Smart BMS CL 12-100

Battery Management System

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1. Safety precautions

⚠️
- Installation must strictly follow the national safety regulations in compliance with the enclosure, installation, creepage, clearance, casualty, markings and segregation requirements of the end-use application.

- Installation must be performed by qualified and trained installers only.

- Carefully study the product manuals of all connected devices before installing them.

- Switch off the system and check for hazardous voltages before altering any connection.

- Do not open the lithium battery.

- Do not discharge a new lithium battery before it has been fully charged first.

- Charge a lithium battery only within the specified limits.

- Do not mount the lithium battery upside down or on its sides.

- Check if the lithium battery has been damaged during transport.

2. Introduction

2.1. General description

The Smart BMS CL 12-100 is an all-in-one battery management (BMS) system for Victron Lithium Battery 12,8V Smart batteries available with a nominal voltage of 12.8V in various capacities. This is the safest of the mainstream lithium battery types. The maximum number of batteries in one system is 20, which results in a maximum energy storage of 84kWh in a 12V system. It has been specifically designed for 12V systems with a 12V alternator such as in vehicles and boats.

It monitors and protects each individual battery cell within the battery (or battery bank) and will disconnect the alternator, charge sources or DC loads in case of low/high battery cell voltage, or high temperature.

A dedicated alternator input provides current limiting and one-way traffic from the alternator into the battery, this so any size alternator (and starter battery) can be safely connected to the lithium battery. The Charge Current Limiter protects the alternator against overload.

The BMS is also equipped with a Remote on/off terminal to turn the BMS (and the system) off via a remote switch, and a pre-alarm contact to give a warning signal before the BMS will disconnect the batteries from the system. Configuration, monitoring and control is done via Bluetooth and the VictronConnect app. This includes Instant Readout, which allows key values to be read out in real time without the need to connect to the BMS, enabling diagnostics at a glance.

2.2. Features and functionality

Alternator/Starter Batt+ port alternator and battery protection

The input current on the Alternator/Starter Batt+ port is electronically limited to approximately 90% of the fuse rating. A 100A fuse, for example, will therefore limit the input current to approximately 90A. (For fuse ratings and corresponding current limit please see the table in the Installation chapter [9]).

Current can flow to the lithium battery only if the input voltage (corresponds to the voltage of the starter battery) exceeds 13V. In addition, no current can flow back from the lithium battery to the starter battery, which prevents the lithium battery from being deeply discharged.

Choosing the right fuse will also:

1. Protect the lithium battery against excessive charge current (important in case of a low capacity battery).

2. Protect the alternator against overload in case of a high capacity lithium battery bank (most 12V alternators will overheat and fail if running at maximum output during more than 5 minutes).

Remote on/off terminal

• The Remote on/off terminal can be used to disable alternator charging while the BMS functionality will remain active regardless of the remote on/off state.

• Depending on the Remote on/off function setting made via the VictronConnect app, it can also be used as system on/off switch (Charge and Load disconnect port will also be disabled) either by using a physical switch or a relay contact between L and H terminal or by using the soft switch in the VictronConnect app. Alternatively, terminal H can be switched to battery plus, or terminal L can be switched to battery minus.

> Note that it is mandatory to install either an on/off switch between L and H of the remote on/off terminal or the wire loop (default) for correct operation. Alternatively, terminal H can be switched to battery plus or terminal L to battery minus.

LED indicators

• The BMS has a number of LED indicators that show the status of the BMS and the various inputs and outputs. See Appendix C [17] for a complete overview of all LED indicators.

Lithium battery protection

• Excessive input voltage and transients are regulated down to a safe level.

• The Smart BMS will stop charging in case of cell over voltage or over temperature.

• It has three outputs, similar to the smallBMS:

1. **Load disconnect**

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- Can be used to control the remote on/off input of a BatteryProtect, inverter, DC-DC converter or other loads that have remote on/off port functionality.

- Normally the Load disconnect output is high and becomes free-floating when cell undervoltage is imminent (default 2.8V, adjustable in battery). Maximum current: 10mA

2. **Pre-alarm**

- The pre-alarm output can be used to issue a visible or audible warning when the battery voltage is low and will trip with a minimum delay of 30 seconds before the Load disconnect output is disabled due to cell undervoltage.

- The output may be used to drive a relay, LED or Buzzer and can be configured as continuous or intermittent signal.

