Training – Riga Feb 2020

Topics for today

Software possibilities / Bluetooth / Monitoring

New products

MultiPlus / Quattro inverter/chargers advanced

Lithium systems

Design of systems

Victron today

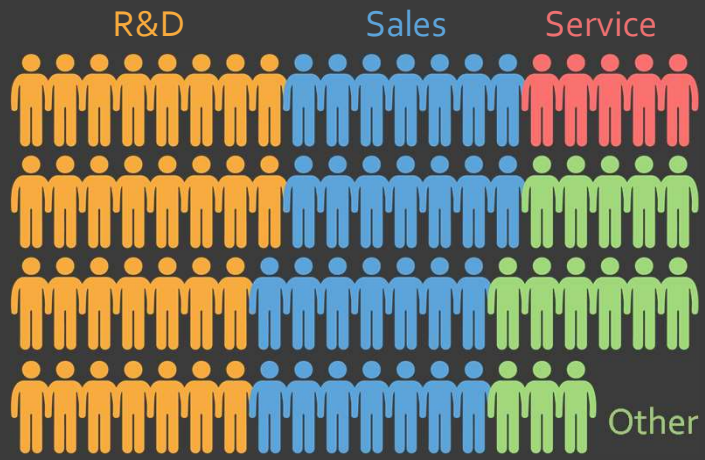
Sales
2019
€171 mln

Growth:
31%

Worldwide
Distributor
Network

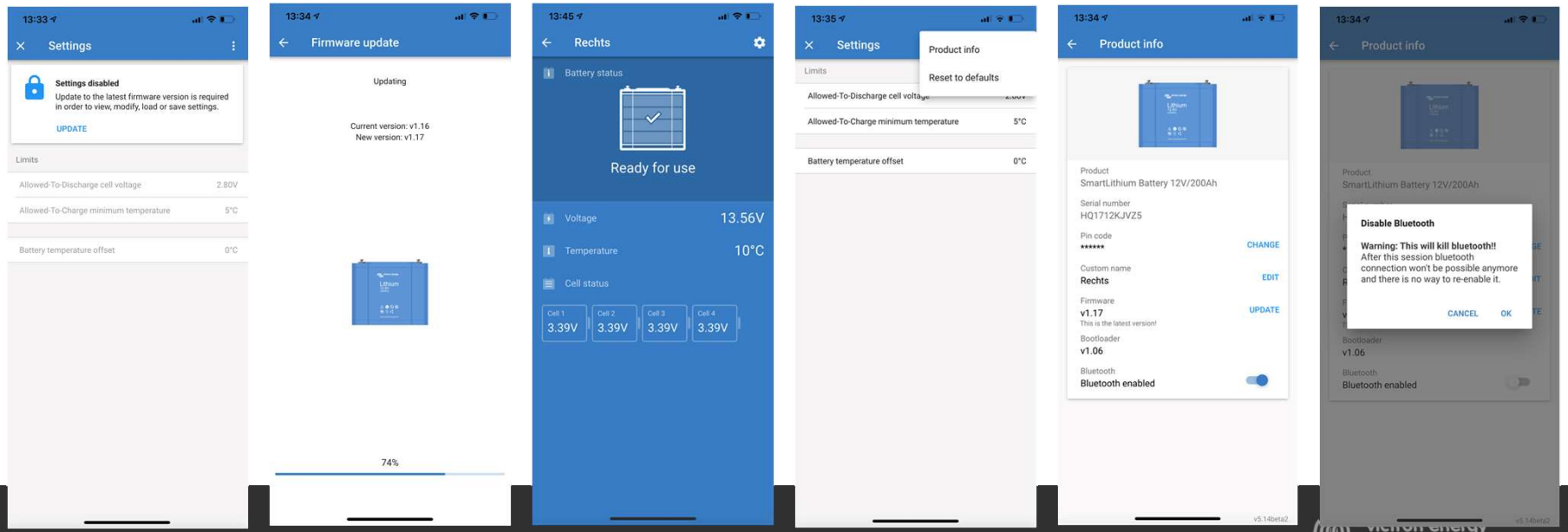
Production
in Far East

Directors Reinout Vader and Matthijs Vader
Together with a team of 102 experts:



victron energy

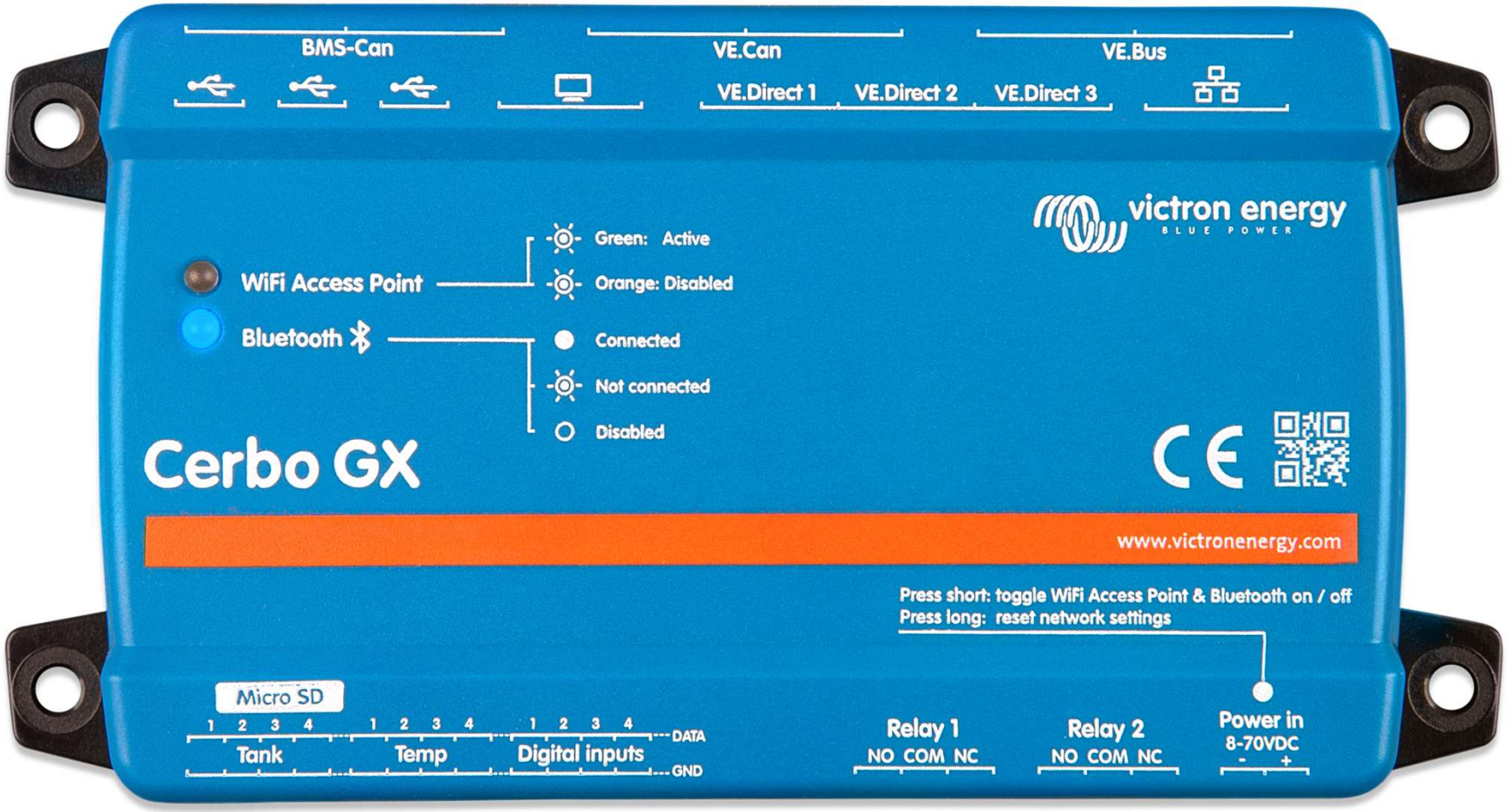
How to disable Bluetooth



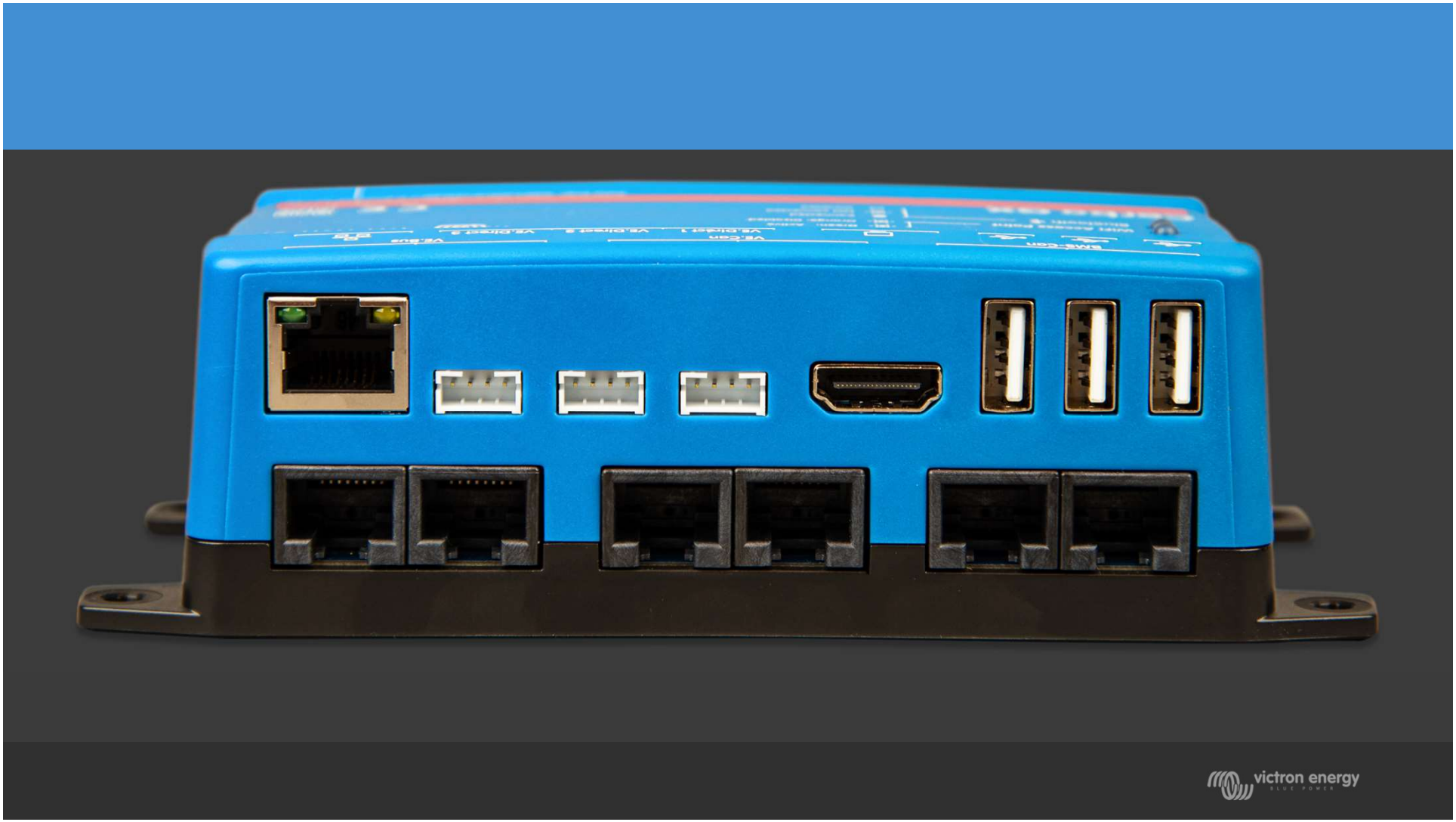
Cerbo GX & GX Touch 50

redefining smart energy

victron energy


BMS-Can
VE.Can
VE.Bus
VE.Direct 1
VE.Direct 2
VE.Direct 3
victron energy
BLUE POWER
WiFi Access Point
Green: Active
Orange: Disabled
Bluetooth
Connected
Not connected
Disabled
Cerbo GX
www.victronenergy.com
Press short: toggle WiFi Access Point & Bluetooth on / off
Press long: reset network settings
Micro SD
1 2 3 4
Tank
1 2 3 4
Temp
1 2 3 4
Digital inputs
DATA
GND
Relay 1
NO COM NC
Relay 2
NO COM NC
Power in
8-70VDC
- +


80ºC 30V COPARTNER
victron energy


victron energy


BMS-Can
VE.Can
VE.Bus
VE.Direct 1
VE.Direct 2
VE.Direct 3
victron energy
BLUE POWER
WiFi Access Point
Green: Active
Orange: Disabled
Bluetooth
Connected
Not connected
Disabled
Cerbo GX
www.victronenergy.com
Press short: toggle WiFi Access Point & Bluetooth on / off
Press long: reset network settings
Micro SD
1 2 3 4
Tank
Temp
Digital inputs
DATA
GND
Relay 1
NO COM NC
Relay 2
NO COM NC
Power in
8-70VDC

Bluetooth – for VictronConnect

Easier access & configuration

- Configure WiFi & LAN
- Open it on VRM
- Open Remote Console

Cerbo GX specifics

- DIN Rail mountable (requires a mounting kit accessory)

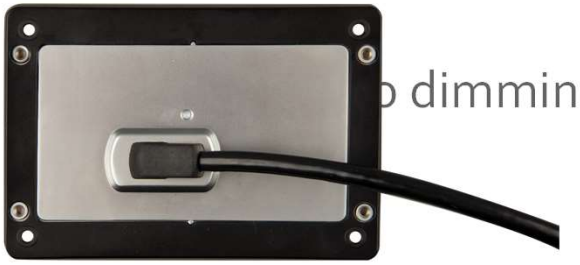
- Dual core CPU
  faster than CCGX & Venus GX; but not as fast as the Maxi GX.

Expected availability is by February, latest

GX Touch 50

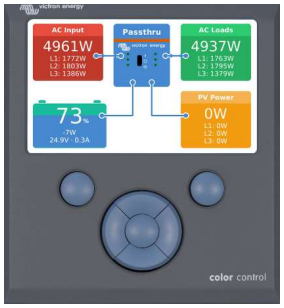
Easy to mount

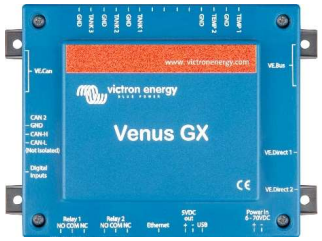
Waterproof



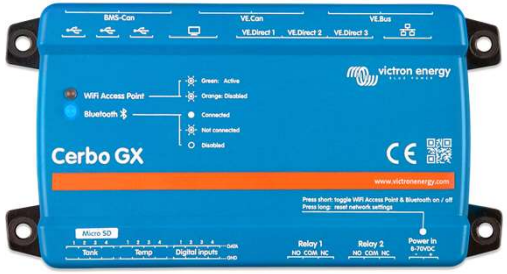
o dimming

VENUS OS


AC Input
4961W
Passthru
AC Loads
4937W
PV Power
0W
73
color control


victron energy
Venus GX


victron energy
Octo GX


victron energy
Cerbo GX

Venus OS V2.40

- Adds NMEA-2000 out function - finally.
- Auto configuring for Managed Batteries (BYD, Pylon, and more) (DVCC enabled; SVS off; etc). → less support
- Add IMT Solar Irradiation meter
- And many, many more new features.

See beta changelog on Community -> Modifications

Planned for release in December this year.

Marine MFD Integration


SIMRAD
SIMULATING...
S HDG 199 °M
11:15:06 20.8 m
Simulator
2 NM
HU
RM
Mode Cus
victron energy
Connected
BATTERY
55.1V -0.4A -20W
95% Idle
SHORE POWER
233V 3.6A 812W
Select shore input limit: 25A
INVERTER/CHARGER
Absorption charging
On
Off
Charger only
AC LOADS
233V 0.9A 231W
DC LOADS
0.1A 5W
SOG kn
7.0
DEPTH m
20.8
COG °M
199
STEER
ECOGPS NM/L
0.2378
TTD hrs
ON/OFF

MFD App

A strong USP for Marine OEMs (and shops)

Use it, learn it, train it. -> sell more

Marine MFD Integration

- New: product page on our website
  https://www.victronenergy.com/panel-systems-remote-monitoring/marine-mfd-gx-integration
- Various small improvements coming: fixing layout issues on a few screen-sizes.

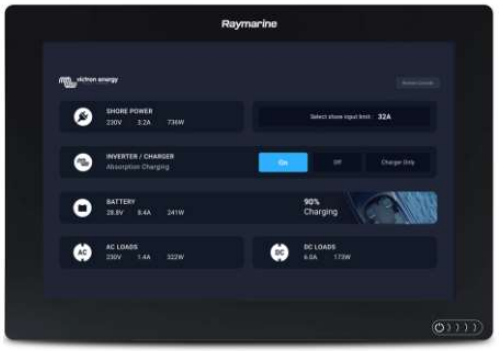
Raymarine

GARMIN

SIMRAD

B&G

LOWRANCE



NMEA2000 on Venus

&

NMEA2000 on Venus

Information available on NMEA2000

- VE.Bus Inverters, Multis & Quattros
- BMV, Lynx BMS, Lynx Shunt, and-so-forth

Later

- Solar Chargers
- And more

Availability

Now

&

MFD App vs NMEA2000 integration

MFD Victron App

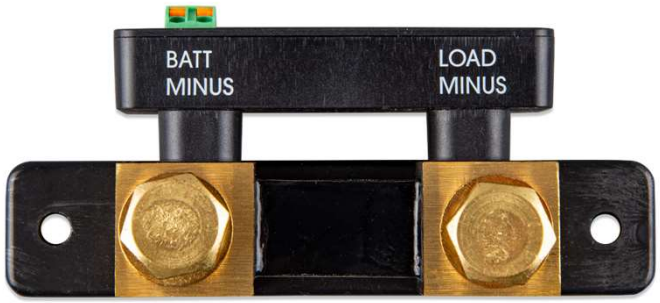
- **No configuration**
- **Good looking overview**
- **Adapts to the type of system**

NMEA2000

- **More flexibility**
- **Decide what parameter to show where**
- **Requires configuration and more specific compatibility.**

More new products

SmartShunt series



SmartShunt series

- VE.Direct cable to GX Device
- Monitoring & setup with VictronConnect
- 500A, 1000A and 2000A model

MultiPlus-II 24/3000

- Lower cost, Easier to install
- Less feed through current, 35A instead of 50A
- Slightly less peak power
- Steel instead of aluminium enclosure

Already in stock

More models coming

SmartSolar MPPT VE.Can Series

- In large parallel systems
- Replaces the old 150/70 & 150/85 VE.Can chargers
- Daisy-chain wiring: less clutter
- Use in large systems

In regards to the "old" VE.Can MPPT:

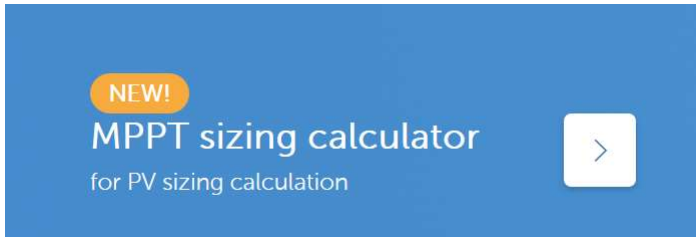
- It will not synchronise with the old ones
- Improved: each charger will be displayed individually
- Improved: supports ESS and Intelligent (Canbus) batteries, just like todays VE.Direct models.

