BSMon

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Welcome to BSMon

In this section:

Introduction

BSMon is a powerful tool that supports users in monitoring the state of Blueshape® batteries.
This tool is intended for usage with all the Blueshape® V-Lock battery models.

The tool consists of a hardware interface called BSMon USB reader, a Computerized Battery Analyzer (called CBA) and a software utility.
Please verify how to connect the battery to the BSMon USB reader

With the software utility, it is possible to monitor the battery status such as pack residual capacity,

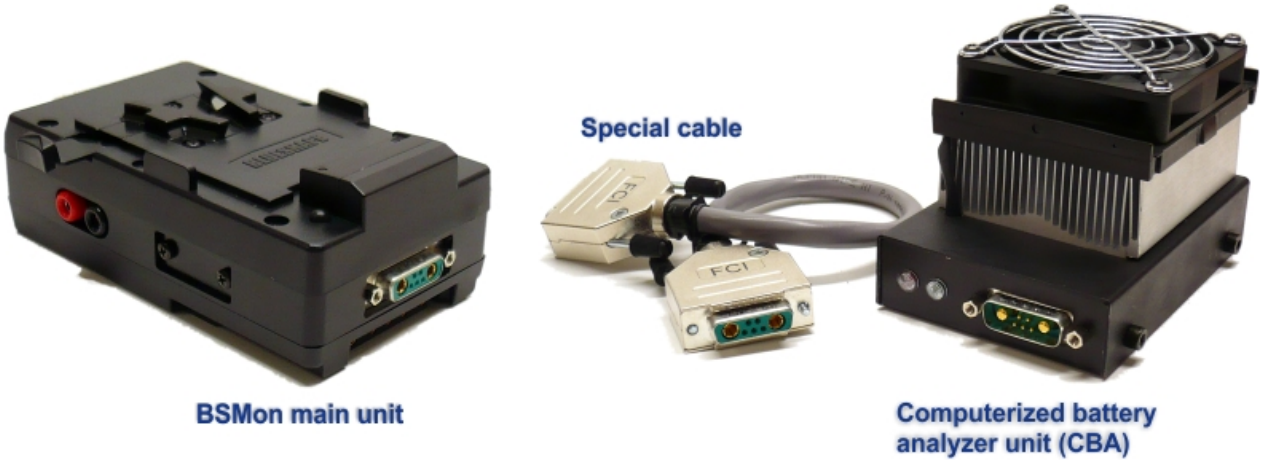
individual cell voltages, cell temperature, cycle count and several additional key parameters.
Through the additional CBA unit it is possible to discharge the pack at various load up to 10A, and measure the live performance.

This tool is designed for remote assistance. The battery status can be exported at any time to Blueshape® support service for battery pack analysis. On the other hand, our support service can prepare special settings when required that can easily be uploaded in the battery to customise its behaviour.

Through the chart utility it is possible to graphically monitor the battery behaviour in real time and perform battery tests with performance analysis. The logged data is accurate (±1mV, ±1mA) and can be used for extensive laboratory investigation of the battery.

System Requirements and description

System Description:



The system consists of these three main parts:

1. the BSMon main unit (interface between PC and Battery)
2. a special cable
3. the computerized battery analyzer (called CBA unit)

The main unit provides the USB connectivity with the PC and accepts the installation of the battery through a V-lock interface. It connects and drives the CBA unit by means of a special multicore cable.

Additionally the main unit can be used as a standalone battery reader and, if installed on any V-Lock enabled device together with a battery, permits tracking down the battery behaviour while in use.

BSMon can efficiently read and test both non-Blueshape® batteries and non V-Lock batteries: in this case a special cable with banana plugs must be used to connect the battery to be analyzed with the main unit through the lateral red and black sockets.

System requirements for software installation:

- OS: Windows 2000/ XP/ Vista/ 7/ 8 either 32bit and 64bit (the drivers for the USB interface may not work properly under older OS such as ME, 98, 95)
- Minimum configuration: Pentium 3 or higher, 128Mb RAM or greater, 25MB HD disk space
- USB 1.0 port or greater
- USB cable
- BSMon unit
- CBA unit (Computerized Battery Analyzer unit) with the special multicore cable

Installation

Follow the steps to understand how to correctly install and connect BSMon v3.0.

1. Get the special multicore cable and connect it to the BSMon unit and to the CBA unit, matching the proper side.

2. Be sure to tighten the screws to lock the cable for power and signal consistency.

3. At this point plug the USB cable into the USB socket of the main unit and connect the other end to the PC: the system will auto detect the interface and will automatically load the proper drivers in the system.

4. The green LED on the CBA unit will turn on to confirm that the unit is properly connected

5. After the system is installed, the battery can be installed on the V-Lock interface of the BSMon unit.

6. In case there is need to test a non V-lock battery, get a proper cable ending with banana plugs on one end, and with proper terminals on the other for connecting with the battery terminals. Connect it to the BSMon unit to start reading. As for the cable length, shorter is better.

To troubleshoot connection problems, please refer to this section

Only the second generation of Blueshape® batteries can be analyzed with this version of BSMon. Read here to understand how to recognize the battery version

Battery version

This version of BSMon is capable of reading only second generation batteries.

To understand the battery version follow the battery serial number written on the back sticker as shown in figure:

Depending on the value of Part 2 and Part 1, the version of the battery can be determined according to the table below:

First Generation	Second Generation
Part 2: **05** Part 1: any	Part 2: **06** Part 1: greater than 40
Part 2: **06** Part 1: up to 40	Part 2: greater than **06** Part 1: any

Support

For support please contact the Blueshape® support team on the following numbers:

Tel: +39-0522-518556

Fax +39-0522-277084

Additionally, you can contact us by email or visit our website to retrieve additional information

Battery Monitor

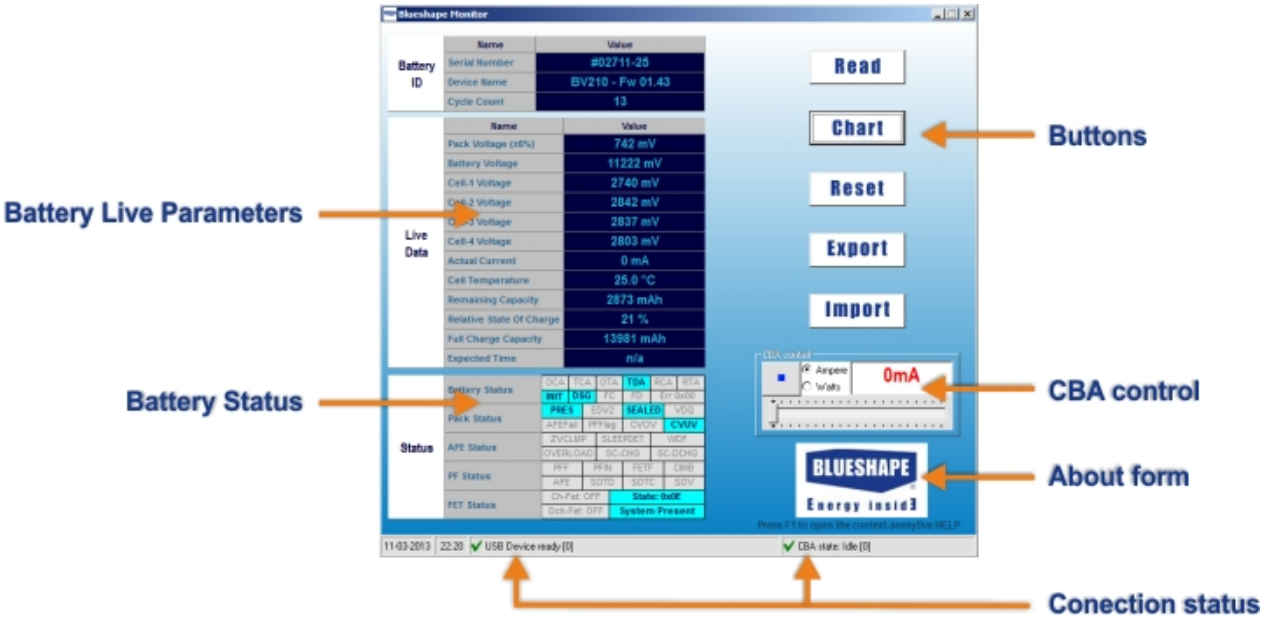
In this section:

Main Form
explains the usage of the functions available on the main form.

