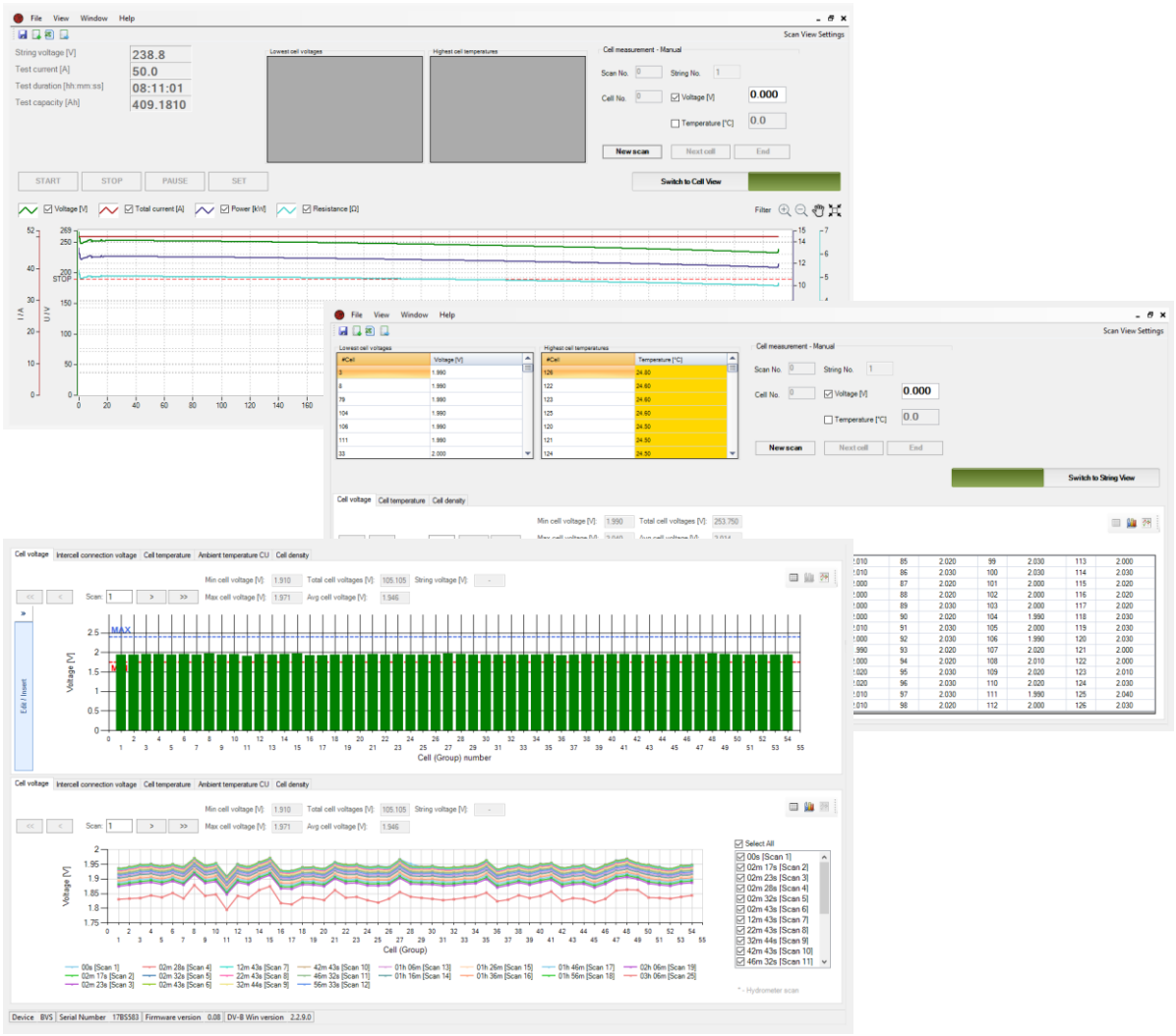
Battery load units BLU Series &
Battery voltage recorder BVR Series

DV-B Win Manual



Manual version: D-BTR100-303-EN
This Manual refers to DV-B Win versions from 2.2.28.0 and above, and FW versions:
From 5.xx, 6.xx, 7.xx, 8.xx, 9.xx for BLU series and 1.3x (BVR11) and 1.2x (BVR22)
Publishing date: 2019-03-10

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1. Introduction

DV-B-Win software version for the BLU device is a part of the Microsoft Windows® application software provided for the DV Power products. It enables the device control and two-way communication between the BLU and a PC over the USB connection.
The following functions are supported by DV-B Win:

- PC control of the BLU device and storing the test results on the PC hard drive.
- Transferring the test results from the internal BLU memory to the PC.

Note: When using the DV-B-Win software, the BLU can be operated only from DV-B Win application. All buttons on the BLU front panel are disabled, except the **STOP** button.

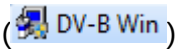
Data transferred from BLU can be saved as a PDF, DOC, or RTF file.
Every test reading contains following information:

- Recorded date and time of the test,
- Memory location in the device internal memory where the results are stored,
- Values of test currents, capacity and string voltages recorded in each test.

2. Minimum PC Requirements

Processor: 2.5 GHz or better
Memory: 2GB or more of system memory
Hard Disk Space: 203,4 MB free or more
Operating system: Windows XP™, Windows Vista™, Windows 7™ or Windows 8™
(*Microsoft®, Windows, Windows XP, Windows Vista, Windows 7 and Windows 8 are either registered trademarks or trademarks of Microsoft Corporation. All other trademarks are the property of their respective owners.)*

3. DV-B Win Installation

The DV-B Win application is started by double-clicking the *DV-B Win.exe* file (

). If the DV-B Win software application is already installed on the PC, the user would be asked if wants to delete the previously installed software version. It is strongly recommended to delete the currently installed software version (Figure 3-1 & Figure 3-2).

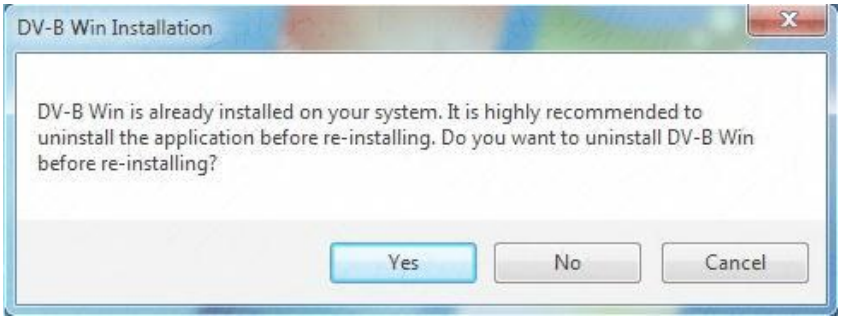


Figure 3-1: Uninstallation message

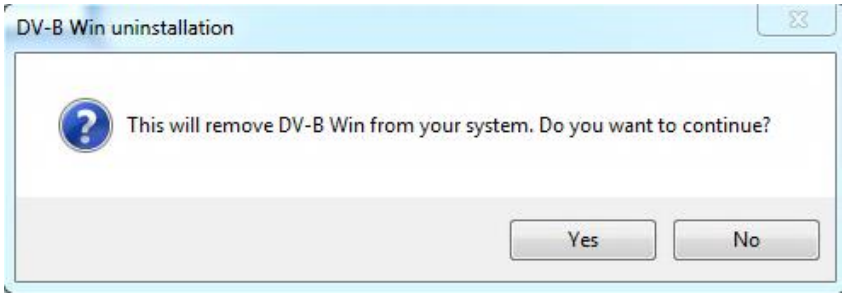


Figure 3-2: Uninstallation message

After click on the **YES** option, the previously installed version will be uninstalled. The user should click on the **Close** button to complete the uninstallation process.

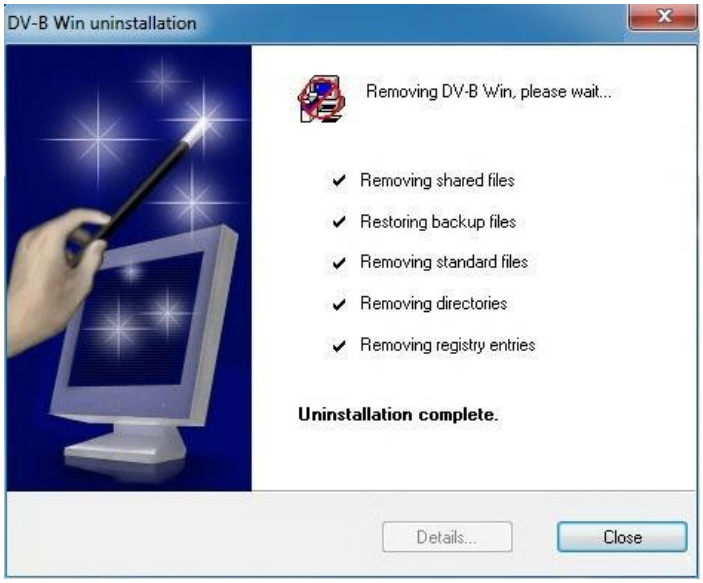


Figure 3-3: "**Uninstallation completed**" message

The next step is to select the language that is going to be used during the installation. The available languages are *English, Deutsch (German)*, *Russky (Russian)*, *Espanol (Spanish)*, *Polski (Polish) and Simplified Chinese*.
After selecting a language, click on the **Next** button to proceed**.**

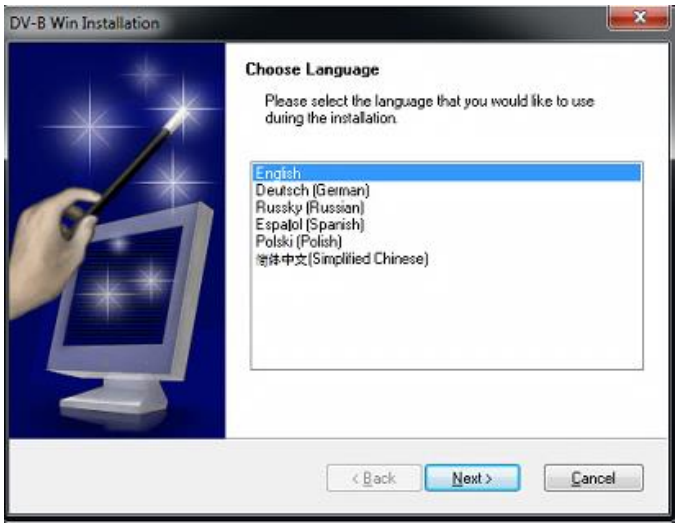


Figure 3-4: Selecting the language during installation

The Welcome window will appear on the screen. Click on the **Next** button to proceed.

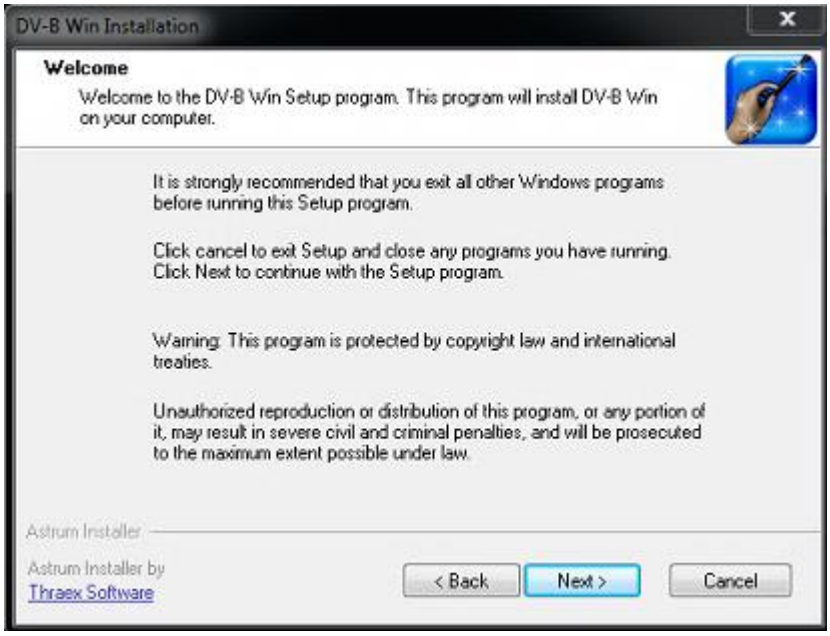


Figure 3-5: The "**Welcome**" message

The installation will automatically check if the computer configuration meets the minimum DV-B-Win requirements. This step is presented in the Figure 3-6. Click the **Next** button to proceed.

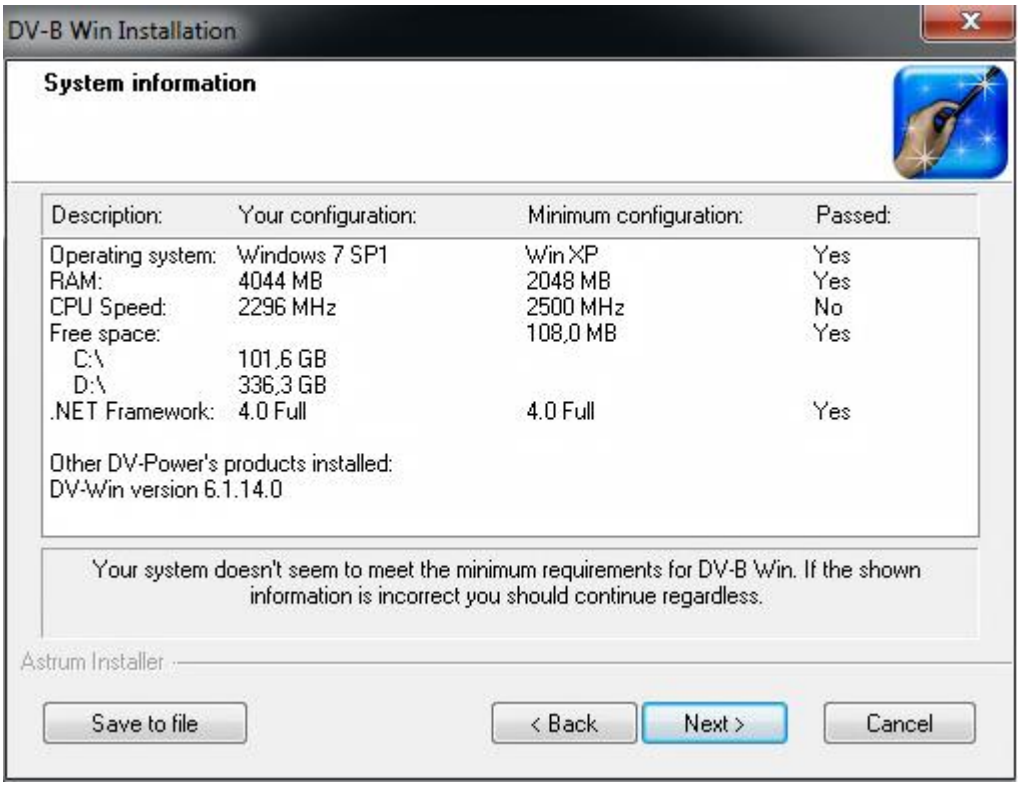


Figure 3-6: "**System information**" message

The installation folder is selected in the following step. The location of this folder can be changed by either selecting the default path or by clicking the **Browse** button to choose a desired one. Click **Next** to proceed.

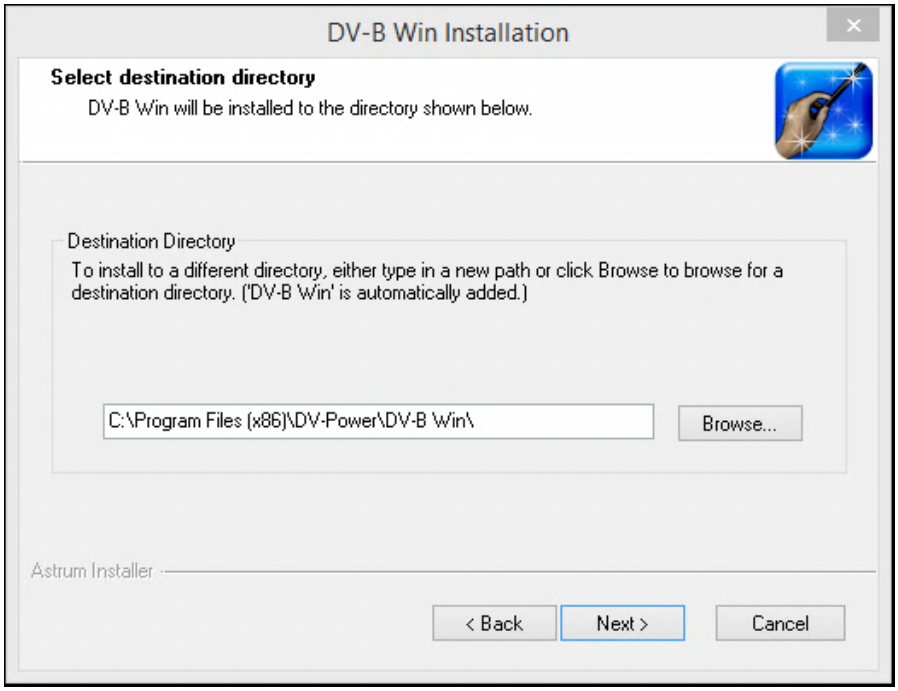


Figure 3-7: The folder location

The program folder is selected in the following screen. Click **Next** to proceed.

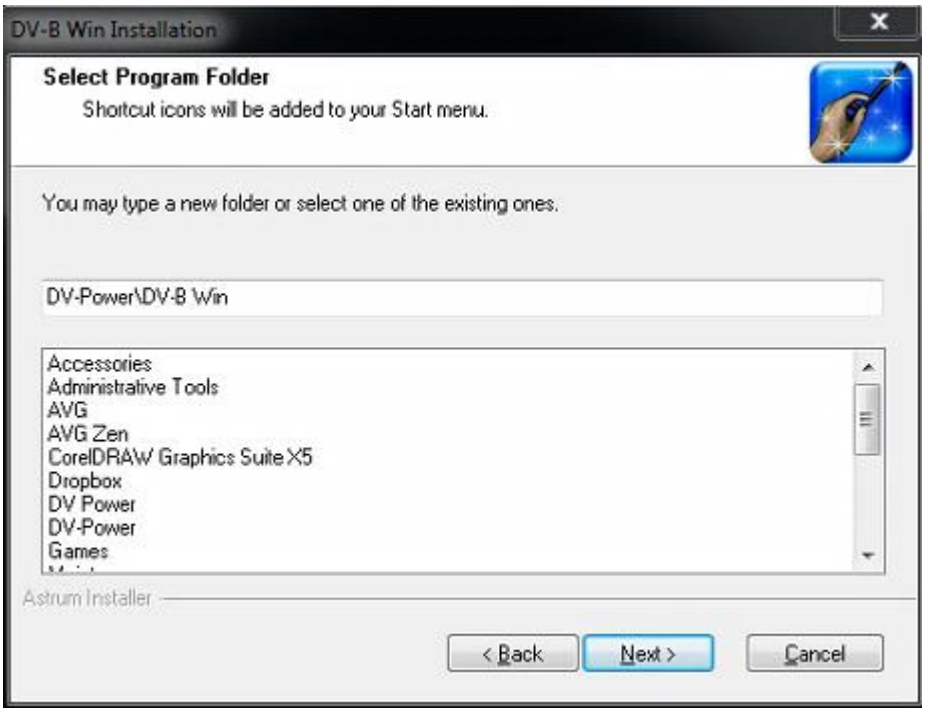


Figure 3-8: Selecting the Program folder

Installation setup parameters will be summarized in the following screen. The click on the **Install** continues the installation.

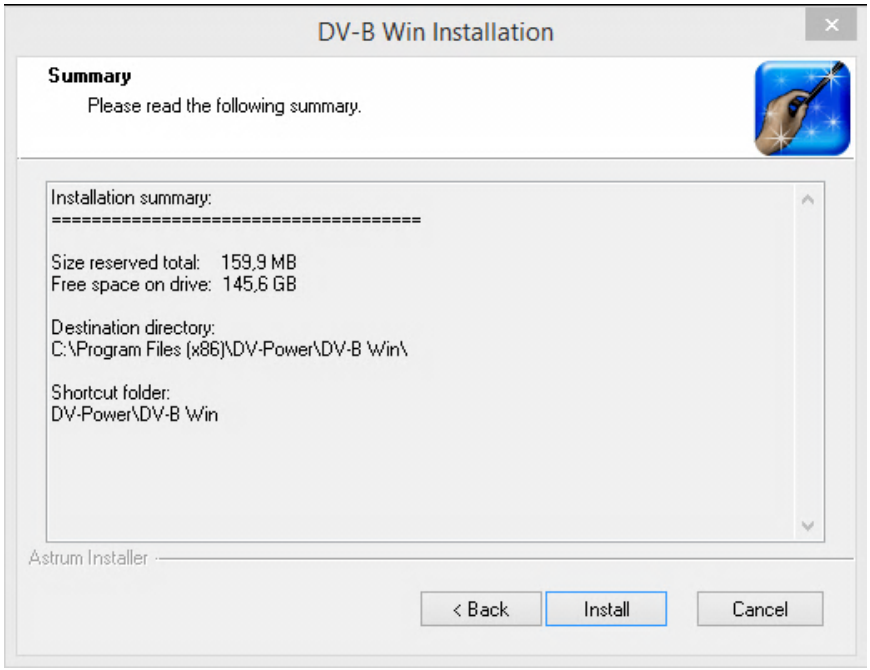


Figure 3-9: The installation summary

The **Finish** button will finalize the DV-B Win installation.

