# BATTERY LOAD UNIT BLU SERIES &

# EXTRA LOAD UNIT BXL SERIES

## Manual


Manual Version: M-BLUNSZ-327-EN

This Manual refers to firmware versions 10.xx / 20.xx / 30.xx
This Manual refers to the SBC application: from 2.2.0
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# Contents

# 1. Introduction

The purpose of this Manual is to provide helpful instructions on how to use the BLU instrument safely, properly and efficiently. It contains information on how to use the BXL Extra Load units as well.

Included instructions will help the user to avoid unsafe situations, reduce maintenance costs and will ensure the reliability and durability of the BLU/BXL instrument.

The BLU must be used in accordance to all existing safety requirements and regulations based on national/local standards for accident prevention and environmental protection.

## 1.1 Safety Instructions

Safety is the responsibility of the user. Before operating the BLU, please read the following safety instructions carefully.

It is not recommended that the BLU/BXL is used (or even turned on) without a careful observation of the instructions listed in this Manual. The BLU/BXL should only be operated by trained and authorized personnel.

### 1.1.1 Safety Terms and Symbols

**Terms in this Manual.** The following terms may appear in this manual:
**WARNING**: Warning statements identify conditions or practices that could result in injury or loss of life.
**CAUTION**: Caution statements identify conditions or practices that could result in damage to this product or to other property.

**Terms placed on the Device**. The following warning terms used in this document may appear on the device:
**WARNING**: Indicates that potential hazard may occur.
**CAUTION**: Indicates that potential damage may occur to the instrument or to the test object connected to the instrument.
**Symbols on the Device**. The following symbols may appear on the device:

Refer to Manual

Protective Earth Terminal

Refer to Manual

### 1.1.2 Terms of Use

- The BLU/BXL shall be used only if it is in good technical condition. Its use shall be in accordance with local safety and industrial regulations. Adequate precautions must be taken to avoid any risks related to high voltages associated with this equipment and nearby objects.
- The BLU/BXL is intended exclusively for the application purposes specified in the “Intended Use” section. The manufacturer and distributors are not liable for any damage resulting from wrong usage. The user bears responsibility in case of not following the instructions defined in this document.
- BLU should operate in the well condition indoor environment, without corrosive, flammable and explosive materials and strong electromagnetic interference.
- Do not remove the protective casing of the BLU/BXL.

- All service and maintenance work must be performed by qualified personnel only.

### 1.1.3 Orderly Practices and Procedures

- The Manual shall always be available on the site where the BLU/BXL is used.
- Before using the BLU/BXL, all personnel (even personnel who only occasionally, or less frequently, work with the BLU/BXL) assigned to operate the BLU/BXL should read this Manual.
- Do not make any modifications, extensions, or adaptations to the BLU/BXL.
- Use the BLU/BXL only with the original accessories provided by its manufacturer.
- Use the BLU/BXL and its original accessories for the device's intended use only.

The device should be kept clean in order to prevent excessive cases of dust or other contaminants affecting its operation. It should be cleaned with water/isopropyl alcohol after any dirt/contaminants are noticed on its surfaces.

### 1.1.4 General Safety Precautions

- **Safety Protocols:** The equipment must be utilized in strict adherence to all safety protocols and regulations as per national/local standards for accident prevention and environmental protection. Adequate precautions must be taken to avoid any risks related to high voltages associated with this equipment and nearby objects.
- **Training:** Only trained and authorized personnel should operate the equipment. Ensure that all personnel are familiar with the equipment's operation, potential hazards, and safety procedures. Always adhere to the manufacturer's operating and maintenance instructions.
- **Protective Gear:** Wear appropriate personal protective equipment (PPE) such as **safety glasses, gloves (of adequate voltage rating), and appropriate attire to reduce the risk of injury.**
- **Inspect the device:** Prior to use, inspect the equipment and corresponding accessories for any visible damage, loose connections, or loose components. Do not operate the equipment if you identify any defects, and report them for immediate repair.
- **Safe Work Area:** Ensure that the work area where the device is used is clean and free from obstructions. BLU / BXL should operate in the well condition indoor environment, without corrosive, flammable and explosive materials and strong electromagnetic interference. Proper lighting should be available to avoid accidents.
- **Emergency Procedures**: Familiarize yourself with the location and use of emergency procedures and first-aid kits in the vicinity of the equipment.

### 1.1.5 Operator Qualifications

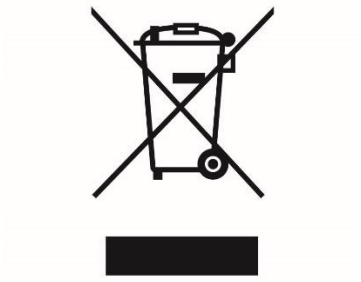
- Testing with the BLU/BXL should only be carried out by authorized and qualified personnel.
- Personnel receiving training, instruction or education on the BLU/BXL should remain under the constant supervision of an experienced operator while working with the test set and the test object.

### 1.1.6 Safe Operating Procedures

- Hazardous voltages of up to 480 V can occur inside the BLU/BXL. Therefore, it is not permitted to remove the protective casing of the BLU/BXL.
- Hazardous voltages exist on the terminals of the BLU/BXL. Switch off and unplug the BLU/BXL before touching the connections, especially if a fault is suspected.
- Before putting the BLU/BXL into operation, check the test set for any visible damage.
- Do not operate the BLU/BXL under wet or moist conditions (condensation).
- BLU should operate in the well condition indoor environment, without corrosive, flammable and explosive materials and strong electromagnetic interference.

- Before putting the BLU/BXL into operation it is important to ensure device is positioned in such a way its cooling is not obstructed by other objects and there is no risk of overheating during its deployment.
- Before running the parallel discharge test with two or more BLU/BXL it is important to provide the hot air from one device is not directed towards another device.
- When setting up the BLU/BXL, make sure the air slots of the test set remain unobstructed (e.g. keep the device at a proper distance from other objects such as a wall, table, chair, etc.). Do not operate the BLU/BXL if explosive gas or vapors are present.
- First connect the cables to the device and then to the tested object, after the test is completed disconnect the cables from the test object first and then from the device.
- Only the external devices which meet the requirements for SELV equipment according to EN 60950 or IEC 60950 should be connected to the BLU/BXL through the serial interface.
- Removing the BLU/BXL protective casing will void the warranty. Any work inside the instrument without prior authorization from DV Power will also void the warranty.
- If the BLU/BXL seems to be malfunctioning, please contact the DV Power Support Team (refer to the "Manufacturer Contact Information" section) after previously checking the "Error Messages" section.
- Every terminal should be checked and verified before connecting the BLU/BXL. Ground connections may be left in place.
- Do not use the BLU/BXL without the extra protective ground cables supplied with the BLU/BXL. It must never be operated in a non-grounded configuration as this may result in an electric shock to the user or damage to the device. Always establish this connection first before establishing any other connections and remove this connection as the very last one.

### 1.1.7 Disposal



DV Power instruments and its accessories are intended for professional use and are not intended for household use. As such they should not be disposed of with waste that was intended for household use.

**For customers inside of the EU/EEA member states area**
DV Power instruments and accessories are subject to the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE). When disposing DV Power instruments and accessories please use your local WEEE collection systems. Instruments and accessories can be returned to DV Power for disposition and treatment of WEEE.

**For customers outside of the EU/EEA member states area**
It is important to follow guidelines that are prescribed for disposal of WEEE in the according country. Dispose of DV Power instruments and accessories according to local legal requirements.

**Note: Never open the measuring circuit while the test is in progress as dangerous high voltage may occur.**

**Never disconnect cables from the battery while the test is in progress. This can cause excessive DC arc flash on external terminals.**

**Be aware of the heat created during the discharge test.**

## 1.2 Power Supply

- Standard voltage supply for BLU series is AC supply (as defined in the section “Technical Data”). Optionally, DC power supply for BLU device can be provided, upon request. Please refer to section “Technical Data” for more details.
- Supply the BLU/BXL only from a power outlet equipped with protective ground.
- In case of AC supply, besides supplying the BLU/BXL from phase-neutral (L1-N, A-N), it may also be supplied from phase to phase (e.g., L1-L2; A-B). However, the voltage must not exceed 264 V AC. Please refer to the “Technical Data” section.
- The BLU/BXL should be positioned in such a way that it is possible to safely disconnect it from the power supply at any moment.

**WARNING / AVERTISSEMENT**

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Il s'agit d'un produit de classe A. Dans un environnement domestique, ce produit peut provoquer des interférences radio, auquel cas l'utilisateur peut être amené à prendre des mesures adéquates.

## 1.3 Intended Use

The Battery Load Units - BLU series are stand-alone or PC-controlled battery capacity test sets, based on a state-of-the-art technology, using the most advanced power electronics solutions with coolers and fans integrated into device. The Battery Extra Load Units - BXL Series can be used as an additional load to be used in combination with BLU series if required discharge current or power exceeds the capacity of single / available BLU devices.

The BLU / BXL series devices are the lightweight solution developed to meet customer’s wide ranging test procedures (standardized as well as customized). Using a BLU device, the capacity test is performed in an accurate, user-friendly way in accordance with battery testing standards (IEEE 450-2010 / 1188-2005 / 1106-2015, IEC 60896-11/22 and other relevant standards).

The capacity test / discharging can be performed at constant current, constant power, constant resistance or in accordance with a pre-selected load profile. The discharge test can be conducted even in case a battery remains connected to the load – by measuring and compensating the load current during the process.

The BLU devices are used for measuring the capacity and full voltage of the batteries that serve as backup power supply in (but not limited to):

- Power plants
- Telecommunication systems
- Generator excitation systems
- Substations
- Protection and control systems

The BLU devices provide the discharge current of up to 340 A and are applicable to battery strings of up to 500 V DC battery levels.

# 1.4 BLU & BXL Series - Models

## BLU100L & BLU100A

- weight – 12,8 kg (28.2 lbs)
- discharge power – up to 14,2 kW
- discharge current – up to 160 A
- designed for 3,0 V – 300 V DC (BLU100L) / 5,55 V – 300 V DC (BLU100A) battery voltage range

## BLU200A

- weight – 14,5 kg (32 lbs)
- discharge power – up to 19,7 kW
- discharge current – up to 240 A
- designed for 5,55 V – 300 V DC battery voltage range

## BLU340A

- weight – 20,6kg (45.4 lbs)
- discharge power – up to 28,4 kW
- discharge current – up to 160 A
- designed for 5,55 V – 300 V DC battery voltage range

## BLU110T

- weight – 12,8 kg (28.2 lbs)
- discharge power – up to 8,5 kW
- discharge current – up to 150 A
- designed for 0,9 V – 70,5 V DC battery voltage range

## BLU220T

- weight – 15,1 kg (33 lbs)
- discharge power – up to 19,2 kW
- discharge current – up to 350 A
- designed for 5,55 V – 70,5 V DC battery voltage range

## BLU360V

- weight – 20,6 kg (45.4 lbs)
- discharge power – up to 28,4 kW
- discharge current – up to 160 A
- designed for 5,55 V – 500 V DC battery voltage range

## BXL-A

| | |
|---|---|
|  | • designed for parallel operation with BLU models<br>• applicable to 5,55 V – 300 V DC battery voltage range<br>• weight – 12,5 kg (28 lbs)<br>• discharge power – up to 24,8 kW<br>• discharge current – up to 250 A |

## BXL-T

| | |
|---|---|
|  | • designed for parallel operation with BLU220T device<br>• applicable to 5,55 V – 70,5 V DC battery systems<br>• weight – 12,5 kg (28 lbs)<br>• discharge power – up to 18 kW<br>• discharge current – up to 330 A |

## BXL-V

| | |
|---|---|
|  | • designed for parallel operation with BLU device<br>• applicable to 5,55 V – 500 V DC battery systems<br>• weight – 16 kg (35 lbs)<br>• discharge power – up to 32,4 kW<br>• discharge current – up to 165 A |

# 2. Description

## 2.1 Front Panel Components

### 2.1.1 BLU SERIES

***1 - Display*** - 5.7'' color touch screen display

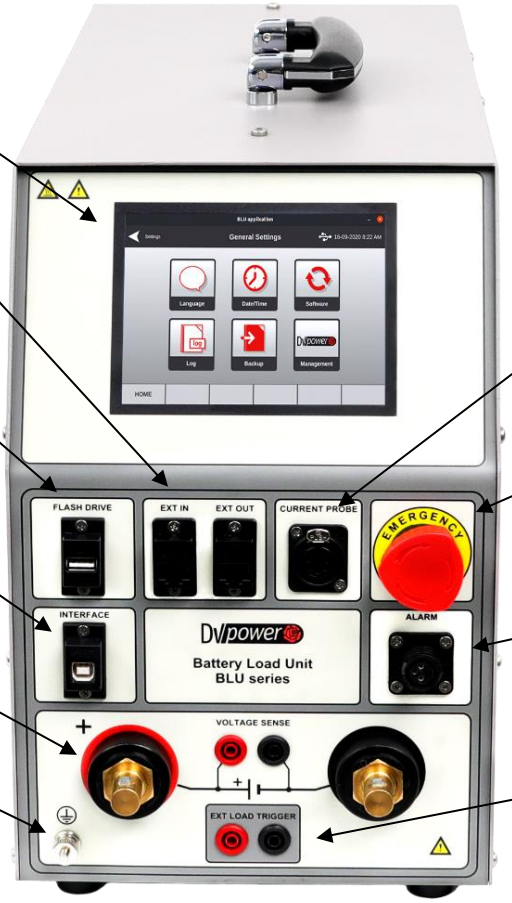
***2 - External input (EXT IN) and external output (EXT OUT)*** used for BLU-BLU parallel operation (not available for BLU100A & BLU100L models)

***3 - Flash drive*** - used for transferring BLU memory data into an external memory stick + SBC / firmware upgrade

***6 - Interface*** - enables controlling the BLU from a PC and downloading previously recorded results.

***8 - Current and Voltage terminals*** - current and voltage test cable terminals

***10 - Protective Earth Connector*** - protective earth connector used to connect to protective ground (PE)




***4 - Current probe*** - measuring load current using the external current probe.

***5 - Emergency STOP button*** - used when unexpected or unwanted action occurs.

***7 - Alarm output*** - used for triggering external alarm buzzer

***9 - External Load trigger*** - used for triggering BXL external load units

1. **5,7'' color touch screen display**
   Displays settings during device test mode selection, as well as the measured values during and after test operation.
2. **External input (EXT IN) and external output (EXT OUT)**
   External input and output are Ethernet ports used to connect two or more BLU devices when parallel discharge test is applied. Connection is established using a network cable and RS485 communication. BLU100A does not provide parallel operation feature.
3. **Flash drive**
   To transfer data from device's internal memory onto an external memory stick.
4. **Current probe**
   Current probe channel serves to connect the current probe, in order to measure current value that is being pulled (drained) from a battery by BXL or any other load.
5. **Emergency STOP button**
   If an unexpected or unwanted action occurs during a test, emergency **STOP** button can be used to terminate this action by stopping the test and preventing risks that may occur. Besides emergency button and overcurrent protection BLU is equipped with additional fuse as the last level of protection.
6. **Interface**
   USB serial interface is provided to connect to an external computer, if required.

7. **Alarm**
   This channel is used for connecting the BLU with an external ALARM buzzer. The external ALARM buzzer will be controlled and activated according to received commands from the BLU.

8. **Current and Voltage terminals**
   The instrument is equipped with current and voltage test cable terminals.

9. **External Load trigger**
   Used for triggering external load if a BXL device is connected.

10. **Protective Earth Connector**

For protection against parasitic currents or voltages, always connect the BLU protective earth connector to the protective ground (PE). Use only the manufacturer supplied cable.
For safety reasons, always establish this connection before establishing any other connections, and remove this connection as the very last step.

11. **Mains Power Connector and Power Switch**

- **I** In this position, the BLU is connected to the main power supply.
- **0** In this position, the BLU is separated from the main power supply.

** Mains power connector and power switch are placed on the front panel of the BLU100A & BLU110T models*

**Note: Do not disconnect the measuring cables from the battery when the test is in process!**

## 2.1.2 BXL SERIES

1. **Display**
   LCD screen 16 characters by 2 lines with backlight, visible at bright sunlight.

2. **Keyboard**
   To control the device please use:
   - ***UP/DOWN*** buttons to set test parameters.
   - ***ENTER*** button to confirm selected test parameters and language settings.
   - ***STOP*** button to stop the test.
   - ***START*** button to start the test.
   - ***SET*** button to go to **SETTINGS** menu.

3. **Mains Power Connector and Power Switch**
   - **I** In this position, the BLU is connected to the main power supply.
   - **0** In this position, the BLU is separated from the main power supply.

4. **Control input (CONTROL IN)**
   Enables connecting and controlling BXL (triggering discharge process) from a BLU device. It is also used for a BXL-BXL connection if multiple BXL devices are used. Connection is established using a set of cables with banana plugs.

5. **Control output (CONTROL OUT)**
   Used to establish connection between two BXL devices, enabling simultaneous triggering of the discharge process on all BXL units. Connection is established using a set of cables with banana plugs.

6. **Emergency STOP button**
   If an unexpected or unwanted action occurs during a test, Emergency Stop button can be used to terminate the test and prevent risks that may occur. Besides emergency button and overcurrent protection BLU is equipped with additional fuse as the last level of protection.

7. **Current and Voltage terminals**
   The instrument is equipped with current and voltage test cable terminals.

8. **Protective Earth Connector**

For protection against parasitic currents or voltages, always connect the BLU protective earth connector to the protective ground (PE). Use only the manufacturer supplied cable.
For safety reasons, always establish this connection before establishing any other connections, and remove this connection as the very last step.

# 3. Getting Started

## 3.1 Connecting BLU & BXL to Test Object

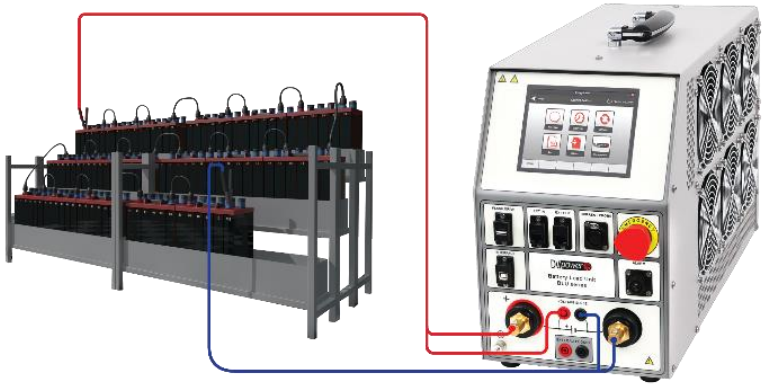
Before the BLU/BXL gets connected to a test object (e.g. a battery), the following steps must be performed:

- Disconnect the battery from its charger in accordance with the national safety regulations.
- The battery should be examined in case of any visual damages or liquid leakage.
- The BLU/BXL itself should be properly grounded. The grounding screw, placed on the front panel of the BLU/BXL, needs to be connected to the PE using the grounding cable.

**Note: Always connect measuring cables to the instrument (BLU/BXL) first and then to the test object. When disconnecting, always disconnect the cables from the test object first and then from the instrument(s).**
**The grounding wire PE should be connected first and disconnected last.**
**Not following these instructions may cause life-threatening situations.**

The BLU can be connected to any battery test object by using a set of the current cables. To maximize the accuracy and measurement repeatability, all clamps must have a good connection to the battery terminals while any crossing between the cables should be avoided. The BLU displays an appropriate message if the connection between a cable clamp and the corresponding battery terminal is not established. The red device terminal should be connected to the plus (+) terminal of the first battery cell in a string (beginning of the string), and the black terminal to the minus (-) terminal of the last battery cell in a string (end of the string). Current cables are represented as red and black thick lines in the Figure 3-1. To establish a smoother regulation of the discharge process, the set of voltage sense cables can be used (thin red and black lines in the Figure 3-1). When using voltage sense cables, the voltage drop on the current cables will not affect a measurement of the battery voltage during the test.

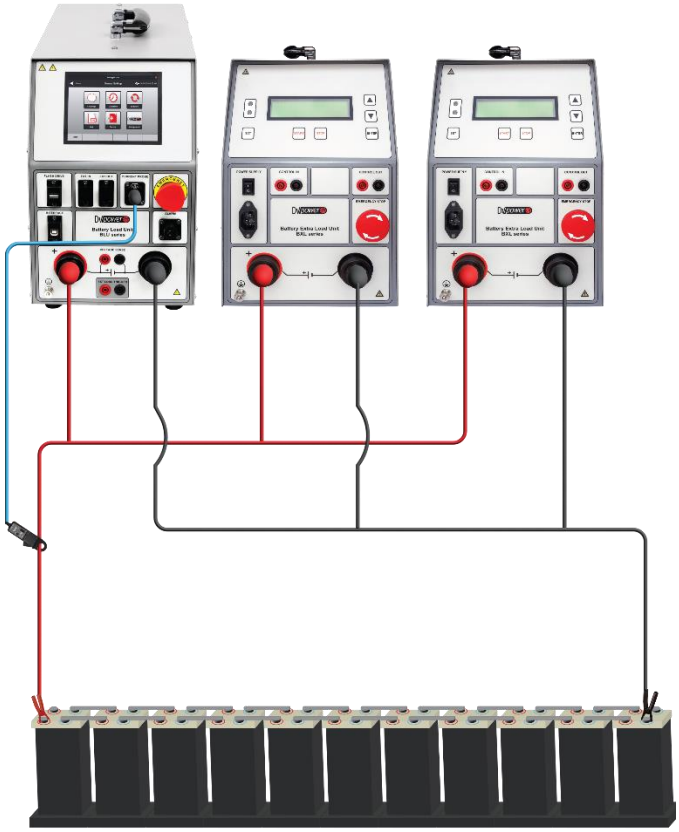
Figure 3-1:
Connecting BLU to test object



If the required discharge current or power exceeds the capacity of a single BLU device, the BXL series external load units can be used. To connect the BXL device the user should follow the same approach as when connecting the BLU device.

Connection diagram for BLU + 2 x BXL units is presented in the Figure 3-2.

Figure 3-2:
Connecting BLU and
2 x BXL to test object

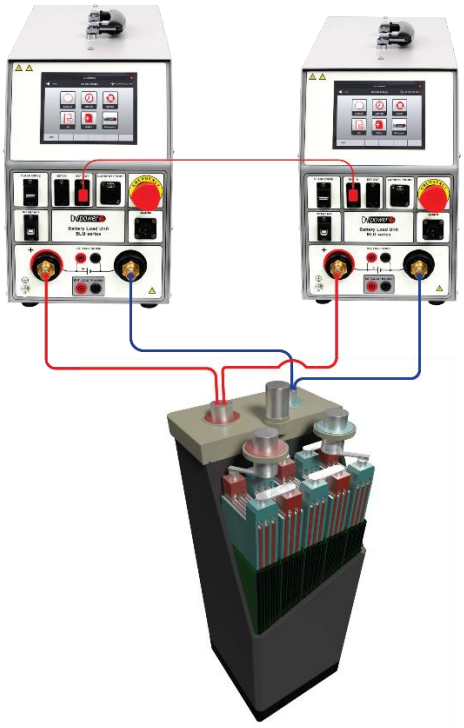


In a BLU & BXL connection, it is necessary to use a current clamp (probe) to be able to regulate a discharge process according to the preset discharge values. The current probe can be connected either to measure a total discharge current (as presented in the Figure 3-2) or a total current conducted by all BXL's units (and additional loads, if any). Depending on the current probe connection point, the appropriate discharge mode (*battery* or *load current* mode) should be selected on the BLU device.

