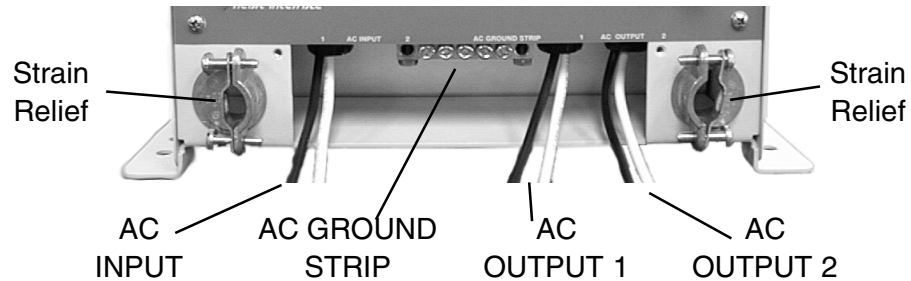
#### Wiring Notes

1. Use appropriate **wire gauges** throughout the installation. Refer to NEC regulations.
2. Conventional **metal strain reliefs** are provided. These can be replaced with plastic strain reliefs for additional corrosion resistance or with 3/4 inch conduit fittings if you are using conduit to route the wiring.
3. **Do not turn the inverter on** until all AC and DC connections (input, output and ground) have been made.

#### Connect the AC input wiring

1. Check to see that each AC input is protected by a branch rated circuit breaker.
  - In the United States, if a 20-amp breaker protects each service to the inverter/charger, no additional circuit breakers are required between the unit and the loads.
  - In Canada, a 15-amp breaker must protect each input.

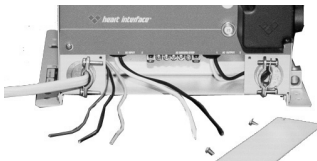
### Example of Single Input/Dual Output Model



- If there is 30-amp service to the inverter/charger, additional 20-amp (15-amp in Canada) circuit breakers are required between the inverter/charger and the loads.

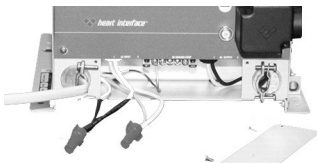
**Note:** Models 15 S/D and 20 S/D have built in branch rated circuit breakers.

2. Open the AC wiring compartment by removing the screws that secure the cover plate.



3. Feed the 3-conductor, AC input wire(s) through the left strain relief and into the AC wiring compartment. Give yourself at least 6 inches of wire to work with.

- If your unit has one AC input, feed one AC input wire through the strain relief and into the AC wiring compartment.
- If your unit has dual AC inputs, feed one or two AC input wire(s) through the strain relief and into the AC wiring compartment.



4. Strip 1/2 inch of insulation off each conductor.
5. Connect each wire to the pigtails:
  - Black to black (hot or line)
  - White to white (neutral)
  - Green or bare copper to AC GROUND STRIP (ground)

Use the provided wire nuts to make the wire connections. You may also use butt splices (not included) to make the wire connections.

If your unit has dual AC inputs, and you are using only one input, connect the wires to AC Input 1. Do not wire the both AC Input 1 and 2 together.



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6. Tug firmly on each connection to make sure they are secure.



## Warning

***Do not connect incoming AC power, from any source, to the AC output of the Freedom Inverter/Charger. This is called back-feeding. Back-feeding will damage the unit and it will void your warranty.***

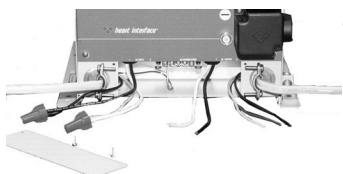
The OVERTEMP/OVERLOAD and the LOW BATTERY LEDs will blink rapidly when the unit is improperly wired and is being back-fed.

## Connect the AC output wiring

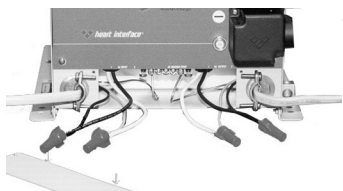
Before you connect the AC output wires, check to make sure that the inverter's AC output's hot and neutral buses are isolated from the main, shore power or generator, hot and neutral circuits.

1. Check the wires for AC voltage. Incoming AC must be fed only to the AC input and never to the AC output.
2. Check to make sure that you are not setting up a circular installation, i.e., the unit's input power comes from the unit's output power. This is the equivalent to plugging the battery charger into the inverter. This will cause the unit to oscillate ON and OFF when the unit is in inverter mode.

This could occur if the unit's AC output is connected to an entire leg of a circuit breaker panel, and then a circuit breaker on that leg is used to feed the unit's input.



3. Feed the 3-conductor, AC output wire(s) through the right strain relief and into the AC wiring compartment. Give yourself at least 6 inches of wire to work with.
  - If your unit has one AC output, feed one AC output wire through the strain relief and into the AC wiring compartment.
  - If your unit has dual AC outputs, and you are using only one AC output, feed one AC output wire through the strain relief and into the AC wiring compartment. Cap off the unused output to prevent a short circuit.



- If your unit has dual AC outputs, and you are using both AC outputs, feed two AC output wire(s) through the strain relief and into the AC wiring compartment.
4. Strip 1/2 inch of insulation off each conductor.
  5. Connect each wire to the unit's AC output wires:
    - Black to black (hot or line)
    - White to white (neutral)
    - Green or bare copper to AC GROUND STRIP (ground)
- Use the provided wire nuts to make the wire connections. You may also use butt splices (not included) to make the wire connections.
6. Tug firmly on each connection to make sure they are secure. Later, if the unit is not operating properly, check these connections first.
  7. Carefully tuck all the wires into the AC wiring compartment.
  8. Replace the cover plate.

### Connect the grounding wires

For safety purposes, the chassis of the inverter/charger must be connected to your AC ground system.

Check the NEC and your local electrical codes for further information on grounding.

**Note:** Do not connect the battery cables to the AC ground strip or to the chassis ground lug of the unit.

### To ground a unit using the ground lug

Ground Lug



1. Use 8 AWG bare copper or green insulated wire.
 

**Note:** Some installations require a heavier grounding wire. Check the NEC and your local electrical codes for specifications.
2. If you are using green, insulated wire, strip both ends of the wire.
3. Secure the wire to the chassis ground lug using the 3/16" Allen wrench.

- 
4. Connect the other end of the wire to the ground bus in your AC electrical system.
  5. Make sure the connection is clean and tight.

### Step 3: Install ground fault circuit interrupters

Certain branch circuits must be equipped with a Ground Fault Circuit Interrupter (GFCI) to conform to NEC regulations. Please consult the code or a qualified electrician for details. Underwriters' Laboratories has tested the following GFCI, and we recommend using it.

- Receptacle Type: Pass & Seymour  
Catalog Number: 1591  
Rated: 15-amps at 120-volts AC



#### Warning

*Use only the GFCI type receptacles detailed in this manual. These will provide you protection against the risk of electric shock. Other types may not operate properly when connected to this inverter, resulting in a potential shock hazard.*

#### To install the GFCI type receptacles

- Refer to GFCI manufacture's recommendations and to the NEC requirements for proper installation.

### Step 4: Connect the battery cables



#### Caution

*Do not connect the Freedom Inverter/Charger to the engine starter battery.*



#### Warning

*The Freedom Inverter/Charger is not DC reverse polarity protected. Be very careful to connect the negative and positive cables to the proper terminals. If the cables are reversed, you will damage your unit and void your warranty.*

---

## Selecting battery cables

The total length of each battery cable must be less than 10 feet.

Considerable amperage passes through the DC wiring (battery cables). Therefore all cables must be properly sized.

### Recommended Battery Cable Size

Model	Cable Size
Freedom 10	2 AWG
Freedom 15 & 15D	1/0 AWG
Freedom 20 & 20D	2/0 AWG
Freedom 25	3/0 AWG
Freedom 30	3/0 AWG

Make sure that the cable size and type meets with NEC requirements for your installation.

Look for the following cable characteristics:

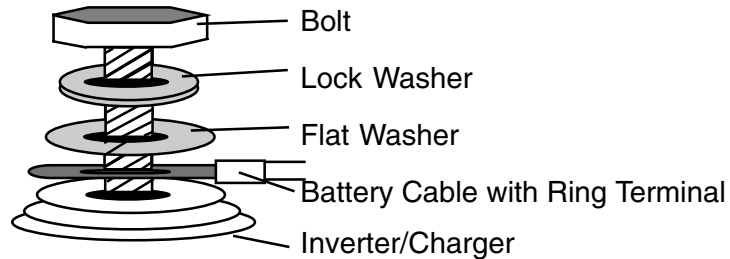
- UL Listed welding or boat cable that is terminated on each end with UL Listed or UL Recognized ring terminal connectors.
- The connectors are attached to the cable using a method approved by the connector manufacturer. Heart Interface recommends using Thomas & Betts (T&B) part number BAL 2038 for the terminal. T&B recommends that each terminal be crimped in two places with a pressure of 15 tons using a hexagonal die. The T&B die has a code number of 54.
- The barrel of the terminal and the first inch of the cable must be covered in UL Listed or UL Recognized heat shrink tubing after the crimp is made. Heart Interface recommends a 2-inch length of 3M HDT 0800 tubing. Other heat shrink may be used if it is UL Listed or UL Recognized, and you follow the manufacturer's directions.

## Installing the battery cables

1. Attach the negative (-) battery cable to the Freedom Inverter/Charger. Follow the battery hardware stack up diagram. The negative cable may be black or yellow for identification.

---

### Battery Cable Hardware Stackup Diagram



2. Tighten the battery terminal bolts to a torque value between 160 inch-pounds and 180 inch-pounds.
3. Install the black battery terminal cover on the negative terminal.
4. Attach the positive (+) battery cable to the unit. Follow the battery hardware stack up diagram. The positive cable may be red for identification.
5. Tighten the battery terminal bolts to a torque value between 160 inch-pounds and 180 inch-pounds.
6. Install the red battery terminal cover on the positive terminal.
7. If the positive (+) and negative (-) cables run parallel to each other, twist the cables together. This will minimize the adverse effects of cable length inductance.
8. Install the fuse in between the positive (+) inverter cable and the positive (+) battery cable. See “Step 5: Install battery cable fuses” on page 26 for instructions.
9. Connect the other end of the positive (+) battery cable to either:
  - Positive post of the house or auxiliary battery bank.
  - Through a battery bank selector switch to one or more battery banks. If you are charging multiple battery banks, you can install a battery bank selector switch to allow the banks to be used or charged individually or simultaneously.
  - Through a solenoid to battery banks connected in parallel.

---

If your battery bank is connected in parallel, you should cross-connect the load by connecting the positive (+) cable from the unit to positive terminal of the first battery.

10. Connect the negative (-) cable from the Freedom Inverter/Charger directly to the negative post of the house or auxiliary battery bank or the ground side of a current shunt. Tighten securely.

If your battery bank is connected in parallel, you should cross-connect the load by connecting the negative (-) cable from the unit to negative terminal of the last battery. Cross-connecting helps to balance the battery bank.

