Instruction manual

Masterunit V3

Inhaltsverzeichnis

1. General safety instructions

Check the delivery contents for completeness and accuracy! Please read the installation and commissioning instructions before installation and follow the instructions described! The listed safety instructions must be observed!

All activities described below may only be carried out by electrically trained professionals!

A single Li-cell or the interconnected battery pack is inherently operational under voltage (DC) due to its design. The voltage level depends on the type of interconnection. Therefore, it is imperative to work with appropriate care in compliance with regulations according to VDE0100!

The cells are designed with protection class IP 0x. Ensure the necessary protection against contact!

Cells and BMS are used as part of a system. Therefore, it is the responsibility of the customer or the system manufacturer/operator to implement the system according to the relevant guidelines (load disconnect switch, protection, etc.)!

Before starting work on live parts, the mains charging plug must be disconnected from the power grid, and the connection to the batteries must be disconnected in a multipole manner!

Before connecting or disconnecting a terminal at a cell or battery, all consumers or charging devices must be disconnected from the battery circuit to ensure it is de-energized! Even standby current could otherwise damage the BMS electronics!

Permissible charging and discharging currents as well as charging and discharging cut-off voltages must not be exceeded! The components of the BMS must be integrated accordingly into the power and control circuit.

The Li-cells may only be charged or discharged within the approved operating limits as specified in the battery datasheets!

When handling the batteries, please refer to the instructions and safety data sheets provided by the respective manufacturers!

Before commissioning, the mechanical aspects (such as installation position, environmental conditions, etc.) and electrical aspects (such as wiring dimensions, polarity of components, cable connections, etc.) of the installation must be checked!

Ensure that no damaged components are used!

When using or installing components improperly, we do not assume any warranty or liability! Our products and BMS components are generally excluded from extended product liability! This installation manual includes the BMS description, installation instructions, and datasheet of the used cell type (Slave Board)! Please check for any updates to the operating instructions on our website! We do not accept liability for technical or printing errors and their consequences! The information in the descriptions is regularly reviewed. Changes due to corrections or technical improvements may be made without prior notice!

GENERAL GUIDELINES FOR HANDLING LITHIUM CELLS AND BMS:
When connecting or interconnecting lithium cells, please consider the following: All battery terminals must be cleaned (using a 3M Bristle-Disc) and subsequently coated with terminal grease or vaseline (for corrosion protection)! The components of the BMS are designed for use in dry areas (IP24). They must be protected from dirt and moisture! When installing the cells, they must be mechanically connected into a unit with a tension frame to prevent potential cell expansion due to internal pressure and to secure them against slipping! The cross-sections of the battery connecting cables must be adequately dimensioned! Only lithium cells in the same state of charge should be interconnected! If necessary, the cells must be individually or in parallel connected and charged via a laboratory power supply unit, considering the permissible charging current (refer to battery datasheet for voltage levels, as they depend on the battery type). Before working on the cells, such as connecting or disconnecting the battery cables:

- Always disconnect the central connector in a BMS with a central box!
- For cell boards, interrupt the battery circuit

2. Introduction

In almost all electronic devices today, energy storage systems are integrated. These allow storing energy for later use. The amount of energy determines how the energy storage system should be managed. BMS V3 is responsible for managing these energy storage systems, which can have various capacities. These are required, for example, in electromobility or in combination with photovoltaic systems. Large capacities must be operated professionally to ensure the storage system always operates within its designated parameters. The Battery Management System V3, with its numerous interfaces, is suitable for almost all large-scale storage projects but can also be used for smaller energy storage systems. All additional components for the BMS can be broadly divided into two categories. The L-Line and C-Line represent two different communication types with their own interfaces on the BMS. The following describes each interface and its respective uses.

3. Interface description

The BMS V3 has several connection options that allow various components to be integrated into the system. Below, each connection will be discussed, explaining which components can be connected.

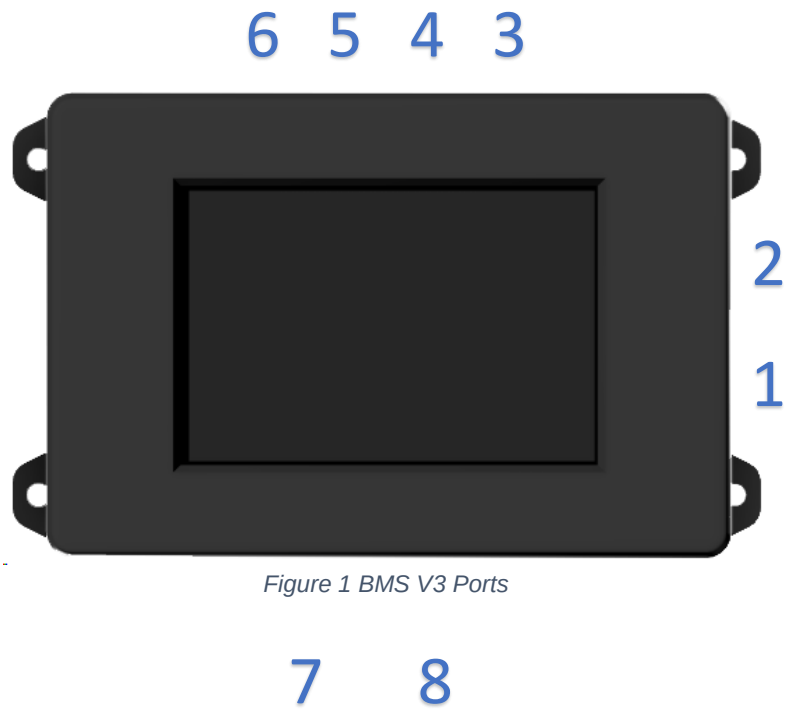


Figure 1 BMS V3 Ports

In total, the BMS offers eight different ports, which may or may not be accessible depending on the version. The ports are marked with numbers above them on the housing. The sequence of the ports corresponds to Figure 1.

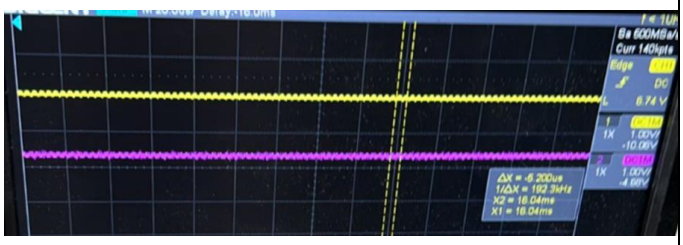
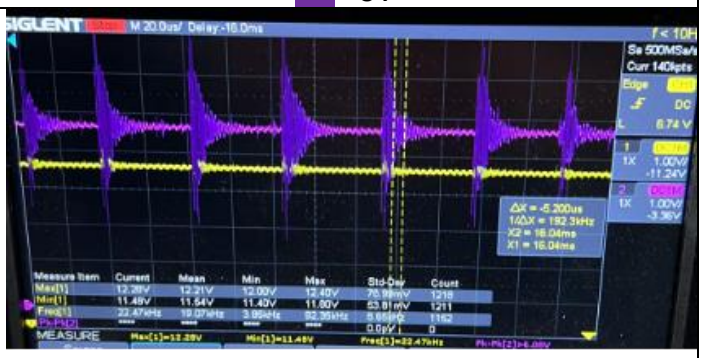
Port Number	Plug type	Function
Port 1	2 Pin clamps	Main Power Supply: The BMS requires a constant 12V voltage source. The polarity is indicated by a + and a – on the housing. (When looking at the side with the terminal, Vdd (12V) is on the left and Vss (GND) is on the right.)
Port 2	4 Pin terminal	Relay Connection: The multifunction relay can be connected to this port. The relay offers 4 interfaces that can be freely configured in the software, for example, to secure charging/discharging or to control peripheral devices such as heating or cooling. (An add-on is required for 3 of the 4 relays.)
Port 3	4 Pin terminal	UART: Port three is a UART interface that cyclically outputs all important information and states of the BMS in a stream. This can be used to implement custom controls / automations. (Requires an add-on.)
Port 4	RJ45 jack	C-Line Interface: On the RJ45 socket at Port Four, all C-Line components are connected. Currently, there are four types of battery boards (Slave Boards) available in the C-Line: 12S, 16S, 18S, and 26S; the corresponding batteries can be found in the battery board description. Since the C-Line operates as a bus system and is galvanically isolated, any number of batteries can be connected in series here. The necessary settings for this are described in the software section. The C-Line current sensor can also be connected there. (Galvanically isolated)
Port 5	RJ45 jack	CAN Interface for Peripheral Devices: Additional devices can be connected to the BMS via Port Five, including chargers used in electromobility and protocols for home systems such as those from Victron and other inverter manufacturers. Supported devices can be found in the compatibility list. (Galvanically isolated)
Port 6	RJ45 jack	L-Line Interface: Port Six is designated for connecting our second category (L-Line) of battery boards. These boards are available in various configurations, allowing to control of most common battery types, from simple LiFePo cells to our LI-Ion BoostPacks 3S. Other L-Line components such as the L-Line current sensor and L-Line relays can also be used via Port Six. Note: Most L-Line components are connected via a red 10-pin connector. Since the L-Line connection on the master unit uses an RJ45 socket, you will need at least one adapter (800302) depending on the configuration. (Galvanically isolated)
Port 7 & 8	Micro USB port	USB Port: (Debug interface) No function for the user

4. Electrical characteristics

The BMS requires a constant 12V power supply. The required current depends on the connected devices. You can calculate the current for your system using the following list.

Device	Current in mA
BMS V3	300
C-Line Current sensor	50
L-Line Current sensor	40
L-Line Cell board 1S	7
L-Line Cell board 3S	21
C-Line Cell board 12S	10
C-Line Cell board 16S	10
C-Line Cell board 18S	10
C-Line Cell board 26S (2*13S)	20
L-Line Relay	30
I2C Relay	150 (37,5 pro Relay)

It is important that a stable 12V power supply is free from interference. This can be generated, for example, using an AC/DC converter available in our shop. A stable 12V battery can also be used. Using poor-quality AC/DC converters or DC/DC converters can cause oscillatory behavior, triggering the undervoltage protection of the BMS V3. Additionally, the 12V output of the ICharger, used as a charging solution for the main battery, is not suitable for powering the BMS. Installing a DC/DC converter between the BMS and ICharger will not solve this issue.

AC/DC converter ---- 12V ---- 5V	ICharger ---- 12V ---- 5V
	

5. Dimensions and mounting

The BMS V3 has external dimensions of 145mm x 85mm x 34.5mm. The rear side consists of an aluminum cooling plate, which should be accessible to air or mounted on a thermally conductive surface. The housing comes standard with four mounting tabs positioned at the corners of the housing. Since the BMS is operated via a resistive touch display, the top side of the BMS must be accessible and should not be touched by surrounding objects. One of the housing screws is located under a warranty seal, which is not allowed to be removed (voids warranty).

6. Commissioning

When the BMS is powered on for the first time, the installation guide starts. This includes connecting to the internet via WLAN and basic settings for your system. **WARNING: None of the available RJ45 ports are intended for an Ethernet connection!** Connecting an Ethernet device (router/switch) can damage the connected device! An internet connection is mandatory and must be re-established periodically during operation to provide the BMS with updates. These not only bring improvements but also continuously make your system safer. After completing the installation guide, you can connect your components. During the initial setup of the battery boards, the BMS will guide you through the individual steps on the display.

