victron energy
BLUE POWER

MultiPlus/ Quattro Diagnostics and repair

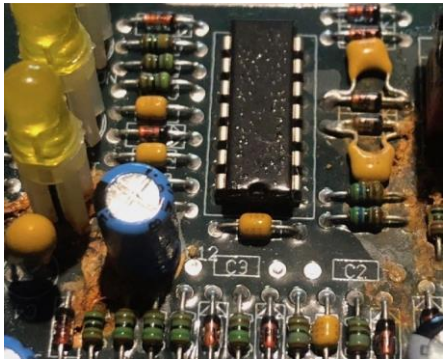
Visual check

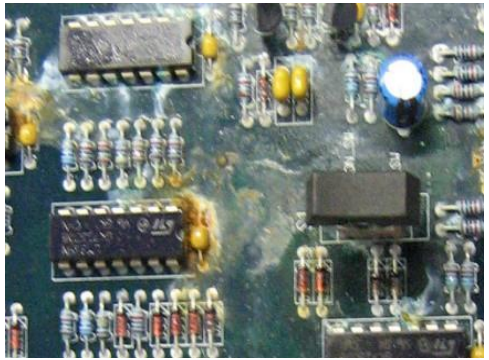
Visual check

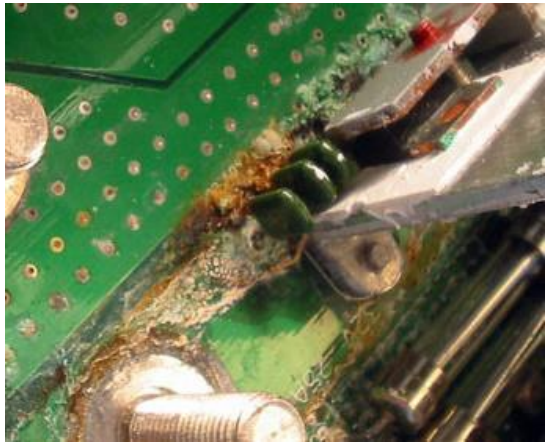
Perform internal and external visual check on the following:

- Burn marks or burn smell
- Corrosion
- Dust, dirt, pests or water ingress
- Damaged or incomplete wiring
- Broken or missing fuses
- Internal or externa mechanical damage
- Foreign objects inside unit, like bits of stripped wire or metal shavings

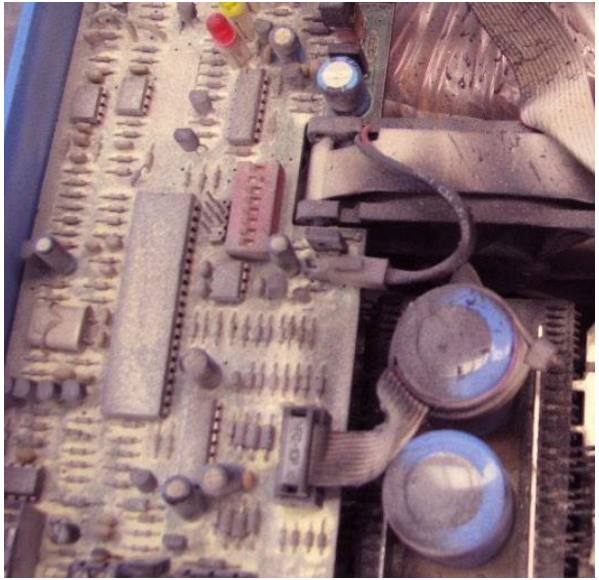
Water damage - Not warranty

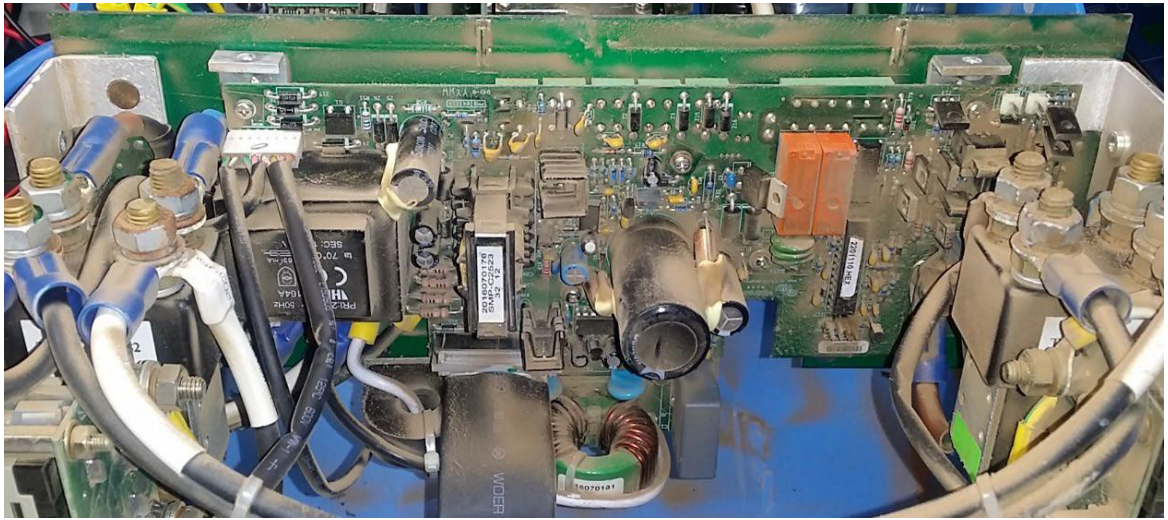




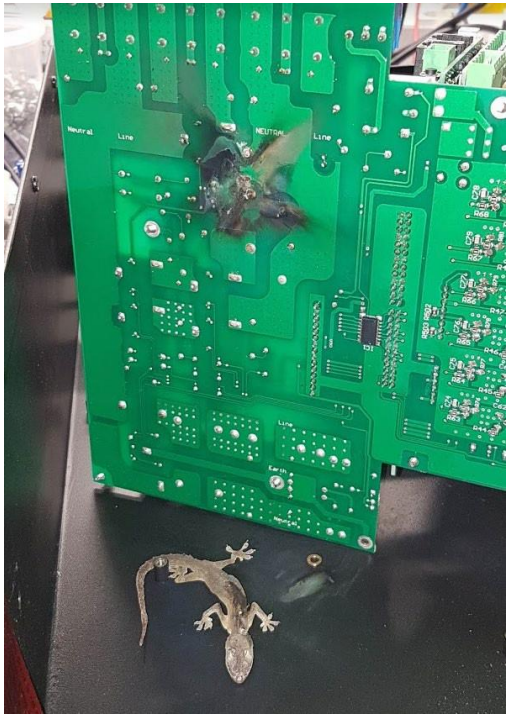


Dirt and dust - Not warranty



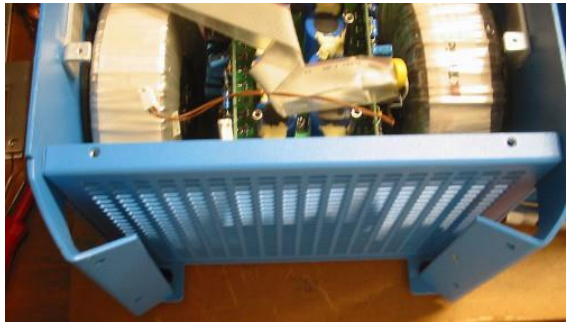


Insects or other pests - not warranty



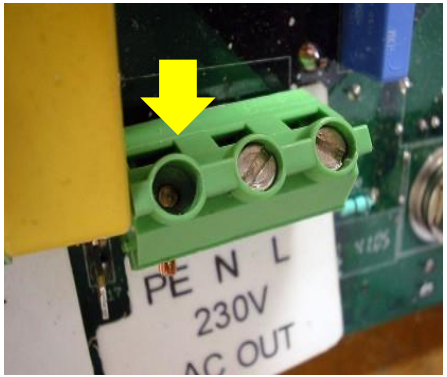
Damaged housing

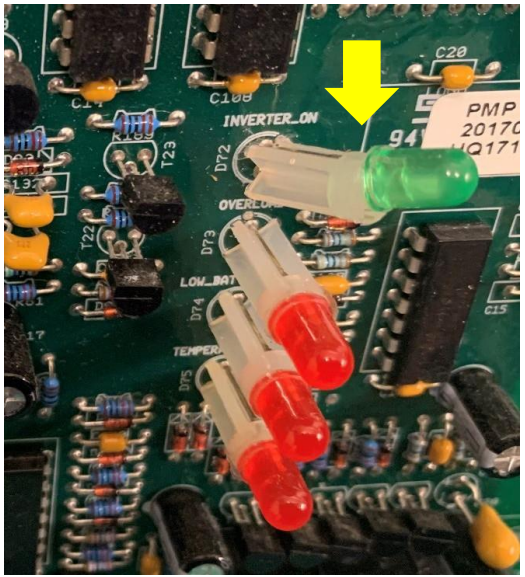
- Not mounted correctly
- Vibration because mounting screws are loose
- Transport damage
- Holes drilled in housing



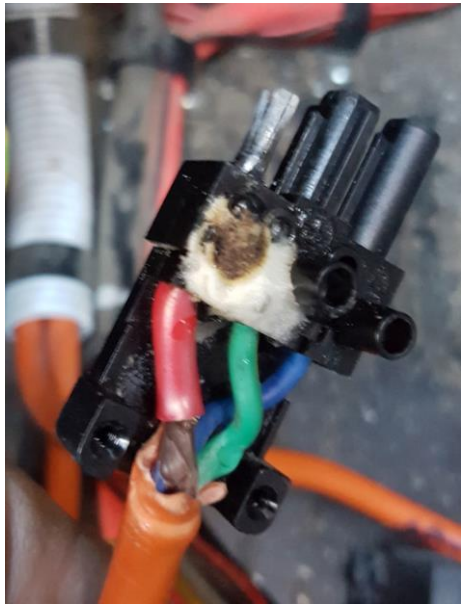
Mechanical damage - Not warranty

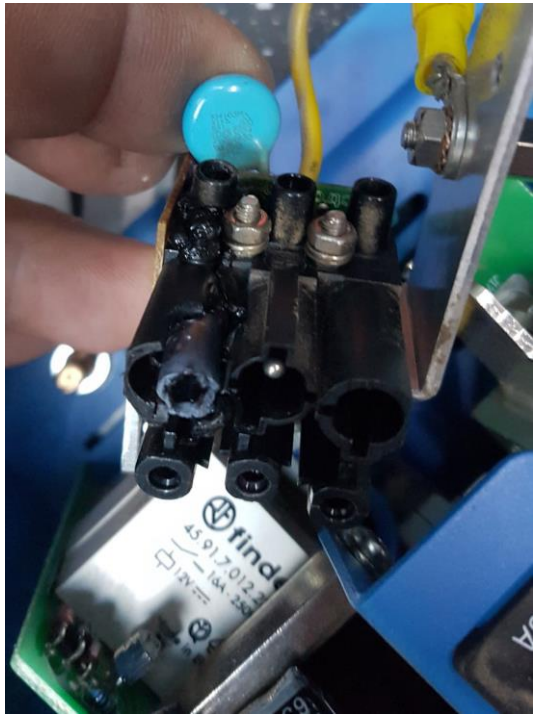
- Broken bolts or screws
- Damaged connectors
- Damaged switch
- Snapped off LEDs





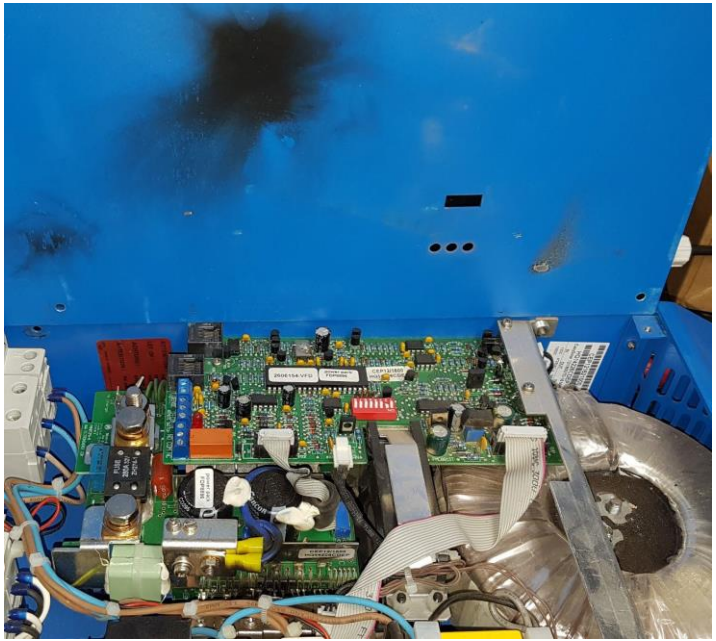
Bad or loose wiring or loose connections



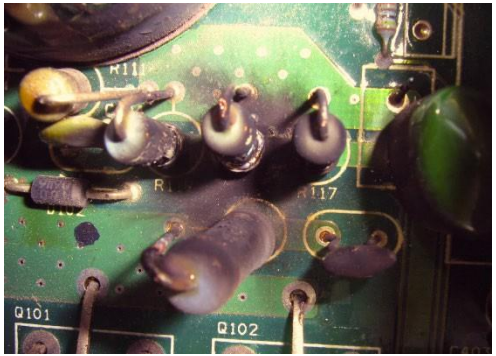


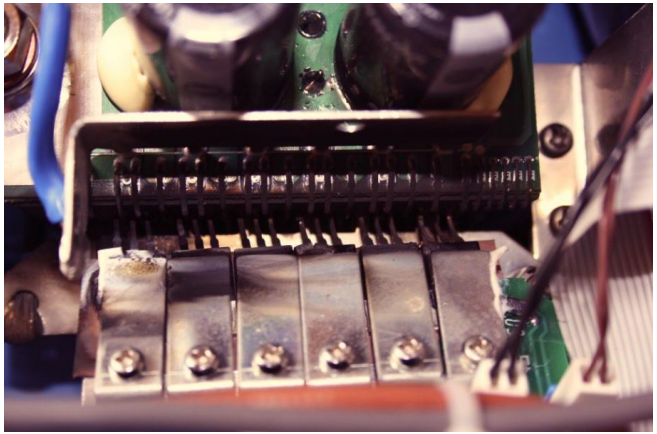
Burned components need to be noted

- Look closely at the circuit boards and also inspect the housing
- Burned components can be due to both warrantable or non-warranty faults



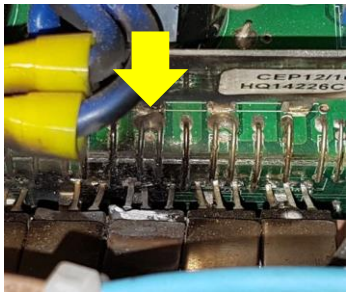
Burned components need to be noted

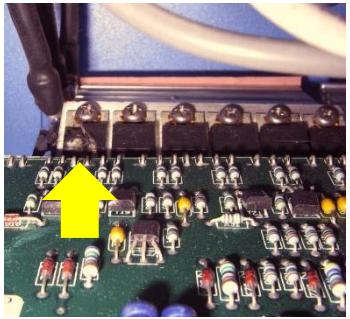


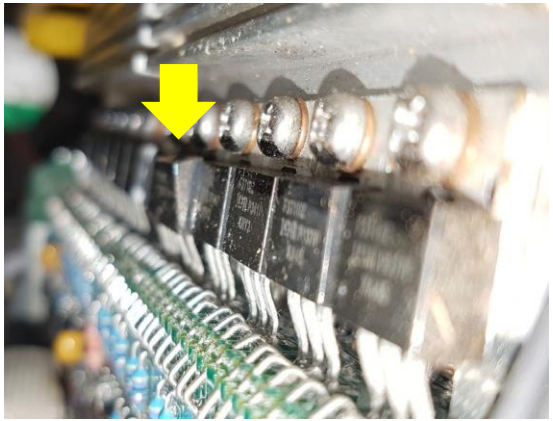


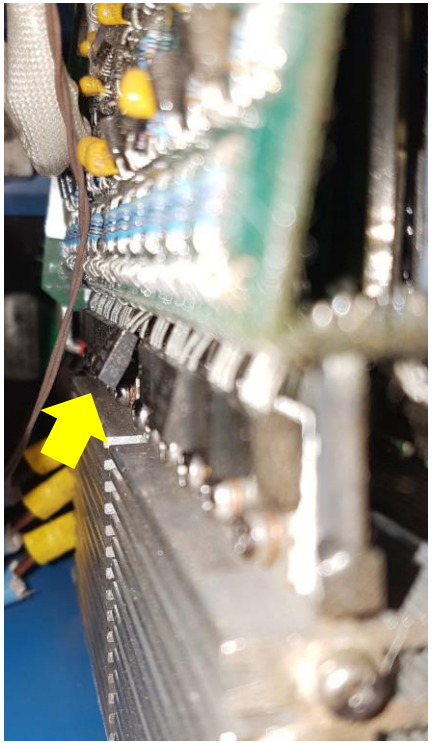
Check for failed FETs

- FETs usually fail due to reverse polarity or dirt or water ingress,
- It can also be that there is a bad FET
- Take top plate off Multi and shine with a torch past the row of FETs









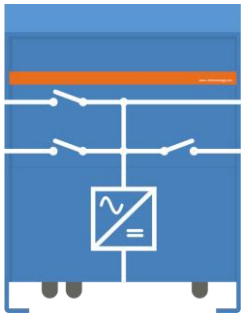
Testing and diagnosing

Inverter charger internal diagrams

Small MultiPlus

MultiCompact

MultiPlus 3K and up



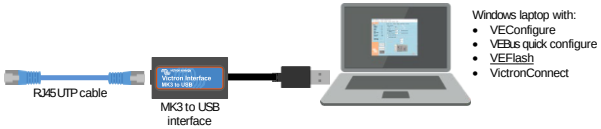
Quattro

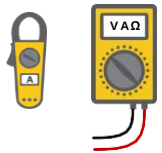
MultiPlus-II

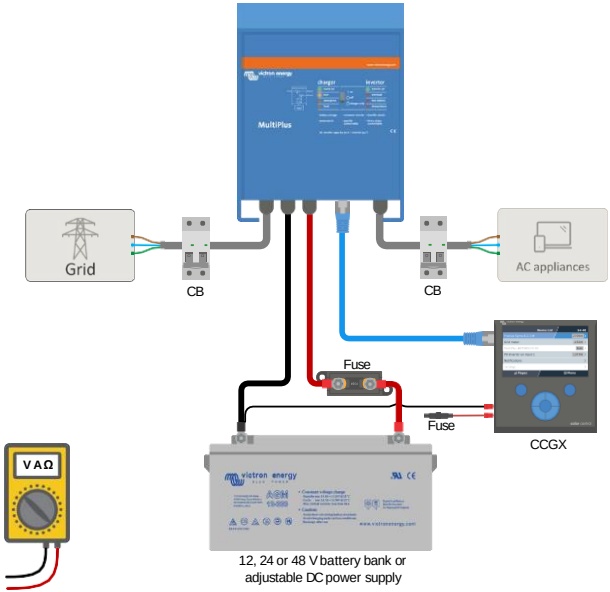
Phoenix Inverter

Basic test setup

- Fused 12, 24 or 48V battery bank or adjustable DC power supply
- AC supply with double pole circuit breaker
- Switchable resistive AC loads like electric heaters (no heat guns)
- Color Control GX and RJ45 UTP cable
- Laptop with VEConfigure tools and VictronConnect installed
- MK3 interface and RJ45 UTP cable
- True RMS Multimeter (Fluke 87) and current clamp
- Antistatic mat and wristband





