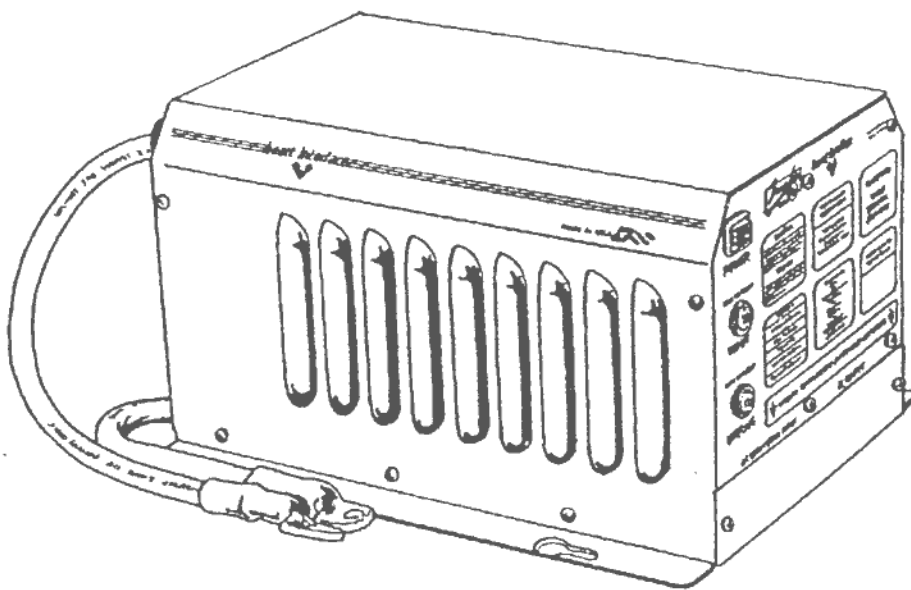




OWNER'S MANUAL



heart interface

A graphic consisting of two solid black diamonds positioned side-by-side, forming a larger diamond shape.

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FREEDOM 10

INTRODUCTION

Your new Freedom 10 from Heart Interface performs three separate functions, DC to AC power inverting, 30 amp transfer switching and three-stage battery charging. A remote control panel is available which uses bar graph LEDs to monitor DC amps and volts, as well as adjust some of the parameters of the unit. The entire system is microprocessor controlled.

The inverter provides 1000 watts of continuous AC power from a deep-cycle battery bank. Up to 1500 watts is available for short-term intermittent use (see Load Duration chart on page 19). The output is modified sine wave and is compatible with virtually all consumer appliances. An idle circuit reduces power when unloaded, there is an automatic low battery cutout circuit, the output is fully voltage and frequency regulated and considerable surge power is available for starting electric motors. In addition, the efficiency of the inverter is about 85-90% throughout most of the power range.

The transfer switch allows the unit to be connected to a 30 amp external AC source, utility power or a generator. Some of the external AC power is used to operate the battery charger, the rest is switched through the unit to the output. Thus the Freedom 10 operates as a self-contained power back-up system, just add batteries. The power sharing feature constantly senses the AC amperage being used by the battery charger and the appliances on the output, and automatically reduces battery charger power

consumption if usage exceeds the input circuit breaker rating. The transfer switch is protected by the 30 amp circuit breaker on the unit.

The battery charger in the Freedom 10 is very powerful and sophisticated. Battery charging is accomplished in 3 distinct stages: Constant Current, Absorption and Constant Voltage. The constant current stage provides the bulk charging, it is initiated every time the charger is activated and delivers a constant 50 amps into the batteries until the voltage reaches 14.4. At this point the absorption stage begins, where the voltage is held constant at 14.4 and the current is gradually ramped down. This continues until either the current reaches 5-7 amps DC or one hour has passed, whichever comes first. At that time the constant voltage stage begins. This is a float or maintenance charge which holds the battery voltage at a lower 13.5 volt level. A full 50 amps of DC current is available in the float charge phase to use as converter power for 12 volt lights and appliances.

Simple, automatic operation is made possible by the microprocessor in the unit. In most cases, the unit is left on and no attention or maintenance is required.

The Freedom 10 remote control panel provides a remote power switch, system status LEDs, DC volts and DC amps bar graphs. In addition, on the rear of the remote is a set of dip switches which allow adjustment of the following:

- 3-Stage or Equalize Charging
- Idle Pulse Width
- Battery Type (Charging Voltages)
- Idle Sensitivity
- Power Sharing

THINGS YOU SHOULD KNOW

CIRCUIT BREAKERS- The 12 amp circuit breaker on the front of the unit protects against sustained inverter overloads up to 2000 watts. Reset by pushing the button back in. The 30 amp circuit breaker on the unit protects the AC input. This circuit breaker will trip if a sustained load of more than 3,600 watts is operated through the unit while an external AC source, shore power or a generator, is operating the battery charger. Reset by pushing back in.

ELECTRONIC PROTECTION- Electronic circuits protect against intermittent inverter overloads over 3000 watts, low and high battery voltage and over-temperature. Reset by turning the power switch off and back on. The fault condition must be eliminated before reset will occur, i.e. remove overload, recharge batteries or allow to cool.

INVERTER IDLE CIRCUIT- This automatic energy saving feature reduces battery power consumption when no load is present. Response from idle is instant and in most cases the operation of the idle circuit is not noticeable. Use of the remote control panel allows the idle circuit sensitivity to be adjusted.

POWER SHARING- The Freedom 10 will automatically reduce the battery charger output, and therefore the AC power consumption, if appliances are turned on that threaten to trip the incoming AC circuit breaker. This feature is set to protect a 30 amp circuit breaker but can be adjusted with the remote control panel.

