

## APPLICATION NOTE 4

08/28/96

### **SUBJECT: Charging deeply discharged electrolyte batteries using the Xantrex Freedom Inverter / Charger and the Freedom Remote Panel or Link 2000**

The gelled electrolyte battery chemistry and construction may present a charging problem when some gelled batteries are discharged below 80% of their capacity. The problem occurs when deeply discharged batteries recharge inefficiently and most of the charge current is used to produce heat rather than a chemical reaction necessary for recharging. This can cause the batteries to overheat and go into a thermal runaway condition that can destroy the battery.

A gelled battery is at 80% discharge level when the open circuit terminal voltage measures 11.80 VDC to 12.00 VDC depending on the manufacturer. The open circuit terminal voltage is measured after the batteries have been at rest for 1 to 3 hours with no load or charge source present.

If it is determined that the batteries have been discharged below 80% there are methods using Xantrex Freedom inverter / chargers that can prevent an overheating condition during recharge by limiting the charge current. The goal is to limit the charge current to a percentage of battery capacity. Depending on the battery manufacturer, the current should be limited between 4% and 25% of capacity. If we assume a 400 amp-hour bank our charge current will be limited to 100 amps or less.

The methods for current limiting require a standard remote panel or the Link 2000. On the back of the Freedom remote there is an 8-position DIP-switch.

We will be positioning switches 2 and 3 on the Freedom remote for setting the charge voltage for gel batteries. If a Link 2000 is being used, ensure battery type 2 is selected in the setup mode.

#### Switch Position Charge Voltage/Float Voltage/Equalize Voltage

2 off, 3 on 14.4 VDC 13.8 VDC 14.4 VDC

2 on, 3 on 14.1 VDC 13.8 VDC 14.1 VDC

The voltages are 14.4 VDC for cool climate (lower than 80 F) and 14.1 VDC for warm climate (higher than 80 F). Select the appropriate setting.

Once the voltages are set up we can limit the current 2 ways. If the serial number of the unit is at or above the number listed below we can set the unit for equalize charge and accomplish an 8 hour timed current limited charge at the equalize voltage. Note: When the battery type is set for gel batteries the equalize voltage is equal to the acceptance voltage.

#### Model Serial Number Current Limit Serial Number Current Limit

Freedom 10 112809 6 amps DC 122603 8 amps DC

Freedom 20 111965 6 amps DC 127058 16 amps DC

Freedom 25 111118 6 amps DC 121252 24 amps DC

This method of current limiting using the "equalize feature" can be set by turning DIP switch number 1 to the "on" position and immediately back to the "off " position. Using a Link 2000 requires that equalize mode be activated through the setup button, the Link owners manual covers this procedure in detail. When this method is used the unit will return to the normal charge mode following the 8 hour equalize charge without any more user intervention.

The second method of charger current limiting can be set by DIP switches 7 and 8 which set power sharing. This method limits the amount of AC current available for the charger to use. The limits are the same for the Freedom 10 and Freedom 20 and differ slightly with the Freedom 25. Power sharing on a Link 2000 is changed through the setup button, please refer to the Link owners manual.

Model Switch setting Power share Charge current

Freedom 10,20,25 7 on, 8 on 5 Amps 25 amps DC

Freedom 10 any other 15,20 &30 Amps 50 amps DC

Freedom 20 7 off, 8 on 15 Amps 75 amps DC

Freedom 20 7 on, 8 off 20 Amps 90 amps DC

Freedom 20 7 off, 8 off 30 Amps 100 amps DC

Freedom 25 7 off, 8 on 20 Amps 90 amps DC

Freedom 25 7 on, 8 off 30 Amps 130 amps DC

Freedom 25 7 off, 8 off unlimited 130 amps DC

If there is any AC load operating on the output of the inverter, the currents in the table will be further reduced.

In an application that employs 2 or more inverter / chargers the battery banks are usually large enough that we can simply turn off one of the chargers and allow the remaining charger to charge at full current. The default mode of charger operation is for the charger to come "on" automatically without regard to the position of the on/off switch either on the unit or on the Freedom remote. Chargers being controlled by a Link 2000's require that the charger be turned on using the "Charge" button on the Link. To change the mode of charger operation to respond to the Freedom remote on/off switch simply turn DIP switch number 4 to the "on" position.

In conclusion, the current limiting of the charger will increase the length of time it takes to recharge the batteries from a deep discharge condition but will prevent overheating and therefore battery damage. The current limiting method that is used is based on the size of the battery bank and the recommendations of the battery manufacturer. The most trouble free current limit set up is the equalize mode. The charger will automatically reset to normal operation following the equalize cycle. The drawback of this mode is that the charge current is very low. Knowing the battery bank size, in amp hours, and the recommended charge current limit of the manufacturer is critical in recharging deeply discharged gel electrolyte batteries.