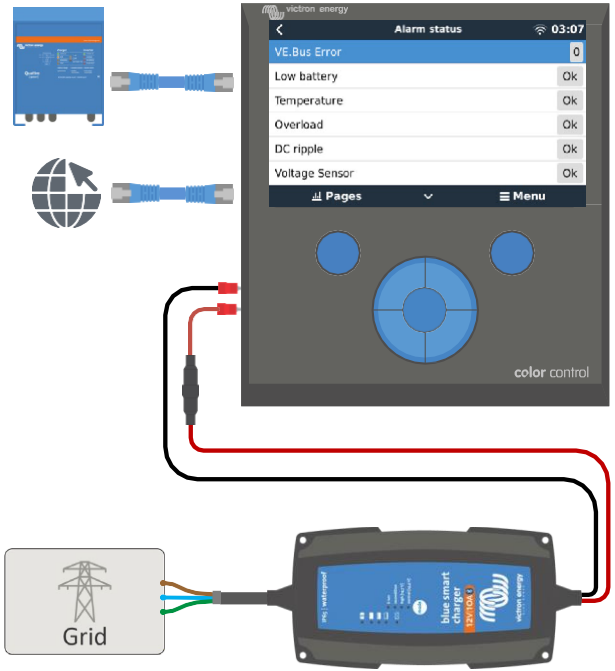


CCGX is a required part of your test bench

- You will see more details on error codes.
- You can use it for datalogging

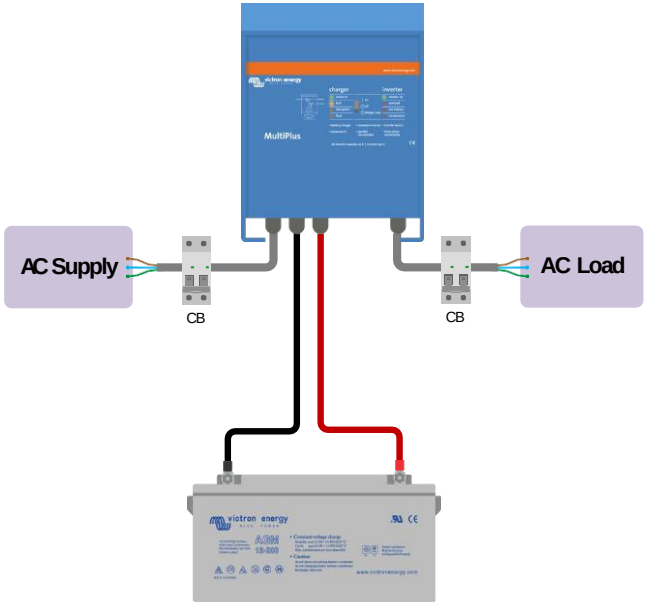
Additional requirements:

- Power the CCGX from AC, use a old power adapter or a blue power charger
- Connect the Color Control to the internet - this way we can remotely access it if needed
- Keep firmware to date, enable automatic firmware updating
- Set the CCGX up on VRM



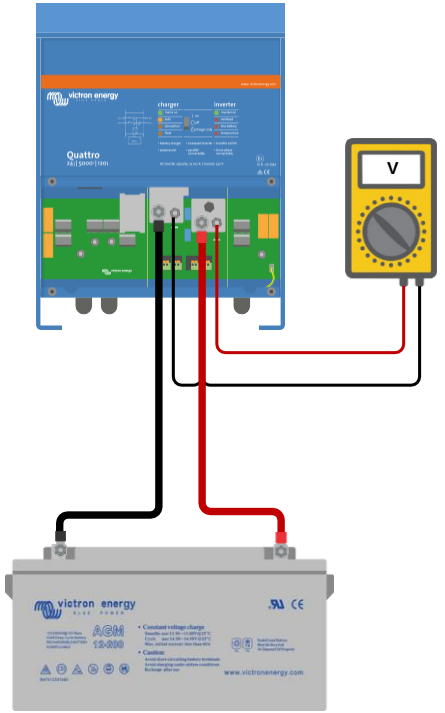
Preparing the multi for diagnostics

- Turn unit off
- Disconnect temperature sensor
- Disconnect voltage sense cables
- Disconnect remote panel
- Connect unit to DC, AC supply and AC load
- Connect unit to CCGX
- Turn off AC supply and AC load off



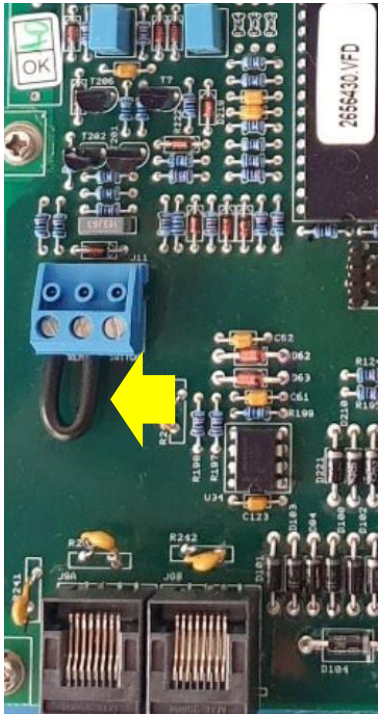
Check battery voltage

- Check if the correct battery voltage is present at the DC terminals inside the Multi or Quattro
- This is always the first step whether the unit is in its installation or on the work bench
- Measuring at the battery is not good enough.
- The reason behind this step is to exclude wiring, battery and installation issues



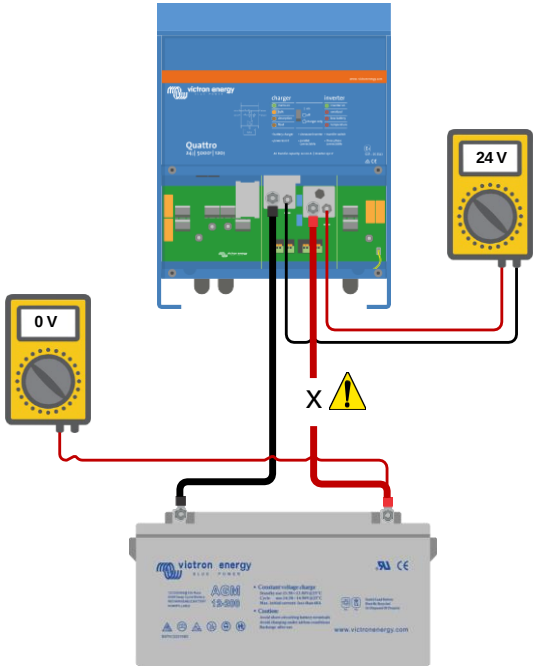
Rule out external on/off control

- Check if the remote on/off wire loop is in place
- Remove all connected control devices MultiControl panel and GX devices



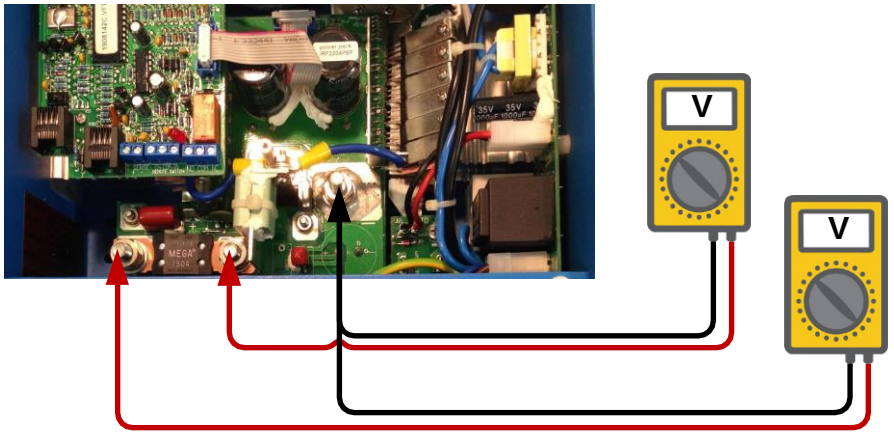
Low voltage battery or zero volt battery

- A Multi will attempt to charge when the battery voltage is very low or zero Volt.
- At first nothing happens and the low battery light might be on, but then, after some time, a secondary power circuit will be powered by the AC voltage and the unit will start to charge.
- In some case this can be confusing for the end user. A scenario might be that a DC fuse has blown, but the unit still appears to work.
- A customer complaint would be: the charge works, but the inverter is broken.
- In case of a Quatro this mechanism is only active for AC input 1



Check internal fuse

MultiCompact and small Multi only



Testing by removing the fuse:

- Remove the fuse
- Inspect fuse for mechanical damage
- Test the fuse with a multimeter

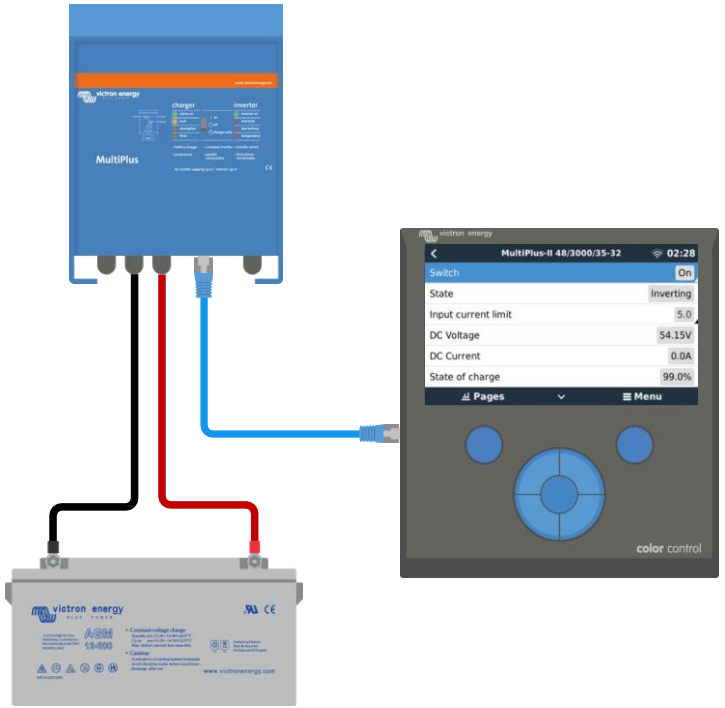
Testing with fuse in situ:

- Measure voltage between negative battery connection and either side of the fuse. Both voltage need to be the sam
- Run the MultiCompact at full load and check the there is no voltage drop over the fuse

Connect CCGX

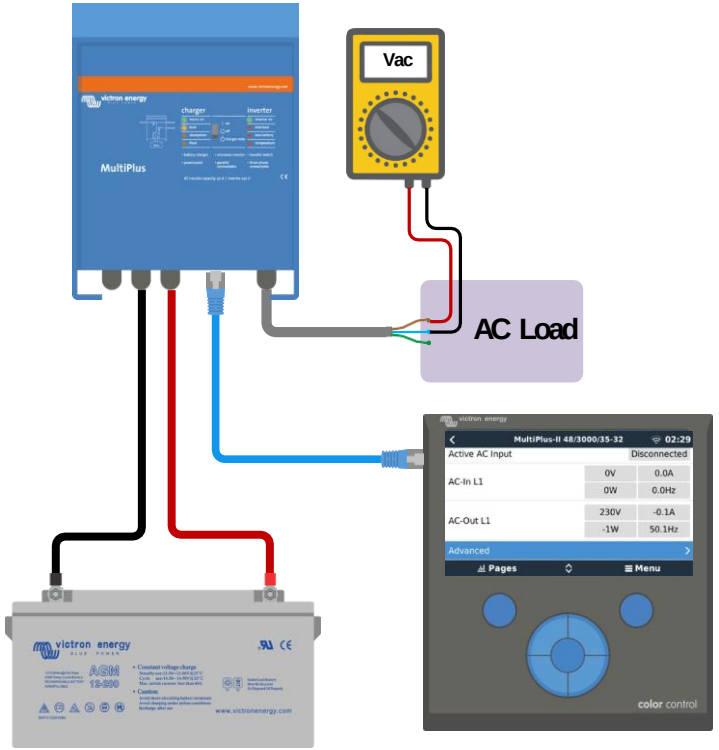
- Turn the Multi off for at least 10 seconds
- Connect CCGX
- Turn Multi on
- Confirm that CCGX is receiving data from The Multi or Quattro

- Have VEConfigure on standby, in case you will need to access the settings



Check inverter operation:

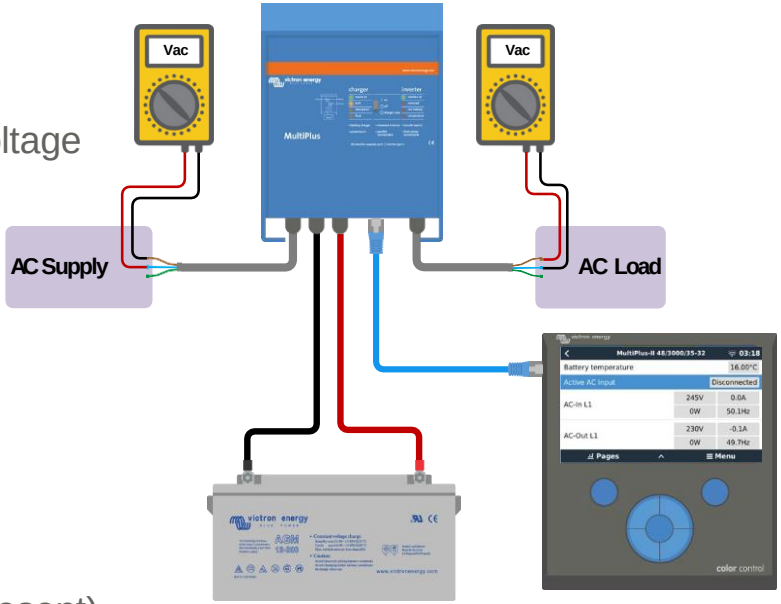
- Check if the green inverter LED is illuminated
- Refer to the manual if any red LEDs are illuminated or blinking or error show up on the CCGX
- Check the operation of the inverter by measuring the AC output with a true RMS voltage meter
- Connect an AC load and check the operation of the inverter, keep measuring the AC output voltage
- Increase the AC load to the Multi's rated power
- Disconnect the AC load



Check switch over

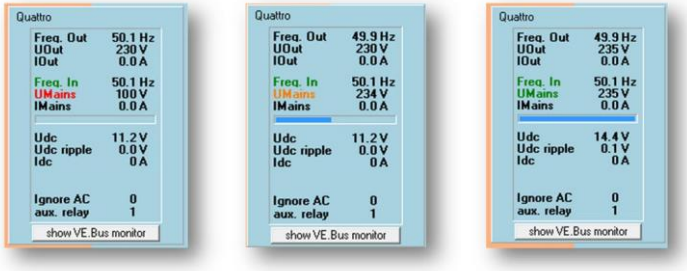
- Connect the AC input and check if the Multi switches from inverting to charging. This can take some time.
- Repeat this for the second AC input for a Quattro
- The AC output voltage should be matched to the AC input voltage during this process

- Check if the green “mains on” LED is illuminated
- Check if the AC output is life
- Check if second AC output becomes life after 2 minutes (if present)



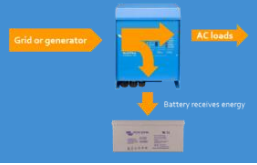
Unit does not accept AC

- Check the AC input connection timer in VEConfigure (firmware 460 and up). It indicates if and when the AC Input is rejected.

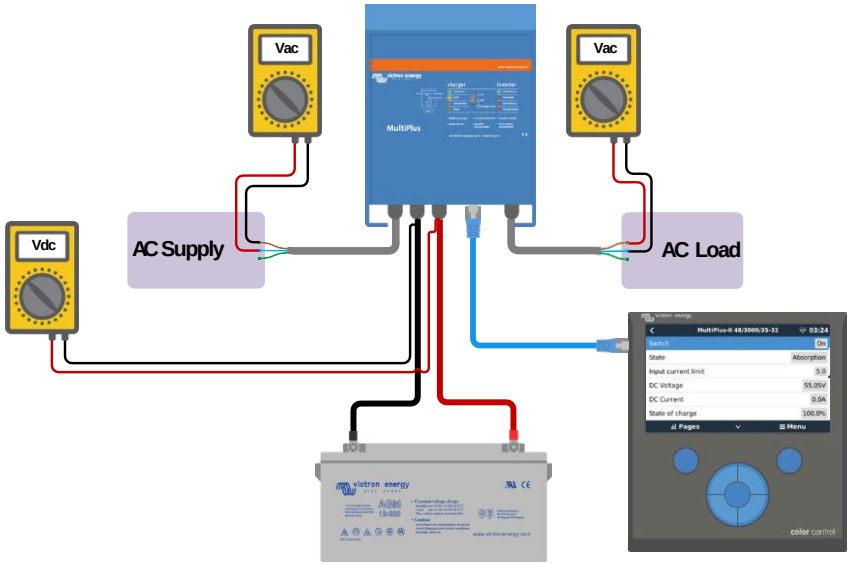


- Be aware that AC input setting, virtual switch or assistants can prevent the unit from connecting to grid
- Check the AC input current setting. If it is set to too low a multi will not connect to AC
- A reason for not connecting could be the relay test has failed (Error 8 or 11 - more info later on this)
- In case of generator, rule out generator issues by testing with grid first (more info later on this)

Check charger operation

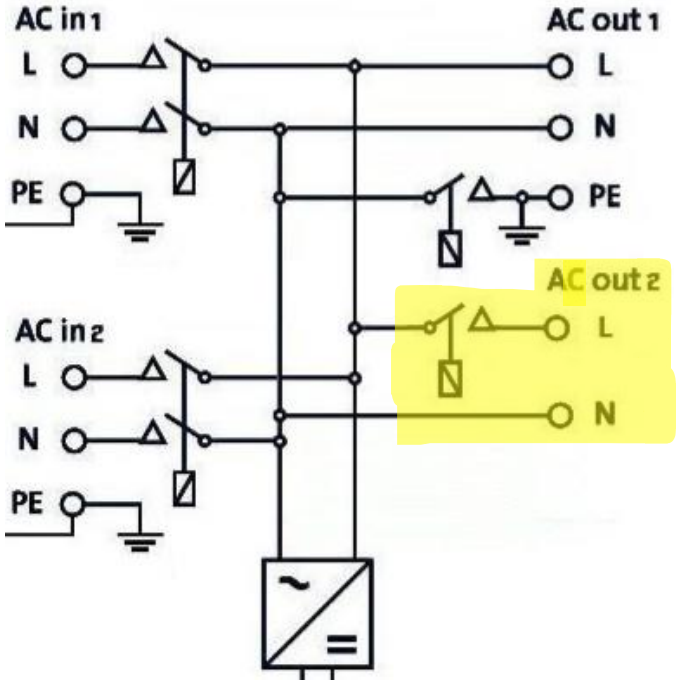


- Check if any of the yellow charger LEDs are illuminated
- Refer to the manual if any red LEDs are illuminated
- Check the operation of the charger, the voltage should go up
- Connect temp sensor, heat the sensor and verify if the charge voltage drops
- Connect an AC load and check if this load gets powered by the Multi.
- Switch the unit to “charger only” and check if the unit charges correctly



Check second AC output

- Only for Units 3kVA and up
- The default operation is for it to become live 2 minutes after AC input has been successfully connected
- Be aware that the normal operation of the second AC output could have been altered with an assistant

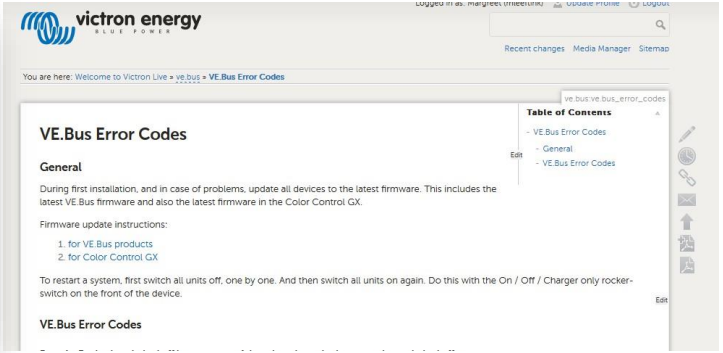


Check power assist

- Increase the AC load and check if the Multi starts power control. The charge current to the battery should reduce
- Increase the AC load even further and check if the Multi starts power assisting. This is indicated by a flashing Inverter LED and a reversal of the battery current
- Be aware that Power assist could be turned off (or is a 500 VA Multi)

