

# Victron & BYD B-Box

The combination of Victron products with BYD B-Box lithium batteries (2.5, 5.0, 7.5, 10.0 and 12.8 models) has been tested and certified by the Victron and BYD R&D departments. The combination is actively supported by both companies.

The BYD B-Box includes an integrated Battery Management System (BMS) with each battery cell unit, and a Battery Management Unit (BMU) that can control up to 32 battery units.

## 1. Product & system compatibility

### 1.1 Offgrid, Backup and Energy Storage Systems are possible

Victron + BYD B-Box can be used for the following system types:

- Off-grid
- Backup
- Energy Storage Systems ([ESS](#).)

### 1.2 A Venus-device is required, either Color Control GX (CCGX) or Venus GX (VGX)

It is essential to use the CAN-bus connection of the CCGX or VGX with the BYD batteries for the keep-alive signal, communication of charge and discharge limits, error codes and state of charge.

When used with B-Box batteries, the minimum required firmware version for the [Color Control GX](#) is v2.15. It is highly recommended to use the latest firmware version on all connected devices, including CCGX/VGX, Inverter/Charger and MPPTs. There are regular updates to improve performance and reliability.

### 1.3 All 48V Multis, MultiPlusses, MultiGrids and Quattros are compatible

The minimum firmware version is 422. Though updating to the latest firmware is recommended where possible.

These inverter/charger units must be connected to the Venus-device via the VE.Bus connection port.

In grid connected systems, advanced control functions are configurable in the ESS settings on the Venus-device.

In off-grid systems, the control functions of the BYD Battery Management System (BMS) are built into the latest version of the Venus-device.

#### 1.3.1 Minimum Battery Sizing

The following information is provided by BYD, it is reproduced here for your convenience and should always be confirmed with the latest BYD manuals and specifications.

Each battery cell is approximately 50Ah at 48V (51.2V nominal). The following charge rates are managed automatically by the BYD BMU and Venus-device. Temperature effects on charge rates should be considered in the design stage in hot and cold climates. Using very large solar arrays with battery banks that are too small can exceed the limits of the batteries ability to charge and possibly lead to the BMU triggering over-current alarms.

The table below shows the minimum number of 2.5 kWh battery cells required for the specified inverter/charger configuration:

Inverter/Charger	1 Phase on-grid	3 Phase on-grid	1 Phase off-grid	3 Phase off-grid
Multiplus 48/3000/35	1	3	2	6
Multiplus 48/5000/70	1	3	3	9
Quattro 48/5000/70-100/100	1	3	3	9
Quattro 48/8000/110-100/100	1	4	5	15
Quattro 48/10000/140- 100/100	1	5	6	18
Quattro 48/15000/200- 100/100	1	6	9	27
EasySolar 48/3000/35-50 MPPT150/70	1	3	2	6
EasySolar 48/5000/70-100 MPPT150/100	1	3	3	9

The specification for these minimum battery sizes was obtained from [BYD's 2018 minimum specification guide](#).

## 1.4 All 48V BlueSolar and SmartSolar MPPT Chargers are compatible

For proper operation, the B-Box battery needs to be able to control the charge current of the solar MPPTs. It is recommended to use the MPPTs with VE.Direct port with BYD batteries.

### MPPTs with a VE.Direct port

MPPTs are controlled via the Venus-device. Make sure the Venus-device runs v2.15 or later, and the MPPTs to 1.30 or the latest available version.

The MPPT requires connection to the Venus-device to regulate charge currents as the batteries require (due to temperature, etc) To test operation, try disconnecting the Venus-device from the MPPT. After a time-out, the MPPT will stop charging and flash an error code on its LEDs. The error code is [error #67: no BMS](#).

### MPPTs with a VE.Can port

Firmware should be at least version 2.05.

When using VE.Can MPPT's, it is recommended to use the Venus GX (VGX), instead of the CCGX. The VGX has two CAN-bus interfaces available and allows communication between the MPPTs, BYD and the VGX.