POWER SWITCH- The power switch on the unit controls both inverter and battery charger functions.

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, this will reduce power consumption. The remote control panel provides bar graph LEDs which show battery voltage and current in both inverter and charger modes. These bar graphs can also display dip switch positions and shutdown conditions. The Freedom 10 is UL Marine Listed only if the remote control is used.

DIP SWITCH PROGRAMMING- On the rear of the remote control panel is a set of small dip switches which are used to adjust the following parameters: battery equalizing, idle pulse width, battery type, idle sensitivity and power sharing. These switches can be changed at any time, even if the unit is operating.

DISABLING THE INVERTER- Use of the remote control panel allows the battery charger to be engaged but the inverter turned off. To disable the inverter cycle the power switch off/on three times quickly. The INV/CHRG LED will flash when the inverter is disabled. This feature can be used when the battery charger is operating and you do not want the inverter to pick up the loads when incoming AC power disappears.

WARNING- THE FREEDOM 10 IS NOT DC REVERSE POLARITY PROTECTED. DOUBLE CHECK TO ENSURE THAT THE BATTERY CABLES ARE CONNECTED PROPERLY.

OPERATION

The only control on the Freedom 10 itself is the power switch. This switch controls on/off and reset for both inverter and battery charger functions. Expect a three second delay when the power switch is turned on before the unit is activated.

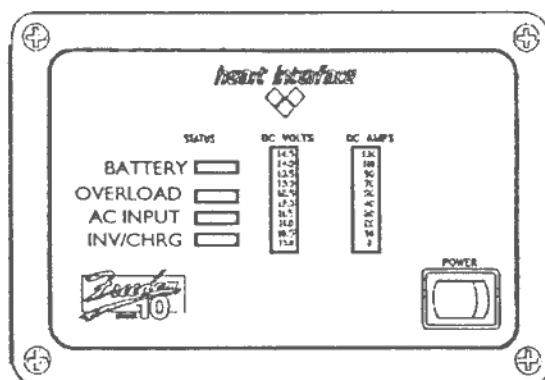
Once properly installed, the power switch is normally left in the on position, enabling both the inverter and the battery charger.

If the unit is connected to external AC, the power switch may be turned off, which disables the battery charger. The internal 30 amp transfer switch will continue to be engaged with the switch off and AC power will be available at the output of the unit.

Inverter protection, idle circuitry, transfer switching, power sharing and battery charger regulation will all function automatically.

THE REMOTE CONTROL PANEL

There is an optional remote control panel available which offers several features not found on the Freedom 10 itself.



The Freedom 10 remote control panel provides the following features:

POWER SWITCH- The switch on the remote is used to control both inverter and battery charger functions. When a remote control is used, the power switch on the unit should be left in the off position. This will reduce battery power consumption when the unit is shut off with the remote control.

The remote control panel allows disabling the inverter while leaving the battery charger on, a feature which is not available from the Freedom 10 alone. This may be useful if a load is operating on the incoming AC power which would discharge the batteries in the case of a power failure. To disable the inverter start with the power switch on and quickly cycle the power switch off/on three times within

three seconds. To return to normal mode (inverter and charger on) turn the power switch off and back on. The power switch on the remote has one further function, by cycling it off/on quickly two times it converts the volt meter bar graph into an indicator of the dip switch settings. These settings are displayed for 10 seconds, after which the bar graph returns to a volt meter display.

DC VOLTS BAR GRAPH- These LEDs indicate battery voltage as measured inside the unit. Each LED segment indicates .5 volts. The DC volts bar graph will stop indicating battery voltage and will indicate dip switch settings if the unit shuts down due to an overload. It will return to indicating battery voltage only after the unit has been reset. Cycling the power switch twice quickly will also cause the bar graph to indicate dip switch settings for 10 seconds, after which it will return to showing battery voltage. When indicating dip switch settings, the lowest LED shows switch 1, the second shows switch 2 etc.

DC AMPS BAR GRAPH- These LEDs approximate DC input current in inverter mode and DC output current in battery charger mode. Two ranges are used, below 60 amps each segment represents a 10 amp increment, above 60 amps each segment represents a 20 amp increment. Above 130 amps, the upper LED segment will blink. The DC amps bar graph will stop indicating DC amps and will indicate the problem if a shutdown occurs. Each LED segment indicates a different problem as described below, starting with the bottom LED first.

LED 1- Illuminates if the unit shuts down for any reason.

LED 2- Illuminates only if there is an over-temperature.

LED 3- Incoming AC reverse polarity. Correct the situation and reset with the power switch.

LED 4- Inverter overload. This situation can be reset with the power switch or plugging in the incoming AC power.

LED 5- Battery overload. This can occur if the battery has been excessively discharged, the voltage is below 8 volts, and the battery charger attempts to put out excessive current. Reduce DC load on the battery and reset with the power switch.

LED 6- Incoming AC backfeed. This is an installation problem, applying the incoming AC to the output of the unit rather than the input. Correct the problem and reset with the power switch.

LED 7-10- Not used.

STATUS LEDs- These four LEDs monitor the system as follows:

INV\CHRG- Power on light. It will be illuminated whenever the power switch is on. When the inverter has been disabled as described above, this LED will flash.

AC INPUT- Illuminates when incoming AC power has been applied and the transfer relays have engaged. There is a 3-5 second delay from the time the AC is applied and this LED illuminates.

OVERLOAD- Steady illumination indicates an over-temperature condition, the unit is shut down. It will reset automatically in inverter mode and charger mode. Flashing illumination of this LED indicates a shutdown, which can be

diagnosed by checking the DC amps bar graph.
BATTERY- This LED will indicate various battery conditions as follows:

Steady illumination- This is a warning condition.