Error codes

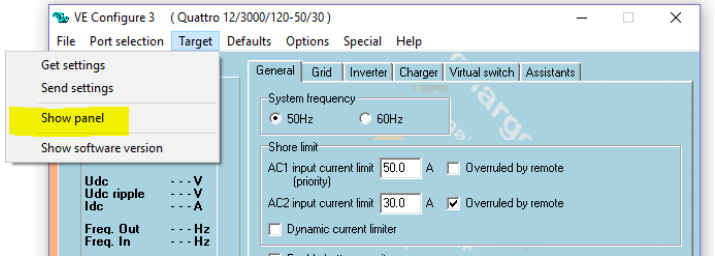
- See manual, chapter VE bus error codes and chapter fault finding
- See Toolkit App
- See Victron Live: https://www.victronenergy.com/live/ve.bus:ve.bus_error_codes
- CCGX



Multi Control panel or virtual control panel

- The Multi Control panel connects to the unit via a RJ45 cable
- The Multi Control panel switch is only operational if the main unit is switched on

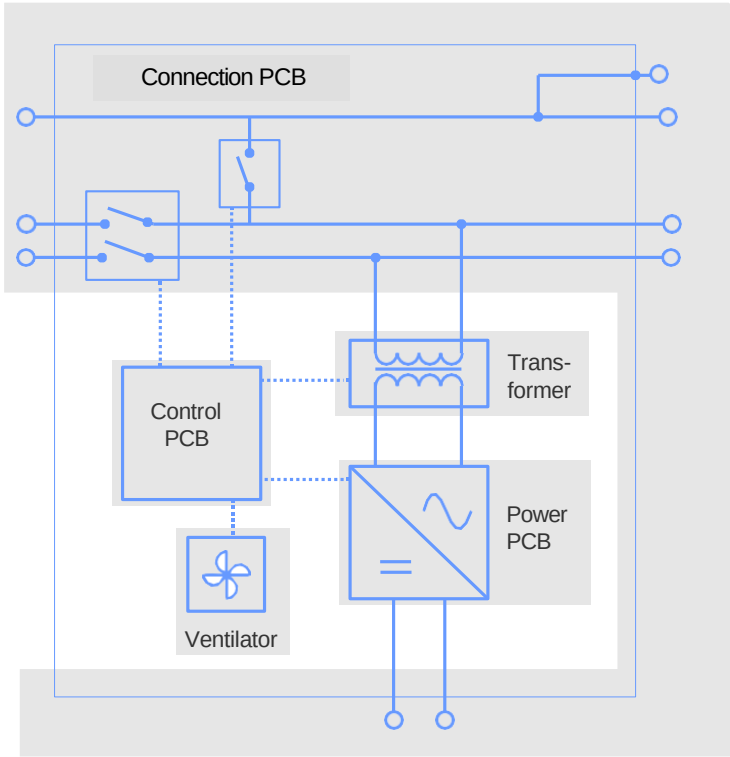
- The Virtual control panel is available from VE. Configure



Circuit boards

The 4 basic Multi building blocks

- Connection board
- Control board
- Power board
- Transformer(s)
- Fan(s)



Control board

Control board

- MultiCompact, MultiPlus. Quattro and large inverters - Always first try to swap a control board and see if this fixes the problem

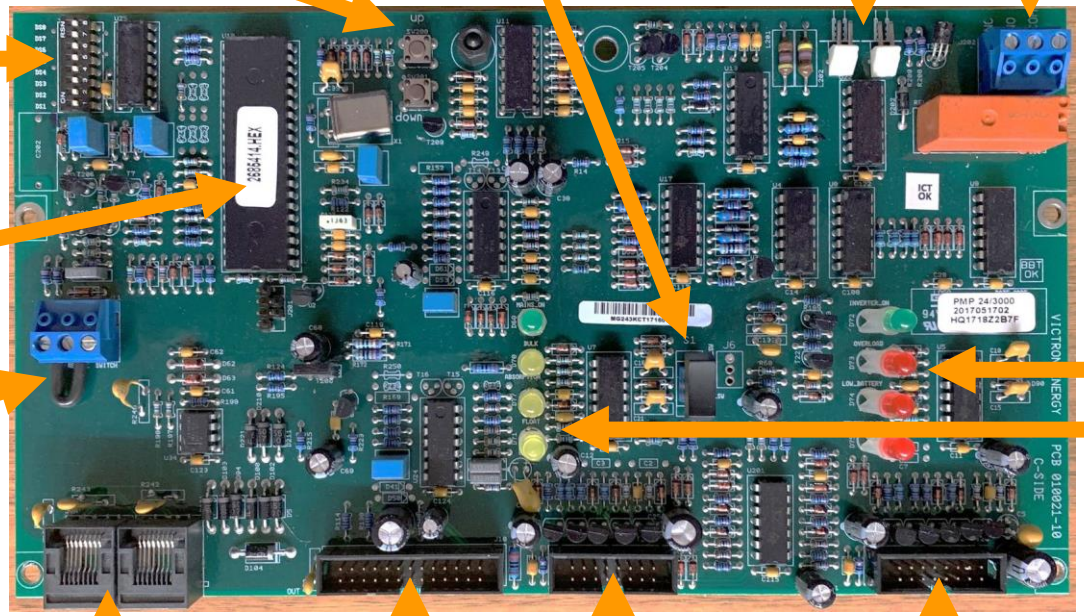
- Control boards can be interchanged between a variety of units for basic testing Providing that:

  - The DC voltage and AC voltage are the same.

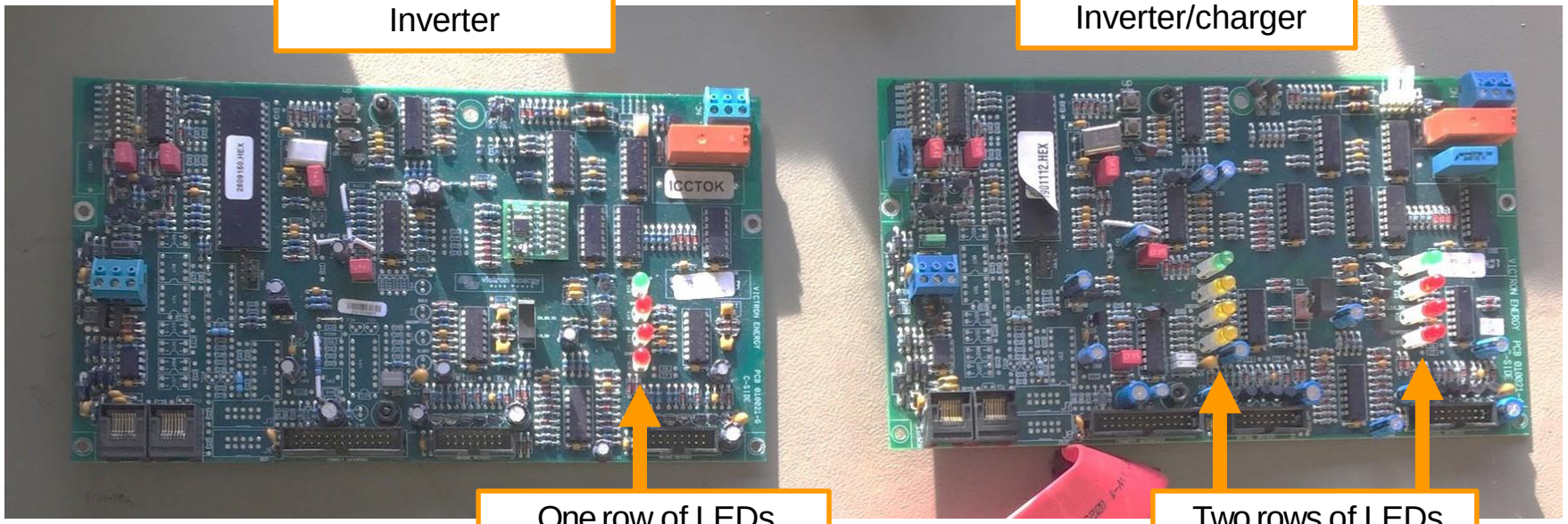
  - Compact and non-compact boards cannot be swapped

  - VE.Bus and non-VE.Bus cannot be swapped. In other words firmware 18 boards cannot be swapped with higher firmware.

