ENGLISH

VE.Bus BMS V2

Product manual

Rev 00 06/2022

Table of Contents

1. General description

Protects each individual cell of a Victron Lithium Battery Smart ($LiFePO_4$) battery

Each individual cell of a $LiFePO_4$ battery must be protected against over voltage, under voltage and over temperature. The Victron Lithium Battery 12.8V & 25.6V Smart have integrated Balancing, Temperature and Voltage control (acronym: BTV) and connect to the VE.Bus BMS V2 with two M8 circular connector cord sets. The BTVs of several batteries can be daisy chained. Please see our Lithium Battery Smart product page for details.

The BMS will:

- Generate a pre-alarm signal to warn of an imminent cell undervoltage.
- Shut down or disconnect loads in case of cell undervoltage.
- Turn off the inverter of VE.Bus inverter/chargers in case of cell undervoltage.
- Reduce the charge current in case of cell overvoltage or overtemperature of VE.Bus inverter/chargers or VE.Bus inverters.
- Shut down or disconnect battery chargers in case of cell overvoltage or overtemperature.

Pre-alarm

The pre-alarm output is normally free floating and becomes high in case of imminent cell undervoltage. It is set by default at 3.1V per cell and is adjustable on the battery between 2.85V and 3.15V per cell. The minimum delay between pre-alarm and load disconnect is 30 seconds.

Load Disconnect

The Load Disconnect output is normally high and becomes free floating in case of cell undervoltage. The Load Disconnect output can be used to control:

- The remote on/off terminal of a load.
- The remote on/off terminal of an electronic load switch like a BatteryProtect (preferred low power consumption solution).

Charge Disconnect

The Charge Disconnect output is normally high and becomes free floating in case of cell over voltage or over temperature. The Charge Disconnect output can be used to control:

- The remote on/off terminal of a charger, like an AC charger, DC-DC charger or solar charger.
- A Cyrix-Li-Charge relay.
- A Cyrix-Li-ct Battery Combiner.

LED indicators

The BMS has the following LED indications:

- Status LED (blue):

  Lights shortly approximately once every 10 seconds to indicate normal operation.
- Cell voltage above 4V LED (red):

  Lights when the charge disconnect output is low because of cell overvoltage or overtemperature.
- Cell voltage above 2.8V LED (blue):

  Lights when the load disconnect output is high and the battery cell voltages are above 2.8V.

Connectivity and communication with GX device

- On/off/charger-only control of VE.Bus products via a GX device.
- Control of products connected to the GX device via DVVC.
- The battery pre-alarm is available on the GX device.

Has separate power input and output connections for GX devices

- The GX-Pow output supplies GX power from either the battery or from the Aux-In input. Whichever voltage is higher.
- An AC-DC adaptor or power supply connected to the Aux-In input ensures that the GX device is powered during a low cell state as long as AC is available.

2. Safety precautions

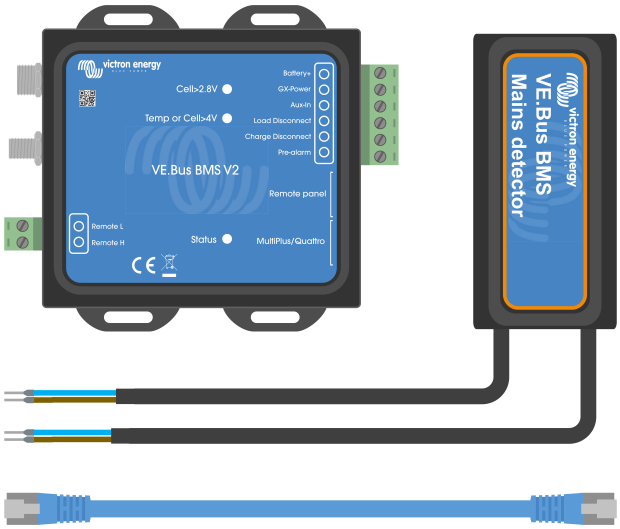
- Installation must strictly follow the national safety regulations in compliance with the enclosure, installation, creepage, clearance, casualty, markings and segregation requirements of the end-use application.
- Installation must be performed by qualified and trained installers only.
- Switch off 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 Li-Ion battery has been damaged during transport.

3. Installation

3.1. What's in the box

The following items are in the box:

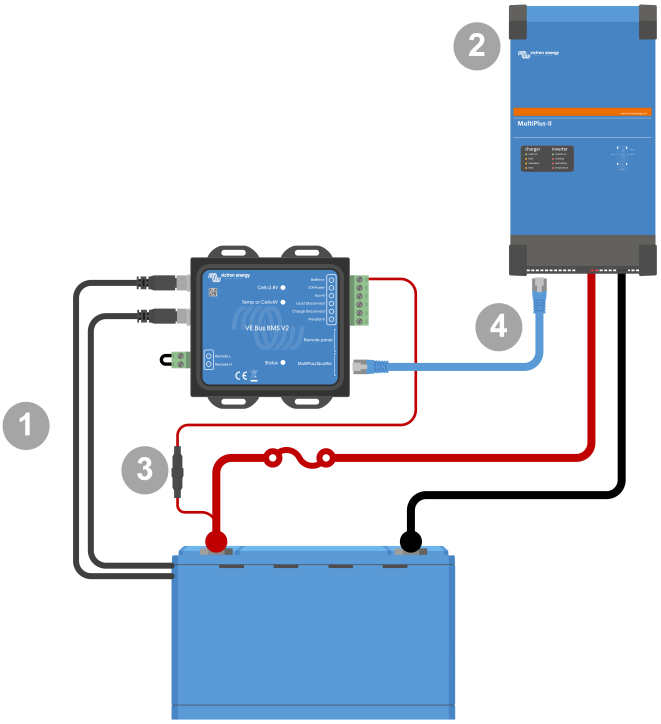
- 1x VE.Bus BMS V2.
- 1x Mains detector.
- 1x 0.3m RJ45 UTP cable.
- Piece of Velcro adhesive hook and loop tape



What's in the box

3.2. Basic installation

1. Connect the battery BMS cables to the BMS. In the case of multiple batteries, see the Battery BMS cable connections [4] chapter.
2. Connect the inverter/charger or inverter positive and negative cables to the battery. Make sure it has been updated to the most recent firmware version. For more information, see the Minimal VE.Bus firmware [4] chapter.
3. Connect the battery positive via the red power cable with the fuse to the BMS "Battery +" terminal.
4. Connect the VE.Bus port of the Inverter/charger or inverter to the "MultiPlus/Quattro" port of the BMS via an RJ45 cable (not included).
5. In case of a non-MultiPlus-II or non-Quattro-II, install the mains detector. For more information, see the Mains detector [5] chapter.



