



Multi and Quattro - parallel and 3 phase

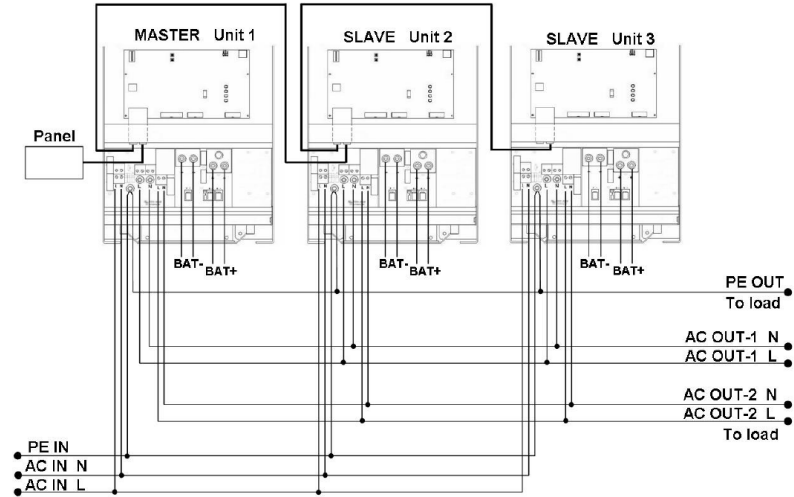
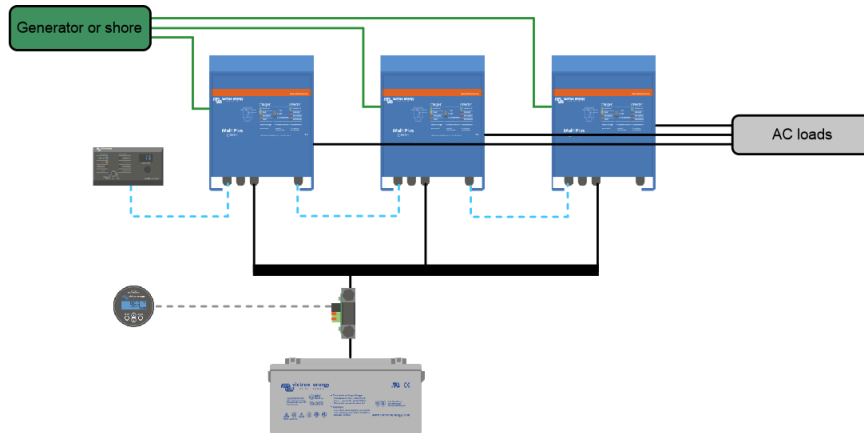
Online training

22/04/2020

System types

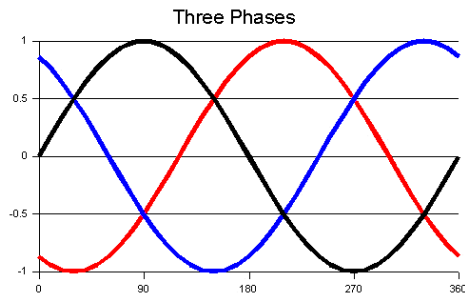
3-phase system

- MultiCompact, MultiPlus, Quattros and large Phoenix inverters can be connected in 3-phase



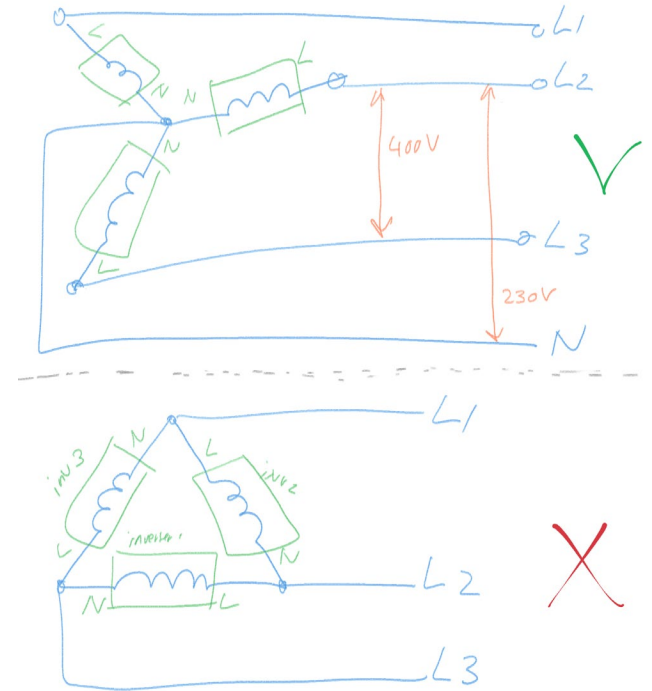
3-Phase balancing

- Each unit is independent within a 3-phase setup.
- The outputs are coordinated to stay 120 degrees away from each other
- Each phase can be different loaded. Full load on one phase and no load on the other phases is not a problem
- Equal loading only becomes important when a 3-phase generator is used
- A 3-phase system can not aid in phase balancing during charging. Each unit will always equally charge the battery.



3-phase star configuration

- Our products have been designed for star (Y) type three phase configuration.
- A star configuration has all neutrals connected
- A Delta (Δ) configuration will lead to certain inverter features not operating as expected. We therefore do not support Δ configuration.
- A delta configuration does not have a distributed Neutral.
- We can only connect to, or generate a 3-phase star(Y) supply.
- But we can supply power to delta (Δ) loads.

