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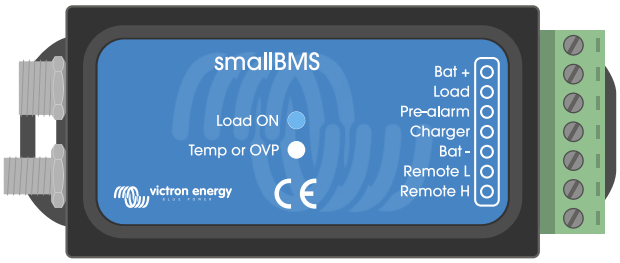


smallBMS with pre-alarm

rev 02 - 01/2023

This manual is also available in HTML5.

Table of Contents

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 smallBMS with pre-alarm is an all-in-one Battery Management System (BMS) for Victron Energy Lithium Battery Smart batteries. These batteries are Lithium Iron Phosphate (LiFePO4) batteries and are available in 12.8V or 25.6V in various capacities. They can be connected in series, parallel and series/parallel so that a battery bank can be built for system voltages of 12V, 24V or 48V. The maximum number of batteries in one system is 20, which results in a maximum energy storage of 84kWh in a 12V system and up to 102kWh in a 24V and 48V system.

To reduce required balancing time, we recommend to use as little different batteries in series as possible for the application. 24V systems are best built using 24V batteries. And 48V systems are best built using two 24V batteries in series. While the alternative, four 12V batteries in series, will work, it will require more periodic balancing time.

For more information on these batteries, visit the Lithium Smart Battery product page.

The smallBMS is a simple and inexpensive alternative to the VE.Bus BMS, but does not have a VE.Bus interface and is therefore not suitable for use with VE.Bus MultiPlus and Quattro inverter/chargers.

2.2. Features and functionality

- **Load Disconnect output**
  - Can be used to control the remote on/off input of a BatteryProtect, Inverters, 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 output current: 1A (not short circuit protected).

    Note that a non inverting or inverting on/off cable may be required, please consult Appendix A [11].
- **Charge disconnect output**
  - 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
- **Remote on/off terminal**
  - Both the Load and Charge disconnect output can be controlled remotely via the remote on/off terminal. When off, both outputs will be free floating so that loads and chargers are turned off.
  - The remote on/off consists of two terminals: Remote L and Remote H. A remote on/off switch or relay contact can be connected between L and H. 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.
- **Pre-alarm output**
  - 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.
  - Its output may be used to drive a relay, LED or Buzzer. Maximum current: 1A (not short circuit protected)
  - The pre-alarm output is normally free floating and becomes high in case of imminent cell under voltage (default 3,1V/cell, adjustable in battery).
- **LED indicators**
  - Load ON (blue): Load disconnect output high (cell voltage >2.8V, adjustable in battery).
  - Temp or OVP (red): Charge disconnect output free floating (due to cell over temperature (>50°C), cell under temperature (<5°C) or cell over voltage).

2.3. What's in the box

- smallBMS

3. Installation

3.1. Important warning

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.

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 smallBMS 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 [11] 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 [11].

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 smallBMS 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 cell overvoltage or low/high temperature of the cells. The Charge disconnect output of the smallBMS can be used for this purpose.
- The Charge disconnect output is normally high (equal to battery voltage) and switches to open circuit state in case of imminent cell overvoltage or low/high temperature.
- 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 [11] for a list of Victron products with this behavior.
- Alternatively, a Cyrix-Li-Charge can be used. The Cyrix-Li-Charge is a unidirectional battery 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 smallBMS.

3.2.4. Battery

- In case of several batteries in parallel and or series configuration, the two M8 circular connector cord sets of each battery should be connected in series (daisy chained). Connect the two remaining cords to the BMS.
- Be sure to read and follow the installation instructions in the Lithium Battery Smart manual.

