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Introduction

Victron products which feature the VE.Direct serial communications interface allow simple access to detailed information of that product. This document describes how to receive and interpret this information.

See our Data communication whitepaper for more information on other protocols and products available: Whitepaper-Data-communication-with-Victron-Energy-products_EN.pdf.

The VE.Direct interface includes two modes: Text-mode and the HEX-mode. The purpose of the Text-mode is to make retrieving information extremely simple. The product will periodically transmit all run-time fields. The HEX-mode allows not only to read data but also write data, for example, change settings.

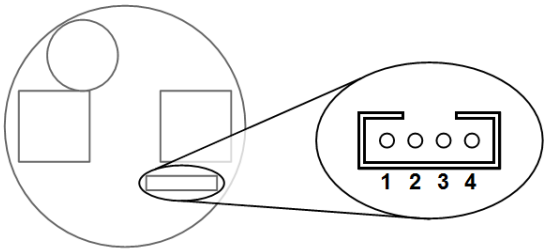
On power up, a VE.Direct interface will always be in Text-mode, and continuously transmits all run-time fields. As soon as it receives a valid HEX-message, it will switch to HEX-mode. It will stay in HEX-mode as long as HEX-messages are frequently received. After a product has not received any valid HEX-messages for several seconds, it will switch back to Text-mode and start to auto transmit the run-time fields periodically again. Some products will send Asynchronous HEX-messages, starting with ":A" and ending with a newline '\n', on their own. These messages can interrupt a regular Text-mode frame.

This document only describes the Text-mode.

Make sure to also read our VE.Direct protocol FAQ, and the Open source page on Victron Live which lists projects from other people using our VE.Direct protocol

Physical interface

The VE.Direct interface is accessed via a 4-pin connector. The picture below shows where the VE.Direct connector is located on a BMV-700.



Pin	Producer	Consumer
1	GND	GND
2	VE.Direct-RX	VE.Direct-TX
3	VE.Direct-TX	VE.Direct-RX
4	Power +	Power +

Producers are products, such as the BMV battery monitor and the MPPT solar chargers. Consumers are products reading the data, such as the Color Control GX. Note that the pins on the MPPT can have alternative functions. Its VE.Direct-RX pin can be used to switch the charger on and off. Its VE.Direct-TX pin can be configured to send a PWM signal, to dim (street-)lights. For details about the connector type see the information at the end of this document.

A VE.Direct to USB interface cable can be purchased from Victron Energy ("VE.Direct to USB", part number ASS030530000). This interface cable provides a virtual comport through USB as well as galvanic isolation.

A VE.Direct to RS232 interface cable can also be purchased from Victron Energy ("VE.Direct to RS232 interface", part number ASS030520500).

Serial port configuration

Baud rate:	19200
Data bits:	8
Parity:	None
Stop bits:	1
Flow control:	None

Pins to use when using the VE.Direct to RS232 interface

For the communication use the GND, RX and TX pins: pin 5, 2 and 3 on the DB9 connector.

Also the DTR signal (pin 4 on the DB9 connector) and/or the RTS signal (pin 7 on the DB9 connector) must be driven high to power the isolated side of the interface. How to program the DTR and RTS differs between used operating systems and hardware.

For more details see:
https://www.victronenergy.com/live/vedirect_protocol:faq#q2when_using_the_vedirect_to_rs232_interface_what_pins_do_i_need

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Message format

The device transmits blocks of data at 1 second intervals. Each field is sent using the following format:

<Newline><Field-Label><Tab><Field-Value>

The identifiers are defined as follows:

Identifier	Meaning
<Newline>	A carriage return followed by a line feed (0x0D, 0x0A).
<Field-Label>	An arbitrary length label that identifies the field. Where applicable, this will be the same as the label that is used on the LCD.
<Tab>	A horizontal tab (0x09).
<Field-Value>	The ASCII formatted value of this field. The number of characters transmitted depends on the magnitude and sign of the value.