7. Wiring

The BMS, adapters, and our C-Line battery boards feature RJ45 sockets, allowing conventional LAN/network cables to be used for connecting these components. The only restriction is that to avoid interference, a shielded cable of at least CAT 5 should be used. On the C-Line battery boards, there are two RJ45 sockets, both of them can be used as inputs or outputs. This means that all battery boards can be connected in series. The last board in the chain will have an unused RJ45 socket where an RJ45 termination resistor should be installed.

When using boards from the L-Line, which have red connectors connected via flat ribbon cables, a battery pack can be assembled similar to the BMS V2. Instructions for making these cables using a crimping template are also available on our website. Once all batteries or battery blocks are interconnected, the flat ribbon cable can be converted to a LAN cable using an adapter (800302). Multiple blocks can be combined using an RJ45 splitter (800304).
It's advisable to minimize signal chain separation in the C-Line. The system remains operational only for short branch-offs.
Two types of relays can be used for system control. The older relays connected via flat ribbon cables (L-Line) retain their functionality for the charge/discharge relay and are non-configurable. The heating relay and alarm relay cannot be controlled.
The I2C multifunction relay, connected via socket 2, allows all four relays to be freely configured (Channels 2, 3, and 4 require an add-on).
If the BMS is to be operated in conjunction with a peripheral component, it can be connected via Port 5. For a charger, you will need adapter 800303, which converts the RJ45 cable to CAN High and CAN Low on two screw terminals. The datasheet of the CAN charger specifies the corresponding cables that can be securely connected via these terminals.
For integration of the BMS into a home energy storage system in combination with a Victron system, you can use adapter 800301. This adapter translates the pin configuration of the BMS to that of the Victron system (such as Cerbo GX).

7.1. C-Line cabling

All components in the C-Line use standard LAN cables with RJ45 connectors to connect to each other. All C-Line components can be connected using the same bus. It is recommended to connect all components together in series. For this reason, each C-Line component has two RJ45 sockets. Each socket can be used either as an input or an output to connect to the next component.

ATTENTION:

1. **The slave units of the 16S, 18S, and 26S battery packs are visually identical. They differ only in their software, so if different variants are ordered, the boards must be stored separately from each other.**
2. **During addressing, each board must be connected one after the other. Only when all cells of a battery pack have been detected may the next board be connected! There is no way to reset an address without sending it in. Therefore, ensure that the assigned addresses are correct! If an addressing process is interrupted, first re-address all cells that have already been addressed, and only connect the new board once all previous cells have been successfully addressed!**
3.

Example:

This system utilizes 4 of our High Capacity Battery Packs. Each of our 16S and 18S packs will have one Cell Balancing Slave Unit attached, while each of the 26S packs will have two units. The attachment process is detailed in the assembly instructions for the High Capacity Battery Pack boards. The wiring configuration of the battery packs does not affect their cascading. They are always connected in series. Figure 3 and Figure 13 illustrate two types of battery wiring. In addition to pure series and parallel connections, combination setups can also be used. Multiple parallel strings, each consisting of an equal number of batteries, are also feasible. It is crucial that the number of batteries connected in series within a single string remains consistent.

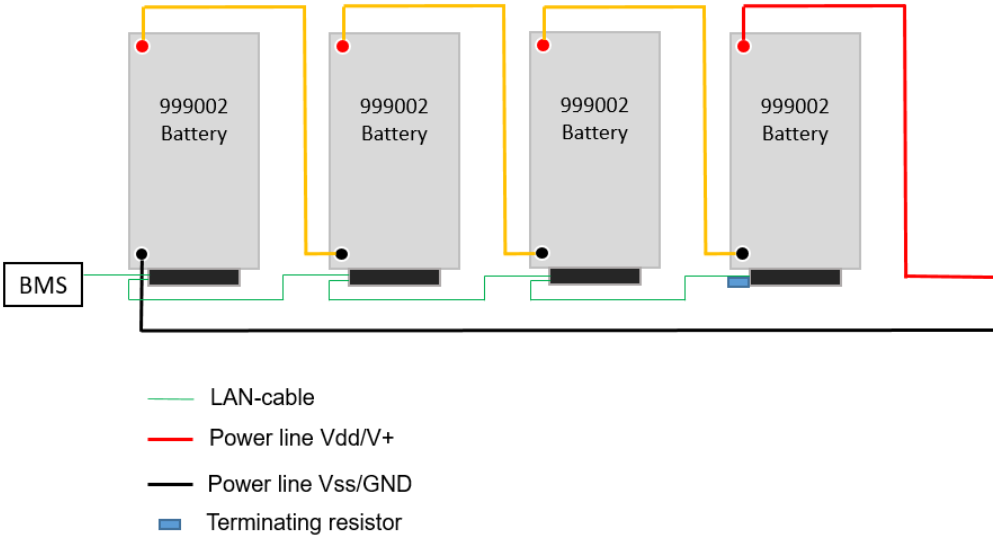


Figure 2 Four batteries in series with circuit board wiring

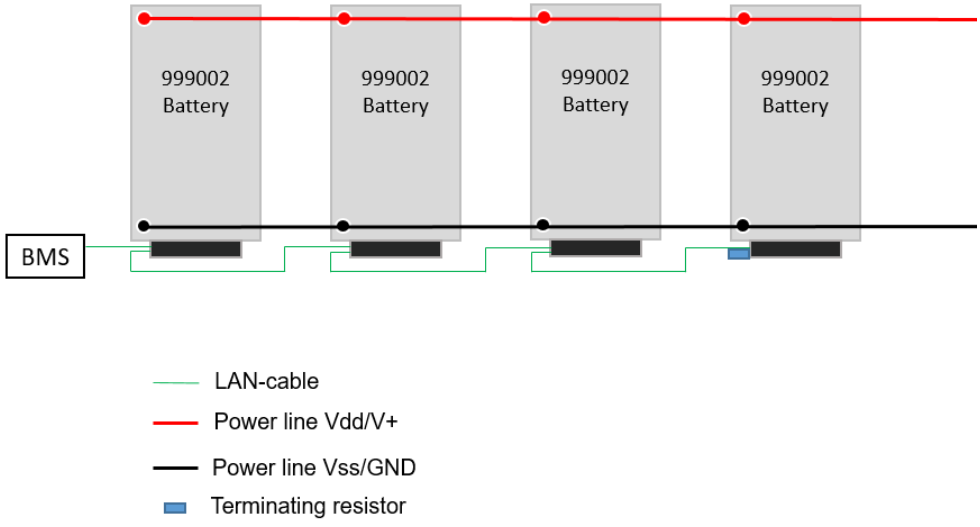


Figure 3 Four parallel batteries with circuit board wiring

To integrate a current sensor, the sensor can be installed in both the positive and ground (GND) paths. For a hassle-free integration, the sensor should be installed in the direction of current flow. For this purpose, there is an arrow on the housing. This arrow must point in the direction of current flow. If the sensor is installed in the GND path, it should therefore point towards the battery and away from the battery in the positive path.

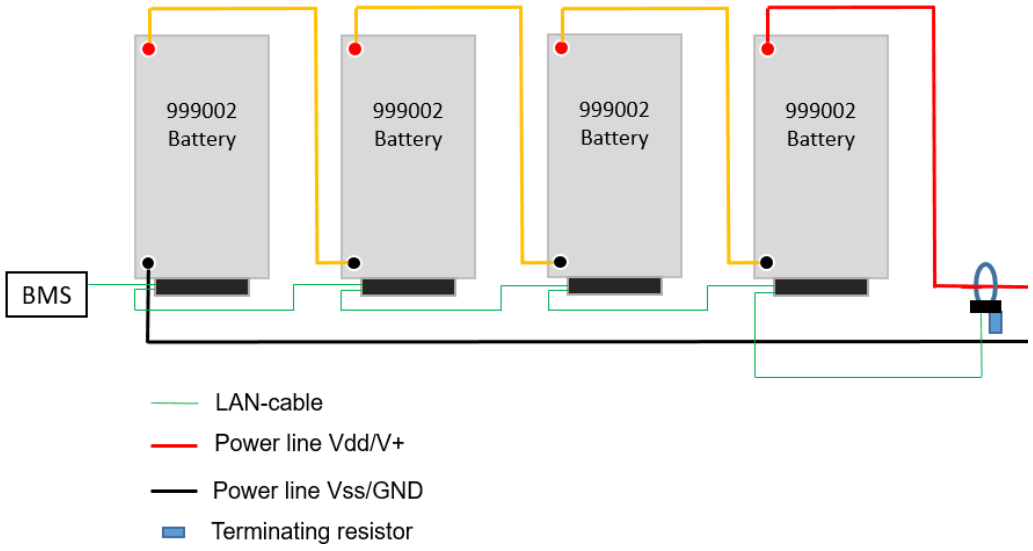


Figure 4 Integration eines C-Line Stromsensor

The wiring between the slave units is identical for all types in the C-Line. In the last participant of the bus system, which has a free socket, the termination resistor is plugged in.

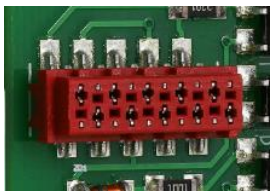
7.2. L-Line wiring

You can find a video for an introduction to our L-Line system with BMS V3 under the following link:
https://youtu.be/QELw-PU8vo8

Important Notes
Since the flat ribbon cable used in an L-Line system is not as well shielded as standard LAN cables, it should be carefully installed:

- Lay it separately from power-carrying cables and/or use appropriate shielding.
- Maintain distance and/or use suitable shielding from heat sources.
- Avoid damage:
  - Miscommunications may occur.
  - Short circuits and fire hazards are possible.

The slave units in our L-Line are also connected in series. The battery can be interconnected in series or parallel, similar to the C-Line. However, combinations of both are advantageous due to the smaller capacities of individual cells. Components in the L-Line all feature a red Micro Match connector directly soldered onto the board.



Through this, the components can be interconnected. The advantage of this system is that each user can build their own custom wiring harness, allowing them to assemble a compact battery block. The necessary

cable for this is a 10-core flat ribbon cable available on our website (320100). On this cable, sockets (320105) can be crimped at any interval. To achieve optimal crimping results and to avoid bending the contacts inside the socket, we offer a crimping template (320108). For crimping, a parallel-guided tool such as a "Knipex pliers wrench 86 05 250" must be used. Using a regular pliers or a pump pliers often leads to faulty crimps!

When setting up a new storage system, it is advisable to first align and secure/press all batteries as they will be used later. Afterward, the cell connectors are installed to conduct current from one cell to another. **CAUTION**: In parallel connections, the voltages at the connection points must be almost equal. If this is not being taken into account, it leads to cells equalizing with each other, resulting in significant degradation or even cell destruction under unrestricted current flow. The cell connectors are fastened with a washer and screw. Only after this should the slave units be attached. The sequence and the required nuts and washers can be found in Figure 5, although this may vary depending on the specific slave board. For instance, when using EVE LF280K with M6 terminals and our slave boards, nuts are not required as the supplied screws with two washers are sufficient for mounting.