**Note:** If you are installing the unit in a vehicle, do not use the vehicle frame, frame ground, or a ground bonding system as the negative conductor.

You may see a spark when the final battery connection is made. This is normal.



### **Warning**

*Do not make this final connection in the presence of flammable fumes.*

11. Check over your cable installation. Make sure that all connections are clean and tight.



### **Warning**

*The Freedom Inverter/Charger is not DC reverse polarity protected. Be very careful to connect the negative and positive cables correctly. If the cables are reversed, you will damage your unit and void your warranty.*

## **Step 5: Install battery cable fuses**

To meet electrical codes, a UL Listed DC Rated slow blow class “T” fuse must be installed in the positive (+) battery cable within 18 inches of the battery. This fuse protects the battery and cables when you have a short circuit. The inverter is protected internally; it will not blow a properly sized fuse.

The recommended fuse and fuse holder is available from your dealer or from Heart Interface.

**Recommended Fuses (UL Listed Class T JLLN with a DC rating)**

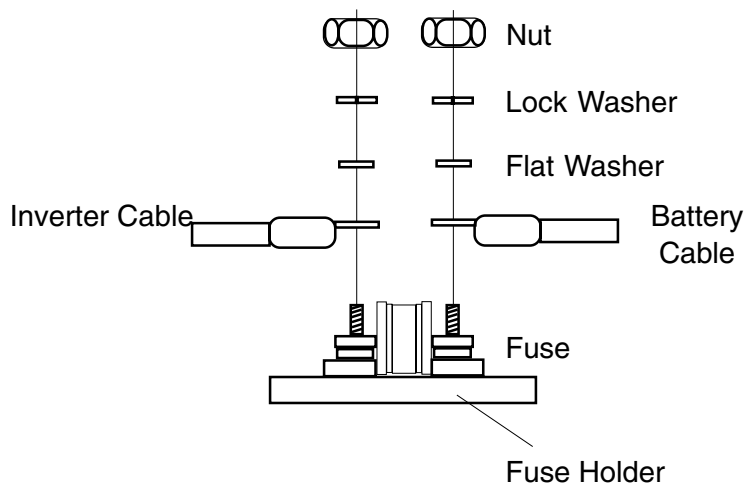
Model	Part	Part Number
10	200-Amp Fuse & Holder 200-Amp Fuse & Holder 200-Amp Fuse Only	84-4155-00 (C/R)* 84-4158-00 (R/R)** 84-4157-00
15 & 15 S/D	200-Amp Fuse & Holder 200-Amp Fuse & Holder 200-Amp Fuse Only	84-4155-00 (C/R)* 84-4158-00 (R/R)** 84-4157-00
20 & 20 S/D	300-Amp Fuse & Holder 300-Amp Fuse & Holder 300-Amp Fuse Only	84-4156-00 (C/R)* 84-4154-00 (R/R)** 84-4151-00
25 D/D	300-Amp Fuse & Holder 300-Amp Fuse & Holder 300-Amp Fuse Only	84-4156-00 (C/R)* 84-4154-00 (R/R)** 84-4151-00
30 D/D	350-Amp Fuse & Holder 350-Amp Fuse & Holder 350-Amp Fuse Only	84-4159-00 (C/R)* 84-4160-00 (R/R)** 84-4152-00

\* Compression/Ring Terminal

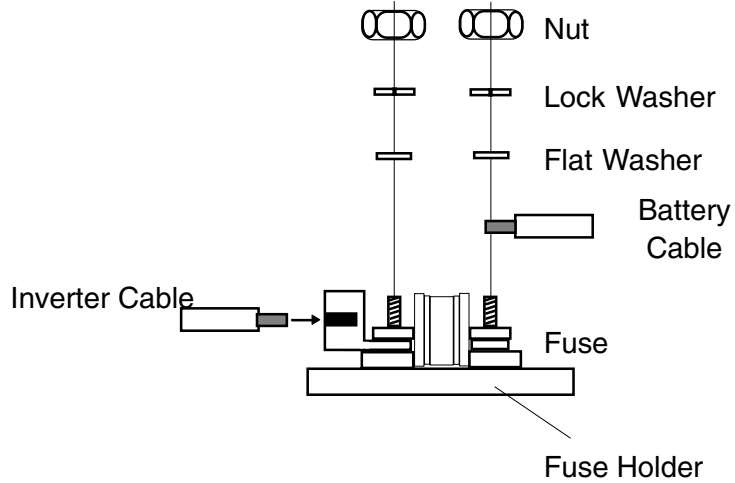
\*\* Ring/Ring Terminal

**To install the fuse and fuse holder**

1. Connect the positive (+) inverter cable to the fuse holder. Assemble the nut and washers in the order shown.
  - If you are using a ring/ring terminal:



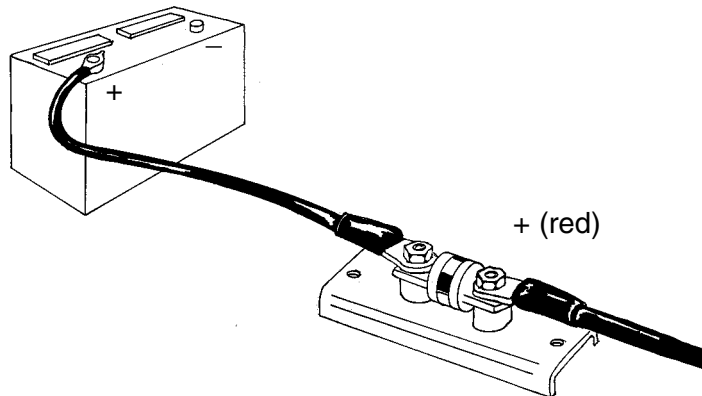
- If you are using a compression/ring terminal:



### Warning

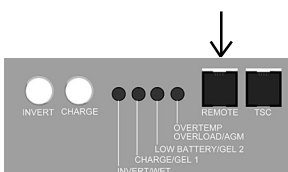
*Improper stack up of hardware will cause excessive heat and cause the fuse to blow.*

2. Connect the positive (+) battery cable to the fuse holder. Assemble the nut and washers in the order shown.
3. Your battery cable fuse installation should look like this:



4. Install protective cover for the fuse.

### Step 6: Install the optional Remote Control Panel or LINK instrument



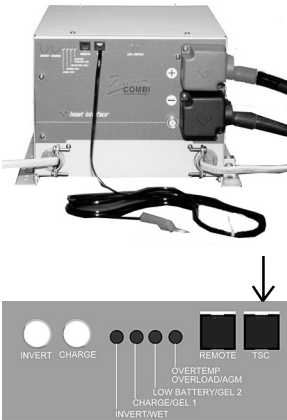
1. Route the remote cable.
2. Connect the cable to the Remote jack on the front of the Freedom Inverter/Charger.



3. Connect the other end of the cable to the Remote Control Panel or LINK instrument.

Refer to the Remote Control Panel or LINK instrument Owner's Manual for more information and operation instructions.

### Step 7: Install the Temperature Sensitive Charging (TSC) sensor, if you are using it



The TSC sensor is a black, 15 foot cable. It has a modular phone plug on one end (RJ11) and an insulated, ring terminal on the other end.

1. Connect the ring terminal end of the cable to the a battery post in the Freedom Inverter/Charger's battery bank.
2. Route the TSC sensor cable to the Freedom Inverter/Charger.
3. Plug the end of the RJ11 cable into the TSC jack on the front of the unit.

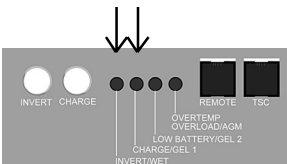
### Step 8: Check over your unit to make sure it is properly installed

Make sure all wiring conforms to local and the NEC regulations. If you have any doubts, consult a qualified electrician.

Do not apply shore power or generator power without performing the following steps:

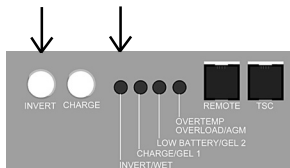
#### Check the Freedom Inverter/Charger

1. Check to make sure that both the inverter and the charger are off, i.e., the INVERT and the CHARGE LEDs should not be illuminated. If you are using a remote control, check the panel to make sure both are off.



#### Check your batteries

1. Check battery polarity. If the unit has been connected to the battery with reverse polarity, it is damaged.
2. Check the battery voltage and ensure it is within proper voltage range, 10.5 to 15.5 volts DC.



### Test the inverter function

1. With no loads connected to the output of the inverter, turn the inverter on by pressing the INVERT button for three seconds. The INVERT LED should be steady.

If you are using a remote control, turn on the inverter with the button on the Remote Control Panel or LINK instrument.

The Freedom unit will produce a slight tick-tick sound. If using a Remote Control Panel or LINK instrument the INVERT/CHARGE LEDs will illuminate and the voltage indicator will display the battery voltage. The DC Amps LED will not be lit because the unit is in the idle mode.

2. Add a load of 7 watts or more to the output of the inverter. A 40-watt incandescent light bulb will work fine. The DC Amps LEDs on the remote control will indicate the DC draw from the battery through the inverter.
3. Leave the load connected and turn off the inverter by:
  - Pressing INVERT on the unit again
  - If you are using a remote control, turning off the INVERT mode on the Remote Control Panel or LINK instrument

### Test the transfer function

1. Check that the unit is off, i.e., the INVERT and CHARGE LEDs are not illuminated.

If you are using a remote control, check that both the INVERT and CHARGE LEDs are off.

2. Apply shore power.
3. There will be an 3-second delay. Then the unit should transfer shore power and power the load. If this does not happen, **do not proceed**.

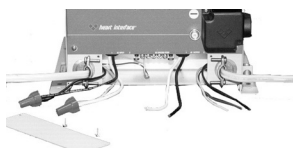
Check for back-feed when the LOW BATTERY and OVERLOAD/OVERTEMP LEDs both blink rapidly. If you are using a remote control, check the panel for a back-feed indication; the panel will show an overload condition.

## Eliminating back-feed



### Warning

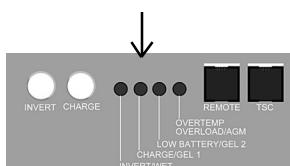
*Use caution when handling the AC output wires. They may have live voltage.*



1. Disconnect the shore power.
2. Disconnect the AC output wires from the inverter.
3. Make sure the inverter is off.
4. Connect a voltmeter to the black and white wires that were attached to the inverter's output.
5. Apply shore power.
6. Measure for voltage between these wires. If there is voltage on these wires, a back-feed condition exists. A back-feed must be corrected or it will damage your unit.

Is it essential that the inverter's AC output's hot and neutral buses are isolated from the main, shore power or generator, hot and neutral circuits.

## Test the battery charger



1. With shore power applied and the transfer switch engaged, the battery charger should operate. The CHARGE LED will blink for three seconds. Then the unit will enter the charge mode and the LED will light.

**Note:** When using Temperature Sensitive Charging, it may take longer for the unit to enter charge mode.

**Note:** When AC is available, the unit automatically defaults to charge mode. If you do not want to charge your batteries, you must press the CHARGE switch to turn it off.

