# Quattro Inverter/Charger 120V

3kVA - 10kVA  Lithium Ion battery compatible  www.victronenergy.com

**Quattro 48/5000/70-100/100**

### Two AC inputs with integrated transfer switch

The Quattro can be connected to two independent AC sources, for example the public grid and a generator, or two generators. The Quattro will automatically connect to the active source.

### Two AC Outputs

The main output has no-break functionality. The Quattro takes over the supply to the connected loads in the event of a grid failure or when shore/generator power is disconnected. This happens so fast (less than 20 milliseconds) that computers and other electronic equipment will continue to operate without disruption.
The second output is live only when AC is available on one of the inputs of the Quattro. Loads that should not discharge the battery, like a water heater for example, can be connected to this output.

### Virtually unlimited power thanks to parallel operation

Up to 6 Quattro units can operate in parallel. Six units 48/10000/140, for example, will provide 48kW / 60kVA output power and 840 Amps charging capacity.

### Split phase and three phase capability

Two units can be configured for split phase, and three units can be configured for three phase output. But that's not all: up to 6 sets of three units can be parallel connected to provide 144kW / 180kVA inverter power and more than 2500A charging capacity. For more detail please enter *parallel* in the search box on our website.

### PowerControl – Dealing with limited generator, shore side or grid power

The Quattro is a very powerful battery charger. It will therefore draw a lot of current from the generator or shore side supply (16A per 5kVA Quattro at 230VAC). A current limit can be set on each AC input. The Quattro will then take account of other AC loads and use whatever is spare for charging, thus preventing the generator or mains supply from being overloaded.

### PowerAssist – Boosting shore or generator power

This feature takes the principle of PowerControl to a further dimension allowing the Quattro to supplement the capacity of the alternative source. Where peak power is so often required only for a limited period, the Quattro will make sure that insufficient mains or generator power is immediately compensated for by power from the battery. When the load reduces, the spare power is used to recharge the battery.

### Solar energy: AC power available even during a grid failure

The Quattro can be used in off grid as well as grid connected PV and other alternative energy systems.
Loss of mains detection software is available.

### System configuring

- In case of a stand-alone application, if settings have to be changed, this can be done in a matter of minutes with a DIP switch setting procedure.
- Parallel and three phase applications can be configured with VE.Bus Quick Configure and VE.Bus System Configurator software.
- Off grid, grid interactive and self-consumption applications, involving grid-tie inverters and/or MPPT Solar Chargers can be configured with Assistants (dedicated software for specific applications).

### On-site Monitoring and control

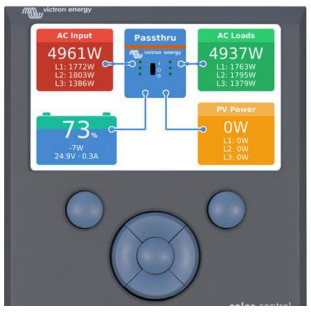
Several options are available: Battery Monitor, Multi Control Panel, Color Control GX or other GX devices, smartphone or tablet (Bluetooth Smart), laptop or computer (USB or RS232).

### Remote Monitoring and control

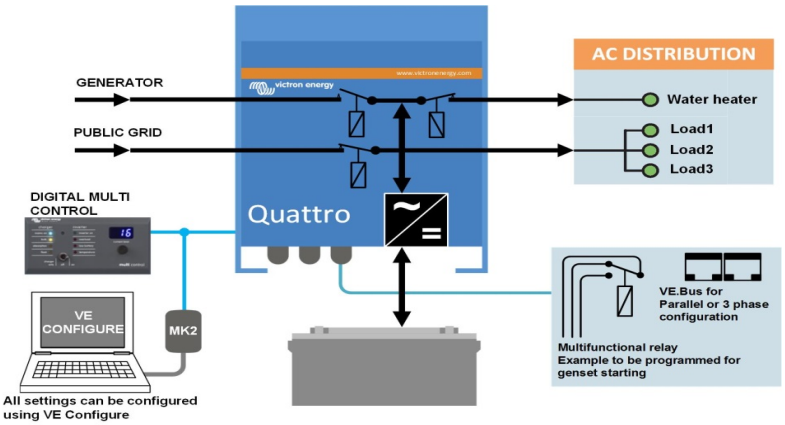
Color Control GX or other GX devices.
Data can be stored and displayed on our VRM (Victron Remote Management) website, free of charge.

### Remote configuring

When connected to the Ethernet, systems with a Color Control GX or other GX device can be accessed and settings can be changed remotely.




**Color Control GX, showing a PV application**



| Quattro | 48/3000/35-50/50 120V | 12/5000/220-100/100 120V<br>24/5000/120-100/100 120V<br>48/5000/70-100/100 120V | 48/10000/140-100/100 120V |
|---|---|---|---|
| PowerControl / PowerAssist | Yes | | |
| Integrated Transfer switch | Yes | | |
| AC inputs (2x) | Input voltage range: 90-140 VAC Input frequency: 45 – 65 Hz Power factor: 1 | | |
| Maximum feed through current | 2x 50 A | 2x 100 A | 2x 100 A |
| **INVERTER** | | | |
| Input voltage range | 9,5 – 17 V 19 – 33V 38 – 66 V | | |
| Output (1) | Output voltage: 120 VAC ± 2% Frequency: 60 Hz ± 0,1% | | |
| Cont. output power at 25°C (3) | 3000 VA | 5000 VA | 10000 VA |
| Cont. output power at 25°C | 2400 W | 4000 W | 8000 W |
| Cont. output power at 40°C | 2200 W | 3700 W | 6500 W |
| Cont. output power at 65°C | 1700 W | 3000 W | 4500 W |
| Peak power | 6000 W | 10000 W | 20000 W |
| Maximum efficiency | 94 % | 94 / 94 / 95 % | 96 % |
| Zero load power | 25 W | 30 / 30 / 35 W | 60 W |
| Zero load power in AES mode | 20 W | 20 / 25 / 30 W | 40 W |
| Zero load power in Search mode | 12 W | 10 / 10 / 15 W | 15 W |
| **CHARGER** | | | |
| Charge voltage 'absorption' (V DC) | 57,6 V | 14,4 / 28,8 / 57,6 V | 57,6 V |
| Charge voltage 'float' (V DC) | 55,2 V | 13,8 / 27,6 / 55,2 V | 55,2 V |
| Storage mode (V DC) | 52,8 V | 13,2 / 26,4 / 52,8 V | 52,8 V |
| Charge current house battery (A) (4) | 35 A | 200 / 120 / 70 A | 140 A |
| Charge current starter battery (A) | 4 A (12V and 24V models only) | | |
| Battery temperature sensor | Yes | | |
| **GENERAL** | | | |
| Auxiliary output (5) | 32 A | 50 A | 50 A |
| Programmable relay (6) | 3x | | |
| Protection (2) | a-g | | |
| VE.Bus communication port | For parallel, split phase and three phase operation, remote monitoring and system integration | | |
| General purpose com. port | 2x | | |
| Remote on-off | Yes | | |
| Common Characteristics | Operating temp.: -40 to +65°C Humidity (non-condensing): max. 95% | | |
| **ENCLOSURE** | | | |
| Common Characteristics | Material & Colour: aluminium (blue RAL 5012) Protection category: IP 21 | | |
| Battery-connection | Four M8 bolts (2 plus and 2 minus connections) | | |
| 230 V AC-connection | Screw terminals 13 mm² (6 AWG) | Bolts M6 | Bolts M6 |
| Weight (kg) | 42 lb 19 kg | 75 / 66 / 66 lb 34 / 30 / 30 kg | 128 lb 58 kg |
| Dimensions (hxwxd) | 14.3 x 10.2 x 8.6 inch<br>362 x 258 x 218 mm | 18,5 x 14,0 x 11,2 inch 470 x 350 x 280 mm<br>17,5 x 13,0 x 9,6 inch 444 x 328 x 240 mm<br>17,5 x 13,0 x 9,6 inch 444 x 328 x 240 mm | 22.6 x 19,2 x 13,6 inch<br>572 x 488 x 344 mm |
| **STANDARDS** | | | |
| Safety | EN-IEC 60335-1, EN-IEC 60335-2-29, EN-IEC 62109-1 | | |
| Emission, Immunity | EN 55014-1, EN 55014-2, EN-IEC 61000-3-2, EN-IEC 61000-3-3, IEC 61000-6-1, IEC 61000-6-2, IEC 61000-6-3 | | |
| Road vehicles | 12V and 24V models: ECE R10-5 | | |
| Anti-islanding | See our website | | |

1) Can be adjusted to 60 HZ; 120 V 60 Hz on request
2) Protection key:
   a) output short circuit
   b) overload
   c) battery voltage too high
   d) battery voltage too low
   e) temperature too high
   f) 230 VAC on inverter output
   g) input voltage ripple too high
3) Non-linear load, crest factor 3:1
4) At 25°C ambient
5) Switches off when no external AC source available
6) Programmable relay that can a.o. be set for general alarm,
   DC under voltage or genset start/stop function
   AC rating: 230 V / 4 A
   DC rating: 4 A up to 35 VDC, 1 A up to 60 VDC

### Digital Multi Control Panel
A convenient and low cost solution for remote monitoring, with a rotary knob to set PowerControl and PowerAssist levels.

### VE.Bus Smart Dongle
Measures battery voltage and temperature and allows monitoring and control of Multis and Quattros with a smartphone or other

Bluetooth enabled device.

### Computer controlled operation and monitoring
Several interfaces are available:

### Color Control GX and other GX devices
Monitoring and control. Locally, and also remotely on the VRM Portal.

### MK3-USB VE.Bus to USB interface
Connects to a USB port (see 'A guide to VEConfigure')

### VE.Bus to NMEA 2000 interface
Connects the device to a NMEA2000 marine electronics network. See the NMEA2000 & MFD integration guide

### BMV-712 Smart Battery Monitor
Use a smartphone or other Bluetooth enabled device to:
- customize settings,
- monitor all important data on single screen,
- view historical data, and to
- update the software when new features become available.

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# Quattro Inverter/Charger

3kVA - 15kVA  Lithium Ion battery compatible

www.victronenergy.com

Quattro
48/5000/70-100/100

Quattro
48/15000/200-100/100

### Two AC inputs with integrated transfer switch

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### Two AC Outputs

The main output has no-break functionality. The Quattro takes over the supply to the connected loads in the event of a grid failure or when shore/generator power is disconnected. This happens so fast (less than 20 milliseconds) that computers and other electronic equipment will continue to operate without disruption.
The second output is live only when AC is available on one of the inputs of the Quattro. Loads that should not discharge the battery, like a water heater for example, can be connected to this output.

### Virtually unlimited power thanks to parallel operation

Up to 6 Quattro units can operate in parallel. Six units 48/10000/140, for example, will provide 48kW / 60kVA output power and 840 Amps charging capacity.

### Split phase options

Two units can be stacked to provide 120-0-120V, and additional units can be paralleled up to a total of 6 units per phase, to supply up to 30kW / 36kVA of split phase power.
Alternatively, a split phase AC source can be obtained by connecting our autotransformer (see data sheet on www.victronenergy.com) to a 'European' inverter programmed to supply 240V / 60Hz.

### Three phase capability

Three units can be configured for three phase output. But that's not all: up to 6 sets of three units can be parallel connected to provide 144kW / 180kVA inverter power and more than 2500A charging capacity.

### PowerControl – Dealing with limited generator, shore side or grid power

The Quattro is a very powerful battery charger. It will therefore draw a lot of current from the generator or shore side supply (16A per 5kVA Quattro at 230VAC). A current limit can be set on each AC input. The Quattro will then take account of other AC loads and use whatever is spare for charging, thus preventing the generator or mains supply from being overloaded.

### PowerAssist – Boosting shore or generator power

This feature takes the principle of PowerControl to a further dimension allowing the Quattro to supplement the capacity of the alternative source. Where peak power is so often required only for a limited period, the Quattro will make sure that insufficient mains or generator power is immediately compensated for by power from the battery. When the load reduces, the spare power is used to recharge the battery.