- Its output is normally free floating and becomes high in case of imminent cell undervoltage (default 3,1V, adjustable in battery). Maximum current: 1A (not short circuit protected).

3. **Charge disconnect**

- The Charge disconnect output can be used to control the remote on/off port of a charger, such as the Phoenix Smart Charger IP43, a Cyrix-Li-Charge relay, a Cyrix-Li-ct Battery Combiner or a BatteryProtect. Note that the Charge disconnect output is not suitable to power an inductive load such as a relay coil.

- The output is normally high and becomes free floating in case of imminent cell overvoltage or overtemperature. Maximum current: 10mA

> In some cases an interface cable such as a non-inverting or inverting on/off cable may be required, see Appendix A [13].

Setup, configuration and monitoring via VictronConnect

- Initial setup, configuration, monitoring and diagnostics of the BMS is done via Bluetooth and the VictronConnect app.

- This includes Instant Readout; a way to view key BMS parameters in real time without having to pair with the BMS.
  The advantage is:

  - Better range than a regular Bluetooth connection

  - The key data at a glance

  - Encrypted data

  - Visual notifications of warnings, alarms and errors

  - This feature is available for a large number of other Victron smart products

2.3. What's in the box

- Smart BMS CL 12-100

- Ground wire with 10mm eye terminal

- 2-pin plug with pre-installed wire loop

- 3-pin plug for load/charge disconnect and pre-alarm

- Megafuse 100A pre-installed

- ATO fuse holder with 2x 7.5A fuse

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3. Installation and configuration

3.1. Important warning and note

⚠️ Lithium batteries are expensive and can be damaged due to over discharge or over charge.

The shutdown due to low cell voltage by the BMS should always be used as a last resort to be on the safe side at all times. We recommend not letting it get that far in the first place and instead either shutting down the system automatically after a defined state of charge (this can be done with a BMV whose relay can control the remote on/off port of the BMS via an adjustable SoC value) so that there is always enough reserve capacity in the battery, or to use the remote on/off function of the BMS as a system on/off switch.

Damage due to over discharge can occur if small loads (such as: alarm systems, relays, standby current of certain loads, back current drain of battery chargers or charge regulators) slowly discharge the battery when the system is not in use.

In case of any doubt about possible residual current draw, isolate the battery by opening the battery switch, pulling the battery fuse(s) or disconnecting the battery plus when the system is not in use.

A residual discharge current is especially dangerous if the system has been discharged completely and a low cell voltage shutdown has occurred. After shutdown due to low cell voltage, a capacity reserve of approximately 1Ah per 100Ah battery capacity is left in the battery. The battery will be damaged if the remaining capacity reserve is drawn from the battery, for example, a residual current of just 10mA can damage a 200Ah battery if the system is left discharged for more than 8 days.

Immediate action (recharge the battery) is required if a low cell voltage disconnect has occurred.

📝 Note that Smart BMS CL units manufactured up to and including ba number HQ2109 (check the SN number on the back of the BMS) are powered from the ALTERNATOR/STARTER BAT port. Units made after that will be powered by the Li-ION port.

3.2. Things to consider

3.2.1. Controlling DC loads via Load disconnect

• DC loads must be switched off or disconnected if there is a risk of cell undervoltage in order to prevent deep discharge. The Load disconnect output of the Smart BMS can be used for this purpose.

• The Load disconnect output is normally high (equal to battery voltage) and becomes free floating (= open circuit) in case of imminent cell undervoltage.

• DC loads with a remote on/off terminal that switches the load on when the terminal is pulled high (to battery plus) and switches it off when the terminal is left free floating can be controlled directly with the Load disconnect output. See Appendix A [13] for a list of Victron products with this behavior.

• For DC loads with a remote on/off terminal that switches the load on when the terminal is pulled low (to battery minus) and switches it off when the terminal is left free floating, the **Inverting remote on-off cable** can be used. See Appendix A [13].

Note: please check the residual current of the load when in off state.

3.2.2. Controlling DC loads with a BatteryProtect

A BatteryProtect will disconnect the load when:

• The input voltage (= battery voltage) has fallen below a preset value (adjustable in BatteryProtect) or when

• the remote on/off terminal is pulled low. The Smart BMS can be used to control the remote on/off terminal of a BatteryProtect.

### 3.2.3. Controlling a battery charger via Charge disconnect

• Battery chargers must interrupt the charging process in case of imminent overvoltage or overtemperature of the cells. The Charge disconnect output of the Smart BMS can be used for this purpose.

