BMV-700 series: Precision Battery Monitoring

BMV-700

BMV bezel square

BMV shunt 500A/50mV
With quick connect pcb

BMV-702 Black

BMV-700H

Battery 'fuel gauge', time-to-go indicator, and much more

The remaining battery capacity depends on the ampere-hours consumed, discharge current, temperature and the age of the battery. Complex software algorithms are needed to take all these variables into account.

Next to the basic display options, such as voltage, current and ampere-hours consumed, the BMV-700 series also displays state of charge, time to go, and power consumption in Watts.

The BMV-702 features an additional input which can be programmed to measure the voltage (of a second battery), battery temperature or midpoint voltage (see below).

Bluetooth Smart

Use the Bluetooth Smart dongle to monitor your batteries on Apple or Android smartphones, tablets, macbooks and other devices.

Easy to install

All electrical connections are to the quick connect PCB on the current shunt. The shunt connects to the monitor with a standard RJ12 telephone cable. Included: RJ 12 cable (10 m) and battery cable with fuse (2 m); no other components needed.

Also included are a separate front bezel for a square or round display appearance, a securing ring for the rear mounting and screws for the front mounting.

Easy to program (with your smartphone!)

A quick install menu and a detailed setup menu with scrolling texts assist the user when going through the various settings.

Alternatively, choose the fast and easy solution: download the smartphone app (Bluetooth Smart dongle needed)

Midpoint voltage monitoring (BMV-702 only)

This feature, which is often used in industry to monitor large and expensive battery banks, is now for the first time made available at a low cost, to monitor any battery bank.

A battery bank consists of a string of series connected cells. The midpoint voltage is the voltage halfway along the string. Ideally, the midpoint voltage would be exactly half of the total voltage. In practice, however, deviations will be seen, that depend on many factors such as a different state of charge for new batteries or cells, different temperatures, internal leakage currents, capacities and much more.

Large or increasing deviation of the midpoint voltage, points to improper battery care or a failed battery or cell. Corrective action following a midpoint voltage alarm can prevent severe damage to an expensive battery. Please consult the BMV manual for more information.

Standard features

- Battery voltage, current, power, ampere-hours consumed and state of charge
- Remaining time at the current rate of discharge
- Programmable visual and audible alarm
- Programmable relay, to turn off non critical loads or to run a generator when needed
- 500 Amp quick connect shunt and connection kit
- Shunt selection capability up to 10.000 Amps
- VE.Direct communication port
- Stores a wide range of historical events**,** which can be used to evaluate usage patterns and battery health
- Wide input voltage range: 6,5 – 95V
- High current measurement resolution: 10 mA (0,01A)
- Low current consumption: 2,9Ah per month (4mA) @12V and 2,2Ah per month (3mA) @ 24V

BMV-702 additional features

Additional input to measure voltage (of a second battery), temperature or midpoint voltage, and corresponding alarm and relay settings.

BMV-700H: 60 to 385 VDC voltage range

No additional parts needed. Note: suitable for systems with grounded minus only (battery monitor is not isolated from shunt).

Other battery monitoring options

- Lynx Shunt VE.Can

More about midpoint voltage

One bad cell or one bad battery can destroy a large, expensive battery bank. When batteries are connected in series, a timely warning can be generated by measuring the midpoint voltage. Please see the BMV manual, section 5.2, for more information.
We recommend our Battery Balancer (BMS012201000) to maximize service life of series-connected batteries.

Battery Monitor	BMV-700	BMV-702 BMV-702 BLACK	BMV-700H
Supply voltage range	6,5 - 95 VDC	6,5 - 95 VDC	60 – 385 VDC
Current draw, back light off	< 4mA	< 4mA	< 4mA
Input voltage range, auxiliary battery	n. a.	6,5 - 95 VDC	n. a.
Battery capacity (Ah)	1 - 9999 Ah		
Operating temperature range	-40 +50°C (-40 - 120°F)		
Measures voltage of second battery, or temperature, or midpoint	No	Yes	No
Temperature measurement range	-20 +50°C		n. a.
VE.Direct communication port	Yes	Yes	Yes
Relay	60V / 1A normally open (function can be inverted)		
RESOLUTION & ACCURACY (with a 500 A shunt)			
Current	± 0,01A		
Voltage	± 0,01V		
Amp hours	± 0,1 Ah		
State of charge (0 – 100%)	± 0,1%		
Time to go	± 1 min		
Temperature (0 - 50°C or 30 - 120°F)	n. a.	± 1°C/°F	n. a.
Accuracy of current measurement	± 0,4%		
Accuracy of voltage measurement	± 0,3%		
INSTALLATION & DIMENSIONS			
Installation	Flush mount		
Front	63mm diameter		
Front bezel	69 x 69mm (2.7 x 2.7 inch)		
Body diameter and depth	52mm (2.0 inch) and 31mm (1.2 inch)		
Protection category	IP55 (not intended for outdoor use)		
STANDARDS			
Safety	EN 60335-1		
Emission / Immunity	EN 55014-1 / EN 55014-2		
Automotive	ECE R10-4 / EN 50498		
ACCESSORIES			
Shunt (included)	500A / 50mV		
Cables (included)	10 meter 6 core UTP with RJ12 connectors, and cable with fuse for '+' connection		
Temperature sensor	Optional (ASS000100000)		