## 1.5 Battery compatibility

The following batteries are supported:

<b>B-BOX LV series type</b>
B-BOX Pro 2.5-10.0
B-BOX Pro 12.8
B-BOX Res 2.5-10.0
B-BOX Compact

Minimum BYD firmware version: BMU\_V2\_V4-13\_15-Mar-2017.

On-screen, or via Remote Console on the Venus-device, this version is named v4.13.

Batteries with older firmware versions can be updated. Please contact BYD for more information.

## 2. Wiring of CAN-bus cable between B-Box and Venus-device

Use the *VE.Can to CAN-bus BMS type A Cable*, part number ASS030710018. Plug the side which is labeled Battery BMS into the BYD BMS. Plug the side labeled Victron VE.Can into the Venus-device.

Then, plug a [VE.Can terminator](#) in the other VE.Can socket on the Venus-device. Two VE.Can terminators are included with the package of the Venus-device as an accessory, only one is used. Keep the other one as a spare.

More information about the cable can be found in [its manual](#).

Without properly connecting this cable, the battery will not show up on the display of the Venus-device. The battery will also turn itself off after several minutes.

It is important to ensure this connection and display of the battery on the Venus-device display before attempting firmware updates or settings changes on other devices if they depend on the power supply from the battery. Without this connection, the battery may turn off unexpectedly. If a reliable DC power supply is required, you can temporarily disconnect the individual BYD battery cells inside their cabinet from the internal Battery Management Unit (BMU). It is the BMU that signals the battery cells to shut down if the signal from the Venus-device has not been received. This is a temporary measure, DO NOT attempt to operate the battery cells normally without connection to the BMU.

## 3. Wiring of the Allow-to-charge and allow-to-discharge contacts

Using the latest firmware on all devices, the BYD allow to charge contacts are only required when using VE.Can MPPT's. If you have an existing system that is configured using the Allow-to-charge contacts, and it is operating correctly, you do not need to make any changes.

The MPPTs with a VE.Can port have a dedicated Remote On/Off input. It needs to be connected to battery positive to enable the charger. Leaving the Remote On/Off input floating or pulling it to ground will disable the charger.

B-Box relays:

- Relay T1-T2: closed if allowed to discharge
- Relay T4-T5: closed if allowed to charge



## 4. VEConfigure settings

This section presumes familiarity with [VEConfigure software](#).

### 4.1 General tab

- Check the “Enable battery monitor” function
- Set the battery capacity to the total capacity of the battery: 50Ah times the number of battery modules.
- The other parameters (“State of charge when bulk finished” and “Charge efficiency”) can be left to their default setting: They are ignored for a BYD installation.

### 4.2 Charge parameters

In normal operation, the charge parameters are controlled by the BYD BMU and communicated through the system by the Venus-device to the inverter/charger and MPPT. However as a precaution it is advised to set these as suggested below.

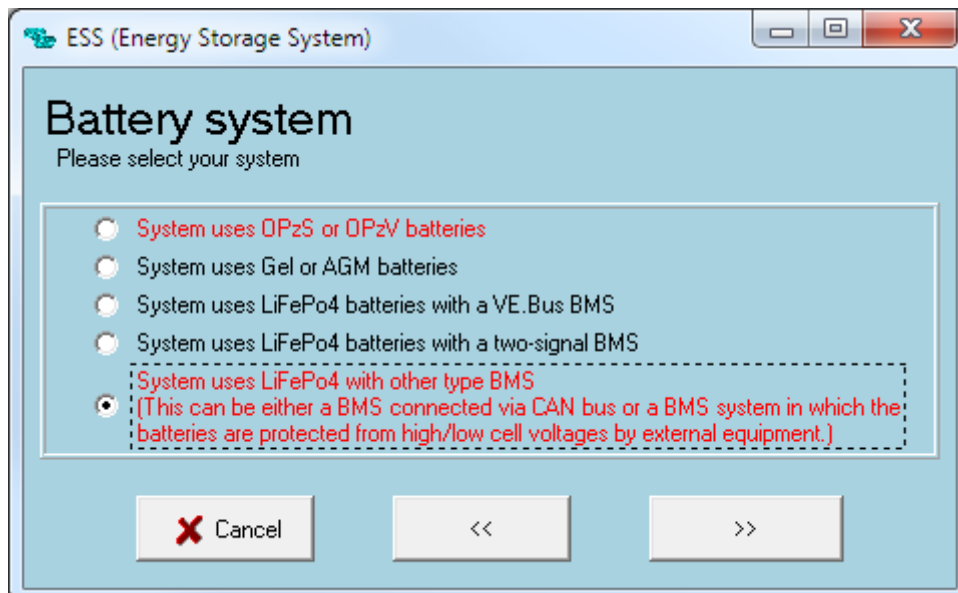
VEConfigure Charge Parameter	Setting
Battery type	Lithium
Charge curve	Fixed
Absorption voltage	55.2 V
Float voltage	55 V
Absorption time	1 Hr