• The Charge disconnect is normally high (equal to battery voltage) and switches to open circuit state in case of imminent cell overvoltage.

• Battery chargers with a remote on/off terminal that activates the charger when the terminal is pulled high (to battery plus) and deactivates when the terminal is left free floating can be controlled directly with the Charge disconnect output. See the Appendix A [13] for a list of Victron products with this behavior.

• Alternatively, a **Cyrix-Li-Charge** can be used. The Cyrix-Li-Charge is a unidirectional combiner that inserts in between a battery charger and the lithium battery. It will engage only when charge voltage from a battery charger is present on its charge-side terminal. A control terminal connects to the Charge disconnect of the Smart BMS.

3.2.4. Multiple batteries in parallel configuration

• In case of multiple batteries in parallel configuration, the two M8 circular connector cord sets of each battery must be connected in series (daisy chained). Connect the two remaining cords to the BMS port.

3.3. System examples

Below you will find a selection of system examples. Note that there are many other possibilities. It is mandatory to study Appendix A [13] as there can be different types of cable interfaces within a product group to control chargers, inverters and inverter/chargers from the Load and Charge disconnect outputs of the BMS.
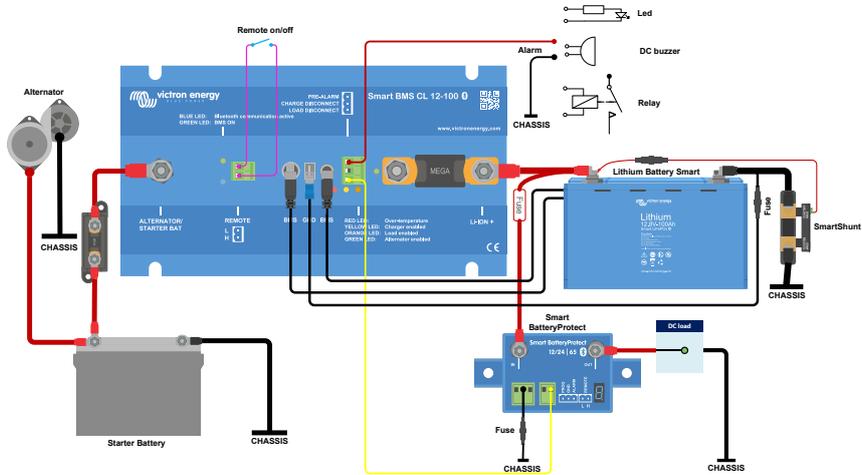

Application example for a vehicle or boat with Smart BatteryProtect

A Smart BatteryProtect protects the lithium battery from further discharge by DC loads when the cell voltage is low. It is controlled via the Load disconnect output of the BMS. The state of charge of the lithium battery can be monitored via a SmartShunt.
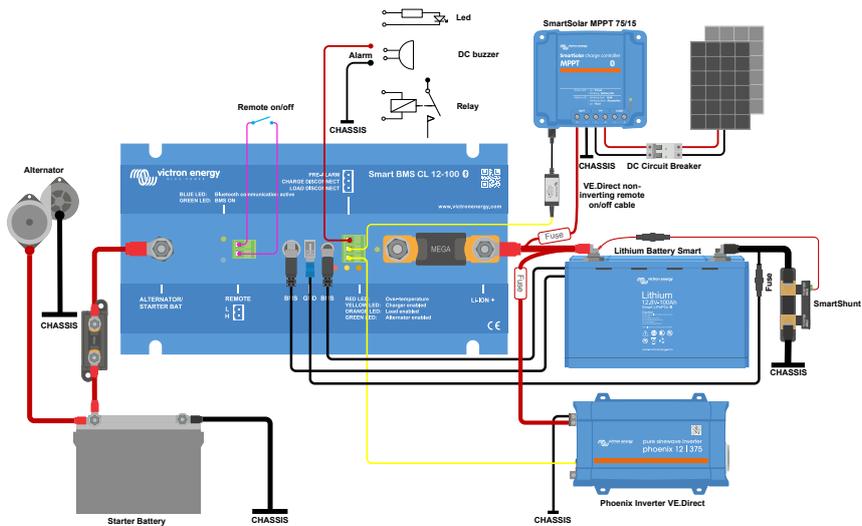
Application example with MPPT and Phoenix inverter