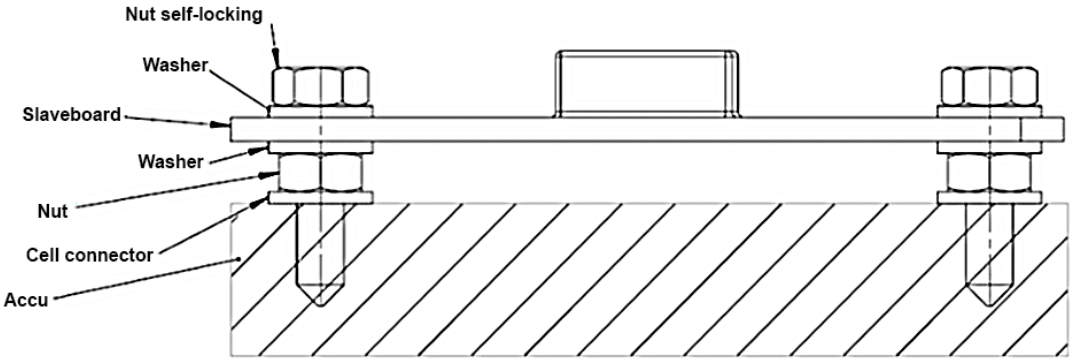


Figure 5 Sequence from battery via cell connector to the slave unit

Next, the flat ribbon cable can be laid over the battery pack, and a marker can be used to indicate where the sockets need to be crimped. Please do not crimp over the battery, as the exposed sockets have open contacts, and there is a risk if the tool falls onto an open power source. After crimping, you can check if all lengths are correct and connect the cable once. **CAUTION**: Before commissioning the master unit, you must disconnect all sockets and reconnect them in sequence for auto-addressing as indicated on the master unit's display. Figure 6 Example of cabling for the L-Line slave units provides an example of a hardware setup with LiFePo4 batteries and the corresponding L-Line units. When using LiFePo4 battery chemistry, it is advisable for the batteries to be under mechanical pressure as they tend to swell. If this can be prevented by a casing, it will extend the lifespan of your batteries.

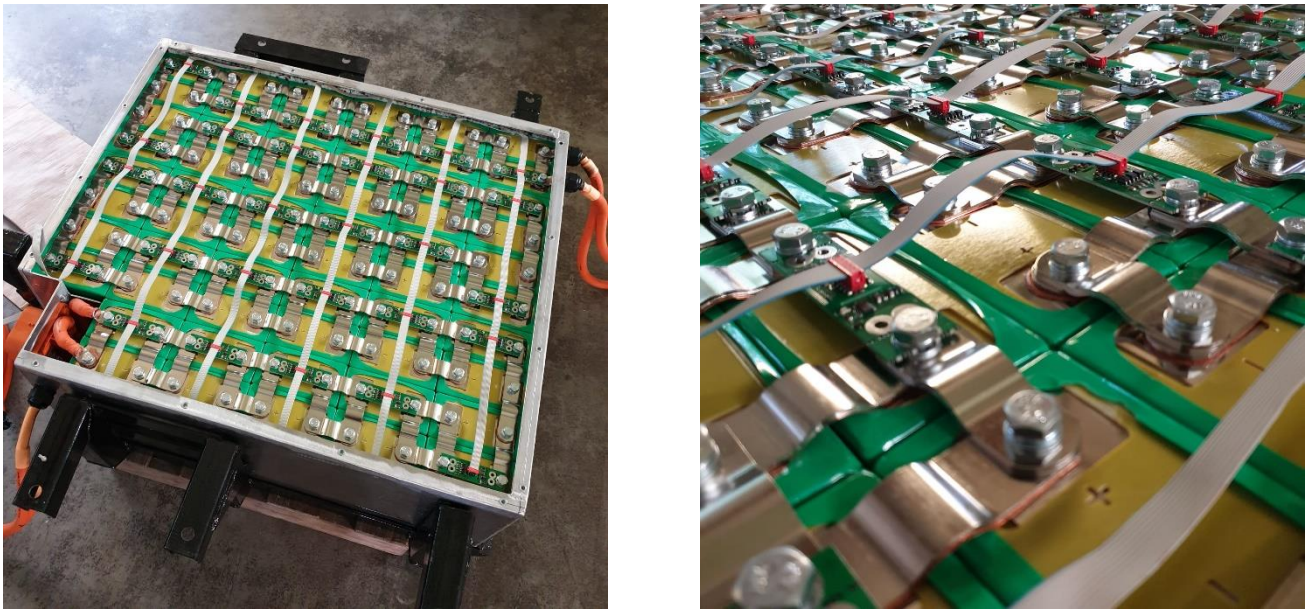


Figure 6 Example of cabling for the L-Line slave units

Other L-Line components, such as the L-Line current sensors (310217|310219|310221) or the L-Line relays (310405), can also be connected via the flat ribbon cable. To connect the flat ribbon cable to the BMS V3, an adapter is required. This L-Line RJ45-ribbon cable adapter (800302) converts the flat ribbon cable into a LAN cable, which can then be plugged into the master unit at the L-Line interface (Port 6). An additional Micro Match socket must be crimped onto the end of the flat ribbon cable for the adapter.

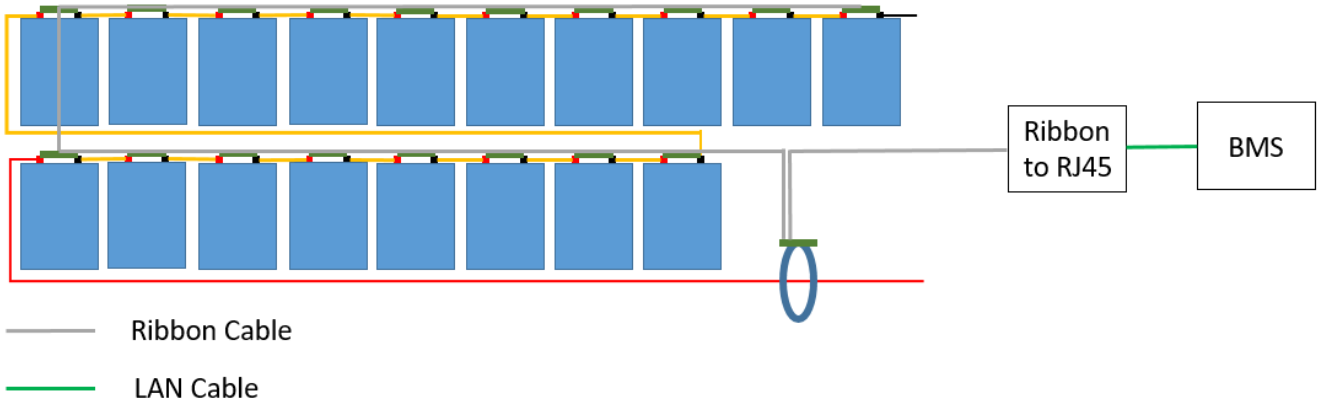


Figure 7 Example of an L-Line system setup with L-Line current sensor

7.3. Peripheral wiring

All peripheral devices are connected via Port 5. This allows the connection of an Energy Storage System (ESS) with a Victron system or the control of a charger. Since the peripheral devices use different connections for their data transmission, each device requires an adapter to be connected. These adapters are available for all our compatible devices in our online shop. To select which device is connected to Port 5 in the BMS, there is a button under the Add-On tab for all devices that allows you to activate and deactivate the respective protocol. Most of these add-ons are paid and must be purchased through our online shop. When purchasing the add-on, you must provide the serial number of the BMS for which you wish to activate it. Activation occurs within 48 hours after receipt of payment. If you have purchased the components for which you need the add-on from us, the add-on is usually included.

Important Note:

If multiple peripheral devices with different communication speeds are required, a notification will appear on the display of the master unit. The communication speed of the ICharger is fixed and cannot be changed. Therefore, if you wish to activate both an ICharger and an inverter, the communication speed of the inverter must match that of the ICharger. The communication speed of the ICharger is always 250 kBit/s.

7.4. C-Line/L-Line mixed wiring

Within a system, it is not necessary to use only C-Line or only L-Line components. Various combinations are possible. However, both cannot be used within cell communication. This means that only either C-Line slave units or L-Line slave units can be used. For the current sensor, on the other hand, either a C-Line or an L-Line sensor can be installed regardless of the slave units.

If the system has C-Line slave units, it can simply be connected as described in the C-Line wiring instructions. If an L-Line current sensor is to be used in a C-Line slave unit system, a short flat ribbon cable must be created that only transitions from flat ribbon to RJ45 (see Figure 8).

Figure 8 Rj45-ribbon adapter with current sensor wire

After that, the sensor can simply be plugged into the L-Line Port 6. Once the L-Line sensor is selected with its measurement range, the measured values will also be displayed.

When using a C-Line current sensor in an L-Line system, the sensor can simply be connected to the C-Line port. However, as with any other C-Line component, a termination resistor must be installed at the end.

7.5. Example applications

In this chapter, several application scenarios are graphically explained. These are not complete circuit diagrams, but only graphical descriptions of which components interact with each other. Therefore, the circuit diagram must be created by each user/installer depending on their system and the components used.

