

# VE.Direct Protocol

## Orion XS DC-DC battery charger

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# 1 VE.Direct Protocol

Note that when connecting to the VE.Direct port, the charger always periodically sends TEXT data to the serial port. See the ["VE.Direct Protocol"](#) document for a detailed description of the contents and availability of the information. **So, this periodic TEXT data is interleaved with the response of the HEX protocol described in this document.**

The frame format of the VE.Direct protocol has the following general format:

: [command] [data][data][...] [check]\n

Where the colon indicates the start of the frame and the newline is the end of frame. The sum of all data bytes and the check must equal 0x55. Since the normal protocol is in text values the frames are sent in their hexadecimal ASCII representation, ['0' .. '9'], ['A' .. 'F'], must be uppercase. There is no need to escape any characters.

: [command] [dataHighNibble, dataLowNibble][.....] [checkHigh, checkLow] \n

Note: The command is only send as a single nibble. Numbers are sent in Little Endian format. An error response with value 0xAAAA is sent on framing errors.

Command		Description
0	Enter boot	0x51FA51FA51FA51FA as payload will enable bootloader mode.
1	Ping (*1)	Check for presence, the response is an 'Rsp ping' containing the value 0xYFFF. Where Y=0b0011 bootloader; Y=0b0111 application; Y=0b1011 tester; Y=0b1111 release candidate
3	App version (*1)	Returns the version of the firmware as stored in the header in an 'Rsp Done' message.
4	Product Id	Returns the Product Id of the firmware as stored in the header in an 'Rsp Done' message.
6	Restart	Restarts the device, no response is sent.
7	Get	Returns a get response with the requested data or error is returned.
		uint16 the id of the value to get uint8 flags, should be set to zero
8	Set	Returns a set response with the requested data or error is returned.
		uint16 the id of the value to set uint8 flags, should be set to zero
		type depends on id value
A	Async	Asynchronous data message. Should not be replied.
		uint16 the id of the value being returned uint8 flags, defined below
		type depends on id value
2, 5, 9, B-F	reserved	

VE.Direct\_responses are formatted in the same manner as commands, but use response codes.:

Response		Description
1	Done	Successful execution of the received command. Payload depends on command.
2	Checksum error	Frame error (payload=0xAAAA)
3	Unknown	Unknown command, data is the unknown command.
4	Error	Frame error (payload=0xAAAA), unable to enter bootloader (payload=0).
5	Ping	Payload=0xYFFF. Where Y=0b0011 bootloader; Y=0b0111 application; Y=0b1011 tester; Y=0b1111 release candidate, note because this product uses 24-bit version encoding there is no version in the response.
7	Get	uint16 id: of the value being returned
		uint8 flags: defined below
8	Set	type depends on id value
		uint16 id of the value which was set
		uint8 flags: defined below
		type depends on id value

Note 1: This product has 24-bit firmware version encoding. This has consequences for the “Ping” command and the “App version” command compared to older products that use 16-bit firmware version encoding. The “App version” command is deprecated and will respond with “Unknown”. The ping command will not respond with a version. To get the product firmware version a “Get” command must be used on register 0x0102. See also chapter 1.3.

The following set / get flags are currently defined (reply):

Flag	Name	Meaning
0x01	Unknown Id	The specified id does not exist
0x02	Not supported	Attempting to write to a read only value
0x04	Parameter Error	The new value is out of range or inconsistent

Product id values

Id	Name	Input / Output Voltage	Max current	Remark
0xA3F0	Orion XS 12V/12V-50A	7-17V / 10-17V	50A	-
0xA3F1	Orion XS 1400	9-35V / 10-35V	50A	-

## 1.1 Get and Set items

### Product information registers

ID	Description	Scale	Type	Unit
0x0100	Product Id	-	un32	-
0x0102	Firmware version	-	un32	-
0x0104	Group Id	-	un8	-
0x010A	Serial number	-	string	-
0x010B	Model name	-	string	-
0x0140	Capabilities	-	un32	-

### Product id (register 0x0100)

Please use the regular hex command :4 to get the product id, this query works on all models and all software versions. The product id 2-byte response has incorrect endianness on some builds and should be ignored. The product id 4-byte response has consistent endianness, byte 0 = instance (0x00), byte 1+2 = product id, byte 3 = reserved (0xFF).