2. Verify the charger is working by using a voltmeter. The battery voltage should gradually increase. If using a Remote Control Panel, the DC Amps LED indicates the current the charger is putting out and the DC Volts LED indicates an increase in battery voltage.

---

### Test the transfer function

1. Turn the INVERT ON; the green LED should blink.
2. Remove shore power. The inverter should automatically pick up the AC load when shore power is removed.

Repeat the test for transfer and battery charger for your generator, if you have one.

Congratulations, you have completed a successful installation!

# INSTALLATION EXAMPLES

Use these installation examples as guidelines; depending on your requirements, your installation may vary.

We recommend that you consult a qualified electrician for proper installation.

## *Installation Configurations*

The following are the most commonly used installations involving specific Freedom Inverter/Charger models, shore power connections, optional generator power, and AC load configurations.

Model	Input/Output Modes	See Installation Option	External AC Power Source
10	Single/Single	1	<ul style="list-style-type: none"> <li>• 30-amp shore power source</li> <li>• Generator</li> </ul>
10	Single/Single	2	<ul style="list-style-type: none"> <li>• Single 30-amp shore power source</li> <li>• 30-amp breaker from a panel fed by a 50-amp, 120-volt, single phase (3-wire) shore power source</li> <li>• 30-amp breaker from one leg of a 50-amp, 120/240-volt, split phase (4-wire) shore power source</li> <li>• Generator</li> </ul>
15	Single/Single	1	<ul style="list-style-type: none"> <li>• 30-amp shore power source</li> <li>• Generator</li> </ul>
15	Single/Single	2	<ul style="list-style-type: none"> <li>• Single 30-amp shore power source</li> <li>• 30-amp breaker from a panel fed by a 50-amp, 120-volt, single phase (3-wire) shore power source</li> <li>• 30-amp breaker from one leg of a 50-amp, 120/240-volt, split phase (4-wire) shore power source</li> <li>• Generator</li> </ul>

<b>Model</b>	<b>Input/ Output Modes</b>	<b>See Installation Option</b>	<b>External AC Power Source</b>
15 S/D	Single/ Dual	5	<ul style="list-style-type: none"> <li>• 30-amp shore power source</li> <li>• 30-amp breaker from panel fed by 50-amp, 120-volt, single phase (3-wire) shore power source</li> <li>• 30-amp breaker from one leg of a 50-amp, 120/240-volt, split phase (4-wire) shore power source</li> <li>• Generator</li> </ul>
20	Single/ Single	1	<ul style="list-style-type: none"> <li>• 30-amp shore power source</li> <li>• Generator</li> </ul>
20	Single/ Single	2	<ul style="list-style-type: none"> <li>• Single 30-amp shore power source</li> <li>• 30-amp breaker from a panel fed by a 50-amp, 120-volt, single phase (3-wire) shore power source</li> <li>• 30-amp breaker from one leg of a 50-amp, 120/240-volt, split phase (4-wire) shore power source</li> <li>• Generator</li> </ul>
20 S/D	Single/ Dual	5	<ul style="list-style-type: none"> <li>• 30-amp shore power source</li> <li>• 30-amp breaker from panel fed by 50-amp, 120-volt, single phase (3-wire) shore power source</li> <li>• 30-amp breaker from one leg of a 50-amp, 120/240-volt, split phase (4-wire) shore power source</li> <li>• Generator</li> </ul>
25 D/D	Single/ Single	1	<ul style="list-style-type: none"> <li>• 30-amp shore power source</li> <li>• Generator</li> </ul>
25 D/D	Single/ Single	2	<ul style="list-style-type: none"> <li>• Single 30-amp shore power source</li> <li>• 30-amp breaker from a panel fed by a 50-amp, 120-volt, single phase (3-wire) shore power source</li> <li>• 30-amp breaker from one leg of a 50-amp, 120/240-volt, split phase (4-wire) shore power source</li> <li>• Generator</li> </ul>

<b>Model</b>	<b>Input/ Output Modes</b>	<b>See Installation Option</b>	<b>External AC Power Source</b>
25 D/D	Dual/ Single	3	<ul style="list-style-type: none"> <li>• Two separate 30-amp shore power sources</li> <li>• Two 30-amp breakers from panel fed by 50-amp, 120-volt, single-phase (3-wire) shore power source</li> <li>• Two 30-amp breakers from 50-amp, 120/240-volt, split phase (4-wire) shore power source</li> <li>• Generator</li> </ul>
25 D/D cont.	Dual/ Dual	4	<ul style="list-style-type: none"> <li>• Two separate 30-amp shore power sources</li> <li>• Two 30-amp breakers from panel fed by 50-amp, 120-volt, single-phase (3-wire) shore power source</li> <li>• Two 30-amp breakers from 50-amp, 120/240-volt, split phase (4-wire) shore power source</li> <li>• Generator</li> </ul>
30, 30 D/D	Single/ Single	1	<ul style="list-style-type: none"> <li>• 30-amp shore power source</li> <li>• Generator</li> </ul>
30, 30 D/D	Single/ Single	2	<ul style="list-style-type: none"> <li>• Single 30-amp shore power source</li> <li>• 30-amp breaker from a panel fed by a 50-amp, 120-volt, single phase (3-wire) shore power source</li> <li>• 30-amp breaker from one leg of a 50-amp, 120/240-volt, split phase (4-wire) shore power source</li> <li>• Generator</li> </ul>
30 D/D	Dual/ Single	3	<ul style="list-style-type: none"> <li>• Two separate 30-amp shore power sources</li> <li>• Two 30-amp breakers from panel fed by 50-amp, 120-volt, single-phase (3-wire) shore power source</li> <li>• Two 30-amp breakers from 50-amp, 120/240-volt, split phase (4-wire) shore power source</li> <li>• Generator</li> </ul>

Model	Input/Output Modes	See Installation Option	External AC Power Source
30 D/D	Dual/Dual	4	<ul style="list-style-type: none"> <li>• Two separate 30-amp shore power sources</li> <li>• Two 30-amp breakers from panel fed by 50-amp, 120-volt, single-phase (3-wire) shore power source</li> <li>• Two 30-amp breakers from 50-amp, 120/240-volt, split phase (4-wire) shore power source</li> <li>• Generator</li> </ul>

#### DC Cable and Fuse General Guide

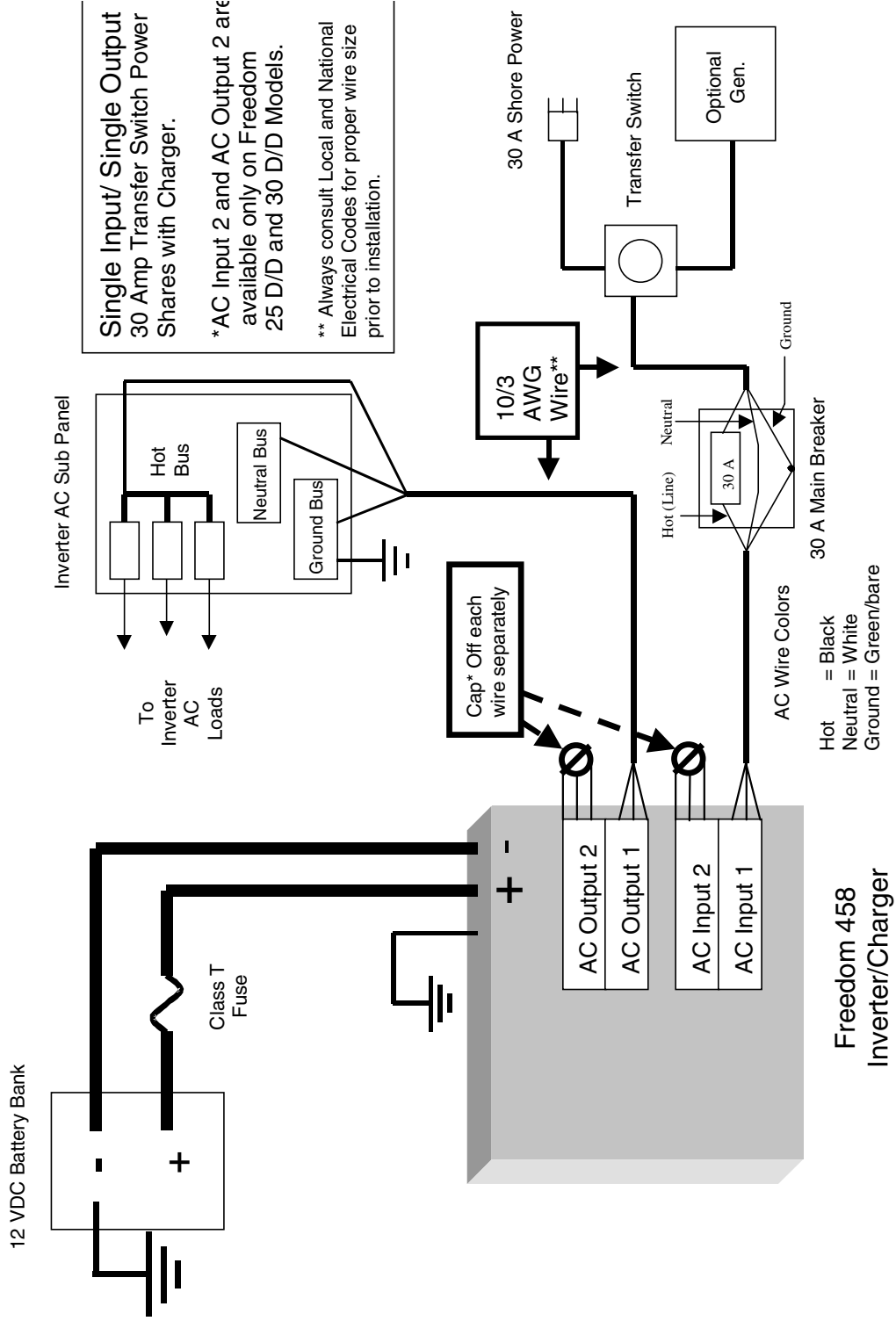
Model	Fuse Size	Typical DC Amps	Cable AWG by Length*		
			1-3 ft.	3-6 ft.	6-10 ft.
10	200-Amp	100	2	2	1/0
15	200-Amp	150	1/0	1/0	2/0
20	300-Amp	200	2/0	2/0	3/0
25	300-Amp	250	2/0	3/0	3/0
30	350-Amp	300	3/0	3/0	4/0

\*This guide is intended to provide general recommendations for fuse and cable sizing. Always consult Local and National Electrical Codes for proper fuse and cable size prior to installation.



# Freedom 458 Installation Option 1

## Freedom 458 Model 10, 15, 20, 25, 30



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## ***Installation Option 1 for Freedom 10, 15, 20, 25 D/D, 30, and 30 D/D***

Inverter Mode	Single Input/Single Output
External Power Source	Single 30-amp shore power source, supplied through a 30-amp branch rated main breaker
Power for AC loads	Power is supplied through the inverter in charge/transfer mode, or by the inverter in invert mode.
Charger	Shares power with the AC loads. It can transfer up to 30-amps.

