Parallel and three phase VE.Bus systems

This manual explains the details of designing, installing and configuring three-phase and parallel systems. It applies to components that use VE.Bus, for example MultiPlus, Quattro and some larger Phoenix inverters.

IMPORTANT:

- Always update all units to the latest 400 firmware version (firmware update instructions).
- Note that some parts of the description below apply only to 4xx firmwares.
- All units in one system must be the same type and firmware version, this includes same size, system voltage, and feature set. The type is indicated by the first four digits of the firmware version number. For details, see the “VE.Bus Firmware Numbering System” section in the VE.Bus Firmware versions explained document.
- Specify with your Victron distributor that you will be connecting units in parallel or multi-phase and identical units must be supplied.

Warning

Parallel and Multiphase systems are complex. We do not support or recommend that untrained and/or inexperienced installers work on these size systems.

Victron is able to provide specific training for these systems to distributors via their regional sales manager. This should be considered essential before attempting design or installation.

First get experience with smaller systems. If you are new to Victron, please start with simpler designs, so that you become familiar with the necessary training, equipment and software required.

It is also recommended to hire an installer that has experience with these more complex Victron systems, for both the design and the commissioning.

Maximum System size

Three phase systems

Using our 15kVA Quattros, the maximum system size is a 180kVA three phase system. Which then consists of four units on each of the three phases: 12 units in total.

Using our 10kVA Quattros, the maximum system size is a 150kVA three phase system. Which then consists of five units on each of the three phases: 15 units in total.

Single phase systems

This is the same as above, but then per phase:

- maximum single phase system with 15kVA Quattros is 75kVA: five units.
- maximum single phase system with 10kVA Quattros is 60kVA: six units.

DC and AC wiring

The VE.Bus cluster maintains a single 'global' status for SoC, DC voltage, and DC current. Every DC connection (on every Multi/Quattro and on every battery) has to be connected together to a single DC bus. Do *not* build systems with separated batteries on multiple (separated) DC bus structures connected to subsets of the Multi/Quattro units in the cluster. This will *not* work.

Also beware of sizing the battery cable and jumpers between cells/batteries.

For units in parallel: Both the DC and AC wiring needs to be symmetrical per phase: use the same length, type and cross-section to every unit in the phase. To make this easy, use a bus-bar or power-post before and after the inverter/chargers.

For units in parallel: use one AC fuse for all units on that phase. Both on the input, and on the output. Multiple fuses which are mechanically connected together is ok: that is also one fuse.

For DC, one fuse per phase is best. If a big single fuse is not available, use one fuse per unit. Same type of fuse due to same resistance.

Beware of phase rotation between the inverter and AC in. When wired in a rotation that is different to the programming of the Multis, the system will not accept the mains input and only operates in inverter mode. If a GX device is connected, it will signal a phase rotation alarm. In that case swap two phases to correct it, or re-program the units to match the wiring rotation.

Note: Do not over-dimension the AC cabling. Using extra thick cabling has negative side effects.

- Technical background: In a parallel system the AC current should be evenly distributed through all paralleled units. When the resistance in the cabling is very low, a small difference in resistance results in a large relative difference.
  This results in bad current distribution.
  An exaggerated example:
  - Using 2 units (A and B) parallel and using extremely good cabling one might achieve a total resistance for Unit_A of 0.0001Ω and a total resistance for Unit_B of 0.0002Ω. This results in Unit_A carrying twice as much current as Unit_B although the resistance difference is very small.
  - Using the same 2 units in parallel with bad AC cabling one might end up with a total resistance for Unit_A of 15Ω and a total resistance for Unit_B of 16Ω. This results in a much better current distribution (Unit_A will carry 1.066 times more current than Unit_A) even if the absolute difference in resistance is much bigger than in the previous example (1Ω vs 0.0001Ω).

A continuous, unbroken negative link must be maintained between all units

VE.Bus is not isolated on the MultiPlus range and Quattros.