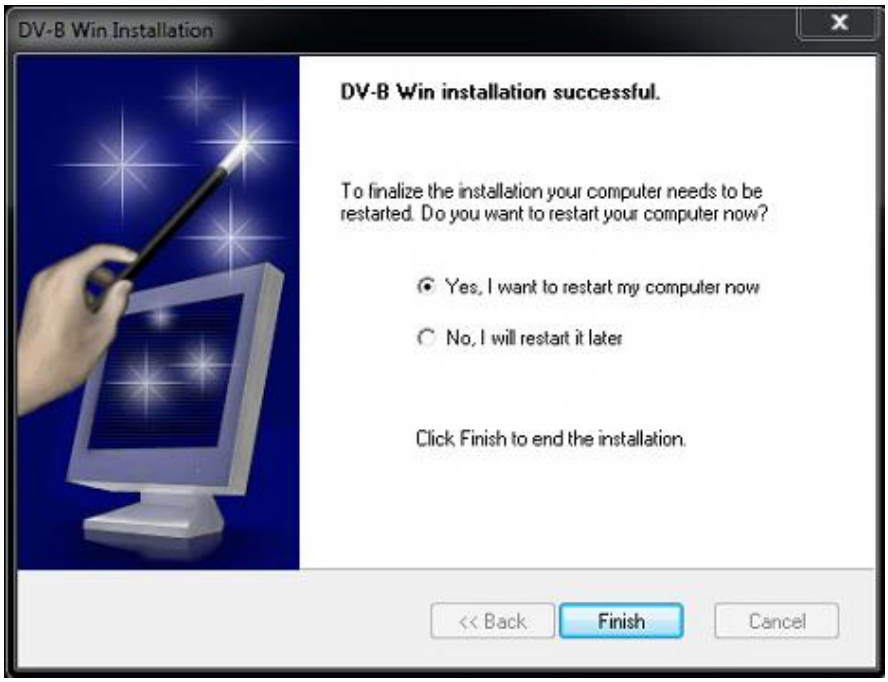


Figure 3-10: Finishing the DV-B Win installation

Note:
It is strongly recommended to restart the computer after the software installation. Avoiding restarting the computer upon installation may result in incorrect operation of the software.

4. Starting DV-B Win Software

To control the BLU instrument using the DV-B Win software, the following steps should be done in the order as indicated below:

1. Switch on the BLU device.
2. Connect the BLU to a PC using provided USB cable.
3. Wait 10 to 20 sec until the drivers are installed. The drivers need to be installed if the BLU is connected to the PC for the first time, or after the DV-B Win software update.
4. Start the DV-B Win software. The DV-B Win software can be started either by clicking *Start - Programs - DV-B Win*, or by double clicking the DV-B Win icon on the desktop.

The starting screen, presented in the Figure 4-1, will be displayed.

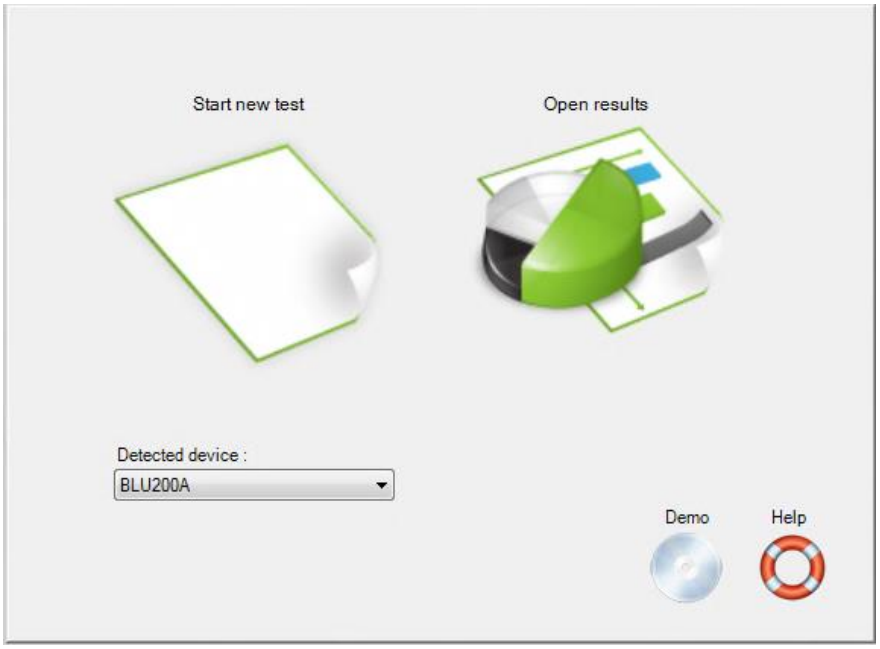


Figure 4-1: The DV-B Win introduction screen

In case the device is not recognized in the detected device field, the ***New*** button shown in the upper left corner of the DV-B Win window should be pressed to connect.

Note:
If connection between BLU and PC is not established, the "*Detected device*" field will display the message: *No device connected.* The possible reasons are:

- **The process of drivers' installation has not been completed. The user should wait until the message "Drivers has been installed successfully" is displayed in the right lower corner of the PC display,**
- **There is a problem with the "PC to USB" and / or "USB to BLU" connection points. It should be checked if the USB cable is properly connected to the PC USB port and to BLU.**
- **There is a mechanical problem with the USB cable. Try to establish communication by using different USB cable.**

If the problem still remains unsolved, the BLU and DV-B Win should be restarted. If the problem remains present after the restart, the DV Power Customer Support Service (support@dv-power.com) should be contacted for further instructions.

If Language needs to be changed, it can be done by selecting *Tools -> Languages* (Figure 4-2).

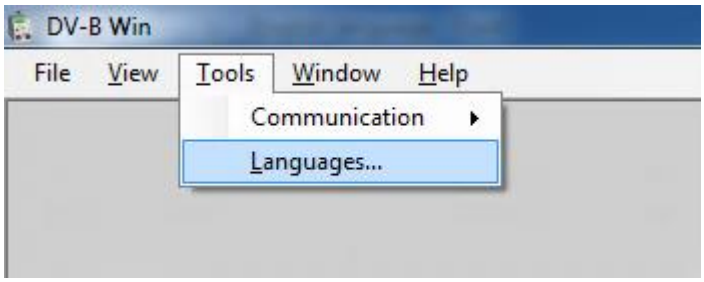


Figure 4-2: The Language change

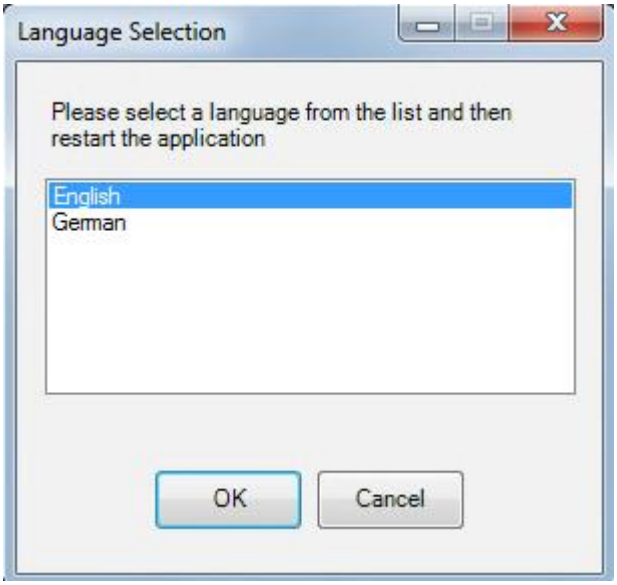


Figure 4-3: Selecting the new language

After selecting new language listed in the Language Selection window, the DV-B Win needs to be restarted in order new language settings to be applied.

To start the new test, click the **Start new test** icon on the screen.
The **Open results** icon provides the previously recorded results.
The **Help** icon displays details about the installed DV-B Win version.

4.1. Initial settings

4.1.1. Test object information

After the device is recognized in the *detected device* field, and a new test was started, the following user interface display will appear.

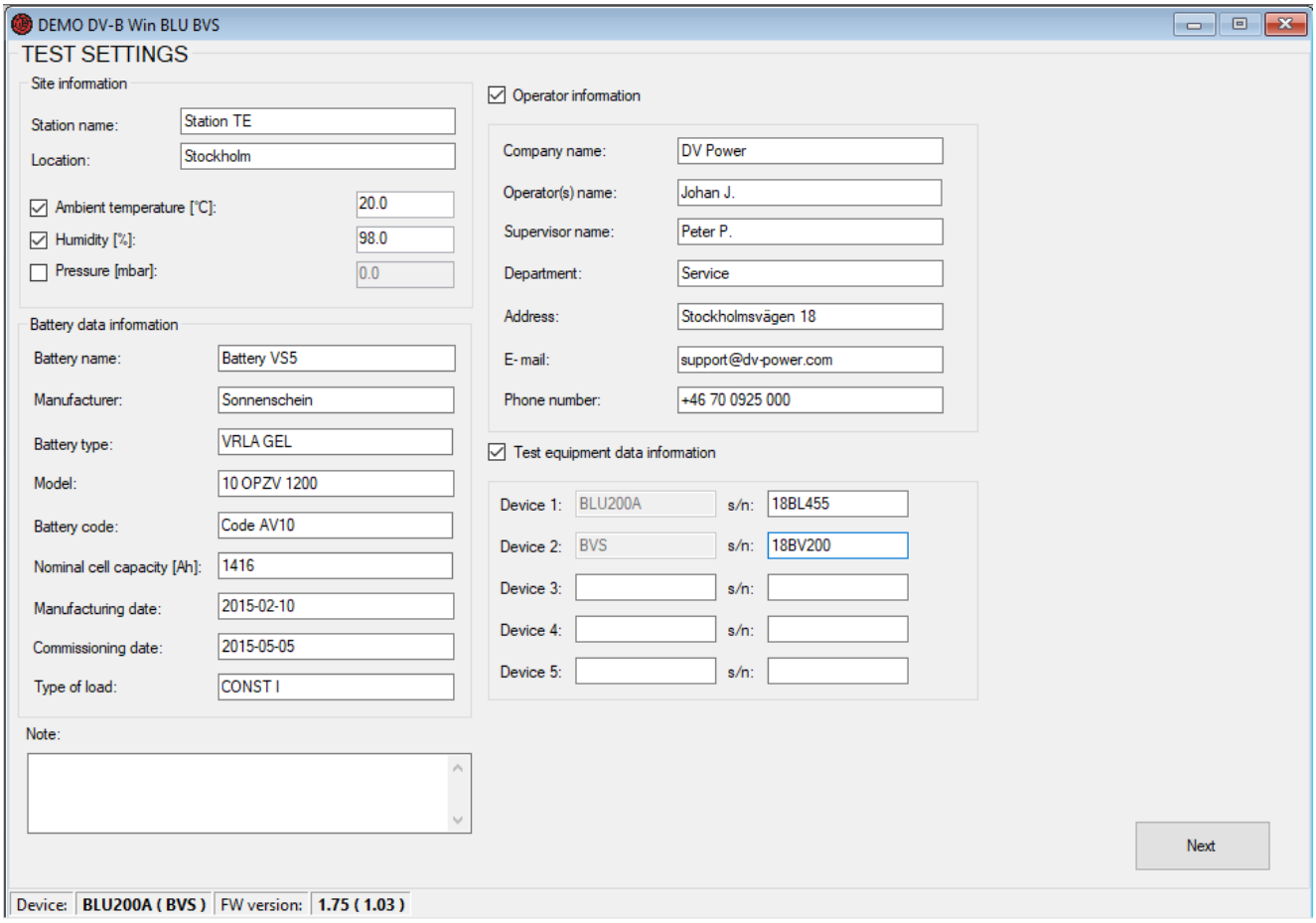


Figure 4-4: The Test general settings menu

The *Test Settings* window enables adding information about location, test object, and the test conditions that may be useful for later analysis. Any data entered in the test info tab will be shown in the automatically generated test report at the end of the test.
If the instrument is used for the first time, all fields will be blank. The DV-B Win software will save the entered settings and offered them as default after the next DV-B Win startup.

Note:
Entering the information in the *Test Settings* menu is optional - It can be proceed to further pre-test steps even if no information is entered in the dedicated fields.

Click on the **Next** button will display additional Test Settings menu which enables setting limits, discharge modes as well as cell measurement mode. (Figure 4-6).

4.1.2. Battery database (BVR series)

In case an instrument from BVR series is detected, the form of the Test Settings will contain an additional section, for the preview of the battery database stored in the internal memory of BVR, as shown in the following figure.

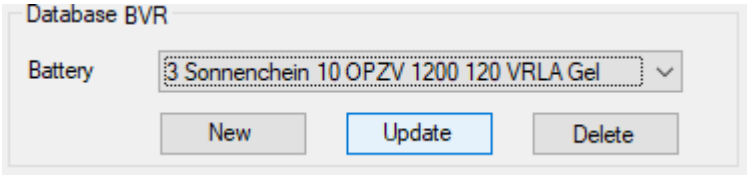


Figure 4-5: BVR battery database in the Test settings form

In this section, the following options are available:

1. ***New battery***: The data entered for the new battery is: the manufacturer, the battery type, the model and the number of elements.

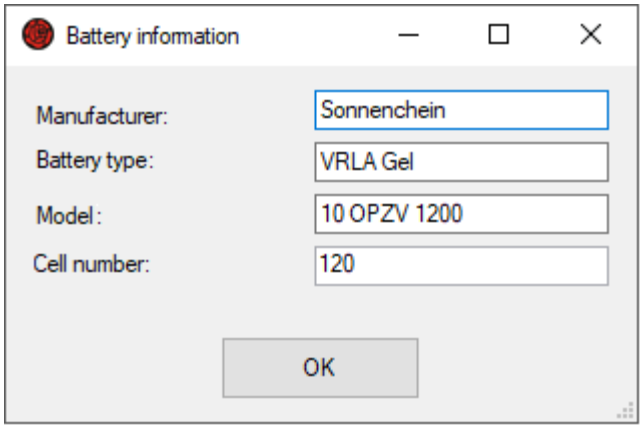


Figure 4-6: Entering a new battery in BVR database

By clicking OK, the new battery will be added to the BVR internal memory database, and this battery will be displayed in the list of available batteries the next time the DV-B Win software with BVR is started. It is also possible to access the results of this battery in the Database menu on the BVR instrument.

2. ***Update*** (for a battery saved to the database) - By pressing this button, the *Battery Information window appears* with current data saved for the selected battery. By pressing *OK*, the new changes are saved to the database.

3. ***Delete***: By pressing the button *Delete*, the battery currently selected in this section will be deleted from the BVR database.

4.2. Test settings

After selecting the information related to the test object, by clicking button *Next*, the second part of the Test Settings will appear, as shown in Figure 4-7. This menu is intended for configuring the test parameters.

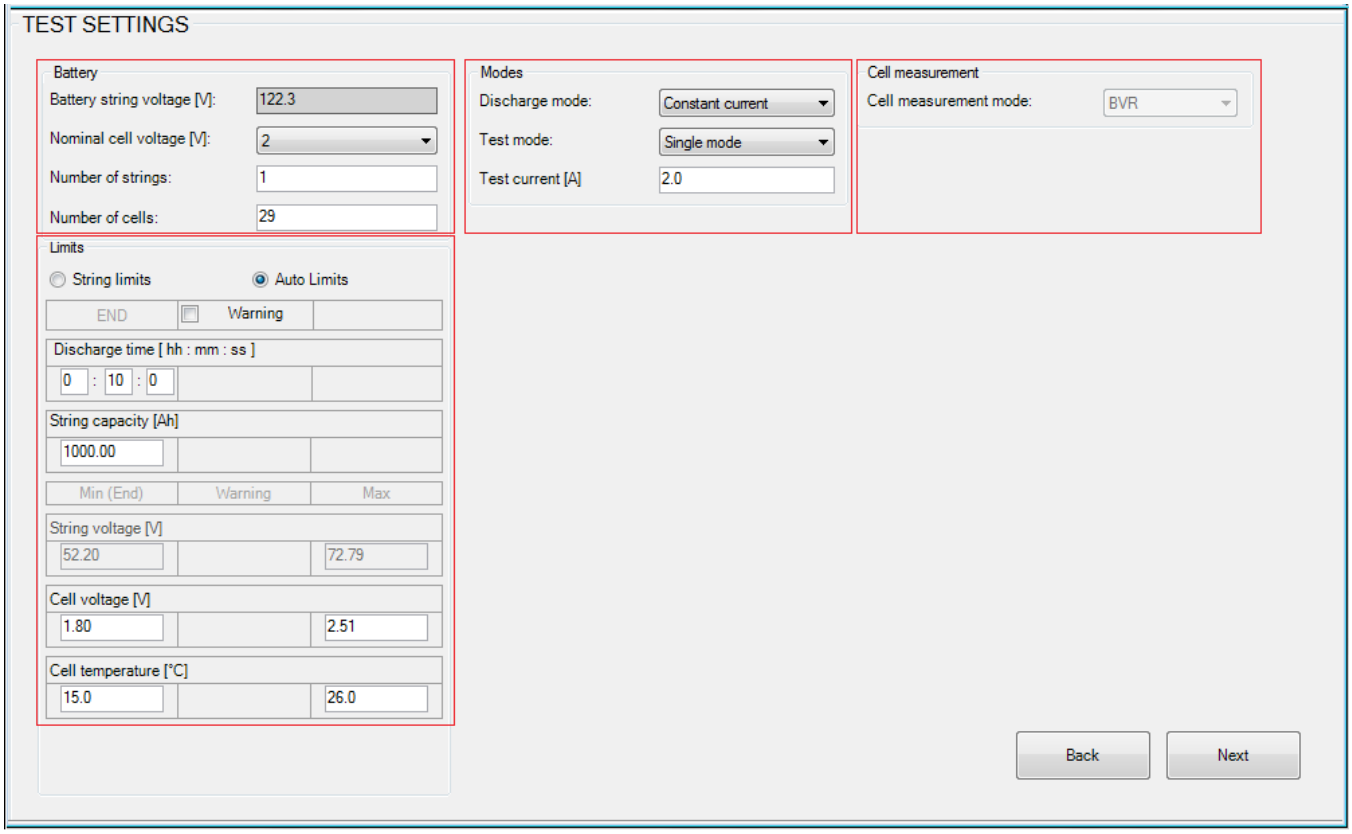
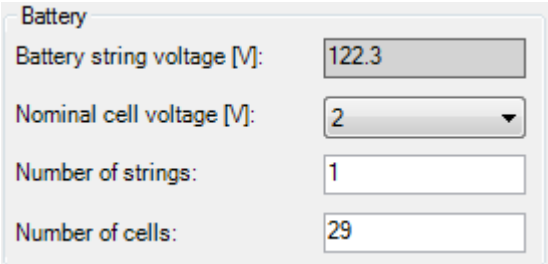


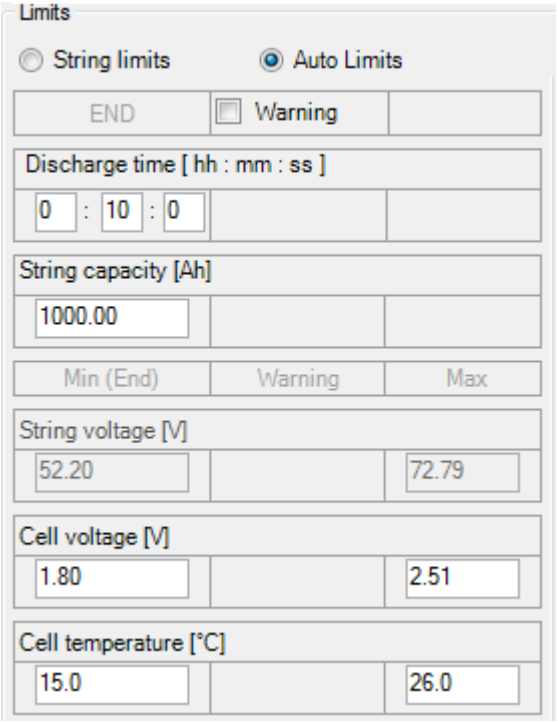
Figure 4-7: The Test Settings menu

4.2.1. Battery configuration



This section includes information about the battery string. *Battery voltage* text box shows the current voltage value the BLU measures on the battery string. Cell voltage is the nominal voltage of cells that make a battery string. An additional option is to enter the total number of cells connected to the BLU.

