victron energy
BLUE POWER

Other Victron Products – Testing and Diagnosing

Skylla, Centaur, Phoenix Chargers

Transformers, Remote Panels –CCGX

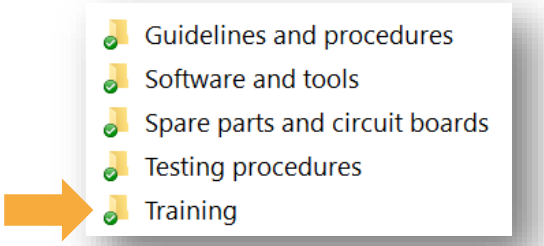
DC Converters , Isolators, Cyrix

Battery Protects & Lynx Distribution

Batteries

Introduction

- Inverters, inverter chargers and MPPTs are covered in separate presentations - For these see the Victron Repair Centre Dropbox



- This presentation deals with the remaining products and the service/repair process
- Skylla chargers and transformers can be repaired by circuit board replacements,
- The others are not repaired, but replaced

Safety warning and disclaimer

- Electricity is dangerous. It can cause harm to persons or property
- Electrical work should always be carried out by a qualified electrician or licensed electrician
- Local safety guidelines and requirements need to be adhered to
- The sole purpose of this training is to aid in the understanding of basic principles behind certain electrical concepts and is intended as a guide only

IMPORTANT:

- AC and DC voltages are dangerous and harmful
- Always use insulated tools when working with electricity and batteries
- Do not short circuit batteries this can cause fire or explosion
- Battery charging can create explosive gasses
- Undersized wiring or bad electrical contact can cause fire
-


BATTERY ENGINEERING
HOUSE OF VICTRON
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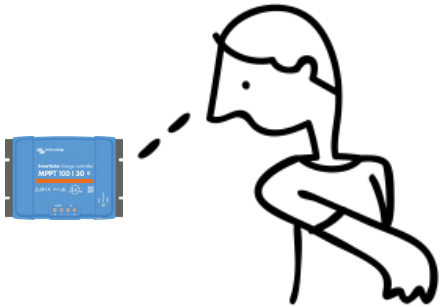
General

Visual check

Always first do a visual check:

- Does the unit have water damage?
- Is the unit very dirty, is there soot, dust or oil present?
- Does the unit have mechanical damage to its housing?
- Does the unit have mechanical damage to its connectors?
- Does the unit have burned connectors?
- Does the unit have burn marks or molten areas to its housing or does it smell burned?

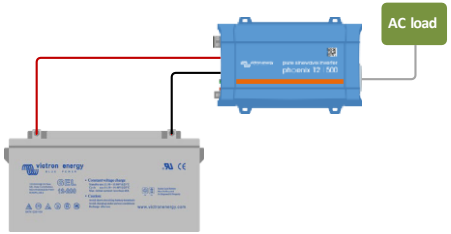


Note that mechanical damage, dirt, dust water and damaged or burned connectors are not covered by warranty. Do not lodge an RMA for a non-warrantable fault

Burn marks or burned components do need to be mentioned when lodging the RMA

DC load or simulated empty battery

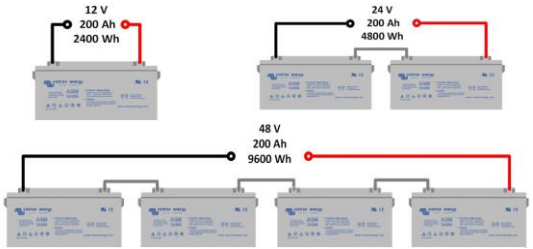
- In case of a charger, use a empty battery or a bad battery with low voltage
- To simulate an empty battery use an inverter with a AC load attached



- If a DC load is needed use a load bank or a construct a simple load using DC incandescent light globes
- Alternatively use an inverter with a AC load attached

DC source

- Use battery or multiples batteries to create different voltages

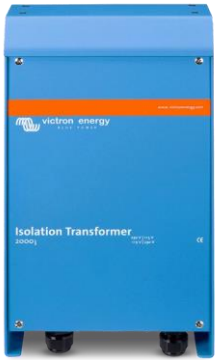


- Use an adjustable power supply

- A charger can also be used as a power supply, use a smart charger together with the VictronConnect App
- The voltage of the smart charger can now be changed quite extensively and there is a power supply mode
- But there are limitations how readily they supply large currents. Big loads might not start
- A better option would be to use a Skylla TG charger

AC source

- Use the grid
- To create adjustable AC voltage use a Variac (variable transformer)
- Or to create 115Vac from a 230Vac supply (or vice versa) use an isolation transformer



AC load

- Use resistive electric appliances, such as multiple incandescent light globes, electric heaters and so on
- It is handy if the heater has a choice between 2 levels, like 1000W and 2000W
- To convert AC output voltage use a Variac or an isolation transformer

Measurements

- Use a quality Multimeter, such as a Fluke 87
- Accuracy and true RMS is important
- Team the multimeter up with a current clamp such as the Fluke i410

- VictronConnect can be used to read values from smart products
- An oscilloscope is not necessarily needed but can come in handy for inverter or inverter/charger testing and when testing mains voltages use a suitable probe

Smart product with Bluetooth issues

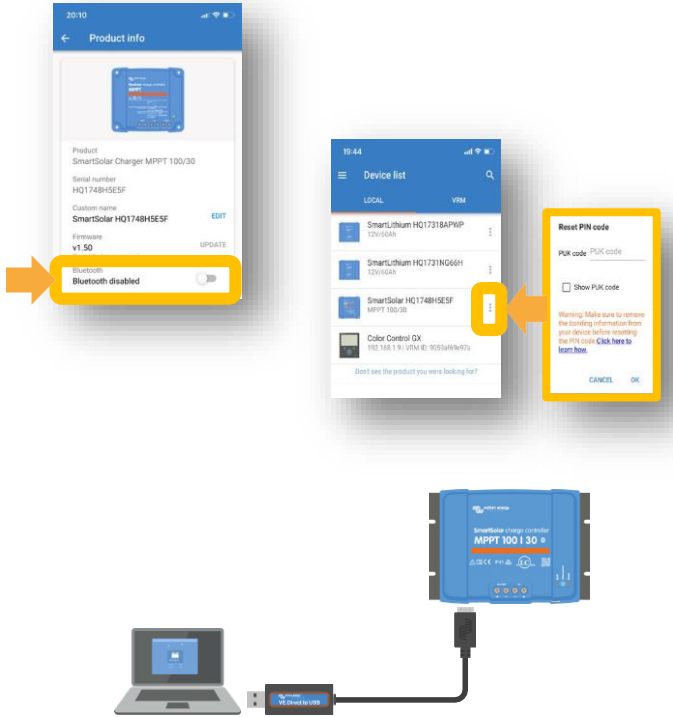
It is highly unlikely that the Bluetooth module is broken

For connection issues see the [Victron Connect Manual]

Some pointers:

- Has Bluetooth been disabled by the customer
- Is the PIN-code lost
- Is there an issue with an Android phone
- Windows Bluetooth is not supported
- Out of range or in metal enclosure?