Alternative approach to increase the load capacity is to use several BLU devices in paralleled connection. Up to 10 BLU devices can be connected in parallel. Connection between BLU devices is established using Ethernet ports and RS485 communication. The communication is based on a MASTER-SLAVE principle – an arbitrarily selected device is set as the MASTER while all the other BLU devices should be set as SLAVE units. In the parallel connection the discharge current (power) is distributed in such a way that MASTER unit operates on its capacity limits, while SLAVE units dissipate rest of the preset discharge current (power).

A connection of the two BLU devices for a parallel discharge test is presented in the Figure 3-3. Thick line connections represent the current cables. The red current cables are to be connected to the plus terminal at the beginning of the battery string. Black current cables are to be connected to the minus terminal at the end of the string. The RS485 connection cable needs to be connected between EXT OUT on the MASTER and EXT IN on the SLAVE unit; otherwise the MASTER-SLAVE communication will not work properly.

Figure 3-3:
Connecting two BLU devices to test object for parallel discharge



**Note:**

- **For safety reasons, a connection between the BLU/BXL and a test object should be always established as described in this Manual.**
- **The measuring cables should not be connected after the start of the test.**
- **No connections between BLU/BXL to battery should be established while the charger is connected to the battery string.**
- **The measuring cables should not be disconnected before the test is over.**
- **It is important to organize working area in order to avoid damaging cables. It may cause life threatening situations.**

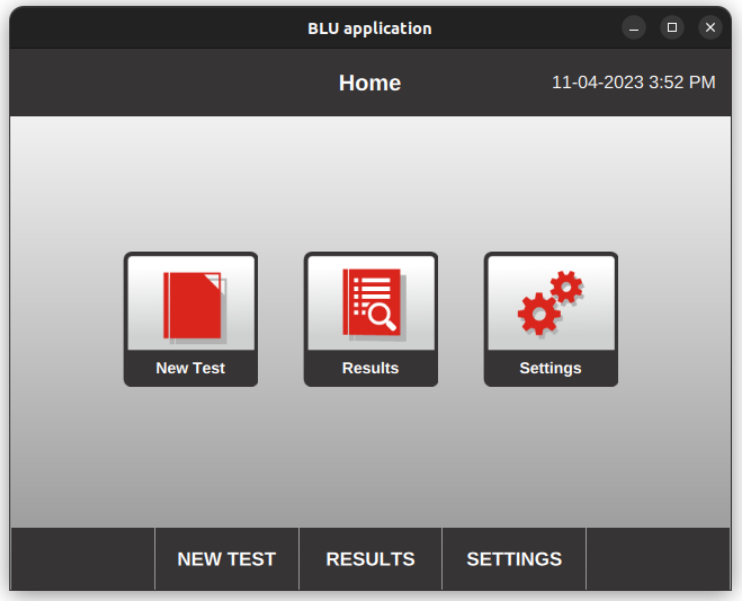
## 3.2 Setting Test Parameters

The BLU instrument can perform the following tests:

- Discharge test
- Parallel discharge test (all models except the BLU100A, BLU100L & BLU110T)
- Discharge test using the current probe

After the BLU device is switched on, the home screen will be displayed, Figure 3-4. There are 3 main menus: New test, Settings and Results. Each of these will be explained in this manual

Figure 3-4:
The initial screen




The application screen consists of 3 parts: Header, Body and Footer (Figure 3-5)

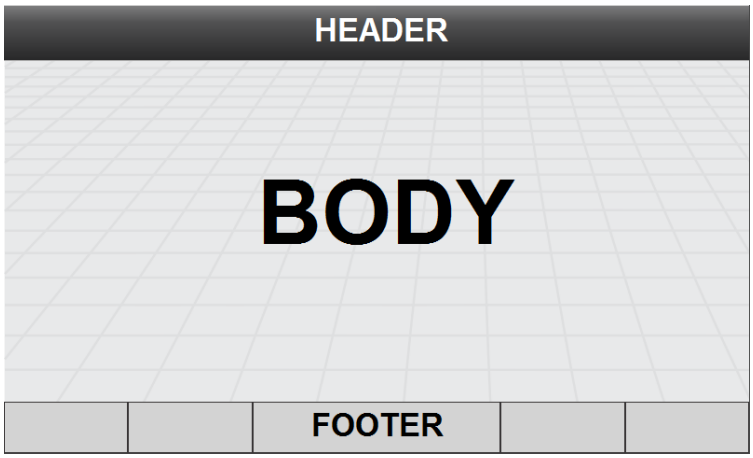



Figure 3-5: Header, Body and Footer of the application screen

The left part of the header is reserved for the Back icon. By clicking this icon, the user is returned one screen backwards. This icon is represented by “<< Previous screen name”, where the text right to << represents the name of the screen where the user will be returned upon clicking this icon. Consequently, this icon is not available in the Home screen, as there is no screen prior to that.

The central part of the header shows the name of the current screen.

The right part of the header is reserved for current date and time. The symbol for USB connection might appear left to the date and time, and it indicates that a USB flash drive is inserted in the flash drive input and recognized by the BLU230T instrument.
The Header part is not present during the test, and the test status is shown in that part of the screen instead.
The body of the application is where the test settings and test results are displayed.
The Footer part consists of six soft keys. These keys have different functions in different screens, and their functions will be explained for each screen.

## 3.3 Setting Menu

This menu is used for making general settings and also some of test settings that do not require frequent changes.

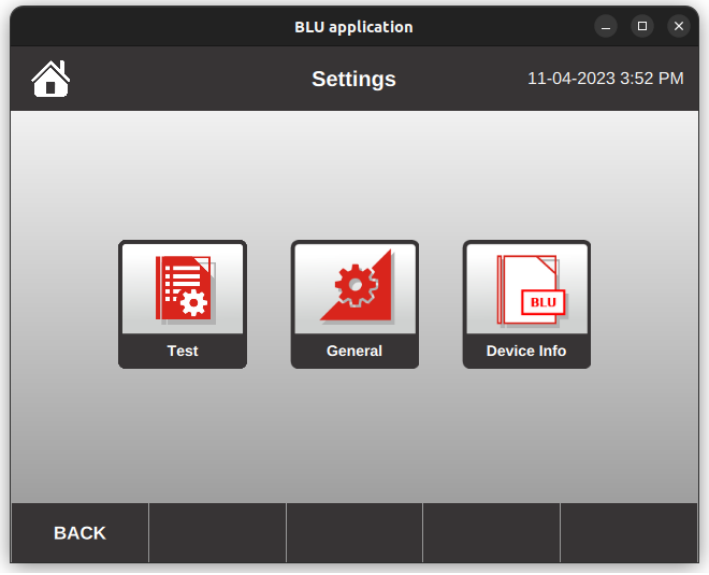



Figure 3-6: Settings menu

### 3.3.1 General Settings

These are general application settings. Four options are available: *Language*, *Date/Time*, *Software*, *Log, Backup* and *Management.*

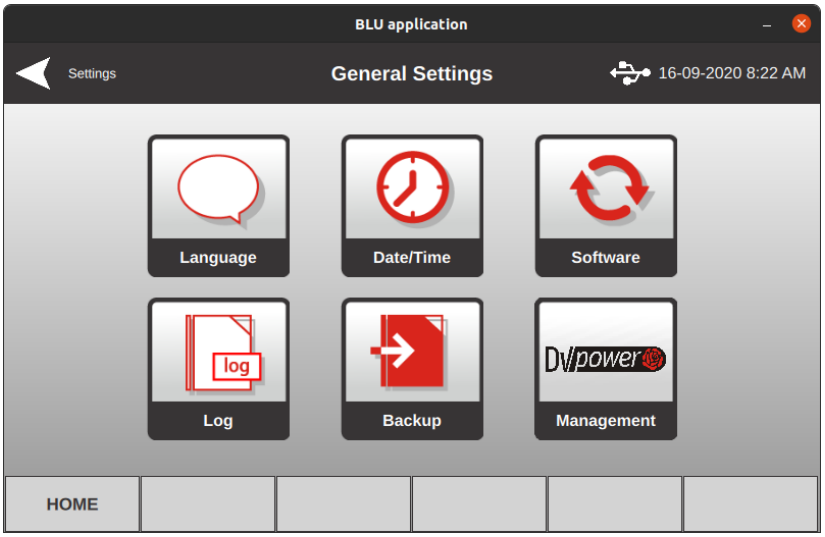



Figure 3-7: General settings

#### 3.3.1.1 Language

English language is selected by default. Other available languages are Italian and German. Translation to other languages is currently in process.

#### 3.3.1.2 Date/Time Settings

Date and time are set by swiping the appropriate columns up and down. To change date format, press the date format footer button. Three formats are available: YYYY-MM-DD, DD-MM-YYYY, and MM-DD-YYYY, where DD represents date, MM represents month, and YYY represents year. To change the time format between 12-hour and 24-hour formats, press the time format footer button.

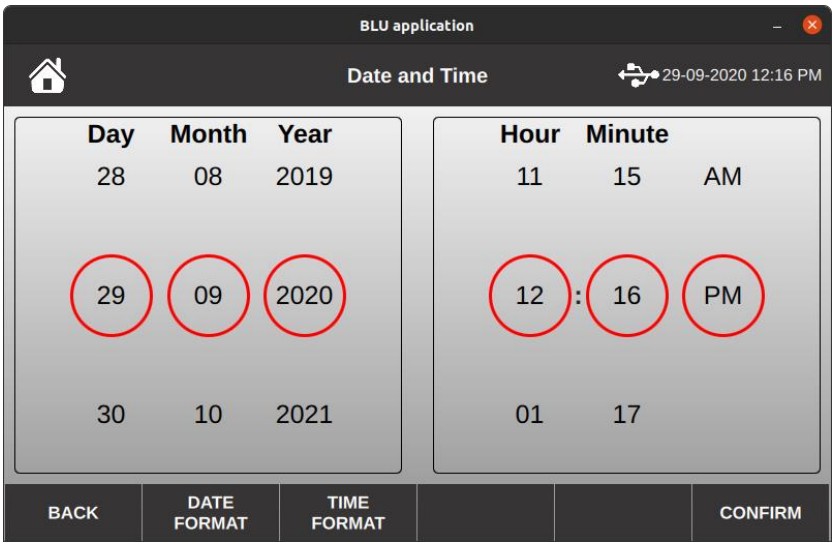



Figure 3-8: Time/Date selection

### 3.3.1.3 Software

This menu shows the versions of firmware and SBC application currently loaded in the instrument, as well as the instruments' serial number. It is also possible to update firmware and SBC application in this menu.

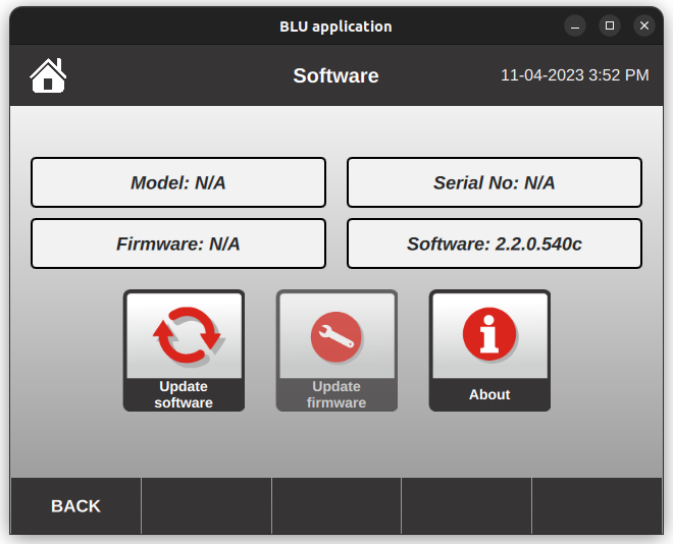



Figure 3-9: Software screen

### 3.3.1.4 Log Menu

This option is used for copying a log file to USB flash drive. This is done if the manufacturer requires the log file for analysis in order to analyze certain issue that may be reported by the user. This option is enabled only if a USB memory stick is inserted in a USB flash drive and detected by the instrument. To copy the log file to the USB memory stick, click this option and wait until the log file is copied. Once the process is finished, the appropriate message will be displayed, as shown in the Figure 3-10.

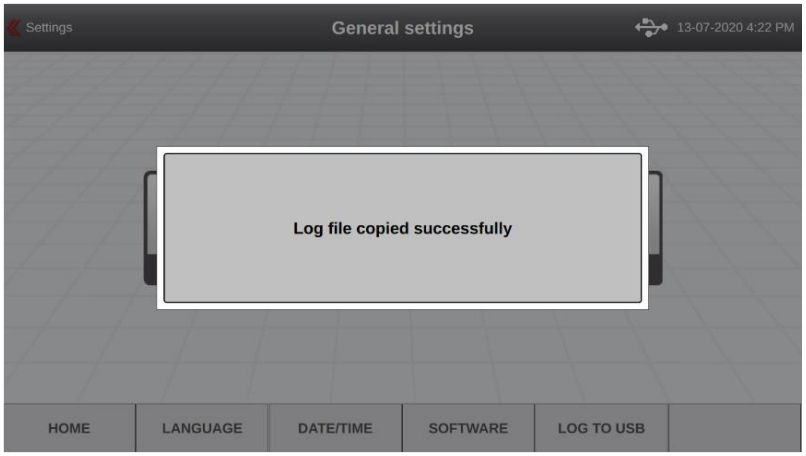



Figure 3-10: Log Menu

#### 3.3.1.5 Backup

The button initiate downloading all templates from the database to USB memory stick.

#### 3.3.1.6 Management

This menu can only be used by DV Power personnel during manufacturing / testing / calibration of the Battery Load Unit. The menu is password-protected.

### 3.3.2 Test Settings

The menu offers the user the following options:

- *Pass / Fail* criteria for measured capacity, and
- change all settings to default settings.

*Pass / Fail* criteria for measured capacity enables to compare the measured capacity with entered nominal capacity. It is necessary the user to enter nominal battery capacity in *Test Info -> Battery info -> Capacity [Ah]* since this value will be compared with the measured capacity. The user can enter capacity pass limit in the range from 1 to 100% (80% will be stated as default), Figure 3-11.
*Pass / Fail* notification will be presented by different colors of the measured capacity in the *Results* menu (*Pass* – green*, Fail* - red). *Pass / Fail* information will be stated in test report created using the DV-B Win software.

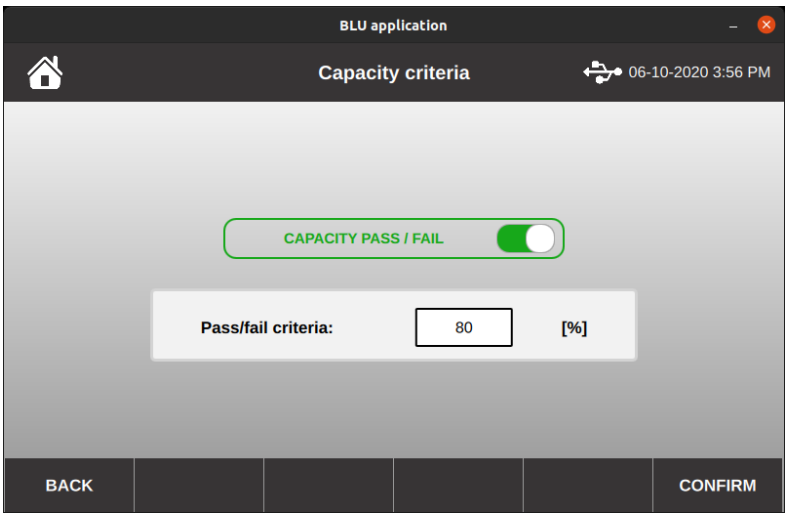



Figure 3-11: Capacity Pass / Fail criteria

### 3.3.2.1 Test Mode Menu

This mode enables the user to select the appropriate discharge mode depending on number and type of discharge units used as well as if the battery will be tested online (while its load is connected).

Available options are:

- *Single* (only one BLU is used. No additional loads are connected to the battery under test).
- *CP* (selected when additional loads will be connected – the regular load and/or BXL Extra Load Units),
- *Parallel* (to be selected when 2 or more BLU's of the same model are used as a system),

The *Test Mode* menu has been presented in the Figure 3-12 below.

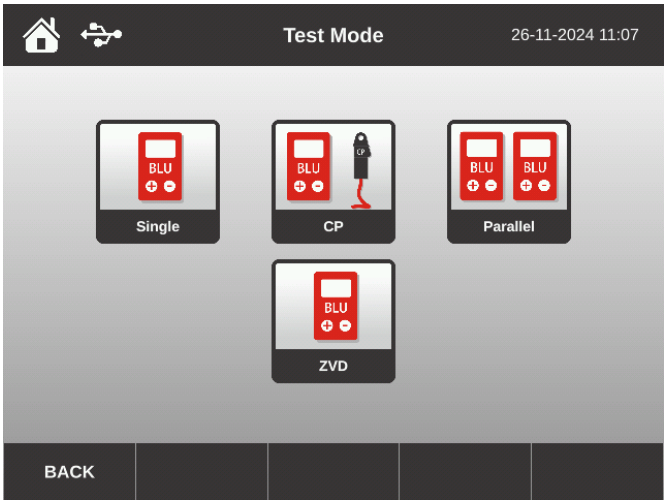


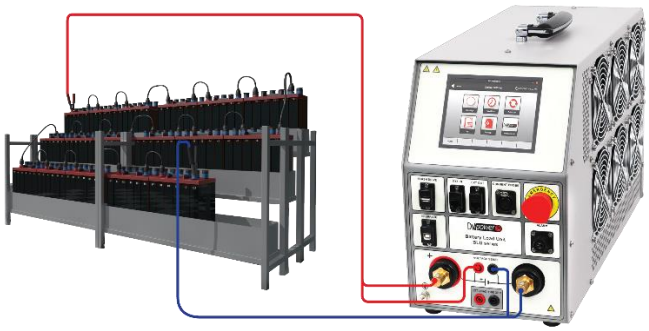

Figure 3-12: Test Mode selection

### 3.3.2.2 Single Mode

The *Single mode* should be selected if only one Battery Load Unit is used for the discharge test. In another words, the regular battery load should be disconnected, and any additional load units should not be connected to the battery.

The connection diagrams is presented on *Figure 3-13*.

Figure 3-13: Connecting BLU to test object



### 3.3.2.3 Current Probe (CP) Mode

The test needs to be performed in the CP mode if the battery needs to remain connected to the load or the BXL-T device (or other device) is used as an additional load to increase discharge current / power. In this mode the measurement will be based either on the total battery current or a load current being measured by the DC current probe. The CP measurement function enables the BLU230T to measure the current in an external path and regulate the process based on this measurement.

The current probe can be connected in one of the following ways:

1. To measure the total discharge current (***Battery current mode***), Figure 3-14a;

2. To measure currents of all extra loads (BXL-T, regular load, etc), except the BLU230T current (***Load current mode***), Figure 3-14b.

Connection diagrams of "*BLU230T to battery"* when regular load remains connected to the battery are presented in Figure 3-14a and Figure 3-14b.

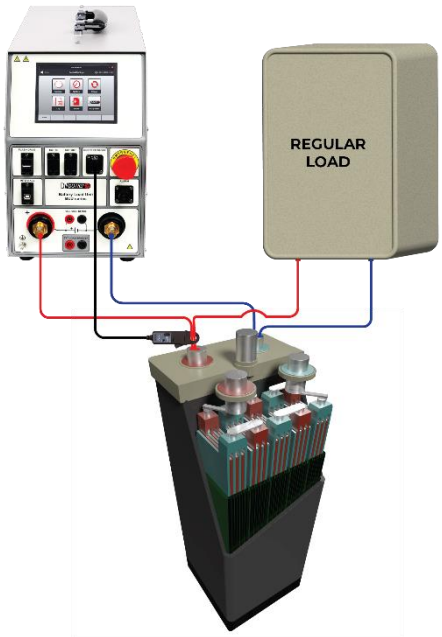



Figure 3-14a: Battery current mode

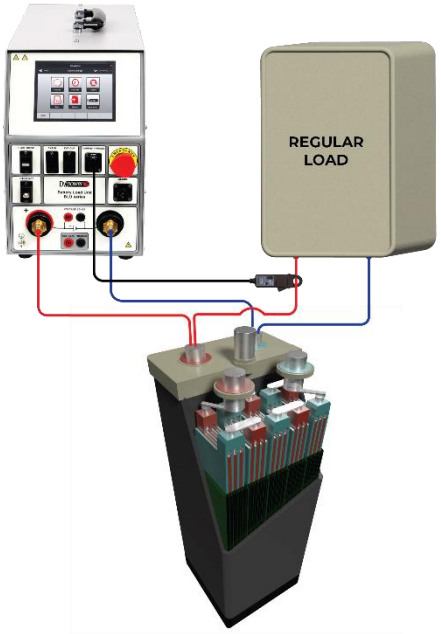



Figure 3-14b: Load current mode

**Battery current mode -** the total current drawn from the battery is measured by using the current probe. The BLU regulates its own discharge current / power to match the preselected battery current/power value. During the discharge test the real-time values of the total current / power discharged from the battery and the current/power dissipated in the BLU will be displayed.

**Load current mode** – this approach is based on measuring the load current. The BLU regulates its own discharge current / power so the sum of measured load current / power and the BLU current / power is equal to the user preselected discharge current / power. During the discharge test the real-time values of the total current / power discharged from the battery and the current / power measured by the current probe will be displayed.

**Note:**

**If available current clamp is battery-operated (supplied from an internal battery), it should be paid attention that battery is capable to supply the clamp throughout the test. Battery-operated clamps are provided with non-rechargeable 9 V battery. Provided battery will be capable to supply the clamp during one 8h or 10h test. Before starting new test of long duration (such as 8 h / 10 h discharge tests), brand-new battery should be used. Minimum capacity of the battery should be 300 mAh.**

**Rechargeable batteries, capacity of 300 mAh or more, can also be used to supply the clamp. Rechargeable battery should be used in fully charged condition (it should be charged within last 12h before discharge test is started). Rechargeable battery should be replaced by new battery according to battery manufacturer suggestions on battery life stated in the manual.**

**In case the used battery is fully discharged before the end of the test, the clamp will switch off. There is no hazard to device or battery string if the clamp switches off. There are 2 possible outcomes if the clamp switches off: BLU230T will terminate the discharge test (if selected test was *CP Battery current*) or BLU230T will continue the test with maximum current that can be achieved (*CP Load current*).**

**Note:**

**In order to save battery life, the probe will automatically switch itself off after approximately 10 minutes (if the green LED is lit). To disable the Auto power off function, switch off the probe and switch on whilst pressing the auto zero button. The red LED will illuminate and the probe will stay on until switched off again.**

After selecting **CP** in the *Test Mode* menu (Figure 3-15), the user needs to select between *Battery current* and *Load current*, and to select corresponding clamp range (1, 10 or 100 mV / A), Figure 3-15 and Figure 3-16. Selected clamp range must be identical to the range set on the used current probe, otherwise measurements will be inaccurate and test might be interrupted.