Troubleshooting
explains the causes of the most frequent problems.

Software update

Main Form



On the main form, there are 5 different sections:

Battery Live Parameters

displays the main battery information as they are retrieved in real time from the battery

Battery Status Information

displays several status bits and their meanings as they are retrieved in real time from the battery

Buttons

in this area there are the five buttons required for operation

CBA Control

in this area there are the five buttons required for operation

Connection Status

in the status bar, the connection status is displayed in real time

About Form

when the Logo is clicked, the 'about' form pops up

Battery Live Parameters

Once the Read button is pressed, the following parameters are cyclically read from the battery.
Not all parameters are read continuously, but only those subject to change with higher frequency are kept fresh.

Battery ID:

Serial Number	#00686-07

shows the serial number of the pack. This number is written in the pack at production time and identifies a unique pack in that productive year. A reference to this number can be found in the sticker on the bottom of the pack.

Device Name	BV100 - Fw 01.40

the device name is the nickname of each model, followed by the firmware revision number. This information, though apparently useless to the user may be significantly important to the Blueshape® support team.

Cycle Count	3

the cycle counter reads how many times, a certain amount of capacity has been removed from the battery. This counter is incremented every time the 80% of pack nominal capacity is removed from the battery, even if a charge cycle occurs in between two different discharge cycles. This information can be useful in determining the age of the battery pack.

Live Data:

Pack Voltage (±6%)	742 mV
Battery Voltage	11222 mV

displays the total voltage of the internal stack of batteries (4 batteries connected in series); this value is calibrated and has a precision of ±1mV.

The pack voltage is also shown: this value is not calibrated (has an error of ±6% and can fluctuate) and represents the voltage read at the pack terminals. In some particular cases, this value can be very low, in the order of few millivolts. In these cases the battery's discharge protection has been activated and this disables the reading of pack voltage at the terminals.

Cell-1 Voltage	4172 mV
Cell-2 Voltage	4163 mV
Cell-3 Voltage	4163 mV
Cell-4 Voltage	4157 mV

displays the single cell voltage of each of the 4 cells that make the battery's internal stack; this value is calibrated and has a precision of ±1mV.

The voltage of each cell normally ranges from a maximum of 4250mV to a minimum of 2700mV.
Other values, lower than this range are possible in cases of deeply discharged batteries. However, higher values are not possible since safety protections prevent the single cell voltage from rising beyond this level.

shows the actual charging or discharging current flowing in (positive) or out (negative) from the battery. This value is calibrated and has a precision of ±1mA. In case of a discharge current, the instant watt is also displayed

this is the actual internal temperature of the pack measured at the middle of the cell stack. All the safety protections implemented inside the battery refer to this temperature for their functionality.

shows the available capacity accumulated inside the battery pack, expressed in mAh. This value decreases down to 0 mAh during discharge and increases during charge up to the max value allowed (Full Charge Capacity).

is the ratio between Remaining Capacity and Full charge Capacity. This is the value represented by the 5 LEDs when the LED button on the battery pack is pressed.

shows the capacity of the pack when in full charge state. This value is "learned" by the battery management system during the initial testing on the production lines, and is kept updated automatically during pack life.
Initially, the full-charge capacity may differ slightly (in excess or in defect) from the nominal capacity, but It should be expected that this value slowly decreases through ageing due to the permanent loss of capacity that steadily occurs from each charge/discharge cycle.

shows the expected time to empty (in case of discharge) or the expected time to full (in case of charge) in minutes.
The amount of time is calculated at run time based on the average current handled by the battery in the last 60 seconds. Note that the data shown may vary rapidly until the current stabilizes.
When the battery is idle, this information is not available.

Battery Status Info

Below the Battery Live Parameters, several status bits are cyclically read from the battery whenever the Read button is pressed,:

Battery Status:	OCA	TCA	OTA	TDA	RCA	RTA
	INIT	DSG	FC	FD	Err 0x00	

gives some information about some states and errors. Each bit is set ON when higlighted, OFF when grayed.

- OCA, Overcharge Alarm: if set, means that the battery is being charged beyond the maximum programmed overcharge limit
- TCA, Terminate Charge Alarm: if set, means that the battery has detected a primary charge termination
- OTA, Overtemperature alarm: if set, means that the battery temperature has reached the programmed Overtemperature threshold (typically 60°C both in charge and discharge)
- TDA, Terminate Discharge Alarm: if set, means that remaining capacity is 0, or the cell Voltage is less than the programmed Terminate Voltage level (12000mV) or at least one of the single cell has dropped below the programmed Cell Undervoltage protection level (2800mV)
- RCA, Remaining Capacity Alarm: if set, means that the remaining capacity is less than the programmed value set at 8% of the nominal capacity.
- RTA, Remaining Time Alarm. if set, means that the estimated remaining time at the present discharge rate is less than the set threshold (10 minutes)
- INIT, Initialised: if set, means that the microcontroller is correctly initialised
- DSG, Discharging: if set, means that the battery is not being charged
- FC, Fully Charged: if set, means that the battery has detected a primary charge termination or an Overcharge condition.
- FD, Fully Discharged: if set, means that the Relative State of Charge has reached the "Battery Low" level, programmed at 8%. Reaching this level makes the LEDs flash when the LED button is pressed.
- ERR, Error Codes: show some possible internal errors, if different than 0x00

Pack Status:	PRES	EDV2	SEALED	VDQ
	AFEFail	PFFlag	CVOV	CVUV

gives some information about Pack status bits. Each bit is set (ON) when higlighted, OFF when grayed.

- PRES: with our current settings this bit should always be set
- EDV2: if set, means that the internal cell stack voltage has reached the EDV2 voltage threshold that corresponds to the "Battery Low" remaining cpacity (programmed at 8%). This voltage level is compensated and calculated automatically based on the discharge conditions, such as instant current, cell temperature and cells internal impedance.
- SEALED: if set, means that the parameters of the battery are sealed and cannot be accessed for read/write.
- VDQ, Valid Discharge Qualified: the current or next discharge cycle is valid for an update of the Full Charge Capacity.
- AFEFail: if set, means that communication between the microcontrollers of the chipset have failed.
- PFFlag: if set, means that the Permanent failure flag has been set; with our current settings this bit should never be set.
- CVOV, Cell Over Voltage: if set, means that a protection limit has been exceeded including prolonged Overcurrent, Overvoltage, or Overtemperature conditions. The bit is not latched and merely reflects the present fault status.
- CVUV, Cell Under Voltage: if set, means that a protection limit has been exceeded including overload or overdischarge conditions. The bit is not latched and merely reflects the present fault status.