### Firmware version (register 0x0102)

Bytes	Description	Scale	Type	Unit
0	Identifier (*1)	-	un8	-
1	Version 0xHHMMLL	-	un24	-

Note 1: Currently has value 0x00

Note 2: vHH.MM, LL == 0xFF means release

### Capabilities<sup>1</sup> (register 0x0140) add 2 and 4

Bit	Description
0	Load output present (0=no, 1=yes)
1	Rotary encoder present (0=no, 1=yes)
2	History support (0=no, 1=yes)
3	Batterysafe mode (0=no, 1=yes)
4	Adaptive mode (0=no, 1=yes)
5	Manual equalise (0=no, 1=yes)
6	Automatic equalise (0=no, 1=yes)
7	Storage mode (0=no, 1=yes)
8	Remote on/off via rx pin (0=no, 1=yes)
9	Solar timer/streetlighting (0=no, 1=yes)
10	Alternative VE.Direct TX pin function (0=no, 1=yes)
11	User defined load switch (0=no, 1=yes)
12	Load current in TEXT protocol (0=no, 1=yes)
13	Panel current (0=no, 1=yes)
14	BMS support (0=no, 1=yes)
15	External control support (0=no, 1=yes)
16	Synchronized charging support (0=no, 1=yes)

17	Alarm relay (0=no, 1=yes)
18	Alternative VE.Direct RX pin function (0=no, 1=yes)
19	Virtual load output (0=no, 1=yes)
20	Virtual relay (0=no, 1=yes)
21	Plugin display support (0=no, 1=yes)
25	Load Automatic Energy Selector (0=no, 1=yes)
26	Battery test (0=no, 1=yes)
27	PAYGO support (0=no, 1=yes)
28	Hibernate mode (0=no, 1=yes)
29	AC power apparent power (0=no, 1=yes)
30	PSU function (0=no, 1=yes)
31	Needs battery to shutdown (0=no, 1=yes)

### Generic device control registers

ID	Description	Scale	Type	Unit
0x0200	Device mode	-	un8	-
0x0201	Device state	-	un8	-
0x0207	Device off reason	-	un32	-

### Device mode values (register 0x0200)

Mode	Meaning
0 or 4	Charger off
1 or 3	Charger on

### Device state values (register 0x0201)

State	Name	Meaning
0	NOT_CHARGING	Not charging
2	FAULT	Failure
3	BULK	Full current charge with charge current set-point
4	ABSORPTION	Voltage controlled with absorption voltage set-point
5	FLOAT	Voltage controlled with float voltage set-point
6	STORAGE	Voltage controlled with storage voltage set-point
7	MANUAL EQUALISE	Voltage controlled with equalisation voltage set-point
11	PSU	Charger acts as power supply with a voltage set-point
245	WAKE-UP	The device is about to start (signal to external control)
246	REPEATED ABSORPTION	The repeated absorption phase is periodically called from the storage mode
247	AUTO EQUALISE	Voltage controlled with equalisation voltage set-point
248	BATTERY SAFE	Charge state where absorption voltage is gradually increased to prevent gassing
250	BLOCKED	Unit being updated, it is not available at the moment
252	EXTERNAL CONTROL	Voltage controlled with remote voltage set-point
255	UNAVAILABLE	No information available

### Device off reason bit-mask (registers 0x0207)

Bit	Meaning
0	No input power
1	Not applicable
2	Soft power switch
3	Remote input
4	Internal reason
5	Pay-as-you-go out of credit
6	BMS shutdown
7	Engine shutdown detection
8	Error
9	Not applicable

### Battery settings registers

**WARNING:** stored in non-volatile memory. Continuous writing, for example from a control loop, will lead to early failure.