3.3. System examples

3.3.1. smallBMS with SmartSolar Charger and a BatteryProtect for DC loads

The below system example shows a small DC off-grid system. The main components are:

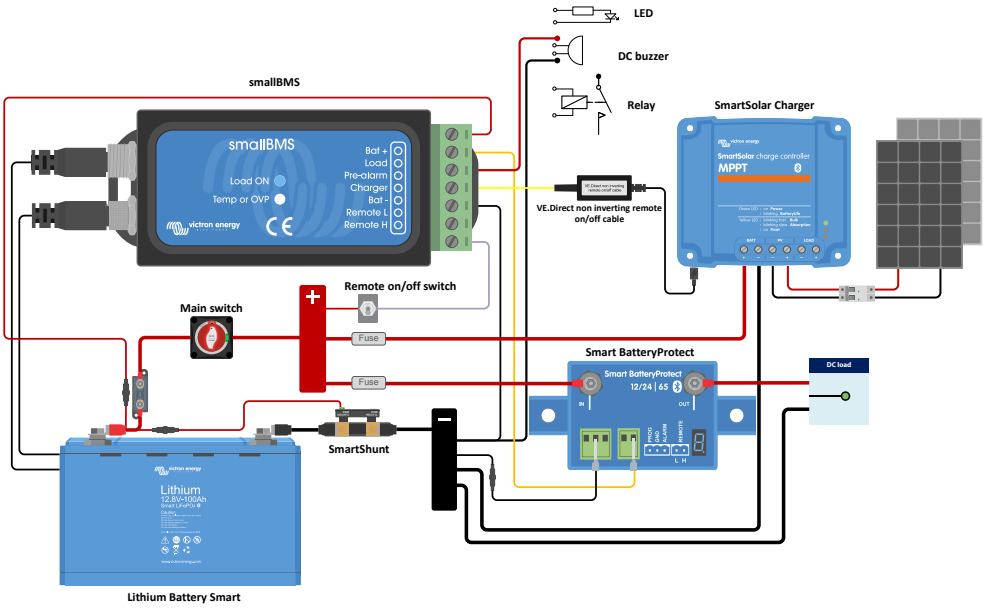
- smallBMS
- 12.8V 100Ah Lithium Battery Smart
- SmartSolar MPPT 75/15
- Smart BatteryProtect 12/24V 65A
- SmartShunt
- VE.Direct non inverting remote on/off cable

The Charge disconnect output controls a SmartSolar Charger via a VE.Direct non inverting remote on/off cable (not necessary with larger MPPTs that have a remote on/off port). In the event of low/high temperature or cell overvoltage, the solar charger will stop charging.

DC loads are controlled via a Smart BatteryProtect. Its remote H input connects to the Load disconnect output of the smallBMS. In the event of a low cell voltage, the Load disconnect output and as a result the remote H input of the Smart BatteryProtect becomes free-floating and disconnects the DC load to prevent further battery discharge.

A remote on/off switch wired between the battery positive busbar and the remote H input of the smallBMS can be used to switch DC loads and chargers off, additionally a Main switch can be used to isolate the positive busbar from the battery.

The SmartShunt connects via Bluetooth to the VictronConnect app on a phone or tablet and you can conveniently read out all monitored battery parameters, like state of charge, time to go, historical information and much more.



3.3.2. smallBMS with Cyrix-Li-ct as a battery combiner

The below system example shows a small DC system in a RV or Boat. The main components are:

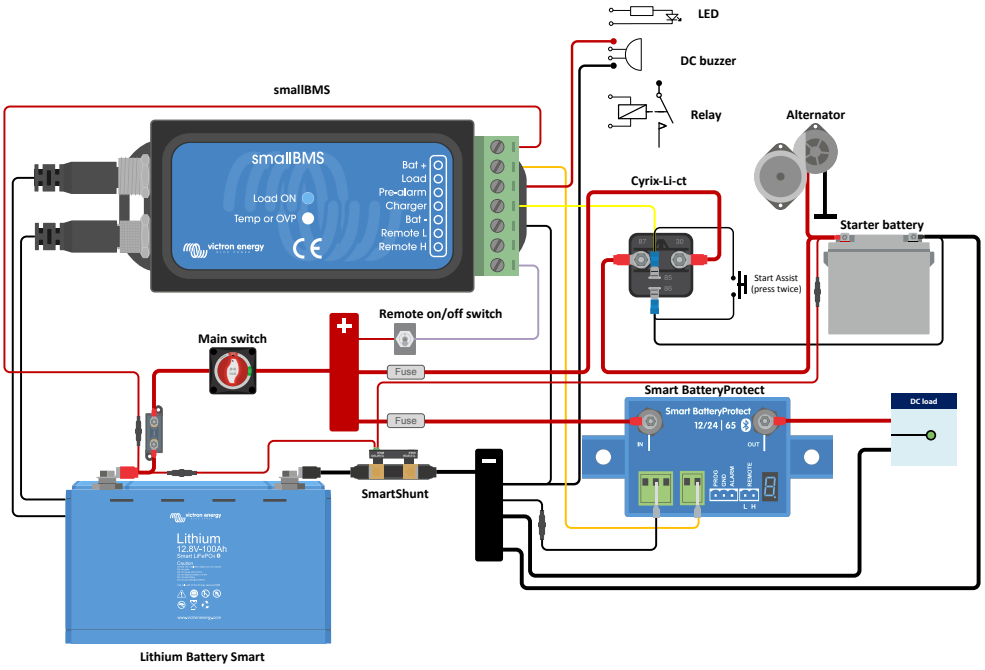
- smallBMS
- 12.8V 100Ah Lithium Battery Smart
- Cyrix-Li-ct
- Smart BatteryProtect 12/24V 65A
- SmartShunt

The Charge disconnect output of the smallBMS controls the BMS charge disconnect input of the Cyrix-Li-ct (pin 85). In the event of low/high temperature or cell overvoltage, the Cyrix-Li-ct will stop charging the lithium battery.

DC loads are controlled via a Smart BatteryProtect. Its remote H input connects to the Load disconnect output of the smallBMS. In the event of a low cell voltage, the Load disconnect output and as a result the remote H input of the Smart BatteryProtect becomes free-floating and disconnects the DC load to prevent further battery discharge.

A remote on/off switch wired between the battery positive busbar and the remote H input of the smallBMS can be used to switch DC loads and chargers off, additionally a Main switch can be used to isolate the positive busbar from the battery.

The SmartShunt connects via Bluetooth to the VictronConnect app on a phone or tablet and you can conveniently read out all monitored battery parameters, like state of charge, time to go, historical information and much more.



3.3.3. smallBMS with Phoenix Inverter

The below system example shows a small DC system. for example, in a Camper. The main components are:

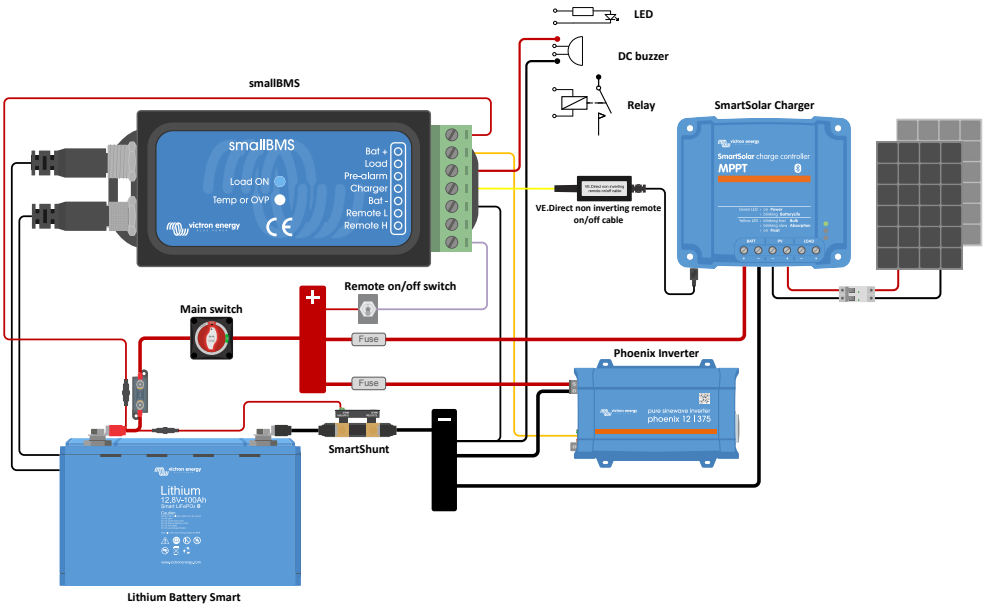
- smallBMS
- 12.8V 100Ah Lithium Battery Smart
- SmartSolar MPPT 75/15
- Phoenix Inverter VE.Direct 12/375
- SmartShunt
- VE.Direct non inverting remote on/off cable