### **Installation Notes**

1. When installing a Freedom 25 D/D or 30 D/D model, the **AC Input 2** and **AC Output 2** wires are not used. They must be capped off.
2. If a **generator** is installed in the system, use a break-before-make AC transfer switch to switch between shore power and generator power. Route AC output from the transfer switch to the input of the inverter/charger.

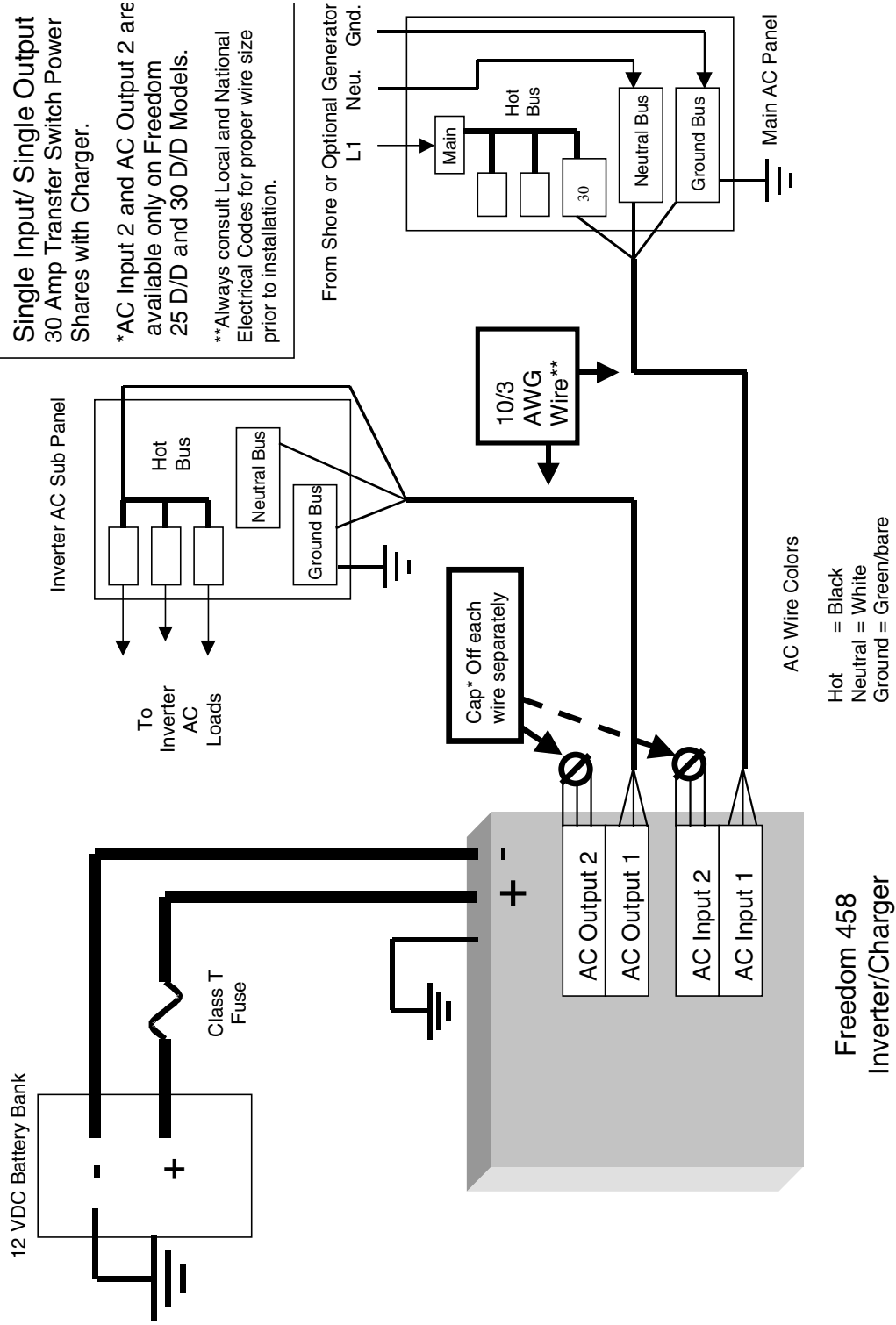
### **Connecting Appliances**

To prevent overloading the inverter or rapidly discharging the battery bank, you should **not** connect any heavy load appliances to the Inverter AC Panel. Heavy load appliances include space heaters, stoves, water heaters, air conditioners, AC to DC converters, or other battery chargers. If these types of loads are present, they should be turned off when you are using inverter power.

If you do not want to manually manage your energy usage, consider using a different installation option.

# Freedom 458 Installation Option 2

## Freedom 458 Model 10, 15, 20, 25, 30



Single Input/ Single Output  
30 Amp Transfer Switch Power  
Shares with Charger.

\*AC Input 2 and AC Output 2 are  
available only on Freedom  
25 D/D and 30 D/D Models.

\*\*Always consult Local and National  
Electrical Codes for proper wire size  
prior to installation.

From Shore or Optional Generator  
L1 Neu. Gnd.

Freedom 458  
Inverter/Charger

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## ***Installation Option 2 for Freedom 10, 15, 20, 25 D/D, 30, and 30 D/D***

Inverter Mode	Single Input/Single Output
External AC Power Source	<ul style="list-style-type: none"><li>• Single 30-amp shore power source</li><li>• 30-amp breaker from a panel fed by a 50-amp 120-volt single phase (3-wire) shore power source</li><li>• 30-amp breaker from a panel fed by one leg of a 50-amp 120/240 split phase (4-wire) shore power source</li><li>• Generator</li></ul>
Power for AC loads	Split between the main loads and the inverter loads.
Charger	Shares power with inverter loads only. It can transfer up to 30-amps.

### **Installation Notes**

1. Use a 30-amp breaker in the main panel and the main neutral bus to supply the inverter **AC input** power.
2. The inverter's **AC output** supplies a separate sub panel. The appliance and outlet loads are then supplied with power from the inverter hot and neutral bus in the sub panel.
3. When setting up this installation option with a Freedom 25 D/D or 30 D/D, the **AC Input 2** and **AC Output 2** are not used. They must be capped off.
4. If a **generator** is installed in the system, use a break-before-make AC transfer switch to switch between shore power and generator power. Route AC output from the transfer switch to the main AC panel.

### **Connecting Appliances**

Only the lighter appliance and outlet circuits should be connected to the Inverter AC Panel. Power for these loads, is supplied through the inverter in charge/transfer mode, or by the inverter in invert mode.

The heavier load appliances, such as space heaters, stoves, water heaters, air conditioners, AC to DC converters, or other

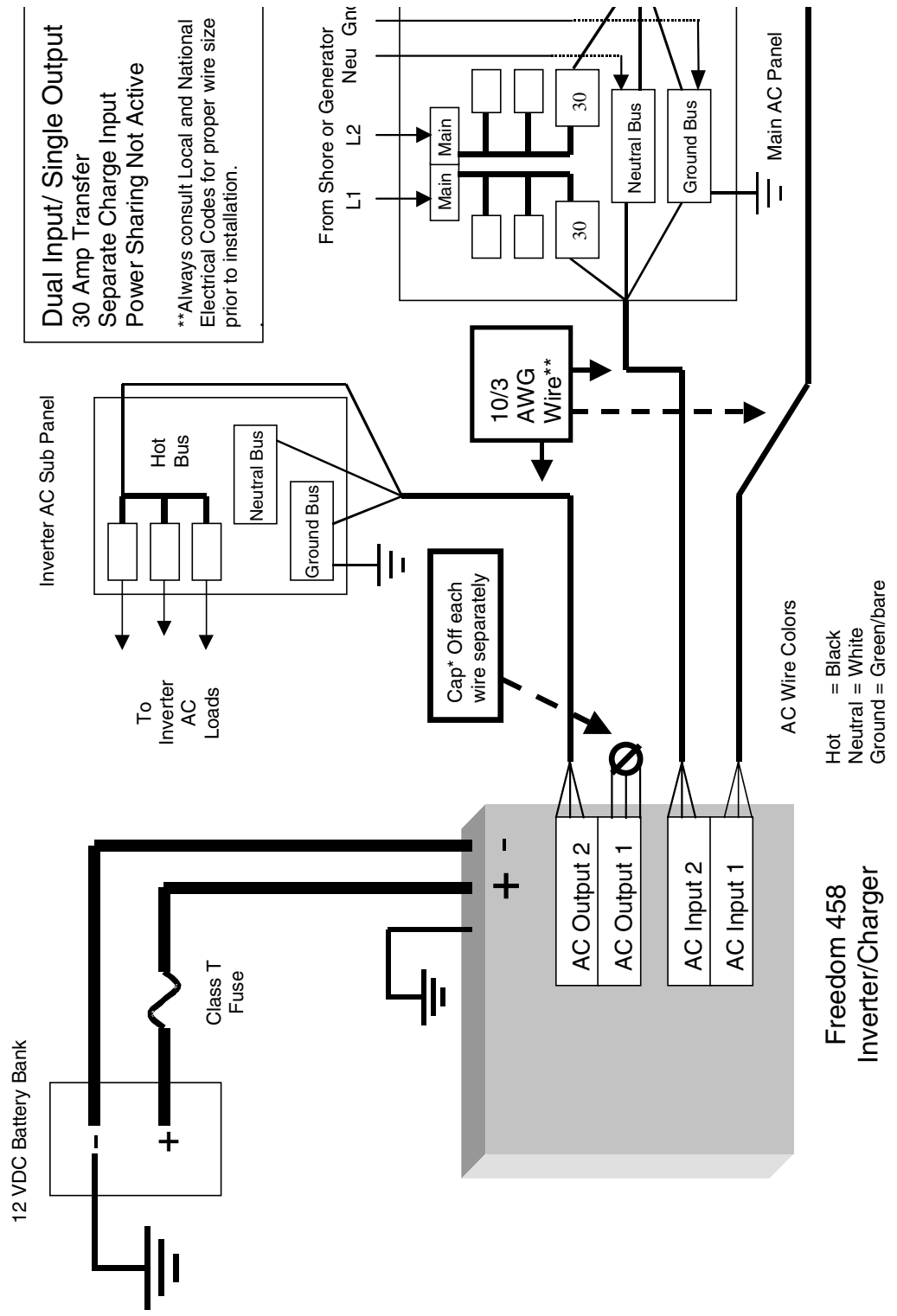
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battery chargers, should be connected to the Main AC Panel. Power for these loads are supplied by shore or generator power that is connected to the main panel.

This split load approach will help avoid problems such as overloading the inverter or rapidly discharging the battery bank. It also eliminates the need to manually manage your energy usage when using inverter power.

# Freedom 458 Installation Option 3

## Freedom 458 Model 25 D/D, 30 D/D



Dual Input/ Single Output  
 30 Amp Transfer  
 Separate Charge Input  
 Power Sharing Not Active

\*\*Always consult Local and National Electrical Codes for proper wire size prior to installation.