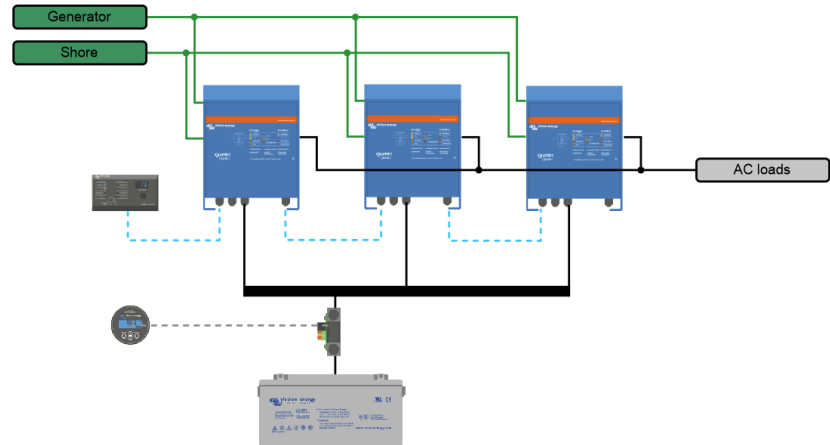


Parallel system

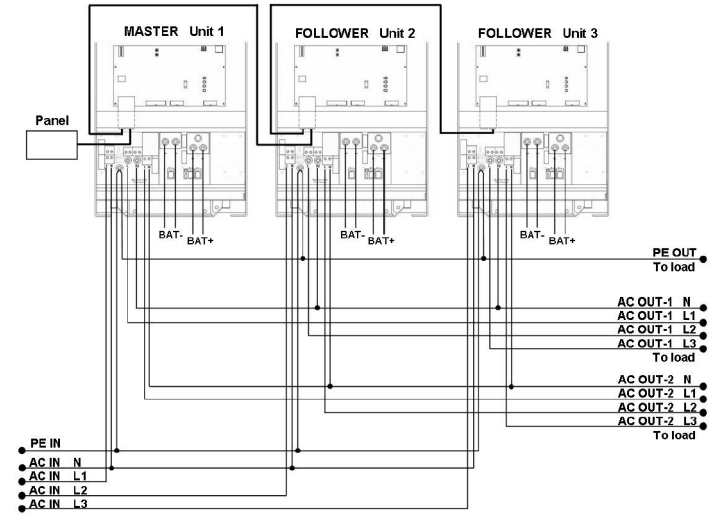
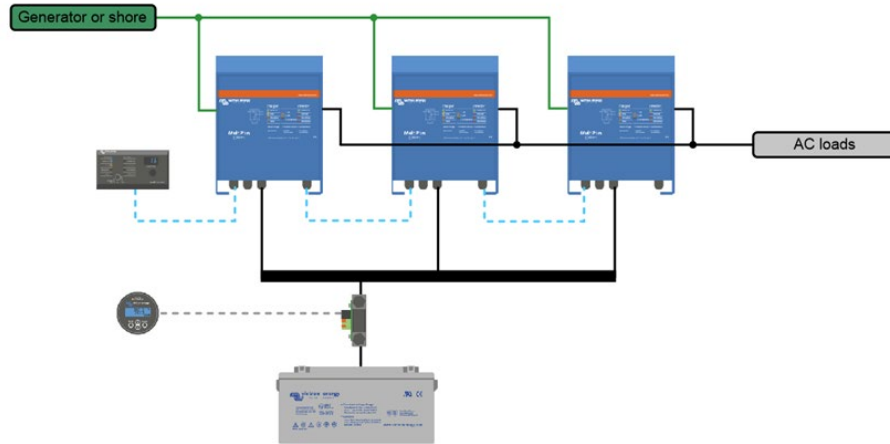
- MultiCompact, MultiPlus, Quattros and large Phoenix inverters can be connected in parallel
- Our largest unit is 15K. Keep in mind that it is better to use a larger unit rather than connect multiple small units in parallel.

The maximum in a parallel string is:

- 6 units up to 10kVA = 60kVA
- 5 units 15kVA = 75KVA

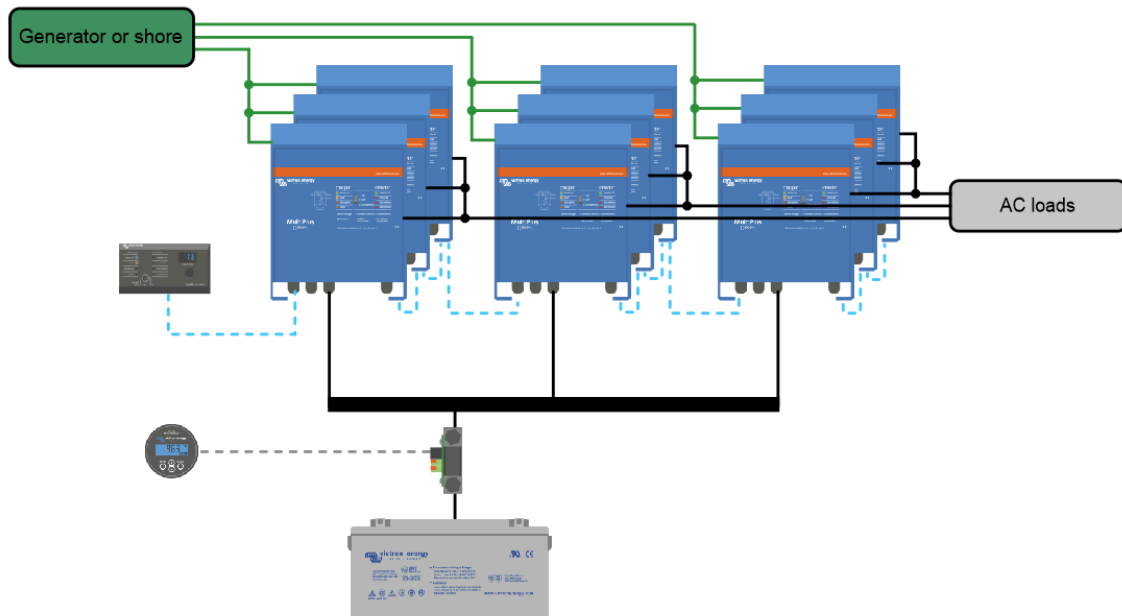


Parallel system



3-phase system using paralleled units per phase

Each phase can be constructed out of multiple paralleled Multis



3-phase system using paralleled units per phase

The maximum system size is a 180kVA

- 4x 15kVA Quattros on each of the three phases
- 12 units in total

The next size down is a 150KVA system

- 5x 10kVA Quattro's on each of the three phase
- 15 units in total.

For even larger systems split the circuits and connect to multiple individual systems.



3-phase system using paralleled units per phase

- Do not underestimate the complexity of large systems!
- We do not support untrained and/or inexperienced installers working on these large size systems
- Consider hiring an experienced installer for design and commissioning. Contact your sales manger.

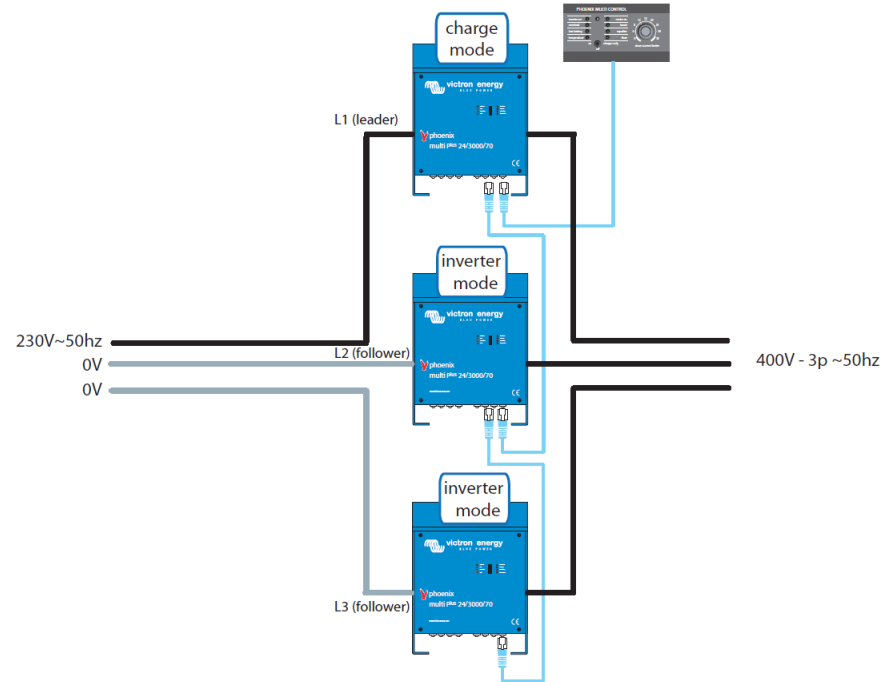
Get experience:

- Start with a parallel, single phase system 10 to 30 kVA
- Then a single unit, 3-phase system 30 kVA
- Then a multiple unit, 3-phase system 60 kVA



1-phase in - 3-phase out system

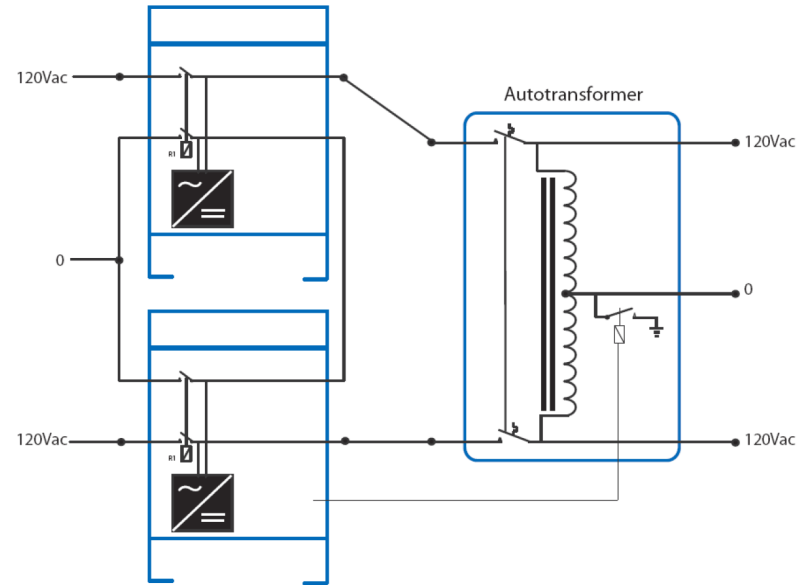
- The first unit will operate as an inverter/charger. It will charge the battery from incoming AC, or it will be an inverter when AC is not available
- The other two units are always running in inverter mode, they take from the battery to create the missing 2 phases