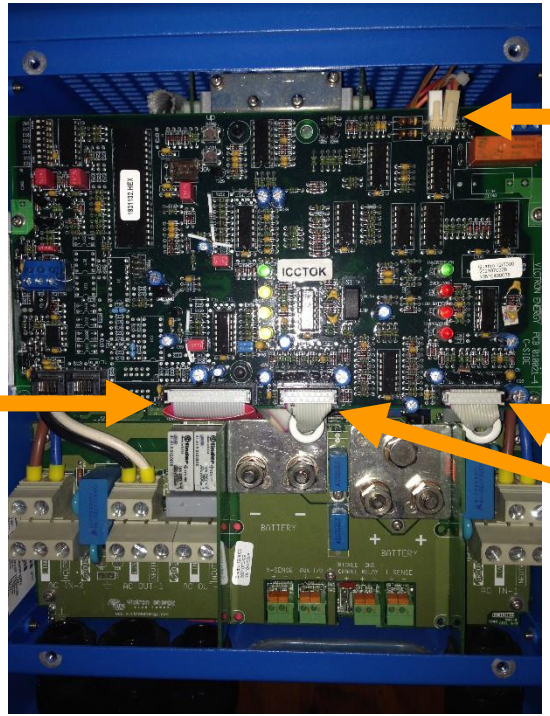
Control board 3K and up



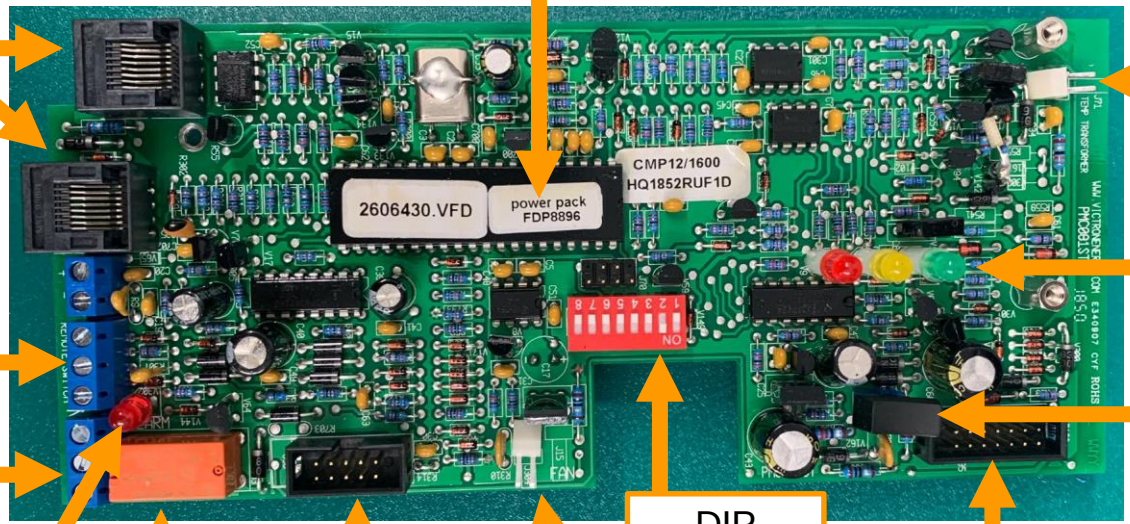
Inverter vs Multi control board



Control board in situ



Control board in situ



Microprocessor with firmware sticker

RJ45 connectors

PTC connector

Remote on/off connector

LEDs

On/off switch

Virtual switch connector

DIP switches

Virtual switch status led

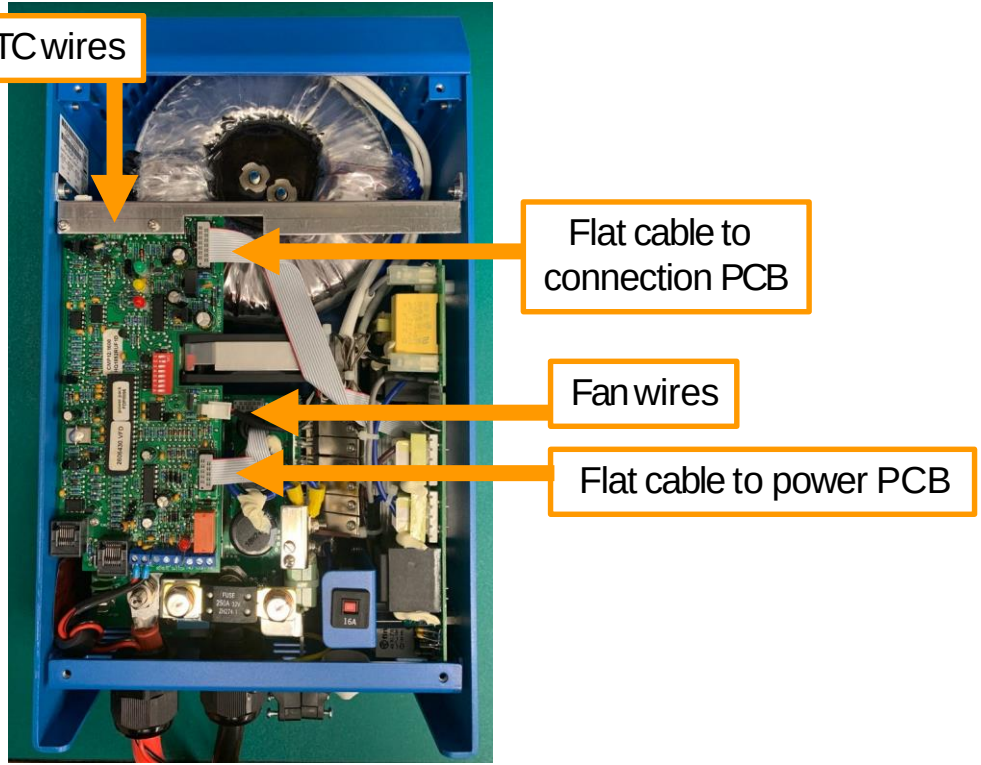
Virtual switch relay

Flat cable to control board

Fan connector

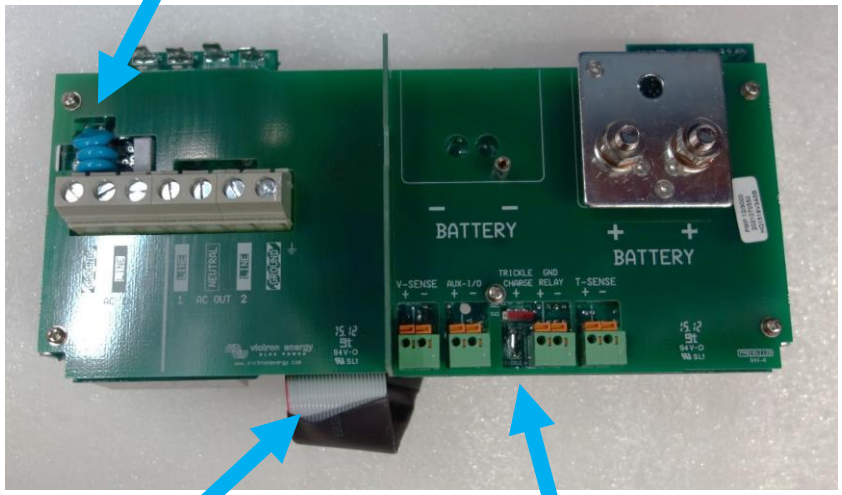
Flat cable to power board

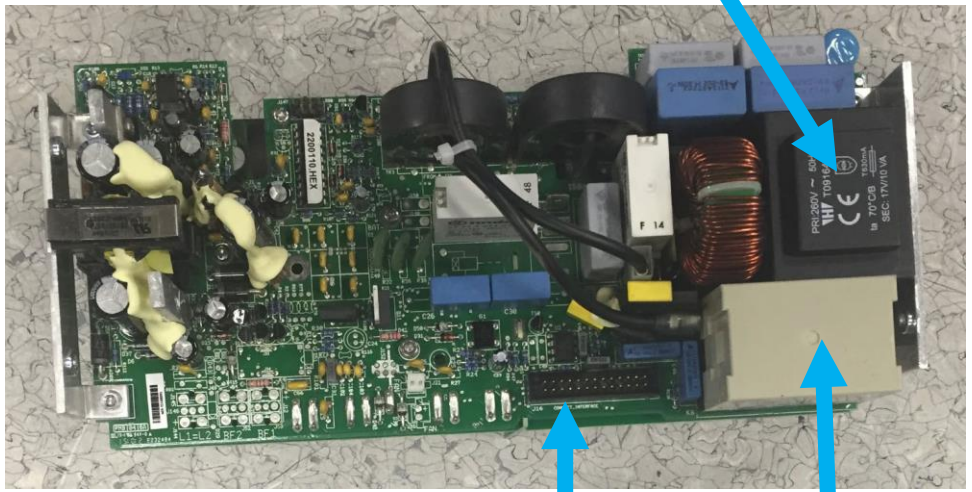
MultiCompact



Connection board

Connection PCB 3K Multi

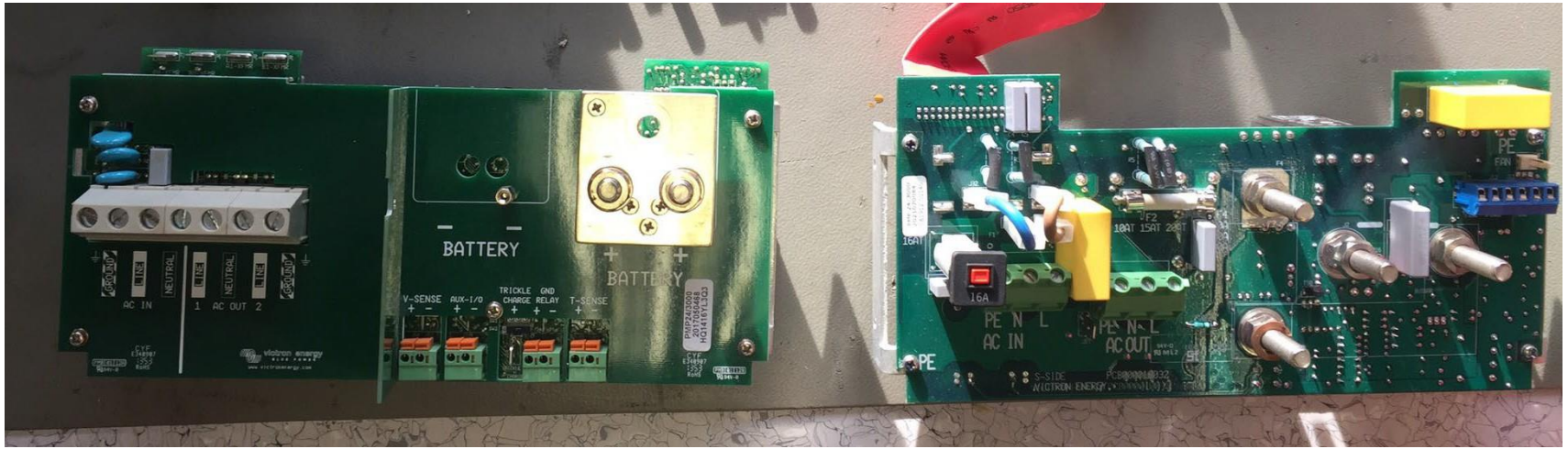




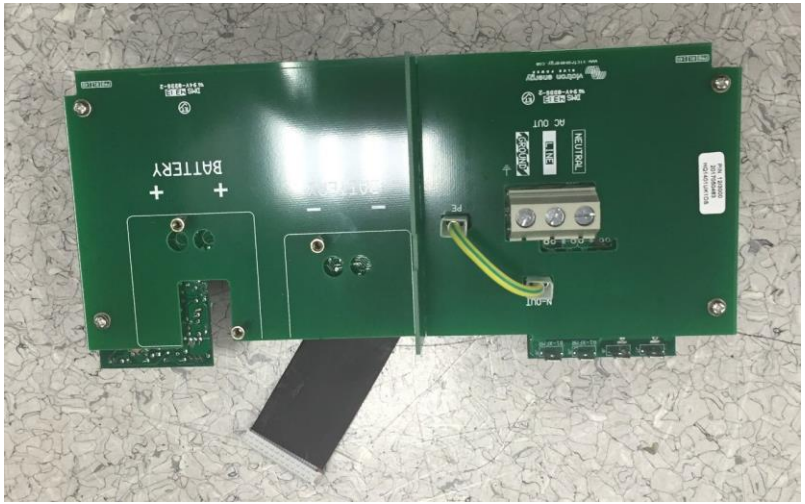
Multi 3K new vs old connection board

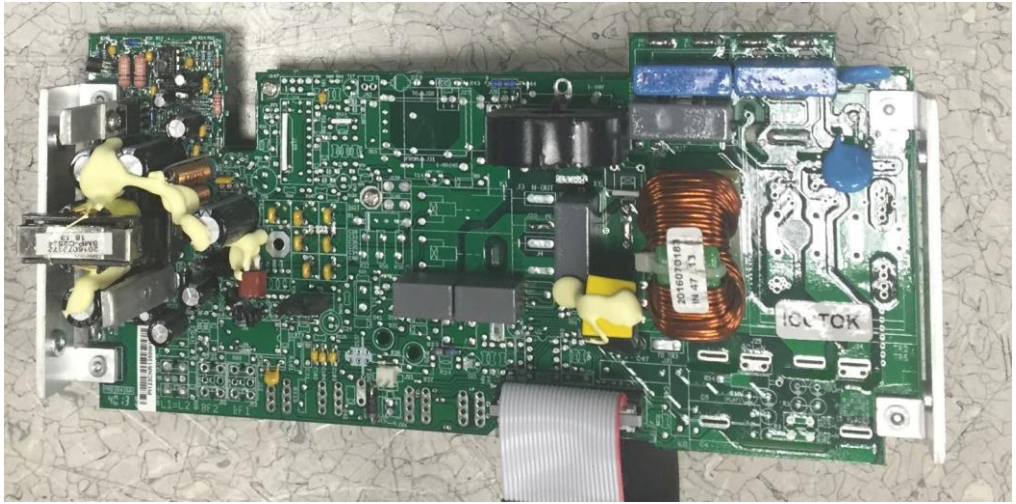
NEW

OLD

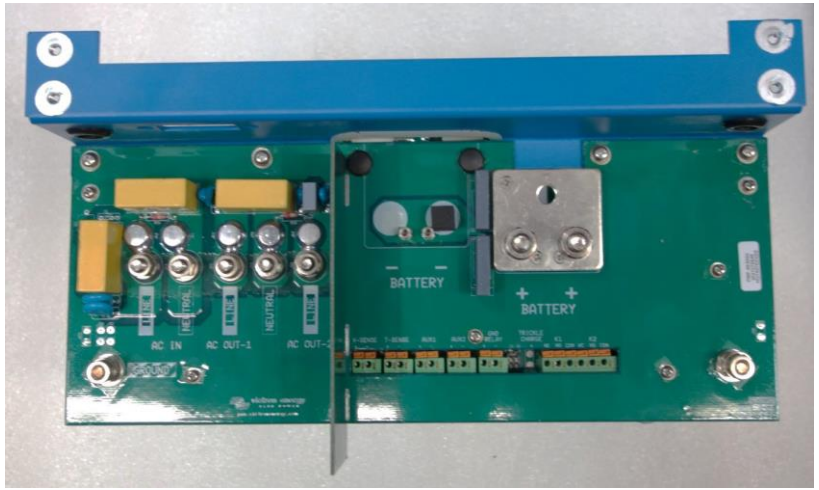


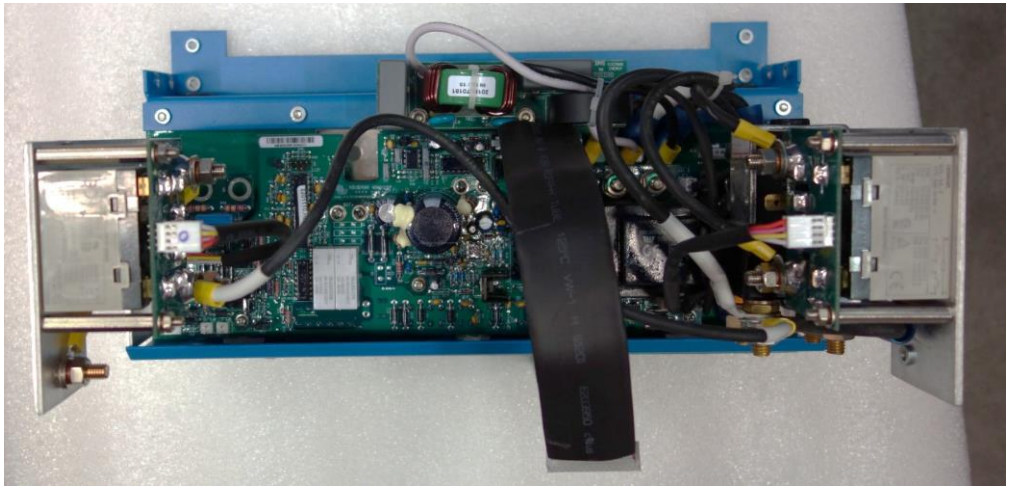
Connection PCB inverter 3K





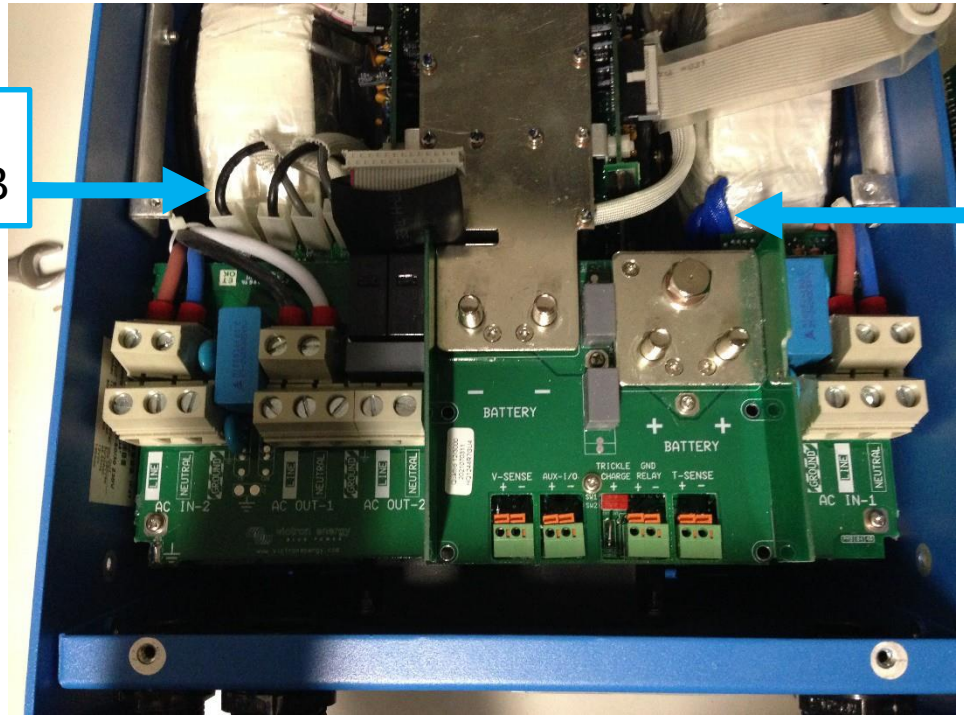
Connection PCB 5K





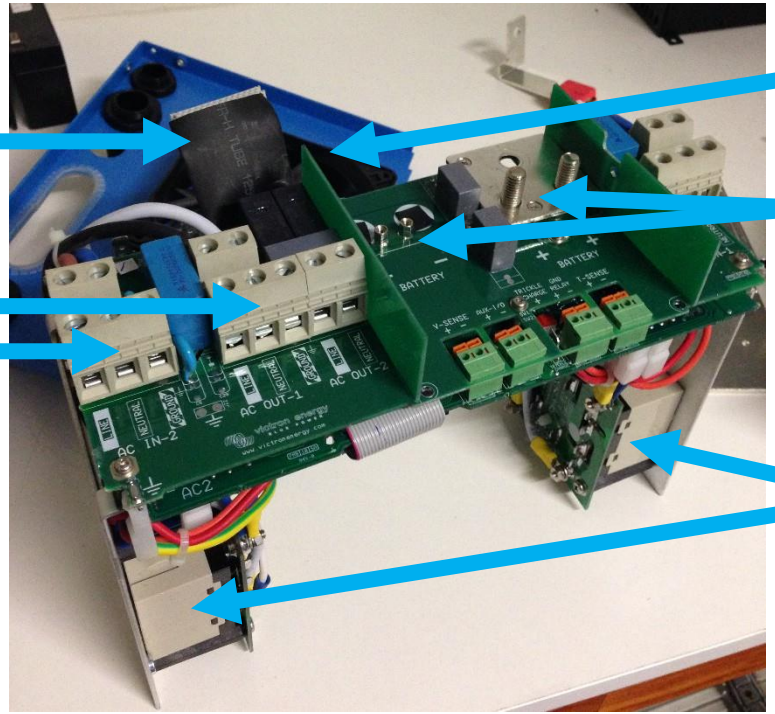
Connection PCB

Transformer wires to connection PCB



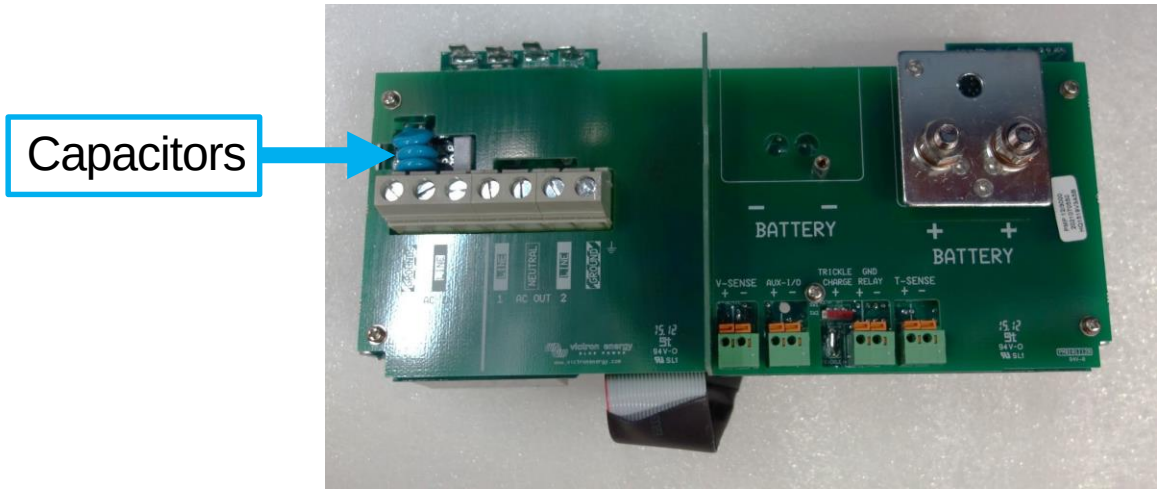
Transformer wires to power PCB

Connection PCB 3K

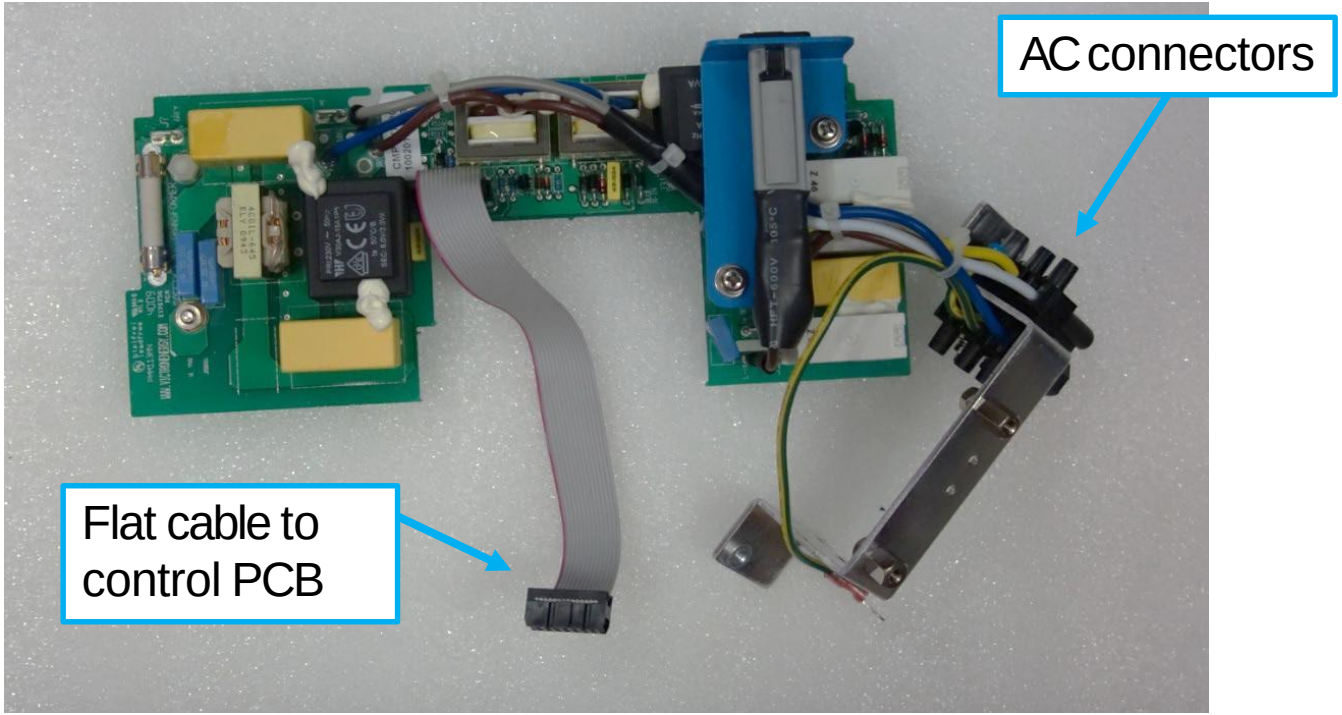


Capacitors

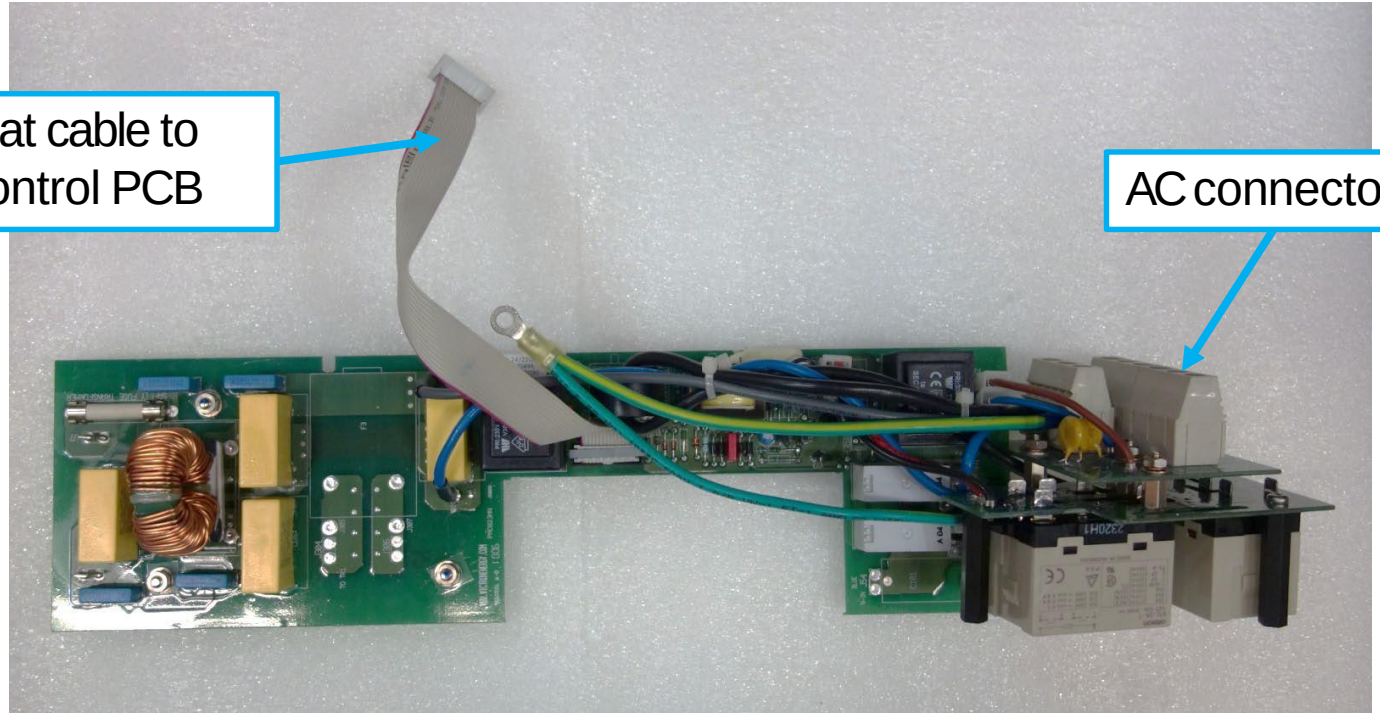
- When the blue capacitors on the connection board are broken or have popped. There usually has been a very high voltage on earth or neutral or there has been a lightning strike.