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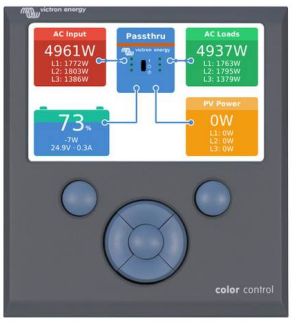
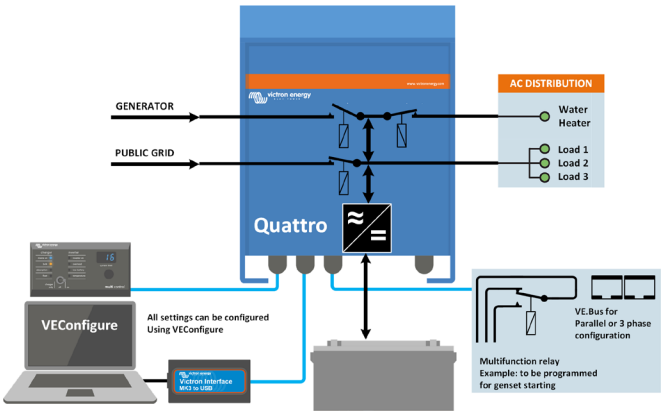



Color Control GX, showing a PV application



| Quattro | 12/3000/120-50/50<br>24/3000/70-50/50 | 12/5000/220-100/100<br>24/5000/120-100/100<br>48/5000/70-100/100 | 24/8000/200-100/100<br>48/8000/110-100/100 | 48/10000/140-100/100 | 48/15000/200-100/100 |
|---|---|---|---|---|---|
| PowerControl / PowerAssist | Yes | | | | |
| Integrated Transfer switch | Yes | | | | |
| AC inputs (2x) | Input voltage range: 187-265 VAC Input frequency: 45 – 65 Hz Power factor: 1 | | | | |
| Maximum feed through current (A) | 2x 50 | 2x100 | 2x100 | 2x100 | 2x100 |
| **INVERTER** | | | | | |
| Input voltage range (V DC) | 9,5 – 17V 19 – 33V 38 – 66V | | | | |
| Output (1) | Output voltage: 230 VAC ± 2% Frequency: 50 Hz ± 0,1% | | | | |
| Cont. output power at 25°C (VA) (3) | 3000 | 5000 | 8000 | 10000 | 15000 |
| Cont. output power at 25°C (W) | 2400 | 4000 | 6500 | 8000 | 12000 |
| Cont. output power at 40°C (W) | 2200 | 3700 | 5500 | 6500 | 10000 |
| Cont. output power at 65°C (W) | 1700 | 3000 | 3600 | 4500 | 7000 |
| Peak power (W) | 6000 | 10000 | 16000 | 20000 | 25000 |
| Maximum efficiency (%) | 93 / 94 | 94 / 94 / 95 | 94 / 96 | 96 | 96 |
| Zero load power (W) | 20 / 20 | 30 / 30 / 35 | 60 / 60 | 60 | 110 |
| Zero load power in AES mode (W) | 15 / 15 | 20 / 25 / 30 | 40 / 40 | 40 | 75 |
| Zero load power in Search mode (W) | 8 / 10 | 10 / 10 / 15 | 15 / 15 | 15 | 20 |
| **CHARGER** | | | | | |
| Charge voltage 'absorption' (V DC) | 14,4 / 28,8 | 14,4 / 28,8 / 57,6 | 28,8 / 57,6 | 57,6 | 57,6 |
| Charge voltage 'float' (V DC) | 13,8 / 27,6 | 13,8 / 27,6 / 55,2 | 27,6 / 55,2 | 55,2 | 55,2 |
| Storage mode (V DC) | 13,2 / 26,4 | 13,2 / 26,4 / 52,8 | 26,4 / 52,8 | 52,8 | 52,8 |
| Charge current house battery (A) (4) | 120 / 70 | 220 / 120 / 70 | 200 / 110 | 140 | 200 |
| Charge current starter battery (A) | 4 (12V and 24V models only) | | | | |
| Battery temperature sensor | Yes | | | | |
| **GENERAL** | | | | | |
| Auxiliary output (A) (5) | 25 | 50 | 50 | 50 | 50 |
| Programmable relay (6) | 3x | 3x | 3x | 3x | 3x |
| Protection (2) | a-g | | | | |
| VE.Bus communication port | For parallel and three phase operation, remote monitoring and system integration | | | | |
| General purpose com. port | 2x | 2x | 2x | 2x | 2x |
| Remote on-off | Yes | | | | |
| Common Characteristics | Operating temp.: -40 to +65°C Humidity (non-condensing): max. 95% | | | | |
| **ENCLOSURE** | | | | | |
| Common Characteristics | Material & Colour: aluminium (blue RAL 5012) Protection category: IP 21 | | | | |
| Battery-connection | Four M8 bolts (2 plus and 2 minus connections) | | | | |
| 230 V AC-connection | Screw terminals 13 mm² (6 AWG) | Bolts M6 | Bolts M6 | Bolts M6 | Bolts M6 |
| Weight (kg) | 19 | 34 / 30 / 30 | 45 / 41 | 51 | 72 |
| Dimensions (hxwxd in mm) | 362 x 258 x 218 | 470 x 350 x 280<br>444 x 328 x 240<br>444 x 328 x 240 | 470 x 350 x 280 | 470 x 350 x 280 | 572 x 488 x 344 |
| **STANDARDS** | | | | | |
| Safety | EN-IEC 60335-1, EN-IEC 60335-2-29, EN-IEC 62109-1 | | | | |
| Emission, Immunity | EN 55014-1, EN 55014-2, EN-IEC 61000-3-2, EN-IEC 61000-3-3, IEC 61000-6-1, IEC 61000-6-2, IEC 61000-6-3 | | | | |
| Road vehicles | 12V and 24V models: ECE R10-4 | | | | |
| Anti-islanding | See our website | | | | |

1) Can be adjusted to 60 HZ; 120 V 60 Hz on request
2) Protection key:
a) output short circuit
b) overload
c) battery voltage too high
d) battery voltage too low
e) temperature too high
f) 230 VAC on inverter output
g) input voltage ripple too high

3) Non-linear load, crest factor 3:1
4) At 25˚C ambient
5) Switches off when no external AC source available
6) Programmable relay that can a.o. be set for general alarm,
DC under voltage or genset start/stop function
AC rating: 230 V / 4 A
DC rating: 4 A up to 35 VDC, 1 A up to 60 VDC

### Digital Multi Control Panel

A convenient and low cost solution for remote monitoring, with a rotary knob to set PowerControl and PowerAssist levels.

### VE.Bus Smart Dongle

Measures battery voltage and temperature and allows monitoring and control of Multis and Quattros with a smartphone or other

Bluetooth enabled device.

### Computer controlled operation and monitoring

Several interfaces are available:

### Color Control GX and other GX devices

Monitoring and control. Locally, and also remotely on the VRM Portal.

### MK3-USB (VE.Bus to USB interface)

Connects to a USB port (see 'A guide to VEConfigure')

### VE.Bus to NMEA 2000 interface

Connects the device to a NMEA2000 marine electronics network. See the NMEA2000 & MFD integration guide

### BMV-712 Smart Battery Monitor

Use a smartphone or other Bluetooth enabled device to:

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# Connecting other lithium systems to Multis and Quattros

Manual

www.victronenergy.com

## Introduction

Besides connecting one of the Victron Energy Lithium battery systems to a Multi or Quattro, it is also possible to connect a system from another manufacturer. In most installations, the Battery Management Systems (BMS) that comes with a type of lithium battery systems will need to have control over the charging and discharging of the battery. In general they will want to stop the charging process when the maximum cell voltage increases above a threshold, and also they will want to switch off loads that are discharging the battery when the minimum cell voltage drops below its threshold.

## Passive versus active balancing

Depending on the type of balancing, active or passive, and also other features of the BMS and Lithium batteries, the signal to stop the charger can have different causes. In a typical passive balancing system, it might only occur when there is a -too high- imbalance between the cells. An active balancing system could give this signal every time the battery is full. Consult the documentation and/or manufacturer of the used system on how to use the different settings of this assistant and the voltages on the charger tab.

## Cell overvoltage and/or battery full condition

On a signal from the BMS, the Multi can be configured to do two things:

- Switch to float
- Disable charger

The appropriate action depends on the type of BMS used, presence of a master BMS safety contactor, and other specifics of the batteries and BMS. Consult the Lithium Battery and BMS supplier for the appropriate settings.

When using the 'switch to float' option, configure the float voltage on a level where the batteries are no longer being charged. The advantage of switching to float instead of completely switching the charger off is that this reduces unnecessary cycling of the battery.

When using the 'disable charger' option, make note of the following: depending on the model, the Multi will draw a small current from the battery, even when AC input is available and passed through to the loads. This current is drawn by the internal power supply of the control circuitry.

## Cell under voltage and/or battery empty condition

When the BMS signals to the Multi that the battery is empty, the inverter in the Multi will be disabled.

## Requirements

BMS

Above mentioned signals need to be two separate potential free contacts that can be wired to the Multi. On the side of the Multi this is an analogue voltage measurement non-isolated with pullup resistor.
Drawing 1 mA is enough for a 'closed'- signal. Since there is no isolation in the Multi, there needs to be isolation on the BMS side. The recommended and most easy way to implement this is with a small potential free relay contact. Alternatively it is also possible to use an opto-coupler.

Multi or Quattro

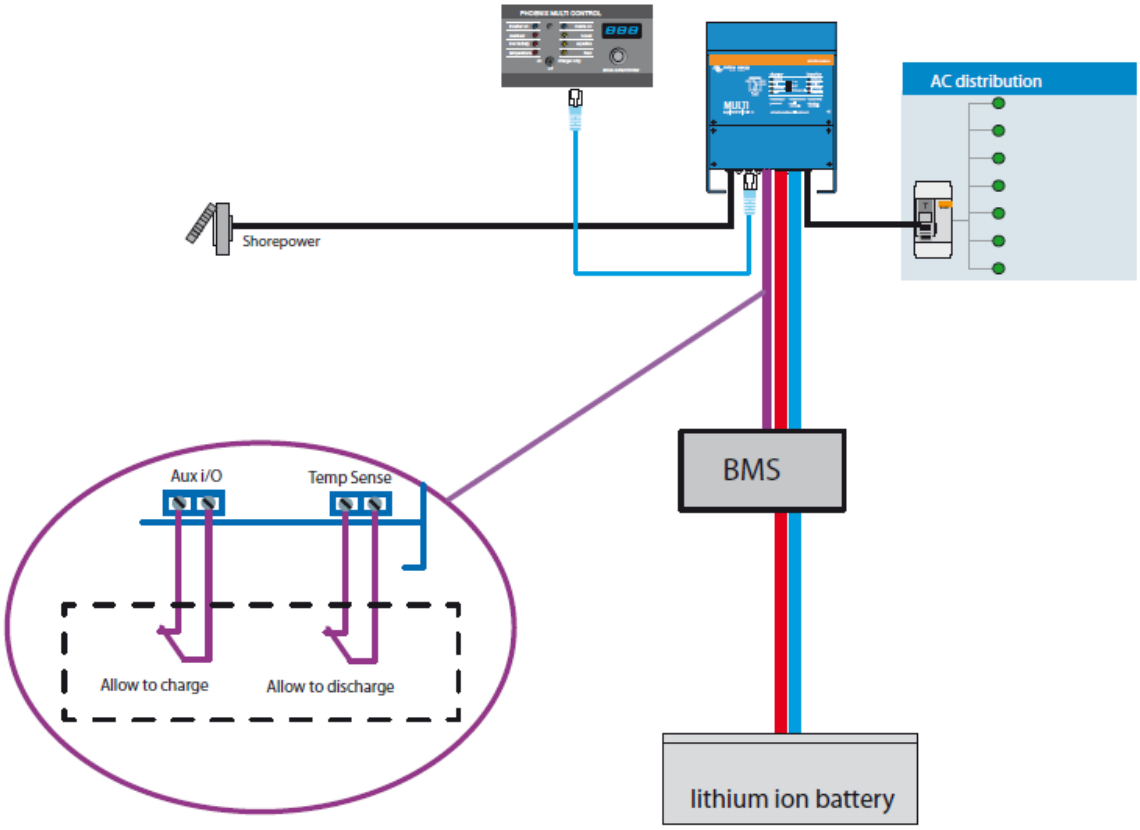
The Multi or Quattro needs to be updated to the latest firmware version. (19xx2xx/20xx2xx or 26xx4xx/27xx4xx)
See the VEConfigure3 Requirements document available on our webpage:
http://www.victronenergy.com/support-and-downloads/software/

The Multi or Quattro needs to be of a recent type that has auxiliary inputs.

Add the assistant "Two-Signal BMS Support" and configure it, and the rest of the VEConfigure3 settings, as required.

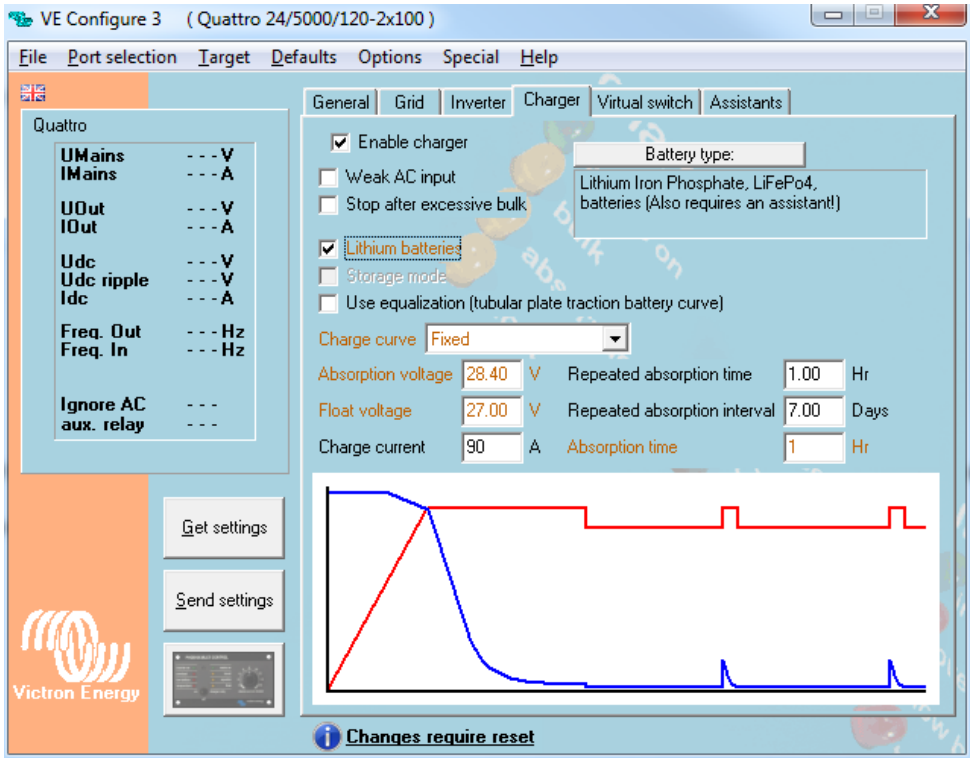
Take extra care when running a parallel or three-phase system. The BMS needs to be wired to one Multi only. The assistant needs to be programmed into all Multis in the system. Follow instruction in the assistant.