- If unable to connect with Bluetooth, connect via USB



Updating firmware, save settings and reset settings

Firmware needs to be updated as part of the test procedure

This to rule out that the product fault is due to a firmware bug

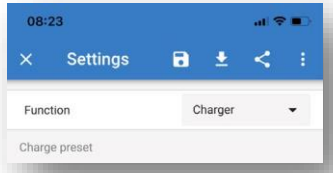
If you update firmware, write down the old version, then update an then write down the new version

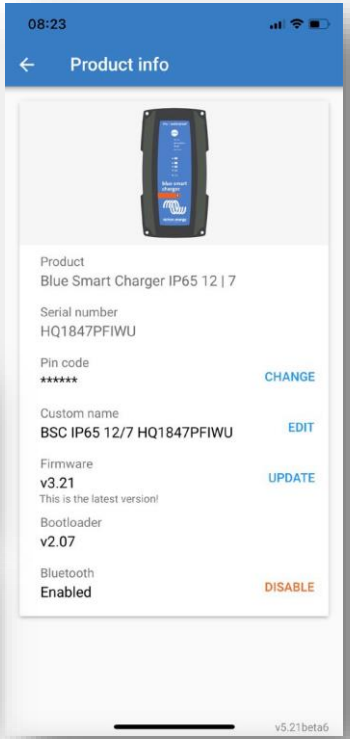
There are two firmwares in a Smart product, the Bluetooth interface firmware and the product firmware

Bad settings could be a cause of a product fault

Save existing file (so you have proof)

Then set settings to default





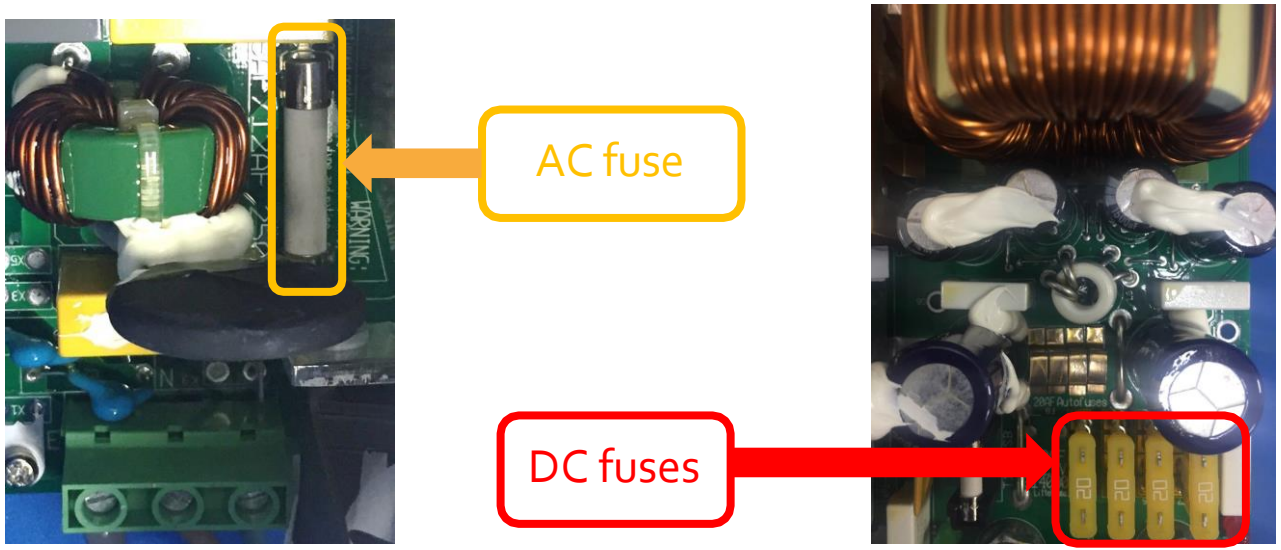
Skylla chargers

Skylla types

- Skylla TG - repairable (board exchange)
- Skylla GMDSS - only GMDSS part available, rest of unit not repairable
- Skylla GL - Not repairable
- Skylla i - Not repairable
- Skylla IP44 - Not repairable

Skylla TG

- Check AC and DC fuses



Full charge power test

- Use a short (15 cm) thick (35mm2) battery cable to connect the positive battery terminal to the negative battery terminal (short circuit)
- Switch Skylla on
- Supply Skylla with connect grid over AC IN
- The Skylla must now start to supply power
- Check if the full power is supplied (look at current LEDs)
- Check if the fan has started
- Leave it working for 10 minutes

Blocked fan

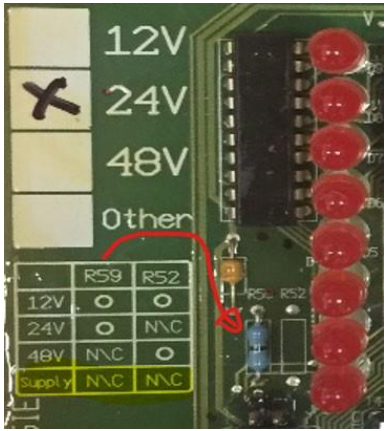
- If the fan cant freely turn when the Skylla is off, the Skylla is faulty

The control board

- The control board is rarely faulty
- It can be used across a variety of Skylla models - in some occasion a pot setting might need to be changed, in this case contact the service department
- The voltage is set via R59 and R52 as per below diagram

Control pcba Skylla

Article code	Description
SPR20040	Control pcba Skylla TG



The power board

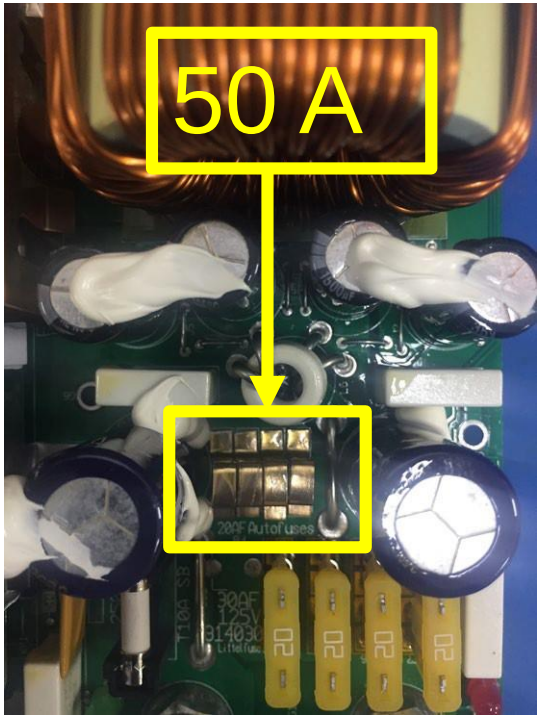
- Only 50A boards available
- Convert these to 30A boards by removing 2 wire links
- See next slide