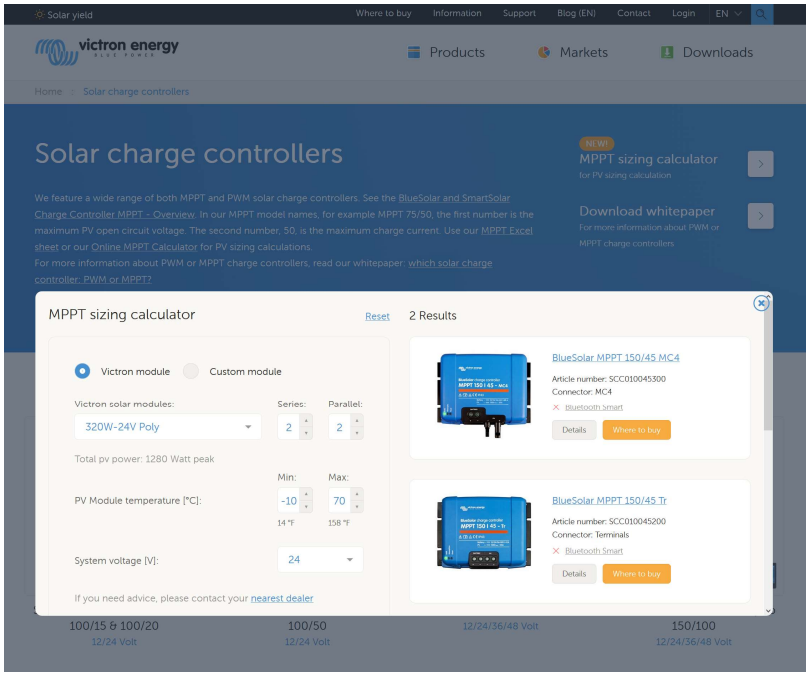
150 V	250V
70 A	70 A
100 A	100 A

MPPT sizing calculator

Can be found on the Solar charge controller product page

For Victron panels or custom panels





VRM Portal developments

- New Advanced page
- Increased SOC retention time from 6 months to four years
- Added various graphs & widgets
- Introduced the Economic report

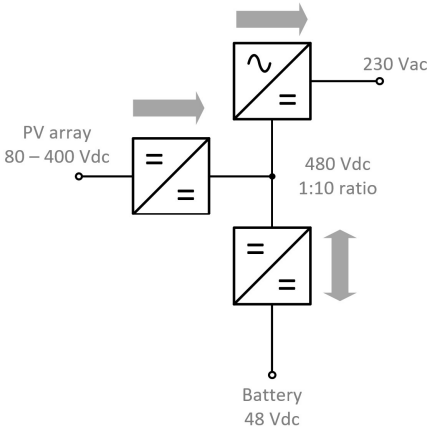
victron energy
BLUE POWER

Training – Inverters and inverter/chargers

Inverter RS Smart - HF inverter 48V/ 6000

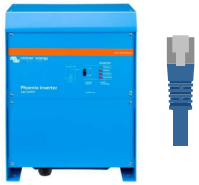
Soon

- 48V 6kVA Inverter with 450V 4kWp PV input
- Small display, VE.Can and VE.Direct
- Supports AC-Coupled PV frequency shift without assistant
- Similar efficiency but lower standby power



Inverter overview

Inverters VE.Direct										
12 V	250	375	500	800	1200	1600	2000	3000		
24 V	250	375	500	800	1200	1600	2000	3000		
48 V	250	375	500	800	1200	1600	2000	3000		



Inverters VE.Bus										
12 V					1200	1600	2000	3000		
24 V					1200	1600	2000	3000	5000	
48 V								3000	5000	

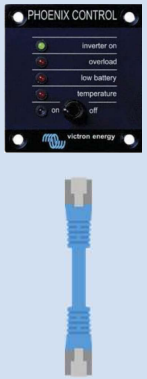
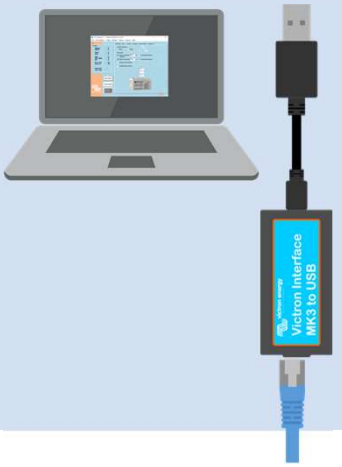
Soon

Inverters RS Smart										
48 V										6000

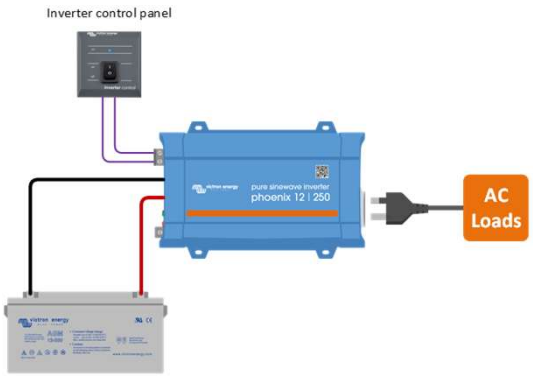
VE Direct inverter accessories

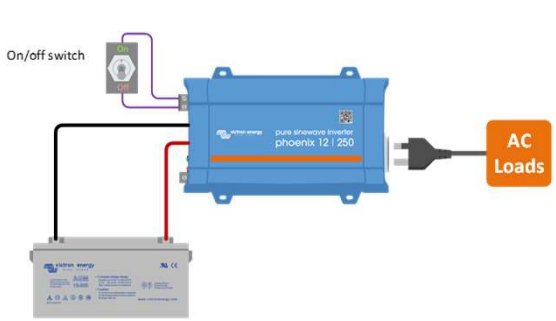
VictronConnect Bluetooth smart dongle	VictronConnect Bluetooth USB interface	VE.Direct cables 0.3 - 10 meter	Inverter control panel
			

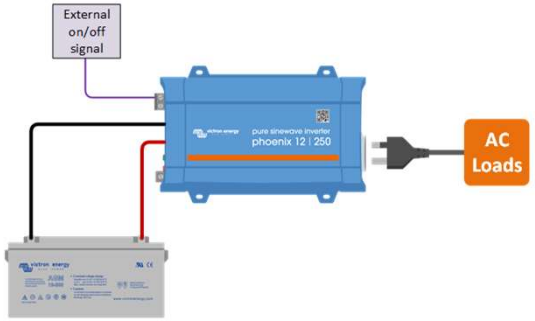
VE.Bus inverter accessories

RJ45 cable 0.3 - 30 meter	Inverter control panel	MK3 - USB interface
		

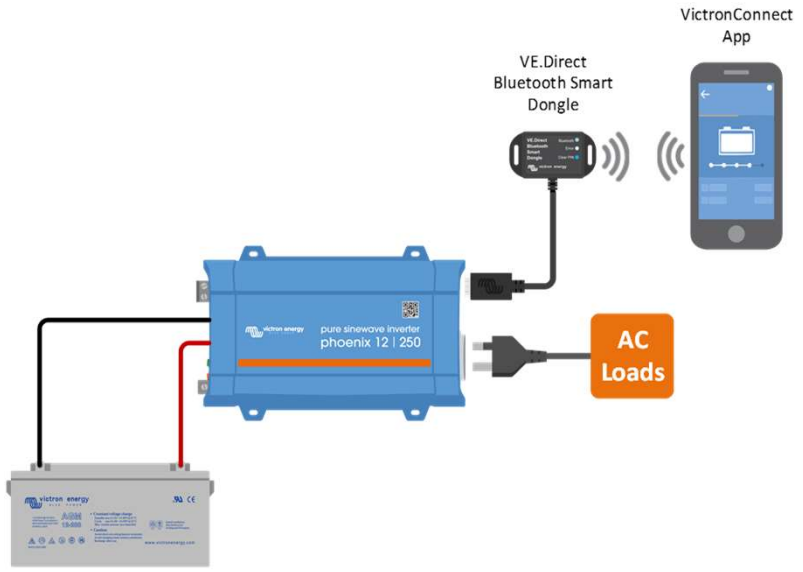
System examples using remote on/off

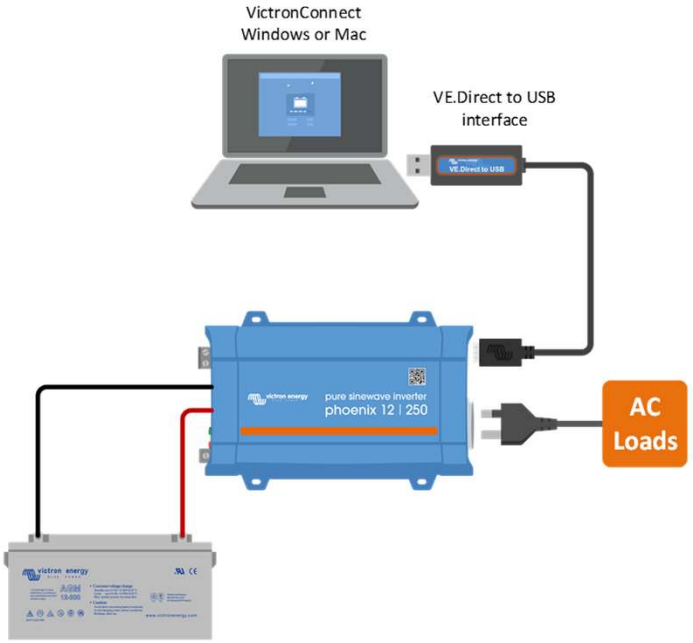






VE.Direct monitoring and setup via VictronConnect





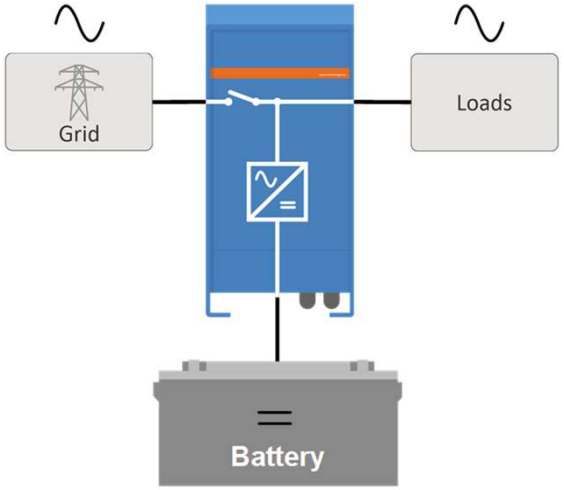
Inverter/charger

Inverter/charger

- An inverter/charger has the functionality of an inverter, a charger and an AC transfer switch.
- The inverter and charger are combined into a bidirectional converter

Main features:

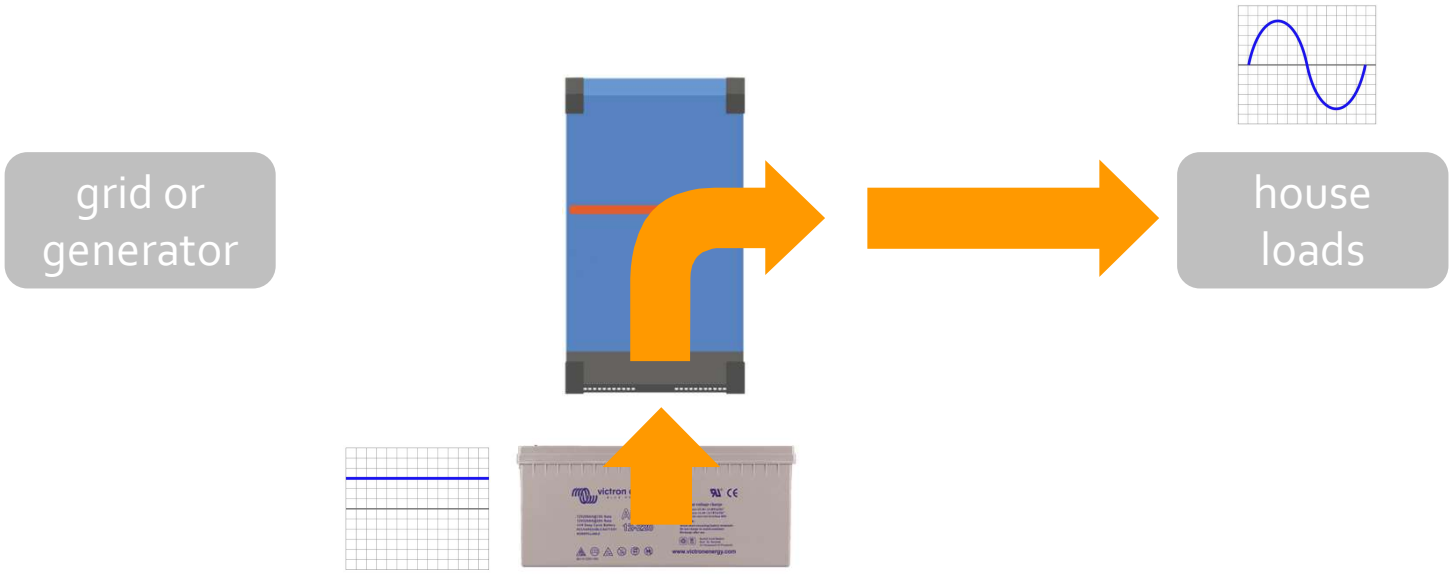
- Unique PowerControl and PowerAssist feature
- Uninterrupted AC power, UPS functionality
- Multiple units can operate in parallel and/or in 3 phase
- Fully computer configurable
- Intelligent and able to communicate with networks
- Available in 230Vac and limited models also in 110Vac



Inverting - changing DC into AC

When no grid or generator is connected the Multi is in inverter mode

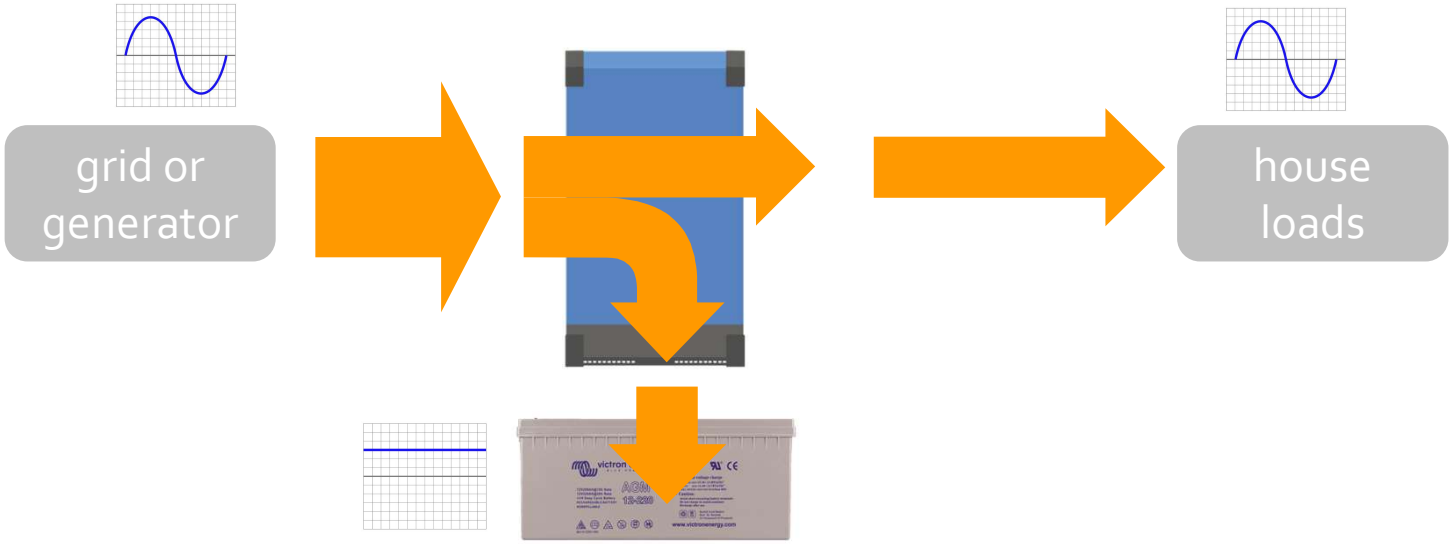
It will supply the AC loads from the battery



Charging - changing AC into DC

When connected to an AC supply the Multi will phase match to this supply

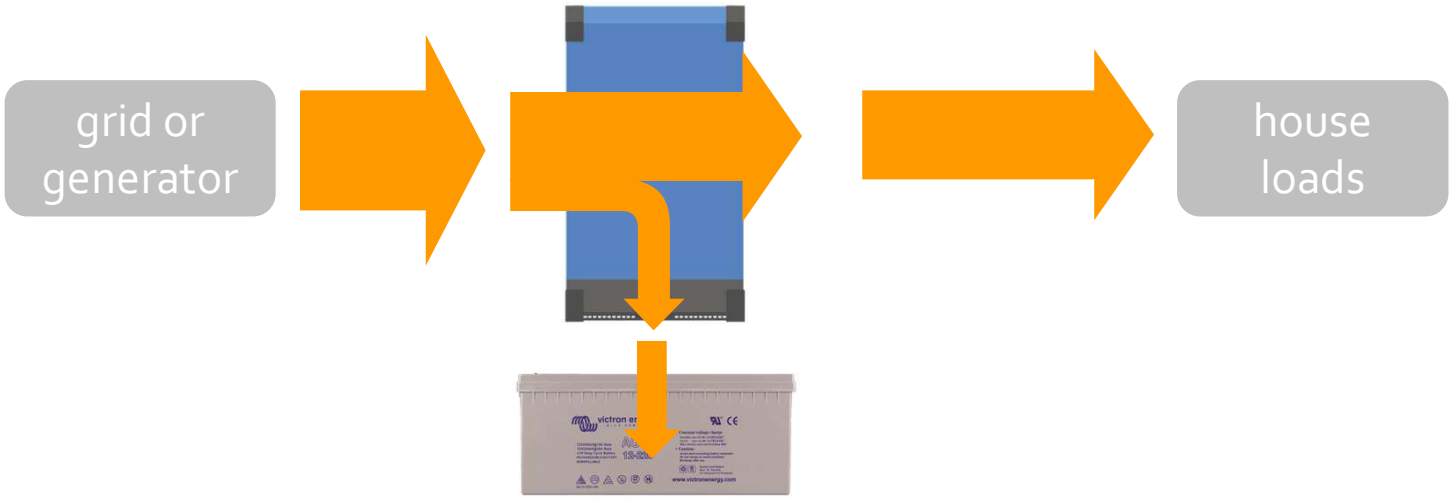
Once matched, the AC supply will supply the AC loads and will charge the battery



PowerControl

If the loads increase the battery charge current will eventually reduce

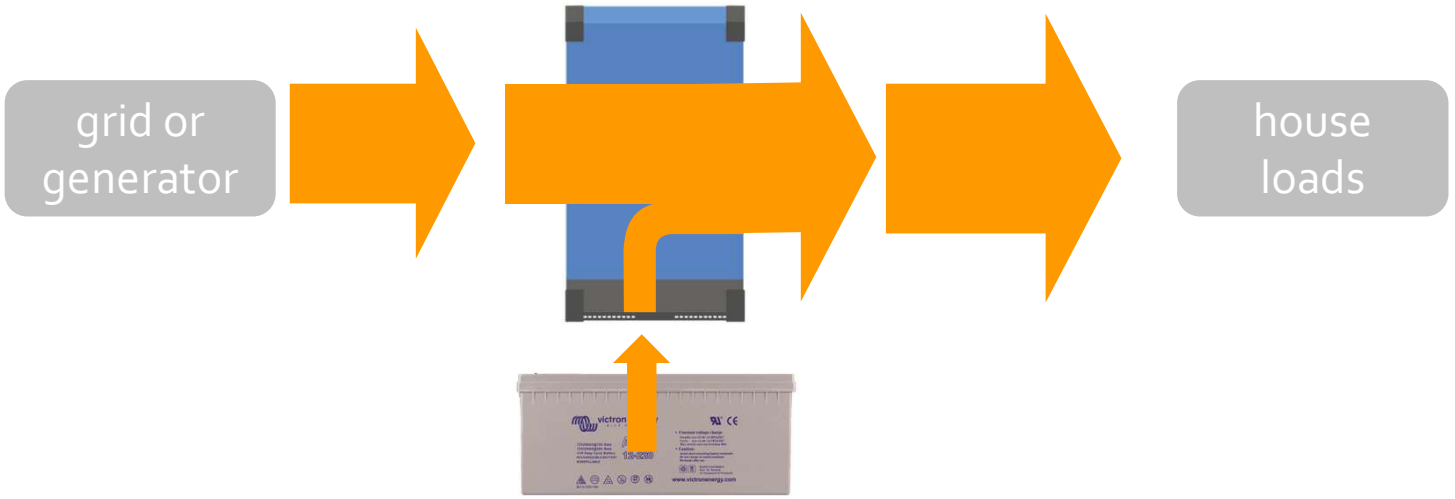
The loads always have first priority and the Multi will not overload the incoming AC supply