Basic BMS connections

Note that the BMS does not have a battery negative connection. This is because the BMS obtains battery negative from the VE.Bus. As such, the BMS cannot be used without a VE.Bus Inverter/charger or a VE.Bus inverter.

3.2.1. Minimal VE.Bus firmware

Before connecting the BMS to the system, the VE.Bus firmware of all inverter/chargers or inverters used in the system needs to be updated to the latest firmware version (version xxxx489 or above).

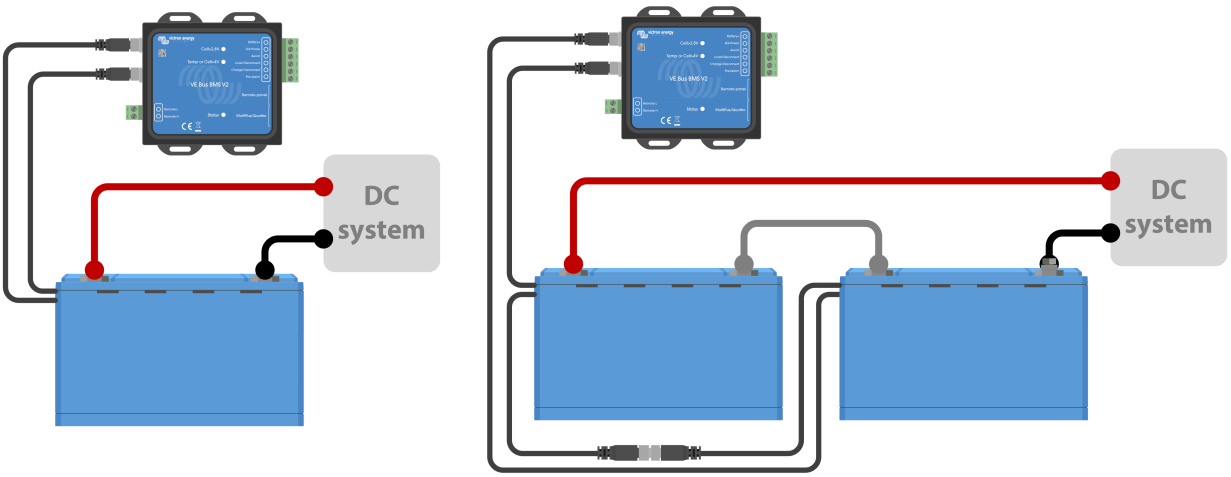
If the inverter/charger firmware is between version xxxx415 and xxxx489, the "VE.Bus BMS" or "ESS" assistant must be installed in the inverter/charger.

If the inverter/chargers or inverters have a VE.Bus firmware version below xxxx415, the BMS will generate a VE.Bus error 15 (VE.Bus combination error). This error indicates that the VE.Bus products or firmware versions cannot be combined. If it is not possible to update the inverter/chargers or inverters to a VE.Bus firmware version xxxx415 or higher the VE.Bus BMS V2 cannot be used.

3.2.2. Battery BMS cable connections

In the case of several batteries in parallel and/or series configuration, the BMS cables should be connected in series (daisy-chained), and the first and last BMS cable should be connected to the BMS.

Should the BMS cables be too short, they can be extended using extension cables, the M8 circular connector Male/Female 3 pole cables.



Left: Connecting a single battery. Right: connecting multiple batteries.

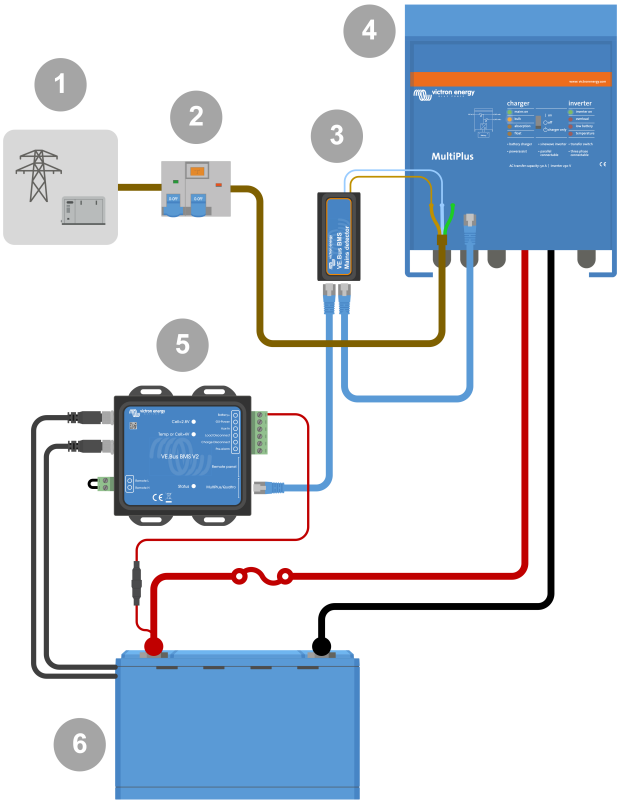
3.2.3. Mains detector

The mains detector is not needed for MultiPlus-II models, Quattro-II models, or inverters. In which case, this chapter can be skipped, and the mains detector should be disposed of.

The purpose of the mains detector is to restart the inverter/charger when the AC supply becomes available, in case the BMS had switched the inverter/charger off due to low cell voltage (so that it can recharge the battery).