7.5.1. Electromobility car/boat with C-Line circuit boards

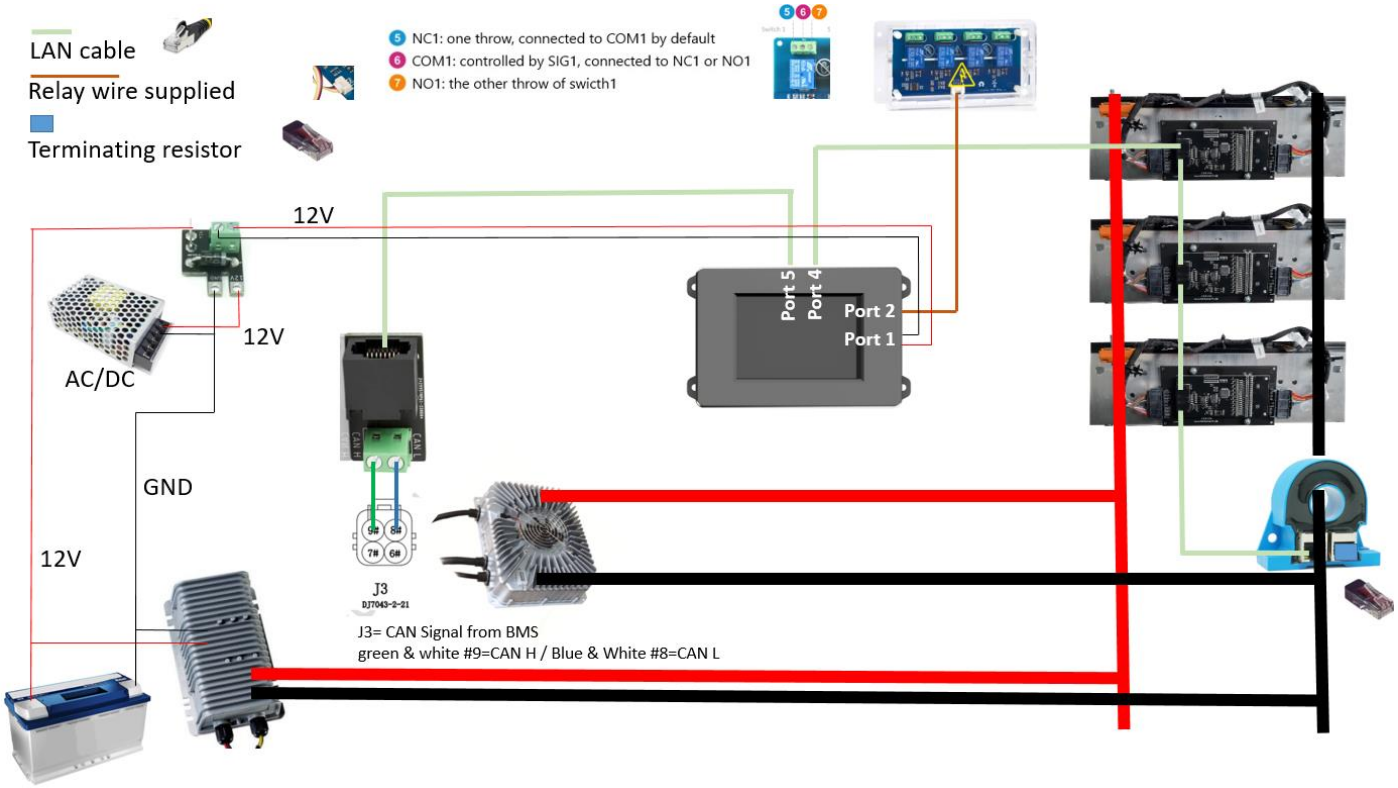


Figure 9 Electromobility application example

In Figure 9, a setup used in electromobility is illustrated. Batteries are used to drive an electric motor and its control. In this example, C-Line boards are installed on the battery, and a C-Line current sensor is used to monitor the current. The battery is charged via an ICharger, which is controlled by the BMS. Since the ICharger is a controlled charger, no relay is needed between the battery and the charger. This is only necessary for an uncontrolled charger. The figure shows a single-phase system, with a maximum charging power of 3.6 kW. If the system is to be charged with 11 kW, you need three IChargers connected in parallel to the same RJ45-ICharger adapter. It is important to note that the charging power set in the BMS is provided by each ICharger. Therefore, set the charging current to the power of one phase.

To supply the conventional 12V battery, which also powers the BMS, a DC/DC converter is used to charge the 12V battery from the main battery. Since this power supply is not switched through when the vehicle is off, a separate 12V power source must be used for charging. A small AC/DC charger connected to one phase of the charging current is used for this. To prevent this charger from charging the 12V battery, a power supply board is interposed. This prevents current from flowing from the AC/DC converter to the 12V battery. The connected multifunction relays can also be used for controls within the system electronics, such as activating a warning light for low battery levels or indicating high loads. The possible uses are versatile due to the variable settings of the relays.

Important Note:

If you do not install a 12V battery, there is a hight probability of interferences on the 12V rail. A 12V battery also acts as a buffer for fluctuations in power consumption on the 12V rail, which a 12V power supply unit can compensate for very poorly. (This issue is described in more detail in Chapter 4)

7.5.2. Victron ESS with C-Line boards

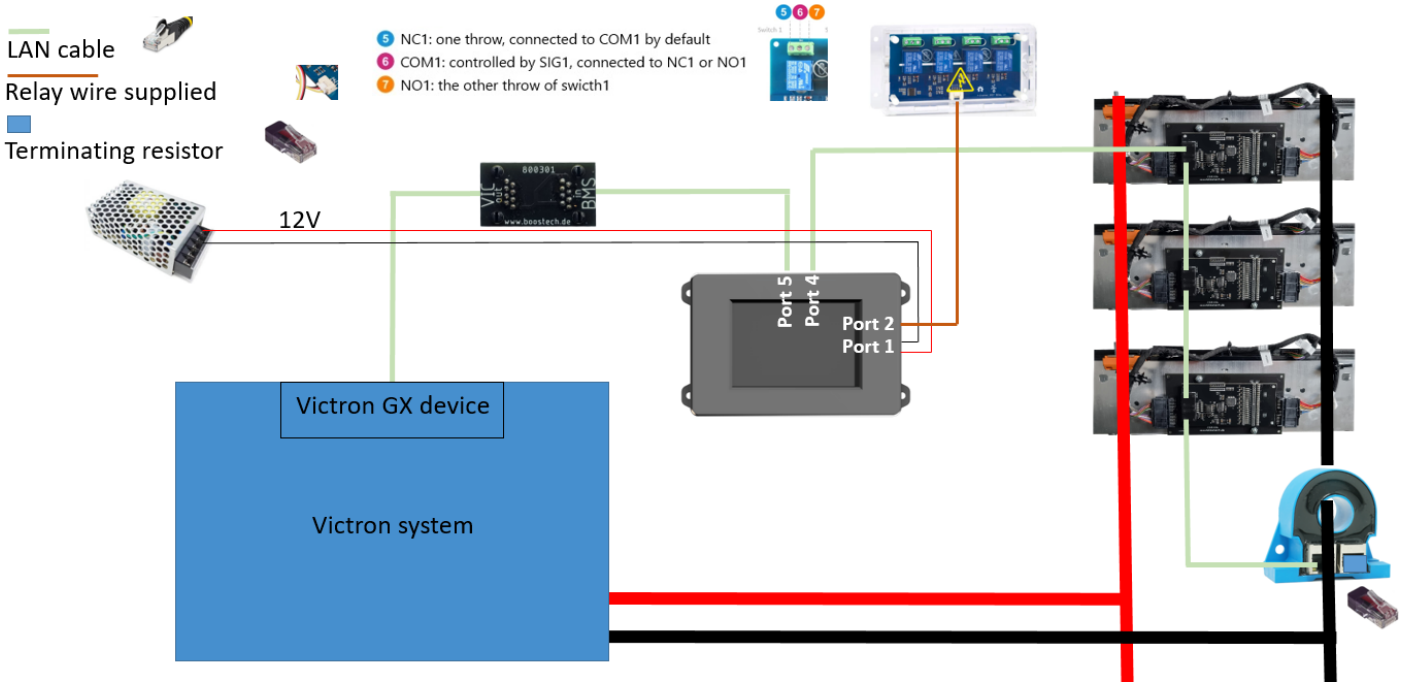


Figure 10 Application example Victron ESS

The BMS V3 can also be combined with a Victron system as an Energy Storage System (ESS). The components shown in Figure 10 are not all necessary but can be used in conjunction to address additional controls, for example.

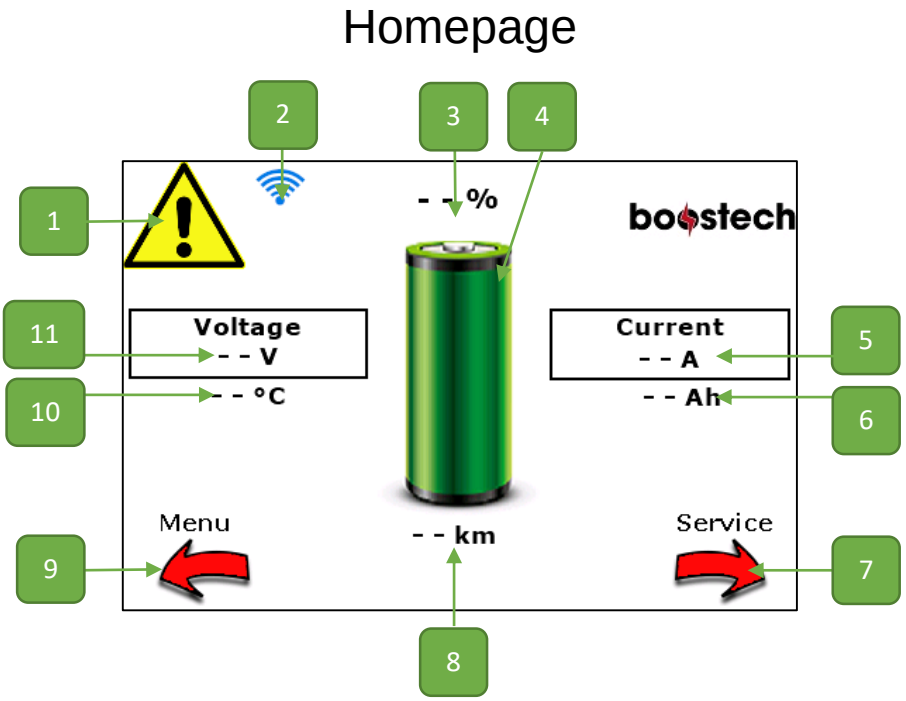
8. Functions and settings

The BMS has several settings that you must select for safe operation. This information is provided by the manufacturers of the batteries and peripheral suppliers you are using. Below, all the information displayed on the screen will be explained, and the functions that can be configured will be described.

The BMS is divided into two main parts. The main screen, the service display, and the individual cell display provide information about your battery. The second part is the menu with its subsections, where all settings for the battery, the display, and the connected devices are adjusted.

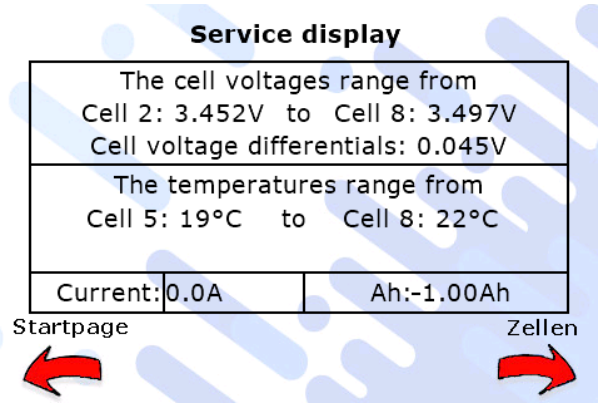
A video to illustrate the introduction to our BMS V3 can be found under the following link:
https://youtu.be/OZlF9QsYDYc

8.1. Battery information



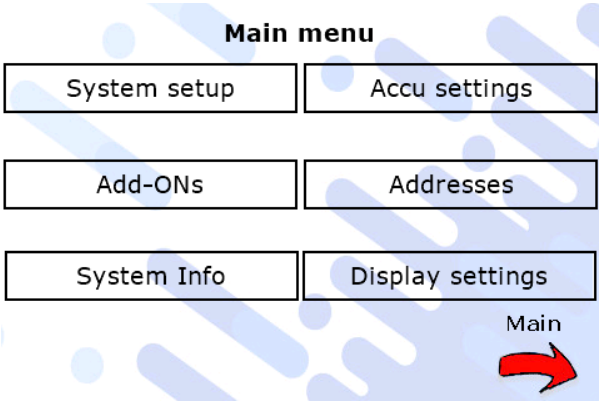
1	When the triangle icon appears, an error has occurred or there is information available. For example, it may indicate a cell failure or the availability of an update. Touching the exclamation mark will display the warning or information. Confirming the action will clear the information/error or initiate a function. You can also exit the display without confirmation. In this case, the message will remain and can be viewed again by touching the exclamation mark.
2	The WLAN symbol is only visible if the BMS is connected to a network.
3	Displays the fill level of the battery as a percentage.
4	Displays the battery level graphically.
5	Displays the current flowing. (negative when current is being drawn/positive when charging)
6	Counts the discharged or charged current. A value of 0 corresponds to a full battery. When the Ah hour counter shows a negative Ah value, the battery is empty. This value is used to calculate

	the state of charge, so it is essential to know and enter the usable capacity in Ah of your battery in the BMS!
7	Click here for the service display. It provides additional information on the main page, which can also be viewed quickly.
8	If you have installed your BMS in a vehicle and determined the distance you can travel on a single battery charge during a test drive, you can enter the distance traveled into the BMS. The BMS will then display the remaining distance you can still travel based on the battery charge level.
9	Here is the menu. All settings for the BMS can be adjusted there.
10	This shows the average temperature of your battery across all cells.
11	Provides information about the current total voltage of your system.