AC Wire Colors  
 Hot = Black  
 Neutral = White  
 Ground = Green/bare

Freedom 458  
 Inverter/Charger

## ***Installation Option 3 for Freedom 25 D/D and 30 D/D***

Inverter Mode	Dual Input/Single Output
External AC Power Source	<ul style="list-style-type: none"> <li>• Two separate 30-amp shore power sources. Both neutrals and both “hots” must be kept separate.</li> <li>• Two 30-amp breakers from panel fed by 50-amp 120-volt, single phase (3-wire), shore power source</li> <li>• Two 30-amp breakers from a panel fed by 50-amp 120/240-volt split phase (4-wire), shore power source</li> <li>• Generator</li> </ul>
Power for AC loads	<ul style="list-style-type: none"> <li>• Split between the main loads and the inverter loads.</li> <li>• Inverter uses AC Input 2 as transfer source. AC Input 2 transfers directly through the inverter to the inverter loads (AC Output 2).</li> </ul>
Charger	<ul style="list-style-type: none"> <li>• Charger uses AC Input 1 as power source. Power shares between charger and inverter loads when only using AC Input 1</li> <li>• No power sharing between charger and the inverter loads when using both AC Inputs.</li> </ul>

### **Installation Notes**

1. These two input breakers (AC Input 1 and 2) can be supplied by the same phase or by opposite phases.
2. **AC Input 1** is used to power the charger only. Use a 30-amp breaker and neutral in the main panel to supply the power to this input.

If only AC Input 1 is supplied power, the unit will charge and power share with AC Output 2. It will also transfer power to the loads on AC Output 2.

3. Use a second 30-amp breaker and neutral in the main panel to supply the power for **AC Input 2**. The power transfers through the inverter to AC Output 2.

If only AC Input 2 is supplied power, the unit will **not** charge, and will only transfer 30-amps through to the inverter loads connected to AC Output 2.

4. **AC Output 1** is not used. It must be capped off.

- 
5. The inverter's **AC Output 2** supplies a separate sub panel. The appliance and outlet loads are then supplied with power from the inverter hot and inverter neutral bus in the sub panel.
  6. If a **generator** is installed in the system, use a break-before-make AC transfer switch to switch between shore power and generator power. Route AC output from the transfer switch to the Main AC Panel.

## Connecting Appliances

Only lighter appliance and outlet circuits should be connected to the Inverter AC Panel. These loads are supplied power through the inverter in transfer mode, or by the inverter in invert mode.

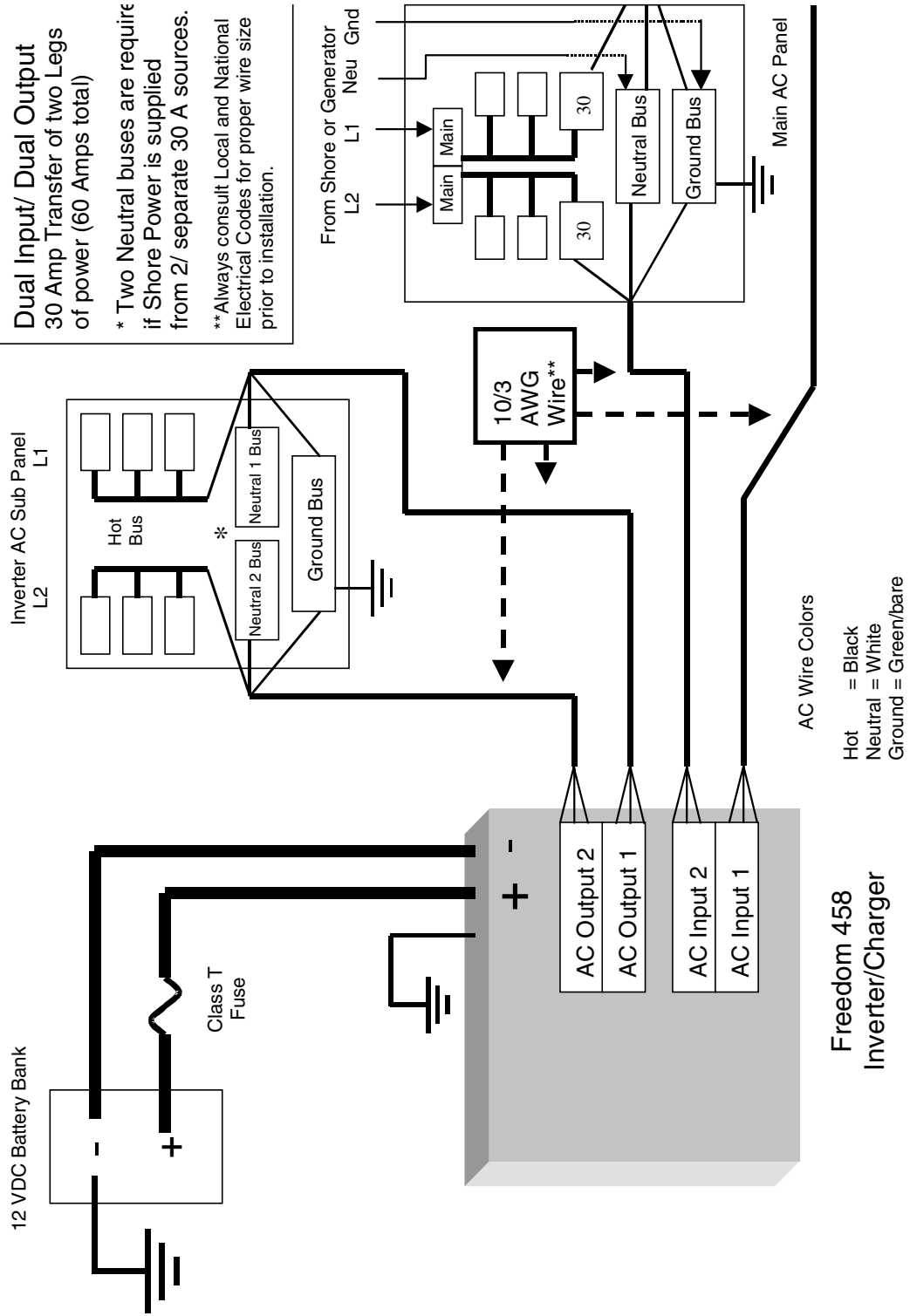
The heavier load appliances, such as space heaters, stoves, water heaters, air conditioners, AC to DC converters, or other battery chargers, should be connected to the Main AC Panel. Power for these loads are supplied by shore or generator power that is connected to the main panel.

This split load approach will help avoid problems such as overloading the inverter or rapidly discharging the battery bank. It also eliminates the need to manually manage your energy usage when using inverter power.



# Freedom 458 Installation Option 4

## Freedom 458 Model 25 D/D, 30 D/D



**Dual Input/ Dual Output**  
30 Amp Transfer of two Legs of power (60 Amps total)

\* Two Neutral buses are required if Shore Power is supplied from 2/ separate 30 A sources.

\*\*Always consult Local and National Electrical Codes for proper wire size prior to installation.

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## ***Installation Option 4 for Freedom 25 D/D and 30 D/D***

Inverter Mode	Dual Input/Dual Output
External AC Power Source	<ul style="list-style-type: none"><li>• Two separate 30-amp shore power sources. Both neutrals and both “hots” must be kept separate.</li><li>• Two 30-amp breakers from panel fed by 50-amp 120-volt, single phase (3-wire), shore power source</li><li>• Two 30-amp breakers from panel fed by 50-amp 120/240-volt split phase (4-wire) shore power source</li><li>• Generator</li></ul>
Power for AC loads	<ul style="list-style-type: none"><li>• Split between the main loads and the inverter loads.</li><li>• AC Input 2 transfers through the inverter to the inverter loads connected to AC Output 2.</li><li>• In INVERT mode, the inverter powers both AC Output 1 and 2.</li></ul>
Charger	<ul style="list-style-type: none"><li>• Charger shares 30-amp source power (AC Input 1) with the inverter loads connected to AC Output 1.</li><li>• In CHARGE/Transfer mode, up to 60 amps can be transferred to the inverter loads.</li><li>• The inverter loads are split into two groups so that these loads can be used to help balance the two legs of shore or generator power.</li></ul>

### **Installation Notes**

1. These two input breakers can be supplied by the same phase or by opposite phases.
2. Use a 30-amp breaker and neutral in the main panel to supply the power to the inverter **AC Input 1**. AC Input 1 is used to power the charger. It transfers up to 30-amps through to the inverter load connected to AC Output 1.  

If only AC Input 1 is supplied power, the unit will charge and it will transfer up to 30-amps through to both AC Outputs 1 and 2. It will power share with these loads.
3. Use a second 30-amp breaker in the main panel to supply the power to **AC Input 2**. This power transfers through the inverter to AC Output 2.

---

If only AC Input 2 is supplied power, the unit will **not** charge. It will only transfer 30-amps through to the inverter loads connected to AC Output 2.

4. The inverter's **AC Outputs 1 and 2** supply a separate sub panel. The appliance and outlet loads are then supplied with power from the inverter hot and inverter neutral buses in the sub panel.
5. If a **generator** is installed in the system, use a break-before-make AC transfer switch to switch between shore power and generator power. Route AC output from the transfer switch to the Main AC Panel.