Note: make sure to double check the float voltage after completing Assistants, and if necessary set it back to 55 V.

### Option A: ESS Assistant

Use this option for ESS systems.

Select the fifth battery type:



ESS Parameter	Settings
Sustain voltage.	50V
Dynamic cut-off values	set all values to 47V.
Restart offset:	4V

### Option B: Off-grid system using CAN-bus cable.

You will need the latest firmware on all connected devices.

On the Venus-device, go to Settings, System setup:

Venus Settings → System Setup Parameter	Value
DVCC	ON
Shared Voltage Sense	OFF

In the Inverter tab of VEConfigure

VEConfigure Inverter Parameter	Setting
DC input low shut-down	47V
DC input low restart	51V
DC input low pre-alarm*	51V

\* The pre-alarm setting is dependant on your preference and on site specific requirements. You may wish for this to be activated earlier (eg 53V) in an off grid situation to allow time to start a backup generator. If the system is configured in ESS mode, you may not wish to have this alarm trigger until below the Sustain threshold voltage (eg 49V), as this system is in no danger normally and will 'sustain' at 50V without needing to trigger an alarm.

## 5. Venus-device Configuration

If you have a VE.Can MPPT, it is advised to use the Venus GX in place of the CCGX.

\* Select the *CAN-bus BMS (500 kbit/s)* CAN-profile in the CCGX. Menu path: *Settings → Services →*

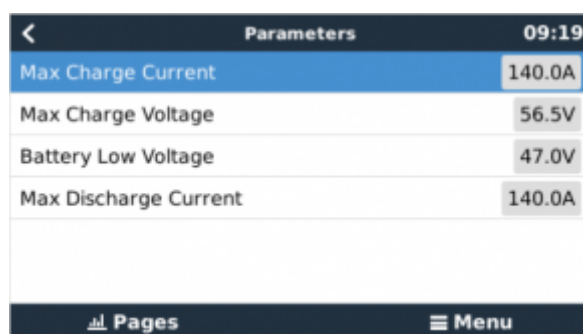
CAN-profile.

- After properly wiring and setting up, the B-Box will be visible as a battery in the device list:



(if you have multiple batteries a single entry will show up, which represents all batteries).

- The parameters option within the battery page shows the actual battery charge and discharge limits



This parameters page is also a good place to check that all batteries are connected and working properly. In normal working conditions, the current limit is 35A per cell. For example, 140A charge current limit (  $140 / 35 = 4$  ) means there are 4 BYD battery cells connected.

## Color Control GX Configuration

The CCGX only has one available VE.Can port. It is not possible to connect both CAN products such as VE.Can MPPT (250 kbit/s) and an B-Box battery CAN-bus (500 kbit/s) together on the CCGX. As the BYD Battery MUST be connected, you will need to use the port for that. This will mean no data is collected from the VE.Can MPPT, nor can the CCGX control it. This means you are required to use the "Allow to Charge" wire configuration for the MPPT.

## Venus GX Configuration

The VGX has two CAN-bus interfaces available. The VE.Can MPPT will remain connected to the VE.Can port, while the BYD CAN-bus cable should use the specific CAN-bus connections (H, L, GND). This allows data from the MPPT and BYD battery simultaneously. You will still need to connect the Allow-to-charge wires if using the VE.Can MPPT and VGX.