Therefore it is very important to prevent damage to the communications cards that the negative battery terminal of a Quattro remains continuous between units as long as the VE.Bus cable that connects the multiple units is connected.

If units need to be isolated at both poles, or local wiring requirements demand double pole isolation for each unit, the communications cables must be removed first AND appropriate safety signage needs to clearly explain this.

Double pole isolation of the system is allowed (and sometimes required), as long as it at the battery connection end of the DC bus, and the Multis/Quattros remain with continuous negative between themselves.

Theory and background information

wiring is further explained in these presentations:

- presentation - DC Ripple
- presentation - Theory on wiring large systems'
- Wiring Unlimited - Chapter 4 - DC Wiring - Parallel and/or 3 phase systems.

Communication wiring

- All units must be daisy chained with the VE.Bus cable (RJ-45 cat5). The sequence for this is not important. Do not use terminators in the VE.Bus network.
- 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. The system will use the one with the highest temperature to determine the temperature compensation.
- Wire the voltage sense on the master of L1.
  (If the system has more than 1 AC input, connect it to the Master corresponding to the first AC input.)

Configuration

Note: Special considerations exist before initial power-up for large systems using Redflow batteries: Click here for details.

In the VE Configuration tools there are two different programs. One to configure small systems and one for larger systems:

- Up to three units: use VE.Bus Quick Configure
- 4 units or more: use VE.Bus System Configurator

Activate VEConfigure from within these programs to make settings per unit. Right click, and select VEConfigure.

Make the following settings in the master of L1:

- All charger settings, such as absorption voltage, float voltage and max charge current.
  (The maximum charge current is multiplied by the number of units in the system: in a 9 unit system set it to 50A to get a 450A maximum charge current.)
- System frequency
- Whether or not “Weak LOM” is used

The following settings need to be made in the master of each phase:

- Inverter output voltage
- Input current limits.
  This makes it possible to set a different input current limit per phase. Note that, similar to the maximum charge current, the input current limit used by the system is multiplied by the number of units in the system.
  (This multiplication is done automatically when using a remote panel to adjust the input current limit.)
- UPS function on/off
- PowerAssist settings
- Accept wide input frequency range on/off

The following settings need to made in each unit in the system:

- Country / grid code standard and other grid related values (AC high/ low values)
- DC input low shut-down values.

A quick way to make settings in all units is the 'send to all units' feature. You'll see the option after making the changes to the first unit.

Note that AES is only operational in stand-alone systems. Not in parallel and multi-phase systems.

Virtual switch

A unique virtual switch configuration can be configured for each unit in the system. With the exception of the Ignore AC input function: configure that in the master of L1.

Assistants

- All self-consumption Assistants, Hub-1 to Hub-4, need to be loaded into each unit in the system.
- PV Inverter Assistant needs to be loaded into each unit in the system.
- The VE.Bus BMS and the Two-Signal BMS support Assistant also need to be loaded in each unit in the system.

(nb: In some cases (depending on the choices made) slaves can be left out, the assistant will notify you about this.)

With all the other Assistants: genset start/stop, relay locker etcetera, a unique configuration can be made in each unit.

Tip: a quick way to load Assistants into each unit in the system is to save the settings after configuring the master in L1. Then open VEConfigure for another unit and load that file. VEConfigure will automatically adapt the Assistants for the slaves. (note: In some cases you might get some warnings. Please step through the assistant in that case.)

Tips and hints

- presentation - DC Ripple
- presentation - Theory on wiring large systems
- VE.Bus error codes
- Victron Toolkit App with LED code definitions
- Use the help-file in VEConfigure, and also in VE.Bus Quick Configure and VE.Bus System Configurator.

System Monitoring

It is strongly recommended that a GX Family Product is used in conjunction with these larger systems. They provide highly valuable information on the history and performance of the system. System notifications are clearly presented and many additional functions are enabled. Data from VRM will greatly speed support if it is required.

Training Video

There is an advanced training video and competency exam for 3 phase and parallel installation and commissioning available on Victron Professional -> E-Learning. You will require an installer account on Victron Professional to access it.

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