In this example, a SmartSolar MPPT 75/15 is controlled via a VE.Direct non-inverting remote on/off cable from the Charge disconnect output of the BMS. The Load disconnect output of the BMS, on the other hand, controls the remote H input of a Phoenix VE.Direct inverter and deactivates further discharging of the lithium battery if the cell voltage is too low. The SmartShunt monitors the state of charge of the lithium battery.
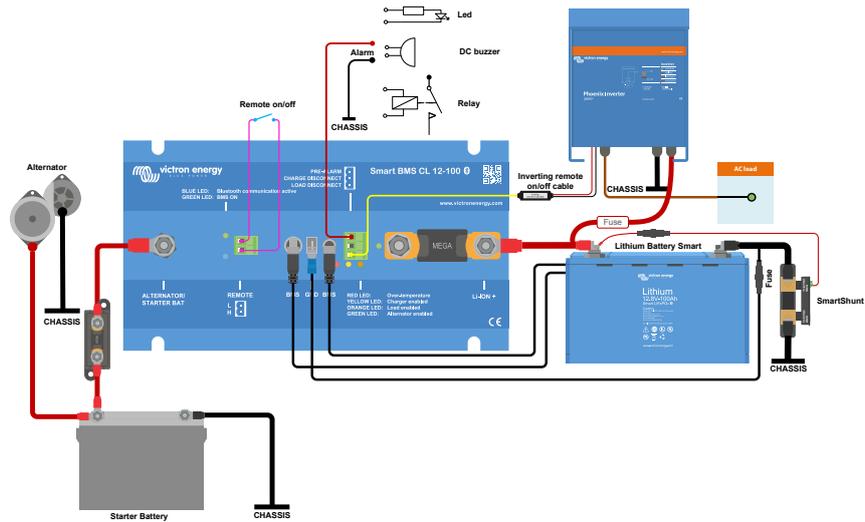
Application example with Phoenix VE.Bus Inverter rated at 3kVA and more

This VE.Bus Inverter needs an inverting remote on/off cable to be controlled by the Load disconnect output of the BMS. The SmartShunt provides information about the state of charge of the lithium battery.
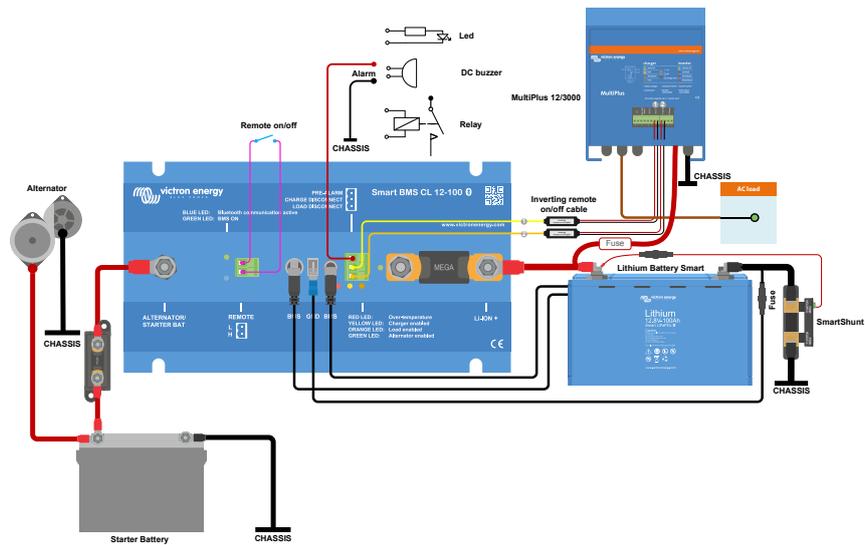
Application example with 3kVA Multi of a recent type that has auxiliary inputs

Larger inverter/chargers, like this MultiPlus 12/3000, require two inverting remote on/off cables, one to control the Multi's charging function via the Charge disconnect output and one to control the Multi's inverter via the Load disconnect output of the BMS. For the above system, the Multi must be of a newer type that has auxiliary inputs. This requires additional configuration. For more information please see the document Manual connecting lithium battery systems to Multis.

3.4. Installation

Before installation, make proper system design considerations to avoid unnecessary connections and to keep cable lengths as short as possible. See also the System examples [7] chapter.

1. Preferably mount the Smart BMS on a vertical surface for optimal cooling.

2. Determine the rating of Alternator/Starter Bat+ port fuse. The fuse doubles as a shunt, thus the Smart BMS will limit the input current according to the rating of this fuse. For fuse and corresponding current limit please see the table below.