AFE Status:	ZVCLMP	SLEEPDET	WDF
	OVERLOAD	SC-CHG	SC-DCHG

gives some informations about the status of the safety IC chip - also called Analog Front End (AFE). Each bit is set ON when higlighted, OFF when grayed.

- ZVCLMP: with our current settings this bit should always be grayed
- SLEEPDET: if set, indicates that the safety IC chip is set in low power mode (also called sleep mode).
- WDF, watchdog fault: if set indicates that a fault has been detected in the oscillator signal inside the chipset.
- OVERLOAD: if set, means that an overload condition is detected (thus a current greater than the programmed threshold) and the related safety protection are activated.
- SC-CHG, Short-Circuit in Charge: if set, means that a short circuit in charge direction has been detected and the related safety protections is activated.
- SC-DCHG, Short-Circuit in Discharge: if set, means that a short circuit in discharge direction has been detected and the related safety protection is activated.

PF Status:	PFF	PFIN	FETF	CIMB
	AFE	SOTD	SOTC	SOV

gives some information about the status of the Permanent Failure register that keeps track of critical errors. Each bit is set ON when higlighted, OFF when grayed.

- PFF: with our current settings this bit should always remain gray.
- PFIN: with our current settings this bit should always remain gray.
- FETF: if set, this indicates a FET or FET driver failure occurred.
- CIMB: if set, this indicates that a severe cell imbalance occurred during charging.
- AFE: if set, this indicates that an AFE integrity fault state occurred meaning that the settings of the safety IC chip may not be consistent.
- SOTD: if set, this indicates a safety overtemperature in discharge occurred.
- SOTC: if set, this indicates a safety overtemperature in charge occurred.
- SOV: if set, this indicates a safety overvoltage occurred.

MosFET Status:	Ch-Fet: ON	State: 0x07
	Dch-Fet: ON	Charge Terminate

gives some informations about the mosFET status.

- Ch-FET: shows the status of the FET that enables/disables charge current. If ON, charge is allowed. If OFF, charge is not allowed as a consequence of a safety protection condition. In case of cells with very low voltage, the normal fast charge is not allowed to avoid damaging cells: charge FET is set to OFF, but a special precharge path is allowed with very low currents (in the order of almost 20mA). In this special case the State indicator will show "precharge".
- Dch-FET: shows the status of the FET that enables/disables discharge current. If ON, discharge is allowed; if OFF discharge is not allowed as a consequence of a safety protection condition.
- State: displays numerical and alphabetical description of the current battery state

Buttons

Each button performs an action.

The read button, when enabled, permits cyclic reading of the battery parameters and status bits. Depending on the speed of the PC, the refresh rate should be approximately 1 second.
When cyclically reading data from the battery, the relevant battery information is logged and stored for charting purposes. Previously logged data, if existing, is overwritten by the new data unless the Shift button is pressed together with this button. In this case, the most recent logged data is held and appended.
When Read is started, the caption turns to Stop: when Stop is pressed, the read action is ended and the last values read are retained and displayed.
If the Read button is disabled (grayed), it means that there is no communication with the battery. Please refer to the troubleshooting section.

By pressing this button the Chart Viewer is launched. The charts are available when at least 2 samples are read from the battery. If not, this button is disabled (grayed).
If BSMon is reading data from the battery, the chart will show real time data.
If BSMon is not reading from the battery, the chart is available only if the previous read had collected enough data. In this case the chart will show the last data logged from the battery.

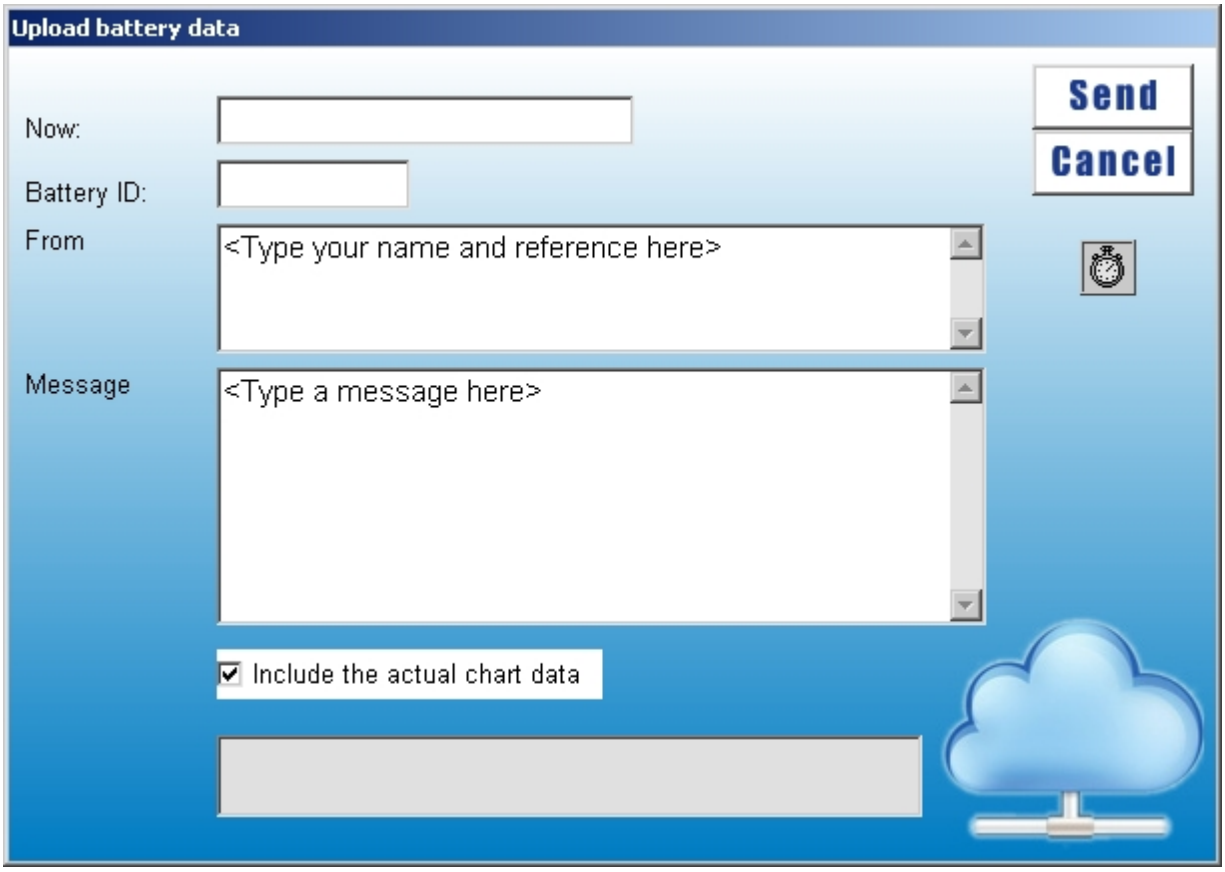
This button will reset the battery.
By resetting the battery, the entire chipset will be forced to reload all the software and the programmed parameters.
This action is normally not necessary but could be helpful if a very critical condition occurs.
On resetting, the remaining capacity is zeroed (naturally, the battery will still hold its real capacity...), and recalculated as soon as possible (normally within 1 minute) by a performance of an estimation based on the cell stack voltage. The result of this self compensation is a Remaining State of Charge set either at 25%, 50% or 75%, depending on voltage.
The misalignment between the real capacity and the estimated capacity calculated in this way will not pose a problem since the battery will re-calibrate and re-align the remaining state of charge with the full state of charge each time upon reaching full charge or full discharge.