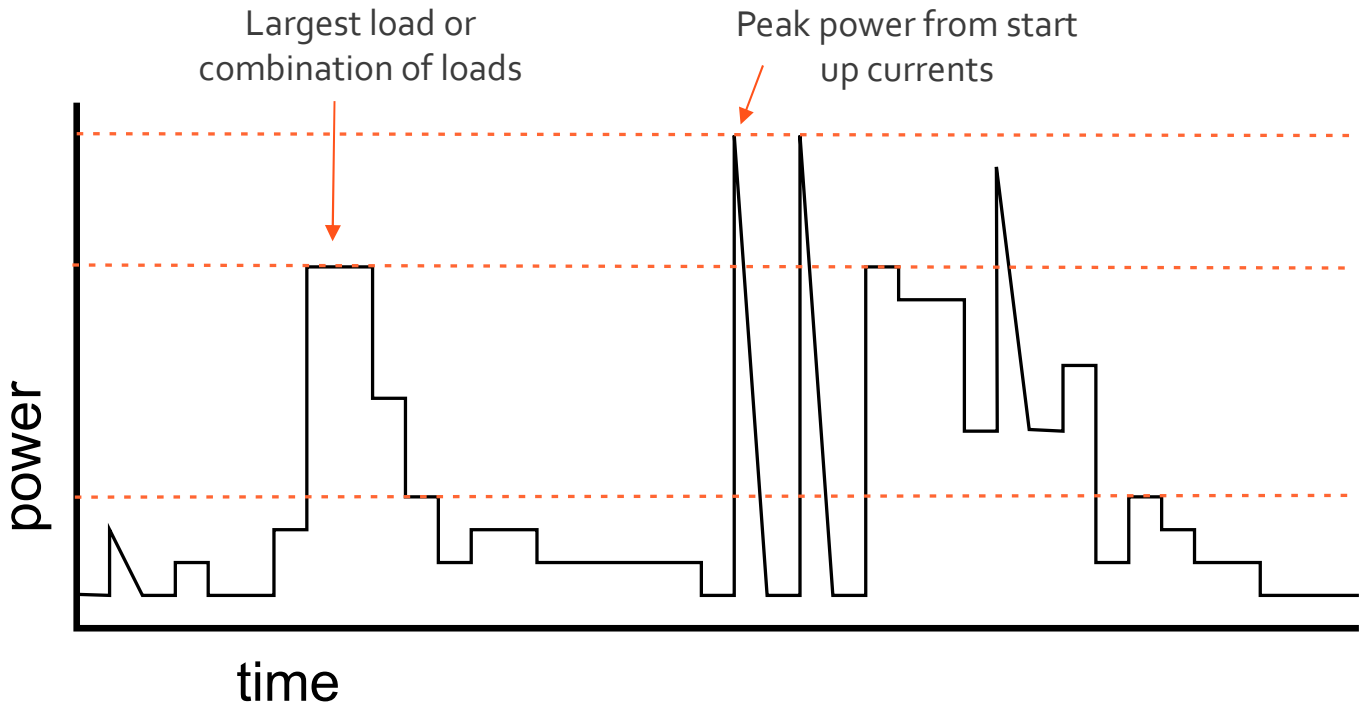
PowerAssist

If the load increases further battery charging will stop

And if the load is further increased, the battery will also provide power to the load



Average load of a system



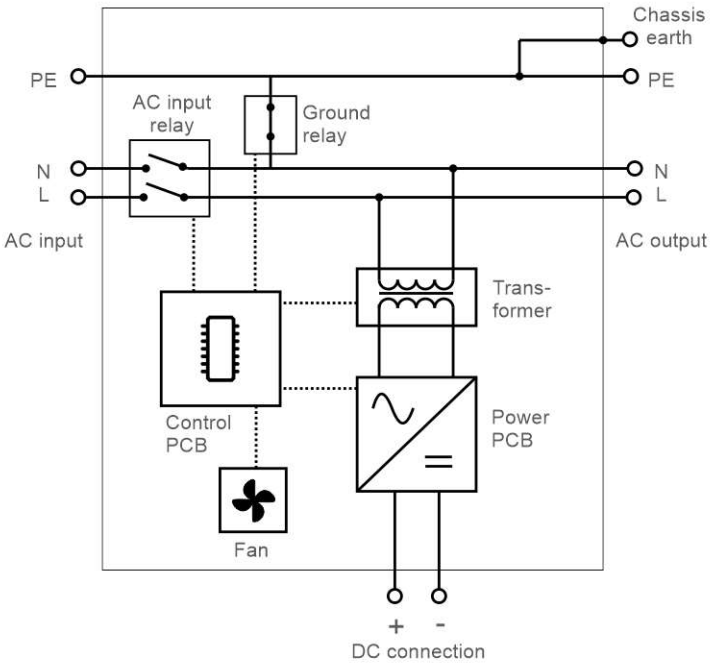
Peak load: This has to match the peak load capability of the Multi

Largest load: This determines the Multi size

Average load:

This determines the generator size in relation to its running hours

Internal wiring diagram basic inverter/charger

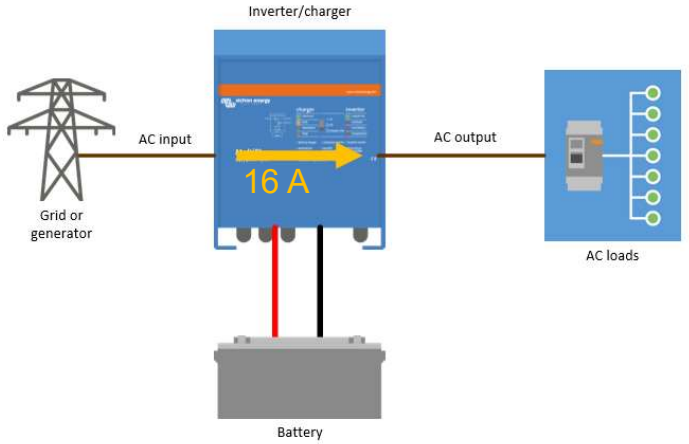


What's in a name?

Example:

PMP483020001 - MultiPlus 48/3000/35-16 - 230V VE.Bus Inverter/Charger

- 48 Volt battery
- 3000 VA continuous power rating
- 35 Amp charger
- 16 Amp AC pass through
- 230Vac model



Inverter/charger models

The widest range in the industry

Inverter/chargers										
12 V	500	800	1200	1600	2000	3000	5000			
24 V	500	800	1200	1600	2000	3000	5000	8000	10.000	
48 V	500	800	1200			3000	5000	8000	10.000	15.000

MultiPlus

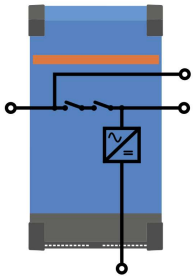
MultiPlus-II

2020

MultiPlus II

- Proven full bridge + toroidal transformer technology
- VE.Bus port for programming via MK3 interface or for connection to a GX device
- PowerAssist and PowerControl, Parallel and 3-phase operational
- IEC 62109-2 and 4777.2 certification
- Internal and optional external current sensor
- LED diagnostics
- Compact enclosure

24 Volt	48 Volt
3000VA - 70A	3000VA -35 A
	5000VA - 70A

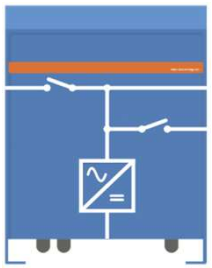
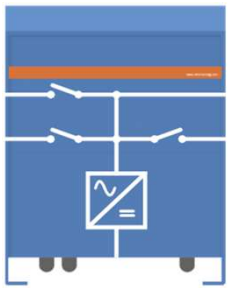
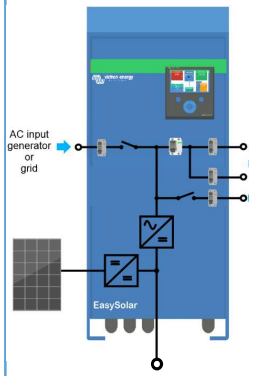
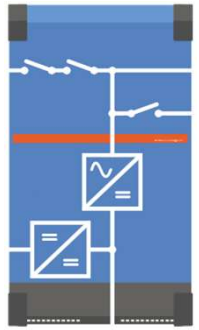


MultiPlus II GX

- Ethernet & Wi-Fi inside
- All GX device functionalities included
- VE.Can port (for managed batteries or MPPTs)

48 Volt
3000 VA
5000 VA

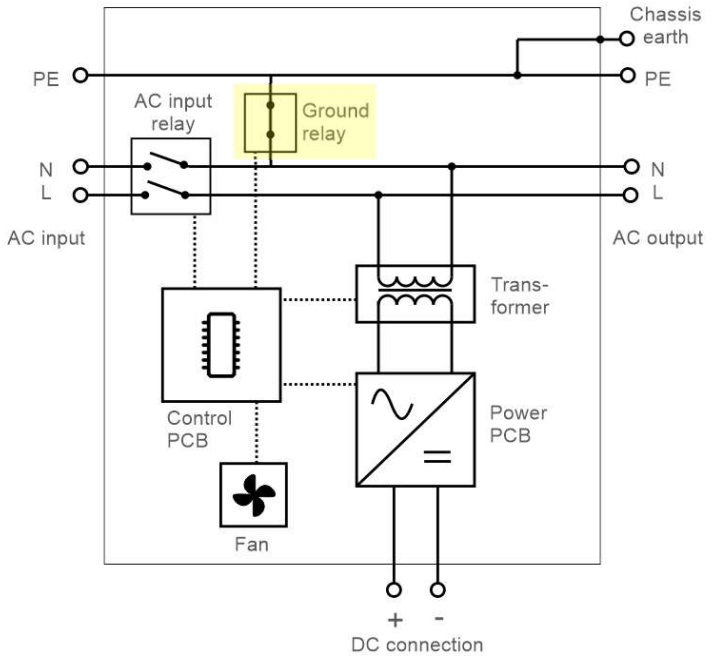
Inverter/charger models

Multi	MultiCompact	MultiPlus	MultiPlus-II	Quattro	EasySolar	EasySolar-II
500-1200	800-2000	3000 – 5000	3000 – 5000	3000 – 15000	1600 - 5000	3000
						

Internal ground relay

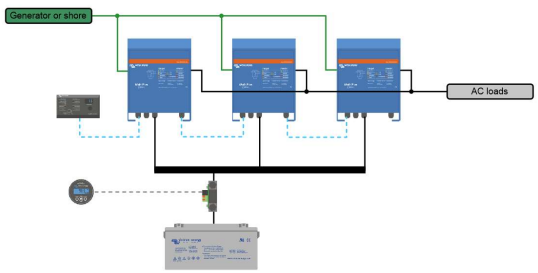
- The ground relay is closed when the back-feed relay is open - Inverting
- The ground relay is open when the back-feed relay is closed - Charging
- This is an essential feature for an RCD connected to the output to function

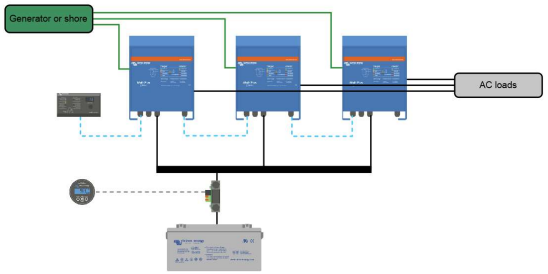
- The ground relay can be disabled if undesirable. Use in VE.Configure

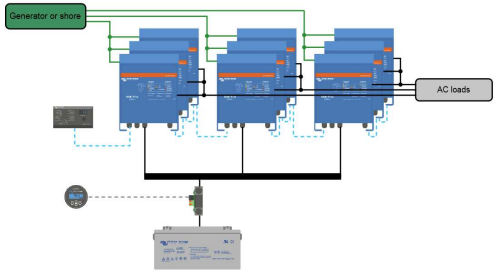


Parallel and/or 3 phase systems

- MultiCompact, MultiPlus, Quattros and large Phoenix inverters can be connected in parallel and/or 3 phase and 2 phase
- The maximum in a parallel string is 5 units up to 10 kVA or 4 units 15 kVA
- All units need to be the same model and be the same age and have the same firmware







What is Lithium?

LFP Features and benefits
and
comparison to Lead-Acid batteries

victron energy

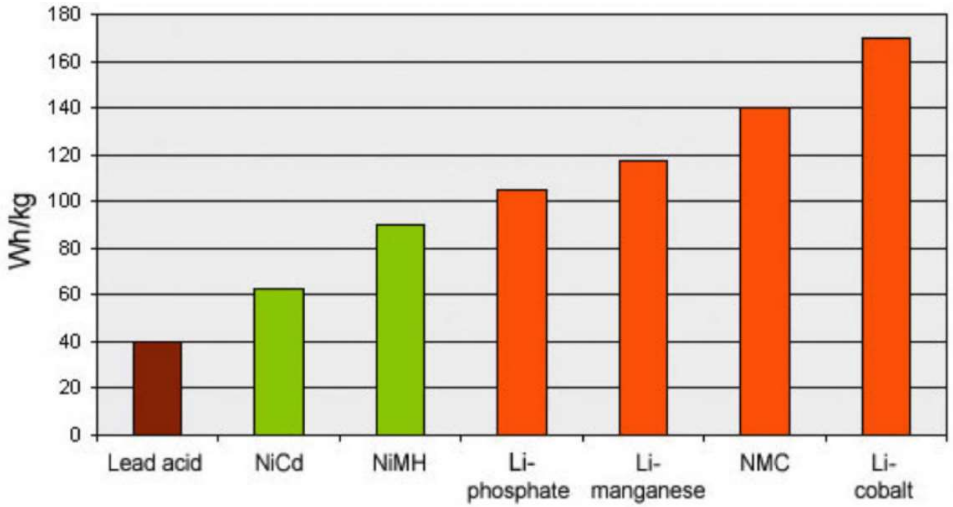
Capacity versus weight ratio

High energy density

- more energy with less weight
- double that of lead

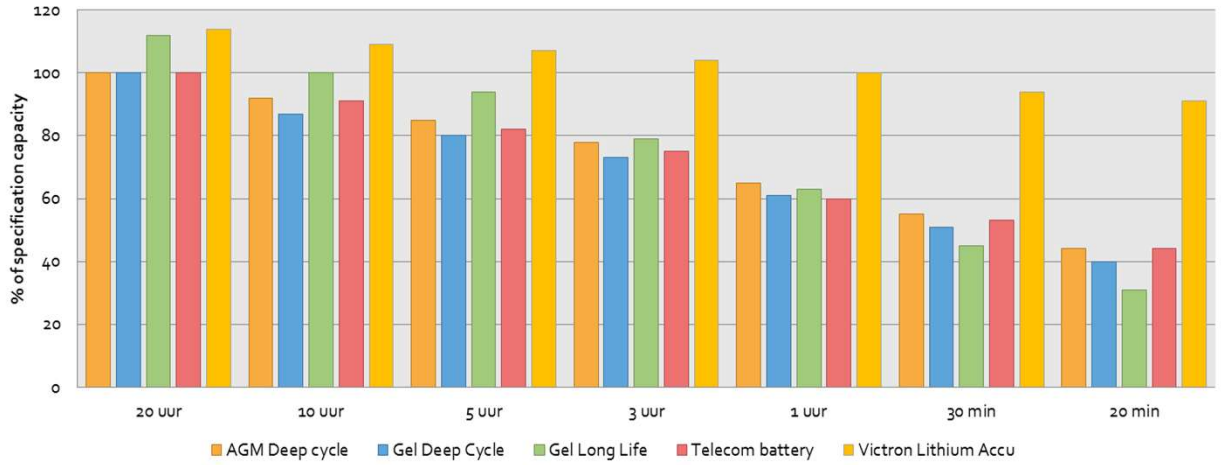
Power to weight

- Lead acid 42 W/h per Kg
- Lithium 105 W/h per Kg



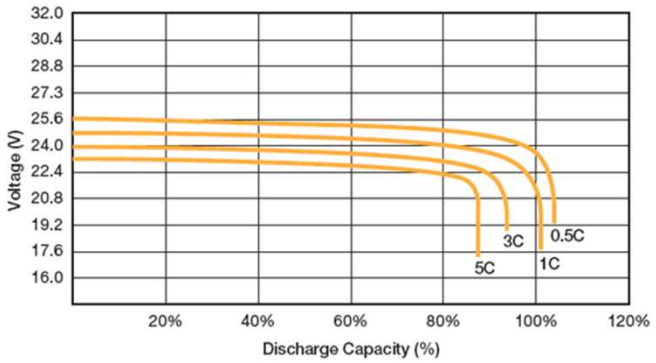
High charge and discharge currents

- Lithium batteries allow for high charge and recharge currents. High current loads can be run from relatively small batteries and recharge can be fast
- The charge and discharge rate can be C1 or C2. This means a total charge or discharge within 1 to 2 hours. Without capacity loss.

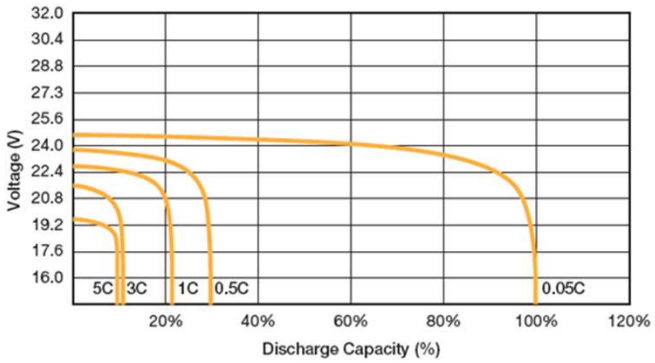


Steady battery voltage and capacity

Lithium

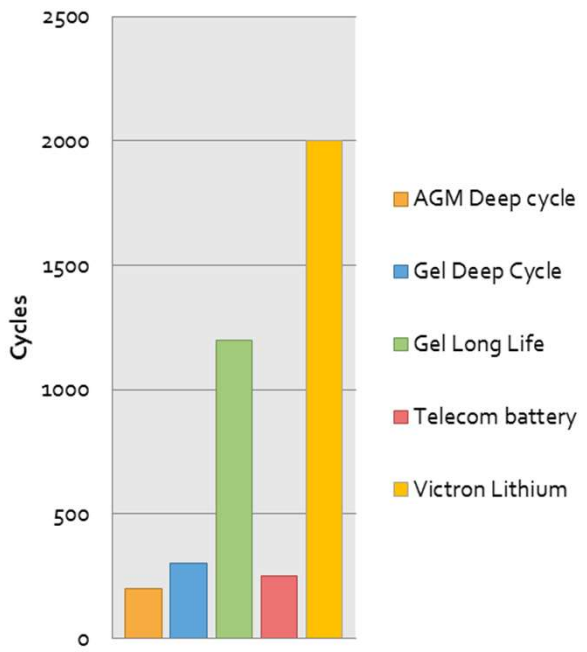


Lead Acid



Long cycle life and high charge efficiency

- Up to six times the battery life of a conventional battery at 50 % discharge
- High charge efficiency, and very little energy loss due to heat development
  - Lead acid 80 %
  - Lithium 92 %



Temperatures

Lithium has better lifetime at higher temperatures

Lithium 12.8V 200Ah	AGM 12V 220Ah	
	+20° C:	7-10 years
-20 to +50 °C	+30° C:	4 years
	+40° C:	2 years

But, lithium cannot be charged below zero degrees while lead acid can

Cycles versus price comparison

- Lithium has a high initial cost, but a cycle costs less

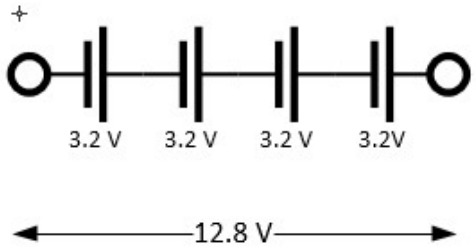
Lithium 12.8V 200Ah Smart	Versus	AGM 12V 220Ah
Cycles	DoD	Cycles
2500	80 %	400
5000	50 %	600
$ 3594	RPP ex GST	$ 829
0.72 $/cycle	@50 % DoD	1.38 $/cycle