Connection PCB 800, 1200 or 1600

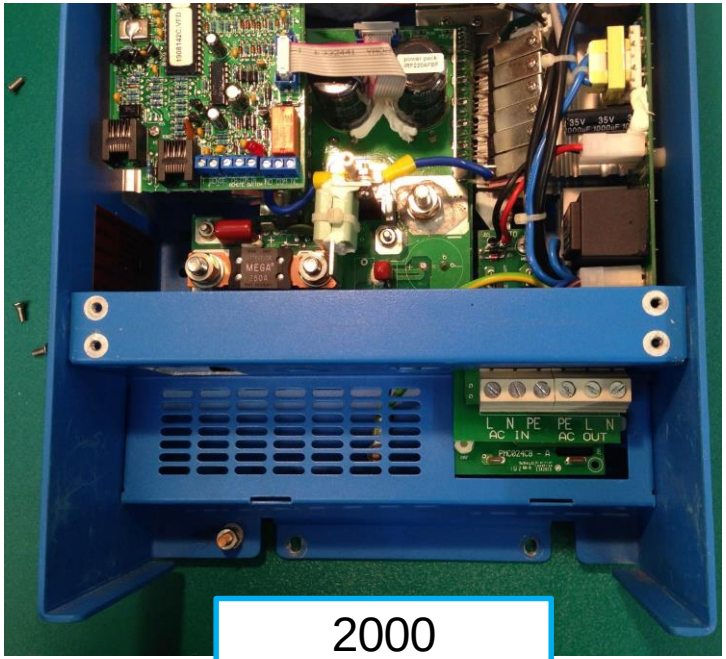


Connection PCB 2K



Connection board in situ Compact 1600 vs 2000

800, 1200 or 1600



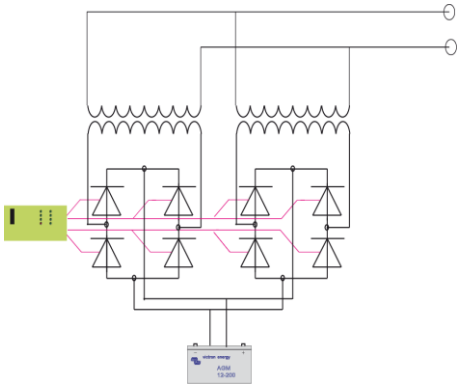
2000

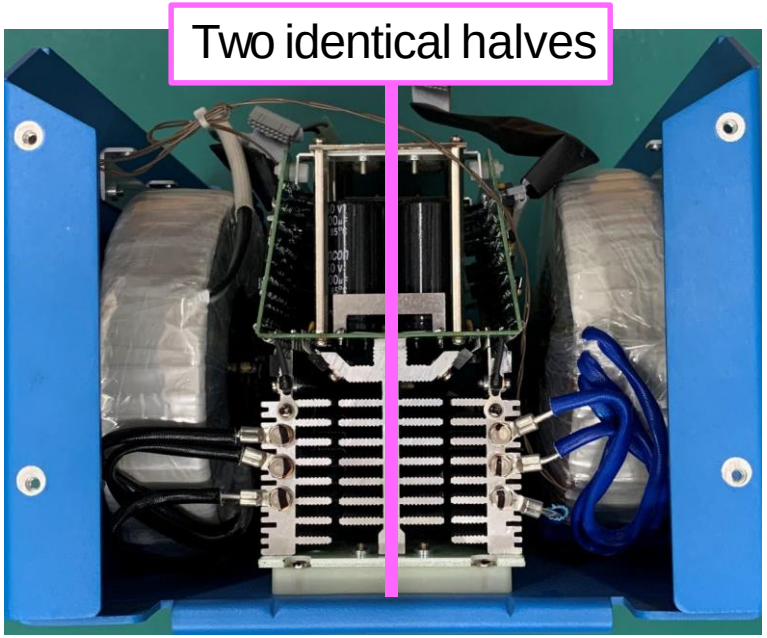
BATTERY ENGINEERING
HOUSE OF VICTRON
victron energy
BLUE POWER

Power board

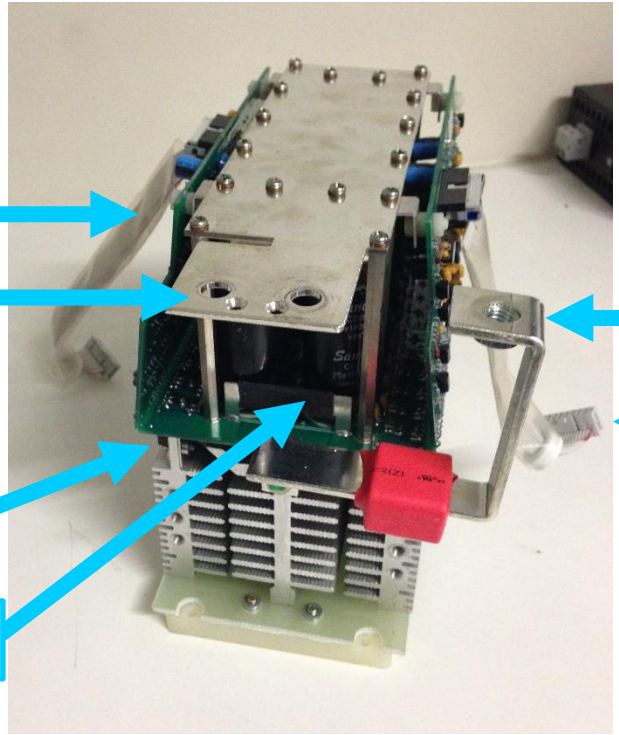
Internally paralleled transformers & power PCBs

- Small MultiPlus, MultiCompact and MultiPlus-II consist of one bi-directional converter and one transformer.
- Bigger MultiPlus (3K and up) consists out of two bi-directional converters and two transformers running in parallel

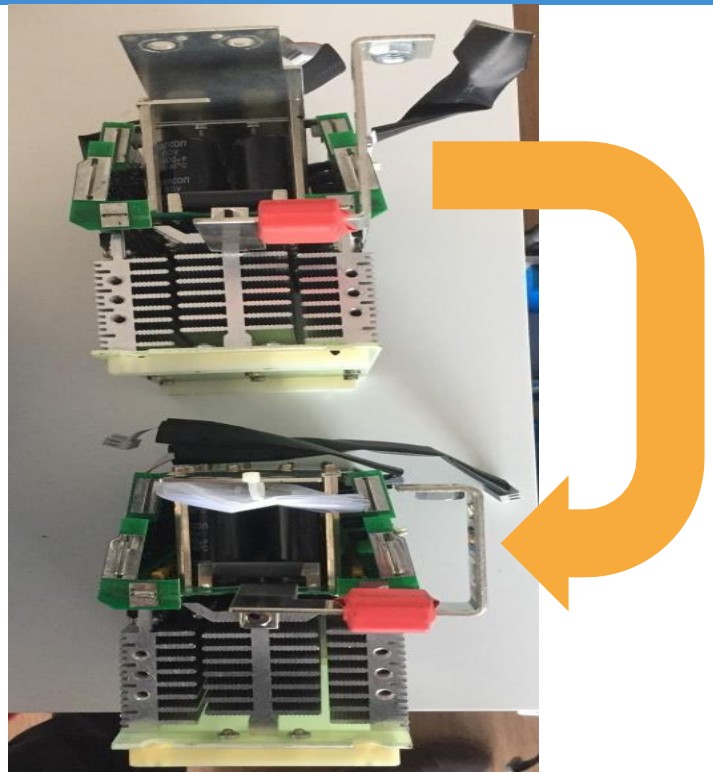




Power PCB 3K

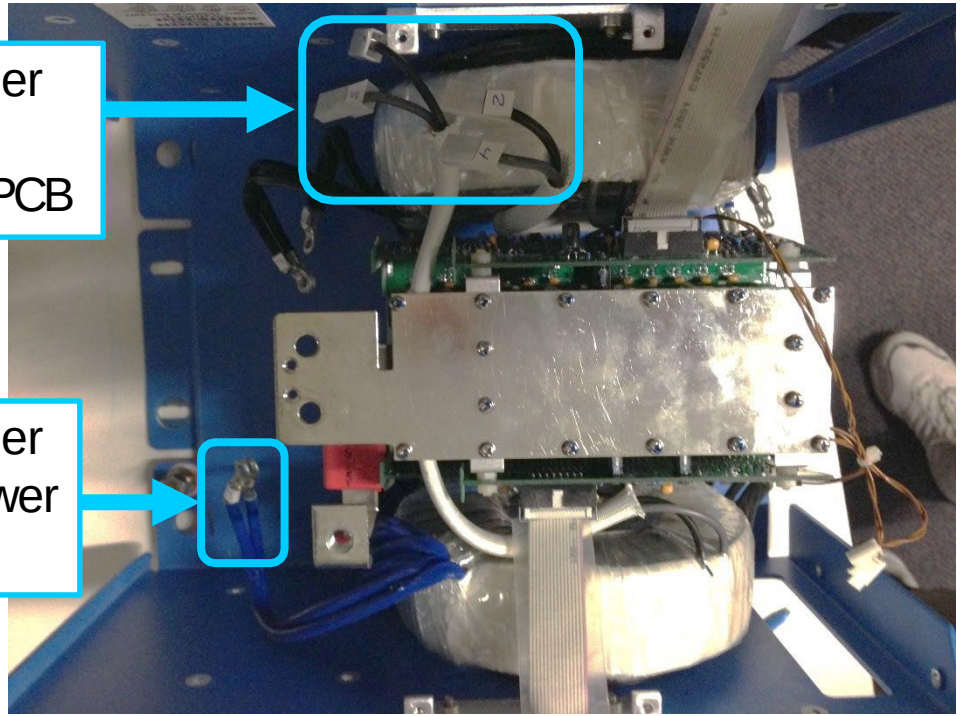

Flat cable to control PCB
Negative DC connection
FETs
Capacitors
Positive DC connection
Flat cable to control PCB

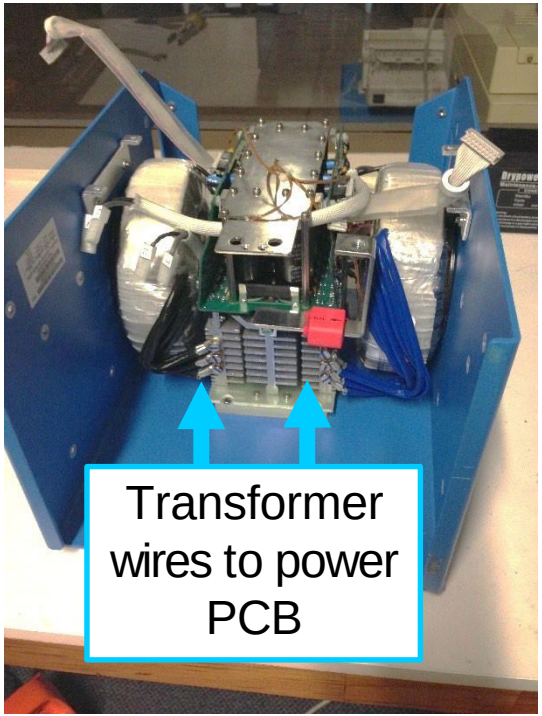
Power board changes



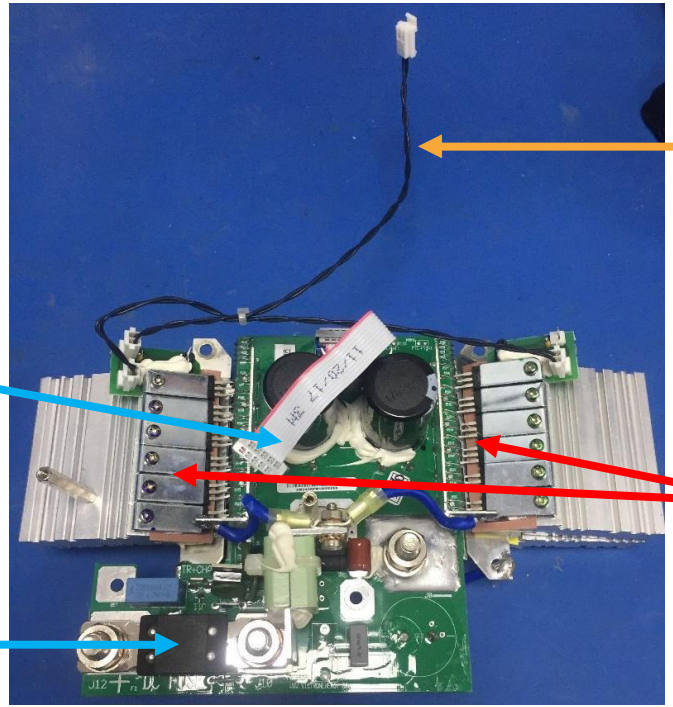
- Occasionally you have to exchange an old positive bracket from an old power PCB to a new power PCB because of a new PCB connection.
- We recommend to keep several brackets from scrapped units in your workplace .

Transformers and power PCB

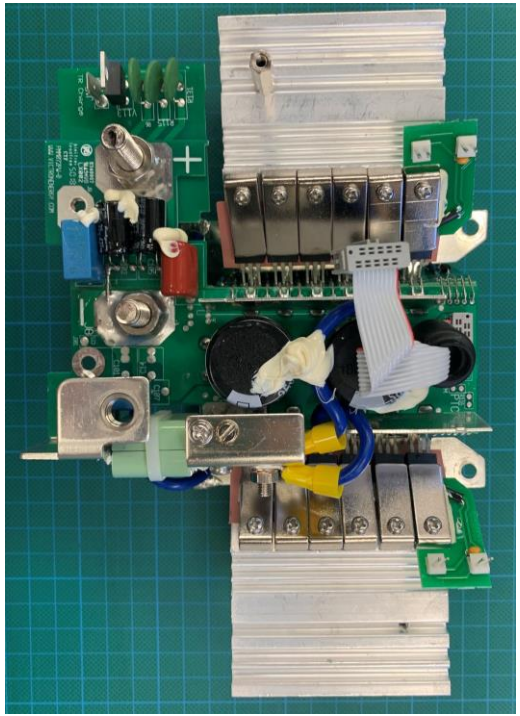


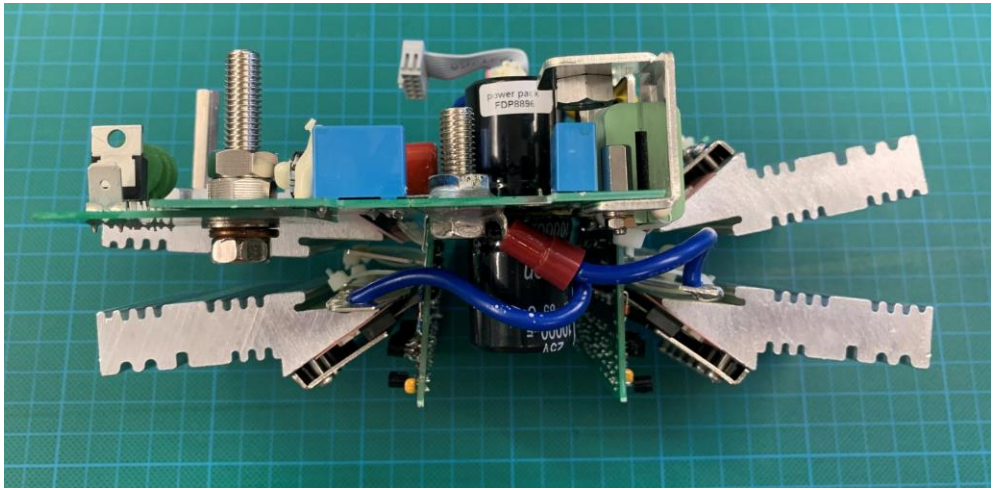


Power PCB compact Multi C



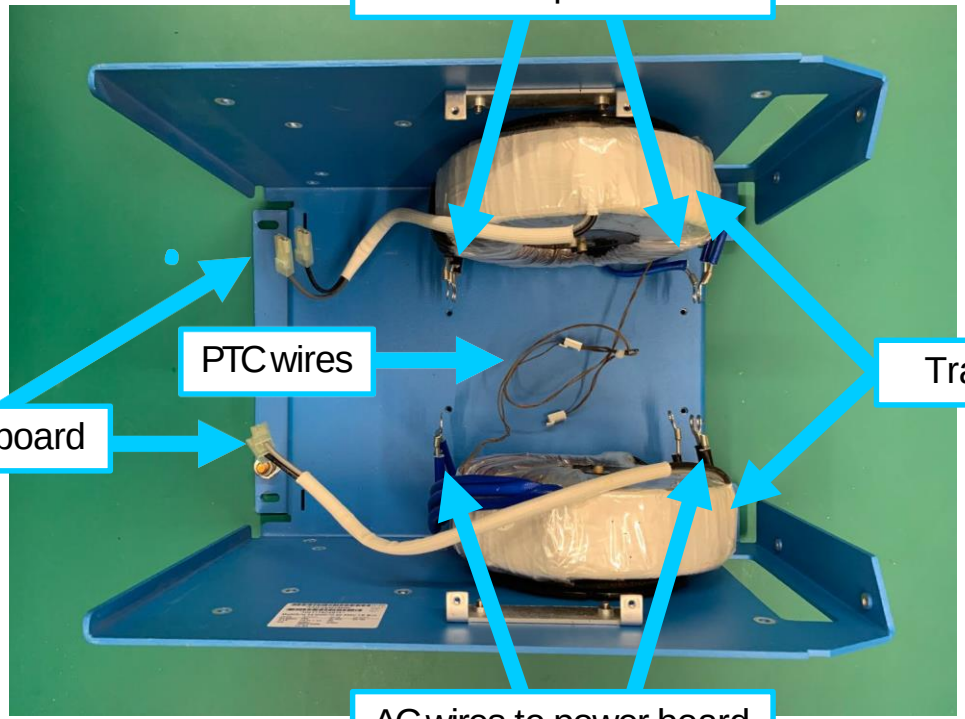
Compact power board



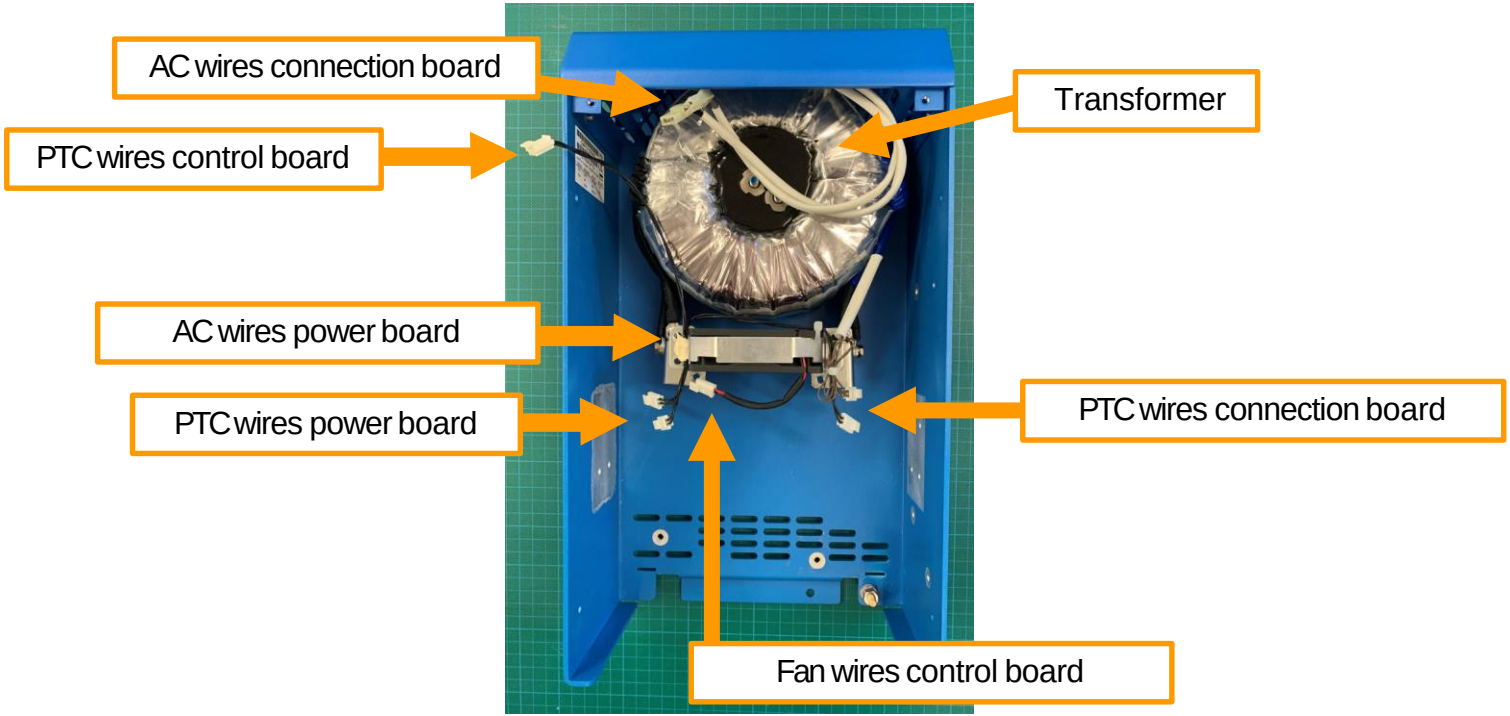


Transformers and fans

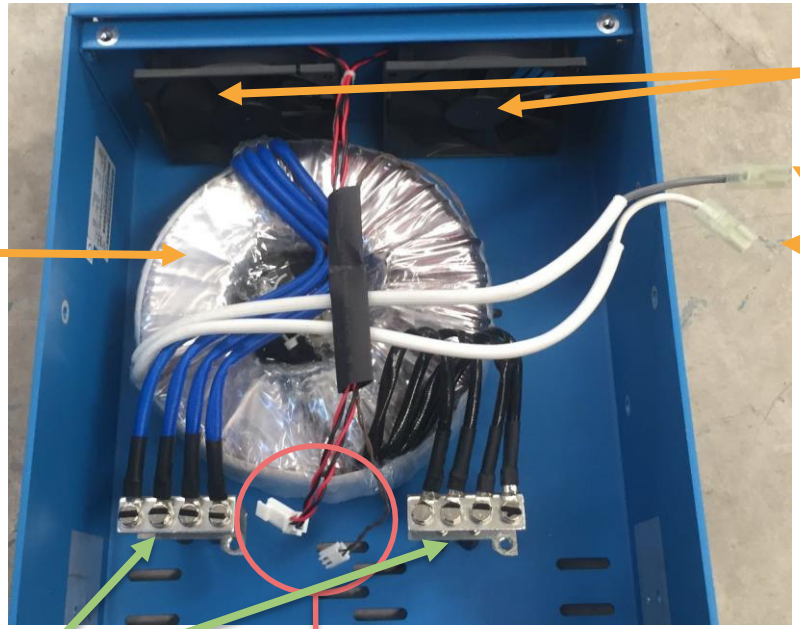
Transformers



Compact 800, 1200 and 1600



Transformer and fans 2K Compact

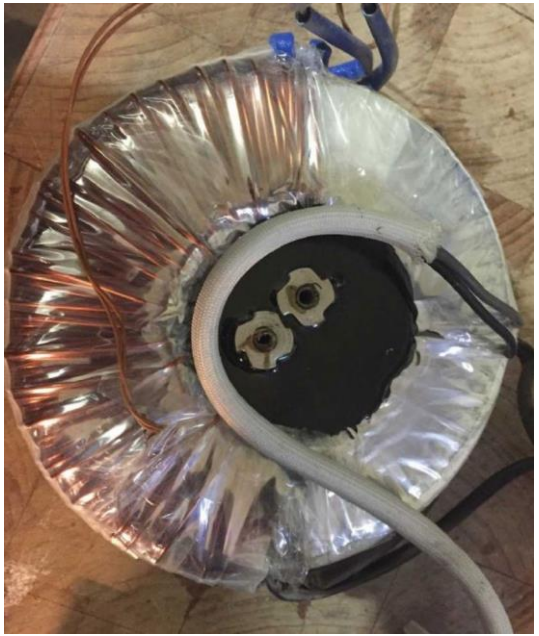


Transformer resistance

Transformer resistances should be:

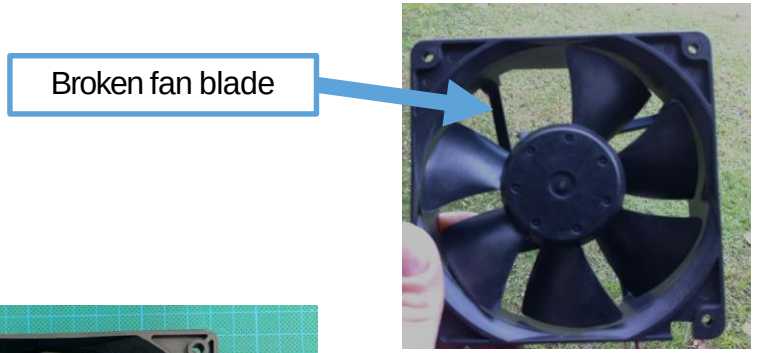
- 12V units 2.3 Ω
- 24V units 1.6 Ω
- 48V 3K units 1.1 or 1.2 Ω
- 5K units 1.3Ω
- 8 and 10K units 0.6Ω

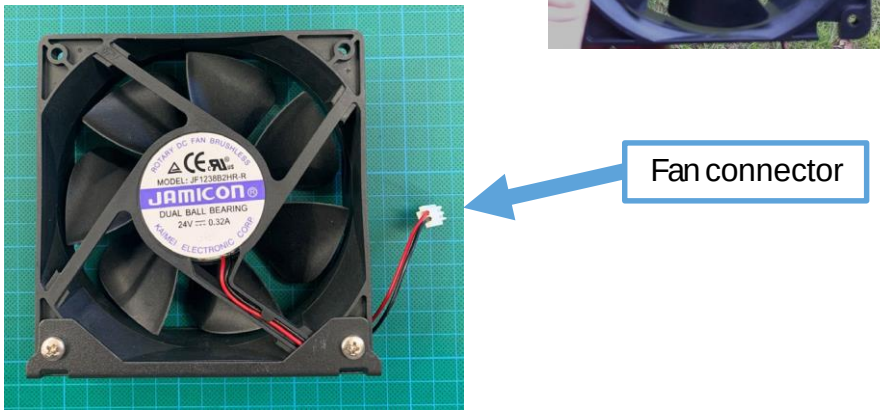
In case there are two transformers, they both need to have similar resistance



Fan

- Fan can get damaged or become faulty or corroded (this is not very common)
- Be aware that if we send a new fan that the fan might not have the connector attached
- Keep some basic stock of fans that you have sourced from scrapped units

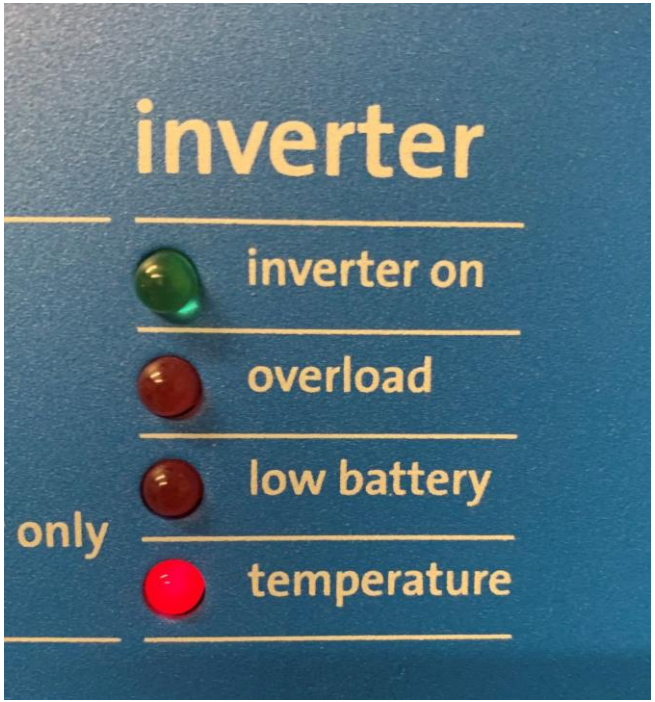




Circuit board notes

Notes on boards

- If the power pack is broken and the temp led is on, then quite often the control board will be broken as well
- It is good practice to always include a control board when a connection or power board is faulty
- Keep a 3K control board of each voltage in stock for diagnostic purposes



Circuit board that are used in more than one unit

PMP 12/3000 = QUA 12/3000 = PIN 12/3000

These all have the same power pcb

PMP 24/3000/70-16 = PMP 24/3000/70-50

Both have the same control pcb

QUA 5000 = PMP 5000

Both have the same control pcb and the same power pcb

PMP 48/5000-50 = PMP 48/5000-100

Both have the same power pcb

CIN 24/1600 = CMP 24/1600

Both have the same power pcb and the same control pcb

CIN 2000 = CMP 2000

Both have the same power pcb and the same control pcb

EasySol 24/1600 = CMP 24/1600

Both have the same control pcb

PIN 48/5000 = PMP 48/5000/70

Both have the same power pcb

QUA 80000 = QUA 10000

Both have the same connection pcb

Abbreviations used:

CIN = Phoenix Inverter Compact

CMP = MultiPlus Compact

PIN = Phoenix Inverter

PMP = MultiPlus

QUA = Quattro

EasySol = EasySolar

When ordering circuit boards

- Each board has an individual part number
- Use this number when ordering circuit boards

Abbreviations used:

CIN = Phoenix Inverter Compact

CMP = MultiPlus Compact

PIN = Phoenix Inverter

PMP = MultiPlus

QUA = Quattro

EasySol = EasySolar

Spare part list in Repair Centre dropbox

- We now allow repair Centre to keep stock of boards, but this is not the case (yet) for self repairing customers
- Contact service department for a link to this file

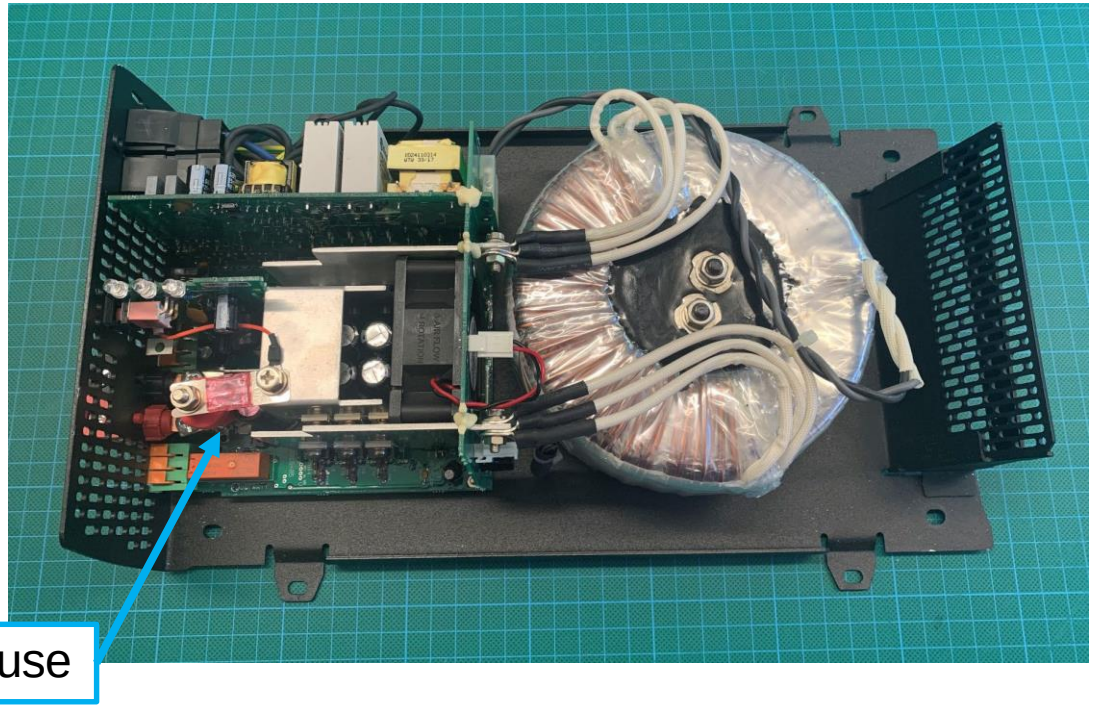
Spareparts per product

Item Code	description	Status	Control PCB/	Control PCB/	Connection PCE	Connection PCE	Power Pack	Power Pack
QUA123020000	Quattro 12/3000/120-50/30 *If stock 0, order QUA123020010*	Inactive	SPR10025		No spare; replace unit		SPR10063	
QUA123020010	Quattro 12/3000/120-50/50 230V VE.Bus	Active	SPR10025		SPR10021		SPR10063	
QUA125020000	Quattro 12/5000/220-100/100 230V VE.Bus	Active	SPR10031		SPR10023		SPR10072	
QUA125021100	Quattro 12/5000/220-100/100 120V VE.Bus	Active	SPR10005		SPR10020		SPR10072	
QUA243020000	Quattro 24/3000/70-50/30 *If stock 0, order QUA243020010*	Inactive	SPR20026		No spare; replace unit		SPR20062	
QUA243020010	Quattro 24/3000/70-50/50 230V VE.Bus	Active	SPR20026		SPR20082		SPR20062	
QUA245020000	Quattro 24/5000/120-2x30 *If stock 0, order QUA245021000*	Inactive	SPR20029		No spare; replace unit		SPR20071	
QUA245021000	Quattro 24/5000/120-50/30 230V*If stock 0,order QUA245021010	Inactive	SPR20029		No spare; replace unit		SPR20071	
QUA245021010	Quattro 24/5000/120-100/100 230V VE.Bus	Active	SPR20029		SPR20047		SPR20071	
QUA245021011	Quattro24/5K/120-100/100-230V+50A*Stock 0,order QUA245021010	Inactive	SPR20029		No spare; replace unit		SPR20071	
QUA245022100	Quattro 24/5000/120-2x60 120/240V-USA Inverter/Charger	Inactive	No spare; replace unit		No spare; replace unit		No spare; replace unit	
QUA245023110	Quattro 24/5000/120-100/100 120V VE.Bus	Active	SPR20098		SPR20020		SPR20071	
QUA248020010	Quattro 24/8000/200-100/100 230V VE.Bus	Active	SPR20039		SPR20006		SPR20069	
QUA481030010	Quattro 48/10000/140-100/100 230V VE.Bus	Active	SPR40043		SPR40080		SPR40038	
QUA483021100	Quattro 48/3000/35-50/50 120V VE.Bus	Active	SPR40096		SPR20048		SPR40082	
QUA483100100	Quattro 48/10000/140-100/100 120V VE.Bus	Active	SPR40043		SPR40080		SPR40038	
QUA483150000	Quattro 48/15000/200-100/100 230V VE.Bus	Active	SPR40045		SPR40047		SPR40044	
QUA485020000	Quattro 48/5000/70-50/30-230V*If stock 0, order QUA485021010	Inactive	SPR40033		No spare; replace unit		SPR40081	
QUA485021010	Quattro 48/5000/70-100/100 230V VE.Bus	Active	SPR40033		SPR40034		SPR40081	
QUA485021011	Quattro 48/5000/70-100/100-S 230V VE.Bus	Active	SPR40033		SPR40034		SPR40081	
QUA485021100	Quattro 48/5000/70-100/100 120V VE.Bus	Active	SPR40099		SPR40023		SPR40081	
QUA488020000	Quattro48/8k/110-100/100 230V*If stock 0, order QUA488024000	Inactive						
QUA488024000	Quattro 48/8000/110-100/100 230V VE.Bus	Active	SPR40079		SPR40080		SPR40035	
EMP243020100	ECOmulti 24/3K/70-50 2,3kWh LiFePO4*IF 0, order EMP243020200	Inactive						
EMP243020200	ECOmulti 24/3K/70-50 2,3kWh LiFePO4*If 0, order EMP243020300	Inactive						
EMP243020300	ECOmulti 24/3000/70-50 2,3kWh LiFePO4	Active	SPR20022				SPR20062	
PMP012202000	Phoe.MultiPlus 12/2000/100-230V *CMP012202000/PMP012302000*	Inactive						

Other Multi types

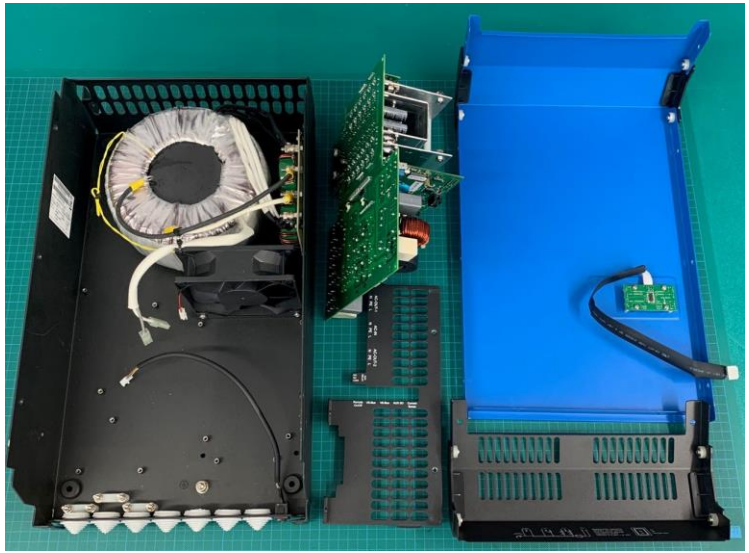
Small Multi

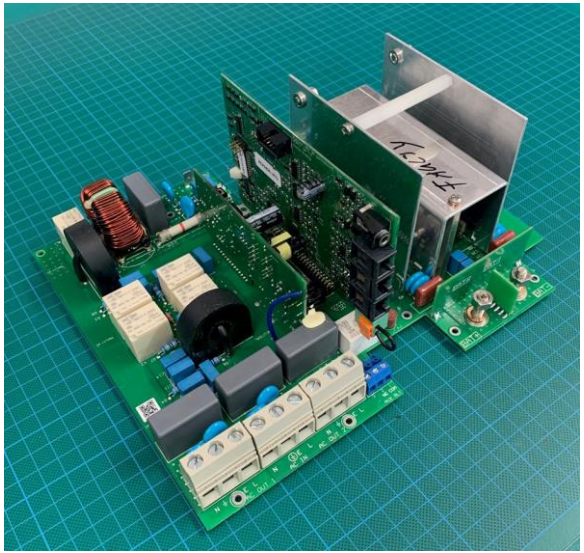
- These are not repaired, but replaced. They only have a single circuit board
- Inspect unit for water damage or dirt
- Check fuse, replace if fuse is blown. (happens during reverse polarity)
- Check for burned AC and DC connectors
- We will need a very good fault description when you lodge the RMA



MultiPlus-II

- These are not repaired, but replaced. They only have a single circuit board
- We will need a very good fault description when you lodge the RMA

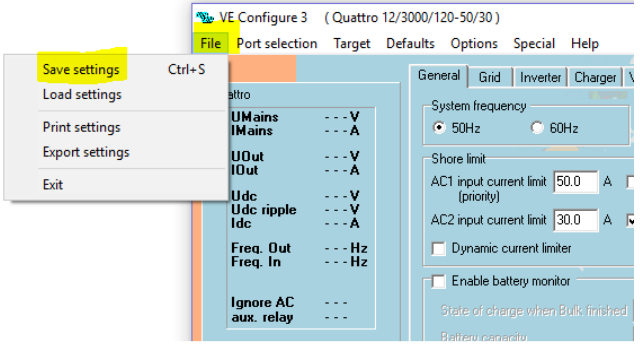


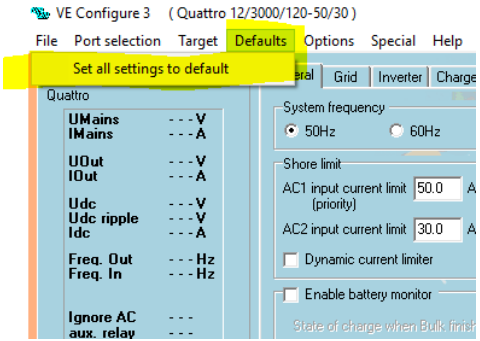


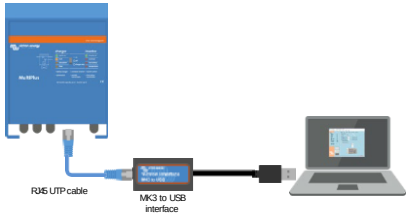
Firmware and programming

Reset to default

- To remedy certain faults, you could try to reset the unit to default values. This is how to do this:
- Save a copy of the current settings. Select “file” and then select “Save settings”
- Set the unit to default. Selecting “Defaults” and then “Set all settings to default”
- A firmware update will also reset to default

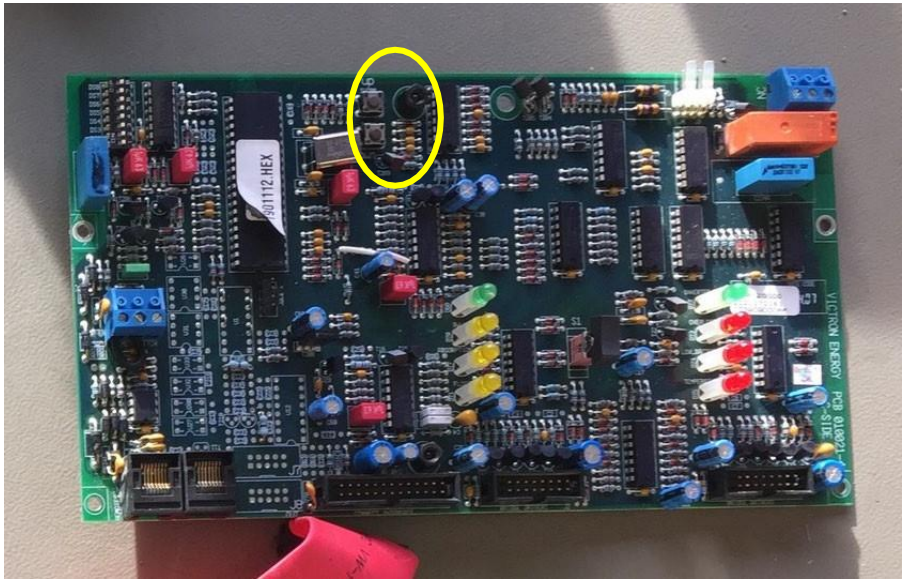






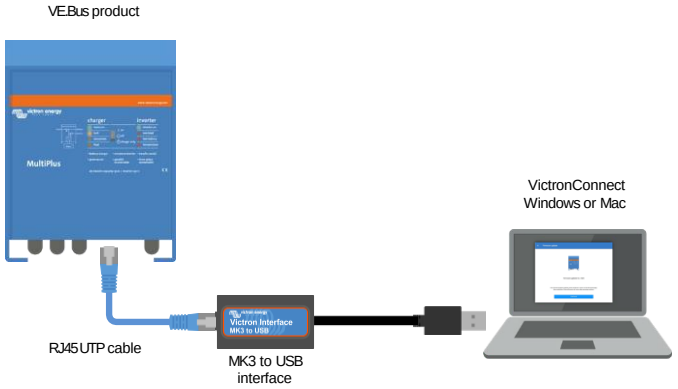
To test without assistants running

- Push the bottom button on the control pcb while turning the unit on.
- This is not possible in MP-IIs, MultiCompact or small multis



