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BLUE POWER

Quick Installation Guide

Quattro 12V 24V 48V 3000VA 230Vac

Included

A

C   D (7x)   E (T-sense)

⚠ For fuse values:
refer to the user manual

Fuse (not included)

Not included

B

Battery

I
Battery Cable +

J
Battery Cable -

M
Remote control

N

L
UTP-Cable

G
TR-Charge

F
GND-relay

H
V-sense

O
AC-OUT

P
AC-IN

K
Battery Link 1x (2x12V)
Battery Link 3x (4x12V)

1
>100mm
>100mm
>100mm
A
B

2
① D
C
① ③
② D

3
E (T-sense)
F (GND-relay)
G (TR-charge)
H (V-sense)
24V H G F E
48V H G F E

4
H (v-sense)
I J
+ -
E (T-sense)
MAIN

5
G
+ -
K
MAIN
TRICKLE

6
M
DIGITAL MULTI CONTROL
L

7
N

8
L N GND   GND L N
AC-OUT 1   AC-OUT 2
O

9
P
P
L N GND   GND L N
AC-IN 2   AC-IN 1

10

Rev.00

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Quick Installation Guide

Quattro 24V 48V 5000VA 230Vac

Included
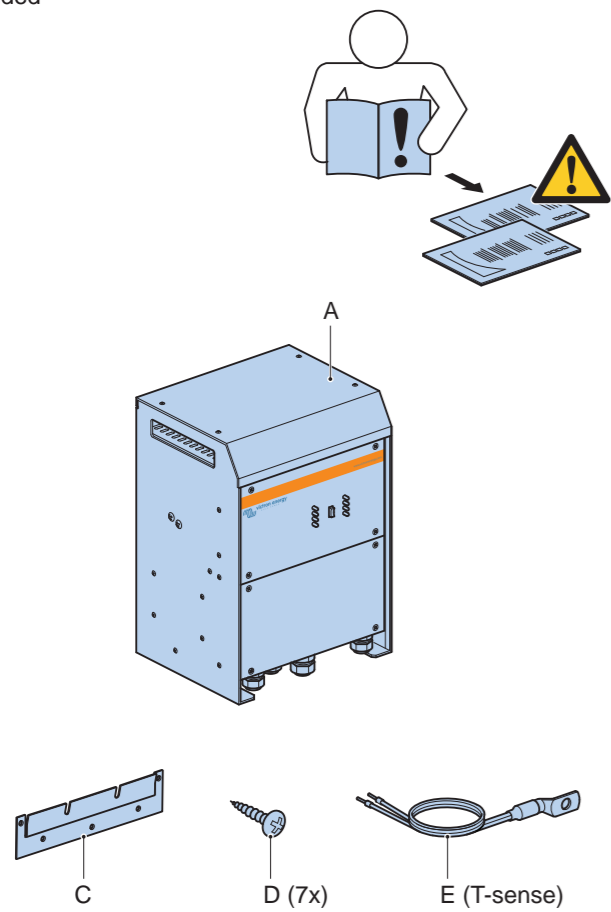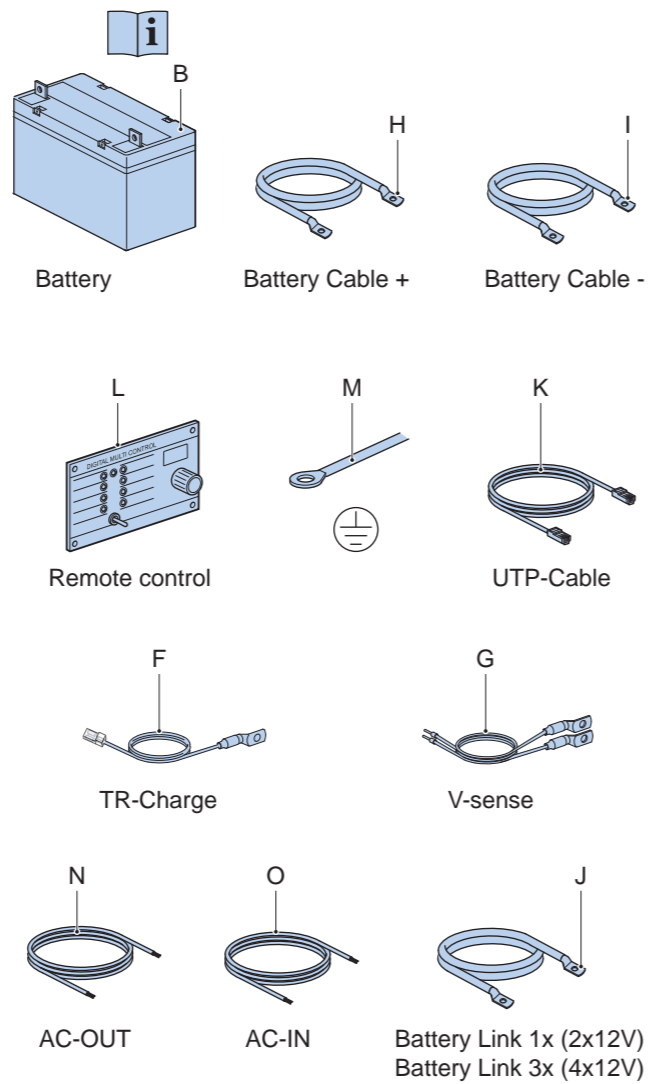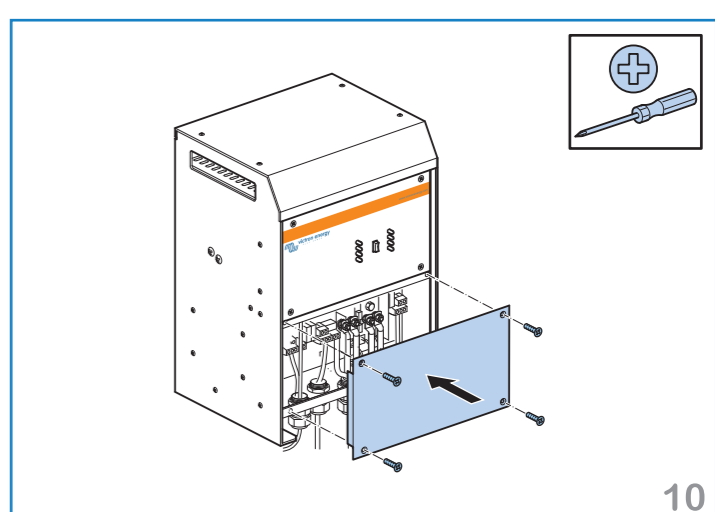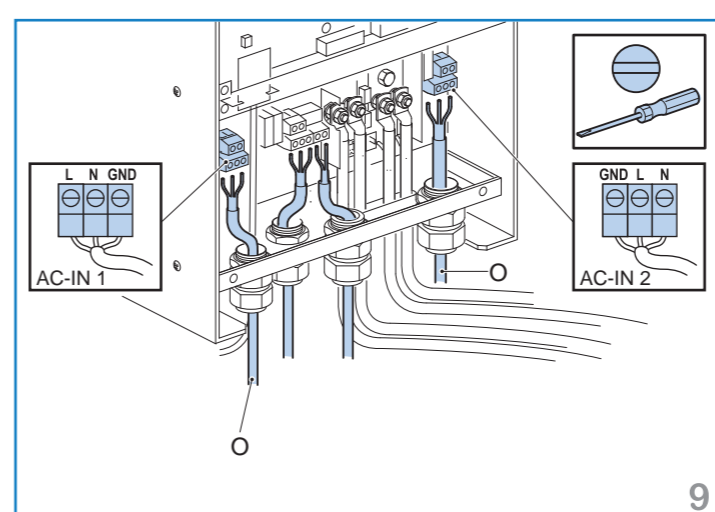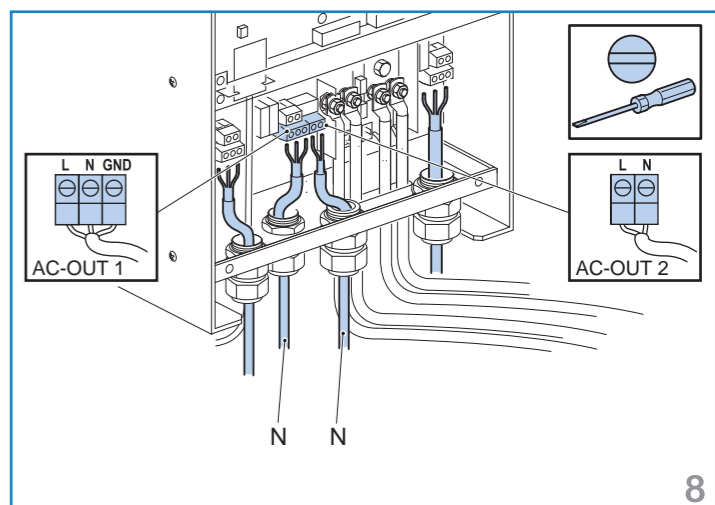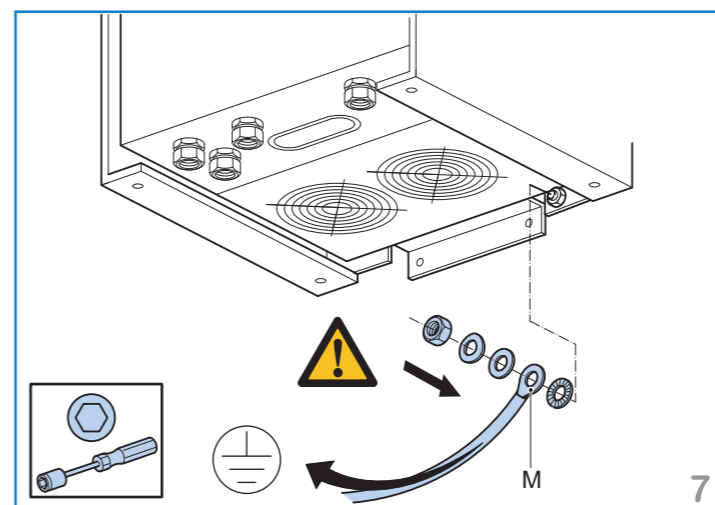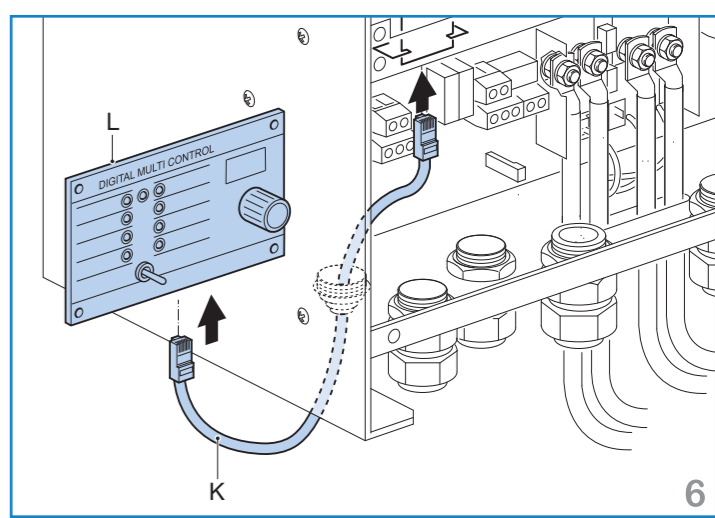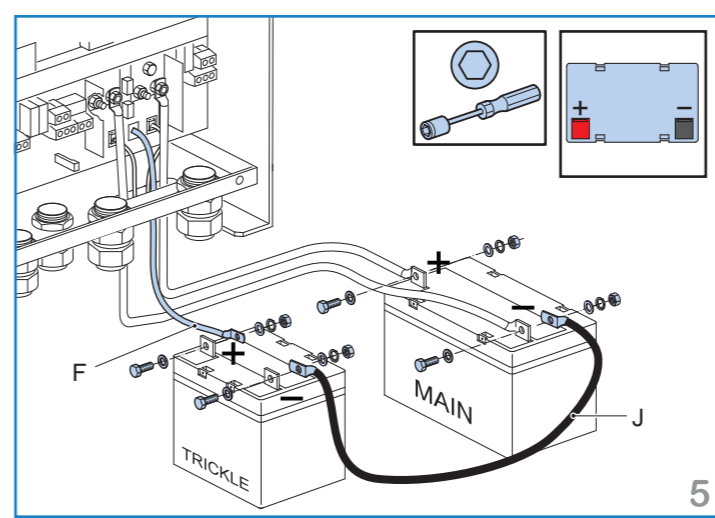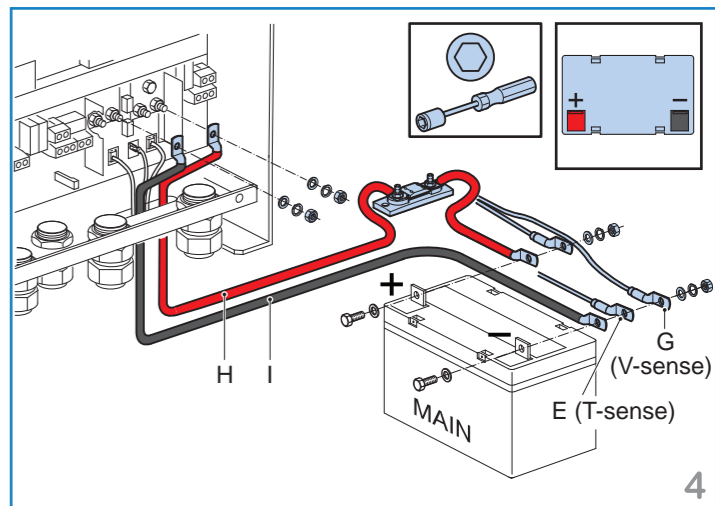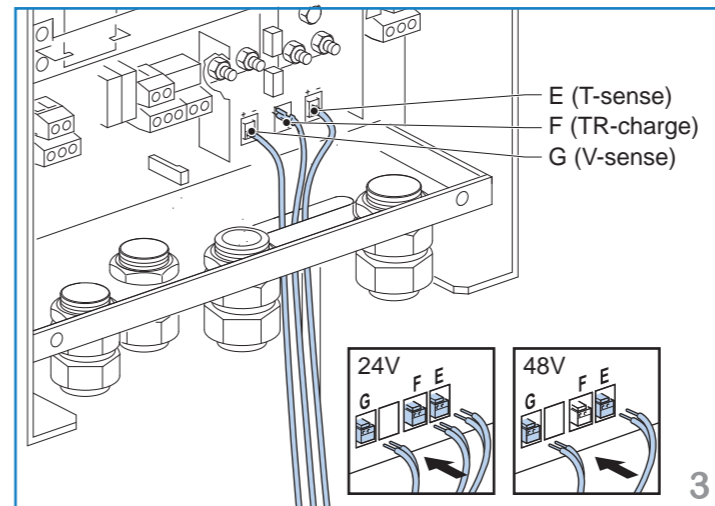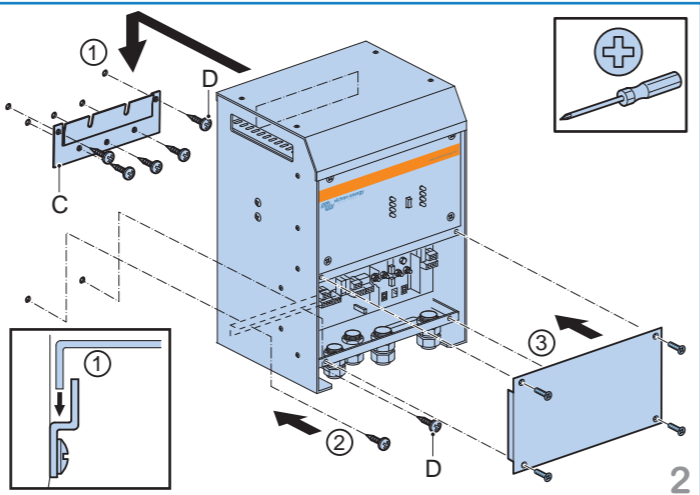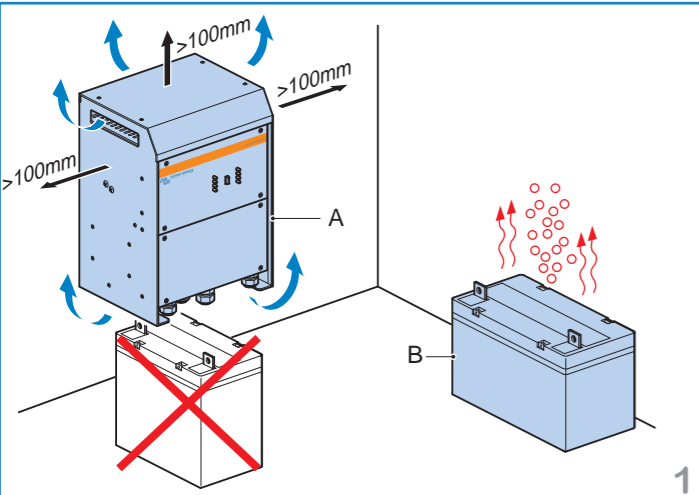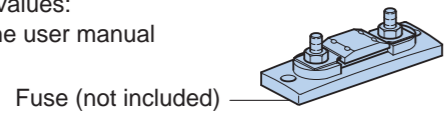
A

C   D (7x)   E (T-sense)

⚠️ For fuse values:
refer to the user manual

Fuse (not included)

Not included

i

B

Battery   Battery Cable +   Battery Cable -

H   I

L   M   K

Remote control   UTP-Cable

F   G

TR-Charge   V-sense

N   O   J

AC-OUT   AC-IN   Battery Link 1x (2x12V)
Battery Link 3x (4x12V)

1

>100mm
>100mm
>100mm
>100mm

A

B

2

① ②
C   D
①
②   D

3

E (T-sense)
F (TR-charge)
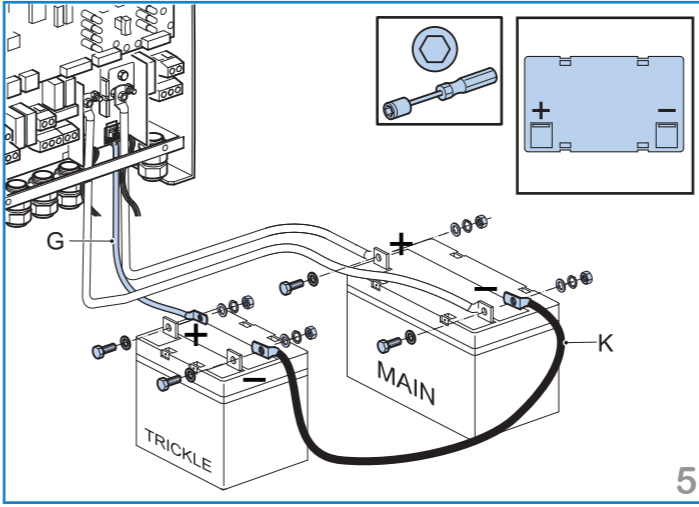G (V-sense)

24V   48V
G F E   G F E

4

H   I
MAIN
G (V-sense)
E (T-sense)

5

F
TRICKLE   MAIN   J

6

L
DIGITAL MULTI CONTROL
K

7

M

8

L N GND
AC-OUT 1

L N
AC-OUT 2

N   N

9

L N GND
AC-IN 1

GND L N
AC-IN 2

O

O

10

Sometimes the features of a new product are so unique that the benefits are difficult to understand or simply denied. The Phoenix MultiPlus is such a product.