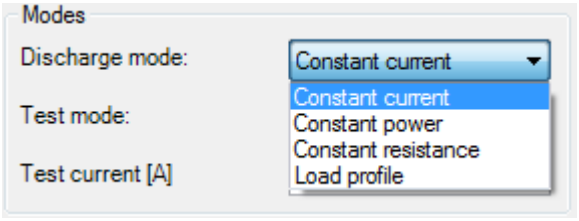
4.2.2. Limits



The user can choose between *String* and *Auto* Limits for warning and end values settings. The *String* Limits option refers to string parameters, such as String End and Warning voltage values. The *Auto Limits* section enables the user to enter cell limits (cell min, cell warning and cell maximum voltage) while total string parameters are calculated based on entered cell data. The total Warning and End limits are calculated by multiplying the user entered number of cells by the entered warning and end voltage per cell. The String END capacity needs to be entered in both Limits types (it is set as 1000 by default).
By selecting the option Warning Limits, the user may enter desired warning values. Once warning values are measured, the corresponding warning messages will appear.

4.2.3. Modes

4.2.3.1. Discharge Modes



In the **Modes** section the user defines the discharge mode for the discharge test. Four types of discharge test are available in the discharge mode: *Constant Current, Constant Power, Constant Resistance* and *Load profile*.

Selecting the *Constant current* mode the discharge process will be regulated on user-selected constant current. The *Constant power / Constant resistance* modes enables capacity testing to be regulated on the basis of constant power / resistance, respectively.
The fourth mode is the *Load profile* mode. It simulates a load profile with desired constant current, power or resistance values during a user selected duration of discharge.

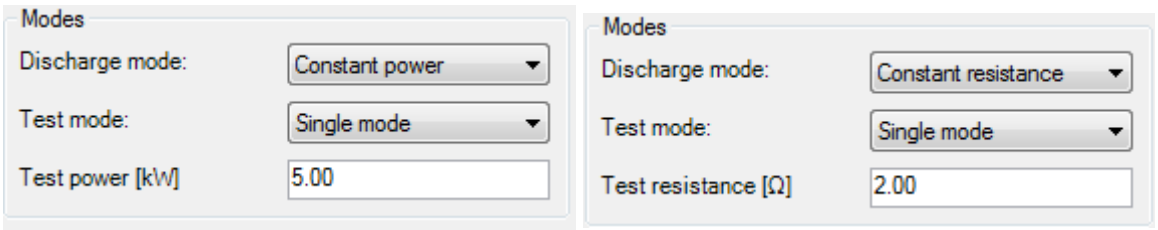


Figure 4-8: The Constant power (left) and Constant resistance (right) discharge mode

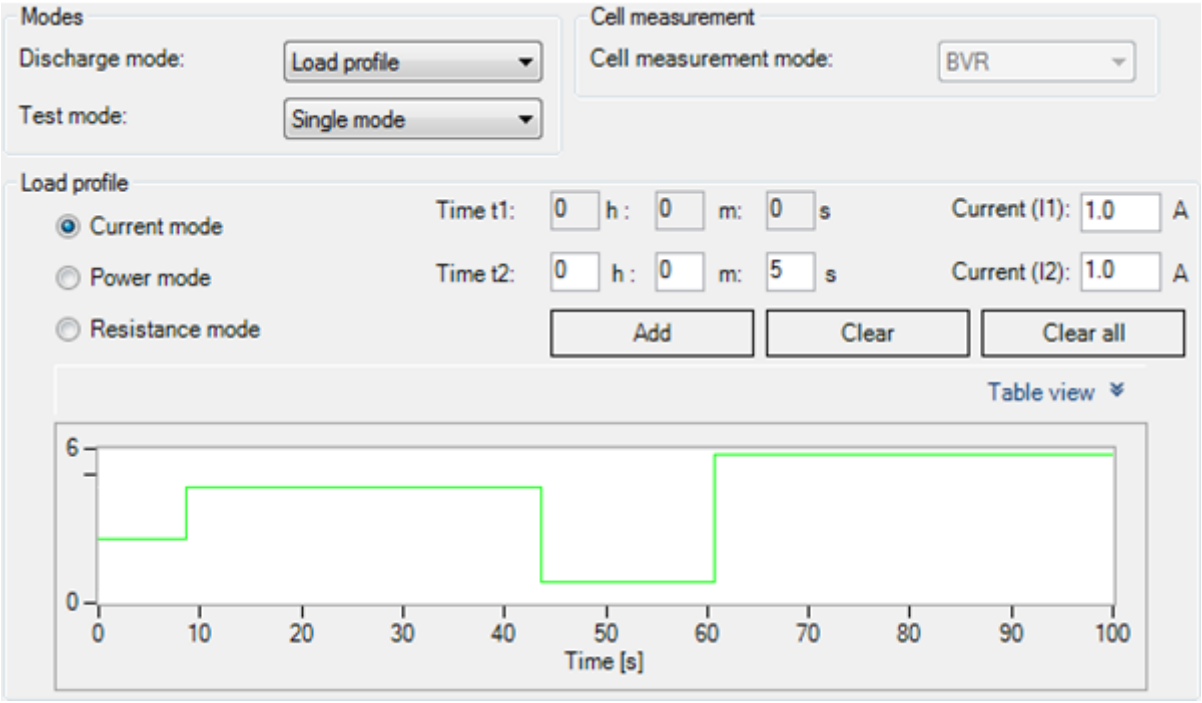
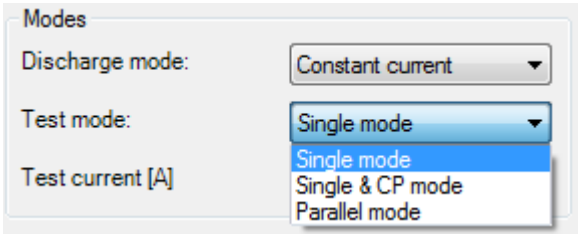


Figure 4-9: The Load profile discharge mode

The *Load profile* section also consists of Constant current, power or resistance modes. All of them may be selected to simulate different types of loads. The Test value and time segments (discharge cycles) are entered by the user. The minimum discharge duration for all available discharge modes is 5 seconds. Defined load profile can be seen in graph and table forms prior the test.

4.2.3.2. Test Modes



The DV-B Win software application provides three types of test modes:

- *Single mode*
- Single & CP mode
- *Parallel mode*.

The *Single mode* (or single-unit mode) is used for an offline discharge test, when the battery is disconnected from the load and the charger(s). In this mode only one load unit is connected to the battery and used to dissipate the energy. The only test parameter that needs to be set in the *Single mode* is current (for the *Constant current* discharge mode), or power (if the *Constant power* discharge mode is previously selected) or resistance (if the selected discharge mode is *Constant resistance*).

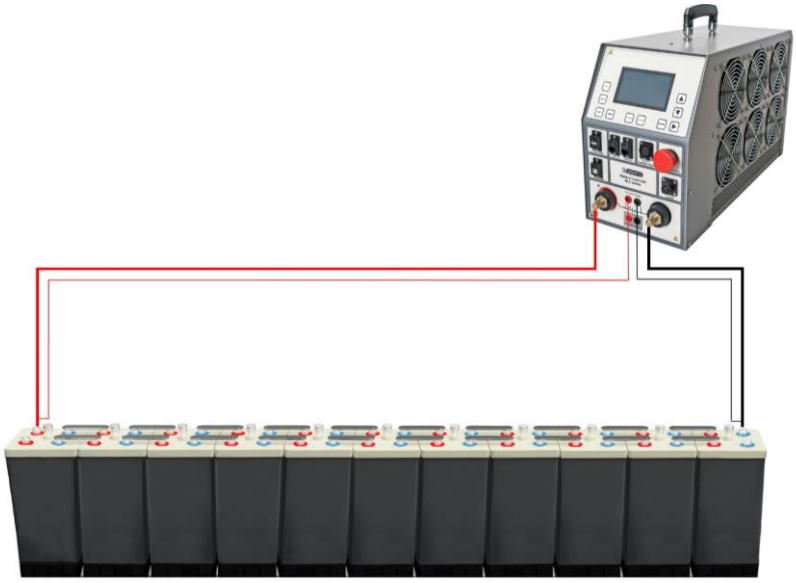
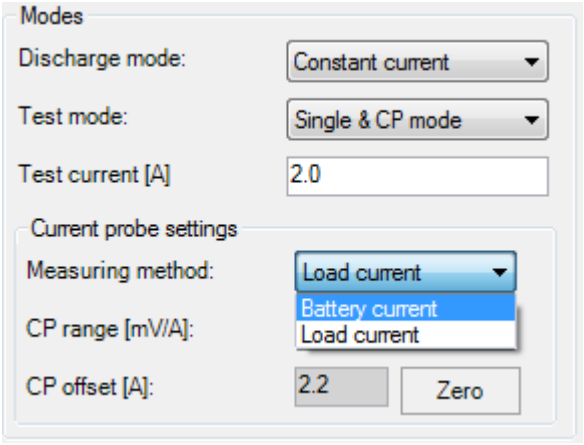


Figure 4-10: BLU - battery connection diagram in the *Single mode*

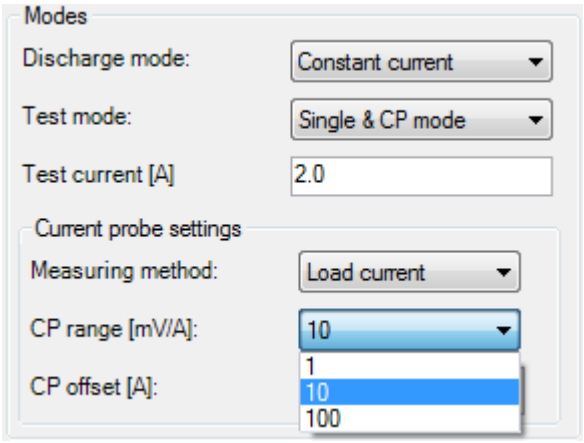
In the *CP mode* the user performs the discharge test while the external load is connected to the battery, or when an Extra Load Unit BXL is connected to the battery. In this mode, the measuring method and a current probe CP range parameters need to be defined in addition to a test value.



The CP mode offers two measurement methods: ***Battery current*** and ***Load current*** mode. The current clamp can be connected in a way to measure total discharge current or total current conducted by BXL's (and additional loads, if any). Depending on the current clamp connection point (Figure 4-10), appropriate discharge mode (*battery* or *load current* mode) should be selected. In both modes the user defines the test current/ power which represents the total current/ power to be discharged from the battery.

- **Battery current -** based on measuring the total current being drawn from the battery by using the current clamp / probe. The BLU regulates its own discharge current / power in order battery current / power to be equal to user preselected discharge current / power. During the discharge test the values of total current / power drawn from the battery and the current/ power dissipated in the BLU will be displayed.
- **Load current** - based on measuring the load current. The BLU regulates its own discharge current / power so that sum of measured load current / power and BLU current / power equals to user preselected discharge current / power. During the discharge test the values of total current / power drawn from the battery and the current / power measured by the current clamp / probe will be displayed.

Based on the selected mode / current being measured by the current clamp, BLU calculates and therefore regulates its discharge current/ power.



After selecting the appropriate measuring mode, the CP range should be set. Selectable value are: **1 mV/A**, **10 mV/A or 100 mV/A.**

The CP range selected on the current probe and the CP range selected in the DV-B Win software must be identical. Otherwise, current clamp / probe measurement will be incorrect.

The next step is to zero the current clamp offset. The ZERO button on the current clamp should be pressed in order the offset value to be changed. The offset should be below 5 A in order clamps to be zeroed. When the CP offset reaches the value under 5 A, the Zero button should be pressed and "**OFFSET ZEROING DONE**" message will appear on the display.

Note:
The current clamp readings will be inaccurate if the current measured by the current clamp during the test is less or equal to zeroed offset value.

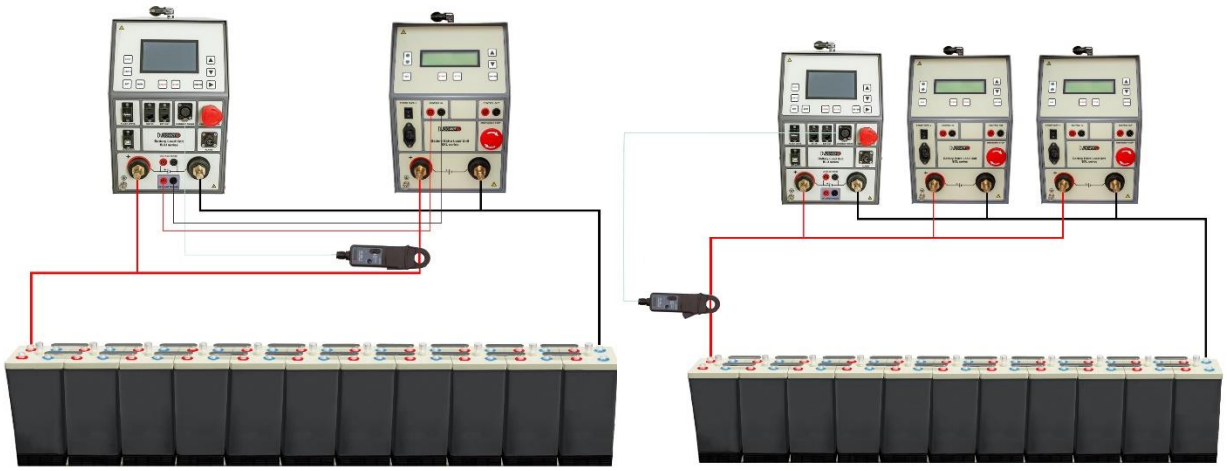
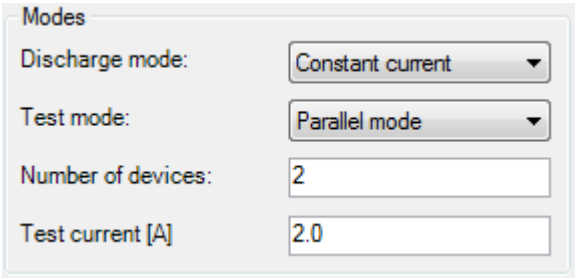


Figure 4-10: Connecting BLU & BXL(s) in **CP MODE -** load current (left) and battery current mode (right)



If the *Parallel mode* is selected as the test mode, the user needs to define total number of devices (Master + Slaves) and the total discharge current/ power/ resistance.

4.2.3.3. Cell measurement mode

Cell voltage/temperature monitoring can be performed manually, by using the Battery Voltage Recorder (BVR), or the Battery Voltage Supervisor (BVS) devices.

In case BVR11 instrument is connected, selectable test modes are:

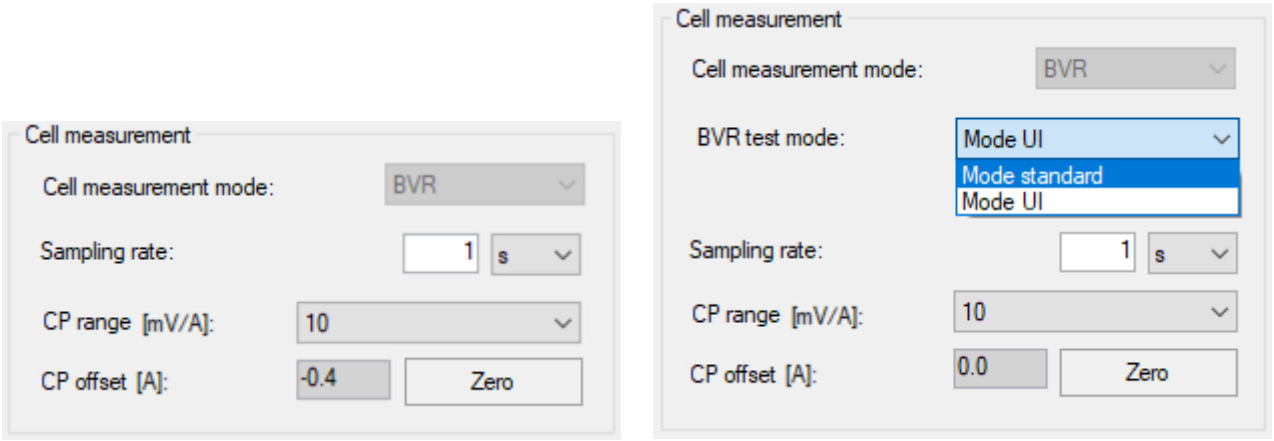
- *Standard Mode* - measuring cell voltage during the test
- *CP mode* - current measurement with current clamps during the test. If this mode is selected, the section for updating the zero offset of the current clamps is displayed (Figure 4-12 a)).

Both test modes can be used in the DV-B Win test form.

In case BVR22 instrument is detected, it is possible to select one of two available modes:

- ***Standard Mode*** - with the same functions as for the BVR11 instrument
- ***U + I mode*** - this mode is intended for measuring battery voltage and current during discharge (instead of BLU) or during battery charging (Figure 4-12 b)). If this mode is selected, the section for updating the zero offset of the current clamps is displayed.

It is possible to select only one of these two modes for BVR22 in the test settings window, as shown in figure 4-12.b).



a) b)

Figure 4-11: Available test modes for BVR11 (a) and BVR22 (b)

Note: If BVR22 instrument is detected with BLU device in DV-B Win, the U + I mode will not be available, since this mode is designed to be used during battery charging / discharging with other load units (where real-time values of test current / voltage are not available).

4.2.4. Status Messages

Ready	User can switch from the Test Settings windows into the Test windows by click on the button “Next”.
Not ready. Try again	Settings initialization failed. Try again by using the “Next” button.
Battery is not connected	The battery is not connected.
Inverted polarity	The cables are not properly connected.
Sleep mode disabled	Computer will not enter in the sleep mode during the test.
Communication error	Error in the communication with the device.
Battery voltage less than end voltage	Check the battery data and the string end voltage limit.
Battery voltage less than warning voltage	Check the battery data and the string warning voltage limit.
Battery current probe mode is ready	The CP mode is successfully configured as the *Battery current mode* on the device.
Load current probe mode is ready	The CP mode is successfully configured as the *Load current mode* on the device.
Offset not zeroed	User did not press the button “Zero” in the Single & CP mode.
Offset zeroing done	The offset zeroing was successful.
Offset is not zeroed	The offset zeroing was not successful.
Error during setting CP mode	Settings initialization failed. Try again by pressing the button “Next”
Parallel mode is ready	The parallel mode is already configured on the device.
Error slave number. Please check slave addresses!	The total device number in parallel mode is not entered correctly. Slave addresses should also be checked.

4.3. Starting the test

After all test parameters have been defined, the following window will appear (Figure 4-13).

