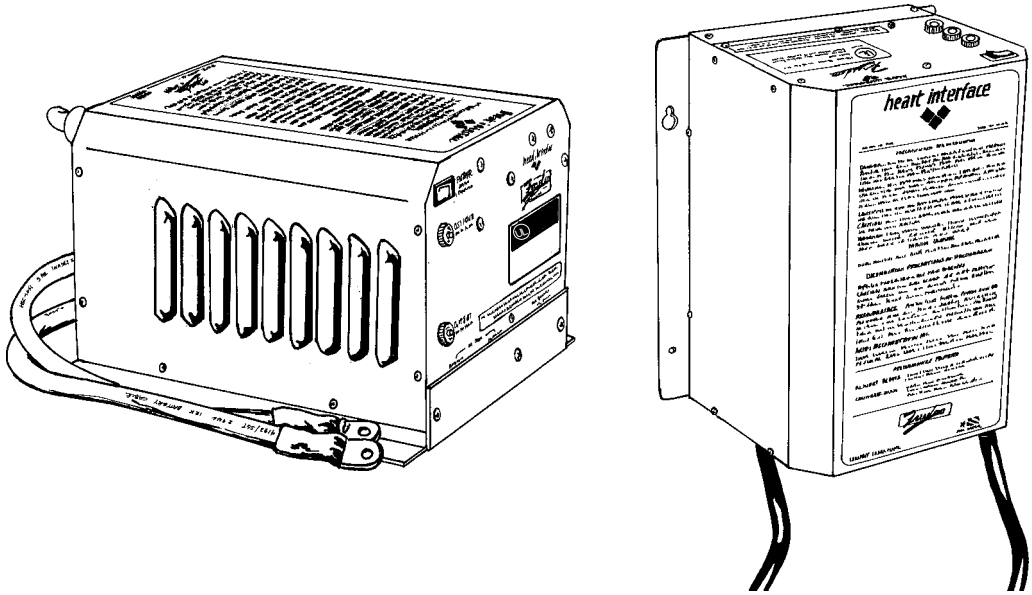
OWNER'S MANUAL

FREEDOM COMBI™ INVERTER/CHARGERS



FREEDOM MODELS 10, 15, 20, 25

heart interface®
A Valley Forge Company

Part No. 90-0113-00
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Thank you for purchasing a Heart Interface Freedom Combi$_{TM}$ Inverter/Charger. Heart Interface takes pride in manufacturing quality products specifically designed to meet your power requirements.

Freedom Combi 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 world-wide by qualified service centers.

If you have any questions about your Freedom Combi, please contact Heart Interface toll free: **(800) 446-6180**.

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

techhelp@heartinterface.com **sales@heartinterface.com**

For your convenience, we’ve included a record log on page 39. Regular system maintenance is important for optimum performance of your Freedom Inverter/Charger. Use this record to keep track of any changes to your electrical system.

SAFETY SUMMARY

General safety information for installation and operation is contained throughout this manual where it applies and is not included in this summary.

Definitions Warning statements identify conditions or practices which could result in personal injury, loss of life, damage to equipment or other property.

Fuse Replacement For continued protection against the possibility of fire, replace the fuse only with a fuse of the specified voltage, current and type ratings.

Power Source To avoid damage, operate the equipment only within the specified AC (line) and DC (battery) voltages.

Servicing To reduce the risk of electric shock do not open this unit. There are no user serviceable parts inside. Refer all service to qualified personnel.

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INTRODUCTION

This owner's manual describes the Freedom Combi$_{TM}$ Inverter/Chargers from Heart Interface. These units perform three distinct functions:

1. DC to AC power inverting.
2. Automatic transfer switching between inverter power and incoming AC power.
3. Automatic 3-Stage Battery charging plus manual battery equalizing.

• The inverters provide regulated 120 Volt AC power and crystal controlled frequency from a deep cycle battery bank in specified watts:

Freedom 10 . . . . . 1000 watts
Freedom 15 . . . . . 1500 watts
Freedom 20 . . . . . 2000 watts
Freedom 25 . . . . . 2500 watts

The output is a modified sine wave and is compatible with most appliances, tools and other 120 VAC equipment. An idle circuit reduces battery power consumption when the loads are removed from the inverter. There is a low battery cutout circuit and momentary surge power of more than twice the inverter rating is available for starting electric motors. High efficiency insures the longest possible battery life between recharges.

• The internal transfer switch allows the Freedom Inverter/Charger to be connected to an external AC source and transfer the source power through to the loads. When disconnected, the transfer switch allows automatic switching back to the inverter.

The Freedom Inverter/Charger operates as a self-contained backup power system, just add batteries.

• Freedom battery chargers are electronically controlled and rated:

Model	12 Volts	24 Volts
Freedom 10	50 Amps DC	25 Amps DC
Freedom 15	75 Amps DC	N/A
Freedom 20*	100 Amps DC	50 Amps DC
Freedom 25	130 Amps DC	65 Amps DC

***Also available in 32 Volt model rated at 35 Amps DC**

They are designed to rapidly and optimally recharge either wet** or gel** cell deep-cycle batteries. Battery charging is accomplished in 3 automatic stages: Bulk Charge, Acceptance Charge and Float Charge. Using a Freedom Remote Control Panel or Link Instrumentation, a manually-engaged Equalizing Charge cycle is possible.

Simple, automatic operation is made possible by the microprocessor in the Freedom Inverter/Charger. In most cases, the unit is left ON and no attention or maintenance is required.

Electronic Protection

Fast-acting electronic circuits protect the inverter from extreme overloads and short circuits. Other protection includes a low and high battery cutoff and automatic shutdown if over temperature occurs. The fault condition must be eliminated before reset will occur. Example: remove overload, recharge batteries or allow to cool. Reset by cycling the power switch on the Freedom Remote Control Panel, Link Instrument or the Freedom unit one time--OFF/ ON.

**Adustable with optional remote (Freedom Remote Panel or Link Instrumentation)

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THINGS YOU SHOULD KNOW

Circuit Breaker Protection

The Freedom Inverter/Charger is circuit breaker protected. The INV/CHG breaker on the front of the unit protects against sustained inverter/charger over current conditions.

Model	Circuit Breaker
Freedom 10	**12 Amp**
Freedom 15	**20 Amp**
Freedom 20	**25 Amp**
Freedom 25	**30 Amp**

The 30 Amp INPUT circuit breaker on the Freedom unit protects the incoming AC circuit. The incoming AC circuit provides power to the battery charger and transfers power to the loads connected to the inverter AC output. The breakers are reset by pushing the button back in.

NOTE: Freedom 25 only. There are 3 circuit breakers on the Freedom 25. The OUTPUT 30 Amp circuit breaker on the front of the unit protects against sustained inverter overloads. The TRANSFER 30 Amp circuit breaker on the unit protects the incoming AC leg which is transferred through to the loads. The CHARGER 30 Amp circuit breaker protects the incoming AC leg which feeds the battery charger.

Thermostat Controlled Cooling

Freedom Inverter/Chargers are equipped with a thermostat controlled fan that cools the unit so it can operate continually at its rating.

Inverter Idle Circuit

This automatic energy saving feature reduces battery power consumption when no load is present. Response from idle is instant. In most cases, the operation of the idle circuit is not noticeable. Use of the Freedom Remote Control Panel or Link Instrumentation allows the idle circuit sensitivity to be adjusted. The unit will not put out 120 Volts when in idle. To bring the unit out of the idle condition, apply a load.

Low and High Battery Protection

When the battery voltage drops to 10 Volts, the Freedom Inverter/Charger will automatically shut off. Recharge the batteries to 13.5 Volts (12 V model). For 24 Volt models, recharge batteries to 31.0 Volts. For 32 Volt models, recharge batteries to 41.38 Volts. Freedom units will automatically reset when shore power is disconnected or reset manually by cycling the power switch OFF/ON

Shut down also occurs for a high battery condition at 15.5 Volts. To restore inverter operation, battery voltage must be below 15.5 Volts. Check all DC sources on the system for excessive voltage.

Power Sharing

When connected to shore power or when using a generator, the battery charger and transfer functions are engaged. A unique Power Sharing feature automatically reduces the AC consumption of the battery charger allowing necessary AC power to the load. This prevents the source AC INPUT circuit breaker from tripping.

The Power Sharing set point of each unit has a factory default setting. This can be adjusted using the Freedom Remote Control Panel or a Link Instrument.

NOTE: Freedom 25 only. Since the Freedom 25 has dual AC inputs, one transfer and one charge, factory default setting for Power Sharing is OFF. If only one leg is used to supply both inputs, set Power Sharing accordingly.

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REMOTE CONTROL PANELS

Freedom Remote Control Panel

An optional remote control panel is available. When the remote is used, the power switch on the unit should be left OFF. The remote control panel provides LED bargraphs which show system status, battery voltage and DC current in both inverter and charger modes.

These bargraphs can also display dip switch positions and shutdown conditions. Dip switches allow the selection of battery type, battery temperature, idle sensitivity, Power Sharing, manual equalizing and auto/manual charge modes. Refer to the Freedom Remote Control Panel Addendum, pages 28-34, in this manual for more information.

Link Instrumentation

More advanced optional remote control panels are also available: the Link 1000, 2000 and 2000R.

Link 1000 controls the Freedom Inverter/Charger and provides complete battery state-of-charge information including DC voltage, current, Amp-hours consumed, Time Remaining and historical data for a single battery bank.

The Link 2000 provides inverter/charger control and complete battery state-of-charge information for up to two battery banks.

The Link 2000R adds the ability to control an engine-driven alternator. This precision regulator transforms an alternator into a 3-stage battery charging system.

If Link Instrumentation is used to control the inverter/charger, refer to the Link Owner's Manual for setup and control information.

Refer to Installation Guide for installation options.

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OPERATION

The Freedom Inverter/Charger provides household 120 Volt AC power from auxiliary DC batteries, automatic battery charging and automatic AC transfer switching.

Power Switch

The Power Switch is located on the front panel. This switch controls ON/OFF and RESET for the inverter.