The purpose of this paper is to step by step clarify the many features of the Phoenix Multi/MultiPlus.
Think of a situation where electricity from the grid or a generator is not available or limited in power. Think of boats, mobile homes, trucks, service vans, remote communication systems or off-grid houses. All too often shore power in the marina or on the camping ground is limited. All too often small gensets are a headache because of premature failure or frequent maintenance.
The Phoenix Multi/MultiPlus solves these problems.

1. The block diagram of the Phoenix Multi and MultiPlus (M/M+)

The most important components and features:

Example 1
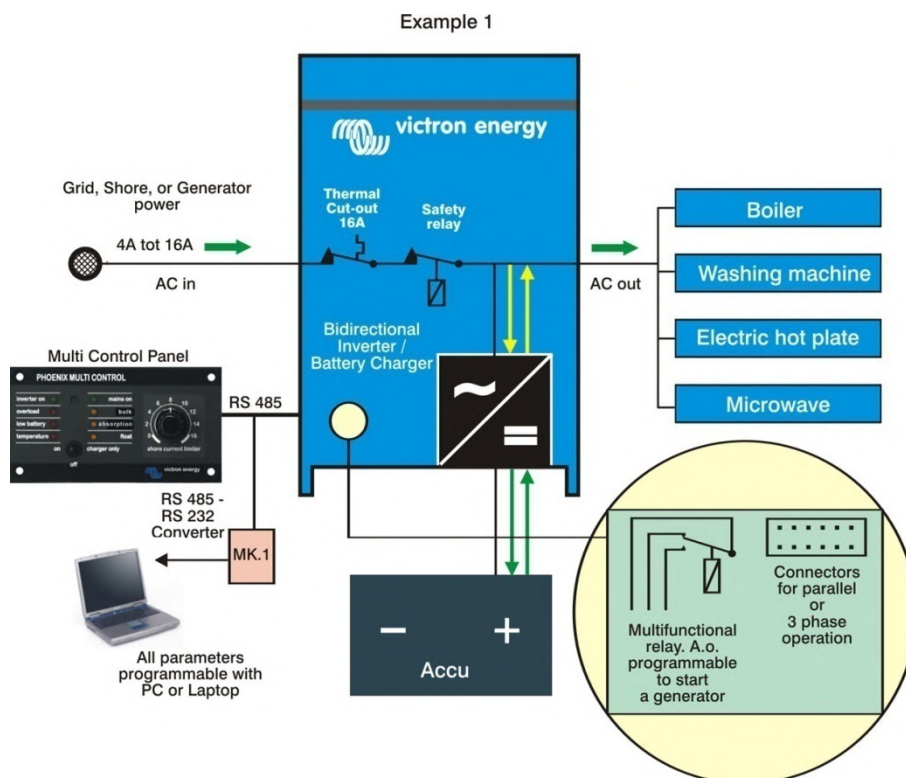
1.1 The bidirectional converter

The M/M+ is built around a bidirectional converter, that operates as an inverter or as a battery charger.
The converter of the M+ does more than a conventional bidirectional converter: it operates in parallel with the grid, with shore power or with a genset. It can add power to AC supply (with energy from the battery) and it will use surplus power to recharge. In most cases the M+ will also reduce the harmonic distortion of the genset voltage (this can be important for certain sensitive loads such as an induction cooker)

1.2 A multifunctional relay

This relay can a. o. be programmed to start a generator based on power demand and / or battery voltage.

1.3 A RS485 port

All parameters of the M/M+ are programmable.
The most important parameters can be programmed with a push button code, but it is much more convenient to use the MK.1 RS485 to RS232 converter, VEConfigure software (downloadable from our website) and a PC Notebook computer.
Examples of programmable parameters:
- inverter DC voltage cut out
- charge curve
- maximum charge current
- parallel operation and 3 phase operation
- programming the multifunctional relay

1.4 Connector for parallel operation and 3 phase operation

Up to 6 Multis can be parallel-connected to increase power to 15 kW.
In 3 phase configuration up to 18 Multis can be used to build a 45 kW inverter / charger!

1.5 AC input with 16 Amp thermal breaker and safety relay

The maximum AC input current of the M/M+ is 16 A. The safety relay makes sure that no dangerous AC voltage will be present on for example the shore power plug when disconnected.

1.6 The Multi Control Panel (16 A or 30 A)

The rotary knob on this panel is crucial: with this knob the maximum AC input current can be set, to a maximum of 16 A or 32 A.

1.7 AC output

To connect the AC appliances

1.8 The drawbacks of a conventional combined inverter / charger

A conventional "combi" will operate as an inverter when there is no AC input voltage present, and as a battery charger when AC is available. That's it.
When AC is available the input current will be the current drawn by the battery charger **plus** the current taken by the connected AC appliances. A powerful battery charger draws a lot of current: a 24 V 70 A charger for example will take nearly 10 A from the AC supply. When connected to a 16 A socket only 6 A will be left for the remaining AC equipment on board.
The result is that a powerful combi will trip a 16 A circuit breaker as soon as some household equipment is switched on
(a high output battery charger will have the same effect)

1.9 PowerControl: how the Phoenix Multi solves the problem described in par. 1.8.

The Phoenix Multi measures the AC input current and gives priority to the connected AC equipment. The PowerControl function makes sure that only whatever current is "left over" is used to charge the batteries. This will be explained below with several examples.

1.10 PowerAssist: this function, unique to the MultiPlus, takes PowerControl to a further dimension, allowing the MultiPlus to supplement the capacity of the AC source.
This is where we "achieved the impossible": the bidirectional converter of the MultiPlus operates in parallel with the AC input and will add current (with energy from the battery) whenever demand exceeds the capacity of the supply!

More power needed than the AC supply permits? The MultiPlus will supply the difference with power taken from the battery.
Has the load been reduced? The MultiPlus will use any surplus power to recharge the battery.

2. How it works in practice

Below are several examples to clarify the benefit of PowerControl (available on both the Multi and the MultiPlus) and of PowerAssist (MultiPlus only).
For the first examples we assume an AC supply limited to max. 4 A.
To make it work the input current limit should be set at 4 A on the Multi Control Panel.
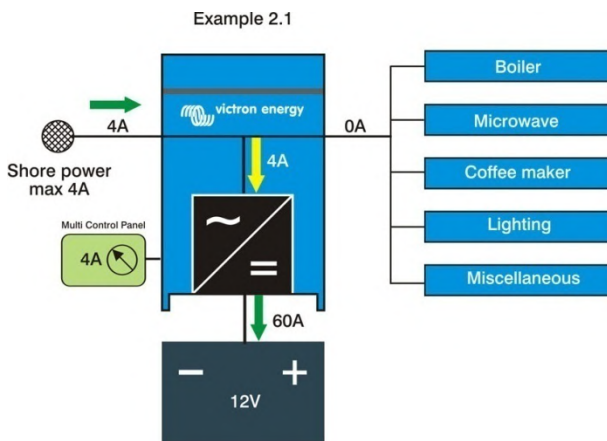
Example 2.1

Example 2.1

In this example all AC loads are off. With the Multi Control Panel set at 4 A the converter will not take more than 4 A, which limits the battery charge current to about 60 A.
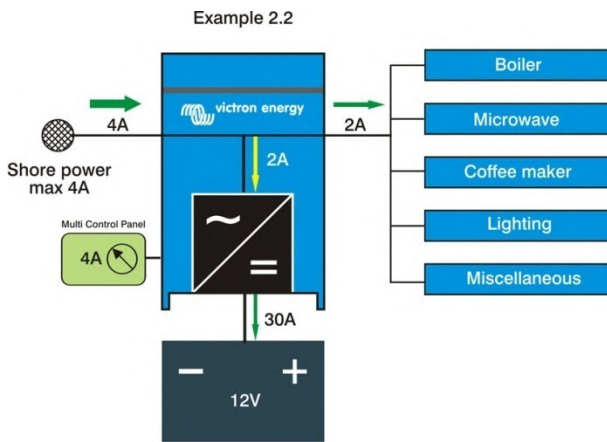
Example 2.2

Example 2.2

Now some small loads are switched on and the load increases to 2 A. Only 4 – 2 = 2 A is left to charge the batteries and the charge current is reduced to about. 30 A. Shore current is automatically limited to 4 A and the circuit breaker will not trip!

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Example 2.3
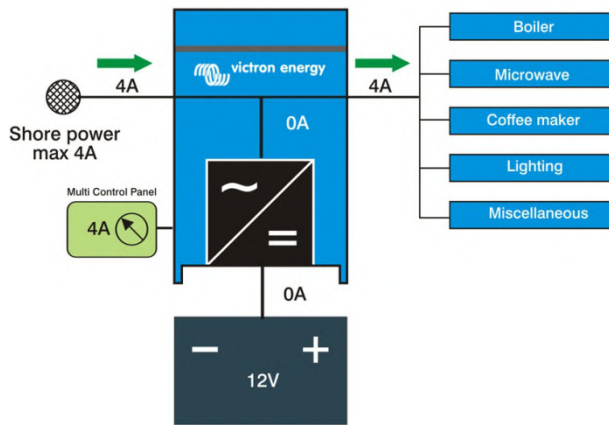
Example 2.3

Example 2.3

The coffee machine is switched on and current consumption increases to 4 A. Nothing is left to charge the batteries: the charge current is automatically reduced to 0. And again: the shore current circuit breaker does not trip!

Example 2.4
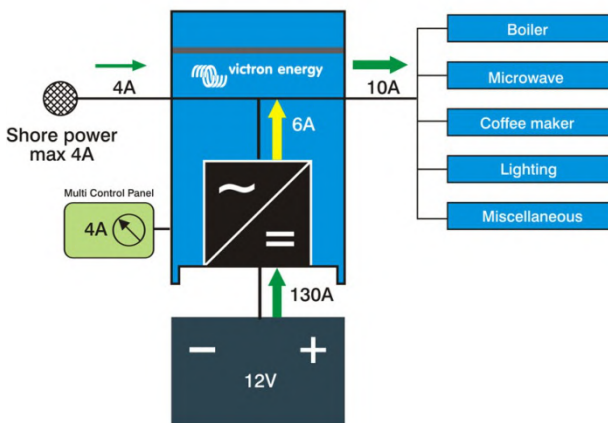
Example 2.4

Example 2.4

And now the impossible happens: the water heater switches on and the current increases to 10 A.
This is where PowerAssist (available on the MultiPlus only) is needed. The bidirectional converter starts operating as inverter to add 6 A to the 4 A that is available from the shore-side: total 6 + 4 = 10 A, and no overload on the AC supply!
As soon as the load reduces to less than 4 A any current that is left over will be used to recharge the battery.

Example 2.5
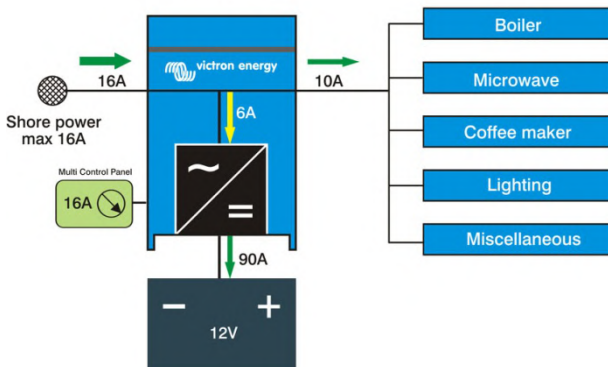
Example 2.5

Example 2.5

In this example a 16 A supply is assumed. On the Multi Control Panel the current limit can now be set at 16 A. The logic remains the same: with 16 A available and 10 A load, 6 – 10 = 6 A is left over, which results in a maximum charge current of 90 A.

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3. More power needed: parallel operation

With a washing machine on board (and possibly also a dishwasher, electric cooker, oven and air conditioning) the current needed will increase to much more than 16 A.
What to do?
One solution is a stronger AC power supply. But more than 16 A shore power is not always easy to find, and berths for mega yachts are expensive!

Why not installing a set of parallel Multi's as shown in the examples below?
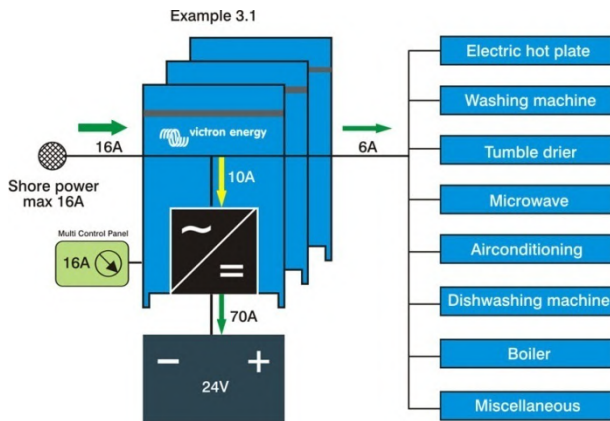
Example 3.1

Example 3.1

In this example 3 Multis 24/3000/70 are operating in parallel. The AC supply is rated at 16 A and therefore the Multi Control Panel is also set at 16 A.
When power demand is low (during the night for ex.) the batteries will be charged. With 6 A needed for different loads, 16 − 6 = 10 A is left over. Therefore the batteries will be charged at max. 70 A. This is much less than the maximum charge current of 3 x 70 = 210 A the 3 Multis are capable of, but then the shore side circuit breaker would trip immediately!
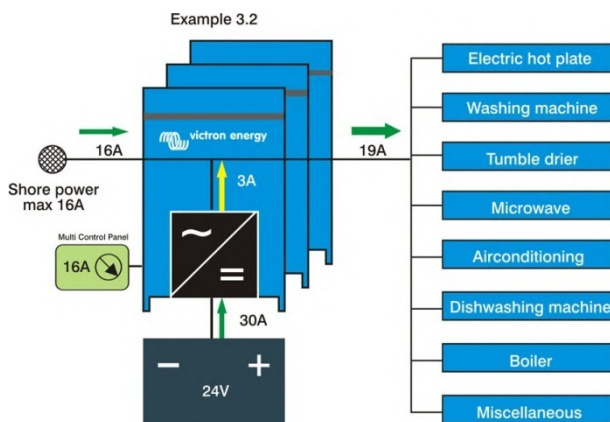
Example 3.2

Example 3.2

Turning on the washing machine (current 13 A) will, during a short period, increase the load to 6 + 13 = 19 A. PowerAssist is now needed to supply the missing 3 A. This is made possible by installing 1 MultiPlus (as Master) and 2 Multis (as Slave). The complete set of 3 units will then have PowerAssist functionality.
And again: the load is 19 A but the supply is only 16 !

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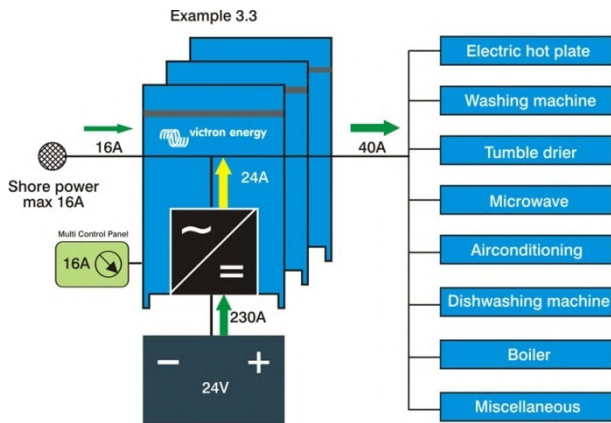
Example 3.3

Example 3.3

The power needed will increase dramatically as soon as more household equipment is switched on, or when the electric cooker is in use. The AC current will peak to 40 A or more. Now the Multis must supply an additional $40 - 16 = 24$ A to the AC source and the batteries will be discharged at a rate of some 230 A. It may be hard to believe but the total discharge of the batteries, measured in Ampere-hours (Ah), will nevertheless be limited. This is because a cooker or washing machine does need a lot of power during only a short period. Practice has shown that 16 A shore current is, on average, more than sufficient for big yachts and or luxury mobile homes. It is only when continuous power requirement increases (due for ex. to air conditioning) that a more powerful supply will be needed.
Please refer to our book "Electricity on Board" for detailed battery capacity calculations.

