

IBPS Software Manual

Rev. 4, July 2009



Intelligent Battery and Power System™

Firmware and Software

User's Guide

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Summary: The *Intelligent Battery and Power System* (IBPS) contains embedded Firmware that allows it to safely operate autonomously without any host intervention. The device can report the properties and status of the battery controller and power subsystem in real time if this feature is desired. The information reported includes Dynamic Power consumption, amp-hours remaining, estimated time to empty, current consumption from the batteries, alarms and battery status and many other operating parameters.

The firmware can be used to configure the battery controller and to report the status of the device operation back to a host via a serial port connection.

Firmware Summary:

- (1) Monitors charge and discharge operations
- (2) Enables the internal DC/DC converter and external user devices to shut off at the end of discharge.
- (3) Provides data to a host or user via its serial communication interface.
- (4) Has option for an LCD Display for charge/discharge time to full/empty and amount of current entering or leaving the batteries.
- (5) Implements a user interface and menu in ASCII/English for the configuration of the device.

OceanServer also makes available two user level Windows™ applications that can be used to monitor the operation of the Intelligent Battery and Power System. The first program is MINIBATS which operates on a Windows™ system that is being powered by the battery controller. The MINIBATS program provides functionality similar to the battery ICON located on the taskbar on laptop computers. The user can see the amount of power they are consuming and the amount of time till empty. It provides the functionality that lets the user cleanly shutdown the operating system or run user applications when the battery power is reaching the end of its capacity. This allows the user to close the program operation and save any files before the power is depleted.

The second application, FULLBATS, can be run on any Windows™ host and is used to monitor the operation of the battery system as a system design / development tool. This program allows the user to monitor the detailed behavior of each battery in the system. The FULLBATS program is useful when developing systems. FULLBATS will monitor the status and proper

operation of the battery system and log detailed data for power consumption analysis.

Connecting IBPS to monitoring device:

To connect the IBPS to a monitoring device, install a Serial Port cable assembly (OceanServer p/n 19-00010-00), onto the 10 pin connector, J8, on the Base Charger. This cable assembly converts the 10-pin stick header (J8) on the Base Charger Module to a 9 position D-Sub (male) Serial Port connector. Standard point to point serial port cables (OceanServer p/n 19-00011-00) can interface the OceanServer IBPS to a PC. The data stream from the IBPS complies with the RS232 NEMA format.

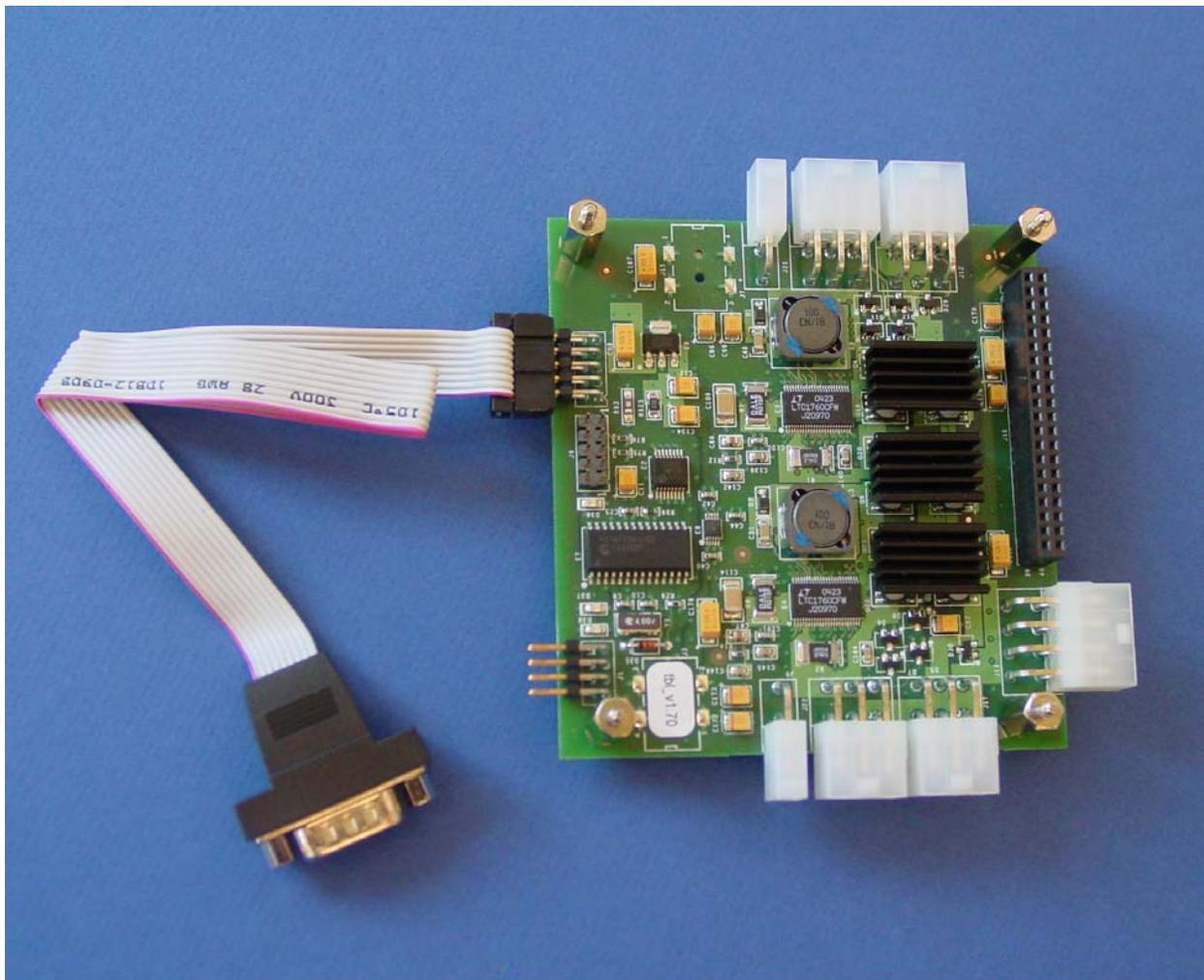


Figure 1: MP04 Module with serial cable attached

System Requirement: Any X86 series PC running MS/Windows 95, 98, NT, 2K, XP or XP Pro for using the OceanServer Windows Software or any

other system with an RS232 port that is operating at 19,200 baud, Data Bits 8, Parity None, Stop Bits 1, and no handshake.

Installation of the IBPS Software: The OceanServer GUI, and an installation utility are provided on a CD, and come with each IBPS. To install this device driver:

- (1) Insert CD into the target system.
- (2) There are two Install Shield programs on the CD, MINIBATS & FULLBATS. Double click on either of these and they will install on the Windows operating system.

MINIBATS Monitoring software application: The MINIBATS software application is designed to be run on the target system and monitor the fuel gauges of the battery system. It provides the basic functionality found on a laptop computer including; Shutdown when discharged, log of power consumption information and overall fuel gauge for the battery configuration.

The normal operating mode of the program is to run at system startup and do an orderly shutdown of the system before the power is depleted. MINIBATS will shrink down to the tool bar and show the Percentage (%) of battery capacity remaining when the user moves the mouse over it.  Click on the battery symbol to open the operating screens.

 The Information icon brings up the main screen showing the basic status of the battery system. It reports estimated time to empty of the power system and how the shutdown functions are set. The window located at the bottom of this screen will have information about changes in state and shutdowns if not run on the target machine.

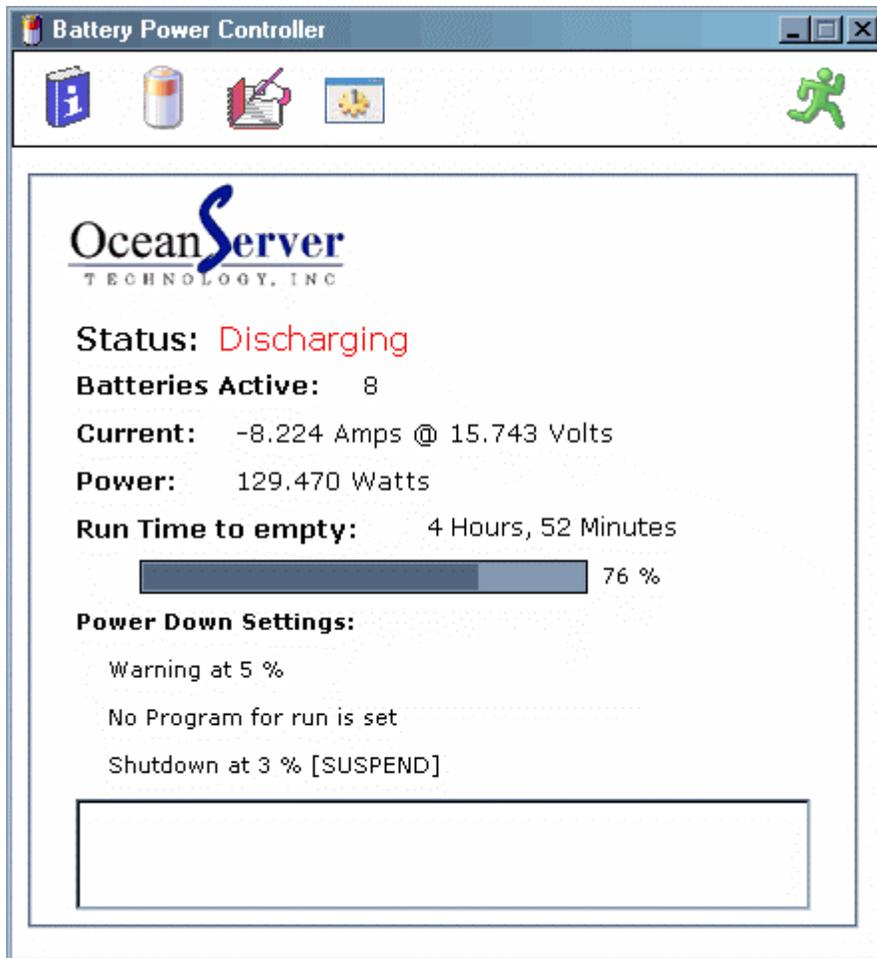


Figure 2: Information displayed when Information icon is selected.

 Click on this icon to display a status of battery state and capacity. See Figure 3.