ID	Description	Scale	Type	Unit
0xEDFF	Batterysafe mode	-	un8	0=off, 1=on
0xEDFE	Adaptive mode	-	un8	0=off, 1=on
0xEDFD	Automatic equalisation mode	-	un8	0=off, 1..250
0xEDFC	Battery bulk time limit	0.01	un16	hours
0xEDFB	Battery absorption time limit	0.01	un16	hours
0xEDF7	Battery absorption voltage	0.01	un16	V
0xEDF6	Battery float voltage	0.01	un16	V
0xEDF4	Battery equalisation voltage	0.01	un16	V
0xEDF2	Battery temp. compensation	0.01	sn16	mV/K
0xEDF1	Battery type	1	un8	0xFF = user
0xEDF0	Battery maximum current	0.1	un16	A
0xEDEF	Battery voltage	1	un8	V
0xEDEC	Battery temperature	0.01	un16	K, 0xFFFF=N/A
0xEDEA	Battery voltage setting	1	un8	V
0xEDE8	BMS present	-	un8	0=no, 1=yes
0xEDE7	Tail current	0.1	un16	
0xEDE6	Low temperature charge current	0.1	un16	A, 0xFFFF=use max
0xEDE5	Auto equalise stop on voltage	-	un8	0=no, 1=yes
0xEDE4	Equalisation current level	1	un8	% (of 0xEDF0)
0xEDE3	Equalisation duration	0.01	un16	hours
0xED2E	Re-bulk voltage offset	0.01	un16	V
xEDE0	Battery low temperature level	0.01	sn16	°C
0xEDCA	Voltage compensation	0.01	un16	V

### Engine shutdown settings

ID	Description	Scale	Type	Unit
0xEE36	Shutdown voltage	0.01	un16	V
0xEE37	Start voltage	0.01	un16	V
0xEE38	Delayed start voltage	0.01	un16	V

0xEE39	Start delay	1	un32	s
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### **Input voltage lockout settings**

ID	Description	Scale	Type	Unit
0x0320	Input voltage lockout	0.1	un16	V
0x0321	Input voltage restart	0.1	un16	V

### **Device function (register 0x0206)**

Value	Meaning
0	Charger
1	PSU

### **Battery type values (register 0xEDF1)**

Value	Name	Meaning
1	DEFAULT	LiFePO4
255	USER	User defined

### **Battery voltage setting values (register 0xEDEF and 0xEDEA)**

Value	Meaning
12	12V battery
24	24V battery
48	48V battery

### **Charger data registers**

ID	Description	Scale	Type	Unit
0xEDBB	Input Voltage	0.01	un16	V
0xEDBD	Input current	0.1	un16	A
0xEDBC	Input power	0.01	un32	W
0xED8D	Output voltage	0.01	un16	V
0xED8F	Output current	0.1	un16	A
0xED8E	Output power	0.01	un32	W
0xD18D	Battery voltage (*1)	0.001	sn32	V
0xEDDB	Charger temperature	0.01	sn16	°C
0xEDEC	Battery temperature (*2)	0.01	un16	K
0xEE12	Estimated battery temperature (*3)	0.01	un16	K

Note 1: The battery voltage is only set when using Victron smart battery sense otherwise the value will be 0x7FFFFFFF

Note 2: Battery temperature will be 0xFFFF

Note 3: This will be the charger temperature

### **Charger error code and warning values (register 0xEDDA)**

Value	E/W	Meaning
0		No error

Value	E/W	Meaning
1	E	Battery temperature too high
2	E	Battery voltage too high
17	E	Charger temperature too high
21	E	Current sense failure
26	E	Charger terminal temperature too high
28	E	Converter issue
33	E	Input voltage too high
67	W	BMS connection lost
116	E	Calibration data lost
117	E	Invalid firmware
119	E	Settings lost
120	E	Reference voltage failure
150	W	Battery temperature too high
151	W	Battery temperature too low
160	W	Charger overtemperature (derating)
161	W	Short circuit detected
162	W	Converter issue

### Restore factory defaults

ID	Description
0x0004	Restore default

When a write message is addressed to register Id 0x0004, all settings of the device, except for the factory calibration data, will be restored to the factory default values. The data part of this message is ignored.