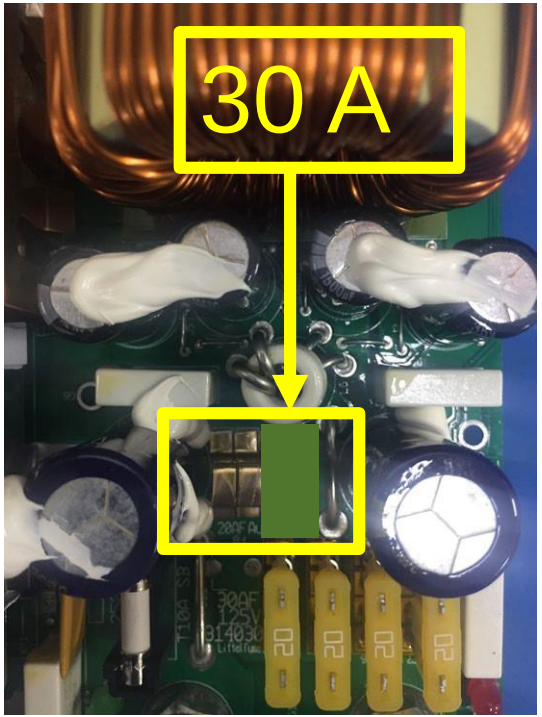
Power pcba Skylla

Article code	Description
SPR20083	Power pcba Skylla TG 24/50 90-265V
SPR20054	Power pcba Skylla TG 24/50 230v
SPR40017	Power pcba Skylla TG 48/25 230v

Convert 50A board to 30A board

To convert a 50A board to a 30A board remove two wire links as indicated in these pictures



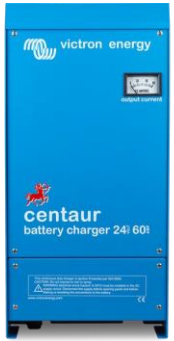


Other chargers

Other charger types - not repairable

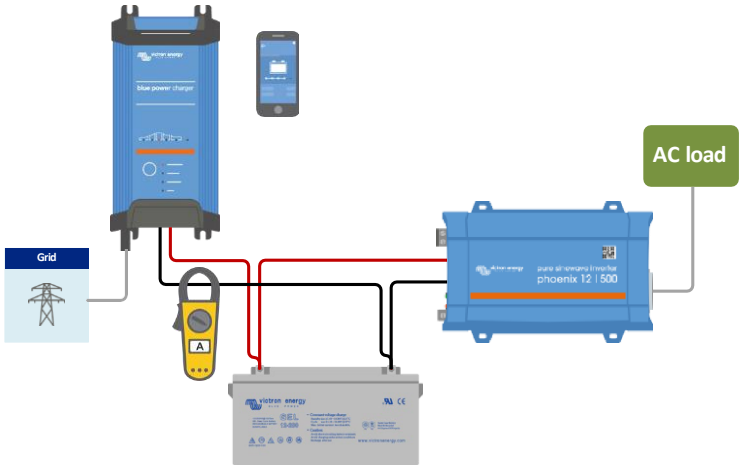
- IP65
- IP67
- Automotive

- Phoenix Smart
- Phoenix
- Centaur



Basic charger test

- Visual check
- Is remote on/off connector wire loop present (if applicable)
- Connect to AC power
- Do you measure an output voltage?
- Repeat this for each output (if applicable)
- Load charger (connect to empty battery or battery with DC load such as an inverter running a large AC load)
- Is full current flowing? Use Victron Connect, look at LEDS, look at dial or or use current clamp
- Check the charge current and voltage settings - see manual or Victron Connect



Centaur

- Very old technology
- Only fixed 3-stage charging
- No external temperature sensing
- Can lead to overcharging, especial if AC gets interrupted often or in hot environments
- Sometimes dial does not read zero when charger is off
- Battery chargers quite often not only charge batteries, but also supply energy to DC loads. If the DC usage on board is very high, the charger may never go in to float mode and can therefore also overcharge batteries

Centaur

- Large models have two circuit boards and when selecting the battery type with the dipswitches, both dipswitches need to be set
- People sometimes forget this, and only set one dipswitch, this can cause overcharging of some battery types
- The flooded lead acid change voltage is a bit on the high side, it is better to set the Centaur charger always on AGM, or better, on GEL setting
- Internal fuses are not serviceable, A blown fuse indicates that there is an internal problem in the Centaur

Phoenix

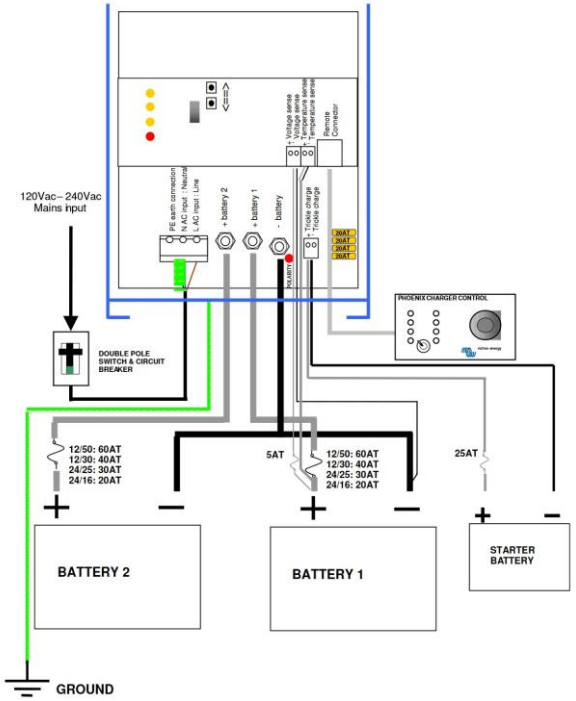
- If the fuses are fitted check the fuse continuity and replace if necessary
- Disconnect the remote control panel to rule out issues
- Disconnect the temperature sensor and the voltage sensor
- Reset the charger to factory settings via the dipswitches, or with remote panel see Phoenix manual or alternatively use VE.Configure
- If VE.Configure is used only the MK2.2-USB can be used
- Check all 3 battery outputs and trickle charge output

ASS030130010	Interface MK2-USB (for Phoenix Charger only)
ASS030140000	Interface MK3-USB (VE.Bus to USB)
ASS030120210	Interface MK2.2b (VE.Bus to RS232)

Phoenix

- Not reverse polarity protected
- First connect all battery cables
- Check that the polarity LED does not light up
- Then place the ATO fuses

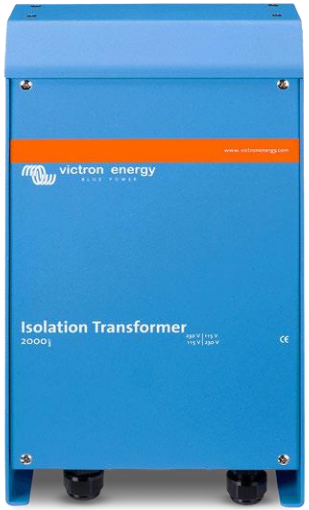
- When it is an out of the box failure always first check if the ATO fuses have been inserted by the customer
- The ATO fuses are included in a plastic bag together with the temperature sensor