4. A DC genset on board

When no AC supply is available (no shore current, because the yacht is sailing) the Multis will operate as inverters and the DC genset will charge the batteries.
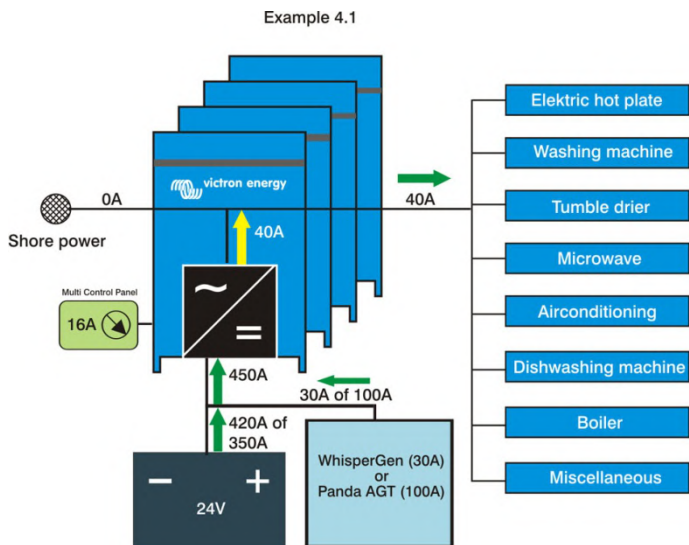
Example 4.1: maximum power required 7 kW, average load 700 W

If a lot of power is required for a short period only, a WhisperGen or a small Fischer Panda DC generator will easily supply the average load. Please refer to our book "Electricity on Board" for more examples

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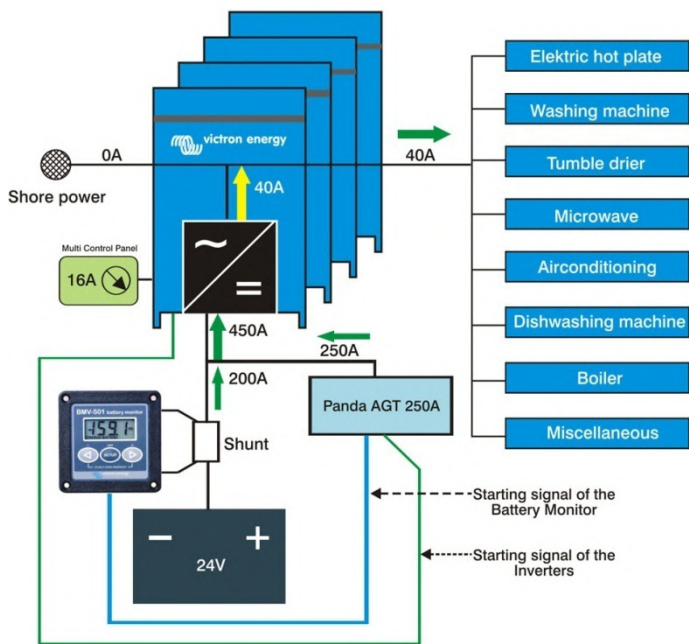
Example 4.2

Example 4.2: maximum power required 7 kW, average load 2 kW

Intensive use of air conditioning will raise power consumption beyond the capacity of the WhisperGen. A powerful DC generator will be needed to keep running hours and noise within acceptable limits.
The multifunctional relay of the Multi can be used to automatically start the generator in case of high power demand. In addition our BMV-501 battery monitor may be used to start the generator once the batteries have been discharged to a pre-set percentage.

A remark about 3 phase electric motors to drive pumps, a diving compressor or air conditioning:
Three phase motors of up to 3 kW can be connected to a single phase supply by adding a 3 phase motor drive with single phase input. The motor drive then takes care of 3 phase to 1 phase conversion and will also reduce start-up current.

Example 4.3
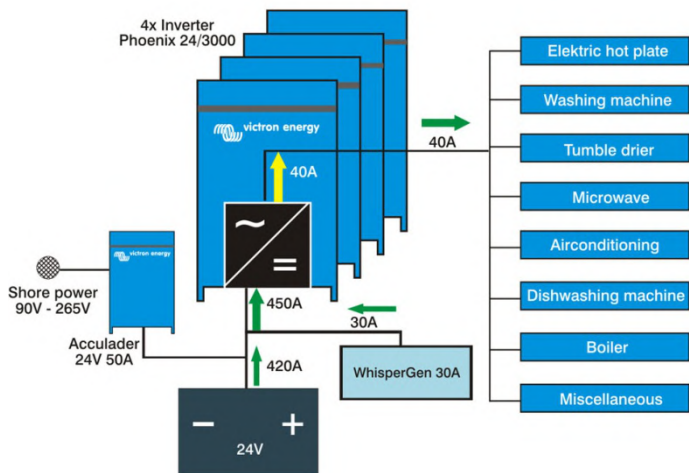
Example 4.3: An alternative solution, using inverters and battery chargers

The maximum AC supply current can also be controlled when only battery chargers are connected to it. All AC equipment should then be supplied by the inverters and the batteries are again used to absorb periods of high power demand.
Using battery chargers with universal 90 to 265 V input capability will make sure that a yacht can connect to any shore power supply anywhere in the world.

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5. How it works with an AC generator

PowerAssist can also be used to boost the output of an AC genset. Next to reducing size and weight of the genset this also has the following advantages:
- In most cases the harmonic distortion of the genset output will be reduced (this can be important for certain sensitive loads such as an induction cooker)
- Because the generator can be reduced in size the load in % of its rated power will increase. This will improve efficiency and increase service life.
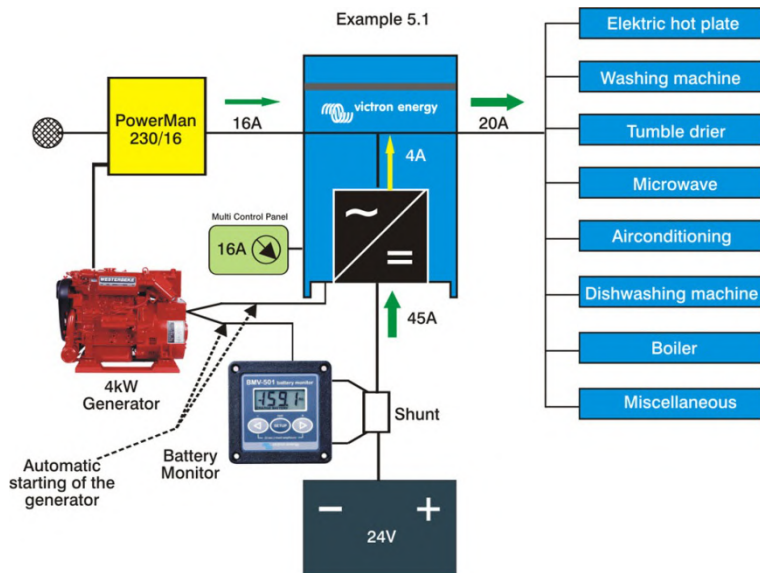
Example 5.1

Example 5.1: maximum power required 2.5 kW

A lot can be achieved with a simple and compact system. As long as either the shore supply is available or the generator is running, the system can supply up to 26 A of AC current, which amounts to 6 kW. (the shore or genset supplies up to 16 A, to which the Phoenix MultiPlus will add up to 10 A)
And the batteries will be recharged as soon the load reduces to less 16 A.

Important building blocks of the system:

a) PowerMan 230/16-0
An automatic 16 A transfer switch.

b) Battery Monitor BMV 501
The BMV 501 keeps track of the state of charge of the battery. The BMV 501 can be programmed to generate a generator start signal when the batteries have been discharged to a pre-set percentage. Together with the start signal from the Multi the generator will start both in case of a high power requirement and when the batteries have been discharged to a pre-set percentage.

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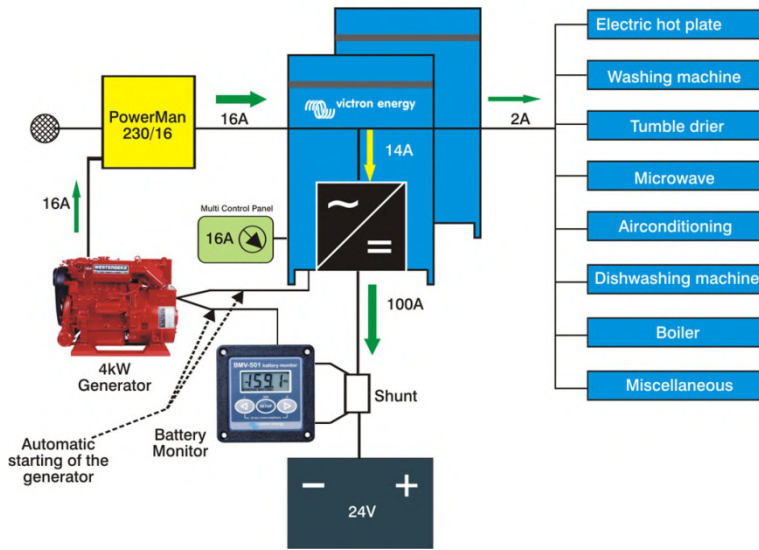
Example 5.2 a
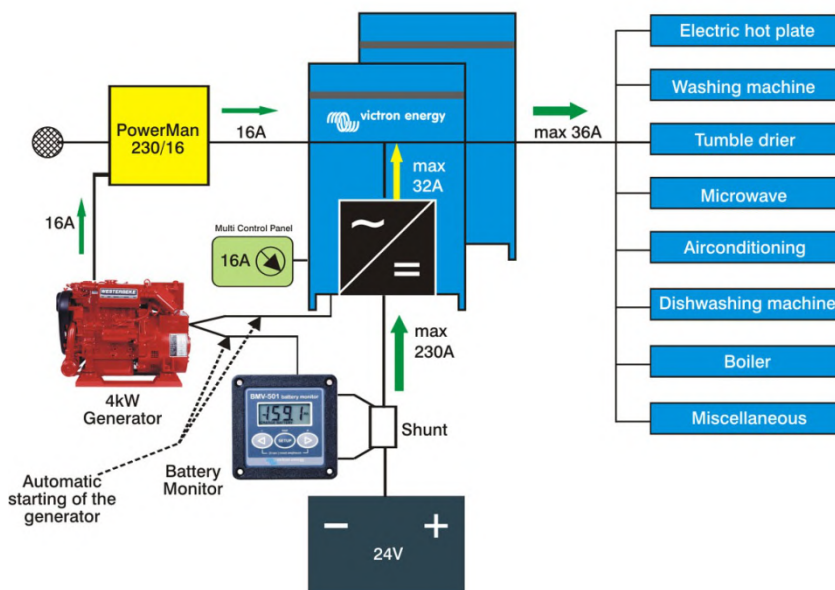
Example 5.2b

Example 5.2a and 5.2b: maximum power required 5 kW

A much more robust system is obtained by installing 2 Multis. The 2 Multis (of which 1 unit should be a MultiPlus to have PowerAssist functionality) can supply sufficient power even when several AC loads are switched on simultaneously. And once the generator is running the system will supply up to 16 + 2 x 10 = 36 A. Moreover the 2 Multis will easily absorb all available power from the generator when recharging the batteries, reducing running hours of the genset to the bare minimum.
Please note that a small 3000 rpm genset has limited service life and is in general not made to run at full load for long periods of time. (reduce output to 70 % of full load with the Multi Control Panel!). A 1500 rpm model is the better choice if intensive use is expected

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Example 5.3

Power Manager Control Panel

16A

RS485

Current limit
for generator (0 - 40A)

max 16A

Shore
power

PowerMan 230/40/2

40A

To
distribution box

max 40A

max 80A

RS485

max 40A

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8kW
Generator

max
350A

max
210A

Shunt

Automatic
starting of the
generator

Battery
Monitor

−   +

24V
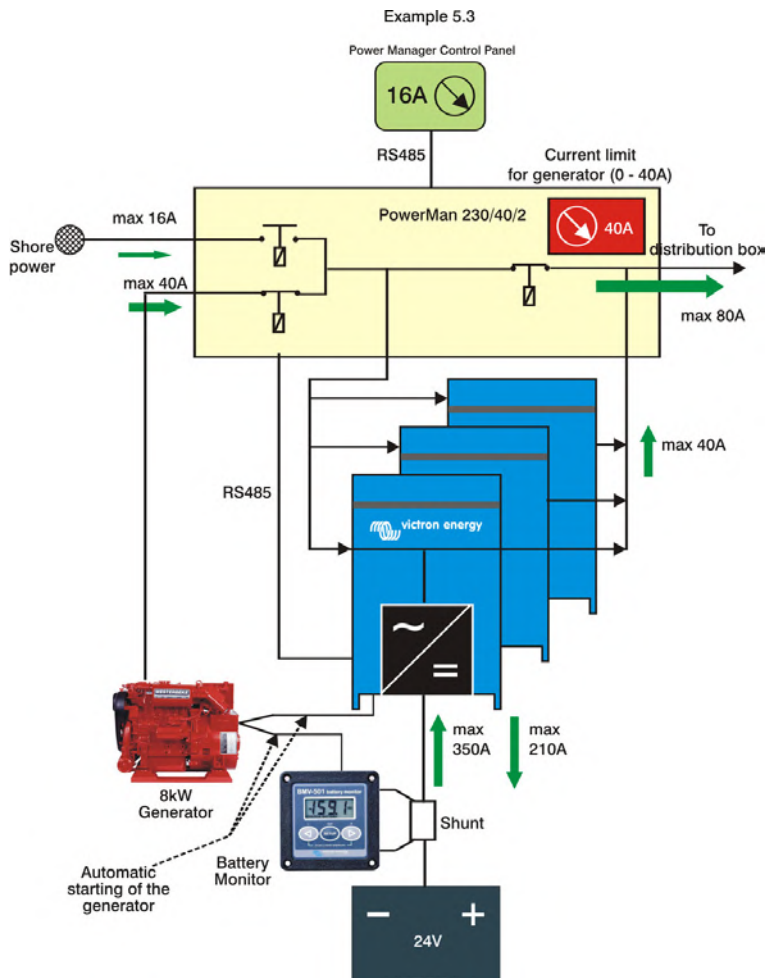
Example 5.3: maximum power required 7 kW, and average power 2 kW (intensive use of air conditioning)

It is now time to install a bigger genset, unless a substantial generator free period is not required.
In this example transfer switch model PowerMan 230/40-2 has been used. This transfer switch will accept up to 40 A of AC input current. The genset current limit can be set inside the cubicle (indicated in red in the schematic diagram above) and is independent from the shore current setting on the PowerMan Control Panel (indicated in green in the schematic diagram above). The PowerMan Control Panel is similar but not identical to the Multi Control Panel.
Up to 3 Multis can be connected directly to the PowerManager.

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Example 5.4

Power Manager Control Panel

16A or 32A

RS485

Optional:
for heavy equipment only
to be used if shore power
or generator power available

max 16A of 32A

Shore power

max 80A

PowerMan 230/80/2

Current limit for generator (0 - 80A)

45A

To distribution box

max 145A

RS485

max 65A

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max 625A   max 350A

12kW Generator

Automatic starting of the generator

Battery Monitor

Shunt

Shore power 16A

Battery Charger 100A

24V

Example 5.4: maximum power required 12 kW, and average power 4 kW (intensive use of air conditioning)

By connecting to 2 shore outlets of 16 A each, up to 32 A (7 kW) of shore current is available. The trick is to connect the AC system to one outlet, and a 100 A battery charger to the other. The transfer switch is a PowerMan 230/80-2, suitable for up to 80 A input.
Up to 6 Phoenix Multis can be connected to this Power Manager.

---

3 phase systems
Phoenix Multis and Phoenix inverters can also be configured for 3 phase operation. We will be pleased to make a proposal for a 3 phase system.

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AC-coupled PV with Fronius PV Inverters

This document describes how to setup Energy-storage, Off-grid/Micro-grid and Backup systems with AC-coupled PV, using Fronius PV Inverters. For Fronius information on the same subject, see their MicroGrid flyer.