### History data

Historical data is available on all models.

ID	Description
0x1030	Clear history
0x106F	Cycle count
0x1099	Cycle sequence number
0x1043	Cumulative user history
0x1042	Cumulative service history
0x1070..0x1098	Cycle history (0x1070=newest, ... , 0x1098=oldest)

Note 1: When reading a daily history register that does not (yet) contain data the response will be an empty record with its flag position set to 0x04.

### Cycle count (register 0x106F)

Bytes	Description	Scale	Type	Unit
0	Number of cycle history entries	-	un8	-

### Cycle sequence number (register 0x1099)

Bytes	Description	Scale	Type	Unit
0	Start time current charge cycle	1	un32	s

**Cumulative service history (register 0x1042)**

Bytes	Description	Scale	Type	Unit
0	Version	-	un8	-
1	Operation time	1	un32	s
5	Charged	0.1	un32	Ah
9	Charge cycles started	-	un32	
13	Charge cycles completed	-	un32	
17	Number of power-ups	-	un32	
21	Number of deep discharges	-	un32	

**Cumulative user history (register 0x1043)**

Bytes	Description	Scale	Type	Unit
0	Version	-	un8	-
1	Operation time	1	un32	s
5	Charged	0.1	un32	Ah
9	Charge cycles started	-	un32	
13	Charge cycles completed	-	un32	
17	Number of power-ups	-	un32	
21	Number of deep discharges	-	un32	

**Cycle history (register 0x1070..0x1098)**

Register 0x1070 contains the newest cycle history, register 0x1098 contains the oldest cycle history. If a value is not available it will contain 0xFFFFFFFF, 0xFFFF, 0xFF for un32, un16, un8 respectively.

Bytes	Description	Scale	Type	Unit
0	Version	-	un8	-
1	Start time	1	un32	s
5	Time bulk	1	un32	s
9	Time absorption	1	un32	s
13	Time re-condition/equalization	1	un32	s
17	Time float	1	un32	s
21	Time storage	1	un32	s
25	Ah bulk	0.1	un32	Ah
29	Ah absorption	0.1	un32	Ah
33	Ah re-condition/equalization	0.1	un32	Ah
37	Ah float	0.1	un32	Ah
41	Ah storage	0.1	un32	Ah
45	Voltage start	0.01	un16	V
47	Voltage end	0.01	un16	V
49	Battery type (*1)	-	un8	-
50	Error (*2)	-	un8	-

Note 1: See register 0xEDF1

Note 2: See register 0xEDDA

## Remote control registers

ID	Description	Scale	Type	Unit
0x2000	Charge algorithm version	-	un8	-
0x2001	Charge voltage set-point (*1)	0.01	un16	V
0x2002	Battery voltage sense (*2)	0.01	un16	V
0x2003	Battery temperature sense (*2)	0.01	sn16	°C
0x200A	Battery charge current	0.001	sn32	A
0x200C	Device state	-	un8	-
0x200D	Network info	-	un8	-
0x200E	Network mode	-	un8	-
0x200F	Network status register	-	un8	-
0x2015	Charge current limit	0.1	un16	A

Note 1: The charge voltage set-point can be read from the master unit and written to the slave units so the group will behave as one unit. See network mode register 0x200E.

Note 2: Remote sensor data can be written to a charger; it will adapt its charge profile accordingly. Reserved values 0xFFFF (voltage) and 0x7FFF (temperature) can be written to indicate that the data is no longer available, so the charger switches back to internal behaviour. These values must be written frequently; the timeout is set to 1 minute after which the unit switches back to internal behaviour.