Split phase system

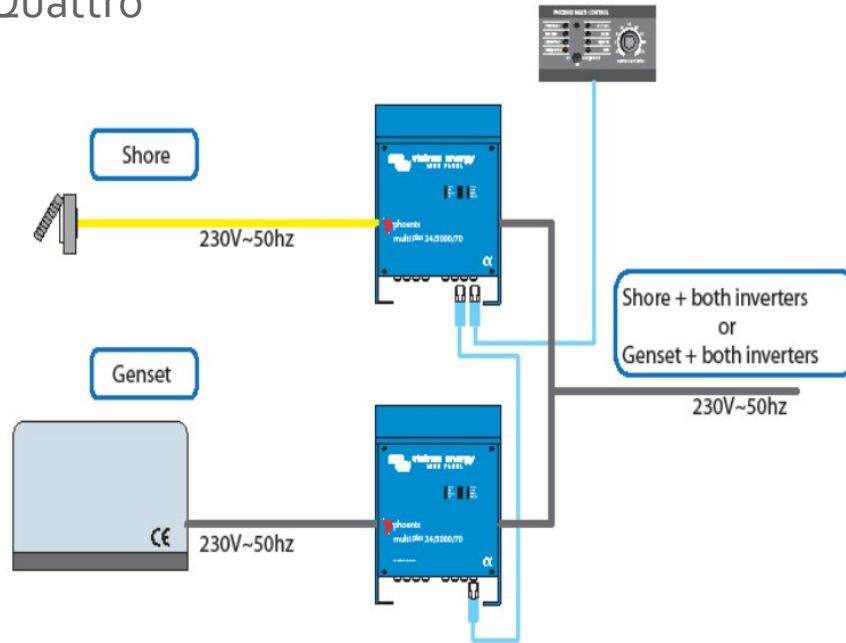
- These are mainly used in 120V systems
- Also stacked inverter setups with an autotransformer are possible

- Split phase 120 degrees
- Split phase 180 degrees
- Split phase 240 degrees
- Split phase 180 (auto detect)



Parallel system with 2 AC inputs

- Similar functionality as a Quattro



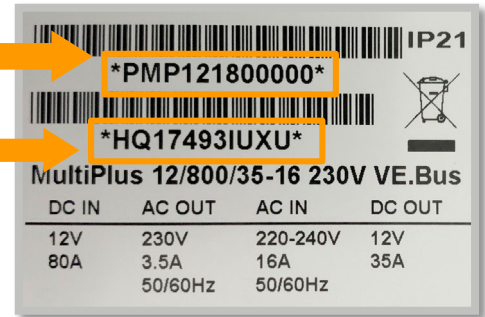
Installation

All units need to be identical

In 3-phase and parallel system all units need to be identical

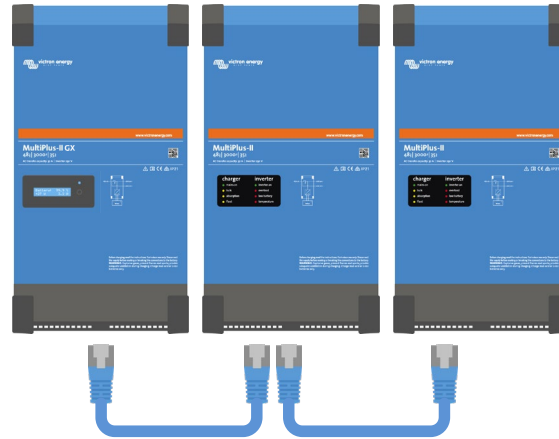
This means they all need to have the same:

- **Part numbers** - they all need to be the same
- **Age** - look at the serial number, first two numbers is year and second two numbers is week of build. Try to order all units in same order or do not use unit more than 1 year apart in age.
- **Firmware version** - update all units to the latest version



Combinations GX and non GX units

- This is possible, but all units need to be of the same age. Order them in the same purchase order. Not allowed to mix units with a age difference of more than half a year.



EasySolar

- Do not use EasySolars in parallel or 3-phase systems. Theoretically they could be used as such, but because of the CBs it will become a very tricky install. We will not support it.
- The EasySolar II can be paralleled or connected in 3-phase



Installation

- The units need to be close to each other and close to the batteries
- They need to be connected to a single battery bank
- Allow at least 10 cm for ventilation purposes under, above and beside the units
- Only one digital Multi Control panel and/or one GX device can be used per system



DC wiring and fusing

Wiring needs to be symmetrical in each phase

- Use the same cable length, type and cross-section to every unit
- Consider using a bus-bar

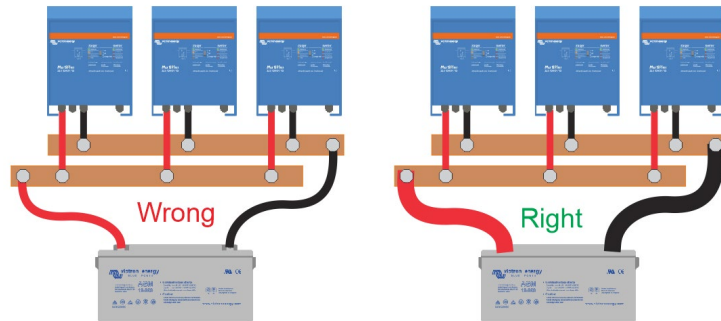
One fuse per phase is best

- If a big single fuse is not available, use one fuse per unit
- Use the same type of fuse due to same resistance

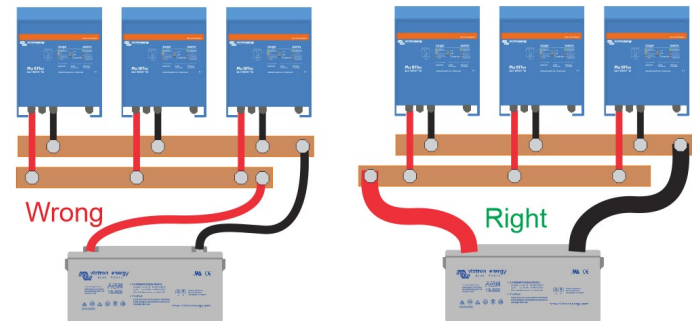


Busbars

- Cable thickness from the battery to the busbar must be equal to the sum of the cables from the busbar to the units