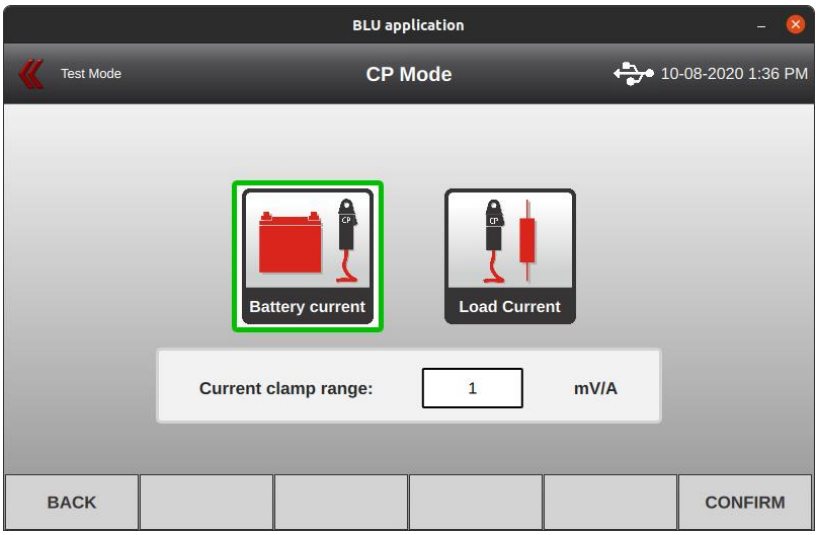



Figure 3-15: Selecting *battery* or *load* mode

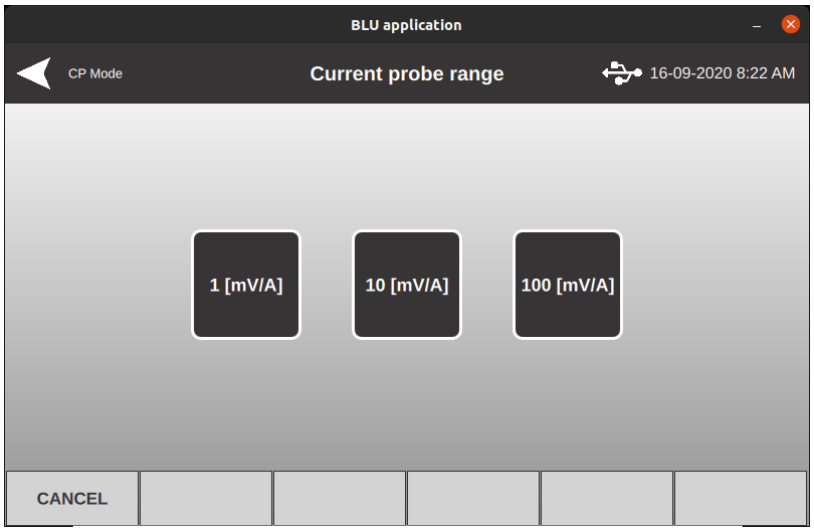



Figure 3-16: Selecting current probe range

Current probe will be zeroed automatically. If automatic zeroing is not possible, the corresponding message will be displayed and manual zeroing on the clamp will be required.

#### 3.3.2.4 Extra Load Units BXL

Extra Load Units BXL Series can be used as an additional load to increase discharge current. When the BXL device is switched on, the initial message informing the user about name of the device and installed firmware version is displayed.

After displaying the initial screen for several seconds, the BXL displays the **CONNECT BATTERY** message. The message will be displayed until the BXL gets connected to a battery.


Figure 3-17: The CONNECT BATTERY message

The *Test Settings* menu will be displayed as BXL is connected to the battery (Figure 3-18).


Figure 3-18: Test settings menu (example from BXL-A)

The displayed parameters are:

- U [V] – battery voltage (not user-changeable),
- R [Ω] – BXL-T internal resistance,
- I [A] – current that will be discharged by the BXL-T at the selected resistance value.

The maximum current that can be achieved by the BXL is a function of the BXL internal resistance. Relation between the maximum current of the BXL and the maximum (initial) voltage of the battery is presented in the Table 3-1. The resistance of the recommended set of the current cables is included in the listed resistance values. Listed resistances are the lowest resistance values that can be selected at the corresponding voltage.

*Table 3.1: Maximum discharge currents at various maximum battery voltages*

| Umax (V) | BXL-A | | BXL-T | | BXL-V | |
|---|---|---|---|---|---|---|
| | Resistance (Ω) | Imax (A) | Resistance (Ω) | Imax (A) | Resistance (Ω) | Imax (A) |
| 7.05 | 0.088 | 80 | 0.084 | 80 | 0.390 | 15 |
| 14.1 | 0.088 | 160 | 0.084 | 165 | 0.390 | 30 |
| 28.2 | 0.112 | 250 | 0.084 | 330 | 0.390 | 65 |
| 56.4 | 0.230 | 245 | 0.174 | 320 | 0.390 | 130 |
| 70.5 | 0.642 | 105 | 0.277 | 250 | 0.390 | 165 |
| 129.3 | 0.802 | 160 | - | - | 1.040 | 120 |
| 141 | 0.802 | 175 | - | - | 1.040 | 130 |
| 258.5 | 3.200 | 80 | - | - | 2.330 | 105 |
| 282.0 | 3.200 | 85 | - | - | 2.330 | 115 |
| 500.0 | - | - | - | - | 9.275 | 50 |

**Note:**

**Selected resistance on the BXL should be high enough so that BXL current is lower than the total discharge current. Otherwise, BLU will not be able to regulate the discharge current and will stop the test.**

After the resistance is selected, the discharge test can be started. By pressing the **ENTER** button, the BXL displays the **Ready** screen.


Figure 3-19:The **Ready** screen menu

The discharge test using a combination of the BLU and the BXL can be started by using two different ways:

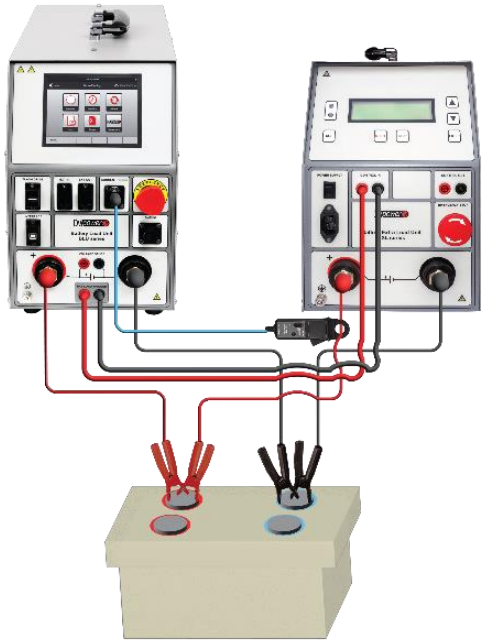
- Pressing the ***START*** buttons: first on the BXL, and then on the BLU.
- Pressing the ***START*** button on the BLU only – if the external trigger cables are used. The external trigger cables enable triggering the BXL by the BLU when the test is initiated on the BLU. It is important to emphasize that in this case the connection between these two units needs to be established by using the cables for simultaneous triggering. Also BXL needs to be in the **Ready** menu.

**Note:**

- **The user-defined discharge current determines the number of BXL units that needs to be used. The BXL(s) need(s) to compensate difference between required load capacities and BLU load capacities.**
- **The BXL is a resistive and non-regulative load. The current conducted by the BXL at the beginning of the test will be different (higher) than the BXL current at the end of the test (due to change in the battery voltage). The BLU needs to have capacity in reserve to compensate the difference at lower battery voltages.**

The correct way to connect BXL to the battery together with BLU is shown on the figure below:

Figure 3-20:
Connecting BLU and BXL devices to test object

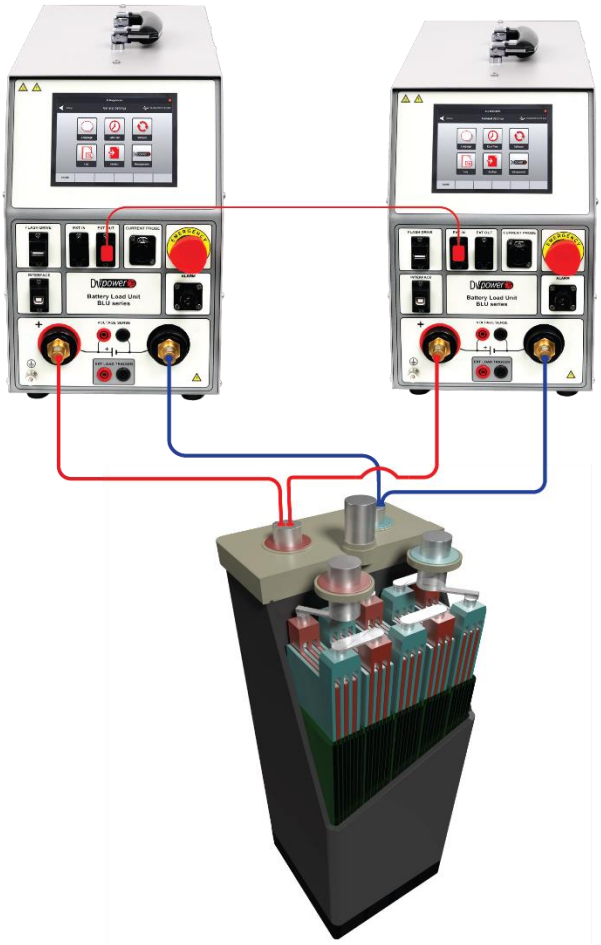


### 3.3.2.5 Parallel Mode

In case the required discharge current or power exceeds the capacity of a single BLU device, up to ten same-model BLU devices can be connected in parallel. The connection between BLU devices is established using Ethernet ports, network cable and RS485 communication. The communication is based on a MASTER-SLAVE principle: One device is always selected to be the MASTER and all the others are the SLAVE units.

The connection between two BLU devices in the parallel mode is presented in the Figure 3-20. The red connections are to be connected to the plus terminal at the beginning of the battery string. The black connections are to be connected to the minus terminal at the end of the battery row. It is necessary to connect the RS485 connection cable between EXT OUT on the Master and EXT IN on the Slave unit.

Figure 3-21: Connecting two BLU devices to test object for **Parallel discharge**



When selecting the Parallel Mode, the BLU changes the display to the Test Settings menu for a parallel discharge test. In the **Parallel Discharge** menu, it needs to be set if BLU is Master or Slave unit and the total number of Slaves (if BLU is Master) or slave address that identifies the slave device. Slave number is an integer number, starting with 1, that is set on the Slave units only.

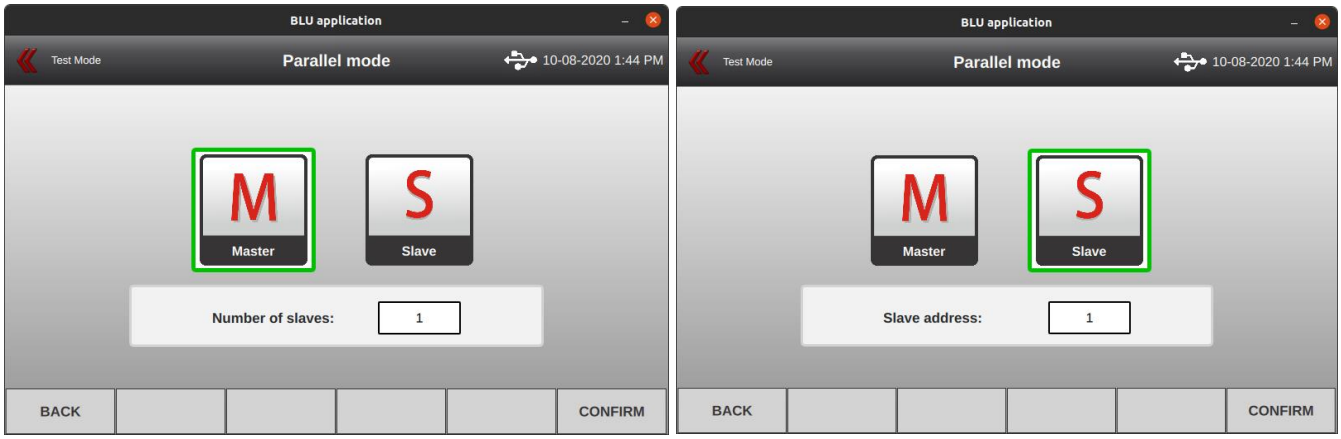



Figure 3-22: **Parallel discharge** screen on Master (left) and Slave units (right)

Press *Confirm* to confirm the selection. After that, the Test Settings screen will be displayed indicating that device is set as Master or Slave.

The following screen is displayed on Slave unit before test is started:

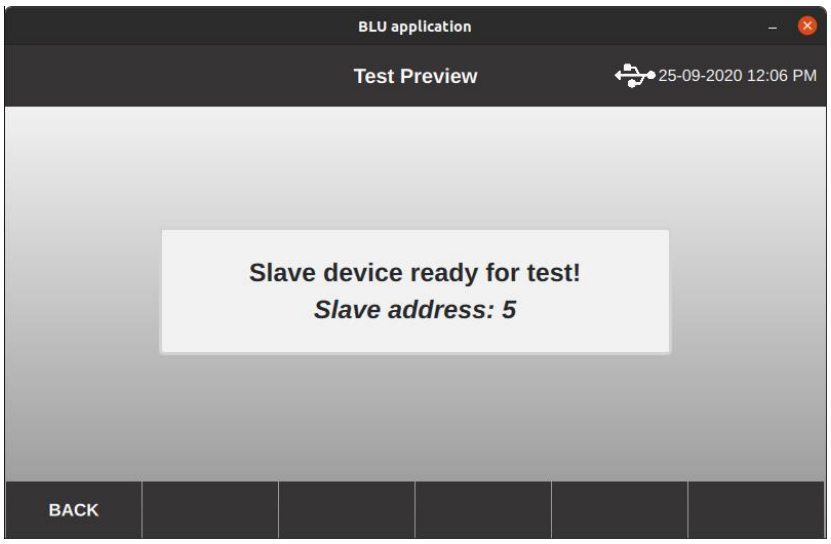



Figure 3-23: Screen on Slave before test is started

The following screen is displayed on Master unit (*Test Preview*) before test is started:

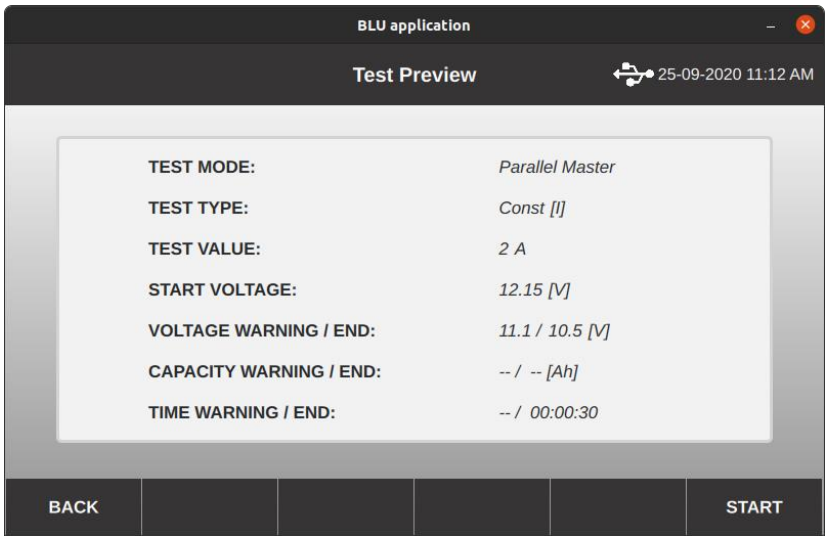



Figure 3-24: Screen on Master before test is started

Table 3.2: Maximum currents for up to four BLU devices connected

| Battery Nominal voltage (V) | No. of units | Maximum discharge current (A) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | BLU100L* | BLU100A* | BLU200A | BLU340A | BLU110T* | BLU220T | BLU360V |
| 1,2 | 1 | - | - | - | - | 100 | - | - |
| | 2 | | | | | 200 | | |
| | 3 | | | | | 300 | | |
| | 4 | | | | | 400 | | |
| 2 | 1 | - | - | - | - | 100 | - | - |
| | 2 | | | | | 200 | | |
| | 3 | | | | | 300 | | |
| | 4 | | | | | 400 | | |
| 3,7 | 1 | 50 | - | - | - | 100 | - | - |
| | 2 | 100 | | | | 200 | | |
| | 3 | 150 | | | | 300 | | |
| | 4 | 200 | | | | 400 | | |
| 6 | 1 | 40 | 40 | 60 | 50 | 100 | 90 | 50 |
| | 2 | 80 | 80 | 120 | 100 | 200 | 180 | 100 |
| | 3 | 120 | 120 | 180 | 150 | 300 | 270 | 150 |
| | 4 | 160 | 160 | 240 | 200 | 400 | 360 | 200 |
| 12 | 1 | 80 | 80 | 120 | 100 | 150 | 175 | 100 |
| | 2 | 160 | 160 | 240 | 200 | 300 | 350 | 200 |
| | 3 | 240 | 240 | 360 | 300 | 450 | 525 | 300 |
| | 4 | 320 | 320 | 480 | 400 | 600 | 700 | 400 |
| 24 | 1 | 160 | 160 | 240 | 160 | 150 | 350 | 160 |
| | 2 | 320 | 320 | 480 | 320 | 300 | 700 | 320 |
| | 3 | 480 | 480 | 720 | 480 | 450 | 1 050 | 480 |
| | 4 | 640 | 640 | 960 | 640 | 600 | 1 400 | 640 |
| 48 | 1 | 160 | 160 | 240 | 160 | 150 | 350 | 160 |
| | 2 | 320 | 320 | 480 | 320 | 300 | 700 | 320 |
| | 3 | 480 | 480 | 720 | 480 | 450 | 1 050 | 480 |
| | 4 | 640 | 640 | 960 | 640 | 600 | 1 400 | 640 |
| 60 | 1 | 120 | 120 | 210 | 160 | 120 | 270 | 160 |
| | 2 | 240 | 240 | 420 | 320 | 240 | 540 | 320 |
| | 3 | 360 | 360 | 630 | 480 | 360 | 810 | 480 |
| | 4 | 480 | 480 | 840 | 640 | 480 | 1080 | 640 |
| 110 | 1 | 110 | 110 | 140 | 160 | - | - | 160 |
| | 2 | 220 | 220 | 280 | 320 | | | 320 |
| | 3 | 330 | 330 | 420 | 480 | | | 480 |
| | 4 | 440 | 440 | 560 | 640 | | | 640 |
| 120 | 1 | 100 | 100 | 140 | 150 | - | - | 150 |
| | 2 | 200 | 200 | 280 | 300 | | | 300 |
| | 3 | 300 | 300 | 420 | 450 | | | 450 |
| | 4 | 400 | 400 | 560 | 600 | | | 600 |
| 220 | 1 | 55 | 55 | 75 | 110 | - | - | 110 |
| | 2 | 110 | 110 | 150 | 220 | | | 220 |
| | 3 | 165 | 165 | 225 | 330 | | | 330 |
| | 4 | 220 | 220 | 300 | 440 | | | 440 |
| 240 | 1 | 50 | 50 | 70 | 100 | - | - | 100 |
| | 2 | 100 | 100 | 140 | 200 | | | 200 |
| | 3 | 150 | 150 | 210 | 300 | | | 300 |
| | 4 | 200 | 200 | 280 | 400 | | | 400 |
| 420 | 1 | - | - | - | - | - | - | 55 |
| | 2 | | | | | | | 110 |
| | 3 | | | | | | | 165 |
| | 4 | | | | | | | 220 |

*BLU100L, BLU100A & BLU110T do not provide parallel operation feature. Multiple BLU units can be used only if one BLU operates in CP mode.

### 3.3.2.6 BLU + ZVD

Zero Voltage Discharge Module ZVD Series is specially designed external module enabling full battery discharge (down to 0 V). It is designed to operate in a system with BLU-A providing total discharge of batteries with voltage up to 500 V DC.
The total battery discharge is required in the battery recycling process. It is important to discharge a battery completely before entering the recycling process, because the battery can contain some remanent energy. That remanent energy can be dangerous and create problems during the disassembling of a battery or even during its transportation.

In order to prevent that, we created the ZVD Series enabling a full battery discharge. A single discharge down to 0 V will not extract all the energy from the battery. Once the discharge is finished, battery voltage will rise to some non-zero value, confirming there is still energy in the battery. The phenomenon is called the battery voltage rebound. BLU-A & ZVD system improves the discharge process by discharging the battery in 2 steps:
*Step 1*: Efficient (up to 60 A) and controlled (current is constant down till 0 V is reached) discharge until battery voltage drops to 0 V.
*Step 2*: ZVD short-circuits the battery to remove the remaining energy.

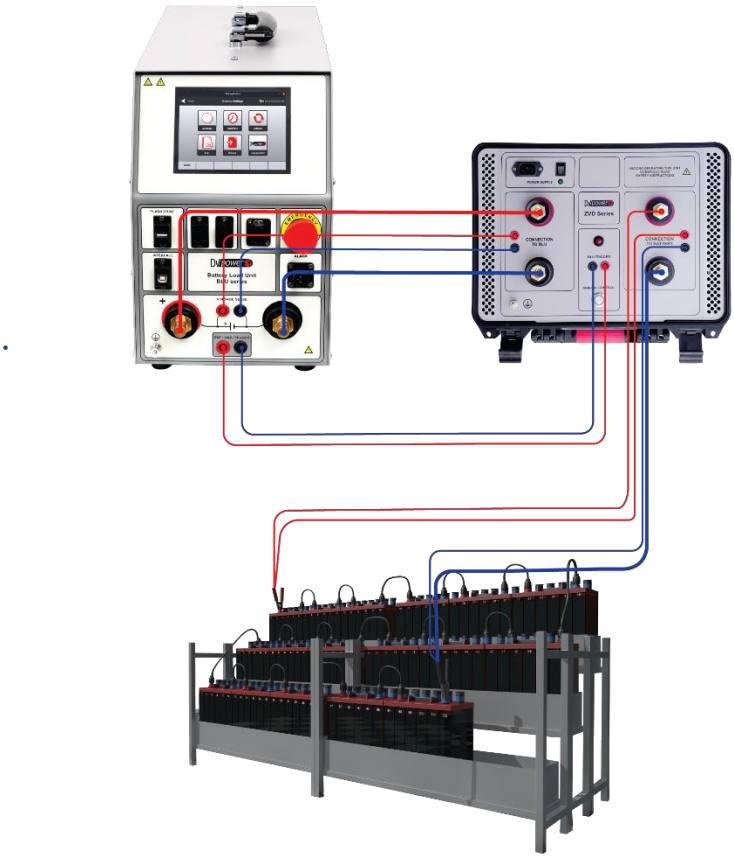


Figure 3-25: **BLU+ZVD** connection principle

### 3.3.3 Test Type Menu

The *Test Type* menu enables specifying the type of the discharge process:

- **Constant current** (the discharge current is constant throughout the test. The current is defined by the user prior the test. The user can change the current value during the test (for example 50 A -> 100 A) without interrupting the test);
- **Constant power** (the discharge power is constant throughout the test. The power is defined by the user prior the test. The user can change the power value during the test (for example 100 W -> 300 W) without stopping the test);
- **Constant resistance** (the BLU resistance is constant throughout the test. The resistance value is defined by the user prior the test. The user can change the resistance during the test (for example 0,1 Ω -> 0,5 Ω) without stopping the test);
- **Constant voltage** (the BLU enables to discharge the battery by constant current until certain voltage is reached (current and voltage are defined by the user). When the voltage value is reached, the discharge current will automatically start to reduce in order battery voltage to be kept on the selected level;

**Note:** Additional test limit is present, therefore, desired voltage and current must be set. More in the 3.3.3.3 Limits Menu paragraph.

- **Profile modes** (Profile I, Profile P, Profile R – enables performing modified Performance tests. Profile modes enable to split the test into intervals and define current, power or resistance value for each interval separately).