### Network mode bit definitions (register 0x200E)

Bit	Name	Description
0	Networked	Visual indication that the unit is controlled remotely
1	Slave mode	Remote control of vset / iset / charge state
2	External control mode	Remote control of vset / iset
3	BMS controlled	Remote control of vset / iset & bms protection active
4	Charge group master	Not used
5	Charge instance master	Unit is the charge master
6	Standby	Keep unit in standby
7	Reserved	

Use cases	Description
Stand-alone	Set 0x200E to b0000000, default behaviour, charger uses internal charge profile
External control mode	Set 0x200E to b0000101, write to registers 0x2001 and/or 0x2015
BMS mode	Set 0x200E to b0001001, write to registers 0x2001 and/or 0x2015

### Networked environment

The only effect of setting bit 0 is that the charger indicates that it operates in a networked environment, this is done by blinking a symbol on the LCD display and/or a blinking state led..

### External control mode (e.g. ESS or DVCC)

Set the charger in this mode to remotely control the charge voltage and/or current setpoint(s).

Depending on the content received, if the unit receives a charge voltage set-point it reports EXTERNAL CONTROL (252). If the unit only receives a current set-point, it still uses its internal charger algorithm and it will keep reporting Bulk, Absorption, etc.

The charger will automatically fall back to stand-alone mode after not receiving data for 1 minute (e.g. if the communication cable is removed).

#### BMS Controlled

Setting the remote BMS mode bit indicates the Solar Charger that it is controlled by a BMS.

These remote control combinations are allowed:

- Control only the current limit, the charger uses its own bulk-absorption-float state machine to determine the voltage setpoint.
- Control only the voltage setpoint, the charger estimates the appropriate charge state based on the voltage. The current limit is set to the battery maximum current (0xEDF0).
- Control both the current limit and voltage setpoint.

BMS Protection mechanism:

- Setting the Remote BMS mode bit and sending a current limit or voltage setpoint makes the Solar Charger automatically enable the BMS present setting (0xEDE8), and store that to flash.
- The effect of this setting is that the charger will no longer operate in stand-alone mode, it requires communication from the BMS: when no data is received, it stops charging and shows error #67.
- To allow for a 'black start', ie. starting up from an empty battery, in the morning, the charger will charge in "Float" mode for 45 seconds, so the BMS can power-up. When after 45 seconds there is still no data received from the BMS, it will switch off and show error #67.

#### Remote sensor data (voltage and/or temperature)

Write the battery temperature data periodically to register 0x2003 and the battery voltage data to register 0x2002. Both have a timeout of 60s, after which the charger will stop using the remote information. The voltage information must be within  $\pm 5V$  with respect to the voltage on the charger terminals. The charger can adapt its charging voltage up to  $\pm 2V$  to compensate for cable losses.

#### ***Network info (register 0x200D)***

This register gives an overview of the active network components; it combines the statuses of multiple interfaces.

Bit	Description
0	Unit is controlled by a BMS
1	Unit voltage set-point is controlled remotely
2	Unit operates as charge slave
3	Unit operates as charge master
4	Unit is using ICHARGE information (battery current estimate)
5	Unit is using ISENSE information (actual battery current)
6	Unit is using TSENSE information
7	Unit is using VSENSE information
8	Unit is held in STANDBY while the network initialises

### **Network status (register 0x200F)**

The low nibble part of this register gives feedback about the charge algorithm, it indicates if the charger operates stand-alone or if it is controlled remotely. This register is maintained per interface.