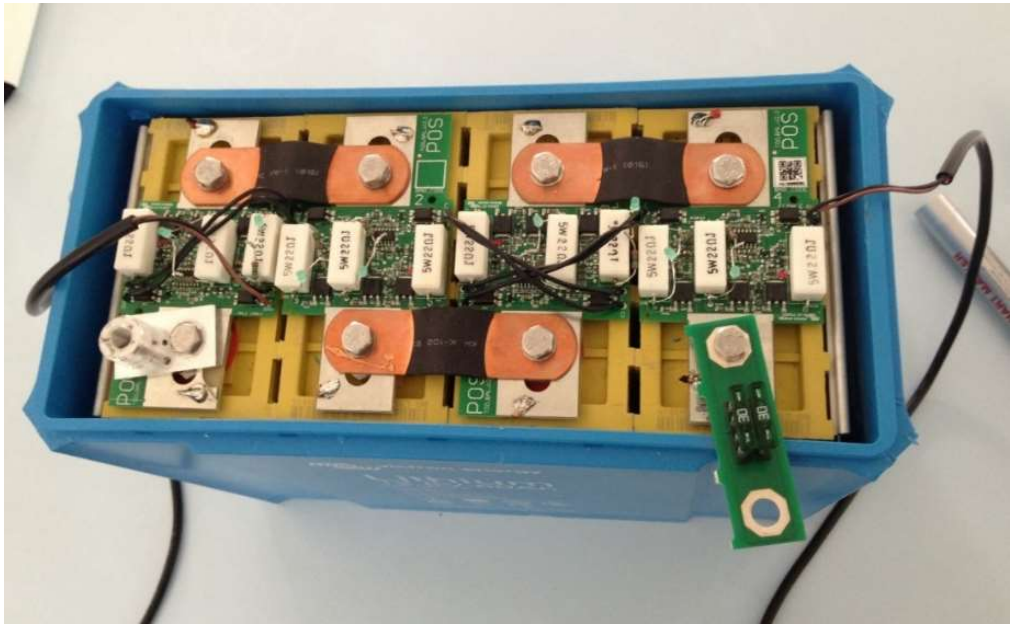
No gassing

- Lithium batteries do not create gas when charging
- Lithium batteries can be placed in the same enclosure as electric equipment
- No air extraction is needed for lithium battery compartment
- No corrosive fumes

A battery is made up of several cells

- The nominal voltage of each cell is 3.2 V
- To create a 12.8 V battery 4 cells are connected in series: 4 x 3.2 = 12.8 V





Update LFP batteries

Size and weight

	LFP 12,8/200 'old'	LFP 12/200-a 'new'	
Weight	42 kg	22 kg	
Specific energy	61 Wh/kg	116 Wh/kg	x 1,9
Energy density	73 Wh/L	220 Wh/L	x 3

Factors to watch out for when using Lithium

Cell balancing

- Lithium cells can easily become unbalanced.

Protection against under voltage

- Very deep discharge will cause unrecoverable damage.

Protection against over voltage

- Charging with a too high voltage will cause fire.

High temperature protection

- Charging when temperatures are too high can cause fire.

Low temperature charge prevention

- Charging below zero will damage the battery.

Cell balancing

The cells of a LFP battery do not auto-balance at the end of the charge cycle.

They need to be balanced during charging.

There are two types of balancing, active or passive:

- Passive balancing - removes energy from the most charged cell and this energy is wasted in heat.
- Active balancing - moves energy from the most charged cell to the least charged cell.

Under and over voltage

Low voltage

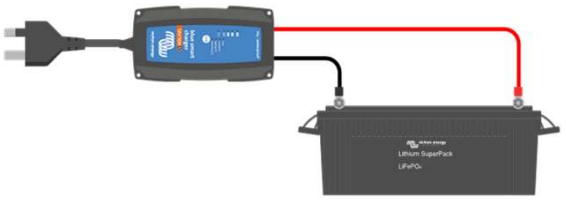
- A LFP cell will fail if the voltage over the cell falls to less than 2.5 V.
- This can cause unrecoverable damage to the cell.
- Loads will need to be turned off, or disconnected, in case of low voltage.

High voltage

- A LFP cell will fail if the voltage over the cell increases to more than 4.2 V.
- The battery will catch fire if the voltage is very high.
- Charge sources will need to be turned off, or disconnected, in case of high voltage

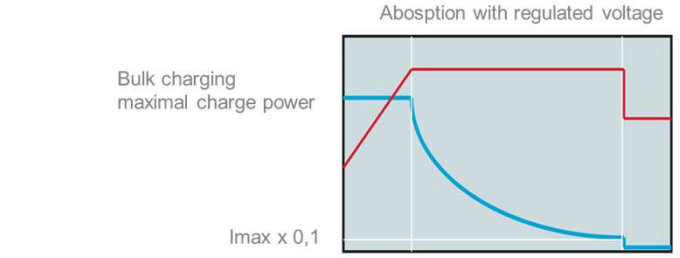
How to charge a lithium battery

The battery charger or inverter/charger needs to have a lithium mode.



Recommended settings:

- Absorption voltage needs to be between 14.0 and 14.4 V, we recommend 14.2 V.
- Set absorption to 2 hours.
- Set float voltage 13.5 V.
- Charge current can be up to 2C, but we recommend 0.5C.



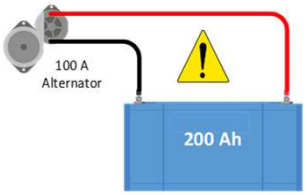
Since the voltage is regulated the current will drop when SOC 100% is reached
When 10% of the nominal charge current is reached the charger will be stopped

Charging from an alternator

A lithium battery has a very low internal resistance.

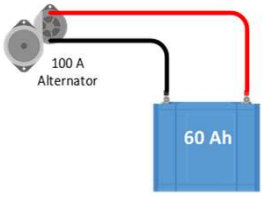
The alternator will try to charge with a current higher than it is designed for.

This will cause damage to the alternator.



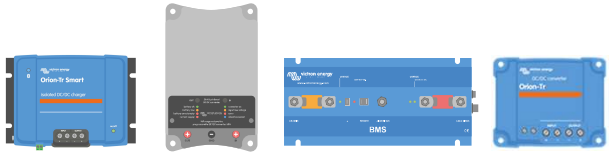
Match the alternator size to the battery capacity:

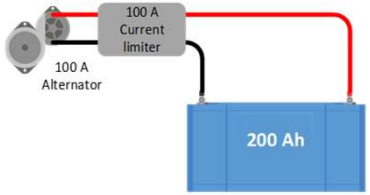
- The alternator will have to be a larger current rating than the C1 rating of the battery bank. Avoid having a small alternator with a big LPF battery bank



Restrict the alternator current into the battery by using:

- A Smart Orion (multiples can be parelelled)
- Buck Boost converter
- An Orion DC/DC converter
- A 12-200 BMS





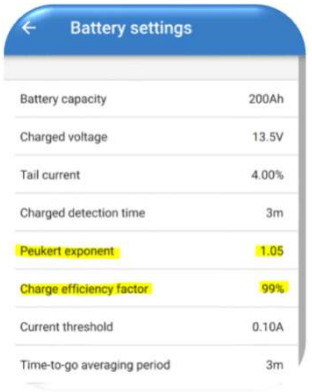
More info see: [blog and video]

BMV settings

Lithium batteries behave different than lead acid batteries during charging and discharging.

Some settings need to be changed in the BMV:

- The charge efficiency of Li-ion batteries is much higher than lead acid batteries. The charge efficiency can be set at 99 %.
- LFB batteries perform much better than lead-acid batteries under high discharge rates. The Peukerts exponent can be set at 1.05.
- For more info see the BMV manual



Lithium SuperPack

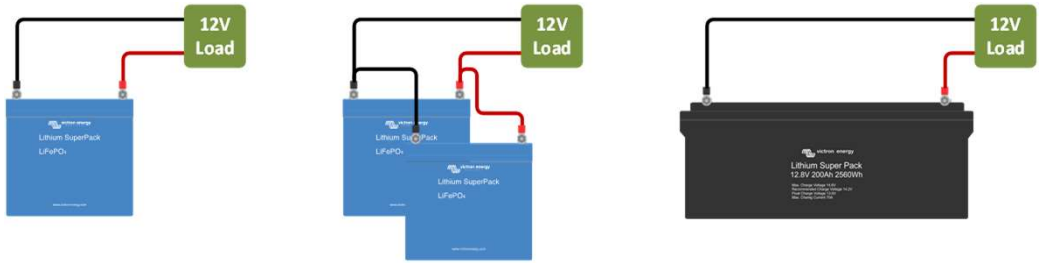
Lithium Super Pack LPF batteries

- Available in 12.8 and 25.6V models
- Can be connected in parallel, but not in series
- Contains internal BMS and disconnect switch. It will disconnect from the system on over voltage, under voltage and high temperatures
- When used with an alternator a current limiting device is needed
- Be aware of the maximum discharge currents. If they are exceeded an internal relay will trip and it will take 10 seconds to reset

12.8 V	25.6 V
20 Ah	
60 Ah	50 Ah
100 Ah	
200 Ah	

Constructing a Super Pack battery bank

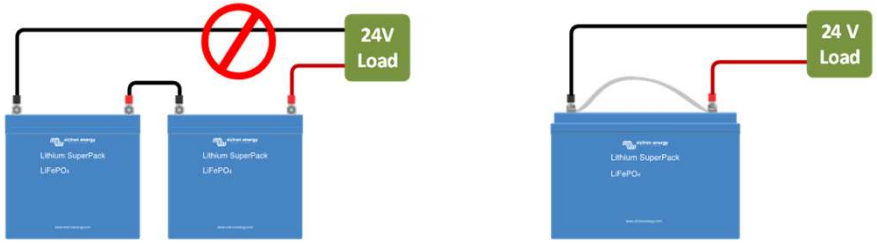
Parallel connections are allowed



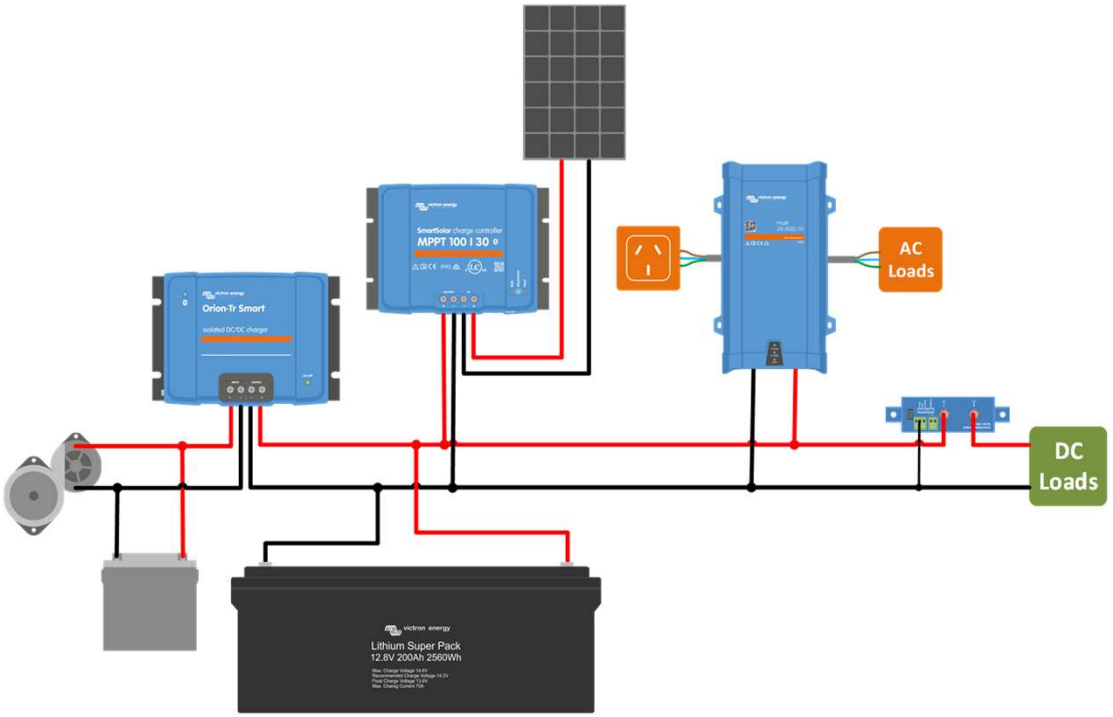
Series connections are **not** allowed

If 24 V is needed, use the 25.6 V battery

48V battery banks are not possible



Lithium SuperPack system example



Lithium Smart LFP batteries

New: the pre-alarm feature

Up to 10 batteries can be paralleled

Up to four 12V batteries or two 24V batteries can be series connected

Balancing/monitoring cables can be daisy-chained and must be connected to a BMS.

LiFePO4 battery 12,8V/60Ah - Smart
LiFePO4 battery 12,8V/100Ah - Smart
LiFePO4 battery 12,8V/150Ah - Smart
LiFePO4 Battery 12,8V/200Ah - Smart
LiFePO4 Battery 12,8V/300Ah - Smart
LiFePO4 Battery 25,6V/200Ah - Smart

VE.Bus BMS Pre-alarm

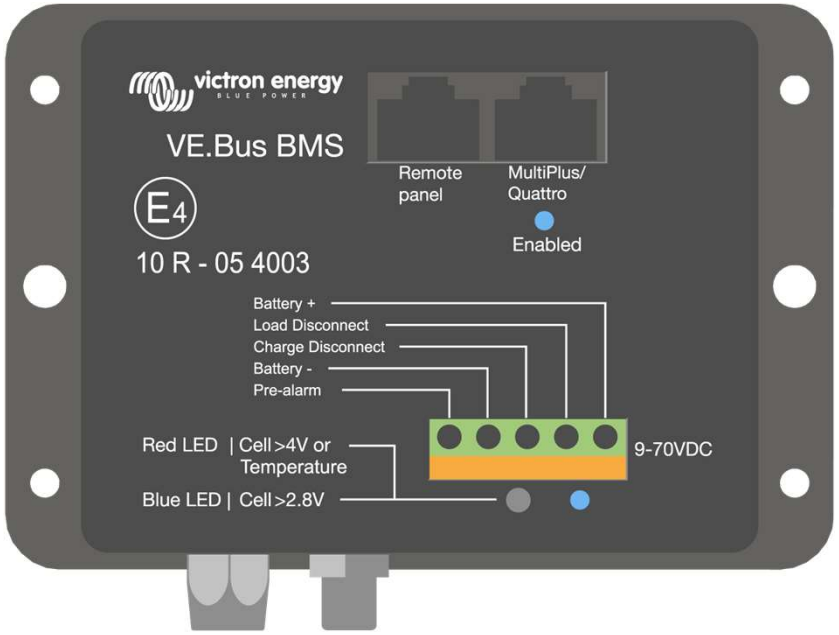
Protects 12V, 24V and 48V systems

Communicates with all VE.Bus products

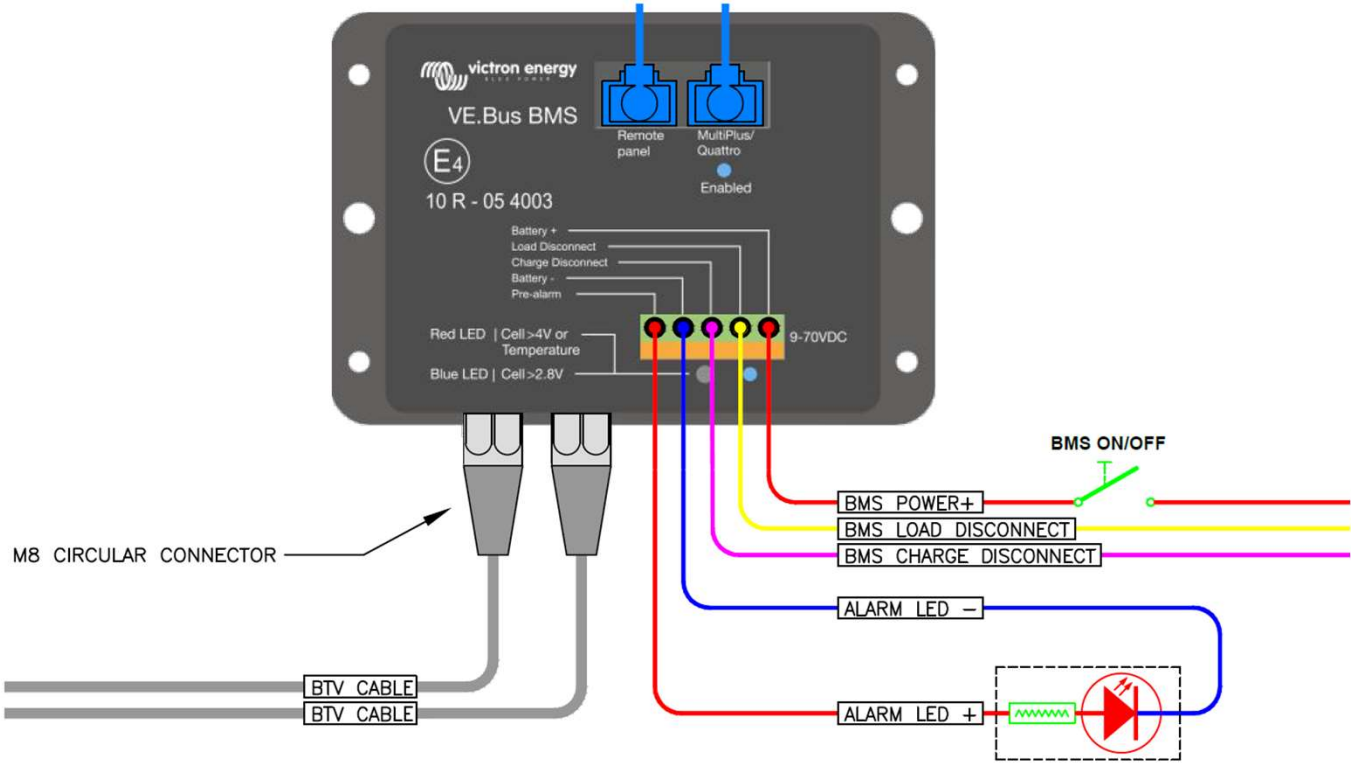
Load Disconnect (2A)

Pre-alarm (5mA)

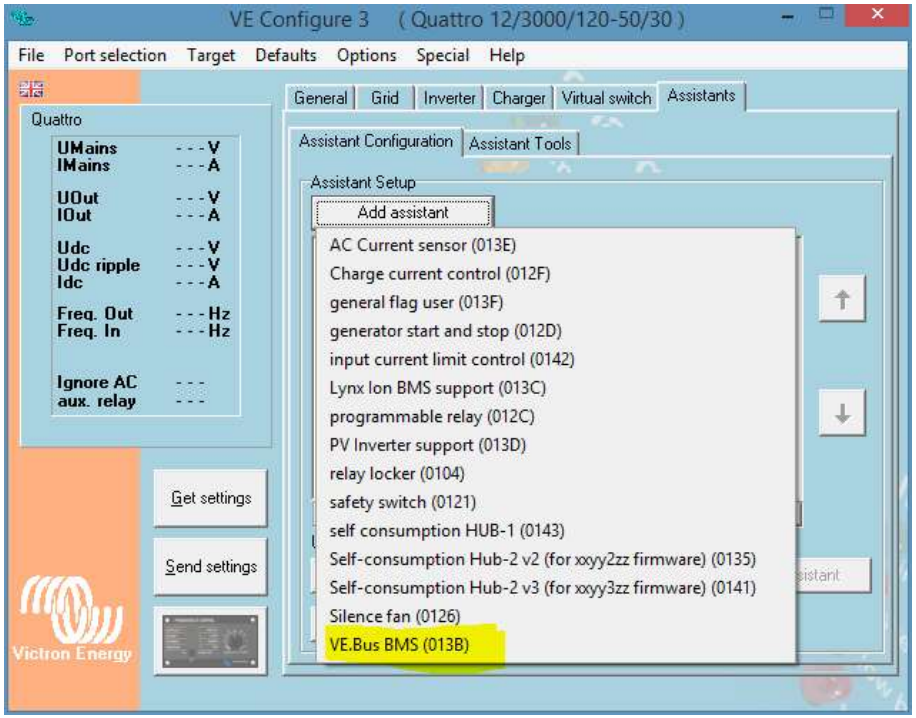
Charge Disconnect (10mA)