Inverter- battery over 15.25 volts or
battery less than 10.50 volts

Charger- battery over 15.25 volts or
battery less than 10.0 volts

Flashing illumination- Indicates the unit has shut down due to high or low battery voltage, or is in the equalize mode.

Inverter- Battery over 15.50 volts for 5 seconds, the unit will automatically reset at 15.25 volts.
Battery less than 10.0 volts for 3 seconds, the unit will automatically reset at the charger float voltage or when incoming AC is applied.

Charger- Battery over 15.50 volts for five seconds, unit will automatically reset at 15.25 volts.
Battery less than 8.0 volts for one minute.
Remove all DC loads and reset with the power switch.

DIP SWITCHES- On the rear of the remote control is a series of eight dip switches. These allow the adjustment of the following parameters:



EQUALIZE OR 3-STAGE CHARGING- Equalizing a battery refers to applying a high voltage controlled over-

charge. This serves to remove all residual sulfate from the battery plates, bring all cells up to the same potential and mixes up the electrolyte, which tends to separate into layers of water and acid. The equalizing cycle is timed to last 8 hours after the switch is cycled, at which point the charger resumes normal charging in the float mode. Turning switch 1 on for 1 second will initiate the equalizing cycle. **The switch must then be turned off.** If the switch is left on, the charger will initiate the equalizing cycle each time the charger is engaged. The "Battery" LED flashes when in the equalizing mode.

WARNINGS- Do not equalize sealed maintenance free batteries with the remote programmed for flooded batteries

Always closely monitor the equalizing process. Do not allow battery gasses to accumulate. Ventilation is very important.

Remove all DC loads from the system before equalizing. The high voltage may damage some equipment.

Do not leave the equalizing switch in the on position. This will cause the unit to go into equalizing mode every time the battery charger is activated.

BATTERY TYPE- Allows the following four different charger voltage settings:

Battery Type & Temperature	Bulk Voltage	Float Voltage	Equalize Voltage
Normal Flooded	14.4	13.5	16.3
Warm Flooded	13.9	13.3	15.8
Normal Gel Cell	14.4	13.8	14.4
Warm Gel Cell	14.1	13.8	14.1

The Freedom 10 accommodates either standard flooded cell lead acid batteries or gel cell batteries such as those from Dynasty or Prevailer. Battery temperature affects the optimum charging voltage, 77 degrees F. is considered normal and 100 degrees F. is considered warm. The default setting is normal flooded, 14.4/13.5.

IDLE PULSE WIDTH- This setting will affect the sensitivity of the idle circuitry and also the idle power consumption. The narrow setting reduces idle power consumption but you may find that small inductive loads such as fluorescent lights will not draw the unit out of idle. The wide setting will result in slightly higher idle power consumption but will respond to smaller loads. See page 22 for a chart showing the idle current consumption in the various settings.

IDLE SENSITIVITY- In most installations the Freedom 10 will be connected to the electrical system, which in itself, without any appliances switched on, represents a load. This is due to the resistance and capacitance of the wires themselves. Using a trial and error process the idle circuit can be adjusted until the unit will detect small loads but still drop into idle when all loads are shut off. Please note that some small loads may never pull the unit out of idle, in this case you may need to use an additional load, such as a small incandescent light, to first activate the circuitry. Use a volt meter to confirm that the unit is in idle. The idle voltage is

typically measured as 25-55 volts with an averaging volt meter.

POWER SHARING- These switches should be set at the value of the circuit breaker that protects the incoming AC power. For instance, in most RV parks or marinas a 30 amp circuit is available. If you are parking at home or running a small generator the setting can be reduced to 10, 15 or 20 amps.

DIP SWITCH ADJUSTMENTS

Note- Factory default settings are all "Off".

Feature	Switch Number		Set Point
Equalize or 3-Stage Charging	1 On		Equalize
	Off		3-Stage Charging
Battery Type	3 On	2 On	Warm Gel
	On	Off	Normal Gel
	Off	On	Warm Flooded
	Off	Off	Normal Flooded
Idle Pulse Width	4 On		Wide
	Off		Narrow
Idle Sensitivity	6 On	5 On	Disabled
	On	Off	15 Watts
	Off	On	6 Watts
	Off	Off	4 Watts
Power Sharing	8 On	7 On	10 Amps
	On	Off	15 Amps
	Off	On	20 Amps
	Off	Off	30 Amps

INSTALLATION

LOCATION- Mount the unit in a dry environment, away from direct contact with water. Allow some airflow around the unit for cooling and do not block either the fan vent or the louvers.

The unit may be mounted vertically or horizontally. When mounting vertically be sure that the fan faces down.

WARNING- DO NOT MOUNT THE UNIT IN THE ENGINE ROOM OF A GASOLINE POWERED BOAT OR IN AN ENCLOSED BATTERY BOX.

Diesel engine rooms are acceptable. The connectors for the remote control and the ground are both located on the bottom of the unit, so be sure to make these connections before securing the unit down. Locate the unit as close to the batteries as possible, preferably within six feet so the battery cables will reach. If the cables must be extended, use 2 AWG stranded wire and do not run the cables more than 10 feet total, in other words, do not add more than 4 feet to the cables.

GROUNDING- The ground connector is located on the bottom of the unit. This connector can accept two wires, one is used to connect the unit to ground, the other can be used to connect any other equipment to ground through the unit. Use an 8 AWG green insulated wire, strip one end and use a screwdriver to secure it to the ground connector. This wire will connect to the ground in your system. In a vehicle connect to the chassis. In a boat connect to the existing AC ground system. In a stationary system

connect to earth ground.