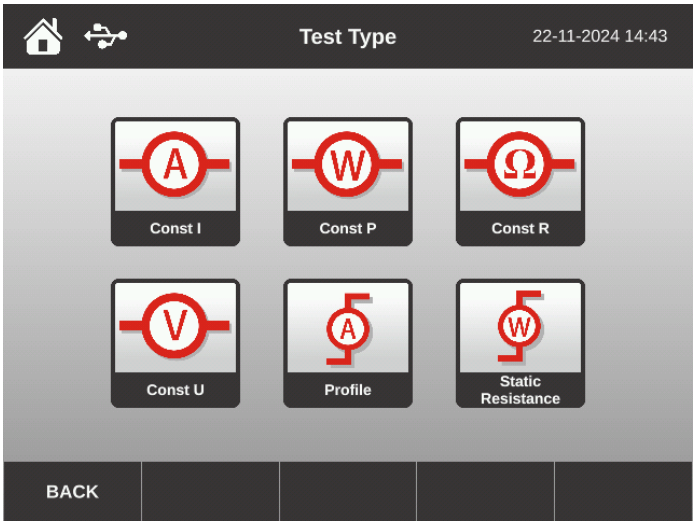



Figure 3-26: The **Test type** menu

#### 3.3.3.1 Profile Modes

PROFILE modes provide selection of time intervals in which the discharge current, power or resistance will be changed in order to perform modified performance tests. Profile modes (PROFILE I, PROFILE P and PROFILE R) can be selected on the Test type screen (Figure 3-24).

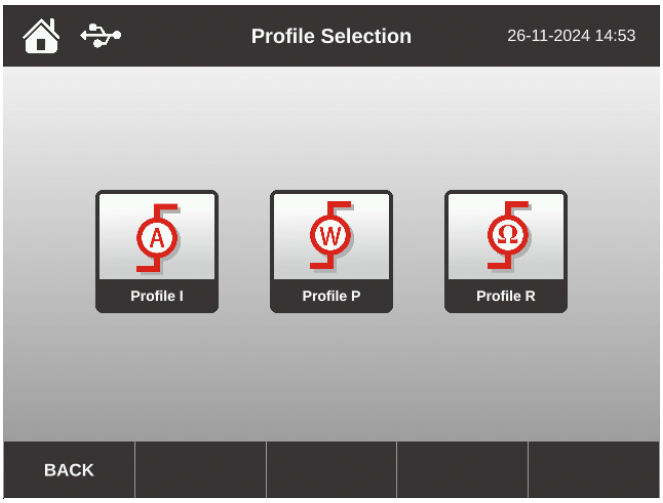



Figure 3-27: The **Profile type** settings

After the required profile has been selected (I, P or R) the test mode needs to be selected.

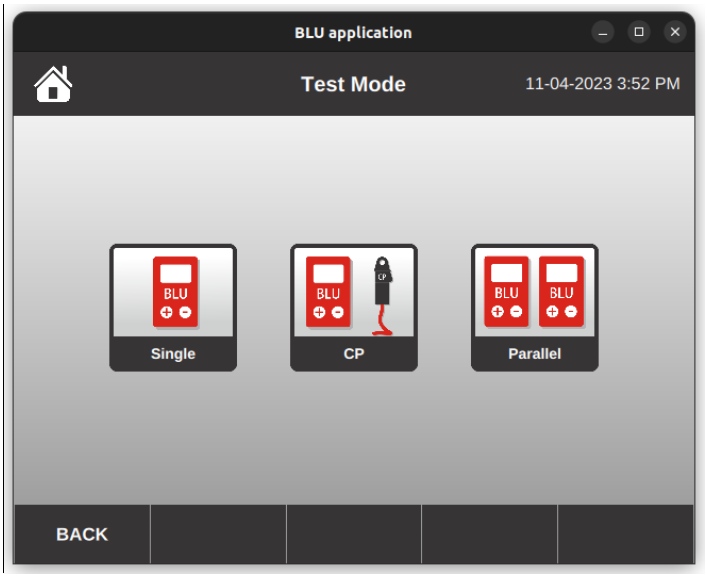



Figure 3-28: **Test mode** settings

After selecting the test mode, the user needs to define number and duration of time intervals and discharge current (*Profile I*), discharge power (*Profile P*) or resistance (*Profile R*) for each of defined time intervals. The corresponding screen for Profile I test type is presented on Figure 3-26. The following buttons are available:

- *Back* – to display the previous screen
- *Add* – to add a new interval (number of intervals is not limited)
- *Clear last* – to delete the latest defined interval
- *Clear all* – to delete all defined intervals
- *Table view* – to present defined intervals in tabular and numerical form
- *Confirm* – to proceed to test after all intervals are defined.

Pressing the *ADD* button, the following screen enabling setting a new interval will be displayed (Figure 3-26):

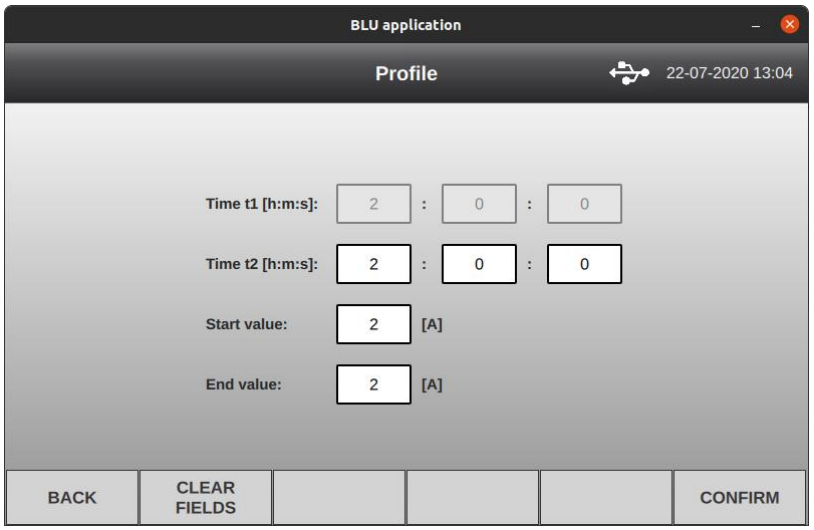



Figure 3-29: **Profile** – adding new interval

End of the previous time interval is stated as beginning of next time interval (*t1*). After defining end time of the interval (*t2*), the user needs to select start and end value of discharge current (*Profile I*) or power (*Profile P*) or resistance (*Profile R*). If start and end value of I, P or R are identical, BLU will keep the discharge current, power or resistance constant throughout the interval (respectively). However, if start vale is not equal to the end value, I, P or R will change in steps during the interval. *Clear fields* will delete all changeable parameters. The new interval is added after *Confirm* button is pressed.

### 3.3.3.2 Test Value

The menu enables to select current, power or resistance value, depending on the selected Test Type.

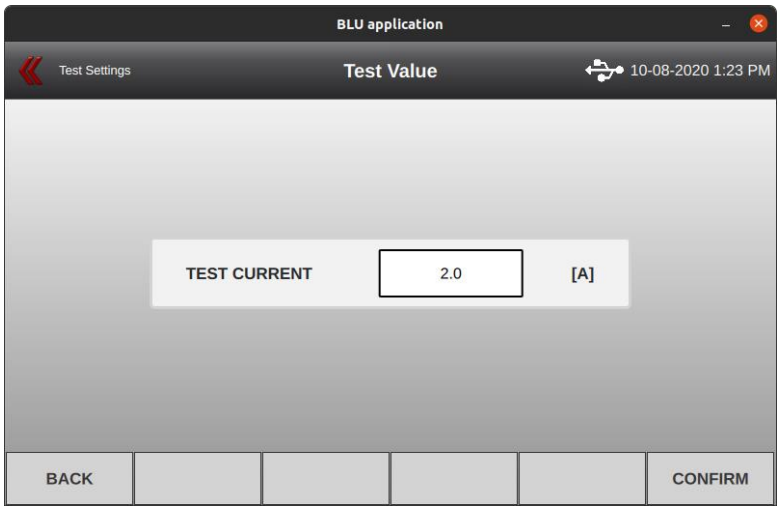



Figure 3-30: Test current value selection

### 3.3.3.3 Limits Menu

The BLU provides 3 adjustable stop points: battery string voltage, discharge time, discharge capacity. In order to set the values of the stop points, the ***Limits*** menu should be entered by selecting the **Limits** button.

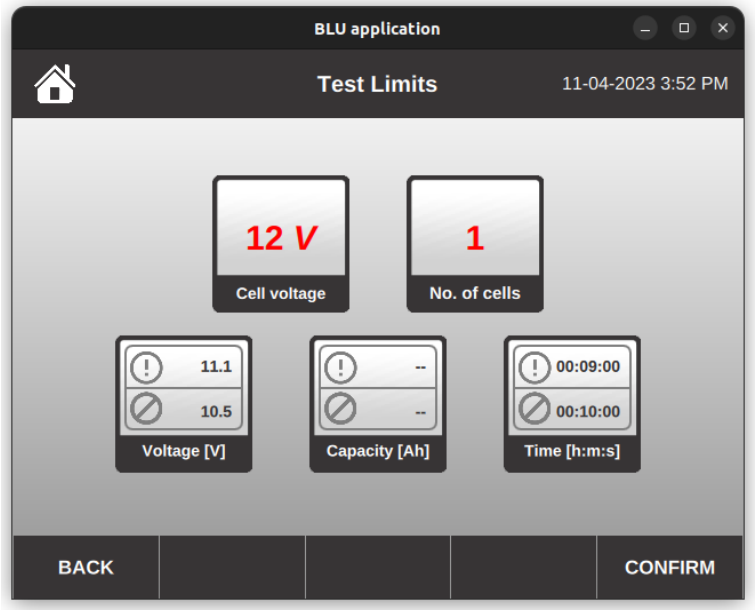



Figure 3-31: Test Limits menu

The first step is to select nominal voltage of the cells *in Cell voltage* menu. The nominal cell voltage depends on type of cells (Lead-acid, Ni-Cd, Li, etc) as well as internal construction (a lead-acid cell can be 2 V, 6 V, 12 V, 24 V, etc). The user can also define custom nominal voltage.
Selectable options are presented in Figure 3-29.

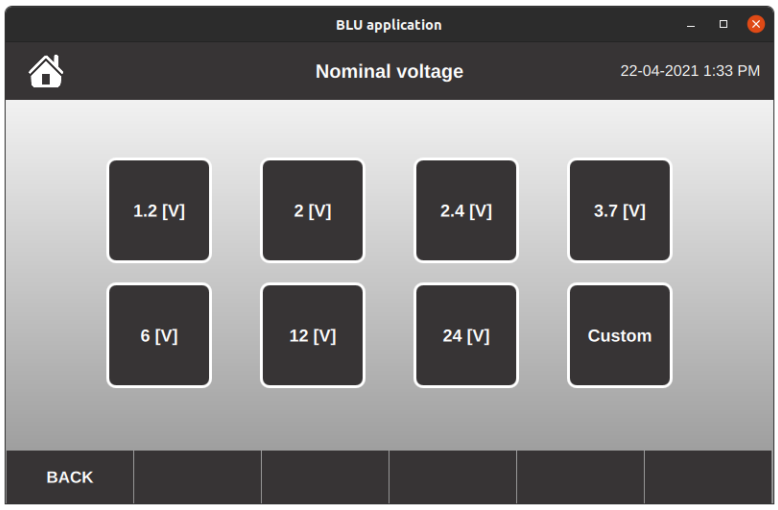



Figure 3-32: Nominal voltage selection

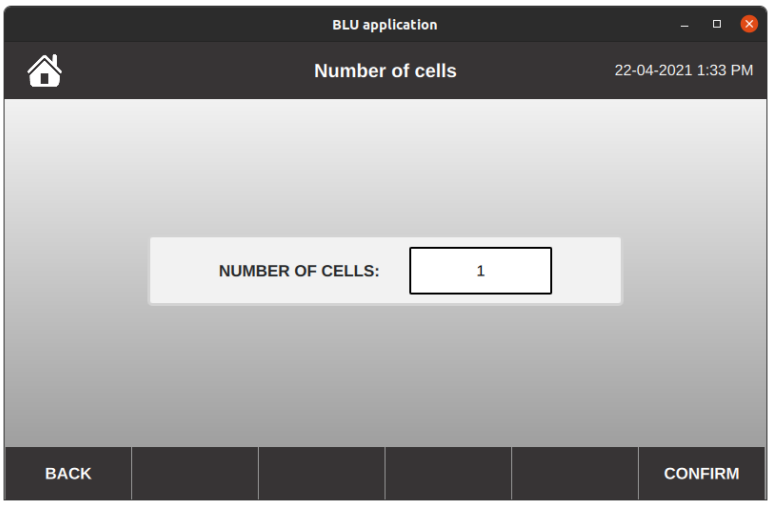



Figure 3-33: Number of cells

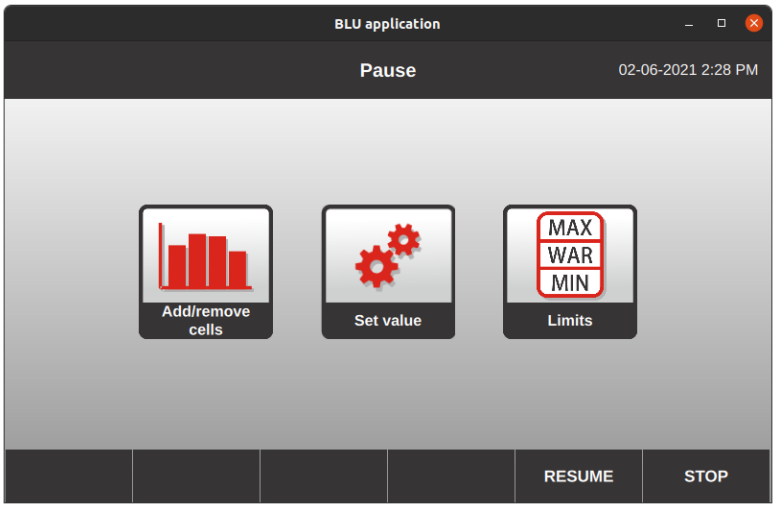



Figure 3-34: Pause menu

*Voltage limits* menu enables setting voltage limits for the entire battery under test. The user can enter End limit and Warning limit.

- If battery voltage drops to entered Warning limit value, the corresponding message will be displayed. The test will not be interrupted.
- If battery voltage drops to entered End limit value, the test will be automatically stopped.

**Note: Both parameters (End limit and Warning limit) can be set as ON or OFF by the user.**

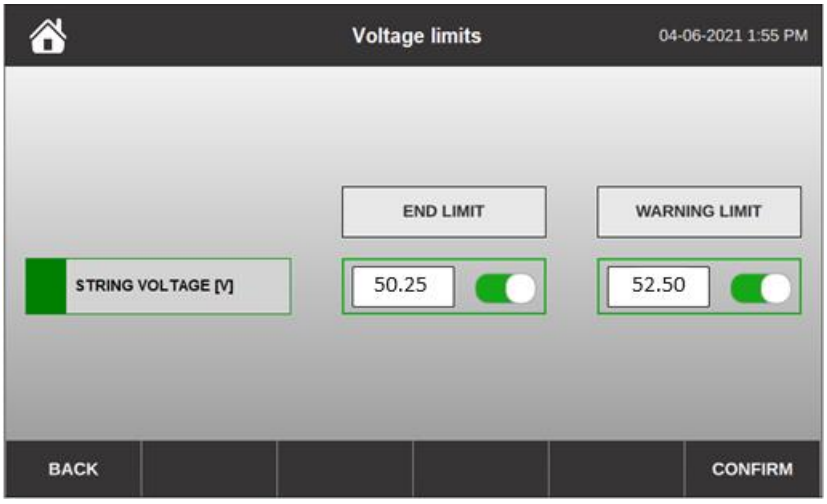



Figure 3-35: Voltage limits settings

The user can also set the *Capacity* limit. Capacity limits can be entered in [Ah] or [kWh] units, if nominal capacity of the battery is entered in [Ah] or [kWh], respectively. If entered *End limit* is reached, the test will be automatically stopped. Reaching the Warning limit will only display an appropriate warning message and will not stop the test, Figure 3-33.

**Note: Both parameters (End limit and Warning limit) can be set as ON or OFF by the user.**

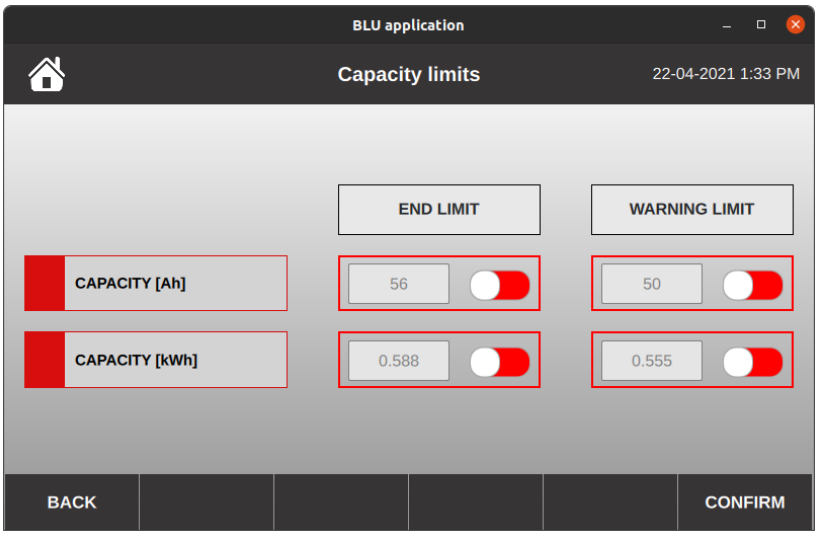



Figure 3-36: Capacity limits

The user can also set the *Time* limit. The *End time limit* cannot be disabled and needs to be properly entered. The *Warning Time* parameter can be enabled / disabled. Reaching the *Warning time limit* will only display an appropriate warning message and will not stop the test, Figure 3-34.

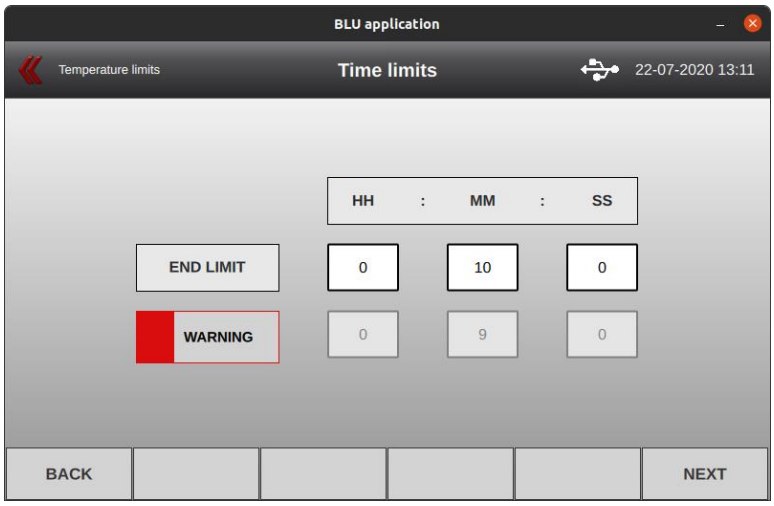



Figure 3-37: Time Limits

In case if CONST U test is chosen, there is an additional limit setting (Const U: ON), shown in Figure 3-38 below:

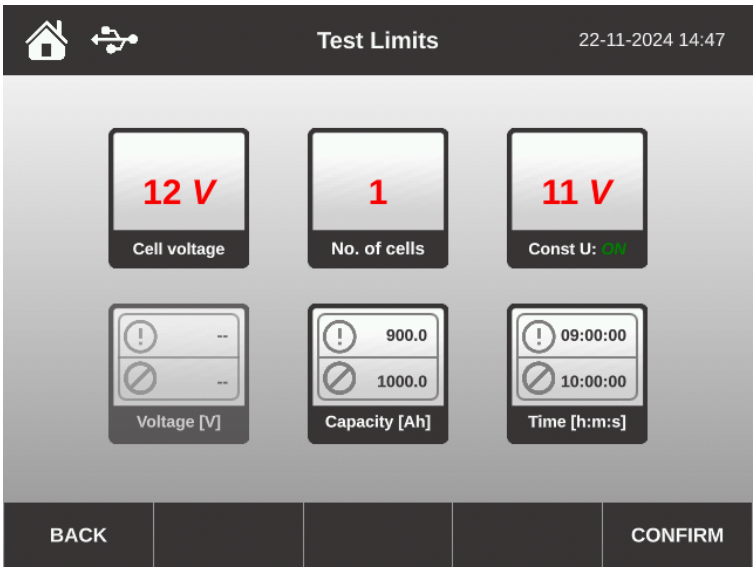



Figure 3-38: CONST U Limit

Two limit parameters must be entered in case of CONST U test:

- Constant voltage [V]; This value represents desired preset voltage that battery needs to be discharged to. The battery will be discharged by constant current until the preset voltage is reached.
- Minimum current [A]; After reaching preset voltage, discharge continues at preset voltage and the discharge current starts to drop. The test will be stopped when discharge current drops to the preset current limit. Stop parameters can also be test time or measured capacity.

Both parameters are shown in the Figure 3-39 below:

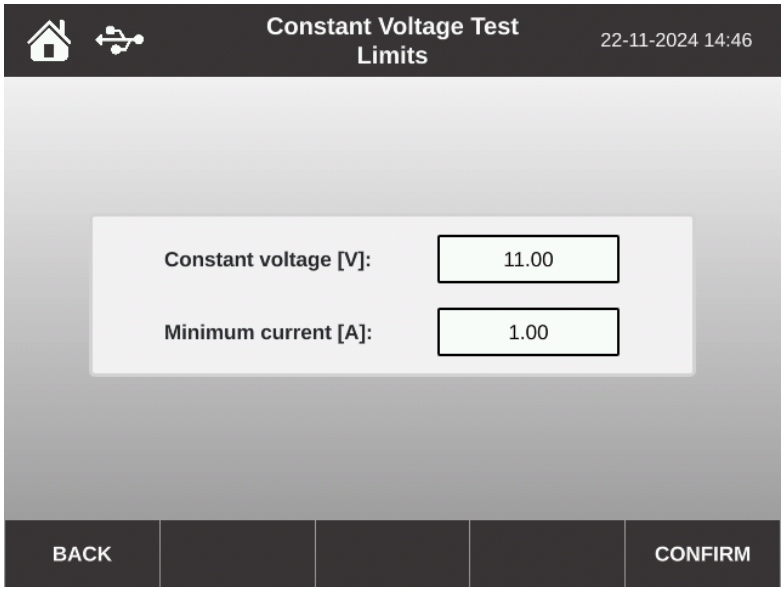



Figure 3-39: CONST U parameters

### 3.3.3.4 Test Info Menu

*Test Info* menu enables entering information about the battery, such as battery manufacturer, battery name, battery, type, etc. Some field in the Battery info menu are marked as (*) and needs to be entered (mandatory fields). Entering nominal capacity of the battery enables comparing obtained capacity value end nominal capacity value. Basic information about the test device (BLU) can be found in the *Device Info* menu.