Be aware that this additional CAN-bus interface is not electrically isolated.

## 6. Configure VE-Direct MPPT

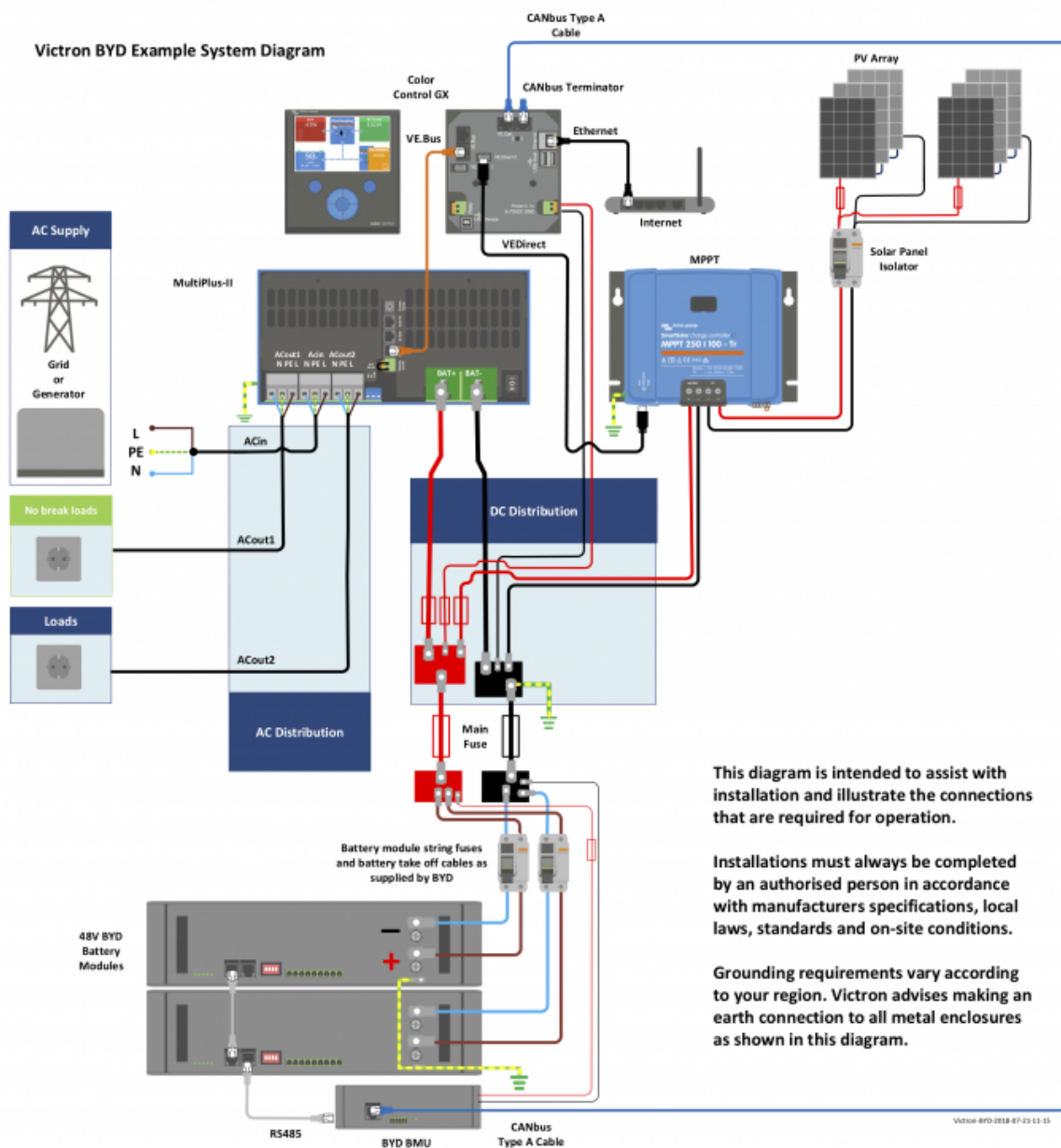
In normal operation the MPPT charge characteristics are governed by the Venus-device connected to the BYD battery.