This procedure will connect the chassis of your Freedom 10 to ground. In addition, the AC input and AC output green wires will be connected to ground through the ground connector. Please note that the battery cables are not connected to ground or the chassis of the Freedom 10.

AC WIRING- Use a screwdriver to remove the two screws which secure the AC wiring compartment cover plate. Inside you will see the compartment is divided into two sections, one labeled UTILITY/GEN AC INPUT the other labeled AC OUTPUT. Each compartment contains three 10 AWG pigtails, black, white and green, with a wire nut on each wire.

Feed your 3 conductor AC input wire through the strain relief and into the appropriate compartment. You should have about 6 inches of individually insulated black, white and green wire. Strip about 1/2 inch of insulation off each conductor and connect to the Freedom 10 pigtails, using the supplied wire nuts. If preferred, you may use crimp connectors, but make sure the crimp is made properly with a high quality crimping tool. Another option is to solder the wires and insulate with heat shrink insulation.

Feed the 3 conductor AC output wire through its strain relief and connect in the same fashion.

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

IMPORTANT NOTE- Improper connections in the AC wiring compartment will result in problems. Make these connections carefully and double-check them.

WARNING- DO NOT CONNECT AC FROM THE UTILITY OR A GENERATOR TO THE AC OUTPUT OF THE INVERTER. THIS IS KNOWN AS BACKFEEDING AND MAY DAMAGE THE UNIT.

DC WIRING- Two battery cables, each six feet long, are provided with the unit. Both are black, the positive cable has a piece of red heat shrink insulation on the end. Keep in mind that high current will pass through the DC wiring. All wires must be properly sized and all connections clean and tight.

The negative cable should be connected directly to the negative post of the battery bank. Tighten securely.

A Class T JIN 250 amp fuse is recommended to protect the positive battery cable. The fuse must be installed within 18 inches of the battery.

If it is desired to use two battery banks, you may connect the positive battery cable through a battery selector switch, making sure that properly sized cable runs from the switch to the batteries.

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

WARNING- THE FREEDOM 10 IS NOT DC REVERSE POLARITY PROTECTED. BE VERY CAREFUL TO CONNECT NEGATIVE AND POSITIVE CORRECTLY, OTHERWISE DAMAGE MAY OCCUR.

REMOTE CONTROL WIRING- The remote control is supplied with a 20 foot section of telephone cable for connection to the unit. Simply plug one end into the connector on the bottom of the unit and the other end into the connector on the back of the remote control panel.

GROUND FAULT CIRCUIT INTERRUPTERS- In order to conform to the Nation Electrical Code certain branch circuits must be equipped with a Ground Fault Circuit Interrupter (GFCI). The following are recommended types of GFCIs.

Receptacle Type: Pass & Seymour
Catalog Number 1591-RW
Rated: 20 amp at 120 volts AC

Breaker Panel Type: Cutler-Hammer
Catalog Number CTL Typ CH
Rated: 20 amp at 120 volts AC

KEY INSTALLATION POINTS

1. Observe proper polarity when connecting batteries. Reverse polarity can result in damage.
2. Do not backfeed the AC output of the inverter with incoming power from the utility or a generator. While the unit is protected against backfeeding, damage may still occur.
3. Do not connect the AC input to the AC output. In effect, this would be plugging the battery charger into the inverter. This could occur if the Freedom 10 is connected to the entire circuit breaker panel, then a circuit breaker on

the panel is used to operate the battery charger. This will cause the unit to oscillate when external power is applied.

4. Always use proper wire and connectors, keeping in mind that considerable amperage flows in the DC circuit. Fusing the positive DC cable is recommended.

5. Keep the Freedom 10 out of the elements and out of direct contact with water.

TROUBLESHOOTING

USING THE REMOTE CONTROL- As described in the "Remote Control Panel" section, the DC Amps bar graph and status LEDs will indicate any problems in the system. Refer to this section when troubleshooting with the remote control panel.

TROUBLESHOOTING WITHOUT THE REMOTE CONTROL PANEL

Problem: No inverter output.

Check:

1. **Battery Voltage-** The inverter will shut off when the voltage reaches 10.2 under load. The battery voltage will rebound when the load is removed. Check all connections and measure the battery voltage under load. The inverter can be reset by cycling the power switch off/on.
2. **Circuit Breaker-** The 12 amp circuit breaker must be pushed in. If it pops out, the loads on the inverter must be reduced. The circuit breaker is reset by pushing back in.
3. **Thermal Condition-** Put your hand on the inverter. If it feels hot the thermal protection may have been activated. Allow time to cool and reduce loads. Reset when cool by cycling the power switch off/on.
4. **Overloads-** Check for short circuits in your wiring or large loads that may be on. Reset inverter by cycling the

power switch off\on. Problem: Inverter output measured with meter, not 120 volts.

Check:

You must use a true RMS meter to accurately measure the output voltage of the inverter. If your meter does not say "true RMS" on it, expect inaccurate measurements. A quick way to check the AC output voltage is to check the brightness of an incandescent light bulb. High or low voltage will cause the light to be excessively bright or dim.

Problem: Little or no output from battery charger.

Check:

1. Wiring connections. First check to see that the incoming AC power is, in fact, reaching the unit. Turn the unit off and check for AC voltage at the output. Check the battery connections.
2. Measure the voltage coming into the Freedom 10. The battery charger output is dependent on the peak AC voltage coming in. Small generators under 4000 watts will operate the charger at a reduced output, but do not provide high enough peak voltage to provide full battery charger output.
3. Check the polarity of the incoming AC power. A volt meter should measure 120 volts between the black and white wires, 120 volts between the black and green wires and zero volts between the white and green wires. If 120 volts is measured between white and green this indicates reverse AC polarity and must be corrected for the unit to function.