### Wiring diagram

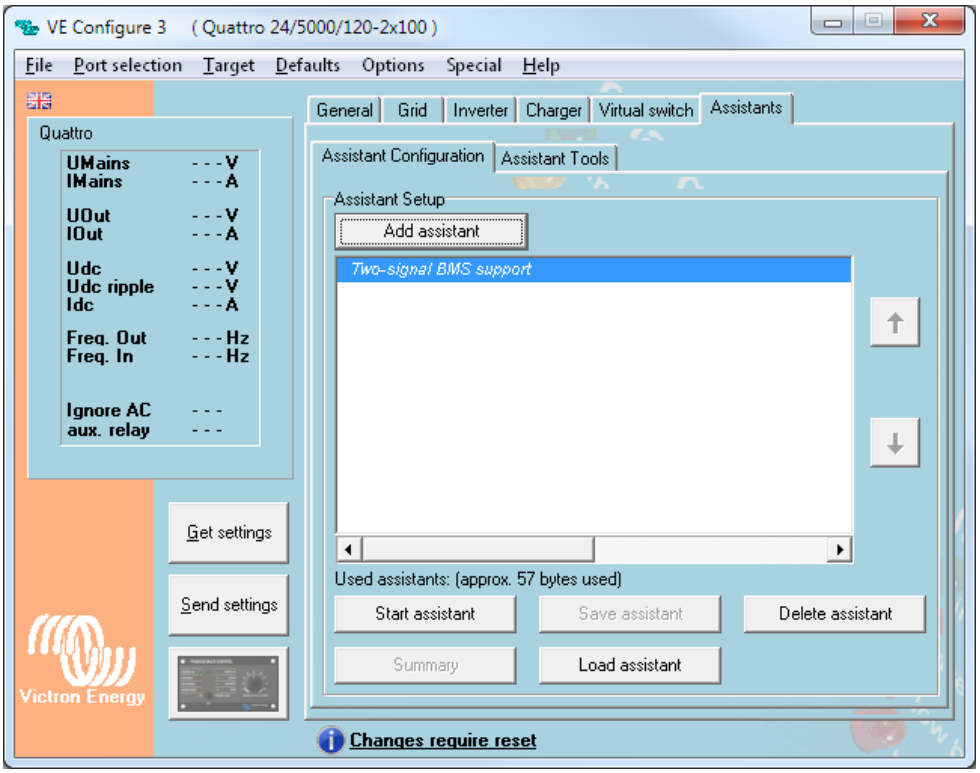


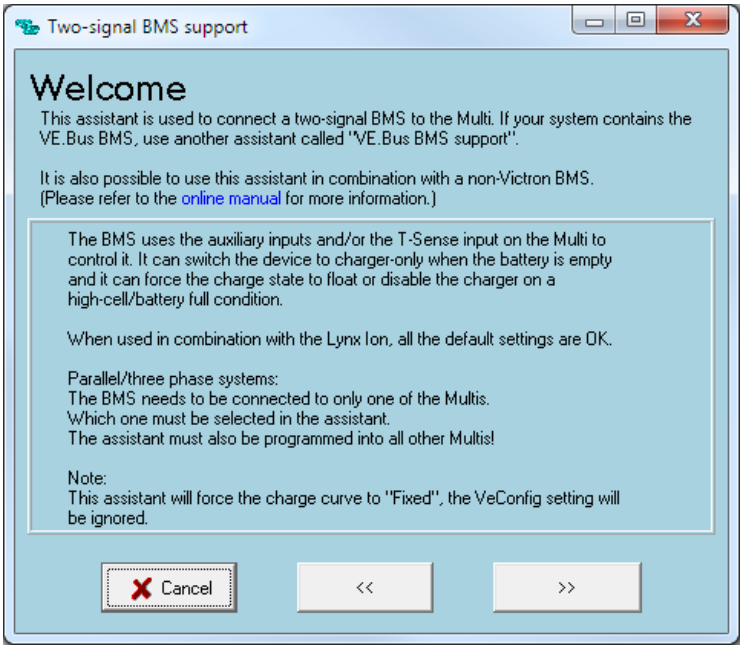

Note; contacts functionality only in combination with Lithium assistant

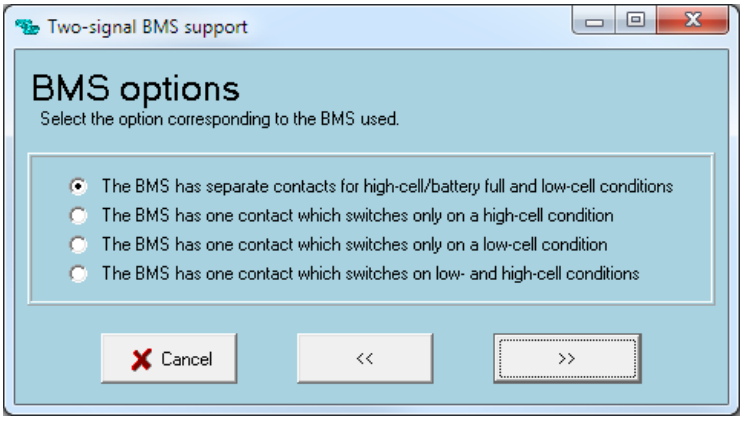
### Charger tab

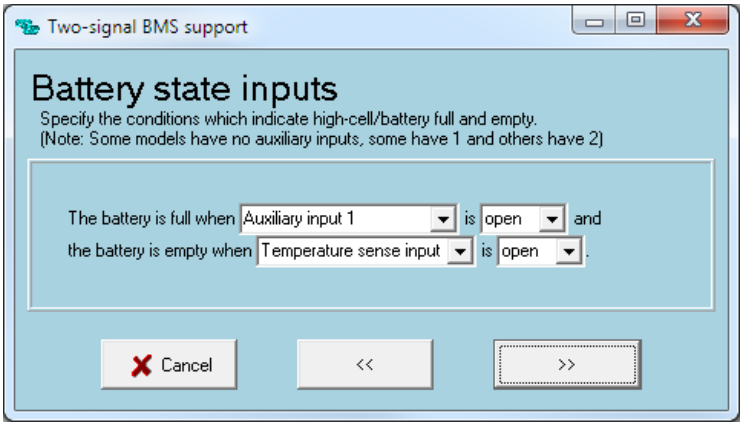

VE Configure 3 ( Quattro 24/5000/120-2x100 )
File Port selection Target Defaults Options Special Help
Quattro
UMains - - - V
IMains - - - A
UOut - - - V
IOut - - - A
Udc - - - V
Udc ripple - - - V
Idc - - - A
Freq. Out - - - Hz
Freq. In - - - Hz
Ignore AC - - -
aux. relay - - -
General Grid Inverter Charger Virtual switch Assistants
Enable charger
Weak AC input
Stop after excessive bulk
Lithium batteries
Storage mode
Use equalization (tubular plate traction battery curve)
Battery type:
Lithium Iron Phosphate, LiFePo4, batteries (Also requires an assistant!)
Charge curve Fixed
Absorption voltage 28.40 V
Float voltage 27.00 V
Charge current 90 A
Repeated absorption time 1.00 Hr
Repeated absorption interval 7.00 Days
Absorption time 1 Hr
Get settings
Send settings
Victron Energy
Changes require reset

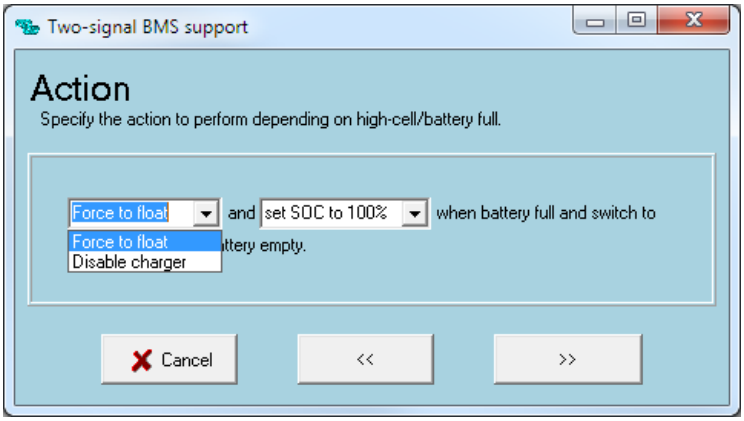
## Screenshots of the Assistant

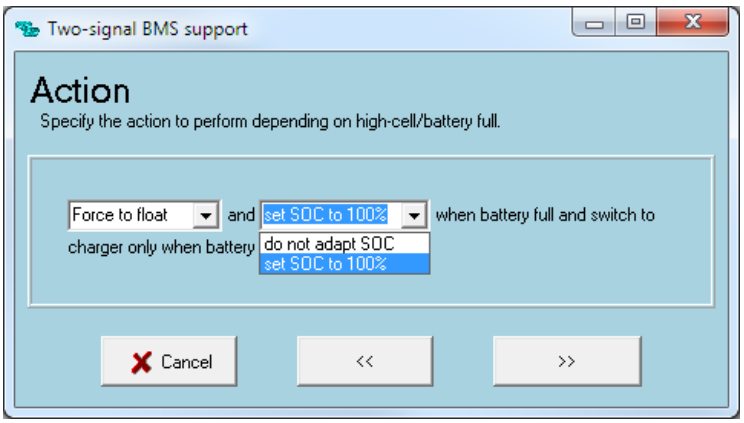


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# Data communication with Victron Energy products

Matthijs Vader

www.victronenergy.com

## Introduction

Many of our customers integrate our products into their own systems, using data communication protocols. There are several options to establish data communication. The purpose of this document is to explain the different options, and help you choose one.

**Communicating to a complete system? Use Modbus-TCP**

Rather than going for direct communication with Inverters, battery monitors or Solar chargers, consider using ModbusTCP. This has two advantages:

1. ModbusTCP is easier than most other protocols
2. Retrieve precalculated system, as available on the Color Control GX

**Looking for internet related protocols? Use the JSON API or MQTT**

Once uploaded to the VRM Portal by a Color Control GX, or another device running our Venus OS, the data can be requested via our VRM JSON API:
https://vrmapi.victronenergy.com/v2/docs

Besides that API, MQTT is also available. More information here: https://github.com/victronenergy/dbus-mqtt/blob/master/README.md

**Integrating into a Marine NMEA 2000 network? See our integration guide:**
https://www.victronenergy.com/live/ve.can:nmea-2000:start

**More information**

As a developer, make sure to also have a look at these two pages:
https://www.victronenergy.com/live/open_source:start
https://github.com/victronenergy/venus/wiki

## Products with data communication

The following product lines have a data communication port, with protocol information available for 3rd parties:

| Product range | Products in that range | Onboard comm. port | 3rd party protocol | How to connect |
|---|---|---|---|---|
| Color Control GX | Gateway to almost all Victron products that have a data communication port | Ethernet | Modbus-TCP | Modbus-TCP |
| Battery monitoring | BMV-600S, BMV-602S and BMV-600HS | BMV-60xS Text (TTL) | CAN and BMV Text | Via interface |
| | BMV-700 and BMV-700H | VE.Direct | VE.Direct | Direct or via interface |
| Inverters | Phoenix Inverter models from 1200 to 5000VA | VE.Bus | CAN and MK2/MK3 | Via interface |
| | Phoenix Inverter 250, 375 and 500VA | VE.Direct | VE.Direct | Direct of via interface |
| Multi Inverter/chargers | Complete range: all Multis and Multi compacts | VE.Bus | CAN and MK2/MK3 | Via interface |
| Quattro's | Complete range | VE.Bus | CAN and MK2/MK3 | Via interface |
| Skylla-i/-IP44 battery chargers | Complete range | VE.Can | CAN | Direct |
| BlueSolar Chargers | BlueSolar MPPT 150/70 and 150/85 (VE.Can) | VE.Can | CAN | Direct |
| | BlueSolar MPPT 75/10 to 150/100 (VE.Direct) | VE.Direct | VE.Direct | Direct or via interface |
| Lynx Ion (Lithium Ion BMS) | Lynx Ion, Lynx Ion + Shunt and Lynx Ion BMS | VE.Can | CAN | Direct |
| Lynx Shunt 1000A VE.Can | Only the Canbus version. | VE.Can | CAN | Direct |
| Peak Power Pack | Complete range | VE.Direct | VE.Direct | Direct or via interface |

## Protocol overview

At Victron Energy we have the following protocols:

| Protocol | 3rd party connections allowed | Topology | Physical | International standard | More information |
|---|---|---|---|---|---|
| Modbus-TCP | Yes (preferred) | | TCP/IP | Modbus-TCP | Further down in this document |
| VE.Direct | Yes (preferred) | Point to point | RS232 / TTL | Proprietary | On our website, see next page for link |
| VE.Can / NMEA2000 | Yes | Drop cables / Daisy chain | CANBUS | J1939 & NMEA2000 | http://www.victronenergy.com/ http://www.nmea.org/ |
| VE.Bus | No | Daisy chain | RS485 | Proprietary | See MK2/MK3 protocol |
| MK2/MK3 Protocol | Yes | Point to point | RS232 | Proprietary | On request |
| BMV Text | Yes | Point to point | RS232 | Proprietary | On our website, see next page for link |
| VE9bit RS485 | No | Point to point | RS485 | Proprietary | Deprecated |



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| | | | | | |
|---|---|---|---|---|---|
| VE.Net | No | Daisy chain | RS485 | Proprietary | Deprecated |

And then there are JSON and MQTT, see introduction.