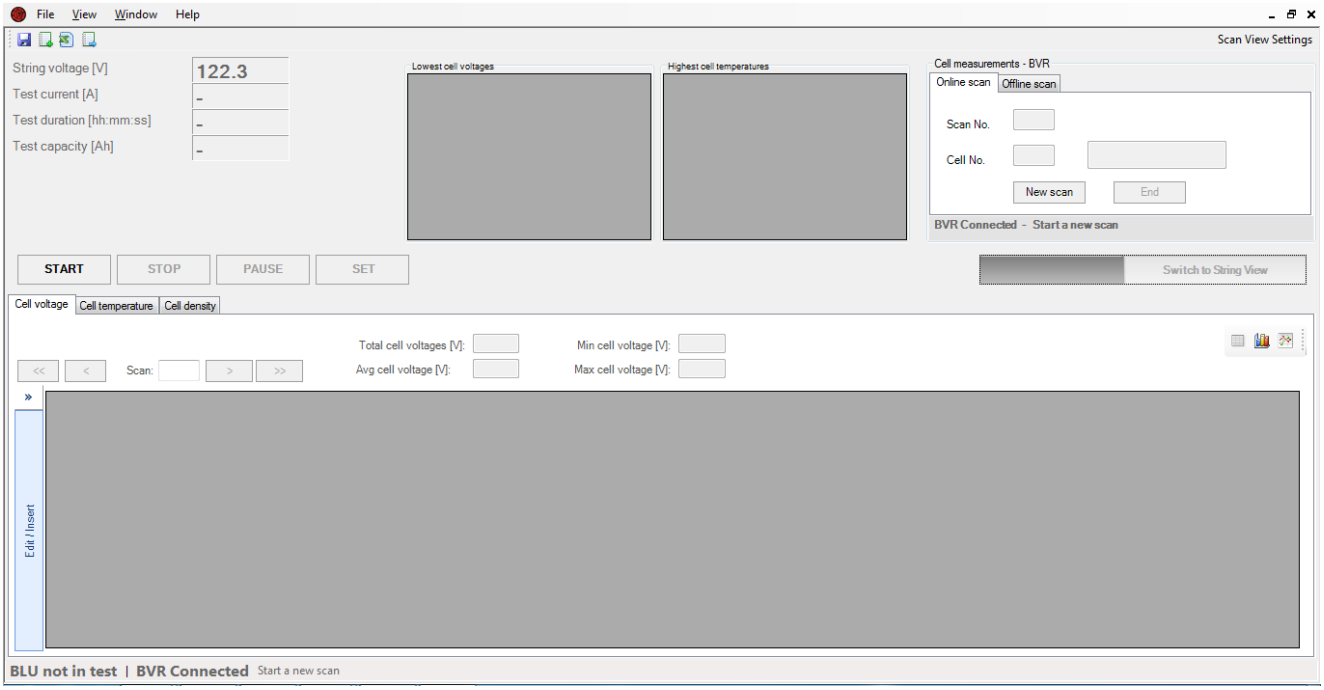
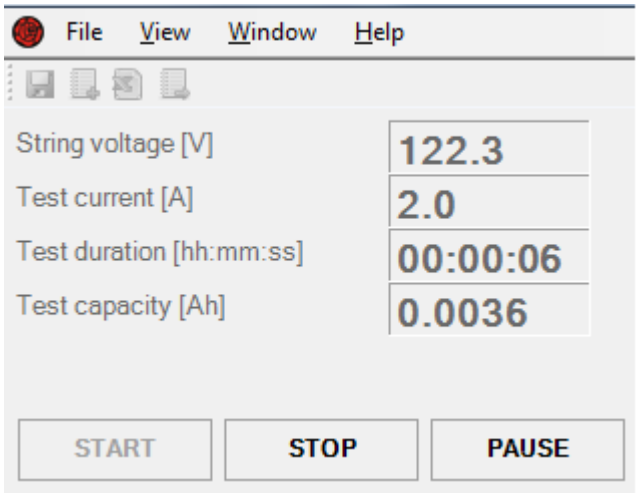


Figure 4-13: Starting test screen

This window contains two tool sections: one is reserved for discharge test and another one for the cell voltage-monitoring mode. Both of these sections contain command tools.

4.3.1. Discharge test

4.3.1.1. Test parameters

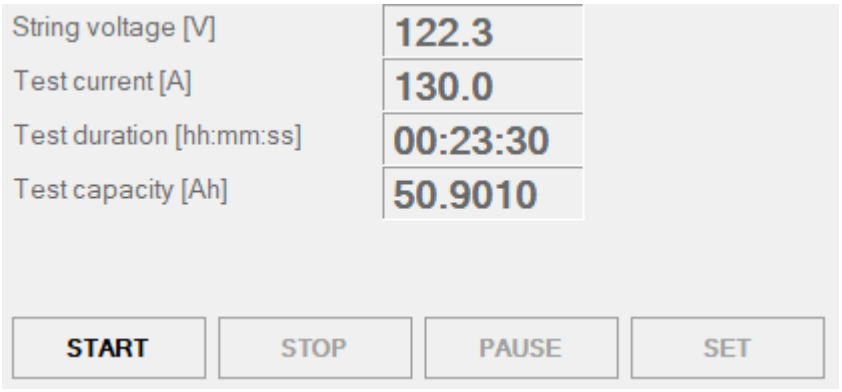


START button - Used to start the discharge test. The test will start with the previously configured parameters. After the test starts, the fields above the command tool, placed in the left upper corner, will show measured test values with 1 second sampling frequency:

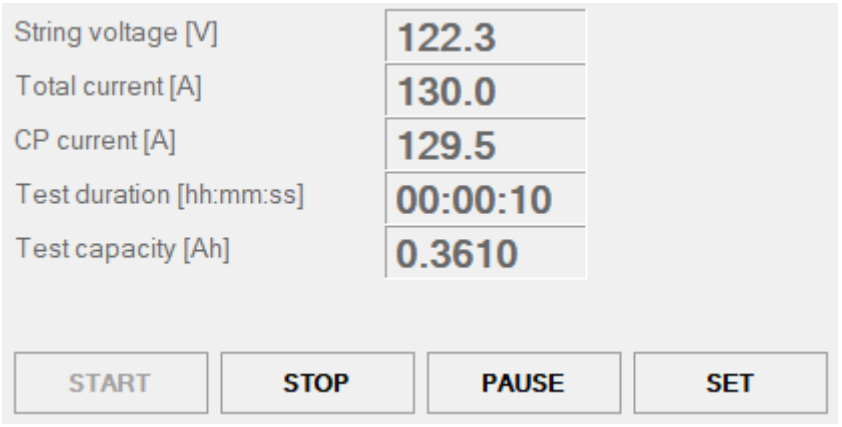
- String voltage [V]
- Test current/ power/ resistance [A/ kW/ Ω]
- Test duration [hh:mm:ss]
- Test capacity [Ah]

During the entire discharge period, corresponding graphs for battery string voltage, discharge current, power and resistance are presented in real time.

Previews of numerical results for Single, Single & CP, and parallel mode test modes are shown in the following figures.



a)



b)

Figure 4-14: Test results displayed in real-time:
a) Single and Parallel test modes
b) Single & CP mode (load current)

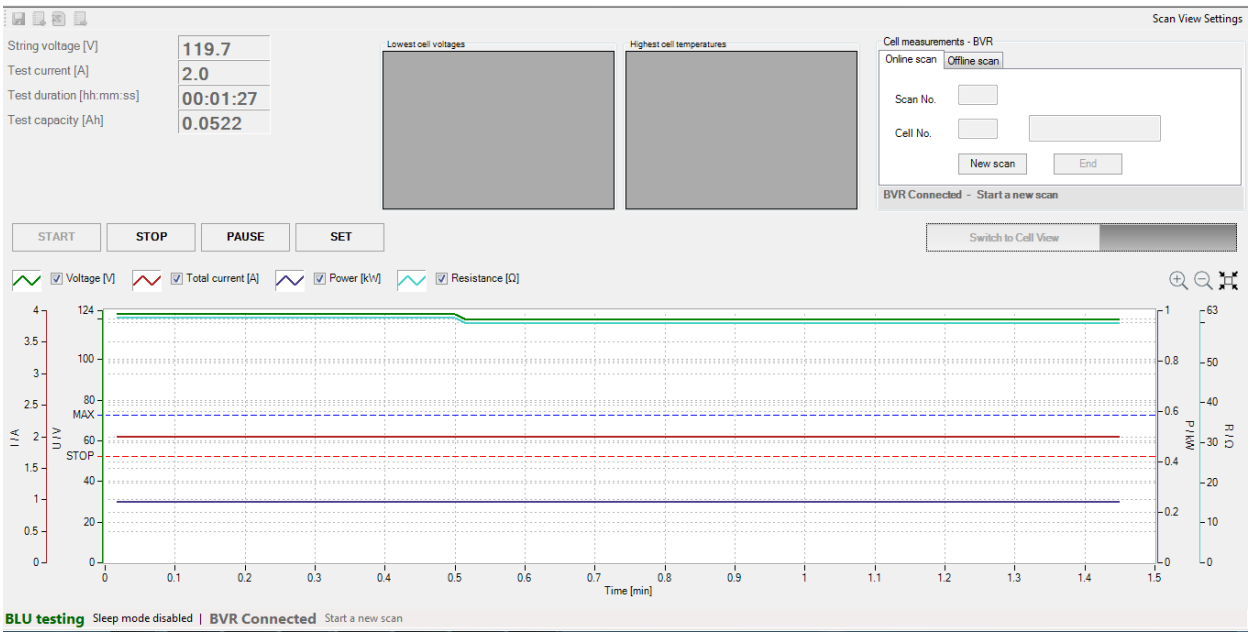
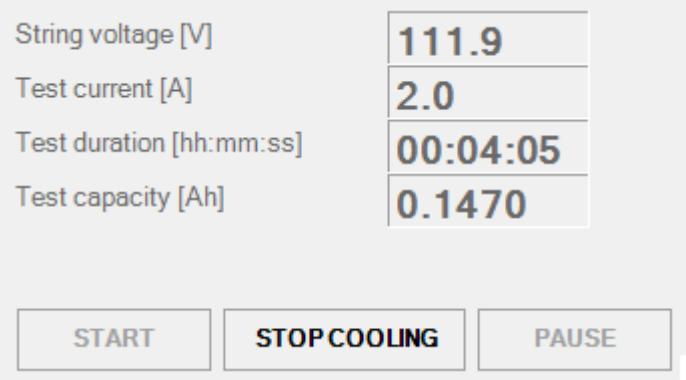


Figure 4-15: Discharge test screen (Single test mode on BLU device)



STOP button - Used to stop the discharge test. Stop button will activate the cooling state which will continue for 60 sec, unless aborted by pressing the STOP COOLING button.

It is recommended not to abort cooling process, especially after several hours long discharge tests,

PAUSE button - Used in case a pause of the test is needed. After pressing the PAUSE button, the following dialog will appear:

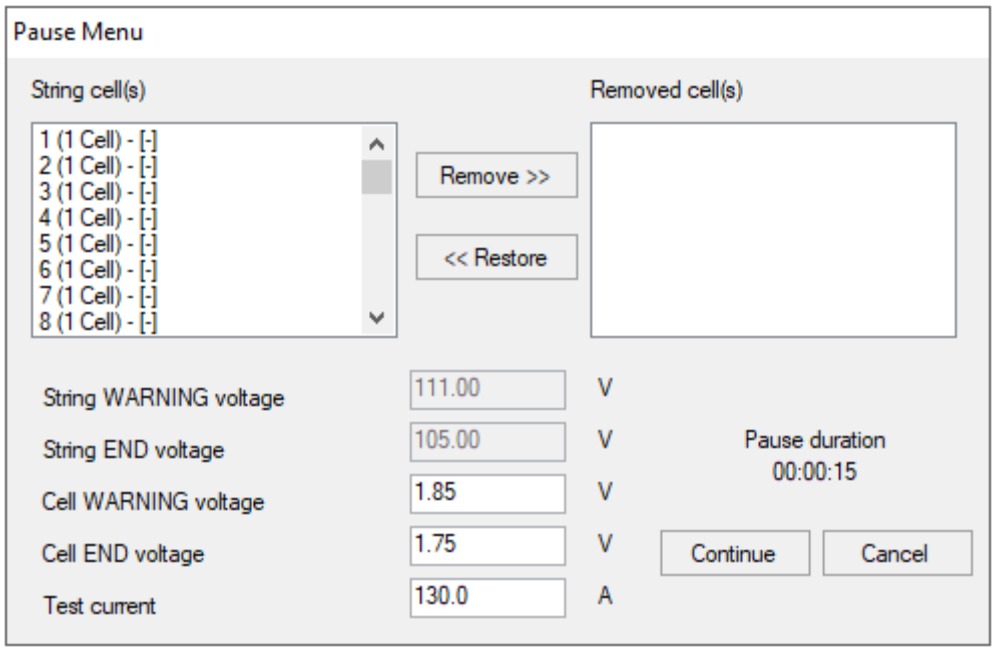


Figure 4-16: Pause test screen

In this dialog window the string end voltage, cell end voltage and test current/ power/ resistance can be changed. As an additional option, it is possible to exclude desired cells from the monitoring process. By pressing "*Continue*", the test will continue with the new test parameters. By pressing "*Cancel*", the test will continue with the previously configured test parameters.

SET button - Click on the SET button displays the SET Menu dialog without stopping the test. It enables to modify the test value (current/ power/ resistance) and test duration. It is important to emphasize that the time duration cannot be changed during the PROFILE test. Click on the "APPLY" button confirms the changes while "CANCEL" closes the SET Menu dialog and continues the test with previous test parameters.

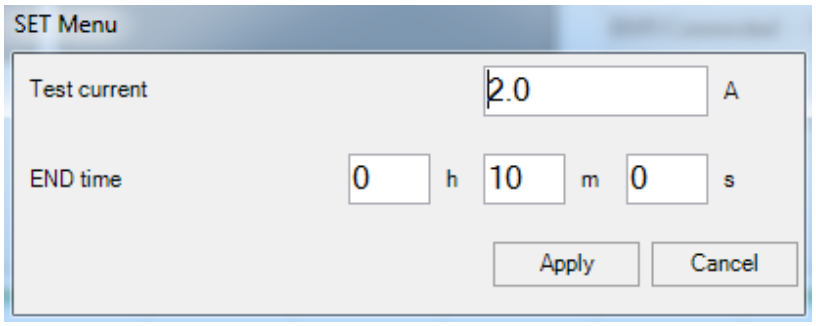


Figure 4-17: SET menu

4.3.1.2. String view results

Results recorded each second during the test process can be seen in a graphical view. The numerical results for every second of a discharge test can be found in a report. Currently measured numerical values of a discharge test are shown in the panel in the top left corner of the window.

Test results are shown at the bottom part of the window. DV-B-Win keeps two types of results: string and cell results. String results are collected from the BLU device and presented under the *String View* section. By pressing the *String Viewer* button the user will see the string results otherwise the cell results will be displayed.

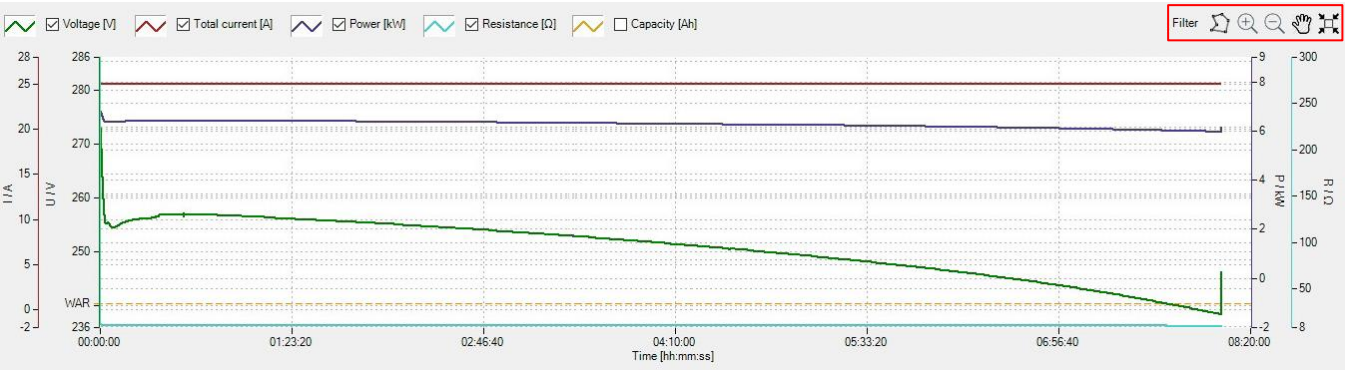


Figure 4-18: String results screen

With a right click of the mouse above the legend of waveforms, the user is able to change a line color, line style and line thickness of a desired waveform. In addition, it is possible to remove or to bring up a view of a waveform on the graph by selecting the check box near the name of the waveform.

Using the grid button next to the legend, the gridlines can be turned on/off.

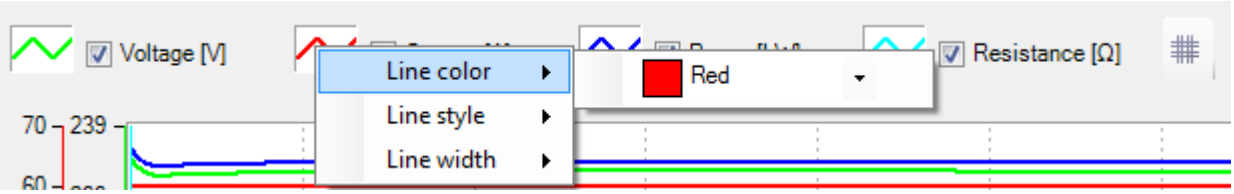


Figure 4-18.a): Section of discharge test screen related to results obtained with BLU

To zoom in the resulting graph use “shift + left/right mouse-click” combination. Click on the waveform area, press shift, click with the left mouse button and drag rectangle over the area selected to zoom in.

4.3.1.3. U+I Mode (BVR22)

BVR22 device can also be used with other battery discharge units on the market, by measuring the voltage and the total current of the battery (to the measurement of battery current and voltage by the SSB instrument during discharge).
To enable this function, the U + I mode should be selected in the Test Settings window.

Note: If the BLU battery discharge unit is also connected to DV-B Win with the BVR22 instrument, the U + I mode will not be available for BVR22 (only ***Standard*** mode can be selected).

The results measured by BVR22 are displayed graphically in the battery preview (instead of the BLU results).

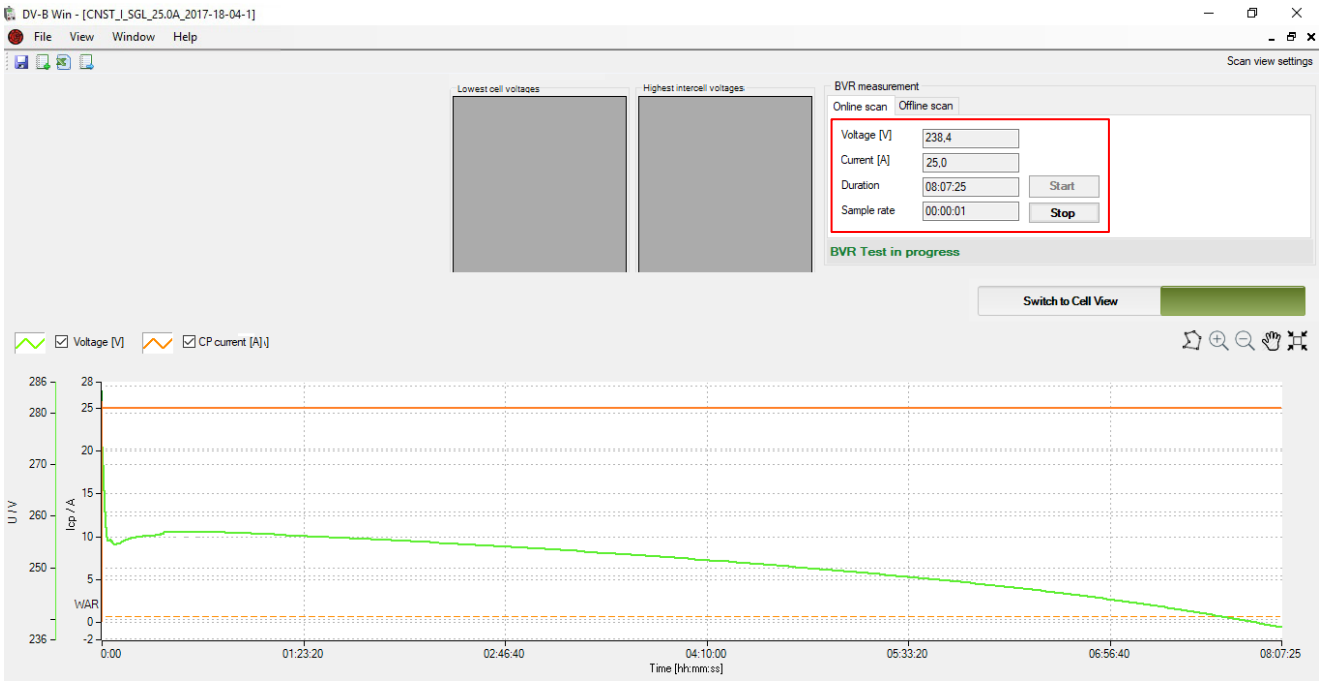


Figure 4-19: Graphical preview of U+I mode test results in real-time

Values measured for the latest scan (the maximum selectable sampling rate is 1 second) are displayed in the upper right portion of the test form (marked in red in Figure 4-19).

4.3.2. Cell measurement

4.3.2.1. Manual mode

This mode will appear on the device display if the cell voltage measuring mode was selected either as “Manual” or “BVR monitoring mode”, while waiting for BVR to connect to the computer.

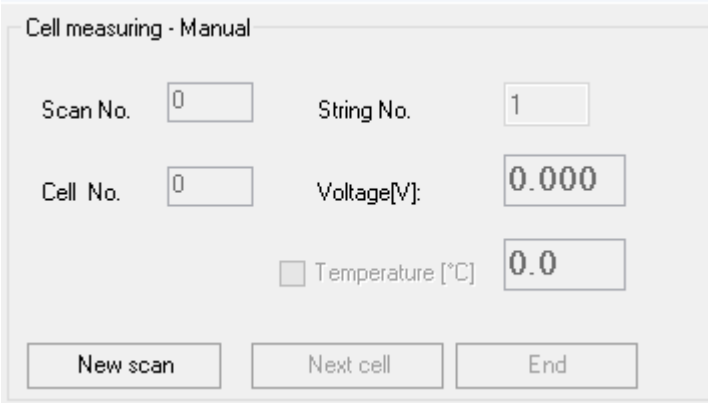


Figure 4-20: Part of discharge test screen related to cell monitoring

The “**New scan**” button is used to start the voltage scan. In the fields above, the user inserts voltage and temperature values for the specific cell.
The “**Next cell**” button is used to enter a corresponding value for the next cell measurement.
The “**End**” button is used to end the current scan.