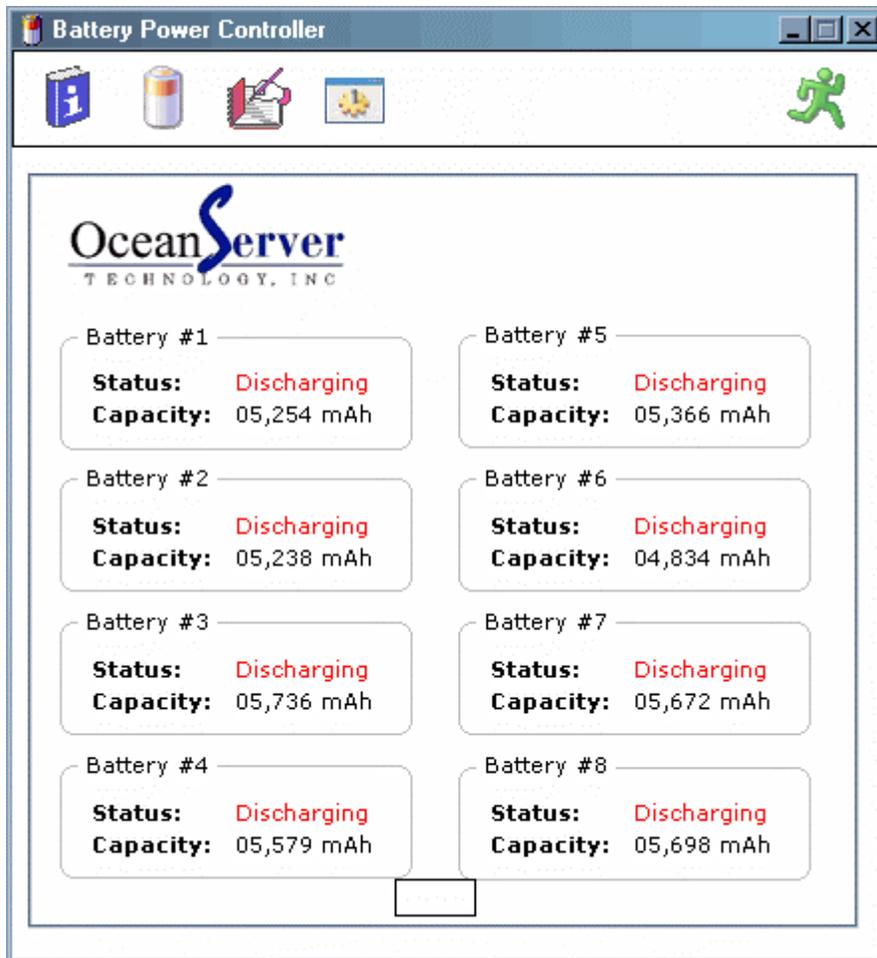


Figure 3: Battery State and Capacity Information



Click this icon to display Log information. See Figure 4.



Figure 4: Log information



When this icon is selected users can change communications settings to work with their system. Shutdown parameters can also be configured. See Figure 5.

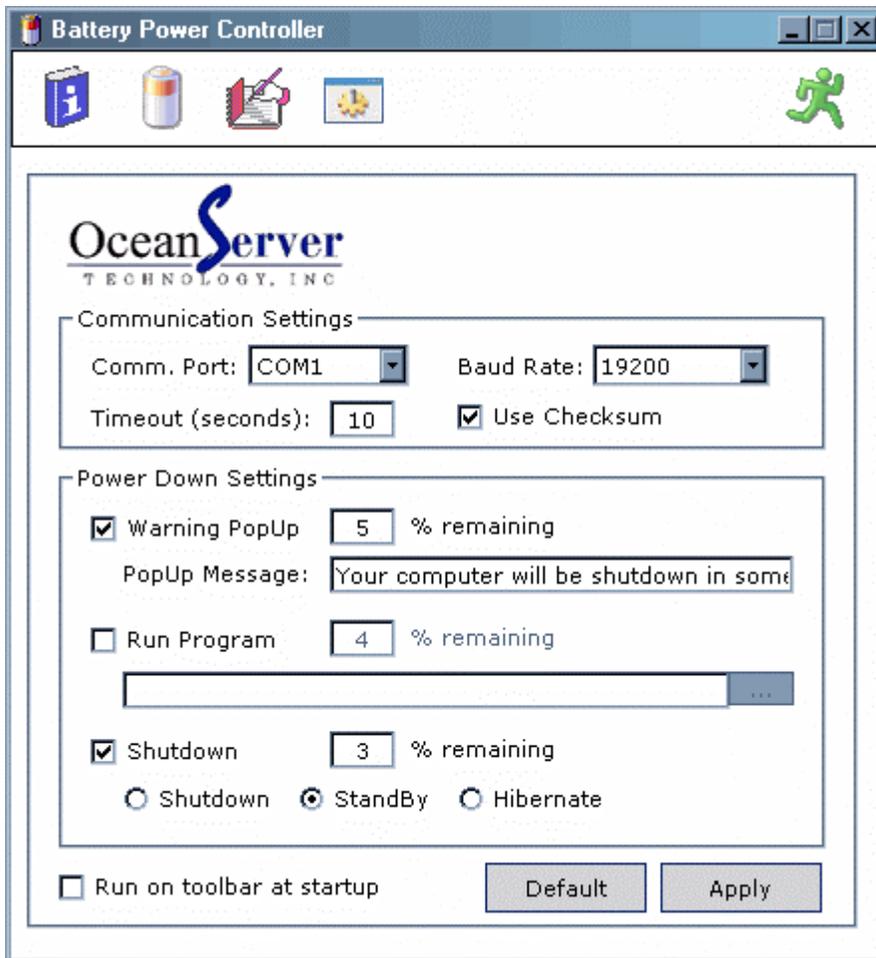


Figure 5: Communication setting and Power Down Settings.



When this icon is selected users will exit the MINIBATS program and will no longer be monitoring the system.

FULLBATS Monitoring software: The FULLBATS software is a useful development tool when testing or evaluating system power consumption. The tool also allows users to monitor the operation of each controller in larger configurations. The software can support up to 16 controllers (128 batteries). The following screen shots show 2 IBPS systems. Controller 1 is an MP-08 with 8 batteries attached and controller 2 is an MP-04 with 4 batteries attached. Contact OceanServer Engineering for configurations larger than one controller and eight battery packs.

System Tab

The Top Level Display gives the user the overview of the attached components and the capacity/status of the system.

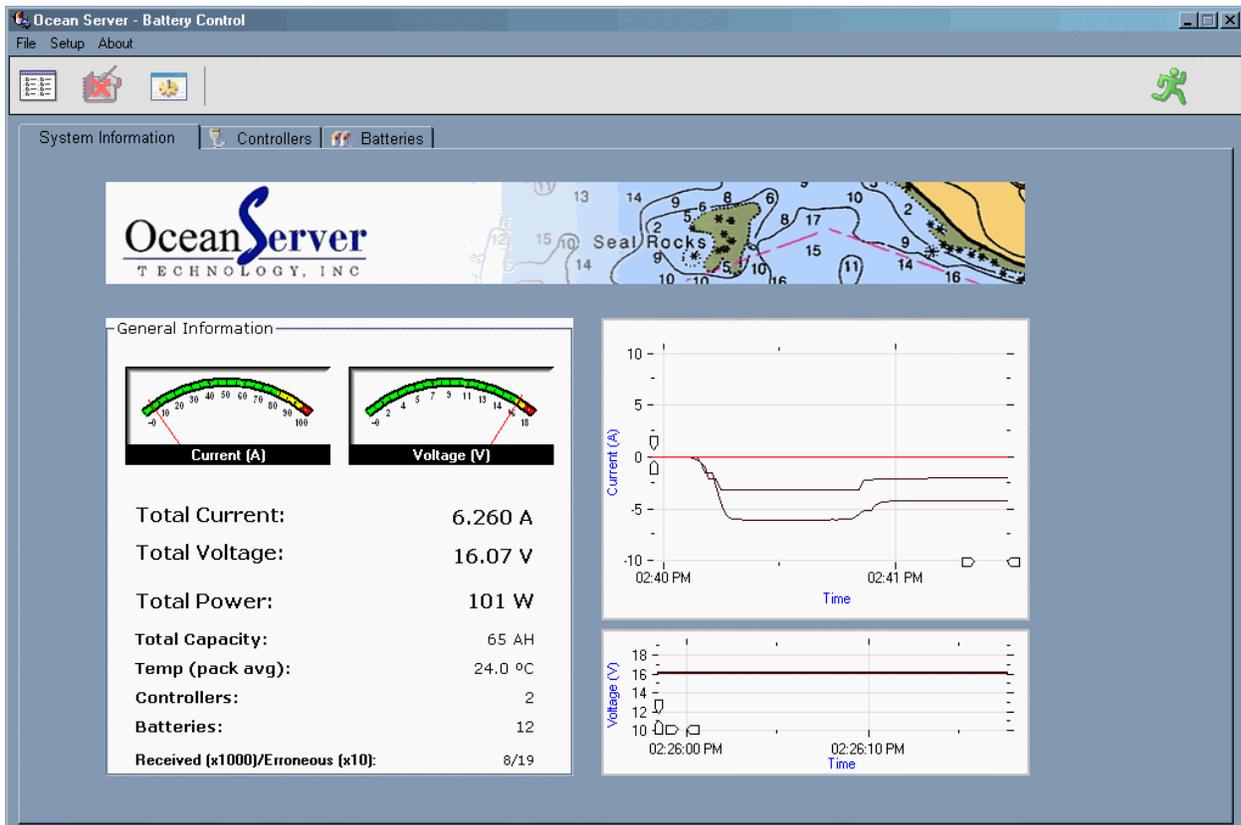


Figure 6: Intelligent Battery Controller Software – System Information Tab

On the left side of the screenshot above, the Total Current and Total Voltage is shown in the text and graphically on the meter. The current convention is positive (+) when current is being supplied to the batteries (charging) and negative (-) when current is being sourced from the batteries (discharging).

Below the current and voltage measurements in the text block are Total Power of the system, Total Capacity (sum of the available capacity as reported from the battery pack in Amp Hours), the number of IBPS Controller/Charger modules active in the system, and the total number of batteries attached to the controllers under management.

To the right side on the same screen are two active graphs that display the current draw and voltage activity over time. This permits the user to note quickly any changes as the load is varied by the served system and to monitor high-level performance factors.

The strip chart graph can actively show different ranges of plotting the data in time and in amplitude. Left click the mouse on the arrow tabs and slide them to change the limits of the plot. Right click the mouse and drag the time along to look back in time of system operation. (Note: The data in these graphs are not persistent. If controllers are switched the data plotted is lost.)

Controllers Tab

The controller screen (See Figure 7) shows the status of each controller and a summary of the batteries attached. The left side of the screen shows a current meter and a graph. The right side of the screen shows a summary of 4 controllers per page. By cycling through the pages using the Controller Navigation buttons, up to 16 controllers can be viewed and monitored.