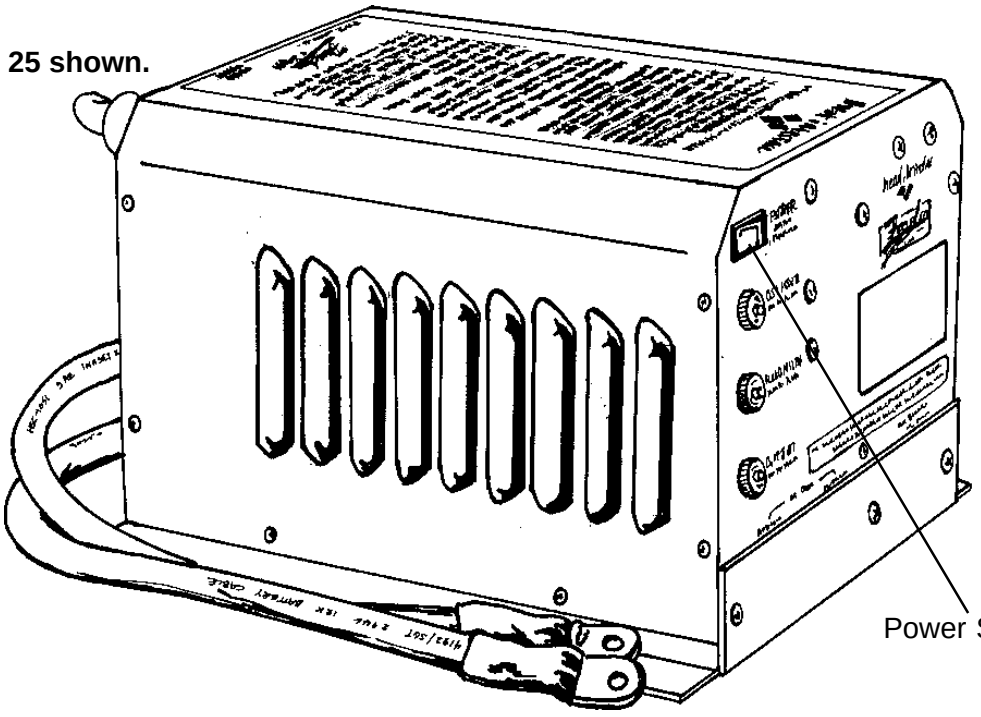
If the unit is connected to external AC power, the battery charger and transfer switch will continue to function, regardless of the position of the switch.

When external AC power is removed and the power switch is in the ON position, the inverter will automatically be ON. If the switch is in the OFF position and external AC power is removed, the inverter will be OFF.

Inverter overload protection, transfer switching, default Power Sharing and 3-stage battery charger regulation will all function automatically.

If installed with the Freedom Remote Control Panel or Link Instrument, the power switch on the unit should be left in the **OFF** position. Refer to Freedom Remote Control Panel Addendum, pages 28-34, or the Link Owner's Manual.

Freedom 25 shown.



Freedom 10 and 20 Circuit Breakers
INPUT
INV/CHG

Freedom 25 Circuit Breakers
CHARGER
TRANSFER
OUTPUT

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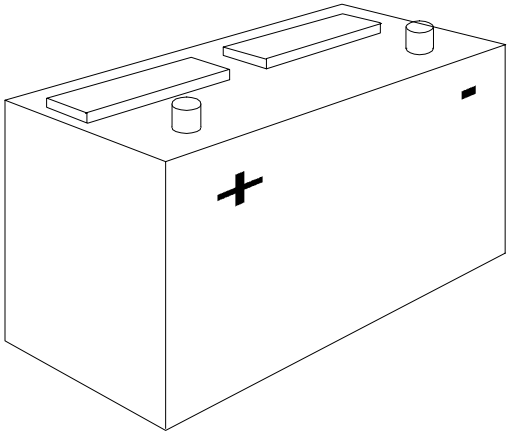
BATTERIES



BATTERY TYPES

Use only deep-cycle batteries with your Freedom Inverter/Charger. These 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 are characterized by relatively thick plates that are alloyed with antimony.

Common marine/RV deep-cycle batteries are acceptable. However, golf cart batteries perform well and may have a longer life. They are 6 Volt batteries that must be used in series pairs. **High quality marine deep-cycle batteries offer good performance** and are available in a wide variety of sizes. Floor sweeper, fork lift or large 2 Volt cells can also offer excellent performance, if their large size can be accommodated.

It should be noted that high antimony deep-cycle batteries will give off gas as a natural result of charging and will experience some water loss. It is **very important that the electrolyte level be checked frequently** and topped off with distilled water when necessary. Never allow the tops of the plates to be exposed to air, as contamination of the cell will result. Keeping the tops of batteries clean will reduce self-discharging. Always provide ventilation for the battery storage compartment.

Do not use car batteries or engine starting batteries of any kind with your inverter/charger. Beware of any battery that is rated in Cold Cranking Amps (CCA). This is a rating which applies only to engine starting batteries. In general, most wet cell batteries that are described as hybrid batteries, suitable for either engine starting or deep-cycle applications, are a compromise and will have limited life if deeply discharged.

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BATTERIES

Beware of so-called maintenance-free batteries. These batteries have calcium alloyed with the lead and hold the liquid electrolyte in a sponge-like material. They are sealed and water can not be added. Do not confuse them with true gel cell or Advanced AGM batteries, they will not hold up to deep discharging and repeated cycling.

Gel Cell Batteries

Gel cell batteries are lead-acid batteries similar in many ways to the common wet cell battery, but differences in the chemistry and construction provide some unique features.

- No Maintenance
- Low Self-Discharging
- Low Internal Resistance

Even though gel cells are sealed batteries, the battery compartment should be ventilated.

Advanced AGM (Absorbed Glass Mat) Batteries

This battery is lead acid but maintenance-free. The performance is similar to gel cell batteries. The charge perameters are similar to wet cell batteries.

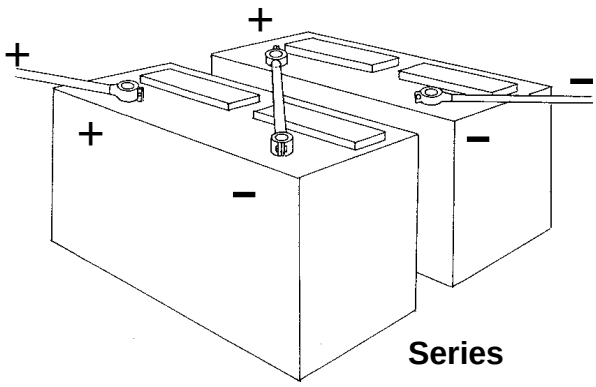
Battery Selection The most important feature to consider in making your battery selection is to select true deep cycle batteries rated in Amp-hours (AH).

BATTERY INTERCONNECTION

In most cases, you will be using a bank of two or more batteries with your inverter/ charger. You may connect batteries together in two configurations, series and parallel.

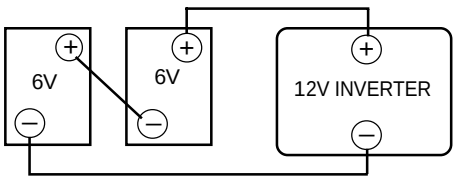
Series

Connecting two batteries in series will double the voltage of the battery bank. For instance, two 6 Volt batteries connected in series will produce 12 Volts. The Amp-hour capacity of the battery bank will be the same as each individual battery. Example, two 6 Volt 220 Amp-hour batteries in series will produce one 12 Volt 220 Amp-hour battery bank.



Series

Series Increase Voltage



EACH BATTERY CAPACITY: 220 AMP-HOURS @ 6 VDC

TOTAL BATTERY BANK CAPACITY: 220 AMP-HOURS @ 12 VDC

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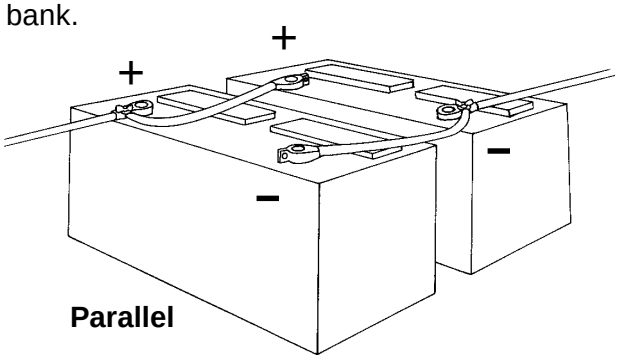
BATTERIES

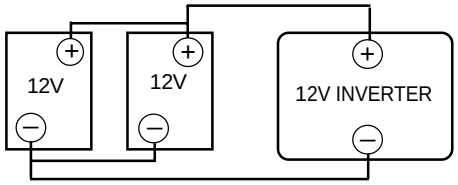
Parallel

Connecting two batteries in parallel will double the Amp-hour rating of the battery bank, while the voltage will be the same as each individual battery. Example, two 12 Volt 105 Amp-hour batteries in parallel will produce one 12 Volt 210 Amp-hour battery bank.



Parallel

Parallel Increase Amp-hour Capacity



EACH BATTERY CAPACITY: 105 AMP-HOURS @ 12 VDC

TOTAL BATTERY BANK CAPACITY: 210 AMP-HOURS @ 12 VDC

Only similar batteries should be connected together in one bank. Do not connect old and new batteries together or wet and gel cell batteries together. In the above drawing, the load is connected to the positive terminal of the first battery and the negative terminal of the last battery. This practice helps to balance the battery bank and is called *cross-connecting* the battery bank.

Note: It is not advisable to connect batteries of different case sizes or Amp-hour ratings in the same battery bank.

Always use wire and terminals for your interconnecting battery cables which are appropriate to handle the current. They must be the same size or larger AWG as the cables supplied with the inverter/ charger.

BATTERY BANK RATINGS AND SIZING

Deep-cycle batteries are usually rated in Amp-hours. The Amp-hour rating is based on a 20 hour discharge cycle, therefore, a 100 Amp-hour battery can deliver 5 Amps for 20 hours. If the discharge rate is greater than 5 Amps, the available Amp-hours are decreased. For example, if the load is increased to 100 Amps, only about 45 Amp-hours will be available at this rate of discharge.