TECHNICAL SECTION

BATTERIES- Use only deep-cycle batteries with your Freedom 10. Deep-cycle batteries are characterized by relatively thick plates that are alloyed with either antimony or calcium. They are designed to tolerate the heavy discharging that is common with an inverter. If you use engine starting batteries of any kind, whether standard car batteries or diesel starting batteries, you should expect rapid deterioration of the storage capability as the battery is cycled.

BATTERY TYPES- There are basically 4 types of deep-cycle batteries that are commonly used with inverters.

Generic RV/Marine Batteries: These are the typical batteries offered by your local RV/marine supply store. Plate thickness is usually minimal, less than .100 inch, and antimony content very low. While cost of these batteries is low, so is expected life when cycled.

Golf Cart Batteries: These are 6 volt 220 amp hour batteries that must be used in pairs to obtain 12 volts. Plate thickness is usually about .100 inch and antimony content 4-6%. These batteries offer relatively long life and a good value.

Rolls/Surrette Batteries: Two companies, Rolls and Surrette, make very high quality marine deep-cycle batteries. Plate thickness is as high as .160 inch and antimony content 6%. Cycle life is very high and all sizes are available.

Gel Cell Batteries: These batteries have been gaining popularity in the past few years. They have the advantage

of being sealed, resulting in no maintenance or fumes. Cycle life of the gel cell is good, though not as high as the Rolls/Surrette batteries.

BATTERY INTERCONNECTING- In most cases you will be using a bank of two or more batteries to power your inverter. You may connect 6 volt batteries together in series pairs to provide 12 volts or you can connect 12 volt batteries in parallel. This is illustrated in figure 6-1.

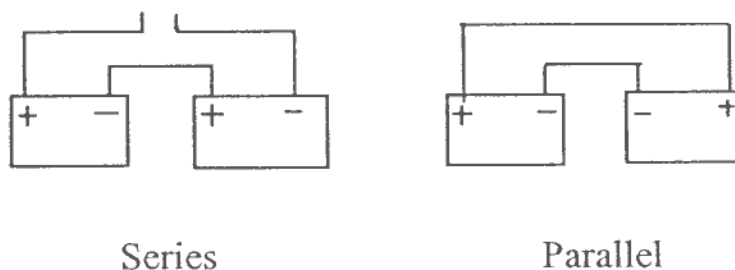


figure 6-1

Series- Connecting 2 batteries in series will double the voltage of the battery bank, so two 6 volt batteries in series provides 12 volts. The amp hour capacity of the battery bank will be the same as that of each battery, it is not doubled.

Parallel- Connecting two batteries in parallel will double the amp hour rating, but leave the voltage the same as each battery. So connecting two 12 volt 105 amp hour batteries together will result in a 12 volt 210 amp hour battery bank.

Only similar batteries should be connected together in one bank. Do not connect old and new batteries together or gel cell and flooded cell batteries. Always use at least 2 AWG cable to interconnect the batteries.

BATTERY RATINGS- Deep-cycle batteries are usually

rated in amp hours. Beware of any battery that carries a cold cranking amp rating, this a starting battery rating. The amp hour rating is for a 20 hour discharge cycle, therefore a 100 amp hour battery will deliver 5 amps for 20 hours. If the discharge rate is greater than this, the available amp hours are decreased.

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

Two formulas are used to figure out battery amp hour consumption, depending on whether the AC amps or AC watts are know.

$$(\text{AC Amps} \times 10) \times 1.1 \times \text{hours of operation} = \text{DC Amp Hours}$$

$$(\text{AC watts} / 12) \times 1.1 \times \text{hours of operation} = \text{DC Amp Hours}$$

In both equations 1.1 is the factor for inverter efficiency.

THE INVERTER-Heart Interface uses Field Effect Transistors (FETs) to switch the high current DC from batteries, creating the modified sine wave. This current is then passed through a robust transformer, where the low voltage is changed to 120 volts AC.

The peak AC voltage is a product of the battery voltage and the transformer turns ratio. The turns ratio is constant but the battery voltage will vary, therefore the peak AC voltage will vary. The unit regulates the RMS AC voltage by varying the pulse width in response to battery voltage and load.

The idle circuitry reduces the RMS AC output voltage to about 30 volts. In the idle mode some electronics will operate, for instance some electronic microwave ovens will continue to tell the proper time, even though the display is not visible. The following chart shows the idle power consumption in milliamps (mA) in the 3 modes that are adjustable with the remote.

	With Remote	Without Remote
Narrow Pulse Width	181 mA	120 mA
Wide Pulse Width	196 mA	NA
Idle Circuit Disabled	496 mA	NA
Unit Shut Off	16 mA	7 mA

THE TRANSFER SWITCH- The Freedom 10 uses three individual single-pole relays to make up the transfer switch. These relays are used to feed the battery charger and to transfer incoming power to the output. The relays are circuit board mounted and the coils operate on low voltage DC, which eliminates any tendency to chatter. A 30 amp circuit breaker protects the relays. Switching time between incoming AC power and inverter power is about 30 milliseconds, which is fast enough to keep up all microwave oven and VCR clocks, and many personal computers.

THE BATTERY CHARGER- The Freedom 10 battery charger provides completely automatic 3 step charging. It is specifically designed to recharge deep-cycle batteries of all kinds. The battery charger features three fully automatic stages, which ensure proper charging. Use of the remote control also provides the ability to manually apply an 8 hour timed equalizing charge.

Constant Current- During the constant current, or bulk

charge phase most of the charge current is delivered to the battery bank. This phase is engaged as soon as the battery charger is activated. As the name implies, a constant 50 amps will be delivered to the battery bank until the voltage reaches 14.4. The result of this is a relatively rapid recharge, a key advantage if operating a generator.