Transformers

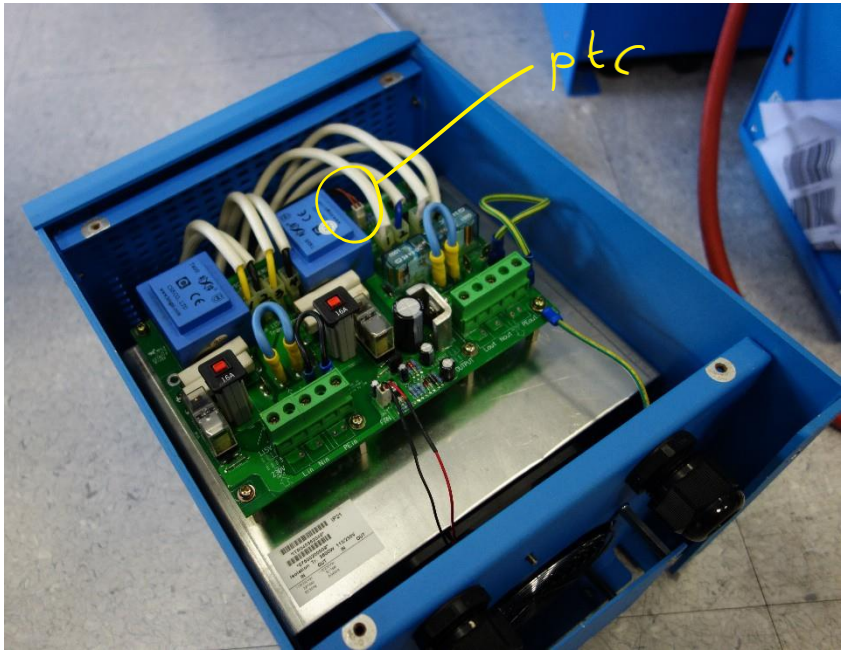
Transformers

The Isolation transformers and the Auto Transformers can be repaired via board replacement



Isolation transformers

- To test the PTC in the transformer, disconnect the PTC (the shiny brown wires on the top circuit board). Short circuit the connector legs on the circuit board with a screwdriver
- The output voltage is always a bit higher than the input voltage (≈ 6%)
- In some cases this can be a problem
- For example in Australia the grid voltage can be on the high side 245V and up



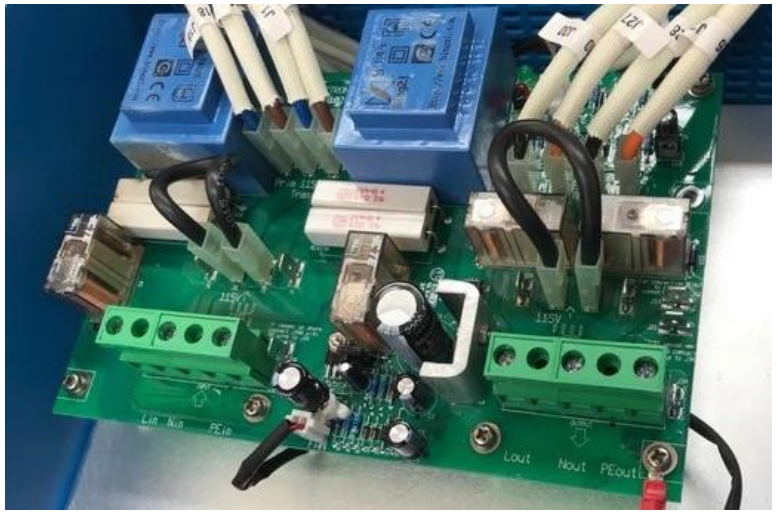
Auto transformer

- The earth relay inside the auto transformer is driven by a 24V (max 100mA) signal from the inverter/charger.

Boards

Spare pcba Isolation / Autotransformer

Article code	Description
SPR00069	PCBA for Isolation Transformer 3600W 115/230V
SPR00068	PCBA for Isolation Transformer 7000
SPR00070	PCBA for Isolation Transformer 3600W 115/230V Auto
SPR00071	PCBA for Autotransformer 120V/230V 32A
SPR00073	PCBA for Autotransformer 120V/230V 32A with LED
SPR00072	PCBA for Autotransformer 120V/230V 100A with LED



Battery monitoring

Battery monitor types

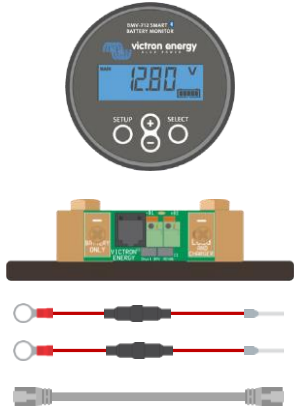
BMV 700

BMV702

BMV702H

BMV712

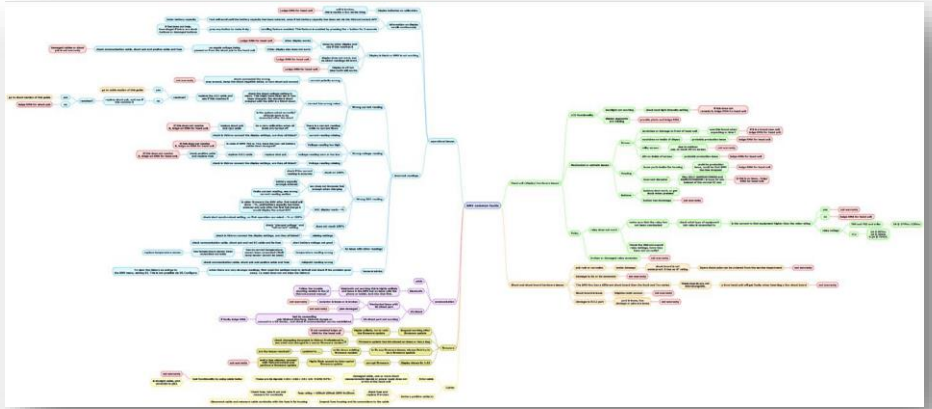
BMV712H



SmartShunt

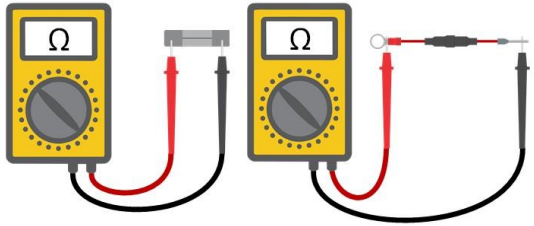
Some common issues

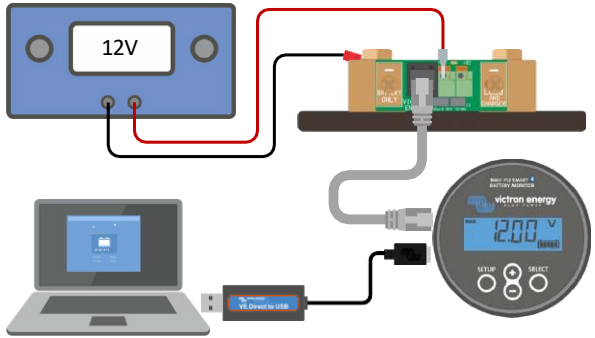
- Blown fuse in red cable
- Corroded shunt board
- Shunt the wrong way around (current reading inversed)
- Bad settings so that BMV will not reach 100% SoC
- Water or dirt in display
- Broken display (not UV resistant)
- Communication issues
- Broken or damaged connectors
- Different or bigger shunt used
- For more see mind map ….