In systems consisting of several units configured for parallel, three-phase, or split-phase operation, the mains detector should be wired in the master or leader unit only.

In the case of a MultiPlus, only use one AC wire pair, and in the case of a Quattro, use both wire pairs.



AC detector wiring example.

#	Description
1	AC grid or generator
2	AC circuit breaker and RCD

#	Description
3	Mains detector
4	Inverter/charger
5	VE.Bus BMS V2
6	Lithium Battery Smart

3.3. Controlling DC loads and chargers

3.3.1. DC load control

DC loads with remote on/off terminals:

DC loads must be switched off or disconnected to prevent cell undervoltage. The "Load Disconnect" output of the BMS can be used for this purpose. The "Load Disconnect" output is normally high (= battery voltage). It becomes free-floating (= open circuit) in case of an impending cell undervoltage (no internal pull down to limit residual current consumption in case of low cell voltage).

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 BMS Load Disconnect output.

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, can be controlled with the BMS Load Disconnect output via an Inverting remote on/off cable.

Note: please check the residual current of the load when in the off state. After low cell voltage shutdown, a capacity reserve of approximately 1Ah per 100Ah battery capacity is left in the battery. For example, a residual current of 10mA can damage a 200Ah battery if the system is left in a discharged state for more than eight days.

Disconnecting a DC load via a BatteryProtect:

Use a BatteryProtect for DC loads that do not have a remote on/off terminal or for switching groups of DC loads off.

A BatteryProtect will disconnect the DC load when:

- Its input voltage (= battery voltage) has decreased below a preset value.
- When its remote on/off terminal is pulled low. The BMS "load disconnect" output can control the remote on/off terminal of the BatteryProtect.

3.3.2. Charger control

Charging the $LiFePO_4$ battery with a battery charger:

Battery charging must be reduced or stopped in time to prevent cell overvoltage or overtemperature from occurring.

The "Charge Disconnect" output of the BMS can be used for this purpose. The "Charge Disconnect" output is normally high (equal to battery voltage) and switches to an open circuit state in case of an impending cell overvoltage.

Battery chargers with a remote on/off terminal that activates the charger when the terminal is pulled high (to battery positive) and deactivates when the terminal is left free-floating can be controlled directly with the "Charge Disconnect" output of the BMS.

For battery chargers with a remote terminal that activates the charger when the terminal is pulled low (to battery minus) and deactivates when the terminal is left free-floating, the Inverting remote on-off cable can be used.

Alternatively, a Cyrix-Li-Charge relay can be used. The Cyrix-Li-Charge relay is a unidirectional combiner that inserts 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" output of the BMS.

Charging the $LiFePO_4$ battery with an alternator:

The Cyrix-Li-ct is recommended for this application. The microprocessor-controlled Cyrix-Li-ct includes a timer and voltage trend detection. This will prevent frequent switching due to a system voltage drop when connecting to a discharged battery. See System with an alternator [12] for an example of such a system.

3.4. Remote connector

The Remote L and remote H BMS terminals can turn the whole system off.

The remote H and L terminals switch the system on when:

- Contact is made between the remote H terminal and L terminal, for example, via the wire bridge or a switch.
- Contact is made between the remote connector H terminal and battery positive.
- Contact is made between the remote connector L terminal and battery negative.

One usage example of the remote connector is if the system is situated in a vehicle and is only allowed to operate when the engine is running. In this case, connect the remote connector H terminal to the vehicle ignition switch.

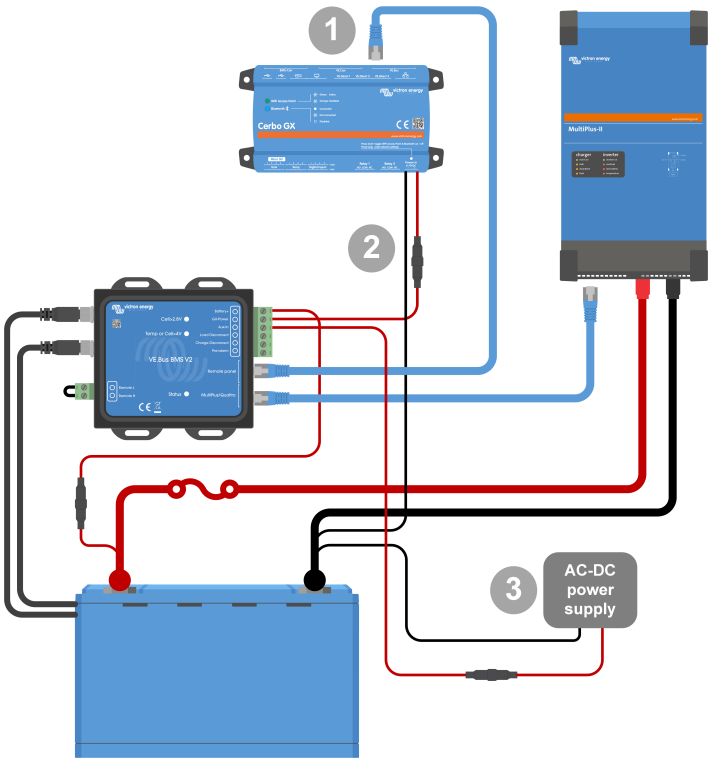
3.5. GX device

For an inverter/charger or an inverter to be controlled by the BMS via a GX device, the following requirements should be met:

- The inverter/charger or inverter VE.Bus firmware version must be version xxxx415 or above.
- The GX device Venus OS firmware must be version 2.80 or above.
- The GX device must be one of these models:
  - Cerbo GX
  - Color Control GX (CCGX) with serial number HQ1707 or newer
  - Venus GX
  - Octo GX

Installation:

1. Connect the GX device VE.Bus port to the "Remote panel" port on the BMS via an RJ45 cable (not included).
2. Connect the GX device "power +" terminal to the "GX-Power" terminal of the BMS and connect the GX device "power -" terminal to the negative terminal of the battery.
3. Connect the positive wire of an (optional) AC-DC power supply to the "AUX-in" terminal of the BMS and connect the negative wire to the negative battery terminal.
4. Perform a "VE.Bus re-detect system" action on the GX device. This action is available in the inverter/charger menu on the GX device.