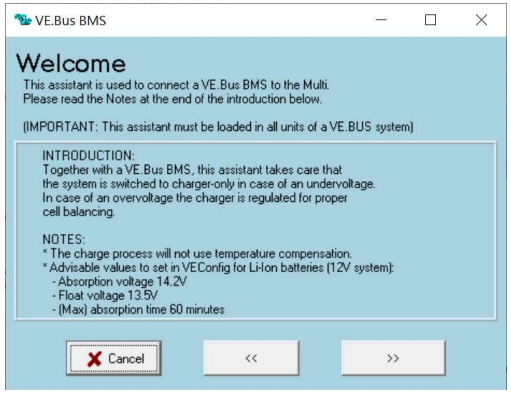


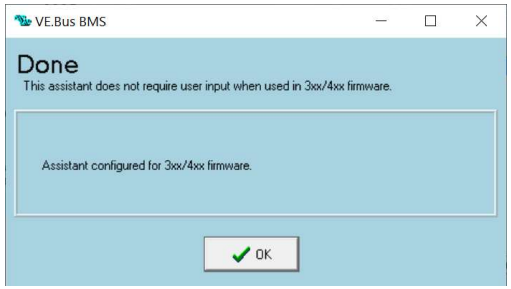
VE.Bus BMS Pre-alarm



When using a VE.Bus BMS programming is needed







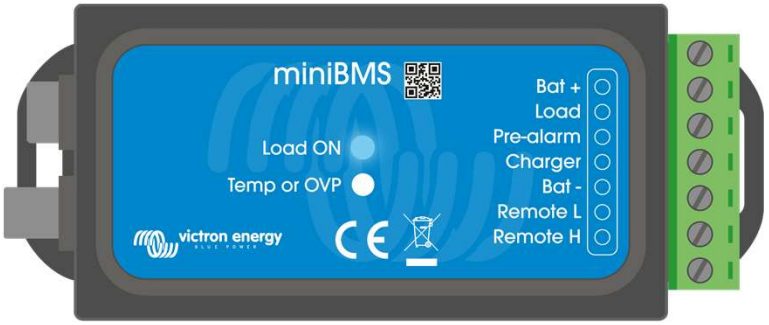
miniBMS Pre-alarm

Protects 12V, 24V and 48V systems

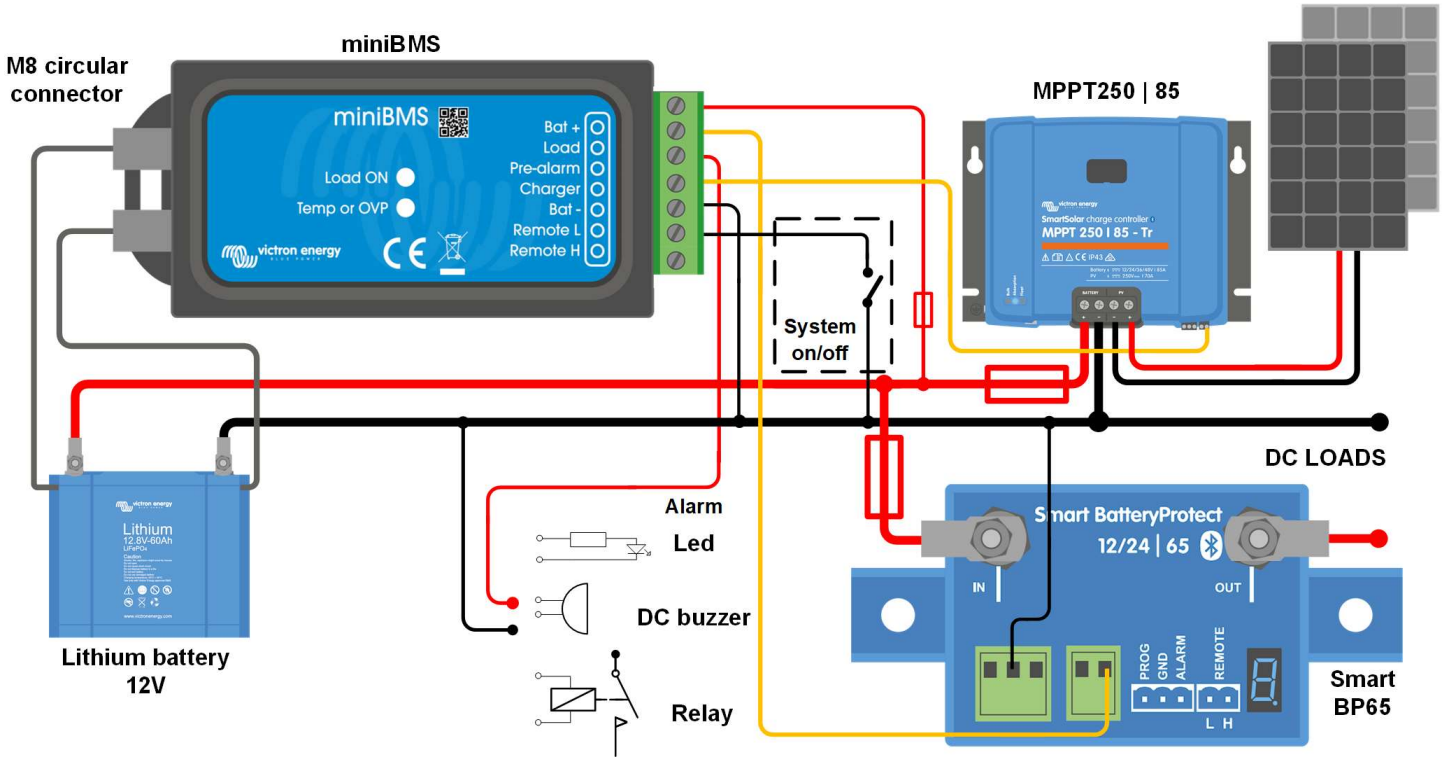
A simple and low cost alternative to the VE.Bus BMS

System on/off input

Load Disconnect output	(1A)
Pre-alarm	(5mA)
Charge disconnect output	(10mA)



miniBMS Pre-alarm



12/200 BMS

Protects 12V systems

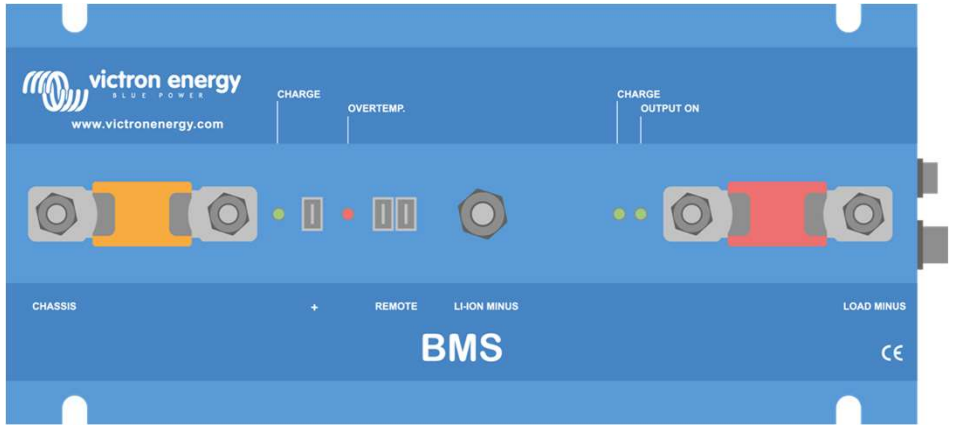
A simple and low cost alternative

System on/off input

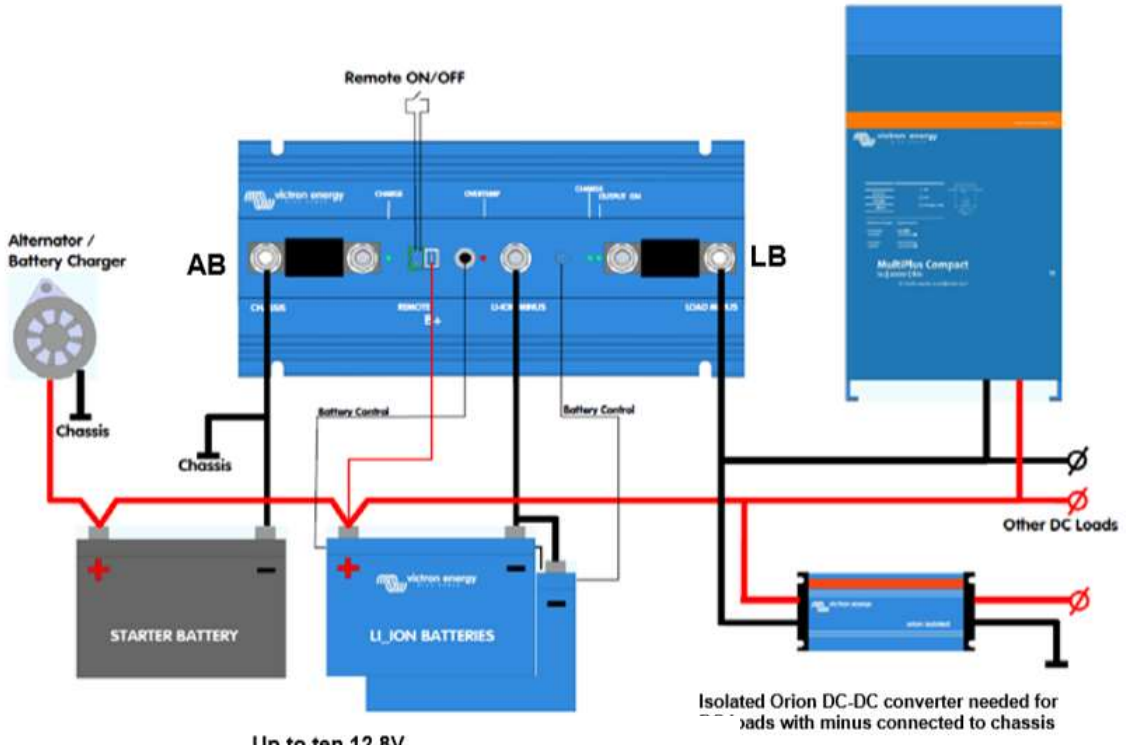
Load Disconnect output (200A)

Alternator charge limiter input (80A)

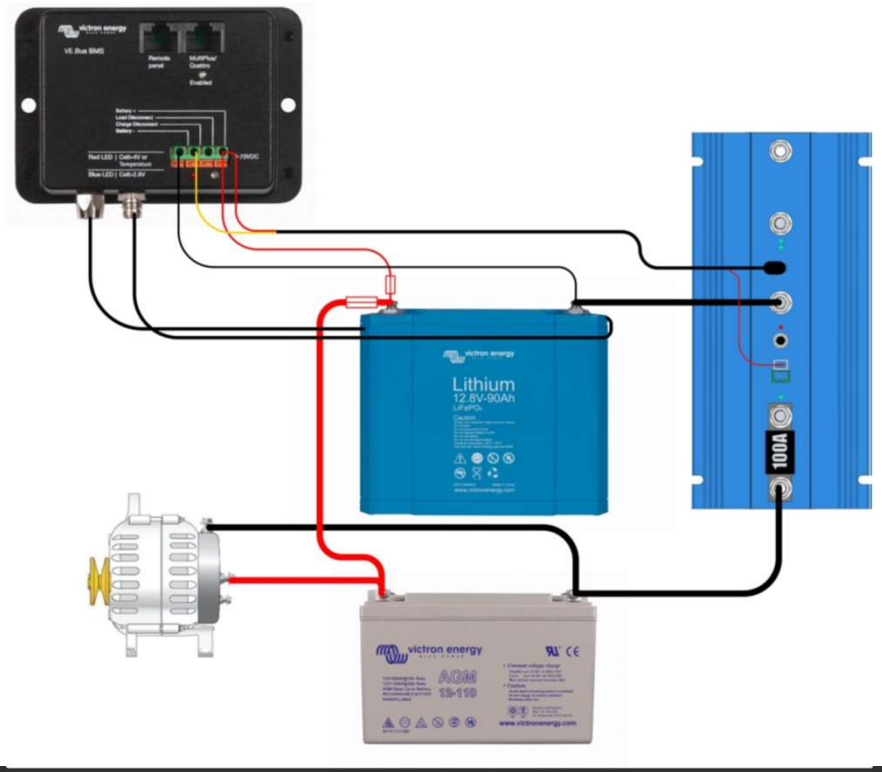
Controlling current is in the minus



12/200 BMS


Remote ON/OFF
Alternator /
Battery Charger
AB
LB
Chassis
Chassis
Battery Control
Battery Control
Other DC Loads
STARTER BATTERY
LI_ION BATTERIES
Isolated Orion DC-DC converter needed for
ads with minus connected to chassis

VE.Bus BMS



Smart BMS CL 12/100

Protects 12V systems

Alternative to Buck Boost converter

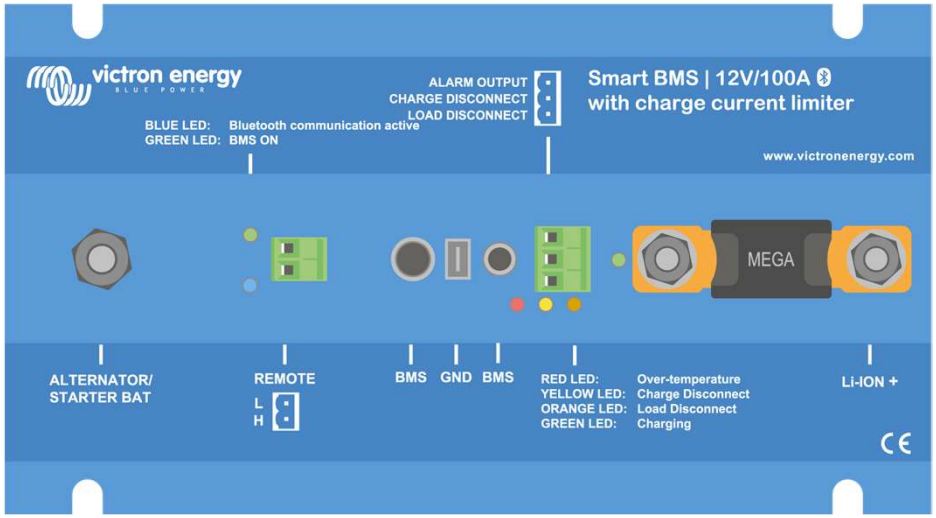
System on/off input

Load Disconnect output (10mA)

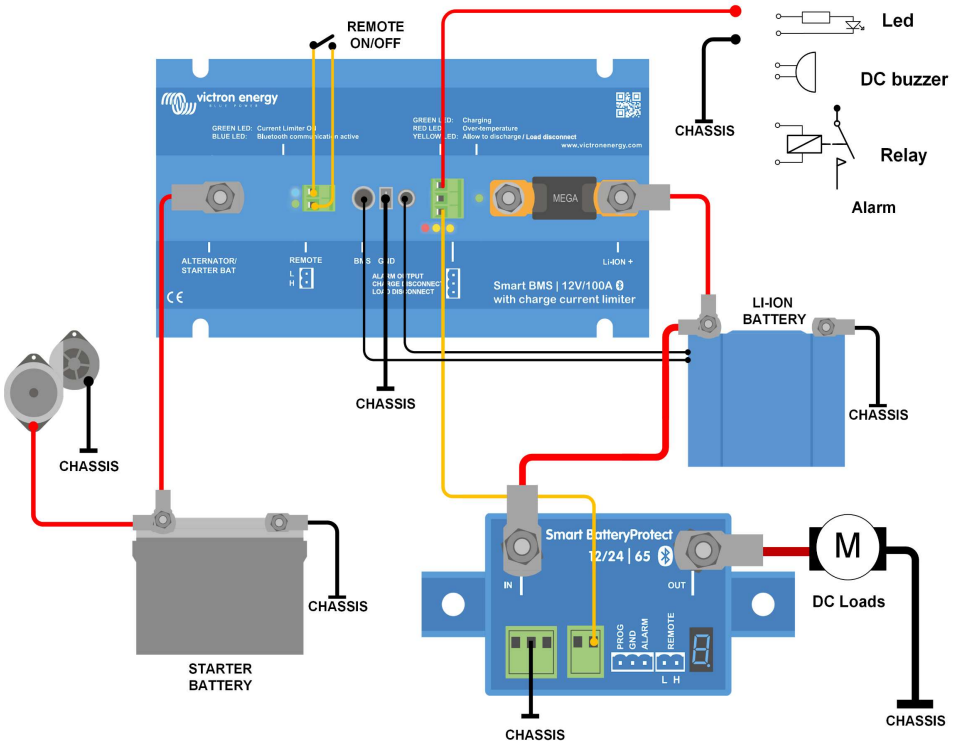
Pre-alarm (1A)

Charge disconnect output (10mA)

Starter battery Protection



Smart BMS CL 12/100



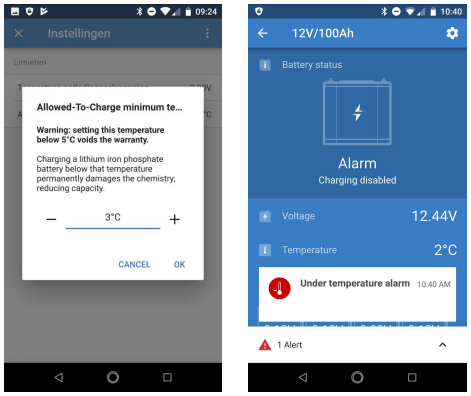
Lithium Smart LFP

- Available in 12.8 and 25.6V models
- Can be connected in parallel and/or in series up to 48V battery bank
- An additional external BMS is needed, 3 different types available
- The BMS will disconnect the loads in case of under voltage and/or over temperature
- The BMS will disconnect the charger in case of over voltage and /or over or under temperature
- When used with an alternator a current limiting device is needed to protect the alternator

12.8V	25.6 V
60 Ah	
100 Ah	
150 Ah	
200 Ah	200 Ah
300 Ah	

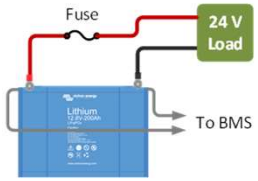
Cell balancing and monitoring

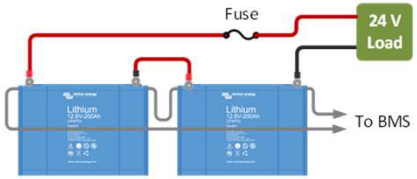
- Active cell balancing
- Built-in Bluetooth
- Cell monitoring via the VictronConnect app

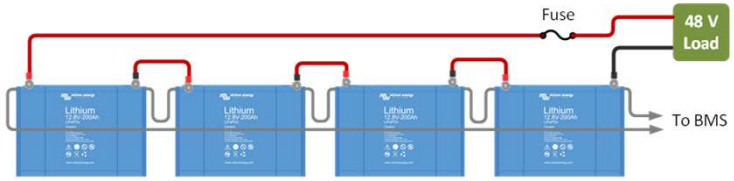


Series battery bank

- 12, 24 or 48 V battery bank, Up to four 12V and two 24V batteries can be series connected
- The BMS communication cables daisy chain to each other and the first and last cable connects to the BMS
- BMS extension cables are called: M8 circular connector Male/Female 3 pole cable (bag of 2)