The Charge disconnect output of the smallBMS controls a SmartSolar Charger via a VE.Direct non inverting remote on/off cable (not necessary with larger MPPTs that have a remote on/off port). In the event of low/high temperature or cell overvoltage, the solar charger will stop charging.

A Phoenix Inverter VE.Direct 12/375 allows powering domestic equipment. Its remote H input connects to the Load disconnect output of the smallBMS. In the event of a low cell voltage, the Load disconnect output and as a result the remote H input of the inverter becomes free-floating and disconnects the Phoenix inverter to prevent further battery discharge.

A remote on/off switch wired between the battery positive busbar and the remote H input of the smallBMS can be used to switch DC loads and chargers off, additionally a Main switch can be used to isolate the positive busbar from the battery.

The SmartShunt connects via Bluetooth to the VictronConnect app on a phone or tablet and you can conveniently read out all monitored battery parameters, like state of charge, time to go, historical information and much more.



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 [6] chapter.

1. Preferably mount the smallBMS on a flat surface.
2. Pull off the wire loop of the remote on/off terminal to prevent unwanted switching of the smallBMS.
3. Install and connect appropriate fuses and all electrical wiring, leaving the negative pole of the lithium battery disconnected from the system.
4. 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.
5. Reinsert the wire loop to the remote on/off terminal of the smallBMS. Alternatively install either an on/off switch between Remote L and Remote H or switch Remote H to battery plus, or Remote L to battery minus.
6. Connect the negative pole of the lithium battery to the system.
7. The smallBMS is now ready for use.

4. Specifications

smallBMS with pre-alarm	
Operating voltage (Vbat)	8 - 70Vdc
Power supply cable and fuse (not supplied)	Recommended fuse size 0.3A - 2.5A, dependent on devices connected to Load disconnect and pre-alarm output
Current consumption, remote on	2.2mA (excluding Load and Charge disconnect output current)
Current consumption, low cell voltage	1.2mA
Current consumption, remote off	1.2mA
Load disconnect output	Normally high (Vbat – 0.1V) Source current limit: 1A (not 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 (low) In case of alarm: output voltage Vbat -0.1V Max output current: 1A (not short circuit protected)
Remote 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 < 3.5V) 3. ON when the H terminal is high (2.9V < VH < Vbat) 4. OFF in all other conditions
GENERAL	
Operating temperature range	-20°C to +50°C (0 - 120°F)
Humidity	Max 95% (non-condensing)
Protection, electronics	IP20
ENCLOSURE	
Weight	0.1kg
Dimensions (hxwxd)	106 x 42 x 23 mm
Material and colour	ABS, matt black
STANDARDS	
Safety	EN 60950
Emission	EN 61000-6-3, EN 55014-1
Immunity	EN 61000-6-2, EN 61000-6-1, EN 55014-2
Automotive Directive	Regulation UN/ECE-R10 Rev.4

5. Appendix

5.1. Appendix A

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

   - **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.