1000A/50mV, 2000A/50mV and 6000A/50mV shunt
The quick connect PCB on the standard 500A/50mV shunt can also be mounted on these shunts.

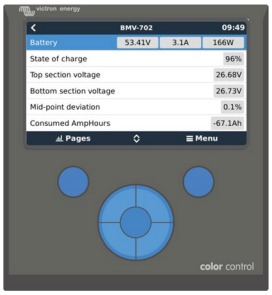
Interface cables
- VE.Direct cables to connect a BMV 70x to the Color Control (ASS030530xxx)
- VE.Direct to USB interface (ASS030530000) to connect several BMV 70x to a Color Control GX or to a computer.

With the **VE.Direct to Bluetooth Smart dongle** real time data and alarms can be displayed on Apple and Android smartphones, tablets, macbooks and other devices.

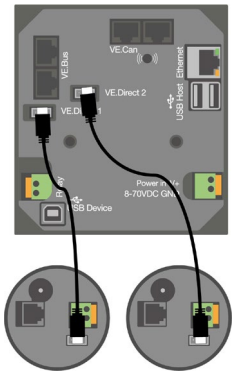
Also use your smartphone to adjust settings!

(the VE.Direct to Bluetooth Smart dongle must be ordered separately)

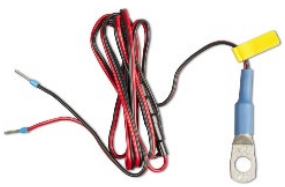
See the VictronConnect BMV app Discovery Sheet for more screenshots



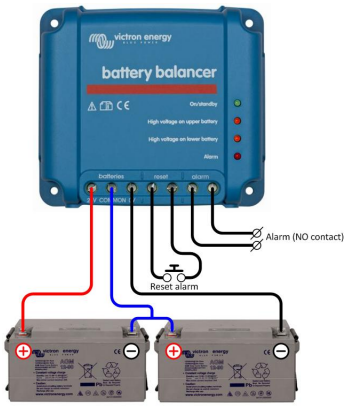
Color Control
The powerful Linux computer, hidden behind the colour display and buttons, collects data from all Victron equipment and shows it on the display. Besides communicating with Victron equipment, the Color Control communicates through CAN bus (NMEA2000), Ethernet and USB.
Data can be stored and analysed on the VRM Portal.



A maximum of four BMVs can be connected directly to a Color Control GX.
Even more BMVs can be connected to a USB Hub for central monitoring.



Temperature sensor



Battery Balancer (BMS012201000)
The Battery Balancer equalizes the state of charge of two series connected 12V batteries, or of several parallel strings of series connected batteries.
When the charge voltage of a 24V battery system increases to more than 27V, the Battery Balancer will turn on and compare the voltage over the two series connected batteries. The Battery Balancer will draw a current of up to 1A from the battery (or parallel connected batteries) with the highest voltage. The resulting charge current differential will ensure that all batteries will converge to the same state of charge.

If needed, several balancers can be paralleled.

A 48V battery bank can be balanced with three Battery Balancers.

victron energy
BLUE POWER

Data communication with Victron Energy products

Matthijs Vader

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.

Besides that API, MQTT is also available.

Integrating into a Marine NMEA 2000 network? See our integration guide.

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	
VE.Can / NMEA2000	Yes	Drop cables / Daisy chain	CANBUS	J1939 & NMEA2000	See MK2/MK3 protocol
VE.Bus	No	Daisy chain	RS485	Proprietary	
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

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

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".

Detailed information on the NMEA2000 PGN's is available for purchase on the NMEA website.