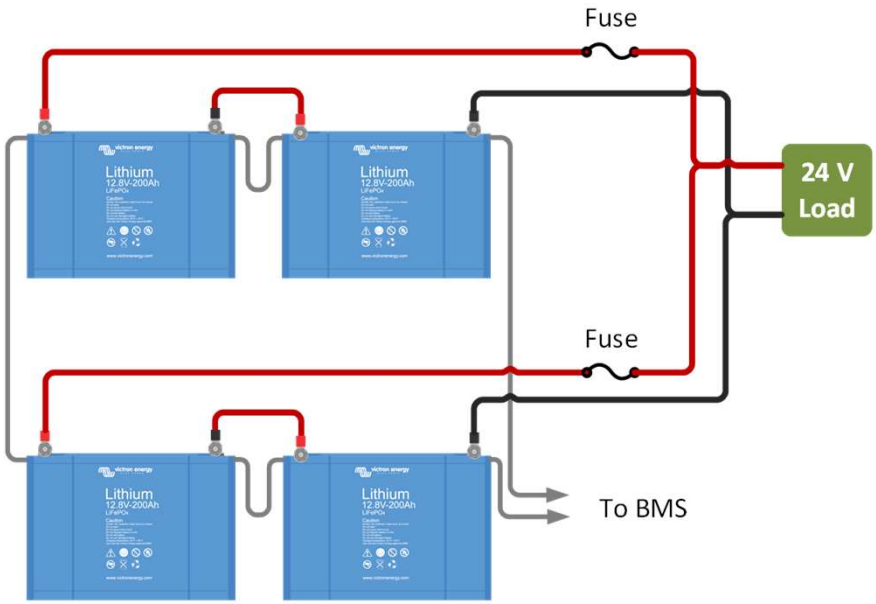






Parallel battery bank

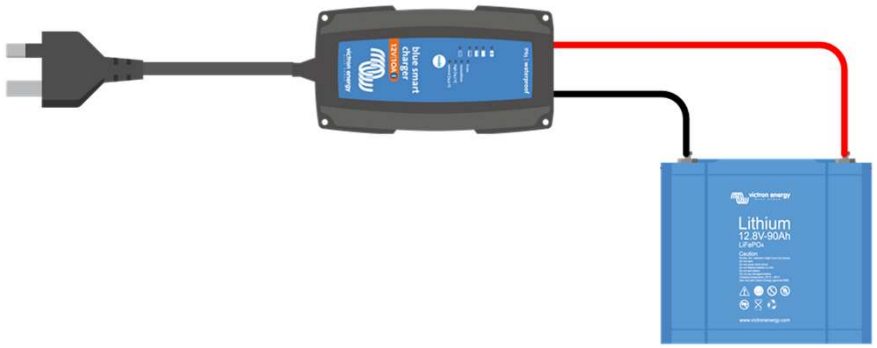
- 12, 24 or 48 V battery bank
- Up to 10 battery strings can be paralleled.
- Each string needs to be fused
- The BMS communication cables are daisy chained
- Do not connect midpoints



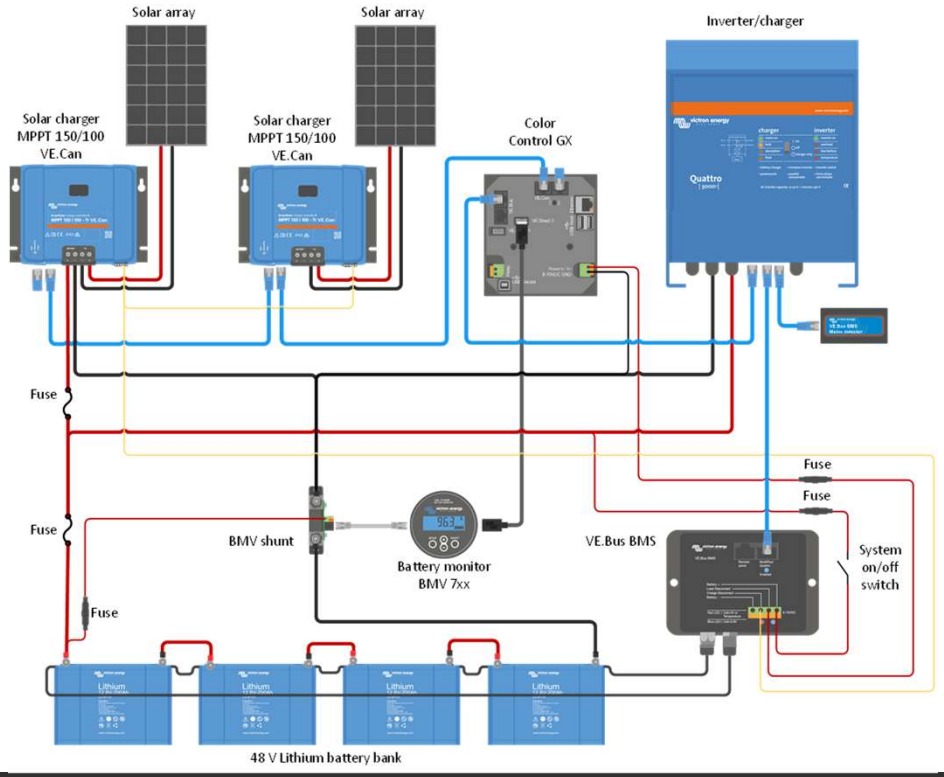
Always charge batteries before use

- Lithium batteries are approximately 50 % charged when shipped
- Each battery needs to be individually charged before use and before they are going to be connected in a series and/or parallel
- Use a low charge rate (C/20 or less) with a charger set at 14.2 V (BlueSmart charger)

BlueSmart IP65 charger



VE.Bus BMS example with inverter/charger



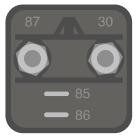
Battery Protect and Cyrix-Li

Battery protect or Cyrix-Li are used to turn a load or charge source of and are controlled by a BMS.

BatteryProtect has a lower self consumption than a Cyrix

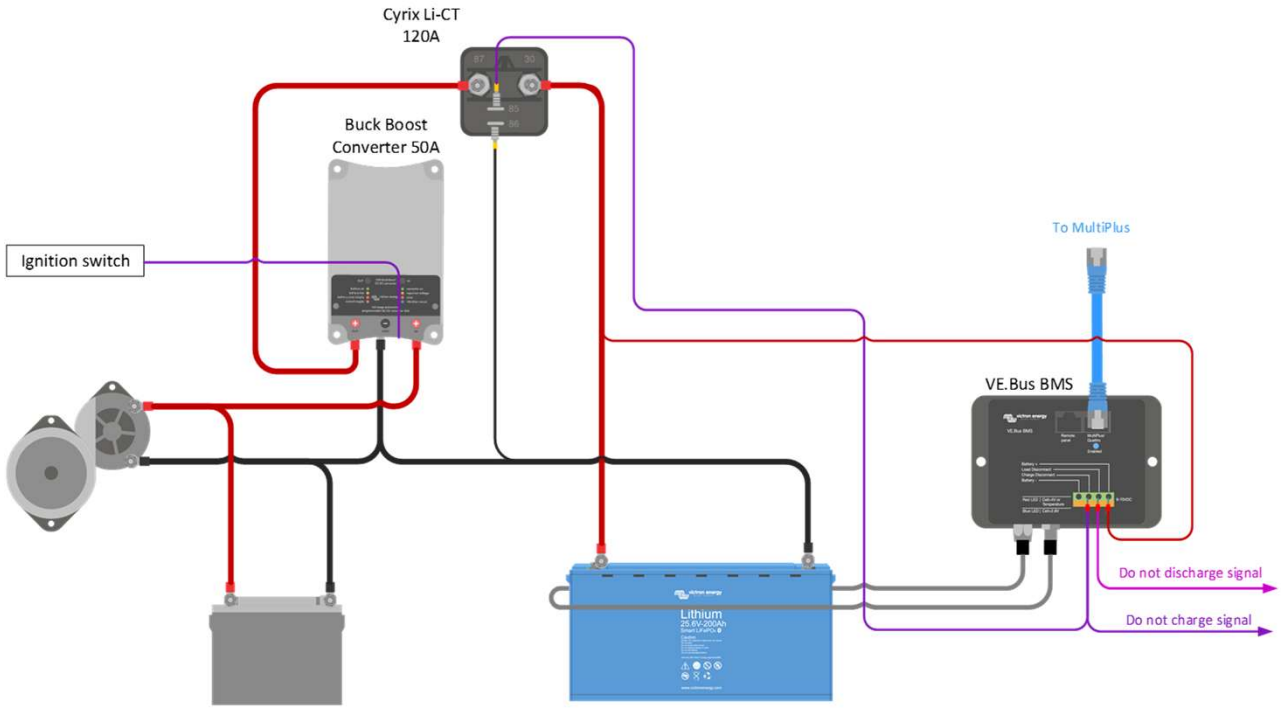
BPR000065400	BatteryProtect 12/24V-65A
BPR000100400	BatteryProtect 12/24V-100A
BPR000220400	BatteryProtect 12/24V-220A
BPR048100400	BatteryProtect 48V-100A
BPR065022000	Smart BatteryProtect 12/24V-65A
BPR110022000	Smart BatteryProtect 12/24V-100A
BPR122022000	Smart BatteryProtect 12/24V-220A
BPR110048000	Smart BatteryProtect 48V-100A

- Turning load off - use BatteryProtect (don't use Cyrix-Li-load)
- Turn charge source off - use BatteryProtect (don't use Cyrix-Li-Charge)
- Cyrix-Li-ct -> use together with Buck boost converter



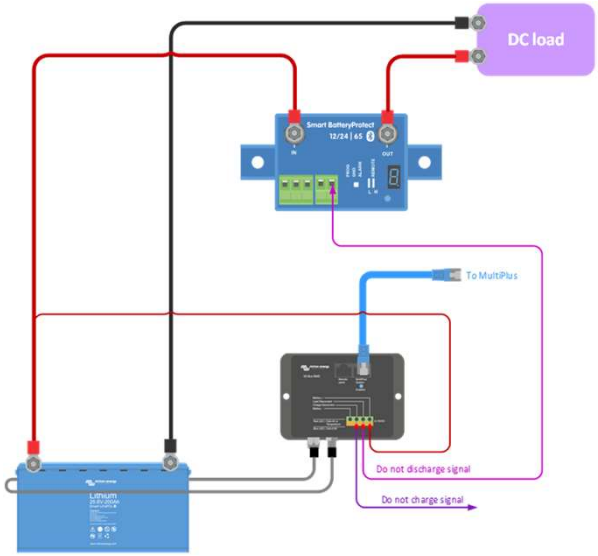
CYR010120450	Cyrix-Li-load 12/24V-120A intelligent load relay
CYR020120450	Cyrix-Li-load 24/48V-120A intelligent load relay
CYR010120430	Cyrix-Li-charge 12/24V-120A intelligent charge relay
CYR020120430	Cyrix-Li-charge 24/48V-120A intelligent charge relay
CYR010120412	Cyrix-Li-ct 12/24V-120A intelligent Li-ion battery combiner
CYR010230450	Cyrix-Li-load 12/24V-230A intelligent load relay
CYR020230450	Cyrix-Li-load 24/48V-230A intelligent charge relay
CYR010230430	Cyrix-Li-charge 12/24V-230A intelligent charge relay
CYR020230430	Cyrix-Li-charge 24/48V-230A intelligent charge relay
CYR010230412	Cyrix-Li-ct 12/24V-230A intelligent Li-ion battery combiner

VE.Bus BMS and Cyrix Li-charge example

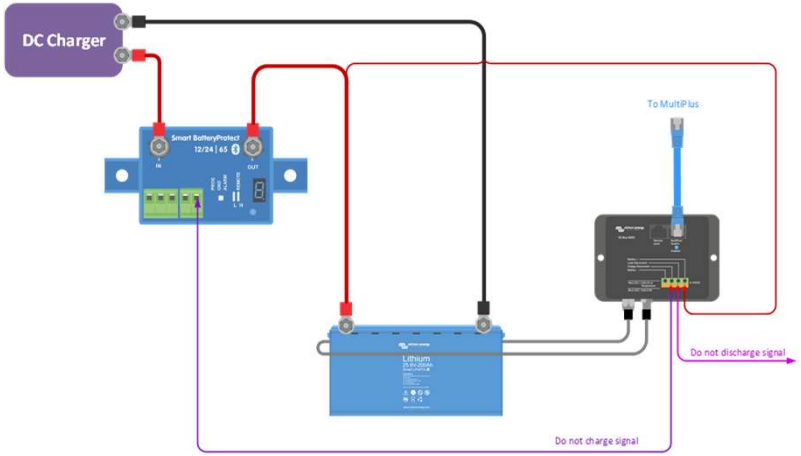


BatteryProtect examples

Disconnecting a load



Disconnecting a charger



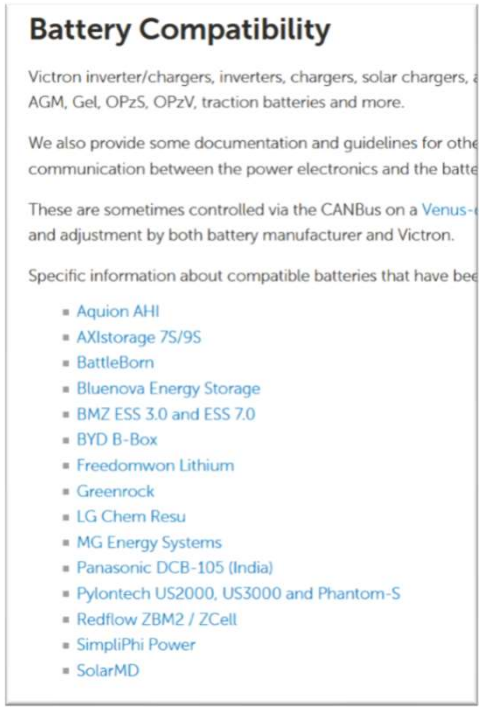
Battery compatibility guide

Most battereis that Victron can connect to are listed on the Victron live website

This list is hard to find. We don't link to this list from our main website.

- It is located on Victron live: https://www.victronenergy.com/live/battery_compatibility:start
- Or google: " Victron battery compatibility"

The list provide link to instructions on how to configure these batteries.



Battery Compatibility

Victron inverter/chargers, inverters, chargers, solar chargers, a
AGM, Gel, OPzS, OPzV, traction batteries and more.

We also provide some documentation and guidelines for othe
communication between the power electronics and the batte

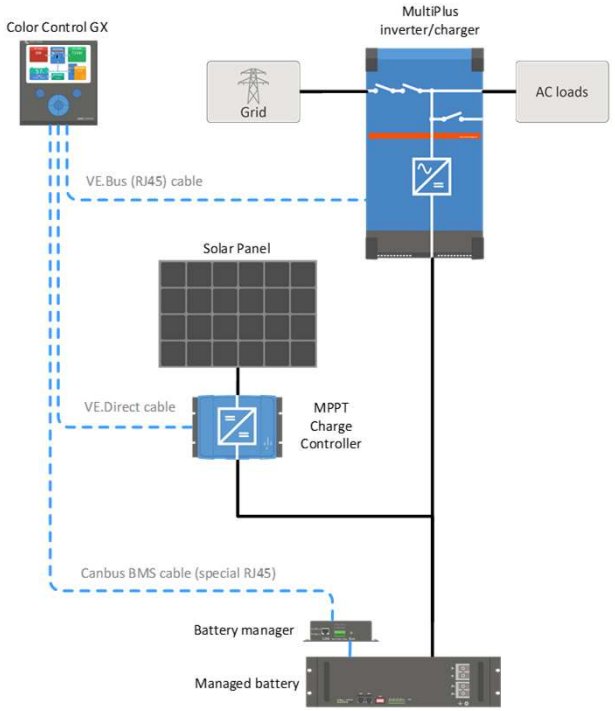
These are sometimes controlled via the CANBus on a Venus-
and adjustment by both battery manufacturer and Victron.

Specific information about compatible batteries that have bee

- Aquion AHI
- AXIstorage 7S/9S
- BattleBorn
- Bluenova Energy Storage
- BMZ ESS 3.0 and ESS 7.0
- BYD B-Box
- Freedomwon Lithium
- Greenrock
- LG Chem Resu
- MG Energy Systems
- Panasonic DCB-105 (India)
- Pylontech US2000, US3000 and Phantom-S
- Redflow ZBM2 / ZCell
- SimpliPhi Power
- SolarMD

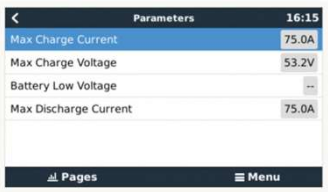
Managed CANbus batteries

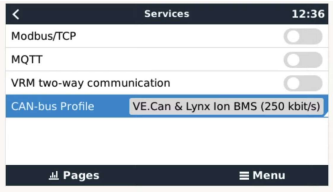
- These batteries contain a BMS (or BMU) and an internal DC breaker
- The BMS calculates state of charge and send this to the GX device
- The BMS communicates with a GX device an the GX device wil communicate with the inverter/charger or MPPT so that the BMS can dictate the system charge current

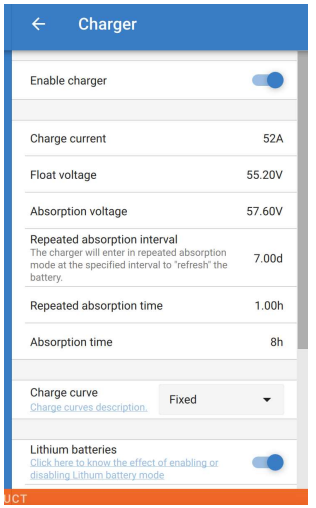


Basic steps setting up a CAN-bus battery

- A GX device like the Color Control, Octo or Venus is needed
- The VE.Can to CAN-bus cable (A or B) connects the battery to the GX device
- Make the appropriate VE configure charge and low voltage settings
- In the GX enable DVCC and set the max charge current
- In the GX device set the correct Can bus protocol



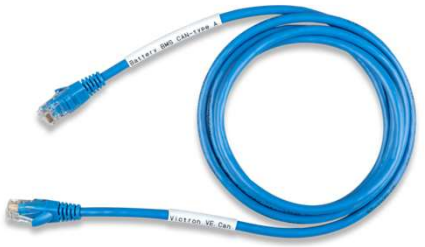




For in depth details and particular settings for your battery see the [Battery Compatibility guide]

VE.Can to CAN-bus BMS cable

- Special cable to connect smart batteries to a GX device, available in 1.8 and 5 meter
- Do not make this cable yourself, but use a manufactured cable



Type A for:

- BYD

Type A

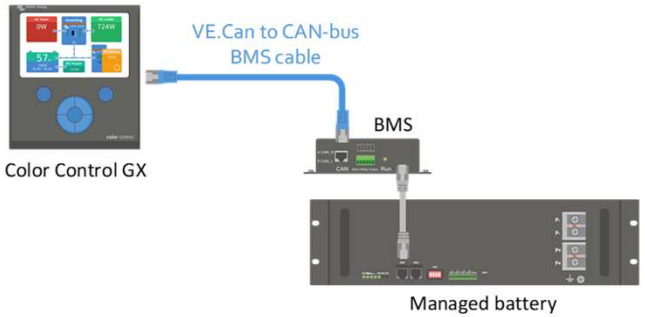
Function	Victron VE.Can side	Battery side
GND	Pin 3	Pin 6
CAN-L	Pin 8	Pin 5
CAN-H	Pin 7	Pin 4

Type B for:

- LG Chem Resu
- AXIstorage
- BMZ
- Pylontech

Type B

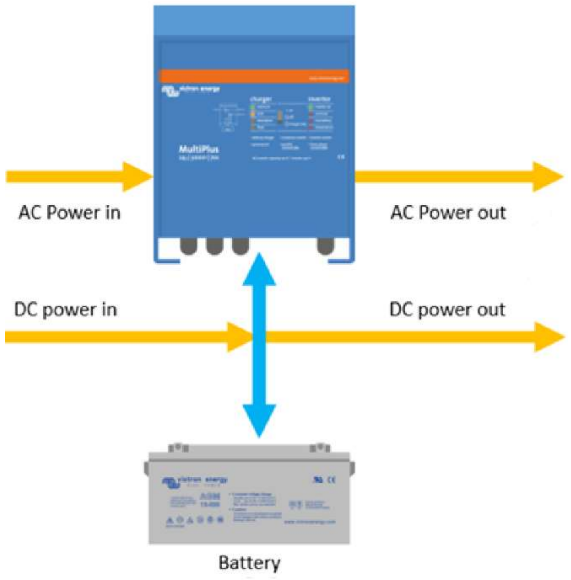
Function	Victron VE.Can side	Battery side
GND	Pin 3	Pin 2
CAN-L	Pin 8	Pin 5
CAN-H	Pin 7	Pin 4



Training - System design

Information needed to be able to design a system

AC input	• Grid, shore power, generator or grid tie inverter. • How much power and when? • Is grid feed allowed?
AC output	• AC loads sizes and peak ratings. • What source will power the loads battery or AC and when?
DC input	• Alternator, solar, wind or DC generator?
DC output	• DC loads sizes and duration
Battery	• Type of battery technology. • Space, weight or budget restrictions?