Deep-cycle batteries can be discharged about 80% before permanent damage occurs, though shallower cycling will result in much longer battery life. 50% cycling is generally considered to be a good compromise between long battery life and a reasonably sized battery bank.

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BATTERIES

To achieve 50% cycling you should calculate your Amp-hour consumption between charging cycles and use a battery bank with twice that capacity**. Each AC appliance or tool has a rating plate on it and will be rated in either AC Amps or Watts or AC VA (Volt-Amps) apparent power. To calculate Amp-hour consumption, use one of the formulas to the right to calculate the DC Amp-hour draw for a 12 Volt system.

Calculate the Amp-hours for every AC appliance or tool that will be operated on the inverter. This will provide the total number of Amp-hours used between recharges. Size the battery bank using this number as a guideline. A good rule to follow is to size the battery bank a minimum of 2 times larger than the total Amp-hour load requirement. Plan on recharging when 50% discharged.

**Batteries are typically charged to 85% of full charge when charging with alternators without 3-stage regulators.

AMP-HOUR CONSUMPTION FORMULAS

(AC Amps x 10) x 1.1 x hours of operation = DC Amp-hours

(Watts/ DC Voltage) x 1.1 x hours of operation = DC Amp-hours

(AC VA/ DC Voltage) x 1.1 x hours of operation = DC Amp-hours

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

In all formulas, 1.1 is the factor for inverter efficiency.

Typical Power Consumptlon

The chart below 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.

If using the same battery bank for the inverter and the DC loads, be sure to consider the power consumption of the DC loads when sizing the battery bank.

Typical Power Consumption

Appliance	Typical Wattage	Appliance Run Times / Amp Hours							
		5 Min.	15 Min.	30 Min.	1 Hr.	2 Hr.	3 Hr.	8 Hr.	24 Hr.
13" Color TV	50	.33	1	2	4	8	12	32	96
19" Color TV	100	.66	2	4	8	16	24	64	192
VCR	50	.33	1	2	4	8	12	32	96
Lamp	100	.66	2	4	8	16	24	64	192
Blender	300	2	6	12					
Laptop Computer	50	.33	1	2	4	8			
Curling Iron	50	.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' Refrigerator*	150			2	4	8	12	32	96
20 cu' 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		

Number in each box represents the total Amp hours used (@ 12 volt DC) based on various continuous run times.
*Note refrigeration is typically calculated using a 1/3-duty cyle.

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BATTERY CHARGING

Battery Charging

Completely recharging wet cell deep-cycle batteries requires the battery voltage to be raised beyond what is known as the gassing point. This is the voltage at which the battery begins to bubble and gas is given off. If charging stops short of this point, sulfate is left on the plates and deterioration of the battery begins. The gassing point will vary with battery temperature.

At 77 degrees F, the gassing point of a 12 Volt battery is about 14.0 Volts. Battery charging without excessive gassing of the batteries is accomplished with three-stage chargers. The Freedom Inverter/Charger utilizes this technique.

Gel cell batteries must not be charged to their gassing point. In fact, 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. Consult the battery manufacturer for specifications.

Conventional Battery Chargers

Most conventional battery chargers are single-stage constant voltage chargers. They must stop short of the gassing point or they will overcharge the battery bank. Most 12 Volt battery chargers bring the battery voltage up to about 13.8 Volts.

This presents two problems. First, since the battery voltage does not reach the gassing point, sulfate is left on the plates. Second, 13.8 Volts is close enough to the gassing point that some gas will escape, and the wet cell battery will need to be frequently topped off with distilled water.

Conventional battery chargers also suffer from another inherent characteristic of design, which is a tapering effect. While they will deliver their rated current into a deeply discharged battery, as the battery voltage rises, the output current of the charger tapers down. This taper continues as the battery is charged, taking a very long time to reach an acceptable recharge level.

Freedom Battery Chargers

Freedom battery chargers are designed to overcome the limitations of conventional chargers by utilizing 3 distinct stages, each designed for optimal recharging of both wet cell and gel cell deep-cycle batteries. Battery type selection is only available through the Freedom Remote Control Panel or a Link Instrument. Refer to the Freedom Remote Control Panel Addendum, pages 28-34, or a Link Owner's Manual.

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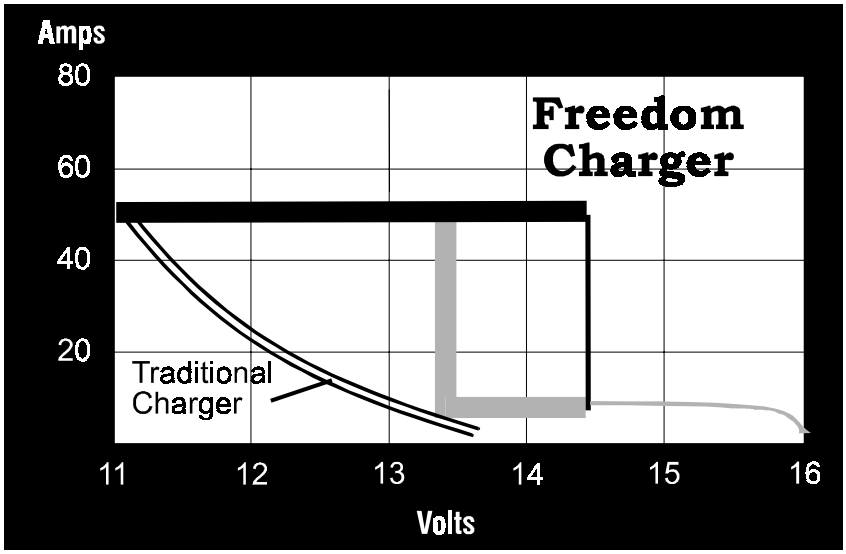
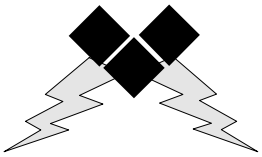
BATTERY CHARGING

The benefits of the Freedom Charger vs. the traditional taper charger.





"Bulk Charge" Constant Current

"Acceptance Charge" Constant Voltage

"Float Charge" Finish

Equalizing

50 Amp Taper Charger

Quicker more complete recharging, safe long term charging and battery rejuvenation through an equalizing charge.

Freedom 10 charge curve shown.

NOTE: Freedom battery chargers are ON whenever there is AC power connected to the charger input, regardless of the condition of the ON/OFF switch on the unit. The charger can be controlled using the Freedom Remote Control Panel or Link Instrumentation.

Each time the battery charger is engaged, the 3 stages proceed automatically, resulting in an efficient complete recharge and safe battery maintenance. Use of the Freedom Remote Control or Link Instrumentation provides the ability to periodically apply an equalizing charge.

Refer to Freedom Remote Control Addendum, pages 28-34, or the Link Instrumentation Owner's Manual for more information.

The battery charger stages are:

Stage 1 - *Bulk Charge* During the bulk charge stage most of the charge is delivered to the battery bank. This phase is engaged as soon as the battery charger is activated. Full rated charger current is delivered to the battery bank until the bulk charge voltage limit is reached. This results in a relatively rapid recharge.

Generally, a wet cell battery bank should not be charged up to the gassing point at a rate which exceeds 25% of its capacity. Example, a 12 Volt battery bank of 520 Amp-hours should not be charged at over 130 Amps.

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BATTERY CHARGING

Gel cell and Advanced AGM batteries can accept a higher rate of charge. Consult the manufacturer for specifications.

Stage *2 - Acceptance Charge* The acceptance stage immediately follows the bulk charge stage. During this stage the battery voltage is held constant at the bulk charge voltage limit and the current gradually ramps down. During this stage the battery is accepting its final amount of charge current and the last of the sulfate on the plates is removed.

The acceptance stage lasts until the charge current reaches the transition point in Amps. A timer will terminate the acceptance stage if this current level is not reached. The time is automatically set when the dip switches for battery type are set on the Freedom Remote Control Panel.

Maximum acceptance time is 1 hour for wet cells and 3 hours for gel cells. Gel cell acceptance time can be longer because they are less likely to gas. Expect wet cell batteries to gas somewhat during acceptance, this is a necessary part of the charging process.

NOTE: Acceptance timers are not used when Link Instruments control the charger. Refer to the Link Owner's Manual.

Stage 3 *- Float Charge* When the acceptance stage is terminated, either because the charge current ramped down to the transition point or the timer engaged, charge current will shut off. The unit monitors the battery voltage while it drifts down from the bulk charge voltage limit. When it reaches the float voltage set point, the float charge stage is engaged.

The float charge stage holds the battery voltage at a lower level, where it is safe 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, while constantly maintaining the float charge voltage.

The battery charger remains in the float charge stage indefinitely until the charger is disconnected from incoming AC power or turned OFF with the Freedom Remote Control Panel or Link Instrument.

ACCEPTANCE TO FLOAT TRANSITION POINTS	
Freedom 10-12V	**5 Amps DC**
Freedom 10-24V	**2.5 Amps DC**
Freedom 15-12V	**10 Amps DC**
Freedom 20-12V	**15 Amps DC**
Freedom 20-24V	**7.5 Amps DC**
Freedom 20-32V	**6 Amps DC**
Freedom 25-12V	**21 Amps DC**
Freedom 25-24V	**10 Amps DC**

Stage 4 - *Equalizing Charge* This is the only battery charger stage which is not engaged automatically. It must be manually initiated each time it is necessary to equalize using a dip switch on the back of the Freedom Remote Control or the front panel on the Link Instrumentation. Applying an equalizing charge is not possible without the use of a Freedom Remote Panel or Link Instrument.

Periodic equalizing is recommended by most wet cell deep-cycle battery manufacturers. There are no firm rules for how often an equalizing charge should be applied, but once a month is a good rule of thumb for batteries which are regularly cycled, less often for systems in only occasional use.

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BATTERY CHARGING

The equalizing charge is a timed, 8-hour cycle. If desired, it can be ended by interrupting the AC power to the charger at any time during the cycle. Equalizing should only be engaged after the batteries have been fully charged by a normal battery charging cycle.