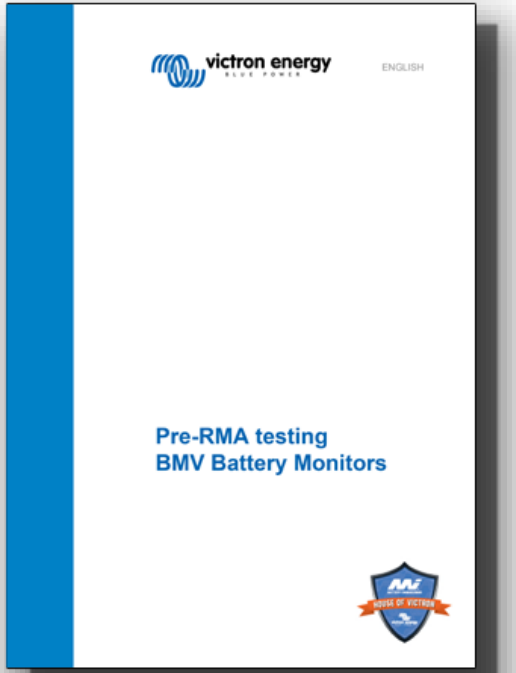
Basic testing steps and common issues

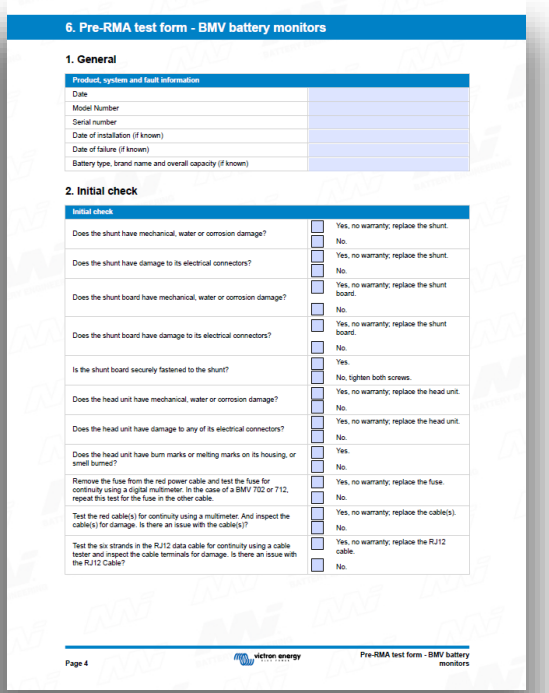
- Visual check
- Check the fuse in the red power cable(s)
- Check the RJ12 cable with a cable tester
- Power up and check voltage and current reading
- Connect with VictronConnect
- Update firmware
- Check if settings are correct
- Display check (if applicable)
- Bluetooth check (if applicable)





Testing procedure and result form RMA





6. Pre-RMA test form - BMV battery monitors

1. General

Product, system and fault information	
Date	
Model Number	
Serial number	
Date of installation (if known)	
Date of failure (if known)	
Battery type, brand name and overall capacity (if known)	

2. Initial check

Initial check		
Does the shunt have mechanical, water or corrosion damage?	☐	Yes, no warranty; replace the shunt.
	☐	No.
Does the shunt have damage to its electrical connectors?	☐	Yes, no warranty; replace the shunt.
	☐	No.
Does the shunt board have mechanical, water or corrosion damage?	☐	Yes, no warranty; replace the shunt board.
	☐	No.
Does the shunt board have damage to its electrical connectors?	☐	Yes, no warranty; replace the shunt board.
	☐	No.
Is the shunt board securely fastened to the shunt?	☐	Yes.
	☐	No, tighten both screws.
Does the head unit have mechanical, water or corrosion damage?	☐	Yes, no warranty; replace the head unit.
	☐	No.
Does the head unit have damage to any of its electrical connectors?	☐	Yes, no warranty; replace the head unit.
	☐	No.
Does the head unit have burn marks or melting marks on its housing, or smell burned?	☐	Yes.
	☐	No.
Remove the fuse from the red power cable and test the fuse for continuity using a digital multimeter. In the case of a BMV 702 or 712, repeat this test for the fuse in the other cable.	☐	Yes, no warranty; replace the fuse.
	☐	No.
Test the red cable(s) for continuity using a multimeter. And inspect the cable(s) for damage. Is there an issue with the cable(s)?	☐	Yes, no warranty; replace the cable(s).
	☐	No.
Test the six strands in the RJ12 data cable for continuity using a cable tester and inspect the cable terminals for damage. Is there an issue with the RJ12 Cable?	☐	Yes, no warranty; replace the RJ12 cable.
	☐	No.

Rj12 cable info

- The RJ12 cable is a "straight" cable. Pin 1 on one side connects to pin 1 on the other side
- Use UTP cable and only use manufactured cables, we sell them in different lengths
- All 6 wires in the cable are used by the BMV
- If one (or more) signals do not arrive at the BMV head unit, the head unit might not be powered or certain current or voltage information will be missing.

The cable carries the following signals:

Pin 1: B1+ - pin 3: Shunt + - pin 5: Ground –

pin 2: B2+ - pin 4: Shunt - - pin 6: Power supply +

Error BL x.xx

- If an error message BL x.xx appears, for example: BL 1.02
- This means that a firmware update has been interrupted.
- To resolve this error, update the firmware using Victron Connect.
- Should the update fail, lodge an RMA.

Spares

- Individual head units, Shunt boards and power cables
- The BMV6s and BMV7 series have the same shunt board
- Two types shunt board: with just a B1 connector or with a B1 and a B2 connection
- The early BMV 6 series has a different shunt board

Spareparts BMV

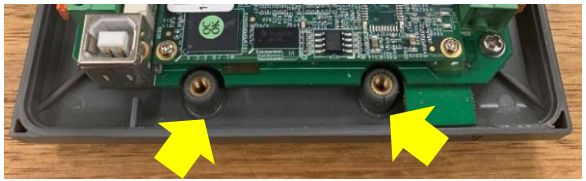
Article code	Description
SPR00036	Display BMV 700
SPR00037	Display BMV 702
SPR00035	Display BMV 712 Smart
SPR00052	PCBA for shunt BMV 600S/700
SPR00053	PCBA for shunt BMV 602S/702
SPR00058	Powersupply cable BMV

Monitoring and remote panels

GX device

- CCGX blue screen or logo screen
- Do a firmware update or manual one via SD card
- It is possible to revert to previous version
- Button issues
- Does not power up
- VRM problems
- Screen issues
- Casing loose
- Reverse polarity will normally not break panel, but it can cause problems if the reverse polarity exists for a long time.
- Error list see CCGX manual