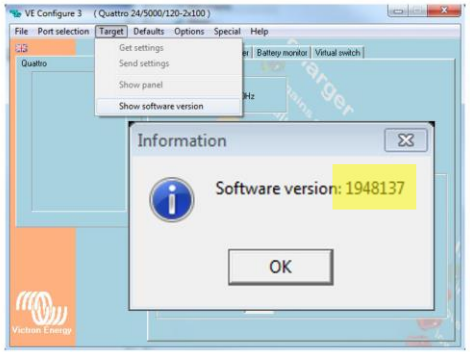
Always update firmware before seeking support

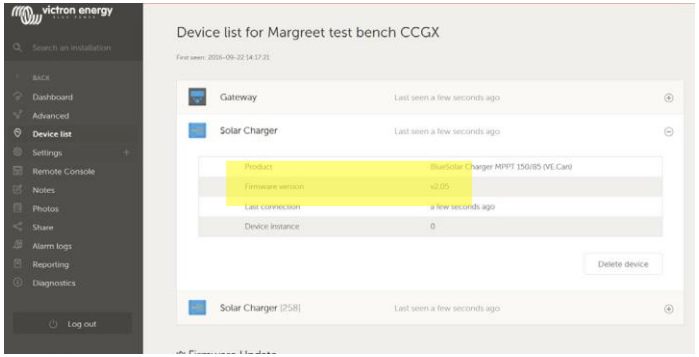
- For firmware updating use VictronConnect
- VEFlash can also still be used, but wil be phased out
- Connect via the MK3- USB interface and RJ45 UTP cable
- Update the unit(s) to the most recent xxxx4xx firmware
- Save settings before you update the firmware

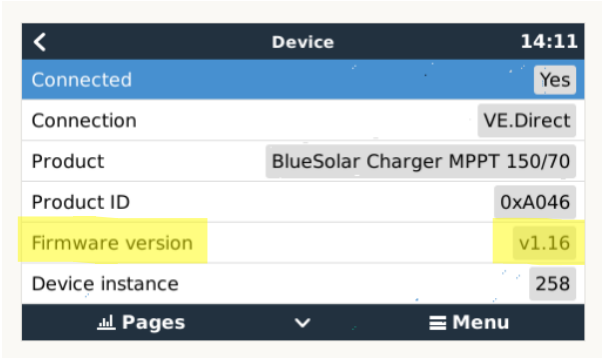


How to find the firmware number of a product

- Via VictronConnect
- Via VEConfigure
- Via GX device
- Via VRM device list







VE.Bus firmware numbers explained

Our firmware version number exists of three parts.

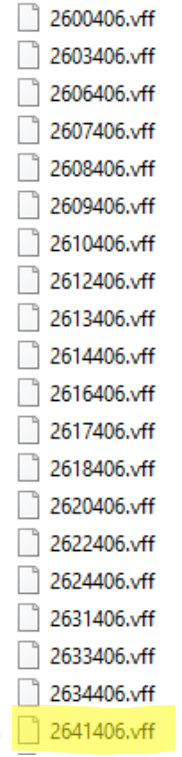
For example 2641159:

26 is the microprocessor family group

41 is the model for example Quattro 24/3000

159 is the firmware version

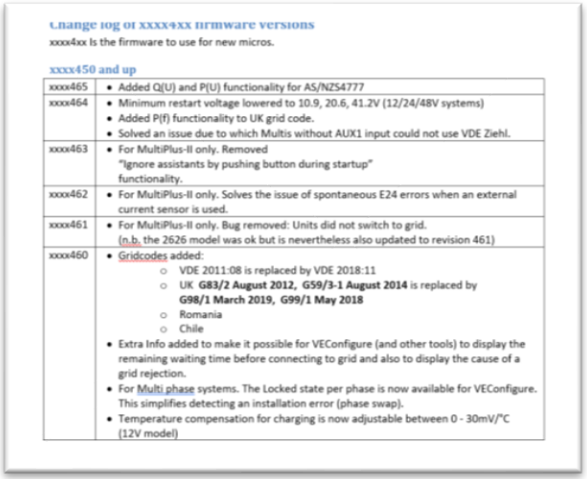
Should you want to update this unit to 4 version firmware,
You will have to choose file 2641406



Firmware files and firmware changelogs

See Victron Professional for:

- Firmware changelog
- Firmware files
- Setup an automatic updating dropbox folder

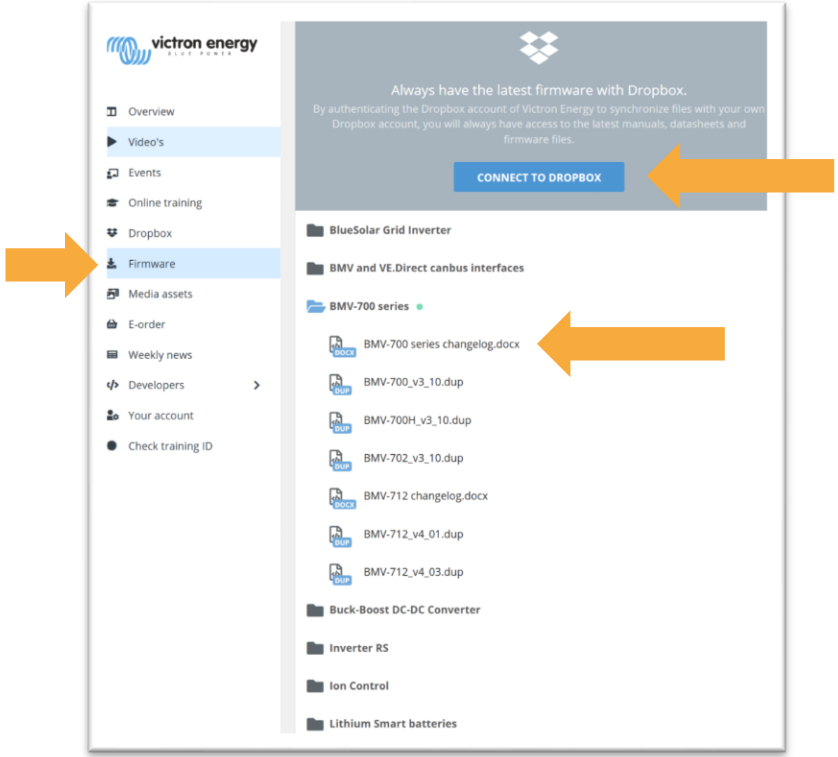


Change log of xxxx4xx firmware versions

xxxx4xx is the firmware to use for new micros.

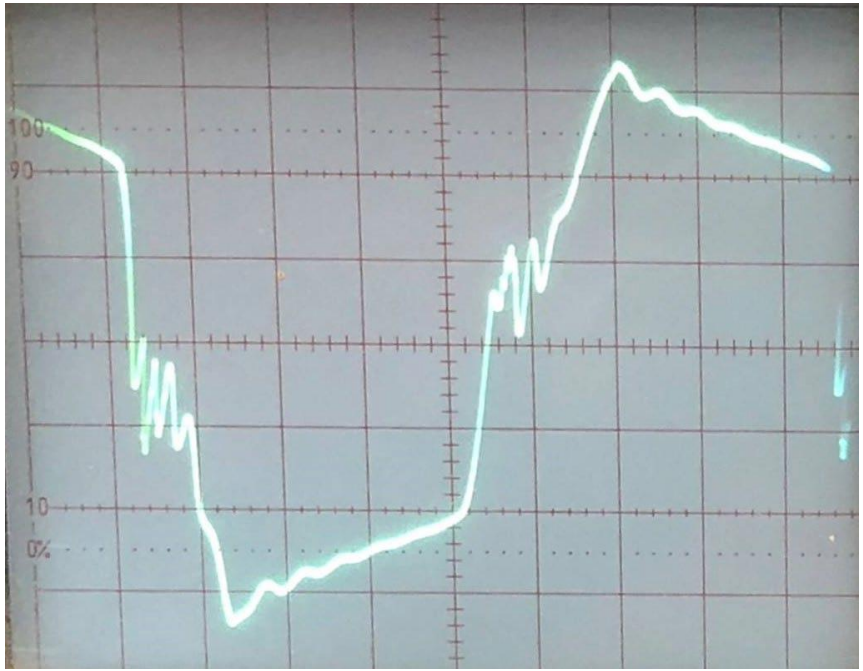
xxxx450 and up

xxxx465	• Added Q(U) and P(U) functionality for AS/NZS4777
xxxx464	• Minimum restart voltage lowered to 10.9, 20.6, 41.2V (12/24/48V systems) • Added P(f) functionality to UK grid code. • Solved an issue due to which Multis without AUX1 input could not use VDE Ziehl.
xxxx463	• For MultiPlus-II only. Removed "Ignore assistants by pushing button during startup" functionality.
xxxx462	• For MultiPlus-II only. Solves the issue of spontaneous E24 errors when an external current sensor is used.
xxxx461	• For MultiPlus-II only. Bug removed: Units did not switch to grid. (n.b. the 2626 model was ok but is nevertheless also updated to revision 461)
xxxx460	• Gridcodes added: ○ VDE 2011:08 is replaced by VDE 2018:11 ○ UK **G83/2 August 2012, G59/3-1 August 2014** is replaced by **G98/1 March 2019, G99/1 May 2018** ○ Romania ○ Chile • Extra Info added to make it possible for VEConfigure (and other tools) to display the remaining waiting time before connecting to grid and also to display the cause of a grid rejection. • For Multi phase systems. The Locked state per phase is now available for VEConfigure. This simplifies detecting an installation error (phase swap). • Temperature compensation for charging is now adjustable between 0 - 30mV/°C (12V model)



Hints and tips

Check the quality of the inverter AC output



- In this case the FET steering on the control PCB was faulty.
- A control PCB swap fixed the issue

Symptoms:

- Unit would make strange noise
- Unit went straight into overload in switched off shortly after
- Voltage AC output not high enough (only noticeable with a true RMS meter)
- Only an oscilloscope showed the real issue

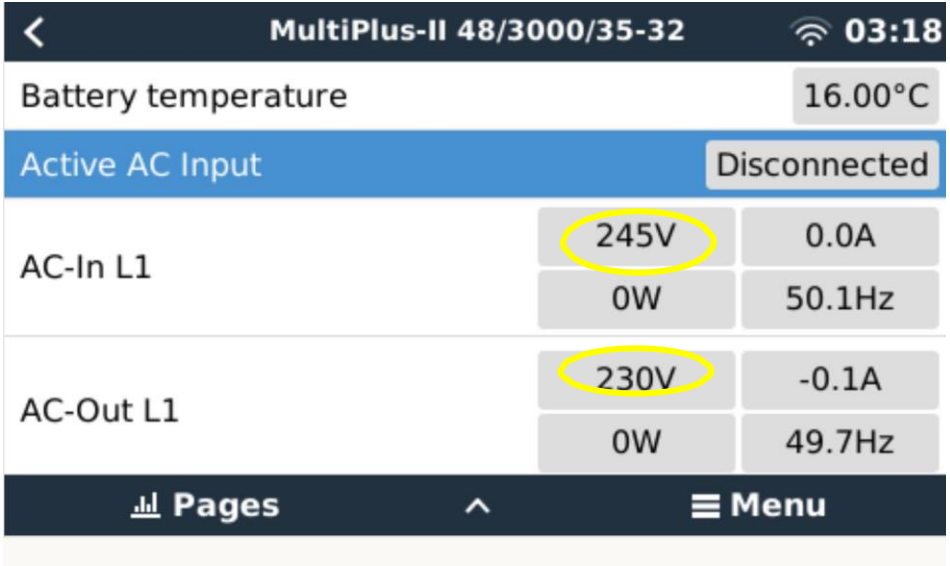
Battery voltage and capacity is very important

- Bad batteries will drop in voltage more severe than good batteries do
- So do batteries that are to small
- Follow the battery bank recommendation in the manual

- Low voltages create higher currents
- Fuses might break easier during high loads
- Low battery voltage interferes with power assist and makes overload worse
- Bad batteries can be a cause of ripple

Switchover

- Switchover time depends on the difference between connected AC and internal AC
- Incoming AC has to be stable for 7 second before switch through
- Newer Multis are faster than older ones



What determines overload

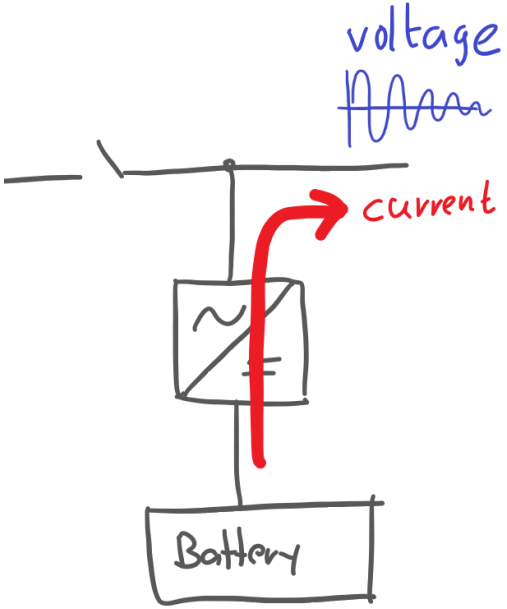
Overload is initiated when:

- The current through the inverter is too high
- When the inverter AC 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



Locked Multi conditions

To clear these alarms the unit has to be turned off and back on again

Locked units alarms:

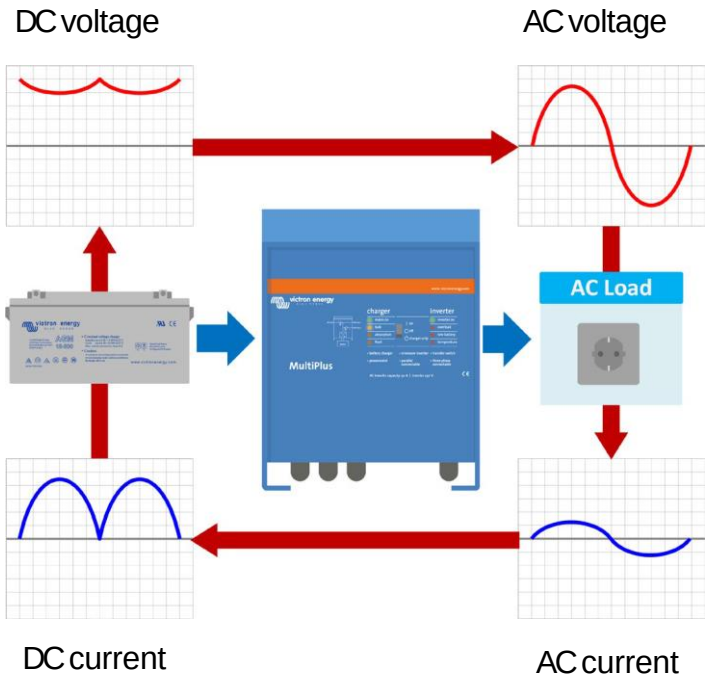
- Severe overload - Like a short circuit, locked multi after the 3th time
- High AC - No LEDs are on and the unit is completely off
- Stop after excessive bulk - 10h bulk is now accumulative
- VE.Bus errors
- Ripple alarm

Ripple Alarm

- Ripple is an imposed AC voltage on the DC voltage
- Overload and low battery blinking at the same time
- Ripple happens at full load and is caused by thin DC cables or bad or small batteries

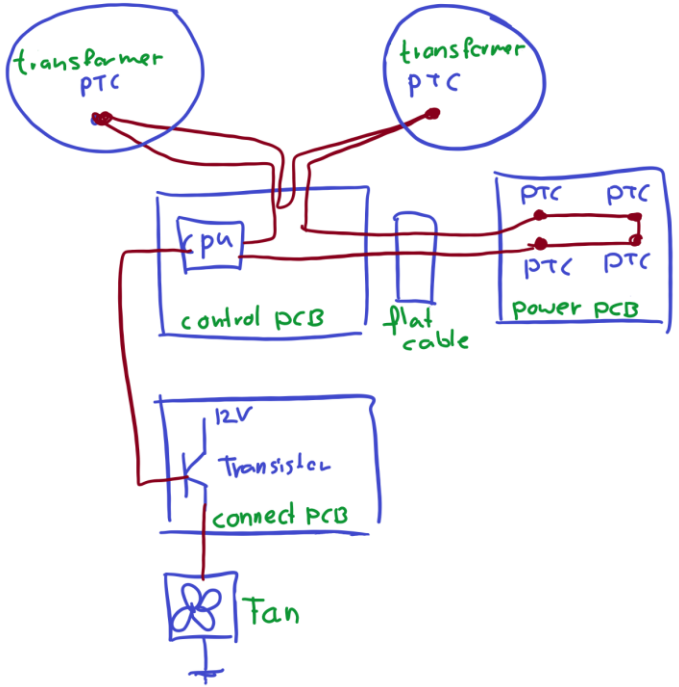
- The ripple alarm voltages are:

	12V	24V	48V
Ripple pre-alarm	1.5V	2.25	3V
Full ripple alarm	2.5V	3.75	5V



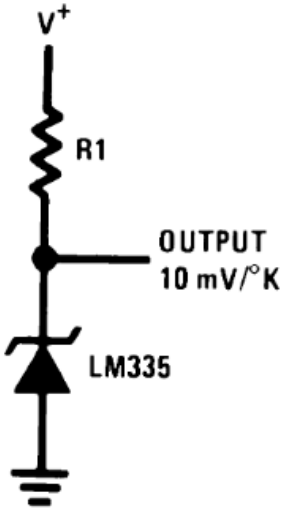
PTCs

- The unit contains a number of PTCs, one in each transformer and a few on the powerpack
- All PTCs are all connected in series
- If one of the PTCs get hot, their resistance increases and this is a signal that there is high temperature.
- The temperature led wil light up and the fans will turn on at full speed
- When one of the PTCs is faulty or has been disconnected, their resistance is very high (infinite) and this will also create a temperature alarm
- The power pack PTCs signals partly travel via the flat cables
- A partly disconnected ribbon cable can also cause a temperature alarm.