During this charge cycle, the battery voltage will increase to the equalize voltage. This will cause the battery bank to gas profusely and will accomplish the following:

1. Removal of residual sulfate. Each time a battery is cycled (discharged and recharged), a small amount of sulfate is left on the plates. Over time, this gradual build-up of sulfate will compromise the performance of the battery. By applying an equalizing charge, the sulfate is returned back to the electrolyte, raising the specific gravity and fully exposing the active material of the plates.

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 up 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.

Equalizing is not required on gel cell batteries. For more information on equalizing using the Freedom Remote Control Panel, refer to the Freedom Remote Control Panel Addendum, pages 28-34. If you equalize using a Link Instrument, refer to the Link Owner's Manual for more information.

For more information and precautions, check the battery manufacturer specifications and recommendations. Additional information on equalizing is also available on our Web site http://www.heartinterface.com.

Charging Over-Discharged Batteries

Charging a battery bank with a terminal voltage of less than 8 Volts presents a special problem for the unit. If this situation arises, the unit will attempt to charge for 1 minute. If the charger senses excessive ripple voltage, it will shut down to protect itself.

To successfully charge an over-discharged battery, you must remove as much DC load as possible and set Power Sharing to the lowest setting. Refer to the Freedom Remote Control Panel Addendum pages 28-34 and Link Owner's Manual for more information.

When charging completely dead batteries, it is helpful to recharge them at lower current levels. To accomplish this, use the Power Sharing feature to reduce the charge current until the battery voltage reaches a normal level.

For battery voltage settings, refer to the Battery Charger Voltage Settings chart on page 17.

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BATTERY CHARGING

WARNINGS

1. Do not equalize gel cell batteries with the remote programmed for wet cells. *Check remote default settings.*

2. Always monitor the equalize charge. *Provide proper ventilation for battery fumes. Do not allow any sparks during equalizing. If one or more cells begin to overflow, terminate the equalize charge.*

3. Check the battery electrolyte both before and after the equalizing charge. *Do not expose the battery plates to air. Leave the battery caps on while equalizing. Top off after equalizing.*

4. Remove all loads from the DC system before equalizing. *Some DC loads may not tolerate the high charge voltage.*

5. Do not leave the equalize dip switch in the ON position on the Freedom Remote Control Panel. *It must be cycled ON/OFF and left in the OFF position. If left ON, the unit will engage the equalizing cycle every time the battery charger is engaged.*

6. With Link Instrumentation*, the red charge LED flashes during the equalizing cycles. When the equalization cycle is complete, the charger automatically goes to float and the green LED is illuminated.*

NOTE: If a continuous DC load in excess of the charge rate is placed on the battery bank, eventually the battery voltage will drop below 8 Volts and the battery charger will shut off. This load must be significantly reduced and the power to the charger cycled to resume charging.

Blinking of the battery LED on the Freedom Remote Control Panel while charging is a warning that an over-discharge is imminent and that the DC load should be reduced. Refer to the Freedom Remote Panel Addendum, page 32.

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BATTERY CHARGER VOLTAGE SETTINGS

Battery Type and Temperature	Bulk Voltage/ Max Time	Float Voltage	Equalize Voltage
12 Volt Wet Cell Warm Temperature	14.0 / 1 hr	13.1	15.8
12 Volt Wet Cell Cool Temperature	14.4 / 1 hr	13.5	16.3
12 Volt Gel Cell Warm Temperature	13.8 / 3 hr	13.3	13.8
12 Volt Gel Cell Cool Temperature	14.1 / 3 hr	13.6	14.1
24 Volt Wet Cell Warm Temperature	28.0 / 1 hr	26.2	31.6
24 Volt Wet Cell Cool Temperature	28.8 / 1 hr	27.0	32.6
24 Volt Gel Cell Warm Temperature	27.6 / 3 hr	26.6	27.6
24 Volt Gel Cell Cool Temperature	28.2 / 3 hr	27.2	28.2
32 Volt Wet Cell Warm Temperature	37.3 / 1 hr	34.9	42.1
32 Volt Wet Cell Cool Temperature	38.4 / 1 hr	36.0	43.5
32 Volt Gel Cell Warm Temperature	36.8 / 3 hr	35.5	36.8
32 Volt Gel Cell Cool Temperature	37.6 / 3 hr	36.3	37.6

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INSTALLATION PRECAUTIONS

CAUTION This equipment is **not ignition protected** and employs components that tend to produce arcs or sparks. To reduce the risk of fire or **explosions, do not install in compartments containing batteries or flammable materials** or areas in which ignition-protected equipment is required.

WARNING

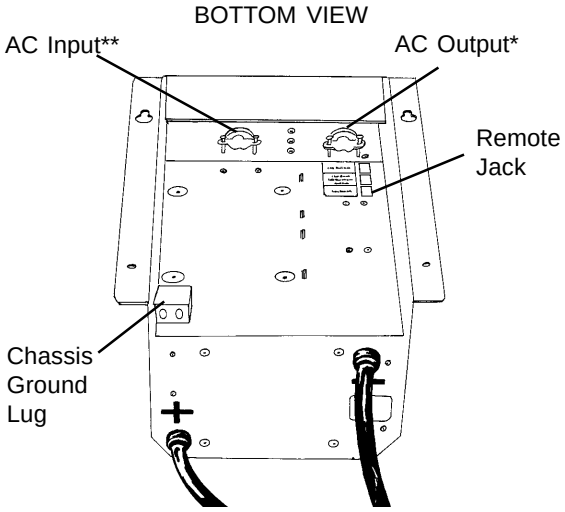
For continued protection against risk of electric shock, use only the ground-fault circuit interrupter (GFCI) type receptacles detailed in this manual. Other types may fail to operate properly when connected to this inverter, resulting in a potential shock hazard.

CAUTION To reduce the risk of electric shock and prevent premature failure due to corrosion, **do not mount where exposed to rain, dripping or spray.**

CAUTION To prevent fire, do not obstruct ventilation openings. Do not mount in a zero clearance compartment, overheating may result.

CAUTION ***Risk of electrical shock. Both AC & DC voltage sources are terminated inside this equipment.*** Each circuit must be individually opened before servicing. When solar array is exposed to light, it supplies a DC voltage to the battery and this equipment.

CAUTION ***Risk of electrical shock. Do not remove cover, no user serviceable parts inside.*** Refer servicing to qualified service personnel.



*Freedom 20D has 2 AC outputs.
**Freedom 25 has 2 AC inputs.

Typical Tools Needed

Flathead and Phillips Screwdrivers
Wrench or pliers for connecting battery cables
Drill
Wire Cutters
Wire Strippers
Misc. assortment of wire ties and connectors

Accessories Needed to Complete Installation

Fuse as required by NEC. Refer to page 25.
Twisted Pair wire for Link Instrumentation
Electrical wire (10 gauge) for AC wiring

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INSTALLATION

The Freedom Combi is appropriate for installation in recreational vehicles (RV), residential solar installations, marine and other applications. Refer to the separate installation guide for typical installation examples and application-specific installation information.

It is recommended that installation be completed by an authorized Heart Interface technical dealer or experienced electrician.

Key Installation Points

The Power Switch must be turned OFF before you begin.

1. Observe proper polarity when connecting batteries. Reverse DC polarity will result in damage to the unit and will void the warranty. Use care when making the DC connections.

WARNING

The Freedom Series is not DC reverse polarity protected. Be very careful to connect the negative and positive cables correctly, otherwise damage will result and the warranty will be void.

2. Do not back-feed the AC output of the inverter with incoming AC power. A back-feed occurs when AC power from shore power or generator is connected to the output of the inverter. This will damage the inverter and void the warranty. Remember that incoming AC must be fed only to the AC input and never the AC output. Always check for AC voltage before connecting wires to the AC output. Do NOT turn the inverter ON until all AC connections have been made. Back-feeding the inverter voids the warranty.

WARNING

Do not connect incoming AC from any source to the AC output of the inverter. This is known as back-feeding and will damage the unit and void the warranty.

3. Do not connect the AC input to the AC output. This would be equivalent to plugging the battery charger into the inverter. This could occur if the unit's AC output is connected to the entire leg of a circuit breaker panel, then a circuit breaker on that leg is used to feed the battery charger input. This will cause the unit to oscillate ON and OFF when the unit is in inverter mode.

4. Always use proper wire and connectors. The proper battery cable size is critical because considerable amperage flows in the DC circuit. Fusing the positive DC cables is required. The AC wire size is dependent on potential current in the circuit. Consult the NEC (National Electric Code) for proper wire gauge.

5. Make sure all wiring conforms to local and national electrical codes. If in doubt, consult with a qualified electrician.

6. To meet electrical codes, a fuse must be installed in the positive battery cable within 18 inches of the battery post. This fuse is intended to protect the battery and cables against a dead short circuit. The inverter is protected internally and will not blow a properly sized fuse.

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7. Keep the inverter/charger out of the elements and out of direct contact with water or spray. Failing to do so may result in premature failure from corrosion and void the warranty.

WARNING

Do not mount the unit in an enclosed battery compartment. Take precautions to keep road dirt and spray off the unit.

8. Mount the unit as close to the batteries as possible but not in the presence of flammable fumes or in an enclosed battery compartment.

9. Keep the overall length of each battery cable less than 10 feet. If needed, attach short extension cables. Do not use frame ground or a ground bonding system as a current carrying conductor. Run the negative cable directly to the battery bank. If the positive and negative cables run parallel to each other, twist the cables together. This will minimize the adverse effects of inductance. If it is absolutely necessary to run cable more than 10 feet, increase the size of the cable.

10. The connectors for the Freedom Remote Control, Link Instrument and the chassis ground bonding lug, as well as for the AC wires, are located on the bottom of the unit. Be sure to make these connections before bolting down the unit.

11. You may mount the unit horizontally (on a shelf) or **vertically** (on a wall or bulkhead). If mounted vertically, you must orient the unit so the switch and the circuit breakers are facing up and the fan and battery cables are facing down.

12. Allow several inches of clearance around the unit to permit a supply of fresh air to the cooling fan. Do not block any of the vents or louvers. The thermostat controlled fan pulls air from outside the unit. It blows air across the internal components, particularly the transformer and heat sinks, then out the side vents.

13. If installing in a system which includes an existing battery charger or converter, **make sure these do not operate from the inverter output AC power.** This sets up a power loop which, due to inefficiencies, will quickly drain the batteries.