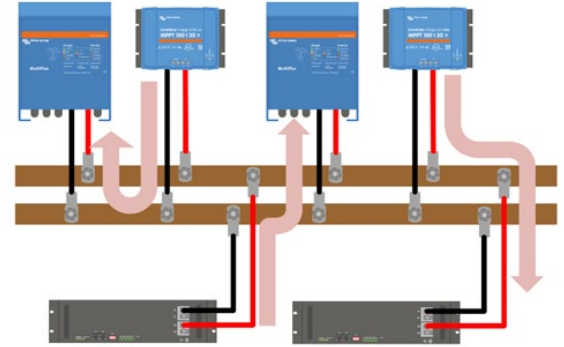
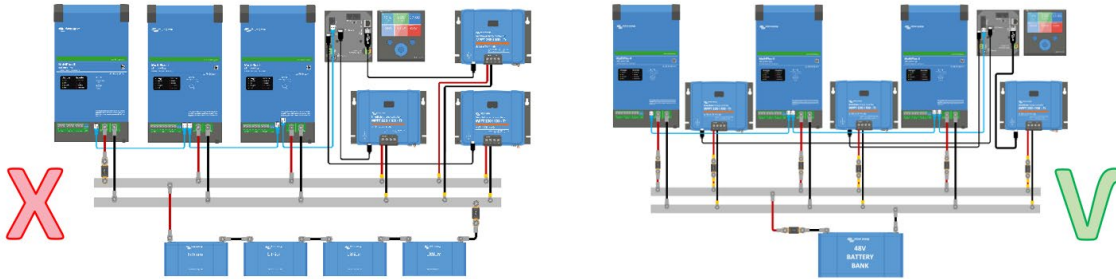


- The current path needs to be the same for each unit, so connect the busbars diagonally



How to mix MPPTs and Multis

- If multiple MPPTs and/or managed batteries are used mix them up between the Multis

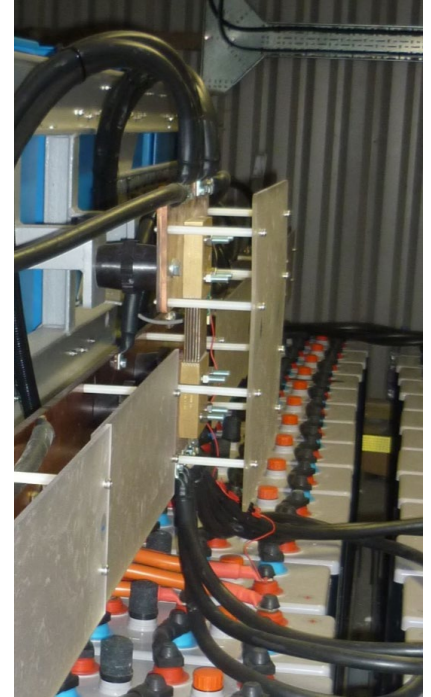


DC shunt

- If a BMV is used, the shunt rating has to match the current in the system
- The shunt that ships with the BMV is rated 500A but we also sell 1000, 2000 and 6000A shunts
- Different shunt settings can be made in the BMV menu

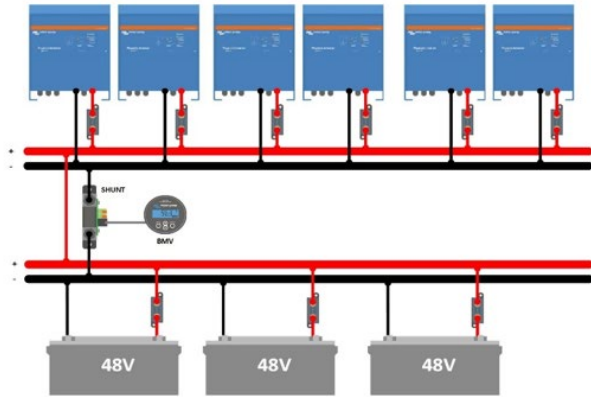


- Consider not using a shunt for very large systems.
- A shunt is not needed if managed batteries used that generate a state of charge value like BYD and Redflow

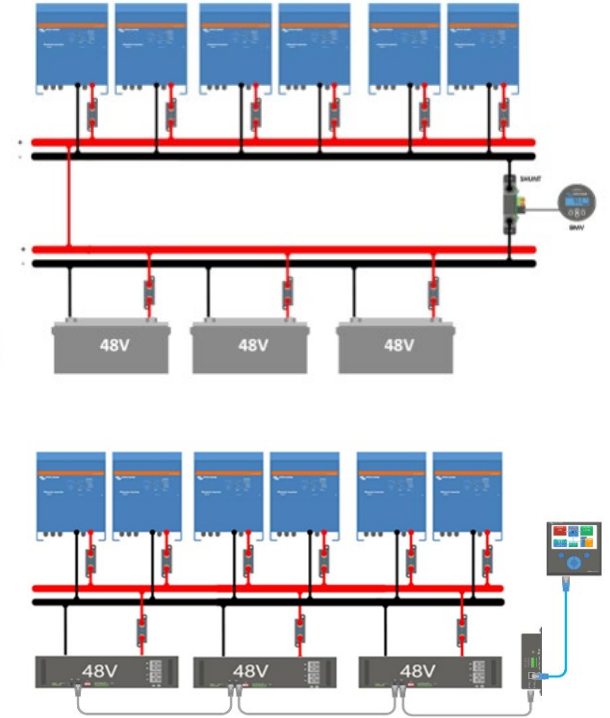


DC Shunt

- Be aware that wrong shunt placement can cause unequal current paths

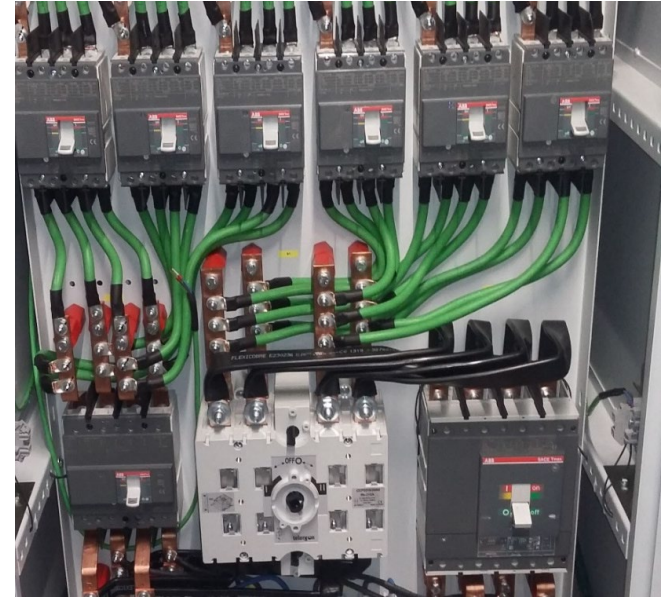


V



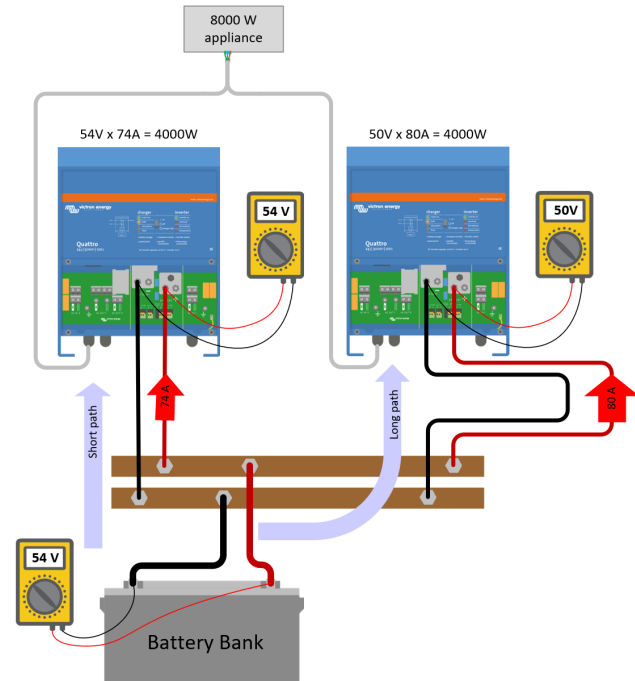
AC fusing

- Use one AC input and AC output fuse for all paralleled units per phase
- Or use mechanically connected individual fuses
- Consider a AC bypass switch
- Consider adding AC input volt meters