This button allows the battery to send information to Blueshape® support team by email.
When clicked, the entire parameter table of the battery and additional real time data are downloaded from the battery within a few seconds and the Export form is displayed for uploading battery data to our servers.

With this button it is possible to re-program the battery by uploading special settings.
When clicked, the Import form is displayed.

Export Battery data

Through this function it is possible to share battery data with Blueshape® customer support service.
Please note that to operate this, an internet connectivity is required .



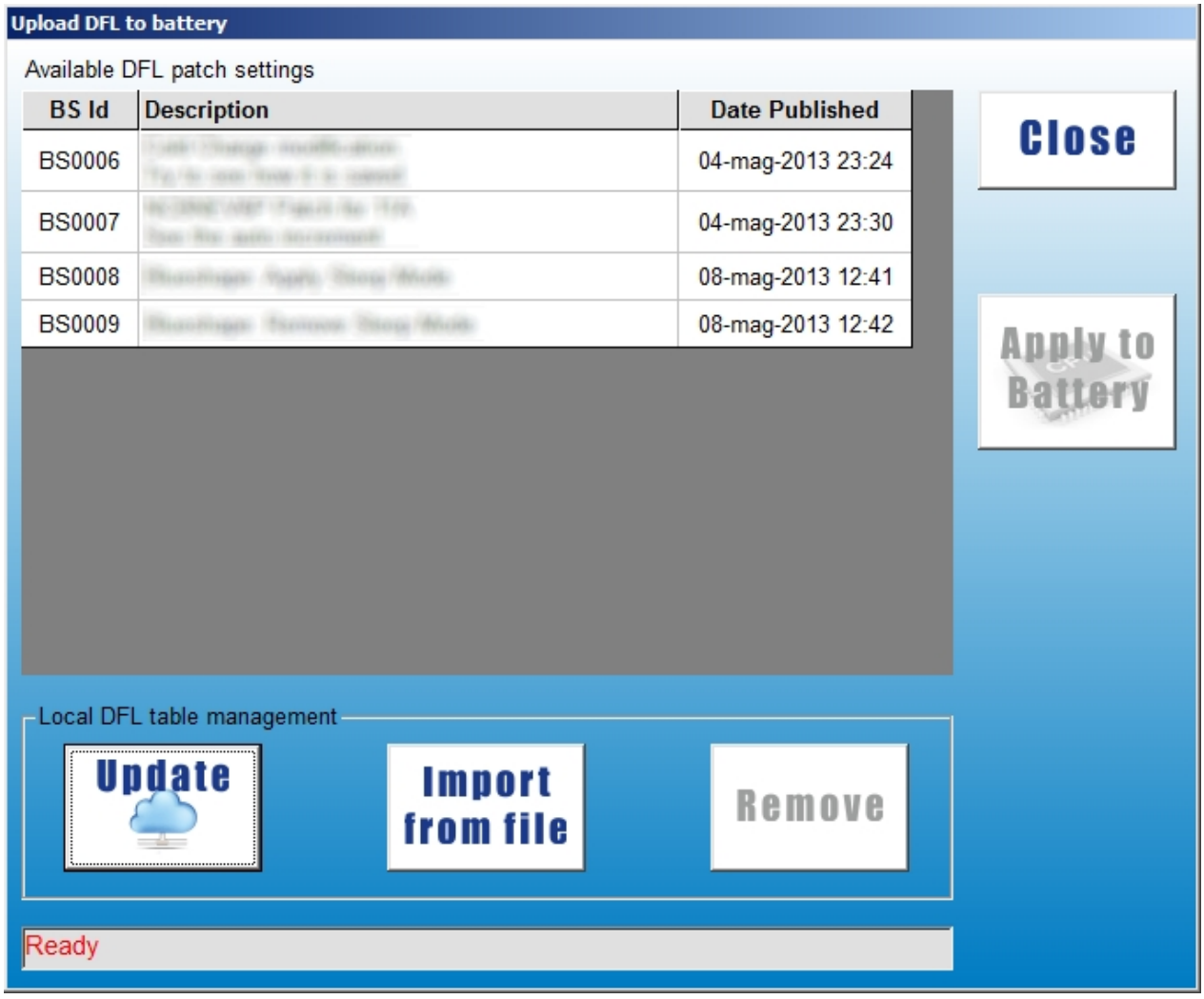
On launching this function, the battery data is captured and packed in a special message together with the full datalog saved so far (if the checkbox is selected). Please note that this operation may last up to 30 seconds

The user is also requested to leave a message to be integrated with the data sent, for better reference.

Finally, by pressing the Send button, the message is sent and the form is closed

Import settings to Battery

Through this function it is possible to modify the battery settings by reprogramming some parameters in the firmware through special patches, called DFL settings.



The main table displays the collection of DFL settings installed locally and available for uploading to Blueshape® batteries.
Only the DFL settings existing in this local table can be used with batteries.

There are two possibilities for collecting DFL settings:

- Downloading from Blueshape®, through online cloud services
- Importing from DFL files

The first time this function is used, it is necessary to populate the local table by downloading all the available DFL settings. This function is achieved by clicking the button "UPDATE": new data are retrieved and saved locally, if available.
It is also suggesteable to refresh and update the local table from time to time, to have always all the latest DFL settings available.

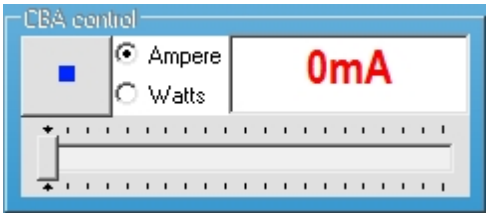
It is a task of our support service to prepare and publish new DFL settings when needed.

In case a special customized setting is needed, because not available among those published online, it is possible to send a request to our customer service and have it done by purpose. Only in this case, it is necessary to upload the received DFL file it in the local collection by pressing the "IMPORT FROM FILE" button, and follow the instructions.

The local DFL table can be further managed by removing settings no more needed, just by selecting the desired row and clicking the "REMOVE" button.

To apply a DFL patch and modify some parameters in the battery firmware, just select the desired patch from the table and click the "APPLY TO BATTERY" button:
the battery is temporarily halted when the new data is being uploaded (it may take up to 20 seconds), and must not be disconnected during this time.
At the end of this operation may be necessary to reset the battery to allow the modified settings to take effect.

CBA control



The CBA control frame allows the control the CBA unit. By operating this control, a load will be instantly set to discharge the battery.

The CBA control is enabled only when a READ session is started and is disabled when the session is stopped.

It consists of:

- a slider, to selected and vary the load
- a stop button
- an option button to switch the load scale between Ampere an Watt
- a display to show the selected load

The slider moves between zero and the max load, tipically 10000mA or 150W: on moving the slider, the display is updated but the load starts only when the mouse button is released.

The red LED on the CBA unit lights on to indicate that the discharge session started, and the fan embedded in the CBA unit start to spin silently.

The discharge current is software and electronically regulated using a solid state switch and fan cooled electronic load, and it is automatically kept constant during the whole test. If the option button is changed between Ampere and Watt, the actual load is converted and shown and the slider scale is changed. However, the load applied to the battery is not affected.