Absorption- After 14.4 volts is reached, the unit goes into the absorption phase, which holds the battery voltage at 14.4 and gradually ramps down the current, until it reaches 5-7 amps or one hour passes, whichever comes first. This phase allows the battery to accept a full charge, eliminating any tendency to surface charge.

Constant Voltage- This is the lower voltage float charge phase, which is maintained indefinitely until the battery charger is unplugged. The float voltage is held at 13.5 volts. At this voltage the full 50 amps of charger current is available to operate 12 volt appliances. It is safe to leave the battery charger on for long periods of time, due to the lower voltage of the float charge.

Equalizing Charge- Periodic equalizing is recommended by deep-cycle battery manufacturers. There are no firm rules as to how often this charge should be applied, but once a month is probably appropriate for systems in constant use, less if the batteries are rarely cycled. The equalizing charge applies a high voltage controlled over-charge, which serves to bring all battery cells up to the same potential, remove all built up sulfate from the plates, and mix up the electrolyte. The equalizing charge is manually applied using the dip switches on the back of the remote control.

WARRANTY

Your Heart Interface Freedom 10 is under limited warranty for a period of 12 months or 30 months from the date of purchase.

Terms of the warranty are spelled out on the warranty registration card. Please fill this card outp completely and return it to Heart Interface in order to validate your warranty.

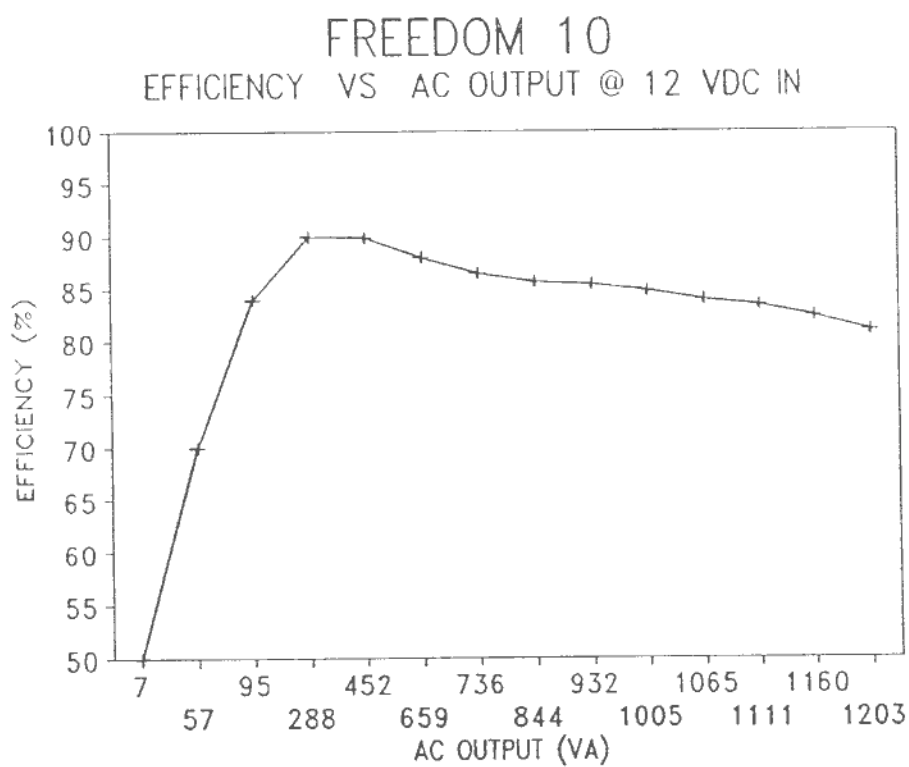
IF THE UNIT REQUIRES SERVICE- First contact Heart Interface by phone. The service manager will ask you for the serial number of your Freedom 10, so have this information ready. Our Service Department will direct you to either return the unit to the factory or a service center.

PHONE NUMBERS- 800-446-6180
206-859-0640

RETURN AUTHORIZATION NUMBER- Every unit returned for service must be accompanied by a Return Authorization Number. This is issued by the Heart Interface service manager and should be written on the outside of the shipping box.

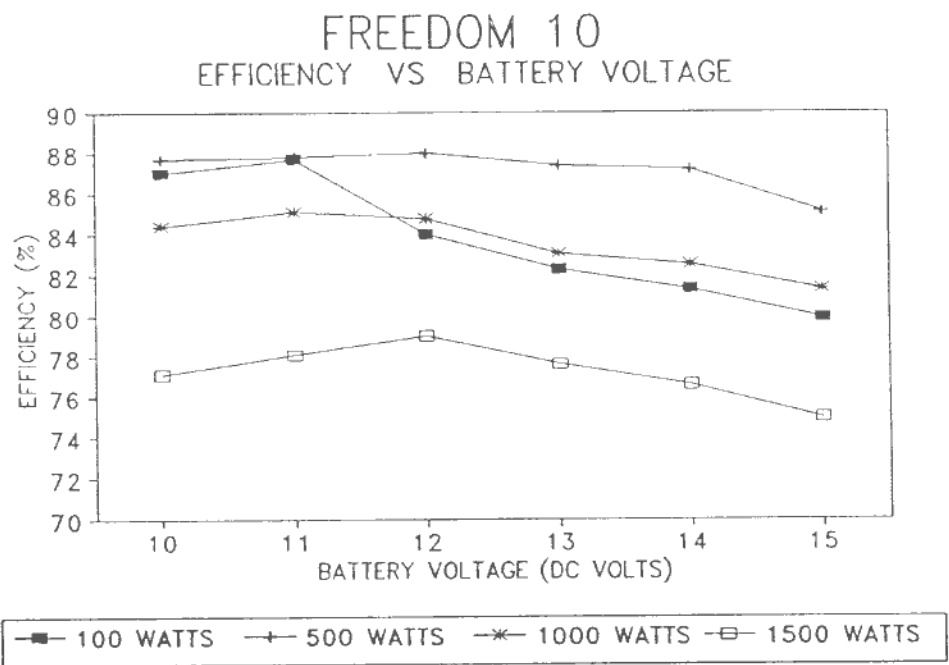
SHIPPING- You must ship the unit to Heart Interface or the service center freight prepaid. Do not ship freight collect.