The Victron system monitor, the Color Control GX includes built-in Fronius monitoring.
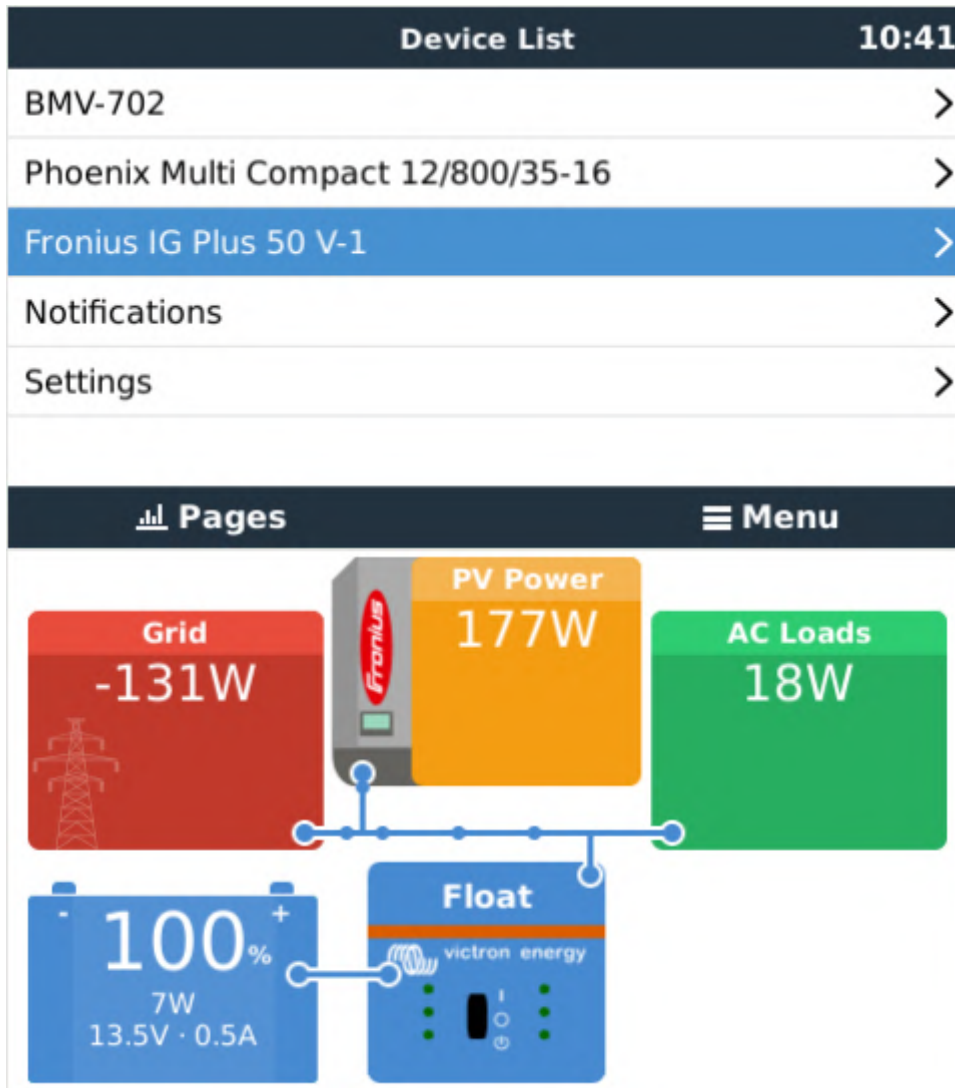
Frequency shifting

To make sure that the Fronius PV inverter works well with Victron inverter/chargers, both must be configured with the right 'frequency shift settings':

- The Fronius PV Inverter must be set to Setup MG, short for Micro-Grid.
- For off-grid systems, load the Multi or Quattro with the PV Inverter support Assistant
- For on-grid / energy-storage systems, load the Multi or Quattro with the ESS Assistant. Read information about ESS in the ESS Design & installation manual.

And the 1:1 limit rule must be adhered to.

Fronius / Victron specifics

This is a very easy setup. The Fronius Setup Microgrid has been developed in close cooperation with Victron. During commissioning, set the PV Inverter to Setup MG50 (or Setup MG60 for 60 Hz systems). Everything is then pre-configured. The Setup MG settings match the default Victron Assistant settings.

Compatible ROW inverters (for "European type AC grid") are:

- Fronius Primo (1~, 3 kW up to 8.2 kW) → Software *fro27140.upd* or higher (see FAQ Q5!)
- Fronius Symo (3~, 3 kW up to 20 kW) → Software *fro27140.upd* or higher (see FAQ Q5!)
- Fronius Eco (3~, 25 kW or 27 kW) → Software *fro27140.upd* or higher (see FAQ Q5!)
- Fronius Agilo (3~, 75 kW up to 100 kW) → Software *update19.tl* or higher
- Fronius IG Plus V (1~, 2~, 3~, 2.5 kW up to 12 kW) → from *IGF 5.0.66* on with settings according to the Victron recommendations

For new systems the Fronius Symo and Fronius Eco inverters are recommended for 3~ applications. The Fronius Primo inverters are recommended for 1~ applications. Please note that all these inverters are transformerless and therefore PV-Modules that require pole-grounding (on the Plus or Minus pole) cannot be connected.

The use of Fronius Galvo inverters is not recommended anymore for new applications - the Fronius Primo is the best substitute and offers higher efficiency, wider DC voltage range and two MPP trackers.

Compatible UL inverters (for "US type AC grid") are:

- Fronius Primo UL (1~, 3.8 kW up to 15 kW) → Software *fro27470.upd* or higher (see FAQ Q5!)
- Fronius Symo 10-24 480V (3~, 10 kW up to 24 kW) → Software *fro27140.upd* or higher (see FAQ Q5!)
- Fronius Symo 10-15 208-240V (3~, 10 up to 15 kW) → Software *fro27140.upd* or higher (see FAQ Q5!)

For the UL inverters, some more Microgrid Setups are available (e.g. for connection with Neutral conductor or without). Also the UL inverters can be used in 60Hz as well as in 50Hz applications. More information can be found in the user manuals.

When setting up a system, always update both the Fronius and the Victron devices to their latest firmware versions. For the latest Fronius firmware and information how to update use this link: Fronius firmware update

Setting up the Fronius with Setup MG50/MG60

When not pre-ordered with a MicroGrid setup, follow these steps:

1. Make sure that the Fronius PV inverter is updated to at least the firmware version mentioned above. See Inverter list above.
2. After making the inverter operational according to the manual, select the language and after this the country specific setup.
3. Here choose MG50 or MG60 depending on the system frequency.

4. Ready to start up.

Setting up the Victron Multi or Quattro

1. After connecting the MultiPlus or Quattro with the battery, you can now connect a computer through the VE.Bus (in combination with the Victron interface MK2USB) to configure the system with the latest version of the software VE.Configure.
2. Go to the tab Assistants:
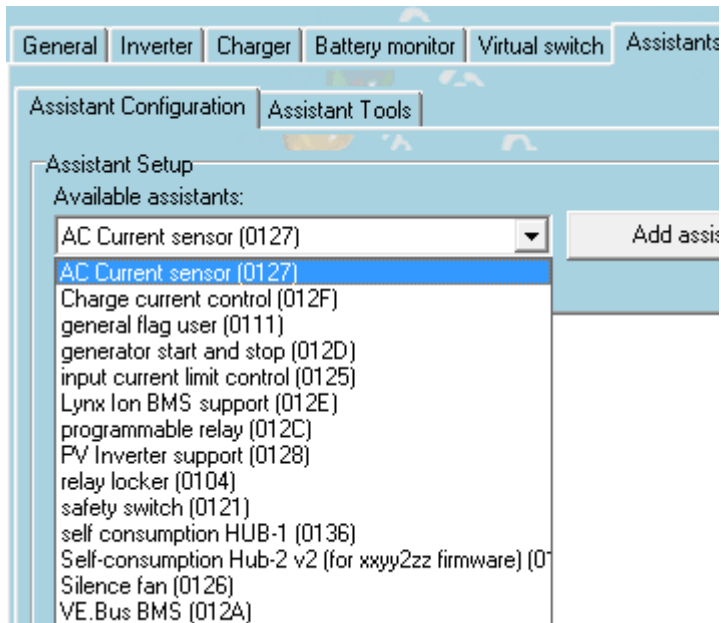
3. Add one of the Assistants that regulate output frequency:
   1. ESS Assistant
   2. PV Inverter support
4. Note that it is not necessary to change the default settings in the Assistant.
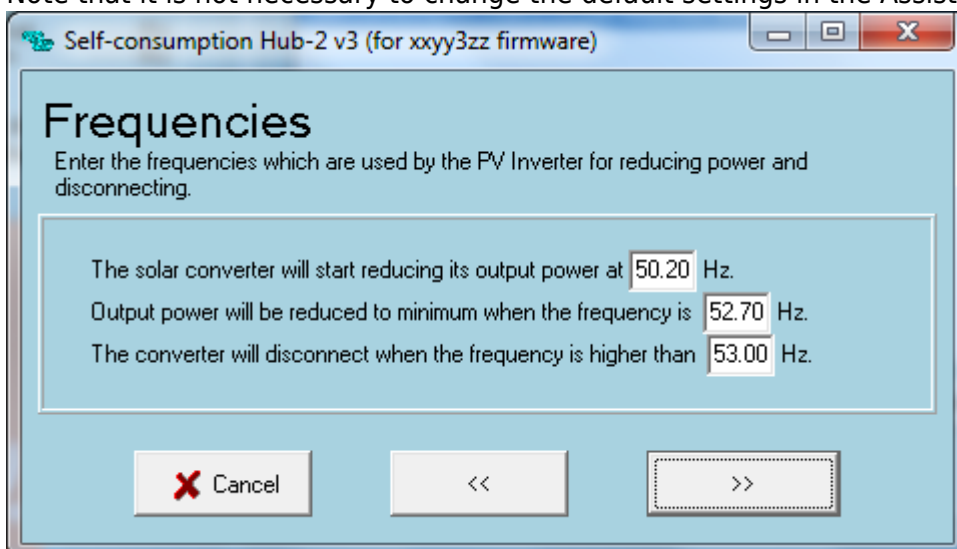
5. Complete the rest of the Assistant and write the new settings to the MultiPlus or Quattro.

Table for settings for 50Hz and 60Hz frequency

State	50Hz	60Hz	.
Start	51.0	60.2	Hz

Minimum	52.7	62.7	Hz
Disconnect	53.0	63.0	Hz

Remote system monitoring

The Victron system can be monitored through Victron VRM Portal if a Color Control GX is present at the site. The Fronius PV inverter data can be integrated into the Color Control GX and therefore also in the VRM portal. So the VRM portal is the recommended monitoring platform also for AC-coupled installations.

However, also Fronius offers an equivalent monitoring solution. The Fronius portal is called Fronius Solar.web. The PV system data can be transfered to the portal if the inverter is equipped with a Datamanager 1.0 or Datamanager 2.0.

The usage of both portals in parallel is possible.

A video instruction how to set up the Datamanager 2.0 + Solar.web can be found here.

Zero Feed-in

It is possible to make a Zero feed-in system with Victron & Fronius. The Venus device will the control the Fronius output power. See the ESS manual, chapter 4.3.11 Fronius Zero feed-in for details.

Frequently Asked Questions

Q1 Why doesn't the frequency settings in the Multi and the Fronius need to be the same?

The first two frequencies do not need to be the same since the Multi actively regulates.

Q2 I have an Fronius IG inverter (not Plus), can that work?

No, the IG inverters cannot be made to work in a MicroGrid system. The appropriate substitute for an IG 30 is the GALVO 2.5-1 or an IG Plus 25V-1 (depending on the desired DC voltage range).

Q3 The system is locked to 53 Hz and does not resume

Q4 Can I use the Fronius Smart Meter?

That depends on the type of system and software configuration.

A Fronius Smart Meter can be used in these two situations:

1. when used only for reporting to Solarweb
2. when used for limiting export, in a system where the Victron system is not configured as an ESS system.

The Fronius Smart-Meter can not be used for the Fronius built-in export limiting feature when part of a Victron ESS system. Instead, use the Victron ESS Fronius Zero-feed in feature, see chapter 4.3.11, Fronius Zero Feed-in, in the ESS manual.

Q5 How can I get the Fronius firmware that improves flickering?

Fronius has a special firmware available, on request, that fixes light flickering issues that occur on certain installations under certain circumstances.

For Fronius PV inverters produced after 2018-week 16, contain the flicker-fix already straight from production.

To update earlier and/or already installed PV Inverters, contact Fronius Tech Support for the file. The required file is fro29130.upd. Which works for all snap-inverter models (Primo, Symo and Eco). There is no, and will be no, fix available for Fronius Galvos.

AC-coupling and the Factor 1.0 rule

1. Introduction to the AC-Coupling concept

Already familiar with the concepts of AC-coupling and regulating PV inverter output power by frequency shifting? Skip to the requirements and limitations:

1. Factor 1.0 rule chapter
2. Minimum battery capacity chapter
3. Requirement of adding DC-Coupling (MPPT Solar Chargers)

1.1 What is AC-coupling?
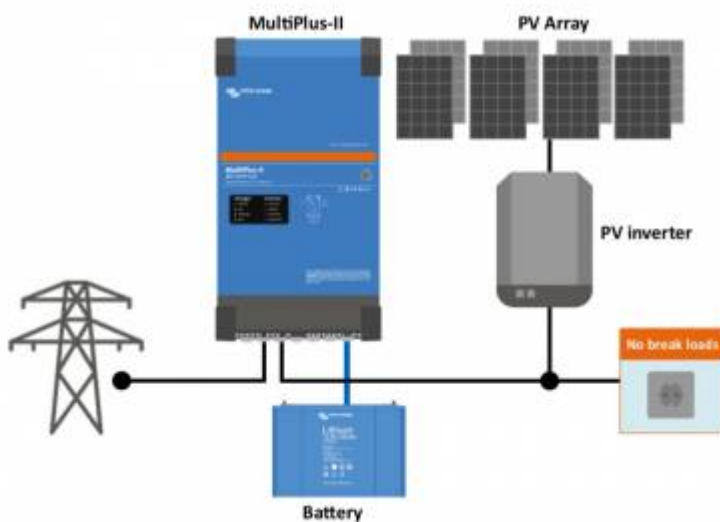
In an AC-coupled system, a grid-tied PV inverter is connected to the output of a Multi, Inverter or Quattro. PV power is first used to power the loads, then to charge the battery, and any excess PV power can be fed back to the grid.

When the Multi or Quattro is connected to the grid, this excess PV inverter power will automatically be fed back to the grid.

When the Multi or Quattro is operating in inverter-mode, disconnected from its AC input, it will create a local grid: a micro-grid. The PV Inverter will accept this micro-grid and will therefore operate even during a black-out. The PV power can even be used to charge the batteries: when there is more PV power available than used by the loads, the power will automatically run through the inverter in reverse direction and charge the batteries. It is necessary to regulate that power to prevent overcharging the batteries as well as overloading the inverter/charger. This is where 'frequency shifting' comes in to the picture, see next section.

Highlights:

- AC-coupling is available in single-phase, split-phase and also three-phase systems.
- Victron Multis and Quattros can prevent feeding back PV power to grid.

- Systems with only a grid-tied PV inverter will fail when there is a grid black-out. A micro-grid system will continue to operate, and even keep using solar power.
- It is also possible to run a AC-coupled micro-grid on a generator
- Most brands of PV inverters can be used for these systems, they need to be setup to support frequency shifting, often called the island-mode or micro-grid mode. For Fronius settings, see AC-coupled PV with Fronius PV Inverters.
- If power will be fed back into the grid an anti-islanding device may have to be added to the system, depending on local regulations.

1.2 What is frequency shifting?

Frequency shifting is used to regulate the output power of a Grid-tie PV Inverter, or Grid-tie Wind inverter, by changing the frequency of the AC. The MultiPlus (or Quattro) will automatically control the frequency to prevent over charging the battery. See also the chapter 'Example & background'.

For how to configure, see chapter 4.

2. The Factor 1.0 rule

The max PV power must be equal or less than the VA rating of the inverter/charger

2.1 Rule definition

In both grid-connected and off-grid systems with PV inverters installed on the output of a Multi, Inverter or Quattro, there is a maximum of PV power that can be installed. This limit is called the factor 1.0 rule: 3.000 VA Multi = 3.000 Wp installed solar power. So for a 8.000 VA Quattro the maximum is 8.000 Wp, for two paralleled 8000 VA Quattros the maximum is 16.000 Wp, etc.

2.2 Example and background

To understand the background, consider the following situation: the PV inverter is at full power, supplying a big load. The Multi is in inverter mode. Then, suddenly and at once, this load is switched off. At that moment the PV inverter will continue operating at full power until the AC frequency has been increased. Increasing this frequency will take a very short time, but during that time all power will be directed into the batteries as there is no other place for it to go. This causes the following:

- When batteries are (nearly) full, the battery voltage will spike, possibly causing the Multi to switch off in DC over-voltage alarm.
- The same spike will cause the AC output voltage of the Multi to spike, as these two are directly related, and when the spike on the battery voltage is high and fast enough, the Multi can never regulate its PWMs down fast enough to prevent the spike on AC. This spike can damage the PV inverter, the Multi and also any connected loads and other equipment.
- Another problem is that the Multi starts charge current protection.
- In the best case it might switch the grid inverter off immediately by setting the AC frequency to the disconnect frequency as configured in the assistant.

It is no problem to overpower the grid inverter by installing more solar panels. Some people do this to increase the generated solar power in winter time or rainy weather. Refer to the PV Inverter datasheet to maximum allowed installed PV power. Two times the inverter nameplate rating or even more is not uncommon!

2.3 Charge current limit

Another question frequently asked is how can this factor be 1.0? Since the charger inside a 3000 VA Multi is not 3000 VA but closer to 2000 VA? The explanation lies in the fact that it will regulate . In other words: when there is too much power coming in, causing the charge current to exceed the limit, it will increase the output frequency again and will keep regulating the AC output frequency to charge with the limit.

An example, a 3000 VA Multi, with 3000 W of solar power coming out of a PV inverter:

1. When the Multi is connected to the grid, all 3000 W can be fed back to the grid through the Multi, no problem.
2. In case the Multi is not connected to the grid, the 3000 Wp is more than the charger in a Multi 3000 VA can handle. The charger is around 2000 W. Therefore the grid inverter assistant will automatically increase the frequency to reduce the output of the grid inverter, to match maximum charge current.

2.4 Should you look at the total PV array, or the PV inverter rating?

The mentioned 3000 Wp and 8000 Wp is the Watt-peak which can be expected from the solar system. So for a oversized PV array, where the total Watt-peak installed PV panels exceeds the power of the PV Inverter, you take the Wp from the inverter. For example 7000 Wp of solar panels installed, with an 6000 Watt PV grid inverter, the figure to be used in the calculations is 6000 Wp.

And for an undersized PV array, where the total Wp of installed PV panels is less than the installed PV grid inverter, you use the Wp from the PV panels in your calculation.

3. Minimum battery capacity

Besides the relation between installed PV Power and the inverter/charger VA rating, it is also important to have a sufficiently sized battery. The minimum battery capacity depends on the type of battery, lead or lithium.

Note that, besides the minimum battery capacity, the mentioned sizes are often also the most economical battery size. In case used for self-consumption purposes that is. In case the goal is to increase autonomy, of course installing a large battery increases the system autonomy in case of a grid failure.