The load can be cleared and the discharge interrupted in three possible ways:

- by the user, when pressing the stop button in the control frame: the read session continues, but the load is cleared
- by the user, when pressing the STOP button to terminate the read session
- by the system, when the minimum battery voltage is reached or when an automatic temperature, current or power protection occur in the CBA unit

Connection status

The bottom border of the main form shows the actual connection status.

Left side: BSMon status

this section provides information about the status of the communication between PC and BSMon:

- when the communication is active, a green mark will appear citing number 0 in square brackets

- If the communication is not good, a red mark will notify it, and a related error message and number will explain the reason.
  The following are the most probable error conditions:

  means that during start-up of BSMon, the USB device had not been detected by the PC

means that the PC could not detect the USB device (BSMon) properly

means that the USB device (BSMon) is no longer responding to the PC

means that the battery is not responding or not properly connected to the USB device (BSMon)

Right side: CBA status

- a red mark means that the CBA Unit is disconnected and not communicating
- a green mark means that CBA load is connected properly. In this case, additional status information are provided in bracket:
  - 0: the unit is idle
  - 1: the load is working, a test is running
  - 2: the test terminated naturally, the battery low voltage limit has been reached
  - 3: the test halted because the CBA unit overheated
  - 4: the test halted because terminated by the user or by other event (i.e. sudden battery cut-off)
  - 5: the unit is executing a command and is temporarily unavailable

To understand how to connect the battery, please refer to the Installation section.

To troubleshoot connection problem, refer to the Troubleshooting section.

Troubleshooting

In this section:

Battery problems
explains how to work around battery related problems.

Communication problems
explains how to work around the most common communication problems.

Battery problems

Battery problems have to be evaluated depending on their specific characteristics.

- The battery does not accept any charge.
  This means that a charge safety protection has been activated, and the related MOSFET should be turned OFF.
  Several reasons could justify this:
  - Overvoltage
  - Overtemperature
  - Undertemperature
  - Charge Overcurrent
- The battery does not allow any discharge.
  This means that a discharge safety protection has been activated, and the related MOSFET should be turned OFF..
  Several reasons could justify this:
  - Undervoltage
  - Overtemperature
  - Discharge Overcurrent
  - Overload

Generally, many of the battery problems can simply be solved by applying a Reset.

However, due to the complexity of the scenario, it is advisable to contact Blueshape support team.

Communication problems

Communication problems can be divided into two sections:

- PC to USB device/BSMon (USB communication problem).
  This type of problem can be caused by a system failure or wrong installation of the drivers. If the installation had been successful, the simplest way to tackle this problem would be to close BSMon and disconnect the USB cable. Eventually, wait for a few seconds and then plug back the USB cable to allow the system to detect the peripheral. Following this, once again launch BSmon.

If the above does not solve the problem, please contact Blueshape® support team.

- BSMon to battery (battery communication problem).
  This type of problem refers to the inability of BSMon to communicate with the battery. Several causes are possible:
  - Older versions: the connection with the reader is not consistent - try fixing it and keeping it stable perhaps with the help of some aid, like rubber bands or similar.
  - Older versions: the golden pads underneath the battery sticker or the golden pins of the reader are dirty - use contact cleaners, like Isopropanol, to ensure a good and stable contact.
  - Older versions: the D-sub connector of the reader is not firmly attached - fix it properly
  - All versions: the battery is not correctly plugged in the V-Lock adapter - lock it firmly.
  - All versions: the battery is in low power mode and cannot communicate - quit the low power mode by charging the battery for just a few minutes.

  If these workarounds do not solve the problem, kindly contact Blueshape® support team.

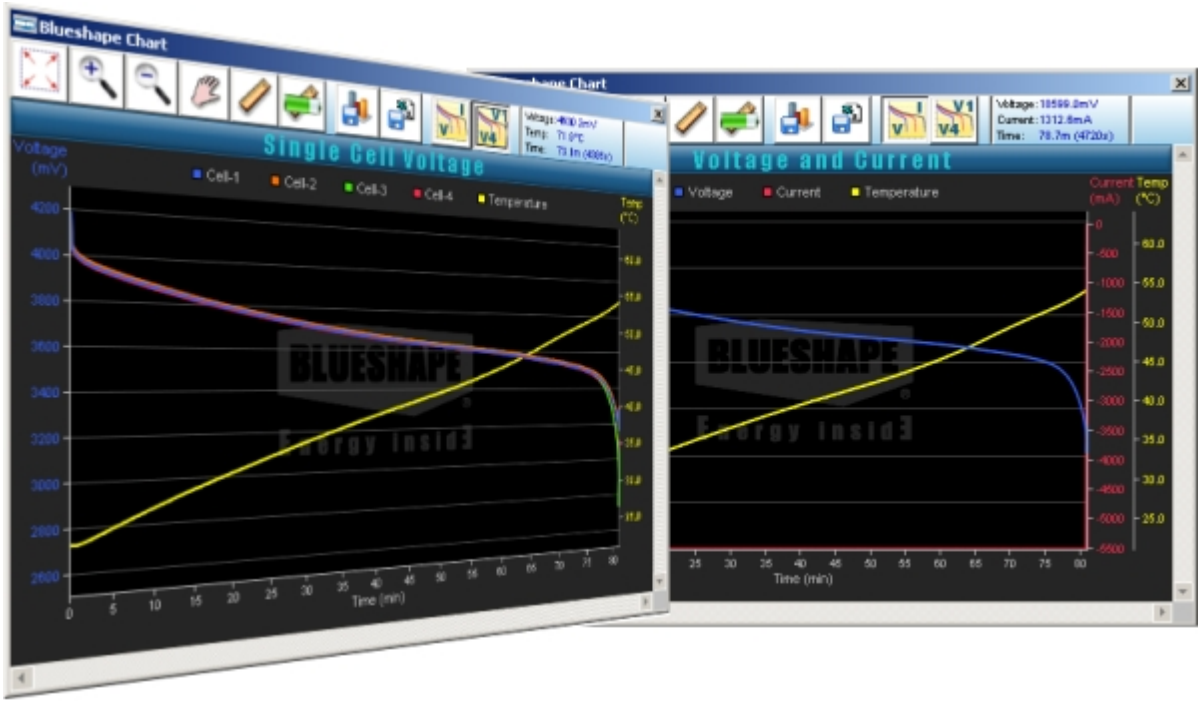
Software Update

By opening the 'about form', a link for updating the software appears at the bottom.

By clicking on it, the software version is examined online (the system needs to be connected to the internet); if an update is available, the user is asked to download it.

It is advisable to check for software updates on a regular basis.

Chart Viewer



In this section:

Introduction

The chart viewer supports the battery analysis, graphically showing the values logged from the battery with high accuracy (±1mV, ±1mA, ±0.1C).

During data logging (started by pressing the Read button) the charts will be dynamic, showing real time data as retrieved from the battery each second.
When the battery is not being read or is not connected, the chart will be available only if the previous readings had processed enough data. In this case, the chart will be static.