EFFICIENCY



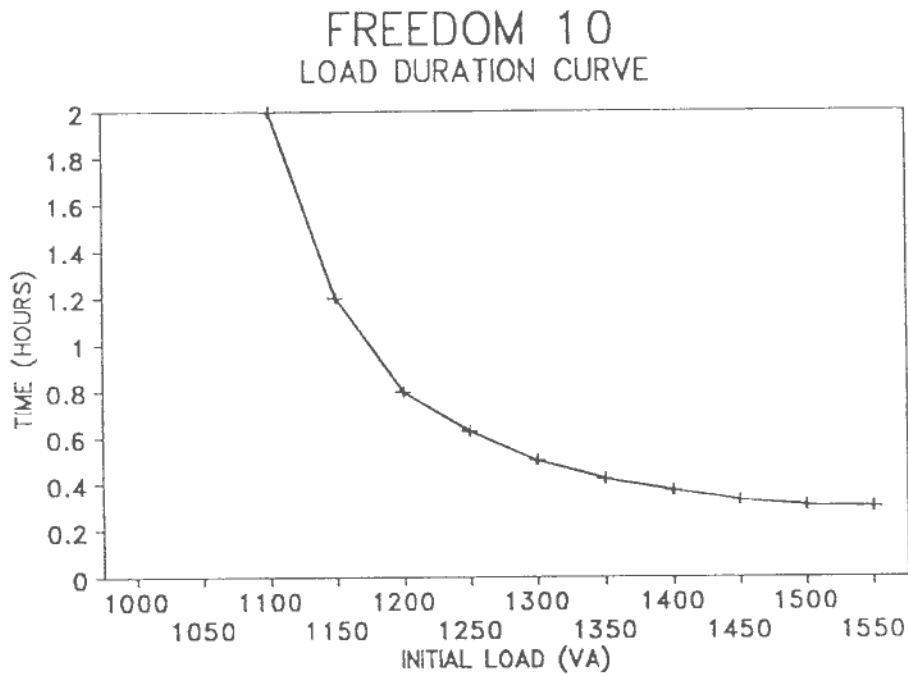
This graph illustrates the efficiency of the Freedom 10. The results are derived by measuring DC input voltage and current and output AC RMS voltage and current. The load is a resistive heating element. Input voltage was maintained at 12 volts throughout the testing. The testing took place at 70 degrees F. ambient temperature.

EFFICIENCY AND BATTERY VOLTAGE



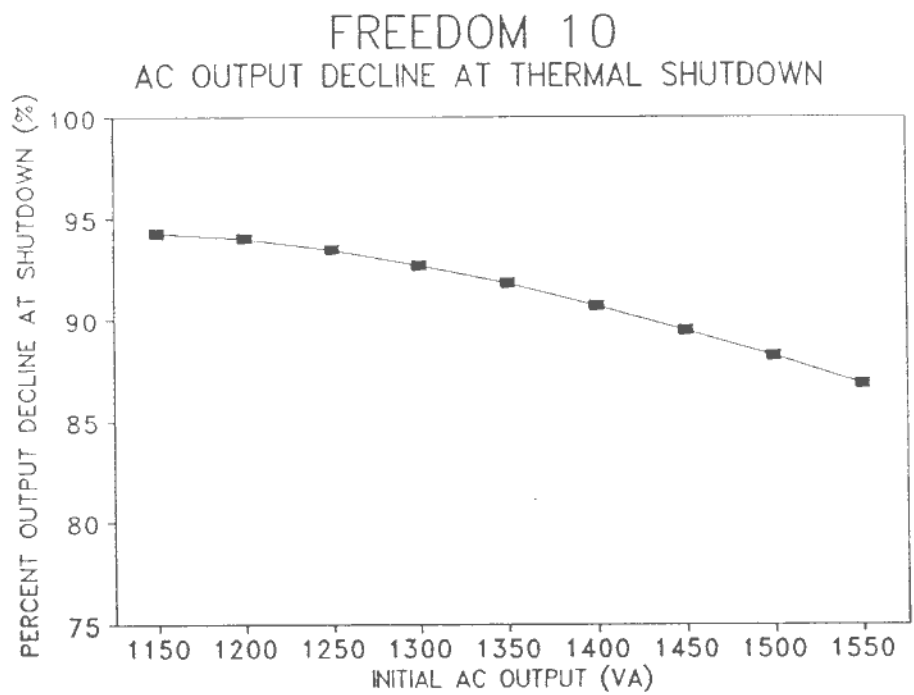
This graph expands on the previous efficiency graph. The four lines illustrate efficiency for four different power levels over the full range of battery voltage. As before, the load is a resistive one and the ambient temperature is 70 degrees F.