Cell monitoring mode using BVR

The online scan with BVR presents performing real-time measured values from the BVR per each cell. The Download section enables downloading selected scans from the BVR device memory.

4.3.2.2. Online scan

To start a new scan press the “**New scan**” button and the measured values for this scan will be entered in the corresponding table field related to the cell ID number.

The “**End**” button is used to end the current scan.

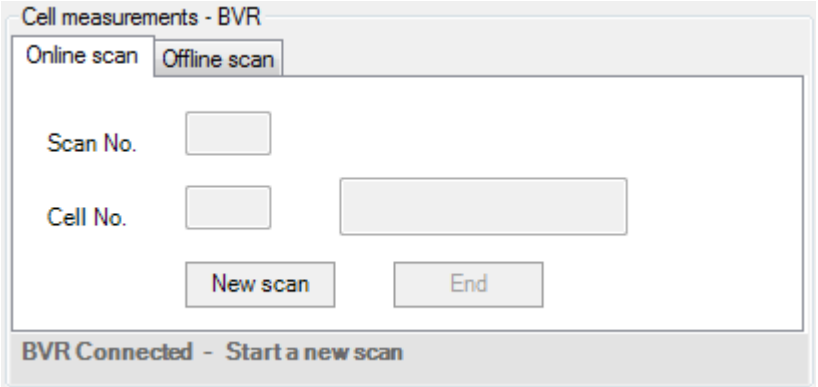


Figure 4-21: Part of discharge test screen related to cell monitoring using BVR

4.3.2.3. Results download

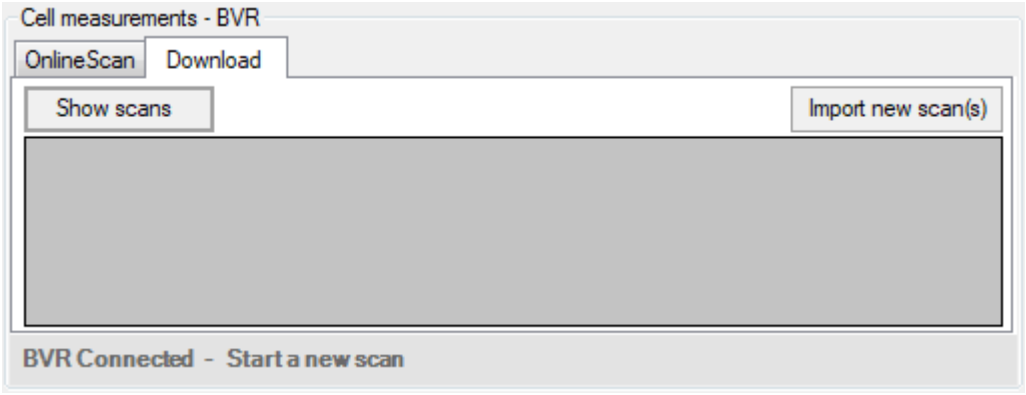


Figure 4-21: Part of discharge test screen related to test results download from BVR

To download the list of the test data from the BVR device, first press the "**Show scans**" button in the ***Download*** tab. The list of scans recorded in the BVR's memory will be presented with a possibility to select desired scans for download, as shown in the figure below.

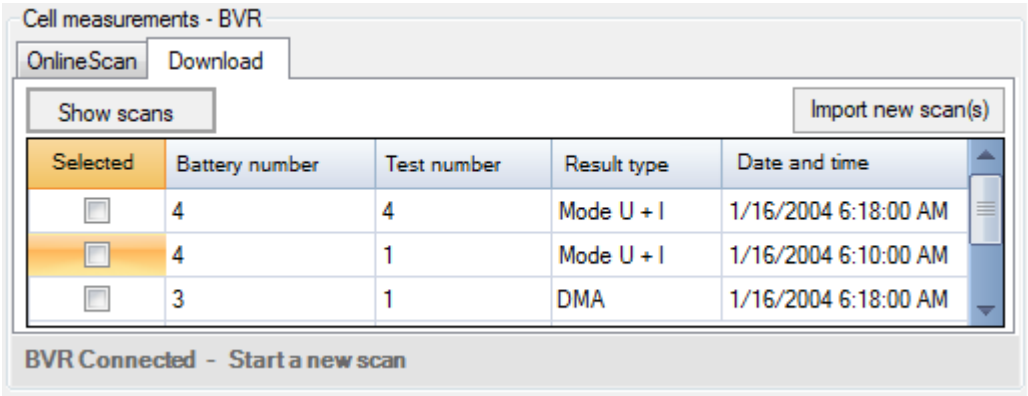


Figure 4-22: Offline cell monitoring using BVR

The column ***Battery number*** represents the ordinal number of the battery in the database of BVR device, for which the test is performed. The column ***Test number*** is the ordinal number of the test performed for a specific battery. The column ***Result type*** represents the test mode for the selected result (***Standard*** mode, ***U+I*** mode and ***DMA***).

To get the test values from the selected scans press the button "*Import scans*". The selected scans will be presented in the cell viewer table in the test form.

The user can use the offline scan function after performing each measurement scan with BVR device, or in case she/he prefers to perform all voltage scans manually on the device during the test, and import all data subsequently. In this case, the user needs to open the discharge test results and import the BVR results in the same file to create a more detailed test report.

4.3.2.4. Cell view results

Cell votage, temperature, and density results are presented graphically and numerically in the Cell view part of the testing form. To navigate to this preview from the BLU results view, select the following button in the test form:



In addition to cell results, the ambient temperature is also measured by BVR at the beginning of each scan, and this value is displayed on the *Cell voltage* tab.

The measured string voltage by BVR is also displayed on the *Cell voltage* tab. The BVR instrument detects the measured voltage as the string voltage, if the measured value is greater than the value of 0.9 * *final string voltage* (entered in *Test settings*). In this way, it is possible to measure both cell and string voltages for each scan.

Navigation between performed scans

Min & max voltage values, total voltage value (the sum of cell voltages) and the average value

Ambient temperature and string voltage measured by BVR for each scan



The user can change the results view type by clicking on the icon in the upper right corner of the Cell preview section, marked in red in the figure below.

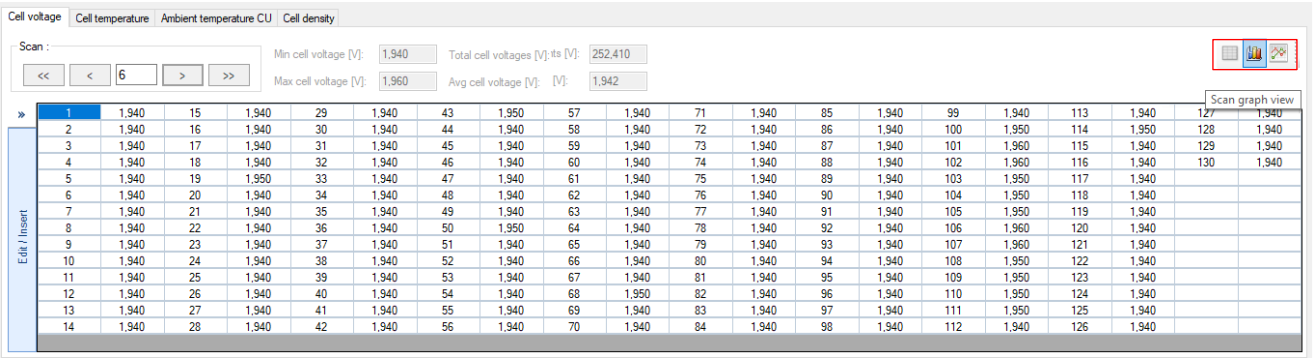


Figure 4-24: Cell results screen (tabular results – by default)

By clicking the icon  in the middle of the section marked in red in Figure 4-24, the histogram view will be activated, as shown in Figure 4-25.

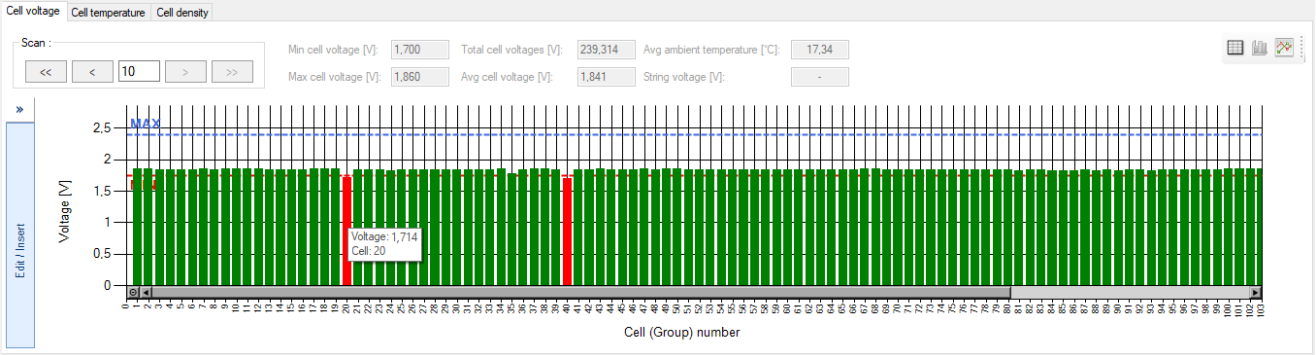


Figure 4-25: Histogram view of cell results

Cells with warning voltage reached during the test are marked in yellow. Cells for which the final cell voltage has been reached are marked in red. By placing the cursor on a specific cell, the voltage and number of active cell are displayed.

By clicking the icon on the right  in Figure 4-26, the line chart preview is enabled. Each scan is presented with a corresponding color (Figure 4-26).

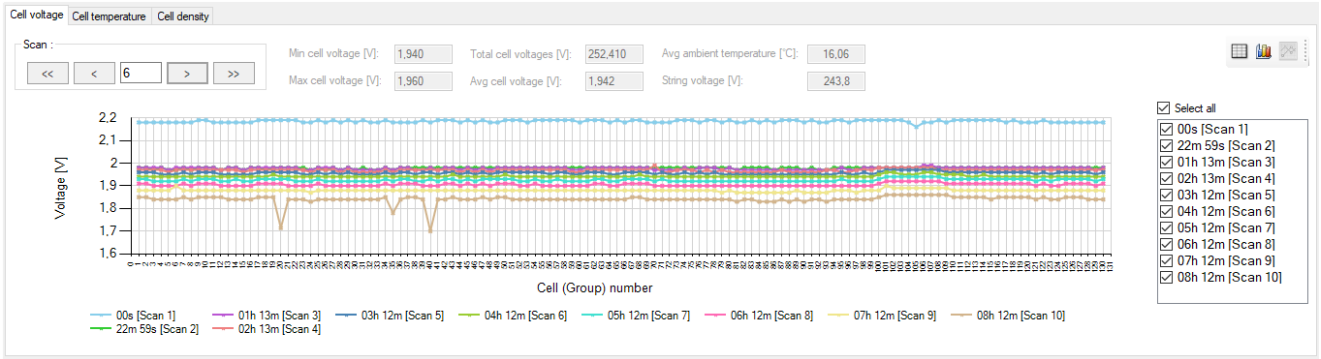


Figure 4-26: Line chart view of cell results

The *Cell temperature* tab displays the min & max temperature values, and the calculated average temperature for the active scan (as for the cell voltage tab). These values can be entered manually or measured by BVR.



Figure 4-27: Cell temperature summarized results

A useful information during the discharge process is the display of lowest cell voltage / highest cell temperature values taken during the latest scan, as well as the cell numbers containing these values. In this way, the user can obtain a direct preview of critical cells in the system, as shown in Figure 4-28.

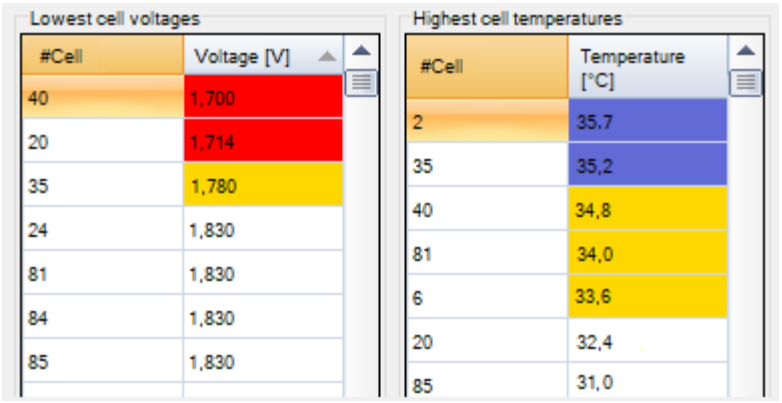
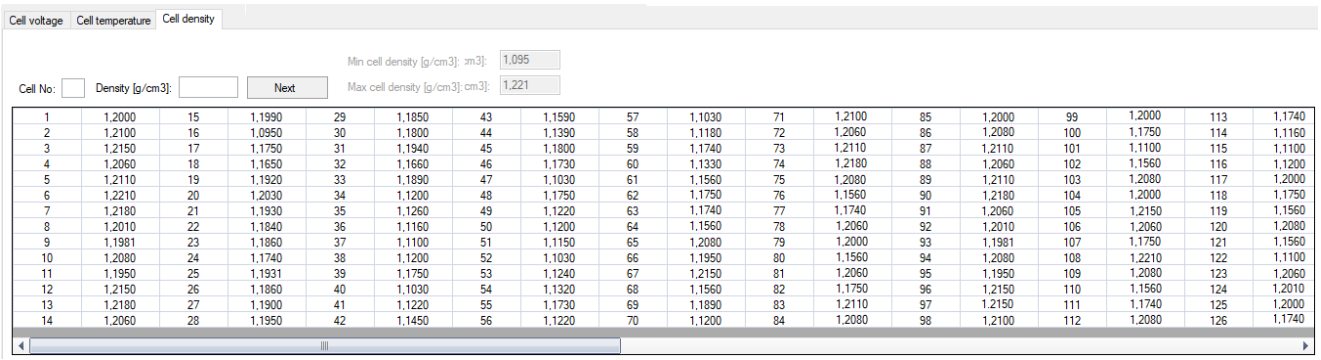


Figure 4-28: Display of cells with critical voltage / temperature values

For vented lead-acid batteries, the electrolyte density measurements can also be taken during the discharge test, as per recommendations of IEEE standards for battery capacity testing. DV-B Win provides an additional tab for entry of measured electrolyte density values, as shown in figure below.



1	1,2000	15	1,1990	29	1,1850	43	1,1590	57	1,1030	71	1,2100	85	1,2000	99	1,2000	113	1,1740
2	1,2100	16	1,0950	30	1,1800	44	1,1390	58	1,1180	72	1,2060	86	1,2080	100	1,1750	114	1,1160
3	1,2150	17	1,1750	31	1,1940	45	1,1800	59	1,1740	73	1,2110	87	1,2110	101	1,1100	115	1,1100
4	1,2060	18	1,1650	32	1,1660	46	1,1730	60	1,1330	74	1,2180	88	1,2060	102	1,1560	116	1,1200
5	1,2110	19	1,1920	33	1,1890	47	1,1030	61	1,1560	75	1,2080	89	1,2110	103	1,2080	117	1,2000
6	1,2210	20	1,2030	34	1,1200	48	1,1750	62	1,1750	76	1,1560	90	1,2180	104	1,2000	118	1,1750
7	1,2180	21	1,1930	35	1,1260	49	1,1220	63	1,1740	77	1,1740	91	1,2060	105	1,2150	119	1,1560
8	1,2010	22	1,1840	36	1,1160	50	1,1200	64	1,1560	78	1,2060	92	1,2010	106	1,2060	120	1,2080
9	1,1981	23	1,1860	37	1,1100	51	1,1150	65	1,2080	79	1,2000	93	1,1981	107	1,1750	121	1,1560
10	1,2080	24	1,1740	38	1,1200	52	1,1030	66	1,1950	80	1,1560	94	1,2080	108	1,2210	122	1,1100
11	1,1950	25	1,1931	39	1,1750	53	1,1240	67	1,2150	81	1,2060	95	1,1950	109	1,2080	123	1,2060
12	1,2150	26	1,1860	40	1,1030	54	1,1320	68	1,1560	82	1,1750	96	1,2150	110	1,1560	124	1,2010
13	1,2180	27	1,1900	41	1,1220	55	1,1730	69	1,1890	83	1,2110	97	1,2150	111	1,1740	125	1,2000
14	1,2060	28	1,1950	42	1,1450	56	1,1220	70	1,1200	84	1,2080	98	1,2100	112	1,2080	126	1,1740

Figure 4-29: Cell density values (entered manually in DV-B Win)

4.3.2.5. Cell trending analysis

Voltage / Temperature trend of a cell can be presented by positioning the cursor on the specific cell column under the graphical view of scan and pressing the right mouse button. The graphical presentation of voltage or temperature trend is shown in the right part of the display.

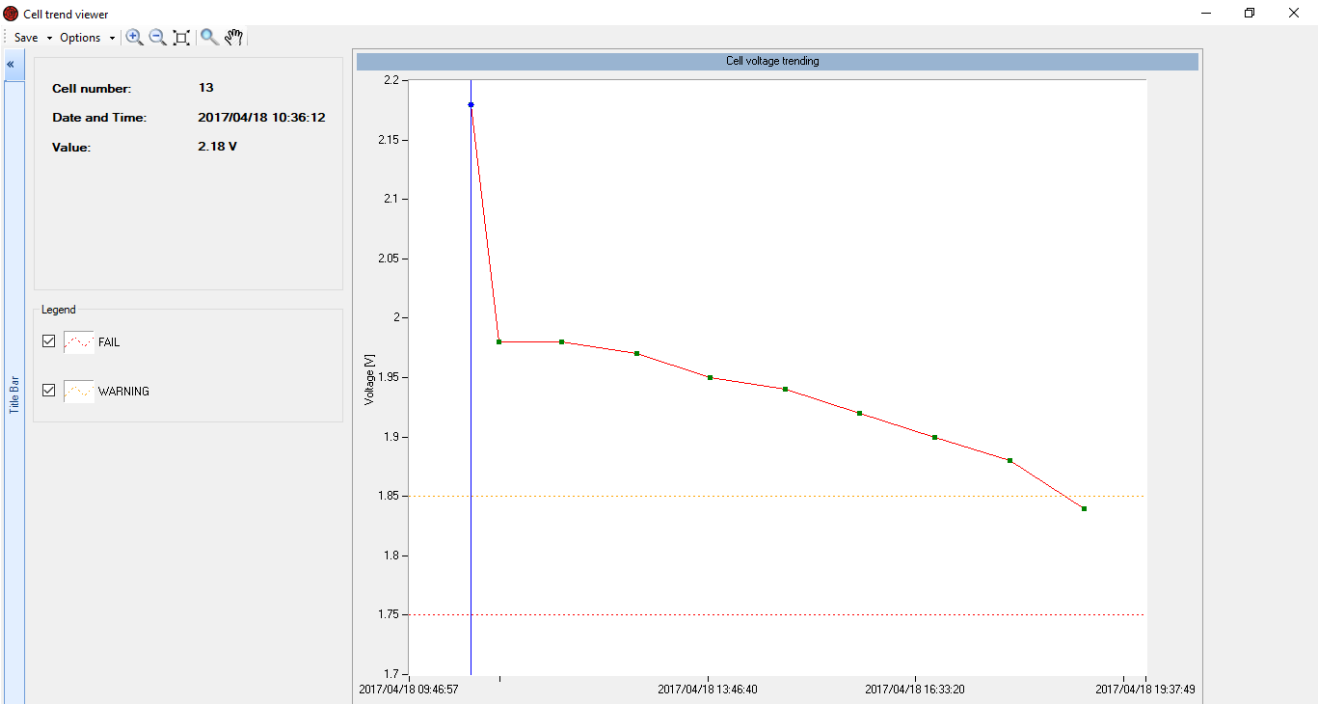


Figure 4-30: Voltage/ temperature trend screen (for cell no. 13)

The panel show on the left of Figure 4-30 displays the active cell number, date and time of the performed measurement, as well as the voltage value for the current position of the cursor (marked in blue in Figure 4-30).



Figure 4-31: Voltage/ temperature trending screen

Cell trend viewer offers a high degree of freedom in personalizing and customizing results representation. For selected cell (e.g. Cell1) there is appearance properties loaded as docking panel colors.