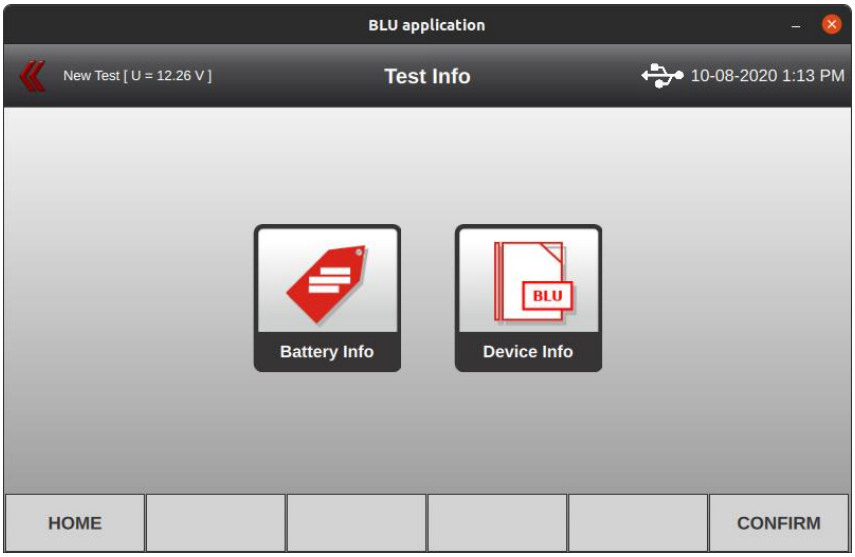
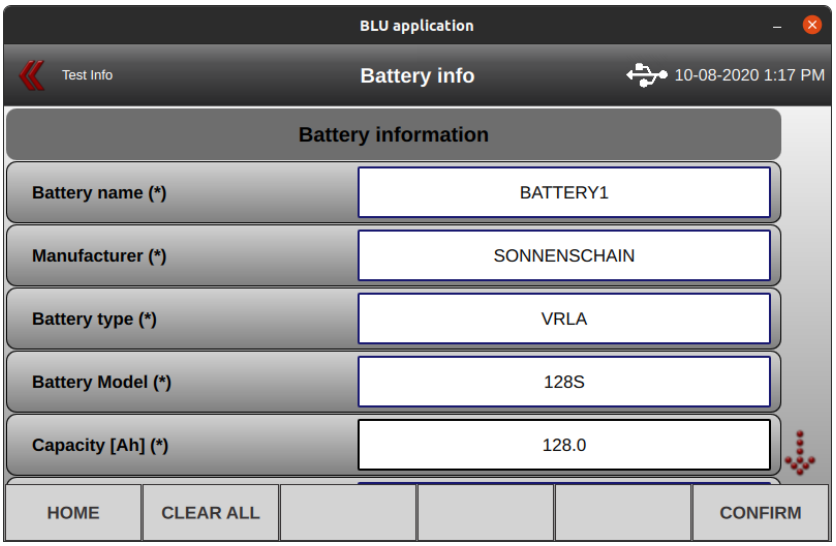



Figure 3-40: Test Info menu

Figure 3-41:
Battery Info menu

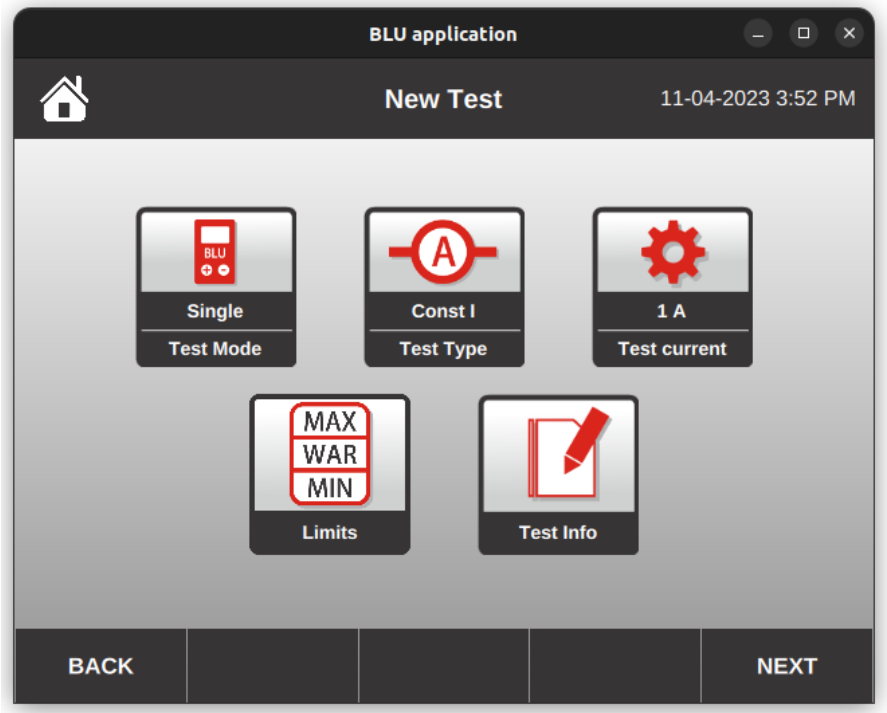



# 4. Test

The user can set all parameters in the *New test* menu, the same way as described in the section *3.3.2. Test Settings*. Once the test is prepared, it can be executed by pressing the footer button Start.

**Note:** When the instrument is turned on, last selected settings and test parameters will be automatically loaded.

Figure 4-1:
New Test menu

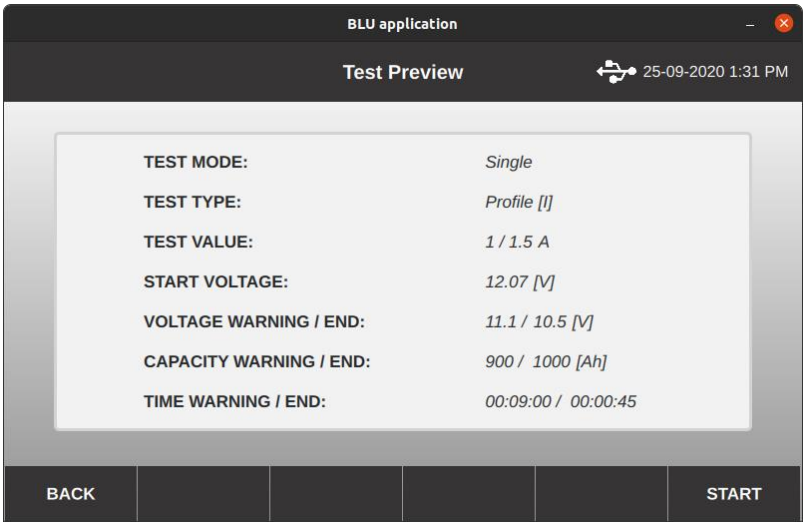


## 4.1 Performing Discharge Tests

### 4.1.1 Single mode

A test is started by pressing the START button / or with external signal in the *Test Preview* screen.

Figure 4-2:
Test Preview screen – Single mode




After test has been initiated, the *Test* screen will be displayed (Figure 4-3). The *Test* screen provides information about battery parameters and test settings in numerical and graphical form. Pre-set numerical limits can also be viewable in the right part of the screen.

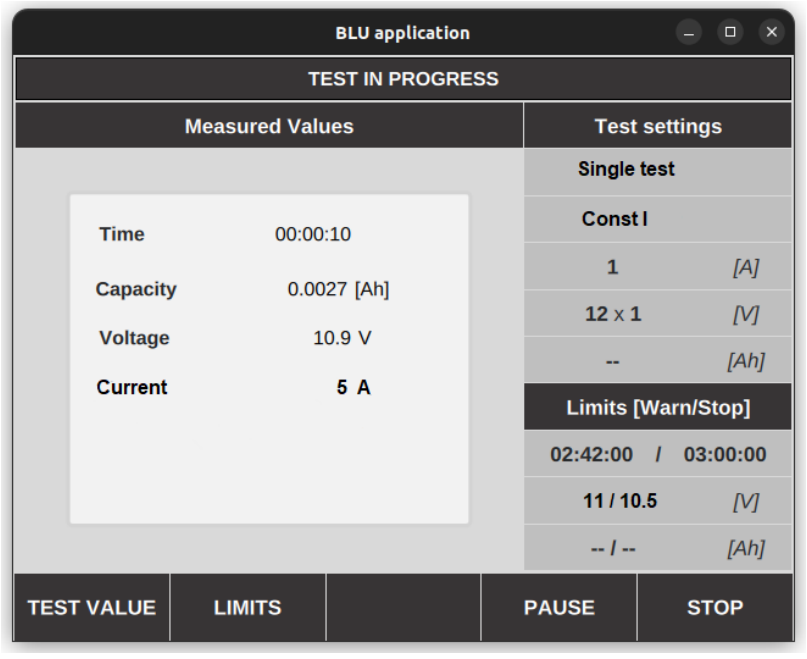



Figure 4-3: Test screen – Single mode

The following parameters are presented during the test:

1. Numerical parameters

1.1 Test values
- Time (*00:00:10* on the Figure 4-4) – elapsed time from start of test,

- Voltage (*10.9 [V]* on the Figure 4-4) – current battery voltage,
- Current (5 *[A]* on the Figure 4-4) – selected discharge current,

Alternatively, test power (in W) or test resistance (in Ω) will be displayed if *Constant power* or *Constant resistance* models has been selected prior the test.

- Measured capacity (*0.0027 [Ah]* on the Figure 4-4) – capacity measured from start of the test

1.2 Limits [Warn/Stop]

- Time (02:42:00 / 03:00:00) – displays *Warning (left)* and *End (right)* limits of test time (only End parameter is set),
- Battery voltage (11 / 10,5 [V]) – displays *Warning (left)* and *End (right)* limits of battery voltage (both values are set),
- Capacity (-- / -- [Ah]) - displays *Warning (left)* and *End (right)* limits for measured capacity (neither value is set).

SETTINGS button

The *Settings* button enables to modify current (or power or resistance, depending on type of test) and preset limits without interrupting the test. Pressing the *Settings* button, the screen presented on Figure 4-4 will be displayed.

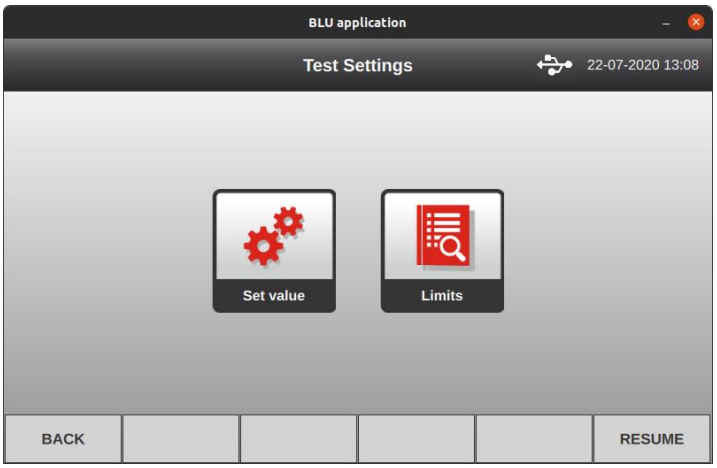



Figure 4-4: Test settings screen

The *Set value* menu and the *Limits* menu are presented on Figure 456. Both menus are described in Sections 3.2.2.2. & 3.2.2.3 of this Manual.

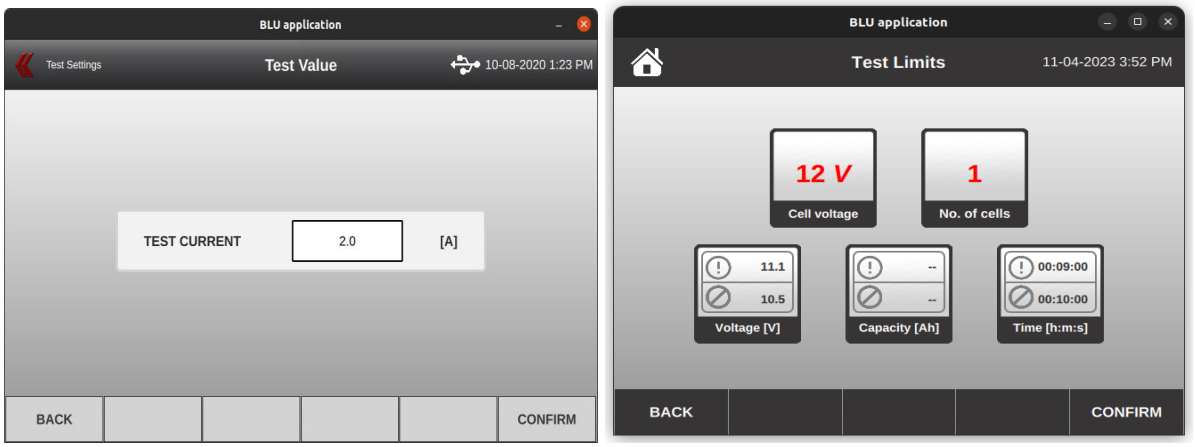



Figure 4-5: *Test value* menu (left) and *Limits* menu (right)

PAUSE button

If the user needs to pause the test (for example, to replace a bad cell) it can be done by pressing the *Pause* button.
Pressing the *Pause* button will temporarily stop the test. During the pause, the user may modify current (or power or resistance, depending on type of test) and preset limits or abort the test (Figure 4-6). Pressing the *Resume* button the test will be continued.

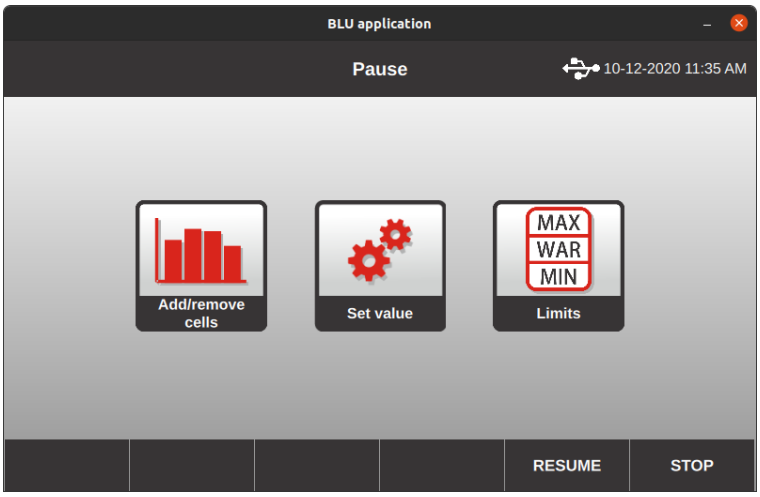



Figure 4-6: Pause screen

The *Set value* menu and the *Limits* menu are described in Sections 3.2.2.2. & 3.2.2.3 of this Manual.

STOP button

Pressing the *STOP* button, the test will be interrupted and the *Cooling* screen will be displayed.

### 4.1.2 Current Probe (CP) Mode

If test in *CP mode* is initiated, the test screen offers same options (parameters change / pausing / graph expanding) and displays almost identical battery and test parameters as described in Section 3.1.1.3. Main differences are related to test current / power / resistance.

#### 4.1.2.1 CP Load Current

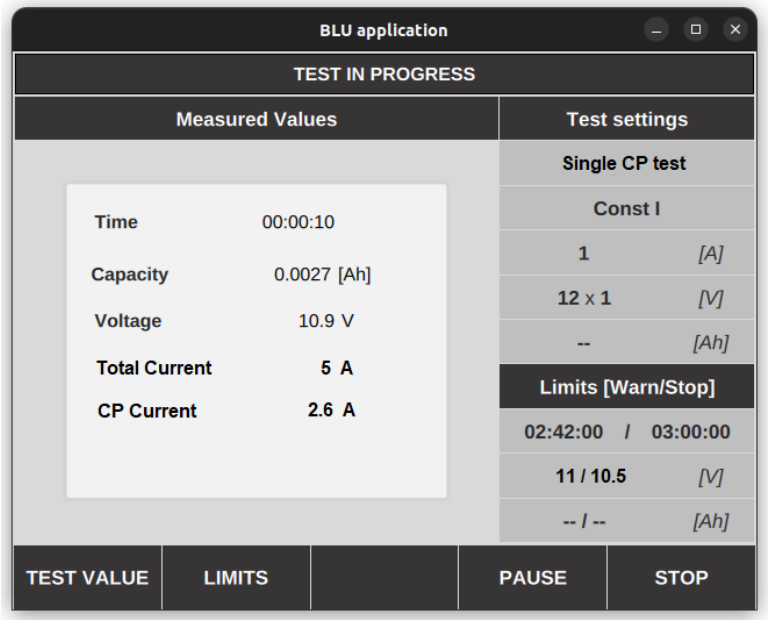



Figure 4-7: Test screen – CP Load Current

The following parameters are presented during the test:

1. Numerical parameters (visible on Figure 4-7)

1.1 Test values
- Test time (*00:00:10*) – elapsed time from start of test,
- Voltage (*10.9 [V]*) – current battery voltage,
- Total Current (5 *[A]* on the Figure 4-7) – selected discharge current
- CP Current (current probe current) (*2.6 A*) – current measured by current probe,

Alternatively, test power (in W) or test resistance (in Ω) will be displayed instead of Test current if *Constant power* or *Constant resistance* modes has been selected prior the test.
- Measured capacity (*0.0027 [Ah]*) – capacity measured from start of the test

1.2 Limits [Warn/Stop]
- Time (02:42:00 / 03:00:00) – displays *Warning (left)* and *End (right)* limits of test time (only End parameter is set),
- Battery voltage (11 / 10,5 [V]) – displays *Warning (left)* and *End (right)* limits of battery voltage (both values are set),
- Capacity (-- / -- [Ah]) - displays *Warning (left)* and *End (right)* limits for measured capacity (neither value is set).

### 4.1.2.2 CP Battery Current

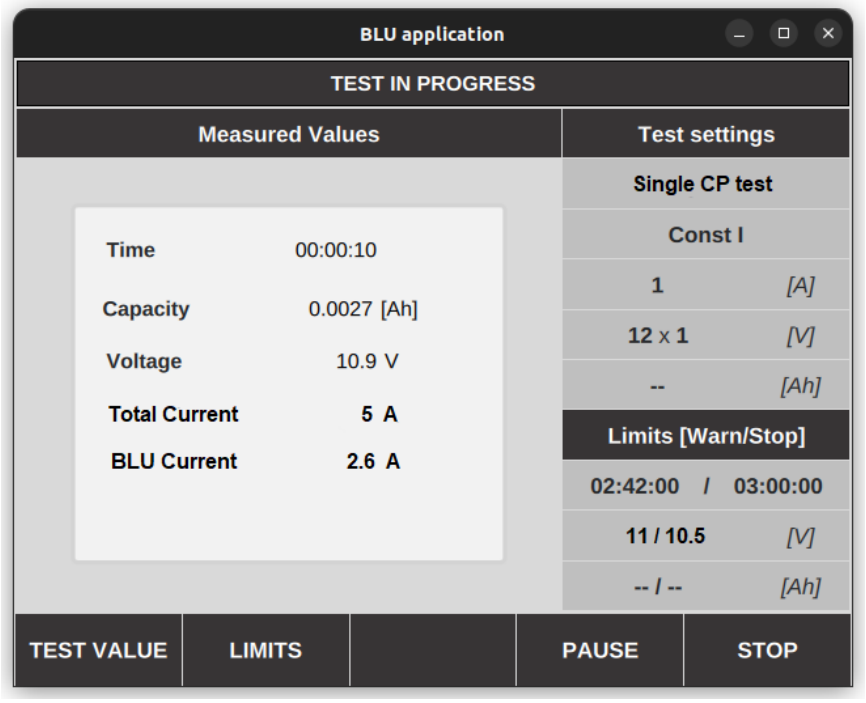



Figure 4-8: Test screen – CP Battery Current

The following parameters are presented during the test:

1. Numerical parameters (visible on Figure 4-8)

1.1 Test values
- Test time (*00:00:12*) – elapsed time from start of test,

- Voltage (*10.9 [V]*) – current battery voltage,
- Total Current (5 *[A]* on the Figure 4-8) – selected discharge current
- BLU Current (current probe current) (*2.6 A*) – current which BLU draws from battery,

Alternatively, test power (in W) or test resistance (in Ω) will be displayed instead of Test current if *Constant power* or *Constant resistance* modes has been selected prior the test.

- Capacity – capacity measured from start of the test

Alternatively, test power (in W) or test resistance (in Ω) will be displayed instead of Test current if *Constant power* or *Constant resistance* modes has been selected prior the test.

1.2 Limits [Warn/Stop]

- Time (02:42:00 / 03:00:00) – displays *Warning (left)* and *End (right)* limits of test time (only End parameter is set),
- Battery voltage (11 / 10,5 [V]) – displays *Warning (left)* and *End (right)* limits of battery voltage (both values are set),
- Capacity (-- / -- [Ah]) - displays *Warning (left)* and *End (right)* limits for measured capacity (neither value is set).

### 4.1.3 Profile Mode

When selected discharge mode is one of *Profile* modes, the user can observe how discharge current (*Profile I* – Figure 4-10) or power (*Profile P*) or resistance (*profile R*) changes when one time interval ends and next one starts. The difference is that the user cannot modify test current / power / resistance during the test.

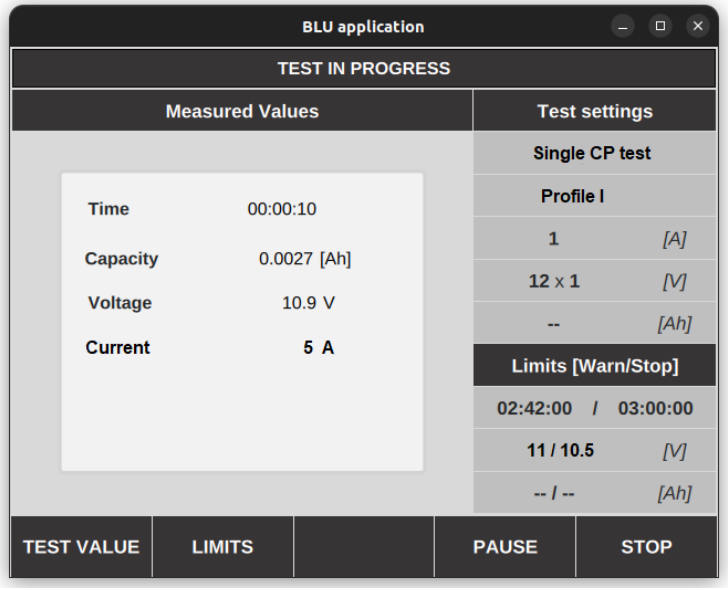



Figure 4-10: Profile Mode Test screen interval

### 4.1.4 Parallel Mode

In parallel mode, one BLU is set as Master and all other BLU's should be set as Slave.
During the test in *Parallel* mode, displayed values on Master and Slave units differs significantly. All test and battery parameters are displayed on the Master unit; Slave units provides information on battery voltage and current of that Slave unit. The test screen on Master unit offers the same options (parameters change / pausing) as described in Section 3.1.1.5.

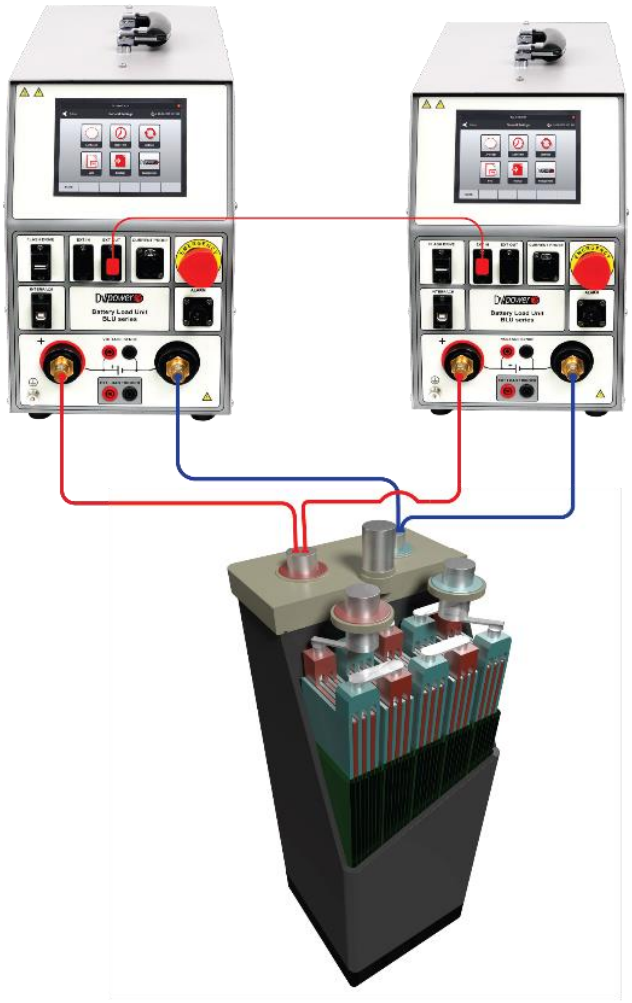


Figure 4-9: BLU connection diagram for Parallel Mode

### 4.1.5 Measurement Parameters

Overview of the maximum currents for various battery voltage ranges with the minimum achievable cell voltage of 1,75 V is presented in the table 3.3. Maximum currents available by using BXL series devices are also presented in the table. The highest resolution of the reading is always displayed.