Temperature

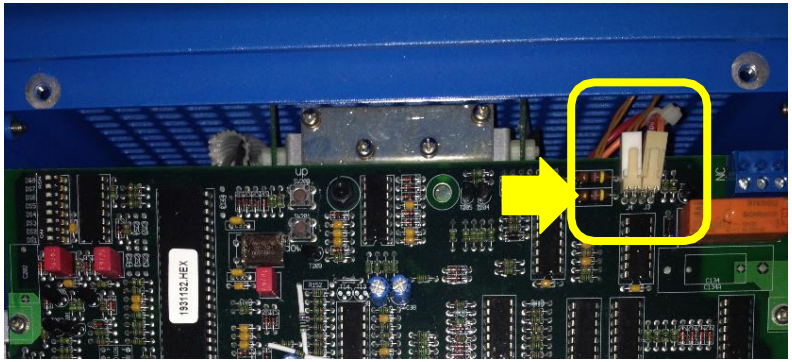
- The temperature led indicates both internal temperature alarms and temperature sensor alarms
- In hot battery situations the charger output will be the float voltage. The unit does not turn off
- The temperature sensor does not contain an PTC or NTC. It is a different type of temperature sensor and is polarity sensitive

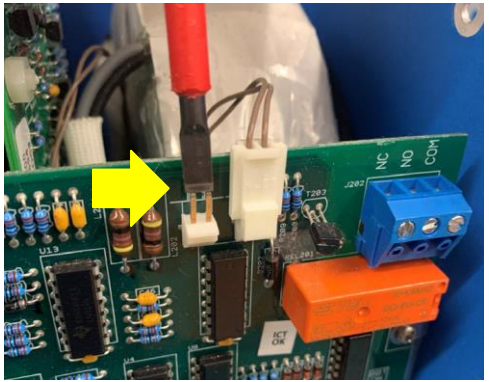


PTCs and fan circuit

- The transformers PTCs connect at the top of the control circuit board. They can be used for two tests:

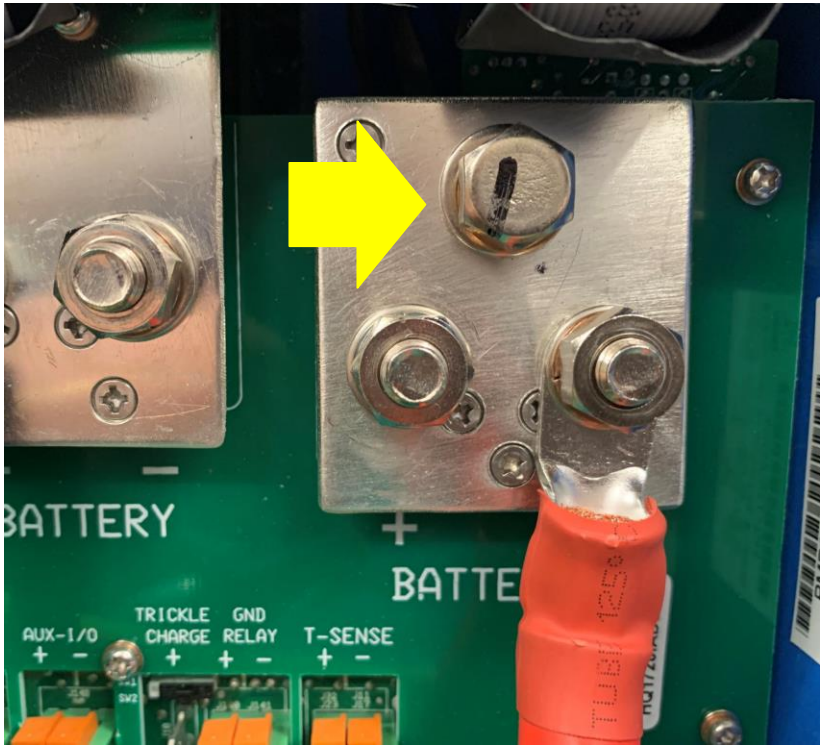
1. **Fan test:** To test if the fan(s) are operational disconnect one of the PTCs and the fans should turn on and the temperature LED lights up
2. **Transformer PTC check:** To rule out if a temperature alarm is created by a faulty transformer PTC, unplug the wire and short the two connector pins. The temperature alarm should stop





Positive DC bolt

- Check if the 3rd positive DC bolt is tightly fastened
- This bolt sometimes gets loosened accidently by the installer during installation or a change to the system
- A loose bolt will lead to premature overload issues

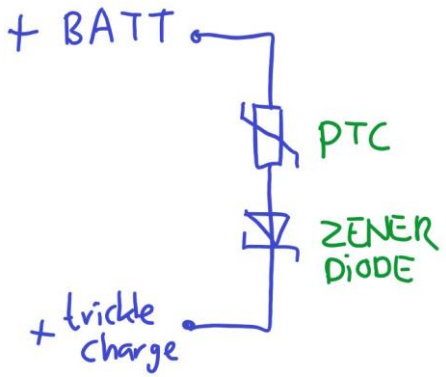


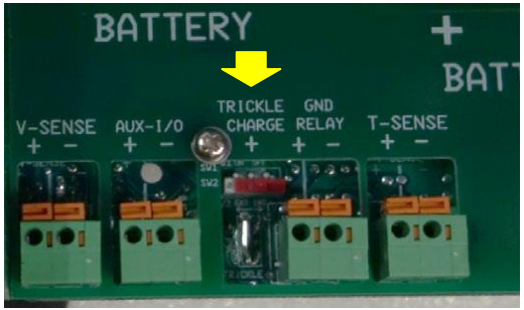
Reverse polarity

- Reverse polarity is when the negative battery cable is connected to the positive Multi terminal and vice versa
- The multi is not protected for this and is not covered by warranty.
- The unit might survive a short reverse polarity even. Usually the DC fuse will blow before the FETs do, but is some extreme cases the FETs will blow
- Most of the time people do not purposefully mix up the cables, but reverse polarity is caused by a wiring mistake or wrongly labelled cables.
- Reverse polarity can not always be detected . In some cases the customer will tell you about it, or you might notice the wiring mistake yourself.

Trickle charge

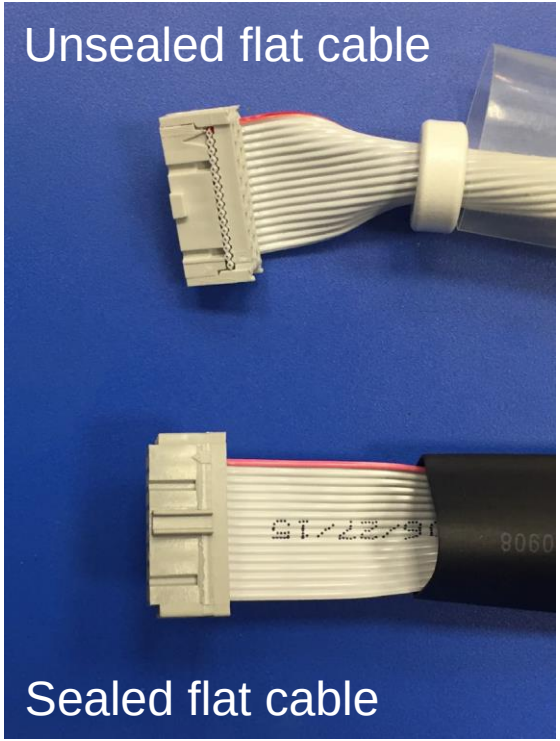
- The trickle charge connection provides a second charge for example a generator start battery.
- Trickle charge can not charge an empty battery it is only intended to keep a full battery full.
- The trickle output is limited by a PTC thermistor
- If there is a “high “ current for some time the current will be limited automatically
- Trickle charge is rated to approximately 2A at 25°C
- The trip current is 4.5A
- In addition to the PTC, a zener diode will prevent the starter battery to discharge to the auxiliary battery
- 48V units do not have a trickle charge connection





Flatcables issue

- There was a flat cable issue in units from 2012 until 2015. The connectors were crimped on to the cable and could become loose.
- The connectors are now moulded on to the cable. With the moulded flat cable the wires at the end are not visible, see photo.
- When the flat cable is not right the main problem seems to be strange LED blinking or false temperature alarms. Or the fan is running constantly.
- These problems also occur if the flat cable connector is not properly inserted in the pcb terminal



Parallel and 3 phase systems

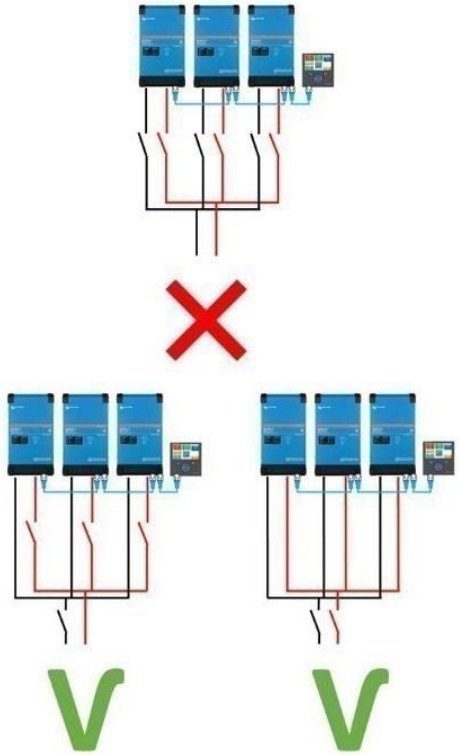
- When testing always leave the units connected to each other and to the Multi Control Panel.
- Never disconnect any of the RJ45 cables while the units are running. Especially in older units.
- In parallel or 3 phase systems only access VE.configure trough VE.Bus quick configure or trough VE.Bus system c0nfigure.
- If one of these units develop a fault, all the units will turn off.
- There are special VE.Bus error codes for multiple unit systems
- If you want to set on of these unit to stand alone. Then turn the system off, starting with the control panel, then the master (the non blinking unit) and then the slave(s). Disconnect the AC cables and set to stand alone using VE.Bus quick configure

Communication wiring

- Always use manufactured RJ45 UTP cables. Don't make them your self. Home made cables are not reliable enough.

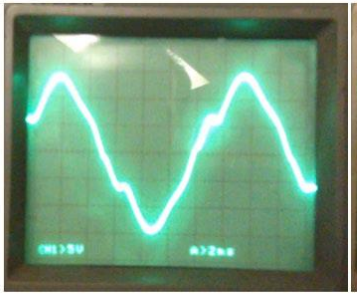
Be aware:

- Not all Multis have galvanic isolation between VE.Bus and the battery
- All Multis need to have interconnected negative battery connections before the communication cables are connected
- If a Multi needs to be taken out of the system all communication cables need to be disconnected before the Multi can be removed

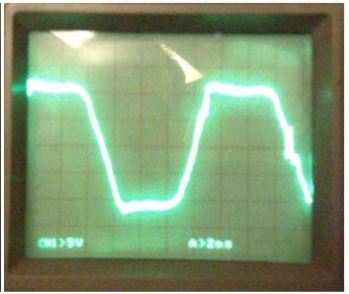


Generator issues

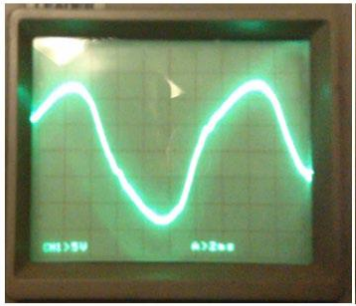
- A Multi or Quattro might not accept generator power
- This often depends on the generator type and the quality of the generated AC
- Please see the white paper: what to do when a MultiPlus does not accept generator power
- Turn UPS off, enable weak AC and set the correct AC input current limit



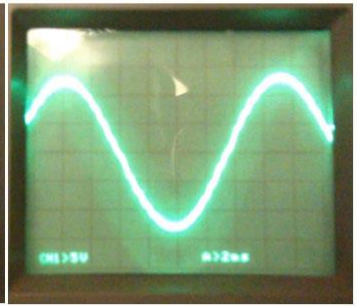
Generator output no load



Generator output large load



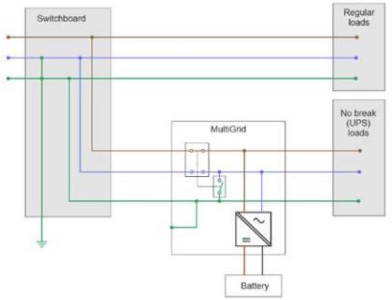
Generator output mid-size load



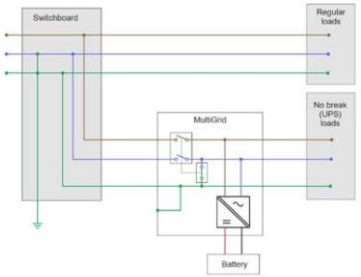
Quattro output

Failed really test MultiGrid - error 11

- Each time before the MultiGrid connects to the grid, a earth relay test is performed
- When the relay test has failed, the unit shuts down and error 11 is generated
- Error 11 can mean that there is relay failure, but it can also signal an installation error



when grid is present



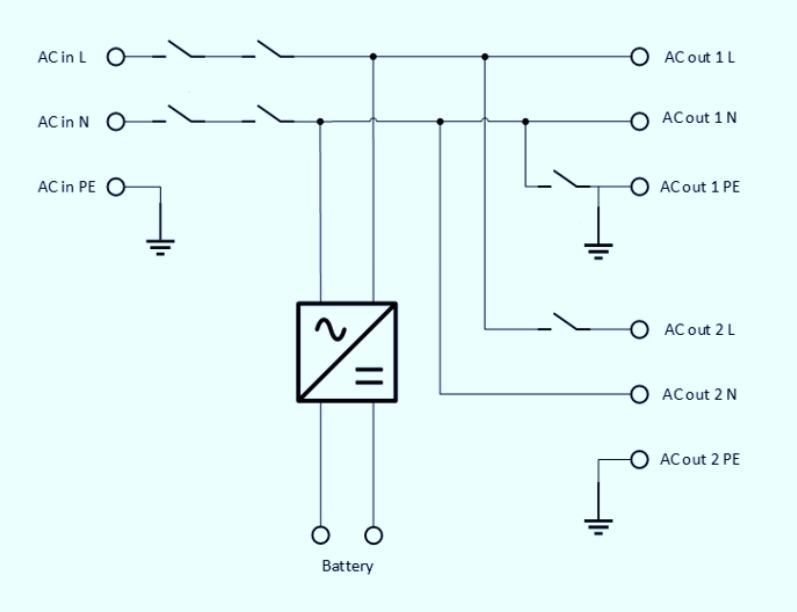
during a grid failure

These are the most common installation errors that will generate an error 11:

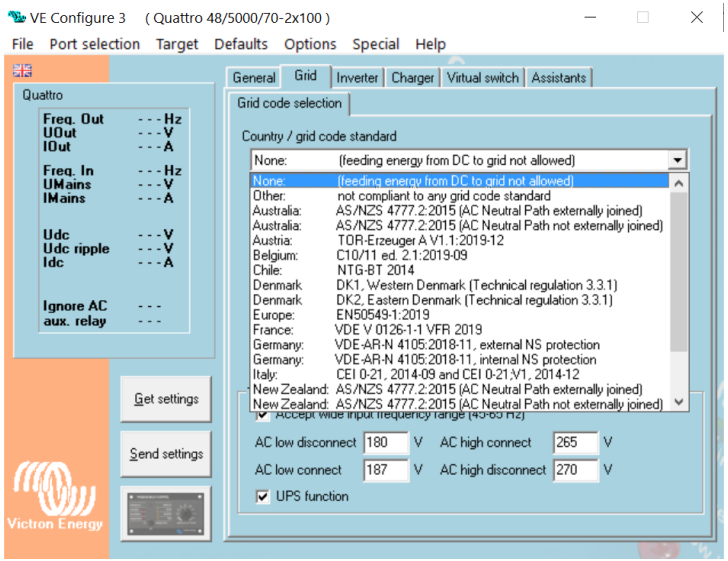
- Active and Neutral have been swapped
- There is and external connection between no-break Neutral and GND
- The input Neutral is connected to the no-break Neutral

MultiPlus AC input and ground relays

- Internal wiring diagram



- Allows for and external bonded neutral
- See grid code setting VEConfigure



Age of units and warranty length

- The first two numbers in the serial number indicated the year of production
- The second two digits indicate the week of that year

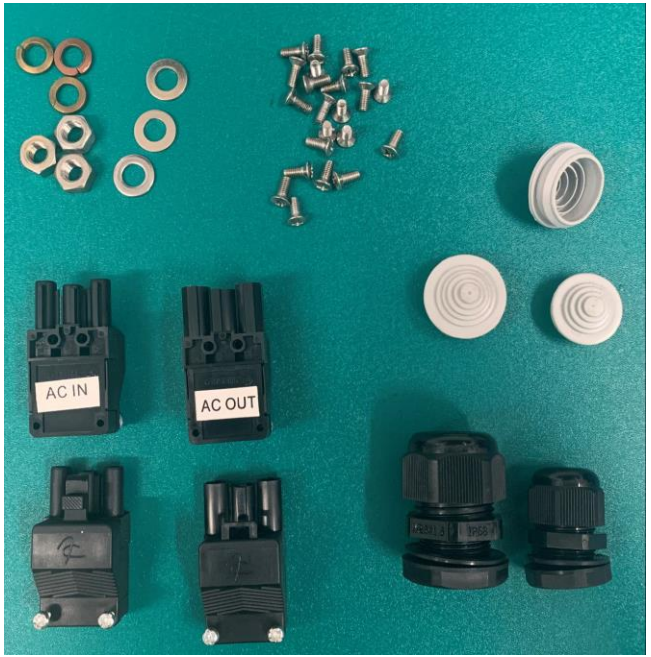
- Warranty is 5.5 years to our customers and 5 years for end users (except batteries)

- The warranty was 2 (2.5) years but has been increased to 5 (5.5) years in January 2015 and for units with serial number 14 and above

Keep spares!

Keep spare parts sourced from previous repairs or product replacements:

- Boards
- Cases or parts of cases and Hanging brackets
- Screws, grommets nuts and washers
- Small multi and
- Temperature sensors
- Cardboard boxes and matching foam inserts
- Fans



It is not allowed to construct second hand units from spare parts with the intention to sell these

Shipping units and circuit boards

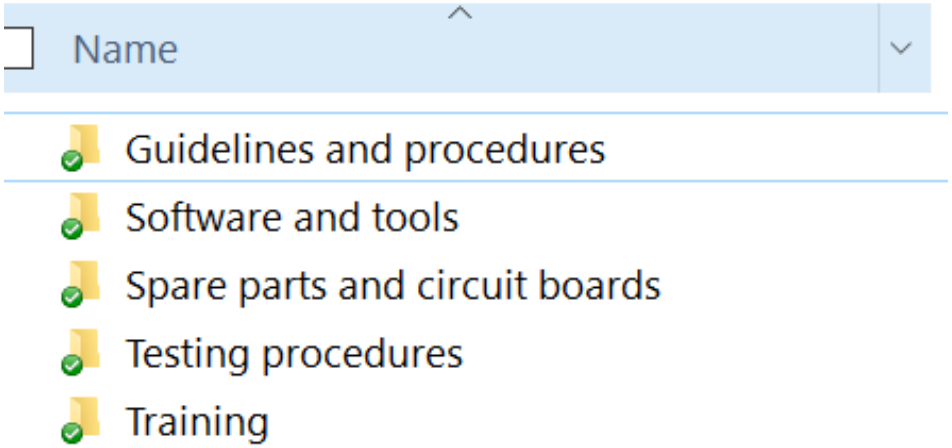
- Units over 25 kilos (3kVA and up) must ship on a pallet, with its back facing down
- Pack in an original box

- Circuit boards should be shipped (and stored) in an antistatic bag

Service Centre dropbox

Contact service department for link

- Guidelines and procedure
- Software tools (Use these after instruction from the Service department)
- Spare parts and circuit boards
- Training material



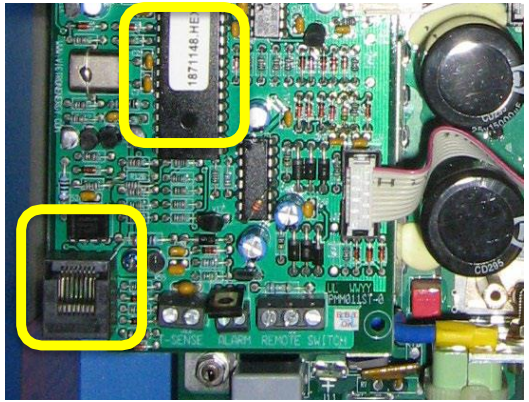
Non VE.Bus versus VE.Bus units

Changeover was from end of 2007 until end 2008

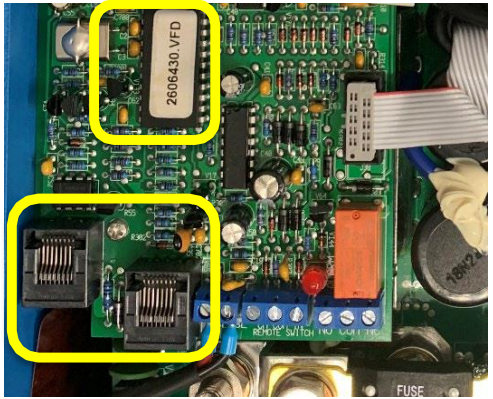
This can be recognized by:

- The firmware number; firmware 18 and lower is pre VE.Bus
- The number of RJ45 connectors; 1 connector is non-VE.Bus and two connectors is VE.Bus

Non VE.Bus



VE.Bus



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