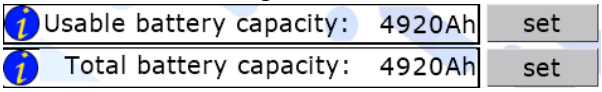


The service display shows the lowest and highest cell voltage, allowing you to observe cell drift during discharge/charge. Additionally, the highest and lowest cell temperatures as well as the average cell temperature are displayed. In the bottom row, the currently flowing current and the discharged energy are also shown.

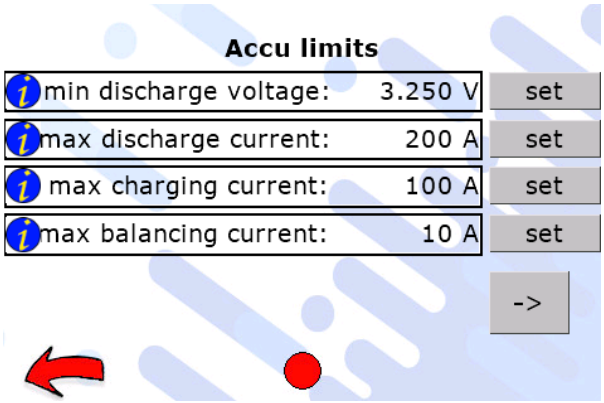
The individual cell display, one page to the right, shows all cells with their voltage and temperature. A battery usually has more than one temperature sensor, but not as many as there are cells. Therefore, some cells do not have a temperature reading. Depending on the battery, the temperatures are usually located at the beginning of the individual blocks of cells.



To the left of the home page is the menu. All settings can be made there.



Next to each setting option, there is always a blue "i" icon, which provides information about the setting when clicked. This way, the display explains itself. It is recommended to go through all the settings and read about what can be configured after the initial setup. Many questions can be answered this way.



The individual pages/menu items are navigated using the red arrows at the bottom of the display. The arrow at the bottom left usually indicates "Back" unless stated otherwise. The menu items typically have a small circle in the lower center of the screen, which allows you to jump directly back to the main display.

8.2. System settings

Main menu -> System settings

Canbus Baudrate	This baud rate sets the speed of the peripheral bus. For example, the correct baud rate for a Victron system or an ICharger can be configured here.
Maximum range	The kilometers shown here are purely based on the battery charge level. They do not account for your driving style. Therefore, the distance will vary depending on elevation changes and your speed. We recommend entering a distance that you have realistically traveled with your vehicle before.
Current sensor	The BMS supports various current sensors. Please select the sensor installed in your system. Choosing the wrong sensor may lead to incorrect measurements or the sensor not being recognized.
Calibrate current sensor	Current sensors that use the Hall effect can undergo certain fluctuations. This function allows you to calibrate your sensor. It's important to note that NO current should be flowing through the sensor during calibration. Only perform this function if you are seeing a positive or negative current reading above 0.5 A with no current flow. After calibration, the displayed current should ideally be around 0A.
Port display	With the help of the port display function, you can conveniently view the ports on the BMS display.
Port display -PIN assignment	You can display the pin assignments of the customer interfaces (CAN [Port 5] and UART [Port 3]) using the PIN assignment function.

Main menu -> System settings -> Advanced settings

Wifi Setup	If you want to establish a connection to a new Wi-Fi network or if you have changed the password of your existing network, you can use this tab to establish a new connection.
Synchronize display	If the BMS is disconnected from power during a settings change, it can cause the data displayed on the screen to become unsynchronized with the settings stored in the BMS. This function overrides all display data to match the settings stored in the BMS. Execute this function if you notice that the settings displayed on the screen do not correspond to the behavior of your BMS.
Reset BMS	You can use this function to reset your BMS to factory settings. All settings will be restored to their default values.
Data access for support	For better assistance with support inquiries, you can use this function to send us the current settings and logs of the master unit. This helps in general problem-solving and ensures quicker communication of issues.

8.3. Battery settings

Main menu -> Battery settings

Usable battery capacity	The usable capacity refers to the amount of energy you intend to extract from your battery. If you have specified the exact cutoff voltages for minimum voltage and shunt voltage that correspond to the battery's limits, then you are using the entire battery capacity. For most battery types, it is advantageous not to utilize the entire voltage range. Particularly with lithium-ion cells containing nickel, manganese, or cobalt, the lifespan is significantly increased by not discharging the battery to its cutoff voltages. By restricting the voltage range, the usable capacity of your battery decreases. To determine the value to use here, refer to the datasheet of your battery and extract the ampere-hours at the specified voltages, then calculate accordingly.  Based on the example provided with the BoostPack, its maximum voltage range is 9.0V to 12.6V. For this example, you want to use it between 10.1V and 12V (highlighted by the yellow lines). This means you intend to utilize the battery between -18,000mAh and -77,000mAh. The difference between these values is 59,000mAh. Therefore, you should enter 59Ah as the usable capacity. This example is quite extreme and is used solely for illustrative purposes. Please do not apply these settings directly to BoostPacks or any other batteries you are using. Adjust the settings according to the specifications and requirements provided for your specific battery.
Total battery capacity	Please enter the total capacity of your battery here. While the BMS itself does not use this for calculations, it is necessary for external components compatible with our BMS that require this information.
Voltage divider	The voltage divider allows you to configure your battery setup flexibly. You can choose how many batteries to connect in series and how many in parallel. It's important to ensure that all parallel strings have the same capacity and the same number of cells. You need to specify the number of parallel strings or batteries in the voltage divider.

	Caution: If you parallel two or more cells directly and use only one slave unit (not recommended), the BMS considers this as one cell. In this case, you do not need to adjust the voltage divider. The default configuration assumes a single string, so you should enter "1" in the voltage divider. "0" is NEVER a selectable option!
Canbus Baudrate	The baud rate in the battery settings determines the speed of the bus responsible for communication with the slave units. Currently, for all C-Line boards, the baud rate is set to 125kBit/s.

Main menu -> Battery settings -> Battery limits -> Page 1

Min discharge voltage	Plece enter the voltage at which you want to stop discharging your battery. Use the entered value for calculating the usable capacity.
Max discharge current	Please enter the maximum current at which you can discharge the battery pack. Connected devices that draw energy from the battery and communicate with the BMS, such as a Victron system, will receive this value as the current limit. If the discharge current exceeds the entered value, the discharge relay will be switched off.
Max charging current	Please enter the maximum current at which you can charge your battery pack. Connected devices used for charging the battery, such as a Victron system or an Icharger, will receive this value as the charging current limit. If the charging current exceeds the entered value, the charge relay will be switched off.
Max equalizing current	The slave units discharge the batteries to a certain voltage based on the balancing algorithm. However, if the battery is being discharged at that moment due to current flow, the balancing stops to avoid additional stress on the accumulator. With this setting, you can choose the current limit up to which the slave units are allowed to continue balancing.

Main menu -> Battery settings -> Battery limits -> Page 2

Min discharge temperature	If the temperature of the battery drops below this value, the discharge process will be stopped and the discharge relay will be deactivated. This function serves to protect the battery from excessively low temperatures.
Max discharge temperature	If the temperature of a battery exceeds this value, the discharge process will be stopped and the discharge relay will deactivate. This function is designed to protect the battery from excessive temperatures.
Min charging temperature	If the temperature of a battery falls below this value, the charging process will be stopped and the charge relay will deactivate. This function is intended to protect the battery from operating at too low temperatures.
Max charging temperature	If the temperature of a battery exceeds this value, the charging process will be stopped and the charge relay will deactivate. This function is intended to protect the battery from operating at excessively high temperatures.

Main menu -> Battery settings -> Advanced settings *(PW protected)

Battery Chemistry	Here you can select the chemical composition of your battery. The different compositions are grouped into categories based on their similar behavior.
Battery Board	With this setting, you choose the type of slave units. The C-Line boards are represented by selecting CAN slave boards. In the L-Line, there are two special boards designated for Tesla batteries and our in-house BoostPacks. Under the "All Others" tab, you can select all other L-Line slave units. These differ mainly in how they connect to the battery.
Early balancing	This setting allows you to switch from the normal balancing algorithm, which only discharges cells above the shunt voltage, to the Early balancing algorithm. The goal of the balancing mode is to equalize all cells to the voltage level of the lowest cell in the whole voltage range. This function is useful for initially balancing a battery pack after assembly and should typically be disabled thereafter. However, in cases where you have a battery pack with significant capacity differences between cells, it may be beneficial to keep this function permanently enabled. This can help prevent cells from drifting apart, especially in the lower voltage ranges.
Shunt voltage	With the Shunt Voltage setting, you configure the voltage at which the shunt resistors begin discharging the battery. This setting also represents the maximum charging voltage for an individual cell. You can find the maximum voltage specification in the datasheet or description of your battery. Set this value according to the manufacturer's recommendations to ensure safe operation and to prevent overcharging of the cells.
Set ampere-hour counter	The BMS continuously measures the current flowing into and out of the battery. Based on these measurements, it calculates the ampere-hours (Ah) that have been discharged from or charged into the battery. If you connect a partially charged battery or if the state of charge was changed while the BMS or sensor was off, you can manually set the Ah value. The BMS always calculates the amount of current discharged from the battery. This means that if the battery was fully charged initially, the displayed Ah value would be 0. As the battery discharges, the displayed Ah value will increase. When the battery is empty, the displayed Ah value should be the negative equivalent of the value set in the battery settings under usable battery capacity. In summary, the Ah value displayed by the BMS reflects the cumulative current flow in and out of the battery, starting from 0 Ah when fully charged and reaching a negative value corresponding to the usable battery capacity when fully discharged.

*(PW protected):

Some settings of the BMS are protected by a password. These settings are essential for configuring and adjusting the BMS and should be set according to the system during installation. The password acts as a barrier against users who are not installers. This is to prevent untrained personnel from making security-critical adjustments.

The password is "0000".

8.4. Add-ONs

With the add-ons, you can unlock additional features for the BMS. To activate them, you need to purchase the corresponding add-on on the online shop at boostech.de, specifying the BMS serial number. Once purchased, it will be unlocked on your system, requiring the BMS to have an internet connection. In the BMS itself, you can view the unlocked add-ons under System Info in the Extensions field. Within the add-ons, buttons will appear grey if they are not yet unlocked. After activation, the buttons will turn red and can be enabled. Each add-on must also be turned on within the BMS after activation by pressing the now red button until it turns green.

8.4.1. Available functions

Relay	1 Free / 3 Chargeable	1. In the relay settings, you can configure up to four relays according to your system's requirements. Only the Universal BMS Relay V3 can be configured. 2. Possible configurations: 3. Charger Relay: The relay remains active as long as your battery may be charged according to your configured parameters. 4. Discharger Relay: The relay remains active as long as your battery may be discharged according to your configured parameters. 5. Heating: You can set a battery PCB temperature threshold, below which the heating relay will activate. 6. Cooling: You can set a battery PCB temperature threshold, above which the cooling relay will activate. 7. V / A / SOC: In these settings, you can activate a relay based on one or more triggers. The following values can be defined separately from other settings, causing the relay to deactivate when exceeded: 7.1. Minimum cell voltage 7.2. Maximum cell voltage 7.3. Maximum current (absolute value, either charging or discharging) 7.4. Minimum State of Charge (SOC) 7.5. Maximum State of Charge (SOC)
Chargers	Chargeable	The Charger Devices add-on allows control of various chargers using an RJ45 Charger Adapter. Within the Charger Devices add-on, supported devices can be activated for operation.
Victron	Chargeable	The Victron add-on enables control of a Victron system. It supports not only the standard control information found in conventional Battery Management Systems, but also the complete Victron protocol including all warning and error signals.
Warning Signals	Free	The BMS is equipped with a sound emitter that can provide acoustic signals indicating its status. It distinguishes between warning and error signals, which can be activated or deactivated via the add-on. This allows system faults to be noticed without the need to monitor the display constantly.