*Table 3.3: Maximum currents for various battery voltage ranges*

| | | Maximum discharge current (A) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Battery voltage (V) | | BLU100L | BLU100A | BLU200A | BLU340A | BXL-A | BLU110T | BLU220T | BXL-T | BLU360V | BXL-V |
| Nom. | Min / Max | | | | | | | | | | |
| 1,2 | 0.9 | - | - | - | - | - | 100 | - | - | - | - |
| | 1.5 | | | | | | | | | | |
| 2,0 | 1.75 | - | - | - | - | - | 100 | - | - | - | - |
| | 2.35 | | | | | | | | | | |
| 3,7 | 3.0 | 50 | - | - | - | - | 100 | - | - | - | - |
| | 4.2 | | | | | | | | | | |
| 6 | 5,25 | 40 | 40 | 60 | 50 | 59 | 100 | 90 | 62 | 50 | 11 |
| | 7.05 | | | | | 80 | | | 80 | | 15 |
| 12 | 10.5 | 80 | 80 | 120 | 100 | 119 | 150 | 175 | 125 | 100 | 22 |
| | 14.1 | | | | | 160 | | | 165 | | 30 |
| 24 | 21.0 | 160 | 160 | 240 | 160 | 186 | 150 | 350 | 250 | 160 | 48 |
| | 28.2 | | | | | 250 | | | 330 | | 65 |
| 48 | 42.0 | 160 | 160 | 240 | 160 | 182 | 150 | 350 | 241 | 160 | 96 |
| | 56.4 | | | | | 245 | | | 320 | | 130 |
| 60 | 52.5 | 120 | 120 | 210 | 160 | 81 | 120 | 270 | 189 | 160 | 122 |
| | 70.5 | | | | | 105 | | | 250 | | 165 |
| 110 | 96.3 | 110 | 110 | 140 | 160 | 120 | - | - | - | 160 | 89 |
| | 129.3 | | | | | 160 | | | | | 120 |
| 120 | 105,0 | 100 | 100 | 140 | 150 | 130 | - | - | - | 150 | 96 |
| | 141.0 | | | | | 175 | | | | | 130 |
| 220 | 192.5 | 55 | 55 | 75 | 110 | 60 | - | - | - | 110 | 78 |
| | 258.5 | | | | | 80 | | | | | 105 |
| 240 | 210.0 | 50 | 50 | 70 | 100 | 65 | - | - | - | 100 | 85 |
| | 300.0 | | | | | 85 | | | | | 115 |
| 420 | 300.0 | - | - | - | - | - | - | - | - | 65 | 30 |
| | 410.0 | | | | | | | | | | 41 |
| | 410.0 | | | | | | | | | 55 | 41 |
| | 500.0 | | | | | | | | | | 50 |
| Weight (kg) | | 12,8 | 12,8 | 14,5 | 20,6 | 12,5 | 12,8 | 15,1 | 12,5 | 20,6 | 16 |
| Max Power (kW) | | 14,2 | 14,2 | 19,7 | 28,4 | 24,8 | 8,5 | 19,2 | 18 | 28,4 | 32,4 |

Typical accuracy of the BLU instrument is:

- ± (0.5 % of reading + 0.2 A) for the current measurement, and
- ± (0.5 % of reading + 0.1 V) for the voltage measurement, with the full scale values shown in the Table 3.3.

Guaranteed accuracy for the BLU instrument is:

- ± (1 % of reading + 0.5 A) for the current measurement, and
- ± (1 % of reading + 1 V) for the voltage measurement.

**Note: It is important to provide a good connection between the clamps and the connecting point on the test object to achieve stable and accurate test results.**

### 4.1.6 BLU + ZVD – Full Battery Discharge

The first step in Li cells recycling is them to be fully discharged (to extract all the energy from them). The recycling process can be safely started after batteries are fully discharged.
To be fully discharged, firstly the battery needs to be discharged down to 0 V. Due to specific properties of batteries, discharge to 0 V will not extract all the energy from the battery. The energy extraction needs to continue, and the simplest way is to short-circuit the battery to discharge the remaining energy. The system ”BLU + ZVD” enables the full battery discharge as described: the battery is discharged to 0 V and afterwards it is short-circuited to remove the remaining energy.
Full battery dsicharge with BLU and ZVD includes 2 steps:
1. Battery discharge down to 0 V (during which energy is dispated on BLU internal structure) and
2. Battery short-circuited by ZVD for complete discharge (discharge of the remianing energy).

#### 4.1.6.1 Connecting ZVD

Before the ZVD has been connected to a test object (e.g. a battery), the following steps have to be verified:

- The test object is disconnected from its charger in accordance with the national safety regulations.
- The battery should be examined in case of any visual damages or liquid leakage
- The ZVD and BLU itself should be properly grounded. To do this, the grounding screws on the top of the ZVD and BLU should be connected to PE using provided grounding cables.

The ZVD should be connected to the BLU and battery in the following order:

- Connect current & sense interconnection leads to BLU and ZVD (thick red and black cables).
- Connect BLU-ZVD trigger cable (thin red and black cables connected to *Ext Load Out* connector on BLU and the *Relay trigger* connector on ZVD)
- Connect & sense current test leads first to ZVD and then to the battery.

To maximize the accuracy and measurement repeatability, all clamps must have a good connection to the battery terminals while any crossing between the cables should be avoided. The BLU-C displays an appropriate message if the connection between a cable clamp and the corresponding battery terminal is not established.

**Always connect current cables in order described above (from BLU to ZVD to battery).**
**When disconnecting, always disconnect cables from the battery first and then from the ZVD.**
**The grounding wire PE should be connected first and disconnected last.**
**Not following these instructions may cause life-threatening situations.**
**Make sure to make all test leads connections before turning ON BLU and ZVD. When disconnecting, make sure to turn OFF BLU and ZVD before disconnecting test leads.**

The connection diagram is presented in the Figure 4-10.

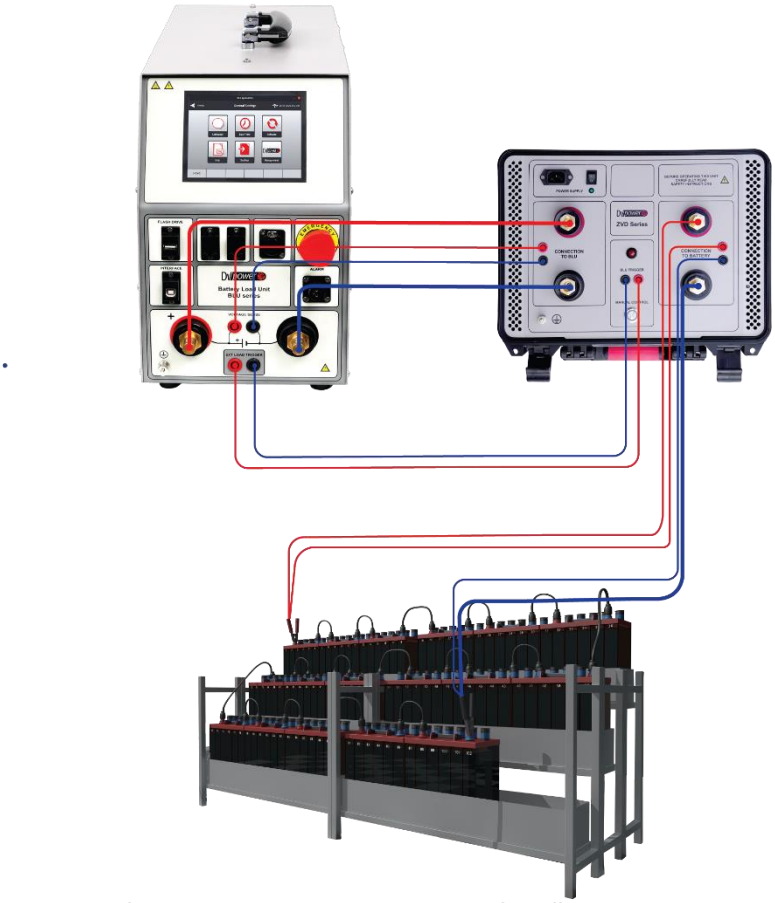


Figure 4-10: BLU & ZVD connection diagram

### 4.1.6.2 Setting Test Parameters

The ”BLU + ZVD” system (connected to a battery as presented in Figure 4-10) enables full discharge of the battery down to 0 V. To use ZVD module for full battery discharge, select ZVD option in Test Mode menu, Figure 4-11.

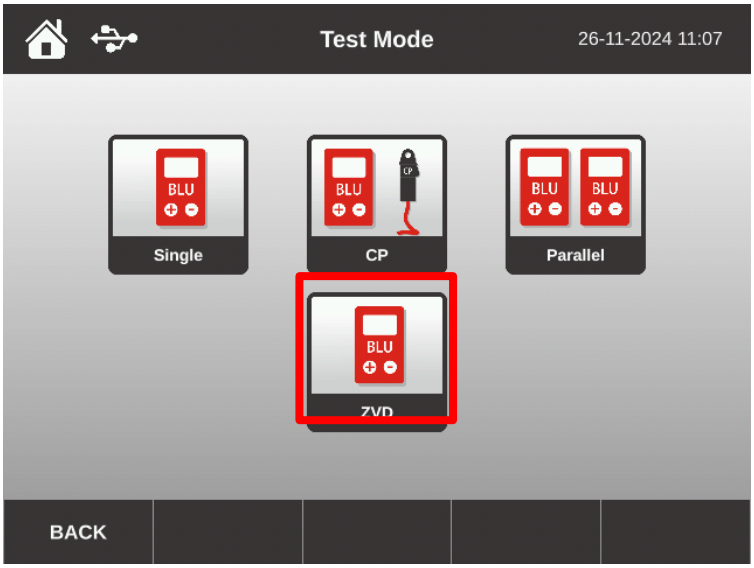



Figure 4-11: BLU – ZVD Test Mode

After the ZVD option has been selected, select option *Manual* on the next screen. *Manual* option means that ZVD needs to be started manually after battery voltage drops to 0 V. Alternative solution (automatic start of ZVD) is currently under development (Figure 4-12).

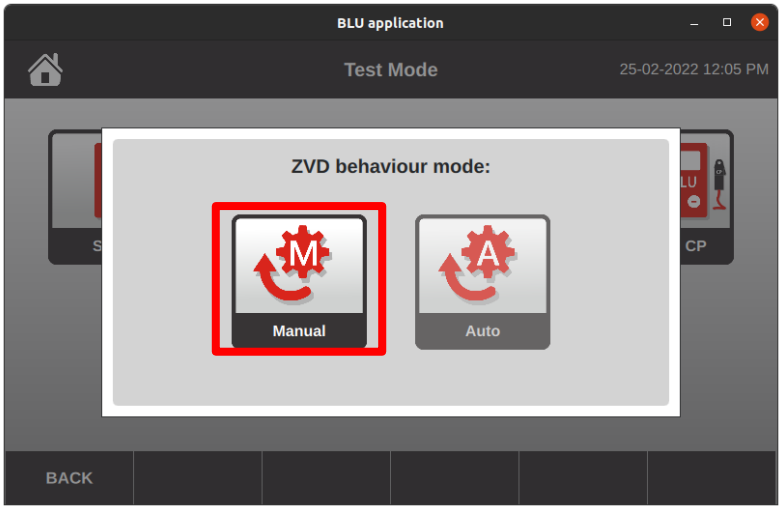



Figure 4-12: ZVD Test Modes

ZVD discharge mode is based on constant current discharge. The next step is to select the discharge current, Figure 4-13. Maximum discharge current of BLU + ZVD system is up to 60 A (if ZVD80 is used) or up to 120 A (if ZVD120) is used.

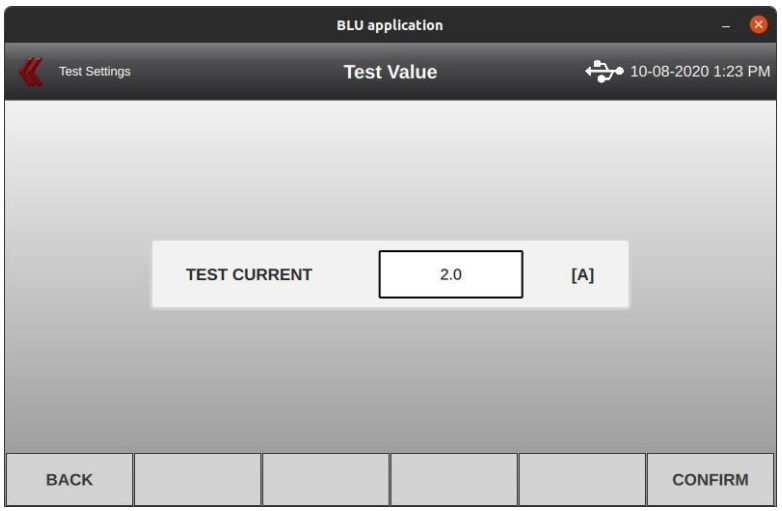



Figure 4-13: Discharge current selection

Regarding the *Limits* menu, the only selection is related to warning and end time parameters.

*Warming time* indicates time period from ZVD activation to alarming the user (message and buzzer) that battery voltage is low. This parameter does not stop or pause the test.
*End time* indicates duration from ZVD activation to automated stopping of the battery discharge.

These parameters, warning and end time, does not need to be set and can be switched off.

After all settings have been completed, the user can proceed to starting the test by pressing the ***Next*** button on *New test* menu, Figure 4-14.

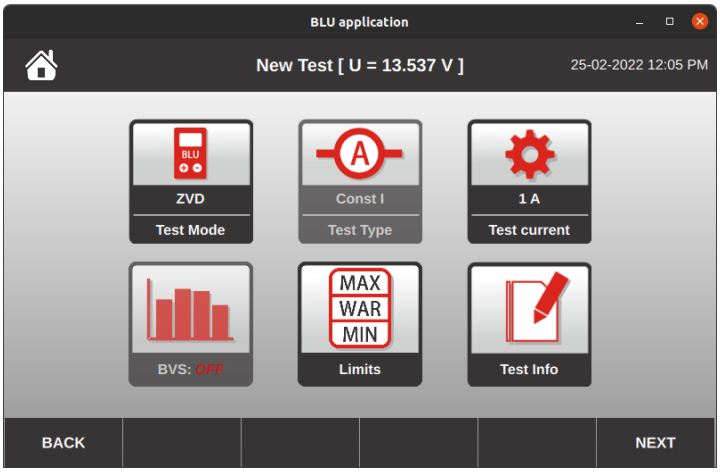



Figure 4-14: ZVD discharge mode settings

After pressing the ***Next*** button and confirming the settings in the following *Test Preview* screen, the discharge can be initiated by pressing the ***Start*** button.

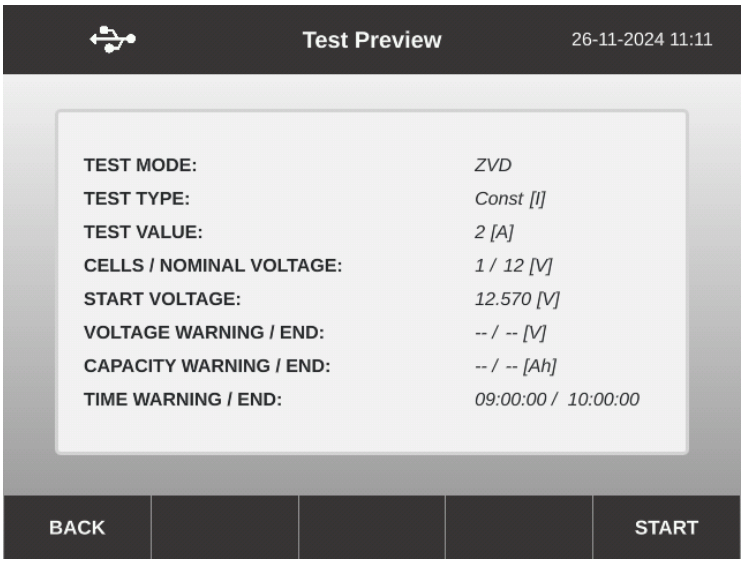



Figure 4-15: Test Preview

After test has been initiated, the *Test* screen will be displayed (Figure 4-16). The *Test* screen provides information about battery parameters and test settings in numerical and graphical form. Pre-set numerical limits can also be viewable in the right part of the screen.

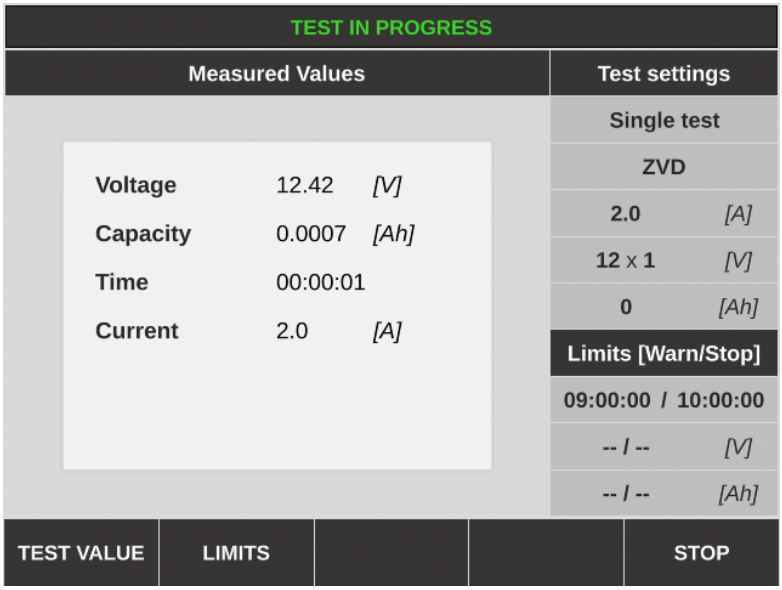



Figure 4-16: Test screen – ZVD mode

The following parameters are presented during the test:

1. Numerical parameters

1.1 Test values
- Test time (*00:00:01* on the Figure 4-16) – elapsed time from start of test,
- Battery voltage (*12.42 [V]* on the Figure 4-16) – current battery voltage,
- Test current (*2.0 [A]* on the Figure 4-16) – selected discharge current,
- Measured capacity (*0.0007 [Ah]* on the Figure 4-16) – capacity measured from start of the test

1.2 Limits [Warn/Stop]
- Time (09:00:00 / 10:00:00) – displays *Warning (left)* and *End (right)* limits of test time (only *End parameter* is set),

When battery voltage drops to 0 V, the user will be alarmed to activate ZVD (short-circuit the battery via ZVD internal structure) or stop the discharge, Figure 4-17.

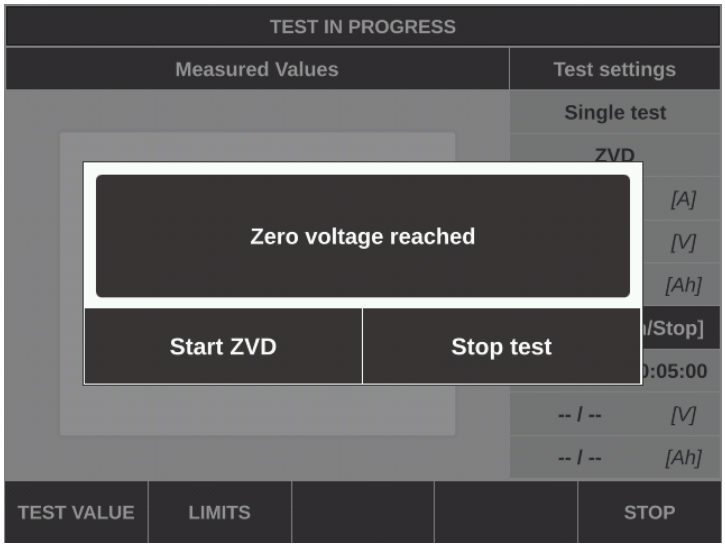



Figure 4-17: ZVD Activation

After selecting ***Start ZVD***¸ battery will be short-circuited over ZVD internal structure. From that point on, the discharge current does not flow through BLU-C internal structure. So BLU will only give information on battery voltage, Figure 4-18.

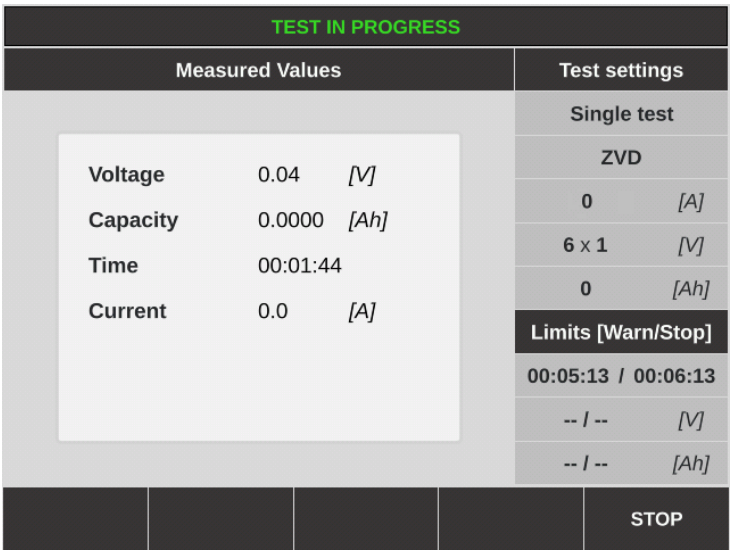



Figure 4-18: ZVD Activated (indicated by BLU current drop to 0 A)

After ZVD is activated (and battery is short-circuited), BLU cannot measure the discharge current. The user can use external current probe to monitor discharge current value.

The battery will remain short-circuited (by ZVD) until one of the two following outcomes happens:
- The preset end time limit was reached, or
- the user pressed the *Stop* button.

In both cases, BLU will not completely stop the test. BLU-C will continue recording the voltage in so called “Monitoring” mode, Figure 4-19.

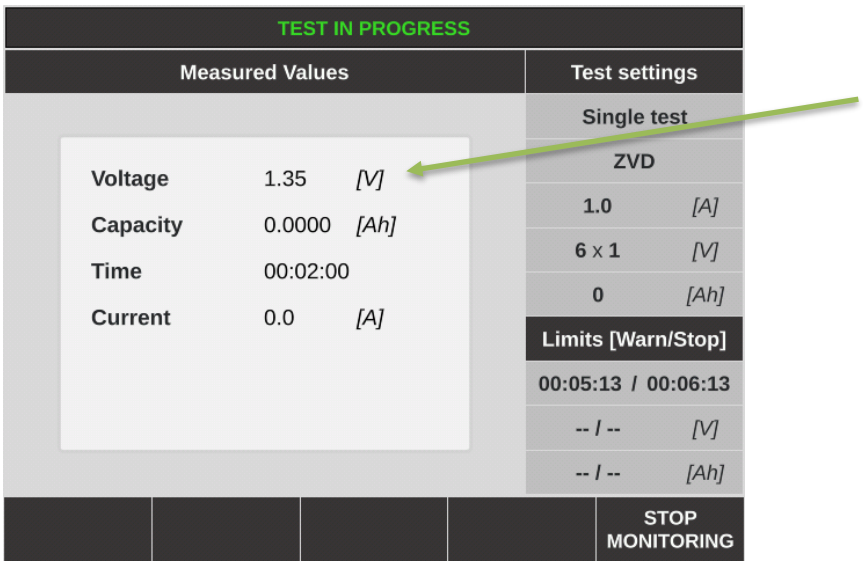



Figure 4-19: BLU Monitoring mode: Battery voltage increases after discharge is stopped

The user can stop the test at any point by pressing *Stop Monitoring* button. The result of the test will be saved in the BLU internal memory.