Data integrity

The statistics are grouped in blocks with a checksum appended. The last field in a block will always be "Checksum". The value is a single byte, and will not necessarily be a printable ASCII character. The modulo 256 sum of all bytes in a block will equal 0 if there were no transmission errors. Multiple blocks are sent containing different fields.

Fields

The values sent over the serial communications interface do not necessarily use the same units as the values on the LCD.

Note: The BMV-60xS does not have a full VE.Direct interface. There is only limited support for the Text-mode, see Table I. More details can be found in the document *BMV-60xS Text Protocol*: http://www.victronenergy.com/upload/documents/BMV-60xS Text Protocol.pdf

The units used by the serial interface are as follows:

Label	Units	Description	BMV 600	BMV 700	MPPT[1]	Phoenix Inverter
V	mV	Main (battery) voltage	•	•	•	•
VS	mV	Auxiliary (starter) voltage	•	•		
VM	mV	Mid-point voltage of the battery bank		•		
DM	‰	Mid-point deviation of the battery bank		•		
VPV	mV	Panel voltage			•	
PPV	W	Panel power			•	
I	mA	Battery current	•	•	•[2]	
IL	mA	Load current			•[3]	
LOAD		Load output state (ON/OFF)			•[4]	
T	°C[5]	Battery temperature		•		

[1] The VE.Direct protocol is available in the MPPT 70/15 from firmware version v1.09 and up, and only in newer type MPPT 70/15s: the ones with a product id other than 0x300. The first batches, with PID 0x300, only support fields PID, SER and FW.

[2] MPPT 75/15 and 100/15: From firmware version v1.15 onwards, the current reported under "I" is the battery current. Firmware version v1.14 and before report the current measured at the output of the converter, without detailing if this current was going to the battery or the loads.

[3] Available since version v1.15, and only for models with a load output.

[4] Available since version v1.12, and only for models with a load output.

Label	Units	Description	BMV 600	BMV 700	MPPT[1]	Phoenix Inverter
P	W	Instantaneous power		•		
CE	mAh[6]	Consumed Amp Hours	•	•		
SOC	‰[6]	State-of-charge	•	•		
TTG	Minutes[6, 7]	Time-to-go	•	•		
Alarm		Alarm condition active	•	•		
Relay		Relay state	•	•	•[8]	
AR		Alarm reason	•	•		•
H1	mAh	Depth of the deepest discharge	•	•		
H2	mAh	Depth of the last discharge	•	•		
H3	mAh	Depth of the average discharge	•	•		
H4		Number of charge cycles	•	•		
H5		Number of full discharges	•	•		
H6	mAh	Cumulative Amp Hours drawn	•	•		
H7	mV	Minimum main (battery) voltage	•	•		
H8	mV	Maximum main (battery) voltage	•	•		
H9	Seconds	Number of seconds since last full charge	•	•		
H10		Number of automatic synchronizations	•	•		
H11		Number of low main voltage alarms	•	•		
H12		Number of high main voltage alarms	•	•		
H13		Number of low auxiliary voltage alarms	•			
H14		Number of high auxiliary voltage alarms	•			
H15	mV	Minimum auxiliary (battery) voltage	•	•		
H16	mV	Maximum auxiliary (battery) voltage	•	•		
H17	0.01 kWh	Amount of discharged energy		•		
H18	0.01 kWh	Amount of charged energy		•		
H19	0.01 kWh	Yield total (user resettable counter)			•	
H20	0.01 kWh	Yield today			•	
H21	W	Maximum power today			•	
H22	0.01 kWh	Yield yesterday			•	
H23	W	Maximum power yesterday			•	
ERR		Error code			•	
CS		State of operation			•	•
BMV		Model description (deprecated)	•	•		
FW		Firmware version	•	•	•	•
PID		Product ID		•	•	•
SER#		Serial number			•	•
HSDS		Day sequence number (0..364)			•[9]	
MODE		Device mode				•
AC_OUT_V	0.01 V	AC output voltage				•
AC_OUT_I	0.1 A	AC output current				•
WARN		Warning reason				•

Table I Supported Text-mode fields

[5] When no temperature sensor is connected, "---" will be sent instead of a value.
[6] When the BMV is not synchronised, these statistics have no meaning, so "---" will be sent instead of a value.
[7] When the battery is not discharging the time- to-go is infinite. This is represented as -1.
[8] Available on SmartSolar mppt chargers from firmware version v1.17
[9] Available on BlueSolar mppt chargers from firmware version v1.16

Detailed field description

I

Both for MPPTs and BMVs: when > 0, the battery is being charged, < 0 the battery is being discharged.