GX device connections.

The functionality of the "GX-Pow" and AUX-In" terminals:

The BMS "GX-Power" output supplies power to the GX device from the battery or from the BMS "Aux-In" input, whichever voltage is higher. Connecting an AC-DC adaptor to the Aux-In input ensures that a GX device remains powered during a low cell state providing an AC input (from the grid or a generator) is available.

3.6. Digital Multi Control panel and VE.Bus Smart dongle

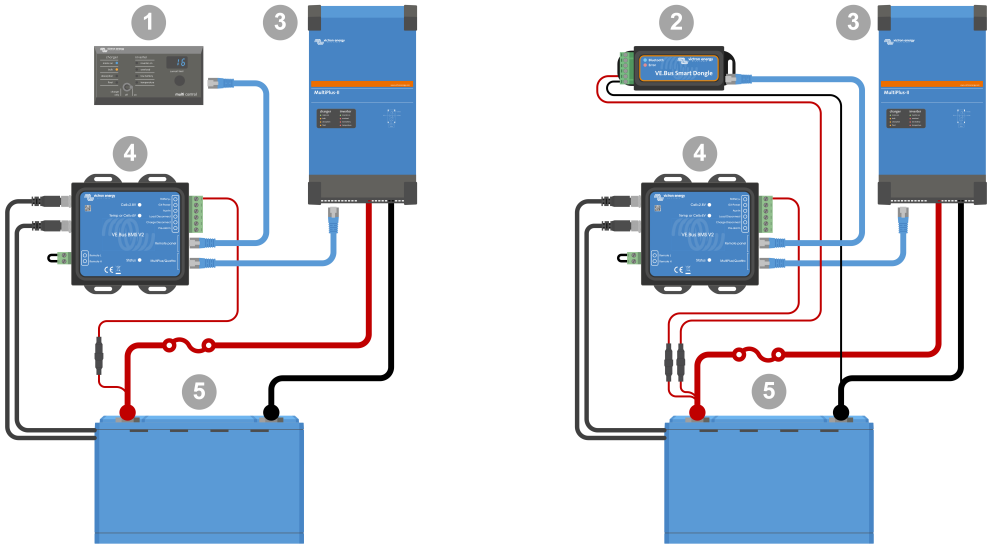
The VE.Bus Smart dongle or Digital Multi Control panel (DMC) can be connected to the "Remote Panel" port on the BMS.

Both a VE.Bus Smart dongle and GX device can be connected to the "Remote Panel" port, and both these devices have on/off/charger-only control of the inverter/charger.

If a Digital Multi Control is also connected, the on/off/charger-only control of the inverter/charger via a GX device and/or a VE.Bus Smart dongle is lost. Only the Digital Multi Control has on/off/charger-only control over the inverter/charger.

For example, the VE.Bus Smart dongle, Digital Multi Control panel and the GX device can all be connected simultaneously to the "Remote Panel" port. However, in this scenario, on/off/charger-only control of the inverter/charger via the GX device and VE.Bus dongle is disabled. Since inverter/charger control is disabled, the GX device or VE.Bus Smart Dongle can also be connected to the BMS Multi/Quattro terminal for easy wiring.

For on/off/charger-only control of an inverter/charger or inverter via a VE.Bus Smart dongle or Digital Multi Control panel, the inverter/charger or inverter VE.Bus firmware version must be version xxxx415 or above.

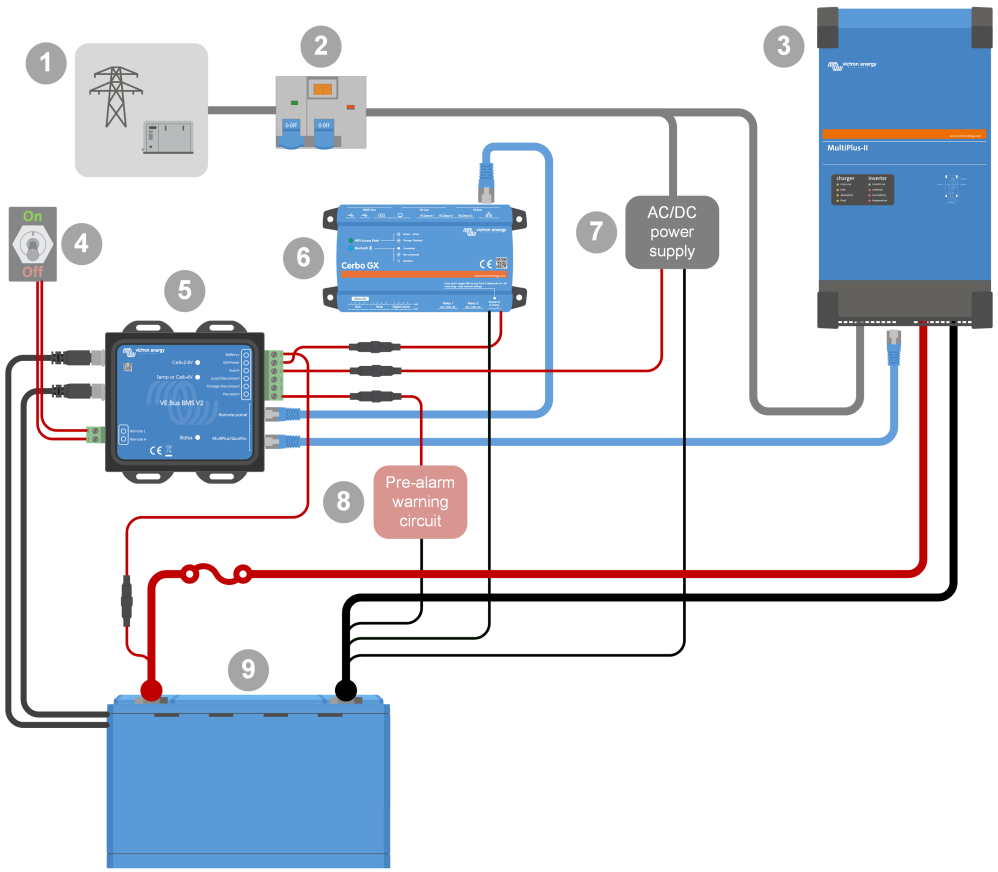


Left: System with a Digital Multi Control Panel. Right: System with a VE.Bus Smart dongle