3. Choosing the right fuse will prevent overheating of the alternator and/or DC cabling.

4. Disconnect the cabling from the minus pole of the starter battery.

5. Pull off the remote on/off connector to prevent unwanted switching of the Smart BMS.

6. Install and connect fuses and all electrical wiring, leaving the negative poles of the lithium batteries and the starter battery disconnected. Connect the starter battery positive to the Alternator/Starter Bat+ terminal and the lithium battery positive to the Li-Ion+ terminal. Make sure the M8 nuts of the fuse are tight (**mounting torque: 10 NM)**.

7. Daisy chain the battery control cables between the lithium batteries and connect the ends to the BMS port. To extend the communication cables between a Lithium Battery Smart and the BMS, use the M8 circular connector Male/Female 3 pole cable extensions.

8. Connect the supplied GND cable to the negative of the lithium battery and the starter battery. Note that the supplied GND cable **must** be protected accordingly. Depending on the application a fuse between 300mA and 1.3A is required. Use the specifications [12] to determine the expected power consumption of the Smart BMS using Load and Charge disconnect and the pre-alarm output. This value multiplied by 1.25 determines the value of the fuse to be used. Example: Current consumption 16mA + Load disconnect output 10mA + Charge disconnect output 10mA + pre-alarm output 1A = 1036mA x 1.25 = 1.3A fuse rating.

9. Reinsert the remote on/off connector on the Smart BMS. It is mandatory to install either an on/off switch between L and H of the remote on/off terminal or the wire loop (default) for correct operation.

10. The Smart BMS is now ready for use.

Fuse rating	Max alternator charge current
125A	100A
100A	90A
80A	60A
60A	50A
2 x 30A	40A
2 x 20A	25A
2 x 15A	20A
2 x 10A	12A
2 x 7.5A	9A

If the required alternator charge current is less than 40A, please use the supplied ATO fuse holder with an appropriate ATO fuse pair according to the table.
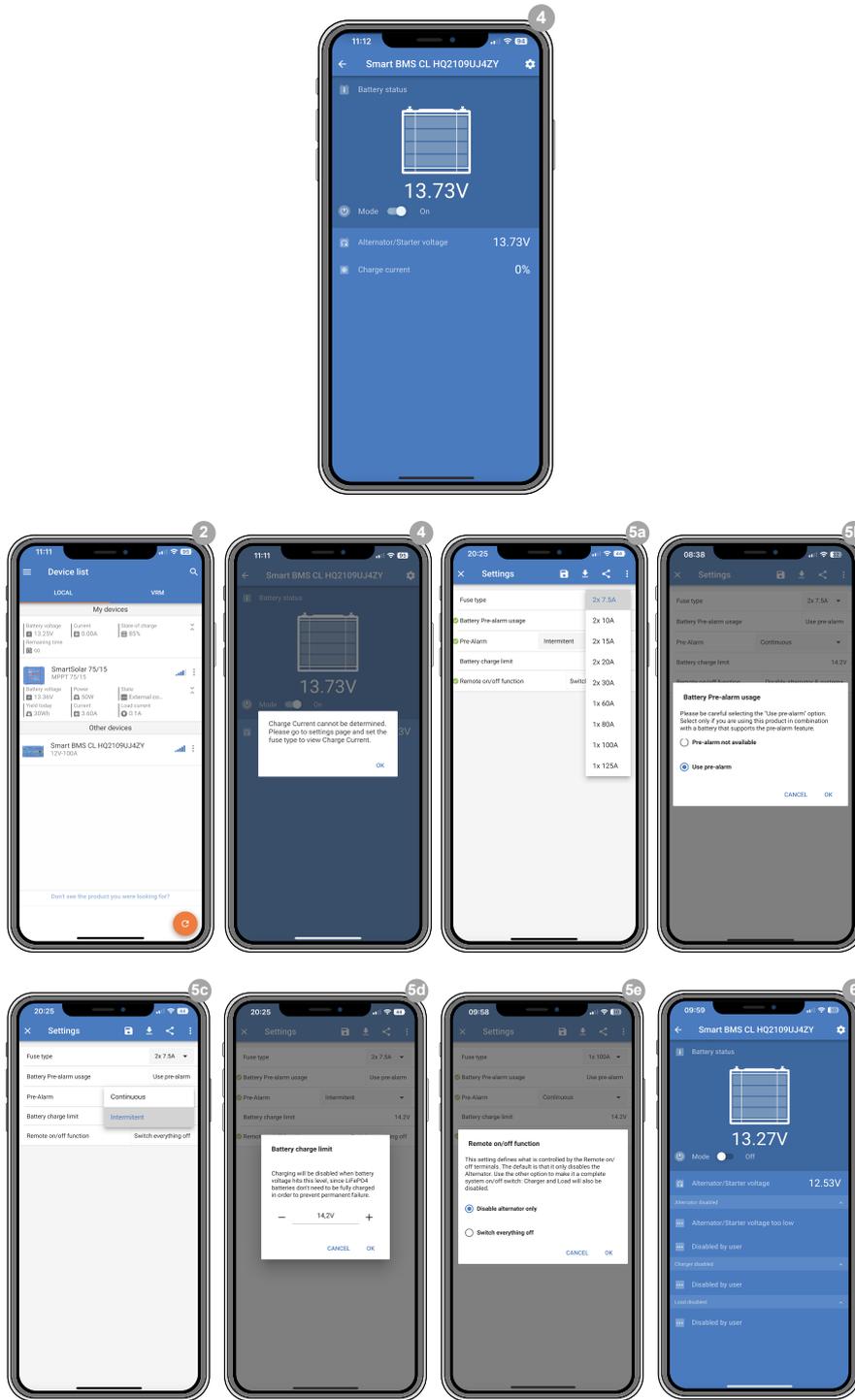
3.5. Configuration