Alarm

This shows the buzzer alarm state of the BMV. During normal operation, this will be "OFF". When a buzzer alarm occurs the value will change to "ON".

Note: This refers to the value of the alarm condition, and not the buzzer itself. This means that once a condition has occurred, the value will be "ON" until all alarm conditions have cleared; regardless of whether or not a button has been pressed to silence the buzzer.

Relay

This shows the relay alarm state of the BMV and the SmartSolar MPPT chargers. During normal operation, this will be "OFF". When a relay alarm occurs the value will change to "ON".

Note for both Alarm and Relay: BMV-600's with firmware v2.09 or lower used to send "On" and "Off" instead of "ON" and "OFF". It is therefore recommended to use a case-insensitive string comparison in your implementation, for example stricmp().

FW

The firmware version of the device. The version is reported as a whole number, e.g. 208 for firmware version 2.08.The value C208 means release candidate C for version 2.08.
Note: This field is available in the BMV since version 2.08

AR

Alarm reason; this field describes the cause of the alarm. Since multiple alarm conditions can be present at the same time the values of the separate alarm conditions are added. The value total is sent in decimal notation.

		BMV	Inverter
Low Voltage	1	•	•
High Voltage	2	•	•
Low SOC	4	•	
Low Starter Voltage	8	•	
High Starter Voltage	16	•	
Low Temperature	32	•	•
High Temperature	64	•	•
Mid Voltage	128	•	
Overload	256		•
DC-ripple	512		•
Low V AC out	1024		•
High V AC out	2048		•

E.g. a value of 5 would indicate the presence of a low SOC alarm and a low Voltage.
Note: This field is available in the BMV since version 2.08

WARN

Warning reason is implemented for inverters only. It provides the cause of a warning. The bit definition is the same as for AR. More warnings can be active at the same time. Warnings always represent the current status of the measured parameter (temperature/Ubat in/VAC-out). This is different than for alarm reason AR. AR remembers the reason what caused the inverter to switch off (active protection) until it is switched on again.

PID

The product id:

BMV-700	0x203
BMV-702	0x204
BMV-700H	0x205
BlueSolar MPPT 70|15*	0x0300
BlueSolar MPPT 75|50*	0xA040
BlueSolar MPPT 150|35*	0xA041
BlueSolar MPPT 75|15	0xA042
BlueSolar MPPT 100|15	0xA043
BlueSolar MPPT 100|30*	0xA044
BlueSolar MPPT 100|50*	0xA045
BlueSolar MPPT 150|70	0xA046
BlueSolar MPPT 150|100	0xA047
BlueSolar MPPT 100|50 rev2	0xA049
BlueSolar MPPT 100|30 rev2	0xA04A
BlueSolar MPPT 150|35 rev2	0xA04B
BlueSolar MPPT 75|10	0xA04C
BlueSolar MPPT 150|45	0xA04D
BlueSolar MPPT 150|60	0xA04E
BlueSolar MPPT 150|85	0xA04F
SmartSolar MPPT 250|100	0xA050
SmartSolar MPPT 150|100*	0xA051
SmartSolar MPPT 150|85*	0xA052
SmartSolar MPPT 75|15	0xA053
SmartSolar MPPT 75|10	0xA054
SmartSolar MPPT 100|15	0xA055
SmartSolar MPPT 100|30	0xA056
SmartSolar MPPT 100|50	0xA057
SmartSolar MPPT 150|35	0xA058
SmartSolar MPPT 150|100 rev2	0xA059
SmartSolar MPPT 150|85 rev2	0xA05A
SmartSolar MPPT 250|70	0xA05B
SmartSolar MPPT 250|85	0xA05C
SmartSolar MPPT 250|60	0xA05D
SmartSolar MPPT 250|45	0xA05E
SmartSolar MPPT 100|20	0xA05F
SmartSolar MPPT 100|20 48V	0xA060
SmartSolar MPPT 150|45	0xA061
SmartSolar MPPT 150|60	0xA062
SmartSolar MPPT 150|70	0xA063
SmartSolar MPPT 250|85 rev2	0xA064
SmartSolar MPPT 250|100 rev2	0xA065
Phoenix Inverter 12V 250VA 230V*	0xA201
Phoenix Inverter 24V 250VA 230V*	0xA202
Phoenix Inverter 48V 250VA 230V*	0xA204
Phoenix Inverter 12V 375VA 230V*	0xA211
Phoenix Inverter 24V 375VA 230V*	0xA212
Phoenix Inverter 48V 375VA 230V*	0xA214
Phoenix Inverter 12V 500VA 230V*	0xA221
Phoenix Inverter 24V 500VA 230V*	0xA222
Phoenix Inverter 48V 500VA 230V*	0xA224
Phoenix Inverter 12V 250VA 230V	0xA231
Phoenix Inverter 24V 250VA 230V	0xA232
Phoenix Inverter 48V 250VA 230V	0xA234