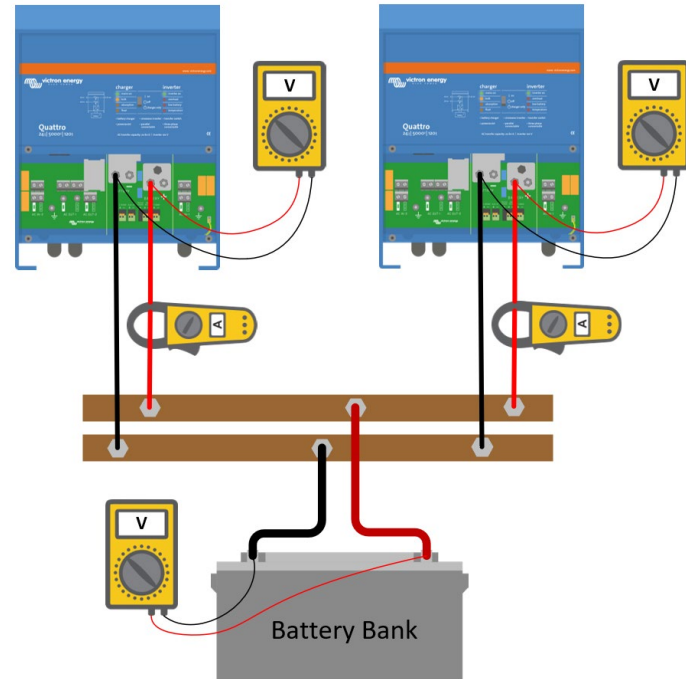
DC wiring paralleled units

- Unequal cable lengths mean different voltages
- Different voltages mean different currents.
- Inverter/charger overload is triggered on current
- The unit with the lower voltage wil go prematurely into overload



Trouble shoot DC wiring issues

- Load the system to its maximum load
- Current clamp the DC wires to each unit
- Compare the current readings, each unit should have similar DC currents



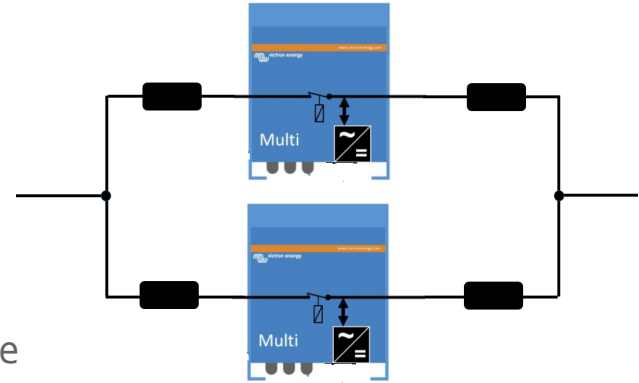
AC wiring paralleled units

- In a parallel system the AC current should be evenly distributed through all paralleled units
- Do not over-dimension the AC cabling
- Using extra thick and extra short AC cabling has negative side effects

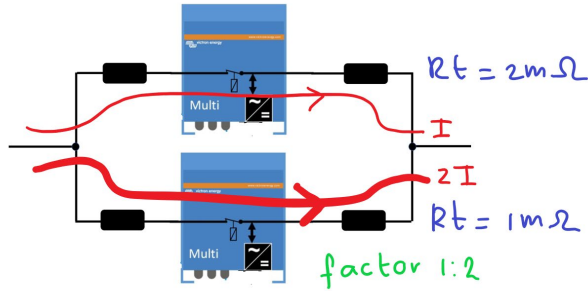


Why is this?

- The resistance of the AC path through the unit is approximately $2\text{m}\Omega$
- The contactor resistance is slightly different per unit
- If low resistance cables are being used current will be diverted from one unit to another
- The voltage drop tolerance of a 100A contactor is about 20mV at 100A.
- The total cable resistance (input + output) should therefore be larger than $R = 60\text{mV}/100\text{A} = 6\text{m}\Omega$.

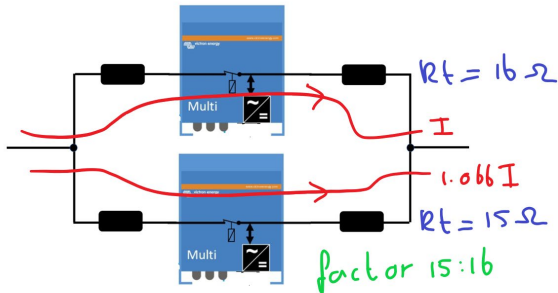


An exaggerated wiring example



If good cabling is used:

- The total resistance for Unit A is $2\text{m}\Omega$
- The total resistance for Unit B is $1\text{m}\Omega$.
- Unit B will carry twice as much current as Unit A

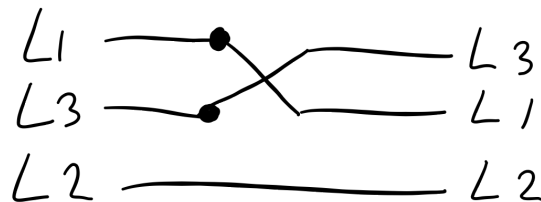
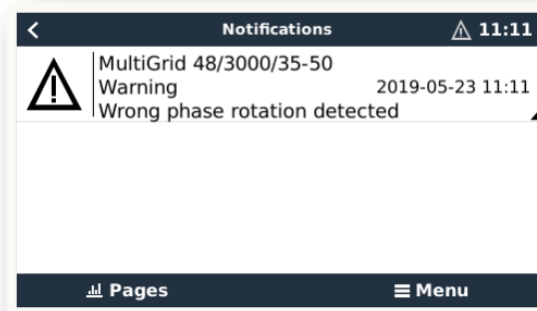


If bad AC cabling is used:

- The total resistance for Unit A is 16Ω
- The total resistance for unit B is 15Ω .
- Unit B will carry 1.066 times more current than unit A

3-phase rotation

- If the phase rotation of the incoming supply is wrong a 3-phase Multi system will stop charging and go into inverter mode
- A phase rotation error will show up on a GX device
- For mobile systems consider a switch to correct phase rotation issues, like:
 - A switch that swaps two of the phases
 - An automatic device that can correct phase rotation



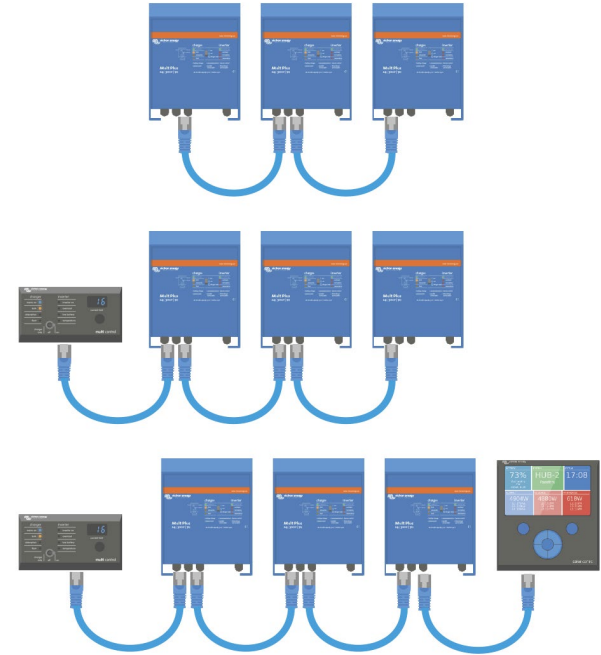
Temperature sensor and Voltage sense wire

- The temperature sensor can be wired to any unit in the system
- For a large battery bank it is possible to wire multiple temperature sensors
- If more temperature sensors are used, the system will use the highest measured temperature
- The voltage sensor is wired to the master of L1