Inverters	Chargeable	The Inverter Add-On allows control of one of the supported inverters.
Customer interface	Chargeable	he customer interface enables the BMS to output all relevant information via CAN or UART. Both protocols can be found on our website as well.

8.4.2. Customer interface UART and CAN

Our customer interface allows you to read all relevant data via a CAN or UART interface. Both interfaces cannot be operated simultaneously. Termination resistors are always necessary for the CAN interface.

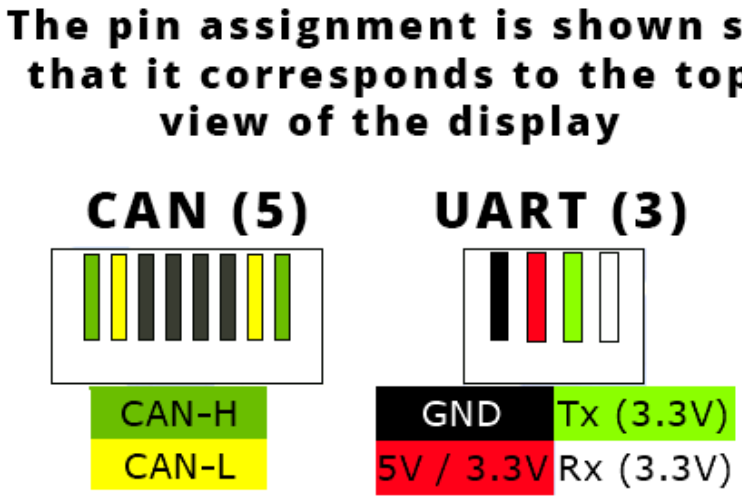
When using the CAN protocol via Port 5, the speed depends on the baud rate set in the system settings.

CAUTION: If you also have chargers or inverters connected to Port 5, the corresponding baud rate for the connected device must remain set!

(For Victron 500kBit/s, iCharger 250kBit/s)

CAN-Protokoll: CAN-Protokoll-fuer-den-Port-5-des-BMS-V3.pdf

UART-Protokoll: UART-Protokoll-fuer-den-Port-3-des-BMS-V3.pdf



8.5. Addressing

Addressing is responsible for the automatic detection and programming of the batteries. During addressing, each cell with its slave unit is assigned an individual address. For this assignment, NONE of the slave boards must be connected to the BMS during auto-addressing! This is particularly important for C-Line boards, as they do not include address reset functionality. Incorrect assignment of these addresses may require the boards to be sent in for service.

If your slave units have already been addressed, the BMS's auto-addressing feature can still be performed again. This might be necessary, for example, when upgrading from V2 to V3 or after resetting the V3.

Sequence Addressing L-Line boards:

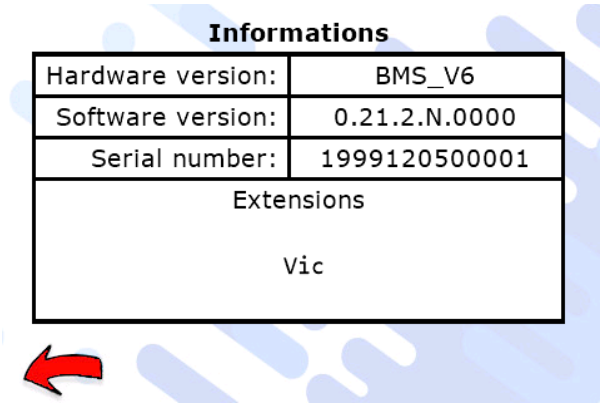
1. Ensure that all slave units are completely disconnected from the ribbon cable.
2. Start the auto-addressing process in the BMS by clicking on "Scan". Once the message "Addressing begins" appears, proceed to step three.
3. Now, connect the first board of your system. If you are using boards like the slave unit for the BoostPack 3, each board is considered as three cells. In other words, the connectors on the same board must be connected consecutively. The BMS should emit a beep for each connector connection and increment the number displayed on the screen.
   3.1. If the addressing process was interrupted, you can resume from the board where you left off. Disconnect all boards until you are sure that the remaining connected cells have already been addressed. Then start the auto-addressing process again and wait until all cells you previously addressed are recognized. Now you can connect the remaining cells consecutively.
   3.2. Once cells have been addressed, they retain their address. If you connect a new BMS or reset your current one, you can read all cells again via a new auto-addressing process. In this case, you do not need to connect the cells consecutively.
4. Once all cells have been recognized, you can stop the scanning process using the "Stop" button. You cannot leave the page without stopping the scan.
5. Verification of addressing: Go to the individual cell display, which can be accessed from the main page by right-clicking twice. All cells in your system should now be displayed. Depending on the board type, some cells may have temperature detection and others may not. However, each cell must display a voltage within the parameters of your battery.

Procedure Addressing C-Line boards:

1. Verify that all slave units are completely disconnected from the ribbon cable.
2. Start the auto-addressing process in the BMS by clicking on "Scan". Once the message "Addressing begins" appears, proceed to step three.
3. Insert the termination resistor into one of the sockets on the board you want to address first. Then, connect the board to the BMS using a standard LAN cable.
4. You will hear several beep tones and the number on the display will sequentially count up all cells of your battery pack. For example, if you are using a 16S battery with a 16S board, after the first block, the display will show '17'. This indicates the next cell it is searching for.
5. After all cells on your board have been recognized, remove the termination resistor and insert it into the next board you want to address.
6. Then, connect the second board to the first one.
7. You will hear multiple beep tones again and the count of battery cells will increment once more.
8. Repeat this process until you have daisy-chained all cell boards together. The termination resistor should be in your last board. If you are not using a CAN current sensor, you can leave it there. Otherwise, insert it into the sensor and connect the last board to the sensor.
9. Once all cells have been recognized, you can stop the scanning process using the "Stop" button. You cannot leave the page without stopping the scan!
10. Verification of addressing: Please go to the individual cell display, accessible by right-clicking twice from the main page. All cells in your system should now be displayed. Depending on the board type, some cells may have temperature detection and others may not. However, each cell must display a voltage within the parameters of your battery.

8.6. System Info

Under System Info, you will find information about your current BMS. Here, you can check the hardware revision and your serial number. The Extensions window displays the add-ons that are activated on this system. Next to the label 'Software Version', you can find the main software installed on your BMS. Please have all information from this page ready when making a call for support regarding any issues or questions about your BMS.



When you click on the 'Software Version' text, another page opens where you can view the software versions of all controllers in your BMS. If you see a notification about an available update when you click on the yellow exclamation mark on the main screen and want to first know which controllers will receive an update, you can decline it. On the aforementioned page under 'Components', you can see which controller is affected. Declining the update notification does not make it disappear permanently; you can simply revisit the main screen to access it again and start the update. Additionally, under the comments section, you can view a change log describing the changes/improvements made in your current version.

8.7. Display settings

Language	Currently, the BMS can display two languages: German and English. Additional languages will be added later.
Brightness	You can adjust the brightness of the display between 10% and 100% using the sliders.
Display calibration	If you feel that the triggered functions do not correspond to what you touched on the display, you can perform a display calibration. Click on the Start button located at the bottom right of the screen. This will turn the display black and four crosses will appear one after another. You need to click on each cross; after each click, the next cross will appear. Please try to place your touch as accurately as possible on each cross. The more accurately you hit the cross, the better your touchscreen will perform.
Darkmode	Not yet available.

Display settings -> page 2

Main display A / W	Through these settings, you can change the displayed unit on the main screen between current in Amperes and power in Watts.
Main display Ah / kWh	Through these settings, you can change the displayed unit on the main screen between ampere-hours and kilowatt-hours.
Display Sleep Mode	Using this button, you can enable or disable the automatic shutdown of the display.
On time in min	his value determines how long the display will wait without input before turning off. After turning off, the display can be reactivated by touching it.

Display settings -> page 3

Display-orientation	This setting allows you to adjust the display orientation, including a 180-degree rotation option. Please follow the instructions provided by the master unit.

9. Functional description and algorithms

The BMS operates with various algorithms that are crucial for implementing the settings chosen by the operator. This section describes the behavior of the BMS and its main functions.

Balancing Algorithms:

Standard balancing	In the standard balancing process, individual cells are balanced to the specified shunt voltage level. Cells that exceed this maximum voltage are actively discharged to prevent further increase in voltage during charging.
Early balancing	If early balancing is active, the battery is continuously balanced within its voltage range. All cells above the lowest shunt voltage are actively discharged. This allows for a balanced battery even during usage, without reaching the maximum voltage during charging. Depending on the battery type, this setting should not be used continuously, as it may lead to increased losses and heat.

Charging and discharging curves:

Charging	When a supported charger (such as ICharger, Victron, or other inverters) is used, the BMS can adjust the charging current according to the battery's current needs. This adjustment is based on the individual cell voltages towards the end of the charging process. The voltage delta at which the current is reduced depends on the battery chemistry used. For LiFePO4 batteries, the current is reduced in the last 3% based on voltage, not state of charge (SOC). For lithium-ion batteries containing nickel, manganese, and/or cobalt, the reduction occurs in the last 1%. However, this voltage delta is not strictly applied to the set shunt voltage. To allow all cells to be fully charged during normal balancing, the battery needs to charge slightly above the shunt voltage. This excess charge allows for balancing (discharging) and leveling of low cells. For LiFePO4 batteries, this excess charge delta is 0.15V, and for lithium-ion batteries, it is 0.02V. This excess charge delta is also the reason why the maximum adjustable values for the shunt voltage have been changed. A range is defined for each battery chemistry where the shunt voltage can be set, for example, LiFePO4 (3.3V - 3.65V) and lithium-ion (3.5V - 4.18V). This range is reduced so that the maximum cell voltage, plus the excess charge delta, does not exceed the critical voltage for the chemistry being used. Special considerations: ○ When a charging process starts, such as after a restart, the charging current is slowly ramped up over the first 10 seconds. This is to protect the charging equipment. ○ If the system is in a cold state, the ICharger limits the initial charging to 1 ampere for the first 30 seconds. This serves as a warm-up phase because its temperature shutdown activates at temperatures below freezing, where a current over 1 ampere could trigger an emergency shutdown.
Discharge	At the lower end of the voltage range, the discharge current is also throttled. This throttling is beneficial specifically for users in photovoltaic installations, as they have the ability to set a discharge current. Across different battery chemistries, the discharge current is gradually reduced to zero in the last 0.15V of the battery chemistry.

	Both the discharge current and the charge current are always calculated based on the maximum values entered by the user for charging and discharging currents. Important note: If the BMS is installed in a vehicle or boat and the battery is discharged almost to its minimum voltage, the BMS may suddenly shut down if a very high current is drawn from the battery in this state. This behavior is intentional and critical because undervoltage of the cells can lead to irreparable damage. When a high current is drawn from a battery, its voltage decreases, and if this voltage drops below the minimum voltage, it becomes dangerous.