3.5.1. Smart BMS settings

The Smart BMS is configured via Bluetooth and the VictronConnect app. See the VictronConnect manual for download and installation details. The following steps describe the configuration process and options:

1. Power up the Smart BMS according to the Installation chapter [9].

2. Open VictronConnect. The Smart BMS will appear on the Device list either under My devices or Other devices (the latter when connecting for the first time).

3. Tap on the Smart BMS. The pairing dialogue will start (default PIN code is 000000).

4. Once connected, the Battery status page is displayed, showing the lithium battery voltage, the soft switch state, Alternator/ Starter voltage and alternator charge current percentage, followed by BMS status messages. When connecting for the first time, a pop-up message appears asking you to set the fuse type in the Settings menu to also be able to see the charge current (in percentage).

5. Tap the cog wheel in the top right to open the Settings menu and set the following:

    1. **Fuse type:**

        Set the correct fuse type rating as explained in the Installation chapter [9]. Make sure it matches with the physically installed fuse.

    2. **Battery Pre-alarm usage:**

        In case of a lithium battery without pre-alarm feature, change the Battery Pre-alarm usage to 'Pre-alarm not available', otherwise leave the default setting 'Use pre-alarm'.

    3. **Pre-alarm:**

        Choose between continuous and intermittent pre-alarm.

    4. **Battery charge limit:**

        Set the Battery charge limit (range: 13.0V..15.3V) to a value at which charging should be deactivated. Normally this value should be 14.2V for a Victron Lithium Battery Smart. As soon as this value is reached, charging of the battery is interrupted via the Alternator/Starter Batt+ and System+ inputs. The inputs will turn on again when the battery voltage is 0.5V below the battery charge limit for 10 (consecutive) seconds.

    5. **Remote on/off function:**

        This setting defines what is controlled by the Remote on/off terminals. The default is that it only disables the Alternator.

        Options are:

        Disable alternator: Disable charging via the Alternator port. The BMS functionality is retained.

        Switch everything off: Everything, including the BMS functions, is switched off. This option is suitable as an on/off switch for the system. Note that the BMS continues to consume energy from the battery to maintain the remote control function, albeit less than 0.01W. But this adds up over time and can completely drain the battery in the long run. Therefore, make sure that the battery is completely disconnected from the system if you leave it to its own for a longer period of time.

6. The configuration of the Smart BMS is now complete and the status is displayed. Depending on the system status, additional information is shown.