Not all the parameters are of interest to display graphically, so only two types of charts will be displayed:

- Voltage and Current:-displays Battery Voltage, Actual Current and Cell Temperature against a time scale
- Single Cell Voltages:-displays Single Cell Voltages and Cell Temperature against a time scale

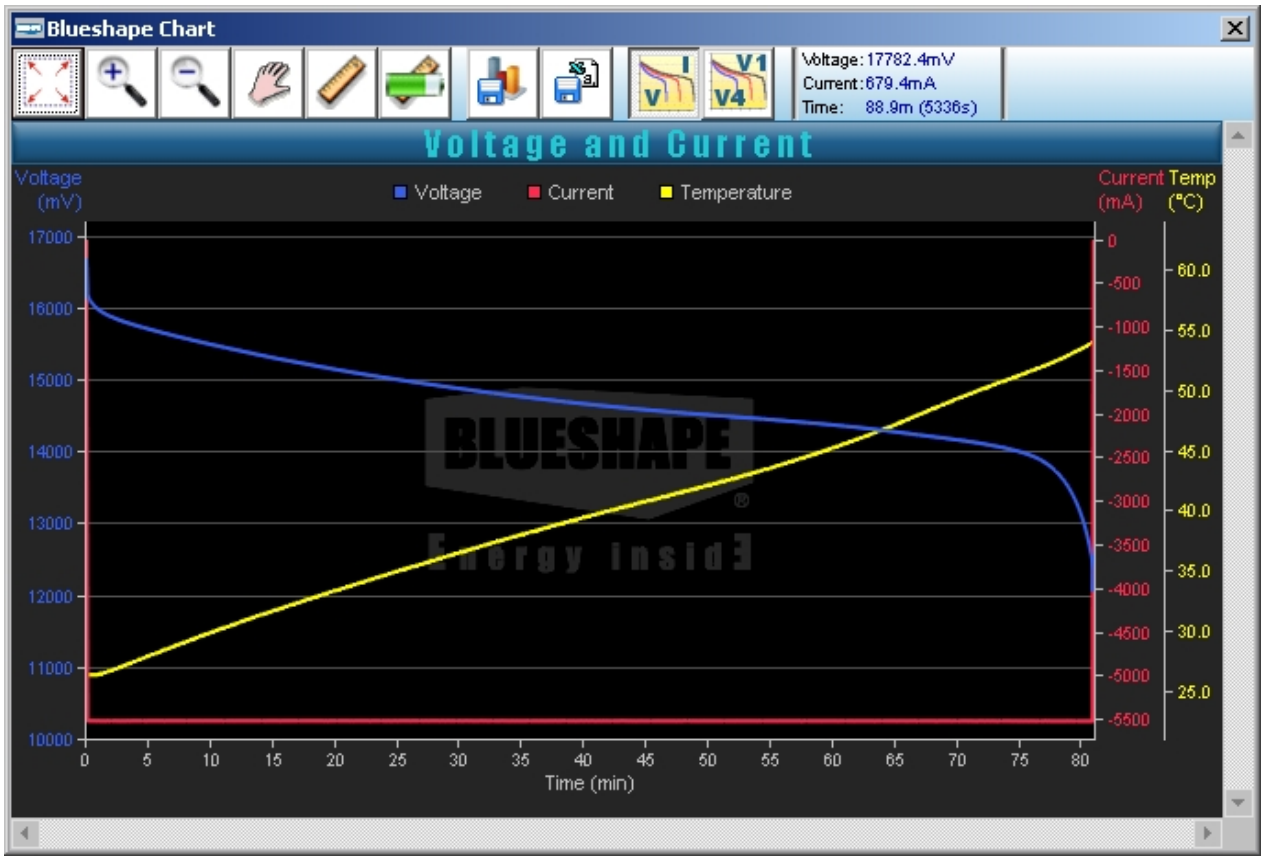
When launched by clicking on the Chart button, the chart viewer will open in a new window allowing better screen management. The user can keep it in foreground as well as sending it to the background, or close it temporarily. Actually, the chart viewer can be opened and closed without any loss of data because data is retained and logged by BSMon independently. Each time it is opened, it shows the entire data logged so far.

Using a load connected to the BSMon USB reader through the banana sockets available on the side panel, or installing the BSMon directly on a device (camcorder or charger) makes it possible to analyse the battery

behaviour during operation.

Voltage and Current

The Voltage and Current chart displays the actual battery voltage and actual charge or discharge currents (with the cell temperature) on a time scale.



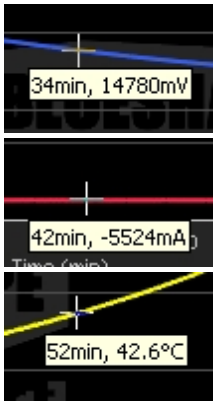
The chart is autoscaled to show all the possible information in one window, scaling automatically from seconds to minutes as logged data accumulates.

The Voltage series shows the Battery Voltage: it is displayed in blue and uses the scale on the left hand side of the chart, that is set automatically from 10000mV to 17000mV.

The Current series shows the Actual Current: it is displayed in red and uses the scale on the right hand side of the chart, that is changed automatically depending on the variety in the data shown. Positive values (charging currents) are plotted above the zero; negative values (discharging currents) below

The Temperature series shows the Cell Temperature: it is displayed in yellow and uses the rightmost scale, that is also changed automatically depending on the data shown.

Chart hot spot:

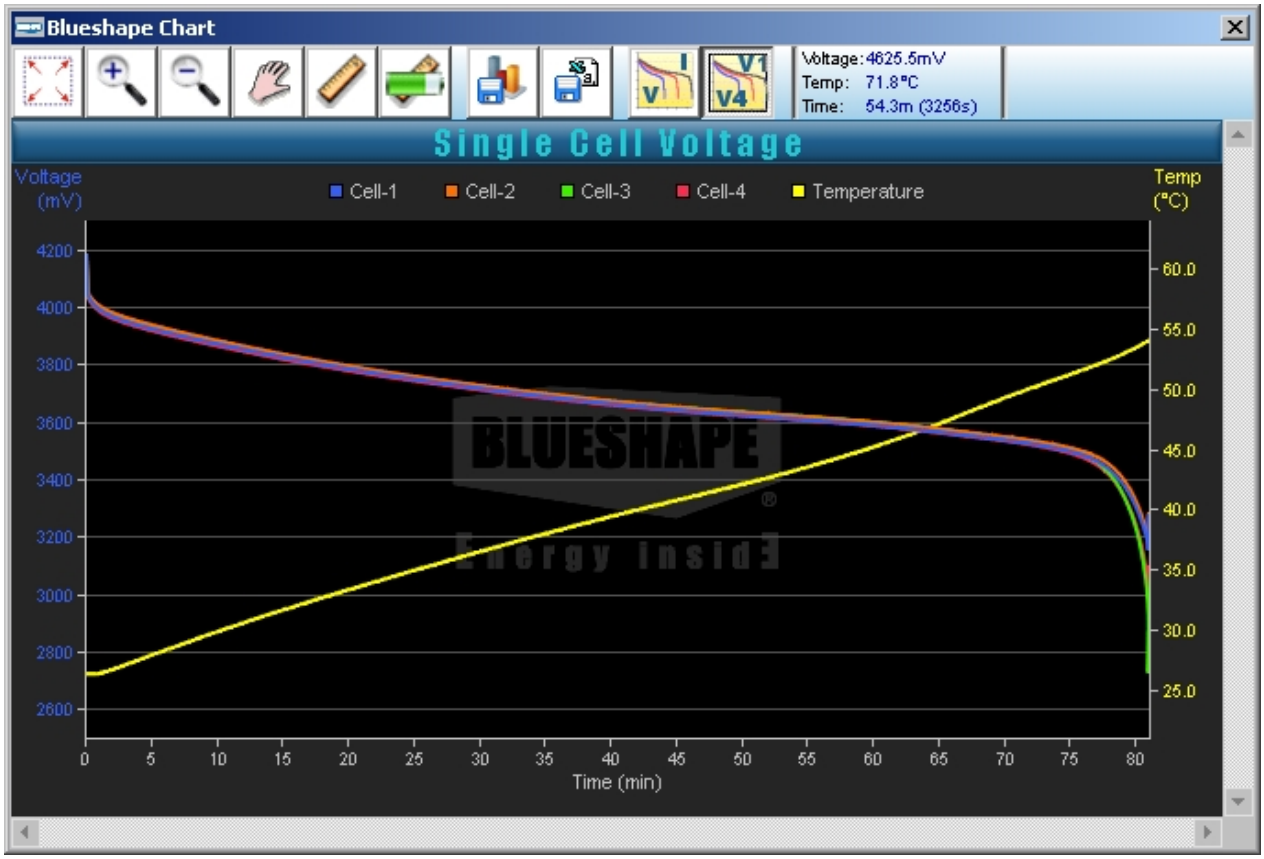


When the mouse moves over a "hotspot" (a chart element that holds relevant information, typically a data series), the pointer changes automatically to a white cross and if the mouse stops over it for a while, the coordinates of that data-point underneath the mouse pops-up.
This functionality is available for each data series, and can help to read the value represented by the selected data point.

Other tools are available to get additional information, analyse data and manipulate the chart.

Single Cell Voltage

The Single Cell Voltage chart display the actual voltage of each of the 4 cells that makes the internal stack of batteries, and the cell temperature on a time scale.

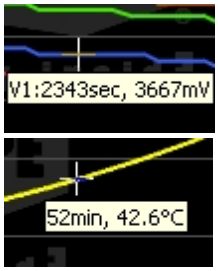


The chart is autoscaled to show all the possible information in one windows, scaling automatically from seconds to minutes as logged data increases.

The Voltage of each single cell is displayed on a different data series painted using different color (blue, orange, green, red) to better distinguish one series from the others. The scale on the left hand side of the chart is set automatically from 2600mV to 4200mV.

The Temperature series shows the Cell Temperature: it is displayed in yellow and uses the scale on the right hand side of the chart, that is changed automatically depending on the data shown.

Chart hot spot:



When the mouse moves over a "hotspot" (a chart element that holds relevant informations, typically a data series), the pointer changes automatically to a white cross and if the mouse stops over it for a while, the coordinates of that data point underneath the mouse pops-up.
This functionality is available for every data series, and can help to read the value represented by the selected data point.

Other tools are available to get additional information, analyse data and manipulate the chart.

Chart Viewer tools

On the top side of the chart viewer form, there is a toolbar that contains several buttons. It also displays additional chart information and allows a good interaction with the chart.

Autoscale

By pressing this button, the chart is re-arranged to show all the data available. The X axis is autoscaled to seconds or minutes (depending on the extension of the logged data).
Depending on the chart, the Y axes are re-scaled as follows:

- Voltage and Current chart:
  - the voltage axis is re-scaled from 10000mV to 17000mV
  - the current axis and the temperature axis are re-scaled to display all the points available on the chart
- Single Cell Voltage chart:
  - the voltage axis is re-scaled from 2600mV to 4200mV
  - the temperature axis is re-scaled to display all the points available on the chart

Zoom In

This button allows magnification of the chart areas.
Learn how to use it

Zoom Out

This button allows reduction of the chart areas.
Learn how to use it

Scroll

This button allows scrolling a magnified chart horizontally and / or vertically.
Learn how to use it

Ruler

This button allows measurement of chart areas.
Learn how to use it

Capacity Ruler

This button allows measurement of the charge/discharge capacity related to a selected chart area.
Learn how to use it

Export chart

This button allows exporting an image of the actual chart in GIF format (Graphics Interchange Format).

Export data

This button allows export of all the data logged in CSV format (Comma Separated Value). CSV file is a special text file format that allows easy data exchange between applications such as spreadsheets and databases.

Chart selector

These buttons allow switching between the two charts available, Voltage and Current chart and Single Cell Voltage chart.

Mouse tracking

When the mouse pointer moves over the chart area, the coordinate indicator box on the top right will show the actual mouse coordinates. Depending on the chart selected, the data is expressed as Voltage (mV), Current(mA), Temperature (°C) and Time(minutes and seconds).

Dynamic chart indicator

If the chart shows dynamic data, the sampling indicator will flash every second to indicate the real time activity. At the same frequency the chart is also refreshed. In case of the static chart, this indicator will be disabled and hidden.

Zoom In/Out

Through zooming, the user can inspect the chart areas and increase or reduce details.

The Zoom tool is selected from 2 buttons located on the toolbar of the chart viewer form.

When selected, the mouse pointer changes to a magnifier with the "+" or "-" sign indicating the action performed:

Zoom In

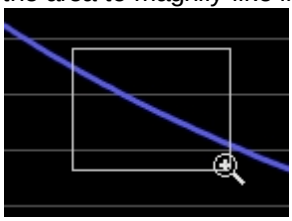
the Zoom-In tool can be operated in two ways

1. by clicking on the chart: when the tool is selected and the user clicks on the chart:
   - the chart is re-centered on that point
   - the chart is magnified by 20%

   To further magnify the chart, the operation can be repeated up to the desired level.

2. by clicking and draging to draw a rectangle over a chart area

by clicking and dragging, a rectangle called marquee is drawn around the area to magnify like in the picture below:



when the mouse is released the entire chart is re-scaled to automatically show only the selected area. Repeat this operation to reach the desired level of resolution.

When the level of detail is increased, the extension of the time scale (X axis) is reduced accordingly.

Zoom Out

the Zoom-Out tool is operated only by clicking on the chart.
By doing so:

- the chart is re-centered at that point
- the view is reduced by 20%

To further reduce the magnification level of the chart, the operation can be repeated up to the desired level.
When the level of detail is increased, the extension of the time scale (X axis) is increased accordingly.

Scroll

With the Scroll tool, the user can move the current chart viewport both vertically and/or horizontally.

The Scroll tool is selected through a button located on the toolbar of the chart viewer form:

When selected and the mouse is clicked on the chart area, the mouse pointer changes to a "4-arrow" indicating the action performed:

This tool operates in a "drag-and-drop" mode: just keep the mouse clicked-down, move the mouse around to scroll the viewport as desired and drag to terminate the action.

During dragging, the chart is automatically refreshed.

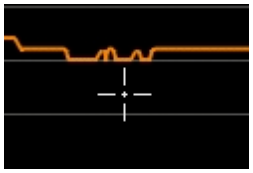
Please note that when scrolling horizontally, the time scale (X axis) can never go negative.

Ruler

With the Ruler tool, the user can easily measure distances, amplitudes, intervals and other relevant parameters on the chart.