Value	Description
0x00	Unit in slave mode (e.g. BMS or ESS controlled)
0x01	Unit is group master
0x02	Unit is instance master (e.g. synchronized charging)
0x03	Unit is both group and instance master
0x04	Unit operates stand-alone (default behaviour)

Bit	Description
4	Unit is using ICHARGE information
5	Unit is using ISENSE information
6	Unit is using TSENSE information
7	Unit is using VSENSE information

### **Link device state (register 0x200C)**

State	Name	Meaning
0	NOT_CHARGING	Not charging
2	FAULT	Failure
3	BULK	Full current charge with charge current set-point
4	ABSORPTION	Voltage controlled with absorption voltage set-point
5	FLOAT	Voltage controlled with float voltage set-point
6	STORAGE (*1)	Voltage controlled with set-point sent by the master
7	MANUAL EQUALISE	Voltage controlled with equalisation voltage set-point
11	POWER SUPPLY (*1)	Voltage controlled with set-point sent by the master
245	WAKE-UP	The device is about to start (signal to external control)
246	REPEATED ABSORPTION (*1)	Voltage controlled with set-point sent by the master
247	AUTO EQUALISE	Voltage controlled with equalisation voltage set-point
248	BATTERY SAFE (*1)	Voltage controlled with set-point sent by the master
249	LOAD DETECT (*1)	Voltage controlled with set-point sent by the master
252	EXTERNAL CONTROL (*1)	Voltage controlled with remote voltage set-point
255	UNAVAILABLE	No information available

Note 1: These states are only possible when in slave mode. The voltage set-point will be the one sent by the master.

### **Total charge current (register 0x2013)**

The estimated battery current: used to check if the tail current condition is met (switch from absorption to float). This is determined by summing up all the known DC battery currents in the system.

### **Charge current limit (register 0x2015)**

The charge current limit of the charger. This register could be used to limit/control the charge current of a charger on a network. It must be written to the charger regularly (more than once a minute) together with register 0x200E (see network mode register 0x200E for more information). Charger charge current limit will be the minimum value between register 0x2015 (charge current limit) and

register 0xEDF0 (maximum battery current setting). When register 0x2015 is not used, charger will use the maximum battery current setting (register 0xEFF0) as charge limit.

## BLE settings

### BLE capabilities (register 0x0150)

Bytes	Description	Scale	Type	Unit
0	Capabilities	-	un32	-

Bit	Meaning
0	Has Support for Ve Reg Ble
1	Ble Mode Off Is Permanent
2	Has Support for Ble Off Recovery Time
3	Recovery Time Zero Off Is Permanent
4	Has Support for Ve Reg VE-Reg Service Mode
5	Has Support for Trends
6	Has Support for Advertisement Key
7	Has Support for Soc Sync Via Trend
8	Has Support for Settings Lock
9..31	Not defined

Note 1: 0 = No, 1 = Yes

### BLE mode (register 0x0090)

Bytes	Description	Scale	Type	Unit
0	Mode (*1)	-	un8	-

Note 1: 0x00 = BLE disabled, 0x01 = BLE enabled

## 1.2 Asynchronous items

The charger can send hex messages asynchronously (without prior request). This is done using :A messages, the format is identical to a Get response.

## 1.3 Message examples

\n at the end of the message is implied.

### Ping

:154

:5FF7FD2

0x7FFF = Application, no version provided

### Application version (deprecated)

:352

:3030F4

Unknown command

### Product Id

:451

:1F0A3C1

0xA3F0 = Orion XS 12V/12V-50A

### Firmware version

:70201004B

:70201000FF120139

0x00 = Identifier

0x0112FF = v1.12-release

### Restart

:64F

No response, restarted

### Get Battery Maximum Current

:7F0ED0071

:7F0ED00F4017C

Value = 0x01F4 = 50.0A

### Set Battery Maximum Current

Set to 10.0A = 0x0064

:8F0ED0064000C

:8F0ED0064000C

Acknowledged with the new value returned.

### Set Battery Maximum Current

Set back to 50.0A again = 0x01F4

:8F0ED00F4017B

:8F0ED00F4017B

Acknowledged with the new value returned.

### Unsupported command

:2000152

:3020050

Unknown response

### Invalid frame (checksum wrong)

:452

:2AAAAFF

Checksum fail

### Asynchronous message

:A0102000543

The unit reports register 0x0201 (device state) with value 0x05 (float).

Changes:

**16-06-2025**

Initial version derived from BlueSolar HEX protocol - rev 18.docx