**NOTE**

After ZVD is activated, BLU does not discharge the battery any more, ZVD does. Therefore, **BLU can be disconnected from ZVD without aborting the discharge process**.
To do so, follow the procedure stated below:

- press the *Manual Control* button on ZVD. When pressed, the button will change color to red. When this button is activated, ZVD can be controlled locally (not on BLU) so BLU can be safely removed.
- press *Stop -> Stop Monitoring* on BLU to stop recording.
- Disconnect BLU from ZVD.

Following this procedure, BLU can be disconnected and used to discharge some other battery bank.

To stop the discharge, press (switch off) the *Manual Control* button on ZVD again..

### 4.1.7 Result Screen

When test is stopped due to any reason (a stop parameter is reached or user pressed the Stop button), the test result will be presented on the screen. The initial information for the user is the test result name which can help to locate the result in the *Result* menu later on. The test name will be defined automatically, Figure 4-11.

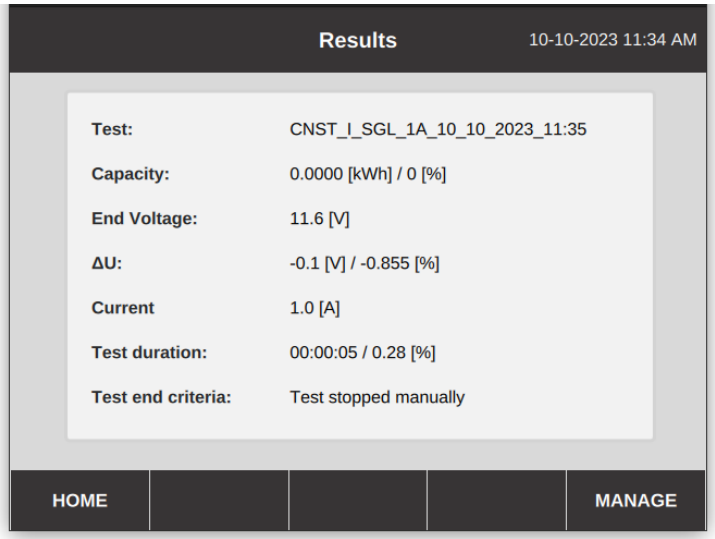



Figure 4-11: Test Result name

The test result name will include information on test mode and test type (*Single_Const I*), test value (*1A*) and date when test is completed (*22_7_2020*), Figure 4-12. The information that the result is saved in the memory will disappear in few seconds, Figure 4-12.

The test result provides the following information about the test:

End values

- Total test time (*00:00:12* on the Figure 4-12),
- Final battery voltage (*11.6 [V]* on the Figure 4-12),
- Test current (*3.0 [A]* on the Figure 4-12),

Alternatively, test power (in W) or test resistance (in Ω) will be displayed if *Constant power* or *Constant resistance* models has been selected prior the test.

- Total measured capacity (*0.0 [Ah]* on the Figure 4-12)

Test Results

- C [%] – measured capacity relative to nominal capacity. If nominal capacity is not entered in *Test Info -> Battery info* menu, "--" will be stated.
If user enabled Capacity *Pass / Fail* criteria in *Home -> Settings – Test Settings* prior the test, *Pass / Fail* notification will be presented by different colors of the measured capacity in the *Results* menu (*Pass* – green, *Fail* - red).
- ΔU [V] – provides information on voltage change from start to end of test.
- ΔU [%] - provides information on voltage change from start to end of test.

Using the button **Manage**, the user can export the result to USB or to proceed to test settings for a new test. The "Export to USB" button will be active only if a USB is connected.

# 5 Results

After the discharge process is completed, the test result will be saved in the BLU230T internal memory. The test name will be defined automatically, Figure 5-1.

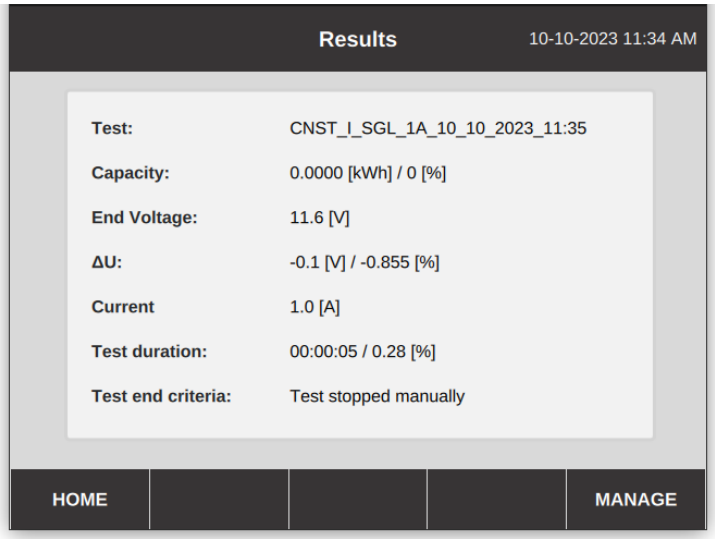



Figure 5-1: Result saved in the BLU internal memory

The test result name will include information on test mode and test type (*Single_Const I*), test value (*1A*) and date when test is completed (*22_7_2020*), Figure 5-1.

All saved test results can be found in the *Results* menu. To enter the *Results* menu, click on *Results* field on the *Home* screen, Figure 5-2.

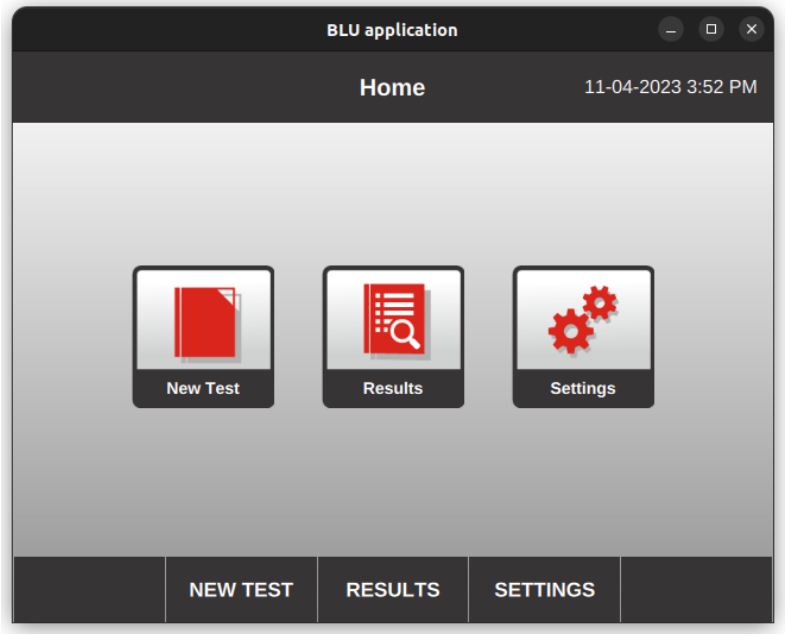



Figure 5-2: Results menu on Home screen

Single-click on the *Results* menu opens the menu, Figure 5-3.

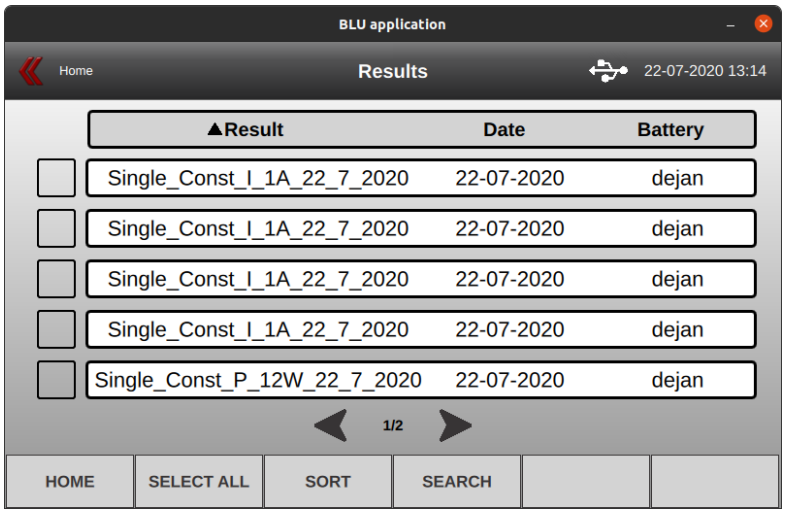



Figure 5-3: Results menu

Three information are visible for each test:

1. **Test name** which includes information on test mode and test type (*Single_Const I*), test value (*1A*) and date when test is completed (*22_7_2020*)
2. **Date** when test is completed
3. **Battery name**

Using the option *Search,* a test result can be search by entering a key word. Additionally, results can be sorted by name, date or date range, Figure 5-4.

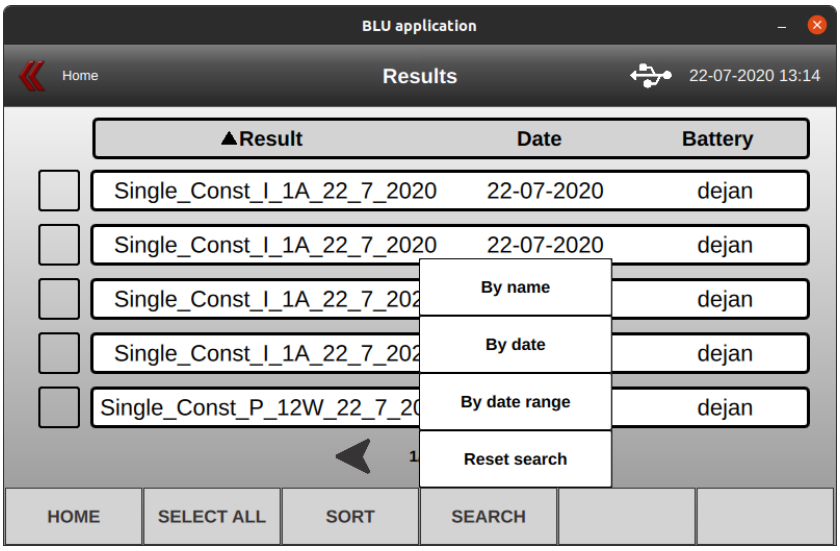



Figure 5-4: Results menu – sorting results

After the specific test result is found, it can be opened by simply clicking on the result name. The result will be presented in numerical form. If the result needs to be exported to USB or simply deleted, it is necessary to mark that result as (√) by clicking on box (☐) related to that result.

# 6. Mains Power Interruption – Automatic Test Resume

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.

After mains power supply is restored, the BLU instrument automatically switches on and displays an appropriate message (Figure 3-64).

After 60 sec, the discharge test will be continued without need for human interaction (the exception are test in *Current probe (CP)* mode which requires current probe zeroing before test can be continued*).* The buzzer will be on until 60 sec time counts down to zero. As the zero is reached, the test continues and all pre-test test settings remain unchanged (end voltage, test time, end capacity, warning limits).

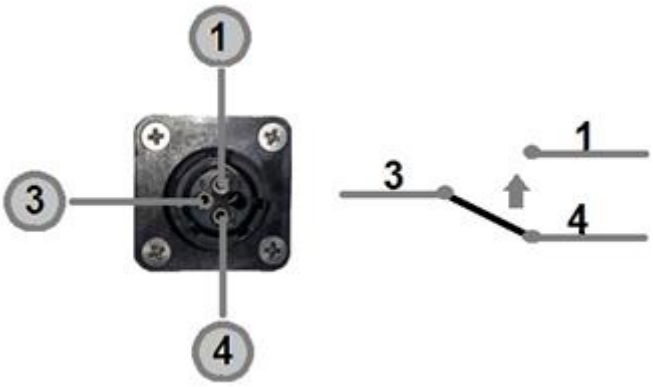
The operator can continue the test manually. The steps to continue with the test depend on the selected test mode (*Single, Current probe-CP, or parallel*).

# 7. External Alarm Function

This function is provided and controlled by a relay connected to a connector called "ALARM" from the figure below. This connector and the adequate cable are used for connecting to the external alarm. The relay specifications are the following: 6 A, 250 V.

The external alarm connector is shown on the figure bellow. The pins 1, 3 and 4 of the connector are in use, where pin 2 is not used. Pin 3 corresponds to common branch of the relay. Pin 1 corresponds to steady state of the relay and pin 4 corresponds to active mode. When relay closes the circuit between pins 3 and 1 the alarm is not activated, i.e. the alarm is in steady mode. However, when relay closes the circuit between pins 3 and 4 the alarm is activated.

Figure 4-1:
The external alarm connector




The cable which is usually plugged in the above connector and connected to the external alarm is shown on the figure below:

Figure 4-2:
The external alarm cable

Green cable corresponds to pin 4, which is connected to the steady mode of the relay.
Brown cable corresponds to pin 1, which is connected to the active state of the relay.
Yellow cable corresponds to pin 3, which is connected to the common branch of the relay.

The alarm is activated in the following scenarios:

- Alarm value of string voltage or discharge time is reached.
- The test is stopped because string voltage limit value or end discharge time are reached
- Power supply suddenly interrupted and the device is turned off.
- Thermal protection is activated due to overheating.
- Fan failure.
- Sudden connection failure between the device and the battery set.

The alarm is acknowledged and reactivated by pressing any of the arrow buttons or by pressing STOP button, depending on a different scenario.

# 8. Warning Messages

Any operational situation requiring additional attention is indicated by an external alarm or by an alarm buzzer sound. Furthermore, the display indicates a status message. To stop the external alarm or the alarm buzzer, the status message should be removed from the display. To stop the test and to return to the **TEST SETTINGS** menu press ***STOP***.

## Warning Message "Cooling"

The ***STOP*** button needs to be pressed 2 times to stop the test. Double-pressing the ***STOP*** button, the BLU enters a cooling stage that lasts 60 seconds while the *Cooling* message is displayed. After several hours long discharge test, it is recommended not to interrupt the 1-minute cooling. However, the cooling process can be terminated sooner by pressing the ***STOP*** button once again.

## Warning Message "STRING ALARM VOLTAGE REACHED"

This message is displayed when the preset warning level of the string voltage value is reached. The audio alarm sounds with one short and sharp tone.

**Note: If the external alarm is not used, the internal BLU alarm buzzer will be activated the same way in all the above scenarios instead.**

## Warning Message "DISCHARGE TIME OVER"

This message is displayed when the value of discharge test time is reached. The test will be stopped and the alarm is activated with the continuous sound lasting 15 seconds. There is a half-minute pause and then again the continuous sound is present for 15 seconds, unless the alarm has been acknowledged by pressing the ***STOP*** button.

## Warning Message "MEMORY FULL"

This message indicates that BLU internal memory capacity is reached and new results cannot be saved. It is necessary to delete some results from the memory to save the just-obtaining results.

## Warning Message "STRING END VOLTAGE REACHED"

This message indicates that the preset end voltage value is reached. The test is stopped and the alarm is activated with the continuous sound lasting 15 seconds. There is a half-minute pause and then again the continuous sound is present for 15 seconds, unless the alarm has been acknowledged by pressing the ***STOP*** button.

# 9. Error Messages

Any operational error is signaled by an external alarm or by an internal device buzzer alarm plus the display indicates a status message. To stop the external alarm or the alarm buzzer, the status message should be removed/acknowledged from the display. To stop the test and to return to the **TEST SETTINGS** menu press ***STOP***.
If abnormal operating conditions occur during the battery testing, the following error messages will appear on the display.

## Error Message "FANS FAILURE"

This message appears if there is a failure of more than one upper fan or any other fan in the device. The alarm is activated and continuous sound is present for 15 seconds followed by a half minute pause and then again the continuous sound is present for 15 second, unless the alarm has been acknowledged.

## Error Message "OVERCURRENT"

This message is shown if the hardware protection (current exceeds BLU maximum current) or the firmware protection (current is 10% over the allowed value) is activated. The test will be stopped and the alarm is activated with the continuous sound for 15 seconds, a half minute pause and the continuous sound again for 15 second, unless the alarm was acknowledged. In this case the suggestion is to restart the device, reset the test parameters and restart the test.

## Error Message "OVERHEATING"

If the BLU operating temperature rises too high this warning will appear. The test will be stopped and the alarm is activated with the continuous sound present for 15 seconds a half a minute pause and again 15 seconds of continuous alarm sound until the alarm is acknowledged.
In the case of overheat, it is necessary to wait for the test set to cool down and repeat the test.

## Error Message "OVERVOLTAGE"

The error message “OVERVOLTAGE” will be displayed if the voltage measured by the BLU instrument is higher than its maximum voltage. The BLU will instantaneously stop the test if voltage measured on its current or voltage terminals is higher than:

- 300 V for BLU100L, BLU100A, BLU200A and BLU340A unit;
- 70.5 V for BLU110T and BLU220T models;
- 500 V for a BLU360 V.

The test can be restarted if the voltage is within the defined range for a specific model.

# 10. Installing Foldable Platform Truck

If ordered, foldable platform truck will not be attached to the transport case. However, the steps to attach the platform to the transport case is simple and not time-consumable.

Step 1. Prepare transport case, the platform track and belt with hooks (Figure 1).
Step 2. Unfold the Platform Track. Move back side of transport case to the Platform Track (Figure 2).
Step 3. Place the hooks around handle at the top (Figure 3).

Step 4. Follow steps marked by 1, 2 and 3 on Figure 4.
Step 5. Pull the belt strongly forward, and press down to fix it (Figure 5). Transport case is ready for moving.


Figure 7-1 and 7-2

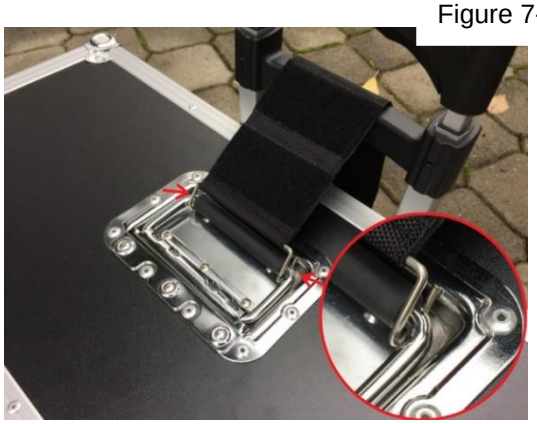
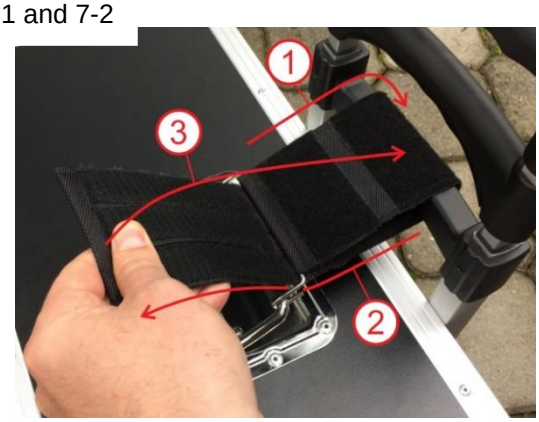




Figure 7-3 and 7-4

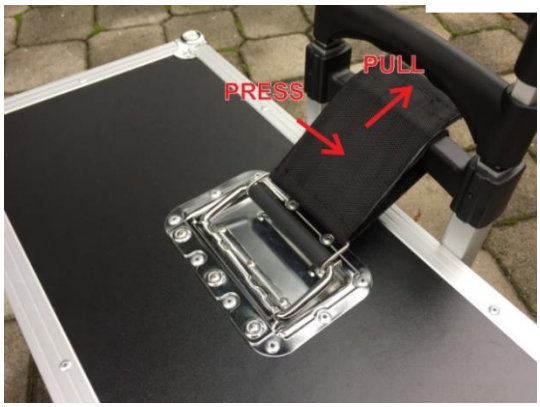


Figure 7-5 and 7-6

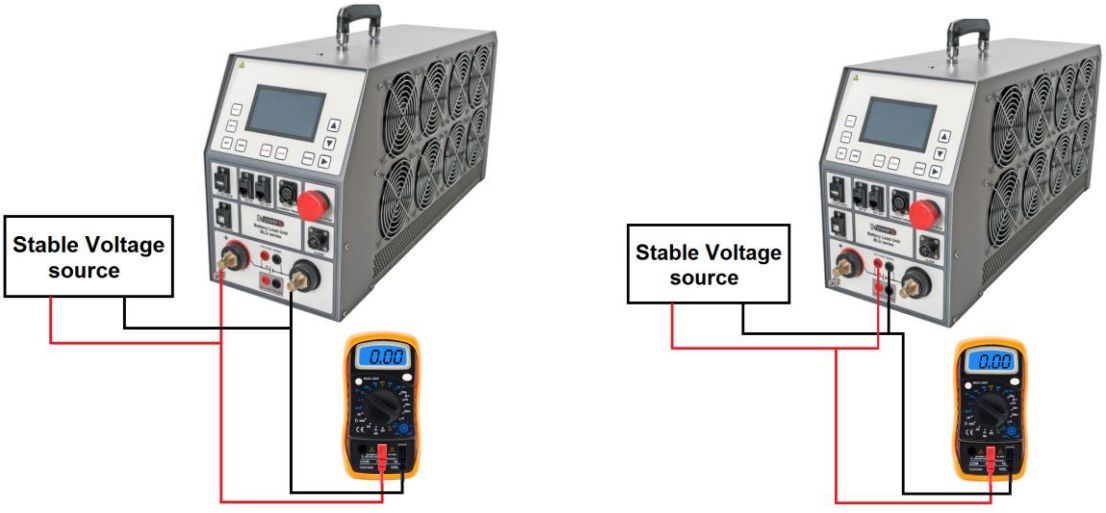
# 11. Troubleshooting guide

## a. Voltage measurement check

If it is suspected that the device is not measuring DC voltage accurately, please perform the voltage measurement check described below.

1. Connect a DC voltmeter to BLU device for voltage measurement check of current terminals channel, as shown in the Figure 8-1.a.
2. Use a stable DC voltage source, to generate required values of test voltages, as stated in Table 8-1.

3. Compare each generated voltage value with the expected value on BLU device from Table 8-1.
4. Repeat the same procedure from points 1-3 for measurement check of VS channel (Figure 8-1.b)




1.1.a. 1.1.b

Figure 8-1: *Connection of BLU device for DC voltage measurement check.*
*8-1.a. Voltage measurement check of current terminal channel*
*8-1.b. Voltage measurement check of VS channel*

| Test voltage [V] | Expected voltage on BLU device [V] |
|---|---|
| **12** | *11.8 – 12.2* |
| **24** | *23.8 – 24.2* |
| **48** | *47.7 – 48.3* |
| **60** | *59.6 – 60.4* |
| **120*** | *109.4 – 110.7* |

| Test voltage [V] | Expected voltage on BLU device [V] |
|---|---|
| **240*** | *218.8-221.2* |
| **320**** | *318.3-321.7* |
| **380**** | *378.0-382.0* |
| **420**** | *417.8-422.2* |
| **480**** | *477.5-482.5* |

Table 8-1 - *DC voltage measurement check*

**applicable for models BLU100A, BLU200A, BLU340A, and BLU360V*
***applicable for model BLU360A*

## b. Current measurement check

If it is suspected that the device is not measuring DC current accurately, please perform the current measurement check described below.