Phoenix Inverter 12V 250VA 120V	0xA239
Phoenix Inverter 24V 250VA 120V	0xA23A
Phoenix Inverter 48V 250VA 120V	0xA23C
Phoenix Inverter 12V 375VA 230V	0xA241
Phoenix Inverter 24V 375VA 230V	0xA242
Phoenix Inverter 48V 375VA 230V	0xA244
Phoenix Inverter 12V 375VA 120V	0xA249
Phoenix Inverter 24V 375VA 120V	0xA24A
Phoenix Inverter 48V 375VA 120V	0xA24C
Phoenix Inverter 12V 500VA 230V	0xA251
Phoenix Inverter 24V 500VA 230V	0xA252
Phoenix Inverter 48V 500VA 230V	0xA254
Phoenix Inverter 12V 500VA 120V	0xA259
Phoenix Inverter 24V 500VA 120V	0xA25A
Phoenix Inverter 48V 500VA 120V	0xA25C
Phoenix Inverter 12V 800VA 230V	0xA261
Phoenix Inverter 24V 800VA 230V	0xA262
Phoenix Inverter 48V 800VA 230V	0xA264
Phoenix Inverter 12V 800VA 120V	0xA269
Phoenix Inverter 24V 800VA 120V	0xA26A
Phoenix Inverter 48V 800VA 120V	0xA26C
Phoenix Inverter 12V 1200VA 230V	0xA271
Phoenix Inverter 24V 1200VA 230V	0xA272
Phoenix Inverter 48V 1200VA 230V	0xA274
Phoenix Inverter 12V 1200VA 120V	0xA279
Phoenix Inverter 24V 1200VA 120V	0xA27A
Phoenix Inverter 48V 1200VA 120V	0xA27C

* These models are phased out.

CS

The state of operation. See the table below for the possible values.

		MPPT	Inverter
Off	0	•	•
Low power	1		• (load search)
Fault	2	•	• (off until user reset)
Bulk	3	•	
Absorption	4	•	
Float	5	•	
Inverting	9		• (on)

ERR

The error code of the device (relevant when the device is in the fault state). See the table below for the possible values.

No error	0
Battery voltage too high	2
Charger temperature too high	17
Charger over current	18
Charger current reversed	19
Bulk time limit exceeded	20
Current sensor issue (sensor bias/sensor broken)	21
Terminals overheated	26
Input voltage too high (solar panel)	33
Input current too high (solar panel)	34
Input shutdown (due to excessive battery voltage)	38
Factory calibration data lost	116

Invalid/incompatible firmware	117
User settings invalid	119

Note1: Error 19 can be ignored, this condition regularly occurs during start-up or shutdown of the MPPT charger. Since version 1.15 this error will no longer be reported.
Note2: Error 21 can be ignored for 5 minutes, this condition regularly occurs during start-up or shutdown of the MPPT charger. Since version 1.16 this warning will no longer be reported when it is not persistent.