14. DC wiring is generally very simple, the positive and negative cables from the inverter/ charger are connected to the house or auxiliary battery. In the case of multiple batteries, the interconnecting jumper cables must be of the same AWG as those supplied with the inverter/ charger.

15. If multiple battery banks are to be charged, a battery selector switch can be installed, allowing the banks to be charged either individually or simultaneously. A solenoid can also be used.

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Grounding

For safety purposes, the chassis of the inverter/charger must be connected to your AC ground system. The chassis ground bonding lug is located on the bottom of the unit. This connector can accept two wires, the first is used to connect the unit to AC ground, the second can be used to connect other AC equipment to the grounding system.

Use green insulated wire (8 AWG for Freedom 10 and 6 AWG for Freedom 20, 25), strip one end and use a screwdriver to secure it to the chassis ground bonding lug. This wire will connect to the ground in your AC electrical system. Make sure the connection is clean and tight.

This procedure will connect the chassis of your unit to AC ground. In addition, the AC input and AC output green wires are connected to chassis ground. It is important to connect these wires to the AC ground bus in the circuit breaker panel.

Some installations require heavier grounding wire. Conform to local and national electrical codes. If in doubt, consult a qualified electrician.

NOTE: **Solar Applications**: Use a 6 AWG green insulated or bare copper wire, if no other equipment is grounded through the unit. If additional equipment is connected to the chassis grounding terminal, larger wire may be required.

Strip one end of the wire and use a screwdriver to secure it to the chassis grounding terminal. This wire will connect to the equipment ground system either at the earth ground electrode or at an electrical equipment enclosure ground bonding terminal. In either case, you must insure that the ground bonding wire does not become smaller between the Freedom Combi unit and the earth ground point.

More information on grounding can be found in the National Electrical Code and local electrical codes.

Note: The battery cables are not connected to ground or the chassis of the unit.

For detailed installation suggestions, refer to the separate Installation Guide.

Neutral Bonding

For safety purposes, the Freedom Combi unit internally bonds the AC ouput neutral (white) to the AC ground (green), when the unit is OFF or in the inverter mode. When incoming AC power is applied and the transfer switch is engaged, the internal neutral-to-ground bond is automatically lifted.

This means that when AC power (shorepower) is applied, the grounding system is connected to the shore power ground, where neutral and earth ground are

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bonded together. This technique insures safety in all conditions and conforms to the requirements of the NEC.

For detailed information, refer to the separate Installation Guide.

AC Wiring

The AC wires route through the strain relief holes in the bottom of the unit. Use a screwdriver to remove the screws which secure the AC wiring compartment cover plate. Inside, the compartment is divided into 2 sections, one labeled **AC Input**, the other labeled **AC Output**. Each side contains 3 (6*) pigtails: black, white and green.

Black. . . . . .Hot or Line
White. . . . . .Neutral
Green. . . . . Ground

Conventional metal strain reliefs are provided. These can be replaced with plastic strain reliefs for additional corrosion resistance or 3/4 inch conduit fittings (1/2 inch for Freedom 10) if the wiring will be routed through a conduit.

You must use 10 AWG copper wire with insulation rated for 60 degrees centigrade or higher for both the AC input and AC output.

WARNING

Do not connect incoming AC from any source to the AC output of the inverter/ charger. This is known as back-feeding and will damage the unit and void the warranty.

*Freedom 25 has 2 AC inputs.
Freedom 20D has 2 AC outputs.

AC Input: Feed the 3 conductor AC input wire through the strain relief and into the AC input compartment. You should have 6 inches of individual insulated black, white and green wire. Strip 1/2 inch of insulation off each conductor and connect to the pigtails: Black to Black, White to White, and Green to Green.

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

NOTE: **Freedom 25 Only.** There are two options for configuring the AC input to the Freedom 25.

Dual Inputs: You may feed the internal battery charger separately from the transfer input which feeds the AC loads. In this case, connect one 30 Amp feed to the charger pigtails and another 30 Amp feed to the transfer switch input.

The advantage is to balance the AC loads when 2 legs of incoming AC power are available. These two feeds can be in or out of phase. **Transfer will only occur when power is applied to both inputs.** The charger can draw up to 27 Amps on one leg of power and the transfer switch can pass up to 30 Amps from the other leg of power.

Single Input: Feed both the battery charger and the transfer switch from the same AC input. In this case you will connect both pigtails together, Black to Black, White to White and Green to Green.

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The advantage is to allow up to 60 Amps of AC power to be brought in on a single cable. Up to 30 Amps is available to the loads, with the balance available to power the battery charger. A single cable should be protected by a 60 Amp breaker or smaller, and 6 gauge wire should be used.

Refer to the Installation Guide for more information.

AC Output: Feed the 3 conductor AC output wire through its strain relief and connect in the same fashion as the AC input wires.

Tug firmly on each connection to make sure they are secure. If the unit is not operating properly, check these connections first.

Carefully tuck the wires into the AC wiring compartment. Replace the cover plate.

Ground Fault Circuit Interrupters

To conform to the NEC, certain branch circuits must be equipped with a Ground Fault Circuit Interrupter (GFCI). Please consult the code or a qualified electrician for details. Any such branch circuit must be protected by a circuit breaker consistent with the GFCI rating. Underwriters Laboratories has tested the following GFCI, and its use is recommended. Receptacle Type:

Pass & Seymour
Catalog Number 1591-RW
Rated: 16 Amps at 120 Volts AC

WARNING

Persons with heart problems or other conditions which make them susceptible to electric shock may still be injured by ground faults on circuits protected by the GFCI Receptacle. No safety devices yet designed will protect against all hazards or carelessly handled or misused electrical equipment or wiring.

Remote Control Wiring

If installing a remote monitor, complete the routing of the remote cable before bolting the unit down. Refer to the Freedom Remote Control Panel Addendum, page 28-34, or the Link Owner's Manual.

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DC Wiring

Two battery cables are provided with the unit. Both are black, the positive cable has a piece of red heat shrink insulation on the end. High current will pass through the DC wiring. All wires must be properly sized and all connections clean and tight.

It is recommended that the battery cables not be lengthened. However, if necessary, it is possible to extend the cables. Use proper extension terminals (Heart Interface part #31-6000-01). Do not bolt the terminals together and cover with tape. Extension cables must be 00 AWG (2 AWG for the Freedom 10), the same type of wire supplied with the unit, and the total length for each battery cable must not exceed 10 feet.

Make sure the connections to the extension cables are tight and properly insulated. Do not attempt to open the case and replace battery cables.

The negative cable should be connected directly to the negative post of the battery bank or the ground side of a current shunt. Tighten securely.

NOTE: If installing in a vehicle, do not use the vehicle frame as the negative conductor.

WARNING

Freedom Inverter/Chargers are not protected against DC reverse polarity. Be very careful to connect the negative and positive cables correctly or damage will result and the warranty will be void.

The positive battery cable (red heat shrink insulation on the end) must be fused and connected to the positive post of the battery bank, or through a selector switch to one or more battery banks.

A spark may be generated when the final battery connection is made. This is normal; do not be alarmed. However, do not make the final connection in the presence of flammable fumes.

Battery Cable Fusing

A fuse is required by the NEC to protect the battery cables. The fuse must be installed in the positive battery cable, within 18 inches of the battery.

Refer to the Installation Guide for installation suggestions.

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Recommended Fuse: ***Class T JLLN*** This fuse with fuse holder is available from your dealer or Heart Interface.

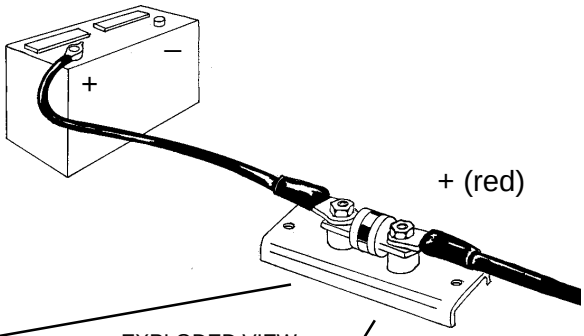
For Freedom 10, 15

200 Amp Fuse & Holder	PN# 84-4155-00	(C/R)*
200 Amp Fuse & Holder	PN# 84-4158-00	(R/R)**
200 Amp Fuse Only	PN# 84-4157-00	

For Freedom 20, 25

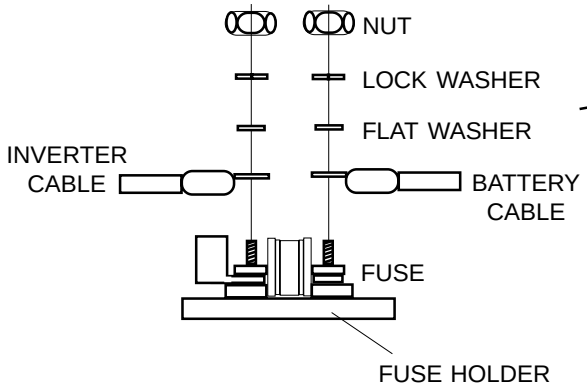
300 Amp Fuse & Holder	PN# 84-4156-00	(C/R)*
300 Amp Fuse & Holder	PN# 84-4154-00	(R/R)**
300 Amp Fuse Only	PN# 84-4151-00	

*C/R. . . . . Compression/Ring Terminal
**R/R. . . . . Ring/Ring Terminal

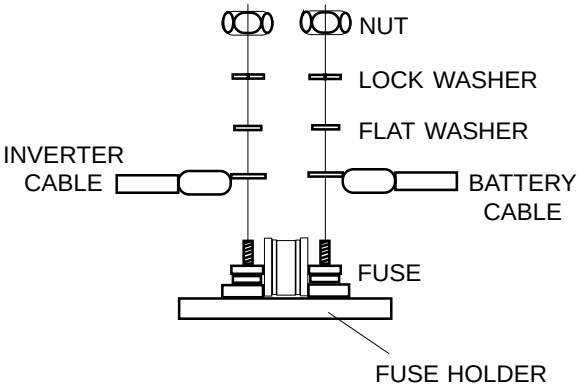


EXPLODED VIEW
OF FUSE ASSEMBLY

COMPRESSION / RING TERMINAL



RING / RING TERMINAL



WARNING

Improper stack up of hardware will cause excessive heat and fuse failure. Stack up as shown.