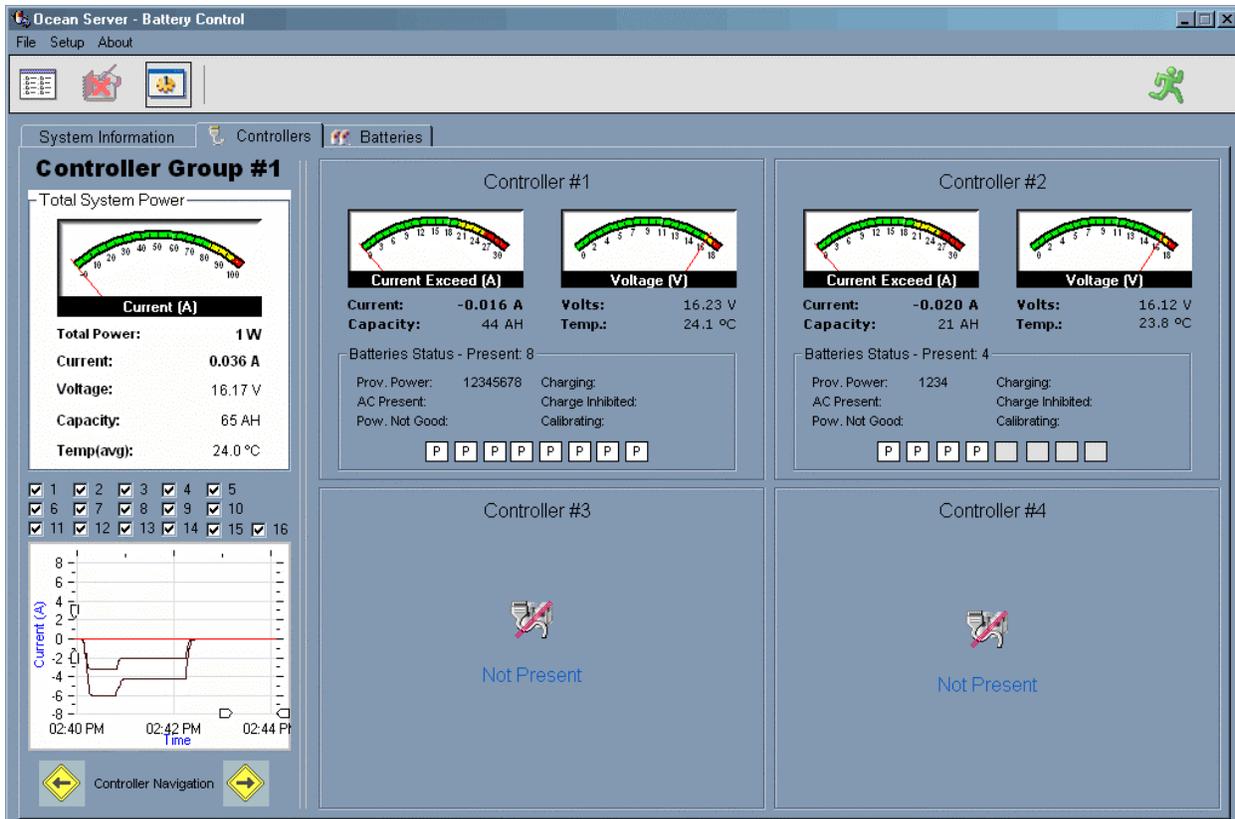


Figure 7: Intelligent Battery Controller Software – Battery Controller Tab

The meter and values in the top left of the screen show the total values for the total system.

The graph on the controller screen displays the total current of the batteries that are connected to the controller. Each controller's current is plotted on the graph. Above the graph is a group of check boxes next to a controller number. Each controller that has a check mark in the box next to it has the current of that controller displayed on the graph. The graph behaves the same as the graph on the main system level screen. The current convention is positive (+) when current is being supplied to the batteries (charging) and negative (-) when current is being sourced from the batteries (discharging). Note: Data is not persistent; if you switch controllers the data from the original controller will be lost.

Each controller block on the right displays a current and voltage meter. Below the meters are the actual values of the total current, total capacity, average voltage, and average temperature of the batteries attached to the controller.

Below the operating parameters of the controller is the status of the batteries that are attached to the controller. The numbers next to the six status lines indicate by number, which battery pack is in the given state.

1. Providing Power: When the battery pack's number is here, the battery pack is switched into the load path and providing power or ready to provide power to source the load.

2. AC Present: When the battery pack's number is here, this indicates that the charge DC voltage, supplied from an AC adapter or power supply, is present and can be used to charge the battery pack. Charging occurs provided there is sufficient voltage and enough current available to charge the batteries and source the load. The batteries are group in pairs and a charge voltage is applied to each battery pair separately so you should see AC present be applied to batteries (1,2), (3,4), etc...

3. Charging: When the battery pack's number is here, it indicates that the battery is in the charge state and is being charged. When a battery reports that it is fully charged it will not allow itself to be charged further.

4. Charge Inhibited: The battery pack is inhibited from being charged. This can result for the following reasons; the pack is fully charged already, the pack is over temperature, or a communication problem reading the battery packs voltage, current and temperature. If the controller cannot communicate to the battery pack, it is not safe to charge the pack.

5. Power No Good: When the battery pack's number is here, this indicates a fault condition prohibiting the batteries from being charged or discharged. The only way to clear this fault is to remove all power from the controller. This fault occurs in an over current situation. This error message will flash in the top of the screen where the Icons are located. When you click on the controller tab you will see which battery has set this condition. The circuit breaker opens the battery up from the circuit when it senses either an over current condition for more than 10ms from the controller or a short circuit voltage at the output of the controller (14.4V drops below 3V). This condition should never happen in a properly designed system, if you are seeing this condition the system is drawing more current than is allowed from the controller, or you have had some failure that is causing excessive current or a short.

6. Calibrating: This indicates that the battery pack is set in a calibration cycle. In general, the controller will not start calibration on a battery.

Status Blocks:

Below the status lines, are small colored boxes that contain a code to give the state of each battery pack. There are 7 possible codes:

C = Charging, the battery pack is charging at > 50mA.

CR = Charge Ready, the battery pack is charging a 50mA or less.

FC = Fully Charged, the battery pack has charge power present the status of the battery pack is fully charged.

D = Discharging, the battery pack is discharging

DR = Discharge Ready, the pack is discharging and the current is $> -50\text{mA}$ and $< 50\text{mA}$.

NG = Power Not Good, there has been an over current status in the battery pack. The only way to clear this condition is to remove all power from the IBPS.

P = Present, the battery pack is present and not in any of the above states.

Batteries Tab

The Batteries screen shows the status of each of the smart battery packs in the cluster. It can be displayed graphically or in a text format.

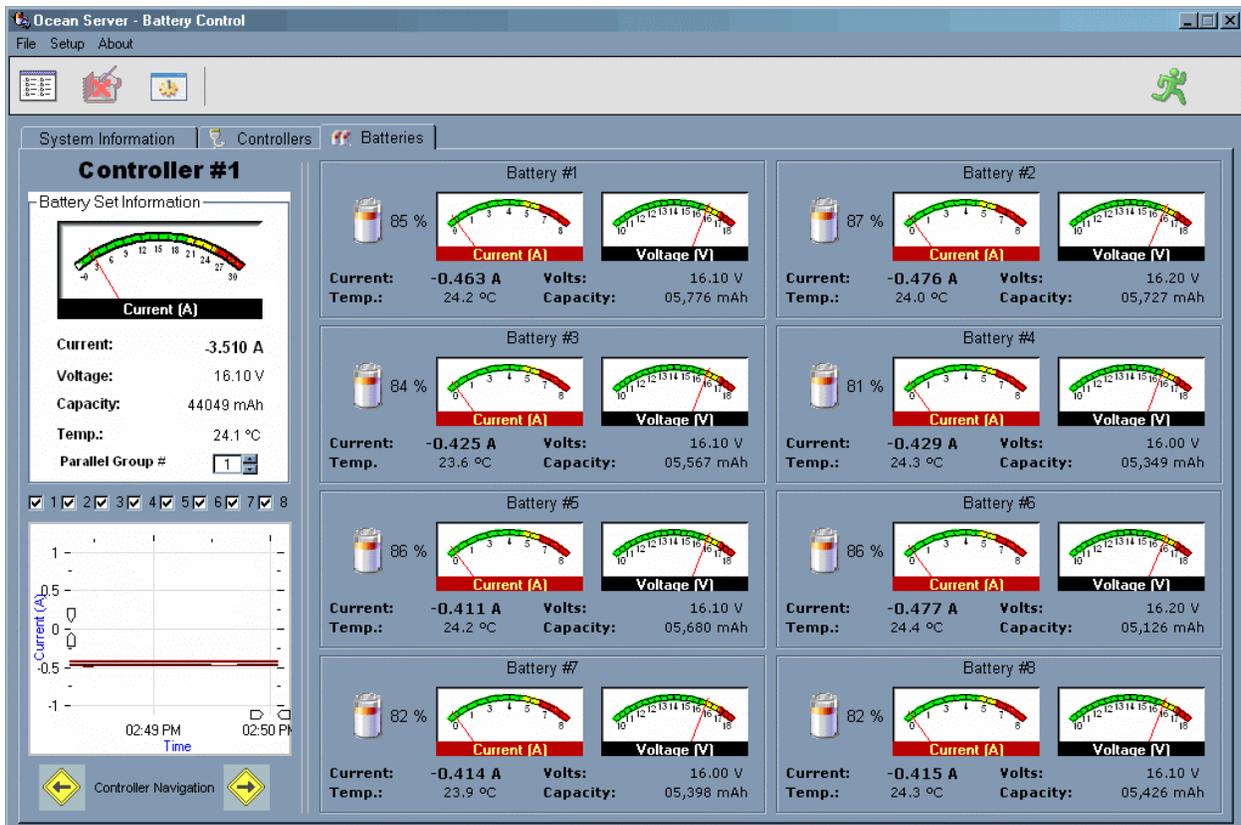


Figure 8: Intelligent Battery Controller Software – Individual Batteries Tab

The graphic and text versions of the Battery Tab both contain a current meter and the actual current, voltage, capacity and temperature of the all the batteries attached to the controller.

The Parallel Group # is used in advanced systems that involve putting multiple controllers in serial to produce higher output voltages. Contact OceanServer for more information.

The graph is an active plotting tool that shows the current draw on each battery plotted vs. time. Use the checkboxes to chose which batteries to plot. The current convention is positive (+) when current is being supplied to the batteries (charging) and negative (-) when current is being sourced from the batteries (discharging). The readings are taken at the terminals of the battery packs to get the maximum safe charge level and current, canceling out the negative effects of cable resistance and IR drop. Note: Data is not persistent; if you switch controllers the data from the original controller will be lost.

The screen displays the battery status in eight frames with graphical meters showing the current draw and voltage of each battery pack. The background color of the current meter changes to indicate the current flow of the battery pack. Yellow indicates charging. Red indicates discharging. Black indicates low current.



Figure 9: Meter showing battery in Charging, Discharging and Low Current state.

Click on the label in each battery box ("Battery #1") to open a full screen of data for each battery pack as shown in Figure 10.