9.1. ICharger

With the ICharger, the battery can be efficiently charged based on its state of charge. The ICharger features an LED that indicates the current charging status. In BMS V3, unlike the previous BMS which supported only two color codes, multiple color codes are supported.

The LED signals are interpreted as follows:

Green - Red	Flashing	Charging / battery not yet full
Green	Permanently illuminated	Battery is fully charged
Green - Green	Flashing	The battery is nearly full but still needs to be balanced to complete the charging.
Orange-Orange	Flashing	Not charging due to exceeding maximum limits (current or voltage).
Red-Red	Flashing	Not charging due to cell loss or current sensor loss.
Red	Permanently illuminated	Not charging; related issue displayed in the BMS.

10. Compatible products

10.1. Slave Boards

C-Line Boards:

- C-Line BMS-BUS-Cellbalancing-Slave Unit for CATL 16S
- C-Line BMS-BUS-Cellbalancing-Slave Unit for CATL 18S
- C-Line BMS-BUS-Cellbalancing-Slave Unit for CATL 26S
- C-Line BMS-BUS-Cellbalancing-Slave Unit for 12S
- C-Line BMS-BUS-Cellbalancing-Slave Unit for BMW i3 90/120 Ah
- C-Line RJ45 Abschlusswiderstand

L-Line Boards:

- L-Line BMS-BUS-Cellbalancing-Slave Unit Universal
- L-Line BMS-BUS-Cellbalancing-Slave Unit für GBS 40/60/100, Winston 90/100/160/200, CALB 40/60/100/180/200, SYNOPOLY 40/60/100/200
- L-Line BMS-BUS-Cellbalancing-Slave Unit für BoostPack 3S
- L-Line BMS-BUS-Cellbalancing-Slave Unit GBS 160/200 AH
- L-Line BMS-BUS-Cellbalancing-Slave Unit Calb CAM72, EVE 105 Ah
- L-Line BMS-BUS-Cellbalancing-Slave Unit Calb CAM72, EVE 105 Ah
- L-Line BMS-BUS-Cellbalancing-Slave Unit GBS 100 AH-A
- L-Line BMS-BUS-Cellbalancing-Slave Unit für Nissan Leaf Zellen
- L-Line BMS-BUS-Cellbalancing-Slave Unit for Tesla Battery V2
-

10.2. Current sensors

- C-Line BMS-Stromsensor 0-800A
- L-Line BMS-Stromsensor bis 350A IP24
- L-Line BMS-Stromsensor bis 750A IP24
- L-Line BMS-BUS-Stromsensor bis 1600A IP24

10.3. Relay

- Universal BMS-BUS-Relais V3
- BMS-Multifunktionsrelais für die Steuerung mit 1 Potentialfreien Kontakt 16A, IP24
  (mit dem BMS V3 nur als Lade- und Entladerelais zu verwenden)

10.4. Power supplies

- BMS-BUS-Netzteil 18-36V DC/12V DC/1,3 A IP24
- BMS-BUS-Netzteil 230V AC/12V DC/25W IP24
- BMS-BUS-Netzteil 36-72V DC/12V DC/0,6 A IP24
- BMS-BUS-Netzteil 9,2-18V DC/12V DC/25W IP24

10.5. Adapter

- Adapter von Victron GX zu BMS
- C-Line & L-Line RJ45 Splitter
- L-Line RJ45-ribbon cable
- RJ45-ICharger

10.6. Supply board for use with a car battery

- BMS-BUS-Versorgungsplatine für Netzteil AC/DC für V3
- BMS-BUS-Versorgungsplatine für Netzteil DC/DC für V3
- BMS-BUS-Versorgungsplatine für Netzteil AC/DC
- BMS-BUS-Versorgungsplatine für Netzteil DC/DC

10.7. Wiring

- L-Line BMS-BUS-Flachbandleitung 1,0m
- L-Line BMS-BUS-Steckereinheit rot
- L-Line Pressschablone für Steckereinheit rot
- L-Line BMS-BUS-Steckereinheit IDC Buchse
- L-Line BMS-BUS-Steckereinheit IDC Stecker

10.8. Chargers

- BMS-iCharger Ladegerät für 48 V (18-60 V) 35 A
- BMS-iCharger Ladegerät für 72 V (36-100 V) 30 A
- BMS-iCharger Ladegerät für 96 V (48-130 V) 25 A 3,25 KW
- BMS-iCharger Ladegerät für 144 V (72-180 V) 20 A 3,25 KW
- BMS-iCharger Ladegerät für 400 V (200-420 V) 10 A

10.9. Victron

All devices with a GX in their name can be used in combination with the BMS V3

11. Reassign L-Line board address

If you have assigned the address of a slave board incorrectly or need to change it later, you can reset it using an address reset. Start the auto-addressing process and allow it to cycle through until it reaches your newly addressed board. When the addressing reaches the address you want to assign to the slave board, you must bridge/short-circuit the temperature sensor across two pins, as shown in Figure 12 and Figure 13.

Notes:

- **The reset function is available for all L-Line slave boards from 08/2019 onwards.**
- **From 05/2024, there is a new revision of the L-Line slave boards. New significantly smaller temperature sensors are installed here. For this revision, special attention must be paid to ensure that the small temperature sensor is not pushed off the board. (See Figure 11)**

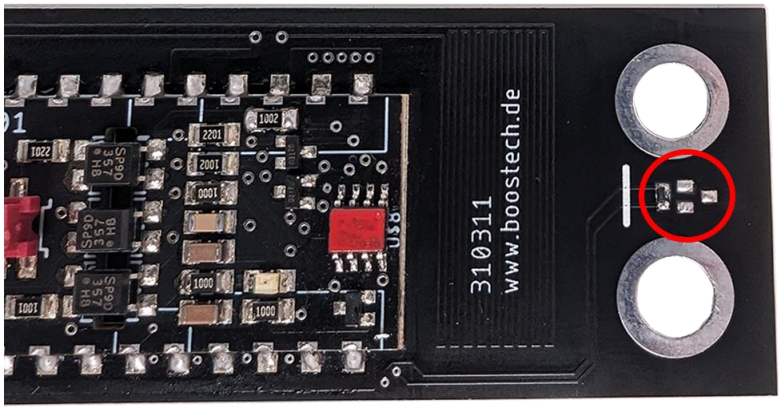


Figure 11 Slave board with new temperature sensor

For the newer slave boards, the reset can be achieved by short-circuiting the two pins as shown inFigure 12.

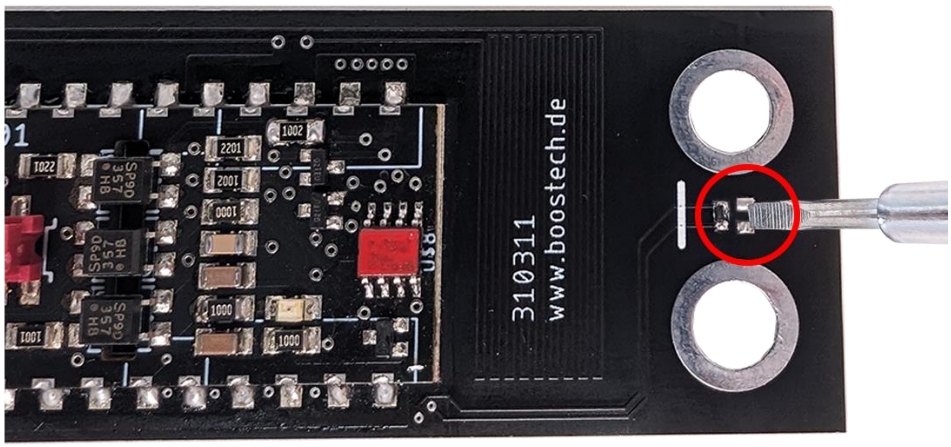


Figure 12 Slave board Note for address reset

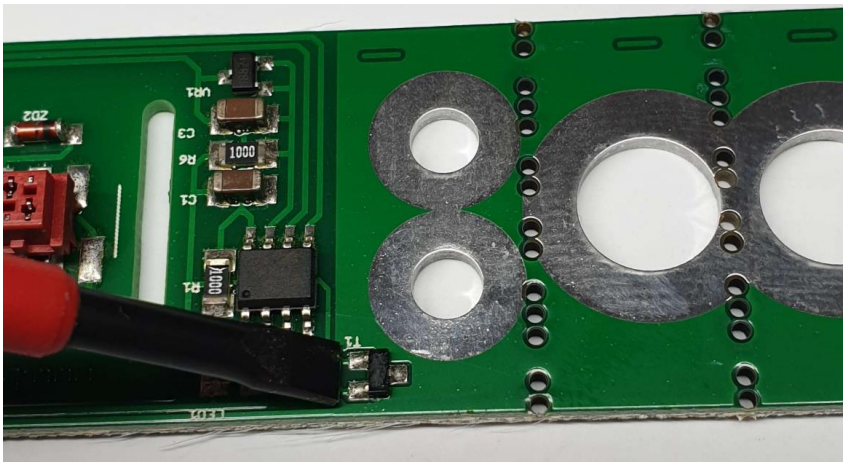
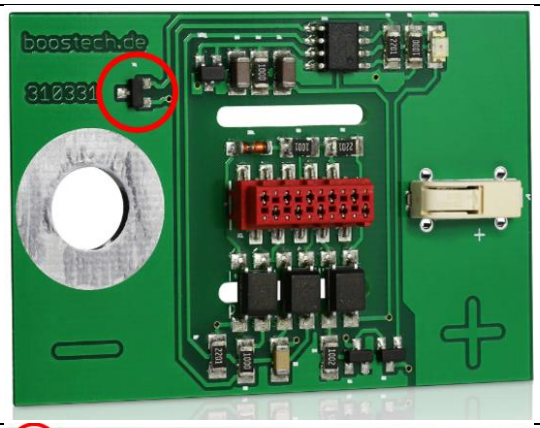
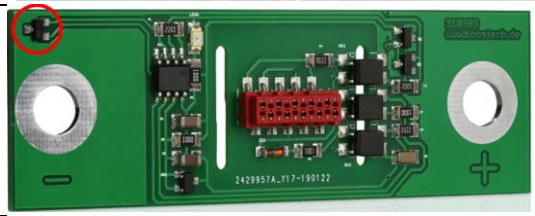
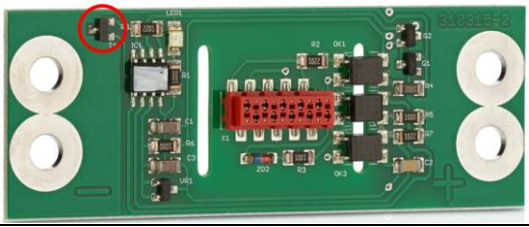
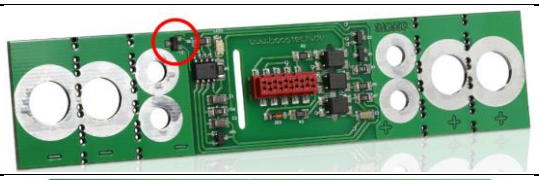
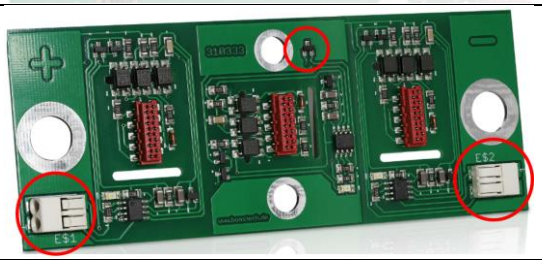
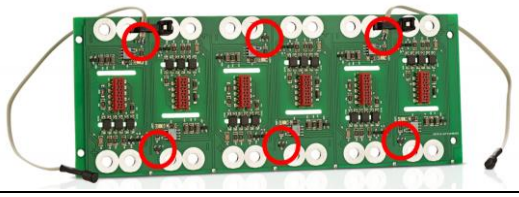


Figure 13 Pins for bridging the temperature sensor

The temperature sensor is labeled 'T1' on the board. The following images depict the sensor's position on various L-Line boards. For the board used with Boostpack 3S, which houses two temperature sensors within the battery, both connector sockets must be short-circuited. The subsequent images illustrate all the points that need to be short-circuited sequentially.