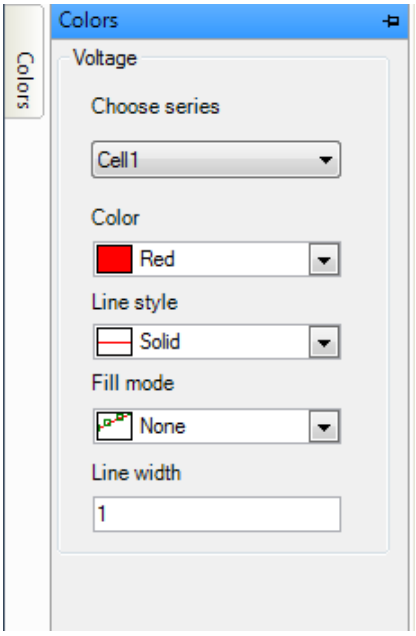


Figure 4-32: Appearance properties in Voltage/temperature trend screen

To zoom in on a specific graph range, use Zoom tool or shift + left mouse button click combination. Click on the waveform area, press shift, click with the left mouse button and drag rectangle over the area to zoom in.

The toolbar under the Options drop-down menu enable excluding /including a view of points values on the waveform. The user can hide or unhide Colors docking panel as well.

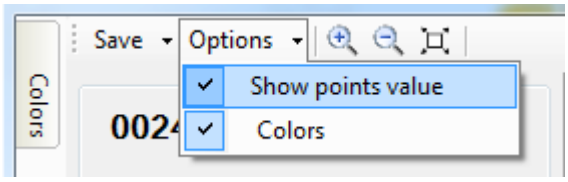


Figure 4-33: Voltage/temperature trend screen - drop down menu

In the toolbar under the Save drop-down menu the user is able to save the resulting graph as an image or to copy it to a clipboard.

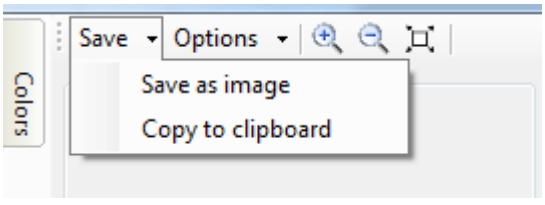


Figure 4-34: Voltage/temperature trend screen - save options

4.4. Saving test results

Results obtained from the devices (BLU or/and BVR) can be saved to a file with .dvvb extension. In the available tools shown in figure below, select *Save* → *Save as file*, where a Save dialog box will appear.

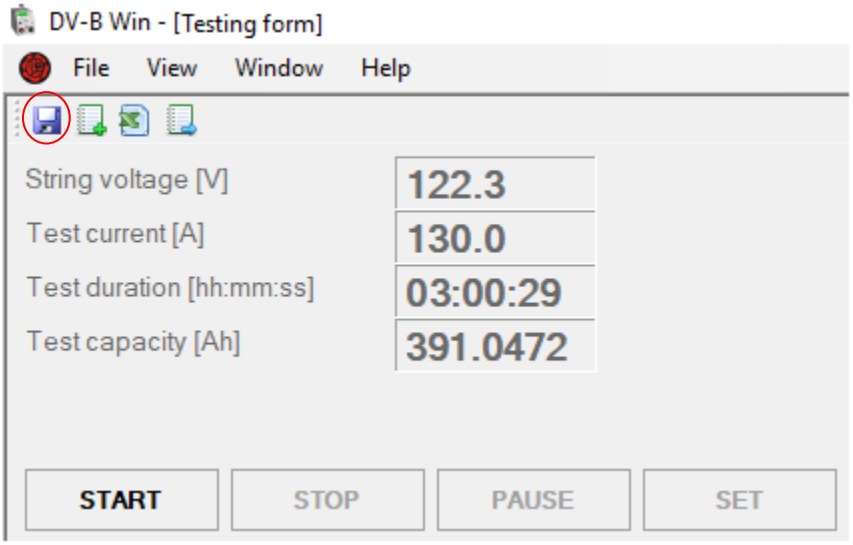


Figure 4-35: Saving test results

Additional available buttons that provide test results collection and analysis tools, are stated below:

Import results

- ***Import BLU results*** - This option provides importing a test result from BLU device during a discharge test, into a result from BVR with cell values. In this way, all discharge data (both from BLU and BVR) can be analyzed in one file and generated in one test report
- ***Import cell results*** - this option provides importing multiple results from BVR device in one DV-B Win file, or adding cell results from BVR to a file with BLU results.
- ***Import BVS log*** - this option is used in case of communication loss between BVS and PC during the discharge test, for import of lost data from BVS (refer to the User manual for BVS series for more information).

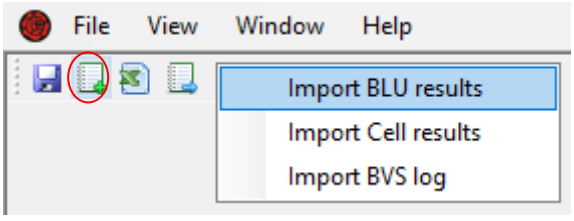


Figure 4-36: Options for results import

Export to Excel

By selecting this button, all results displayed in the testing form (from BLU and BVR) will be exported into one excel file.

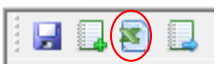


Figure 4-37: Export to Excel

Results obtained from the devices (BLU or/and BVR) can be saved to a file with the .dvvb extension. In the Save menu choose Save » Save as file where a Save dialog box will appear.

4.5. Power supply interruption - Automatic resume (BLU)

The BLU Series instruments provide a special feature: automatic test resume in case of mains power supply interruption, short-term or long-term. The instrument will pause the discharge tests if mains power supply is interrupted, while all parameters of the discharge test (measured capacity, elapsed time, battery voltage with 1 sec sampling resolution, discharge current / power / resistance with 1 sec sampling resolution) are recorded in the device's memory.

In case mains power supply is interrupted, the BLU unit switches off while the DV-B Win software displays an appropriate message within 5 sec (Figure 4-38.a).

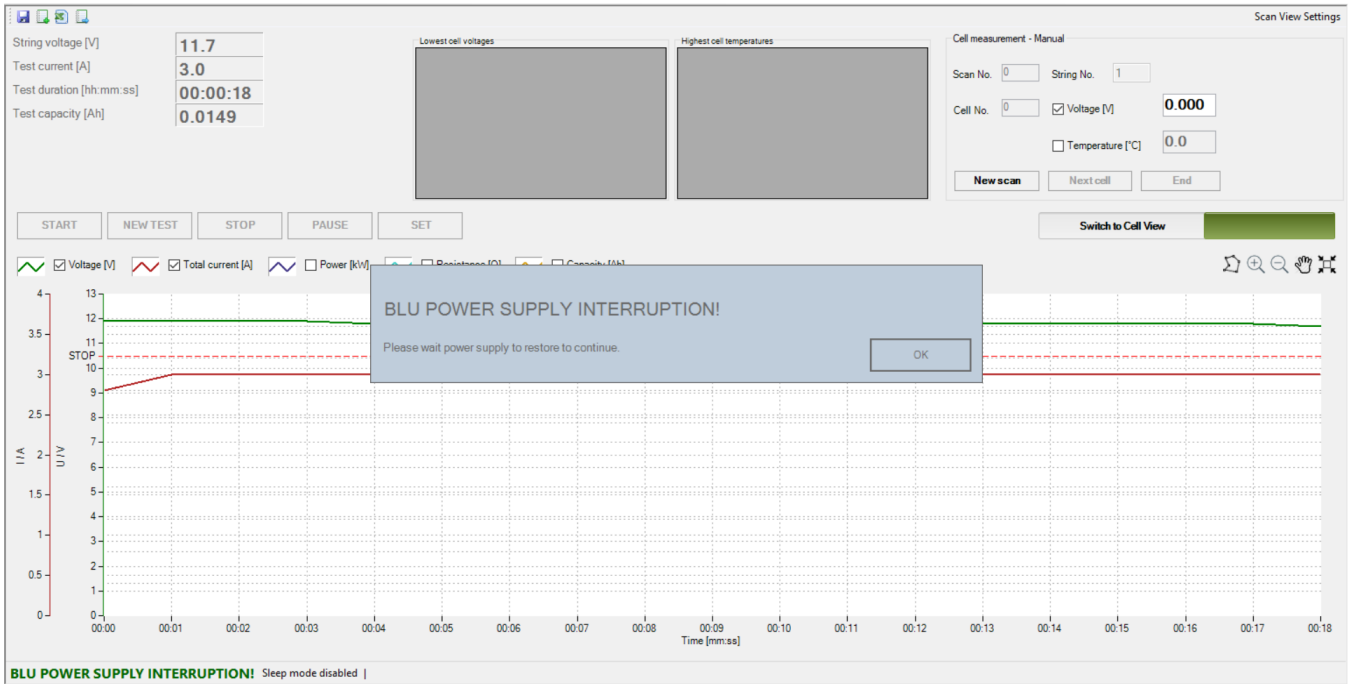


Figure 4-38-a): Test Resume feature

After mains power supply is restored, the DV-B Win software displays a message: "Power supply has been restored!" (Figure 4-38.b).

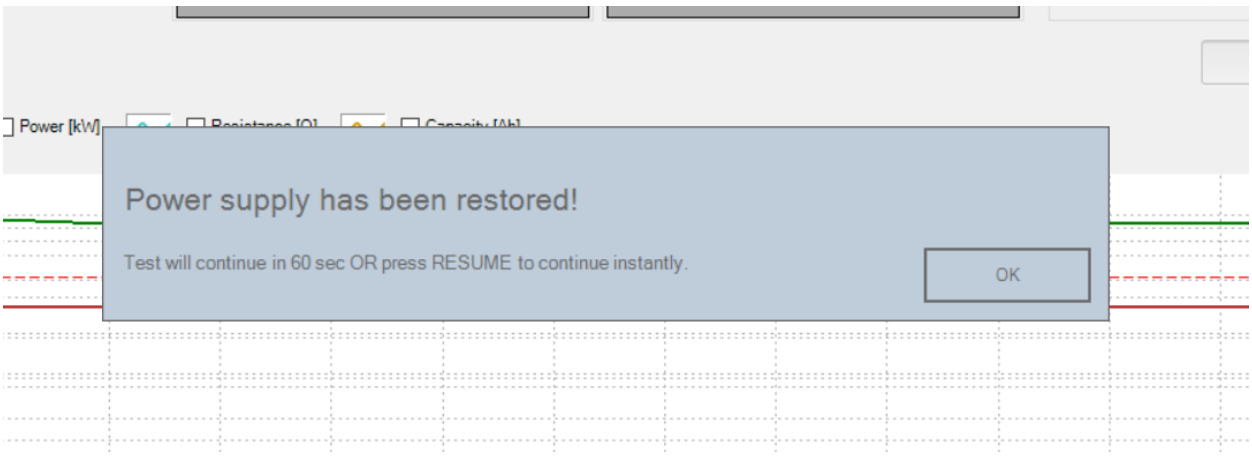


Figure 4-38.b): Message "*Power supply has been restored*"

The test can be continued in two ways: automatically (without human interaction) and manually.

As the mains power supply is restored, the buzzer will become active and the instrument will start counting time (from 60 sec to 0 sec). After 60 sec period has elapsed, the buzzer will be deactivated and the discharge test will be continued without need for human interaction (the exception are tests in *Current probe (CP)* mode which require current probe zeroing before test can be continued*).* All pre-test test settings remain unchanged (end voltage, test time, end capacity, warning limits).

However, if present, the operator does not need to wait for 60 sec test to be continued. As the information that *mains supply is restored* is displayed, the test can be continued by clicking on the Resume button in the DV-B Win software (Figure 4-39). Note that tests in *Current probe (CP)* mode require current probe zeroing before test can be continued.

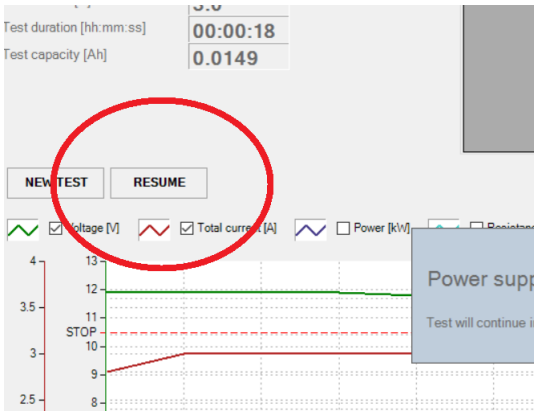


Figure 4-39: Button RESUME for manual test resume

A click on the *Resume* button will continue the test while any test settings will remain unchanged. During the test, the test settings can be changed (test current / power / resistance and limits) as in case of non-interrupted tests. If the user wants to abort the current test and start a new test, it can be done by using the *New Test* button. A click on the *New Test* button will irretrievably abort the current discharge test and the *Test Settings* menu will be displayed.

Note: The information that the mains power supply was interrupted will be stated in the report, in the "Report comments" section

5. Creating Test report

A Test report can be generated by pressing the icon "*Report*" on the toolbar (marked with a red circle in the figure below).

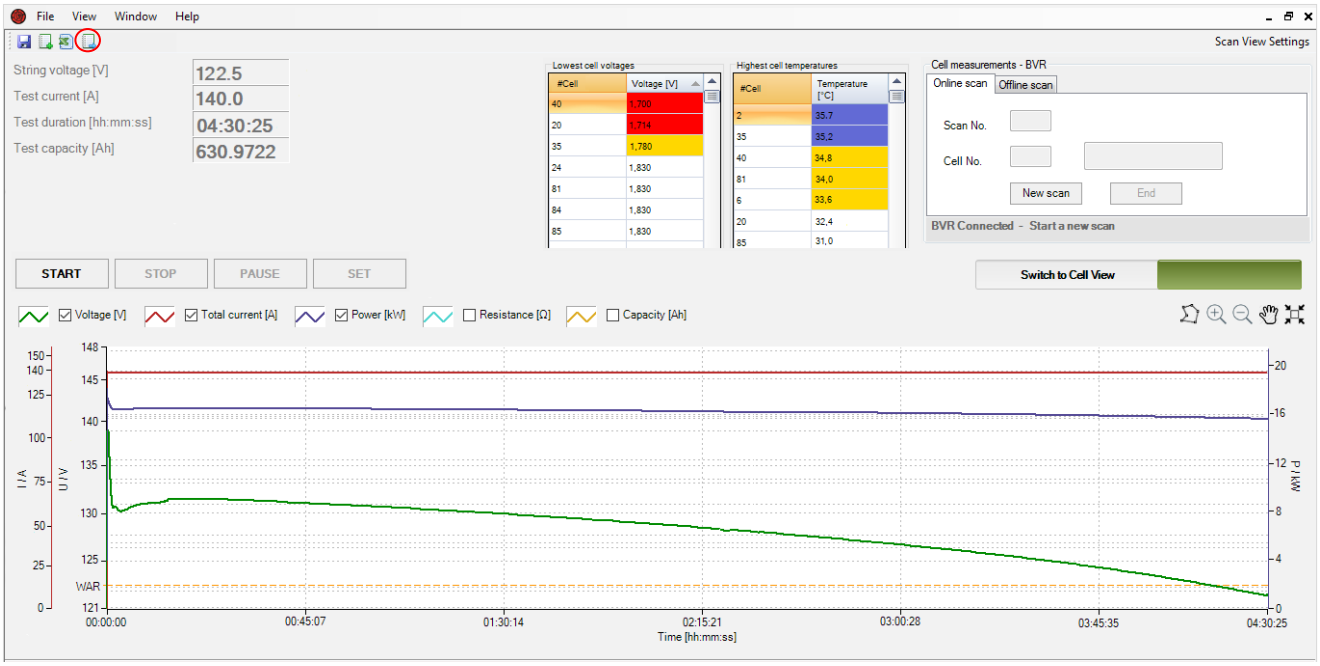


Figure 5-1: Test report creation

After clicking the report button on the toolbar, the report viewer opens:

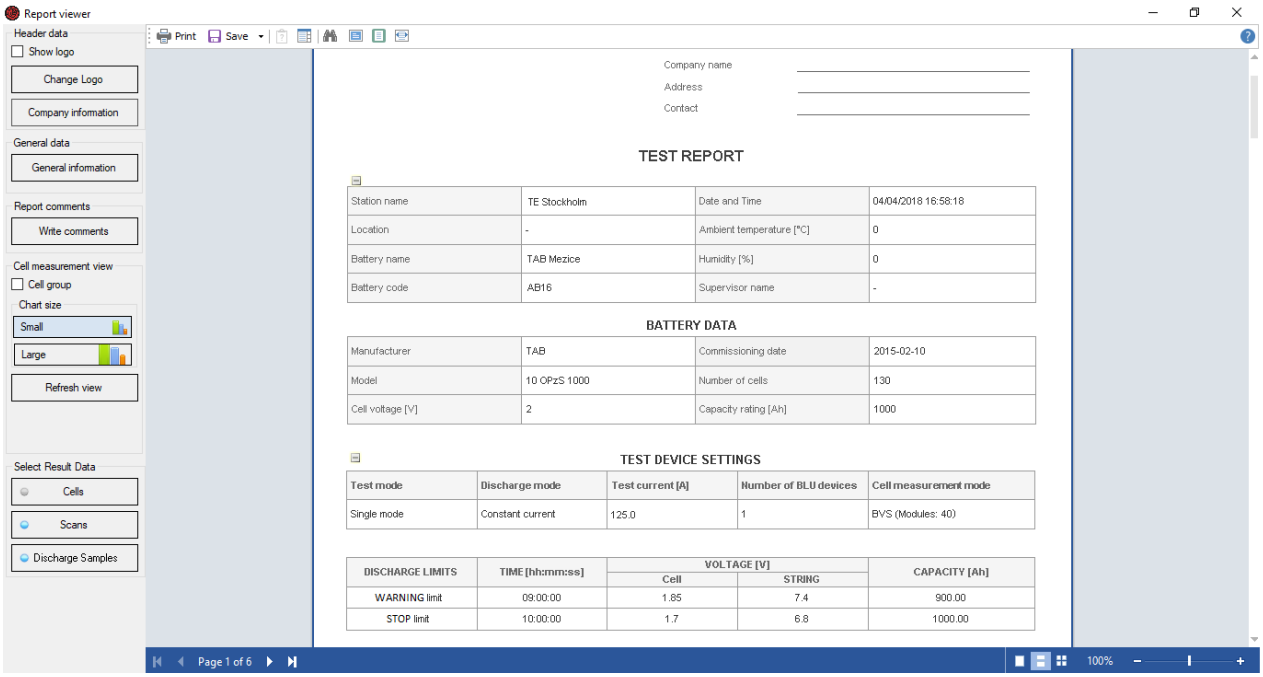


Figure 5-2: Test report layout (for a test performed with BLU & BVR)

The Report viewer tool has several sections, allowing the user to modify the test report:

Change logo - enables the user to change the company logo in the test report.

Company information - This button includes basic company information. By clicking on the *Company information* button, the following window appears:

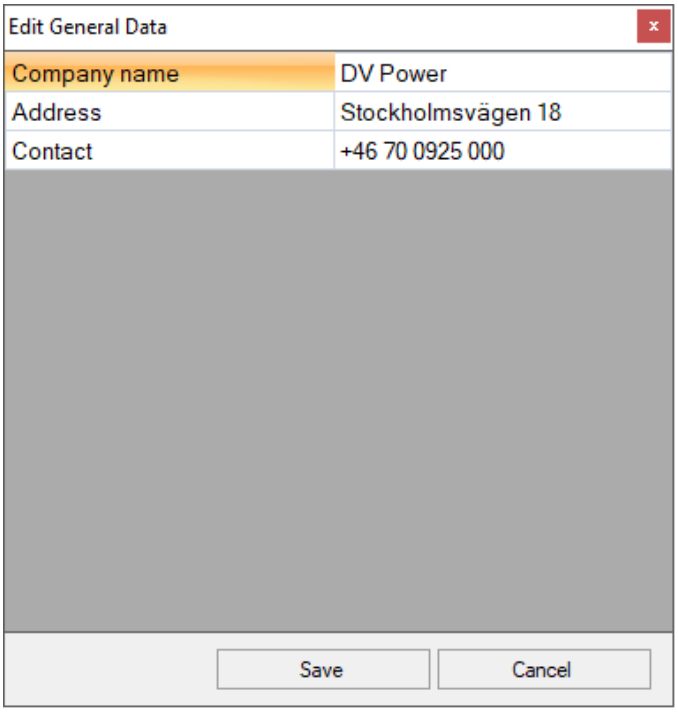


Figure 5-3: Company information data editing

General information - This section includes *General information* button allowing the user to change the previously entered information about location data and test object. By clicking on the *General information* button the following window appears:

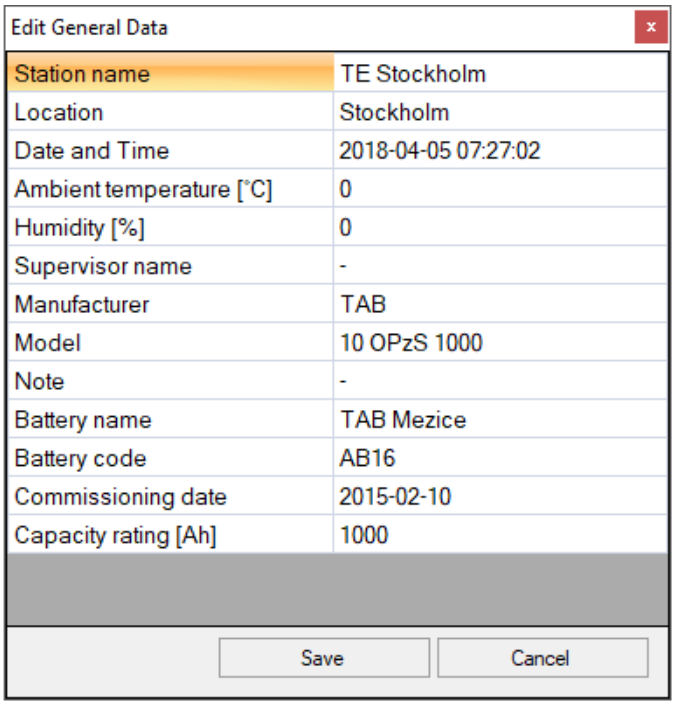


Figure 5-4: General data editing

Write comments - enables writing notes and comments in the report document:

Cell measurement view - enables the user to exclude or include cell groups from the test report, and to choose whether to use a detailed or default cell results view in the test report. After every change it is necessary to click the ***Refresh Report*** button in order to confirm all changes.