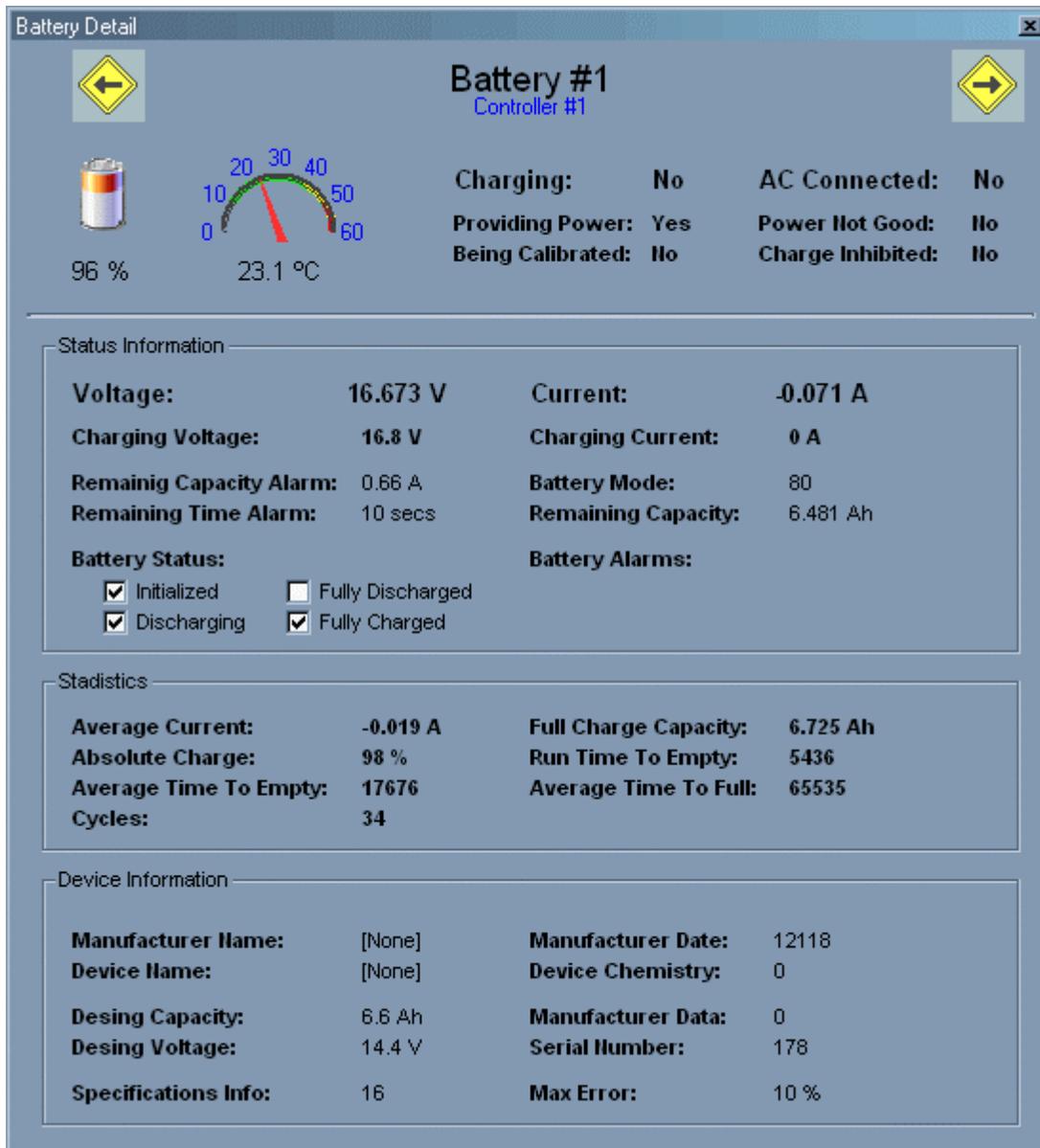


Figure 10: Data displayed via a click on the “Battery #n” label

The Battery Tab can also display more detailed data in text. See Software setup.

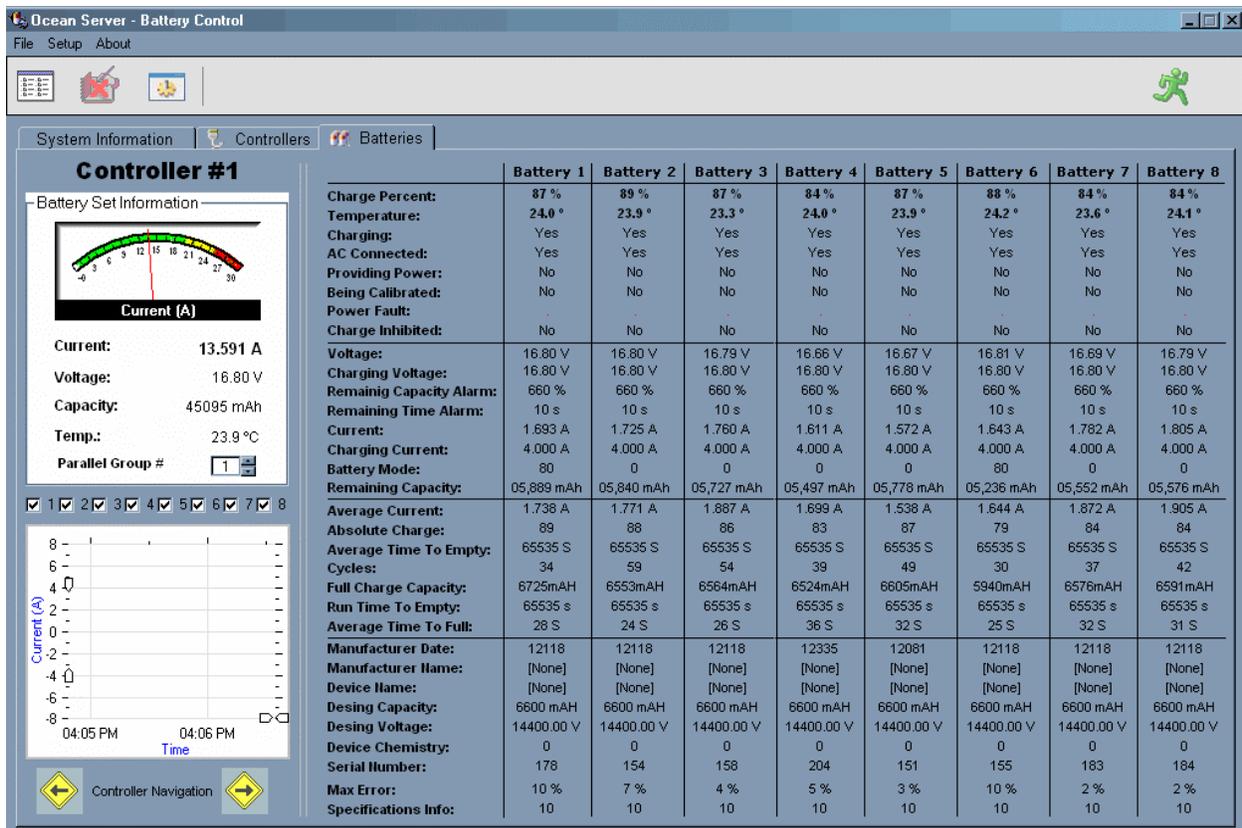


Figure 11: Intelligent Battery Controller Software – Individual Batteries Tab

This screen displays detailed information about each of the battery packs information reported via its SMB bus connection. This data includes the measurement of current, voltage, and temperature, which is the most useful real time information. Other data includes the status of the battery pack and any alert conditions reported as well as the status of the fuel gauge and design limits.

Because the battery packs are operated in a group and some of the packs do not get to see the “fully discharged” state, an inaccuracy in the “capacity remaining” and “percent remaining” calculations contained in each individual battery pack will occur. The MAX error values will be low if the pack has seen what it calls a full calibration cycle. The controller develops a composite value for the percent of capacity remaining and reports this number. OceanServer recommends when using percentage values for shutdown via the MINIBATS program, to use the 3% value for shutdown and 4-5% for “Run Program” when discharged. The linearity of the fuel gauge at lower percentages is not exact as various group behaviors of the battery packs may require the cycle to be truncated.



Software Setup

Clicking “Setup” in the upper left corner of the main screen allows to configure and customize the data presented in the Fullbats software.

Serial Port Communication Setup

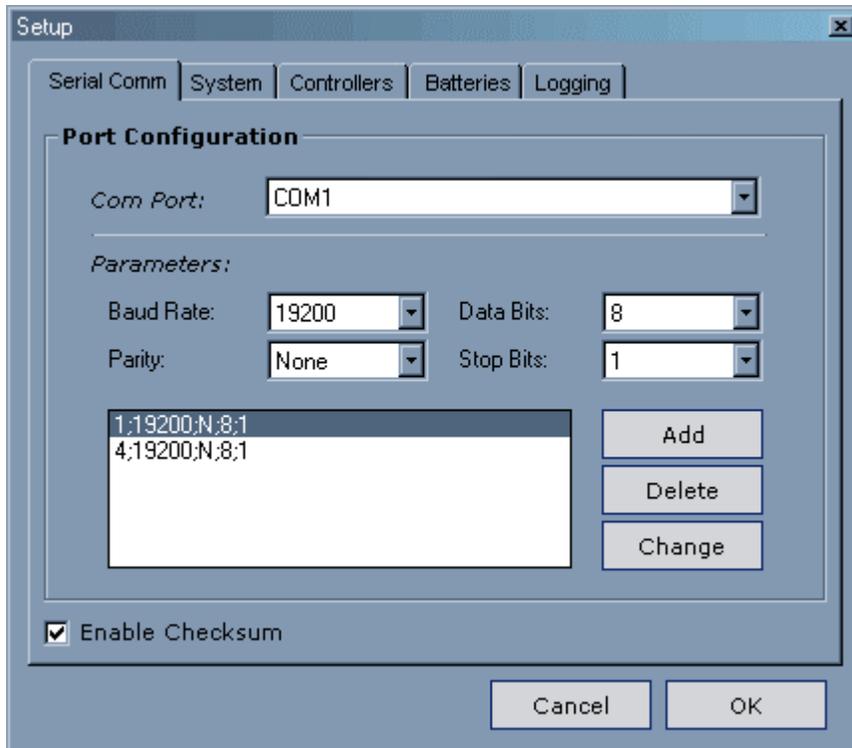


Figure 12: Serial communication setup.

The program supports reading and displaying data from a dozen ports simultaneously for use in custom multi-controller configurations. Configure which COM port will be monitored under the Serial Comm tab. The setup is 19,200 baud, no parity, 8 data bits, 1 stop bits. This is the default configuration. More than one COM port can be added.

System Setup

The meters seen in the System, Controller, and Battery tabs on the main screen can be configured to match the system that is connected to the controllers. To configure the ranges that the meters use when they display current and voltage, click on the corresponding tab and insert the values. See Figures 13, 14 and 15 below.

The System tab allows you to adjust the current and voltage meters for the system to match your configuration. The System tab also allows you to adjust the frequency of data updates and to define how much data is present for the graphs.