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INSTALLATION

Follow these instructions to insure proper start up and confirm that the installation is correct.

1. Check to make sure the power switch on the inverter is in the OFF position. If connected to a Freedom Remote Control Panel or a Link Instrument, make sure the switches for the inverter and charger are OFF.

2. Check battery polarity. If the unit was connected to the battery with reverse polarity, the unit will be damaged. The positive battery cable has red heat shrink insulation on the end.

3. Check the battery voltage and ensure it is within proper range for the unit (10-15 VDC).

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

1. Test the inverter function:

• With no loads connected to the ouput of the inverter, turn ON the power switch on the inverter. If using a remote, leave the power switch on the unit OFF and turn ON the inverter with the switch on the Freedom Remote Control Panel or Link Instrument.

• The Freedom unit will produce a slight buzz. If using a Freedom Remote Control Panel, the INV/CHRG LED 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.

• Add a load to the output of the inverter. An incandescent light bulb will work fine. The light should come on and the DC Amps LED will indicate the DC draw from the battery

WARNING

Do not turn the inverter ON before eliminating any possibility of backfeed.

through the inverter. Leave the load connected and turn OFF the unit at the power switch on the Freedom Remote Control Panel or Link Instrument.

•Turn OFF the unit at the power switch or on the Freedom Remote Control Panel or Link Instrument.

2. Test the transfer function:

NOTE: The front panel “Power” switch does not disconnect DC or AC power to the unit.

• Be sure all the power switches are in the OFF position. If there is a back-feed in the installation, the unit will protect itself only if the switch is turned OFF.

• Apply shore power to the unit. The unit should transfer shore power and illuminate the light bulb or power the load with the switch in the OFF position. If this does not happen, do not proceed. If you are using a Freedom Remote Control Panel, check the panel for back-feed indication. The panel will show an overload condition and LEDs 1 and 6 will be lit. Eliminate the back-feed condition.

• If you are not using a Freedom Remote Control Panel, test for back-feed. Disconnect from shore power and disconnect the AC ouput wires on the inverter. Apply shore power and measure for voltage between the black and white wires that feed the electrical panel, not the inverter wires. If there is voltage on these wires, a back-feed condition exists

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and must be removed or damage will result. Refer to page 19 for more information or call Heart Interface.

3. Test the battery charger function:

• With shore power applied and the transfer switch engaged, the battery charger should be in operation.

NOTE: The charger will work with the switch in the OFF position. Verify the charger is working by using a Volt meter. The battery voltage gradually increases. If using a Freedom Remote Control Panel, the DC Amps LED indicates the current level the charger is putting out and the DC Volts LED indicates an increase in battery voltage on the DC Volts indicator.

• Turn the power switch ON and disconnect shore power. The inverter should automatically pick up the load when shore power is removed.

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

Congratulations, you have completed a successful installation.

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TROUBLESHOOTING

Problem	Things to Check
No Inverter Output	1. Battery voltage under load below 10 Volts. Charge batteries. 2. Loose battery connections, open battery switch or blown DC fuse. Tighten connections or replace fuse. 3. Tripped circuit breaker on front panel. Reset breaker. 4. Thermal condition, high powered loads or inadequate ventilation may cause overheating. Allow to cool. 5. Overloads or short circuit, check for excessive loads or bad wiring connections. Disconnect loads.
Low Inverter Output Voltage	Confirm that your Volt meter is a True RMS meter. Standard Volt meters will not accurately read the waveform of the inverter and may read anywhere from 90 to 120 volts. If a True RMS meter is not available, check the brightness of an incandescent light bulb - if it appears normal, the output voltage is properly regulated.
Little or No Output from Battery Charger	1. Wiring connections - check both the AC and DC connections. 2. AC input voltage - low voltage input will result in low DC output current. Expect reduced charger output from generators under 3,500 watts.
Microwave Oven Cooking Slow	1. Microwave ovens will normally cook slow on inverters due to a slightly low peak AC voltage. 2. Cooking speed will be determined by battery voltage. Low voltage results in increased cooking time. Support the battery bank with an alternator or other charging source for quicker cooking.
Slow or Fast Digital Clock	1. Digital clocks either employ an internal time base or derive their time base from the incoming AC waveform. The frequency is well regulated at 60 Hz. The clock either counts the number of peaks in the waveform or the number of times the waveform crosses zero Volts. The circuitry to count the zero crossing events is more popular. The longer zero cross time of the inverter's modified sine wave may cause double clocking, resulting in a faster clock.

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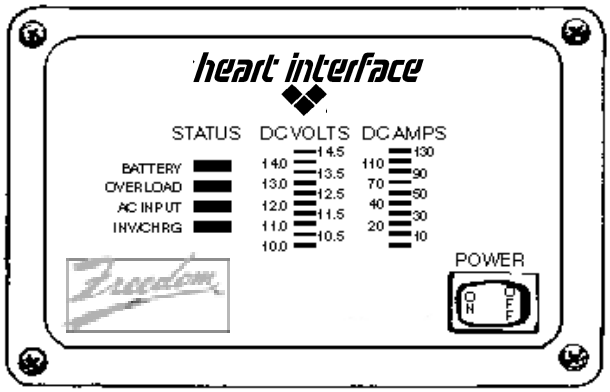
REMOTE CONTROL PANEL ADDENDUM

An optional remote control panel is available for the Freedom Combi Series. It offers several features not found on the unit. The Freedom Remote Control Panel provides LED bargraphs which show system status, battery voltage, and current in both inverter and charge modes. These bargraphs also display dip switch positions and shut down conditions.



Freedom Remote Panel for 12 Volt units shown.

Remote Power Switch

The switch on the remote is used to control the inverter and the battery charger function. When a remote control is used, the power switch on the inverter should be left in the OFF position.

System Status LEDs

These 4 LEDs monitor the system as described in the table on page 33.

DC Volts Bargraph

These LEDs indicate the battery voltage as measured inside the unit. Each LED segment indicates .5 Volts (1 Volt*). If an overload occurs and the unit shuts down, the DC Volts bargraph will stop indicating battery voltage and display the dip switch settings. It will return to indicating battery voltage only after the unit has been reset.

To review the dip switch settings, cycle the power switch OFF/ON two times within one second. This will cause the DC Volts bargraph to illuminate the corresponding dip switch settings for 10 seconds. Refer to the chart on page 33.

NOTE: **Freedom 20/32 Volt only.** Each LED on the DC Volts bargraph corresponds to 1.33 Volts.

DC Amps Bargraph

These LEDs approximate DC input current in inverter mode and DC output current in battery charger mode. Two ranges are used -- below 50 (25*) Amps each segment represents a 10 (5*) Amp increment, above 50 (25*) Amps each segment represents a 20 (10*) Amp increment. Above 130 Amps, a flashing LED indicates the value displayed plus 100 Amps (flashing 50 LED is equal to 50 + 100 or 150 Amps DC).

NOTE: **Freedom 20/32 Volt only.** Each LED on the DC Amps bargraph below 14.0 represents a 3.5 Amp increment, above 14.0 represents a 7.0 Amp increment.

Above 49 Amps, the DC Amps bargraph will display a blinking LED corresponding to that value plus 49. For example, a blinking 21.0 DC Amps LED indicates 70 Amps (49.0 + 21.0 = 70.0).

If a shut down occurs, the DC Amps bargraph will stop indicating DC Amps and will indicate the type of problem. Each LED segment indicates a differrent problem as described in the troubleshooting section on page 34.

*24 Volt models.

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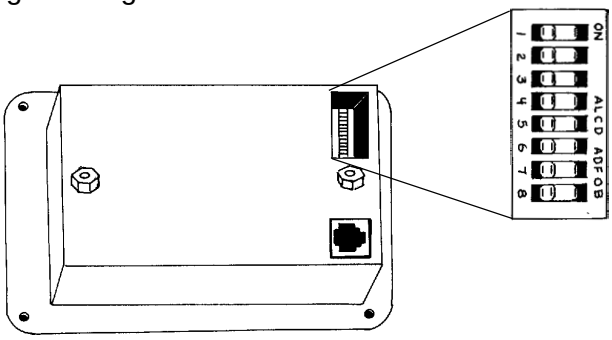
REMOTE CONTROL PANEL

Dip Switches

On the back of the Freedom Remote Control Panel is a set of 8 dip switches which are used to make several adjustments. On the switch block, each switch is numbered. . . 1 through 8 and the ON position is indicated. The switch settings can be changed at any time, even while the unit is operating. Following is a discussion of each adjustment. Refer to the table on page 33 for dip switch programming.



SWITCH #1 - *Manual Equalizing*

Cycling this switch ON for 1 second, then OFF, will initiate an equalizing charge cycle. The battery charger must be engaged before cycling the switch. **The dip switch must always be returned to the OFF position. If it is left ON, an equalizing charge cycle will initiate every time the charger is engaged - this could cause battery damage.**

The equalizing cycle is timed to last 8 hours from the time the switch is cycled, at which point the charger resumes normal charging in the float stage.

The battery LED blinks when equalizing. See page 14 for discussion of the theory and procedure for battery equalizing.

Equalizing is not required on gel cell batteries.

NOTE: If the dip switches are set in one of the two gel cell positions, the equalizing charge voltage is the same as the bulk charge voltage, therefore, equalizing is equivalent to an 8-hour acceptance stage and is not harmful.

NOTE: Do not leave the equalize dip switch in the ON position on the Freedom Remote Control Panel. *It must be cycled OFF and left in the OFF position. If left ON, the unit will engage the equalizing cycle every time the battery charger is engaged.*

NOTE: Equalizing gel cell batteries with the Freedom Remote Control Panel set to gel type batteries results in the charge voltage holding at the acceptance voltage for 8 hours. This can be useful for restoring capacity to cells that have been left in a deeply discharged state for a long period of time.

NOTE: **Freedom 20 & 25 Only.** To limit the DC current on the Freedom 20 and 25 during equalizing to less than the default setting, turn on dip switches 7 and 8 before starting the equalizing charge. Do not operate AC loads that are on the output of the inverter/charger when equalizing.