## Connecting Appliances

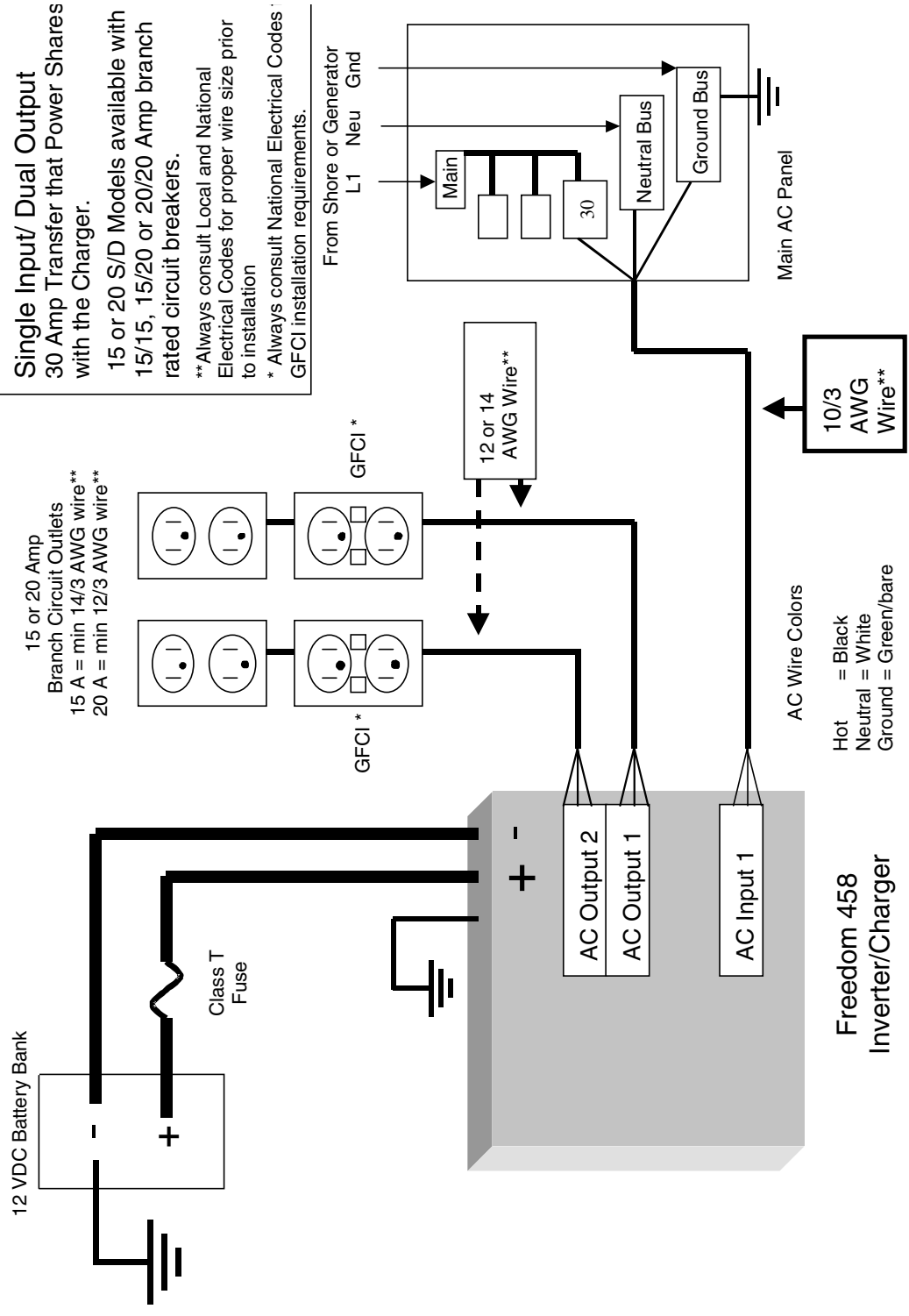
Only lighter appliance and outlet circuits should be connected to the Inverter AC Panel. These loads are supplied power through the inverter in transfer mode, or by the inverter in invert mode.

The heavier load appliances, such as space heaters, stoves, water heaters, air conditioners, AC to DC converters, or other battery chargers, should be connected to the Main AC Panel. Power for these loads is supplied by shore or generator power that is connected to the main panel.

This split load approach will help avoid problems such as overloading the inverter or rapidly discharging the battery bank. It also eliminates the need to manually manage your energy usage when using inverter power.

# Freedom 458 Installation Option 5

## Freedom 458 Model 15 S/D, 20 S/D



**Single Input/ Dual Output**  
 30 Amp Transfer that Power Shares with the Charger.

15 or 20 S/D Models available with 15/15, 15/20 or 20/20 Amp branch rated circuit breakers.

\*\*Always consult Local and National Electrical Codes for proper wire size prior to installation

\* Always consult National Electrical Codes GFCI installation requirements.

From Shore or Generator  
 L1 Neu Gnd

**AC Wire Colors**  
 Hot = Black  
 Neutral = White  
 Ground = Green/bare

---

## **Installation Option 5 for Freedom 15 S/D and 20 S/D**

Inverter Mode	Single Input/Dual Output
External AC Power Source	<ul style="list-style-type: none"><li>• Single 30-amp shore power source</li><li>• 30-amp breaker from panel fed by 50-amp 120-volt single phase (3-wire) shore power source</li><li>• 30-amp breaker from panel fed by one leg of a 50-amp 120/240-volt split phase (4-wire) shore power source</li><li>• Generator</li></ul>
Power for AC loads	Split between main loads and two branch circuits for the inverter loads (AC Output 1 and AC Output 2).
Charger	Shares power with inverter loads only.

### **Installation Notes**

1. Use a 30-amp breaker in the main panel and the main neutral bus to supply the power to the **AC Input**.
2. All **15-amp outputs** should use 12- or 14-gauge\* wires for the output circuit.
3. All **20-amp outputs** should use 12-gauge wires.\*
4. Use a **GFI (GFCI) type** outlet as the first outlet in the line. Consult Local and NEC for specific GFI installation recommendations. See “Step 3: Install ground fault circuit interrupters” on page 23.
5. If a **generator** is installed in the system, use a break-before-make AC transfer switch to switch between shore power and generator power. Route AC output from the transfer switch to the Main AC Panel.

\*Always consult Local and NEC for proper wire size prior to installation.

### **Connecting Appliances**

The inverter has two AC Outputs that are protected by internal branch rated circuit breakers. These eliminate the need for a separate sub panel. These supply two appliance and/or outlet circuits with power directly from the inverter AC outputs.

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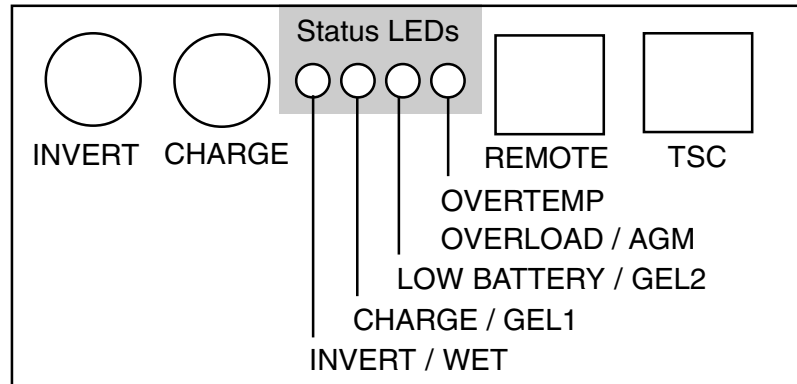
Only lighter appliance and outlet circuits should be connected to AC Output 1 and AC Output 2. These loads are supplied power through the inverter in charge/transfer mode, or by the inverter in invert mode. The charger shares power with the inverter loads only and can transfer up to 30-amps.

The heavier load appliances, such as space heaters, stoves, water heaters, air conditioners, AC to DC converters, or other battery chargers, should be connected to the Main AC Panel. Power for these loads is supplied by shore or generator power that is connected to the main panel.

This split load approach will help avoid problems such as overloading the inverter or rapidly discharging the battery bank. It also eliminates the need to manually manage your energy usage when using inverter power.

# OPERATION

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The Freedom Inverter/Charger performs three distinct functions:

1. **DC to AC power inverting.** This provides 120-volt AC power from deep cycle DC batteries.
2. **Automatic transfer switching** between inverter power and incoming AC power. The unit can use external AC as its power source in addition to batteries. The internal transfer switch allows the Freedom Inverter/Charger to transfer the AC power through directly to the loads.

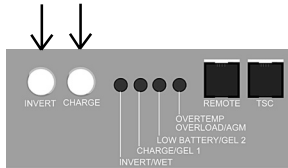
When the external AC power source is disconnected, the transfer switch allows automatic switching back to the inverter.

3. **Automatic 3-stage battery charging** plus manual battery equalizing.

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## Selecting the Battery Type

The selected battery type tells the Freedom Inverter/Charter what voltage settings to use. The unit remembers which type of battery you select. It will use this type each time you connect input power.



1. If the inverter is on, i.e., the INVERT LED is a steady green or blinking, press the INVERT button for 5 seconds. All the LEDs will go out.
2. Press CHARGE. One of the four LEDs will rapidly blink indicating the present battery type setting.
3. Press CHARGE again until the desired battery type is selected.
4. Wait 5 seconds. The unit will return to normal operation with the selected battery type.



## Reading the Status LEDs

For further information, refer to the “Troubleshooting LED Status” chart on page 54.

LED	State	Status
INVERT	Solid Green	Unit is in invert mode.
	Blinking Slowly (once a second)	Inverter is in standby mode, with AC power applied, and the transfer switch engaged.
	No Light	Inverter is turned off.
CHARGE	Solid Green	Charger is turned on.
	Blinking Slowly (once a second)	Charger is ready, but external AC power is not available.
	No Light	Charger is turned off.
LOW BATTERY	Solid Red	Battery warning condition. Battery voltage is below 10.5 volts DC or above 15.0 volts DC.
	Blinking Slowly (once a second)	Unit has shutdown. Battery voltage is either below 10.0 volts DC or above 15.5 volts DC.
	Blinking Rapidly (five times a second)	Potential problem in the DC system has been detected. Check batteries, battery cables and DC loads.
	No Light	Battery voltage is normal, i.e., between 10.5 and 15.0 volts DC.
OVERTEMP/ OVERLOAD	Solid Red	Unit is too hot, or the required output current is too high. Unit will automatically restart when it has cooled down. Check for excessive loads or a short circuit on the inverter output. Correct the problem and restart by pressing INVERT.
	Blinking Slowly (once a second)	System has shut off and will not automatically restart. Either output current is too high or there is a short circuit. Correct the problem and restart by pressing INVERT.
	No Light	Operation is normal.
LOW BATTERY & OVERTEMP/ OVERLOAD	Both Blinking Rapidly (five times a second)	AC power back-feed exists, i.e., external AC power is connected to the inverter’s output. Inspect the wiring and correct the problem before using the unit. Using the unit with a back-feed will damage it and void your warranty.

### Troubleshooting LED Status

		LED Status			Operation Status	Notes
INVERT	CHARGE	LOW BATTERY	OVERTEMP OVERLOAD			
Solid Green	Blinking Green	Off	Off	Inverting. Charger is ready but no external AC available.	Normal	
Blinking Green	Solid Green	Off	Off	Inverter is in standby. Battery is being charged.	Normal, changing current limited if AC load exceeds Power Sharing setting.	
Blinking Green	Off	Off	Off	Inverter is in standby. Charger manually turned off.	If AC power is removed and reapplied, the charger will automatically turn on.	
Off	Solid Green	Off	Off	Inverter is off. Battery is being charged.	Reset the inverter by pressing the INVERT button. The INVERT LED should blink.	
Solid Green	Blinking Green	Solid Red	*	Inverting. Charger is ready but no external AC available. Battery voltage warning: 10V<volts DC>15V	Inverter shut down. Operation will resume when battery reached 13.5 volts.	
Solid Green	Blinking Green	*	Solid Red	Inverting. Charger is ready but no external AC available. Charger over-temperature warning	Warning. Inverter shut down	
Off	Blinking Green	Slow Blinking Red	*	Battery voltage shut down 10V<VDC>15V	Inverter shut down. Operation will resume when battery reached 13.5 volts.	

LED Status					Operation Status	Notes
INVERT	CHARGE	LOW BATTERY	OVERTEMP OVERLOAD			
Off	Blinking Green	*	Slow Blinking Red	Charger ready but no external AC power available. Charger over-temperature shut down.	Operation will automatically resume after unit has cooled down.	
Off	Blinking Green	*	Fast Blinking Red	Inverter Overload Shutdown	Reduce AC load. Manually restart the system.	
Off	Blinking Green	Fast Blinking Red	Fast Blinking Red	Back-feed shutdown. Incorrect AC wiring.	Correct AC input wiring before use. Manually restart the system.	
Off	Blinking Green	Fast Blinking Red	Off	Battery ripple	Warning	

\*Can be either on or off.