## NMEA2000 Certified products

This table lists all Victron products that have an NMEA2000 or VE.Can communication port, and the status of NMEA2000 certification. Note that the mentioned NMEA2000 database version number is the database version used by the latest firmware of each product.

| Part number | Product | NMEA2000 Certified? | NMEA2000 DB |
|---|---|---|---|
| ASS030520000 | BMV-60xS to NMEA2000 interface | Yes | v1.301 |
| ASS030520100 | VE.Bus to NMEA2000 interface | Pending a firmware update due to the new AC PGN's | |
| LYN040102100 | Lynx Shunt VE.Can | Yes | v1.301 |
| LYN040301000 | Lynx Ion | No | |
| LYN010100100 | Ion Control | No | v1.301 |
| SCC010070000 | BlueSolar MPPT 150/70 (12/24/36/48V-70A) | No | v2.000 |
| SKI024080000 | Skylla-i battery charger 24V/80A (1+1) | Yes | v2.000 |
| SKI024080002 | Skylla-i battery charger 24V/80A (3) | No | v2.000 |
| SKI024100000 | Skylla-i battery charger 24V/100A (1+1) | Yes | v2.000 |
| SKI024100002 | Skylla-i battery charger 24V/100A (3) | No | v2.000 |

Make sure to read our NMEA 2000 & MFD integration guide: https://www.victronenergy.com/live/ve.can:nmea-2000:start

## Staying up-to-date

Send an email to mvader@victronenergy.com, asking to be on the protocol-mailing-list. If you have received protocol documentation from us by email, you are on this list automatically.

## Details per protocol

VE.Can / NMEA2000

Canbus is the preferred protocol for third parties to communicate with our products. Our CANbus protocol is based on the NMEA2000 and J1939 protocols.

Further down in this document is a list per product with supported NMEA2000 PGNs. All data and settings that are not covered by the NMEA2000 standard PGNs are available through proprietary PGNs. More information is in the manuals of the Canbus-enabled products on our website, and in the document "VE.Can registers - public.docx". Look for it on the Whitepapers page on our website.

Detailed information on the NMEA2000 PGN's is available for purchase on the NMEA website (www.nmea.org). See the NMEA 2000® Appendix B POWER SUBSET.

VE.Direct

VE.Direct is a combination of what we used to call the HEX protocol and the BMV text protocol. It combines the advantages of both: in text-mode the products automatically transmit all important parameters every second. To implement code which reads and interprets this data is extremely simple. If more functionality is needed, such as changing settings, one can switch to the HEX protocol. Communication ports on new Victron products will always be either VE.Can or VE.Direct ports. The VE.Direct port is for products where a full Canbus connection adds to much cost. VE.Direct documentation is available on our website. Look for the VE.Direct Protocol document on: http://www.victronenergy.com/support-and-downloads/whitepapers/. And see also the VE.Direct FAQ: https://www.victronenergy.com/live/vedirect_protocol:faq.



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Modbus TCP

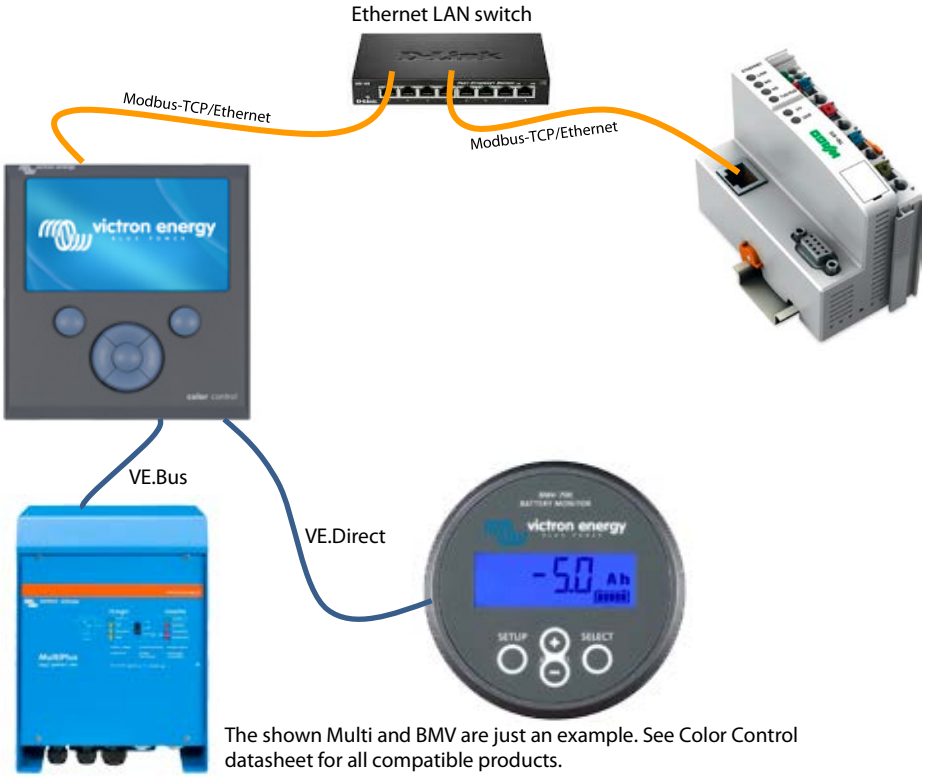
The industry standard Modbus TCP is a well-known and open communication protocol, used in many PLCs and SCADA systems. The Victron Color Control GX acts as a Modbus-TCP gateway. Connect it to the Victron products that you want to monitor, and then communicate from your PLC to the Ethernet LAN port on the Color Control GX. It allows reading information, and writing operational parameters, such as Multi on/off and input current limiter settings. Changing configuration settings, such as battery capacity or float or absorption voltages, is not yet possible.

Check the Color Control GX Datasheet to find out which products are supported by the Color Control GX.

We use the default Modbus TCP port number, which is 502. The unit id, sometimes called 'slave address', specifies what product connected to the CCGX needs to be addressed. See the tab 'Unit ID mapping' in the Modbus-TCP excel sheet. The register addresses are listed on the first tab of the excel sheet, in column C. There are two data types, uint16 and int16. After receiving the value, divide it by the Scale factor to get the value in the unit as specified in column G.

Download the list of registers from our website, look for the CCGX Modbus-TCP register list on http://www.victronenergy.com/support-and-downloads/whitepapers/.

The FAQ page as well as a commenting system to put questions is available on Victron Live: http://www.victronenergy.com/live/ccgx:modbustcp_faq




The shown Multi and BMV are just an example. See Color Control datasheet for all compatible products.



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VE.Bus

VE.Bus is our proprietary protocol used by the Inverters to synchronize their AC outputs. There are VE.Bus communication ports on our Inverters, Multi's and Quattro's. The synchronization feature is mission-critical. Direct third-party connections are not allowed. All interfacing has to be done via Modbus TCP (preferred), "VE.Bus to CANbus/NMEA2000 interface", or via the MK2/MK3:

MK2/MK3 Protocol

The MK2.2 and MK3 provide a galvanically isolated connection to VE.Bus, and it translates the VE.Bus protocol into the "MK2/MK3 Protocol". The MK2/MK3 Protocol allows reading information, turning the device on and off, changing the current limits and configuring a device. To download the document, look for the 'Interfacing with VE.Bus products – MK2/MK3 protocol' on: http://www.victronenergy.com/support-and-downloads/whitepapers/

Note that implementing the MK2/MK3 protocol is a task which is not to be underestimated. It is a complicated protocol, and unless there is a huge commercial interest, we cannot give any support or help during the implementation(!). Make sure to have a look at Appendix 2 in that document, which is an annotated example for a typical UI.

Note that there is no difference in protocol between the MK2 and MK3 interfaces.

BMV-60xS Text Protocol (deprecated)

All of our BMV-600's feature a serial communication interface which allows simple access to detailed battery status information. This protocol only allows reading information from the battery monitor. Setting parameters or 'synchronizing' the BMV is not possible. Documentation is available on our website, look for the BMV60xS Text protocol: http://www.victronenergy.com/support-and-downloads/whitepapers/. Note that this Text protocol is now part of the VE.Direct protocol. The successor of the BMV-600, the BMV-700, works with the VE.Direct protocol. See earlier in this document for more information on the VE.Direct protocol.

VE.Net (deprecated)

VE.Net is a proprietary protocol used by some of our control panels. Third party connections are not possible. New products will not be equipped with VE.Net. They are equipped with VE.Can or VE.Direct instead.

VE 9bit RS485 (deprecated)

This protocol was used to communicate to our Multi's and Quattro's before they had paralleling and three phase capabilities. This protocol is no longer maintained. Documentation is not available.

## Accessories to communicate with VE.Bus (Inverter, Multi, Quattro)

| Partnumber | Product name | RS-232 | Canbus | SMS | Web | Ethernet | SNMP |
|---|---|---|---|---|---|---|---|
| ASS030120200 | Victron Interface MK2.2b – RS232 | X | | | | | |
| ASS030130000 | Victron Interface MK2-USB | X[1] | | | | | |
| ASS030140000 | Victron Interface MK3-USB | X[2] | | | | | |
| ASS030520100 | VE.Bus to NMEA2000 interface | | X | | | | |
| ASS030520105 | VE.Bus to VE.Can interface | | X[3] | | | | |
| BPP000300100R | Color Control GX | | X | | X | X | |
| VGR000200000 | Victron Global Remote 2 | | | X | X | | |
| VGR200100000 | Victron Ethernet Remote | | | X | X | X | X |

## Accessories to communicate with a VE.Direct product

| Partnumber | Product name | RS-232 | Canbus | SMS | Web | Ethernet | SNMP |
|---|---|---|---|---|---|---|---|
| ASS030530000 | VE.Direct to USB interface | | | | | | |
| ASS030520500 | VE.Direct to RS232 | X | | | | | |
| ASS030520300 | VE.Direct to NMEA2000 interface | | X | | | | |
| ASS030520400 | VE.Direct to VE.Can interface | | X[4] | | | | |
| BPP000300100R | Color Control GX | | X | | X[5] | X | |

1 The Victron Interface MK2-USB is an MK2.2b with built-in RS232 to USB Converter.
2 The Victron interface MK3-USB also has a built-in RS232 to USB Converter. There is no RS232 version of the MK3 available.
3 The VE.Bus to VE.Can interface is the same as the VE.Bus to NMEA2000 interface. The only difference is the canbus connection. The VE.Bus to VE.Can interface has two RJ-45 sockets; the other one has the NMEA2000 Micro-c plug.
4 The VE.Direct to VE.Can interface is the same as the VE.Direct to NMEA2000 interface. The only difference is the canbus connection. The VE.Direct to VE.Can interface has two RJ-45 sockets; the other one has the NMEA2000 Micro-c plug.
5 Data, including historic data, can be accessed via https://vrm.victronenergy.com. All data is stored in our database. Logs can be downloaded, see chapter "Getting the data from VRM".



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## Accessories to communicate with a BMV-60xS battery monitor

| Partnumber | Product name | RS-232 | Canbus | SMS | Web | Ethernet | SNMP |
|---|---|---|---|---|---|---|---|
| ASS030071000 | BMV Data Link RS232 | X | | | | | |
| ASS030520000 | BMV-60xS to NMEA2000 interface | | X | | | | |
| ASS030520020 | BMV-60xS to VE.Can interface | | X | | | | |
| VGR000200000 | Victron Global Remote 2[6] | | | X | X | | |
| VGR200100000 | Victron Ethernet Remote[7] | | | X | X | X[8] | X |

## FAQ – General

Q1: Do I need an MK2 or MK3 for each product in a system with multiple VE.Bus products in parallel or three-phase?
No. Per VE.Bus system you need only one of those interfaces.

Q2: Do I need a VE.Bus to NMEA2000 interface for each product in a system with multiple VE.Bus products in parallel or three-phase?
No. Per VE.Bus system you need only one of those interfaces.