#	Description
1	Digital Multi Control panel
2	VE.Bus Smart dongle
3	MultiPlus-II Inverter/charger.
4	VE.Bus BMS V2. The VE.Bus Smart dongle needs to measure the battery voltage. Therefore its Battery+ terminal needs to be connected to the positive battery terminal. Be aware that the VE.Bus Smart dongle will not be turned off by the BMS in case of a low cell warning and will continue to draw a little current from the battery.
5	Lithium Battery Smart or battery bank consisting of multiple batteries creating a 12V, 24V or 48V battery bank.

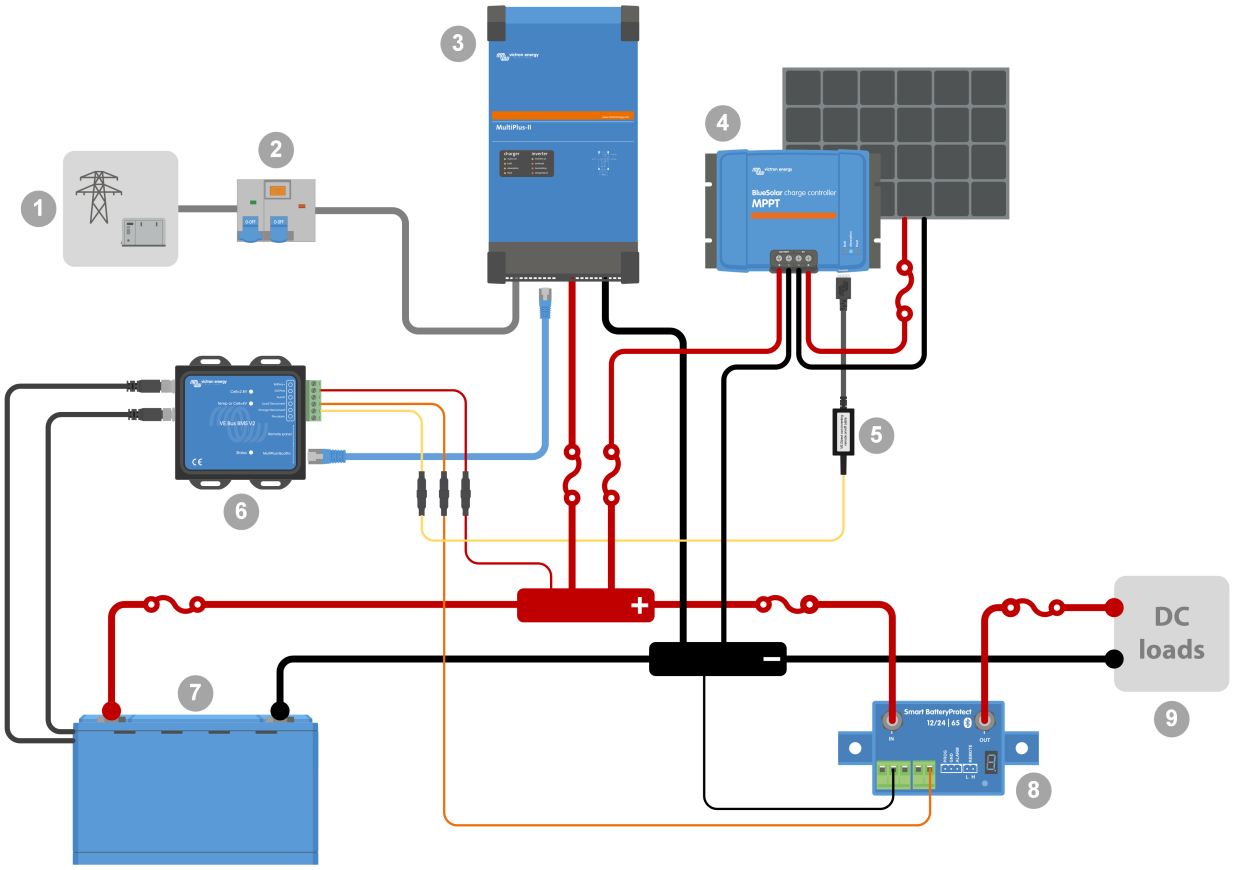
4. System examples

4.1. System with a GX device, on/off switch and pre-alarm circuit



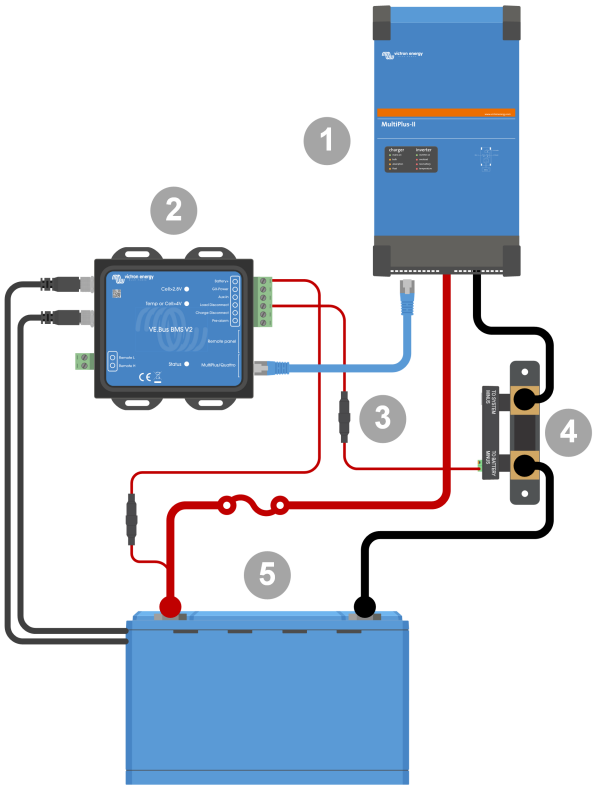
#	Description
1	AC source, grid or generator.
2	Circuit breaker and RCD.
3	MultiPlus-II Inverter/charger.
4	System on/off switch.
5	VE.Bus BMS V2.
6	Cerbo GX.
7	AC-DC power supply, providing backup power to the Cerbo GX should the battery be too far discharged.
8	Pre-alarm warning circuit, giving an advanced warning in case of an imminent system shutdown due to a too far discharged battery.
9	Lithium Battery Smart or battery bank consisting of multiple batteries creating a 12V, 24V or 48V battery bank.