# POWER INVERTING

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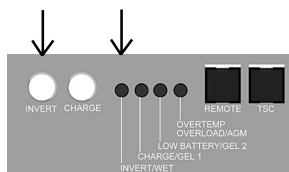
The inverter takes the DC power provided by deep cycle battery banks, and transforms it to regulated 120 volt AC power at the crystal controlled, 60 Hz frequency. Your unit is rated at:

Freedom 10	1000 watts
Freedom 15 & 15 S/D	1500 watts
Freedom 20 & 20 S/D	2000 watts
Freedom 25 D/D	2500 watts
Freedom 30 D/D	3000 watts

The output power is a modified sine wave. It is compatible with most appliances, tools and other 120-VAC equipment.

**Note:** Certain laser printers, bread-makers, dimmer lights, variable speed tools, digital clocks and small battery chargers may not operate on this type of power.

## Turning the Inverter On and Off



### To turn the inverter on

- Press the INVERT button on the front of the unit for three seconds. The green INVERT status light should be solid green.
- If you are using the Remote Control Panel or the LINK instrument, you can use it to turn the inverter on.

### To turn the inverter off

- Press the INVERT button again. The INVERT status light will not be lit.
- If you are using the Remote Control Panel or the LINK instrument, you can use it to turn the inverter off.

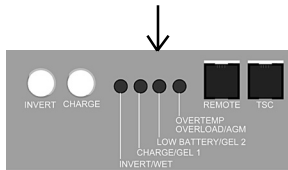
Turn the inverter off when you will not be using the unit for an extended period of time. This reduces battery power consumption to a very low level.

### To reset the unit after correcting a problem

- Press the INVERT button to reset after a fault condition.

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## Battery Shutdown



### Low Battery Voltage Shutdown

If the battery voltage drops to 10.0 volts, the inverter will automatically shut off. Charge the batteries to 13.5 volts to automatically resume operation.

### High Voltage Battery Shutdown

Voltage shutdown also occurs at 15.5 volts. Check all DC sources on the system to find out why you have excessive voltage, and correct the problem.

Operation will resume automatically when the battery voltage drops below 15.5 volts.

# BATTERY CHARGING

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The Freedom Inverter/Charger is designed to rapidly and optimally charge wet, gel, or Absorbed Glass Mat (AGM) cell deep-cycle batteries. Each model is rated at the following maximum output current:

Model	Maximum Output Current
Freedom 10	50 Amps DC
Freedom 15, 15 S/D	75 Amps DC
Freedom 20, 20 S/D	100 Amps DC
Freedom 25 D/D	130 Amps DC
Freedom 30, 30 D/D	140 Amps DC

## *Turning the Charger On and Off*

### **To turn the charger on**

- If your unit has dual inputs, and you have installed the unit using one of the installation options described in the “Installation” section, connect the power to AC Input 1.
- The Freedom Inverter/Charger automatically turns on when you connect AC power to the AC Input.
- If you are using the Remote Control Panel or the LINK instrument, you can use it to turn the charger on.

### **To turn the charger off**

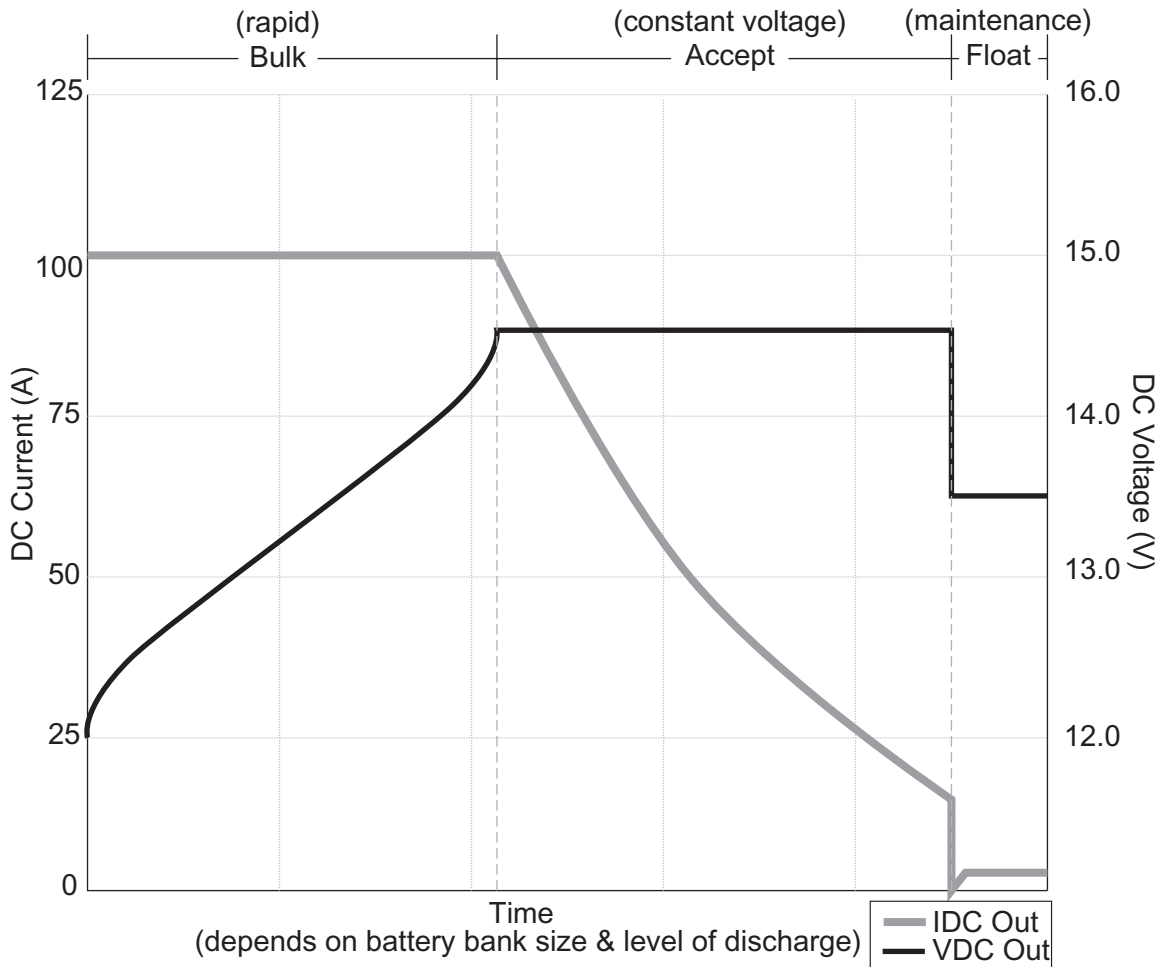
- Press CHARGE on the front of the unit.  
**Note:** You can only turn the charger off when AC power is being supplied.
- If you are using the Remote Control Panel or the LINK instrument, you can also use it to turn the charger off.

## *Automatic 3-Stage Battery Charging*

When you connect AC power to the Freedom Inverter/Charger input, the battery charger automatically turns on. If you are using the Remote Control Panel or the LINK instrument, use it to turn the charger on.

The battery charger proceeds through the three charging stages automatically, resulting in an efficient, complete charge.

**Automatic 3-Stage Battery Charging**  
**Time vs. DC Current in Amps**  
**Time vs. DC Voltage in Volts**



The battery charger stages are:

1. Bulk Charge
2. Acceptance Charge
3. Float Charge
4. Equalizing Charge (optional)

---

## Stage 1—Bulk Charge

During the bulk charge stage most of the energy that has been consumed during discharge is returned to the battery bank.

The charger enters this phase as soon as you turn the charger on, i.e., as soon as you connect AC power to the appropriate AC input. The charger delivers full rated current to the battery bank, until the acceptance charge voltage limit is reached. This results in a relatively rapid recharge.

### Bulk Charging Wet Cell Batteries

Generally, a wet cell battery bank should not be charged at a rate that exceeds 25% of its capacity.

When you completely charge a wet cell deep-cycle battery, you must raise the battery voltage beyond the point where the battery begins to bubble and give off gas. This is called the gassing point. If charging stops short of this point, sulfate is left on the plates and the battery begins to deteriorate. The gassing point will vary with battery temperature. At 77° F, the gassing point of a 12-volt battery is about 14.0 volts.

### Bulk Charging Gel Cell and AGM Batteries

Gel cell and AGM batteries can accept a higher current rate of charge (amps). Consult the manufacturer for specifications.

Do not charge AGM and Gel cell batteries to their gassing point. The high voltage charging which gasses these batteries is harmful to them. They typically require a lower bulk charge voltage and a higher float voltage than wet cell batteries.



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## Stage 2—Acceptance Charge

The acceptance stage immediately follows the bulk charge stage. During this stage the battery voltage is held constant at the acceptance charge voltage limit and the current gradually ramps down. The battery accepts its final charge current and the last of the sulfate on the plates is removed. This completely charges the battery.

The acceptance stage lasts until the charge current reaches the float transition point or until the maximum acceptance time is reached.

**Acceptance to Float Transition Points**

Model	Maximum Output Current
Freedom 10	10 Amps DC
Freedom 15 & 15 S/D	12 Amps DC
Freedom 20 & 20 S/D	15 Amps DC
Freedom 25 D/D	15 Amps DC
Freedom 30 D/D	15 Amps DC

### Acceptance Time Limits

A timer will terminate the acceptance stage if float transition current level is not reached. The acceptance stage timer is automatically disabled when you use a LINK instrument.

The selected battery type determines the acceptance stage time limit. Maximum acceptance time is:

- **Wet cell batteries:** 1 hour. Wet cell batteries will gas during acceptance. This is a necessary part of the charging process.
- **Gel cell batteries:** 3 hours. Gel cell acceptance time is longer because they are less likely to gas.
- **AGM batteries:** 1 hour.

**Battery Charger Acceptance Voltage Settings in DC Volts**

Temperature		Type 0	Type 1	Type 2	Type 3
°F	°C	Wet Cell	Gel 1*	Gel 2*	AGM
120	49	12.5	13.0	13.0	12.9
110	43	13.6	13.5	14.0	13.9
100	38	13.8	13.7	14.1	14.0
90	32	14.0	13.8	14.2	14.1
80	27	14.2	14.0	14.3	14.2
70**	21**	14.4	14.1	14.4	14.3
60	16	14.5	14.3	14.5	14.4
50	10	14.5	14.4	14.5	14.5
40	5	15.5	14.5	14.5	14.5
30	-1	15.5	14.5	14.5	14.5

\*There are two settings for gel batteries. The Gel 1 setting is for long battery life; the Gel 2 setting is for rapid charging. Check with the battery manufacturer to determine the proper setting for your batteries.

\*\*Default setting when the temperature sensor is not connected.

**Stage 3—Float Charge**

When the acceptance stage is completed, the charge current will shut off. The Freedom Inverter/Charger monitors the battery voltage while it drifts down from the acceptance charge voltage limit. When it reaches the float voltage set point, the float charge stage engages.