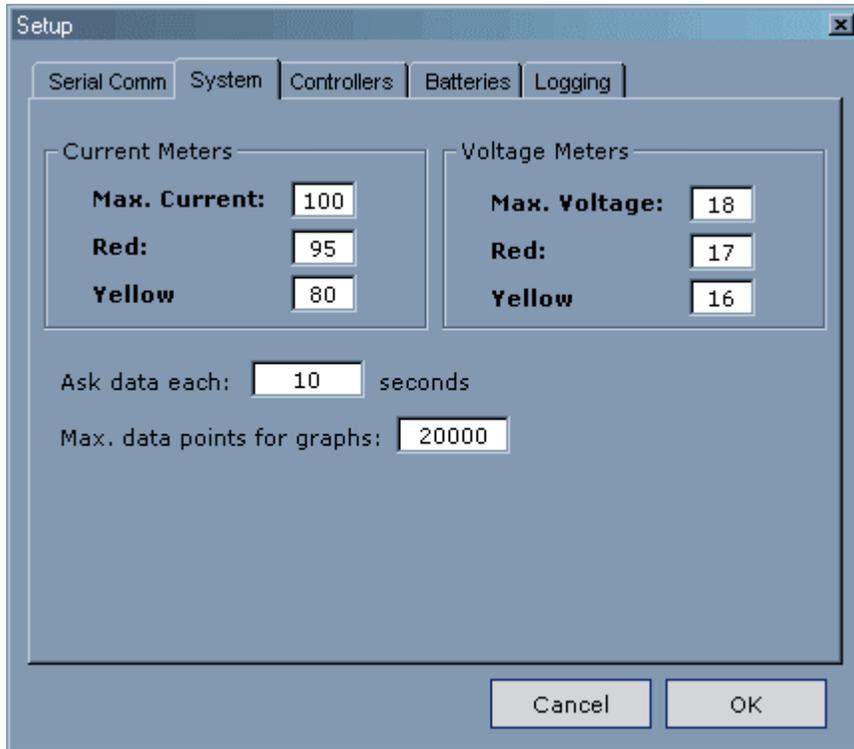


Figure 13: System Tab.

The Controller tab allows you to adjust the current and voltage meters for each individual controller to match your configuration. The controller tab also allows you to indicate the timeout value for a controller. On a busy computer it is possible for the communication to the controllers to timeout. If the Windows™ system is busy it may be necessary to increase the "Not present" timeout value.

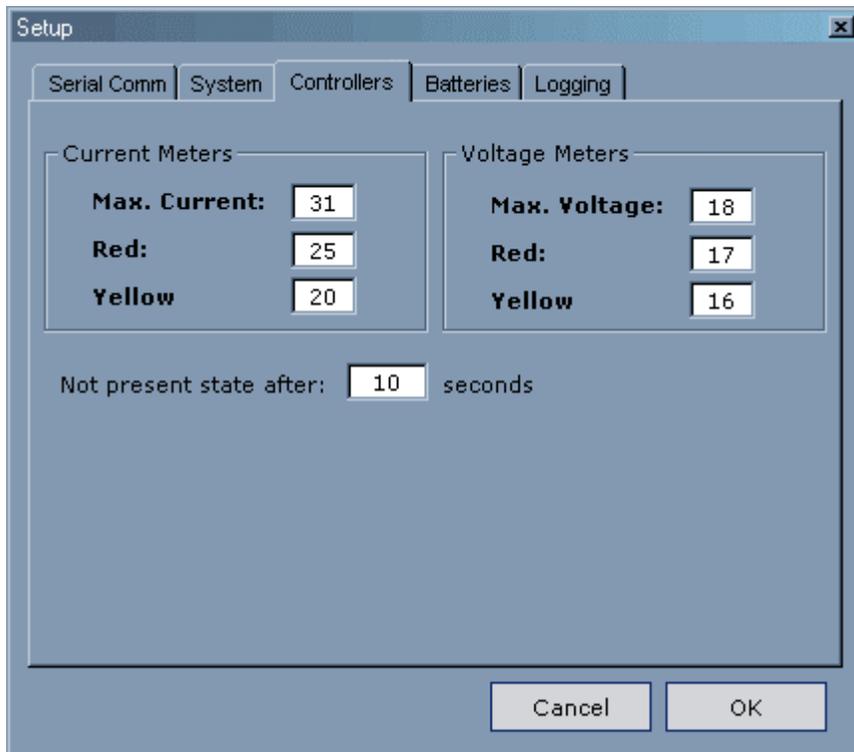


Figure 14: Controllers Tab.

The Batteries tab allows you to adjust the current and voltage meters for each individual battery to match your configuration. The Batteries tab allows you to filter data. This is useful when checksumming is not enabled on the controller. By leaving checksum enabled in the firmware data filtering isn't necessary. The battery screen can also be put in text mode to output detailed status of all of the batteries attached to a controller.

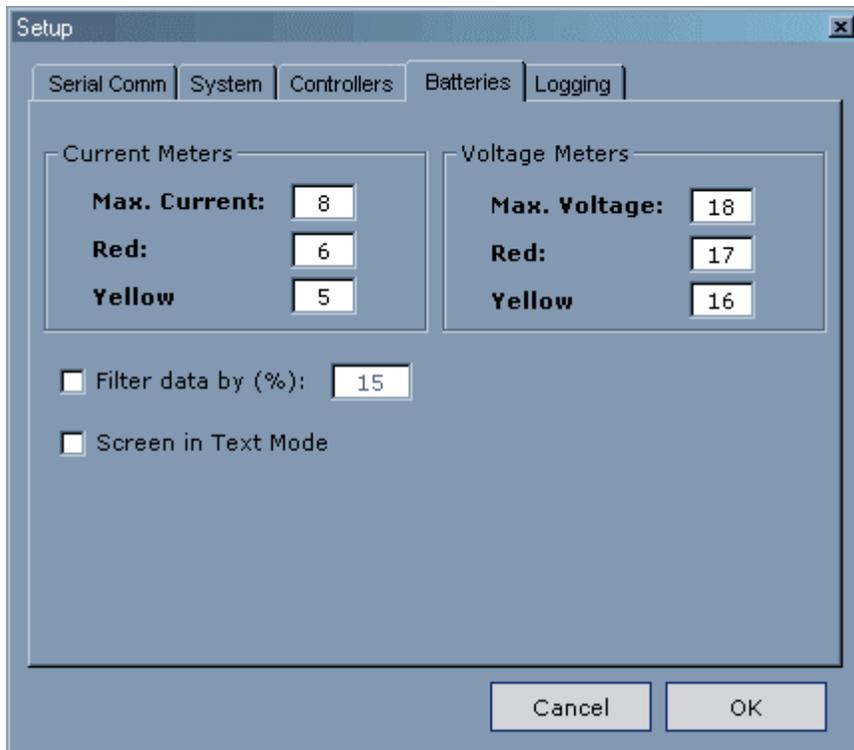


Figure 15: Batteries Tab

Figure 16 shows the Logging tab which allows users to select the root filename for a set of log files and the time interval for each sample to be collected. Click on the logging icon on the top of the screen to start logging ASCII comma delimited data into a text file.



Logging is currently disabled.



Logging is currently enabled.

This file can be opened with Microsoft EXCEL and plotted or analyzed. Users can extract the current consumption data for each battery or the system as a whole for analysis of the power consumption of the system when working with the battery controller.

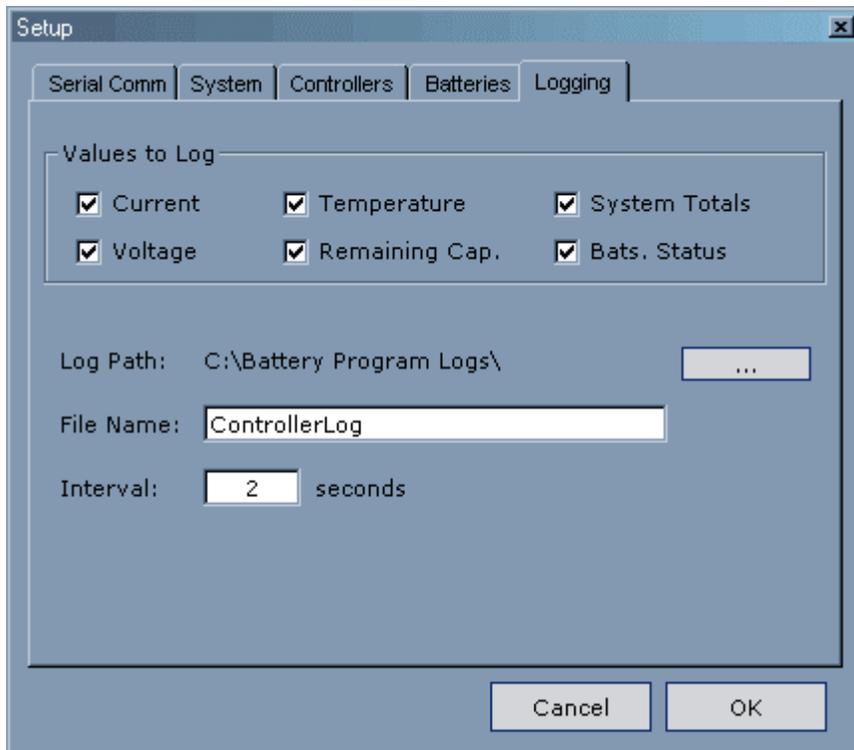


Figure 16: Logging Tab.

There is one log file created for the system total values and one for each of the controllers being monitored. The system log file has the prefix "System-" added to the file name. The controller log files have the prefix "Cx" added to the file name where "x" is the controller number. This would be "C1" for controller 1.

This shows the "System" log file opened using the Notepad editor. The log file will have a time and date stamp at the beginning of each entry. The Log file also contains the following parameters total current, average voltage, and the number of batteries. The current is in milliamps and the voltage is in millivolts. It also breaks down those values by controller.

The column headings for the controllers are in the format of "Cx-y" where "C" stands for controller, "x" is the controller number, and "y" is the parameter.

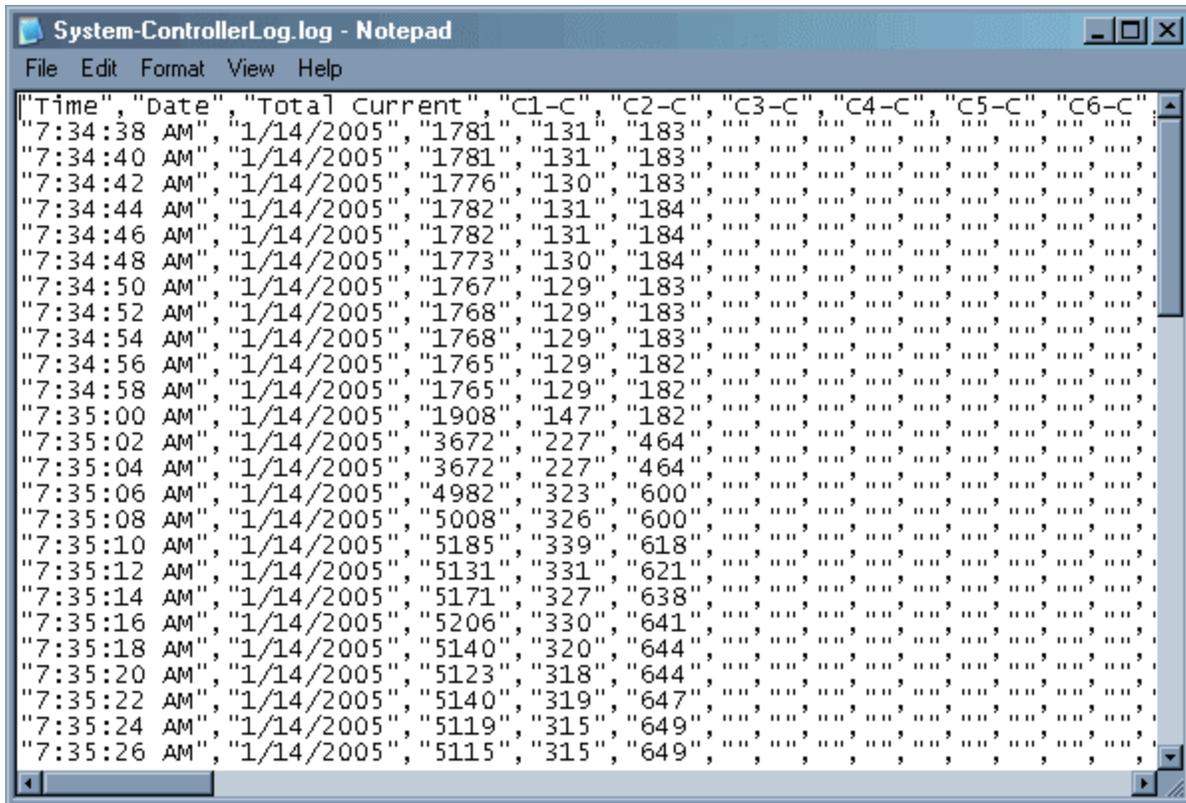


Figure 17: Screen capture of System Logging information.