3.1 Lead batteries

1 kWp installed PV power requires approximately 5kWh of battery:

- 100 Ah accubank 48 Vdc
- 200 Ah accubank 24 Vdc
- 400 Ah accubank 12 Vdc

3.2 Lithium batteries

1,5 kWp installed PV power requires:

- 100 Ah accubank 48 Vdc
- 200 Ah accubank 24 Vdc
- 400 Ah accubank 12 Vdc

4 Requirement of adding DC-Coupling - MPPT Solar Chargers

Not required for Energy Storage Systems in Germany or other reliable grid situations.

Required for offgrid systems as well as backup systems that need to overcome extended grid failures.

Reason: recover from deadlock situation of AC-Coupling only situation.

5 Software configuration

Multis and Quattros with factory settings will not shift the AC output frequency to regulate charge current. When setting up an AC Coupled system, install either the ESS Assistant (for grid-connected systems) or the PV Inverter Support Assistant (for off-grid systems).

Other options, all deprecated, are:

1. Self-consumption Hub-2 v3 assistant
2. Hub-4 Assistant in combination with the PV Inverter support Assistant
3. Use the Inverter period time settings on the Virtual switch tab.

Monitoring

See section 1.5 in the GX manual.

Automatic Generator start/stop

1. Which relay and control to use?

Various Victron products have functions to automatically signal when to start and stop a generator. Here is advice on when to use which product and method.

Option 1: GX device like CCGX or Venus GX

When there is a GX device (CCGX, Venus GX, or other) in the system, the best option is to use its Generator Start Stop mechanism. Its the most feature-rich generator start/stop system that we have to offer. It provides for basic functions as starting and stopping on Battery State of Charge, Battery voltage as well as High load situations. And also has many advanced features, including automatic test runs and silent times.

Option 2: BMV Battery Monitor

The next most used option is a BMV-700 Battery Monitor or similar model. It can start the generator on low battery voltage and/or low battery state of charge. See the BMV-700 manual for configuration.

Option 3: Using the relay in the Multis or Quattros

The Multis, MultiPlus-IIs, Quattros, EasySolars and the rest of the VE.Bus family also have Generator start/stop feature with a relay. There are two different ways to configure them:

1. Generator Start/stop function of the Virtual Switch (recommended)
2. Generator start/stop Assistant (more advanced / complex)

Combining the options

Lastly, its of course also possible to combine above mentioned methods, by wiring the open contacts in parallel to each other, or in series, to the Generator.

2. How to wire generators with a three-wire interface

All above Victron products and devices have a single relay; which will close when the generator needs to starts; and then expect the generator to then keep running until the relay is opened again. Or the other way around.

When having a generator that requires a start pulse and a stop pulse, such as for example Cummins/Onan generators; additional wiring is required.

_____

To start such a genset, the open/close contact needs to be converted into a start and stop pulse. Below solution, using standard available timing relays, does exactly that: when the open/close contact closes it generates the start pulse, and when the open/close contact opens again it generates the stop pulse.

Note that this solution should only be used on gensets that have their OWN control panel monitoring and automatically stopping on loss of oil pressure and other sensors. In other words: do not wire this directly to the starter motor and fuel solenoid.
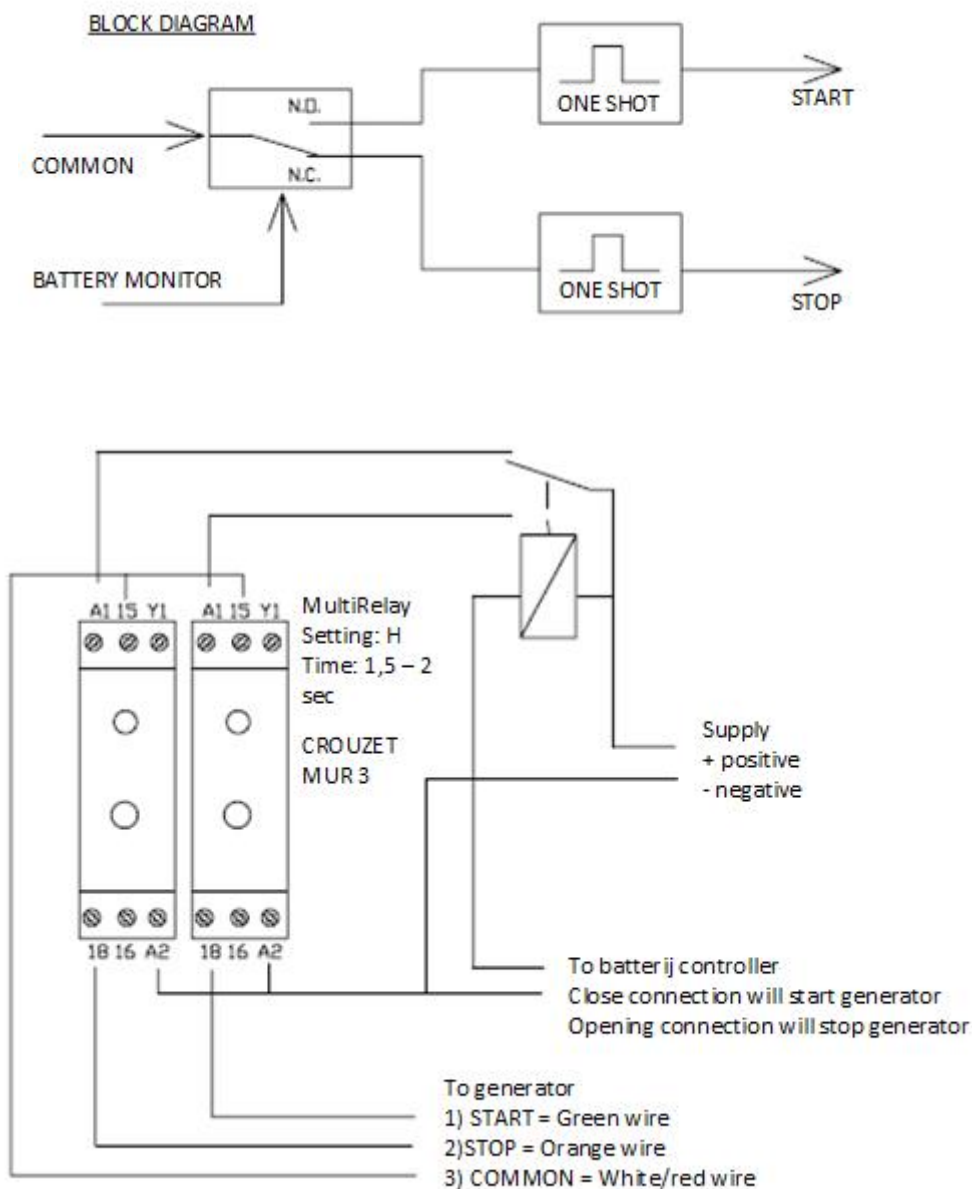
Alternative using Assistants

(provided by Thierry Cortasa)

hi

just for information, one solution using multiplus relay for start stop a three-wire generator. i use k1

_____

and k2 relais and relai programmable assistant

first to close k1 if voltage under 24v (for exemple) segond to open k1 if ac1 avalable third to close k2 if voltage uper 27v (for exemple) last to open k2 if ac1 not avalable

in this case you have a three-wire system with out any think more needed !

i have some systeme using this solution and all looks ok

NMEA 2000 & MFD integration guide

1. Introduction

This technical document explains how to integrate a Victron system onto a Marine MFD, such as those from Garmin, Raymarine Navico and other brands.

There are multiple ways to integrate, so make sure to closely read the complete introductory chapter to find the best method for your type of system.

Systems with a GX Device

For most installations and integrations, it will be best to use one of our GX Products. It acts as a hub, collecting information from connected equipment, such as Inverters, Battery Monitors and Chargers; and then making them available to the MFD.

A GX Device can be connected to a Marine MFD in two ways: the simple plug and play like method uses an Ethernet connection, which enables the MFD App. Available for Raymarine, Garmin, as well as the Navico brands B&G, Lowrance and Simrad. Click those links to go straight to all information, videos and manuals.

The other type of integration is to connect the GX Device to the NMEA2000 network. See the NMEA 2000 chapter in the CCGX manual for details.

Both connections can be made and used at the same time, and each has its advantages and disadvantages. The MFD App is by far the simplest method. It presents an easy to use system overview without requiring any configuration. The NMEA 2000 integration on the other hand, whilst being more complex, allows more customisation on the MFD: the data will show up in the data-tree of the MFD, and most MFDs then allow the user to configure various pages and combinations of information. This is not so with the MFD App, as the only available settings are to show or hide battery parameters (Voltage, SOC, Current) as well as naming the batteries.

Note that, besides making information available on NMEA 2000, a GX Device can also tank level data from NMEA 2000. More information in the NMEA 2000 tank sender section in the CCGX Manual.

Direct connection - products with a VE.Can port only

Some of our products feature a VE.Can port; and can thus be directly connected to the NMEA 2000 network. No electronic converter necessary; only a plug conversion cable, the VE.Can to NMEA2000 cable.

Using our converter interfaces (DEPRECATED!)

- VE.Bus to NMEA 2000 interface
- VE.Direct to NMEA 2000 interface, for BMV Battery Monitors (only).

Note that the use of both those interfaces is deprecated. Use a GX Device instead.

What is NMEA 2000?

NMEA 2000 is is a plug-and-play communications standard used for connecting marine sensors and display units within ships and boats.

Victron Energy is a member of the NMEA 2000 organisation, and we have several of our products certified by NMEA 2000.

For brevity, this document will refer to NMEA 2000 as N2K.

Modbus-TCP Integration

For larger vessels, using custom designed SCADA systems, the recommended protocol to use is ModbusTCP. See our GX ModbusTCP Manual.

2. Varia

2.1 VE.Can products (Skylla-i, Skylla-IP44, Lynx Shunt, Lynx Ion+Shunt and more)

Since the Victron VE.Can communication protocol is based on N2K, the following products can all be connected directly to a N2K network. The only thing necessary is a plug converter: the VE.Can to NMEA 2000 cable.

- Skylla-i 24V Battery Chargers
- Skylla IP44 Battery Chargers
- Lynx Shunt Battery Monitors
- Lynx Ion + Shunt all models
- SmartSolar MPPT Solar Chargers with VE.Can communications port
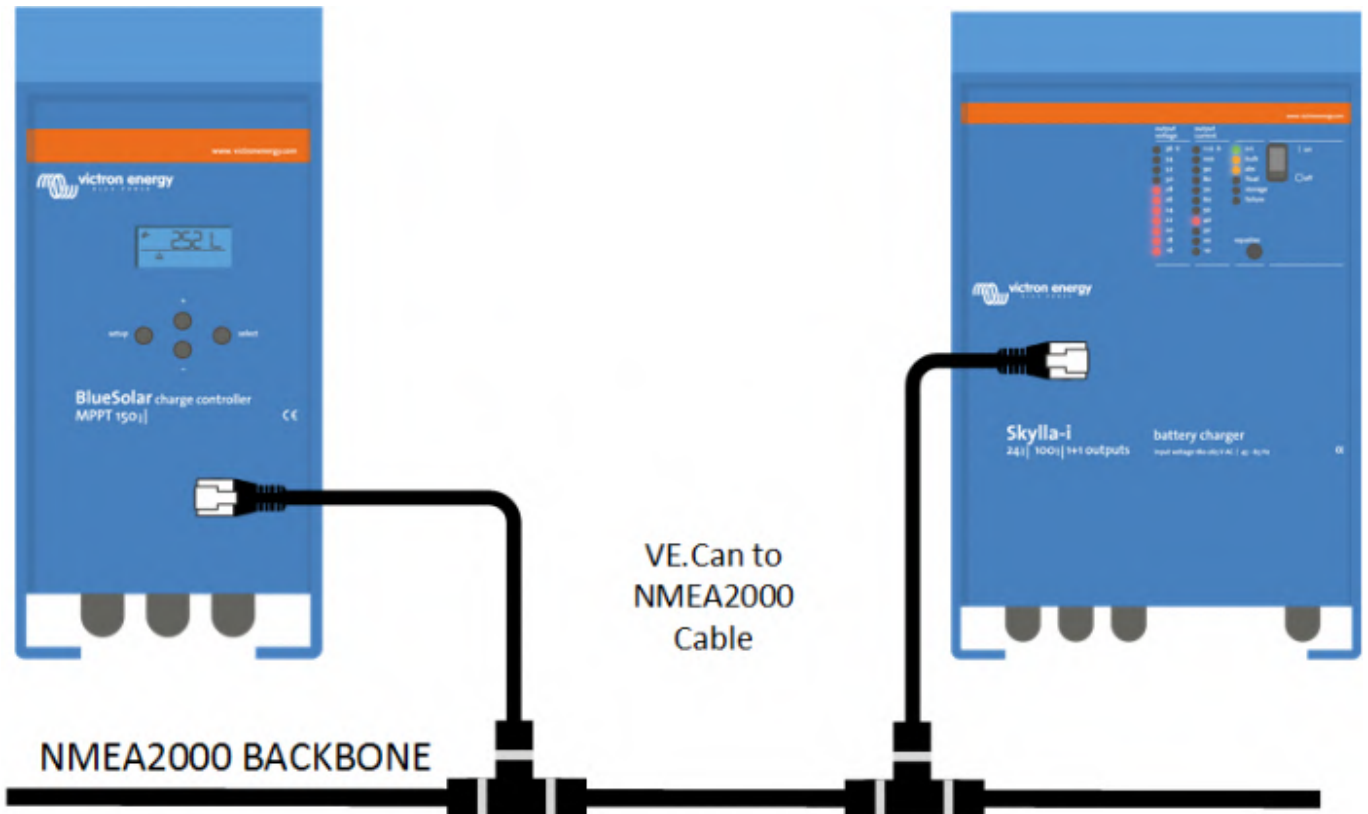
2.1 Raymarine & EmpirBus

Besides using NMEA 2000 and/or the Lighthouse App, integration onto Raymarine MFDs can also be done with an Empirbus NXT MCU . Though both are connected to the same N2K network, the NXT MCU translates the N2K PGNs originating from the Victron equipment into Raymarine proprietary messages.

In the EmpirBus Studio software you will find dedicated Victron building blocks than can be drawn onto the diagram.

Next, use the EmpirBus Graphical tool to design the pages for on the Raymarine MFDs.

The EmpirBus system requires the data instance of battery status and dc detailed status to be unique when using multiple sources. (how to change data instances)
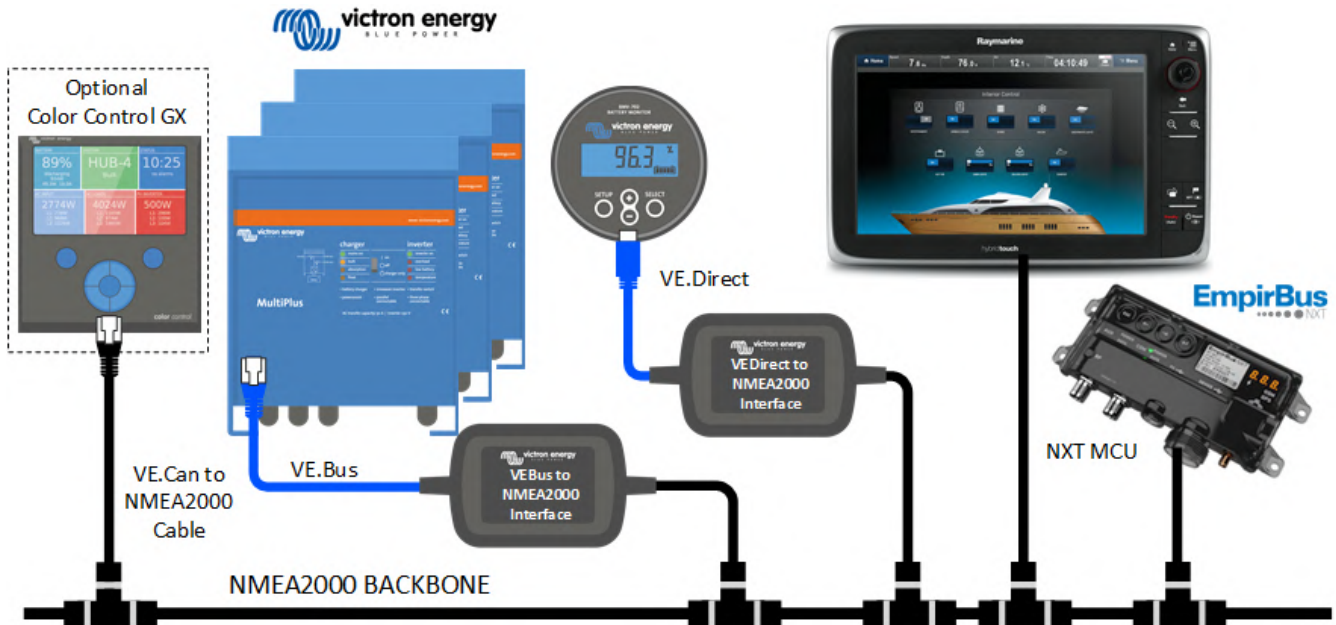
2.2 Maretron

All data sent out by Victron devices can be picked up by the Maretron MFDs & software. See the Maretron N2KView® vessel monitoring and control software.

3. PGN overview

Refer to our Datacommunication whitepaper, page 8 and beyond, for a list of Victron products and their supported PGNs.

4. FAQ

Note that there are many more generic frequently asked questions answered in the Data communication white paper.

Q1: What about instances? Device instances, data instances?

See Changing NMEA2000 instances for details on that.

Q2: Can MPPT Solar Chargers with a VE.Direct port also be connected?

No, they cannot be connected. Even though the VE.Direct to NMEA 2000 interface can be physically connected to these solar chargers, it will not work. Use our Solar Chargers with a VE.Can port instead.