Q3. Why is it not possible that my application directly communicates with the Victron via VE.Bus messages?
VE.Bus is our proprietary protocol used by the Inverters to synchronize their AC outputs. It is not possible to connect directly because as soon as other people are on that bus we cannot guarantee the proper working of paralleled and three-phase operations. Note that even in all our own display and control products that talk to VE.Bus, for example the Color Control GX and the VE.Bus to NMEA2000 interface, we have an MK2/MK3 IC. So even at Victron we are not talking directly to VE.Bus.

## FAQ – Canbus communication

Q10: Which version of J1939 is actually implemented (J1939/11, J1939/15, J1939/14...)?
We are using the NMEA2000 protocol, which is based on ISO 11783-3 (Datalink Layer) and ISO 11783-5 (Network management). ISO 11783-3 is virtually identical to the SAE data link layer SAE J1939-21. The network layer (ISO 1183-5) is based on SAE J1939-81. For more information, see also http://www.nmea.org/content/nmea_standards/white_papers.asp.

Q11: Is the bus speed 250kbps?
Yes, the bus speed is 250kpbs

Q12: Is the identifier extended (29-bits)?
Yes, the ISO11783 standard defines the use of the extended identifier (29-bits).

Q13: Are the data fields always 8 bytes long?
Yes, the data fields are always 8 bytes long.

Q14: Can you send us the PGN definition?
This detailed documentation has to be bought from the NMEA website. You can buy the Power PGN's at http://www.nmea.org/store/index.asp?show=pdet&pid=322&cid=7. The product name is "NMEA 2000® Appendix B POWER SUBSET PGN (NMEA Network Messages) – Electronic", USD 500,= for non-members. Note that for the VE.Bus AC messages you need some SAE documentation as well. More information on the used PGN's is further down below in this document.

Q15: Are all the messages broadcasted or do they have to be requested/polled?
The important messages (AC status, Battery status, etc.) are broadcasted. Others have to be polled.

Q16: Do I need to terminate the canbus?
Yes you do. Use one 120Ohm 0,25W 5% resistor at both ends of the canbus. Connect it between CAN-H and CAN-L. Victron Energy sells a set of VE.Can terminators with part number ASS030700000.

[6] The Victron Global Remote has two communication ports. It can connect to a BMV and a VE.Bus product or system at the same time.
[7] The Victron Ethernet Remote has only one communication port, it can connect to one device.
[8] Data can be accessed via a local, password secured, website, running on a web server in the Victron Ethernet Remote. Note that only the current values can be accessed. Historic data is not available on the local web server.



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Q17: Do I need to power the canbus?
That differs per product. Some products power the canbus themselves others don`t. To power the canbus, supply anywhere between 9 and 36Volts to V+ and V-. See also the pin outs below. A small list at the time of writing:

| | |
|---|---|
| Skylla-i | Powers the canbus, isolated |
| Skylla-IP44 | Powers the canbus, non-isolated |
| Lynx Shunt VE.Can | Powers the canbus, isolated |
| Lynx Ion BMS | Powers the canbus, isolated |
| Lynx Ion + Shunt | Powers the canbus, isolated |
| Lynx Ion | Does not power the canbus, depends on the Lynx Shunt VE.Can to power both the VE.Can and the BMS canbus |
| Color Control GX | Does not power the canbus, and needs a powered canbus to operate |
| VE.Bus to NMEA2000 interface | Does not power the canbus, and needs a powered canbus to operate |
| VE.Bus to VE.Can interface | Does not power the canbus, and needs a powered canbus to operate |
| BMV-60xS to NMEA2000 interface | Does not power the canbus, and needs a powered canbus to operate |
| VE.Direct to NMEA2000 interface | Does not power the canbus, and needs a powered canbus to operate |
| VE.Direct to VE.Can interface | Does not power the canbus, and needs a powered canbus to operate |
| BlueSolar MPPT 150/70 | Does power the canbus, not isolated. See manual for info on a resistor that is mounted to prevent ground loops. |

The mentioned 9 to 36Volt is conform the NMEA2000 standards. Most of our products accept an input voltage from 7 to 70VDC, see the datasheets.

Q18: What is the difference between NMEA2000 and VE.Can?
The only difference is in the physical connection and the isolation:

| | **VE.Can** | **NMEA2000** |
|---|---|---|
| Physical connector | RJ-45 | Micro-C |
| Isolation | Differs per product, see Q17 above and/or datasheet | Always |

Q19: What is the pin out of VE.Can?
The two RJ-45 sockets on each product that has VE.Can are paralleled. Note that we use RJ-45 also for VE.Bus or VE.Net connections, see the datasheet to make sure that your product has a VE.Can connection.

| | |
|---|---|
| 1 | Not connected |
| 2 | Not connected |
| 3 | NET-C (V-) |
| 4 | Not connected |
| 5 | Not connected |
| 6 | NET-S (V+) |
| 7 | CAN-H |
| 8 | CAN-L |

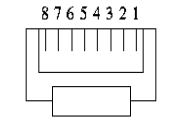


*Figure 1:*
*End view of RJ45 Plug*

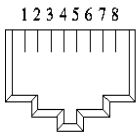
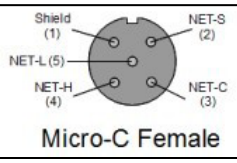


*Figure 2:*
*Looking into an RJ45 Jack*

Q20: What is the pin out of NMEA-2000?

| | |
|---|---|
| 1(brown): | Shield |
| 2(red): | NET-S (V+) |
| 3(black): | NET-C (V-) |
| 4(white): | NET-H (CAN-H) |
| 5(blue): | NET-L (CAN-L) |




Q21: I do not want to implement the full ACL procedure, what fixed source address shall I use?
Address 0xFE is reserved for when you cannot perform an ACL (Address Claim) procedure. You are free to use this address. See also Q24.

Q22: What is Victron's NMEA2000 manufacturer code?
It is 358 (0x166)



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Q23: Instances: I have multiple BMV's (or another canbus product) in the same network, how do I address them?
You need to use instances to differentiate between multiple similar products in the same network. There are different types of instances within NMEA2000:

*Device instance*
The device instance is sent in PGN 0xEE00, ISO Address Claim, as a combined field of Device Instance Lower (ISO ECU Instance) and Device Instance Upper (ISO Function Instance).
The Device instance is used by Victron chargers (Skylla-i/-IP44, VE.Can MPPTs) to configure them in the same group and synchronize them.

*Data instances (Battery Instance, DC Detailed Instance, Switch bank instance, etc.)*
These instances are embedded in the different PGN's. All Victron products support changing these instances through a complex write, PGN 0x1ED00, Complex Request Group Function Code 5, write fields.

*System instance*
The system instance is also sent in PGN 0xEE00, field 8. It is not used. All Victron products do support changing this instance by sending a complex command.

**Instance conflicts**
If you have connected multiple products sending out the same PGN with the same data instance number, you might encounter a data instance conflict. Typically this can be seen on display's showing an alternating value. E.g. The VE.Direct to NMEA2000 interface and VE.Bus to NMEA2000 interface are both sending out PGN 127508 with Battery instance 0. To solve this issue one of the Battery instances needs to be changed to another (unique) number. We recommend to change the Battery instance of the VE.Bus to NMEA2000 instance to 5.

More information about changing instances is here: http://www.victronenergy.com/documentation/ve.can:changing_nmea2000_instances.

**Display manufacturers**
The display manufacturers use different types of instances to show data for multiple batteries, inverters or chargers:

Garmin needs the data-instances to be different.

Raymarine needs the device instance to be different in order to show information for (for example) multiple batteries. They use the data-instance to connect multiple products, for example gps-es, as a way of redundancy.

Maretron sometimes needs the data-instances to be different, and some other times they need to device instance to be different.
Note: this information about other manufacturers is mostly learned by experience. If you have more information about this, which could be useful to others, please let us know via mvader@victronenergy.com.

Q24: Do the Victron VE.Can and NMEA2000 products used fixed network address or do they support NMEA address claim ISO 602928?
All our products have implemented the address claim procedure. See also Q21.

Q25: I want to read the State of Charge (0 to 100%) as calculated by the Multis and Quattros. I do understand that this SOC is only reliable if there are no DC loads or other battery chargers in the system (almost impossible on a boat, but in a self-consumption system this is very possible). And I cannot find the SOC in the PGNs.
Correct, the information is in PGN 127506, but transmission of that PGN is disabled by default, because it is not valid in all systems. To enable transmission of this PGN, change the transmission interval. To do this at protocol level, see NMEA2000 documentation, PGN 126208 - NMEA - Request group function (field 1 = 0x00). And then field 3, transmission interval. To do this at PC level, use Actisense NMEA Reader or other PC software that has this functionality.

Q26: Which products have a bag of VE.Can RJ-45 terminators included?
These products are shipped with two pieces of VE.Can RJ-45 terminators:

- Color Control GX
- MPPT 150/70 and MPPT 150/85 Solar Charge Controllers
- Lynx Ion + Shunt all models
- Lynx Ion BMS all models
- Lynx Shunt VE.Can
- VE.Bus to VE.Can interface
- VE.Direct to VE.Can interface
- Skylla-i control
- CANUSB

These products are shipped without:

- Ion Control (not necessary since terminators *are* included with the Lynx Ion + Shunt)
- BMV-60xS to VE.Can interface
- VE.Can to NMEA2000 Micro-C male cable
- VE.Can resistive tank sensor (not necessary, terminators are included with the CCGX)

Note that it will normally not be necessary to purchase the terminators separately.



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## Canbus PGN overview per product

Use below tables to see where to find what data. There is a freely available PDF file on the NMEA2000 website that also gives a good overview. Go to http://www.nmea.org/content/nmea_standards/downloads.asp, and then the link called "NMEA2000 Parameter Group Descriptions (Messages) with Field Description". To get the detailed information in order to decode the PGNs, see Q14 in the FAQs.

VE.Bus products (Multi's, Quattro and Inverters)

| Data | PGN Name | PGN dec | PGN hex | Field | Remarks |
|---|---|---|---|---|---|
| Battery voltage | Battery Status | 127508 | 0x1F214 | 2 | |
| Battery current | Battery Status | 127508 | 0x1F214 | 3 | |
| State of Charge (%) | DC Detailed Status | 127506 | 0x1F212 | 4 | This PGN is disabled by default, since the reported value is only valid in systems with no other chargers or dc loads. Use the proper NMEA method to enable it, which is a complex request. |
| Battery temperature | Battery Status | 127508 | 0x1F214 | 4 | |
| Charger on/off switch | Charger Status | 127507 | 0x1F213 | 5 | |
| Charge state | Charger Status | 127507 | 0x1F213 | 3 | Off, bulk, absorption, float etcetera. |
| Inverter on/off switch | Inverter Status | 127509 | 0x1F215 | 5 | |
| Inverter Operating State | Inverter Status | 127509 | 0x1F215 | 4 | Off, inverting, etcetera. |
| L1 AC input voltage | J1939-75 PGN | 65014 | 0xFDF6 | | AC input information is sent from a different network address than all other PGNs. To distinguish, use the device function code from the ACL PGN, which is "154 AC Input monitor" for the AC input information. All other PGN's are sent with device function code "153 Inverter". See manual for more information. |
| L1 AC input current | J1939-75 PGN | 65014 | 0xFDF6 | | |
| L1 AC input frequency | J1939-75 PGN | 65014 | 0xFDF6 | | |
| L1 AC input power | J1939-75 PGN | 65013 | 0xFDF5 | | |
| L1 AC output voltage | J1939-75 PGN | 65014 | 0xFDF6 | | These parameters are sent per phase, see manual for information about all phases. |
| L1 AC output current | J1939-75 PGN | 65014 | 0xFDF6 | | |
| L1 AC output frequency | J1939-75 PGN | 65014 | 0xFDF6 | | |
| L1 AC output power | J1939-75 PGN | 65013 | 0xFDF5 | | |
| Warnings and alarms | Binary Switch Bank Status | 127501 | 0x1F20D | | Switch bank instance 0 |
| LED states | Binary Switch Bank Status | 127501 | 0x1F20D | | Switch bank instance 1. This message is by default not enabled, see manual on how to enable it. |

The Battery instance from PGNs 127508 (field 1), DC Instance from PGN 127506 (field 2) and PGN 127509 (field 3) and Charger Instance from PGN 127507 (field 1) are the same number. Changing one of the instances will change all of the mentioned instances.
See the VE.Bus to NMEA2000 interface manual for more details (https://www.victronenergy.com/accessories/ve-bus-to-nmea2000-interface).