Numerical test results are displayed in the following order:

- ***Discharge test results***: these results represent values measured by BLU device with sampling rate of 1 sec during the discharge test. Test parameters that are being displayed are battery voltage, test current / power / resistance and capacity for each sample.
- ***Cell measurement values***: This part of the test report represents measured data for cell voltage and cell temperature measured by BVR, and cell density (if this data was previously entered manually in DV-B Win)

Tabular results from discharge test with BLU device are displayed for the first and the last scan by default. By selecting the button Discharge samples in the left part of report tools, it is possible to choose specific (or all) BLU samples for display. The figure below shows tabular results recorded for each sampels (1 second) with BLU device.

TEST RESULTS

Discharge mode: Constant current

Sample No.	Time	Voltage [V]	Test current [A]	Test capacity [Ah]	Test power [kW]	Test resistance [Ω]
0	00:00:00	284.3	25.0	0.0000	7.11	11.4
1	00:00:01	284.3	0.0	0.0000	0.00	300.0
2	00:00:02	283.4	22.9	0.0001	6.49	12.4
3	00:00:03	281.8	25.7	0.0072	7.24	11.0
4	00:00:04	281.6	25.5	0.0143	7.18	11.0
5	00:00:05	281.5	25.4	0.0214	7.15	11.1
6	00:00:06	280.8	25.3	0.0284	7.10	11.1
7	00:00:07	277.0	25.2	0.0354	6.98	11.0
8	00:00:08	276.3	25.2	0.0424	6.96	11.0
9	00:00:09	276.0	25.1	0.0494	6.93	11.0
10	00:00:10	275.9	25.1	0.0564	6.93	11.0
11	00:00:11	275.7	25.1	0.0634	6.92	11.0
12	00:00:12	275.5	25.0	0.0704	6.89	11.0
13	00:00:13	275.3	25.0	0.0773	6.88	11.0
14	00:00:14	275.1	25.0	0.0842	6.88	11.0
15	00:00:15	274.9	25.0	0.0911	6.87	11.0
16	00:00:16	274.7	25.0	0.0980	6.87	11.0
17	00:00:17	274.5	25.0	0.1049	6.86	11.0
18	00:00:18	274.3	25.0	0.1118	6.86	11.0
19	00:00:19	274.1	25.0	0.1187	6.85	11.0
20	00:00:20	274.0	25.0	0.1256	6.85	11.0

Figure 5-5: Numerical results from BLU

Besides selection of specific samples to show, a specific range of samples can also be shown, as well as the sample rate (in seconds):

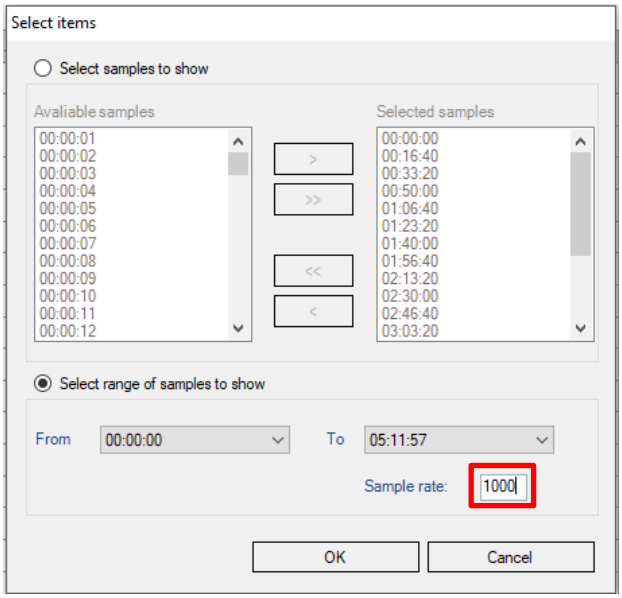


Figure 5-6: Selection of range of discharge samples

For the option shown in figure 5-6, the range of samples to show is 1000, which corresponds to display of samples with a sampling time of 1000 seconds.

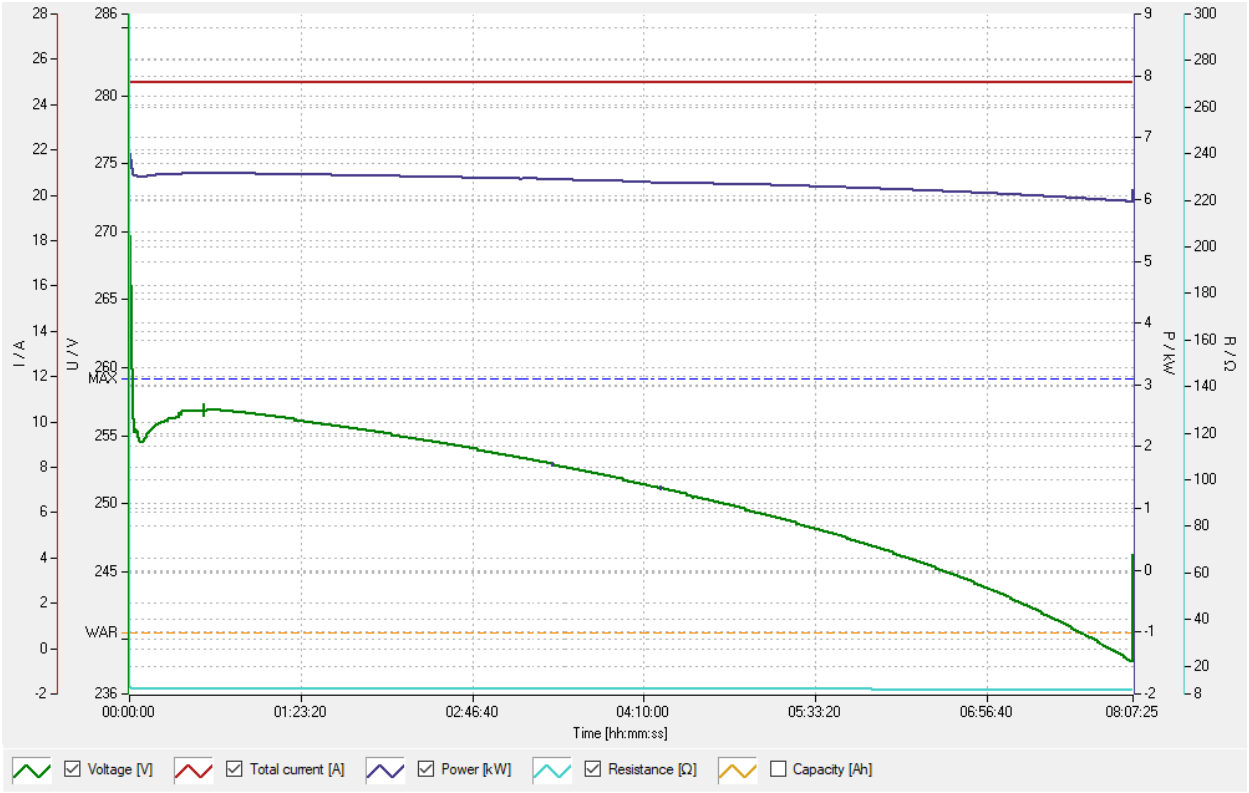
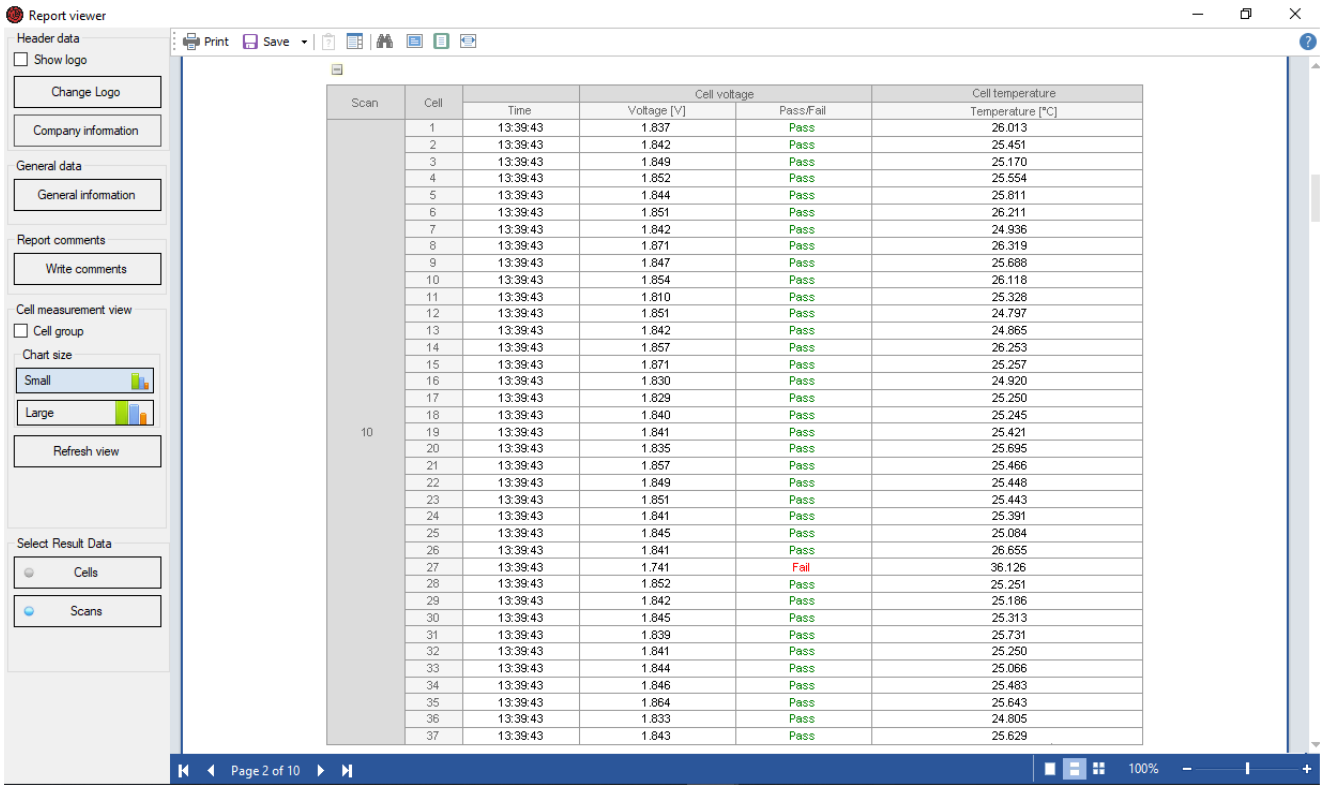


Figure 5-7: Battery discharge graph (BLU device)

Cell measurement values measured by BVR are also shown in numerical and graphical views.

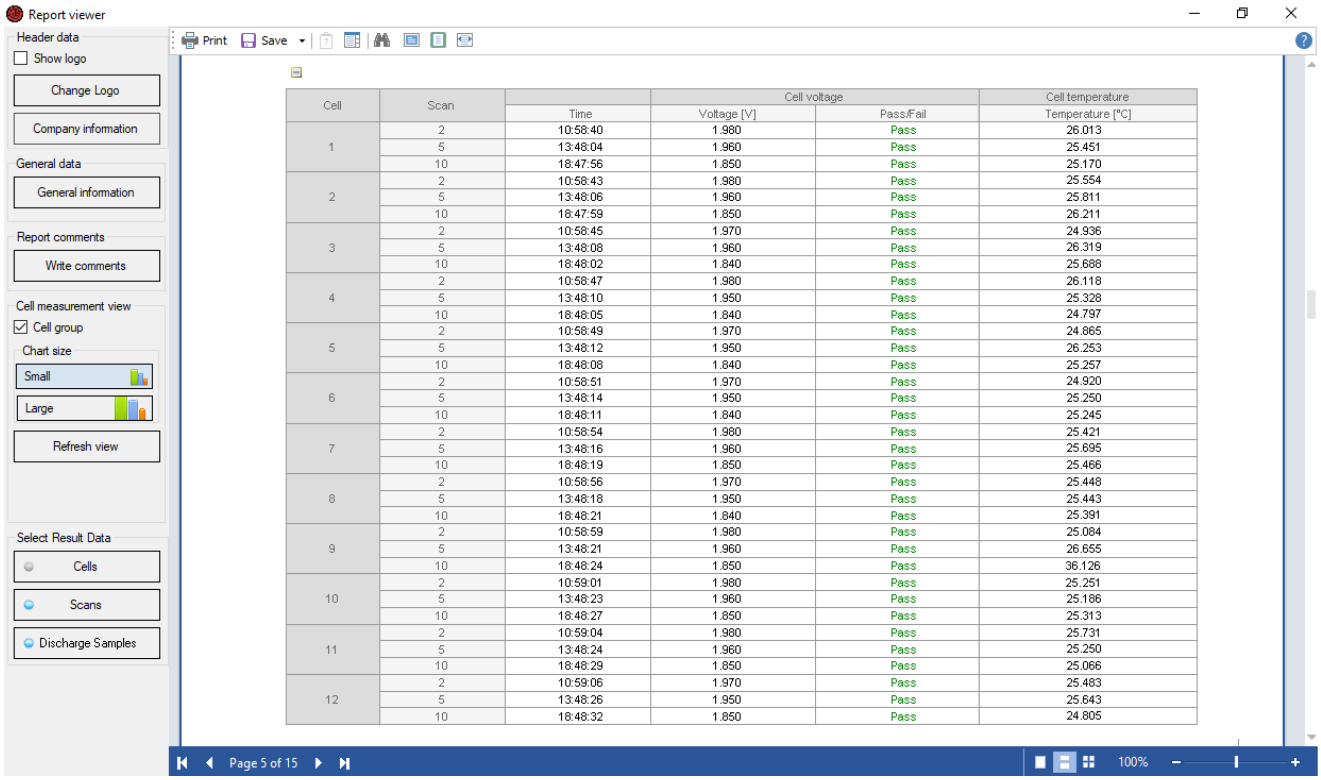
Tabular results of cell measurements can be displayed in two ways:

- ***Scan view*** - this view is active by default, and numerical results for this view are sorted for all cells by scans, as shown in figure 5-8.a).
- ***Cell view*** - by selecting the check box *Cell group* in the test report tools, numerical results will be distributed by cells. In this case, scans taken for one cell will be collected, as shown in figure 5-8.b).



Scan	Cell	Time	Cell voltage Voltage [V]	Cell voltage Pass/Fail	Cell temperature Temperature [°C]
10	1	13:39:43	1.837	Pass	26.013
	2	13:39:43	1.842	Pass	25.451
	3	13:39:43	1.849	Pass	25.170
	4	13:39:43	1.852	Pass	25.554
	5	13:39:43	1.844	Pass	25.811
	6	13:39:43	1.851	Pass	26.211
	7	13:39:43	1.842	Pass	24.936
	8	13:39:43	1.871	Pass	26.319
	9	13:39:43	1.847	Pass	25.688
	10	13:39:43	1.854	Pass	26.118
	11	13:39:43	1.810	Pass	25.328
	12	13:39:43	1.851	Pass	24.797
	13	13:39:43	1.842	Pass	24.865
	14	13:39:43	1.857	Pass	26.253
	15	13:39:43	1.871	Pass	25.257
	16	13:39:43	1.830	Pass	24.920
	17	13:39:43	1.829	Pass	25.250
	18	13:39:43	1.840	Pass	25.245
	19	13:39:43	1.841	Pass	25.421
	20	13:39:43	1.835	Pass	25.695
	21	13:39:43	1.857	Pass	25.466
	22	13:39:43	1.849	Pass	25.448
	23	13:39:43	1.851	Pass	25.443
	24	13:39:43	1.841	Pass	25.391
	25	13:39:43	1.845	Pass	25.084
	26	13:39:43	1.841	Pass	26.655
	27	13:39:43	1.741	Fail	36.126
	28	13:39:43	1.852	Pass	25.251
	29	13:39:43	1.842	Pass	25.186
	30	13:39:43	1.845	Pass	25.313
	31	13:39:43	1.839	Pass	25.731
	32	13:39:43	1.841	Pass	25.250
	33	13:39:43	1.844	Pass	25.066
	34	13:39:43	1.846	Pass	25.483
	35	13:39:43	1.864	Pass	25.643
	36	13:39:43	1.833	Pass	24.805
	37	13:39:43	1.843	Pass	25.629

Figure 5-8.a): Cell measurement values for scan no. 10 (*Scan view* – by default)



Cell	Scan	Time	Cell voltage Voltage [V]	Cell voltage Pass/Fail	Cell temperature Temperature [°C]
1	2	10:58:40	1.980	Pass	26.013
	5	13:48:04	1.960	Pass	25.451
	10	18:47:56	1.850	Pass	25.170
2	2	10:58:43	1.980	Pass	25.554
	5	13:48:06	1.960	Pass	25.811
	10	18:47:59	1.850	Pass	26.211
3	2	10:58:45	1.970	Pass	24.936
	5	13:48:08	1.960	Pass	26.319
	10	18:48:02	1.840	Pass	25.688
4	2	10:58:47	1.980	Pass	26.118
	5	13:48:10	1.950	Pass	25.328
	10	18:48:05	1.840	Pass	24.797
5	2	10:58:49	1.970	Pass	24.865
	5	13:48:12	1.950	Pass	26.253
	10	18:48:08	1.840	Pass	25.257
6	2	10:58:51	1.970	Pass	24.920
	5	13:48:14	1.950	Pass	25.250
	10	18:48:11	1.840	Pass	25.245
7	2	10:58:54	1.980	Pass	25.421
	5	13:48:16	1.960	Pass	25.695
	10	18:48:19	1.850	Pass	25.466
8	2	10:58:56	1.970	Pass	25.448
	5	13:48:18	1.950	Pass	25.443
	10	18:48:21	1.840	Pass	25.391
9	2	10:58:59	1.980	Pass	25.084
	5	13:48:21	1.960	Pass	26.655
	10	18:48:24	1.850	Pass	36.126
10	2	10:59:01	1.980	Pass	25.251
	5	13:48:23	1.960	Pass	25.186
	10	18:48:27	1.850	Pass	25.313
11	2	10:59:04	1.980	Pass	25.731
	5	13:48:24	1.960	Pass	25.250
	10	18:48:29	1.850	Pass	25.066
12	2	10:59:06	1.970	Pass	25.483
	5	13:48:26	1.950	Pass	25.643
	10	18:48:32	1.850	Pass	24.805

Figure 5-8.b): Cell view: selected scans for display 2, 5 and 10

Following figures present examples of cell voltage measurements in histogram and line chart views, measure by BVR device.