HSDS
Historical data. The day sequence number, a change in this number indicates a new day. This implies that the historical data has changed. Range 0..364.
Note: The HSDS field is available in the MPPT charger since version v1.16.

SER#
The serial number of the device. The notation is LLYYMMSSSSS, where LL=location code, YYWW=production date stamp (year, week) and SSSSS=unique part of the serial number.
Example: HQ1328Y6TF6

BMV (deprecated)
This field contains a textual description of the BMV model, for example 602S or 702. It is deprecated, refer to the field PID instead.

MODE
The possible values for the device mode are listed in this table.

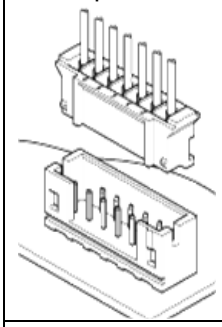
VE_REG_MODE_INVERTER	2
VE_REG_MODE_OFF	4
VE_REG_MODE_ECO	5

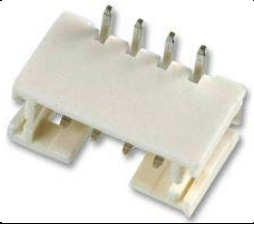
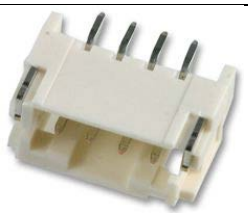
Implementation guidelines

When implementing a VE.Text parser it is recommended to reserve two buffers. For the field label a buffer of 9 bytes is needed and for the field value a buffer length of 33 bytes is required. The value should be parsed as soon as a single field is received and should then be stored in a temporary record. The maximum number of fields in a block is 18; keep at least 18 temporary records. Once the complete block is validated by evaluating the checksum, the contents of the temporary records can be copied to its corresponding final records. If the checksum turned out to be invalid, the temporary records need to be cleared.

Connector types

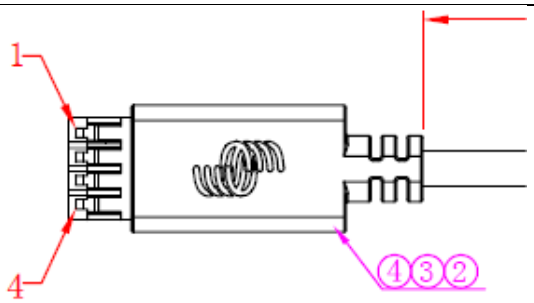
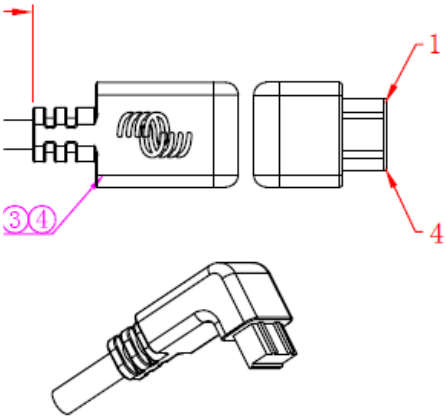
Below the information about the connector type used for VE.Direct. There are 3 through hole type connectors and 2 surface mount types available.