1. Connect BLU device, a battery, a DC voltmeter and a 1 mΩ/100 mΩ test shunt (depending on the test current), as shown in Figure 8.2.
2. Select the test current values on BLU, as shown in Table 8.2, by entering the TEST menu on the device, and selecting a test in CONST I mode.
3. To start the test, click on button ENTER to enter the *Ready menu,* and press START.
4. Measure the voltage drop on the test shunt $R_{shunt}$ using the digital voltmeter.
5. Compare voltage drop values on the test shunts measured with the digital multimeter, with the expected voltage drop values, given in Table 8.2.

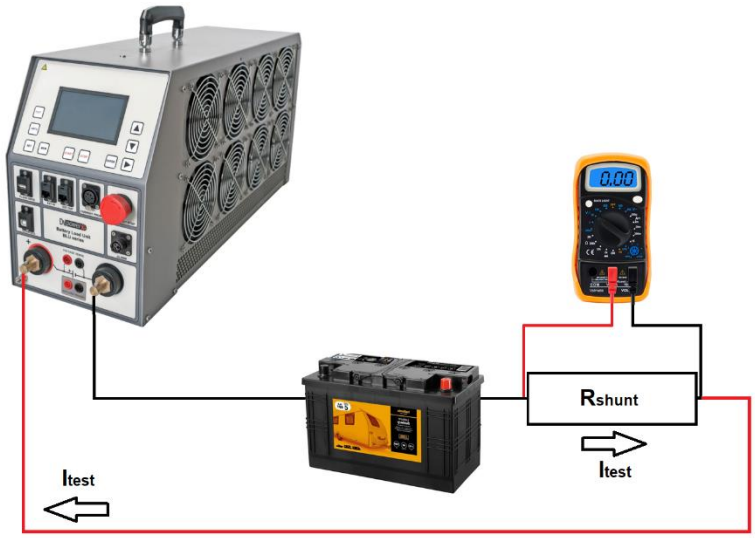



Figure 8-2: *Connection of BLU device for DC curent measurement check.*

| BLU test current [A] | $R_{shunt}$ [mΩ] | Measured voltage drop $V_{shunt}$ [mV] |
|---|---|---|
| *5* | **100** | 477,5 – 522,5 |
| *10* | **100** | *975,0 – 1025,0* |
| *15* | **100** | *1 472,5 – 1 527,5* |
| *20* | **100** | *1 970,0 – 2 030,0* |
| *25* | **100** | *2 467,5 – 2 532,5* |
| *50* | **100** | 4 955,0 – 5 045,0 |

| BLU test current [A] | $R_{shunt}$ [mΩ] | Measured voltage drop $V_{shunt}$ [mV] |
|---|---|---|
| *100* | **1** | 99,3 – 100,7 |
| *150* | **1** | 149,0 – 151,0 |
| *200** | **1** | 198,8 – 201,2 |
| *240** | **1** | 248,5 – 251,5 |
| *300*** | **1** | 298,3 – 301,7 |
| *350*** | **1** | 348,0 – 352,0 |

Table 8-2 - *DC current measurement check*

**applicable for models BLU220T and BLU200A*
***applicable for model BLU220T*

**NOTE:** Since the maximum current available on the BLU device depends on the measured voltage, please choose the rated voltage of the battery, according to table 3.3, for choosing the appropriate test current values.

# 12. Customer Service

Before calling or sending an e-mail to Customer Service for assistance, please take the following steps:

- Check all cable connections.
- Try the test on another instrument, if available.
- Perform the troubleshoot procedure.
- Have the following information available: instrument serial numbers, hardware configuration, and software revision.
- Exact description of the problem, including DUT (Device Under Test), error messages and the sequence of events before it appeared.
- List of solutions that have been tried.

The Customer Support Department can be reached at:

Local support (Sweden): + 46 8 731 78 24
International support: + 46 70 0925 000
E-mail: support@dv-power.com

**Note**: **Email communication is preferred for support issues, since the case is then documented and traceable. Also, the time zone problems and issues with occupied telephones do not occur.**

# 13. Packing the Instrument for Shipment

If you need to send the instrument to DV Power for servicing, please contact the DV Power Customer Service for return instructions at:

Local support (Sweden): +46 8 731 78 24
International support: +46 70 0925 000
E-mail: support@dv-power.com

**Note**: **DV Power is not responsible for any damage during shipping. Please carefully protect each instrument from shipping and handling hazards. Ensure the protective covers are securely in place. Instrument has to be sent to DV Power as freight pre-paid, unless other arrangements have been authorized in advance by the DV Power Customer Service.**

To prepare an instrument for shipment, please follow these instructions:

1. Disconnect and remove all external cables. Do not include manuals, cables, and transducer connecting rods unless recommended by DV Power Customer Service.

2. Reuse the original packing material if it is available. If it is not available, pack the instrument for shipment according to the instructions for fragile electronic equipment. It is recommended use two-wall minimum corrugated cardboard box with a minimum 5 cm (2 inch) thick poly foam padding, or a wooden crate with minimum of 5 cm (2 inch) thick poly foam padding all around.

# 14. Members Area

DV Power customer can create account to get access to DV Power Members Area. By creating an account with DV Power you get access to:

- Application Notes
- Published Articles

To create an account please visit DV Power register on page: dv-power.com/register/.
If you register a valid DV Power instrument you will get access to:

- DV-Win Software
- Manuals
- Troubleshooting Guides

To register an instrument please log in and visit dv-power.com/register-new-product/. Your access will be granted after a verification process for which is normally one working day required.
If you require additional help during the process of registration, please contact us via e-mail support@dv-power.com.

# Technical Data

## Mains Power Supply

- Connection according to IEC/EN60320-1; C320
  90 V – 264 V AC, 50 / 60 Hz, single-phase

## Dimensions and Weights

### BLU Series

| Model | | Dimensions | Weight |
|---|---|---|---|
| **BLU100A & BLU100L** (without acc.) | Instrument | 440 x 221 x 355 mm | 12,8 kg |
| | Transport case * | 545 x 300 x 418 mm | 6,9 kg |
| | Canvas Transport case ** | 570 x 310 x 415 mm | 3,6 kg |
| **BLU200A** (without acc.) | Instrument | 560 x 221 x 355 mm | 14,5 kg |
| | Transport case * | 665 x 300 x 418 mm | 8,5 kg |
| | Canvas Transport case ** | 690 x 310 x 415 mm | 3,7 kg |
| **BLU110T** (without acc.) | Instrument | 440 x 221 x 355 mm | 12,8 kg |
| | Transport case * | 545 x 300 x 418 mm | 6,9 kg |
| | Canvas Transport case ** | 570 x 310 x 415 mm | 3,6 kg |
| **BLU220T** (without acc.) | Instrument | 560 x 221 x 355 mm | 15,1 kg |
| | Transport case * | 665 x 300 x 418 mm | 8,5 kg |
| | Canvas Transport case ** | 690 x 310 x 415 mm | 3,7 kg |
| **BLU340A** (without acc.) | Instrument | 730 x 221 x 355 mm | 20,6 kg |
| | Transport case * | 795 x 290 x 415 mm | 10,1 kg |
| **BLU360V** | Instrument | 730 x 221 x 355 mm | 20,6 kg |
| | Transport case * | 795 x 290 x 415 mm | 10,1 kg |

* Included instrument transport case
** Optional instrument transport case

### BXL Series

| Model | Dimensions | Weight |
|---|---|---|
| **BXL-A** | 560 x 221 x 355 mm | 12,5 kg |
| **BXL-T** | 560 x 221 x 355 mm | 12,5 kg |
| **BXL-V** | 730 x 221 x 355 mm | 16 kg |

## Measurement

### Internal voltage measurement

| Model | Range ** | Resolution |
|---|---|---|
| **BLU100A** | 0 – 300 V DC | 0,1 V or better* |
| **BLU100A** | 0 – 300 V DC | 0,1 V or better* |
| **BLU200A** | 0 – 300 V DC | 0,1 V (0,002 V up to 60 V, 0,02 V up to 300 V)* |
| **BLU340A** | 0 – 300 V DC | 0,1 V or better* |
| **BLU110T** | 0 – 75 V DC | 0,1 V or better* |
| **BLU220T** | 0 – 75 V DC | 0,1 V or better* |
| **BLU360V** | 0 – 500 V DC | 0,1 V or better* |

* Optionally / provided on request
** Range is set automatically at start of test

- Typical accuracy: ± 0.5% of reading ± 0.1 V

### Internal current measurement

| Model | Range | Resolution |
|---|---|---|
| **BLU100L** | 0 – 300 A DC | 0.1 A |
| **BLU100A** | 0 – 300 A DC | 0.1 A |
| **BLU200A** | 0 – 300 A DC | 0.1 A |
| **BLU340A** | 0 – 300 A DC | 0.1 A |
| **BLU360V** | 0 – 300 A DC | 0.1 A |
| **BLU110T** | 0 – 300 A DC | 0.1 A |
| **BLU220T** | 0 – 400 A DC | 0.1 A |

- Display range: 0 – 2 999.9 A DC
- Basic accuracy: ± (0.5 % of reading + 0.1 A)
- Resolution: 0,1 A

### Time measurement

- Typical accuracy:
  ± 0.1 % of reading ± 1 digit

### Input for current probe

- Range: 0 – 1 V DC
- mV/A ratio: Software settable values: 0.3 to 100 mV/A
- Input impedance: > 1 MΩ

## Load section

| Model | Battery Voltage |
|---|---|
| BLU100L | 3.0 – 300 V DC |
| BLU100A | 5.25 – 300 V DC |
| BLU200A | 5.25 – 300 V DC |
| BLU340A | 5.25 – 300 V DC |
| BLU360V | 5.25 – 500 V DC |
| BLU110T | 0.9 – 70.5 V DC |
| BLU220T | 5.25 – 70.5 V DC |

- Power: 28.4 kW (max)
- Discharge modes:
  Constant current / power / resistance; current, power or resistance profile mode

### Constant current (Const I)

| Model | Range | Resolution |
|---|---|---|
| BLU100L | 0 – 160 A DC* | 0,1 A |
| BLU100A | 0 – 160 A DC* | 0,1 A |
| BLU200A | 0 – 240 A DC* | 0,1 A |
| BLU340A | 0 – 160 A DC* | 0,1 A |
| BLU360V | 0 – 160 A DC* | 0,1 A |
| BLU110T | 0 – 150 A DC* | 0,1 A |
| BLU220T | 0 – 340 A DC* | 0,1 A |

* Range of currents settable on a single unit

- Typical accuracy: ± (0.5 % of reading + 0.2 A)
- Ripple: max 0.4 A peak

### Constant resistance (Const R)

| Model | Resistance |
|---|---|
| BLU100L | 0.1 – 300 Ω |
| BLU100A | 0.2 – 300 Ω |
| BLU200A | 0.2 – 300 Ω (0.2 – 3000 Ω)* |
| BLU340A | 0.2 – 300 Ω |
| BLU110T | 0.01 – 70.5 Ω |
| BLU220T | 0.2 – 70.5 Ω |
| BLU360V | ≤ 200 mΩ – 500 Ω |

* Optionally / provided on request

- Typical accuracy: ± 1%
- Resolution: up to 0.01 Ω

## Warranty

- 3 years

### Constant power (Const P)

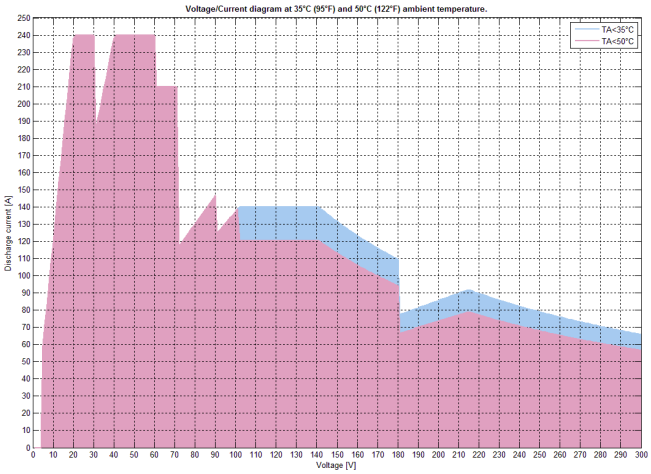
| Model | Range | Resolution |
|---|---|---|
| BLU100L | 0 – 14.2 kW* | 0.01 kW |
| BLU100A | 0 – 14.2 kW* | 0.01 kW |
| BLU200A | 0 – 19.7 kW** | 0.01 kW |
| BLU340A | 0 – 28.4 kW* | 0.01 kW |
| BLU360V | 0 – 28.4 kW** | 0.01 kW |
| BLU110T | 0 – 8.5 kW* | 0.01 kW |
| BLU220T | 0 – 19.2 kW* | 0.01 kW |

- Typical accuracy: ± 1%
- Ripple: max 0.2 kW

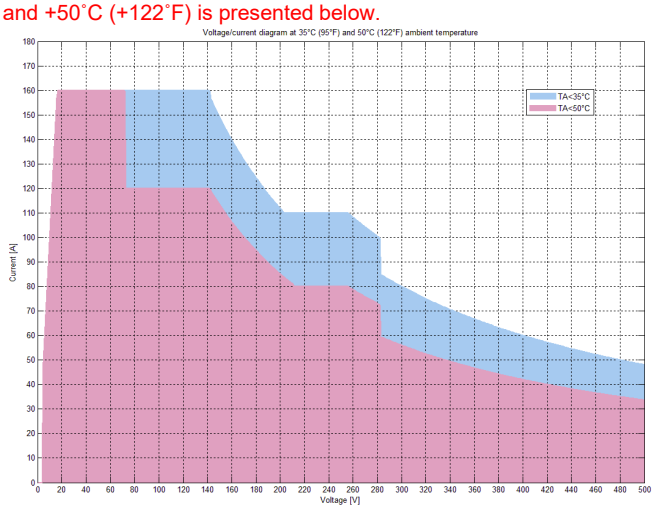
* Discharge power range settable on a single unit

** For BLU200A and BLU360V models, maximum power derates at temperatures over +35˚C (+95˚F).

Current / voltage diagram for the BLU200A model at +35˚C (+95˚F) and +50˚C (+122˚F) is presented below.




Current / voltage diagram for the BLU360V model at +35˚C (+95˚F) and +50˚C (+122˚F) is presented below.



## Display

### Size

- 4,3 inch color touch screen display (BLU)
- LCD screen 16 characters by 2 lines with backlight, visible in bright sunlight (BXL)

### Range / Resolution

- Current: 0 – 2 999,9 A DC / 0,1 A
- Voltage: 0 – 999,9 V DC / 0,1 V
- Capacity: 0 – 9999,9999 Ah / 0,0001 Ah
- Time: 00h:00m:00s - 23h:59m:59s / 1 sec

### STOP parameters

- End voltage (total battery or per-cell voltage)
- Capacity
- Test time

### Environment conditions

- Operating temperature:
  -10 °C to +50 °C / 14 °F to +122 °F
- Storage & Transportation temperature:
  -40 °C to +70 °C / -40 °F to +158 °F
- Relative humidity: up to 95%, non-condensing
- Pollution degree: 2

### Shock/Vibration/Fall

- Instrument: ETSI EN 300 019-2-7 class 7M2
- Instrument in transport case: ISTA 2A

### Communication with PC ()

- USB
- RS232 (optional)

### Protection

- Thermal cut-outs and automatic overload protection
- Emergency Stop button
- Overcurrent, overheat and overvoltage protection

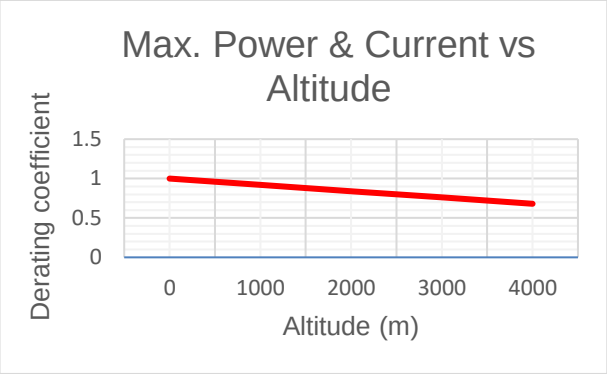
### Available languages

- English, German, French, Spanish

### Altitude

- Operating: up to 4000 m*
- Storage: up to 10 000 m

* Maximum current and power derates at higher altitudes. Max. power and current derating coefficient, as a function of altitude, is presented in the figure below.




### Current probe specifications

| Current probe | Ranges | mV/A – ratio | Supply |
|---|---|---|---|
| Current clamp 30/300 A* | 30 A | 10 mV / A | From the instrument |
| | 300 A | 1 mV / A | |

*** current clamps 1000 A can be provided on request.**

### Encapsulation class / Ingress protections

- IP20

### Applicable Standards

- IEEE 450-2010, IEEE 1188-2005, IEEE 1106-2015, IEC 60896-11, IEC 60896-22 and other relevant standards
- Safety
  - Low Voltage Directive:
    Directive 2014/35/EU (CE conform)

    Applicable standards, for a class I instrument, pollution degree 2, Installation category II: IEC EN 61010-1
- Electromagnetic Compatibility:
  - Directive 2014/30/EU (CE conform)
    Applicable standard: EN 61326-1
- CAN/CSA-C22.2 No. 61010-1

*All specifications herein are valid at ambient temperature of + 25 °C /+ 77°F and standard accessories.*
*Specifications are subject to change without notice.*

# Accessories

Current cables

Extension cables

Sense cables with dolphin clips

Transport case for BLU

Current probe 30/300 A

Cable bag

Cable set for BLU-BXL simultaneous triggering

Cable for BLU-BLU parallel operation

Cable for external alarm

# Order Info

| Instrument | Article No |
|---|---|
| Battery Load Unit BLU100L | BLU100L-N-00 |
| Battery Load Unit BLU100A | BLU100A-N-00 |
| Battery Load Unit BLU200A | BLU200A-N-00 |
| Battery Load Unit BLU110T | BLU110T-N-00 |
| Battery Load Unit BLU220T | BLU220T-N-00 |
| Battery Load Unit BLU340A | BLU340A-N-00 |
| Battery Load Unit BLU360V | BLU360V-N-00 |
| Battery External Load Unit BXL-A | BXL400X-A-00 |
| Battery External Load Unit BXL-T | BXL400X-T-00 |
| Battery External Load Unit BXL-V | BXL400X-V-00 |

| Included Accessories | Article No |
|---|---|
| Windows based DV-B Win PC software including USB cable (*for BLU models*) | |
| Mains Power cable | MPCXXA-XX-00 |
| Ground (PE) cable | CABLE-GND-00 |
| Transport case for BLU – small size<br>(*for BLU100L, BLU100A and BLU110T models*) | HARD-CASE-B0 |
| Transport case for BLU – medium size<br>(*for BLU200A, BLU220T, BXL-A and BXL-T models*) | HARD-CASE-BL |
| Transport case for BLU – large size<br>(*for BLU340A, BLU360V and BXL-V models*) | HARD-CASE-B1 |

| Standard | Article No |
|---|---|
| Current cables 2 x 3 m 25 mm$^2$ (9.84 ft., 4 AWG) with alligator clamps (A4) isolated (*for BLU110T*) | C2-03-25FA4I |
| Current cables 2 x 3 m 35 mm$^2$ (9.84 ft., 2 AWG) with alligator clamps (A4) isolated (*for BLU100L: BLU100A, BLU340A, BLU360V, BXL-A and BXL-V models*) | C2-03-35VA4I |
| Current cables 2 x 3 m 50 mm$^2$ (9.84 ft., 0 AWG) with alligator clamps (A4) isolated (*for BLU200A*) | C2-03-50VA4I |
| Current cables 2 x 3 m 70 mm$^2$ (9.84 ft., 00 AWG) with alligator clamps (A4) isolated (*for BLU220T*) | C2-03-70FA4I |
| Cable bag | CABLE-BAG-00 |

| Optional | Article No |
|---|---|
| Current cables 2 x 3 m 50 mm$^2$ (9.84 ft., 0 AWG) with alligator clamps (A4) isolated (*for BLU100L, BLU100A, BLU340A, BLU360V, BXL-A and BXL-V models*) | C2-03-50VA4I |
| Current cables 2 x 5 m 35 mm$^2$ (16.4 ft., 2 AWG) with alligator clamps (A4) isolated (*for BLU100L, BLU100A, BLU340A, BLU360V, BXL-A and BXL-V models*) | C2-05-35VA4I |
| Current cables 2 x 5 m 50 mm$^2$ (16.4 ft., 0 AWG) with alligator clamps (A4) isolated (*for BLU100L, BLU100A, BLU200A, BLU340A, BLU360V, BXL-A and BXL-V models*) | C2-05-50VA4I |
| Current cables 2 x 5 m 70 mm$^2$ (16.4 ft., 00 AWG) with alligator clamps (A4) isolated (*for BLU220T and BXL-T models*) | C2-05-70FA4I |
| Current cables 2 x 10 m 35 mm$^2$ (32.8 ft., 2 AWG) with alligator clamps (A4) isolated (*for BLU100L, BLU100A, BLU340A, BLU360V and BXL models*) | C2-10-35VA4I |
| Current cables 2 x 10 m 70 mm$^2$ (32.8 ft., 00 AWG) with alligator clamps (A4) isolated (*for BLU220T and BXL-T models*) | C2-10-70FA4I |
| Extension cables 2 x 5 m 35 mm$^2$ (16.4 ft., 2 AWG) (*for BLU100L, BLU100A, BLU340A, BLU360V, BXL-A and BXL-V models*) | E2-05-35VA3I |
| Extension cables 2 x 3 m 50 mm$^2$ (19.84 ft., 0 AWG) (*for BLU100L, BLU100A, BLU200A, BLU340A, BLU360V, BXL-A and BXL-V models*) | E2-03-50VA3I |
| Extension cables 2 x 5 m 70 mm$^2$ (16.4 ft., 00 AWG) (*for BLU220T and BXL-T models*) | E2-05-70VFMI |
| Extension cables 2 x 10 m 35 mm$^2$ (32.8 ft., 2 AWG) (*for BLU100L, BLU100A, BLU340A, BLU360V and BXL models*) | E2-10-35VA3I |
| Extension cables 2 x 10 m 50 mm$^2$ (32.8 ft., 0 AWG) (*for BLU100L, BLU100A, BLU340A, BLU360V and BXL models*) | E2-10-50VA3I |
| Sense cables 2 x 3 m (9.84 ft.) with banana plugs + dolphin clip (*for BLU models*) | S2-03-00BPDC |
| Sense cables 2 x 5 m (16.4 ft.) with banana plugs + dolphin clip (*for BLU models*) | S2-05-00BPDC |
| Sense cables 2 x 10 m (32.8 ft.) with banana plugs + dolphin clip (*for BLU models*) | S2-10-00BPDC |
| Current clamp 30/300 A power supplied from the instrument with extension 5 m (16.4 ft.) (*for BLU models*) | CACL-0300-06 |
| Cable for external alarm (*for BLU models*) | CABLE-EXA-05 |
| Extension cable for external alarm 5 m (16.4 ft.) (*for BLU models*) | E1-EXABLU-05 |
| Cable for BLU-BLU parallel operation 3 m (9.84 ft.) (*for BLU200A, BLU220T, BLU340A and BLU360V models*) | CP-03RJ45-00 |
| Cable set 2 x 2 m 1 mm$^2$ (6.56 ft., 17 AWG) for BLU-BXL simultaneous triggering (*for BXL models*) | PO-02-01BPBP |
| Cable set 2 x 5 m 1 mm$^2$ (16.4 ft., 17 AWG) for BLU-BXL simultaneous triggering (*for BXL models*) | PO-05-01BPBP |

## IBEKO Power AB 2024



## Manufacturer Contact Information

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