4.2. System with a BatteryProtect and solar charger



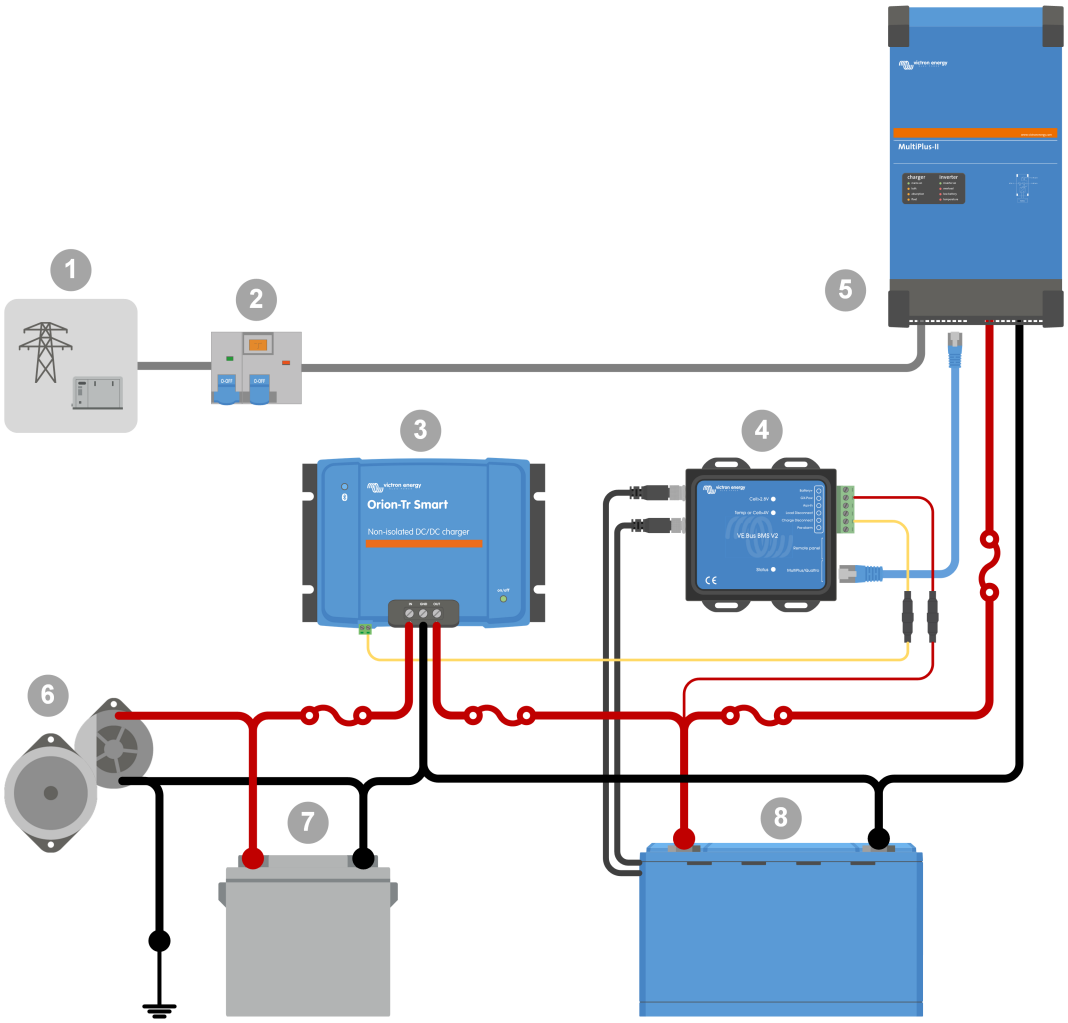
#	Description
1	AC source, grid or generator.
2	Circuit breaker and RCD.
3	MultiPlus-II Inverter/charger.
4	Solar charger.
5	VE.Direct non-inverting remote on/off cable connects between the solar charger VE.Direct port and the BMS "Charge Disconnect" terminal.
6	VE.Bus BMS V2.
7	Lithium Battery Smart or battery bank consisting of multiple batteries creating a 12V, 24V or 48V battery bank.
8	BatteryProtect.
9	DC loads.