L-Line BMS-BUS-Cellbalancing-Slave Unit Universal	
L-Line BMS-BUS-Cellbalancing-Slave Unit Calb CAM72, EVE 105 Ah	
L-Line BMS-BUS-Cellbalancing-Slave Unit GBS 100 AH-A	

L-Line BMS-BUS-Cellbalancing-Slave Unit für GBS 40/60/100, Winston 90/100/160/200, CALB 40/60/100/180/200, SYNOPOLY 40/60/100/200	
L-Line BMS-BUS-Cellbalancing-Slave Unit GBS 160/200 AH	
L-Line BMS-BUS-Cellbalancing-Slave Unit für Nissan Leaf Zellen	
L-Line BMS-BUS-Cellbalancing-Slave Unit für BoostPack 3S	
L-Line BMS-BUS-Cellbalancing-Slave Unit for Tesla Battery V2	

12. Conversion from BMS V2 to BMS V3

If you want to replace your BMS V2 with a BMS V3, this is possible in every case. The Masterunit V3 supports almost all hardware components (see compatible products) and software functions that could be connected to the BMS V2. Additionally, the V3 offers improved display and user interface, and new functions and compatible devices have been added.

Various adapters are available to adapt the V2 wiring to the V3 connectors. The BMS V2 uses a flat ribbon cable with Micro Match connectors for all communications, while the Masterunit V3 uses RJ45 sockets for this purpose. To use the same battery pack created for the V2 with the V3, you only need the "L-Line RJ45-ribbon cable" (800302) adapter. You can connect your sub-boards to the V3 batteries using an additional standard LAN cable. The current sensor and relays can remain on the flat ribbon cable as usual.

While the V2 current sensor and relays can only be connected to Port 6 of the V3, the port for the slave boards depends on your variant. If your battery block is built with L-Line boards (all shown in Chapter 11), these will also be connected to Port 6, allowing a common flat ribbon cable to be used for sub-boards, current sensor, and relays. However, if you have C-Line boards, these must be connected to Port 4. If your C-Line slave boards do not have RJ45 sockets but are interconnected via a flat ribbon cable, you will need a separate "L-Line RJ45-ribbon cable" (800302) adapter for this purpose. For C-Line boards, the current sensor and relays must be connected via their own adapter and cannot share the same flat ribbon cable.

If your system uses a charger that does not have a control interface, you do not need to change the wiring for the charging relay. However, if you use a controllable charger such as the ICharger, you will need an "RJ45-ICharger" adapter for control. The functionality of the CAN-Box, which controlled the charger for the BMS V3, is now integrated directly into the V3. Therefore, the CAN-Box is redundant and can be removed from the system. Use the adapter to connect the ICharger directly to the BMS V3 via CAN-H and CAN-L on Port 5. Here too, you will need an additional LAN cable.

If your system is used in electromobility, it has a supply board that separates the power supply of the 12V battery and the power supply when charging. The V2 supply board provided voltage to the flat ribbon cable, which in turn powered the BMS V2 and other components. In contrast, the BMS V3 has a direct power connection via two screw terminals. It supplies the connected components through Ports 4 and 6 with the required power. For optimal installation, you should replace the supply board and connect the power directly through two separate conductors to the BMS V3. If no other ports of the BMS V3 are to be used, i.e., no Universal Relays V3 and no function via Port 3, it is possible to power the BMS through Port 6. This is only possible if no C-Line sub-boards are used.

In this exceptional case, the power supply can be introduced via the existing supply board onto the flat ribbon cable and transferred to the BMS V3 via the "L-Line RJ45-ribbon cable" (800302) adapter.

13. Problem solving

If your BMS system has an error, there are two possible sources of the problem. The first is the construction and connection of the components together. The second relates to incorrect or missed settings within the BMS.

- If individual cells in an existing system are not functioning or if a cell is not recognized during addressing, you can check the following points:
    1. Check the cell voltages: If the cell voltage is below 2.5V, communication problems may arise. A too low cell voltage should be avoided for all battery types (LiFePO, NMC, etc.). Always refer to the battery manufacturer's datasheet for specific guidelines.
       Special case: If errors such as cell dropout or undervoltage occur consistently in the lower voltage range, for example when significant current is drawn from a nearly empty battery, it may be due to the voltage drop occurring. Immediate action is necessary to protect the batteries from irreversible damage.

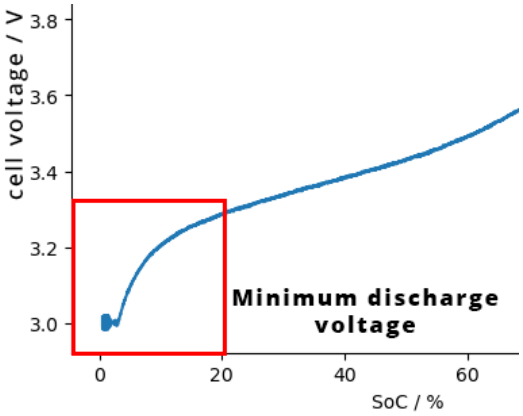
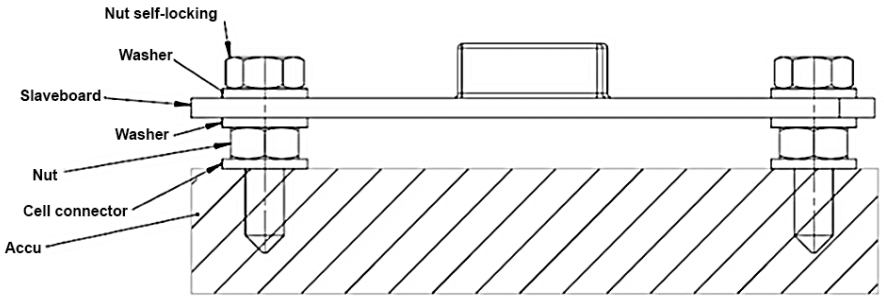


Figure 14 Minimum discharge voltage Li-Ion 3.6V

As shown in Figure 14, the cell voltage drops significantly in the lower voltage range. This behavior intensifies with increased energy or current draw from the battery. For Lithium Iron Phosphate (LiFePO4) batteries, this voltage range is typically <2.7V and is even more pronounced.

2. Micro Match Connector: If a crimping tool was used without a proper crimping template or if the tool lacks parallel guidance, it can lead to short circuits or areas with poor contact. Improperly crimped connectors can deform the socket over time, potentially causing issues. To avoid these problems, please use the crimping template provided by us along with a Knipex pliers wrench 86 05 250 or an equivalent tool.

3. Assembly Error Between Slave Board and Battery: When mounting the slave board onto the battery, it is crucial to use a spacer between the boards and the cell connectors. This can be achieved by using a nut and a washer between the board and the cell connector.



Without the spacer, scratches can occur in the board's coating, potentially leading to short circuits within the board.
Polarity: The slave boards have polarity markings for their connection to the battery. These are marked with + for VDD and - for VSS/GND. Connecting the board to the battery with reversed polarity will lead to damage shortly after connection. Unfortunately, this cannot be prevented by safety mechanisms as they would interfere with voltage measurements. This error typically manifests with visible burn marks on the board.

4. If sporadic errors such as cell or current sensor failures occur after installation and addressing, especially during system operation, this is often due to the length and positioning of the ribbon cable. The ribbon cable is an unshielded conductor susceptible to electromagnetic interference (EMI), which can be generated by current flow in parallel cables or from devices like chargers and motor controllers. Therefore, we recommend separating the signal cables from the slave boards to the BMS from the power-carrying cables. For longer distances (>1.5m), a shielded conductor should be used. An adapter board for a LAN cable can facilitate this, as LAN cables inherently provide shielding. If using a ribbon cable, a separate shielding should be applied. A ferrite ring can offer partial mitigation, but complete shielding effectiveness requires shielding the entire cable.

- Problems due to incorrect or incorrect settings
    1. The BMS features a tutorial that automatically runs during setup, requiring basic information about the system. Incorrect or imprecise entries during this setup can lead to inaccurate results in the BMS. One of the common issues is related to the State of Charge (SOC) display, which represents the current battery charge level and relies on a current sensor for calculation. During setup, you're prompted to enter the usable capacity, which differs from the total capacity. Configuring an battery for longevity alters the maximum charge and discharge voltages from the battery's upper limits. For lithium-ion batteries with a nominal voltage of 3.6V, it's advisable to set an SOC range of 20% to 80% of the actual battery capacity. This can be adjusted in the BMS by not setting the lowest discharge voltage and maximum charging voltage (shunt voltage) to the maximum limits. By doing so, the BMS utilizes only 60% of the battery's actual capacity. When the voltage settings and the setting for usable battery capacity don't align, the displayed SOC can be higher than the actual charge level. (See instructions in Chapter 8.3)
    2. If the BMS shows current flow during your system's idle state, it could be due to a faulty zero-point calibration. For L-Line current sensors, you can easily perform a calibration while the system is idle and no current is actually flowing.
       (System Settings ⇾ Calibrate Current Sensor)
    3. If the displayed current flow is always in the opposite direction than expected, your current sensor might either be installed in the "wrong direction" or the flow direction has been reversed in the BMS.
       (System Settings ⇾ Calibrate Current Sensor ⇾ Reverse Current Sensor can be adjusted at any time.)
    4. If you feel that settings you've made aren't being displayed or applied, please perform the "Display Synchronize" function under System Settings ⇾ Advanced Settings. If there's a discrepancy between touchscreen input and the resulting action, you can calibrate the display in Display Settings.

14. Comments and notes

If you have any further questions or comments, you can reach us during our phone support hours or send us an email inquiry. For expert advice and consultation, you can contact us using the provided contact information.

When contacting our support team for assistance with your system, please have the following information ready:

- Customer number or order number
- BMS Masterunit serial number
  - Located on the back or accessible via the display (Main Menu → System Info)
- General information about your system
  - Type of battery used
  - Installed slave boards
  - Presence of a current sensor (Yes/No) and details if applicable
- PV storage (e.g., Victron system)
  - Access may require VRM portal from Victron
  - For other systems, details about inverters, MPPTs, etc., may be necessary
- Vehicle information
  - Total system voltage
  - Type of charger used
  - System configuration

Having these details readily available will help expedite and streamline our support process, ensuring we can assist you effectively with any questions or issues you encounter.

To the contact form:

Contact