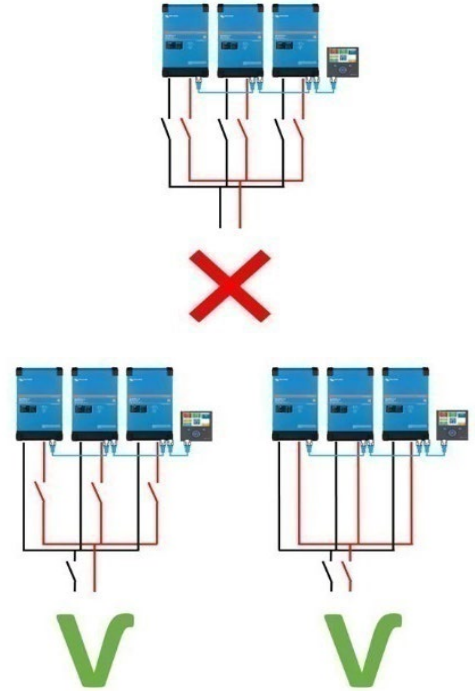
Communication cable

- All units must be daisy chained with VE.Bus cable (RJ-45 UTP). The sequence for this is not important.
- Do not use terminators in the VE.Bus network.
- Only use manufactured UTP cables (not home made)
- Only one (optional) Multi Control panel and/or CCGX can be used per system
- The Multi Control panel will also require configuration.
- For system more than a Dongle is needed



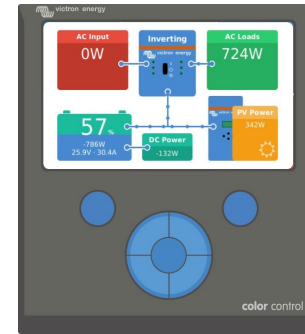
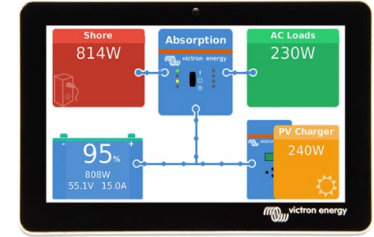
Communication wiring

- Not all Multis have galvanic isolation between VE.Bus and the battery
- An unwanted current can occur in the communication cable if the communication cables are connected and the battery negative is not connected
- This current will damage the Multi's communication chip
- 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



Install a GX device

- More comprehensive read out
- System performance history
- Additional functionality
- Comprehensive system notifications
- Better alarm reporting
- Gateway for support



System configuration

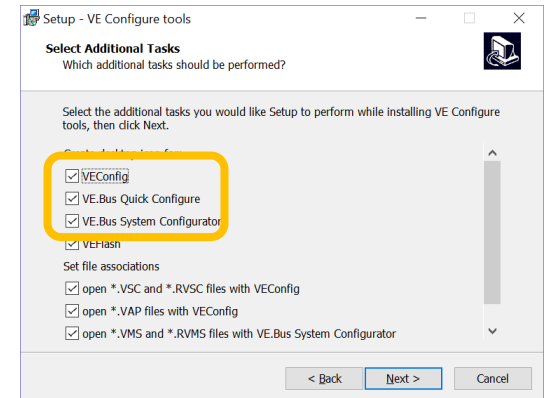
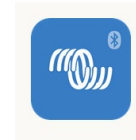
Software needed for programming

Victron Connect is used for updating firmware

VE configuration tools for VE.Bus Products contains:

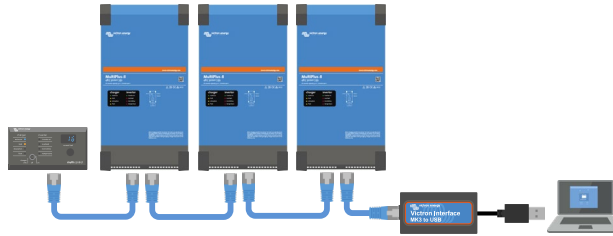
- **VEConfigure 3** is used for system settings
- **VEBus Quick Configure** or **VEBus System Configurator** are used to set up 3-phase and/or parallel systems

Software is available from the Victron downloads page:
<https://www.victronenergy.com/support-and-downloads/software>

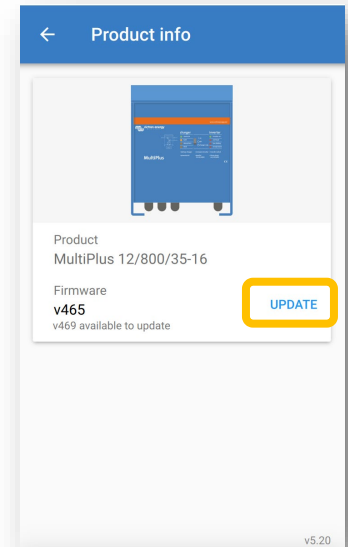


Before programming

- Update all units to the latest firmware version
- Interconnect the units with RJ45 cables
- Connect a MK3-USB interface

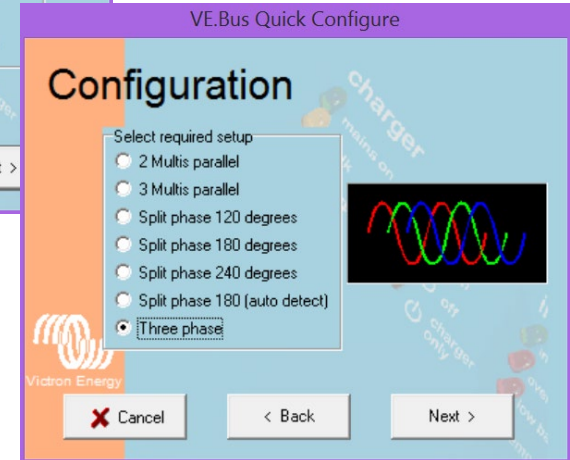
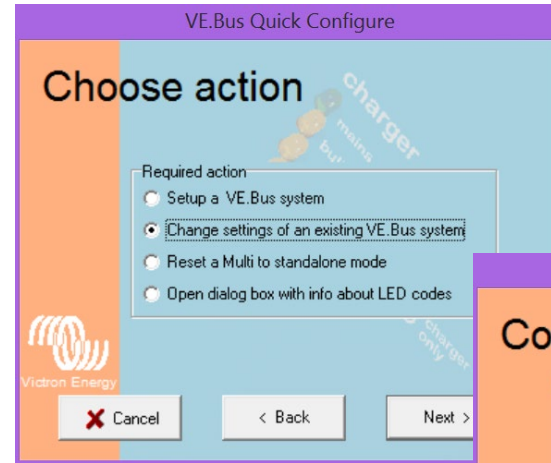
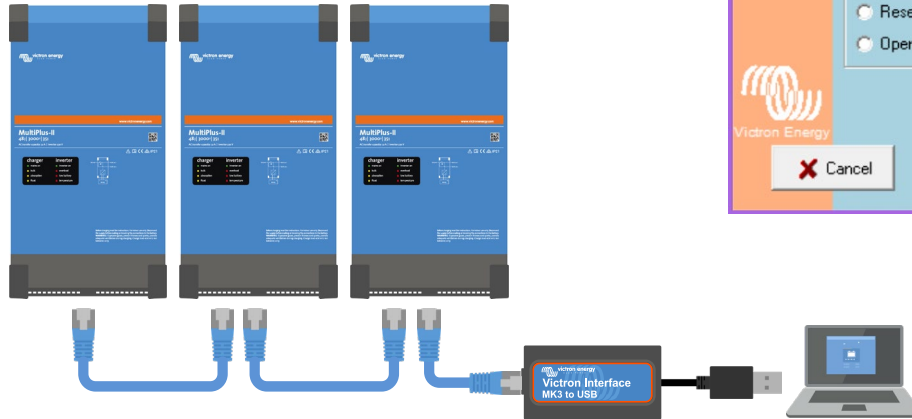