Mechanical damage by mounting screw



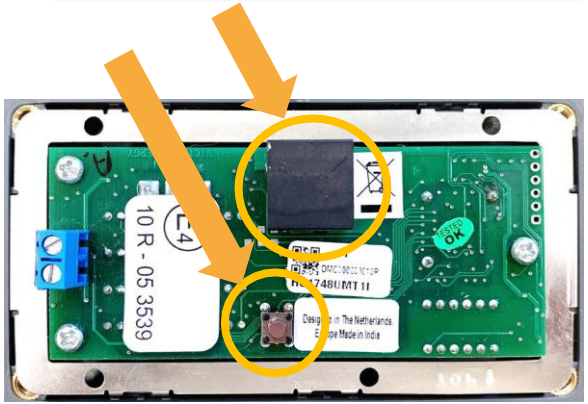
Start-up issues

- If CCGX is stuck on blue screen or has other start-up issues the best way to try to fix is to reinstall the firmware manually via a micro SD card
- Micro SD card needs to be formatted as FAT or FAT32
- Micro SD card needs to be 32GB or smaller
- Follow these instructions

- Afterward you will need to update the firmware to the most recent version
- This can be done automatically or manually via SD card
- See here for instructions

Multi control - common issues

- Damaged or missing current limit knob
- UTP connector funny, right angle connector, not easy to get RJ45 connector in, might get damaged when mistreated
- Button on the back is for manual programming
- Take care not to accidentally have it touching anything after it has been installed



DC/DC converters

DC/DC converters

Orion-Tr DC-DC Converters Isolated
12 / 24 / 48 Volt

Orion-Tr DC-DC Converters Non-isolated
24 Volt

Orion-Tr Smart DC-DC Charger Isolated

Orion-Tr Smart DC-DC Charger Non-Isolated

Orion DC-DC Converters Non-isolated, High power
12 / 24 Volt

Orion DC-DC Converters 110V, Isolated
12 / 24 Volt

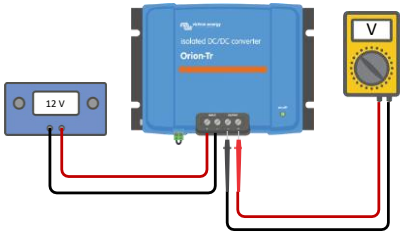
Orion IP67 24/12 and 12/24 DC-DC Converters
12 / 24 Volt

Buck-Boost DC-DC Converter 25A / 50A / 100A

Basic test DC/DC converter

- Visual check
- Is the remote on /off wire (if applicable)
- Power input side and measure output voltage
- Connect DC load to output and check current
- Connect with VictronConnect (if available) and check settings, has perhaps the voltage or current been changed?

- For the Buck Boost converter use it's special software



Battery isolators and combiners

The various types

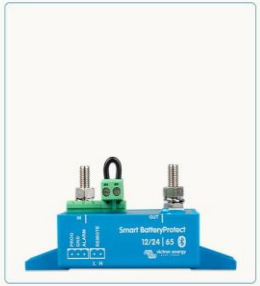
Argo Diode Battery Isolators

Argo FET Battery Isolators

Argo Diode Battery Combiners

Cyrix Battery Combiners

120A / 230A / 400A



Smart BatteryProtect

BatteryProtect

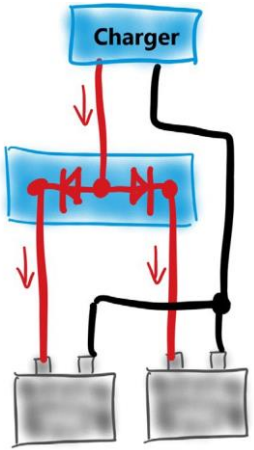
Argo isolator and Argo combiner

- Current ratings need to be adhered to
- Not suitable for 48V
- Dual alternators can cause issues, use two Cyrix instead
- Remember that these products are unidirectional

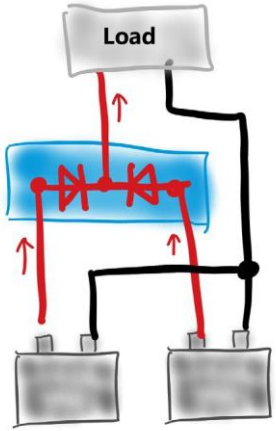
To test:

- Test each diode in both directions
- Then connect input to a DC source
- Check if all outputs work
- There will be a voltage drop over the diodes
  - Diode : 0.3V at low current 0.45V at higher currents
  - FET: 0.01 at low current 0.2V at higher currents

Splitter



Combiner

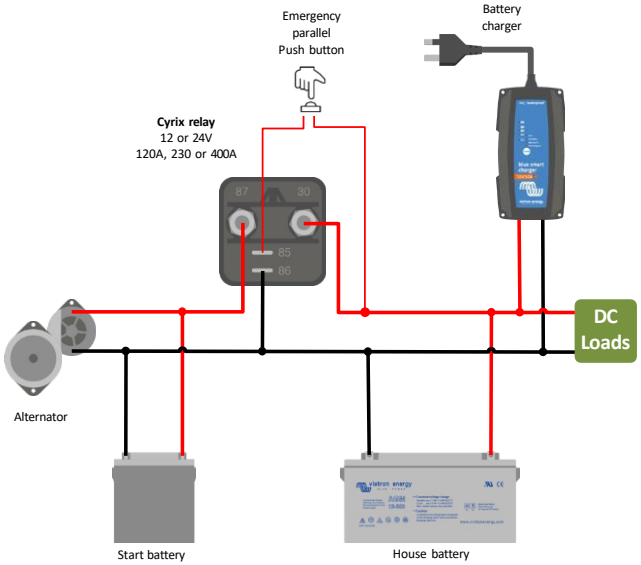


Cyrix

- Don’t exceed current rating - check system to find out if this has been the case
- Negative needs to be connected for it to work
- Emergency parallel switch used?

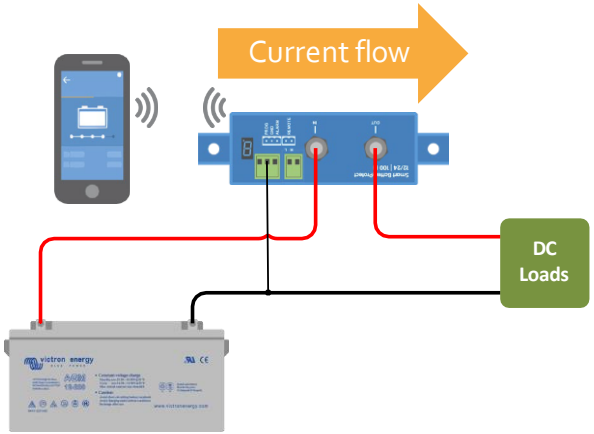
To test:

- Connect voltage on one side, increase voltage and
- See if relay will click
- Connect voltage on other side and repeat test



Battery Protect

- Short circuit protected - shows E1
- Current limiting - should not get damaged due to overcurrent
- Unidirectional - current can only flow from in to out