Skylla-i/-IP44 battery charger family

| Data | PGN Name | PGN dec | PGN hex | Field | Remarks |
|---|---|---|---|---|---|
| Battery voltage | Battery Status | 127508 | 0x1F214 | 2 | The 3-output model has 3 instances of PGN 0x1F214, one for each output. Field 1 of this PGN, Battery Instance is used to distinguish between them. |
| Battery current | Battery Status | 127508 | 0x1F214 | 3 | |
| Battery temperature | Battery Status | 127508 | 0x1F214 | 4 | |
| Relay and alarms | Binary Switch Bank Status | 127501 | 0x1F20D | | |
| Charger state | Converter Status | 127750 | 0x1F306 | 3 | Off, bulk, absorption, float etcetera. |
| AC input current | AC Power / Current Phase | 127744 | 0x1F300 | 3 | AC RMS Current |
| Charger on/off | Charger Status | 127507 | 0x1F213 | 5 | DEPRECATED: PGNs 127507 and 127503 are deprecated in favor of 127750 and 127744<br><br>They are not being transmitted by default. They can still be requested though, and also they can be configured to be transmitted on an interval. |
| Charge state | Charger Status | 127507 | 0x1F213 | 3 | |
| AC input current[9] | AC Input Status | 127503 | 0x1F20F | 7 | |
| Equalization pending | Charger Status | 127507 | 0x1F213 | 6 | |
| Equal. time remaining | Charger Status | 127507 | 0x1F213 | 8 | |

Note that the Skylla-i/-IP44 will switch off when there is no mains available. It will therefore also stop sending and responding to Canbus messages.

[9] The AC Input Status PGN 127503 is not present on the Skylla-IP44



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BlueSolar MPPT 150/70 and 150/85

| Data | PGN Name | PGN dec | PGN hex | Field | Remarks |
|---|---|---|---|---|---|
| Battery voltage | Battery Status | 127508 | 0x1F214 | 2 | Battery instance 0 |
| Battery current | Battery Status | 127508 | 0x1F214 | 3 | Battery instance 0 |
| Battery temperature | Battery Status | 127508 | 0x1F214 | 4 | Battery instance 0 |
| PV voltage | Battery Status | 127508 | 0x1F214 | 2 | Battery instance 1 |
| PV current | Battery Status | 127508 | 0x1F214 | 3 | Battery instance 1 |
| Relay and alarms | Binary Switch Bank Status | 127501 | 0x1F20D | | |
| Charger state | Converter Status | 127750 | 0x1F306 | 3 | Off, bulk, absorption, float etcetera. |
| Charger on/off | Charger Status | 127507 | 0x1F213 | 5 | DEPRECATED: PGN 127507 is deprecated in favor of 127750.<br><br>They are not being transmitted by default. They can still be requested though, and also they can be configured to be transmitted on an interval |
| Charge state | Charger Status | 127507 | 0x1F213 | 3 | |
| Equalization pending | Charger Status | 127507 | 0x1F213 | 6 | |
| Equal. time remaining | Charger Status | 127507 | 0x1F213 | 8 | |

The Battery instance for PGNs 127508 can be changed. After you did that, you can still distinguish between the Battery and PV information by looking at the DC detailed status PGN, 127506 0x1F212. It will report the DC Type, field 3, as Battery or Solar Cell. Field 2, DC Instance, equals the Battery instance in the Battery Status PGN for battery and solar information.

BMV-60xS and BMV-700 Battery Monitors

| Data | PGN Name | PGN dec | PGN hex | Field | Remarks |
|---|---|---|---|---|---|
| Battery voltage | Battery Status | 127508 | 0x1F214 | 2 | Battery Instance 0 |
| Battery current | Battery Status | 127508 | 0x1F214 | 3 | Battery Instance 0 |
| State of Charge (%) | DC Detailed Status | 127506 | 0x1F212 | 4 | DC instance 0 |
| Time Remaining | DC Detailed Status | 127506 | 0x1F212 | 6 | DC instance 0 |
| Consumed Ah | Proprietary VREG 0xEEFF | 61439 | 0xEFFF | | Is also broadcasted at 1.5 seconds interval, see manual. |
| Starter battery voltage | Battery Status | 127508 | 0x1F214 | 2 | Battery Instance 1. Only sent for BMV-602. |
| Relay and alarms | Binary Switch Bank Status | 127501 | 0x1F20D | | See manual for more information |

Notes:

- Battery instance 0 and DC Instance 0 are the same instance number, only the name is different in the NMEA2000 documentation.
- Above table is valid for the latest firmware version of the BMV to NMEA2000 interface cable, v1.06. Previous firmware versions used PGN 127502 instead of 127501 to report relay and alarm status.

See the manual of the BMV to NMEA2000 Interface for more details (https://www.victronenergy.com/accessories/ve-direct-to-nmea2000-interface).

Lynx Shunt VE.Can

| Data | PGN Name | PGN dec | PGN hex | Field | Remarks |
|---|---|---|---|---|---|
| Battery voltage | Battery Status | 127508 | 0x1F214 | 2 | Battery instance 0. This voltage is measured before the main fuse. |
| Fused voltage | Battery Status | 127508 | 0x1F214 | 2 | Battery instance 1. This voltage is measured after the main fuse. |
| Battery current | Battery Status | 127508 | 0x1F214 | 3 | Battery instance 0 |
| Battery temperature | Battery Status | 127508 | 0x1F214 | 4 | Battery instance 0 |
| State of Charge (%) | DC Detailed Status | 127506 | 0x1F212 | 4 | DC instance 0 |
| Time Remaining | DC Detailed Status | 127506 | 0x1F212 | 6 | DC instance 0 |
| Consumed Ah | Proprietary VREG 0xEEFF | 61439 | 0xEFFF | | Is also broadcasted at 1.5 seconds interval. |
| Relay and alarms | Binary Switch Bank Status | 127501 | 0x1F20D | | Switch instance 0 |

Note that Battery instance 0 and DC Instance 0 are the same instance number, only the name is different in the NMEA2000 documentation.



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Lynx Ion, Lynx Ion + Shunt and Lynx Ion BMS

| Data | PGN Name | PGN dec | PGN hex | Field | Remarks |
|---|---|---|---|---|---|
| Battery pack voltage | Battery Status | 127508 | 0x1F214 | 2 | Battery instance 0 |
| Battery pack current | Battery Status | 127508 | 0x1F214 | 3 | Battery instance 0 |
| Battery pack highest temperature | Battery Status | 127508 | 0x1F214 | 4 | Battery instance 0 |
| State-Of-Charge (SOC) | DC detailed Status | 127506 | 0x1F212 | 4 | DC instance 0 |
| Time-To-Go (TTG) | DC detailed Status | 127506 | 0x1F212 | 6 | DC instance 0 |
| Lowest cell voltage in pack | Battery Status | 127508 | 0x1F214 | 2 | Battery instance 1 |
| Highest cell voltage in pack | Battery Status | 127508 | 0x1F214 | 2 | Battery instance 2 |
| Battery voltage | Battery Status | 127508 | 0x1F214 | 2 | Battery instance 10 t/m 25 |
| Battery temperature | Battery Status | 127508 | 0x1F214 | 4 | Battery instance 10 t/m 25 |

Notes:

- Both the Lynx Ion and the Lynx Shunt VE.Can are sending Battery pack voltage and Battery pack current. Distinction can only be made on product id.
- Battery instance 0 and DC Instance 0 are the same
- One or more 24V 180Ah batteries together in one system are a Battery pack.
- One 24V 180Ah battery, consisting of 8 cells is a Battery.



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## DEPRECATED: Getting data from VRM with wget

Use the JSON API for this, instead of wget. See: https://vrmapi.victronenergy.com/v2/docs

## DEPRECATED: VRM Juice API

Use the new JSON VRM API, instead of Juice. See https://vrmapi.victronenergy.com/v2/docs

## Links to interesting products

Note that we have not tested all these products, and they are not affiliated to Victron Energy in any way. We do not take any responsibility.

Consider using our own Color Control GX as the Victron to ModbusTCP converter, instead of below products.

1. NMEA2000 to Modbus RS485 converter by Offshore Systems (UK) Ltd:
   http://www.osukl.com/3155.htm

2. Converters from NMEA2000 to a variety of protocols, one of them is Modbus:
   http://www.adfweb.com/home/products/NMEA2000_Conveters.asp?frompg=nav14_2

3. RS232 to Ethernet/LAN Converter. Works well with the BMV Text Protocol. With the MK2/MK3 Protocol it is not very stable. The ATOP SE5001-S2
   http://www.atop.com.tw/en/productList2.php?pl1_id=2



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## Document History

| Rev. | Date | Name | Details |
|---|---|---|---|
| 1 | | Matthijs Vader | Initial version |
| 2 | | Matthijs Vader | Changed 9bit protocol from Daisy Chain to point to point. |
| 3 | | Matthijs Vader | Added FAQ section for the Canbus communication. |
| 4 | 2012-jan-24 | Matthijs Vader | Added names of the VE.Bus and BMV protocol documents. And added link to Canbus manuals on our website. |
| 5 | 2012-may-3 | Matthijs Vader | Canbus is the preferred protocol.<br>Added list of products, and how to connect via Canbus.<br>Added information on the HEX protocol.<br>BMV Protocol is now available on our website.<br>Various rewording and layout changes.<br>Added 'Staying-up-to-date'.<br>Added several items to the FAQ. |
| 6 | 2012-june-29 | Matthijs Vader | Added Q3 to the FAQ (29 bits identifier)<br>Changed Q7 (termination resistors)<br>Inserted Q8 (powering the Canbus) |
| 7 | 2012-nov-19 | Matthijs Vader | Added Q12 (network address without ACL procedure)<br>Added chapter "Canbus PGN overview per product"<br>Renumbered Canbus FAQ |
| 8 | 2012-nov-21 | Matthijs Vader | Added NMEA2000 to Modbus RS485 converter by Offshore Systems (UK) Ltd |
| 9 | 2013-feb-2 | Matthijs Vader | Changed the colors mentioned at Q20, NMEA 2000 cable pin out<br>Added PGN DC Detailed Status 127506 0x1F212 to the VE.Bus PGNs<br>Changed PGN Number 127502 to 127501 in the VE.Bus PGNs<br>Added 7 to 70VDC to Q17<br>Remarked that VE.Bus Switch bank instance 1 is by default not enabled.<br>Added column to product table: onboard comm. Port<br>Added PGN 127501 to list of Skylla-i and BlueSolar MPPT 150/70 PGNs<br>Added information about instances, Q23<br>Changed the information in Getting the data from VRM with information for the new VRM website<br>Replaced HEX with VE.Direct |
| 10 | 2013-apr-20 | Matthijs Vader | Added comment about Consumed Ah for BMV-60xs and Lynx Shunt VE.Can<br>Added Q24<br>Added table on certified products. |
| 11 | 2013-july-7 | Matthijs Vader | Added note that Battery instance and DC instance are the same to BMV-60xS, Lynx Ion and Lynx Shunt VE.Can<br>Updated BMV Canbus table, binary switch bank status instead of control. |
| 12 | 2013-august-7 | Matthijs Vader | Added note that Battery instance and DC instance are the same to BMV-60xS, Lynx Ion and Lynx Shunt VE.Can<br>Updated BMV Canbus table, binary switch bank status instead of control.<br>Fixed typo: a VE.Net to BMV2000 interface was mentioned. Should have been BMV-60xS to NMEA2000. |
| 13 | 2013-august-13 | Matthijs Vader | Added info to Q16, termination |
| 14 | 2014-february-3 | Matthijs Vader | Added part number of our terminators to Q16<br>Updated VE.Can/NMEA2000 protocol section<br>Added new interfaces (…. to VE.Can interface)<br>Added NMEA2000 database version numbers<br>Added new interfaces such as VE.Direct to RS232 interface<br>Added Modbus-TCP |
| 15 | 2014-March-24 | Matthijs Vader | Updated getting data from VRM with wget section<br>Added VRM JSON API link |
| 16 | 2014-May-30 | Matthijs Vader | Added (JUICE) on page 10.<br>Updated Modbus-TCP: available<br>Added new solar chargers |
| 17 | 2014-May-31 | Matthijs Vader | Added more information and example on Modbus-TCP |
| 18 | 2014-Sept.-26 | Matthijs Vader | Modbustcp now also supports writing values (multi on/off and input current limit)<br>Added Q25 on VE.Bus SOC<br>Added link to changing NMEA2000 instances information on Victron Live. |
| 19 | 2014-Dec-04 | Matthijs Vader | Changed ModbusTCP text: it still said that it was read only in some places.<br>Moved ModbusTCP FAQ to Victron Live. |
| 20 | 2015-Jan-27 | Matthijs Vader | Updated download links, almost all documents are now downloadable from our website instead of needing to ask us by email for one.<br>Added link to Juice API page on Victron Live. |
| 21 | 2015-Aug-27 | Matthijs Vader | Chapter 'Getting data from VRM with wget': changed download link for 'Template to retrieve data' |
| 22 | 2016-Feb-1 | Matthijs Vader | Added Q26; products that are shipped with or without VE.Can RJ-45 terminators |
| 23 | 2016-Apr-13 | Matthijs Vader | Added Phoenix Inverters 250, 3675 and 500VA VE.Direct inverters |



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| | | | |
|---|---|---|---|
| | | | Added link to VE.Direct protocol FAQ as well as VE.Direct RS232 interface<br>More small cleanups and updates left and right |
| 24 | 2016-Nov-18 | Matthijs Vader | Skylla-i and Solar Charger with VE.Can connection: 127503 and 127507 are deprecated in favor of 127750 and 127744 |
| 25 | 2016-Nov-30 | Matthijs Vader | Reworded introduction, putting more focus on ModbusTCP<br>Deprecated the Juice and wget methods of getting data from vrm. |
| 26 | 2017-May-10 | Matthijs Vader | Added info on MK3-USB |
| 27 | 2017-Sept.-21 | Martin Bosma | Added info about battery instances for VE.Bus to NMEA 2000/VE.Can interface<br>Added Skylla-IP44 and Lynx Ion BMS<br>Updated text of Q23 and added text about instance conflicts |



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# Operating a MultiPlus or Quattro in parallel with an Engine Driven Inverter System

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## Engine Driven Inverter System or Variable speed AC Generator

A variable speed AC generator, like for instance a Dynawatt or a Dometic Travelpower generator, will produce a constant voltage of 230VAC when mounted to the engine of a vehicle or boat. Due to a DC-AC converter mounted to the generator both value and frequency of the generated voltage are (within limits) independent of the engine's speed. A major drawback using this concept is that the power output of these units depends on the engine's speed. In case the engine is running idle or at low speed, the alternator just does not generate power at all *(RPM<3000)* or performs at a fraction of its maximum rating *(3000<RPM<7000)*. So, when a large load is switched on while the engine is at low speed, there just may not be enough power available.
Due to the resulting power shortage, these alternator systems may stall or even get damaged beyond repair.
Another issue within mobile applications is the charging of the DC battery in case the original DC alternator was replaced by an AC alternator. One would then need additional equipment to provide solid DC power to charge the vehicle's battery and/or feed other DC loads aboard. This equipment will draw power from the AC alternator as well and using such equipment will therefore have a negative effect on the alternators performance.