The Controller log has detailed information about each controller. There is one file for each controller. The log file will have a time and date stamp at the beginning of each entry. The Log file also contains the current, voltage, temperature, capacity, and status. The current is in Amps, the voltage is in volts, the temperature is in degrees Celsius, and the capacity is in Amp-hrs. The battery status is read from the battery pack status register where I=initialized, D=discharging, Fc=fully charged, and Fd= fully discharged.

The column headings for the batteries are in the format of "Bcx-y where "B" stands for battery, "c" stands for the controller the battery is attached to, "x" is the battery number, and "y" is the parameter.

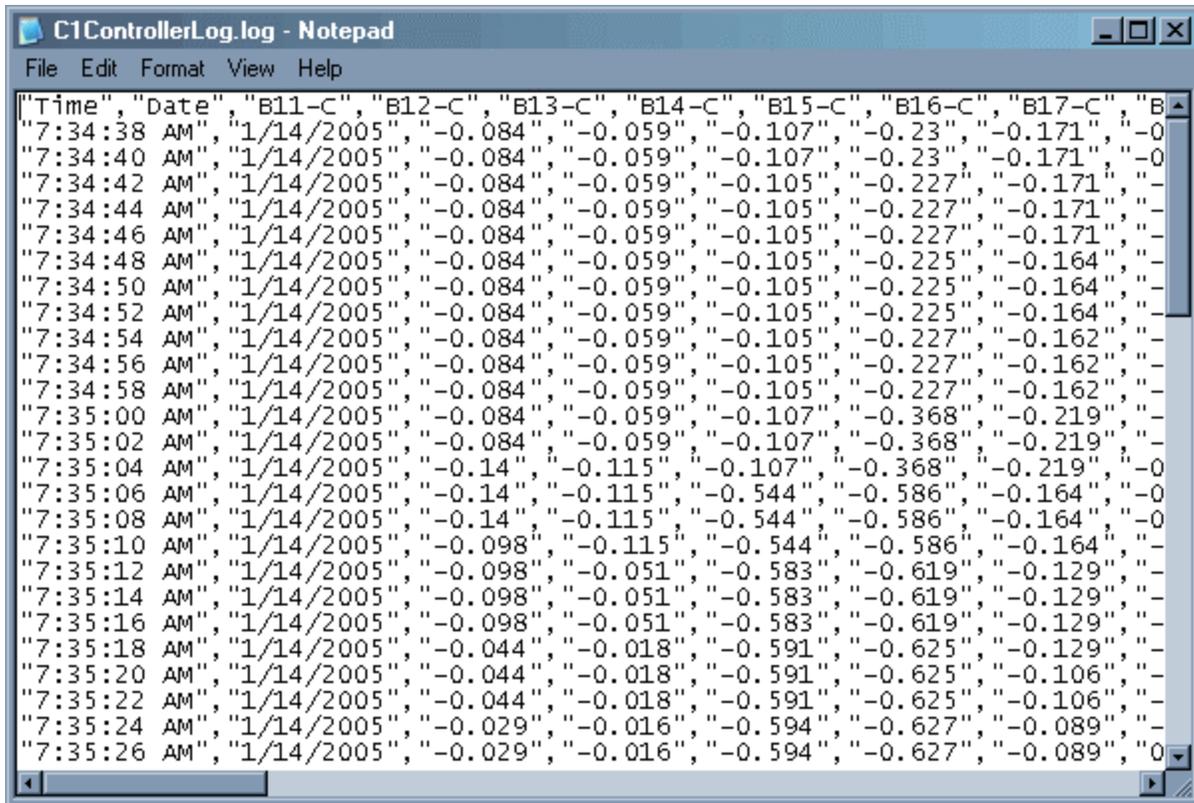


Figure 18: Screen capture of Controller Logging information.

This data logging is useful to monitor the detailed operation of the system to verify that it operates as expected over its full cycle.

LCD Screen Option

The Intelligent Battery and Power System (IBPS) has an optional LCD screen that can be installed. It is useful in applications where the user needs visibility of battery status but there is no serial console available. There are three modes for the display. There is also an option to have it display any combinations of those three modes. See the section on LCD Firmware Setup for more instructions on configuring the three modes of operation.

Mode 1:

As seen in Figures 19 and 20, the screen indicates in text and via a graph the average percent charge available in the battery packs. The "C" and "D" indicate the batteries are "C" charging or "D" discharging.

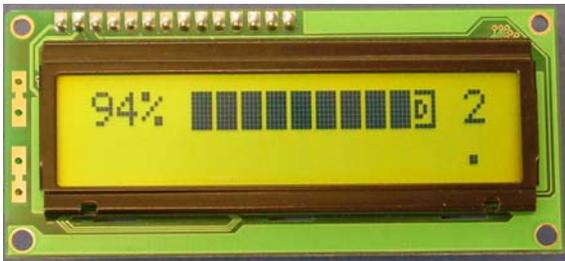


Figure 19: Discharging display
(Controlled under the firmware "Clear" command)

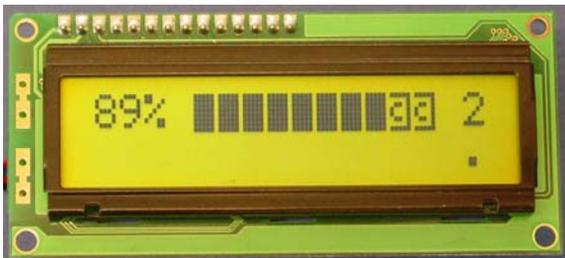
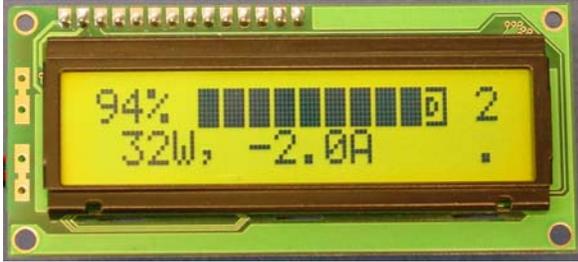


Figure 20: Charge display
(Controlled under the firmware "Clear" command)

Mode 2:

As seen in Figures 21 and 22, the power and current that is leaving or entering the batteries is displayed. Negative indicates power leaving the batteries.



**Figure 21: Power and Current leaving battery display
(Controlled under the firmware Disp 1 command)**



**Figure 22: Power and Current entering batteries display
(Controlled under the firmware Disp 1 command)**

Mode 3:

As seen in Figures 23 and 24, the state of the batteries and time to complete discharge or charge is displayed.



**Figure 23: Time to discharging complete display
(Controlled under the firmware Disp 2 command)**



**Figure 24: Time to fully charged complete display
(Controlled under the firmware Disp 2 command)**

The number to the right of the graph indicates the number of batteries attached to the controller.

The “^” or “.” to the far right on line 2 of the display indicates the status of the external on/off signal. The “^” indicates that the external signal is in the “on” state (logic high), and the “.” indicates that the external signal is in the “off” state (logic low).

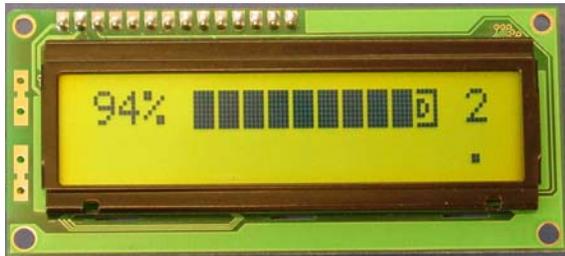


Figure 25: Shows status of the on/off signal as being “Off”

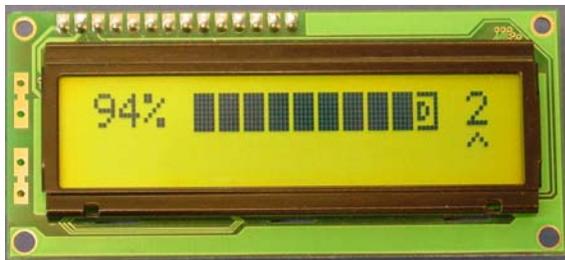


Figure 26: Shows status of the on/off signal as being “On”

If external on/off signal is turned off due to the shutdown criteria being met as set up in the firmware, “Shutdown” will appear on line 2.

If a “Power No Good” protection fault occurs and “Protection Fault” will be displayed on line 1 and “Shutdown” will be displayed on line 2. The only way to clear the “Power No Good” status is to remove all power from the controller. The “Power No Good” occurs due to an over current condition. See the IBPS Hardware User Guide for more information.

If external on/off signal is turned off due to the shutdown criteria being met for “Fully_disc set in packs”, “Full Discharge” will be displayed on line 1.

Advanced Firmware Setup:

The *Intelligent Battery and Power System* (IBPS) contains embedded Firmware that allows it to safely operate autonomously without any host intervention. The firmware can be used to configure the battery controller

and to report the status of the device operation back to a host via a serial port connection and by the LCD screen. In this section the user will learn some of the more advanced features of the firmware.

After establishing a serial connection to the IBPS a user can type the break character <space> (the space bar key) and the controller will offer a menu. Refer to section "Connecting IBPS to a Monitoring Device" for more information on connecting the IBPS to a serial port for monitoring.

The following screen capture shows the menu. The default configuration of the controller is setup to operate automatically with standard parameters. Users are not required to access the device for configuration.

```
=====
MP-04/08 V2.03
OceanServer Technology, Inc (c) 2005
www.ocean-server.com
```

```
S - Setup Controller
B - Battery Status
X - Host HEX
H - Help
```

->

By selecting "S - Setup Controller"

The additional configuration settings available to the user are displayed.

```
->S
..Setup Controller
. N - Set NVRAM Data
. R - Reset NVRAM to Default values
. E - Dump EERAM
->
```

Once at the Setup Controller menu, option "N" will allow you to change the settings. Option "R" will reset the values to the default values. Option "E" will allow you to dump the EERAM data (this is useful only for debug purposes).