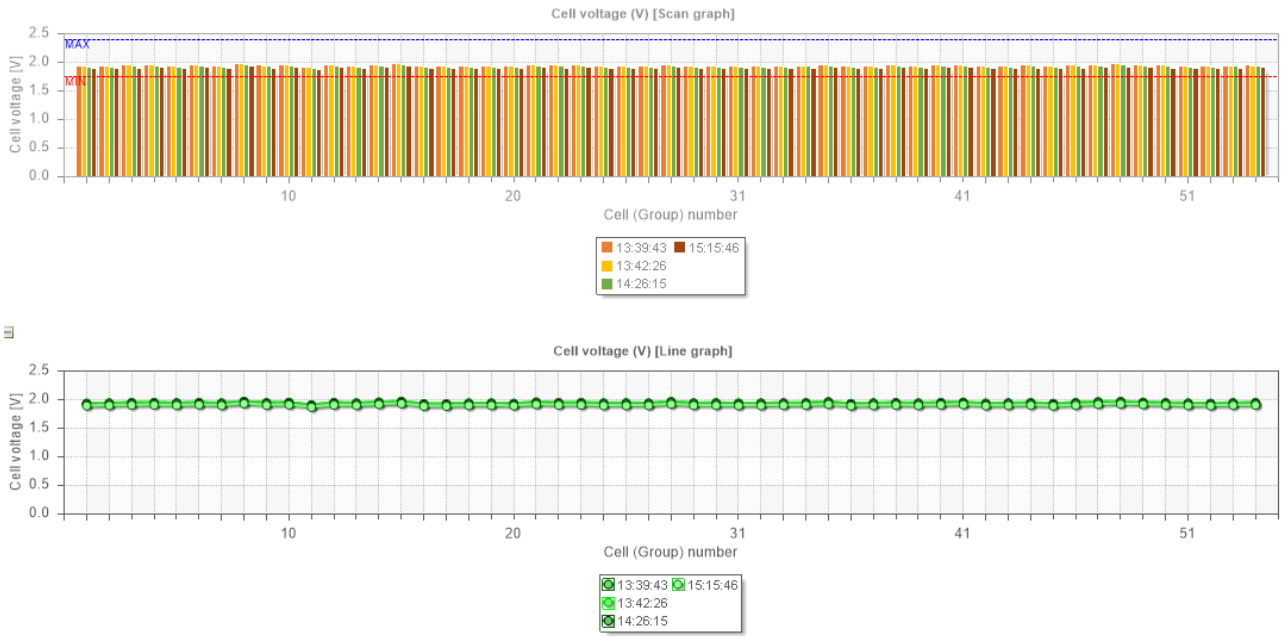


Figure 5-9: Measured cell voltages in graph forms (4 scans for a battery with 54 cells)

Specific cells or scans can be included in the test report, by selecting buttons *Cells* and *Scans* in the left part of the report tools. An example of these options are stated in figures below, for a test of a battery system of 54 cells - all cells are chosen for display, and 250 scans in total - scans 1, 50, 100, 150, 200 and 250 are chosen for display.

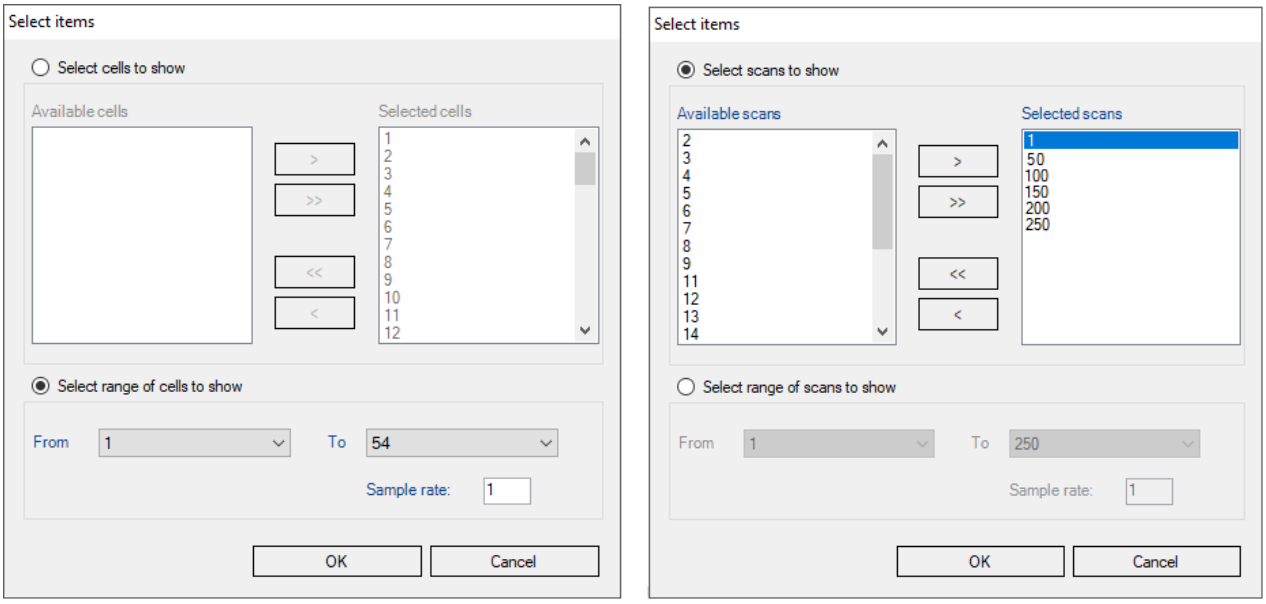


Figure 5-10: Selection of a particular cell / scan or range of cells / scans to show

Based on the selection in figures above, tabular and graphical display of results will be updated with selected cells / scans as well.

6. Comparing Test Results

DV-B Win software provides an additional tool for analysis and trending of cell voltages during the battery's service life. The test comparison feature enables comparing capacity discharge graphs (for BLU series of devices) as well as cell voltages (for BVR / BVS series) during different discharge tests. In this way, it is possible to verify the battery's remaining effective capacity in time.

The comparison of the battery voltage drop obtained during multiple periodically performed capacitance tests can be a useful indicator of premature deterioration of the battery. Overlaying several test results in a graph can help to obtain a wide range of information about the effective capacity of the battery.

The figure below shows the comparison form for two capacitance tests, performed for a battery in a period of one year with BLU & BVR instruments. The battery contains 114 cells with nominal voltage of 2 V (battery *Sonnenschein 10 OPzV1000*, model *NGA6021000HS0FA*). Configured test parameters are: I_{test} = 100 A, T_{fin} = 10h, U_{fin} = 205,0 V, C_{fin} = 1000 Ah.

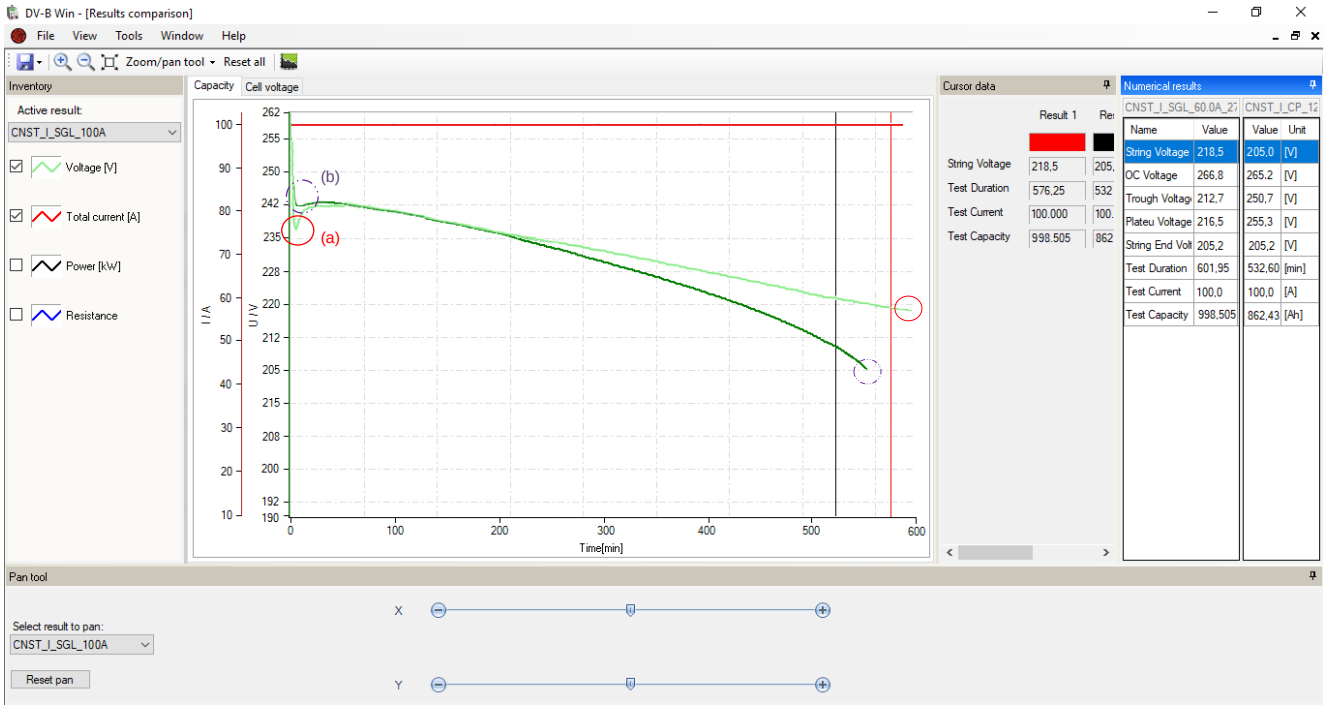


Figure 6-1: Capacity test results comparison

An additional parameter which can help analyze the behavior of the battery, is the so-called *coup de fouet*. The coup de fouet is represented by a sudden voltage drop at the beginning of the discharge test (during the first few minutes), followed by an increase in voltage. This phenomenon is marked in red in Figure 6-1 for test no. 1 (the voltage graph marked in light green) and in purple for test no. 2 carried out 1 year later (the voltage graph marked in dark green).

Analysis of *coup de fouet* can lead to conclusions only if the test parameters are identical for the two analyzed results (as in Figure 6-1). A larger voltage drop in coup de fouet corresponds to a healthier battery. The *coup de fouet* for the test nb. 2 is notably lower compared to the test no. 1, which indicates a deterioration of battery capacity. In addition, the final voltage of the battery (205 V, which corresponds to a final voltage of 1,75 V / cell) is reached before the predefined final time during test no. 2 (the end recommended by the manufacturer is 10 hours, and the final voltage is waiting after 9 hours: 22 min), which also confirms a loss of capacity of the battery.
In the tab for capacity results comparison, two cursors are available to obtain the measured values at any specific time for the two compared tests (marked in red and black in the figure above).

Using the comparison tools with DV-B Win, it is also possible to compare the voltages of the individual elements of the two analyzed tests (*Cell voltage* tab).

Cell voltage values from two discharge tests performed on the battery from Figure 6-1 are shown in figures below (results from test no. 1 are marked in light green and results from test no. 2 in dark green).

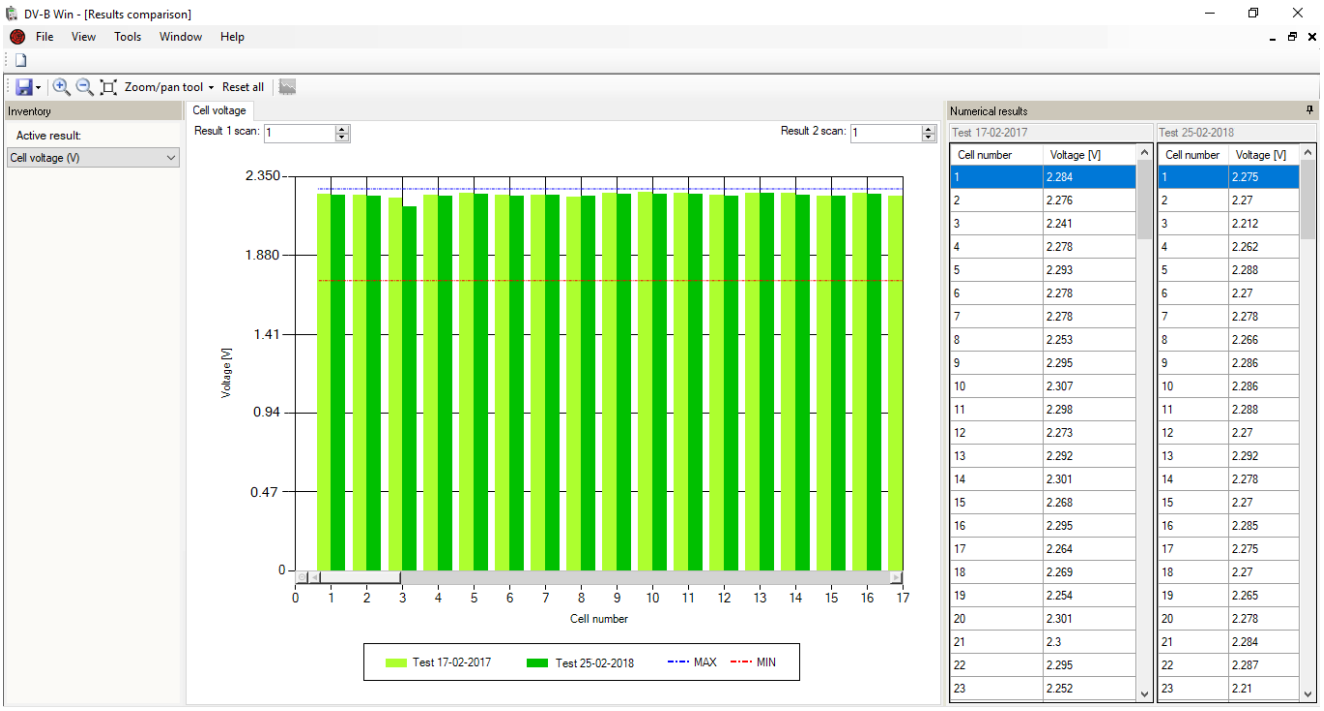


Figure 6-2: Cell voltage comparison (Scan no.1 for both tests)

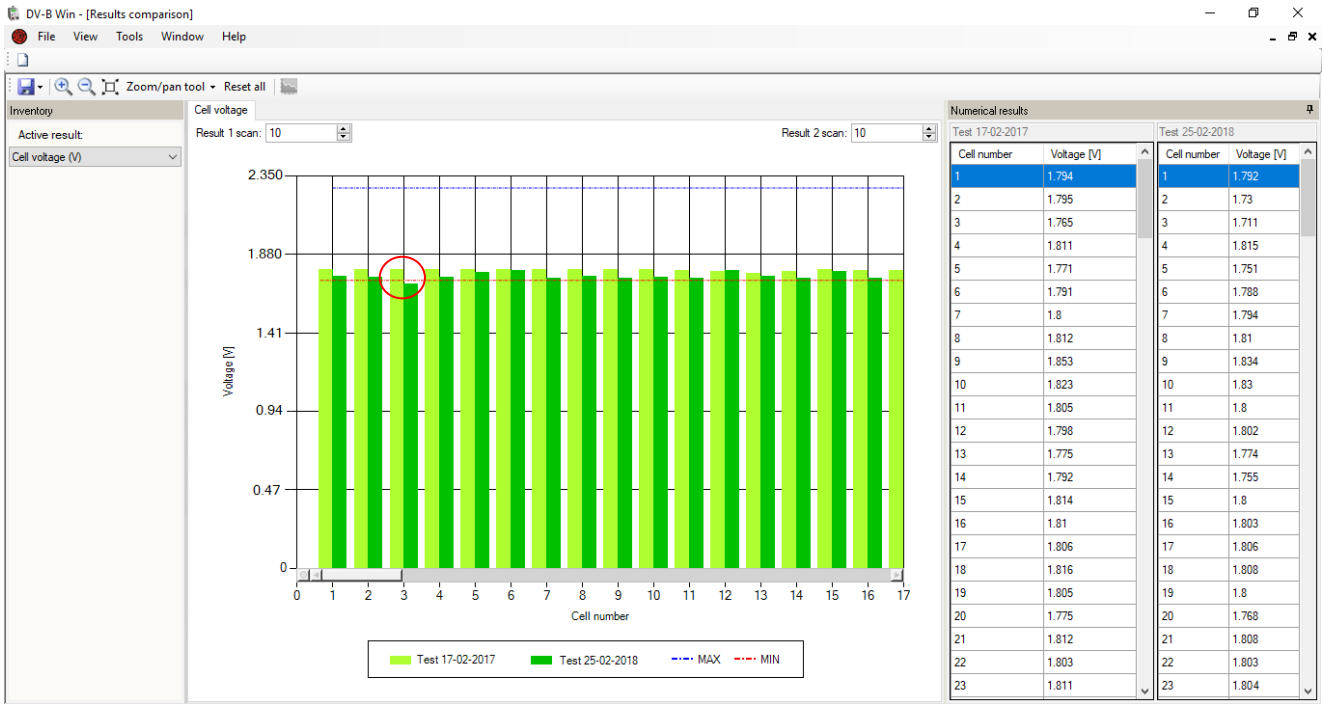


Figure 6-3: Cell voltage comparison (last scan for both tests)

In the example shown above, both discharge tests contain 10 scans taken by BVR during the discharge test. It is possible to choose specific scans in both test results to be compared (in boxes *Result 1 / 2 scan* in the upper part of figure 6-2), so that scans taken during the same time in both tests can be compared.

Based on the results, a degradation of performance in time can be seen for most cells, especially for cell no. 3. The end voltage during the second discharge test of 1,711 V is below the end limit 1,75 V, therefore it is recommended to replace this cell.

To analyze one cell in more details during two discharge tests, the cell trending can be started as well. To do this, double right-click on the cell being analyzed in figure 6-1. The following figure shows the behavior of cell no. 3 from the tested battery during both capacity tests.

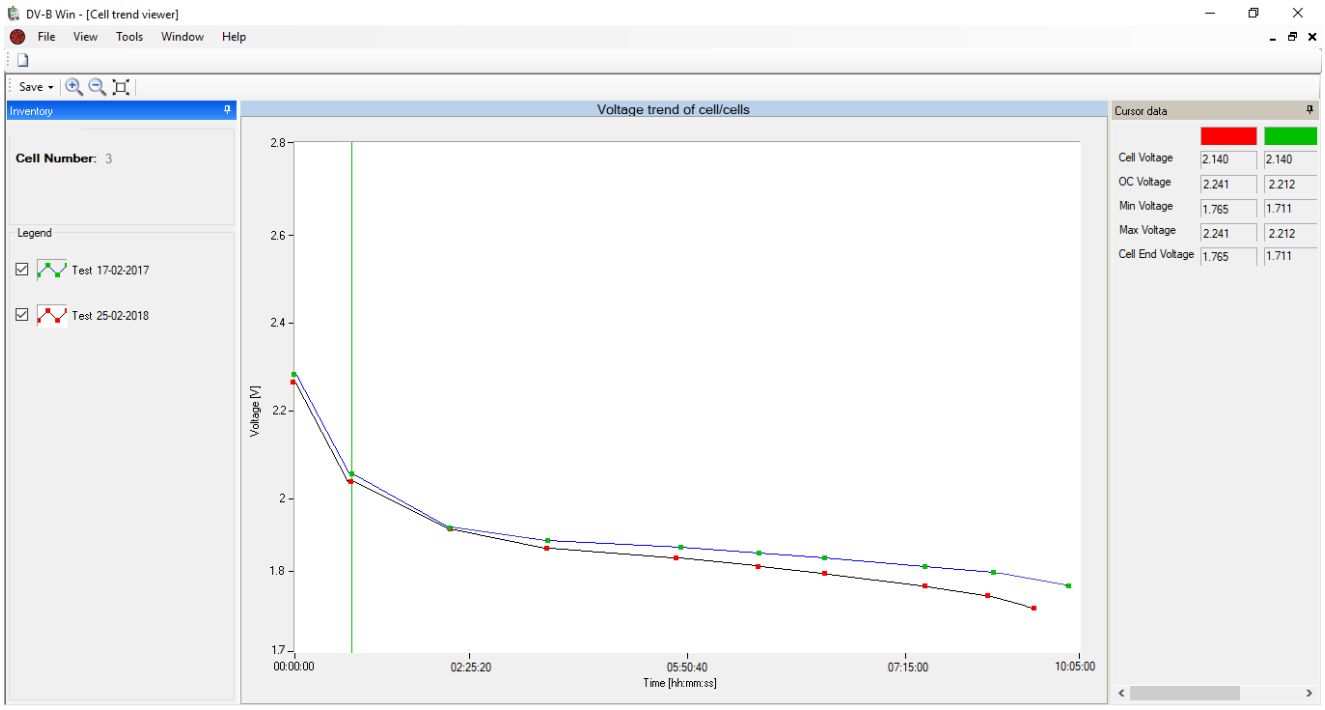


Figure 6-4: Trending of cell no.3 during two subsequent discharge tests

Based on this graph, it can be seen that the voltage of cell no. 3 is starting to drop rapidly during the second discharge test, in comparison to its behavior during the first test.

As shown in figures above, cell trending and results comparison tools can be very useful for analyzing your battery's condition during its operating life. With regular inspections of the behavior of all cells in the battery, bad cells can be detected in time before jeopardizing the entire battery, and more importantly the user's safety and load supply in critical situations.

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Manufacturer Contact Information

IBEKO Power AB

Box:	1346, 181 25 Lidingö, Sweden
Fax:	+ 46 8 731 77 99
Local support (Sweden):	+ 46 8 731 78 24
International support:	+ 46 70 0925 000
E-mail:	support@dv-power.com
Website:	http://www.dv-power.com