- Make sure the GX device is disconnected.
- If the system will be using a Digital MultiControl it will need to be connected during programming
- In a 3-phase system the AC out neutrals will need to be connected



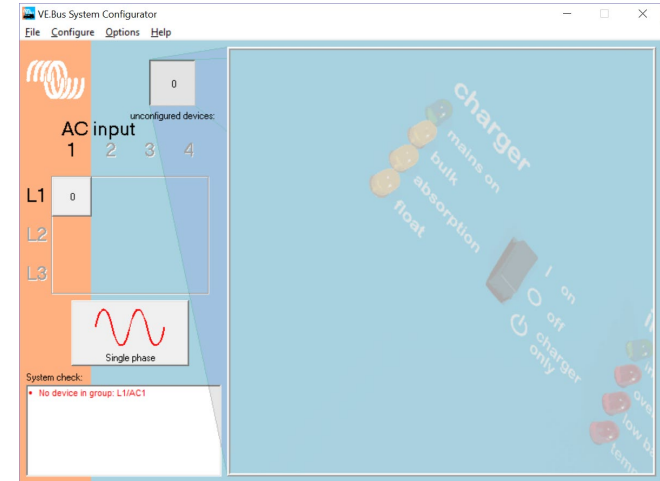
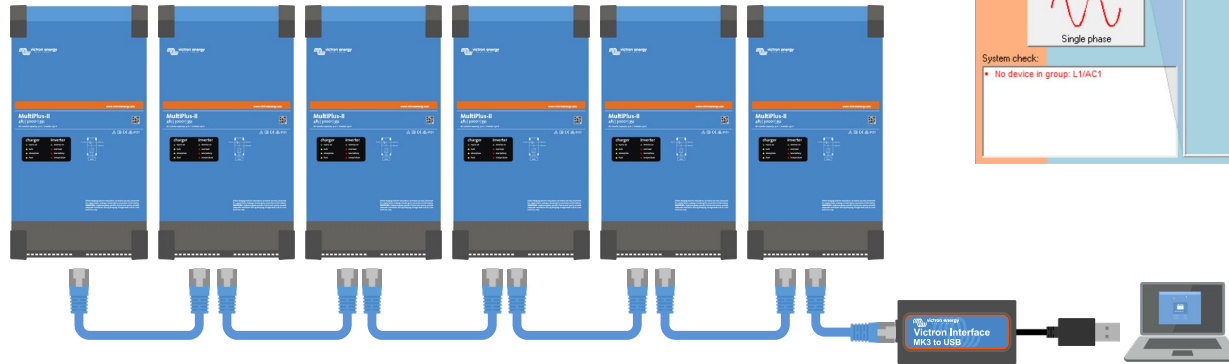
VEBus quick configure -

- For systems up to 3 units
- 3-phase, split phase or parallel



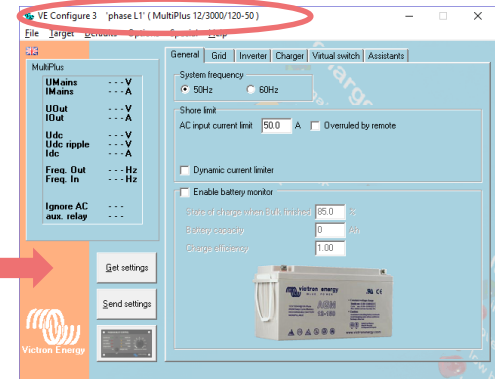
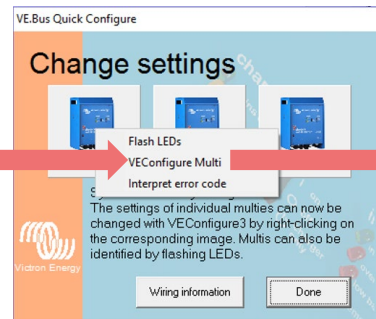
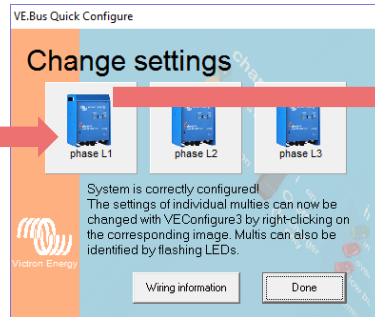
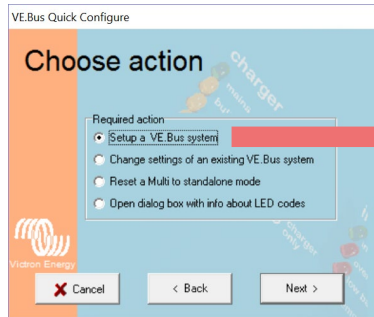
VEBus system configurator -

- For systems with 4 or more units
- For special systems , like 1-phase in and 3-phase out



VEConfigure

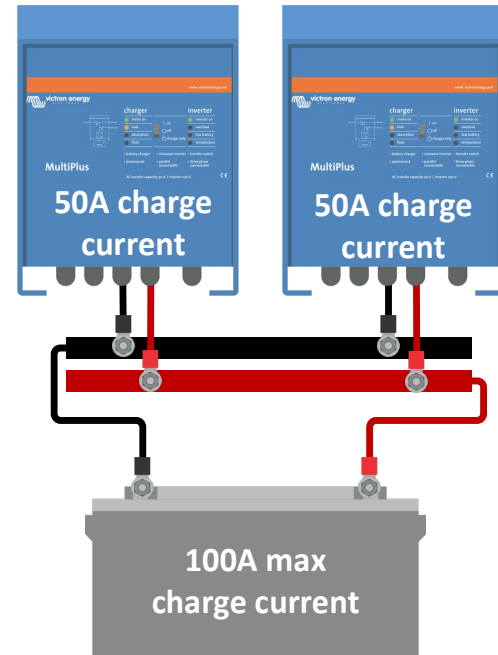
- The final settings are done via VE.Configure.
- Use a VE.Bus program to access the VE configure settings
- VE.Configure will ask you to send the settings to this unit or to all units?



VE.Configure master of L1

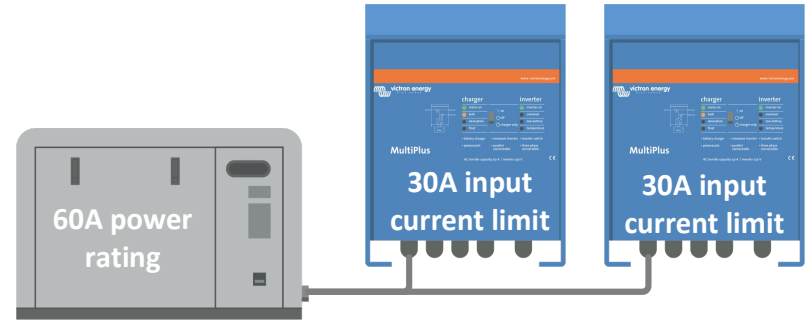
- System frequency
- Ignore AC input function
- Weak LOM
- All charger settings, such as:
 - Absorption voltage
 - Float voltage
 - Charge current

Note: The maximum charge current multiplied by the number of units in the system. Example: To get a 450A maximum charge current in a 9 unit system set the charge current to 50A per unit



VE.Configure master of each phase

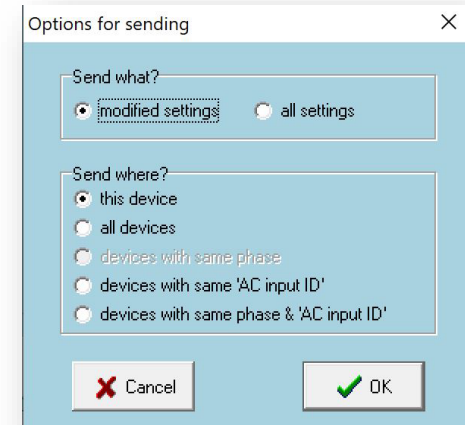
- Inverter output voltage
- UPS function on/off
- Power Assist settings
- Accept wide input frequency range
- Input current limit(s)



Note: The input current limit used by the system is multiplied by the number of units in the system. For example; a current setting of 30A in two Multis means a total current limit of 60A. This multiplication factor is also used by the remote control panel or GX device. It is possible to set a different input current limit per phase.