This section presumes familiarity with [VictronConnect](#)

The settings below are a precautionary measure.

MPPT Parameter	Setting
Battery voltage.	48V
Absorption voltage	56.5V

## 7. Example Wiring Diagram



## 8. Troubleshooting

If the system is not operating correctly, go through these steps.

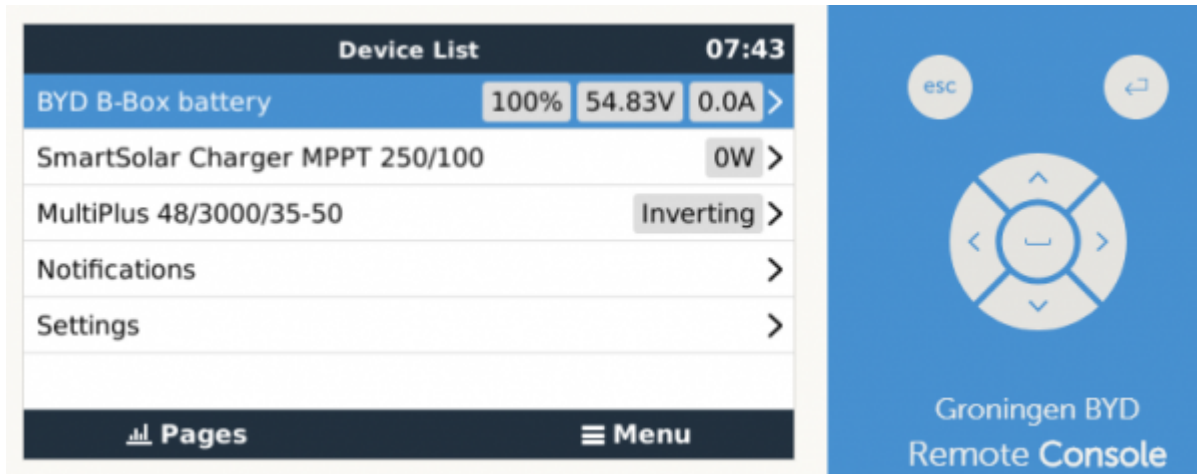
### Step 0. If the Inverter/Charger or Venus-device does not switch on

As a safety precaution, the inverter/charger will not switch on if the Venus-device is not on. If you are unable to start the system due to a total system blackout / battery shutdown due to low voltage, you may need to disconnect the VE.BUS connection cable between the inverter/charger and Venus-device.



You can then start the inverter/charger from an external charge source such as a generator or grid connection. Once the inverter/charger has started, it should supply power to the DC terminals and this should start the Venus-device and BYD battery again. You will need to then reconnect the VE.Bus Communications cable back to the inverter/charger and Venus-device.

### Step 1. Check that the BYD battery is visible on the Venus-device list



If its not visible, check:

- Venus-device firmware version (update to latest version, v2.15 or later)
- BYD firmware version (see requirement above)
- CAN-bus communication cabling between BYD and Victron system. Make sure that it is in the right way around. If the special cable is plugged in reversed it won't work.
- BYD system is up and running (RUN led on BYD BMU is on)

### Step 2. Check that the BYD battery is ready for use

Check the Max Charge Voltage parameter. This voltage parameter is sent, together with the other three parameters, by the BYD system via the CAN-bus cable. They are visible on the Venus-device: Device List → BYD B-Box battery → Parameters menu.

When ready for use, the Max Charge Voltage will read 56.5 V. In case there is an error in the BYD system (wiring, addressing, or other), it will be 42 V:



Locally on-site, you can check the Run LED on the BYD BMU, it needs to be lit up continuously:



A blinking RUN led indicates an error. On the Victron system this is visible as a Max Charge Voltage of 42 V instead of 56.5 V.