VE.Direct

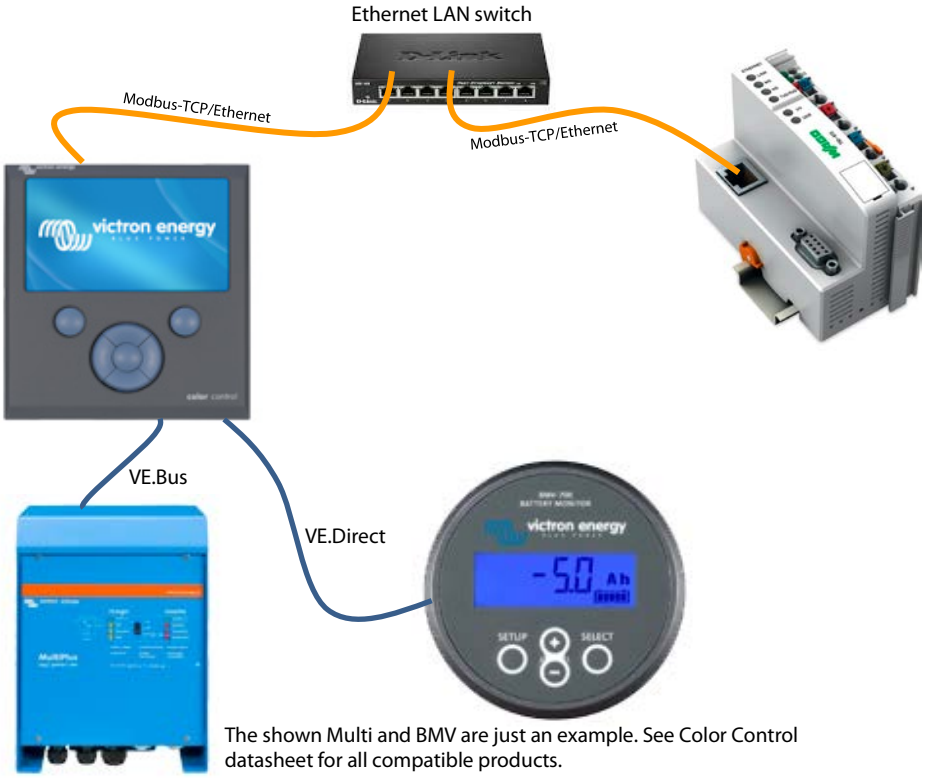
VE.Direct is a combination of what we used to call the HEX protocol and the BMV text protocol. It combines the advantages of both: in text-mode the products automatically transmit all important parameters every second. To implement code which reads and interprets this data is extremely simple. If more 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.

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.



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

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.

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. 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. All data is stored in our database. Logs can be downloaded, see chapter "Getting the data from VRM".

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.

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. 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.

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

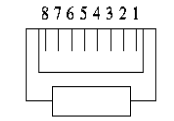


Figure 1:
End view of RJ45 Plug

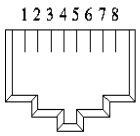
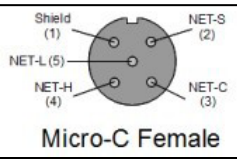


Figure 2:
Looking into an RJ45 Jack

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)

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.

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.

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.

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, 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.

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 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

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. 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.

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.

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.

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. Added list of products, and how to connect via Canbus. Added information on the HEX protocol. BMV Protocol is now available on our website. Various rewording and layout changes. Added 'Staying-up-to-date'. Added several items to the FAQ.
6	2012-june-29	Matthijs Vader	Added Q3 to the FAQ (29 bits identifier) Changed Q7 (termination resistors) Inserted Q8 (powering the Canbus)
7	2012-nov-19	Matthijs Vader	Added Q12 (network address without ACL procedure) Added chapter "Canbus PGN overview per product" 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 Added PGN DC Detailed Status 127506 0x1F212 to the VE.Bus PGNs Changed PGN Number 127502 to 127501 in the VE.Bus PGNs Added 7 to 70VDC to Q17 Remarked that VE.Bus Switch bank instance 1 is by default not enabled. Added column to product table: onboard comm. Port Added PGN 127501 to list of Skylla-i and BlueSolar MPPT 150/70 PGNs Added information about instances, Q23 Changed the information in Getting the data from VRM with information for the new VRM website Replaced HEX with VE.Direct
10	2013-apr-20	Matthijs Vader	Added comment about Consumed Ah for BMV-60xs and Lynx Shunt VE.Can Added Q24 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 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 Updated BMV Canbus table, binary switch bank status instead of control. 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 Updated VE.Can/NMEA2000 protocol section Added new interfaces (…. to VE.Can interface) Added NMEA2000 database version numbers Added new interfaces such as VE.Direct to RS232 interface Added Modbus-TCP
15	2014-March-24	Matthijs Vader	Updated getting data from VRM with wget section Added VRM JSON API link
16	2014-May-30	Matthijs Vader	Added (JUICE) on page 10. Updated Modbus-TCP: available 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) Added Q25 on VE.Bus SOC 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. 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. 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

			Added link to VE.Direct protocol FAQ as well as VE.Direct RS232 interface 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 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 Added Skylla-IP44 and Lynx Ion BMS Updated text of Q23 and added text about instance conflicts