A solution for these issues is to install one or more Victron MultiPlus *(or Quattro)* inverter/chargers in between of alternator and load. A unique feature, found only on the MultiPlus and Quattro models, called *'PowerAssist'* enables them to charge the batteries whenever the alternator generates a surplus of energy and is able to generate additional AC power whenever the alternator does not generate enough to feed the full AC load.
This means that when the engine is at moderately high speed, the installed batteries will be charged by the MultiPlus *(or Quattro)* using the optimum procedure. On the other hand, when the engine is at low speed and the alternator just cannot generate sufficient power by itself, the MultiPlus *(or Quattro)* will generate the additional AC power required to supply the existing AC load.

The most important requirement for the installation to perform as described is to have knowledge of the engine's actual speed *(the alternator's speed)*. In theory, this could be done by measuring the alternator's AC output but practice has shown that this method is not reliable enough. Being aware of this problem, Victron Energy engineered and created an interface module to measure the actual alternator's speed. Connecting the output of this interface to the MultiPlus *(or Quattro)* enables the MultiPlus to precisely calculate the power available from the alternator. As a result, the MultiPlus can adjust its own performance to generate the extra AC power needed. No more, no less. This will ensure a power system to perform as expected. At any rpm, with any load.

The graph below globally illustrates the performance of an installation consisting of a Travelpower 3,5kW alternator and a MultiPlus 24/3000/70 inverter/charger. Together they provide enough power for heavy loads up to 6500 Watts if needed, but whenever alternator power becomes low, the MultiPlus alone will still provide enough power to feed a 3000 Watt load. As a rule of thumb, the maximum load installed is usually limited by the alternator's maximum performance, so now sufficient AC power will be available all the time!

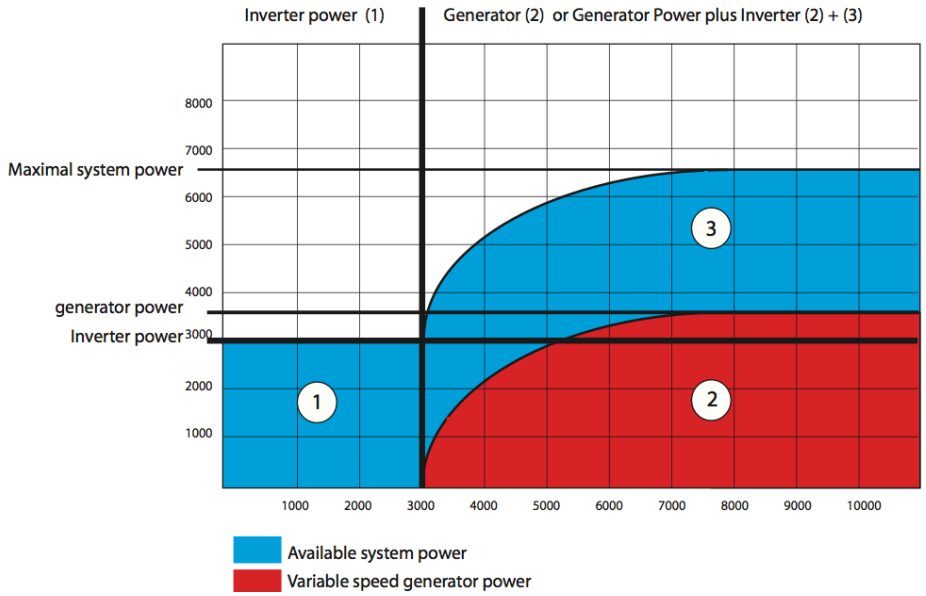


Figure 1:
Increased power performance, showing allowable load (Watt) versus alternator speed (RPM).

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## Brief installation instructions

### Required:

- One or more Victron Energy MultiPlus inverter/charger(s) with firmware 19xx008 or newer.
- A  Victron Energy 16A transfer switch (optional).
- A Victron Energy INTERFACE 1140 module (tachometer).
- A remote panel with generator support (a VE.Bus Multi Control or a VE.Bus Digital Multi Control). Note: firmware 1120119 or newer is required when using an external relay as a transfer switch.
- An UTP cable, available from Victron Energy as well.

### Steps to perform:

- Connect one end of a color-coded twin-wire cable to the tacho connections on the generator and connect the other end to the input of the INTERFACE 1140 module.

  Warning:
  Very high voltage may be present on these wires that can be hazardous for humans and animals. Be sure to make solid connections. Cable or wires used may never be subject to mechanical stress.

- Connect an UTP cable between the INTERFACE 1140 output and the MultiPlus.
- When using an external relay as transfer switch, be sure to connect the Remote Panel as shown.

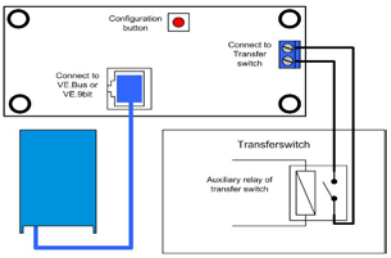



Figure 2: *Using an auxiliary relay*
The auxiliary relay contact must be closed whenever the engine's generator is selected.

### Remarks:

- In case a Remote Panel is connected and AC power is drawn from shore, the shore current setting as specified by the Remote Panel is used and measured values from INTERFACE 1140 are ignored.
- When no Remote Panel is connected, the MultiPlus will always use the shore current set point as derived from the INTERFACE 1140 measurements.

The '*Dynamic Current Limiter*' setting must be unchecked and the '*Overruled by Remote*' setting must be checked (both settings are preset this way by default). The value of the '*AC Input Current Limit*' setting will be ignored.

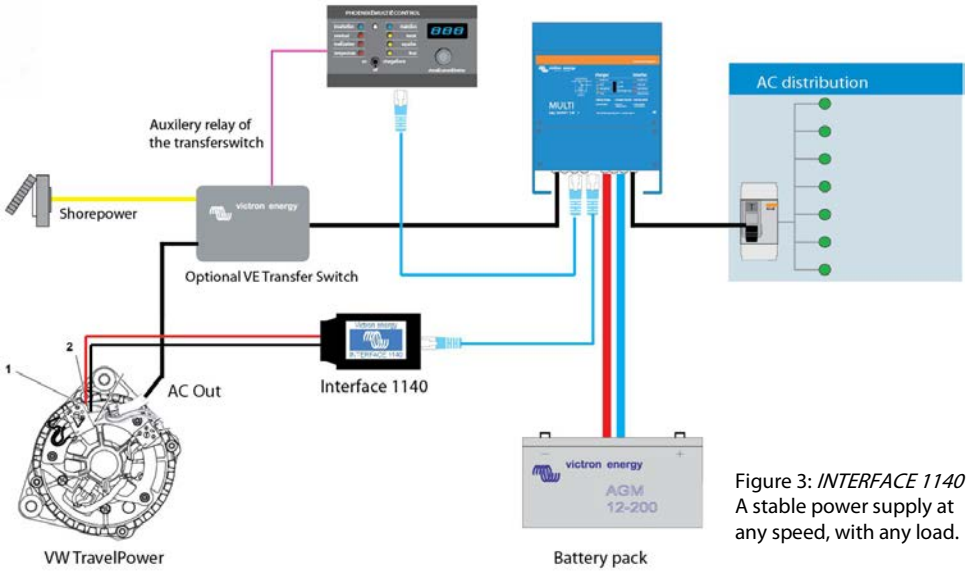



Figure 3: *INTERFACE 1140*
A stable power supply at any speed, with any load.

# Telecom white paper

How to reduce the cost of supplying power to an off-grid BTS (and simultaneously increase up time)



## 1. Conventional solution

Off-grid BTS supplied by 1 or 2 generators, each rated at 7,5 kVA

### 1.1 Load and fuel consumption

| | Duration (hr) | Load (W) | Energy (kWh) | | Generator load (%) | Fuel (l/hr) | Duration (hr) | l/day |
|---|---|---|---|---|---|---|---|---|
| **Day** | | | | | | | | |
| BTS + MW | 12 | 1000 | 12.0 | | | | | |
| Air-conditioning | 12 | 836 | 10.0 | | | | | |
| | | | 1836 | 22.0 | 24% | 1 | 12 | 12 |
| **Night** | | | | | | | | |
| BTS + MW | 12 | 700 | | | | | | |
| | | | 700 | 8.4 | 9% | 0.9 | 12 | 10.8 |
| **Total per day** | | | | **30.4** | | | | **22.8** |

### 1.2 Capital and operational expenses (1 generator 7,5 kVA)

**Capital Expenditures (Capex):**
Generator 7,5 kVA 3 phase **$6,500.00**

**Operating Expenditures (Opex) + equipment replacement costs:**

| | | | |
|---|---|---|---|
| Generator replacement every 2 years, costs per year (replacement after 18.000 running hours) | | | $3,250.00 |
| Fuel consumption, liters per day | | 22.8 | |
| Cost of 1 liter of diesel (including delivery) | | $1.00 | |
| Cost per day | | $22.80 | |
| Cost per year | | | $8,322.00 |
| Periodic maintenance (24/24 operation) | | | |
| Every 250 hr: | oil change (3 liter) | $15.00 | |
| | oil filter | $10.00 | |
| | travel and work | $100.00 | |
| Costs per year (site visit every 10 days, 32x per year) | | | $4,500.00 |
| Every 500 hr: | fuel filter and other maintenance | $25.00 | |
| Cost per year | | | $450.00 |
| **Opex per year** | | | **$16,522.00** |

### 1.3 Capital and operational expenses (2 generators 7,5 kVA)

For reasons of reliability, often 2 generators are installed.
Capex roughly doubles in comparison with 1.2.
Opex is similar to 1.2.

## 2. A Hybrid solution consisting of a generator, a MultiPlus and a battery

This configuration consists out of: one generator, a 3 Phase MultiPlus inverter/charger system and a battery. By using this configuration you can reduce the running hours of the generator by a factor 2 or more. Typically the generator would supply the load and recharge the battery during day time. The inverter/charger would take over during the night; when the air-conditioning is off. In order not to over stress the battery, the calculation below is based on a generator run time of 8 hr per day.

During the night the load is 700 Watt. This will be supplied by the inverter/charger. In addition, the inverter/charger will also supply the load during 4 hours of day time. In case of a 24 V battery, the discharge current would be:

Idn = 700/20 = 35 A during night time (12 hr), and
Idd = 1836/20 = 91 A during day time (4 hr)

For this example we are using a rather low discharge voltage (20 V) in order to take into account efficiency losses in the inverter/charger and cabling.

Total discharge: Cd = 12 x Idn + 4 x Idd = 420 + 364 = 784 Ah.

During the day the generator will supply the load and recharge the battery.
The average recharge current during the 8 hours available will be:

Cd / 8 = 98 A.

And the average power required by the inverter/charger:
Pm = 98 x 28 = 2744 W.

We are using a rather high average recharge voltage in order to take into account efficiency losses of the battery, cabling and inverter/charger.

Battery capacity needed: 1600 Ah (the reserve capacity will also allow for approximately 8 hours MTTR in case of generator failure).

Battery type: we recommend flooded tubular plate lead acid for the best price/performance comparison (this the battery used in electric vehicles such as fork lift trucks).

### 2.1. Load and fuel consumption

| | Duration (hr) | Load (W) | Energy (kWh) | | Generator load (%) | Fuel (l/hr) | Duration (hr) | l/day |
|---|---|---|---|---|---|---|---|---|
| **Day** | | | | | | | | |
| BTS + MW | 8 | 1000 | 8.0 | | | | | |
| Air-conditioning | 8 | 836 | 6.7 | | | | | |
| Inverter/charger | 8 | 2744 | 22.0 | | | | | |
| | | | 4580 | 36.6 | 61% | 1.6 | 8 | 12.8 |
| **Night:** | Generator | off | | | | | | |
| **Total per day** | | | | **36.6** | | | | **12.8** |

**The amazing result is that although the total energy consumption has increased from 30,4 to 36,6 kWh, fuel consumption has decreased from 22,8 to 12,8 liter.**
The increased energy consumption is due to efficiency losses in the battery, cabling and inverter/charger.
The dramatically improved fuel efficiency is due to better fuel efficiency of the generator at higher load.