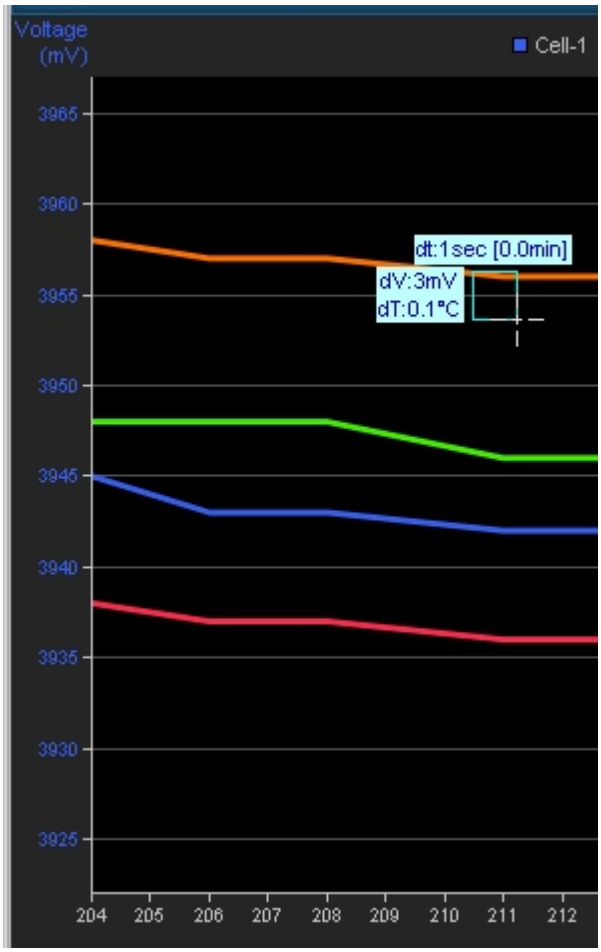
The Ruler tool is selected through a button located on the toolbar of the chart viewer form.

When selected, the mouse pointer changes to a large cross to mark the region of measurement.

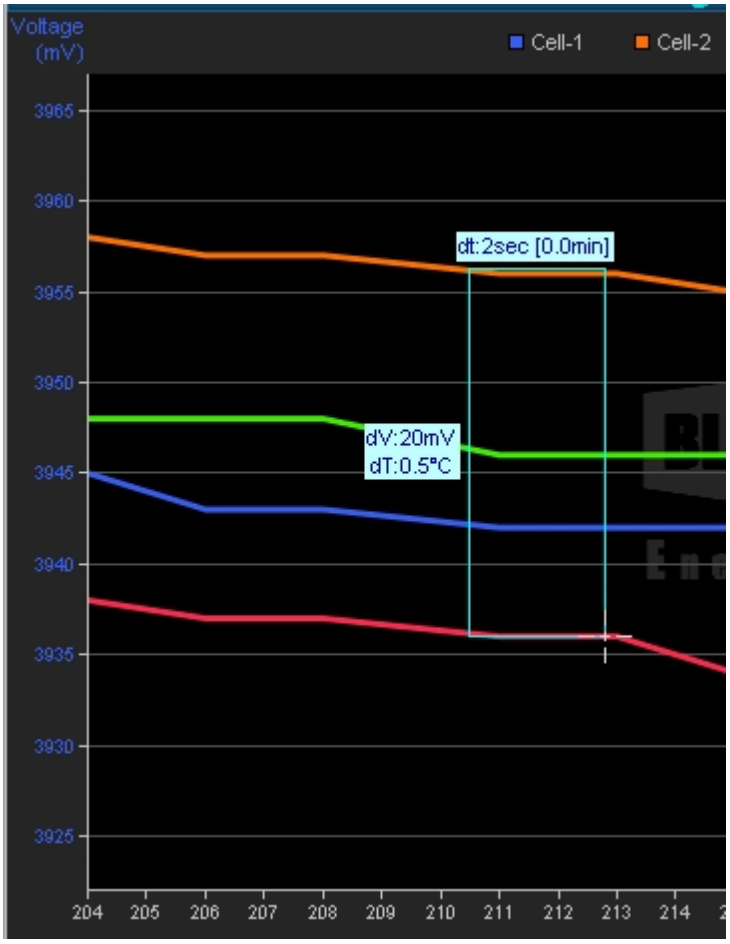


The tool is operated by clicking on the selected point in the chart and dragging the selection to reach the desired point of measurement as described below:

1. when clicking, a rectangle marquee is established at the originally clicked point



2. the marquee will extend following the mouse movement till the button is released; during the mouse movement two indicators pop-up to higlight the distance travelled from the original point.



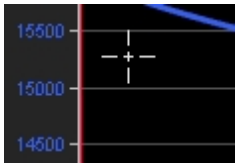
The horizontal distance represents the time elapsed in seconds (with minutes in brackets).
The vertical distance represents the difference in voltage, current and temperature between two points on the chart.

Capacity ruler

With the Capacity ruler tool, the user can easily measure the capacity charged and/or discharged with reference to a specific chart area.

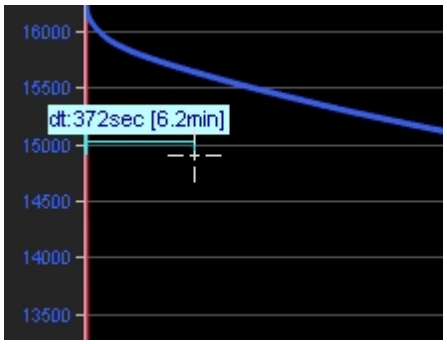
The Capacity ruler tool is selected through a button located in the toolbar of the chart viewer form.

When selected, the mouse pointer changes to a large cross to mark the region of measurement.

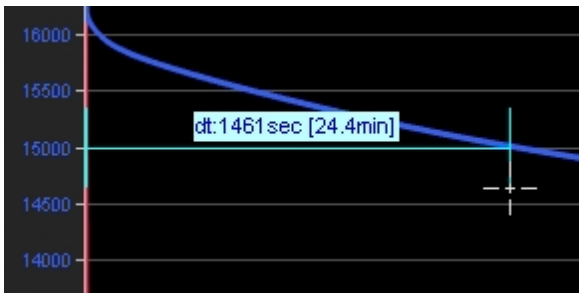


The tool is operated by clicking on the selected point in the chart and dragging the selection to reach the desired point of measurement as described below:

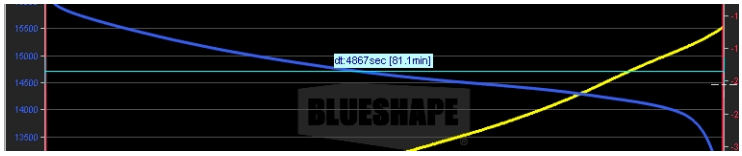
1. when clicking, a dimension line is established at the original clicked point.



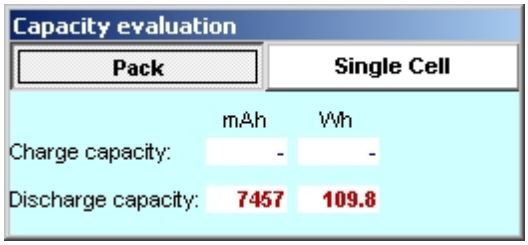
2. the dimension line will extend following the mouse movement till the button is released; during the mouse movement an indicators pops up to highlight the distance traveled on the x-axis from the original point.

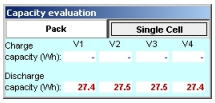


3. when the ending point is reached, release the mouse.



4. a small window pops-up at the top-rightmost edge of the chart area, showing the result of the capacity measurement.





The capacity is calculated for the period selected.
If in the selected range of data both charge and discharge currents are found, they are accounted separately.

Pack-level capacity is calculated in mAh (milliAmpere-hour) and Wh (watt-hour)
Cell level capacity is only calculated and Wh (watt-hour) per single cell

The pop-up window is cleared on exiting the Capacity ruler tool.