The values for each parameter are shown in one of two formats. The first format has the current value in parentheses, "()". The second format, used for a range of values, is in the form of [current_value, min_value-max_value]. In this example [1,1-50], the current value is equal to 1 and the range that can be input is 1 - 50.

The following screen capture shows resetting the default values into the NVRAM and displays the default value.

```
=====
MP-04/08 V2.03
OceanServer Technology, Inc (c) 2005
www.ocean-server.com

S - Setup Controller
B - Battery Status
X - Host HEX
H - Help

->S
..Setup Controller
. N - Set NVRAM Data
. R - Reset NVRAM to Default values
. E - Dump EERAM
->R
RESET NVRAM? ->Y

S - Setup Controller
B - Battery Status
X - Host HEX
H - Help

-> S
..Setup Controller
. N - Set NVRAM Data
. R - Reset NVRAM to Default values
. E - Dump EERAM
->N
Set NVRAM..
Cont ID (1):
Powerup Command ( ) :
PowerFlag, 1=SWITCH, 2=MOMENTARY (2) :

LCDon, 1=on, [1,0-1], new value:
Cycle length, [25,2-50], new value:
Disp 1, [1,1-50], new value:
Disp 2, [10,1-50], new value:
Clear, [20,1-50], new value:

PIC Sleep,1=yes, [0,0-1], new value:
Checksum on host data, 1=yes, [1,0-1], new value:
Hold for off?,1=yes, [1,0-1], new value:
Message delay in 0.4 sec , [20,4-40], new value:

Shutdown when...
```

Charge pcnt < x, 1=yes, [0,0-1], new value:

Min voltage reached, 1=yes, [0,0-1], new value:

Min packcount, 1=yes, [0,0-1], new value:

Fully_disc set in packs, 1=yes, [1,0-1], new value:

packs FD, [2,1-7], new value:

Max bat current >x, 1=yes, [1,0-1], new value:

current, 0.1 amp, [60,20-60], new value:

Total current >x, 1=yes, [1,0-1], new value:

current, amps, [32,6-32], new value:

“Cont ID (1)”

In multi controller environments the user will need to uniquely identify each controller if they will be connected directly to a PC for monitoring. Unique values will facilitate identification of data collected. Valid options for this field are 1-9 and A-E (A=10... E=16).

“Powerup command ()”

Valid inputs “B” or “X” This is run at the startup of the controller. “B” will display Battery Status, “X” will dump the Host HEX data.

“PowerFlag, 1=SWITCH, 2=MOMENTARY (2)”

This option allows the user to configure an external switch on J1 pin 2 and 4 for the IBPS. When set to 1, the switch input behaves like a toggle switch. An open circuit will turn the device off, a closed circuit will turn it on.

When set to 2 the switch input behaves like momentary switch in a PC. It allows you to connect the controller to a PC. The controller will monitor the PS_ON# signal from a PC motherboard. The PS_ON# signal is routed through a DC-023 DCDC module. When off, pushing the switch will turn the system on. When using the IBPS to power a PC (using the ATX power connector on a motherboard) you must make sure that the BIOS is set to “AC Loss Auto restart” [ON] or the motherboard will expect that its power button is pushed. This is required since the IBPS DC-023 does not supply +5VSB when power is turned off to conserve battery power.

The off/on switch also controls an external signal on J1 pin 6 that can be used to turn an external system off or on. When “on”, the output signal is high. When “off” the output signal is low.

Firmware Setup LCD options:

“LCDOn, 1=on, [1,0-1],”

This allows the user to enable or disable the LCD screen.

The four following values are related to what is displayed on the screen.

“Cycle length, [25,2-50],”

The LCD display can has 3 different modes of information that it can display, but it can only display one mode at a time. To display all 3 modes, the LCD display runs in a loop or cycle. A cycle can be made up of 2 – 50 intervals of time. Each interval of time is about 0.5 seconds. Cycle length indicates how many intervals of time the display will run before resetting the cycle. The user will pick a cycle length based on how long they want the different screens to be displayed. Think of it as counting from 1 to the value in “Cycle Length” with half-second delays between each number. Once the cycle reaches the “Cycle Length” it starts the cycle over again.

“Disp 1, [1,1-50],”

“Disp 1” is the display that has the power and current that is leaving or entering the batteries (as shown in Figure 21 and 22). The value of “Disp 1” will indicate at what interval the LCD will display this mode. It will display this mode until the LCD display is told to display a different mode.

“Disp 2, [10,1-50],”

“Disp 2” is the display that shows the state of the batteries and time to complete discharge or charge (shown in Figure 23 and 24). The value of “Disp 2” will indicate at what interval the LCD will display this mode. It will display this mode until the LCD display is told to display a different mode.

Clear, [20,1-50],”

“Clear” is the display screen that indicates in text and via a graph, the average percent charge available in the battery packs and the number of battery packs attached to the controller (as shown in Figures 19 and 20). The value of “Clear” will indicate at what interval the LCD will display this mode. It will display this mode until the LCD display is told to display a different mode.

In the default mode, it will in the “Disp 1” mode until it changes to “Disp 2”. It will then be in “Disp 2” mode until it changes to “Clear”. It will stay in the “Clear” mode until the “Cycle Length” is reached. At this point the cycle will start over again.

The following are some examples of setup of the LCD and how it will behave.

Examples:

Cycle length, [20,2-50], new value:

Disp 1, [5,1-50], new value:

Disp 2, [10,1-50], new value:

Clear, [1,1-50], new value:

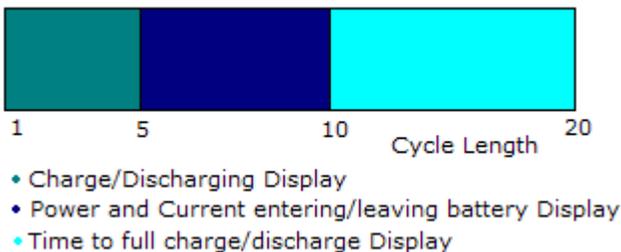
When the firmware is programmed as above the LCD will cycle through all three displays.

The length of the cycle is about 10 seconds (20 x 0.5 seconds).

"Clear" mode will be displayed for about 2 seconds ((5 - 1) x 0.5 seconds), at which point "Disp 1" mode will be displayed (when the count = 5).

"Disp 1" mode will then remain on for about 2.5 seconds ((10 - 5) x 0.5 seconds), at which point "Disp 2" will be displayed (when the count = 10).

"Disp 2" mode will then remain on for about 5 seconds ((20-10) x 0.5 seconds), at which point the cycle will start over (when the count = 20) and display "Clear" mode.



Cycle length, [2,2-50], new value:

Disp 1, [1,1-50], new value:

Disp 2, [25,1-50], new value:

Clear, [25,1-50], new value:

When the firmware is programmed as above the LCD will only display "Disp 1" mode (the Power and Current entering or leaving the battery as seen in Figures 21 or 22).

The length of the cycle is about 1 second (2 x 0.5 seconds).

"Disp 1" mode will be displayed for about 1 second, at which point the cycle will start over (when the count = 2) and display "Disp 1" mode. "Disp 2" and "Clear" never get displayed since the cycle resets once it gets to 2 and never reaches the values set in "Disp 2" and "Clear". Since "Disp 1" mode was turned on and no other mode over rode it, it will always be displayed.



1 Cycle Length 2

- Charge/Discharging Display
- Power and Current entering/leaving battery Display
- Time to full charge/discharge Display

Cycle length, [2,2-50], new value:

Disp 1, [25,1-50], new value:

Disp 2, [1,1-50], new value:

Clear, [25,1-50], new value:

When the firmware is programmed as above the LCD will only display "Disp 2" mode (the state of the batteries and the time to discharge or charge complete as seen in Figures 23 or 24). This is similar to the example above.



1 Cycle Length 2

- Charge/Discharging Display
- Power and Current entering/leaving battery Display
- Time to full charge/discharge Display

Cycle length, [2,2-50], new value:

Disp 1, [25,1-50], new value:

Disp 2, [25,1-50], new value:

Clear, [1,1-50], new value:

When the firmware is programmed as above the LCD will only display "Clear" mode (the charge or discharge display as shown in Figures 19 or 20, based on whether the batteries are charging or discharging). This is similar to the examples stated above.



1 Cycle Length 2

- Charge/Discharging Display
- Power and Current entering/leaving battery Display
- Time to full charge/discharge Display

Cycle length, [20,2-50], new value:

Disp 1, [10,1-50], new value:

Disp 2, [25,1-50], new value:

Clear, [1,1-50], new value:

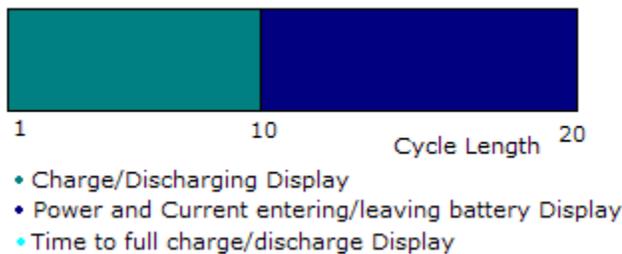
When the firmware is programmed as above the LCD will display "Clear" mode and "Disp 1" mode (screen Figures 19 or 20, and also Figures 21 or 22).

The length of the cycle is about 10 seconds (20 x 0.5 seconds).

"Clear" mode will be displayed for about 4.5 seconds ((10 - 1) x 0.5 seconds), at which point "Disp 1" mode will be displayed (when the count = 10).

"Disp 1" mode will then remain on for about 5 seconds ((20-10) x 0.5 seconds), at which point the cycle will start over (when the count = 20) and display "Clear" mode.

"Disp 2" mode will not be displayed since the cycle will reset at 20 and never reach the value in "Disp 2" (25).



"PIC Sleep, 1=yes, [0,0-1]"

This option allows the user to put the PIC to sleep. This is useful in applications where the system will be turned off for an extended period. Allowing the PIC to sleep while the system is turned off will conserve battery power.

If the controller was turned off via an off/on switch and is in sleep mode, then the controller will not respond to the break character. When in this mode, the switch must be turned on before the firmware will respond to the break character. When the PIC is in sleep mode, the controller will still continue to charge and discharge the batteries. See Hardware Manual for more information on connecting an off/on switch.

"Checksum on data, 1=yes, [1,0-1]"

This option turns on and off the checksum data when communicating to the host.

“Hold for off?, 1=yes, [1,0-1]”

This option allows for a delay on momentary switches to avoid a change in state if the switch is accidentally pushed. When set to 1 the momentary switch needs to be held for 2 seconds before the state of the momentary switch is honored. When set to 0 the state will change as soon as the momentary switch is hit.

“Message delay in 0.4 sec , [20,4-40]”

This option is how frequently the PIC will send information to the host. The smaller the number in “Message delay” the faster it will update the host.