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3.5.2. VictronConnect status display

4. Specifications

Smart BMS CL 12-100	
Alternator port - max charge current	100A (with a 125A fuse)
Input voltage to start charging	>13A
Current consumption, remote on	16mA (excluding Load output and Charge output current)
Current consumption, remote off	5mA (BMS functionality still active)
Load disconnect output	Normally high (Vbat – 0.1V) Source current limit: 10mA (short circuit protected) Sink current: 0A (output free floating)
Charge disconnect output	Normally high (Vbat – 0.1V) Source current limit: 10mA (short circuit protected) Sink current: 0A (output free floating)
Pre-alarm output	Normally free floating High (Vbat) in case of alarm, max. 1A (not short circuit proof)
System on/off: Remote L and Remote H	Use modes: 1. ON when the L and H terminal are interconnected 2. ON when the L terminal is pulled to battery minus (V < 5V) 3. ON when the H terminal is high (V > 3V) 4. OFF in all other conditions
GENERAL	
Operating temperature range	-40°C to +60°C
Humidity, maximum / average	100% / 95%
Protection, electronics	IP65
DC power connection	M8
Mounting torque	10Nm
DC connector battery minus	Faston female, 6.3mm
ENCLOSURE	
Weight	1.6 kg
Dimensions (hxwxd)	65 x 120 x 224 mm
STANDARDS	
Emission	EN 61000-6-3, EN 55014-1
Immunity	EN 61000-6-2, EN 61000-6-1, EN 55014-2
Automotive Directive	ECE R10-5

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5. Appendix

5.1. Appendix A

1. **Loads which can be controlled directly by the Load disconnect output of the Smart BMS:**

    • **Inverters:**

    All Phoenix inverters VE.Direct and Phoenix Inverters Smart. Connect the Load disconnect output of the BMS to terminal H of the 2-pole connector of the inverter.

    • **DC-DC converters:**

    All Tr type DC-DC converters with remote on/off connector and Orion 12/24-20. Connect the Load disconnect output of the BMS to the right hand terminal of the 2-pole connector.

    • **BatteryProtect and Smart BatteryProtect:**

    Connect the Load disconnect output of the BMS to terminal 2.1 (right hand terminal) for the BatteryProtect and H pin of the 2-pole connectorfor the Smart BatteryProtect.

    • **Cyrix-Li-Load:**

    Connect the Load disconnect output of the BMS to the control input of the Cyrix.

2. **Loads for which an inverting remote on-off cable is needed (article number ASS030550100 or -120):**

    • **Phoenix VE.Bus inverters and VE.Bus Inverter Compact rated at 1200VA or more**

3. **Solar charge controllers which can be controlled directly by the Charge disconnect output:**

    • **BlueSolar MPPT 150/70 and 150/80 CAN-bus:**

    Connect the Charge disconnect output of the BMS to the left hand terminal of the 2-pole connector (B+).

    • **SmartSolar MPPT 150/45 and higher, 250/60 and higher**

    Connect the Charge disconnect output of the BMS to the **right** hand terminal (marked +) or the **left** hand terminal (marked H) of the 2-pole connector.

4. **Solar charge controllers for which a VE.Direct non-inverting remote on-off cable is needed (article number ASS030550320):**

    • **BlueSolar MPPT models except the BlueSolar MPPT 150/70 and 150/80 CAN-bus**

    • **SmartSolar MPPT up to 150/35**

5. **Battery Chargers:**

    • **Phoenix Smart IP43 Chargers:**

    Connect the Charge disconnect output of the BMS to terminal H of the 2-pole connector.

    • **Skylla TG battery chargers:**

    Use a non-inverting remote on-off cable (article number ASS030550200).

    • **Skylla-i battery chargers:**

    Use a Skylla-i remote on-off cable (article number ASS030550400).

    • **Other battery chargers:**

    Use a Cyrix-Li-Charge or connect the charger to the primary side of the Smart BMS.

6. **MultiPlus:**

    • **MultiPlus 500VA – 1600VA & MultiPlus Compact 800VA – 2kVA**

These MultiPlus models can be controlled from the Load Disconnect and Charge Disconnect outputs by using the Smart BMS CL 12/100 to MultiPlus cable (article number ASS070200100). This cable must be wired to the remote on/off connector of the MultiPlus:

- When used with the MultiPlus 500VA-1200VA models, connect the black wire to the ON terminal and the red wire to the (+) terminal.

- When used with the MultiPlus 1600VA model, connect the black wire to the left terminal and the red wire to the right terminal.

- When used with the MultiPlus Compact 800VA-2kVA models, connect the black wire to the middle terminal and the red wire to the right (IN) terminal.

Both, the Load disconnect and Charge disconnect outputs of the BMS, must be in 'High' state in order for the MultiPlus to operate. After shutdown due to low battery voltage, run the alternator or use a battery charger on the primary side of the BMS to reset the system. The MultiPlus will then switch on and start charging (if connected to an AC power source).