To test

- Connect voltage input one side
- Check if same voltage on output
- Reduce voltage and see if output will go to oV
- If unit does not work, check the remote on/off link
- For smart models, check settings via Victron Connect App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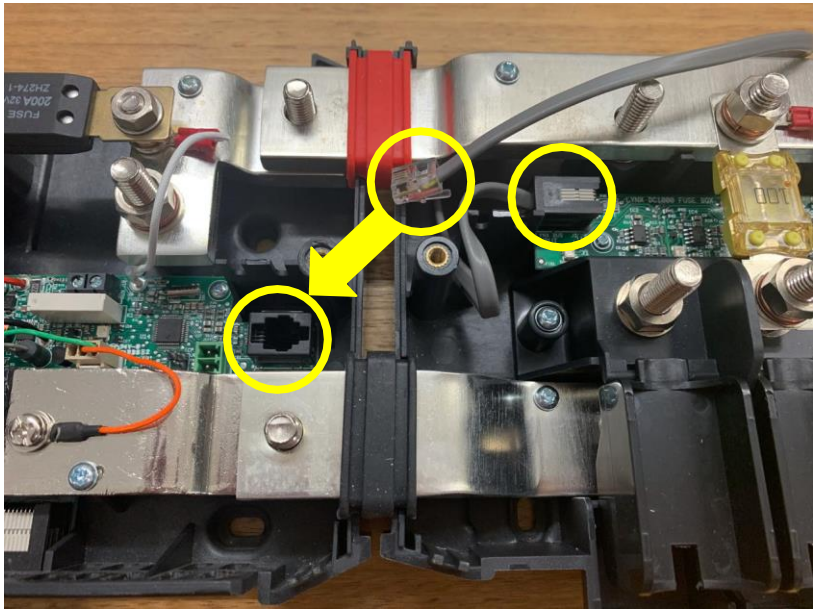
Lynx

Lynx distributor

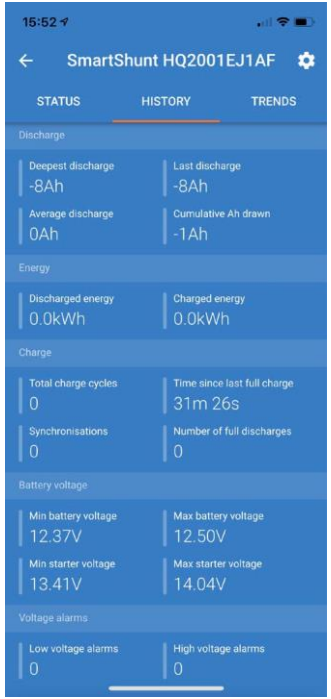
- Lynx distributor needs to be powered from the lynx shunt for the fuse warning lights to work
- When powered the green power LED is on
- Any red LED means that the fuse has blown



Lead acid batteries

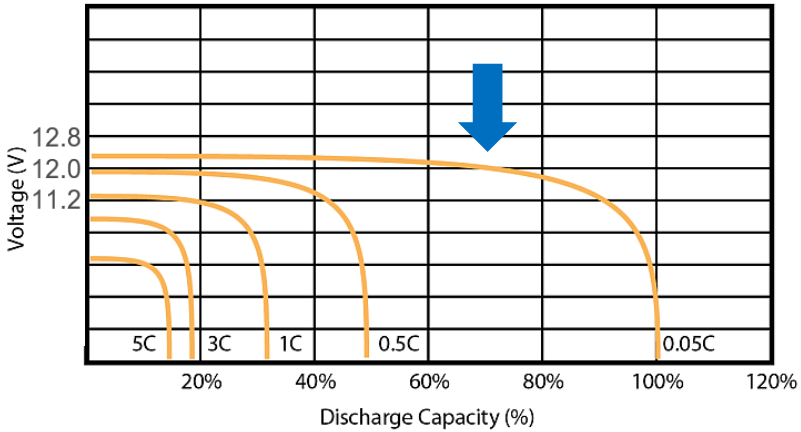
Some pointers

- Don’t use hand held battery testers they are only suitable for car starter batteries
- Weigh sealed battery to see if water has been lost (emergency venting)
- It is hard to tell what happened to the battery so look at BMV history before deciding to lodge a RMA
- How many cycles (equal cycles and synchronisations is ideal)
- Deepest and average discharge (50 % average ideal)
- Max voltage, number of full discharges
- We would prefer only to warrant our batteries if also a BMV is used
- User abuse is not warranty
- Battery warranty is 2 years



Testing battery capacity

- Charge the battery until the battery charger goes into float
- Discharge the battery with a constant load at C20 rate (=20 hour rate = 0.05C)
- C20 is capacity/20. For a 220Ah battery this is 220/20=11A
- Stop discharge when battery voltage drops below 12V
- This happens at about 75% DoD
- This way you can calculate the battery capacity
- When batteries age or get damaged, their capacity reduces



Bad batteries cause other issues as well

Batteries can cause a lot of strange symptoms in a Victron product when the battery is:

- Empty
- Almost empty
- Capacity too small
- Bad quality
- Broken
- Damaged because of too many deep discharges
- Too old
- Too hot or too cold

Always first rule out a battery issue and only then look at the connected Victron product

Lithium batteries

Some pointers

- It is hard to tell what happened to the battery
- No warranty if no BMS
- No warranty if batteries have been totally discharged or charged below 5°C
- Look at BMV history before deciding to lodge a RMA
- How many cycles?
- Deepest and average discharge (should not be lower than 10% Soc)
- Max voltage, number of full discharges
- User abuse is not warranty
- Battery warranty is 3 years

New and old LFP batteries

Evolution of our LFP batteries:

Early models:

- LFP without BMS (passive balancing)
- LFP with BMS wires on either side (passive balancing)

2017 onwards:

- LFP Smart with BMS wires on either side (active balancing)
- LFP Smart with wires on one side (active balancing and pre-alarm)

Under and over voltage

Low voltage

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

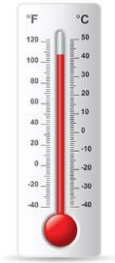
High voltage

- A LFP cell will fail if the voltage over the cell increases to more than 4.2V
- The battery will melt or burn if the voltage is very high
- In case of high voltage charge sources will need to be turned off or disconnected

Temperatures

High temperatures

- Lithium batteries will get damaged if the battery is used at temperatures greater than 50°C
- Loads and charge sources need to be disconnected or turned off when the temperature exceeds 50°C