DC Current Default Settings During Equalize:

	Freedom 20	Freedom 25
12 Volts:	16 Amps	24 Amps
24 Volts:	8 Amps	12 Amps
32 Volts:	6 Amps	N/A

SWITCH #2 & #3 - Battery Type and Temperature Gel cell and wet cell batteries have slightly different charge voltage requirements. Optimum battery charging is

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temperature dependent. For these reasons, the dip switches allow four different battery charger voltage set points, depending on battery type and ambient temperature:

Cool Wet Cell . . . . < 80 degrees F.
Warm Wet Cell . . . > 80 degrees F.
Cool Gel Cell . . . . .< 80 degrees F.
Warm Gel Cell . . . .> 80 degrees F.

Refer to the table on page 17 for the specific voltages for each setting.

SWITCH *#4 - Auto Charge* With the switch in the OFF position, the remote panel ON/OFF switch only controls the inverter operation. With the dip switch turned ON, it allows the power ON/OFF switch on the front of the remote to control the battery charger as well as the inverter.

SWITCH #5 & #6 - ***Idle Sensitivity*** Most installations will be connected to the electrical system, which in itself, with no appliances turned on, represents a small load. Using a trial and error process, the idle ciruit can be adjusted until the unit will detect small loads but still drop into idle mode when all loads are shut off.

NOTE: Some small loads may not pull the unit out of idle mode. If this occurs, you may disable the idle circuit or use an additional load (i.e., a small incandescent light) to first activate the idle circuitry. You can confirm the unit is in idle mode by checking the DC Amps bargraph. The lowest LED goes out when the unit is in idle mode.

A Volt meter can be used to confirm the idle condition. Idle mode output voltage will typically measure between 10 and 55 Volts with an averaging AC Volt meter. See the Troubleshooting chart, page 27, for a discussion of measuring inverter output voltage with a meter.

SWITCH #7 & #8 - *Power Sharing*
These switches should be set to match the value of the circuit breaker which protects the incoming AC power. They may also limit the output current from the battery charger.

To successfully charge an over discharged battery, you must remove as much DC load as possible. Set dip switches 7 and 8 to the ON position to limit the amount of charge current and the resulting ripple voltage. After the battery voltage has reached 10 Volts, these switches can be set to their previous positions.

Use the 5 Amp Power Sharing setting for small generators, or for charging deeply discharged batteries.

System DC
Current Consumption vs Idle Mode

Idle Mode	With Remote	Without Remote
Normal Idle	181 mA	120 mA
Idle Circuit Disabled	496 mA	N/A
Unit Shut Off	16 mA	7 mA

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REMOTE CONTROL PANEL

NOTE: **Freedom 25 only**. If feeding both inputs with one 30 Amp breaker, set Power Sharing to 30 Amps.

Dip Switch Status

You can check the position of the dip switches by quickly cycling the power switch OFF/ON twice. The DC Volts bargraph will cease to display battery voltage and will indicate the settings of each dip switch. In this mode the bottom LED will illuminate if switch 1 is ON; the second LED will illuminate if switch 2 is ON, etc. Dip switch settings are indicated for 10 seconds after which time the display returns to indicating battery voltage.

Factory default settings for all dip switches are in the OFF position.

Remote Control Wiring

The Freedom Remote Control Panel is supplied with 25 or 50 feet of telephone cable for connection to the unit. Simply plug one end of the cable into the remote connector on the bottom of the inverter/charger labeled “Remote” and the other end into the connector on the back of the Freedom Remote Control Panel.

Routing the remote cable away from AC and DC wires will minimize the potential for interference which may affect the LED bargraphs.

The remote control cable can be extended up to 50 feet if required. Use standard 4 or 6 conductor telephone cable. Use a single length cable with no connnectors or in-line splices. If phone cable is left over, wrap excess wire in a figure 8 configuration and store it in an area away from AC equipment to prevent electrical interference.

Once the above steps have been completed, the unit can be bolted down.

Refer to page 33 for the Dip Switch Programming chart.

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REMOTE CONTROL PANEL STATUS LEDs

Status LED	Purpose
INV/CHRG (Inverter/Charger)	Power on light. It will be illuminated whenever the power switch is ON (inverter ON) or when there is incoming AC power and the charger comes ON.
AC Input	Illuminates when incoming AC power has been applied and the transfer relays have engaged. There is a 7-12 second delay from the time the AC is applied and this LED illuminates.
Steady Overload	Indicates an over-temperature condition, the unit is shut down. It will reset automatically after cooling.
Blinking Overload	Inverter mode- Shutdown, diagnose problem using DC Amps bargraph. Charger mode- Excessive DC voltage ripple. Remove loads from DC battery bank. See LED 5 in the Troubleshooting chart, page 34.
Steady Battery (12 Volt model)	This is a High/Low Battery warning condition. Inverter mode: Battery > 15.25 or < 10.50 Volts, Charger mode: Battery > 15.25 or < 10.00 Volts
Blinking Battery (12 Volt model)	Indicates either a shutdown or equalizing. Battery > 15.50 Volts, will auto-reset at 15.25 Inverter mode: Battery <10.00 Volts, will auto reset at charger float voltage or upon AC input. Charger mode: Battery < 8.00 Volts for 1 minute, remove all DC loads. If dip switch #4 is ON, reset by cycling the power switch. If dip switch #4 is OFF, reset by disconnecting and reapplying shore power.
Steady Battery (24 Volt model)	This is a High/Low Battery warning condition. Inverter mode: Battery > 30.5 or < 21 Volts Charger mode: Battery > 30.5 or < 20 Volts
Blinking Battery (24 Volt model)	Indicates either a shutdown or equalizing. Battery > 31 Volts, will auto-reset at 30.5. Inverter mode: Battery < 20 Volts, will auto reset at charger float voltage or upon AC input. Charger mode: Battery < 16 Volts for 1 minute, remove all DC loads. If dip switch #4 is ON, reset by cycling the power switch. If dip switch #4 is OFF, reset by disconnecting and reapplying shore power.
Steady Battery (32 Volt model)	Indicates a High/Low battery warning condition. Inverter mode: Battery voltage > 41.3 Volts or < 28.04 Volts. Charger mode: Battery voltage 41.3 Volts or < 26.7 Volts.
Blinking Battery (32 Volt model)	Indicates either a shutdown or equalizing. Battery > 41.3 Volts, will auto reset at 40.7 Volts. Inverter mode: Battery < 26.7 Volts, will auto resent at charger float voltage or upon AC input. Charger mode: Battery voltage < 22.0 Volts for one minute, remove all DC loads and manually reset by cycling the power switch. If dip switch #4 is ON, reset by cycling the power switch. If dip switch #4 is OFF, reset by disconnecting and reapplying shore power.

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REMOTE CONTROL PANEL

DIP SWITCH PROGRAMMING:

Feature	Switch Number		Set Point		
Equalize or 3-Stage Charging	**1**				
	Toggle On/Off		Equalize (Do not leave ON)		
	Off		3-Stage Charging*		
Battery Type	**2**	**3**			
	On	On	Warm Gel Cell (> 80 deg. F.)		
	Off	On	Cool Gel Cell (< 80 deg. F.)		
	On	Off	Warm Wet Cell (> 80 deg. F.)		
	Off	Off	Cool Wet Cell (< 80 deg. F.)*		
Auto Charge	**4**				
	On		Disable: Charger responds to ON/OFF switch.		
	Off		Enable: Charger ON when AC connected.*		
Idle Sensitivity	**5**	**6**			
	On	On	Idle Disabled		
	Off	On	15 Watts		
	On	Off	6 Watts		
	Off	Off	4 Watts*		
Power Sharing	**7**	**8**	**FDM 10**	**FDM 20**	**FDM 25**
	On	On	5 Amps	5 Amps	5 Amps
	Off	On	15 Amps	15 Amps	20 Amps
	On	Off	20 Amps	20 Amps	30 Amps
	Off	Off	30 Amps*	30 Amps*	Disabled*

*Indicates factory default setting.

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TROUBLESHOOTING WITH THE FREEDOM REMOTE CONTROL PANEL DC AMPS BARGRAPH

Use this chart when the overload LED is blinking indicating an overload condition has occurred. LEDs are numbered counting from the bottom up.

LED Number	Indication
LED 9-10	Not used for troubleshooting.
LED 8	High battery voltage shutdown during charge mode. Check all charging sources for proper voltage. Reset by cycling the power switch.
LED 7	Triac thermal run away. Turn OFF and allow to cool down.
LED 6	Incoming AC back-feed. Potentially damaging to the unit. Disconnect incoming AC power and correct the situation. WARNING: Do not turn inverter ON before eliminating back-feed.
LED 5	Battery overload caused by excessively discharged batteries. Refer to page 15.
LED 4	Inverter overload caused by too large a load or short circuit. Reset by cycling power switch or plugging in incoming AC power.
LED 3	Not used for troubleshooting.
LED 2	Over-temperature. Allow to cool.
LED 1	Illuminates if the unit shuts down for any reason.

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GLOSSARY

Alternating Current (AC) An electric current that reverses direction at regular intervals. Sources of alternating current are shore power, generator power, inverter power or household current.

Ampere (Amp, A) The unit of measure of electron flow rate of current through a circuit.

Ampere-hour (Amp-Hr., AH) A unit of measure for a battery's electrical storage capacity, obtained by multiplying the current in amperes by the time in hours of discharge (Example: a battery which delivers 5 amperes for 20 hours delivers 5 amperes times 20 hours, or 100 Amp-Hr. of capacity.)

AH Capacity The ability of a fully charged battery to deliver a specified quantity of electricity (Amp-Hr., AH) at a given rate (Amp, A) over a definite period of time (Hr.). The capacity of a battery depends upon a number of factors such as: active material, weight, density, adhesion to grid, number, design and dimensions of plates, plate spacing design of separators, specific gravity and quantity of available electrolyte, grid alloys, final limiting voltage, discharge rate, temperature, internal and external resistance, age and life of the battery (bank).

AGM (Absorbed Glass Mat) Battery A lead acid, maintenance-free battery.