VE.Configure each unit

- Country/grid code standard or grid related values (AC high/low values)
- DC input low shut-down values
- Virtual switch settings (with exception of AC ignore)
- All assistants
- Note that the programmable relay and K relay(s) can be uniquely programmed in each unit.
- A quick way to make settings in all units is use the “send to all units” feature.



VE.Bus error codes

- A VE.Bus error code is a blinking inverter LED in combination with a charger status LED
- The blinking is always in anti phase! If LEDs blinks in phase it is NOT an error
- If one or more systems shut own after a fault or alarm, all units have to be switched off and back on again!
- If there is an alarm in a one of the units of a 3-phase system, like low battery, overload, temperature or ripple, all units will switch off.
- The GX device will tell you in which phase the alarm occurred.

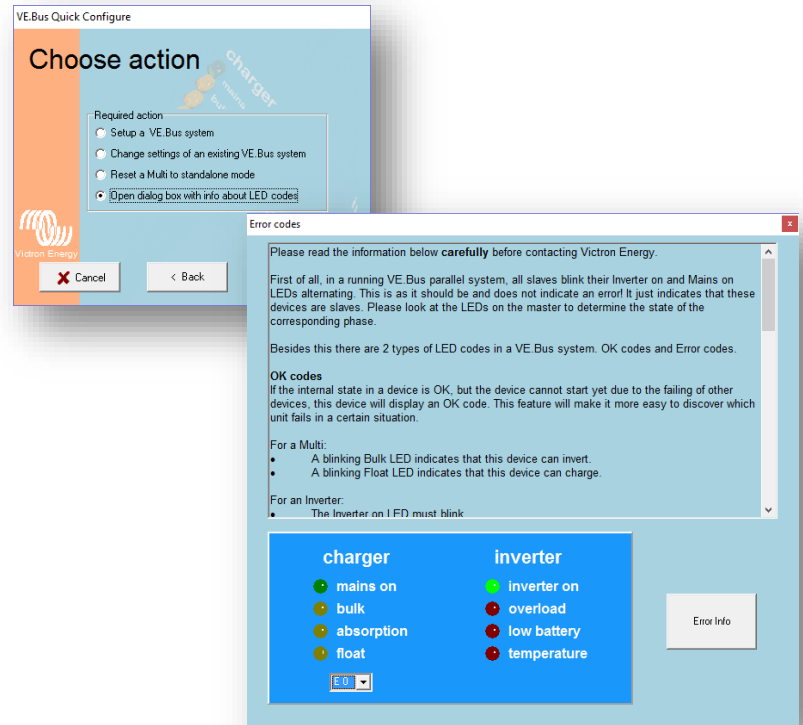


Error overview

For a list of the VE.Bus error codes see:

- The manual of the Multi or Quattro
- The VE.Bus Quick configure software
- The Toolkit App

- VE.Bus error code document:
https://www.victronenergy.com/live/ve.bus:ve.bus_error_codes



More information

More information

- Product manuals
- Parallel and 3-phase manual:
https://www.victronenergy.com.au/live/ve.bus:manual_parallel_and_three_phase_systems
- Victron Professional training course “Three phase and parallel”: <https://www.easy-lms.com/course-40760>
- Large systems: <https://www.victronenergy.com/blog/2016/12/01/building-an-unattended-battery-based-energy-system/>

Pre VE.Bus

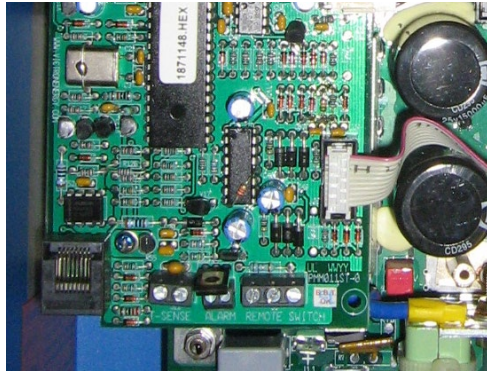
Non VE.Bus versus VE.Bus units

Changeover was from end of 2007 until end 2008

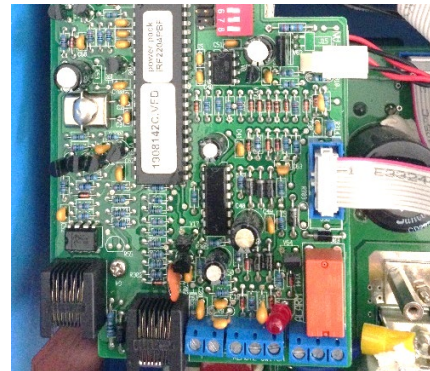
This can be recognized by:

- 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

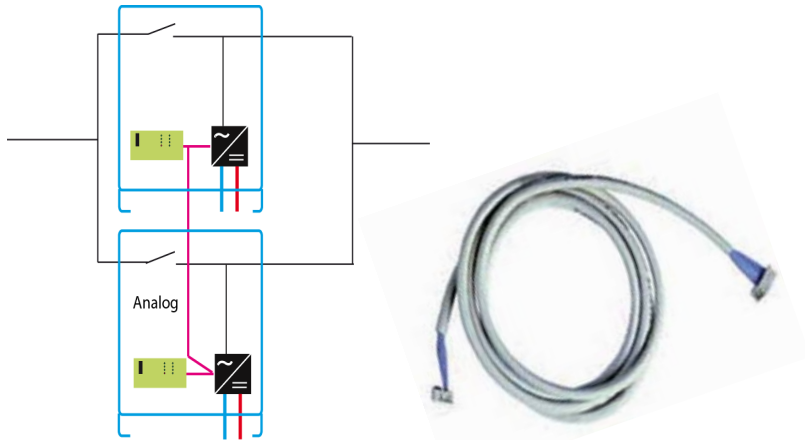


VE.Bus

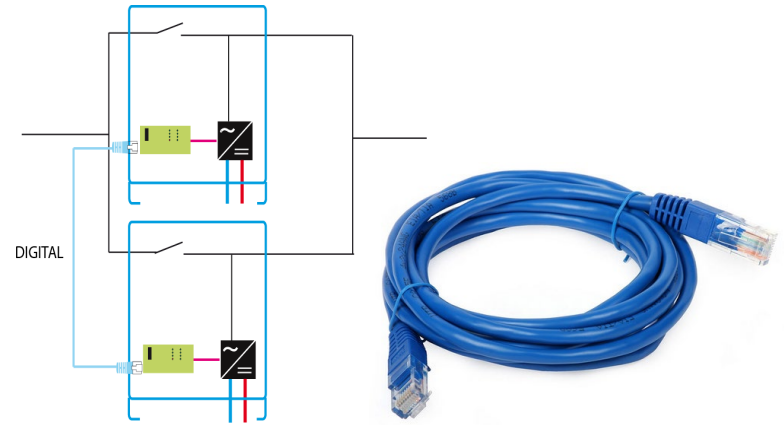


VE.Bus vs non VE.Bus

Firmware version 15xyyyy, 17xyyyy and 18xyyyy are non VE.Bus.



Non VE.Bus: Ribbon cable



VE.Bus: RJ45 cable



Energy. Anytime. Anywhere.