Similarly, also a GX Device does not (yet) transmit data from connected Solar Chargers on its NMEA2000-out port.

Q3: What about terminators and network layout?

A N2K CAN bus network needs to be laid out as in a backbone configuration, using drop cables to connect to each device. Also, there should be only two terminators in the network. Therefore:

- Use the NMEA 2000 cable as the backbone.
- Run a separate drop cable separately to each Victron device. The drop cable will be one of these three products:
  - VE.Bus to NMEA 2000 interface
  - VE.Direct to NMEA 2000 interface
  - VE.Can to NMEA 2000 cable
- Only terminate the NMEA 2000 backbone, do not terminate on the VE.Can side.

Q4: What PGNs does a GX Device transmit on N2K?

See the NMEA 2000 chapter in the CCGX manual for details.

Q5: Can integration onto Raymarine displays also be done without Empirbus NXT?

Yes, see the Raymarine integration page on our website.

Q6: What about Maretron and other brand tank sensors on the Ccgx?

See chapter 1.4.7 in the Color Control GX manual.

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. Also, apply the same torque on all connections.

With regards to AC fusing, each unit needs to be fused individually. Both on its AC-out and AC-in. Multiple circuit breakers which are mechanically connected together is OK: that is also one fuse. Make sure to use the same type of fuse on each unit due to same resistance.

With regards to DC fusing, each unit needs to be fused individually. Make sure to use the same type of fuse on each unit due to same resistance.

For both AC and DC fusing and protection, consult the product manual for details and recommended ratings.

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
  (the effective input current limit is the setted limit multiplied by the number of units per phase. For example, setting a 10A limit with VEConfigure in a system with two units per phase results on a 20A limit for that phase. Being able to set a different limit per phase allows for maximum configurability.

  Setting an input current limit works differently when setting the AC input current limit on a remote control panel, for example a DMC or GX device. Then (a) only one value can be set by the user, not one per phase, and (b) the configured limit will be used as the limit per phase. The difference is due to the different use case of both ways of setting it: settings in VEConfigure are supposed to be fixed in the install and done be the installer, for example matching an installed generator. And the input current limit as set on the GX device is intended to be set by the end-user, for example on a yacht or in a motor home, and being able to set it depending on the actual shore connection - and ofcourse without having to do the maths of multiplying with the number of installed units on a phase.)
- 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.

Charger settings (voltage and current limits) are overridden if DVCC is configured and if a CANBus BMS is active in the system.

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

Assistants can be used to expand the potential configuration options of your system, and are required

in some installation types. When using assistants with multiple units, some assistants are required to be loaded onto all units in the system individually, and some assistants are able to be just loaded onto some or one of the units.

- If you are using a self-consumption assistant, such as ESS, Hub-1 to Hub-4, the assistant will need to be loaded into each unit in the system individually.
- 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.

VE.Bus Error Codes

General

During first installation, and in case of problems, update all devices to the latest firmware. This includes the latest VE.Bus firmware and also the latest firmware in the GX device.

Firmware update instructions:

1. for VE.Bus products
2. for Color Control GX

To restart a system, first switch all units off, one by one. And then switch all units on again. Do this with the On / Off / Charger-only rocker-switch on the front of the device.

WARNING: The steps and instructions explained here, are intended to be carried to be carried out by trained professionals. AC (and also DC) Voltages can be lethal. And certain settings and firmware updates require experience and training as well.

Network cable quality

Make sure to use industrially made network cabling. Using self crimped RJ45 cables is a known cause of various of below list of errors.

This applies to network cables for split-, three phase and parallel systems as well as connecting a GX Device or other accessory on the VE.Bus network.

VE.Bus Error Codes

Error 1 - Device is switched off because one of the other phases in the system has switched off

One of the phases in a multi-phase system has failed. Commonly because of a Low battery, Overload or High temperature alarm. When this happens, the other phases will show VE.Bus Error Code 1.

Trouble shooting: Look for the failing phase, which will be the phase that is not showing VE.Bus Error Code 1. And check the LEDs on that phase to find out what the reason was for the shut down.

Diagnosing on VRM First make sure that Automatic alarm monitoring is enabled; that is necessary to create the Overload and Temperature errors in the log. You will see Overload and Temperature alarms occurring at the same time as VE.Bus Error 1.

Note for split- and three-phase systems: VRM, nor the CCGX, will indicate on which phase the overload or the temperature alarm occured. To find out on which unit the error occurs, go to system after it has switched off. And look on the LEDs. The unit with the overload or temperature alarm, will have the

corresponding alarm LED lit continuously. The other units will indicate a VE.Bus error, indicating that they miss one unit.

Error 2 - New and old types MK2 are mixed in the system

This should never happen, contact Victron service.

Error 3 - Not all, or more than, the expected devices were found in the system

Possible causes and solutions:

1. This error often follows VE.Bus Error 1. Solution: solve the cause for VE.Bus Error 1. Note that when using an older CCGX (version before v1.40), it can be that the first error is not reported on the Alarm log on VRM. So even when it only lists VE.Bus Error 3, it can very well be that that error was preceeded by VE.Bus Error 1.
2. The system is not properly configured: all VE.Bus devices connected to the VE.Bus network must be configured as one parallel, split- and/or three-phase system. Do not connect two separate VE.Bus systems together.
3. Communication cable error: Check the communication cables. Make sure to use commercial patch leads and not hand-crimped cables - VE.Bus cabling is very sensitive to physical wiring faults.
4. DC fuse blown of one or more units in the system: When mains is available all units seems to work correctly, but as soon as mains fails, or as soon as the system decides to switch to Island mode for any other reason, the non powered units are disconnected from the system.

Error 4 - No other device found

The master device is configured to run in a parallel-, split- and/or three-phase system, but cannot find other devices on the bus.

Multiple possible causes:

1. During a system restart

Error 4 can be seen temporarily while the system restarts after an error. Not a real error in that case, no need to investigate.

2. Because of issues in cabling

Faulty cables. Check the communication cables. Don't use self made cables.

Error 5 - Overvoltage on AC out

This problem can occur when the AC wiring of one of the slave units is not connected properly, or not connected at all.

Check the AC wiring.

Error 6 - Error in DDC Program

This means: error in an Assistant. To solve, follow these steps:

1. update VE.Bus firmware in all devices to the latest firmware.
2. download the latest VEConfigure and make sure it has downloaded all the latest Assistants.
3. re-configure the system

Error 7 - VE.Bus BMS detected, but not configured

A VE.Bus BMS device is connected but there is no Assistant loaded which handles the VE.Bus BMS.

Solution: configure the use of the VE.Bus BMS in one of the Assistants.

Error 8 - Ground relay test failed

Indicates a failed automatic Ground relay self-test on the MultiPlus-II or EasySolar-II relays.

See Error 11 for details & instructions.

Error 10 - System time synchronisation problem

This typically happens during a system restart, and is then not a real error; no need to investigate.

For example this screenshot from the Color Control GX:
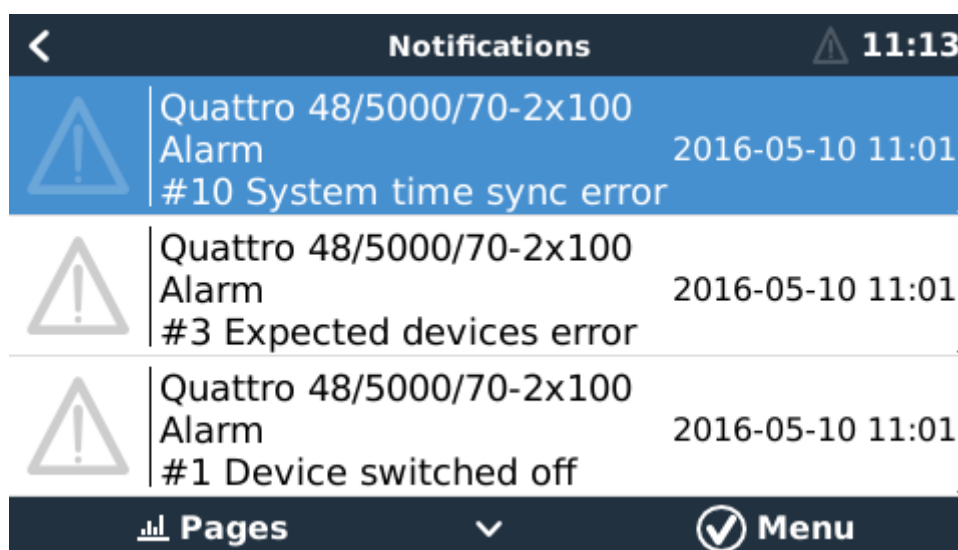
The real problem is Error 1. In this example it was caused by switching device L2 off with the front toggle switch. It was then quickly followed by Error 3. And when switching device L2 back on, briefly Error 10 is visible, followed by full recovery.

Note: System restarts can also be triggered when using Remote VEConfigure.

Other possibility: DC fuse blown of one or more units in the system. When mains is available all units seems to work correctly, but as soon as mains fails, the non powered units are disconnected from the system.

Error 11 - Relay Test Fault - Installation error or possibly relay failure

Error 11 indicates a failed automatic self-test of the MultiPlus-II or EasySolar-II relays. It is often a result of an installation or wiring issue, though it can also be triggered by a hardware failure (eg inoperable relays).

If a grid code is selected in VEConfigure, then the backfeed relays are tested every time before connecting to the mains.

Ground relays are also tested and can trigger an Error 11. During inverter operation, disconnected from mains, the relay is continuously tested to be closed. And it is tested to open properly during switchover to mains. The ground relay tests are always performed: with or without a configured grid code. Unless the relay is disabled in VEConfigure. See product manual for more information regarding the ground relay.

Steps to take:

Step 1: Make sure that the units have been updated to the latest firmware version. There have been various VE.Bus error 11 related improvements in the firmware. This may correct the error, and if it does not, it will provide additional information to assist troubleshooting.

Step 2: Verify that system is properly wired to your installation and your local codes. Remember to check the earth connection on the unit AC input. Earth should be grounded according to your local grid rules. Do not connect Earth to Neutral in the unit itself. This will create a safety hazard and may prevent RCD devices from working. Contact another licensed electrician if in doubt.

Step 3: Disconnect the L and N wiring from the ACout terminals on each inverter/charger. Which, in case of a parallel or three phase system, isolates the ACout connections for each unit. If the system then starts normally there might be a problem with a connected load (e.g. a leakage between load, neutral and ground).

Step 4: Check your Neutral-out connection. In most cases there should be no external connection between ACin-Neutral to ACout-Neutral, or to Earth.

In Australia, it is possible if required to install with a connection between Neutral-in and Neutral-out using AS4777.2:2015. Select either design configuration in the grid code section while programming the MultiPlus-II with firmware 466 and above.
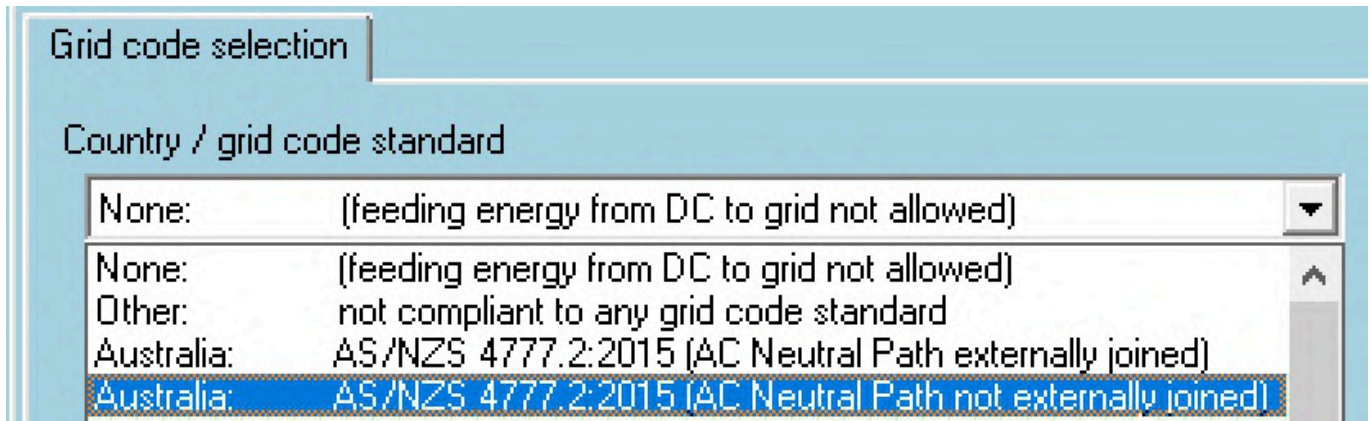
After configuration, always confirm that the system is safe with routine electrical safety checks in both modes (eg test RCD operation with AC input connected and disconnected).

Step 5: Neutral and line input might be inverted. Check the input connections, swap them if needed and retry. In this case, "Failing step: 8" will show.

Detailed diagnosis of Error 11

After updating your VE.Bus inverter/charger to firmware 454 or higher; and running Venus OS v2.23 or later, a detailed VE.Bus Error 11 report is available in the GX device menu, under MultiPlus → Alarm Status → VE.Bus Error 11 report.

Examples of information in the GX Device menus:

The information shown is:

- A six digit number; which contains all the details
- An error ID (#16 for example). Note that this does not count the the number of VE.Bus errors; its just a unique ID that can help recognizing that a new error has occured.
- Flags
- The failed step; it counts backwards: step 9 → 8 → 7 and so forth.

Common causes:

- Failing step #8: check that line and neutral have not been swapped. Unlike non-grid code installations; line and neutral need to be wired correctly.
- PE2 closed error or GND Relay Error: check that AC-out Neutral is not wired to ground, or AC-in Neutral + ground. Short circuiting them is not allowed without specific firmware and grid code. Also, check that there is no leakage between Neutral and ground, for example because broken consumer. Start by disconnecting all loads: open all the circuit breakers. Then test to confirm there is no continuity between ACin-Neutral and ACout-Neutral.
- AC0/AC1 mismatch and UMains error: this is fixed in VE.Bus inverter/charger firmware version 455.

Other shown error details, listed below, are not related to any known installation issue and can be caused by a faulty unit or configuration issue. In any case, also when one of below errors shows, to go through all the above steps for any error 11 issue.

- Failing steps #2-7.
- AC0 /AC1 mismatch.
- Communication error.
- UMains mismatch.
- Period Time mismatch.
- Drive of BF relay mismatch.
- PE2 open error.

Unable to solve?

When the error persists after the all above steps, or when any other Failed step or extra explanation

shows, then the unit may be faulty. Follow the support procedure and contact your dealer. Make sure to document full system wiring in a diagram, all steps and tests taken to diagnose and rule out installation error, and provide a photo of the error details shown on the GX Device menu.

Error 12 - Config mismatch with 2nd mcu

Some Multi models (e.g. MultiPlus-II) have two microcontrollers.

Certain configuration settings, as done with VEConfigure, have to be stored in both microcontrollers.

In very rare situations it can happen that the stored configurations do not match and that the mismatch cannot be handled automatically. In this case error E12 will be generated.

To solve this error, connect the device to VEConfigure 3, verify/correct the settings and press 'Send Settings'.

Make sure to select the option 'all settings' instead of 'modified settings'.

Error 14 - Device cannot transmit data

Most probably a short circuit in the communication cables.

Another possibility, very rare though, is a broken component on the board. Return the device to the nearest service point for repair.

Error 16 - VE.Bus dongle is missing

Update firmware to latest version: VE.Bus dongles are no longer necessary.

Error 17 - Phase master missing

Error 17 shows on slaves (only). The slaves in a system will report this error when the communication with the phase-master has timed out.

This error can only occur on systems with multiple devices installed per phase. For example a single phase installation with two or more devices in parallel, or a three-phase installation with six or more devices.

Steps to take:

1. In some cases this error can be seen temporarily while using Remote VEConfigure to write a new configuration.
   Solution: ignore the error; the system will recover by itself.
2. The most likely cause is a cable-related communication issue on the VE.Bus network:
   Solution: First check the network cables sockets. If that doesn't solve it, replace all network cables, including the cable to the GX Device. Make sure to also inspect the female RJ-45

sockets, instead of only the cabling: sometimes badly mounted RJ45 cable connectors prevent the spring-contacts in the female RJ45 connectors on the Multis to properly make contact. Make sure to machine-made cabling. Do not use self-crimped cables.

3. DC fuse blown. In this case, all units can in some situations seem fine and work well as long as mains is available. And then when there is no longer AC available on the input (mains fails or generator is stopped) the non powered units are disconnected from the system.
   Solution: Check the fuse in all units; replace the broken one.
4. Update firmware and Assistants of the inverter/chargers. And of the GX Device.
   Solution: Update the Inverter/charger firmware - Update the Assistants - Update the GX Device firmware.

Systems with multiple slaves per phase

Error 17 can show on one or more slaves in a phase (visible by looking at the LEDs, not on VRM or GX Device). If the slaves can still communicate with each other; then the error will only show on one slave: all slaves that can see on the network that another slave is already showing Error 17 will not show the error as well.

Unable to solve it?

If after all above steps you are still experiencing a VE.Bus Error 17, contact your dealer whom will contact Victron repairs; please provide photos of the installation and network cabling. Depending on the situation, they might advice to replace the GX device and the inverter/chargers. We advise to first replace cables, and if that doesn't help then thereafter only the GX device at first, since that is less work than replacing the inverter/chargers.

Error 18 - AC Over-voltage on the output of a slave while switched off

Solution: check if AC wires are not swapped by accident. There can never be voltage on the AC out when a unit is switched off.

Error 22 - This device cannot function as a slave

This device is an obsolete and unsuitable model. It should be replaced.

Error 24 - Switch-over system protection initiated

This error indicates that one or more units report feeding back a significant current through its back-feed relay, while those relay are supposed to be open, and -obviously- no current can flow through an open circuit.