Perform the calculations in this order

Step 1. Power out calculations:

- How big are the loads, AC and/or DC
- At which times

Step 2. Inverter calculations:

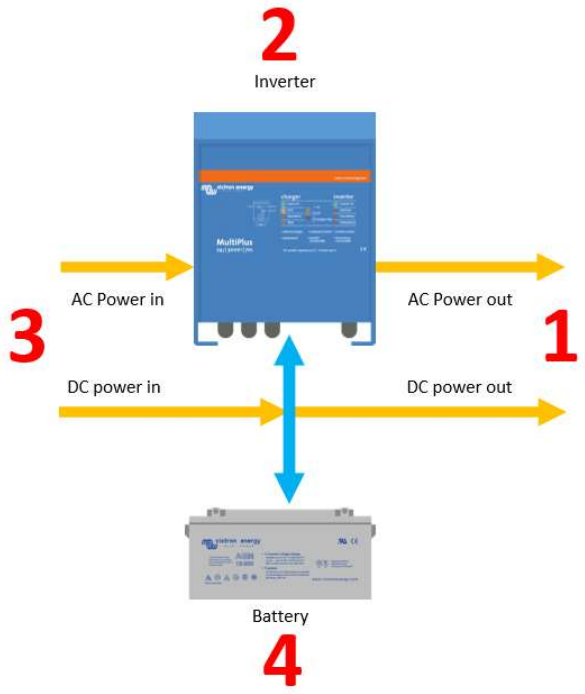
- Peak power requirements

Step 3. Power in calculations:

- Which source(s), AC and/or DC
- At which times during a day

Step 4. Battery calculations:

- Autonomy
- Depth of discharge
- Charge rate
- Discharge rate



Calculate in Watts

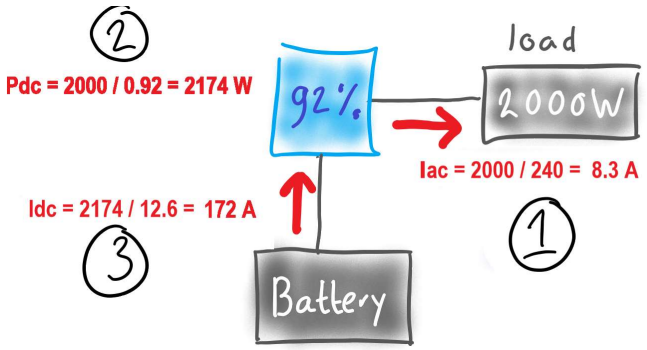
When making system calculations, always calculate in energy

In other words, always calculate in Watts.

Watt = Volt x Amp

kW = kilo Watt = 1000 W

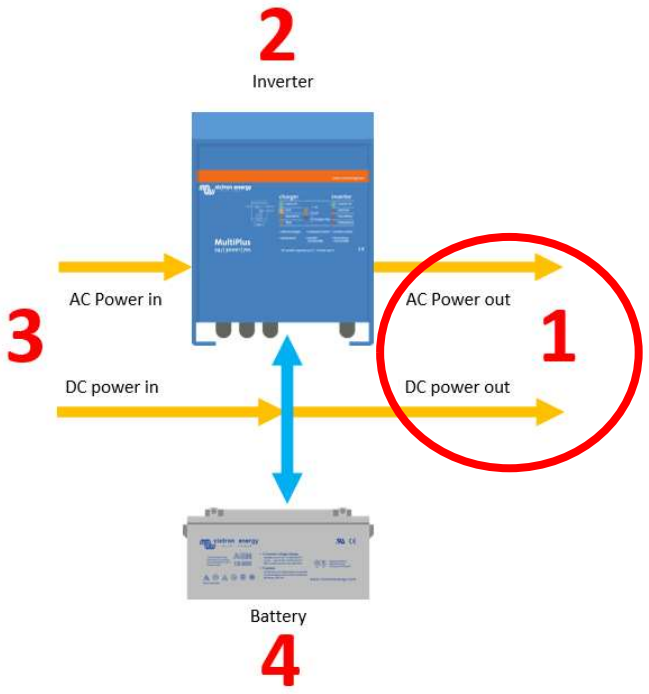
kWh = kilo Watt hour



Power out calculations:

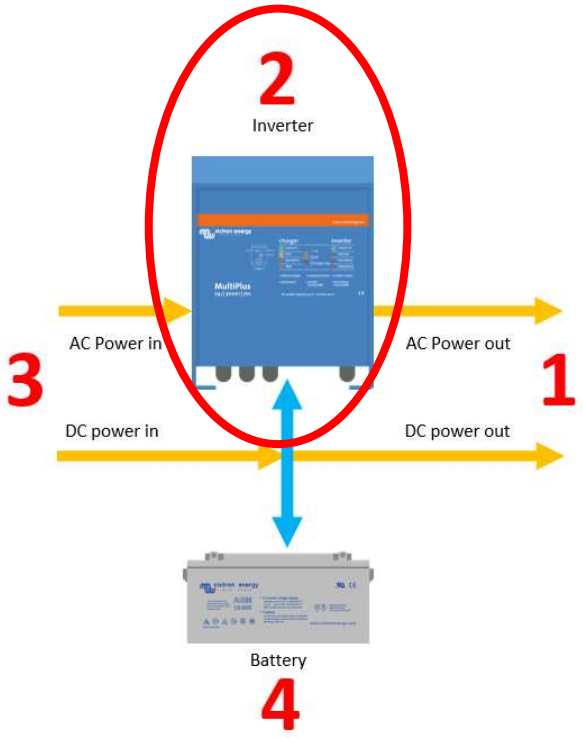
- Make a list of:
  - all AC loads
  - and DC loads

- Determine how long these loads are running
- In case of PV also note what time of day these are running

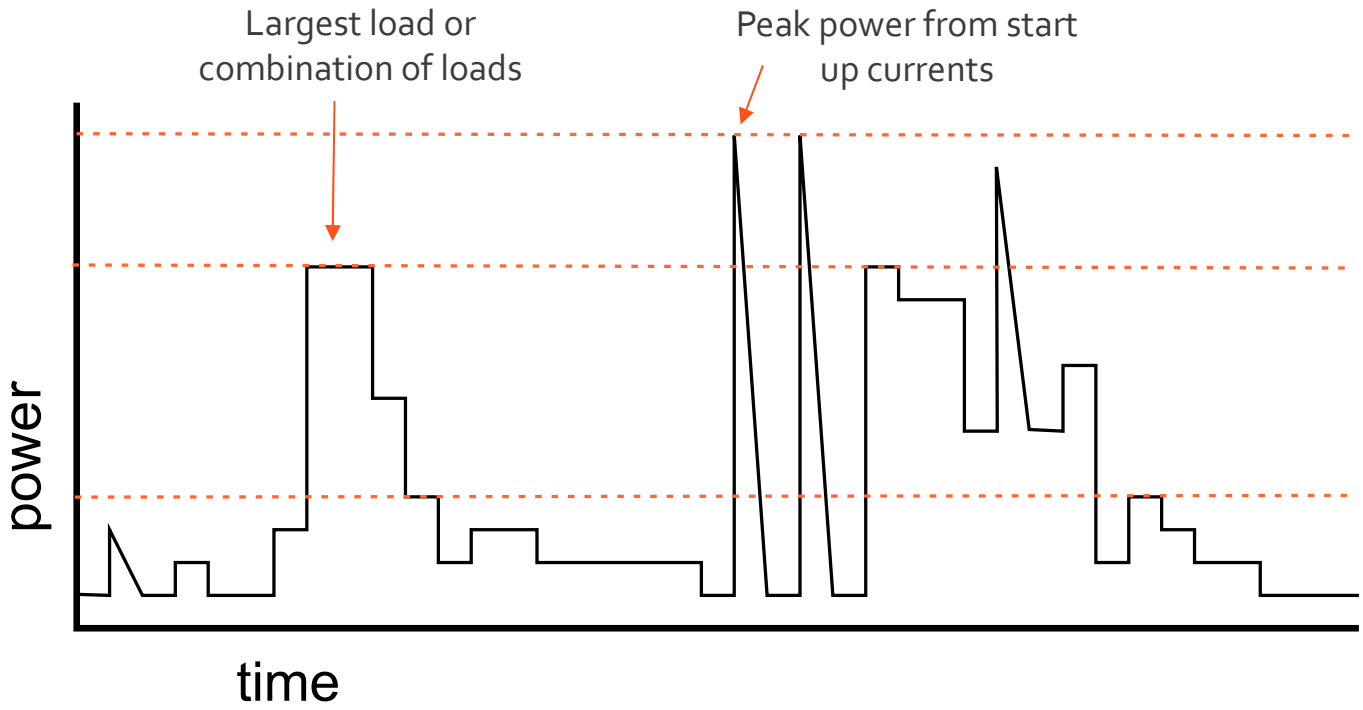


Inverter calculations

- Determine the peak power of the system.
- The loads that are running at the same time determines the inverter size
- Also look closer into loads that could have a high start up power.



Average load of a system



Peak load: This has to match the peak load capability of the Multi

Largest load: This determines the Multi size

Average load:

This determines the generator size in relation to its running hours

Power in calculations

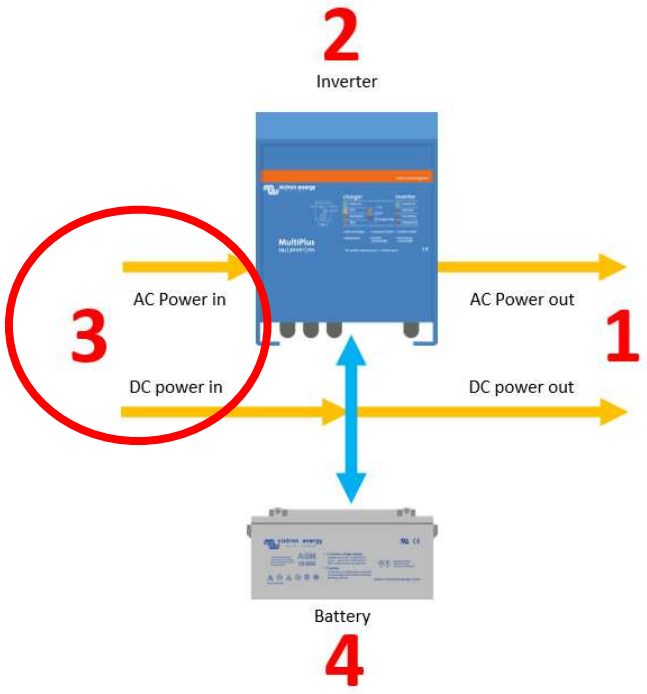
Find out what type of power is coming into the system and for how long and at which times during a day

AC power:

- Generator, Grid

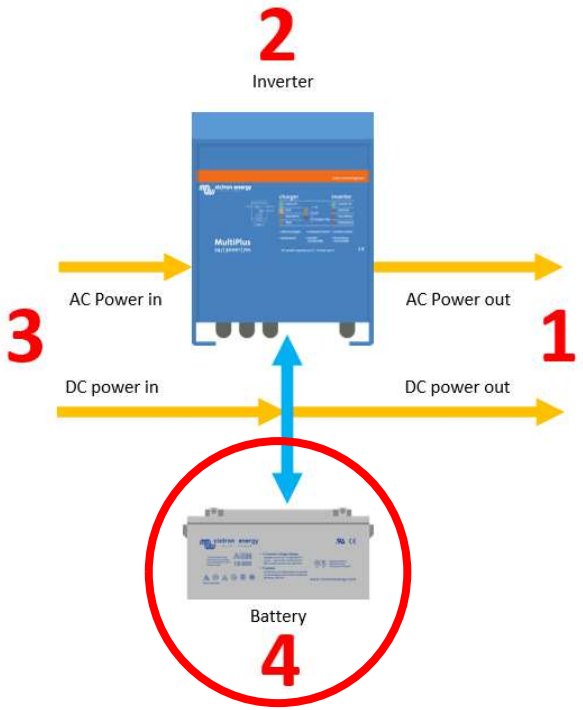
DC power

- Solar, wind, alternator, DC generator



Battery calculations

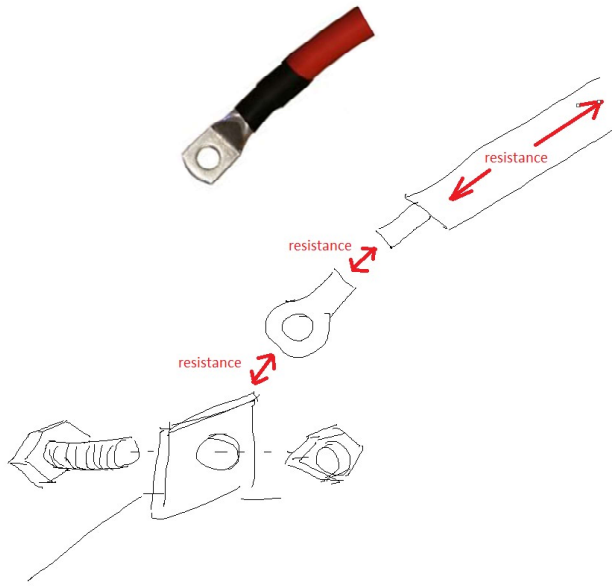
- System stand alone time
- Battery capacity
- Depth of discharge
- Charge rate
- Discharge rate



Cable resistance

- To give an indication of cable resistance, the total resistance for a 20cm 35 m² cable is about 1,5 milliohms

- You might say that 1.5 mΩ is not much. But the internal resistance of the Multi and the batteries are also low. Therefore it does matter a lot!



Cable resistance and voltage drop

A cable has a certain resistance. When you send current through a cable a voltage drop will occur.

Example:

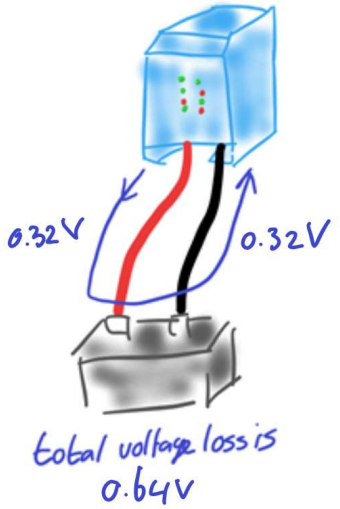
Resistance of a cable is 1.6m Ω

A 2400W load at 12V creates a current of 200 A

V = I x R

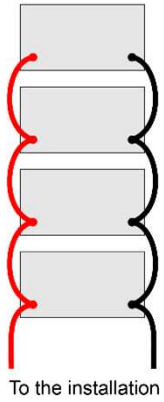
The voltage drop over one cable is 200 x 0.0016 = 0.32 V

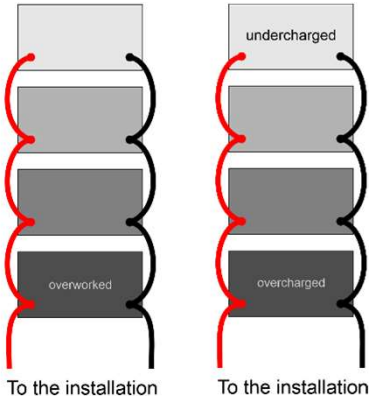
The total voltage loss over both cables is 0.64 V

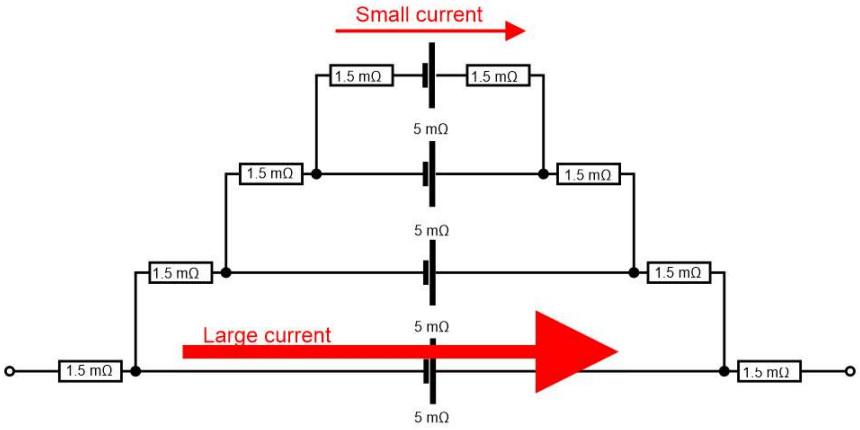


Common battery bank wiring mistake

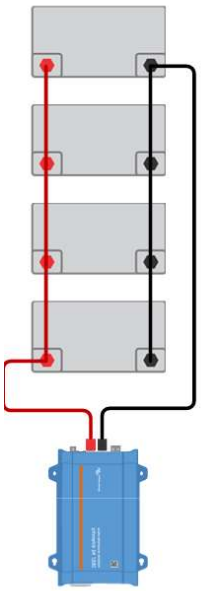
- Each interconnecting cable contains resistance
- The path to the last battery contains more resistance than the path to the first battery
- This will result in an overworked first battery and will fail prematurely



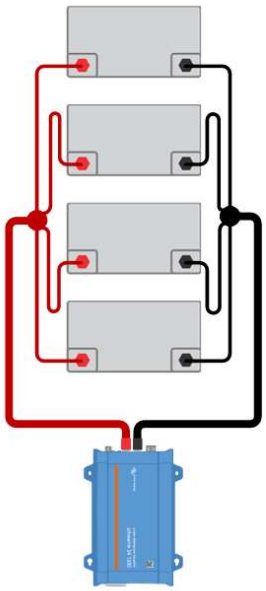




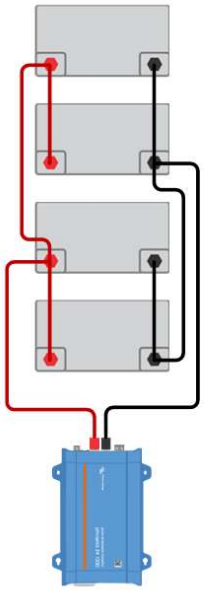
Correct ways of connecting parallel battery banks



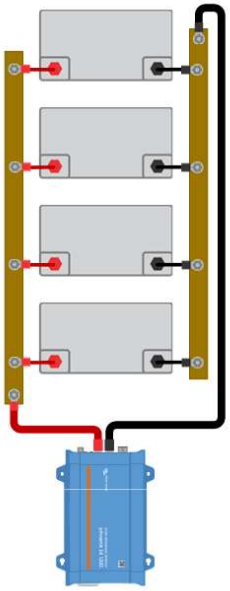
Diagonally



Posts



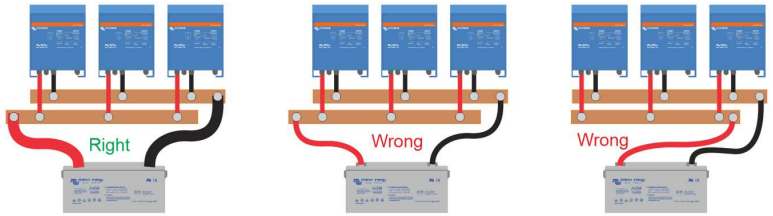
Halfway

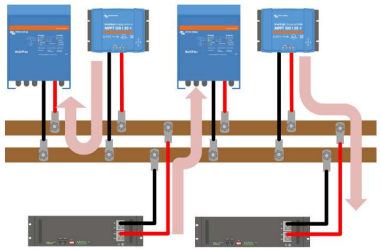


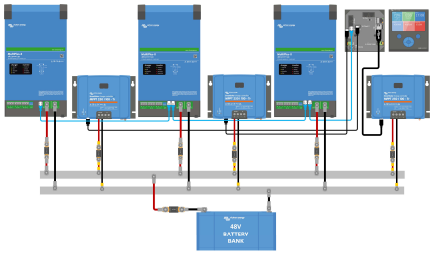
Busbars

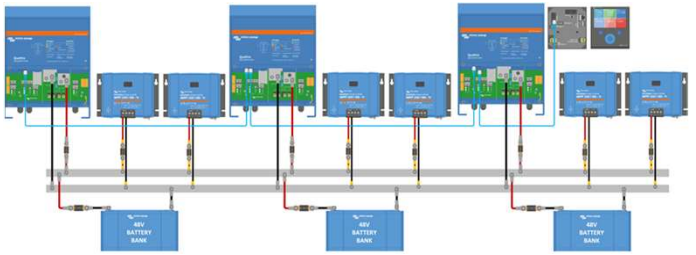
Busbars

- The cross-section of the cable from battery to busbar must equal the sum of the cables form busbar to DC equipment
- Cross connect the busbar
- Intermix batteries and DC loads on the bus