LOAD DURATION



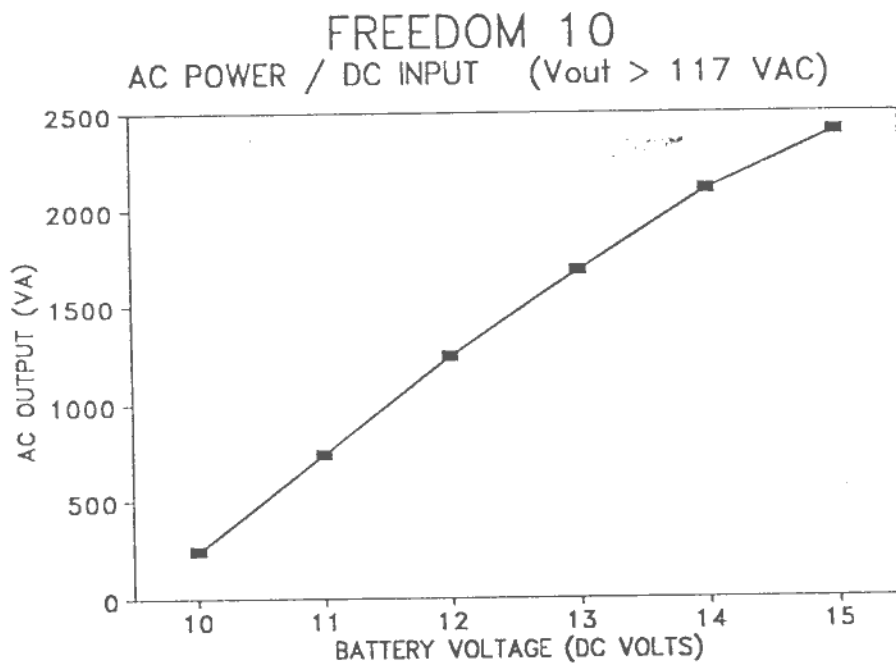
This graph illustrates how long the Freedom 10 can operate loads in excess of its rating. The inverter is capable of operating 1000 watt resistive loads continuously, at 70 degrees F. ambient temperature. For the tests that provided this graph battery voltage was held stable at 12 volts, the load was resistive and the ambient temperature 70 degrees F. The load was measured in VA, which is RMS volts times RMS amps. Each cross on the graph represents a tested data point. For each data point, the test began with the inverter at 70 degrees F.

OUTPUT POWER AT THERMAL SHUTDOWN



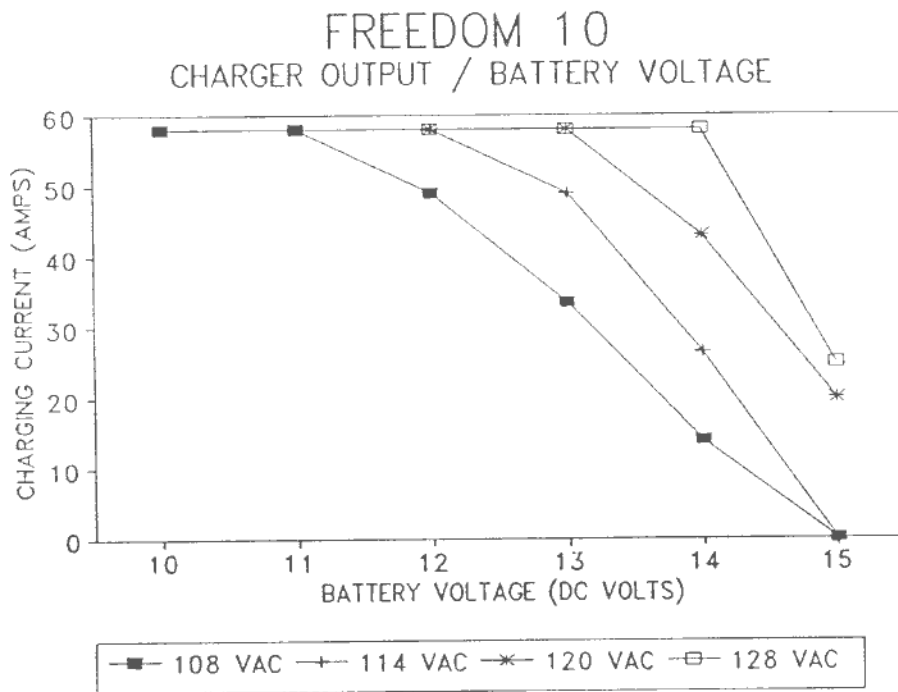
This graph accompanies the Load Duration graph. During the load duration test, as the inverter approaches thermal shutdown the heat of the transformer and Field Effect Transistors causes their resistance to increase. This increased resistance results in a reduction of the output voltage. This graph shows the reduction of the output power (RMS volts times RMS amps) as a percentage of the original load at thermal shutdown.

OUTPUT POWER AND BATTERY VOLTAGE



As the battery voltage declines and the load increases, the ability of the Freedom 10 to regulate its output voltage is reduced. This graph illustrates the curve where the unit can continue to output 117 volts RMS. The load is resistive and the ambient temperature is 70 degrees F.

CHARGER OUTPUT AND AC INPUT VOLTAGE



This graph illustrates the degradation in battery charger output current as the AC input voltage drops. The battery charger is designed to operate on 120 volts. It will still perform its three step charging if the AC input voltage is below 120 volts but the charging current will be reduced.



Underwriters Laboratories Inc.®

CERTIFICATE OF COMPLIANCE

Company Name and Location: Heart Interface Corp.
811 1st Avenue South
Kent, Washington 98032

File Number:
NC1531

Date of Report:
13 May, 1992

Product Description: Freedom 10 Inverter/Charger Unit for Emergency Vehicle
and Land Vehicle Use

Investigated in Accordance with:

Society of Automotive Engineers (SAE) J551, Oct '85

Model Designation: 50317

Serial No.: 81-0100-001

Additional Information/Remarks:

Tested with Optional Remote Status Panel, Model 82-0100-001

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Eric B. Bant
EMI Testing Services

Reviewed by:

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