- BMU led blinking once every time, focus on the communication with the inverter
- BMU led blinking more than once (2, 3 or 4 times) focus on the ADDR and communication (cables) between batteries and BMU.
- Battery module SOC LED scrolling side to side: review the ADDR and check/replace the communication cables leading to that battery

Addressing of the battery modules must start at 1, must be continuous and there may not be two modules with the same address. See BYD documentation for details.

In case above doesn't help, and the battery indicates 42V and/or the RUN led is not blinking continuous, please contact BYD support or refer to BYD documentation.

### Restarting the BYD system

Restarting the BYD system is always necessary after adding, or removing, battery modules from the system. It may also be necessary to clear some severe error conditions.

To power down a battery module: one by one, push the reset button on the Battery Module for 5 seconds, until the yellow ARM LED flashes. Once releasing the button, the ARM LED will keep blinking for a few more seconds and then all LEDs switch off on the battery module.

Once all battery modules are powered down, the BMU will shut down also: RUN LED is off.

To power up: one by one shortly press the reset button on the battery modules.

It might be that after power up one or modules will light the ARM (Alarm) LED continuously for a short while. Wait for this to auto-correct itself.

In general the ARM LED on the battery module has these meanings:

- Could be a temporary issue, that corrects self automatically after a short while (matter of minutes).
- Could be an external issue, unacceptable voltage or current.

## 9. Step by Step Guide

If you need further details, a user contributed [step by step installation guide is available here](#). Please be aware that this guide is no longer current. It should not be considered a best practice, but provides further detail and insights from an actual installation.

## 10. Known Issues

### 10.1 Inaccurate State of Charge (SoC) Readings

Each BYD battery module has it's own BMS. This BMS reports it's battery information to the BMU which is connected to the Venus-device and reported to the user and the system.

Each BYD module BMS has a threshold current of 1A (~50W) before it begins to report. For multiple modules, this is additive. So 4 modules could supply a 180W load and report it as 0 W.

This leads to the state of charge reported by the BMU to not accurately match the actual state of charge of the battery.

This limitation also applies to charge currents as well as loads. However it is more common to have low powered loads for long periods of time than low charge currents.

The reported State of Charge will self correct when the battery is 100% full or near 10% empty, and this can appear as sudden jumps in the VRM from very little load or charge.

This has no impact on actual usable capacity of battery, only on the how it is reported to the user and other systems (such as alarms or triggers).

### Work-arounds

If precise state of charge is important, then it is recommended to install a Victron BMV shunt, and program the Venus-device to use it for the displayed State of Charge. The limitations of this method are if cells are added, removed or shut down, the BMV will continue to report SoC based on the total Ah of storage set.

You should have alarms and auto-start generators programmed to operate on system voltage as well as state of charge.

System voltage is always reported accurately, and action should be taken once batteries are below 50V for any length of time,

### Example

This example below clearly shows the comparison between a BYD BMU (512) and the shunt reading that is reported by the BMV-700 (258).

You can observe a 'flat' reading from the BYD during the night, while the BMV continues to read the discharge and report a slowly decreasing state of charge.



## 10.2 125A cabinet limit

The IP55 BYD cabinets are designed to take 4 battery modules and are supplied with 125A circuit breakers. Each battery module is able to supply and receive a continuous 35A, all together a combined 140A. This means it is possible to overload the circuit breaker.

If you have multiple large charge sources, set the DVCC distributed charge current limit to 120A per cabinet to stay under the circuit breaker limit.

If you have a system with multiple cabinets, try to balance the modules evenly between the cabinets to make it less likely to overload the breakers.

Multiple cabinets will also require other circuit protection at the DC bus level.

## 10.3 Cold Weather Performance

The BYD cells will limit the charge current allowed at lower temperatures.

Temperature (Celsius)	Charge Current Limit Per Cell	C rating
50 to 13 degrees	35 A	0.7C
12 to 3 degrees	6 A	0.12C
2 to -7 degrees	3 A	0.06C

Keep your batteries in a climate controlled environment as close to 20 degrees celsius as possible for best performance. Depending on your climate, consider insulation and reverse cycle air-conditioning to prevent issues in hot and cold weather.

Cells will also heat themselves up when charged and discharged.

## 11. DISQUS

~~DISQUS~~

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