“Shutdown when...”

Note that the shutdown conditions do not disconnect the batteries from the load. The controller will still supply battery power. When the shutdown conditions are satisfied the Battery controller module will change the state of the external on/off signal to “off” (J1 pin 6 = low). This can be used to turn off your system or disconnect your load. If a DC-023 module is attached to your battery controller, then the outputs of the DC-023 are turned off.

“Charge pcnt < x, 1=yes, [0,0-1]”

This option allows the IBPS to set the on/off signal to “off” if the charge of the batteries has reached less than x%. When set to 1, the firmware allows you to set the shutdown charge percentage.

Charge pcnt < x, 1=yes, [1,0-1], new value:

Percent To shut, [30,1-99], new value:

“Percent To shut, [30,1-99]”

This is only valid when the option to shutdown when charge pcnt <x has the value of 1. When the charge percentage gets below the “Percent To shut” value the IBPS will set the on/off signal to “off”.

“Min voltage reached, 1=yes, [0,0-1],”

This option allows the IBPS to set the on/off signal to “off” if the voltage drops below 12V at the load. The 12V is the voltage estimated at the load. The estimate is calculated based on the following formula:

Battery shutdown voltage = 12V + (Iout * .068) where Iout is the current being supplied by the batteries and .068 is a constant to estimate the voltage drop of the system.

As an example, if the system was drawing 2A, the on/off signal will be set to off when the system voltage equals 12.136V ($12 + (2 * .068)$).

“Min packcount, 1=yes, [0,0-1],”

This option allows the IBPS to set the on/off signal to “off” if the number of battery packs that are connected is equal to or less than the value in “# packs”

Min packcount, 1=yes, [1,0-1], new value:
packs, [2,1-7], new value:

“# packs, [2,1-7],”

This option is only valid when “Min packcount” has a value of 1. When the number of battery packs attached to the controller is equal to or less than “# packs” the IBPS will set the on/off signal to “off”

“Fully_disc set in packs, 1=yes, [0,0-1],”

This option allows the user to have the IBPS to set the on/off signal to “off” if the number of battery packs that are fully discharged is equal to the “# packs FD”

Fully_disc set in packs, 1=yes, [1,0-1], new value:
packs FD, [2,1-7], new value:

“# packs FD, [2,1-7],”

This option is only valid when “Fully_disc set in packs” has a value of 1. When the number of fully discharged battery packs attached to the controller is equal to or greater than “# packs FD” the IBPS will set the on/off signal to “off”

“Max bat current >x, 1=yes, [1,0-1]”

This option allows the IBPS to set the on/off signal to “off” if the “Max battery current” is above the value the user has specified in “Max battery current”.

Max battery current SD, 1=yes, [1,0-1], new value:
current, 0.1 amp, [60,20-60], new value:

“current, 0.1 amp, [60,20-60]”

This option is only valid when “Max battery current SD” has a value of 1. When the value of the battery current is greater than “Max battery current” the IBPS will set the on/off signal to “off”

"Total current >x, 1=yes, [1,0-1]"

This option allows the IBPS to set the on/off signal to "off" if the maximum current is above the number specified in "maximum current"

Total current SD, 1=yes, [1,0-1], new value:
current, amps, [32,6-32], new value:

"current, amps, [32,6-32]"

This option is only valid when "Total current SD" has a value of 1. When the value of the total current of the controller is greater than "maximum current" the IBPS will set the on/off signal to "off".

By selecting "B - Battery Status"

The Screen will show the battery status of the batteries that are connected to the controller.

=====
MP-04/08 V2.03
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- S - Setup Controller
- B - Battery Status
- X - Host HEX
- H - Help

->B

Battery:	(01)	(02)	(03)	(04)	(05)	(06)	(07)	(08)
Status:	00E0							
	. Fc							

Voltage	16.332	16.389	16.344	16.301	16.307	16.393	16.290	16.384
Current	-1.53	-1.12	-1.56	-1.56	-1.46	-1.32	-1.70	-1.56

Temp C	24.0	22.8	23.0	23.7	23.8	23.7	23.3	23.5
Charge%	100	100	100	100	100	100	100	100
Cap Ah	6.17	6.31	6.44	6.39	6.33	6.35	6.43	6.43

Current: -11.847 A, Power: 193.5 W
Voltage: 16.33 V -> 16.23 V
Avg Charge: 100%

** Discharging **

Runtime to empty: 257 min, 4.29 hours

=====

Example 2 Battery status screen

```
->B
1) Battery: | (01) (02) (03) (04) (05) (06) (07) (08)
2) Status: | 00E0 00E0 00E0 00E0 00E0 00E0 00E0 00E0
3)          | . Fc . Fc

4) Voltage | 16.332 16.389 16.344 16.301 16.307 16.393 16.290 16.384
5) Current | -1.53 -1.12 -1.56 -1.56 -1.46 -1.32 -1.70 -1.56

6) Temp C | 24.0 22.8 23.0 23.7 23.8 23.7 23.3 23.5
7) Charge% | 100 100 100 100 100 100 100 100
8) Cap Ah | 6.17 6.31 6.44 6.39 6.33 6.35 6.43 6.43

9) Current: -11.847 A, Power: 193.5 W
10) Voltage: 16.33 V -> 16.23 V
11) Avg Charge: 100%

12) ** Discharging **
13) Runtime to empty: 257 min, 4.29 hours
```

Line 1 identifies the battery.

Line 2 contains the value of the BatteryStatus register as defined by the Smart Battery Data Specification. See Smart Battery Data Specification for more information.

Line 3 identifies battery state, AC = charge power is present, Fc = fully charged, FD = fully discharged, NG = Power no good (power fault).

Line 4 is the voltage reported by the battery.

Line 5 is the current reported by the battery. A negative number indicates that the battery is discharging and a positive number indicates that the battery is charging.

Line 6 is the temperature in Celsius reported by the battery.

Line 7 is the charge percentage reported by the fuel gage in the battery.

Line 8 is the charge capacity in Amp-hrs.

Line 9 is the total current and power of all batteries listed. Power is computed using average voltage and total current.

Line 10 shows the average voltage as reported by the batteries followed by the estimated voltage seen at the load. The estimated voltage seen at the load is the value that is used when comparing to the "Shutdown voltage" parameter in the NVRAM settings. $V_{est.} = V_{average} - ((I_{average}) \times BatCable)$, where $I_{average}$ = total current divided by the number of batteries attached to the controller and BatCable = the value of the "Bat Cable offset" parameter. See the "Shutdown voltage" and "Bat Cable offset" parameters in the NVRAM setup section for more information.

Line 11 is the average charge of all of the batteries.

Line 12 indicates whether the batteries are charging or discharging. If line 12 is not present, then the batteries are just outputting a low current value.

Line 13 will give the run time to empty of the batteries listed based on the current usage when discharging. When the batteries are charging, this line will have the time to fully charge. Line 13 is only present when Line 12 is present.

By selecting "X - Host HEX", data for the host will be sent across the RS232 Com Port. If checksum is enabled, the checksum will follow each line after the "%". The checksum is an unsigned byte wide sum of every character value between the "\$" and the "%".

IBPS MP-04/08 V1.61

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S - Setup Controller
B - Battery Status
X - Host HEX
H - Help

->X

\$\$,01,270F,02,00,04,60%21
\$C1,01,FF,02,00,03,FF,04,00,05,00,06,00,07,00%72
\$B11,02,000A,01,0294,03,0080,08,0B94,09,4115,0A,FFEC,0B,FEC3%3D
\$B11,0C,000A,0D,0060,0E,0062,0F,1952,10,1A45,11,4B67,12,0519%33
\$B11,13,FFFF,14,0000,15,41A0,16,00E0,17,0022,18,19C8,19,3840%3C
\$B11,1A,0010,1B,2F56,1C,00B2%35
\$B12,10,1999,11,FFFF,12,0533,13,FFFF,14,0000,15,41A0,16,00E0%4B
\$B12,17,003B,18,19C8,19,3840,1A,0010,1B,2F56,1C,009A%34
\$B13,10,19A4,11,FFFF,12,03E0,13,FFFF,14,0000,15,41A0,16,00E0%4C
\$B13,17,0035,18,19C8,19,3840,1A,0010,1B,2F56,1C,009E%46

\$B14,10,197C,11,32E1,12,0433,13,FFFF,14,0000,15,41A0,16,00E0%4D
\$B14,17,0026,18,19C8,19,3840,1A,0010,1B,302F,1C,00CC%3F
\$B15,02,000A,01,0294,03,0000,08,0B90,09,4114,0A,0000,0B,FECB%43
\$B15,0C,0003,0D,0061,0E,0061,0F,193C,10,19CD,11,FFFF,12,04E6%43
\$B15,13,FFFF,14,0000,15,41A0,16,00E0,17,0030,18,19C8,19,3840%3B
\$B15,1A,0010,1B,2F31,1C,0097%4E
\$B16,10,1734,11,FFFF,12,0526,13,FFFF,14,0000,15,41A0,16,00E0%42
\$B16,17,001E,18,19C8,19,3840,1A,0010,1B,2F56,1C,009B%36
\$B17,10,19B0,11,FFFF,12,0445,13,FFFF,14,0000,15,41A0,16,00E0%3C
\$B17,17,0024,18,19C8,19,3840,1A,0010,1B,2F56,1C,00B7%4B
\$B18,10,19BF,11,4C77,12,049E,13,FFFF,14,0000,15,41A0,16,00E0%4F
\$B18,17,0029,18,19C8,19,3840,1A,0010,1B,2F56,1C,00B8%46

“\$S” indicates system data.

The value after 01 contains in Hex (16 bit unsigned), the minutes to empty. This value is meaningless if the batteries are charging.

The value after 02 is reserved.

The value after 03 (if present) is a text message to the system. Some example notes:

\$S, 03, "PIC Wakes"%41
\$S, 03, "Power ON (DC)"%28
\$S, 03, "Power OFF (DC)"%66
\$S, 03, "PIC Sleeps"%36

The value after 04 is the average charge percent in Hex.

“\$Cc” indicates controller data where “c” is the controller number as defined by the “This controller’s ID” parameter in the NVRAM. The controller data is set up as a bit mask where the LSB (on the right) correlates to battery 1 and the MSB correlates to battery 8.

The value after 01 indicates which batteries are present.

The value after 02 indicates which batteries are charging.

The value after 03 indicates which batteries are supplying power to the system.

The value after 04 is reserved.

The value after 05 indicates which batteries have charge power present.

The value after 06 indicates which batteries have “Power no good” status. If this status occurs all power to the controller needs to be removed to clear this error.

The value after 07 indicates which batteries are charge inhibited.

“\$Bcb” indicates battery data where “c” is the controller number the battery is connected to and “b” is battery number. The byte values correspond to register addresses followed by the value read from the register. The

registers are defined in the Smart Battery Data Specification. See the Smart Battery Data Specification for more information.

Customer Support

Send technical questions to: support@ocean-server.com

Or call us at 508-678-0550 during normal business hours.

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