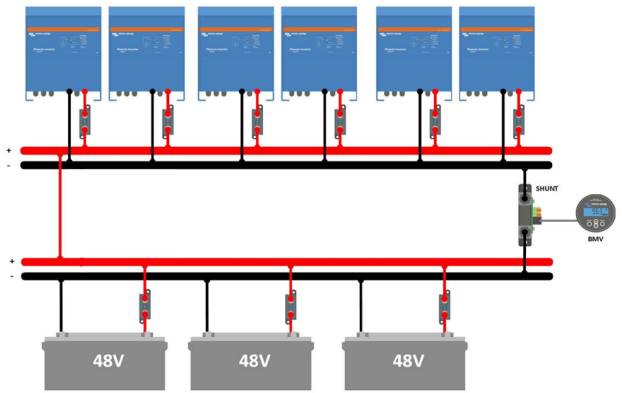


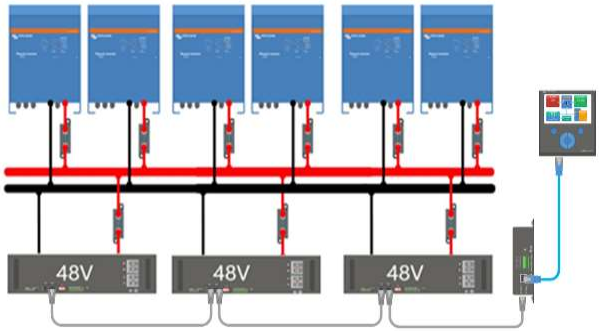




Shunt and busbar considerations

- Shunt placement
- Is a shunt needed? Be aware that it can introduce issues





System installation

Read the product manual safety and wiring instructions

Follow local wiring and installation regulations

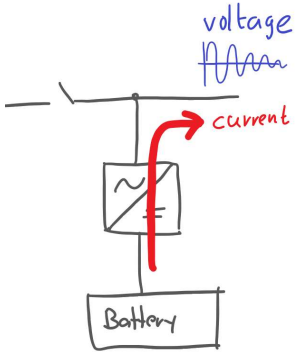
Correct product placement

- no electronics directly above lead acid batteries
- keep products cool
- pay attention to IP ratings

What determines overload

Overload is initiated when:

- the current through the inverter is too high
- When the inverter output voltage drops



When determining loading, always look at the AC output current

- Current = power / voltage
- For a 8000 VA unit at 240V the current rating is 8000/240 = 33.33 A
- This is the half hour current
- The peak current is twice that, so 2 x 33.33 = 66.66A

When investigating overload situations use a true RMS current clamp, and maximum load is related to temperature

Overload, how long

This guide can be used, provided:

- The battery voltage remains stable
- The unit is not over-heated due to earlier overload attempts

Overload	Time
130% of nominal power	30 minutes
Overload where the output voltage remains stable	2 minutes
150% of nominal power where the output voltage remains stable	5 seconds
Peak power of 200% of the nominal power (short-circuit)	0.5 seconds = 30 cycles

Start up current of loads:

- Single phase motor: 6 x nominal current
- 3 Phase motor: 3 x nominal current
- For inductive or capacitive loads (0.7 power factor): double inverter size is needed

Soft start devices:

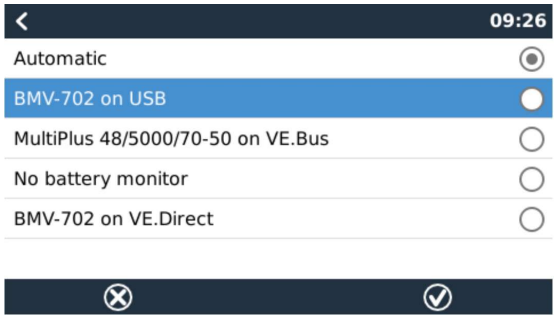
- Use frequency drive devices,
- Don't use devices that chop the sine wave

Training - Advanced programming

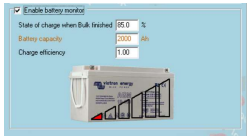
Battery monitoring and GX device

GX device allows for one SoC for the whole system

- The CCGX or Venus itself does not calculate State of Charge (SoC)
- It retrieves the SoC value from a connected device like a Multi, BMV, Lynx shunt or a "smart" battery:

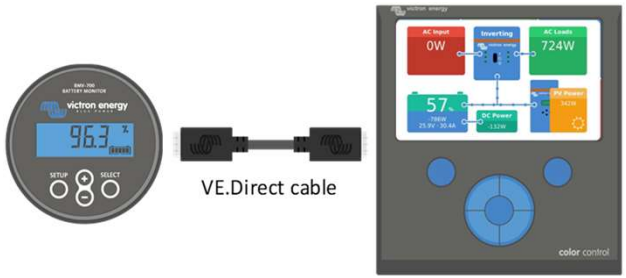


- BMV 7xx series
- Lynx shunt
- VE.Bus

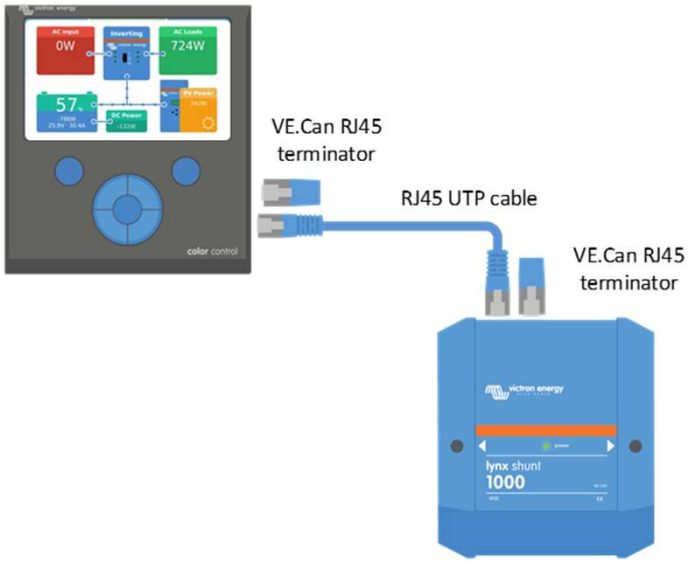


- Smart battery with a built-in battery monitors like BYD, Redflow and others. For full list and more info see: https://www.victronenergy.com/live/battery_compatibility:start

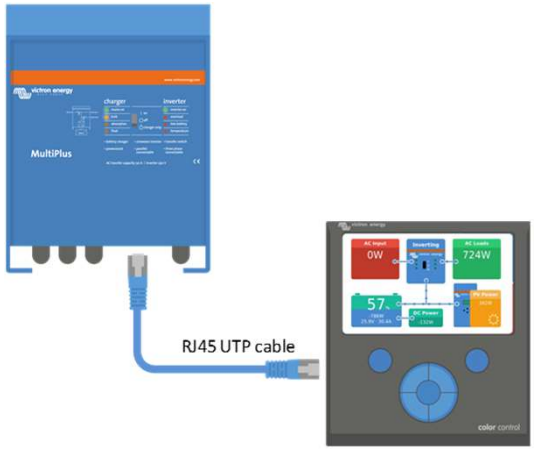
BMV-7xx series



Lynx shunt



VE.Bus



Smart battery

Type A for:

- BYD

Type A

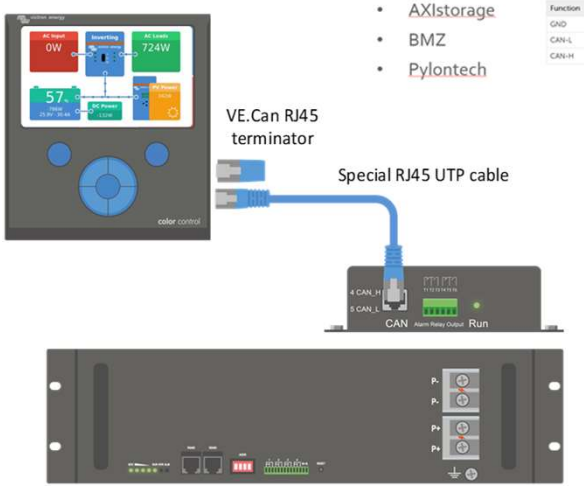
Function	Victron VE.Can side	Battery side
GND	Pin 3	Pin 6
CAN-L	Pin 8	Pin 5
CAN-H	Pin 7	Pin 4

Type B for:

- LG Chem Resu
- AXIstorage
- BMZ
- Pylontech

Type B

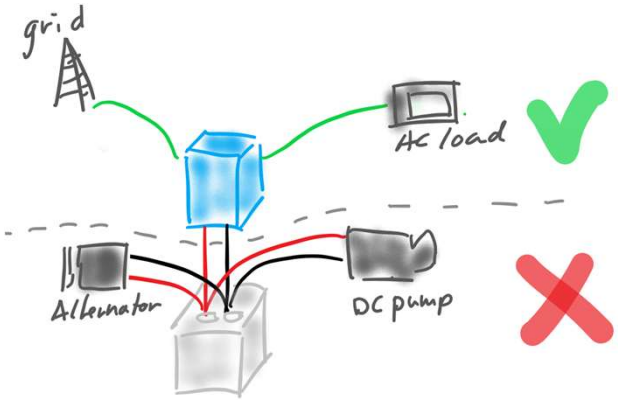
Function	Victron VE.Can side	Battery side
GND	Pin 3	Pin 2
CAN-L	Pin 8	Pin 5
CAN-H	Pin 7	Pin 4



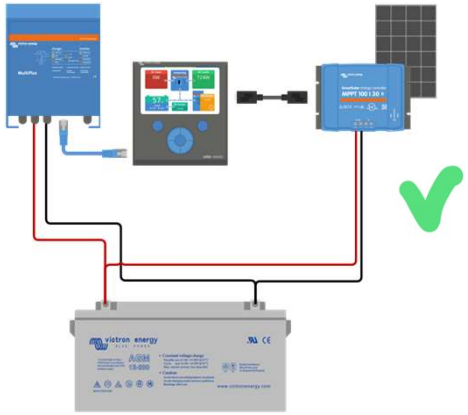
Note on VE.Bus SoC

- The Multi measures how much current goes in and out of the battery,
- But … it will miss the current from external DC sources or loads

Don't use the VE.Bus SoC when there are DC loads or charge sources in a system

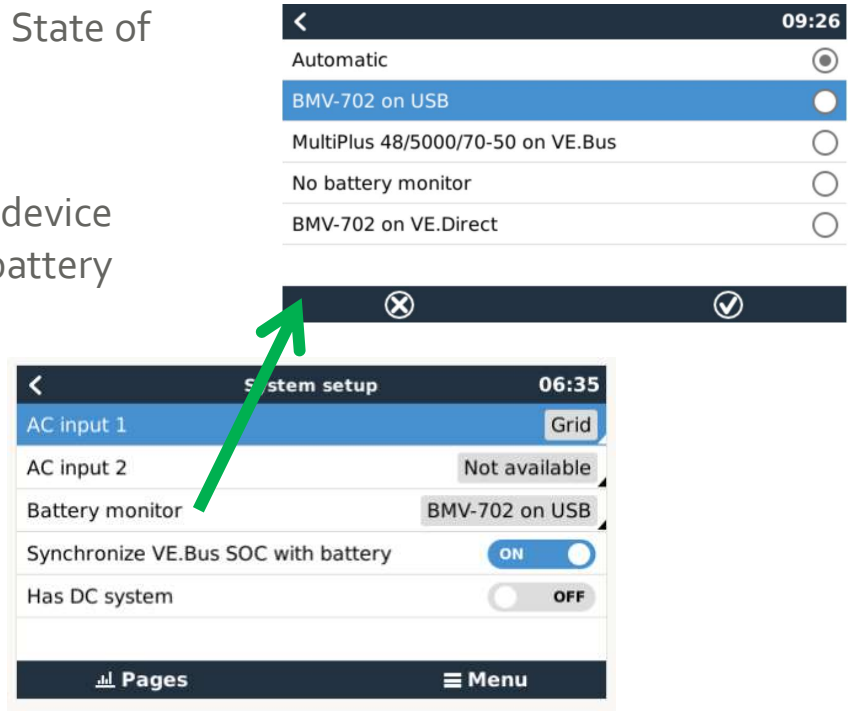


Do use VE.Bus SoC if there are only Victron products in the system and they are all connected to a GX device



GX device allows for one SoC for the whole system

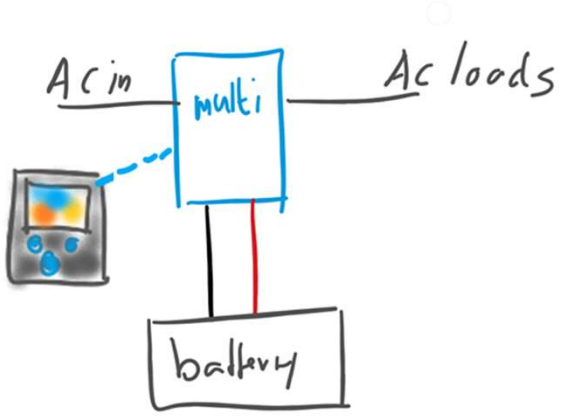
- The CCGX or Venus itself does not calculate State of Charge (SoC)
- It retrieves the SoC value from a connected device like a Multi, BMV, Lynx shunt or a "smart" battery



Battery and Multi or Quattro with CCGX

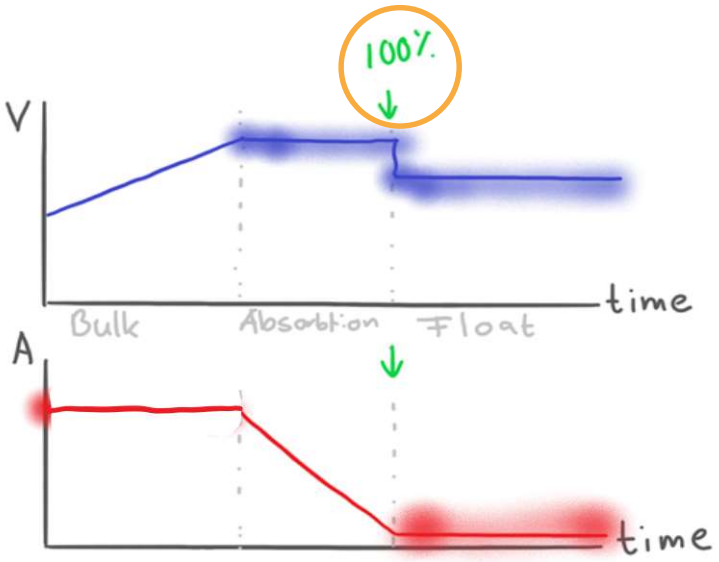
If the Multi is the only product connected to the battery. No external battery monitor is required. The Multi can calculate SoC.

- In VEConfigure enable and configure the Battery Monitor
- In the CCGX select VE.Bus SoC



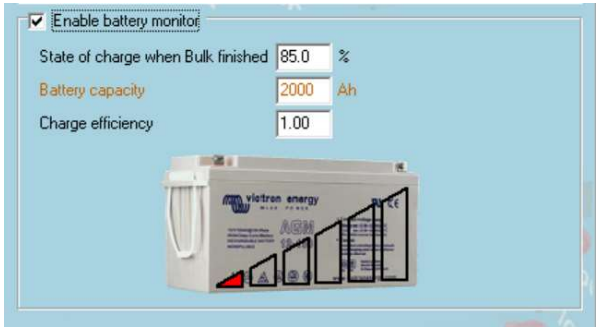
BMV and Lynx synchronisation

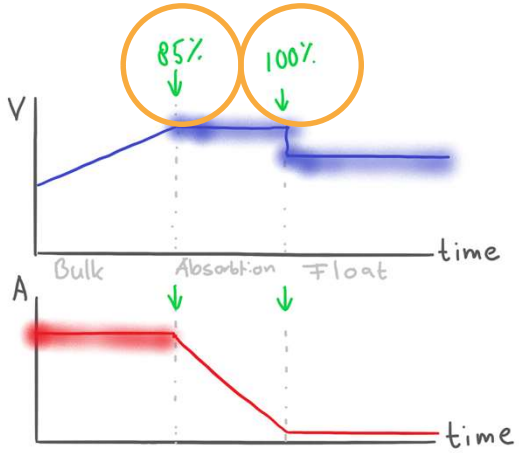
- These battery monitors synchronises when the battery is fully charged
- This happens when the current is below and voltage is above a certain level
- The battery needs to be charged on a regular basis to prevent drift.



VE.Bus synchronisation

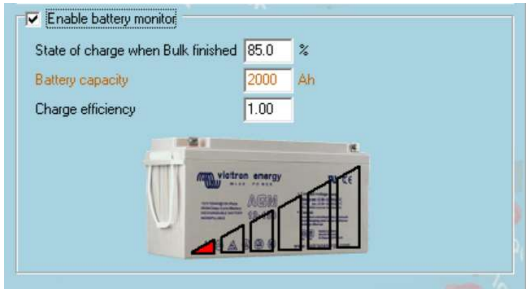
- When the bulk charge stage is finished the Multi sets the SoC to the percentage you have entered into the settings.
- The Multi will also set the SoC to 100% when the absorption charge stage is finished



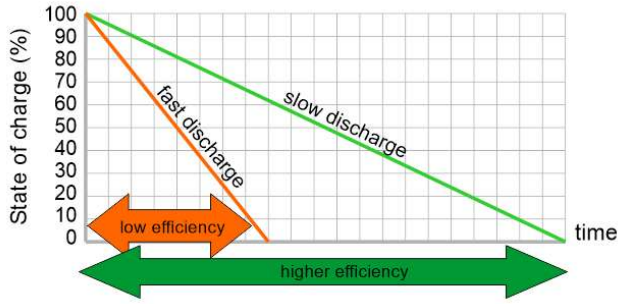


VE.Bus charge efficiency

- Charge efficiency recommendations:
  - Lead acid = 0.85 - 0.75
  - Lithium = 0.99 - 0.95



- The Multi does not take the Peukert exponent into consideration. This means that it will not differentiate between fast or slow discharge.
- If the Peukert exponent of the battery is much higher than 1, it might be beneficial to use a BMV for SoC calculation.



SoC is stuck at 85%

The problem:

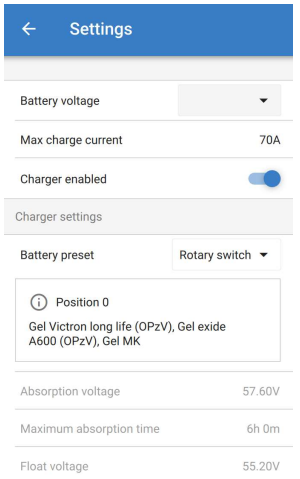
- In an off-grid system (non ESS) when charging from an MPPT and you are using VE.Bus SoC, the Soc wil not get above 85%
- But … when charging from a generator via the Multi, the SoC will eventually go to 100%

The reason this happens:

- The Multi won't increase its SoC over 85% as long as it has not detected that the battery voltage has reached its "set" absorption voltage.

The fix:

- Set the Absorption voltage of the MPPT is slightly above that of the Multi.



victron energy
BLUE POWER






Energy. Anytime. Anywhere.