4.3. System with a battery monitor



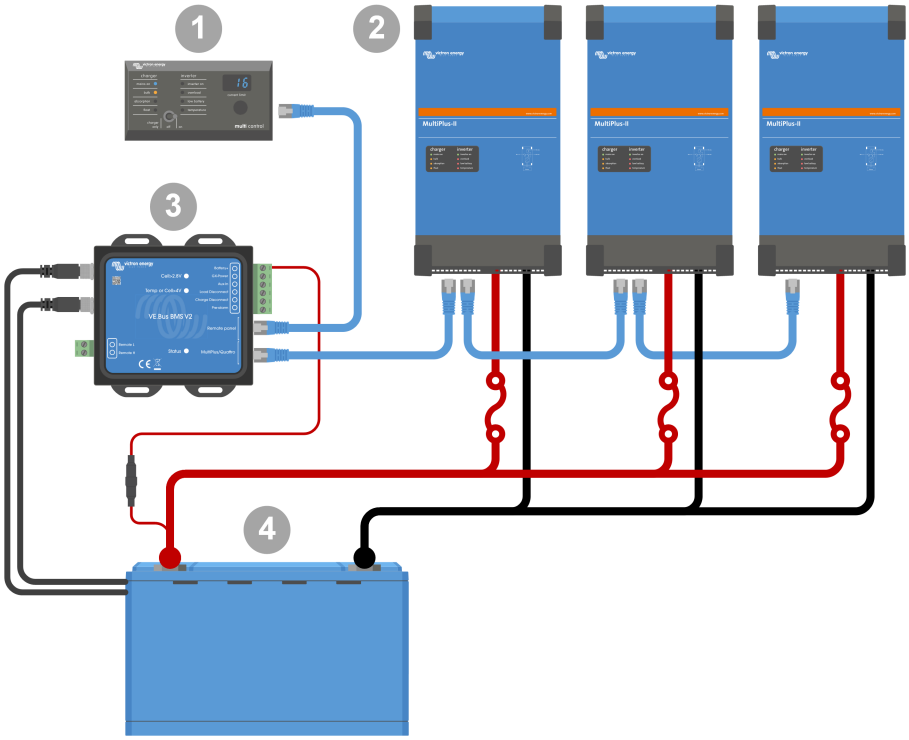
#	Description
1	MultiPlus-II Inverter/charger.
2	VE.Bus V2 BMS.
3	SmartShunt power wire (B+) connected to the "load Disconnect" terminal on the VE.Bus V2 BMS.
4	Smart Shunt battery monitor. In case a BMV battery monitor is used, its shunt needs to be wired in a similar way.
5	Lithium Battery Smart or battery bank consisting of multiple batteries creating a 12V, 24V or 48V battery bank.

4.4. System with an alternator



#	Description
1	AC source, grid or generator.
2	Circuit breaker and RCD.
3	Orion DC-DC charger, the remote H terminal is connected to the "Charge Disconnect" terminal on the VE.Bus V2 BMS.
4	VE.Bus BMS V2.
5	MultiPlus-II Inverter/charger.
6	Starter monitor and alternator.
7	12V Starter battery.
8	Lithium Battery Smart or battery bank consisting of multiple batteries creating a 12V or 24V battery bank.

4.5. Three-phase system with a Multi Control panel



#	Description
1	Digital Multi Control panel.
2	MultiPlus-II Inverter/charger programmed as a 3-phase system.
3	VE.Bus BMS V2.
4	Lithium Battery Smart or battery bank consisting of multiple batteries creating a 12V, 24V or 48V battery bank.

5. Operation

5.1. Important warning

Lithium batteries are expensive and can be damaged due to over discharge or over charge. 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. A residual current of 10mA for example may damage a 200Ah battery if the system is left in discharged state during more than 8 days.

5.2. LED indications

LED	Colour	Behaviour	Meaning
Status	Blue	Off	BMS is off
		Lights shortly approximately once every 10 seconds.	BMS is operating normally.
		Flashes rapidly at approximately 15 times per second.	The BMS is stuck in boot loader mode due to a faulty application.
Cell > 2.8V	Blue	Off	Low cell voltage. The BMS has switched the DC loads and the inverter off. Charge the battery or connect an AC supply to the inverter/charger. Once the battery voltage has increased sufficiently, the DC loads and inverter will be switched on again.
		On	Cell voltage within normal range.
Cell > 4V	Red	Off	Cell voltage and temperature within normal range.
		On	High cell voltage or high temperature. The BMS has switched off the chargers. Check for a faulty charger and/or reduce battery temperature. Once the battery voltage and/or temperature have been sufficiently reduced, the BMS will switch the chargers back on.

6. Frequently asked questions

Q1: I have disconnected the VE.Bus BMS, my inverter/charger will not switch on; why?

If the inverter/charger cannot find the BMS, it will go into an emergency mode. In this mode, the inverter/charger will charge the batteries with a maximum of 5A, up to 12, 24 or 48V (depending on the system voltage). While the inverter/charger is in this mode, only the "Mains on" LED is illuminated. If you disconnect the AC input, the inverter/charger will switch off and will not start to invert since it cannot get verification on the battery health from the BMS. Note that when the batteries are depleted or disconnected, a Quattro will need to be powered from AC input 1. Supplying power to AC Input 2 will not make a Quattro switch on and start charging.

Q2: The batteries are empty, and the inverter/charger will not start to charge; how to get the system up and running again?

When lithium batteries are depleted, the voltage is around 9V or lower, and the battery voltage might be below the operating window of the BMS. In that case, the BMS will not be able to start the inverter/charger. To start the system again, disconnect the BMS from the inverter/charger, and refer to Q1. Note that it might be necessary to disconnect the GX device, NMEA2000 interfaces or other similar products. As long as they are not switched on themselves, they can prevent the inverter/charger from starting up. A more straightforward option to revive a depleted system might be to connect a small battery charger, for example, a 5A charger, and wait for the battery voltage to get back up to 12, 24 or 48V (depending on the system voltage).

Q3: What happens with the inverter/charger when the BMS gives a low cell voltage signal?

The inverter/charger will be set to "charger only mode", and the batteries are charged when an AC input is available. Should AC not be available, the inverter/charger is off.

Q4: What happens with the inverter/charger when the BMS gives a high cell voltage signal?

The high cell voltage signal will only be given when there are unbalanced cells. The inverter/charger will switch to bulk and starts charging with a reduced charge current. This allows the balancing system in the batteries to re-balance the cells.

Q5: What does it mean when the BMS displays an error 15?

With VE.Bus firmware versions below version xxxx415 the VE.Bus BMS V2 will generate a VE.Bus error 15, VE.Bus combination error. This error indicates that the VE.Bus products or firmware versions cannot be combined. Resolution: Update the inverter/charger to a firmware version xxxx415 or higher, if available.