Brand		JST		
Serie		PH connector, 4 pin types		
Description 		Pitch 2.0mm Available in through hole and smt. Top and side entry models Also a high version of the through hole top entry model is available Most types are available from Farnell.		
		Website information		
		http://www.jst-mfg.com/product/detail_e.php?series=199		
		http://www.jst-mfg.com/product/pdf/eng/ePH.pdf		
Through hole		**Farnell code**	**JST code**	**Link**
Pcb part straight		9492437	B4B-PH-K-S(LF)(SN)	http://nl.farnell.com/jst-japan-solderless-terminals/b4b-ph-k-s-lf-sn/header-top-entry-4way-2mm/dp/9492437
Pcb part 90degree		9492488	S4B-PH-K-S (LF)(SN)	http://nl.farnell.com/jst-japan-solderless-terminals/s4b-ph-k-s-lf-sn/header-side-entry-4way/dp/9492488
Surface mount				
Pcb part straight		9491929	B4B-PH-SM4-TB(LF)(SN)	http://nl.farnell.com/jst-japan-solderless-terminals/b4b-ph-sm4-tb-lf-sn/header-top-entry-smd-4way/dp/9491929
Pcb part 90 degree smd		9492631	S4B-PH-SM4-TB(LF)(SN)	http://nl.farnell.com/jst-japan-solderless-terminals/s4b-ph-sm4-tb-lf-sn/header-side-entry-smd-4way/dp/9492631
Pcb part straight high type		-	BH4B-PH(LF)(SN)	http://www.jst-mfg.com/product/detail_e.php?series=200 http://www.jst-mfg.com/product/pdf/eng/ePH-H.pdf

			
TH top entry	TH side entry	SMT top entry	SMT side entry

VE.Direct cable

For the VE.Direct cable a molded part was created to make it more durable.
There is a straight and 90 degree angle model. See pictures below.

	
VE.Direct straight cable connector	**VE.Direct 90 degree cable connector**

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Document history

Version	Date	Changes
1	24 April 2008	Document created.
1.1	05 May 2008	Added historical information for the starter battery. Added alarm and relay state information.
1.2	16 May 2008	Added the part number for the serial to TTL cable.
2.0	16 June 2008	Added a checksum field to the protocol, and removed the ETX framing character.
2.1	05 May 2009	Added details on which RS232 connections must be implemented by the monitoring application.
2.2	24 June 2009	Updated to reflect the change in product naming.
2.3	01 December 2009	Added BMV-600S and field BMV, FW and AR
2.4	12 April 2011	Renamed the protocol and document to BMV Text Protocol
2.5	16 October 2012	Added details on On/Off vs ON/OFF for Relay and Alarm state
3.0	31 June 2013	Document changed to be the VE.Direct specification document
3.1	16 August 2013	Added BMV-70x alarms Added detailed field description paragraph Description of release candidates in FW field
3.2	7 February 2014	Removed fields H13 and H14 from BMV-70x
3.3	24 March 2014	Added history fields (HS* and HDn*) for the MPPT chargers.
3.4	22 May 2014	Updated product id list (PID)
3.5	3 July 2014	Added error 119 in the error code table (ERR)
3.6	30 July 2014	Changed HDnYP> HdnY, HdnYC> HDnC, added HSDS
3.7	11 September 2014	Text protocol I=Battery current, CS=Charger state. Added remark HS*, HDn* are available since v1.15. Added IL (load current)
3.8	24 September 2014	Updated physical connection section Removed HDn*, HS* sections, moved to HEX protocol Updated HSDS description.
3.9	30 September 2014	Reworded some sentences to make them more clear and changed footnote sign to numbers. ~~H19..H23 deprecated since v1.16~~, HSDS will be available from v1.16
3.10	6 November 2014	ERR section, added note 2 regarding error 21.
3.11	7 November 2014	ERR section, updated note 2 regarding error 21.
3.12	9 December 2014	H19..H23 will remain present
3.13	29 January 2015	Added chapter 'Implementation guidelines'
3.14	25 March 2015	Fields table: removed deprecated for fields H19..H23
3.15	1 May 2015	Updated charger error code table (ERR)
3.16	9 July 2015	Added information about connector types
3.17	20 July 2015	Updated whitepaper url in the introduction section
3.18	20 August 2015	Added links to open source page and vedirect faq
3.19	25 February 2016	Updated PID section (MPPT models) Relay field now also available in SmartSolar models
3.20	14 March 2016	Updated with Phoenix Inverter textmode fields
3.21	1 April 2016	Mention Asynchronous HEX-messages. Added VE.Direct to RS232 interface cable.
3.22	28 September 2016	Swapped RX & TX in the pinout
3.23	2 October 2017	Added pin information for VE.Direct to RS232 interface
3.24	22 March 2018	Added PIDs for 120V + 800VA + 1200VA inverters and new Smart Solar chargers