- **MultiPlus-II and MultiPlus 3kVA or more**

  For more info on how to configure the MultiPlus to work with the Smart BMS CL 12-100 please refer to the document on our website: https://www.victronenergy.com/upload/documents/Manual-Connecting-other-lithium-battery-systems-to-Multis-and-Quattros-EN.pdf

  - The Load disconnect and Charge disconnect outputs will be wired to the MultiPlus with two inverting remote on-off cables (article number ASS030550100) as shown in the System example [7] for the MutliPlus 3kVA.

5.2. Appendix B

Error, Alarm and Warning Codes

E-B30: Calibration failure

Internal malfunction – calibration data failure/missing.

> Contact dealer for support – Fault is not user correctable and Smart BMS requires replacement.

E-B31: Configuration failure

Internal malfunction - configuration data failure/missing.

> To recover the Smart BMS from this condition:
>
> 1. Reset the unit to factory defaults under - Settings > More options > Reset to defaults
>
> 2. Disconnect all power and wait 3 minutes before reconnecting
>
> 3. Reconfigure the unit as required

E-B32: Battery BMS Cable not connected or defect

Detached or defect battery BMS cable (with M8 circular connector) detected.

When BMS cables are neither detached nor defect, this can happen when the pre-alarm feature is enabled while using batteries not supported this feature.

> 1. Check if battery supports pre-alarm feature. If not:
>
> 2. Go to Settings page and disable pre-alarm feature.

Note that for Smart BMS devices with firmware v1.08 and later, BMS cable error detection has been removed. For these devices, the error message is no longer displayed.

E-B33: Reference Voltage failure

Internal malfunction - reference voltage failure/missing.

> Contact dealer for support - Fault is not user correctable and Smart BMS requires replacement

A-B11: Undervoltage

Undervoltage protection is activated in the event that the battery does not allow discharge.

> 1. Switch off/disconnect loads and recharge the battery
>
> 2. Check charging system and battery for proper operation

A-B15: Over temperature

Over temperature protection is activated in the event of excessive internal temperature.

> 1. Make sure that the correct fuse rating has been selected. Choosing the right fuse will also prevent overheating of the alternator and/or DC cabling.
>
> 2. Check for loose/high resistance connections and ensure that appropriate gauge wiring is used in the installation.
>
> 3. Do not install the Smart BMS unit in a location exposed to high temperature or radiant heat. Relocate the Smart BMS to a cooler position or provide additional active cooling.

W-B12: Undervoltage warning

Urgent intervention required to prevent system shutdown.

1. Switch off/disconnect loads and recharge the battery.

2. Check charging system and battery for proper operation.

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5.3. Appendix C

LED indicators (from left to right)

1. Green: Smart BMS is active

2. Blue: blinking – Bluetooth broadcasting, ON – connection established

3. Red: Over-Temperature protection of the Smart BMS

4. Yellow: Charge disconnect output is enabled

5. Orange: Load disconnect output is enabled

6. Green: Alternator charging
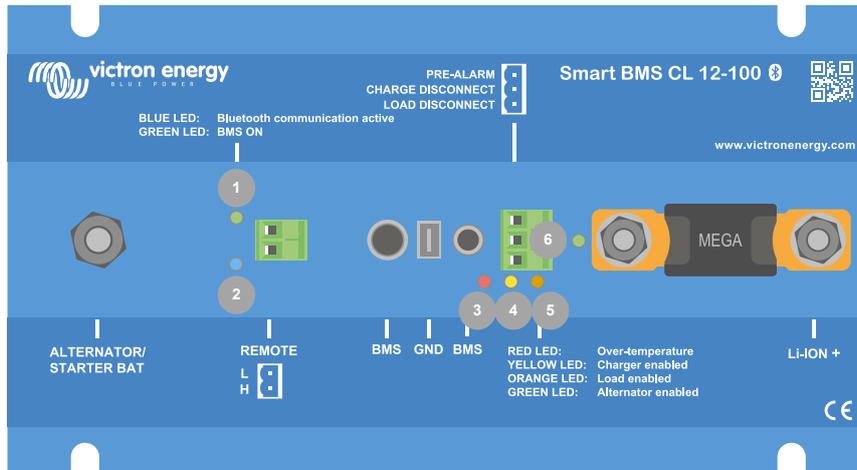
5.4. Dimensions Smart BMS CL 12-100