The float charge stage holds the battery voltage constant, at a preset lower level for long term battery maintenance. During the float charge stage, the full output current of the battery charger is available to operate any DC appliances that may be on the system.

---

The battery charger remains in the float charge stage until:

- You disconnect incoming AC power from the charger
- You press CHARGE on the unit to turn the charger off
- You turn the charger off using the Remote Control Panel or LINK instrument

#### Battery Charger Float Voltage Settings in DC Volts

Temperature		Type 0	Type 1	Type 2	Type 3
°F	°C	Wet Cell	Gel 1*	Gel 2*	AGM
120	49	12.5	13.0	13.0	12.9
110	43	12.7	13.0	13.4	12.9
100	38	12.9	13.2	13.5	13.0
90	32	13.1	13.3	13.6	13.1
80	27	13.3	13.5	13.7	13.2
70**	21**	13.5	13.6	13.8	13.3
60	16	13.7	13.8	13.9	13.4
50	10	13.9	13.9	14.0	13.5
40	5	14.1	14.1	14.1	13.6
30	-1	14.3	14.2	14.2	13.7

\*There are two types of gel batteries. Gel 1 batteries are usually long life batteries; Gel 2 batteries are rapid charging. Check with the battery manufacturer to determine the proper setting for your batteries.

\*\*Default setting when the temperature sensor is not connected.

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## Optional Equalizing Charge

### Stage 4 - Equalizing Charge (Optional)



#### Warning

*Do not equalize gel cell or AGM batteries.*

The equalizing charge is a controlled, over-charge cycle. During the cycle, the battery voltage will increase to the equalizing voltage. This will cause the battery bank to gas profusely. Equalizing voltage is fixed at 16.3 volts DC.

Periodic equalizing is recommended by most **wet cell**, deep cycle battery manufacturers. Follow the battery manufacturer's recommendations. Equalizing is recommended only for wet cell batteries.

**You can only initiate an equalizing charge with a Remote Control Panel or LINK instrument.**

#### Benefits of Equalizing

1. **Removal of residual sulfate.** Each time a battery is cycled (discharged and charged), a small amount of sulfate is left on the internal plates. Over time, the sulfate will build up, and it will compromise the performance of the battery. By applying an equalizing charge, the sulfate is returned back to the electrolyte.
2. **Bring all cells to the same potential.** All lead-acid batteries are made up of individual 2-volt cells. As the battery bank is cycled, slight differences in the cells result in different cell voltages, affecting the overall charge effectiveness. Equalizing brings all cells to the same voltage and the electrolyte in each cell to the same specific gravity.
3. **Mixing up of the electrolyte.** Electrolyte in battery cells tend to separate into layers of acid and water. The vigorous bubbling action of the battery during equalizing serves to physically mix the electrolyte.

---

### To equalize the batteries

Equalizing is recommended only for wet cell batteries. Do not equalize gel cell or AGM batteries.

1. Do not equalize the batteries until they have completed the full 3-stage charge cycle.
2. Remove all loads from the DC system. Some DC loads may not tolerate the high charge voltage.
3. Provide proper ventilation for the battery fumes.
4. Check the battery electrolyte level. Ensure the plates are covered. It is best not to completely top off the batteries before you equalize.
5. Replace the battery caps. Leave the caps on while equalizing.
6. For instructions on starting the equalizing cycle, refer to the Remote Control Panel or LINK instrument manual.
7. Monitor the equalizing charge cycle:
  - Do not allow any sparks.
  - If one or more cells begin to overflow, terminate the equalizing charge cycle.

During the cycle:

- The battery, state-of-charge LEDs will sequence on the Remote Control Panel.
  - The red charge LED flashes on the LINK instrument.
8. If you do not interrupt the AC power to the charger, a timer will stop the equalization charge cycle in 8 hours. The charger automatically goes to float and
    - Green float LED battery status light is illuminated on the Remote Control Panel.
    - Green float LED is lit on the LINK instrument.
  9. Check the battery electrolyte level. Top off with distilled water if necessary. This is a good time to perform routine battery maintenance.

---

#### **To cancel equalizing**

- Interrupt the AC power to the charger at any time during the cycle.

### ***Temperature Sensitive Charging (TSC)***

When the battery temperature sensor is connected to the unit and to the batteries, the charge voltage is controlled based on battery temperature. The charger adjusts the charge voltage to the best level. This minimizes water loss in wet cell batteries. Charge voltage regulation optimizes the battery life cycle.

If the sensor is not connected, the charge voltage levels are set to defaults based on the type of battery. See the “Battery Charger Acceptance Voltage Settings in DC Volts” chart on page 62 and the “Battery Charger Float Voltage Settings in DC Volts” chart, on page 63.

#### **To connect the TSC sensor**

For instructions on installing the TSC sensor, see Installation section, “Step 7: Install the optional Temperature Sensitive Charging (TSC) sensor” on page 29.

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## **REPLACING BATTERY CABLE FUSES**

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Battery cable fuses provide continued protection against the possibility of fire. When the fuse blows, replace the battery cable fuse with a fuse of the specified voltage, current and type ratings. See Installation section, “Step 5: Install battery cable fuses” on page 26 for specifications.

# RESETTING CIRCUIT BREAKERS

Your Freedom Inverter/Charger has the following supplemental circuit breakers:

- S/D models have output circuit breakers (OUT1 and OUT2) to protect the output AC circuits. These can be used for branch circuit protection.
- INVERT/CHARGE breaker protects against sustained inverter/charger over current conditions.

## Circuit Breaker Protection in Amps

Model	Invert/Charge
Freedom 10	15 Amps DC
Freedom 15	20 Amps DC
Freedom 20	25 Amps DC
Freedom 25 D/D	30 Amps DC
Freedom 30 D/D	30 Amps DC

## Single Input, Dual Output Circuit Breaker Protection in Amps

Model	Part Number	Invert/Charge	Output 1	Output 2
15 S/D	81-1521-12	15	20	20
15 S/D	81-1522-12	20	15	20
15 S/D	81-1523-12	20	15	15
20 S/D	81-2021-12	25	20	20
25 D/D	81-2022-12	30	15	20
30 D/D	81-2023-12	30	15	15

### To reset the circuit breakers

1. Remove the fault.
2. Reset supplemental circuit breakers by pushing the button back in.
3. Reset integral branch circuit rated breakers by moving the appropriate breaker switch to on.

# SPECIFICATIONS

Model	10	15, 15 S/D	20, 20 S/D	25 D/D	30, 30 D/D
Part Number	81-1010-12	81-1510-12 81-1521-12* 81-1522-12* 81-1523-12*	81-2010-12 81-2021-12* 81-2022-12* 81-2023-12*	81-2530-12**	81-3010-12 81-3030-12**
Nominal Battery Voltage	12 VDC	12 VDC	12 VDC	12 VDC	12 VDC
Battery Voltage Range	10.0-15.5 VDC	10.0-15.5 VDC (+/- 0.2)	10.0-15.5 VDC (+/- 0.2)	10.0-15.5 VDC (+/- 0.2)	10.0-15.5 VDC (+/- 0.2)
Low Battery Cutout	10 VDC (+/- 0.5)	10.0 VDC (+/- 0.5)	10.0 VDC (+/- 0.5)	10.0 VDC (+/- 0.5)	10.0 VDC (+/- 0.5)
AC Input Voltage Range	90-130 VAC Normal: 120 VAC	90-130 VAC Normal: 120 VAC	90-130 VAC Normal: 120 VAC	90-130 VAC Normal: 120 VAC	90-130 VAC Normal: 120 VAC
Frequency Regulation	60 Hz, Quartz Regulated	60 Hz, Quartz Regulated	60 Hz, Quartz Regulated	60 Hz, Quartz Regulated	60 Hz, Quartz Regulated
Inverter Output Power (Continuous)	1000 VA	1500 VA	2000 VA	2500 VA	3000 VA
Inverter Voltage Regulation	120 V +/- 5% True RMS	120 V +/- 5% True RMS	120 V +/- 5% True RMS	120 V +/- 5% True RMS	120 V +/- 5% True RMS
Wave Shape	Modified Sine Wave	Modified Sine Wave	Modified Sine Wave	Modified Sine Wave	Modified Sine Wave
Surge Power	30 Amps	55 Amps	70 Amps	80 Amps	90 Amps
No Load Current Drain (Idle Mode)	0.12 Amps	0.12 Amps	0.12 Amps	0.12 Amps	0.12 Amps



Model	10	15, 15 S/D	20, 20 S/D	25 D/D	30, 30 D/D
Power Factors Allowed	All	All	All	All	All
Full Load Efficiency	85%	86%	85%	87%	86%
Peak Efficiency	93%	92%	93%	93%	93%
Protection	Over/Under Utility Voltage, Over/Under Battery Voltage, Short-Circuit, Circuit Breaker, Over Temperature	Over/Under Utility Voltage, Over/Under Battery Voltage, Short-Circuit, Circuit Breaker, Over Temperature	Over/Under Utility Voltage, Over/Under Battery Voltage, Short-Circuit, Circuit Breaker, Over Temperature	Over/Under Utility Voltage, Over/Under Battery Voltage, Short-Circuit, Circuit Breaker, Over Temperature	Over/Under Utility Voltage, Over/Under Battery Voltage, Short-Circuit, Circuit Breaker, Over Temperature
Charging Rate	50 Amps (3-stage)	75 Amps (3-stage)	100 Amps (3-stage)	130 Amps (3-stage)	140 Amps (3-stage)
AC Input (Max. Charge Mode)	12 Amps	17 Amps	21 Amps	26 Amps	28 Amps
Bulk Charge Voltage***	14.3 VDC**	14.3 VDC**	14.3 VDC**	14.3 VDC**	14.3 VDC**
Float Charge Voltage***	13.4 VDC**	13.4 VDC**	13.4 VDC**	13.4 VDC**	13.4 VDC**

\*Single AC Input, Dual AC Output Models

\*\*Dual AC Input, Dual AC Output Models

\*\*\*Variable on unit with Temperature Sensor installed. Adjusted by Battery type selected.

Model	10	15, 15 S/D	20, 20 S/D	25 D/D	30, 30 D/D
Equalizing Charge Voltage	16.3 VDC**	16.3 VDC**	16.3 VDC**	16.3 VDC**	16.3 VDC**
Status Panel	Optional Remote Control Panel or LINK Instrument	Optional Remote Control Panel or LINK Instrument	Optional Remote Control Panel or LINK Instrument	Optional Remote Control Panel or LINK Instrument	Optional Remote Control Panel or LINK Instrument
Weight	35 lbs.	45 lbs.	45 lbs.	50 lbs.	50 lbs.
Dimensions	13.2"L x 11.5"W x 7.9"H	13.2"L x 11.5"W x 7.9"H	13.2"L x 11.5"W x 7.9"H	13.2"L x 11.5"W x 7.9"H	13.2"L x 11.5"W x 7.9"H

\*Single AC Input, Dual AC Output Models

\*\*Dual AC Input, Dual AC Output Models

\*\*\*Variable on unit with Temperature Sensor installed. Adjusted by Battery type selected.