7. Technical specifications VE.Bus BMS V2

Electrical	
Input voltage range	9 – 70Vdc
Current draw, regular operation	10mA (excluding Load Disconnect current)
Current draw, low cell voltage	2mA
GX power output	1A
Aux-in input	1A
Pre-alarm output current rating	1A, not short circuit protected
Load disconnect output	Normally high (output voltage ≈ supply voltage – 1V) Floating when the load needs to be disconnected Source current limit: 1A Sink current: 0A
Charge disconnect output	Normally high, (output voltage ≈ supply voltage – 1V) Floating when charger should be disconnected Source current limit: 10mA Sink current: 0A
Remote on/off terminals	Usage modes to turn the system on or off: a. ON when the L and H terminal are interconnected (switch or relay contact) b. ON when the L terminal is pulled to battery minus (V<3.5V) c. ON when the H terminal is high (2.9V < VH < Vbat) d. OFF in all other conditions
VE.Bus communications ports	2 x RJ45 sockets to connect to all VE.Bus products

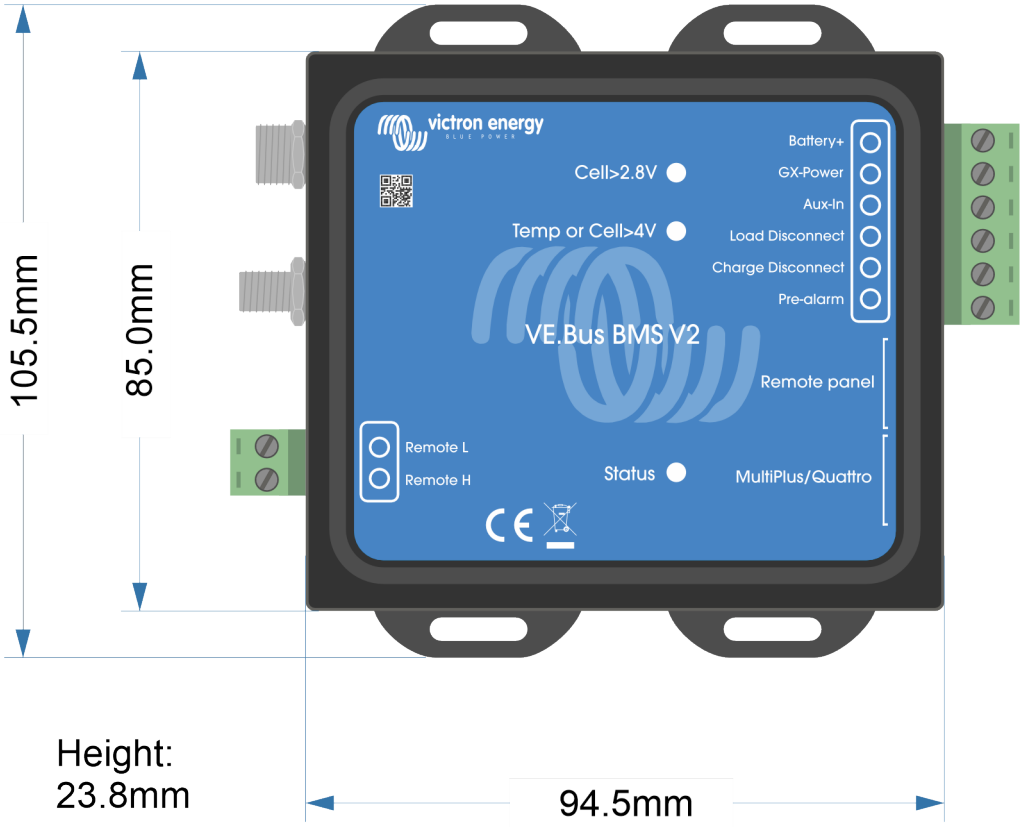
General	
Operating temperature	-20 to +50°C 0 - 120°F
Humidity	Max. 95% (non-condensing)
Protection grade	IP20

Enclosure	
Material	ABS
Colour	Matt black with a blue sticker
Weight	120gr
Dimension (h x w x d)	23.8mm x 94.5mm x 105.5mm

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	EN 50498

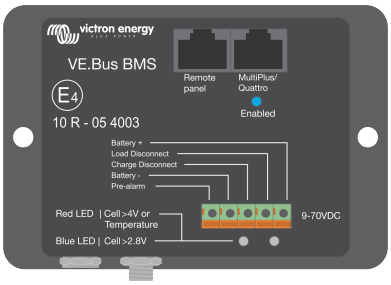
8. Appendix

8.1. Dimensions VE.Bus BMS V2



8.2. VE.Bus BMS V2 compared to VE.Bus BMS

This table highlights the differences between the VE.Bus BMS V2 compared to it's predecessor, the VE.Bus BMS.

Feature	VE.Bus BMS V2	VE. Bus BMS
Product image.		
MultiPlus Quattro port.	Yes.	Yes.
Remote panel port.	To connect a GX device or a Digital Multi Control panel.	Only to connect a Digital Multi Control panel.
GX device communication.	Yes, the BMS broadcasts operational data and the BMS can control equipment that is connected to a GX device, like solar chargers and certain AC chargers via DVCC.	No.
GX Power terminal.	Yes, to power a GX device.	No.

Feature	VE.Bus BMS V2	VE. Bus BMS
BMS firmware update.	Yes, both locally and also remotely via the VRM portal.	Not possible.
Inverter/charger "in system" firmware update.	Yes, both locally and also remotely via the VRM portal.	No, the inverter/charger needs to be disconnected while its firmware is updated.
Usable without a VE.Bus connection.	No. The BMS has no battery minus connection, battery minus is supplied by the VE.Bus. and VE.Bus needs to be connected for the BMS to be powered.	Yes.
Load disconnect terminal.	Yes.	Yes.
Pre-alarm terminal.	Yes.	Yes.
Charge disconnect terminal.	Yes.	Yes.
Remote on/off terminal.	Yes.	No. If remote on/off control is needed, a switch needs to be placed in the positive power supply line to the BMS.
Aux terminal.	Yes.	No.
MultiPlus/Quattro enabled LED.	No.	Yes. This LED is on when the BMS is sending a "standby" command to the inverter/charger.
Status LED.	Yes, this LED indicates that the BMS is sending information frames to the inverter/charger. The LED can also indicate if the BMS is stuck in boot loader mode.	No.
Low cell voltage LED.	Yes.	Yes.
High cell voltage and/or temperature LED.	Yes.	Yes.