### 2.2. Capital and operational expenses, hybrid solution

| | | | | |
|---|---|---|---|---|
| **Capex:** | | | | |
| Generator 7,5 kVA 3 phase | $6,500.00 | | | |
| Tubular plate battery 24V/1600Ah (including automatic watering system) | $3,500.00 | | | |
| 3x MultiPlus 24/1600/40 | $2,424.00 | (see note 1) | | |
| VE.Net control and monitoring | $500.00 | (see note 2) | | |
| **Total** | **$12,924.00** | | | |
| | | | | |
| **Opex + equipment replacement costs:** | | | | |
| Generator replacement every 6 years, costs per year (replacement after 18.000 running hours, 8 hours per day) | | | $1,083.33 | |
| Battery replacement every 4 years, costs per year | | | $875.00 | (see note 3) |
| Multi replacement every 8 years, costs per year | | | $303.00 | |
| VE.Net replacement every 8 years, costs per year | | | $62.50 | |
| | | | | |
| Fuel consumption, liters per day | | 12.8 | | |
| Costs of 1 liter of diesel (including delivery) | | $1.00 | | |
| Costs per day | | $12.80 | | |
| Costs per year | | | $4,672.00 | |
| | | | | |
| Periodic generator maintenance (8/24 operation) | | | | |
| Every 250 hr: | oil change (3 liter) | $15.00 | | |
| | oil filter | $10.00 | | |
| | travel and work | $100.00 | | |
| Costs per year (site visit every month, 12x per year) | | | $1,500.00 | |
| | | | | |
| Every 500 hr: fuel filter and other maintenance | | $25.00 | | |
| Costs per year | | | $150.00 | |
| | | | | |
| **Opex per year** | | | **$8,645.83** | |
| 10% capex costs over additional Investment | | $6,424.00 | $642.40 | |
| **Total** | | | **$9,288.23** | |
| | | | | |
| **Yearly costs advantage of hybrid solution** | | | **$7,233.77** | |
| Total cost has been reduced by more than 40%! | | | | |

## 3. Additional advantages of the hybrid system

### 3.1. Increased reliability compared to the 1 generator solution

In case of generator failure the system will operate on battery for at least 8 hours (800 Ah battery reserve capacity, discharge current 91 A).

### 3.2. Longer generator engine life due to higher load

When operating at low load, the engine will suffer bore glazing, reducing service life. Replacement intervals therefore may even exceed 6 years in case of the hybrid solution.

### 3.3. Less pollution

Less pollution is the result of lower fuel consumption and better combustion.

### 3.4. Possibility to add solar or wind power

The battery is already there!

### 3.5. Improved control and monitoring with VE.Net

VE.Net enables remote control and monitoring of the inverter/chargers and the generator.

## 4. DC solution

Supplying the BTS directly with the DC from the battery. The inverter/chargers would be replaced by battery chargers.
This would eliminate the capex for 3x Multi 24/1600/40 ($2.240,00). They would be replaced by 2x Skylla 24/80 ($1.846,00).
The costs reduction is not impressive.
The DC supply voltage would range from 20 V (battery discharged) to 34 V (absorption charge). If the BTS needs a better stabilized voltage, the additional costs of a DC-DC converter would result in the DC solution being more expensive than the hybrid solution.

Alternatively, a 48 V battery could be used, if the DC voltage required for the BTS is 48 V.

## Notes

**1. MultiPlus 24/1600/40**
Three units are needed, to create a 3 phase AC supply.
Continuous AC output at 25°C: 3 x 1600 = 4800 VA.
Continuous AC output at 45°C: 3300 VA.
Peak output: 9600 VA.
AC transfer switch included in the Multi's.
When the generator is running, the Multi's will automatically reduce battery charge current if needed to prevent an overload of the generator during periods of peak demand by the BTS.

**2. VE.Net**
Needed for timing (8/24 operation of the generator) and monitoring of battery state of charge.
VE.Net can also be used to monitor and control both the Victron equipment and the generator from a central control room.

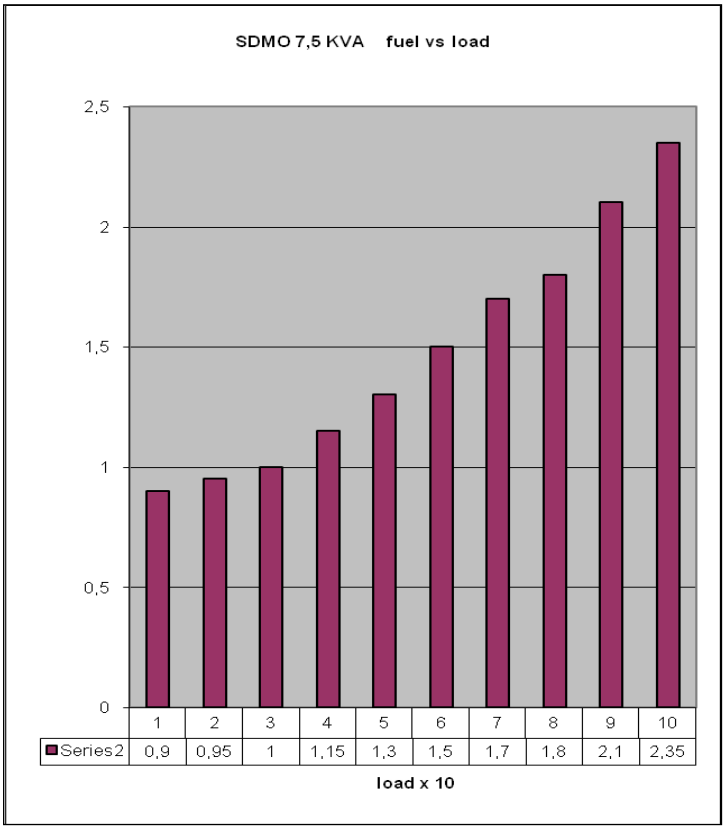
**3. Battery**
The tubular plate lead-acid battery offers the best price performance (that is why it is the standard battery for forklifts).

Cycle life
Battery manufacturers claim 1500 - 2000 charge/discharge cycles of 80%, in forklift applications.
This is equivalent to 2400 - 3200 cycles of 50%, which is well in excess of 4 years (4 x 365 = 1460 cycles) service life as assumed under 2.2.
Cycle life is not much affected by temperature.

Float life
Float life is reduced by 50% for every 10°C temperature increase.
Manufacturers claim 10 to 20 years float life for flooded tubular plate batteries, at 20°C ambient temperature.
This would reduce to 5 - 10 years at 30°C ambient and 3,5 - 7 years at 35°C (average temperature)

Service life
End of life is reached when either the max # of cycles is reached, or when the end of float life is reached, whichever comes first.
Battery manufacturers experience and guarantee conditions (and possibly local field experience with electric forklifts) is needed to obtain reasonable certainty that 4 years service life is realistic.

**4. Fuel consumption of generator: see table**

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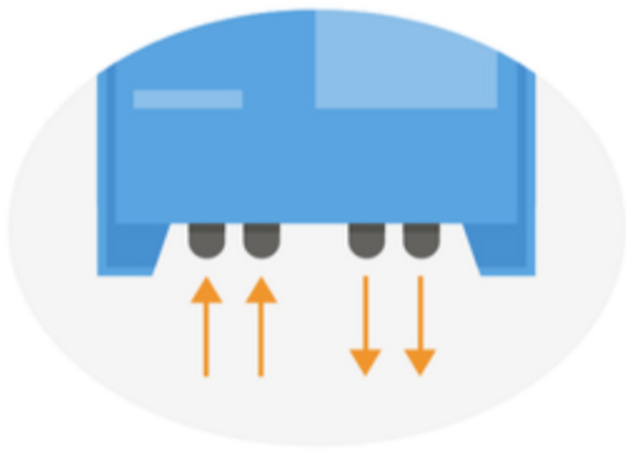
## Two AC Inputs & two AC Outputs

The Quattro can be connected to two independent AC sources, for example shore-side power and a generator, or two generators. The Quattro will automatically connect to the active source. The main output has no-break functionality. In the event of a grid failure, or shore or generator power being disconnected, the Quattro takes over the supply to the connected loads. This happens so fast (less than 20 milliseconds) that computers and other electronic equipment will continue to operate without disruption. The second output is live only when AC is available on one of the inputs of the Quattro. Loads that should not discharge the battery, such as air-conditioning or a water heater can be connected to this output.



## Unique PowerAssist feature

The Quattro will prevent overload of a limited AC source, such as a generator or shore power connection. First, battery charging will automatically be reduced when otherwise an overload would occur. The second level will boost the output of a generator or shore side supply with power taken from the battery.

## Virtually unlimited power thanks to parallel operation

Up to 6 Quattros can operate in parallel to achieve higher power output. Three phase or split phase operation is also possible. Please check our datasheets to see which models have paralleling, three phase and split phase capabilities.

## Remote Monitoring and Control

Monitor and control your Quattro and system or systems' locally (LAN) or remotely via the internet from anywhere in the world, using the free VRM app and free VRM portal website. Access can be from a phone, tablet, laptop or PC for multiple operating systems. There is no end to the level of control, via the required Color Control GX or Venus GX, from adjusting your Quattro to setting a Geofence for hire vehicles and more...

# Configuring solar systems with Quattros and Multis

Technical articles


Good day!

To help determine which settings are the most suitable for different types of solar systems using a Victron Energy Quattro or MultiPlus Inverter/Charger, we have developed a guide: VE.Bus-solar-system-configs (an Excel *.xlsx file). There is also identical content in this PDF guide, for those that don't have Excel.

This guide is a decision tree that will help installers discuss system installations with their customers. By choosing one answer that best reflects a system (for each of four questions asked) a recommended software configuration will be arrived at. Here are the details of those four questions:

## Q 1: What type of system?

1. A backup system: the (only) goal of the energy stored in the battery is to power the loads during a mains outage.
2. A pure self-consumption system: all energy stored in the battery can be used to power the loads when there is no, or not enough solar power available.
3. A self-consumption system with a battery reserve: a mix of the two types above. For example use the top 30% of the battery to increase the self-use of solar power, whilst keeping the other 70% available for a mains outage.
4. Off-grid site: no mains available. Only a genset, or not even that.
5. Intentional islanding: used in countries with a bad grid. For example with brown outs and spikes. In this case it is preferred to always run in Inverter mode, even when the public grid is available. The well known corresponding setting is AC Ignore in VEConfigure3.

## Q 2: How to charge the batteries?

1. Always: typically for a backup system: when the power is restored, the customer wants to have the battery recharged as fast as possible, which includes recharging the battery with power from the grid.
2. PV Only: use only power coming from the sun to charge the batteries, except when the lifetime of the battery is at stake. For example, a prolonged shortage due to bad weather. In that case Sustain will use a minimal amount of energy from the grid to keep the batteries in a healthy state.
3. Genset.

## Q 3: Is feed-in allowed?

This is an important and changing political topic in many countries. In Spain there is even a tax on energy harvested from the sun, for systems that are totally off-grid! Politics aside for now, the different answers we have seen are:

1. Feed-in is wanted: the meter runs in reverse, or there is some other mechanism in place that lets the customer sell energy back to the utility.
2. Feed-in is no problem, but not wanted either: all energy being fed back is lost, in a sense that it is not being payed for by the utility. But it doesn't hurt either.
3. Feed-in is absolutely not wanted, not even for a few seconds: to illustrate, there are certain prepaid meters in South-Africa that will disconnect the customer when it detects energy being fed back into the grid.
4. Feed-in is not wanted, because every kWh being fed back is just counted as energy being used and feeding back increases the end-customer's energy bill instead of decreasing it.

## Q 4: PV Inverters or MPPT Solar Charge Controllers?

1. If PV Inverters, look for the lines in the Excel sheet that state AC-Coupled.
2. If MPPT Solar Charge controllers, look for the lines in the guide that state DC-Coupled.

## Configuration solution

Having answered the four questions together with the user of the system, look in the guide to see where the decision tree guides you.

## Hub-4 for a system containing only MPPTs?

One thing you'll find when examining the guide is that the Hub-4 Assistant shows up in many places, even in systems with MPPT Charge Controllers. This solution has several advantages over the other Assistants. To name but a few:

- There is an extensive manual for the Hub-4 system.
- Set SOC levels: the Hub-1 Assistant can not work with SOC levels, it works on voltage.
- BatteryLife: prevent cycling your batteries at their low end.
- Use the grid when available: no switching between grid and inverter, less risk of overload, sinus wave distortions and other issues.

See the last question in the Hub-4 FAQ for more details on making a DC-Coupled system with the Hub-4 Assistant.

## Conclusion

I am convinced this guide will help you find the right approach in designing systems for your customers. It has certainly helped me recently when guiding dealers and distributors, as well as end-customers. We'll be improving the guide and further simplifying the software setup as we move along, which will help us come closer and closer to our end-goal: setting up a system should be simple and intuitive.

In case of any questions, please use the Disqus comments section below.

Best regards,

Matthijs