What is the back-feed relay? It is the relay that closes when connecting to the grid or generator. And which opens when there is no power available, ie when the system is in island- or invert-mode.

Error 24 is raised when a Multi or Quattro detects current flowing through the back-feed relay during a

period when the relay should be open. This can mean one of two things:

1. The relay did not open.
2. The related current measurement circuit is faulty.

Error 24 is a very rare error. Possible causes in order of probability:

- There is too much AC load connected at the moment the relay needs to switch off. This large current will prevent the relay contacts from opening.
  Solution: remove excessive load. See transfer switch capacity in the datasheet for the maximum rating.
- The AC input voltage slowly drops before it is being rejected by the Multis. Typically happens in installations with a generator. Especially when combined with AC loads that increase their current draw when the AC voltage drops: by the time that the inverter/charger initiates the disconnect, the current through the relays has increased well beyond the ratings, and is too high to open them.
  Solution: Make the Multis or Quattros disconnect earlier: increase lower limit of AC input voltage in VEConfigure3. For example to 210 VAC. The factory setting is 180 VAC.
- The back-feed relay has a hardware failure
  Solution: Replace faulty unit.
- The related current measurement circuit is faulty.
  Solution: Replace faulty unit.

Diagnosing a parallel, multi or split-phase system?

Error 24 will always appear on all units at the same time. There is unfortunately no indication, not on LEDs, nor on a GX device, VRM, or any other manner, to see which of the devices caused the error. Below procedures outlines how to manually determine which unit has a faulty relay.

Do make sure to first, always double check option 1 and 2 in above list. Those are the common causes. In case that doesn't lead to a solution, follow this procedure to find out if its a relay issue, and then which unit.

Execute this procedure right after the error occurred; do not first reset the system.

Step 1

Start with making a video of all units and their LED code. Do not first reset the system; and do not reset it after making the video either.

Step 2

Completely disconnect all AC wiring, both in- and out, on all units. Make pictures of the terminals; to make sure when discussing this with an engineer; there is no misunderstanding on what has been meant by this instruction.

Step 3 Now, with an ohm-meter, measure the resistance between the neutral terminals on AC-input and the AC-output, A working unit will show no connection between these terminals. And also measure the resistance between the Line terminals of AC-input and AC-output.

A faulty unit will measure zero or close to zero resistance.

Good units will measure discontinuity between the Line in and out terminals. And measure a few

hundred ohms between the neutral In and Out AC terminals.

Error 25 - Firmware incompatibility

Make sure to use the same firmware in all devices.

Error 26 - Internal error

Should not occur. Switch all equipment off, and then on again; it will then resume operation. Contact Victron Energy if the problem persists.

VictronConnect - VE.Bus Configuration guide

1. # Warning

:⚠:

The features described in this document are powerful tools. They are intended for use by Victron-trained Engineers, Installers and Dealers. Its usage must not be attempted by system Owners and Users.

Configuring our Inverter/chargers, such as Multis and Quattros, requires both training and experience.

Victron offers no direct support for un-trained individuals carrying-out configuration.

Settings are protected by a password. This password is provided with Victron training. Please contact your Victron Distributor for further information.

2. # Introduction

The information available here applies to all Inverters and Inverter/chargers that have a VE.Bus communication port:

- MultiPlus (including Compact)
- MultiPlus-II
- MultiPlus-II GX
- MultiGrid
- Quattros
- EasySolar
- EasySolar-II
- EasySolar-II GX
- Phoenix Inverters with a VE.Bus port
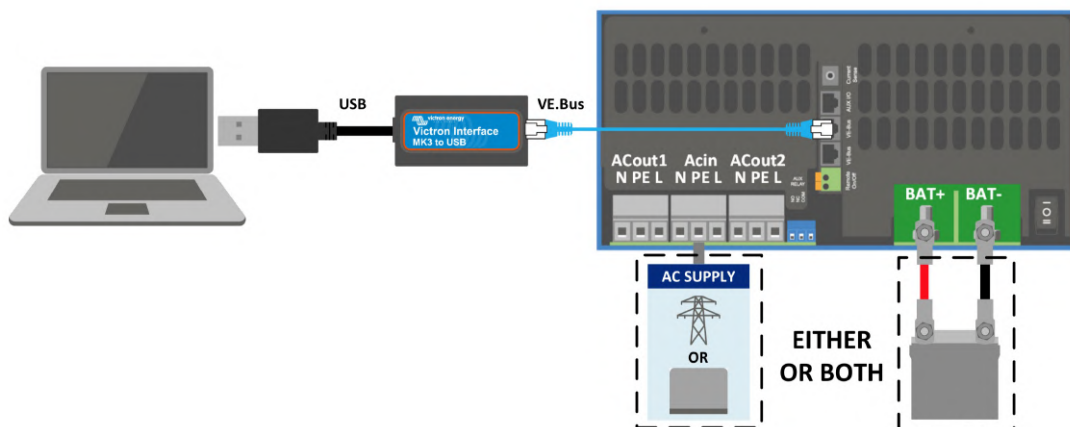
More general information about the VictonConnect App - how to install it; for example - can be found by referring to the overall VictronConnect manual.

3. # Limitations

3.1. # VictronConnect vs VEConfigure & VEFlash

VictronConnect is replacing VEConfigure and VEFlash. Its easier to use and works on more devices, not only on Windows.

The following features are not yet supported in VictronConnect. If you require this advanced functionality, you will still need to use VEConfigure.

- Assistants (eg AC PV, ESS)
- Configuring MultiPhase and Parallel systems
- Virtual Switch, though some Virtual Switch functionality is available via the new AC input control feature.
- Changing the Grid Code
- Lithium Battery Wizard (for lithium battery types that require installation of an Assistant eg VE.Bus BMS)
- External Current Sensor - This is for use with the Multiplus-II external current sensor

3.2. # Required firmware versions

Firmware version 200 is required to see data and make changes to settings.

To perform a firmware update, besides requiring firmware version 200, also the product needs to be equipped with a new type microcontroller. Since at least five years, all inverter/chargers have been shipped with a new type microcontroller. This microcontroller can be recognised by checking the 7 digit software number on a sticker on the device, it must start with 26 or 27. For more information, see the VE.Bus firmware versions explained document. When above requirements are not met, use VEFlash for firmware updating.

3.3. # VE.Bus Smart dongle limitations

When connected over bluetooth, using the VE.Bus Smart Dongle, only status data, voltages, and other information can be read. And it can be operated: switch between On, Off and Charger-only mode, and set a Shore current input limit. No changes can be made to the product.

An MK3-USB is required to change settings and perform firmware updates and settings. And, as that requires a USB port, it is not possible to change inverter/charger configuration or perform firmware updates on a Apple iPad or iPhone.

VictronConnect does not work with the MK2-USB.

4. # Overview Video

There is a video overview of this document, and it is intended to be used along side the more in-depth written documentation.

5. # Connecting

Connecting the VE.Bus Inverter/Charger to your device requires an MK3-USB for configuration mode, or VE.Bus Smart Dongle for status mode.

The MK3-USB or Smart dongle goes between the VE.Bus port on the inverter/charger, and either USB or Bluetooth connection on your computer.

You will also need a straight RJ45 UTP cable. Also known as Ethernet patch or LAN cables. Use an industrially manufactured cable. Handcrimped cables often give problems. Even in case a hand crimped cable works for a computer network, it might not be of sufficient quality to work to connect Victron products.

Connecting with an Android device will require an additional OTG cable to convert the USB cable from the MK3-USB to the data port on your device (typically micro-USB or USB-C).

This OTG adapter is not provided by Victron and will need to be sourced seperately.

To communicate, the Victron device must be supplied with the appropriate voltage.

Product	Voltage Required
Multi/Quattro	Either AC or DC
Multi Compact	DC
Inverters	DC

Once the connection is established, the program loads up the information from the connected unit.

6. # Demo Mode Menu

You can learn more about VictronConnect using the demo menu option. This option allows you to load a "demo" device which simulates a real system. You can then adjust the settings/options. An in-app description in provded for some settings.

There is a choice of demo devices:
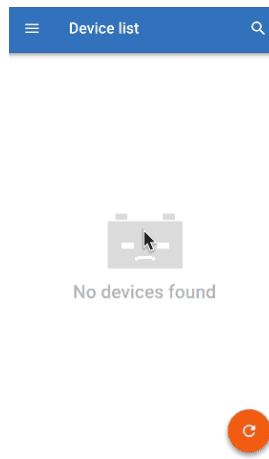
To access demo mode, select the three bar icon at the top left of the device list. Then Demo library.

Scroll through the options and then click or tap your selection.

It is possible to save the configuration you have made in demo mode, and load it into a real device.

7. # Display Options

There are two different modes available when connecting to a VE.Bus device with VictronConnect, **Status** & **Settings**

8. # Status Mode
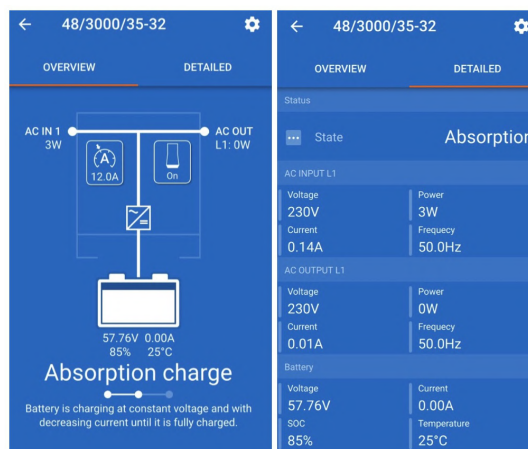
Status is available on Windows, macOS, Android and iOS operating systems.

You can access Status by either the MK3-USB or via Bluetooth with the VE.Bus Smart Dongle.

From the status window it is possible to switch the device On / Off / Charger Only from the switch button icon. It is also possible to quickly adjust the AC input current limit (if the overruled by the remote panel setting is enabled).

For more information about this mode, and making the connection with the VE.Bus Smart Dongle, please watch this video:

# 9. # Settings Mode

You can only access Settings with a MK3-USB. You cannot use a VE.Bus Smart Dongle to access Settings Mode.

Settings is available on Windows, macOS and Android operating systems.

Settings on iPhone is not supported at this time, as iPhone does not support OTG connections from USB and is unable to connect to the MK3-USB.

10. # Description of Settings

10.1. # General
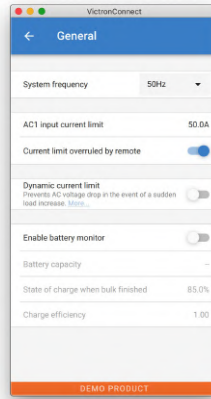
10.1.1. # System frequency setting

Alters the output frequency setting for the inverter.

10.1.2. # AC1 input current limit

This setting is only active if no system panel is installed (is overruled by the remote panel if connected).

10.1.3. # Current limit overruled by remote

If Overruled by remote is enabled, the input current limit can be set remotely by a GX Device or a Digital Multi Control. If not enabled, it cannot be changed.

The use case is to typically leave it unchecked in stationary applications, as well as inputs connected to a generator, since for them the input current limit is a static value and defined during installation.

For shore connections (boat and vehicle use) you check the box, so that the user of the system can change the input current limit to match the shore connection they are currently using.

10.1.4. # Dynamic current limit

Setting for use with 'small' generator - If an inverter-generator is used, such as the HONDA EU series, the shore current setting will be dynamically reduced (following a period of low current consumption) to compensate for the engine reaction time when higher loads are activated.

10.1.5. # Enable Battery Monitor

Enabling the VE.Bus battery monitor, this also enables many features that can use a State of Charge (SOC).

10.1.6. # Battery capacity

In order for the battery monitor to be able to correctly calculate the "state of charge" the battery capacity of the connected batteries must be known. Use this setting to specify the connected battery capacity in Ah.

10.1.7. # State of charge when bulk finished

Use this setting to specify what the "state of charge" is set to when the Bulk phase is finished. This helps to calibrate "state of charge" value due to inevitable measurement errors that accumulate over several charge/discharge cycles.

10.1.8. # Charge efficiency

Setting the charge efficiency takes into account losses that occur when charging to improve the accuracy of the State of charge reading. If you find the state of charge accuracy is drifting over time, try adjusting this setting.

10.2. # Grid
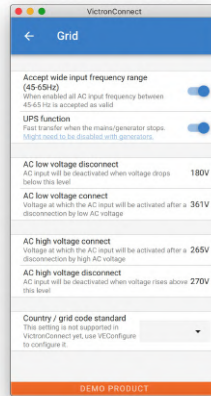
10.2.1. # Accept wide frequency range

Set the sensitivity of frequency measurement. This setting is used to indicate whether it is necessary for the input frequency to be exactly 50 or 60 Hz. This is a setting that is primarily used in conjunction with generators (speed may not always be stable) to prevent the Multi from rejecting the input supply

10.2.2. # UPS Function

Determines whether the Multi should be critical of the distortion in the supply waveform.

If UPS Function is deselected, this automatically activates the function preventing the lower voltage limit from being exceeded with heavy start-up loads! (previously labeled 'Allow inrush current')

10.2.3. # AC Voltage Connection and Disconnection

Voltage limits at which feedback relay opens/closes.

These are the limits at which the unit will accept or reject the supply. If the input voltage drops below the set value of the lower limit, the charger output will be reduced to the minimum to prevent further reduction of the voltage.

10.2.4. # Country / grid code standard

Grid code setting is not yet available in VictronConnect. Depending on the installation and regional requirements you may need to need to use VEConfigure to adjust additional settings.

10.3. # Inverter
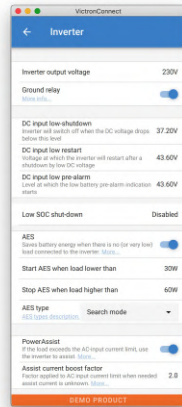
10.3.1. # Inverter output voltage

This is normally 120/230 Vac.

10.3.2. # Ground Relay

Used to enable/disable the internal ground relay functionality. Connection between N and PE during inverter operation.

The ground relay is useful when an earth-leakage circuit-breaker is part of the installation. When the internal transfer switch is open (inverter mode) the Neutral of the inverter is connected to PE. When the transfer switch closes (AC input is transferred to the output) the Neutral is first disconnected from PE. Warning: Disabling the ground relay on "120/240V" models (split phase models) will disconnect the L2 output from the inverter.

10.3.3. # DC input low-shutdown

To set the low battery voltage level at which the inverter shuts off. To ensure long battery life, this value should be set according to your battery manufacturer specification.

10.3.4. # DC input low restart

To set the voltage at which the inverter restarts after low voltage shut-down. To prevent rapid fluctuation between shut-down and start up, it is recommended that this value be set at least one volt higher than the low battery shut-down voltage.

10.3.5. # DC input low pre-alarm

DC input low pre-alarm With this setting one can determine the level at which the Low batter pre-alarm indication starts. Note that in fact the parameter which is changed is an offset voltage relative to the DC input low restart level which in its turn is relative to the DC input low shut-down level. The result of this is that, when changing either one of DC input low restart and DC input low shut-down, this "DC input low pre-alarm" level changes also!

10.3.6. # Low SOC shut-down

If the Multi is set to have State of Charge enabled, you can use this feature to shut it down when it reaches the set level. This can be useful on systems where battery voltage does not give a good indication of battery level.

10.3.7. # AES

Energy saving setting to conserve power if there is no significant load drawn from the inverter.

If the system has consumers with high inrush characteristics (such as microwave ovens and air-conditioning) deactivate AES to prevent them from switching on too slowly and causing overload.

10.3.8. # PowerAssist

Use PowerAssist to prevent an external AC input circuit breaker to trip due to excessive load. If the load exceeds the AC input current limit the Multi will start inverting in parallel with the external AC supply and will provide the extra current needed. Note: When PowerAssist is enabled there is a minimum AC input current limit depending on the device type. Setting a lower limit than this minimum will result in the minimum limit. Note that in a parallel system this limit is per device!

10.3.9. # Assist current boost factor

This value is normally set to 2. This is a safe value because any small peak will be compensated by the inverter and the excessive power will not overload the input circuit protection. Be very careful with this setting and change it only once you have carefully considered the possible negative aspects of doing so!

10.4. # Charger
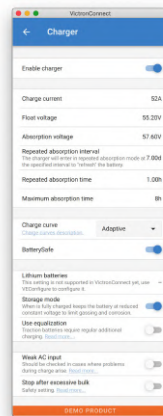
10.4.1. # Enable charger

The inverter and assist functions of the Multi will continue to operate, but it will no longer charge; the charging current is therefore zero!

100% self-consumption by disabling the charge functionality of the Multi It can be quite expensive to charge the batteries from the grid. Lead-acid batteries have a low charge efficiency. About 20% of the energy used to charge the batteries is lost in the form of heat. Some installers therefore prefer to disable the charger functionality of the Multi.

When the charger functionality is disabled and the Multi is accepting the grid, it will supply the loads with grid power, but will not charge the batteries. The batteries will only receive charge from the MPPT charge controllers. In this type of system it is very important to have a large enough solar array. It is also important that the Ignore AC battery voltage settings are set higher than you would do normally. This is to make sure that the battery has some extra charge left should there be a blackout.

WARNING Incorrect system design can cause battery damage. Disabling the charger is only recommended in systems that have excess solar power. If the batteries get empty during the night, the system cannot be recovered unless you connect an external battery charger.

10.4.2. # Charge current

Use this setting to specify the current with which the battery is charged during the bulk phase. Note that the actual charge current depends on other conditions also. Therefore it is possible that the actual charge current is lower than this setting. This can, among others, be due to a low AC input current limit in combination with a high load; high environmental temperature; too high ripple voltage due to improper cabling. For lead batteries, the charging current should be approximately 10 to 20% of the battery capacity. Also keep in mind the DC consumption that is expected in the system.