AWG (American Wire Gauge) A standard used to measure the size of wire.

Circuit An electric circuit is the path of an electric current. A closed circuit has a complete path. An open circuit has a broken or disconnected path.

Circuit (Series) A circuit which has only one path for the current to flow. Batteries arranged in series are connected with the negative of the first to the positive of the second, negative of the second to the positive of the third, etc. If two 6 Volt batteries of 50 ampere-hours capacity are connected in series, the circuit voltage is equal to the sum of the two battery voltages, or 12 Volts, and the ampere-hour capacity of the combination is 50 ampere-hours.

Circuit (Parallel) A circuit which provides more than one path for current flow. A parallel arrangement of batteries (of like voltage and capacity) would have all positive terminals connected to a conductor and all negative terminals connected to another conductor. If two 12 Volt batteries of 50 ampere-hour capacity each are connected in parallel, the circuit voltage is 12 Volts, and the ampere-hour capacity of the combination is 100 ampere-hours.

Combi Freedom Combi$_{TM}$ is a trademark of Heart Interface to indicate a combination inverter/charger.

Current The rate of flow of electricity or the movement rate of electrons along a conductor. It is comparable to the flow of a stream of water. The unit of measure for current is ampere.

Cycle In a battery, one discharge plus one recharge equals one cycle.

Dip Switch A series of small switches used for special programming of the Freedom Combi. These switches are located on the back of the Freedom Remote Control Panel.

Direct Current (DC) Current that flows continuously in one direction such as that from batteries, photovoltaics, alternators, chargers and DC generators.

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GLOSSARY

Equalize Charge A controlled overcharge of the batteries which brings all cells up to the same voltage potential, extends the battery life, restores capacity and mixes the electrolyte. This can only be done using the Freedom Remote Control Panel or a Link Instrument.

Gel Cell Battery A type of battery that uses a gelled electrolyte solution. These batteries are sealed and are virtually maintenance-free. Not all sealed batteries are the gel cell type.

GFCI (Ground Fault Circuit Interrupter) A protective device that rapidly de-energizes a circuit when current to ground exceeds a predetermined value.

Ground The reference potential of a circuit. In automotive use, the result of attaching one battery cable to the body or frame which is used as a path for completing a circuit in lieu of a direct wire from a component. This method is not suitable for connecting the negative cable of the inverter to ground. Instead, route the cable directly to the negative terminal of the battery.

LED (Light Emitting Diode) Indicator light.

NEC National Electric Code

Negative Designating or pertaining to electrical potential. The negative terminal is the point from which electrons flow during discharge.

Ohm A unit for measuring electrical resistance.

Ohm's Law Expresses the relationship between Voltage (V) and Current (I) in an electrical circuit with resistance (R). It can be expressed as follows: V=IR. If any two of the three values are known, the third value can be calculated by using the above formula.

Positive Designating or pertaining to electrical potential; opposite of negative. The positive battery terminal is the point where electrons return to the battery during discharge.

Power Sharing The feature of the charger to reduce its output when the AC power being consumed by the charger and external AC loads connected to the output of the inverter are in excess of the input breaker rating.

Universal Combi$_{TM}$ Combination inverter/ charger that accepts 120 VAC 60 Hz or 230 VAC 50 Hz for charging.

Volt The unit of measure for electric potential.

Watt The unit for measuring electrical power, i.e., the rate of doing work, in moving electrons by or against an electric potential.

Watt-Hour (Watt-HR, WH) The unit for measuring electrical energy which equals Watts x Hours.

Wet Cell Battery A type of battery that uses liquid as an electrolyte. The wet cell battery requires periodic maintenance; cleaning the connections, checking the electrolyte level and performing an equalization cycle.

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SPECIFICATIONS

	FREEDOM 10		FREEDOM 20***			FREEDOM 25	
MODEL	12 V	24 V	12 V	24 V	32 V	12 V	24 V
Part Number	81-0104-12	81-0110-24	81-0205-12	81-0200-24	81-0213-32	81-0253-12	81-0250-24
Nominal Battery Voltage	12 VDC	24 VDC	12 VDC	24 VDC	32 VDC	12 VDC	24 VDC
Battery Voltage Range	10.0 - 15.5 VDC	20 - 31 VDC	10.0 - 15.5 VDC	20 - 31 VDC	26.7 - 41.3 VDC	10.0 - 15.5 VDC	20 - 31 VDC
Low Battery Cutout	10.0 VDC	20.0 VDC	10.0 VDC	20.0 VDC	26.7 VDC	10.0 VDC	20.0 VDC
AC Input Voltage Range	90 - 130 VAC	90 - 130 VAC	90 - 130 VAC	90 - 130 VAC	90 - 130 VAC	90 - 130 VAC	90 - 130 VAC
Frequency Regulation	.05% @ 60 Hz	.05% @ 60 Hz	.05% @ 60 Hz	.05% @ 60 Hz	.05% @ 60 Hz	.05% @ 60 Hz	.05% @ 60 Hz
Inverter Output Power (Continuous)	1000 VA	1000 VA	2000 VA	2000 VA	2000 VA	2500 VA	2500 VA
Inverter Voltage Regulation	120V +/- 5% True RMS	120V +/- 5% True RMS	120V +/- 5% True RMS	120V +/- 5% True RMS	120V +/-5% True RMS	120V +/- 5% True RMS	120V +/- 5% True RMS
Wave Shape	Modified Sine Wave	Modified Sine Wave	Modified Sine Wave	Modified Sine Wave	Modified Sine Wave	Modified Sine Wave	Modified Sine Wave
Surge Power (15 seconds)	3000 VA**	3000 VA**	4500 VA	4500 VA	4500 VA	5200 VA	5200 VA
No Load Current Drain (Idle Mode)	.12 Amp	.06 Amp	.12 Amp	.06 Amp	.045 Amp	.12 Amp	.06 Amp
Power Factors Allowed	All	All	All	All	All	All	All
Full Load Efficiency	85%	85%	84%	84%	84%	86%	86%
Peak Efficiency	92%	92%	93%	93%	93%	94%	94%
Protection	Circuit Breaker, Electronic, Thermal, High Battery, Low Battery	Circuit Breaker, Electronic, Thermal, High Battery, Low Battery	Circuit Breaker, Electronic, Thermal, High Battery, Low Battery	Circuit Breaker, Electronic, Thermal, High Battery, Low Battery	Circuit Breaker, Electronic, Thermal, High Battery, Low Battery	Circuit Breaker, Electronic, Thermal, High Battery, Low Battery	Circuit Breaker, Electronic, Thermal, High Battery, Low Battery
Charging Rate	50 Amps	25 Amps	100 Amps	50 Amps	35 Amps	130 Amps	65 Amps
AC Input (Max. Charge Mode)	11 Amps	11 Amps	23 Amps	23 Amps	23 Amps	27 Amps	27 Amps
Bulk Charge Voltage	14.4 VDC*	28.8 VDC*	14.4 VDC*	28.8 VDC*	38.4 VDC	14.4 VDC*	28.8 VDC*
Float Charge Voltage	13.5 VDC*	27.0 VDC*	13.5 VDC*	27.0 VDC*	36.0 VDC	13.5 VDC*	27.0 VDC*
Equalizing Charge Voltage	16.3 VDC*	32.6 VDC*	16.3 VDC*	32.6 VDC*	43.5 VDC	16.3 VDC*	32.6 VDC*
Status Panel	Opt. Remote or Link Instruments	Opt. Remote or Link Instruments	Opt. Remote or Link Instruments	Opt. Remote or Link Instruments	Opt. Remote	Opt. Remote or Link Instruments	Opt. Remote or Link Instruments
Weight	31 lbs.	31 lbs.	52 lbs.	52 lbs.	52 lbs.	56 lbs.	56 lbs.
Dimensions	12" x 9.75" x 7"	12" x 9.75" x 7"	12" x 11.5" x 8.75"	12" x 11.5" x 8.75"	12" x 11.5" x 8.75"	12" x 11.5" x 8.75"	12" x 11.5" x 8.75"

UL Listed, C-UL Listed for residential photovoltaic systems and land vehicles. *Adjustable setting with the optional Freedom Remote Control Panel or Link Instrumentation. **Not evaluated by UL for surge rating. ***Freedom 20D has the same specifications as the Freedom 20.

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SPECIFICATIONS

MODEL	FREEDOM 15
Nominal Battery Voltage	12 VDC
Battery Voltage Range	10.0 - 15.5 VDC
Low Battery Cutout	10.0 VDC
AC Input Voltage Range	90-130 VAC
Frequency Regulation	.05% @ 60 Hz
Inverter Output Power (Continuous)	1500 VA
Inverter Voltage Regulation	120V +/- 5% True RMS
Wave Shape	Modified Sine Wave
Surge Power (15 seconds)	4000 VA
No Load Current Drain (Idle Mode)	.12 Amp
Power Factors Allowed	All
Full Load Efficiency	85%
Peak Efficiency	92%
Protection	Circuit Breaker, Electronic, Thermal, High Battery, Low Battery
Charging Rate	75 Amps
AC Input (Max. Charge Mode)	11 Amps
Bulk Charge Voltage	14.4 VDC*
Float Charge Voltage	13.5 VDC*
Equalizing Charge Voltage	16.3 VDC*
Status Panel	Optional Remote or Link Instruments
Weight	45 lbs.
Dimensions	12" x 11.5" x 8.75"

UL Listed, C-UL Listed for residential photovoltaic systems and land vehicles. *Adjustable setting with the optional Freedom Remote Control Panel or Link Instrumentation. **Not evaluated by UL for surge rating.

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WARRANTY

Your Heart Interface Freedom Combi™ Inverter/Charger is under limited warranty for either 12 (commercial) or 30 months from date of purchase.

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

If the unit requires service, contact Heart Interface by telephone. The service technician will ask for the serial number of your unit. Please have this information ready.

Phone numbers: (253) 872-7225
(800) 446-6180

A return authorization number will be required on all returns. This number is issued by the service technician and should be written on the packaging.

You must ship the unit to Heart Interface or a field service center freight prepaid.

Freedom™
Inverter/Chargers

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Kent WA 98032-2416
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