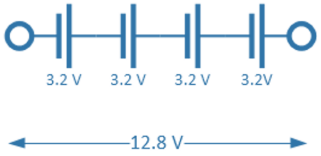


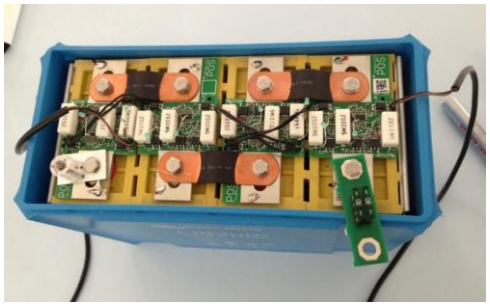
Low temperatures

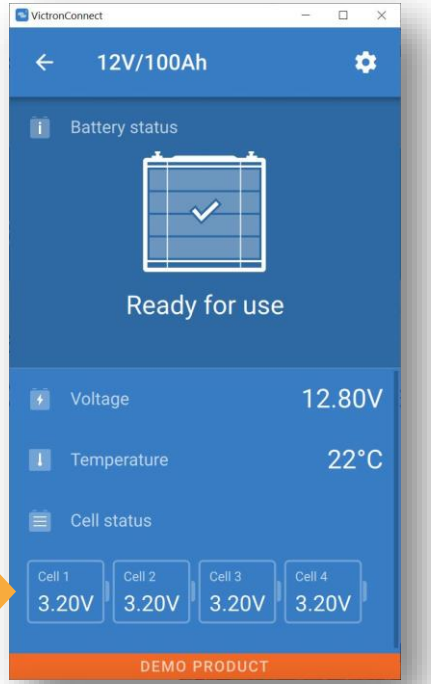
- LFP batteries will get damaged if they are charged in below zero temperatures (discharge is allowed)
- Charge sources will need to be disconnected or turned off when the battery temperature is less than 5°C

Cell voltages

- 12.8V battery has 4 cells in series
- LFP Batteries are not serviceable
- Use VictronConnect to analyse the cell voltages
- A cell will fail if the voltage is less than 2.5V



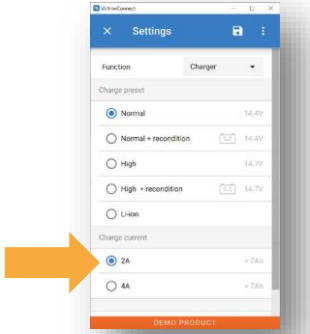




Recovery after very low battery

NOTE that this procedure might not always work and there is a realistic chance that the battery is unrecoverable:

- Connect a 12/4 BlueSmart charger and set it to lithium and set current to 2A
- Make note of the starting voltage
- Make note of the voltages at regular intervals
- Leave the charger connected and see if the voltage slowly increases
- Leave the charger connected for 24 hours
- Once the battery has reached 13.6 V disconnect the charger
- Let the battery sit for a few hours
- Check the voltage of the battery, it should comfortable sit above 12.8 V like 13.2 or higher
- If the voltage is below 12.8 wait 24 hours and measure again.
- if voltage is even lower the battery is unrecoverable damaged



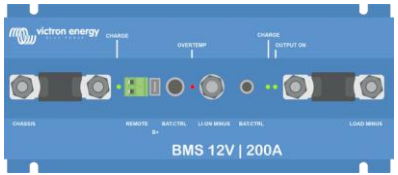
An external BMS is always needed

- VE.Bus BMS with mains detector

BMS300200000	VE.Bus BMS

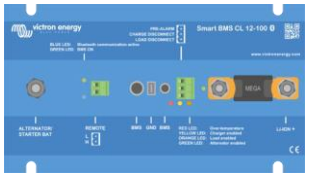
- Mini BMS

BMS400100000	miniBMS



- BMS 12-200

BMS012201000	Battery Management System BMS 12/200

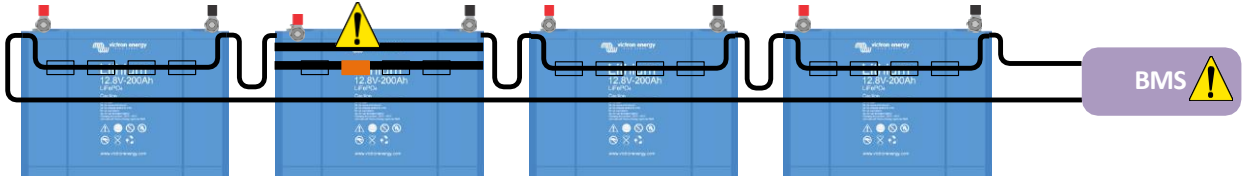


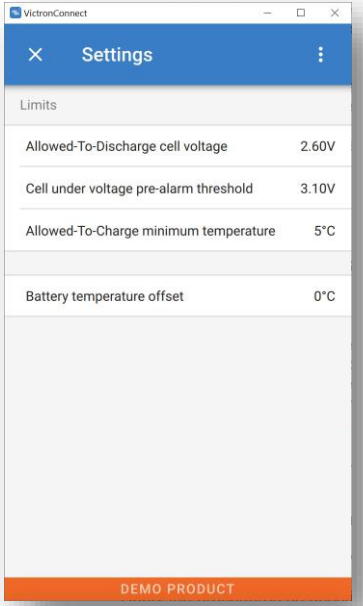
- Smart BMS CL 12/100 with Bluetooth

BMS110022000	Smart BMS CL 12-100

How does the BMS work

- The battery takes care of active cell balancing during charging
- Each battery cell has a voltage and temperature sensor
- These are all connected in series to the BMS.
- An alarm signal will be send to the BMS when:
  - Cell voltage too low: 2.6V (can be increased with VC)
  - Cell Voltage pre-alarm signal (can be set to 2.8V and up with VC)
  - Cell voltage too high: 3.75V
  - Temperature too low : 5°C (can be changed with VC, less than 5°C will void warranty)
  - Temperature too high: 75°C

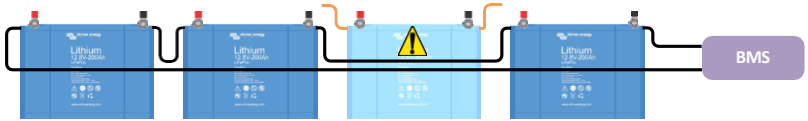




Trouble shooting BMS and batteries

- To test if the BMS is functional, disconnect the BMS communication cable and see if the BMS will go into alarm mode

- Non-smart battery: to rule out an issue with a individual battery, bypass the battery communication and see if the BMS alarm goes away



- Smart battery: use the VictronConnect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Spare parts

Other spare parts

Fans and Miscellaneous

Spare parts miscellaneous

Article code	Description
SPR00045	AC-out connector
SPR00046	AC-in connector
SPR00043	PPP Cable, Push button switch
SPR00059	Powersupply cable VenusGX/ColorControl
SPR00034	VE.Net battery Controller Skylla TG GMDSS
SPR00056	Circuitbreaker Easy Plus Compact 12/1600/70
SPR00042	Ferrite Bead (bag of 5)

Spare fan

Article code	Description
SPR00051	Fan for Phoenix Multi Plus C 12/800/35
SPR00040	Fan for Phoenix Multi Plus C 12/1200/1600
SPR00049	Fan for Phoenix Multi Plus C 12/2000/80
SPR00054	Fan for Phoenix Multi Plus C 24/800/16
SPR00041	Fan for Phoenix Multi Plus C 24/1200/1600
SPR00050	Fan for Phoenix Multi Plus C 24/2000/50
SPR00055	Fan MultiPlus-II 48/3000 (with connectors crimped)
SPR00057	Fan MultiPlus-II 48/5000 (with connectors crimped)
SPR00038	Fan for Phoenix Multi/Quattro/ITR3600
SPR00039	Fan for Skylla TG
SPR00044	Fan for Phoenix Charger
SPR00048	Fan for Isolationtransformer 2000
SPR00047	Fan for Isolationtransformer 7000

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