10.4.3. # Float voltage

Use this setting to specify the Float voltage. Float stage is reduced voltage from absorption, used to trickle in current to finish battery charge without creating excess heat or gassing.

10.4.4. # Absorption voltage

Use this setting to specify the Absorption voltage. Absorption is the charge phase where the battery is held at continuous target voltage with variable current.

10.4.5. # Repeated absorption interval

Use this setting to specify the interval between repeated absorptions.

10.4.6. # Repeated absorption time

Specify the duration of the repeated absorption "pulses".

10.4.7. # Maximum absorption time

If the charge curve is fixed then this setting is used to determine the absorption time. In all other cases this setting determines the maximum absorption time.

10.4.8. # Charge curve

Under normal circumstances always select the adaptive mode. If the balance between the charger and battery is not ideal, it may be better to choose fixed mode otherwise the voltage will rise too quickly or too slowly and the battery may be over or under charged as a result.

10.4.9. # BatterySafe

BatterySafe curve has a special regulation in the absorption phase. The absorption phase will start when the voltage reaches 14.4V (for a 12V battery) regardless of the specified absorption voltage. During the absorption phase the voltage will increase with a fixed ramp until the voltage reaches the absorption voltage or until the calculated absorption time is over. In the latter case the absorption phase will end before the absorption voltage is reached.

In a lead acid battery the charge process isn't always perfectly spread throughout the battery so therefore it can happen that when charging fast (at the limit of what the battery can handle voltage wise), a part of the battery is already "charged" while other parts still have the ability to absorb energy. When the charger is going "full power" to the setpoint voltage to enter absorption the change is quite realistic that a part of the battery is getting overcharged.

BatterySafe reduces the charge current when the voltage is approaching the setpoint to enter absorption. Therefore the battery gets a longer lifetime.

Same as for Adaptive (when the absorption period is calculated from the time the charger is in the Bulk phase), it helps extend the lifespan of the battery.

In general, beware that the wish to charge "as fast as possible" often results in a shorter lifespan of the (lead acid) battery. Taking it a bit slower will indeed cost fuel/time but will pay itself back in battery lifetime. Charging the battery with the generator is most efficient in the 50-80% SOC range. So have this done daily and only go to 100% weekly as then the battery monitor is synced and the battery gets a needed full charge.

10.4.10. # Lithium battery mode

10.4.10.1. # Checkbox function

The table below shows the effect of Enabling or Disabling Lithium battery mode:

Feature	Lithium mode Disabled (default)	Lithium mode Enabled
Temperature compensation	Lead algorithm	No temperature compensation
Re-bulk voltage	1.3V less than Float-voltage, to a maximum of 12.9V	0.2V less than Float-voltage, to a maximum of 13.5V

Note: All mentioned voltages and thresholds are for a 12V system. For 24 multiply by two; and for 48V, multiply by four. So for example at 48V, the re-bulk mechanism for a lithium battery will use Vfloat - 0.8V with a maximum of 54V.

Temperature compensation Charge voltage are not increased or decreased within normal temperature ranges (5°C - 40°C) for lithium batteries. Enabling Lithium mode will disable the normal built-in temperature compensation features that are used for lead acid batteries.

Re-bulk voltage The Re-bulk voltage is the point that the charger returns to the bulk charging stage. It depends upon the float voltage. Lithium batteries tend to have a more stable voltage output and a narrower voltage range than lead acid batteries, so in lithium mode the value between float and re-bulking is reduced.

10.4.10.2. # Required setting per lithium type

A) Batteries with built-in BMS

Batteries with built-in BMS, including charge and discharge interruptors, such as the Victron Superpack, Battleborn or Simplify battery brands. Also known as 'drop-in replacement' type batteries. For these types, enable the lithium battery mode; and set the charging voltages as per the battery manual. There is no need for Assistants or other configuration.

B) Victron V12.8 and 25.6V batteries, requiring a VE.Bus BMS

These require additional configuration that is not currently supported by VictronConnect. Please use VEConfigure instead and install the VE.Bus BMS Assistant, as well as check the Lithium battery checkbox.

C) Intelligent batteries, connected to a GX-device with DVCC enabled:

Checking or not checking the box doesn't matter; it has no effect. In systems with such a battery, all charger settings are overridden by parameters coming from the CAN-bus.

Examples are Victron 24V Lithiums with a Lynx BMS, BYD, Pylontech, MG Electronics, Freedomwon, Redflow, and others.

10.4.11. # Storage mode

With this feature active, after 24 hours in float charge, the charging voltage will be reduced below the float voltage to provide optimum protection of the battery against overcharging; charging current will continue to be applied regularly to compensate for self-discharge. This is the rest voltage if the battery is fully charged.

10.4.12. # Use equalisation

For optimum charging, special traction batteries require a fixed charging current phase in addition to a voltage curve. Beware that this often results in a higher charging voltage that can be damaging to DC loads!

10.4.13. # Weak AC input

If the quality of the supply waveform is less than the charger expects, it will reduce its output to ensure that the COS phi (difference between current/voltage phases) remains acceptable. This protection can be deactivated for low capacity or poorly regulated power supplies.

10.4.14. # Stop after excessive bulk

If the absorption voltage has not been reached after 10 hours, the battery may be faulty and the charger will switch off for safety reasons. This setting will trigger the lithium battery options and wizard, depending on the configuration of your lithium battery and manufacturers advice you may need to adjust additional settings as well.

10.5. # AC Input Control

The AC Input Control can be set up in numerous ways, for example, the Multi will disconnect from the grid when the batteries are full enough and/or the AC load is not too big. The Multi will disconnect from the grid most of the time. It will only let the grid in when the batteries are empty or when you are running a big AC load. You now can use the grid like you would use a backup generator.

The mechanism behind the AC Input Control is the opening or closing the Multi's internal AC input relay.

This feature in not enabled by default.

The normal function of this relay is to open as soon as the grid or generator is not there. For example, during a blackout or when a generator is off. This is a safety action. The relay prevents energy feeding into the grid during a blackout or when the generator is off.

This relay can also be setup to purposefully ignore the grid. It will still perform its normal safety action but it can open and disconnect from the grid under more situations. It can ignore the grid when the batteries are still full enough. Now DC solar power can be prioritized and the grid will be used like a backup generator

10.5.1. # When can the grid be controlled ?

The AC input relay can be programmed to selectively ignore the grid, while looking at two parameters: It can look at battery voltage and/or at AC load parameters.

The grid is ignored when the batteries are full enough. The grid is let in when the batteries are empty

- This setting can be used to charge the batteries from the grid should the batteries get too empty. This can occur, for example, at night or during a long period of bad weather.
- In this scenario the Multi will look at the battery voltage. It will let the grid in when the battery voltage is too low, for a certain amount of time. It will ignore the grid as soon as the battery voltage has increased above a certain level, for a certain amount of time.

- The multi can also disconnect the grid on battery state of charge.

The grid is ignored when the AC loads are low. The grid is let in when the AC loads are high

- This setting can be used to allow grid in when the AC load is higher than the Multi rating. This will prevent the Multi going into overload. This setting can also be used for large loads that you do not want to run from the battery.
- In this scenario the Multi will look at the AC load. As soon as it sees that the load is above a certain level, for a certain amount of time, the Multi will let the grid in. The multi will stop letting the grid in as soon as it sees that the AC load has dropped below a certain level, for a certain amount of time.
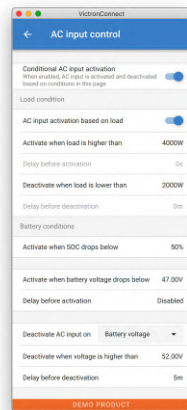
10.5.2. # Conditional AC input activation

Enables the use of AC Input Control to modify the operation of the feedback relay.

10.5.3. # Load Conditions

This setting can be used to allow grid in when the AC load is higher than the Multi rating. This will prevent the Multi going into overload. This setting can also be used for large loads that you do not want to run from the battery.

In this example the grid will not be ignored when the load exceeds 4000 Watts, with no delay.

Do not ignore AC input means that the grid is accepted because the AC input relay is closed. The grid will be ignored when the load drops below 2000 W.

Ignore AC means that the grid is ignored because the AC input relay is open.

Depending on your load, if the AC input relay is opening and closing frequently, add a time delay before activation and deactivation.

AC input activation based on load

Activate when load is higher than W

Delay before activation T

Deactive when load is lower than W

Delay before deactivation T

10 .5.4. # Battery Conditions

This setting can be used to charge the batteries from the grid should the batteries get too empty. This can occur, for example, at night or during a long period of bad weather.

In this example, the grid is not ignored when the battery voltage is less than 47 Volt. Do not ignore AC input means that the grid is accepted because the AC input relay is closed.

The grid will be ignored again when the battery voltage exceeds 52 Volts for more than 5 minutes.

Ignore AC means that the grid is ignored because the AC input relay is open. Apart from "battery voltage", there are two other options to choose from: "bulk finished" or "absorption finished".

Choosing "absorption finished" is a good way to ensure the batteries are getting a full charge every now and then. But it can lead to a higher electricity bill. The absorption charge stage of a lead-acid battery is much less efficient than the bulk stage.

This could be a reason to choose the "bulk finished" option. At the end of the bulk charge stage a lead-acid battery is about 85% full.

It is also possible to let grid in when the batteries fall below a certain state of charge.

IMPORTANT

In a DC coupled solar system the "state of charge" option should only be used if you have a GX device in the system. And the GX device is connected to both the Multi and the MPPT solar charger(s) and/or a BMV battery monitor. In addition to this a setting needs to be made in the GX device.

11. # Firmware Updates

11.1. # When to do a firmware update

It is not required to keep your Victron equipment updated to the latest firmware version. Stable systems should be left with their current firmware. Here is when to perform a firmware update:

- During commissioning / first install;
- When trouble shooting;
- To add a new feature that is required by the installation.

Firmware updates are only available in Settings Mode, requiring a password - zzz

11.2. # Warning - reset to factory defaults

:⚠:

All settings will be reset to factory defaults after the firmware update process.

11.3. # Procedure

Once you are connected to the unit, enter the settings, select the Product Info from the top right dots.

VictronConnect comes with the most up to date versions of the firmware already, so an internet connection is not required.

Click update and then do not touch either device until the firmware update is complete.

There is a video of the proceedure here:
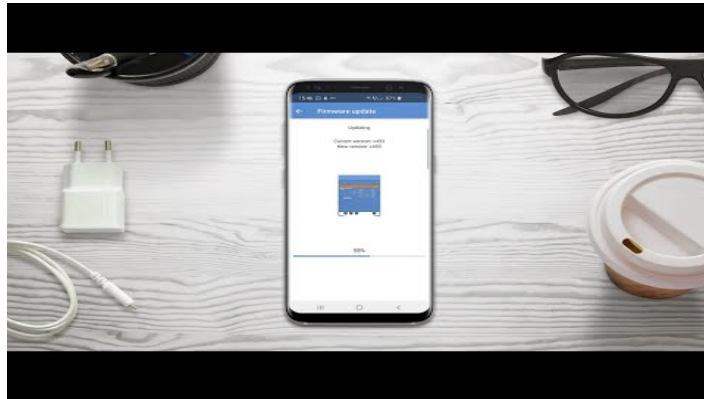
Step by Step:

If the firmware update fails, please attempt it again. If you still cannot recover the unit, Please use the alternative method and follow these steps using the VEFlash software instead.

11.4. # Firmware updates with multiple units (eg 3 phase)

It is possible to use VictronConnect to efficiently update the firmware for 3 phase, or parallel units.

To do this, the units must already be programmed for their multiple unit configuration and connected to each other.

Units will be returned to factory default settings once the firmware update is complete. So make sure that settings and parameters are saved, and you will also need to reprogram them for their multiple unit configuration (as is covered in the 3 phase and parallel documentation).

12. # Troubleshooting

12.1. # I am having connection issues

If you are having difficulty with connecting to a VE.Bus device with a laptop and an MK3-USB adaptor, try the following troubleshooting steps to help isolate the issue.

1. Make sure the device is connected to a power supply and switched on
2. Test the cable with a cable-tester and/or try another one. There can be a difference in pin arrangement in some network cables. The required cable is a straight-through cable, not a cross-over cable.

12.1.1. # See if the MK3-USB works with a GX device.

In case you have a GX device available; you can use it to test the MK3-USB.

1. Make sure the GX device is running v2.23 or later;
2. The Multi should be disconnected from the GX device's VE.Bus port.
3. Connect the MK3 USB plug into the GX's USB socket.
4. Connect the Multi to the MK3 with network cable.
5. The Multi should appear on the GX device.

If all those do not work; the MK3 may be broken, please contact your dealer.

12.2. # I am having bluetooth connection issues

12.3. # VE.Bus firmware update fails at 5% on macOS

There is a known issue that makes VE.Bus firmware updates randomly fail on some macOS laptops. We are working on it; a new VictronConnect version fixing this issue is expected in the near future.

Meanwhile this is the workaround for this: Proceed to update as usual and quickly minimise the VictronConnect window when progress bar is shown because the update starts. After ~20 seconds you can maximise VictronConnect to see the update status. This issue was introduced in VictronConnect v5.9.

For those with a technical background and wondering how, why and what minimising has to do with this: yes this really works, and relates to a power saving mode that has a side effect on serial communication.

12.4. # I am having settings issues and would like to start again

You can reset the unit to the factory settings. In the Settings / Product info screen, you can update the devices firmware. This firmware update process will reset settings to the factory default.

12.5. # Still having issues?

If you have additional questions or comments after reading this document, please contact your Victron Dealer who is trained in using this software, and has a known good testing configuration.

Adaptive Charging: how it works

The text below closely follows the explanation given in the Phoenix battery charger info sheet, but with additional detail.

For general knowledge about batteries and battery charging, please refer to the text Electricity on Board, available on the website of Victron Energy.

1. The right amount of charge: variable absorption time

To fully charge a battery, a period of charging at a relatively high voltage is needed. This period of the charging process is called absorption charge. A battery that has been deeply discharged needs an absorption time of several hours, whereas a battery that is only slightly discharged requires a much shorter absorptoin period.

Classic 3-step chargers nevertheless have a fixed absorption time, for example 4 hours. Charging a battery with a fixed absorption time works well as long the battery has been, on average, substantially discharged before a recharge cycle is started.

In several applications however a fixed absorption time can lead to overcharging, which will reduce service life. In case of flooded batteries frequent topping off of the electrolyte will also be needed, due to increased gassing.

Consider for example a typical boat, or a coach, connected to a shore-side supply with limited output. Household equipment like a microwave, coffee maker, washing machine or an electric stove might trip the shore supply circuit breaker. The solution is to run this equipment from the battery with help of an inverter. A charger is connected to shore power to charge the battery. The battery in this case is used as a peak shaver, with short discharges every time there is a high current draw due to household equipment being used. Chances are that, in case of a fixed absorption time, the battery will be subjected almost continually to absorption charge. The result is overcharging, which will substantially shorten battery life and might even result in thermal runaway of the batteries.
An adaptive charger will also execute a recharge cycle after each shallow discharge, but the absorption time will be much shorter, thereby increasing battery life.

The absorption time of a Phoenix Charger or Phoenix Multi will adapt itself as follows:
after each period of bulk charge (= the charger has reached its maximum current) an absorption period of 20 times the the bulk charge period will follow, with a maximum set at, for example, 4 hours.

2. Preventing damage due to excessive gassing: the BatterySafe mode

Often the absorption charge voltage of a battery does not exceed the gassing voltage limit (approximately 14,4 V for a fully charged 12 V battery). Some batteries however need a higher absorption voltage to fully charge them (tubular or thick plate deep cycle batteries for ex.), and open, flooded, batteries in general can be charged faster by not only increasing the bulk charge rate, but also the absorption voltage.

A high charge rate will heat the battery (temperature compensation needed!) and will also increase gassing, in extreme cases up to the point that the gas bubbles will push the active mass out of the plates, destroying the battery. The BatterySafe mode limits the rate of voltage rise of the charger output after the gassing voltage has been reached. The effect is a sharp drop in charge current which prevents excessive gassing (see fig. 2 on the Phoenix battery charger info sheet).

3. Less maintenance and aging when the battery is not in use: the Storage mode

After completion of the absorption period, a battery charger in general switches to the float charge mode. In case of a 3-stage charger the float voltage should be sufficiently high to compensate for self discharge of the battery, but should at the same time be as low as possible in order to limit corrosion of the positive plates and gassing. In practice the balance isn't perfect: flooded batteries will gas substantially more than when left open circuited and will need regular topping up.

We have therefore introduced a fourth stage: the Storage mode. The Storage mode kicks in whenever the battery has not been subjected to discharge during 24 hours. In the Storage mode float voltage is reduced to 2,2 V/cell (13,2 V for a 12 V battery), which is close to the open circuit voltage of a fully charged battery.
Corrosion and gassing are reduced to absolute minimum, but self-discharge is not compensated. To compensate for self discharge, and to stir up the electrolyte, the voltage is raised back to absorption level once every week.

Note: although sealed (VLRA AGM or gel) batteries can be float charged at 13,5 V to 13,8 V during long periods of time (no topping up needed!), some studies have shown that the Storage mode will increase service life of sealed batteries (see for ex. 'Batterie Technik' by Heinz Wenzl, Expert Verlag, 1999).

Adding a forth charge stage, the Storage mode, also provides the option to increase the voltage during the third, 'float' stage to 2,33 V/cell (14 V for a 12 V battery). This is the charge voltage generally used for starter batteries in vehicles, and is ideal to 'supercharge' an already charged battery.

ESS - Start page

An Energy Storage System (ESS) is a specific type of power system that integrates a power grid connection with a Victron Inverter/Charger, GX device and battery system. It stores solar energy into your battery during the day, for use later on when the sun stops shining.

- ESS Quick Installation Guide
- ESS Design & installation manual
- External control (ESS mode 2 and 3)